



## **STF-501C series**

### **Industrial Serial-to-Fiber Converter**



## **User's Manual**

Version 1.1



## **LEGAL**

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## **CE NOTICE**

Marking by the symbol CE indicates compliance of this equipment to the EMC directive of the European Community. Such marking is indicative that this equipment meets or exceeds the following technical standards: EN55022 Class A, EN61000-4-2 ESD Level 3, EN61000-4-3 RS Level 3, EN61000-4-4 EFT Level 3, EN61000-4-5 Surge Level 3, EN61000-4-6 CS Level 3.

***Industrial Serial-to-Fiber Converter***

Industrial Grade RS-485 / RS-422 / RS-232 Fiber Media Converter

User Manual

Version 1.1 Sep 13, 2013

This manual supports the following models:

STF-501C series

This document is the current official release manual. Please check our website for any updated manual or contact us by E-mail.

<b>CHAPTER 1. INTRODUCTION .....</b>	<b>7</b>
1.1 WELCOME .....	7
1.2 PRODUCT DESCRIPTION .....	7
1.2.1 Features .....	7
1.2.2 Specifications .....	7
1.2.3 Block Diagram .....	8
1.2.4 Theory of Operation .....	9
1.2.5 Applications .....	9
1.2.6 RS-485 4 wire vs. 2 wire .....	9
1.2.7 RS-485 Termination .....	9
1.2.8 RS-485 Pull High, Pull Low .....	10
<b>CHAPTER 2. INSTALLATION.....</b>	<b>11</b>
2.1 DIN RAIL MOUNTING .....	11
2.1.1 Bracket Mounting.....	11
2.1.2 Rail Mounting .....	11
2.1.3 Rail Dismounting .....	12
2.2 WALL MOUNTING .....	12
2.3 ELECTRICAL INSTALLATION.....	13
2.3.1 DC Power.....	13
2.3.2 Alarm Contact.....	13
2.4 RS-485/422 CONNECTIONS .....	14
2.5 RS-232 CONNECTIONS .....	14
2.6 FIBER CONNECTION .....	14
<b>CHAPTER 3. CONFIGURATION AND OPERATION.....</b>	<b>ERROR! BOOKMARK NOT DEFINED.</b>
3.1 CONFIGURATION .....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
3.1.1 DIP Switch .....	<i>Error! Bookmark not defined.</i>
3.1.2 Pull High/Low .....	<i>Error! Bookmark not defined.</i>
3.1.3 LED Definitions .....	<i>Error! Bookmark not defined.</i>
3.2 OPERATION .....	<b>ERROR! BOOKMARK NOT DEFINED.</b>
3.2.1 Two Unit Point-to-Point.....	<i>Error! Bookmark not defined.</i>
3.2.2 One-way Daisy Chain .....	<i>Error! Bookmark not defined.</i>
3.2.3 Three or more units Ring Topology .....	<i>Error! Bookmark not defined.</i>

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## Chapter 1. Introduction

### 1.1 Welcome

Thank you for purchasing our STF-501C series fiber port serial media converter. This media converter is an "industrial strength" product that employs rugged mechanical materials and construction, component selection for wide temperature, highly reliable and long life operation and an electrical design that prevents internal damage or data disruption from surges, power spikes or other electromagnetic interference.

### 1.2 Product Description

The STF-501C series is an industrial grade fiber media converter that provides a fiber connection to extend asynchronous RS-232, RS-485 or RS-422 serial transmissions over a distance of up to 2km using multimode fiber or up to 60km using single mode fiber. The duplex fiber provides pint-to-point connections. Single fiber simplex connections allow connecting multiple devices in a cascaded or "daisy chain" fashion with single fiber ring architecture. However, no redundancy is provided and any break can disable the entire ring. The converter is capable of selecting interface modes for connection to RS-232 (3 wire), RS-485 (2 wire, half duplex) or RS-422/485 (4 wire, full duplex). The STF-501C series secures asynchronous serial data transmissions over EMI resistant fiber at speeds up to 1024kbps. STF-501C series media converters feature an alarm relay contact and two redundant DC power inputs. The STF-501C series reliable industrial design is perfect for keeping your industrial automation applications running smoothly and continuously. STF-501C series media converters are available in two operating temperature ranges, a standard 0° to 60°C commercial temperature range or an extended -40° to 75°C range in -T models.

#### 1.2.1 Features

- Extends serial transmissions up to 2km, 30km or 60km
- Supports fiber daisy chain or ring connections (half-duplex)
- Redundant dual power inputs 12/24/48VDC
- Supports RS-422, RS-485(2/4 wire), and RS-232 transmission to dual fiber connections.
- Enhanced serial baud rate up to 1024kpbs (RS-422/485) or 230.4kbps (RS-232)
- 2.5KV isolation for serial signals
- Supports relay output for power or fiber link failure warning
- Hardened housing with IP30 protection
- Fan-less and DIN-Rail design for harsh industrial environments
- Adjustable pull high/low resistor and terminator for RS-422/485 transmission

#### 1.2.2 Specifications

##### Optical Interface

Connector :	SC or ST
Fiber Optical data rate :	50.000Mbps
Fiber Optical line coding :	4B5B + NRZI
Fiber Port :	One duplex fiber port
Fiber Type :	MM 2km or SM 30km/60km (duplex fiber)
Wavelength :	MM 1310nm, SM 1310, 1550nm
Point to Point Transmission :	Half or Full duplex
Ring Transmission :	Simplex, Half duplex

##### Electrical Interface

Serial Connectors :	RS-422/RS-485(5 pin terminal) RS-232(DB9 Female) RS-485 : 4, 2 wires, RS-422 : 4 wires
RS-485 direction :	Automatic detection
Copper Baud rate :	50 to 1024Kbps(RS-422/485), 230.4Kbps(RS-232-CH1), 115.2Kbps(RS-232-CH2)
Serial Isolation :	2.5KV for serial signals
Surge Protection :	8KV ESD for serial signals
Pull High/ Pull Low :	selected by 10 position rotary switches
120 ohm terminator :	Option by Dip switch

**Alarm Contact**

One relay output with current carrying capacity of 0.5A @ 125VAC or 1A @ 30 VDC (resistive)

**Power**

Power Input : 12, 24, 48 VDC (9.6 ~ 58VDC absolute)  
 Power Consumption : 5W  
 Power Reversal Protection : Yes  
 Over Current Protection : Signal Short Together Protected  
 Terminal Block for Power and Alarm : Yes

**Physical Characteristics**

Metal Housing  
 Water & Dust : IP30 Protection Rating  
 Dimensions : 106 x 39 x 142mm (D x W x H)  
 Net Weight : 720g  
 Mounting : DIN-Rail mounting, Wall Mounting (kits included)

**Environmental Limits**

Operating Temperature:  
 Standard Temperature Model: 0°C ~ 60°C (32 to 140°F)  
 Wide Temperature Model: -40°C ~ 75°C (-40 to 167°F)  
 Storage Temperature: -40 to 85°C (-40 to 185°F)  
 Relative Humidity: 5 ~ 95%

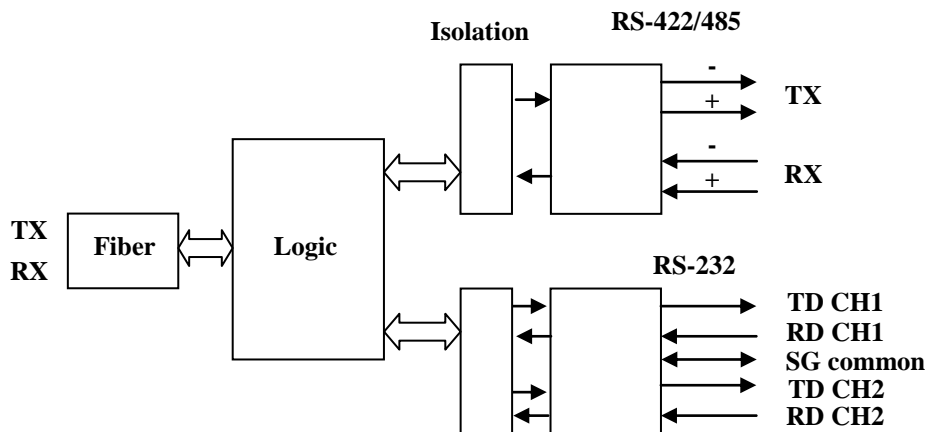
**Certifications**

Safety : UL508 (Pending)  
 EMC : CE, FCC  
 EMI : EN55022 Class A  
 EMS: EN61000-4-2 ESD Level 3  
 EN61000-4-3 RS Level 3  
 EN61000-4-4 EFT Level 3  
 EN61000-4-5 Surge Level 3  
 EN61000-4-6 CS Level 3  
 Free Fall : IEC 60068-2-32  
 Vibration : IEC 60068-2-6  
 Shock : IEC 60068-2-27  
 Green : RoHS  
 MTBF : 797,101 Hrs

**1.2.3 Block Diagram**

The STF-501C series has a configurable 2-wire / 4-wire RS-485/422 interface and two RS-232 3-wire interfaces. The two RS-232 interfaces share a common ground but are isolated from power ground and from the RS-485/422 interface by 2.5KV isolation. The RS-485/422 interface is also isolated from power ground and from the RS-232 signals by 2.5KV isolation.

An interface converter, with isolation, is created between the RS-422/485 and Channel 1 RS-232. The second RS-232 channel is independent and can carry data separately from the first channel.



Basic block diagram of STF-501C series (for reference only)



### **1.2.4 Theory of Operation**

The STF-501C series uses control logic to connect an RS-485/422 interface, two RS-232 3-wire interfaces to a single bi-directional optical fiber channel. STF-501C series units are interconnected by the fiber port in point-to-point applications. A simplex fiber can form a ring topology, but without protection. It uses Master/Slave hierarchy where only one master unit exists and all other units are slave in the application. In an 'idle' condition, all interfaces are in a listening state. When any one receive interface receives data transmission, it will broadcast and transmit out across all units and transmit interfaces. STF-501C series operates completely at the physical layer, transparent to communication protocols. The communication protocols are required to handle bi-directional data flow control and device addressing.

### **1.2.5 Applications**

RS-485 signals are used in a wide range of computer and automation systems. RS-485 is used for low-speed data communications and the physical layer underlying many standard and proprietary automation protocols used to implement Industrial Control Systems, including the most common versions of Modbus and Profibus. The Profibus (Process Field Bus) protocol uses RS-485 physical medium when deploying field bus solutions in factory and process automation environments. Since RS-485 signals are differential, they resist external electromagnetic interference from motors and welding equipment.

In theatre and performance venues, RS-485 networks are used to control lighting and other systems using the DMX512 protocol.

In surveillance, RS-485 is used to control pan tilt zoom (PTZ) cameras via Panasonic, Pelco D/P, Samsung and Sony protocols.

RS-485 is also used in building automation as the simple bus wiring where long cable length is ideal for joining remote devices. RS-485 may be used to control video surveillance systems or to interconnect security control panels and devices such as alarm sensors, intrusion devices or access control card readers.

The STF-501C series uses a complete galvanic ally isolated full duplex RS485/RS422 transceiver. Coupled inductors and an isolation power transformer provide 2500VRMS of isolation between the line transceiver and the logic interface. This converter is ideal for systems where the ground loop needs to be broken to allow for large common mode voltage variation.

### **1.2.6 RS-485 4 wire vs. 2 wire**

RS-485 is a multipoint specification and uses a half-duplex, 2-wire communication connection. RS-485 drivers need to be put in transmit mode explicitly by asserting a signal to the driver. When not transmitting, the drivers present a high impedance on the wire pair. The protocol layer must handle transmission to avoid two devices "talking" at once.

When switching the RS-485 to 4-wire mode, we actually are making an RS-422 interface which is full duplex and with separate TX and RX wire pairs. In 4-wire mode, the transmit drivers are always enabled. This means that 4-wire mode is only applicable for point-to-point applications and cannot be used in multipoint applications.

### **1.2.7 RS-485 Termination**

Depending on the wire gauge of the cable and the materials used in the insulation, twisted-pair wire has "characteristic impedance" associated with it that is usually specified by the cable manufacturer. The RS-485 specification recommends, but does not specifically dictate, that this "characteristic impedance" be 120Ω.

Because of the high frequencies and the distances involved, proper attention must be paid to transmission-line effects. A detailed discussion of transmission-line effects and proper termination techniques is well beyond the scope of this user manual. With this in mind, terminations will be briefly discussed in their simplest form as they relate to RS-485.

A terminating resistor is simply a resistor placed at the extreme end or ends of a cable. The value of the terminating resistor is ideally the same value as the characteristic impedance of the cable. In the STF-501C series, this value is fixed at 120Ω.

When no termination resistance is applied to the wiring, reflections will occur as the signal travels down the cable. Although some reflections are inevitable due to cable and resistor tolerances, large enough mismatches can cause reflections big enough to cause errors in the data.

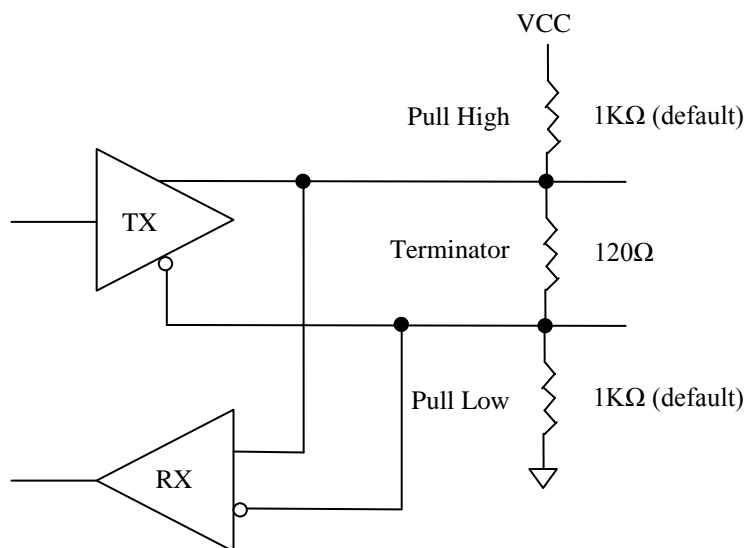
Knowing this, it is important to match the terminating resistance and the characteristic impedance as closely as possible. The position of the terminating resistors is also very important. As a general rule, termination resistors should be placed at both far ends of the cable. Although properly terminating both ends is absolutely critical for most system designs, it can be argued that in one special case only one termination resistor is needed. This case occurs in a system when there is a single transmitter and that single transmitter is located at the far end of the cable. In this case there is no need to place a termination resistor at the end of the cable with the transmitter, because the signal is intended to always travel away from this end of the cable.

### 1.2.8 RS-485 Pull High, Pull Low

Somewhere along the set of wires, pull up or pull down resistors are established to fail-safe bias of each data line/wire when the lines are not being driven by any device. This way, the lines will be biased to known voltages and nodes will not interpret the noise from un-driven lines as actual data. Without biasing resistors, the data lines may float in such a way that electrical noise sensitivity is greater when all device stations are silent or unpowered.

The STF-501C series uses rotary switches to select from ten different bias resistor values. The factory default setting is at position 4. The factory defaults provide bias resistors of 1KΩ in the pull high and pull low positions. When changing the rotary switches, it is important to maintain the same setting on both switches.

The following electrical circuit shows the locations of the pull high, pull low bias resistors, the terminating resistor and the relationship of transmitter and receiver in a 2-wire half duplex RS-485 application.



Pull High / Pull Low Bias Resistors and Termination

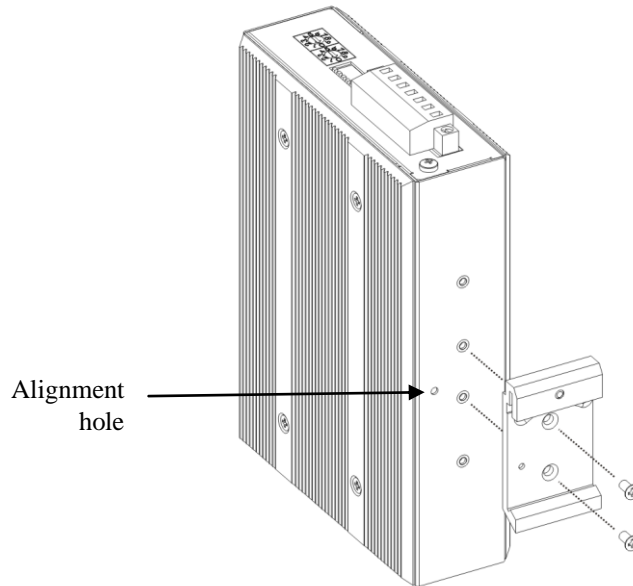
## Chapter 2. Installation

The STF-501C series offers two mounting options; DIN Rail mounting or Wall mounting. For each, a different mounting bracket is required. Both mounting option brackets are included.

### 2.1 DIN Rail mounting

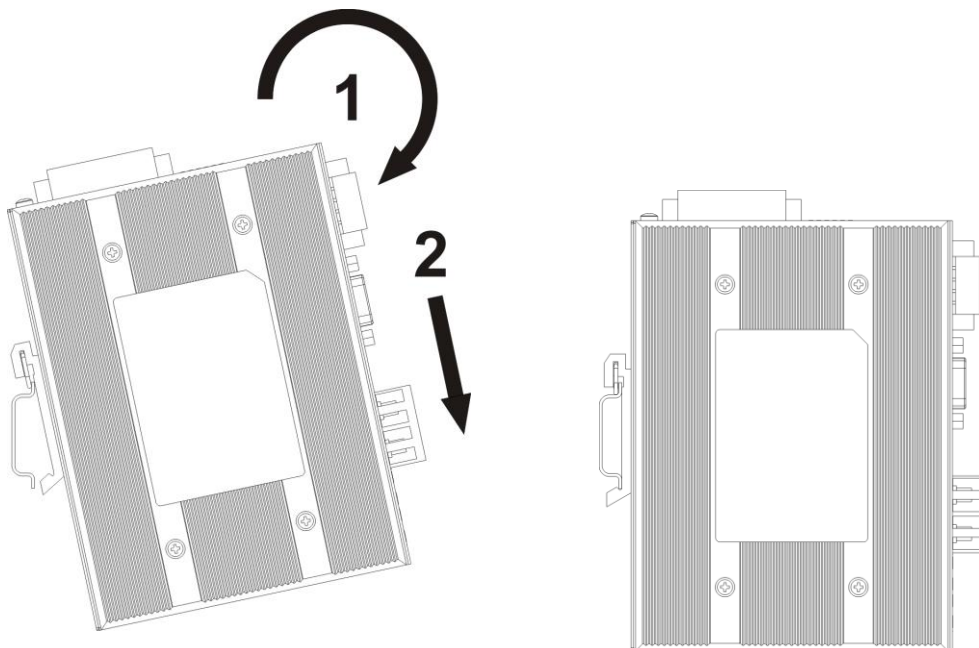
#### 2.1.1 Bracket Mounting

To support DIN Rail mounting, the STF-501C series must first have the DIN Rail bracket installed. Position the bracket, as shown below, and use the two provided flathead screws to attach the bracket to the center two mounting holes. Note the alignment pin of the bracket must align with the hole in the STF-501C series.



#### 2.1.2 Rail Mounting

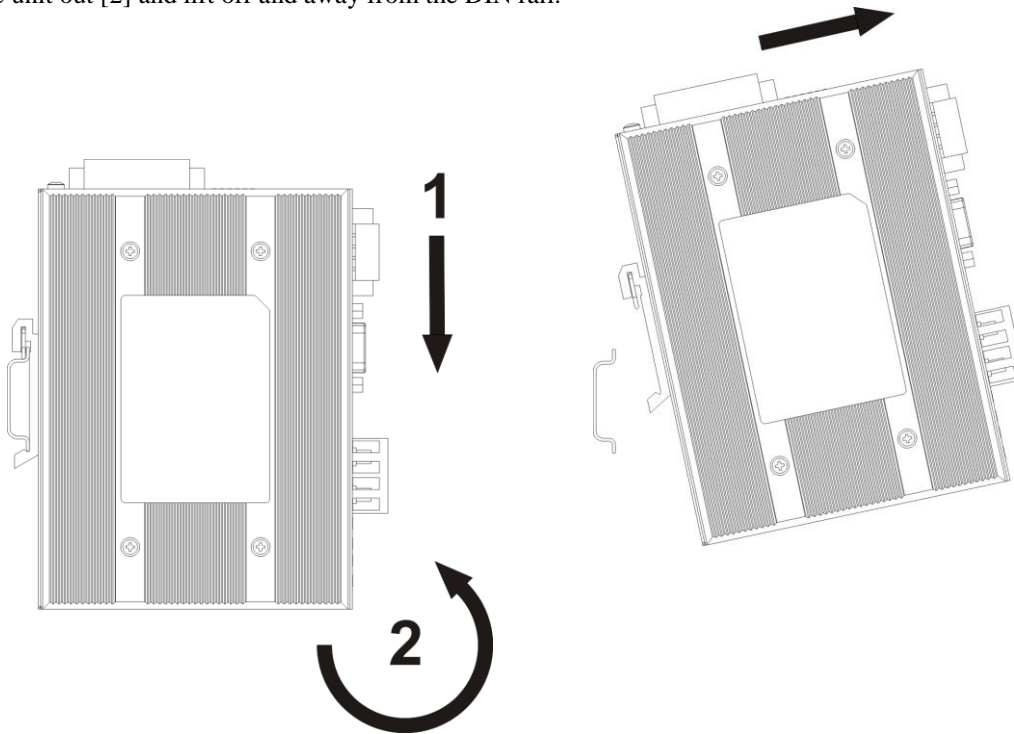
Place the STF-501C series bracket over the top rail of DIN rail. Swing the unit into position [1] and snap the unit in place by placing a slight downward pressure [2] until the bottom of the bracket locks with the lower rail.



Rail mounting the STF-501C series

### 2.1.3 Rail Dismounting

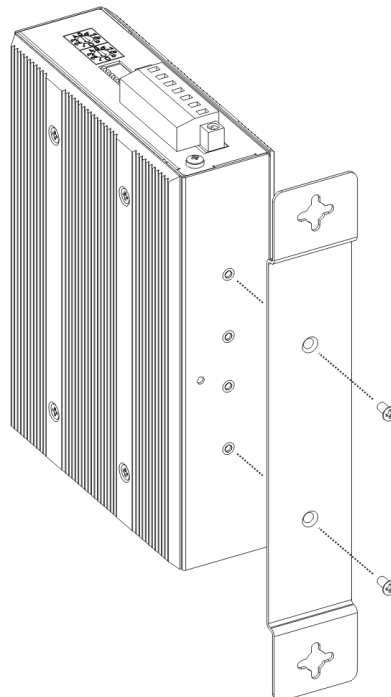
To remove the STF-501C series unit, use a slight downward pressure [1] and release the lower rail from the bracket. Swing the unit out [2] and lift off and away from the DIN rail.



Rail dismounting the STF-501C series

### 2.2 Wall mounting

To support wall mounting, the STF-501C series unit must first have the wall mount bracket installed. You may use the bracket as a template for locating and drilling (if necessary) the wall mounting holes, prior to assembly. After preparing the wall mount location, attach the wall mount bracket to the unit, as shown below. Use the two provided flathead screws to attach the bracket to the outer two mounting holes.



The wall mount bracket is attached with two screws

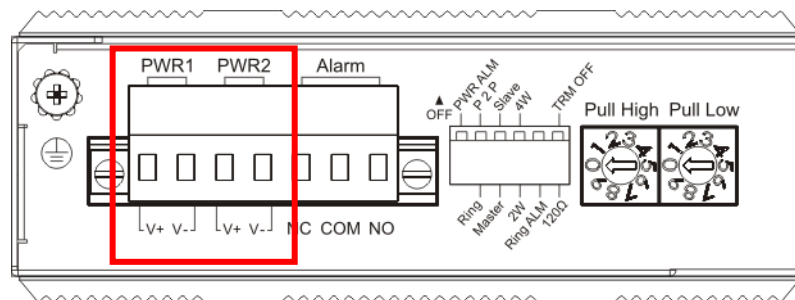
### 2.3 Electrical Installation

The electrical, signal and optical connections will be explained here. The DC power, alarm and RS-485 connections all use terminal blocks. A flat blade screwdriver (with blade width of ~2 mm) is required to secure the wiring in the terminal blocks.

#### 2.3.1 DC Power

There are input connectors for two power sources. Only one power source is required for normal operation. The second power source input may be provided for redundancy. When operating in a critical environment, connecting to two separate power sources will ensure non-stop operation even in the event that one power source fails.

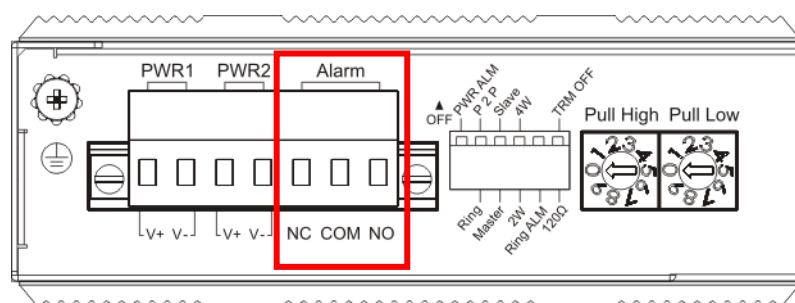
The power inputs are protected against reverse polarity connections, in fact they will actually work if power is reverse connected. However, we highly recommend following the proper polarity connection for power. Not all devices are designed with such protection features as the STF-501C series.



Physical connections for two power inputs

#### 2.3.2 Alarm Contact

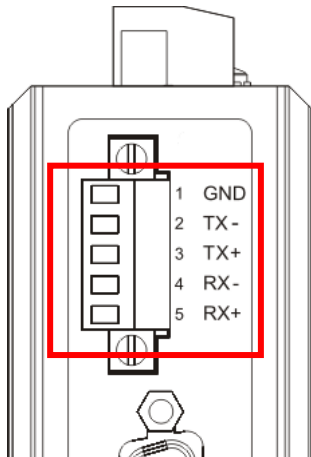
The STF-501C series has a single, normally open / normally closed alarm relay contact. Depending on some DIP switch settings, this alarm contact can create a closed or open circuit when conditions such as power failure or fiber disconnect occurs. The alarm contact is capable of carrying up to 1A @ 24VDC and can be used to complete or break a circuit for a visible or audible alarm.



Physical connections for relay contacts

### 2.4 RS-485/422 Connections

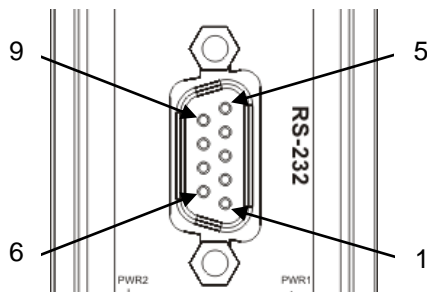
The STF-501C series provides terminal connections for the twisted pair RS-485 interface wiring. When using 4-wire RS-485 or RS-422, connect transmit and receive pairs as indicated in the table under "4-Wire Mode". When using 2-wire RS-485, connect the single wire pair with the polarity indicated in the table under "2-Wire Mode".



Pin	4-Wire Mode	2-Wire Mode
1	Ground	Ground
2	TX- (transmit minus)	-----
3	TX+ (transmit plus)	-----
4	RX- (receive minus)	TRX- (Tx/Rx minus)
5	RX+ (receive plus)	TRX+ (Tx/Rx plus)

### 2.5 RS-232 Connections

The STF-501C series uses a 9 pin D-Sub female connector for RS-232 connections. This D-Sub connects to one RS-232 channel (using only 3-wire) by the standard pins 2(TD), 3(RD) & 5(SG). A second RS-232 channel uses non-standard pin assignment, utilizing the pins normally used for handshaking, 7(RD), 8(TD) & 5(SG).

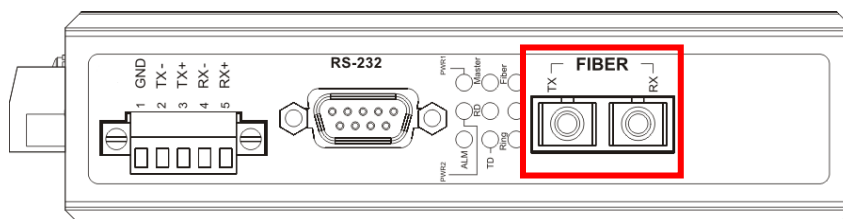


Pin	Function
1	
2	Ch1 TD
3	Ch1 RD
4	
5	GND
6	
7	Ch2 RD
8	Ch2 TD
9	

### 2.6 Fiber Connection

The STF-501C series is available with fiber connectors for SC or ST and for multi-mode or single mode fiber. The fiber connection requires duplex cables and proper adherence to connections for RX and TX. The following table describes the attributes of the various transceivers available for the STF-501C series.

Connector Type	Wavelength	Media	Optical TX Power	Optical RX Sensitivity	Power Budget	Distance	Diode
SC or ST	1310nm	MMF	-14~-20dBm	-31dBm	11dB	2KM	VCSEL
SC or ST	1310nm	SMF	-5~-15dBm	-35dBm	20dB	30KM	FP
SC or ST	1310nm	SMF	0~-5dBm	-35dBm	30dB	60KM	FP

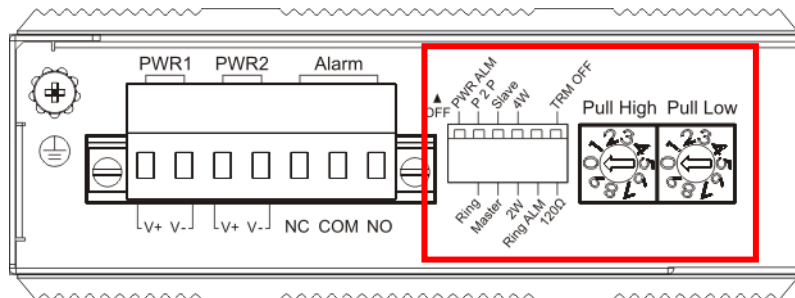


## Chapter 3. Configuration and Operation

### 3.1 Configuration

#### 3.1.1 DIP Switch

The STF-501C series uses a 6-pole DIP (dual inline package) switch and two 10-position rotary switches for all configuration settings. There is no provision for any software configuration.



The DIP switch sets the operational mode, configures alarm and interface operation, while the rotary switches are used exclusively for the pull high, pull low bias resistors in the RS-422 (RS-485) receive circuits.

Sw	Position	Function	
1	OFF	Loss either input power, no alarm	
	ON	Loss either input power, alarm active	
2	OFF	Normal Point-to-Point mode	
	ON	Simplex fiber ring mode	
3	OFF	Operation Mode	Slave
	ON		Master
4	OFF	RS-485 Mode	4-Wire
	ON		2-Wire
5	OFF	Ring Alarm	Disable
	ON		Enable
6	OFF	Termination (RS-485)	OFF
	ON		120Ω

**Switch 1 :** When connecting the STF-501C series to only a single power source, leave this switch OFF or the alarm will be constantly on. When connecting to two separate power sources, turn this switch ON and alarm will occur if either power source fails.

**Switch 2 :** The normal point-to-point operation of the STF-501C series should leave this switch OFF. When set to ON, the converter can be set in a simplex ring with multiple units. By simplex fiber connection, the “transmit fiber” of one unit goes to the “receive fiber” of another unit. Then its transmit fiber connects to yet another unit until the last transmit fiber connects to the original unit. This completes a ring, but only with a single fiber. No redundancy is supported and any single fiber breakage or STF-501C series powered off would bring down all transmission. Please use this mode with care and some forethought.

**Switch 3 :** In any application, using two or more STF-501C series, one unit should be set to 'Master' mode and all other units must be set to 'Slave'.

**Switch 4 :** This switch sets the RS-485 to either 2-wire or 4-wire operation. In 2-wire operation, connect the wire pair to only the RX+ and RX- connections.

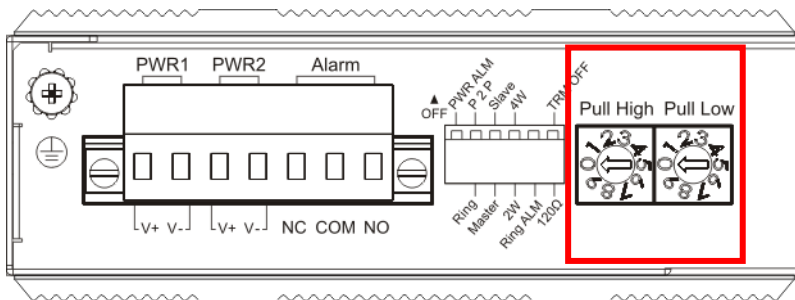
**Switch 5 :** This switch should only be enabled when the STF-501C series unit has its fiber connected in a ring topology. Then, when enabled, if any break occurs in the fiber ring, the alarm is become active. For point-to-point or linear topology, disable this switch or alarm will be constantly active.

**Switch 6 :** This switch enables the internal signal termination by placing a 120 ohm resistance across the RX complimentary pair. (Refer to Chapter 1 [Section 1.2.7](#) for more detailed description of termination.)

### 3.1.2 Pull High/Low

The pull high / pull low bias is explained in more detail in Chapter 1 [Section 1.2.8](#). The bias resistance should be set to position setting no.4 for 1KΩ from the factory. It is highly recommended to set both high and low rotary switches to the same setting. Using different settings will put an unequal bias on the circuit and could cause more noise by unbalancing the common-mode rejection capability of the balanced transmission wire pair.

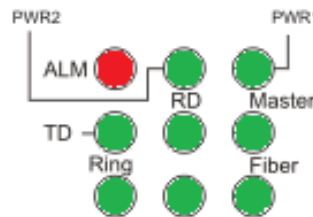
The following graphic shows the two Pull High, Pull Low rotary switches in the no. 0 position. The table lists the bias resistor values for the rotary switch positions.



Position	Resistance (Ohms)
0	100K
1	9.9K
2	5K
3	3.3K
4	1K (default)
5	920
6	840
7	774
8	500
9	475

### 3.1.3 LED Definitions

The front panel has a 3 x 3 matrix of 2.5mm LEDs. The LEDs are used to quickly diagnose the link and alarm condition of the STF-501C series.



The following table lists and describes the meanings of the LEDs.

LED	Color	State	Definition
ALM	Red	OFF	Normal operation with no alarms
		ON	Alarm exists for power or fiber link**
PWR2	Green	OFF	There is no DC power at PWR2 input
		ON	DC power normal at PWR2 input
PWR1	Green	OFF	There is no DC power at PWR1 input
		ON	DC power normal at PWR1 input
TD	Green	OFF	Transmit data is idle (Mark)
		ON	There is data transmitted (Space)
RD	Green	OFF	Receive data is idle (Mark)
		ON	There is data being received (Space)
Master	Green	OFF	Configured in Slave mode
		ON	Configured in Master mode
Ring	Green	OFF	Ring failure
		ON	Ring OK
	Green	OFF	reserved
		ON	reserved
Fiber1	Green	OFF	Fiber has no link
		ON	Fiber has optical link

\*\* Depends on the settings of DIP switch 1, 2 & 5 for alarm reporting.



### 3.2 Operation

The following examples are for reference and as an aid in understanding the operating modes and DIP switch selections of the STF-501C series converter.

#### 3.2.1 Two Unit Point-to-Point

In the very simplest application, a duplex fiber connects two STF-501C series units. One unit is set as 'Master' the other as 'Slave'. The RS-485 and RS-232 are completely isolated electrically. A receive signal can only be connected to either the RS-485 (terminal block) or to the RS-232 DB9 (not both at the same time). That received signal will be transmitted simultaneously on every transmit connection, both RS-485 and RS-232.

In the example below, the 'Master' unit is receiving RS-485 serial signal. The signal is repeated out of every other transmit pin.

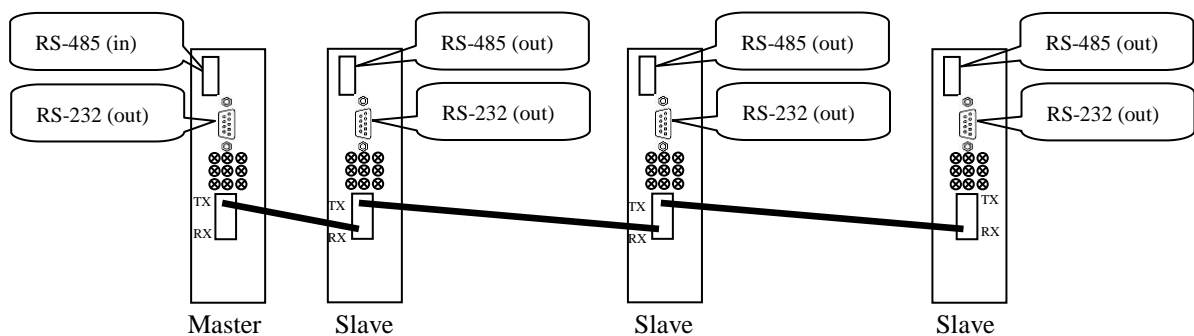


#### 3.2.2 One-way Daisy Chain

In this application, data transmission only occurs one-way. When used in this manner, data can be transmitted from a host (at the master unit) to all remote devices. These devices could be connected to text displays in public venues such as in rail or bus terminals or for warning signs along highways. The data from the host can be used to continuously update the displayed text information.

In the application, one unit is set as 'Master' and others as 'Slave'. The RS-485 and RS-232 are completely isolated electrically. A receive signal can only be connected to either the RS-485 (terminal block) or to the RS-232 DB9 (not both at the same time). That received signal will be transmitted simultaneously on every transmit connection, both RS-485 and RS-232.

In the example below, the 'Master' unit is receiving RS-485 serial signal. The signal is repeated out of every other transmit pin.



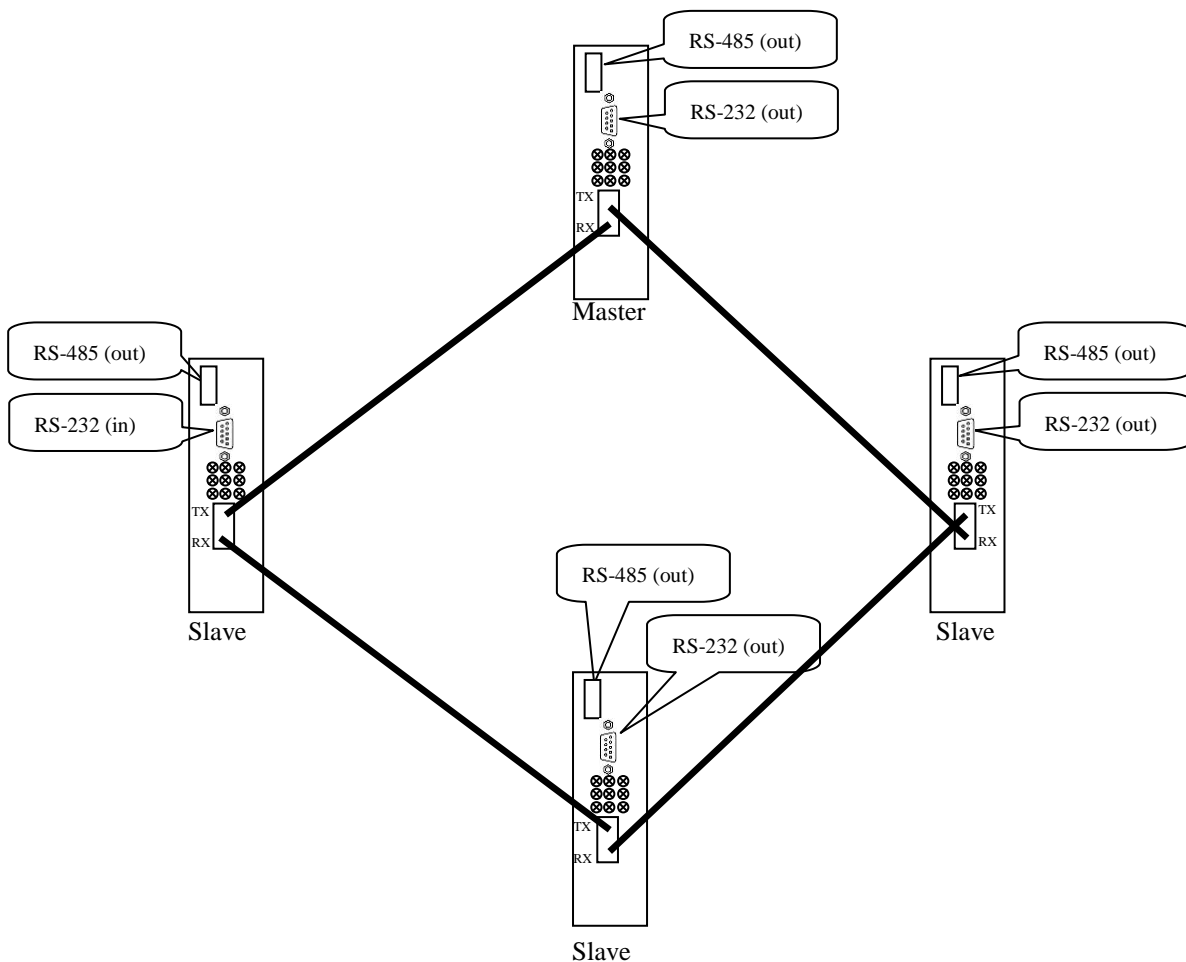
3.2.3 Three or more units Ring Topology

CAUTION : This application provides no fiber redundancy. In the event of any one fiber link loss, or any device powered off, 2-way transmission between all the devices will not be possible. Depending on where the link is broken, there still may be transmit or receive path between some devices. A better product for this ring topology would be the STF-502C series product which supports dual fiber ports.

In the single fiber ring topology, the fiber transmit of one device connects to the fiber receive of the next device. Then its fiber transmit again connects to the next device fiber receive, until a completed ring is formed.

The STF-501C series operates completely at Layer 1. However, the logic control will ensure that any transmitted data will flow to each device in the ring but will not loop. The protocol layer is required to handle proper communication flow control. Reception of data at any receive should only be allowed from one device at a given moment. That received data will then be broadcast (transmitted) to all units and interfaces out.

In the example below, one RS-232 interface receives data and it is broadcast to all other interfaces.



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