



QPV

Electronic High Resolution Pressure Control Valve

How It Works

The Equilibar QPV1 is a high resolution electronic pressure regulator designed to precisely control the pressure of inert gaseous media. It 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). It is available in 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 for non-ATEX use. 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 effect 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 was produced 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 version 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.

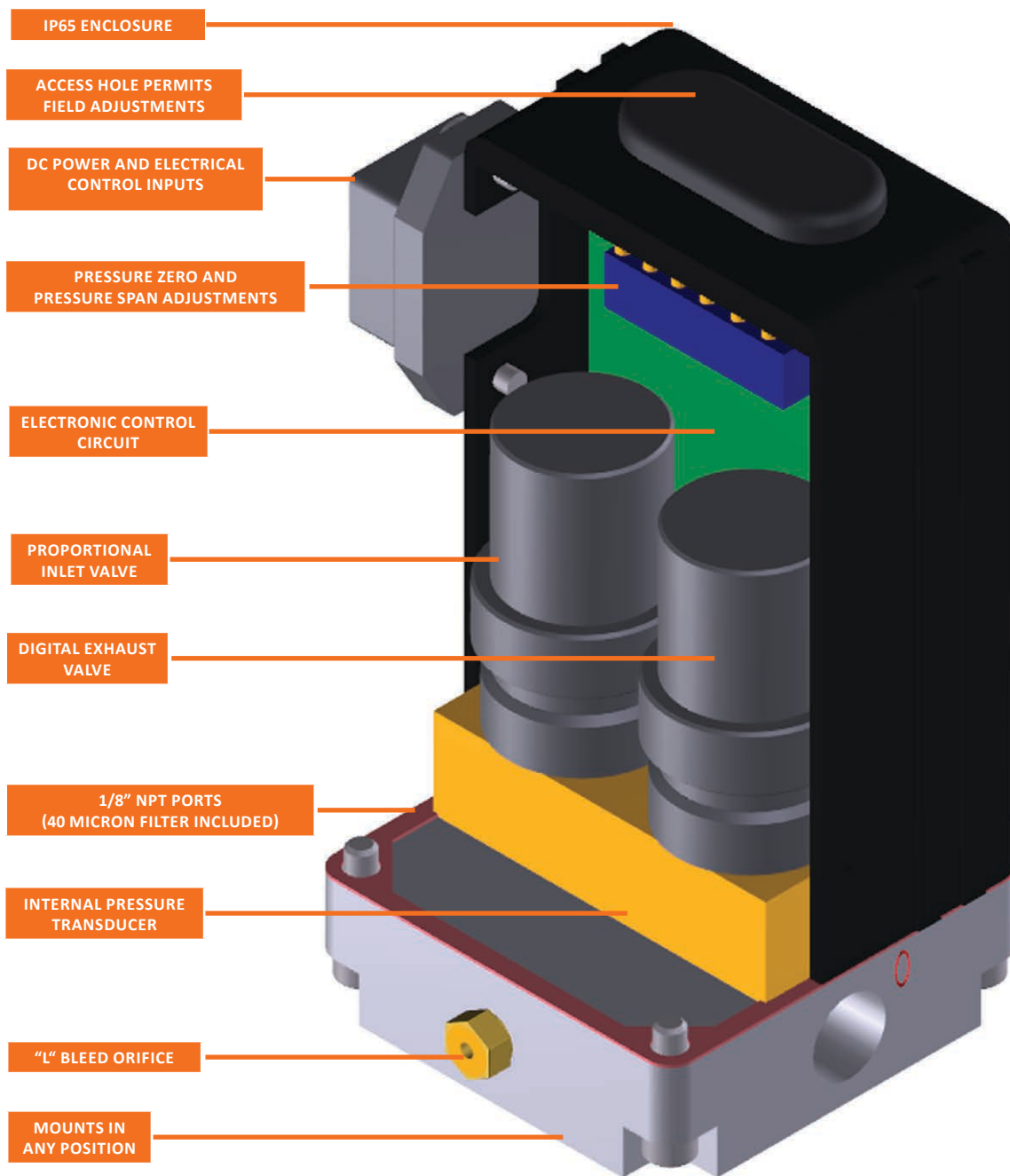
Standard QPV2 series products are shipped from the factory calibrated to accept a 0-10 VDC signal from the external pressure sensor. 4-20mA signal inputs for the external sensor

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 regulators 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.

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 for non-explosive environments.

- 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 inH₂O (0-5 mbar) and as high as 0-150 psig (0-10 bar)
- Positive, vacuum-through-positive, vacuum-only, and absolute-pressure options available
- For use in non-hazardous, non-ATEX environments

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 Ω	-
Current	-	100 Ω	-
PNEUMATIC	MINIMUM	TYPICAL	MAXIMUM
Inlet Pressure ¹	Full Vacuum	110% of full scale calibration	165 psig (11.37 bar)
Pressure Range ²	Full Vacuum	-	150 psig (10.34 bar)
Flow Rate	0	-	1 SCFM (0.47 Liters/sec) ³
Filtration Required ⁴	-	40 Micron	-
Resolution	$\pm 0.2\%$ F.S.	$\pm 0.010\%$ F.S.	$\pm 0.005\%$ F.S. ⁵
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 ⁶	10 cc	20 cc	-
PHYSICAL	MINIMUM	TYPICAL	MAXIMUM
Operating Temperature	32°F (0°C)	-	158°F (70°C)
QPV Environment Protection ⁷	-	NEMA 4 / IP65	-
QPV Weight	-	1.02 lbs (0.5kg)	-
QPV Electrical Connector	-	6 pin Hirshman Connector	-

¹ Depends on the inlet valve orifice size

² Pressure ranges are customer specified

³ Maximum for 100 psig model, lower pressure models have lower maximum flow rates

⁴ FPP1 sintered 40 micron filter included

⁵ At 100 psig working pressure

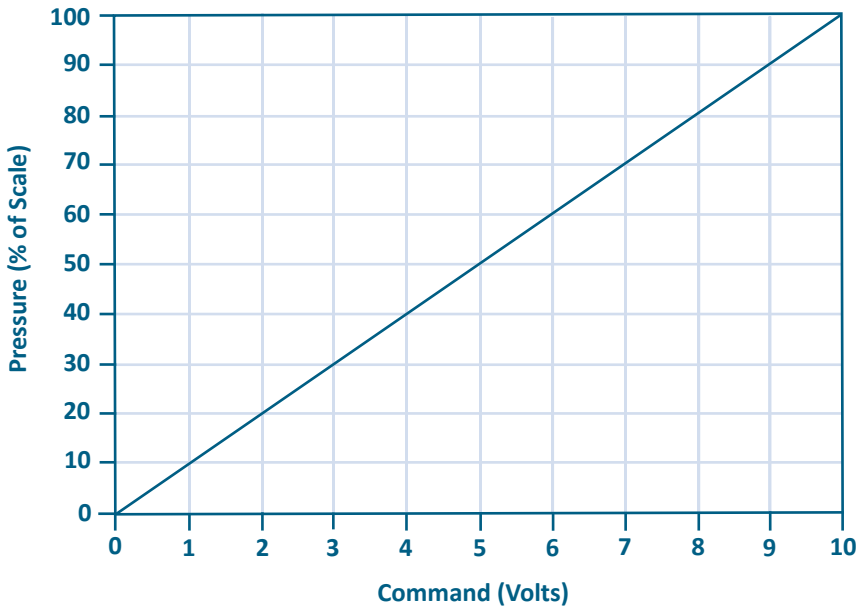
⁶ The minimum downstream closed volume is determined by the pressure range, orifice size, plumbing, as well as other factors. Consult factory for applications with total volumes less than 10 ccs.

⁷ CE(EMC) compliant only for voltage command and monitor signal on QPV1T__ EE (without LED digital display) and QPV1M__ EE (without LED digital display).

***Not intended for hazardous/explosive environments. *Meant for use with air or inert gases only.**

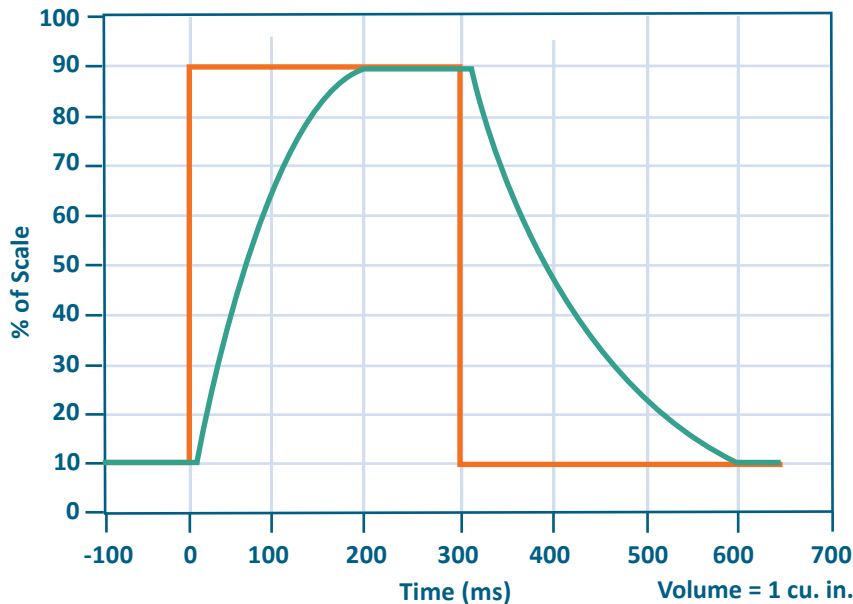
Performance (Continued)

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.

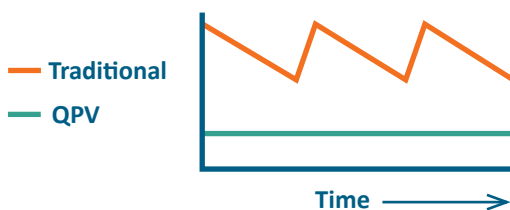
RESPONSE TO STEP INPUT



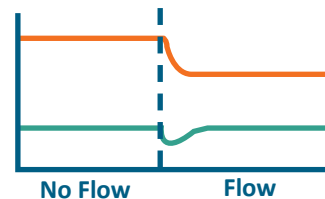
Times for QPV (0.040" valve orifice) to fill/exhaust a closed chamber. Step command signal is superimposed over pressure trace. Time is determined by difference between command signal and pressure achieved.

— Command
— Pressure

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

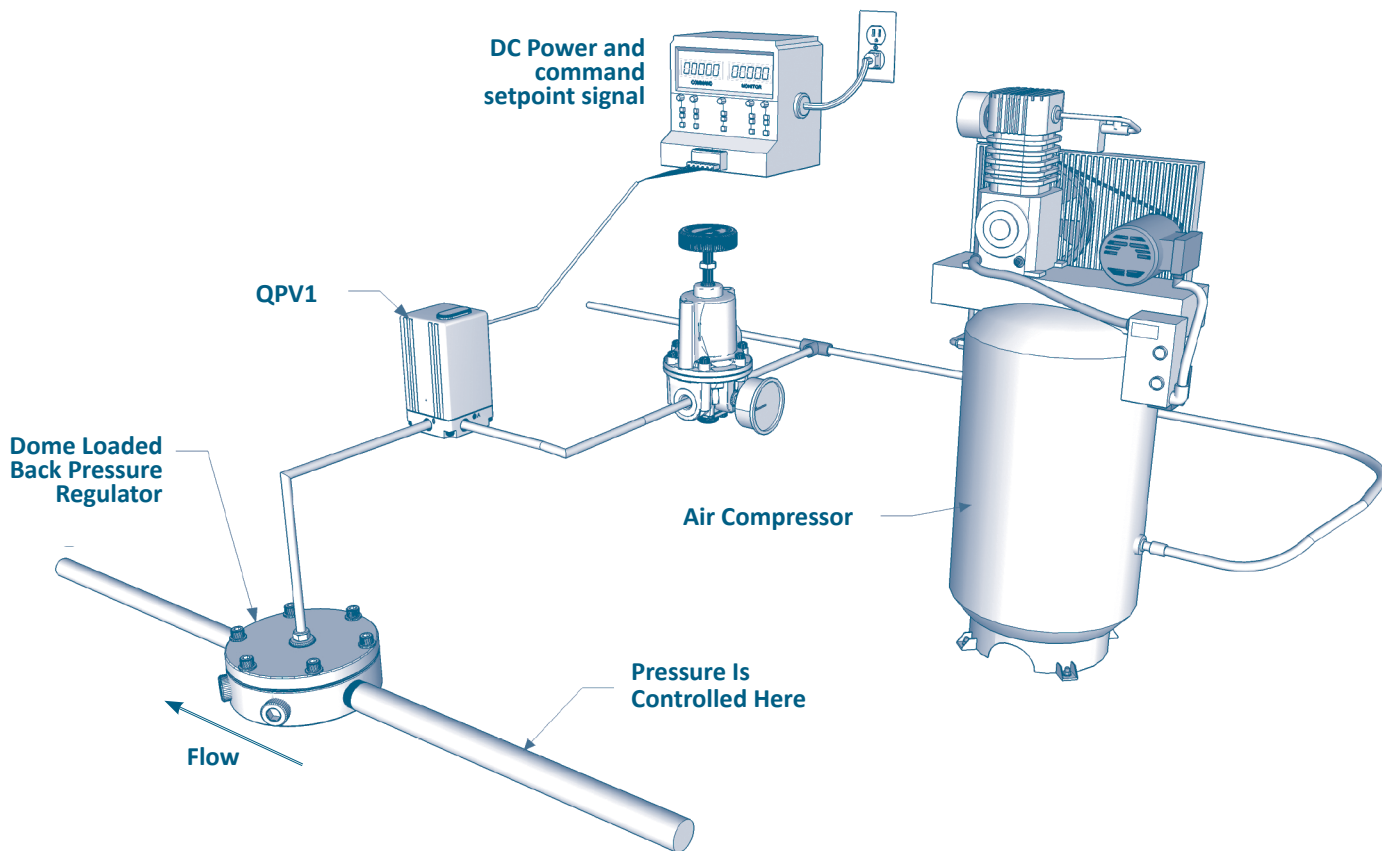
A common application for the QPV1 is to pilot operate an Equilibar® Back Pressure Regulator (BPR).

Equilibar back pressure regulators are dome-loaded. In this design, gas or liquid is fed into a “dome” chamber on top of the regulator to provide the loading mechanism that determines pressure setpoint—also known as the pilot pressure. The pressure of the pilot gas or liquid is set by a second regulator called a pilot regulator. Supplying 1 unit pressure to the dome yields 1 unit pressure on the inlet of the Equilibar BPR.

Using the QPV1 as a pilot regulator to provide constant pressure of an inert gas onto the dome of 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.



QPV1 with optional digital display



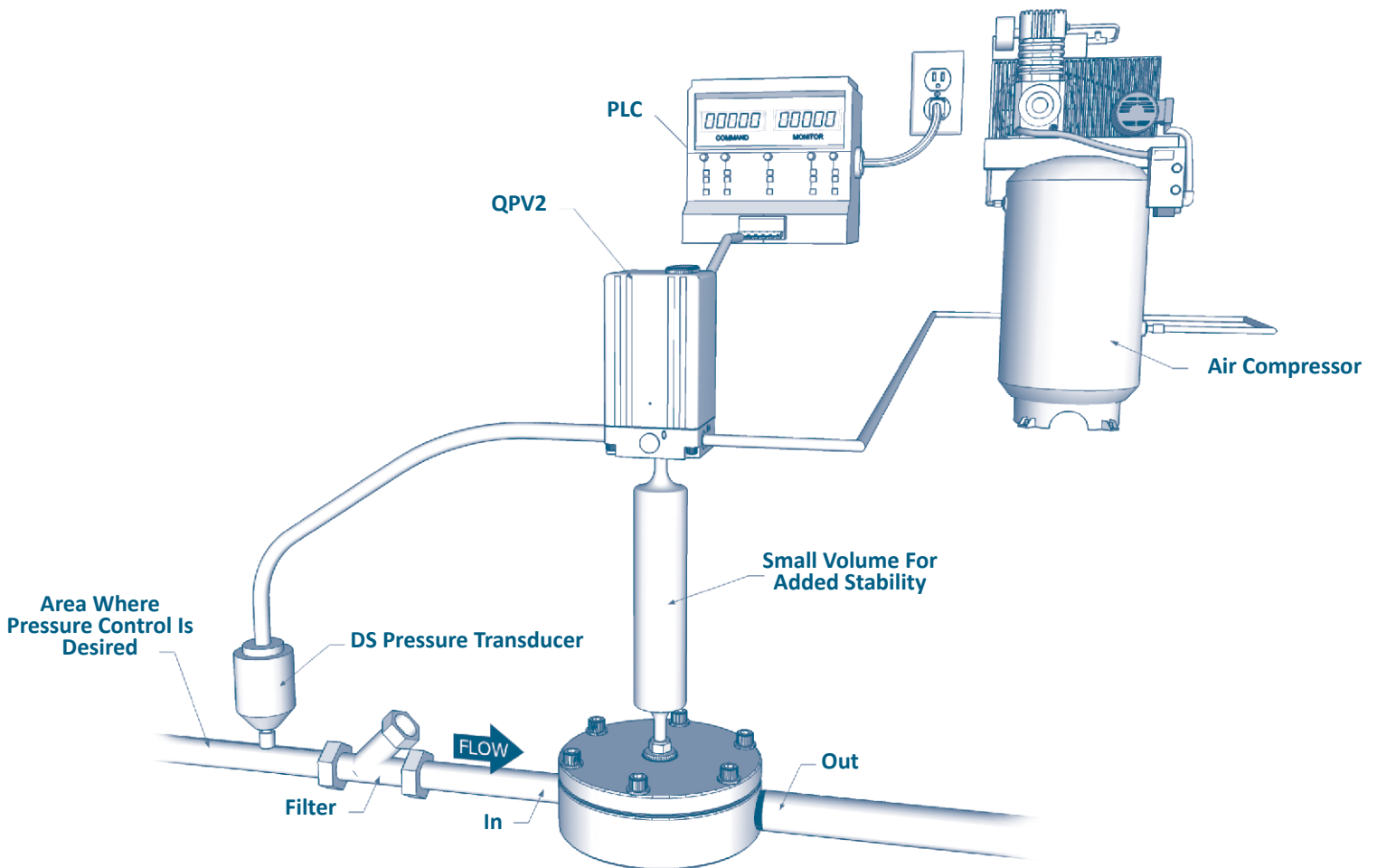
QPV1 serves as pilot regulator to provide constant setpoint pressure to Equilibar GSD dome-loaded back pressure regulator

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, a process may have a filter, a long length of pipe, or some other obstruction upstream of the 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 at its inlet.

A pressure transducer installed prior to the filter can send feedback to a QPV2 closed loop electronic pressure regulator. The QPV2 pilot operates a dome-loaded back pressure regulator based on the feedback and is able to control to 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

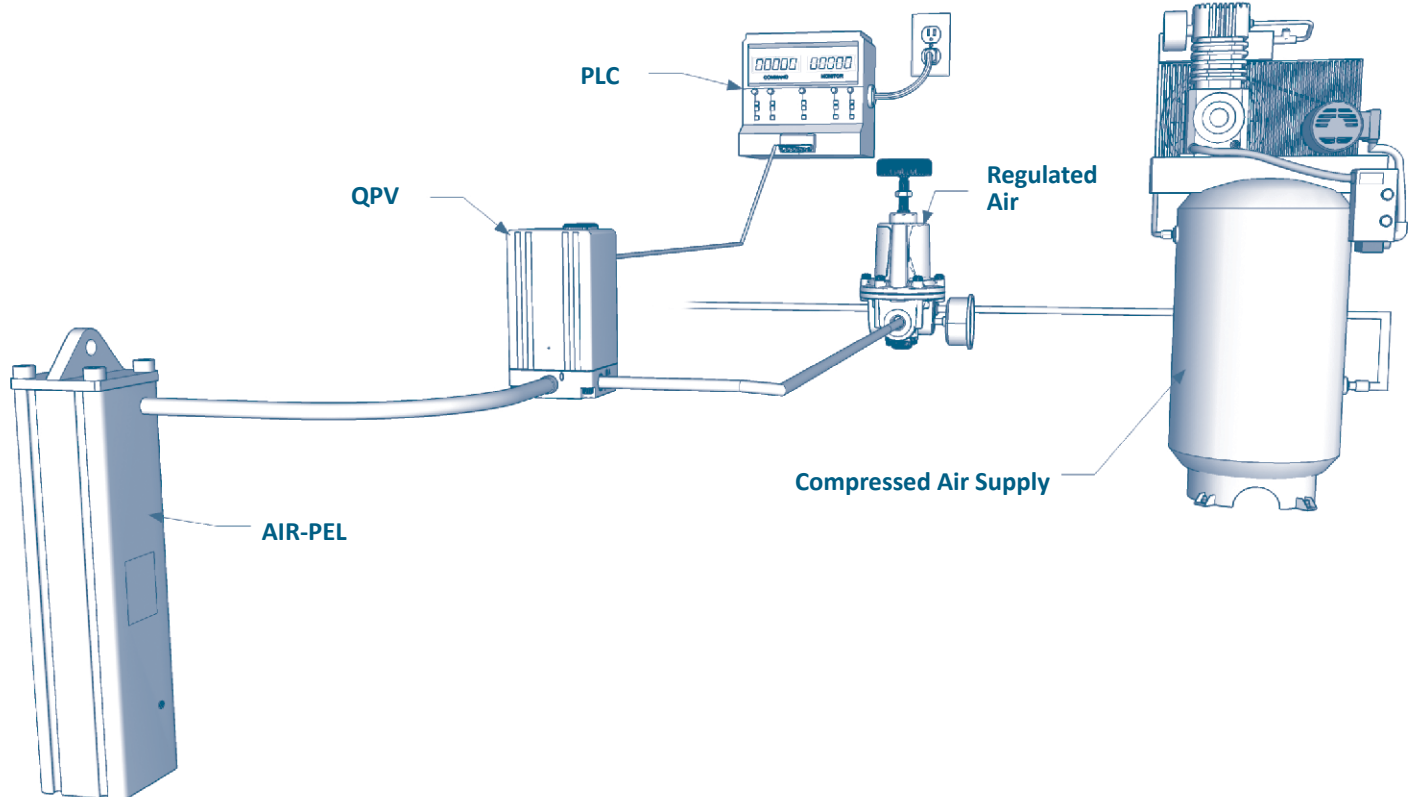
HIGH RESOLUTION FORCE CONTROL USING AIR-PEL CYLINDERS

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 loss. This is achieved by eliminating the internal seals altogether and relying on extremely close tolerances to minimize the resultant leakage.

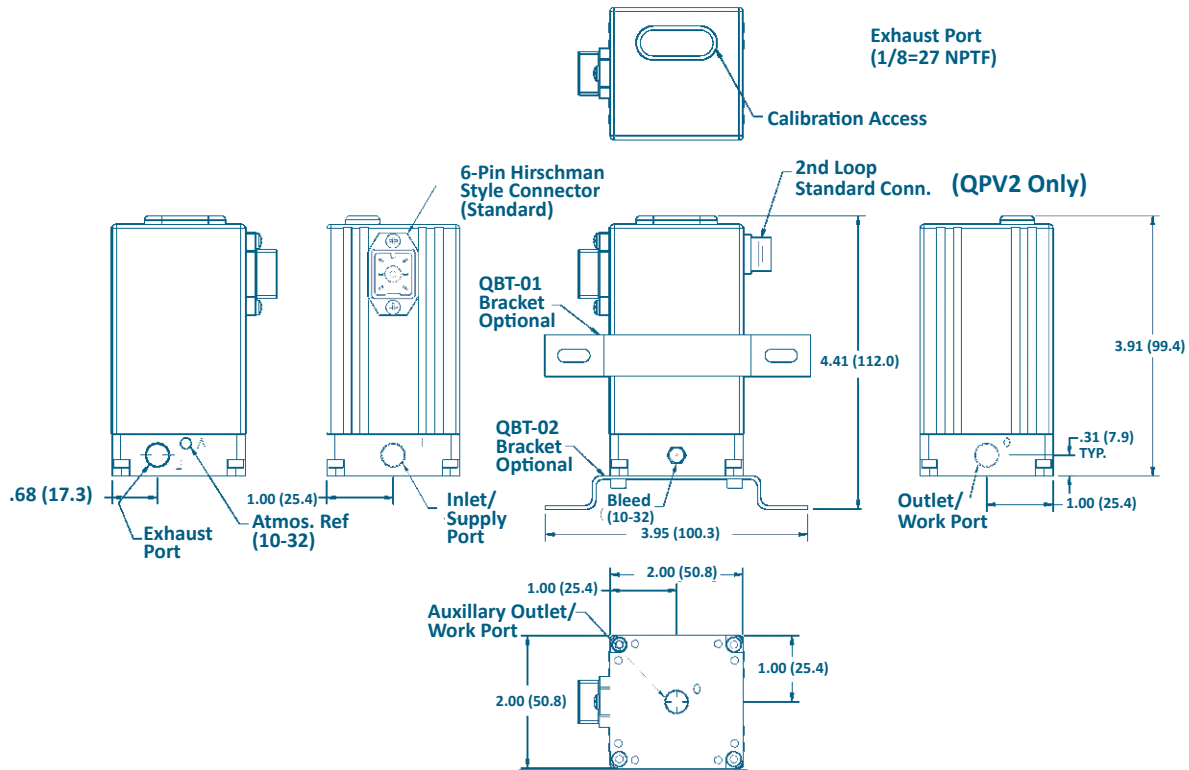
The QPV series proportional solenoid valve opens to precisely match the flow rate required to keep up with the leakage from the cylinder. The ultra high resolution pressure control from the QPV combined with the frictionless cylinder technology allows small changes to be made directly in the force output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



Standard QPV



Dimensional Drawing & Accessories



QBT-01



QBT-02



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]

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 (Typical)
- 2 External Loop (Rare)

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*¹
- C 4 to 20 mADC (Sinking)
- S 4 to 20 mADC (Sourcing)

*Requires E, I, or K for INPUT SIGNAL RANGE

*¹ 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

8 FULL SCALE PRESSURE TYPE

- N 100% Pressure Is Below Zero (Requires L option #14)
- P 100% Pressure is Above Zero
- Z 100% Pressure is Zero (Typical)

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 H₂O
- BR Bar
- MW mm H₂O
- KP Kilopascal
- KG Kilograms/cm²
- MP Megapascal
- TR Torr*
- MH mm Hg
- CW Centimeters H₂O

*Requires A for PRESSURE UNIT OF MEASURE

11 PRESSURE UNIT OF MEASURE

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

12 INLET VALVE¹

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

13 EXHAUST VALVE¹

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

14 BLEED ORIFICE²

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

15 DIGITAL DISPLAY

- ___ No Digital Display
- DD Digital Display Included

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

² 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.

Typically In Stock QPV Configurations

PART NUMBER	PRESSURE RANGE	TYPE	MANIFOLD MATERIAL	THREAD TYPE	INPUT SIGNAL RANGE	MONITOR SIGNAL RANGE	BLEED ORIFICE ¹	DIGITAL DISPLAY ²	TYPICAL LEAD TIME ³
QPV1MANISZN30IHGXCL	0-30 in Hg (vacuum)	Single Loop	Aluminum	NPT	4 to 20 mADC	4 to 20 mADC (Sourcing)	Y	No	2-3 Days
QPV1MANEEZN30IHGXCL	0-30 in Hg (vacuum)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP760TRACXL	0-760 torr (absolute)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP10IWGAXL	0-10 in H ₂ O (gauge)	Single Loop	Aluminum	NPT	0 to 10 Vdc	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP1PSGAXL	0-1 PSI (gauge)	Single Loop	Aluminum	NPT	0 to 10 Vdc	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP10PSGAXL	0-10 PSI (gauge)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP50PSGAXL	0-50 PSI (gauge)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP100PSGAXL	0-100 PSI (gauge)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days
QPV1MANEEZP150PSGAXL	0-150 PSI (gauge)	Single Loop	Aluminum	NPT	0 to 10 VDC	0 to 10 VDC	Y	No	2-3 Days

¹ Bleed orifice recommended for maximum stability

² Digital Display available on any model at 4-6 week lead time

³ Custom part numbers available on any model at 4-6 week lead time



QPV with optional digital display



Standard QPV

WARRANTY

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, LLC WITH REGARD TO CONSEQUENTIAL DAMAGES, WARRANTIES OF MERCHANTABILITY, DESCRIPTION, AND FITNESS FOR A PARTICULAR PURPOSE.

About Equibar

Equibar provides innovative and robust pressure control technology for researchers and engineers worldwide. We are proud to design, manufacture, and test our patented back pressure regulators in our factory overlooking the Blue Ridge Mountains near Asheville, NC.

APPLICATION ENGINEERING— WHAT SETS US APART

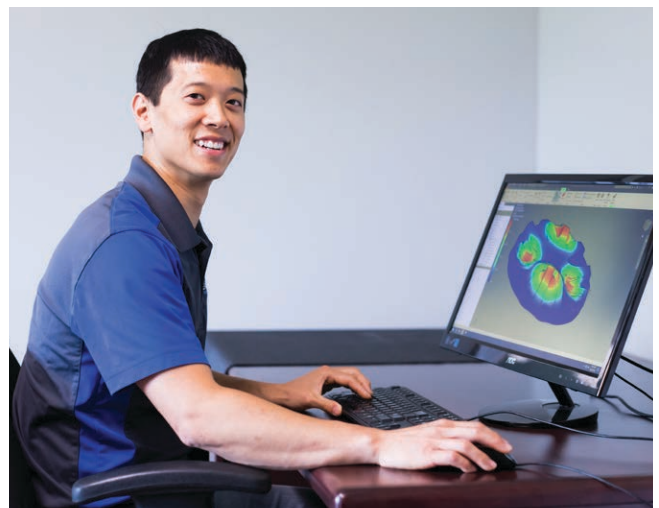
Unlike mass-market regulator distributors, we focus on working with you, the scientist or engineer with a complex pressure control scenario.

Our application engineers work collaboratively with clients to identify the optimal model, trim, and diaphragm for each application's unique challenges. No matter where you are on the globe, you can stay in close contact with your engineer by email, telephone, videoconferencing, or fax.

After installation, your application engineer will support you with start-up information and fine-tuning as needed.



Each application is reviewed by our engineering team to ensure quality performance of our products.



Our engineers offer custom designed solutions for the most difficult pressure control challenges. Feel free to contact us to discuss your situation.



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Made in the
USA

Equibar's quality system is
ISO 9001:2015 certified.