

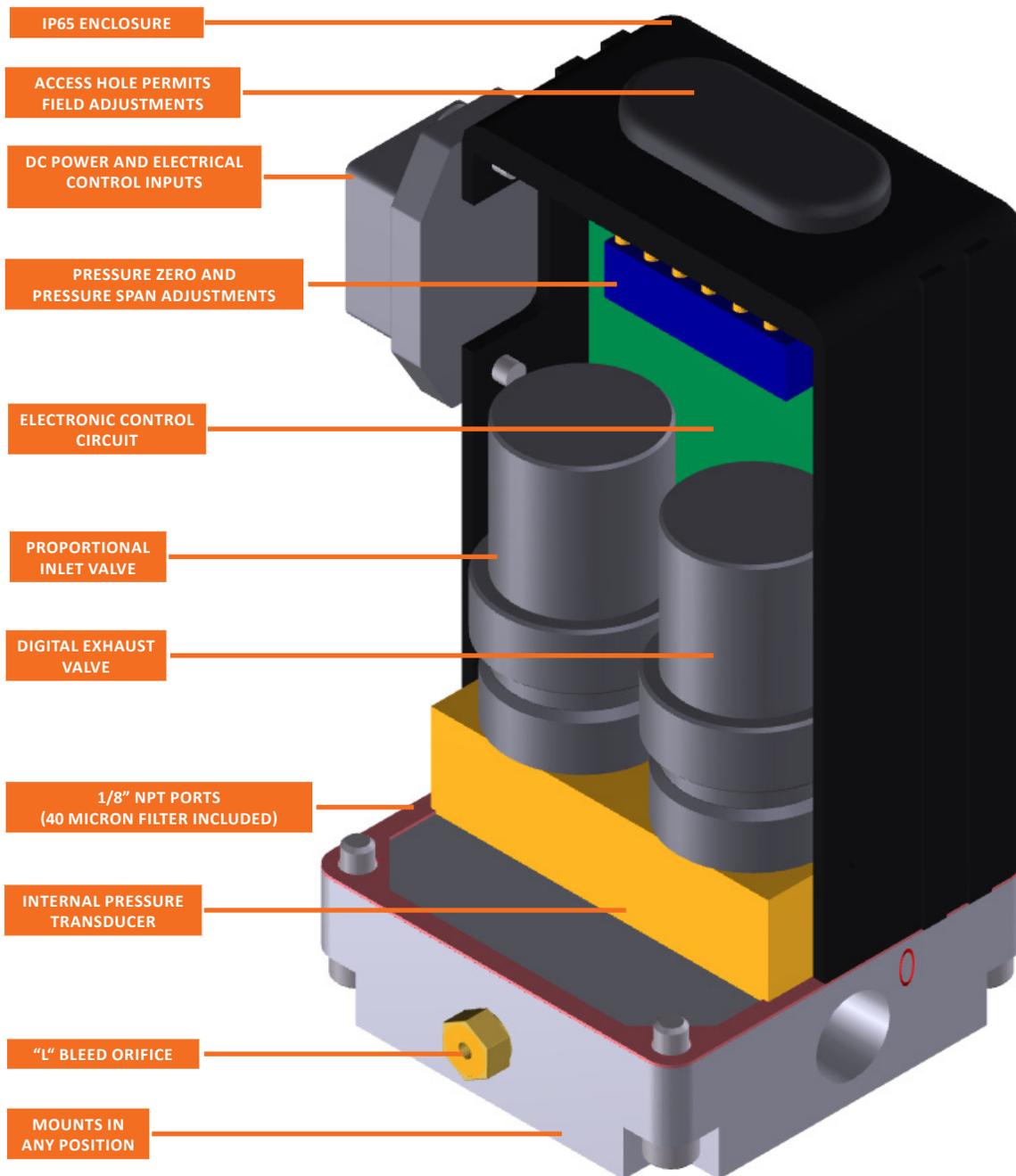


## QPV

Electronic High Resolution Pressure  
Control Valve



# Inside the QPV



The Equilibar® QPV series electronic pressure regulator uses advanced technology circuitry to drive a true proportional response solenoid valve to provide improved resolution, near zero dead band, and longer solenoid valve life.

The Equilibar® QPV series of ultra high resolution closed loop electronic pressure regulators incorporate two internal solenoid valves, an integrated pressure sensor, an electronic control circuit, a manifold, and a protective housing.

- Ultra high resolution pressure control
- Resolution as high as  $\pm 0.005\%$  F.S.
- Proportional inlet valve eliminates digital stepping
- Control pressure ranges as low as 0-2 in H<sub>2</sub>O [0-5 mbar] and as high as 0-150 psig [0-10 bar]
- Positive, vacuum through positive, vacuum, and absolute pressure options available

# How It Works

The QPV1 is a high resolution electronic pressure regulator. The QPV1 provides a regulated output pressure that is proportional to an electrical command signal input. The QPV1 is available in a wide range of calibrated pressure ranges covering vacuum through 150 psig (10 Bar). The QPV1 is available in either 0-10 VDC or 4-20 mA analog signal types.

The QPV1 is a complete closed loop control valve consisting of two internal solenoid valves, a manifold, an electronic control circuit board, and a pressure transducer all contained in a protective IP65/NEMA4 housing. Pressure is controlled by the use of two solenoid valves. One valve functions as inlet control and acts to allow supply media into the system to increase the controlled pressure. The other solenoid valve acts as the exhaust and will decrease the controlled pressure by venting to atmosphere. The inlet solenoid valve operates in a proportional manner to the current supplied by the QPV1's electronic control circuit. This variable orifice affect allows precise control of pressure at low flow conditions and avoids the digital steps of traditional ON/OFF solenoids. The ability to vary the inlet solenoid valve orifice opening in an analog fashion allows the QPV1 to control pressure with extremely high resolution. The exhaust solenoid is a standard ON/OFF solenoid and allows excess media to be vented from the system.

The regulated pressure output is measured by a pressure transducer internal to the QPV1. This pressure transducer provides a feedback signal to the QPV1's electronic control circuit. The control circuit compares the internal sensor feedback signal to the command signal input. Any difference between the two signals causes the appropriate solenoid valve to open, allowing flow in or out of the system. Accurate pressure is maintained by controlling these two valves.

The QPV1 is a relatively low flow regulator. This makes the QPV1 a great choice any time low flow rates or small volumes require precise pressure control. The QPV1 is often used to provide the pilot pressure signal to the dome of either an Equilibar back pressure regulator or an Equilibar vacuum regulator. The QPV1 can then be used to electronically control back pressure or vacuum pressure in line sizes from 1/8 inch through 6 inch by pilot operating the appropriately sized regulator.

An electronic monitor output signal from the internal pressure transducer is provided. All QPV1 valves come standard with an analog voltage monitor output. A 4-20mA monitor is available optionally.

The QPV1 series is available in two generations. The older 'T' models used brass hex fittings in the side of the canister for the inlet and outlet port connections. An improved 'M' series uses a solid aluminum base with integral inlet and outlet ports. Both models have identical performance and are pin-for-pin compatible. Both models use the same control circuit, solenoid valves, electrical connector, and internal pressure sensor.

## Downstream Sensor Input (QPV2 ONLY)

The QPV2 is a dual sensor versions of the QPV1. The QPV2 uses an external sensor as the feedback signal for the internal control circuit. This external signal is typically a pressure transmitter that is located on the controlled pressure port of the dome loaded regulator that is being pilot operated by the QPV2 pneumatic output signal. This scenario is used if the pilot operated regulator has excessive mechanical hysteresis and controlling the pilot pressure only does not result in satisfactory control of the output pressure.

Standard QPV2 series products are shipped from the factory calibrated to accept a 0-10 VDC signal from the external pressure sensor. 4-20mA signal inputs for the external sensor are available optionally.

The QPV2 features two analog monitor signals. The primary analog monitor is a repeat of the signal from the external pressure sensor. This primary monitor signal is available in 0-10VDC or 4-20mA. This signal type is independent of the original signal type used by the external sensor. A secondary monitor signal is available from the internal pressure sensor. The internal sensor is not used by the QPV2 for control, but the monitor signal can be useful in diagnosing problems as this signal indicates the pressure on the output port of the QPV2.

Note: The QPV2 requires an external feedback loop. The external loop is more difficult to control. The speed of response of the external sensor, the length and volume of the piping between the QPV2 and the external sensor, and any restrictions between the external sensor and QPV2 all act to create delay in the system. This delay can cause the QPV2 output pressure to oscillate in an overshoot-then-undershoot cycle. The tuning of the QPV2 PID circuit becomes more critical. Because this tuning must be achieved in the actual application and may not be adequate to handle all situations, there is some risk in specifying a QPV2. For applications that only require a few regulators to be installed using a QPV1 in conjunction with an external PID controller and an external sensor feeding the external controller is a more reliable solution. The QPV2 is most useful when large numbers of electronic regulator need to be installed as the risk versus reward is a better balance. While there is risk the QPV2 will not work the potential reward is that the QPV2 will act as both the controller and the pressure regulator which results in a smaller, simpler system.

# General Specifications & Performance Characteristics

| ELECTRICAL               | MINIMUM | TYPICAL      | MAXIMUM |
|--------------------------|---------|--------------|---------|
| Supply Voltage           | 15VDC   | -            | 24VDC   |
| Supply Current           | 100mADC | -            | 350mADC |
| Command Signal           |         |              |         |
| Voltage                  | 0VDC    | -            | 10VDC   |
| Current                  | 4mADC   | -            | 20mADC  |
| Analog Monitor Output    |         |              |         |
| Voltage                  | 0VDC    | -            | 10VDC   |
| Current                  | 4mADC   | -            | 20mADC  |
| Command Signal Impedance |         |              |         |
| Voltage                  | -       | 10K $\Omega$ | -       |
| Current                  | -       | 100 $\Omega$ | -       |

| PNEUMATIC                        | MINIMUM          | TYPICAL                        | MAXIMUM                  |
|----------------------------------|------------------|--------------------------------|--------------------------|
| Inlet Pressure <sup>1</sup>      | Full Vacuum      | 110% of full scale calibration | 165 psig (11.37 bar)     |
| Pressure Range <sup>2</sup>      | Full Vacuum      | -                              | 150 psig (10.34 bar)     |
| Flow Rate                        | 0                | -                              | 1 SCFM (0.47 Liters/sec) |
| Filtration Required <sup>4</sup> | -                | 40 Micron                      | -                        |
| Resolution                       | $\pm 0.2\%$ F.S. | $\pm 0.010\%$ F.S.             | $\pm 0.005\%$ F.S.       |
| Accuracy (Pressure)              | $\pm 0.5\%$ F.S. | $\pm 0.25\%$ F.S.              | $\pm 0.1\%$ F.S.         |
| Accuracy (Monitor)               | $\pm 0.5\%$ F.S. | $\pm 0.3\%$ F.S.               | -                        |
| Repeatability                    | $\pm 0.2\%$ F.S. | $\pm 0.02\%$ F.S.              | -                        |
| Port Size (all)                  | -                | 1/8 inch NPT female            | -                        |
| Critical Volume <sup>5</sup>     | 10 cc            | 20 cc                          | -                        |

| PHYSICAL                   | MINIMUM    | TYPICAL                  | MAXIMUM      |
|----------------------------|------------|--------------------------|--------------|
| Operating Temperature      | 32°F (0°C) | -                        | 158°F (70°C) |
| QPV Environment Protection | -          | NEMA 4 / IP65            | -            |
| QPV Weight                 | -          | 1.02 lbs (0.5kg)         | -            |
| QPV Electrical Connector   | -          | 6 pin Hirshman Connector | -            |

<sup>1</sup> Depends on the inlet valve orifice size.

<sup>2</sup> Pressure ranges are customer specified.

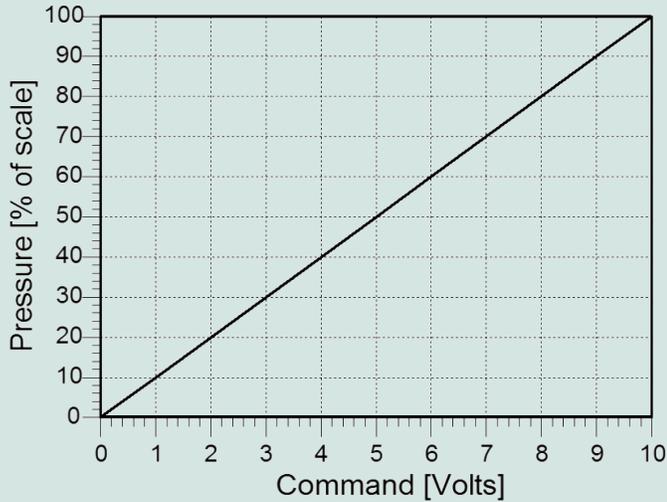
<sup>3</sup> At 100 psig working pressure.

<sup>4</sup> FPP1 sintered 40 micron filter included

<sup>5</sup> The minimum downstream closed volume is determined by the pressure range, orifice size, plumbing, as well as other factors. Consult factory for applications with total volumes less than 10 ccs.

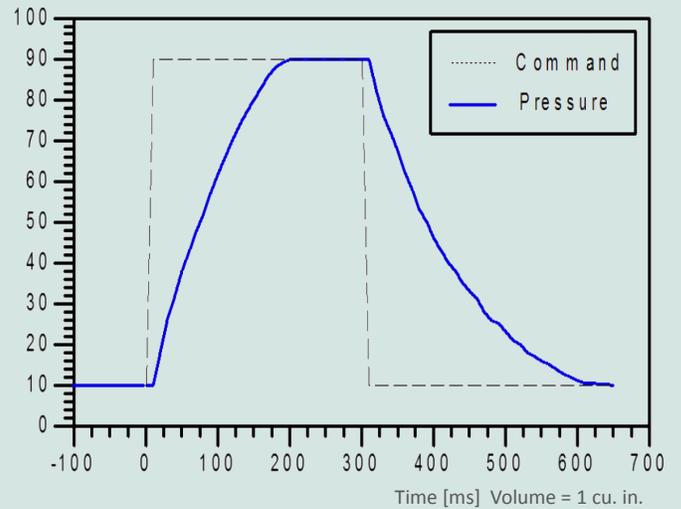
# Performance (Continued)

LINEARITY



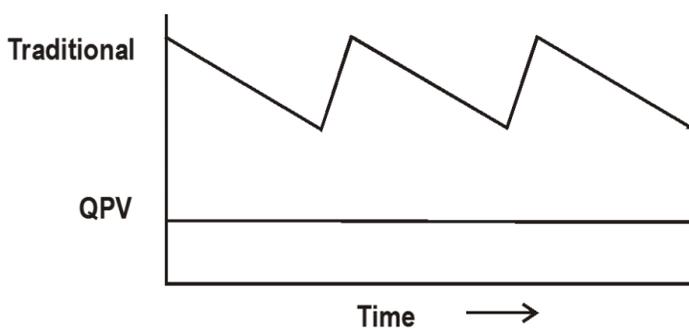
This chart shows the linear characteristics of QPV products when given a ramp signal from 0-10 volts. Characteristics would be similar for 4-20 mA units.

RESPONSE TO STEP INPUT

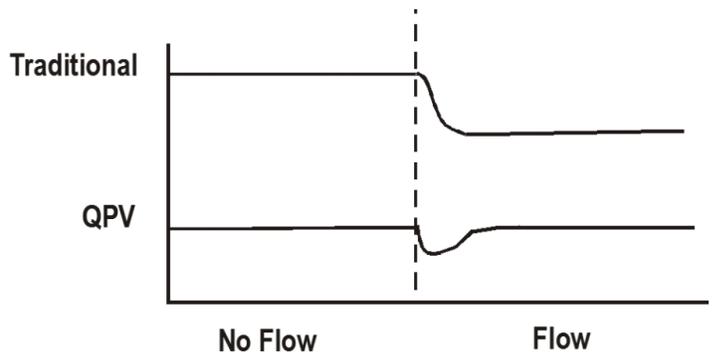


Times for QPV (0.040" valve orifice) to fill/ exhaust a closed chamber. Step command signal is superimposed over pressure trace. Time is determined by difference between command signal and pressure achieved.

QPV VS. TRADITIONAL

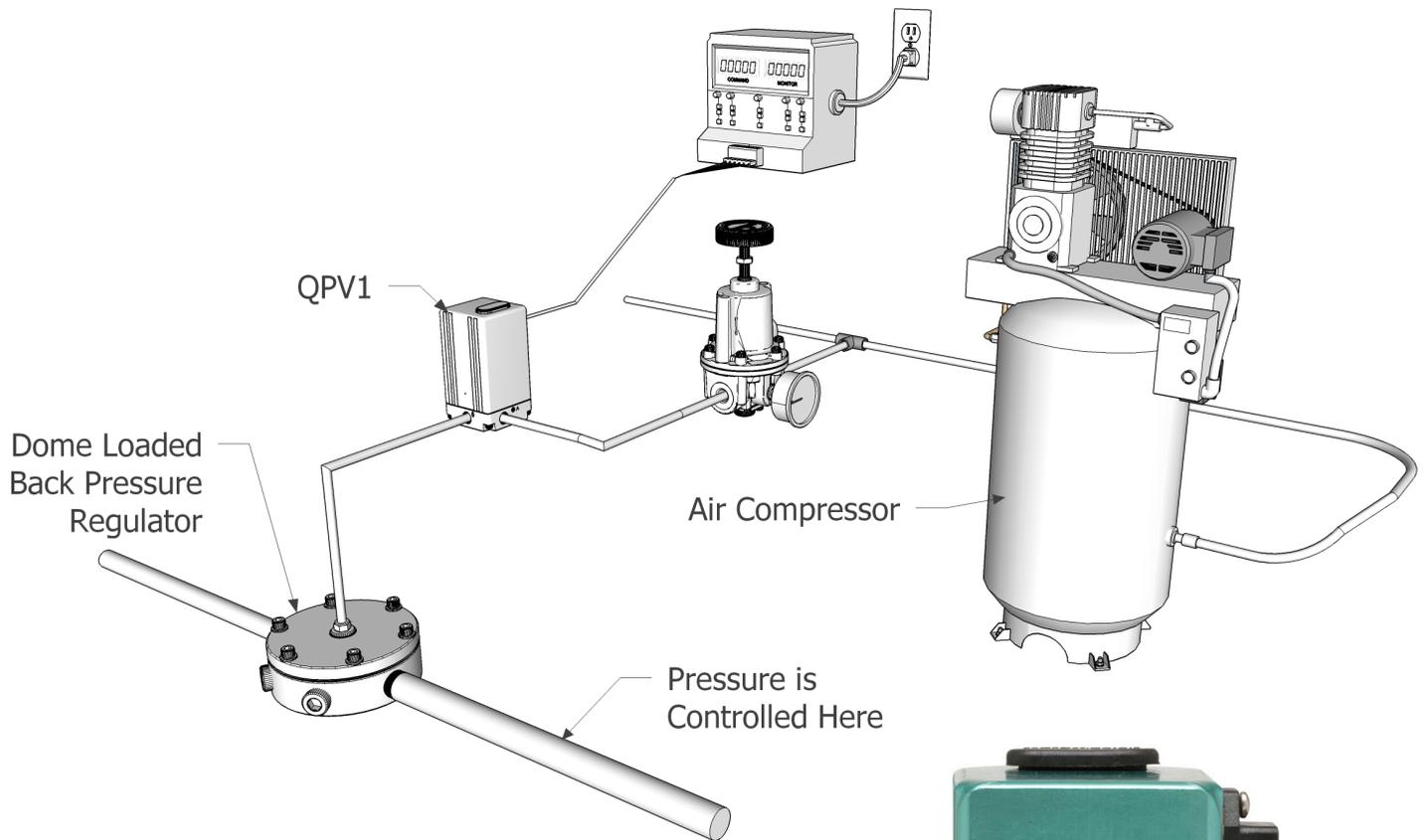


When flow or leakage is present in the system, traditional two valve I/P's bleed down and then actuate the inlet valve to compensate. This gives erratic pressure and flow. The QPV opens its inlet valve proportionally to match the system flow, resulting in steady pressure.



When transitioning from no flow to flow conditions, traditional I/P's experience droop and lock up errors. The QPV features an error integrator circuit that proportionally opens the inlet valve to maintain pressure as system flow changes.

# Application Highlight: Open Loop Electronic Back Pressure Control with a QPV1



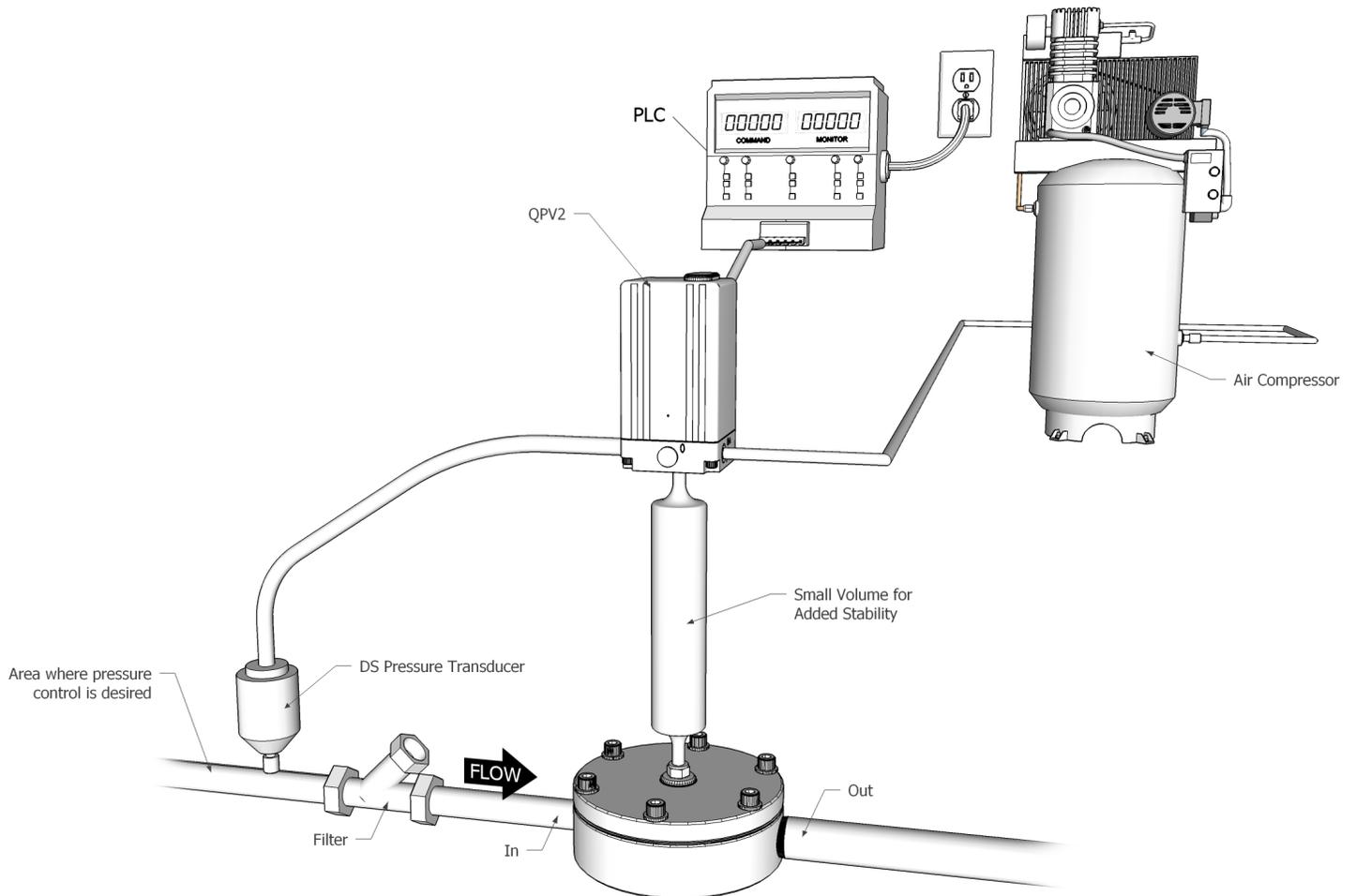
A common application for the QPV1 is to pilot operate an Equilibar® Back Pressure Regulator (BPR).

Equilibar® back pressure regulators function with a 1:1 inlet pressure to reference pressure ratio, so supplying 1 unit pressure to the reference port yields 1 unit pressure on the inlet of the Equilibar® BPR.

Using the QPV1 on an Equilibar® BPR is an easy way to get electronic back pressure control. The frictionless Equilibar design allows the back pressure control to make use of the high resolution of the QPV.



# Application Highlight: Closed Loop Electronic Back Pressure Control with a QPV2

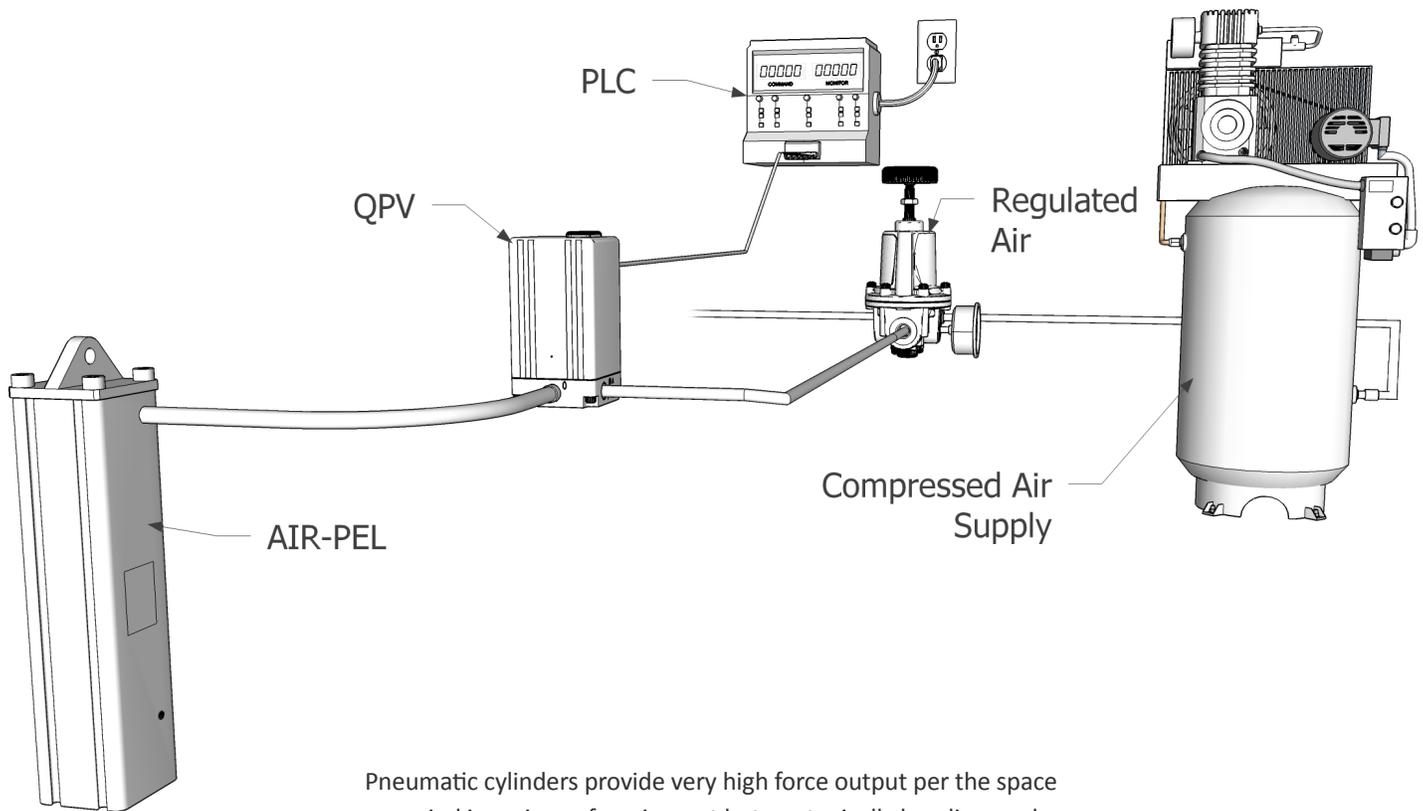


There are often applications where a user desires to control pressure in one part of an installation but needs to install the pressure regulator elsewhere. For example, having a filter, a long length of pipe, or some other obstruction before a back pressure regulator. As debris is collected in the filter the pressure drop across the filter changes, but the back pressure regulator is only capable of controlling the pressure between itself and the filter.

By using installing a pressure transducer prior to the filter and sending the feedback to a QPV2 closed loop electronic pressure regulator which pilot operates a dome loaded back pressure regulator we are able to set the pressure before the filter. The QPV2 modulates the command given to the dome loaded back pressure regulator based on the reading from the DS pressure transducer instead of controlling the back pressure regulator on a strict 1:1 pilot pressure to control pressure ratio.

# Application Highlight: High Resolution Force Control Using Air-Pel Cylinders

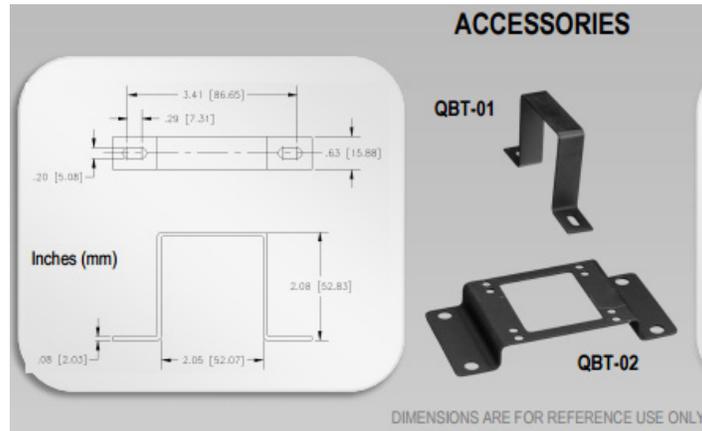
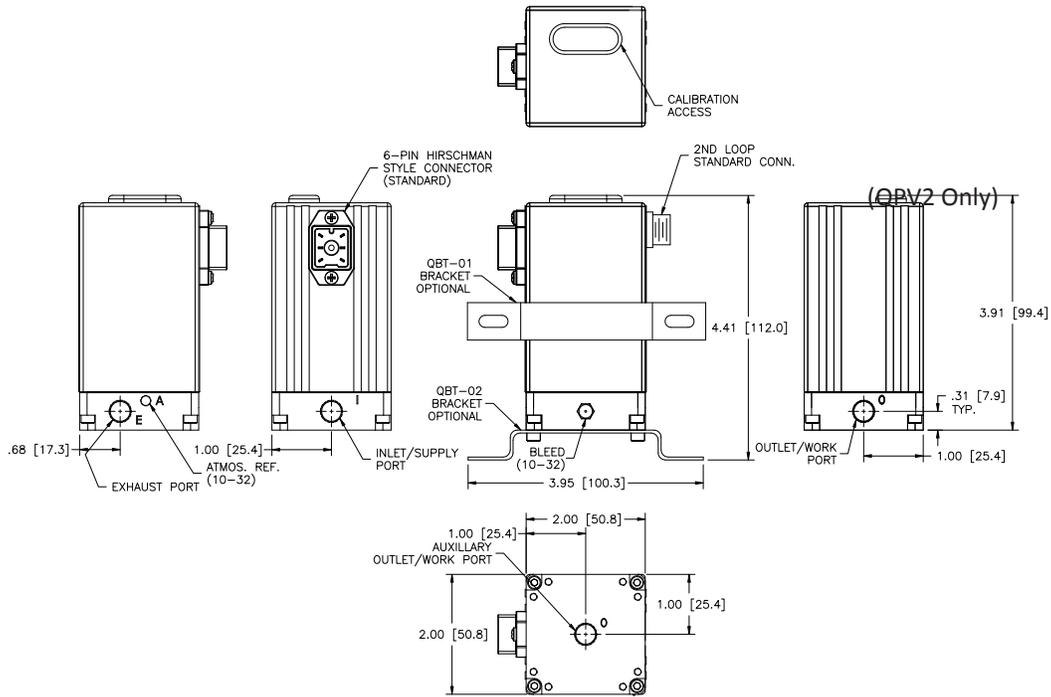
---



Pneumatic cylinders provide very high force output per the space occupied in a piece of equipment but are typically handicapped by high friction caused by the internal pneumatic seals. New frictionless pneumatic cylinder technologies typified by the Air Pel brand allow a pneumatic cylinder to convert a pressure directly into a force without any frictional losses. This is achieved by eliminating the internal seals altogether and relying on extremely close tolerances to minimize the resultant leakage.

The QPV series proportional solenoid valve opens to precisely match the flow rate required to keep up with the leakage from the cylinder. The ultra high resolution pressure control from the QPV combined with the frictionless cylinder technology allows small changes to be made directly in the force output without the need for expensive load cells and complicated force control feedback loops.

# Dimensional Drawing & Accessories



## Pre-Assembled QBT Power Cord

Part Number: QBT-C-6 (Typical)

Length in Feet

Other lengths are available

[from 1 to 25 feet (8 meters), 1 foot increments]

Equilibar® products are warranted to the original purchaser only against defects in material or workmanship for one (1) year from the date of manufacture. The extent of Equilibar's liability under this warranty is limited to repair or replacement of the defective unit at Equilibar's option. Equilibar® shall have no liability under this warranty where improper installation or filtration occurred.

All specifications are subject to change without notice. THIS WARRANTY IS GIVEN IN LIEU OF, AND BUYER HEREBY EXPRESSLY WAIVES, WARRANTIES OR LIABILITIES, EXPRESS, IMPLIED OR STATUTORY, INCLUDING WITHOUT LIMITATION ANY OBLIGATION OF Equilibar® WITH REGARD TO CONSEQUENTIAL DAMAGES, WARRANTIES OF MERCHANTABILITY, DESCRIPTION, AND FITNESS FOR A PARTICULAR PURPOSE.

WARNING: Installation and use of this product should be under the supervision and control of properly qualified personnel in order to avoid the risk of injury or death.

# QPV Ordering Information

| EXAMPLE PART NUMBER | QPV | 2 | M | B | N | E | E | Z | 0 | P | 150 | PS | G  | A  | X  | L  | DD |
|---------------------|-----|---|---|---|---|---|---|---|---|---|-----|----|----|----|----|----|----|
| Your Part Number:   | QPV |   | M |   |   |   |   |   |   |   |     |    |    |    |    |    |    |
|                     |     | 1 |   | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9   | 10 | 11 | 12 | 13 | 14 | 15 |

## 1 TYPE

- 1 Single Loop
- 2 External Loop

## 2 MANIFOLD MATERIAL

- B Brass
- A Aluminum (Typical)

## 3 THREAD TYPE

- N NPT
- P BSPP

## 4 INPUT SIGNAL RANGE

- E 0 to 10 Vdc (Single Ended)
- I 4 to 20 mADC (Differential)
- K 0 to 5 Vdc
- V 1 to 5 Vdc
- A RS 232 Serial Input\*
- B RS 485 Serial Input\*
- N Ethernet (Mod-bus TCP)

\*Requires X for Monitor Signal Range

## 5 MONITOR SIGNAL RANGE

- X No Monitor
- E 0 to 10 Vdc
- K 0 to 5 Vdc\*
- V 1 to 5 Vdc\*<sup>1</sup>
- C 4 to 20 mADC (Sinking)
- S 4 to 20 mADC (Sourcing)

\*Requires E, I, or K for Input Signal Range

\*<sup>1</sup> Requires V for Input Signal Range

## 6 ZERO OFFSET

- N 0% Pressure Starts Below Atmosphere
- P 0% Pressure Starts Above Atmosphere
- Z 0% Pressure Starts at Zero (Typical)

## 7 ZERO OFFSET PRESSURE

Typical is blank\* - If greater than 30% of full scale Pressure (#9 below) please consult factory

\*If Z for Zero Offset (#6), please leave blank

<sup>1</sup> Inlet valves orifice size and the exhaust valve are factory determined based on the application's flow and pressure specs.

<sup>2</sup> Bleed orifice is required when the QPV is used in an application that is static (no flow). Dynamic applications (under flow) do not need a bleed orifice to function properly. Consult our Application Engineering Department for your specific application needs. We are here to help you.

## 8 TYPE

- N 100% Pressure Ends Below Atmosphere
- P 100% Pressure Ends Above Atmosphere
- Z 100% Pressure Ends at Zero

## 9 FULL SCALE PRESSURE

Must be less than or equal to 150 psig

## 10 PRESSURE UNIT

- |               |                                 |
|---------------|---------------------------------|
| PS PSI        | IH Inches Hg                    |
| MB Millibars  | IW Inches H <sub>2</sub> O      |
| BR Bar        | MW mm H <sub>2</sub> O          |
| KP Kilopascal | KG Kilograms/cm <sup>2</sup>    |
| MP Megapascal | TR Torr*                        |
| MH mm Hg      | CW Centimeters H <sub>2</sub> O |

\*Requires A for Pressure Unit of Measure

## 11 PRESSURE UNIT OF MEASURE

- A Absolute Pressure
- D Differential Pressure
- G Gage Pressure

## 12 INLET VALVE<sup>1</sup>

- A 0.013"
- B 0.025"
- C 0.040"
- D 0.060"
- E 0.089"
- N No Inlet Valve\*
- X 0.040"\*

## 13 EXHAUST VALVE<sup>1</sup>

- A 0.013"
- B 0.025"
- C 0.040"
- D 0.060"
- E 0.089"
- N No Inlet Valve\*
- X 0.040"\*

\*Vacuum Pressure Units Only

## 14 BLEED ORIFICE<sup>2</sup>

- N No Bleed Orifice
- L Include Bleed Orifice (0.0047 inch diameter typical)

## 15 DIGITAL DISPLAY

- No Digital Display
- DD Digital Display Included

# Typically In Stock QPV Configurations

| PART NUMBER          | PRESSURE RANGE        | TYPE        | MANIFOLD MATERIAL | THREAD TYPE | INPUT SIGNAL RANGE | MONITOR SIGNAL RANGE    | BLEED ORIFICE <sup>1</sup> | DIGITAL DISPLAY <sup>2</sup> | TYPICAL LEAD TIME <sup>3</sup> |
|----------------------|-----------------------|-------------|-------------------|-------------|--------------------|-------------------------|----------------------------|------------------------------|--------------------------------|
| QPV1MANISZN30IHGXCL  | 0-30 in Hg (vacuum)   | Single Loop | Aluminum          | NPT         | 4 to 20 mADC       | 4 to 20 mADC (Sourcing) | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZN30IHGXCL  | 0-30 in Hg (vacuum)   | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP760TRACXL | 0-760 torr (absolute) | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP10IWGAXL  | 0-10 in H2O (gauge)   | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP1PSGAXL   | 0-1 PSI (gauge)       | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP10PSGAXL  | 0-10 PSI (gauge)      | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP50PSGAXL  | 0-50 PSI (gauge)      | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP100PSGAXL | 0-100 PSI (gauge)     | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |
| QPV1MANEEZP150PSGAXL | 0-150 PSI (gauge)     | Single Loop | Aluminum          | NPT         | 0 to 10 Vdc        | 0 to 10 Vdc             | Y                          | X                            | 1-2 Days                       |

## About Equilibar

Equilibar, LLC manufactures and markets our specialized products worldwide. Equilibar branded products are made in the USA, and protected by US and foreign patents. All of our products are assembled, inspected and tested by trained technicians in Fletcher, NC.

## Application Engineering— how we are different

Unlike mass-market regulator distributors, everything about Equilibar is focused on you, the scientist or engineer with a unique pressure control challenge.

We assign an Application Engineer to you, typically within moments of your call. We work with you closely to identify the optimum model, trim, and diaphragm to best meet your challenge. You can stay in touch with your Application Engineer by email, telephone, mobile phone, or fax.

After installation, if there are any unexpected issues, your Application Engineer is still available to support you with start-up information or (if needed) expedited replacement parts.

## Contact our Engineers

At Equilibar, your application's unique requirements will be carefully addressed by one of our trained Application Engineers. Please contact us if you have any questions or special requirements.

Equilibar, LLC  
320 Rutledge Rd.  
Fletcher, North Carolina 28732  
United States  
Tel: +1-828-650-6590  
Fax: +1-801-504-4439  
Monday - Friday  
8:00 AM - 5:00 PM EST  
12:00 - 21:00 GMT  
inquiry@equilibar.com

<sup>1</sup> Bleed orifice recommended for maximum stability

<sup>2</sup> Digital Display available on any model at 4-6 week lead time

<sup>3</sup> Custom part numbers available on any model at 4-6 week lead time



