

## Variable Air Volume Modular Assembly (VMA) 1400 Series

The Variable Air Volume Modular Assembly (VMA) Series is a family of configurable digital controllers. Each model in the VMA1400 Series combines a controller, pressure sensor, and/or actuator housed in one preassembled unit.

Unique features that reduce installation and commissioning time while enhancing Variable Air Volume (VAV) system operation make the VMA the product of choice for VAV systems.

The VMA1400 Series is available in four models:

- Cooling Only (VMA1410)
- Cooling with Reheat and/or Fan (VMA1420)
- External Actuator (VMA1430)
- Metasys® Zoning Package (VMA1440)

**Note:** The VMA1440 is used exclusively as part of the Metasys Zoning Package. See the Metasys Zoning Package Product Bulletin (LIT-639050) for details.



**Figure 1: VMA1430 and VMA1410/1420  
(1440 Not Shown)**

Features and Benefits	
<input type="checkbox"/> <b>Integrated Module</b>	Includes controller, pressure sensor, and/or actuator, preassembled to reduce installation time
<input type="checkbox"/> <b>Enhanced Actuator (All Models but 1430)</b>	Provides a fast response stepper motor that drives the damper from full open to close in 30 seconds
<input type="checkbox"/> <b>Automated Commissioning (All Models but 1440)</b>	Uses Proportional Adaptive (P-Adaptive) and Pattern Recognition Adaptive Control (PRAC) for continuous loop tuning
<input type="checkbox"/> <b>Advanced Diagnostics</b>	Offers damper stall detection, starved box detection, actuator motor duty cycle, VAV box flow test, and other diagnostics on most models
<input type="checkbox"/> <b>Network Communications</b>	Enables integration into a Building Automation System (BAS)
<input type="checkbox"/> <b>Easy Configuration</b>	Provides simple question/answer software format for quick selection of project-specific applications
<input type="checkbox"/> <b>Software Addressing</b>	Allows remote addressing and identification from a configuration tool

## Actuator Enhancements

The VMA1410, 1420, and 1440 use an actuator with a fast response stepper motor, which is quiet (<35 dBA) and precise (23 K resolution). The stepper motor drives the damper from full open to full close in 30 seconds. This significantly reduces the time to commission and balance a VAV terminal box. The stepper motor quickly and accurately adjusts the damper position in response to new conditions, minimizing position hunting and motor runtime. The VMA1430 requires an external floating/3-wire (incremental) or proportional actuator.

## Applications

The VMA1400 Series controllers can be configured for most single and dual duct VAV applications. The VMA1420 requires an additional damper actuator with Differential Pressure Transducer (DPT) sensor for dual duct or supply/exhaust applications. The VMA1430 requires two external actuators and an additional DPT for dual duct or supply/exhaust applications.

Standard applications for the VMA1410, 1420, and 1430 reside in the HVAC PRO library. The VMA1440 is factory loaded with the Metasys Zoning Package application.

See Table 1 and Table 2 for more detailed application and control options. Also refer to the *Variable Air Volume Modular Assembly (VMA) 1400 Series Application Note (LIT-6375125)*.

**Table 1: Applications**

Applications	Control Options	VMA1400 Model			
		1410	1420	1430	1440
<b>System Types</b>	Single Duct	x	x	x	x
	Dual Duct		x	x	
	Fan Powered (Series or Parallel)		x	x	x
	Pressure Independent	x	x	x	
	Supply/Exhaust		x	x	
<b>Heating (Terminal Box)</b>	Metasys Zoning Package				x
	Floating 3-Wire Valve Actuator		x	x	x
	Proportional Valve Actuator		x	x	x
	Normally Open or Normally Closed Valve		x	x	x
	1-3 Stage Electric		x	x	
<b>Heating (Supplemental)</b>	2 Stage Electric				x
	Floating 3-Wire Valve Actuator		x	x	x
	Proportional Valve Actuator		x	x	x
	Normally Open or Normally Closed Valve		x	x	x
<b>Cooling (Terminal Box)</b>	Single Stage Electric		x	x	x
	Stepper Motor Damper Actuator	x	x		x
<b>Floating/3-Wire (Incremental) Actuator</b>	External Damper and Valve		x	x	
	Valve only				x
<b>Proportional Actuator</b>	External Damper and Valve		x	x	x
<b>Fan (Fan Powered Terminal Box)</b>	Parallel, Temperature based		x	x	x
	Parallel, Airflow Setpoint		x	x	
	Series, On/Off Control		x	x	x
	Series, Proportional Control		x	x	
<b>Lighting</b>	On/Off (In Relation to Occupancy Mode)		x	x	
<b>Modes</b>	Occ/Temp Occ/Standby/Off/Shutdown/Window	x	x	x	
	Occ/Temp Occ/Unocc				x

## Advanced Diagnostics

The VMA1400 Series has several unique diagnostic features. Diagnostics include damper stall detection (all models but VMA1430), starved box detection (all models but VMA1440), actuator motor duty cycle, VAV box flow test, and others.

The VMA constantly monitors the space temperature and airflow and generates alarms to alert the operator of setpoint deviations. The operator can react quickly, taking corrective action to get the system back into desired operation. This assures occupants better comfort control.

## Functionality

Quick installation and easy commissioning help to greatly reduce setup time. The integrated VMA1400 package design reduces or eliminates the need to fasten and wire the pressure sensor and actuator to the controller.

The unique stepper motors in the VMA1410, 1420, and 1440 allow fast positioning of the damper. Modular assembly and automated tuning reduce the total time spent at the job site while still providing a quality installation. New software commissioning tools quickly monitor and adjust all operating parameters.

Programs and configuration data are saved in non-volatile Flash memory. Because of this, there is no need to reload software if a power failure occurs.

Additionally, users can download firmware upgrades to existing units when enhancements are developed, without replacing the controller.

HVAC PRO software and VMA1400 Balancing Tool (VBT) software allow remote checkout and commissioning of the VAV box.

**Note:** VBT software cannot be used with the VMA1440.

The user can also assign address identification to the VMA1400 Series product, either using hardware DIP switches or software. Set the DIP switches to 0 or 255 (factory set to 255) to allow software addressing.

## Automated Commissioning

Simply mount, wire, configure, download, and commission the controller. Because the VMA1410, 1420, and 1430 perform loop tuning automatically, there is no need to set proportional bands and integration terms (the VMA1440 works with factory-set parameters). There is no need to set any jumpers or switches. Even network addressing can be done via software, if desired. Refer to Table 2 for point assignments and ratings.

The VMA1410, 1420, and 1440 are configured to detect the damper end-stops automatically. On power up, the actuator drives to both hard stops on the VAV box and remembers these positions. These automated features get the system operating quickly.

## Hardware

The VMA1400 modular assembly is in a durable, plenum-rated, plastic housing. The controller and pressure sensor are enclosed in one module attached to the actuator.

The unique VMA1400 plastic housing may eliminate the need for a separate enclosure for plenum-rated construction. Check code requirements for appropriate applications. Line voltage relays and transformers still require an enclosure.

The N2 communication connector has removable screw terminals. Input/Output (I/O) connections to the VMA are easy-to-use spade lugs. If you prefer screw terminal I/O connections, be sure to order the appropriate optional removable screw terminal kit accessories.

The differential pressure sensor in the VMA1400 Series controllers (all models but VMA1440) provides consistent flow readings with minimal drift. This means auto-zero calibration is required less often. There are no filters to change, which ensures accuracy.

A Light-Emitting Diode (LED), visible through the VMA1400 housing, indicates that power is connected and communication has been established.

**Table 2: Available VMA Models**

Inputs/Outputs	Points	Rating	VMA1400 Model			
			1410	1420	1430	1440
<b>Analog Inputs:</b>						
<b>Zone Temperature</b>	AI-1 *	1 K Ni, Si, Pt, or 2.25 K NTC	x	x	x	x
<b>Zone Setpoint</b>	AI-2 *	1.6 K ohm Potentiometer	x	x	x	x
<b>Sideloop (humidity, dew point) (for 1410, 1420, 1430) or Static Pressure (for 1440)</b>	AI-3	0-16 VDC		x	x	x
<b>Supply Air Temperature or Supplemental Heat Temperature</b>	AI-4	1 K Ni, Si, Pt, or 2.25 K NTC		x	x	x
<b>Velocity Pressure</b>	Internal	0-374 pa (0-1.5 in. W.C.)	x	x	x	
<b>Binary Inputs:</b>						
<b>Temporary Occupied Button</b>	BI-1 *	Dry contact	x	x	x	x
<b>Occupied or User Configurable (for 1440)</b>	BI-2	Dry contact	x	x	x	
<b>Off or Window or Shutdown (for 1410, 1420, 1430) or User Configurable (for 1440)</b>	BI-3	Dry contact	x	x	x	x
<b>Analog Outputs:</b>						
<b>Proportional Heat or External Damper (for 1440, AO-2 is Bypass/Slave Damper)</b>	AO-1	0-10 VDC @ 10 mA		x	x	x
	AO-2	0-10 VDC @ 10 mA		x	x	x
<b>Binary Outputs:</b>						
<b>Lights, Fan, External Damper, Box Heat - On/Off Valve or 1-3 stage Electric, Supplemental Heat - On/Off Valve or Single Stage Electric Heat</b>	BO-1 - BO-5 (BO-1 - BO-4 for 1440)	24 VAC Triac @ 0.5 A each		x	x	x
<b>Stepper Motor with Position Feedback</b>	Internal	2-phase Stepper [up to 93° rotation @ 4 N.m (35 lb.in)]	x	x		x

\* Zone bus commands override these inputs when used with TE-7700 RF Temperature Sensors. The inputs cannot be used for any other purpose.

## Installation

Field mounting the VMA1400 Series controller is easy. Minimal wiring and fastening, automatic loop tuning, fast damper response, and multiple units powered by one transformer are only some of the timesaving features.

The small housing dimensions of the VMA1410, 1420, and 1440 (153 x 102 x 102 mm [6 x 4 x 4 in.]) and VMA1430 (153 x 102 x 83 mm [6 x 4 x 3.25 in.]) meet industry mounting requirements and make the controller easy to handle. The VMA1430 has a flat, plastic base instead of an actuator.

Only one mounting screw is used to mount the VMA1410, 1420, and 1440 to the VAV terminal box. Two screws mount the VMA1430. Additionally, on the VMA1410/1420/1440, a single set screw attaches the damper shaft to the actuator. The set screw has a self-locking cup point end to resist loosening due to vibration.

The actuator coupling is serrated, providing additional damper shaft grip and minimizing shaft slippage during operation. The coupling accommodates shafts from 10 mm (3/8 in.) square and up to 13 mm (1/2 in.) diameter round. A gear release lever allows easy resetting of the damper to full open or close.

The controller address, which is unique for each VMA, can be set using the DIP switches that are accessible through the VMA housing, or via software using either HVAC PRO software (Release 7.02 or later) or VBT1400 software (VMA1410, 1420, or 1430 only).

Multiple controllers can be connected to a single transformer. Refer to the *Variable Air Volume Modular Assembly (VMA) 1400 Series Overview and Engineering Guidelines Technical Bulletin (LIT-6363120)*.

The AC power input is isolated from the DC inputs and outputs by an internal transformer. This eliminates polarity issues, ground loops, and the need for a separate isolation transformer. Power, N2 communications, and binary outputs are all separately isolated.

### Metasys Network Configuration

A user can realize even greater benefits when the VMA1400 Series controller is part of a larger Metasys Network that serves a facility. To accommodate indoor air quality concerns and energy savings strategies, the Metasys Network provides more complete building control than before. The VMA connects to the Metasys N2 Bus and a Network Control Module (NCM200 or later) or N30.

With the network configuration, a user can plug a laptop directly into the NCM or N30 to monitor controllers on the N2 Bus. No additional converters are required.

### Tool Configuration

The VMA1400 Series controller is easily configured using the HVAC PRO software tool. HVAC PRO software is part of the M-Tool suite of tools. The software also runs on a Metasys Operator Workstation (OWS) connected to the N2 Bus to configure, download, and commission the controller.

A user can configure the VMA1400 using HVAC PRO software (Release 7.02 or later) by simply responding to a series of yes/no and multiple choice questions and specifying setpoints and other parameters. HVAC PRO software has a library of applications, control sequences, and algorithms that automatically configure the controller in response to the answers.

**Note:** When using the dual duct application and/or TMZ1600 LCD display room sensor, use HVAC PRO software Release 8.0 or later to configure the controller. The Supply/Exhaust application requires HVAC PRO software Release 8.01 or later. The TE-7700 RF Temperature Sensor System Application requires HVAC PRO software Release 8.04 or later. (The TE-7700 Series RF Wireless System includes a TE-7710 RF sensor transmitter and a TE-7720 RF receiver that is hard-wired to the VMA.)

Once the controller is configured, users can make future changes to the control setpoints and operating parameters from any OWS or laptop connected to the VMA1400 Series controller or room sensor.

Refer to the *HVAC PRO User's Guide* for details.

### Room Sensors

A variety of room sensors are available for use with the VMA1400. Select the standard TE-6700 room sensor (TE-7000 in Europe), the TMZ1600, or the TE-7710 RF room sensor. The TMZ1600 allows the user to change temperature setpoints, select a timed override occupancy mode, and view the outside air temperature simply by using the pushbutton keypad.

The TE-7710 allows the user to change the common setpoint and select a timed override occupancy mode.

The VMA1400 Series controller connects to TE-6700 or TMZ1600 room sensors via an 8-pin phone jack. The TE-6700 also offers models with screw terminal connections. The TE-7000 (Europe only) connects with screw terminals.

The TE-7720 RF receiver connects to the VMA1400 via an 8-pin phone jack and a 2-wire power cord.

Using the 6-pin phone jack on the TE-6700 or TMZ1600 or 4-pin jack on the TE-7000 (Europe only), a user can connect a laptop to download, commission, and balance.

### Advanced Installation Management (AIM) Tools

An enhanced room schedule in spreadsheet format saves time when commissioning and balancing the VMA1400 Series. Users can add new parameters, including minimum/maximum cubic feet per minute (cfm), pickup gain, box area, and bias setting.

Users can make parameter adjustments in the spreadsheet, then download them to multiple VMA1400 Series controllers, even those with different configurations. Users can print a spreadsheet report showing information for all zones in the project.

## Balancing Tools

The VMA1400 Series controller includes two balancing tool options that make balancing fast and accurate:

- HVAC PRO commissioning tool. A balancing tool screen allows a balancer to quickly make adjustments to the VMA without needing to access the configuration. The screen includes controller parameter information including box area, an automatically calculated pickup gain, and flow (cfm) data.

- VMA1400 Balancing Tool (VBT) software (VMA1410, 1420, and 1430 only). This software is part of Configuration Tools (Release 7.02 or later) and can be downloaded to a Palm™ compatible handheld device. Refer to the *Using the VMA1400 Balancing Tool (VBT) Software Technical Bulletin (LIT-6363092)* for more information on compatibility and functionality. VBT software is also available to order as AP-VMAVBT1-0.

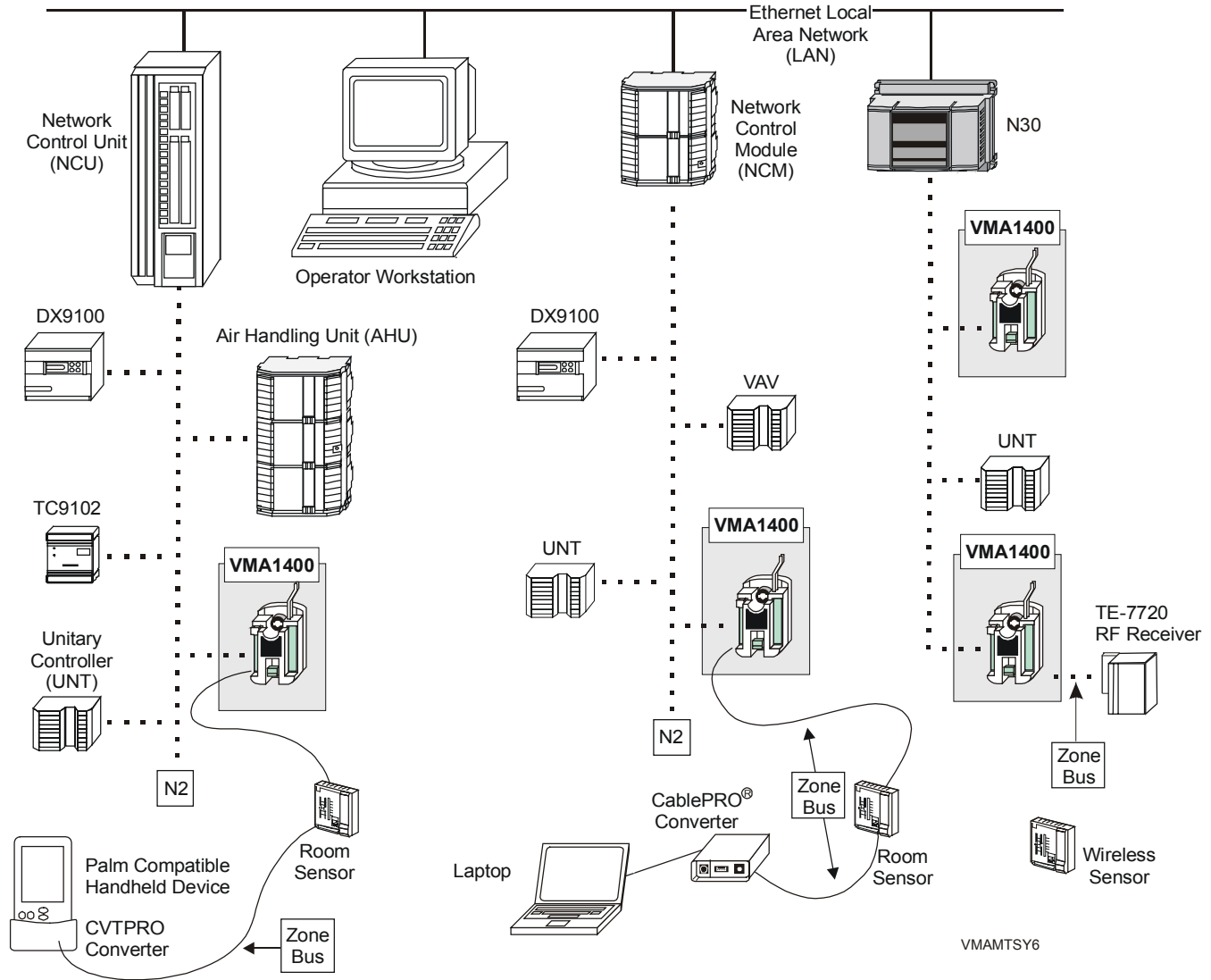


Figure 2: VMA in Metasys Network Diagram

**Table 3: Accessories (Order Separately)**

<b>Accessory</b>	<b>Description</b>			
<b>Transformer</b>	AS-XFR050	AS-XFR100	Y63 through Y66 Series	
<b>Screw Terminal Kit</b>	AP-TBK1002-0*	Removable 2-position screw terminal kit (100 pcs)		
	AP-TBK1003-0*	Removable 3-position screw terminal kit (100 pcs)		
	M9000-106	Removable 4-position screw terminal (1 piece)		
	AP-TBK4N2-0	Replacement N2 Bus 4-position screw terminal kit (10 pcs)		
	* These terminals fit over the existing I/O spade lugs.			
<b>Room Sensors</b>	TE-6700, TE-7000 (Europe only), TE-7710 with TE-7720, and TMZ1600			
<b>8-Pin Room Sensor Communication Cables (Connection made from back of sensor.)</b>	<b>Length</b>	<b>Part Number</b>		
	7.5 m (25 ft) 15 m (50 ft) 22.5 m (75 ft) 30 m (100 ft)	CBL-STAT25-SW CBL-STAT50-SW CBL-STAT75-SW CBL-STAT100-SW		
<b>HVAC PRO Software (EURO PRO in Europe)</b>	MW-MTOOL-0  M-Tool Release 2.0 or later, which includes HVAC PRO software Release 8.01, supports dual duct application, supply/exhaust application, and TMZ1600 LCD room sensor.  M-Tool Release 5.1 includes HVAC PRO software Release 8.04 to support the TE-7700 RF Sensor.			
<b>VBT Software</b>	AP-VMAVBT Version 2.0 is available or M-Tool Release 5.1 or later includes the VBT Software.			
<b>Converters</b>	AS-CVTPROx00-0	AS-CBLPRO-2 (US)	IU-9100-0 (Europe)	MM-CVT101-0 (US)

**Note:** The Zone Terminal does not communicate with the VMA.

## Technical Specifications

<b>Product Name</b>	Variable Air Volume Modular Assembly (VMA) 1400 Series			
<b>Product Code Number</b>	<b>Cooling Only:</b>	<b>Cooling w/Reheat and/or Fan:</b>	<b>External Actuator:</b>	<b>Metasys Zoning Package:</b>
<b>Single Unit:</b>	AP-VMA1410-0	AP-VMA1420-0	AP-VMA1430-0	AP-VMA1440-0
<b>Bulk Pack:</b>	AP-VMA1410-0D	AP-VMA1420-0D	AP-VMA1430-0D	
<b>Buy American:</b>	AP-VMA1410-0G	AP-VMA1420-0G	AP-VMA1430-0G	
<b>Supply Voltage</b>	20-30 VAC at 50 or 60 Hz			
<b>Optional Fuse Current</b>	0.6 ampere for VMA1410; 2.0 amperes for a VMA1420 and 1440; 1.2 amperes for VMA1430			
<b>Power Consumption</b>	VMA1410/1420/1440: VMA1430:	10 VA maximum (Relay and valve requirements not included.) 3 VA maximum (Damper actuator, relay, and valve requirements not included.)		
<b>Ambient Operating Conditions</b>	0 to 50°C (32 to 122°F)			
<b>Ambient Storage Conditions</b>	-40 to 70°C (-40 to 158°F)			
<b>Terminations</b>	6.3 mm (1/4 in.) spade lugs (Communication has screw terminals.)			
<b>Serial Interfaces</b>	N2 Bus and Zone Bus			
<b>N2 Controller Addressing</b>	DIP switch set (1-253) Addresses 254 and 255 are reserved. Software addressable with HVAC PRO software, Release 7.02 or later.			
<b>Communications Bus</b>	N2 between VMA and NCM or N30. Zone Bus between VMA and room sensor (8-pin phone jack or wire to spade lugs or optional plug-on terminals) (Not available when the TE-7720 RF Receiver is applied).			
<b>Mounting</b>	One screw (included) mounts the VMA1410/1420/1440 to the VAV box. One screw attaches the damper shaft to the actuator, 8 mm (5/16 in.) square head set screw with 44 N·m (389.4 lb-in.) of axial holding power for up to 13 mm (1/2 in.) round damper shafts. Minimum damper shaft length is 44.5 mm (1-3/4 in.). Two screws (included) are used to mount the VMA1430 to the VAV box.			
<b>Housing</b>	Plastic housing for controller/actuator with UL94-5VB Plenum Flammability Rating			
<b>Dimensions (L x W x H)</b>	VMA1410/1420/1440: VMA1430:	153 x 102 x 102 mm (6 x 4 x 4 in.) 153 x 102 x 83 mm (6 x 4 x 3.25 in.)		
<b>Continued on next page . . .</b>				



## Technical Specifications (Cont.)

<b>Actuator Torque</b>	4 N·m (35 lb-in) minimum (VMA1410/1420/1440 only)
<b>Shipping Weight</b>	VMA1410/1420/1440: 13.1 kg (29 lb) for a box of ten, 1.3 kg (2.8 lb) each VMA1430: 5 kg (11.02 lb) for a box of ten, 0.5 kg (1.06 lb) each
<b>Electrical Inputs</b>	Analog Inputs: Nickel, silicon, platinum (1 K ohm), or NTC (2.25 K) RTD room sensors, 1.6 K setpoint potentiometer (2-wire) Voltage input for 0-10 VDC (humidity or pressure sensor) Binary Inputs: Dry contacts Input configurations vary based on model type.
<b>Velocity Pressure</b>	Velocity Pressure for 374 Pascal (0-1.5 in. W.C.)
<b>Outputs</b>	No outputs on VMA1410 (internal stepper motor) Binary outputs, 24 VAC triac switched, 25-500 mA loads Stepper drive, 2 to 767 steps per second (23,000 step resolution) (VMA1410/1420/1440 only) Analog output, 0-10 VDC @ 10 mA maximum
<b>Standards Compliance</b>	CSA 22.2 No. 205, UL 916, UL 864 (UUKL), UL 94-5VB, FCC Part 15, Subpart B, Class A and B, C-tick Australia/NZ, AS/NZS 4251.1, CISPR 22, Class B, CE Directive (89/336/EEC, EN50081-1, EN50082-2) Industrial, IEEE 472, IEEE518, IEEE587 Category A/B, IEC-950, IEC 801-2, -3, -4, -6, -7, -8, ANSI C62.41 A/B

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

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