SIEMENS

RUGGEDCOM RSG2288

Installation Guide

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Preface

This guide describes the RUGGEDCOM RSG2288. It describes the major features of the device, installation, commissioning and important technical specifications.

It is intended for use by network technical support personnel who are responsible for the installation, commissioning and maintenance of the device. It is also recommended for use by network and system planners, system programmers, and line technicians.

Alerts

The following types of alerts are used when necessary to highlight important information.

DANGER!
DANGER alerts describe imminently hazardous situations that, if not avoided, will result in death or serious injury.

WARNING!
WARNING alerts describe hazardous situations that, if not avoided, may result in serious injury and/or equipment damage.

CAUTION!
CAUTION alerts describe hazardous situations that, if not avoided, may result in equipment damage.

IMPORTANT!
IMPORTANT alerts provide important information that should be known before performing a procedure or step, or using a feature.

NOTE
NOTE alerts provide additional information, such as facts, tips and details.

Related Documents

Other documents that may be of interest include:

- ROS User Guide for the RUGGEDCOM RSG2288

Accessing Documentation

The latest user documentation for RUGGEDCOM RSG2288 v is available online at www.siemens.com/ruggedcom. To request or inquire about a user document, contact Siemens Customer Support.

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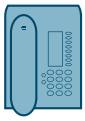

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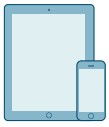

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- Access Siemens' extensive library of support documentation, including FAQs and manuals
- Submit SRs or check on the status of an existing SR
- Contact a local Siemens representative from Sales, Technical Support, Training, etc.
- Ask questions or share knowledge with fellow Siemens customers and the support community

1 Introduction

The RUGGEDCOM RSG2288 is a rugged, fully managed, modular Ethernet switch specifically designed to operate reliably in electrically harsh and climatically demanding utility substation, railway and industrial environments. The RUGGEDCOM RSG2288 includes the IEEE 1588 v2 protocol with hardware time stamping, allowing high precision time synchronization over the Ethernet network with accuracies of 1 µs or better. The RUGGEDCOM RSG2288's superior rugged hardware design coupled with the embedded Rugged Operating System (ROS) provides improved system reliability and advanced cyber security and networking features, making it ideally suited for creating Ethernet networks for mission-critical, real-time, control applications.

The RUGGEDCOM RSG2288's modular flexibility offers 100/1000BaseX fiber and 10/100/1000BaseTX copper port combinations. Support for front or rear mount connectors coupled with support for multiple fiber connector types (SFP, GBIC, LC, SC) without loss of port density makes the RUGGEDCOM RSG2288 highly versatile and suitable for any application. The RUGGEDCOM RSG2288 is packaged in a rugged, galvanized steel enclosure with industrial grade DIN, panel, or 48 cm (19 in) rack-mount mounting options.

The following sections provide more information about the RUGGEDCOM RSG2288:

- Section 1.1, "Feature Highlights"
- Section 1.2, "Description"
- Section 1.3, "Precision Time Protocol (PTP) Support"

Section 1.1

Feature Highlights

Ethernet Ports

- Up to 9 x Gigabit Ethernet ports (copper and fiber)
- Up to 9 x 100Base-FX Fiber Fast Ethernet ports (copper and fiber)
- 2-port modules for tremendous flexibility
- Non-blocking, store and forward switching
- Supports many types of fiber (multimode, single mode, bidirectional single strand)
- Full compliance with IEEE: 802.3, 802.3u & 802.3z
- Full duplex operation and flow control (IEEE 802.3x)
- Long haul optics allow Gigabit at distances up to 70 km
- Industry standard fiber optic connectors: LC, SC, SFP, GBIC

Advanced Time Synchronization

- Support for IEEE 1588 v2, GPS and IRIG-B time synchronization
- Hardware time stamping on all ports including Gigabit
- Transparent clock operation for high precision on switched networks (1us or better)
- Peer-to-peer path delay measurements
- High precision TCXO (Temperature Compensated Oscillator)

- Supports master, slave and transparent clock modes
- Support for IRIG-B input and output

Rated for Reliability in Harsh Environments

- Immunity to EMI and heavy electrical surges
- Zero-Packet-Loss™ technology
- -40 to 85 °C (-40 to 185 °F) operating temperature (no fans)
- Conformal coated printed circuit boards (optional)
- 18 AWG galvanized steel enclosure
- Hazardous Location Certification: Class 1 Division 2

Universal Power Supply Options

- Fully integrated, dual-redundant (optional) power supplies
- Universal high-voltage range: 88-300 VDC or 85-264 VAC
- Popular low voltage ranges: 24 VDC (10-36 VDC), 48 VDC (36-72 VDC)
- Screw or pluggable terminal blocks for reliable, maintenance-free connections
- CSA/UL 60950-1 safety approved to 85 °C (185 °F)

Section 1.2

Description

The RUGGEDCOM RSG2288 features various ports, controls and indicator LEDs on the display panel for connecting, configuring and troubleshooting the device. The display panel can be located on the rear, front or top of the device, depending on the mounting configuration.

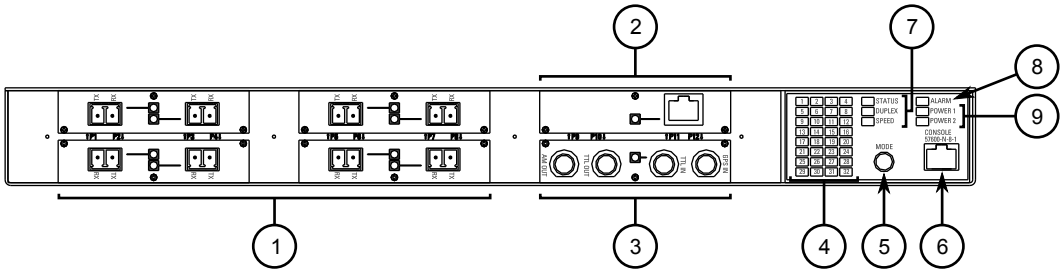

Figure 1: RUGGEDCOM RSG2288

1. Fiber or Copper Ethernet Ports **2.** Copper Ethernet Port **3.** BNC Ports **4.** Port Status Indicator LEDs **5.** Mode Button **6.** RS-232 Serial Console Port (RJ45) **7.** Display Mode Indicator LEDs **8.** Alarm Indicator LED **9.** Power Module Indicator LEDs

- **Communication Ports** – Ports for communicating with other devices or accessing the RUGGEDCOM ROS operating system are described in Chapter 3, *Communication Ports*.
- **Port Status Indicator LEDs** – Port status indicator LEDs indicate the operational status of each port, dependent on the currently selected mode.

Mode	Color/State	Description
Status	Green (Solid)	Link detected
	Green (Blinking)	Link activity
	Off	No link detected
Duplex	Green	Full duplex mode
	Orange	Half duplex mode
	Off	No link detected
Speed	Green (Solid)	100 Mb/s
	Green (Blinking)	1000 Mb/s
	Orange (Solid)	10 Mb/s
	Off	No link detected

- **Display Mode Indicator LEDs** – The display mode indicator LEDs indicate the current display mode for the port status indicator LEDs (i.e. Status, Duplex or Speed).
- **Mode button** – The **Mode** button sets the display mode for the port status indicator LEDs (i.e. Status, Duplex or Speed). It can also be used to reset the device if held for 5 seconds.
- **Alarm Indicator LED** – The alarm indicator LED illuminates when an alarm condition exists.
- **Power Module Indicator LEDs** – The power module indicator LEDs indicate the status of the power modules.
  - **Green** – The power supply is supplying power
  - **Red** – Power supply failure
  - **Off** – No power supply is installed
- **RS-232 Console Port** – The serial console port is for interfacing directly with the device and accessing initial management functions. For information about connecting to the device via the serial console port, refer to Section 2.6, “Connecting to the Device”.

Section 1.3

Precision Time Protocol (PTP) Support

The Precision Time Protocol (PTP) module adds the ability to provide time synchronization via Ethernet using the Precision Time Protocol (PTP) and Network Time Protocol (NTP), and to synchronize with an external IRIG-B source or GPS network.

The PTP module features BNC ports for AM OUT, TTL IN/OUT and GPS IN. It also includes an LED to indicate when synchronization has been achieved.

NOTE
The PTP module can only be installed in slot 6. For more information, refer to Chapter 3, Communication Ports.

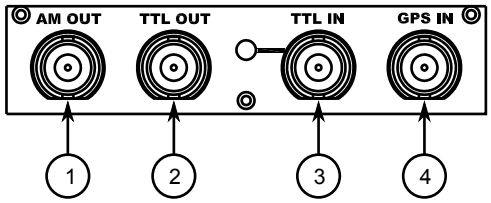

Figure 2: PTP Module

1. AM OUT Port **2.** TTL OUT Port **3.** TTL IN Port **4.** GPS IN Port

For more information about the BNC ports, refer to Section 3.5, “BNC Ports”.

The following sections describe the PTP support in more detail:

- Section 1.3.1, “Supported Time Synchronization Sources”
- Section 1.3.2, “AM and TTL Outputs”
- Section 1.3.3, “IEEE 1588 Support”

Section 1.3.1

Supported Time Synchronization Sources

The following time synchronization sources are supported by the RUGGEDCOM RSG2288, with or without the PTP card:

Synchronization Source	Without PTP Card	With PTP Card
NTP	✓	✓
IEEE 1588 v2	✓	✓
IRIG-B PWM	×	✓
GPS	×	✓

NTP

NTP (Network Time Protocol) is the standard for synchronizing the clocks of computer systems throughout the Internet and is suitable for systems that require accuracies in the order of 1 ms.

IRIG-B PWM

IRIG-B time synchronization is an even older, established, inter-device time synchronization mechanism providing accuracy in sub-milliseconds.

GPS

The Global Positioning System (GPS), as a source of accurate time, requires an external GPS antenna input to provide accurate time signals comparable to 500 ns. The RUGGEDCOM RSG2288 can use the GPS receiver on the PTP module to provide the time base for the system.

IEEE 1588

IEEE 1588 is designed to provide networked, packet-based time synchronization between different networking nodes (PTP devices). The RUGGEDCOM RSG2288 supports PTP v2, which is defined in the IEEE 1588-2008 standard. IEEE 1588 is designed to fill a niche not well served by either of the two older, dominant protocols, NTP and IRIG-B. IEEE 1588 is also designed for applications that cannot bear the cost of a GPS receiver at each node or for which GPS signals are inaccessible.

The RUGGEDCOM RSG2288 supports ordinary clock, boundary clock and transparent clock modes. An ordinary clock can be configured as either a Grandmaster Clock (GM) or a Slave Clock (SC) within the master-slave hierarchy.

Every Ethernet port on the RUGGEDCOM RSG2288 supports IEEE 1588. For more information, refer to Section 1.3.3, “IEEE 1588 Support”.

Section 1.3.2

AM and TTL Outputs

The PTP card provides AM (Amplitude Modulated) and TTL (Transistor-Transistor Logic) outputs.

The AM OUT port supports the IRIG-B AM signal format, while the TTL OUT port supports the IRIG-B PWM and PPS signal formats. Enabling/disabling the output ports and – in the case of TTL OUT – selecting the signal format is controlled through the RUGGEDCOM ROS operating system.

IMPORTANT!
The input impedance of third-party AM inputs must be 100 Ω minimum.

The number of devices that can be connected to the AM OUT and TTL Out ports is dependent on the cabling type and length, as well as the input impedances of the devices. The following simplified circuit schematic shows the interface between an IRIG-B source and connected devices.

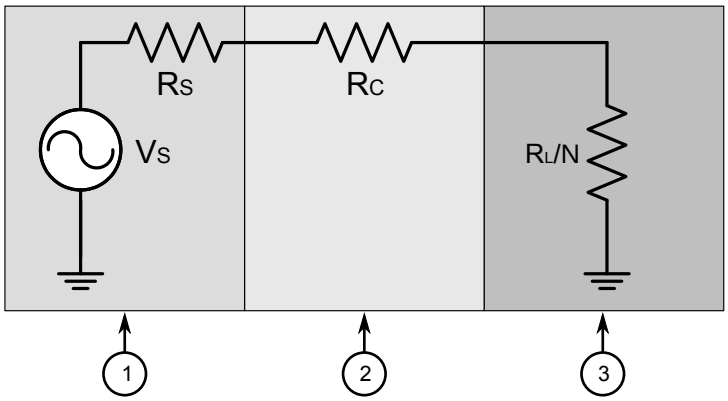

Figure 3: IRIG-B Simplified Circuit Schematic

1. Source **2.** Cabling **3.** Device

The maximum number of devices (N) that can be connected to the source is determined by checking if the source current (IS) required to drive the connected devices is less than the maximum drive current the source can provide, and verifying that the load voltage (VL) the connected devices see is greater than the minimum required voltage.

Section 1.3.3

IEEE 1588 Support

RUGGEDCOM RSG2288 supports various IEEE 1588 time synchronization capabilities and provides synchronization in 2-step mode. This mode supports the following clock types:

- Peer-to-Peer Transparent Clock
- End-to-End Transparent Clock
- End-to-End Slave Clock
- End-to-End Master Clock
- Peer-to-Peer Slave Clock
- Peer-to-Peer Master Clock
- Ordinary/Transparent Clock
- Boundary Clock

2 Installing Device

The following sections describe how to install the device, including mounting the device, installing/removing modules, connecting power, and connecting the device to the network.

DANGER!
Electrocution hazard – risk of serious personal injury and/or damage to equipment. Before performing any maintenance tasks, make sure all power to the device has been disconnected and wait approximately two minutes for any remaining energy to dissipate.

WARNING!
Radiation hazard – risk of serious personal injury. This product contains a laser system and is classified as a CLASS 1 LASER PRODUCT. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

IMPORTANT!
This product contains no user-serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void.

Changes or modifications not expressly approved by Siemens Canada Ltd. could invalidate specifications, test results, and agency approvals, and void the user's authority to operate the equipment.

IMPORTANT!
This product should be installed in a restricted access location where access can only be gained by authorized personnel who have been informed of the restrictions and any precautions that must be taken. Access must only be possible through the use of a tool, lock and key, or other means of security, and controlled by the authority responsible for the location.

- Section 2.1, “Mounting the Device”
- Section 2.2, “Connecting Power”
- Section 2.3, “Installing a GPS Antenna”
- Section 2.4, “Connecting the Failsafe Alarm Relay”
- Section 2.5, “Grounding the Device”
- Section 2.6, “Connecting to the Device”
- Section 2.7, “Cabling Recommendations”

Section 2.1
Mounting the Device

The RUGGEDCOM RSG2288 is designed for maximum mounting and display flexibility. It can be equipped with connectors that allow it to be installed in a 48 cm (19 in) rack, 35 mm (1.4 in) DIN rail, or directly on a panel.

NOTE
For detailed dimensions of the device with either rack, DIN rail or panel hardware installed, refer to Chapter 5, Dimension Drawings.

The following sections describe the various methods of mounting the device:

- Section 2.1.1, “Mounting the Device to a Rack”
- Section 2.1.2, “Mounting the Device on a DIN Rail”
- Section 2.1.3, “Mounting the Device to a Panel”

Section 2.1.1
Mounting the Device to a Rack

The RUGGEDCOM RSG2288 can be secured to a standard 48 cm (19 in) rack using separately purchased rack mount adapters. The adapters can be installed at the front or rear of the chassis.

Each adapter kit includes four adapters.

CAUTION!
Vibration hazard – risk of damage to the device. In high-vibration or seismically active locations, always install four rack mount adapters (two at the front of the chassis and two at the rear).

CAUTION!
Electrical/mechanical hazard – risk of damage to the device. Before installing the device in a rack, make sure of the following:

- *When installing the device in a closed or multi-device rack, be aware that the operating ambient temperature of the rack may be higher than the ambient temperature of the room. Make sure the rack is installed in a suitable environment that can withstand the maximum ambient temperature generated by the rack.*
- *Make sure each device in the rack is separated by at least one rack-unit of space, or 44 mm (1.75 in), to promote convectional airflow. Forced airflow is not required. However, any increase in airflow will result in a reduction of ambient temperature and improve the long-term reliability of all equipment mounted in the rack space.*
- *Do not exceed the maximum number of devices or weight restrictions specified by the rack manufacturer.*
- *Do not overload the supply circuit. Refer to the over-current protection and power supply ratings specified by the rack manufacturer.*
- *Make sure the rack and all devices have a proper ground-to-Earth connection. Pay particular attention to power supply connections other than direct connections to the branch circuit (e.g. power strips).*

To secure the device to a standard 48 cm (19 in) rack, do the following:

NOTE
The device can be ordered with the communication ports located at the front or rear of the device. Placing the ports at the rear allows all data and power cabling to be installed and connected at the rear of the rack.

1. Make sure the rack mount adapters are installed on the correct side of the chassis.

- To make the modules and ports accessible, install the rack mount adapters at the rear of the chassis
- To make the management ports and LEDs accessible, install the rack mount adapters at the front of the chassis

NOTE
The chassis features multiple mounting holes, allowing the rack mount adapters to be installed up to 25 mm (1 in) from the face of the device.

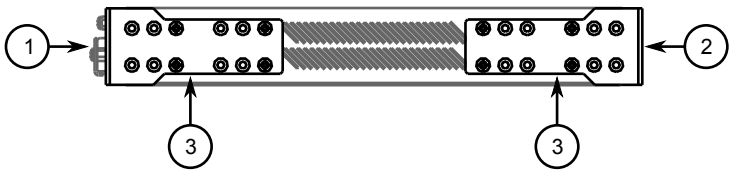

Figure 4: Rack Mount Adapters

1. Rear **2.** Front **3.** Rack Mount Adapter

2. If required, install adapters on the opposite side of the device to protect from vibrations.
3. Insert the device into the rack.
4. Secure the adapters to the rack using the supplied hardware.

Section 2.1.2
Mounting the Device on a DIN Rail

For DIN rail installations, the RUGGEDCOM RSG2288 can be equipped with panel/DIN rail adapters pre-installed on each side of the chassis. The adapters allow the device to be slid onto a standard 35 mm (1.4 in) DIN rail.

IMPORTANT!
DIN rail mounting is not recommended for constant vibration environments.

To mount the device to a DIN rail, do the following:

1. Align the adapters with the DIN rails and slide the device into place.

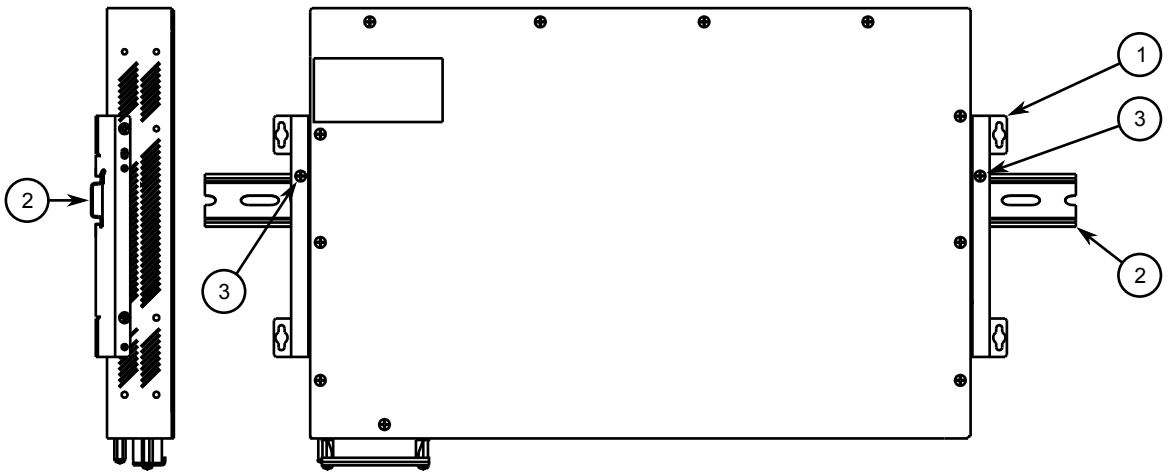

Figure 5: DIN Rail Mounting

1. Panel/DIN Rail Adapter **2.** DIN Rail **3.** Screw

2. Install one of the supplied screws on either side of the device to secure the adapters to the DIN rails.

Section 2.1.3

Mounting the Device to a Panel

For panel installations, the RUGGEDCOM RSG2288 can be equipped with panel/DIN rail adapters pre-installed on each side of the chassis. The adapters allow the device to be attached to a panel using screws.

To mount the device to a panel, do the following:

1. Place the device against the panel and align the adapters with the mounting holes.

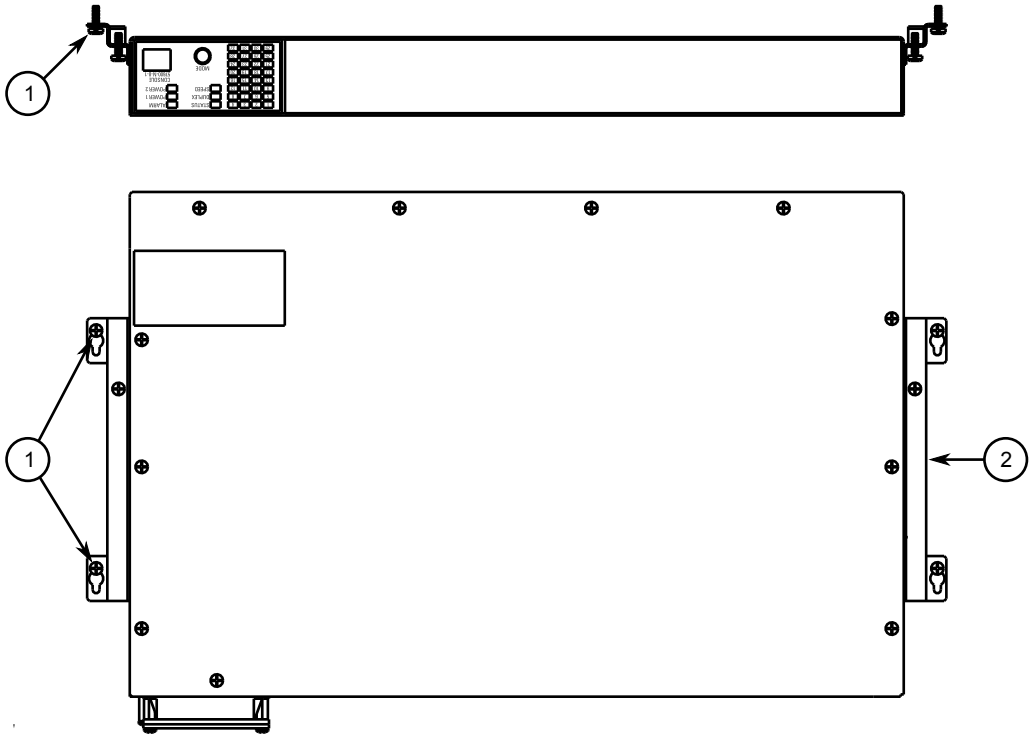

Figure 6: Panel Mounting

1. Screw **2.** Panel/DIN Rail Adapter

2. Install the supplied screws to secure the adapters to the panel.

Section 2.2

Connecting Power

The RUGGEDCOM RSG2288 supports a single or dual redundant AC and/or DC power supplies. The use of two power modules is recommended to provide redundancy and load balancing.

The RUGGEDCOM RSG2288 can be equipped with either a screw-type or pluggable terminal block, which provides power to both power supplies. The screw-type terminal block is installed using Phillips screws and compression plates, allowing either bare wire connections or crimped terminal lugs. Use #6 size ring lugs for secure, reliable connections under severe shock or vibration.

CAUTION!

Electrical hazard – risk of damage to the device. Disconnect the device from the power supply if power input is above or below the specified input range. For more information, refer to Section 4.1, "Power Supply Specifications".

NOTE

- *For maximum redundancy in a dual power supply configuration, use two independent power sources.*

- *Use only #16 gage copper wiring when connecting terminal blocks.*
- *For 100-240 VAC rated equipment, an appropriately rated AC circuit breaker must be installed.*
- *For 125/250 VDC rated equipment, an appropriately rated DC circuit breaker must be installed.*
- *A circuit breaker is not required for 12, 24 or 48 VDC rated power supplies.*
- *It is recommended to provide a separate circuit breaker for each power supply module.*
- *Equipment must be installed according to applicable local wiring codes and standards.*

The following sections describe how to connect power to the device:

- Section 2.2.1, “Connecting AC Power”
- Section 2.2.2, “Connecting DC Power”
- Section 2.2.3, “Wiring Examples”

Section 2.2.1

Connecting AC Power

To connect a high AC power supply to the device, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Do not connect AC power cables to terminals for DC power. Damage to the power supply may occur.

CAUTION!
Electrical hazard – risk of damage to equipment. Before testing the dielectric strength (HIPOT) in the field, remove the metal jumper. This metal jumper connects transient suppression circuitry to chassis ground and must be removed in order to avoid damage to transient suppression circuitry during testing.

NOTE
The terminal block is divided into separate terminals for each internal power supply. Make sure to connect the external power supply to the appropriate terminals.

NOTE
The screw-type terminal block is installed using Phillips screws and compression plates, allowing either bare wire connections or crimped terminal lugs. Use #6 size ring lugs for secure, reliable screws, which must be removed to make connections.

1. Remove the terminal block cover.
2. If a screw-type terminal block is installed, remove the screws from the appropriate terminals. Use these screws along with #6 ring lugs to secure the wires to the terminal block.
3. Connect the positive wire from the power source to the positive/live (+/L) terminal on the terminal block. For more information, refer to Section 2.2.3, “Wiring Examples”.

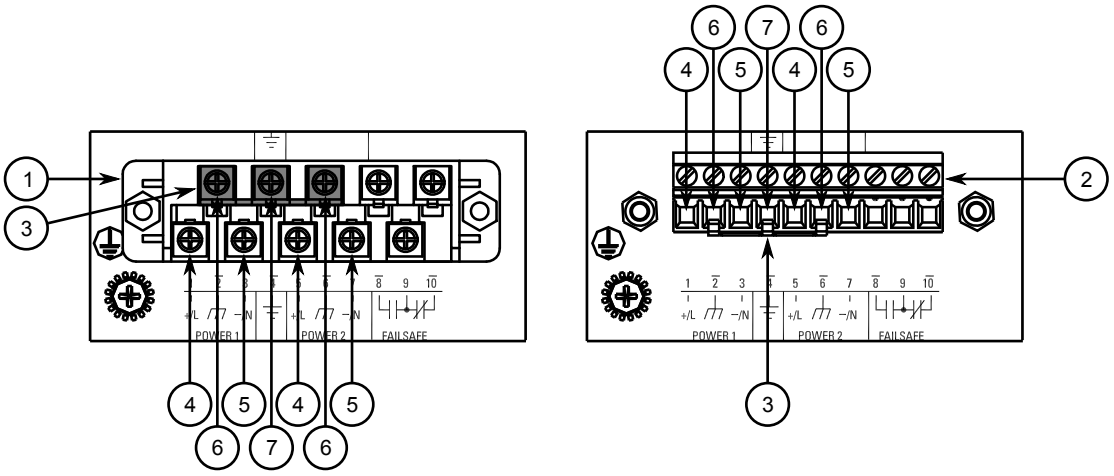

Figure 7: Terminal Block Wiring

1. Screw-Type Terminal Block **2.** Pluggable Terminal Block **3.** Jumper **4.** Positive/Live (+/L) Terminal **5.** Negative/Neutral (-/N) Terminal (-/N) **6.** Surge Ground Terminal **7.** Chassis Ground Terminal

4. Connect the negative wire from the power source to the negative/neutral (-/N) terminal on the terminal block. For more information, refer to Section 2.2.3, “Wiring Examples”.
5. Install the supplied metal jumper between terminals 2, 4 and 6 to connect the surge ground terminals to the chassis ground terminal. The surge ground terminals are used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
6. Connect the ground terminal on the power source to the chassis ground terminal on the device. For more information, refer to Section 2.5, “Grounding the Device”

DANGER!
Electrocution hazard – risk of death, serious personal injury and/or damage to the device. Make sure the supplied terminal block cover is always installed before the device is powered.

7. Install the terminal block cover.

Section 2.2.2
Connecting DC Power

To connect a high or low DC power supply to the device, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Before testing the dielectric strength (HIPOT) in the field, remove the metal jumper. This metal jumper connects transient suppression circuitry to chassis ground and must be removed in order to avoid damage to transient suppression circuitry during testing.

NOTE
The terminal block is divided into separate terminals for each internal power supply. Make sure to connect the external power supply to the appropriate terminals.

NOTE
The screw-type terminal block is installed using Phillips screws and compression plates, allowing either bare wire connections or crimped terminal lugs. Use #6 size ring lugs for secure, reliable screws, which must be removed to make connections.

1. Remove the terminal block cover.
2. If a screw-type terminal block is installed, remove the screws from the appropriate terminals. Use these screws along with #6 ring lugs to secure the wires to the terminal block.
3. Connect the positive wire from the power source to the positive/live (+/L) terminal on the terminal block. For more information, refer to Section 2.2.3, “Wiring Examples”.

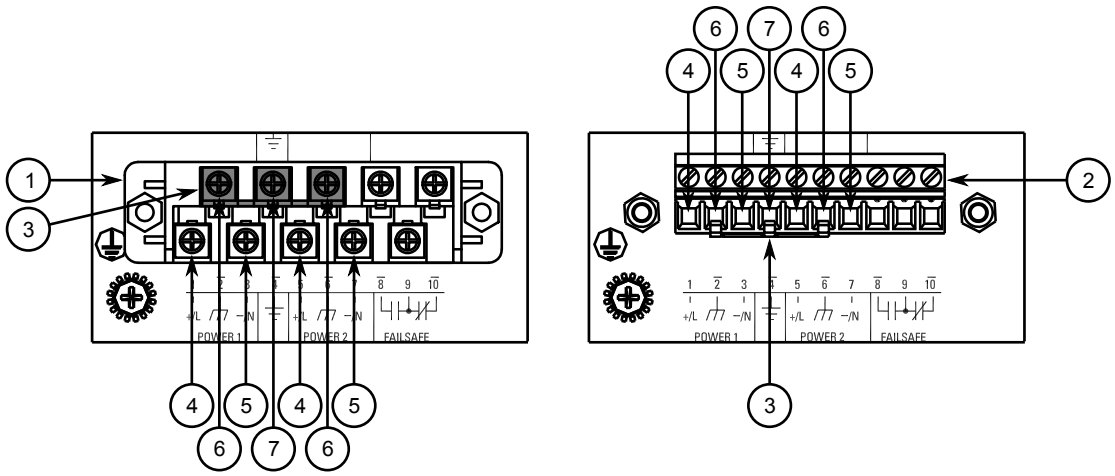

Figure 8: Terminal Block Wiring

1. Screw-Type Terminal Block **2.** Pluggable Terminal Block **3.** Jumper **4.** Positive/Live (+/L) Terminal **5.** Negative/Neutral (-/N) Terminal (-/N) **6.** Surge Ground Terminal **7.** Chassis Ground Terminal

4. Connect the negative wire from the power source to the negative/neutral (-/N) terminal on the terminal block. For more information, refer to Section 2.2.3, “Wiring Examples”.
5. Install the supplied metal jumper between terminals 2, 4 and 6 to connect the surge ground terminals to the chassis ground terminal. The surge ground terminals are used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
6. Connect the ground terminal on the power source to the chassis ground terminal on the device. For more information, refer to Section 2.5, “Grounding the Device”

DANGER!
Electrocution hazard – risk of death, serious personal injury and/or damage to the device. Make sure the supplied terminal block cover is always installed before the device is powered.

7. Install the terminal block cover.

Section 2.2.3
Wiring Examples

The following illustrate how to connect power to single and dual power supplies.

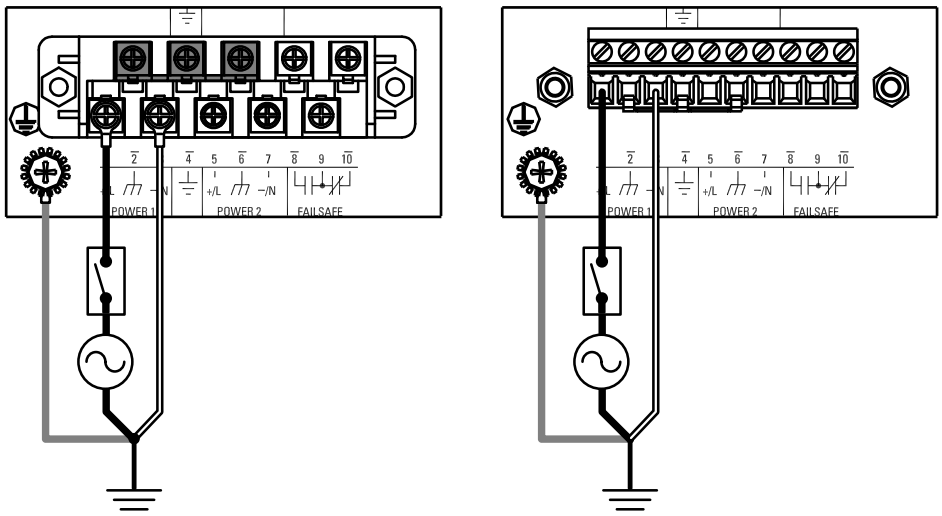

Figure 9: Single AC Power Supply

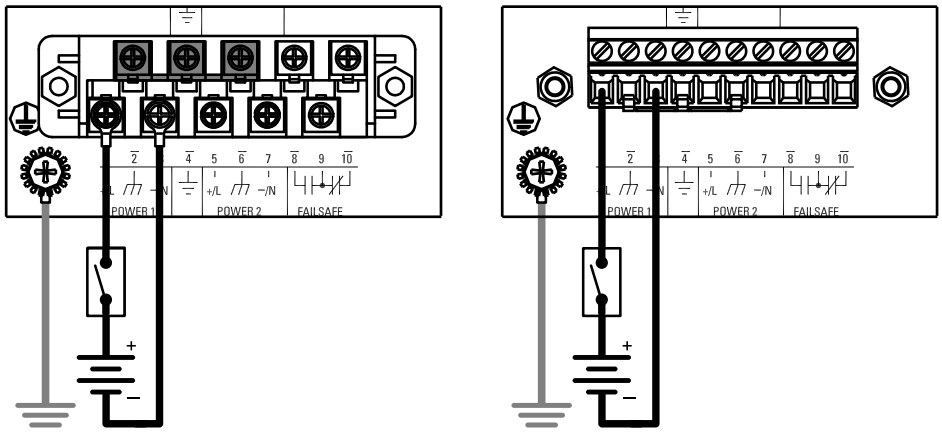

Figure 10: Single DC Power Supply

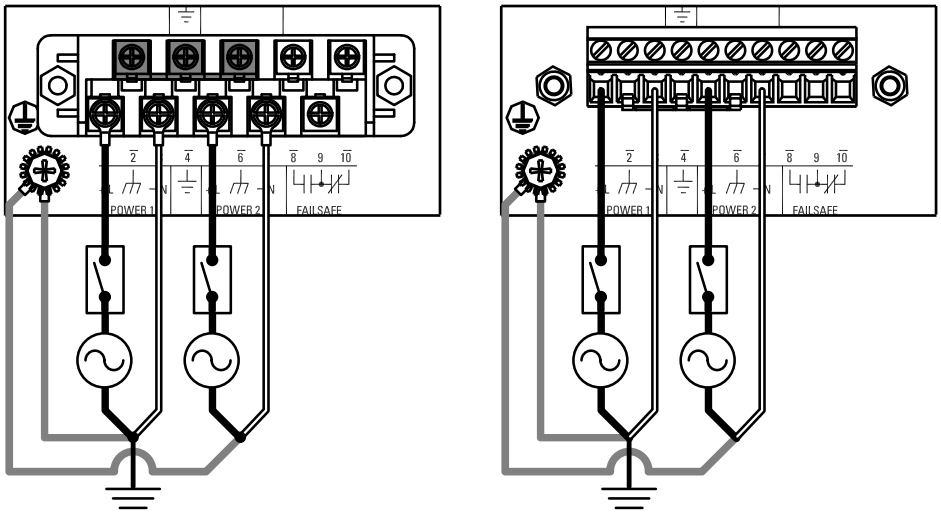

Figure 11: Dual AC Power Supply

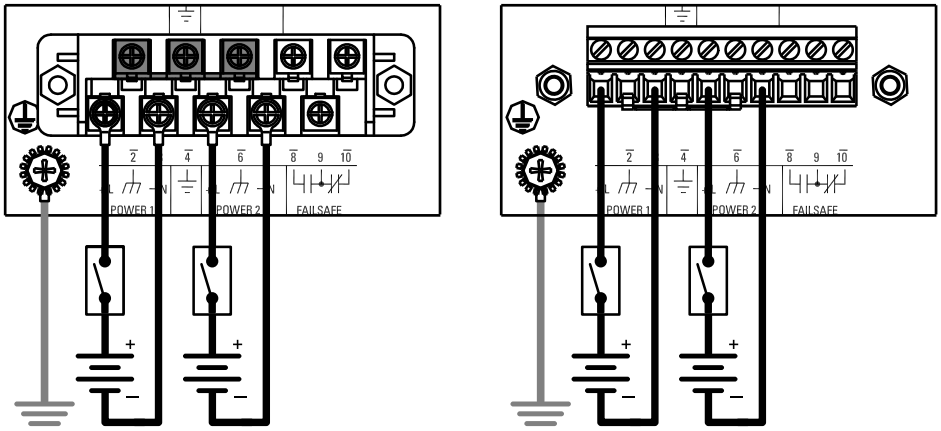

Figure 12: Dual DC Power Supply

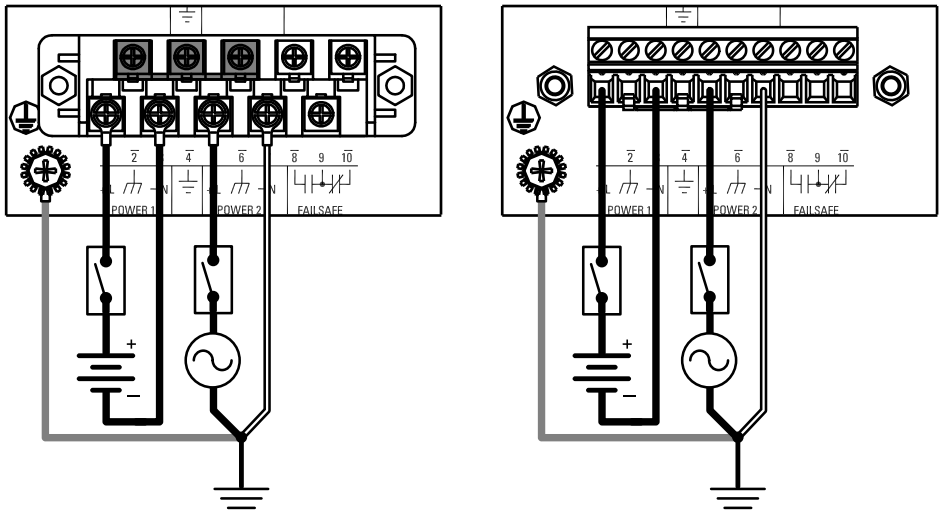

Figure 13: Dual AC/DC Power Supply

Section 2.3

Installing a GPS Antenna

For increased signal coverage and improved performance, the GPS antenna is intended to be installed in a remote location separate from the RUGGEDCOM RSG2288.

IMPORTANT!
A PTP card must be installed in the RUGGEDCOM RSG2288 for GPS capabilities. For more information, refer to Section 1.3, "Precision Time Protocol (PTP) Support".

NOTE
A specific brand of antenna is not specified.

To install the GPS antenna, do the following:

IMPORTANT!
The antenna installation must be as per Article 810 of the NEC. Specifically, the grounding conductor must not be less than 10 AWG (Cu). The scheme should be either:

- *In accordance with UL 96 and 96A Lightning Protection Components and Installation Requirements for Lightning Protection Systems (LPS)*
- *Tested in accordance with UL 50 and UL 497*

IMPORTANT!
A Radio Frequency (RF) site survey is recommended prior to any installation to help determine the best location for the GPS antenna. For assistance, contact a Siemens Sales representative.

IMPORTANT!

Although it is not possible to protect the antenna from a direct lightning strike, the antenna and connected components can be protected from secondary effects through installation location and protection devices.

Install the antenna at least 15 meters away from and lower than any structures that attract lightning. GPS antenna damage is usually not the result of a direct lightning strike, but due to high currents induced by the effects of a lightning strike on a nearby structure. Siemens also recommends installing lightning protectors in the antenna line to protect the receiver and connected devices. If a lightning protector is installed, it is important to make sure it has a low impedance path to the ground.

NOTE

The GPS IN port provides 5 VDC at up to 10 mA to power the antenna. For best results, a total gain of 18 dB at the antenna input is recommended, which includes the antenna gain, cable loss, lightning protector loss, line amplifier gain and filter loss.

NOTE

For technical specifications, refer to Section 4.6, "PTP Specifications".

1. Mount the antenna to a pole or wall in an area that provides good signal coverage and is away from any signal noise emanating from other communications equipment. Make sure 90° of the sky is visible to the antenna.

   NOTE

   Using any length of coaxial cable will add time delay to the GPS signal, which degrades the accuracy of the calculated time and position. The time delay is dependent on the type of dielectric material in the cable and ranges from 10 to 2 ns/ft. The following are examples of the day that can be expected based on the dielectric type.

Dielectric Type	Time Delay (ns/ft)	Propagation Velocity (% of c)
Solid Polyethylene (PE)	1.54	65.9
Foam Polyethylene (FE)	1.27	80.0
Foam Polystyrene (FS)	1.12	91.0
Air Space Polyethylene (ASP)	1.15-1.21	84-88
Solid Teflon (ST)	1.46	69.4
Air Space Teflon (AST)	1.13-1.20	85-90

2. Using shielded, low loss 50 Ω coaxial cables, connect the antenna to a lightning protector. Make sure the cables are routed away from any noise sources, such as Switch-Mode Power Supplies (SMPS).

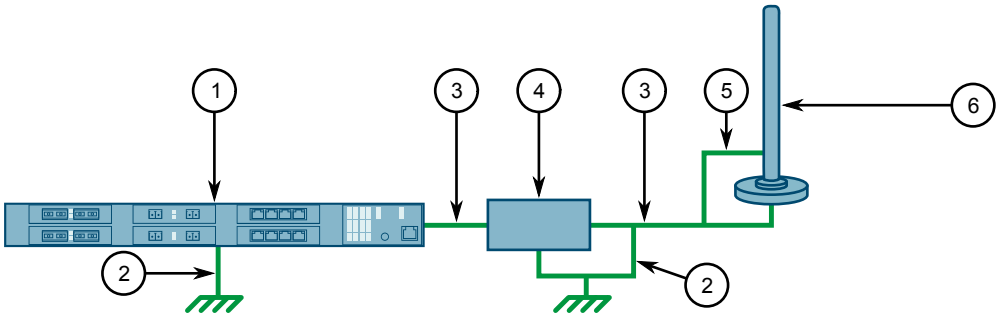

Figure 14: Antenna and Lightning Protector Assembly

1. RUGGEDCOM RSG2288 **2.** Drain Wire **3.** Shielded Coaxial Cable **4.** Lightning Protector **5.** Ground Wire **6.** Antenna

NOTE

Although active GPS antennas have gain, depending on the length of the coaxial cable used, the gain may be insufficient, in which case a line amplifier is required.

Most active antennas include filters. However, if there is a high potential for electromagnetic interference, such as from the near field of a radio transmitter, additional antenna line filtering may be necessary.

3. [Optional] Install one or more line amplifiers, as required.
4. If installed indoors, install a lightning arrestor at the entrance to the building and one near the RUGGEDCOM RSG2288.
5. Connect the lightning protector to the the **GPS IN** port.

Section 2.4

Connecting the Failsafe Alarm Relay

The failsafe relay can be configured to latch based on alarm conditions. The NO (Normally Open) contact is closed when the unit is powered and there are no active alarms. If the device is not powered or if an active alarm is configured, the relay opens the NO contact and closes the NC (Normally Closed) contact.

NOTE

Control of the failsafe relay output is configurable through ROS. One common application for this relay is to signal an alarm if a power failure occurs. For more information, refer to the ROS User Guide for the RUGGEDCOM RSG2288.

The following shows the proper relay connections.

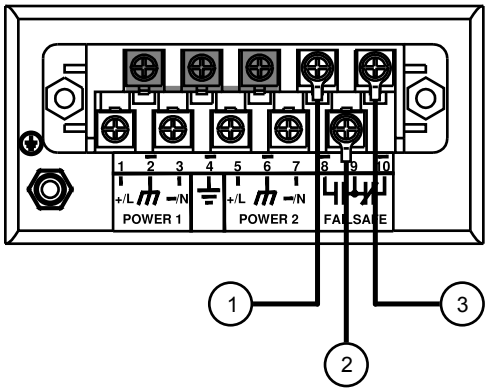

Figure 15: Failsafe Alarm Relay Wiring

1. Normally Open **2.** Common **3.** Normally Closed

Section 2.5

Grounding the Device

The RUGGEDCOM RSG2288 chassis ground terminal uses a #6-32 screw. It is recommended to terminate the ground connection with a #6 ring lug and torque it to 1.7 N·m (15 lbf·in).

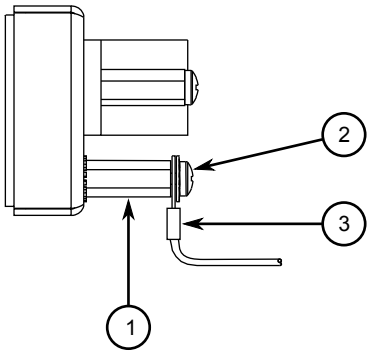

Figure 16: Chassis Ground Connection

1. Stainless Steel Stud **2.** #6-32 Screw **3.** #6 Ring Lug

Section 2.6

Connecting to the Device

The following describes the various methods for accessing the ROS console and Web interfaces on the device. For more detailed instructions, refer to the *ROS User Guide* for the RUGGEDCOM RSG2288.

RS232 Console Port

Connect a PC or terminal directly to the RS232 console port to access the boot-time control and ROS interfaces. The console port provides access to ROS's console and Web interfaces.

IMPORTANT!
The console port is intended to be used only as a temporary connection during initial configuration or troubleshooting.

Connection to the console port is made using an RJ45-to-DB9 console cable. The following is the pin-out for the console port:

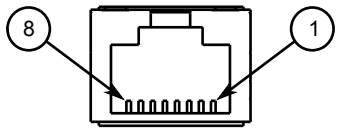

Figure 17: RJ45 Console Port Pin Configuration

Pin		Name	Description	Comment
RJ45 Male	DB9 Female			
1	6	DSR[a]	Data Set Ready	
2	1	DCD[a]	Carrier Detect	Reserved (Do Not Connect)
3	4	DTR[a]	Data Terminal Ready	
4	5	GND	Signal Ground	
5	2	RxD	Receive Data (to DTE)	
6	3	TxD	Transmit Data (from DTE)	
7	8	CTS[b]	Clear to Send	
8	7	RTS[b]	Read to Send	
1	9	RI[c]	Ring Indicator	

[a] *The DSR, DCD and DTR pins are connected together internally.*

[b] *The CTS and RTS pins are connected together internally.*

[c] *RI is not connected.*

Communication Ports

Connect any of the available Ethernet ports on the device to a management switch and access the ROS console and Web interfaces via the device's IP address. For more information about available ports, refer to Chapter 3, *Communication Ports*.

Section 2.7

Cabling Recommendations

Before connecting the device, be aware of the recommendations and considerations outlined in the following sections:

- Section 2.7.1, “Protection On Twisted-Pair Data Ports”
- Section 2.7.2, “Gigabit Ethernet 1000Base-TX Cabling Recommendations”

Section 2.7.1

Protection On Twisted-Pair Data Ports

Siemens does not recommend the use of copper cabling of any length for critical, real-time substation automation applications. All copper Ethernet ports on RUGGEDCOM products include transient suppression circuitry to protect against damage from electrical transients and conform with IEC 61850-3 and IEEE 1613 Class 1 standards. This means that during a transient electrical event, communications errors or interruptions may occur, but recovery is automatic.

Siemens also does not recommend using copper Ethernet ports to interface with devices in the field across distances that could produce high levels of ground potential rise (i.e. greater than 2500 V), during line-to-ground fault conditions.

Section 2.7.2

Gigabit Ethernet 1000Base-TX Cabling Recommendations

The IEEE 802.3ab Gigabit Ethernet standard defines 1000 Mbit/s Ethernet communications over distances of up to 100 m (328 ft) using all 4 pairs in category 5 (or higher) balanced, unshielded twisted-pair cabling. For wiring guidelines, system designers and integrators should refer to the Telecommunications Industry Association (TIA) TIA/EIA-568-A wiring standard that characterizes minimum cabling performance specifications required for proper Gigabit Ethernet operation. For reliable, error-free data communication, new and pre-existing communication paths should be verified for TIA/EIA-568-A compliance.

The following table summarizes the relevant cabling standards:

Cabling Category	1000Base-TX Compliant	Required Action
< 5	No	New wiring infrastructure required.
5	Yes	Verify TIA/EIA-568-A compliance.
5e	Yes	No action required. New installations should be designed with Category 5e or higher.
6	Yes	No action required.
> 6	Yes	Connector and wiring standards to be determined.

Follow these recommendations for copper data cabling in high electrical noise environments:

- Data cable lengths should be as short as possible, preferably 3 m (10 ft) in length. Copper data cables should not be used for inter-building communications.
- Power and data cables should not be run in parallel for long distances, and should be installed in separate conduits. Power and data cables should intersect at 90° angles when necessary to reduce inductive coupling.
- Shielded/screened cabling can be used when required. Care should be taken to avoid the creation of ground loops with shielded cabling.

3 Communication Ports

The RUGGEDCOM RSG2288 can be equipped with various types of communication ports to enhance its abilities and performance.

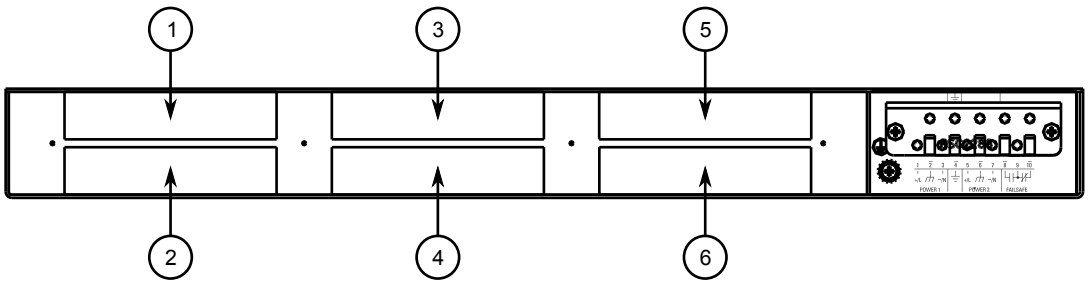

Figure 18: Port Assignment

Each type of module has a specific location in the RUGGEDCOM RSG2288 chassis:

- Slots 1 to 4 support any combination of two-port fiber or copper Ethernet modules up to 1 Gbps
- Slot 5 supports a one-port fiber or copper Ethernet module up to 1 Gbps
- Slot 6 houses the PTP Source Card

The exact configuration of the device can be determined by reading the factory data file through the ROS user interface. For more information about how to read the factory data file, refer to the *ROS User Guide* for the RUGGEDCOM RSG2288.

Each communication port is equipped with an LED that indicates the link/activity state of the port.

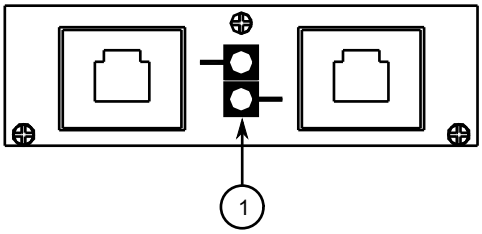

Figure 19: Port LEDs

1. Port LED

LED State	Description
Green (Solid)	Link established
Green (Blinking)	Link activity
Off	No link detected

The following sections describe the available communication ports:

- Section 3.1, “Copper Ethernet Ports”
- Section 3.2, “Fiber Optic Ethernet Ports”
- Section 3.3, “SFP Optic Ethernet Ports”
- Section 3.4, “GBIC Optic Ethernet Ports”
- Section 3.5, “BNC Ports”

Section 3.1
Copper Ethernet Ports

The RUGGEDCOM RSG2288 supports several 10/100/1000Base-TX Ethernet ports that allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cables with either RJ45 male connectors. The RJ45 connectors are directly connected to the chassis ground on the device and can accept CAT-5 shielded twisted-pair (STP) cables.

WARNING!
Electric shock hazard – risk of serious personal injury and/or equipment interference. If shielded cables are used, make sure the shielded cables do not form a ground loop via the shield wire and the RJ45 receptacles at either end. Ground loops can cause excessive noise and interference, but more importantly, create a potential shock hazard that can result in serious injury.

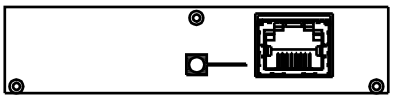

Figure 20: 1 x 10/100/1000Tx with RJ45 Ports (1CG01)

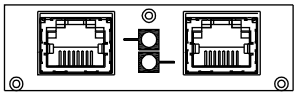

Figure 21: 2 x 10/100/1000Tx with RJ45 Ports (CG01)

Each port features an LED that indicates the state of the port.

State	Description
Yellow (Solid)	Link established
Yellow (Blinking)	Link activity
Off	No link detected

The following are the pin-out descriptions for the RJ45 connectors:

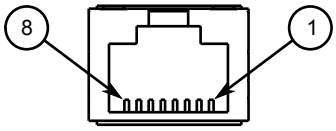

Figure 22: RJ45 Ethernet Port Pin Configuration

Pin	Name		Description
	10/100Base-TX	1000Base-TX	
1	RX+	BI_DA+	Receive Data+ or Bi-Directional Pair A+
2	RX-	BI_DA-	Receive Data- or Bi-Directional Pair A-
3	TX+	BI_DB+	Transmit Data+ or Bi-Directional Pair B+
4	Reserved (Do Not Connect)	BI_DC+	Transmit Data+ or Bi-Directional Pair C+
5	Reserved (Do Not Connect)	BI_DC-	Receive Data- or Bi-Directional Pair C-
6	TX-	BI_DB-	Transmit Data- or Bi-Directional Pair B-

Pin	Name		Description
	10/100Base-TX	1000Base-TX	
7	Reserved (Do Not Connect)	BI_DD+	Receive Data- or Bi-Directional Pair D+
8	Reserved (Do Not Connect)	BI_DD-	Receive Data- or Bi-Directional Pair D-

For specifications on the available copper Ethernet ports, refer to Section 4.4, “Copper Ethernet Port Specifications”.

Section 3.2
Fiber Optic Ethernet Ports

Fiber optic Ethernet ports are available with either MTRJ (Mechanical Transfer Registered Jack), LC (Lucent Connector), SC (Standard or Subscriber Connector) or ST (Straight Tip) connectors. Make sure the Transmit (Tx) and Receive (Rx) connections of each port are properly connected and matched to establish a proper link.

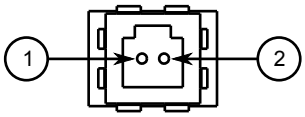

Figure 23: MTRJ Port

1. Tx Connector **2.** Rx Connector

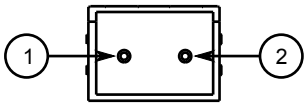

Figure 24: LC Port

1. Tx Connector **2.** Rx Connector

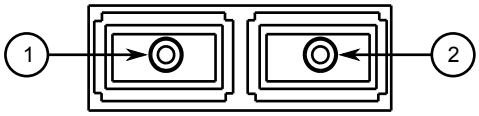

Figure 25: SC Port

1. Tx Connector **2.** Rx Connector

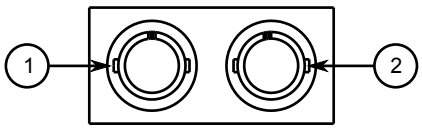

Figure 26: ST Port

1. Tx Connector **2.** Rx Connector

For specifications on the available fiber optic Ethernet ports, refer to Section 4.5, “Fiber Optic Ethernet Port Specifications”.

Section 3.3
SFP Optic Ethernet Ports

SFP (Small Form-Factor Pluggable) optic Ethernet ports are available with LC (Lucent Connector) connectors. Make sure the Transmit (Tx) and Receive (Rx) connections of each port are properly connected and matched to establish a proper link.

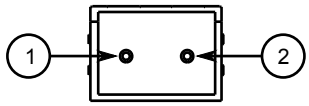

Figure 27: LC Port

1. Tx Connector **2.** Rx Connector

NOTE
SFP modules, as well as their optical ports, can be safely inserted and removed while the chassis is powered and operating.

The following sections describe how to install and remove SFP optical ports:

- Section 3.3.1, “Installing an SFP Optical Port”
- Section 3.3.2, “Removing an SFP Optical Port”

Section 3.3.1

Installing an SFP Optical Port

To install an SFP optical port, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Use only components certified by Siemens with RUGGEDCOM products. Damage to the module and device may occur if compatibility and reliability have not been properly assessed.

CAUTION!
Electrical hazard – risk of damage to equipment. Make sure all electrostatic energy is dissipated before installing or removing components from the device. An electrostatic discharge (ESD) can cause serious damage to the component once it is outside the chassis.

1. Make sure all potential electrostatic build-up has been properly discharged to prevent electrostatic discharges (ESD). This can be accomplished by wearing an ESD wrist strap or by touching Earth or the chassis ground.
2. Remove the dust cover from the port opening in the module.

   CAUTION!
   Mechanical hazard – risk of component damage. SFP optical ports are designed to insert in only one orientation. Do not force the port into the module.
3. Remove the port from its packaging.
4. Insert the port into the module and swing the bail-latch up to lock it in place.

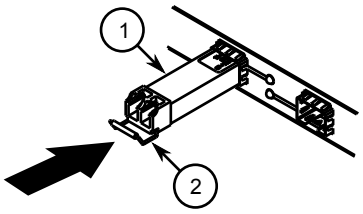

Figure 28: Installing an SFP Optical Port (Typical)

1. SFP Optical Port **2.** Metal Bail-Latch

5. Remove the dust cover from the port.
6. Connect a cable to the port and test the connection.

Section 3.3.2

Removing an SFP Optical Port

To remove an SFP optical port, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Make sure all electrostatic energy is dissipated before performing installing or removing components from the device. An electrostatic discharge (ESD) can cause serious damage to the component once it is outside the chassis.

1. Make sure all potential electrostatic build-up has been properly discharged to prevent electrostatic discharges (ESD). This can be accomplished by wearing an ESD wrist strap or by touching Earth or the chassis ground.
2. Disconnect the cable from the port.
3. Swing the metal bail-latch down and pull the port from the module.

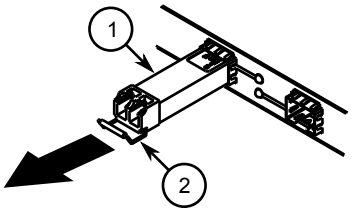

Figure 29: Removing an SFP Optical Port (Typical)

1. SFP Optical Port **2.** Metal Bail-Latch

4. Store the port in an ESD-safe bag or other suitable ESD-safe environment, free from moisture and stored at the proper temperature (-40 to 85 °C or -40 to 185 °F).
5. Insert a plug in the empty port opening to prevent the ingress of dust and dirt.

Section 3.4
GBIC Optic Ethernet Ports

GBIC (Gigabit Interface Converter) optic Ethernet ports are available with SC (Standard or Subscriber Connector) connectors.

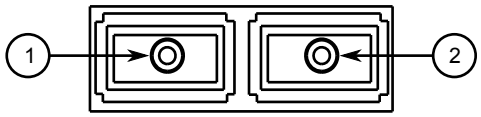

Figure 30: SC Port

1. Tx Connector **2.** Rx Connector

The following sections describe how to install and remove GBIC optical ports:

- Section 3.4.1, “Installing a GBIC Optical Port”
- Section 3.4.2, “Removing a GBIC Optical Port”

Section 3.4.1
Installing a GBIC Optical Port

To install a GBIC optical port, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Use only components certified by Siemens with RUGGEDCOM products. Damage to the module and device may occur if compatibility and reliability have not been properly assessed.

CAUTION!
Electrical hazard – risk of damage to equipment. Make sure all electrostatic energy is dissipated before installing or removing components from the device. An electrostatic discharge (ESD) can cause serious damage to the component once it is outside the chassis.

1. Make sure all potential electrostatic build-up has been properly discharged to prevent electrostatic discharges (ESD). This can be accomplished by wearing an ESD wrist strap or by touching Earth or the chassis ground.
2. Remove the dust cover from the port opening in the module.

   CAUTION!
   Mechanical hazard – risk of component damage. GBIC optical ports are designed to insert in only one orientation. Do not force the port into the module.
3. Remove the port from its packaging.
4. Squeeze the latches on either side of the port and insert the port into the module.

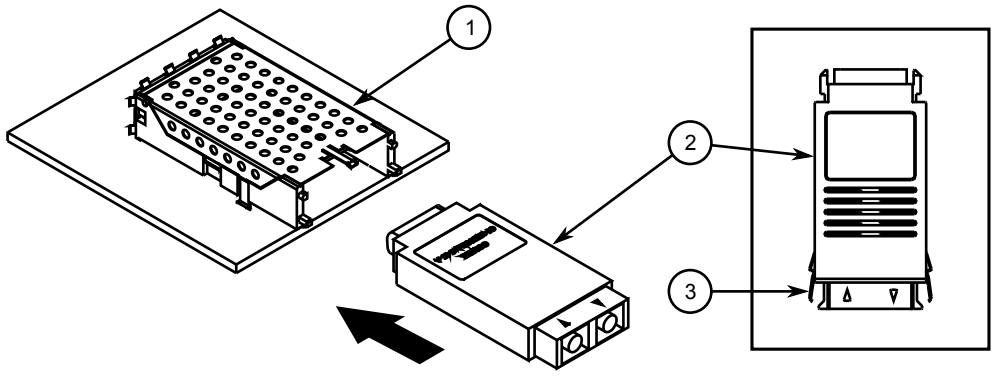

Figure 31: Installing a GBIC Optical Port

1. GBIC Optical Port Module **2.** GBIC Optical Port **3.** Locking Latch

5. Release the latches and make sure the module is locked in place.
6. Remove the dust cover from the port.
7. Connect a cable to the port and test the connection.

Section 3.4.2

Removing a GBIC Optical Port

To remove an GBIC optical port, do the following:

CAUTION!
Electrical hazard – risk of damage to equipment. Make sure all electrostatic energy is dissipated before performing installing or removing components from the device. An electrostatic discharge (ESD) can cause serious damage to the component once it is outside the chassis.

1. Make sure all potential electrostatic build-up has been properly discharged to prevent electrostatic discharges (ESD). This can be accomplished by wearing an ESD wrist strap or by touching Earth or the chassis ground.
2. Disconnect the cable from the port.
3. Squeeze the latches on either side of the port and pull it from the module.

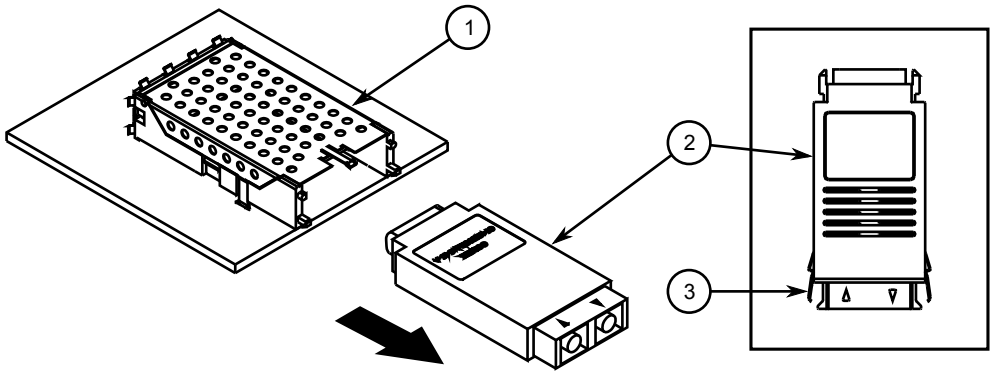

Figure 32: Removing a GBIC Optical Port

1. GBIC Optical Port Module **2.** GBIC Optical Port **3.** Locking Latch

4. Store the port in an ESD-safe bag or other suitable ESD-safe environment, free from moisture and stored at the proper temperature (-40 to 85 °C or -40 to 185 °F).
5. Insert a plug in the empty port opening to prevent the ingress of dust and dirt.

Section 3.5

BNC Ports

The following BNC ports are available on the PTP module:

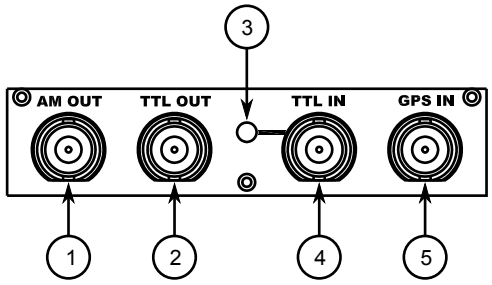

Figure 33: PTP Module

1. AM OUT Port **2.** TTL OUT Port **3.** Sync LED **4.** TTL IN Port **5.** GPS IN Port

Port	Function
AM IN	AM-level IRIG-B signal input, software enabled
TTL OUT	IRIG-B PWM or 1 PPS signal output, software selectable
TTL IN	TTL-level IRIG-B PWM signal input
GPS IN	GPS antenna input

Inputs are controlled by RUGGEDCOM ROS and only one can be active at any time. For information about activating an input, refer to the *RUGGEDCOM ROS User Guide* for the RUGGEDCOM RSG2288.

The color of the **Sync** LED on the front panel of the PTP module indicates the status of the incoming timing signal:

- **Green** – Signal locked
- **Amber/Yellow** – Holdover (GPS lock has been achieved, but the receiver no longer sees the minimum number of required satellites)

- **Red** – Error
- **Off** – No signal detected

4 Technical Specifications

The following sections provide important technical specifications related to the device and available modules:

- Section 4.1, “Power Supply Specifications”
- Section 4.2, “Failsafe Relay Specifications”
- Section 4.3, “Supported Networking Standards”
- Section 4.4, “Copper Ethernet Port Specifications”
- Section 4.5, “Fiber Optic Ethernet Port Specifications”
- Section 4.6, “PTP Specifications”
- Section 4.7, “Operating Environment”
- Section 4.8, “Mechanical Specifications”

Section 4.1

Power Supply Specifications

CAUTION!
Electrical hazard – risk of damage to the device. Disconnect the device from the power supply if power input is above or below the specified input range.

Power Supply Type	Input Range		Internal Fuse Rating[ab]	Maximum Power Consumption[c]
	Minimum	Maximum		
24 VDC	10 VDC	36 VDC	6.3 A(F)	28 W
48 VDC	36 VDC	72 VDC	3.15 A(T)	
HI (125/250 VDC)[d]	88 VDC	300 VDC	2 A(T)	
HI (110/230 VAC)[d]	85 VAC	264 VAC	2 A(T)	

[a] *(F) denotes fast-acting fuse*

[b] *(T) denotes time-delay fuse.*

[c] *Power consumption varies based on configuration. 10/100Base-TX ports consume roughly 1 W less than fiber optic ports.*

[d] *The HI power supply is the same power supply for both AC and DC.*

Section 4.2

Failsafe Relay Specifications

Parameter	Value (Resistive Load)
Max Switching Voltage	240 VAC, 125 VDC

Parameter	Value (Resistive Load)
Rated Switching Current	2 A @ 240 VAC, 0.15 A @ 125 VDC, 2 A @ 30 VDC
Maximum Switching Capacity	150 W, 500 VA

Section 4.3
Supported Networking Standards

Standard	Description
IEEE 802.3	10BaseT
IEEE 802.3u	100BaseTX/100BaseFX
IEEE 802.3z	1000BaseSX/LX
IEEE 802.3ab	1000BaseTx
IEEE 802.3x	Flow Control
IEEE 802.1D	MAC Bridges
IEEE 802.1Q	VLAN (Virtual LAN) Tagging
IEEE 802.1p	Class of Service
IEEE 1588 v2	Precision Time Protocol

Section 4.4
Copper Ethernet Port Specifications

The following details the specifications for copper Ethernet ports that can be ordered with the RUGGEDCOM RSG2288.

Section 4.4.1
Copper Gigabit Ethernet (1 Gbps) Port Specifications

NOTE

- *Maximum segment length is greatly dependent on factors such as fiber quality, and the number of patches and splices. Consult a Siemens sales associate when determining maximum segment distances.*
- *All optical power numbers are listed as dBm averages.*
- *F51 transceivers are rated for -40 to 85 °C (-40 to 185 °F).*

Connector	Duplex[e]	Cable Type[f]	Wiring Standard[g]	Maximum Distance[h]	Isolation[i]
RJ45	FDX/HDX	> CAT-5	TIA/EIA T568A/B	100 m (328 ft)	1.5 kV

[e] *Auto-Negotiating*

[f] *Shielded or unshielded.*

[g] *Auto-crossover and auto-polarity.*

[h] *Typical distance. Dependent on the number of connectors and splices.*

[i] *RMS 1 minute.*

Section 4.5

Fiber Optic Ethernet Port Specifications

The following sections list specifications of the optical transceivers used in the modules available for the RUGGEDCOM RSG2288:

- Section 4.5.1, “10FL Ethernet Optical Specifications”
- Section 4.5.2, “Fast Ethernet (10/100 Mbps) Optical Specifications”
- Section 4.5.3, “Gigabit Ethernet (1 Gbps) Optical Specifications”

Section 4.5.1

10FL Ethernet Optical Specifications

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[j]	Tx min (dBm)	Tx max (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Distance (typ.) (km)	Power Budget (dB)
MM	ST	62.5/125	850	-16	-9	-34	-11.2	2	18
		50/125		-19.8	-12.8				14.2

[j] *Typical.*

Section 4.5.2

Fast Ethernet (10/100 Mbps) Optical Specifications

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[k]	Tx min. (dBm)	Tx max. (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Maximum Distance (km)[l]	Power Budget (dB)
MM	ST	62.5/125	1300	-19	-14	-31	-14	2	12
		50/125		-22.5					8.5
MM	SC	62.5/125	1300	-19	-14	-31	-14	2	12
		50/125		-22.5					8.5
MM	MTRJ	62.5/125	1300	-19	-14	-31	-14	2	12
		50/125		-22.5					8.5
SM	ST	9/125	1310	-15	-8	-32	-3	20	17
SM	SC	9/125	1310	-15	-8	-31	-7	20	16
SM	LC	9/125	1310	-15	-8	-34	-7	20	19

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[k]	Tx min. (dBm)	Tx max. (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Maximum Distance (km)[l]	Power Budget (dB)
SM	SC	9/125	1310	-5	0	-34	-3	50	29
SM	LC	9/125	1310	-5	0	-35	3	50	30
SM	SC	9/125	1310	0	5	-37	0	90	37
SM	LC	9/125	1310	0	5	-37	0	90	37
MM	LC	62.5/125	1300	-19	-14	-32	-14	2	13

[k] *Typical.*

[l] *Typical distance. Dependent on the cable type, number of connectors and number of splices.*

Section 4.5.3

Gigabit Ethernet (1 Gbps) Optical Specifications

Fixed Gigabit Transceivers

NOTE
These transceivers utilize a distributed feedback (DFB) type laser and are rated for -20 to 85 °C (-4 to 185 °F) operation only.

Mode	Connector Type	Cable Type (µm)[m]	Tx λ (nm)[n]	Tx Minimum (dBm)[o]	Tx Maximum (dBm)[o]	Rx Sensitivity (dBm)[o]	Rx Saturation (dBm)[o]	Maximum Distance (km)[p]	Power Budget (dB)
MM	LC	50/125	850	-9	-2.5	-20	0	0.5	11
		62.5/125							
SM	SC	9/125	1310	-10	-3	-20	-3	10	10
SM	LC	9/125	1310	-9.5	-3	-21	-3	10	11.5
SM	SC	9/125	1310	-5	0	-20	-3	25	15
SM	LC	9/125	1310	-7	-3	-24	-3	25	17

[m] *All cabling is duplex type unless specified otherwise.*

[n] *Typical.*

[o] *All optical power numbers are listed as dBm averages.*

[p] *Typical distance. The maximum segment length is greatly dependent on factors such as fiber quality, and the number of patches and splices. Consult a Siemens sales associates when determining maximum segment distances.*

SFP Gigabit Transceivers

NOTE
SFP transceivers have a temperature range of -40 to 85 °C (-40 to 185 °F), unless specified otherwise.

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[q]	Tx Minimum (dBm)[r]	Tx Maximum (dBm)[r]	Rx Sensitivity (dBm)[r]	Rx Saturation (dBm)[r]	Maximum Distance (km)[s]	Power Budget (dB)
MM	LC	50/125	850	-9	-2.5	-20	0	0.5	11
		62.5/125						0.3	
SM	LC	9/125	1310	-9.5	-3	-19	-3	10	9.5
SM	LC	9/125	1310	-7	-3	-23	-3	25	16
SM[t]	LC	9/125	1550	0	5	-23	-3	70	23

[q] *Typical.*

[r] *All optical power numbers are listed as dBm averages.*

[s] *Typical distance. The maximum segment length is greatly dependent on factors such as fiber quality, and the number of patches and splices. Consult a Siemens sales associates when determining maximum segment distances.*

[t] *Operating temperature range of -20 to 85 °C (-4 to 185 °F).*

GBIC Gigabit Transceivers

NOTE
GBIC transceivers have a temperature range of -40 to 85 °C (-40 to 185 °F), unless specified otherwise.

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[u]	Tx Minimum (dBm)[v]	Tx Maximum (dBm)[v]	Rx Sensitivity (dBm)[v]	Rx Saturation (dBm)[v]	Maximum Distance (km)[w]	Power Budget (dB)
SM	SC	9/125	1310	-9.5	-3	-21	-3	10	11.5
SM	SC	9/125	1310	-7	-3	-24	-3	25	17
SM[x]	SC	9/125	1550	0	5	-23	-3	70	23

[u] *Typical.*

[v] *All optical power numbers are listed as dBm averages.*

[w] *Typical distance. The maximum segment length is greatly dependent on factors such as fiber quality, and the number of patches and splices. Consult a Siemens sales associates when determining maximum segment distances.*

[x] *Operating temperature range of -20 to 85 °C (-4 to 185 °F).*

Section 4.6
PTP Specifications

IRIG-B PWM Input Specifications

Parameter	Typical Value
Input Voltage	TTL-Compatible
Input Impedance	>200 kΩ

IRIG-B PWM Output Specifications

Parameter	Typical Value
Output Current (I_s)	100 mA
Output Voltage (V_s)	TTL-Compatible
Output Impedance (R_s)	50 Ω

IRIG-B AM Output Specifications

Parameter	Typical Value
Carrier Frequency	1 kHz
Modulation Depth	3:1±10%
Output Current (I_s)	15 mA
Output Impedance (R_s)	10 Ω
Output Voltage (V_s)	6 V_{p-p}

GPS Standalone Antenna Requirements

Characteristic	Active Antenna
Polarization	RHCP (Right-Hand Circular Polarized)
Receive Frequency	1.57542 GHz ± 1.023 MHz
Power Supply	5 VDC
DC Current	< 10 mA at 3 VDC
Antenna Gain	Select antenna gain based on system configuration
Total Gain at PTP GPS Input (includes antenna gain, cable loss, lightning arrestor loss, line amplifier gain and filter loss)	Total Gain≤ 18 dBi
Axial Ratio	< 3 dB
Output VSWR	< 2.5

Section 4.7

Operating Environment

Parameter	Range	Comments
Ambient Operating Temperature	-40 to 85 °C (-40 to 185 °F)	Ambient Temperature as measured from a 30 cm radius surrounding the center of the enclosure.
Ambient Relative Humidity	5% to 95%	Non-condensing
Ambient Storage Temperature	-40 to 85 °C (-40 to 185 °F)	

Section 4.8

Mechanical Specifications

Parameter	Value
Dimensions	Refer to Chapter 5, *Dimension Drawings*
Weight	4.8 kg (10.6 lbs)
Ingress Protection	IP40 (1 mm or 0.04 in objects)
Enclosure	18 AWG Galvanized Steel

5 Dimension Drawings

NOTE
All dimensions are in millimeters, unless otherwise stated.

NOTE
Dimensional tolerances are in accordance with ISO 2768-mK, unless otherwise stated.

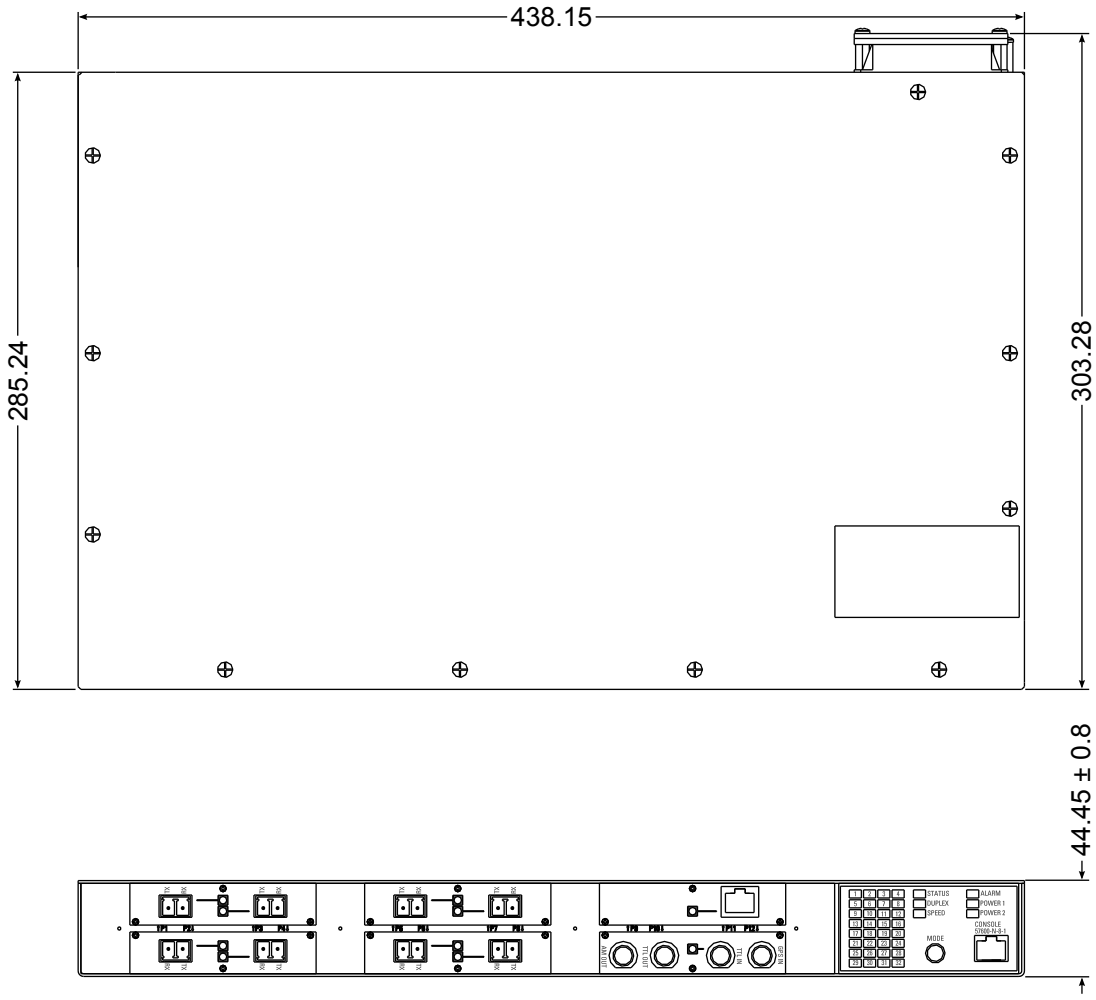

Figure 34: Overall Dimensions

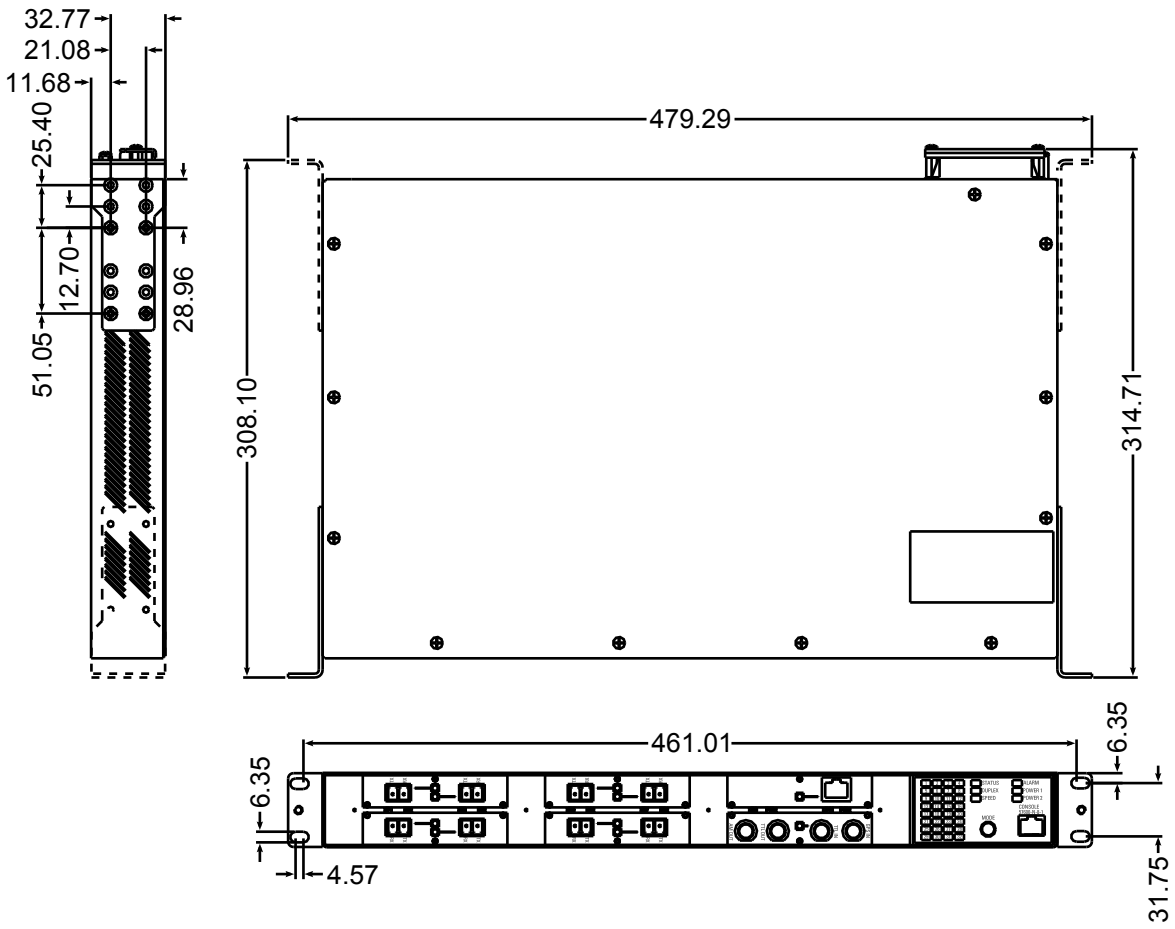

Figure 35: Rack Mount Dimensions

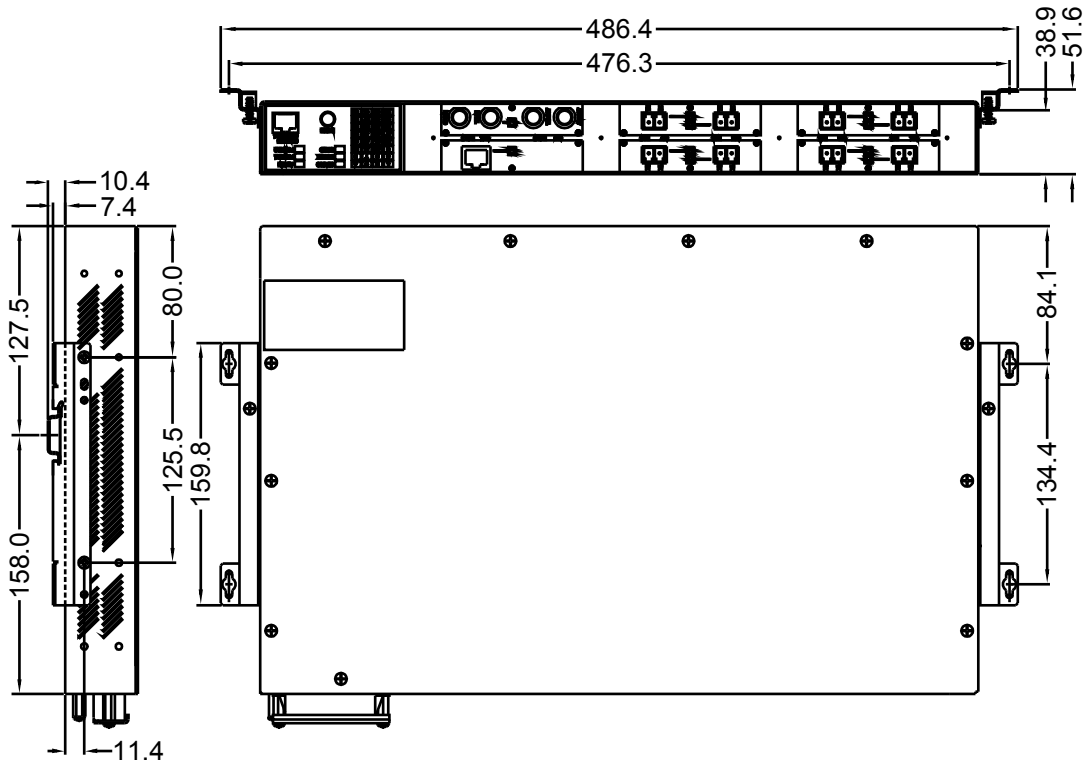

Figure 36: Panel and DIN Rail Mount Dimensions

6 Certification

The RUGGEDCOM RSG2288 device has been thoroughly tested to guarantee its conformance with recognized standards and has received approval from recognized regulatory agencies.

- Section 6.1, “Standards Compliance”
- Section 6.2, “Agency Approvals”
- Section 6.3, “EMC and Environmental Type Tests”

Section 6.1

Standards Compliance

The RUGGEDCOM RSG2288 complies with the following standards:

- **FCC Compliance**
  This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

  This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference on his own expense.
- **Industry Canada Compliance**
  CAN ICES-3 (A) / NMB-3 (A)
- **Other**
  - IEC 61000-6-2 (Generic Industrial)
  - NEMA TS-2 (Traffic Control Equipment)
  - IEEE 1613 (Electric Utility Substations)
  - IEC 61850-3 (Electric Utility Substations)

Section 6.2

Agency Approvals

Agency	Standards	Comments
CSA	CSA C22.2 No. 60950-1, UL 60950-1	Approved
CE	EN 60950-1, EN 61000-6-2, EN 60825-1, EN 55022 Class A, EN 50581	CE Compliance is claimed via Declaration of Self Conformity Route
FCC	FCC Part 15, Class A	Approved
FDA/CDRH	21 CFR Chapter I, Sub-chapter J	Approved

Agency	Standards	Comments
ISO	ISO9001:2008	Designed and manufactured using an ISO9001:2008 certified quality program

Section 6.3

EMC and Environmental Type Tests

The RUGGEDCOM RSG2288 has passed the following EMC and environmental tests.

IEC 61850-3 EMC Type Tests

NOTE

- *If the unit contains copper ports, the IEC 1613 conformance is Class 1, during which disturbance errors may occur but recovery is automatic.*
- *If the unit contains all fiber ports, the IEC 1613 conformance is Class 2, during which no disturbance errors will occur.*

Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8 kV	4
		Enclosure Air	+/- 15 kV	
IEC 61000-4-3	Radiated RFI	Enclosure Ports	20 V/m	
IEC 61000-4-4	Burst (Fast Transient)	Signal Ports	+/- 4 kV @ 2.5 kHz	
		DC Power Ports	+/- 4 kV	4
		AC Power Ports		
		Earth Ground Ports		
IEC 61000-4-5	Surge	Signal Ports	+/- 4 kV Line-to-Ground, +/- 2 kV Line-to-Line	4
		DC Power Ports	+/- 2 kV Line-to-Ground, +/- 1 kV Line-to-Line	3
		AC Power Ports	+/- 4 kV Line-to-Ground, +/- 2 kV Line-to-Line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal Ports	10 V	3
		DC Power Ports		
		AC Power Ports		
		Earth Ground Ports		
IEC 61000-4-8	Magnetic Field	Enclosure Ports	40 A/m, Continuous, 1000 A/m for 1 s	
IEC 61000-4-29	Voltage Dips and Interrupts (DC Power Ports)	DC Power Ports	30% for 0.1 s 60% for 0.1 s 100% for 0.05 s	

Test	Description		Test Levels	Severity Levels
		AC Power Ports	30% for 1 period 60% for 50 periods	
IEC 61000-4-11	Voltage Dips and Interrupts (A. C. Power Ports)	AC Power Ports	100% for 5 periods 100% for 50 periods	
IEC 61000-4-12	Damped Oscillatory	Signal Ports	2.5 kV Common, 1 kV Differential Mode @1 MHz	3
		DC Power Ports		
		AC Power Ports		
IEC 61000-4-16	Mains Frequency Voltage	Signal Ports	30 V Continuous, 300 V for 1s	4
		DC Power Ports		
IEC 61000-4-17	Ripple on DC Power Supply	DC Power Ports	10%	3
IEC 60255-5	Dielectric Strength	Signal Ports	2 kV (Fail-Safe Relay Output)	
		DC Power Ports	2 kV	
		AC Power Ports	2 kV	
	HV Impulse	Signal Ports	5 kV (Fail-Safe Relay Output)	
		DC Power Ports	5 kV	
		AC Power Ports		

IEEE 1613 EMC Immunity Type Tests

NOTE
The RUGGEDCOM RSG2288 meets Class 2 requirements for an all-fiber configuration and Class 1 requirements for copper ports.

Description		Test Levels
ESD	Enclosure Contact	+/- 2 kV, +/-4 kV, +/-8 kV
	Enclosure Air	+/-4 kV, +/-8 kV, +/-15 kV
Radiated RFI	Enclosure Ports	35 V/m
Fast Transient	Signal Ports	+/- 4 kV @ 2.5 kHz
	DC Power Ports	+/- 4 kV
	AC Power Ports	+/- 4 kV
	Earth Ground Ports	+/- 4 kV
Oscillatory	Signal Ports	2.5 kV Common Mode @1MHz
	DC Power Ports	2.5 kV common, 1 kV differential mode @ 1 MHz
	AC Power Ports	2.5 kV common, 1 kV differential mode @ 1 MHz
HV Impulse	Signal Ports	5 kV (Fail-Safe Relay Output)

Description		Test Levels
	DC Power Ports	5 kV
	AC Power Ports	5 kV
Dielectric Strength	Signal Ports	2 kV
	DC Power Ports	2 kV
	AC Power Ports	2 kV
Damped Oscillatory Magnetic Field	Enclosure Ports	100 A/m Peak

Environmental Type Tests

Test	Description		Test Levels
IEC 60068-2-1	Cold Temperature	Test Ad	-40 °C (-40 °F), 16 Hours
IEC 60068-2-2	Dry Heat	Test Bd	85 °C (185 °F), 16 Hours
IEC 60068-2-30	Humidity (Damp Heat, Cyclic)	Test Db	95% (non-condensing), 55 °C (131 °F), 6 cycles
IEC 60068-21-1	Vibration		2g @ 10-150 Hz
IEC 60068-21-2	Shock		30 g @ 11 ms