

The Smart Flow Control Series combining a V6W0000 Six-Way Ball Valve with a smart programmable digital actuator (VMA) is the most efficient way to control technology advanced applications.

The Smart Flow Control Series delivers flow control performance and greater flexibility through sensor connection and extensive capabilities. Room control is easily integrated into the VMA by connecting a NS8000 Network Sensor.

Figure 1: Smart Flow Control Series with V6W0000 Six-Way Ball Valve, VMA and NS8000 Network Sensor.



- Nominal voltage 24V AC
- Programmable smart actuator equipped with multiple signal options and Pattern Recognition Adaptive Control (PRAC)
- High-tech control performance
- BACnet® MS/TP and BACnet® IP protocol communication
- Electronic pressure independent solution - Vortex Trail Flow Sensor fully integrated
- Two sequences (cooling/heating) with one 90° smart rotary actuator
- Separated PI control for cooling and heating
- Delta T management and energy management
- Built-in room control and extensive sensor capability
- VMA is used in combination with a NS8000 Series Room Sensor to provide an all in one full-control user experience
- Capability for measuring and displaying zone temperature, occupancy detection, duct temperature, zone humidity and dewpoint, determination, carbon dioxide (CO2) level, setpoint adjustments, fan speed control or discharge air temperatures.
- Metasys® software design
- Compact size and quick field installation
- Low noise operation

Ordering charts

Item	DN	Connection	Description
SFC1656-V6W0-0	DN15	1/2" female BSPP	Smart Flow Control Kit (VMA, six-way valve, flow sensor, cable)
SFC1656-V6W1-0	DN15	3/4" male flat ends	Smart Flow Control Kit (VMA, six-way valve, flow sensor, cable)
SFC1930-V6W0-0	DN15	1/2" female BSPP	Smart Flow Control IP Kit (VMA, six-way valve, flow sensor, cable, valve linkage)
SFC1930-V6W1-0	DN15	3/4" male flat ends	Smart Flow Control IP Kit (VMA, six-way valve, flow sensor, cable, valve linkage)

Item	SFC1656-V6W0-0 contains
210906341K	Flow sensor
114604	Corner-wire box for connector M12x1 with cable - 3 pole
MS-VMA1656-1	VMA
V6WOAAE	Six-way valve (female connection)

Item	SFC1656-V6W1-0 contains
210906341K	Flow sensor
114604	Corner-wire box for connector M12x1 with cable - 3 pole
MS-VMA1656-1	VMA
V6W1AAE	Six-way valve (male connection)

Item	SFC1930-V6W0-0 contains
210906341K	Flow sensor
114604	Corner-wire box for connector M12x1 with cable - 3 pole
MS-VMA1930-0	VMA IP
V6WOAAE	Six-way valve (female connection)
M9000-551	Valve linkage kit

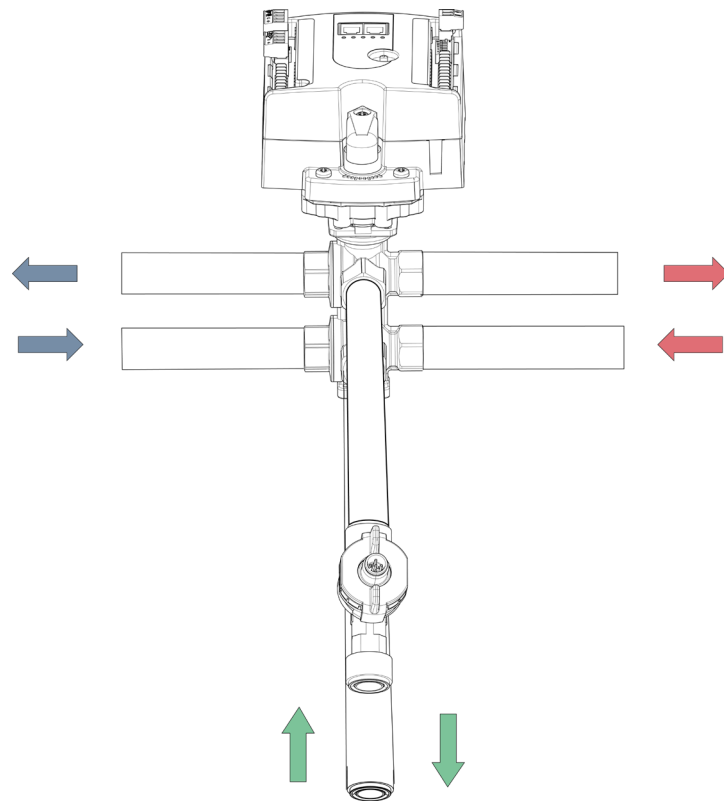
Item	SFC1930-V6W1-0 contains
210906341K	Flow sensor
114604	Corner-wire box for connector M12x1 with cable - 3 pole
MS-VMA1930-0	VMA IP
V6W1AAE	Six-way valve (male connection)
M9000-551	Valve linkage kit

Accessories	Description
063GI-DN15	Insulating case
AP-TBK2PW-0	Replacement power terminal, two-position connector, gray (bulk pack of 10)
AP-TBK4SA-0	Replacement MS/TP SA bus terminal, four-position connector, brown (bulk pack of 10)
AP-TBK4FC-0	Replacement MS/TP FC bus terminal, four-position connector (bulk pack of 10)
AP-TBK1002-0	Screw terminal block kit for spade lugs, two-position connector (bulk pack of 100)
AP-TBK1003-0	Screw terminal block kit for spade lugs, three-position connector (bulk pack of 100)
114604	Corner-wire box for connector M12x1 with cable - 3 pole

Note: Accessories to be ordered separately

Applications

Figure 2: Terminal unit applications and room space control



Chilled ceiling



Fan coil



Chilled beam



Climate ceiling



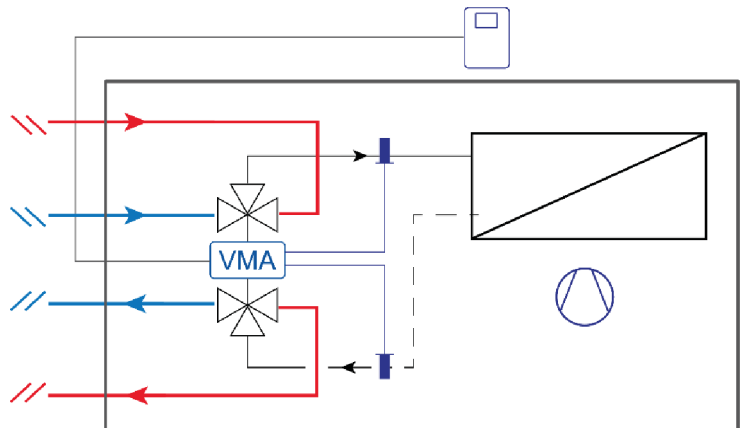
Small air handling unit



Design considerations

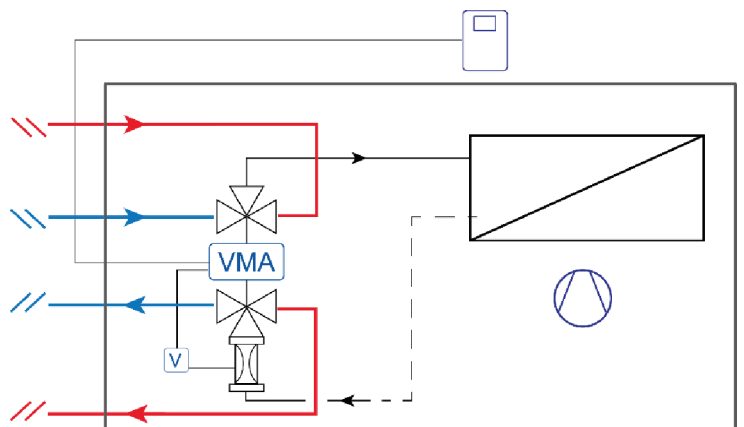
Delta T control management

- Dynamic balancing based on Delta T across the unit
- Control signal compensation based on Delta T improves system energy efficiency
- Eliminates low Delta T issues
- Improves start-up system efficiency
- Non-intrusive balancing solution
- Application flexibility with NS8000 Sensor



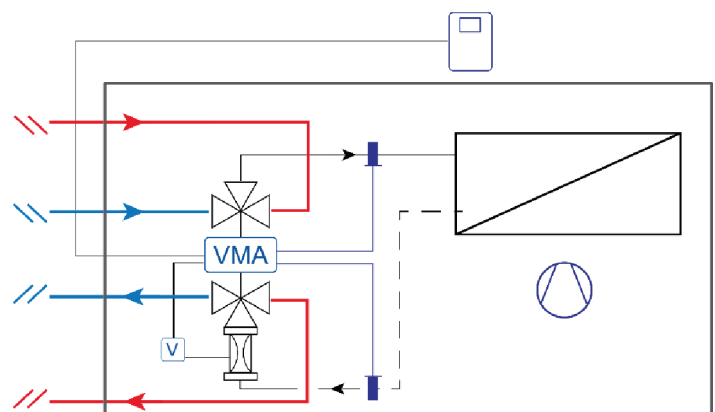
Electronic Pressure Independent Control Valve

- Dynamic balancing based on electronic flow sensor solution
- Control valve position based on flow set point
- Accurate flow system measurement
- Application flexibility with NS8000 Sensor



Energy Control Valve

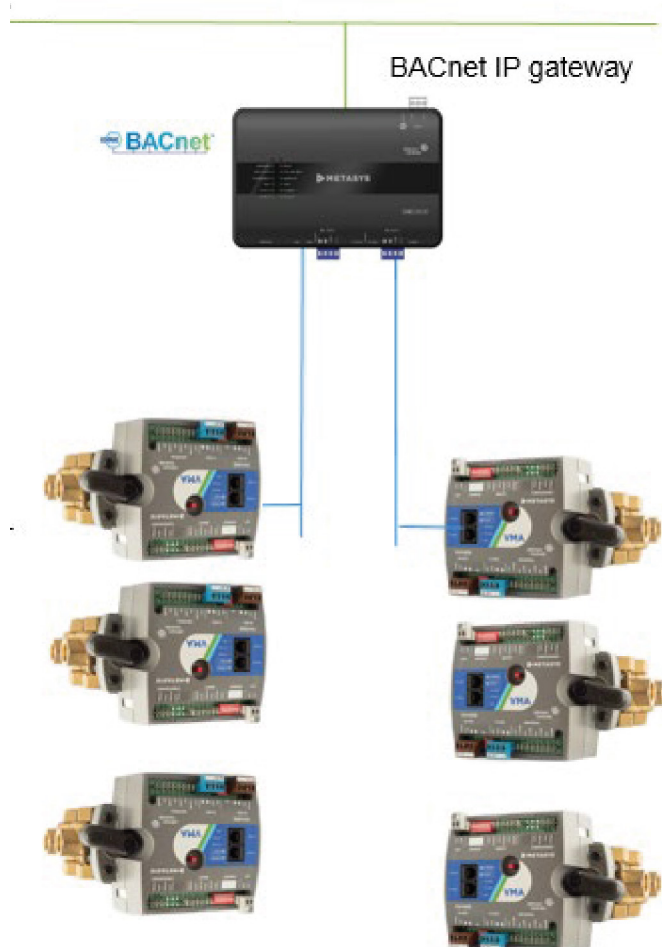
- Dynamic balancing based on electronic flow sensor solution
- Control valve position based on flow set point
- Eliminates low Delta T issues
- Accurate flow system measurement
- Application flexibility with NS8000 Sensor



Solution benefits

- Accurate pressure independent flow control: 0.5 to 10 l/min
- Flow feedback for pumping group control maximizes energy efficiency
- Eliminates the need for a PICV or balancing valve within the HVAC system
- Reduces installation and equipment cost
- Easy commissioning for cooling and heating through Metasys ® software
- No discs or special manual flow settings
- Eliminates intensive and laborious zone-by-zone manual valve adjustment and reduces commissioning cost and time
- PRAC Room Temperature Control and PRAC Flow Control

Figure 3: Connected Metasys BACnet/IP example



Features	Customer benefit
All in one solution	Engineering, installation, and commissioning savings
Programmable	Control built around customer need
Built-in room control	Labour and material savings
Sensor extensive capability	Wide range of applications
Metasys ® software design	Easy commissioning and building management system control
Flattening architecture	Simplified control architecture improving efficiency and system performance

Operation

Valve operation

The valve is equipped with two balls with an "L" hole. A reference mark made by laser is placed on the main stem; ball position is identified by this mark even after the valve is installed.

Figure 4: Stem/ball rotations

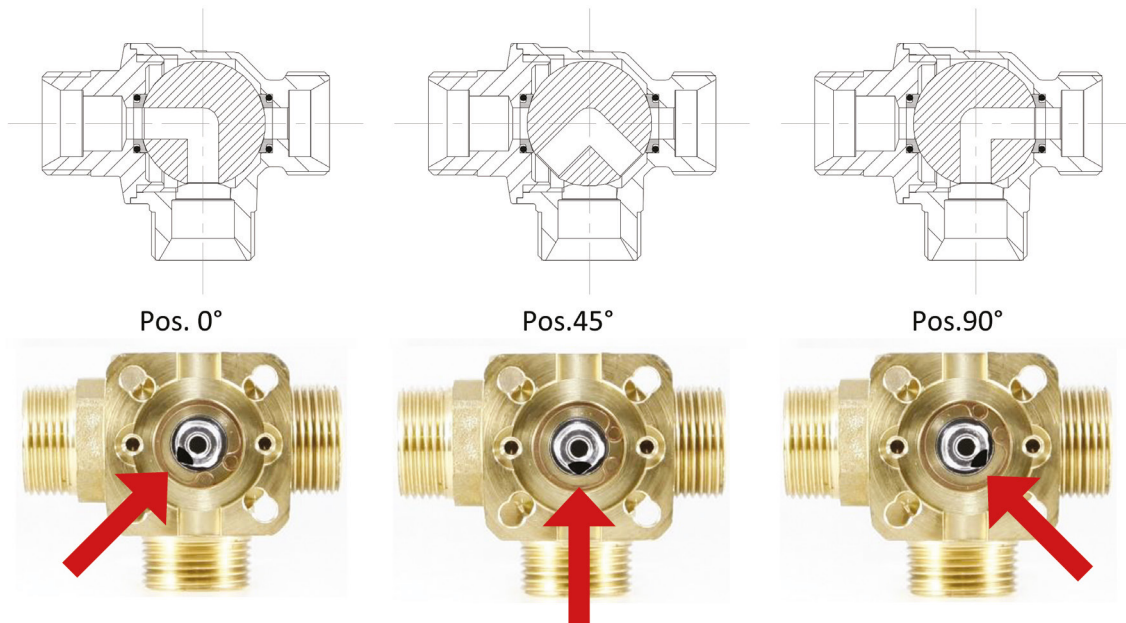
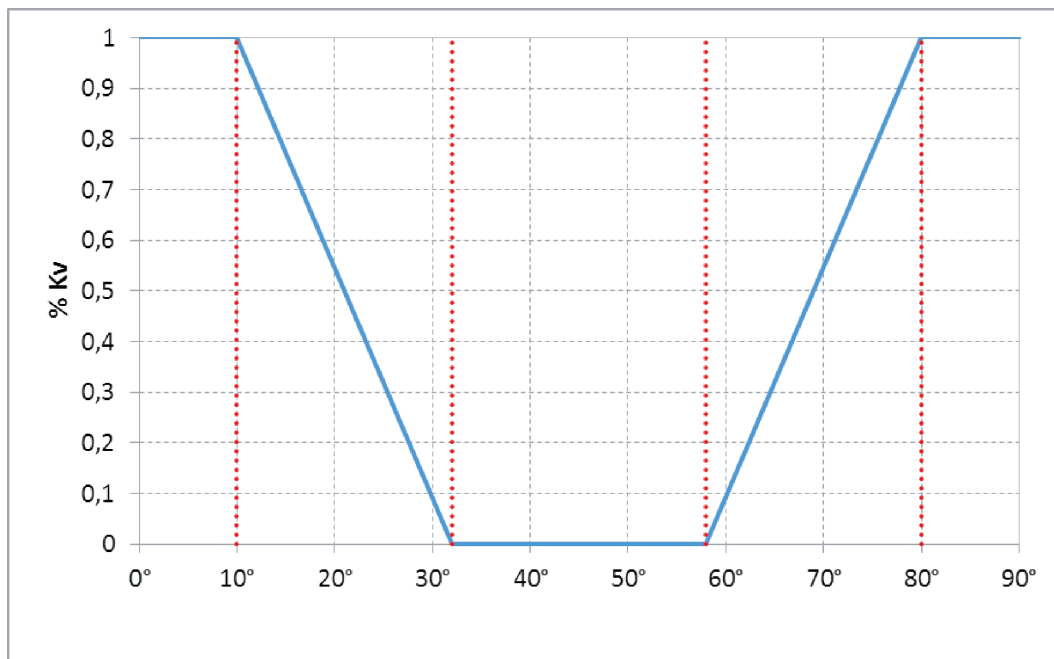
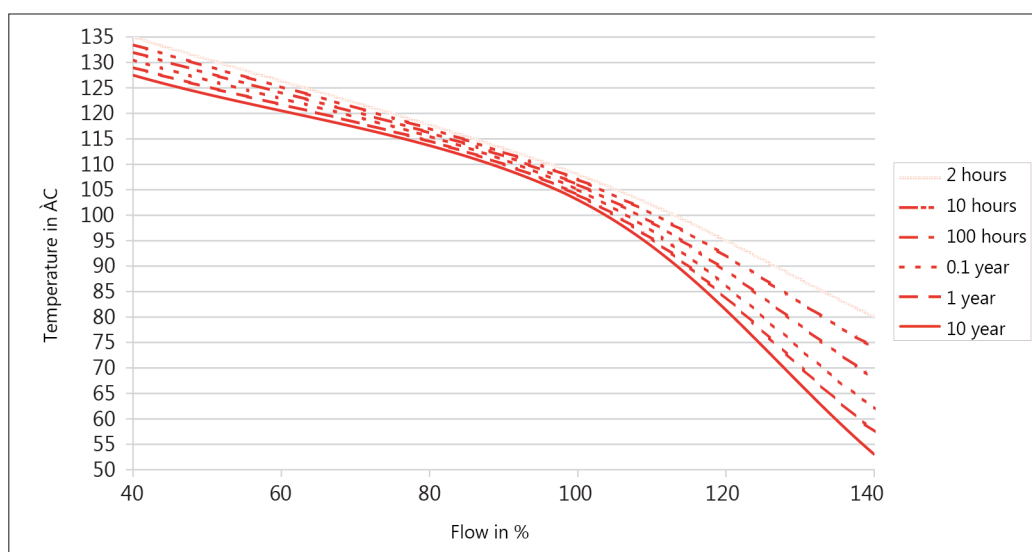


Figure 5: Characteristic operation curve



Flow sensor operation

Figure 6: Minimum life span on high flow rate and high temperature



Glycol influence

Figure 7: Definition of viscosity of glycol-water compound

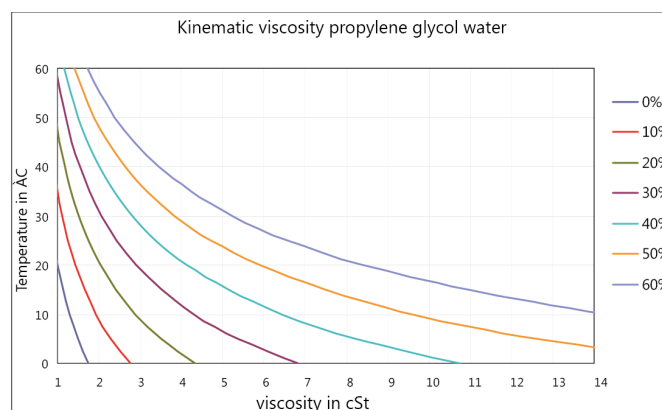
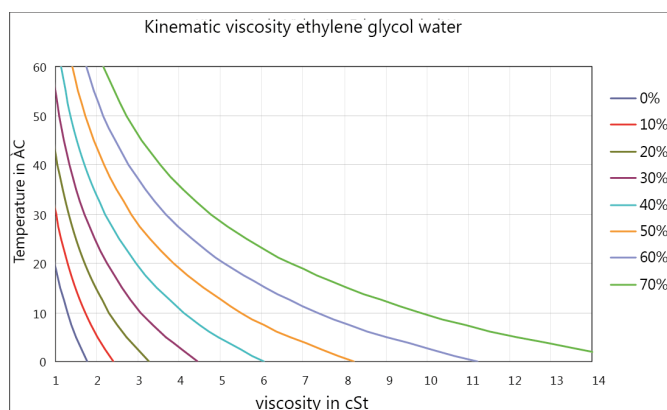


Figure 8: Definition of respond threshold

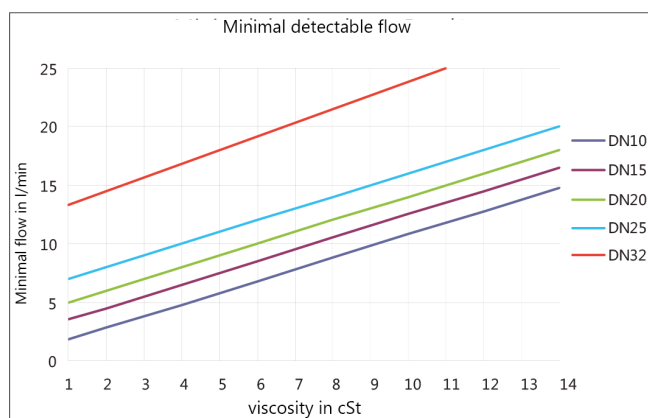
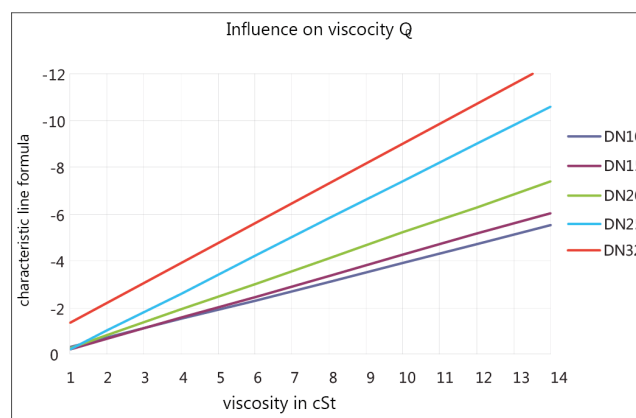


Figure 9: Definition of characteristic line formula

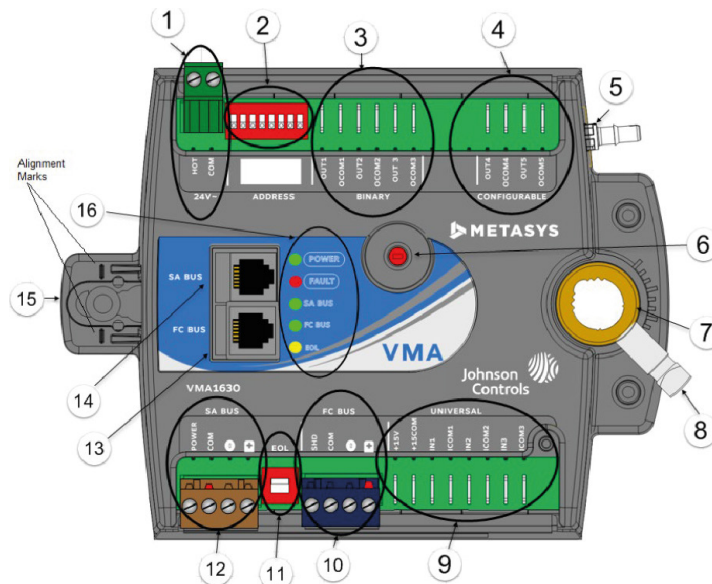


VMA controller operation

VMA is a programmable smart actuator that embeds input and output hardware to extend control capability within HVAC systems. In addition to valve control, VMA is programmable for fan, damper, or electrical heater control purposes and alarms.

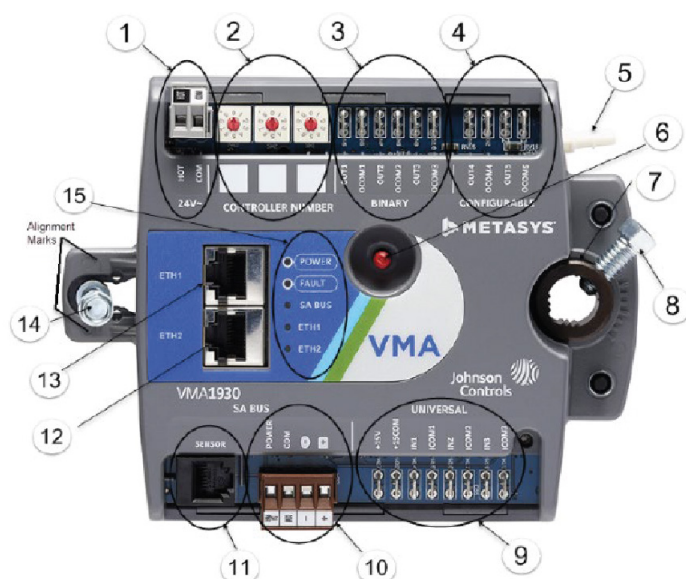
VMA is used in combination with NS Series Network Sensors to provide a modern interface to the room occupant; monitoring presence, temperature, humidity, and CO2 for optimal comfort control.

Figure 10: VMA Series - BACnet MS/TP VMA model



	Description
1	24 VAC, Class 2 supply power block terminal
2	Device address DIP switch block
3	Binary outputs, 24 VAC triacs
4	Configurable outputs: voltage analog output (0-10 VDC) and binary output (24 VAC Triac) (VMA1630, 1626 AND 1628)
5	Dual port fitting
6	Manual override button
7	Coupler bolt
8	Controller coupler
9	Universal input: voltage analog input (0-10 VDC) Resistive analog inputs (0-600k ohm) 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
11	EOL (End-of-Line) switch
12	SA Bus terminal block
13	Modular port (FC Bus) RJ-12 6-pin modular jack
14	Modular port (SA Bus) RJ-12 6-pin modular jack
15	Captive spacer and screw
16	LED status indicators

Figure 11: VMA Series 1930 - BACnet IP VMA model

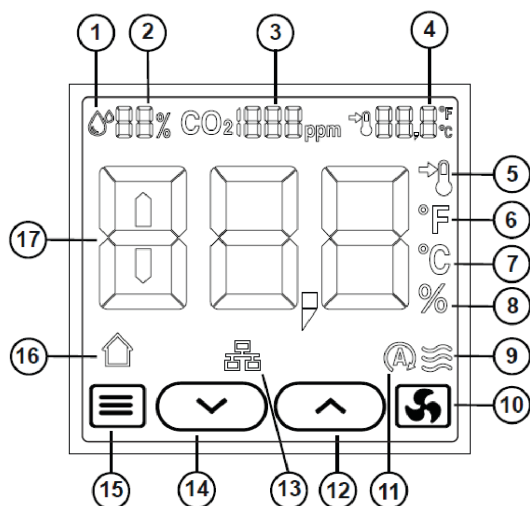


	Description
1	24 VAC, Class 2 supply power block terminal
2	Controller number rotary switches numbered from 000 to 999
3	Binary outputs, 24 VAC triacs
4	Configurable outputs: voltage analog output (0-10 VDC) and binary output (24 VAC triac)
5	Dual port fitting
6	Manual override button
7	Coupler bolt
8	Controller coupler
9	Universal input: voltage analog input (0-10 VDC) Resistive analog inputs (0-600k ohm) 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	SA Bus terminal block.
11	Sensor port (SA Bus) RJ-12 6-pin modular jack
12	ETH2 ethernet port for BACnet/IP communications
13	ETH1 ethernet port for BACnet/IP communications
14	Captive spacer and screw
15	LED status indicators

Network sensor operation

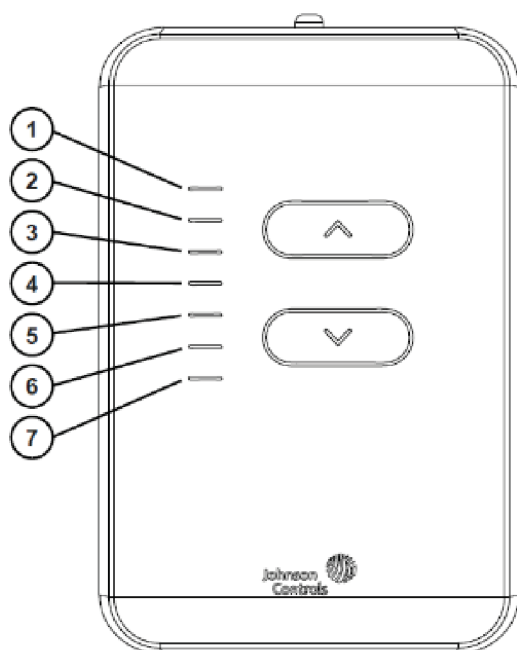
The NS Series Network Sensor monitors zone temperature, relative humidity, carbon dioxide (CO2), motion, and local temperature setpoint adjustments. The sensor transmits this data to a controller on the Sensor/Actuator (SA) bus. Some NS Series Network Sensor models include an onboard passive infrared (PIR) occupancy sensor that detects motion to determine if a space is occupied.

Figure 12: NS8000 Network Sensor touch display model



	Description
1	Humidity indicator
2	Humidity measurement
3	CO2
4	Configurable setpoint or current temperature
5	Setpoint indicator icon
6	Fahrenheit
7	Celsius
8	Percent relative humidity
9	Fan speed bars
10	Fan
11	Automatic fan speed
12	Up adjustment or navigation
13	SA bus online indicator
14	Down adjustment or navigation
15	Menu or enter
16	Occupancy indicator
17	Default display value (setpoint, zone temperature, relative humidity)

Figure 13: NS8000 Network Sensor non-display LED indication model

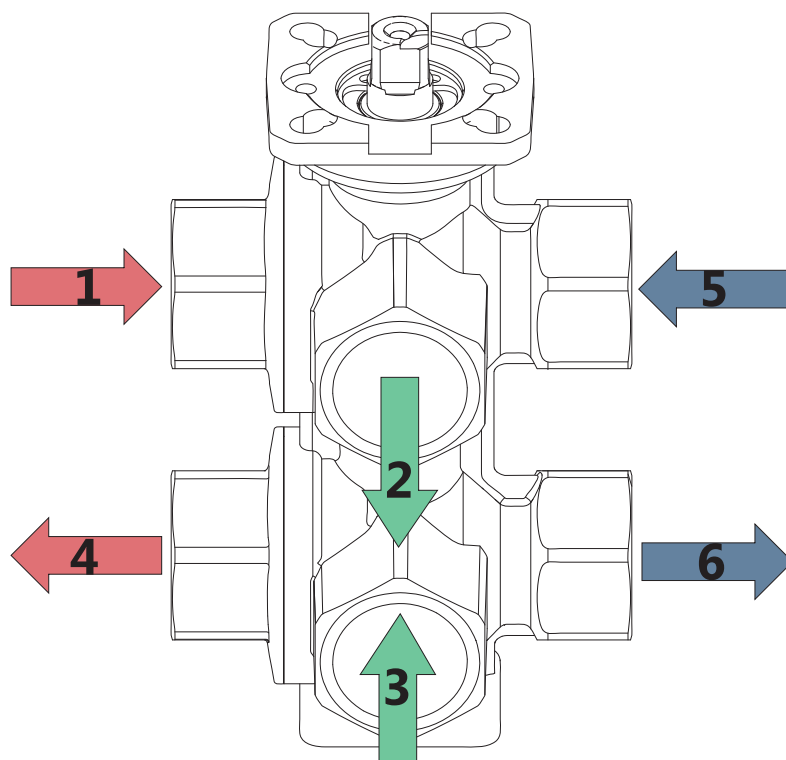


	Description
1	Partially lights up in red and fully lights up in red
2	Partially lights up in red and fully lights up in red
3	Fully lights up in red
4	Center LED fully lights up in white
5	Fully lights up in blue
6	Partially lights up in blue and fully lights up in blue
7	Partially lights up in blue and fully lights up in blue

Installation

Valve installation

Figure 14: Input and output flows



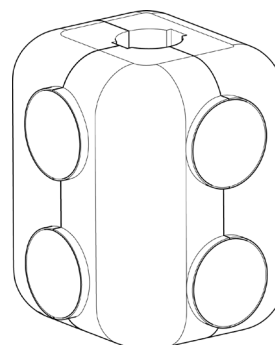
Valve port	Description
1	Source 1 supply (shown as hot water, hot or cold)
2	Coil supply
3	Coil return
4	Source 1 return (shown as hot water, can be hot or cold)
5	Source 2 supply (shown as hot water, can be hot or cold)
6	Source 2 return (shown as hot water, can be hot or cold)

Item	DN connection
SFC1656-V6W0-0	DN15 1/2" female BSPP
SFC1656-V6W1-0	DN15 3/4" male flat ends

Insulating case

In order to ensure the thermal insulation of the six-way valve, an insulating case is available as optional (to be purchased separately). The case can be installed even when the valve is already connected to pipes.

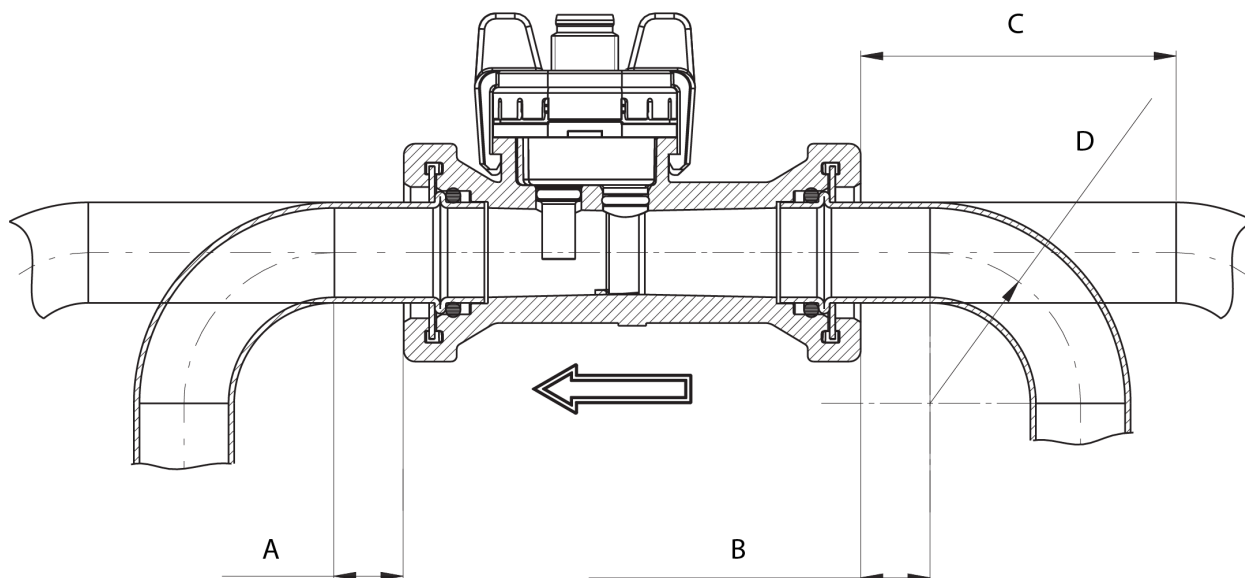
Figure 15: Insulating case for DN 15 valves



Flow sensor installation

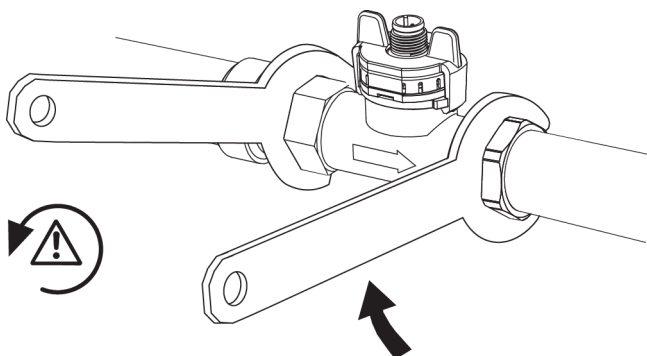
To ensure the correct function of the sensor; only diameter changes from large to small are allowed. Avoid repeated elbows in the same level at entryside.

Figure 16: Flow sensor dimensions



	Dimension
A	Minimum 1 x DN
B	Minimum 0.5 x DN for recommended 90° elbow with min 1.8 x DN
C	Minimum 5 x DN for alternative elbows
D	Minimum R 1.8 x DN

Figure 17: Flow sensor installation

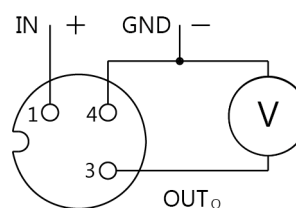


	DN 6/8/10 G 1/2	DN 6/8/10 G 3/4	DN15 G 3/4	DN15 G1	DN20 G1	DN20 G 1 1/4	DN25 G1 1/4	DN25 G1 1/2
M min (Nm)	1	1	1	2	2	2.5	2.5	2.5
M max (Nm)	12	12	12	12	12	15	15	15

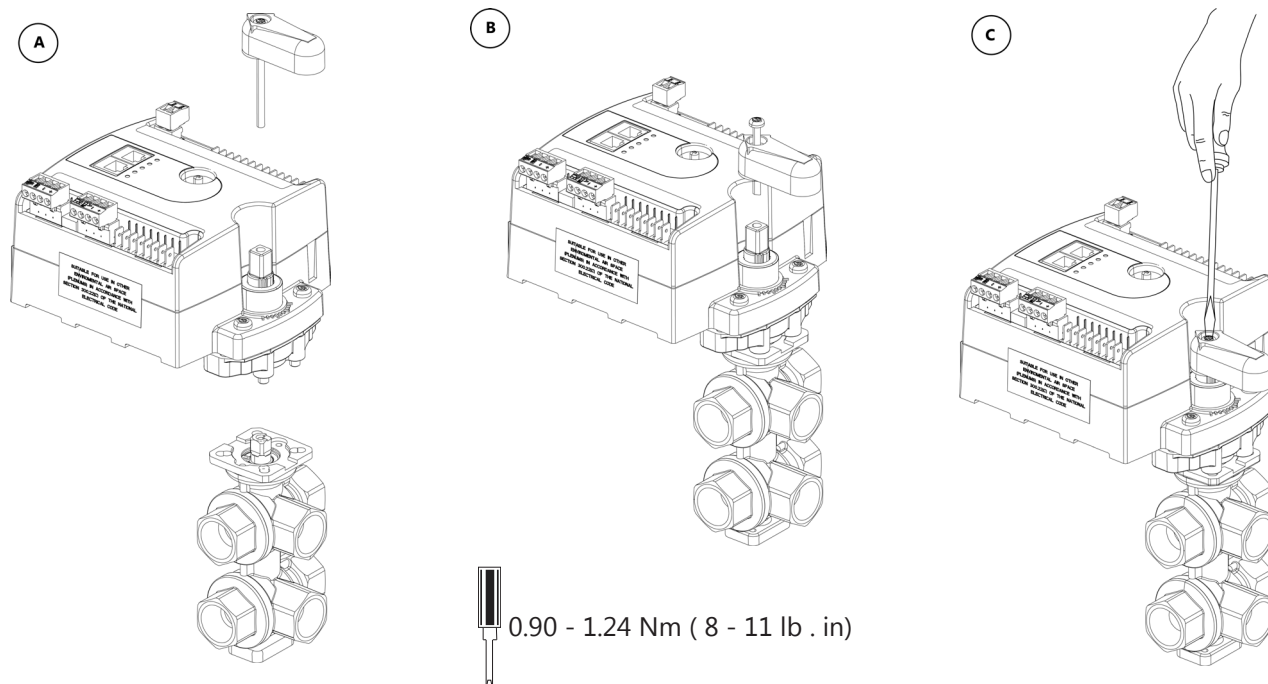
Cable

Corner-wire box for connector M12x1 with cable. Three-pole 200cm.

Figure 18: Voltage output



VMA installation

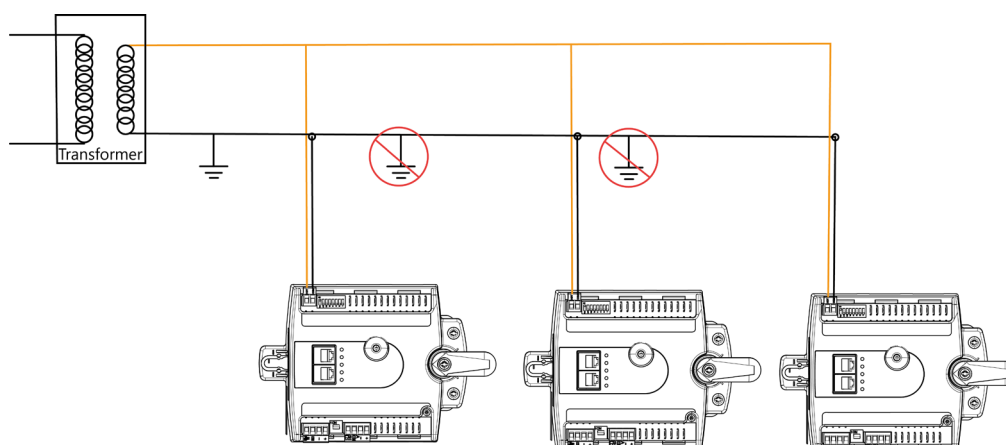


CAUTION: Risk of Electric Shock.

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

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.

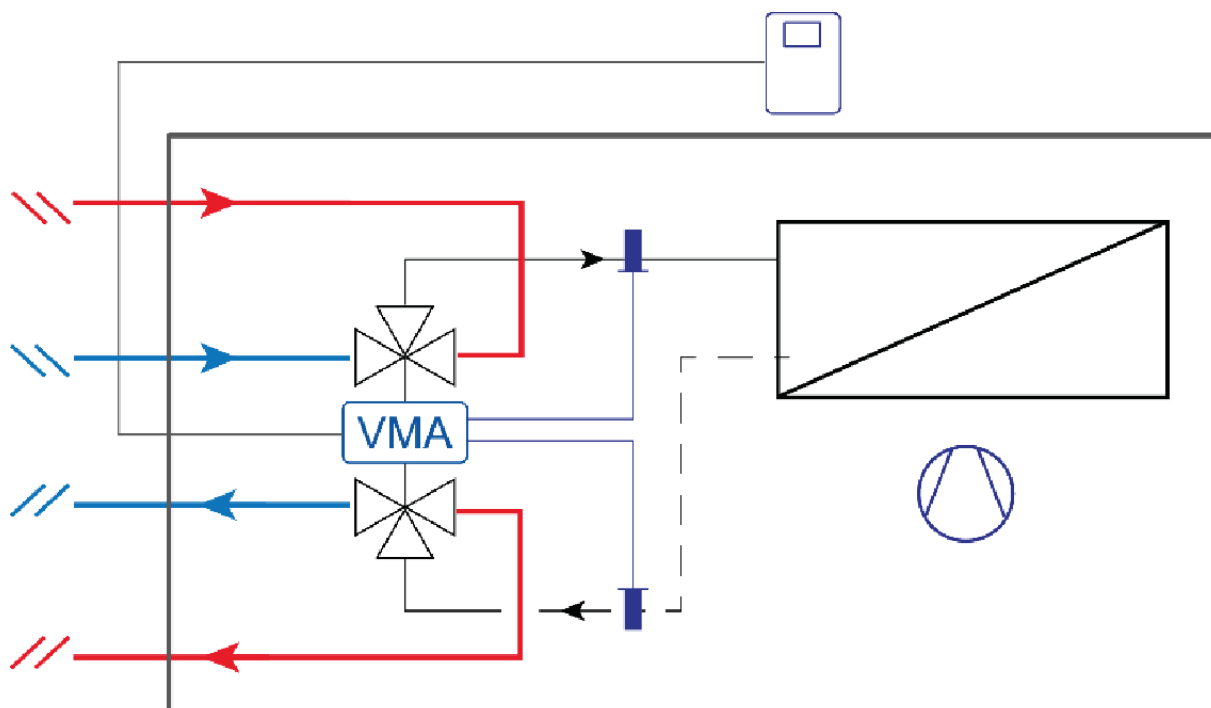
Figure 19: VMA grounding



Supply voltage (50/60 Hz)	24 VAC (nominal, 20 VAC minimum/30 VAC maximum)
Power supply class	Safety Low-Extra Voltage (SELV)
Power consumption	10 VA typical, 14 VA maximum

Design examples

Delta T application example

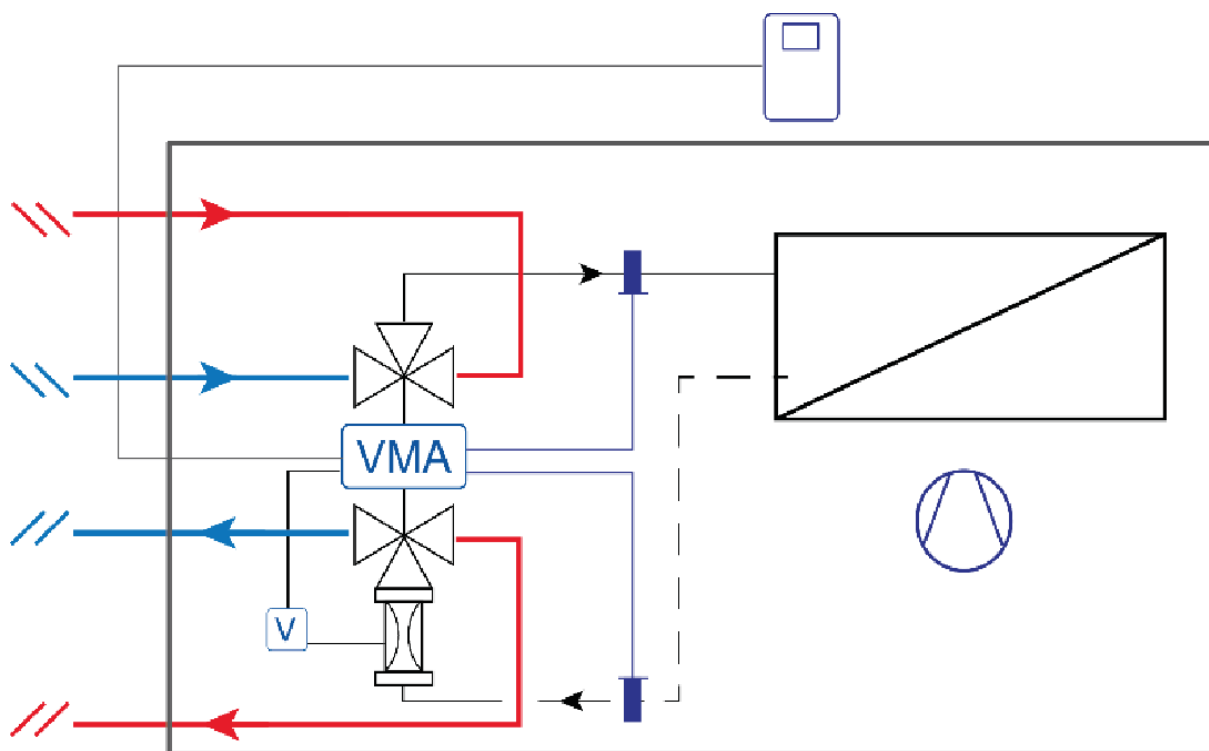


Point list	Description	Type
IN1	Universal input	Available extra sensor or binary input
IN2	Universal input	PT1000 inlet water temperature
IN3	Universal input	PT1000 outlet water temperature
OUT1	Binary output	Available output
OUT2	Binary output	Available output
OUT3	Binary output	Available output
OUT4	Configurable output	Available output
OUT5	Configurable output	Available output
SA Bus	Local communication port	NS8000 Room Sensor
FC Bus	BACnet communication port	MS/TP



Point list	Description	Type
+15V	Power supply output	Flow sensor input IN (pin 1)
+15COM	Power supply output	Flow sensor input GND (pin 4)
IN1	Universal Input	Flow sensor output OUT (pin 3)
IN2	Universal Input	Available extra sensor or binary input
IN3	Universal Input	Available extra sensor or binary input
OUT1	Binary Output	Available output
OUT2	Binary Output	Available output
OUT3	Binary Output	Available output
OUT4	Configurable Output	Available output
OUT5	Configurable Output	Available output
SA Bus	Local Communication Port	NS8000 Room Sensor
FC Bus	BACnet Communication Port	MS/TP

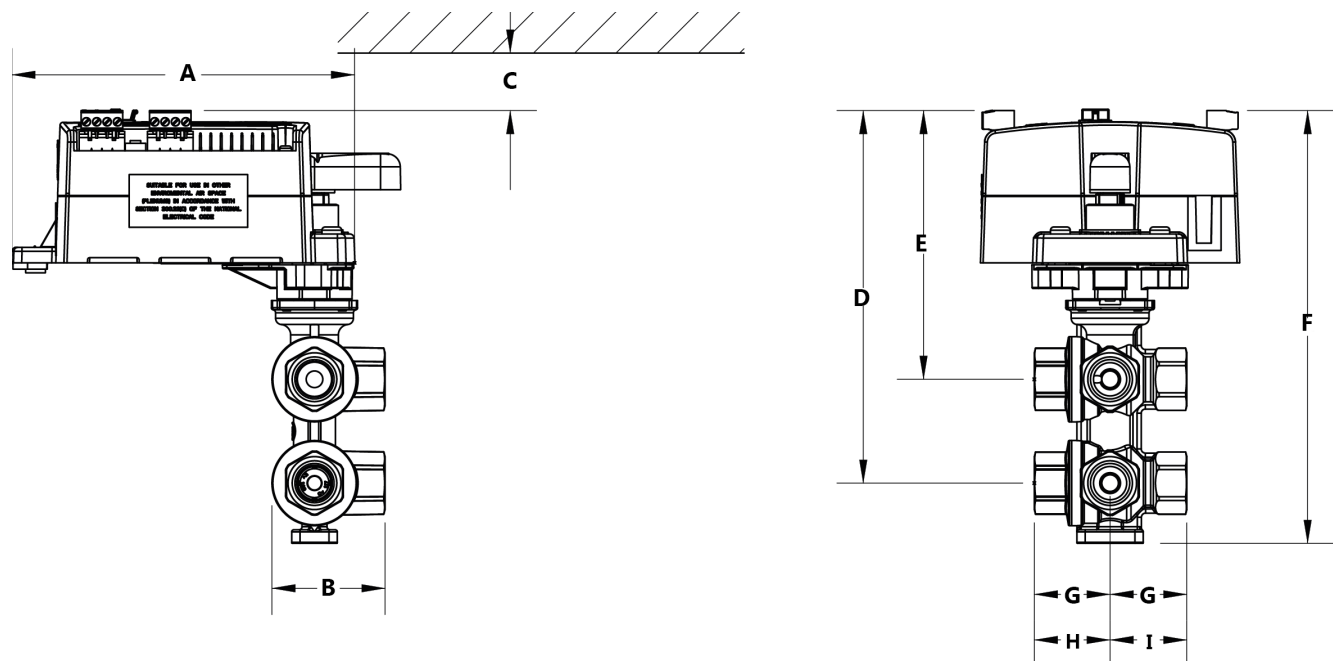
Energy Control Valve application example



Point list	Description	Type
+15V	Power supply output	Flow sensor input IN (pin 1)
+15COM	Power supply output	Flow sensor input GND (pin 4)
IN1	Universal input	Flow sensor output OUT (pin 3)
IN2	Universal input	PT1000 inlet water temperature
IN3	Universal input	PT1000 outlet water temperature
OUT1	Binary output	Available output
OUT2	Binary output	Available output
OUT3	Binary output	Available output
OUT4	Configurable output	Available output
OUT5	Configurable output	Available output
SA Bus	Local communication port	NS8000 Room Sensor
FC Bus	BACnet communication port	MS/TP

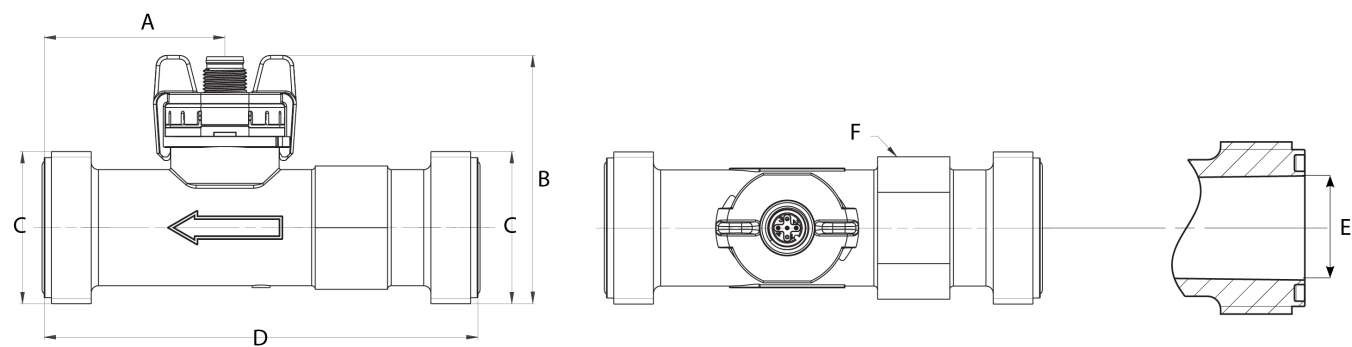
Dimensions

Figure 20: Valve and VMA dimensions (mm)



	A	B	C	D	E	F	G	H	I
VW60AAE	165	55	90 min.	179	129	208	37	-	-
V6W1AAE	165	56	90 min.	179	129	208	-	41	34

Figure 21: Flow sensor dimensions (mm)



	A	B	C	D	E	F
DN6	43.7	53.0	G 1/2	77	11.5	12

Technical specifications

VMA Series	
Supply voltage	24 VAC (nominal, 20 VAC minimum/30 VAC maximum), 50/60 Hz, Power Supply Class 2 (North America), Safety Extra-Low Voltage (SELV) (Europe)
Power consumption	10 VA typical, 14 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 3-Wire pluggable screw terminal blocks Sensor port: RJ-12 6-pin modular jacks
Controller addressing	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.)
Communications bus	BACnet MS/TP, RS-485: 3-wire FC Bus between the supervisory controller and field controllers 4-wire SA Bus from the VMA controller, network sensors, and other sensor/actuator devices, includes a terminal to source 15 VDC supply power from VMA to SA Bus devices
Processor	Renesas® 16-bit H8S/239x microcontroller
Memory	1 MB flash memory and 512 KB RAM
Input and output capabilities	VMA1610: 1 - Universal input: Defined as 0–10 VDC, 4–20 mA, 0–600k ohm, or binary dry contact VMA1620: 1 - Universal input: Defined as 0–10 VDC, 4–20 mA, 0–600k ohm, or binary dry contact 3 - Binary outputs: Defined as 24 VAC triac (internal power source) 2 - Configurable outputs: Defined as 0–10 VDC or 24 VAC triac BO
Analog input/analog output resolution and accuracy	Analog input: 15-bit resolution Analog output: 16-bit resolution and ± 200 mV in 0–10 VDC applications
Differential pressure transducer	Analog output range : -1.5 to 1.5 in. WC Accuracy $\pm 1.3\%$ full span maximum 3 ($\pm .039$ in. WC). Typical accuracy at zero (null) pressure is $\pm 0.2\%$ full scale
Actuator rating	4 N•m
Dimensions	165 x 125 x 73 mm
Weight	0.65 kg
Compliance	CE Mark – Johnson Controls deems that this product is in compliance with the essential requirements and other relevant provisions of the EMC Directive 2004/108/EC.
	BACnet Testing Laboratories (BTL) Protocol Revision 7 Listed BACnet Application Specific Controller (B-ASC)

V6W0000 Valve	
Service	Hot water, chilled water, 50/50 glycol solutions
Vnom [l/h]	1250
Kvs [m3/h]	1.25
Fluid temperature limits	-10°C to 120°C
Nominal pressure	PN16
Characteristic curve	Linear
Total operation angle	90°
Sequence 1	0 - 32°
Dead band	32° - 58°
Sequence 2	58° - 90°
Max. differential pressure	2 bar
Leakage level	EN12266-1/12 P12 cl. A
Weight	1020 g
Water quality	UNI 8065 - Fe<0.5mg/kg - Cu<0.1 mg/Kg

Flow Sensor	
Measuring principle	Vortex, piezoelectric sensor element
Measuring range	0.5...10 l/min / 30...600 l/h
Nominal diameter	DN6
Accuracy at < 50% FS (water)	< 1% FS
Accuracy at > 50% FS (water)	< 2% measuring value
Power supply	Voltage output 11.5...33 VDC
Output flow	Analogue signal 0...10 V

NS8000 Network Sensor			
Supply voltage		9.8 VDC to 16.5 VDC; 15 VDC nominal (from SA bus)	
Current consumption	Base current draw (all models)		3 mA maximum (non-transmitting)
	CO ₂ models		15 mA maximum additional current (during measurement)
	Display models - backlight on		10 mA additional current
	Warmer/cooler models - LEDs on		8 mA additional current
	Note: SA bus applications are limited to a power load of 210 mA. The best practice when configuring an SA bus is to limit the total available operating power consumption to 120 mA or less. This power level allows you to connect a BTCVT Wireless Commissioning Converter temporarily or a DIS1710 Local Controller Display to the bus for commissioning, adjusting, and monitoring.		
Terminations		Modular jack and screw terminal block	
Network sensor addressing	All models		DIP switch set from 199 to 206; factory set at 199
Wire size	Modular jack models		24 AWG or 26 AWG (0.5 mm or 0.4 mm diameter); three twisted pair (six conductors)
	Screw terminal block models		18 AWG to 22 AWG (1 mm to 0.6 mm diameter); 22 AWG (0.6 mm diameter)
Communication rate		Auto-detect: 9.6 kbps, 19.2 kbps, 38.4 kbps, or 76.8 kbps	
Temperature measurement range		32°F/0°C to 104°F/40°C	
Temperature sensor type		Digital temperature sensor	
Humidity sensor type		Thin film capacitive sensor	
Ambient conditions	Operating		32°F to 122°F (0°C to 50°C); 10% to 90% RH, noncondensing; 85°F (29°C) maximum dew point
	Storage	Display models	-40°F to 122°F (-40°C to 50°C); 5% to 95% RH, noncondensing
		Non-display models	-40°F to 185°F (-40°C to 70°C); 5% to 95% RH, noncondensing
Temperature resolution		±0.5°F/±0.5°C	
Temperature accuracy	NS Series Network Zone Sensor		±1°F/±0.6°C
	Temperature element only		±0.36°F/±0.2°C at 70°F/21°C
Humidity element accuracy	NSB8BPN24x-0 models		±2% RH for 20% to 80% RH at 50°F to 95°F (10°C to 35°C) ±4% RH for 10% to 20% and 80% to 90% RH at 50°F to 95°F (10°C to 35°C)
	NSB8BHxxxx-0 models		±3% RH for 20% to 80% RH at 50°F to 95°F (10°C to 35°C) ±6% RH for 10% to 20% and 80% to 90% RH at 50°F to 95°F (10°C to 35°C)
CO ₂ measurement range		0 ppm - 2000 ppm	

Smart Flow Control Series

NS8000 Network Sensor (2 of 2)		
CO ₂ sensor accuracy	Accuracy	±30 ppm ±3% of CO ₂ reading at 77°F (25°C) and 978 hPa (1,000 ft/300 m)
	Temperature dependence	±1.4 ppm/°F (± 2.5 ppm/°C)
	Pressure dependence	Refer to the NS8000 Series Network Sensors Installation Instructions (24-11256-00007) for CO ₂ altitude compensation.
CO ₂ sensor operation range		32°F to 122°F (0°C to 50°C)
Time constant		10 minutes nominal at 10 fpm airflow
Default temperature setpoint adjustment range		50°F/10°C to 86°F/30°C in 0.5° increments
CO ₂ sensor lifespan		10 years under standard operating conditions
PIR occupancy sensor motion detection		Minimum 94 angular degrees up to a distance of 26 ft (8m); based on clear line of sight

Materials		
Valve	Body	CW602N (EN 12167) CuZn36Pb2As
	O-ring	EPDM - Perox
	Seats	PTFE
	Stem	CW614N (EN 12164) CuZn39Pb3 chrome plated
	Ball	CW614N (EN 12164) CuZn39Pb3 chrome plated
	Antifriction seat	PTFE
	Seeger	Phosphor bronze
Actuator	Housing	Enclosure material: ABS polycarbonate UL94 5VB; self-extinguishing, plenum rated protection class: IPSO (IEC529)
Flow sensor	Materials in contact with fluid	ETFE
	Sensor paddle	PA6T/61 (40% GF)
	Case with damming body	EPDM - Perox
	Sealing material	FPM

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 shall not be liable for damages resulting from misapplication or misuse of its products.

Product warranty

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

Software terms

Use of the software that is in (or constitutes) this product, or access to the cloud, or hosted services applicable to this product, if any, is subject to applicable terms set forth at www.johnsoncontrols.com/techterms. Your use of this product constitutes an agreement to such terms.

Patents

Patents <http://jcipat.com>

Single point of contact

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