RDC485FO USERS MANUAL

INDUSTRIAL FIBER-OPTICS TO RS-485 (2 OR 4-WIRE) SERIAL CONVERTER
(DEFAULT FACTORY SETTING: 4-WIRE MODE)

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1. INTRODUCTION

The rdc485fo is an industrial-grade fiber optic to RS-485 serial converter. It helps you do your job faster and better, and unlike cheaper commercial-grade products, you'll be able to install and forget about it.

1.1. Product Overview

The rdc485fo is designed specifically for use in industrial panel applications. It provides the following unique combination of features:

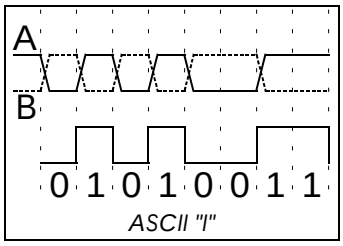
- Fiber optics provides an intrinsically 100% galvanically isolated, noise-free, lightning immune data communications signal. The rdc485fo uses high-quality Agelant (HP) components to communicate up to 4km at 820nm over 62.5/125, 100/140, or 50/125 µm multimode fibers. The standard connector is ST, SC and SMA.
- The rdc485fo fully supports EIA/RS-485 in 2 or 4-wire mode, plus is fully compatible with most EIA/RS-422 4-wire links.
- Unlike self-powered (parasitic) fiber optic units which draw limited power from a computer interface, the fully powered rdc485fo offers 100% predictable performance 24-hours a day, 365 days a year.
- The serial port is a removable 5-screw compression terminal for industrial sized field wires.
- Optionally, the serial port of the rdc485fo can have 2500v optical/galvanic isolation from the power supply. This is critical with most DC powered systems.
- For rapid troubleshooting, there are LED indicators for data transmission and power status.
- Wide power supply range (9 to 36vdc) allows use with 9v, 12v, 24v supplies or direct from 12v or 24v battery systems. Optional model rdc485fo-hv supports 38 to 58vdc for use with 48vdc power systems. For 110vac or 230vac operation, any common 9v or 12vdc wall transformer can be used.

1.2. User Interface

The rdc485fo is designed for user-friendly application. Green LED **ps/v+** lights when external power is properly applied. Green LED **ps/iso** lights when the internal isolating DC-to-DC converter is working properly. This isolation provides over 10,000,000 ohms of resistance between the power supply ground and serial in-R

terface ground to eliminate ground loops. Yellow LED **rx/serial** lights when any data is received on the serial interface. Yellow LED **rx/fiber** lights when any data is received on the fiber optic interface. Terminals **V+** and **0v-** are the DC power supply inputs. Terminal **pstest** is a well-regulated 5vdc output with reference to 0v- and can be used to draw up to 100mA of 5vdc power for other uses.

1.3. What is RS-485?



RS-485 is a half-duplex data communication standard that can be used for point-to-point or multi-drop applications. It uses twisted wire pairs. Data is transmitted by a differential voltage signal. ***The two wires in a pair are not a loop*** -- both are '+' signals sourcing current to a third "virtual" ground conductor. For example, here is the differential signal for an ASCII character 'I'. Labels vary from vendor to vendor. The most common are to label them “A” and “B” or “+” and “-“. Data is represented by the relative voltage of A to B. When $V_A < V_B$, then the data is a binary 1. When $V_A > V_B$, then the data is a binary 0. An idle line without data will be in the binary 1 state. This differential voltage signal is quite robust and not susceptible to noise or minor shifts in signal reference ground.

1.4. Two or Four Wire RS-485

2-wire RS-485 is strictly half-duplex. One wire pair is used as a bi-directional bus, first transmitting a "request" and then receiving a "response". Many industrial products support both 2 or 4 wire RS-485. Providing terminals for 4-wire, they allow external jumpers to short the two “+” signals and two “-“ signals for 2-wire.

4-wire uses two twisted wire pairs - one for transmit and one for receive. The Tx pair is used by a master device to communicate with the slave devices, and the Rx pair is used by the slave devices to respond. 4-wire RS-485 is more robust than 2-wire with low quality cable or high environmental noise. It also reduces the data communication interrupt load on the slave devices.

Note that there is a special form of 2-wire RS-485 which allows an optional 2nd wire pair to be used as a control (RTS) signal to manage repeaters in the system.

2. DETERMINING EIA/RS-485 TERMINAL NAMES

Due to the “relative” naming conventions in the EIA/RS-485 standard, wiring multi-vendor RS-485 devices often involves wiring apples to oranges. It may even require some bench-top experimentation. Fortunately the EIA/RS-485 interface cannot be damaged by reverse wiring or short-circuits to ground.

2.1. Per EIA/RS-485

EIA/RS-485 defines the labels "A" and "B" to be used as follows: Voltage of A shall be negative in respect to B for a binary 1. Sounds simple? Unfortunately, there are two common logic systems. Computer systems treat 0v and 5v as 0 and 1 respectively, while the most common RS-485 chips label (and general telecommunications) treat 0v and 5v as 1 and 0 respectively. To avoid the issue, many vendors select other naming conventions.

2.2. Determining your terminal names

RDC names it's A/B terminals as "-" and "+" respectively - since when measured by a volt meter, the "A" terminal of an idle asynchronous RS-485 data line will be a lower voltage than the "B" terminal. Another common naming conventions is to label them as "X"/"not X", where X is a name like DAT or BUS, and the "not" condition is marked either by a bar over the name or a leading "*". An example would be "DAT+/DAT-" or "DAT/*DAT". Generally the "--" and "not" terminals correspond to "A", but vendors are free to label them opposite here as well.

A direct method to determine the absolute A/B terminals would be helpful. If your asynchronous device outputs a voltage when idle, then the terminal with the higher voltage is "+". Unfortunately, most devices will show no measurable voltage difference between their terminals; slave devices are normally in receive mode and do not affect the terminal voltage.

3. INTERNAL JUMPER SETTINGS

3.1. Selecting 2 or 4-wire operation

The left-most 2 jumpers (**4W** and **2W**) define 2 or 4-wire operation. The default factory setting: 4-wire mode. For RS-485 2-wire, place a shunt/jumper on the **2W** position only. For RS-485 4-wire or RS-422, place a shunt/jumper on the **4W** position only. You are not required to externally short T+/R+ and T-/R- for 2-wire operation.

3.2. Placing your bus terminating resisters

Each RS-485 wire pair requires one or two 120 ohm terminating resisters - assuming your cable has a characteristic impedance of 120 ohms. The rdc485fo has two internal 120 ohm terminating resisters enabled by the **R-Term** and **T-Term** jumpers. For RS-485 2-wire bus or point-to-point link, you must enable a terminating resister at each end (total 2 for this 1 pair). For RS-485 4-wire point-to-point link, you must enable a terminating resister at each receive end (total 1 for each pair, 2 for the 2 pair). For RS-485 4-wire bus, you must enable a terminating resister at each end of each pair (total 2 for each pair, 4 for the 2 pair). If your cable has a different impedence – for example you'll find quality 100 ohm twisted pair cable easier to buy – you can disable the internal jumpers and install external terminating resisters.

3.3. Placing your bus bias resisters

The rdc485fo only works with a proper bias applied to each pair. These bias resisters prevent an idle (floating) wire pair from causing noise, plus this bias is critical to proper "auto-line-turnaround". The rdc485fo has four internal 470 ohm bias resisters. The jumpers **R-Bias-** and **R-Bias+** enable the pull-up/pull-down bias on the receive wire pair R+/R-. The jumpers **T-Bias-** and **T-Bias+** enable the pull-up/pull-down bias on the transmit pair T+/T-. jumpers. Each wire pair must have at least one, but no more than two sets of bias resisters enabled.

Refer to our website link, Products-->Jumper Settings, to learn how to open casing.

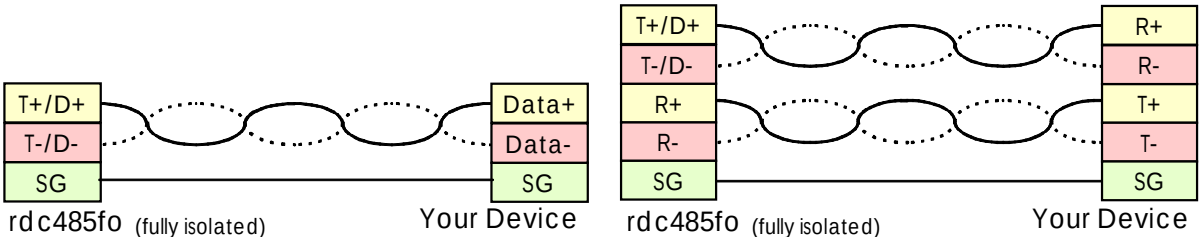
4. INTERFACE WIRING

4.1. Fiber Optics Connection:

The rdc485fo has either 2 ST-compatible bayonet connectors (option -st) or 2 SMA threaded connectors (option -sma). 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 you should plan on providing space to neatly coil a 6 inch or 15cm loop diameter of extra fiber. The rdc485fo's transmit (TX) connector is connected to the receive (RX) connector of the remote device, and the rdc485fo's receiver (RX) connector is connected to the transmitter (TX) connector of the remote device,

4.2. RS-422 & RS-485 wiring (fully isolated, model: rdc485fo–2p)

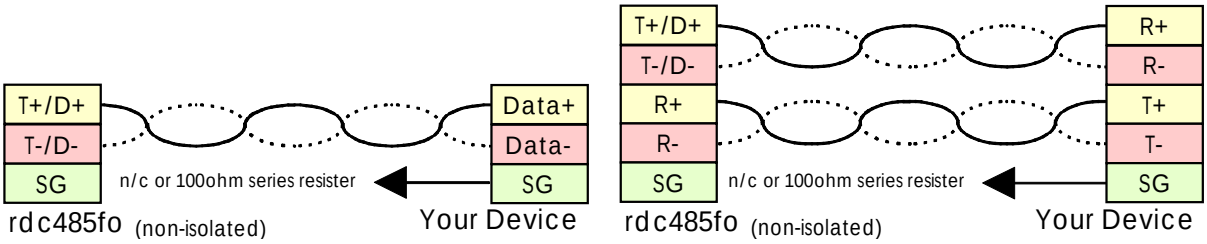
For galvanically isolated rdc485fo the signal ground (SG) must be connected for RS-422 and RS-485. It is also ***critical that the Signal Ground be properly connected - you void your warrantee if you do not connect this ground properly***. If your RS-485 bus does not have the 3rd ground wire, then you should at least connect the Signal Ground (SG) of the RS-485 to the nearest device's digital ground. See *RDC application note AN005 (Grounding for RS-422/485)* for more information on the importance of this ground.



RS-485 2-wire ***RS-422 or RS-485 4-wire***

4.3. RS-422 & RS-485 wiring (non-isolated, model: rdc485fo–1p)

For non-isolated rdc485fo, the signal ground should be left unconnected or (per EIA/RS-485) you should insert a 100 ohm 1 watt resister in series with your signal ground wire. Since in the non-isolated rdc485fo the RS-485 signal ground is shorted to your 0v- power supply ground, this resister discourages damaging ground surges rom damaging either the rdc485fo or your attached device. See RDC *application note AN005 (Grounding for RS-422/485)* for more information on the importance and possible designs for this ground.



RS-485 2-wire ***RS-422 or RS-485 4-wire***

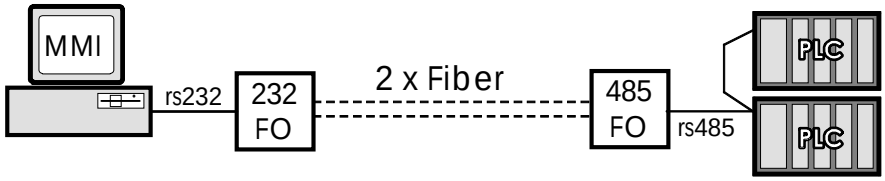
5. TESTING YOUR OPTIC FIBER:

The easiest way to test your rdc485fo is to reverse wire the RX+ and RX- terminals from a standard RS-422 TX+ and TX-. This causes the rdc485fo to think it's seeing a continuous binary "0", which turns the fiber transmitter on. The light from the transmitter can easily be seen with the naked eye. Since this isn't a laser-diode, this is safe to look at. At the remote end, you can easily see which fiber in a multi-fiber cable is emitting the light, and if connected to the remote device, it's "Receive" LED should light.

6. APPLICATION EXAMPLES

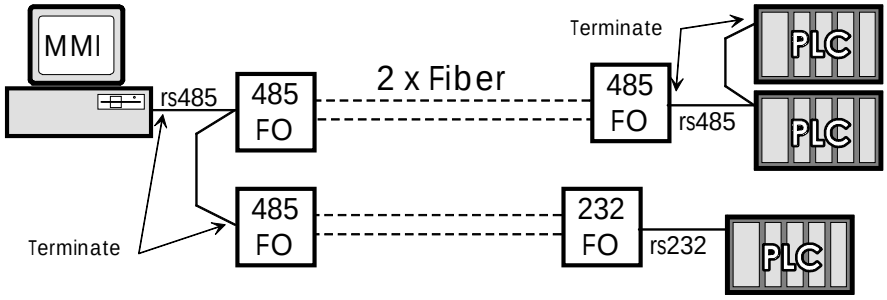
6.1. Standard Point-to-Point Connection

When most industrial people use fiber optics, they use it in a point-to-point connection. The fiber is functioning like a modem or line driver. This example also highlights mixing the rdc232fo to support RS-232 at one end and the rdc485fo to support multi-drop RS-485 at the other end. Of course, two rdc485fo can also be connected in a point-to-point link, plus 2-wire at one end can be mixed with 4-wire at the other end.



6.2. Robust 'Star' Multi-Drop Design

A robust "multi-drop" design uses multiple rdc485fo near the Master in an RS-485 multi-drop bus. A master poll is repeated out each of the central rdc485fo units. The master device must also support RS-422 or RS-485 (2 or 4-wire). If your Master device has an RS-232 port, the RobustDC rdc485ic makes an ideal RS-232 to RS-485 converter. You'll find using RS-485 4-wire with a shared signal reference is the most robust installation. Plus using RS-485 4-wire at the master is more efficient since the central rdc485fo will NOT repeat the slave responses back out to the remote slaves - only the Master device see the slave responses. The rdc485fo can be configured for RS-485 4-wire whether the master device has an RS-422 or an RS-485 4-wire interface.



7. TECHNICAL SPECIFICATION

7.1. Port Description

7.1.1. **RS-422, RS-485**; Working voltage range +12/-7vdc; Max voltage range ±15vdc; Max surge ±25vdc

7.1.2. **Fiber Optics**; 820nm over 62.5/125, 100/140, or 50/125 µm fibers. ST, SC or SMA connectors.

7.1.3. **Speed**; Tested to 115K baud; No configuration required

7.1.4. **Character Setting**; any combination of parity, data, stop, and start bits; No configuration required

7.2. Isolation (Per ISO/IEC 9549)

7.2.1. **Fiber Optics**; intrinsic full isolation

7.2.2. **RS-485 to Supply**; ; model "-1p" none ; model "-2p" 2500v (galvanic, 3Kv test)

7.2.3. **Casing**; dielectric strength per DIN VDE 0303/part 2 is 400kV/cm

7.3. Power Supply

7.3.1. **rdc485fo-5v**; regulated 5vdc ±5%; 1watt (Max 200 mA)

7.3.2. **rdc485fo-dv**; unregulated 9 to 36 vdc; 1.2 watt (Max 50 mA at 24vdc)

7.3.3. **rdc485fo-hv**; unregulated 38 to 58 vdc; 1.44 watt (Max 30 mA at 48vdc)

7.4. Environmental

7.4.1. **Ambient Operating Temp**; -40°C to +65°C

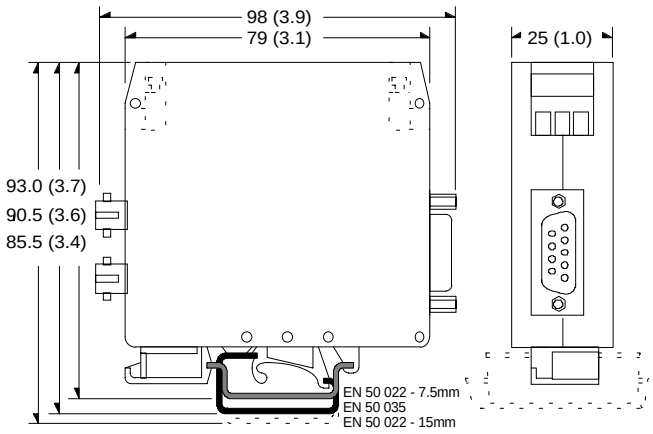
7.4.2. **Ambient Storage Temp**; -40°C to +100°C

7.4.3. **Relative Humidity**; 10-90%, non condensing

7.4.4. **Casing;** fungus and termite resistant

7.4.5. **Casing; flame characteristics**:
self-extinguishing per UL 94 V2

7.5. Mechanical Dimensions



7.5.1. **Height; Width; Depth** (See drawing).

7.5.2. **Weight**; less than 130g.

7.5.3. **Terminal Capacity**; 2.5mm (12 AWG)

7.5.4. **Mounting Rail**; DIN EN 50022 (35mm sym)
DIN EN 50025 (32mm asym) *Note: removal from a DIN EN 50025 rail is difficult*.