LN Series Input/Output (I/O) Extension Modules

Installation Instructions

LN-IOE400-0, LN-IOE410-0, LN-IOE420-0

Application

The LN Series Input/Output (I/O) Extension Module product line is compatible with the LN-PRG600-2 and LN-PRG600-12 Series controllers. These devices are microprocessor-based and designed to control various HVAC equipment, such as roof top units, large air handling units, central plant applications, including chillers and boilers.

The LN PRG600 Series Controllers are built on a platform compatible with the LN Series I/O Extension Modules, but have different numbers of inputs and outputs. Each LN Series I/O Extension Module also has different numbers of digital outputs or universal outputs. The LN Series I/O Extension Modules provide additional hardware point capacity for the LN PRG600 Series controllers.

Follow these recommendations for proper installation and operation of each I/O Extension Module:

- Inspect the I/O Extension Module for shipping damages. Do not install damaged I/O Extension Module.

- Keep the I/O Extension Module at room temperature for at least 24 hours prior to installation to allow any condensation that may have accumulated during shipping to evaporate.

- If the I/O Extension Module is used in a manner not specified by Johnson Controls, the functionality and the protection provided by the I/O Extension Module may become impaired.

- Avoid areas where corroding, deteriorating, or explosive vapors, fumes, or glass may be present.

- Do not drop the I/O Extension Module or subject it to physical shock.

Note: The I/O Extension Module's plastic enclosure has a back plate that is separate from the front plate allowing the back plates to be shipped directly to the installation site while all the engineering is done elsewhere.

> **IMPORTANT:** Prevent any static electric discharge to the controller. Static discharge can damage the controller and void the warranties.

North American Emissions Compliance

Canada

> **Industry Canada Statement**
>
> The term **IC** before the certification/registration number only signifies that the Industry Canada technical specifications were met.
>
> Le terme **C** » précédant le numéro d'accréditation/inscription signifie simplement que le produit est conforme aux spécifications techniques d'Industry Canada.

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.
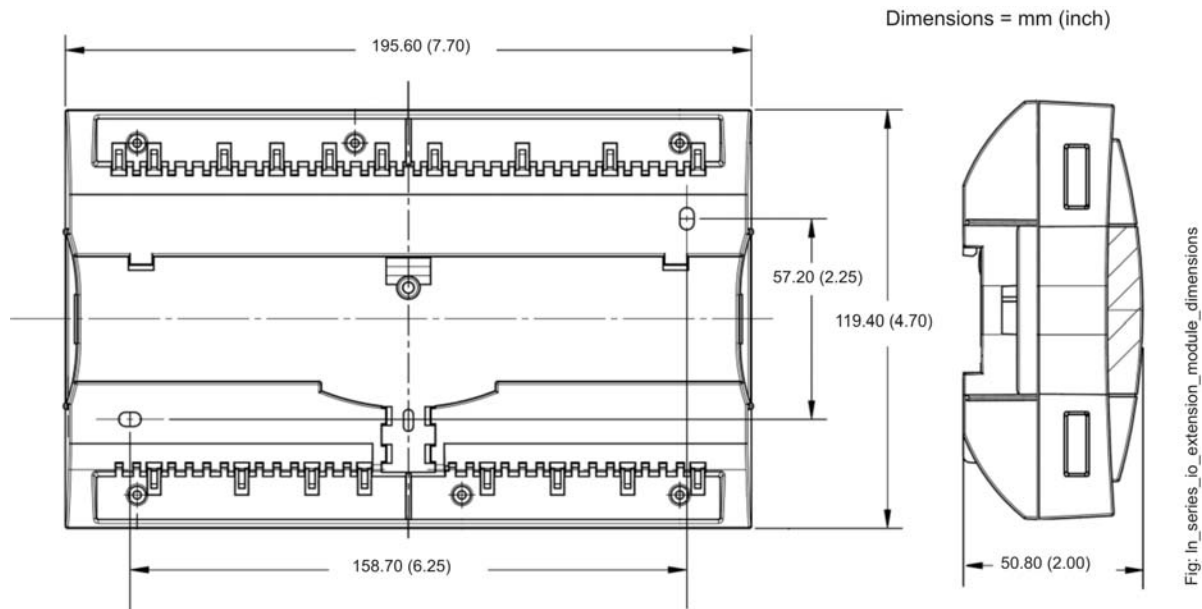
Johnson Controls

Dimensions = mm (inch)

195.60 (7.70)

57.20 (2.25)

119.40 (4.70)

158.70 (6.25)

50.80 (2.00)

Fig: ln_series_io_extension_module_dimensions

Figure 1: LN Series I/O Extension Module Dimensions, mm (in.)

Installation

Observe these guidelines when installing an I/O Extension Module:

- Transport the I/O Extension Module in the original container to minimize vibration and shock damage.

- Verify that all parts shipped with the I/O Extension Module.

- Do not drop the I/O Extension Module or subject it to physical shock.

Location Considerations

- Allow for proper clearance around the I/O Extension Module's enclosure, wiring terminals, and address switch to provide easy access for hardware configuration and maintenance.

- Orient I/O Extension Module with the ventilation slots and power supply/output terminal block connector towards the top to permit proper heat dissipation.

- Do not mount the I/O Extension Module on surfaces prone to vibration, such as duct work, or in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.

- Ensure proper ventilation of each I/O Extension Module and avoid areas where corroding, deteriorating, or explosive vapors, fumes, or gases may be present.

Mounting

You can mount the I/O Extension Module on a DIN Rail, on a wall, or in a panel. The I/O Extension Module is equipped with two mounting holes 0.25 x 0.165 in. (6.35 x 4.191 mm).

DIN Rail

To mount the module on a DIN rail:

1. Ensure the DIN rail is properly mounted on the wall.

2. Clip the module onto the DIN rail.

Wall Mount

To mount the module on a wall:

1. Press on the side clips to separate the module's front and back plates.

2. Use the holes on the back plate to mark the wall location.

3. Drill the holes.

4. Clean the surface and mount the module using the appropriate screws.

Typical Air Handling Unit Application Wiring Diagram

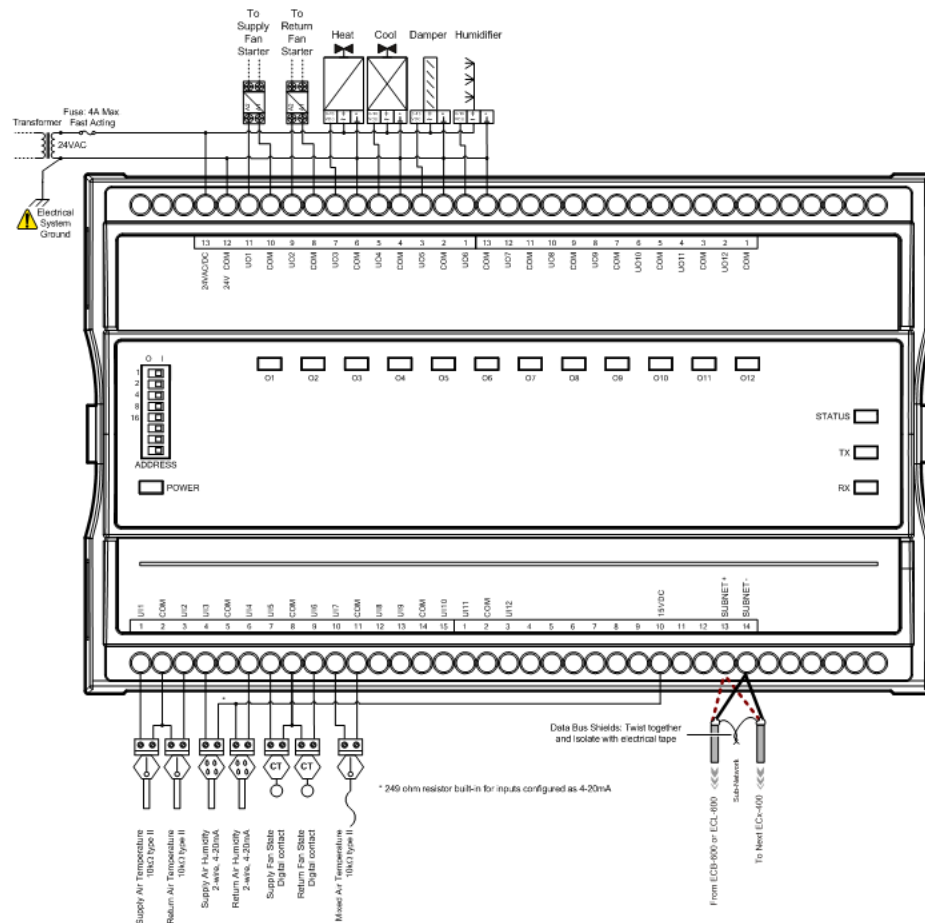Figure 2 shows a typical Air Handling Unit (AHU) application wiring diagram.

Figure 2: Typical Power and Network Connections for Air Handling Unit Application

Wiring

	CAUTION: Risk of Electric Shock. Disconnect the power supply before making electrical connections to avoid electric shock. **MISE EN GARDE : Risque de décharge électrique.** Débrancher l'alimentation avant de réaliser tout raccordement électrique afin d'éviter tout risque de décharge électrique.

Follow these wiring recommendations:

- Remove the front plate from the back plate to facilitate in the wiring process. Use a small flat screwdriver to tighten the terminal connector screws once the wires are inserted.

- Keep power cables apart from other types of wiring to avoid ambient noise transmission to other wires (for example, for power, 3-wire voltage, and current inputs and outputs).

- Use wires or flat cables ranging from 22 to 14 AWG (0.644 to 1.630 mm diameter) per pole. Power cables must remain between 18 to 14 AWG (1.024 to 1.630 mm) diameter.

- Do not connect the universal inputs, analog/digital outputs or common terminals to earth or chassis ground unless otherwise stated.
- Keep all wires away from high speed data transmission cables (for example, Ethernet cable).
- Keep input and output wires in conduits, trays, or close to the building frame whenever possible.

Power Wiring

> **IMPORTANT:** This is a Class 2 Product. Use a Class 2 transformer only (rated at 100 VA or less at 24 VAC) to power the controller.

Device power requirements for the LN Series I/O Extension Module is 24 VAC ±15%, Class 2.

For more information and requirements for powering an LN Series I/O Extension Module, refer to the *LONWORKS® LN-Series Network Communication and Interface Guide Technical Bulletin (LIT-12011253)*.

We recommend wiring only one controller per 24 VAC transformer. When only one transformer is available, determine the maximum number of controllers that can be supplied using the following method for calculating the required power transformer capacity:

1. Add up the maximum power consumption of all controllers, including external loads, and multiply this sum by 1.3.

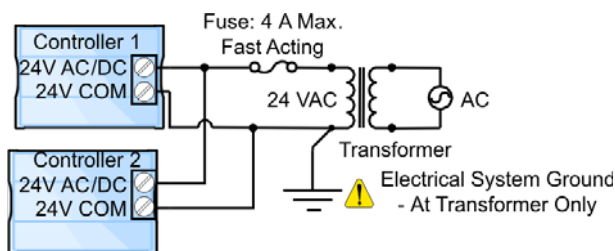2. If the resulting number is higher than 100 VA, use multiple transformers

Figure 3: Power Wiring – AC

Use an external fuse on the 24 VAC/DC side (secondary side) of the transformer to protect all controllers against power link spikes (Figure 3 and Figure 4).
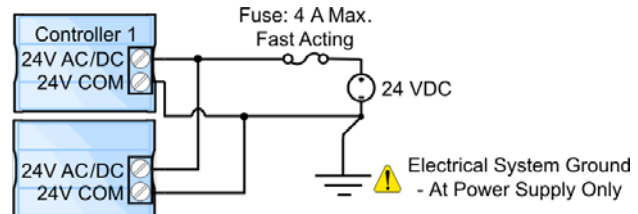

Figure 4: Power Wiring – DC

> **IMPORTANT:** Maintain consistent polarity when you connect the controllers and devices to the transformer.

> **IMPORTANT:** One terminal on the secondary side of the transformer must be connected to the building's ground. All 24 V COM terminals of all controllers and peripherals throughout the LAN or the subnetwork must be connected to the grounded transformer as shown in Figure 3 and Figure 4. This ensures that the 24 V COM terminals of all devices connected to any LAN or subnetwork in the building are at the same potential.

> **IMPORTANT:** The COM terminals of the controller are internally wired to the 24 V COM terminal of the power supply. Connecting a peripheral or another controller to the same transformer without maintaining polarity between these devices will cause a short circuit.

> **IMPORTANT:** A mechanical ground is unacceptable. Do not use a pipe, conduit, or duct work for a ground. The power supply must have a dedicated ground wire that comes from the main electrical supply panel.

Input Wiring

Each I/O Extension Module has physical connections for inputs (marked Ulx), which are software configurable from within the device's LNS® plug-in or wizard. Each input can be configured for digital, resistive, current, or voltage signals. You must configure the input types properly in the software plug-in or wizard to ensure proper input readings. The physical connections for inputs are marked as Ulx.

> **IMPORTANT:** Before you connect input equipment to the extension module, refer to the installation instructions from the equipment manufacturer.

Note: For wire length less than 75 feet (23 m), use a shielded or unshielded 18 AWG wire.

Note: For a wire up to 200 feet (61 m) long, a shielded 18 AWG wire is recommended.

Note: The wire should be shielded on the I/O Extension Module side and the shield length should be kept as short as possible.

Wiring Digital Inputs

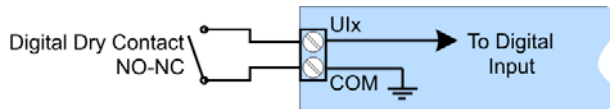Use this input configuration to monitor digital dry contacts, as well as pulsed contacts.

Figure 5: Digital Input – Digital Dry Contact (N.O. and N.C.)

Wiring Resistive Inputs

Use this input configuration to monitor Resistance Temperature Detectors (RTD), thermistors, such as 1,000 ohm RTDs to 10k ohm Type II and Type III thermistors, and potentiometers, such as 10k ohm and 100k ohm.
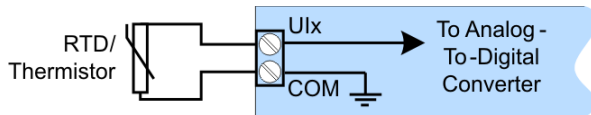
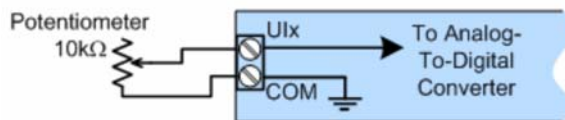

Figure 6: Resistive Input – RTD/Thermistor Input

Figure 7: Resistive Input – 10k ohm Potentiometer Input

Wiring Current Inputs

Current inputs have a range of 0 to 20 mA. Set the jumper to the 0 to 20mA position for all current inputs. This setting provides the required 249 ohm resistance for the controller's current inputs. Depending on the transducer power requirements, you may use any of the following input configurations. Use Figure 8 for the 2-wire, 0 to 20 mA transducer powered by the controller's internal 15 VDC power supply.
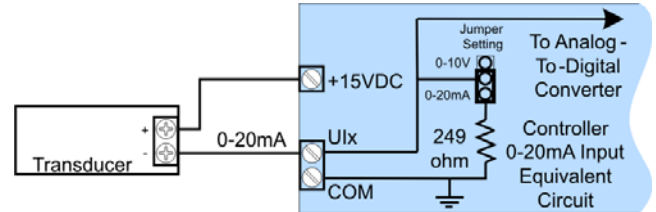

Figure 8: Current Input – 2-Wire Transducer Powered by the Controller

Use the Figure 9 configuration for a 2-wire, 0 to 20 mA transducer powered by an external 24 AC/DC power supply.
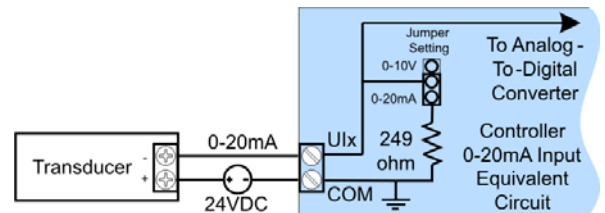

Figure 9: Current Input – 2-Wire Transducer, Externally Powered

Use the Figure 10 configuration for a 3-wire, 0 to 20 mA transducer powered by an external 24 AC/DC power supply.
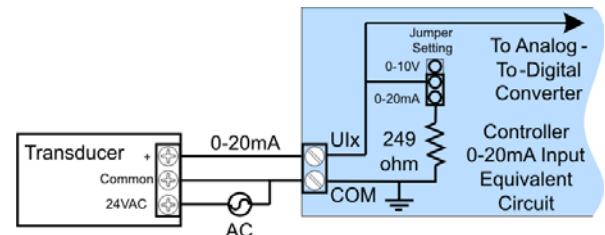

Figure 10: Current Input – 3-Wire Transducer, Externally Powered

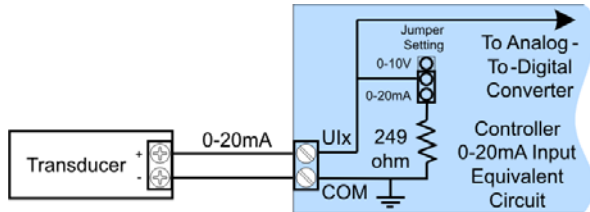Use the Figure 11 configuration for a transducer powered by its own power source.

Figure 11: Current Input – Transducer with Its Own Power Source

Wiring Voltage Inputs

Voltage inputs have a range of 0 to 10 VDC or 0 to 5 VDC. Connect the voltage input according to Figure 12 if you are using a 3-wire 0 to 10 V or 0 to 5 V transducer.
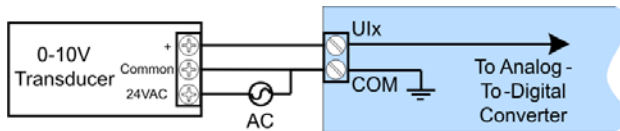

Figure 12: Voltage Input – 3-Wire Transducer

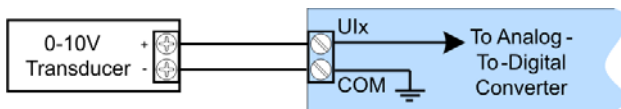Connect the voltage input according to Figure 13 if the transducer is powered by its own power source.

Figure 13: Voltage Input – Transducer with Its Own Power Source

Wiring Pulse Inputs

The pulse inputs support a maximum input frequency of 1 Hz (500 ms minimum ON/OFF) or 50 Hz (10 ms minimum ON/OFF). Connect the pulse input according to Figure 14 for a pulse meter that can pull down a +5 VDC supply with a 10k ohm pull-up resistor (internal supply type).
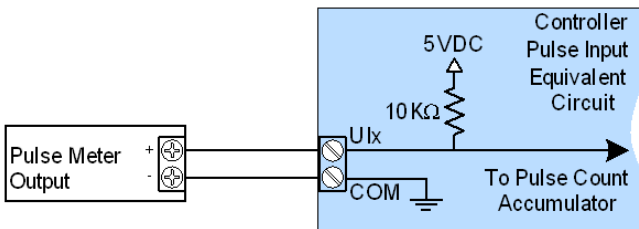

Figure 14: Internal Supply, 2-wire Pulse Meter

Output Wiring

Each extension module has physical connections for universal outputs. These outputs are all software configurable.

> **IMPORTANT:** Before you connect output equipment to the extension module, refer to the installation instructions from the equipment manufacturer.

Output Wiring Recommendations

Output wiring recommendations include:

- For a wire length less than 75 feet (23 m) long, use either a shielded or unshielded 18 AWG wire.

- For a wire length up to 200 feet (61 m) long, use a shielded 18 AWG wire.

- The shield of the wire should be grounded on the controller side and the shield length should be kept as short as possible.

Wiring Universal Outputs (UOx)

You can configure universal outputs to provide either a discrete signal of 0 or 12 VDC, a linear signal ranging from 0 to 10 VDC, or a 0 to 20 mA signal. The discrete signal can be used to generate a pulse wave modulation (PWM) signal or a simple two-state signal. These outputs are protected by an auto-reset fuse.

Wiring Discrete Outputs

If a 12 VDC relay is being controlled, connect it to a universal output according to Figure 15.
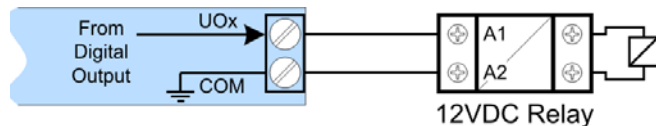

Figure 15: Discrete 0 or 12 VDC Universal Output – Relay

Wiring Current Outputs

The 0 to 20 mA signal is configurable by jumper (Figure 16).
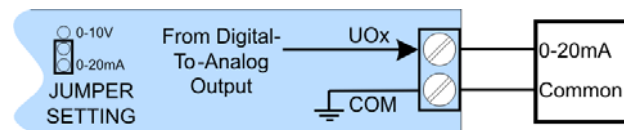

Figure 16: 0 to 20 mA Universal Output and Jumper Configuration

Voltage Outputs

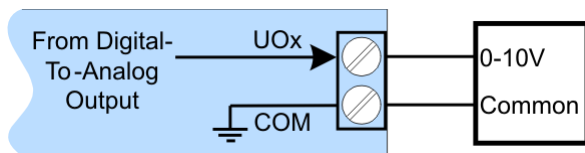Connect the 0 to 10 VDC as shown in Figure 17.

Figure 17: Voltage 0 to 10 VDC Universal Output

If you are controlling an analog actuator, connect the 0 to 10 VDC output, along with an external 24 VAC power source, to the analog actuator (Figure 18).
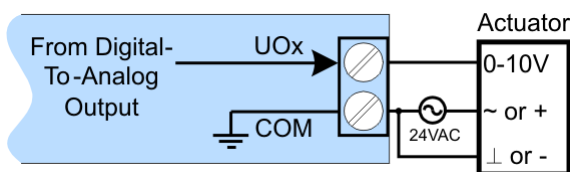
Figure 18: Voltage 0 to 10 VDC Universal Output – Analog Actuator

Subnetwork Communications Wiring with the LN-PRG6x0-xx Controller

LN-IOE400 Series I/O Extension Modules are connected to the **Subnet-** and **Subnet+** terminals of the LN-PRG6x0-xx controllers.

For optimal performance, use 24 AWG (0.65 mm) stranded, twisted pair shielded cable. The subnetwork communication wire is polarity sensitive and the only acceptable topology is to daisy-chain the cable from one I/O Extension Module to the next.

For more information on subnetworks for the LN-IOE400 Series Extension Modules and LN-PRG6x0-xx controllers, refer to the *LONWORKS LN Series Network Communication and Interface Guide Technical Bulletin (LIT-12011253)* and the *LN Series Input/Output Extension Modules and Communicating Sensors Subnetwork for LN-VAVCF-12 and LN-PRGxxx-12 Application Note (LIT-12011815)*.

Subnet Bus Shielding Recommendations

- When the subnetwork data bus is connected to a following device, twist data bus shields together.

- Isolate all shields with electrical tape so there is no exposed metal that can touch ground or other conductors.

- Connect the shield of the data bus to the electrical system ground at only one point, usually at one end of the bus as shown in Figure 19

As shown in Figure 20, Figure 21, and Figure 22:

- The first and last daisy-chained subnetwork device must have its EOL resistors enabled. All other devices must have their EOL resistor disabled.

- The I/O Extension Module and the LN-SVSENx-0 share the same subnetwork.

Refer to the *LN Series Input/Output (I/O) Extension Modules Subnetwork Application Note (LIT-12011706)* for additional information.

About the Subnetwork Bus

The LN Free Programmable PRG 600 Series controllers use the Subnetwork bus to support the LN-IOE400 Series Extension Modules through 2-wire shielded cable.

The LN-PRG6x0-xx Controllers also use the subnetwork bus to support one or more LN-SVSENx-0 Communicating Sensors using standard structural cabling.
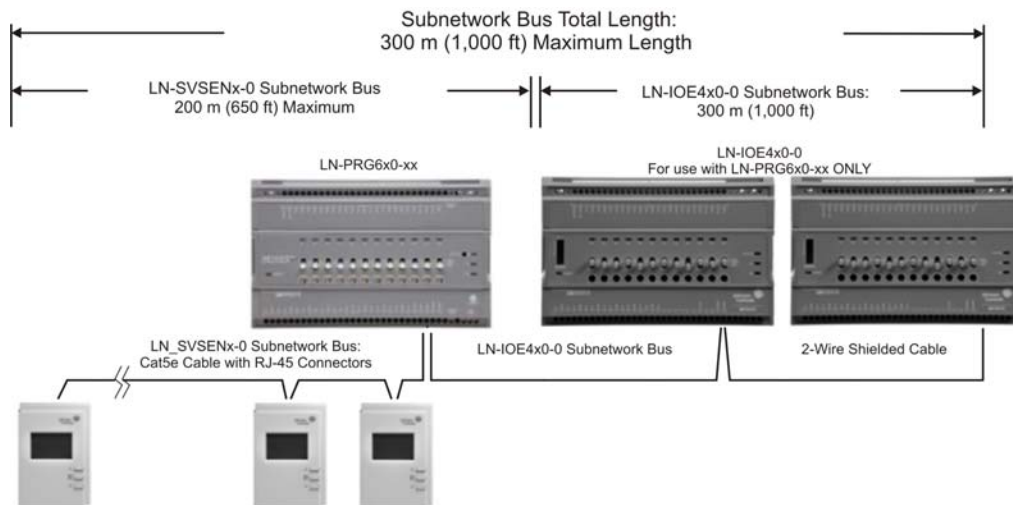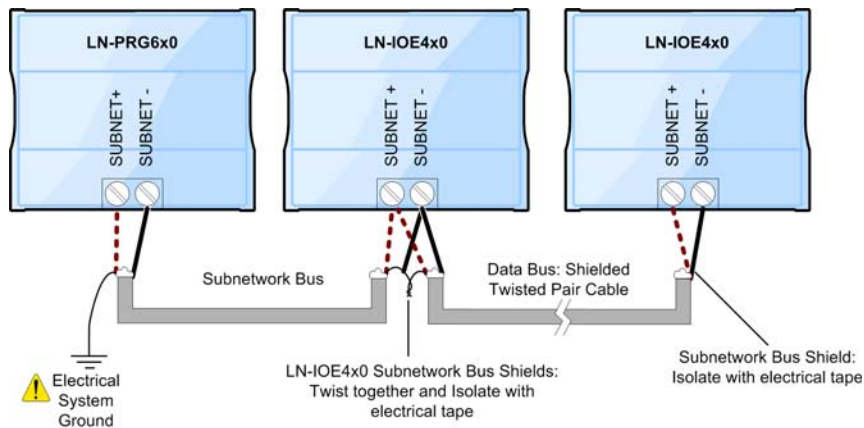
Subnetwork Bus Total Length

The total maximum length of all subnetwork buses, including both the length of the LN-SVSENx-0 Sensors subnetwork bus and the LN-IOE4x0-0 subnetwork bus is 1,000 ft (300 m). The maximum length of the LN-SVSENx-0 subnetwork bus is 650 ft (200 m). The maximum length of the LN-IOE4x0-0 subnetwork bus is 1,000 ft (300 m). See Figure 20.

Subnetwork Bus Topology and EOL Terminations with the LN-PRG6x0-xx Controllers

When the LN-IOE400 Series Extension Modules are installed with LN-PRG6x0-xx controllers, only the EOL terminations of LN-PRG6x0-xx controller and the last I/O Extension Module are set to ON. All other I/O Extension Modules must have their EOL terminations set to OFF. See Figure 21.

When the LN-IOE400 Series Extension Modules are installed with an LN-PRG6x0-xx controller and with LN-SVSENx-0 sensor(s), only the EOL terminations on the last I/O Extension Module and the last LN-SVSENx-0 sensor are set to ON. The LN-PRG6x0-xx controller and all other I/O Extension Modules and LN-SVSENx-0 sensors must have their EOL terminations set to OFF. See Figure 22.

Figure 19: Subnetwork Bus Shielding

Figure 20: Subnetwork Bus Overview Showing the LN-SVSENx-0 Subnetwork Bus and the LN-IOE4x0-0 Subnetwork Bus
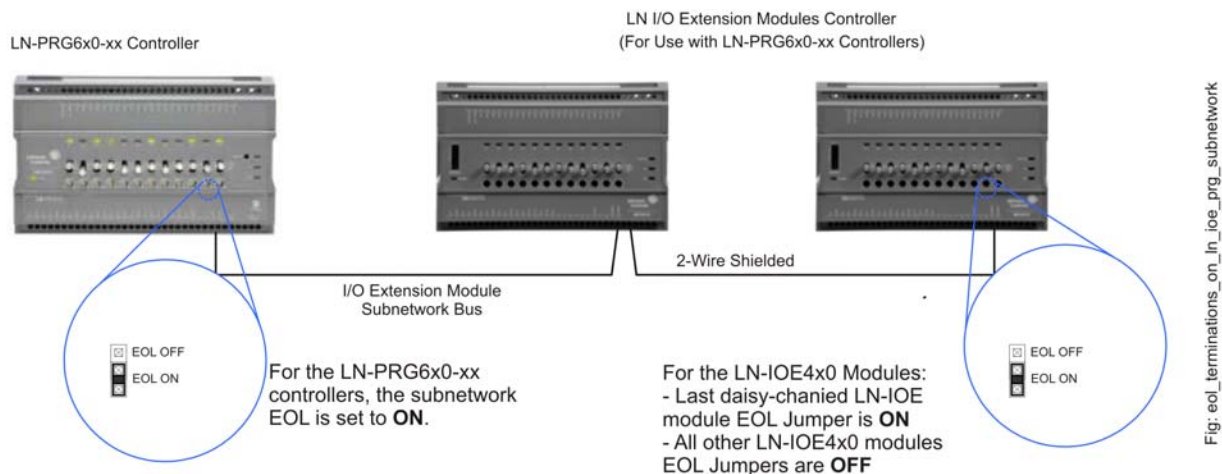
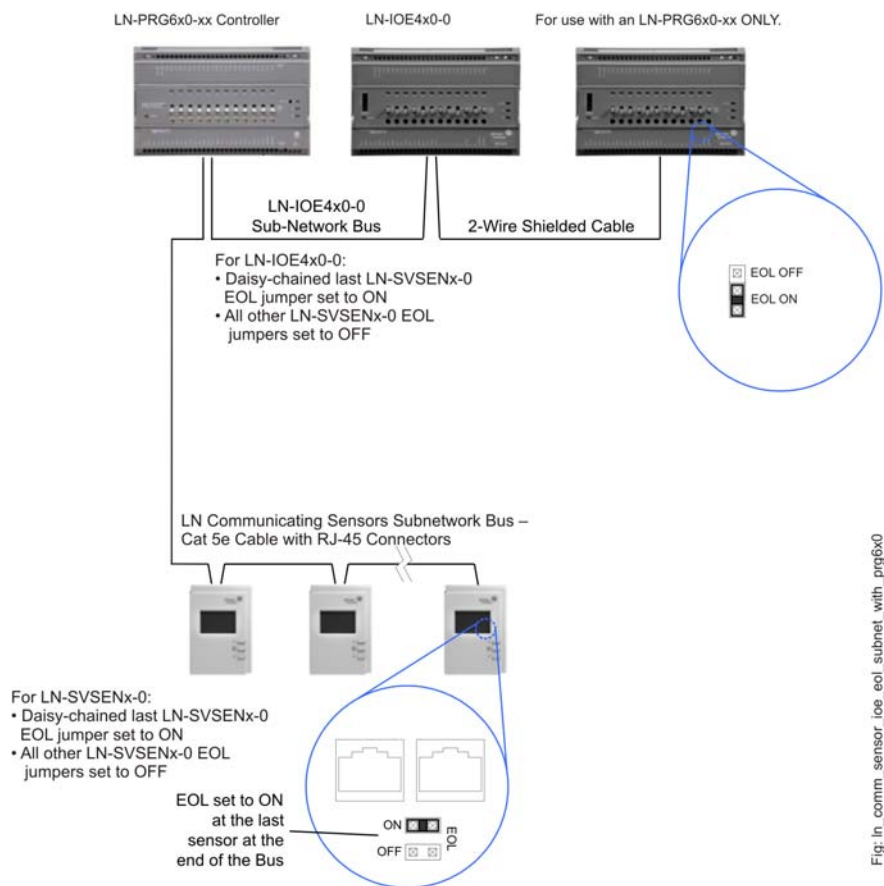**Figure 21: Setting the EOL Terminations on the Subnetwork Bus**

Figure 22: Setting the EOL Terminations on the LN-IOE4x0-0 Subnetwork Bus When LN-SVSENx-0 Sensors Are Used

If you are inserting multiple wires in the terminals, properly twist wires together prior to inserting them in the terminal connectors. For more information on network topology and wire length restrictions, refer to *The LONWORKS LN-Series Network Communication and Interface Guide Technical Bulletin (LIT-12011253)*.

Setup and Adjustments

I/O Extension Module Addressing

Using the DIP switch located on the faceplate, you must set the Subnet ID Address 1 or 2. Figure 23 shows an example of how to set the device's Subnet ID Address DIP switch.

The address is the sum of the numbers set to ON. For example, if the second DIP switch is set to ON, the I/O Extension Module address is 2. You must power cycle the I/O Extension Module after the Subnet ID DIP Switch change.

Strain Relief and Terminal Block Cover

In certain jurisdictions, terminal block covers are required to meet local safety regulations. Strain reliefs and terminal block covers are available for controllers housed in large enclosures and are used to relieve tension on the wiring and conceal the controllers' wire terminals. Strain reliefs and terminal block covers are optional and are sold separately.

Figure 23: Typical I/O Extension Module DIP Switch Set to 2

Figure 24: Large Enclosure Strain Relief and Terminal Block Cover Installation

Maintenance

> ⚠️ **CAUTION: Risk of Electric Shock.**
> Disconnect the power supply before making any electrical connections to avoid electric shock.
>
> **MISE EN GARDE : Risque de décharge électrique.**
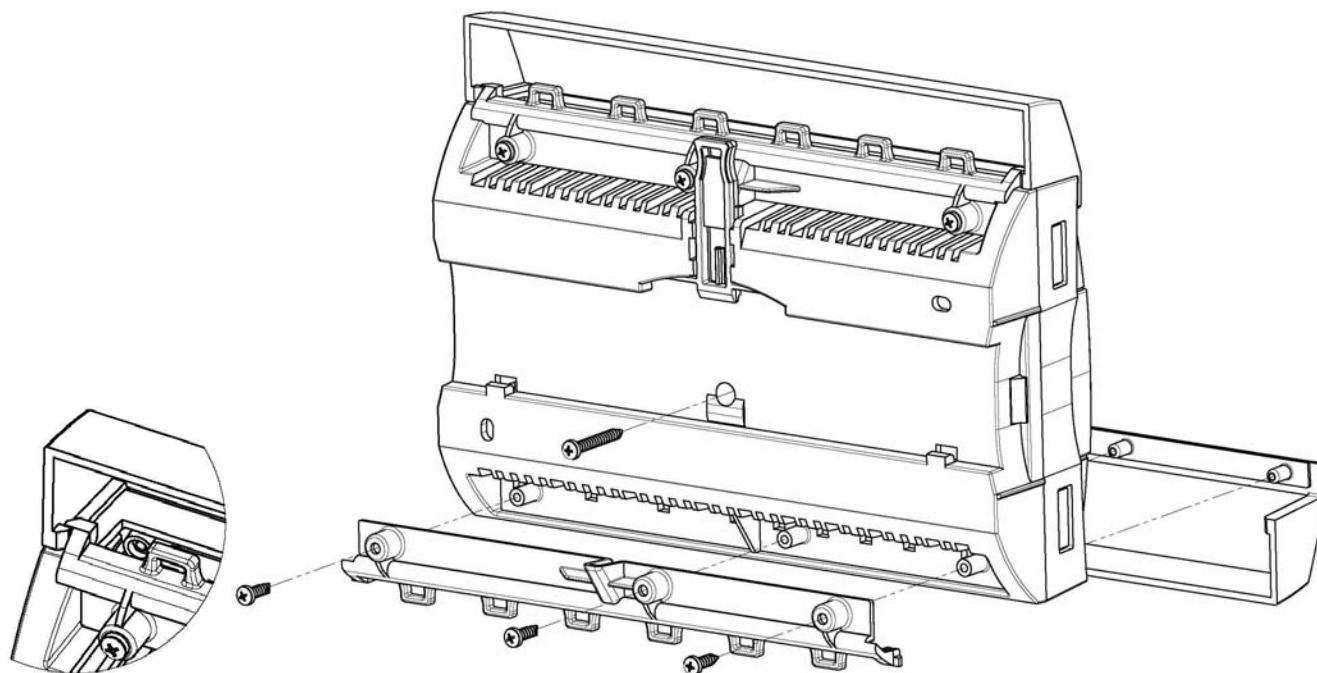> Débrancher l'alimentation avant de réaliser tout raccordement électrique afin d'éviter tout risque de décharge électrique.

Each controller requires minimal maintenance, but it is important to:

- clean the outside of the front plate and the inside of the back plate with a dry cloth.

Troubleshooting

Table 1 describes some troubleshooting scenarios.

- verify the tension of all wires and cables each time you service the controller.

Disposal

The Waste Electrical and Electronic Equipment (WEEE) Directive sets regulations for the recycling and disposal of products. The WEEE 2002/96/EG Directive applies to stand-alone products that can function on their own and are not a part of another system or piece of equipment. For this reason, Johnson Controls® products are exempt from the WEEE Directive.

Nevertheless, they are marked with the WEEE symbol, indicating the devices are not disposed with municipal waste.

Dispose of products at the end of their useful life according to local regulations and the WEEE Directive.

Table 1:   Troubleshooting (Part 1 of 2)

Problem	Possible Solution
Controller is powered but does not turn on.	
Fuse Is Blown	Disconnect power from the controller and check the fuse integrity. Reconnect power.
Power Supply Polarity	Verify that consistent polarity is maintained between all controllers and the transformer. Ensure that the COM terminal of each controller is connected to the same terminal on the secondary side of the transformer. See Figure 3 and Figure 4.
I/O Extension Module cannot communicate on the subnetwork.	
Absent or Incorrect Supply Voltage	1. Check power supply voltage between 24 VAC/DC ±15% and COM pins, and ensure that it is between acceptable limits. 2. Check for tripped fuse or circuit breaker.
Overloaded Power Transformer	Verify the transformer is powerful enough to supply all controllers. See *Power Wiring*.
Network Not Wired Properly	Check that the wire connections are correct.
Absent or Incorrect Network Termination	Check the network terminations. Only the last LN-IOE4x0-0 Extension Module must have it EOL termination set to ON. See Figure 21. When one or more LN-SVSENx-0 sensors are connected to the controller, only the last LN-SVSENx-0 must have its EOL termination set to ON. See Figure 22.
There is another controller with the same Subnet ID on the subnetwork	Each I/O Extension Module on the subnetwork must have a unique Subnet ID. Look at the Subnet ID DIP switch on the faceplate of each I/O Extension Module.
Network length	Check that the total wire length does not exceed specifications. Refer to the *LN Series Input/Output (I/O) Extension Modules Subnetwork Application Note (LIT-12011706)*.
Wire type	Check that the wire type agrees with specifications. Refer to the *LN Series Input/Output (I/O) Extension Modules Subnetwork Application Note (LIT-12011706)*.
Hardware input is not reading the correct value.	
Input Wiring Problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.

Table 1: Troubleshooting (Part 2 of 2)

Problem	Possible Solution
Open Circuit or Short Circuit	Using a voltmeter, check the voltage on the input terminal. A short circuit has a 0 V value and an open circuit has a 5 V value.
Configuration Problem	Check the configuration of the input using the controller configuration plug-in or wizard. Refer to the online help for more information.
Over Voltage or Over Current at an Input	An over voltage or over current at one input can affect the reading of other inputs. Observe the allowed voltage/current range limits for all inputs.
Hardware output is not operating correctly.	
Fuse has blown (auto reset fuse)	Disconnect the power and outputs terminals. Then wait a few seconds to allow the auto-reset fuse to cool down. Check the power supply and the output wiring if necessary. Reconnect the power.
Output Wiring Problem	Check that the wiring is correct according to this manual and according to the peripheral device's manufacturer.
Configuration Problem	Using the controller configuration wizard (LN-GPI), check the configuration of the input. Refer to the controller's user guide for more information.
0 to 10 V Output, 24 VAC Powered Actuator is Not Moving	Check the polarity of the 24 VAC power supply connected to the actuator while connected to the controller. Reverse the 24 VAC wire if necessary.
Rx/Tx LEDs	
Rx LED not Blinking	Data is not being received from the Subnetwork bus.
Tx LED not Blinking	Data is not being transmitted onto the Subnetwork bus.

Status LED Operation

Table 2:   Status LED Operation Guide – Normal Operation

Operation	Service
Fast Blink Continuous ● ● ● ● ● **(150 ms On, 150 ms Off, Continuous)**	• Initialization: the device is starting up. • Firmware upgrade in is progress and the controller operation is temporarily unavailable. The new firmware is being loaded into memory and the process takes a few seconds. Do not interrupt power to the device during this time.
Solid ON	Firmware upgrade in is progress and the controller operation is temporarily unavailable. The new firmware is being loaded into memory and the process takes a few seconds. Do not interrupt power to the device during this time.
The Status LED is Always OFF	The controller is operating normally.

Table 3:   Status LED Operation Guide – Repeats every 2 seconds (highest priority first)

Operation	Service
Long blink continuous **(1s On, 1s Off, Continuous)** ━ ━ ━ ━ ━	The controller is not configured. Appropriate action: Commission the controller.
Long Long Long Blink **(800 ms On, 300 ms Off, 800 ms On, 300 ms Off, 800 ms Off)** ━ ━ ━	The controller is offline. Appropriate action: Verify that the: • I/O Extension Module's Subnet ID Address is correctly set. See *Setup and Adjustments*. • Subnetwork bus cable is not cut, short-circuited, or too long. See *Subnetwork Communications Wiring with the LN-PRG6x0-xx Controller*. • Associated LN-PRG6x0-12 controller has power.

Repair Information

If the LN Series I/O Extension Module fails to operate within its specifications, replace the unit. For a replacement controller, contact the nearest Johnson Controls® representative.

Technical Specifications

LN-IOE4x0-0 Series (Part 1 of 2)

Product Code	LN-IOE400-0, LN-IOE410-0, LN-IOE420-0
Power Requirements	**Voltage:** 24 VAC/DC; ±15%, 50/60 Hz, Class 2
	Protection: 3.0 A user-replaceable fuse
	Power Consumption: 22 VA typical plus all output loads; LN-IOE400-0, LN-IOE410-0: 50 VA maximum; LN-IOE420-0: 16 VA maximum; 10 VA typical on all loads
Communication	**Communication Bus:** RS-485
	Baud Rate: 38, 400 bps
	Addressing: DIP switch
Environmental	**Operating Temperature:** 0 to 50°C, (32 to 122°F)
	Storage Temperature: -20 to 50°C, (-4 to 122°F)
	Relative Humidity: 0 to 90% noncondensing
General	**Processor:** STM32 (ARM Cortex™ M3) MCU, 32 bit
	Processor Speed: 64 MHz
	Clock: Real-time clock chip
	Battery for Clock: CR2032 lithium battery
	Memory: 64 KB Nonvolatile Flash (applications and storage); 20 KB RAM
	Status Indicator: Green LED – power status and subnetwork TX, Orange LED – service and subnetwork RX
Enclosure	**Material:** FR/ABS
	Dimensions (with screws): 7.7 x 4.7 x 2.0 in. (195.6 x 119.4 x 50.8 mm)
	Shipping Weight: 1.17 lbs (0.53 kg)
Inputs	**Number of Inputs:** 12
	LN-SVSENx-0 Sensors: 12
	Input Types: universal software configurable
	Voltage: 0 to 10 VDC (40k ohm input impedance)
	0 to 5 VDC (high input impedance)
	Current: 0 to 20 mA with 249 ohm jumper configurable internal resistor
	Digital: dry contact
	Pulse: 1 Hz maximum, 500 ms On/500 ms off; dry contact
	Resistor Support: 0 to 350k ohms. All thermistor types that operate within this range are supported. The following temperature sensors are pre-configured:
	Thermistor:
	Type 2 and Type 3 10k ohm (10k ohm at 25°C [77°F])
	Platinum:
	PT1000 1k ohm (1k ohm at 0°C [32°F])
	Nickel:
	RTD Ni1000 (1k ohm at 0°C [32°F])
	RTD Ni1000 (1k ohm at 21°C [69.8°F])
	Input Resolution: 16-bit analog/digital converter
	Power Supply Output: 15 VDC; maximum 200 mA (16 inputs x 20 mA each)

Outputs	**Universal Outputs:** 12
	Universal Output Characteristics:
	0 to 10 VDC linear; digital 0 to12 VDC (on/off), PWM, floating, or 0 to 20 mA (jumper configurable); software configurable.
	PWM control: adjustable period from 2 to 15 minutes
	Floating control:
	minimum plus on/off: 500 ms
	adjustable drive time period
	HOA: Hands-Off-Auto switch (when equipped)
	Hand position potentiometer range: 0 – 12.5 VDC
	60 mA maximum at 12 VDC (60°C; 140°F)
	Load Resistance: minimum resistance 200 ohms for 0 to 10 VDC and 0 to 12 VDC, maximum 500 ohm for 0 to 20 mA output
	Auto reset fuse
	60 mA at 60°C (140°F)
	100 mA at 20°C (68°F)
	Output Resolution: 10-bit digital/analog converter
Electromagnetic Compatibility	**CE Emission:** EN61000-6-3: 2007 Generic standards for residential, commercial, and light-industrial environments (pending).
	CE Immunity: EN61000-6-1: 2007; Generic standards for residential, commercial, and light-industrial environments (pending).
Compliance:	
United States	UL Listed, File E107041, CCN PAZX, Under UL 916, Energy Management Equipment
	FCC Compliant to CFR 47, Part 15, Subpart B, Class A
Canada	UL Listed, File E107041, CCN PAZX7, Under CAN/CSA C22.2 No. 205, Signal Equipment
	Industry Canada, ICES-003
Europe CE	CE Mark – Johnson Controls, Inc., declares that the products are in compliance with the essential requirements and other relevant provisions of the EMC Directive 2004/108/EC.

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