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Rdc485fh User Manual

Isolated RS-485 to Dual WDM Hub
Isolated RS-485 to WDM Converter
Isolated RS-485 to Dual Single Mode FO Hub
Isolated RS-485 to Single Mode FO Converter
Isolated RS-485 to Dual Multi Mode FO Hub
Single Mode to Multi Mode FO Converter

1. Product Overview

The rdc485fh is a customizable Fiber Hub that supports up to 2 fiber ports and a RS-485 port. Hence, it can function either as a Converter/Repeater or a Hub. When only 2 ports are installed, it acts as a transparent converter/repeater, depending on the type of ports installed. When all ports are installed, it acts as a Hub. For both cases, any combination of fiber heads (Single Mode, Multi-Mode, WDM) and connectors (ST, SC, FC) are possible.

Fiber optics signals are intrinsically isolated, and immune to both interference and lightning. Signals in single mode fiber can travel over a much longer distance as compared with those in multi-mode fiber. WDM (Wavelength Division Multiplexing) allows 2 or more optical signals with different wavelengths to "share" a single cable, thus effectively reducing the amount of cables by half.

The rdc485fh is designed to be used in an industrial panel and it provides the following unique combination of features:

- 2.5 KV isolation between RS-485 Port and Power Port.
- Intrinsic isolation between fiber ports and all other ports.
- LED indicators for main power, fiber optic and RS-485.
- Wide power supply range (9 to 48 Vdc)
- Long fiber transmission distance (40 km for singlemode, 20 km for WDM, 2 km for multimode)
- WDM option on fiber side reduces amount of cabling
- Built-in (can be enabled/disabled by user) biasing resistors on RS-485 side

2. Operation

The rdc485fh supports up to 3 ports (2 Fiber, 1 RS-485) as shown in figure 1 below.

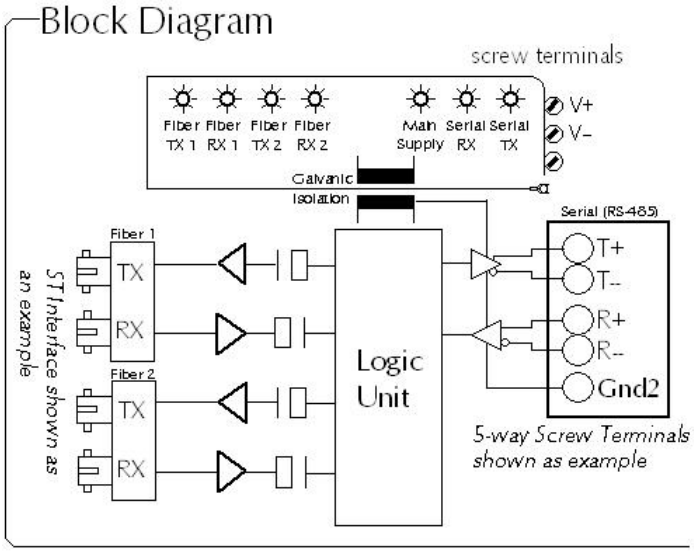


Figure 1 : Block Diagram of the rdc485fh

The *Logic Unit* receives data from any one port and routes the data out via the other 2 ports. For example, data entering Fiber Port 1 will be sent out via the RS-485 port and Fiber Port 2.

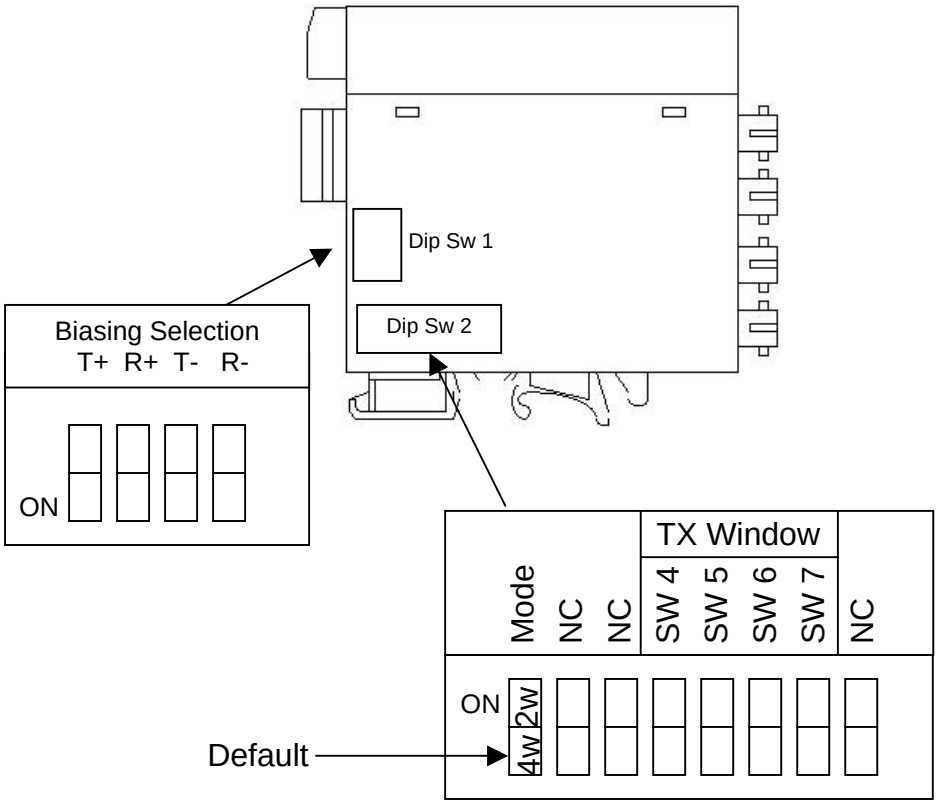
Moreover, not all 3 ports have to be installed (See datasheet for manufacturing options). With 2 ports, the rdc485fh can function as a converter (between RS-485 to fiber or even fiber to fiber like multimode to singlemode etc) or even as a fiber-to-fiber repeater (multimode to multimode, WDM to WDM etc). When 3 ports are installed, the rdc485fh acts as a hub.

Full-duplex operation is always enabled at the fiber side. The RS-485 side will operate in full-duplex mode if, and only if 4-wire mode is enabled.

Take note that hubs, in general, are not designed for full-duplex operation. In the case of the rdc485fh, when full duplex transmissions occur between 2 ports, no data loss will occur. However, the third port will send out garbled information.

3. Installation

Figure 2 below shows the location of all the Dip Switches necessary for configuration.



No	Speed	TX Window				Remarks
		SW 4	SW 5	SW 6	SW 7	
1	9600	OFF	OFF	OFF	OFF	Default
2	19200	OFF	OFF	OFF	ON	
3	38400	OFF	OFF	ON	ON	
4	57600	OFF	ON	OFF	OFF	
5	115200	ON	OFF	ON	ON	

Figure 2 : Location of Dip Switches

3.1 RS-485

Mode Selection

The rdc485fh can operate in either 2-wire or 4-wire (default) mode. Its operating mode can be selected by Dip Switch 2 as shown in figure 2.

Proper Biasing

The rdc485fh only works with a proper bias applied to each RS-485 wire pair. These bias (pull-up and pull-down) resistors prevent an idle (floating) wire pair from picking up noise. For convenience, the rdc485fh has four built-in 470-ohm resistors (2 for each wire pair) and they can be enabled or disabled by Dip Switch 1 as shown in figure 2. T+ and T- refer to the pull-up and pull-down resistors respectively of the transmit wire pair. The same thing applies to R+ and R-. Each wire pair must have at least one set, but not more than 2 sets of bias resistors enabled at any one time.

Proper Termination

Each RS-485 wire pair requires a terminating resistor at the start and end of the bus. These resistors help to reduce signal reflections on the bus, especially for long distance lines and/or at higher baud rates. The value of this resistor is dependent on the characteristic impedance of the cable (120 to 150 ohms is a common value, but other values are available as well). As such, the rdc485fh does not provide any terminating resistor. It is up to the user to add the terminating resistors externally. For RS-485 lines operating in 2-wire mode, 2 resistors are required (one for each end). In RS-485 4-wire mode, 4 will be required (2 in each wire pair).

TX Window / Speed Selection

All RS-485 transmitters must "release" the bus after it is done transmitting. The time taken for a transmitter to release the bus is known as the "turn-around" time. The rdc485fh needs 3 ms to turn-around. If this value can be set on the master and slave(s), then the TX Window can be ignored (i.e. set SW4 ~ SW& to "OFF"). If a near instantaneous turn-around is required, then this can be done by setting Dip Switch 2 as shown in figure 2. If speeds other than those shown are required, use the next slower speed setting. Take note however, that the rdc485fh is tested to operate from 9600 to 115200 bps.

3.2 Fiber Optic

The rdc485fh has can be fitted with ST, SC or FC connectors. Note that all fiber optic cables need gentle handling and have a specified minimum bend radius. Please refer to your cable specs for details, but it is recommended that some space be provided to neatly coil extra fiber in a loop about 6-inch or 15 cm in diameter.

With the exception of WDM heads, all connections between 2 fiber devices should be "crossed". In other words, the transmit port of one device should be connected to the receive port of the other, and vice versa.

WDM heads have full-duplex capabilities while running on a single fiber cable. This is because both signals in the cable are transmitting at different wavelengths. Hence, there is only one connector for WDM heads.

Take note that the WDM heads in the rdc485fh come in types 'a' and 'b' (see datasheet for more details on the part number). Type 'a' heads transmit at a wavelength of 1310 nm and receive on 1550 nm while type 'b' heads transmit at a wavelength of 1550 nm and receive on 1310 nm. Hence, type 'a' heads must be paired with type 'b' heads.

The maximum transmission distances for the various types of fiber heads are dependent on the link loss budget. If there are splices or additional connectors along the fiber lines, then the maximum distances may not apply.

3.3 Power

The rdc485fh will accept any DC voltage in the range of 9 ~ 48 Vdc. It will work off 9, 12, 15 and 24-volt power supplies or direct power up from 12 or 24-volt battery systems.

4. Typical Applications

4.1 Distance Extension (Between Serial/Fiber)

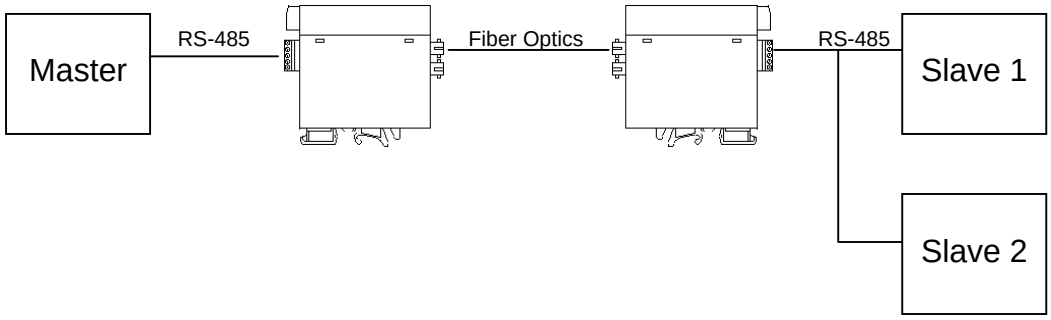


Figure 3 : Serial to Fiber distance extension

The rdc485fh extends communication distance between the Master and the Slaves as shown in Figure 3 above. In this case, it would be a good idea to use WDM heads because

(i) the number of fiber optic cables required would be halved.
(ii) there would be no chance of reversing the TX and RX connections because there is only one connector.
(ii) the probability of failure due to fiber optic cables would be lower. (See Appendix 1 for mathematical proof.)

4.2 Distance Extension (Between Fiber to Fiber conversion)

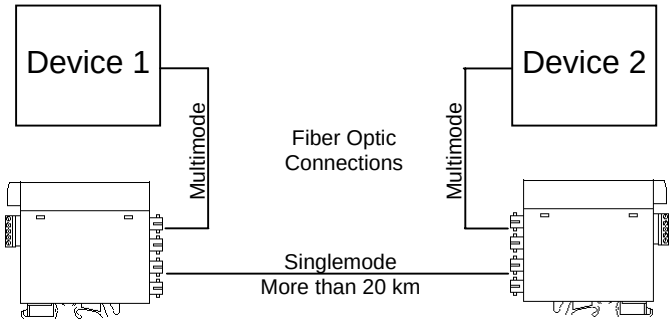


Figure 4 : Fiber to Fiber distance extension

As shown in figure 4 above, the rdc485fh extends the communication distance of Device 1 and Device 2 by performing fiber optic signal conversions between multimode and singlemode. Any combination of fiber optic heads (Multimode, Singlemode, WDM) and connectors (ST, SC, FC) is also possible.

4.3 Fiber Signal Distribution

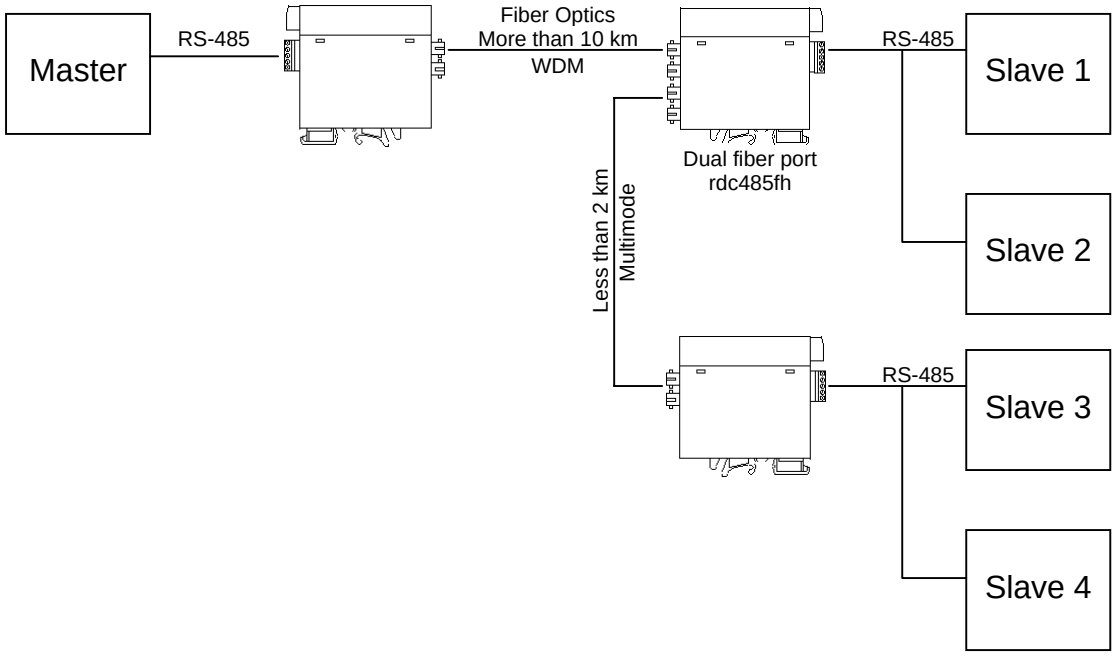


Figure 5 : rdc485fh as a fiber signal distributor

When configured as a hub as shown in figure 5 above, the rdc485fh functions as a fiber signal distributor. Moreover, the rdc485fh converts a bi-directional WDM signal to a dual fiber multimode signal. In this case, it is recommended to use WDM for the long distance (more than 10 km) section and multimode for the short (less than 2 km) one.

5. Technical Specification

5.1	Interface	: Single mode 1310 nm : Multi-mode 1300 nm : WDM 1310/1550 nm
5.2	Connector	: ST, SC, FC connectors for fiber heads : 5-way Removable Screw Terminals for RS-485 side : 3-way Screw Terminal for Power Supply
5.3	Loss Budget	: 9 dBm for multimode on 62.5/125 um cable : 12 dBm for WDM heads on 9/125 um cable : 19 dBm for singlemode heads on 9/125 um cable
5.4	Power Supply	
5.4.1	Operating Voltage	: 9 to 48 Vdc
5.4.2	Power consumption	: 2.4 W Nominal (100 mA @ 24 Vdc), 2.6 W Max
5.4.3	User Indications	: Green LED for main power supply
5.5	Isolation	
5.5.1	RS-485 and Supply	: 2.5 KV
5.5.2	Intrinsic isolation at Fiber Ports	

5.6 Communication

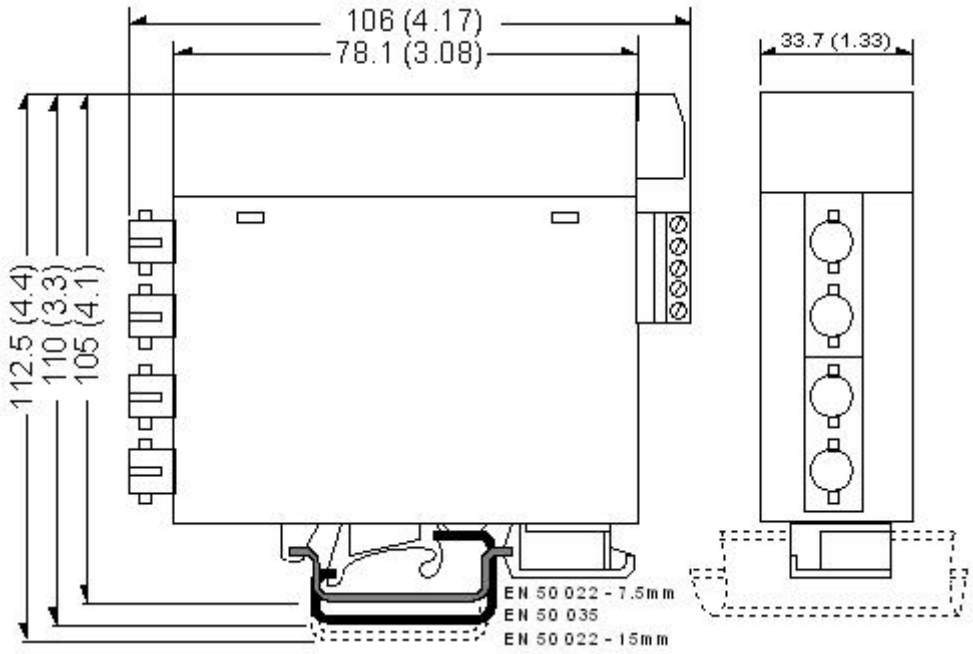
5.6.1	Maximum Speed	: Up to 115 kbps
5.6.2	Character Setting	: Transparent, no configuration required
5.6.3	User Indications	: Yellow LED indicators for all ports
5.6.4	Practical Distance	: Up to 2 km for multimode
		: Up to 20 km for WDM
		: Up to 40 km for singlemode

5.7 Environmental

5.7.1	Operating Temp	: 0C to +60C
5.7.2	Storage Temp	: -40C to +100C
5.7.3	Relative Humidity	: 10-90%, non condensing
5.7.4	Casing	: nylon polymide, fungus and termite resistant
		: self-extinguishing per UL 94 V2

5.8 Mechanical Dimensions

5.8.1	Height, Width, Depth	: (See drawing)
5.8.2	Weight	: Approx.: 130g
5.8.3	Terminal Capacity	: 2.5mm(12AWG)
5.8.4	Mounting Rail	: DIN EN 50022(35mm sym)
		: DIN EN50025 (32mm sym)
		Note: Its difficult to remove from a DIN EN50025 rail.



Appendix 1

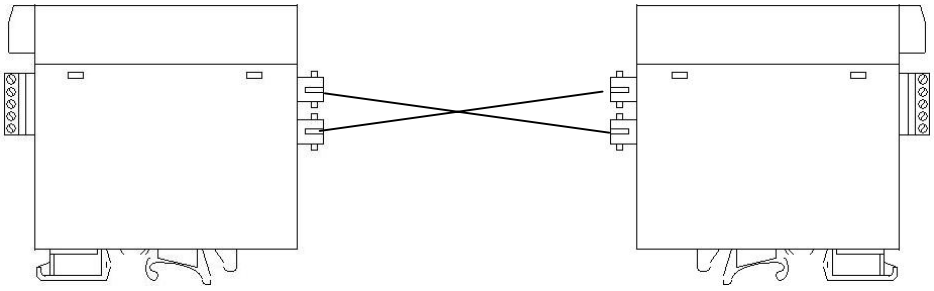


Figure 6 : Standard connection for non-WDM fiber

As shown in figure 6 above, standard fiber optic connections (dual cables) are crossed (i.e. TX to RX etc). We define a case of total communication failure if both, or any one of the fiber optic cable fails.

Let PTF = Probability of Total Communication Failure
P1F = Probability of Cable 1 failing
P2F = Probability of Cable 2 failing

Therefore,

PTF(Dual Cable Connection) = P1F(1 – P2F) + P2F(1 – P1F) + P1F * P2F

Or

PTF = 1 – (1 – P1F) (1-P2F)

If P1F = P2F = 5 % , i.e. 0.05, then PTF(Dual Cable Connection) = 0.0975 or 9.75 %

With WDM, there is only one connection.
This implies that P2F = 0 (i.e. no chance to fail since it does not exist)

And the equation for PTF(Dual Cable Connection) reduces to

PTF (Single Cable Connection) = P1F

Hence, the PTF(Single Cable Connection) is simply 0.05 or 5 %.

In conclusion, the probability for total communication failure is higher for dual cables as compared to single cables.