F4-CG Series General Purpose Application Controllers Installation Guide

Part No. 24-10143-01787 Rev. C

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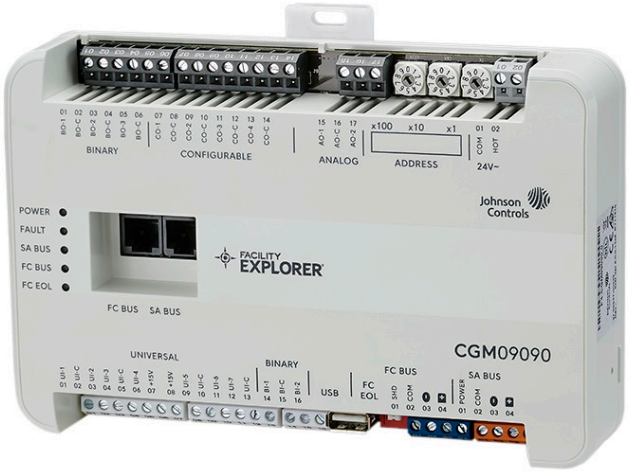
Application

The CGM09090 and CGM04060 General Purpose Application MS/TP Controllers (CGs) are equipment controllers that run pre-engineered and user-programmable applications, and provide the inputs and outputs required to monitor and control a wide variety of HVAC and other facility equipment. CG series controllers operate on an RS-485 BACnet® MS/TP Bus as BACnet Advanced Application Controllers (B-AACs) and integrate into Johnson Controls® and third-party BACnet systems.

CG series controllers include an integral real-time clock, which enables the controllers to monitor and control schedules, calendars, and trends, and operate for extended periods as stand-alone controllers when offline from the Facility Explorer® system network.

Figure 1: F4-CGM09090



Communications Protocols

The CG series controllers can communicate using BACnet MS/TP, N2, or wireless Zigbee®. By default, these controllers communicate using the BACnet MS/TP protocol. The BACnet protocol is a standard for ANSI, ASHRAE, and the International Standards Organization (ISO) for building controls.

The CG series controllers can be used as functional replacements for legacy N2 controllers. The N2-capable MS/TP equipment controller models provide a cost-effective upgrade and modernization path for customers with existing N2 controllers. For installation and commissioning support, and tips for efficient and safe replacement, refer to the *Modernization Guide for Legacy N2 Controllers (LIT-12012005)* and the controller-specific documentation. For information about mapping N2 Objects in controllers with switchable communications protocols, refer to the *N2 Compatibility Options* chapter of the *Controller Tool Help (LIT-12011147).*

To configure CG series controllers to communicate using the N2 communications protocol, see Configuring N2 communications.

These controllers can also be installed in a wireless application using a ZFR183x Pro Wireless Field Bus Router. To configure these controllers to communicate using the wireless communications protocol, see Configuring wireless communications.

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 the following guidelines when installing a controller:

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

Parts included

- One CGM controller with removable terminal blocks (Input/Output, Power, FC, and SA bus terminal blocks are removable)
- One installation instructions sheet

(barcode for factory use only)

F4-CGM9090-0, F4-CGM04060-0

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 (1/8 in. or 3.2 mm) or Philips#2 screwdriver for securing wires in the terminal blocks

Physical features

The following figure displays the physical features of the CGM09090 and the CGM04060 controllers, and the accompanying table provides a description of the physical features and a reference to further information where required.

Figure 2: CGM Physical Features (CGM09090 model shown)

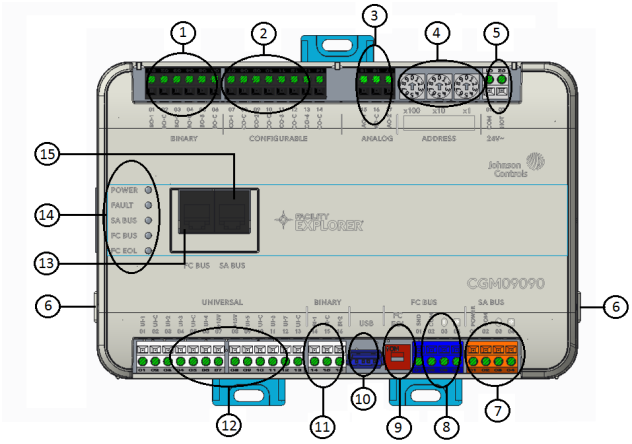


Table 1: Physical features of CGM controllers

	Physical Feature: Description and References
1	Binary Outputs (BO) Terminal Block: Black terminals. See Table 3.
2	Configurable Outputs (CO) Terminal Block: Black terminals. See Table 3.
3	Analog Output (AO) Terminal Block: Black terminals. Only present on CGM09090 model. See Table 3.
4	Device Address Rotary Switch Block: Decimal Addressing. See Setting the device address.
5	Supply Power Terminal Block: Gray terminals; 24 VAC, Class 2. See Supply power terminal block)
6	Cover Lift Tab. See Removing the controller cover
7	Sensor Actuator (SA) Bus Terminal Block: Orange terminal. See SA bus terminal block
8	Field Controller (FC) Bus Terminal Block: Blue terminal. See FC bus terminal block (or N2 protocol as required))
9	End-of-Line (EOL) Switch. See Setting the End-of-Line (EOL) switch)
10	Universal Serial Bus (USB) 2.0 host type A Port **Note:** The USB feature is not currently supported.
11	Binary Input (BI) Terminal Block: White terminals. See Table 3)

Table 1: Physical features of CGM controllers

	Physical Feature: Description and References
12	Universal Inputs (UI) Terminal Block: White terminals. See Table 3)
13	FC Bus Port RJ-12 6-pin Modular Jack (see FC bus port)
14	LED Status Indicators (see Table 10)
15	Sensor (SA Bus) Port: RJ-12 6-Pin Modular Jack (see SA Bus port)

Mounting

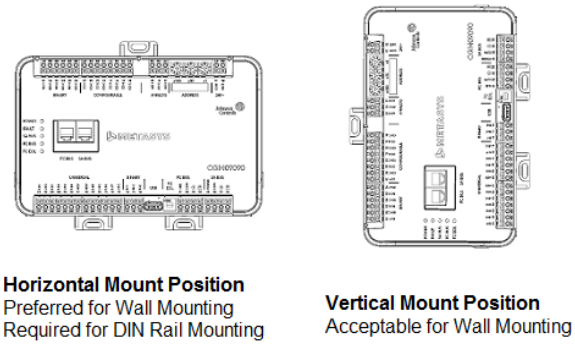
Observe the following guidelines when mounting a controller:

- 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.
- 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 13.
- 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 ductwork.
- Do not mount the controller in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.

On panel or enclosure mount applications, observe the following additional guidelines:

- 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 3: Controller mounting position



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

Vertical Mount Position
Acceptable for Wall Mounting

Mounting features and dimensions

Figure 4: Back of CGM09090 controller

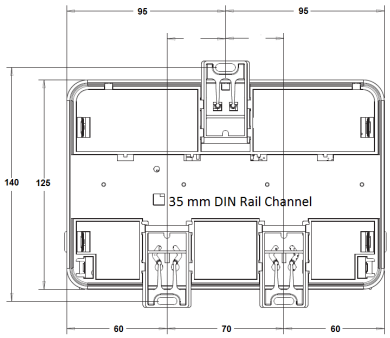
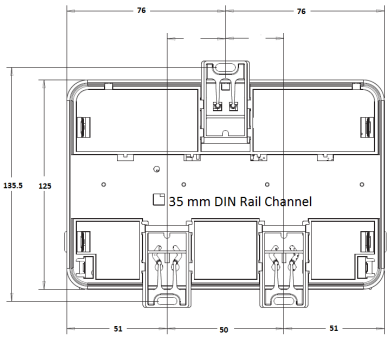


Figure 5: Back of CGM04060 controller



Note:

- Mounting dimensions are listed in millimeters in the above figures.
- The DIN rail channel and the mounting clips are shown in an extended position.

DIN rail mount applications

About this task:
To mount a CGM controller horizontally on a 35 mm DIN rail (recommended method), complete the following steps:

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.
2. Pull the two bottom mounting clips outward from the controller to the extended position (Figure 4 or Figure 5).
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 4 or Figure 5), 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

About this task:
To mount a CGM controller directly on a wall or other flat vertical surface, complete the following steps:

1. Pull the two bottom mounting clips outward and ensure they are locked in the extended position as shown in Figure 4 or Figure 5.
2. Determine the proper mounting position the expansion module will be installed. Mark the mounting hole locations on the wall using the dimensions for the controller listed in Mounting features and dimensions, 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 marked locations, and insert appropriate wall anchors in the 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 over-tighten the mounting screws. Over-tightening the screws may damage the mounting clips.

Wiring

Observe the following guidelines when wiring a CGM controller:

CAUTION

Risk of Electric Shock:

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

ATTENTION

Mise En Garde: 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

Mise En Garde: 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 about configuring and wiring an MS/TP Bus, FC bus, and SA bus, refer to the *FX-PC Series Controllers MS/TP Communications Bus Technical Bulletin (LIT-12011670).*. For detailed information about wiring an N2 network, refer to the *N2 Communications Bus Technical Bulletin (LIT-636018)*.

Terminal blocks and bus ports

See Physical features for terminal block and bus port locations on the CGM controller. Observe the following guidelines when wiring a CGM controller.

Input and Output terminal blocks

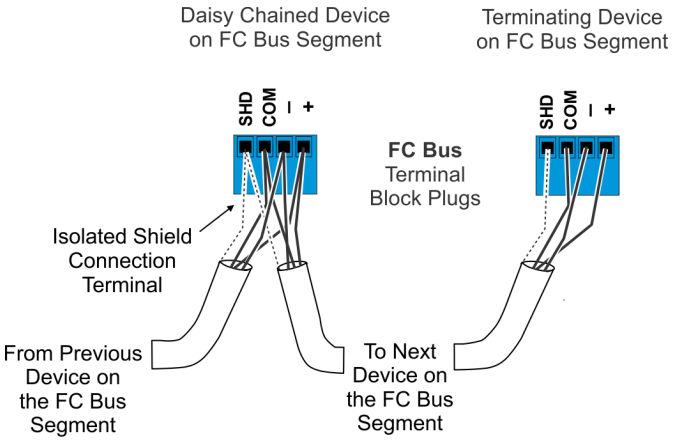
CGM controllers have removable input and output terminal blocks. All of the input terminal blocks are located on the bottom of the controller, and the output terminal blocks are located on the top of the controller. . For more information about I/O terminal functions, requirements, and ratings, see Terminal wiring guidelines, functions, ratings, and requirements.

FC bus terminal block (or N2 protocol as required)

The FC bus terminal block is a blue, removable, 4-pin terminal block that fits into a board-mounted pin header.

When connecting the CGM to the FC Bus, wire the bus terminal blocks on the controller and other FC Bus devices in a daisy-chain configuration using 3-wire twisted, shielded cable as shown in Figure 6. For more information about FC Bus terminal functions, requirements, and ratings, see Table 5.

Figure 6: FC Bus terminal block wiring



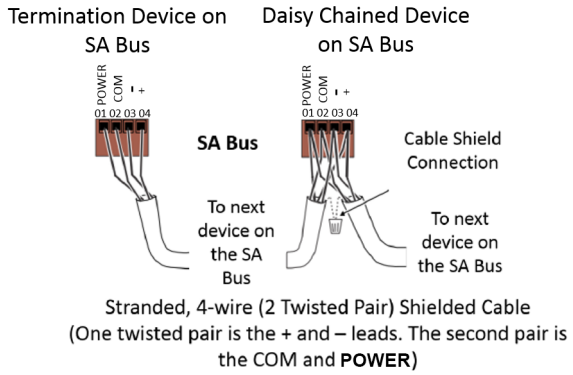
Note: The FC bus Shield (SHD) terminal is isolated and can be used to connect (daisy chain) the shields for FC bus wiring.

SA bus terminal block

The SA Bus terminal block is an orange, removable, 4-pin terminal block that fits into a board-mounted pin header.

When connecting an SA Bus device to the controller, wire the SA Bus terminal block on the controller and other SA bus devices in a daisy-chain configuration using 4-wire twisted, shielded cable as shown in Figure 7. See Terminal wiring guidelines, functions, ratings, and requirements for more information about communication bus terminal block functions, ratings, and requirements.

Figure 7: SA Bus Terminal Block Wiring



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

Note: Do not use the modular SA Bus port and the terminal block SA Bus simultaneously. Only use one of these connections at a time.

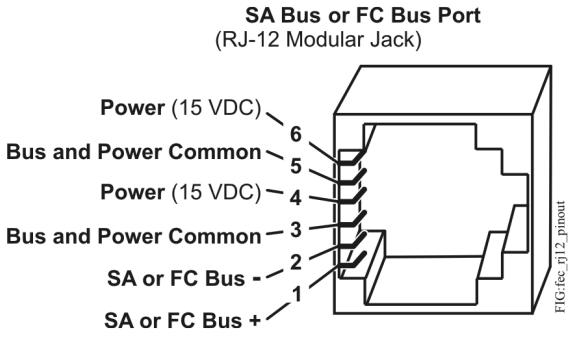
Note: The CGM controller is the EOL for the SA Bus.

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 Mobile Access Portal (MAP) Gateway, or the ZFR Pro Wireless Field Bus Router.

The FC bus port is connected internally to the FC bus terminal block. See Table 5 for more information about communication bus port functions, ratings, and requirements. The FC bus port pin assignment is shown in Figure 8.

Figure 8: Pin number assignments for FC bus and SA bus ports on equipment controllers



SA Bus port

The SA Bus port on the front of the controller is an RJ-12, 6-position modular jack that provides a connection for the MAP Gateway, the VAV Balancing Tool, the FX-DIS1710 local controller display, specified network sensors, or other SA Bus devices with RJ-12 plugs. When the CGM is configured for N2 network communication, you must download and commission the controller using the SA Bus port.

The Sensor port is connected internally to the SA bus terminal block. See Table 5 for more information about communication bus port functions, ratings, and requirements. The SA Bus port pin assignment is shown in Figure 8.

Supply power terminal block

The 24 VAC supply power terminal block is a gray, removable, 2-pin terminal block that fits into a board-mounted pin header 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 9. For more information about the Supply Power Terminal Block, see Table 5.

Figure 9: 24 VAC supply power terminal block wiring

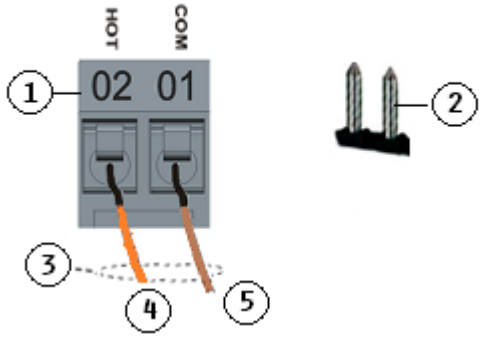


Table 2: Supply power terminal block wiring

	Description
1	Supply power terminal block
2	Supply power terminal header
3	Wires from Johnson Controls 24 VAC, class 2 power transformer
4	24 VAC (Orange wire)
5	COM (Brown wire)

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 equipment 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 equipment controller does not require an earth ground connection.

Important: Power wires must be less than 30 meters (100 ft) between controller and transformer

Terminal wiring guidelines, functions, ratings, and requirements

This section provides further guidelines on input and output wiring, maximum cable length versus load current, and SA Bus and supply power wiring.

Input and Output wiring guidelines

Table 3 provides information and guidelines about the functions, ratings, and requirements for the controller input and output terminals, and Table 4 also references guidelines for determining proper wire sizes and cable lengths.

In addition to the wiring guidelines in Table 3, 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 the 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.

I/O terminal block functions, ratings, and requirements

Table 3: I/O terminal block functions, ratings, requirements, and cable guidelines

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 **UI-*n*** terminals. Provides 100 mA total current	Same as (Universal) **UI-*n*** **Note:** Use 3-wire cable for devices that source power from the +15V terminal.
	UI-*n*	**Analog Input - Voltage Mode (0–10 VDC)** 10 VDC maximum input voltage Internal 10k ohm Pull-down	See Guideline **A** in Table 4
		Analog Input - Current Mode (4–20 mA) Internal 100 ohm load impedance **Note:** Current loop jumpers must be in the Enabled position to maintain a closed 4-20 mA current loop. See Setting the UI current loop jumpers.	See Guideline **B** in Table 4.
		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	See Guideline **A** in Table 4.
		Binary Input - Dry Contact Maintained Mode 1 second minimum pulse width Internal 12 V. 15k ohm pull up	See Guideline **A** in Table 4.
	UI-C or **UI-C*n***	**Universal Input Common** for all Universal Input terminals **Note:** All Universal UI-C or UI-C*n* terminals share a common, which is isolated from all other commons.	Same as (Universal) **UI-*n***

Table 3: I/O terminal block functions, ratings, requirements, and cable guidelines

Terminal Block label	Terminal label	Function, ratings, requirements	Determine wire size and maximum cable length
BINARY (Inputs)	**BI-***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 4.
		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	
	BI-C or **BI-C***n*	**Binary Input Common** for all Binary Input terminals ⓘ **Note:** All Binary BI-C or BI-C*n* terminals share a common, which is isolated from all other commons, except the Configurable Output (CO) common when the CO is defined as an Analog Output.	
CONFIGURABLE (Outputs)	**CO-***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 4.
		Binary Output - 24 VAC Triac (External Power Source only) Connects CO*n* to CO-C or CO-C*n* when activated. External Power Source Requirements: 24 VAC maximum output voltage 0.5 A maximum output current 40 mA minimum load current	See Guideline **C** in Table 4.
	CO-C or **CO-C***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) **CO-***n*.

Table 3: I/O terminal block functions, ratings, requirements, and cable guidelines

Terminal Block label	Terminal label	Function, ratings, requirements	Determine wire size and maximum cable length
ANALOG (Outputs)	**AO-***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. ⓘ **Note:** The Analog Output (AO) operates in the Voltage Mode when connected to devices with impedances greater than 1,000 ohm. Devices that drop below 1,000 ohm may not operate as intended for Voltage Mode applications.	See Guideline **C** in Table 4.
		Analog Output - Current Mode (4–20 mA) Requires and external load between 0 and 300 ohm. ⓘ **Note:** The Analog Output (AO) operates in the Current Mode when connected to devices with impedances less than 300 ohm. Devices with impedances greater than 300 may not operate as intended for Current Mode applications.	
	AO-C or **AO-C***n*	**Analog Output Signal Common** for all Analog Output terminals. ⓘ **Note:** All Analog Output Common terminals share a common, which is isolated from all other commons.	
BINARY (Output)	**BO-***n*	**Binary Output - 24 VAC Triac** (External Power Source) Connects BO-*n* to BO-C or BO-C*n* when activated. External Power Source Requirements: 24 VAC maximum output voltage 0.5 A maximum output current 40 mA minimum load current	See Guideline **C** in Table 4.
	BO-C or **BO-C***n*	**Binary Output Common** for all Binary Output terminals. ⓘ **Note:** Each Binary Output Common terminal is isolated from **all** other commons, including other Binary Output Common terminals.	

Cable and wire length guidelines

Table 4 defines cable length guidelines for the various wire sizes that may be used for wiring low-voltage (<30 V) input and outputs. The required wire sizes and lengths for high-voltage (>30 V) Relay Outputs are determined by the load connected to the relay, and local, national or regional electrical codes.

Table 4: Cable length guidelines

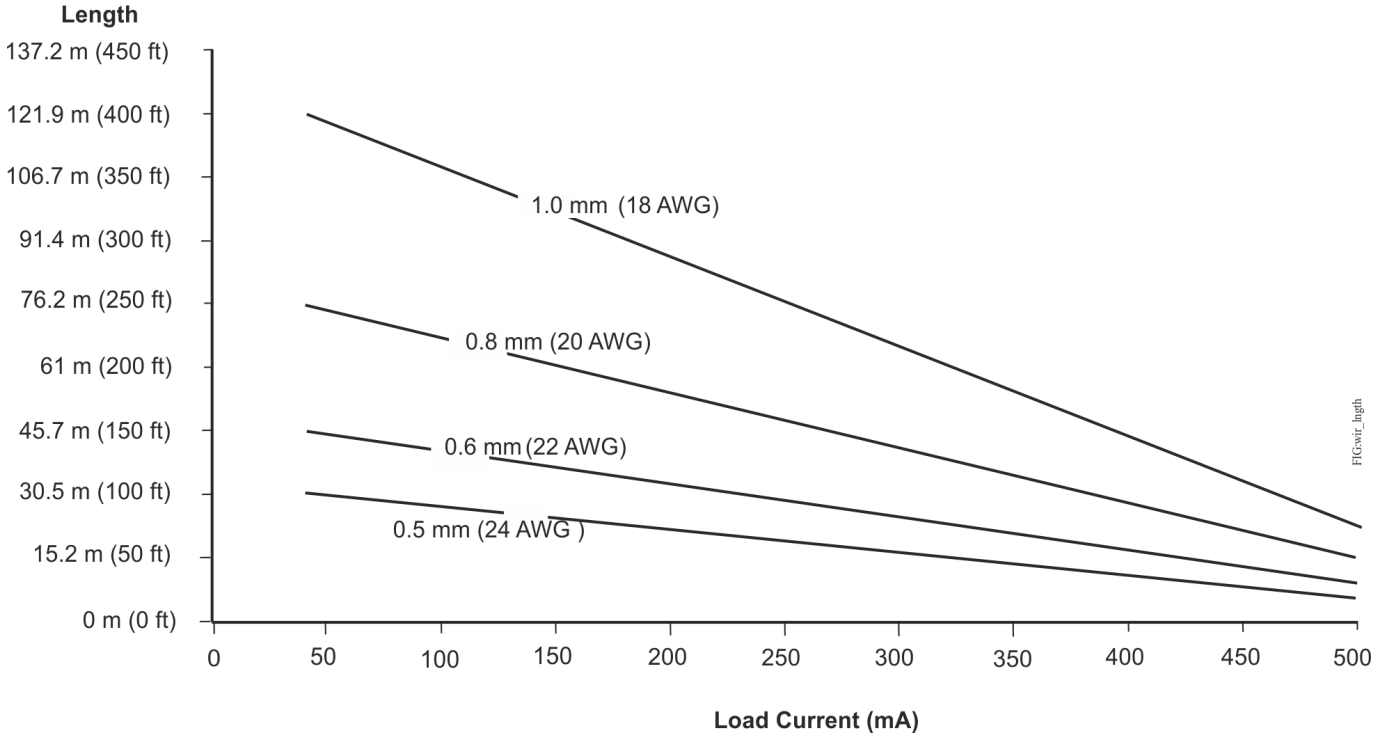
Guideline	Wire size/Gauge and type	Maximum cable length and type	Assumptions
A	1.0 mm (18 AWG) stranded copper	457 m (1,500 ft) twisted wire	100 mV maximum voltage drop Depending on the cable length and the connected input or output device, you may have to define an offset in the setup software for the input or output point.
	0.8 mm (20 AWG) stranded copper 297 m (975 ft) twisted wire	297 m (975 ft) twisted wire	
	0.6 mm (22 AWG) stranded copper 183 m (600 ft) twisted wire	183 m (600 ft) twisted wire	
	0.5mm (24 AWG) stranded copper 107 m (350 ft) twisted wire	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 the cable length 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	137 m (450 ft) twisted wire	
	0.6 mm (22 AWG) stranded copper 183 m (600 ft) twisted wire	91 m (300 ft) twisted wire	
	0.5 mm (24 AWG) stranded copper 107 m (350 ft) twisted wire	61 m (200 ft) twisted wire	
C	See Figure 10 to select wire size/ gauge. Use stranded copper wire.	See Figure 10 to determine cable length. Use twisted wire cable.	N/A

Maximum cable length versus load current

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

Note: Figure 10 applies to low-voltage (<30 V) inputs and outputs only.

Figure 10: Maximum wire length for low-voltage (<30 V) Inputs and Outputs by current and wire size



Communications bus and supply power wiring guidelines

Table 5 provides information about the functions, ratings, and requirements for the communication bus and supply power terminals. The table also provides guidelines for wire sizes, cable types, and cable lengths for wiring the controller's communication buses and supply power.

Important: Refer to the *N2 Modernization Guide for Legacy N2 Controllers (LIT-12012045)* for guidelines when you use this device on an N2 bus.

In addition to the guidelines in Table 5, observe the following guidelines when wiring an FC Bus, SA bus or the 24 VAC supply power:

- Run **all** low-voltage wiring and cables separate from high-voltage wiring.
- All FC and SA bus cables, regardless of wire size, should be twisted, insulated, stranded copper wire.
- Shielded cable is strongly recommended for all FC and SA bus cables.
- Refer to the *FX-PC Series Controllers MS/TP Communications Bus Technical Bulletin (LIT-12011670)* for detailed information regarding wire size and cable length requirements for FC and SA buses.

Communications bus and supply power terminal blocks, ratings, and requirements

Table 5: Communications bus and supply power terminal blocks, functions, ratings, requirements, and cable guidelines

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	
	SHD	Isolated terminal	
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 MAP Gateway or ZFR (or ZFR Pro) Wireless Router	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 POWER are the second twisted pair of wires.
	COM	SA Bus Signal Reference and 15 VDC Common	
	POWER	15 VDC Supply Power for Devices on the SA Bus (Maximum total current draw for SA Bus is 240 mA.)	
SA BUS (Port)	**SA BUS**	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	24 AWG 3-pair CAT3 cable <30.5 m (100 ft)
24V~	**HOT**	**24 VAC Power Supply - Hot** Supplies 20–30 VAC (Nominal 24 VAC)	0.8 mm to 1.0 mm (18 AWG) 2-wire < 30 m (100 ft)
	COM	**24 VAC Power Supply Common** (Isolated from all other Common terminals on controller) 14 VA	

Note: See Input and Output wiring guidelines to determine wire size and cable lengths for cables other than the recommended cables.

Note: The FC bus and SA 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)*.

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.

Note: The CGM04060 model does not have analog outputs. References to the analog output apply to the CGM09090 model only.

Table 6: Termination details

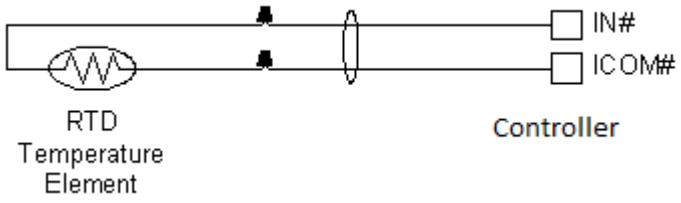
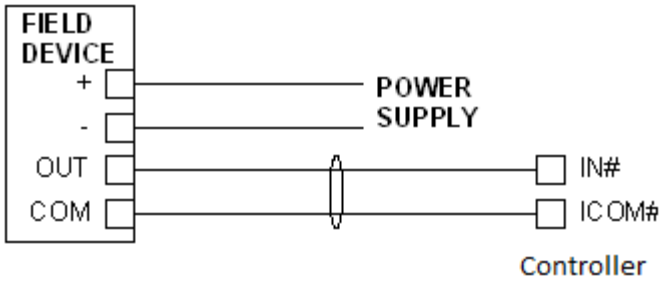
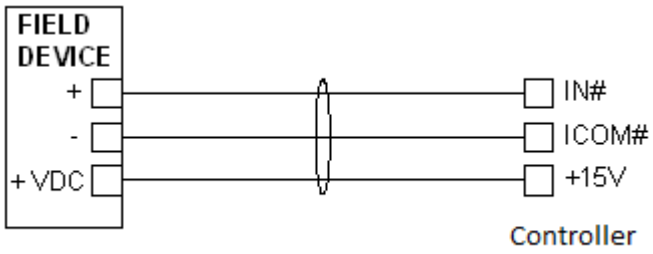
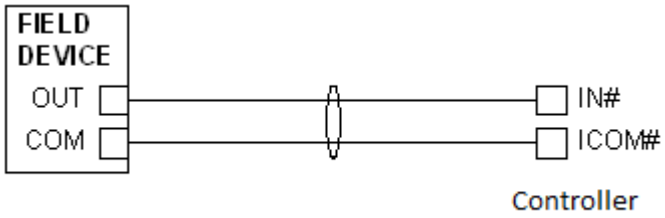
Type of field device	Type of Input/ Output	Termination diagrams
Temperature Sensor	UI	
Voltage Input - External Source	UI	
Voltage Input - Internal Source	UI	
Voltage Input (Self-Powered)	UI	

Table 6: Termination details

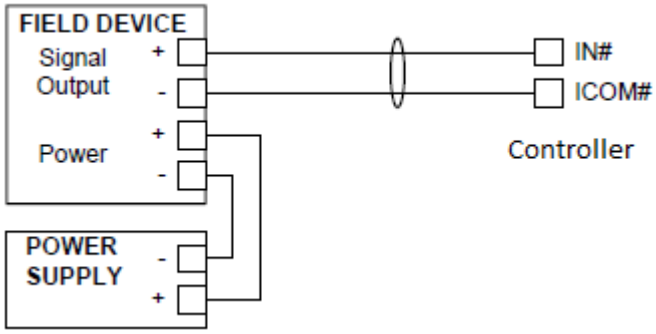
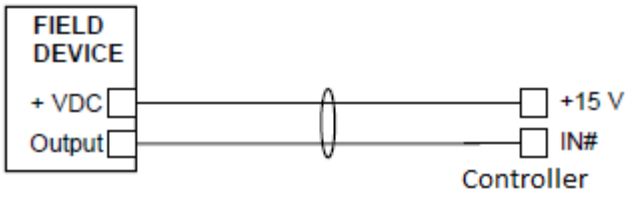
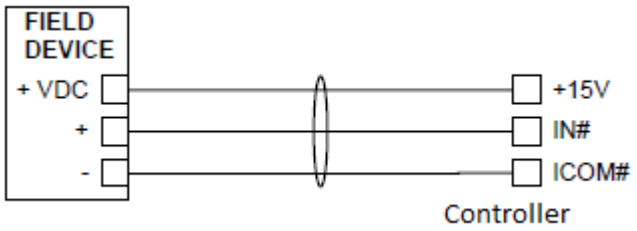
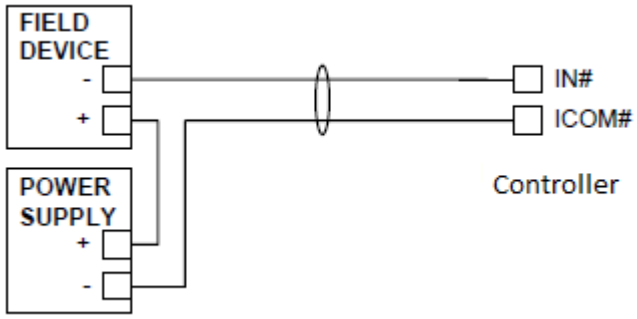
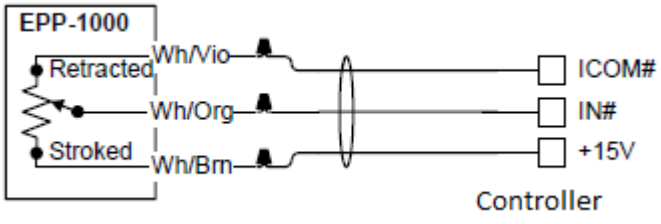
Type of field device	Type of Input/ Output	Termination diagrams
Current Input - External Source (Isolated)	UI	
Current Input - Internal Source (2-wire)	UI	
Current Input - Internal Source (3 wire)	UI	
Current Input - External Source (in Loop)	UI	
Feedback from EPP-1000	UI	

Table 6: Termination details

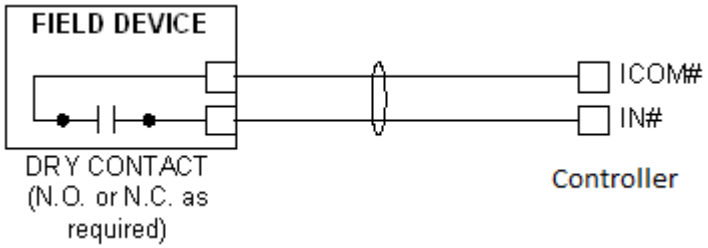
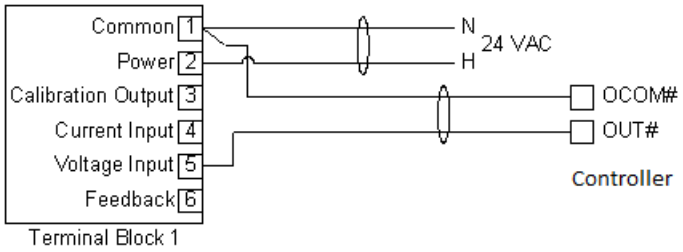
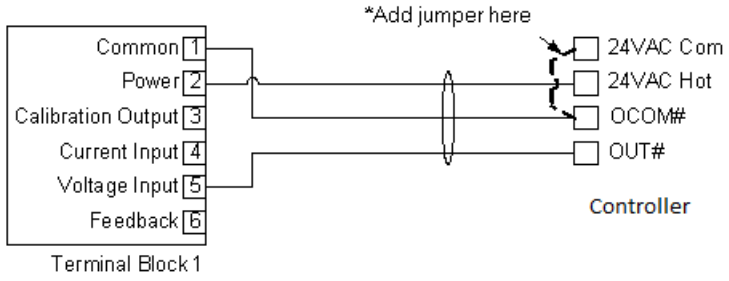
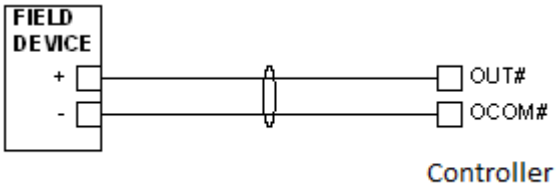
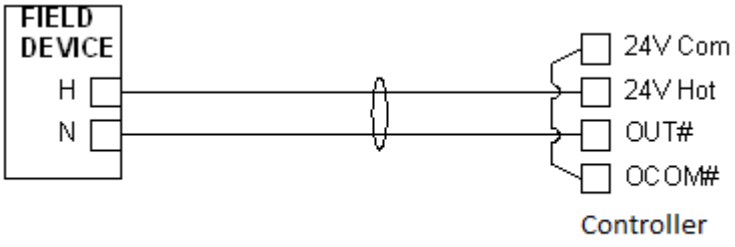
Type of field device	Type of Input/ Output	Termination diagrams
Dry Contact (Binary Input)	UI or BI	
0–10 VDC Output to Actuator (External Source)	CO or AO	
0–10 VDC Output to Actuator (Internal Source)	CO or AO	
Current Output	CO or AO	
24 VAC Triac Output (Switch Low, External Source)	CO or AO	

Table 6: Termination details

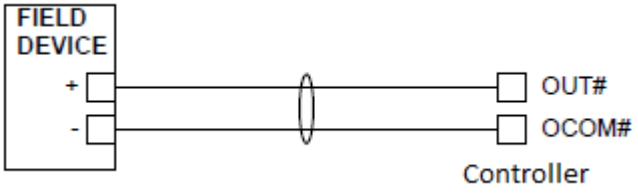
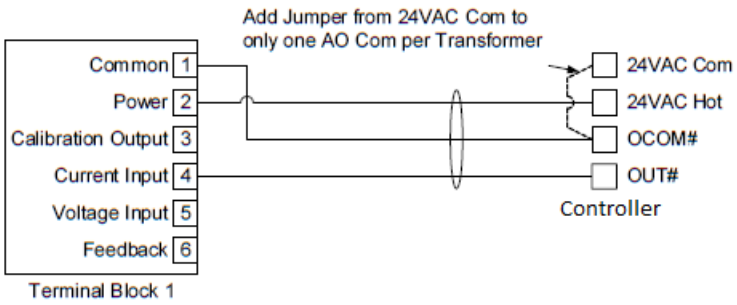
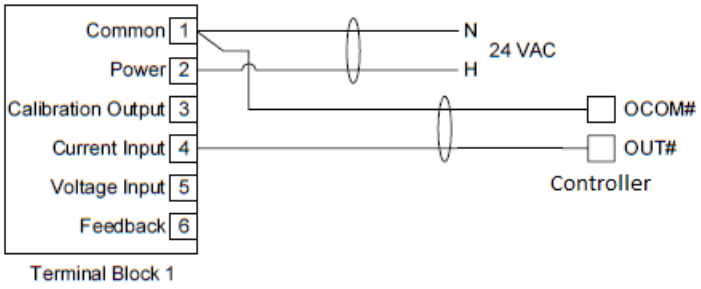
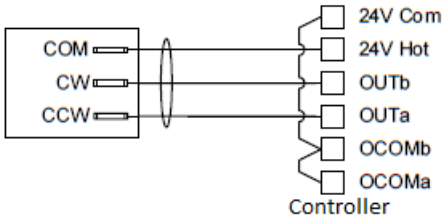
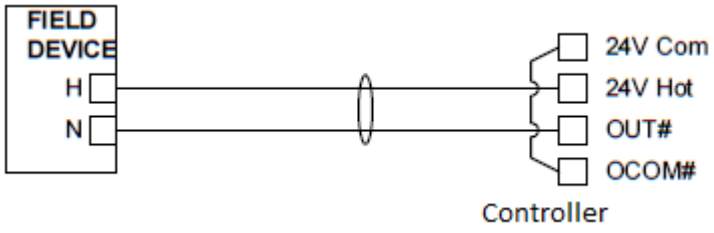
Type of field device	Type of Input/ Output	Termination diagrams
Analog Output (Current)	AO	
4–20 mA Output to Actuator	AO	
4–20 mA Output to Actuator	AO	
Incremental Control to Actuator (Switch Low, Externally Sourced)	BO	
24 VAC Binary Output (Switch Low, Externally Sourced)	BO	

Table 6: Termination details

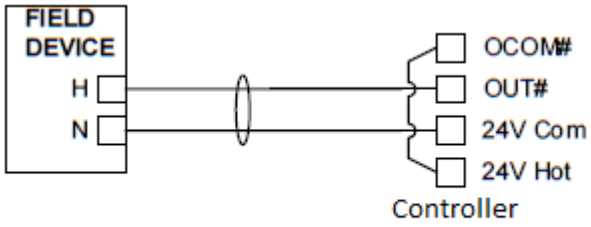
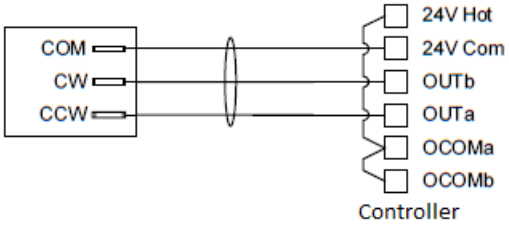
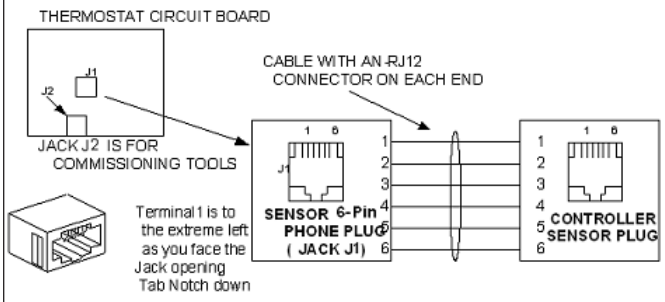
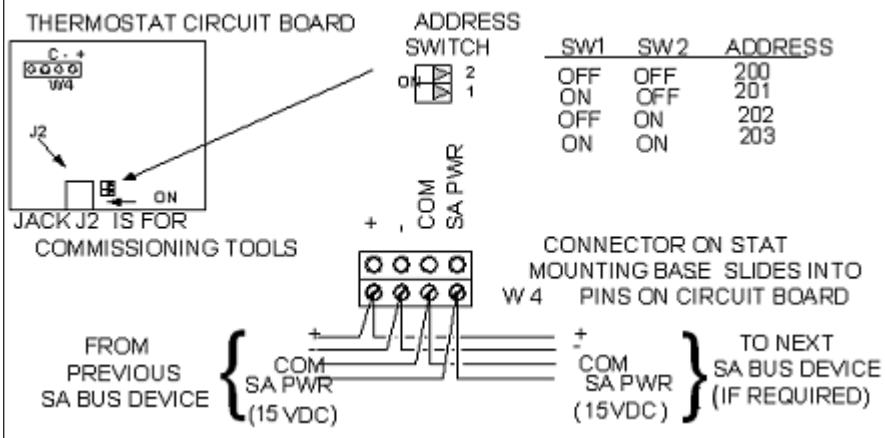
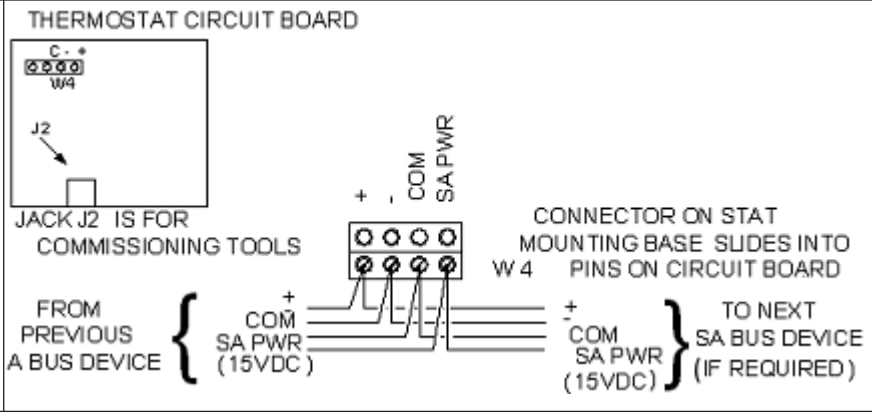
Type of field device	Type of Input/ Output	Termination diagrams
24 VAC Binary Output (Switch High, Externally Sourced)	BO	
Incremental Control to Actuator (Switch High, Externally Sourced)	BO	

Table 6: Termination details

Type of field device	Type of Input/ Output	Termination diagrams
Network Stat with Phone Jack (Fixed Address = 199)	SA Bus	 **Note:** The bottom jack (J2) on the TE-700 and TE-6x00 Series Sensors is not usable as a zone bus or an SAB connection.
Network Stat with Terminals Addressable	SA Bus	
Network Stat with Terminals (Fixed Address = 199)	SA Bus	

Setup and adjustments

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

Configuring N2 communications

About this task:
N2-capable controllers support the full range of possible N2 device addresses provided by the N2 protocol standard (1-254).

To configure a controller to communicate using the N2 protocol, complete the following steps:

1. Disconnect the 24 VAC supply from the controller.
2. Set the address switches to the desired N2 address. For details about setting a device address, see Setting the device address.
3. Reconnect the 24 VAC supply to the controller.
4. Using an SA bus connection, download the firmware and controller application file configured for N2 to the controller.

Switching the Communications Protocol from N2 to MS/TP

About this task:
For N2 sites that are converting to BACnet MS/TP, you can switch the communications protocol of N2-configured MS/TP controllers back to BACnet MS/TP.
To switch the CGM controller operating in N2 mode back into BACnet MS/TP mode, complete the following steps:

1. Disconnect the 24 VAC supply from the controller.
2. Set the address switches to the desired BACnet MS/TP address. For details about setting a device address, see Setting the device address.
3. Reconnect the 24 VAC supply to the controller.
4. Using an SA Bus connection, download a controller application file configured for BACnet MS/TP to the controller.

Configuring wireless communications

About this task:
To configure a controller for use with the ZFR Pro Series Wireless Field Bus system, complete the following steps:

1. Disconnect the 24 VAC supply from the controller.
2. 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 expansion modules to an SA bus only.)
3. **Important:** Before the CGM controller is powered on, connect the FX-/ZFR Pro Wireless Field Bus Router to the FC bus port (RJ-12 modular jack) on the front of the controller.
4. Ensure that the controller's rotary switches are set to the correct device address. For details about setting a device address, see Setting the device address.
5. Reconnect the 24 VAC supply to the controller.

   For more information about the ZFR Pro Wireless Field Bus system, refer to the *WRG1830/FX-ZFR183x Pro Series Wireless Field Bus System Technical Bulletin (LIT-12013553)*.

Setting the device address

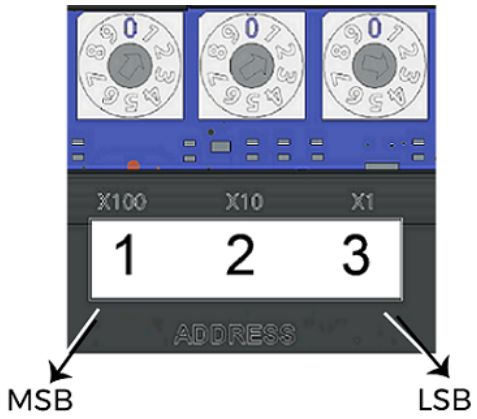
About this task:
F4 Series equipment controllers are master devices on MS/TP (FC or SA) buses. Before you operate controllers on a bus, you **must** set a valid and unique device address for each controller on the bus.
The following table describes the valid rotary switch device addresses for communications bus applications.

Table 7: Switch device addresses

FC Bus Communication Mode	Valid Device Address Range
Wired MS/TP communication	4-127 **Note:** Addresses 0-3 are reserved and not for use on equipment controllers.
Zigbee wireless communication	4-127 **Note:** Addresses 0-3 are reserved and not for use on equipment controllers.
N2 communication	1-254 **Note:** Addresses 0 and 255 are reserved and not for use on equipment controllers.

The device address is a decimal address that is set using three rotary switches located at the top of the controller. The numbers are ordered from left to right, most significant bit (MSB) to least significant bit (LSB) when the controller is oriented as shown in Physical features. In the following figure, the switches are set to 1 2 3, designating this controller's device address as 123.

Figure 11: Device address rotary switch block



The device address must match the device address defined in the Controller Configuration Tool (CCT) under ***Define Hardware > Network Settings***.
To set the device addresses on CGM controllers, complete the following steps:

1. Set a unique and sequential device address for each of the devices connected on the FC or SA Bus, starting with device address 4.
2. 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 devices do not need to be physically connected on the bus in their numerical device address order.
3. Write each controller's device address on the white label below the device address rotary switch block on the controller's cover.

Refer to the *FX-PC Series Controllers MS/TP Communications Bus Technical Bulletin (LIT-12011670)* for more information about controller device addresses and how to set them on MS/TP buses.

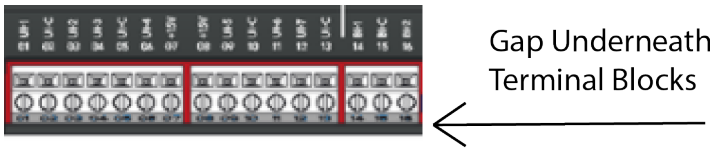
Removing a terminal block

About this task:
To remove a terminal block from the circuit board, complete the following steps:

Note: You need a flat blade screwdriver to remove the terminal block.

1. To prevent any possibility of damage from an accidental short, **remove power from the controller**.
2. Underneath the terminal block, in the small gap between the bottom of the terminal block and the circuit board, insert the flat blade of the screwdriver.

Figure 12: Terminal block



3. To detach the left-hand side of the terminal block, position the flat blade underneath the terminal block to the left, and push down the screwdriver handle. When you do this, you are using the screwdriver as a lever to pry up the terminal block.
4. To detach the right-hand side of the terminal block, position the flat blade underneath the terminal block to the right, and push down the screwdriver handle.
5. If necessary, repeat steps 3 and 4 until the terminal block is removed.

Removing the controller cover

About this task:

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

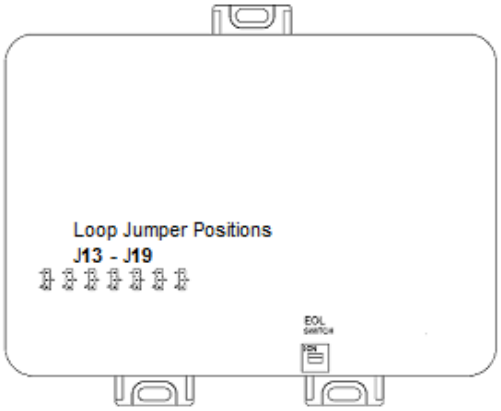
Important: Disconnect all power sources to the controller before removing the cover and changing the position of any jumper on the controller. Failure to disconnect power before changing a jumper can result in damage to the controller and void any warranties.

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, complete the following steps:

1. Place your fingertips under the two cover lift tabs (Physical features) 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 13: CGM with cover removed showing EOL switch and jumper positions (CGM09090 model shown)



Setting the End-of-Line (EOL) switch

About this task:
Each CGM controller has an EOL switch, which, when set to ON (up), sets the controller as a terminating device on the bus. See Figure 13 for the EOL switch location. The default EOL switch position is OFF (down).

Figure 14: End-of-Line switch positions

To set the EOL switch on a controller, complete the following steps:

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: For detailed information about EOL termination rules and EOL switch settings on FC buses, refer to the *FX-PC Series Controllers MS/TP Communications Bus Technical Bulletin (LIT-12011670)*.

3. If the controller is a terminating device on the FC 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 controller is connected to power with its EOL switch set to ON, the amber EOL LED on the controller cover is illuminated.

Setting the UI current loop jumpers

CAUTION

Risk of Electric Shock:

Disconnect supply power to the devices before attempting to adjust the UI current loop jumpers. Failure to disconnect the supply power may result in electric shock.

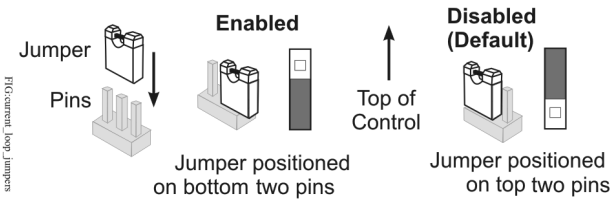
ATTENTION

Mise En Garde: Risque de décharge électrique:

Débrancher l'alimentation de l'controller avant tout réglage du UI current loop jumpers. Le non-respect de cette précaution risque de provoquer une décharge électrique.

The UI current loop jumpers are on the circuit board under the controller cover near the UI terminals (Figure 13). When a UI is defined (in the system software) as a 4-20 mA Analog Input, set the UI's current loop jumper to the Enabled position (Figure 15).

Figure 15: UI Current Loop Jumper Positions



Setting the current loop jumper to the Enabled position, 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.

Important: A current loop jumper must be in the Enabled position to maintain a closed 4-20 mA current loop.

The following tables identify the current loop switches associated with each UI on the CGM09090 and CGM04060 controllers.

Table 8: CGM09090 UI Inputs and jumper labels

Universal Input label	Jumper label on circuit board
UI-1	J13
UI-2	J14
UI-3	J15
UI-4	J16
UI-5	J17
UI-6	J18
UI-7	J19

Table 9: CGM04060 UI Inputs and jumper labels

Universal Input label	Jumper label on circuit board
UI-1	J10
UI-2	J11
UI-3	J12

Setting up a local display

CGM models do not have an integral display, but can be connected to an FX-DIS1710 Local Controller Display. For detailed information about setting up and operating a remotely connected FX-DIS1710 display, refer to the *FX-DIS Local Controller Display Technical Bulletin (LIT-12011666)*.

Input/Output Wiring Validation

The CGM controllers ship with a default state that can assist in validating the wiring of the input and output terminals prior to download of an application file. When the controller is powered on in this state, the Fault LED will flash in a pattern of two quick blinks and then a long pause (see Table 10).

To make use of this feature, ensure the rotary switches are set to the desired address and wire the input and output terminals. Apply power to the CGM controller and connect to the device with either a MAP Gateway or MS-DIS1710-0 Local Display to view the points in the controller. The CGM controller will report an Operational status even though there is no true application loaded. CCT will not be able to commission or upload the device as a result until a true application is downloaded. The application name displayed will be the address of the controller followed by the model of the controller and “Default State”.

For example, a CGM09090 controller whose rotary switches are set to 8 would have the default state application name of “8-CGM09090 Default State”.

The default state creates I/O points for all connections on the input and output terminals. It assumes all Universal Inputs (UIs) are Nickel temperature sensors. All Configurable Outputs (COs) are treated as Binary Outputs (BOs) with an initial value of 0. The default state also takes input from a Network Sensor at address 199. If there is no connected Network Sensor, the startup of this default state will be delayed by 30 seconds as the controller attempts to establish connection with the sensor.

Commissioning equipment controllers

You commission MS/TP equipment controllers with the CCT software using either Mobile Access Portal (MAP) Gateway , a ZFR wireless dongle, or through the FX Supervisory Controller acting as a BACnet router. For detailed information about commissioning equipment controllers, refer to *Controller Tool Help (LIT-12011147)*.

Troubleshooting equipment controllers

Observe the Status LEDs on the front of the equipment controller. Table 10 provides LED status indicator information for troubleshooting the controller. To troubleshoot an integral or local controller display, refer to the *FX-DIS1710 Local Controller Display Technical Bulletin (LIT-12011666)*.

LED status and states

Table 10: Status LEDs and description 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	2 blinks followed by long pause = Controller powered on in default state. For more information about this default state, see Input/Output Wiring Validation. Off Steady = No Faults On Steady = Device Fault; no application loaded; Main Code download required, if controller is in Boot mode, or a firmware mismatch exists between the CGM and the ZFR1811 Wireless Field Bus Router. Blink - 2 Hz = Startup in progress, not ready for normal operation Rapid blink = SA Bus communications issue
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

Ordering information and accessories

The following tables provide the product code number and description for the CGM models and accessories.

Table 11: CGM Series ordering information

Product code number	Description
F4-CGM04060-0	10-point General Purpose Application MS/TP Controller Includes: MS/TP (and N2) communication; 10 points (3 UI, 1 BI, 4 CO, 2 BO); real-time clock; 24VAC input
F4-CGM09090-0	18-point General Purpose Application MS/TP Controller Includes: MS/TP (and N2) communication; 18 points (7 UI, 2 BI, 4 CO, 2 AO, 3 BO); real-time clock; 24VAC input

Table 12: CGM Controller accessories (order separately)

Product Code Number	Description
XPM Series Expansion Modules	Refer to the *Facility Explorer CG, CV Equipment Controllers and XPM Expansion Modules Product Bulletin (LIT-12013225)* for a complete list of available XPM series expansion modules.
FX-FCP-0	License enabling Facility Explorer Equipment Controller Firmware Package Files required for CCT
Mobile Access Portal (MAP) Gateway	Refer to the *Mobile Access Portal Gateway Catalog Page (LIT-1900869)* to identify the appropriate product for your region.
FX-DIS1710-0	Local Controller Display
NS Series Network Sensors	Refer to the *NS Series Network Sensors Product Bulletin (LIT-12011574)* for specific sensor model descriptions.
AS-CBLTSTAT-0	Cable adapter for connection to 8-pin TE-6700 Series sensors
NS-WALLPLATE-0	Network Sensor Wall Plate
WRZ Series Wireless Room Sensors	Refer to the *WRZ Series Wireless Room Sensors Product Bulletin (LIT-12000653)* for specific sensor model descriptions.
WRZ-7860-0	Refer to the *WRZ-7860 Receiver for One-to-One Wireless Room Sensing Product Bulletin (LIT-12011640)* for a list of available products.
WRZ-SST-120	Wireless System Survey Tool (for use with the lower power 10mW WRZ and WRZ-7860 systems) Refer to the *WRZ-SST-120 Wireless Sensing System Tool Installation Instructions (LIT-24-10563-55)* for usage instructions.
ZFR-HPSST-0	Wireless System Survey Tool (for use with the higher power WRG1830/ZFR183x systems)
WRG1830/ZFR183x 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 such as the network engine. Refer to the *WRG1830/ZFR183x Pro Series Wireless Field Bus System Catalog Page (LIT-1901026)* for a list of available products.
Y64T15-0	Transformer, 120/208/240 VAC Primary to 24 VAC Secondary, 92 VA, Foot Mount, 72.2 cm (30 in.), Primary Leads and 76.2 cm (30 in.) Secondary Leads, Class 2
Y65A13-0	Transformer, 120 VAC Primary to 24 VAC Secondary, 40 VA, Foot Mount (Y65AS), 20.32 cm (8 in.), Primary Leads and 76.2 cm (30 in.) Secondary Leads, Class 2
Y65T31-0	Transformer, 120/208/240 VAC Primary to 24 VAC Secondary, 40 VA, Foot Mount (Y65AR+), 20.32 cm (8 in.), Primary Leads and Secondary Screw Terminals, Class 2
Y65T42-0	Transformer, 120/208/240 VAC Primary to 24 VAC Secondary, 40 VA, Hub Mount (Y65SP+), 20.32 cm (8 in.), Primary Leads and Secondary Screw Terminals, Class 2

Table 12: CGM Controller accessories (order separately)

Product Code Number	Description
ACC-TBKINOUT-0	Input and Output terminal block replacement kit for SNC, CGM, CVM and XPM products. Kit includes 5 of each 2, 3, and 4 position Input and Output terminal blocks.
ACC-TBKPWFCSA-0	Power, FC Bus, and SA Bus terminal block replacement kit for SNC, CGM, CVM, and XPM products. Kit includes 5 of each terminal block type.
MS-FIT100-0	The Field Inspection Tool or (FIT) is a portable handheld device with a user interface that is used to test and troubleshoot the BACnet protocol MS/TP RS-485 communications bus that connects supervisory controllers and equipment controllers to field point interfaces. The FIT can be used to check out the wiring of the MS/TP RS-485 bus as well as verify proper communications of supervisory controllers and equipment controllers connected to the bus. The FIT can be used on both the FC Bus and SA Bus.

Technical specifications

Table 13: Technical specifications

	Descriptions
Power Requirement	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 ⓘ **Note:** The USB feature is not currently supported. ⓘ **Note:** The 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).
Power Source	+15 VDC power source terminals provide 100 mA total current. CGM09090: Quantity 2-located in Universal IN terminals for active (3-wire) input devices. CGM04060: Quantity 1-located in Universal Input terminals for active (3-wire) input devices.
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
Communications Protocol	BACnet MS/TP; N2. Wireless also supported (at FC Bus and for Sensors) with additional hardware.
Device Addressing for BACnet MS/TP	Decimal address set via three rotary switches; valid controller device addresses 4-127
Device Addressing for N2	Decimal address set via three rotary switches: valid controller device addresses 1-254
Communications Bus	BACnet MS/TP (default); N2 3-wire FC Bus between the supervisory controller and equipment controllers 4-wire SA Bus between equipment controller, network sensors and other sensor/actuator devices, includes a lead to source 15 VDC supply power (from equipment controller) to bus devices.
Processor	RX64M Renesas® 32-Bit microcontroller
Memory	16 MB flash memory and 8 MB SDRAM
Real-Time Clock Backup Power Supply	Super capacitor maintains power to the onboard real-time clock for a minimum of 72 hours when supply power to the controller is disconnected.
Input and Output Capabilities	**Universal Inputs:** Defined as 0–10 VDC, 4–20 mA, 0–600k ohms, or Binary Dry Contact **Binary Inputs:** Defined as Dry Contact Maintained or Pulse Counter/Accumulator Mode **Configurable Outputs** Defined as 0-10 VDC or 24 VAC @500mA Triac BO **Analog Outputs:** Defined as 0–10 VDC or 4–20 mA **Binary Outputs:** Defined as 24 @500mA VAC Triac (external power source only)
Universal Input (UI) Resolution/ Analog Output (AO) Accuracy	**Input:** 24-bit Analog to Digital converter **Output:** +/- 200 mV accuracy in 0–10 VDC applications
Terminations	**Input/Output:** Pluggable Screw Terminal Blocks **FC Bus, SA Bus and Supply Power:** 4-Wire and 2-Wire Pluggable Screw Terminal Blocks **FC Bus and SA Bus Ports:** RJ-12 6-Pin Modular Jacks
Mounting	Horizontal on single 35 mm DIN rail mount (recommended), or screw mount on flat surface with three integral mounting clips on controller
Housing	**Enclosure material:** ABS and polycarbonate UL94 5VB; Self-extinguishing Protection Class: IP20 (IEC529)
Dimensions (Height x Width x Depth)	**F4-CGM04060-0:**150 mm x 125 mm x 44.5 mm (5-7/8 in. x 4-7/8 in. x 2-1/8 in.) including terminals and mounting clips **F4-CGM09090-0:** 150 mm x 190 mm x 44.5 mm (5-7/8 in. x 7-1/2 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	**F4-CGM04060-0:** 0.29 kg (0.64 lb) **F4-CGM09090-0:** 0.5 kg (1.1 lb)

Table 13: Technical specifications

	Descriptions
Compliance	**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 and RoHS Directive.
CE	**Australia and New Zealand:** RCM Mark, Australia/NZ Emissions Compliant
	BACnet International: BACnet Testing Laboratories™ (BTL) Protocol Revision 18 Listed and Certified BACnet Advanced Application Controller (B-AAC), based on ANSI/ASHRAE 135-2016

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.

Repair information

If an equipment expansion module fails to operate within its specifications, replace the expansion module. For a replacement expansion module, contact your Johnson Controls representative.

Product warranty

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

Patents

Patents: https://jcipat.com

Single point of contact

APAC	Europe	NA/SA
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