SIEMENS

RUGGEDCOM MX5000

Installation Guide

03/2016
RC1059-EN-05

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Contacting Siemens

Address
Siemens Canada Ltd.
Industry Sector
300 Applewood Crescent
Concord, Ontario
Canada, L4K 5C7

Telephone
Toll-free: 1 888 264 0006
Tel: +1 905 856 5288
Fax: +1 905 856 1995

E-mail
ruggedcom.info.i-ia@siemens.com

Web
www.siemens.com/ruggedcom

Table of Contents

Preface

This guide describes the RUGGEDCOM MX5000. 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.

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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:

- *ROX II User Guide for the MX5000*

Accessing Documentation

The latest user documentation for RUGGEDCOM MX5000 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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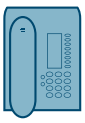

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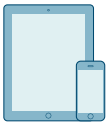

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- Access Siemens' extensive library of support documentation, including FAQs and manuals
- Submit SRs or check on the status of an existing SR
- Contact a local Siemens representative from Sales, Technical Support, Training, etc.
- Ask questions or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

1 Introduction

The RUGGEDCOM MX5000 is a MIL-STD, high-port density routing and switching platform, designed to operate in the most demanding environments.The MX5000 can withstand high levels of electromagnetic interference, radio frequency interference, and a wide temperature range of -40 to 85 °C (-40 to 185 °F). The MX5000 is designed to meet the challenging climatic and environmental demands found in utility, industrial, and military network applications.

The MX5000's superior hardware design, coupled with the embedded RUGGEDCOM MX5000 operating system, provides improved system reliability for the most demanding network applications. The cyber security and networking features make it ideally suited for creating secure Ethernet networks for mission critical, real-time, control applications.

The MX5000 is a scalable, modular platform providing the ability to change the configuration as the network grows and needs change.

The following sections provide more information about the MX5000:

Section 1.1

Feature Highlights

Ethernet Ports

- Up to 48 copper ports
- Up to 48 100Base-FX optical ports
- Up to 2 Gigabit Ethernet ports
- Long-haul optics allow distances up to 90 km (56 mi)
- Multiple connector types: ST, MTRJ, LC, SC

Reliability in Harsh Environments

- Immunity to EMI and high voltage electrical transients
- Zero-Packet-Loss Technology
- -40 to 85 °C (-40 to 185 °F) operating temperature (no fans within chassis or modules)
- Conformal coated printed circuit boards (optional)

Modularity

- Up to 6 slots for line modules
- Up to 48 10/100Base-TX or 48 100Base-FX ports

Universal Power Supply Options

- Fully integrated, dual-redundant (optional) power supplies
- Universal high voltage ranges: 88-300 VDC or 85-264 VAC

- Terminal blocks for reliable maintenance-free connections
- CSA/UL 60950-1 safety approved to 85 °C (185 °F)

Section 1.2
Description

The MX5000 features various ports, controls and indicator LEDs on individual modules and the front panel for connecting, configuring and troubleshooting the device.

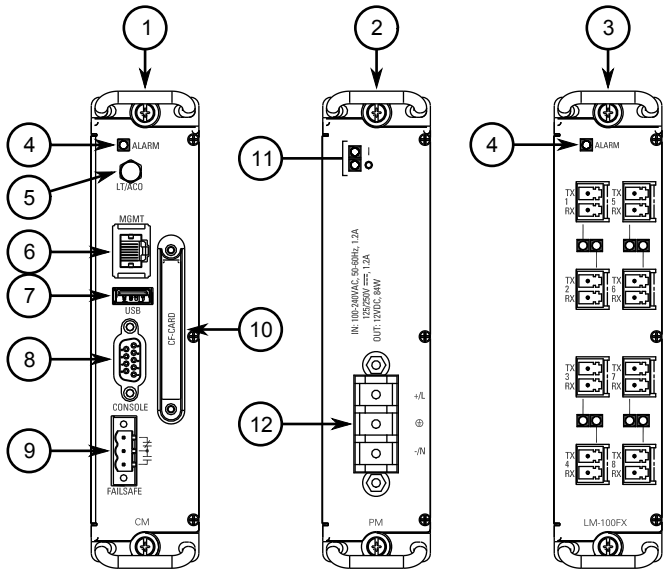

Figure 1: RUGGEDCOM MX5000 Modules

1. Control Module **2.** Power Module **3.** Line Module (Typical) **4.** Alarm Indicator LED **5.** Lamp Test/Alarm Cut-Off (LT/ACO) Button **6.** Management Ethernet Port **7.** Utility USB Port **8.** RS232 Serial Console Port (DB9) **9.** Failsafe Alarm Relay **10.** Compact Flash Card Port **11.** Power Module Indicator LEDs **12.** Power Supply Terminal Block

When the MX5000 is configured for *rack front* mounting, these ports, controls and LEDs are located on the front panel.

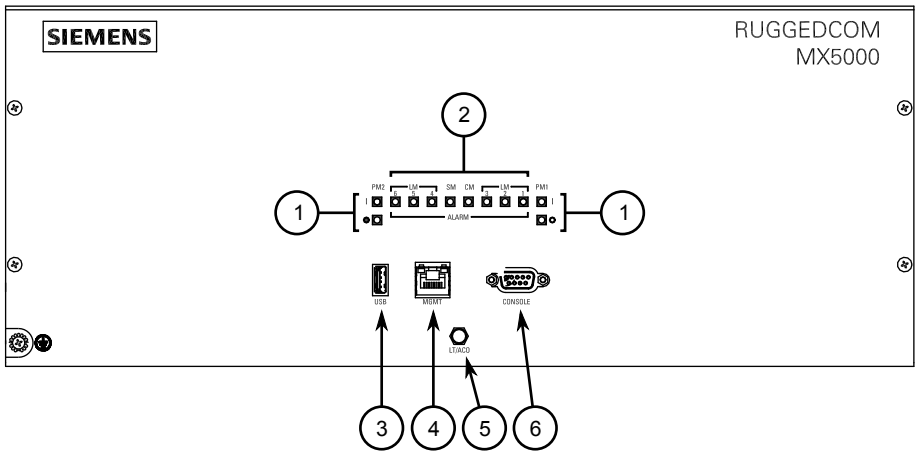

Figure 2: Front Panel

1. Power Module Indicator LEDs **2.** Alarm Indicator LEDs **3.** Utility USB Port **4.** Management Ethernet Port **5.** Lamp Test/Alarm Cut-Off (LT/ACO) Button **6.** RS232 Serial Console Port (DB9)

Power Module Indicator LEDs	Indicate the status of the power modules. • I = The power supply is receiving power • O = The power supply is supplying power
Alarm Indicator LED	Indicates when an alarm condition exists. • Green = Alarms cleared/acknowledged • Red = Alarm
Lamp Test/Alarm Cut-Off (LT/ACO) Button	This button performs two functions: • Press and hold this button to test all indicator LEDs • Press and release this button to acknowledge an active alarm
Management Port	This 10/100Base-T Ethernet port is used for system management that is out-of-band from the switch fabric.
Utility USB Port	Use the USB port to upgrade the ROX II software or install files, such as configuration files and feature key files. For more information, refer to the *RUGGEDCOM ROX II User Guide* for the RUGGEDCOM MX5000.
Compact Flash Card Port	Houses the compact flash card, which contains active and backup installations of ROX II, along with the configuration database and other system data.
RS232 Serial 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 2.5, “Connecting to the Device”.
Failsafe Alarm Relay	Latches to default state when a power disruption or other alarm condition occurs. For more information, refer to: • Section 2.4, “Connecting the Failsafe Alarm Relay” • Section 4.2, “Failsafe Relay Specifications”
Power Supply Terminal Block	A pluggable terminal block. For more information, refer to: • Section 2.2, “Connecting Power” • Section 4.1, “Power Supply Specifications”

2 Installing the Device

The following sections describe how to install the device, including mounting the device, 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!
Burn hazard – risk of serious personal injury. Avoid contact with the surface of the unit. The metal surface may be hot due to the high allowable ambient temperature per specification.

Éviter tout contact avec la surface. La surface métallique peut être chaude a cause d'une température ambiante élevée selon les spécifications. S.V.P. se référer à la version française de ce guide pour les détails.

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

The MX5000 is designed for maximum mounting and display flexibility. It can be equipped with adapters that allow it to be installed in a 48 cm (19 in) rack or directly on a panel.

NOTE
For detailed dimensions of the device with mounting 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 to a Panel”

Section 2.1.1
Mounting the Device to a Rack

For installations, the MX5000 can be equipped with adapters pre-installed at the front or rear of the chassis. Additional adapters are provided to further secure the device in high-vibration or seismically active locations.

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

1. Make sure the adapters are installed on the correct side of the chassis.
   - To make the modules and ports accessible, install the adapters at the rear of the chassis
   - To make the management ports and LEDs accessible, install the adapters at the front of the chassis

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

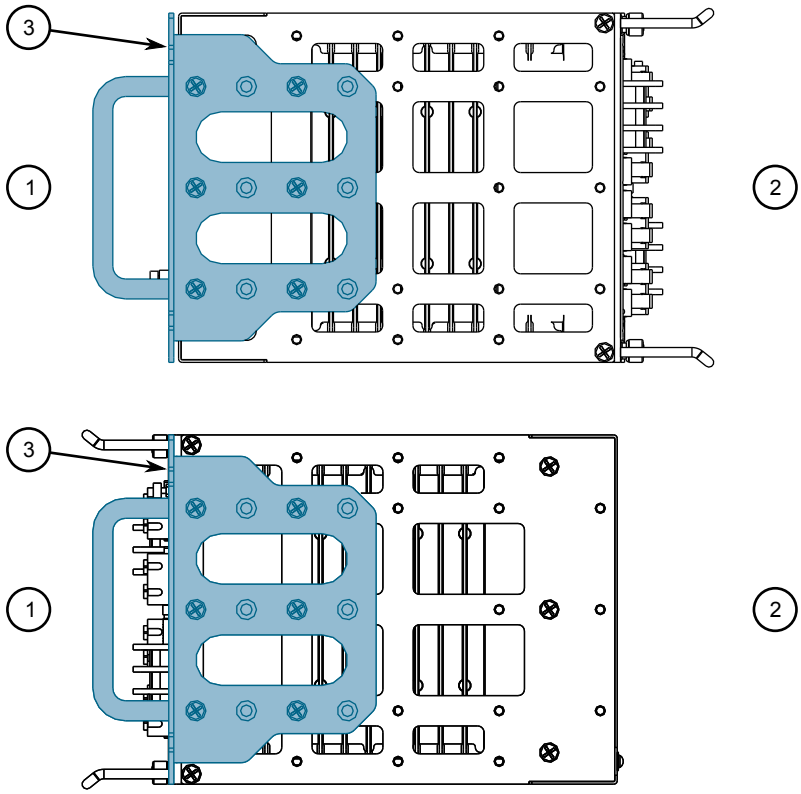

Figure 3: Adapters

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

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

> **NOTE**
> *Since heat within the device is channeled to the enclosure, it is recommended that 1 rack-unit of space, or 44 mm (1.75 in), be kept empty above the device. This allows a small amount of 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.*

4. Secure the adapters to the rack using the supplied hardware.

Section 2.1.2

Mounting the Device to a Panel

For panel installations, the MX5000 can be equipped with 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.

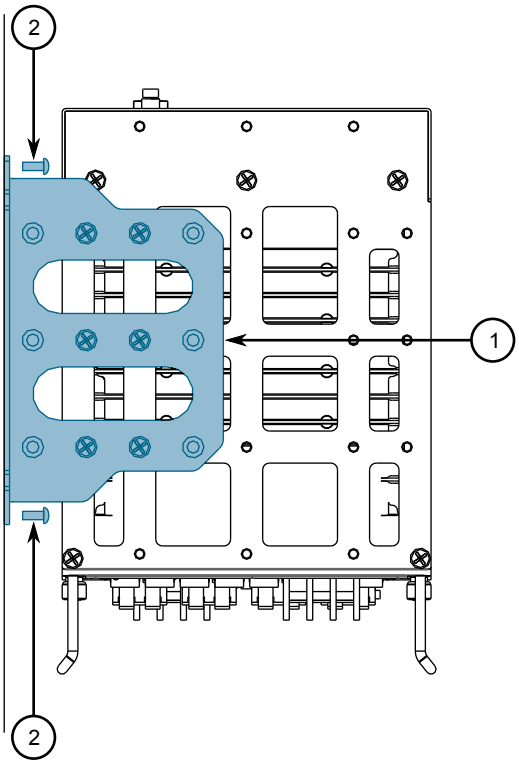

Figure 4: Panel Mounting

1. Screw **2.** Adapter

2. Install the supplied screws to secure the adapters to the panel. Make sure the screws are torqued to 2 ± 0.1 N·m (18 ± 1 lbf-in)

Section 2.2

Connecting Power

The MX5000 supports dual redundant AC and/or DC power supplies that can be installed in any combination. The use of two power modules is recommended to provide redundancy and load balancing.

The MX5000 is equipped with a screw-type terminal block, which provides power to both power supplies. The terminal block is installed using Philips 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.

IMPORTANT!

- *In an AC/DC power arrangement, the placement of the AC and DC power supplies is not slot-dependent. Either power module slot can be used for AC or DC power.*
- *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 125/230 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.*
- *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, “Installing/Removing Power Supplies”
- Section 2.2.2, “Connecting AC Power”
- Section 2.2.3, “Connecting DC Power”

Section 2.2.1
Installing/Removing Power Supplies

The MX5000 supports dual redundant AC and/or DC power supplies that can be installed in any combination. Slots for the removable power modules are located on the rear panel of the device.

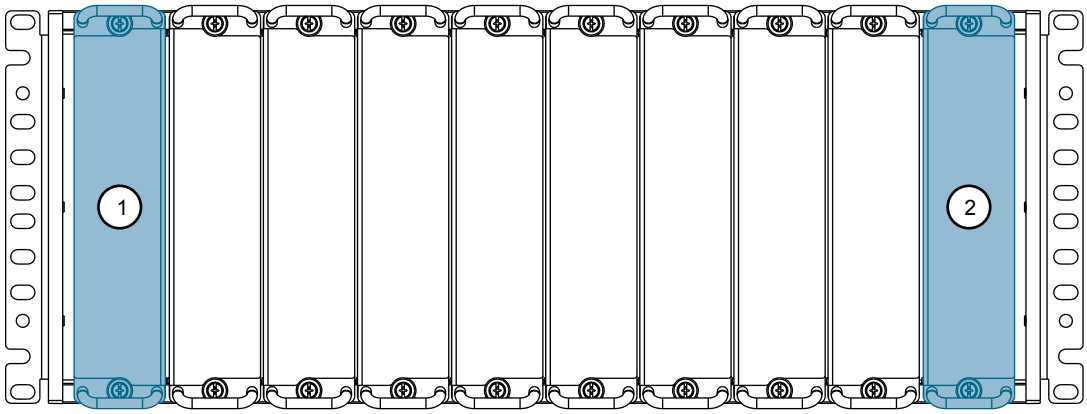

Figure 5: Power Module Slots

1. Slot PS1 **2.** Slot PS2

DANGER!
Electrocution hazard – risk of serious personal injury or death. The device may have two power supplies equipped, which may be connected to separate power sources. Make sure all power sources are isolated before servicing the power supplies.

The following sections describe how to install, remove and connect the power supplies:

- Section 2.2.1.1, “Installing a Power Supply”
- Section 2.2.1.2, “Removing a Power Supply”

Section 2.2.1.1
Installing a Power Supply

To install a power supply, do the following:

NOTE
The power supplies are hot swappable. It is not necessary to disconnect power to the device before installing or removing a power supply.

1. Remove the blank power module assembly or, if equipped, the currently installed power supply. For information about removing a power supply, refer to Section 2.2.1.2, “Removing a Power Supply”.
2. Insert the power supply into the empty slot. When power is supplied to the device, the top and bottom LEDs on the power supply should be green, indicating that power is being received and supplied to the device.

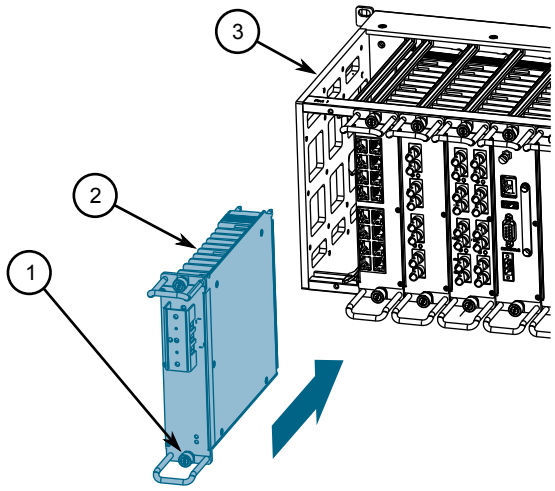

Figure 6: Installing a Power Supply

1. Screws **2.** Power Supply **3.** Chassis

3. Hand-tighten the screws to secure the power supply.

Section 2.2.1.2
Removing a Power Supply

To remove a power supply, do the following:

NOTE
The power supplies are hot swappable. It is not necessary to disconnect power to the device before Removing or removing a power supply.

1. Remove the screws that secure the power supply.
2. Pull the power supply from the chassis.

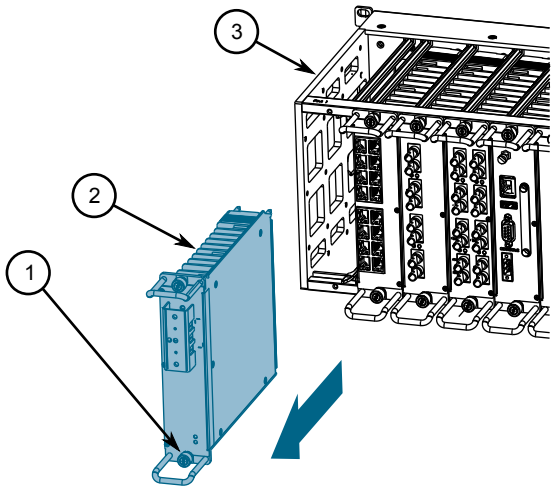

Figure 7: Removing a Power Supply

1. Screws **2.** Power Supply **3.** Chassis

3. Install the blank power module assembly into the empy slot to prevent the ingress of dust and dirt.

Section 2.2.2

Connecting AC Power

To connect AC power to the device, do the following:

DANGER!
Electrocution hazard – risk of death, serious personal injury and/or damage to the device. Make sure the supplied cover is always installed over high voltage screw-type terminal blocks.

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

NOTE
The terminal block is installed using Philips 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. Connect the positive wire from the power source to the live terminal on the terminal block.

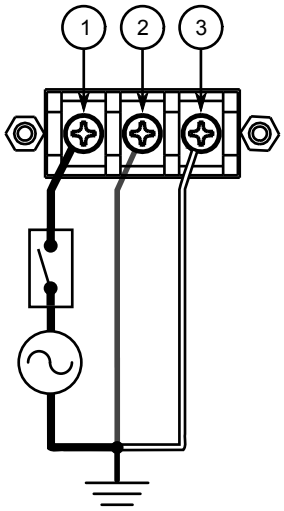

Figure 8: AC Terminal Block Wiring

1. Live Terminal **2.** Ground Terminal **3.** Neutral Terminal

2. Connect the negative wire from the power source to the neutral terminal on the terminal block.

IMPORTANT!
If the ground terminals are not connected to safety Earth, the chassis ground connection must be connected. For more information, refer to Section 2.3, "Grounding the Device".

3. Using a braided wire or other appropriate grounding wire, connect the ground terminal to the chassis ground connection. The ground terminal is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
4. Connect the ground terminal on the power source to the ground terminal on the device. For more information, refer to Section 2.3, "Grounding the Device".

Section 2.2.3
Connecting DC Power

To connect DC power to the device, do the following:

NOTE
The terminal block is installed using Philips 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. Connect the positive wire from the power source to the positive terminal on the terminal block.

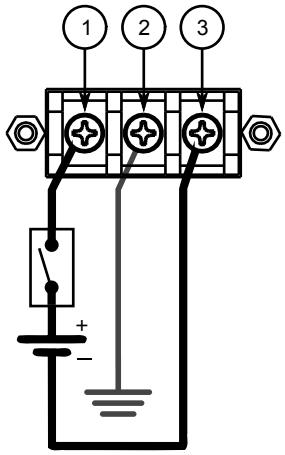

Figure 9: DC Terminal Block Wiring

1. Live Terminal **2.** Ground Terminal **3.** Neutral Terminal

2. Connect the negative wire from the power source to the neutral terminal on the terminal block.

IMPORTANT!
If the ground terminals are not connected to safety Earth, the chassis ground connection must be connected. For more information, refer to Section 2.3, "Grounding the Device".

3. Using a braided wire or other appropriate grounding wire, connect the ground terminal to the chassis ground connection. The ground terminal is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
4. Connect the ground terminal on the power source to the ground terminal on the device. For more information, refer to Section 2.3, "Grounding the Device".

Section 2.3

Grounding the Device

Connect the chassis ground terminal to protective Earth if neither of the power supplies are already connected.

If the ground terminal on the power supply module(s) is not connected to safety Earth, a connection must be provided from the chassis ground terminal.

IMPORTANT!
*If the ground terminal on the power supply module(s) **is** connected to safety Earth, a connection from the chassis ground terminal is not required.*

The MX5000 chassis ground terminal uses a #8-32 screw. It is recommended to terminate the ground connection with a #8 ring lug and torque it to 3.4 N·m (30 lbf·in).

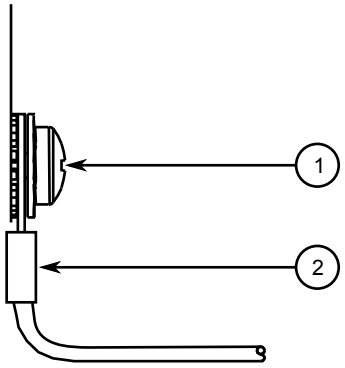

Figure 10: Chassis Ground Connection

1. #8-32 Screw **2.** #8 Ring Lug

Section 2.4

Connecting the Failsafe Alarm Relay

The failsafe relay on the Control Module (CM) 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.

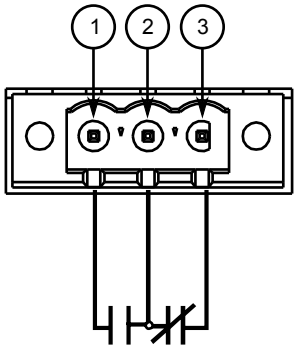

Figure 11: Failsafe Alarm Relay Wiring

1. Normally Open **2.** Common (Ground) **3.** Normally Closed

Pin	Function
NC	Normally Closed
Common	Ground
NO	Normally Open

Section 2.5

Connecting to the Device

The following describes the various methods for accessing the ROX II console and Web interfaces on the device. For more detailed instructions, refer to the *ROX II User Guide* for the RX5000.

Serial Console and Management Ports

Connect a PC or terminal directly to the serial console or management ports to access the boot-time control and ROX II interfaces. The serial console port provides access to ROX II's console interface, while the management port provides access to ROX II's console and Web interfaces.

IMPORTANT!
The serial console and management (MGMT) ports are intended to be used only as temporary connections during initial configuration or troubleshooting.

The serial console port implements RS232 DCE (Data Communication Equipment) on a DB9 connector. The following is the pin-out for the port:

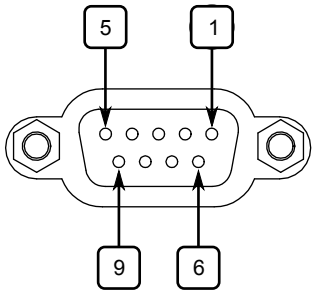

Figure 12: Serial DB9 Console Port

Pin	Name	Description
1	DCD	Data Carrier Detect
2	RX	Receive Data
3	TX	Transmit Data
4	DTR	Data Terminal Ready
5	GND	Signal Ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear To Send
9	Reserved (Do Not Connect)	

The management port is a 10/100Base-TX copper Ethernet port with an RJ45 connector. The following is the pin-out for the management port:

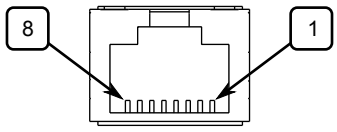

Figure 13: RJ45 Management Port

Pin	Name	Description
1	TX+	Transmit Data+
2	TX-	Transmit Data-
3	RX+	Receive Data+
4	Reserved (Do Not Connect)	
5	Reserved (Do Not Connect)	
6	RX-	Receive Data-
7	Reserved (Do Not Connect)	
8	Reserved (Do Not Connect)	

Communication Ports

Connect any of the available Ethernet ports on the device to a management switch and access the ROX II console and Web interfaces via the device's IP address. The factory default IP address for the RUGGEDCOM MX5000 is https://192.168.0.2.

For more information about available ports, refer to Chapter 3, *Communication Ports*.

Section 2.6
Cabling Recommendations

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

- Section 2.6.1, “Protection On Twisted-Pair Data Ports”
- Section 2.6.2, “Gigabit Ethernet 1000Base-TX Cabling Recommendations”

Section 2.6.1
Protection On Twisted-Pair Data Ports

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 2.6.2
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 MX5000 can be equipped with various types of communication ports to enhance its abilities and performance. Each set of communication ports is part of a field replaceable module that makes switching ports fast and easy.

Use the ROX II software to determine which ports are equipped on the device. For more information, refer to the *ROX II User Guide* for the RX5000.

Each type of module has a specific location in the MX5000 chassis.

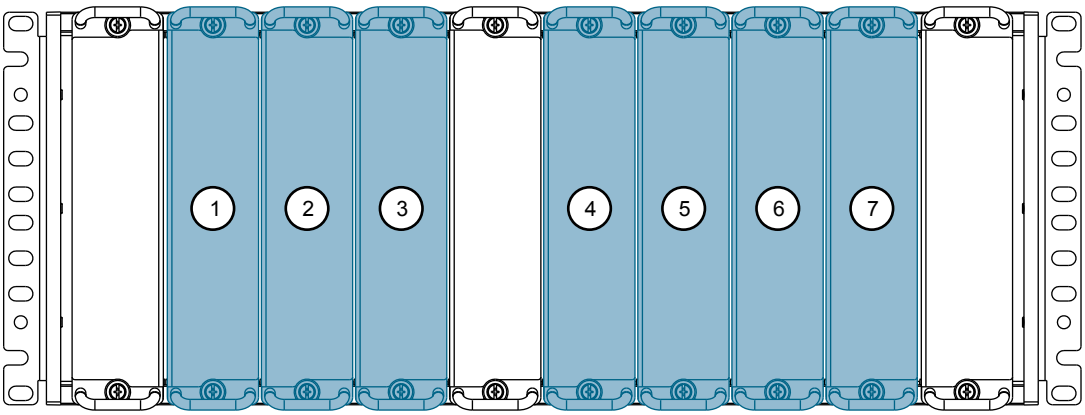

Figure 14: Module Assignment

1. Ethernet Module Slot (LM1) **2.** Ethernet Module Slot (LM2) **3.** Ethernet Module Slot (LM3) **4.** Switch Module (SM) **5.** Ethernet Module Slot (LM4) **6.** Ethernet Module Slot (LM5) **7.** Ethernet Module Slot (LM6)

Slot Type	Description
SM	The *Switch Module* contains the chassis-wide Ethernet switch fabric that interconnects Ethernet ports on all installed line modules.
LM1 through LM6	One to six Ethernet Line Modules can be installed in the MX5000.

CAUTION!
Mechanical hazard – risk of damage to equipment. Do not apply vertical force to the handles on the modules. Damage to the handles may occur, which is not covered by warranty. Avoid resting the device on any flat surface where pressure is applied to the module handles.

IMPORTANT!
Use one of the available 88 Gigabit Ethernet switch modules when any 4-port Gigabit Ethernet line module is installed. When a 4-port Gigabit Ethernet line module is used with an 8 Gigabit Ethernet switch module, only the first port on the line module will be enabled.

IMPORTANT!
Use one of the available 88 Gigabit Ethernet switch modules when a 16-port 100TX copper line module is installed. Using an 8 Gigabit Ethernet switch module will cause an over-subscription of packets, resulting in random packet loss if the line module traffic exceeds 1 Gbps.

The following sections describe the available modules and how to install/remove them:

Section 3.1
Serial Ports

The MX5000 supports DB9 serial ports, which can be run in RS232, RS485 or RS422 mode.

NOTE
On power-up, all serial ports default to RS485 mode. Each port can be individually set to RS232, RS485 or RS422 mode through ROX II. For more information, refer to the ROX II User Guide for the MX5000.

LEDs

All serial ports feature an LED that indicates the current state of the port.

State	Description
Green	Link activity detected
Off	No link detected

Pin-Out Description

The following are the pin-outs for the DB9 connectors:

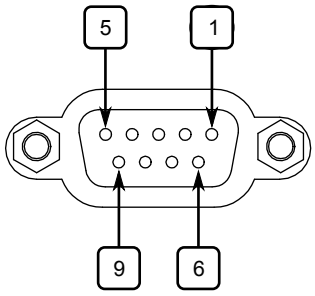

Figure 15: DB9 Serial Port

Pin	Function		
	RS232 Mode	RS422 Mode	RS485 Mode
1		RX-	
2	RX	TX+	TX+/RX+
3	TX	RX+	
4	IRIG_B_Out		
5	COM (Isolated GND)		
6	COM (Isolated GND)		
7		TX-	TX-/RX-
8			
9	COM (Isolated GND)		
Body	Chassis GND[a]		
Screws	Chassis GND[a]		

[a] *Connected internally.*

Connecting to RS485 Devices

For information about how to connect devices configured to run in RS485 mode, refer to Section 3.6, “Connecting Multiple RS485 Devices”.

Specifications

For specifications on serial ports, refer to Section 4.5, “Serial Port Specifications”.

Section 3.2

Switch Ports

The MX5000 supports a single Layer 2 or Layer 3 switch module that can operate at 8 or 88 Gbps. The switch module supports either RJ45, LC (Lucent Connector) or SC (Standard or Subscriber Connector) connectors.

Pin-Out Description

The following are the pin-out descriptions for the RJ45, LC and SC connectors:

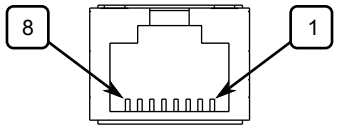

Figure 16: RJ45 Ethernet Port Pin Configuration

Pin	Name		Description
	10/100Base-TX	1000Base-TX	
1	RX+	BI_DB+	Receive Data+ or Bi-Directional
2	RX-	BI_DB-	Receive Data- or Bi-Directional

Pin	Name		Description
	10/100Base-TX	1000Base-TX	
3	TX+	BI_DA+	Transmit Data+ or Bi-Directional
4	Reserved (Do Not Connect)		
5	Reserved (Do Not Connect)		
6	TX-	BI_DA-	Transmit Data- or Bi-Directional
7	Reserved (Do Not Connect)		
8	Reserved (Do Not Connect)		

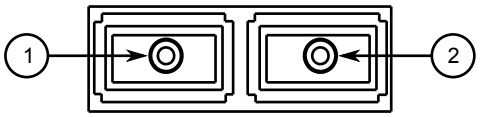

Figure 17: SC Port

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

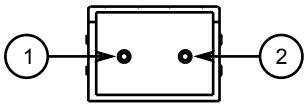

Figure 18: LC Port

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

Specifications

For specifications on the available fiber optic Ethernet ports, refer to Section 4.3, “Copper Ethernet Port Specifications” or Section 4.4, “Fiber Optic Ethernet Port Specifications”.

Section 3.3

Copper Ethernet Ports

The MX5000 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 or Micro-D male connectors. The RJ45 and Micro-D connectors are directly connected to the chassis ground on the device.

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.

LEDs

Each RJ45 port features a **Speed** and **Link** LED that indicates the state of the port.

LED	State	Description
Speed	Yellow	The port is operating at maximum speed (100 or 1000 Mbps)

LED	State	Description
	Off	The port is not operating at maximum speed
Link	Yellow (Solid)	Link established
	Yellow (Blinking)	Link activity
	Off	No link detected

Pin-Out Description

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

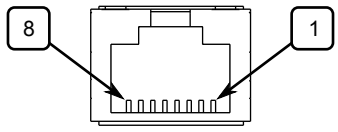

Figure 19: RJ45 Ethernet Port Pin Configuration

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

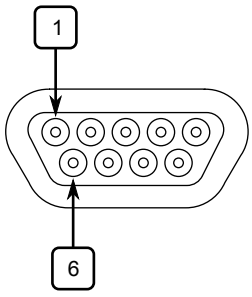

Figure 20: Micro-D 10/100Base-TX Port Pin Configuration

Pin	10/100Base-TX	1000Base-TX
1	TX+	B+
2	Reserved (Do Not Connect)	D+
3	Reserved (Do Not Connect)	
4	Reserved (Do Not Connect)	C+
5	RX+	A+
6	TX-	B-
7	Reserved (Do Not Connect)	D-
8	Reserved (Do Not Connect)	C-
9	RX-	A-

Specifications

For specifications on the available copper Ethernet ports, refer to Section 4.3, “Copper Ethernet Port Specifications”.

Section 3.4
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.

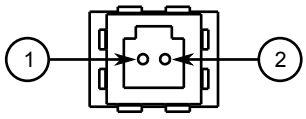

Figure 21: MTRJ Port

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

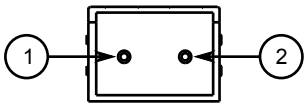

Figure 22: LC Port

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

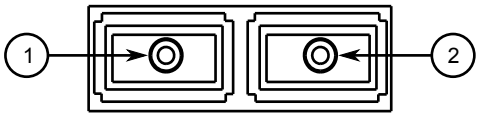

Figure 23: SC Port

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

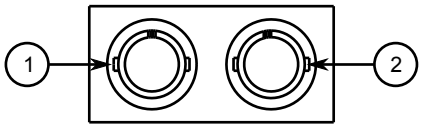

Figure 24: ST Port

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

For specifications on the available fiber optic Ethernet ports, refer to Section 4.4, “Fiber Optic Ethernet Port Specifications”.

Section 3.5
Installing/Removing Modules

The following sections describe how to install and remove modules:

- Section 3.5.1, “Installing a Module”
- Section 3.5.2, “Removing a Module”

Section 3.5.1
Installing a Module

Upon installing a new module in the device, all the features associated to the module are available in the operating system. For more information, refer to the *ROX II User Guide* for the RX5000.

To install a module, do the following:

1. Make sure power to the device has been disconnected and wait approximately two minutes for any remaining energy to dissipate.
2. If the device is installed in a rack, remove it from the rack.
3. Remove the current module from the slot. For more information, refer to Section 3.5.2, “Removing a Module”.
4. Insert the new module into the slot.

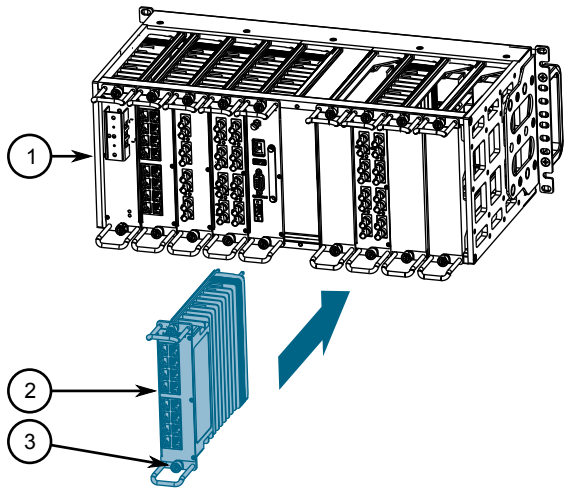

Figure 25: Installing a Module

1. Chassis **2.** Module **3.** Screw

5. Tighten the screws to secure the module.
6. If necessary, install the device in the rack.
7. Connect power to the device.

Section 3.5.2

Removing a Module

Once a module is removed, all the features associated with the module are hidden or disabled in the operating system.

To remove a module, do the following:

1. Make sure power to the device has been disconnected and wait approximately two minutes for any remaining energy to dissipate.
2. If the device is installed in a rack, remove it from the rack.
3. Loosen the screws that secure the module.
4. Pull the module from the chassis to disconnect it.

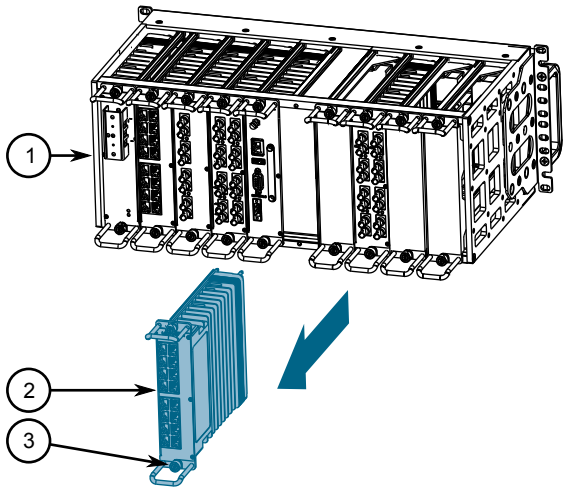

Figure 26: Removing a Module

1. Chassis **2.** Module **3.** Screw

5. Install a new module or a blank module (to prevent the ingress of dust and dirt). For more information, refer to Section 3.5.1, “Installing a Module”.
6. If necessary, install the device in the rack.
7. Connect power to the device.

Section 3.6

Connecting Multiple RS485 Devices

Each RS485 port can communicate with multiple RS485 devices by wiring devices together in sequence over a single twisted pair with transmit and receive signals on the same two wires (half duplex). For reliable, continuous communication, adhere to the following guidelines:

- To minimize the effects of ambient electrical noise, use shielded cabling.
- The correct polarity must be observed throughout a single sequence or ring.
- The number of devices wired should not exceed 32, and total distance should be less than 1219 m (4000 ft) at 100 kbps.
- The Common terminals should be connected to the common wire inside the shield.
- The shield should be connected to earth ground at a single point to avoid loop currents.
- The twisted pair should be terminated at each end of the chain.

The following shows the recommended RS485 wiring.

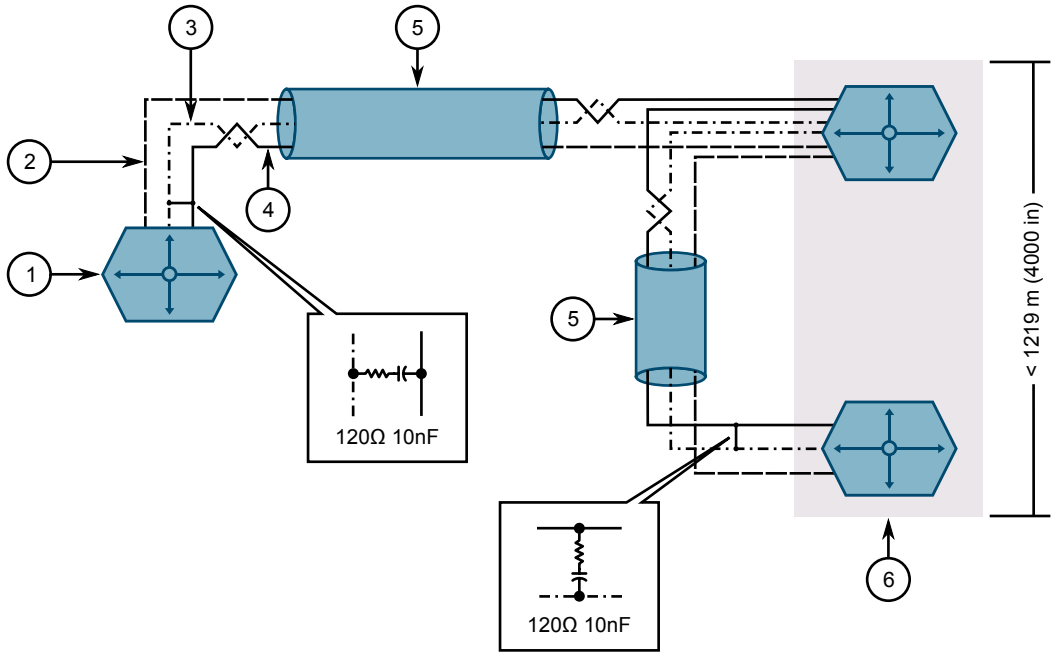

Figure 27: Recommended RS485 Wiring

1. MX5000 Device **2.** Common (Isolated Ground) **3.** Negative **4.** Positive **5.** Shield to Earth (Connected At a Single Point)
6. RS485 Devices (32 Total)

4 Technical Specifications

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

Section 4.1

Power Supply Specifications

Power Supply Type	Input Range		Internal Fuse Rating	Max. Power Consumption[a]
	Min	Max		
HI (125/250 VDC)[b]	88 VDC	300 VDC	6.3 A, 250 V(T)[c]	84 W[d]
HI (110/230 VAC)[b]	85 VAC	264 VAC		

[a] *Power consumption varies based on the device configuration. Each 10/100Base-Tx port consumes roughly 1 W less than a fiber optic port.*

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

[c] *(T) denotes time-delay fuse. Internal fuse is not user-replaceable.*

[d] *Rating at 85 °C (185 °F) ambient temperature at worst-case load.*

Section 4.2

Failsafe Relay Specifications

Maximum Switching Voltage	Rated Switching Current	Isolation
30 VDC	2 A, 60 W	1500 V_{rms} for 1 minute
125 VDC	0.24 A, 30 W	
125 VAC	0.5 A, 62.5 W	
220 VDC	0.24 A, 60 W	
250 VAC	0.25 A, 62.5 W	

Section 4.3
Copper Ethernet Port Specifications

The following details the specifications for copper Ethernet ports that can be ordered with the MX5000.

Speed[e]	Connector	Duplex[e]	Cable Type[f]	Wiring Standard[g]	Maximum Distance[h]	Isolation[i]
10/100Base-TX	RJ-45	FDX/HDX	> CAT 5	TIA/EIA T568A/B	100 m (328 ft)	1.5 kV
10/100Base-TX	Micro-D	FDX/HDX	> CAT 5	TIA/EIA T568A/B	100 m (328 ft)	1.5 kV
10/100Base-TX	Micro-D	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 4.4
Fiber Optic Ethernet Port Specifications

The following sections detail fiber optic specifications for ports that can be equipped on the MX5000. The user determines the type of optics at the time of ordering, and can determine the ports installed on a particular unit by reading the factory data file via the ROX II user interface. The specifications are organized by order code. Module order codes are contained within each unit when it is assembled and configured at the factory. For information about obtaining factory configuration data, refer to the *ROX II User Guide* for the RX5000.

- Section 4.4.1, “Fast Ethernet (100 Mbps) Optical Specifications”
- Section 4.4.2, “Gigabit Ethernet (1 Gbps) Optical Specifications”

Section 4.4.1
Fast Ethernet (100 Mbps) 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 (km)[j]	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

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[j]	Tx min. (dBm)	Tx max. (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Distance (km)[j]	Power Budget (dB)
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
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

[j] *Typical.*

Section 4.4.2
Gigabit Ethernet (1 Gbps) Optical 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).*

Mode	Connector Type	Cable Type (µm)	Tx λ (nm)[k]	Tx min. (dBm)	Tx max. (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Distance (km)[k]	Power Budget (dB)
MM	LC	50/125 62.5/125	850	-9	-2.5	-20	0	0.5	11
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

[k] *Typical.*

Section 4.5
Serial Port Specifications

Order Code	Baud Rate	Connector	Isolation
MS01	1200 to 230400 kbps	DB9	2.5 kV

Section 4.6
Operating Environment

Parameter	Range	Comments
Ambient Operating Temperature	-40 to 85 °C (-40 to 185 °F)	Measured from a 30 cm (12 in) 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 4.7
Mechanical Specifications

Parameter	Value
Dimensions	Refer to Chapter 5, *Dimension Drawings*.
Weight	14-16 kg (30-35 lbs)
Ingress Protection	IP40
Chassis Material	Aluminum

5 Dimension Drawings

NOTE
All dimensions are in millimeters, unless otherwise stated.

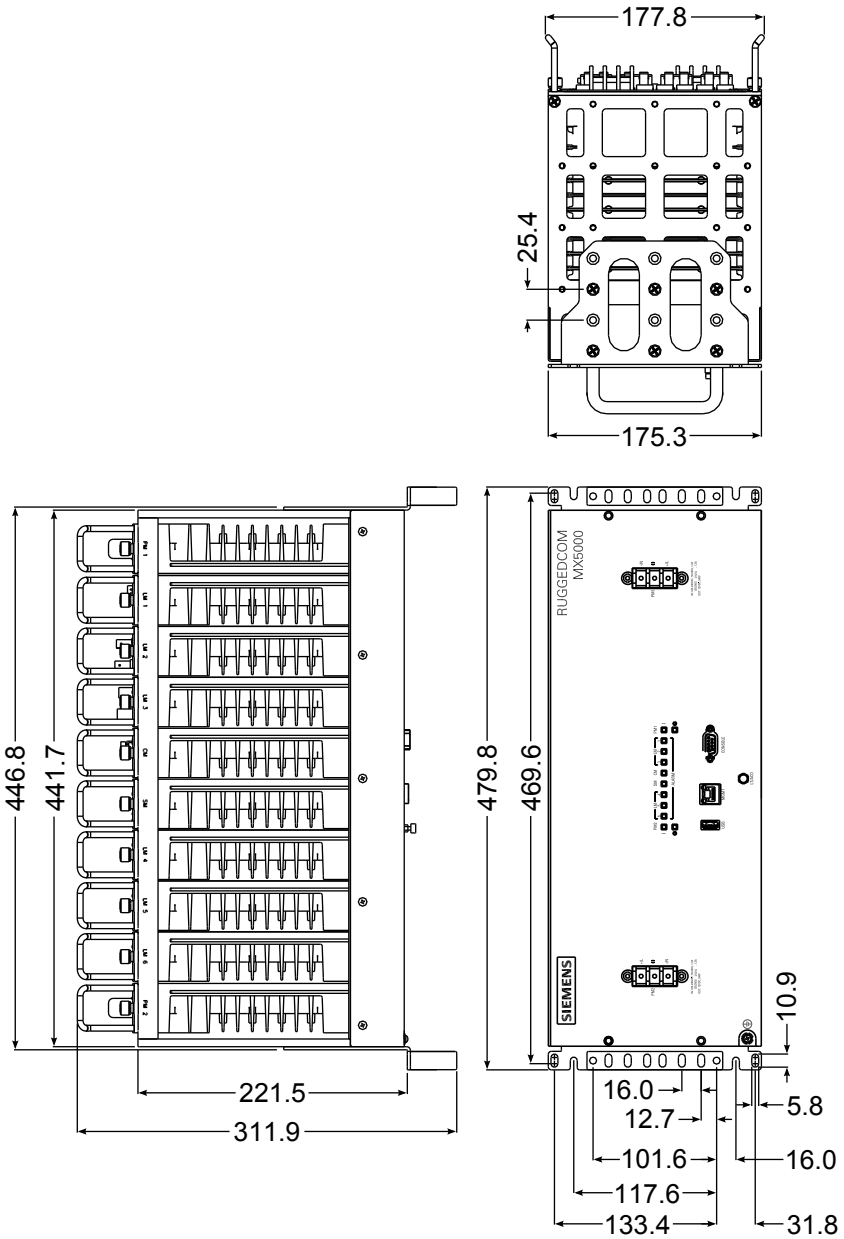

Figure 28: Overall Dimensions

6 Certification

The RUGGEDCOM MX5000 device has been thoroughly tested to guarantee its conformance with recognized standards and has received approval from recognized regulatory agencies.

Section 6.1

Approvals

The following details the approvals issued for the RUGGEDCOM MX5000:

Section 6.1.1

TÜV

This device is certified by TÜV to meet the requirements of the following standards:

- **CAN/CSA-C22.2 NO. 60950-1-07**
  Information Technology Equipment – Safety – Part 1: General Requirements (Bi-National standard, with UL 60950-1)
- **UL 60950-1**
  Information Technology Equipment – Safety – Part 1: General Requirements)

Section 6.1.2

European Commission (EC)

This device is declared by Siemens Canada Ltd. to comply with essential requirements and other relevant provisions of the following EC directives:

- **EN 60950-1**
  Information Technology Equipment – Safety – Part 1: General Requirements

- **EN 61000-6-2**
  Electromagnetic Compatibility (EMC) – Part 6-2: Generic Standards – Immunity for Industrial Environments
- **EN 60825-1**
  Safety of Laser Products – Equipment Classification and Requirements
- **EN 55022**
  Information Technology Equipment – Radio disturbance characteristics – Limits and methods of measurement
- **EN 50581**
  Technical Documentation for the Assessment of Electrical and Electronic Products with Respect to the Restriction of Hazardous Substances

The device is marked with a CE marking and can be used throughout the European community.

A copy of the CE Declaration of Conformity is available from Siemens Canada Ltd.. For contact information, refer to the section called “Contacting Siemens”.

Section 6.1.3
FCC

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.

Section 6.1.4
FDA/CDRH

This device meets the requirements of the following U.S. Food and Drug Administration (FDA) standard:

- Title 21 Code of Federal Regulations (CFR) – Chapter I – Sub-chapter J – Radiological Health

Section 6.1.5
ISO

This device was designed and manufactured using a certified ISO (International Organization for Standardization) quality program that adheres to the following standard:

- **ISO 9001:2008**
  Quality management systems – Requirements

Section 6.1.6
Industry Canada

This device is declared by Siemens Canada Ltd. to meet the requirements of the following Industry Canada standard:

- CAN ICES-3 (A)/NMB-3 (A)

Section 6.1.7
Other Approvals

This device meets the requirements of the following additional standards:

- **IEEE 1613**
  IEEE Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations
- **IEC 61850-3**
  Communications Networks and Systems for Power Utility Automation – Part 3: General Requirements
- **IEC 61000-6-2**
  Electromagnetic Compatibility (EMC) – Part 6-2: Generic Standards – Immunity for Industrial Environments

Section 6.2
MIL-STD Ratings

Standard	Description	Comments
MIL-STD 901D	Shock (Hard-Mounted)	Approved
MIL-STD 461	EMI	Approved
DOD-STD 1399	Magnetic Field (DC Magnetic Exposure)	Approved
MIL-STD 1399 (Section 300B)	Electrical Power Interface Standards for Shipboard Systems	Approved

Section 6.3
EMC and Environmental Type Tests

The MX5000 has passed the following EMC and environmental tests.

IEC 61850-3 EMC Type Tests

Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8 kV	4
		Enclosure Air	+/- 15 kV	4

Test	Description		Test Levels	Severity Levels
IEC 61000-4-3	Radiated RFI	Enclosure Ports	20 V/m	Note[a]
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4 kV @ 2.5 kHz	Note[a]
		DC Power ports	+/- 4 kV	4
		AC Power ports	+/- 4 kV	4
		Earth ground ports	+/- 4 kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4 kV line-to-earth, +/- 2 kV line-to-line	4
		DC Power ports	+/- 2 kV line-to-earth, +/- 1 kV line-to-line	3
		AC Power ports	+/- 4 kV line-to-earth, +/- 2 kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10 V	3
		D.C Power ports	10V	3
		AC Power ports	10V	3
		Earth ground ports	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure Ports	100 A/m	
			1000 A/m for 1 s	5
IEC 61000-4-29	Voltage Dips & Interrupts	DC Power ports	30% for 0.1 s, 60% for 0.1 s, 100% for 0.05 s	
		AC Power ports	30% for 1 period, 60% for 50 periods	
IEC 61000-4-11	Voltage Dips & Interrupts	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	2.5 kV common, 1 kV differential mode @1MHz	3
		AC Power ports	2.5 kV common, 1 kV differential mode @1MHz	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30 V Continuous, 300 V for 1 s	4
		DC Power ports	30 V Continuous, 300 V for 1 s	4
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	5 kV	

[a] *Siemens-specified severity levels*

IEEE 1613 EMC Type Tests

NOTE
The MX5000 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 @1 MHz
	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)
	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

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 60255-21-1	Vibration		2 g @ 10 - 150 Hz
IEC 60255-21-2	Shock		30 g @ 11 mS