

## VG7000 Series Bronze Control Valves

VG7000 Series Bronze Control Valves are designed primarily to regulate the flow of water and steam in response to the demand of a controller in Heating, Ventilating, and Air Conditioning (HVAC) systems. These valves are available in Normally Open (N.O.), Normally Closed (N.C.), and three-way mixing configurations. Both electric and pneumatic actuators are available for factory or field mounting.

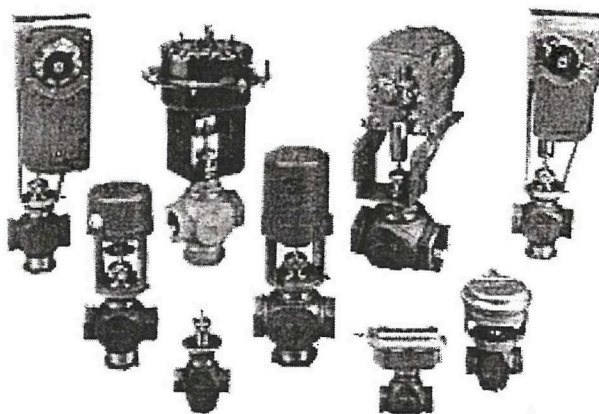


Figure 1: VG7000 Series Bronze Control Valves

Features and Benefits	
<input type="checkbox"/> <b>Complete Family of 1/2 through 2 in. Bronze Valves, Brass and Stainless Steel Trim, with Several Styles of Electric and Pneumatic Actuators</b>	Offers a broad selection to choose from, including electric spring return actuators, a true 1-1/4 in. valve body, a 3/4 in. valve with small oval top actuator, and Stainless Steel (SS) trim capable of 100 psig saturated steam
<input type="checkbox"/> <b>Flexible Features and Options Ordering Matrix</b>	Engineer to suit your specific application from thousands of easy-to-select, factory-assembled combinations
<input type="checkbox"/> <b>Uses Standard Johnson Controls Ring Pack Packings</b>	Provides industry-leading reliability and operating life
<input type="checkbox"/> <b>Every Valve Tested for Tight Shutoff</b>	Provides energy conservation and ensures occupant comfort
<input type="checkbox"/> <b>Standard Bonnet and Stem Design</b>	Allows easy field retrofit, easy field mounting, and interchangeability of actuators with the use of standardized mounting kits

**Table 1: Ordering Data — VG7000 Series Bronze Control Valves**

<b>VG</b>	<b>Valve Global</b>														
1	2	7	<b>Product Family</b> 7 = Cast Bronze												
3	2	<b>Body Type</b> 2 = Two-Way, Normally Open/Push-Down-To-Close													
	4	4 = Two-Way, Normally Closed/Push-Down-To-Open													
		5 = Two-Way Angle, Normally Open/Push-Down-To-Close													
		8 = Three-Way Mixing													
	4	<b>End</b> 4 = Threaded (NPT)													
	5	<b>Connections</b> 5 = Union Globe/Union Angle													
		7 = Union Sweat, 3/8 in. Tubing (1/2 in. Body Size Only)													
		8 = Union Sweat, Standard Tubing (1/2, 3/4, and 1 in. Body Sizes Only)													
		9 = Union Sweat, 3/4 in. Tubing (1/2 in. Body Size Only)													
	1	<b>Trim and Flow Characteristics</b> 1 = Brass Equal Percentage (All Two-Way and 1/2 in. Three-Way)													
	6	2 = Brass Linear (Two-Way Union Angle and All Three-Way)													
		3 = Stainless Steel Equal Percentage (Two-Way Only)													
		4 = Stainless Steel Linear (Three-Way Only)													
	L	<b>Size and Cv (Kv)</b> C = 1/2 in., 0.73 Cv (0.63 Kv)													
	7	E = 1/2 in., 1.8 Cv (1.6 Kv)													
		G = 1/2 in., 4.6 Cv (4.0 Kv)													
		L = 3/4 in., 7.3 Cv (6.3 Kv)													
		N = 1 in., 11.6 Cv (10.0 Kv)													
		P = 1-1/4 in., 18.5 Cv (16.0 Kv)													
		R = 1-1/2 in., 28.9 Cv (25.0 Kv)													
		S = 2 in., 46.2 Cv (40.0 Kv)													
	T	<b>Stem Type</b> T = Standard Threaded Stem (All Except V-3801, MP84, VA-8x2x)													
	8	S = Slotted Stem and Small Bonnet (Factory-Mounted V-3801, VA-8x2x Only)													
		M = Large Threaded Stem (Factory-Mounted MP84 Only)													
	+	<b>Actuator Mounting</b> + = Factory-Mounted Actuator (See Tables 2 and 3.)													
	9	(Leave Fields 9 through 15 blank for valve without factory-mounted actuator. Valve without factory-mounted actuator is available with standard threaded stem only.)													

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 = Field

<b>V</b>	<b>G</b>	<b>7</b>	<b>2</b>	<b>4</b>	<b>1</b>	<b>L</b>	<b>T</b>	<b>+</b>							
Valve								+	Actuator						

Example: Cast bronze valve, two-way, normally open/push-down-to-close, threaded (NPT) end connections, brass trim, equal percentage, 3/4 in., 7.3 Cv, standard threaded stem.

Note: Refer to Table 2 when adding a factory-mounted pneumatic actuator to a valve body. Refer to Table 3 when adding a factory-mounted electric actuator to a valve body.

**Table 2: Ordering Data — Adding a Factory-Mounted Pneumatic Actuator**

<b>V</b>	<b>G</b>	<b>7</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>L</b>	<b>T</b>	<b>+</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>8</b>	<b>V-3000/V-3801</b>	3801 = V-3801-8001 Small Oval Top (Slotted Stem Only)	
1	2	3	4	5	6	7	8	9	10	11	12	13	<b>Pneumatic Actuator</b>	3008 = V-3000-8011 Exposed 3003 = V-3000-8003 Enclosed	
<i>(See Actuator Product/Technical Bulletin.)</i>															
<b>B</b>															
<b>Spring Range (V-3000/V-3801)</b>															
B = 3 to 6 psig (Suggested for N.O. Valves with Positioner)															
D = 4 to 8 psig (Suggested for Three-Way Valves with Positioner)															
E = 9 to 13 psig (Suggested for N.C. Valves with Positioner)															
<b>P</b>															
<b>Accessories (V-3000/V-3801)</b>															
P = V-9502 Positioner (Not Avail. with V-3801-8001 or V-3000-8003)															
Blank = None															
<b>8</b>	<b>2</b>													<b>MP8000 Series</b>	82 = MP82, 25 sq in. Spring-Return-Up (SS or Brass Trim)
10	11													<b>Pneumatic Actuator</b>	84 = MP84, 50 sq in. Spring-Return-Up (SS Trim Only)
<i>(See Actuator Product Bulletin.)</i>															
<i>(Only spring-return-up models of MP8000 Series Pneumatic Actuators are available factory-mounted to VG7000 Series Bronze Control Valves.)</i>															
<b>1</b>															
<b>Stroke (MP8000 Series)</b>															
1 = 5/16 in. (1/2 or 3/4 in. Valves with MP82 Actuator Only)															
2 = 1/2 in. (1 or 1-1/4 in. Valves with MP82 Actuator Only)															
3 = 3/4 in. (1-1/2 or 2 in. Valves with MP82 or MP84 Actuator)															
<b>C</b>															
<b>Spring Range (MP8000 Series)</b>															
C = 3 to 7 psig (Suggested for N.O. Valves with Positioner)															
D = 4 to 8 psig (Suggested for Three-Way Valves with Positioner)															
E = 9 to 13 psig (Suggested for N.C. Valves with Positioner)															
<b>01</b>															
<b>Accessories (MP8000 Series)</b>															
00 = None															
01 = V-9502 Positioner															

<b>V</b>	<b>G</b>	<b>7</b>	<b>2</b>	<b>4</b>	<b>3</b>	<b>L</b>	<b>T</b>	<b>+</b>	<b>8</b>	<b>2</b>	<b>1</b>	<b>C</b>	<b>0</b>	<b>1</b>	
Valve									+	Actuator					

Example: Cast bronze valve, two-way, normally open, threaded (NPT) end connections, stainless steel trim, equal percentage, 3/4 in., 7.3 Cv, standard threaded stem, MP82 Series Pneumatic Actuator, 5/16 in. stroke, 3 to 7 psig spring range, with factory-mounted V-9502 Positioner.

Note: Refer to Table 1 when ordering a valve body only. Refer to Table 3 when adding a factory-mounted electric actuator to a valve body. For valid valve and actuator combinations, see Tables 16 and 17.

**Table 3: Ordering Data — Adding a Factory-Mounted Electric Actuator**

1 2 3 4 5 6 7 8 9 10 11 12 13															<b>VG7241LT+7150</b>	<b>VA-7150/VA-7200</b>	7150 = VA-7150-1001 On/Off (Floating)		
10 11 12 13																<b>Electric Actuator</b>	7152 = VA-7152-1001 Proportional, 0-10 VDC	(Available for PDTC	
																(See Actuator	7153 = VA-7153-1001 On/Off (Floating), Feedback	Two-Way and	
																Product/Technical	7200 = VA-7200-1001 On/Off (Floating)	Three-Way Body	
																Bulletin.)	7202 = VA-7202-1001 Proportional, 0-10 VDC	Styles Only)	
																	7203 = VA-7203-1001 On/Off (Floating), Feedback		
															<b>G</b>	<b>Voltage</b>	G = 24 VAC		
															14	(VA-7150/VA-7200)			
																<b>Accessories</b>	Blank = None		
															15	(VA-7150/VA-7200)			
10 11 12															<b>926</b>	<b>M9116/M9216</b>	<b>Non-Spring Return</b>	(Available for	
10 11 12																<b>Electric Actuator</b>	916 = M9116-xxx-2, 24 VAC/VDC	PDTC Two-Way	
																(See Actuator	<b>Spring Return</b>	and Three-Way	
																Product Bulletin.)	926 = M9216-xxx-2, Spring-to-Open (Up), 24 VAC/VDC	Body Styles	
																	946 = M9216-xxx-2, Spring-to-Close (Down), 24 VAC/VDC	Only)	
															<b>AGA</b>	<b>Features</b>	AGA = On/Off (Floating)		
															13 14 15	(M9116/M9216)	AGC = On/Off (Floating), 2 Aux. Sw.		
																	GGA = Prop., 0-10 VDC, Feedback	(M9116	
																	GGC = Prop., 0-10 VDC, Feedback, 2 Aux. Sw.	Only)	
																	HGA = Prop., 0-10 VDC, Feedback	(M9216	
																	HGC = Prop., 0-10 VDC, Feedback, 2 Aux. Sw.	Only)	
10 11															<b>3U</b>	<b>M100 Series</b>	<b>Non-Spring Return</b>	(Available for	
10 11																<b>Electric Actuator</b>	5U = M150xxx	PDTC Two-Way	
																(See Actuator	<b>Spring Return</b>	and Three-Way	
																Product Bulletin.)	3U = M130xxx, Spring-to-Open (Up)	Body Styles	
																	3D = M130xxx, Spring-to-Close (Down)	Only)	
															<b>AGA</b>	<b>Features</b>	AGA = On/Off (Floating), 24 VAC		
															12 13 14	(M100 Series)	CGA = Proportional, Digital Input, 24 VAC		
																	GGA = Proportional, 0-10 VDC, 24 VAC		
																	JGA = Proportional, Slide-Wire, 24 VAC		
															<b>A</b>	<b>Accessories</b>	A = Y68AA-1 Transformer, 120 VAC	(Not Available	
															15	(M100 Series)	D = Y68DA-1 Transformer, 240 VAC	for CGA	
																	H = Y68HA-1 Transformer, 24 VAC	Models)	
																	Blank = None Required		
10 11 12 13															<b>8020</b>	<b>VA-8x2x/VA-805x</b>	8020 = VA-8020-1, On/Off (Floating)	(Available for	
10 11 12 13																<b>Electric Actuator</b>	8122 = VA-8122-1, Proportional	PDTC Two-Way	
																(See Actuator	8050 = VA-8050-1, On/Off (Floating)	and Three-Way	
																Product/Technical	8051 = VA-8051-1, On/Off (Floating), Feedback	Body Styles Only)	
																Bulletin.)	8052 = VA-8052-1, Proportional	(Available for All Body Styles)	
															<b>G</b>	<b>Voltage</b>	G = 24 VAC		
															14	(VA-8x2x/VA-805x)			
																<b>Accessories</b>	Blank = None		
															15	(VA-8x2x/VA-805x)			
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 = Field															<b>VG7241LT+8020G</b>	Example: Cast bronze valve, two-way, push-down-to-close, threaded (NPT) end connections, brass trim, equal percentage, 3/4 in., 7.3 Cv, standard threaded stem, VA-8020-1 On/Off (Floating) Electric Actuator, 24 VAC supply.			
Valve															+	Actuator			

Note: Refer to Table 1 when ordering a valve body only. Refer to Table 2 when adding a factory-mounted pneumatic actuator to a valve body. For valid valve and actuator combinations, see Tables 16 and 17.

## Application Overview

VG7000 Series Bronze Control Valves feature brass and stainless steel trim, and are available in two-way configurations with Push-Down-To-Close (PDTC – normally open if pneumatic or spring return) or Push-Down-To-Open (PDTO – normally closed if pneumatic or spring return) with threaded (NPT), union sweat, union globe, and union angle end connections. The valve can be ordered with a variety of pneumatic actuators: V-3000-8011 (exposed, with or without a factory-mounted positioner), V-3000-8003 (enclosed), V-3801-8001 (oval top), and higher force MP8000 Series Actuators (with or without a factory-mounted pneumatic positioner).

VG7000 Series Valves can also be ordered with any of the following series electric actuators: VA-7150, VA-7200, VA-8x2x, VA-805x, M9116, M9216, M130, or M150. All electric actuators are fully compatible with Johnson Controls controllers, reducing installation costs. Valves without actuators can be ordered with the standard bonnet and stem design, allowing easy interchangeability of actuators with the use of standardized mounting kits. Refer to Tables 1, 2, and 3 for ordering data and additional details. For valid valve and actuator combinations, refer to Tables 16 and 17. For Buy American requirements, refer to Table 18 for available combinations.

The modulating valve plug of VG7000 Series Valves provides an equal percentage flow characteristic for two-way valves, and equal percentage or linear for three-way valves. Tight shutoff is ensured using a molded elastomeric disk in valves with brass trim, and a precisely machined metal-to-metal seat for valves with stainless steel trim. An arrow is cast on one side of the valve body indicating the direction of flow for proper piping.

## Pneumatic Actuator Selection (See Tables 8, 10, 11, 16, 17, and 18)

Notes: The V-3000-8011, V-3000-8003, and V-3801-8001 Pneumatic Actuators should not be confused with the V-3000-1, V-3000-2, and V-3802-1 Pneumatic Actuators.

Refer to the *V-3000-8011 (Exposed) and V-3000-8003 (Enclosed) Pneumatic Valve Actuator Product/Technical Bulletin (LIT-977252)* in the *Valve and Actuator Manual (FAN 977)* for specifics regarding interchangeability.

The V-3801-8001 is not a direct replacement for the V-3802-1, since V-3802-1 is not compatible with VG7000 Series Valves.

## V-3801-8001 Pneumatic Actuator

The V-3801-8001 is a low force, oval top actuator designed specifically for 1/2 and 3/4 in. valves where mounting space is restricted. The V-3801-8001 has sufficient force to handle most seating pressures, and the molded diaphragm design provides a constant effective area (4 sq in.) throughout the valve stem stroke. Due to the simplicity of the design, it is more economical to replace the actuator than repair it. The actuator assembly can be removed or repositioned by loosening a single set screw without disturbing the rest of the valve assembly.

Because the V-3801-8001 uses a unique slotted valve stem for factory assembly (refer to the *Stem Type* section in Table 1), the spring kits available are for field mounting to standard threaded stem valves. Refer to Table 8 for mounting kit code numbers.

## V-3000-8011 Pneumatic Actuator

The V-3000-8011 is a versatile, medium-force pneumatic actuator that can be used in most HVAC applications, including sequential control of valves. Refer to Tables 10 and 11 for actuator sizing and selection.

The permanently captured, molded rolling diaphragm of the V-3000-8011 provides a constant effective area (8 sq in.) throughout the valve stem stroke. Like the V-3801-8001, it is more economical to replace the actuator than to repair it due to the simplicity of the design. The actuator assembly can be removed or repositioned by loosening a single set screw without disturbing the rest of the valve assembly.

The V-9502 Pneumatic Positioner is also available for factory or field mounting to the V-3000-8011.

## V-3000-8003 Pneumatic Actuator

The V-3000-8003, operationally similar to the V-3000-8011, is designed for enclosed installation in a location where the actuator might be subjected to tampering. Unlike the V-3000-8011, this model has a replaceable molded diaphragm design.

## MP8000 Series Pneumatic Actuators

The higher force MP82 (25 sq in. effective diaphragm area) and MP84 (50 sq in. effective diaphragm area) Pneumatic Actuators are used where higher maximum closeoff pressures are required, such as 1-1/2 and 2 in. brass trim valves and 1/2 through 2 in. stainless steel trim valves.

These actuators are equipped with a molded synthetic rubber diaphragm contained in a sturdy, carbon-steel housing that protects it against dirt and damage. The actuator can be easily removed to perform inline servicing to all parts of the valve. The MP8000 Actuators are available factory mounted or are easily field mounted to VG7000 Series Valves. Refer to Table 8 for the appropriate mounting kit.

The MP8000 Actuators are designed to allow for reversing the action of the actuators in the field. If desired, the action of the MP8000 on Normally Open (N.O.) valves can be reversed from spring-return-up to spring-return-down or vice versa. To field reverse the actuator, refer to the *MP8000 Pneumatic Valve Actuators Technical Bulletin (LIT-977258)* found in the *Valve and Actuator Manual (FAN 977)*.

The V-9502 Pneumatic Positioner is also available for factory or field mounting to MP8000 Series Pneumatic Valve Actuators.

## T-3000 Valve Top Thermostat Actuators

The T-3111 and T-3311 Series Valve Top Thermostat Actuators are available for field mounting to all VG7000 Series Valves (N.O., N.C., and three-way). The valve top thermostats are a combination of a pneumatic thermostat and a pneumatic valve actuator. The T-3111 and T-3311 are available in both direct and reverse acting models with various features and options. Refer to the *T-3111 Integral Thermostat and Piston Top Valve Actuator Single Temperature, Single Pressure Product/Technical Bulletin (LIT-7171137)* and the *T-3311 Integral Thermostat and Piston Top Valve Actuator Dual Temperature, Dual Pressure Product/Technical Bulletin (LIT-7171152)* found in the *Pneumatic Control Manual (FAN 717.1)* for specifications and ordering information.

Note: A mounting kit is required to field mount T-3111 or T-3311 Valve Top Thermostats to a valve. Refer to Table 8 for the appropriate mounting kit code number.

## Electric Actuator Selection

Factory-mounted electric actuators are available on two-way PDTC and three-way mixing valve configurations only. Actuators can be easily field reversed if required. The actuators can be field mounted on PDTO valves if desired. All proportional electric actuator assemblies are factory calibrated for nominal 0 to 10 VDC operation, to drive down with an increase in signal. The VA-8052 is available on all valve styles: PDTO, PDTC, and three-way.

### VA-7150 Series Electric Actuators

The VA-7150 Series Actuators use a reversible synchronous motor and magnetic clutch to accurately position the valve. This non-spring return actuator has a 90 lb force output. The magnetic clutch maintains a constant load at the end of travel, ensuring tight valve shutoff and automatically compensating for seat wear.

This actuator is available in three models: floating three-wire (VA-7150), floating with 0 to 2000 ohm feedback (VA-7153), or 0 to 10 VDC proportional control (VA-7152).

### VA-7200 Series Electric Actuators

The VA-7200 Series Actuators use a reversible synchronous motor and a magnetic clutch to accurately position the valve. This non-spring return actuator has a 180 lb force output. The magnetic clutch maintains a constant load at the end of travel, which ensures tight shutoff and automatically compensates for seat wear. This actuator is available in three models: floating three-wire (VA-7200), floating with 0 to 2000 ohm feedback (VA-7203), or 0 to 10 VDC (0 to 20 mA) proportional control (VA-7202).

### VA-8x2x Series Electric Actuators

The VA-8x2x Series Actuators are synchronous motor-driven, force sensor limited, non-spring return actuators that feature a 22 lb seating force in a compact design. The VA-8020 accepts floating control from a three-wire, 24 VAC control signal. The VA-8122 typically accepts proportional control from a 0 to 10 VDC control signal; however, it can be field adjusted to accept signals up to 20 VDC. In addition, the VA-8122 features an input signal reversing feature that allows it to be used in both heating and cooling applications.

Note: The VA-8x2x is only available factory mounted on 1/2 and 3/4 in. valves. Because the VA-8x2x requires a unique slotted valve stem for factory assembly, it is necessary to select the "S" option in the *Stem Type* section of Table 1.

## VA-805x Series Electric Actuators

The VA-8050, VA-8051, and VA-8052 Series Electric Actuators are synchronous motor-driven, non-spring return actuators that feature a force sensing mechanism that ensures a constant 50 lb seating force. The VA-8050 accepts floating control and requires a three-wire, 24 VAC control signal from a controller. The VA-8051 accepts floating control with a three-wire 24 VAC control signal. The VA-8051 includes a 3,400 ohm position feedback potentiometer for remote position feedback. The VA-8052 provides proportional control and requires a two-wire, 0 to 10 VDC control signal and 24 VAC power. All VA-805x actuated VG7000 assemblies are equipped with an insulator for use in steam applications.

Note: The VA-805x is only available factory mounted on 1/2 and 3/4 in. valves.

## M9116 Series Electric Actuators

The M9116 Series is a line of motor driven, non-spring return actuators that operate on 24 VAC or VDC power and are available for use with floating or proportional controllers. When coupled with the M9000-500 Valve Mounting, the rotary motion of this actuator is converted into linear motion that will operate 1/2 through 2 in. VG7000 Series Valves. The actuator and mounting deliver a minimum stem force of 180 lb in both directions. A compression spring on the output shaft of the mounting automatically compensates for seat wear. Integral auxiliary switches are available for indicating end stop position or to perform switching functions. Position feedback is available via switches, a potentiometer, or a 0 (2) to 10 VDC signal.

## M9216 Series Electric Actuators

The M9216 Series is a line of motor driven, spring return actuators that operate on 24 VAC or VDC power and are available for use with on/off, floating, or proportional controllers. When coupled with the M9000-500 Valve Mounting, the rotary motion of this actuator is converted into linear motion that will operate 1/2 through 2 in. VG7000 Series Valves.

The actuator and mounting deliver a minimum stem force of 180 lb in both directions. A compression spring on the output shaft of the mounting automatically compensates for seat wear. Integral auxiliary switches are available for indicating end stop position or to perform switching functions. Position feedback is available via switches, a potentiometer, or a 0 (2) to 10 VDC signal.

## M100 Series Electric Actuators

The M100 Series is a rotary actuator used to position valves in HVAC and industrial applications. When coupled with a VG7000-M1x0 Series Valve Mounting Kit, the rotary motion of the M100 Series Actuator is converted to linear movement. The mounting kit includes an overtravel spring, which determines the maximum seating pressure in conjunction with actuator selection.

Only the M130 and M150 Actuators are available factory mounted to VG7000 Series Valves, although the M110, M120, and M140 Actuators are available for field mounting. Refer to Table 4 for ordering information and additional details. Kits are available to field mount all M100 models; refer to Tables 4, 7, and 9 for detailed information.

**Table 4: M100 Actuator Mounting Kits**

Actuator	Seating Force (lb)	Mounting Kit
M110	40	VG7000-M110
M120/M130	100	VG7000-M130
M140	150	VG7000-M140
M150	270	VG7000-M150

The M120, M140, and M150 are non-spring return actuators that will hold their position when de-energized. The M110 and M130 are spring return actuators that return the valve to its normal operating position when the power is disconnected. A braking mechanism keeps the return spring from driving the motor actuator toward its return position during normal reversible operation. The gear train and motor are housed in an oil-filled compartment designed for extended life.

The M100 provides the appropriate interface for a variety of electronic controllers through selection of factory-installed circuit boards. The M100 Series Actuator is compatible with all Johnson Controls controllers. The M100 can provide proportional, floating, potentiometer, or on/off control, as well as control by direct digital input from zone bus controllers. The M100 Actuator requires a 24 VAC, 50/60 Hz power supply; however, transformer options are available.

The actuator can be mounted for stem-up or stem-down operation. On three-way valves, the seating force can be applied on both the up and the down stroke. Factory mounting is limited to PDTTC two-way and three-way valves for M130 Spring Return and M150 Non-Spring Return Actuators. Refer to Table 3 for information to order the desired return action for factory-mounted M130 and M150 Actuators.

**Table 5: Shipping Weights for Brass Trim Valves**

Actuator	Valve Size, in.					
	1/2	3/4	1	1-1/4	1-1/2	2
V-3801-8001	2.5	3.1	---	---	---	---
V-3000-8011	3.1	4.2	6.2	6.1	11.8	16.9
V-3000-8003	3.2	4.3	6.3	6.2	11.9	17.0
MP82	---	---	14.0	16.0	19.0	24.0
MP84	---	---	---	---	---	---
VA-7150	3.9	5.0	7.0	6.9	12.6	17.7
VA-7200	---	---	7.5	7.4	13.1	18.2
VA-8x2x	4.6	5.9	---	---	---	---
VA-805x	2.2	3.3	---	---	---	---
M9116	5.1	6.2	8.2	8.1	13.8	18.9
M9216	8.6	9.7	11.7	11.6	17.3	22.4
M130	11.2	12.3	14.3	14.2	19.9	25.0
M150	---	---	---	---	25.0	25.0

Note: Weights are approximate and based on the heaviest valve. Add 2 lb (0.9 kg) for pneumatic assemblies with a positioner, as well as M130 and M150 electrically actuated assemblies with the transformer option.

**Table 6: Shipping Weights for Stainless Steel Trim Valves**

Actuator	Valve Size, in.					
	1/2	3/4	1	1-1/4	1-1/2	2
V-3000-8011	3.4	4.2	6.6	8.6	---	---
V-3000-8003	3.5	4.2	6.7	8.7	---	---
MP82	11.0	12.0	14.0	16.0	19.0	24.0
MP84	---	---	---	---	32.0	37.0
VA-7150	3.9	4.2	6.6	8.6	12.6	17.7
VA-7200	4.7	5.5	7.9	9.9	13.1	18.2
M9116	5.1	6.2	8.6	10.6	13.8	18.9
M9216	8.6	9.7	12.1	14.1	17.3	22.4
M130	11.5	12.3	14.7	16.7	19.9	25.0
M150	---	---	14.7	16.7	19.9	25.0

Note: Weights are approximate and based on the heaviest valve. Add 2 lb (0.9 kg) for pneumatic assemblies with a positioner, as well as M130 and M150 electrically actuated assemblies with the transformer option.



## Mounting Kits

The Y20EBE-11 Valve Mounting Adaptor Kit is designed to adapt current Y20EBD-x Mounting Kits to field mount M100 Series Actuators on VG7000 Series Valves. Refer to Table 7 for the appropriate mounting kit code number.

## Field Mounting

A standard bonnet/stem design allows for easy field mounting of actuators. Refer to Table 1 to order valves without actuators, Tables 7, 8, and 9 to order the appropriate mounting kits, and Tables 16 and 17 to identify compatible actuators. Refer to the appropriate actuator product bulletin for specific actuator code number information.

**Table 7: M100 Mounting Kits (Includes Linkage and Adaptor)**

Mounting Kit	Adaptor Kit	Mounting Kit Code Number
Y20EBD-2	Y20EBE-11	VG7000-M140
Y20EBD-3	Y20EBE-11	VG7000-M150
Y20EBD-5	Y20EBE-11	VG7000-M110
Y20EBD-6	Y20EBE-11	VG7000-M130

**Table 8: Field Mounting Kits for Pneumatic Actuators**

Actuator Style	Valve Size in. (DN) <sup>(1)</sup>	Spring Range psig (kPa)	Mounting Kit Code Number
T-3x11 V-3000-8011 V-3000-8003	1/2 or 3/4 (DN15 or DN20) 5/16 in. (8 mm) Stroke	3 to 6 (21 to 41)	VG7000-1001 <sup>(2)</sup>
		4 to 8 (28 to 55)	VG7000-1002 <sup>(2)</sup>
		9 to 13 (62 to 90)	VG7000-1003 <sup>(2)</sup>
T-3x11 V-3000-8011 V-3000-8003	1 or 1-1/4 (DN25 or DN32) 1/2 in. (13 mm) Stroke	3 to 6 (21 to 41)	VG7000-1004 <sup>(2)</sup>
		4 to 8 (28 to 55)	VG7000-1005 <sup>(2)</sup>
		9 to 13 (62 to 90)	VG7000-1006 <sup>(2)</sup>
T-3x11 V-3000-8011 V-3000-8003	1-1/2 or 2 (DN40 or DN50) 3/4 in. (19 mm) Stroke	3 to 6 (21 to 41)	VG7000-1007 <sup>(2)</sup>
		4 to 8 (28 to 55)	VG7000-1008 <sup>(2)</sup>
		9 to 13 (62 to 90)	VG7000-1009 <sup>(2)</sup>
V-3801-8001	1/2 or 3/4 (DN15 or DN20) 5/16 in. (8 mm) Stroke	3 to 6 (21 to 41)	VG7000-1010 <sup>(2)</sup>
		4 to 8 (28 to 55)	VG7000-1011 <sup>(2)</sup>
		9 to 13 (62 to 90)	VG7000-1012 <sup>(2)</sup>
V-3801-8001	1/2 or 3/4 (DN15 or DN20) 5/16 in. (8 mm) Stroke	Kit with Three Springs: 3 to 6, 4 to 8, and 9 to 13 (Includes hardware to adapt one valve only.)	VG7000-1015 <sup>(2)</sup>
MP82/MP83	1/2 or 3/4 (DN15 or DN20) with Stainless Steel Trim	Not Applicable	MP8000-6701 <sup>(3)</sup>
MP82/MP83	1 through 2 (DN25 through DN50) with 1/4 in. Stem and Stainless Steel or Brass Trim	Not Applicable	MP8000-6702 <sup>(3)</sup>
MP84/MP85	1-1/2 through 2 (DN40 through DN50) with 3/8 in. Stem and Stainless Steel Trim	Not Applicable	MP8000-6703 <sup>(4)</sup>

<sup>(1)</sup> DN is the European designation for body size in metric units (mm).

<sup>(2)</sup> The mounting kits include: upper spring seat, spring, stem extension, stem locking screw (or set screw), and a bonnet adaptor for the V-3801-8001.

<sup>(3)</sup> The mounting kits include: stem nut (1), stem extender nuts (2), stem extender (1), and yoke nut (1).

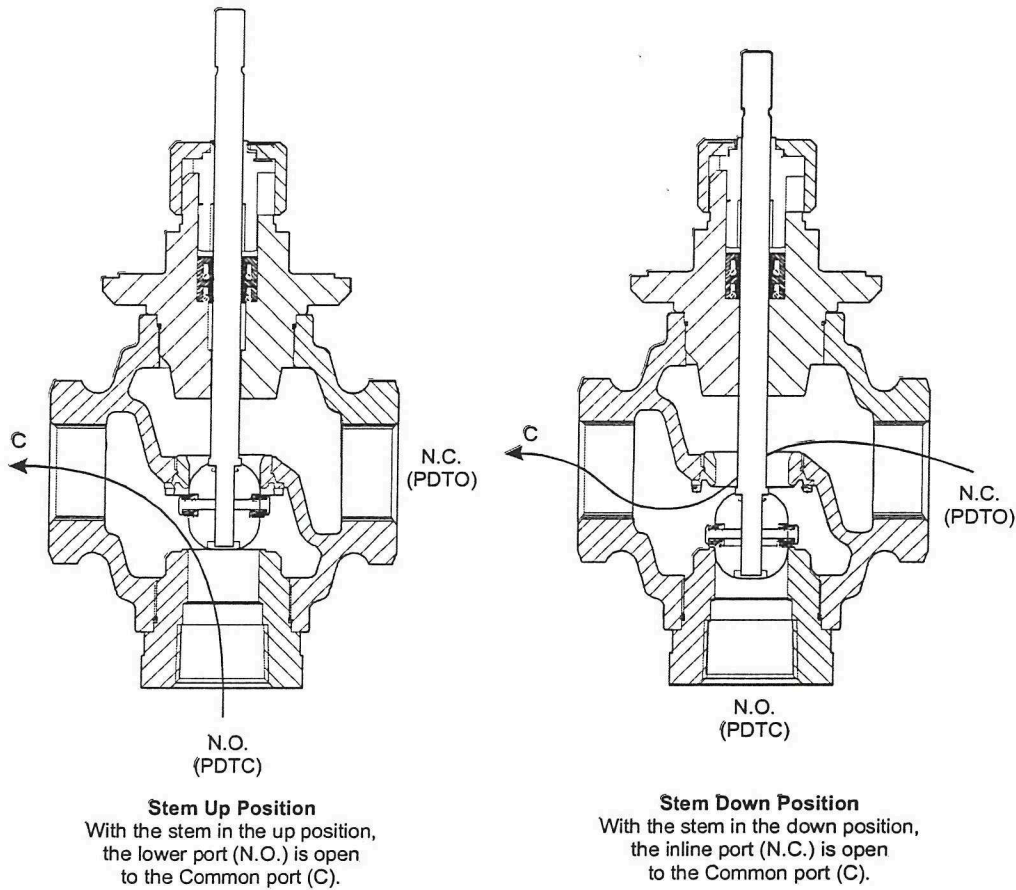
<sup>(4)</sup> The mounting kit includes: stem nuts (2) and yoke nut (1).

Note: All mounting kits are for use with valves with standard threaded stem design only.

**Table 9: Field Mounting Kits for Electric Actuators**

Actuator Style	Valve Size, in. (DN)	Mounting Kit Code Number
M110	1/2 through 2 (DN15 through DN50)	VG7000-M110
M120/M130	1/2 through 2 (DN15 through DN50)	VG7000-M130
M140	1/2 through 2 (DN15 through DN50)	VG7000-M140
M150	1/2 through 2 (DN15 through DN50)	VG7000-M150
VA-715x	1/2 through 2 (DN15 through DN50)	None Required
VA-720x	1 through 2 (DN25 through DN50)	None Required
VA-8x2x	Not available for field mounting.	
VA-805x	Not available for field mounting.	
M9x16	1/2 through 2 (DN15 through DN50)	M9000-500

Note: All mounting kits are for use with valves with standard threaded stem design only.



**Figure 2: Three-Way Mixing Valves  
Fluid Flow Direction and Port Designation**

**Table 10: Brass Trim –  
Maximum Closeoff Pressures, psig (kPa) for Pneumatically Actuated Valves**

Actuator Style	Valve Size in. (DN) Brass Trim	Maximum Cv (Kv) Factor	Two-Way Normally Open or Three-Way N.O. Port (With 20 psig Supply) Spring Range (psig) <sup>(1)</sup>			Two-Way Normally Closed or Three-Way N.C. Port (With 0 psig Supply) Spring Range (psig) <sup>(1)</sup>		
			3 to 6 <sup>(2)</sup> (21 to 41)	4 to 8 (28 to 55)	9 to 13 (62 to 90)	3 to 6 <sup>(2)</sup> (21 to 41)	4 to 8 (28 to 55)	9 to 13 (62 to 90)
V-3801-8001 (248°F [120°C]) <sup>(3)</sup>	1/2 (DN15)	0.73 (0.63)	186 (1,282)	157 (1,082)	84 (579)	37 (255)	57 (393)	158 (1,089)
	1/2 (DN15)	1.8 (1.6)	186 (1,282)	157 (1,082)	84 (579)	37 (255)	57 (393)	158 (1,089)
	1/2 (DN15)	4.6 (4.0)	105 (723)	89 (613)	48 (331)	18 (124)	28 (193)	76 (524)
	3/4 (DN20)	7.3 (6.3)	67 (462)	56 (386)	30 (207)	11 (76)	16 (110)	45 (310)
V-3000-8011 (284°F [140°C]) and V-3000-8003 (248°F [120°C]) <sup>(3)</sup>	1/2 (DN15)	0.73 (0.63)	365 (2,515)	339 (2,336)	191 (1,316)	100 (689)	142 (978)	348 (2,398)
	1/2 (DN15)	1.8 (1.6)	365 (2,515)	339 (2,336)	191 (1,316)	100 (689)	142 (978)	348 (2,398)
	1/2 (DN15)	4.6 (4.0)	225 (1,550)	192 (1,323)	108 (744)	49 (338)	68 (469)	168 (1,158)
	3/4 (DN20)	7.3 (6.3)	144 (992)	122 (841)	69 (475)	29 (200)	41 (282)	100 (689)
	1 (DN25)	11.6 (10)	90 (620)	76 (524)	42 (289)	17 (117)	25 (172)	65 (448)
	1-1/4 (DN32)	18.5 (16)	55 (379)	47 (324)	26 (179)	10 (69)	14 (96)	37 (255)
	1-1/2 (DN40)	28.9 (25)	35 (241)	30 (207)	16 (110)	6 (41)	9 (62)	23 (158)
2 (DN50)	46.2 (40)	22 (152)	19 (131)	11 (76)	4 (28)	6 (41)	14 (96)	
MP82 (284°F [140°C]) <sup>(3)</sup>	1 (DN25)	11.6 (10)	279 (1,924)	257 (1,772)	148 (1,020)	70 (483)	96 (662)	223 (1,536)
	1-1/4 (DN32)	18.5 (16)	170 (1,172)	157 (1,082)	90 (621)	40 (276)	55 (379)	128 (883)
	1-1/2 (DN40)	28.9 (25)	109 (752)	100 (689)	58 (400)	25 (172)	34 (234)	79 (545)
	2 (DN50)	46.2 (40)	70 (483)	64 (441)	37 (255)	16 (110)	21 (145)	50 (345)

<sup>(1)</sup> The recommended spring ranges for use with a V-9502 Positioner are: 3 to 6 psig (21 to 41 kPa) and 3 to 7 psig (21 to 48 kPa) for N.O. valves, 9 to 13 psig (62 to 90 kPa) for N.C. valves, and 4 to 8 psig (28 to 55 kPa) for three-way valves.

<sup>(2)</sup> 3 to 7 psig (21 to 48 kPa) for MP82 Actuators.

<sup>(3)</sup> The maximum valve fluid temperature is as follows:

Actuator Style	Water	Saturated Steam
V-3801-8001	248°F (120°C)	15 psig (103 kPa)
V-3000-8011	284°F (140°C)	38 psig (262 kPa)
V-3000-8003	248°F (120°C)	15 psig (103 kPa)
MP82	284°F (140°C)	38 psig (262 kPa)

**Table 11: Stainless Steel Trim – Maximum Closeoff Pressure, psig (kPa) for Pneumatically Actuated Valves**

Actuator Style	Valve Size, in. (DN) SS Trim	Maximum Cv (Kv) Factor	Two-Way Normally Open or Three-Way N.O. Port (With 20 psig Supply) Spring Range (psig) <sup>(1)</sup>			Two-Way Normally Closed or Three-Way N.C. Port (With 0 psig Supply) Spring Range (psig) <sup>(1)</sup>		
			3 to 6 <sup>(2)</sup> (21 to 41)	4 to 8 (28 to 55)	9 to 13 (62 to 90)	3 to 6 <sup>(2)</sup> (21 to 41)	4 to 8 (28 to 55)	9 to 13 (62 to 90)
V-3000-8011 and V-3000-8003 (338°F [170°C]) <sup>(3)</sup>	1/2(DN15)	0.73 (0.63)	299 (2,060)	255 (1,757)	143 (985)	75 (517)	106 (730)	261 (1,798)
	1/2 (DN15)	1.8 (1.6)	299 (2,060)	255 (1,757)	143 (985)	75 (517)	106 (730)	261 (1,798)
	1/2 (DN15)	4.6 (4.0)	169 (1,164)	144 (992)	81 (558)	36 (248)	51 (351)	126 (868)
	3/4 (DN20)	7.3 (6.3)	108 (744)	92 (634)	52 (358)	22 (152)	31 (214)	75 (517)
	1 (DN25)	11.6 (10)	67 (462)	57 (393)	32 (220)	13 (90)	19 (131)	49 (338)
	1-1/4 (DN32)	18.5 (16)	41 (282)	35 (241)	19 (131)	7 (48)	11 (76)	28 (193)
MP82 (338°F [170°C]) <sup>(3)</sup>	1/2 (DN15)	0.73 (0.63)	308 (2,124)	308 (2,124)	308 (2,124)	280 (1,929)	308 (2,124)	308 (2,124)
	1/2 (DN15)	1.8 (1.6)	308 (2,124)	308 (2,124)	308 (2,124)	280 (1,929)	308 (2,124)	308 (2,124)
	1/2 (DN15)	4.6 (4.0)	308 (2,124)	308 (2,124)	275 (1,895)	135 (930)	183 (1,261)	308 (2,124)
	3/4 (DN20)	7.3 (6.3)	308 (2,124)	304 (2,095)	175 (1,206)	81 (558)	109 (751)	252 (136)
	1 (DN25)	11.6 (10)	209 (1,440)	193 (1,330)	111 (765)	53 (365)	72 (496)	168 (1,158)
	1-1/4 (DN32)	18.5 (16)	128 (882)	118 (813)	68 (469)	30 (207)	41 (282)	96 (661)
	1-1/2 (DN40)	28.9 (25)	82 (565)	75 (517)	43 (296)	19 (131)	25 (172)	59 (407)
	2 (DN50)	46.2 (40)	52 (358)	48 (331)	28 (193)	12 (83)	16 (110)	37 (255)
MP84 (338°F [170°C]) <sup>(3)</sup>	1-1/2 (DN40)	28.9 (25)	165 (1,137)	152 (1,047)	88 (606)	39 (269)	53 (365)	121 (834)
	2 (DN50)	46.2 (40)	106 (730)	97 (668)	56 (386)	24 (154)	33 (227)	76 (524)

<sup>(1)</sup> The recommended ranges for use with a V-9502 Positioner are: 3 to 6 psig (21 to 41 kPa) and 3 to 7 psig (21 to 48 kPa) for N.O. valves, 9 to 13 psig (62 to 90 kPa) for N.C. valves, and 4 to 8 psig (28 to 55 kPa) for three-way valves.

<sup>(2)</sup> 3 to 7 psig (21 to 48 kPa) for MP82 and MP84 Actuators.

<sup>(3)</sup> The maximum closeoff pressure listed is limited to the maximum allowable ANSI valve body rating corresponding to the maximum temperature rating (308 psig [2,122 kPa] at 338°F [170°C]) of the valve.

**Table 12: Brass Trim – Maximum Closeoff Pressures, psig (kPa) for PDTC Two-Way and PDTC Port for Three-Way Electrically Actuated Valves**

Valve Size, in. (DN)	Maximum Cv (Kv) Factor	VA-715x	VA-720x	M9x16	M110*	M120* and M130	M140*	M150	VA-8x2x	VA-805x
1/2 (DN15)	0.73 (0.63)	345 (2,377)	---	345 (2,377)	144 (992)	345 (2,377)	345 (2,377)	345* (2,377)	112 (772)	289 (1,991)
1/2 (DN15)	1.8 (1.6)	345 (2,377)	---	345 (2,377)	144 (992)	345 (2,377)	345 (2,377)	345* (2,377)	80 (551)	208 (1,433)
1/2 (DN15)	4.6 (4.0)	216 (1,488)	---	345 (2,377)	82 (565)	221 (1,523)	337 (2,322)	345* (2,377)	45 (310)	118 (813)
3/4 (DN20)	7.3 (6.3)	138 (951)	---	289 (1,991)	52 (358)	141 (971)	215 (1,481)	392* (2,701)	29 (200)	75 (517)
1 (DN25)	11.6 (10.0)	86 (593)	179 (1,233)	182 (1,254)	31 (214)	88 (606)	135 (930)	248* (1,709)	---	---
1-1/4 (DN32)	18.5 (16.0)	52 (358)	109 (751)	111 (765)	19 (131)	54 (372)	82 (565)	152* (1,047)	---	---
1-1/2 (DN40)	28.9 (25.0)	34 (234)	70 (482)	71 (489)	12 (83)	34 (234)	53 (365)	97 (668)	---	---
2 (DN50)	46.2 (40.0)	21 (145)	45 (310)	46 (317)	8 (55)	22 (152)	34 (234)	62 (427)	---	---

\* The M110, M120, and M140 Actuators are not available factory coupled to the valve body. The maximum closeoff pressure values are provided because these actuators can be field mounted to the VG7000 valve body using the mounting kits listed in Tables 7 and 9. The M150 Actuator is not available factory coupled to 1/2 through 1-1/4 in. size valve bodies. The M150 Actuator can be ordered factory coupled to 1-1/2 and 2 in. size valve bodies with brass trim only.

Notes: The maximum closeoff pressure listed is limited to the maximum allowable ANSI valve body rating corresponding to the maximum temperature rating (345 psig [2,377 kPa] at 281°F [138°C]) of the valve, except for VA-8x2x Actuators that are limited to 195°F (91°C) maximum temperature and 381 psig (2,625 kPa) pressure rating.

The maximum closeoff pressures listed are for actuators coupled to the appropriate mounting kits listed in Tables 7 and 9. Refer to Tables 16 and 17 for valid factory-mounted combinations, and Tables 7 and 9 for available field mounting kits. The maximum fluid temperature is 284°F (140°C) water to 38 psig (262 kPa) saturated steam.

**Table 13: Brass Trim – Maximum Closeoff Pressures, psig (kPa) for PDT0 Two-Way and PDT0 Port for Three-Way Electrically Actuated Valves**

Valve Size, in. (DN)	Maximum Cv (Kv) Factor	Not Available Factory Coupled for PDT0 Two-Way – Field Mounting Only 284°F (140°C) Maximum Fluid Temperature <sup>(2)</sup>								
		VA-715x	VA-720x	M9x16	M110 <sup>(1)</sup>	M120 <sup>(1)</sup> and M130	M140 <sup>(1)</sup>	M150	VA-8x2x	VA-805x
1/2 (DN15)	0.73 (0.63)	345 (2377)	---	345 (2377)	200 (1378)	345 (2377)	345 (2377)	345 <sup>(1)</sup> (2377)	345 <sup>(1)</sup> (2377)	345 <sup>(1)</sup> (2377)
1/2 (DN15)	1.8 (1.6)	345 (2377)	---	345 (2377)	200 (1378)	345 (2377)	345 (2377)	345 <sup>(1)</sup> (2377)	112 (772)	289 (1991)
1/2 (DN15)	4.6 (4.0)	257 (1171)	---	345 (2377)	97 (668)	262 (1805)	345 (2377)	345 <sup>(1)</sup> (2377)	54 (372)	140 (965)
3/4 (DN20)	7.3 (6.3)	153 (1054)	---	321 (2212)	58 (400)	156 (1075)	239 (1647)	345 <sup>(1)</sup> (2377)	32 (220)	83 (572)
1 (DN25)	11.6 (10)	100 (690)	209 (1440)	213 (1468)	36 (248)	103 (710)	158 (1089)	291 <sup>(1)</sup> (2005)	---	---
1-1/4 (DN32)	18.5 (16)	57 (393)	120 (827)	122 (841)	21 (145)	59 (407)	90 (620)	167 <sup>(1)</sup> (1151)	---	---
1-1/2 (DN40)	28.9 (25)	36 (248)	74 (510)	76 (524)	13 (90)	36 (248)	56 (386)	103 (710)	---	---
2 (DN50)	46.2 (40)	22 (152)	46 (317)	47 (324)	8 (55)	23 (158)	35 (241)	64 (441)	---	---

<sup>(1)</sup> The M110, M120, and M140 Actuators are not available factory coupled to the valve body. The maximum closeoff pressure values are provided because these actuators can be field mounted to the VG7000 valve body using the mounting kits listed in Tables 7 and 9. The M150 Actuator is not available factory coupled to 1/2 through 1-1/4 in. size valve bodies. The M150 Actuator can be ordered factory coupled to 1-1/2 and 2 in. size valve bodies with brass trim only.

<sup>(2)</sup> The maximum fluid temperature is 284°F (140°C) water to 38 psig (262 kPa) saturated steam.

Notes: The maximum closeoff pressure listed is limited to the maximum allowable ANSI valve body rating corresponding to the maximum temperature rating (345 psig [2,379 kPa] at 281°F [138°C]) of the valve, except for VA-8x2x Actuators which are limited to 195°F (91°C) maximum temperature and 381 psig (2,625 kPa) pressure rating.

The maximum closeoff pressures listed are for actuators coupled to the appropriate mounting kits listed in Tables 7 and 9. Refer to Tables 16 and 17 for valid factory-mounted combinations, and Tables 7 and 9 for available field mounting kits.

**Table 14: Stainless Steel Trim – Maximum Closeoff Pressures, psig (kPa) for PDTC Two-Way and PDTC Port for Three-Way Electrically Actuated Valves**

Valve Size, in. (DN)	Cv (Kv) Factor	VA-715x	VA-720x	M9x16	M110*	M120* and M130	M140*	M150
1/2 (DN15)	0.73 (0.63)	239 (1,647)	308 (2,122)	308 (2,122)	90 (620)	308 (2,122)	308 (2,122)	308 (2,122)
1/2 (DN15)	1.8 (1.6)	239 (1,647)	308 (2,122)	308 (2,122)	90 (620)	244 (1,681)	308 (2,122)	308 (2,122)
1/2 (DN15)	4.6 (4.0)	135 (930)	278 (1,915)	283 (1,950)	51 (351)	138 (951)	211 (1,454)	308 (2,122)
3/4 (DN20)	7.3 (6.3)	86 (593)	177 (1,220)	180 (1,240)	32 (220)	88 (606)	134 (923)	245 (1,688)
1 (DN25)	11.6 (10)	54 (372)	112 (772)	114 (785)	19 (131)	55 (379)	84 (579)	155 (1,068)
1-1/4 (DN32)	18.5 (16)	33 (227)	68 (469)	70 (482)	12 (83)	33 (227)	52 (358)	95 (655)
1-1/2 (DN40)	28.9 (25)	21 (145)	44 (303)	45 (310)	8 (55)	21 (145)	33 (227)	61 (420)
2 (DN50)	46.2 (40)	13 (90)	28 (193)	28 (193)	5 (34)	14 (96)	21 (145)	39 (269)

\* The M110, M120, and M140 Actuators are not available factory coupled to the valve body. The maximum closeoff pressure values are provided because these actuators can be field mounted to the VG7000 valve body using the mounting kits listed in Tables 7 and 9. The M150 Actuator is not available factory coupled to 1/2 and 3/4 in. size valve bodies. The M150 Actuator can be factory ordered coupled to 1 through 2 in. size valve bodies with stainless steel trim only.

Notes: The maximum closeoff pressure listed is limited to the maximum allowable ANSI valve body rating corresponding to the maximum pressure/temperature rating (308 psig [2,122 kPa] at 338°F [170°C]) of the valve.

The maximum closeoff pressures listed are for actuators coupled to the appropriate mounting kits listed in Tables 7 and 9. Refer to Tables 16 and 17 for valid factory-mounted combinations, and Tables 7 and 9 for available field mounting kits. The maximum fluid temperature is 338°F (170°C) water to 100 psig (690 kPa) saturated steam.

**Table 15: Stainless Steel Trim – Maximum Closeoff Pressures, psig (kPa) for PDTO Two-Way and PDTO Port for Three-Way Electrically Actuated Valves**

Valve Size, in. (DN)	Maximum Cv (Kv) Factor	Not Available Factory Coupled for PDTO Two-Way (Field Mounting Only)						
		VA-715x	VA-720x	M9x16	M110*	M120* and M130	M140*	M150
1/2 (DN15)	0.73 (0.63)	308 (2,122)	308 (2,122)	308 (2,122)	125 (861)	308 (2,122)	308 (2,122)	308 (2,122)
1/2 (DN15)	1.8 (1.6)	308 (2,122)	308 (2,122)	308 (2,122)	125 (861)	308 (2,122)	308 (2,122)	308 (2,122)
1/2 (DN15)	4.6 (4.0)	161 (1,109)	308 (2,122)	308 (2,122)	61 (420)	164 (1,130)	250 (1,723)	308 (2,122)
3/4 (DN20)	7.3 (6.3)	96 (661)	197 (1,357)	201 (1,385)	36 (248)	98 (675)	149 (1,027)	273 (1,881)
1 (DN25)	11.6 (10)	63 (434)	131 (903)	133 (916)	23 (158)	64 (441)	99 (682)	182 (1,254)
1-1/4 (DN32)	18.5 (16)	36 (248)	75 (517)	76 (524)	13 (90)	37 (255)	57 (393)	104 (717)
1-1/2 (DN40)	28.9 (25)	22 (152)	46 (317)	47 (324)	8 (55)	23 (158)	35 (241)	64 (441)
2 (DN50)	46.2 (40)	14 (97)	29 (200)	30 (207)	5 (34)	14 (96)	22 (152)	40 (276)

\* The M110, M120, and M140 Actuators are not available factory coupled to the valve body. The maximum closeoff pressure values are provided because these actuators can be field mounted to the VG7000 valve body using the mounting kits listed in Tables 7 and 9. The M150 Actuator is not available factory coupled to 1/2 and 3/4 in. size valve bodies. The M150 Actuator can be ordered factory coupled to 1 through 2 in. size valve bodies with stainless steel trim only.

Notes: The maximum closeoff pressure listed is limited to the maximum allowable ANSI valve body rating corresponding to the maximum pressure/temperature rating (308 psig [2,122 kPa] at 338°F [170°C]) of the valve.

The maximum closeoff pressures listed are for actuators coupled to the appropriate mounting kits listed in Tables 7 and 9. Refer to Tables 16 and 17 for valid factory-mounted combinations, and Tables 7 and 9 for available field mounting kits. The maximum fluid temperature is 338°F (170°C) water to 100 psig (690 kPa) saturated steam.



**Table 16: Brass Trim – Available Factory-Mounted Combinations<sup>(1)</sup>**

	Valve Size, in.					
	1/2	3/4	1	1-1/4	1-1/2	2
Valve Stroke, in. (mm)	5/16 (8)		1/2 (13)		3/4 (19)	
Valve Stem Diameter, in. (mm)	1/4 (6.35)		3/8 (9.52)			
Maximum Cv (Kv) Factor	0.73 (0.63) 1.8 (1.6) 4.6 (4.0)	7.3 (6.3)	11.6 (10)	18.5 (16)	28.9 (25)	46.2 (40)
<b>Pneumatic Actuators</b>						
V-3801-8001	X	X	---	---	---	---
V-3000-8011 <sup>(2)</sup>	X	X	X	X	X	X
V-3000-8003	X	X	X	X	X	X
MP82 <sup>(2)</sup>	---	---	X	X	X	X
MP84 <sup>(2)</sup>	---	---	---	---	---	---
<b>Electric Actuators<sup>(3)</sup></b>						
VA-715x	X	X	X	X	X	X
VA-720x	---	---	X	X	X	X
VA-8x2x	X	X	---	---	---	---
VA-805x	X	X	---	---	---	---
M9x16	X	X	X	X	X	X
M130	X	X	X	X	X	X
M150	---	---	---	---	X	X
<b>End Connection Combinations</b>						
NPT (Internal)	X	X	X	X	X	X
Union Angle <sup>(4)</sup>	X	---	---	---	---	---
Union Globe <sup>(4)</sup>	X	---	---	---	---	---
Union Sweat (3/8 in. Tubing)	X	---	---	---	---	---
Union Sweat (Standard)	X	X	X	---	---	---
Union Sweat (3/4 in. Tubing)	X	---	---	---	---	---

<sup>(1)</sup> Items shown as "—" are not available factory mounted, and not recommended for field assembly.

<sup>(2)</sup> Available with or without a positioner.

<sup>(3)</sup> Electric actuators are available on two-way PDTC and three-way mixing valves only.

<sup>(4)</sup> NPT (internal) inlet x NPT (external) outlet.

**Table 17: Stainless Steel Trim – Available Factory-Mounted Combinations<sup>(1)</sup>**

	Valve Size, in.					
	1/2	3/4	1	1-1/4	1-1/2	2
Valve Stroke, in. (mm)	5/16 (8)		1/2 (13)		3/4 (19)	
Valve Stem Diameter, in. (mm)	1/4 (6.35)		3/8 (9.52)			
Maximum Cv (Kv) Factor	0.73 (0.63) 1.8 (1.6) 4.6 (4.0)	7.3 (6.3)	11.6 (10)	18.5 (16)	28.9 (25)	46.2 (40)
<b>Pneumatic Actuators</b>						
V-3000-8011 <sup>(2)</sup>	X	X	X	X	---	---
V-3000-8003	X	X	X	X	---	---
MP82 <sup>(2)</sup>	X	X	X	X	X	X
MP84 <sup>(2)</sup>	---	---	---	---	X	X
<b>Electric Actuators<sup>(3)</sup></b>						
VA-715x	X	X	X	X	X	X
VA-720x	X	X	X	X	X	X
M9x16	X	X	X	X	X	X
M130	X	X	X	X	X	X
M150	---	---	X	X	X	X

<sup>(1)</sup> Items shown as "---" are not available factory mounted, and not recommended for field assembly.

<sup>(2)</sup> Available with or without a positioner.

<sup>(3)</sup> Electric actuators are available on two-way PDTC and three-way mixing valves only.

Note: Stainless steel trim is available only with NPT (internal) end connections.

**Table 18: Buy American – Available Factory-Mounted Brass Trim Combinations<sup>(1)</sup>**

	Valve Size, in.					
	1/2	3/4	1	1-1/4	1-1/2	2
Valve Stroke, in. (mm)	5/16 (8)		1/2 (13)		3/4 (19)	
Valve Stem Diameter, in. (mm)	1/4 (6.35)		3/8 (9.52)			
Maximum Cv (Kv) Factor	0.73 (0.63) 1.8 (1.6) 4.6 (4.0)	7.3 (6.3)	11.6 (10)	18.5 (16)	28.9 (25)	46.2 (40)
<b>Pneumatic Actuators</b>						
V-3000-8011 (without Positioner)	X	X	X	X	X	X
V-3000-8003	X	X	X	X	X	X
<b>Electric Actuators<sup>(2)</sup></b>						
VA-805x	X	X	---	---	---	---
M9x16	X	X	X	X	X	X
M130	X	X	X	X	X	X
M150	---	---	---	---	X	X
<b>End Connection Combinations</b>						
NPT (Internal)	X	X	X	X	X	X
Union Angle	X	---	---	---	---	---
Union Globe	X	---	---	---	---	---
Union Sweat (3/8 in. Tubing)	X	---	---	---	---	---
Union Sweat (Standard)	X	X	X	---	---	---
Union Sweat (3/4 in. Tubing)	X	---	---	---	---	---

<sup>(1)</sup> To order a Buy American model, change the code number from **VG** to **VH**.

**V H 7 2 4 1 L T + 3 0 0 8 B**

Example: **VH7241LT+3008B** – Buy American valve, cast bronze, two-way, N.O., brass equal percentage trim, 3/4 in., 7.3 Cv, factory mounted V-3000-8011 Actuator with a 3 to 6 psig (21 to 41 kPa) spring range.

<sup>(2)</sup> Electric actuators are available on two-way PDTC and three-way mixing valves only (except for the VA-8052, which is available in all body styles).

Note: Buy American models are only available with brass trim.

## Operation

### V-3000, V-3801-8001, and MP8000 Series Pneumatic Actuators

Air pressure from a pneumatic controller is applied to the diaphragm of the actuator, which moves the piston against the forces of the internal spring and the fluids. The piston will move the valve plugs to a position where the diaphragm pressure and the spring force balance against the fluid forces. These fluid forces will cause the operating ranges to shift from the nominal spring range. Reducing the air pressure to the diaphragm of the actuator allows the spring to return the valve plug to its normal position.

For applications requiring stable, accurate control and sequencing, the V-3000-8011, MP82, and MP84 are available with a V-9502 Pneumatic Positioner. The V-9502 Pneumatic Positioner will compensate for the spring range shift, and the valve will operate within the published range. Refer to the *Operation* section of the *V-9502 Pneumatic Valve Actuator Positioner Product Bulletin (LIT-977265)* in the *Valve and Actuator Manual (FAN 977)* for more details.

To ensure installed performance quality and optimal maximum closeoff pressure when using the positioner, the following spring ranges are recommended:

Normally Open Valve: 3 to 6 psig  
(3 to 7 psig for MP82/MP84)

Normally Closed Valve: 9 to 13 psig

Three-Way Mixing Valve: 4 to 8 psig

Positioners are factory calibrated to match the nominal spring range of the actuator and valve assembly.

### VA-715x and VA-720x Series Electric Valve Actuators

The VA-715x and VA-720x Series Actuators operate on 24 VAC, and are available for on-off/floating control action or proportional control. A reversible synchronous motor and a magnetic clutch are used to accurately position the valve. The actuator maintains position even if power to the actuator is removed. The magnetic clutch maintains a constant load at the end of travel, which ensures tight valve shutoff and compensates for seat wear. Refer to the appropriate electric valve actuator literature in the *Valve and Actuator Manual (FAN 977)* for specifications and available options.

### VA-8x2x and VA-805x Series Electric Valve Actuators

The VA-8x2x and VA-805x Series Actuators operate on 24 VAC, and are available for on/off, floating, or proportional control. The signal drives the actuator motor, causing the valve stem to move in the desired direction. Once the valve stem reaches the end of travel, a shutoff force builds up. When the force reaches its maximum, a lever within the actuator trips a force sensor, which stops the motor.

Field calibration of the force sensor is not required. The actuator maintains the shutoff force even if power to the controller is lost. Valve stem positioning can be accomplished manually by turning the adjustment knob on the lower right portion of the actuator. Rotating the adjustment knob counterclockwise moves the valve stem up. Refer to the appropriate electric valve actuator literature in the *Valve and Actuator Manual (FAN 977)* for specifications and available options.

### M9x16 Series Electric Actuators

The M9x16 Series Actuators operate on 24 VAC or VDC power, and are available for use with floating or proportional controllers. When coupled with the M9000-500 Valve Mounting, the rotary motion of this actuator is converted into linear motion that will operate 1/2 through 2 in. VG7000 Series Valves. A compression spring on the output shaft of the mounting automatically compensates for seat wear.

On three-way valves, the preset spring load is applied at both ends of travel. On loss of power, the spring return M9216 Actuator will return to its normal position. Refer to the appropriate electric actuator literature or the *M9000-500 Valve Linkage Kit for M9x16 Series Electric Motor Actuators Product/Technical Bulletin (LIT-977352)* in the *Valve and Actuator Manual (FAN 977)* for specifications and available options.

## M100 Series Electric Actuators

The M100 Series Actuators operate on 24 VAC, and are available for on-off/floating or proportional control.

A rack and pinion drive mechanism provides the linear movement. The rack assembly contains a spring that maintains valve closeoff when compressed by overtravel of the actuator. On three-way valves, this seating force is applied on both the up and the down stroke. The actuator has an adjustable travel limit that provides the desired overtravel. On loss of power, the spring return actuator will return to its normal position. Refer to the *M100 Series Motor Actuator Product Bulletin (LIT-2681059P)* and/or the *VG7000 Valve Linkage for M100 Series Motor Actuators Technical Bulletin (LIT-977355)* in the *Valve and Actuator Manual (FAN 977)* for specifications and available options.

## Installation and Servicing

It is recommended that the VG7000 Series Valves be mounted in an upright position in a conveniently accessible location. Sufficient clearance must be allowed for actuator removal. (Refer to the *Dimensions* section for more details.) The valve must be piped with the flow in the direction indicated by the arrow, so that the plug seats against the flow.

On electrically actuated valve assemblies, all wiring must be in accordance with applicable electrical code requirements. Input lines to the actuator must be wired correctly for the valve to move in the proper direction.

Notes: All actuators must be protected against moisture, which could enter the housing. Also, the actuator must **not** be covered with thermal insulating material.

VG7000 Series Valves should not be used for fluid service other than those indicated in the *Specifications* section.



### CAUTION:

#### Equipment Damage Hazard.

Do not allow foreign materials such as weld slag, thread burrs, metal chips, and scale to enter the piping system. This debris can damage or severely impede the operation of the valve.

This is particularly critical with smaller valves, as the debris may be larger than the valve opening and may never pass to downstream filters. Subsequent flushing and filtering the system with the valve installed will not remedy the problem.

When servicing, ensure:

- The pneumatic or electrical power to the actuator is turned off or isolated. Do not touch or attempt to connect or disconnect wires when electrical power is on.



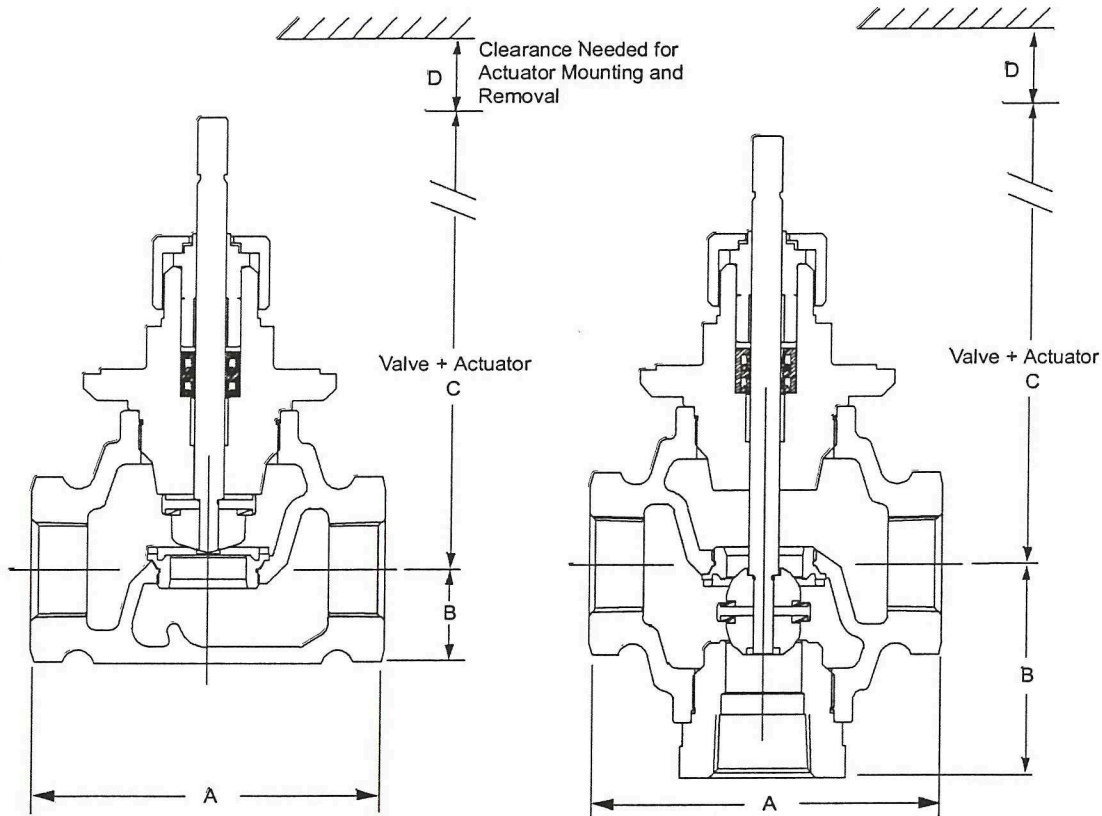
### WARNING:

#### Personal Injury Hazard.

Disconnect the power supply before wiring connections are made to prevent possible personal injury or damage to the equipment. Make and check all wiring connections before applying power to the system. Short-circuited or improperly connected wires may result in permanent damage to the equipment.

- The electrical wiring connections are in accordance with the National Electrical Code and local regulations.
- Sufficient clearance is allowed for actuator removal from the valve.
- No pressure is applied to the piping system when servicing the valve.

# Dimensions



Note: Refer to Tables 23 and 24 for overall assembly height (C) and clearance (D) dimensions.

**Figure 3: Two-Way and Three-Way Valve Dimensions**

**Table 19: Threaded (Internal NPT) Valve Dimensions, in. (mm)**

Valve Size, in. (DN)	A		B		
	N.O./N.C./Three-Way		N.O.	N.C.	Three-Way
1/2 (DN15)	3 (76)		13/16 (21)	1-9/16 (39)	1-13/16 (46)
3/4 (DN20)	3-7/32 (81)		15/16 (24)	1-5/8 (41)	2-1/8 (54)
1 (DN25)	4-1/8 (104)		1-5/32 (29)	1-3/4 (44)	2-9/16 (65)
1-1/4 (DN32)	4-23/32 (119)		1-11/32 (34)	2 (51)	2-25/32 (70)
1-1/2 (DN40)	5-1/8 (130)		2-5/32 (55)	2-3/4 (70)	3-3/8 (85)
2 (DN50)	5-29/32 (150)		2-1/8 (53)	2-27/32 (72)	3-3/4 (95)

Note: Refer to Table 23 and 24 for overall assembly height "C" and clearance "D" dimensions.

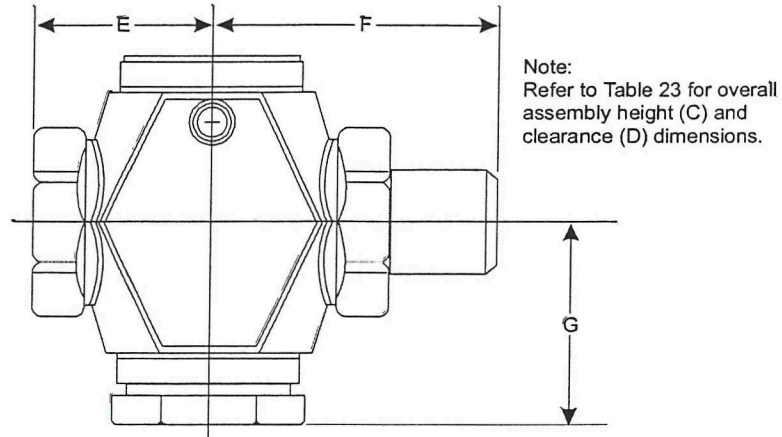


Figure 4: Two-Way Union Globe Valve Dimensions

Table 20: Two-Way Union Globe Valve Dimensions, in. (mm)

Valve Size, in. (DN)	E	F	G
1/2 (DN15) N.O./PDTC	1-1/2 (38)	2-21/32 (68)	13/16 (20)
1/2 (DN15) N.C./PDTO	1-1/2 (38)	2-21/32 (68)	1-17/32 (39)

Note: Refer to Table 23 for overall assembly height "C" and clearance "D" dimensions.

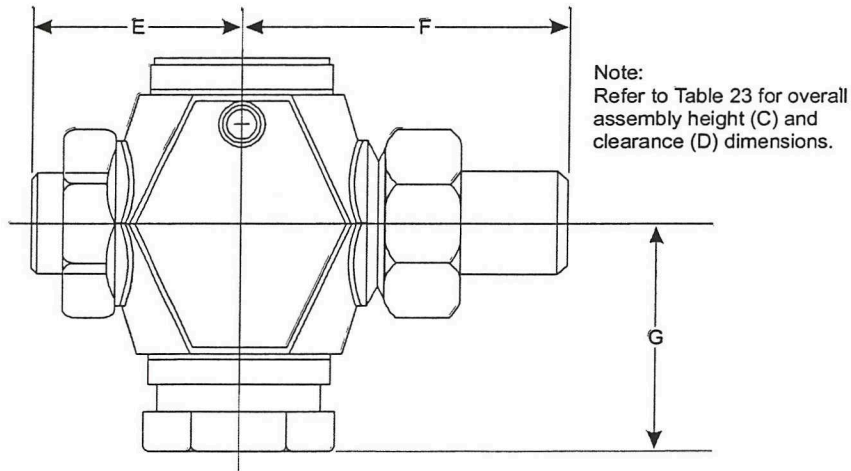


Figure 5: Two-Way Union Angle Valve Dimensions

Table 21: Two-Way Union Angle Valve Dimensions, in. (mm)

Valve Size, in. (DN)	E	F	G
1/2 (DN15) N.O./PDTC	1-23/32 (44)	2-21/32 (68)	1-7/8 (48)

Note: Refer to Table 23 for overall assembly height "C" and clearance "D" dimensions.

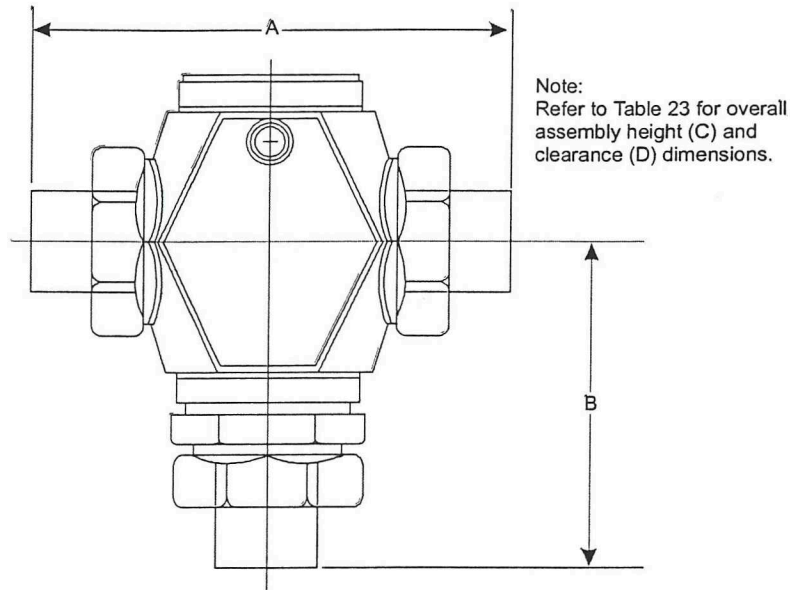


Figure 6: Two-Way and Three-Way Union Sweat Valve Dimensions

Table 22: Union Sweat Valve Dimensions, in. (mm)

Valve Size, in. (DN)	A	B		
		Two-Way N.O./PDTC	Two-Way N.C./PDTO	Three-Way Mixing
1/2 (DN15), 3/8 in. Tubing	4-3/16 (106)	13/16 (20)	1-17/32 (39)	2-17/32 (64)
1/2 (DN15), 1/2 in. Tubing	4-3/16 (106)	13/16 (20)	1-17/32 (39)	2-17/32 (64)
1/2 (DN15), 3/4 in. Tubing	4-25/32 (122)	13/16 (20)	1-17/32 (39)	2-17/32 (64)
3/4 (DN20)	5-1/16 (129)	15/16 (24)	1-9/16 (40)	3-1/4 (82)
1 (DN25)	6-3/32 (155)	1-1/8 (28)	1-3/4 (45)	3-23/32 (94)

Note: Refer to Table 23 for overall assembly height "C" and clearance "D" dimensions.



**Table 23: Brass Trim Actuator Dimensions, in. (mm)**

Actuator Style	C*						D*
	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)	1-1/4 in. (DN32)	1-1/2 in. (DN40)	2 in. (DN50)	
V-3000-8011	4-3/4 (120)	4-3/4 (120)	5-31/32 (151)	5-7/8 (149)	5-13/16 (147)	6-3/16 (157)	3-9/16 (90)
V-3000-8003	5-11/32 (135)	5-11/32 (135)	6-9/16 (166)	6-19/32 (167)	6-13/32 (162)	6-13/16 (172)	3-9/16 (90)
V-3801-8001	4 (102)	4 (102)	---	---	---	---	2-3/8 (60)
MP82	---	---	12-23/32 (323)	12-27/32 (326)	12-13/32 (341)	13-13/16 (351)	2 (51)
VA-715x	7-11/16 (195)	7-11/16 (195)	8-5/8 (219)	8-5/8 (219)	9-5/32 (233)	9-5/32 (233)	2-1/2 (64)
VA-720x	---	---	9-19/32 (244)	9-5/8 (244)	9-15/16 (252)	10-3/4 (273)	4-1/2 (114)
VA-8x2x	6-7/16 (164)	6-7/16 (164)	---	---	---	---	1-1/2 (38)
VA-805x	7-3/16 (183)	7-3/16 (183)	---	---	---	---	2 (51)
M9x16	14 (356)	14 (356)	15-7/32 (386)	15-7/32 (386)	15-1/16 (382)	15-15/32 (392)	---
M100	10-13/16 (274)	10-13/16 (274)	12-1/32 (305)	12-1/32 (305)	11-7/8 (301)	12-1/4 (311)	---

\* Dimension "C" is the overall height above the centerline of the valve body, and dimension "D" is the clearance required for actuator removal (as illustrated in Figure 3.)

**Table 24: Stainless Steel Trim Actuator Dimensions, in. (mm)**

Actuator Style	C*						D*
	1/2 in. DN15	3/4 in. DN20	1 in. DN25	1-1/4 in. DN32	1-1/2 in. DN40	2 in. DN50	
V-3000-8011	5-7/16 (138)	5-7/16 (138)	6 (152)	6-1/4 (158)	---	---	3-9/16 (90)
V-3000-8003	6-1/16 (153)	6-1/4 (158)	6-19/32 (167)	6-21/32 (173)	---	---	3-9/16 (90)
MP82	12-3/4 (324)	13-17/64 (352)	13-39/64 (346)	13-27/32 (352)	14-1/32 (356)	14-15/64 (361)	2 (51)
MP84	---	---	---	---	17-7/32 (437)	17-27/64 (443)	2 (51)
VA-715x	8-13/32 (214)	8-5/8 (219)	8-31/32 (228)	9-7/32 (234)	9-13/32 (239)	9-5/8 (244)	2-1/2 (64)
VA-720x	9-3/32 (256)	9-5/16 (236)	9-21/32 (245)	9-7/8 (251)	10-3/32 (256)	10-9/32 (261)	4-1/2 (114)
M9x16	14-11/16 (373)	14-29/32 (378)	15-1/4 (387)	15-1/2 (393)	15-23/32 (399)	15-7/8 (403)	---
M100	11-1/2 (292)	11-23/32 (297)	12-1/16 (306)	12-5/16 (312)	12-1/2 (318)	12-11/16 (322)	---

\* The extended bonnet is standard for VG7000 Series Valves with stainless steel trim to allow higher fluid temperatures (100 psig [689 kPa] saturated steam at 338°F [170°C]). Dimension "C" is the overall height above the centerline of the valve body, and dimension "D" is the clearance required for actuator removal (as illustrated in Figure 3.)

## Maintenance and Accessories

The maintenance parts available for the VG7000 Series Valves are listed in Table 25. Refer to Table 26 for a list of available accessories. For a replacement VG7000 Series Valve, contact the nearest Johnson Controls representative.

**Table 25: Maintenance Parts (Order Separately)**

Code Number	Description
VG7000-6001	<p>Ring Pack Packing Kits for Brass Trim Valves:</p> <p><b>Single Pack for 1/4 in. Stem (1/2 or 3/4 in. Valves)</b></p> <p>Kit Includes: two ring packs (U-cup with installed O-ring), one stem wiper, one insertion/removal tool, one bullet, one grease tube, and one 3 in. (76 mm) strip of crocus cloth</p>
VG7000-6002	<p><b>Single Pack for 3/8 in. Stem (1 through 2 in. Valves)</b></p> <p>Kit includes: two ring packs (U-cup with installed O-ring), one stem wiper, one stem guide, one insertion/removal tool, one sleeve packing installer, one grease tube, and one 3 in. (76 mm) strip of crocus cloth</p>
VG7000-6003	<p>Ring Pack Packing Kits for Brass Trim Valves:</p> <p><b>10 Pack for 1/4 in. Stem (1/2 or 3/4 in. Valves)</b></p> <p>Kit Includes: twenty ring packs (U-cup with installed O-ring), ten stem guides, one insertion/removal tool, one bullet, two grease tubes, and one 24 in. (610 mm) strip of crocus cloth</p>
VG7000-6004	<p><b>10 Pack for 3/8 in. Stem (1 through 2 in. Valves)</b></p> <p>Kit includes: twenty ring packs (U-cup with installed O-ring), ten stem wipers, ten stem guides, one insertion/removal tool, one sleeve packing installer, two grease tubes, and a 24 in. (610 mm) strip of crocus cloth</p>
VG7000-6011	<p>PTFE V-Ring Packing Kits for Stainless Steel Trim Valves:</p> <p><b>Single Pack for 1/4 in. Stem, SS Trim (1/2 or 3/4 in. Valves)</b></p> <p>Kit includes: two Teflon® V-rings, one rubber V-ring, two Teflon stem wipers, one Teflon stem guide, one Teflon bushing, one steel washer, one spring, one insertion/removal tool, one bullet, one grease tube, and one 3 in. (76 mm) strip of crocus cloth</p>
VG7000-6012	<p><b>Single Pack for 3/8 in. Stem, SS Trim (1 through 2 in. Valves)</b></p> <p>Kit includes: two Teflon V-rings, one rubber V-ring, two Teflon stem wipers, one Teflon stem guide, one Teflon bushing, one steel washer, one spring, one insertion/removal tool, one sleeve packing installer, one grease tube, and one 3 in. (76 mm) strip of crocus cloth</p>

**Table 26: Accessories (Order Separately)**

Code Number	Description
---	For specific actuator code numbers, refer to appropriate product bulletins.
---	For mounting and linkage kits, refer to Tables 6, 7, 8, and 9 in this bulletin.
EP-8000-1	EP Transducer, Low Volume, 0.5 to 9 VDC
EP-8000-2	EP Transducer, High Volume, 0.25 to 9.5 VDC
EP-8000-3	EP Transducer, Low Volume, 4 to 20 mA DC
EP-8000-4	EP Transducer, High Volume, 4 to 20 mA DC
EP-8000-101	EP-8000 Electro-Pneumatic Transducer Mounting Kit
R-3710	0.007 in. Restrictor (Required for Low Volume EP-8000 Models)
A-4000-1037	Inline Air Filter (Required for all EP-8000 Models)
JC 5361	Hypodermic Needle Test Probe Assembly
G-2010	0 to 30 psig (0 to 207 kPa) Gauge
VA-8000-102	Valve Position Indicator for Electrically Actuated Valves with VA-805x Actuators Only
V-9502-90 V-9502-91	<b>Positioners for V-3000-8001 and V-3000-8011:</b> Pneumatic Positioner (Less Spring) for V-3000-8011 Pneumatic Positioner (Less Spring) for V-3000-8001
V-9502-6801 V-9502-6802 V-9502-6801 V-9502-6802 V-9502-6801 V-9502-6803	<b>Positioner Feedback Springs for V-3000-8001 and V-3000-8011:</b> 5/16 in. (8 mm) Stroke for 1/2 or 3/4 in. Valve – 3 psig (21 kPa) Span 5/16 in. (8 mm) Stroke for 1/2 or 3/4 in. Valve – 8 psig (55 kPa) Span 1/2 in. (13 mm) Stroke for 1 or 1-1/4 in. Valve – 5 psig (34 kPa) Span 1/2 in. (13 mm) Stroke for 1 or 1-1/4 in. Valve – 12 psig (83 kPa) Span 3/4 in. (19 mm) Stroke for 1-1/2 or 2 in. Valve – 10 psig (69 kPa) Span 3/4 in. (19 mm) Stroke for 1-1/2 or 2 in. Valve – 4 psig (28 kPa) Span
V-9502-95 MP8000-6002 EPP-1000-8 MP8000-6003	<b>Positioners and Positioner Accessories for MP8000 Series Actuators:</b> Pneumatic Positioner (Less Spring and Mounting Hardware) V-9502 Pneumatic Positioner Mounting Kit with Springs Electro-Pneumatic Positioner (Less Mounting Hardware) EPP-1000 Electro-Pneumatic Positioner Mounting Kit
V-9502-76 V-9502-8100 V-9502-8102 V-9502-8106	<b>Positioner and Feedback Springs for V-400 and V-500 Actuators:</b> Pneumatic Positioner (Less Spring) 5/16 in. (8 mm) Stroke for 1/2 or 3/4 in. Valve – Adjustable 3 to 12 psig (21 to 83 kPa) Span 1/2 in. (13 mm) Stroke for 1 or 1-1/4 in. Valve – Adjustable 3 to 12 psig (21 to 83 kPa) Span 3/4 in. (19 mm) Stroke for 1-1/2 or 2 in. Valve – Adjustable 3 to 12 psig (21 to 83 kPa) Span

Note: Positioner accessory kits include positioner and all the appropriate mounting hardware, excluding the positioner feedback spring that must be ordered separately.

# Reconditioning Kits and Tools

Table 27: Ordering Data – VG7000 Series Reconditioning Kits

<b>VG</b>	<b>Valve Global</b>									
1	2	7	<b>Product Family</b> 7 = Cast Bronze							
3	4	<b>Body Type</b> 2 = Two-Way, Normally Open/Push-Down-To-Close 4 = Two-Way, Normally Closed/Push-Down-To-Open 5 = Two-Way Angle, Normally Open/Push-Down-To-Close 8 = Three-Way Mixing								
	<b>K</b>	<b>Reconditioning Kits</b> K = Inner Valve Reconditioning Kits <i>(Includes: bonnet, bonnet nut, packing, stem, plug, disk, and seat; replaceable seat is available for stainless steel trim valves only.)</i>								
5										
1	<b>1</b>	<b>Trim and Flow Characteristic</b> 1 = Brass Equal Percentage (All Two-Way and 1/2 in. Three-Way) 2 = Brass Linear (Two-Way Union Angle and All Three-Way) 3 = Stainless Steel Equal Percentage (Two-Way Only) 4 = Stainless Steel Linear (Three-Way Only)								
6										
	<b>R</b>	<b>Size and Cv (Kv)</b> C = 1/2 in., 0.73 Cv (0.63 Kv) E = 1/2 in., 1.8 Cv (1.6 Kv) G = 1/2 in., 4.6 Cv (4.0 Kv) L = 3/4 in., 7.3 Cv (6.3 Kv) N = 1 in., 11.6 Cv (10.0 Kv) P = 1-1/4 in., 18.5 Cv (16.0 Kv) R = 1-1/2 in., 28.9 Cv (25.0 Kv) S = 2 in., 46.2 Cv (40.0 Kv)								
7										
	<b>T</b>	<b>Stem Type</b> T = Standard Threaded Stem (All Except V-3801, V-500, MP84, VA-8x2x) S = Slotted Stem and Small Bonnet (Factory-Mounted V-3801, VA-8x2x) L = Large Threaded Stem (Factory-Mounted V-500 Only) M = Large Threaded Stem (Factory-Mounted MP84 Only)								
8										
	<b>+</b>	<b>Optional Lower Body</b> + = Lower Body Option (For 1-1/2 and 2 in. Bodies Only) <i>(Leave Fields 9 and 10 blank for 1/2 through 1-1/4 in. kits and for 1-1/2 and 2 in. kits without lower body.)</i>								
9										
	<b>W</b>	<b>N.C. Valve Bottom Cap</b> W = Two-Way Bottom Cap <i>(For 1-1/2 and 2 in. valves, it is recommended that a new bottom cap is ordered with the reconditioning kit.)</i>								
10										
	<b>4</b>	<b>Three-Way Lower Body</b> 4 = NPT <i>(For 1-1/2 and 2 in. valves, it is recommended that a lower body with matching end connection is ordered with the reconditioning kit.)</i>								
10										

1 2 3 4 5 6 7 8 9 10 = Field

**VG74K1RT+4**

Reconditioning Kit + 1-1/2 or 2 in. Bottom Cap/Lower

Example: Cast bronze valve, two-way, normally closed/push-down-to-open, brass trim, equal percentage, 1-1/2 in., 28.9 Cv, standard threaded stem, with a three-way lower body.

The reconditioning kits for VG7000 Series Valves include all the components necessary to return a valve to “near new” condition. These kits are available according to the convenient features and options format shown in Table 27. A descriptive list of the components in each kit is given below. Note that 1-1/2 and 2 in. two-way N.C. and three-way valves incorporate a stem guide in the bottom body of the valve.

The stem guide is integral for N.C./PDTO valves and the lower body for three-way valves. Depending on the wear condition of this part, it may or may not need to be replaced. While replacement is always recommended, these parts are available as an optional component included in the kit or ordered separately. The code numbers for these parts are listed in Table 28. Refer to Table 29 for the required stainless steel seat removal tools.

For N.O./PDTC valves with brass trim, the kit contains:

- bonnet, packing, and stem and plug assembly

For N.C./PDTO and three-way valves with brass trim, the kit contains:

- stem and plug assembly
- all packing components
- bonnet
- bottom cap/lower body (optional for 1-1/2 and 2 in. valves only)

For N.O./PDTC valves with stainless steel trim, the kit contains:

- preassembled bonnet, packing, and stem and plug assembly
- stainless steel seat

For N.C./PDTO and three-way valves with stainless steel trim, the kit contains:

- stem and plug assembly
- stainless steel seat (two for three-way valves)
- all packing components
- bonnet
- bottom cap/lower body (optional for 1-1/2 and 2 in. valves only)

**Table 28: Lower Body Kits**

Code Number	Valve Type	End Connection
VG7000-6101	1-1/2 in. Brass, N.C./PDTO	Bottom Cap
VG7000-6105	1-1/2 in. Brass, Three-Way	NPT
VG7000-6106	2 in. Brass, N.C./PDTO	Bottom Cap
VG7000-6110	2 in. Brass, Three-Way	NPT
VG7000-6111	1-1/2 in. Stainless Steel, N.C./PDTO	Bottom Cap
VG7000-6115	1-1/2 in. Stainless Steel, Three-Way	NPT
VG7000-6116	2 in. Stainless Steel, N.C./PDTO	Bottom Cap
VG7000-6120	2 in. Stainless Steel, Three-Way	NPT

**Table 29: Seat Removal Tools\***

Code Number	Valve Size, in. (DN)
X-200-8104	1/2 (DN15)
X-200-8106	3/4 (DN20)
X-200-8107	1 (DN25)
X-200-8108	1-1/4 (DN32)
X-200-8109	1-1/2 (DN40)
X-200-8110	2 (DN50)

\* For stainless steel trim valve seats only.

# Specifications

<b>Product</b>	VG7000 Series Bronze Control Valves		
<b>Models and Ordering Data</b>	See Tables 1, 2, and 3.		
<b>Service*</b>	Hot Water, Chilled Water, Glycol Solutions, or Steam for HVAC Systems		
<b>Valve Body Size/Cv (Kv)</b>	<b>1/2 in. (DN15)</b>	0.73 (0.63), 1.8 (1.6), and 4.6 (4.0)	
	<b>3/4 in. (DN20)</b>	7.3 (6.3)	
	<b>1 in. (DN25)</b>	11.6 (10)	
	<b>1-1/4 in. (DN32)</b>	18.5 (16)	
	<b>1-1/2 in. (DN40)</b>	28.9 (25)	
	<b>2 in. (DN50)</b>	46.2 (40)	
<b>Valve Stroke</b>	5/16 in. (8 mm) for 1/2 and 3/4 in. Valves (DN15 and DN20)		
	1/2 in. (13 mm) for 1 and 1-1/4 in. Valves (DN25 and DN32)		
	3/4 in. (19 mm) for 1-1/2 and 2 in. Valves (DN40 and DN50)		
<b>Valve Body Rating</b>	Meets Requirements of ANSI B16.15, Class 250		
<b>Valve Assembly Maximum Allowable Pressure/Temperature</b>	<b>Steam</b>	<b>Brass Trim</b>	35 psig (241 kPa) Saturated Steam at 281°F (138°C)
		<b>SS Trim</b>	100 psig (690 kPa) Saturated Steam at 338°F (170°C)
	<b>Water</b>	<b>Brass Trim</b>	400 psig (2,756 kPa) Up to 150°F (66°C), Decreasing to 365 psig (2,515 kPa) at 248°F (120°C)
		<b>SS Trim</b>	400 psig (2,756 kPa) Up to 150°F (66°C), Decreasing to 308 psig (2,122 kPa) at 338°F (170°C)
<b>Leakage</b>	<b>Brass Trim</b>	0.01% of Maximum Flow per ANSI/FCI 70-2, Class 4	
	<b>SS Trim</b>	0.05% of Maximum Flow	
<b>Inherent Flow Characteristics</b>	Equal Percentage: N.O./PDTC and N.C./PDTO Valves Linear: Three-Way Mixing Valves		
<b>Rangeability**</b>	25:1 for All Sizes		
<b>Spring Range Pneumatic Actuators</b>	3 to 6 psig (21 to 41 kPa); 3 to 7 psig (21 to 48 kPa) for MP8000 Series 4 to 8 psig (28 to 55 kPa) 9 to 13 psig (62 to 90 kPa)		
<b>Maximum Recommended Operating Pressure Drop</b>	<b>Steam</b>	<b>Brass Trim</b>	15 psig (103 kPa) for All Valve Sizes
		<b>SS Trim</b>	100 psig (690 kPa) for All Valve Sizes
	<b>Water</b>	<b>All Trim</b>	35 psig (241 kPa) for 1/2 through 1-1/4 in. Valves; 30 psig (207 kPa) for 1-1/2 and 2 in. Valves
<b>Maximum Actuator Supply Pressure (Pneumatically Actuated Valves Only)</b>	25 psig (172 kPa) Maximum		
<b>Maximum Closeoff Pressures</b>	See Tables 10 through 15.		

Continued on next page . . .

\* Proper water treatment is recommended; refer to VDI 2035 Standard.

\*\* Rangeability is defined as the ratio of maximum flow to minimum controllable flow.

# Specifications (Cont.)

<b>Materials</b>	<b>Body</b>	Cast Bronze
	<b>Bonnet</b>	Brass
	<b>Brass Stem</b>	Stainless Steel
	<b>Trim Plug</b>	Brass
	<b>Seat</b>	Brass Against Molded Elastomeric Disk
	<b>Packing</b>	Self-Adjusting Ethylene Propylene Rubber (EPR) Ring Pack U-Cups
	<b>SS Stem</b>	Stainless Steel
	<b>Trim Plug</b>	Stainless Steel
	<b>Seat</b>	Stainless Steel
	<b>Packing</b>	Spring Loaded PTFE and Elastomer V-Rings
<b>Valve Fluid Operating Temperature Limits</b>	<b>Brass Trim</b>	Pneumatic: <b>For V-3801-8001 and V-3000-8003 Actuators:</b> 35 to 248°F (2 to 120°C) 15 psig (103 kPa) Saturated Steam <b>For MP82 and V-3000-8011 Actuators:</b> 35 to 284°F (2 to 140°C) 38 psig (262 kPa) Saturated Steam
		Electric: <b>For VA-8x2x and VA-805x Actuators:</b> Water: 195°F (91°C) Maximum Steam: Actuator is <b>not</b> rated for this application. <b>For All Other Actuators:</b> 35 to 284°F (2 to 140°C) 38 psig (262 kPa) Saturated Steam
	<b>SS Trim</b>	Pneumatic and Electric: 35 to 338°F (2 to 170°C) 100 psig (690 kPa) Saturated Steam
<b>Actuator Ambient Operating Temperature Limits</b>	<b>For M9x16 Series Electric Actuators:</b> The maximum ambient operating temperature is limited to 110°F (43°C) for fluid operating temperatures greater than 285°F (141°C).	
	<b>For All Other Actuators:</b> Refer to the appropriate actuator or linkage kit product bulletin. Ambient operating temperature or other service limitations vary by selected actuator.	
<b>Accessories (Order Separately)</b>	See Table 26.	

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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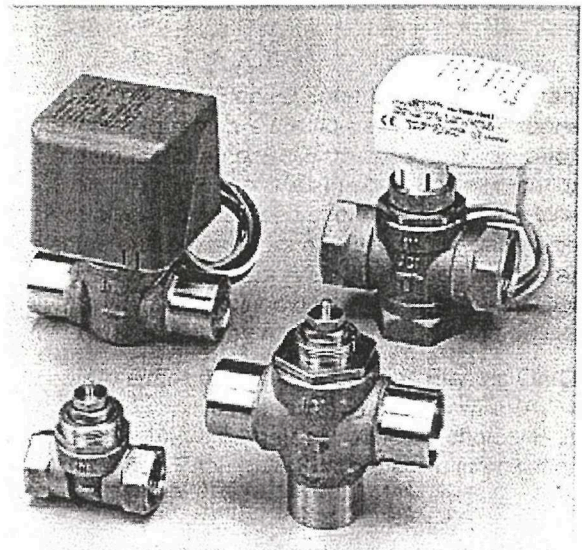
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## VG5000 Series Electric Zone Valves

*VG5000 Series Electric Zone Valves are primarily designed to regulate the flow of water in response to the demand of a controller in zone, fan coil, and Variable Air Volume (VAV) reheat coil applications. The valves can be used in combination with VA-7010 electric on/off actuators and VA-7450 floating or proportional actuators. VG5000 Series Valves are available in Normally Open (N.O.), Normally Closed (N.C.), or three-way mixing configurations.*

*Refer to either the VA-7010 Series Electric On/Off Actuator Product/Technical Bulletin or the VA-7450 Electronic Valve Actuator Product/Technical Bulletin (FAN 977 or FAN 1628.3) for specific information.*



**Figure 1: VG5000 Series Electric Zone Valves**

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>Forged Brass Body and Stainless Steel Stem and Spring</b>	Ensures long life
<input type="checkbox"/> <b>Rubber Compound Plug for Bubble-Tight Shutoff</b>	Maximizes energy savings
<input type="checkbox"/> <b>Field-Adjustable Cv for Select Body Styles</b>	Reduces stock and offers flexibility
<input type="checkbox"/> <b>Easy, Field-Replaceable Packing</b>	Shortens service time
<input type="checkbox"/> <b>Actuator Can Be Field Installed After Piping</b>	Simplifies installation in confined locations
<input type="checkbox"/> <b>Built-In Return Spring for VA-7010 Actuators</b>	Allows the valve to return to normal position when the actuator is de-energized

Table 1: Ordering Information

V G		Valve Global																
1	2	5	Product												5 = Electric Zone Valve			
		3	Family															
		2	Body												2 = Two-Way N.O. (PDTC)			
		4	Type												4 = Two-Way N.C. (PDTO)			
															8 = Three-Way Mixing			
		4	End												4 = Threaded (NPT)			
		5	Connections												7 = Sweat Ends			
		0	Trim												0 = Stainless Steel Stem, Rubber EPT Plug, Flat Disk			
		6																
		E C	Size and Maximum Cv										Threaded (NPT)			Sweat Ends		
		7	8										N.O.	N.C.	3-Way	N.O.	N.C.	3-Way
			(Kv = Cv x 0.857)										(PDTC)	(PDTO)	Mixing	(PDTC)	(PDTO)	Mixing
			BC = 1/2 in. (DN15)										—	—	—	0.46	—	—
			CC = 1/2 in. (DN15)										0.74	0.74	0.74	0.74	0.74	—
			DC = 1/2 in. (DN15)										1.17	1.17	1.17	1.17	1.17	—
			EC = 1/2 in. (DN15)										1.9	1.9	1.9	1.9	1.7	1.7
			HC = 3/4 in. (DN20)										—	1.9	—	—	1.9	—
			JC = 3/4 in. (DN20)										3.0	3.0	3.0	3.0	3.0	—
			KC = 3/4 in. (DN20)										4.1	4.1	4.1	4.1	3.7	3.7
			FC = 1 in. (DN25)										—	3.0	—	—	3.0	—
			LC = 1 in. (DN25)										—	4.7	—	4.7	4.7	—
			MC = 1 in. (DN25)										6.4	6.4	6.4	6.4	5.8	5.8
		+	Actuator Mounting												+ = Factory-Mounted Actuator			
		9													(Leave fields 9 through 14 blank for valve without factory-mounted actuator.)			
		7	Actuator Style										7010 = VA-7010 On/Off (Available on all valve body types.)					
		10	11										7450 = VA-7450 On/Off, Floating					
		12	13										7452 = VA-7452 Proportional					
													(Both styles available on N.O. and three-way mixing valve body types only.)					
		G	Supply Voltage										VA-7010	VA-7450	VA-7452			
		14	A = 120 VAC										-8002	—	—			
			D = 230 VAC										-8003	—	—			
			G = 24 VAC										-8001	-10011	-90011			
			F = 208 VAC										-8006	—	—			
			S = 277 VAC										-8007	—	—			

1	2	3	4	5	6	7	8	9	10	11	12	13	14 = Field
V	G	5	2	4	0	E	C	+	7	0	1	0	G
Valve								+	Actuator				

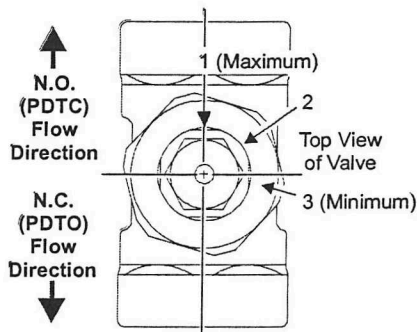
Example: Electric zone valve, two-way N.O., threaded (NPT) end connections, stainless steel stem, rubber EPT plug, flat disk, 1/2 in. (DN15), 1.9 Cv, factory-mounted VA-7010-8001 Electric Actuator, 24 VAC supply.

**Table 2: Field-Adjustable Cv for VG5000 Series Electric Zone Valves**

Valve Body Size (in.)	Valve Body Code Number	Cv Adjustment Indexes		
		1*	2*	3*
1/2	VG5240CC	1.90	1.17	0.74
	VG5240DC			
	VG5240EC			
	VG5440CC			
	VG5440DC			
	VG5440EC			
	VG5270BC	1.17	0.74	0.46
	VG5270CC			
	VG5270DC			
	VG5470CC	1.70	1.17	0.74
	VG5470DC			
VG5470EC				
VG5470KC				
3/4	VG5440HC	4.10	3.00	1.90
	VG5440JC			
	VG5440KC			
	VG5470HC	3.70	3.00	1.90
	VG5470JC			
	VG5470KC			
1	VG5440FC	6.40	4.70	3.00
	VG5440LC			
	VG5440MC			
	VG5470FC	5.80	4.70	3.00
	VG5470LC			
	VG5470MC			

\* Refer to Figure 2 for the location of the Cv selection marks.

Note: Two-Way N.O. (PDTC) valves in sizes 3/4 and 1 in. and all three-way valves do not feature an adjustable Cv. (For Kv equivalent, multiply the Cv value by 0.857.)



**Figure 2: Location of the Cv Selection Marks**

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

Product Code Number	Description
VG5000-1	Packing Nut with Integral O-Ring
VA-7450-8900	Manual Override Ring Accessory (Opens N.C. valves or the N.C. port of three-way valves for VA-7450 and VA-7452 actuated assemblies.)

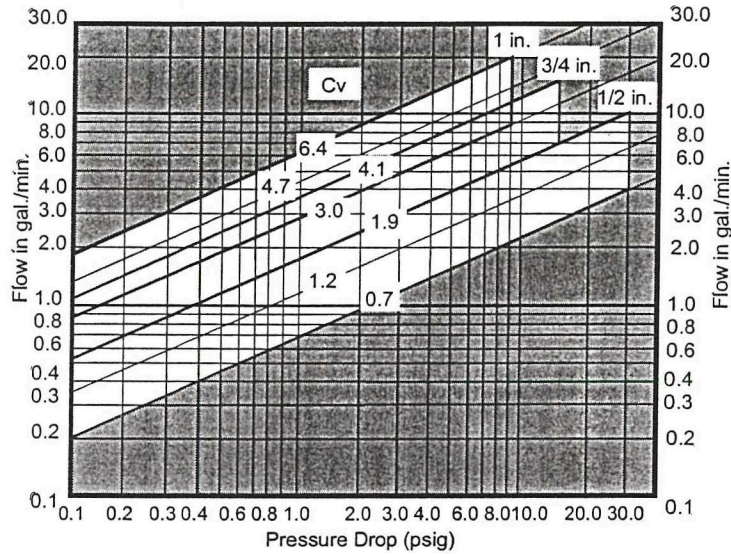


Figure 3: Pressure Drop vs. Flow

Table 4: Closeoff Pressures, psig (kPa)

Valve Size	Threaded (NPT) Ends			Sweat Ends		
	N.O. (PDTC)	N.C. (PDTO)	Three-Way Mixing	N.O. (PDTC)	N.C. (PDTO)	Three-Way Mixing
1/2 in. = BC	—	—	—	45 (310)	—	—
CC	30 (207)	30 (207)	30 (207)	45 (310)	30 (207)	—
DC	30 (207)	30 (207)	30 (207)	45 (310)	30 (207)	—
EC	30 (207)	30 (207)	30 (207)	30 (207)	30 (207)	30 (207)
3/4 in. = HC	—	14.5 (100)	—	—	14.5 (100)	—
JC	20 (138)	14.5 (100)	14.5 (100)	20 (138)	14.5 (100)	—
KC	14.5 (100)	14.5 (100)	14.5 (100)	14.5 (100)	14.5 (100)	14.5 (100)
1 in. = FC	—	9 (62)	—	—	9 (62)	—
LC	—	9 (62)	—	12 (83)	9 (62)	—
MC	9 (62)	9 (62)	9 (62)	9 (62)	9 (62)	9 (62)

Note: Closeoff pressures are the same for both VA-7010 and VA-745x actuators.

## Actuator Assemblies

VG5000 Series Valves are specifically designed for use with VA-7010 Series Electric On/Off and VA-745x Series Electronic Actuators.

Note: For soldering reasons, factory-ordered assemblies featuring sweat end connections are shipped with the actuator separated from the valve body.

## Operation

**IMPORTANT:** It is recommended that the valve be mounted within 90 degrees of the upright position.

### VA-7010 Series (On/Off Control)

When power is applied to the actuator, the motor drives the gear assembly pushing the valve stem down against the force of the return spring. When power is removed, the actuator retracts allowing the return spring to move the valve stem up, in the direction of its normal position. Figure 4 illustrates the effect that valve stem movement has on flow.

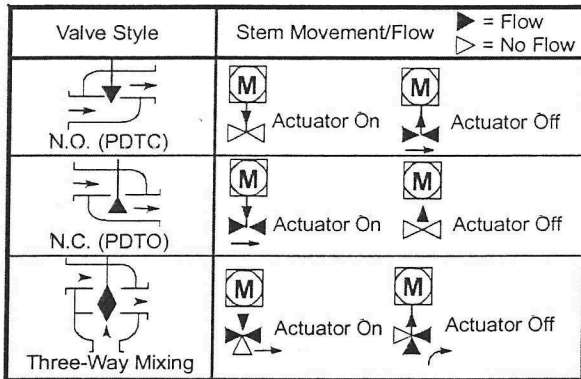


Figure 4: Flow Diagram

### VA-7450-10011 (On/Off or Floating Control)

When power is applied to the Common (blue) and Down (red) wires, the motor drives the gear assembly, pushing the valve stem down against the force of the return spring. When power is applied to the Common (blue) and Up (white) wires, the actuator retracts allowing the return spring to move the valve stem up to its normal position. When power is removed, the actuator will hold its position.

If power remains applied to either the red or white wire, the actuator will time out and shut off the motor after approximately 80 seconds, holding its current position. Figure 4 illustrates the effect that valve stem movement has on flow.

### VA-7452-90011 (Proportional Control)

When the signal increases in Direct Action (DA) configuration or decreases in Reverse Action (RA) configuration, the actuator motor drives the gear assembly, pushing the valve stem down against the force of the valve return spring.

When the signal decreases in DA configuration or increases in RA configuration, the actuator retracts and allows the valve return spring to move the valve stem up, in the direction of its normal position.

Upon loss of the supply voltage, the actuator will hold its position. Figure 4 illustrates the effect that valve stem movement has on flow.

# Dimensions

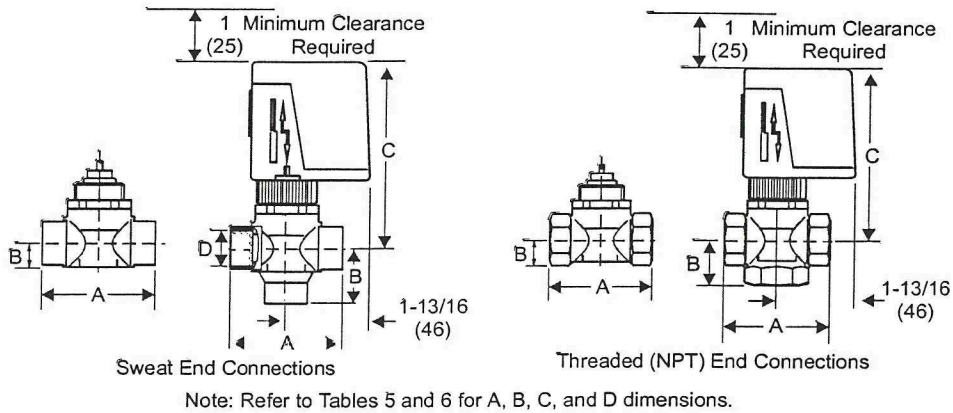


Figure 5: VG5000 Series Valve/VA-7010 Series Actuator Dimensions, in. (mm)

Table 5: VG5000 Series Valve/VA-7010 Series Actuator Dimensions, in. (mm)  
(Sweat End Connections)

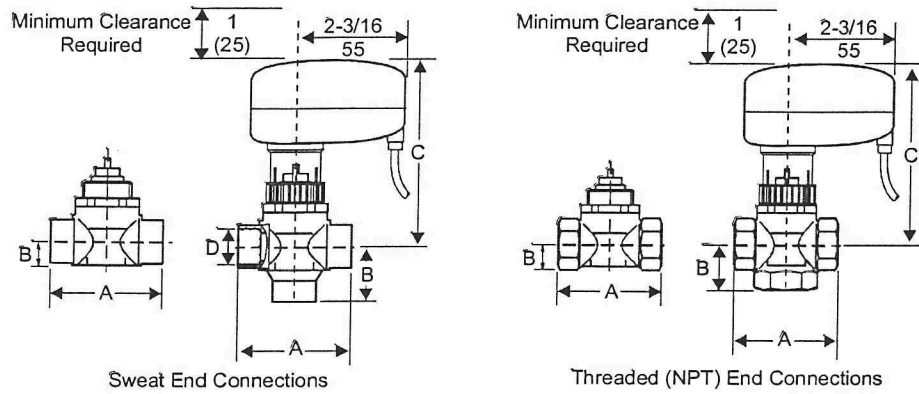
Dimension	Two-Way			Three-Way Mixing		
	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
A	2-13/32 (61)	3-1/16 (78)	3-3/4 (95)	2-13/32 (61)	3-1/16 (78)	3-3/4 (95)
B	1/2 (13)	21/32 (17)	21/32 (17)	1-7/32 (31)	1-17/32 (39)	1-29/32(48)
C*	3-15/16 (100)	4-1/16 (103)	4-3/16 (106)	3-15/16 (100)	4-3/32 (104)	4-1/4 (108)
D	5/8 (16)	7/8 (22)	1-1/8 (29)	5/8 (16)	7/8 (22)	1-1/8 (29)

\* For actuator-only dimensions, refer to the VA-7010 Series Electronic On/Off Actuator Product/Technical Bulletin (LIT-977360).

Table 6: VG5000 Series Valve/VA-7010 Series Actuator Dimensions, in. (mm)  
(Threaded End Connections)

Dimension	Two-Way			Three-Way Mixing		
	(1/2 in.) DN15	3/4 in. (DN20)	1 in. (DN25)	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
A	2-5/32 (55)	2-19/32 (66)	3-17/32 (90)	2-5/32 (55)	2-19/32 (66)	3-17/32 (90)
B	19/32 (15)	3/4 (19)	15/16 (24)	1-5/32 (29)	1-5/16 (33)	1-15/32 (37)
C*	3-27/32 (98)	4-1/32 (102)	4-5/32 (106)	3-27/32 (98)	4-1/32 (102)	4-5/32 (106)

\* For actuator-only dimensions, refer to the VA-7010 Series Electronic On/Off Actuator Product/Technical Bulletin (LIT-977360).



Note: Refer to Tables 7 and 8 for A, B, C, and D dimensions.

Figure 6: VG5000 Series Valve/VA-745x Series Actuator Dimensions, in. (mm)

Table 7: VG5000 Series Valve/VA-745x Series Actuator Dimensions, in. (mm)  
(Sweat End Connections)

Dimension	Two-Way			Three-Way Mixing		
	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
A	2-13/32 (61)	3-1/16 (78)	3-3/4 (95)	2-13/32 (61)	3-1/16 (78)	3-3/4 (95)
B	1/2 (13)	21/32 (17)	21/32 (17)	1-7/32 (31)	1-17/32 (39)	1-29/32(48)
C*	3-23/32 (94)	3-27/32 (98)	3-31/32 (100)	3-23/32 (94)	3-7/8 (98)	4-1/32 (102)
D	5/8 (16)	7/8 (22)	1-1/8 (29)	5/8 (16)	7/8 (22)	1-1/8 (29)

\* For actuator-only dimensions, refer to the VA-7450 Series Electronic Valve Actuator Product/Technical Bulletin (LIT-977324).

Table 8: VG5000 Series Valve/VA-745x Series Actuator Dimensions, in. (mm)  
(Threaded End Connections)

Dimension	Two-Way			Three-Way Mixing		
	(1/2 in.) DN15	3/4 in. (DN20)	1 in. (DN25)	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
A	2-5/32 (55)	2-19/32 (66)	3-17/32 (90)	2-5/32 (55)	2-19/32 (66)	3-17/32 (90)
B	19/32 (15)	3/4 (19)	15/16 (24)	1-5/32 (29)	1-5/16 (33)	1-15/32 (37)
C*	3-5/8 (92)	3-13/16 (96)	3-15/16 (100)	3-5/8 (92)	3-13/16 (97)	3-15/16 (100)

\* For actuator-only dimensions, refer to the VA-7450 Series Electronic Valve Actuator Product/Technical Bulletin (LIT-977324).

# Specifications

<b>Product</b>	VG5000 Series Electric Zone Valves		
<b>Models</b>	Refer to Table 1.		
<b>Body Rating</b>	PN16 Maximum Pressure: 300 psig (2,067 kPa)		
<b>Service*</b>	Hot and Cold Water for HVAC Systems		
<b>Valve Sizes</b>	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
<b>Maximum Closeoff Pressure</b>	Refer to Table 4.		
<b>Leakage</b>	0.01% of Maximum Flow; 100% Production Tested		
<b>End Connections</b>	Threaded (NPT): ANSI B1.20.1 Sweat: ANSI B16.18		
<b>Stroke</b>	0.12 in. (3 mm)		
<b>Materials:</b>			
<b>Valve, Packing Nut, Cage</b>	Brass		
<b>Stem</b>	ANSI 300 Stainless Steel		
<b>Spring</b>	Stainless Steel		
<b>Plug</b>	Rubber EPT		
<b>Packing</b>	Two Rubber EPT O-Rings		
<b>Fluid Temperature Limits</b>	35 to 203°F (2 to 95°C)		
<b>Ambient Temperature Limits</b>	35 to 122°F (2 to 50°C)		
<b>Flow Characteristics</b>	On/Off with VA-7010 Actuator; Two-Way Models with VA-7450 Series Actuators Approximately Equal Percentage; Three-Way Models with VA-7450 Series Actuator Approximately Linear for Service Port		
<b>Valve Body Shipping Weight, lb (kg):</b>	1/2 in. (DN15)	3/4 in. (DN20)	1 in. (DN25)
<b>N.O. (PDTC)</b>	0.57 (0.26)	0.86 (0.39)	1.52 (0.69)
<b>N.C. (PDTO)</b>	0.68 (0.31)	0.93 (0.42)	1.48 (0.67)
<b>Three-Way Mixing</b>	0.73 (0.33)	1.06 (0.48)	1.74 (0.79)
<b>Actuator Shipping Weight, lb (kg)</b>	VA-7010: 1.10 (0.50) VA-745x: 0.40 (0.18)		

\* Proper water treatment is recommended; refer to VDI 2035 Standard.

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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## J Series Electric Zone Valves

*J Series Electric Zone Valves accurately control the flow of saturated steam, hot water, and chilled water through coils and heat exchangers of all types, in a wide range of HVAC applications. The spring return, two-position design with synchronous motor has been proven reliable in millions of installations worldwide. The actuator can be removed from the valve body quickly and easily, simplifying installation and servicing. No special linkage kit or commissioning is required.*

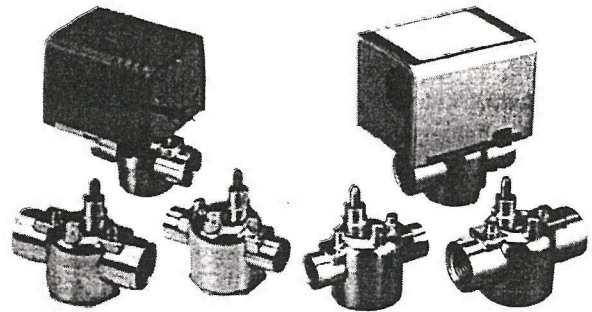


Figure 1: J Series Electric Zone Valves

### Features and Benefits

- |  |   |
|--|---|
| <input type="checkbox"/> <b>Quick and Simple Actuator Removal</b>                | Eases installation and provides quick actuator replacement during service                 |
| <input type="checkbox"/> <b>Bubble-Tight Shutoff</b>                             | Conserves energy and accurately controls zone temperature for increased comfort           |
| <input type="checkbox"/> <b>High Closeoff Pressure Actuator Option Available</b> | Satisfies demanding requirements of high-rise buildings and high-pressure pumping systems |
| <input type="checkbox"/> <b>Interchangeable Actuators</b>                        | Allows field conversion from normally open to normally closed without re-piping           |
| <input type="checkbox"/> <b>Choice of End Connections</b>                        | Provides increased versatility and replacement capability                                 |

**Table 1: Ordering Data**

<b>J</b>												
<b>Electric Zone Valve</b>												
1	<b>T</b>		<b>Valve Type and Temperature Rating</b>		T = On/Off, Standard Temperature S = On/Off, High Temperature							
2	<b>2</b>		<b>Valve Configuration</b>		2 = Two-Way 3 = Three-Way Mixing/Diverting							
3	<b>3</b>		<b>Valve Size</b>		2 = 1/2 in. 3 = 3/4 in. 4 = 1 in. 5 = 1-1/4 in.							
4	<b>1</b>		<b>Valve End Connections</b>		1 = Sweat: 1/2, 3/4, 1, and 1-1/4 in. 2 = Threaded (NPT): 1/2, 3/4, and 1 in. 4 = Inverted Flare: 3/4 in. only <i>Note: Inverted flare fittings are sold separately; refer to Table 2 for ordering details.</i>							
5	<b>3</b>		<b>Cv</b>		<b>Valve Size</b>		<b>Two-Way</b>		<b>Three-Way</b>			
6			<i>(Kv = Cv x 0.857)</i>		1/2 in. Threaded and Sweat Only		1 = 1.0 2 = 2.5 3 = 3.5		3 = 4.0			
					3/4 in. Threaded and Sweat Only		2 = 2.5 3 = 3.5		5 = 5.0			
					3/4 in. Inverted Flare Only		3 = 3.5		3 = 4.0			
					1 in. Sweat Only		7 = 7.0		7 = 7.0			
					1 in. Threaded Only, and 1-1/4 in. Sweat Only		7 = 7.0		7 = 7.5			
7	<b>G</b>		<b>Actuator Pressure Rating</b>		G = Standard Closeoff Pressure H = High Closeoff Pressure ( <i>N.C. Valves Only</i> )							
8	<b>1</b>		<b>Spring Return</b>		1 = Normally Closed ( <i>All Valves</i> ) 2 = Normally Open ( <i>Two-Way Valves Only</i> ) <i>Note: Three-way valves are shipped from the factory in the normally closed configuration; for normally open configuration, simply turn the valve around.</i>							
9	<b>3</b>		<b>Actuator Temperature Rating</b>		3 = Standard Temp ( <i>Standard Temp Valves Only</i> ) 4 = High Temp ( <i>High Temp Valves Only</i> )							
10	<b>A</b>		<b>Voltage</b>		A = 24 VAC, 60 Hz B = 120 VAC, 60 Hz							
11	<b>0</b>		<b>Electrical Leads</b>		02 = 18 in. Wire Leads							
12	<b>2</b>		<b>Options</b>		0 = None							
13	<b>0</b>											

1	2	3	4	5	6	7	8	9	10	11	12	13 = Field
J	T	2	3	1	3	G	1	3	A	0	2	0
<b>Valve</b>						<b>Actuator</b>						

*Example: Electric zone valve, On/Off, standard temperature, two-way, 3/4 in. sweat ends, 3.5 Cv, standard closeoff pressure spring return electric actuator, normally closed, 24 VAC, 60 Hz, 18 in. wire leads.*

## Application Overview

J Series Electric Zone Valves control the flow of saturated steam, hot water, and chilled water through coils and heat exchangers of all types, in a wide range of HVAC applications. A variety of models handle all water system control needs, as well as saturated steam applications of 15 psig (103 kPa) or lower. The J Series is designed to withstand the high moisture conditions found in many concealed fan coil installations.

## Valve Body Features

The J Series valve body features an integral seat, and is available in normally open, normally closed, and three-way mixing/diverting styles. The one-piece body design permits high pressure ratings: 300 psig (2,067 kPa) system operating pressure and 400 psig (2,756 kPa) static test pressure.

The valves are available with the following end connections:

- 5/8, 7/8, 1, and 1-1/4 in. O.D. sweat (solder joints for copper tubing)
- 1/2, 3/4, and 1 in. internal threaded (NPT)
- inverted flare fittings (copper tubing with a flare nut for union connections)

## Valve Action

J Series Electric Zone Valves are operated by a hysteresis synchronous motor. Upon demand, the motor opens a normally closed valve. When the thermostat is satisfied, a spring returns the valve to the closed position. On two-way valves, the paddle assembly closes against the flow as illustrated in Figure 2. For three-way valves, refer to Figure 3.

## Temperature Ratings

J Series Electric Zone Valves are available in two temperature ranges:

**Standard Temperature Rating** for chilled water and hot water up to 200°F (93°C), in an ambient temperature of 104°F (40°C).

**High Temperature Rating** for chilled water, hot water up to 250°F (121°C) in an ambient temperature of 169°F (76°C), and saturated steam (250°F at 15 psig; 121°C at 103 kPa).

## Manual Operating Lever

All J Series Electric Zone Valves (except normally open two-way models) are equipped with a manual operating lever. This lever:

- allows the valve to be opened for system flushing before it is put into operation
- prevents damage to the paddle on three-way valves, and allows flushing of the system by maintaining the valve in the mid-position
- resets to normal position the first time the valve is cycled

**Note:** The manual lever can not be used to close the bypass port on three-way valves.

## End Connections for Inverted Flare Valves

Inverted flare fittings must be ordered separately to adapt inverted flare J Series Electric Zone Valves to 1/2, 3/4, and 1 in. copper piping; refer to Table 2 for a list of fittings available. This style of end connection eliminates the need for precision-cut lengths of copper tubing. These close-quarter fittings make installation easy without the use of tube benders or flaring tools. The inverted flare fittings are sweated onto the copper tubing; valve installation consists of simple wrench connections.

Advantages of the inverted flare construction include:

- The valve can be installed with no possibility of heat damage during the soldering operation.
- The valve can be easily removed if necessary to clean the system or make repairs.
- The fittings can withstand the high temperatures of silver soldering.
- When used for replacement work, labor is saved because the old valve can be removed using the fittings, rather than cutting or unsweating.

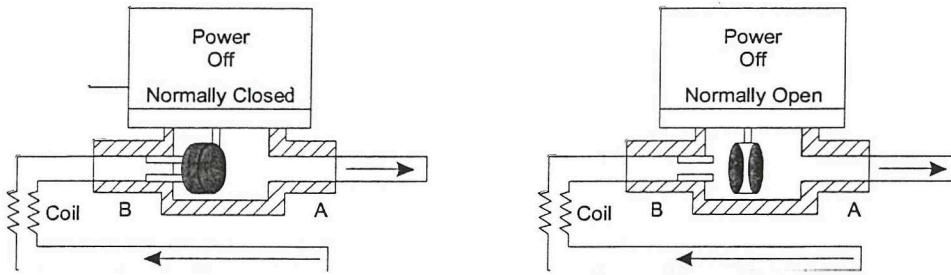


Figure 2: Flow Diagrams for Two-Way J Series Electric Zone Valves

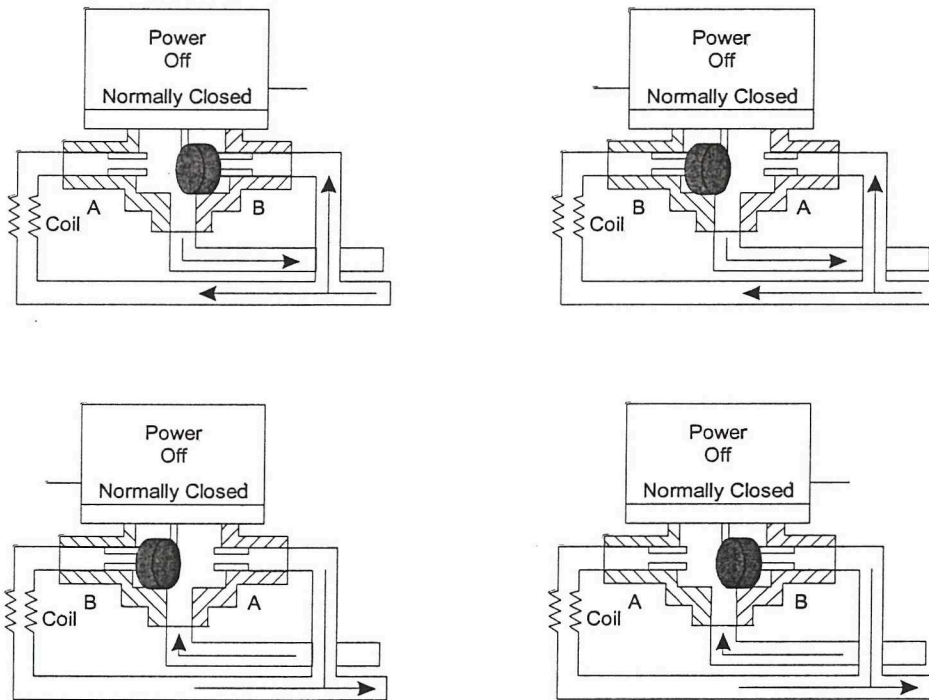


Figure 3: Flow Diagrams for Three-Way J Series Electric Zone Valves

## Installation

All wiring must be in accordance with local electrical code requirements. The actuator housing must be protected from moisture. In horizontal piping applications, it is recommended that the valve be mounted within 85° of the upright position. When mounted in vertical piping, the valve must be protected from moisture.

Solder connections require a lead or tin-based solder with a melting point below 600°F (316°C). Avoid overheating the end connections.

## Repair Information

Available repair parts for J Series Electric Zone Valves include replacement valve bodies, replacement actuators, and the end connections included in Table 2. No other field repairs should be attempted.

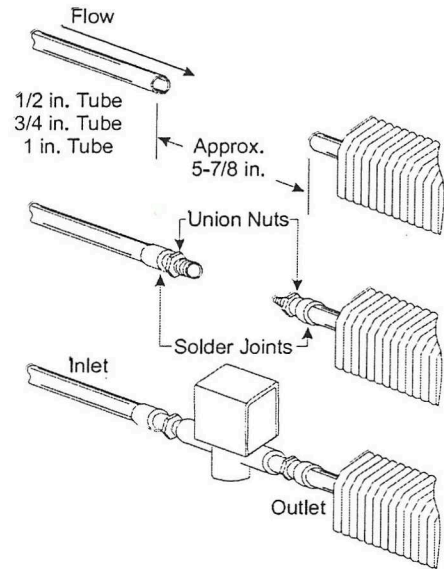


Figure 4: Installation of Inverted Flare J Series Electric Zone Valves

Table 2: Inverted Flare Fittings (Order Separately)

Code Number	Description	Length in. (mm)
J647-601	For 1/2 in. (5/8 in. O.D.) Copper Tubing	15/16 (24)
J647-602	For 1/2 in. (5/8 in. O.D.) Copper Tubing	1-11/16 (43)
J647-603	For 1/2 in. (5/8 in. O.D.) Copper Tubing	3 (76)
J647-604	For 3/4 in. (7/8 in. O.D.) Copper Tubing	1-27/32 (47)
J647-605	For 1/2 in. (5/8 in. O.D.) Copper Tubing	1-15/16 (49)
J647-606	For 1 in. (1-1/8 in. O.D.) Copper Tubing	2-3/8 (60)
J647-607	Inverted Flare Nut	----

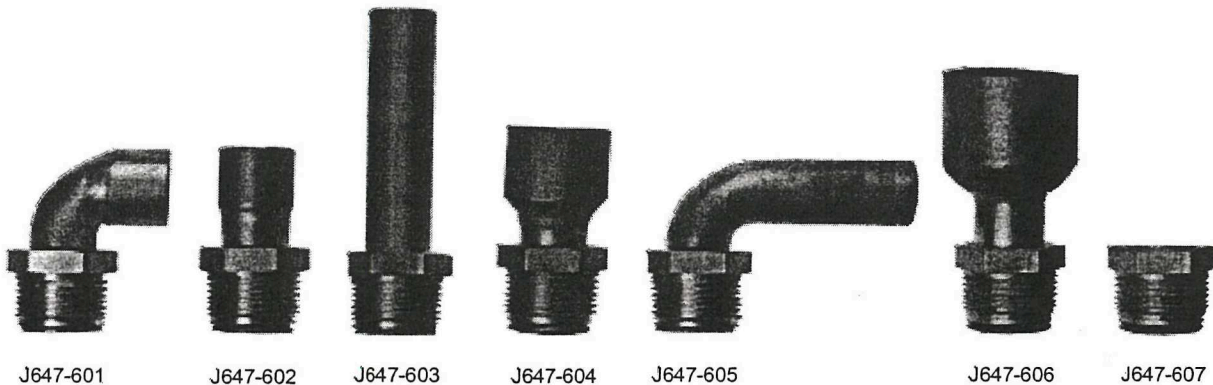


Figure 5: Inverted Flare Fittings (Order Separately)

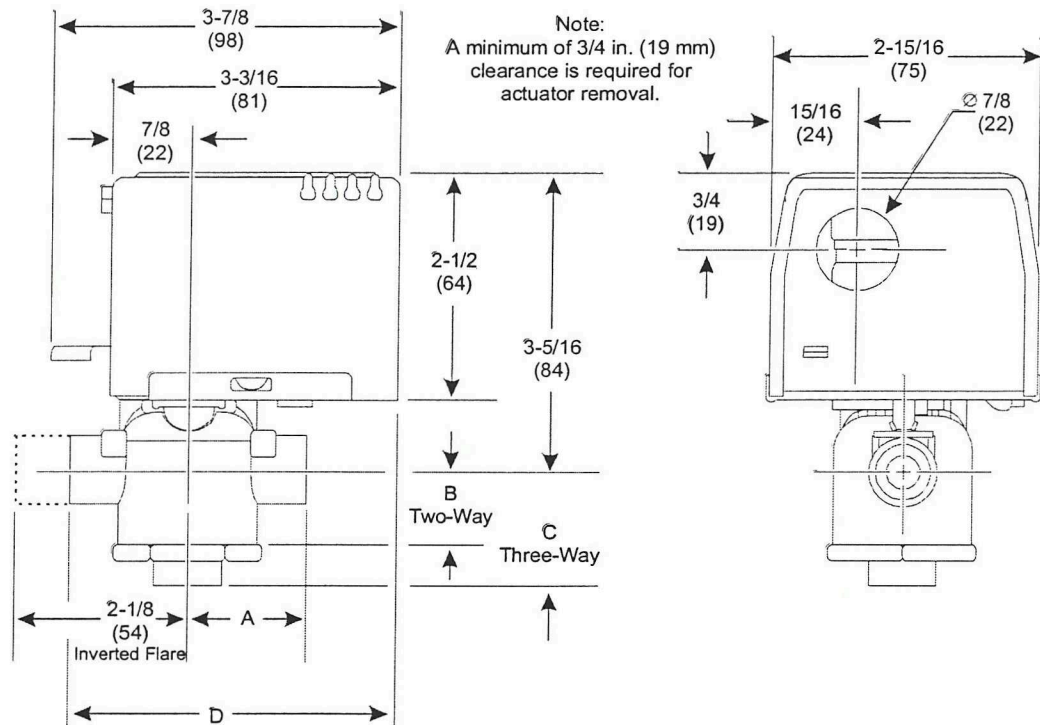


Figure 6: J Series Electric Zone Valve Dimensions, in. (mm)

Table 3: J Series Electric Zone Valve Dimensions, in. (mm)

Valve Size	A	B (Two-Way Models)	C (Three-Way Models)	D (Standard Closeoff Models)	D (High Closeoff Models)
1/2 in. Sweat	1-5/16 (33)	15/16 (24)	1-5/16 (33)	3-5/16 (84)	3-5/8 (92)
3/4 in. Sweat	1-3/8 (35)	15/16 (24)	1-11/16 (43)	3-3/8 (86)	3-3/4 (95)
1 in. Sweat	1-11/16 (43)	15/16 (24)	1-11/16 (43)	3-5/8 (92)	4 (102)
1-1/4 in. Sweat	1-7/8 (48)	1 (25)	1-13/16 (46)	3-11/16 (94)	4-1/8 (105)
1/2 in. Threaded (NPT)	1-3/8 (35)	15/16 (24)	1-5/16 (33)	3-3/8 (86)	3-5/8 (92)
3/4 in. Threaded (NPT)	1-11/16 (43)	15/16 (24)	1-7/16 (37)	3-5/8 (92)	4 (102)
1 in. Threaded (NPT)	1-7/8 (48)	1 (25)	1-11/16 (43)	3-11/16 (94)	4-1/8 (105)
3/4 in. Inverted Flare	1-3/8 (35)	15/16 (24)	1-5/16 (33)	4-1/8 (105)	4-1/8 (105)

---

**Notes**

# Specifications

<b>Product</b>	J Series Electric Zone Valves				
<b>Service*</b>	Hot Water, Chilled Water, 50% Glycol Solutions, and 15 psig (103 kPa) Saturated Steam for HVAC Systems				
<b>End Connections</b>	Threaded (NPT), Sweat, or Inverted Flare				
<b>Fluid Temperature Limits</b>	<b>Standard</b>	200°F (93°C) Water in an Ambient Temperature of 104°F (40°C)			
	<b>High</b>	250°F (121°C) Water in an Ambient Temperature of 169°F (76°C) or 15 psig (103 kPa) Steam at 250°F (121°C)			
<b>Valve Body Pressure Rating</b>	300 psig (2,067 kPa) System Operating Pressure and 400 psig (2,756 kPa) Static Test Pressure				
<b>Valve Cv (Kv) and Closeoff Pressure Ratings</b>	<b>Size</b>	<b>Two-Way Cv (Kv)</b>	<b>Three-Way Cv (Kv)</b>	<b>Standard Closeoff</b>	<b>High Closeoff</b>
				50 psig (345 kPa)	75 psig (517 kPa)
	1/2 in. Threaded and Sweat Only	1.0 (0.9)	----	30 psig (207 kPa)	50 psig (345 kPa)
		2.5 (2.1)	----	20 psig (138 kPa)	30 psig (207 kPa)
	3/4 in. Threaded and Sweat Only	3.5 (3.0)	4.0 (3.4)	50 psig (345 kPa)	50 psig (345 kPa)
		2.5 (2.1)	----	20 psig (138 kPa)	30 psig (207 kPa)
	3/4 in. Inverted Flare Only	3.5 (3.0)	5.0 (4.3)	13 psig (90 kPa)	20 psig (138 kPa)
3.5 (3.0)		4.0 (3.4)	20 psig (138 kPa)	30 psig (207 kPa)	
1 in. Sweat Only	7.0 (6.0)	7.0 (6.0)	10 psig (69 kPa)	15 psig (103 kPa)	
1 in. Threaded Only, and 1-1/4 in. Sweat Only	7.0 (6.0)	7.5 (6.4)	15 psig (103 kPa)	25 psig (172 kPa)	
<b>Cycle Times</b>	<b>Power Stroke</b>	9 to 11 Seconds			
	<b>Spring Return</b>	4 to 5 Seconds			
<b>Leakage</b>	Bubble-Tight Shutoff				
<b>Materials</b>	<b>Body</b>	Forged Brass			
	<b>Stem</b>	Brass (Hard Chrome Plated)			
	<b>Base Plate and Bearing Plate</b>	Stainless Steel			
	<b>Actuator Housing</b>	Stainless Steel			
	<b>Actuator Cover</b>	Aluminum			
	<b>Valve Operating Paddle</b>	Standard Temperature Models: Buna-N Rubber High Temperature Models: Saturated Nitrile			
	<b>Stem Assembly O-Ring Seals</b>	Viton™			
<b>Agency Approvals</b>	cUL and UL Listed (File No. MH7186), cUL and UL Recognized (File No. MH25807), CE Mark Compliant				
<b>Electrical Requirements</b>	24 VAC, 60 Hz (6.5W), 7 VA or 120 VAC, 60 Hz (6.5W), 7 VA				
<b>Electrical Wiring</b>	18 in. (457 mm) Wire Leads				

\*Proper water treatment is recommended; refer to VDI 2035 Standard.

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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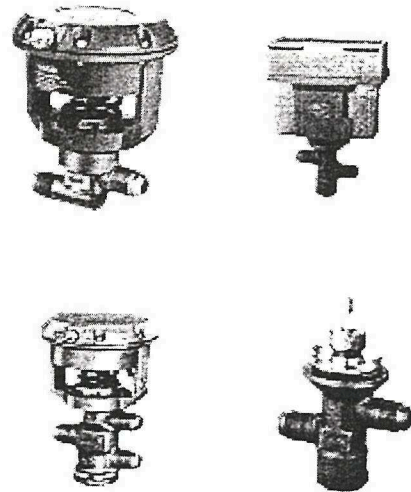
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## Flare Valves 1/2 inch 2-Way and 3-Way

The 1/2 inch flared valve line is designed to accurately regulate the flow of hot or cold water in small HVAC terminal units. These 1/2 inch valves are available with a factory installed V-3000-1 exposed type pneumatic actuator; enclosed actuators (V-3000-2) are also available (order separately). This valve style can be ordered for field mounting the VA-805X and M100 Series electric actuators. These electric actuators can also be ordered factory-assembled to the flare valves.



**Figure 1: 1/2 in. Flare Valves**

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>1/2 in. O.D. S.A.E. 45° Flare Connections</b>	No solder installation with copper tubing; easy removal for maintenance
<input type="checkbox"/> <b>Uses Standard Johnson Controls Non-adjustable Ring Pack Packings</b>	Proven reliability and long life
<input type="checkbox"/> <b>Body Rated 400 psig Static Pressure</b>	Not restricted to building location
<input type="checkbox"/> <b>Every Valve Tested for Tight Initial and Long Term Shutoff</b>	Assures occupant comfort and energy conservation
<input type="checkbox"/> <b>Factory Assembled Valves Available with Pneumatic or Electric Actuators</b>	Fast, simple installation minimizing job site time

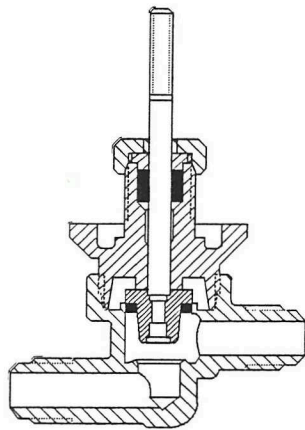
## Application Overview

The 1/2 inch flared connection valve line is designed to accurately regulate the flow of hot or cold water in small HVAC terminal units. The V-3766, V-3966 and V-4332 1/2 inch valves are available with a factory installed V-3000-1 exposed type pneumatic actuator; enclosed actuators (V-3000-2) are also available (order separately).

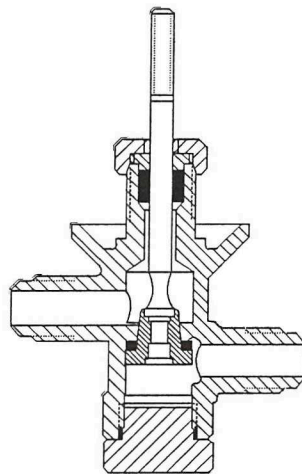
The VB-3766, VB-3966 and VB-4322 1/2 inch valve bodies are available with or without a factory coupled VA-805X Electric Actuator or an M100 Series Electric Motor Actuator with Y20EBD-X Linkage Kit.

The valve and actuator provide a Push-Down-To-Close (PDTC) combination for Normally Open (N.O.) applications and a Push-Down-To-Open (PDTO) combination for Normally Closed (N.C.) applications.

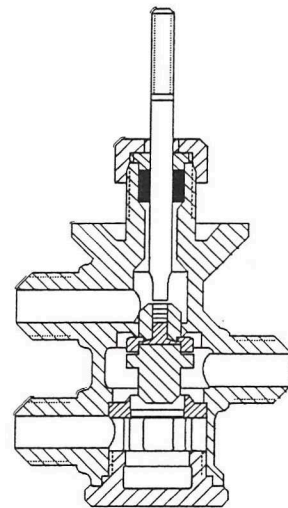
All valves contain a modulating plug, which provides an equal percentage relationship between valve travel and flow at a constant pressure drop. A molded composition disc that assures tight shutoff is bonded to the valve plug assembly and can be removed for servicing.



Normally Open (N.O.)\*  
PDTC



Normally Closed (N.C.)\*  
PDTO



Three Way Mixing (MX)

\*With V-3000-1 Pneumatic Actuator

Figure 2: Internal Views of the Flare Valve Body

**Table 1: Ordering Data Pneumatically Actuated 1/2 in. Valves with Flared Connections**

Valve Body	Max. Cv	Style ①	Rangeability*	Valve Suffix (Max. Closeoff Pressure psi) ②		
				V-3000-1 Actuator		
				Spring Ranges (psi)		
				3 to 6	4 to 8	9 to 13
V-3766	1.0	N.O.	7:1	-1001 (345)	–	–
	1.7	N.O.	12:1	-1002 (345)	–	–
	3.2	N.O.	23:1	-1003 (345)	–	–
V-3966	1.7	N.C.	12:1	–	–	-1001 (240)
	3.2	N.C.	23:1	–	–	-1002 (240)
V-4332	1.2	MX	7:1	–	-1007 (240/240)	-1004 (240/240)
	2.0	MX	12:1	–	-1009 (240/240)	-1006 (240/240)

\* Rangeability is defined as the ratio of maximum flow to minimum controllable flow.

① N.O. = Normally Open

N.C. = Normally Closed

MX = Mixing Valve, Max. Closeoff Pressure (N.C. port/N.O. port)

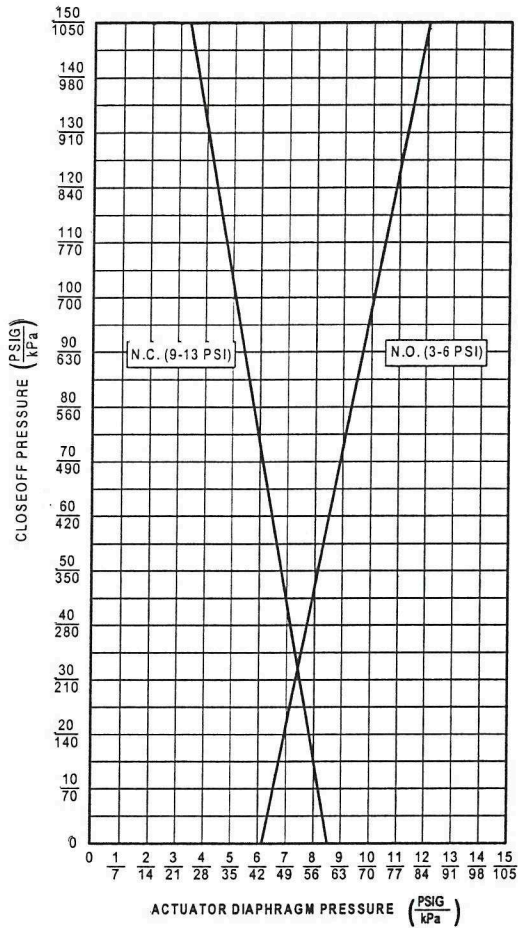
② Max. closeoff pressures listed are for 20 psi supply pressure to diaphragm for normally open and 0 psi supply pressure to diaphragm for normally closed.

**Table 2: Ordering Data--Electric Actuators**

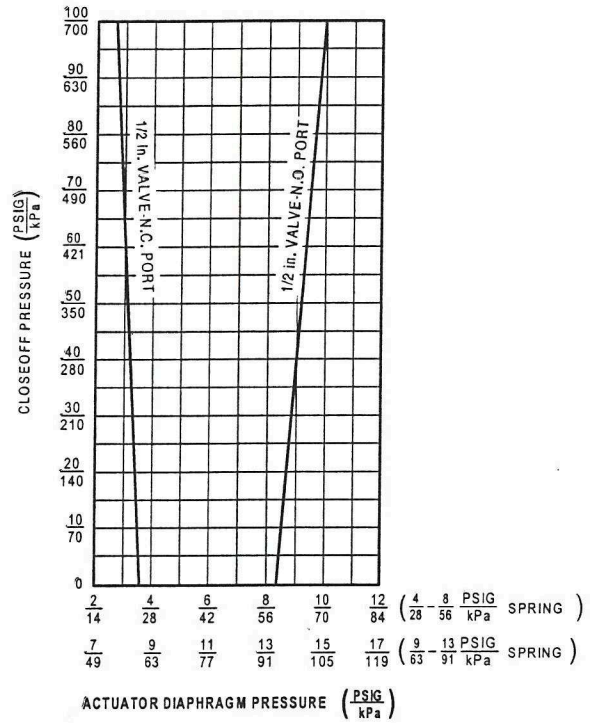
Valve Body	Style	Max. Cv	Rangeability	Assembly Order Code No. (Max. Shutoff Pressure)			M100 Series ① (Max. Shutoff Pressure)	
				VA-8050	VA-8051	VA-8052	M110 Y20EBD-5	M120/M130 Y20EBD-1
VB-3766-1	PDTC	1.0	7:1	AV-8050-1007 (150 psi)	AV-8051-1007 (150 psi)	–	① (140 psi)	① (150 psi)
VB-3766-2	PDTC	1.7	12:1	AV-8050-1008 (150 psi)	AV-8051-1008 (150 psi)	–	① (140 psi)	① (150 psi)
VB-3766-3	PDTC	3.2	23:1	AV-8050-1009 (150 psi)	AV-8051-1009 (150 psi)	–	① (140 psi)	① (150 psi)
VB-3966-1	PDTO	1.7	12:1	–	–	AV-8052-1024 (150 psi)	① (150 psi)	① (150 psi)
VB-3966-2	PDTO	3.2	23:1	–	–	AV-8052-1025 (150 psi)	① (150 psi)	① (150 psi)
VB-4332-4	MIX	1.2	7:1	AV-8050-1016 (100 psi)	AV-8051-1016 (100 psi)	AV-8052-1016 (100 psi)	① (100 psi)	① (100 psi)
VB-4332-5	MIX	2.0	12:1	AV-8050-1017 (100 psi)	AV-8051-1017 (100 psi)	AV-8052-1017 (100 psi)	① (100 psi)	① (100 psi)

① See Table 5 for M100 Assembly order procedure.

# Spring Shift Tables for 1/2 in. Flare Valves



**Figure 3: Closeoff Pressures Two Way Normally Open (V-3766) or Normally Closed (V-3966) with V-3000-1 Pneumatic Actuator**



**Figure 4: Closeoff Pressures Three Way (V-4332) with V-3000-1 Pneumatic Actuator**

## Valve Actuator Selection

### V-3000 Series Pneumatic Actuators

Two models of V-3000 Series Pneumatic Actuators are available. The exposed model (V-3000-1) is designed for installation in a protected location. The enclosed model (V-3000-2) is available separately and is designed for installation in a location where the actuator might be subjected to tampering. See Table 1 for actuator sizing selection. A V-9502 Series Valve Positioner can be ordered separately for use on the exposed model in applications where sequential operation is desired or additional positioning power is necessary. The V-9502 Pneumatic Valve Actuator Positioner is a precision relay device designed to operate a valve actuator in applications requiring stable, accurate control. The positioner provides maximum positioning power to resist external forces, which might otherwise overcome the actuator. Refer to Table 6 for ordering information.

Both models of the V-3000 have a molded synthetic elastomer diaphragm design. This molded diaphragm provides a constant effective area throughout the valve stem stroke. All parts are protected by a sturdy die cast aluminum housing. The actuator assembly can be removed or repositioned by loosening a single set screw without disturbing the rest of the valve assembly.

### VA-8050, VA-8051, and VA-8052 Series Electric Actuators

The VA-8050-1, VA-8051-1, and VA-8052-1 Series Electric Actuators are synchronous motor-driven, non-spring return actuators that feature a force sensing mechanism that assures a constant 50 pound seating force. The VA-8050-1 accepts floating control and requires a 3-wire, 24 VAC control signal from a controller. The VA-8051-1 accepts floating/incremental or proportional control with either a 3-wire, 24 VAC control signal or a +/- VDC signal from a DSC-8500. For DSC-8500 applications, a VA-8000-104 Auxiliary Interface Board (ordered separately, see Table 6) is required. The VA-8051-1 includes a 3400 ohm position feedback potentiometer for remote position indication to meters or as a position feedback to a DSC-8500. The VA-8052-1 provides proportional control and requires a 2-wire, 0 to 10 VDC control signal and 24 VAC power.

### Valve Body Types for Electric Actuators

For floating/incremental signal non-spring return, actuators VA-8050 and VA-8051, the push down to close (VB-3766-1) body type meets the needs of any HVAC application. Because of this, push down to open (V-3966-1) type is not available with these actuators.

For the VA-8052 proportional actuator, a push down to open body type is available to suit heating only control applications.

### M100 Electric Actuators

M100 Series Electric Actuators are rotary actuators which, coupled with a Y20EBD-X linkage kit can be mounted on a flare valve. The actuator can be adjusted for the desired closeoff pressure on the valve (see Table 3).

**Table 3: M100 Electric Actuator Models**

Actuator	Type	Linkage	Valve
M110 ①	Spring Return	Y20EBD-5	VB-3XXX-
M120 ①	Non Spring Return	Y20EBD-1	VB-3XXX-
M130 ①	Spring Return	Y20EBD-1	VB-3XXX-
VA-8050	Non Spring Return	None Required	VB-3XXX-
VA-8051	Non Spring Return	None Required	VB-3XXX-
VA-8052	Non Spring Return	None Required	VB-3XXX-

① Refer to separate *M100 Product Bulletin* for complete options available.

The M120 is a non-spring return actuator which will hold its position when de-energized. The M110 and M130 are spring return actuators which will return the valve to its normal operating position when de-energized.

The actuator can be mounted for stem up or stem down operation, push down to close, push down to open, pull up to close, or pull up to open. On 3-way valves, the seating force can be applied on both the up and the down stroke.

Through selection of plug-in electronic boards, the M100 Series actuator is compatible with all Johnson Controls controllers and can provide proportional action on-off (floating), potentiometer, and Metasys® as well as control by direct digital input from C500 or Metasys Zone Bus controllers. The M100 Series actuator requires 25 VA from a 24 VAC, 50/60 Hz power supply.

Factory assembly of M100 Series actuators to flare valves is available using Q99 ordering codes as follows:

**Table 4: Q99 Ordering Codes**

Code	Valve Body Example ①	Valve Type
Q99ADN-1	VB-3766	2-Way Valves, Stem Down
Q99ADN-3	VB-4332	3-Way Valves, Stem Down
Q99AUP-1	VB-3766	2-Way Valves, Stem Up
Q99AUP-3	VB-4332	3-Way Valves, Stem Up

① Any valve body listed in Table 2 can be selected.

Example of factory ordering procedure (order must be given in this sequence for factory to assemble it):

**Table 5: Factory Ordering Procedure**

Item	Description	Code Number
1	Valve Body	VB-3766-1
2	M100 Actuator	M110AAB-1
3	Linkage	Y20EBD-5
4	Assembly Code	Q99ADN-1

**Table 6: Accessories (Order Separately)**

Description	Code Number
Enclosed V-3000 Actuator for Field Mounting	V-3000-2
Valve Position Indicator for V-3000-1 Exposed Style Pneumatically Actuated Valves	V-3000-10
Valve Position Indicator for Electrically Actuated Valves with VA-805X Actuators only	VA-8000-102
Auxiliary Interface Board for Use with Electrically Actuated Valves Used in Conjunction with a DSC-8500	VA-8000-104
Valve Positioner for Field Mounting to a V-3000-1 Exposed Style Pneumatically Actuated Valve	V-9502-15
Valve Positioner Spring for V-3000-1 Exposed Style Pneumatically Actuated Valves Using a V-9502-15 Positioner	
Span	
3.0 psi (21 kPa)	V-9502-20
4.3 psi (30 kPa)	V-9502-101
8.0 psi (56 kPa)	V-9502-19

## Operation

### V-3000-1 or -2

Air pressure from a pneumatic controller is applied to the diaphragm of the actuator, which moves the piston against the forces of the internal spring and the fluids. The piston will move the valve plugs to a position where the diaphragm pressure and the spring force balance against the fluid forces.

These fluid forces will cause the operating range to shift from the nominal spring range. Reducing the air pressure to the diaphragm of the actuator allows the spring to return the valve plug to its normal position.

### VA-8050-1 and VA-8051-1 Actuated Valves

The VA-8050-1 and VA-8051-1 actuated valves operate on a 24 VAC control signal from a compatible controller. Recommended system controllers for the VA-8050-1 include Metasys, the DSC-8500, and the C210 Digital Controller. Recommended system controllers for the VA-8051-1 include the DSC-8500 and the C210 Digital Controller.

The controller sends a 24 VAC signal to the up or down terminal on the circuit board depending on the desired movement of the valve. This signal causes the motor to rotate in the proper direction and, through the lead screw and lever, move the valve stem and plug assembly up or down. When the controller stops sending a signal, the valve stem and plug assembly remains in place.

When the controller closes the valve, a shutoff force will build up. When this force reaches 50 pounds, the lever activates a force sensor which stops the motor. Field calibration of the force sensor is not required. The actuator maintains the shutoff force even if power to the controller is lost.

When the controller signals the valve to move in the opposite direction, the shutoff force will be reduced and the valve will modulate.

On VA-8051-1 actuated valves, an internal position feedback potentiometer is connected to the R, W, and S terminals. Specifically, the wiper is connected to W. The wiper will be at the R end when the actuator is retracted and at the S end when the actuator is fully stroked.

### VA-8052-1 Actuated Valves

The VA-8052-1 actuated valve operates on 24 VAC power and a 0 to 10 VDC control signal from a compatible controller. Recommended system controllers include the Metasys C210 Digital Controller and the DSC-8500.

The controller sends a voltage signal (typically 0 to 10 VDC) to the COM (common) and IN (input) terminals on the actuator circuit board, depending on the desired position of the valve. This signal is compared to the actual valve position via the integral feedback potentiometer. The internal circuit then causes the motor to rotate in the proper direction and, via the lead screw and lever, move the valve stem and plug assembly to the position called for by the input signal.

When the controller closes the valve, a shutoff force builds up. When this force reaches 50 pounds, the lever activates a force sensor, which stops the motor. Field calibration of the force sensor is not required. The actuator maintains the shutoff force even if power to the controller is lost. When the controller signals the valve to move in the opposite direction, the shutoff force is reduced and the valve modulates.

### M100 Series Actuated Valves

The M100 Series actuated valve operates on 24 volts AC and is available with On-Off/floating control action or proportional control action. The actuator is spring return to normal position on loss of power. The M100 Series is Metasys compatible and will work with any Johnson Controls controller.

The controller sends a signal to the actuator dependent on the desired movement of the valve. This signal causes the motor to rotate in the proper direction and, through the rack and pinion, drive the valve stem and plug assembly up or down. When the controller stops sending a signal, the valve stem and plug assembly remains in place. When the controller closes the valve, it applies the set spring load to the valve stem at the actuator's end of travel. On 3-way valves, the preset spring load is applied at both ends of travel. On loss of power, the actuator will return to its normal position and apply the set load to the valve stem in that position.

## Installation

It is recommended that these valves be mounted in an upright position in a conveniently accessible location. Sufficient clearance must be allowed for actuator and trim removal. These valves must be piped with the flow in the direction indicated by the arrow so that the plug seats against the flow.

On electrically actuated valve assemblies, all wiring must be in accordance with applicable electrical code requirements. Input lines to the actuator must be wired correctly for the valve to move in the proper direction. When used with V-3000 pneumatic actuators, field adjustments for accurate sequencing with other valves can be made to "fine tune" the actuator. Turning the actuator lower spring seat will compress or extend the spring to change the setting of the valve. Turning the lower spring seat counterclockwise (looking down on the actuator) will raise the diaphragm pressure required to start to move the valve; clockwise will lower this setting. Table 7 gives the adjustment ratio for V-3000 actuators used on flare valves.

**Table 7: Spring Adjustment Ratios**

Valve	Actuator	Spring Size, psi ①	Adjustment Ratio ②
Flare	V-3000	3-6	0.53
	V-3000	4-8	0.71
	V-3000	9-13	0.71

① The spring range is specified by the diaphragm pressure at the top of the stroke and the bottom of the stroke.

② The Adjustment Ratio is given as changes in diaphragm pressure (psig) per turn of the lower spring seat.



# Dimensions for Pneumatically Actuated 1/2 inch Flare Valves

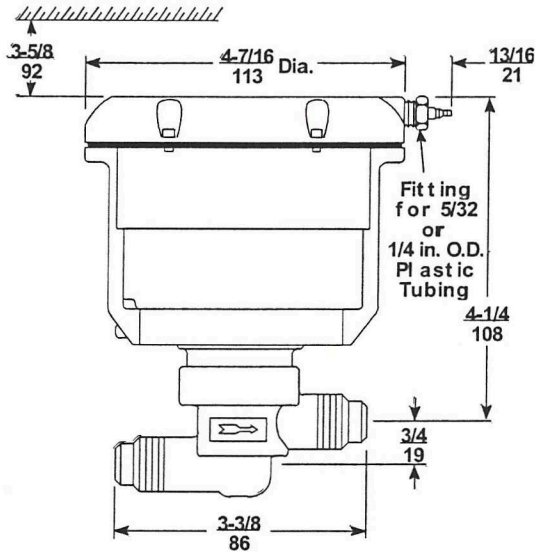


Figure 5: Two Way N.O. with V-3000-1 V-3766

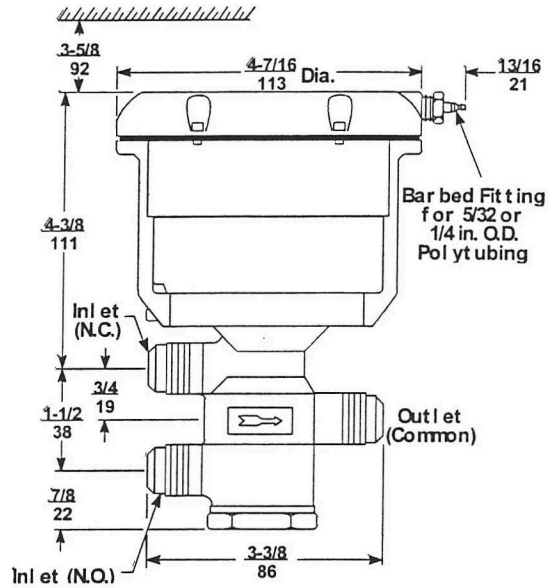


Figure 7: V-4324 Three Way Mixing with V-3000-1 Pneumatic Actuator

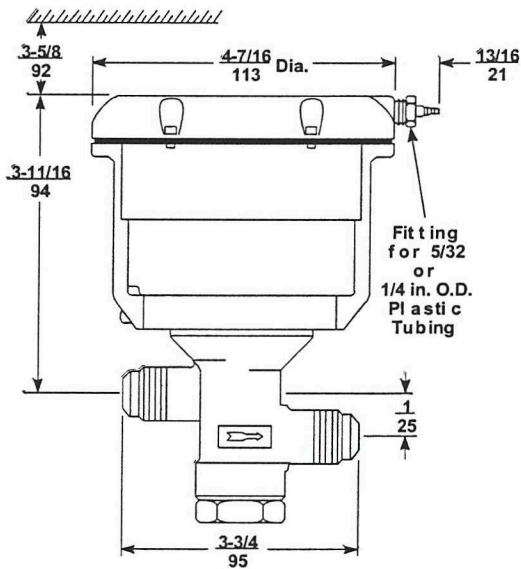


Figure 6: Two Way N.C. with V3000-1 V-3966

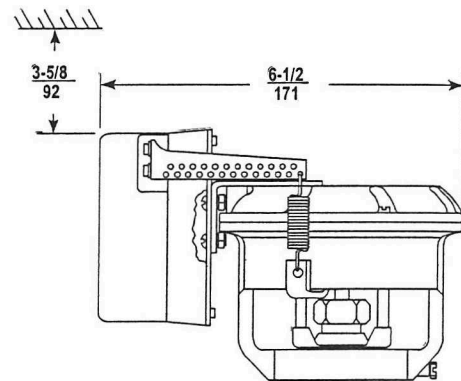


Figure 8: V-9502-1 Pneumatic Positioner

# Dimensions for 1/2 inch Flare Valves with Electric Actuators

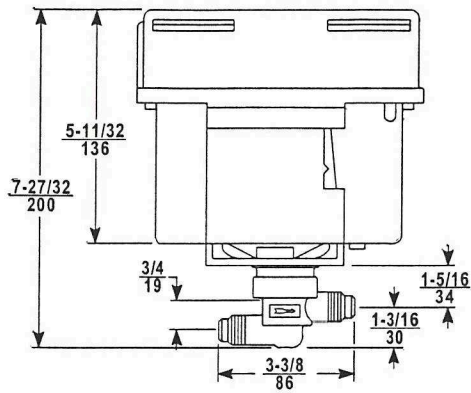


Figure 9: Two Way PDTC with VA-805X AV-805X

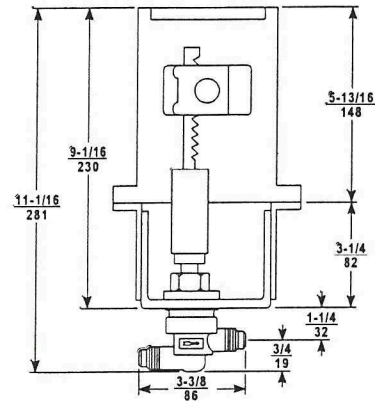


Figure 12: Two Way PDTC with M100 Series Electric Actuator

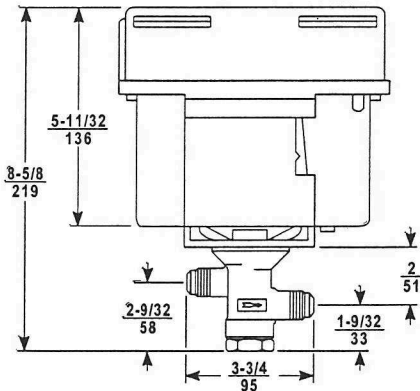


Figure 10: Two Way PDTO with VA-805X AV-805X

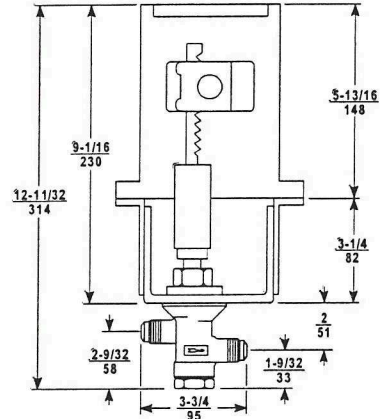


Figure 13: Two Way PDTO with M100 Series Electric Actuator

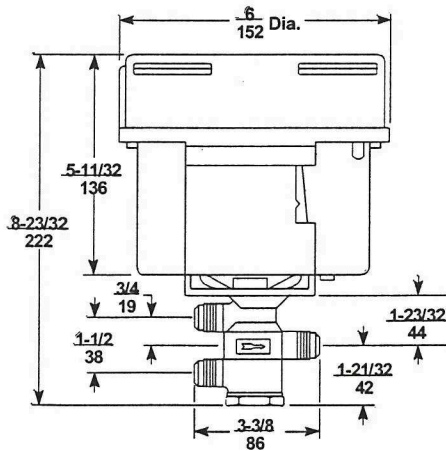


Figure 11: AV-805X Three Way Mixing with VA-805X Electric Actuator

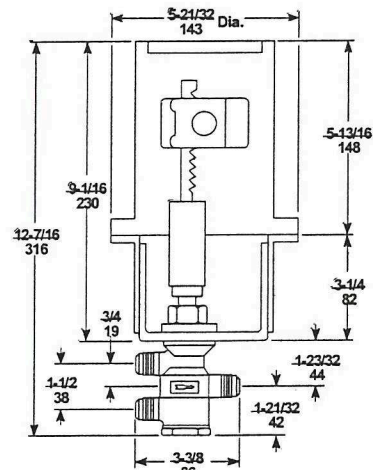
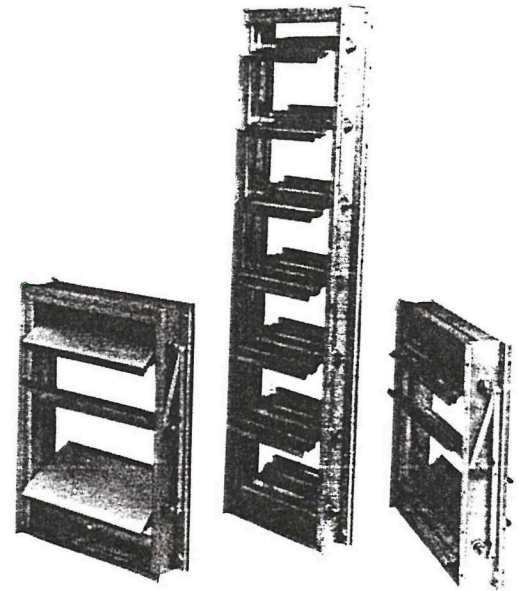


Figure 14: Three Way Mixing with M100 Series Electric Actuator

## CD-1300 Control Dampers Class I, II, and III Leakage Resistance

*Johnson Controls provides top quality control dampers that fit your size and application requirements.*

- *Class I leakage resistance*  
**CD-1330 Airfoil**  
*(high performance) blades*
- *Class II leakage resistance*  
**CD-1320 Double-piece**  
*(performance) blades*
- *Class III leakage resistance*  
**CD-1310 16-gauge**  
*(standard value) blades*



**Figure 1: CD-1300 Damper Family**

### Features and Benefits

<input type="checkbox"/> <b>Tested to Over 100,000 Cycles</b>	Assures long damper life
<input type="checkbox"/> <b>Three-Year Warranty on Materials and Workmanship</b>	Provides confidence of company standing behind product
<input type="checkbox"/> <b>Self-compensating, Stainless Steel Side Seals</b>	Minimizes leakage between the blades and the damper frame
<input type="checkbox"/> <b>Blade Rotation Stop</b>	Prevents over-rotation of blades in fully open position
<input type="checkbox"/> <b>Square Blade Pins</b>	Provides non-slip pivoting of the blade
<input type="checkbox"/> <b>Five Working Day Standard Shipping</b>	Results in fast response for short lead time projects
<input type="checkbox"/> <b>One Working Day Fast Track Shipping Available</b>	Fast Track provided at a cost premium

## Applications

CD-1300 dampers come in three leakage resistance classes to meet different application and environmental requirements. These applications include but are not limited to:

- volume (air) control applications, which regulate air flow
- temperature control applications, which maintain a constant temperature
- pressure control applications, which maintain a constant pressure

## Sample Specifications

Furnish and install Johnson Controls CD-1300 Series Control Dampers.

Damper frames are to be constructed of formed 13-gauge galvanized sheet steel, mechanically joined with linkage concealed in the side channel to eliminate noise and friction. Compressible spring stainless steel side seals and self-lubricating bearings shall also be provided.

Damper blade width shall not exceed 8 inches and shall be provided with seals. Blade rotation is to be parallel or opposed as shown on the schedules.

Damper performance shall be tested in accordance with AMCA Standard 500 and specified as follows:

- CD-1330 dampers with seals for Class I leakage resistance in applications requiring very tight closure and high velocities
- CD-1320 dampers with seals for Class II leakage resistance in applications requiring tight closure with less velocity such as outdoor air
- CD-1310 dampers with seals for Class III leakage resistance in applications where tight closure is not required such as return air applications, and not outdoor air applications

Damper sealing force at 4 inches differential shall not exceed 6 inch-pounds per square foot. The damper must be rated to operate over a temperature range of -40°F to 200°F (-40°C to 93°C) standard.

Damper sizing shall be by the designer in accordance with accepted industry practices to ensure proper system performance. Blank off plates and duct-to-damper transitions may be required.

**Table 1: Leakage Resistance Classes**

Class	Static Pressure (inches water)			
	1	4	8	12
I	4	8	11	14
II	10	20	28	35
III	40	80	112	140

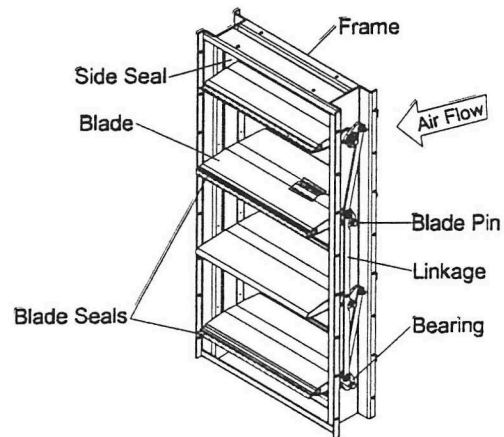
Leakage in cfm/sq ft ( $m^3/s/m^2 \times 196$ )

## Construction

**Table 2: Materials**

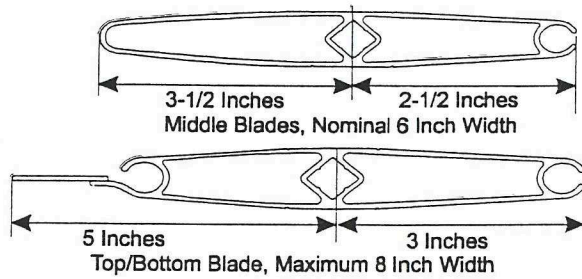
<b>Frame</b>	13-gauge galvanized steel
<b>Blades</b>	CD-1310: 16-gauge galvanized steel CD-1320: Double layer of 22-gauge galvanized steel, mechanically joined CD-1330: 1/16-inch aluminum in airfoil shape All blades are 6 inch nominal width and 8 inch maximum width.
<b>Linkage</b>	1/8 inch rolled steel, zinc plated
<b>Blade Pin</b>	3/8 inch square steel, zinc plated
<b>Blade Pin Extension</b>	1/2 inch diameter, 7 inch long
<b>Bearings</b>	Included with all control dampers
<b>Bearings</b>	Self-lubricating acetal or Self-lubricating bronze
<b>Blade Seal</b>	CD-1310: santoprene CD-1320: santoprene or silicone CD-1330: santoprene
<b>Side Seals</b>	Self-compensating stainless steel

## Components



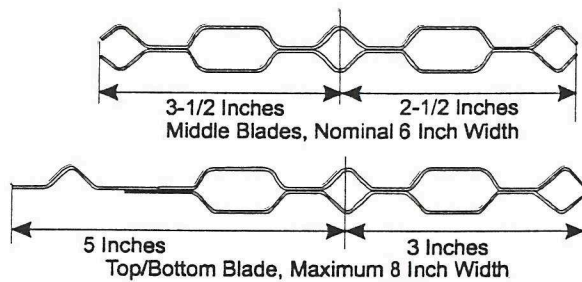
**Figure 2: Damper Components**

Each frame is made of galvanized sheet steel, formed into channels, and mechanically joined for maximum strength. The modular design of the frames means that they can be quickly and easily coupled in the field.



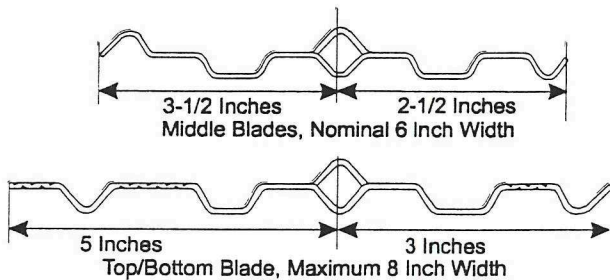
**Figure 3: Airfoil Blade Profile**

Airfoil blades are made from nominal 1/16 inch extruded aluminum in an airfoil shape for high performance. Blade and side seals are standard.



**Figure 4: Double-Piece Blade Profile**

Double-piece blades are made from two layers of 22-gauge rolled sheet metal, mechanically joined for strength. Blade and side seals are standard.



**Figure 5: 16-Gauge Blade Profile**

16-gauge blades are made from rolled 16-gauge galvanized steel. Blade and side seals are standard.

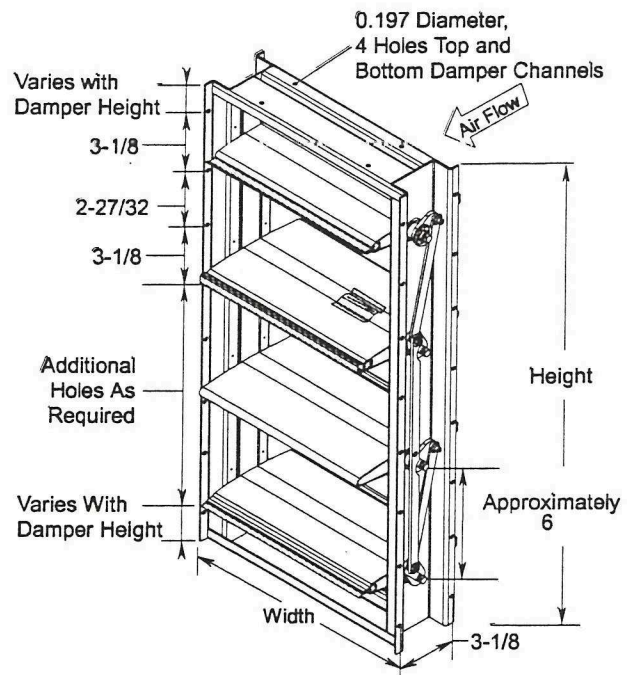
The top and bottom blades may be up to 8 inches in width with up to 2 inch extensions on one side of each blade as shown in Figures 3, 4, and 5.

Note: All dimensions are nominal.

## Maintenance

Johnson Controls CD-1300 dampers have no components that require routine scheduled maintenance.

## Dimensional Data



**Figure 6: Mounting Dimensions, in.**

**Table 3: Single-Panel Size Limits**

<b>Width of Single Panel</b>	All: 8 to 48 in.
<b>Height of Single Panel</b>	CD-1310: 6 to 76 in. CD-1320: 6 to 76 in. CD-1330: 7 to 76 in.
<b>Size Increment</b>	All: 1 in.

Note: All Johnson Controls height and width dimensions are from the outside edges of the frame.

## Ordering Information

- Determine required size and type of damper.
  - Select the features from *Table 4: Damper System Building Blocks* that match the operation and performance required.
  - Enter width and height of damper.
- Note: To find actual damper size, multiply the nominal size by 0.99479.
- Enter options required.

**Table 4: Damper System Building Blocks**

C	Product Family	C = Control M = Multiple panel
O	Blade Operation	O = Opposed P = Parallel
A	Blade Type	A = Airfoil P = Double-Piece V = 16-gauge
B	Bearing Type	A = Acetal B = Bronze
S	Seal Type	H = Silicone (CD-1320 only) S = Santoprene
w w 0	Width Dimensions	See Table 3 for limitations.
h h 0	Height Dimensions	See Table 3 for limitations.
	Options (limit two)	See Tables 5 or 6 for descriptions and combinations.

C	O	A	B	S	-	w	w	w	x	h	h	h	-	-	Ordering Code Number
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	----------------------

### Standard Control Dampers (Product Family "C"):

Control dampers can be ordered to a maximum of 96 inches wide and 76 inches high. These dampers are shipped as separate panels a maximum of 48 inches wide and 76 inches high, and include pin-to-pin coupling kit DMPR-KC202.

**IMPORTANT:** The third digit in the width and height blocks will always be a zero.

### Multiple Panels (Product Family "M"):

These dampers will be shipped as separate panels, maximum of 48 inches wide and 76 inches high.

Each individual panel will be identified for assembly in the field.

Ordering size limits are 192 inches wide and 228 inches high.

**IMPORTANT:** All three width and height digits will be used for specifying size.

The following kits will be provided but will not be factory assembled:

Jackshafts (DMPR-KC205 two-panel, DMPR-KC206 three-panel) will be provided for dampers greater than 48 inches wide and 11 inches high (minimum of two blades).

Vertical Coupling (DMPR-KC100) will be provided for dampers greater than 76 inches high.

Support Bar (DMPR-KC200) will be provided for extra support at internal junctions of four panels.

# Options

**Table 5: Standard Control Dampers**

Code	Option Description
A	Field-installed jackshaft
B	Left side linkage (when facing air leaving side)
C	Dual linkage
F	1.5 inch L flange, entering side
G	1.5 inch L flange, leaving side
H	12 inch wide side plate

**Option Combinations**

	A	B	C	F	G	H
A		x	x	x	x	x
B	x			x	x	x
C	x			x	x	x
F	x	x	x			
G	x	x	x			
H	x	x	x			

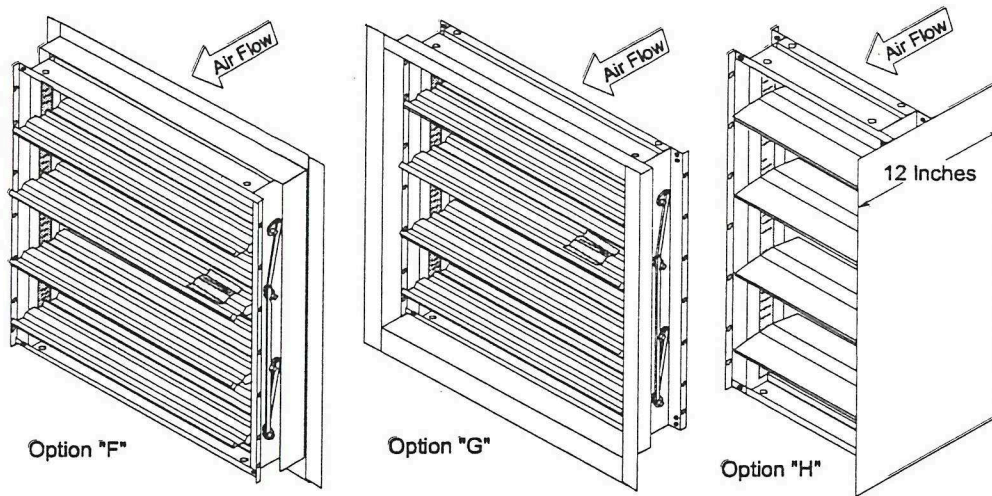
**Table 6: Multiple Panel Control Dampers**

Code	Option Description
B	Left side linkage (when facing air leaving side)
C	Dual linkage

**Option Combinations**

	B	C
B		
C		

Notes: Limit of two factory-installed options.  
Standard assembly includes right side linkage when facing air leaving side.



**Figure 7: Factory-Installed Flange Options**

# Replacement Parts

**Table 7: Replacement Seals**

Description	Number	Description	Number
Blade Seal, standard temp, double-piece and airfoil middle, parallel	DMPR-RC001	Blade Seal, standard temp, 16-gauge after 06/96, double-piece and airfoil top/bottom with extensions	DMPR-RC006
Blade Seal, standard temp, double-piece and airfoil middle, opposed	DMPR-RC002	Blade Seal, high temp, double-piece middle, opposed	DMPR-RC051
Blade Seal, standard temp, 16-gauge prior to 06/96	DMPR-RC003	Blade Seal, high temp, double-piece middle, parallel	DMPR-RC052
Blade Seal, standard temp, airfoil with extension	DMPR-RC004	Blade Seal, high temp, double-piece top/bottom	DMPR-RC053
Blade Seal, standard temp, double-piece top/bottom	DMPR-RC005	Blade Seal, high temp, double-piece top/bottom with extensions	DMPR-RC054

Note: The length of all replacement blade seals will fit a single blade in a 48 inch wide panel.

# Accessories

**Table 8: Typical Accessory Kits**

Description	Kit Number	Description	Kit Number
Blade Pin Extension Support Bracket	DMPR-KC001	Horizontal Blade-to-Blade Bracket	DMPR-KC151
3-1/4 inch Blade Pin Extension	DMPR-KC002	90° Blade-to-Blade Linkage	DMPR-KC152
7 inch Blade Pin Extension	DMPR-KC003	Support Bar	DMPR-KC200
15 inch Blade Pin Extension	DMPR-KC004	Damper Fastener	DMPR-KC201
Blade Pin Extension with Coupler	DMPR-KC005	Pin-to-Pin Coupling	DMPR-KC202
Blade Pin Extension Coupler	DMPR-KC006	Drive Arm and U-bolt	DMPR-KC203
Crank Arm, 7/16 inch shaft, adjustable 1 to 2-3/4 inch radius	DMPR-KC050	One-Panel Jackshaft	DMPR-KC204
Blade Arm	DMPR-KC054	Two-Panel Jackshaft	DMPR-KC205
Internal Vertical Blade-to-Blade Linkage	DMPR-KC100	Three-Panel Jackshaft	DMPR-KC206
External Vertical Pin-to-Pin Linkage	DMPR-KC101	Manual Locking Quadrant	DMPR-KC250
Linkage Rod, 4 feet	DMPR-KC102	Universal Mounting Bracket	DMPR-KC251
Horizontal Face/Bypass Bracket	DMPR-KC150	Collar	DMPR-KC252

Note: A Blade Pin Extension is standard with all control dampers. Additional blade pin extensions without brackets are ordered using DMPR-KC003.

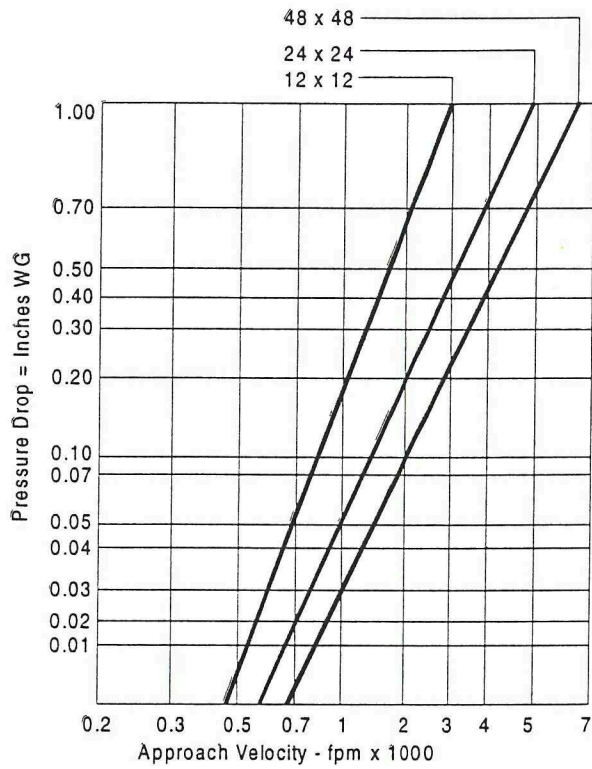
# Weight

**Table 9: Approximate Weights (does not include packaging), lb (kg)**

Height, in.	Width, in.						
	12	18	24	30	36	42	48
6	5 (2.3)	8 (3.7)	9 (4.1)	11 (5.0)	13 (5.9)	15 (6.8)	17 (7.7)
12	9 (4.1)	12 (5.4)	13 (5.9)	15 (6.8)	17 (7.7)	19 (8.6)	21 (9.5)
18	13 (5.9)	16 (7.3)	18 (8.2)	20 (9.1)	22 (10)	24 (11)	31 (14)
24	15 (6.8)	18 (8.2)	23 (10)	28 (13)	32 (15)	35 (16)	40 (18)
30	16 (7.3)	20 (9.1)	27 (12)	33 (15)	39 (18)	45 (20)	52 (24)
36	18 (8.2)	24 (11)	32 (15)	40 (18)	46 (21)	53 (24)	60 (27)
42	21 (9.5)	30 (14)	36 (16)	44 (20)	50 (23)	58 (26)	65 (30)
48	29 (13)	35 (16)	42 (19)	50 (23)	57 (26)	65 (30)	72 (33)
54	32 (15)	39 (18)	45 (20)	53 (24)	63 (29)	71 (32)	81 (37)
60	35 (16)	42 (19)	48 (22)	56 (25)	66 (30)	74 (34)	90 (41)
66	38 (17)	45 (20)	51 (23)	59 (27)	69 (31)	77 (35)	99 (45)
72	41 (19)	48 (22)	54 (25)	63 (29)	72 (33)	84 (38)	103 (47)
76	45 (20)	55 (25)	65 (29)	76 (35)	86 (39)	97 (44)	108 (50)

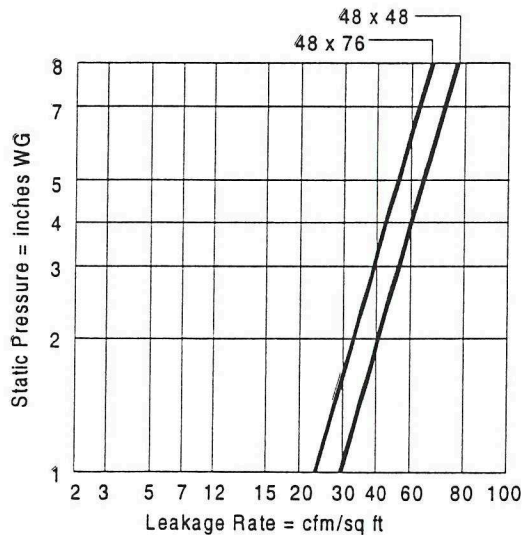


# Technical Data

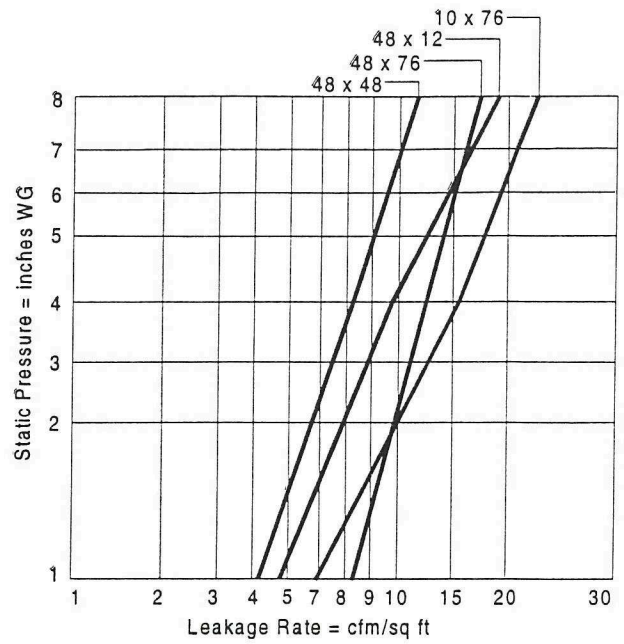


**Figure 8: Pressure Drop Curve - Fully Open**

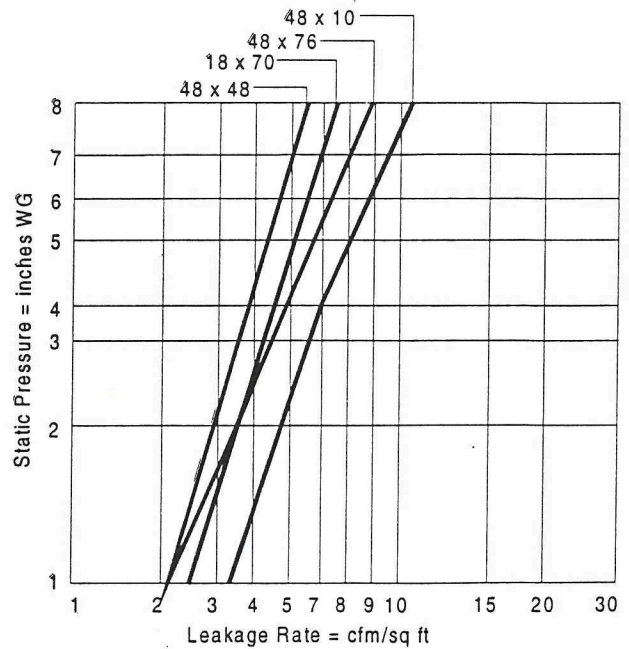
Note: The pressure drop is the same for all models.



**Figure 9: CD-1310 Leakage Resistance**



**Figure 10: CD-1320 Leakage Resistance**



**Figure 11: CD-1330 Leakage Resistance**

The graphs show resultant air leakage through the damper, corrected to standard temperature and pressure conditions, as determined using instrumentation and procedures in accordance with AMCA Standard for Test Methods for Louvers, Dampers, and Shutters No. 500.

# Specifications

<b>Product</b>	M9104 Series Electric Motor Actuator	
<b>Power Requirements</b>	Floating:	20 to 30 VAC at 50/60 Hz; 3.4 VA supply, minimum; Class 2
	Proportional:	20 to 30 VAC at 50/60 Hz; 5.0 VA supply, minimum; Class 2
<b>Input Signal</b>	Floating:	20 to 30 VAC at 50/60 Hz
	Proportional:	0 to 10 VDC or 0 to 20 mA
<b>Input Signal Adjustments</b>	Floating:	CW and COM Terminals, CW rotation; CCW and COM Terminals, CCW rotation
	Proportional:	Voltage Input or Current Input
	Jumper-selectable:	0 (2) to 10 VDC or 0 (4) to 20 mA
	Factory Setting:	0 to 10 VDC, CW rotation with signal increase
	Proportional:	Action is Direct (CW) or Reverse (CCW) with signal increase (jumper-selectable).
<b>Input Impedance</b>	Floating:	250 ohms, nominal
	Proportional:	Voltage Input, 150,000 ohms; Current Input, 500 ohms
<b>Feedback Signal</b>	Proportional:	0 to 10 VDC or 2 to 10 VDC for 90° (1 mA at 10 VDC) (Corresponds to input signal span selection.)
<b>Switch Contact Rating</b>	Two SPDT (Single-Pole, Double-Throw) rated at 24 VAC 1.5A inductive, 3A resistive, 35 VA maximum per switch	
<b>Electrical Connections</b>	1/4 in. spade terminals (optional Pluggable Terminal Blocks)	
<b>Mechanical Connection</b>	3/8 to 1/2 in. (10 to 12.7 mm) round shaft or 3/8 in. (10 mm) square shaft	
<b>Enclosure</b>	NEMA 2, IP32	
<b>Torque</b>	Running:	35 lb-in (4 N·m)
	Breakaway:	35 lb-in (4 N·m) minimum
	Stall:	40 lb-in (4.5 N·m) minimum
<b>Cycles</b>	100,000 full cycles, 2,500,000 repositions rated at 35 lb-in (4 N·m)	
<b>Audible Noise Rating</b>	35 dBA maximum at 1 m	
<b>Rotation</b>	Adjustable from 30 to 90°, CW or CCW	
<b>90 Degree Rotation Time</b>	Nominal 90 seconds at 60 Hz Nominal 108 seconds at 50 Hz	
<b>Ambient Operating Conditions</b>	-4 to 125°F (-20 to 52°C); 90% RH maximum, non-condensing	
<b>Ambient Storage Conditions</b>	-40 to 176°F (-40 to 80°C); 90% RH maximum, non-condensing	
<b>Dimensions (H x W x D)</b>	5.9 x 4.2 x 2.64 in. (150.1 x 106.5 x 67 mm)	
<b>Shipping Weight</b>	2.4 lb (1.08 kg)	
<b>Agency Compliance</b>	UL 873 Listed, File E27734, Guide XAPX CSA C22.2 No. 139, File LR85083, Class 3221 02 CE Directive 89/336/EEC	

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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**Table 8: Repair Kits**

Valve Code Number	Repair Kit Code Number	Description
V-3766 VB-3766	V-3754-6010*	Spring Kit, 3-6 psig, 1/2 in. stroke for V-3011, V-3020, V-3752, V-3755, V-4510, V-5250 (1-1/2 and 2), V-3754 (1/2 and 3/4), and V-3766 (1/2) Valve with V-3000-1 or V-3000-2 Actuator
V-3966 VB-3966	V-3754-6009*	Spring Kit, 9-13 psig, 1/2 in. stroke for V-3011, V-3020, V-3212, V-3752, V-3755, V-3970, V-4322 (1-1/2 and 2), V-3974, V-3966, V-6139 (1/2), V-3754, V-3974, V-4324 (1/2 and 3/4) Valve with V-3000-1 or V-3000-2 Actuator
V-4332 VB-4322	V-4332-6001*	Spring Kit, 4-8 psig, 5/16 in stroke for V-3212, V-3970, V-4322 (1/2 and 3/4), V-4332, V-4333 (1/2), V-4334 (5/8), and VT Valve with V-3000-1 or V-3000-2 Actuator
	V-3752-6022*	Spring Kit, 9-13 psig, 5/16 in. stroke for V-3011, V-3020, V-3212, V-3752, V-3755, V-3970, V-4322 (1/2 and 3/4), V-4334 (5/8), V-4332, V-4333, V-5416, V-7416 (1/2), V-6143 (3/8 and 3/4) and VT Valve with V-3000-1 or V-3000-2 Actuator
All Assemblies	V-9999-608**	Ring Pack Packing Kits: Single Pack
	V-9999-610**	10-Pack (Contains enough materials to repack 10 valves)
	V-9999-630***	50-Pack (Contains U-cups and O-rings only to repack 50 valves)

\* Spring kit contains: spring, upper and lower spring plate, stem extension, lock screw, and instructions.

\*\* Packing kit contains: O-rings, crocus cloth, assembly tool, gland nut liner, guide, extractor/installer, ring pack assembly, follower, grease and instructions.

\*\*\* Silicone grease is not included in this kit; order V-9999-606 separately.

Note: For actuator repair parts, refer to the appropriate actuator product bulletin.

**Table 9: List of Valid Flare Valve Code Numbers**

Pneumatic				
Valid Pneumatic Valve/Actuator Assembly Code Number	Spring Range	Cv	Style	
V-3766-1001	3-6	1.0	N.O.	
V-3766-1002	3-6	1.7		
V-3766-1003	3-6	3.2		
V-3966-1001	9-13	1.7	N.C.	
V-3966-1002	9-13	3.2		
V-4332-1004	9-13	1.2	MIX	
V-4332-1006	9-13	2.0		
V-4332-1007	4-8	1.2		
V-4332-1009	4-8	2.0		
VB-3766-1	None	1.0	PDTC	
VB-3766-2	None	1.7		
VB-3766-3	None	3.2		
VB-3966-1	None	1.7	PDTO	
VB-3966-2	None	3.2		
VB-4332-4	None	1.2	MIX	
VB-4332-5	None	2.0		
Electric				
Valid Actuator/Valve Factory-Assembly Code Number	Actuator	Valve	Cv	Valve Body Style
AV-8050-1007	VA-8050-1 Floating/incremental	VB-3766-1	1.0	Two-Way (Flared) (PDTC)
AV-8050-1008		VB-3766-2	1.7	
AV-8050-1009		VB-3766-3	3.2	
AV-8050-1016		VB-4332-4	1.2	Three-Way Mix (Flared)
AV-8050-1017		VB-4332-5	2.0	
AV-8051-1007	VA-8051-1 Floating/incremental feedback	VB-3766-1	1.0	Two-Way (Flared) (PDTC)
AV-8051-1008		VB-3766-2	1.7	
AV-8051-1009		VB-3766-3	3.2	
AV-8051-1016		VB-4332-4	1.2	Three-Way Mix (Flared)
AV-8051-1017		VB-4332-5	2.0	
AV-8052-1024	VA-8052-1 Proportional	VB-3966-1	1.7	Two-Way (Flared) (PDTO)
AV-8052-1025		VB-3966-2	3.2	
AV-8052-1016		VB-4332-4	1.2	Three-Way Mix (Flared)
AV-8052-1017		VB-4332-5	2.0	

# Specifications

Models	Pneumatic	Electric
See Tables 1 and 2 for ordering code numbers.	V-3766--PDTC (Normally Open)	VB-3766--PDTC
	V-3966--PDTO (Normally Closed)	VB-3996--PDTO
	V-4332--Three Way Mixing	VB-4332--Three Way Mixing
<b>Service</b>	Hot and Cold Water	
<b>Control Air Connection (Pneumatic Operation)</b>	1/8 in. NPT Barbed Fitting for 5/32 or 1/4 in. O.D. Polytubing	N/A
<b>Flow Characteristics</b>	Equal Percentage	
<b>Actuator Sizing/Max. Closeoff Pressure</b>	See Tables 1 and 2.	
<b>Valve Stem Diameter</b>	1/4 inch	
<b>Flow Coefficients (Cv)</b>	Two Way: 1.0, 1.7, 3.2; Three Way (Mixing): 1.2, 2.0. See Table 1 and 2.	
<b>Maximum Seat Leakage</b>	PDTC (N.O.) and PDTO (N.C.): 0.05% of Maximum Rated Valve Capacity Three Way Mixing: 0.5% of Maximum Rated Valve Capacity	
<b>Maximum Recommended Differential Pressure for Valve Sizing</b>	35 psi (245 kPa)	
<b>Rangeability</b>	See Table 1.	
<b>Valve Stroke</b>	5/16 in.	
<b>Maximum Allowable Pressure/Temperature</b>	(2-Way) V-3766, VB-3766, V-3966, VB-3966 400 psi (2800 kPa) up to 150°F (66°C) Decreasing to 345 psi (2415 kPa) at 281°F (140°C) (3-Way Mixing) V-4332 and VB-4332 250 psi (1750 kPa) Max. to 281°F (140°C)	
<b>Ambient Temperature Limit</b>	-10 to 150°F (-23 to 66°C)	-10 to 140°F (-23 to 60°C) w/VA-8050 Actuator -35 to 125°F (-37 to 52°C) w/M100 Series Actuator
<b>Fluid Operating Temperature Limits</b>	281°F (140°C) Maximum	195°F (90°C) Maximum w/VA-805X Actuator 281°F (140°C) Maximum w/M100 Series Actuator
<b>Materials</b>	<b>Stem</b>	Stainless Steel
	<b>Plug</b>	PDTC (N.O.) and PDTO (N.C.): Brass with Molded and Bonded Composition Disc Three Way Mixing: Brass (metal-to-metal seating)
	<b>Body</b>	Cast Brass with Natural Finish
	<b>Actuator</b>	Die Cast Aluminum with Enamel Finish   See electric actuator product bulletin.
	<b>Diaphragm</b>	Molded Reinforced Synthetic Rubber   N/A
	<b>Spring Ranges (Nominal)</b>	3 to 6 psi (21 to 42 kPa) N.O. Only   N/A 4 to 8 psi (28 to 56 kPa) MX Only and 9 to 13 psi (63 to 91 kPa) N.C. and MX
	<b>Body Style and Sizes</b>	Offset Globe for 1/2 in. S.A.E. Flared Connections
	<b>Max Control Pressure</b>	30 psi (210 kPa)   N/A
	<b>Accessories</b>	See Table 6.

Note: For electric actuator specifications, refer to the appropriate electric actuator product bulletin. 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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## M100G Proportional Motor Actuators with DC/mA Control Signal Input R81GAA-2 Interface Board

The M100G Series Motor Actuator is used in applications where dampers or valves are to be modulated open or closed. Typical applications include:

- positioning of D-1300 Series Dampers
- opening and closing a diverting valve
- positioning a hot water, chilled water, or steam valve
- controlling an inlet vane damper on a fan
- outdoor air, return air, and exhaust dampers
- face and bypass control
- blade positioning for variable volume fans

Refer to damper manufacturer's information to properly size the damper and actuator. Return to normal actuators are recommended for use with outdoor air dampers.

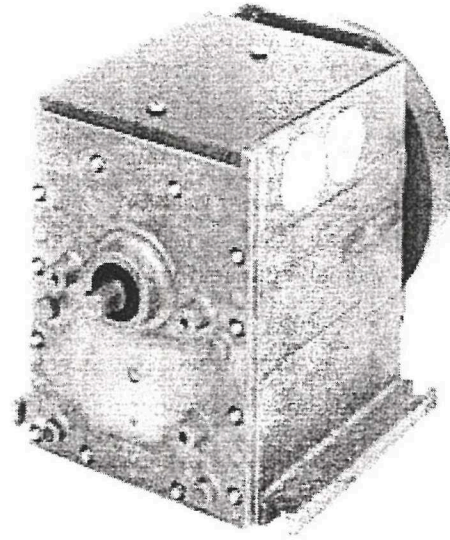


Figure 1: M100 Series Motor Actuator

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>Output Versatility</b>	Both ends of output shaft can be used for linkage connections for dampers and full power in both directions
<input type="checkbox"/> <b>Load Versatility</b>	Available in torques of 25, 35, 50, 75, and 150 in·lbs (2.8, 4.0, 5.7, 8.5, and 17 N·m)
<input type="checkbox"/> <b>Travel Adjustment Located in Top Wiring Compartment</b>	Easy field screwdriver adjustment, reduces installation time
<input type="checkbox"/> <b>R81 Plug-in Electronic Interface Boards</b>	Faster replacement or conversions and when necessary, shorter service times, reduces inventory

## Operation

Use the jumper selectable, direct and reverse acting M100G Series Motor Actuators with R81GAA-2 circuit boards in damper and valve applications for proportional 0 to 10 VDC or 4 to 20 mA direct or reverse acting control signals. This unit is a replacement for existing M100G and M100H motor actuators.

Note: Spring return models always return Counterclockwise (CCW) to the zero position when power is removed.

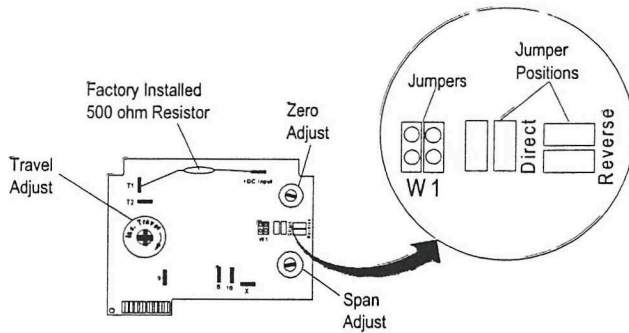


Figure 2: R81GAA-2 Circuit Board

The board is factory set in direct acting mode for 4 to 20 mA. When direct acting mode is selected, there will be a Clockwise (CW) action of the motor actuator on signal increase. When reverse acting mode is selected by changing the orientation of the jumpers at W1, there will be a counterclockwise action with a signal increase. Selecting reverse acting mode will require calibration.

A 500 ohm resistor with quick-connect terminals is factory installed between terminal T1 and the DC input terminal for 4 to 20 mA operation. Use the resistor for applications with a DC mA current controller. The resistor must be removed for applications with a DC voltage controller. An optional 750 ohm resistor (RES22A-600) is available for 0 to 24 mA control or use with a JCI N500A controller interface.

## Options

The following table lists the torque rating for each model (MXXXGYZ-2--X = Model No.):

Table 1: Torque Rating

Model	Description
M110	25 in·lb (2.8 N·m) Torque with Spring Return
M120	35 in·lb (4.0 N·m) Torque, Non-Spring Return
M130	50 in·lb (5.7 N·m) Torque with Spring Return
M140	75 in·lb (8.5 N·m) Torque, Non-Spring Return
M150	150 in·lb (17 N·m) Torque, Non-Spring Return

The torque ratings listed are relative to 90 degree actuator rotation. When used with certain linkage arrangements, a multiplication factor results when actuator travel is increased up to 270 degrees. See the linkage instruction sheet for actual forces developed.

The following table lists the input voltage options (MXXXGYZ-2--Y = Power Source Option):

Table 2: Input Voltage Options

Option	Description
A	120 VAC
D	240 VAC
G	24 VAC
H	24 VAC 1:1 Isolation

The following table lists the factory mounted accessories available (MXXXGYZ-2--Z = Accessory Option):

Table 3: Factory Mounted Accessories

Option	Description
A	No auxiliary switch.
B	One SPDT switch S91DJ-1 installed on auxiliary end of M100.
C	Two SPDT switches S91EJ-1 installed on auxiliary end of M100.
D	S91PT-1 Potentiometer (1000 ohm) installed on auxiliary end of M100.

## Travel and Timing

The M100G Motor Actuator travel is factory set at 90 degrees and is adjustable from 65 to 270 degrees.

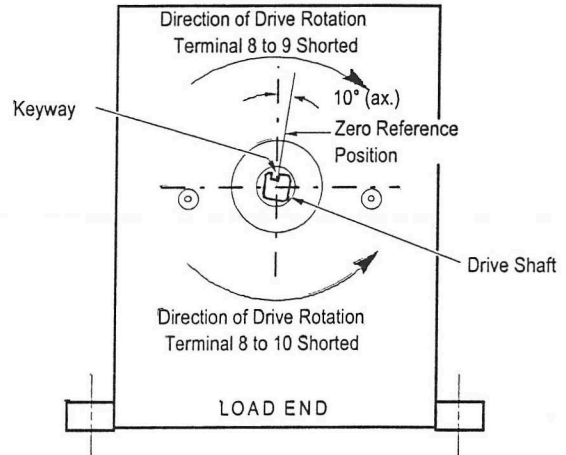
The timing of the actuator is 38 seconds for 90 degree rotation and 60 seconds for 160 degree rotation.

When using Y20 valve linkage kits, each 15 degrees of actuator rotation results in 0.1 inch (2.54 mm) of linear movement of the rack assembly.

## Load End

It is preferable that all linkage connections be made to the drive shaft on the load end of the actuator. The load end is rated for up to 200 lbs dead weight. The auxiliary end shaft drive should be limited to load equivalents of 10 lbs dead weight.

## Direction of Rotation



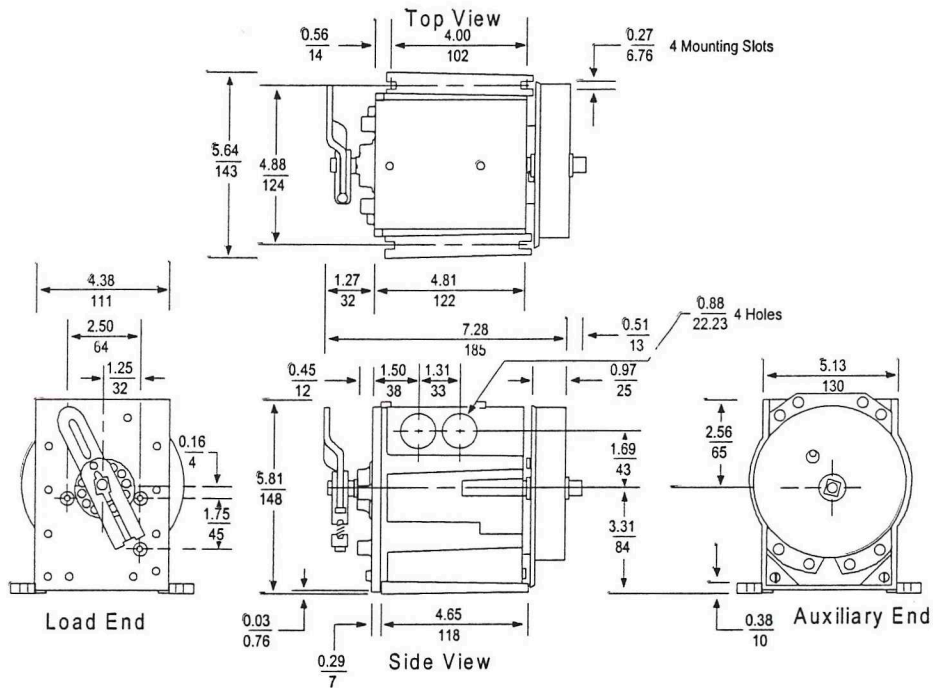
**Figure 3: Direction of Rotation**

All reference to the direction of rotation is when viewing the load end as stamped on the actuator housing shown in Figure 3. From this view, the CCW limit is the zero reference.

The actuators are factory set at zero position, which is 10 degrees clockwise from vertical (see Figure 3) and for 90 degrees clockwise travel. Direction of spring return models is always return to the CCW zero position.



# Dimensions



**Figure 4: M100 with Spring Return Dimensions**

Figure 4 shows the dimensions for a standard M100 Series Motor Actuator. Allow additional space for options such as a switch kit (two inches additional length at auxiliary end).

## Installation

### Tools Needed

- screwdriver, Phillips-head (No. 1 or 2 tip)
- screwdriver, flat-blade, 1/8 inch tip

### Precautions and Code Requirements

Note: All Series M100 Motor Actuators are for use only as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the user to add devices (safety, limit controls) or systems (alarm, supervisory systems) that protect against and/or warn of control failure.

- Follow NEC and local electrical codes.
- Disconnect all power supplies.
- Observe the following ranges and limitations:

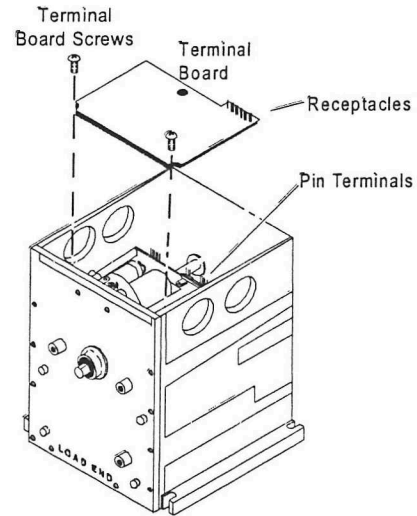
<b>Power Requirements</b>	24 VAC at 50/60 Hz, 25 VA spring return, 20 VA non-spring return
<b>Ambient Operating Conditions</b>	-40° to 125°F (-40° to 52°C), 90% RH non-spring return -35° to 125°F (-37° to 52°C), 90% RH spring return
<b>Ambient Storage Conditions</b>	-40° to 125°F (-40° to 52°C), 90% RH

- Do not install the motor actuator in atmospheres with explosive vapors or escaping gases, or where vapors having deteriorating properties might attack the actuator's metal parts.
- Seal wiring to return air systems to prevent aspiration of corrosive air into the actuator.

### Mounting

- Provide four 1/4 x 1 inch bolts for mounting the motor actuator.
- Upright mounting of the motor actuator is preferred. This is not always possible and multi-position mounting is possible as long as the output shaft is parallel to the floor.

- When mounting on a valve, do not mount below the horizontal plane of the valve piping to prevent damage to the motor actuator if the valve leaks or develops condensation.
- Valve medium temperatures above 250°F (121°C) are permissible only if the maximum ambient temperature at the motor actuator is less than 105°F (41°C).
- Locate the motor actuator where the shaft and wiring terminals are accessible.
- Follow installation procedures for the linkage kit to couple the motor actuator and the controlled device.
- Perform travel adjustments described in the *Commissioning Procedures* section on page 9 as required.



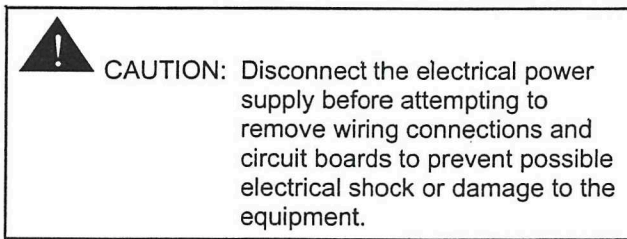
**Figure 5: Terminal Receptacles**

1. Install the terminal board by carefully placing the terminal receptacles onto the pin terminals. The terminal board engages only the pin terminals on the right hand side, just below the receptacles shown.
2. Fasten the board in place using the screws that are supplied with the R81 kit when installing in M100X.

## R81 Installation

M100X base motor actuators are provided with no circuit boards mounted within the unit. Remove the top cover and proceed to *Installing Boards*. To replace the electronic circuit boards in an existing M100 Motor Actuator, proceed as follows:

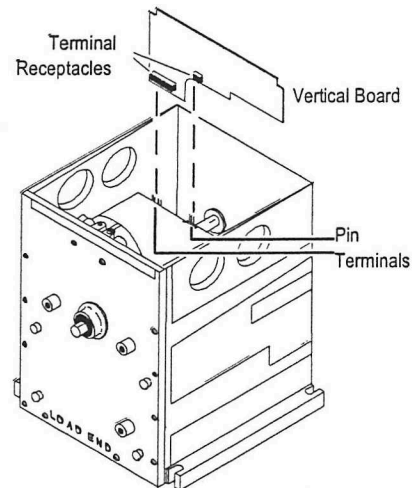
### Removing Boards



1. Remove the motor actuators top cover by loosening the two cover screws.
2. Verify that power is removed from the unit and disconnect all wiring connections to the terminal board.
3. Loosen the bracket screw and remove the bracket.
4. Pull the vertical board straight upward. Be careful not to bend or damage the pin terminals.
5. Remove the two screws from the terminal board.
6. Remove the terminal board by grasping the receptacles and lifting straight upward being careful not to bend or damage the pin terminals.

### Installing Boards

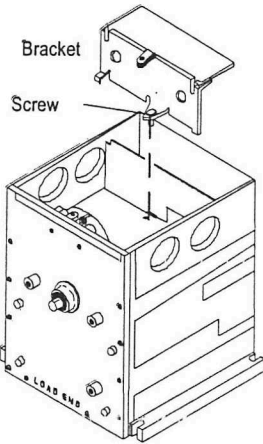
To install the circuit boards:



**Figure 6: Installing Vertical Board**

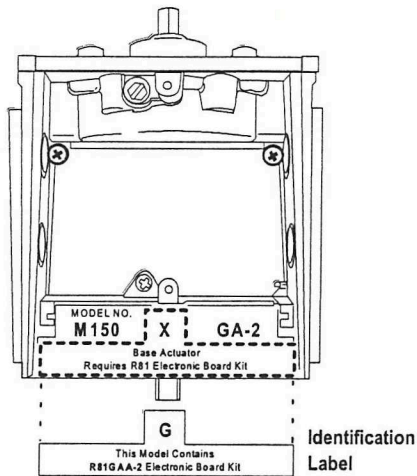
3. Install the vertical board by carefully placing the terminal receptacles onto the two sets of pin terminals as shown in Figure 6.

Note: Properly align all pins within the receptacle.



**Figure 7: Installing Bracket**

- Place the bracket, supplied with the motor actuator, over the vertical board and fasten the bracket in place with captive screw through the terminal board as shown in Figure 7. The bracket is provided for use with M100X base actuators.



**Figure 8: Installing Identification Label**

- Install the adhesive backed label supplied in the R81 kit when being applied to an M100X base actuator.

**IMPORTANT:** As shown in Figure 8, locate the label on the insulation barrier. The letter on the R81 label will complete the number that identifies the Series M100 with the R81 installed.

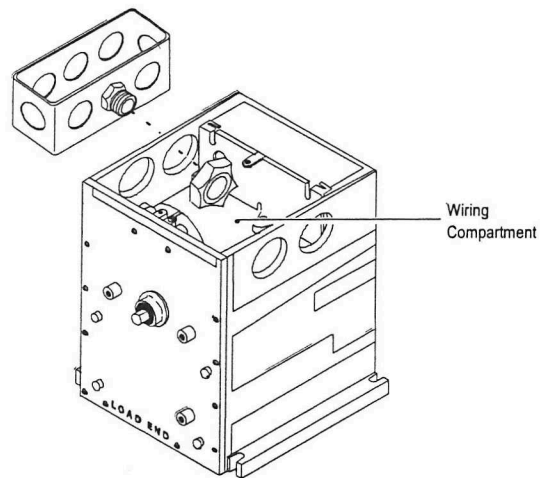
- Install the motor actuator.
- Make control and 24 VAC wiring connections.
- Turn on power supply.
- Adjust, and check operation.

## Wiring



**CAUTION:** Disconnect the electrical power supply before wiring the motor actuator to avoid possible electrical shock or damage to the equipment. Always disconnect the 24 VAC power supply before attempting to make any wiring connections.

Make all wiring connections using copper conductors only. Wire in accordance with NEC and local regulations.



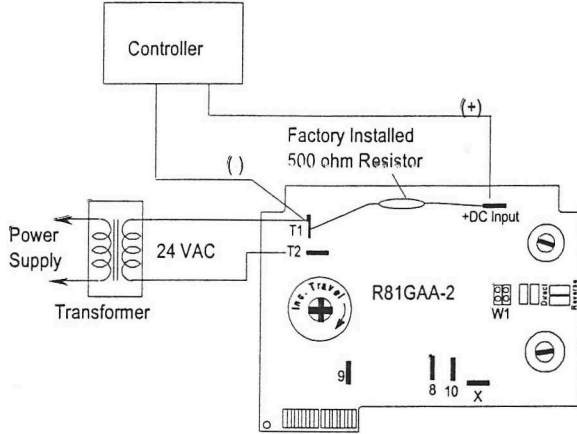
**Figure 9: Attaching Wiring Junction Box To M100**

Make all splices in junction boxes using approved solderless connectors, or by soldering and then taping the connections. Locate all splicing and excess wiring outside the motor actuator wiring compartment. If desired, add a standard electrical box to the wiring compartment of the motor actuator as shown in Figure 9.

**Note:** Use an electrical box to connect the high voltage wiring to a Y68 top mounted transformer.

Runs less than 50 feet (15 m) long require no shielded cable for the VDC/mA control wiring. Avoid running low voltage control wiring in the same conduit as line voltage or 24 VAC wiring or other conductors that supply highly inductive loads (contactors, coils, motors, generators, etc.).

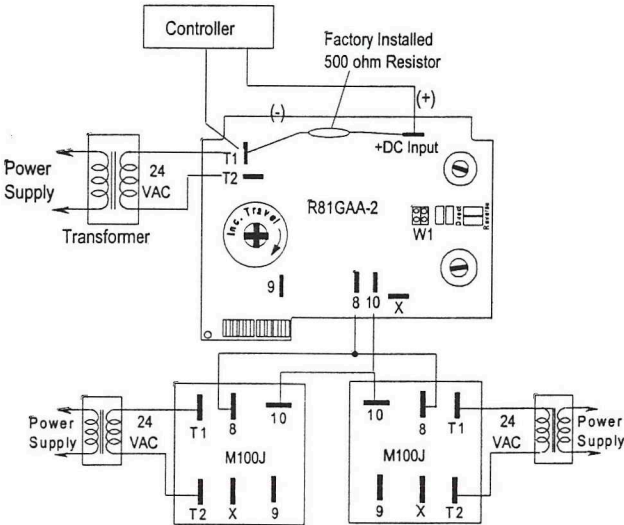
If the control wiring is over 50 feet (15 m) long, run in a common conduit, or near inductive loads, we recommend the use of shielded cable. Use 22 AWG gauge, Beldfoil 8761 or equivalent for runs up to 250 feet (76 m). For 250 feet (76 m) to 500 feet (152 m) runs, use 18 AWG gauge Beldfoil 8760 or equivalent. Connect the shield only at the controller. Do not connect shield to any other point.



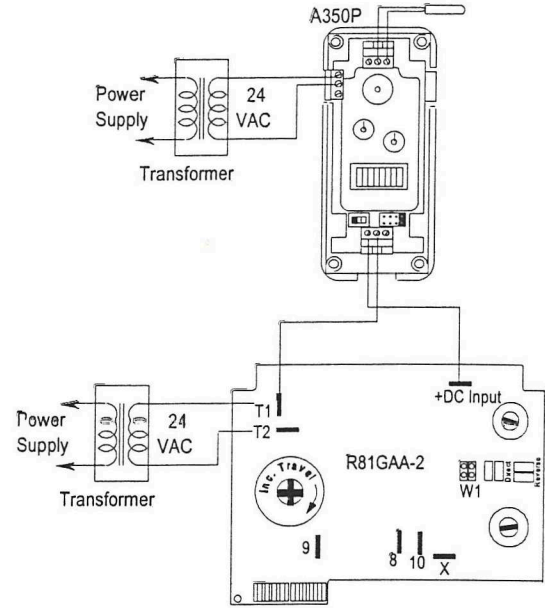
**Figure 10: Typical Single Unit Wiring Diagram**

**Note:** The factory installed resistor is for a mA controller and must be removed when a DC voltage controller is used.

**Note:** Power the controller by a separate transformer, other than the transformer powering the motor actuator.

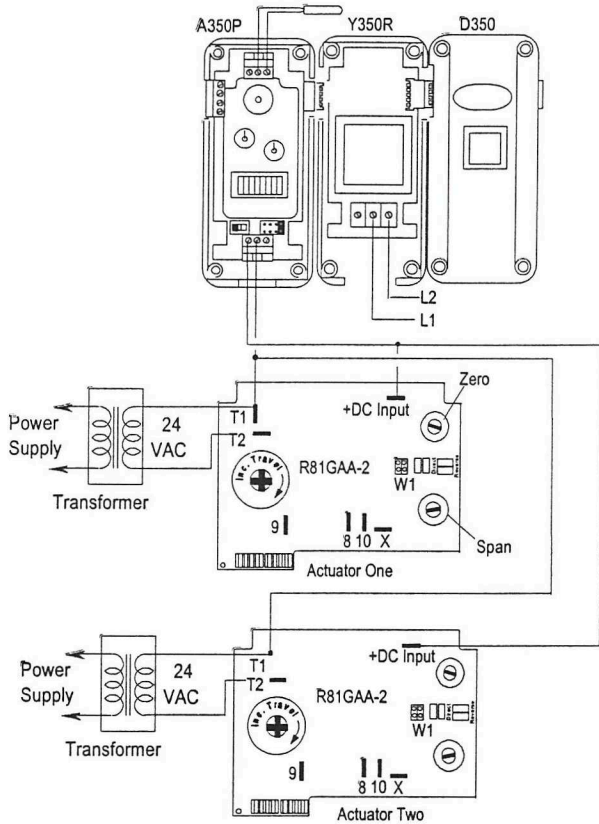


**Figure 11: Typical Parallel Wiring Diagram**



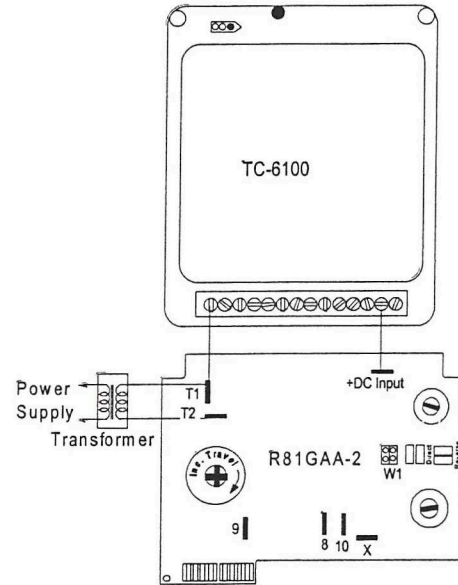
**Figure 12: Wiring to A350P**

Figure 12 shows an A350P powered by an external transformer driving an M100G Motor Actuator with DC voltage input. Note that the factory installed resistor has been removed. When an A350P is powered by a Y350R Power Module, the motor actuator is powered by a separate 24 VAC supply.



**Figure 13: Sequencing with A350P**

Figure 13 shows an A350P sequencing M100G Motor Actuators. Set actuator one zero adjust to minimum (0.25 VDC) and set the span to the desired portion of the A350P output signal that will drive the actuator from full CCW to full CW (example 5 VDC). Set actuator number two zero adjust to the A350P voltage output where actuation will begin (example 5.5 VDC) and set the span to the desired portion of the A350P output signal that the actuator will drive from full CCW to full CW (example 9.5 VDC).



**Figure 14: Wiring To TC-6100**

Figure 14 shows an M100G wired to a TC-6100 Cybertronic Temperature Controller. Connections one and thirteen are used.

To connect the wires:

1. Loosen the two screws securing the top cover and remove the top cover for access to the wiring terminals.
2. Use a hammer and punch to drive out one of the access hole plugs.
3. Install the conduit connector to the motor actuator and secure using the conduit nut provided with the connector.
4. Connect the controller to the terminals located in the wiring compartment.
5. Connect 24 VAC to terminals T1 and T2.

Note: To avoid potential miswiring or control signal problems, the use of separate transformers on each M100 is required.

For further information on any of the controllers illustrated, reference the applicable controller literature.

A 500 ohm resistor for 0 to 20 mA with quick-connect terminals is factory installed between terminal T1 and the DC input terminal. The resistor is for applications with a DC milliamper controller. Remove the resistor for applications with a DC voltage controller. An optional 750 ohm resistor is available for use with an N500 Controller.

The input impedance of the M100G Motor Actuators is 44,000 ohms.

### **Checkout Procedure**

After installation and wiring are complete, make system settings and apply power. After assembling the linkage and motor actuator to the valve or damper, cycle the motor actuator using the controller.

Observe at least three complete operating cycles to see that all components are functioning correctly. Do not stall the motor actuator with the damper or valve. If not allowed to complete the full stroke, damage to the motor actuator will result.

### **Travel Adjustment**

The rotational travel is field adjustable from 65 to 270 degrees rotation by turning the travel adjustment. Changing the travel adjustment affects the clockwise limit of the actuator's rotation.

1. Run the motor actuator to its CW limit by jumpering terminals 8 and T1 (24 VAC supplied to terminals T1 and T2).
2. Turn the travel adjustment potentiometer on the terminal board clockwise to increase the travel and counterclockwise to reduce the total travel.
3. For further information on travel adjustment, refer to the damper or valve linkage instruction sheet.

## **Commissioning Procedures**

### **Zero and Span**

The "Zero" (0.25 minimum, 24 VDC maximum) and "Span" (2 minimum 18 VDC maximum) adjustments are field adjustable. This allows the selection of any portion of the signal input to fully modulate the motor actuator.

### **Manual Override**

Use the following procedures to manually override the motor actuator.



**CAUTION:** This procedure is for checkout of the actuator only and not for continuous operation of the motor actuator.

1. Disconnect all control inputs before manually overriding the motor actuator.
2. Connecting terminals 8 and T1 will drive the motor actuator in the CW direction. This will override the VDC/mA input and drive the motor to its full adjusted travel.
3. Connecting terminals 8 and 10 will drive the motor actuator in the CCW direction. This will override the VDC/mA input and drive the motor to its starting point.

### **Direct Acting Mode Calibration**

1. Properly set up the motor actuator for the applied input. Use a factory installed 500 ohm resistor between T1 and DC input for 0 to 20 mA signal. Use a field supplied 750 ohm resistor for 0 to 24 mA and no resistor for DC voltage input.
2. Set the jumpers to direct acting position as shown in Figure 2.
3. Apply 24 VAC to terminals T1 and T2.
4. Increase the zero adjustment to its maximum and decrease the span adjustment to its minimum.

Note: Direction indicators for increasing each adjustment are on the potentiometer.

5. Apply power to the controller that supplies the DC control voltage (mA) to the motor actuator.
6. Using a DC voltmeter, adjust the controller setpoint to produce the minimum voltage at which the actuator will be at its desired full counterclockwise position.

Note: The motor actuator ignores voltages below the selected value.

7. Slowly decrease the zero adjustment until the motor actuator begins to respond. The motor actuator should start and run clockwise about two angular degrees.
8. Slowly increase the zero adjustment enough to return the motor actuator to its normal CCW position.
9. Leave the zero adjustment set at this point.
10. Adjust the controller setpoint to produce the maximum voltage at which the actuator will be at its desired full CW position.
11. Slowly increase the span adjustment until there is a slight CCW movement of the motor actuator. The motor actuator should start and back up about two angular degrees.
12. To be sure complete travel is achieved, the span adjustment must be decreased just enough to return the motor actuator to its maximum CW travel limit.
13. Leave the span adjustment set at this point.

Repeat the preceding steps to verify achievement of the complete control range. Perform at least three complete operating cycles of the system before leaving the installation.

### **Reverse Acting Mode Calibration**

1. Properly set up the motor actuator for the applied input. Use a factory installed 500 ohm resistor between T1 and DC input for 0 to 20 mA signal. Use a 750 ohm field supplied resistor for 0 to 24 mA and no resistor for DC voltage input.
2. Set the jumpers to the reverse acting mode as shown in Figure 2.
3. Apply 24 VAC to terminals T1 and T2 and wait for the motor actuator to travel to its full CW limit.
4. Decrease the zero and span adjustments to their minimums.

Note: Direction indicators for increasing each adjustment are on the potentiometer.

5. Apply power to the controller that supplies the DC control voltage (mA) to the motor actuator.
6. Using a DC voltmeter, adjust the controller setpoint to produce the maximum voltage at which the actuator will be at its desired full CCW position.

Note: The motor actuator ignores voltages above the selected value.

7. Slowly increase the zero adjustment until the motor actuator begins to respond. The motor actuator should start and run clockwise about two angular degrees.
8. Slowly decrease the zero adjustment enough to return the motor actuator to its normal CCW position.
9. Leave the zero adjustment set at this point.
10. Adjust the controller setpoint to produce the minimum voltage at which the actuator will be at its desired full CW position.

Note: The motor actuator ignores voltages below the selected value.

11. Slowly increase the span adjustment until there is a slight CCW movement of the motor actuator. The motor actuator should start and back up about two angular degrees.
12. To be sure complete travel is achieved, the span adjustment must be decreased just enough to return the motor actuator to its maximum CW travel limit.
13. Leave the span adjustment set at this point.

Repeat the preceding steps to verify achievement of the complete control range. Perform at least three complete operating cycles of the system before leaving the installation.

### ***Troubleshooting***

1. Remove the control signal.
2. Maintain isolated 24 VAC power.
3. Jumper pin 8 to T1, motor will drive CW.
4. Jumper pin 8 to pin 10, motor will drive CCW.

Take the following steps to check the proper functioning of the motor actuator and associated controls:

1. The voltage at terminal 10, with reference to terminal T1, should be approximately +12 VDC constant.
2. Be sure the actuator model selected has a range that covers the controller voltages desired.
3. By adjusting the controller setpoint up and down, the resulting voltage changes received by the motor actuators should result in proportional

changes in the output voltage across terminal 8 and terminal 10. Output voltage should be between 0 and -2 VDC (terminal 10 reference).

### ***R*replacement**

The drive motor and gear train are immersed in oil and sealed in a die cast case. Therefore, maintenance is not necessary.

For replacement, contact the nearest Johnson Controls Representative.



## Specifications

<b>Product</b>	M100G
<b>Power Requirements</b>	24 VAC at 50/60 Hz, 25 VA spring return, 20 VA non-spring return
<b>Rotation Timing</b>	38 seconds for 90° travel 60 seconds for 160° travel
<b>Ambient Operating Conditions</b>	-40° to 125°F (-40° to 52°C), 90% RH non-spring return -35° to 125°F (-37° to 52°C), 90% RH spring return
<b>Ambient Storage Conditions</b>	-40° to 125°F (-40° to 52°C), 90% RH
<b>Dimensions (H x W x D)</b>	5.64 in. x 4.38 in. x 4.94 in. (143 mm x 111 mm x 125 mm) without transformer
<b>Shipping Weight</b>	9 lbs (4.1 kg) without transformer
<b>Enclosure</b>	NEMA-1
<b>Agency Listings</b>	UL Recognized File E27734 Guide XAPX2 CSA Certified File L4573 Class 4813 02
<b>Accessories (Order Separately)</b>	S91DJ-1, Auxiliary switch kit with one SPDT switch S91EJ-1, Auxiliary switch kit with two SPDT switches S91PT-1 Auxiliary potentiometer switch kit, 1000 ohms, 1/3 watt SEL12A-600R, Weatherproofing kit for S91 CVR83A-600R, Weather resistant cover Q99ADN-1 or Q99AUP-1, Assembly charge for 2-way valves, 1/2 through 2 inch Q99ADN-2 or Q99AUP-2, Assembly charge for 2-way valves, 2-1/2 inch and over Q99ADN-3 or Q99AUP-3, Assembly charge for 3-way valves, 1/2 through 2 inch Q99ADN-4 or Q99AUP-4, Assembly charge for 3-way valves, 2-1/2 inch and over

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

The VAV Modular Assembly (VMA) is a family of configurable digital controllers. The VMA1410 and VMA1420 include a controller, pressure sensor, and actuator housed in a prewired unit. The actuator uses a fast response stepper motor for quick damper positioning. The VMA1430 includes only the controller and prewired pressure sensor and provides the flexibility of an external floating or proportional actuator.

There are many new and unique features that reduce installation and commissioning time, while enhancing Variable Air Volume (VAV) system operation. This makes the VMA the product of choice for VAV systems.

The VMA is offered as three models:

- cooling only (VMA1410)
- cooling with reheat and/or fan (VMA1420)
- external actuator (VMA1430)

All are designed for pressure independent, single duct systems. The VMA1420 and 1430 can also be used with parallel or series fan powered boxes.

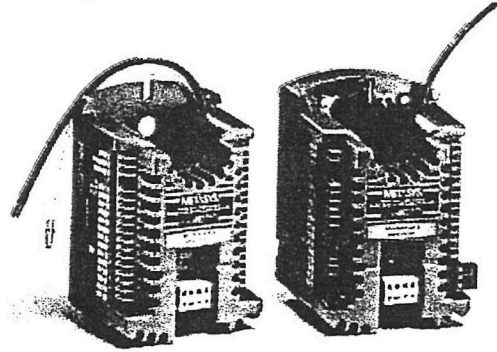


Figure 1: VMA1430 and VMA1410/1420

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>Integrated Module</b>	Pre-assembled controller with pressure sensor and actuator reduces installation time. The VMA1410/1420 includes an actuator. The compact footprint is easy to handle.
<input type="checkbox"/> <b>Enhanced Actuator (VMA1410,1420)</b>	Fast response stepper motor drives the damper from full open to closed in only 30 seconds and accurately positions the damper to minimize motor runtime, extending motor life.
<input type="checkbox"/> <b>Automated Commissioning</b>	Proportional adaptive algorithms, patented P-Adaptive and Pattern Recognition Adaptive Control (PRAC) technologies provide continuous loop tuning.
<input type="checkbox"/> <b>Advanced Diagnostics</b>	System deviations related to flow, damper travel, and energy use can be identified and corrected using comparative values.
<input type="checkbox"/> <b>Network Communications</b>	VMA can be integrated as a part of a facility management system.
<input type="checkbox"/> <b>Easy Configuration</b>	Simple question/answer software format for quick selection of project specific applications.
<input type="checkbox"/> <b>Software Addressing</b>	Software addressing is available as an option when remote identification is needed.

## Actuator Enhancements

The VMA1410 and 1420 use a new actuator with a fast response stepper motor, which is quiet (<35 dBA) and precise (23K 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, which minimizes position hunting and motor runtime. The VMA1430 utilizes an external floating/3-wire (incremental) or proportional actuator.

## Applications

The VMA can be configured for most single and dual duct VAV applications. If using a VMA1420 for a dual duct application, an external damper and DPT sensor are required. The VMA1430 requires two external actuators and an additional DPT for the dual duct application. Standard applications reside in the HVAC PRO™ library, which utilizes a question/answer wizard format.

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

**Table 1: Applications**

Applications	Control Options	Model VMA1410	Model VMA1420	Model VMA1430
<b>System Types</b>	Single Duct	✓		
	Dual Duct		✓	✓
	Fan Powered (Series or Parallel)		✓	✓
	Pressure Independent	✓	✓	✓
<b>Heating (Terminal Box)</b>	Floating 3-wire Valve Actuator		✓	✓
	Proportional Valve Actuator		✓	✓
	Normally Open (N.O.) or Normally Closed (N.C.) Valve		✓	✓
	1-3 Stage Electric		✓	✓
<b>Heating (Supplemental)</b>	Floating 3-wire Valve Actuator		✓	✓
	Proportional Valve Actuator		✓	✓
	Normally Open (N.O.) or Normally Closed (N.C.) Valve		✓	✓
	Single Stage Electric		✓	✓
<b>Cooling (Terminal Box)</b>	Stepper Motor Damper Actuator	✓	✓	
<b>Floating/3-wire (Incremental) Damper Actuator</b>	Damper and Valve		✓	✓
<b>Proportional Damper Actuator</b>	Damper and Valve		✓	✓
<b>Fan (Fan Powered Terminal Box)</b>	Parallel, Temperature based		✓	✓
	Parallel, Air Flow Setpoint		✓	✓
	Series, On/Off Control		✓	✓
	Series, Proportional Control		✓	✓
<b>Lighting</b>	On/Off (In Relation to Occupancy Mode)		✓	✓
<b>Modes</b>	Occupied/Temporary	✓	✓	✓
	Occupied/Standby/ Off/Shutdown/Window			

## Advanced Diagnostics

The VMA has several unique diagnostic features. On the VMA1410/1420, the damper position is recorded to identify any deviations that may indicate problems with damper travel. Diagnostics include damper stall detection (VMA1410/1420 only), starved box detection, actuator motor duty cycle, VAV box flow test, and others.

The space temperature and airflow are constantly monitored and alarm to alert the operator of system changes. 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 VMA setup time. The integrated VMA package design reduces or eliminates the need to fasten and wire the sensor and actuator (VMA1410/1420) to the controller.

The unique stepper motor in the VMA1410/1420 allows fast positioning of the damper. Modular assembly and automated tuning reduces the total time spent at the job site, yet provides a quality installation. New software commissioning tools quickly monitor and adjust all operating parameters.

If a power failure occurs, there is no need to reload software, since the programs and configuration data are saved in non-volatile Flash memory.

Additionally, firmware upgrades can be downloaded to existing units when enhancements are developed, without replacing the VMA.

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

The user can also assign address identification to the VMA1400 Series product either using hardware DIP switches or software. Hardware addresses must be maintained at 0 or 255 to allow software addressing to be selected.

## Automated Commissioning

Simply mount, wire, configure, download, and commission the controller. There is no need to set proportional bands and integration terms, since loop tuning is done automatically. You do not 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 and VMA1420 are configured to set the end-stops automatically (patent pending). On power up, the actuator drives to both hard stops on the VAV box and remembers these positions. These automated features get your system operating quickly.

## Hardware

The VMA modular assembly is in a durable plenum rated plastic housing. The controller and pressure sensor are enclosed in one module attached to the actuator, while the VMA1430 uses a separate, external actuator.

The unique VMA 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. 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 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 VMA housing, indicates that power is connected and communication has been established.

**Table 2: Available VMA Models**

Inputs/Outputs	Points	Rating	VMA1410 (Cooling Only)	VMA1420 (Cooling w/reheat)	VMA1430 (External Actuator)
<b>Analog Inputs:</b>					
Zone Temperature	AI-1	1K Ni, Si, Pt, or 2.25K NTC	✓	✓	✓
Zone Setpoint	AI-2	1.6K ohm Potentiometer	✓	✓	✓
Sideloop (humidity, dew point)	AI-3	0-16 VDC		✓	✓
Supply Air Temperature or Supplemental Heat Temperature	AI-4	1K Ni, Si, Pt, or 2.25K NTC		✓	✓
Velocity Pressure	Internal	0-374 pa (0-1.5 in. W.C.)	✓	✓	✓
<b>Binary Inputs:</b>					
Temporary Occupied Button	BI-1	Dry contact	✓	✓	✓
Occupied	BI-2	Dry contact	✓	✓	✓
Off or Window or Shutdown	BI-3	Dry contact	✓	✓	✓
<b>Analog Outputs:</b>					
Proportional Heat or External Damper	AO-1	0-10 VDC @ 10 mA		✓	✓
	AO-2	0-10 VDC @ 10 mA		✓	✓
<b>Binary Outputs:</b>					
Lights, Fan, External Damper, Box Heat - Valve or 1-3 stage Electric Supplemental Heat - Valve or Single Stage Electric Box Heat	BO-1 - BO-5	24 VAC Triac @ 0.5A each		✓	✓
Stepper Motor with Position Feedback	Internal	2-phase Stepper [up to 93° rotation @ 4 N·m (35 lb·in)]	✓	✓	

## Installation

Field mounting the VMA 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 (L x W x H), 153 x 102 x 102 mm (6 x 4 x 4 inch) [153 x 102 x 83 mm (6 x 4 x 3.25 inch) for the VMA1430] meets industry mounting requirements and is 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 to the VAV terminal box. Two screws mount the VMA1430. Additionally, on the VMA1410 and VMA1420, 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 inch) square or round, up to 13 mm (1/2 inch) diameter round. A gear release lever allows easy resetting of the damper to full open or closed.

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 HVAC PRO software Release 7.02 or later. Refer to the *HVAC PRO User's Guide (LIT-6375040)* for details.

Multiple VMAs 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

You can realize even greater benefits when the VMA is part of a larger Metasys Network that serves your 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).

With the network configuration, you can plug your laptop directly into the NCM to monitor controllers on the N2 Bus. No additional converters are required.

## Tool Configuration

The VMA integrated 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.

Configure the VMA using HVAC PRO software (Release 7.02 or later) by simply responding to a series of yes/no and multiple choice questions, and then specifying setpoints and other parameters. If you are using the dual duct application and/or new TMZ1600 LCD display room sensor, you need HVAC PRO software Release 8.0 or later to configure the VMA 1400. HVAC PRO software has a library of applications, control sequences, and algorithms that automatically configure the controller in response to your answers.

Once configured, you can make future changes to the control setpoints and operating parameters from any Metasys Operator Workstation or from any laptop connected to the VMA or room sensor.

## Demo Kit (AP-VMADEMO-0)

Looking for a great way to demonstrate the exclusive features of the VMA to your customers? Consider ordering a portable, easy to use VMA Demo Unit. Simply connect a laptop to the unit and use HVAC PRO or VBT software to demonstrate the VMA advantage.

## Room Sensors

A variety of room sensors are available for use with the VMA. Select the standard room sensor TE-6400 nickel or platinum (1K ohm) sensor or select the AP-TMZ1600-0 LCD room sensor. The TMZ 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 VMA will also retrofit to existing silicon sensors (TE-6000-960).

The VMA connects to the room sensor via an 8-pin phone jack. The TE-6x00 also offers models with screw terminal connection.

Using the 6-pin phone jack on the TE-6x00 or TMZ1600, you can connect a laptop to download, commission, and balance.

## Balancing Tools

The VMA includes three new balancing tool options, which makes balancing fast and accurate:

1. HVAC PRO commissioning tool. This is a balancing tool screen to allow a balancer to quickly make adjustments to the VMA without needing to access the configuration. The screen includes VMA parameter information including box area, an automatically calculated pickup gain, and flow (cfm) data.
2. VMA Balancing Tool (VBT) software. This software is part of Configuration Tools (Release 7.02 or later) and can be downloaded to a common handheld interface such as 3COM® PalmPilot™ or IBM® Workpad™. Refer to the *Using the VMA Balancing Tool (VBT) Software Technical Bulletin (LIT-6363092)* for more information on compatibility and functionality. VBT software is also available to order as AP-VMABVT1-0.

## AIM Tools

- Alnor Balometer DB150 has a Johnson Controls menu specific to balancing the VMA 1400 product. The balometer is supplied with a conversion cable that connects to the room sensor phone jack and allows direct communication to the VMA 1400 Series.

All these tools are unique to the Johnson Controls VMA 1400 Series and provide easy methods to read and adjust parameters for better zone control.

An enhanced room schedule in spreadsheet format saves time to commission and balance the VMA 1400 Series. New parameters can be added, including: minimum/maximum cfm, pickup gain, box area, and bias setting.

Parameter adjustments can be made in the spreadsheet, then downloaded to multiple VMAs, even those with different configurations. A spreadsheet report can be printed showing information for all zones in the project.

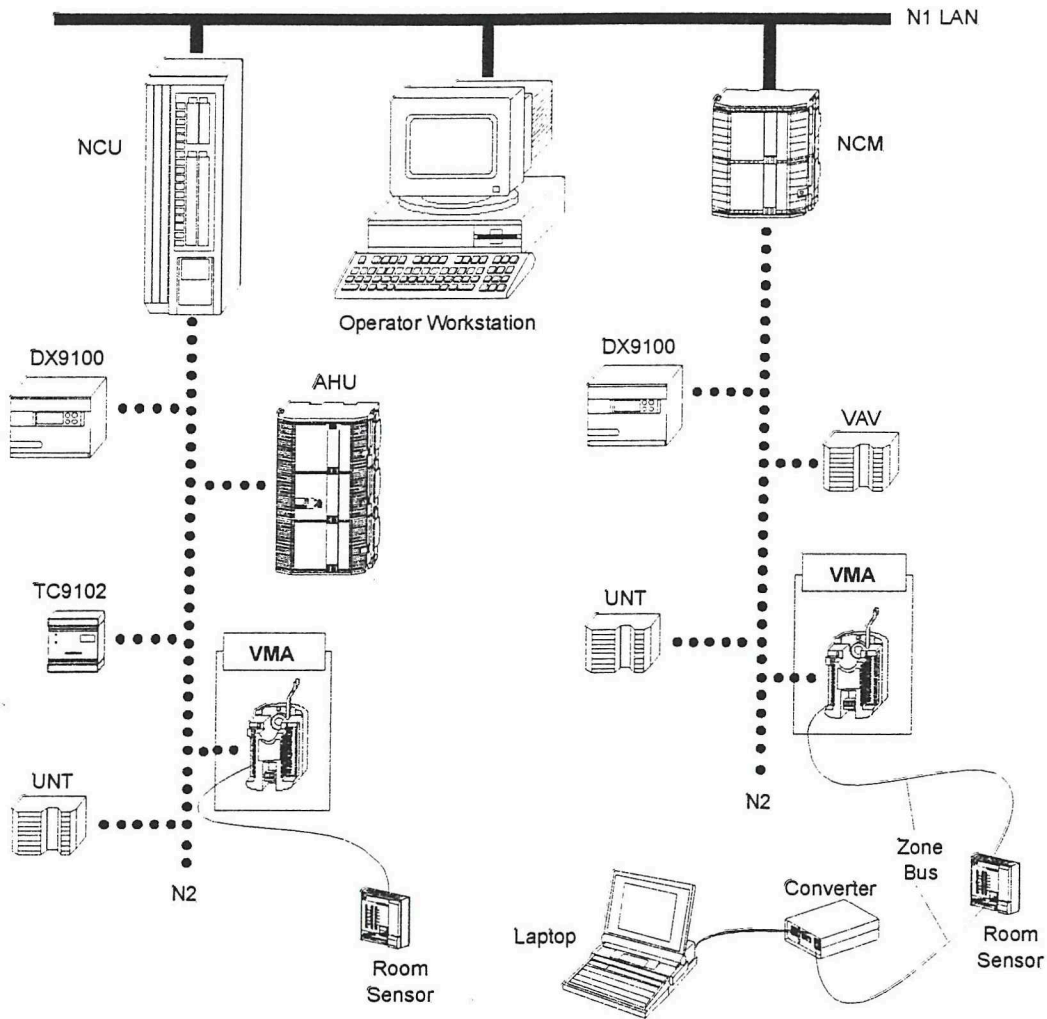


Figure 2: VMA in Metasys Network Diagram

## Accessories (Order Separately)

**Table 3: Accessories**

<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)	
	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-6400 and AP-TMZ1600-0		
<b>Room Sensor Wall Mounting Plate</b>	TE-6400W-600 for room sensor. The AP-TMZ1600-0 LCD room sensor is shipped with both a back plate and an optional wallbox mounting plate.		
<b>8-pin Room Sensor Communication Cables (Connection made from back of TE-6400 sensor)</b>	<b>Length</b>	<b>Part Number</b>	
	25 ft	CBL-STAT25-SW	
	50 ft	CBL-STAT50-SW	
	75 ft	CBL-STAT75-SW	
	100 ft	CBL-STAT100-SW	
<b>HVAC PRO</b>	MW-MTOOL-0, FA-MTOOL-0 (M-Tool Release 1.0 or later, which includes HVAC PRO software Release 8.0, supports dual duct application and TMZ 1600 LCD room sensor).		
<b>VBT Software</b>	AP-VMAVBT1-0 is available with Configuration Tools Release 7.02 or later and M-Tool Release 1.0 or later.		
<b>Converters</b>	AS-CBLPRO-2	IU-9100-0 (Europe)	MM-CVT101-0 (US)

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

## Specifications

<b>Product Name</b>	Variable Air Volume Modular Assembly (VMA)		
<b>Product Code Number</b>	<b>Cooling Only Models:</b>	<b>Cooling w/Reheat and/or Fan:</b>	<b>External Actuator Models:</b>
<b>Single Unit</b>	AP-VMA1410-0	AP-VMA1420-0	AP-VMA1430-0
<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 ampere for a VMA1420; 1.2 ampere for VMA1430		
<b>Power Consumption</b>	VMA1410/1420	10 VA maximum (Relay and valve requirements not included.)	
	VMA1430	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 inch) spade lugs (Communication has screw terminals.)		
Continued on next page . . .			



## Specifications (Cont.)

<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 (3-wire). Zone Bus between VMA and room sensor (8-pin phone jack or wire to spade lugs or optional plug-on terminals)
<b>Mounting</b>	One screw (included) mounts the VMA1410/1420 to the VAV box. One screw attaches damper shaft to the actuator, 8 mm (5/16 inch) square head set screw with 44 N·m (375 lb·in) of axial holding power for up to 13 mm (1/2 inch) round damper shafts. Minimum damper shaft length is 44.5 mm (1-3/4 inch). 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 153 x 102 x 102 mm (6 x 4 x 4 inch) VMA1430 153 x 102 x 83 mm (6 x 4 x 3.25 inch)
<b>Actuator Torque</b>	4 N·m (35 lb·in) minimum (VMA1410/1420 only)
<b>Shipping Weight</b>	VMA1410/1420 13.1 kg (29 lb) for a box of ten, 1.3 kg (2.8 lb) each VMA1430 5 kg (10.6 lb) for a box of ten, 0.5 kg (1.06 lb) each
<b>Electrical Inputs</b>	Analog Inputs: <ul style="list-style-type: none"> <li>Nickel, silicon, or platinum (1K ohm) or NTC (2.25K) RTD room sensors, 1.6K setpoint potentiometer (2-wire)</li> <li>Voltage input for 0-10 VDC (humidity or dew point sensor)</li> </ul> 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, except 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 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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## M9200 Series Electric Spring Return Actuator

The M9200 Series is a direct-mount, spring return line of electric actuators that operates on 24 VAC or VDC power and is available for use with on/off, floating, proportional, or resistive controllers. These bi-directional actuators do not require a damper linkage, and are easily installed on a round shaft up to 3/4 in. (20 mm) diameter or a square shaft up to 5/8 in. (16 mm). They can also be mounted to valves using one of the M9000-5xx Valve Linkage Kits.

The M9200 models deliver 140 lb·in (16 N·m) of torque. The angle of rotation is mechanically adjustable from 30 to 90°. Integral auxiliary switches are available to indicate end-stop position or to perform switching functions at any angle within the selected rotation range. Position feedback is available through switches, a potentiometer, or a 0 (2) to 10 VDC signal.

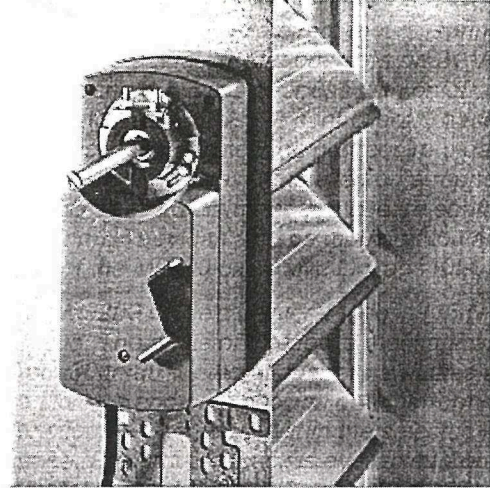


Figure 1: M9200 Series Spring Return Actuator

### Features and Benefits

<input type="checkbox"/> <b>Bi-directional, Fail-safe Spring Return</b>	Allows selectable rotation/spring return direction simplifying installation
<input type="checkbox"/> <b>Four Control Input Types</b>	Meets the needs of most applications
<input type="checkbox"/> <b>Wide Range Resistive Input</b>	Interfaces to 3-wire resistive controllers from 100 to 10,000 ohms
<input type="checkbox"/> <b>Zero and Span Adjustment on Proportional Models</b>	Allows sequential operation of dampers from a single input signal of 0 (2) to 10 VDC or 0 (4) to 20 mA
<input type="checkbox"/> <b>On/Off Control</b>	Provides simple, 2-wire control for low-cost applications
<input type="checkbox"/> <b>Electronic Stall Detection</b>	Provides higher reliability by deactivating the actuator when a stall condition is detected
<input type="checkbox"/> <b>Output Position Feedback</b>	Provides simple, closed-loop control with accurate position sensing (standard on proportional and resistive models, optional on floating models)
<input type="checkbox"/> <b>Calibration Output on Proportional Models</b>	Increases speed and accuracy of zero and span adjustments over the entire range without waiting for mechanical rotation
<input type="checkbox"/> <b>Manual Override</b>	Allows manual positioning when the actuator is not powered; simplifies setup and field adjustments
<input type="checkbox"/> <b>NPT Conduit Adaptor (Included)</b>	Meets electrical code requirements

## Application Overview

**IMPORTANT:** This device is not designed or intended to be used in or near environments where explosive vapors or gases could be present, or environments where substances corrosive to the device's internal components could be present.

M9200 actuators are designed to position air dampers and valves in HVAC systems. Applications include:

- positioning return air, exhaust, or outdoor air dampers
- controlling face and bypass dampers
- positioning blades for variable volume fans
- positioning valves used with an M9000-5xx Valve Linkage

Refer to the manufacturer's information to properly size the damper, valve, and/or actuator.

## Operation

**IMPORTANT:** All M9200 Series actuators are designed for use only in conjunction with operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add safety devices or alarm systems that protect against, and/or warn of, control failure.

M9200 actuators operate on 24 VAC at 50/60 Hz or 24 VDC. They use a DC motor with stall detection circuitry that operates throughout the entire stroke. The proportional and resistive actuators employ noise filtering techniques on the control signal to eliminate response to spurious noise.

Rotation is mechanically limited to 93° by integral end-stops. The position of the actuator is visually indicated from 0 to 90° on the cover. An anti-rotation bracket prevents lateral movement of the actuator.

The damper position can be set manually with the manual override feature in the event of a power failure.

## Installation

### Parts Included

- M9216 actuator
- NPT conduit adaptor (two included for actuators with switches or a feedback potentiometer)
- anti-rotation bracket
- two No. 12-24 sheet metal screws
- 5 mm manual crank

### Tools Required

- 1/4 in. (7 mm) and 1/8 in. (3 mm) flat-blade screwdrivers
- Phillips No. 2 screwdriver
- center punch
- adjustable wrench or 7 mm and 10 mm nut drivers
- needle-nose pliers
- DVM or M9000-200 Commissioning Tool (for models with zero and span potentiometers)

# Dimensions

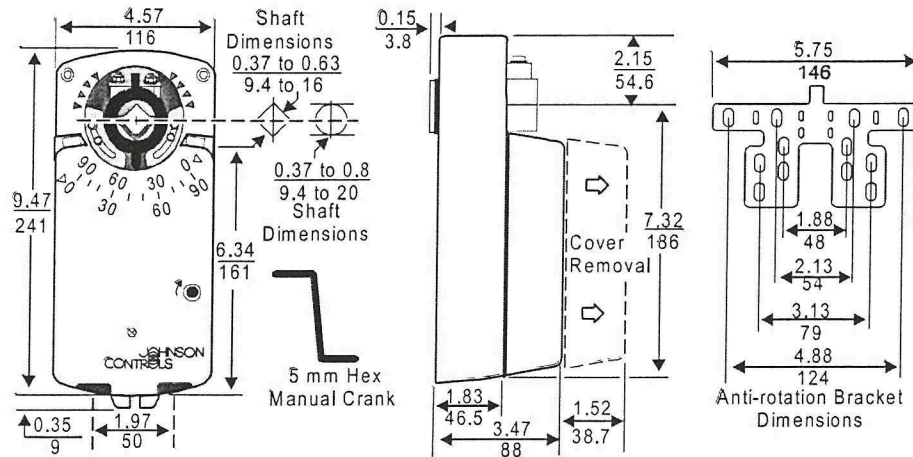


Figure 2: Actuator, Anti-rotation Bracket, and Manual Crank Dimensions, in. (mm)

## Spring Return Direction

The actuator is factory set to spring return in a Counterclockwise (CCW) direction.

### Clockwise (CW)

To change the spring return direction to Clockwise (CW), refer to Figure 3 and proceed as follows:

1. Turn the actuator over, release the locking clip with a flat-blade screwdriver, and remove it from the coupler.
2. Remove coupler and sleeve from the front of the actuator, and slide the sleeve off of the coupler.

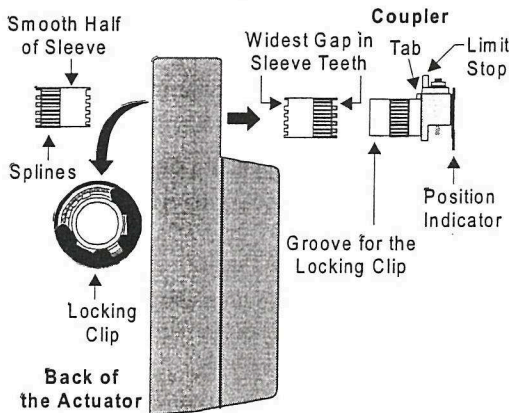


Figure 3: Changing the Spring Return Direction

3. Insert the sleeve into the back of the actuator with the smooth half of the sleeve inserted first.

Note: Make sure the widest gap in the sleeve teeth align with the two guide marks on the back of the actuator. (See Figure 4.)

**IMPORTANT:** When the sleeve is changed from the front of the actuator to the back, the actuator's drive direction is also reversed.

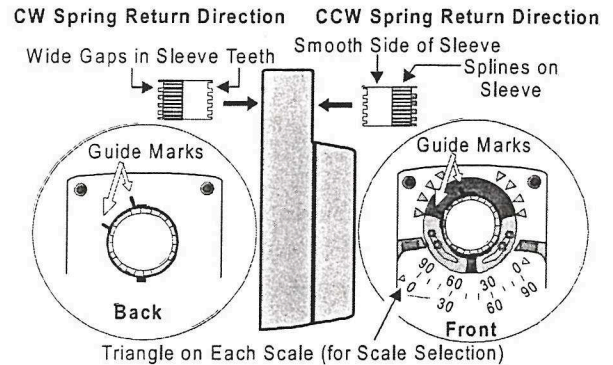


Figure 4: Location of Guide Marks

4. Align the tab on the coupler with the wide gap in the sleeve teeth, and insert the coupler into the front of the actuator.
5. Replace the locking clip to secure the coupler and sleeve in the actuator.
6. Fill in the triangle on the actuator cover with a marking pen to indicate the scale being used.

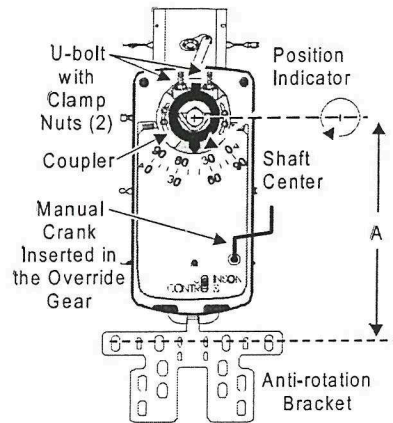
## Counterclockwise

To set the actuator to spring return in a CCW direction, refer to Figure 3 and proceed as follows:

1. Turn the actuator over, release the locking clip with a flat-blade screwdriver, and remove it from the coupler.
2. Remove the coupler from the front of the actuator, and the sleeve from the back of the actuator.
3. Insert the sleeve into the front of the actuator with the smooth half of the sleeve inserted first.

Note: Make sure the widest gap in the sleeve teeth align with the two guide marks on the front of the actuator.

4. Repeat Steps 4, 5, and 6 of the previous section.



Note: "A" is the distance from the center of the holes in the anti-rotation bracket to the center of the shaft. (See Table 1.)

Figure 5: Mounting Positions

## Mounting

**IMPORTANT:** Make sure the space between the back of the actuator and mounting surface is at least 5/32 in. (4 mm).

M9200 actuators can be mounted in any convenient orientation. They can be installed on a shaft that is 3/8 to 3/4 in. (9.5 to 19 mm) round or a 3/8 to 5/8 in. (9.5 to 16 mm) square, 3 in. (76 mm) or longer. If the shaft is less than 3 in. (76 mm) long, install an extension recommended by the damper or valve manufacturer. For 1 in. (25.4 mm) outside diameter shafts, use the M9000-154 1 in. Jackshaft Coupler.

To mount the actuator, proceed as follows:

**CAUTION: Equipment Damage Hazard.** The tab on the anti-rotation bracket must fit midpoint in the actuator slot to prevent actuator binding and premature wear.

1. Refer to the "A" Dimensions in Table 1 and Figure 5 to ensure the anti-rotation bracket tab fits midway in the actuator slot.

Table 1: Shaft Sizes and Distances from the Anti-rotation Bracket to Shaft Center

Shaft Diameter	5/8 in.	1/2 in.	3/8 in.
"A" Dimensions (See Figure 5.)	8-1/4 in. 209 mm	8-5/16 in. 211 mm	8-3/8 in. 213 mm

2. Bend or cut the anti-rotation bracket to fit the damper frame or duct as shown in Figure 6.

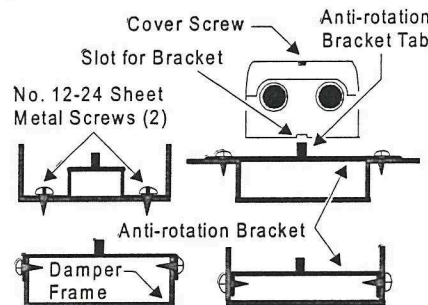


Figure 6: Anti-rotation Bracket Positions

3. Attach the anti-rotation bracket to the damper or duct with a 1/4 in. flat-blade screwdriver, using the two No. 12-24 sheet metal screws provided.

**IMPORTANT:** Do not overtighten the sheet metal screws, or the mounting surface can be stripped.

4. Slide the actuator onto the damper shaft, positioning the anti-rotation bracket tab into the slot at the bottom of the actuator. (See Figure 5.)
5. Insert the manual crank. Push it in firmly, and turn it CW 4 or 5 turns (position indicator is at the 3 to 5° mark on the actuator scale). Turn the manual crank 1/4 turn CCW to lock this position.
6. Close the damper tightly.

7. Keeping the actuator flat, evenly hand tighten each clamp nut onto the U-bolt. Use a 10 mm nut driver or adjustable wrench to finish securing the U-bolt to the damper shaft.
8. Turn the manual crank CW to release the spring, and remove the manual crank. (The actuator will spring return to its starting position.)
9. Verify that the actuator rotates freely throughout the range. (This can be done by applying a full stroke control signal or reinserting the manual crank and turning it CW to rotate the coupler to the fully open position.)

## Rotation Range

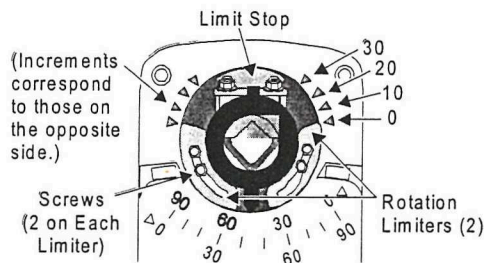
The actuator is factory set for 0 to 93° rotation. The rotation range is changed by repositioning the coupler and adjusting the rotation limiters. This can be done by using an input signal or the manual crank.

To change the rotation range using the manual crank:

1. Push the manual crank into the manual override gear firmly, and wind in a CW direction until the position indicator reaches the 45° position.

**IMPORTANT:** Turn the manual crank in a CW direction only, unless locking a new position.

2. Lock this position by winding the manual crank 1/4 turn CCW or until a slight resistance is felt.
3. Use a 7 mm nut driver to loosen the screws on the rotation limiter. (See Figure 7.)



Note: Rotation limiters are shown factory set in the fully down position for 90° rotation.

**Figure 7: Rotation Limiters**

4. Slide the rotation limiter to the desired position, and retighten the screws to a maximum of 30 lb·in (3.4 N·m).

Examples of rotation limiter adjustments:

For a range of 30°, adjust both limiters fully up.

- To set a rotation range of 45°, adjust one rotation limiter to 30° and the other to 15°.
- To set a range of 60°, adjust one limiter to 30°, and leave the other at 0°.

5. Reinsert the manual crank into the manual override gear.
6. Repeat Steps 2 through 5 to set the rotation range for the second rotation limiter.
7. Release the manual crank spring lock by winding it 1/4 turn in a CW direction.
8. Remove the manual crank, and return it to its original position on the actuator cover.

Note: When changing the rotation range on models with auxiliary switches, one or both switches may need to be adjusted. (See *Auxiliary Switches* section.)

## Feedback Signal

The feedback signal will vary with a change to the rotation range. The resistance feedback is reduced corresponding to the reduced rotation range for the AGD and AGE models.

For the HGA, HGC, JGA, and JGC models, a change to the rotation range changes the feedback signal and the operating range proportionally. (See Figure 8.)

		Rotation Range							
		Rotation Limiter Adjustment				Rotation Limiter Adjustment			
		90°	75°	60°	45°	30°	15°	0°	
		0°	15°	30°	45°	60°	75°	90°	
Direct Acting	0-10V Feedback	10.0V	8.3V	6.7V	5.0V	3.3V	1.7V	0.0V	
	2-10V Feedback	10.0V	8.7V	7.3V	6.0V	4.7V	3.3V	2.0V	
Reverse Acting	0-10V Feedback	0.0V	1.7V	3.3V	5.0V	6.7V	8.3V	10.0V	
	2-10V Feedback	2.0V	3.3V	4.7V	6.0V	7.3V	8.7V	10.0V	
Direct or Reverse Acting	0-135 ohms Feedback	135Ω	113Ω	90Ω	68Ω	45Ω	23Ω	0Ω	
	0-1000 ohms Feedback	1000Ω	833Ω	667Ω	500Ω	333Ω	167Ω	0Ω	

Note: 0-10V or 2-10V is available on HGA, HGC, JGA, JGC models. 0-135 ohms feedback is available on AGD models and 0-1000 ohms feedback on AGE models.

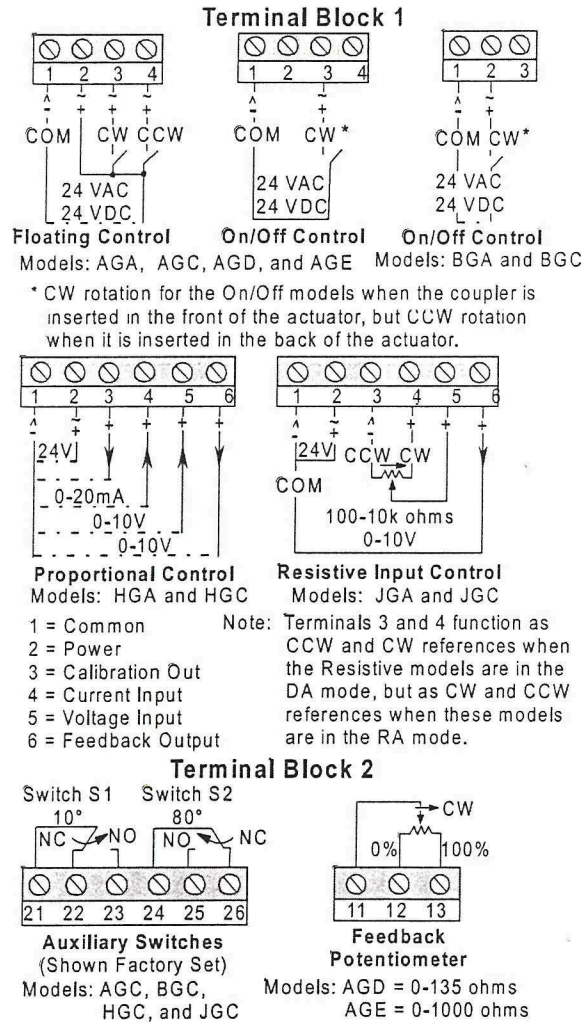
**Figure 8: Nominal Feedback Signal Relative to Rotation Range**

# Wiring

**CAUTION: Equipment Damage Hazard.** Disconnect all power supplies before wiring connections are made, or prior to performing maintenance. Check all wiring connections before applying power to the system. Short-circuited or improperly connected wires will result in permanent damage to the equipment.

**IMPORTANT:** Make all wiring connections in accordance with the National Electrical Code and local regulations. Because of the actuator's movement during operation, wire strain reliefs must be provided.

Refer to Figure 9 for the applicable M9200 actuator.



**Figure 9: Wiring for M9200 Models**

**IMPORTANT:** There is a 25-second delay before the actuator (except the BGA and BGC models) responds after power is applied.

Do not switch 24 VAC from CW to CCW (or CCW to CW) in less than 0.5 seconds.

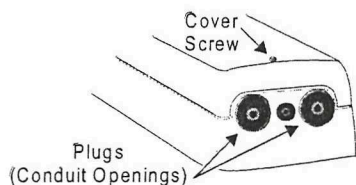
## Options

Wiring is made through the conduit openings or through the conduit adaptor, which converts the opening for a threaded NPT conduit fitting.

### Through the Conduit Openings

Depending on the M9200 model selected, one or both conduit openings are used. Refer to Figure 10 and proceed as follows:

1. Loosen the cover screw with a No. 2 Phillips screwdriver, and remove the actuator cover.
2. Push the plastic plug out of the conduit opening with fingertip.



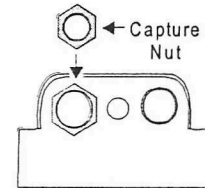
**Figure 10: Location of the Conduit Openings**

3. Puncture a hole through the center of the plug with a Phillips screwdriver, and reinsert the plug into the conduit opening.
4. Insert the cable wires through the hole in the conduit plug, and connect to the terminal block using the wiring diagrams in Figure 9.
5. Replace the actuator cover, and retighten the cover screw.

### With the Conduit Adaptor (M9000-100 included)

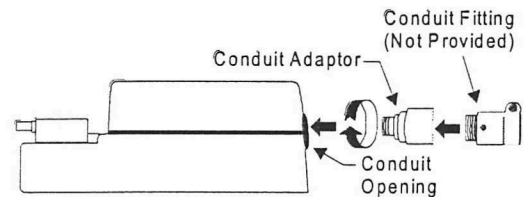
Refer to Figure 11 and proceed as follows:

1. Push the plastic plug out of the conduit opening with fingertip.
2. Slide the capture nut into the slot located inside of the conduit opening. (See Figure 11.)



**Figure 11: Capture Nut**

3. Insert the conduit adaptor into the conduit opening, and hand tighten by turning in a CW direction as shown in Figure 12.



**Figure 12: Conduit Adaptor Wiring**

**IMPORTANT:** Use flexible metallic conduit or its equivalent with the fitting. Do not overtighten the conduit adaptor into the actuator to avoid damaging the actuator housing.

4. Insert the conduit fitting (not provided) into the adaptor, and hand tighten in a CW direction. (See Figure 12.)
5. Insert the cable wires through the conduit adaptor assembly, and connect to the terminal block using the wiring diagrams in Figure 9.
6. Tighten the clamp on the conduit fitting.



# Calibration

## Jumper Settings

Floating (AGA, AGC, AGD, and AGE) and on/off (BGA and BGC) models do not have jumper settings. Resistive (JGA and JGC) models are factory set for direct acting with Jumper W1 in the DA position.

Proportional (HGA and HGC) models are factory set with Jumper W1 in the DA position, Jumper W2 in the 0 to 10 VDC or 0 to 20 mA position, and Jumper W3 in the fixed position. (See Figure 13.)

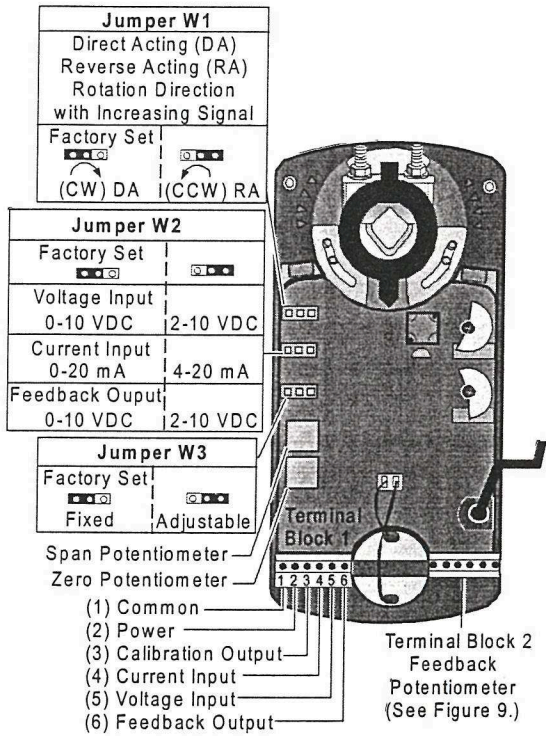


Figure 13: Calibrating M9216 Proportional Models

## Direction of Action

Drive direction is dependent on the position of Jumper W1 and the spring return direction as shown in Table 2. To change the spring return direction, see the *Spring Return Direction* section

Table 2: Settings for Direction of Action

Location of Jumper W1/ Direction of Spring Return	Drive Direction with a Minimum Input Signal	Drive Direction with a Maximum Input Signal
DA/CCW	CCW	CW
RA/CCW	CW	CCW
DA/CW	CW	CCW
RA/CW	CCW	CW

To set an actuator for reverse acting, proceed as follows for the appropriate model:

### Proportional (HGA and HGC) and Resistive (JGA and JGC) Models

1. Move Jumper W1 from the factory set DA position to the RA position. (See Figure 14.)
2. Apply power and then a control signal to the actuator to verify proper operation. (See Table 2.)

Note: HGA and HGC models may require potentiometer settings. Proceed to the *Potentiometer Settings* section.

### Floating (AGA, AGC, AGD, and AGE) Models

For floating models, reverse the control wiring connections from Terminals 3 and 4 to Terminals 4 and 3. (See Figure 9, *Terminal Block 1*.)

### On/Off (BGA and BGC) Models

RA is selected by changing the actuator coupler for on/off operation. (See the *Spring Return Direction* section.)

## Potentiometer Settings

**IMPORTANT:** Both zero and span potentiometers must be adjusted to ensure full actuator travel and complete calibration.

The HGA and HGC models have two potentiometers, zero and span. These potentiometers do not require adjustment when Jumper W3 is in the fixed position (factory set). When Jumper W3 is in the adjustable (ADJ) position, proceed as follows:

Use either Terminals 3 and 5 or Terminals 3 and 4, a control signal, and a voltmeter. The zero and span potentiometers can be adjusted as follows without waiting for the actuator to drive to the final position.

### *Adjusting the Zero and Span*

1. Verify that Jumper W2 is in the 0 to 10 VDC position, and place Jumper W3 in the adjustable (ADJ) position. (See Figure 13.)
2. Provide 24 VAC or 24 VDC power to Terminal 1 (Common) and Terminal 2.
3. Connect the Common from the controller to Terminal 1, and either a voltage signal to Terminal 5 or a current signal to Terminal 4.
4. Connect Terminals 1 and 3 to a voltmeter to monitor the calibration output.
5. Use a 1/8 in. (3 mm) flat-blade screwdriver to turn the zero potentiometer fully CW and the span potentiometer fully CCW.
6. Apply the minimum (zero point) control signal required for positioning the actuator at the minimum position.
7. Monitor DC calibration output. To adjust the zero potentiometer, turn it CCW until the voltmeter displays 0 volts or slightly less (-0.1 volt).
8. Adjust the control signal to the maximum voltage desired to cause full rotation. (Signals greater than 10 volts have no further effect.)
9. Monitor calibration output at Terminals 1 and 3. Adjust the span potentiometer CW to increase the calibration output to 10 volts.
10. Verify that the actuator is properly calibrated by adjusting the control signal to the minimum and maximum levels.

Example for a zero of 3 VDC and a span of 5 VDC:

- a. Apply a 3-volt control signal to the actuator, and turn the zero potentiometer CCW until the calibration output at Terminal 3 is 0 volts.
- b. Apply maximum voltage. (In this case, it is 8 VDC, which results in a span of 5 volts.)
- c. Monitor calibration output at Terminal 3, and adjust the span potentiometer CW until 10 volts is reached.

**Note:** Mechanical movement is not immediate due to a delay in the actuator's response to the control signal.

## Auxiliary Switches

The M9216-xxC models have built-in auxiliary switches which can be set for any angle between 0 and 90° (factory set for 10 and 80°) using either an input signal or the manual crank. (Refer to the *Specifications* section for auxiliary switch ratings.)

The following procedures serve as examples to change the position of the auxiliary switch angles.

### Adjusting Switch Cam S1

To change the angle of Switch Cam S1 to 20°:

1. Insert the manual crank into the manual override gear.
2. Push in and turn the manual crank CW. Using the 0 to 90° nodule guides, rotate the coupler until the position indicator is at 20°.
3. Rotate Switch Cam S1 CCW, aligning the edge of the switch cam with the switch plunger until the plunger rises. (See Figure 14.)

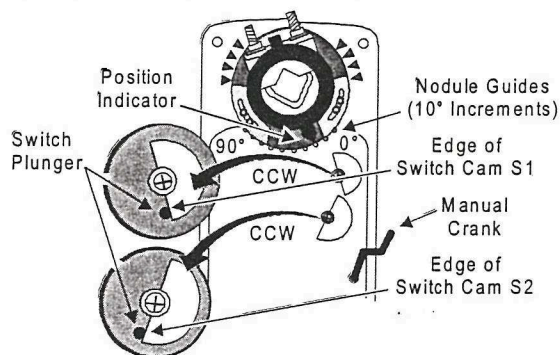


Figure 14: Switch Cam Angle Settings

Note: The normally closed contact closes, and the normally open contact opens. (See Figure 9, *Terminal Block 2, Auxiliary Switches*.)

### Adjusting Switch Cam S2

To change the angle of Switch Cam S2 to 70°:

1. Push in and turn the manual crank CW. Using the 0 to 90° nodule guides, rotate the coupler until the position indicator is at 70°.
2. Rotate Switch Cam S2 CCW, aligning the edge of the switch cam with the switch plunger until the plunger rises. (See Figure 14.)

Note: The normally closed contact opens, and the normally open contact closes. (See Figure 9, *Terminal Block 2, Auxiliary Switches*.)

3. Turn the manual crank CW to release the spring, and remove it. (The actuator will spring return the coupler to the 0° position.)
4. Replace the actuator cover, and return the manual crank to its original position on the actuator cover.

## Replacement and Repair

Field repairs must not be made. To order, refer to the *Ordering Information* section for the desired product code number, and contact the nearest Johnson Controls representative.

# Ordering Information

**Table 3: Actuators Available**

M9200 Series Electric Motor Spring Return Actuator 140 lb-in (16 N-m)	M9216-AGA-2	M9216-AGC-2	M9216-AGD-2	M9216-AGE-2	M9216-BGA-2	M9216-BGC-2	M9216-HGA-2	M9216-HGC-2	M9216-JGA-2	M9216-JGC-2
On/Off Control	*	*	*	*	■	■				
Floating Control	■	■	■	■						
Proportional Control							■	■		
VDC and mA Input with Zero and Span							■	■		
Resistive Input Control									■	■
Feedback										
135 ohm Potentiometer			■							
1000 ohm Potentiometer				■						
0 to 10 VDC Feedback							■	■	■	■
2 Auxiliary Switches		■				■		■		■

\* Can be used with 2-wire on/off control.

Note: All models (except the BGA and BGC) have a 25-second delay upon startup.

**Table 4: Accessories Available**

Product Code Number	Description
<b>DMPR-KR003</b>	Sleeve Pin Kit (for Johnson Controls RD-2000 round dampers with a 5/16 in. diameter shaft)*
<b>DMPR-KC003</b>	Blade Pin Extension without Bracket (for Johnson Controls CD-1300 direct-mount applications)
<b>DMPR-KC254</b>	Inside Frame Mounting Kit (for Johnson Controls damper applications requiring the actuator within the airstream)
<b>M9000-100</b>	Conduit Adaptor Kit
<b>M9000-103</b>	14 VA Transformer, 120/24 VAC, 60 Hz
<b>M9000-104</b>	14 VA Transformer, 230/24 VAC, 60 Hz
<b>M9000-151</b>	Base Mount Linkage Kit (for remote inside duct floor mounting)
<b>M9000-153</b>	Crank Arm Kit (for remote mounting)
<b>M9000-154</b>	1 in. Jackshaft Coupler (for mounting on a 1 in. diameter damper shaft)
<b>M9000-200</b>	Commissioning Tool (provides a control signal to drive proportional [voltage, current, resistive], floating, or on/off actuators)
<b>M9000-500</b>	Valve Linkage Kit (for field mounting M9216 actuators to Johnson Controls VG7000 1/2 in. through 2 in. globe-style valve bodies)
<b>M9000-510</b>	Valve Linkage Kit (for field mounting the M9108, M9116, M9124, and M9216 actuators to VG1000 1/2, 3/4, 1, and 1-1/4 in. ball valves, DN15, DN20, DN25, and DN32)
<b>M9000-511</b>	Valve Linkage Kit (for field mounting the M9124 actuator to the VG1000 1-1/2 in. ball valve, DN40)

\* Furnished with the damper and can be ordered separately.

# Specifications

<b>Product</b>	M9200 Series Electric Spring Return Actuator
<b>Power Requirements</b>	20 to 30 VAC at 50/60 Hz or 24 VDC $\pm$ 10%; 12 VA supply, minimum; Class 2 (10 VA supply, minimum for On/Off models only)
<b>Input Signal</b>	Floating (Axx Models): 24 VAC at 50/60 Hz or 24 VDC, 4.8 mA (on/off mode, 500 mA maximum) On/Off (Bxx Models): 24 VAC at 50/60 Hz or 24 VDC, 420 mA maximum Proportional: 0 to 10 VDC or 0 to 20 mA Resistive: 100 to 10,000 ohms
<b>Input Signal Adjustments</b>	Floating Factory Setting: Terminals 1 and 3, CW rotation; Terminals 1 and 4, CCW rotation On/Off Factory Setting: Terminals 1 and 2, CW rotation Proportional (Voltage Input or Current Input): Jumper selectable, Fixed: 0 (2) to 10 VDC or 0 (4) to 20 mA Adjustable: Zero, 0 to 6V (0 to 12 mA); Span, 2 to 10V (4 to 20 mA) Factory Setting: 0 to 10 VDC, 0 to 20 mA, CW rotation with signal increase Proportional and Resistive: Direction of action is jumper selectable Direct (CW) or Reverse (CCW) with signal increase.
<b>Input Impedance</b>	Proportional: Voltage Input, 205,000 ohms; Current Input, 500 ohms Resistive: 1.8 Megohms
<b>Feedback Signal</b>	Floating: 1,000 ohms or 135 ohms (models with feedback potentiometer) Proportional: 0 to 10 VDC or 2 to 10 VDC for 90° (1 mA at 10 VDC) (Corresponds to input signal span selection and also rotation limits) Resistive: 0 to 10 VDC for 90° (1 mA at 10 VDC)
<b>Switch Contact Rating</b>	Two SPDT (Single-Pole, Double-Throw) rated at 24 VAC 1.5A inductive, 3A resistive, 35 VA maximum per switch
<b>Spring Return</b>	Factory Setting: CCW (Direction is selectable with the coupler.)
<b>Mechanical Output</b>	Running torque: 140 lb-in (16 N·m)
<b>Rotation Range</b>	Adjustable from 30 to 90°, mechanically limited to 93°
<b>Rotation Timing</b>	70 to 130 seconds for 0 to 140 lb-in (0 to 16 N·m); 90 seconds nominal at 50% rated load (Powered rotation is faster in the spring return direction than in the spring winding direction; power failed spring return is less than 15 seconds.)
<b>Cycle Life</b>	65,000 full stroke cycles
<b>Electrical Connection</b>	Screw terminals for 22 to 14 AWG (Insert a maximum of two 18, 20, or 22 AWG per terminal.)
<b>Mechanical Connection</b>	3/8 to 3/4 in. (10 to 20 mm) diameter round shaft 3/8 to 5/8 in. (10 to 16 mm) square shaft
<b>Enclosure</b>	NEMA 2, IP42
<b>Ambient Conditions</b>	Operating: -4 to 122°F (-20 to 50°C); 0 to 95% RH, non-condensing Storage: -40 to 186°F (-40 to 86°C); 0 to 95% RH, non-condensing
<b>Dimensions (H x W x D)</b>	9.82 x 4.57 x 3.62 in. (249.4 x 116 x 91.9 mm)
<b>Shipping Weight</b>	6.4 lb (2.9 kg)
<b>Agency Compliance</b>	UL 873 Listed, File E27734, Guide XAPX for Class 2 operation CSA C22.2 No. 139 Certified, File LR85083, Class 3221 02 for Class 2 operation CE Directive 89/336/EEC

*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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## M9104 Series Electric Motor Actuator

The M9104 Series is a direct-mount line of motor actuators that operates on 24 VAC power and is available for use with incremental or proportional controllers. These non-spring return actuators are easily installed on a Variable Air Volume (VAV) box, a round damper shaft up to 1/2 inch (13 mm) diameter, or a 3/8 inch (10 mm) square shaft.

The M9104 models have a 35 lb·in (4 N·m) running torque and 40 lb·in (4.5 N·m) minimum stall torque. They have a nominal 90 second travel time for 90° of rotation at 60 Hz (108 seconds at 50 Hz).

The M9104 models are available with integral auxiliary switches to perform switching functions at any angle within the selected rotation range. Proportional models feature 0 to 10 VDC position feedback.

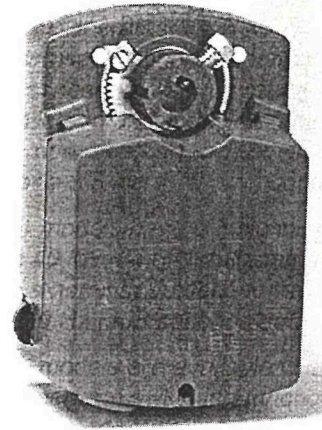


Figure 1: M9104 Series Actuator

Features and Benefits	
<input type="checkbox"/> 35 dBA Rating	Meets audible requirements for open ceilings
<input type="checkbox"/> 100,000-Cycle Rating	Extends actuator life due to improved technology
<input type="checkbox"/> Direct Shaft Mount with Single-screw Coupler	Simplifies installation and provides 3-point shaft gripping
<input type="checkbox"/> Magnetic Clutch	Provides torque protection for the damper and actuator
<input type="checkbox"/> Jumper-selectable Rotation Direction on Proportional Models	Simplifies installation
<input type="checkbox"/> Adjustable Rotation Stops	Allow application versatility with 30 to 90° Clockwise (CW) or Counterclockwise (CCW) rotation
<input type="checkbox"/> 1/2 in. NPT Threaded Conduit Openings	Allow the use of armored cable
<input type="checkbox"/> Manual Gear Release	Simplifies setup and field adjustments
<input type="checkbox"/> 0 to 10 VDC Feedback on Proportional Models	Provides simple, closed-loop control with accurate position sensing

## Application

The M9104 is used to position dampers, such as RD-2000 Series Round Dampers and CD-1300 Control Dampers, in typical HVAC applications. It is also used to position the blades in a VAV box.

Refer to the damper or VAV box manufacturer's information to select the proper timing for the actuator. Refer to the appropriate application note for specific wiring diagrams and information.



**CAUTION: Equipment Damage Hazard.**  
Do not install the actuator in atmospheres where explosive or corrosive vapors or escaping gases are present. This could result in damage to the unit.

## Operation



**WARNING:** All M9104 actuators are designed for use only in conjunction with operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add safety devices or alarm systems that protect against, and/or warn of, control failure.

The M9104 provides a 35 lb-in (4 N-m) running torque and a minimum stall torque of 40 lb-in (4.5 N-m) for floating or proportional control of VAV box dampers.

The M9104 mounts directly on the duct surface, round damper, or small rectangular damper with an anti-rotation bracket and two sheet metal screws (included). Additional linkages or couplers are not required.

A controller provides a control signal to the actuator depending upon the desired movement of the damper blade. This signal causes the motor to rotate in the proper direction and moves the damper blade open or closed.

**Note:** To avoid excessive wear or drive time on the motor, use a controller and/or software that provides a time-out function to remove the signal at the end of rotation (stall).

The actuator rotates at a nominal rate of 1° per second (90° in 90 seconds) at 60 Hz input. The actuator rotation is field adjustable from 30 to 90°. Actual rotation time for actuators, using less than 90° rotation, should be determined and that value used with the controller software. For example, 60 seconds would be used for 60° rotation.

## Dimensions

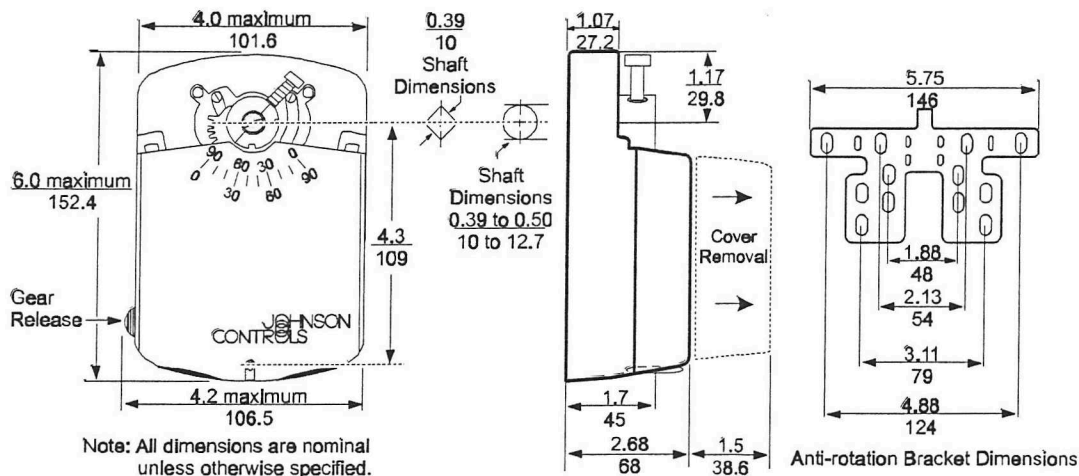


Figure 2: Actuator and Anti-rotation Bracket Dimensions, in. (mm)

## Installation

### Parts Included

- M9104 Series actuator
- anti-rotation bracket
- two No. 12-24 sheet metal screws
- spade terminals

### Tools Required

- 1/4 in. (7 mm) flat-blade screwdriver
- Phillips No. 1 screwdriver
- center punch
- 5/16 in. (8 mm) square socket or 3/8 in. (10 mm) 12-point socket
- needle-nose pliers

## Mounting

The M9104 actuators are not position sensitive and can be mounted in any convenient orientation. They can be installed on a 3/8 in. to 1/2 in. (10 to 13 mm) round shaft or a 3/8 in. (10 mm) square shaft that is 1.7 in. (43 mm) or longer. If the shaft is less than 1.7 in. (43 mm), install an extension recommended by the damper manufacturer.

To mount the actuator, proceed as follows:

1. Press and hold the gear release lever, and rotate the coupler to the 0 or 90° position. Release the gear release lever. (See Figure 4.)
2. Bend or cut the anti-rotation bracket to fit the damper frame or duct as shown in Figure 3.

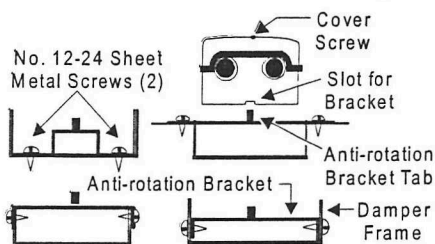


Figure 3: Anti-rotation Bracket Positions

3. Close the damper.
4. Insert the anti-rotation bracket tab into the slot at the bottom of the actuator (shown in Figure 3), and slide the actuator onto the shaft.
5. Refer to the "A" Dimensions in Table 1 and Figure 4 to position the anti-rotation bracket tab midway in the actuator slot.

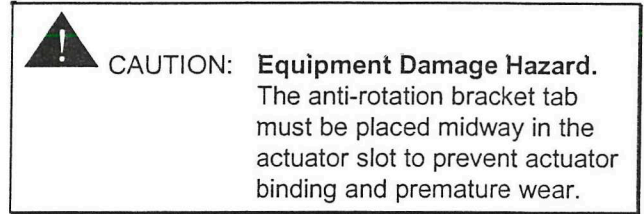


Table 1: Shaft Sizes and Distances from the Anti-rotation Bracket to Shaft Center

Shaft Diameter	1/2 in.	3/8 in.
"A" Dimensions	5-1/8 in.	5-1/16 in.
	130 mm	128 mm

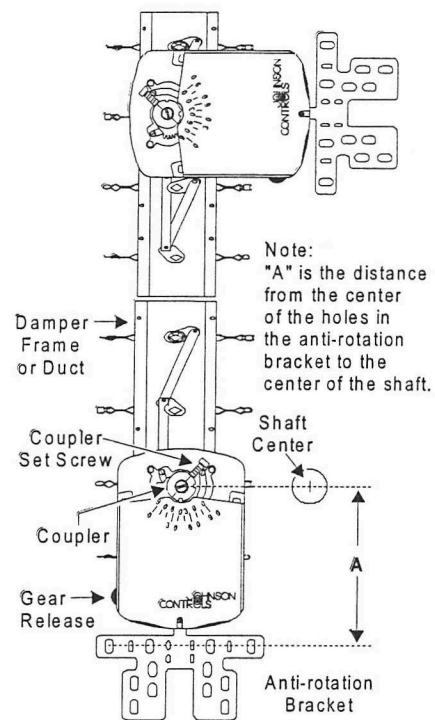
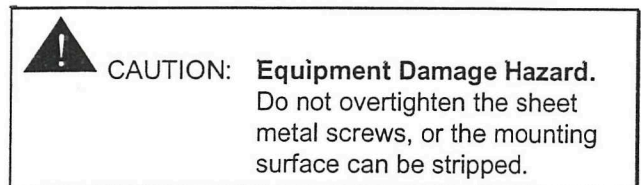


Figure 4: Mounting Positions

6. Attach the anti-rotation bracket to the damper or duct using two No. 12-24 sheet metal screws.



7. Secure the coupler to the shaft using a 5/16 in. (8 mm) square socket or 3/8 in. (10 mm) 12-point socket to tighten the coupler set screw against the damper shaft. (See Figure 4.)



- Continue tightening the coupler set screw shown in Figure 4 to achieve a torque of 150 to 180 lb·in (17 to 20 N·m).

Note: Keep the actuator parallel to the mounting surface while tightening the set screw.

- Press and hold the gear release lever, and turn the shaft by hand to ensure the damper rotates from its fully closed to fully open position.
- Release the gear release lever.

## Setting the Actuator Stroke

The damper must be checked as follows:

- Make sure that the damper blade is visually accessible or its position is permanently marked on the end of the damper shaft as shown in Figure 5.

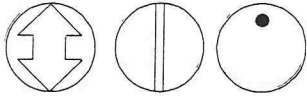


Figure 5: Damper Position Icons

- Grasp the damper shaft firmly with a pliers and manually turn the damper to fully open.

## Rotation of 90°

If the damper shaft rotation is 90°:

- Press and hold the gear release lever shown in Figure 4, and rotate the actuator coupler and damper shaft to the fully closed position as shown in Figure 6.

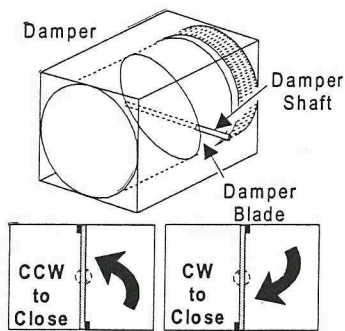


Figure 6: Damper Rotation

- Note the rotation travel (30 to 90°) and direction, either Clockwise (CW) or Counterclockwise (CCW), required to close the damper.

If rotation is less than 90°, proceed to *Rotation Less than 90°* section.

- Release the gear release lever.

## Rotation Less than 90°

If the damper shaft rotation is less than 90°, the stroke of the actuator has to be adjusted with the scale on the actuator cover. (See Figure 7.)

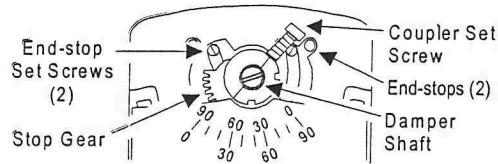


Figure 7: Setting the Rotation Range

Use the center of the coupler set screw as a pointer to observe the position on the scale when rotating the coupler from one side to the other.

Examples:

- For a rotation range of 90°, move both end-stop set screws fully up as shown in Figure 7.
- To set a rotation range of 60°, leave one end-stop set screw fully up, and adjust the other set screw so the coupler rotates between the 30° and the 90° indicator marks on the scale.
- To set a rotation range of 45°, adjust both end-stop set screws so the coupler rotates between the 30° and 75° indicator marks on the scale.
- To set a rotation range of 30°, move both end-stop set screws so the coupler rotates between the 30° and 60° indicator marks on the scale.

To accurately set the end-stops:

- Press and hold the gear release lever. Turn the actuator coupler to the minimum rotation position for the minimum ventilation flow required.
- Release the gear release lever.
- Use a flat-blade screwdriver to loosen the end-stop set screw on the actuator that is closest to the stop gear, and move it in its slot so it is tight against the stop gear. (See Figure 7.)

**IMPORTANT:** Do not remove the end-stop set screws, as this could interfere with the actuator's operation.

- Repeat Steps 1 through 3 to set the desired maximum rotation position.
- Tighten both end-stop set screws to a minimum of 25 lb·in (2.8 N·m).
- Turn the actuator coupler and the damper shaft to the minimum rotation position.

# Calibration

## Jumper Settings

The M9104-AGx-2 floating actuators do not have jumper settings. The M9104-GGx-2 proportional actuators are factory set for direct acting with Jumper W1 in the DA position. For 0 to 10 VDC input, Jumper W2 is in the 0 to 10 position, and Jumper W3 is in the VDC position.

The VDC/mA terminal is the control signal input. For voltage input, Jumper W3 must be in the VDC position. For current input, Jumper W3 must be in the mA position. The FB Terminal is the feedback output. (See Figure 8.)

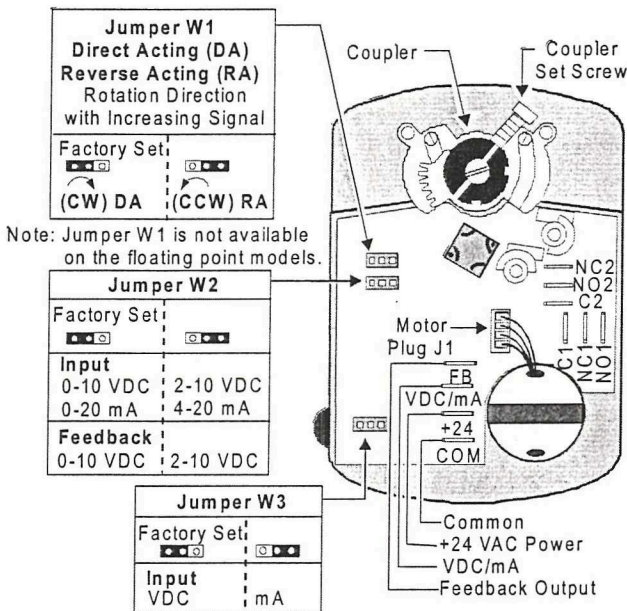


Figure 8: Calibrating M9104-GGx-2 Models

## Direction of Action

In the DA mode, a minimum control signal will drive the actuator to the full CCW position, and a maximum control signal will drive it to the full CW position.

For Reverse Acting (RA) operation, a minimum control signal will drive the actuator to the full CW position, and a maximum control signal will drive it to the full CCW position.

To set an actuator for RA, perform the procedures that follow for the appropriate model.

## Floating (AGA and AGC) Models

To select the actuator's direction of action, loosen the cover screw, and remove the actuator cover. For CW rotation, apply 24 VAC to the COM and CW Terminals. For CCW rotation, apply 24 VAC to the COM and CCW Terminals. (See Figure 9.)

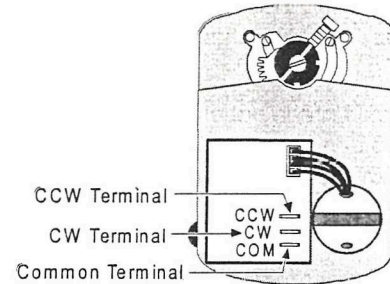


Figure 9: Rotation for Floating Models

**IMPORTANT:** Do not use Motor Plug J1 to reverse the rotation direction, or the actuator will not operate properly.

## Proportional (GGA and GGC) Models

The M9104-GGx-2 actuators are factory set for Direct Acting (DA). To set the actuator for Reverse Acting (RA), loosen the cover screw, and remove the actuator cover. Remove Jumper W1, and place it in the RA position. (See Figure 8.)

## Feedback Signal

The feedback signal will vary with a change to the rotation range. For the GGA and GGC models, a change to the rotation range changes the feedback signal and the operating range proportionally. (See Figure 10.)

		Rotation Range						
		Set Screw Adjustment			Set Screw Adjustment			
		90°	75°	60°	45°	30°	15°	0°
		0°	15°	30°	45°	60°	75°	90°
Direct Acting	0-10V Feedback	10.0V	8.3V	6.7V	5.0V	3.3V	1.7V	0V
	2-10V Feedback	10.0V	8.7V	7.3V	6.0V	4.7V	3.3V	2.0V
Reverse Acting	0-10V Feedback	0.0V	1.7V	3.3V	5.0V	6.7V	8.3V	10.0V
	2-10V Feedback	2.0V	3.3V	4.7V	6.0V	7.3V	8.7V	10.0V

Note: 0-10V or 2-10V is available on GGA and GGC models.

Figure 10: Nominal Feedback Signal Relative to Rotation Range

# Specifications

<b>Product</b>	M9104 Series Electric Motor Actuator
<b>Power Requirements</b>	Floating: 20 to 30 VAC at 50/60 Hz; 3.4 VA supply, minimum; Class 2 Proportional: 20 to 30 VAC at 50/60 Hz; 5.0 VA supply, minimum; Class 2
<b>Input Signal</b>	Floating: 20 to 30 VAC at 50/60 Hz Proportional: 0 to 10 VDC or 0 to 20 mA
<b>Input Signal Adjustments</b>	Floating: CW and COM Terminals, CW rotation; CCW and COM Terminals, CCW rotation Proportional: Voltage Input or Current Input Jumper-selectable: 0 (2) to 10 VDC or 0 (4) to 20 mA Factory Setting: 0 to 10 VDC, CW rotation with signal increase Proportional: Action is Direct (CW) or Reverse (CCW) with signal increase (jumper-selectable).
<b>Input Impedance</b>	Floating: 250 ohms, nominal Proportional: Voltage Input, 150,000 ohms; Current Input, 500 ohms
<b>Feedback Signal</b>	Proportional: 0 to 10 VDC or 2 to 10 VDC for 90° (1 mA at 10 VDC) (Corresponds to input signal span selection.)
<b>Switch Contact Rating</b>	Two SPDT (Single-Pole, Double-Throw) rated at 24 VAC 1.5A inductive, 3A resistive, 35 VA maximum per switch
<b>Electrical Connections</b>	1/4 in. spade terminals (optional Pluggable Terminal Blocks)
<b>Mechanical Connection</b>	3/8 to 1/2 in. (10 to 12.7 mm) round shaft or 3/8 in. (10 mm) square shaft
<b>Enclosure</b>	NEMA 2, IP32
<b>Torque</b>	Running: 35 lb-in (4 N·m) Breakaway: 35 lb-in (4 N·m) minimum Stall: 40 lb-in (4.5 N·m) minimum
<b>Cycles</b>	100,000 full cycles, 2,500,000 repositions rated at 35 lb-in (4 N·m)
<b>Audible Noise Rating</b>	35 dBA maximum at 1 m
<b>Rotation</b>	Adjustable from 30 to 90°, CW or CCW
<b>90 Degree Rotation Time</b>	Nominal 90 seconds at 60 Hz Nominal 108 seconds at 50 Hz
<b>Ambient Operating Conditions</b>	-4 to 125°F (-20 to 52°C); 90% RH maximum, non-condensing
<b>Ambient Storage Conditions</b>	-40 to 176°F (-40 to 80°C); 90% RH maximum, non-condensing
<b>Dimensions (H x W x D)</b>	5.9 x 4.2 x 2.64 in. (150.1 x 106.5 x 67 mm)
<b>Shipping Weight</b>	2.4 lb (1.08 kg)
<b>Agency Compliance</b>	UL 873 Listed, File E27734, Guide XAPX CSA C22.2 No. 139, File LR85083, Class 3221 02 CE Directive 89/336/EEC

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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## CD-1300 Control Dampers Class I, II, and III Leakage Resistance

*Johnson Controls provides top quality control dampers that fit your size and application requirements.*

- Class I leakage resistance  
 CD-1330 **Airfoil**  
 (high performance) blades
- Class II leakage resistance  
 CD-1320 **Double-piece**  
 (performance) blades
- Class III leakage resistance  
 CD-1310 **16-gauge**  
 (standard value) blades

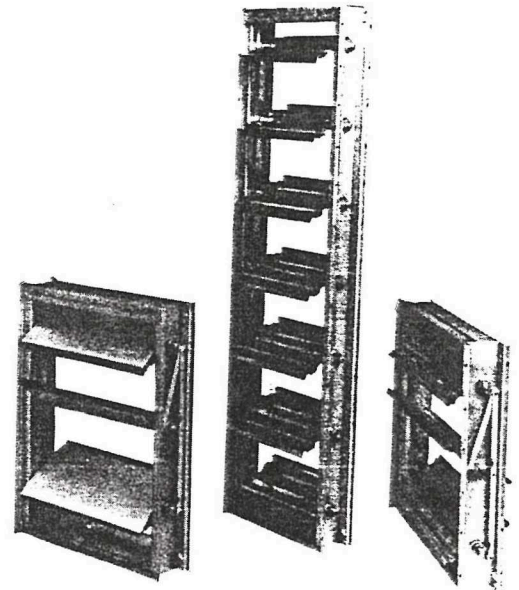


Figure 1: CD-1300 Damper Family

Features and Benefits	
<input type="checkbox"/> <b>Tested to Over 100,000 Cycles</b>	Assures long damper life
<input type="checkbox"/> <b>Three-Year Warranty on Materials and Workmanship</b>	Provides confidence of company standing behind product
<input type="checkbox"/> <b>Self-compensating, Stainless Steel Side Seals</b>	Minimizes leakage between the blades and the damper frame
<input type="checkbox"/> <b>Blade Rotation Stop</b>	Prevents over-rotation of blades in fully open position
<input type="checkbox"/> <b>Square Blade Pins</b>	Provides non-slip pivoting of the blade
<input type="checkbox"/> <b>Five Working Day Standard Shipping</b>	Results in fast response for short lead time projects
<input type="checkbox"/> <b>One Working Day Fast Track Shipping Available</b>	Fast Track provided at a cost premium

# Performance Data

	CD-1310	CD-1320	CD-1330
<b>Leakage tested in accordance with AMCA Standard No. 500</b>	See Figure 9.	See Figure 10.	See Figure 11.
<b>Operating Torque</b> @ 0.5 in. static, 100 fpm velocity @ 1 in. static, 1000 fpm velocity	3.25 in-lb/sq ft 4.25 in-lb/sq ft	4.5 in-lb/sq ft 5.5 in-lb/sq ft	4.5 in-lb/sq ft 5.5 in-lb/sq ft
<b>Velocity and pressure limits recommended to meet other performance specifications (not structural limits):</b>			
12 in. wide damper	6000 fpm 6 in. W.C.	8000 fpm 8 in. W.C.	8000 fpm 12 in. W.C.
24 in. wide damper	4500 fpm 6 in. W.C.	6000 fpm 8 in. W.C.	8000 fpm 10 in. W.C.
36 in. wide damper	3000 fpm 4.5 in. W.C.	4000 fpm 6 in. W.C.	6000 fpm 10 in. W.C.
48 in. wide damper	1500 fpm 3 in. W.C.	2000 fpm 4 in. W.C.	4000 fpm 4 in. W.C.
<b>Pressure Drop</b>	Approach Velocity (fpm)		
Damper fully open	<b>1000</b>	<b>2000</b>	<b>3000</b> <b>4000</b>
12 x 12 in.	0.16	0.62	
24 x 24 in.	0.05	0.20	0.42    0.77
48 x 48 in.	0.03	0.10	0.25    0.45
<b>Standard Temperature Rating</b>	-40°F to 200°F (-40°C to 93°C)		
<b>High Temperature Rating</b> CD-1320 with bronze bearing and silicone seals	-65°F to 250°F (-54°C to 121°C)		

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.

At Johnson Controls, delivering environmentally sound products and services is part of our corporate-wide commitment to continuous improvement. We do this by reducing raw material consumption, recycling, eliminating the use of toxins, and conserving and preserving natural resources. We believe that what is good for the environment and the safety and health of all people is good for Johnson Controls. And we never forget that clean water, air, and land is everyone's business.



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**FAN 268.1**  
Damper and Actuator Product Guide  
Printed in U.S.A.



## Operator Workstation

*Total Optimized Control. That's how the Metasys® Network manages your system. That's also the whole idea behind the Metasys Operator Workstation (OWS). It combines sophisticated software features with industry standard personal computers into an easy-to-learn information management tool. Thanks to its instantly understandable graphics-based interface, everything in the Metasys Network from alarm monitoring to developing new control strategies can be done quickly and easily. Operators spend less time learning how to use the system, and more time using it to improve occupant comfort and to reduce your facility's operating costs.*

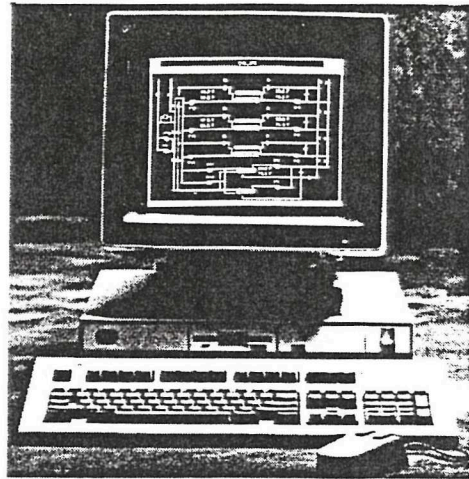


Figure 1: Operator Workstation

Features and Benefits	
<input type="checkbox"/> <b>Mouse-driven Interface with a Convenient Combination of Graphics and Text</b>	Allows ease of use
<input type="checkbox"/> <b>Consistent Interface to HVAC, Lighting, Fire, and Access Control Functions; Full English Commands and Descriptors</b>	Provides learning ease
<input type="checkbox"/> <b>Point Focus Windows, Standard Summaries, Historical Data Storage</b>	Allows powerful facility analysis
<input type="checkbox"/> <b>Advanced Alarm Management Program, Alarm Messages, Maintenance Messages, and Operator Instructions</b>	Reduces maintenance problems
<input type="checkbox"/> <b>Dynamic Information Exchange Between the Metasys Network and Third-party Windows® Applications</b>	Provides Metasys data that can be easily integrated with spreadsheets and other applications

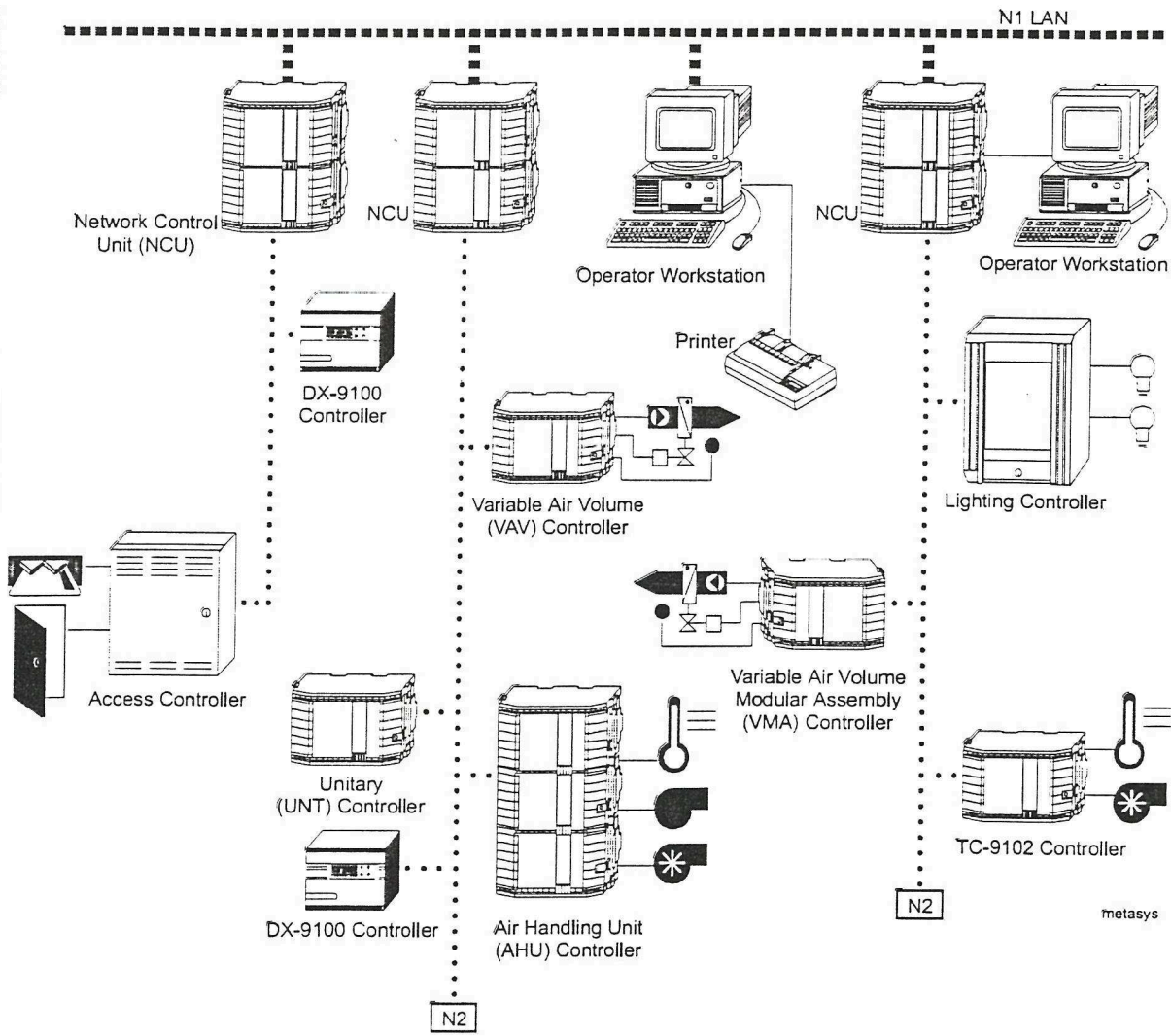


Figure 2: Metasys Network with Operator Workstation

## Simplest Interface

The Metasys Operator Workstation was designed to be easy to learn and use while still providing advanced facility management capabilities. It presents graphical displays of your facility's floor plans and equipment schematics that instantly show potential problem areas through the use of vivid colors and dynamic data displays. Your operators use a computer mouse to "point and click" their way through your facility without ever touching a keyboard. And when detailed information is needed about some aspect of your facility, the Operator Workstation can quickly supply a wealth of trend graphs, history logs, schedules, and more, all at the touch of a button. Why is the Operator Workstation so easy to learn? First, it is based on the popular Microsoft® Windows software, which has proven itself in many microcomputer applications to reduce learning time compared to conventional text and keyboard-oriented software schemes. Instead of memorizing codes, select the functions you want to perform by pointing to them. And what you point to is the second reason why the Operator Workstation is easy to learn.

The Metasys Network uses an object-oriented software architecture distributed throughout the network. This allows an Operator Workstation to simultaneously gather information from anywhere on the network and consolidate it into facility-wide reports. All your facility's equipment is logically organized and displayed in both full color dynamic graphics and easy-to-use text displays.

The Operator Workstation also lets you run other popular software packages. Programs that are directly compatible with Microsoft Windows, such as word processing and graphics packages, run concurrently with all Metasys Operator Workstation functions.

What's more, with the optional Metalink™ program, Windows-based spreadsheets, word processors, and database managers can be linked to "live" Metasys data. For example, energy usage reports can be prepared that contain up-to-the-minute consumption and operating costs.

Your facility operators will quickly master the Operator Workstation, making full use of Metasys capabilities. This means that you will realize the full benefits of the Metasys promise--comfort and safety for your occupants and lower operating costs for your facility.

## Network Map

Getting anywhere in the Metasys Network is easy. And figuring out how to get there is even easier, thanks to the Metasys Network Map, a hierarchical representation of the entire system.

The Network Map shows you how everything is laid out, in a format similar to a family tree. Operators see the entire facility management system at a glance--which systems serve which floors, which zones are served by different mechanical systems, etc.

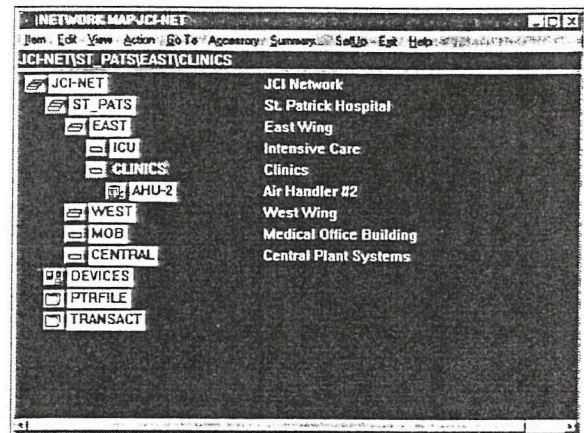


Figure 3: Network Map Lets Operator Penetrate to Any System

Finding your way to the desired information is simply a matter of using the mouse to point to a particular floor or piece of equipment and clicking the button. It's not necessary to "drive" through a time-consuming series of screens, because the operator gets directly to any level of information desired from a single display.



## Graphical System Penetration

Through a single click of the mouse, the operator can change from a textual to a graphical representation of your facility. The operator can “move” through buildings, floors, and areas without ever leaving the terminal by simply pointing at symbols and clicking the mouse button. In a flash, going from one building to another is a click away.

Using the high-resolution color graphics, an operator may look at the outside representation of a building and see a problem area.

Then, penetrating to a particular floor by clicking with the mouse button, the operator can display the floor in question, along with all current information, including security and fire zone status.

By clicking on the symbol for the Air Handling Unit (AHU) for that floor, the operator can then make any adjustments necessary to bring the equipment back in line with the rest of the system.

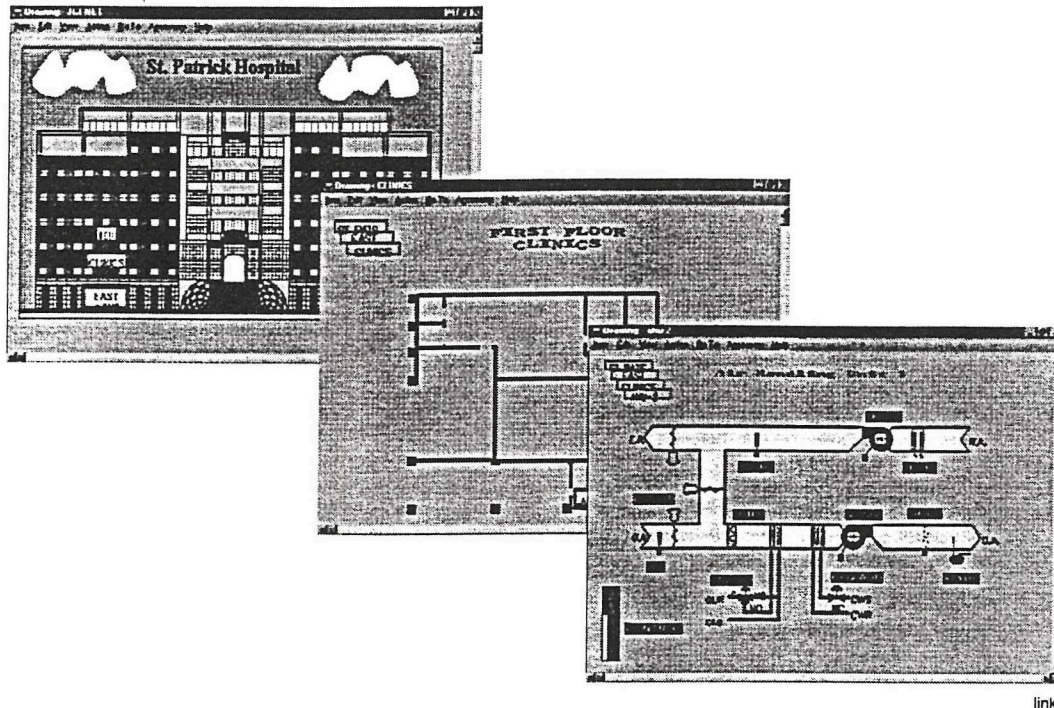


Figure 4: Linked Graphical Screens Allow System Penetration

## Point Focus Window

While the operation of your facility is usually reviewed through displays that represent groups of points, such as floor plans or mechanical systems, it is sometimes necessary to focus on a single piece of equipment or a point monitoring the temperature in a single area. That's where the Metasys Point Focus Window comes into play.

From the Network Map or a system graphic display, the operator can zoom in on specific information related to any point in the network.

This information will include its current reading, its setpoint and deadband, current alarm status, associated alarm messages, whether it's enabled or disabled, etc.

Rather than just a static picture, the Point Focus Window displays a point's value as a dynamic trend graph, allowing the operator to watch how the point is actually performing.

## Point History Feature

Fine tuning a system requires more than current readings, however. This is why the Metasys Network has been designed to offer not only instantaneous access to current conditions, but also historical performance information as well.

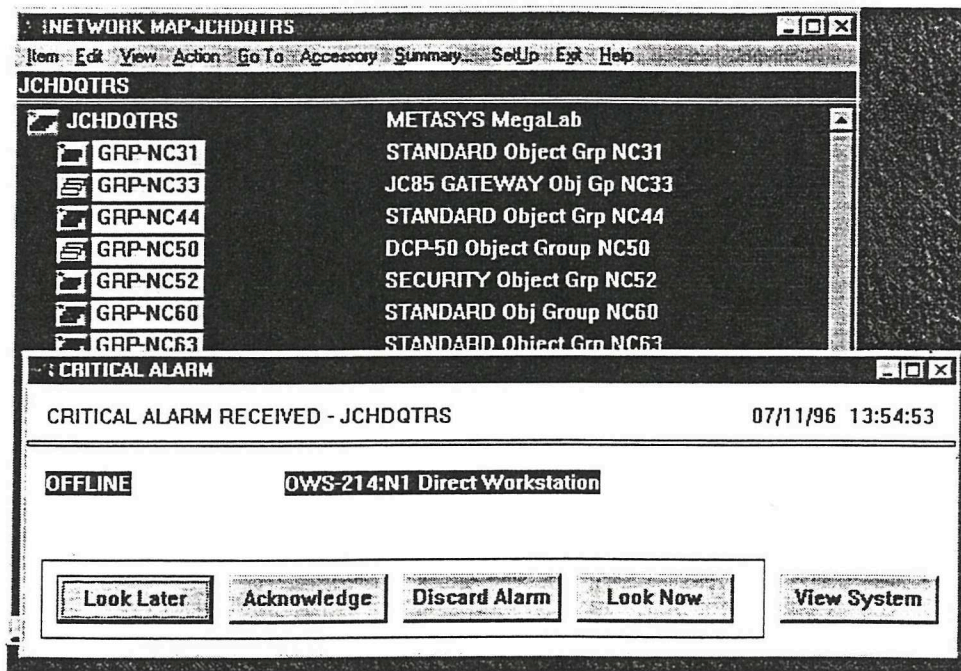
When the Point History feature is enabled, the Metasys Network anticipates your need for information by automatically collecting periodic data samples for every point in the system, without any programming or setup by the user.

This information can be optionally uploaded to an Operator Workstation for longer term data analysis. By sampling every point, your operators see changes in operational trends that could potentially lead to a problem, before it occurs. And when a problem does happen, you can analyze it based on the conditions that led up to it or resulted from it, and prevent it from happening again.

## Sophisticated Alarm Management

Because all alarms that occur in a facility don't deserve the same attention, the Metasys Network handles each point in a different way. Some alarms are more important than others, so the Operator Workstation prioritizes and displays the most important ones first. And, since different types of alarms are only important to certain operators, the Metasys Network selectively direct various alarms to different Operator Workstations anywhere on the network—even remotely connected via a dial-up modem.

When critical building alarms occur, the Operator Workstation provides the operator with immediate notification. In addition to acknowledging the alarm, the operator has the option of placing the alarm record in either a reminder file (notify the operator again that the alarm still exists) or a follow-up file (track the alarm report and any follow-up activities that are being used to rectify the situation). This prevents the danger that an alarm may be forgotten altogether. Non-critical alarms are saved in the Operator Workstation where they may be dealt with at the operator's convenience.

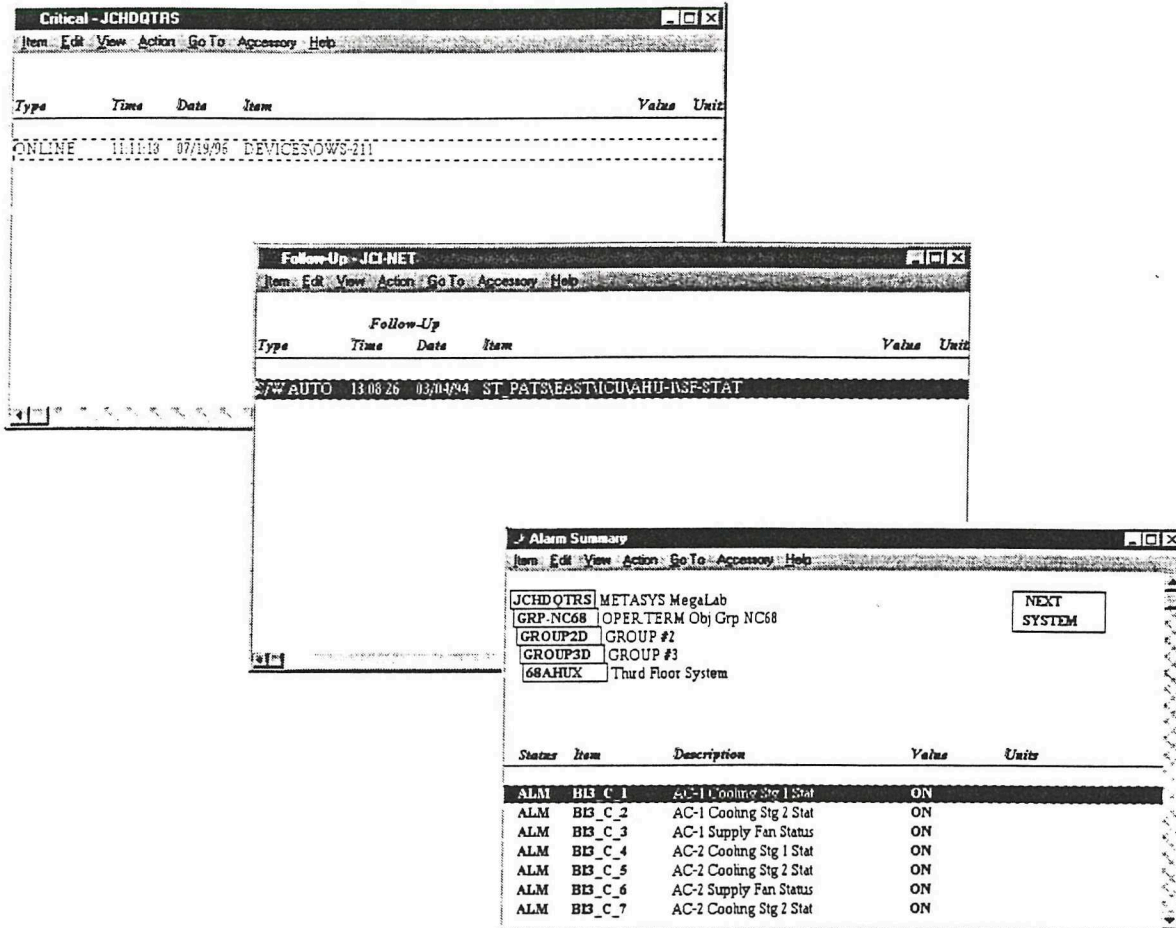


alarms

Figure 6: Metasys Operator Quickly View and Respond to Critical Alarms

# Full Complement of Summaries

Keeping track of alarms is just one function of the Metasys Operator Workstation. Summaries of all points and limits are quickly available, as are summaries of all points that are overridden, in alarm, disabled, or locked out.



summary

Figure 7: Metasys Network Provides a Wide Array of Comprehensive Summaries and Reports

## **P**assword Protection

To minimize the chance of unauthorized use of such a simple, yet powerful workstation, network security is provided through five levels of password access. Based on the clearance level assigned by the building manager or owner, each user may have access to only certain commands. Additionally, the user can be restricted to selected building equipment and system points. And, because the operator only sees those items and commands to which he has access, Password actually adds to the simplicity of the interface as well as ensures its security.

The Metasys Network can also provide valuable documentation regarding operator activity. By saving all transactions in the Operator Workstation, the Metasys Network allows managers and users to quickly and conveniently review how equipment was started, stopped, or overridden, when alarms were acknowledged, when setpoints were changed, etc.

## **M**ultiple Hardware Platforms

The Operator Workstation software operates on a number of popular microcomputers. Personal Computers (PCs) using the Pentium® processor is the preferred hardware platform. They offer superior performance and adaptability to future advances in the microcomputer industry. In addition, a portable or laptop PC can be used as a portable operator's terminal with some restrictions on software feature availability.

## **F**lexible Configurations

The Metasys Network supports multiple Operator Workstations connected to its network. A workstation may be connected directly to the N1 LAN (Local Area Network) by means of an ARCNET® or Ethernet communications card installed within the PC. It may also be connected to as many as four Network Control Units on separate networks using simple RS-232 connections. Finally, a workstation can be connected to an NCU using a dial-up or leased line telephone modem, allowing remote monitoring and programming of the Metasys Network.

Regardless of how the Operator Workstation is connected to the Metasys Network, it has full and total access to all points on the system, restricted only by the user's password.

## **C**onclusion

The Operator Workstation combines the best industry standard hardware and software with Johnson Controls 100-plus years of control experience to create an easy-to-learn and use, yet powerful interface to the Metasys Network.

But the energy that went into putting this system together is nothing compared to the energy your facility will save by using it.

# Specifications

<b>Recommended PC Platforms</b>	Pentium-based models or higher (Refer to the <i>Metasys Network Technical Manual [FAN 636]</i> , <i>Operator Workstation Configurations Bulletin [LIT-636013d]</i> for a current list of supported models.)
<b>Memory</b>	128 Mb of RAM recommended for Windows 98 64 Mb of RAM for Windows 98 (minimum required)  256 Mb of RAM recommended for Windows NT® 128 Mb of RAM for Windows NT (minimum required)
<b>Disk</b>	CD-ROM drive for loading software; 10 GB hard disk recommended, 2 GB hard disk minimum required
<b>Monitor</b>	VGA (640 x 480) or better; Super VGA (800 x 600); Hi-Rez VGA (1280 x 1024)
<b>Software</b>	Microsoft Windows 98 or Microsoft Windows NT Metasys Person-Machine Interface (PMI)
<b>Optional Software</b>	M-Web (Standard or Enterprise Editions)
<b>Ambient Operating Conditions</b>	Refer to PC vendor literature.
<b>Ambient Storage Conditions</b>	Refer to PC vendor literature.
<b>Approximate Dimensions System Unit (H x W x D)</b>	
<b>Desktop</b>	152 x 406 x 419 mm (6 x 16 x 16.5 in.)
<b>Floor Standing</b>	597 x 165 x 483 mm (23.5 x 6.5 x 19 in.)
<b>Portable</b>	114 x 216 x 343 mm (4.5 x 8.5 x 13.5 in.)
<b>Shipping Weight</b>	Varies according to model. Refer to vendor literature.
<b>Agency Compliance</b>	FCC Part 15, Subpart J, Class A UL 916 CSA C22.2 No. 205 Refer to PC vendor literature for CE Mark compliance.
<b>Agency Listings</b>	UL Listed and CSA Certified
<b>Accessories (Order Separately)</b>	Modem (for dial-up or multi-direct connections) ARCNET N1 LAN board (for N1 LAN connection) Ethernet IP N1 LAN board (for N1 LAN connection) Serial communications board (for multiple direct connections)

*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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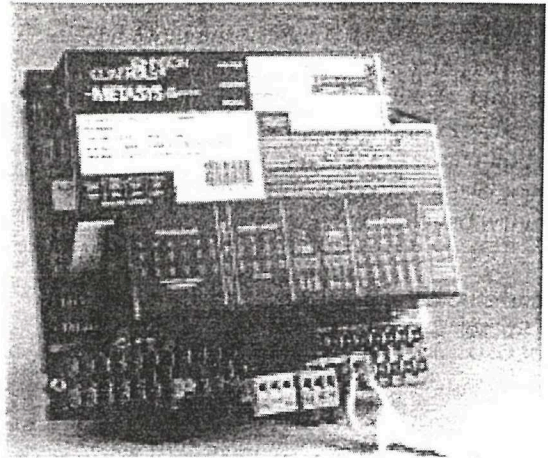
[www.johnsoncontrols.com](http://www.johnsoncontrols.com)  
**FAN 635**  
Metasys Network Sales Resource Manual  
Release 11.00  
Printed in U.S.A.



# Unitary Controller (UNT)

*The Metasys® Unitary (UNT) Controller is an electronic device for digital control of packaged air handling units, unit ventilators, fan coils, heat pumps, and other terminal units serving a single zone or room. It can also be configured as a generic input/output device for basic point monitoring applications when used within a Metasys Network.*

*You can easily configure point inputs and outputs and software features to control a wide variety of HVAC equipment applications. You may use the UNT as a standalone controller or connected to the Metasys Network through a Network Control Module (NCM) or Companion™.*



**Figure 1: Unitary Controller**

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>Standalone Control</b>	System reliability
<input type="checkbox"/> <b>Network Communications over N2 Bus</b>	Facility-wide control efficiencies and cost effective sensor sharing
<input type="checkbox"/> <b>Built-in Control Program Library</b>	No programming
<input type="checkbox"/> <b>Isolated N2 Circuitry</b>	More reliable operation
<input type="checkbox"/> <b>Removable N2 and 24 VAC Power Plugs</b>	Allows disconnection of an individual controller without disrupting other controller connections
<input type="checkbox"/> <b>Screw Terminals for I/O Connections Available in Some Models</b>	"Quick Connect" lugs and crimping tool not required
<input type="checkbox"/> <b>Available Pre-mounted in Single High EWC Enclosure with 50 VA Transformer</b>	Easy to mount on any wall Lockable, ready to go

## Flexible Hardware Packaging

The Unitary Controller is available in different hardware sets to suit environmental and application needs. A list of the controller

hardware that is the same is listed below. Following that is a table describing the hardware differences.

**Table 1: Unitary Controller Hardware Characteristics--Similarities**

<b>6 Analog Inputs</b>	RTD temperature elements (1000 ohm nickel, platinum, or silicon) Adjustable 0 to 2K ohm setpoint potentiometers 0 to 5 VDC, 1 to 5 VDC or 0 to 10 VDC transmitters
<b>4 Binary Inputs</b>	(4) 24 VAC input only (24 VAC provided) (1) Momentary pushbutton from zone sensor for temporary occupancy mode (BI 5) BI 4 may be used as an accumulator input for frequencies less than 2 Hz.
<b>Zone Bus (See Table 2 below.)</b>	Removable screw terminal block, LED Indication, 8-pin phone jack on controller
<b>24 VAC Power in Termination</b>	Removable screw terminal block
<b>N2 Bus</b>	Removable screw terminal block, electronically isolated circuitry

**Table 2: Unitary Controller Hardware Characteristics--Differences**

	UNT110-1	UNT111-1	UNT120-1	UNT121-1	UNT140-1	UNT141-1
<b>Operating Temperature Rating</b>	32 to 140°F (0 to 60°C)	32 to 140°F (0 to 60°C)	-40 to 140°F (-40 to 60°C)	-40 to 140°F (-40 to 60°C)	32 to 140°F (0 to 60°C)	32 to 140°F (0 to 60°C)
<b>Analog Outputs: 0 to 10 VDC @ 10 mA</b>	None	2	None	2	None	2
<b>Binary Outputs: 24 VAC Triacs @ 0.5 amps or 0.8 amps if total power is limited Low or High side common selectable</b>	8	6	8	6	8	6
<b>Zone Bus (See Table 1 above.)</b>					Additional 6-pin Phone Jack	Additional 6-pin Phone Jack
<b>I/O Terminations</b>	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Quick Connects (Spade Lugs)	Fixed Screw Terminal Block	Fixed Screw Terminal Block
<b>Available pre-mounted in EWC10 with 24 VAC 50 VA transformer</b>	UNT110-101	UNT111-101			UNT140-101	UNT141-101

## **F**lexible Hardware Packaging

The Unitary Controller can be configured to match most applications found in today's fast evolving marketplace. The UNT is available in two different versions, differing in their output point configuration. Each of these two versions are available in models with "Quick Connects" (spade lugs) or screw terminations for input/output points. The versions with "Quick Connects" are also available in low temperature models for rooftop applications. This allows you to economically select a controller to match the needed application.

## **C**ontroller Enclosure Options

The controller mounts easily to any surface using either direct mount or a controller enclosure. The common packaging for the UNT Controller is in the ENC100 or EWC10. The UNT120/121 Controller must be installed in the BZ-1000-7 enclosure unless it is mounted within the enclosed low voltage electrical compartment of the mechanical unit being controlled.

The UNT controller can be purchased pre-mounted in an EWC10 enclosure, including a 50 VA transformer (-101 suffix).

## **E**asy Monitoring and Diagnostics with the Zone Terminal (AS-ZTU100-1)

The Zone Terminal (ZT) is a person/controller interface developed as an easy-to-use controller adjustment and indication device. The ZT is designed for the user who needs a straightforward method to monitor and adjust setpoints in an HVAC zone. The ZT plugs into the TE-6400 Metastat™ or TE-6100-11 or -12 Zone Sensor to communicate with the UNT Controller.

## **C**onvenient Configuration Setup

The UNT Controller doesn't need to be programmed in the traditional sense. Instead, the control algorithms and input/output point assignments are configured with the use of the HVAC PRO for Windows™ software tool.

The HVAC PRO for Windows runs on a laptop computer plugged directly into the UNT Controller, or into a jack at the room sensor or M100C Series Motor Actuator. The jack is connected back to the UNT Controller over a 3 wire cable called a Zone Bus. Programs loaded into the UNT Controller are saved in nonvolatile E<sup>2</sup>PROM memory, so there is no need to reload software after a loss of power.

A second option allows you to load the configuration from the laptop via the N2 Bus. This option speeds up the initial loading and commissioning process by allowing you to load multiple controllers from one location.

Programming a UNT Controller is a simple matter of responding to a series of "yes-no" and multiple choice questions, and specifying setpoints and other parameters. No previous software programming experience is required.

The UNT Controller has a library of proven control sequences and proportional-integral algorithms that are automatically configured into a total system sequence-of-operation in response to your answers to the questions. Once configured, the UNT Controller's operating parameters, such as setpoints and tuning parameters may be changed from any Metasys operator device.



## Metasys Network Configuration

As powerful as the UNT Controller is by itself, your facility benefits even more when UNT Controllers are part of a larger Metasys Network. Each UNT Controller can connect to the Metasys N2 Bus (Figure 2). Either a Network Control Unit or Companion system can be programmed to provide added energy management and supervisory control capabilities, including optimal start, demand limiting, load rolling, runtime totalization, and more.

Metasys Dynamic Data Access™ networking software, available from the Network Control Unit, makes all information from each UNT Controller available throughout the facility. Dynamic Data Access also makes sensor values, operating status, and any other parameter in the UNT Controller available to operators anywhere in your facility.

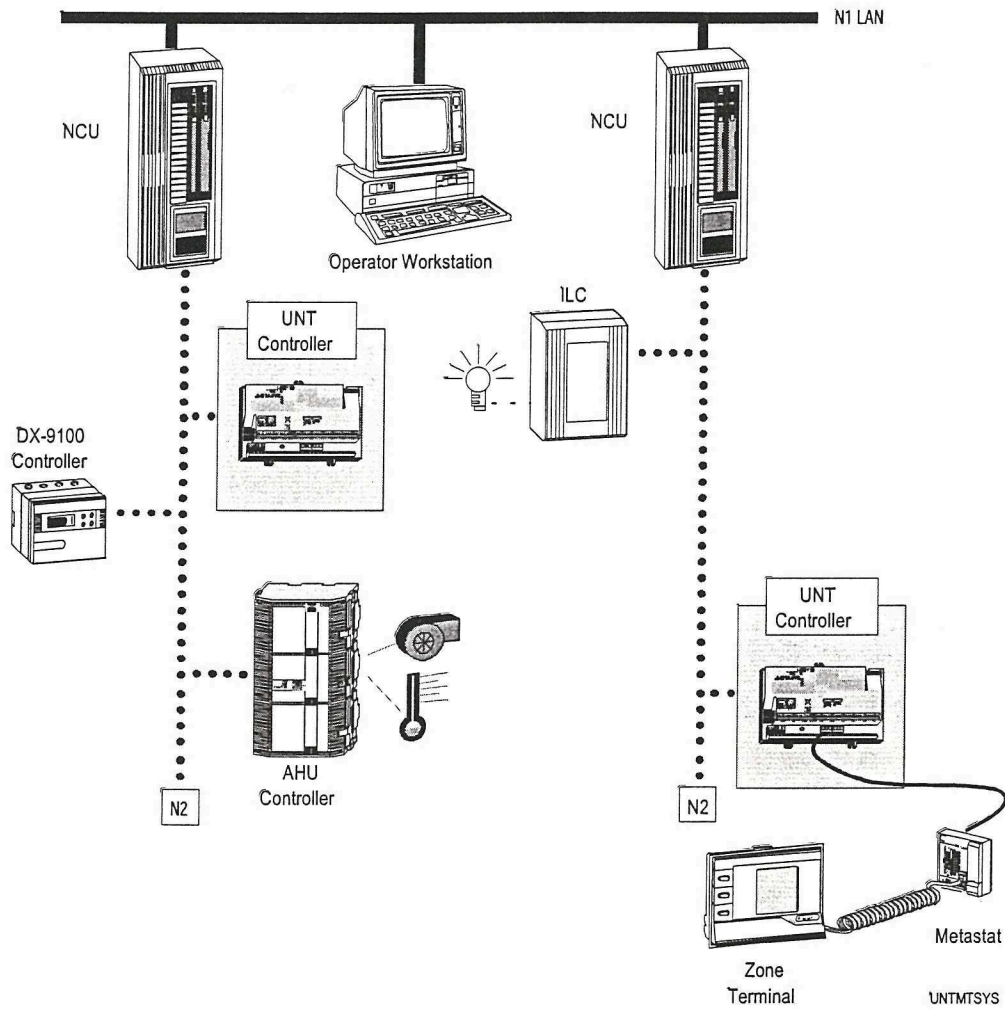


Figure 2: UNT Controller in Metasys Network

## Metasys Companion Configuration

Metasys Companion connects to the UNT Controller over an independent N2 Bus (Figure 3). User access is through the Companion System, which implements built-in

energy management programs throughout the devices on the bus.

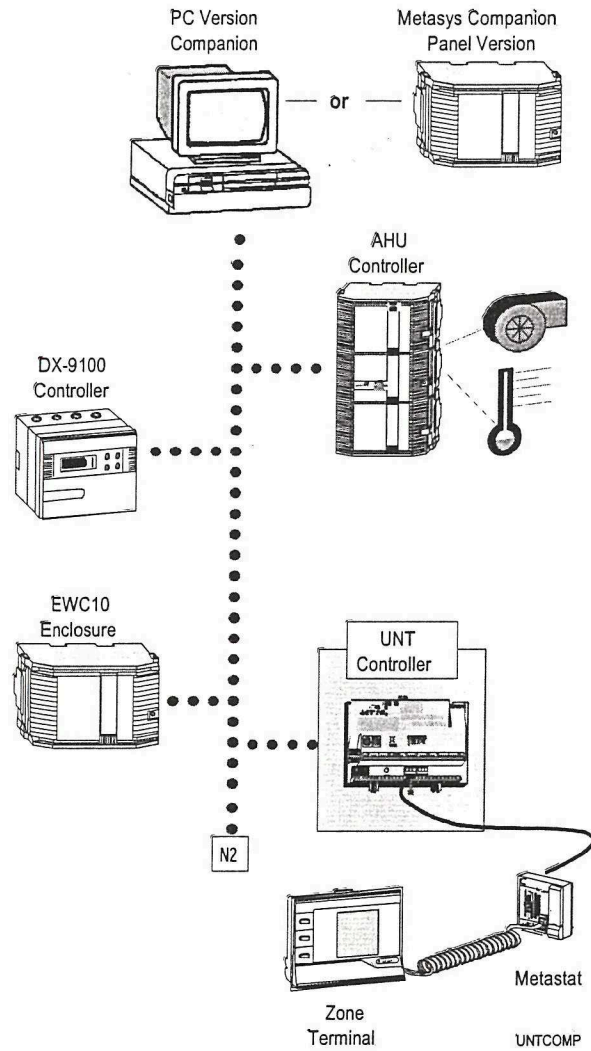


Figure 3: UNT Controller in Companion System

## Application Flexibility

The UNT11n and UNT12n Series with “Quick Connects” are packaged for convenient factory mounting by original equipment manufacturers or for field installations where “Quick Connects” are preferred. The new UNT14n is packaged to accommodate field installations using screw terminations. In addition, points unused in the control scheme can be used in supervisory monitoring and control or standalone applications by the Metasys Network.

The UNT Controller offers a variety of zone sensor connection options that let you select the features you--and your occupants--need. The simplest and most economical option is a solid-state sensing element wired directly to the controller. When this option is chosen, all setpoint adjustments are made using the Operator Workstation or Network Terminal on the Metasys Network, or from the Zone Terminal or Companion system.

A second option provides the occupants in the zone the ability to adjust the setpoint to their preference, within a restricted range established by you. The user setpoint can be overridden by you at any time using the operator interface devices or application programs in the Network Control Unit. This allows maximum energy savings while still allowing occupants some control over their environment.

A third option uses an occupancy sensor to automatically or manually set back or set up zone temperatures when no one is around. This can further increase energy savings in individual offices or conference rooms.

In addition, using the HVAC PRO for Windows software, you can access sideloops that are separate from the main control logic. See your *HVAC PRO for Windows User's Manual* for further explanation of this powerful feature.

Other options provide for control of room lighting as well as temperature, turning lights on or off based on the occupancy sensor, or scheduled commands issued from the network. A Boost mode switch allows an occupant to temporarily provide extra cooling or heating, which is useful for conference rooms that experience large heat load fluctuations.

You can choose to select a Temp Occ mode instead of the Boost mode. Temp Occ mode switch allows an occupant to put the controller into an unscheduled occupied mode for a specified period of time (i.e., go occupied for three hours when the switch is pressed.)

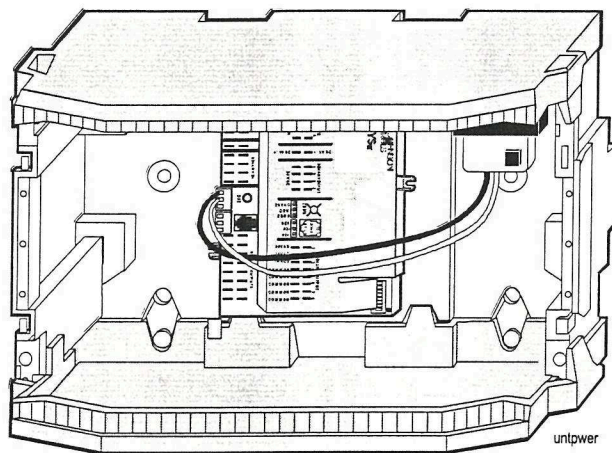


Figure 4: AS-UNT1nn-101 Enclosure with 50 VA Transformer

**Table 3: Applications and Options**

Application Classifications	Software Options
Primary Equipment Types	Unit vents      ASHRAE Cycle 1 ASHRAE Cycle 2 ASHRAE Cycle 3 ASHRAE Cycle W  Heat pumps      Water to air Air to air  Packaged rooftops Fan coils Generic point multiplexer
Primary Control Strategies	Room/zone control
Economizer Changeover Strategies	Dry bulb Outside air enthalpy Differential outside/return air temperature Outside air and return air enthalpy comparison Binary input from external economizer Supervisory network command
Mixed Air Control Strategies	Proportional output to OA/RA damper actuator Binary output to economizer actuator Zone bus output to OA/RA damper actuator
Heating Configuration	Modulated single coil Staged electric heat (3-stage max.) Modulated common heating/cooling coil Reversing valve logic for heat pumps Incremental
Cooling Configuration	Modulated single coil Staged DX (2-stage max.) Modulated common heating/cooling coil Reversing valve logic for heat pumps Incremental
Fan Start/Stop	Continuous operation Cycled with call for heating/cooling
Lighting Control	On and off outputs to lighting relay in conjunction with Occ/Unocc mode
Unoccupied Control	Setup and setback Morning warmup and cooldown

## Conclusion

As either a member of the fully integrated system, or as a standalone controller, the UNT Controller represents a way to optimize the operation of your HVAC equipment.

The UNT Controller combines the best of ease-of-setup and operation, flexibility of application, and precise control for comfort and energy management.

# Specifications

<b>Product</b>	<b>Separate Controllers</b> AS-UNT110-1 / AS-UNT111-1 AS-UNT120-1 / AS-UNT121-1 AS-UNT140-1 / AS-UNT141-1		
	<b>Pre-mounted Controllers (in an EWC10 enclosure with 50 VA transformer)</b> AS-UNT110-101 / AS-UNT111-101 AS-UNT140-101 / AS-UNT141-101		
<b>Ambient Operating Conditions</b>	32 to 140°F (0 to 60°C) and -40 to 140°F (-40 to 60°C) for UNT12n-1 10 to 90% RH		
<b>Dimensions (H x W x D)</b>	6.5 in. x 6.4 in. x 2.2 in. (165 x 163 x 56 mm) without enclosure 9 in. x 16 in. x 7.5 in. (229 x 406 x 191 mm) with AS-ENC100 enclosure		
<b>Ambient Storage Conditions</b>	-40 to 158°F (-40 to 70°C) 10 to 90% RH		
<b>Power Requirements</b>	24 VAC, 50/60 Hz at 40 VA (per typical system)		
<b>Shipping Weight</b>	1.4 lb (0.64 kg)		
<b>Standards Compliance</b>	IEEE 472	IEEE 518	IEEE 587 Category A
	FCC Part 15, Subpart J, Class A		
	UL 916	UL 864	
<b>Agency Listings</b>	UL Listed and CSA Certified as part of the Metasys Network.		
<b>Accessories (Order Separately)</b>			
<b>Power Supply</b>	(AS-XFR100) or (EN-EWC15-0)		
<b>Zone Terminal</b>	(AS-ZTU100-1)		
<b>Enclosure Kit</b>	(AS-ENC100-0) or (EN-EWC10-0) or (EN-EWC15-0) or (BZ1000-7)		
<b>HVAC PRO Interface</b>	(AS-CBLPRO-2)		
<b>N2 Plugs/Power Plugs Replacement Kit</b>	(AS-TBKIT-0) (Kit consists of five of each plug type.)		
<b>Zone Sensors</b>	(TE-6400 Series)		
<b>Converter</b>	(MM-CVT101-0)		

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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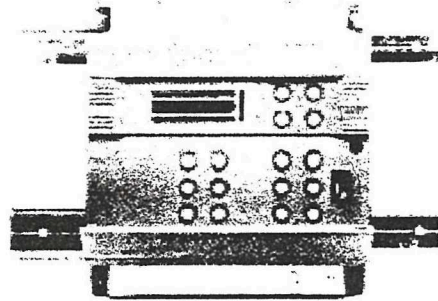
**FAN 635**  
Metasys Network Sales Resource Manual  
Printed in U.S.A.

## Extended Digital Controller

*(DX-9100) is the ideal digital control solution for multiple chiller or boiler plant applications, air handling units, or distributed lighting control.*

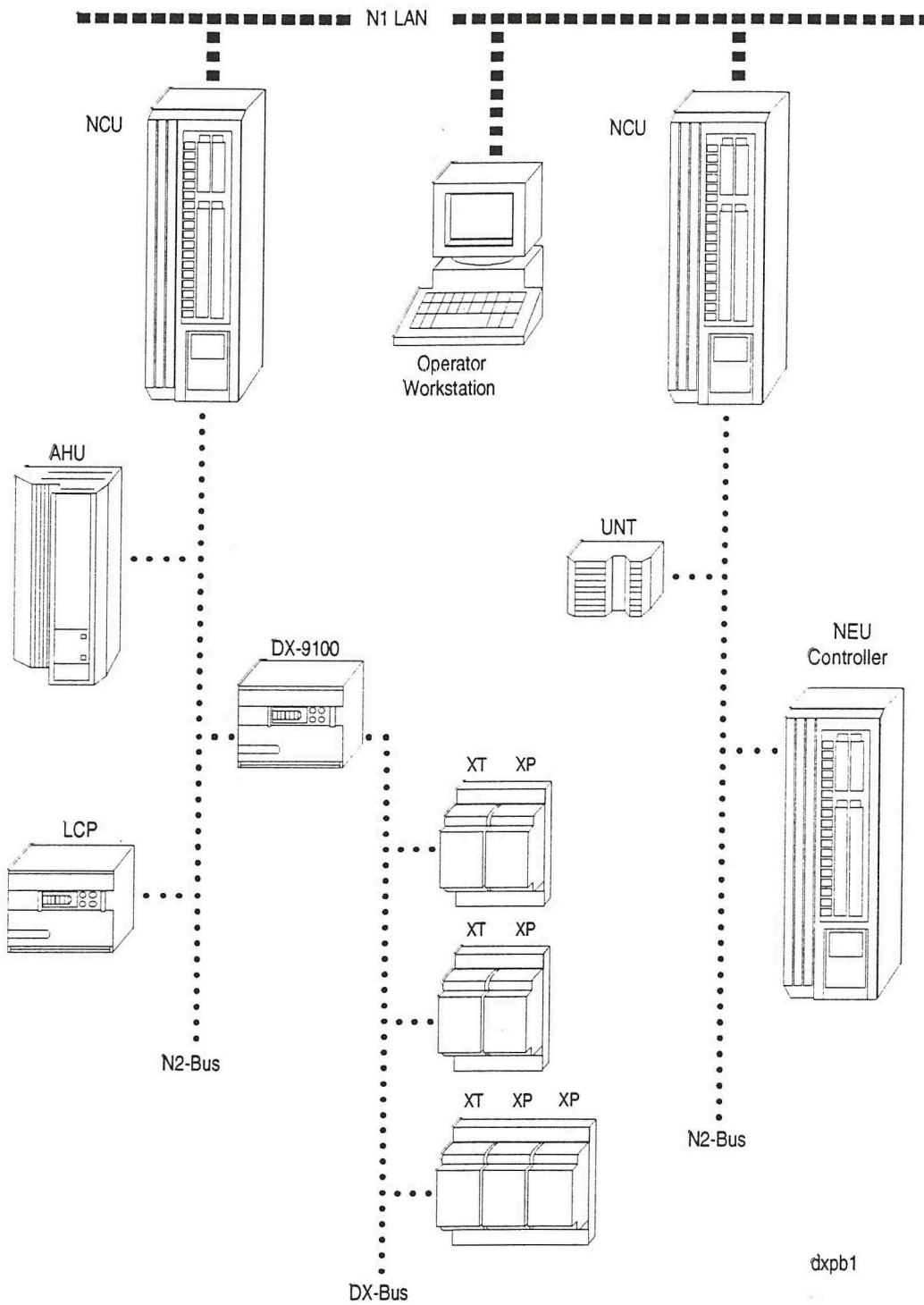
*As a standalone controller, the DX 9100 provides a real-time clock, extendable I/O, and graphic software programming to target a variety of applications. Individual point monitoring and control is available through the front panel LED display.*

*The DX-9100 also connects to Metasys® over the N2 Bus, integrating its point and control information with the entire Metasys Network.*



**Figure 1: DX-9100**

<b>Features and Benefits</b>	
<input type="checkbox"/> <b>Real-time Clock and Scheduling</b>	Standalone control
<input type="checkbox"/> <b>Program Stored In EEPROM</b>	System reliability
<input type="checkbox"/> <b>Additional Analog and Binary I/O Combinations</b>	Accommodates the I/O type and count needed for the job
<input type="checkbox"/> <b>Both Graphic and Character-based Configuration Tools</b>	Graphical GX tool for programming, or hand-held SX tool for service personnel's troubleshooting or on-the-fly adjustment
<input type="checkbox"/> <b>Dynamic Data Access™ Networking Software Capabilities</b>	Facility-wide control efficiencies and cost-effective information sharing
<input type="checkbox"/> <b>Built-in Local Status Display Control Panel</b>	Direct access to point control and information

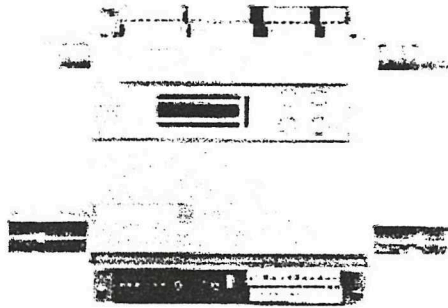


**Figure 2: Extended Digital Controller on the Metasys Network**

## **F**lexible Installation

The Extended Digital Controller can be installed using either the existing mounting holes or via a DIN rail. You can mount the DX-9100 into any enclosure or directly onto the controlled equipment: both mounting options present the

same attractive yet robust design. The separate mounting and wiring base also make the DX-9100 easy to install--first you connect the field wiring, and then install the controller.

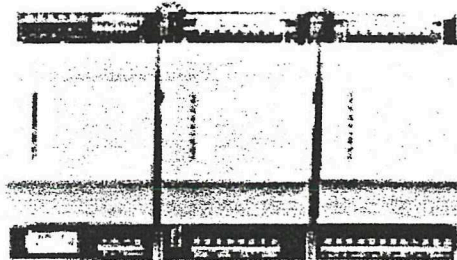


**Figure 3: DX-9100 With Mounting Base**

## **E**xtension Modules

Extension Modules (XTs, XPs) are submodules that provide various combinations of analog and binary I/O points. They may be mounted next to the controller on the same DIN rail, or remotely,

up to 1200 yards from the controller. Up to eight submodules can connect to the Extension Bus, which has the same physical characteristics as the Metasys N2 Bus.



**Figure 4: Extension Modules**



**Table 1: DX Configuration**

Point Type	Quantity		Characteristics
	DX-9100	XT	
Analog Inputs	8	6	0-10 VDC (300 K ohm ) 0/4-20 mA DC (100 ohm) RTD (1000 ohm nickel and 1000 ohm platinum)
Binary Inputs	8	4/8/16	Dry Contacts
Binary Outputs	6	4/8/16	24 VAC Triacs 0.5 amps XT only: Relay Contact (250 V, 3 amps AC)
Analog Outputs	4 4	2	0-10 VDC (10 mA max.) or 0/4 - 20 mA DC 0-10 VDC (10 mA max.) only

**Table 2: XT Configuration**

Maximum Number of XTs per DX	8
Maximum Number of I/O for each XT	16 (8 analog)
Maximum Number of I/O per DX	64

## **C**onvenient Configuration Setup

The Extended Digital Controller does not need to be programmed in the traditional sense. Instead, the control algorithms, time programs, and input/output point assignments are configured by a graphic configuration tool. The graphic software runs on an IBM-compatible computer, which plugs into the controller's N2 Bus.

Program data and parameters loaded into the controller and extension modules are stored into EEPROM, so there is no need to reload software after a loss of power. Real time and operating data in the controller are stored in battery-backed RAM.

Configuring a controller and its extension modules is a simple matter of filling in a flowchart diagram that connects inputs to control and logic blocks, then closing the control loop by making the connection from the control and logic blocks to the outputs. As the flowchart is being filled in, the setpoint parameters, gains, alarm limits, start and stop times, and so forth are added around the input and outputs to complete the configuration.

## **B**uilt-in Display Panel

Once the controller and its extension modules are configured, the operating parameters and input/output values can be seen at the display panel built into the controller. Outputs can be manually overridden and operating parameters may be changed by an operator who has plugged his security key into the controller. The same information viewed on the face of the controller can be displayed and changed from any of the Metasys operator devices.

## **A**pplication Flexibility

The Extended Digital Controller can be configured to meet a wide variety of basic HVAC and multiple boiler or chiller central plant applications. Preconfigured examples are available for common applications to use as a foundation for customizing to your particular facility. If the preconfigured examples don't cover your requirements, you can instead configure a totally customized process.

In addition, points unused in the control scheme can be used in non-critical supervisory or control applications by the Metasys Network.

## Networking Capabilities

As powerful as the Extended Digital Controller is by itself, your facility will benefit even more when controllers are part of a larger Metasys Network. Each DX Controller can connect to the Metasys N2 Bus. Either a Network Control Unit or Companion™ Workstation can be programmed to provide added energy management and supervisory control capabilities, such as trend log, historical data storage, plant-to-plant interlocking, and more.

The Metasys Dynamic Data Access networking software, available from the Network Control Unit, makes information from each controller available throughout the facility, so that it is possible, for example, to reset the boiler or chiller discharge temperature setpoint based on the demand requirements of a group of application specific controllers. Dynamic Data Access also makes sensor values, operating status, and other parameters in the controller available to operators anywhere in your facility.

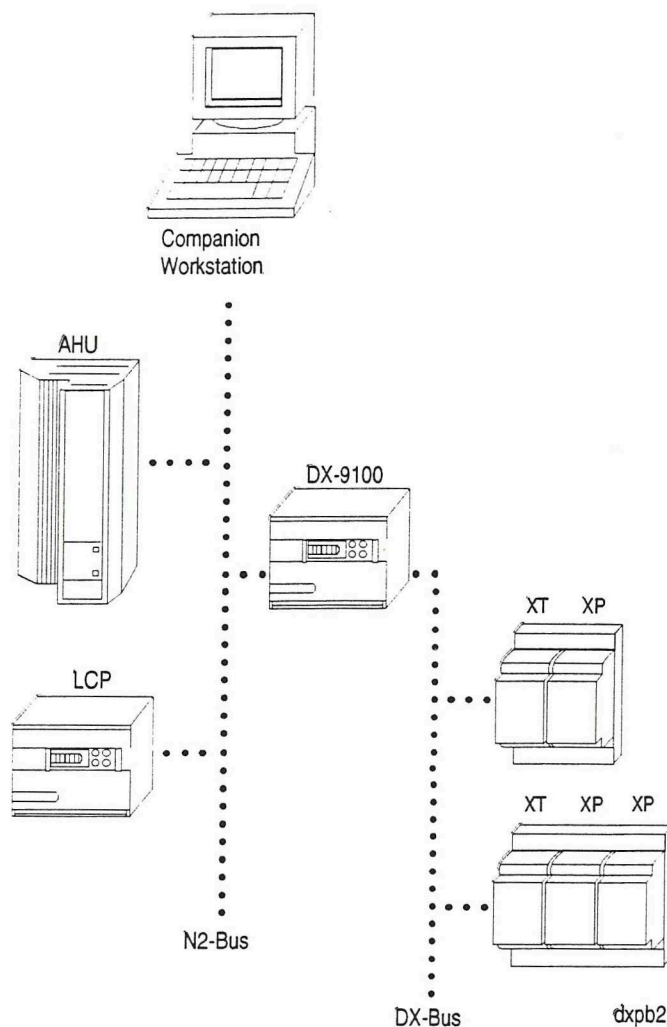


Figure 5: Extended Digital Controller Under Companion

## **P**recise, Flexible Control

As a member of either the fully integrated system or as a standalone controller, the DX Controller represents the best way to fully optimize the operation of your refrigeration,

HVAC, or lighting control applications. It combines ease of setup and operation, flexibility of application, and precise control for comfort and energy management.

---

## Notes

# Specifications

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**Product** *Extended Digital Controller (DX-9100)*  
DX Controller (DX9100-8454)  
DX Mounting Base (DX9100-8990)  
DX Wiring Protection Kit. (DX9100-8991)

---

**Power Requirements** 24 VAC +/- 10% at 50/60 Hz

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**Ambient Operating** 32 to 122°F (0 to 50°C)

**Conditions** 10 to 90% Non-Condensing RH

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**Ambient Storage** 0 to 160°F (-20 to 70°C)

**Conditions** 5 to 95% RH

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**Dimensions (H x W x D)** 7.9 in. x 7.2 in. x 3.9 in. (200 x 184 x 100 mm)

---

**Shipping Weight** 4.7 lbs (2.2 kg)

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**Agency Listings** UL Listed and CSA Certified

---

<b>Extension and Expansion Modules</b>		
	XT-9100	Extension Module
	XP-9102	6 Analog Inputs, 2 Analog Outputs
	XP-9103	8 Digital Outputs (triacs)
	XP-9104	4 Digital Inputs, 4 Digital Outputs (triacs)
	XP-9105	8 Digital Inputs
	XP-9106	4 Digital Outputs (relay)

---

*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.*

**JOHNSON  
CONTROLS**

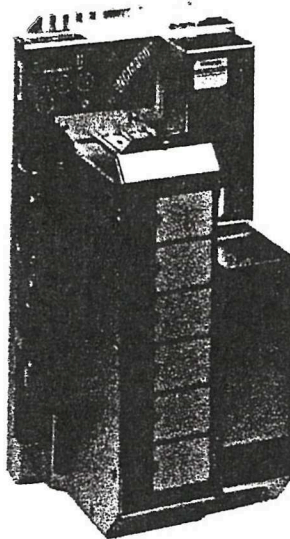
**Controls Group**  
507 E. Michigan Street  
P.O. Box 423  
Milwaukee, WI 53201

**FAN 635**  
Metasys Network Sales Resource Manual  
Printed in U.S.A.

# Network Control Module



NCM200 (installs into base frame)



Standalone NCM300

The NCM comes in two different packages: a plug-in module or a standalone unit. As a module, it plugs into either a 1-slot, 2-slot, or 5-slot base frame mounted in an enclosure. As a standalone unit, the NCM mounts directly into an enclosure. Both NCMs support ASCs and NEUs.

## Features

- fast, efficient communication between other NCMs and the Operator Workstation to provide for point sharing and building-wide interlocks
- modular design that provides for easy and quick installation
- battery-backed memory that saves the NCM's programming in case of power outage
- collects and stores data on historical trends, equipment runtime, and energy consumption, making this information immediately accessible to an operator at the workstation
- LED indicators on front of panel supply evidence of the module's condition and help determine if the module is functioning properly
- NCM200/300 can support connection to an ARCNET N1 LAN
- NCM350 can support connection to an ETHERNET N1 LAN

## To Order

Contact your local Johnson Controls Representative.

## Description

The Network Control Module (NCM) is the main processor in the NCU. Fully user-programmable, it is responsible for supervisory control activities for the points and control loops connected to the NCU and all NEUs and application specific controllers with which it communicates on its local buses.

You choose your NCM's configuration, whether as a standalone controller, a node on

the N1 LAN working in concert with other NCMs, or as a connectivity device. In this connectivity application, the NCM can bring other, non-Johnson Controls systems under Metasys control or interface Metasys to a host system. The battery-backed memory of the NCM stores application programs, user data bases, and point histories. The NCM includes features to coordinate system-wide efficiency, keeping you informed and in control while ensuring occupant safety and comfort.

## Accessories

Code Number	Description
<b>NCM200</b>	
NU-NIM206-1	Network Identity Module 206
NU-L2B101-0	L2 Submodule
NU-COM101-0	RS-232 Submodule
NU-PWR101-0	Power Supply Module
NU-BAT101-0	Battery Submodule
NU-CBL101-0	RS-232 Cable 35 ft., DB25 (right angle with narrow profile)
MHK-101-0	Male Hood Kit for NU-CBL101-0, DB25
FHK-101-0	Female Hood Kit for NU-CBL101-0, DB25
NU-MDM-101-0	JCI Modem Submodule
<b>NCM300/350</b>	
NU-NET101-0	N1 ARCNET LAN Card for NCM300/350
NU-NET301-0	N1 ETHERNET LAN Card for NCM350
MM-CVT101-0	RS-232 to RS-485 Converter
<b>NCM200 and NCM300/350</b>	
TTM101-0	Table Top Modem (JCI Proprietary Line)
TTM102-0	Table Top Modem (Leased Line)
TTM103-0	Table Top Modem (JC/LINK Generic Bridge)

## Selection Chart

Code Number	Description
NU-NCM201-1	Network Control Module 200
NU-NCM300-1	Network Control Module 300
NU-NCM350-1	Network Control Module 350
NU-NCM350-8	Network Control Module 350 with 8 MEG Memory

## Repair Parts

Code Number	Description
<b>NCM200 and NCM300</b>	
NU-NCM201-701	Repair part for NCM200
NU-NCM300-701	Repair part for NCM300
NU-NCM350-701	Repair part for NCM350-1
NU-NCM350-708	Repair part for NCM350-8
NU-PWR300-0	Replacement Power Supply, NCM300/350
NU-BAT300-0	Replacement Battery Pack, NCM300/350

**Network Control Module (Continued)**

**Specifications**

	NCM200	NCM300/350
<b>Power Requirements</b>	85-264 VAC at 50/60 Hz	90 to 240 VAC, 670 to 250 mA, 50/60 Hz
<b>Power Consumption</b>	Power is from the power module (NU-PWR101-0)	60 VA (maximum), 25 VA (typical) at 50/60 Hz
<b>Memory Options</b>	4 Mb standard	2 Mb standard (4, 6, or 10 Mb optional); 8 Mb standard with NCM350-8
<b>Dimensions</b>	14 in. H x 2.25 in. W x 7.0 in. D (35.5 x 5.7 x 17.8 cm)	12.4 in. H x 6.0 in. W x 5.5 in. D (32 x 15 x 14 cm)
<b>Shipping Weight</b>	5 lb (2.25 kg)	4.2 lb (1.9 kg)
<b>Ambient Operating Conditions</b>	32 to 122°F (0 to 50°C) 10 to 90% RH	32 to 122°F (0 to 50°C) 10 to 90% RH
<b>Ambient Storage Conditions</b>	-40 to 158°F (-40 to 70°C) 5 to 95% RH	32 to 122°F (0 to 50°C) 10 to 90% RH
<b>Agency Compliance</b>	FCC Part 15 Class A	FCC Part 15 Class A
<b>Agency Listing</b>	UL 916 Listed CSA C22.2 No. 205 Certified UL-864	UL 916 Listed CSA C22.2 Certified Meets EMC directive 89/336/EEC UL 864 Listing in process CUL 527 Listing in process

## P32 Series Sensitive Differential Pressure Switch For Combustion Air Applications

### Application

This P32 differential pressure switch is for use in combustion applications where a proof of air flow is needed for proper system operation.

Typical applications include:

- Pulse combustion appliances.
- Appliances with power vented exhaust.
- Any appliance that requires proof of flow before initiating burner operation.

In all combustion applications, the P32 **must** be used in conjunction with a backup device to either check the P32's operation each time the appliance cycles, or to operate independently of the P32 to de-energize the burner circuit should improper appliance operation occur. (See P32 Application Chart and explanations.)

All P32 switches are designed for use *only* as operating controls. Where an operating control failure would result in personal injury and/or loss of property, it is the responsibility of the installer to add devices (safety, limit controls), or systems (alarm, supervisory systems) that protect against, or warn of, control failure.

### Features

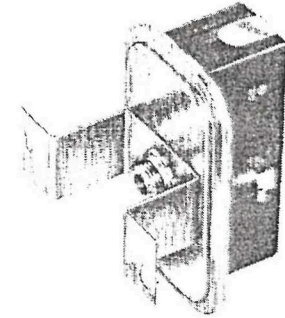
- Easy-to-read set point scale.
- Versatile mounting options.
- Durable construction.
- Set point switching repeatability.

### General Description

This control senses a change in the differential pressure (either velocity pressure or pressure drop across a fixed restriction) as air flow in the flue changes.

The differential pressure, as sensed by the two sensing ports, is applied to the two sides of a diaphragm in the control. The spring loaded diaphragm moves and actuates the switch.

The P32 can also be used to detect small positive gage pressure by using only the high pressure connection and leaving the low pressure connector open, or to detect vacuum by using only the low pressure connection and leaving the high pressure connector open to ambient pressure.



**Fig. 1 – P32 Differential Pressure Switch for Combustion Air Applications.**

P32s are factory set at the bottom of their operating range with the diaphragm in a vertical plane. The setting will change if mounted in other positions.

### Specifications

<b>Product</b>	P32	Differential Pressure Switch
<b>Maximum Electrical Rating</b>	UL	2 Amps., 7 Amps. Inrush at 25 VAC
	CSA	2 Amps., 7 Amps. Inrush at 25 VAC
<b>Ambient Temperature*</b>	<b>Minimum</b>	-40°F (-40°C)
	<b>Maximum</b>	165°F (75°C)
<b>Maximum Pressure at Either Connection</b>		1 PSIG (6.9 kPa)
<b>Connectors</b>	<b>High Pressure</b>	Metal, 1/8" Female NPT Inside, 1/2" NPSM Outside for Mounting
	<b>Low Pressure</b>	Molded, 1/8" Female NPT
<b>Cover Material</b>		.032" (0.8 mm) Cold Rolled Steel, Zinc Plated
<b>Diaphragm Housing Material</b>		.040" (1 mm) Cold Rolled Steel, Zinc Plated
<b>Enclosure (Body and Wiring Compartment)</b>		Molded Polycarbonate
<b>Mounting</b>		Direct Mount or With Optional Mounting Bracket, Normal Mounting Position is With Diaphragm in a Vertical Plane
<b>Set Point</b>		Normally Factory Set at Bottom of the Range With Diaphragm in a Vertical Plane, SPDT Models Normally Set Where Red to Yellow Contacts Open, Factory Setting is Made at Room Temperature
<b>Shipping Weight</b>	<b>Less Bracket</b>	Individual Pack .9 Lb. (0.41 kg) Overpack of 10 Units 10 Lb. (4.5 kg)
	<b>With Bracket</b>	Individual Pack 1.0 Lb. (0.45 kg) Overpack of 10 Units 11 Lb. (5.0 kg)

\*Temperature at which no physical damage to the P32 results.



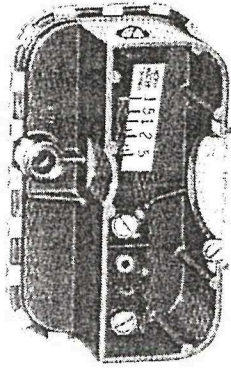


Fig. 2 — Interior view of a P32 Differential Pressure Switch.

Mounting with the steel housing (high pressure connector) down will increase the set point by about 0.07 in. W.C. (0.017 kPa). If mounted with the steel housing up, the switch may be inoperative at minimum setting.

The P32 adjustable models may be readjusted for other than the vertical plane position specified by the Original Equipment Manufacturer. The adjusting screw must be sealed after readjustment is completed.

The P32 should be used only in conjunction with a redundant safety device such as a spill switch or self-checking relay circuit and only on open combustion equipment. Closed combustion units require a self-checking relay circuit. (See Fig. 6.)

If required, the P32 can be factory set for a specific mounting position on quantity orders.

The adjusting screw must be sealed. If this is not done by the factory, then it must be sealed at the equipment's point of manufacture by the Original Equipment Manufacturer.

### Optional Constructions

#### Accessory Kit

Kit No. FTG18A-600R for remote mounting includes a 4 in. (102 mm) sensing tube with 1/8 in. Female NPT connector

and 1-1/2 in. (38 mm) square mounting flange, 2 "L" 1/4 in. barbed x 1/8 in. Male NPT fittings, 2 #10 self-tapping screws 1/2 in. (12.7 mm) long, and a pressure sensitive gasket. (See Fig. 3.)

#### Connector Fitting

1/8 in. Male NPT x 1/4 in. compression for 1/4 in. metal tubing. 1/8 in. Male NPT x 1/4 in. angled barbed fitting for 1/4 in. plastic tubing and 1/8 in. Male NPT x 3/8 in. barbed fitting for 3/8 in. I.D. tubing.

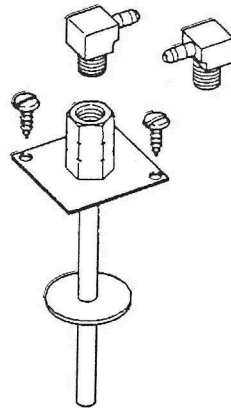
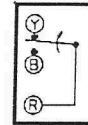


Fig. 3 — Remote sensing probe kit No. FTG18A-600R.



ACTION ON INCREASE OF DIFFERENTIAL PRESSURE

Fig. 4 — Contact action on P32 with SPDT contact action.

#### Contact Action

Models are available with Open High, Open Low, or SPDT contact action. (See Fig. 4.)

#### Mounting Bracket

Universal "L" mounting bracket No. BKT182-2, if required or channel "U" bracket, Part No. BKT229-1. (See Fig. 5.)



L Bracket U Bracket

Fig. 5 — Optional mounting brackets.

### Type Number Selection

P32	A	Adjustable Set Point, Range Scale Plate, NEMA Type 1 Enclosure
	B	Adjustable Set Point, No Scale Plate, NEMA Type 1 Enclosure
	C	Fixed Set Point, No Scale Plate, NEMA Type 1 Enclosure
	H	Adjustable Set Point, Range Scale Plate, Less Enclosure
	J	Adjustable Set Point, No Scale Plate, Less Enclosure
	K	Fixed Set Point, No Scale Plate, Less Enclosure
	G	SPST, Open Low, Screw Terminal
	H	SPST, Open High, Screw Terminals
	R	SPST, Open Low, 1/4" x .032" Quick Connect Terminals
	S	SPST, Open High, 1/4" x .032" Quick Connect Terminals
	T	SPDT, Screw Terminals
	U	SPDT, 1/4" x .032" Quick Connect Terminals

### Range and Differential Specifications

Ranges		Differential								
Inches W.C.	kPa	Standard				Close				
		At Minimum Set Point	At Maximum Set Point	At Minimum Set Point	At Maximum Set Point	At Minimum Set Point	At Maximum Set Point			
		in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	in. W.C. kPa	
<b>Adjustable Set Point</b>										
.05 to 5.0	.012 to 1.24	.04 .01	.2 .05	.025 .006	.11 .027					
.15 to 12	.037 to 2.99	.07 .017	.6 .149	.04 .01	.5 .124					
<b>Fixed Set Point</b>										
.05 to .5	.012 to .12	.04 .01	.05 .012	.025 .006	.03 .007					
.15 to 1.0	.037 to .25	.07 .017	.09 .022	.04 .01	.06 .015					

### Scale Plate

An internal scale plate is available on adjustable models.

### Wiring

All wiring is made to the terminals in the wiring enclosure. The terminals can be either screw type or 1/4 in. x .032 in. quick connect type.

The SPDT models have color coded wiring terminals. The Red terminal is common. The Red to Yellow circuit opens on a differential pressure decrease and the Red to Blue circuit closes.

The correct model must be chosen so that all of the terminals provided are wired into the circuit.

### Repairs and Replacement

Field repairs must not be made. These switches must be replaced with an exact replacement. For a replacement switch, contact the nearest Johnson Controls wholesaler or the manufacturer of the appliance.

### Ordering Information

To order, specify:

1. Complete Product Number, if available.
2. If the complete Product Number is not available, specify Type Number, see "Specifications."
3. Set point, differential and mounting position. If other than standard, quantity orders only.
4. Mounting bracket, if required.
5. Any other pertinent information.

### Explanation of P32 Application Chart

Column 1 concerns applications where proof of draft is required to pass a delayed electronic ignition test. A P32 used to detect induced draft or pressure in a closed combustion device must be backed up with a relay to prove actuation on every cycle.

Column 2 lists P32 applications for proof of blower operation on open combustion condensing appliances. A properly applied thermal spill switch or checking relay circuit would produce appliance shutdown in the event of P32 failure.

Column 3 is similar to Column 2 in that flue gas spillage must not occur. However, Column 2 applications attempt to prove lack of flow by detecting a decrease in pressure. Column 3 applications

prove lack of flow by detecting an increase in static pressure. This method requires the use of a P32 with **normally closed contacts**. Because the P32 will not be called upon to operate on every cycle, it is not desirable for the P32 to be used in this application. Relay checking is usually not possible because the P32 only operates intermittently in this application. A spill switch must be used to back up a P32 for blocked flue detection.

### P32 Application Chart

Usage	Application		
P32	Column 1 Delayed Ignition	Column 2 Proof of Blower	Column 3 Blocked Flue
Without Relay Checking or Redundant Safety Device	N.A.	N.A.	N.A.
With a Redundant Safety Device Only	N.A.	Only If Delayed Ignition Tests Can Be Met At P32 Failure, N.O. Contact, SPST	Only If Delayed Ignition Tests Can Be Met At P32 Failure, N.C. Contact, SPST
With Relay Checking on Every Cycle	Yes *SPDT	Yes *SPDT	Yes *SPDT
With Relay Checking and Appropriate Spill Switch	Yes *SPDT	Yes *SPDT	Yes *SPDT

\* SPDT Usage requires N.C. contact across relay contact.  
N.A. — Not applicable for this use.

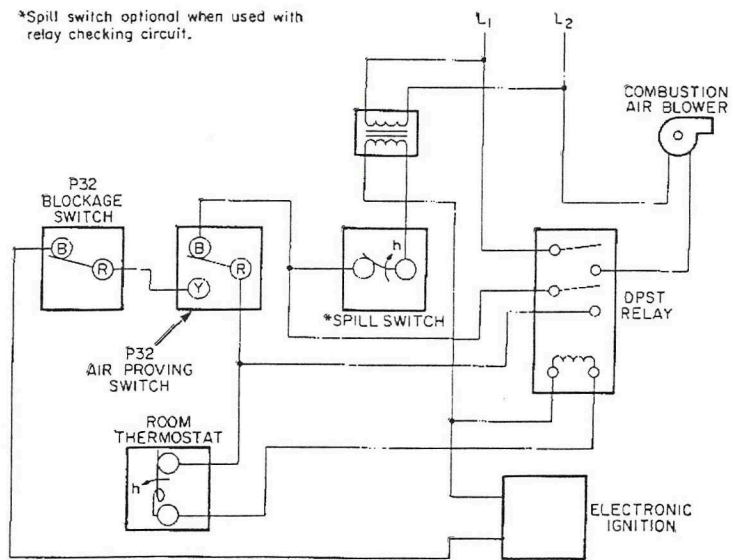
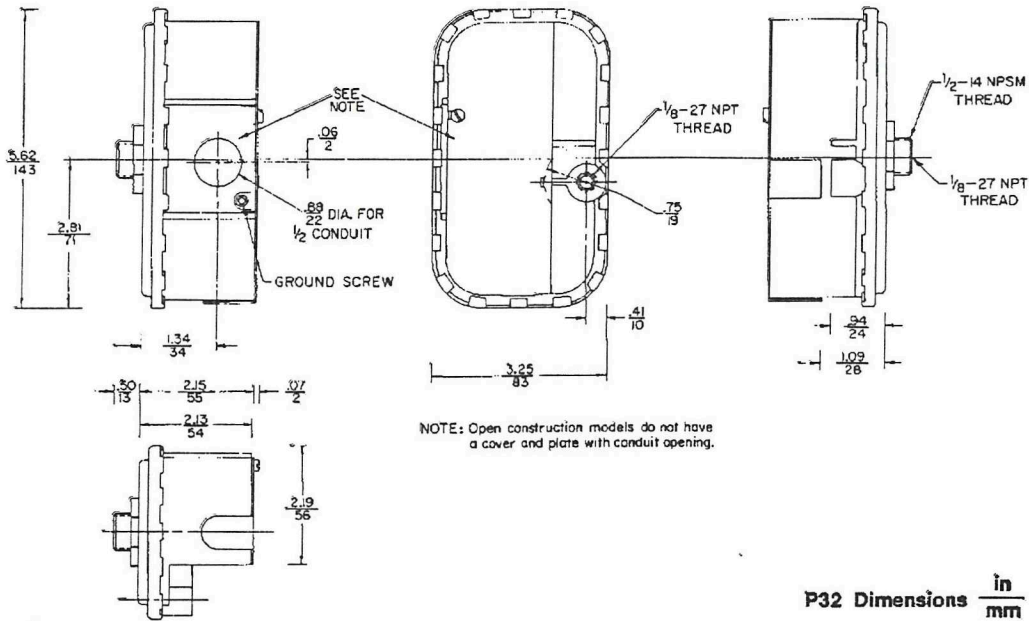
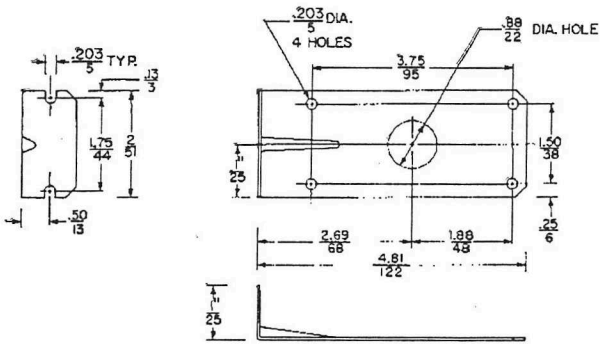


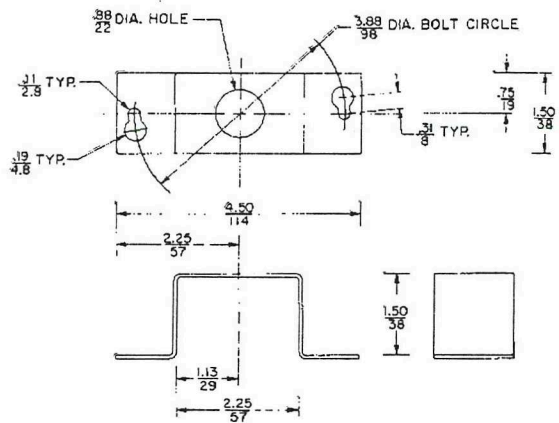
Fig. 6 — Typical wiring hookup.



P32 Dimensions  $\frac{\text{in}}{\text{mm}}$



BKT182-2 Dimensions  $\frac{\text{in}}{\text{mm}}$



BKT229-1 Dimensions  $\frac{\text{in}}{\text{mm}}$

Performance specifications appearing herein are nominal and are subject to accepted manufacturing tolerances and application variables.

U.L. Guide No. MFHX, MFHX-2  
File MH10588

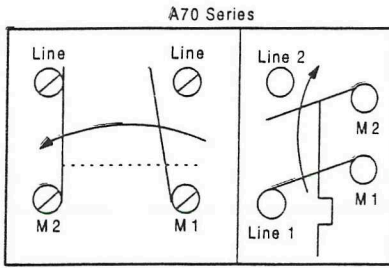
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Controls Group  
507 E. Michigan Street  
P.O. Box 423  
Milwaukee, WI 53202

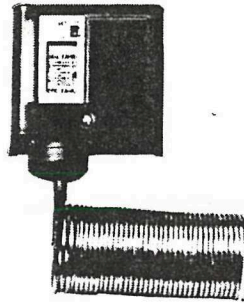
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A70 Series

# Four Wire, Two Circuit Temperature Control



Action on Increase  
of Temperature



A70GA-1

### Applications

Typical applications would include energizing an indicator light upon low temperature cutout on a ventilating system.

### Replacement Parts

Code Number	Description
CVR17A-620R	Automatic reset
CVR17A-621R	Manual reset

### To Order

Specify code number from the selection chart below.

### Description

The A70 Series are heavy duty temperature controls that incorporate a vapor charged sensing element. The A70G, A70H, and A70K have a 4-wire, 2-circuit contact block that contains two isolated sets of contacts.

The contacts are designed so that when the main contact opens, the auxiliary contact closes.

### Features

- long-life, snap-acting contacts
- automatic or manual reset models

### Selection Chart

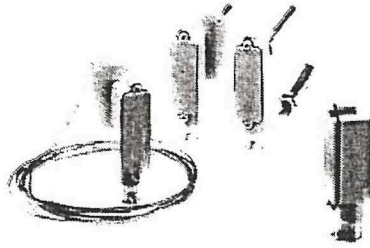
Code Number	Switch Action (Main Contacts Line-M2)	Range °F (°C)	Diff F° (C°)	Bulb and Capillary	Max Bulb Temp °F (°C)	Range Adjuster
A70GA-1*	Open Low	15 to 55 (-10 to 15)	5 (2.8)	20 ft of 1/8 in. O.D. Tubing	400 (260)	Screwdriver Slot
A70GA-2	Open Low	35 to 80 (0 to 25)	3 to 30 Set at 12	3/8 in. x 3 in. 6 ft Cap.	250 (121)	Screwdriver Slot
A70HA-1*	Open Low	15 to 55 (-10 to 15)	Manual Reset	20 ft of 1/8 in. O.D. Tubing	400 (260)	Screwdriver Slot
A70HA-2	Open Low	35 to 80 (0 to 25)	Manual Reset	3/8 in. x 3 in. 6 ft Cap.	250 (121)	Screwdriver Slot
A70KA-1	Open High	100 to 170 (38 to 77)	Manual Reset	3/8 in. x 10 in. 6 ft Cap.	240 (116)	Screwdriver Slot

Pole Number	Electrical Ratings							
	LINE-M2 (Main)				LINE-M1 (Auxiliary)			
Motor Ratings VAC	120	208	240	277	120	208	240	277
AC Full Load Amp	16.0	9.2	8.0	-	6.0	3.3	3.0	-
AC Locked Rotor Amp	96.0	55.2	48.0	-	36.0	19.8	18.0	-
AC Non-Inductive Amp	16.0	9.2	8.0	7.2	6.0	6.0	6.0	6.0
Pilot Duty - Both Poles	125 VA, 24 to 600 VAC							
	57.5 VA, 120 to 300 VDC							

\* Low cutout stop set and sealed at 35°F (1.6°C). Control responds only to the lowest temperature along any one ft. of entire 20 ft. element or bellows cup.

**TE-6300 Series**

**Temperature Sensor**



TE-6300 Series Temperature Sensors

**Description**

The TE-6300 Temperature Sensor line offers an economical solution for a wide variety of temperature sensing needs--including wall mount, outdoor air, duct, well, or duct averaging applications. Sensors are available in the following types: 1000 ohm thin-film nickel, 1000 ohm nickel averaging, 1000 ohm thin-film platinum, 2.2K ohm thermistor, and 1000 and 100 ohm platinum equivalent averaging. Each sensor is packaged with the necessary mounting accessories, maximizing ordering and installation ease, and therefore reducing both commissioning time and cost.

**Features**

- full line of sensors
- inexpensively priced
- single assembly ordering
- conduit-friendly mounting
- standard PVC enclosures
- stainless steel sensor probe

**Applications**

See Selection Chart/Sensor Application Matrix on the next page.

**To Order**

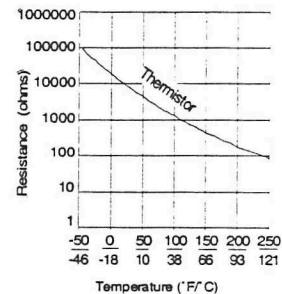
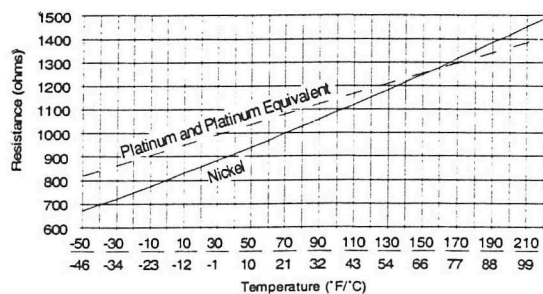
Specify code number from the selection chart on the next page.

**Nominal Temperature vs Resistance for Nickel, Platinum (and Platinum Equivalent)\*, and Thermistor Sensors**

Temperature		Resistance (Ohms)			Temperature		Resistance (Ohms)		
°F	°C	Nickel	Platinum	Thermistor	°F	°C	Nickel	Platinum	Thermistor
-50	-46	674	821	109872	90	32	1060	1125	1652
-40	-40	699	843	75466	100	38	1090	1147	1313
-30	-34	725	865	52571	110	43	1121	1168	1051
-20	-29	751	887	37116	120	49	1152	1190	847
-10	-23	777	908	26539	130	54	1184	1211	687
0	-18	803	930	19208	140	60	1216	1232	561
10	-12	830	952	14062	150	66	1248	1254	461
20	-7	858	974	10408	160	71	1281	1257	380
30	-1	885	996	7784	170	77	1314	1296	316
40	4	914	1017	5880	180	82	1348	1317	264
50	10	942	1039	4484	190	88	1382	1339	221
60	16	971	1061	3450	200	93	1417	1360	187
70	21	1000	1082	2678	210	99	1452	1381	158
80	27	1030	1104	2095	220	104	1487	1402	135

**Specifications**

TE-6300 Series Temperature Sensor		
Accuracy	Nickel	±0.34°F @ 70°F (±0.18°C @ 21°C)
	Nickel Averaging	±3.0°F @ 70°F (±1.67°C @ 21°C)
	Platinum	±0.65°F @ 70°F (±0.36°C @ 21°C) DIN Class B
	Platinum Equivalent	Approximately ±1.08°F @ 70°F (±0.56°C @ 21°C)
	Thermistor	±0.36°F (±0.2°C) in the range of 32 to 158°F (0 to 70°C)
Temperature Limits	Probe Assembly: -50 to 220°F (-46 to 82°C); Conduit Box: -50 to 122°F (-46 to 50°C)	



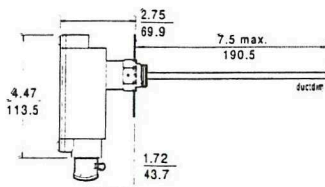
Temperature vs Resistance for the Nickel, Platinum, Platinum Equivalent \*, and Thermistor Sensors

\* For 100 ohm platinum equivalent sensors, divide the resistance values for the 1000 ohm platinum sensors by 10

**Product Overview**

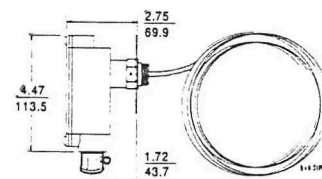
**Duct probe sensor includes:**

- 8 in. nickel, platinum, or thermistor sensor
- quick mount sensor holder
- metal mounting plate with screws (4) and locknut
- conduit enclosure with cover
- 1/2 in. EMT conduit adapter
- wire nuts (2)



**Duct averaging sensor includes:**

- 8 or 17 ft nickel, or 10 or 20 ft platinum sensor
- quick mount sensor holder
- metal mounting plate with screws (4) and locknut
- conduit enclosure with cover
- 1/2 in. EMT conduit connector
- wire nuts (2)

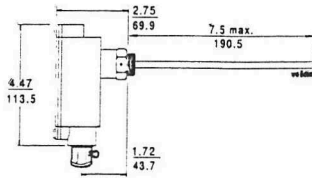


# TE-6300 Series Temperature Sensor (Continued)

## Product Overview (Continued)

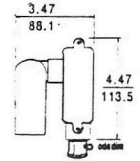
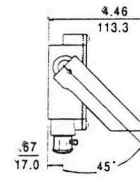
### Well insertion sensor includes:

- 6 in. or 8 in. nickel or platinum, 8 in. thermistor
- quick mount sensor holder
- conduit enclosure with cover
- 1/2 in. EMT conduit connector
- wire nuts (2)



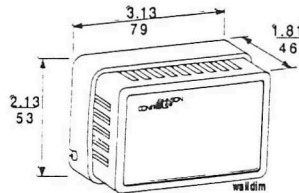
### Outdoor air sensor includes:

- 3 in. nickel, platinum, or thermistor sensor
- outdoor air shield
- conduit enclosure with cover
- 1/2 in. EMT conduit connector
- wire nuts (2)



### Wall mount sensor includes:

- nickel, platinum, or thermistor sensor
- white T-4000 style cover and base with silver faceplate and horizontal logo
- mounting screws (2)
- wall anchors (2)
- wire nuts (2)



Dimensions are given as in./mm

## Selection Chart

For this application . . .	suggested Code No.	Description	Application Notes
Space	TE-6314P-1	Nickel sensor	2-screw wall plate for surface mounting; white cover The TE-1800-9600 Mounting Hardware must be ordered separately when mounting the wall unit to a handy box.
	TE-6324P-1	Platinum (Pt.) sensor	
	TE-6344P-1	Thermistor	
Outdoor Air	TE-6313P-1	Nickel, 3 in. probe	Used to sense outside ambient temperature to determine efficient heating and cooling strategies
	TE-6323P-1	Platinum, 3 in. probe	
	TE-6343P-1	Thermistor, 3 in. probe	
Duct	TE-6311P-1	Nickel, 8 in. probe	4-screw mounting plate provided; can be used for ducts or plenums; ideal in freezer lockers or where sensor mounting should be located outside of the sensed area; a 12 in. sensor probe that can be cut is available for use in larger duct.
	TE-6321P-1	Platinum, 8 in. probe	
	TE-6341P-1	Thermistor, 8 in. probe	
Duct Averaging	TE-6315P-1	Nickel, 8 ft averaging element	4-screw mounting plate mounts to duct; used in duct where average temperature is needed; approximately one ft of sensor is recommended for each sq ft of duct cross section.  The TE-6001-8 Element Holder is included with the platinum equivalent averaging sensors but must be ordered separately (if desired) for use with nickel averaging sensors.
	TE-6316P-1	Nickel, 17 ft averaging element	
	TE-6327P-1	1000 ohm Pt., 10 ft avg. element	
	TE-6328P-1	1000 ohm, Pt., 20 ft avg. element	
	TE-6337P-1	100 ohm Pt., 10 ft avg. element	
Series Parallel	TE-6315P-1	Nickel, 8 ft averaging element	4-screw mounting plate mounts to duct; uses 4, 9, 16, or more duct averaging sensors.  The TE-6001-8 Element Holder is included with the platinum equivalent averaging sensors but must be ordered separately (if desired) for use with nickel averaging sensors.
	TE-6316P-1	Nickel, 17 ft averaging element	
	TE-6327P-1	1000 ohm Pt., 10 ft avg. element	
	TE-6328P-1	1000 ohm, Pt., 20 ft avg. element	
	TE-6337P-1	100 ohm Pt., 10 ft avg. element	
Well Insertion	TE-631AP-1	Nickel, 6 in. probe, threadless	Sensor holder has 1/2 in. NPT threads, threadless holder has set-screw type mounting; thermal well should be mounted at an angle such that condensation will run out of the well; however, if that is not possible, seal the quick mount sensor holder and the wiring end of the sensor probe with RTV silicon rubber.
	TE-6312P-1	Nickel, 8 in. probe, threaded	
	TE-6322P-1	Platinum, 8 in. probe, threaded	
	TE-632AP-1	Platinum, 6 in. probe, threadless	
	TE-6342P-1	Thermistor, 8 in. probe, threaded	

## Accessories (Optional)

Code No.	Description
ADP11A-601R	BX adapter (pkg. 10)
TE-6001-8	Element holder for mounting an averaging sensor
TE-1800-9600	Mounting hardware for mounting wall mount unit to a handy box
TE-6300-101	12 in. nickel probe that can be cut to an appropriate length
TE-6300-104	12 in. thermistor probe that can be cut to an appropriate length
TE-6300-102	12 in. platinum probe that can be cut to an appropriate length
TQ-6000-1	4-20 mA output transmitter for use with the 100 ohm platinum sensor
WZ-1000-2	6 1/2 in. length, stainless steel well, thermal compound included
WZ-1000-4	6 1/2 in. length, stainless steel well
WZ-1000-5 *	4-11/16 in. length, brass well (for TE-631AP-1 and TE-632AP-1 only)

\* Use the TE-631AP-1 or TE-632AP-1 with these wells.

## Repair Parts

Code No.	Description
TE-6300-601	8 in nickel probe
TE-6300-602	8 in. platinum probe
TE-6300-603	3 in. nickel probe
TE-6300-604	3 in. platinum probe
TE-6300-605	Quick-mount sensor holder (pkg. of 10)
TE-6300-606	8 in. thermistor probe
TE-6300-607	3 in. thermistor probe
TE-6300-609	Threadless sensor holder (pkg. of 10)
ADP11A-600R	EMT conduit adapter (pkg. of 10)
T-4000-3139 *	White Thermostat Cover

\* Refer to T-4000 Accessories on Page 1-138 in the Pneumatics section of this catalog.

# TE-6700 Series 2nd Generation Temperature Elements

*The TE-6700 Series is our 2nd Generation of temperature elements. This line is comprised of attractively styled, feature-packed temperature sensing products offering ease of installation, user friendliness, and application flexibility in one package.*

*The TE-6700 Series Temperature Elements supersede the TE-6400 Series for space sensing applications. The 2nd Generation elements are designed for use with most Johnson Controls controllers, and now work directly with the VMA1200 and VMA1400 Series controllers. Johnson Controls consolidated the 300 original TE-64xx product code numbers to 40 TE-67xx numbers. This reduces product inventory, improves product delivery, and makes many features now standard.*

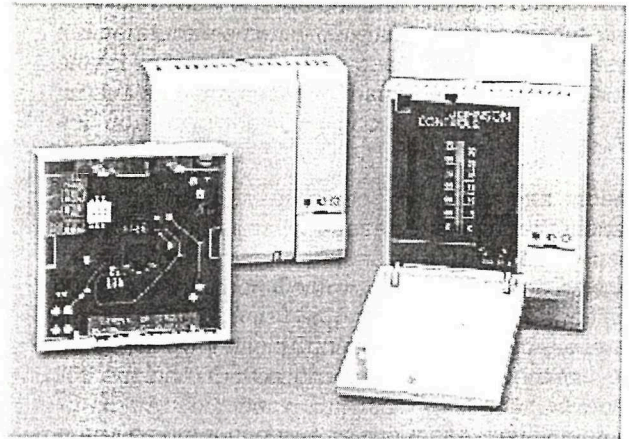


Figure 1: TE-6700 Series Temperature Elements

Features and Benefits	
<input type="checkbox"/> <b>Temperature Sensor Time Response Improvement (TRI)</b>	Improves temperature control of the space, increases employee productivity and comfort, and reduces energy consumption
<input type="checkbox"/> <b>Controller Configuration Switch</b>	Allows users to adjust room comfort and to choose occupancy features that match the application and controller
<input type="checkbox"/> <b>Occupancy Light-Emitting Diode (LED) Indicator</b>	Displays the controller's current operating mode
<input type="checkbox"/> <b>Manual Override Pushbutton (PB)</b>	Signals the controller that the space is occupied in order to override time-of-day scheduling
<input type="checkbox"/> <b>Globally Scaled Unit</b>	Includes setpoint and bulb indicator (both optional) that measure Fahrenheit and Celsius ranges, 65 to 85°F (19 to 29°C)
<input type="checkbox"/> <b>Universal Mounting</b>	Ships with wallbox and surface mounting plates (all installation hardware included)
<input type="checkbox"/> <b>Single or Dual Setpoint Adjustment</b>	Allows for separate heating and cooling settings; makes setpoint viewing and adjustment easier
<input type="checkbox"/> <b>Analog Profile and Starfield Display Compatible</b>	Analyzes heating and cooling efficiency with the M-Series Workstation

## Product Overview

**IMPORTANT:** The TE-6700 Series elements are intended to provide an input to equipment under normal operating conditions. Where failure or malfunction of the TE-6700 could lead to an abnormal operating condition that could cause personal injury or damage to the equipment or other property, other devices (limit or safety controls) or systems (alarm or supervisory) intended to warn of, or protect against, failure or malfunction of the TE-6700 must be incorporated into and maintained as part of the control system.

TE-6700 Series is the second generation of temperature elements for space applications. The temperature sensor is time response improved, resulting in a 70% decrease in time response. This improvement in time response leads to:

- increased comfort and a reduction of hot/cold complaints
- increased comfort by eliminating temperature overshoot
- increased savings/reduced energy consumption
- extended life of HVAC (Heating, Ventilating, and Air Conditioning) products by eliminating adjustments due to slow thermal response or inaccurate temperature reporting

A manual override PB allows the occupant to control the space temperature. This feature allows the end user to signal the controller that the space is occupied after hours or on weekends.

An occupancy LED with pad-printed identification is standard. A red LED displays a controller's current operating mode: On = Occupied, Off = Unoccupied, Flashing = Standby.

Another new feature is the controller compatibility Dual Inline Package (DIP) switch, which programs the TE-6700 to:

- disable the PB and LED indicator
- enable PB with LED indicator
- enable PB without LED indicator

The DIP switch matches the PB and LED indication with features recognized by more recent Johnson Controls controllers. Specifically, the DIP switch allows for matching controller features to disable the occupancy LED and/or PB.

The TE-6700 is available with a phone jack or terminal block wiring connections, and either a 1000 ohm nickel or platinum temperature sensing element. The unit can be used with Application Specific Controllers (ASCs) or for universal applications.

When released, the TE-6700's access door swings down to reveal the Zone Bus connector and optional temperature indicator and setpoint adjustments.

Three temperature setpoint adjustment types are available:

- **Single Setpoint Adjustment, Warmer/Cooler:** setpoint can be adjusted up to heat or down to cool.
- **Single Setpoint Adjustment, Fahrenheit/Celsius:** setpoint can be adjusted to any value within the 65 to 85°F (19 to 29°C) range.
- **Dual Setpoint Adjustment, Fahrenheit/Celsius, Scaled:** separate heating and cooling setpoints can be individually adjusted within the 65 to 85°F (19 to 29°C) range.

The TE-6700 features a quick-mount design that saves time and simplifies installation. Two bases and screws are provided with the sensor, so it can be mounted directly to drywall (spring clips provided) or a U.S. wallbox.

## Dimensions

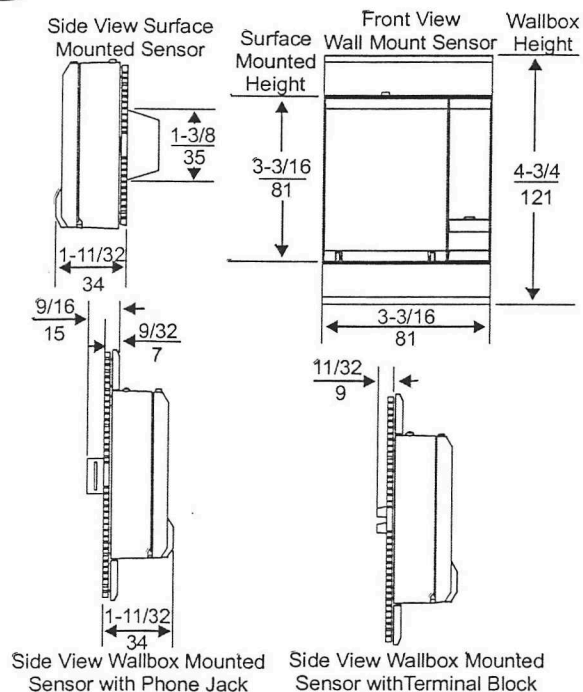


Figure 2: TE-6700 Dimensions, in. (mm)



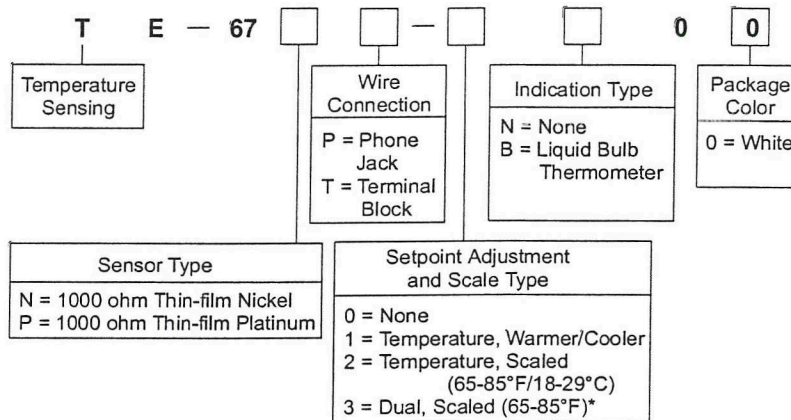
## Repair and Replacement

The TE-6700 units are not field repairable.

**IMPORTANT:** The Printed Circuit Board (PCB) is retained with a tamper-resistant mechanism. Removal of the PCB from the plastic housing will void the product warranty.

## Ordering Information

To order a replacement or an accessory, contact the nearest Johnson Controls representative. Specify the desired product code number from Figure 3 or Table 1.



\* These models do not have a functioning LED, but all models have the manual override PB.

Example 1: To order a nickel sensor with a phone jack, a warmer/cooler temperature setpoint, and a liquid bulb thermometer, specify Product Code Number TE-67NP-1B00.

Example 2: To order a platinum sensor with a terminal block, a scaled temperature setpoint, and no indication, specify Product Code Number TE-67PT-2N00.

**Figure 3: Ordering Template**

**Table 1: Accessories**

Product Code Number	Description
ACC-DWCLIP-0	Drywall Clip Mounting Kit (10/bag)
ACC-INSL-0**	Wallbox Mounting Pad (10/bag)
ACC-INSL-1**	Surface Mounting Pad (10/bag)
GRD10A-608	Plastic Guard with Baseplate and Mounting Ring
T-4000-119	Allen-head Adjustment Tool (30/bag)
TE-67D0-601	Door Replacement Kit with Johnson Controls Logo (10/box)
TE-67D0-602	Door Replacement Kit without a Logo (10/box)
TE-67E0-600	Replacement Endcaps (10/bag)
TE-67L-600	Fahrenheit Label Replacement Kit
TE-67L-601	Celsius Label Replacement Kit
TE-67S-600	Surface Mounting Kit
TE-67W-600	U.S. Wallbox Mounting Kit

\*\* These foam pads will help prevent drafts from entering the unit through the wall, and make installation easier when mounting on an uneven surface.

# Specifications

<b>Product</b>	TE-6700 Series 2nd Generation Temperature Elements	
<b>Nickel Sensor</b>	Temperature Sensor:	1000 ohm thin-film nickel
	Temperature Coefficient:	Approximately 3 ohms per F° (5.4 ohms per C°)
	Reference Resistance:	1000 ohms at 70°F (21°C)
	Accuracy:	±0.34F° at 70°F (±0.18C° at 21°C)
<b>Platinum Sensor</b>	Temperature Sensor:	1000 ohm thin-film platinum
	Temperature Coefficient:	Approximately 2 ohms per F° (3.9 ohms per C°)
	Reference Resistance:	1000 ohms at 32°F (0°C)
	Accuracy:	±0.65F° at 70°F (±0.36C° at 21°C)
<b>Temperature Indicator</b>	Type:	Liquid filled bulb thermometer
	Range:	40 to 90°F or 5 to 30°C
	Resolution:	Fahrenheit scale graduated at 10F° intervals; Celsius scale and graduated at 5C° intervals.
<b>Setpoint</b>	Single Adjustment:	Warmer/cooler, red/blue visual scale, or temperature – scaled °F/°C
	Dual Adjustment:	Heating and cooling, graduated scale 65 to 85°F (19 to 29°C)
	Resistance:	Nominal 1.5k ohm
	Resolution:	Fahrenheit scale graduated at 5F° intervals; Celsius scale at 2C° intervals
<b>Sensor Response Time</b>	One-time constant = 8 ±2 minutes at 10 feet per minute (fpm) airflow rate	
<b>Field Connections</b>	Phone Jack:	8-pin connector for 8-conductor 24 AWG phone cable
	Terminal Block:	Screw type terminals for 18 to 24 AWG wire
<b>Zone Bus Access</b>	6-pin connector with front access for a laptop with HVAC PRO™ software, Palm™ compatible handheld device with Variable Air Volume Modular Assembly Balancing Tool (VBT) software, or a Zone Terminal	
<b>Manual Override</b>	Integral momentary pushbutton (DIP switch selectable)	
<b>LED Display</b>	Red LED indicates three modes of operation (application and controller dependent)	
<b>Ambient Operating Conditions</b>	32 to 131°F (0 to 55°C) 0 to 100% RH, non-condensing; 85°F (29°C) maximum dew point	
<b>Ambient Storage Conditions</b>	-40 to 160°F (-40 to 71°C) 0 to 100% RH, non-condensing; 85°F (29°C) maximum dew point	
<b>Mounting Style</b>	Standard bases for surface or U.S. wallbox mounting, including hardware	
<b>Materials</b>	White plastic case with dark grey plastic mounting bases	
<b>Dimensions (H x W x D)</b>	3.2 x 3.2 x 1.4 in. (81 x 81 x 36 mm)	
<b>Shipping Weight</b>	1 lb (0.5 kg)	

*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.*

**JOHNSON  
CONTROLS**

Controls Group  
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P.O. Box 423  
Milwaukee, WI 53201

Printed in U.S.A.  
www.johnsoncontrols.com

## INSTALLATION

### !CAUTION!

- This product is not intended for life or safety applications
- Installing sensors in an energized motor control center or on any energized conductor can be hazardous.

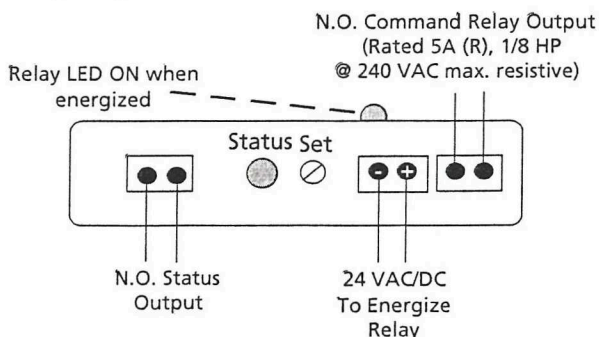
Severe injury or death can result from electrical shock during contact with high voltage conductors or related equipment. Disconnect and lock-out all power sources during installation. Applications shown are suggested means of installing sensors, but it is the responsibility of the installer to ensure that the installation is in compliance with all national and local codes. Installation should be attempted only by individuals familiar with codes, standards, and proper safety procedures for high-voltage installations.

1. Ensure power conductor to be monitored is disconnected and locked out from the power source!
2. Locate in a NEMA 1 enclosure or better, such as an approved starter enclosure. Install the adjustable mounting bracket to the back or floor of the enclosure.
3. Align to permit the conductor to fit through the hole. Slide the conductor through the center hole in the sensor and connect the conductor to the lugs on the motor starter.

**Note:** Low (<1 amp) and high (>135 amps) applications may require special installation:

- a. Low amperage (<1 amp FLA) - to provide adequate current, wrap conductor through the center hole and around the sensor body to produce multiple turns and increase flow. Measured current = Actual Current x Number of turns.
  - b. High amperage (>135 amp FLA) - current flows in excess of 135 amps require the use of an appropriately sized external current transformer. Install the external CT on the conductor and run the CT secondary wire through the sensor. **CAUTION:** CTs can contain hazardous voltages. Install CTs in accordance to manufacturers' specifications and instructions.
4. Wire as shown below. Use copper conductors only for command relay output. Terminal tightening 3.5lbs torque. Note: Testing the STATUS output of this sensor with a digital ohm meter may yield inaccurate, but relative readings of switching (i.e., 6 Meg Ohms.) Use an Analog VOM for readings similar to loop.

### Wiring Diagram



STATUS output is closed when sensed current is above set-point (LED ON). Turn SET clockwise to increase set-point.

## Installation Instructions

### HAWKEYE 735

### Adjustable Current Status Sensor with Command Relay

#### VERIS INDUSTRIES, INC.

10831 S.W. CASCADE BLVD.  
PORTLAND, OREGON 97223  
(503) 598-4564 FAX (503) 598-4664  
1-800-354-8556

http://www.veris.com email:sales@veris.com



## CALIBRATION

**NOTE:** Status LED is lit when output is ON (Closed) Sensor output is closed when sensed current is above set-point. Turn clockwise to increase set-point.

1. Turn on the load source and allow the motor or other load to reach normal operating condition.
2. If the status LED is lit, turn the setpoint screw clockwise until the LED goes out, then stop. If the status LED is not lit, turn the setpoint screw counterclockwise until the LED lights, then clockwise until the LED goes out, then stop. Sensor threshold is now balanced at the current level being monitored.
3. For undercurrent indication (for most status applications), turn the setpoint counterclockwise 1/4 turn from the position determined in step 2. The status LED should be ON. For variable frequency drives operating at greater than 25Hz, run drive at slowest speed above 25 Hz, and adjust as above. For drives operating below 25 Hz or with motors under 5 HP, consult factory. The sensor is now calibrated to provide indication of current flows below normal FLA.

An "open" condition of the sensor output after this adjustment indicates that the equipment has been turned off or has failed (belt loss, electrical failure, etc..)

**NOTE:** To calibrate the sensor for over-current indication, turn the setpoint screw 1/4 turn clockwise rather than counterclockwise. If the current exceeds the setpoint, the contact will close.

### !CAUTION!

Status indicators of this device should not be relied on to determine whether or not the monitored conductor is connected to a power source. Doing so may result in injury or death from electrical shock.

## SPECIFICATIONS

Amperage Ratings.....1 to 135A continuous  
Sensor Supply Voltage.....Induced from monitored conductor  
Supply Current.....Induced from monitored conductor  
Isolation.....600VAC rms  
Trip set-point.....Adjustable to +/- 1% of range  
Sealing.....N.E.M.A. 1  
Temperature range.....-15 to 60° C  
Humidity range.....0-95% non-condensing  
Status Output Rating (resistive).....N.O. 0.1A @ 30 VAC/DC  
Relay Contact Rating:

Inductive...N.O. 2.0A @ 250 VAC; 30 VDC  
Resistive....N.O. 5.0A @ 250 VAC; 30 VDC

Relay Coil.....24 VAC/DC; 10 mA nom.