

Network Adapter



The FA-ISOCON Universal Isolated Network Adapter is used to place **Automationdirect** CPUs and other RS-232 devices such as operator interfaces and industrial computers on a RS-422 (4-Wire) or RS-485 (2-Wire) multi-drop network. The Network Adapter converts RS-232 signal levels to isolated RS-422 or RS-485 signal levels. All **Automationdirect** CPU ports that support multi-drop networking protocols can be used with the FA-ISOCON.

The FA-ISOCON features Automatic Network Transmitter Enable so that an RTS output is not required on the connected RS232 device.

The FA-ISOCON is a direct functional replacement for the FA-ISONET.

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Benefits of Network Isolation

- ✓ Isolation removes ground loop currents from data lines. The resultant noise voltages due to transformer like coupling are also eliminated.
- ✓ Completely eliminates common mode noise effects.
- ✓ Many forms of radiated noise are reduced to negligible limits.

Example: A host computer and a PLC are linked via a RS-422 4 wire plus ground connection. When an electric motor near the PLC is started up, a momentary difference in ground potentials at the host computer and the PLC may occur due to the surge in current required by the motor. If no isolation is used then data may be lost during the surge interval. A substantial surge could damage the computer.

Hardware Features

- ✓ Automatic Network Transmit Enable so that an RTS output is not required on the connected RS232 device.
- ✓ RS232 connection can be made to an RJ12 connector or to a 4 position removable terminal block.
- ✓ RS422 or RS485 connection is made to a 5 position removable terminal block.
- ✓ Backwards compatible with FA-ISONET.
- ✓ Converts most RS-232 data interfaces to an isolated RS-422 (4-wire plus signal ground) or RS-485 (2-wire plus signal ground) data interface. The minimum RS-232 interface requirement is a TXD output, an RXD input, and a signal ground.
- ✓ Isolated network drivers are short-circuit current limited and over-load protected.
- ✓ Network connections have substantial transient over-voltage protection.
- ✓ Flexible mounting, the included cable and the pre-wired connectors make the Network Adapter very easy to install on **Automationdirect** CPUs.
- ✓ The 5V RS-232 power source is either inside the communication cable connected to the PLC CPU or is derived from the +24V user power supply built into the PLC CPU base power supply.
- ✓ Both 4-wire plus ground (RS-422 full duplex) and 2-wire plus ground (RS-485 half duplex) networks are supported.
- ✓ The termination resistors required at the extreme ends of the network are built-in.
- ✓ Built-in bias resistors prevent reception of erroneous data when the network is idle (all receiver inputs are floating when no transmitter on the network is active).
- ✓ Drivers are slew-rate-limited to minimize EMI and reflections. Provides errorless data transmission.
- ✓ Receive, Transmit and Transmit Enable LED indicators simplify troubleshooting.
- ✓ Designed and tested with **Automationdirect** PLCs for use in a noisy industrial environment.

Basics of RS232, RS422, and RS485

RS232, RS422, and RS485 are electrical interface specifications and recommendations (RS stands for Recommended Standard) that dictate things like signal types, signal levels, maximum number of transmitters and receivers, and maximum distances allowed. The electrical interface does not dictate what software communication protocols (Modbus, DirectNet, K-Sequence, etc) can be used on the interface.

The two basic types of data communication connections are point-to-point and multi-drop. A point-to-point connection connects two devices to each other. RS232, RS422, and RS485 can all be used for point-to-point connections. A multi-drop connection connects three or more devices to each other on a common bus. RS422 and RS485 can be used for multi-drop connections, RS232 cannot be used for multi-drop connections.

RS232 is a single ended point-to-point electrical interface suitable for data communication applications up to 50 feet. On AutomationDirect PLCs, RS232 is typically used for communications between a PC and the PLC when programming the PLC.

RS422 is 4-wire differential point-to-point or multi-drop electrical interface suitable for data communication applications up to 4000 feet. RS422 is specified for one transmitter and up to ten receivers on a daisy chain bus (without a repeater). RS422 uses two pairs of conductors, one pair of conductors to connect the network master transmitter to each of the slaves receivers, and a second pair of conductor to connect all of the network slave transmitters to the network master receiver. The network master can keep it's transmitter on all the time but only one slave at a time may enable it's transmitter.

RS485 is a 2-wire differential point-to-point or multi-drop electrical interface suitable for data communication applications up to 4000 feet. RS485 is specified for up to thirty two transceivers (transmitter/receiver) on a daisy chain bus (without a repeater). RS485 uses one pair of conductors that connect the transceivers of all of the devices on the bus together. Only one device at a time can have it's transmitter enabled.

RS485 can also be wired as a 4-wire differential point-to-point or multi-drop connection. In this case up to thirty two transceivers (transmitter/receiver) can be on a daisy chain bus (without a repeater). The FA-ISOCON uses RS485 for both 2-wire and 4-wire connections. 4-wire RS485 can be connected to 4-wire RS422 devices but then the RS422 specification of one transmitter and ten receivers must be observed.

A typical multi-drop application would be a Modbus network where there is one Modbus Master connected to multiple Modbus Slaves. Any communication protocol where all the devices on the network can properly control the transmitters and the communications timing can be multi-dropped.

FA-ISOCAN Components

- (A) FA-ISOCAN Isolated Network Adapter Module with attached mounting bracket.
- (B) One foot reverse modular cable with two RJ12 6P6C plugs to connect the FA-ISOCAN Network Adapter to **Automationdirect** PLC CPUs with RJ12 connectors.
- (C) One foot cable with RJ12 6P6C plug and RJ11 4P4C plug to connect the FA-ISOCAN Network Adapter directly to the DL340 CPU.
- (D) DB25 Male to RJ12 6P6C Connector (for 405 CPUs, DCM, or 25-Pin PC DTE Serial Ports)
- (E) DB9 Female to RJ12 6P6C Connector (for 9-Pin PC Serial Ports)

Specifications

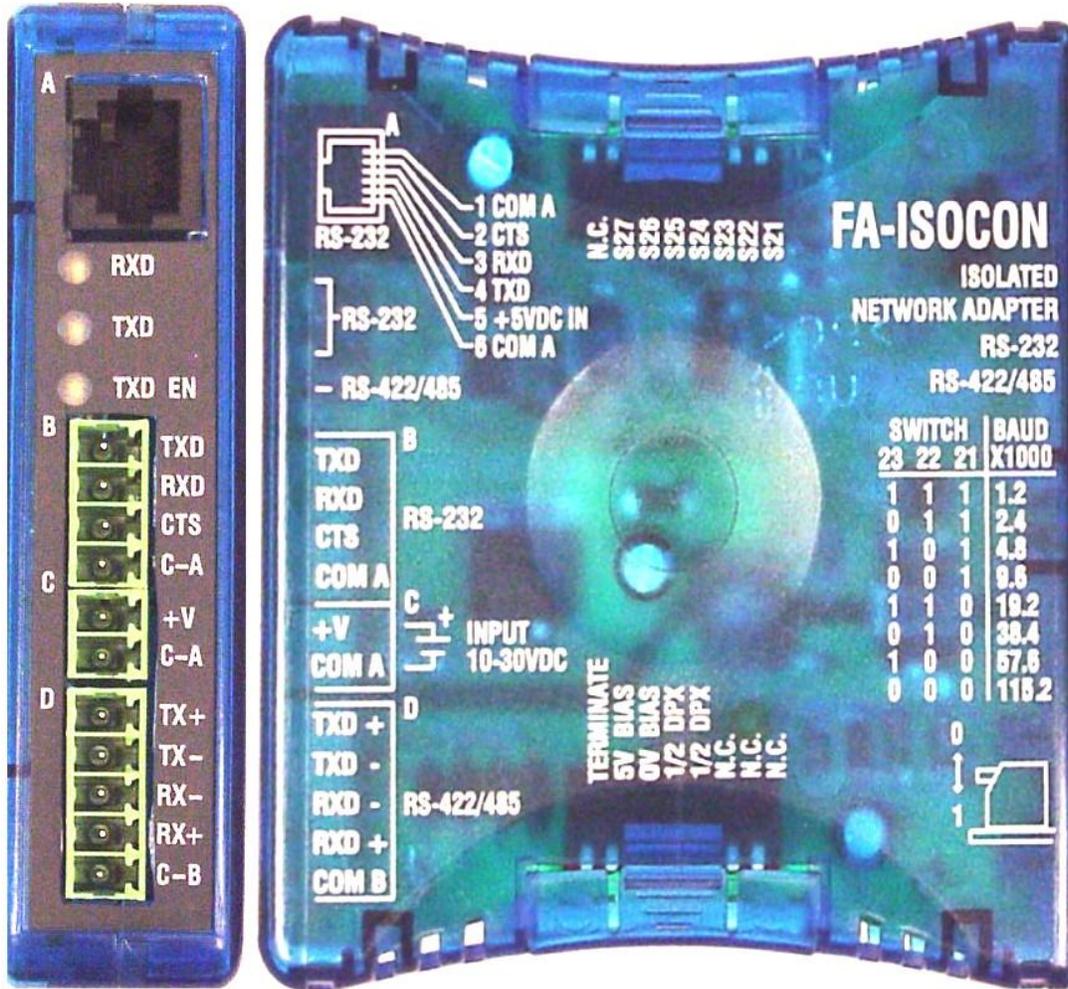
Maximum Network Cable Length	4000 feet
Maximum Number of Devices	32 per network
Maximum Data Rate	115,200 bits per second
Maximum Driver Load	62Ω
Differential Output Voltage	±1.5V to ±6V
Minimum Network Driver Active State	RXD+ 1.5V less than RXD-
Current from CPU +5Vdc Supply	
No Load	80mA
Typical Load	82mA (120Ω Termination)
Maximum Load	100mA (62Ω Termination)
External 24VDC Power Supply	10 to 30 VDC 70mA
Voltage Withstand	1.2KV _{rms} /1 sec, 1.0KV _{rms} /1 min
Isolation Resistance	>10 ¹⁴ Ω /7pF
Operating Temperature	0 to 60 ⁰ C

UL Information

- A. THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION 2, GROUPS A, B, C AND D OR NON-HAZARDOUS LOCATIONS ONLY.
- B. WARNING - EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2/ZONE 2.
- C. WARNING - EXPLOSION HAZARD - DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

Configuration

Connectors, LEDs, and Dipswitches



A – RJ12 connector for RS232

RXD – RS232 Receive Data LED

TXD – RS232 Transmit Data LED

TXD EN – RS422/485 Transmitter Enable LED

B – 4 Position Terminal Block connector for RS232

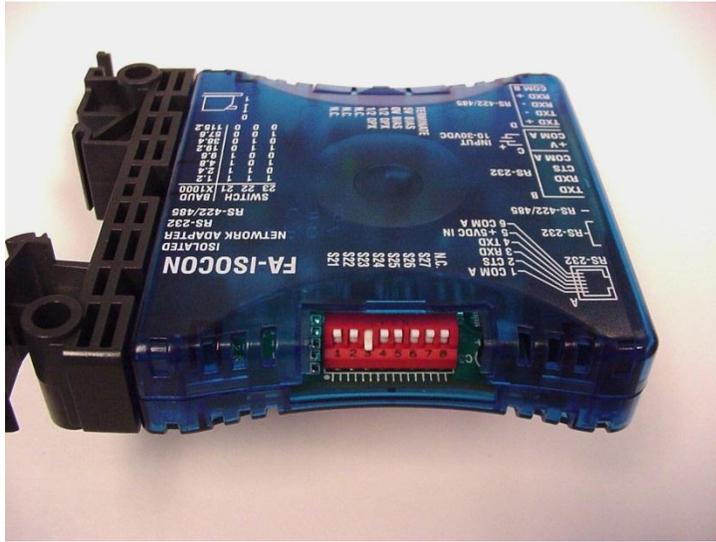
C – 2 Position Terminal Block for 24VDC connection

D – 5 Position Terminal Block for RS422/485 Connection

Top Dipswitch – Baud Rate and Transmitter Control Selection

Bottom Dipswitch – Terminate, Bias, and Duplex Selection

Top Dipswitch



The dipswitches are located under a switch cover. Remove the switch cover by pressing down on the plastic ridges and sliding the switch cover out.

Transmitter Enable Delay Selection (Only needed if using Automatic Network Transmit Enable). See page 9 for details.	Delay Time	Suggested Baud Rate	S21	S22	S23
	8.33ms	1200	Down	Down	Down
	4.16ms	2400	Down	Down	Up
	2.08ms	4800	Down	Up	Down
	1.04ms	9600	Down	Up	Up
	0.52ms	19200	Up	Down	Down
	0.26ms	38400	Up	Down	Up
	0.17ms	57600	Up	Up	Down
0.08ms	115200	Up	Up	Up	
Transmitter Control		S24	S25	S26	S27
	Automatic Network Transmit Enable (2-wire or 4 wire)	Up	Up	Up	Up
	CTS Controlled Transmit Enable (2-wire or 4 wire)	Down	Down	Up	Down
Transmitter Always ON (4-wire only)	Down	Down	Down	Up	
NOTE: Dipswitch positions are referenced to the picture. Down=ON / 1, Up=OFF / 0					

Which Transmitter Control Should I Use?

A 2-wire application (point-to-point or multi-drop) requires all network nodes to enable transmitters only when transmitting. If the RS232 device provides a properly controlled RTS then select 'CTS Controller Transmit Enable'. If the RS232 device does not provide RTS or it is not properly controlled then select 'Automatic Network Transmit Enable'. See the following section "Which 'Transmitter Enable Delay' should I use...".

In a 4-wire point-to-point application, select 'Transmitter Always ON' for both nodes.

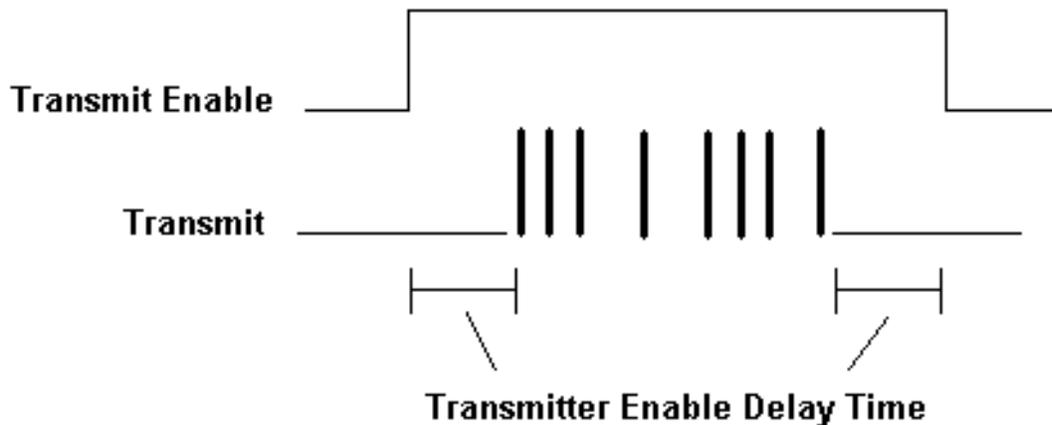
In a 4-wire multi-drop application where the FA-ISOCON is the master node select 'Transmitter Always ON'.

In a 4-wire multi-drop application where the FA-ISOCON is a slave node then the transmitter must only be enabled when transmitting. If the RS232 device provides a properly controlled RTS then select 'CTS Controller Transmit Enable'. If the RS232 device does not provide RTS or it is not properly controlled then select 'Automatic Network Transmit Enable'.

Which 'Transmitter Enable Delay' should I use with 'Automatic Network Transmitter Enable' (ANTE)

ANTE is usually the best option when using a 2-wire RS485 network because it takes care of the RS485 transmitter timing automatically based on the 'Transmitter Enable Delay Selection' dipswitches.

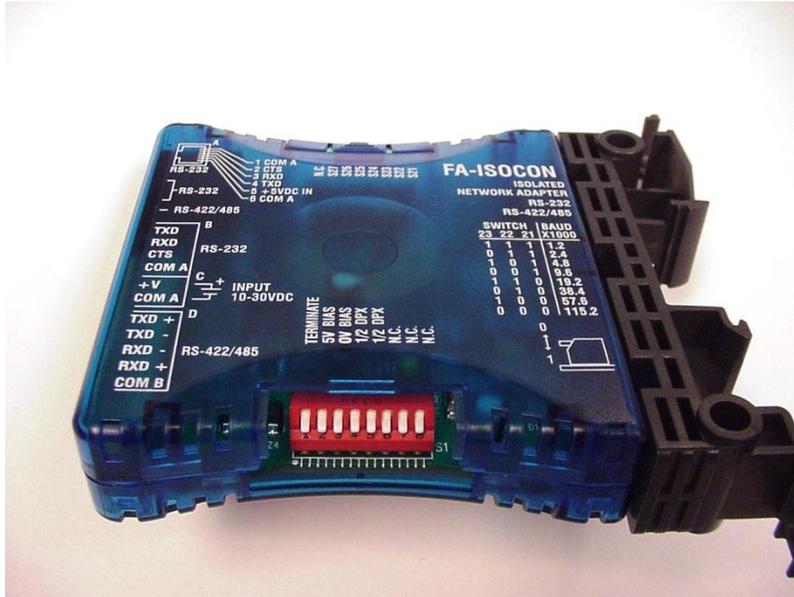
The FA-ISOCAN 'Transmitter Enable Delay' times are set to correspond to one character time of a specific baud rate. The 'Transmitter Enable Delay' time is the delay time from when the FA-ISOCAN enables the RS485 transmitters to when data starts to be transmitted, and also the delay from the end of transmission until the RS485 transmitters are disabled as shown below:



Since the FA-ISOCAN is an isolation adapter, it does not have an independent baud rate. The FA-ISOCAN passes data at the same rate at which it receives it on the RS232 side or the RS422/485 side. All devices will have some Transmitter Enable Delay time and typically that time is "one character time" for that specific baud rate. For example, one character time at 9600 baud is 1.04ms. Normally for the FA-ISOCAN to work properly, the Transmitter Enable Delay time must be set to correspond to the baud rate of the devices on the network.

In some cases, a device may respond faster than one character time. If that is the case, the Transmitter Enable Delay time must be shorter. Since this time is selectable in the FA-ISOCAN this issue is easily overcome by selecting a shorter Transmitter Enable Delay time. For example a AutomationDirect GS Series drive communicating at 9600 baud responds faster than the 1.04ms associated with this baud rate. If the FA-ISOCAN dipswitches are set to 1.04ms there may be some communication issues. To overcome this issue, the delay time is set to 0.52ms (normally associated with 19200 baud), thus eliminating the potential communication issue. With devices using transmitter delay times other than the typical one character time, some trial and error may be required to determine the best setting.

Bottom Dipswitch



The dipswitches are located under a switch cover. Remove the switch cover by pressing down on the plastic ridges and sliding the switch cover out.

Terminate

To enable the factory installed 120Ω termination resistor, set the TERMINATE switch down (ON / 1). Set the switch up (OFF / 0) for all intermediate drops along the network (factory default). Termination resistors should only be installed at the extreme ends of a daisy chain network.

5V Bias / 0V Bias

For optimum performance, RS-422 and RS-485 receivers should be in the inactive state (mark) when their inputs are open or floating. A receiver's inputs will be floating when all transmitters on the network are disabled. The FA-ISOCON includes bias resistors to force the receivers into the inactive state when the network is idle. The network biasing must only be done at the extreme ends of the cable runs.

To install the bias resistors, set the '5V Bias' and '0V Bias' switches down (ON / 1). Set the switches up (OFF / 0) for all intermediate drops along the network (factory default).

If the RS-422 driver of the network master is always enabled then the last slave does not need to be biased. In all other configurations it is normally better to bias the network at both ends. Some host computer software packages will not work without network biasing resistors on the host computer RS-422 or RS-485 receivers.

½ DPX

The two '½ DPX' switches are used to internally short TXD+ to RXD+ and TXD- to RXD-. Set both switches down (ON / 1) for a 2-wire (RS485) connection. Set both switches up (OFF / 0) for a 4-wire (RS422) connection.

Network Adapter RS-422/485 Connections

The connection to the RS-422 (4-wire) or RS-485 (2wire) multi-drop network is made at a five position removable terminal block. The following diagrams show 4-wire and 2-wire network connections.

Connecting Cables and Line Termination

A dual, RS-422, or single, RS-485, shielded twisted pair connection between devices is recommended. No signal ground connect is required if all devices on the network are isolated.

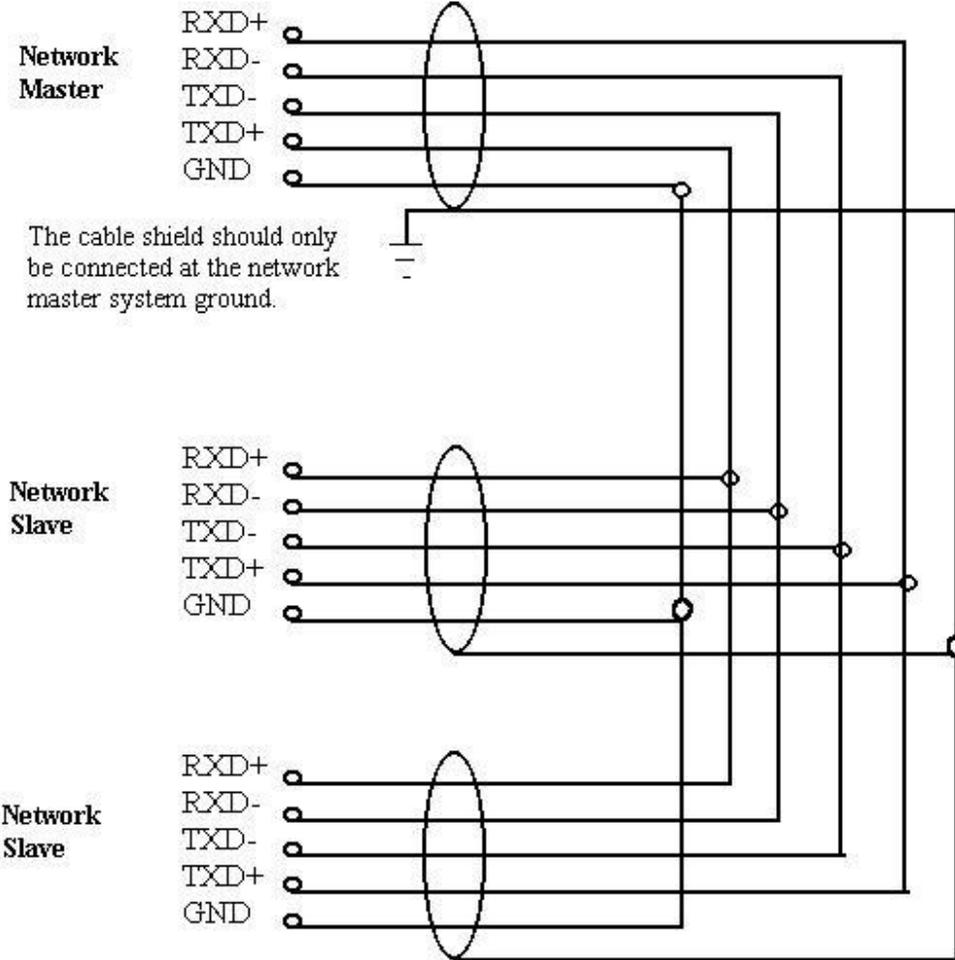
Proper termination of the balanced transmission line is required to prevent data errors. The characteristic impedance of the cable will determine the proper value of terminating resistors. A typical AWG 22 solid wire with .060 inch plastic cover, twisted 4.5 times per foot has a characteristic impedance of about 120 Ω . Termination must only be done at the extreme end of the cable runs. Addition of intermediate terminations will adversely load the line.

Cable Shielding

Shielding improves noise immunity (magnetic field protection).

It is important to ground the shield at one end only. Grounding both ends of the shield will cause magnetic field induced noise currents to flow through ground. Noise may then appear on the data lines due to transformer like coupling with the shield.

RS422 / 4-Wire Connection



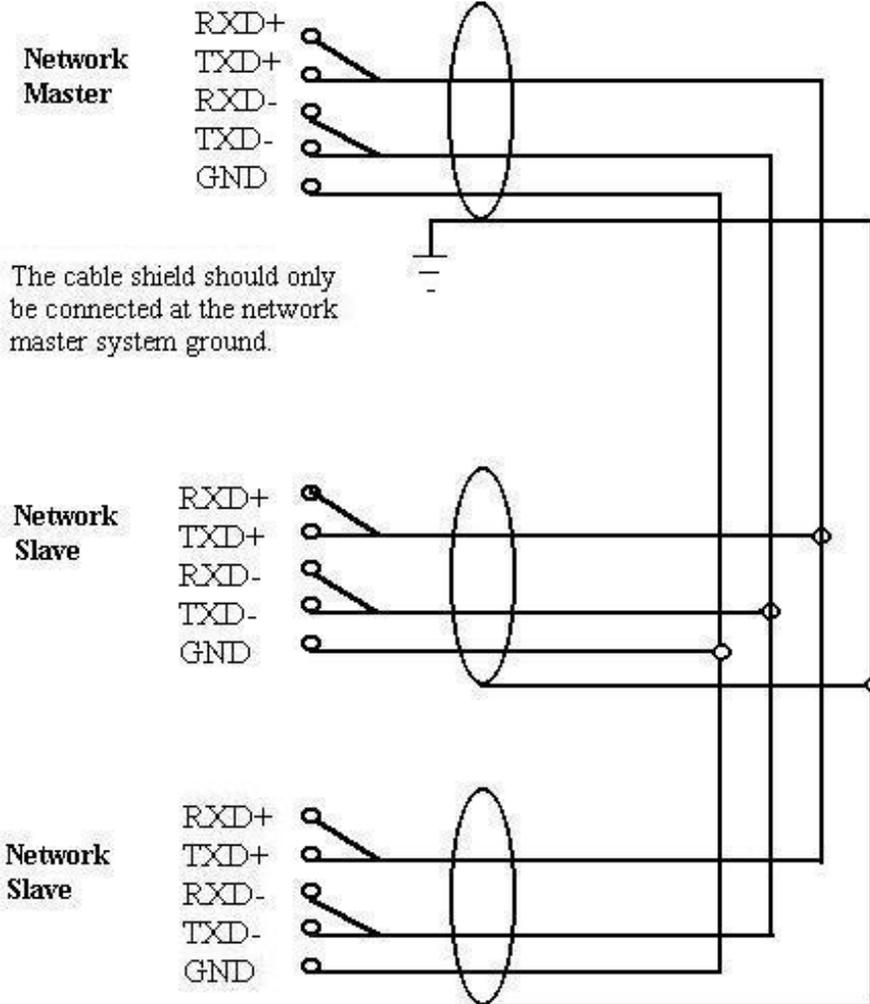
NOTE: The drawing is shown as a bus network for clarity, all connections should be made directly to the FA-ISOCAN.

- Recommended cable is **Belden 9729** or equivalent.
- The 'Terminate', '0V Bias', and '5V Bias' dipswitches should be set ON for the extreme ends of the network and OFF for intermediate drops.
- A 4-wire connection should be used for multi-dropping AutomationDirect PLCs.
- When extending the network cable to an outside environment, precautions must be observed to protect the network from outside elements such as lightning, water, snow, ice, etc.

Transient suppression is provided on the FA-ISOCAN, FA-ISONET, F2-UNICON, and FA-UNICON but it is not sufficient protection from induced voltage spikes due to nearby lightning strikes.

WARNING: If network cable is run in an outdoor environment then external lightning protections must be added. There are several methods to reduce the induced voltage spikes from nearby lightning strikes including but not limited to spark gap protection and larger transient suppressors. Protection for each installation must be considered on a case by case basis.

RS485 / 2-Wire Connection



NOTE: The drawing is shown as a bus network for clarity, all connections should be made directly to the FA-ISOCAN.

- Recommended cable is **Belden 9841** or equivalent
- The 'Terminate', '0V Bias', and '5V Bias' dipswitches should be set ON for the extreme ends of the network and OFF for intermediate drops.
- It is not necessary to short the RXD+/TXD+ and RXD-/TXD- pins if the '½ DPX' dipswitches are set to ON.
- When extending the network cable to an outside environment, precautions must be observed to protect the network from outside elements such as lightning, water, snow, ice, etc.

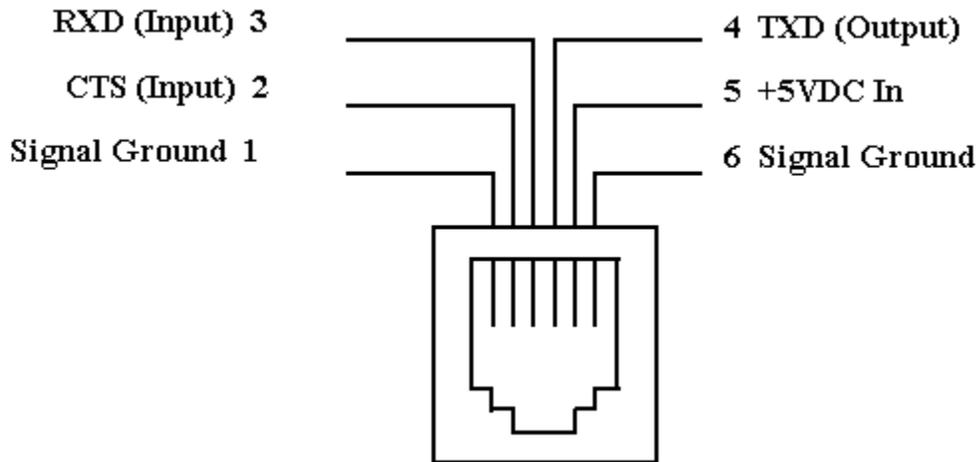
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WARNING: If network cable is run in an outdoor environment then external lightning protections must be added. There are several methods to reduce the induced voltage spikes from nearby lightning strikes including but not limited to spark gap protection and larger transient suppressors. Protection for each installation must be considered on a case by case basis.

RS232 Pin Outs

WARNING: RS232 connections can be made to the RJ12 connector or to the 4 position terminal block marked B, but not to both.

The telco style RJ12 connector (6P6C, 6 Position 6 Conductor) is used to make the RS232 connection to various RS232 devices. **If your RS232 device supplies 5VDC, it can be connected to pin 5 to power the FA-ISOCAN, do not connect this pin if you are using 24VDC to power the FA-ISOCAN.**



The 4 position terminal block connections are marked TXD (Output), RXD (Input), CTS (Input), and C-A (Signal Ground). Use this connection if you prefer a terminal block connection over an RJ12 connection.

If the 'Transmitter Control' dipswitches are set for 'Automatic Network Transmit Enable' or 'Transmitters Always ON' then a connection to CTS is not required. If the 'Transmitter Control' dipswitches are set for 'CTS Controlled Transmit Enable' then a connection to CTS is required and the connected RS232 device must properly control the RTS signal.

24VDC Connection

24VDC can be supplied to power the FA-ISOCAN at the two-position terminal block below the RJ12 connector marked '+V' and 'C-A'. **If you connect 24VDC at this terminal do not connect 5VDC to pin 5 of the RJ12 connector.**

Mounting

There are two ways to mount the FA-ISOCAN Isolated Network Adapter.

- (1) Panel mount next to the CPU.
- (2) Din #3 rail or A Series rail mount using supplied hardware.

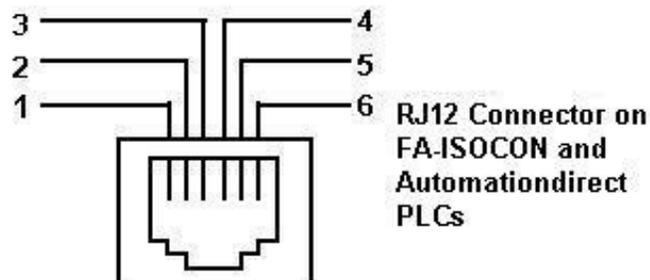
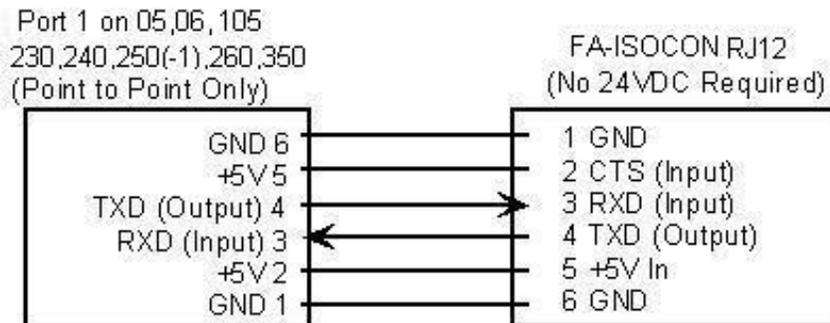
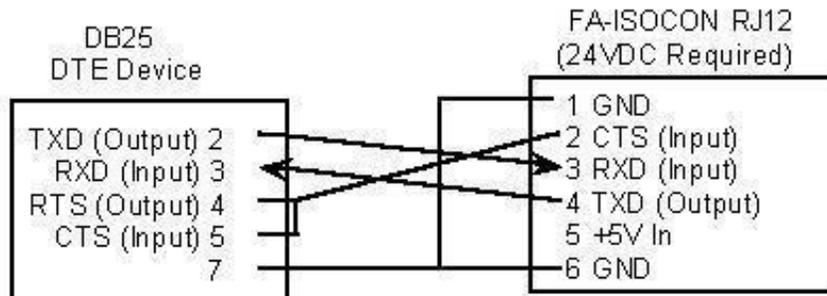
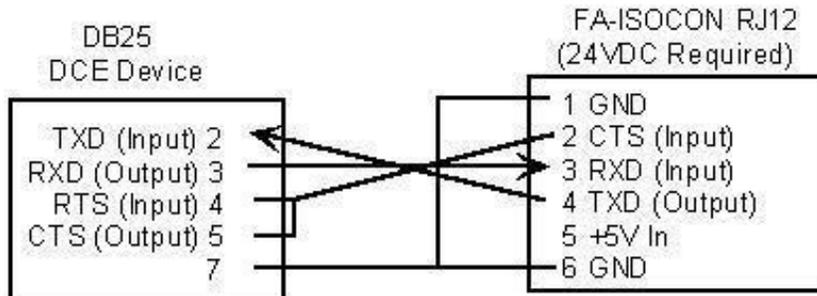
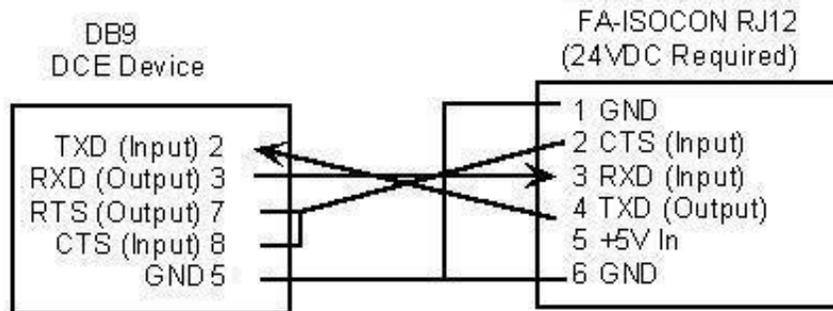
To install the unit on a DIN rail hook the top of the DIN connector on the DIN rail, then pull the unit down (the top of the DIN connector is designed to flex) and rotate the bottom of the DIN connector onto the DIN rail.

Common RS232 Connections using FA-ISOCAN Components

The FA-ISOCAN comes with four components (1' 6P6C Cable, 1' 6P4C Cable, DB25 connector, DB9 connector) that allow you to make RS232 connections without having to build a cable. The following table shows which components are used in common configurations.

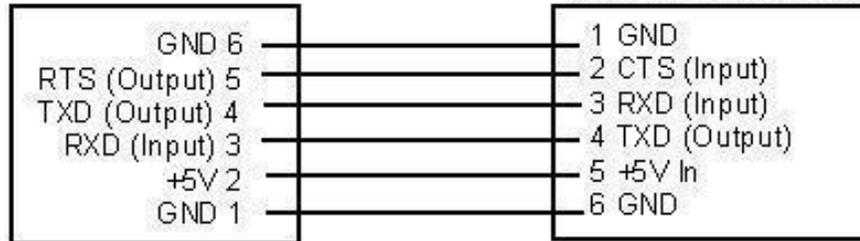
Connection	6P6C Cable	6P4C Cable	DB25	DB9	External 24VDC Required	Comments
05, 06 105, 230, 240, 250 (-1), 260, 350 Port1 (RJ12)	Y	N	N	N	N	2 or 4-Wire Point-to-point Only
05, 240 Port 2 (RJ12)	Y	N	N	N	N	2 or 4-Wire
340 Port 1 (RJ11)	N	Y	N	N	Y	2 or 4-Wire Point-to-point Only
340 Port 2 (RJ11)	N	Y	N	N	Y	2 or 4-Wire
350 Port 2	Y	N	Y	N	Y	2 or 4-Wire Use in applications requiring isolation
430, 440, 450 25-Pin Port	Y	N	Y	N	Y	2 or 4-Wire Use in applications requiring isolation
25 Pin PC Connection	Y	N	Y	N	Y	2-Wire or 4 Wire
9 Pin PC Connection	Y	N	N	Y	Y	2-Wire or 4 Wire

Common RS232 Pin-Outs



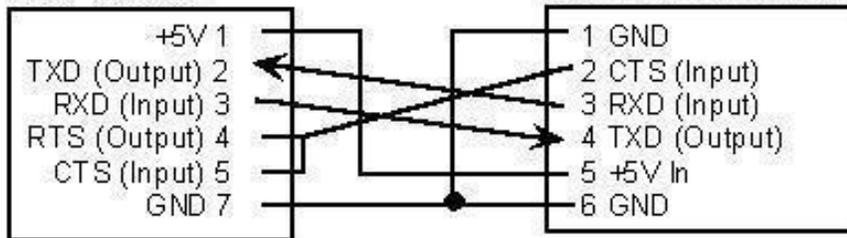
240 Port 2 (RJ12)

FA-ISOCAN RJ12
(No 24VDC Required)



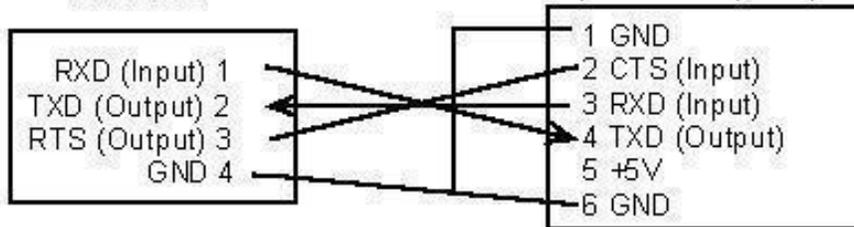
06, 250(-1), 260
Port 2 (15 Pin)

FA-ISOCAN RJ12
(No 24VDC Required)



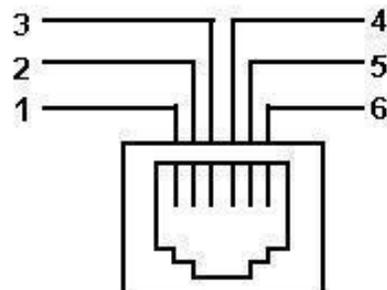
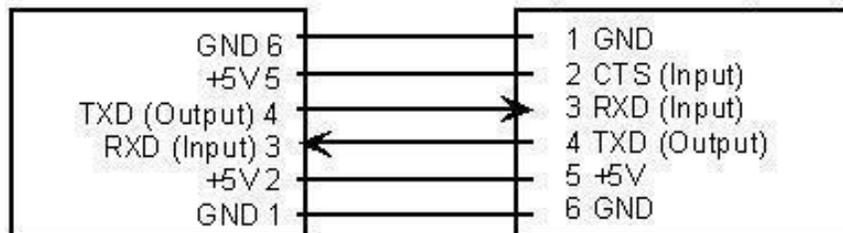
340 Port 2

FA-ISOCAN RJ12
(24VDC Required)



450 Port 2 (RJ12)
(Point to Point Only)

FA-ISOCAN RJ12
(No 24VDC Required)



**RJ12 Connector on
FA-ISOCAN and
Automationdirect
PLCs**

Troubleshooting

Normal Operation FA-ISOCN As Network Master

4-Wire Connection / Transmitter Control set for CTS Control or Automatic Control

- TX EN LED turns ON
- TXD LED flashes (Data Sent to Network)
- TX EN LED turns OFF
- RXD LED flashes (Data Received from Network)

4-Wire Connection / Transmitter Control set for Always On

- TX EN LED turns ON and stays ON
- TXD LED flashes (Data Sent to Network)
- RXD LED flashes (Data Received from Network)

2-Wire Connection / Transmitter Control must be set for CTS Control or Automatic Control

- TX EN LED turns ON
- TXD LED flashes (Data Sent to Network)
- RXD LED flashes (Echo of Data Sent to Network)
- TX EN LED turns OFF
- RXD LED flashes (Data Received from Network)

Normal Operation FA-ISOCN As Network Slave

4-Wire Connection / Transmitter Control set for CTS Control

- RXD LED flashes (Data Received from Network)
- TX EN LED turns ON
- TXD LED flashes (Data Sent to Network)
- TX EN LED turns OFF

4-Wire Connection / Transmitter Control set for Always On

- TX EN LED turns ON and stays ON
- RXD LED flashes (Data Received from Network)
- TXD LED flashes (Data Sent to Network)

2-Wire Connection / Transmitter Control must be set for CTS Control or Automatic Control

- RXD LED flashes (Data Received from Network)
- TX EN LED turns ON
- TXD LED flashes (Data Sent to Network)
- RXD LED flashes (Echo of Data Sent to Network)
- TX EN LED turns OFF

Common Problems

TXD LED flashes but data is not transmitted / TX EN LED does not turn ON

The TX EN (Transmit Enable) LED indicates when the RS422/485 transmitters are enabled. If the transmitters are not enabled then no data is transmitted even though the TXD LED may be flashing.

If the selected Transmitter Control is 'CTS Controlled Transmit Enable' then the RS422/485 transmitters are controlled by the CTS input on the RJ12 connector (pin 2).

If the application is a 4-wire network and FA-ISOCAN in the network master or is used in a point-to-point configuration then change the Transmitter Control to 'Transmitter Always ON' so the RS422/485 transmitters are always enabled.

RXD LED never flashes

If the FA-ISOCAN is the network master then the network slave is not responding. There are many possible causes for this so you will need to look at all available troubleshooting information on the master and slave nodes to isolate the problem. Some possibilities include:

- Baud Rate mismatch
- Framing mismatch
- Protocol mismatch
- Wiring problem
- Network Slave configuration problem

RXD LED stays ON solid

A network wiring problem or a defective node could cause this problem.

- Verify cabling and cable type
- Disconnect one node at a time to isolate the problem

RXD LED flashes as expected but the RS232 data is corrupted

A network wiring problem or a defective node could cause this problem.

- Verify cabling and cable type
- Disconnect one node at a time to isolate the problem

FA-ISOCON Dimensions

