OptiFlex™ I/O Expanders (part no. FIO)

Technical Instructions

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⚠ Verify that you have the most current version of this document. Go to the **Automated Logic® Partner Community** website to download it.

Important changes are listed in **Document revision history** at the end of this document.

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Contents

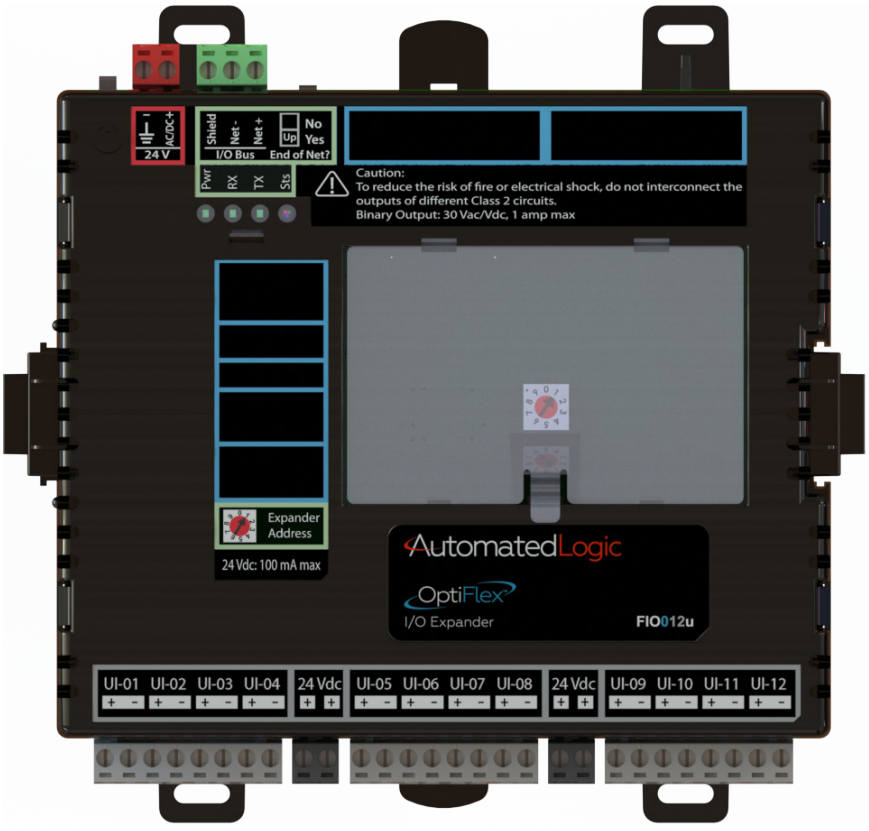
What are OptiFlex™ I/O Expanders?

OptiFlex™ I/O Expanders (part no. FIO) connect to OptiFlex™ BACnet Building Controllers to provide inputs and outputs. You can connect up to 9 FIO expanders to the following OptiFlex™ BACnet Building Controllers:

- OFBBC
- OFBBC-NR
- OF1628
- OF1628-NR
- OF028-NR

This expander (part#)...	Provides this number of inputs...	And this number of outputs...
FIO012u	12	0
FIO48u	8	4
FIO812u	12	8
FIO88u	8	8

FIO012u



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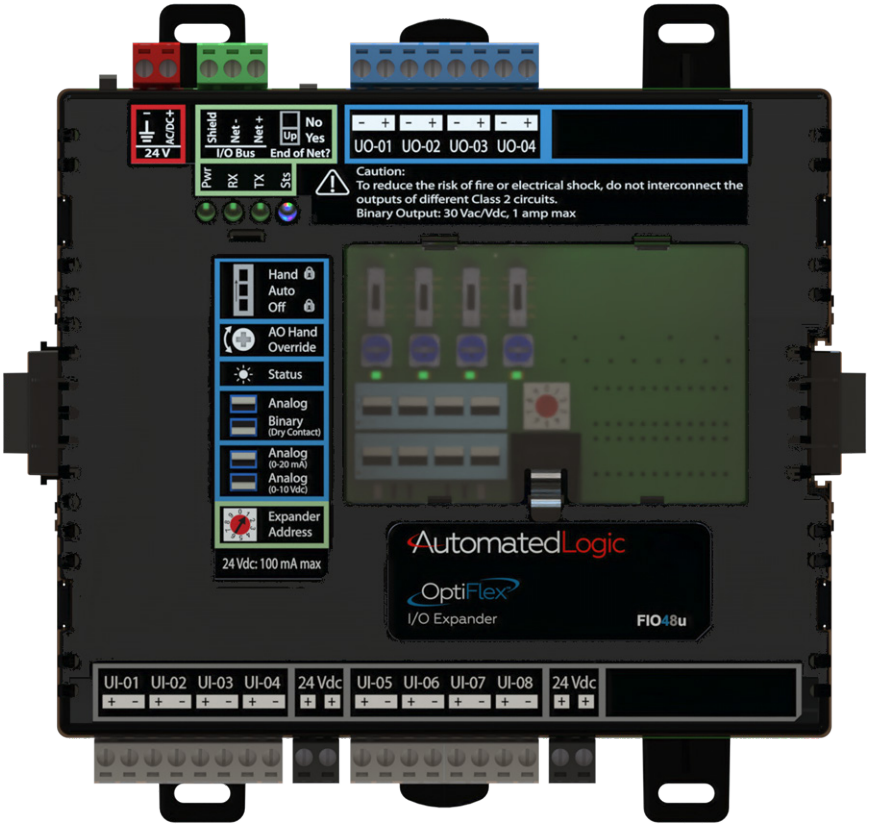
FIO48u



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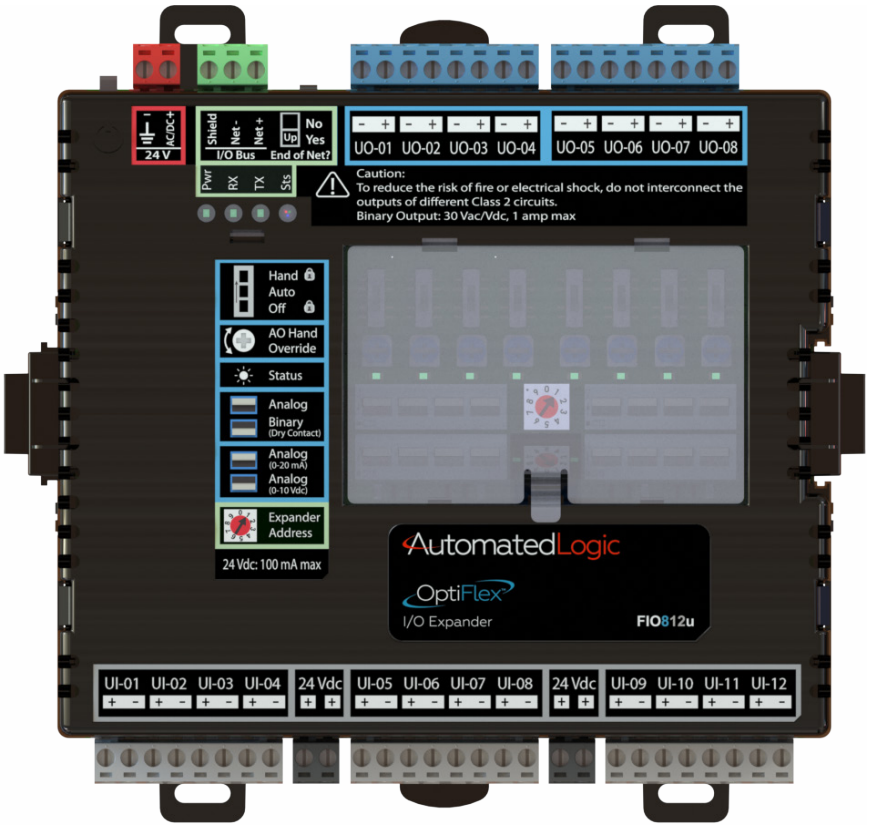
FIO812u



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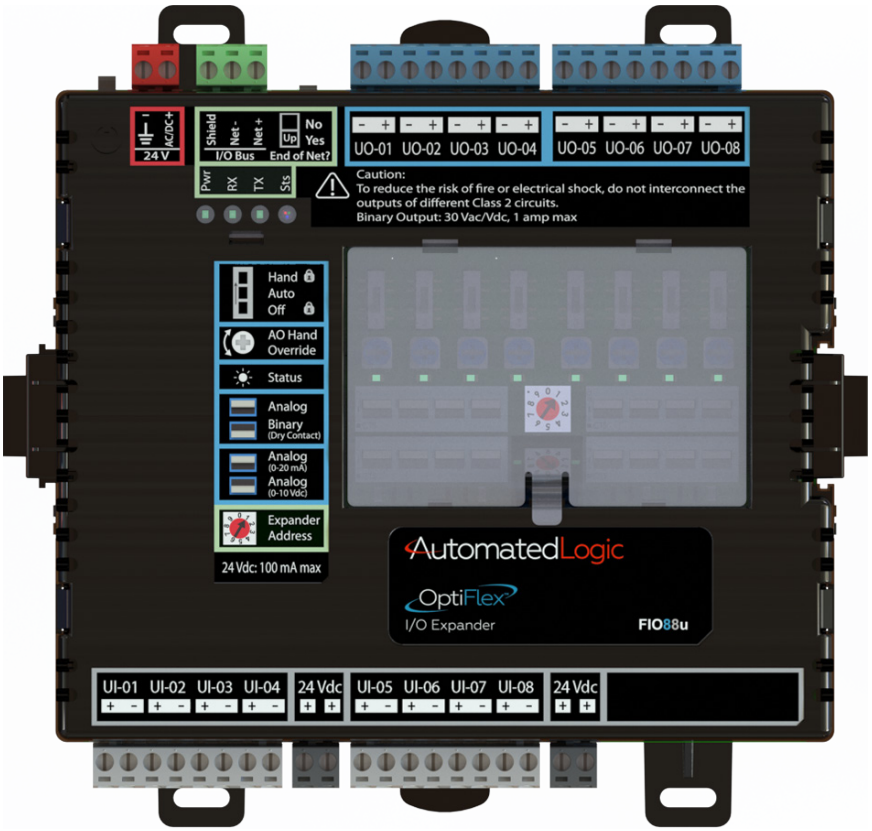
FIO88u



Specifications

Power	24 Vac ±10%, 50–60 Hz, 50 VA 26 Vdc ±10%, 12 W
I/O Bus port	Provides communication for wired FIO expanders that are powered by external power supplies. The port's **End of Net?** switch can be used to terminate the expander network.
I/O bus edge connector	6-pin connector that provides communication and power to a directly-connected FIO expander. See FIO expander configurations to determine how many FIO expanders you can use with the edge connector.
Inputs	**This expander...** — **Provides...** FIO012u — 12 inputs FIO48u — 8 inputs FIO812u — 12 inputs FIO88u — 8 inputs Inputs are configurable in the control program for 0–5 Vdc, 0–10 Vdc, 0–20 mA, RTD, thermistor, dry contact, or pulse counter.
Input resolution	16 bit A/D

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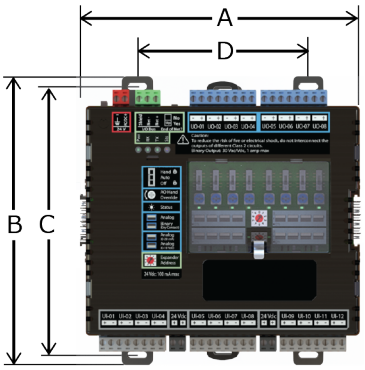
Input pulse frequency	40 pulses per second. Minimum pulse width (on or off time) required for each pulse is 12.5 msec.
Outputs	**This expander...** **Provides...** FIO012u No outputs FIO48u 4 outputs FIO812u 8 outputs FIO88u 8 outputs Outputs can be set as analog or binary outputs. Analog outputs can be used for 0-10 Vdc or 0-20 mA devices. Binary outputs have a built-in relay and can be used to switch external devices or relays up to 1A, 30 Vac/Vdc.
Output resolution	12 bit D/A
Microprocessor	32-bit microprocessor with 256 kB Flash memory and 64 kB SRAM
Protection	The FIO expander has two fast acting, 5mm x 20mm glass fuses: • A 2A fuse for the FIO expander's power • A 4A fuse for the I/O bus edge connector The power and network ports comply with the EMC requirements EN50491-5-2.
Status indicators	LEDs indicate status of communications, system state (running or errors), outputs, and power
Environmental operating range	-40 to 158°F (-40 to 70°C), 10-95% relative humidity, non-condensing **NOTES** • The FIO expander is suitable for installation inside or outside the building envelope. • Install in a UL Listed enclosure only. • Do not change the position of the power or **End of Net** switch at temperatures below -22°F (-30C) to ensure proper operation and electrical connectivity.
Physical	Fire-retardant plastic ABS, UL94-5VA
Terminal blocks and connectors	Screw-type terminal blocks. 0.2 in (5.08 mm) pitch connectors
Overall dimensions	A: 6.9 in. (17.53 cm) B: 6.95 in. (17.65 cm) Depth: 2.09 in. (5.31 cm)
Screw mounting dimensions	C: 6.45 in (16.38 cm) D: 4.1 in. (10.4 cm)
Weight	1.1 lb. (0.49 kg)



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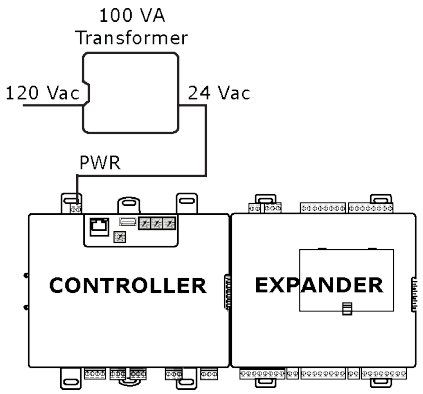
Compliance	United States of America: FCC compliant to Title CFR47, Chapter 1, Subchapter A, Part 15, Subpart B, Class A; UL Listed to UL 916, PAZX, Energy Management Equipment
	Canada: Industry Canada Compliant, ICES-003, Class A cUL Listed UL 916, PAZX7, Energy Management Equipment
	Europe: CE Mark, UK: UKCA EN50491-5-2:2009; Part 5-2: EMC requirements for HBES/BACS used in residential, commercial and light industry environment RoHS Compliant: 2015/863/EU REACH Compliant
	Australia and New Zealand: C-Tick Mark, AS/NZS 61000-6-3

FIO expander power and communication configurations

The FIO expander can be connected to the OptiFlex™ BACnet Building Controller or another FIO expander in one of the following ways:

- Directly-connected to the I/O bus edge connector that provides power and communication



See *Connecting the FIO expander to the controller's I/O bus edge connector* (page 8).

- Wired to the I/O Bus port for communication and then wired to an external transformer for power

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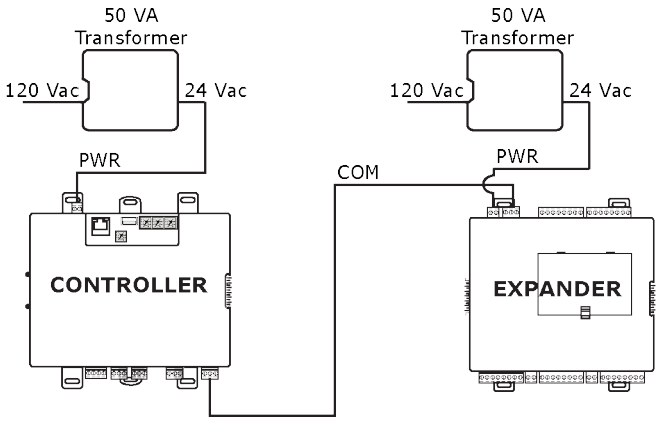

See *Wiring the FIO expander to the controller's I/O bus* (page 9).

The connection/wiring configuration that you use depends on:

- The number of FIO expanders you need
- Whether you use AC or DC power supply
- The size of the power supply
- Which controller you use

See the individual controller's *Technical Instructions* to see applicable configurations and power arrangements.

NOTE The controller has built-in I/O bus network termination and must be the first device on the expander network. Add termination to the last FIO expander on the network by setting I/O Bus **End of Net?** switch to **Yes** (Up).

WARNING Do not apply line voltage (mains voltage) to the controller's ports and terminals.

CAUTIONS

- The FIO expander is powered by a Class 2 power source. Take appropriate isolation measures when mounting it in a control panel where non-Class 2 circuits are present.
- Automated Logic® controllers can share a power supply as long as you:
  - Maintain the same polarity.
  - Use the power supply only for Automated Logic® controllers.

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Connecting the FIO expander to the controller's I/O Bus edge connector

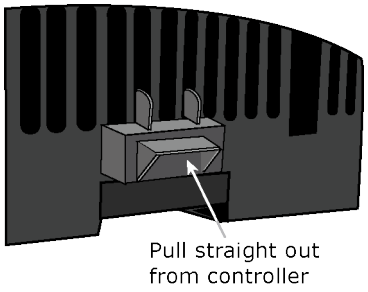
If you connect the expander to the controller's I/O bus edge connector, the connector provides power and communication to the expander.

To connect and mount the expander

NOTE The following instructions assume that the controller is already mounted either on a DIN rail or using screws.

1 Turn off the controller's power.

2 Remove the plastic protective cap from the controller's I/O bus edge connector and the expander's edge connector.

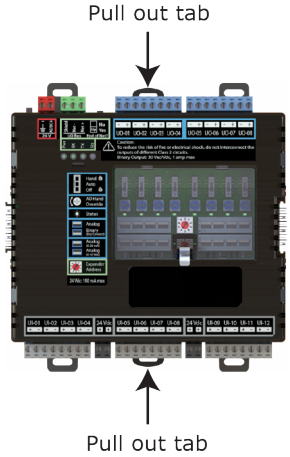


WARNING This connector provides power and communication. To prevent risk of shock, do not touch the bare edge connector if the controller's power is on.

3 Follow the appropriate instructions below for DIN rail mount or screw mount.

DIN rail mount

1 Push down and pull out the center tabs shown below to clear the DIN rail trough on the back of the expander.



2 Slide the expander's left edge connector down onto the controller's edge connector. Both the controller and expander are now on the DIN rail.

3 Push the expander's center tabs towards the expander until you hear them click.

4 Pull gently on the expander to verify that it is locked in place.

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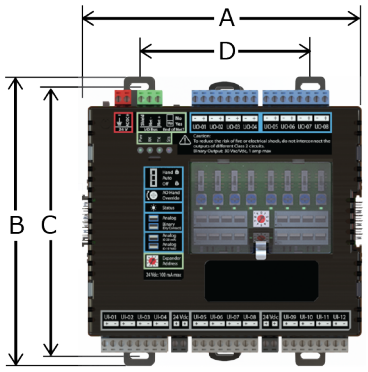
Screw mount

1. Slide the expander's left edge connector down onto the controller's edge connector.
2. Insert #6 screws through the expander's mounting holes. Use no more than 8 in.lbs. torque to secure plastic tab to mounting surface.



A:	6.9 in. (17.53 cm)
B:	6.95 in. (17.65 cm)
C:	6.45 in. (16.38 cm)
D:	4.1 in. (10.4 cm)
Depth:	2.24 in (5.69 cm)

Wiring the FIO expander to the controller's I/O Bus

If you wire the FIO expander to the controller, you must do the following:

1. *Mount the expander* (page 10)
2. *Wire an external power supply to the expander* (page 11)
3. *Wire the expander for communication with the controller* (page 12)

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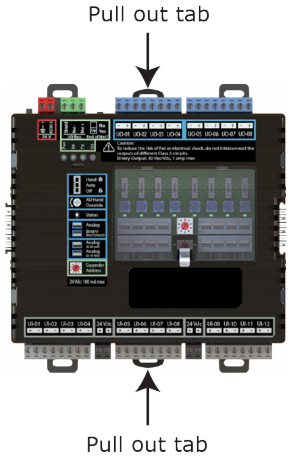
To mount the expander

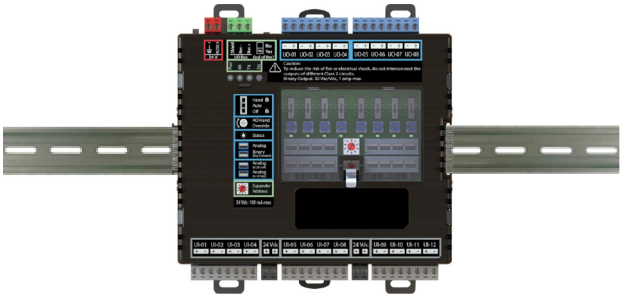
NOTE We recommend screw mounting when installing in a high temperature and high humidity environment.

DIN rail mount

1 Push down and pull out the center tabs shown below to clear the DIN rail trough on the back of the expander.



2 Place the expander on the DIN rail so that the rail is in the trough on the back of the expander.



3 Push the center tabs towards the expander until you hear them click.

4 Pull gently on the expander to verify that it is locked in place.

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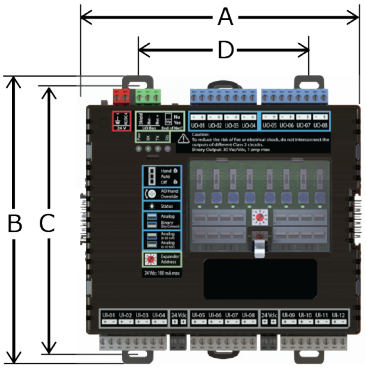
Screw Mount

Leave about 2 in. (5 cm) on each side of the controller for wiring.

Insert #6 screws through the mounting tabs. Use no more than 8 in.lbs. torque to secure plastic tab to mounting surface.



A:	6.9 in. (17.53 cm)
B:	6.95 in. (17.65 cm)
C:	6.45 in. (16.38 cm)
D:	4.1 in. (10.4 cm)
Depth:	2.24 in (5.69 cm)

To wire an external power supply to the expander

When wiring the expander to the controller's **I/O Bus** port, you need an external power supply for the expander. See *FIO expander power and communication configurations* (page 6).

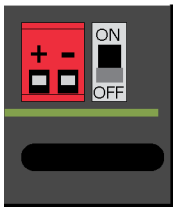
WARNING Do not apply line voltage (mains voltage) to the controller's ports and terminals.

CAUTIONS

- The FIO expander is powered by a Class 2 power source. Take appropriate isolation measures when mounting it in a control panel where non-Class 2 circuits are present.
- Automated Logic® controllers can share a power supply as long as you:
  - Maintain the same polarity.
  - Use the power supply only for Automated Logic® controllers.

To wire the power supply to the expander

1 Make sure the FIO expander's power switch is in the **OFF** (down) position to prevent it from powering up before you can verify the correct voltage.



2 Remove power from the power supply.

3 Pull the red screw terminal connector from the expander's power terminals labeled **24 V** (**+/-**).

4 Connect the power supply's wires to the red screw terminal connector.

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5 Connect an 18 AWG or larger wire from the power supply's negative (-) terminal to earth ground. This wire must not exceed 12 in. (30.5 cm).

6 Apply power to the power supply.

7 Measure the voltage at the red screw terminal connector to verify that the voltage is within the operating range of 20 to 30 Vac or 23.4 to 30 Vdc.

8 Insert the red screw terminal connector into the expander's power terminals.

9 To verify the polarity of the wiring, measure the voltage from the negative terminal of the red screw terminal connector to a nearby ground. The reading should be 0V.

10 Turn on the FIO expander's power switch.

11 Verify that the **PWR** LED on top of the expander is on.

12 Measure the voltage at the red screw terminal connector to verify that the voltage is within the operating range of 20 to 30 Vac or 23.4 to 30 Vdc.

To wire the expander for communications

Use ARC156 wiring (22 AWG, low-capacitance, twisted, stranded, shielded copper wire) to wire the FIO expander to the controller. Do not exceed 1000 feet (305m) total wire length for the I/O bus.

WARNING Do not apply line voltage (mains voltage) to the expander's ports and terminals.

1 Turn off the controller's and expander's power.

2 Wire the expander's **I/O Bus** port to the same port on the controller.

NOTES

- To use more than one expander, wire their **I/O Bus** ports together in a daisy-chain configuration. The controller must be the first device on the expander network.
- Use the same polarity throughout the network segment.

3 On the last expander on the I/O bus, set the I/O Bus **End of Net?** switch to **Yes** to apply network termination and bias.

NOTE The controller has built-in I/O bus network termination and must be the first device on the expander network.

4 Turn on the controller's and expander's power.

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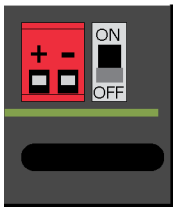
To address the FIO expander

You must give the FIO expander an address that is unique among the controller's expanders.

1 Turn off the power switch on the controller that the FIO expander is attached to.



2 Set the FIO expander's address (1 to 9) on the rotary switch. For example, the switch below shows an address of 1.

3 Turn on the controller's power switch. The controller reads the FIO expander's address each time you turn on the controller's power.

NOTE If the controller that this expander is attached to also has MEx expanders, the MEx addresses should be from 1 to 6, and the FIO expanders use any of the remaining unused addresses. For example, if the controller has 4 MEx expanders and 5 FIO expanders, the MEx expanders will use addresses from 1 to 4, and the FIO expanders will use 5 to 9.

Wiring inputs and outputs

Inputs

The FIO expander has inputs that accept the following signal types.

Signal Type	Description
Thermistor [1]	• Precon Type 2 (10kOhm at 77 °F) • Precon Type 3 (10kOhm at 77 °F) • Carrier YSI 5kOhm at 77 °F • TS-5700-850 10kOhm w/ 11kOhm shunt (5238 ohm@77°F) Input voltages should be from 0.09 Vdc to 4.36 Vdc for thermistors.
Dry contact	The maximum current when the contact is closed is 0.5 mA. The input voltage should be 4.5V when the contact is open. Maximum closed contact resistance is 1kOhms.
0–5 Vdc 0–10 Vdc	The input impedance of the FIO expander is approximately 221 kOhm when configured as a voltage input.

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Signal Type	Description
0–20 mA	The input resistance on the positive (+) terminal is 200 Ohms when configured as a current input. Each **24 Vdc** connector is capable of supplying 24 Vdc to multiple 4–20 mA transducers. **CAUTION** Both connectors combined must not exceed: 66.7 mA for the FIO48u and FIO88u 100 mA for the FIO012u and FIO812u
RTD [1]	• Platinum 1kOhm at 32°F (0°C) (0.00375 TCR) • Nickel-iron 1kOhm at 70°F (21°C) • Platinum TS-8000 1kOhm at 32°F (0°C) (0.00385 TCR) • Balco (nickel-iron) TS8000 1kOhm at 70°F (21°C) Input voltages should be from 0.3–0.68V. **NOTE** Automated Logic® recommends use of an external current transducer between an RTD and the FIO expander to improve accuracy and resolution.
Pulse counter [2]	Pulse counting up to 40 pulses per second. Minimum pulse width (on or off time) required for each pulse is 12.5 msec.

[1] To use a thermistor or RTD not listed above, you can set up a custom translation table for your sensor in the controller's driver.

[2] The FIO expander can perform pulse counting for dry contact or voltage inputs if you assign the input to a Pulse to Analog Input microblock. See *To adjust input and output properties* (page 19).

WARNING Do not apply voltage to any input configured for 0-20 mA as this could damage the expander.

Outputs

The FIO expander's universal outputs can be set as analog or binary on their two DIP switches.

The expanders' outputs return to their unconfigured state if they are removed from the program or the program is deleted from the controller. Also, outputs time out and return to their unconfigured or off state after two minutes of inactivity. The unconfigured state results in:

- Not running control programs that are due to download
- Losing power to the controller, but not the expander

NOTE This does not apply to outputs that have been locked in the WebCTRL® application.

Analog outputs

Outputs set up as analog can be used for:

- 0-10 Vdc devices
- 0-20 mA devices

WARNING Do not apply voltage to any output whose DIP switch is set to Analog.

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If output controls a...	Resistance to ground must be...
0–10 Vdc device	500 Ohms minimum
0–20 mA device	500 Ohms maximum

NOTE The device must share the same ground as the expander.

Binary outputs

The outputs have a built-in relay and provide a dry contact so an external voltage source must be wired to one of the two terminals.

Outputs set up as binary can be used to switch external devices and relays up to 1A, 30 Vac/Vdc.

Wiring specifications

Input wiring

Input	Maximum length	Minimum gauge	Shielding
Thermistor Dry contact	1000 feet (305 meters)	22 AWG	Shielded
0–5 Vdc 0–10 Vdc	1000 feet (305 meters)	26 AWG	Shielded
0–20 mA	3000 feet (914 meters)	26 AWG	Shielded or unshielded
RTD	100 feet (30 meters)	22 AWG	Shielded

NOTES

- Automated Logic® recommends use of an external current transducer between an RTD and the FIO expander to improve accuracy and resolution.
- RTD inputs require either sensor calibration or an estimated offset correction for wiring resistance. See *Offset and Polarity values* (page 22).

Output wiring

To size output wiring, consider the following:

- Total loop distance from the controller to the controlled device

  NOTE Include the total distance of actual wire. For 2-conductor wires, this is twice the cable length.
- Acceptable voltage drop in the wire from the controller to the controlled device
- Resistance (Ohms) of the chosen wire gauge
- Maximum current (Amps) the controlled device requires to operate

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To wire inputs and outputs

WARNING Do not apply line voltage (mains voltage) to the controller's ports and terminals.

1. Verify that the FIO expander's power and communications connections work properly.
2. Turn **off** the FIO expander's power.
3. Connect the input wiring to the **UI** screw terminals on the FIO expander.

   WARNING Do not apply voltage to any input configured for 0-20 mA as this could damage the expander.

   NOTE Connect the shield wire to the – terminal with the ground wire. Do not connect the shield wire at the other end of the cable as this will cause a ground loop error.

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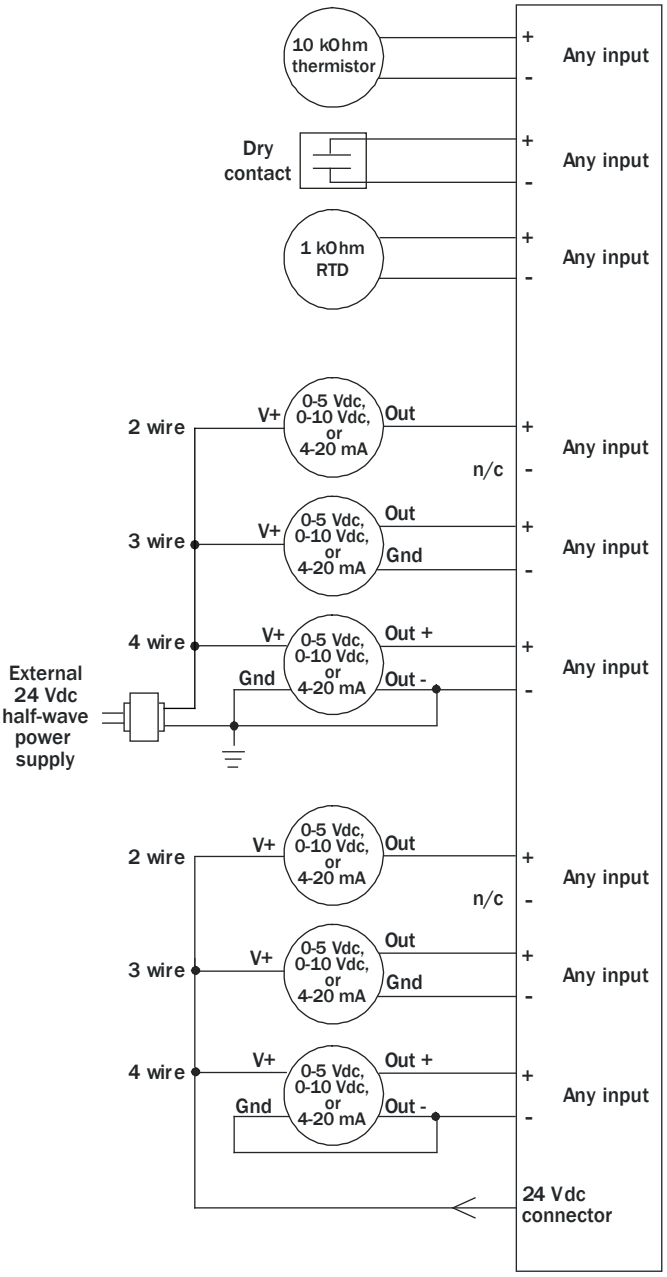

NOTE For a loop-powered 4-20 mA sensor, wire the sensor's positive terminal to the **+** terminal on the FIO expander's **24 Vdc** connector. Wire the sensor's negative terminal to an input's **+** terminal.

4 Connect binary and analog output wiring to the **UO** screw terminals on the FIO expander and to the controlled device. Connect the ground wire to the UO's – terminal.

WARNING Do not apply voltage to any output whose DIP switch is set to Analog.

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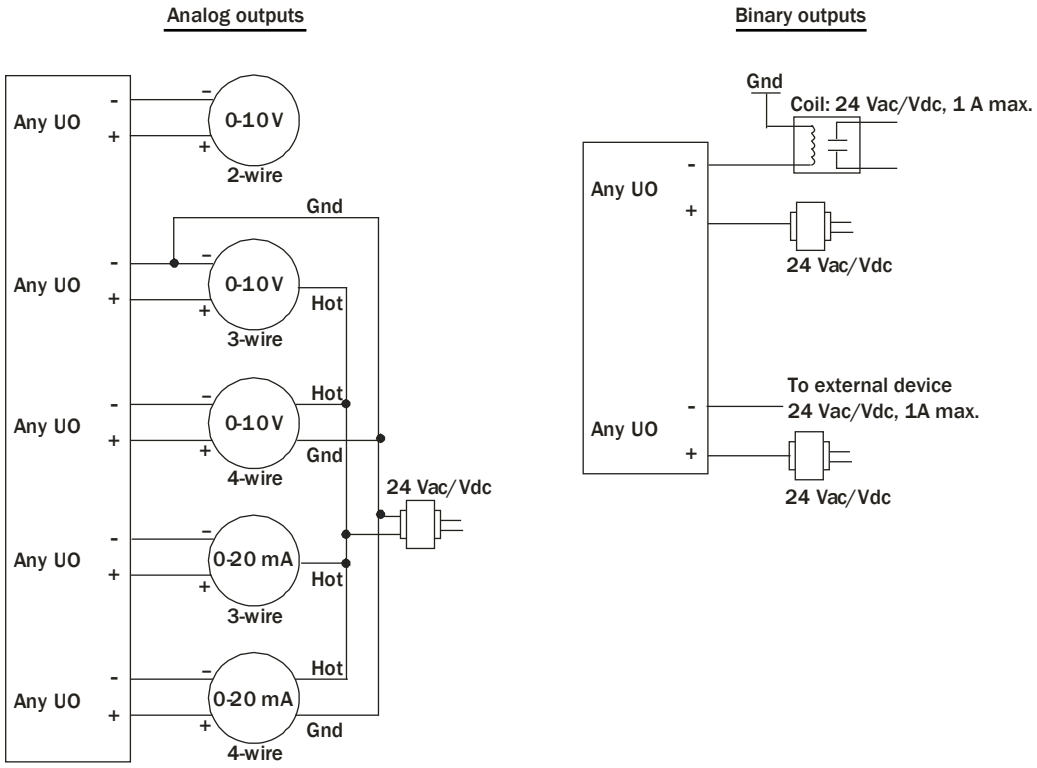

5 Set each output's two DIP switches to the appropriate settings for the type of device wired to the output.

For...	Set top DIP switch to...	Set bottom DIP switch to...
Analog 0-20 mA	Up	Up
Analog 0-10 Vdc	Up	Down
Binary	Down	N/A

CAUTION Outputs are set to Binary in the factory. To avoid damage to the expander, use a voltmeter to verify there is no voltage on the + and – terminals before setting the DIP switch to Analog.

6 Turn **on** the FIO expander's power.

See *Troubleshooting inputs and outputs* (page 24).

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To adjust input and output properties

An input or output must be assigned to its corresponding point in the control program. This is typically done when the control program is created, but you can adjust the settings at the time of installation in the WebCTRL® interface.

1 In the WebCTRL® **Geographic** tree, select the equipment controlled by the FIO expander.

2 On the **Properties** page, select the **I/O Points** tab.

3 For each point, type the expander's rotary switch address in the **Exp** field and the number of the expander's corresponding input or output in the **Num** field.

EXAMPLE If UO-01 on the FIO expander (which has a rotary switch address of 5) is used for the point **Fan S/S**, enter `5:1` in the **Exp:Num** column for **Fan S/S**.

NOTE Do not assign the same output number to more than one point.

4 Enter the appropriate values for each input and output in the remaining columns. See *Input values*, *Output values*, *Resolution values* and *Offset/Polarity values* below.

CAUTION Do not assign two input microblocks to the same physical input using Dry Contact in one and Binary Input in the other. This results in faulty behavior.

5 If you have not performed the initial download to the attached controller, you must download now to verify inputs and outputs.

6 To verify each input's operation, force each sensor to a known value, then compare it to the **Value** shown on the **Properties** page on the **I/O Points** tab.

7 To verify each output's operation, lock each output to a known condition on the **I/O Points** tab, then verify that the equipment operates correctly.

See *Troubleshooting inputs and outputs* (page 24).

Input values

Input	I/O Type	Sensor/Actuator Type	Min/Max
Analog (BAI)			
0-5 Vdc	**0–5 Volt**	**Linear Full Range**	Engineering values associated with 0 Vdc (Min) and 5 Vdc (Max) [1]
		No Translation	N/A. The input microblock's value will be the raw voltage of the input.
0-10 Vdc	**0–10 Volt**	**Linear Full Range**	Engineering values associated with 0 Vdc (Min) and 10 Vdc (Max) [1]
		No Translation	N/A. The input microblock's value will be the raw voltage of the input.
2-10 Vdc	**0–10 Volt**	**Linear w/Offset, 2–10 Volts**	Engineering values associated with 2 Vdc (Min) and 10 Vdc (Max) [1]
0-20 mA	**0–20 mA**	**Linear Full Range**	Engineering values associated with 0 mA (Min) and 20 mA (Max) [1]

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Input	I/O Type	Sensor/Actuator Type	Min/Max
		No Translation	N/A. The input microblock's value will be the raw milliamps of the input.
4-20 mA	**0–20 mA**	**Linear w/Offset, 4–20 mA**	Engineering values associated with 4 mA (Min) and 20 mA (Max) [1]
RTD	**RTD Input**	Select your RTD type or set up and select a **Non-Linear, Custom Table** [2, 4]	N/A
Thermistor	**Thermistor**	Select your Thermistor type or set up and select a **Non-Linear, Custom Table** [2]	N/A
Pulse to Analog (BPTA) [3]			
Pulse Counter	Dry Contact or Binary Input	N/A	N/A
Binary (BBI)			
Dry Contact	**Dry Contact**	N/A	N/A

CAUTION Do not assign two input microblocks to the same physical input using Dry Contact in one and Binary Input in the other. This results in faulty behavior. [5]

[1] The sensor reads a value and sends a corresponding signal (Volt or mA) to the FIO expander's physical input. The Analog Input microblock uses the Min and Max values to linearly translate the signal into the engineering value used in subsequent control logic. For example, set Min to 0 and Max to 10 for a 4–20 mA sensor that measures velocity from 0.0 to 10.0 inches/second so that when the input reads 4 mA, the microblock outputs a value of 0. Similarly, when the input reads 8 mA, the microblock outputs a value of 2.5.

[2] You can set up a custom translation table on the driver's Custom Translation Tables pages in the WebCTRL® interface.

[3] The control program must have one Pulse to Analog Input microblock for each pulse counting input.

[4] To improve the accuracy for RTD sensors used with long cables, see *Offset/Polarity values* (page 22).

[5] Binary Input and Dry Contact input types are not interchangeable. Setting an input to Dry Contact applies a wetting voltage to sense a dry contact. Setting an input to Binary Input will not apply a wetting voltage.

Output values

Output	I/O Type	Sensor/Actuator Type	Min/Max
Analog (BAO)			
0-10 Vdc	**Electrical 0–10 Volt**	**Linear Full Range**	Engineering values associated with 0 Vdc (Min) and 10 Vdc (Max) [1]
		No Translation	N/A. The Analog Output microblock will output the same value that comes in to the microblock.

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Output	I/O Type	Sensor/Actuator Type	Min/Max
2-10 Vdc	**Electrical 0–10 Volt**	**Linear w/Offset, 2–10 Volts**	Engineering values associated with 2 Vdc (Min) and 10 Vdc (Max) [1]
0-20 mA	**Electrical 0–20 mA**	**Linear Full Range**	Engineering values associated with 0 mA (Min) and 20 mA (Max) [1]
		No Translation	N/A. The Analog Output microblock will output the same value that comes in to the microblock.
4-20 mA	**Electrical 0–20 mA**	**Linear w/Offset, 4–20 mA**	Engineering values associated with 4 mA (Min) and 20 mA (Max) [1]
Digital (Binary) (BBO)			
Relay	**Relay/Triac Output**	N/A	N/A

[1] The Analog Output microblock uses the Min and Max values to linearly translate its incoming value into a physical output signal (Volt or mA) sent from the FIO expander to an actuator. For example, set Min to 0 and Max to 100 for an Analog Output microblock that receives a 0 to 100% open signal from a PID microblock and that controls a 0–10 Vdc actuator so that when the PID signal is 100%, the FIO expander output is 10 Vdc. Similarly, when the PID signal is 50%, the FIO expander output is 5 Vdc.

Resolution values

Resolution is not particular to a type of input or output, but the driver handles analog and binary inputs and outputs differently. To set these values appropriately, you should understand how the driver uses them.

Resolution	Notes
Analog Input (BAI)	The driver rounds the microblock's present value according to the resolution. **EXAMPLE** If the calculated present value is 13.789 and you set the **Resolution** to 0.1, the control program uses 13.8 for any calculations downstream from the microblock.
Analog Output (BAO)	The driver rounds the wire input value to the microblock before performing any scaling calculations. **EXAMPLE** If the wire input value is 13.789 and you set the **Resolution** to 0.1, the microblock uses 13.8 for any scaling calculations.

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Offset/Polarity values

Offset/Polarity is not particular to a type of input or output, but the driver handles analog and binary inputs and outputs differently. To set these values appropriately, you should understand how the driver uses them.

<table>
<tr><th>Offset/Polarity</th><th>Notes</th></tr>
<tr><td>Analog Input (BAI)</td><td>Offset value (positive or negative) adds a fine adjustment to a sensor reading after all scaling for calibration.
EXAMPLE If a sensor reads 74.9°F when the actual measured value is 73.6°F, enter an Offset of <code>-1.3</code> to calibrate the sensor to the measured value.
RTD inputs require either sensor calibration or an estimated offset correction for wiring resistance. Cable length and size affects RTD sensor accuracy. Use the following information for a 100 ft. (30.48 m) cable as a guideline for entering an offset. For shorter cable, scale the offset linearly. For example, for a 50 ft. cable, use half the offset shown below.
<table>
<tr><th rowspan="2">RTD sensor</th><th colspan="2">Offset for 100 ft. (30.48 m) cable</th></tr>
<tr><th>22 AWG</th><th>18 AWG</th></tr>
<tr><td>Platinum 1kOhm at 32°F (0°C) (0.00375 TCR)</td><td>-1.5</td><td>-0.59</td></tr>
<tr><td>Nickel-iron 1kOhm at 70°F (21°C)</td><td>-1.1</td><td>-0.43</td></tr>
<tr><td>Platinum TS-8000 1kOhm at 32°F (0°C) (0.00385 TCR)</td><td>-1.5</td><td>-0.59</td></tr>
<tr><td>Balco (nickel-iron) TS8000 1kOhm at 70°F (21°C)</td><td>-1.4</td><td>-0.56</td></tr>
<tr><td>Cable resistance for signal and ground wires (ohms)</td><td>3.1</td><td>1.24</td></tr>
</table>
</td></tr>
<tr><td>Analog Output (BAO)</td><td>You can use the Offset value (positive or negative) to calibrate an output, but you generally do not need to. If used, the driver adds the offset value to the wire input value before performing any scaling calculations to determine the FIO expander's output.</td></tr>
<tr><td>Binary Input (BBI)</td><td>Polarity determines the microblock's present value when no signal is received from the equipment.
When no signal is received from the equipment, if Polarity is set to:
normal—present value is off
reversed—present value is on</td></tr>
<tr><td>Binary Output (BBO)</td><td>Polarity determines the FIO expander's output based on the control program's signal to the microblock.
When the control program's signal to the microblock is on, if Polarity is set to:
normal—output is on
reversed—output is off
NOTE Regardless of Polarity, the output will be off if the FIO expander loses power.</td></tr>
</table>

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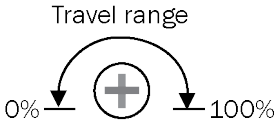
To use an output's Hand-Auto-Off switch

You can control an output using the **Hand-Auto-Off** switch.

Set the switch to...	To...
Hand	• Turn on a binary output. • Allow an analog output to be controlled by the **AO Hand Override** potentiometer.
Auto	Let the control program control the output
Off	Turn off the output

The **AO Hand Override**, located below the **Hand-Auto-Off** switch, allows you to manually control the output level of an analog output. Place the **Hand-Auto-Off** switch in the **Hand** position, then turn the potentiometer counterclockwise to reduce the output, or clockwise to increase the output.



The control program can monitor the status of a **Hand-Auto-Off** switch and display the status on the control program's **Properties** page > **I/O Points** tab in the WebCTRL® interface. The **Value** of the point monitoring the **Hand-Auto-Off** switch shows **Off** if the switch is set to **Auto**, and **On** if the switch is set to **Hand** or **Off**.

To monitor the position of the manual Hand-Auto-Off switch

1. Insert a BACnet Binary Input microblock in the control program.
2. On the microblock's **Properties** page in the WebCTRL® interface, set the **I/O Type** field to **H-A-O Status Feedback**.
3. In the **Input Number** field, type the number of the output you want to monitor.

Troubleshooting

If you have problems mounting, wiring, or addressing the FIO expander, contact Automated Logic® Technical Support.

LED's

The LED's on the FIO expander show the status of certain functions.

If this LED is on...	Status is...
Pwr	The FIO expander has power.
RX	The FIO expander is receiving data from the I/O bus.

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If this LED is on...	Status is...	
TX	The FIO expander is transmitting data over the I/O bus.	
Sts	Green, slow blink:	Expander is functioning normally.
	Red, fast blink:	The controller cannot update the expander's firmware. In the WebCTRL® application, go to the controller driver **I/O Bus and Xnet Expanders** page to see if the expander is communicating with the controller.
	Green, fast blink:	Firmware download is in progress.
	Red, continuously on:	Invalid configuration settings. Contact Technical Support.
Status	Located just below each output's **AO Hand Override** potentiometer, the LED flashes when the expander starts up. After startup, if the output is: • Binary, the LED will be either on or off to indicate the output's status. • Analog, the LED's brightness indicates the strength of the output signal.	

Troubleshooting inputs and outputs

The WebCTRL® interface shows if you have I/O errors resulting from:

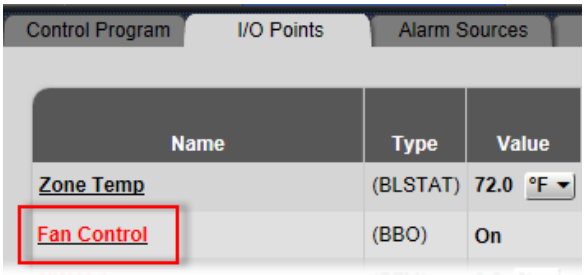
- A misconfigured microblock
- A misconfiguration on the expander
- A missing or disconnected expander

To check for errors:

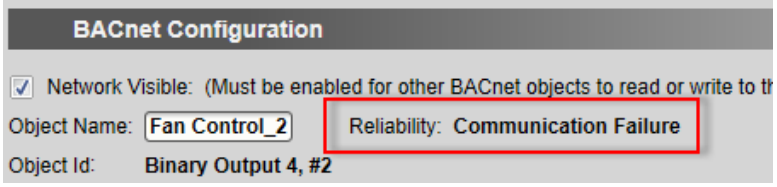
1 In the WebCTRL® **Geographic** or **Network** tree, select the equipment controlled by the OptiFlex™ BACnet Building Controller.

2 On the **Properties** page, select the **I/O Points** tab.

3 Click the **Name** of any input or output whose name is red (indicates an error) to open its dialog box.



4 On the **Details** tab, scroll down to see the **Reliability** field under **BACnet Configuration**.



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5 Anything other than **No Fault Detected** indicates an error. See the table below to determine the error and possible actions to take.

Reliability description	Possible error	Verify that...
Communication Failure	• Expander is not connected to the controller. • The expander has no power. • The controller is offline.	• The expander is connected to the controller's I/O bus edge connector or wired to the I/O Bus port. • The expander has power.
Configuration Error	• The microblock's **I/O Type** and **Sensor/Actuator Type** are not compatible.	• The **I/O Type** and **Sensor/Actuator Type** combination is valid for the I/O number and microblock type.
	• The output's DIP switch setting does not match the connected device.	• The DIP switch setting is appropriate for the output and microblock type.
	• Invalid expander address or I/O number.	• The expander is present and functional at the address shown in the WebCTRL® interface and that I/O number is valid.
Over Range	• Input exceeds the **Min/Max** limits.	• The input is within the **Min/Max** limits.
No Output	• Output's **Hand-Auto-Off** switch is in **Hand** or **Off** position.	• The expander's **Hand-Auto-Off** switch is in the **Auto** position.
No Sensor	• No device is attached to the output.	• The device is present and functioning.
Shorted Loop	• Internal voltage feedback does not correspond with commanded value.	• The load on the output is within the valid range. • A voltage/current source has not been connected to an output.
Open Loop	• Internal current feedback does not correspond with commanded value.	• The load on the output is within the valid range. • A voltage/current source has not been connected to an output.
Unreliable Other	• Feedback from the expander does not correspond with commanded value (for example, the output relay is not in commanded state).	• Expander may be faulty. Contact Technical Support.

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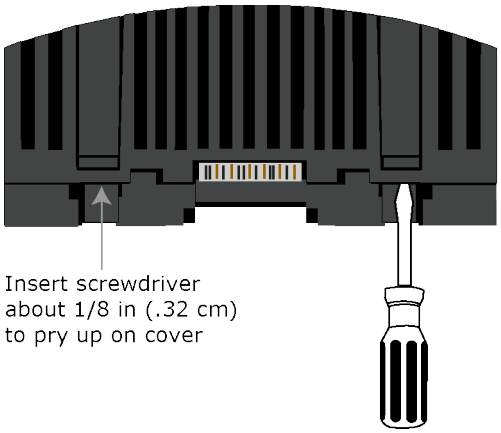
To get the FIO expander's serial number

If you need the FIO expander's serial number when troubleshooting, the number is laser-etched on the board inside the FIO expander. To remove the cover, insert a small flathead screwdriver as shown below, and then gently pry up on the cover until it is released from the base.



To monitor expander communication

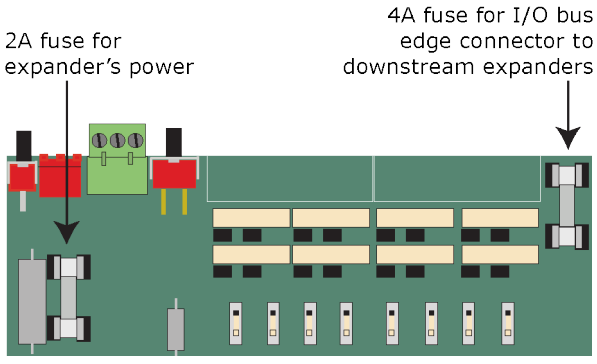
You can add an analog input in a control program that will provide the communication status of the FIO expander. If the input reads a value of 81, the expander is communicating. If the input reads 0, the expander is not communicating.

To have the input provide the FIO expander's status, define the following properties for the input.

Expander: The expander number you want to read
Input Number: 1
Input Type: Special

To replace the FIO expander's fuses

The FIO expander has 2 fuses:



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Symptoms of a blown fuse:

- Expander's power fuse—The expander's **Pwr** LED is not lit.
- I/O bus edge connector fuse—The **Pwr** LED is not lit on downstream expanders connected to the edge connector.

NOTE If the expander's power fuse blows but not its I/O bus edge connector fuse, the expander will be off but not the downstream expanders.

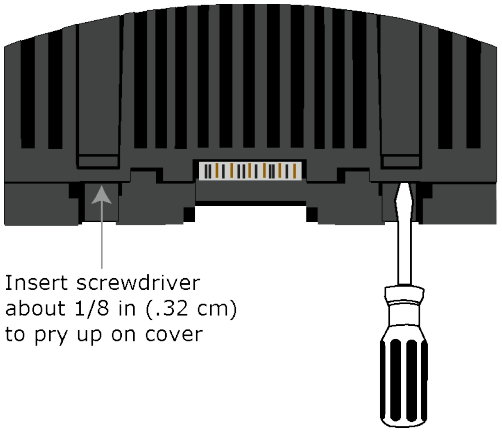
If you suspect a fuse is blown, remove the fuse as described below, and use a multimeter to check it. If the fuse is blown, try to determine why it blew before you replace it. Check the power wiring polarity of the FIO expander and any other devices that share the power supply. Use the same polarity for all of them.

The fuses are fast-acting, 5mm x 20mm glass fuses that you can purchase from one of the following vendors:

Manufacturer	Mfr. Part # for 2A fuse	Mfr. Part # for 4A fuse
Littelfuse	0217002.HXP	0217004.HXP
Bussmann	S500-2-R	S500-4-R
Belfuse	5SF 2-R	5SF 4-R
Optifuse	FSD-2A	FSD-4A

To replace a fuse:

1. Turn off the FIO expander's power switch.
2. Do one of the following:
   - If the FIO expander is wired to an external power supply, remove the red power connector.
   - If the FIO expander is getting power through another device's I/O bus edge connector, disconnect the expander from the edge connector.
3. On one end of the expander, insert a small flathead screwdriver as shown below, and then gently pry up on the cover until it is released from the base.



4. Remove the cover from the base.
5. Use a fuse puller to remove the blown fuse.
6. Use the fuse puller to snap the new fuse into the fuse holder.

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7 Replace the expander's cover.

8 Depending on how you removed power in step 2, replace the expander's power connector or reattach it to a device's I/O bus edge connector.

9 Turn on the FIO expander's power switch.

10 Verify the **Pwr** LEDs on this expander and any downstream expanders are lit.

Compliance

FCC Compliance

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1 This device may not cause harmful interference.

2 This device must accept any interference received, including interference that may cause undesired operation.

NOTE 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 the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and if it is not installed and used in accordance with this document, it 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 own expense.

CAUTION Any modifications made to this device that are not approved by Automated Logic® will void the authority granted to the user by the FCC to operate this equipment.

CE and UKCA Compliance

WARNING This is a Class B product. In a light industrial environment, this product may cause radio interference in which case the user may be required to take adequate measures.

Industry Canada Compliance

This Class A digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe A est conforme à la norme NMB-003 du Canada.

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Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
7/12/22	CE and UKCA Compliance	Added UKCA compliance and updated for next gen	X-PM-AB-R-BH
	To monitor expander communication	Updated input value	X-PM-BM-E
1/19/22	Specifications	Updated EU Compliance	X-PM-BM-E
	Wiring inputs and outputs > Outputs	Added details about the expander returning to an unconfigured state	X-TS-RB-E-BM
8/19/20	Cover, What are FIO expanders	Updated company logo	A-D
	To adjust input and output properties Input Values	Caution added regarding assigning two microblocks to the same physical input.	X-TS-RB-E-BK
	FIO Expander power and communication configurations	Removed power and configurations for the OFBBC and referred user to the controller's <technical instructions>	X-D
	What are the OptiFlex™ I/O Expanders?	Added OFBBC-NR, OF1628, OF1628-NR, OF028-NR	X-D
6/3/19	To wire the expander for communications	Changed total wire length for the IO bus from 2000 feet to 1000 feet	X-H-RD-E-TA

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