Serial Data Fiber Optic Converter

Transmit RS-232/422/485 serial data over fiber with maximum reliability

Introduction

The RLH Serial Data Fiber Optic Converter transmits RS-232/422/485 serial data over fiber optic cable. It transmits simultaneously to each serial port, providing the option to interface between one of three different serial data communication standards.

Designed for operation in harsh environments, this fiber converter allows for long distance communication while providing immunity to EM/RFI and transient surges along the fiber path. This rugged, industrial grade converter is ideal for applicants where reliability is critical, and is suitable for use in non temperature controlled environments.

A comprehensive set of LEDs on the front panel indicate power status and RS-232/422/485 activity. Features include redundant power inputs with a system alarm contact for remote monitoring, and it includes both a DIN rail clip and wall mount ears for ease of installation. This system is made in the U.S.A. and is covered by our Lifetime Warranty.

Serial Data Fiber Optic Converter shown with SFP Transceiver Installed

Features
Transparent RS-232/422/485 extension over fiber
Compatible with all MSA Compliant Gigabit SFPs
Supports RS-232 baud rates of 50 bps to 128 kbps
Supports RS-422/485 baud rates of 50 bps to 2.5 Mbps
Rotary Switch for RS-422/485 pull high/low resistor value
Compatible Protocols: DNP, Modbus, DF1, Profibus, BACnet MS/TP, asynchronus HDLC
Supports Fiber Ring Configuration
Hardened to operate in -40°F to +158°F (-40°C to +70°C)
DIN rail or wall mount (Wall mount ears included)
Redundant Power Inputs (12~48VDC)
Lifetime warranty
Made in USA

General Safety Practices

Intended Audience

This guide is intended for use by knowledgeable installation, operation and repair personnel. Every effort has been made to ensure the accuracy of the information in this guide. However, due to constant product improvement, specifications and information contained in this document are subject to change without notice.

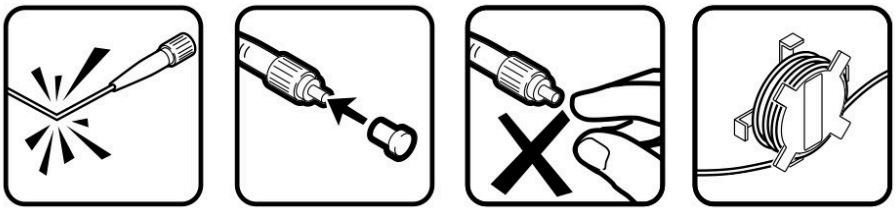
Conventions

Symbols for notes, attention, and caution are used throughout this manual to provide readers with additional information, advice when special attention is needed, and caution to prevent injury or equipment damage.

The equipment discussed in this document may require tools designed for the purpose being described. RLH recommends that service personnel be familiar with the correct handling and use of any installation equipment used, and follow all safety precautions including the use of protective personal equipment as required.

- Never install during a lightning storm or where unsafe high voltages are present.
- Active phone lines may carry high DC voltages. Use caution when handling copper wiring.
- Do not open the enclosure, there are no user serviceable parts.

Guidelines for handling terminated fiber cable



- Do not bend fiber cable sharply. Use gradual and smooth bends to avoid damaging glass fiber.
- Keep dust caps on fiber optic connectors at all times when disconnected.
- Do not remove dust caps from unused fiber.
- Keep fiber ends and fiber connectors clean and free from dust, dirt and debris. Contamination will cause signal loss.
- Do not touch fiber ends.
- Store excess fiber on fiber spools at site

Caution - Severe Shock Hazard

Laser Safety

Do not look directly into a fiber-optic transceiver or into the ends of fiber-optic cables. Fiber-optic transceivers and fiber-optic cable connected to a transceiver emit laser light that can cause eye damage.

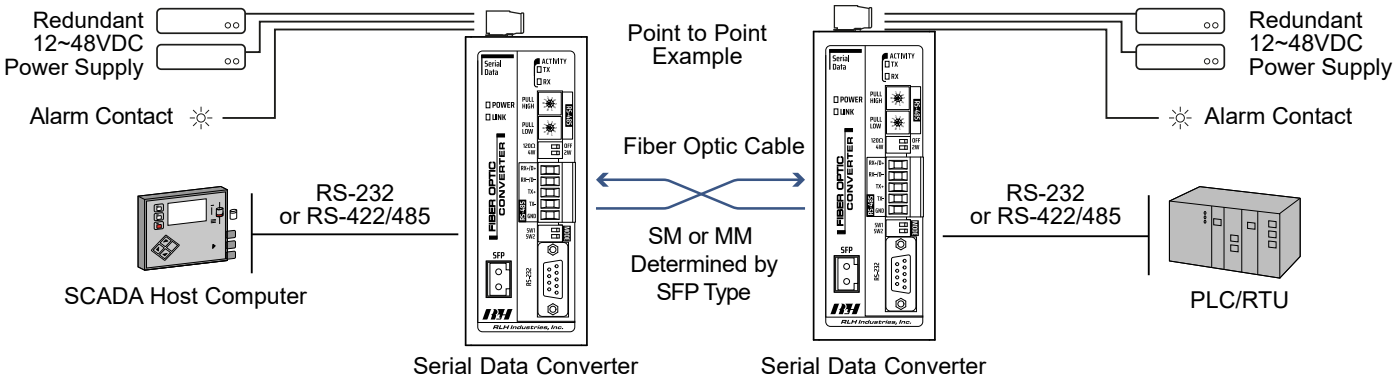
System Description

Overview

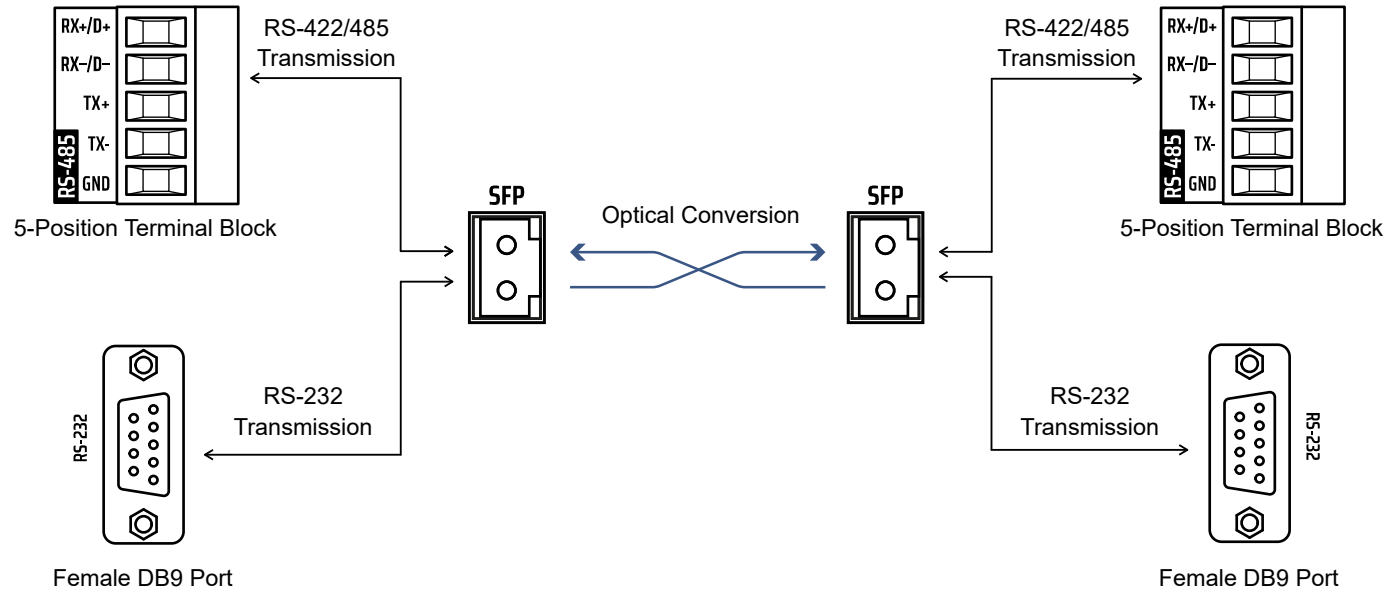
The RLH Serial Data Fiber Optic Converter is designed to transmit RS-232, RS-422, and RS-485 serial data signals over over a fiber optic cable assembly connected by Gigabit-rated Small Form-factor Pluggable (SFP) modules. This conversion through a fiber optic medium enables the transmission of serial data over long distances, improved signal integrity, noise immunity, and reduced electromagnetic interference (EMI). This system also supports transmission line termination resistance/biasing for RS-422/RS-485 applications, RS-485 2-Wire/4-Wire selection and conversion, cross-standard (RS-232/RS-422/RS-485) conversion, and a simplex Fiber Ring mode that forms half-duplex serial links across a ring topology.

Serial Data Conversion

Once two (2) RLH Serial Data Fiber Optic Converter units successfully establish a fiber link, users can transmit serial data between the connected devices (e.g., HMIs, PLCs, RTUs) at each end of the system through the media converters. This system maintains a single SFP port that is compatible with all Gigabit-rated MSA Compliant Multimode and Singlemode SFPs.



System Diagram

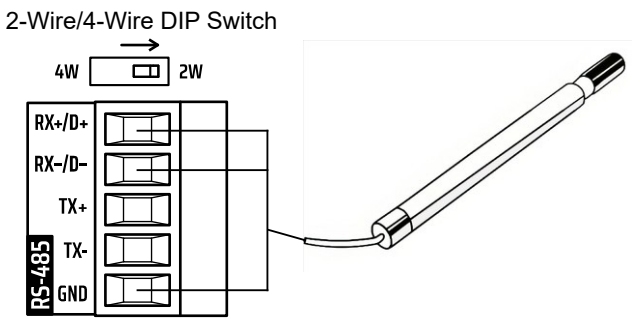


System Transmission Flow

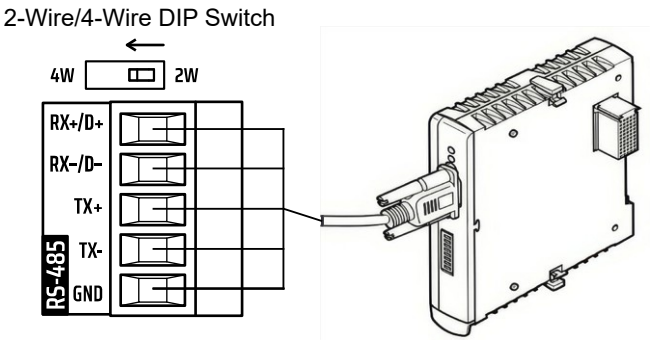
System Description

(RS-485) 2-Wire/4-Wire Selection

The RLH Serial Data Fiber Optic Converter is designed to transmit RS-232, RS-422, and RS-485 serial data signals over over a fiber optic cable assembly connected by Gigabit-rated Small Form-factor Pluggable (SFP) modules. This conversion through a fiber optic medium enables the transmission of serial data over long distances, improved signal integrity, noise immunity, and reduced electromagnetic interference (EMI). This system also supports transmission line termination resistance/biasing for RS-422/RS-485 applications, RS-485 2-Wire/4-Wire selection and conversion, cross-standard (RS-232/RS-422/RS-485) conversion, and a simplex Fiber Ring mode that forms half-duplex serial links across a ring topology.



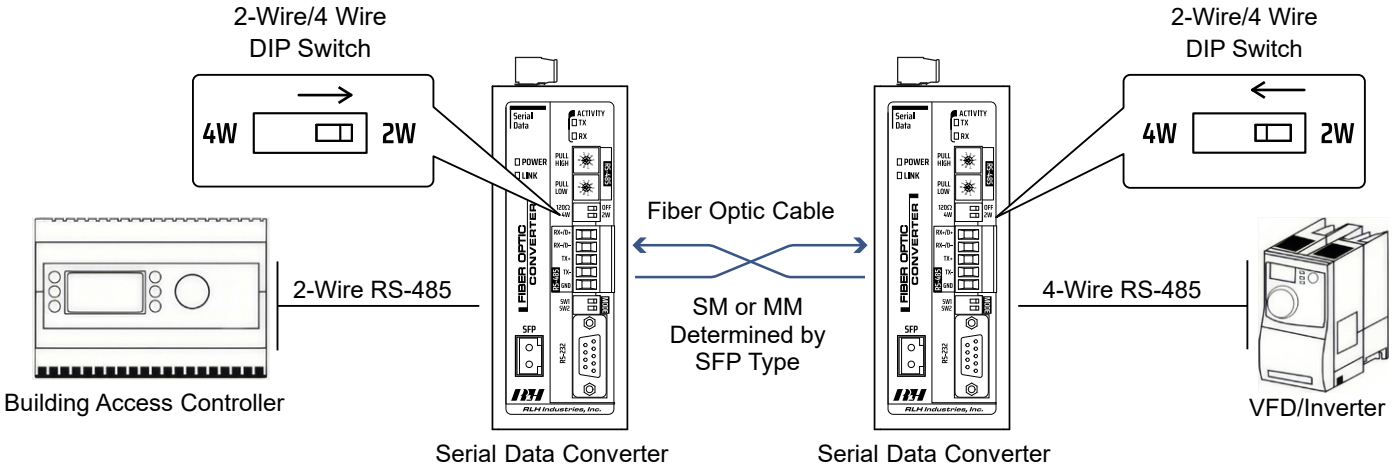
2-Wire RS-485 Application



2-Wire RS-485 Application

(RS-485) 2-Wire/4-Wire Conversion

The RLH Serial Data Fiber Optic Converter can also automatically convert RS-485 signals between 2-Wire and 4-Wire instruments, ensuring seamless communication across the fiber link despite any wiring configuration differences. This feature is particularly valuable in legacy systems where different generations of RS-485 equipment already coexist, or are expected to coexist as the network topology evolves. The conversion enforces a half-duplex communication format. Note that the DIP switch controlling the 2-Wire/4-Wire wiring configuration applies to the outgoing signal transmission. A media converter intended to transmit 2-Wire data should never set this DIP switch in the 4-Wire position.

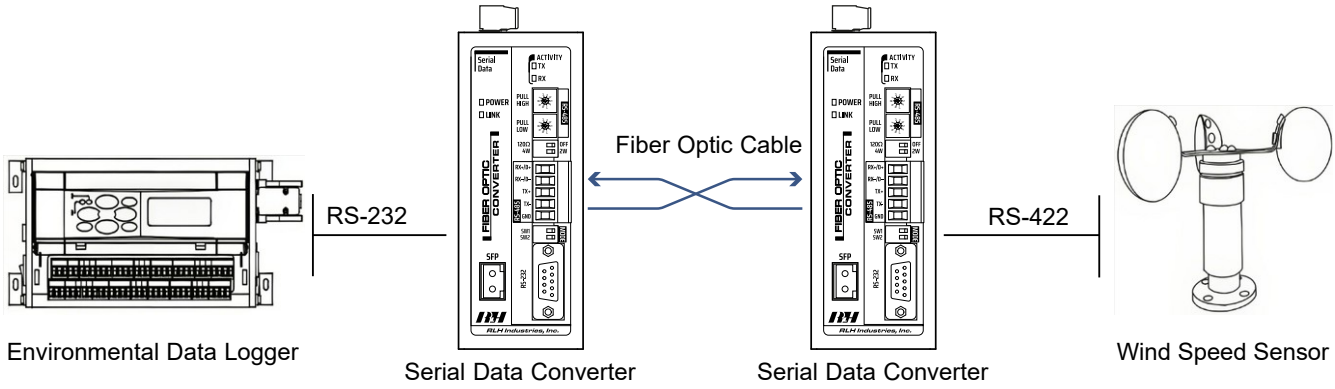


2-Wire/4-Wire Conversion

System Description

(RS-232/422/485) Cross-Standard Conversion

This system supports interoperability between the RS-232, RS-422, and RS-485 serial communication standards. Serial data transmissions received through the fiber link by the media converter are automatically converted to each respective standard: RS-232 via the 3-pin DB9 port, and RS-422 or RS-485 via the 5-position terminal block. The media converter determines the intended serial communication standard transmission format based on whether the DB9 port or terminal block is used, the users wiring configuration, and the RS-485 2-Wire/4-Wire DIP switch setting. Note: The 3-pin DB9 port and 5-position terminal block cannot transmit data simultaneously. Only one serial communication standard can be transmitted at any given time from a single media converter unit.

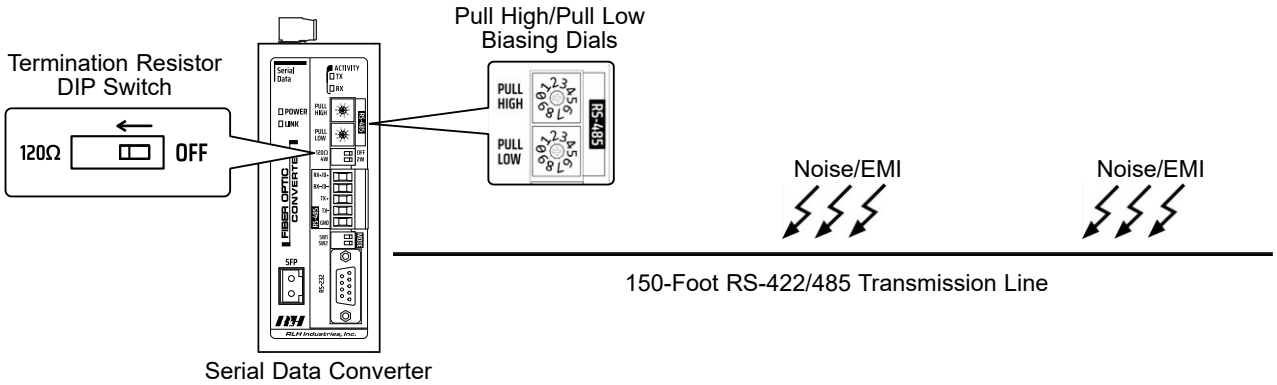


Cross-Standard Conversion Application

(RS-422/485) Termination Line Resistance/Biasing

The RLH Serial Data Fiber Optic Converter features a 120Ω termination resistor and biasing dials to encourage reliable communication across RS-422 and RS-485 systems. This 120Ω termination resistor is applied to the RS-422/485 terminal blocks differential signal lines, preventing signal reflections that can occur in networks with long transmission lines or daisy-chained devices. It is controlled via a DIP switch on the media converters front panel.

The biasing dials introduce a DC bias to each differential line, ensuring proper idle voltage levels on the transmission line when no data is being transmitted. This prevents inactive, undriven lines from being misinterpreted as data transmission logic states (high/low). Stabilizing the transmission lines idle voltage levels with the biasing dials is crucial for maintaining data transmission integrity, particularly in long-distance, noisy, and multi-device networks.



Termination Line Resistance/Biasing Application

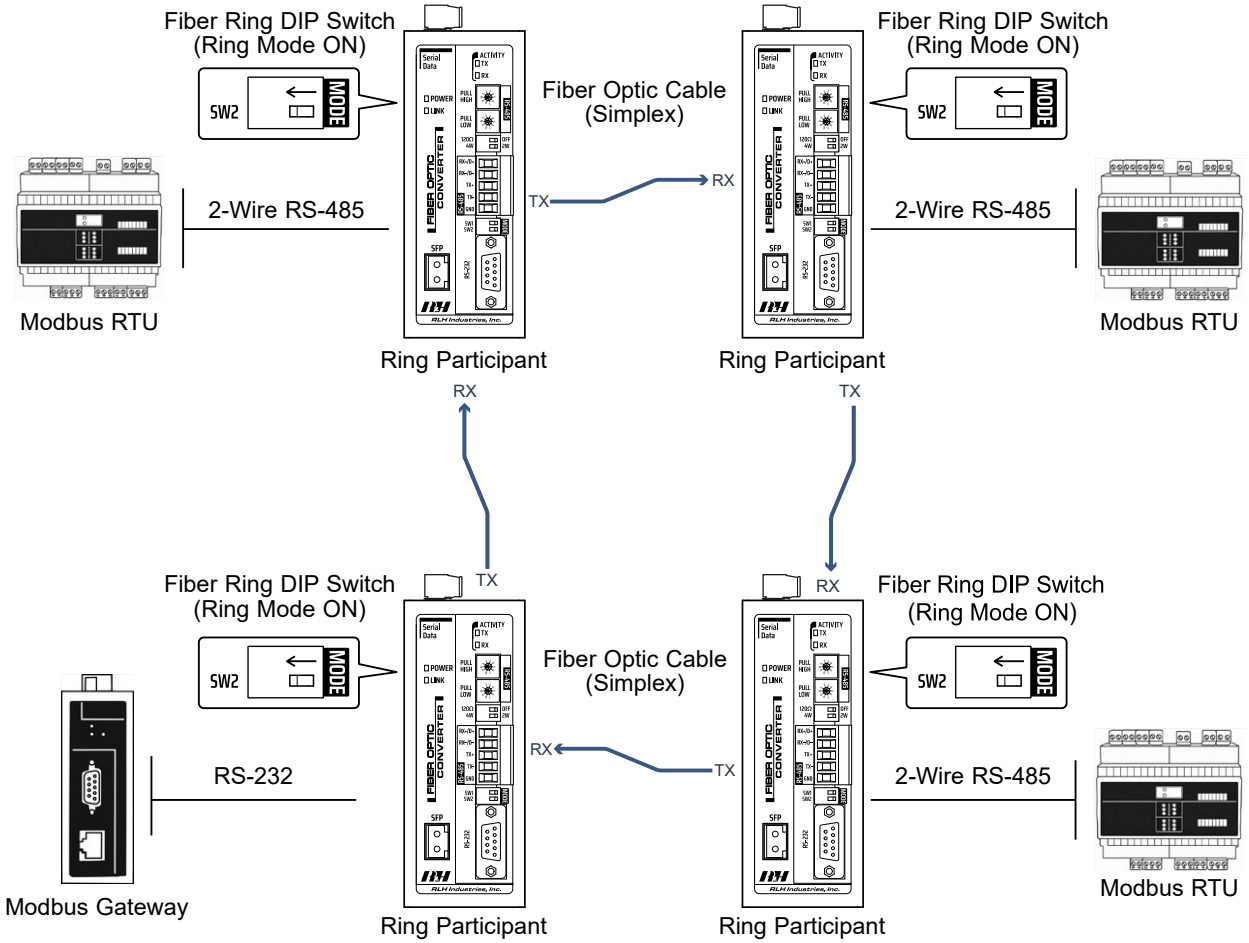
System Description

(RS-232/422/485) Fiber Ring Mode

The RLH Serial Data Fiber Optic Converters Fiber Ring Mode is a half-duplex networking arrangement in which multiple media converters are interconnected in a loop, or ring, of simplex fiber connections between adjacent media converters. The media converters contained within a Fiber Ring can transmit any combination of RS-232, RS-422, and/or RS-485 serial data.

In this topology, a media converters outgoing data transmission is relayed across the Fiber Ring to each subsequent remaining media converter. The Fiber Ring itself functions in a half-duplex data transmission format, with devices idly waiting for data reception prior to transmitting a response. To accommodate this half-duplex data transmission 'waiting time', each connected serial device must introduce an inter-frame delay that ensures a minimum gap of at least 16 bits. The duration of this delay, in seconds, depends on the baud rate of the serial device.

Incorporating a Fiber Ring media converter topology provides users with an easily scalable, modular form of incremental network growth. Fiber Rings ultimately simplify the installation and cost of serial data networks that include RLH Serial Data Fiber Optic Converters. Fiber Rings also simplify the troubleshooting of serial data transmission failures by isolating the individual fiber links in which serial data flow is interrupted.



Fiber Ring Mode Application

Installation

Prior to Installation

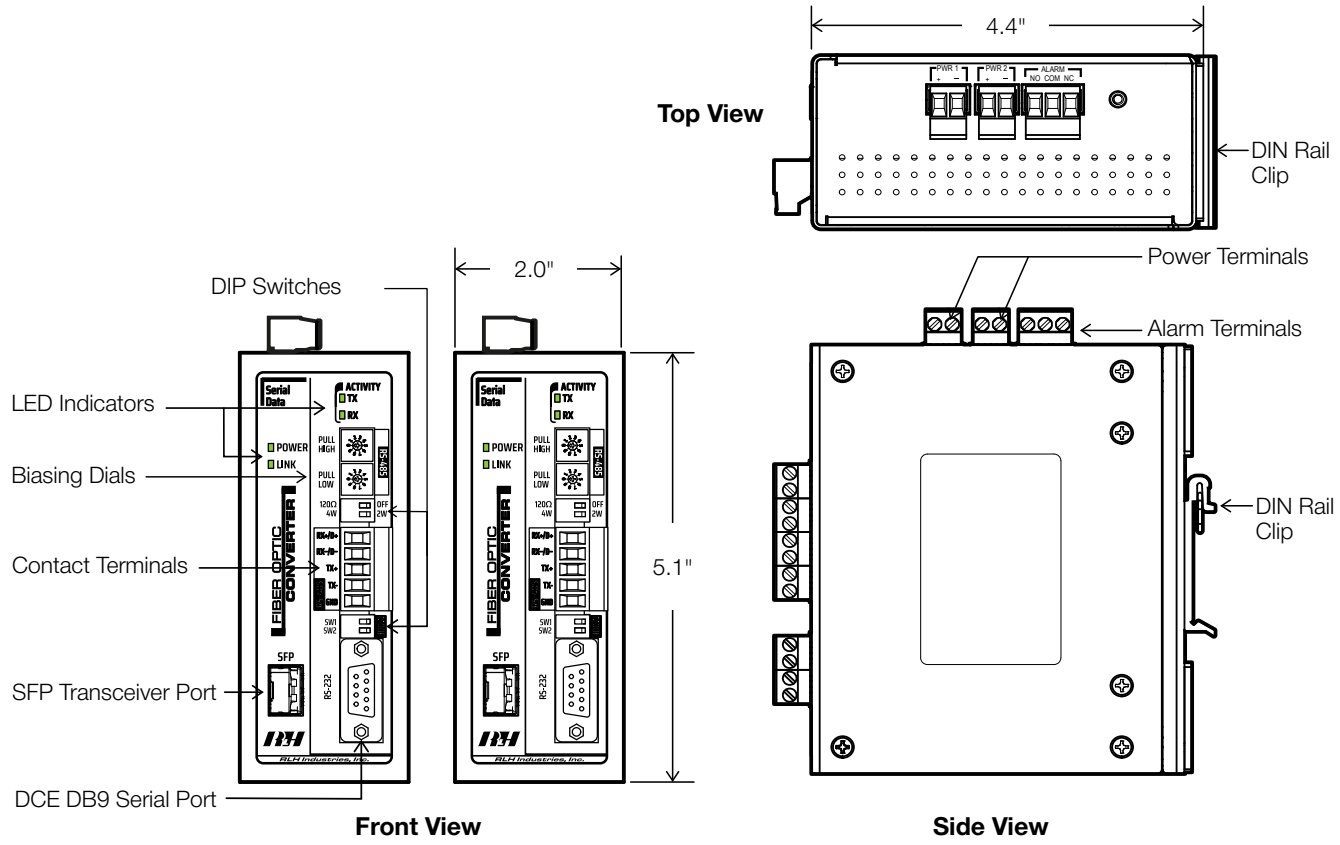
Check for shipping damage:

- Check the contents to ensure correct model and fiber type
- Have a clean, dry, installation environment ready

Required for installation

- 24-48 VDC Power Source
- T35 DIN rail or suitable wall mount location
- A weatherproof enclosure is required for outdoor use

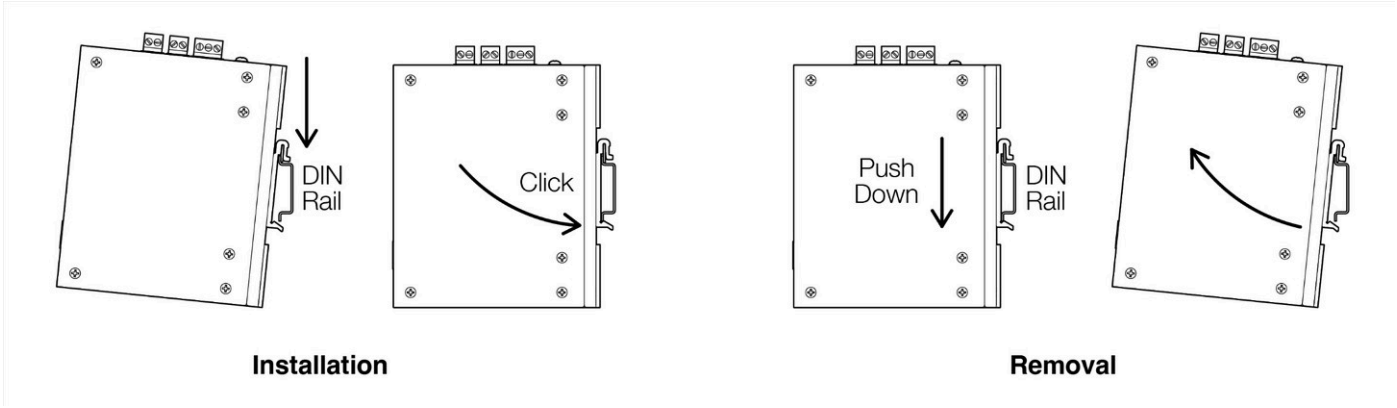
Dimensions



Installation

DIN Rail Mounting

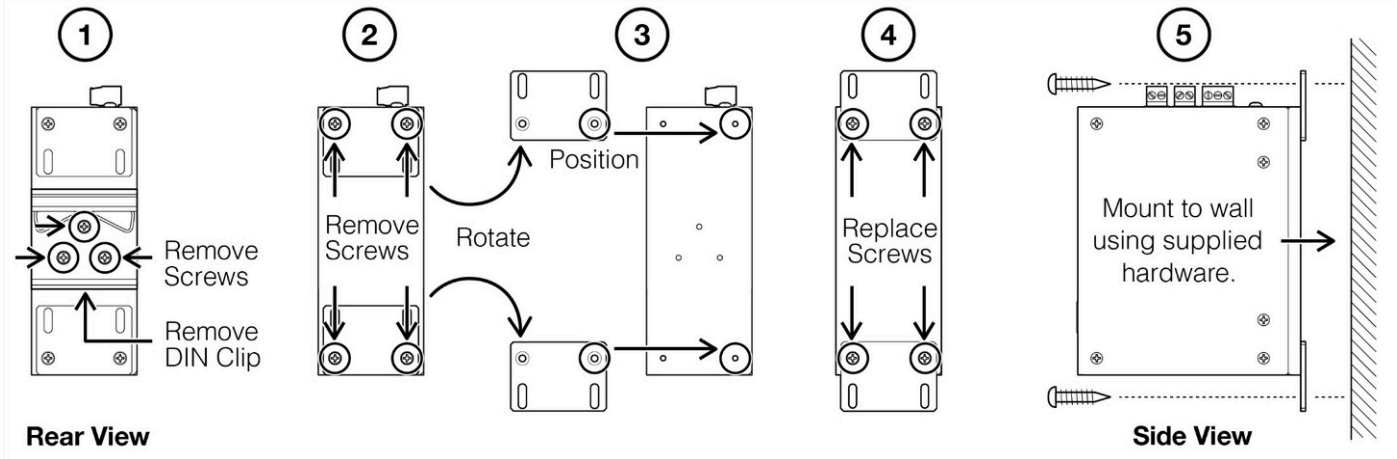
The DIN clip for mounting the system is mounted onto the rear panel. Hook the DIN clip on the top flange of the DIN rail, press down and rotate to the locked position to install. To remove, push down to depress the spring latch and rotate off of the DIN rail.



DIN Rail Mounting

Wall Mounting

The system can be easily wall mounted by attaching the provided wall mount ears and hardware. Attache the wall mount ears by following the instructions below.



Wall Mounting

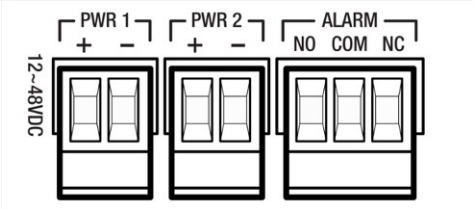
Installation

Connect Power Cable

Ensure power supply is OFF prior to wiring the system. Connect a 12-48VDC power supply to the screw down terminals located on the top of the unit.

- Requires one (1) 12-48VDC power supply. Use a second power source for redundant power.
- The terminal blocks are removable and accept wire sizes 16~26 AWG.
- Fully seat the terminal blocks back into the connector before operating the system.

Note: The power inputs are polarity insensitive. Be sure to convert the appropriate power source is being used before wiring.

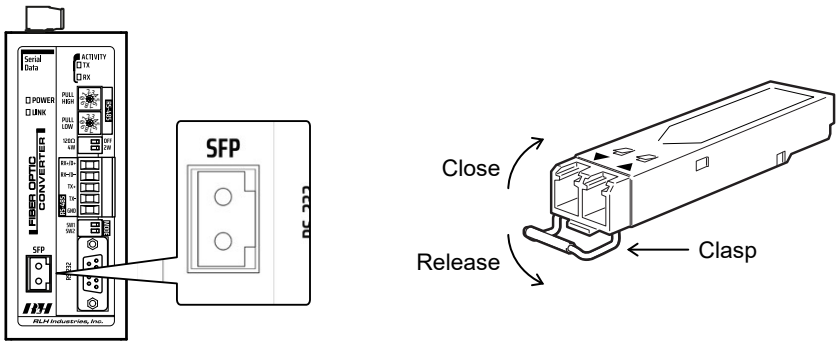


Power and Alarm Terminals

Install SFP Transceiver

This system requires MSA compliant, Gigabit fiber optic SFP transceivers. An Industrial grade SFP is recommended to enable reliable operation throughout the entire operational range. SFP transceivers are sold separately.

- Dual fiber systems require identical SFP transceivers.
- Single fiber systems require a matching pair, side A and side B.
- Close clasp and slide the SFP transceiver into the port.
- To remove, pull the clasp back to release it, and then slide it out



SFP Transceiver

Connect Fiber Optic Cable

The optical ports are for use with SFP transceivers only. Remove the dust caps from the SFP transceiver and fiber connectors. Plug the cable(s) securely into the SFP.

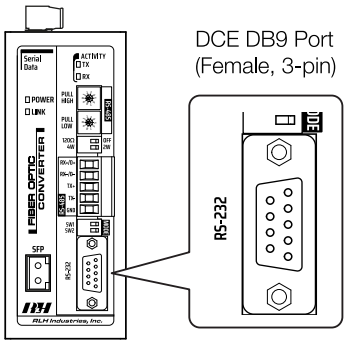
- Dual fiber systems require the TX fiber port to be connected to the RX fiber port on the other end.
- Once the system is properly connected and power is applied, the LINK LED should turn ON.

Installation

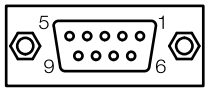
Connect Serial Ports

The RLH Serial Data Fiber Optic Converter can transport 3 pins of RS-232 through an integrated 3-pin DB9 female connector head interface on the bottom of the housing s front panel. Please refer to the below pinouts to ensure that the appropriate connections are being made.

This 3-pin DB9 port is configured as a DCE (Data Communications Equipment) interface and requires a straight-through cable to connect to serial devices that are designed with a DTE (Data Terminal Equipment) interface. Conversely, use a crossover cable when connecting serial devices with a DCE-configured RS-232 interface.



DB-9 Port Pinouts		
Pin	Name	Function
2	RXD	Receive Data
3	TXD	Transmit Data
5	GND	Ground Signal



DB9 Port Pinout

DB9 Serial Cables

Straight-Through

A straight-through cable connects devices with different interface types, such as from the DTE interface of a PC to the DCE interface of a modem. In this configuration, the transmit (TXD) and receive (RXD) lines are directly connected. The below chart outlines the straight-through signal direction between DTE and DCE devices, when considering the 3-pin DB9 interface used by the RLH Serial Data Fiber Optic Converter.

DTE Device			Straight Through Cable	DCE Device		
Function	Name	Pin	Signal Direction	Pin	Name	Function
Receive Data	RXD	2	←	2	RXD	Receive Data
Transmit Data	TXD	3	→	3	TXD	Transmit Data
Ground Signal	GND	5	—	5	GND	Ground Signal

Null Modem/Crossover

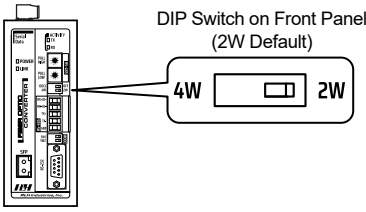
A null modem or crossover cable connects devices with the same interface types, such as from the DTE interface of a PC to the DTE interface of another PC. In this configuration, the transmit (TXD) and receive (RXD) lines are crossed to align the signal paths correctly between the two devices. The below chart outlines the crossover signal direction between DTE and DTE devices, when considering the 3-pin DB9 interface used by the RLH Serial Data Fiber Optic Converter.

DTE Device			Straight Through Cable	DCE Device		
Function	Name	Pin	Signal Direction	Pin	Name	Function
Receive Data	RXD	2	⤫	2	RXD	Receive Data
Transmit Data	TXD	3	⤫	3	TXD	Transmit Data
Ground Signal	GND	5	—	5	GND	Ground Signal

Configuration

(RS-485) 2-Wire/4-Wire Selection Switch

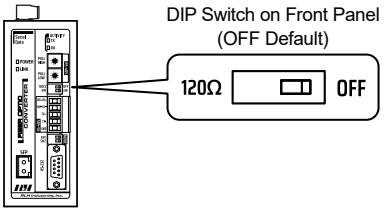
This DIP switch modifies the RS-422/485 communication buss outgoing data transmission format. When the media converters connected serial device transmits using RS-422 or 4-Wire RS-485, configure this DIP switch in the left position. For 2-Wire RS-485 serial devices, keep the DIP switch in its default rightmost position.



2-Wire/4-Wire Selection Switch	
Setting	Switch Position
2W	→
4W	←

(RS-422/485) 120Ω Termination Resistor Switch

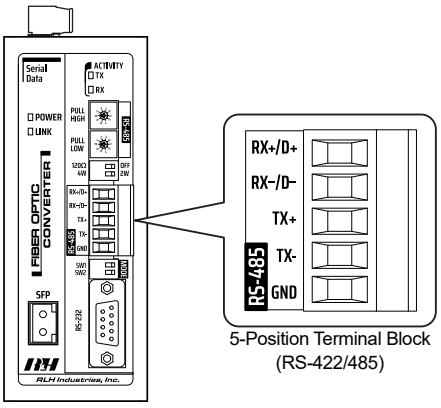
Termination resistors are used on RS-422 and RS-485 networks to match the impedance of a serial devices receiving circuit to the networks transmission line, reducing signal reflections. On this media converter, the termination resistor (typically 120Ω for RS-422/485 networks) can be enabled by moving this DIP switch to the left position. By default, the switch is in the OFF position as termination resistors are not always necessary to implement. If this termination resistor is used, the Pull High/Low biasing dials' rotary switch should both be set to the 0 position



2-Wire/4-Wire Selection Switch	
Setting	Switch Position
OFF	→
120Ω	←

(RS-422/485) Terminal Bloc Configuration

The RS-422/485 communication bus operates through the application of a 5-position screw-down terminal block. The tables below map each terminal to its corresponding function, based on the serial communication standard used by the connected serial device:



RS-485 (2 Wire)	
Terminal	Function
TX+ (DATA+)	Transmit +
TX- (DATA-)	Transmit -
GND	Signal Ground

RS-485/422 (4 Wire)	
Terminal	Function
RX+/D+	Receive+
RX-/D-	Receive-
TX+ (DATA+)	Transmit +
TX- (DATA-)	Transmit-
GND	Signal Ground

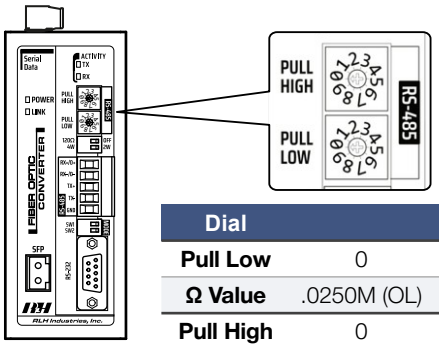
Configuration

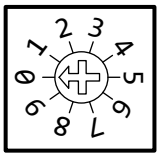
(RS-485/422) Biasing Dials - Pull High and Pull Low

The RLH Serial Data Fiber Optic Converter includes two biasing dials to configure the pull-high and pull-low resistors on the RS-422/485 terminals data transmission lines. These resistors ensure a stable voltage differential between the data transmission lines when the media converter is idle, preventing the communication errors caused by floating voltages (undefined or fluctuating voltage levels).

The biasing dials should be used when there is a risk of floating voltage on the data transmission lines, such as in noisy environments, networks with many devices, or when long cable runs are used. A properly configured RS-422/485 network maintains a minimum differential voltage of 200mV between the data transmission lines, which is essential for correctly interpreting the communication standards data logic states (0/1).

Each biasing dial adjusts the resistance applied to either the pull-high resistor for the positive voltage line, or the pull-low resistor for the negative voltage line. The dials feature ten distinct positions, with each corresponding to a specific resistance value in Ohms. The numerical positions of the Pull High and Pull Low dials should be the same.



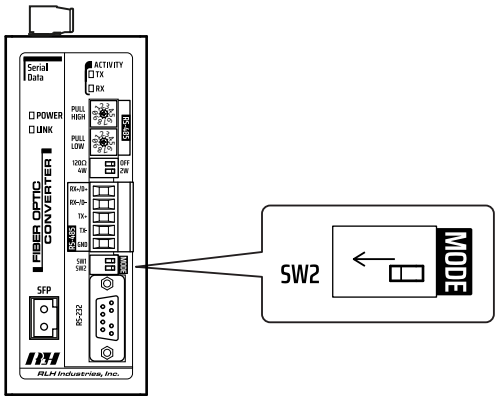


Biasing Dial

Dial	Settings									
Pull Low	0	1	2	3	4	5	6	7	8	9
Ω Value	.0250M (OL)	9.67K	4.9K	3.29K	0.993K	0.903K	0.828K	0.769K	0.496K	0.473K
Pull High	0	1	2	3	4	5	6	7	8	9
Ω Value	0.256M (OL)	.10.56K	5.83K	4.22K	1.949K	1.861K	1.786K	1.723K	1.458K	1.435K

(RS-232/422/485) Fiber Ring Mode Switch

This DIP switch controls whether the media converter participates in a Fiber Ring, allowing it to pass data to other Fiber Ring participants across the Ring. By default, the media converter is not a Fiber Ring participant.



Fiber Ring Mode Selection Switch	
Setting	Switch Position
SW2 (OFF)	→
SW2 (ON)	←

System Specifications

RS-232 Specifications

DB-9 Port (Female)	PIN 2 - RXD, PIN 3 - TXD, PIN 5 - GND

RS-485/422 Specifications

4 Wire Mode	TX-, TX+, RX-, RX+, Ground		
2 Wire Mode	TX+ (Data+), TX- (Data-), Ground		
DIP Switches	120Ω/OFF	120-Ohm Termination Resistor	(Default Position is OFF)
	4W/2W	2-Wire/4-Wire RS-485 configuration	(Default Position is 2W)
	SW1	Reserved	(Default Position is OFF)
	SW2	Fiber Ring Mode	(Default Position is OFF)
RS-422/485 Biasing	Pull High/Low Rotary Switches	9.67 kilo-ohm, 4.9 kilo-ohm, 3.29 kilo-ohm, 993 ohm, 903 ohm, 828 ohm, 769 ohm, 496 ohm, 473 ohm (default), 240 ohm	

General Specifications

Fiber Port	1 Gigabit SFP Slot, Accepts MSA compliant 1.25Gbps SFPs (Sold separately)	
LED	Power, Fiber Link, Serial Data Activity (232/485)	
Power	Standard model	12~48VDC (11~53V)
	-A powering option	125VDC (42~160V)
	Dual redundant power options - Polarity insensitive	
Power Consumption	8 Watts Maximum	
DC Input Isolation	1.5KV	
Overcurrent Protection	1.0A Automatic Recovery	
System Status Alarm	Normally Open / Closed Relay (SPDT)	
Temperature	Storage	-40°C to +85°C (-40°F to +185°F)
	Operating	-40°C to +70°C (-40°F to +158°F)
Dimensions	H 5.2" x W 2.2" x D 4", (131mm x 56mm x 102mm) - not including DIN clip	
Weight	1.6 lbs. (0.73kg)	
Mounting	Standard T-35 DIN rail clip and wall mount ears (Included)	
Humidity	95% non-condensing	
Safety	FCC Class B, CE, RoHS, UL Listed, CB Scheme	
Warranty	Lifetime - Visit www.fiberopticlink.com for warranty information and coverage details	

Ordering Information

Description	Part Number
Serial Data Fiber Optic Converter, RS-232/422/485, 1 SFP Slot, Powered by 12-48VDC	**FBX-SERIAL-1**

- Add **-A** to the end of the part number for 125VDC powering option.
- A complete system requires two (2) units.

RLH Certified Transceivers

Description	Mode	Conn.	Distance	Fibers	Wavelength	Part Number
Multimode, LC, 550m/1804 feet, Dual Fiber, 850nm	MM	LC	550m/1804 feet	Dual Fiber	850nm	**SFP-1G-03-2**
Multimode, LC, 2km/1.2 miles, Dual Fiber, 1310nm	MM	LC	2km/1.2 miles	Dual Fiber	1310nm	**SFP-1G-04-2**
Singlemode, LC, 20km/12.4 miles, Dual Fiber, 1310nm	SM	LC	20km/12.4 miles	Dual Fiber	1310nm	**SFP-1G-30-2**
Singlemode, LC, 60km/37 miles, Dual Fiber, 1550nm	SM	LC	60km/37 miles	Dual Fiber	1550nm	**SFP-1G-31-2**
Singlemode, LC, 120km/74 miles, Dual Fiber, 1550nm, with Digital Diagnostic Monitoring	SM	LC	120km/74 miles	Dual Fiber	1550nm	**SFPD-1G-34-2**
Singlemode, LC, 20km/12.4 miles, Single Fiber – Side A, Tx1310/Rx1550	SM	LC	20km/12.4 miles	Single Fiber Side A	T-1310/ R-1550	**SFP-1G-20-2**
Singlemode, LC, 20km/12.4 miles, Single Fiber – Side B, Rx1310/Tx1550	SM	LC	20km/12.4 miles	Single Fiber Side B	T-1310/ R-1550	**SFP-1G-21-2**
Singlemode, LC, 60km/37 miles, Single Fiber – Side A, Tx1310/Rx1550, with Digital Diagnostic Monitoring	SM	LC	60km/37 miles	Single Fiber Side A	T-1310/ R-1550	**SFPD-1G-24-2**
Singlemode, LC, 60km/37 miles, Single Fiber – Side B, Rx1310/Tx1550, with Digital Diagnostic Monitoring	SM	LC	60km/37 miles	Single Fiber Side B	T-1310/ R-1550	**SFPD-1G-25-2**

- Single fiber (bi-directional) SFP transceivers must always be paired, side A and side B

DB-9 Serial Cables

Description	Side 1	Side 2	Part Number
Straight Through 6' RS-232 Male to Male Cable	DB-9 Male	DB-9 Male	**DB9-S-MM-06FT**
Straight Through 6' RS-232 Male to Female Cable	DB-9 Male	DB-9 Female	**DB9-S-MF-06FT**
Straight Through 6' RS-232 Female to Female Cable	DB-9 Female	DB-9 Female	**DB9-S-FF-06FT**
Null/Crossover 6' RS-232 Male to Female Cable	DB-9 Male	DB-9 Female	**DB9-X-MF-06FT**
Null/Crossover 6' RS-232 Female to Female Cable	DB-9 Female	DB-9 Female	**DB9-X-FF-06FT**
DB-9 Female to Male Gender Converter	DB-9 Male	DB-9 Male	**DB9-GENDER-MM**

Contact

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