

NDIO34 Installation Instructions

Applications

The NDIO34 is a compact, input/output module used for auxiliary monitoring and control when operated with an FX20 or FX60 supervisory controller. The NDIO34 expands the FX20/FX60 by an additional 34 logic controlled points. This includes 16 universal inputs, 10 form A (Single Pole, Single Throw [SPST]) relay outputs, and 8 analog (voltage only) outputs. In addition, the NDIO34 provides power to the attached FX20/FX60, using either an externally supplied 24 VAC transformer or 24 VDC power supply.

You can use the onboard Input/Output (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 NDIO34 also includes eight analog outputs to proportionally control dampers, valves, and other devices.

You can use a maximum of one NDIO34 module per FX20/FX60; however, you can add 2 additional NDIO16 modules to provide a total of 32 UIs, 18 relay outputs, and 16 analog output points.



Figure 1: NDIO34

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 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

Included in this package are the following items:

- one NDIO34 module
- one grounding wire with a quick-disconnect 0.187 in. female connector
- one 15-position terminal plug and three 12-position terminal plugs for I/O wiring
- one 2-position terminal plug for 24 VAC power
- sixteen 499-ohm resistors for 4-20 mA inputs
- *NDIO34 Installation Instructions (Part No.24-10174-42)*

Unpack the NDIO34 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.

Special Tools Needed

The following supplies and tools are required for installation:

- one of the following suitable power sources:
 - UL listed, Class 2, 24 VAC transformer, rated a minimum of 8.5 to 20 VA. This is the approximate power range, from the FX20/FX60 with NDIO34 alone to a fully-expanded unit with two additional NDIO16 modules and other option cards. A dedicated transformer is required (cannot power additional equipment).
 - 24 VDC power supply capable of supplying at least 1 A (24 W).
- DIN rail

Use DIN Rail type NS35/7.5 (35 x 7.5 mm) and DIN rail end clips. The length of DIN rail should be of sufficient length to accommodate the FX20/FX60, the NDIO34, 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 FX20/FX60 controller and NDIO34 module.
- small flat-blade screwdriver

Use to mount and remove the NDIO34 from the DIN rail and 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 NDIO34's electrical ratings.

IMPORTANT: Do not install or use this NDIO34 in or near environments where corrosive substances or vapors could be present. Exposure of the NDIO34 to corrosive environments may damage the device's internal components and voids the warranty.

IMPORTANT: Avoid hot plug-in or the removal of any I/O module from the FX20/FX60 (or other accessory module). You must first remove power from the unit. If the unit switches to battery operation, wait for all Light-Emitting Diodes (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 one NDIO34 module into a single FX20/FX60. This causes unexpected effects on the software and may overload the power supply.

IMPORTANT: Use this NDIO34 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.

NDIO34 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 NDIO34 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.

NDIO34 Installation

If you plan to install the FX20/FX60 and NDIO34 at the same time, refer to the *FX20/FX60 Installation Instructions (Part Number 24-10174-77)*.

Note: The NDIO34 module is typically the approved power source used in place of a separate power module accessory.

Note: We support a maximum of two NDIO16 modules.

Installation and startup procedures for the NDIO34 are as follows:

1. Mount the NDIO34 module with the FX20/FX60. See *Physically Mounting the NDIO34 Module with the FX20/FX60*.
2. Make sure the NDIO34 input connector is properly seated into the IO connector on the FX20/FX60 (or, if used, another NDIO16 module).
3. Make sure the NDIO34 input connector is properly seated into the IO connector on the FX20/FX60 (or, if used, another NDIO16 module).
4. Make wiring connections for earth ground, 24 VAC power, and I/O wiring. See *Wiring*.
5. Apply power and perform an initial checkout. See *Starting the NDIO34 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).

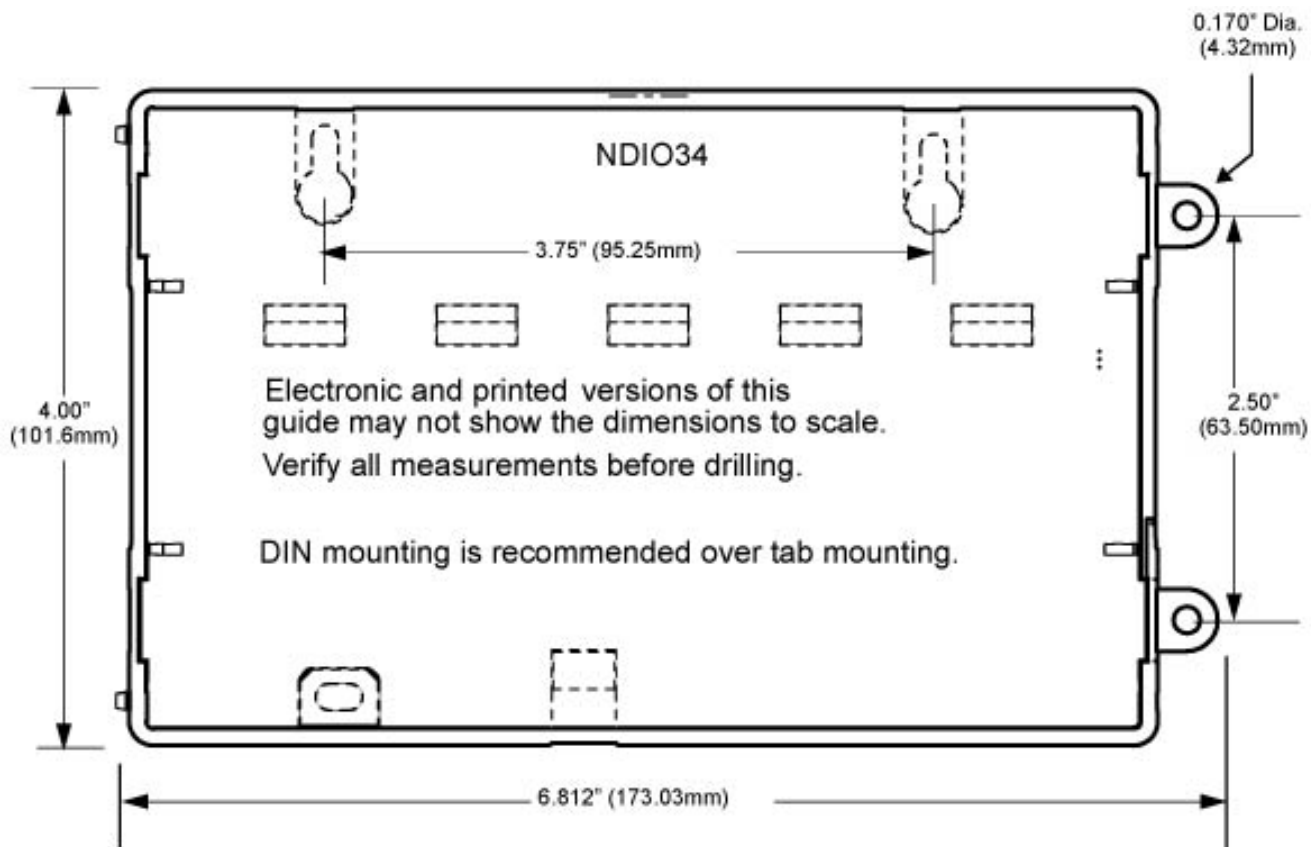
- For a controller mounted inside an enclosure, ensure that the enclosure is designed to keep the unit within its required operating range (considering a 20-watt dissipation by the controller). This is especially important if the controller is mounted inside an enclosure with other heat producing equipment.
- 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 NDIO34 Module with the FX20/FX60

The following information applies about physically mounting the NDIO34:

- It is not necessary to remove the cover before mounting.
- Mount the NDIO34 in any orientation.
- We recommend that you mount a 35 mm wide DIN rail. Both the FX20/FX60 and the NDIO34 have a molded DIN rail slot and locking clip, as does the 24 VAC power module and the NDIO16 expansion modules. Mount these components on a DIN rail to ensure accurate alignment of connectors between all modules.
- If DIN rail mounting is impractical, use screws in mounting tabs on the FX20/FX60, the NDIO34, and any other connected accessory (for example, a power module and an NDIO16 module). See Figure 2 for tab dimensions.



When mounting FX20/FX60, you can simplify any future removal or replacement of it by **not** installing screws in its **accessory module side tabs** (see below).

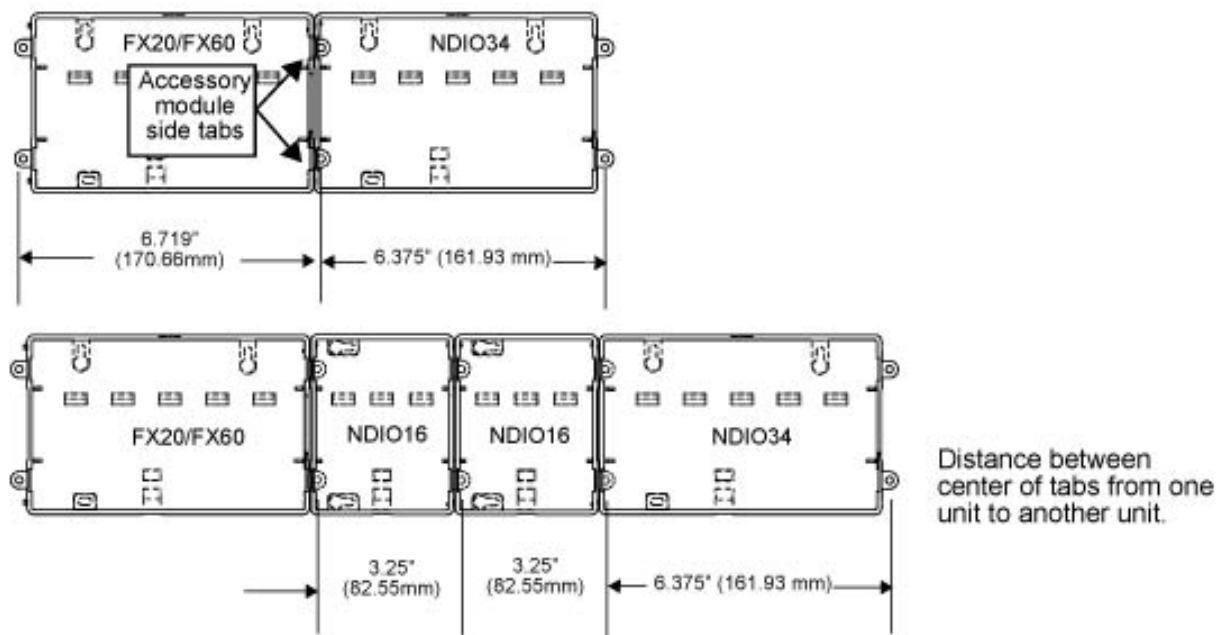


Figure 2: Tab Mounting Dimensions

Mounting the NDIO34 on the DIN Rail

To mount the NDIO34 on the DIN rail:

1. Remove the bottom I/O connector plug that covers the plastic DIN locking clip.
2. Position the NDIO34 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 NDIO34 to force the locking clip to snap over the edge of the DIN rail.
4. Slide the NDIO34 along the DIN rail to connect the 20-position plug into the FX20/FX60 (or, if used, the NDIO16). The NDIO34 is at one end at all the connected modules.
5. Make sure all modules are firmly seated.
6. 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.
7. To remove an NDIO34 module from the DIN rail, slide it away from the other modules. Insert a screwdriver in the DIN plastic locking tab and pull downward, then lift the unit outward.

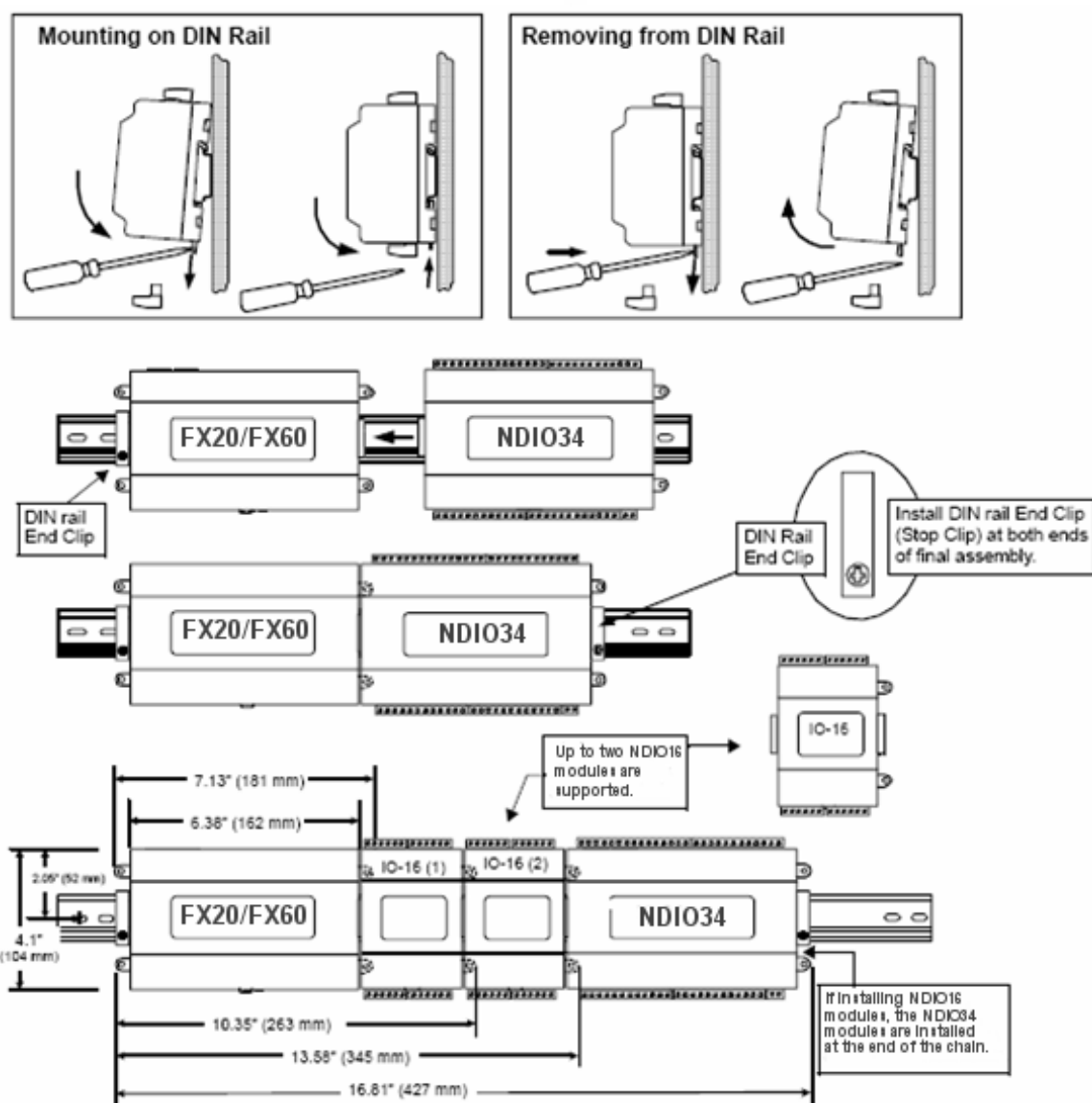


Figure 3: NDIO34 Mounting Details

Wiring

The NDIO34 provides 16 universal inputs supporting:

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

The NDIO34 provides 18 outputs, including:

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

Wiring terminal positions are shown in Figure 4, along with LED locations.

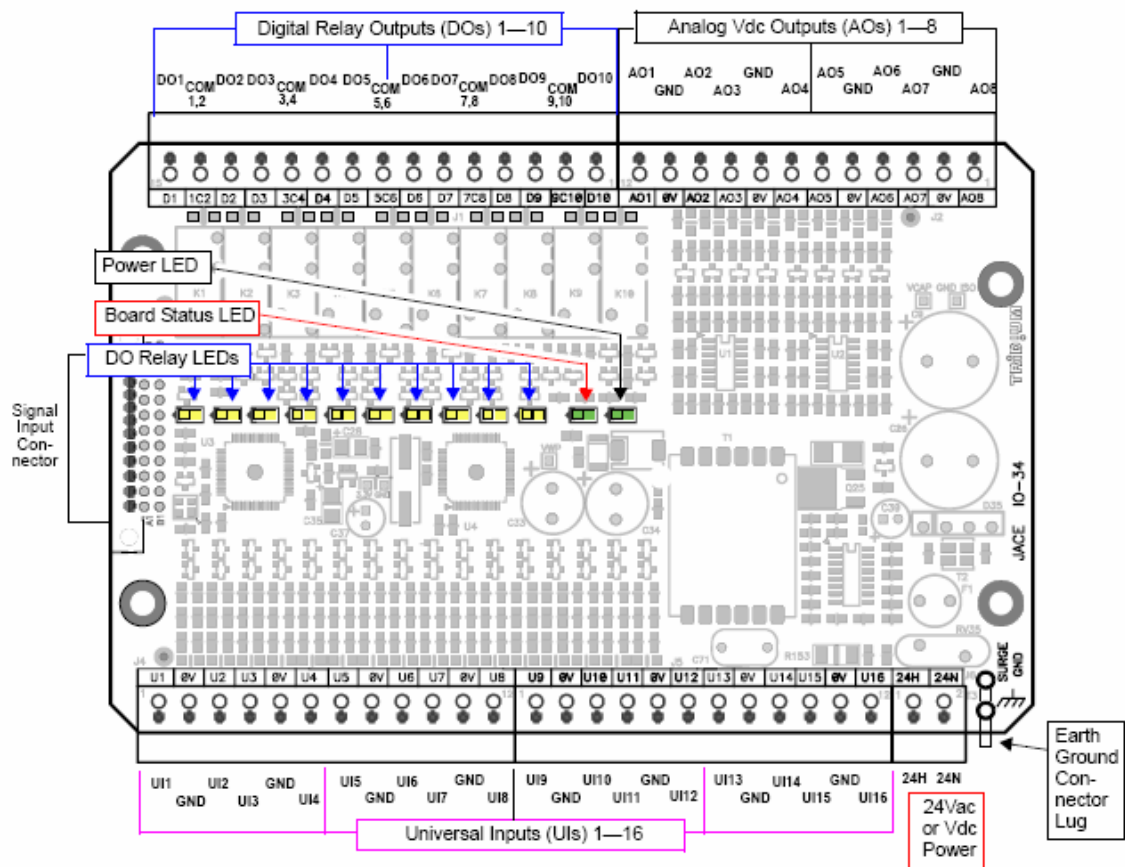


Figure 4: NDIO34 Wiring Terminal Locations

Make wiring connections to the NDIO34 in the following order:

1. Connect the earth grounding wire (with spade connector) from the earth ground lug on the NDIO34 to a nearby earth grounding point. See *Grounding*.
2. Prepare power wiring (leave the unit powered off). See *Power Wiring*.
3. Connect I/O wiring. See sections *Inputs* and *Outputs*.
4. Apply power to the unit. See *Starting the NDIO34 and FX20/FX60*.

Grounding

An earth ground spade lug (0.187 in.) is provided on the base of the NDIO34 (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.

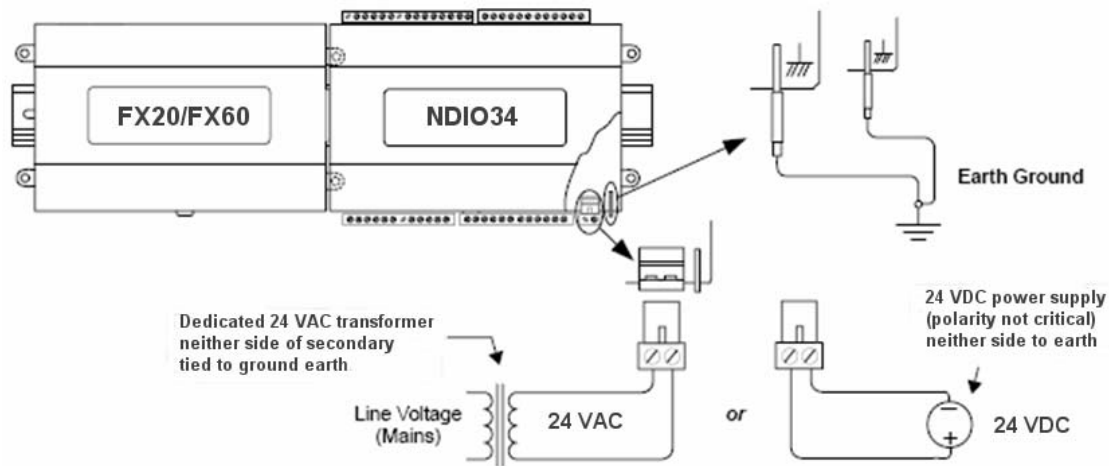


Figure 5: NDIO34 Power Wiring and Earth Ground Connections

Power Wiring

You can power the NDIO34 by wiring the module to a dedicated Class 2, 24 VAC transformer, or to a 24 VDC power source. The NDIO34 provides power to the attached FX20/FX60, and up to two attached NDIO16 modules (if used).

If the NDIO34 is powered from a 24 VAC transformer, do not power other equipment with the transformer; otherwise, conducted noise problems may result. Also, do not ground either side of the transformer's 24 VAC secondary.

- **FX20/FX60 with NDIO34 module alone** - approximately 8.5 VA (AC) or 8.5 W (DC)
- **FX20/FX60 with NDIO34, two additional NDIO16 modules, plus option boards** - up to 20 VA (AC) or 20 W (DC)

As shown in Figure 5, the NDIO34's 2-position power connector is located at the lower corner of the unit. Unplug the connector from the module and make connections to it as shown.

Do not apply 24 V power (reinsert connector plug into the NDIO34) until all other wiring is completed, including NDIO34 inputs and outputs.

Inputs

Each of the 16 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 Ndio software module contains an 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 Extensible Markup Language (XML) files. See Figure 6 for the wiring diagram.

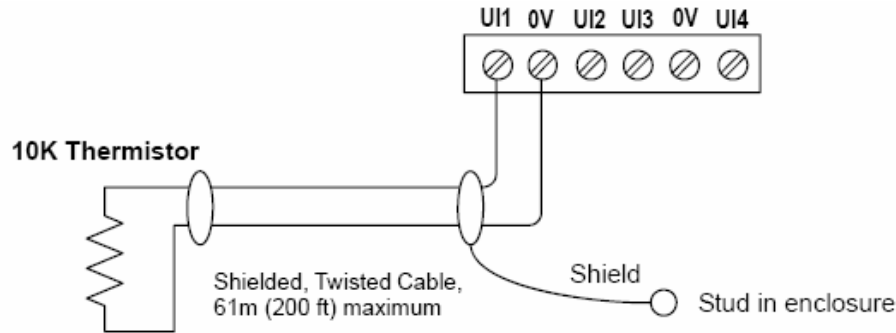


Figure 6: Thermistor Wiring

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.

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.

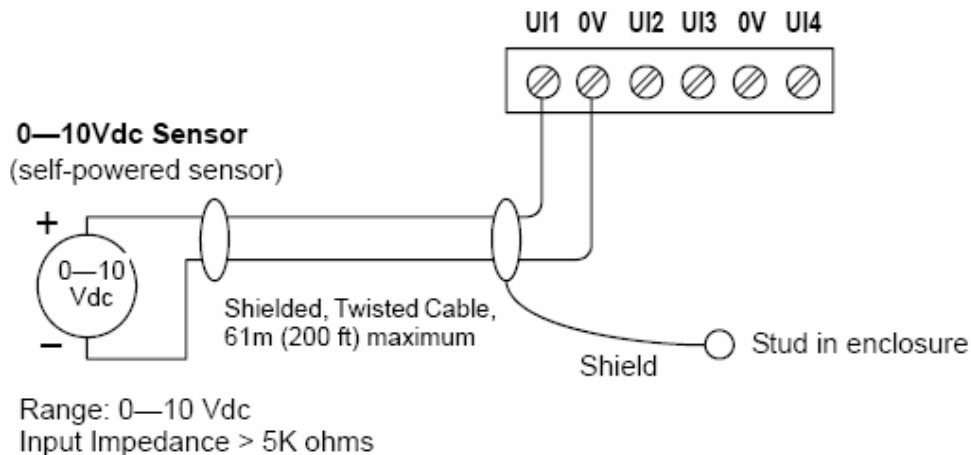


Figure 7: 0-10 VDC Wiring

4-20 mA

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

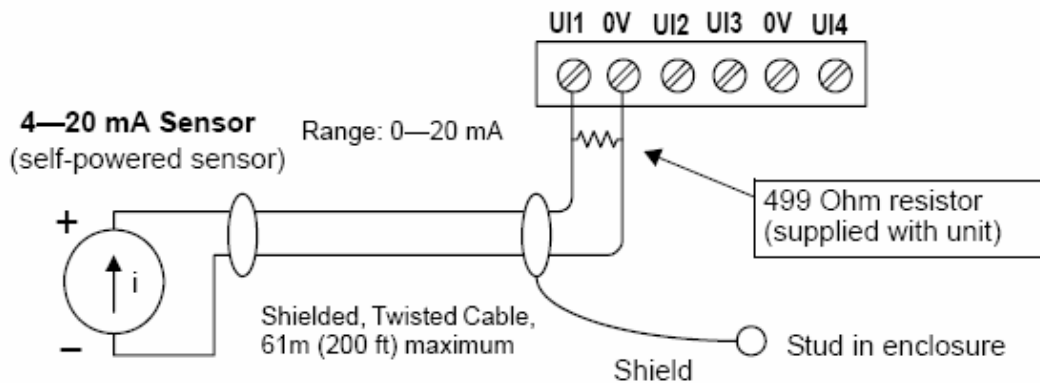


Figure 8: 4-20 mA Wiring

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.

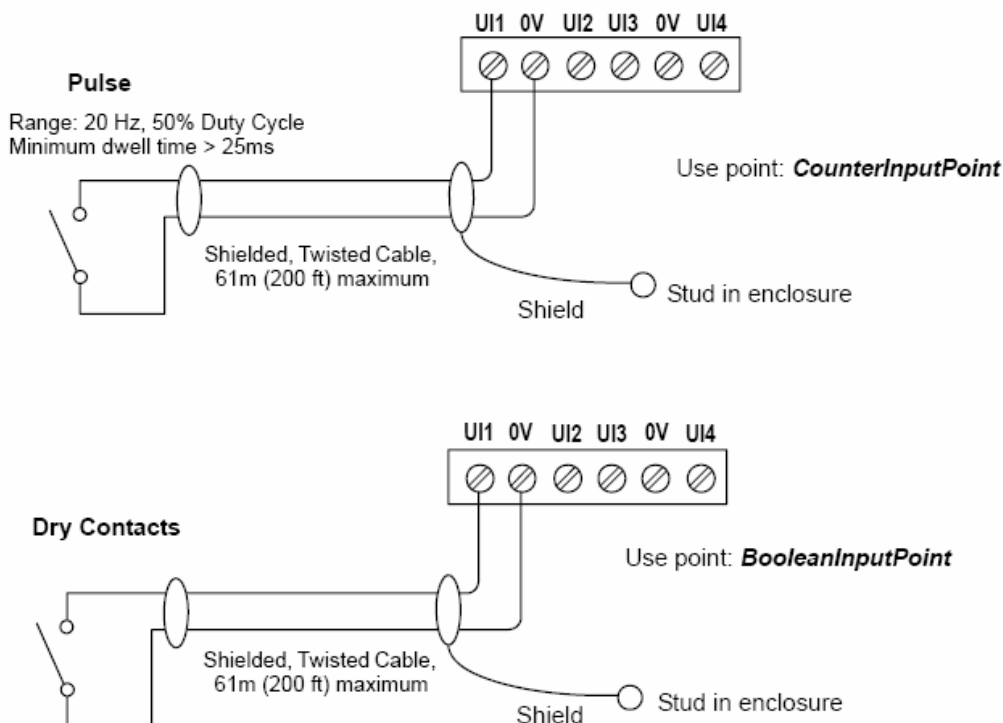


Figure 9: Binary Input Wiring

Outputs

One NDIO34 module includes ten digital relay outputs and eight 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.

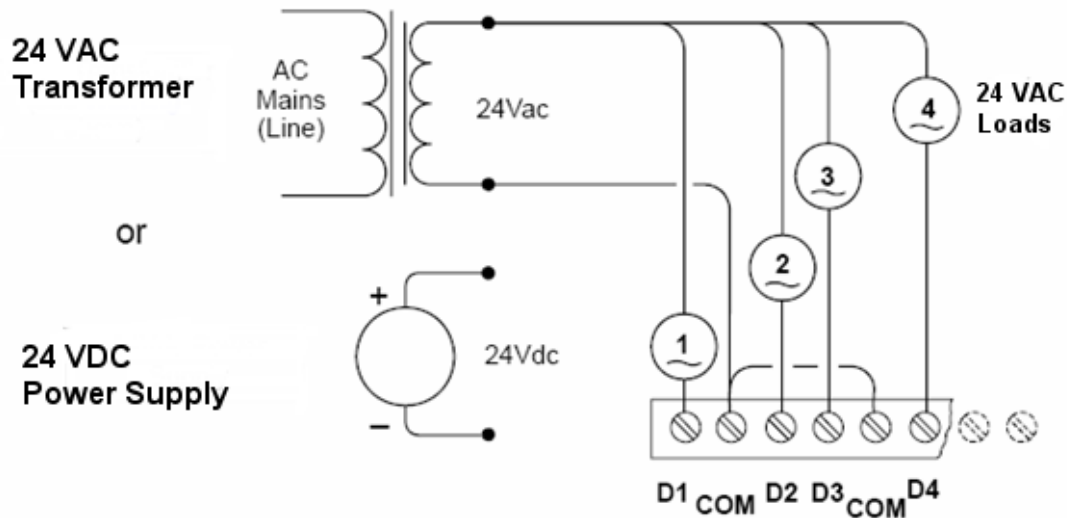


Figure 10: Binary Output Wiring

The 15-position binary output connector plug has 5 common terminals C (1-2, 3-4, 5-6, 7-8, 9-10), which 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-D10) 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.

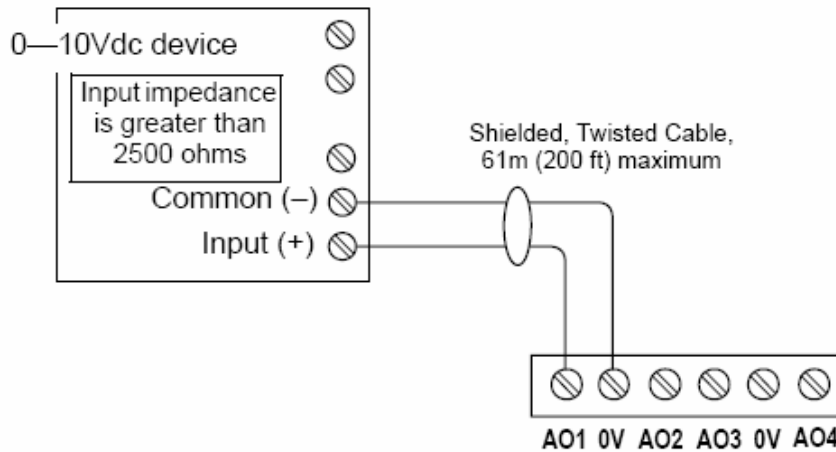


Figure 11: Analog Output Wiring

Setup and Adjustments

In the FX20/FX60 station database, each NDIO34 module appears as one NdioBoard under the station's NdioNetwork. If an FX20/FX60 only has one NDIO34 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 NDIO 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.

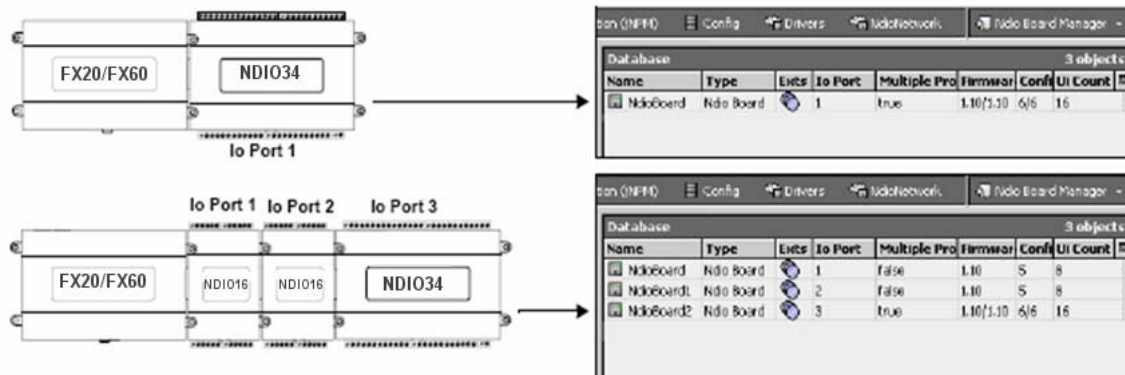


Figure 12: NDIO Board Assignment

Once the operating system identifies the NDIO34 processors, the status LED on each NDIO34 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.

When the status LED of the NDIO34 module is not lit, all outputs are in **failsafe** state. This means relay outputs are Off, and all AOs are at 0 volts.

Each type of input or output requires a special 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 you need for each input or output type appear in Table 1.

Table 1: NDIO Point Representation

Physical I/O Type	NDIO Point Type
Physical I/O Type	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 NDIO34 and FX20/FX60

To start NDIO34 and FX20/FX60:

1. Plug in the 24 V connector plug to apply power. The NDIO34 board status LED is initially Off (Figure 12), but the power LED on the NDIO34 and FX20/FX60 should be lit. Allow the FX20/FX60 sufficient time to boot (at least 2 minutes).
2. Verify that the NDIO34 board status LED is now lit green (two green LEDs are visible).
3. 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.

4. If not already present, add an NdioNetwork component to the station's Drivers container.
5. Use the Manager views and Learn Mode to discover and add NDIO34 components to the station database.

See *Starting the NDIO34 and FX20/FX60* for more details.

Repair Information

There are two categories of NDIO34 replacement parts:

- standard replacement parts
- new replacement unit

Standard Replacement Parts

Standard replacement parts appear in Table 2.

Table 2: NDIO34 Replacement Parts

Part Number	Description
LP-KITNDIO34-0	NDIO34 Hardware Replacement Bag: includes: <ul style="list-style-type: none">• sixteen 499-ohm resistors• one 15-position connector plug (for BOs)• three 12-position connector plugs (3 for UIs, 1 for AOs)• one 2-position connector plug (for power)• one grounding wire with quick disconnect (0.187 in. female connector)

New Replacement Unit

To replace a faulty NDIO34, order a new one. To ensure proper credit for NDIO34 still under warranty, contact customer service for return authorization.

Replacing an NDIO34

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 NDIO34:

1. Use FX Workbench to back up the FX20/FX60 configuration to your computer.
2. Remove power to the FX20/FX60. The unit automatically powers down.
3. If any I/O points have voltage, turn the devices off or disconnect power to them.
4. Note positions of I/O and power wiring going to the NDIO34.

If necessary, label connectors to avoid misconnection after you replace the NDIO34. The software in the FX20/FX60 expects the terminal positions to be the same in the replacement NDIO34 to collect data from or to control the attached devices.

5. Unplug all power, I/O, and ground connectors from the NDIO34.
6. Remove any screws or DIN rail clips securing the NDIO34, removing it from its mounting.
7. Mount the replacement NDIO34 as it was previously, using the same DIN rail location and/or screws.
8. Reconnect the earth ground wires to the NDIO34 grounding lug.
9. Reconnect all I/O connectors to the NDIO34.
10. If any of your I/O points have voltage, turn the devices back on or reconnect power to them.
11. Restore power to the NDIO34, and perform a checkout using FX Workbench (see *Starting the NDIO34 and FX20/FX60*).



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