

RS-485 Port Isolator

IC690ACC903

GFK-1663B
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The IC690ACC903 RS-485 Port Isolator replaces the obsolete IC655CMM590 Isolated Repeater/Converter (also known as the “Brick”). This Port Isolator provides the basic functionality of the IC655CMM590 Isolated Repeater/Converter except for the converter function. The Port Isolator features 500 volts of isolation in a compact package servicing all IC693, IC697, and IC200 PLC product lines. The Port Isolator connects either directly to a 15-pin RS-485 serial port or through the optional 12 inch (30 cm) extension cable, IC690CBL003, which may be ordered separately. The extension cable is intended for applications where direct connection to the port is obstructed by surrounding equipment or when it is not acceptable for the Port Isolator to protrude from a PLC module. The Port Isolator can operate in either single or multidrop mode, selected by a recessed slide switch on the top of the module (see switch in figure below).

The Port Isolator provides the following features:

- Four opto-isolated signal channels: SD, RD, RTS, and CTS
- Electrical compatibility with RS-485
- Single or multidrop operation
- A 5V DC/DC converter for power isolation
- Support for hot insertion

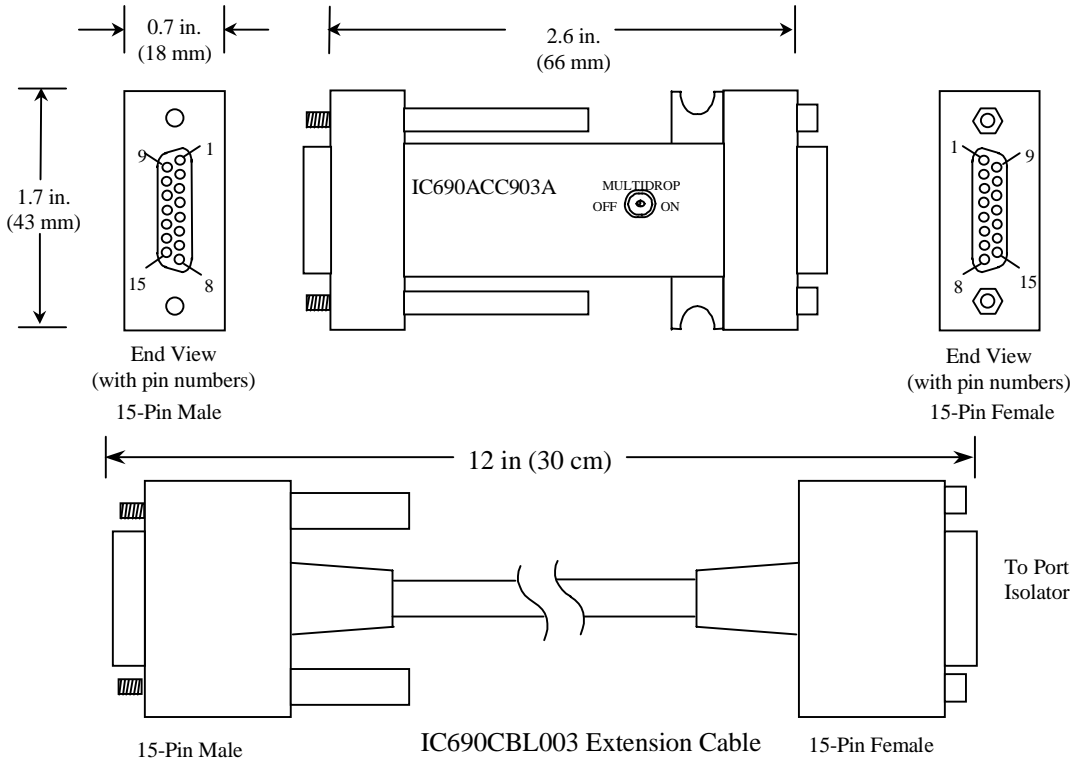


Figure 1. IC690ACC903 Port Isolator and IC690CBL003 12" (30 cm) Extension Cable

Connector Pin-Outs

The Isolator provides two connectors, one 15-pin male D-type (PL1) and one 15-pin female D-type (PL2). The tables below list the connections for these two connectors.

PL1: 15-Pin Male D-Connector			
Pin	Name	Type	Description
1	SHLD	-	Chassis Ground
2	NC	-	
3	NC	-	
4	NC	-	
5	5V	-	+5V power
6	CTS (A')	In	Clear to send -
7	0V	-	Ground
8	RTS (B)	Out	Request to send +
9	NC	-	
10	SD (A)	Out	Send data -
11	SD (B)	Out	Send data +
12	RD (A')	In	Read data -
13	RD (B')	In	Read data +
14	CTS (B')	In	Clear to send +
15	RTS (A)	Out	Request to send -

PL2: 15-Pin Female D-Connector			
Pin	Name	Type	Description
1	NC	-	
2	NC	-	
3	NC	-	
4	TESTID	-	ID resistor
5	5V	-	+5V power
6	RTS (A)	Out	Request to send -
7	0V	-	Ground
8	CTS (B')	In	Clear to send +
9	RT	-	Terminating Resistor*
10	RD (A')	In	Read data -
11	RD (B')	In	Read data +-
12	SD (A)	Out	Send data -
13	SD (B)	Out	Send data +-
14	RTS (B)	Out	Request to send +
15	CTS (A)	In	Clear to send -

* To terminate the RD balanced line, place a jumper wire from pin 9 to pin 10.

Note: A denotes minus (-) and B denotes plus (+). A and B denote outputs and A' and B' denote inputs.

Installation

The Isolator is packaged in a plastic enclosure designed for either (1) direct attachment to a serial port or (2) attachment through the optional IC690CBL003 12" extension cable for panel mounted applications. Two M3 thumbscrews secure the Port Isolator to its mating connector. If panel mounting the Isolator using the optional extension cable, you will need to provide the two 6-32 x 3/8" (4 x 9 mm) mounting screws (see Figure 2 below).

When installing the Isolator, tighten the connector screws and panel mounting screws (if used) to the following torque values:

Screws	Size	Torque
Connector Thumbscrews (supplied with Isolator)	3 mm	8 in./lbs.
Panel Mounting Screws (user-supplied)	#6/32 x 3/8" (4 x 9 mm)	12 in./lbs.

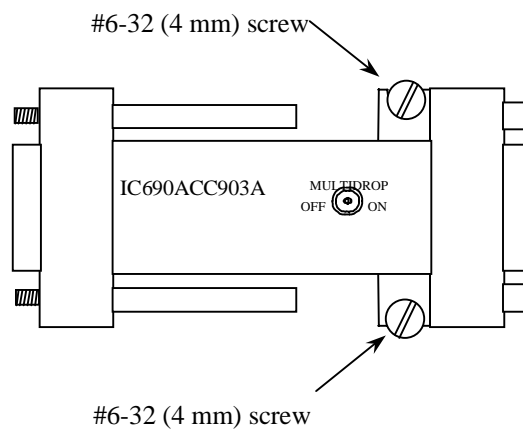


Figure 2. Port Isolator Mounted to Panel

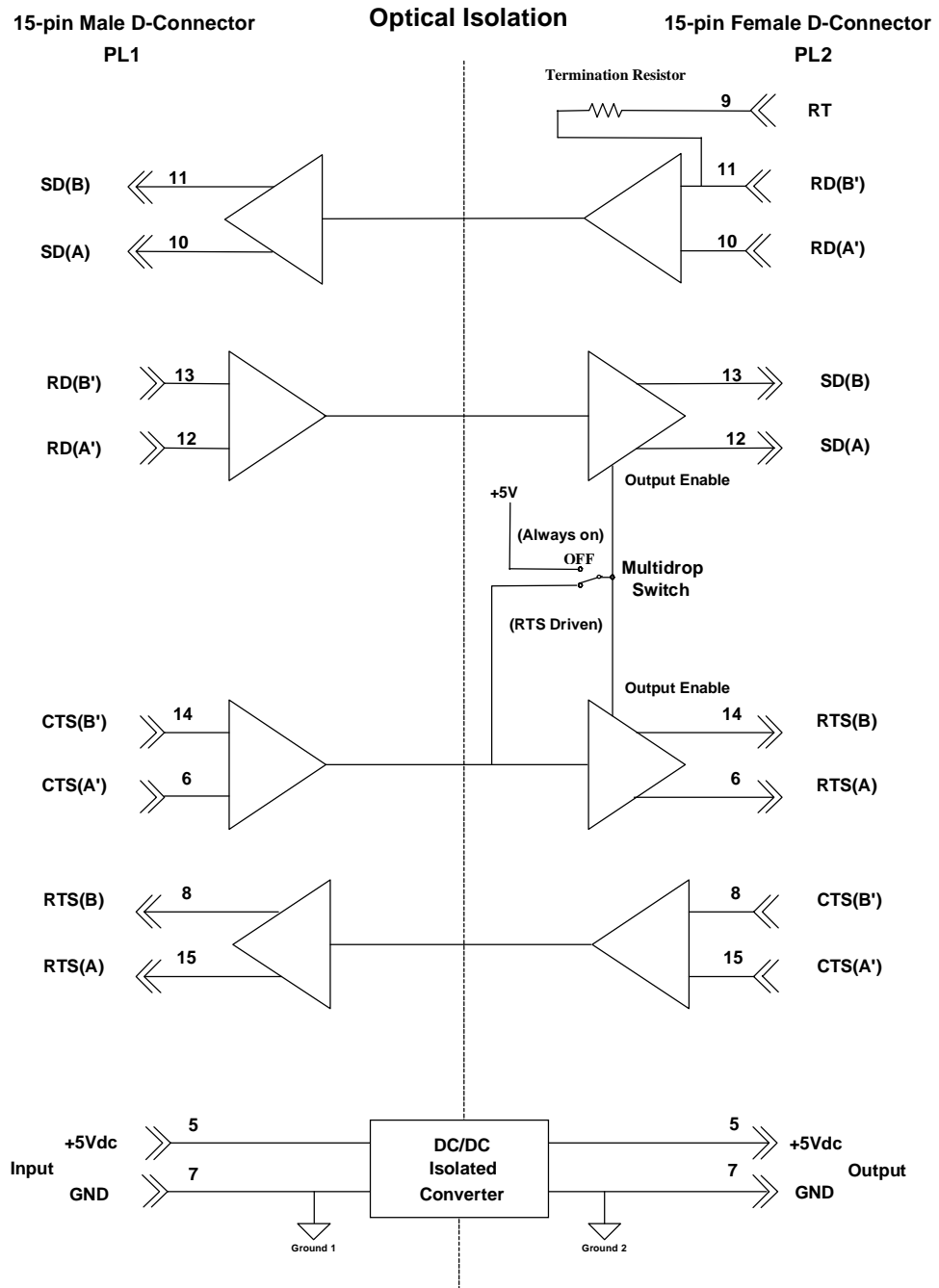


Figure 3. IC690ACC903 Block Diagram

The RS485 Port Isolator supports both port-to-port and multi-drop configurations (Figure 4). In some cases it may be necessary to power the Port Isolator by a source other than the host port. This configuration is used to prevent an interrupt in communications if the host system requires a power cycle. It also prevents power loss to equipment using the port for power. If you wish to use an external power source, you will need to build a custom cable as shown in Figure 5.

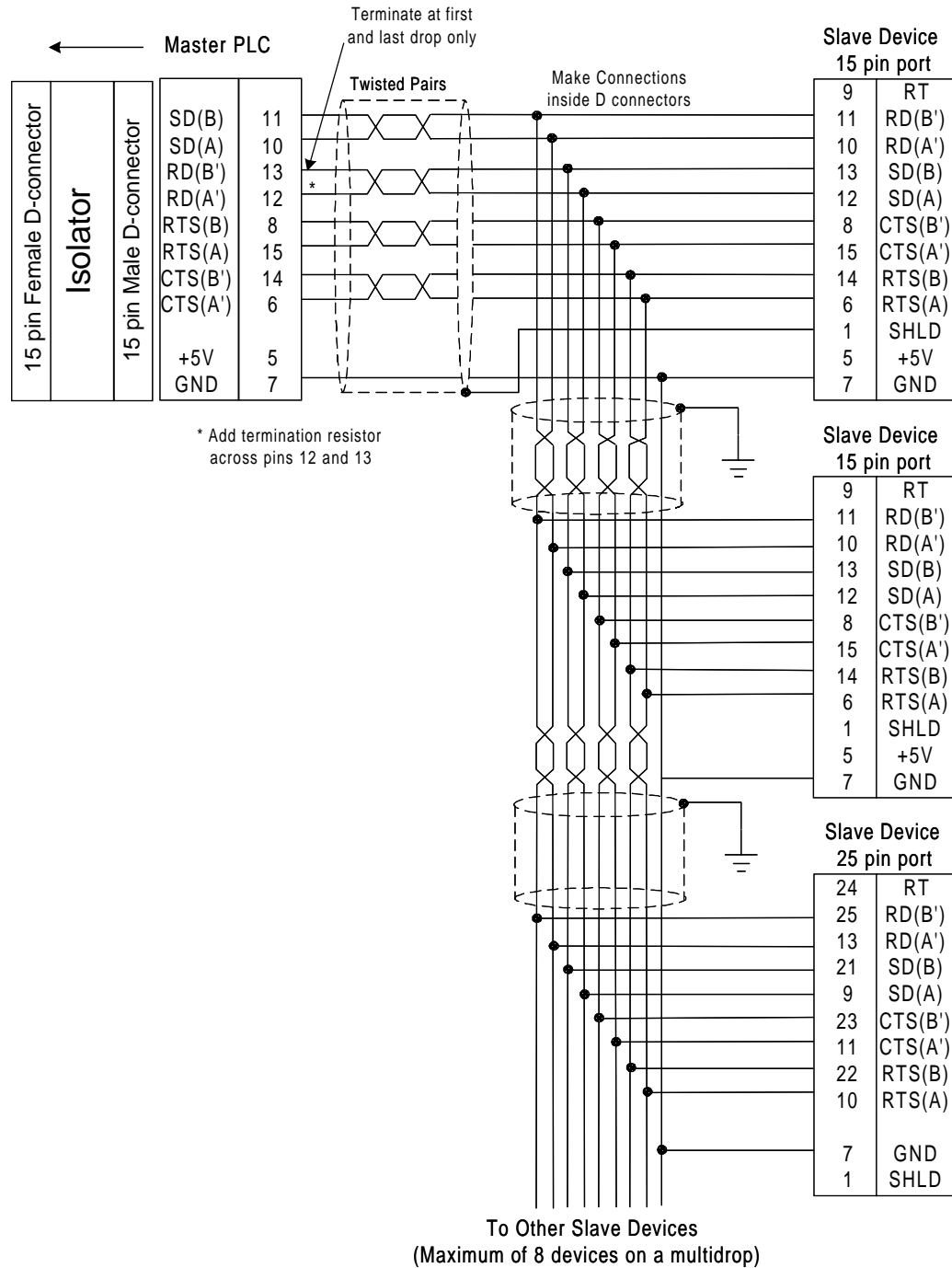


Figure 4. Multidrop Configuration Connecting Devices with 15-Pin Ports and 25-Pin Ports

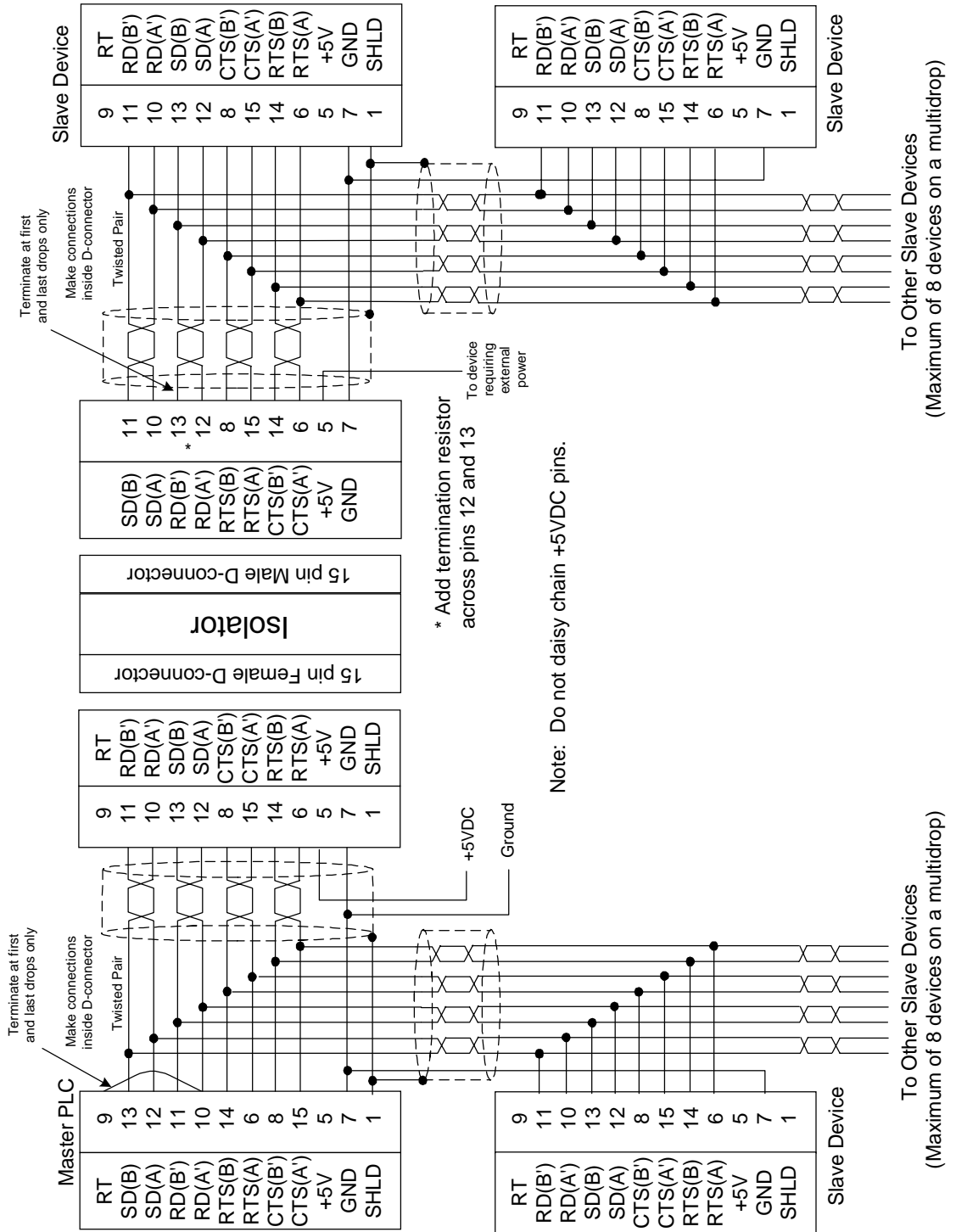


Figure 5. Cable for Supplying External Power Through the Port Isolator

Specifications

Mechanical	
RS-485	15-pin D shell male for direct mounting to serial port on the programmable controller 15-pin D shell female for communication cable
Installation Hardware	Two M3 thread connector thumbscrews. Recommended torque: 8 in./lbs. (supplied with Isolator) Two #6/32 x 3/8" (4 x 9 mm) machine screws (user supplied) if mounting to panel. Recommended torque: 12 in./lbs.
Electrical	
Voltage Supply	+5VDC (usually supplied by port)
Typical Current	25 mA for Port Isolator circuitry 100 mA available for external equipment
Ground Isolation	500 Volts
Conformance	EIA-422/485 Balanced Line
Operating Temperature	0° - 70°C (32° - 158° F)
Baud Rate	Those supported by PLC

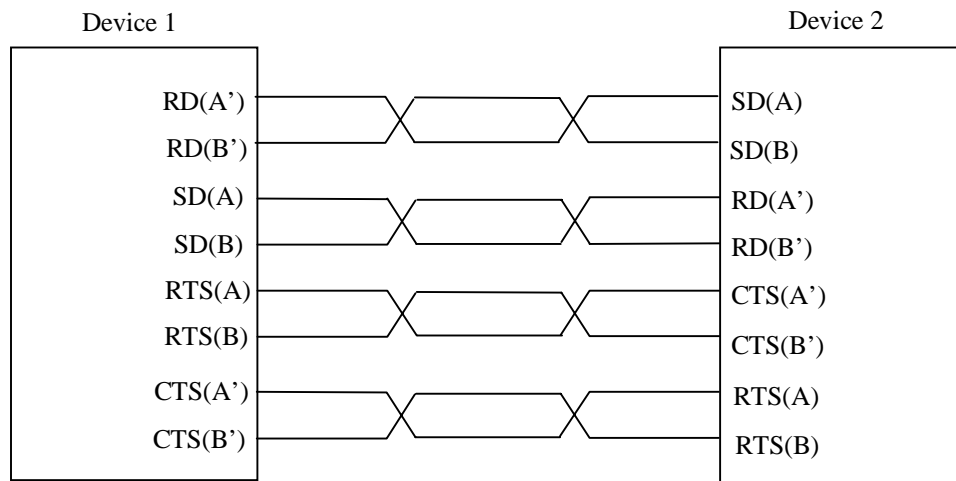
Application Information

RTS Control

- ❑ IC693, IC697, and IC200 serial ports use tri-state buffers (line drivers), which have the following three states: Logic 1, Logic 0, and Disconnected. When used on a shared line, as in a multidrop arrangement, the buffer must be placed in the disconnected state when not transmitting so that it does not disable the line. This is done by means of an internal control signal, which enables the buffer when it needs to transmit and disconnects the buffer when it is not transmitting. This internal control function on these PLC ports is transparent to the user. However, buffer control for a Port Isolator used in a multidrop system comes externally from an RTS signal from a slave device.
- ❑ In general, the female end of the Port Isolator should be connected toward the Master end of the system. The female end has tri-state buffers (the male end of the Port Isolator only uses two-state buffers). The tri-state buffers are required if the line between the Port Isolator and the Master is shared with slave devices, since only one slave device can transmit at a time and all other devices, when not transmitting, must disconnect from the shared line. Tri-state buffers are not required on the male end of the Port Isolator since only the Master can transmit to slave devices and, therefore, the line is not shared with other transmitting devices.
- ❑ If the line between the Port Isolator and the master device is shared with other slave devices, the Port Isolator's tri-state buffers must be placed in the disconnected state when not transmitting. This is accomplished by the Request to Send (RTS) signals from slave devices connected to the CTS input on the male side of the Port Isolator (see Examples 2 and 3, below). When an RTS signal goes high, the buffers are enabled. When the RTS signal goes low, they are disconnected.

Connections and Termination

- All connections must be made at the serial ports, inside the cable connectors, in a “daisy-chain” style using high-quality, shielded, twisted-pair cable. No line “stubs” and no intermediate terminal blocks are permitted. Violating this rule can result in standing waves on the transmission line, which would cause improper operation.
- When a Port Isolator is applied to a system, it results in two separate lines that are not physically connected. Each must be handled as a separate line for termination purposes. However, only lines longer than six feet (2 meters) require termination. Termination is required on each RD signal pair, but only at the end of the line. As shown by the following figure, what is considered the RD (receive) signal pair by receiving devices is considered to be the SD (send) signal pair by transmitting devices, and what is considered the CTS signal pair by receiving devices is considered to be the RTS signal pair by transmitting devices.



Termination is required across RD terminals if line is longer than 6 feet (2 meters).

Figure 6. Typical RS-485 Connections (Shield not Shown)

- Since the master is the only device that receives slave transmissions (slaves cannot transmit to each other), it must have termination at its receive (RD) terminals, and it (the master) must always be located at the end of its line.
- The female end of the Port Isolator and most RS-485 PLC serial ports have built-in termination resistors that are connected by installing a jumper on the cable connector. However, the male end of the Port Isolator does not have a built-in termination resistor. To terminate it, either (1) install a resistor in the cable connector across RD(A') and RD(B') at the Port Isolator, or (2) if the Port Isolator male end is within 6 feet of the next slave device, the termination may be done at the slave device. If a resistor is added, its value should be matched, within reason, to the impedance of the cable used. Typical impedance is 100 to 120 ohms. If cable impedance is not known, a 120 ohm resistor would probably be a suitable choice.

Power Requirement

- The Port Isolator requires a power input of 5VDC at 25 mA (minimum) on pin 5 of the male connector for operation of the Port Isolator circuitry. Additionally, it has an internal power isolator that can provide an isolated 5VDC at 100 mA output on pin 5 of the female connector that can be used for converters or other low-power devices. If this isolated power output is used, it will increase the Port Isolator's input power requirement beyond the minimum 25 mA.
- If the Port Isolator is mounted directly to a 15-pin female PLC serial port, it receives its power directly from pin 5 of the serial port connector.
- If the Port Isolator is not directly mounted to a PLC port, care must be taken that the voltage drop across the interconnection cable is not excessive. At least 4.7VDC is required on pin 5 of the male connector when the Port Isolator is under full load, including any load connected on the 5VDC isolated output on pin 5 of the female connector. The voltage drop across the interconnection cable depends on (1) the size of the cable conductors, (2) the length of the cable, and (3) the amount of current required by the Port Isolator and any devices connected to its 5VDC isolated output. Excess voltage drop will not be a problem for a cable that is a few feet (a couple of meters) long. However, for longer cable lengths, the voltage should be carefully measured at the Port Isolator power input, between pins 5 (+5VDC) and 7 (0V) of the male connector, to ensure it is receiving at least 4.7 VDC under full load. If it is not possible to obtain the minimum voltage with longer cable lengths, use an external power supply mounted near the Port Isolator.

Multidrop Switch

This recessed slide switch is mounted on the top of the Port Isolator. It can be set with the tip of a miniature screwdriver (do not use a pencil – graphite dust from a pencil can damage the switch). When in the ON position, the Port Isolator's tri-state buffers are controlled by RTS signals on its CTS input on the male connector. When in the OFF position, the Port Isolator's tri-state buffers are activated all of the time, so that, effectively, they function like a standard (two-state) buffer. After ensuring that the female Port Isolator connector is connected to the master device, use the following general guidelines for setting the MULTIDROP switch (also, refer to the "Application Examples" section for more information):

- If the Port Isolator's female connector is the only device connected to the master, we recommend you set the switch in the OFF position.
- If the Port Isolator's female connector shares a line with other slave devices as well as the master, the switch must be set in the ON position, and the RTS control lines must be connected to the Port Isolator's CTS input on the male connector (in order to control the tri-state buffers).

Signal Polarity

Some manufacturers label their lines with a – or +, such as RD– and RD+. However, the EIA RS-485 specification uses the letters A and B, such as RD(A) and RD(B), to signify polarity. In general, the "A" polarity corresponds to the "–" polarity, and the "B" polarity corresponds to the "+" polarity. Reversing the polarity of RS-485 signal lines should not damage the equipment; however, the equipment will probably not communicate if polarity is reversed.

Port Isolator Application Examples

Example 1

In this example, the Port Isolator isolates the Master from the Slaves. The Slaves are not isolated from each other. Since the Port Isolator is the only device that connects directly to the Master, no RTS control for the Port Isolator tri-state buffers is required from the slaves. This lack of RTS control requires that the Multidrop switch be set to OFF, which will place the Port Isolator's female end output buffers in the connected condition all of the time. However, if the RTS control lines from Slave #1 and Slave #2 were connected to the Port Isolator, the Multidrop switch could be set to either position and the system would work. Note that the RD terminals at the ends of each line must be terminated (indicated by asterisks) if the line is longer than 6 feet (2 meters). Since there is no built-in termination resistor on the male end of the Port Isolator, either (1) an external resistor (typically 120 ohms) can be added inside the connector, or (2) if the Port Isolator is located less than 3 feet (1 meter) from the nearest slave (Slave #1 in this example), the termination can be connected at that slave instead.

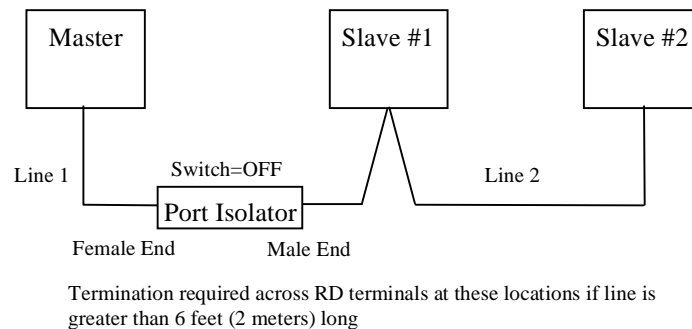


Figure 7. Example 1, Master Isolated from Slaves

Example 2

In Example 2, the Master and Slave #1 are isolated from Slave #2 and Slave #3. Since both the Port Isolator and Slave #1 share the same line (Line 1) to the Master, the Port Isolator's output tri-state buffer must be in the disconnected state when it is not sending. This requires that both Slave #2 and Slave #3, whenever transmitting, must send an RTS signal to the Port Isolator CTS input on the male (Line 2) end, and it also requires that the switch be set to the ON position. Note that the RD terminals at the ends of each line must be terminated (indicated by asterisks) if the line is longer than 6 feet (2 meters). Since there is no built-in termination resistor on the male end of the Port Isolator, either (1) an external resistor (typically 120 ohm) can be added inside the connector, or (2) if the Port Isolator is located less than 3 feet (1 meter) from the nearest slave (Slave #2 in this example), the termination can be connected at that slave instead.

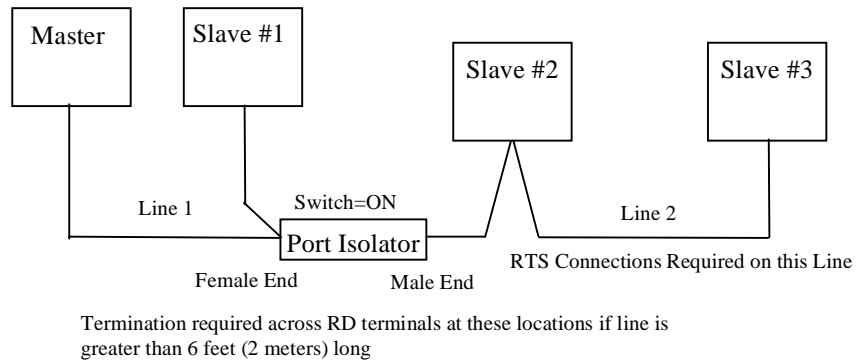


Figure 8. Example 2, Master and Slave #1 Isolated from Slaves #2 and #3

Example 3

In Example 3, the Master, Slave #1, and Slave #2 are isolated from Slaves #3 and #4. Since the Port Isolator, Slave #1, and Slave #2 all share the same line (Line 1) to the Master, the Port Isolator’s output tri-state buffer must be in the disconnected state when it is not sending. This requires that either Slave #3 or Slave #4, whenever transmitting, must send its RTS signal to the Port Isolator CTS input on the male (Line 2) end, and it also requires that the switch be set to the ON position. Note that the RD terminals at the ends of each line must be terminated (indicated by asterisks) if the line is longer than 6 feet (2 meters). Since there is no built-in termination resistor on the male end of the Port Isolator, either (1) an external resistor (typically 120 ohm) can be added inside the connector, or (2) if the Port Isolator is located less than 3 feet (1 meter) from the nearest slave (Slave #3 in this example), the termination can be connected at that slave instead.

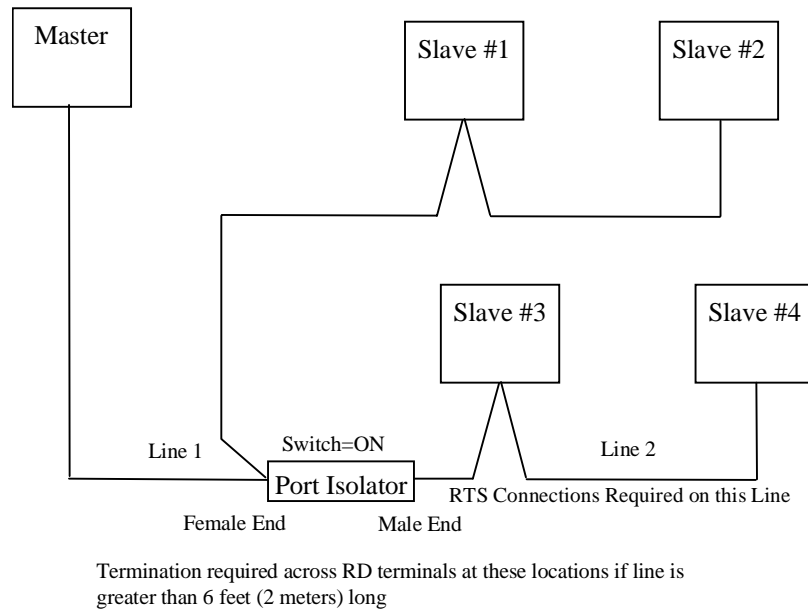


Figure 9. Example 3, Master, Slave #1, and Slave #2 Isolated from Slave #3 and Slave #4

Example 4

The Port Isolator is used in this example to isolate the programmer (a personal computer), from the IC693 PLC serial port. In this case, an IC690ACC903 Miniconverter is also used since it is necessary to convert the personal computer's RS-232 serial port output to RS-485, which is the standard supported by the PLC's serial port. The Port Isolator plugs into the PLC serial port, and the Miniconverter plugs into the Port Isolator. The use of the Port Isolator in this arrangement is recommended to avoid possible damage to the equipment in cases where it is doubtful that the personal computer and the PLC are at the same ground potential. If the Port Isolator cannot be plugged directly into the PLC serial port, perhaps due to lack of clearance space, panel-mount the Port Isolator and connect it to the PLC via an IC690CBL003 12" extension cable, which must be purchased separately. The serial port connector on the IC693 power supply has sufficient current capacity to support both the Port Isolator and the Miniconverter. Note that Port 2 on CPUs 351, 352, and 363 are isolated internally and, therefore, do not require an external Port Isolator.

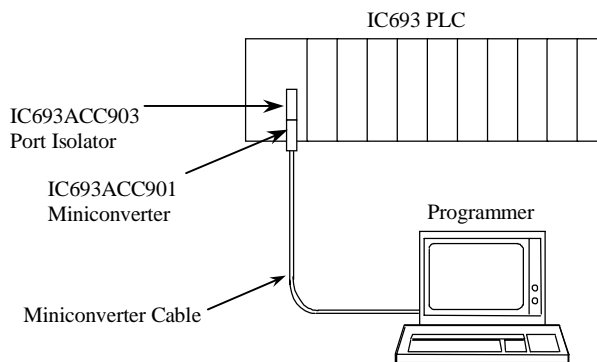


Figure 10. Example 4, Isolating the PLC from a Programmer

Changes to Previous Version of this Document

The following changes were made to the previous version (GFK-1663A) of this data sheet:

- It was stated that the IC690CBL003 cable came with the Port Isolator. This is not the case. It must be ordered separately.
- The “Application Information” and “Port Isolator Application Examples” sections were added.
- Errors in the “Connector Pin-Out” section and in Figures 4 and 5 were corrected.