



## Model: FOSTCDRI Fiber Optic to RS-232, RS-422, RS-485 Converter with Triple Isolation

### Description

The FOSTCDRI is designed to provide the most versatile connection possible between any asynchronous serial equipment using fiber optic cable. It allows any two pieces of asynchronous serial equipment to communicate full or half-duplex over two fibers at typical distances up to 2.5 miles (4 km). The converter can also be set up in "Repeater" mode to create a multi-drop master/slave configuration, allowing one serial device to talk to multiple slave devices around a fiber ring. The DIN rail mountable box makes it ideal for industrial cabinets and enclosures.

RS-232 data signals up to 115.2K bps and RS-422, or RS-485 data signals up to 460K bps are supported. Different standards can be mixed and matched to allow RS-232 devices to connect to your RS-422 or RS-485 system. This means the FOSTCDRI can replace converters and isolators when connecting remote devices, while providing the EMI/RFI and transient immunity of optical fiber.

The FOSTCDRI supports both the Transmit and Receive data lines, and provides full hardware control of the RS-422/485 driver with B&B Electronics' automatic Send Data Control circuit. Timeouts are dip-switch selectable between 0.10 and 1.3. All serial connections are provided on terminal blocks, while the multimode fiber is connected via two ST connectors. The unit is powered by 10 to 48VDC at 140 mA max. This power is isolated from the rest of the converter allowing almost any DC power rail to be used.

### RS-232 Connections

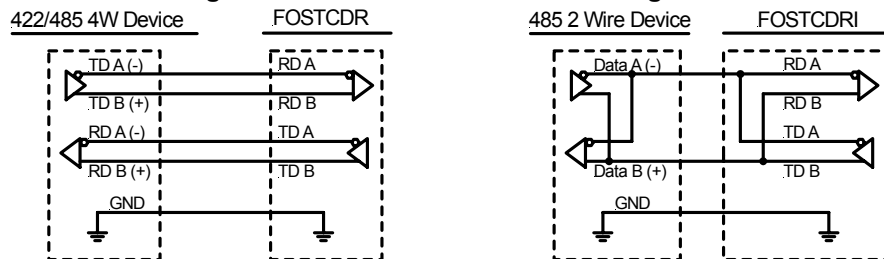
Connection of the FOSTCDRI is simple and straightforward. The RS-232 driver and receiver are connected to 2 terminal blocks. The RS-232 DATA OUT is on terminal block (1), and the RS-232 DATA IN is on terminal block (3). Ground is located on terminal block (5), and power comes in on a separate set of terminal blocks. The switch on the bottom selects between RS-232 and RS-422/485.

### RS-422 and RS-485 Connections

The RS-422/485 driver and receiver are connected to 4 terminal blocks. Signal ground is on terminal block (5), and power comes in on a separate set of terminal blocks. When connecting to a four-wire RS-422/485 device or system, connect the output of your device to terminal block (4) (RDB or RD+) and terminal block (3) (RDA or RD-). Connect the input to your device to terminal block (2) (TDB or TD+) and terminal block (1) (TDA or TD-). For two-wire RS-485 systems, the driver and receiver of the FOSTCDRI are connected together by placing switches 3 and 4 into the On position. This allows the FOSTCDRI to communicate half-duplex over the same pair. Refer to Figure 1 for connection diagrams to your RS-422 or RS-485 equipment.

If termination is needed, the PCB is laid out to allow a termination resistor to be placed in across the RD(A) and RD(B) lines by placing switch 5 into the On position. The off-state 1.2k Ohm bias resistor values can also be removed by placing switch 6 for the transmit and switch 7 for the receive into the On positions. Before making modifications to the FOSTCDRI, be sure to consult B&B Electronics' free RS-422/485 Application Note or other sources of information to see if termination is necessary. B&B Electronics' Application Note is available on our website.

**Figure 1: RS-422/485 Connection Diagrams**



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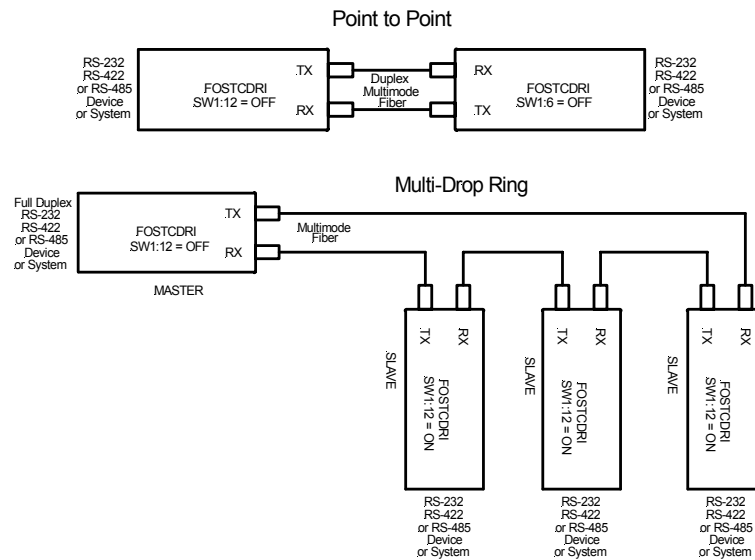
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### Fiber Optic Connections

The FOSTCDRI uses a separate LED emitter and photo-detector operating at 820 nm wavelength. Connections to the emitter and detector are on ST type connectors. Most multimode glass fiber size can be used including 50/125  $\mu\text{m}$ , 62.5/125  $\mu\text{m}$ , 100/140  $\mu\text{m}$ , and 200  $\mu\text{m}$ . One fiber is required for each connection between a transmitter and receiver. In a point-to-point configuration, two fibers are required between the two modems, one for data in each direction. A multi-drop ring configuration requires one fiber between TX and RX around the loop. See Figure 2 for typical point to point and multi-drop configurations.

The most important consideration in planning the fiber optic link is the “power budget” of the fiber modem. This value represents the amount of loss in dB that can be present in the link between the two modems before the units fail to perform properly. This value includes line attenuation as well as connector loss. For the FOSTCDRI the typical connector-to-connector power budget is 12.1 dB. Because 62.5/125  $\mu\text{m}$  cable typically has a line attenuation of 3 dB per Km at 820 nm, the 12.1 dB power budget translates into 2.5 miles (4 km). This assumes no extra connectors or splices in the link. Each extra connection would typically add 0.5 dB of loss, reducing the possible distance by 166 m (547 ft.). The actual loss should be measured before assuming distances.

Figure 2: Typical Setups



### Dip-Switch Setup

The Dip-Switch (SW1) on the FOSTCDRI defines the mode of operation when being used for RS-422 or RS-485. Positions 8 through 11 on the switch determine the timeout of the RS-485 driver. Because the driver is controlled by hardware, a specific time must be set to tell the hardware how long to wait for data on the fiber side before turning off the RS-422/485 driver. If this time is set too short, the driver could be disabled before transmission is complete, resulting in data corruption. If the time is set too long, the RS-485 device may respond before the RS-422/485 driver in the FOSTCDRI is disabled, corrupting this response. We recommend that the timeout be set for approximately one character time or longer. The character times for several different baud rates are selectable on switch positions 8 through 11.

If you need a different timeout than what is provided, R10 can be removed and replaced with a different value R9. Table 1 shows different timeout values for the switch positions as well as typical R9 replacement values.

Table 1: RS-485 Timeout Selection

Baud Rate	Pos. 8	Pos. 9	Pos. 10	Pos. 11	R9	Time(ms)
1200	ON	OFF	OFF	OFF	820 K $\Omega$	8.20
2400	ON	OFF	OFF	OFF	430 K $\Omega$	4.30
4800	ON	OFF	OFF	OFF	220 K $\Omega$	2.20
9600	OFF	OFF	OFF	ON	Not Used	1.30
19.2K	OFF	OFF	ON	OFF	Not Used	0.56
38.4K	OFF	ON	OFF	OFF	Not Used	0.27
57.6K	ON	OFF	OFF	OFF	Not Used	0.22
76.8K	ON	OFF	ON	ON	Not Used	0.14
115.2K	ON	ON	ON	OFF	Not Used	0.10
153.6K	ON	OFF	OFF	OFF	6.2 K $\Omega$	0.06
230.4K	ON	OFF	OFF	OFF	4.3 K $\Omega$	0.04
460.8K	ON	OFF	OFF	OFF	2.2 K $\Omega$	0.02

Position 12 of SW1 sets the unit in a “Multidrop” mode or a “Point-to-Point” mode. When the FOSTCDRI is set in a “Multidrop” mode, data arriving on the fiber optic receiver is repeated back out the transmitter. When set in a “Point-to-Point” mode, data arriving at the fiber optic receiver is not sent back out the fiber optic transmitter. Position 12 must be turned “On” when the FOSTCDRI is to be used in a multi-drop ring configuration. It must be turned “Off” when the FOSTCDRI is to be used as either end of a point-to-point communication line. See Figure 3 for typical system setups using the FOSTCDRI in its different modes.

Positions 1 and 2 of SW1 determine when the RS-422/485 driver and receiver are enabled. Position 1 controls the driver and Position 2 controls the receiver. For RS-422 operation, set both switches to the “Off” position. For multi-drop RS-485 four-wire systems, position 1 should be “On” and position 2 should be “Off.” This allows the receiver to be enabled all of the time and eliminates some possible timing problems. For RS-485 two-wire systems, both switches should be in the “On” position. This disables the RS-422/485 receiver whenever the driver is enabled, preventing data from being echoed back to the fiber side of the FOSTCDRI.

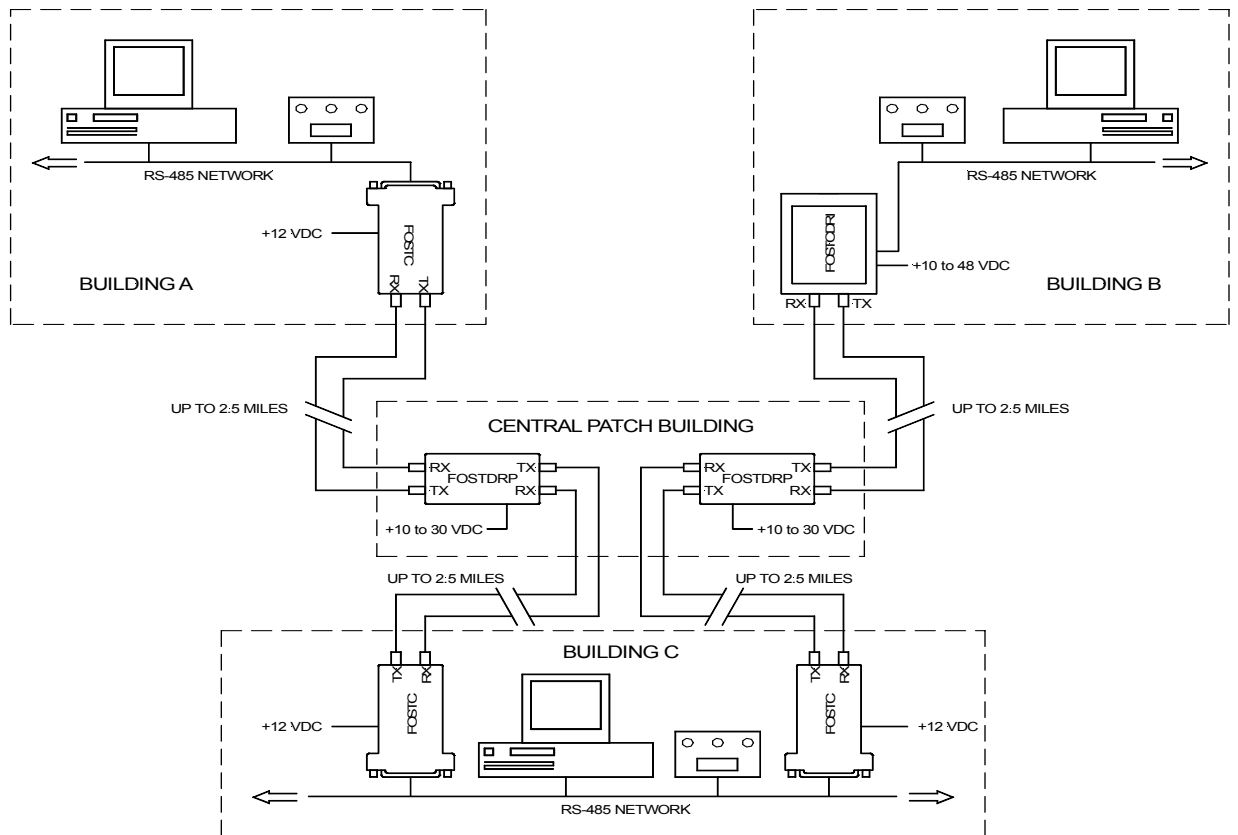
**Table 2: 422/485 Switch Settings**

	Position 1 TX Enable	Position 2 RX Enable	Position 3 4/2 Wire	Position 4 4/2 Wire
<b>RS-485 2-Wire Mode (half duplex)</b>	ON	ON	ON	ON
<b>RS-485 4-Wire Mode (full duplex)</b>	ON	OFF	OFF	OFF
<b>RS-422 Mode (full duplex)</b>	OFF	OFF	OFF	OFF

Table 2 illustrates the switch settings for typical setups.

**Typical Installation Configuration**

Below is a University Campus setup illustrating the basic configuration of a typical Fiber Optic Network. This scenario uses a combination of B&B Electronics fiber devices including 3 of the FOSTCs, 2 of the fiber repeaters-FOSTDRP, and one DIN rail mount Fiber Converter model FOSTCDRI. Each of the items requires a power supply (not shown).



**Figure 3. Typical Campus Setup**



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## Multi-drop Operation

A multi-drop configuration is created by forming a ring of FOSTCDRI's. Each transmitter is tied to the following converter's receiver, starting at a master node and continuing around to each slave and back to the master. By setting SW1:12 to the "On" position on the slaves, all data sent from the master or preceding slaves is echoed back out the fiber transmitter to the rest of the slaves and eventually back to the master node.

Because all data is echoed back, there are special considerations when constructing a multi-drop system. The master will see its own transmitted data. This means that the master device must be full-duplex (RS-232, RS-422, or four-wire RS-485) and that it must be capable of ignoring or otherwise accepting its own echoed transmission. Slaves must also be able to accept data from previous slaves in the loop.

## Interfacing to Fiber Devices from Other Manufacturers

**Note:** The factory default for the LED emitter is to have the light ON in the idle state. To interconnect with other devices that have the light OFF in the idle state, this unit would need to be modified. To modify the unit so that the light is OFF in the idle state, contact B&B Electronics Technical Support.

## Specifications/Features - All specifications given using 62.5/125µm glass multi-mode fiber.

Transmission Line:	Dual multimode optical cable
Point-to-Point Transmission:	Asynchronous, half or full-duplex
Multi-Drop Transmission:	Asynchronous, half duplex fiber ring
Interfaces:	RS-232, RS-422, or RS-485
Connectors:	Terminal block for serial connection, ST connectors for fiber
Isolation:	2,000 Volts RMS for 1 minute isolation of data lines and power supply.
Dimensions:	4.9 x 4.5 x 1.3 in (12.4 x 11.4 x 3.2 cm)
Power Supply Connections:	Terminal blocks 10 to 48VDC (+/- 20%)
Recommended Power Supply:	B&B Electronics Model# 232PS4 or #DR-30-12
Temperature Rating:	-40 to +80°C (-40 to +176°F)
Approvals:	cUL, Class1 Div2

**Table 3: Operating Parameters**

Parameter	Min.	Typical	Max.	Conditions
Data Rates (RS-232 Operation)	0 bps		115.2 kbps	
Data Rates (RS-422/485 Operation)	0 bps		500 kbps	
Power Supply Voltage	10 VDC	12 VDC	48 VDC	
Power Supply Current Draw			150 mA	Full RS-485 Termination
Optic Wavelength		820 nm		
Fiber TX Launch Power	-17 dBm	-13 dBm	-10 dBm	
Minimum Required Fiber Rx Power		-25.4 dBm	-24 dBm	
Maximum Receiver Power			-10 dBm	
Coupled Power Budget		12.1 dB		
Fiber Range		2.5 mi (4 km)		
End to End Delay		2000 ns	2650 ns	Point-to-Point RS-232 Operation (See Notes 1 & 2)
End to End Delay		550 ns	1000 ns	Point-to-Point RS-422/485 Operation (See Notes 1 & 2)
End to End Skew		900 ns	1100 ns	Point-to-Point RS-232 Operation (See Note 3)
End to End Skew		50 ns	120 ns	Point-to-Point RS-422/485 Operation (See Note 3)
Maximum Total Fiber Ring Length			5 mi (8 km)	(See Note 1)
Delay between Rx & Tx on a fiber ring	52 µs			(See Note 4)

Note 1: For the total transmission time over long fibers, the time to transverse the fiber must be considered if delay is an issue. Light takes about 8.05 microseconds to travel over 1 mile (1.6 km) of fiber.

Note 2: When operating in a ring configuration, each node in addition to the two in the point-to-point specification adds an additional 100 to 200 nanoseconds of delay.

Note 3: When operating in a ring configuration, each node in addition to the two in the point-to-point specification adds an additional 50 to 70 nanoseconds of skew.

Note 4: When operating in a ring configuration, each serial device must wait at least this minimum time between receiving data from the ring and transmitting back on to it.



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**Table 4: Recommended Maximum FOSTCDRIs in a Fiber Ring Topology**

Baud Rate	RS-232 Operation	RS-422/485 Operation
460.8 kbps	N/A	2
230.4 kbps	N/A	4
115.2 kbps	2	8
57.6 kbps	8	16
38.4 kbps	16	24
19.2 kbps and lower	32	32

**Table 5: FOSTCDRI Dip Switch Diagram**

Switch	ON	OFF
1	TX Send Data	TX Enabled
2	RX Send Data	RX Enabled
3	2 Wire	4 Wire
4	2 Wire	4 Wire
5	Termination In	Termination Out
6	TX Bias Resistors Out	TX Bias Resistors In
7	RX Bias Resistors Out	RX Bias Resistors In
8	57.6 K Baud	
9	38.4 K Baud	
10	19.2 K Baud	
11	9600 Baud	
12	Multidrop Fiber	Point-to-Point Fiber

**DECLARATION OF CONFORMITY**

Manufacturer's Name: B&B Electronics Manufacturing Company  
 Manufacturer's Address: P.O. Box 1040  
 707 Dayton Road  
 Ottawa, IL 61350 USA  
 Model Numbers: FOSTCDRI  
 Description: Industrial Isolated RS232/422/485 Fiber Converter  
 Type: Light industrial ITE equipment  
 Application of Council Directive: 89/336/EEC  
 Standards: EN 55022  
 EN 61000-6-1  
 EN 61000 (-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11)




Michael J. Fahrion, Director of Engineering



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