

RuggedServer™ RS416

Modular Serial Device Server with Integrated Managed Ethernet Switch



Installation Guide

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Federal Communications Commission Radio Frequency Interference Statement

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 at his expense.

Caution

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

Should this device require service see the "Warranty" section of this installation guide.

Important

This unit should be installed in a restricted access location where access can only be gained by service personnel or users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

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3 Product Overview

3.1 Functional Overview

The **RuggedServer™ RS416** 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 a modular design that can support up to 16 serial ports and up to 4 Ethernet ports, the RS416 is able to interconnect multiple types of intelligent electronic devices (IEDs) that have different methods of communications. Using the RS416 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 RS416 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 RS416 meets or exceeds a wide range of industry standards including IEC 61850, IEEE 1613, IEC 61000-6-2, IEC 61800-3, and NEMA TS-2. The RS416 also features a wide operating temperature range of -40°C to +85°C allowing it to be installed in virtually any location.

The embedded Rugged Operating System (ROS™) within the RS416 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 RS416 is ideal for creating mission-critical, real-time, control applications in any harsh environment. The RS416 is also backed by RuggedCom's all inclusive five year warranty and unsurpassed technical support.

3.2 Feature Highlights

Serial Device Server

- Modular design allows for 4, 8, 12, or 16 serial ports
- Fully compliant EIA RS422 / TIA RS485, RS422, RS232
- serial ports (software selectable) - DB9 or RJ45 connectors
- Transmit serial data over an IP network
- Support for Modbus TCP, DNP 3, TIN serial protocols
- Baud rates up to 230 kbps
- Raw socket mode allows conversion of any serial protocol
- Point-to-point and multi-point modes
- Converts Modbus RTU to Modbus
- Supports multiple Modbus masters
- Converts DNP3.0 to DNP over UDP/TCP

Ethernet Ports

- Integrated Ethernet Switch - 2 or 4 port options
- (copper and/or fiber)
- High performance and throughput Ethernet switching
- Fully IEEE 802.3, IEEE 802.3u, IEEE 802.3x compliance
- Non-blocking, store and forward switching

RuggedRated™ for Reliability in Harsh Environments

- Immunity to EMI and heavy electrical surges
- Meets IEEE 1613 (electric utility substations)
- Exceeds IEC 61850-3 (electric utility substations)
- Exceeds IEC 61800-3 (variable speed drive systems)
- Exceeds IEC 61000-6-2 (generic industrial)
- Exceeds NEMA TS-2 (traffic control equipment)
- Fully independent 2 kV (RMS) isolated serial ports
- -40°C to +85°C operating temperature (no fans)
- 18 AWG galvanized steel enclosure

Universal Power Supply Options

- Fully integrated, dual-redundant (optional) power supplies
- Universal high-voltage range: 88-300 VDC or 85-264 VAC
- Popular low voltage DC ranges: 12 VDC, 24 VDC, 48 VDC
- Terminal blocks for reliable maintenance free connections
- CSA/UL 60950 safety approved to +85°C

Rugged Operating System (ROS™) Features

- Simple plug and play operation - automatic learning, negotiation, and crossover detection
- Integrated Cyber Security features
- RSTP (802.1w) and Enhanced Rapid Spanning Tree (eRSTP™) network fault recovery (<5ms)
- Quality of Service (802.1p) for real-time traffic
- VLAN (802.1q) with double tagging and GVRP support
- IGMP Snooping for multicast filtering
- Port Rate Limiting and Broadcast Storm Limiting
- Port configuration, status, statistics, mirroring, security

Management Tools

- Web-based, Telnet, CLI management interfaces
- SNMP v1/v2/v3
- Remote Monitoring (RMON)
- Rich set of diagnostics with logging and alarms

3.3 Display Panel Description

The RS416 is equipped with a versatile display panel, shown in Figure 1, which is designed to provide quick status information for each port, as well as the entire device to allow for simple diagnostics and troubleshooting. It features:

- RS232 console port for 'out of band' console access and configuration
- Power supply and Alarm status indicators
- Convenient port status indicators conveying Link-Activity, Duplex, or Speed via push-button control.
- System reset via push-button if held for 5 seconds

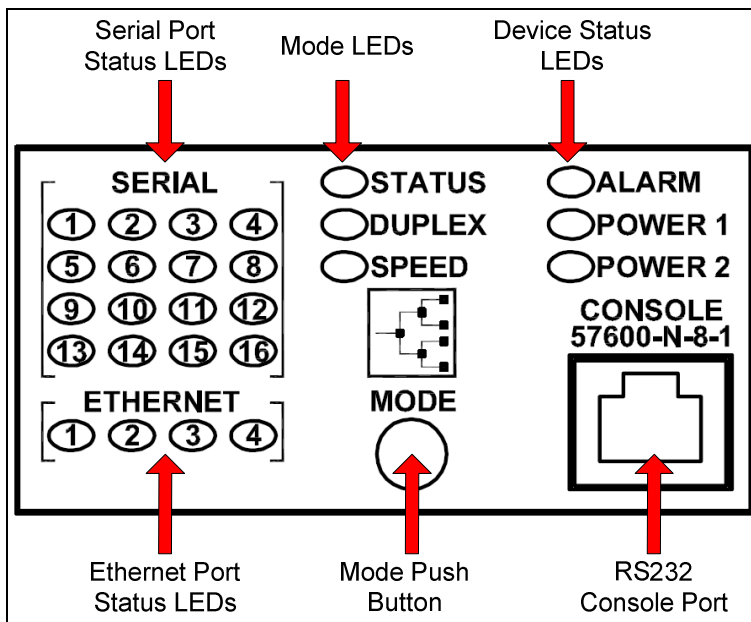


Figure 1: RS416 LED Display Panel

Device status LEDs exist to provide a quick visual indicator to operators for operational status of the unit. Table 1 defines the possible LED colours and the corresponding description.

LED	Colour	Description
Power 1 / 2	Green	Power supply operating normal
	Red	Power supply failure
Alarm	Red	Alarm exist – login to console to determine alarm code
	Off	No alarms exist

Table 1: LED Display – Device status LED behavior definition

The port-based LEDs can be cycled between three display modes: Status, Duplex, and Speed. Pushing the mode button causes the display mode to be cycled. Table 2 and Table 3 define the possible port LED colours and the corresponding description.

<i>Mode</i>	<i>Colour</i>	<i>Ethernet Port Status LEDs</i>	<i>Serial Port Status LEDs</i>
Status	Green (Solid)	Link	-
	Green (Blinking)	Activity	Traffic
	Off	No link	No Traffic
Duplex	Green (Solid)	Full-Duplex	Full-Duplex
	Orange (Solid)	Half-Duplex	Half-Duplex
	Off	No link	No link
Speed	Green Blinking	-	> 57600 bps
	Green (Solid)	10 0Mbps	19200 bps – 57600 bps
	Orange (Solid)	10 Mbps	< 19200 bps
	Off	No link	No link

Table 2: LED Display - Port LED behavior definition

4 Installation

4.1 Mounting

The RS416 has been designed with maximum mounting and display flexibility. Customers can order an RS416 that can be mounted in a standard 19" rack, 1" DIN Rail, or directly onto a panel. For rack mount installations, the RS416 can be ordered with connectors on the front of the unit, or located on the rear of the chassis to allow for all data and power cabling to be installed and connected at the rear of the rack. See Figure 2 for rack mount orientation examples.

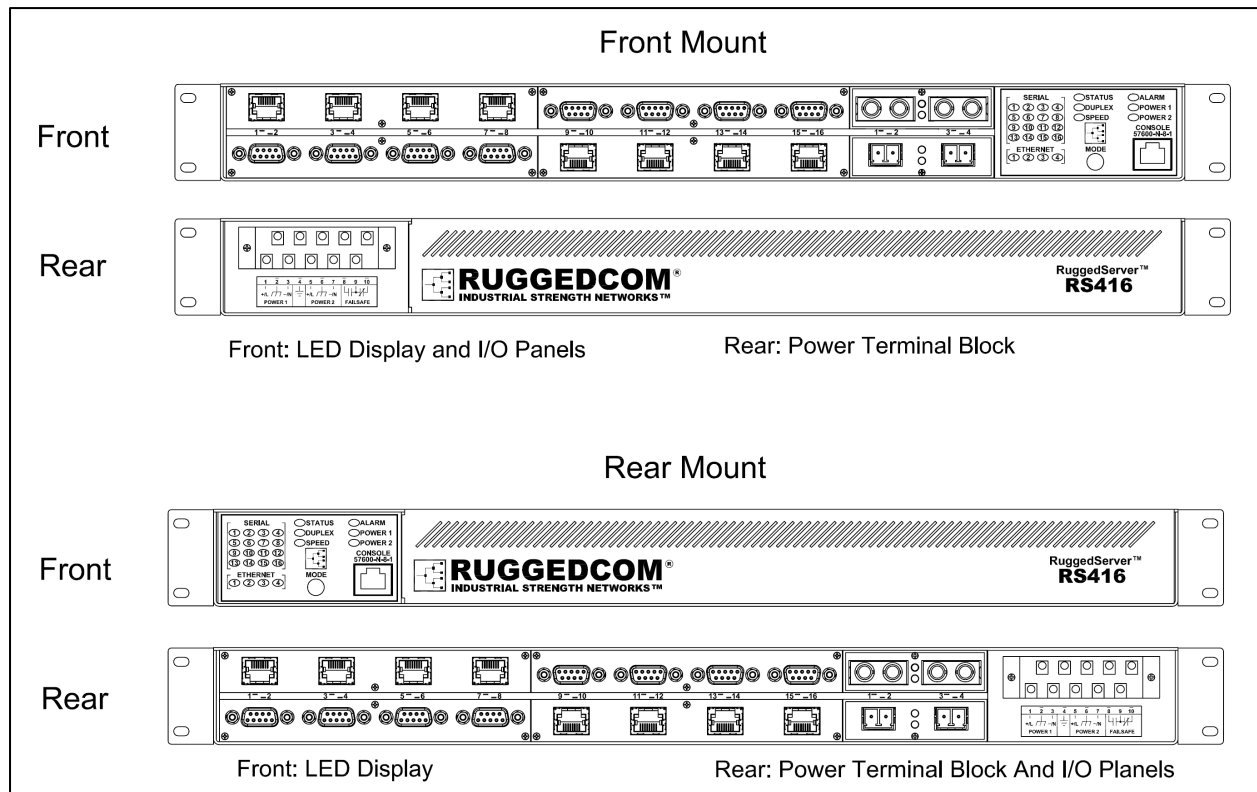


Figure 2: RS416 Series Rack mount chassis orientation options – Front and rear mount.

4.1.1 Rack Mounting

The RS416 can be rack mounted using the included rack mount adapter assemblies shown in Figure 3. Secure the one rack mount adapter to the front of each side of the chassis using the included black PAN head Philips screws in the positions shown in Figure 4. The entire chassis can then be mounted to a standard 19" rack. An additional two rack mount adapters are included to optionally secure the rear of the chassis in high-vibration, or seismically active locations.

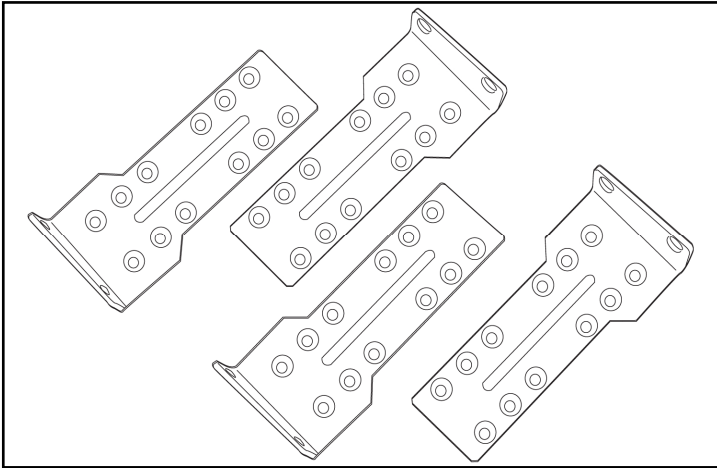


Figure 3: 19" Rack Mount Adapters

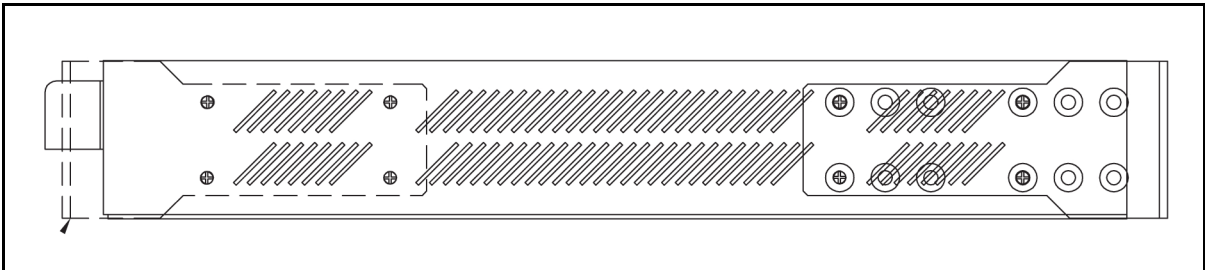


Figure 4: Rack mount adapter mounting location

NOTE: Since heat within the RS416 is channeled to the enclosure, it is recommended that 1 rack unit of space (1.75") be kept unpopulated and free of equipment above each RS416 product to allow for a small amount of convectional airflow. Although forced airflow is not necessary, any increase in airflow will result in a reduction of ambient temperature that will improve long-term reliability of all equipment mounted within the rack space.

4.1.2 Panel and DIN Rail Mounting

The RS416 can be ordered as a Panel/DIN mount chassis. Both options involve the use of the panel/DIN adapters to be mounted on each side of the chassis enclosure. The adapter allows the chassis to be mounted on the standard 1" DIN rail using the grooves in the adapter, secured using the included Philips screw. See Figure 5 for a PANEL/DIN mount diagram.

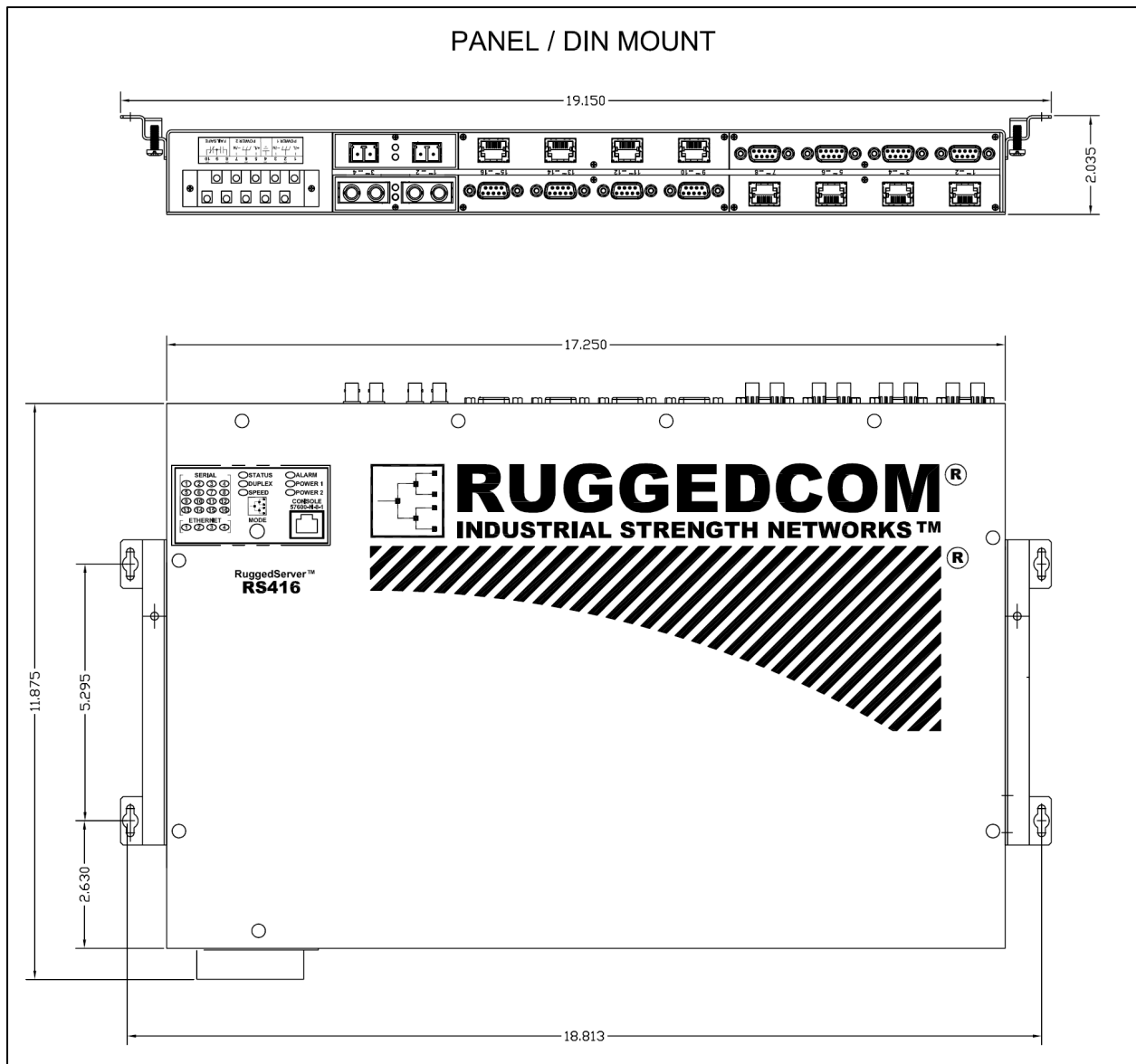


Figure 5: RS416 Series PANEL/DIN RAIL mounting diagram with

4.2 Power Supply Wiring and Grounding

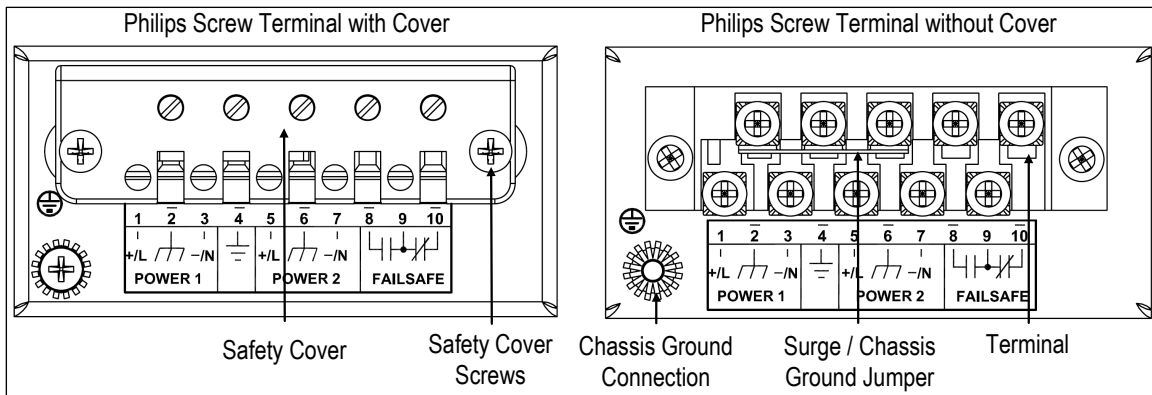


Figure 6: RS416 Series Philips Screw Terminal Block

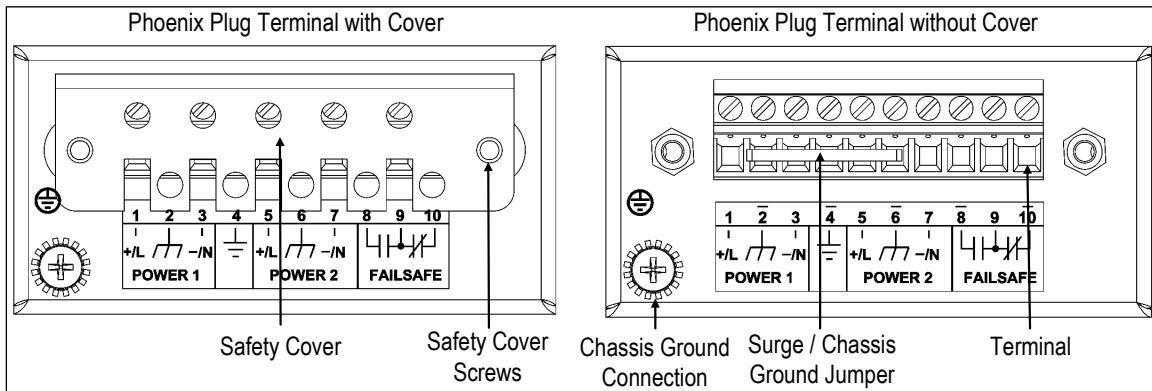


Figure 7: RS416 Series Phoenix Plug Terminal Block

The RS416 supports dual redundant power supplies – “Power Supply 1 (PS1)” and “Power Supply 2 (PS2)”. The connections for PS1, PS2 and the fail-safe relay are located on the terminal block as shown in Figure 6 and Figure 7.

The RS416 can be equipped with either a Philips Screw Terminal Block or a Phoenix Plug Terminal Block. The Philips Screw Terminal Block has Philips screws with a compression plate allowing either bare wire connections or crimped terminal lugs. We recommend the use of #6 size ring lugs to ensure secure, reliable connections under severe shock or vibration. Both terminal blocks have a safety cover which must be removed via two Phillips screws before connecting any wires. The safety cover must be re-attached after wiring to ensure personnel safety. Refer to Table 3 below for a description of each terminal as well as sections 4.2.1 through 4.2.3 for wiring examples.

Terminal #	Description	Usage
1	PS1 Live / +	PS1 Live / + is connected to the positive (+) terminal if the power source is DC or to the (Live) terminal if the power source is AC.
2	PS1 Surge Ground	PS1 Surge Ground is connected to the Chassis Ground via a jumper on the terminal block. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry.
3	PS1 Neutral / -	PS1 Neutral / - is connected to the negative (-) terminal if the power source is DC or to the (Neutral) terminal if the power source is AC.
4	Chassis Ground	Chassis Ground is connected to the Safety Ground terminal for AC inputs or the equipment <i>ground bus</i> for DC inputs. Chassis ground connects to both power supply surge grounds via a removable jumper.
5	PS2 Live / +	PS2 Live / + is connected to the positive (+) terminal if the power source is DC or to the (Live) terminal if the power source is AC.
6	PS2 Surge Ground	PS2 Surge Ground is connected to the Chassis Ground via a jumper on the terminal block. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry.
7	PS2 Neutral / -	PS2 Neutral / - is connected to the negative (-) terminal if the power source is DC or to the (Neutral) terminal if the power source is AC.
8	Relay NO Contact	Normally open, failsafe relay contact.
9	Relay Common	Failsafe relay common contact.
10	Relay NC Contact	Normally closed, failsafe relay contact.

Table 3: RS416 Power terminal block connection description

4.2.1 AC Power Supply Wiring Examples

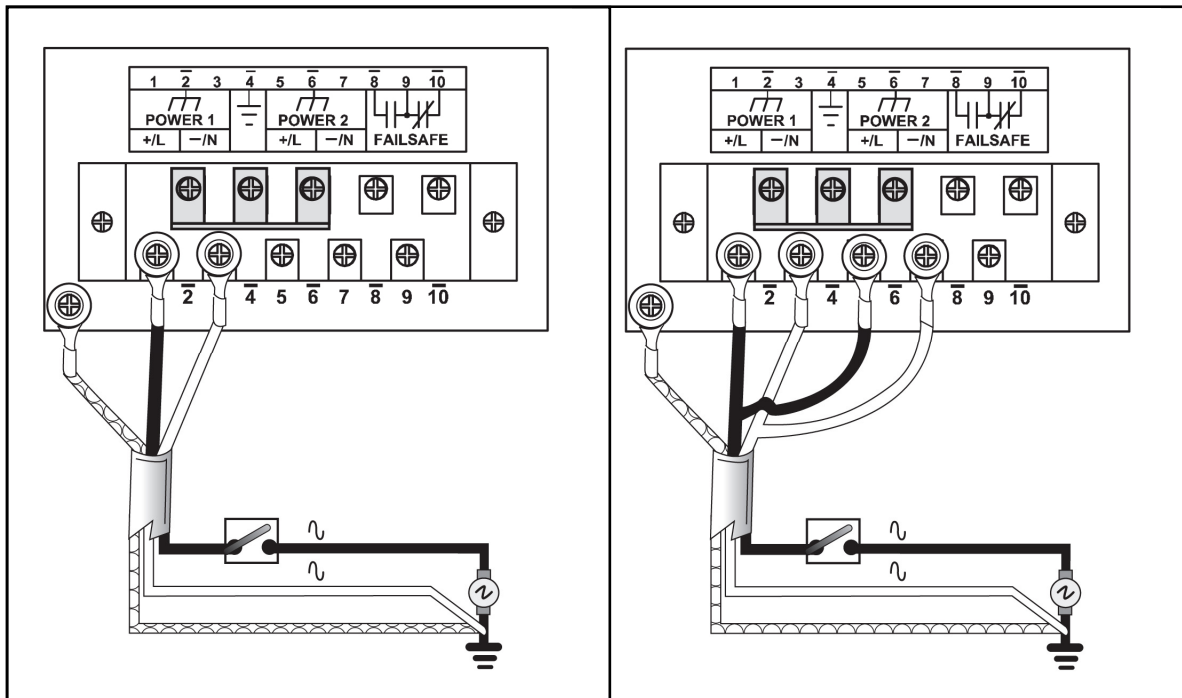


Figure 8: AC Power supply wiring examples

NOTES:

1. 100-240VAC rated equipment: A 250VAC appropriately rated circuit breaker must be installed within 3m of unit.
2. Equipment must be installed according to the applicable country wiring codes.
3. When equipped with two HI voltage power supplies, independent AC sources can be used to power the product for greater redundancy. However, separate circuit breakers must be installed and separately identified (not shown in above figure).

4.2.2 DC Power Supply Wiring Examples

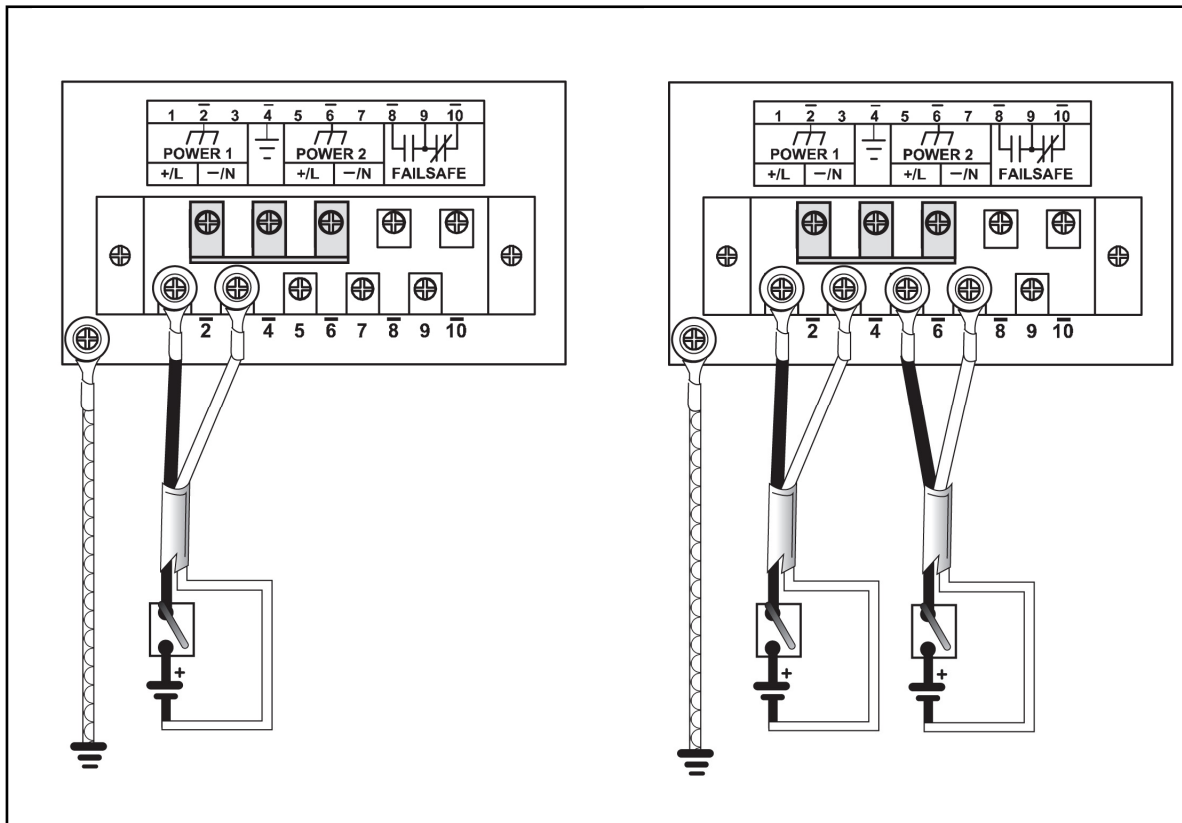


Figure 9: DC Power supply wiring examples

NOTES:

1. 88-300VDC rated equipment: A 300VDC appropriately rated circuit breaker must be installed within 3m of unit.
2. A circuit breaker is not required for 12, 24 or 48 VDC rated power supplies.
3. Equipment must be installed according to the applicable country wiring codes.
4. When equipped with two HI voltage power supplies, independent AC sources can be used to power the product for greater redundancy. However, separate circuit breakers must be installed and separately identified.
5. When equipped with two DC voltage power supplies (88-300VDC rated); independent DC sources may be used to power the product for greater redundancy. However, separate circuit breakers must be installed and separately identified (as shown in the above figure).

4.2.3 Dual Power Supplies Wiring Examples

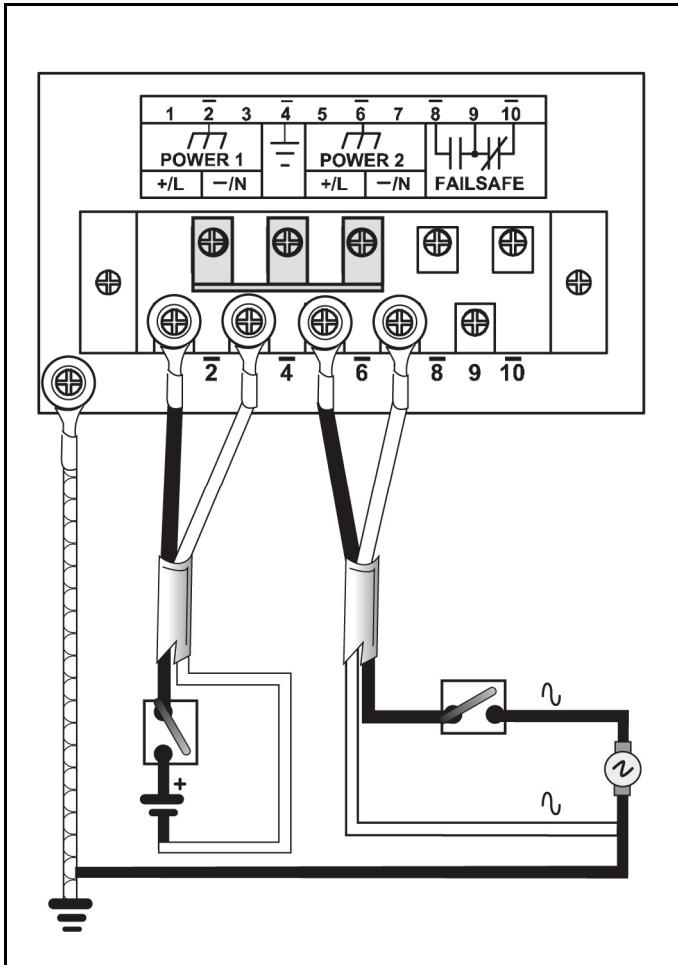


Figure 10: DC And AC power supply wiring examples

NOTES:

1. 88-300VDC rated equipment: A 300VDC appropriately rated circuit breaker must be installed within 3m of unit.
2. 100-240VAC rated equipment: A 250VAC appropriately rated circuit breaker must be installed within 3m of unit.
3. A circuit breaker is not required for 12, 24 or 48 VDC rated power supplies.
4. Separate circuit breakers must be installed and separately identified.
5. Equipment must be installed according to the applicable country wiring codes.

4.3 Dielectric Strength (HIPOT) Testing

For dielectric strength (HIPOT) testing in the field, users must remove the metal jumper located on terminal 2, 4, and 6 of the power supply terminal block. This metal jumper connects transient suppression circuitry to chassis ground and must be removed in order to avoid damage to transient suppression circuitry during HIPOT testing. Figure 11 shows the proper HIPOT test connections and should be followed to avoid damage to the device.

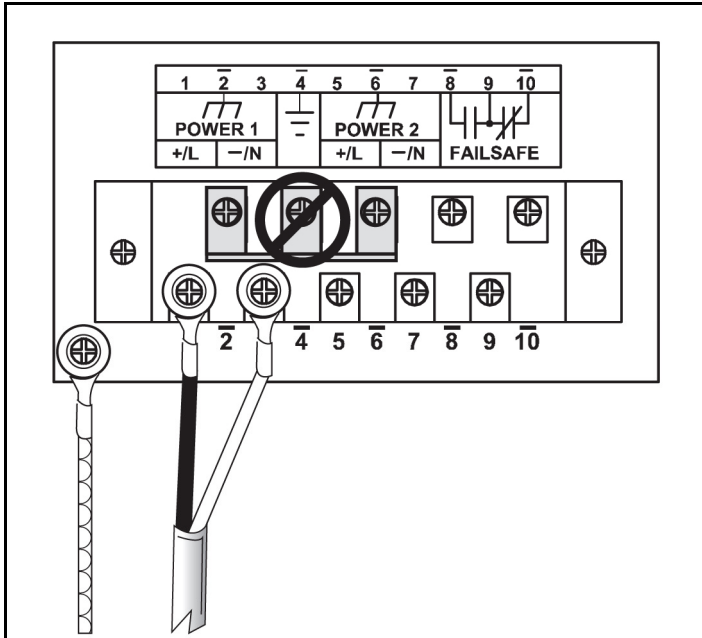


Figure 11: Dielectric Strength (HIPOT) Testing

4.4 Failsafe Alarm Relay Wiring

The “Failsafe” output relay is provided to signal critical error conditions that may occur on the RS416. The contacts are energized upon power up of the unit and remain energized until a critical error occurs. The proper relay connections are shown in Figure 12. One common application for this output is to signal an alarm if a power failure or removal of control power occurs. The failsafe relay current and power handling capabilities are defined in

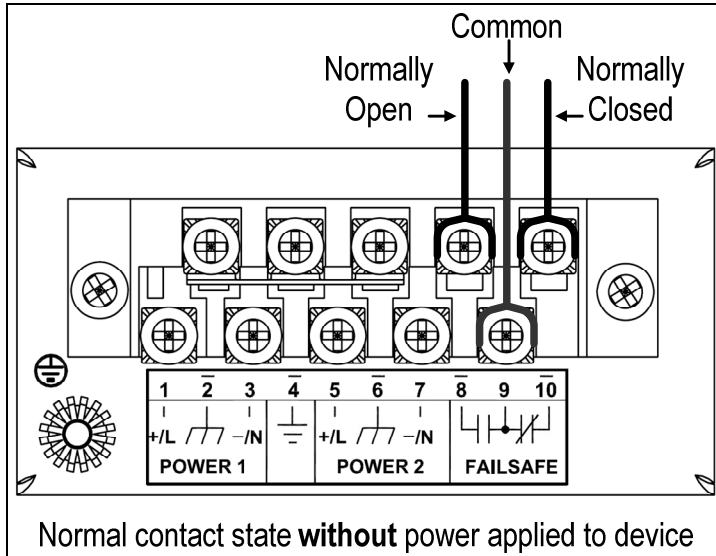


Figure 12: Failsafe Alarm Relay Wiring

4.5 Console Port Wiring

A RS232 console port for configuration and management of the device is located on the LED display module shown in Figure 13. This port is intended to be a temporary connection during initial configuration or troubleshooting and allows for direct access to the serial-based management console. The connection is made using the DB9-Female to RJ45 console cable included in the device packaging shown below. Console connection settings are 57600 baud, no parity bits, 8 data bits, and 1 stop bit.

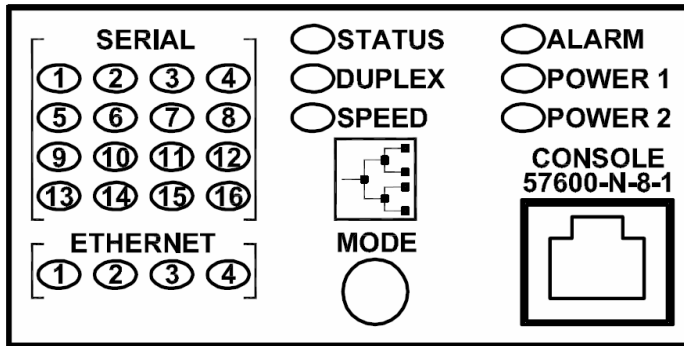


Figure 13: Console port location on display board

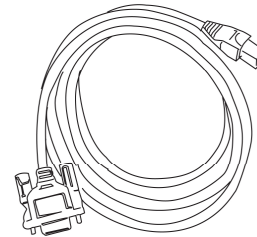


Figure 14: Console cable

For user reference, the console cable pin-out is shown in the table below.

<i>RuggedCom RS232 over RJ45 pin-out specification</i>		
<i>Signal Name (PC is DTE)</i>	<i>Female DB9</i>	<i>Male RJ45</i>
DCD – Carrier detect	1	2
TxD – Transmit Data	2	5
RxD – Receive Data	3	6
DTR – Data terminal ready	4	3
Signal GND	5	4
DSR – Data set ready	6	1*
RTS – Ready to send	7	8
CTS – Clear to send	8	7
RI – Ring Indicator	9	1*

Table 4: RS232 over RJ45 console cable pin-out

After initial configuration, the RS416 can be configured via a number of mechanisms such as Telnet, and the built-in web server. Consult the RuggedSwitch ROS User Guide for further details.

NOTE: This port is not intended to be a permanent connection and the cable shall be less than 2m (6.5 ft) in length.

4.6 Serial Ports

The RS416 can be equipped with a Fiber Serial Interface, RS232/RS485/RS422 DB9 serial ports or RS232/RS485/RS422 RJ45 serial ports.

4.6.1 Fiber Serial Interface

The RS416 can be equipped with a Fiber Serial Interface (ST connector only) which allows RS485, RS422, or RS232 devices to communicate over secure, noise immune, optically isolated, fiber optic cabling at extended distances as well as protocol independent conversion to multimode fiber optics.

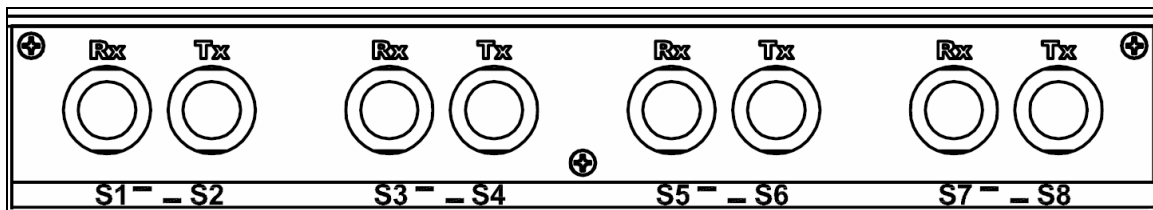


Figure 15: Fiber Serial Interface (ST Connector)

4.6.2 RS232/RS485/RS422 via DB9

Each port is individually selectable via software to be RS232, RS485 or RS422. The DB9 port and pin-out is shown below.

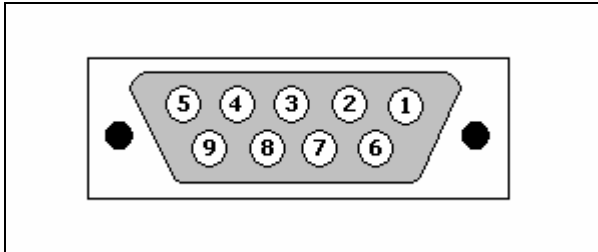


Figure 16: DB9 Female DCE Port pin-out

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

Table 5: DB9 Female DCE Port pin-out

NOTES:

1. No internal termination is provided.
2. Pins 1, 4, and 6 are connected internally. Pins 7 and 8 are connected internally. The pins are permanently asserted to 5V so that DTE devices that require DCD, DTR, or CTS signals will operate. However, hardware flow control via RTS is not recognized.
3. The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.

4.6.3 RS232/RS485/RS422 via RJ45

Each port is individually selectable via software to be RS232, RS485 or RS422. The RJ45 port and pin-out is shown below.

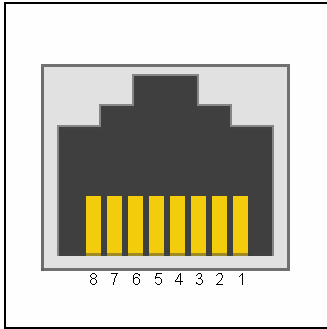


Figure 17: RJ45 Port pin-out

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

Table 6: RJ45 Port pin-out

NOTES:

1. No internal termination is provided.
2. Pins 1, 2, and 3 are connected internally. Pins 7 and 8 are connected internally. The pins are permanently asserted to 5V so that DTE devices that require DCD, DTR, or CTS signals will operate. However, hardware flow control via RTS is not recognized.
3. The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.

4.6.4 RS485 Wiring

Each RS485 port can communicate to multiple RS485 devices by daisy chaining devices over a single twisted pair with transmit and receive signals on the same two wires (half duplex). The following guidelines should be followed to ensure reliable continuous communication:

1. To minimize the effects of ambient electrical noise, shielded cabling is recommended.
2. The correct polarity must be observed throughout a single daisy chain.
3. The number of devices wired should not exceed 32, and total distance should be less than 4000 feet (at 100 kbps).
4. The Common terminals should be connected to the common wire inside the shield.
5. The shield should be connected to earth ground at a single point to avoid loop currents
6. The twisted pair should be terminated at each end of the chain.

The figure below shows the recommended RS485 wiring.

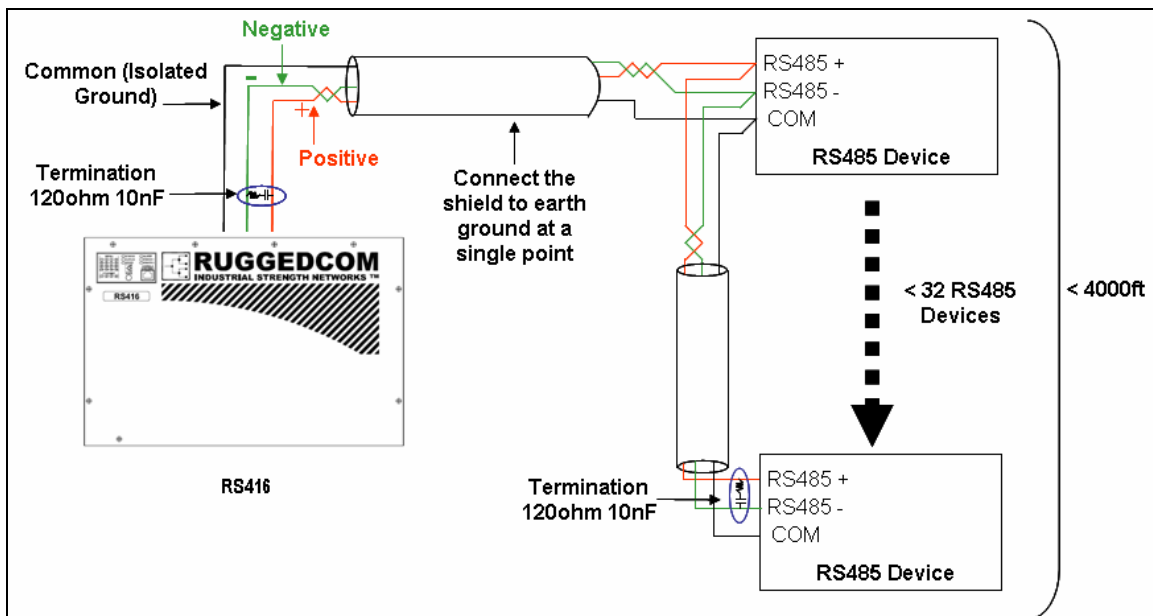


Figure 18: Conceptual recommended RS485 wiring diagram

4.6.5 Serial Port Transient Protection

RuggedCom does not recommend the use of copper cabling of any length for critical real-time substation automation applications. However, transient suppression circuitry is present on all copper ports to protect against damage from electrical transients and to ensure IEC 61850-3 and IEEE 1613 Class 1 conformance. This means that during the transient event communications errors or interruptions may occur but recovery is automatic.

RuggedCom also does not recommended to use these ports to interface to field devices across distances which could produce high levels of ground potential rise, (i.e. greater than 2500V) during line to ground fault conditions.

4.7 Ethernet Ports

4.7.1 Copper Ports

The RS416 may have up to 4 10/100BaseTX ports that allow connection to standard CAT-5 UTP cable with RJ45 male connectors. All RJ45 Ethernet ports feature auto-negotiating, auto-polarity, and auto-crossover functions. The RJ45 receptacles can also accept and take advantage of screened (commonly known as “shielded”) cabling. Figure 19 shows the RJ45 port pins configuration.

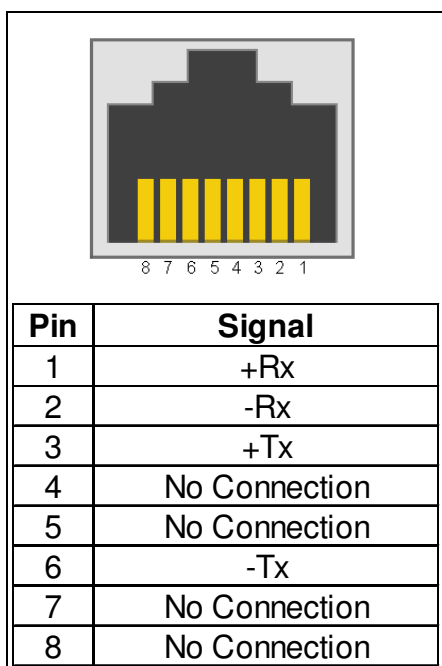


Figure 19: RJ45 port pins configuration.

NOTE: RuggedCom does not recommend the use of copper cabling of any length for critical real-time substation automation applications. However, transient suppression circuitry is present on all copper ports to protect against damage from electrical transients and to ensure IEC 61850-3 and IEEE 1613 Class 1 conformance. This means that during the transient event communications errors or interruptions may occur but recovery is automatic. RuggedCom also does not recommended to use these ports to interface to field devices across distances which could produce high levels of ground potential rise, (i.e. greater than 2500V) during line to ground fault conditions.

4.7.2 Fiber Optic Ports

Depending on the order code of the product, the RS416 can be equipped with several different types of fiber optic ports. The Transmit (TX) and Receive (RX) connections of each port must be properly connected and matched for proper link and operation. Modules populated on the top row of the device typically have locking mechanisms or tabs towards the top of the unit. Modules located on the bottom row of the device have locking mechanisms or tabs towards the bottom of the device.

The drawings in the following figures show each fiber optical connector style with a side and top view to allow the user to identify the proper cable connection orientation. If modules are populated on the bottom row of the device, the transceiver orientation will be reversed (i.e. RX and TX will be reversed).

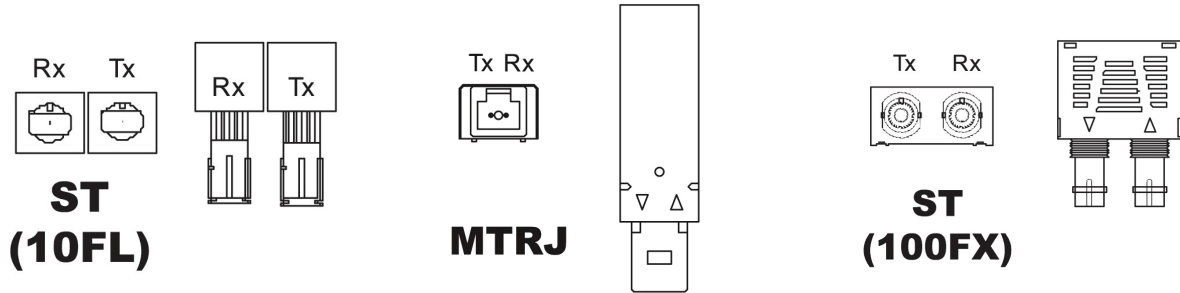


Figure 20: 10FL ST connector

Figure 21: 100FX MTRJ connector

Figure 22: 100FX ST connector

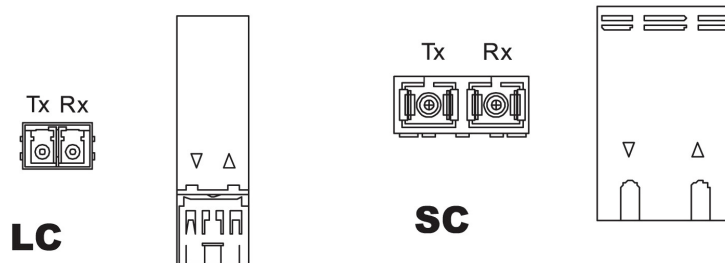


Figure 23: 100FX LC connector

Figure 24: 100FX SC connector

4.7.3 Ethernet Panel Description

Each Ethernet module is equipped with two LEDs that indicate link/activity status information. The LED will be solid for ports with link, and will blink for activity. The diagram in Figure 25 highlights the port and the associated link/activity LED.

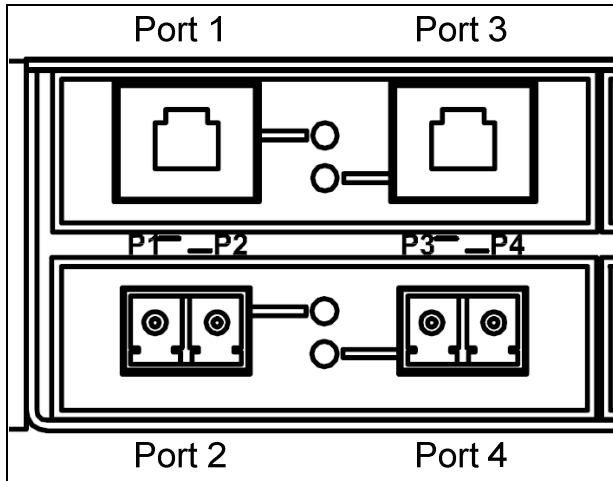


Figure 25: Ethernet panel LED description

5 Technical Specifications

5.1 Power Supply Specifications

Power Supply Type	Input Range		Fuse Rating	Max. Power Consumption ³
	Min	Max		
12 – 24 VDC	10 VDC	36 VDC	6.3A(F) ²	15 W
24 VDC	18 VDC	36 VDC	5A(F) ²	
48 VDC	36 VDC	59 VDC	2A(T) ²	
HI (125/250 VDC) ¹ HI (110/230 VAC) ¹	88 VDC 85 VAC	300 VDC 265 VAC	2A(T) ^{1,2}	

Table 7: Power Supply Specifications

NOTES:

1. This is the same power supply for both AC and DC.
2. (F) Denotes fast-acting fuse, (T) denotes time-delay fuse
3. Power consumption varies based on configuration. 10/100Tx ports consume roughly 1W less than fiber optic ports
4. For continued protection against risk of fire, replace only with same type and rating of fuse.

5.2 Failsafe Relay Contact Ratings

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

Table 8: Failsafe Relay Contact Ratings

5.3 Data Port Specifications

5.3.1 Serial Ports

5.3.1.1 Copper Ports

<i>Parameter</i>	<i>Specifications</i>	<i>Notes</i>
Baud Rate	300 bps – 230 kbps	
Connector	DB9 or RJ45	
Isolation	2.5 kV	RMS 1-minute

Table 9: Copper Port Specification

5.3.1.2 Fiber Optic Ports

<i>Parameter</i>	<i>Specifications</i>
Mode	Multimode
Connector	ST
Typical Dist. (km)	5
Optical Wavelength (nm)	820
Cable Size Core/Cladding (um)	50/125 62.5/125

Table 10: Fiber Optic Port Specification

NOTES:

1. Maximum segment length is greatly dependent on factors such as fiber quality, and number of patches and splices. Please consult RuggedCom sales associates when determining maximum segment distances.

5.3.2 Ethernet Ports

5.3.2.1 Copper Ports

<i>Parameter</i>	<i>Specification</i>	<i>Notes</i>
Speed	10/100 Mbps	Auto-negotiating
Duplex	FDX / HDX	Auto-negotiating
Cable-Type	> Category 5	Shielded/Unshielded
Wiring Standard	TIA/EIA T568A/B	Auto-Crossover, Auto-polarity
Max Distance	100 m	
Connector	RJ45	
Isolation	1.5 kV	RMS 1-minute

Table 11: Ethernet Ports - Copper Specifications

5.3.2.2 Fiber Optic Ports

The following sections detail fiber optic specifications on ports that can be ordered with the RS416. The user determines the type of optics at time of ordering and can determine the modules installed on a particular unit by reading the factory data file via the ROS™ user interface. The following section provides detailed specifications of fiber optic modules.

The dual-port fast Ethernet optical specifications for slots 5 and 6 are shown in Table 12 organized by module order code. Module order codes are contained within each product's factory data when assembled and configured at the factory. Consult ROS™ to determine the optical assemblies installed in a particular product.

<i>Optics Order Code</i>	<i>Mode / Connector</i>	<i>Tx λ (nm)</i>	<i>Cable Type² (μm)</i>	<i>Tx Pwr (dBm)³ (Min/Max)</i>	<i>Rx Sensitivity (dBm)³</i>	<i>Rx Saturation (dBm)³</i>	<i>Typical Distance (km)¹</i>	<i>Power Budget (dB)</i>
12-11-0011	MM / ST	850	50/125	-16.5/-10.6	-34	-11.2	2	21
12-11-0012	SM / ST	1310	9/125	-27 / -14	-35	-3	5	8
12-11-0007	MM / ST	1310	50/125	-15.7	-33.5	-11	2	17
12-11-0009	MM / SC							
12-11-0008	MM / MTRJ							
12-11-0046	MM / LC	1310	50/125	-19 / -14	-32	-14	2	15
12-11-0006	SM / ST	1310	9/125	-15/-8	-32	-7	20	16.5
12-11-0005	SM / SC							
12-11-0004	SM / LC							
12-11-0031	SM / SC	1310	9/125	-5 / 0	-35	-3	50	32.5
12-11-0032	SM / LC							
12-11-0033	SM / SC							
12-11-0034	SM / LC	1310	9/125	0 / 5	-37	0	90	39.5

Table 12: Ethernet Ports – Fiber Optic Specifications

NOTES:

1. Maximum segment length is greatly dependent on factors such as fiber quality, and number of patches and splices. Please consult RuggedCom sales associates when determining maximum segment distances.
2. All optical power numbers are listed as dBm averages.
3. All cabling is duplex type unless otherwise specified.
4. These transceivers utilize a distributed feedback (DFB) type laser and are rated for -20°C to +85°C operation only.

5.4 Type Test Specifications

Electrical Safety	Levels	Comments
Dielectric Withstand	2 kV rms for 1 minute	ANSI/IEEE C37.90 (1989) IEC 60255-5 (Section 6)
High Voltage Impulse	5 kV peak	IEC 60255-5 (Section 8)
Insulation Resistance	500 VDC for 1 minute	IEC 60255-5 (Section 6)

Table 13: Type Test Specification - Electrical Safety

Electrical Environment	Levels	Comments
High Frequency Disturbance (Oscillatory)	2.5 kV @ 1MHz for 2s	ANSI/IEEE C37.90.1 IEC 60255-22-1
IEC Surge	4 kV / 2 kV	IEC 61000-4-5 (Level 4)
IEC Fast Transient	2 kV / 1 kV	IEC 61000-4-4 (Level 4)
ANSI/IEEE Fast Transient	4 kV	ANSI/IEEE C37.90.1
IEC Radiated RFI Immunity	10 V/m	IEC 61000-4-3
ANSI/IEEE Radiated RFI Immunity	35 V/m	ANSI/IEEE C37.90.2
ESD (Electrostatic Discharge)	15 kV (air discharge) 8 kV (contact)	IEC 61000-4-2 (Level 4)

Table 14: Type Test Specification - Electrical Environment

Atmospheric Environment	Levels	Comments
Temperature (Dry Cold)	-40°C	IEC 60068-2-1 Test Ad: 16 hrs @ -40°C
Temperature (Dry Heat)	85°C	IEC 60068-2-2 Test Bd: 16 hrs @ 85°C
Humidity	95% non-condensing	IEC 60068-2-30 Test Db: 6 cycles, 55°C, 95% Humidity

Table 15: Type Test Specification - Atmospheric Environment

5.5 Operating Environment

Parameter	Range	Comments
Ambient Operating Temperature	-40 to 85°C	Ambient Temperature as measured from a 30cm radius surrounding the center of the RS1600 enclosure.
Ambient Relative Humidity	5% to 95%	Non-condensing
Ambient Storage Temperature	-40 to 85°C	

Table 16: Operating Environment

5.6 Mechanical Specifications

Parameter	Value	Comments
Dimensions	18.29 x 10.17 x 1.74 inches (464,57) x (258,32) x (44,20) mm	(Length x Width x Height) with mounting brackets installed
Weight	10 lb (4.5 Kg)	
Enclosure	18 AWG galvanized steel	

Table 17: Mechanical Specifications

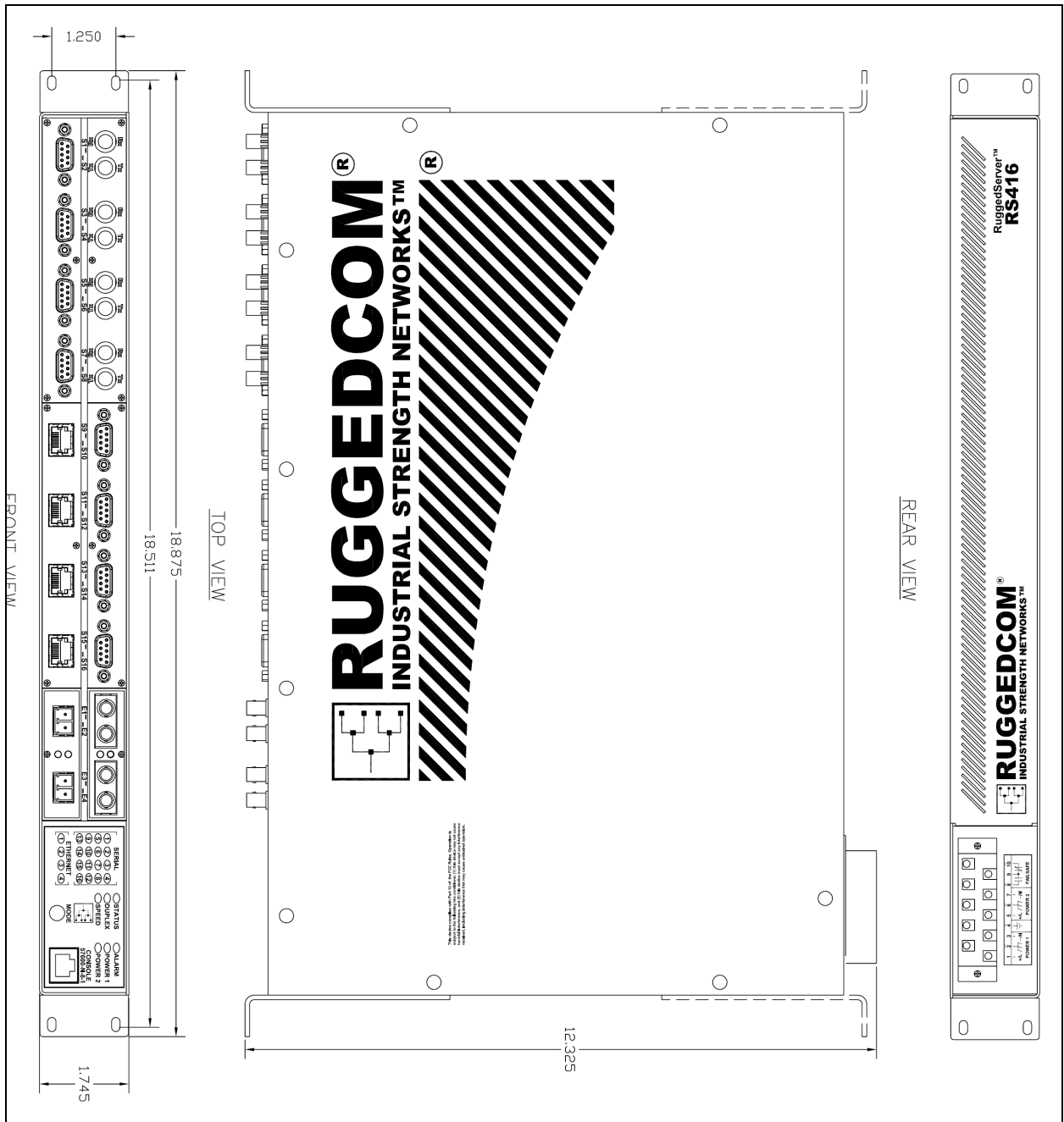


Figure 26: Mechanical Drawing

6 Agency Approvals

Agency	Standards	Comments
CSA	CSA C22.2 No. 60950, UL 60950	Approved
CE	EN 60950, EN 61000-6-2	Approved
FCC	FCC Part 15, Class A	Approved
CISPR	EN55022, Class A	Approved
FDA/CDRH	21 CFR Chapter 1, Subchapter J	Compliant
IEC/EN	EN60825-1:1994 + A11:1996 + A2:2001	Compliant

Table 18: Agency Approvals

7 Warranty

RuggedCom warrants this product for a period of five (5) years from date of purchase. For warranty details, visit <http://www.ruggedcom.com> or contact your customer service representative.

Should this product require warranty or service contact the factory at:

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Fax: (905) 856-1995