Block 208 Hougang Street 21
#04-213 Singapore (530208)
Tel: (65)62843373 Fax: (65)62857737

ECD485IC USERS MANUAL

ISOLATED RS-232 TO RS-485 CONVERTER
FOR 2 AND 4-WIRE RS-485 WITH GROUND WIRE

1. INTRODUCTION

RS-485 has become one of the most common data communication standards in "open" multi-vendor automation projects. More robust than RS-232 and more flexible than RS-422, it allows a single master device to communicate with multiple slave devices.

1.1. Product Over-view

For robust operation, the ECD485ic is an essential component of your industrial applications. It provides the following unique combination of features:

Safely converts between EIA standard RS-232 and RS-485 signals.

Isolates and protects the data signals and power supply grounds.

With floating grounds, RS-232 cable runs up to 50m can be guaranteed with quality, low-capacitance cable like Beldon 1422A at 42pF/m. (RS-232 requires < 2500pF per signal wire.)

Over 2500v optical isolation between RS-232 and RS-485 (5kv test isolation) and 2500v galvanic isolation between RS-485 and the power supply (3kv test isolation). The full isolation 3-port model also has isolation between RS-232 and power supply.

For rapid troubleshooting, LED indicators for the TX, RX, and power status.

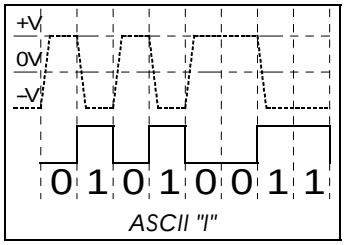
Wide power supply range (9 to 36vdc) with spike protection allows use with 9v, 12v, 15v, 24v power supplies or direct from 12v or 24v battery systems.

Offers the option of 9-pin d-sub shell connector (AT style) or large capacity (2.5mm²) compression screw terminals, giving maximum flexibility in installation in panels and terminal boxes.

9-pin female "DCE like" ports allow use of ribbon cables from 9-pin computer ports.

600 watt transient suppresser diodes are installed on isolated ports (600w for 1ms with less than 1psec response to over-voltage)

1.2. What is RS-232?



RS-232 is an interface standard - not a data communication standard. This means it can only go short distances and has very limited driving power. It provides full-duplex, point-to-point data transfer between two devices. The signal ground is included as one of the wires, so it is *very* susceptible to damaging ground loops. Data is transmitted as a voltage polarity relative to the common signal ground. For example, here is the signal for an ASCII character 'I'. When signal voltage > +3v, then the data is a binary 0. When signal voltage < -3v, then the data is a binary 1. A voltage signal between -3v and +3v is undefined. An idle line without data will be in the binary 1 state. This voltage signal referenced to a shared ground is quite susceptible to noise, plus the existence of the ground wire leads to grounding and surge problems.

1.3. What is RS-485?

RS-485 is a half-duplex data communication standard which can be use 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'. Though labels vary from vendor to vendor, one wire of the pair is often labeled A and the other B. 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.

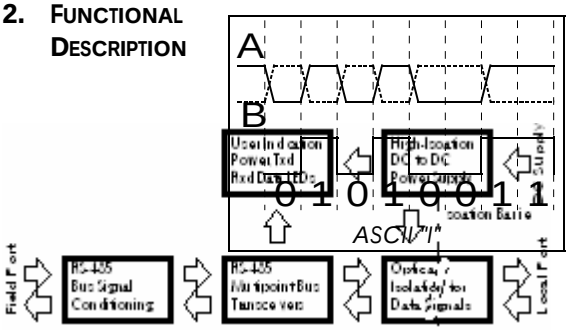
1.4. Two or Four Wire RS-485

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 A signals and two B 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. FUNCTIONAL DESCRIPTION



2.1. Isolated Power Supply

A power conditioning circuit steps 9-36vdc down to a stable, filtered 5vdc. High isolation DC-to-DC converters convert this to one or two isolated 5vDC supplies. In all models (-2p and -3p), RS-485 port-A has a fully isolated supply. In the case of full 3-of-3 port galvanic isolation models (option -3p), RS-232 port-B also has an isolated supply, while in the partial 2-of-3 port galvanic isolation models (option -2p), RS-232 port-B is powered directly from the filtered 5vdc without isolation.

2.2. Optical Isolation for Data Signals

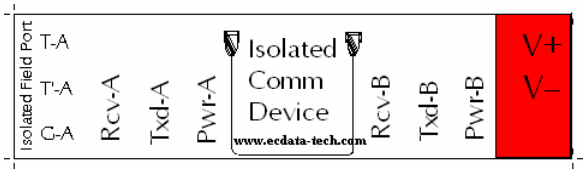
Digital opto-couplers are used to move the data signals between the two sides of the converter. These are superior to the more common analog opto-couplers, as they add little distortion and therefore support high baud rates. The isolated power supplies and optical data signals complete the galvanic isolation required.

2.3. RS-485 Bus Transceiver

Line interface driver/receiver chips convert the field signals to standard TTL-level signals. The full EIA/RS-485 specification is meet by using SN75176 compatible chips. Since 2-wire RS-485 is a bi-directional bus, it requires the transmitter/receiver circuit to switch between transmit and receive as appropriate - the ECD485ic uses

an effective method to do this with 100% software transparency.

2.4. User Indication



The face of the ECD485ic is shown above. Green LEDs (Pwr-A & Pwr-B) light showing isolated power is available from the isolated DC-to-DC converters. Yellow LEDs (Rcv-A, Txd-A & Rcv-B, Txd-B) light when data is received and transmitted on the respective port (RS-485 is port A, RS-232 is port B).

2.5. Signal Conditioning

For normal operation, the ECD485ic has 6 jumpers installed to terminate and bias the RS-485 interface. These are only removed when more than two (2) units of ECD485ic are connected to the same RS-485 wire pair. For example, if 4 units of ECD485ic connect to a wire pair, at least 2 of them must have all 3 jumpers removed. Both ports have transient suppression diodes rated at 500w or higher.

3. Determining RS-485 Terminal Names

Due to a lack of naming conventions, wiring multi-vendor RS-485 devices often involves wiring "apples" to "oranges". It may require some bench-top experimentation. While this sounds bad, it is often required when integrating multi-vendor systems. Neither the RS-485 nor the RS-232 interface can be damaged by reverse wiring or short-circuits to ground.

3.1. Per EIA-485

EIA-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.

3.2. Determining terminal names

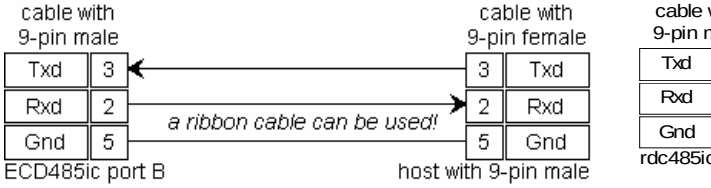
EC Data names it's A/B terminals as "-" and "+" respectively - since when measured by a volt meter, the "A" terminal of an idle asynchronous RS-485 data line will be a lower voltage than the "B" terminal. Another common naming conventions is to label them as "X"/"not X", where X is a name like DAT or 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.

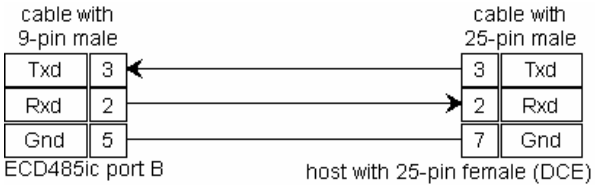
4. Installation

4.1. Making Standard RS-232 Cables

The ECD485ic has one 9-pin female connector which looks like a 9-pin "modem" or DCE port.



Cable A : host with 9-pin DTE port



Cable C : host with 25-pin DCE port

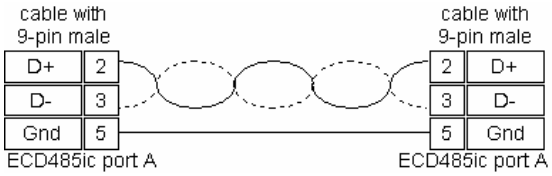
4.2. Plan your RS-485 wiring (Screw Terminal Models - cc & cd)

For 2-wire RS-485, all "+" terminals connect to one wire of the pair, and all "-" terminals to the other wire. As a convention, EC Data suggests choosing the darker wire (or solid color) for "+" and lighter color (or striped) for "-". Since the bus is bi-directional, all terminals "+" and "-" both transmit and receive when appropriate. *Remember, RS-485 is NOT a loop.*

On the ECD485ic, the top screw terminals are physically labeled D+A, D-A, Gnd-A. On the removable terminals this is labeled T+, T-, R+, R-, SG. Note that the important thing is the "+" and "-" in the names. The D+A top terminal and the T+ terminal are internally connected, as are the D-A and T-. With 2-wire RS-485 you can easily use 2 wire lugs on the Port A side - great when you are doing a multi-drop bus without stubs.

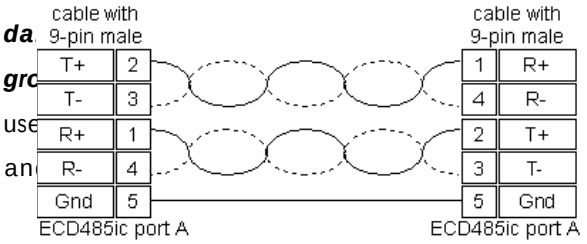
It is also ***critical that the Signal Ground be properly connected - you void your warrantee if you do not connect this ground properly***. If your RS-485 bus does not have the 3rd ground wire, then you should at least connect the Signal Ground (Gnd-A or SG) of RS-485 to the nearest device's digital ground.

4.3. Plan your RS-485 wiring (D-Sub Shell Models - dd)



RS-485 2-wire Cable

Standard RS-232 interface devices cannot be da
gr
use
an

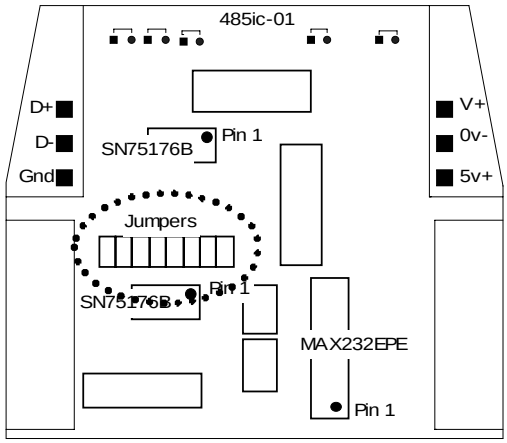


RS-485 2-wire Cable

With the 9-pin D-sub shell option for the RS-485, the same 2 or 4-wire signals are available on pins 2, 3, 5 and 1, 2, 3, 4, 5 respectively. The diagram above shows how to write a cable between 2 units of ECD485ic. To facilitate making multi-drop cables each signal (but ground) is available on 2 pins. Pin #1 (R+) is also on pin #6, pin #2 (T+) is also on pin #7, pin #3 (T-+) is also on pin #8, and pin #4 (R-) is also on Pin #9.

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 (Gnd-A or SG) of RS-485 to the nearest device's digital ground.

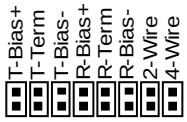
4.4. Placing your bus terminators



Jumper location

Each RS-485 segment requires a 120 ohm terminating resister at each end - assuming your

cable has a characteristic impedance of 120 ohms.



Detail of jumpers

4.5. Planning the panel wiring

Power Supply: The ECD485ic (9 to 36vdc) is fully protected from reverse wiring and will sustain no damage. The ECD485ic (5vdc +- 5%) model is partially protected and if a fuse is installed in the V+ supply wire, should not sustain any damage.

RS-485 Fuses: RS-485 field wires should be protected by 250mA fuses. RS-485 interface ICs are internally protected from short-circuits. These fuses protect the system from over-voltages caused by mis-wiring - for example wiring 110vac to the bus.

RS-485 Lightning Protection: If required, the RS-485 field wires should be protected by standard lightning protection devices. EC Data suggests 15v or 16v surge protection. While many venders suggest clamping surges to 6v or 7v, this disregards that RS-485 can work up to +12 volts. Clamping at too low of a voltage can lead to the RS-485 drivers operating at near short-circuit conditions and driving at the full current. This can cause over-heating of device and/or power supply.

4.6. Physical installation

The unit mounts on a standard DIN rail as listed in the specification.

5. TECHNICAL SPECIFICATION

5.1. RS-485 port Description

5.1.1. 2-wire Signals; D+A, D-A, and Gnd-A, D+B, D-B, and Gnd-B

5.1.2. **Duplex**; half duplex. direction automatic.

5.1.3. **Line Voltage**; -7v to +12v permits 7vdc ground difference between devices.

5.1.4. **Bias**; 470 pull-up (D+A, D+B) 470 pull-down (D-A,D-B) jumper selectable.

5.1.5. **Bus Termination**; 120 jumper selectable.

5.1.6. **Official maximum Bus Length**; 1000m per EIA-485, 500m per ISO 8482

5.1.7. **Practical maximum Bus Length**; 3000m with high-quality cable and other conditions.

5.1.8. **Maximum Speed**; At least 115Kbps

5.2. Isolation

5.2.1. **Power Supply,** between input supply and data signals; full galvanic isolation; 3kV test voltage

5.2.2. **Power Supply,** between input supply and data signals; full galvanic isolation; 3kV test voltage

5.2.3. **Data,** between RS-485 port A and port B; optical isolation; 5kV test voltage

5.2.4. **Encapsulant (if ordered)**: 14,000v per mm

5.2.5. **Overall rating at least 2500v**

5.3. Power Supply

5.3.1. **5v Model**; Supply of 4.75v to 5.25v (175mA average)

5.3.2. **9-36v Model**; 1.2watt (at 24vdc about 50mA)

5.4. Environmental

5.4.1. **Ambient operating temperature**; 0C to +60C

5.4.2. **Ambient storage temperature**; -40C to +100C

5.4.3. **Relative Humidity**; 10 to 95% RH, non condensing

5.4.4. **Casing; fungus and termite resistance**; Good.

5.4.5. **Casing; flame characteristics**: self-extinguishing.

5.5. Mechanical Dimensions

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

5.5.2. **Weight**; 130g.

5.5.3. **Terminal Capacity**;
2.5mm strand (12 AWG)
4.0mm solid (12 AWG).

5.5.4. **Mounting Rail**;
DIN EN 50022 (35mm "symetrical")
DIN EN 50025 (32mm "asymetrical")
Note: it fits best on the DIN 50022 style rail.