

SIEMENS

Installation Manual

SIMATIC NET

Rugged Ethernet Switches

RUGGEDCOM RS401

Edition

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SIEMENS

SIMATIC NET

Rugged Ethernet Switches RUGGEDCOM RS401

Installation Manual

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Legal Information

Warning Notice System

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

DANGER

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

WARNING
--

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

CAUTION
--

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

NOTICE

indicates that property damage can result if proper precautions are not taken.
--

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

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper Use of Siemens Products

Note the following:

WARNING
--

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.
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Trademarks

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Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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Preface

This guide describes the RUGGEDCOM RS401. 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.

Related Documents

Other documents that may be of interest include:

- [RUGGEDCOM ROS Configuration Manual \[https://support.industry.siemens.com/cs/ww/en/view/109737244\]](https://support.industry.siemens.com/cs/ww/en/view/109737244)

Accessing Documentation

The latest user documentation for RUGGEDCOM RS401 is available online at <https://support.industry.siemens.com>. To request or inquire about a user document, contact Siemens Customer Support.

Training

Siemens offers a wide range of educational services ranging from in-house training of standard courses on networking, Ethernet switches and routers, to on-site customized courses tailored to the customer's needs, experience and application.

Siemens' Educational Services team thrives on providing our customers with the essential practical skills to make sure users have the right knowledge and expertise to understand the various technologies associated with critical communications network infrastructure technologies.

Siemens' unique mix of IT/Telecommunications expertise combined with domain knowledge in the utility, transportation and industrial markets, allows Siemens to provide training specific to the customer's application.

For more information about training services and course availability, visit <https://www.siemens.com> or contact a Siemens Sales representative.

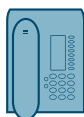
Customer Support

Customer support is available 24 hours, 7 days a week for all Siemens customers. For technical support or general information, contact Siemens Customer Support through any of the following methods:



Online

Visit <http://www.siemens.com/automation/support-request> to submit a Support Request (SR) or check on the status of an existing SR.



Telephone

Call a local hotline center to submit a Support Request (SR). To locate a local hotline center, visit https://w3.siemens.com/aspa_app/-?lang=en.



Mobile App

Install the Industry Online Support app by Siemens AG on any Android, Apple iOS or Windows mobile device and be able to:

- 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

Contacting Siemens

Address	Siemens AG 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	https://www.siemens.com

Introduction

The RUGGEDCOM RS401 is an industrially hardened, serial device server with an integrated, fully managed Ethernet switch, designed to operate reliably in electrically harsh and climatically demanding environments. Featuring an integrated 4 port serial server, a 4 port managed Ethernet switch, and an optional V.90 modem, the RUGGEDCOM RS401 is able to interconnect multiple types of intelligent electronic devices (IEDs) that have different methods of communications. Using the RUGGEDCOM RS401 results in fewer connectivity devices (which reduces overall system costs) and also extends the useful life of existing legacy IEDs (which minimizes capital expenditure for new equipment).

The RUGGEDCOM RS401's compact design makes it ideally suited for panel mount locations or installations with tight space restrictions.

The RUGGEDCOM RS401 provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of environments found in electric utility substations, factory floors or in curb side traffic control cabinets. The RUGGEDCOM RS401 meets or exceeds a wide range of industry standards including IEC61850, IEEE1613, IEC61000-6-2, IEC1800-3 and NEMA TS-2. The RUGGEDCOM RS401 also features a wide operating temperature range of -40 to 85 °C (-40 to 185 °F) allowing it to be installed in virtually any location.

The RUGGEDCOM RS401 also includes an industrially rated integrated power supply that can support a wide range of power supply options suitable for multiple industries and for worldwide operability. Options include 24 VDC, 48 VDC, 88-300 VDC and 85-264VAC, allowing for great installation flexibility.

The embedded Rugged Operating System (ROS) within the RUGGEDCOM RS401 provides advanced Layer 2 and Layer 3 networking functions, advanced cyber security features, and a full array of intelligent functionality for high network availability and manageability. Coupled with the ruggedized hardware design, the RUGGEDCOM RS401 is ideal for creating mission-critical, real-time, control applications in any harsh environment.

1.1 Feature Highlights

Serial Device Server

- Fully compliant EIA/TIA RS485, RS422, RS232 serial ports (software selectable) - DB9, RJ45, Phoenix style connectors
- Transmit serial data over an IP network
- Support for Modbus TCP, DNP 3, T1N serial protocols
- Baud rates up to 230 kbps

- Point-to-point and multi-point modes
- Convert Modbus RTU to Modbus TCP
- Supports multiple Modbus masters
- Serial IP port redirection software to support PC applications statistics and built-in *sniffer* for troubleshooting

Cyber Security Features

- Multi-level user passwords
- SSH/SSL (128-bit encryption)
- Enable/disable ports, MAC based port security
- Port based network access control (802.1x)
- VLAN (802.1Q) to segregate and secure network traffic
- RADIUS centralized password management
- SNMPv3 authentication and 56-bit encryption

Ethernet Ports

- Integrated Ethernet Switch – up to 4 ports
- High performance and throughput Ethernet switching
- Fully IEEE 802.3, IEEE 802.3u, IEEE 802.3x compliance
- Non-blocking, store and forward switching
- 10/100Base-TX, 10Base-FL, 100Base-FX options

Remote Dial Up Access

- Integrated V.90 modem and PPP server
- Provides remote access to serial devices and Ethernet LAN

Rated for Reliability in Harsh Environments

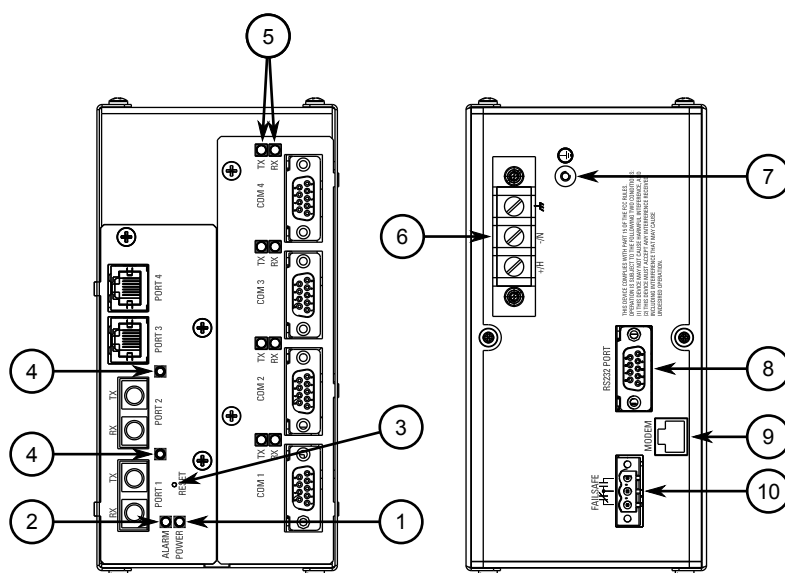
- Immunity to EMI and heavy electrical surges
- Fully independent 2 kV (RMS) isolated serial ports
- -40 to 85 °C (-40 to 185 °F) operating temperature (no fans)
- 18 AWG galvanized steel enclosure

Universal Power Supply Options

- Fully integrated power supplies (no external adaptors)
- Popular low voltage ranges: 24 VDC (10-36 VDC), 48 VDC (36-59 VDC)
- Universal high-voltage range: 88-300 VDC or 85-264 VAC
- CSA/UL 60950 safety approved to 85 °C (185 °F)

1.2 Description

The RUGGEDCOM RS401 features various ports, controls and indicator LEDs on the front panel for connecting, configuring and troubleshooting the device.



- ① POWER LED
- ② ALARM LED
- ③ RESET Button
- ④ Ethernet Port Status LEDs
- ⑤ Serial Port Status LEDs
- ⑥ Power Supply Terminal Block
- ⑦ Surge Ground Terminal
- ⑧ RS232 Serial Console Port (DB9)
- ⑨ Modem Port (Optional)
- ⑩ Failsafe Alarm Relay

Figure 1.1 RUGGEDCOM RS401 Modules

POWER LED	Illuminates when power is being supplied to the device.	
ALARM LED	Illuminates when an alarm condition exists.	
RESET Button	Shuts down and restarts the device.	
Ethernet Port Status LEDs	Indicate the status of the associated Ethernet port.	
LINK	Solid	Link established
	Blinking	Link activity
	Off	No link detected
Rx	Blinking	Link activity (receive)
	Off	No link activity
Tx	Blinking	Link activity (transmit)

1.3 Required Tools and Materials

	<table><tr><th>LED</th><th>State</th><th>Meaning</th></tr><tr><td></td><td>Off</td><td>No link activity</td></tr></table>	LED	State	Meaning		Off	No link activity							
LED	State	Meaning												
	Off	No link activity												
Ethernet Port Status LEDs	Indicate the status of the associated serial port. <table><tr><th>LED</th><th>State</th><th>Meaning</th></tr><tr><td rowspan="2">RxX</td><td>Blinking</td><td>Link activity (receive)</td></tr><tr><td>Off</td><td>No link activity</td></tr><tr><td rowspan="2">Tx</td><td>Blinking</td><td>Link activity (transmit)</td></tr><tr><td>Off</td><td>No link activity</td></tr></table>	LED	State	Meaning	RxX	Blinking	Link activity (receive)	Off	No link activity	Tx	Blinking	Link activity (transmit)	Off	No link activity
LED	State	Meaning												
RxX	Blinking	Link activity (receive)												
	Off	No link activity												
Tx	Blinking	Link activity (transmit)												
	Off	No link activity												
Communication Ports	Receive and transmit data, as well as provide access to the RUGGEDCOM RS401 Web interface. For more information about the various ports available for the RUGGEDCOM RS401, refer to " Communication Ports (Page 21) ".													
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 " Connecting to the Device (Page 19) ".													
Failsafe Alarm Relay	Latches to default state when a power disruption or other alarm condition occurs. For more information, refer to: • "Connecting the Failsafe Alarm Relay (Page 14)" • "Failsafe Alarm Relay Specifications (Page 29)"													
Power Supply Terminal Block	A pluggable terminal block. For more information, refer to " Connecting Power (Page 16) " and " Power Supply Specifications (Page 29) ".													

1.3 Required Tools and Materials

The following tools and materials are required to install the RUGGEDCOM RS401:

Tools/Materials	Purpose
AC or DC power cord (16 AWG)	For connecting power to the device.
Multi-mode and/or single-mode fiber optic cables	For connecting the device to a LAN.
CAT-5 Ethernet cables	For connecting the device to a LAN.
Flathead screwdriver	For mounting the device to a DIN rail.
Phillips screwdriver	For mounting the device to a panel.
4 x #6-32 screws	For mounting the device to a panel.

1.4 Decommissioning and Disposal

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

Decommissioning

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

For more information, refer to the associated *Configuration Manual*.

Recycling and Disposal

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

1.5 Cabling Recommendations

Siemens recommends using SIMATIC NET industrial Ethernet shielded cables for all Ethernet ports.

1.5.1 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.

1.5.2 Supported Fiber Optic Cables

The following fiber optic cable types are supported under the stated conditions.

Cable Type	Wavelength (nm)	Modal Bandwidth (MHz·km)	Distance (m)		
			100Base-FX	1000Base-SX	10GBase-SR
OM1 (62.5/125)	850	200	—	275	33
	1300	500	2000	—	—
OM2 (50/125)	850	500	—	550	82
	1300	500	2000	—	—
OM3 (50/125) ^a	850	1500	—	550	300
	1300	500	2000	—	—
OM4 (50/125) ^a	850	3500	—	550	400

1.5.2 Supported Fiber Optic Cables

Cable Type	Wavelength (nm)	Modal Band-width (MHz·km)	Distance (m)		
			100Base-FX	1000Base-SX	10GBase-SR
	1300	500	2000	—	—

^a Laser optimized.

Installing the Device

This section describes how to install and connect to the RUGGEDCOM RS401.

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.

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.

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 AG 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.

2.1 General Procedure

The general procedure for installing the device is as follows:

IMPORTANT

The user is responsible for the operating environment of the device, including maintaining the integrity of all protective conductor connections and checking equip-

ment ratings. Make sure to review all operating and installation instructions before commissioning or performing maintenance on the device.

1. **Review the relevant certification information for any regulatory requirements.**

For more information, refer to ["Approvals \(Page 35\)"](#).

2. **Unpack and inspect the device.**

For more information, refer to ["Unpacking the Device \(Page 8\)"](#).

3. **Mount the device.**

For more information, refer to ["Mounting the Device \(Page 8\)"](#).

4. **Connect the failsafe alarm relay.**

For more information, refer to ["Connecting the Failsafe Alarm Relay \(Page 14\)"](#).

5. **Connect power to the device and ground the device to safety Earth.**

For more information, refer to ["Connecting Power \(Page 16\)"](#).

6. **Connect the device to the network.**

For more information, refer to ["Communication Ports \(Page 21\)"](#).

7. **Configure the device.**

For more information, refer to ["Configuring the Device \(Page 20\)"](#).

2.2 Unpacking the Device

When unpacking the device, do the following:

1. Inspect the package for damage before opening it.
2. Visually inspect each item in the package for any physical damage.
3. Verify all items are included.

NOTICE

If any item is missing or damaged, contact Siemens for assistance.

2.3 Mounting the Device

The RUGGEDCOM RS401 is designed for maximum mounting and display flexibility. It can be equipped with connectors that allow it to be installed in a 35 mm (1.4 in) DIN rail or directly on a panel.

IMPORTANT

Heat generated by the device is channeled outwards from the enclosure. As such, it is recommended that 2.5 cm (1 in) of space be maintained on all open sides of the device to allow for some convectonal 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.

Note

For detailed dimensions of the device with either DIN rail or panel hardware installed, refer to ["Dimension Drawings \(Page 31\)"](#).

2.3.1 Mounting the Device on a DIN Rail

For DIN rail installations, the RUGGEDCOM RS401 can be equipped with panel/DIN rail adapters preinstalled on each side of the chassis. The adapters allow the device to be slid onto a standard 35 mm (1.4 in) IEC/EN 60715 or TS35 DIN rail.

Note

The device is available with a front panel or side panel mount option.

Mounting the Device

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

1. Hook the top teeth of the adapters onto the DIN rail.

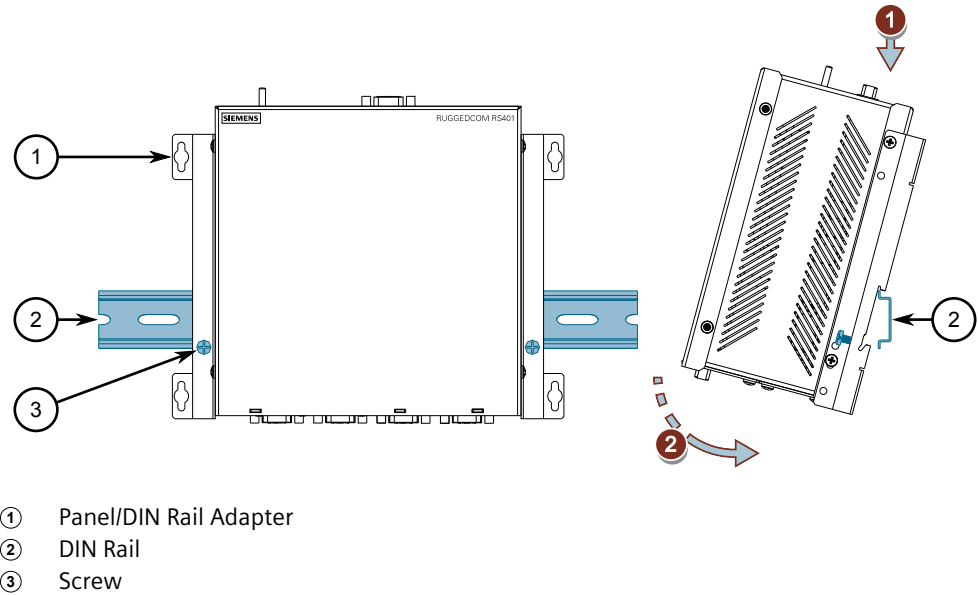


Figure 2.1 Mounting the Device to a DIN Rail (Front Panel Mount Option)

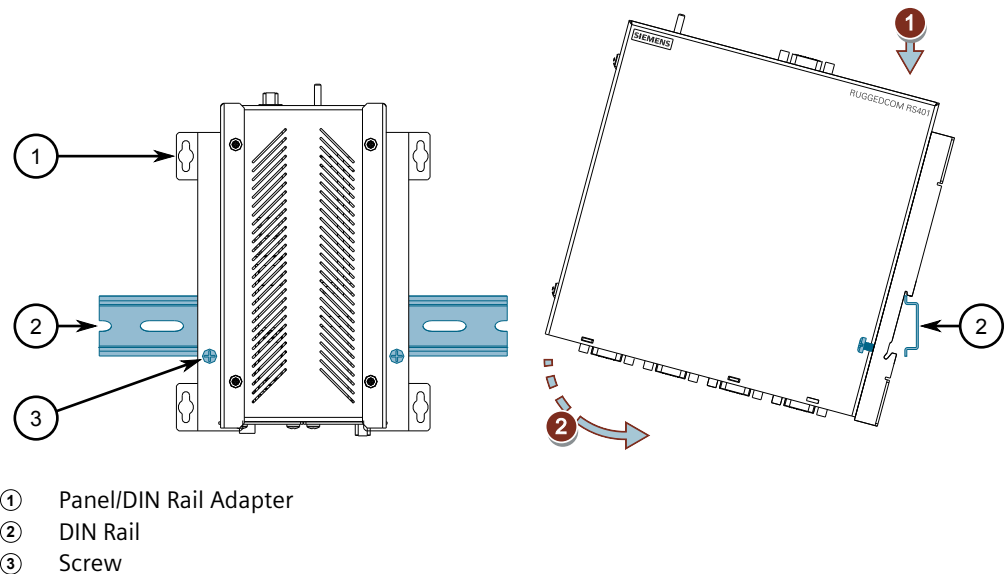


Figure 2.2 Mounting the Device to a DIN Rail (Side Panel Mount Option)

2. Install one of the supplied #8-32 lock screws on either side of the device to secure the adapters to the DIN rails.

Removing the Device

To remove the device from a DIN rail, do the following:

1. Loosen or remove the #8-32 lock screws on both sides of the device.

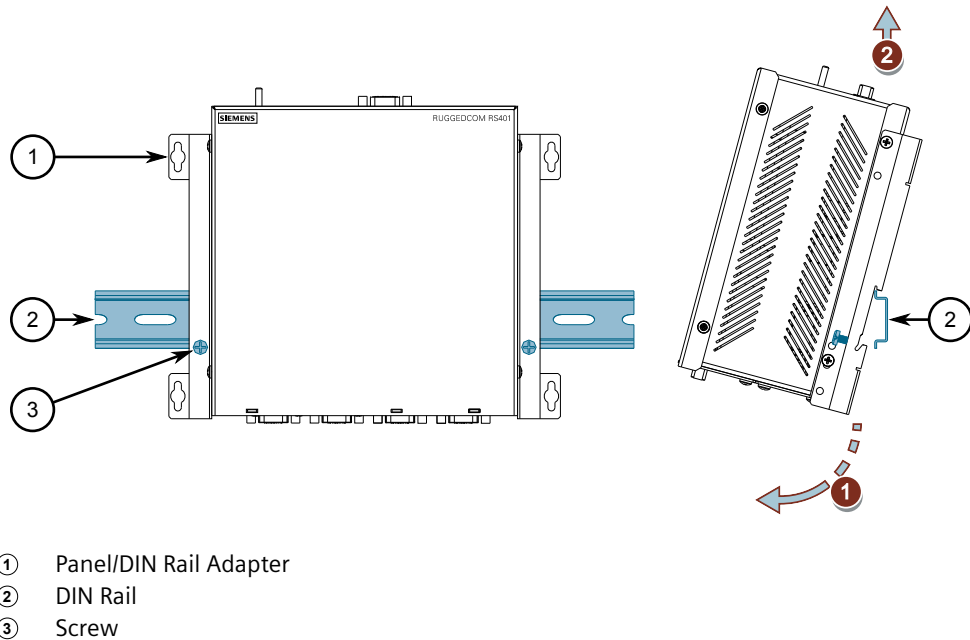


Figure 2.3 Removing the Device from a DIN Rail (Front Panel Mount Option)

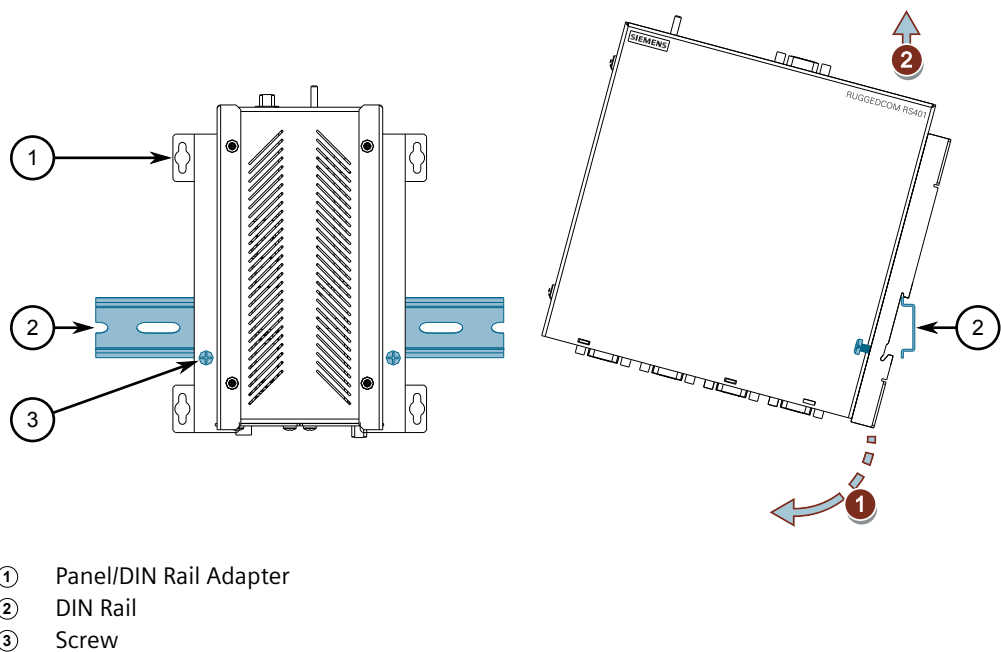


Figure 2.4 Removing the Device from a DIN Rail (Side Panel Mount Option)

2. Lift the device off the DIN rail.

2.3.2 Mounting the Device to a Panel

For panel installations, the RUGGEDCOM RS401 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.

Note

The device is available with a front panel or side panel mount option.

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.

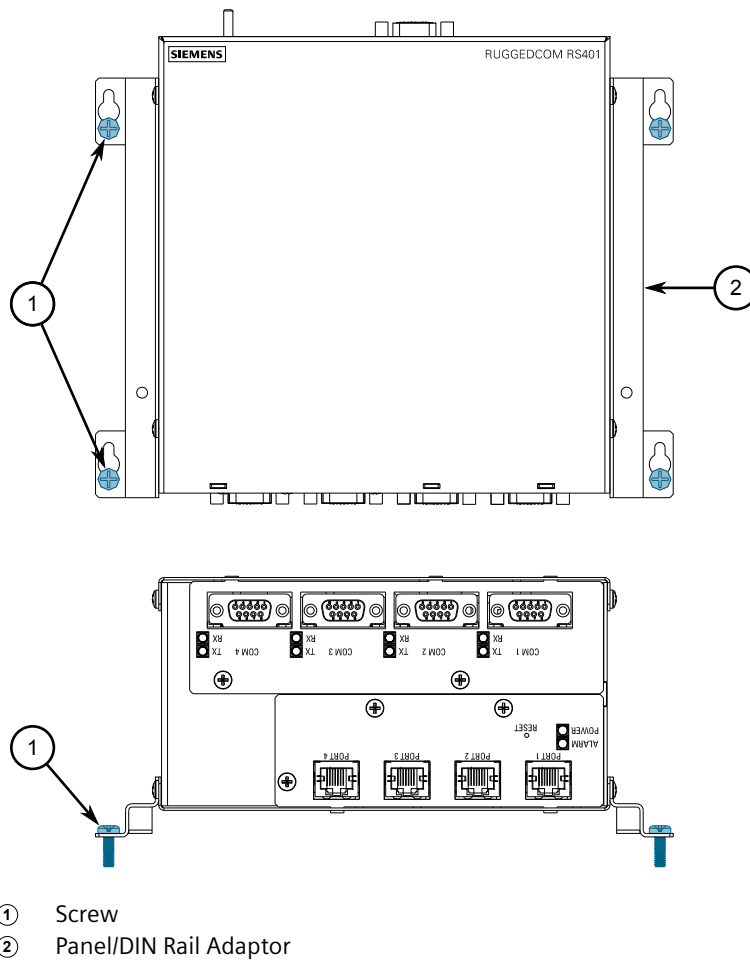


Figure 2.5 Panel Mounting (Front Mount Orientation)

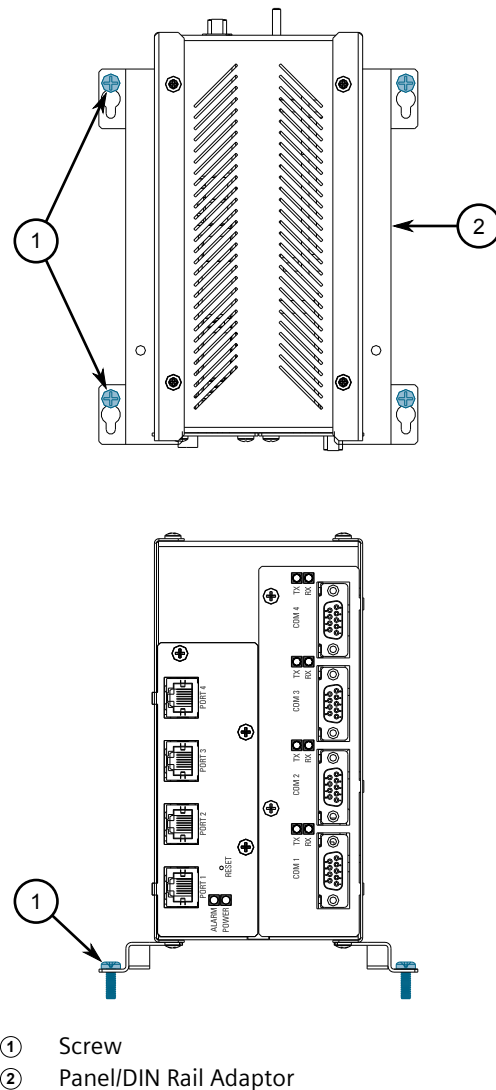


Figure 2.6 Panel Mounting (Side Mount Orientation)

2. Secure the device to the panel using four #6-32 screws.

2.4 Connecting the Failsafe Alarm Relay

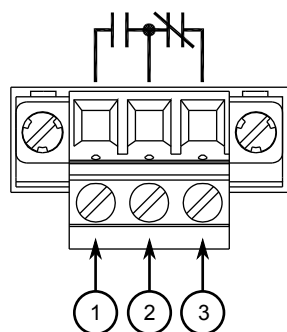
The failsafe relay can be configured to latch based on alarm conditions. The NO (Normally Open) contact is closed when the unit is powered and there are no active alarms. If the device is not powered or if an active alarm is configured, the relay opens the NO contact and closes the NC (Normally Closed)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

Note

Control of the failsafe relay output is configurable through RUGGEDCOM RS401 . One common application for this relay is to signal an alarm if a power failure occurs.

For more information, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

The following shows the proper relay connections.

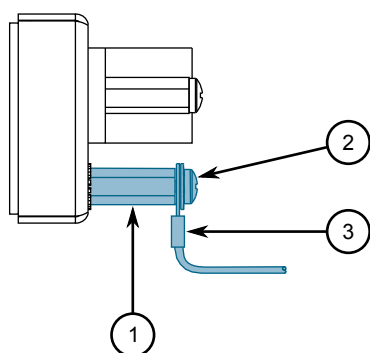


- ① Normally Open
- ② Common
- ③ Normally Closed

Figure 2.7 Failsafe Alarm Relay Wiring

2.5 Grounding the Device

The RUGGEDCOM RS401 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).



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

Figure 2.8 Chassis Ground Connection

2.6 Connecting Power

The RUGGEDCOM RS401 supports a single integrated high AC/DC or low DC power supply

Note

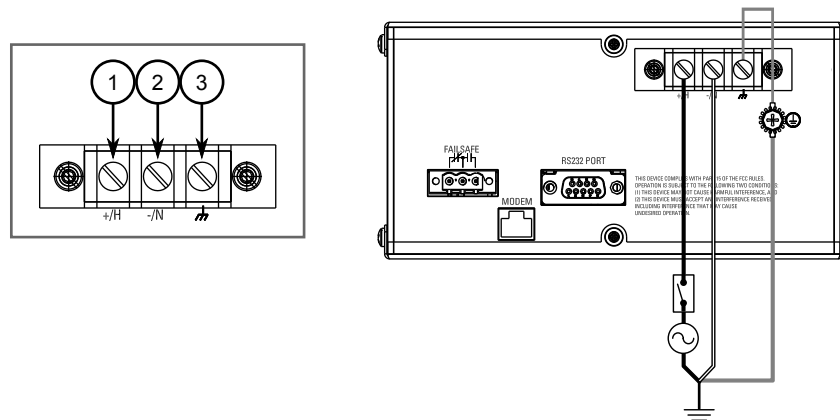
- For 88-300 VDC rated equipment, an appropriately rated circuit breaker must be installed.
 - For 100-240 VAC rated equipment, an appropriately rated circuit breaker must be installed.
 - Use only #16 gage copper wiring when connecting terminal blocks.
 - A circuit breaker is not required for 12, 24 or 48 VDC rated equipment.
 - Power input terminals have reverse polarity protection for 12, 24 and 48 VDC rated equipment.
 - Equipment must be installed according to applicable local wiring codes and standards.
-

2.6.1 Connecting AC Power

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

NOTICE
Electrical hazard – risk of damage to equipment
Before testing the dielectric strength (HIPOT) in the field, remove the braided ground cable connected to the surge ground terminal and chassis ground. This cable connects transient suppression circuitry to chassis ground and must be removed in order to avoid damage to transient suppression circuitry during testing.

1. Connect the positive wire from the power source to the positive/hot (+/H) terminal on the terminal block.



- ① Positive/Hot (+/H) Terminal
- ② Negative/Neutral (-/N) Terminal
- ③ Surge Ground Terminal
- ④ Braided Ground Cable

Figure 2.9 Terminal Block Wiring

2. Connect the negative wire from the power source to the negative/neutral (-/N) terminal on the terminal block.
3. Using a braided wire or other appropriate grounding wire, connect the surge ground terminal to the chassis ground connection. The surge 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 chassis ground terminal on the device. For more information, refer to "[Grounding the Device \(Page 15\)](#)".

2.6.2 Connecting DC Power

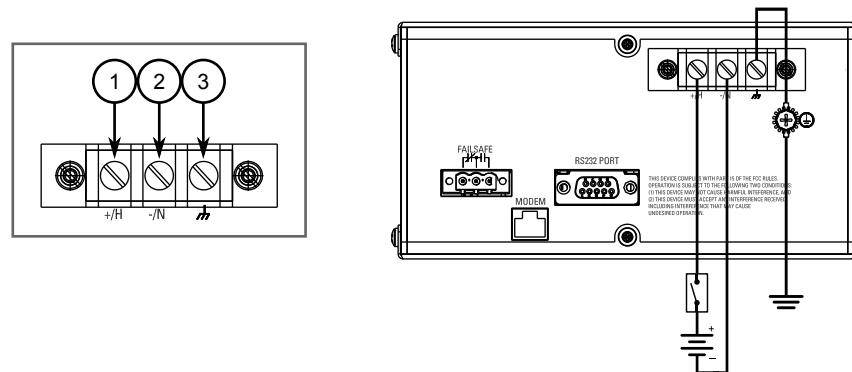
To connect a high or low DC power supply to the device, do the following:

NOTICE

Electrical hazard – risk of damage to equipment

Before testing the dielectric strength (HIPOT) in the field, remove the braided ground cable connected to the surge ground terminal and chassis ground. This cable connects transient suppression circuitry to chassis ground and must be removed in order to avoid damage to transient suppression circuitry during testing.

1. Connect the positive wire from the power source to the positive/hot (+/H) terminal on the terminal block.



- ① Positive/Hot (+/H) Terminal
- ② Negative/Neutral (-/N) Terminal
- ③ Surge Ground Terminal
- ④ Braided Ground Cable

Figure 2.10 Terminal Block Wiring

2. Connect the negative wire from the power source to the negative/neutral (-/N) on the terminal block.
3. Using a braided wire or other appropriate grounding wire, connect the surge ground terminal to the chassis ground connection. The surge 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 chassis ground terminal on the device. For more information, refer to ["Grounding the Device \(Page 15\)"](#).

Device Management

This section describes how to connect to and manage the device.

3.1 Connecting to the Device

The following describes the various methods for accessing the RUGGEDCOM RS401 console and Web interfaces on the device. For more detailed instructions, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

Serial Console Port

Connect a PC or terminal directly to the serial console port to access the boot-time control and RUGGEDCOM RS401 console interface.

IMPORTANT

The serial console port is 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:

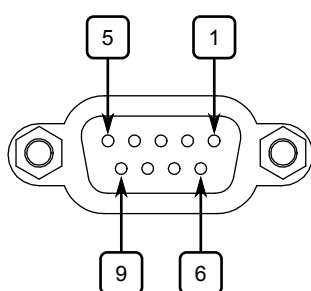


Figure 3.1 Serial DB9 Console Port

Pin	Name	Description
1 ^a	Reserved	(Do Not Connect)
2	TX	Transmit Data
3	RX	Receive Data
4 ^a	Reserved	(Do Not Connect)
5	GND	Signal Ground
6 ^a	Reserved	(Do Not Connect)
7 ^b	Reserved	(Do Not Connect)
8 ^b	Reserved	(Do Not Connect)
9	Reserved	(Do Not Connect)

^a Connected internally.

^b Connected internally.

Communication Ports

Connect any of the available Ethernet ports on the device to a management switch and access the RUGGEDCOM RS401 console and Web interfaces via the device's IP address. For more information about available ports, refer to ["Communication Ports \(Page 21\)"](#).

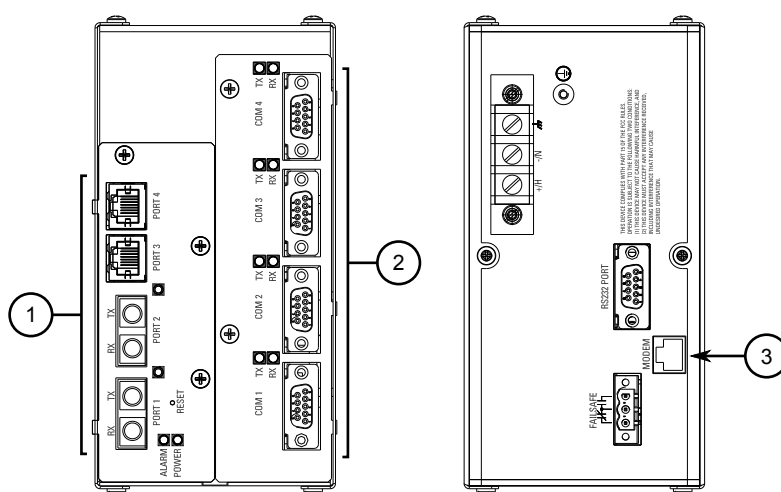
3.2 Configuring the Device

Once the device is installed and connected to the network, it must be configured. All configuration management is done via the RUGGEDCOM ROS interface. For more information about configuring the device, refer to the *RUGGEDCOM ROS Configuration Manual* associated with the installed software release.

Communication Ports

The RUGGEDCOM RS401 can be equipped with various types of communication ports to enhance its abilities and performance. To determine which ports are equipped on the device, refer to the factory data file available through RUGGEDCOM RS401 . For more information on how to access the factory data file, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

Each communication port type has a specific place in the RUGGEDCOM RS401 chassis.



- ① Copper or Fiber Ethernet Ports
- ② Serial Ports
- ③ Modem Port (Optional)

Figure 4.1 Port Assignment

4.1 Copper Ethernet Ports

The RUGGEDCOM RS401 supports several 10/100Base-TX Ethernet ports that allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cables with RJ45 male connectors. The RJ45 connectors are directly connected to the chassis ground on the device and can accept CAT-5 shielded twisted-pair (STP) cables.

⚠ 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 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
	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 is the pin-out for the RJ45 male connectors:

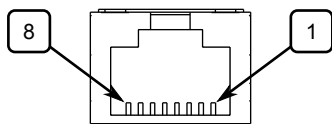


Figure 4.2 RJ45 Ethernet Port Pin Configuration

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

Specifications

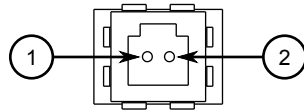
For specifications on the available copper Ethernet ports, refer to "[Copper Ethernet Port Specifications \(Page 29\)](#)".

4.2 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

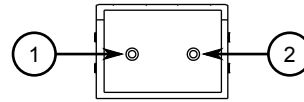
(Straight Tip) connectors. Make sure the Transmit (Tx) and Receive (Rx) connections of each port are properly connected and matched to establish a proper link.

Port Types



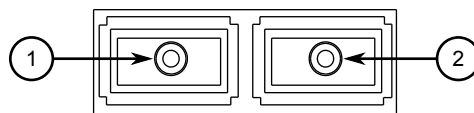
- ① Tx Connector
- ② Rx Connector

Figure 4.3 MTRJ Port



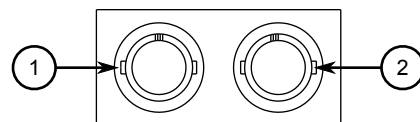
- ① Tx Connector
- ② Rx Connector

Figure 4.4 LC Port



- ① Tx Connector
- ② Rx Connector

Figure 4.5 SC Port



- ① Tx Connector
- ② Rx Connector

Figure 4.6 ST Port

Specifications

For specifications on the available fiber optic Ethernet ports, refer to ["Fiber Optic Ethernet Port Specifications \(Page 30\)"](#).

4.3 Modem Port

The RUGGEDCOM RS401 can optionally be equipped with a V.90 Modem connection for PPP (Point-to-Point Protocol) connections. For information about how to configure and operate the modem, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

WARNING

Fire hazard – risk of serious personal injury and/or damage to equipment

To reduce the risk of fire, use only #26 AWG or larger telecommunication line cord.

The modem card is equipped with a standard RJ11 telephone port. The following is the pin-out description for the RJ11 port:

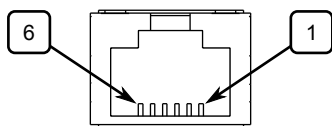


Figure 4.7 RJ11 Port Pin Configuration

Pin	Description
1	Reserved (Do Not Connect)
2	Reserved (Do Not Connect)
3	Ring
4	Tip
5	Reserved (Do Not Connect)
6	Reserved (Do Not Connect)

Note

This product meets the applicable Industry Canada technical specifications.

The Ringer Equivalence Number is an indication of the maximum number of devices allowed to be connected to a telephone interface. The termination on an interface may consist of any combination of devices subject only to the requirement that the sum of the RENs of all the devices does not exceed five.

4.4 Serial Ports

The RUGGEDCOM RS401 supports RJ45 or 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 RUGGEDCOM RS401. For more information, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

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

State	Description
Green	Activity detected
Off	No activity

For specifications on serial ports, refer to ["Serial Port Specifications \(Page 31\)"](#).

4.4.1 Serial RS232 DB9 Ports

Serial RS232 DB9 ports offer a female Data Communications Equipment (DCE) interface. When communicating with a Data Terminal Equipment (DTE) device, such as a PC, a straight-through serial cable (3 pin or 9 pin) is required. When communicat-

ing with an another DCE device, such as another RUGGEDCOM RS401, the RX and TX pins must be *crossed-over* using, for example, a NULL modem cable.

The following is the pin-out description for the RS232 DB9 ports:

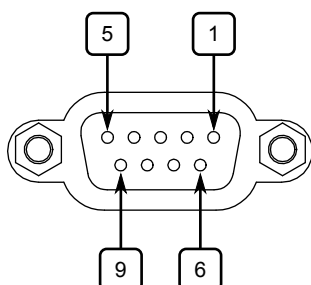


Figure 4.8 RS232 DB9 Serial Console Port

Pin	Name	Description
1	Reserved (Do Not Connect)	
2	TX	Transmit Data
3	RX	Receive Data
4	Reserved (Do Not Connect)	
5	GND	Common Ground
6	Reserved (Do Not Connect)	
7	Reserved (Do Not Connect)	
8	Reserved (Do Not Connect)	
9	Reserved (Do Not Connect)	

4.4.2 Serial RS232/RS485/RS422 DB9 Ports

The RUGGEDCOM RS401 can be equipped with serial RS232/RS485/RS422 DB9 ports. Each port can be set individually through the RUGGEDCOM RS401 operating system to operate in RS232, RS485 or RS422 mode. For more information, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

The following is the pin-out description for the RS232/RS485/RS422 DB9 ports:

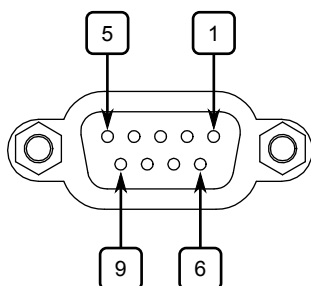


Figure 4.9 RS232/RS485/RS422 DB9 Serial Console Port

Pin ^a	Name		
	RS232 Mode	RS485 Mode	RS422 Mode
1	CD (No Connection)	—	—
2	TX	TX/RX+	TX+
3	RX	—	RX+
4	DTR (No Connection)	—	—
5	Common (Isolated Ground) ^b		
6	DSR (No Connection)	—	RX-
7	CTS ^c	TX/RX-	TX-
8	RTS ^c	—	—
9	RI (No Connection)	—	—
Shield	Chassis Ground		

^a No internal termination is provided.

4.4.3 Serial RS232/RS485/RS422 RJ45 Ports

- ^b The Common terminal is optically isolated. However, there is transient voltage protection circuitry between the Common terminal and chassis ground.
- ^c Pins 7 and 8 are connected together internally. In RS232 mode, these pins enter a high impedance state. A DTE that asserts RTS will see CTS asserted, although the device will not perform hardware flow control.

4.4.3 Serial RS232/RS485/RS422 RJ45 Ports

The RUGGEDCOM RS401 can be equipped with serial RS232/RS485/RS422 RJ45 ports. Each port can be set individually through the RUGGEDCOM RS401 operating system to operate in RS232, RS485 or RS422 mode. For more information, refer to the *RUGGEDCOM ROS Configuration Manual* for the RUGGEDCOM RS401.

The following is the pin-out description for the RS232/RS485/RS422 RJ45 ports:

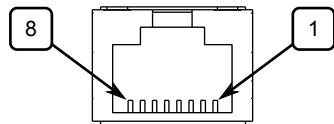


Figure 4.10 RS232/RS485/RS422 RJ45 Serial Console Port

Pin ^a	Name		
	RS232 Mode	RS485 Mode	RS422 Mode
1	DSR ^b		RX-
2	DCD ^b		
3	DTR ^b		
4	Common (Isolated) Ground		
5	RXD ^c		RX+
6	TXD ^c	TX/RX+	TX+
7	CTS		
8	RTS	TX/RX-	TX-
Shield	Chassis Ground		

^a No internal termination is provided.

^b The DSR, DCD and DTR pins are connected together internally.

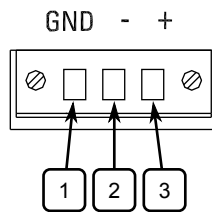
^c In RS232 mode, the RJ45 ports conform to EIA-561 DTE, which transmit on TXD and receive on RXD.

4.4.4 Serial Insulated Terminals

The RUGGEDCOM RS401 can be equipped with serial RS485 insulated terminals. The terminals are terminated by default from the factory. Termination provided is AC Termination style 120 Ohm resistor in series with a 10nF capacitor. The following details the appropriate jumper configuration for each RS485 port.

Port	Jumper Number	Jumper Position	
		No Termination	AC Termination
1	JP5	Removed	Installed
2	JP6		
3	JP7		
4	JP8		

The following is the pin-out description for the RS485 insulated terminals:



Terminal	Description
1	Positive
2	Negative
3	Common (Isolated Ground)

Figure 4.11 Serial Insulated Terminal Port

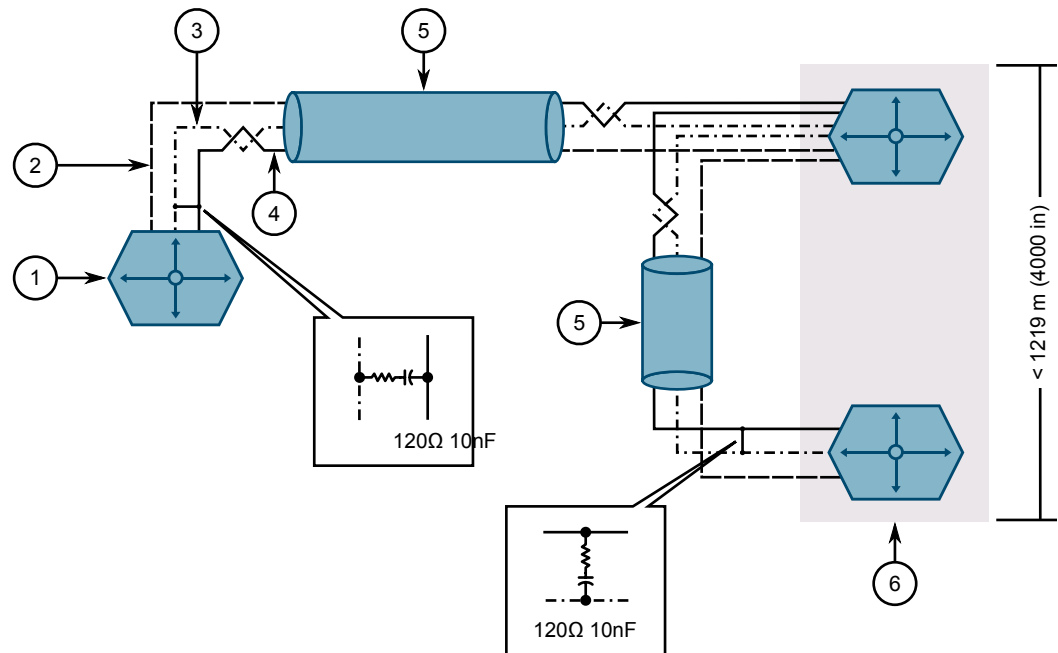
4.4.5 Connecting Multiple RS485 Devices

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.

4.4.5 Connecting Multiple RS485 Devices



- ① RUGGEDCOM RS401
- ② Common (Isolated Ground)
- ③ Negative
- ④ Positive
- ⑤ Shield to Earth (Connected At a Single Point)
- ⑥ RS485 Devices (32 Total)

Figure 4.12 Recommended RS485 Wiring

Technical Specifications

This section details the specifications and operating conditions of the device.

5.1 Power Supply Specifications

Power Supply Type	Minimum Input	Maximum Input	Internal Fuse Rating	Maximum Power Consumption
12-24 VDC	10 VDC	36 VDC	6.3 A(F) ^a	8 W
48 VDC	36 VDC	59 VDC	2 A(T) ^a	
HI (125/250 VDC) ^b	88 VDC	300 VDC	2 A(T) ^{a b}	
HI (110/230 VAC) ^b	85 VAC	265 VAC		

^a (F) denotes fast-acting fuse; (T) denotes time-delay fuse.

^b This is the same power supply for both AC and DC.

5.2 Failsafe Alarm Relay Specifications

Max Switching Voltage	30 VAC, 80 VDC, 125 VAC, 250 VAC
Rated Switching Current	0.3 A @ 30 VAC 1 A @ 30 VDC, 0.3 A @ 80 VDC 0.2 A @ 250 VAC 0.6 A @ 125 VAC

5.3 Copper Ethernet Port Specifications

The following details the specifications for copper Ethernet ports that can be ordered with the RUGGEDCOM RS401.

Speed ^a	Connector	Duplex ^a	Cable Type ^b	Wiring Standard ^c	Maximum Distance	Isolation ^d
10/100Base-TX	RJ45	FDX/HDX	> CAT-5	TIA/EIA T568A/B	100 m (328 ft)	1.5 kV

^a Auto-negotiating.

^b Shielded or unshielded.

^c Auto-crossover and auto-polarity.

^d RMS 1 minute.

5.4 Fiber Optic Ethernet Port Specifications

The following details the specifications for fiber Ethernet ports that can be ordered with the RUGGEDCOM RS401.

10Base-FL Ethernet Optical Specifications

Mode	Con- nector	Tx λ (nm) ^a	Cable Type (μ m) ^b	Tx (dBm peak) ^b		Rx Sen- sitivity (dBm Av- erage) ^b	Rx Satur- ation (dBm Peak) ^b	Distance (km) ^c	Pow- er Bud- get (dB)
				Minimum	Maximum				
MM	ST	62.5/125	1300	-19	-14	-33.9	-14	2	14.9

^a Typical.

^b To convert from average to peak, add 3 dBm. To convert from peak to average, subtract 3 dBm.

^c 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.

Fast Ethernet (100 Mbps) Optical Specifications

Mode	Con- nector	Cable Type (μ m) ^a	Tx λ (nm) ^b	Tx (dBm peak) ^a		Rx Sen- sitivity (dBm Av- erage) ^a	Rx Satur- ation (dBm Peak) ^a	Distance (km) ^c	Pow- er Bud- get (dB)
				Minimum	Maximum				
MM	LC	62.5/125	1310	-20	-14	-31	-14	2	11
MM	ST	62.5/125	1300	-19	-14	-33.9	-14	2	11.4
MM	ST	50/125	1300	-22.5	-14	-33.9	-14	2	14.9
MM	ST	62.5/125	1300	-19	-14	-30	-14	2.5	11
MM	SC	62.5/125	1300	-19	-14	-33.9	-14	2	14.9
MM	SC	50/125	1300	-22.5	-14	-33.9	-14	2	14.9
MM	MTRJ	62.5/125	1300	-19	-14	-33.5	-14	2	14.5
MM	MTRJ	50/125	1300	-22.5	-14	-33.5	-14	2	14.5
SM	ST	9/125	1310	-15	-7	-34	-3	20	19
SM	SC	9/125	1300	-15	-8	-31	-7	20	16
SM	SC	9/125	1310	-5	0	-34	-3	50	29
SM	SC	9/125	1310	0	5	-37	0	90	42
SM	LC	9/125	1300	-15	-8	-38	-3	20	23
SM	LC	9/125	1310	-5	0	-35	-3	50	30
SM	LC	9/125	1310	0	5	-37	0	90	37

^a To convert from average to peak, add 3 dBm. To convert from peak to average, subtract 3 dBm.

^b Typical.

^c 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.

5.5 Serial Port Specifications

Port Type	Media	Distance	Connector Type
RS232	Standard RS232 Shielded Serial Cable	15 m (49 ft)	DB9
RS485	Shielded Twisted-Pair	1200 m (3937 ft)	Insulated Terminals
RS232/RS485/RS422	Shielded Twisted-Pair	1200 m (3937 ft)	DB9
RS232/RS485/RS422	Shielded Twisted-Pair	1200 m (3937 ft)	RJ45

5.6 Operating Environment

The RUGGEDCOM RS401 is rated to operate under the following environmental conditions.

Ambient Operating Temperature ^a	-40 to 85 °C (-40 to 185 °F)
Ambient Storage Temperature	-40 to 85 °C (-40 to 185 °F)
Ambient Relative Humidity ^b	5% to 95%
Maximum Altitude	2000 m (6562 ft)

^a Measured from a 30 cm (12 in) radius surrounding the center of the enclosure.

^b Non-condensing.

5.7 Mechanical Specifications

Weight	1.9 kg (4.2 lb)
Ingress Protection	IP30
Enclosure	18 AWG Galvanized Steel

5.8 Dimension Drawings

Note

All dimensions are in millimeters, unless otherwise stated.

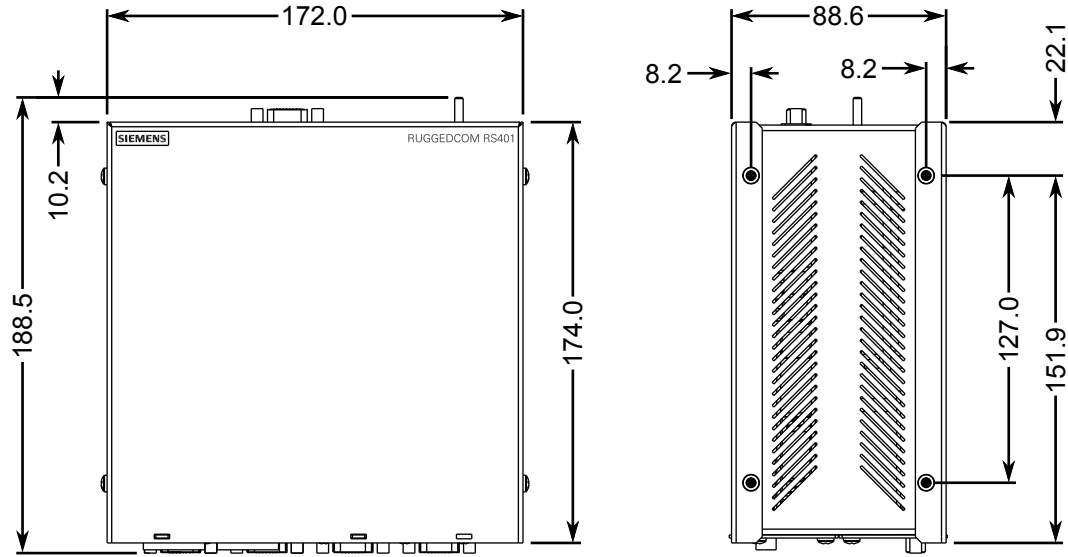


Figure 5.1 Overall Dimensions

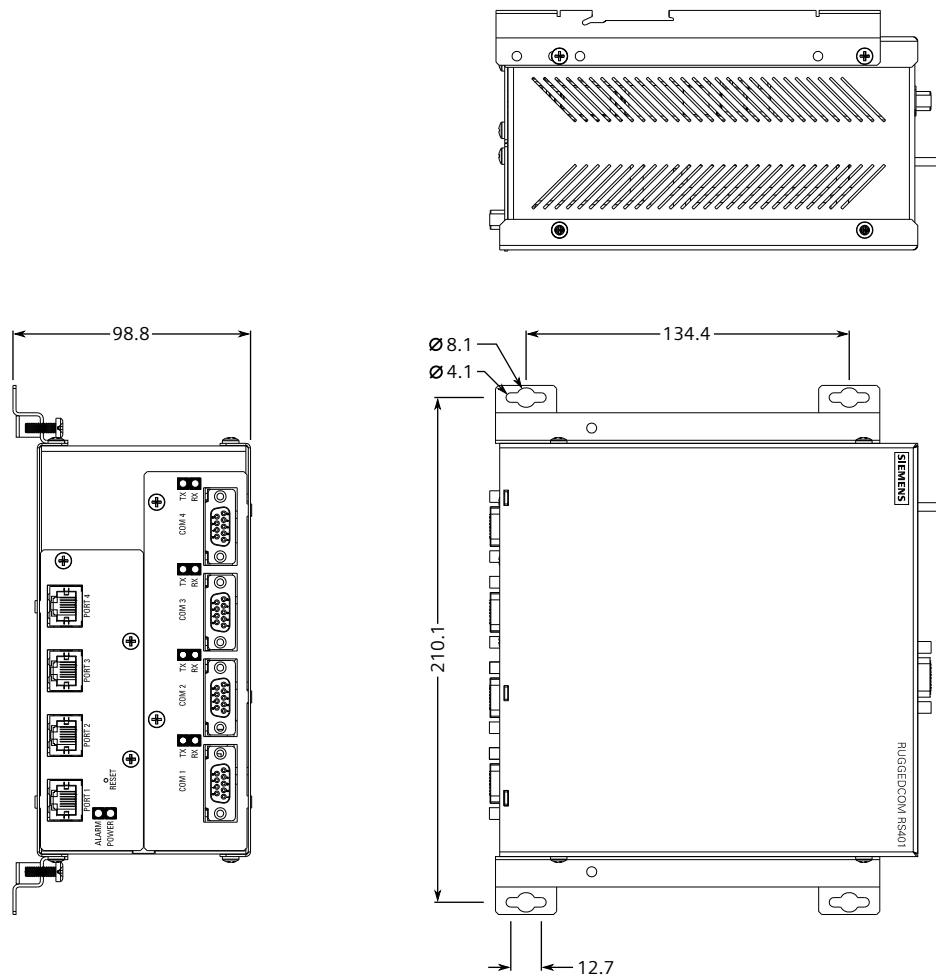


Figure 5.2 Panel and Din Rail Mount Dimensions (Front Mount Option)

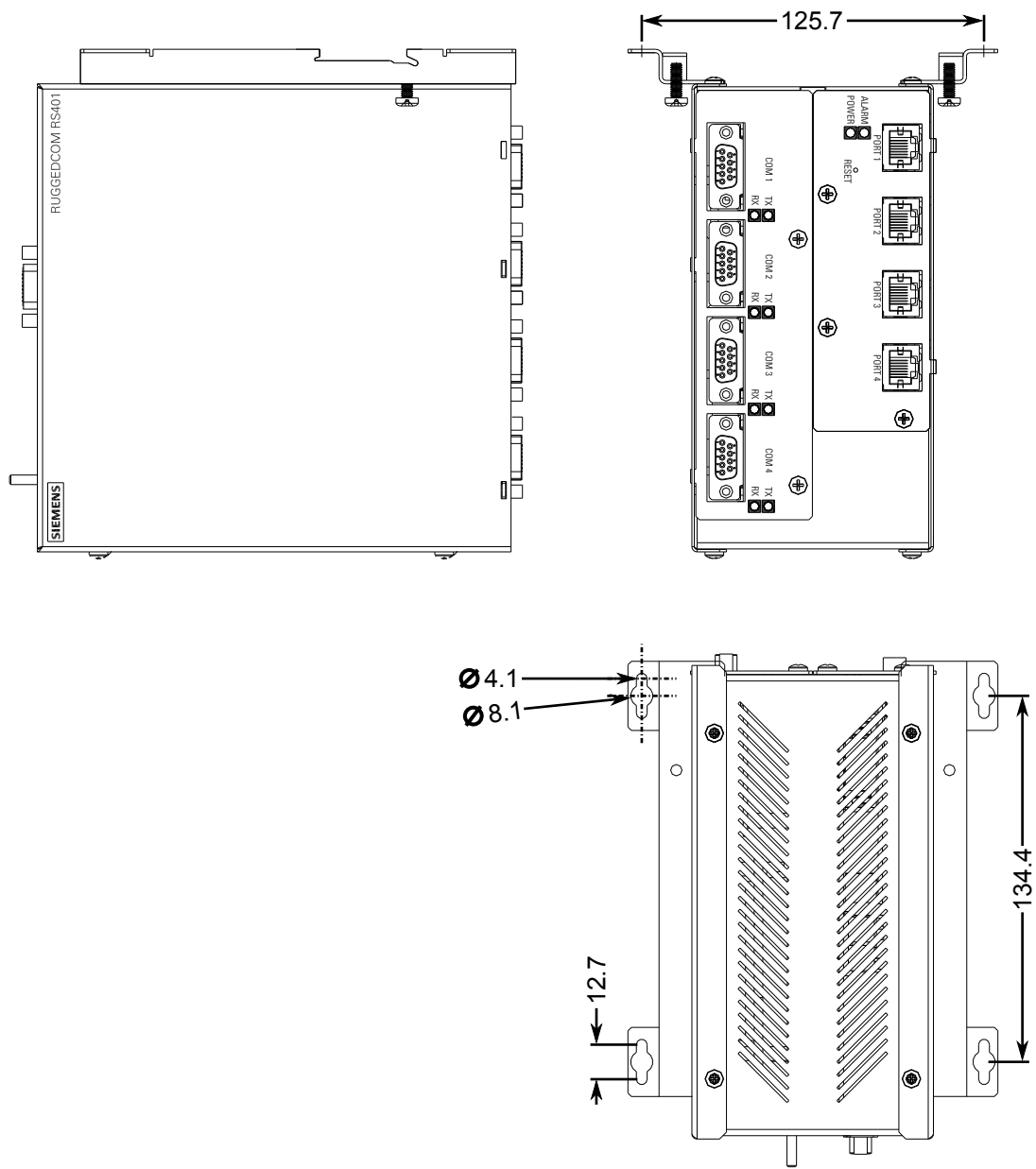


Figure 5.3 Panel and Din Rail Mount Dimensions (Side Mount Option)

Certification

The RUGGEDCOM RS401 device has been thoroughly tested to guarantee its conformance with recognized standards and has received approval from recognized regulatory agencies.

6.1 Approvals

This section details the standards to which the RUGGEDCOM RS401 complies.

6.1.1 CSA

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

- **CSA-C22.2 NO. 60950-1**
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)

6.1.2 European Union (EU)

This device is declared by Siemens AG to comply with essential requirements and other relevant provisions of the following EU 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 AG. For contact information, refer to ["Contacting Siemens \(Page vi\)"](#).

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.

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

6.1.5 ISED

This device is declared by Siemens AG to meet the requirements of the following ISED (Innovation Science and Economic Development Canada) standard:

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

6.1.6 ACMA

This device meets the requirements of the following Australian Communications and Media Authority (ACMA) standards under certificate ABN 98 004 347 880:

- Radiocommunications (Compliance Labelling – Devices) Notice 2014 made under Section 182 of the Radiocommunications Act 1992
- Radiocommunications Labelling (Electromagnetic Compatibility) Notice 2008 made under Section 182 of the Radiocommunications Act 1992
- Radiocommunications (Compliance Labelling – Electromagnetic Radiation) Notice 2003 made under Section 182 of the Radiocommunications Act 1992
- Telecommunications Labelling (Customer Equipment and Customer Cabling) Notice 2001 made under Section 407 of the Telecommunication Act 1997

The device is marked with an RCM symbol to indicate compliance when sold in the Australian region.



A copy of the Declaration of Conformity is available via Siemens Industry Online Support at <https://support.industry.siemens.com/cs/ww/en/view/89855782>.

6.1.7 RoHS

This device is declared by Siemens AG to meet the requirements of the following RoHS (Restriction of Hazardous Substances) directives for the restricted use of certain hazardous substances in electrical and electronic equipment:

- **China RoHS 2**
Administrative Measure on the Control of Pollution Caused by Electronic Information Products

A copy of the Material Declaration is available online at <https://support.industry.siemens.com/cs/ww/en/view/109738831>.

6.1.8 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

6.2 EMC and Environmental Type Tests

The RUGGEDCOM RS401 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
IEC 61000-4-3	Radiated RFI	Enclosure Ports	20 V/m	
IEC 61000-4-4	Burst (Fast Transient)	Signal Ports	±4 kV at 2.5 kHz	
		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	10 V	3
		AC Power Ports	10 V	3
		Earth Ground Ports	10 V	3
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	30% for 0.1 s, 100% for 0.05 s	
		AC Power Ports	30% for 1 period, 60% for 250 periods	
IEC 61000-4-11			100% for 5 periods, ² 100% for 50 periods ²	
IEC 61000-4-12	Damped Oscillatory	Signal Ports	2.5 kV common, 1 kV differential mode at 1 MHz	3
		DC Power Ports	2.5 kV common, 1 kV differential mode at 1 MHz	3
		AC Power Ports	2.5 kV common, 1 kV differential mode at 1 MHz	3

Test	Description		Test Levels	Severity Levels
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 kVac (Fail-Safe Relay Output)	
		DC Power Ports	1.5 kVDC	
		AC Power Ports	2 kVAC	
	H.V. Impulse	Signal Ports	5 kV (Fail-Safe Relay output)	
		DC Power Ports	5 kV	
		AC Power Ports	5 kV	

IEEE 1613 (C37.90.x) EMC Immunity Type Tests

Note

The RUGGEDCOM RS401 meets Class 2 requirements for an all-fiber configuration and Class 1 requirements for copper ports.

Description		Test Levels
ESD	Enclosure Contact	±8 kV
	Enclosure Air	±15 kV
Radiated RFI	Enclosure Ports	35 V/m
Fast Transient	Signal Ports	±4 kV at 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 at 1 MHz
	DC Power Ports	1 kV Common and Differential Mode at 1 MHz
	AC Power Ports	1 kV Common and Differential Mode at 1 MHz
Dielectric Strength	Signal Ports	2 kVAC
	DC Power Ports	1.5 kVDC
	AC Power Ports	2 kVAC

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 at 10-150 Hz
IEC 60255-21-2	Shock		30 g at 11 ms

Further Information

Siemens RUGGEDCOM

<https://www.siemens.com/ruggedcom>

Industry Online Support (service and support)

<https://support.industry.siemens.com>

Industry Mall

<https://mall.industry.siemens.com>

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