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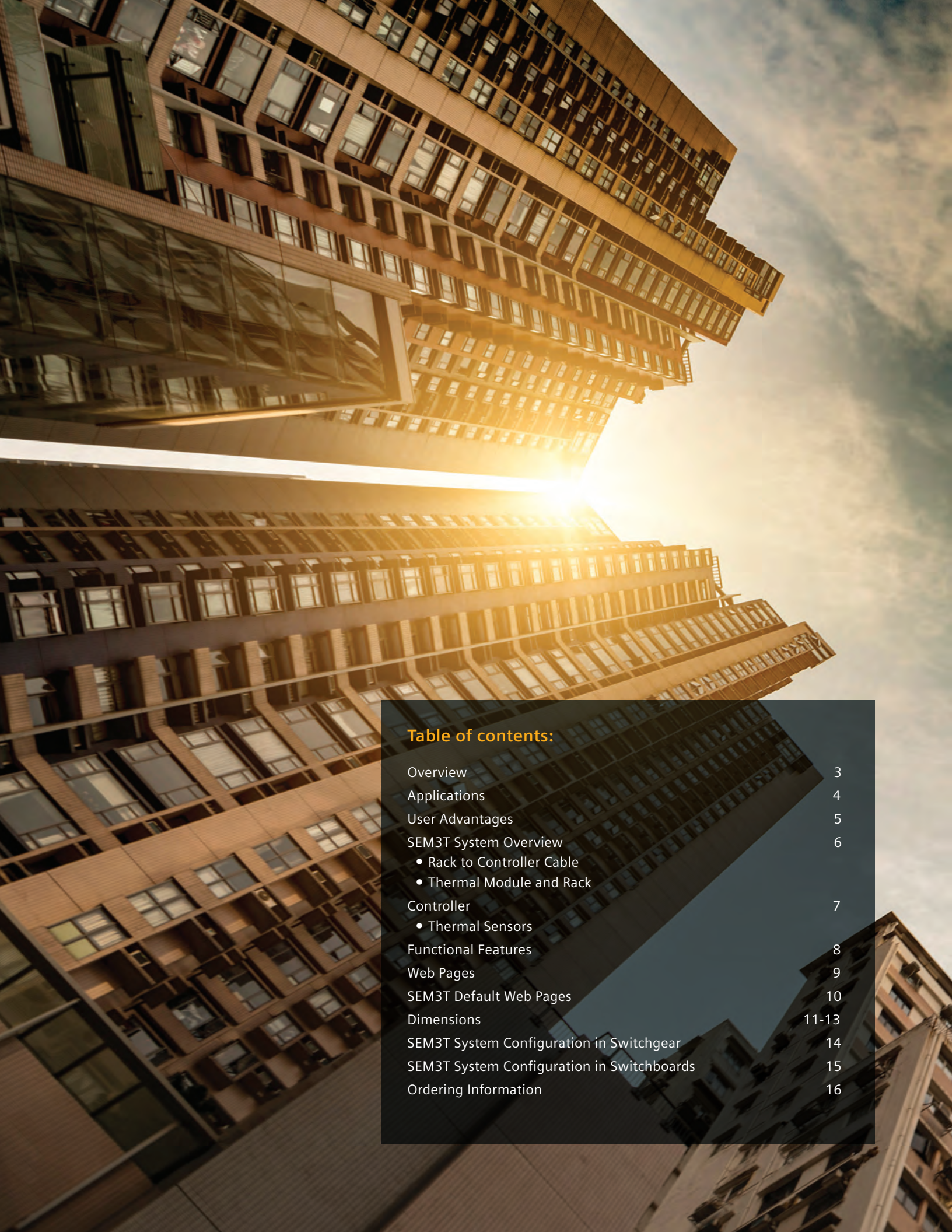
SEM3T™ Thermal Monitoring System

Selection and Application Guide

usa.siemens.com/SEM3T



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Overview

Siemens Thermal Monitoring System (SEM3T) is a modular monitoring solution for thermal monitoring, alarm notifications, historical logging/trending, and reporting.

The design of SEM3T, like that of SEM3, allows a user to select appropriate monitoring locations to efficiently and economically monitor temperature. SEM3T uses standardized components that can be easily integrated into low voltage switchgear, switchboards, paralleling switchgear, and panelboards systems to measure key joint temperatures while withstanding the harsh environments. SEM3T is also offered in retrofit applications found in electrical equipment.

SEM3T is a reliable and easily installed thermal monitoring solution which can monitor numerous locations within low voltage apparatus including bus joints, lug landings, bus ducts, transformers and circuit breakers. SEM3T sensors can be positioned appropriately to detect ambient temperature, as well as overloaded or poorly conducting electrical connections.

SEM3T has the flexibility to be installed as a standalone thermal monitoring solution with real time data available from the built-in web interface. SEM3T sensors require no calibration. Thermal measurement accuracy is ± 4°C for full range 0°C to 130°C (32°F to 266°F) and ± 2°C for standard 40°C to 105°C (104°F to 221°F. This system allows a user to select areas to be monitored without excessive hardware, space, and possible system interference. SEM3T has a built-in industry standard Modbus TCP communication and is easily integrated into MindSphere for cloud monitoring. SEM3T comes with dual Ethernet port for daisy chain over Ethernet and Wi-Fi as an option. SEM3T web pages can also be set by a user to four different languages (English, German, French, or Spanish) for configurations and real-time data display.

Applications

Commercial

SEM3T is a fully outfitted solution for commercial space electrical equipment monitoring. SEM3T can collect and trend thermal data to help you better monitor power connections and extend the lifecycle of electrical components while keeping all the data in one place. Due to the small footprint of SEM3T, integration is simplified. The system can fit into existing electrical equipment leaving more space to conduct business.

Industrial

SEM3T offers a solution that is ideal for facilities large or small. Whether you are utilizing thermal monitoring to better target planned preventative maintenance or troubleshoot equipment outages for faster return to operations, SEM3T can accurately track and alert abnormal thermal issues. With its competitively advantaged system, SEM3T is a new tool to help reduce maintenance costs with minimal onsite testing.

SEM3T was designed with safety in mind. SEM3T can help you pinpoint problem areas and get early alerts from thermal issues. SEM3T provides a more robust thermal measurement system as compared to IR scan that cannot clearly see obscured connections.

User Advantages

For many years, scheduled infrared thermography (IR) inspections have been the accepted method for reducing risk of fire by identifying faulty or loose connections in electrical distribution systems. SEM3T is a system specifically designed to provide continuous thermal monitoring. It offers a safer, more effective way to detect thermal risks before they progress into a major failure.

The method also delivers up to a 10:1 return on investment due to avoided equipment damage and downtime.

Continuous Thermal Monitoring is now enabling safer, more efficient inspection of energized electrical equipment, ensuring electrical asset integrity. This becomes apparent when looking at the technology comparison of SEM3T to IR windows and thermal imaging.

Operations Owner

SEM3T application is compact and easily implemented into Siemens low voltage switchgear, switchboards, and panelboards. With this thermal monitoring system added to your equipment, you receive 24/7 live monitoring of your electrical equipment. Insurance companies can offer reduced rates for their insurance policy premium.

Contractors

SEM3T thermal system provides an ideal electrical equipment monitoring system for contractors and installers. The installation of SEM3T when combined with other Siemens equipment is simple, saving time during installation. The device will come pre-installed with no separate enclosures to mount – simply add the temperature sensors to the areas of interest and attach the sensor depending on the configuration.

Engineers and Consultants

SEM3T application is compact and easily integrated into Siemens low voltage switchgear, switchboards, and panelboards. With this thermal monitoring system added to your equipment, you receive live monitoring of your selected components with a reliable wired solution ready to withstand harsh plant environments. Installation of SEM3T is simple and no further calibration is needed.

SEM3T System Overview

SEM3T Controller

SEM3T Controller can provide thermal monitoring for up to 45 Thermal points. SEM3T Controller acts as a Data Server and processes the data from the Thermal Modules. The controller can be configured to create several groups with multiple thermal points. This information either viewed in real-time or communicated to other systems through its communication interfaces. Some applications may require for more than 45 thermal points in one apparatus electrical equipment. If so, then simply add a second controller. Two controllers can monitor up to 90 thermal points. Using the available dual Ethernet ports in each controller, daisy chaining of multiple controllers in a serial fashion is achievable.

- SEM3T Controller has built-in web pages for real-time data, historical logging/trending, alarm notifications, KPI dash boards, and configurations
- Easy to integrate to Siemens MindSphere cloud platform – MindSphere ready device
- 24vdc power supply
- Optional Wi-Fi
- Available standard communication protocol: **Modbus TCP** for integration with monitoring software system, **SMTP** for emailing, and **NTP** for network time synchronization
- Dual Ethernet (RJ45) ports for daisy chain over ethernet
- Meets global certifications/ standards

SEM3T Thermal Module

The Thermal Module reads the address from the racks designated by its location and thermal signals from its respective thermal sensor. Each Thermal Module is an independent thermal module that samples thermal signals, processes these signals using the embedded algorithms and communicates these parameters to the controller. When the thermal module is powered and is communicating properly with the controller, the power LED will blink.

- One thermal module per thermal monitoring location
- No configuration required for the modules
- Connects directly to thermal sensors

SEM3T Thermal Sensors

Thermal Sensors are components used for thermal measurement. SEM3T product is UL listed. Thermal Sensor lead wires come with standard 10’ can be extended up to 50’, still maintaining the thermal output accuracy.

- Thermal Sensors are designed to work specifically with the SEM3T product
- Lead wire type: UL rated operating temperature to 200°C, 600V rated, UL style 1199, 18AWG, 10 x 30 stranded
- Primary rating: 600VAC
- Overvoltage category: CAT IV
- Operating temperature 0°C to 130°C
- Very reliable non-powered wired Sensors are designed to withstand harsh environments

Thermal Sensors come in the following variants and sizes:

- 4 types Sensor Screw Ring terminals for monitoring thermal points at joint locations
- Sensor S-Ring sizes: 1/4”, 5/16”, 3/8”, 1/2”
- Cylindrical sensor for monitoring ambient temperature Sensor C-Ring

SEM3 Racks

The SEM3 Racks are the holders for the thermal modules. Embedded within a rack is the internal addressing for the communication of thermal information from the module to the controller via Ethernet cables. A two-way DIP switch is available on the 9, 15, and 21 position racks for thermal monitoring addressing, whereas a rotary switch is available to set the addressing on 3 and 6 position racks.

- Five types of racks available
- DIP switch or rotary switch for controller to recognize module location and rack assignments

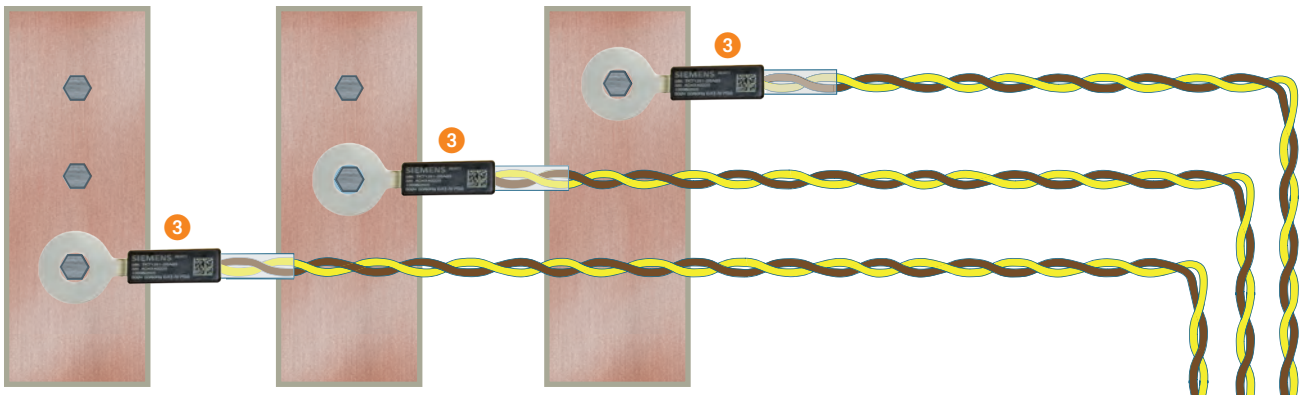
Rack to Controller Cables

The communications cables connect the SEM3 racks to the controller and daisy chain additional meter racks together in series (for 3 and/or 6 meter module racks only). Multiple lengths are available to suit a wide variety of panelboard and switchboard configurations. The data cables are insulated for 600V applications and are not standard Ethernet cables.
NOTE: See ordering information page for cable sizes and catalog numbers.

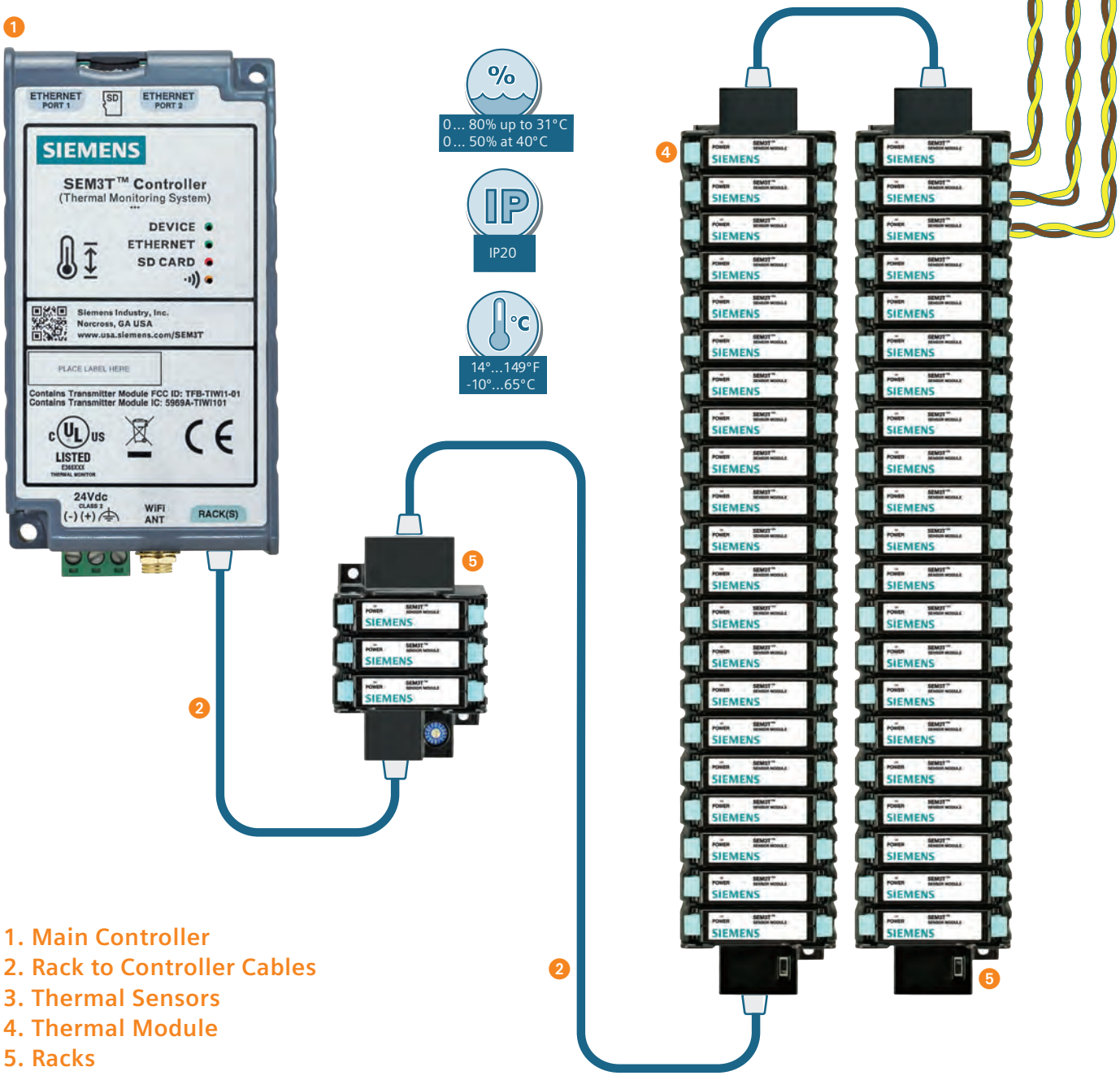
- Seven cable lengths
- 600V rated ethernet cable. Note: Regular Ethernet RJ45 cables are rated only up to 300V and are not allowed to use for this application

General

- Scalable, customizable, and configurable
- Modular design simplifies installation and use
- Min and max alarms
- Low cost and low maintenance
- 24x7 Monitoring
- Measures the absolute value (target temperature rises over ambient)
- Ability to measure key joints including bus splice, and breaker lugs
- Proactive monitoring avoids costly downtime
- Extend bus life and optimize bus performance



Inside electrical apparatus equipment



1. Main Controller
2. Rack to Controller Cables
3. Thermal Sensors
4. Thermal Module
5. Racks

Functional Features

Instantaneous Values		
Realtime	Temperature	✓
	Temperature Rise	✓
	Mean Temperature	✓
	Total System Average	✓
Realtime with Timestamp	Min/Max Temperature	✓
Realtime Total System with Timestamp	Min/Max Temperature	✓
Alarming / Monitoring Functions		
Under Temperature	Warning and Alarm	✓
Under Temperature Time Delay	Warning and Alarm	✓
Over Temperature	Warning and Alarm	✓
Over Temperature Time Delay	Warning and Alarm	✓
Communications		
Ethernet - Modbus TCP/IP	Integrated dual RJ45 ports as standard (can support up to 3 masters and 1 integrated web access simultaneously)	10/100 base-T (100 Mbit/sec)
NTP (Network Time Protocol)	Synchronize with local PC clock or NTP server for Time synchronization	± 1 seconds
SMTP (Simple Mail Transfer Protocol)	Default web pages allows user to configure SMTP email setup to send email out directly from controller	✓
WiFi	Optional WiFi configurable for hotspot or serve as a client system	IEEE 802.11 b/g/n, 2.4 Ghz
HTTP	Webserver built-In for realtime and configuration	Default IP : 192.168.1.65, User Name: admin, Password: sem3
General		
Password Protection		✓
MindSphere Enabled	Built-In MindConnect Library for cloud monitoring	✓
Realtime clock	Built-In realtime clock to store Date and Time	up to 3 days no power
Technical Data		
Controller Power Supply	DC	UL Listed 24V DC Class II power supply, Overvoltage (UL 61010), pollution degree 3 (UL 61010)
Controller Degree of Protection	Front/Rear	IP20
Controller Operating Temperature Range	°C / °F	-10°C to +65°C / 14°F to 149°F
Controller Humidity	%	Maximum relative humidity 80% for temperature up to 31°C decreasing linearly to 50% relative humidity at 40°C
Controller Altitude / Elevation	Meters/Foot	3000 Meters/9843 Feet
Sensor Operating Temperature range	°C / °F	0°C to 130°C / 32°F to 266°F
Sensor Accuracy range	°C / °F	40°C to 105°C (± 2°C) / 104°F to 221°F (± 4°F)
Sensor Overvoltage Category	IV	✓
Sensor Altitude / Elevation	Meters	3000 Meters/9843 Feet
Sensor Cable Wire Type	600V rated	UL rated operating temperature to 200°C, 600V rated, UL style 1199, 18 AWG, 10x30 stranded
Controller Rack Connector		12VDC, 0.5A max
Thermal Sensor		5VDC, 0.14mA max
Sensor Module		12VDC, 12mA max
Rack - Ethernet Connector		12VDC, 0.5A max
Rack - Module Connector		12VDC, 12mA max
Safety Standards and Compliance		
CSA C22.2 No. 61010-1 Safety Requirements for Electrical Equipment for Measurement		
UL61010-1 (IEC 61010-1) Test and Measurement Equipment		

Web Pages

Cutting-edge web-enabled configuration and real-time data display

View your system thermal point readings from anywhere using standard web browsers.

Everyday functionality, including system status, alarm status, min and max temp.

Web enabled configuration provides authenticated access to common functions:

- **System Settings –** System Settings will allow you to Configure IP and Web Settings.
- **Global Settings –** Global Settings will allow you to set alarm thresholds and set-points for different alarm conditions. Settings saved here will override all other settings. These settings need to be completed before branch configuration.
- **Branch Configuration –** Branch configuration allows you to change basic attributes of a branch, set specific thermal point warnings, labels, and alarm thresholds.
- **Set Up Virtual Thermal Points (Grouping) –** SEM3T now allows a user to set up virtual thermal points by users desired group method. The Virtual thermal points can be logged.
- **Real-time Data –** Constantly updates information for all configured and responding thermal modules. The real-time data allows you to view real-time data along with any alarms that are active for a particular thermal module real time trending.
- **Diagnostics –** Diagnostics will allow you to see and download the Modbus register address information for individual thermal modules for integrating with Electrical Power Monitoring systems, Building Management systems, SCADA, and third party outside systems.
- **Data Logging –** The power of SEM3T includes the ability to log data in the controller up to 180 days.

User Management – Supervisors can manage all accounts currently registered in the system. There are three User Access levels: Supervisor, Controller, and Observer.

Supervisor – Access to all pages with administrator rights.

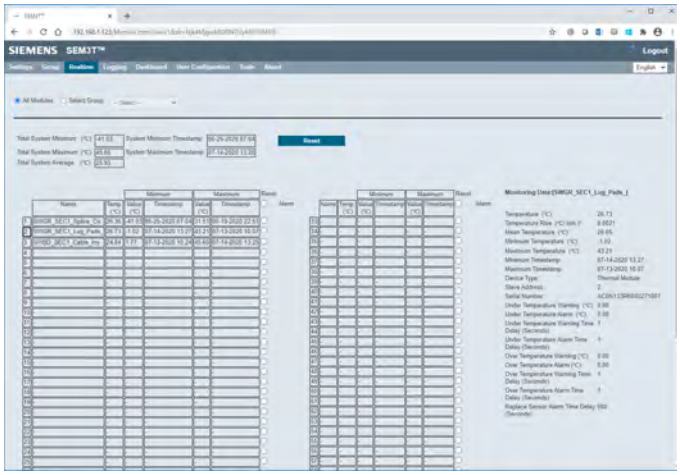
Controller – Access to "Home," "Realtime," and "User Profile" pages with alarm acknowledgment.

Observer – Access to "Home," "Realtime," and "User Profile" pages (viewing access only).

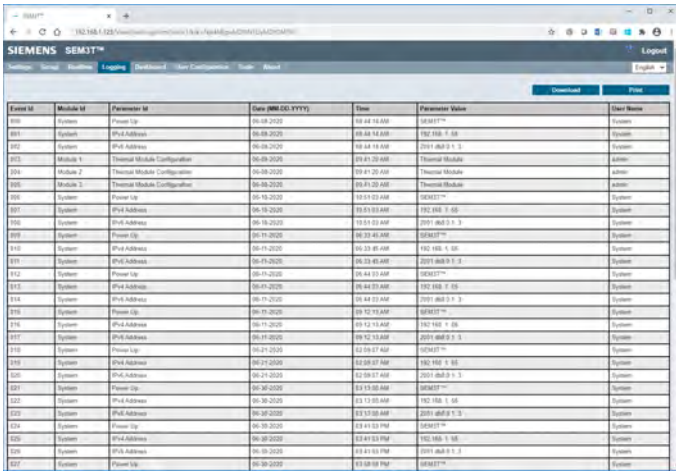
Maximum Temperature

Temperature

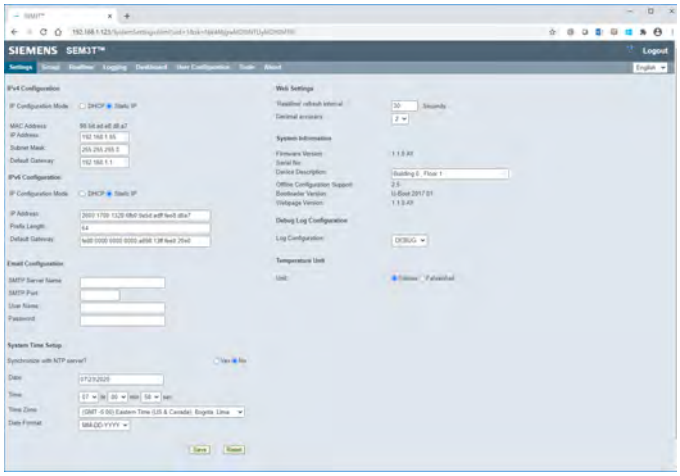
SEM3T Default Web Pages



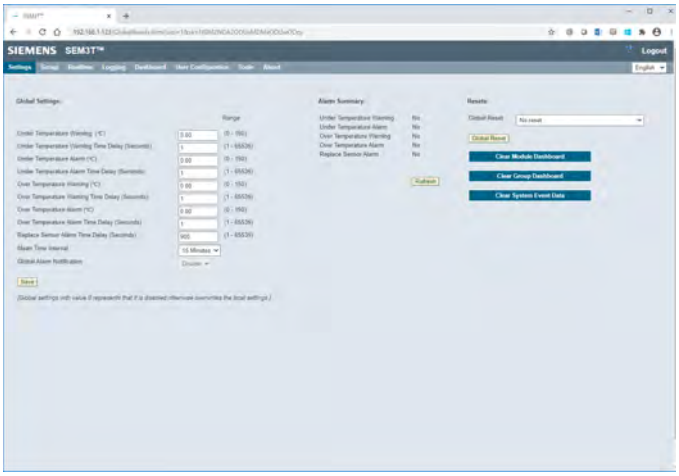
Realtime: User can view and acknowledge the alarms and can monitor thermal points



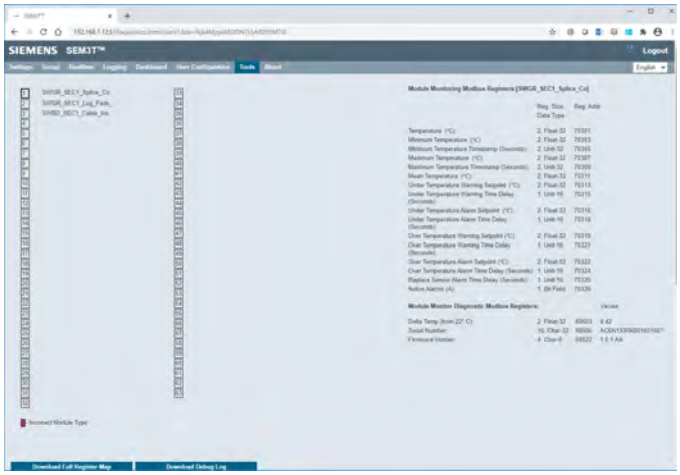
System event log



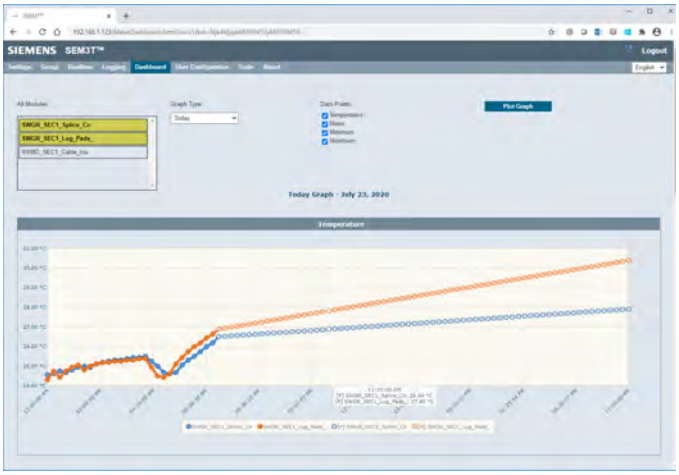
Systems Configurations



Global settings: Allows User to configure alarm setpoint thresholds



Diagnostics: Displays active thermal monitoring Modbus Registers and firmware upgrade



The SEM3T dashboard can plot selected thermal points. This information can be used to identify potential hot spots early to turn into preventive actions

Dimensions

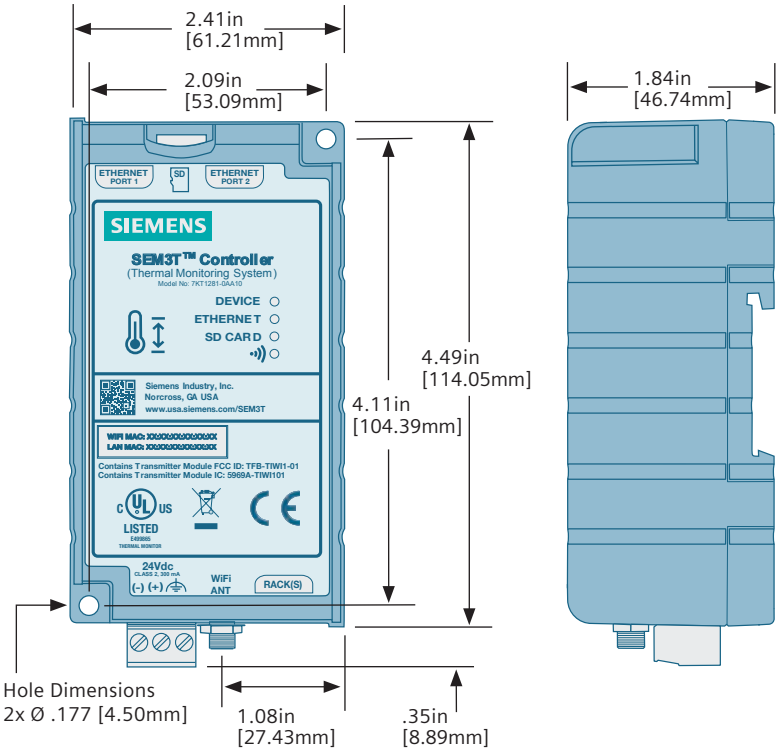
SEM3T Controller

Part	Catalog number
SEM3T Controller with Wi-Fi	7KT1281-0AA10
SEM3T Controller without Wi-Fi	7KT1281-0AA00

Controller

Description	Information
Altitude / Elevation	3000 Meters/9843 Feet
Humidity	Maximum relative humidity 80% for temperature up to 31°C decreasing linearly to 50% relative humidity at 40°C
Operating Temperature Range	-10°C to +65°C / 14°F to 149°F
Power Supply Requirement	UL Listed 24V DC Class II power supply.

	IN-LBS [Nm]	mm²	AWG
24 V DC power supply leads	5 [.56]	.50 to 2.50	22 to 14
Thermal Sensor Leads	1.7 [.19]	0.75	18

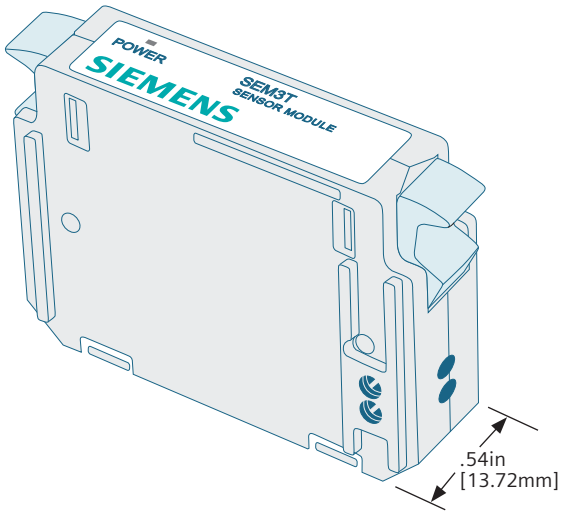


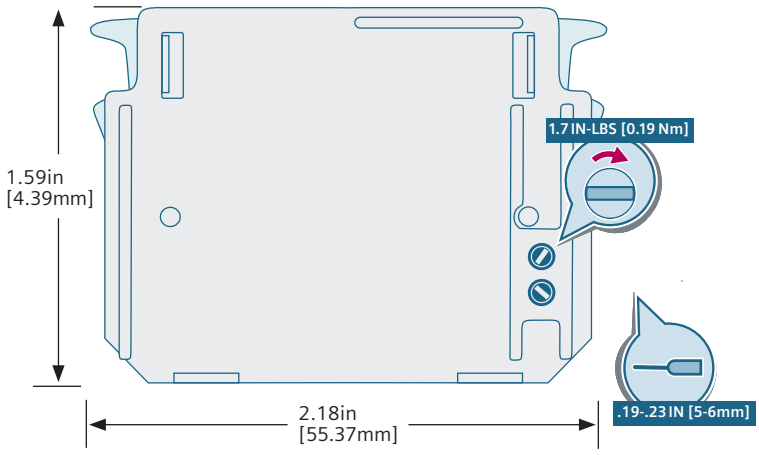
SEM3T Thermal Module

Thermal Module Information

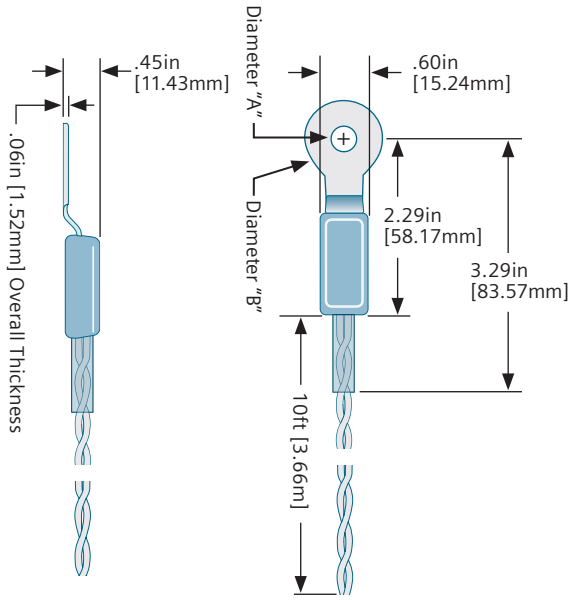
Description	Information
Altitude / Elevation	3000 Meters/9843 Feet
Pollution Degree	3 (UL 61010)
Overvoltage Category	IV (UL 61010)
Operating Temperature Range	-10°C to +65°C / 14°F to 149°F

Part	Catalog number
SEM3T Sensor Module	7KT1281-1AA00





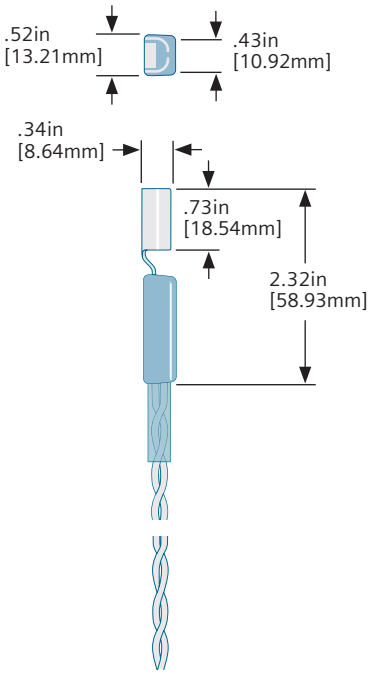
SEM3T Thermal Sensors



Screw Ring Terminal

Dimensions inches [mm]				Torque (lb-ft) for non-lubricated threads*
Description	Catalog Number	A	B	
SEM3T sensor 1/4" terminal	7KT1281-2SA00	0.257 [6.527]	0.625 [15.875]	6 - 9
SEM3T sensor 5/16" terminal	7KT1281-2SA01	0.323 [8.204	1.00 [25.4]	6 - 9
SEM3T sensor 3/8" terminal	7KT1281-2SA02	0.386 [9.804]	1.125 [28.575]	20 - 30
SEM3T sensor 1/2" terminal	7KT1281-2SA03	0.515 [13.081]	1.25 [31.75]	40 - 50

*** Example: The SEM3T Sensor 1/4" terminal accepts a 1/4" bolt /screw and the tightening torque is 6-9 lb-ft.**



Cylindrical Ring Terminal

Description	Catalog Number
SEM3T sensor cylindrical	7KT1281-2CA00

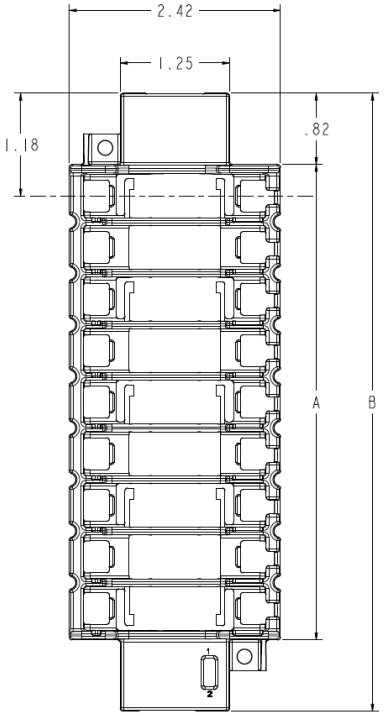
Sensor Information

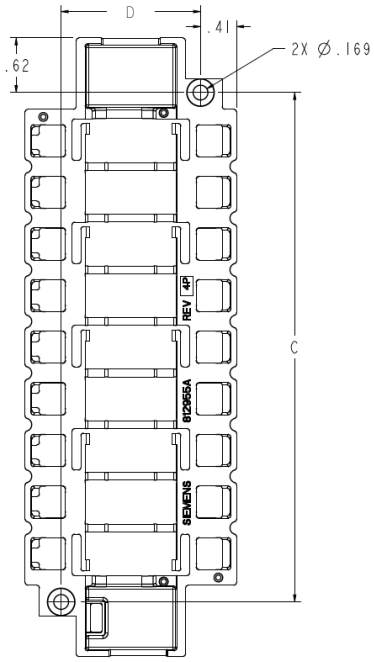
Description	Information
Altitude / Elevation	3000 Meters/9843 Feet
Pollution Degree	3 (UL 61010)
Overvoltage Category	IV (UL 61010)
Operating Temperature Range	0°C to 130°C / 32°F to 266°F
Wire Type	UL rated operating temperature to 200°C, 600V rated, UL style 1199, 18 AWG, 10x30 stranded

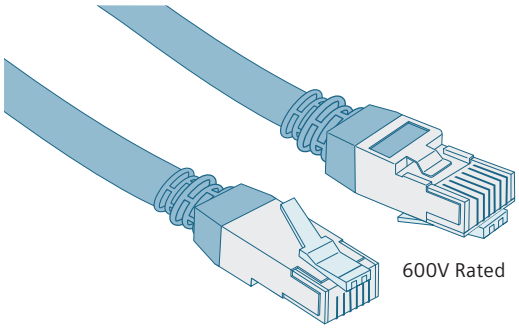
Racks and Cables

Variable Dimensions inches [mm]

Catalog Number	Description	A	B	C	D
US2:SEM3RACK3	3 position rack	1.90 [48.26]	3.57 [90.68]	2.28 [57.91]	1.79 [45.46]
US2:SEM3RACK6	6 position rack	3.67 [93.22]	5.34 [135.64]	4.05 [102.87]	1.79 [45.46]
US2:SEM3RACK9	9 position rack	5.44 [138.18]	7.07 [179.58]	5.82 [147.83]	1.59 [40.38]
US2:SEM3RACK15	15 position rack	8.98 [228.09]	10.61 [269.49]	9.36 [237.74]	1.59 [40.38]
US2:SEM3RACK21	21 position rack	12.52 [318.01]	14.15 [359.41]	12.90 [327.66]	1.59 [40.38]







6” (152.40 mm) — US2:SEM3CAB6INCH

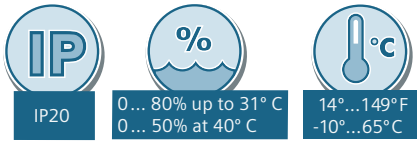
12” (304.80 mm) — US2:SEM3CAB12INCH

24” (609.60 mm) — US2:SEM3CAB24INCH

36” (914.40 mm) — US2:SEM3CAB36INCH

Product Connector Electrical Ratings

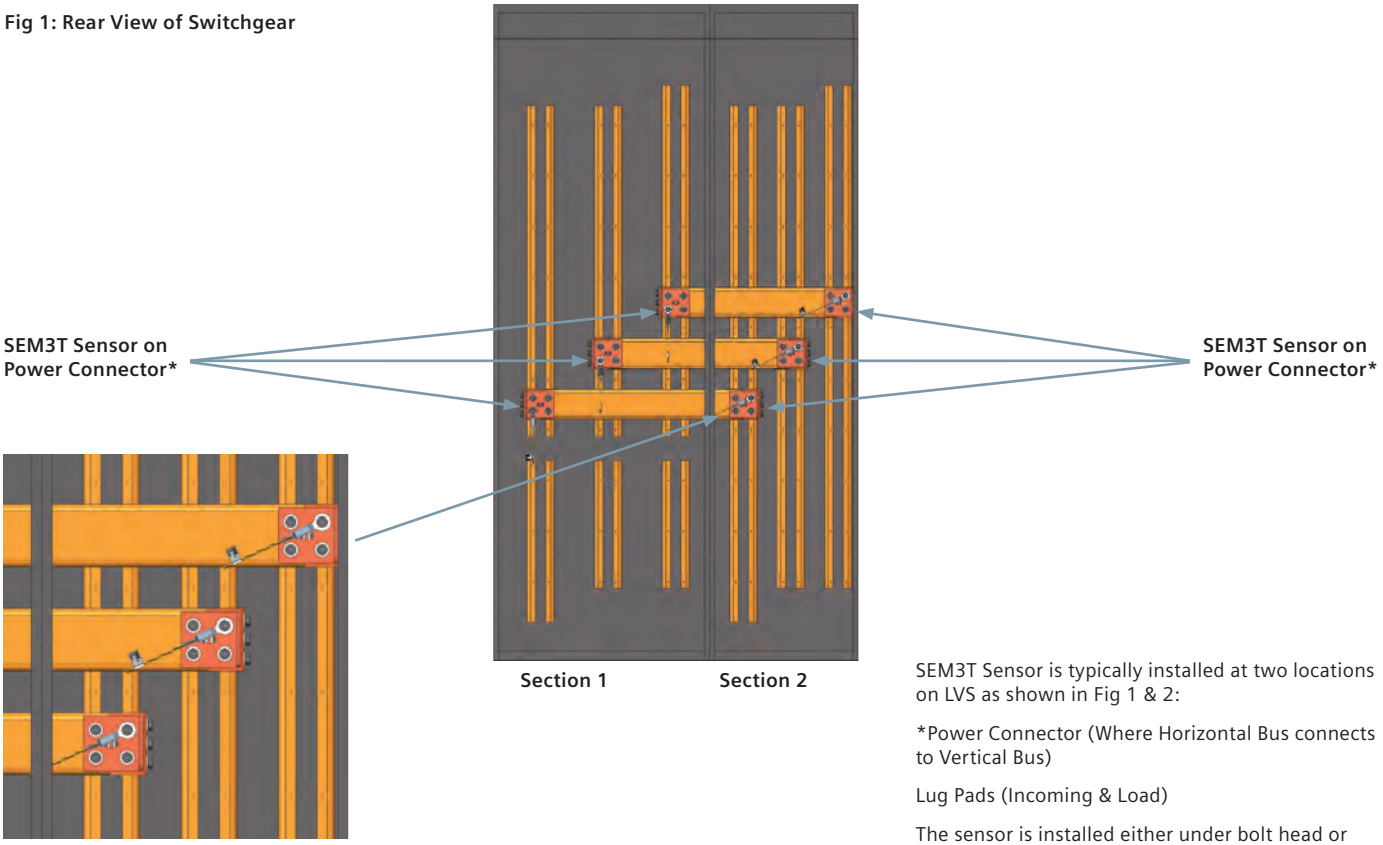
Description	Information
Controller Rack Connector	12VDC, 0.5A max
Sensor	5VDC, 0.14mA max
Module	12VDC, 12mA max
Rack - Ethernet Connector	12VDC, 0.5A max
Rack - Module Connector	12VDC, 12mA max



SEM3T System Configuration in Switchgear

Typical SEM3T Thermal Sensor locations in Low Voltage Switchgear.

Fig 1: Rear View of Switchgear



SEM3T Sensor is typically installed at two locations on LVS as shown in Fig 1 & 2:

*Power Connector (Where Horizontal Bus connects to Vertical Bus)

Lug Pads (Incoming & Load)

The sensor is installed either under bolt head or nut as applicable, one sensor per phase.

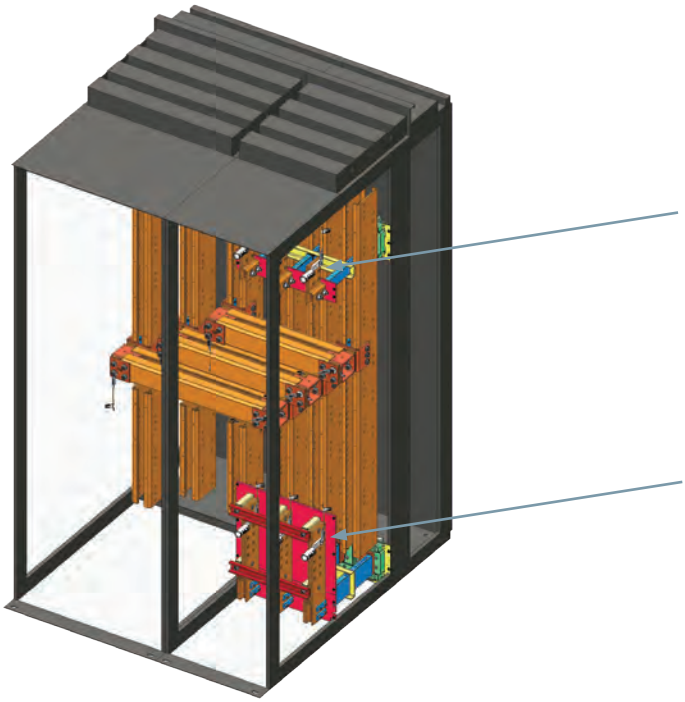
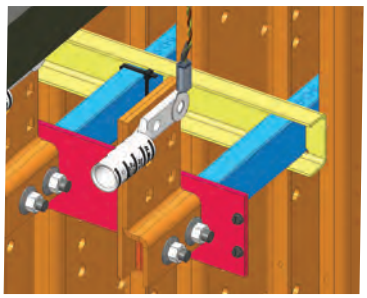
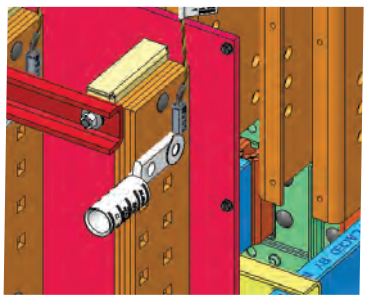


Fig 2: Rear Iso View of Switchgear



SEM3T Sensor on Lug Pads.



Mounted over the Lug

SEM3T System Configuration in Switchboards

Typical SEM3T Thermal Sensor locations in Low Voltage Switchboards

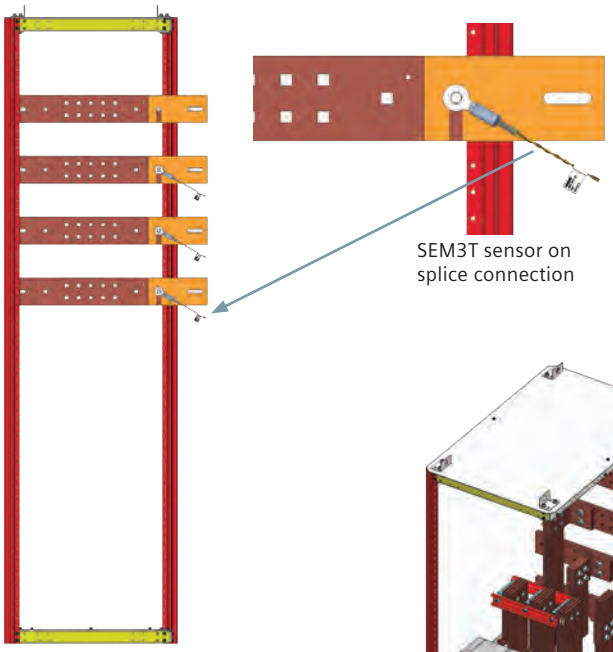


Fig 3: Front view of Switchboard

SEM3T Sensor is typically installed at following locations on Switchboard as shown in Fig 3 & 4:

Splice

Lug Pads (Incoming & Load)

The sensor is installed either under bolt head or nut as applicable, one sensor per phase.

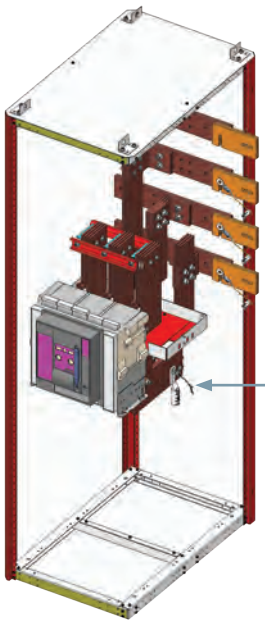
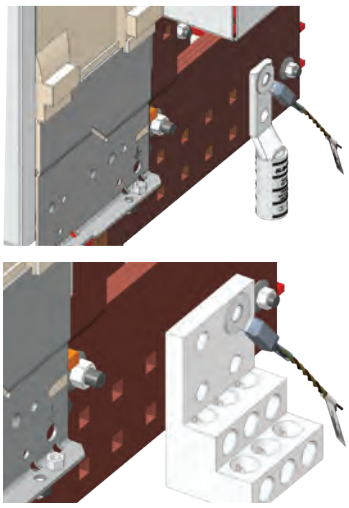


Fig 4: Front Iso view of Switchboard

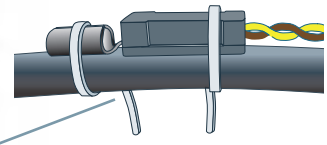


SEM3T Sensor on Lug Pads, mounted over the lug

SEM3T Sensor C-Ring is installed on cable insulation for outgoing MCCB breakers. The sensor is installed with a cable zip tie.

One sensor per phase.

Fig 5: Front View of Panel



SEM3T Sensor C-Ring is installed on the cable insulation of P4, P5 Panels as shown in Fig 5:

The sensor is installed with a cable zip tie, one sensor per phase.

Ordering Information

Controller	Catalog number	
SEM3T Controller with Wi-Fi	7KT1281-0AA10	
SEM3T Controller wiithout Wi-Fi	7KT1281-0AA00	
Thermal Sensor Module		
SEM3T Sensor Module	7KT1281-1AA00	
Thermal Sensors		
SEM3T Sensor Screw Ring Terminal 1/4"	7KT1281-2SA00	
SEM3T Sensor Screw Ring Terminal 5/16"	7KT1281-2SA01	
SEM3T Sensor Screw Ring Terminal 3/8"	7KT1281-2SA02	
SEM3T Sensor Screw Ring Terminal 1/2"	7KT1281-2SA03	
SEM3T Sensor Cylindrical Ring Terminal	7KT1281-2CA00	
Accessories		
SEM3T Wi-Fi Antenna and Cable	7KT1281-8AN00	
Meter Racks		
Module Rack 3 Position	US2:SEM3RACK3	
Module Rack 6 Position	US2:SEM3RACK6	
Module Rack 9 Position	US2:SEM3RACK9	
Module Rack 15 Position	US2:SEM3RACK15	
Module Rack 21 Position	US2:SEM3RACK21	
Cables		
Controller to Rack Cable - 6 inch	US2:SEM3CAB6INCH	
Controller to Rack Cable - 12 inch	US2:SEM3CAB12INCH	
Controller to Rack Cable - 24 inch	US2:SEM3CAB24INCH	
Controller to Rack Cable - 36 inch	US2:SEM3CAB36INCH	
Controller to Rack Cable - 5 Foot	US2:SEM3CAB5FT	
Controller to Rack Cable - 10 Foot	US2:SEM3CAB10FT	
Controller to Rack Cable - 20 Foot	US2:SEM3CAB20FT	

Notes

Notes

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