FX-SC8XIOR16-0 Module Installation Instructions

Applications

This document describes how to mount and wire an FX-SC8XIOR16-0 (IOR-16) option module for an FX80 controller. The IOR-16 is designed for the remote monitoring and control of applications to facilitate end-to-end automation and device-to-enterprise integration. It expands an FX80 Supervisory Controller with 16 I/O points consisting of the following:

- Eight universal inputs (UI): Type 3 (10K) thermistors, 0-100kΩ, 0-10 VDC, 0-20 mA with external resistor
- Four relay outputs (RO): Form A contacts, 24 VAC @ 0.5 A rated
- Four analog outputs (AO) (1-10 VDC)

Figure 1: FX-SC8XIOR16-0 Module

The IO module uses DIN rail mounting and has two end-mounted five-pin connectors that support direct-chaining to other IOR-16 modules or FX-SC8XIOR34-0 (IOR-34) modules. Communications to an FX80 Controller use RS-485 multidrop on three wires of an end-mounted five-pin connector. The other two wires on that connector are for INPUT power (15 VDC) and are supplied from a DIN-mountable option (IOR-34) or a third party 13.5 VDC to 15.75 VDC power supply. The RS-485 bus is wired back to COM1 or COM2 of the FX80 controller.

Part No. 24-10143-01701 Rev. A

2019-03-22

(barcode for factory use only)

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 may cause harmful interference, in which case the users will be required to correct the interference at their own expense.

Canada

This Class (A) digital apparatus meets all 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

Unpack the FX-SC8XIOR 16-0 and inspect the contents of the package for damaged or missing components. If the module is damaged, contact the Johnson Controls® Product Sales Operations team and return any damaged components for repair or replacement.

Power supply options

An FX80 controller can support up to a maximum of sixteen IOR-16 modules through a single RS-485 bus. The controller counts as two modules if an IOR-34 is included. You can provide power to the IOR-16 from the five-pin connector of an IOR-34. Each IOR-34 module can power up to four IOR-16 modules. You can also use a third-party 13.5 VDC to 15.75 VDC power supply (output regulated to within ±4%) wired to the P+ and P- terminal of an IOR-16 module's 5-position end connector.

Table 1 shows possible options for combinations of IOR-16 and IOR 34 modules. For example, option 2 includes a total of fourteen IOR-16s and one IOR-34. The IOR-34 powers four of the IOR-16s. The remaining ten IOR-16s must be powered by an external source.

Table 1: IO Module combinations and IOR-16 power options

Combinations	Modules	Number of Devices	Powered by IOR-34s	Powered by External Supply
Option 1	IOR-16	16	0	16
	IOR-34	0		
Option 2	IOR-16	14	4	10
	IOR-34	1		
Option 3	IOR-16	12	8	4
	IOR-34	2		
Option 4	IOR-16	10	10	0
	IOR-34	3		
Option 5	IOR-16	8	8	0

Table 1: IO Module combinations and IOR-16 power options

Combinations	Modules	Number of Devices	Powered by IOR-34s	Powered by External Supply
	IOR-34	4		
Option 6	IOR-16	6	6	0
	IOR-34	5		
Option 7	IOR-16	4	4	0
	IOR-34	6		
Option 8	IOR-16	2	2	0
	IOR-34	7		
Option 9	IOR-16	0	0	0
	IOR-34	8		

Note: Both IOR-16s and IOR-34s must have a UPS power backup if continuous operation during power failures is a requirement. See Voltage drop considerations

Voltage drop considerations

If you use the FX80 and its backup battery to power the IOR-16 module, be aware of voltage drops in the connecting "trunk power" cabling. Some modules are not mounted in the same enclosure with the FX80 Supervisory Controller. This situation applies only if the modules are located in different locations, that is, not near the FX80 Supervisory Controller.

Note: When all four relays are pulled in each IOR-16 draws, at most, 0.133 A. This can introduce voltage drop when long cabling distances are used for power or backup. See Table 2.

Table 2: IOR-16 Power consumption

Device	Max per System	Amps/ W used @ 15 VDC (each)	Notes
IOR-16	See Power supply options	0.133 A / 2.00 W	Has 4 on-board relays

Undersized selection of power cabling can result in unacceptably high voltage drops, and remotely located IOR-16 modules may not operate correctly, especially during emergency (battery backup) operation.

The maximum allowable voltage drop due to wiring considerations is 1.5V. This is equal to the difference in voltage that is measured across the P+ and P- at the source power supply, and the P + and P- at the furthest expansion module (IOR-16). The following table provides a voltage drop chart, showing voltage drops per 100 feet of paired wire of different gauges (AWG), at different load amperes.

Table 3: Voltage drop per 100 feet run (30m) of paired wire

Gauge (AWG)	Load Current						
	0.10A	**0.25A**	**0.5A**	**1.0A**	**1.5A**	**2.0A**	**4.0A**
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

Table 3: Voltage drop per 100 feet run (30m) of paired wire

Gauge (AWG)	Load Current						
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

Parts included

- FX-SC8XIOR 16-0 module with quick disconnect female connectors.
- Hardware bag containing the following items:
  - One grounding wire, with a quick-disconnect 0.187 in. female connector.
  - Eight 499Ω resistors, that are used for 4-20mA inputs.

Special tools needed

- FX-SC8XIOR 34-0 or other 13.5 VCD to 15.75 VDC power supply source. See Power supply options
- A suitable power source, such as one of the following:
  - UL listed, Class 2, 24 VAC transformer, rated a minimum of 21.6 VAC to 26.4VAC and 28VA.

    ⓘ **Note:** A dedicated transformer is required. Only an FX80 and the IOR-34 module may be powered from the same transformer.
  - 22 VDC to 26.4VDC power supply capable of supplying at least 916 mA (22 Watts). This is sufficient to power a fully loaded IOR-34 (Four IOR-16 modules plus the IOR-34)
- A DIN rail, type NS35/7.5 (35mm x 7.5mm) and DIN rail end-clips (stop clips), recommended for mounting with the controller. The DIN rail must be of sufficient length to accommodate both the FX80 and any other modules.
- Suitable screws and screwdriver for mounting the DIN rail, or if the DIN rail not used, for mounting the bases of the controller and the module. A small flat-bladed screwdriver is needed for wiring the terminals.

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

⚠ Warning

Risque de décharge électrique
Débrancher l'alimentation avant de réaliser tout branchement électrique. Tout contact avec des composants conducteurs de tensions dangereuses risque d'entraîner une décharge électriqueet de provoquer des blessures graves, voire mortelles.

General Precautions

- **Important:** Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations. Do not exceed the IOR-16s electrical ratings.
- **Important:** Use this IOR-16 Module only as an operating control. Where failure or malfunction of the IOR-16 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 ward off or protect against failure or malfunction of the IOR-16.

Static Discharge Precautions

Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within the devices are sensitive to static discharge. Follow these precautions when installing, servicing, or operating the system:

- **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, with the wrist strap clamp secured to earth ground.

Module connection precautions

ⓘ **Note:** Do not connect more than the maximum number of IOR-16 modules to the RS-485 port of the parent FX80 Supervisory Controller. Sixteen is the maximum number supported in software. However, fewer IOR-16 modules can be supported. See Power supply options.

⚠ CAUTION

Risk of Property Damage
Do not connect more than the maximum allowed IOR-16 modules to a single power source. Overloading may cause overheating or blowing an internal, non-replaceable fuse. See Power supply options.

⚠ CAUTION

Risk of Property Damage
Connect S terminal wiring as shown in Figure 7 or communication errors may result. S terminal serves as reference ground between isolated RS-485 ports on FX80 Supervisory Controllers and IOR-16 and IOR-34 modules.

Mounting

The IOR-16 modules support mounting on EN 50022 standard 7.5mm x 35mm DIN rail or panel mounting.

⚠ CAUTION

Risk of Property Damage
Do not mount hardware on both a DIN rail and with tab mounts to another surface. This causes physical stress on equipment and prevents good connections between the FX80 controller and IOR-16 modules.

⚠ CAUTION

Risk of Property Damage
Do not mount DIN rail stops so that they press against IOR-16 end connectors. If possible, use low-profile rail stops to eliminate possibility of contact and damage to the connectors.

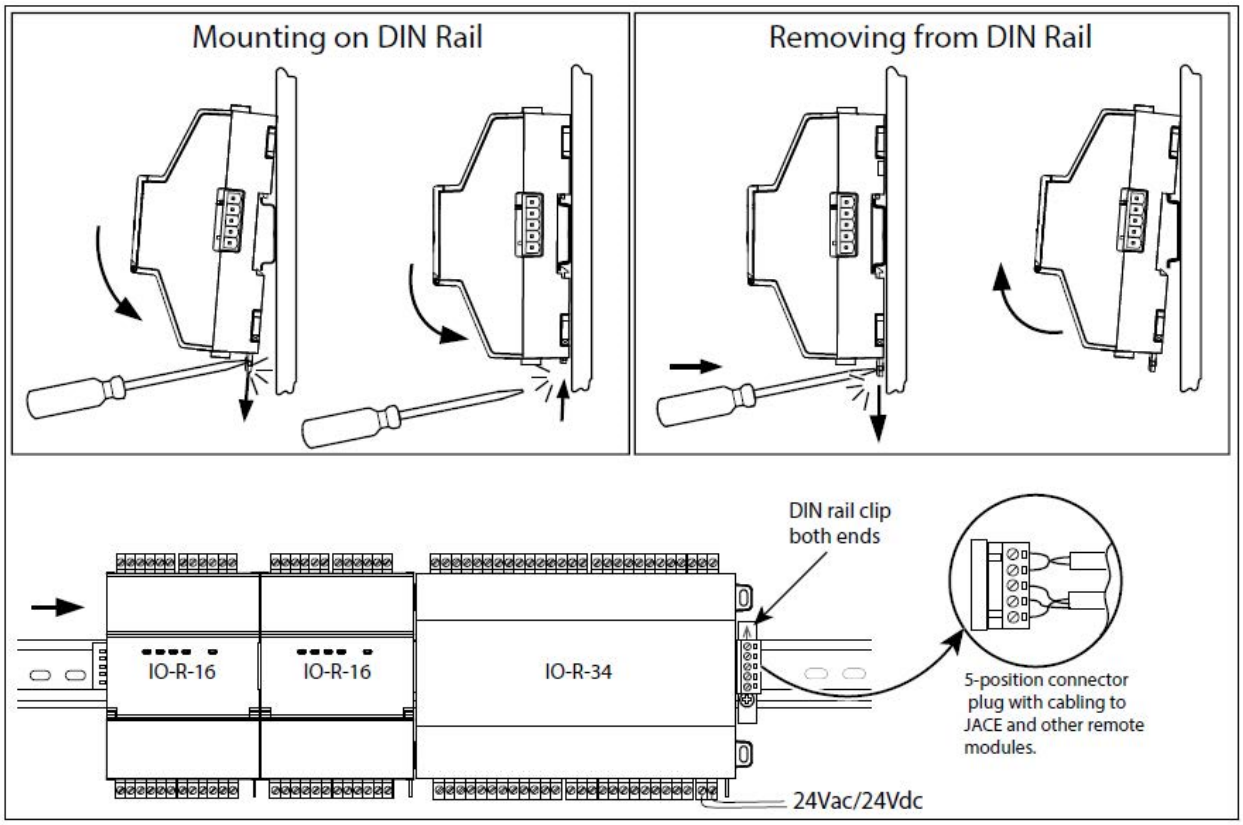
Mounting on a DIN Rail

The following applies to mounting an IOR-16 module:

- Use horizontal mounting as it is the preferred method to facilitate head dissipation.
- Mounting on a 35mm wide DIN rail is recommended. The IOR-16 unit base has a molded DIN rail slot and locking clip, which simplifies mounting with other modules. 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 IOR-16.

1. Pull the module's locking clip down.

Figure 2: Fastening to the rail



2. Tilt the module to hook over the DIN rail. Rotate the module flush against the DIN rail and then press the locking clip upwards to release it and secure the module to the rail.
3. Slide the IOR-16 module along the DIN rail to its intended location. If you want to connect another mounted module, seat the 5-position plug into that module's connector socket.
4. Carefully install DIN rail end clips to the DIN rail to secure the assembly. Make sure that the DIN rail stops do not press against the end connectors on the IOR-16.
5. Repeat this for all items, until all are mounted on the DIN rails, firmly connected to each other, and secured with DIN rail end clips.

IOR-16 board layout and terminals

The IOR-16 module provides eight universal inputs, four digital relay outputs, and four 0-10 VDC analog outputs. The following table shows the wiring terminal positions and LED locations.

Figure 3: Remote I/O Module Wiring Terminal Locations

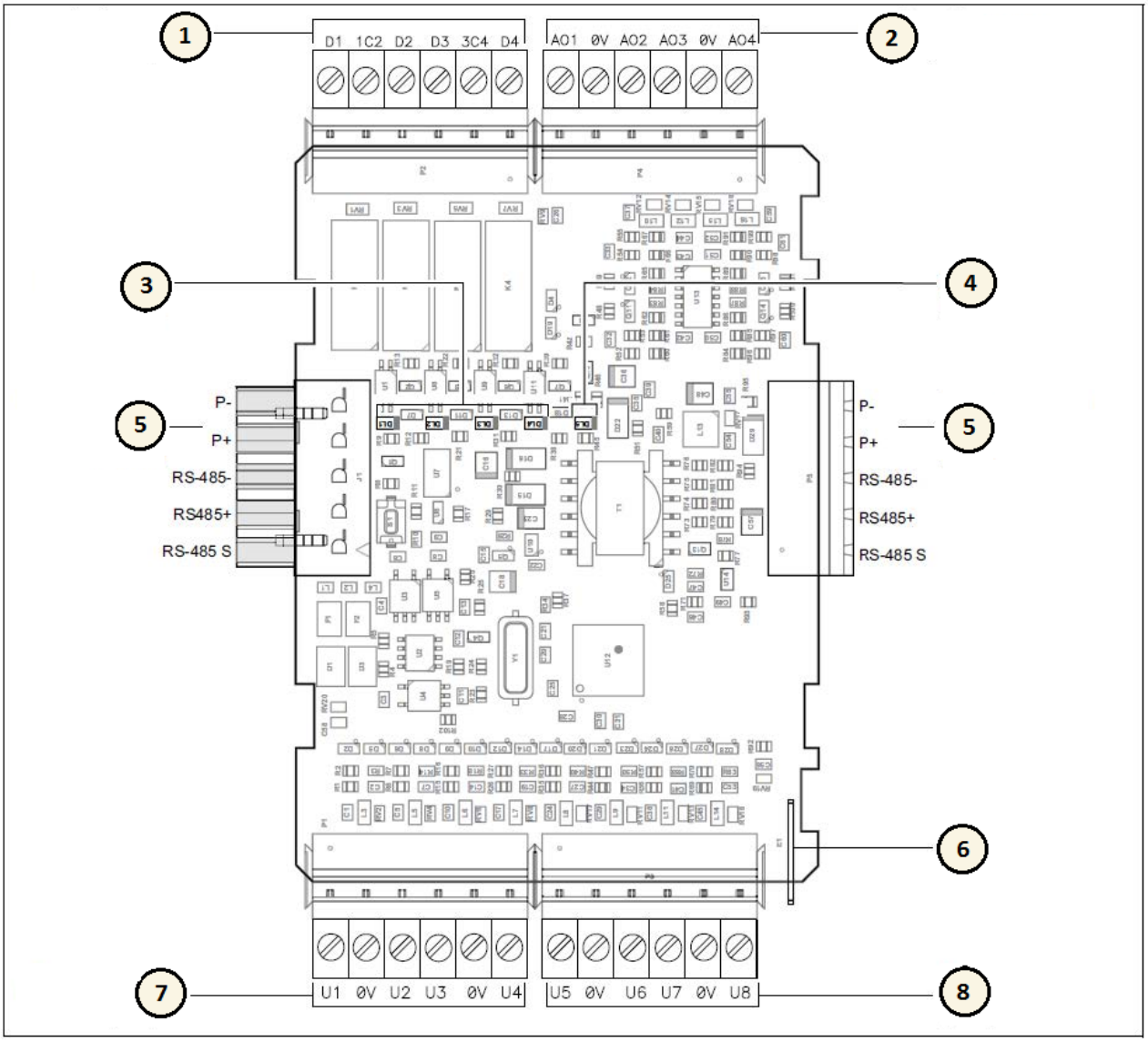


Table 4: I/O Module wiring terminal

Number	Description
1	Digital Relay Outputs (D1 to D4)
2	Analog VDC Outputs
3	Relay Output LEDs
4	RS-485 Staus LED
5	Five-pin connector 15 VDC Power RS-485
6	Earth Grounding Connector Lug
7	Universal Inputs (U1 to U4)
8	Universal Inputs (U5 to U8)

Wiring

See Figure 3 to locate connectors and other components on the Remote I/O Module.

Make connections to the Remote I/O Module in the following order:

1. Connect the earth grounding wire with spade connector from the earth ground lug on the IOR-16 to a nearby earth grounding point. See Grounding.
2. Wire the power supply to the IOR-16.

   ➧ **Important:** Do not energize the power source until all other wiring is completed.

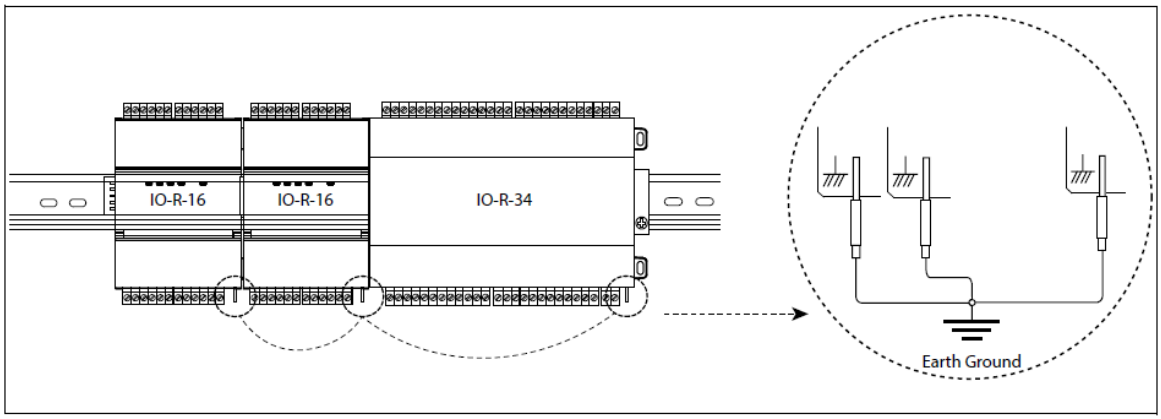
   To wire the IOR-16, choose one of the following options:

   - If powering the IOR-16 from an IOR-34, slide the two modules together to mate the connectors.
   - If powering the IOR-16 from a third-party 13.5 VDC to 15.75 VDC power supply, wire the positive and negative lines from the power supply to the P+ and P- terminals of the five-position end connector plug. See Power from third-party 13.5 VDC to 15.75 VDC power supply.
3. Connect RS-485 wiring between the IOR-16 module and the FX80 Supervisory Controller, and (if applicable) between the IOR-16 module and other remote IOR-16 modules, in a continuous multidrop fashion. See RS-485 Communications.
4. Connect I/O wiring. See sections Inputs and Outputs.
5. Apply power to the unit. See Power up and initial checkout.

Grounding

The circuit board of the IOR-16 module includes an earth ground spade lug (0.187 in.) for connection to earth ground. For maximum protection from electrostatic discharge or other forms of electromagnetic interference, connect the earth ground of each device using a 16 AWG or larger wire. Keep these wires as short as possible. See Figure 4 for the location of the earth grounding wire.

Figure 4: Earth ground connections required to each IOR-16



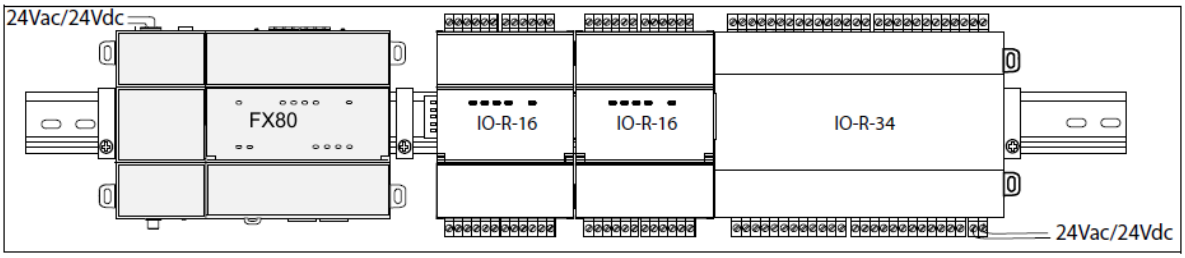
ⓘ **Note:** Connect any remote IO-R-16 modules to a nearby earth ground in the same manner.

Power from IOR-34

If powering one or more IOR-16 modules from an IOR-34 module, connect the modules as shown in Figure 5. Power and RS-485 communication connection is provided through the 5-position Powered RS-485 connector. Each IOR-34 can power up to four IOR-16 modules.

➤ **Important:** Do not apply power at any location until all other wiring is completed. See Power up and initial checkout.

Figure 5: IOR-16 Modules powered by IOR-34 connection



IOR-16 modules can be powered this way (from an IOR-34), or locally using a third-party 13.5 - 15.75 Vdc power supply. When IO modules are located long distances from the IO-R-34 you must use a third-party power supply to avoid excessive voltage drops due to wiring resistance. See Power from third-party 13.5 VDC to 15.75 VDC power supply.

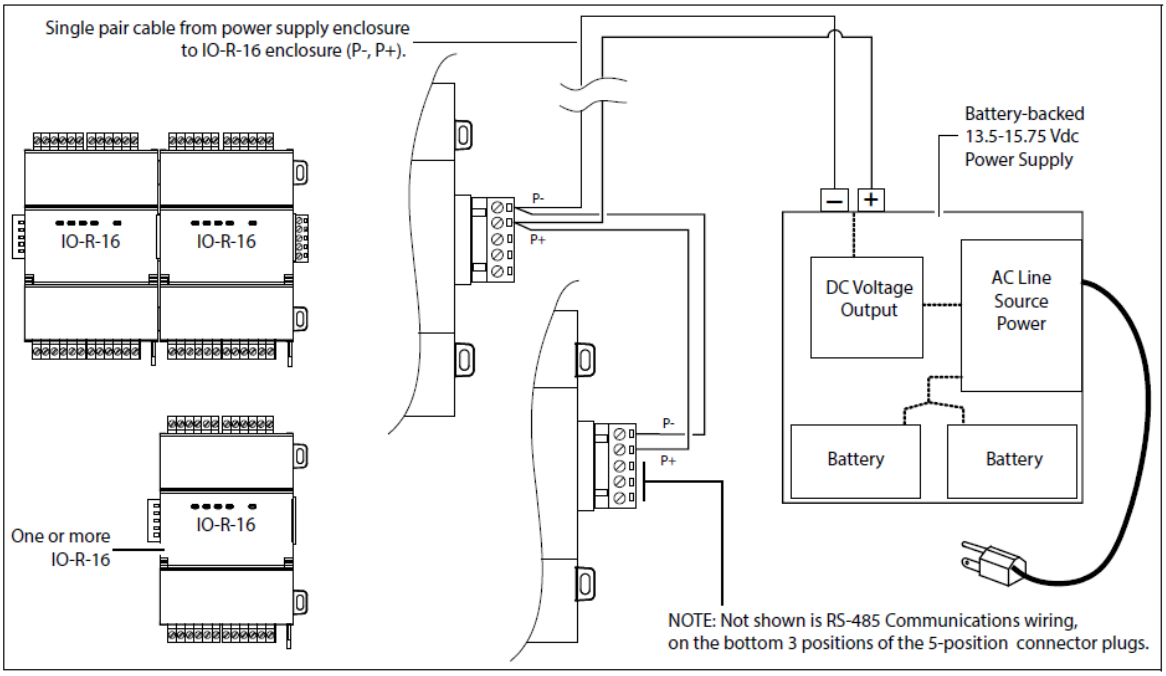
Power from third-party 13.5 VDC to 15.75 VDC power supply

IOR-16 modules can be powered by a third-party, 13.5 VDC to 15.75 VDC power supply. A battery-backed power supply is recommended. This provides power to the IO modules during AC power loss scenarios. Figure 6 shows wiring for two assemblies of IOR-16 modules powered by a battery-backed power supply.

ⓘ **Note:**

- For power budgeting purposes, estimate each IOR-16 module to consume 2W nominal (0.133 A @15V). The typical current will be less as this estimates considers a scenario when all four relays are pulled in.
- Be aware of potential voltage drops when connecting by "trunk power" cabling. Voltage drops are more typical when modules are not located near the power supply. See Voltage drop considerations.
- For other wiring on the five-position end connector, see RS-485 Communications.
- Do not apply power until all other wiring is completed. See Power up and initial checkout.

Figure 6: Third-party 12 VDC, battery backed, power supply powering IOR-16 Modules



Note:

- Power must be regulated to within ± 4%.
- Power supply models furnishing 15 VDC output are the most commonly available.
- Only remote IOR-16 modules can be powered by a 15 VDC power supply. The FX80 controller and the IOR-34 requires 24 VDC.

RS-485 Communications

RS-485 communications from the FX80 controller to each IO module requires a continuous daisy-chain wiring topology using a shielded, twisted-pair cable. Wire between the IOR-16 assemblies using the five-position end connectors. At the controller, wire to either of its three-position RS-485 connectors.

Use shielded 18-22 AWG wiring. The wiring should be of 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, for example at the FX80 Supervisory Controller.

Bias Settings

Each RS485 port on the FX80 has an adjacent three-position switch, with the following settings:

- **BIA** - (default, middle) RS485 biasing and termination: 2.7Ω bias resistors with no terminal resistor
- **END** - RS485 biasing and a termination: 562Ω bias resistors and 150Ω termination resistor
- **MID** - RS485 biasing or termination: 47.5K bias resistors with no termination resistor

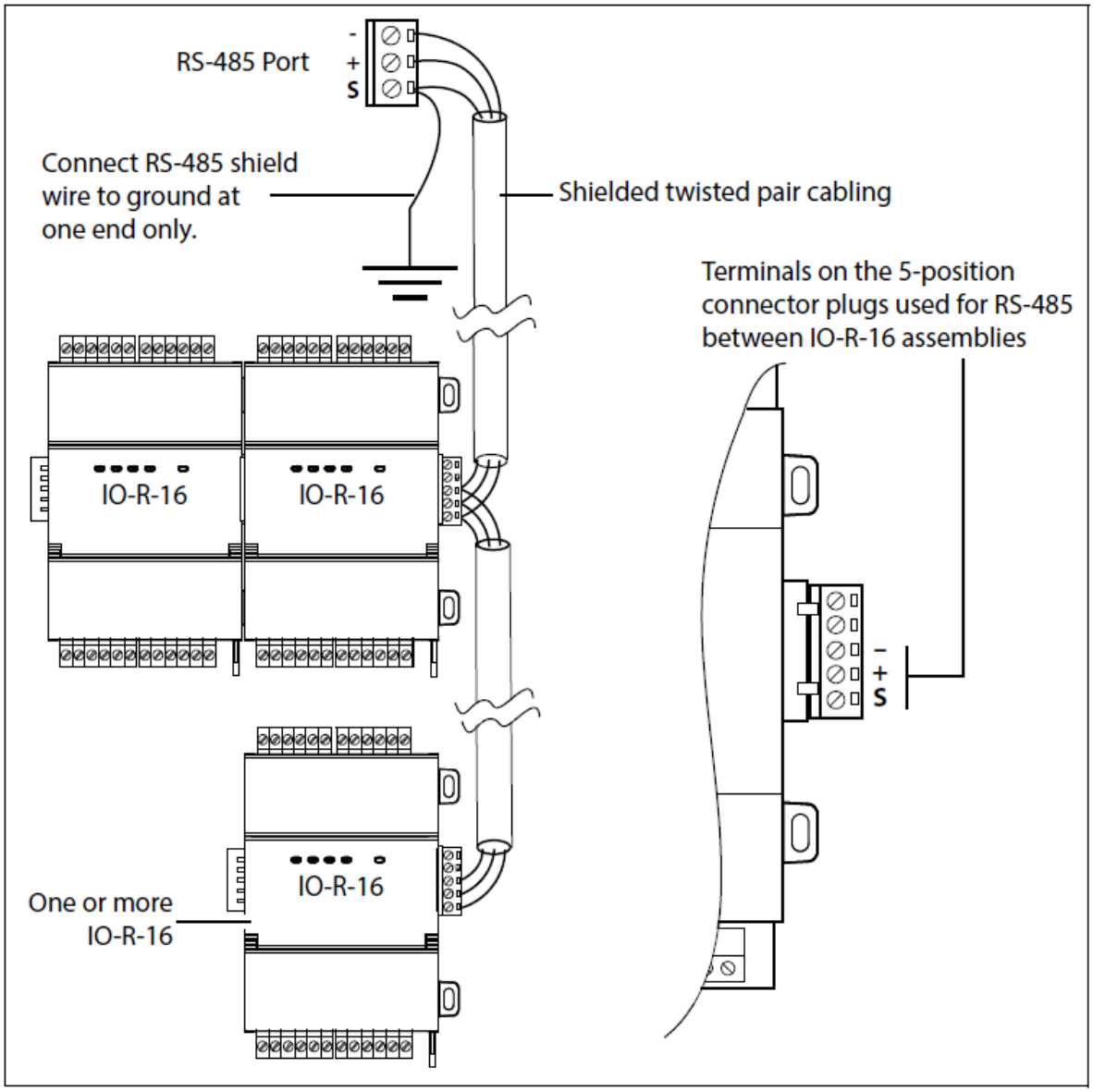
The following list contains best practice for the switch settings:

- **BIA** - (Default, middle) Often best if the RS485 trunk needs biasing, but when the controller is not installed at the end of the trunk
- **END** - Often best if the controller is installed at the end of an RS485 trunk of devices that is already not biased
- **MID** - Often best if the controller is put in the middle of an already-biased trunk

You can change the position of an RS485 port's bias switch while the controller is running.

➤ **Important:** Connect S terminal wiring as shown in Figure 7 or communication errors may result. S terminal serves as reference ground between isolated RS-485 ports on FX80 controller and IOR-16 and IOR-34 modules.

Figure 7: RS-485 wiring from the FX80 to one or more IOR-16 Modules using daisy-chain connection



Inputs

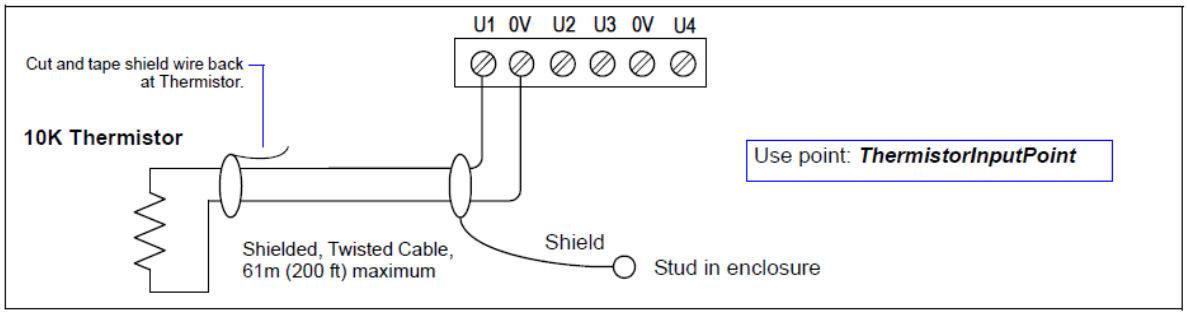
Each of the 8 universal inputs (UI) can support any of the following:

- **Type-3 10KΩ Thermistor**
- **Resistive 0-100kΩ**
- **0 to 10 VDC**
- **4-20 mA**
- **Binary Input**

Thermistor

Inputs support 10k Thermistor temperature sensors. Input accuracy is in the range of ±1% of span. By default, conversion is for a standard, Type 3 thermistor sensor, with a sensor range of -10°F to 135°F (23.3°C to 57.2°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 kitIo module contains an .xml folder with thermistor curves for various thermistor temperature sensors. You can also edit and export customized thermistor curve .xml files for reuse.

Figure 8: Thermistor wiring



Resistive 0-100KΩ

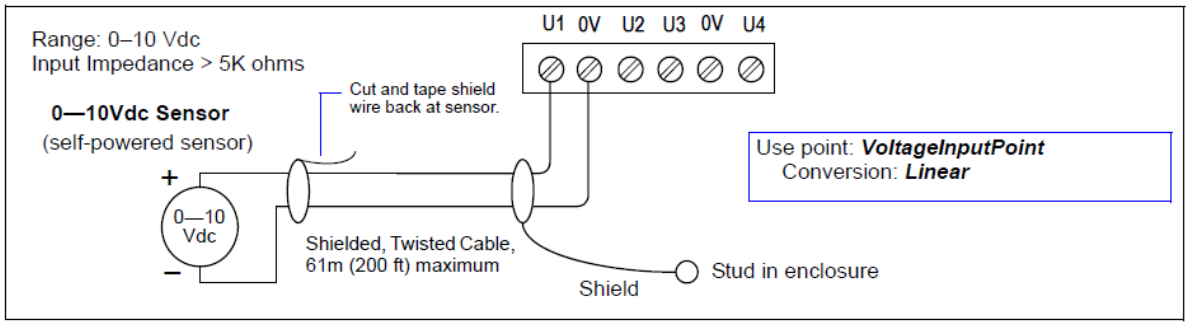
Inputs can read a resistive signal within a range from 0 to 100,000Ω. Wiring is the same as shown in Figure 8. Resistive signals require a Resistive Input Point.

➽ **Important:** Universal inputs provide optimum resistive-to-temperature resolution in the 10kΩ range. For a sensor with a range far from 10kΩ (such as a 100-Ω or 1,000-Ω sensor), resolution is so poor that it becomes unusable. To successfully use such a sensor, install a transmitter that produces a VDC or mA signal, and then wire the transmitter to the universal input 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 5kΩ. 0–10 V accuracy is ±2% of span, without user calibration. Then following image shows the wiring diagram for a 0–10 VDC sensor. 0–10 VDC sensors require a Voltage Input Point.

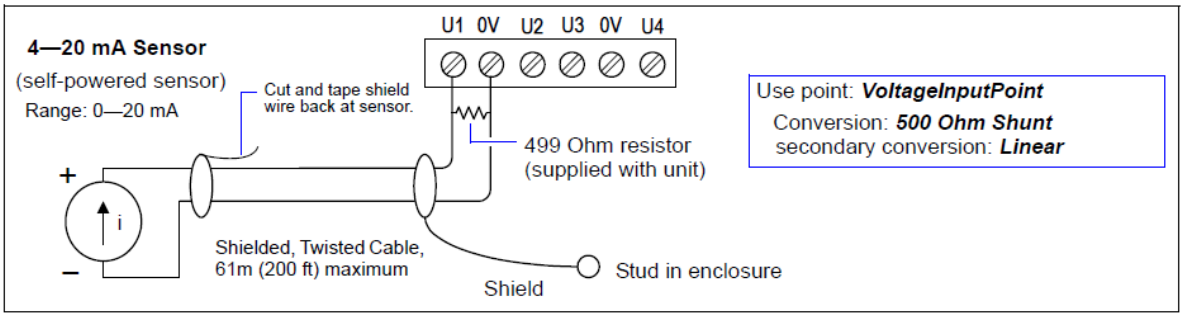
Figure 9: 0-10 VDC



4-20 mA

Inputs support self-powered 4–20 mA sensors. Input accuracy is ±2% of span, without user calibration. The following image shows the wiring diagram, which requires a 499-Ω resistor wired across the input terminals. 4–20 mA sensors also require the Voltage Input Point.

Figure 10: 4-20 mA



⚠ CAUTION

Risk of Personal Injury and Property Damage

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 IOR-16 module, and remove power from the IOR-16 module. It is important not to apply external power to the universal inputs without the 499-Ω resistor in place. Even a momentary application of power (say, 24 VDC) to the universal input terminals without the resistor may damage circuitry on the IOR-16. 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.

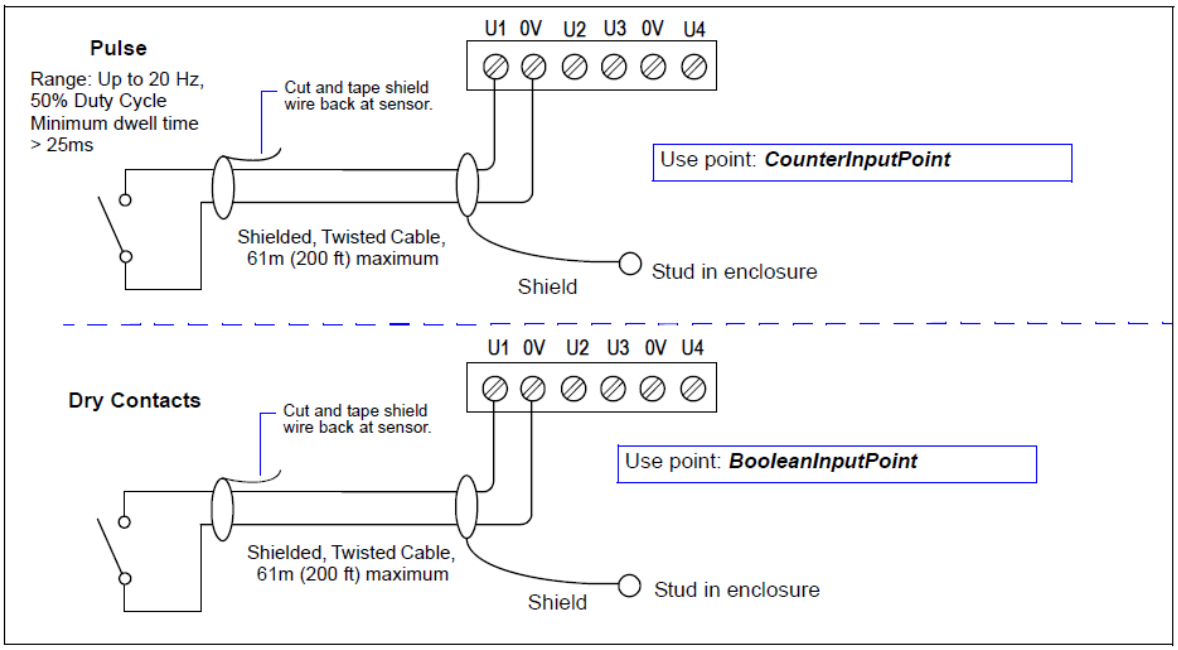
- Pulse contacts may have a change-of-state (COS) frequency of up to 20 Hz with a 50% duty cycle.

  ⓘ **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 330µA short-circuit current. For a pulse contact, use the ***CounterInputPoint*** in the station database. For other dry contacts, use the ***BooleanInputPoint***. The following image shows the wiring diagram (which is identical for both uses), but with different types of Nrio software points used for either application.

Figure 11: Binary inputs



Outputs

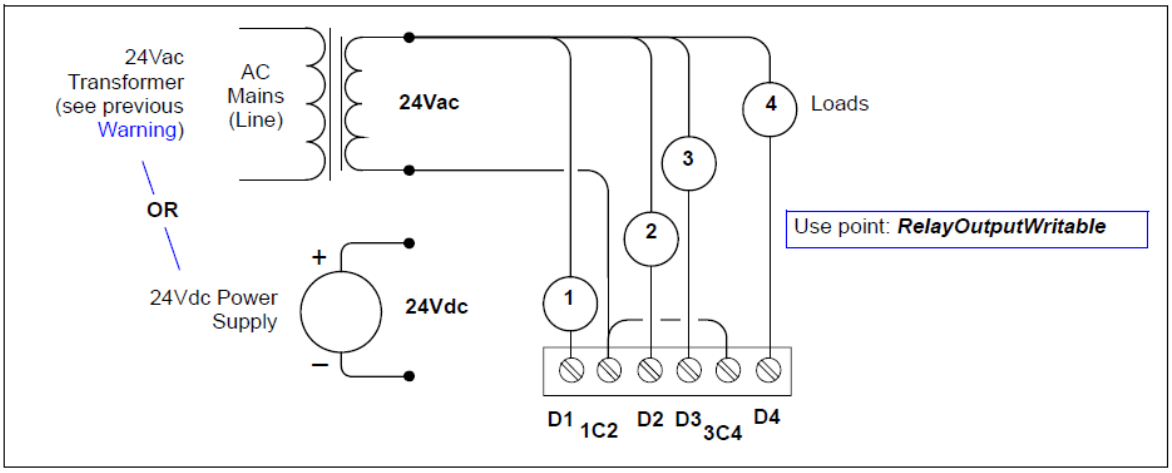
An IOR-16 module has four digital relay outputs and four 0-10 volt analog outputs.

Relay Outputs

Each relay output is rated at 24 VAC or 24 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 12: Relay output wiring diagram



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 to D4) is located on the board (see Figure 3), 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.

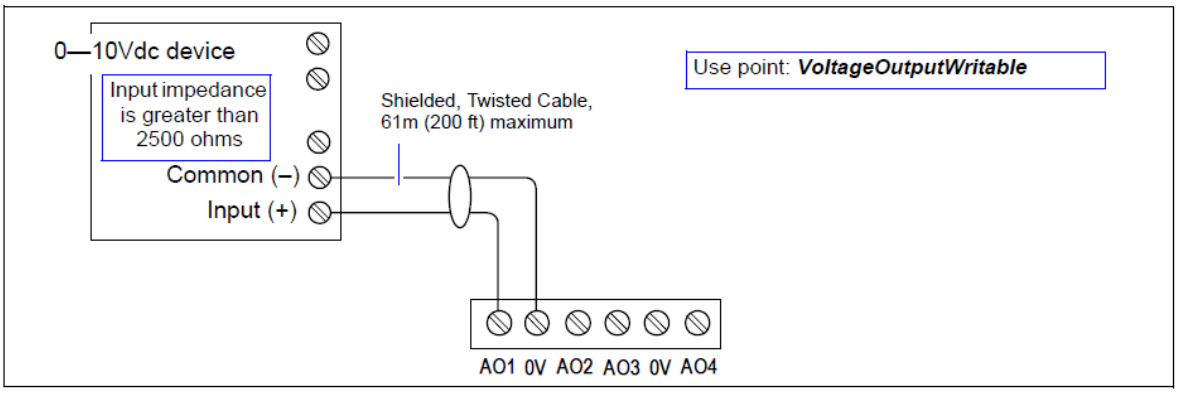
Therefore, an **On** status indicates that the load is powered.

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 VDC to 10 VDC range. For this 0 VDC to10 VDC full range, the minimum input impedance of a device controlled by the AO must be greater than 2,500Ω.

If the device's input impedance is less than 2,500Ω, the 4 mA maximum current limits the voltage output range. For example, for a device with a 1,000Ω input impedance, the AO would work as a 0 VDC to 4 VDC analog output. For each AO, use a Voltage Output Writable in the station database. The following image shows typical wiring for an AO:

Figure 13: Analog output wiring diagram



Nrio16Module (software) representation

In the Niagara station interface to the FX80 and IOR-16 module, the module's I/O is modeled in the station's NrioNetwork (copies from the Nrio palette), under a child Nrio16Module device level component. This Nrio16Module has a default name of **Nrio16Modulen**

ⓘ **Note:** After a remote I/O module is discovered and added to the station under this NrioNetwork (each one as a Nrio16Module), the serial status LEDs for the FX80's RS-485 port continually flash, which indicates polling activity. At this time, the Status LED on the IOR-16 module lights solid green. When an IOR-16 module's status LED is blinking, it is an indication that the unit is not online. Each input or output used requires a 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.

Power up and initial checkout

1. Apply power to the IOR-16. The IOR-16 module's board status LED (Figure 3) are initially blinking.
2. Open a station connection to the FX80 controller using Workbench. If not already present, add a NrioNetwork component to the station's Driver Container.
3. Configure the NrioNetwork's Port Name property to match the FX Supervisory Controller's RS-485 port COM assignment.
4. Perform a **Discover** action from the NrioNetwork's Nrio Device Manager view. Each discovered remote I/O module appears in the top part of the Discovered pane in the view, with each IOR-16 module appearing as an lo16 type.
5. Add each discovered IOR-16 module to the station, renaming it to reflect its actual location. Each I/O module is represented by an Nrio16Module component.
6. Verify that each IOR-16 module's board status LED is now lit solid green.
7. You can now discover, add, and configure I/O points under each Nrio16Module's Points device extension.

   ⓘ **Note:** To associate a discovered device to a specific IOR-16 module, right-click Wink Device action. This cycles a relay-output on that IOR-16 several times, which you can see or hear if nearby. This action is available both before and after a discovered device is added to the station.

   ⓘ **Note:** If an Nrio16Module is selected in the Nrio Device Manager view, and the **Upgrade Firmware** button is active, its best practice to upgrade its firmware. After clicking **Upgrade Firmware**, do not interrupt power to the IOR-16 module and FX Supervisory Controller, or to 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.