Metasys System FEC1611 and FEC1621 Field Equipment Controller Installation Guide

Part No. 24-10143-136 Rev. N

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Application

The FEC16 Field Equipment Controller (FEC) is part of the *Metasys*® system Field Equipment Controller family. The FEC16 controller runs pre-engineered and user-programmed applications and provides the inputs and outputs required to monitor and control a wide variety of HVAC equipment.

The FEC controllers can communicate using either BACnet MS/TP or N2 communications protocols. These controllers used as MS/TP devices operate on an RS-485 BACnet® MS/TP Bus as BACnet Application Specific Controllers (B-ASC) and integrate into Johnson Controls® and third-party BACnet systems.

With Release 10.1, you can use the Controller Configuration Tool (CCT) 13.0 and later software to switch the FEC to use the N2 protocol.

The FEC16 controller is available with or without an integral LCD and push-button user interface.

Communications protocol

The *Metasys*® system FEC Family Controllers and network sensors communicate using either the standard BACnet protocol, based on the ANSI/ASHRAE 135-2008, or the BACnet/IP protocol. The BACnet protocol is a standard for ANSI, ASHRAE, and the International Standards Organization (ISO) for building controls.

FEC, VMA16, VMA18, and most IOM field controllers are BTL-listed as BACnet Application Specific Controllers (B-ASCs). FAC field controllers and the VMA1930 Field Controller are BTL-listed as BACnet Advanced Application Controllers (B-AACs).

Release10.1 and later of the Controller Configuration Tool (CCT) can be used to switch Field Bus communications protocol in supported FAC, FEC, and VMA controllers to be either the standard BACnet MS/TP or the N2 protocol. All new controllers use either BACnet MS/TP as the default communications protocol, or BACnet/IP. Switchable communications protocols in the MS/TP models provide a cost-effective upgrade and modernization path for customers with existing N2 controllers.

North American emissions compliance

United States

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area may cause harmful interference, in which case the users will be required to correct the interference at their own expense.

Canada

This Class (A) digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulations.

Cet appareil numérique de la Classe (A) respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

Installation

Observe these guidelines when installing a field controller:

- Transport the controller in the original container to minimize vibration and shock damage.
- Verify that all parts shipped with the controller.
- Do not drop the controller or subject it to physical shock.

Parts included

- One field controller with removable terminal blocks
- One installation instructions sheet

Materials and special tools needed

- Three fasteners appropriate for the mounting surface (M4 screws or #8 screws)
- One 20 cm (8 in.) or longer piece of 35 mm DIN rail and appropriate hardware for DIN rail mount (only)
- Small straight-blade screwdriver for securing wires in the terminal blocks

Mounting

Observe these guidelines when mounting a field controller:

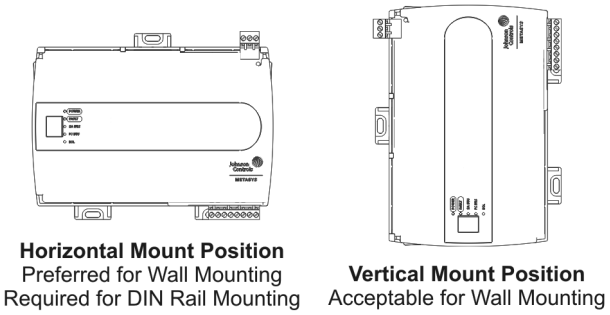
- Ensure the mounting surface can support the controller, DIN rail, and any user-supplied enclosure.
- Mount the controller horizontally on 35 mm DIN rail whenever possible.
- Mount the controller in the proper mounting position (Figure 1).
- Mount the controller on a hard, even surface whenever possible in wall-mount applications.
- Use shims or washers to mount the controller securely and evenly on the mounting surface.
- Mount the controller in an area free of corrosive vapors and observe the Ambient Conditions requirements in Table 10.

- Provide for sufficient space around the controller for cable and wire connections for easy cover removal and good ventilation through the controller (50 mm [2 in.] minimum on the top, bottom, and front of the controller).
- Do not mount the controller on surfaces prone to vibration, such as duct work.
- Do not mount the controller in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.

Observe these additional guidelines when mounting a controller in a panel or enclosure:

- Mount the controller so that the enclosure walls do not obstruct cover removal or ventilation through the controller.
- Mount the controller so that the power transformer and other devices do not radiate excessive heat to the controller.
- Do not install the controller in an airtight enclosure.

Figure 1: Field Controller mounting positions



Horizontal Mount Position
Preferred for Wall Mounting
Required for DIN Rail Mounting

Vertical Mount Position
Acceptable for Wall Mounting

DIN rail mount applications

Mounting the controller horizontal on 35 mm DIN rail is the preferred mounting method.
To mount a field controller on 35 mm DIN rail:

1. Securely mount a 20 cm (8 in.) or longer section of 35 mm DIN rail horizontal and centered in the desired space so that the controller mounts in the horizontal position shown in Figure 1.
2. Pull the two bottom mounting clips outward from the controller to the extended position (Figure 2).
3. Hang the controller on the DIN rail by the hooks at the top of the (DIN rail) channel on the back of the controller (Figure 2), and position the controller snugly against the DIN rail.
4. Push the bottom mounting clips inward (up) to secure the controller on the DIN rail.

To remove the controller from the DIN rail, pull the bottom mounting clips out to the extended position and carefully lift the controller off the DIN rail.

Wall mount applications

To mount a field controller directly on a wall or other flat vertical surface:

1. Pull the two bottom mounting clips outward and ensure they are locked in the extended position as shown in Figure 2.
2. Mark the three mounting hole locations on the wall using the dimensions in Figure 2 and one of the mount positions shown in Figure 1. Or hold the controller up to the wall or surface in a proper mount position and mark the hole locations through the mounting clips.
3. Drill holes in the wall or surface at the locations marked in Figure 2, and insert appropriate wall anchors in all of the mounting holes (if necessary).
4. Hold the controller in place, and insert the screws through the mounting clips and into the holes (or anchors). Carefully tighten all of the screws.

➤ **Important:** Do not overtighten the mounting screws. Overtightening the screws may damage the mounting clips.

Figure 2: Back of Controller showing extended mounting clips, DIN rail channel, and mounting dimensions, mm (in.)

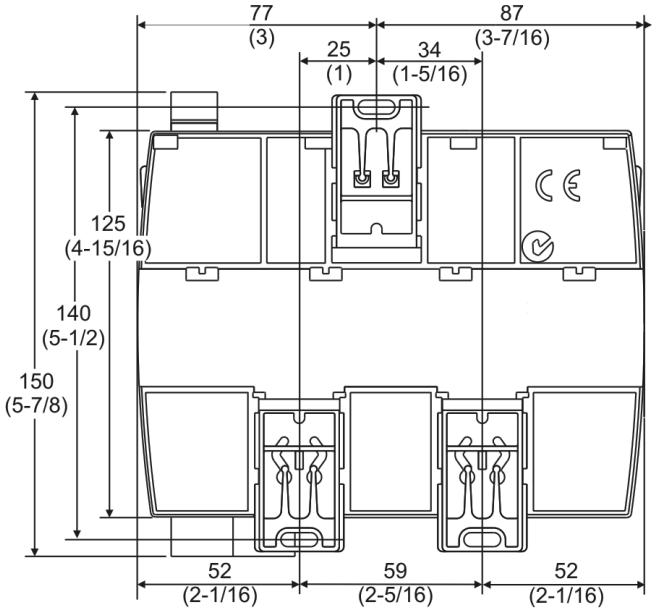


Figure 3: FEC1621 physical features

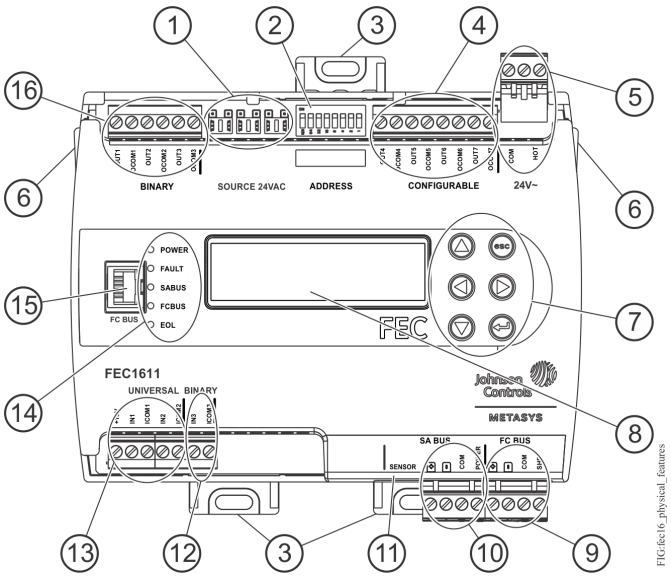


Table 1: FEC1621 physical features callouts and descriptions

	Physical feature: description and references
1	Binary Output (BO) Source Power Selection Jumpers (see Binary Output (BO) source power selection jumpers)
2	Device Address DIP Switch Block (see Figure 9)
3	Mounting Clip
4	Configurable Output (CO) Terminal Blocks (see Table 2)
5	24 VAC, Class 2 Supply Power Terminal Block (see Figure 6)
6	Cover Lift Tab (One of Two) (see Figure 3)
7	Display Navigation Buttons (see Setting up an integral or local display) **Note:** Not available on all FEC models.
8	LCD Display Area (see Setting up an integral or local display) **Note:** Not available on all FEC models.
9	FC Bus Terminal Block (see FC bus terminal block)
10	Sensor Actuator (SA) Bus Terminal Block (see SA bus terminal block)
11	Sensor Port (Sensor Actuator [SA] Bus, RJ-12 6-pin Modular Jack) (see Figure 6)
12	Binary Inputs (BIs) Terminal Block (see Table 2)
13	Universal Inputs (UIs) Terminal Blocks (see Table 2)
14	LED Status Indicators (see Table 8)
15	Field Controller (FC) Bus Port (RJ-12 6-pin Modular Jack) (see Figure 6)
16	Binary Output (BO) Terminal Block (see Table 2)

Wiring

CAUTION

Risk of Electric Shock

Disconnect the power supply before making electrical connections to avoid electric shock.

ATTENTION

Risque de décharge électrique

Débrancher l'alimentation avant de réaliser tout raccordement électrique afin d'éviter tout risque de décharge électrique.

CAUTION

Risk of Property Damage

Do not apply power to the system before checking all wiring connections. Short circuited or improperly connected wires may result in permanent damage to the equipment.

ATTENTION

Risque de dégâts matériels

Ne pas mettre le système sous tension avant d'avoir vérifié tous les raccords de câblage. Des fils formant un court-circuit ou connectés de façon incorrecte risquent d'endommager irrémédiablement l'équipement.

- **Important:** Do not exceed the controller electrical ratings. Exceeding controller electrical ratings can result in permanent damage to the controller and void any warranty.
- **Important:** Use copper conductors only. Make all wiring in accordance with local, national, and regional regulations.
- **Important:** Electrostatic discharge can damage controller components. Use proper electrostatic discharge precautions during installation, setup, and servicing to avoid damaging the controller.

For detailed information on configuring and wiring an MS/TP Bus, FC bus, and SA bus, refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)*. For

detailed information on wiring an N2 bus, refer to the *N2 Communications Bus Technical Bulletin (LIT-636018)*.

FEC terminal blocks and bus ports

See Figure 3 for terminal block and bus port locations on the FEC16 controller. Observe the following guidelines when wiring a controller.

Input and Output terminal blocks

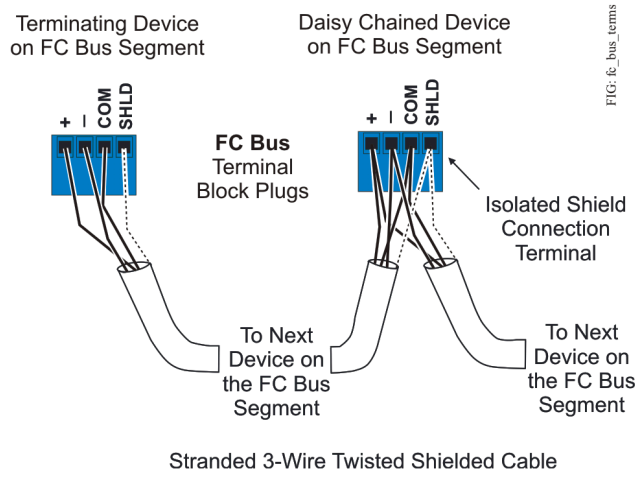
All of the fixed input terminal blocks are mounted on the bottom of the controller and the output terminal blocks are mounted on the top of the controller. See Table 2 for more information about I/O terminal functions, requirements, and ratings.

FC bus terminal block

The FC Bus terminal block is a blue, removable, 4-terminal plug that fits into a board-mounted jack.

Wire the removable FC bus terminal block plugs on the controller, and other controllers in a daisy-chain configuration using 3-wire twisted, shielded cable as shown in Figure 4. See Table 4 for more information.

Figure 4: FC bus terminal block wiring



Stranded 3-Wire Twisted Shielded Cable

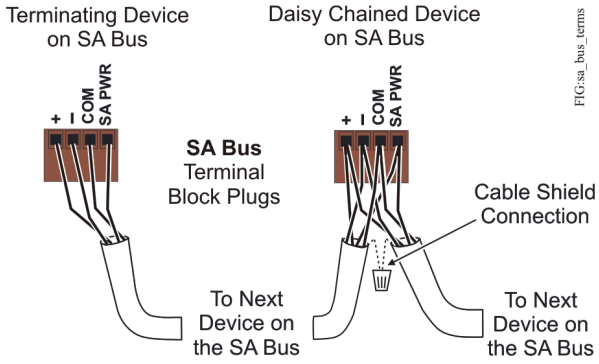
Note: The FC bus Shield (SHLD) terminal is isolated and can be used to connect (daisy chain) the shields for FC bus wiring.

SA bus terminal block

The SA Bus terminal block is a brown, removable, 4-terminal plug that fits into a board-mounted jack.

Wire the removable SA Bus terminal block plugs on the controller and other SA Bus devices in a daisy-chain configuration using 4-wire twisted, shielded cable as shown in Figure 5. See Table 4 for more information.

Figure 5: SA bus terminal block wiring



Stranded, 4-Wire (2 Twisted Pair) Shielded Cable
(One twisted pair is the **+** and **-** leads.
The second pair is COM and SA PWR.)

Note: The SA PWR terminal supplies 15 VDC. The SA PWR terminal can be used to connect (daisy chain) the 15 VDC power leads on the SA bus.

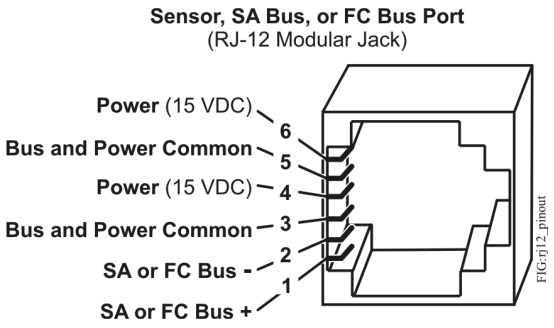
FC bus port

The FC bus port on the front of the controller is an RJ-12, 6-position modular jack that provides a connection for the Wireless Commissioning Converter or any models of the ZFR or ZFR Pro Routers for wireless field bus applications.

The FC bus port is connected internally to the FC bus terminal block. See Table 4 for more information. The FC bus Port pin assignment is shown in Figure 6.

Note: When an FEC is configured for N2 network communication, the FC bus port is not used.

Figure 6: Pin number assignments for sensor, SA bus, and FC bus ports on Controllers



Sensor port

The Sensor (SA Bus) port on the bottom of the controller (Figure 3) is an RJ-12, 6-position modular jack that provides a connection for the Wireless Commissioning Converter,

the VAV box Balancing Tool, specified network sensors, or other SA Bus devices with RJ-12 plugs.

When the FEC is configured for N2 communication, the SA Bus port must be used to download and commission the controller.

A DIS1710 Local Controller Display also can be connected to the SA Bus port (but only on FEC models without integral display and push-buttons).

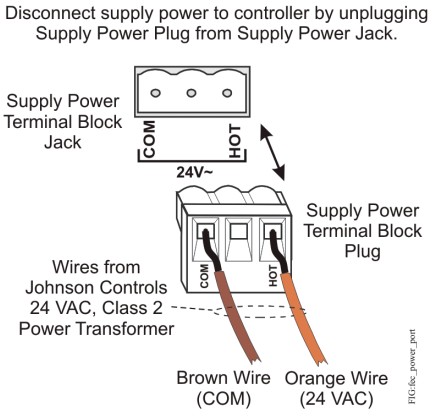
The Sensor port is connected internally to the SA bus terminal block. See Table 4 for more information. The Sensor Port pin assignment is shown in Figure 6.

Supply power terminal block

The 24 VAC supply power terminal block is a gray, removable, 3-terminal plug that fits into a board-mounted jack on the top right of the controller.

Wire the 24 VAC supply power wires from the transformer to the HOT and COM terminals on the terminal plug as shown in Figure 7. The middle terminal on the supply power terminal block is not used. See Table 4 for more information about the Supply Terminal Block.

Figure 7: 24 VAC supply power terminal block wiring



Note: The supply power wire colors may be different on transformers from other manufacturers. Refer to the transformer manufacturer's instructions and the project installation drawings for wiring details.

Important: Connect 24 VAC supply power to the controller and all other network devices so that transformer phasing is uniform across the network devices. Powering network devices with uniform 24 VAC supply power phasing reduces noise, interference, and ground loop problems. The controller does not require an earth ground connection.

Wireless Field Bus applications

When configured for BACnet MS/TP communication, the controller can also be installed in a ZFR/ZFR Pro Wireless Field Bus System.
To configure a controller for use with a Wireless Field Bus system:

1. Wire the input/output terminals and SA bus.

Note: In wireless network applications, do not connect any wires to the FC Bus terminal block. (Connect the SA/FC terminal block on an Input/ Output Module (IOM) to an SA bus only.)

2. Connect the ZFR/ZFR Pro Wireless Field Bus Router to the FC bus port (RJ-12 modular jack) on the front of the controller.
3. Ensure that the controller's device address DIP switches are set to the correct device address. See Setting the device addresses.
4. Set DIP switch 128 to ON, which enables wireless operation on the controller.

For more information on the ZFR Pro Wireless Field Bus system, refer to the *WNC1800/ZFR182x Pro Series Wireless Field Bus System Product Bulletin (LIT-12012320).*

For more information on the ZFR Wireless Field Bus system, refer to the *ZFR1800 Series Wireless Field Bus System Product Bulletin (LIT-12011336).*

Terminal Wiring Guidelines, Functions, Ratings, and Requirements

Input and Output wiring guidelines

Table 2 provides information and guidelines about the functions, ratings, and requirements for the controller input and output terminals; and references guidelines for determining proper wire sizes and cable lengths.

In addition to the wiring guidelines in Table 2, observe these guidelines when wiring controller inputs and outputs:

- Run all low-voltage wiring and cables separate from high-voltage wiring.
- All input and output cables, regardless of wire size or number of wires, should consist of stranded, insulated, and twisted copper wires.
- Shielded cable is not required for input or output cables.
- Shielded cable is recommended for input and output cables that are exposed to high electromagnetic or radio frequency noise.
- Inputs/outputs with cables less than 30 m (100 ft) typically do not require an offset in the software setup. Cable runs over 30 m (100 ft) may require an offset in the input/output software setup.

Table 2: FEC16 terminal blocks, functions, ratings, requirements, and cables

Terminal block label	Terminal label	Function, ratings, requirements	Determine wire size and maximum cable length
UNIVERSAL (Inputs)	**+15 V**	**15 VDC Power Source** for active (3-wire) input devices connected to the Universal IN*n* terminals. Provides 100 mA total current	Same as (Universal) **IN***n* **Note:** Use 3-wire cable for devices that source power from the +15V terminal.
	IN*n*	**Analog Input - Voltage Mode (0–10 VDC)** 10 VDC maximum input voltage Internal 75k ohm Pull-down	See Guideline **A** in Table 3.
		Analog Input - Current Mode (4–20 mA) Internal 100 ohm load impedance **Note:** Current loop jumpers are fail-safe to maintain a closed 4 to 20 mA current loop, even when the power to the controller is interrupted or off. See Universal Input current loop jumpers.	See Guideline **B** in Table 3.
		Analog Input - Resistive Mode (0–600k ohm) Internal 12 V, 15k ohm pull up Qualified Sensors: 0-2k ohm potentiometer, RTD (1k Nickel [Johnson Controls® sensor], 1k Platinum, and A99B Silicon Temperature Sensor) Negative Temperature Coefficient (NTC) Sensor (10k Type L, 10k JCI Type II, 2.252k Type II)	See Guideline **A** in Table 3.
		Binary Input - Dry Contact Maintained Mode 1 second minimum pulse width Internal 12 V. 15k ohm pull up	See Guideline **A** in Table 3.
	ICOM*n*	**Universal Input Common** for all Universal Input terminals **Note:** All Universal ICOM*n* terminals share a common, which is isolated from all other commons.	Same as (Universal) **IN***n*
BINARY (Inputs)	**IN***n*	**Binary Input - Dry Contact Maintained Mode** 0.01 second minimum pulse width Internal 18 V, 3k ohm pull up	See Guideline **A** in Table 3.
		Binary Input - Pulse Counter/Accumulator Mode 0.01 second minimum pulse width (50 Hz at 50% duty cycle) Internal 18 V, 3k ohm pull up	
	ICOM*n*	**Binary Input Common** for all Binary Input (IN) terminals **Note:** All Binary ICOM*n* terminals share a common, which is isolated from all other commons, except the Configurable Output (CO) common (OCOM*n*) when the CO is defined as an Analog Output.	
BINARY (Output) Power Selection Jumper positioned to External (**EXT**) power.	**OUT***n*	**Binary Output - 24 VAC Triac** (External Power Source) Connects OUT*n* to OCOM*n* when activated. External Power Source Requirements: 30 VAC maximum output voltage 0.5 A maximum output current 1.3 A at 25% duty cycle 40 mA minimum load current	See Guideline **C** in Table 3.
	OCOM*n*	**Binary Output Common** (for OUT*n* terminal) **Note:** Each Binary Output Common terminal (OCOM*n*) is isolated from **all** other commons, including other Binary Output Common terminals.	

Table 2: FEC16 terminal blocks, functions, ratings, requirements, and cables

Terminal block label	Terminal label	Function, ratings, requirements	Determine wire size and maximum cable length
BINARY (Output) Power Selection Jumper positioned to Internal (**INT**) power.	**OUT***n*	**Binary Output - 24 VAC Triac** (Internal Power Source) **Model FEC1611-0:** Sources internal 24 VAC power (24~ COM). **Model FEC1611-1:** Sources internal 24 VAC power (24~ HOT).	See Guideline **C** in Table 3.
	OCOM*n*	**Binary Output - 24 VAC Triac** (Internal Power Source) **Model FEC1611-0:** Connects OCOM*n* to 24~ HOT when activated. **Model FEC1611-1:** Connects OCOM*n* to 24~ COM when activated. Internal Power Source: 30 VAC maximum output voltage 0.5 A maximum output current 1.3 A at 25% duty cycle 40 mA minimum load current	
CONFIGURABLE (Outputs)	**OUT***n*	**Analog Output - Voltage Mode (0–10 VDC)** 10 VDC maximum output voltage 10 mA maximum output current Required an external load of 1,000 ohm or more.	See Guideline **A** in Table 3.
		Binary Output - 24 VAC Triac (External Power Source only) Connects OUT*n* to OCOM*n* when activated. External Power Source Requirements: 30 VAC maximum output voltage 0.5 A maximum output current 1.3 A at 25% duty cycle 40 mA minimum load current	See Guideline **C** in Table 3.
	OCOM*n*	**Analog Output Signal Common** All Configurable Outputs (COs) defined as Analog Outputs (AOs) share a common, which is isolated from all other commons except the Binary Input common. **Binary Output Signal Common** All Configurable Outputs (COs) defined as Binary Outputs are isolated from all other commons, including other CO commons.	Same as (Configurable) **OUT***n*.

Cable and wire length guidelines

The table below defines cable length guidelines for the various wire sizes that may be used for wiring low-voltage (<30 V) input and outputs.

Table 3: Cable length guidelines for recommended wire sizes for low-voltage (<30 V) Inputs and Outputs

Guideline	Wire size/Gauge and type	Maximum cable length and type	Assumptions
A	1.0 mm (18 AWG) stranded copper	457 m (1,500 ft) twisted wire	100 mV maximum voltage drop Depending on cable and the connected input or output device, you may have to define an offset in the setup software for the input or output point.
	0.8 mm (20 AWG) stranded copper	297 m (975 ft) twisted wire	
	0.6 mm (22 AWG) stranded copper	183 m (600 ft) twisted wire	
	0.5 mm (24 AWG) stranded copper	107 m (350 ft) twisted wire	
B	1.0 mm (18 AWG) stranded copper	229 m (750 ft) twisted wire	100 mV maximum voltage drop Depending on cable and the connected input or output device, you may have to define an offset in the setup software for the input or output point.
	0.8 mm (20 AWG) stranded copper	137 m (450 ft) twisted wire	
	0.6 mm (22 AWG) stranded copper	91 m (300 ft) twisted wire	
	0.5 mm (24 AWG) stranded copper	61 m (200 ft) twisted wire	

Table 3: Cable length guidelines for recommended wire sizes for low-voltage (<30 V) Inputs and Outputs

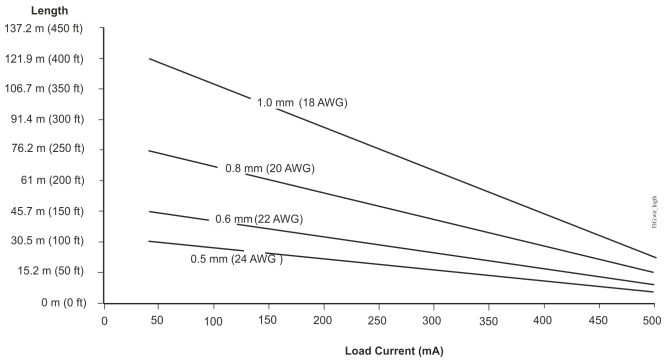
Guideline	Wire size/Gauge and type	Maximum cable length and type	Assumptions
C	See Figure 8 to select wire size/gauge. Use stranded copper wire	See Figure 8 to determine cable length. Use twisted wire cable.	N/A

Maximum cable length versus load current

Use the figure below to estimate the maximum cable length relative to the wire size and the load current (in mA) when wiring inputs and outputs.

Note: Figure 8 applies to low-voltage (<30 V) inputs and outputs only.

Figure 8: Maximum wire length for low-voltage (<30 V) Inputs and Outputs by current and wire Size



SA/FC bus and supply power wiring guidelines

Table 4 provides information about the functions, ratings, and requirements for the communication bus and supply power terminals; and guidelines for wire sizes, cable types, and cable lengths when wiring the controller's communication buses and supply power.

In addition to the guidelines in Table 4, observe these guidelines when wiring an SA or FC bus and the 24 VAC supply power:

- Run all low-voltage wiring and cables separate from high-voltage wiring.
- All SA and FC bus cables, regardless of wire size, should be twisted, insulated, stranded copper wire.
- Shielded cable is strongly recommended for all SA and FC bus cables.
- Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for detailed information about wire size and cable length requirements for the SA and FC buses.

Table 4: Communications bus and supply power terminal blocks, functions, ratings, requirements, and cables

Terminal block/ Port label	Terminal labels	Function, electrical ratings/Requirements	Recommended cable type
FC BUS	**+** **-**	FC Bus Communications	0.6 mm (22 AWG) stranded, 3-wire twisted, shielded cable recommended
	COM	Signal Reference (Common) for Bus communications	
	SHLD or **SHD**	Isolated terminal (optional shield drain connection)	
FC BUS (Port)	**FC Bus**	RJ-12 6-Position Modular Connector provides: FC Bus Communications FC Bus Signal Reference and 15 VDC Common 15 VDC, 180 mA, Power for Wireless Commissioning Converter or ZFR or ZFR Pro Wireless Router	Wireless Commissioning Converter retractable cable or 24 AWG 3-pair CAT 3 Cable <30.5 m (100 ft)
SA BUS	**+** **-**	SA Bus Communications	0.6 mm (22 AWG) stranded, 4-wire (2 twisted-pairs), shielded cable recommended. **Note:** The + and - wire are one twisted pair, and the COM and SA PWR are the second twisted pair of wires.
	COM	SA Bus Signal Reference and 15 VDC Common	
	SA PWR	15 VDC Supply Power for Devices on the SA Bus (Maximum total current draw for SA Bus is 240 mA.)	
Sensor	**Sensor**	RJ-12 6-Position Modular Connector provides: SA Bus Communications SA Bus Signal Reference and 15 VDC Common 15 VDC Power for devices on the SA bus and Wireless Commissioning Converter	24 AWG 3-pair CAT3 cable <30.5 m (100 ft)

Table 4: Communications bus and supply power terminal blocks, functions, ratings, requirements, and cables

Terminal block/ Port label	Terminal labels	Function, electrical ratings/Requirements	Recommended cable type
24~	HOT	**24 VAC Power Supply - Hot** Supplies 20–30 VAC (Nominal 24 VAC)	0.8 mm to 1.0 mm (18 AWG) 2-wire
	COM	**24 VAC Power Supply Common** (Isolated from all other Common terminals on controller) 35 VA	

Note: The SA Bus and FC Bus wiring recommendations in this table are for MS/TP bus communications at 38.4k baud. For more information, refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for detailed information about wire size and cable length requirements for the SA and FC buses.

Termination diagrams

A set of Johnson Controls termination diagrams provides details for wiring inputs and outputs to the controllers. See the figures in this section for the applicable termination diagrams.

Table 5: Termination details

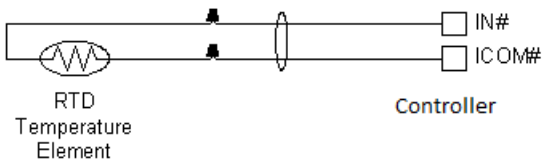
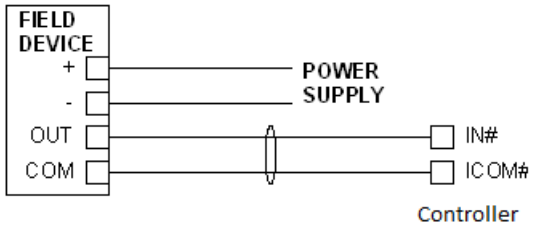
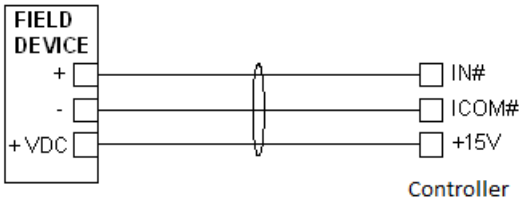
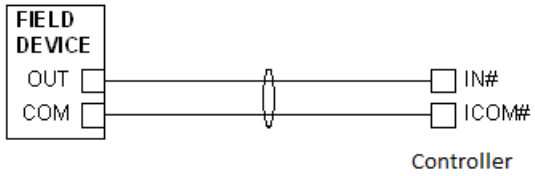
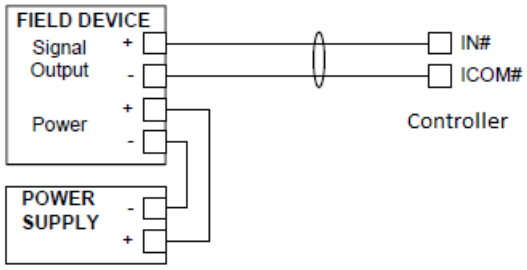
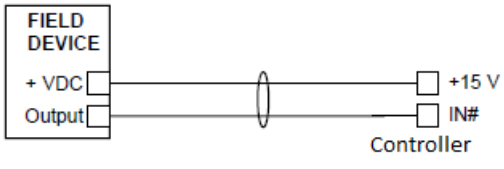
	Type of Input/ Output	Termination diagrams
Temperature Sensor	UI	
Voltage Input - External Source	UI	
Voltage Input - Internal Source	UI	
Voltage Input (Self-Powered)	UI	
Current Input - External Source (Isolated)	UI	
Current Input - Internal Source (2 wire)	UI	

Table 5: Termination details

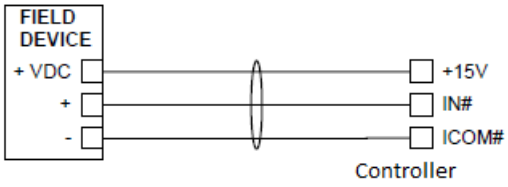
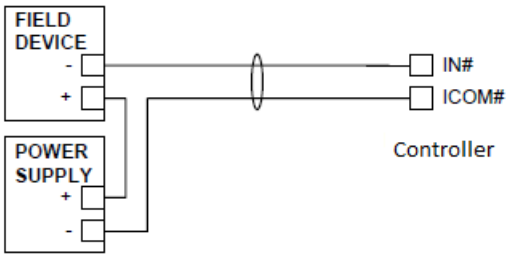
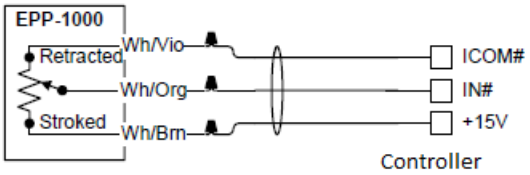
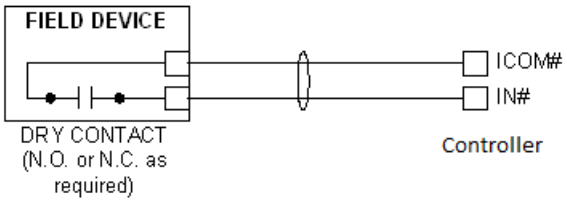
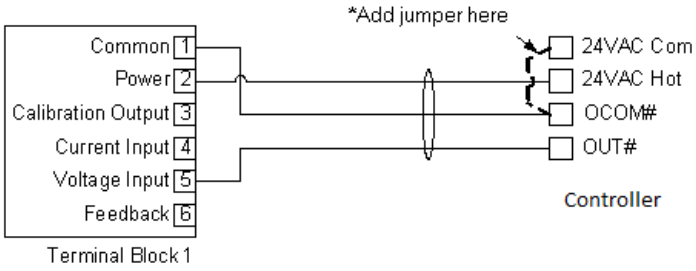
	Type of Input/ Output	Termination diagrams
Current Input - Internal Source (3 wire)	UI	
Current Input - External Source (in Loop)	UI	
Feedback from EPP-1000	UI	
Dry Contact (Binary Input)	UI or BI	
0-10 VDC Output to Actuator (External Source)	CO or AO	 **Note:** Add jumper from 24 VAC Com to only one CO Com (on FEC16xx) or only one AO Com or CO com (on FEC26xx) per transformer.

Table 5: Termination details

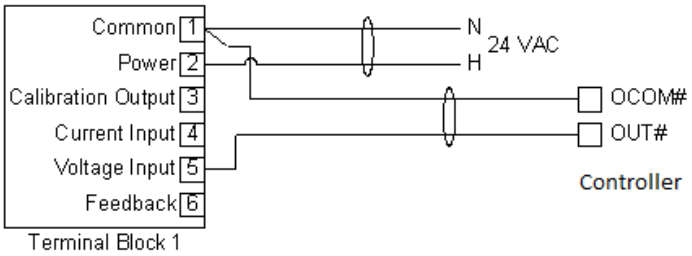
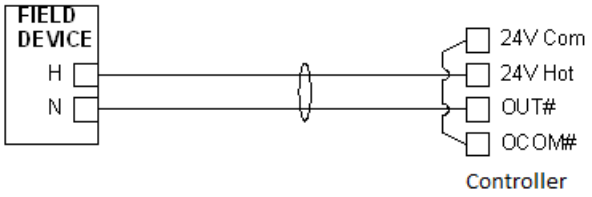
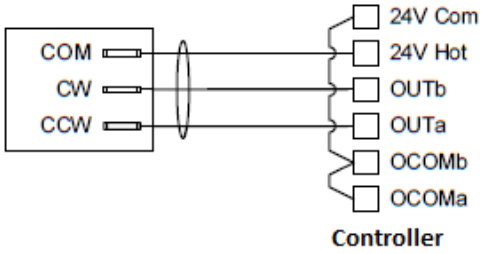
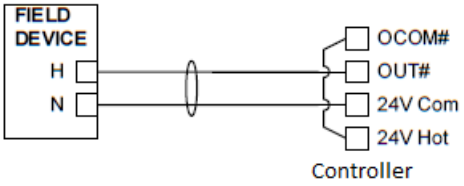
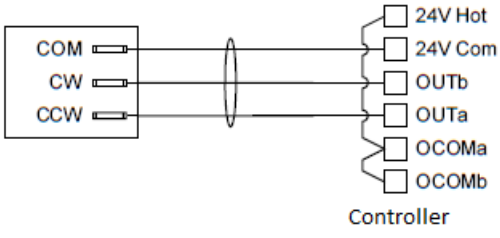
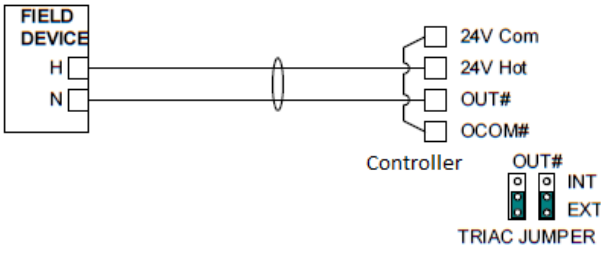
	Type of Input/ Output	Termination diagrams
0-10 VDC Output to Actuator (Internal Source)	CO or AO	
24 VAC Triac Output (Switch Low, External Source)	CO or AO	
Incremental Control to Actuator (Switch Low, Externally Sourced)	CO or AO	
24 VAC Binary Output (Switch High, Externally Sourced)	CO or AO	
Incremental Control to Actuator (Switch High, Externally Sourced)	CO or AO	
24 VAC Binary Output (Switch Low, Externally Sourced)	BO	

Table 5: Termination details

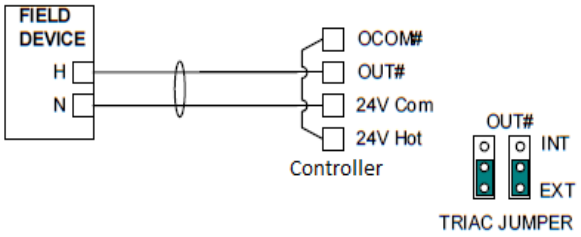
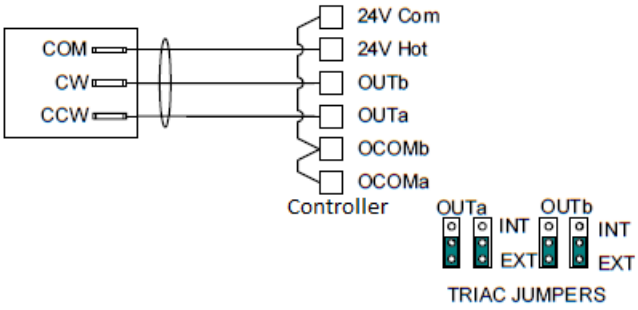
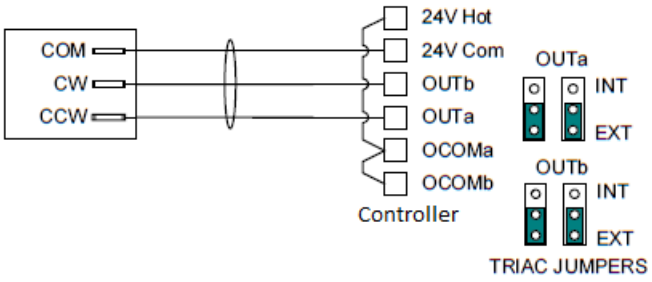
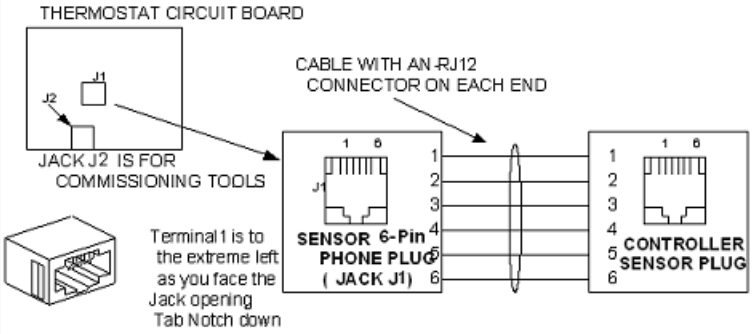
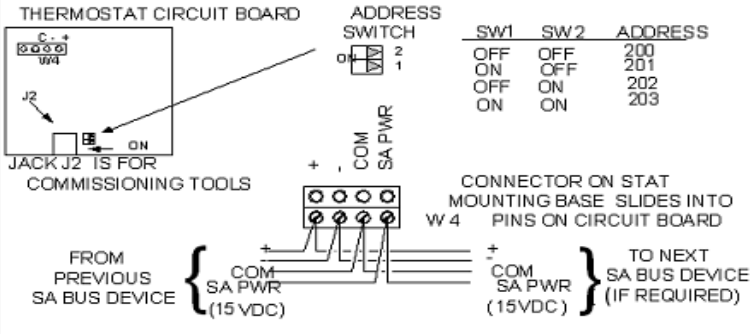
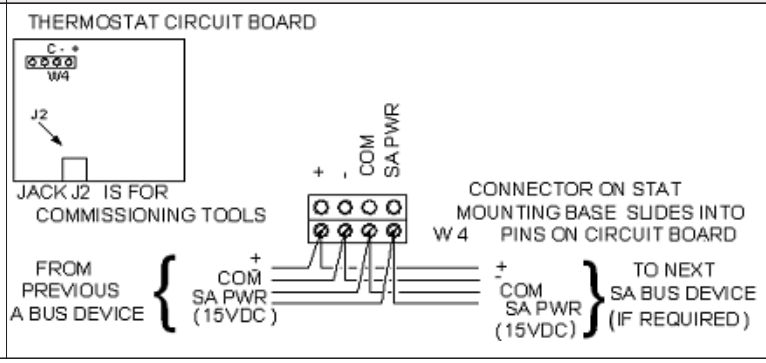
	Type of Input/ Output	Termination diagrams
24 VAC Binary Output (Switch High, Externally Sourced)	BO	
Incremental Control to Actuator (Switch Low, Externally Sourced)	BO	
Incremental Control to Actuator (Switch High, Externally Sourced)	BO	
Network Stat with Phone Jack (Fixed Address = 199)	SA Bus	
Network Stat with Terminals Addressable	SA Bus	

Table 5: Termination details

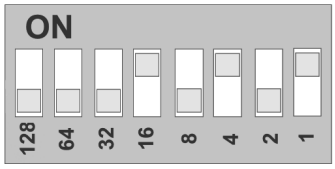
	Type of Input/ Output	Termination diagrams
Network Stat with Terminals (Fixed Address = 199)	SA Bus	

Setup and Adjustments

Setting the device addresses

Metasys field controllers are devices on MS/TP (SA or FC) buses. Before operating field controllers on a bus, you **must** set a valid and unique device address for each controller on the bus. You set a controller's device address by setting the positions of the switches on the DIP switch block at the top of the controller (Figure 3). Consult the appropriate Communications Technical Bulletin to find valid addresses for these controllers. The DIP switch block has eight switches numbered 128, 64, 32, 16, 8, 4, 2, and 1 (Figure 9). Switches 64 through 1 are device address switches. Switch 128 is a mode switch that enables a field controller to operate on a an FX-ZFR/ ZFR Pro Series Wireless Field Bus. Switch 128 must be set to Off for all hard-wired SA and FC bus applications. Set switch 128 to ON for wireless FC bus applications **only**. Non-wireless devices may use addresses greater than 127 if they are using the N2 protocol.

Figure 9: Device address DIP switch block set to address 21



Note: *Metasys* FEC controllers ship with switch 128 ON and the remaining address switches off rendering the controllers wired devices, which do not operate on MS/TP buses, but will not interfere with bus operation. Set a valid and unique device address on the controller before applying power to the controller on the bus.

To set the device addresses on *Metasys* field controllers:

1. Set **all** of the switches on the address DIP switch block (128 through 1) to off.
2. Set one or more of the seven address switches (64 though 1) to ON, so that the sum of the switch numbers set to ON equals the intended device address. See Table 6 for valid device addresses.

Set the highest number switch that is less than or equal to the intended device address to ON. Then continue setting lower numbered switches until the total equals the intended address. For example, if the intended device address is 21, set switch 16 to ON first, then set switch 4 ON, followed by switch 1 (16+4+1= 21). See Figure 9.

3. Set switch 128 to ON **only** for controllers on a ZFR/ ZFR Pro Series Wireless Field Bus application. For all hard-wired SA and FC bus applications, ensure that switch 128 is set to Off.

Note: Do **not** connect a controller with switch 128 set to ON to an active (hard-wired) SA or FC bus. When a controller with switch 128 set to ON and a device address from 4 to 127 is connected to a wired field bus, the entire field bus is rendered inoperable until the controller is disconnected or switch 128 is set to Off.

Refer to the *WNC1800/ZFR182x Pro Series Wireless Remote Field Bus System Technical Bulletin (LIT-12012356)* or the *ZFR1800 Series Wireless Field Bus System Technical Bulletin (LIT-12011295)* for more information on device addresses in wireless applications.

4. Set a unique and sequential device address for each of the controllers connected on the SA or FC bus starting with device address 4.

To ensure the best bus performance, set sequential device addresses with no gaps in the device address range (4, 5, 6, 7, 8, 9, and so on). The controllers do **not** need to be physically connected on the bus in their numerical device address order.

5. Write each field controller's device address on the white label below the DIP switch block on the controller's cover.

Table 6 describes the FC bus and SA bus devices addresses for Johnson Controls® MS/TP communications bus applications.

Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for more information on controller device addresses and how to set them on MS/TP buses.

Refer to the *Modernization Guide for Legacy N2 Controllers (LIT-12012005)* for more information on controller device addresses and how to set them on N2 buses.

Table 6: SA/FC bus device address descriptions for MS/TP Controllers

Device address	Use on description
0 (Switch 128 Off)	Reserved for FC Bus Supervisory Controller (not for use on field controllers).
1 to 3 (Switch 128 Off)	Reserved for peripheral devices (not for use on field controllers).
4 to 127 (Switch 128 Off)	Used for MS/TP devices (field controllers) that are hardwired to an SA Bus or FC Bus.
0 to 3 (Switch 128 ON)	Reserved addresses for wired devices (not for use on field controllers). ⓘ **Note:** *Metasys* field controllers ship with switch 128 ON and the remaining address switches off rendering the controllers wired devices, which do not operate on MS/TP buses.
4 to 127 (Switch 128 ON)	Used for MS/TP devices (field controllers) that are used in a ZFR or a ZFR Pro Wireless Field Bus System. ⓘ **Note:** Do **not** connect a controller with switch 128 ON to an active (**hard-wired**) SA or FC bus. When a controller with switch 128 ON and a device address from 4 to 127 is connected to a wired field bus, the entire field bus is rendered inoperable until the controller is disconnected or switch 128 is set to Off.

Setting the N2 Controller Address to be Greater than 127

N2-configured controllers support the full range of possible N2 device addresses provided by the N2 protocol standard (1–254). However, these controllers require special configuration for addresses above 127.
Use the following instructions for controllers greater than 127.

ⓘ **Note:** Before you perform this procedure, make sure that your controller has been converted from BACnet to N2 protocol first. Refer to the *Modernization Guide for Legacy N2 Controllers (LIT-12012005)* for more information.

ⓘ **Note:** This special configuration is required because controller addresses above 127 were originally intended for use with the Wireless Field Bus system.

1. Disconnect the 24 VAC supply from the controller.
2. Remove the FC Bus connector from the controller.
3. Set the address switch set to the desired N2 address.
4. Set the address switch segment labeled 128 to OFF.
5. Reconnect the 24 VAC supply to the controller.
6. Using an SA bus connection, download the firmware and controller application file. The download process asks to confirm switching the communication protocol to N2.
7. Click OK.
8. After the download is finished, disconnect the 24 VAC supply to the controller.
9. Set the address switch segment labeled 128 to ON.
10. Reattach the FC Bus connector to the controller.
11. Reconnect the 24 VAC supply to the controller.

Removing the Controller cover

➤ **Important:** Electrostatic discharge can damage controller components. Use proper electrostatic discharge precautions during installation, setup, and servicing to avoid damaging the controller.

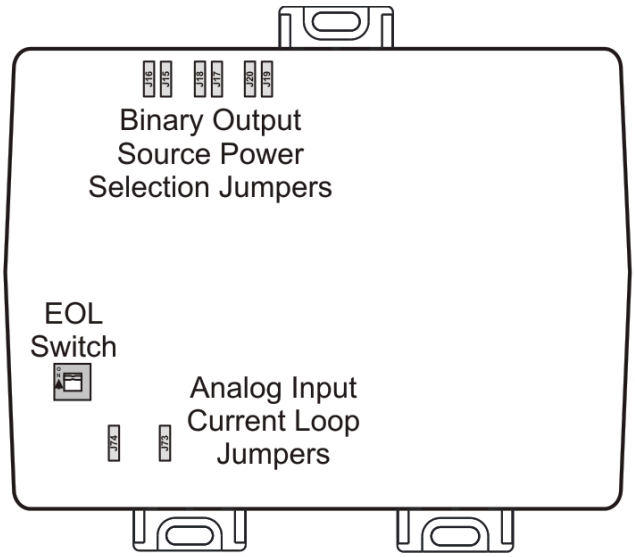
➤ **Important:** Disconnect all power sources to the controller before removing the cover and changing the position of any jumper or the EOL switch on the controller. Failure to disconnect power before changing a jumper or EOL switch position can result in damage to the controller and void any warranties.

The controller cover is held in place by four plastic latches that extend from the base and snap into slots on the inside of the housing cover.

To remove the controller cover:

1. Place your fingernails under the two cover lift tabs (Figure 3) on the sides of the housing cover and gently pry the top of the cover away from the base to release the cover from the two upper latches.
2. Pivot the top of the cover further to release it from the lower two latches.
3. Replace the cover by placing it squarely over the base, and then gently and evenly push the cover on to the latches until they snap into the latched position.

Figure 10: FEC16 with cover removed showing EOL switch and jumper positions



Setting the End-of-Line (EOL) switch

Each controller has an EOL switch, which, when set to ON, sets the controller as a terminating device on the bus. See Figure 10 for the EOL switch location. The default EOL switch position is Off.

Figure 11: End-of-Line switch positions

To set the EOL switch on a controller:

1. Determine the physical location of the controller on the FC bus.
2. Determine if the controller must be set as a terminating device on the bus.

Note: Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for detailed information about EOL termination rules and EOL switch settings on FC buses.

Refer to the *N2 Communications Bus Technical Bulletin (LIT-636018)* for detailed information about EOL termination rules and EOL switch settings on N2 buses.

3. If the controller is a terminating device on the bus, set the EOL switch to ON. If the controller is not a terminating device on the bus, set the EOL switch to Off.

When a field controller is connected to power with its EOL switch set to ON, the amber EOL LED on the controller cover is lit.

Setting the Input and Output Jumpers

Binary Output (BO) source power selection jumpers

CAUTION

Risk of Electric Shock

Disconnect supply power to the controller before attempting to adjust the Binary Output Source Power Selection Jumpers. Failure to disconnect the supply power may result in electric shock.

ATTENTION

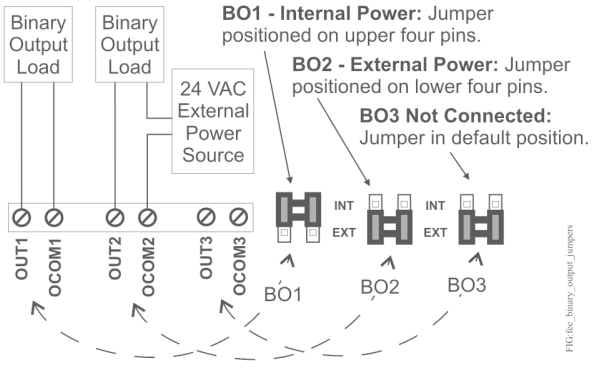
Risque de décharge électrique

Débrancher l'alimentation de l'controller avant tout réglage du Binary Output Source Power Selection Jumpers. Le non-respect de cette précaution risque de provoquer une décharge électrique.

Important: Do **not** connect an external power source to a BO when the BO power source jumper is in the internal power (INT) position. Connecting external power to a BO that sources internal power can damage the controller and void any warranties.

The BO source power selection jumpers determine whether a BO provides internal power (sourced from the controller) to the output load (INT position) or requires an external power source (EXT position) for the output load. Figure 12 shows an example of a controller BOs and the associated power selection jumpers to the right of the BOs terminal block.

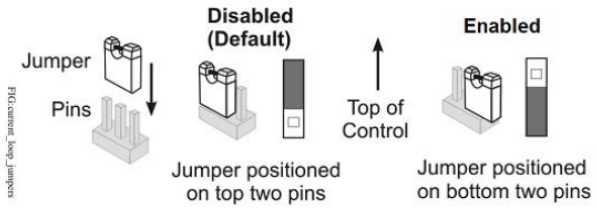
Figure 12: Example binary Outputs and the associated source power jumper positions



Universal Input current loop jumpers

The Universal Input (UI) current loop fail-safe jumpers are on the circuit board under the controller cover near the UI terminals (Figure 10). When a UI is defined (in the system software) as a 4–20 mA Analog Input and the UI's current loop jumper is in the Disabled (default) position (Figure 13), the 4–20 mA current loop circuit opens whenever power to the controller is interrupted or off.

Figure 13: Current loop jumper positions



Setting the current loop jumper to the Enabled position (Figure 13) connects an internal 100 ohm resistor across the UI terminals, which maintains the 4–20 mA current loop circuit even when power to the controller is interrupted or off.

Important: Current Loop jumpers must be in the Disabled (default) position for all UIs that are not set up to operate as 4–20 mA analog inputs.

The table below identifies the current loop jumpers associated with each UI on the FEC16 controller.

Table 7: FEC16 UI Inputs and jumper labels

Universal Input label	Jumper label on circuit board
IN1	J74
IN2	J73

Setting up an integral or local display

FEC1621 models have an integral LCD and push-button user interface that allows you to set up and monitor the FEC, the FEC I/O points, and the modules and I/O points connected on the SA bus. FEC1611 models do not have an integral display, but can be connected to a DIS1710 Local Controller Display. For detailed information on setting up and operating either an integral user interface or a remotely connected DIS1710 display, refer to the *DIS1710 Local Controller Display Technical Bulletin (LIT-12011270)*.

Commissioning controllers

You commission field controllers with CCT 13.0 and later software, either via a Bluetooth® Wireless Commissioning Converter, a USB wireless dongle, or in BACnet Router mode when connected to a Network Automation Engine (NAE) or Network Control Engine (NCE). Refer to the *Controller Tool Help (LIT-12011147)* for detailed information on commissioning controllers.

Note: The MAP Gateway serves as a replacement for the BTCVT, which is no longer available for purchase, but continues to be supported.

Troubleshooting controllers

Observe the Status LEDs on the front of the controller and see Table 8 to troubleshoot the controller. To troubleshoot an integral or local controller display, refer to the *DIS1710 Local Controller Display Technical Bulletin (LIT-12011270)*.

Table 8: Status LEDs and descriptions of LED states

LED label	LED color	Normal LED state	Description of LED states
POWER	Green	On Steady	Off Steady = No Supply Power or the controller's polyswitch/resettable fuse is open. Check Output wiring for short circuits and cycle power to controller. On Steady = Power Connected
FAULT	Red	Off Steady	Off Steady = No Faults On Steady = Device Fault; no application loaded; Main Code download required, if controller is in Boot mode Blink - 2 Hz = Download or Startup in progress, not ready for normal operation
SA BUS	Green	Blink - 2 Hz	Blink - 2 Hz = Data Transmission (normal communication) Off Steady = No Data Transmission (N/A - auto baud not supported) On Steady = Communication lost, waiting to join communication ring
FC BUS	Green	Blink - 2 Hz	Blink - 2 Hz = Data Transmission (normal communication) Off Steady = No Data Transmission (auto baud in progress) On Steady = Communication lost, waiting to join communication ring
EOL	Amber	Off (Except on terminating devices)	On Steady = EOL switch in ON position Off Steady = EOL switch in Off position

Repair information

If a controller fails to operate within its specifications, replace the controller. For a replacement controller, contact your Johnson Controls representative.

Accessories ordering information table

See the following table for controller accessories ordering information.

Table 9: Accessories ordering information

Product code number	Description
MS-DIS1710-0	Local Controller Display (for use with MS-FEC2611 model only)
TP-2420	Transformer, 120 VAC Primary to 24 VAC secondary, 20 VA, Wall Plug
Y65T31-0	Transformer, 120/208/240 VAC Primary to 24 VAC Secondary, 40 VA, Foot Mount, 8 in. Primary Leads and Secondary Screw Terminals, Class 2 ⓘ **Note:** Additional Y6x-x Series transformers are also available. Refer to the *Series Y63, Y64, Y65, Y66, and Y69 Transformers Product Bulletin (LIT-125755)* for more information.
AS-XFR050-0	Power transformer (Class 2, 24 VAC, 50 VA maximum output), no enclosure
AP-TBK4SA-0	Replacement SA Bus Terminal Blocks, 4-Position, Brown, Bulk Pack of 10
AP-TBK4FC-0	Replacement FC Bus Terminal Blocks, 4-Position, Blue, Bulk Pack of 10
AP-TBK3PW-0	Replacement Power Terminal Blocks, 3-Position, Gray, Bulk Pack of 10
WNC1800/ZRF182x Pro Wireless Field Bus System	This system is used for installations that support BACnet/IP but can also coexist with the ZFR1800 Series when installed under the same supervisor (i.e., network engine). Refer to the *WNC1800/ZFR182x ProSeries Wireless Field Bus System Product Bulletin (LIT-12012320)* for a list of available products.
ZFR1800 Series Wireless Field Bus System	This system is used for installations that only support BACnet MS/TP. Refer to the *ZFR1800 Series Wireless Field Bus System Product Bulletin (LIT-12011336)* for a list of available products.
NS Series Network Sensors	Refer to the *NS Series Network Sensors Product Bulletin (LIT-12011574)* for specific sensor model descriptions.
WRZ Series Wireless Room Sensors	Refer to the *WRZ Series Wireless Room Sensors Product Bulletin (LIT-12000653)* for specific sensor model descriptions.

Technical specifications

Table 10: FEC16 technical specifications

Product Code Numbers	MS-FEC1611-1: 10-Point FEC MS-FEC1611-1ET: FEC1611 Extended Temperature controller for rooftop applications. Supports operational temperature range of -40 °C to 70 °C (-40 °F to 158 °F). MS-FEC1621-1: 10-Point FEC with integral display and push-button user interface.
Supply Voltage	24 VAC (nominal, 20 VAC minimum/30 VAC maximum), 50/60 Hz, power supply Class 2 (North America), Safety Extra-Low Voltage (SELV) (Europe)
Power Consumption	14 VA maximum for FEC1611 only 20 VA maximum for FEC1621 (with integral display) only ⓘ **Note:** VA rating does **not** include any power supplied to the peripheral devices connected to Binary Outputs (BOs) or Configurable Outputs (COs), which can consume up to 12 VA for each BO or CO; for a possible total consumption of an additional 84 VA (maximum).
Ambient Conditions	**Operating:** 0°C to 50°C (32°F to 122°F); 10% to 90% RH noncondensing **Storage:** -40°C to 80°C (-40°F to 176°F); 5% to 95% RH noncondensing **FEC16 Extended Temperature Field Equipment Controller** **Operating:** -40 to 70°C (-40 to 158°F); 10 to 90% RH noncondensing **Storage:** -40 to 80°C (-40 to 176°F); 5 to 95% RH noncondensing
Controller Addressing for BACnet MS/TP	DIP switch set; valid controller device addresses 4–127 (Device addresses 0–3 and 128–255 are reserved and not valid controller addresses.)
Controller Addressing for N2	DIP switch set; valid control device addresses 1-254
Communications Bus	**RS-485: selectable BACnet MS/TP or N2** 3-wire FC bus between the supervisory controller and other controllers 4-wire SA bus between controller, network sensors and other sensor/actuator devices, includes a lead to source 15 VDC supply power (from controller) to bus devices. **N2 Open Protocol:** N2/FC Bus: 1.0 mm (18 AWG) standard 3-wire, twisted, shielded cable recommended between the supervisory controller and field controllers
Processor	H8SX/166xR Renesas® 32-bit microcontroller
Memory	640 KB flash memory and 128 KB RAM
Input and Output Capabilities	**2 - Universal Inputs:** Defined as 0-10 VDC, 4-20 mA, 0-600k ohm, or Binary Dry Contact **2 - Binary Input:** Defined as Dry Contact Maintained or Pulse Counter/Accumulator Mode **3 - Binary Outputs:** Defined as 24 VAC Triac (selectable internal or external source power) **4 - Configurable Outputs:** Defined as 0-10 VDC or 24 VAC Triac BO
Analog Input/Analog Output Resolution and Accuracy	**Input:** 16-bit resolution **Output:** 16-bit resolution, +/- 200 mV accuracy in 0-10 VDC applications
Terminations	**Input/Output:** Fixed Screw Terminal Blocks **SA/FC Bus and Supply Power:** 4-Wire and 3-Wire Pluggable Screw Terminal Blocks **SA/FC Bus Port:** RJ-12 6-Pin Modular Jacks
Mounting	Horizontal on single 35 mm DIN rail mount (preferred), or screw mount on flat surface with three integral mounting clips on controller
Housing	**Enclosure material:** ABS and polycarbonate UL94 5VB; Self-extinguishing, Plenum Rated Protection Class: IP20 (IEC529)
Dimensions (Height x Width x Depth)	150 mm x 164 mm x 53 mm (5-7/8 in. x 6-1/2 in. x 2-1/8 in.) including terminals and mounting clips ⓘ **Note:** Mounting space requires an additional 50 mm (2 in.) space on top, bottom and front face of controller for easy cover removal, ventilation and wire terminations.
Weight	0.4 kg (0.9 lb)

Table 10: FEC16 technical specifications

Compliance CE	**United States:** UL Listed, File E107041, CCN PAZX, UL 916, Energy Management Equipment FCC Compliant to CFR47, Part 15, Subpart B, Class A
	Canada: UL Listed, File E107041, CCN PAZX7 CAN/CSA C22.2 No.205, Signal Equipment Industry Canada Compliant, ICES-003
	Europe: Johnson Controls declares that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive.
	Australia and New Zealand: RCM Mark, Australia/NZ Emissions Compliant
	BACnet International: BACnet Testing Laboratories (BTL) Protocol Revision 4 Listed BACnet Application Specific Controller (B-ASC)

The performance specifications are nominal and conform to acceptable industry standard. For application at conditions beyond these specifications, consult the local Johnson Controls® office. Johnson Controls shall not be liable for damages resulting from misapplication or misuse of its products.

Product warranty

This product is covered by a limited warranty, details of which can be found at www.johnsoncontrols.com/buildingswarranty.

Single point of contact

APAC	Europe	NA/SA
JOHNSON CONTROLS C/O CONTROLS PRODUCT MANAGEMENT NO. 32 CHANGJIJANG RD NEW DISTRICT WUXI JIANGSU PROVINCE 214028 CHINA	JOHNSON CONTROLS WESTENDHOF 3 45143 ESSEN GERMANY	JOHNSON CONTROLS 507 E MICHIGAN ST MILWAUKEE WI 53202 USA

For more contact information, refer to www.johnsoncontrols.com/locations.