Model: FOSTCDR

Send RS-232, 422 or 485 Signals Up to 2.5 Miles with Fiber Optic Modem

Description

The FOSTCDR 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. 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 FOSTCDR can replace converters and isolators when connecting remote devices, while providing the EMI/RFI and transient immunity of optical fiber.

The FOSTCDR supports both the Transmit and Receive data lines, and provides full hardware control of the RS-422/485 driver with B&B's automatic Send Data Control circuit. Timeouts are dip-switch selectable between 0.10 and 2.2 ms. 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 30VDC at 140 mA max.
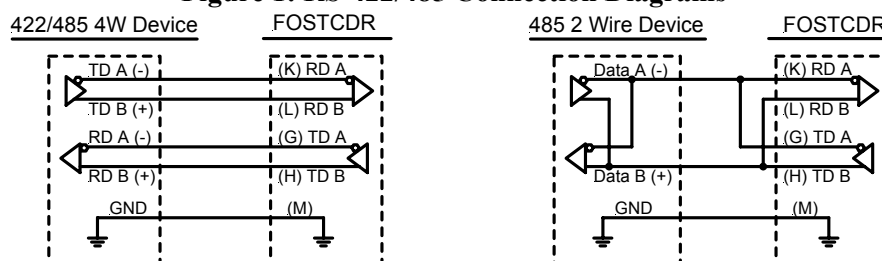
RS-232 Connections

Connection of the FOSTCDR 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 (A), and the RS-232 DATA IN is on terminal block (D). Ground is located on terminal block (B) and (C), and power comes in on terminal block (F).

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 (M), and power comes in on terminal block (J). When connecting to a four-wire RS-422/485 device or system, connect the output of your device to terminal block (L) (RDB or RD+) and terminal block (K) (RDA or RD+). Connect the input to your device to terminal block (H) (TDB or TD+) and terminal block (G) (TDA or TD-). For two-wire RS-485 systems, the driver and receiver of the FOSTCDR must be connected together by tying terminal blocks (L) and (H) together and (G) and (K) together. This allows the FOSTCDR 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 PCBD is laid out to allow a termination resistor (Rt) to be soldered in across the RD(A) and RD(B) lines. The off-state bias resistor values can also be changed by removing R8 and R16 and replacing them with through-hole components. Before making modifications to the FOSTCDR, be sure to consult B&B Electronics' free RS-422/485 Application Note or other sources of information to see if termination is necessary. The Application Note is available from our website, or call and we will be happy to send you one at no charge.

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

Fiber Optic Connections

The FOSTCDR 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 μm, 62.5/125 μm, 100/140 μm, and 200 μm. 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 FOSTCDR the typical connector to connector power budget is 12.1 dB. Because 62.5/125 μm 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. 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

Point to Point

Multi-Drop Ring
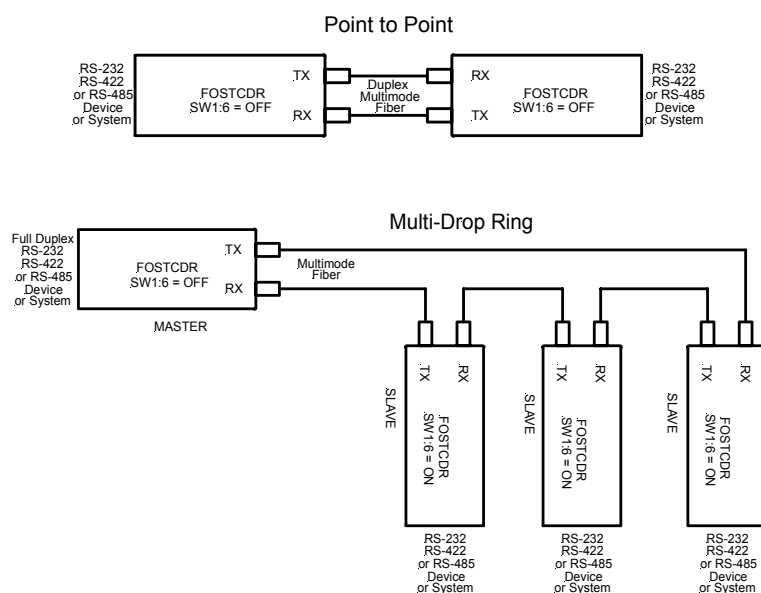
Dip-Switch Setup

The Dip-Switch (SW1) on the FOSTCDR defines the mode of operation when being used for RS-422 or RS-485. Positions 1 through 5 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 FOSTCDR 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 1

Table 1: RS-485 Timeout Selection

Baud Rate	Pos. 1	Pos. 2	Pos. 3	Pos. 4	Pos. 5	R9	Time(ms)
1200	ON	OFF	OFF	OFF	OFF	820 KΩ	8.20
2400	ON	OFF	OFF	OFF	OFF	430 KΩ	4.30
4800	OFF	OFF	OFF	OFF	ON	Not Used	2.20
9600	OFF	OFF	OFF	ON	OFF	Not Used	1.30
19.2K	OFF	OFF	ON	OFF	OFF	Not Used	0.56
38.4K	OFF	ON	OFF	OFF	OFF	Not Used	0.27
57.6K	ON	OFF	OFF	OFF	OFF	Not Used	0.22
76.8K	ON	OFF	ON	ON	OFF	Not Used	0.14
115.2K	ON	ON	ON	OFF	OFF	Not Used	0.10
153.6K	ON	OFF	OFF	OFF	OFF	6.2 KΩ	0.06
230.4K	ON	OFF	OFF	OFF	OFF	4.3 KΩ	0.04
460.8K	ON	OFF	OFF	OFF	OFF	2.2 KΩ	0.02

through 5. 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.

Position 6 of SW1 sets the unit in a "Multidrop" mode or a "Point-to-Point" mode. When the FOSTCDR 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 6 must be turned "On" when the FOSTCR is to be used in a multi-drop ring configuration. It must be turned "Off" when the FOSTCDR is to be used as either end of a point-to-point communication line. See Figure 3 for typical system setups using the FOSTCDR in its different modes.

Positions 7 and 8 of SW1 determine when the RS-422/485 driver and receiver are enabled. Position 7 controls the driver and Position 8 controls the receiver. For RS-422 operation, set both switches to the "Off" position. For multi-drop RS-485 four-wire systems, position 7 should be "On" and position 8 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 FOSTCDR.

Table 2 illustrates the switch settings for typical setups.

Table 2: 422/485 Switch Settings

	Position 7 TX Enable	Position 8 RX Enable
RS-485 2-Wire Mode (half duplex)	ON	ON
RS-485 4-Wire Mode (full duplex)	ON	OFF
RS-422 Mode (full duplex)	OFF	OFF

Typical Installation Configuration

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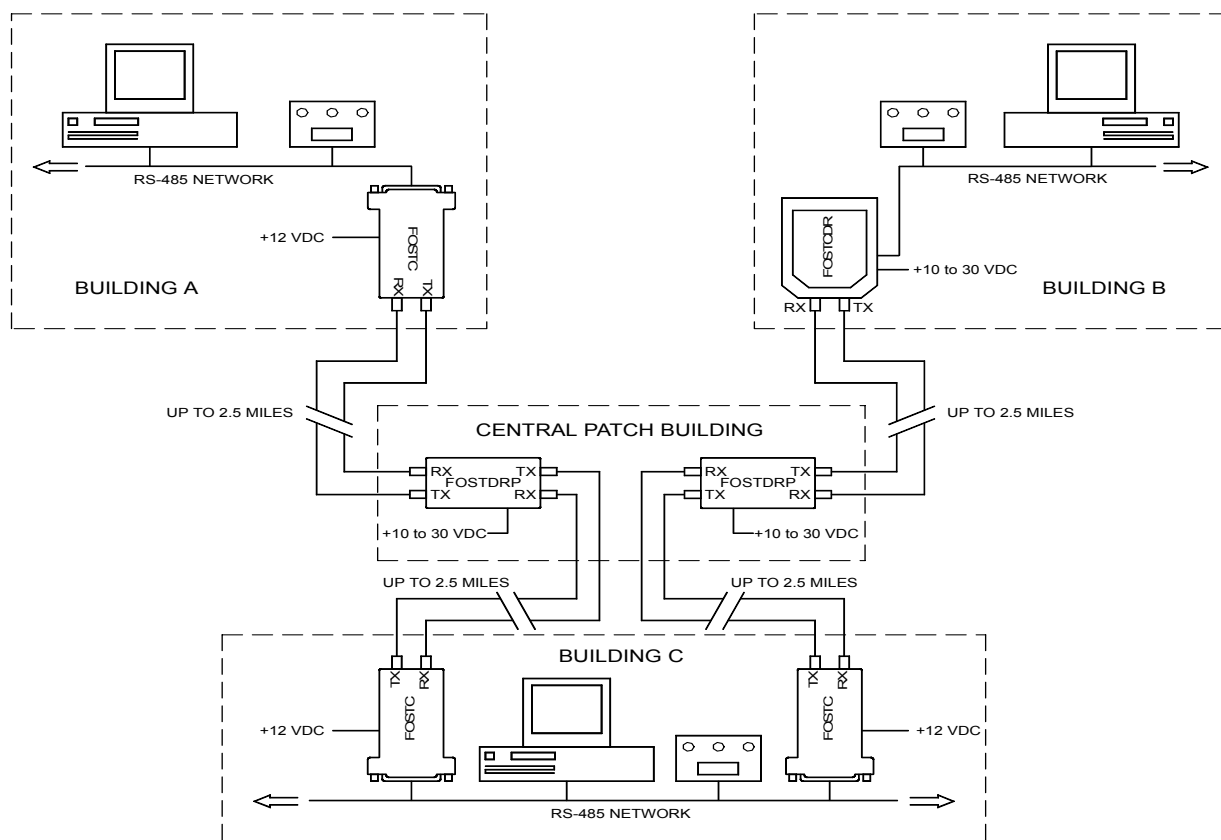

Figure 3. Typical Campus Setup

Multi-drop Operation

A multi-drop configuration is created by forming a ring of FOSTCDRs. 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 SW1:6 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

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:	DB25 female for serial connection, ST connectors for fiber
Dimensions:	4.3 x 2.3 x 0.95 in (11 x 5.9 x 2.5 cm)
Power Supply Connections:	Terminal blocks
Recommended Power Supply:	B&B Model# 232PS4
Temperature Rating:	-40 to +80°C (-40 to +176°F)

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

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	30 VDC	
Power Supply Current Draw			140 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 miles		
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 Miles	(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 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.

Table 4: Recommended Maximum FOSTCDRs in a Fiber Ring Topology

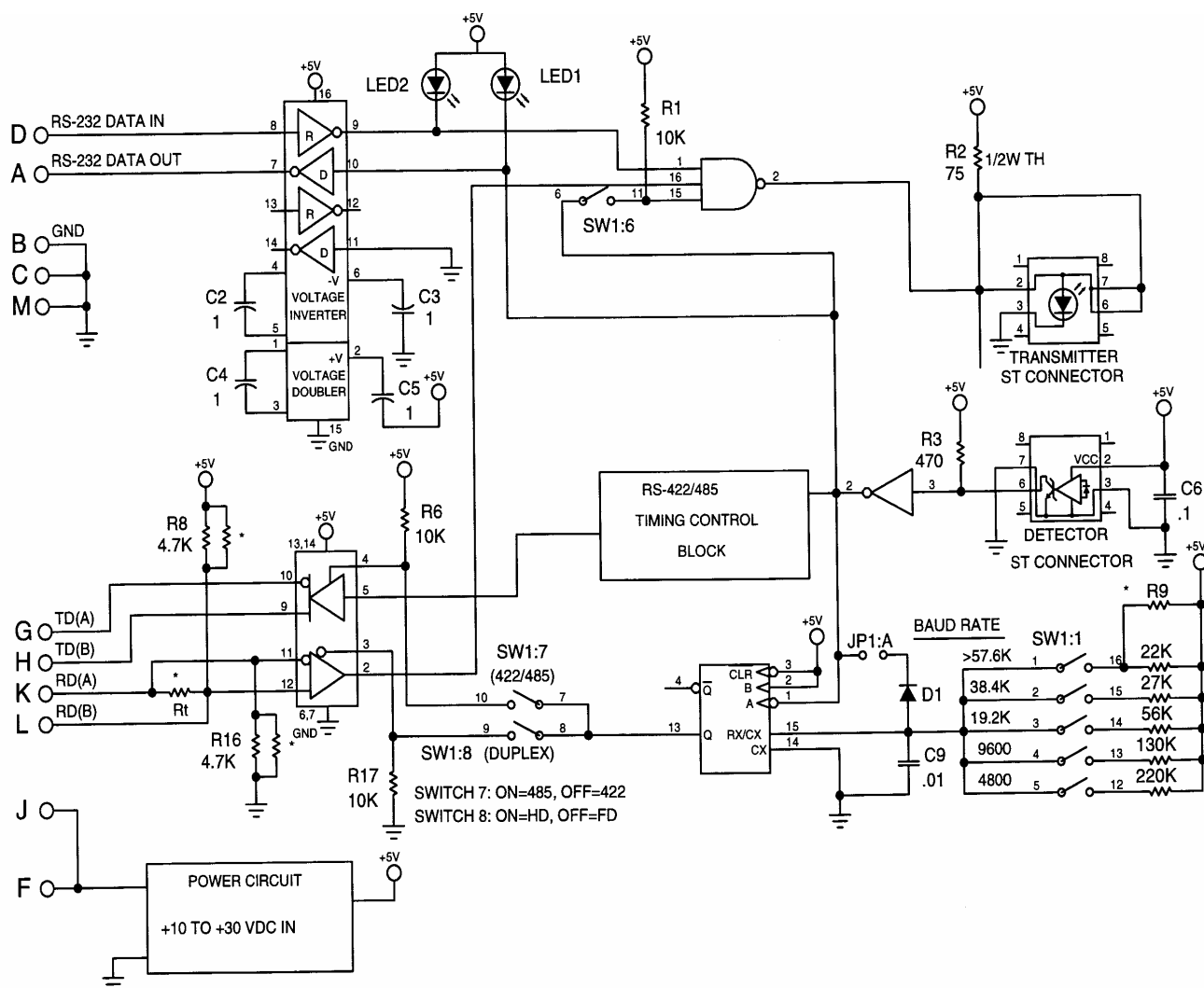| Baud Rate	RS-232 Operation	RS-422/485 Operation
460.8 kbps	N/A	2
230.4 kbps	N/A	4
115.2 kbps	2	8
57.6 kbps	8	16
38.4 kbps	16	24
19.2 kbps and lower	32	32

Figure 4: FOSTCDR Circuit Diagram