

# FXRIO16 Remote Input/Output (I/O) Module

## Installation Instructions

LP-FXRIO16-0

Part No. 24-10564-41, Rev. —  
Issued August 29, 2010

### Applications

The FXRIO16 Remote Input/Output (I/O) module expands an FX Supervisory Controller (controllers with Niagara<sup>AX</sup>-3.4 or later and an available RS-485 port) with 16 I/O points that can be remotely located, including:

- Eight Universal Inputs (UIs), compatible with 0–10 VDC, 4–20 mA, dry contacts, pulsing dry contacts, 0–100k ohm resistive, or Type 3 thermistor temperature sensors.
- Four Digital Outputs (DOs) with Form-A relay contacts; for on/off control of loads up to 24 VAC/ VDC, at 0.5 A maximum.
- Four 0–10 VDC Analog Outputs (AOs) for analog control of loads at 2.5k ohm minimum, or 4 mA drain maximum.

The FXRIO16 module uses DIN rail mounting, and has two end-mounted, 6-pin connectors that support direct-chaining (in-line attachment) to other FXRIO16 modules.

Communications to the remote FX Supervisory Controller use RS-485 multidrop on three wires of an end-mounted, 6-pin connector. The other three wires on that connector are primary DC power and battery backup for the module, which can be supplied from that same FX Supervisory Controller (such as an FX22/ FX62 or FX70). Alternatively, you can power the FXRIO16 locally (for use with an FX20 or FX60) with a DIN-mountable LP-FXPM263-0 universal AC power supply module, or a third-party 12–15 VDC power supply, and wire only the RS-485 bus back to the parent FX Supervisory Controller.



Figure 1: FXRIO16 Module

## North American Emissions Compliance

### United States

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his/her own expense.

### Canada

This Class (A) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (A) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## Installation

### System Planning

The maximum number of FXRIO16 modules supported by an FX Supervisory Controller differs according to its model type. In addition, depending on the station resource usages in an FX Supervisory Controller, acceptable system operation may require adding fewer than the maximum amount of FXRIO16 modules.

Other considerations also apply when adding FXRIO16 modules. For example, an FXRIO16 module under an FX20/FX60 Series controller will **not** have the inherent battery backup feature provided by the later FX22/FX62 or FX70 Series supervisory controller platforms.

Finally, when cabling power to those FXRIO16 modules located away from the FX Supervisory Controller, allowances must be made for voltage drops introduced by cabling distances. See [Voltage Drop Considerations](#) on page 4.

### Supported Numbers of FXRIO16 Modules

Table 1 provides a quick comparison of FX Supervisory Controller models compatible with FXRIO16 modules, including the maximum possible number of FXRIO16 modules supported.

**Note:** Station operation of each FX Supervisory Controller at maximum limits with **only** the necessary Niagara<sup>AX</sup> software components (Nrio driver and associated points) is roughly at 50% resource usage, without other driver networks, control logic, and so on. Therefore, maximum numbers **may be less** for an FX Supervisory Controller, particularly if you have an existing FX20/FX60 with one or more NDIO-based modules (LP-NDIO34-0 or LP-NDIO16-0).

**Note:** Currently, only FX Supervisory Controller models listed in Table 1, at Niagara<sup>AX</sup>-3.4 or later, support FXRIO16 modules.

**Table 1: Maximum Number of FXRIO16 Modules Supported, by Compatible FX Supervisory Controller Platform Models**

FX Supervisory Controller Model	Maximum Number of FXRIO16	6-Position Power/ RS-485 <sup>1</sup>	Maximum Number Powered by FX Supervisory Controller <sup>2</sup>
FX22	3 <sup>3</sup>	Yes	3
FX70	16	Yes	8
FX20	4	No	— <sup>4</sup>
FX60	16	No	— <sup>4</sup>
FX62	15 <sup>3</sup>	Yes	7

1. Powering FXRIO16 modules from an FX22/FX62/FX70 with 6-position power/RS-485 provides battery backup during power blips.

2. Maximum number powered by an FX22/FX62/FX70 assumes FXRIO16s are located nearby with minimal voltage drop from power cabling.  
If an FX22/FX62/FX70 supports more FXRIO16 modules than this (for example, the FX70), or if some FXRIO16 modules are long distances away (for example, 900 ft [274 m] away), they need to be powered locally by LP-FXPM263-0 power module, or other battery-backed 12 V power supplies.
3. In addition to 16 points of onboard I/Os provided by this FX22/FX62/FX70.
4. FX20/FX60s do not have the 6-position power/RS-485 connector to power FXRIO16 modules. Therefore, all FXRIO modules must be powered directly from an LP-FXPM263-0 power supply module, or other battery-backed 12 V power supplies. The maximum number (16) shown for a FX60 Series assumes a dedicated LP-FXPM263-0 power supply module for just the FXRIO16 modules.

### **Battery Backup Operation**

When FXRIO16 modules are powered by FX22/FX62/FX70 with 6-position power/RS-485 connectors (that is, wired to the PS+, PS-, and BB terminals) they can benefit from battery-backed protection against system power events. Note this requires the FX22/FX62/FX70 to have the optional (external) Sealed Lead-Acid (SLA) battery installed, as the FX Supervisory Controller's internal Nickel-metal Hydride (NiMH) battery provides power blip backup only for its onboard circuitry. You also need a graceful shutdown of controller's running station, if a longer power outage occurs.

**Note:** The other direct attachment type I/O expansion modules (LP-NDIO34-0 and LP-NDIO16-0, using Ndio driver) already provide this type of shutdown protection described in this section.

An FXRIO16 with battery backup can provide continuous system operation during a power event, essentially making it a non-event for both the FX Supervisory Controller and the FXRIO16 module. Depending on the capacity of the external batteries, this backup operation can extend over many minutes of AC power loss, and/or over multiple successive power blips. An FXRIO16 wired this way is often described as powered by the FX Supervisory Controller. Although during normal operation, sometimes power is supplied by the LP-FXPM263-0 power supply module attached to, and powering, the FX Supervisory Controller itself (FX70).

Note this supplied-by-FX-Supervisory-Controller battery-backup operation is **not** available when using FXRIO16 modules with FX20/FX60 Series controllers; that is, FX Supervisory Controllers **without** the 6-position power/RS-485 connector. Or, in any scenario where FXRIO16 modules must be located hundreds of feet away from the FX Supervisory Controller (cabling voltage drop issues). In these cases, you must **locally power** those FXRIO16 modules, using one of two methods:

- Local LP-FXPM263-0 power supply module attachment to the FXRIO16 module. Although convenient, be aware that this method invites power event issues. See [\*Operation without Battery Backup\*](#) on page 3.
- Third-party, battery-backed, 12 VDC power supply, wired to the PS+ and PS- terminals of the FXRIO16 module's 6-position end connector. This method is typically recommended, for reasons noted here.

Note that power wiring for all different scenarios is included in this document. See [\*Wiring\*](#) on page 9.

### **Operation without Battery Backup**

If an FXRIO16 module is powered locally with an LP-FXPM263-0 power supply module (for example, an FX20/FX60 Series job), and a momentary AC power loss occurs, note that a number of problems can result, including:

- Load cycling from FXRIO16 relays dropping out, including a multiple-second lag to first re-establish communications with the FX Supervisory Controller (Nrio driver) before relays can pull in again, as needed.
- Loss of totalized counts originating in the FXRIO16.
- History (logging) entries for associated I/O points as **down**, as well as Nrio **device down** alarms.

Also, loss of power without battery backup makes an I/O firmware upgrade a risky operation. Such an upgrade is initiated from the Nrio Device Manager view (in a station connection to the FX Supervisory Controller). If this upgrade process is interrupted by an FXRIO16 power cycle, the module may be rendered inoperable, and likely needs to be replaced.

Therefore, consider powering FXRIO16 modules with a battery-backed 12 V power supply, as necessary.

## Voltage Drop Considerations

If you use the FX Supervisory Controller and its backup battery to power FXRIO16 modules (and some modules are not mounted in the same enclosure with the FX Supervisory Controller) be aware of voltage drops in the connecting trunk-power cabling. Typically, this situation applies only if modules are located in different locations; that is, not near the FX Supervisory Controller.

**Note:** The 15 VDC power supply and the backup batteries charged by the FX Supervisory Controller must **always** be located near the FX Supervisory Controller, either in the same enclosure (typical), or in an adjacent enclosure.

Each FXRIO16 draws (at most, when all four relays are pulled in) 0.125 A, and thus can introduce voltage drop when long cabling distances are used for power/backup battery. In addition, when sizing the sealed lead-acid batteries for an FX Supervisory Controller, you should factor in additional Ampere hour (Ah) capacity according to the numbers of FXRIO16 modules. Table 2 provides a summary of FXRIO16 power consumption for these purposes.

**Table 2: Amps/Watts, and Recommended Minimum 12 V SLA battery Ah capacities, per FXRIO16**

Device	Max per System	Amps/W used at 15 VDC (each)	12 V Backup Battery (4 hours) min. recommended Ah (each)	Notes
FXRIO16	See Table 1.	0.125 A/1.88 W	0.65 Ah	Has four on-board relays.

An undersized selection of power cabling can result in unacceptably high voltage drops; and remotely located FXRIO16 modules may not operate correctly, especially during emergency (battery backup) operation.

Table 3 provides a voltage drop chart, showing voltage drops per 100 ft (30 m) of paired wire of different gauges (AWG), at different load amperes.

**The maximum allowable voltage drop due to wiring is 1.5 V.** This equates to the difference in voltage measured across the PS+ and PS- at the source FX Supervisory Controller power supply, and the PS+ and PS- at the furthest expansion module (FXRIO16). Or, when powered by battery backup, the difference in voltage measured across the BB and PS- at the source FX Supervisory Controller, and the BB and PS- at the furthest expansion module (FXRIO16).

**Table 3: Voltage Drop Per 100 Feet Run (30 m) of Paired Wire**

Gauge (AWG)	Load Current						
	0.10 A	0.25 A	0.5 A	1.0 A	1.5 A	2.0 A	4.0 A
10	0.020	0.05	0.10	0.20	0.30	0.40	0.80
12	0.032	0.08	0.16	0.32	0.48	0.64	1.27
14	0.050	0.13	0.25	0.50	0.75	1.01	2.02
16	0.080	0.20	0.40	0.80	1.20	1.60	3.20
18	0.127	0.32	0.64	1.27	1.91	2.54	5.08
20	0.202	0.50	1.01	2.02	3.03	4.03	8.07
22	0.320	0.80	1.60	3.20	4.80	6.40	12.81

For an example, consider a system where two FXRIO16 modules are mounted remotely in a location 500 ft (366 m) away. In this example, worst-case amperes used by each remote FXRIO16 is 0.125 A. Looking at Table 3 at the 0.25 A column, a #16 AWG cable pair drops 0.20 V per 100 ft (30 m), meaning a 500-foot (152-meter) run would drop slightly over 1 V. The #16 AWG cable would be a good choice over an #18 AWG cable, which would drop over 2 V (above the 1.5 V maximum allowable drop).

### Parts Included

Unpack the FXRIO16 module and inspect the contents of the package for damaged or missing components. If damaged, notify the appropriate carrier at once, and return for immediate replacement.

Included in this package are the following items:

- a Remote I/O Module (FXRIO16).
- this *FXRIO16 Installation Instructions, Part No. 24-10564-41, Rev. —*.
- a hardware bag containing the following items:
  - Four pin-mount, 6-position, screw-terminal connectors for connection of universal inputs, analog outputs, and relay outputs. For more details, see [About Screw Terminal Connectors](#) on page 8.
  - One 6-position screw terminal end-plug, for wiring RS-485 communications from the parent FX Supervisory Controller, as well as 15 VDC power and battery backup.
  - One grounding wire, with quick-disconnect 0.187 in. female connector.
  - Eight 499-ohm resistors, used for 4–20 mA inputs.

### Special Tools Needed

The following supplies and tools are required for installation:

- Approved 12–15 VDC power supply source and (optional) 12 VDC backup battery source, by either:
  - Wiring to the remote parent FX Supervisory Controller's 6-position and a Powered RS-485 connector, such as on a FX22/FX62 controller or FX70 controller. We recommend this method.
  - Using a DIN-mountable LP-FXPM263-0 power supply module to furnish 15 VDC power to the FXRIO16.

- Using a third-party, 12–15 VDC power supply, with output regulated to within  $\pm 4\%$ .
- If DIN mounting, a DIN rail, type NS35/7.5 (35 mm x 7.5 mm) and DIN rail end-clips (stop clips), and screws for mounting (see Figure 2).
- Suitable tools and supplies for making all wiring terminations.

### Safety Precautions



#### **WARNING: Risk of Electric Shock.**

Disconnect the power supply before making electrical connections. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

**IMPORTANT:** Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations. Do not exceed the FXRIO16 electrical ratings.

**IMPORTANT:** To reduce the risk of fire or electrical shock, install in a controlled environment relatively free of contaminants.

**IMPORTANT:** Use this FXRIO16 Input/Output Module only as an operating control. Where failure or malfunction of the FXRIO16 could lead to personal injury or property damage to the controlled equipment or other property, additional precautions must be designed into the control system. Incorporate and maintain other devices, such as supervisory or alarm systems or safety or limit controls, intended to warn of or protect against failure or malfunction of the FXRIO16.

### Static Discharge Precautions

Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within the FXRIO16 are sensitive to static discharge.

**IMPORTANT:** Work in a static-free area. Discharge any static electricity you may have accumulated. Discharge static electricity by touching a known, securely grounded object. Do not handle the Printed Circuit Board (PCB) without proper protection against static discharge. Use a wrist strap when handling PCBs. Secure the wrist strap clamp to earth ground.

## FXRIO16 Module Connection Precautions

**IMPORTANT:** Do not connect more than the maximum number of FXRIO16 modules to the RS-485 port of the parent FX Supervisory Controller; note that 16 is the maximum number supported in software. However, less FXRIO16 modules may be supported. See *Supported Numbers of FXRIO16 Modules* on page 2.

## FXRIO16 Module Installation and Startup Outline

**Note:** If installing the FX Supervisory Controller and FXRIO16 module at the same time, refer to the appropriate FX Supervisory Controller Installation Instructions for your specific controller.

The major steps to installing and starting the FXRIO16 module are as follows:

1. Physically mount the FXRIO16 module onto DIN rail. See *Mounting* on page 6. If directly attaching to other modules, ensure that the 6-position end connector(s) are properly seated into the end connectors of the other units. Note the previous *FXRIO16 Module Connection Precautions* on page 6.
2. Make wiring connections for grounding, power, RS-485 communications, and I/O points. See *Wiring* on page 9.
3. Apply power and perform an initial checkout. See *Powerup and Initial Checkout* on page 17.

## Mounting

The following applies to mounting a FXRIO16 Remote I/O Module:

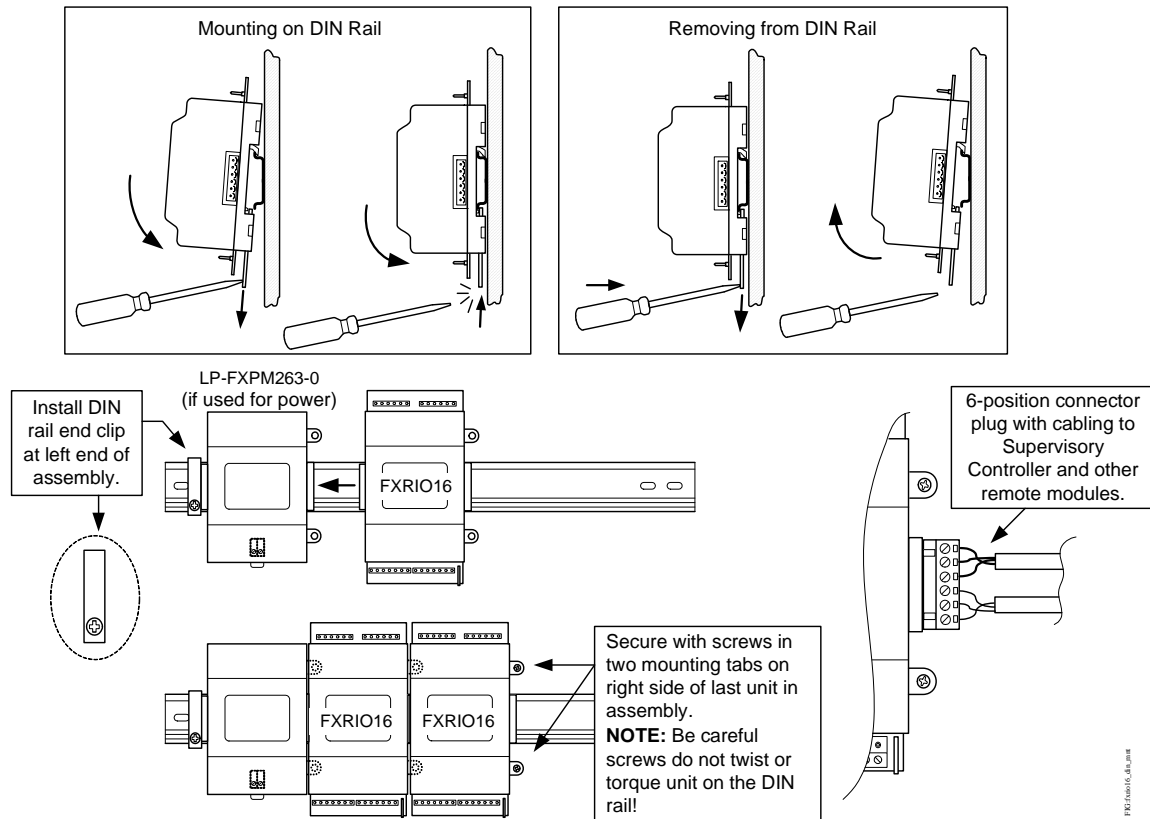
- You can mount the unit in any orientation. It is not necessary to remove the cover before mounting.
- We recommend you mount on a 35 mm wide DIN rail. The FXRIO16 module unit base has a molded DIN rail slot and locking clip which simplifies mounting two or more units together (or to an LP-FXPM263-0 power supply module). Mounting on a DIN rail ensures accurate alignment of connectors between all modules.
- If DIN rail mounting is impractical, you can use screws in mounting tabs on the FXRIO16 module. See *Tab Mounting Details* on page 8.

## Mounting the FXRIO16 Module on an Installed DIN Rail

To mount the FXRIO16 module on an installed DIN rail:

1. Position the FXRIO16 module on the rail, tilting to hook the DIN rail tabs over one edge of the DIN rail (see Figure 2).
2. Use a screwdriver to pry down the plastic locking clip, and push down and in on the FXRIO16 module, to force the locking clip to snap over the other edge of the DIN rail.
3. Slide the FXRIO16 module along the DIN rail to its intended location.  
  
If connecting to another module already mounted, seat its 6-position plug into that module's connector socket.
4. Install DIN rail end clips to secure the assembly, or install screws in mounting tabs.

5. Repeat this process for all items, until all are mounted on the DIN rail(s), firmly connected to each other, and secured with DIN rail end clips or mounting tab screws.



**Figure 2: FXRIO16 Module DIN Rail Mounting Details**

**Note:** To remove an FXRIO16 module from DIN rail, remove DIN rail end clips or mounting tab screws, and (if applicable) slide it away from other modules. Insert a screwdriver in the center plastic locking tab and pull downwards, then lift the unit outwards.

## Tab Mounting Details

We recommend DIN mounting over tab mounting. See Figure 3 for tab mounting dimensions.

**Note:** Electronic and printed versions of this guide may not show dimensions to scale. Verify all measurements before drilling.

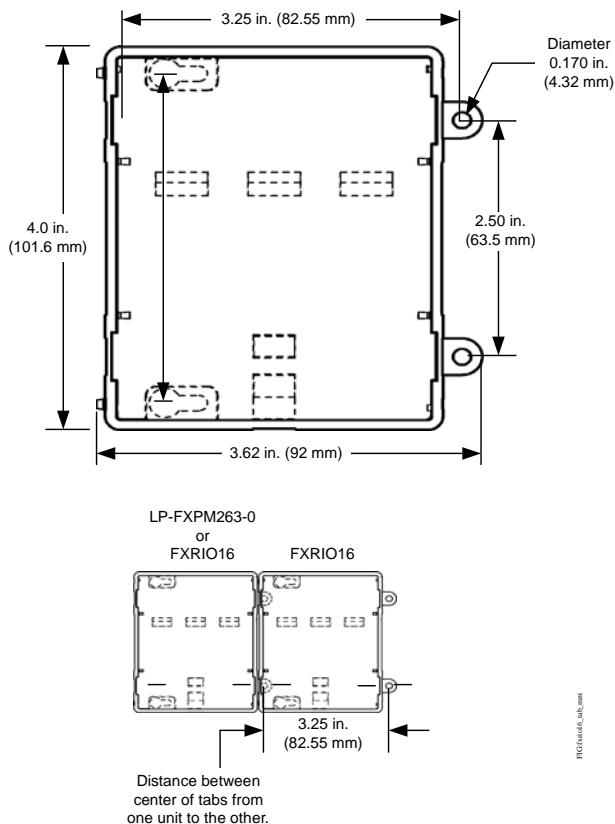


Figure 3: Tab Mounting Dimensions, in. (mm)

## FXRIO16 Module Board Layout and Terminals

The FXRIO16 module provides:

- Eight Universal Inputs (see [Inputs](#) on page 14).
- Four Digital Relay Outputs (see [Relay Outputs](#) on page 16).
- Four 0–10 VDC Analog Outputs (see [Analog Outputs](#) on page 16).

Wiring terminal positions are shown in Figure 4, along with Light-Emitting Diode (LED) locations.

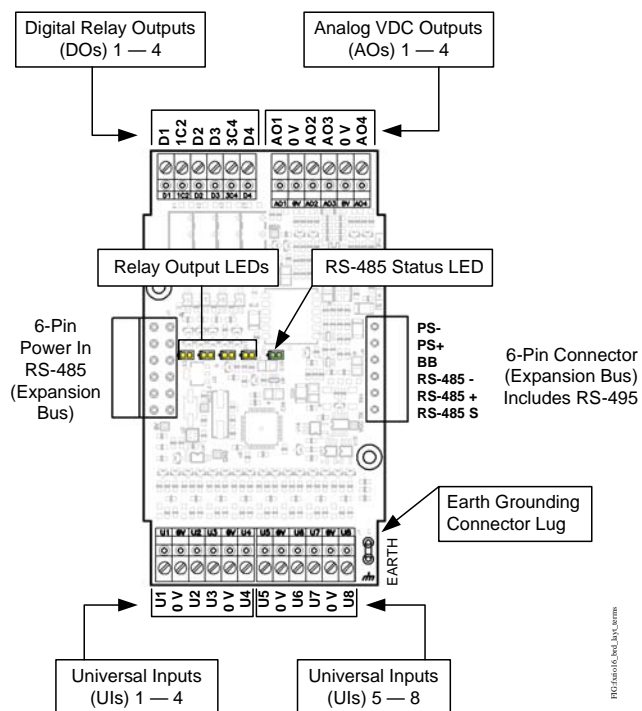


Figure 4: FXRIO16 Module Wiring Terminal Locations (screw terminal connectors shown installed)

## About Screw Terminal Connectors

Screw terminal connectors are shipped loose in a separate hardware bag. If desired, you can make wiring terminations to connectors **before** installing on the FXRIO16 module circuit board pins. Removal of the pin-mounted connectors may be difficult, especially if they are pushed all the way down and wiring has been landed.



In general, it may be easiest to wire to loose connectors (held next to pins), and then install the connectors after completing the wiring.



**CAUTION: Risk of Electric Shock.**

Disconnect the power supply before making electrical connections to avoid electric shock.

**IMPORTANT:** Before using the following method to remove connectors, remove all power to the FXRIO16 module, and remove power to any other connected external devices. Otherwise, a short circuit will result.

To remove a pin-mounted connector plug using needle nose pliers:

1. Remove all power.
2. Insert the tips of the pliers into the outermost wiring termination ports of the connector. Note that if wiring is already landed in those ports, you may need to remove those wires first.
3. With a gentle rocking motion, pull upwards, perpendicular to the circuit board.
4. The connector will come free from the circuit board pins. If you removed wiring from the outermost connector ports, reconnect that wiring as it was before.

## Wiring

See Figure 4 to locate connectors and other components on the FXRIO16 module.

Make connections to the FXRIO16 module in the following order:

1. Connect the earth grounding wire (with spade connector) from the earth ground lug on the FXRIO16 module to a nearby earth grounding point. See [Grounding](#) on page 9 for details.

2. Wire the supply power to the FXRIO16 module, but **do not energize the power source** until all other wiring is completed. Depending on the FX Supervisory Controller, and how you are powering the FXRIO16 module, methods differ:

- a. If powering the FXRIO16 module from an FX Supervisory Controller that is equipped with a 6-position powered RS-485 connector (supplies 15 VDC and battery backup on three wires of this connector), **unplug** this connector at the FX Supervisory Controller. Then wire to the 6-position connector plug for each assembly of FXRIO16 modules via the shortest route possible. See [Power from the FX Supervisory Controller 6-Position Connector](#) on page 10.

**Note:** This power method is not available for most FX20/FX60 Series; instead, use the following Step b or Step c.

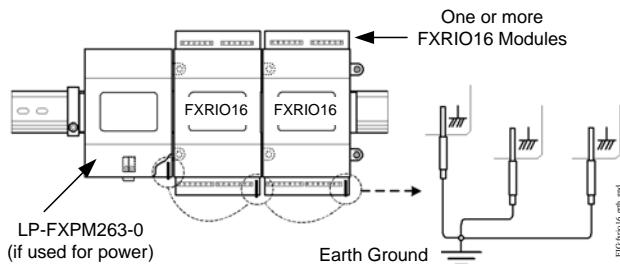
- b. If powering the FXRIO16 module from a local LP-FXPM263-0 power supply module, wire the **disconnected** AC line circuit to the 2-position terminal block under the LP-FXPM263-0 power supply module's cover. See [Power from Local LP-FXPM263-0 Power Supply Module](#) on page 11.
- c. If powering the FXRIO16 module from a third-party, 2–15 VDC power supply, wire the positive and negative lines from the power supply to the PS+ and PS– terminals of the 6-position end connector plug. See [Power from Third-Party 12–15 VDC Power Supply](#) on page 12.

3. Connect RS-485 wiring between the FXRIO16 module and the FX Supervisory Controller, and (if applicable) to other remote FXRIO16 modules, in a continuous multidrop fashion. See [RS-485 Communications](#) on page 14.
4. Connect I/O wiring. See sections [Inputs](#) on page 14, and [Outputs](#) on page 16.
5. Apply power to the unit. See [Powerup and Initial Checkout](#) on page 17.

## Grounding

An earth ground spade lug (0.187 in.) is provided on the circuit board of the FXRIO16 module (and LP-FXPM263-0 power supply module) for connection to earth ground. For maximum protection from electrostatic discharge or other forms of Electromagnetic Interference (EMI), connect **each** device's earth ground using a #16 AWG or larger wire. Keep these wires as short as possible.

See Figure 5 for the location of the earth grounding wire for both the FXRIO16 module and LP-FXPM263-0 power supply module.



**Figure 5: Earth Ground Connection Required to Each FXRIO16 and Power Module**

**Note:** Connect any remote FXRIO16 modules to a nearby earth ground in the same manner.

### Power from the FX Supervisory Controller 6-Position Connector

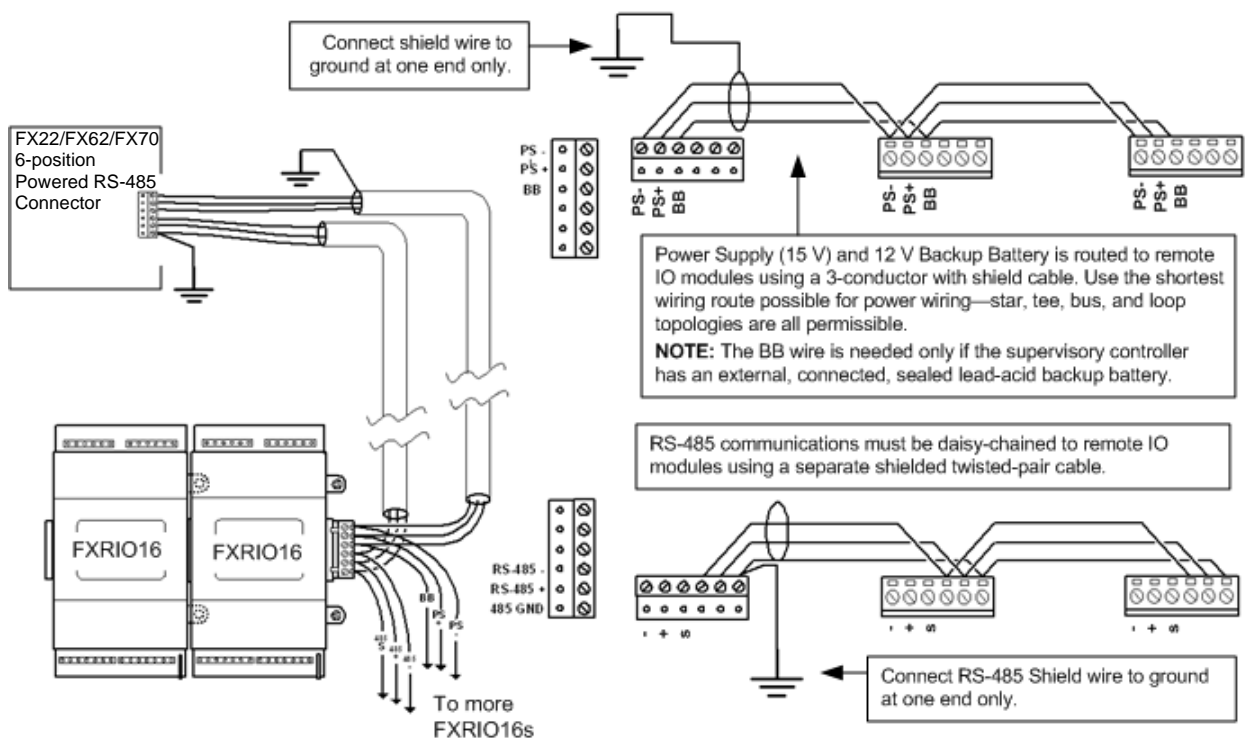
**Note:** This method is not an option for FX20/FX60 Series controllers.

If powering one or more FXRIO16 modules from an FX Supervisory Controller with a 6-position powered RS-485 connector, then you typically route the 15 VDC and 12 V backup battery (BB) to the modules via a 3-conductor with shield cable. The remaining three positions are used for RS-485 communications between the FX Supervisory Controller and the FXRIO16 modules, using a separate shielded, twisted-pair cable. See Figure 6.

**Note:** If the FX Supervisory Controller is not connected to a (optional, external) sealed lead-acid battery, the BB wire is not required. This situation permits use of a single-pair shielded cable, versus a 3-conductor with shield cable.

**Note:** For power budgeting purposes, estimate each FXRIO16 module to consume 2 W nominal (125 mW at 15 V). Typical current will be less, as this estimate factors in all four relays being pulled in.

**Note:** Do not apply power (plug in the 6-position connector at the FX Supervisory Controller) until all other wiring is completed. See *Powerup and Initial Checkout* on page 17.



**Figure 6: FXRIO16 Modules Powered by FX22/FX62/FX70 with a 6-Position Pwr/485 Connector (RS-485 wiring also shown)**

In some cases, some number of FXRIO16 modules may be powered this way (from FX Supervisory Controllers), whereas others may be powered locally using either an LP-FXPM263-0 power supply module, or a third-party, 12–15 VDC power supply. This may be advisable when I/O modules are located long distances from the FX Supervisory Controller to avoid excessive voltage drops due to wiring resistances. See the following sections:

- [Power from Local LP-FXPM263-0 Power Supply Module](#) on page 11.
- [Power from Third-Party 12–15 VDC Power Supply](#) on page 12.

### **Power from Local LP-FXPM263-0 Power Supply Module**

If powering FXRIO16 modules from a directly attached AC power supply (LP-FXPM263-0 power supply module), wire the AC circuit to the LP-FXPM263-0's 2-position terminals (must remove cover). See Figure 7.



#### **WARNING: Risk of Electric Shock.**

Disconnect the power supply before making electrical connections. Contact with components carrying hazardous voltage can cause electric shock and may result in severe personal injury or death.

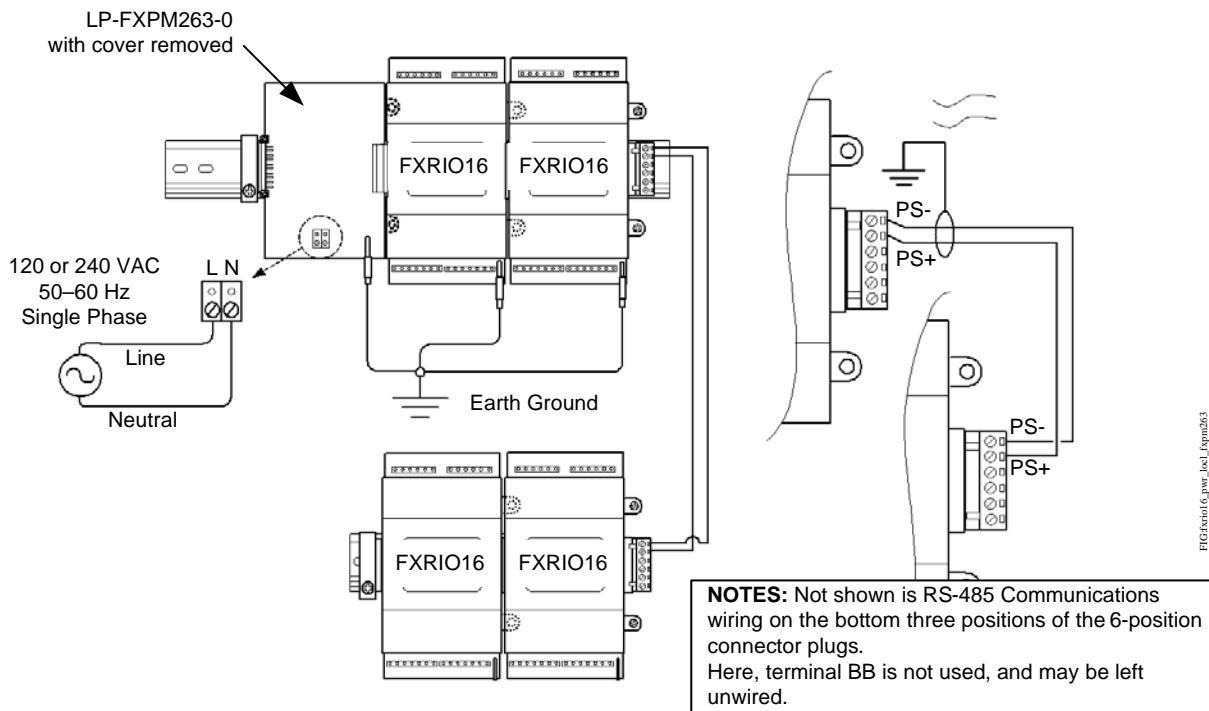
**IMPORTANT:** Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations. Do not exceed the FX Supervisory Controller's electrical ratings.

**IMPORTANT:** Do not exceed the 30 W capacity of the LP-FXPM263-0 power supply module by the powered devices.

**Note:** For power budgeting purposes, estimate each FXRIO16 module to consume 2 W nominal (125 mW at 15 V). Typical current will be less, as this estimate factors in all four relays being pulled in.

**Note:** For other wiring on the 6-position end connector, see [RS-485 Communications](#) on page 14.

**Note:** Do not apply power (energize the LP-FXPM263-0 power supply module) until all other wiring is completed. See *Powerup and Initial Checkout* on page 17.



**Figure 7: Power from a Local LP-FXPM263-0 Power Supply Module**

If the LP-FXPM263-0 power supply module powers additional FXRIO16 modules (not attached in same assembly), wire a single-pair cable with shield between assemblies, connecting PS- to PS-, and PS+ to PS+, via the shortest route possible. See Figure 7.

### **Power from Third-Party 12–15 VDC Power Supply**

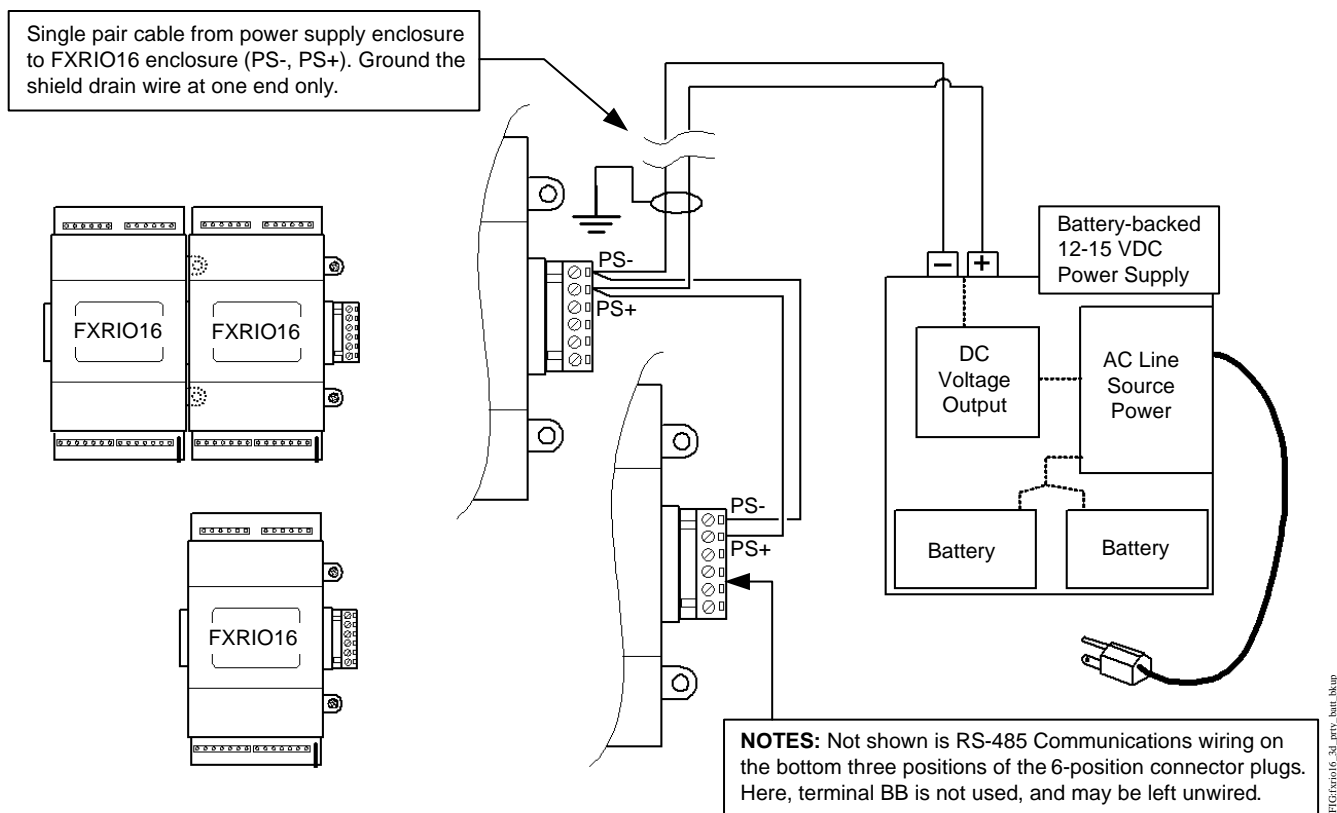
FXRIO16 modules can be powered by a third-party, 12–15 VDC power supply, as an alternative to using a LP-FXPM263-0 power supply module. We recommend a battery-backed power supply. This battery-backed power supply provides power to the I/O module(s) during AC power loss scenarios.

Figure 8 shows wiring for two assemblies of FXRIO16 modules powered by a battery-backed power supply.

**Note:** For power budgeting purposes, estimate each FXRIO16 module to consume 2 W nominal (125 mW at 15 V). Typical current will be less, as this estimate factors in all four relays being pulled in.

**Note:** For other wiring on the 6-position end connector, see *RS-485 Communications* on page 14.

**Note:** Do not apply power (energize the power supply) until all other wiring is completed. See *Powerup and Initial Checkout* on page 17.



**Figure 8: Third-party 12 VDC, Battery Backed, Power Supply Powering FXRIO16 Modules**

**Note:** Power must be regulated to within  $\pm 4\%$ .

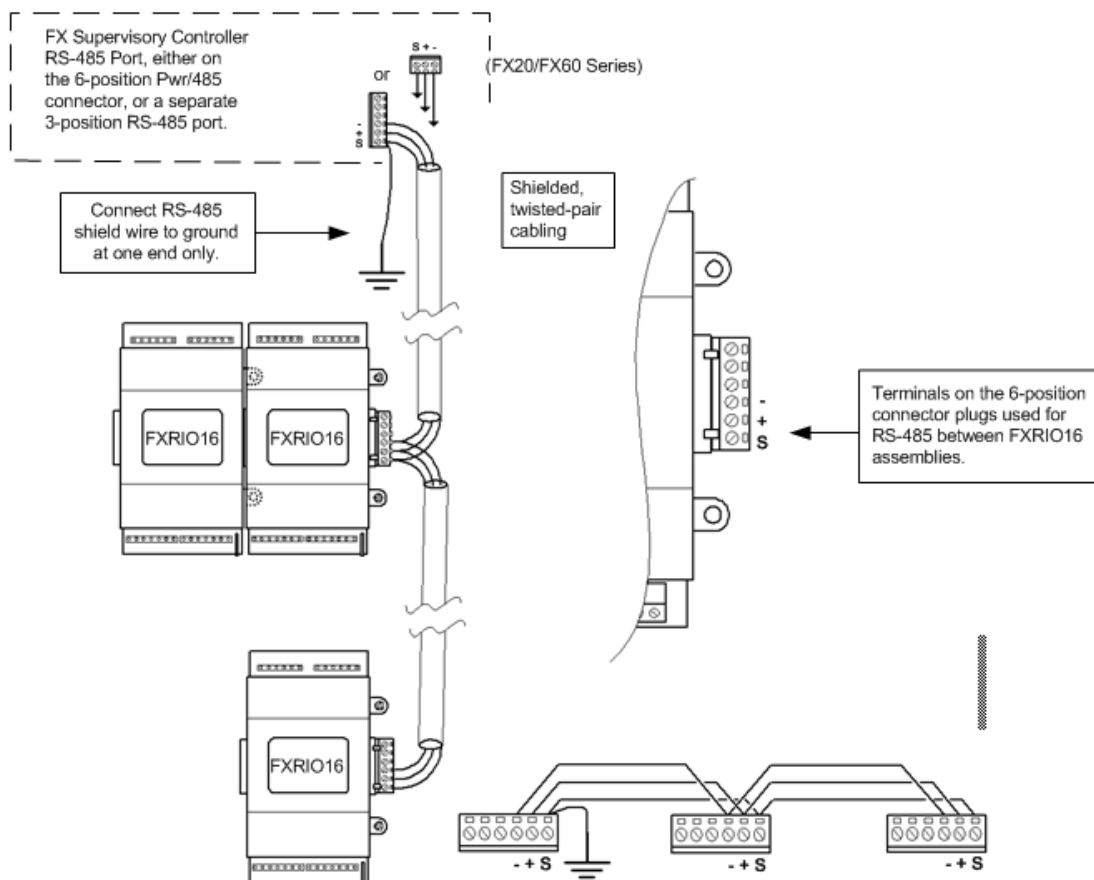
**Note:** Power supply models furnishing 12 VDC output are the most commonly available.

**Note:** Only remote FXRIO16 modules can be powered by a 12 VDC power supply; the FX Supervisory Controller requires 15 VDC. Depending on the FX Supervisory Controller model, this 15 VDC may be furnished by an integral power supply, or from an external power supply module, such as the LP-FXPM263-0. Refer to the appropriate FX Supervisory Controller Installation Instructions for your specific controller.

## RS-485 Communications

RS-485 communications from the FX Supervisory Controller to each FXRIO16 module (or assembly of modules) requires a continuous daisy-chain wiring topology using a shielded, twisted-pair cable. Wire between FXRIO16 assemblies using the 6-position end connectors. At the FX Supervisory Controller, wire to either its 3-position RS-485 connector, or if equipped, to its 6-position Pwr/485 connector.

Use shielded 18-22 AWG wiring (refer to the Telecommunications Industry Association/Electronic Industries Alliance 485 [TIA/EIA-485] standard). Wire in a continuous multidrop fashion, meaning plus to plus, minus to minus, and shield to shield. Connect the shield to earth ground at one end only, such as at the FX Supervisory Controller. See Figure 9.



**Figure 9: RS-485 Wiring from the FX Supervisory Controller to One or More FXRIO16 Modules Using a Daisy-Chain Connection**

## Inputs

Each of the eight Universal Inputs (UI) can support any one of the following:

- See Type-3 10k ohm Thermistor on page 15.
- See Resistive 0–100k ohms on page 15.
- See 0–10 VDC on page 15.
- See 4–20 mA on page 15.
- See Binary Input on page 16.

## Thermistor

Inputs support 10k Thermistor temperature sensors. Input accuracy is in the range of  $\pm 1\%$  of span. By default, conversion is for a standard, Type 3 thermistor sensor, with a sensor range of  $-10$  to  $135^{\circ}\text{F}$  ( $23.3$  to  $57.2^{\circ}\text{C}$ ). Using a conversion type of Tabular Thermistor, you can specify a different thermistor response curve by importing a thermistor curve .xml file. Currently, the **kitlo** module contains an **XML** folder with thermistor curves for various thermistor temperature sensors. You can also edit and export (for reuse) customized thermistor curve Extensible Markup Language (XML) files.

Figure 10 shows the wiring diagram.

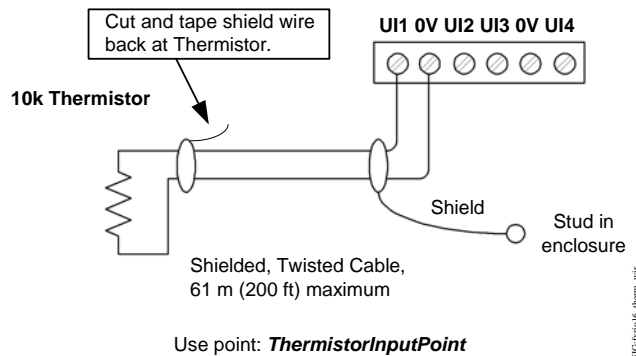


Figure 10: Thermistor Wiring

## Resistive 0–100k ohms

Inputs can read a resistive signal within a range from 0 to 100,000 ohms. Wiring is the same as shown for a Thermistor temperature sensor (Figure 10).

Resistive signals require a **ResistiveInputPoint**.

**IMPORTANT:** UI inputs provide optimum resistive-to-temperature resolution in the 10k ohm range. For a sensor with a range far from 10k ohms (such as a 100-ohm or 1,000-ohm sensor), resolution is so poor as to be unusable. To successfully use such a sensor, install a transmitter that produces a VDC or mA signal, and then wire the transmitter to the UI according to the 0–10 VDC or 4–20 mA instructions.

## 0–10 VDC

Inputs support self-powered 0–10 VDC sensors. Input impedance is greater than 5k ohms. 0–10 V accuracy is  $\pm 2\%$  of span, without user calibration. Figure 11 shows the wiring diagram for a 0–10 VDC sensor.

0–10 VDC sensors require a **VoltageInputPoint**.

Range: 0–10 VDC  
Input Impedance > 5k ohms

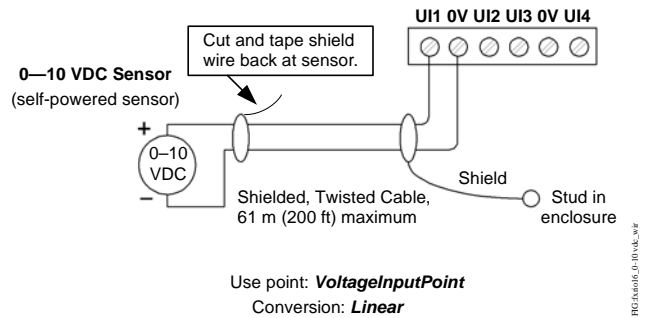


Figure 11: 0–10 VDC Wiring

## 4–20 mA

Inputs support self-powered 4–20 mA sensors. Input accuracy is  $\pm 2\%$  of span, without user calibration. Figure 12 shows the wiring diagram, which requires a 499-ohm resistor wired across the input terminals.

4–20 mA sensors also require the **VoltageInputPoint**.

**4–20 mA Sensor**  
(self-powered sensor)  
Range: 0–20 mA

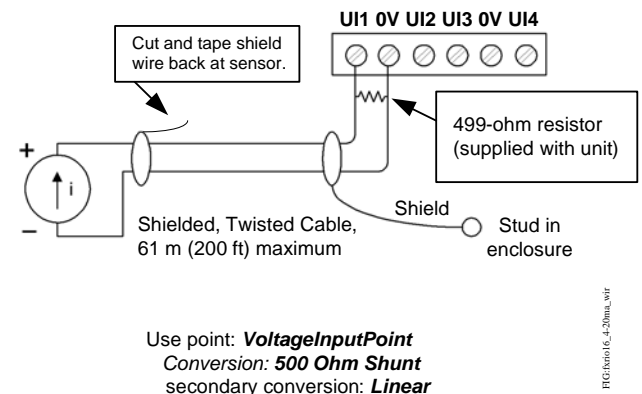


Figure 12: 4–20 mA Wiring



**CAUTION: Risk of Electric Shock.**  
Disconnect the power supply before making electrical connections to avoid electric shock.

**IMPORTANT:** When using an externally powered 4–20 mA sensor, be sure to de-energize its power supply before making or changing any wiring connections to the FXRIO16 module; in addition to removing power from the FXRIO16 module.

**IMPORTANT:** It is important to not apply external power to the UI inputs without the 499-ohm resistor in place. Otherwise, even a momentary application of power (say, 24 VDC) to the UI terminals without the resistor may damage circuitry on the FXRIO16. Only after completing all input wiring should you restore power to such external power supplies.

## Binary Input

Inputs support both pulse contacts and normal dry (equipment status) contacts.

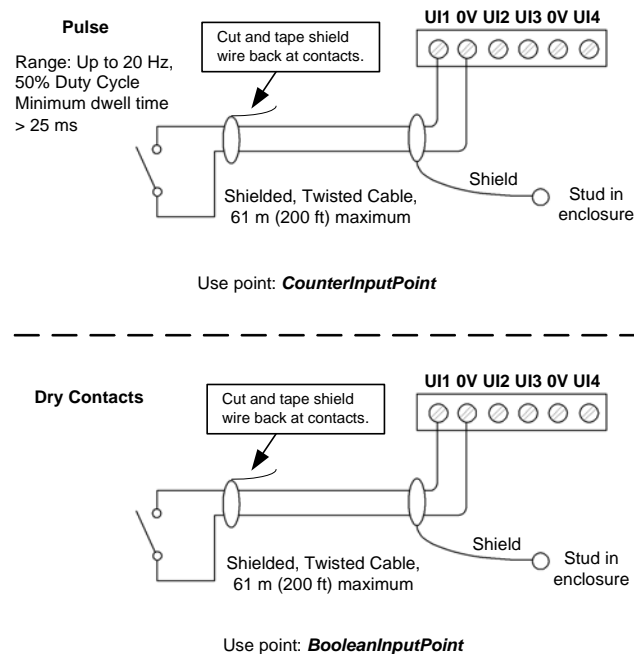
- Pulse contacts may have a change-of-state (COS) frequency of up to 20 Hz with a 50% duty cycle.

**Note:** Minimum dwell time must be > 25 ms. (Contacts must remain open at least 25 ms and be closed at least 25 ms.)

- Standard dry contacts must have a 1 Hz (or less) COS frequency, with minimum dwell time > 500 ms. (Contacts must remain open at least 500 ms and be closed at least 500 ms.)

Both types of dry contacts support 3.3 VDC open circuits, or 330 microampere ( $\mu$ A) short-circuit current. For a pulse contact, use the **CounterInputPoint** in the station database. For other dry contacts, use the **BooleanInputPoint**.

Figure 13 shows the wiring diagram (which is identical for both uses), but with different types of Nrio software points used for either application.



**Figure 13: Binary Input Wiring**

## Outputs

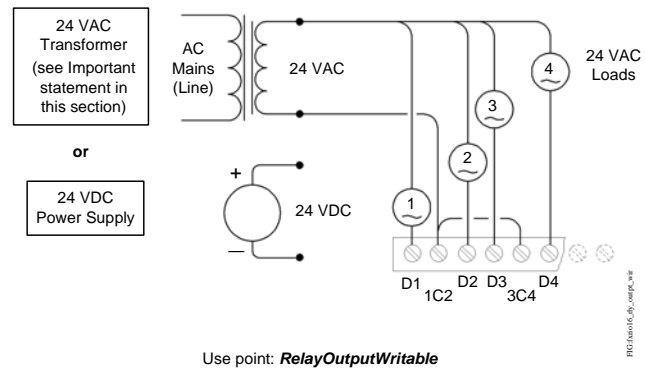
An FXRIO16 module has four Digital Relay Outputs (see [Relay Outputs](#) on page 16) and four 0–10 V Analog Outputs (see [Analog Outputs](#) on page 16).

## Relay Outputs

Each relay output is rated at 24 VAC or VDC at 0.5 A. Relay outputs have Metal Oxide Varistor (MOV) suppressors to support inductive-type loads such as heavy-duty relay coils.

**IMPORTANT:** Relays are not rated for AC mains (line level) powered loads (instead, 24 V maximum). Use an external 24 V transformer or a 24 VDC power supply to power loads.

Use a **RelayOutputWritable** in the station for each output. Figure 14 shows an example wiring diagram.



**Figure 14: Relay Output Wiring**

Note that the two common DO terminals (1C2, 3C4) are isolated from each other. This method is useful if controlled loads are powered from different circuits.

An LED status indicator for each relay (D1—D4) is located on the board (see Figure 4), and also visible through the cover. Under normal operation, each digital status LED indicates activity as follows:

- Off**—relay open/no current flows.
- On**—relay closed/load current flows.

Therefore, an **On** status indicates that the load is powered.

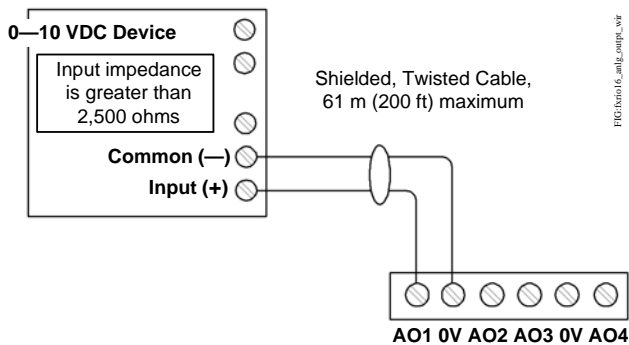
## Analog Outputs

Analog Outputs (AOs) are referenced by the terminals labeled **An** and **0V** (ground). Each AO can supply a maximum of 4 mA over the entire 0 to 10 VDC range. For this 0–10 V full range, the minimum input impedance of a device controlled by the AO must be greater than 2,500 ohms.



If the device's input impedance is less than 2,500 ohms, the 4 mA maximum current limits the voltage output range. For example, for a device with a 1,000 ohm input impedance, the AO would work as a 0-4 VDC analog output.

Figure 15 shows typical wiring for an AO. For each AO, use a **VoltageOutputWritable** in the station database.



Use point: **VoltageOutputWritable**

**Figure 15: Analog Output Wiring**

## Operation

### **Nrio16Module (Software) Representation**

In the station interface to the FX Supervisory Controller and FXRIO16 module, the module's I/O is modeled in the station's **NrioNetwork** (copied from the **nrio** palette), under a child **Nrio16Module** device level component. This Nrio16Module has a default name of **io16\_n**.

**Note:** After a remote I/O module is discovered and added to the station under this NrioNetwork (each one as an Nrio16Module), the serial status LEDs for the FX Supervisory Controller's RS-485 port continually flash, reflecting polling activity. At this time, the STATUS LED on that FXRIO16 module lights solid green.

**Note:** When a FXRIO16 module's status LED is not lit solid green, all of its outputs are in failsafe state (all relay outputs OFF, and all AOs are at a 0-volt level).

**Note:** Blinking of a remote I/O module's status LED occurs for two reasons, shown at different rates:

- Rapid flash (low duty cycle), meaning the unit is unconfigured. Discovery and addition to the station database is required.

- Equal time on and off (50% duty cycle), meaning the unit is configured but currently offline with the FX Supervisory Controller. Check RS-485 wiring between the controller and remote I/O module.

Each input or output used requires a special Niagara Remote Input/Output (Nrio) point to be added in the station database. These components act as the station interface to the physical I/O points. The Nrio points you need for each input or output type are noted in previous wiring sections in **boldface**.

### **Powerup and Initial Checkout**

To perform powerup and initial checkout:

1. Apply power to the FXRIO16 (depending on power source, this means either plugging in a 6-position end connector, energizing an LP-FXPM263-0 power supply module, or powering on the connected FX Supervisory Controller or third-party 12–15 VDC power supply).

The FXRIO16 module's board status LED (see Figure 4) will initially be blinking.

2. Using FX Workbench, open a station connection to the FX Supervisory Controller. If not already present, add an **NrioNetwork** component to the station's Drivers Container.
3. Configure the NrioNetwork's **Port Name** property to match the FX Supervisory Controller's RS-485 port **COM** assignment (for example, COM2), and set its **Trunk** property to a unique number Nrio-wide (for example, 2).
4. From the NrioNetwork's **Nrio Device Manager** view, perform a **Discover**. Each discovered remote I/O module will be listed in the top **Discovered** pane in the view, with each FXRIO16 module appearing as an **io16** device type.

**Note:** To associate a discovered device to a specific FXRIO16 module, issue a right-click **Wink Device** action; this action cycles a relay output on that FXRIO16 module several times, which you can hear or see if nearby. This action is available both before and after a discovered device is added to the station.

5. Add each discovered FXRIO16 module to the station, renaming it to reflect its actual location (see Note above). Each I/O module is represented by an **Nrio16Module** component.
6. Verify that each FXRIO16 module's board status LED is now lit solid green.

**Note:** If an **Nrio16Module** is selected in the **Nrio Device Manager** view, and the **Upgrade Firmware** button is active, we recommend that you upgrade its firmware. After selecting this, **do not interrupt power to the FXRIO16 module and FX Supervisory Controller, or the communications between them**, until the firmware upgrade job finishes. Typically, this takes less than 2 minutes, with job completion signaled in the FX Workbench view.

7. Discover, add, and configure I/O points under each Nrio16Module's Points device extension.

## Repair Information

### Replacement Parts

Servicing the FXRIO16 module may call for replacement parts. There are two categories of parts:

- [Standard Replacement Parts](#) on page 18.
- [New Replacement Units](#) on page 18.

### Standard Replacement Parts

Standard replacement parts are listed in Table 4 and can be ordered from stock. Standard replacement parts cannot be returned for credit and should be disposed of in an appropriate manner.

**Table 4: Standard FXRIO16 Module Replacement Parts.**

Part Number	Description
LP-KITFXRIO-0	Hardware bag for FXRIO16 module. Includes four pin-mount, 6-position screw terminal connectors for I/O points, one end-mount 6-position screw terminal plug for power and RS-485 communications, eight 499-ohm, 1%, 0.6 W resistors, and one grounding wire with quick-disconnect 0.187 in. female connector.

### New Replacement Units

To replace a faulty unit, order and install a new FXRIO16 module. Note that FX Supervisory Controller accessories do not have special field replacement units with separate part numbers.

To replace a faulty FXRIO16 module, order a new one. To ensure proper credit for an FXRIO16 module still under warranty, contact customer service for return authorization.

**Note:** Before ordering a new FXRIO16 module, we recommend that you contact your normal technical support resource to eliminate the possibility of a software issue or mis-configuration problem.

### Replacing the FXRIO16 Module

**IMPORTANT:** Before handling circuit boards, discharge any accumulated static by touching the nearby earth grounding point. For details, see [Static Discharge Precautions](#) on page 5.

To replace the FXRIO16 module in the field, proceed as follows:

1. Using FX Workbench, back up the FX Supervisory Controller's configuration to your computer.
2. Remove power to the FXRIO16 module. The unit should power down automatically.
 

**Note:** If any I/O points have voltage, turn the devices off or disconnect power to them.
3. Note positions of all I/O wiring going to the FXRIO16 module to be replaced, as well as for any other installed modules. If necessary, label connectors and accessory modules to avoid misconnection later (after the FXRIO16 module is replaced). The software that runs on the FX Supervisory Controller expects the terminal positions to be the same in the replacement FXRIO16 module, in order to collect data from, or to control, the attached devices.
4. Unplug all connectors from the FXRIO16 module, including all I/O connectors and earth ground wire.
 

**Note:** Removal of the four pin-mounted I/O connector plugs may be difficult. For related details about removing them, see [About Screw Terminal Connectors](#) on page 8.
5. Remove any screws or DIN rail clips securing the FXRIO16 module, removing it from its mounting. See Figure 2 for details on removal from (and mounting onto) DIN rail.
6. Mount the replacement FXRIO16 module as it was previously, using the same DIN rail location and/or screws.
7. Reconnect the earth ground wire to the FXRIO16 module grounding lug.
8. Reconnect all I/O connectors to the FXRIO16 module.

9. If any of your I/O points have voltage, turn the devices back on, or reconnect power to them.
10. Reconnect the 6-position end-mount connector, and ensure that power is applied to the FXRIO16 module as well as the FX Supervisory Controller.

For related details, see *Powerup and Initial Checkout* on page 17.



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