

Tiered Solutions Base Upgradable Valves deliver exceptional performance for systems requiring airflow control be carried out by the Building Automation System (BAS). Each Tiered Solutions valve uses an analog command signal from the BAS to deliver the desired airflow for the zone's current conditions. Leveraging the accuracy and reliability of Phoenix Controls' venturi body design, each Tiered Solutions valve is fitted with either a high-speed smart actuator or a medium-speed actuator plus flow feedback module. Each actuator type requires a different method of BAS control. Smart actuators use scaled flow commands while medium-speed actuators with feedback modules use actuator-position commands. The later depends upon the BAS to develop control algorithms that generate actuator-position commands and do signal tuning to stabilize those commands.

All Tiered Solution valves generate scaled flow feedback signals for use by the BAS. This feedback signal is provided directly from a valve's smart actuator or from the external feedback module on valves with medium-speed actuators. For enhanced safety, a flow alarm can be generated by an optional factory-provided pressure switch.

This unique combination of a Phoenix Controls high-performance venturi airflow valve with smart actuator or medium-speed actuator/flow feedback module and pressure switch gives you the flexibility to choose your own control methods and rely on the valve to deliver the accurate and reliable performance your facility demands for safe operation and reduced energy costs.

FEATURES

- Stable, accurate airflow with broad flexibility in BAS implementation of temperature and other zone controls.
- Proportional valve control via high-speed scaled flow commands or medium-speed actuator-position commands.
- Precise flow feedback signals for BAS use.
- One flow feedback module per each medium-speed single or multi-body valve.
- Fail to last position or, for smart actuator only, fail to normally open/closed via optional card inside housing.
- Flow alarm via pressure switch.
- Configuration tools with user-friendly graphical interfaces for easy customization of feedback signal or, for smart actuator only, command signal.
- Shut-off capability for all valve sizes.
- Low noise diffuser construction.



Smart Actuator

OSHPD Certified

This device is certified for OSHPD Seismic Certification Preapproval per 2013 CBC, 2012 IBC, ASCE 7-10, and IEC-ES-AC-156. OSHPD Special Certification number OSP-0290-10.

NVLAP Accreditation

All venturi valves are characterized on NVLAP Accredited Airstations, Lab Code 200992-0. NVLAP is administered by the National Institute of Standards and Technology (NIST).

ISO

Phoenix Controls designs, develops, manufactures, and sells products, systems, and service to control the environment and airflow of critical spaces. Phoenix Controls is registered to ISO 9001:2008.

Warranty

Phoenix Controls Warrants all venturi valves against defects in material and workmanship for a period of 5 years. All other equipment manufactured by Phoenix Controls, such as sash sensors, fume hood monitors, and equipment supplied but not manufactured by Phoenix Controls is covered by a 3 year warranty.

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SPECIFICATIONS

Construction: Standard and Shut-off Valves (Designs A and S)

- 16 ga. spun aluminum valve body with continuous welded seam
- Valve bodies available as uncoated aluminum, with corrosion-resistant baked-on phenolic coating, or with PVDF (polyvinylidene fluoride) coating
- Shaft bearing surfaces: Polyphenylene sulfide (PPS) and either polypropylene (Construction A, B, and C) or PTFE *Teflon (Construction D)
- Spring grade stainless steel spring and polyester or PPS slider
- Supply valves insulated with 3/8" (9.5 mm) flexible closed-cell polymer-based foam. Flame/smoke rating 25/50. Density is 1.5 lb/ft³ (24.0 kg/m³)

Construction: Low-leakage Shut-off Valves (Design L)

- 16 ga. spun aluminum valve body with continuous welded seam
- Valve bodies available as uncoated aluminum with corrosion-resistant baked-on phenolic coating, or with PVDF (polyvinylidene fluoride) coating
- Shaft bearing surfaces: Polyphenylene sulfide (PPS) and either polypropylene (Construction A, B, and C) or PTFE *Teflon (Construction D)
- Spring grade stainless steel spring and polyester or PPS slider
- Supply valves insulated with 3/8" (9.5 mm) flexible closed-cell polymer-based foam. Flame/smoke rating 25/50. Density is 1.5 lb/ft³ (24.0 kg/m³)
- Cone gasket: Viton

Sound

Designed for low sound power levels to meet or exceed ASHRAE noise guidelines.

Operating Range

- 32-122 °F (0-50 °C) ambient
- 10-90% non-condensing RH

Performance

- Pressure independent over a 0.3"-3.0" WC (75-750 Pa) drop across valve
- Volume control accurate to ± 5% of airflow feedback signal
- No additional straight duct runs needed before or after valve
- Available in flows from:
 - High-speed smart actuators: 35-10,000 CFM (60-16,990 m³/hr)
 - Medium-speed actuators: 35-6,000 CFM (60-10,194 m³/hr)
- Response time to change in command signal:
 - Smart actuator: < 1 second
 - Medium-speed actuator: Dependent on BAS control loop timing
- Response time to change in duct static pressure: <1 second

Smart High-Speed Actuator (Control Type T)

- Proportional with optional NO/NC failsafe capability
- Controlled by direct acting**, scaled flow command
- Power: 24 Vac (±15%) @ 50/60 Hz
- Power Consumption (with or without failsafe)
 - Singles 35 VA, duals 50 VA, triples 85 VA, quads 100 VA
 - Note: All power consumption ratings are based on fully-loaded I/O.
- Flow Input/Output (defaults):
 - 2-10 Vdc flow command signal
 - Field installation of 500 ohm ¼ W resistor converts command signal to 4- 20 mA
 - 2-10 Vdc flow feedback signal
 - Scaled as detailed in Valve Scale Factors section
- Electrical connections to 10-pin terminal block
- Electronic overload protection
- Housing Material: UL94-5VA
- Valve Clamps: Mechanical clamping not available

Medium-Speed Actuator (Control Types Q and S)

- Proportional, fail to last position
- Controlled by direct acting**, actuator-position command
- Control signal types:
 - Control Type Q: 2 to 10 Vdc (field installation of 500 ohm ¼ W resistor converts it to 4-20 mA)
 - Control Type S: 0.5 to 10 Vdc

- Power: 24 Vac (±20%) @ 50/60 Hz
- Power consumption: Singles and duals 28 VA, triples and quads 56 VA
- Electrical connections to 3 ft (1m), 18 GA plenum rated cable pig-tail, crimped with ferrule ends
- Electronic overload protection
- Minimum full stroke* time (*= min to max flow position):
 - 3 seconds (singles and single-portion of triples)
 - 5 seconds (duals, dual-portion of triples, and quads)
- Housing:
 - NEMA 2, IP54, UL enclosure Type 2
 - Material: UL94-5VA
- Valve Clamps

The ability to mechanically clamp Q and S actuators is limited as shown below. Designate the need for factory-set mechanical clamps by entering an M in the *Min & Max Clamp* fields for the valve(s) on the Room Schedule Sheet. *If the two Clamp fields are empty, the valve will ship WITHOUT mechanical settings.*

Medium-Speed Actuators: Control Types Q and S			
Valve Size	Smallest Difference Between Minimum and Maximum Settings	Minimum Clamp Range (CFM)	Maximum Clamp Range (CFM)
108	50	35-345	700-35
110	50	50-460	1000-50
112	75	90-575	1500-90
114	150	200-2000	2500-200
210	200	100-1600	2000-120
212	200	180-1750	3000-200
312	Has two actuators; See 112 and 212 above		
412	Has two actuators; See 212 above for each		

Flow Feedback Module

- Consists of factory-installed enclosure with flow feedback card
- Power: 24 Vac (±15%) @ 50/60 Hz or ±15 Vdc
- Power/Current Consumption: 1.5 VA or 35 mA
- Output (defaults):
 - 2-10 Vdc flow feedback signal
 - Scaled as detailed in Valve Scale Factors section
- Weight: > 6 oz.
- Enclosure
 - Dimensions: 6" x 3.2" x 1.9"
 - Material: Flame retardant polypropylene carbonate (PPC)
 - Color: Black

Regulatory Compliance



WEEE Directive 2012/19/EC
Waste Electrical and Electronic Equipment Directive
At the end of the product life dispose of packaging and product in a corresponding recycling center. Do not dispose of the unit with the usual domestic refuse. Do not burn the product.

NOTE: CE compliance not applicable to medium-speed actuators. For flow feedback cards to maintain CE compliance, input/output cable lengths in excess of 32.8 feet (10 meters) must be shielded.

- RoHS
- FCC

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

 1. This device may not cause harmful interference.
 2. This device must accept any interference received, including interference that may cause undesired operation.
- EU Contact Address:

Honeywell GmbH
Boebinger Str. 17
71101 Schoenaich, Germany

*Teflon is a registered trademark of DuPont Company.

** Direct acting: Flow increases or decreases as command increases or decreases, respectively.

ORDERING GUIDE

BSV A 1 14 M - A Q F H Z - PSL -

VALVE FAMILY

Note: Supply valves come standard with insulation and blocks.

BEV = Base upgradable exhaust valve
BSV = Base upgradable supply valve

VALVE CONSTRUCTION

A = Body and cone - uncoated aluminum; Shaft - uncoated 316 stainless steel (see Note 3)
B = Body and cone with baked phenolic coating; PFA-coated 316 stainless steel shaft (see Note 3)
C = Body, cone and hardware with baked phenolic/epoxy phenolic coating; PFA-coated 316 stainless steel shaft (see Note 3)
D = Body, cone and hardware with PVDF coating; PFA-coated 316 stainless steel shaft (see Note 1)

NUMBER OF VALVE BODIES

F = One with welded circular flanges: Single flanged (see Notes 2, 14)
1 = One: Single no flange
2 = Two, Dual: 10, 12, and 14-inch only (see Notes 1, 5, 14)
3 = Three, Triple: 12 and 14-inch only (see Notes 1, 5, 14)
4 = Four, Quad: 12 and 14-inch only (see Notes 1, 5, 14)

VALVE SIZE

08 = 8-inch (7.88"/200 mm outer diameter); Single Only (see Note 3)
10 = 10-inch (9.88"/251 mm outer diameter); Single and Dual Only
12 = 12-inch (11.88"/302 mm outer diameter)
14 = 14-inch (13.88"/353mm outer diameter) (see Notes 4, 5)

FLOW/PRESSURE OPERATING RANGE

M = Medium pressure: 0.6" to 3.0" / 150 to 750 Pa (see Notes 4, 6, 14)
L = Low pressure: 0.3" to 3.0" / 75 to 750 Pa (see Notes 6, 7, 8)

VALVE OPTIONS

As required; list alphabetically, separated by dashes.

EVI = Exhaust valve with insulation and blocks (see Note 11)
IBO = Insulation blocks only, no insulation (see Note 12)
PSL = Pressure switch, low limit (see Note 6)
REI = Remote electronics, indoor (see Notes 10, 13)
SFB = Square flange on both ends of single body valve (see Notes 1, 14)
SFX = Square flange on one end of single body valve: inlet on exhaust; discharge on supply (see Notes 1, 14)

FAILSAFE POSITION

C = Normally closed; Control Type T Only
O = Normally open; Control Type T Only
Z = To last position

VALVE ORIENTATION

H = Horizontal
U = Vertical up (see Note 8)
D = Vertical down

VALVE CONTROLLER DESIGNATION

F = Flow feedback module; no command capability (see Note 9)
N = No controller (see Note 10)

CONTROL TYPE

Q = Rotary, medium-speed, proportional 2 - 10 Vdc electric actuator; IP54 (see Notes 5, 9)
S = Rotary, medium-speed, proportional 0.5 - 10 Vdc electric actuator; IP54 (see Notes 5, 9)
T = SMART, linear, high-speed, proportional 2 - 10 Vdc electric actuator (see Notes 10, 13)

VALVE DESIGN

A = Conical shape diffuser
L = Low Leakage Shut-off Valve (see Notes 1, 3, 4, 7)
S = Standard Shut-off Valve (see Notes 1, 3, 8)

NOTES:

- Valve Construction D: ONLY available in single-body valves (Number of Valve Bodies = F or 1) of Design A without square flanges (Options SFB or SFX).
- For flange bolt-hole patterns refer to *MKT-0061 Flanges For Single Body Valves*.
- 8-inch shut-off valves (Design = L and S): ONLY available in Valve Construction A (uncoated).
- 14-inch medium pressure (Range = M), low leakage shutoff valves (Valve Design = L): NOT available.
- 14-inch valves with Control Types Q and S: ONLY available as singles (Number of Valve Bodies = F or 1).
- Pressure switch alarm set point: 0.3" WC for medium pressure and 0.2" WC for low pressure valves.
- Low pressure (Range = L), low leakage shut-off valves (Valve Design = L): NOT available in any size.
- Low pressure (Range = L), standard shut-off valves (Valve Design = S): NOT available as vertical up (Valve Orientation = U).
- Control Types Q and S:
 - REQUIRE flow feedback (Valve Controller Designation = F).
 - Can be mechanically clamped if desired; designate the need for these factory settings by placing an M in the Min and Max Clamp fields on the Room Schedule Sheet. If the two Clamp fields are empty, the valve will ship WITHOUT mechanical clamps (refer to Specifications / Valve Clamps for details).
- Control Type T:
 - Is ONLY available with Valve Controller Designation N, since it has built-in flow feedback.
 - CANNOT have option REI.
 - Has no mechanical clamps.
- Valve Option EVI: ONLY available on exhaust valves (BEV); NOT available with IBO.
- Valve Option IBO: Available on exhaust and supply valves (BEV and BSV); NOT available with EVI.
- Valve Option REI, for Control Types Q and S only: Remote Electronics, *Indoor Installations ONLY*. The distance between the valve and its controller is limited to 150 feet (45.7 meters) of 22-gauge cable.
- Valve Options SFB and SFX: Cannot be ordered with Valve Construction D, Number of Valve Bodies F, 2, 3 or 4, nor with each other.

FLOW/PRESSURE OPERATING RANGE TABLE

Notes referenced in the tables below are detailed on page 3 under the Ordering Guide..

Valve Design	Pressure Range	Size	Operating Range in CFM (m ³ /hr)				Pressure Drop Across Valve
			Single	Dual	Triple	Quad	
A = Standard	M = Medium	08"	35-700 (60-1185)	-----	-----	-----	0.6-3.0" WC (150-750 Pa)
		10"	50-1000 (85-1695)	100-2000 (170-3390)	-----	-----	
		12"	90-1500 (155-2545)	180-3000 (310-5090)	270-4500 (465-7635)	360-6000 (620-10,180)	
		14"	200-2500 (340-4245)	400-5000 (680-8490) <i>(see Note 5)</i>	600-7500 (1020-12,735) <i>(see Note 5)</i>	800-10000 (1360-16,980) <i>(see Note 5)</i>	
	L = Low	08"	35-500 (60-845)	-----	-----	-----	0.3-3.0" WC (75-750 Pa)
		10"	50-550 (85-930)	100-1100 (170-1860)	-----	-----	
		12"	90-1050 (155-1780)	180-2100 (310-3560)	270-3150 (465-5340)	360-4200 (620-7120)	
		14"	200-1400 (340-2375)	400-2800 (680-4750) <i>(see Note 5)</i>	600-4200 (1020-7125) <i>(see Note 5)</i>	800-5600 (1360-9500) <i>(see Note 5)</i>	
L and S = Low Leakage and Standard Shut-off <i>(see Note 1)</i>	M = Medium	08" <i>(see Note 3)</i>	35-600 (60-1015)	-----	-----	-----	0.6-3.0" WC (150-750 Pa)
		10"	50-850 (85-1440)	100-1700 (170-2880)	-----	-----	
		12"	90-1300 (155-2205)	180-2600 (310-4410)	270-3900 (465-6615)	360-5200 (620-8820)	
		14" <i>(see Note 4)</i>	200-1600 (340-2715)	400-3200 (680-5430) <i>(see Note 5)</i>	600-4800 (1020-8145) <i>(see Note 5)</i>	800-6400 (1360-10860) <i>(see Note 5)</i>	
S = Standard Shut-off <i>(see Notes 1, 8)</i>	L = Low	08" <i>(see Note 3)</i>	35-400 (60-675)	-----	-----	-----	0.3-3.0" WC (75-750 Pa)
		10"	50-450 (85-760)	100-900 (170-1520)	-----	-----	
		12"	90-900 (155-1525)	180-1800 (310-3050)	270-2700 (465-4575)	360-3600 (620-6100)	
		14"	200-1000 (340-1695)	400-2000 (680-3390) <i>(see Note 5)</i>	600-3000 (1020-5085) <i>(see Note 5)</i>	800-4000 (1360-6780) <i>(see Note 5)</i>	

KEY VALVE COMPONENTS

Actuator Control Type

The following table presents a feature summary for the actuators available on Tiered Solutions valves.

Control Type	Command Type	Command Signal	Feedback Signal	Speed	Mechanical Clamps	Available Valve Sizes	Requires
Q	Actuator Position	*2 - 10 Vdc	From separate flow feedback module: 2 - 10 Vdc (default signal and range) or 4 - 20 mA (field set via jumpers)	Medium	Yes	Single 8", 10", 12", and 14" Dual 10" and 12" Triple 12" Quad 12"	<ul style="list-style-type: none"> ▪ External flow feedback module. ▪ BAS control algorithms and signal tuning.
S	Actuator Position	0.5 - 10 Vdc					
T	Flow	*2 - 10 Vdc (default range)	2 - 10 Vdc (default range)	High	No	All sizes: Single 8", 10", 12", and 14" Dual 10", 12", and 14" Triple 12" and 14" Quad 12" and 14"	None of the above

* Field installation of 500 ohm ¼ W resistor converts signal to 4-20 mA.

Refer to Valve Scale Factors on page 13 (Vdc) and 15 (mA).

Valve Controller Designation

N: No Controller - For Control Type T only; separate electronics not required since smart actuator's feedback capability is built into it.

F: Flow Feedback Module - Includes a feedback circuit board in a small black plastic enclosure installed on the valve's base channel. It provides a 2-10 Vdc factory default feedback signal scaled to indicate airflow. If desired, field jumper settings can change the feedback signal to 4-20 mA. Refer to Valve Scale Factors on page 13 (Vdc) and 15 (mA).

Valve Options

PSL: Pressure switch - Provides alarm monitoring by detecting low static pressure across the valve. On multi-body valves (duals, tri-plex, and quads) multiple pressure switches are provided with one connected across each body.

APPLICATIONS

Phoenix Controls Tiered Solutions valves are built and characterized on NVLAP air stations. At the customer's facility BAS controllers are mounted on these supply and general exhaust valves. Analog signals are hard wired between the BAS controller and the Tiered Solutions valve. The BAS commands each Tiered Solutions valve to meet the zone's current demand conditions (occupancy, ventilation, temperature control, hood requirements, zone balance, etc.).

The wiring connections and method of BAS control differs for valves fitted with high-speed smart actuators from those with medium-speed actuators plus flow feedback modules. Valves with smart actuators require *scaled flow* commands from the BAS to accurately and consistently deliver the desired flow setpoint. The smart actuators' default command signal is 2 - 10 Vdc with scaling based on the maximum flow of each valve type*. Field installation of 500-ohm, ¼ watt resistors easily converts it to 4 - 20 mA*. If desired, custom command signal scaling can be field configured via the Smart Actuator Configuration Tool (SACT).

Valves with medium-speed actuators and feedback modules require *actuator-position* commands. These valves must be specifically ordered with position-control signals of either 0.5 - 10 Vdc or 2 - 10 Vdc. The later can be converted to 4 - 20 mA by field installing a 500-ohm, ¼ watt resistor. No other command signal customization is available, nor does flow scaling apply.

Medium-speed units also require the BAS to monitor the valve's flow feedback, develop and use control algorithms to generate commands that move the actuator to the position that delivers the desired flow, and do signal tuning to stabilize those commands.

The default feedback signal of smart actuators and flow feedback cards is 2 - 10 Vdc, with scaling based on maximum valve flow*. Voltage is the only feedback signal type available from smart actuators. Outputs from flow feedback cards, however, can be field changed to 4-20 mA* via jumper settings. If desired, custom scaling can be field configured for both products via the SACT or Digital flow feedback Configuration Tool (DCT) respectively. From flow feedback cards the BAS uses this signal in its control loop to generate the position command to the valve's medium-speed actuator and also uses it for zone balance. However, the BAS only uses flow feedback from smart actuators for zone balance control. No BAS control programming or signal tuning is needed to accurately and repeatably control airflow valves with smart actuators.

Both smart and medium-speed actuators are available with fail to last position failsafes. Smart actuators can also be ordered with normally open or closed failsafes (O or C). If desired, such valves can be field configured to fail to different states: closed (fully retracted) or open (fully extended) via DIP switches, or another software configured position via the SACT.

**Refer to Valve Scale Factors on page 13 (Vdc) and 15 (mA).*

BAS CONTROL REQUIREMENTS

For Valves with Smart Actuators

The smart actuator is a single contained unit that accepts an analog flow command signal and generates an analog flow feedback. The BAS controller and smart actuator must be configured with the same *signal per flow unit* scale factors* for the command and feedback signals to represent the same flow values in each device.

This is the only requirement. Because the smart actuator uses scaled flow signals, no BAS programming or PID loop tuning is needed to achieve stable control.

* Refer to Valve Scale Factors on page 13 (Vdc) and 15 (mA).

For Valves with Medium-Speed Actuators and Flow Feedback Modules

Each valve has a proportional actuator, directly controlled by the BAS, and a separate module that generates an accurate, scaled, flow feedback signal. The BAS controller and feedback card must be configured with the same *signal per flow unit* scale factors* for the feedback signal to represent the same flow value in each device.

Additionally, the BAS controller must be programmed to use the scaled flow feedback signal in a control algorithm to generate unscaled, actuator-position commands. Then the BAS must tune or "optimize" the coefficients of the algorithms' PID control loop to achieve stable actuator control.

Use the following guidelines to implement BAS control of Tiered Solutions valves with medium-speed actuators.

* Refer to Valve Scale Factors on page 13 (Vdc) and 15 (mA).

Programming

1. Use the raw, unfiltered flow feedback signal for PID control. **Do not attempt to "condition" the feedback signal.** Feedback is stable. The PID will perform better with unconditioned feedback.
2. As with any PID algorithm, custom programming is needed to control the valve's actuator effectively. Take these items into account when developing the BAS code
 - a. The valve's change of flow relative to its actuator's change of position is nonlinear. Meaning that flow changes more for a given change of actuator position at higher flows than lower. To stabilize control at both the high and low ends, scale the tuning factors based on valve flow feedback. When the actuator (and valve) is more open, the tuning factors will be smaller since smaller changes are desired. When the actuator (and valve) is more closed, the tuning factors will be larger as larger changes are desired.
 - b. Prevent the control signal from exceeding the speed of the actuator; to start (use ~25% of actuator full stroke /per second).
 - c. When flow feedback is within 5% of the desired airflow, limit the control signal to even smaller adjustments per second to minimize overshoot.
 - d. Build in a dead band to prevent the actuator from constantly modulating (use ~1% of desired airflow).
3. It is likely that code developed for one kind (supply or general exhaust) and size of valve with the same actuator and control signal can be copied and used on other valves of the same type.

Tuning the PID Loop

Correct PID tuning will extend the life of the actuator and reduce the position time of the supply and exhaust valves as they are commanded to new flows based on the zone's current demand conditions (occupancy, ventilation, temperature control, hood requirements, zone balance, etc.).

1. Kp should be very small or even 0.
2. Start with a small Ki and test the response to a typical change in setpoint.
3. Increase Ki and continue to test until output is unstable, then decrease value.
4. Add Kd last and only if there is undesirable overshoot, start small and slowly increase until satisfactory.

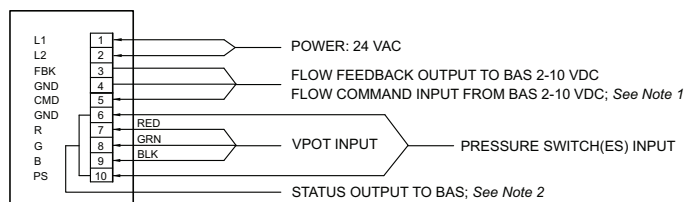
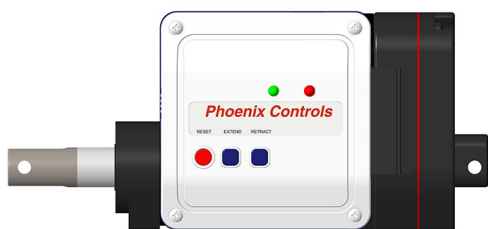
MOUNTING BAS CONTROLLER (PROVIDED BY OTHERS) ON VALVE

- Mount to base channel with self-tapping screws (not provided)
- Do not touch, scratch, or pierce valve body with mounting hardware
- BAS controller location must allow clearance for cable routing and entry
- Full movement of actuator cannot be impeded by controller or cabling

WIRING

Smart Actuator

The diagram below shows connections to single and dual valves. For triple and quad units, two sets of connections are made - one at each section of the valve.



Smart Actuator Connections

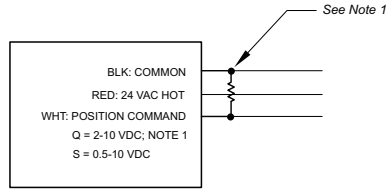
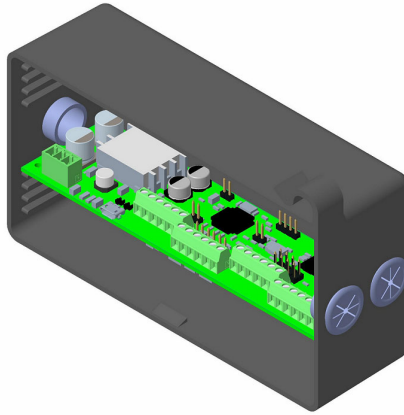
NOTES:

- 1: Field installation of 500 Ω 1/4 W resistor converts signal to 4-20 mA. Connect between GND on pin 4 and CMD.
- 2: Open = alarm, Closed = normal

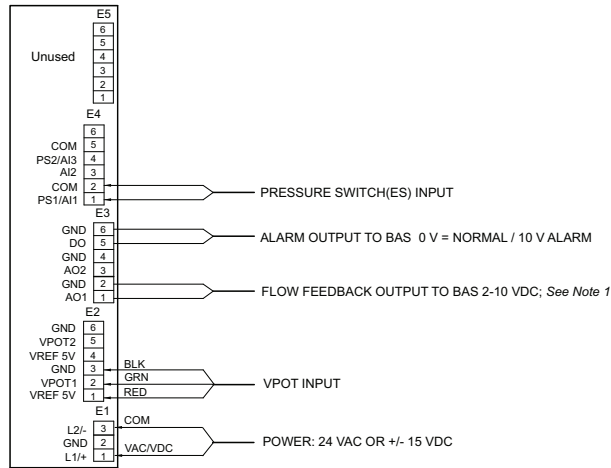
Medium-Speed Actuator/Flow Feedback Module

One flow feedback card is provided for each single, dual, triple, and quad valve. Triple and quad valves come in two sections with the feedback module on the first and an enclosure with 8-pin terminal strip on the second. This strip is used to field wire signals over to the flow feedback card.

Single and Dual Valves



Actuator Connections

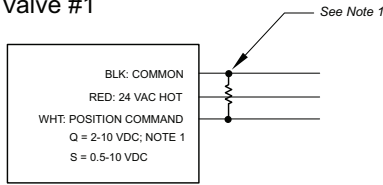


Flow Feedback Card Connections

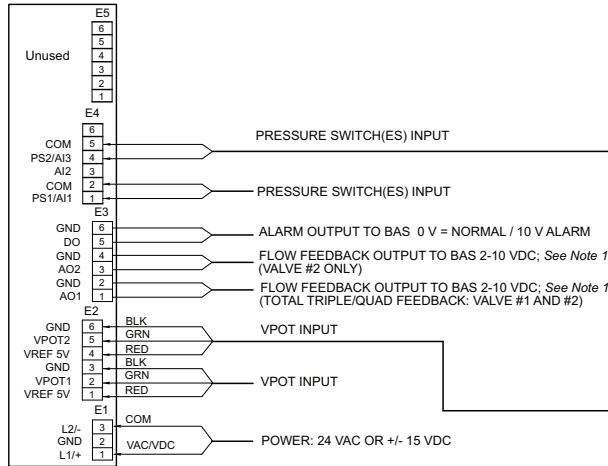
NOTE:
 1. Field installation of 500Ω 1/4 W resistor converts signal to 4-20 mA.
 Connect between: BLK & WHT on actuator and GND & AO on feedback card.

Triple and Quad Valves

Valve #1

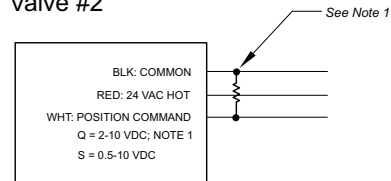


Actuator Connections

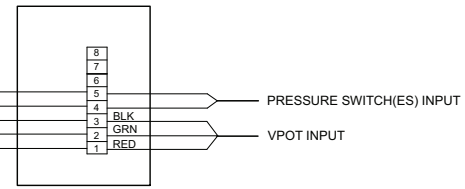


Flow Feedback Card Connections

Valve #2



Actuator Connections



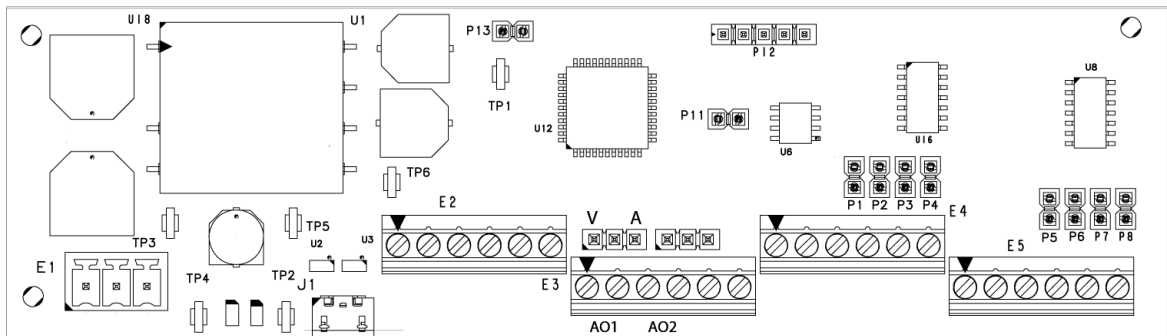
8-pin Terminal Strip Connections

NOTE:

- Field installation of 500Ω 1/4 W resistor converts signal to 4-20 mA.
Connect between: BLK & WHT on actuator and GND & AO on feedback card.

CAUTION: To maintain the flow feedback card's CE agency compliance, input/output cable lengths that exceed 32.8 feet (10 meters) require shielded cable.

Output Signal Jumpers

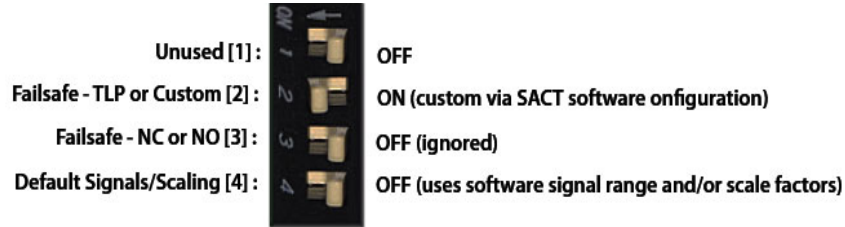


The flow feedback card's factory default signal is voltage. This can be changed to current in the field. Simply move the yellow jumper above AO1 on terminal block E3 to the center and right-most pins as shown in the chart below.

Terminal Block	Signal Connection	Jumper Set	Signal Type	Jumper Positions		
				Left (V)	Center	Right (A)
E3	AO1	Left above E3	Vdc	X	X	
			mA		X	X
	AO2	Right above E3	Unused	Anywhere		

ADDITIONAL SMART ACTUATOR FEATURES

DIP Switches



Function

Smart actuator functions can be adjusted by DIP Switch settings. When desired, additional software customization can be made with the SACT.

Switch	Name	Effect When ON	Effect When OFF
1	Unused	None	None
2	Failsafe: To-last-position or Ready to Customize	Actuator fails to-last-position, unless a custom flow has been set in software via the Smart Actuator Configuration Tool.	Failsafe is governed by Switch 3.
3	Failsafe: Normally Closed or Normally Open	<p><i>When Switch 3 is ON and 2 is OFF:</i> Actuator fails fully retracted with valve at:</p> <ul style="list-style-type: none"> Standard (Design A): Specified minimum flow. Shut-off and low leakage (Designs L and S): Shut-off. <p><i>When both Switches 3 and 2 are ON:</i> Switch 3 is ignored and 2 governs.</p>	<p><i>When both Switches 3 and 2 are OFF:</i> Actuator fails fully extended with valve at specified maximum flow (Designs A, L, S). <i>When Switch 3 is OFF and 2 is ON:</i> Switch 3 is ignored and 2 governs.</p>
4	Default Signal Ranges and Scaling	Default signal ranges and scale factors are used as defined in the Valve Scale Factor section.	Custom signal ranges and/or scale factors are used - configured in software via the Smart Actuator Configuration Tool.

Default Positions

The smart actuator's DIP switches have different default positions based on the valve failsafe ordered. See below for details.

Switch	Name	Default DIP Switch Positions by Valve Failsafe		
		C (Normally Closed)	O (Normally Open)	F (To-last-position)
1	Unused	OFF		
2	Failsafe: To-last-position or Ready to Customize*	Off	Off	On
3	Failsafe: Normally Closed or Normally Open	On	Off	Off (Ignored)
4	Default Signal Ranges and Scaling	On**		

* To set a custom failsafe flow: Configure the setting in the SACT and download the value.

** To use custom signal ranges and/or scale factors: Set Switch 4 to Off, enable the I/O Scaling section of the SACT, and configure then download the custom values.

LED Status

The green and red LEDs on the smart actuator indicate the following states.

LED Status		Indicates
Green	Red	
Off	Off	No Power
Blinking	Off	Normal operation
Blinking	Blinking	Alarm (low pressure) condition or failure during power up*
On	On	In manual override mode

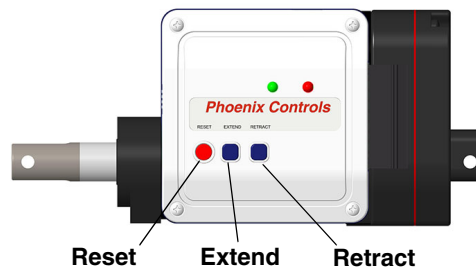
*If alarm occurs immediately after powering on the actuator, an error in its start-up routine has occurred. Check wiring. Then, if needed, connect the actuator to the SACT software tool for further trouble shooting.

Manual Override

The manual override buttons are used to move the smart actuator to a desired position for commissioning and troubleshooting.

The smart actuator is direct acting; as it's shaft extends valve flow increases and as it retracts flow decreases.

- To engage manual override, press and hold the two blue buttons on the smart actuator for 5 seconds. Both the red and green LED's will stay lit indicating you are in manual mode.
- To open the valve (extend) press the blue button closest to the red Reset button. To close the valve (retract) press the blue button furthest from the red Reset button.
- To disengage manual override press the Reset button.
- The actuator's green and red LEDs return to normal operation.



VALVE SCALE FACTORS

Default Voltage Scale Factors

The factory default signals for the smart actuator (flow command and feedback) and the flow feedback card are 2 - 10 Vdc. The default scaling of these signals is detailed in the chart below, where 2 Vdc represents zero flow and 10 Vdc the maximum specified flow of the valve. The voltage signal range and scaling can be field customized, if desired, by using the SACT or DCT software configuration tools.

Pressure / Operating Range	Valve Design / Number of Bodies	Valve Size	CFM (Min / Max)	Default 2 - 10 Vdc signals with Scale Factors = Max CFM / (10-2) Vdc, where: Flow = (Feedback Vdc - 2 Vdc) x Scale Factor					
				Scale Factor (CFM per volt)	Low Signal Out-of-Range Vdc	Low Limit Vdc	0 Flow Vdc	Vdc (Min / Max)	High Signal Out-of-Range Vdc
M	A / 1 or F	8	35 / 700	87.50	0	2	N/A	2.400 / 10.000	10.1
M	A / 1 or F	10	50 / 1000	125.00	0	2	N/A	2.400 / 10.000	10.1
M	A / 1 or F	12	90 / 1500	187.50	0	2	N/A	2.480 / 10.000	10.1
M	A / 1 or F	14	200 / 2500	312.50	0	2	N/A	2.640 / 10.000	10.1
M	A / 2	10	100 / 2000	250.00	0	2	N/A	2.400 / 10.000	10.1
M	A / 2	12	180 / 3000	375.00	0	2	N/A	2.480 / 10.000	10.1
M	A / 2	14	400 / 5000	625.00	0	2	N/A	2.640 / 10.000	10.1
M	A / 3	12	270 / 4500	562.50	0	2	N/A	2.480 / 10.000	10.1
M	A / 3	14	600 / 7500	937.50	0	2	N/A	2.640 / 10.000	10.1
M	A / 4	12	360 / 6000	750.00	0	2	N/A	2.480 / 10.000	10.1
M	A / 4	14	800 / 10000	1250.00	0	2	N/A	2.640 / 10.000	10.1
M	S or L / 1 or F	8	35 / 600	75.00	0	2	2	2.467 / 10.000	10.1
M	S or L / 1 or F	10	50 / 850	106.25	0	2	2	2.471 / 10.000	10.1
M	S or L / 1 or F	12	90 / 1300	162.50	0	2	2	2.554 / 10.000	10.1
M	S or L / 1 or F	14	200 / 1600	200.00	0	2	2	3.000 / 10.000	10.1
M	S or L / 2	10	100 / 1700	212.50	0	2	2	2.471 / 10.000	10.1
M	S or L / 2	12	180 / 2600	325.00	0	2	2	2.554 / 10.000	10.1
M	S or L / 2	14	400 / 3200	400.00	0	2	2	3.000 / 10.000	10.1
M	S or L / 3	12	270 / 3900	487.50	0	2	2	2.554 / 10	10.1
M	S or L / 3	14	600 / 4800	600.00	0	2	2	3.000 / 10.000	10.1
M	S or L / 4	12	360 / 5200	650.00	0	2	2	2.554 / 10.000	10.1

Pressure / Operating Range	Valve Design / Number of Bodies	Valve Size	CFM (Min / Max)	Default 2 - 10 Vdc signals with Scale Factors = Max CFM / (10-2) Vdc, where: Flow = (Feedback Vdc - 2 Vdc) x Scale Factor					
				Scale Factor (CFM per volt)	Low Signal Out-of-Range Vdc	Low Limit Vdc	0 Flow Vdc	Vdc (Min / Max)	High Signal Out-of-Range Vdc
M	S or L / 4	14	800 / 6400	800.00	0	2	2	3.000 / 10.000	10.1
L	A / 1 or F	8	35 / 500	62.50	0	2	N/A	2.56 / 10.000	10.1
L	A / 1 or F	10	50 / 550	68.75	0	2	N/A	2.727 / 10.000	10.1
L	A / 1 or F	12	90 / 1050	131.25	0	2	N/A	2.686 / 10.000	10.1
L	A / 1 or F	14	200 / 1400	175.00	0	2	N/A	3.143 / 10.000	10.1
L	A / 2	10	100 / 1100	137.50	0	2	N/A	2.727 / 10.000	10.1
L	A / 2	12	180 / 2100	262.50	0	2	N/A	2.686 / 10.000	10.1
L	A / 2	14	400 / 2800	350.00	0	2	N/A	3.143 / 10.000	10.1
L	A / 3	12	270 / 3150	393.75	0	2	N/A	2.68 / 10.000	10.1
L	A / 3	14	600 / 4200	525.00	0	2	N/A	3.143 / 10.000	10.1
L	A / 4	12	360 / 4200	525.00	0	2	N/A	2.686 / 10.000	10.1
L	A / 4	14	800 / 5600	700.00	0	2	N/A	3.143 / 10.000	10.1
L	S / 1 or F	8	35 / 400	50.00	0	2	2	2.700 / 10.000	10.1
L	S / 1 or F	10	50 / 450	56.25	0	2	2	2.889 / 10.000	10.1
L	S / 1 or F	12	90 / 900	112.50	0	2	2	2.800 / 10.000	10.1
L	S / 1 or F	14	200 / 1000	125.00	0	2	2	3.600 / 10.000	10.1
L	S / 2	10	100 / 900	112.50	0	2	2	2.889 / 10.000	10.1
L	S / 2	12	180 / 1800	225.00	0	2	2	2.800 / 10.000	10.1
L	S / 2	14	400 / 2000	250.00	0	2	2	3.600 / 10.000	10.1
L	S / 3	12	270 / 2700	337.50	0	2	2	2.800 / 10.000	10.1
L	S / 3	14	600 / 3000	375.00	0	2	2	3.600 / 10.000	10.1
L	S / 4	12	360 / 3600	450.00	0	2	2	2.800 / 10.000	10.1
L	S / 4	14	800 / 4000	500.00	0	2	2	3.600 / 10.000	10.1

Default Current Scale Factors

The smart actuator flow command and flow feedback card can be field configured for current signals. The smart actuator requires a 500 ohm, ¼ W resistor be field wired across the command terminals, while the feedback card requires a field jumper change. Once set to current the default 2 - 10 Vdc signal is changed to 4 - 20 mA. The default current scaling is shown in the chart below, where 4 mA represents zero flow and 20 mA the maximum specified flow of the valve. The current signal range and scaling can be field customized, if desired, by using the SACT or DCT software configuration tools.

Pressure / Operating Range	Valve Design / Number of Bodies	Valve Size	CFM (Min / Max)	Default 4-20 mA signals with Scale Factors = Max CFM / (20-4) mA, where: Flow = (Feedback mA - 2 mA) x Scale Factor					
				Scale Factor (CFM per mA)	Low Signal Out-of-Range mA	Low Limit mA	0 Flow mA	mA (Min / Max)	High Signal Out-of-Range mA
M	A / 1 or F	8	35 / 700	43.750	0	4	N/A	4.800 / 20.000	20.2
M	A / 1 or F	10	50 / 1000	62.500	0	4	N/A	4.800 / 20.000	20.2
M	A / 1 or F	12	90 / 1500	93.750	0	4	N/A	4.960 / 20.000	20.2
M	A / 1 or F	14	200 / 2500	156.250	0	4	N/A	5.280 / 20.000	20.2
M	A / 2	10	100 / 2000	125.000	0	4	N/A	4.800 / 20.000	20.2
M	A / 2	12	180 / 3000	187.500	0	4	N/A	4.960 / 20.000	20.2
M	A / 2	14	400 / 5000	312.500	0	4	N/A	5.280 / 20.000	20.2
M	A / 3	12	270 / 4500	281.250	0	4	N/A	4.960 / 20.000	20.2
M	A / 3	14	600 / 7500	468.750	0	4	N/A	5.280 / 20.000	20.2
M	A / 4	12	360 / 6000	375.000	0	4	N/A	4.960 / 20.000	20.2
M	A / 4	14	800 / 10000	625.000	0	4	N/A	5.280 / 20.000	20.2
M	S or L / 1 or F	8	35 / 600	37.500	0	4	4	4.933 / 20.000	20.2
M	S or L / 1 or F	10	50 / 850	53.125	0	4	4	4.941 / 20.000	20.2
M	S or L / 1 or F	12	90 / 1300	81.250	0	4	4	5.108 / 20.000	20.2
M	S or L / 1 or F	14	200 / 1600	100.000	0	4	4	6.000 / 20.000	20.2
M	S or L / 2	10	100 / 1700	106.250	0	4	4	4.941 / 20.000	20.2
M	S or L / 2	12	180 / 2600	162.500	0	4	4	5.108 / 20.000	20.2
M	S or L / 2	14	400 / 3200	200.000	0	4	4	6.000 / 20.000	20.2
M	S or L / 3	12	270 / 3900	243.750	0	4	4	5.108 / 20.000	20.2
M	S or L / 3	14	600 / 4800	300.000	0	4	4	6.000 / 20.000	20.2

Pressure / Operating Range	Valve Design / Number of Bodies	Valve Size	CFM (Min / Max)	Default 4-20 mA signals with Scale Factors = Max CFM / (20-4) mA, where: Flow = (Feedback mA - 2 mA) x Scale Factor					
				Scale Factor (CFM per mA)	Low Signal Out-of-Range mA	Low Limit mA	0 Flow mA	mA (Min / Max)	High Signal Out-of-Range mA
M	S or L / 4	12	360 / 5200	325.000	0	4	4	5.108 / 20.000	20.2
M	S or L / 4	14	800 / 6400	400.000	0	4	4	6.000 / 20.000	20.2
L	A / 1 or F	8	35 / 500	31.250	0	4	N/A	5.120 / 20.000	20.2
L	A / 1 or F	10	50 / 550	34.375	0	4	N/A	5.455 / 20.000	20.2
L	A / 1 or F	12	90 / 1050	65.625	0	4	N/A	5.371 / 20.000	20.2
L	A / 1 or F	14	200 / 1400	87.500	0	4	N/A	6.286 / 20.000	20.2
L	A / 2	10	100 / 1100	68.750	0	4	N/A	5.455 / 20.000	20.2
L	A / 2	12	180 / 2100	131.250	0	4	N/A	5.371 / 20.000	20.2
L	A / 2	14	400 / 2800	175.000	0	4	N/A	6.286 / 20.000	20.2
L	A / 3	12	270 / 3150	196.875	0	4	N/A	5.371 / 20.000	20.2
L	A / 3	14	600 / 4200	262.500	0	4	N/A	6.286 / 20.000	20.2
L	A / 4	12	360 / 4200	262.500	0	4	N/A	5.371 / 20.000	20.2
L	A / 4	14	800 / 5600	350.000	0	4	N/A	6.286 / 20.000	20.2
L	S / 1 or F	8	35 / 400	25.000	0	4	4	5.400 / 20.000	20.2
L	S / 1 or F	10	50 / 450	28.125	0	4	4	5.778 / 20.000	20.2
L	S / 1 or F	12	90 / 900	56.250	0	4	4	5.600 / 20.000	20.2
L	S / 1 or F	14	200 / 1000	62.500	0	4	4	7.200 / 20.000	20.2
L	S / 2	10	100 / 900	56.250	0	4	4	5.778 / 20.000	20.2
L	S / 2	12	180 / 1800	112.500	0	4	4	5.600 / 20.000	20.2
L	S / 2	14	400 / 2000	125.000	0	4	4	7.200 / 20.000	20.2
L	S / 3	12	270 / 2700	168.750	0	4	4	5.600 / 20.000	20.2
L	S / 3	14	600 / 3000	187.500	0	4	4	7.200 / 20.000	20.2
L	S / 4	12	360 / 3600	225.000	0	4	4	5.600 / 20.000	20.2
L	S / 4	14	800 / 4000	250.000	0	4	4	7.200 / 20.000	20.2

RECOMMENDED CABLES

Cable Type	Plenum Rated	Function	Wire Gauge	Primary Vendor/Part #	Alternate Vendor/Part #	Color Code	Notes
2C Round	No	24 Vac power	18	Belden 9409		1: Red 2: Black	Must be stranded
			14	Belden 9411			
2C Round	Yes	24 Vac power	18	Belden 82740	Windy City NP002360	1: Red 2: Black	Must be stranded
			14	Windy City NP007960			
TSP	No	I/O signal wiring	22	Belden 9501		1: Black&Red	Twisted Shielded Pair
2 TSP	No	I/O signal wiring	22	Belden 9502		1: Black&Red 2: Black&White	Two Twisted Pair, Shielded
3C Round	No	Signal	22	Belden 8443		1: Red 2: Black 3: Green	Must be stranded
3C or 4C Round	Yes	Signal	22	Belden 88444	Windy City 004380	1: Red 2: Black 3: Green 4: White (not used as 3C)	Must be stranded
4C Round	No	Signal	22	Belden 8444	Manhattan M13304	1: White 2: Green 3: Black 4: Red	Must be stranded
5C Round	No	Signal	22	Belden 8445	Manhattan M13305	1: White 2: Brown 3: Black 4: Red 5: Green	Must be stranded
8C	No	Signal	22	Belden 9421	Manhattan M13308	1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes
8C	Yes	Signal	22	Comtran 4956		1: White 2: Orange 3: Black 4: Red 5: Green 6: Yellow 7: Blue 8: Brown	No substitutes
3C MS/TP	No	Shielded	22	Belden 3106A (120 ohm)		1: White with Orange stripe 2: Orange with White stripe 3: Blue with White stripe	Shielded with drain
3C MS/TP	Yes	Shielded	22	Connect-Air W223C-2060YPC		1: Black 2: White 3: Red	Foil shield with drain wire