

NDIO16 Installation Instructions

Applications

The NDIO16 is a compact, Input/Output (I/O) module used for auxiliary monitoring and control when used with an FX20 or FX60 supervisory controller. The NDIO16 expands the FX20/FX60 by an additional 16 logic controlled points. This includes eight universal inputs, four form A (Single Pole, Single Throw [SPST]) relay outputs, and four analog (voltage only) outputs.

You can use the onboard I/O to monitor pulse contacts from power/demand meters, analog sensors, or transducers. You can also use the I/O to control energy consuming devices such as fans, lights, or pumps with digital relay outputs. The NDIO16 also includes four analog outputs to proportionally control dampers, valves, and other devices.

You can use a maximum of four NDIO16 modules per FX20/FX60, which provides a total of 32 Universal Inputs (UIs), 16 relay outputs, and 16 analog output points. Alternatively, you can use a maximum of two additional NDIO16 modules per FX20/FX60 if the modules are used with one NDIO34 module. This provides a total of 32 UIs, 18 relay outputs, and 16 analog output points.



Figure 1: NDIO16

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

Parts Included

Unpack the NDIO16 and inspect the contents of the packages for damaged or missing components. If damaged, notify the appropriate carrier, and return any damaged components for repair or replacement.

Included in this package are the following items:

- one NDIO16 module
- one grounding wire with a quick-disconnect 0.187 in. female connector
- four 6-position terminal plugs for I/O wiring
- eight 499-ohm resistors for 4-20 mA inputs
- *NDIO16 Installation Instructions (Part No. 24-10174-50)*

Special Tools Needed

The following supplies and tools are required for installation:

- DIN rail
Use DIN Rail type NS35/7.5 (35 x 7.5 mm) and DIN rail end clips. Length of DIN rail should be of sufficient length to accommodate the FX20/FX60, the NDIO16, and all other optional modules.
- suitable screws and screwdriver to mount the DIN rail
If the DIN rail is not used, use screws and a screwdriver to mount the bases of the FX20/FX60 controller and NDIO16 module.
- small flat-blade screwdriver
Use to mount and remove the NDIO16 from the DIN rail and to make connections for I/O and power wiring.



WARNING: Risk of Electric Shock.

Disconnect 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 connections in accordance with local, national, and regional regulations. Do not exceed the NDIO16's electrical ratings.

IMPORTANT: Do not install or use this NDIO16 in or near environments where corrosive substances or vapors could be present. Exposure of the NDIO16 to corrosive environments may damage the device's internal components and void the warranty.

IMPORTANT: Avoid hot plug-in or the removal of any I/O module from the FX20/FX60 (or other accessory module). This means you must first remove power from the unit. If the unit switches to battery operation, wait for all LEDs to go out. Plugging or unplugging an I/O module from a powered FX20/FX60 should not cause damage to either the FX20/FX60 or I/O module hardware; however, note that all I/O modules are initialized upon station startup, and if not (continuously) present following a power cycle, are inoperable.

IMPORTANT: Do not plug more than four NDIO16 modules into a single FX20/FX60. Doing so has unexpected effects on the software and may overload the power supply.

IMPORTANT: Use this NDIO16 only as an operating control. Where failure or malfunction of the NDIO 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 NDIO.

NDIO16 modules are designed to be directly plugged into the FX20/FX60 or attached modules. Do not use a ribbon cable or extend the length of the I/O cable as this increases radiated signal noise, decreases analog stability, and may introduce communication problems.

Static Discharge Precautions

Static charges produce voltages high enough to damage electronic components. The microprocessors and associated circuitry within an NDIO16 controller 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.

NDIO16 Installation

If you plan to install the FX20/FX60 and NDIO16 at the same time, refer to the *FX20/FX60 Installation Instructions* (Part Number 24-10174-77).

Note: We support a maximum of four NDIO16 modules.

Installation and startup procedures for the NDIO16 are as follows:

1. Physically mount the NDIO16 module with the FX20/FX60. See *Physically Mounting the NDIO16 Module with the FX20/FX60*.
2. Make sure the NDIO16 input connector is properly seated into the I/O connector on the FX20/FX60 (or, if used, another NDIO16 module).
3. Make wiring connections for earth ground and I/O wiring. See *Wiring*.
4. Apply power and perform an initial checkout. See *Starting the NDIO16 and FX20/FX60*.

Recommendations and Precautions

Follow these recommendations and precautions when you mount and install the unit:

- Use this controller for indoor use only. Do not expose the unit to ambient conditions outside the range of 0 to 50°C (32 to 122°F) and relative humidity outside the range of noncondensing 5 to 95% (Pollution Degree 1).
- For a controller mounted inside an enclosure, ensure that the enclosure is designed to keep the unit within its required operating range (considering a 20-watt dissipation by the controller). This is especially important if the controller is mounted inside an enclosure with other heat producing equipment.
- Do not mount the unit:
 - in an area where excessive moisture, corrosive fumes, or explosive vapors are present
 - where vibration or shock is likely to occur
 - in a location subject to electrical noise. This includes the proximity of large electrical contactors, electrical machinery, welding equipment, and spark igniters.

Mounting

Physically Mounting the NDIO16 Module with the FX20/FX60

The following information applies to physically mounting the NDIO16:

- It is not necessary to remove the cover before mounting.
- Mount the NDIO16 in any orientation.
- We recommend that you mount the NDIO16 on a 35-mm wide DIN rail. Both the FX20/FX60 and the NDIO16 have a molded DIN rail slot and locking clip, as does the 24 VAC power module. Mounting these components on a DIN rail ensures accurate alignment of connectors among all modules.
- If DIN rail mounting is impractical, use screws in mounting tabs on the FX20/FX60, the NDIO16s, and any other optional module (for example, a power module). See Figure 2 for tab dimensions.

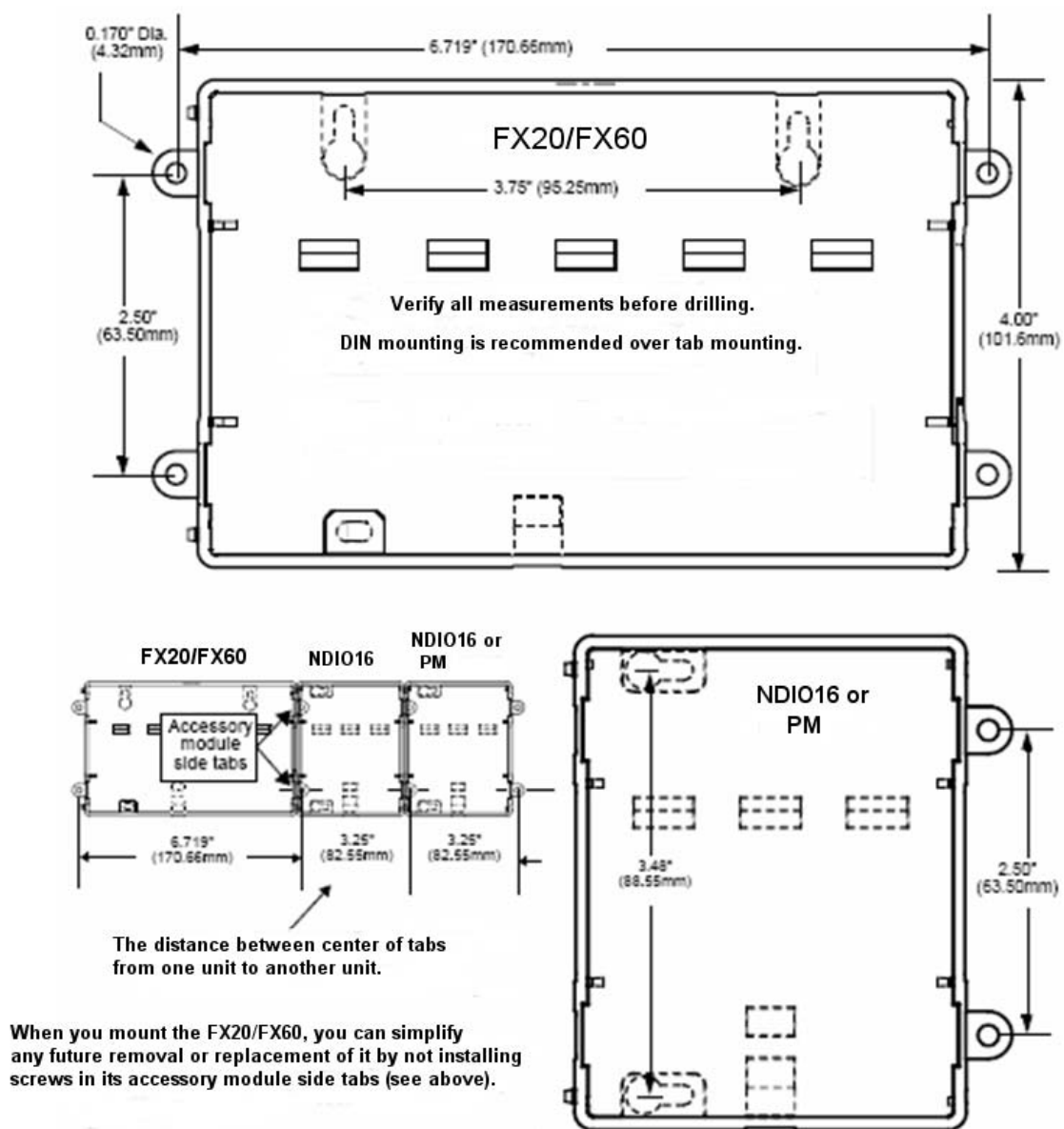


Figure 2: Tab Mounting Dimensions

Mounting the NDIO16 on the DIN Rail

To mount the NDIO16 on the DIN rail:

1. Remove the bottom I/O connector plug that covers the plastic DIN locking clip.
 2. Position the NDIO16 on the DIN rail, tilting the module to hook the DIN rail tabs over one edge of the DIN rail.
 3. Use a screwdriver to pry down the plastic locking clip, and push down and in on the NDIO16 to force the locking clip to snap over the edge of the DIN rail.
 4. Slide the NDIO16 along the DIN rail to connect is 20-position plug into the FX20/FX60 (or, if used, another NDIO16).
 5. Mount all NDIO16 modules together.
 6. If used, mount the DIN rail power module.
- If a DIN rail mount power module is used, it mounts last.
7. Make sure all modules are firmly seated.
 8. To keep the final assembly together, secure the assembly at both ends with DIN rail end-clips. This also prevents the assembly from sliding on the DIN rail. See Figure 3.
 9. To remove an NDIO16 module, you may first need to remove an I/O connector plug.
 10. To remove an NDIO16 module from the DIN rail, slide it away from the other modules. Insert a screwdriver in the DIN plastic locking tab and pull downward, and then lift the unit outward.

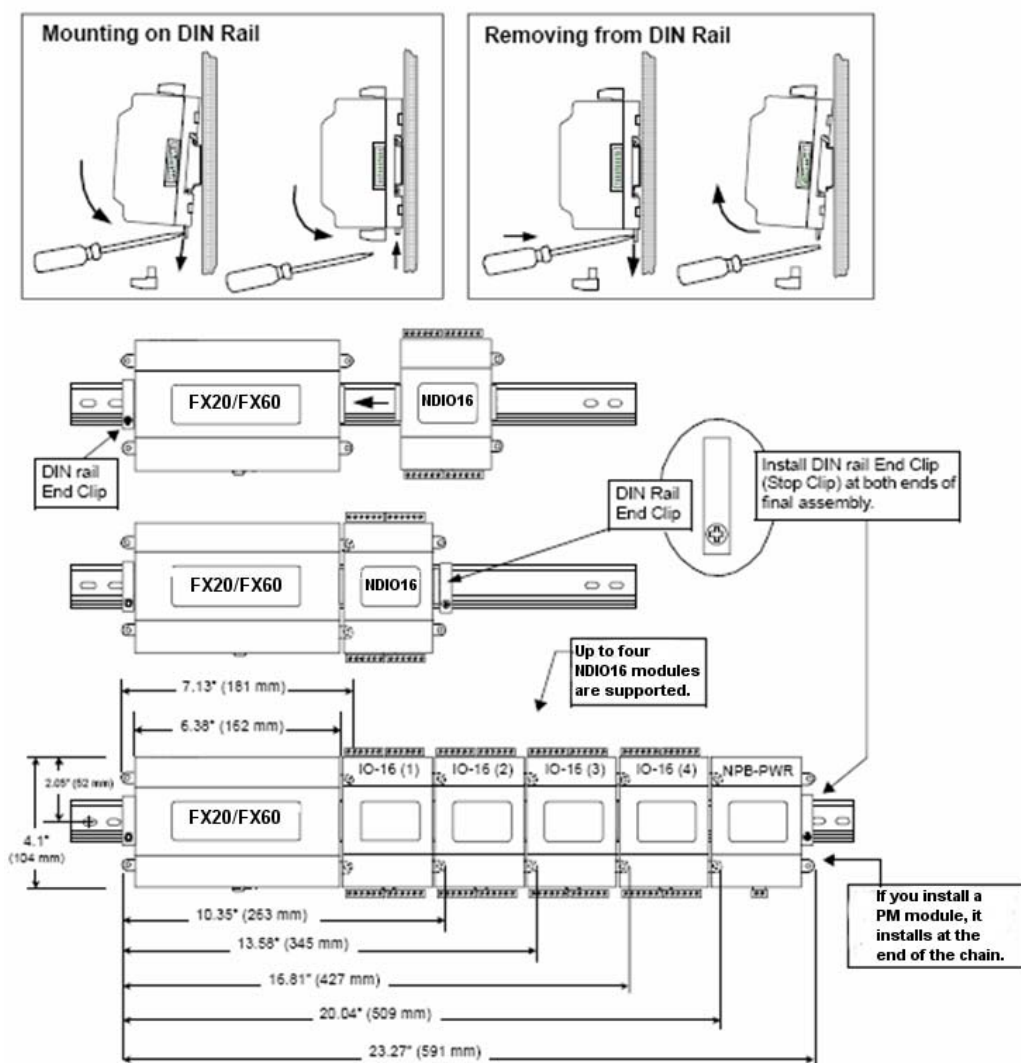


Figure 3: NDIO16 Mounting Details

Wiring

The NDIO16 provides eight universal inputs supporting:

- analog inputs (temperature, resistance, voltage, and current)
- digital inputs (contact closure and pulse count)

The NDIO16 provides 8 outputs, including:

- 4 relay (24 VAC/DC, 0.5 A max.) outputs
- 4 analog outputs (0-10 VDC)

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

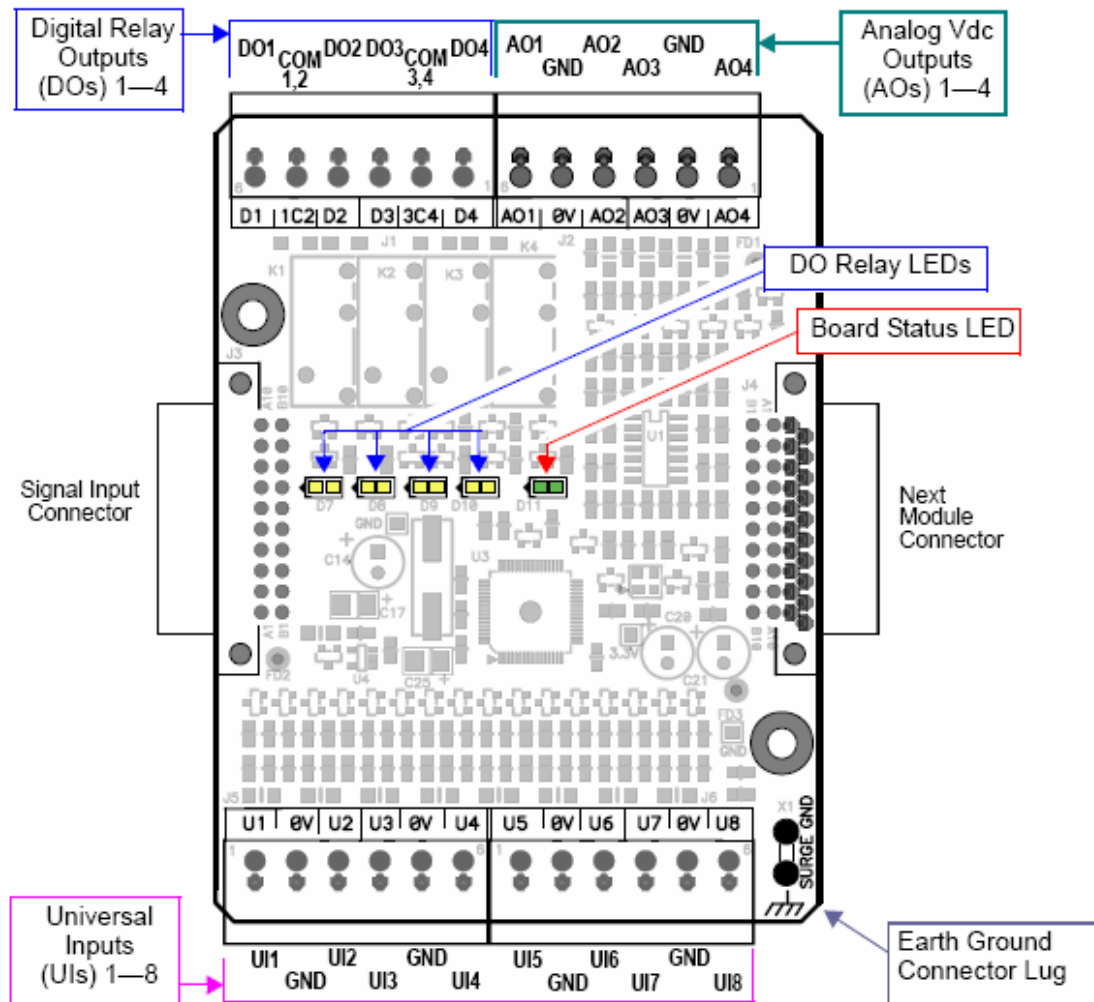


Figure 4: NDIO16 Wiring Terminal Locations

Make wiring connections to the NDIO16 in the following order:

1. Connect the earth grounding wire (with spade connector) from the earth ground lug on the NDIO16 to a nearby earth grounding point. See *Grounding*.
2. Connect I/O wiring. See *Wiring and Outputs*.
3. Apply power to the unit. See *Starting the NDIO16 and FX20/FX60*.

Grounding

An earth ground spade lug (0.187 in.) is provided on the base of the NDIO16 (as well as the FX20/FX60 and DIN rail power module) to connect to earth ground. For maximum protection from electrostatic discharge or other forms of Electromagnetic Interference (EMI), connect each earth ground using 16 AWG or larger wire. Keep these wires as short as possible. See Figure 5.

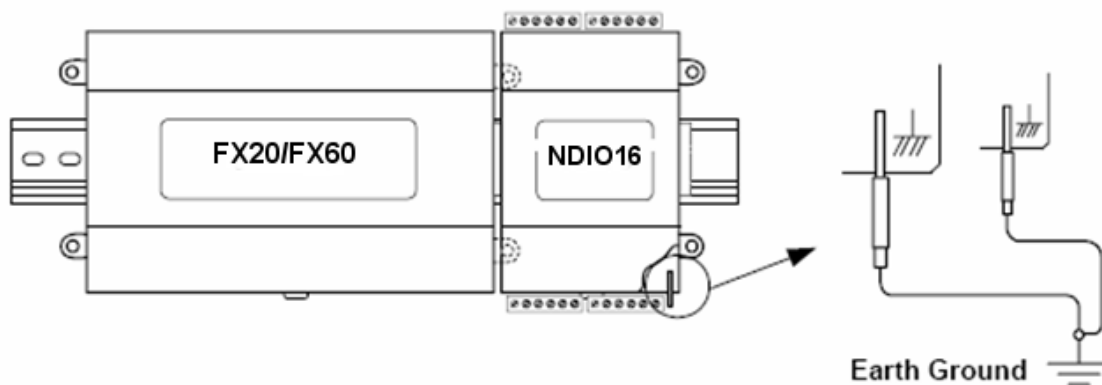


Figure 5: NDIO16 Power Wiring and Earth Ground Connections

IMPORTANT: Do not apply power until all other wiring is completed, including NDIO16 inputs and outputs. See *Starting the NDIO16 and FX20/FX60*.

Each of the eight UIs can support any one of the following:

- Type-3 10k ohm Thermistor
- resistive: 0-100k ohms
- 0-10 VDC
- 4-20 mA
- binary input

Thermistor

The inputs support 10k ohm 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°F (-23.3 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 NDIO16 module contains an Extensible Markup Language (XML) folder with thermistor curves for a Radio Shack® sensor model 271-0110 and TE-6300 10k type sensor. You can also edit and export (for reuse) customized thermistor XML files. See Figure 6 for the wiring diagram.

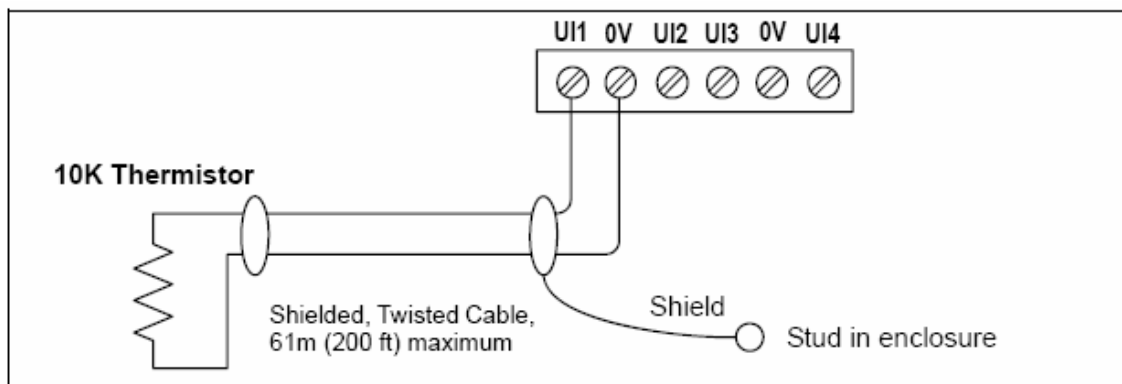


Figure 6: Thermistor Wiring

Resistive 0-100k Ohms

The inputs can read a resistive signal within a range from 0 to 100,000 ohms. The wiring is the same as the thermistor temperature sensor.

Note: Universal Inputs (UIs) are optimized to provide the best resolution around the 10k ohm range. For a sensor with a range far from 10k ohms (such as a 100 ohm or 1,000 ohm type), resolution is poor. To use such a sensor, we recommend that you 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

The inputs support self-powered 0-10 VDC sensors. Input impedance is greater than 5k ohms. Accuracy of the 0-10 input is $\pm 2\%$ of span, without user calibration. See Figure 7 for the wiring diagram.

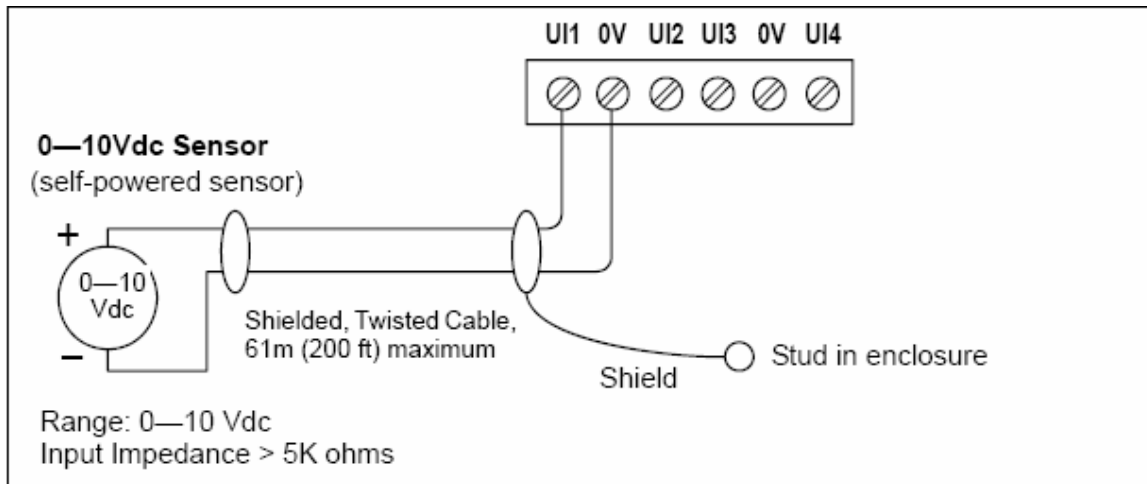


Figure 7: 0-10 VDC Wiring

4-20 mA

The inputs support self-powered 4–20 mA sensors. Input accuracy is $\pm 2\%$ of span, without user calibration. Figure 8 shows the wiring diagram, which requires a 499 ohm resistor wired across the input terminals.

4–20 mA sensors also require the VoltageInputPoint.

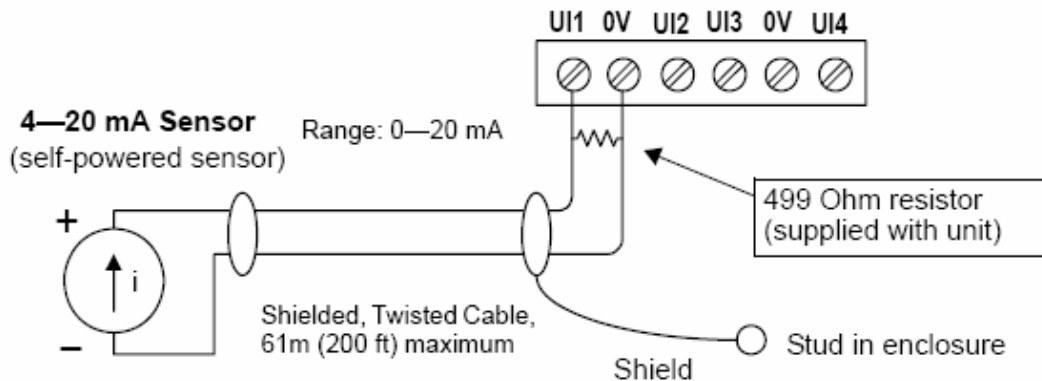


Figure 8: 4-20 mA Wiring

Binary Input

The universal 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. Minimum dwell time must be greater than 25 milliseconds (contacts must remain open at least 25 milliseconds and be closed at least 25 milliseconds).

Standard dry contacts must have a 1 Hz or less COS frequency, with the minimum dwell time greater than 500 milliseconds (contacts must remain open at least 500 milliseconds and be closed at least 500 milliseconds).

Both types of dry contacts support 3.3 VDC open circuits or 330 microampere short-circuit current. See Figure 9 for the wiring diagram.

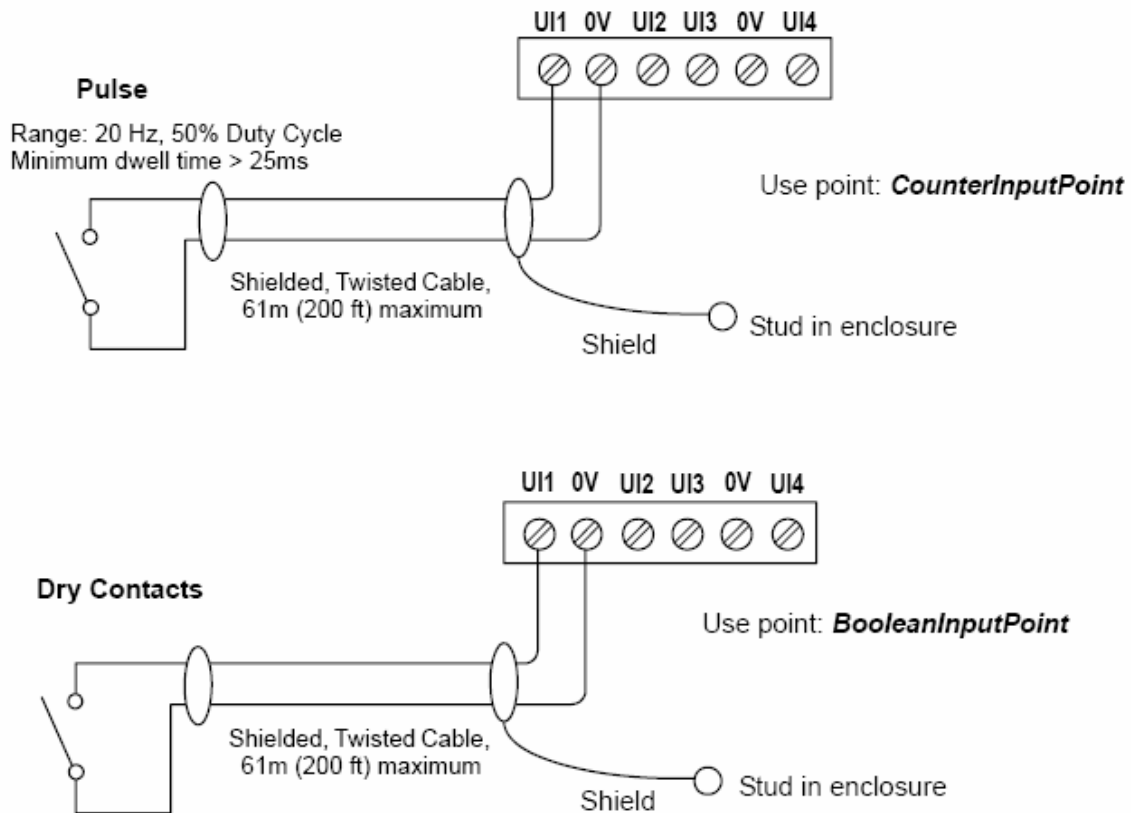


Figure 9: Binary Input Wiring

Outputs

One NDIO16 module includes four digital relay outputs and four 0-10 VDC analog outputs.

Relay Outputs

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

Note: Relays are not for AC mains (line level) powered loads (instead, 24 V maximum).

IMPORTANT: Do not use the FX20/FX60's power transformer to power I/O loads. Using the FX20/F60's transformer introduces potentially damaging switching transients into the FX20/FX60.

See Figure 10 for the wiring diagram.

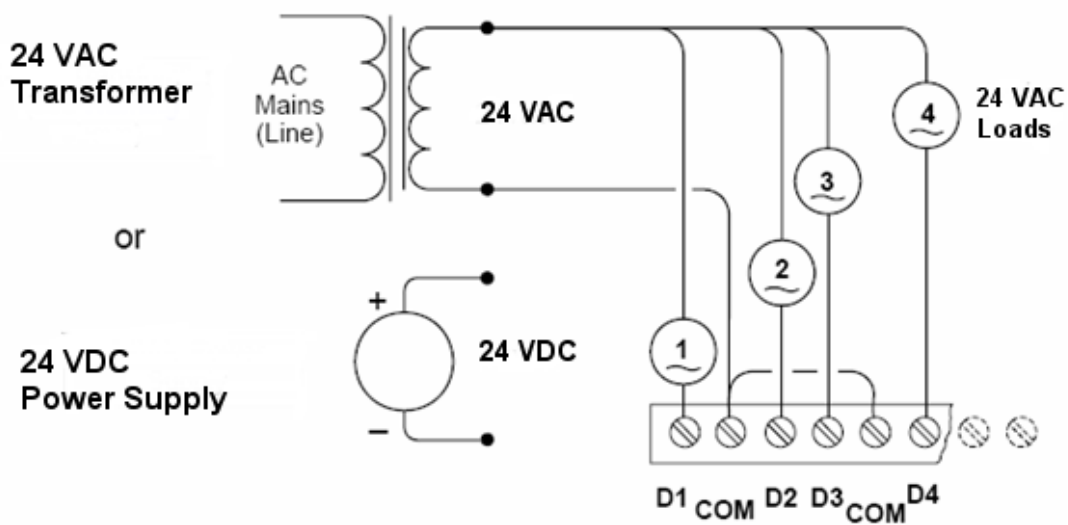


Figure 10: Binary Output Wiring

The two common Digital Output (DO) terminals are isolated from each other. This is useful when powering loads from different 24 VAC sources.

A yellow LED status indicator for each relay (D1-D4) is located on the board and is 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 AOn and 0 V (ground). Each AO can supply a maximum of 4 mA over the entire 0-10 VDC range. The minimum input impedance of a device controlled by an AO must be greater than 2,500 ohms. See Figure 11 for the wiring diagram.

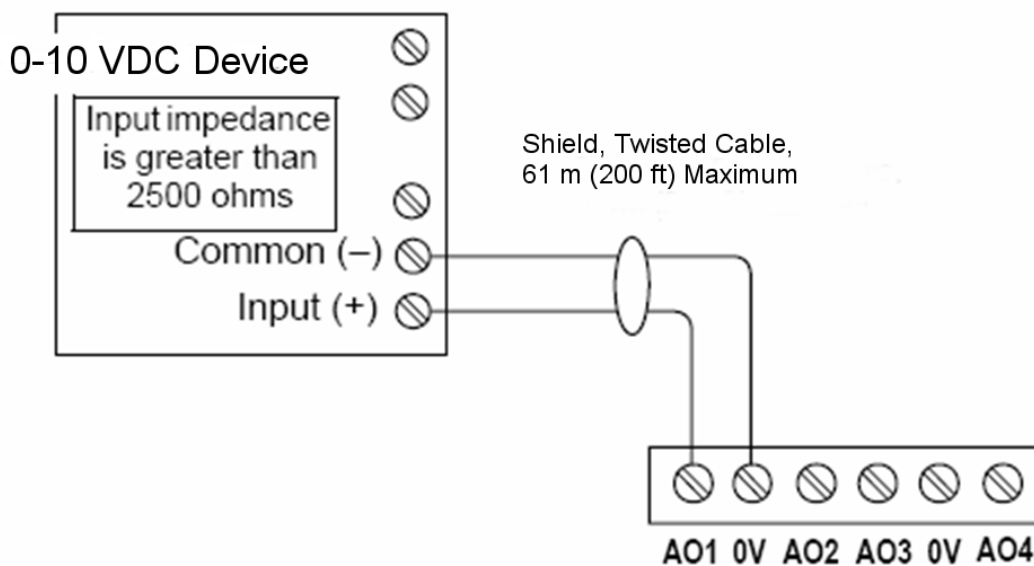


Figure 11: Analog Output Wiring

Setup and Adjustments

In the FX20/FX60 station database, each NDIO16 module appears as one NdioBoard under the station's NdioNetwork. If an FX20/FX60 only has one NDIO16 module, then the NdioNetwork has a single NdioBoard component, where the **Io Port** property of the NdioBoard is 1. See the top of Figure 12.

Upon discovery, if the FX20/FX60 has multiple NDIO16 modules, then the module closest to the FX20/FX60 is the first NdioBoard (property **Io Port 1**). The next module in the chain is NdioBoard1 (property **Io Port 2**). The third module is NdioBoard2 (property **Io Port 3**). See the bottom of Figure 12.

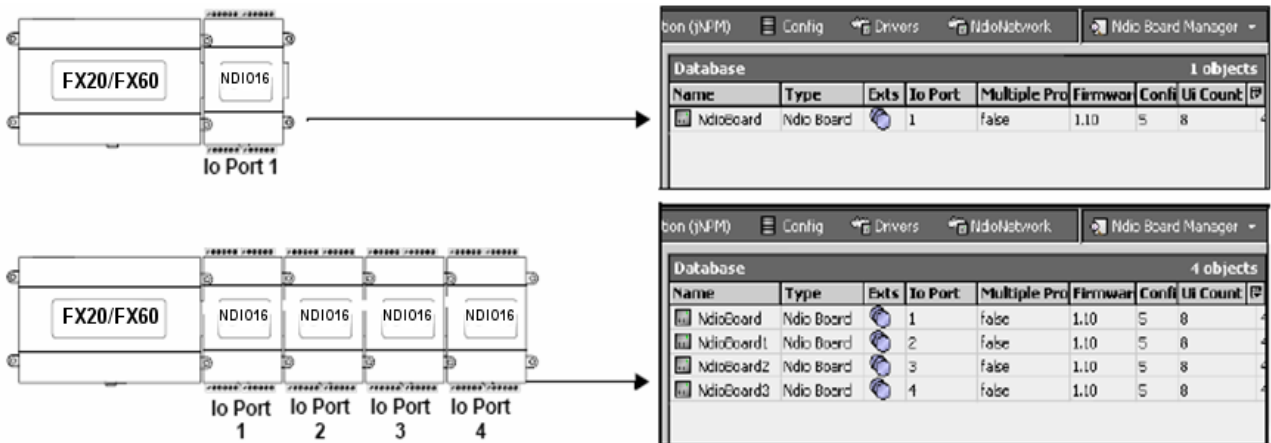


Figure 12: NDIO16 Board Assignment

Once the operating system identifies the NDIO16 processors, the status LED on each NDIO16 module turns green. The green status LED means that the FX20/FX60 can communicate with the I/O. The green status LED does not indicate anything about the status of the station or its NDIO components.

Note: When the status LED of the NDIO16 module is not lit, all outputs are in **failsafe** state. This means relay outputs are Off, and all Analog Outputs (AOs) are at 0 volts.

Each type of input or output requires a special Niagara Direct Input/Output (NDIO) point to be added in the station database. These components act as the station interface to the physical I/O points. The NDIO points for each input or output type appear in Table 1.

Table 1: NDIO Point Representation

Physical I/O Type	NDIO Point Type
Thermistor Input	ThermistorInputPoint
Resistive Input	ResistiveInputPoint
0-10 VDC Input	VoltageInputPoint
4-20 mA Input	VoltageInputPoint
Pulse Input	CounterInputPoint
Dry Contact Input	BooleanInputPoint
Relay Output	BooleanOutputWritable
Analog Output	VoltageOutputWritable

Starting the NDIO16 and FX20/FX60

To start NDIO16 and FX20/FX60:

1. Apply power to the FX20/FX60 using either the wall or a DIN rail mount power module.

The NDIO16 board status LED is initially Off (Figure 12). Allow the FX20/FX60 sufficient time to boot (at least 2 minutes).

2. Verify that the NDIO16 board status LED is now lit green.

- Using FX Workbench, open the station (if running). For more information, refer to the *FX Workbench User's Guide* (LIT-12011149).

You can also open a platform connection and start the station with using the Station Director.
- If not already present, add an NdioNetwork component to the station's Drivers container.
- Use the Manager views and Learn Mode to discover and add NDIO16 components to the station database.

Repair Information

There are two categories of NDIO16 replacement parts:

- standard replacement parts
- new replacement unit

Standard Replacement Parts

Standard replacement parts appear in Table 2.

Table 2: NDIO16 Replacement Parts

Part Number	Description
LP-KITNDIO16-0	<p>The NDIO16 Hardware Replacement Bag includes:</p> <ul style="list-style-type: none"> four 6-position terminal plugs for I/O wiring eight 499-ohm resistors one grounding wire with quick disconnect (0.187 in. female connector)

New Replacement Unit

To replace a faulty NDIO16, order a new one. To ensure proper credit for NDIO16 still under warranty, contact customer service for return authorization.

Replacing an NDIO16

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.

To replace an NDIO16:

- Use FX Workbench to back up the FX20/FX60 configuration to your computer.
- Remove power to the FX20/FX60. The unit automatically powers down.

Note: If any I/O points have voltage, turn the devices off or disconnect power to them.
- Note the positions of all I/O wiring going to the NDIO16 you want to replace (as well as for any other installed modules).

If necessary, label connectors and accessory modules to avoid misconnection after you replace the NDIO16. The software in the FX20/FX60 expects the terminal positions to be the same in the replacement NDIO16 to collect data from or to control the attached devices.
- Unplug all connectors from the NDIO16, including all I/O connectors and earth ground wire.
- Remove any screws or DIN rail clips securing the NDIO16, removing it from its mounting. See *Mounting the NDIO16 on the DIN Rail*.
- Mount the replacement NDIO16 as it was previously, using the same DIN rail location and/or screws.

7. Reconnect the earth ground wires to the NDIO16 grounding lug.
8. Reconnect all I/O connectors to the NDIO16.
9. If any of your I/O points have voltage, turn the devices back on or reconnect power to them.
10. Restore power to the NDIO16, and perform a checkout using FX Workbench (see *Starting the NDIO16 and FX20/FX60*).



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