VMA1615/1626/1628/1630 VAV Controllers Installation Instructions

MS-VMA1615, MS-VMA1626, MS-VMA1628, MS-VMA1630

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Refer to the QuickLIT website for the most up-to-date version of this document.

Applications

The VMA1615/1626/1628/1630 programmable digital controllers are designed for VAV applications that communicate through the BACnet® Master-Slave/Token-Passing (MS/TP) or N2 protocol. These VMA controllers feature combinations of an integral digital pressure sensor (DPT), a damper actuator, and a 32-bit microprocessor. The VMA1626 has an actuator but does not contain a DPT. The VMA1628 model has a DPT but does not contain an actuator. The controllers' small package size facilitates quick field installation and efficient use of space without compromising high-tech control performance. These VMA controllers connect easily to the wired and wireless network sensors for zone and discharge air temperature sensing.

Switchable Communications Protocols

By default, the *Metasys*® system FEC Family Controllers and network sensors communicate using either the standard BACnet protocol based on the ANSI/ASHRAE 135-2004, or the BACnet/IP protocol.

The BACnet protocols standard for ANSI, ASHRAE, and the International Standards Organization (ISO) for building controls.

FEC, IOM, and VMA16 Controllers are BTL-tested and 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). The NS Series Sensors are BTL-listed as BACnet Smart Sensors (B-SSs).

Release 10.1 and later of CCT can be used to switch the Field Bus communications protocol in supported FEC Family Field Controllers VMA Series Controllers to be either the standard BACnet Master-Slave/Token-Passing (MS/TP) or the N2 protocol. All new controllers either use 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. The *Modernization Guide for Legacy N2 Controllers (LIT-12012005)* and the controller-specific documentation provide installation and commissioning support and include tips for efficient and safe replacement. Refer to the *N2 Compatibility Options* chapter of the *Controller Tool Help (LIT-12011147)* for information about mapping N2 Objects in controllers with switchable communications protocols.

The N2-capable FEC Family Controllers can be used as functional replacements for legacy N2 controllers. The N2-capable FEC Family Controllers:

- have the input and output (I/O) quantities and characteristics of the FEC Family Controllers
- must be programmed with CCT, which has similar, but not identical programming capabilities as HVACPro, GX9100, GPL, and other legacy tools
- support SA Bus devices
- support WRZ wireless sensors from the controller using the WRZ-7860 receiver
- are available in Buy American versions (most models)

The N2-capable FEC family controllers:

- do not support Zone Bus (for example, TMZ sensors and M100 actuators) or XT-Bus (System 91) devices (for example, XT, XTM, and XP modules)
- do not support a wireless connection to the N2 bus
- do not support NxE passthrough
- are not listed for UL864 UUKL; N2 **is not** supported as part of the *Metasys* 9th Edition listing for Smoke Control System Equipment

Johnson Controls

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 VMA1615/1626/1628/1630 controller:

- Transport the VMA controller in the original container to minimize vibration and shock damage to the VMA controller.
- Do not drop the VMA controller or subject it to physical shock.

Parts Included

- one VMA1615/1626/1628/1630 controller with removable SA bus and power terminal blocks
- one installation instructions sheet
- one self-drilling No. 10 x 25 mm (1 in.) screw
- the VMA1628 model includes a 1.25 inch extended length screw.

Materials and Special Tools Needed

- several 6 mm (1/4 in.) female spade terminals for input and output wiring and crimping tool or spade mounted terminal blocks
- small, straight-blade screwdriver for securing wires in the terminal blocks
- 8 mm (5/16 in.) wrench or 10 mm (3/8 in.) 12-point socket to tighten the square coupler bolt
- several shims or washers to mount the VMA
- power screwdriver, 100 mm (4 in.) extension socket, punch, drill, and 3.5 mm (9/64 in.) drill bits to mount the VMA
- pliers to open and close the damper
- required length of 3.97 mm (5/32 in.) ID pneumatic tubing and barbed fittings

Mounting

Observe these guidelines when mounting a VMA:

Important: When the air supply to the VAV box is below 10°C (50°F), make sure that any condensation on the VAV box, particularly on the damper shaft, does not enter the VMA electronics. Mount the VMA vertically above the damper shaft to allow any shaft condensation to fall away from the VMA. Additional measures may be required in some installations.

- Ensure that the mounting surface can support the VMA and any user-supplied enclosure.
- Mount the VMA on a hard, even surface whenever possible.
- Use shims or washers to mount the VMA securely and evenly on the mounting surface.
- Mount the VMA in an area free of corrosive vapors that matches the ambient conditions specified in the *Technical Specifications* section.
- Provide sufficient space around the VMA for cable and wire connections and adequate ventilation through the controller (at least 50 mm [2 in.] on the top, bottom, sides, and front of the controllers).
- Do not mount the VMA in areas where electromagnetic emissions from other devices or wiring can interfere with controller communication.
- Avoid mounting the VMA on surfaces with excessive vibration.
- When using the VMA1615/1626/1628/1630 to replace a VMA1610 or VMA1620 controller, plug the unused open hole in the duct work from the original VMA mounting if possible. Plug the hole using the sheet metal screw from the original installation (preferred option).

On panel or enclosure mount applications, observe these additional guidelines:

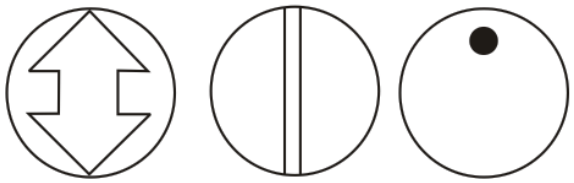
- Do not install the VMA in an airtight enclosure.
- Mount the VMA so that the enclosure walls do not obstruct cover removal or ventilation through the controller.
- Mount the VMA so that the power transformer and other devices do not radiate excessive heat to the controller.

To mount the VMA1615/1626/1628/1630 controllers:

1. Set all the switches on the field controller to their known settings.
2. Place the VMA controller in the proper mounting position on the damper shaft so that the wiring connections are easily accessible. Make sure the VMA controller base is parallel to the VAV box (perpendicular to the damper shaft). If needed, use a spacer to offset tipping of the VMA controller caused by the shaft bushings.
   Note: Use the alignment marks to center the captive spacer to ensure sufficient VMA movement in either direction.
3. Secure the self-drilling No. 10 screw through the captive spacer (*Figure 2*) with a power screwdriver and 100 mm (4 in.) extension socket. Otherwise, use a punch to mark the position of the shoulder washer, and then drill a hole into the VAV box using a 3.5 mm (9/64 in.) drill bit. Insert the mounting screw and tighten against the spacer. For the VMA1628 models, use the additional 1.25 inch screw to mount to one of the two holes provided near the actuator opening (see *Figure 2*) to mount the controller.

   Important: Do not overtighten the screw, or the threads may strip. If mounting to the VAV box, make sure the screws do not interfere with damper blade movement.
4. Locate the damper position using the typical marking on the end of the damper shaft as shown in the figure below.

Figure 1: Typical Damper End Shaft Icons



5. Note the direction, clockwise (CW) or counterclockwise (CCW), required to close the damper. Grasp the damper shaft firmly with pliers, and either manually close the damper for 90° boxes or manually open the damper for 45° or 60° boxes.
6. Push down and hold the Manual Override button (*Figure 2*) and turn the VMA controller coupler until it contacts the mechanical end-stop at either the full-closed (90° boxes) or full-open (45° and 60° boxes) position.
7. If the damper for a 90° box closes CCW, rotate the coupler to the CCW mechanical limit. If the damper for a 90° box closes CW, rotate the coupler to the CW mechanical limit. The open end-stop is automatically set for 90° boxes.
   For 45° and 60° boxes, hard stops must be provided at both full-closed and full-open damper positions. By installing the VMA controller at the full-open position, the VMA controller provides the open stop

for 45° and 60° boxes. The closed damper seal provides the full-closed stop.

8. All models are compact in size and are easily installed on VAV boxes. The VMA1615/1626/1630 models have either a round shaft up to 13 mm in diameter or a 10 mm square shaft. Tighten the square coupler bolt to the shaft using an 8 mm (5/16 in.) wrench or 10 mm (3/8 in.) 12-point socket. Tighten to 10.5 to 11.5 N·m (95 to 105 lb·in).
9. Skip this step if you are installing the VMA1626 model. Loop the pneumatic tubing (supplied by field personnel) to include a trap for condensation. Attach the needed length of tubing (supplied and installed by field personnel) to the dual port fitting on the VMA controller and the other ends of the tubing to the pressure transducer in the VAV box application (*Figure 2*).
   Note: The VMA uses a digital non-flow pressure sensor (all models except the VMA1626) with bidirectional flow operation, which allows you to connect the high- and low-pressure DP tubes to either barbed fitting on the VMA controller. You do not need to make a specific high- or low-side connection when you attach the tubing to the barbed fittings on the VMA.
10. Push the Manual Override button, and turn the actuator coupling manually to ensure that the actuator can rotate from full-closed to full-open positions without binding.
11. Complete the mounting by rotating the damper to the full-open position.

NOTICE

Risk of Property Damage. Rotate the damper to the full-open position before starting the air handler. Failure to rotate the damper to the full-open position may result in damage to the VAV box or ductwork when the air handler is started.

Risque de dégâts matériels. Faire pivoter le registre pour le placer en position d'ouverture complète avant de démarrer l'unité de traitement d'air. Le non-respect de cette directive risque d'endommager le caisson de l'unité à volume d'air variable (VAV) ou le réseau de conduites au démarrage de l'unité de traitement d'air.

Figure 2: VMA1615/1626/1628/1630 Controller Wiring Terminations and Physical Features (VMA1630-1 Model Shown)

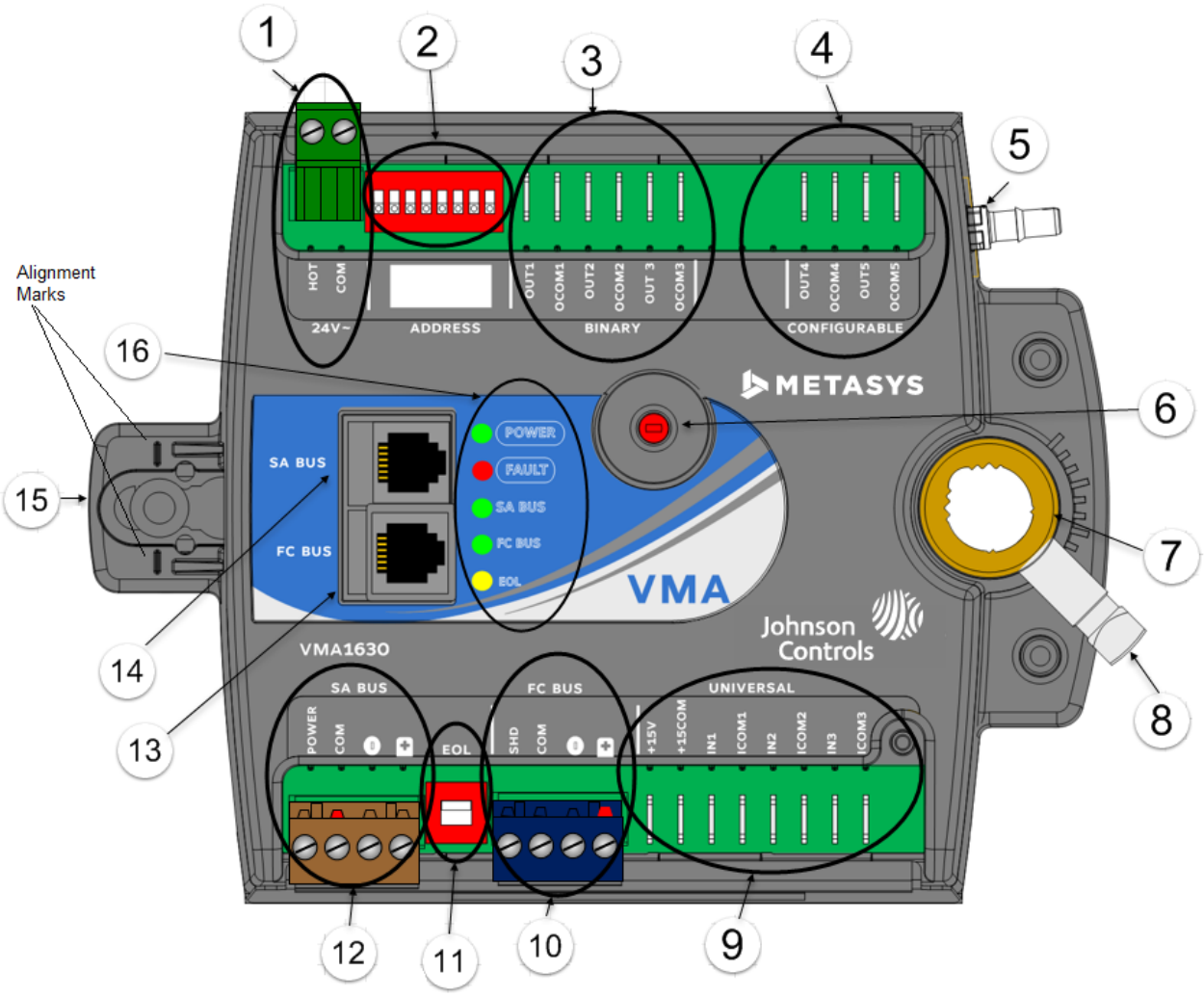


Table 1: VMA1615/1626/1628/1630 Feature Callout Numbers and Descriptions

Callout	Physical Features: Description and References
1	24 VAC, Class 2 Supply Power Terminal Block (see *Supply Power Terminal Block*)
2	Device Address DIP Switch Block (see *Setting the Device Address*)
3	Binary Outputs, 24 VAC Triacs (see *Table 3*)
4	Configurable Outputs: Voltage Analog Output (0–10 VDC) and Binary Output (24 VAC Triac) (VMA1630, 1626, and 1628 (see *Table 3*)
5	Dual Port Fitting (see *Figure 2*)
6	Manual Override Button (see *Mounting*)
7	Controller Coupler (see *Mounting*)
8	Coupler Bolt (see *Mounting*)
9	Universal Input: Voltage Analog Input (0–10 VDC) Resistive Analog Inputs (0–600k ohm) (see *Table 3*): 0–2k Potentiometer RTD: 1k Nickel, 1k Platinum, or A99B SI NTC: 10K Type L (10K Johnson Controls Type II is equivalent to Type L) or 2.252K Type II Dry Contact Binary Input
10	FC Bus Terminal Block. May also be used for N2 connections. See *FC Bus Terminal Block (Or N2 Protocol As Required)*.
11	EOL (End-of-Line) Switch (see *Setting the EOL Switch*)
12	SA Bus Terminal Block
13	Modular Port (FC Bus) RJ-12 6-Pin Modular Jack (see *Modular Ports*)
14	Modular Port (SA Bus) RJ-12 6-Pin Modular Jack (see *Modular Ports*)
15	Captive Spacer and Screw (see *Figure 2*)
16	LED Status Indicators (see *Table 9*)

Wiring

⚠ CAUTION

Risk of Electric Shock. Disconnect the power supply before making electrical connections to avoid electric shock.

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

Important: Do not connect supply power to the controller before finishing wiring and checking all wiring connections. Short circuits or improperly connected wires can result in damage to the controller and void any warranty.

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, Field Controller (FC), or Sensor/Actuator (SA) Bus, refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034).*

VMA Terminals and Bus Ports

See (*Figure 2*) for input and output terminal and bus port locations on the VMA1615/1626/1628/1630 controllers. Observe the following guidelines when wiring a VMA controller.

Input and Output Terminals

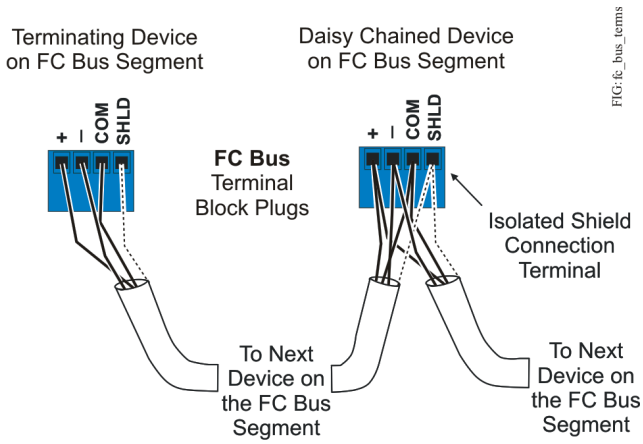
The input spade terminals are located on the side of the VMA near the FC Bus terminal block. The output spade terminals are located on the opposite side of the controller near the power supply terminal block. See *Table 3* for more information.

FC Bus Terminal Block (Or N2 Protocol As Required)

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 VMA and other controllers in a daisy-chain configuration using 3-wire twisted, shielded cable as shown in *Figure 3*. See *Table 5* for more information.

Figure 3: FC Bus Terminal Block Wiring



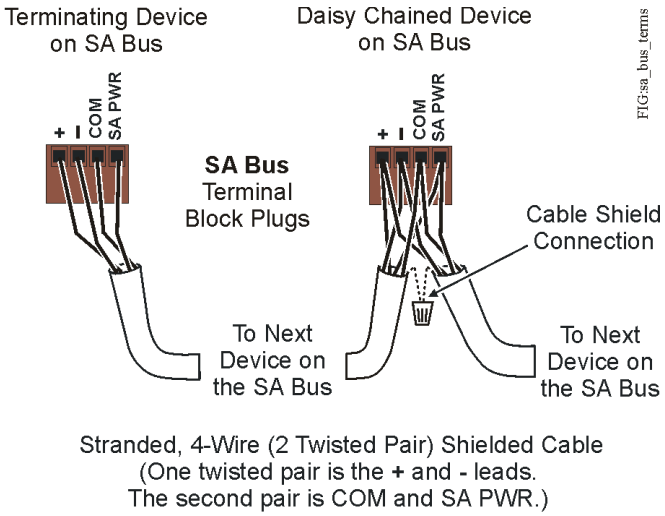
Note: The Shield terminal (SHLD) on the FC Bus terminal block is isolated and can be used to connect the cable shields on the bus (*Figure 3*).

SA Bus Terminal Block

The SA Bus terminal block is a brown, removable, 4-terminal plug with +15 VDC that fits into a board-mounted jack.

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

Figure 4: SA Bus Terminal Block Wiring

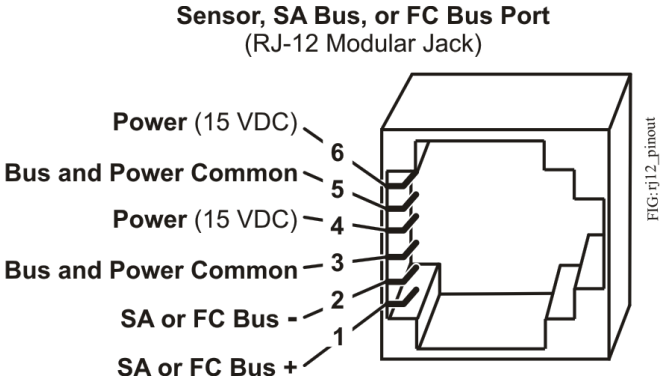


Modular Ports

The modular and FC Bus ports on the face of the VMA (*Figure 2*) are RJ-12 (6-position) modular jacks as shown in *Figure 5*.

The modular SA Bus port provides a connection for the Wireless Commissioning Converter (BTCVT), VAV Balancing Tool, DIS1710 Local Controller Display, WRZ78xx Series One-to-One Wireless Transmitter, and NS Series sensors. The modular FC Bus port provides a connection for the Wireless Commissioning Converter and the ZFR Wireless Router.

Figure 5: Pin Number Assignments for Sensor (SA Bus and FC Bus) Ports on VMA1615/1626/1628/1630 Controllers



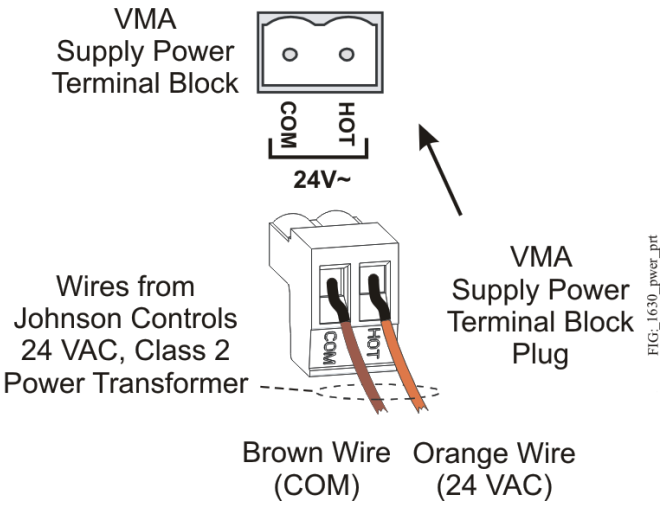
Note: Do not use the modular SA Bus port and the terminal block SA Bus simultaneously. Only use one of these connections at a time.

Supply Power Terminal Block

The 24 VAC supply power terminal block is a gray, removable, 2-terminal plug that fits into a board-mounted jack on the upper left of the VMA 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 6*. See *Table 5* for more information.

Figure 6: 24 VAC Supply Power Terminal Block Wiring

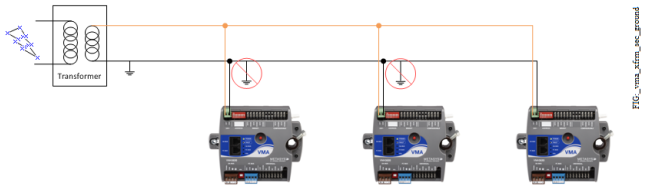


Important: Exercise caution while rewiring the power plug when replacing a VMA1610 or VMA1620 controller. The supply power terminal on a new VMA is a two-position terminal block (*Figure 6*). A VMA1610 or VMA1620 controller uses a three-position terminal block, and the center position is not used. Stray wire strands may make contact and cause a short circuit across the 24 VAC power supply.

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 VMA 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 VMA does not require an earth ground connection. However, when grounding the secondary of the 24 VAC transformer is required, only one connection to ground should be made near the transformer. See the following figure.

Figure 7: Transformer Grounding



NOTICE

Risk of Property Damage: Do not apply power to the system before checking all wiring connections. Improper wiring of this terminal may cause a short circuit across the 24 VAC power supply on -1 VMA models. A short circuit may result in a tripped circuit breaker or blown fuse. If using a transformer with a built-in fuse, the transformer may need to be replaced.
Risque de dommages matériels: Ne mettez pas l'appareil sous tension avant d'avoir vérifié toutes les connexions du câblage. Le câblage inadéquat de cette borne peut causer un court-circuit sur l'alimentation électrique de 24 V c.a. des VMA16xx-1 modèles. Un court-circuit peut causer le déclenchement du disjoncteur ou le grillage d'un fusible. Si vous utilisez un transformateur avec un fusible intégré, vous pourriez devoir remplacer le transformateur.

To wire the VMA1615/1626/1628/1630 controller:

1. Terminate wiring according the appropriate figure in *Termination Diagrams*.
2. Wire network sensors and other devices to the VMA's SA Bus.
3. Wire the FC Bus in a daisy chain.
4. Ensure that the VMA's device address DIP switches are set to the appropriate device address. (See *Setting the Device Address*.) Also, activate the end-of-line (EOL) switch if necessary.
5. Connect the VMA controller to 24 VAC, Class 2 power.

Note: If you are using the VMA1615/1626/1628/1630 controller with the ZFR1800 Series Wireless Field Bus System, refer to the *ZFR1811 Wireless Field Bus Router Installation Instructions (Part No. 24-10325-10)or the ZFR1812 Wall Mount Wireless Field Bus Router Installation Instructions (Part No. 24-10325-45)*.

VMA Terminal Functions, Ratings, Requirements, and Wiring Guidelines

Input and Output Wiring Guidelines

Table 3 provides information about the functions, ratings, and requirements for the VMA input and output terminals, and *Table 4* provides guidelines for wire sizes and cable lengths.

In addition to the wiring guidelines in *Table 3*, observe these guidelines when wiring VMA 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 twisted, insulated, and stranded copper wires.
- Shielded cable is not required for input or output cables but is recommended for input and output cables that are exposed to high electromagnetic or radio frequency noise.
- Cable runs of less than 30 m (100 ft) typically do not require an offset in the input/output software setup.
- Cable runs over 30 m (100 ft) may require an offset in the input/output software setup.

Maximum Cable Length versus Load Current

Use *Figure 8* to estimate the maximum cable length relative to the wire size and the load current (in mA) when wiring inputs and outputs.

FC and SA Bus and Supply Power Wiring Guidelines

Table 5 provides information about terminal block functions, ratings, and requirements.

Table 5 also provides wire size, cable type, and cable length guidelines for wiring the VMA communication buses and supply power.

In addition to the guidelines in *Table 5*, observe these guidelines when wiring the SA/FC Buses and 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 *MS/TP Communications Bus Technical Bulletin (LIT-12011670)* for detailed information regarding wire size and cable length requirements for the FC and SA 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 2: Termination Details

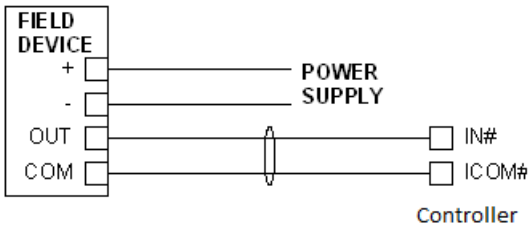
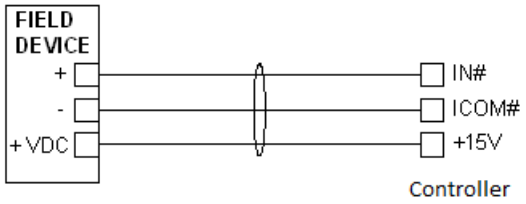
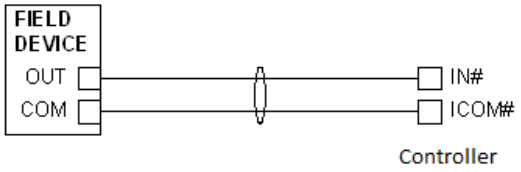
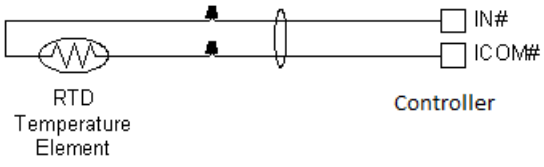
Type of Field Device	Type of Input/Output	Termination Diagrams
Voltage Input - External Source	UI	
Voltage Input - Internal Source	UI	
Voltage Input (Self-Powered)	UI	
Temperature Sensor	UI	

Table 2: Termination Details

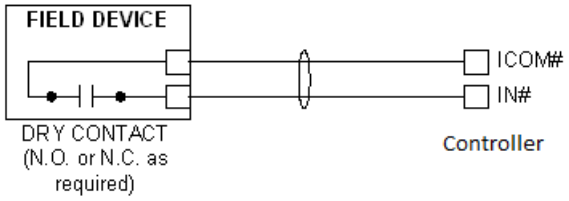
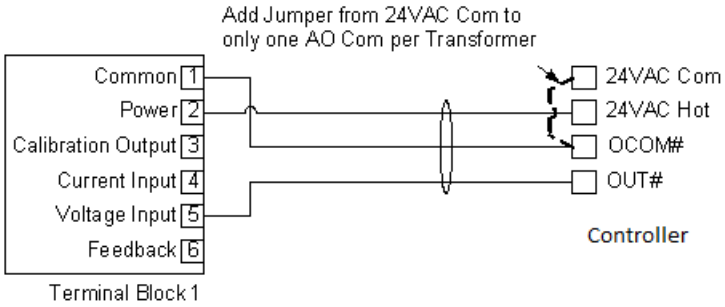
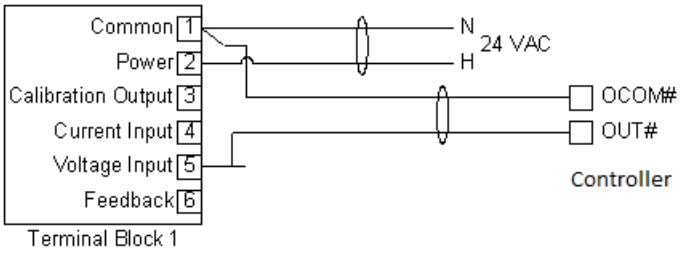
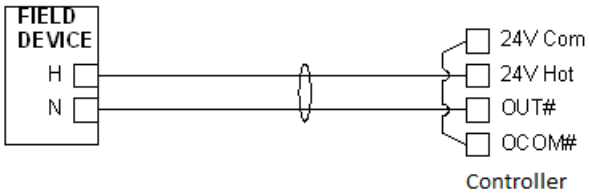
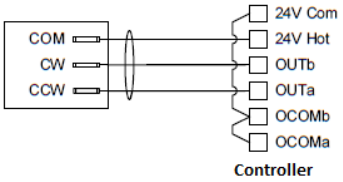
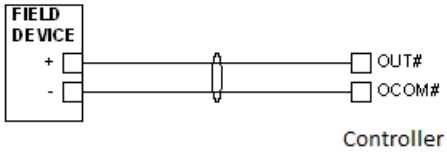
Type of Field Device	Type of Input/Output	Termination Diagrams
Dry Contact	UI	
0–10 VDC Output to Actuator (External Source)	CO	
0–10 VDC Output to Actuator (Internal Source)	CO	
24 VAC Triac Output (Switch Low, External Source)	CO	 **Note:** Applies to CO4 and CO5.
Incremental Control to Actuator (Switch Low, External Source)	CO	 **Note:** Applies to CO4 and CO5.
Analog Output (Voltage)	CO	

Table 2: Termination Details

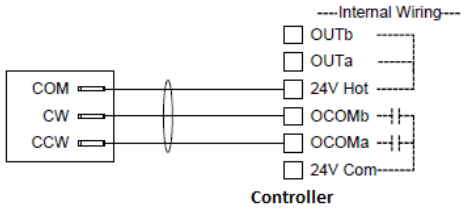
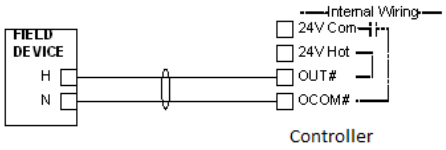
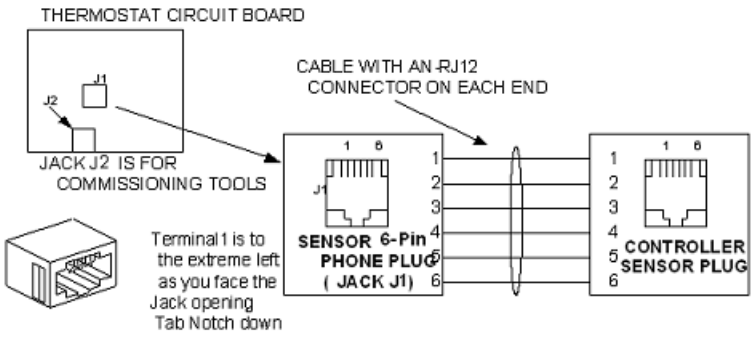
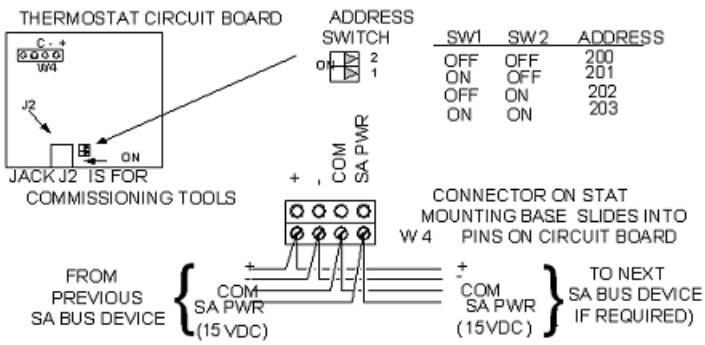
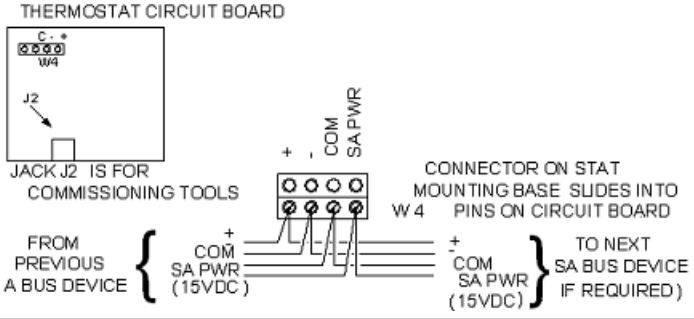
Type of Field Device	Type of Input/Output	Termination Diagrams
Incremental Control to Actuator (Switch Low, Internally Sourced)	BO	 **Note:** Applies to BO3 (for VMA 1630 only), BO1, and BO2.
24 VAC Binary Output (Switch Low, Internally Sourced)	BO	
Network Stat with Phone Jack (Fixed Address = 199)	SA Bus	
Network Stat with Terminals Addressable	SA Bus	
Network Stat with Terminals (Fixed Address = 199)	SA Bus	

Table 3: I/O Terminal Blocks, Functions, Ratings, Requirements, and Cables

Terminal Block Label	Terminal Labels	Function, Ratings, and Requirements	To Determine Wire Size and Maximum Cable Length[1]
UNIVERSAL (Inputs)	**+15 V**	**15 VDC Power Source** for active (3-wire) input devices connected to the Universal INn terminals. Provides 35 mA total current.	Same as (Universal) **IN***n*. **Note:** Use 3-wire cable for devices that source power from the +15 V terminal.
	IN*n*	**Analog Input - Voltage Mode (0–10 VDC)** 10 VDC maximum input voltage Internal 75k ohm Pulldown	See Guideline A in *Table 4*.
		Analog Input - Resistive Mode (0–600k ohm) Internal 12 V, 15k ohm pull up Qualified Sensors: 0–2k potentiometer, RTD (1k Nickel [Johnson Controls sensor], 1k Platinum, and A99B Silicon Temperature Sensor) Negative Temperature Coefficient (NTC) Sensor 10K Type L (10K Johnson Controls Type II is equivalent to Type L) or 2.252K Type II	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*.
	ICOM*n*	**Universal Input Common** for all Universal IN terminals **Note:** All Universal ICOMn terminals are isolated from all other commons on the -0 models. The -1 model ICOMn terminals are isolated from FC BUS COM terminals only.	Same as (Universal) **IN***n*.
BINARY (Outputs)	**OUT***n*	**Binary Output - 24 VAC Triac (Internal Power)** Sources internal 24 VAC power (24~ HOT)	See Guideline C in *Table 4*.
	OCOM*n*	**Binary Output - 24 VAC Triac (Internal Power)** Connects OCOMn to 24~ COM when activated. Internal Power Source: 30 VAC maximum voltage to load 0.5 A maximum output current 1.3 A at 25% duty cycle 40 mA minimum load current	See Guideline C in *Table 4*.

Table 3: I/O Terminal Blocks, Functions, Ratings, Requirements, and Cables

Terminal Block Label	Terminal Labels	Function, Ratings, and Requirements	To Determine Wire Size and Maximum Cable Length[1]
CONFIGURABLE (Outputs)	**OUT***n*	**Analog Output - Voltage Mode (0–10 VDC)** 10 VDC maximum output voltage 10 mA maximum output current External 1k to 50k ohm load required	See Guideline A in *Table 4*.
		Binary Output 24 VAC Triac Connects OUT to OCOM when activated. External Power Source: 30 VAC maximum voltage to load 0.5 A maximum output current 1.3 A at 25% duty cycle 40 mA minimum load current	See Guideline C in *Table 4*.
	OCOM*n*	**Analog Output Signal Common**: All Configurable Outputs defined as Analog Outputs share a common, which is isolated from all other commons except the Binary Input common.	Same as (Configurable) **OUT***n*.
		Binary Output Signal Common: All Configurable Outputs defined as Binary Outputs are isolated from all other commons, including other Configurable Output commons.	

1 *Table 4* defines cable length guidelines for the various wire sizes that may be used for input and output wiring.

Table 4: Cable Length Guidelines for Recommended Wire Sizes

Guideline	Wire Size/Gauge and Type	Maximum Cable Length and Type	Assumptions
A	1.5 mm^2 (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	
	24 AWG stranded copper 107 m (350 ft) twisted wire	107 m (350 ft) twisted wire	
B	1.5 mm^2 (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	
	24 AWG stranded copper 107 m (350 ft) twisted wire	61 m (200 ft) twisted wire	
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

Figure 8: Maximum Wire Length by Current and Wire Size

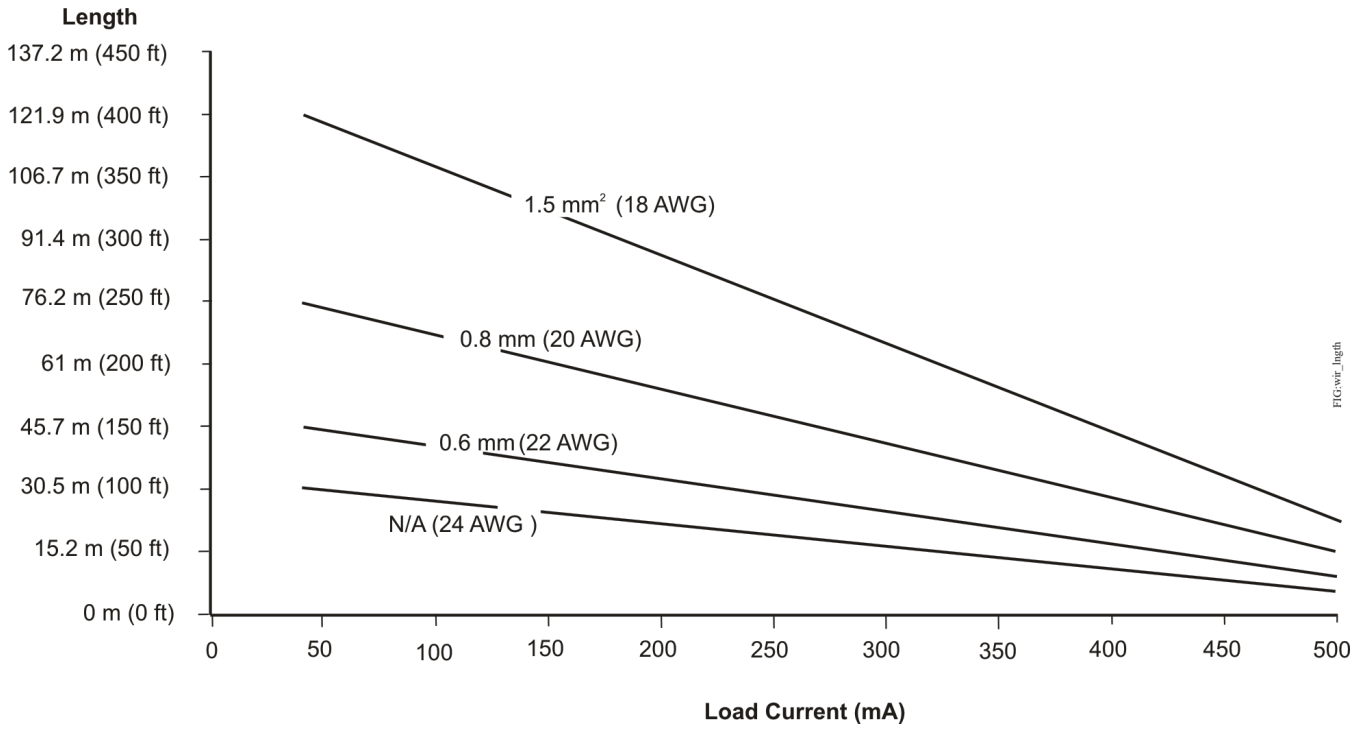


Table 5: Communication Bus and Supply Power Terminal Blocks, Functions, Ratings, Requirements, and Cables

Terminal Block/Port Label	Terminal Labels	Function, Electrical Ratings/Requirements	Recommended Cable Type[1]
FC BUS[2]	**+** **-**	FC Bus Communications	0.6 mm (22 AWG) stranded, 3-wire twisted, shielded cable recommended
	COM	Signal Reference (Common) for bus communications	
	SHLD	Isolated terminal (optional shield drain connection)	
SA BUS[2]	**+** **-**	SA Bus Communications	0.6 mm (22 AWG) stranded, 4-wire (2 twisted-pairs), shielded cable recommended **Note:** The + and - wires are one twisted pair, and the COM and SA PWR wires are the second twisted pair.
	COM	SA Bus Signal Reference and 15 VDC Common	
	SA PWR	15 VDC Supply Power for Devices on the SA Bus	
FC BUS[2]	**FC BUS**	RJ-12 6-Position Modular Port provides FC Bus Communications FC Bus provides 15 VDC Power for: • Wireless Bluetooth® Commissioning Converter • Wireless ZigBee® Field Bus Router	24 AWG 3-pair CAT 3 Cable <30.5 m (100 ft)

Table 5: Communication Bus and Supply Power Terminal Blocks, Functions, Ratings, Requirements, and Cables

Terminal Block/Port Label	Terminal Labels	Function, Electrical Ratings/Requirements	Recommended Cable Type[1]
SA BUS[2]	**SA BUS**	RJ-12 6-Position Modular Port provides SA Bus Communications SA Bus provides 15 VDC Power for: • NS Series Sensors • Wireless ZigBee WRZ-78xx Series One-to-One Wireless Receiver • Wireless Bluetooth Commissioning Converter (BTCVT) • DIS1710 Local Controller Display • VAV Balancing Tool	24 AWG 3-pair CAT 3 Cable <30.5 m (100 ft)
24~	**HOT**	**24 VAC Power Supply - Hot** Supplies 20–30 VAC (Nominal 24 VAC)	0.8 mm to 1.5 mm^2 (20 to 18 AWG) 2-wire
	COM	**24 VAC Power Supply Common** The -0 models isolate this terminal from all other commons. The -1 models only isolate this terminal from the FC bus common.	

1 See *Table 4* to determine wire size and cable lengths for cables other than the recommended cables.
2 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)*.

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.

Setting the Device Address

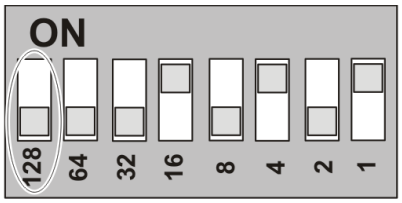
Metasys® field controllers are master devices on BACnet® MS/TP (SA or FC) Buses. Before operating field controllers on a bus, you must set a valid and unique device address for each controller on the bus.

Set a field controller's device address by setting the positions of the switches on the Device Address DIP switch block at the top of the controller (*Figure 2*). Device addresses 4 through 127 are the valid addresses for these controllers.

The DIP switch block (*Figure 9*) has eight switches numbered 128, 64, 32, 16, 8, 4, 2, and 1. Switches 64 through 1 are device address switches. Switch 128 is a mode switch that enables a field controller to operate on a ZFR1800 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.

Figure 9: Device Address Switches Set to 21

Note: Switch 128 is used to enable or disable a VMA for wireless operation.



Note: *Metasys* field controllers ship with Switch 128 ON and the remaining address switches OFF. This renders the controllers wired slave devices, which do not interfere on MS/TP Buses and do 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 a *Metasys* field controller:

1. Set all of the switches on the field controller's device address DIP switch block (128 through 1) to OFF.
2. Set one or more of the seven address switches (64 through 1) to ON, so that the sum of the switch numbers set to ON equals the intended device address. See *Table 6* and *Table 7* for valid field controller 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 ZFR1800 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 wirelessly enabled field controller to a wired FC Bus.

   Refer to 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 field 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 field 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.

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

Table 6 and *Table 7* show and describe the valid FC Bus and SA Bus device addresses for Johnson Controls MS/TP communications bus applications.

Table 6: FC Bus Device Address Descriptions

Device Address	Address Description
0 **(Switch 128 OFF)**	Reserved for FC Bus Supervisory Controller (not valid for field controllers).
1 to 3 **(Switch 128 OFF)**	Reserved for peripheral devices (not valid for field controllers).
4 to 127 **(Switch 128 OFF)**	Valid for MS/TP Master field controllers on a **hard-wired** SA Bus or FC Bus.

Table 7: Wireless Field Bus Device Address

Device Address	Address Description
0 to 3 **(Switch 128 ON)**	Reserved addresses for wired slave devices (not valid for field controllers). **Note:** *Metasys* controllers ship with 128 ON and the remaining address switches OFF, rendering the controllers wired slave devices, which do not operate on *Metasys* field buses.
4 to 127 **(Switch 128 ON)**	Valid for MS/TP Master field controllers on **wireless FC Buses only**. **Note:** Do **not** connect a *Metasys* controller with these device addresses to an active **wired** SA or FC Bus. When a controller with one of these device address is connected to a wired field bus, the 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 (1-255). However, these controllers require special configuration for addresses above 127.

Use the following instructions for controller addresses greater than 127.

Notes:

- Prior to performing this procedure, be sure the controller has been converted from BACnet to N2 protocol first. Refer to the *Modernization Guide for Legacy N2 Controllers (LIT-12012005)* for more information.
- 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.

Setting the EOL Switch

Each field controller has an EOL switch, which, when set to ON (up), sets the field controller as a terminating device on the bus. See (*Figure 2*) for the EOL switch location on the field controller. The default EOL switch position is OFF (down). The amber EOL LED illuminates to show the EOL is active.

Figure 10: EOL Switch Positions

To set the EOL switch on a field controller:

1. Determine the physical location of the controller on the SA or FC Bus.
2. Determine if the controller must be set as a terminating device on the bus.
   Note: The EOL termination rules for SA Buses and FC Buses are different. Refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)* for detailed information regarding EOL termination rules and EOL switch settings on SA and FC Buses.
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.
   Note: When the EOL switch is set to ON, the LED light on the face of the controller is illuminated.

Commissioning

Use the following procedure to commission the VMA1615/1626/1628/1630 controller:

1. Download the control application to the VMA controller using the Controller Configuration Tool (CCT). Refer to the *Controller Tool Help (LIT-12011147)*.
2. Commission the VAV Box. Refer to the *Controller Tool Help (LIT-12011147)*.
3. Perform airflow balancing on the VAV box. Refer to the *VAV Balancing Tool Technical Bulletin (LIT-12011087)*.
4. Perform commissioning checkout procedures. Refer to the Controller Tool *Help (LIT-12011147)*.

The CCT connects to the VMA through a laptop computer using different connection options: the Wireless Commissioning Converter, or the wired BACnet Ethernet to MS/TP Router can be used when using the BACnet MS/TP protocol. When the controller is configured to use the N2 protocol, you must use the Commissioning Converter at the SA bus. Wireless connections are not supported in N2 mode. These connection options require additional hardware listed in *Table 10*.

Repair Information

If the VMA1615/1626/1628/1630 controller fails to operate within its specifications, replace the unit. For a replacement unit, contact the nearest Johnson Controls representative.

Troubleshooting

Table 9 provides LED status indicator information for troubleshooting the VMA1615/1626/1628/1630 controller. *Table 8* provides some additional troubleshooting information for possible problems.

Note: If you experience short circuits in the 24 VAC power supply causing protective devices such as breakers or fuses to trip, make sure that the power connections on the VMA are not reversed. The most common cause of this problem is when the 24 VAC power supply on the VMA is reversed but not reversed on a connected secondary device. Improper wiring of this power terminal may cause a short circuit across the 24 VAC power supply on -1 models.

Table 8: Troubleshooting

Problem			Possible Cause	Correction	Verification
Controller is Off	Power at Primary of Transformer, 0V at Secondary	Transformer has tripped	1. Transformer is shorted 2. 24VAC powered sensor is not wired with the same polarity as the controller 3. SA bus device is not wired with the same polarity as the controller	1. Ensure polarity of ~24 V COM / ICOM / + 15VCOM/SA BUS COM on the controller, auxiliary devices and I/O is the same. 2. Ensure OUT1-OUT3 terminals of binary outputs are not connected to ~24 VAC COM, verify that OCOM1-OCOM3 are not connected to ~24 VAC HOT (these terminals are internally sourced). 3. Verify the short circuit has been resolved with an ohm-meter. 4. Reset the breaker/fuse or replace the transformer. **Note:** When replacing the transformer, it is recommended to replace with a model that utilizes a resettable circuit breaker. A circuit breaker makes solving wiring problems easier.	1. Disconnect the secondary of the 24 VAC transformer 2. Use an ohm-meter to measure between ~24 V HOT and COM; there should be no short circuit. **Note:** Note that some installations require the secondary of the Transformer to be Earth Grounded. If this is the case, verify that the Earth Ground connection is valid and not shared between multiple pieces of equipment.
	Power at Primary of Transformer, 24 V at Secondary, 0V at Fuse/Breaker.	Breaker/Fuse has tripped.			
Configurable output - analog mode is invalid.	0–10 V output is set to 10–100%, but 0 V is at output terminals	Output is in protection mode - a state the analog portion of the configurable output goes into when it detects a wiring problem. The analog output is set to 0% regardless of the command whenever a wiring fault is detected.	Power polarity mismatch between connected device and configurable output	Ensure polarities of ~24 V COM/OCOM match and that the connected end device uses the same polarity.	1. Measure the output and verify that it matches the command. 2. Disconnect the connected device and verify the commanded value is present.
	0–10V output has an undesirable offset of up to 1 V	Common Reference is incorrect	OCOM terminal is not connected	Connect OCOM terminal of the configurable output to the common of the connected end device.	

Table 9: VMA Controller Status LEDs

LED Label	LED Color	Normal State	Descriptions of LED States
POWER	Green	On Steady	Off Steady = No power On Steady = Power is supplied by primary voltage
FAULT	Red	Off Steady	Blink - 2 Hz = Download or startup in progress, not ready for normal operation, SA Bus devices offline (such as netsensors) Rapid blink = SA Bus communications issue Off Steady = No faults On Steady = Device fault or no application loaded
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
SA BUS	Green	Blink - 2 Hz	Blink - 2 Hz = Data transmission (normal communication) Fast blink - 1/2 hz = SA bus communication fault Off Steady = No data transmission (N/A - auto baud not supported) On Steady = Communication lost; waiting to join communication ring
EOL	Amber	Off	On Steady = EOL is active Off Steady = EOL is not active

Accessories

Use *Table 10* to order accessories.

Table 10: VMA1615/1626/1628/1630 Controller Accessories (Order Separately)

Product Code Number	Description
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
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
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
AP-TBK1002-0	2-position Screw Terminal that plugs onto VMA Output Point Spade Lugs
AP-TBK1003-0	3-position Screw Terminal that plugs onto VMA Output Point Spade Lugs
AP-TBK4SA-0	Replacement MS/TP SA Bus Terminal, 4-Position Connector, Brown, Bulk Pack of 10
AP-TBK4FC-0	Replacement MS/TP FC Bus Terminal, 4-Position Connector, Blue, Bulk Pack of 10
AP-TBK2PW-0	Replacement Power Terminal, 2-Position Connector, Gray, Bulk Pack of 10
F-1000-325	Replacement Barbed Fitting for use on VMA1615, VMA1630, and VMA1832 for Connecting Tubing, Bulk Pack of 10
F-1000-326	Flexible Tubing Extension with Barbed Fitting for VMA1615, VMA1630, and VMA1832, 35.56 cm (14 in.) Length, Bulk Pack of 20
MS-BTCVT-1	Wireless Commissioning Converter, with Bluetooth Technology

Table 10: VMA1615/1626/1628/1630 Controller Accessories (Order Separately)

Product Code Number	Description
MS-BTCVTCBL-700	Cable Replacement Set for the MS-BTCVT-1 or the NS-ATV7003-0; includes One 1.5 m (5 ft) Retractable Cable
MS-DIS1710-0	Local Controller Display
MS-VMAACT-701	VMA Actuator Assembly Gearbox Replacement Kit
MS-ZFR1810-0	Wireless Field Bus Coordinator, 10 mW Transmission Power. Functions with NAE35xx, NAE45xx, NAE55xx, and NCE25xx Models.
MS-ZFR1811-0	Wireless Field Bus Router, 10 mW Transmission Power. Functions with *Metasys* BACnet Field Equipment Controller (FEC)s, VMA1600s, and WRZ-TTx Series Wireless Mesh Room Temperature Sensors.
TL-BRTRP-0	Portable BACnet/IP to MS/TP Router
WRZ-7860-0	Many-to-One ZigBee Wireless Receiver for Wireless Sensor Only Applications
WRZ-SST-100	Wireless Sensing System Tool Kit
ZFR-USBHA-0	USB Dongle with ZFR Driver provides a wireless connection through CCT to allow wireless commissioning of the wirelessly enabled FEC, FAC, IOM, and VMA16 field controllers. Also allows use of the ZFR Checkout Tool (ZCT) in CCT. **Note:** The ZFR-USBHA-0 replaces the IA OEM DAUBI_2400 ZigBee USB dongle. For additional information on the ZFR-USBHA-0 ZigBee dongle, refer to the *ZFR1800 Series Wireless Field Bus System Technical Bulletin (LIT-12011295)* or *ZFR1800 Series Wireless Field Bus System Quick Reference Guide (LIT-12011630).*
IOM Series Controllers	Refer to the *Metasys® System Field Equipment Controllers and Related Products Product Bulletin (LIT-12011042)* for a complete list of available IOM Series Controllers.
NS Series Sensors	Refer to the *NS Series Network Sensors Product Bulletin (LIT-12011574)* for a complete list of available NS Series Sensors.
WRZ Series Sensors	Refer to the *WRZ Series Wireless Room Sensors Product Bulletin (LIT-12011653) for a complete list of available WRZ Series Sensors.*

Technical Specifications

Table 11: VMA1615/1626/1628/1630 Controllers

Product Code Numbers	**MS-VMA1615-0:** 32-bit, Integrated VAV Controller/Actuator/Pressure Sensor - DPT, 3 UI and 2 BO, 24 VAC, FC and SA Bus **MS-VMA1615-1:** 32-bit, Integrated VAV Controller/Actuator/Pressure Sensor - DPT, 3 UI and 2 BO, 24 VAC, FC and SA Bus **MS-VMA1626-0:** 32-bit, Integrated VAV Controller/Actuator (No Pressure Sensor - DPT); 3 UI, 3 BO, and 2 CO; 24 VAC; FC and SA Bus **MS-VMA1628-0:** 32-bit, Integrated VAV Controller/(No Actuator) Pressure Sensor - DPT; 3 UI, 3 BO, and 2 CO; 24 VAC; FC and SA Bus **MS-VMA1630-0:** 32-bit, Integrated VAV Controller/Actuator/Pressure Sensor - DPT; 3 UI, 3 BO, and 2 CO; 24 VAC; FC and SA Bus **MS-VMA1630-1:** 32-bit, Integrated VAV Controller/Actuator/Pressure Sensor - DPT; 3 UI, 3 BO, and 2 CO; 24 VAC; FC and SA Bus
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)

Table 11: VMA1615/1626/1628/1630 Controllers

Power Consumption	10 VA typical, 14 VA maximum **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 60 VA (maximum).
Ambient Conditions	**Operating:** 0 to 50°C (32 to 122°F) **Storage:** -40 to 70°C (-40 to 158°F)
Terminations	Inputs/Outputs: 6.3 mm (1/4 in.) Spade Lugs FC Bus, SA Bus, and Supply Power: 4-Wire and 2-Wire Pluggable Screw Terminal Blocks FC and SA Bus Modular Ports: RJ-12 6-Pin Modular Jacks
Controller Addressing for BACnet MS/TP	DIP switch set; valid field controller device addresses 4–127 (Device addresses 0–3 and 128–255 are reserved and not valid field controller addresses.)
Controller Addressing for N2	DIP switch set; valid field controller device addresses 1–255
Communications Bus[1]	**RS-485: selectable between BACnet MS/TP or N2** FC Bus: 0.6 mm (22 AWG) standard 3-wire, twisted, shielded cable recommended between the supervisory controller and field 10/100 Mbps; 8-pin RJ-45 connector SA Bus: 0.6 mm (22 AWG) stranded, 4-wire (2-twisted pairs) shielded cable recommended from the VMA controller for network sensors and other sensor/actuator devices; includes a terminal to source 15 VDC supply power from VMA to SA Bus devices[1]
Processor	RX63N 32-bit RX630 32-bit Renesas microcontroller
Memory	1 MB flash memory and 512 KB RAM
Universal Input Mode/Configurable Output Mode Accuracy	**UI Analog Input Mode:** 15-bit resolution on UIs **CO Analog Output Mode (VMA1626/1628/VMA1630 only):** 0–10 VDC ± 200 mV
Air Pressure Differential Sensor	Range: -1.5 in. to 1.5 in. W.C. **Performance Characteristics:** Accuracy: ±1.3% Full Span Maximum[2] (±0.039 in. W.C.) Typical accuracy at zero (null) pressure is ±0.02 in. W.C.[3] (if provided)
Actuator Rating	4 N·m (35 lb·in) minimum shaft length = 44 mm (1-3/4 in.) (if provided)
Mounting	Mounts to damper shaft using single set screw and to duct with single mounting screw
Dimensions (Height x Width x Depth)	165 x 125 x 73 mm (6.5 x 4.92 x 2.9 in.) **Center of Output Hub to Center of Captive Spacer:** 135 mm (5-5/16 in.)
Weight	0.65 kg (1.45 lb)

Table 11: VMA1615/1626/1628/1630 Controllers

Compliance	**United States:** UL Listed, File E107041, CCN PAZX, UL 916, Energy Management Equipment; Suitable for use in other environmental air space (plenums) in accordance with Section 300.22(C) of the National Electric Code. 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
CE	**Europe:** CE Mark – 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 7 Listed BACnet Application Specific Controller (B-ASC)

1 For more information, refer to the *MS/TP Communications Bus Technical Bulletin (LIT-12011034)*.
2 Combined error due to offset, non-linearity, and temperature variation.
3 Includes error due to non-linearity.

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.

European Single Point of Contact:
JOHNSON CONTROLS
WESTENDHOF 3
45143 ESSEN
GERMANY

NA/SA Single Point of Contact:
JOHNSON CONTROLS
507 E MICHIGAN ST
MILWAUKEE WI 53202
USA

APAC Single Point of Contact:
JOHNSON CONTROLS
C/O CONTROLS PRODUCT MANAGEMENT
NO. 22 BLOCK D NEW DISTRICT
WUXI JIANGSU PROVINCE 214142
CHINA

Building Technologies & Solutions
507 E. Michigan Street, Milwaukee, WI 53202

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www.johnsoncontrols.com