Complete closed-loop electronic pressure controllers with integrated transducers in single compact packages

640B/641B

ELECTRONIC PRESSURE CONTROLLER

The 640B and 641B Pressure Controllers are self contained, compact, closed-loop electronic pressure control systems. Each contains a capacitance manometer, normally-closed proportioning control valve, and closed-loop control electronics. The 640B controls absolute pressure; the 641 controls gauge pressure, (pressure relative to ambient barometric pressure). Both transducers are Baratron® capacitance manometers, with Full Scale pressure ranges from 100 psi to as low as 10 Torr. Baratron capacitance manometers – well-known for their percent of Reading accuracy, stability, and resolution – provide precise measurements at lower pressures and over wider dynamic ranges than strain gauge transducers. Furthermore, Baratron capacitance manometers have no silicone oil fill which can result in hysteresis and can slow the controller time response.

Electrically similar to a standard MFC, the 640B/641B are powered by ±15 VDC at only 200 mA, permitting use with standard power supply/display electronics. The pressure output and input control signals are linear 0-5 or 0-10 VDC. Two trip points are included in the 640/641, with LED status indicators, for use as simple on/off process limits.

During final testing at MKS, the 640/641 control loop tuning parameters are preset for typical installation conditions, but are field adjustable for different conditions and optimum performance. The Proportional and Integral Term adjustments are simple rotary switches, rather than potentiometers, to enable OEMs, or users with multiple controllers, to preset all units to the same control loop parameters.

Features & Benefits

- Integral Baratron capacitance manometer provides accuracy, reliability, and wide range
- Controller Full Scale ranges as low as 10 Torr for use in low pressure processes
- Can be used with upstream or downstream controller applications
- Controls absolute or gauge pressure
- Elastomer and all-metal sealed versions available
- Two alarm trip points for process limit control
- Perform closed-loop electronic pressure control in-line with compact, 3” MFC-type footprint package
- Reduce overall system cost while saving valuable rack space
- Obtain precise, repeatable pressure control/measurement over wide range of pressures with proven Baratron® capacitance manometer technology

Valve Solutions

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Inlet Pressure (psia)	Differential Pressure (psi)									Inlet Pressure (Torr)
	>50	50	30	15	8	4	2	1	0.5	
100	>585	585	480	355	265	190	135	95	65	5170
50	–	295	295	240	185	130	95	65	50	2585
30	–	–	175	175	140	100	75	50	40	1551
20	–	–	–	115	110	80	60	40	30	1034
15	–	–	–	90	90	70	50	35	25	776
10	–	–	–	–	60	55	40	30	20	517
5	–	–	–	–	–	30	25	20	15	259
2	–	–	–	–	–	–	10	10	9	103
1	–	–	–	–	–	–	–	6	6	51.7
	>2585	2585	1551	776	414	207	103	51.7	25.9	
	Differential Pressure (Torr)									

Figure 1 —
Index Number Table (See Note)

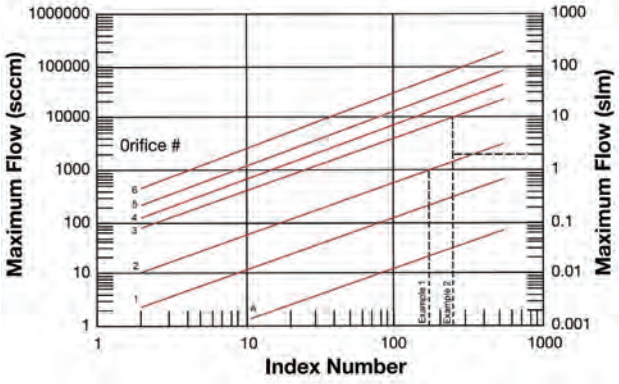


Figure 2 —
Orifice Selection Graph (See Note)

Valve Orifice

The flow through any orifice depends on the size of the orifice, the inlet and outlet pressures, and gas density. To simplify 640/641 orifice selection, use the following procedure:

1. On the Index Number Table in Figure 1, choose your inlet pressure from the column of pressures on the left – the pressure that will be applied to the inlet of your 640/641. (Note that the values are absolute pressure.)
2. Next, from the row of pressures at the top of that table, select your differential (delta) pressure – this is the inlet pressure minus your outlet pressure.
3. Locate the Index Number – where your selected row and column intersect.
4. If you are using N_2, skip to step #6. For other gases, calculate the Density Correction Factor by the following formula:

   $$\text{Density Correction Factor} = \sqrt{\frac{N_2 \text{ Density}}{\text{Gas Density}}}$$

5. Multiply this Density Correction Factor times the Index Number found in step 3, to determine your density-corrected Index Number.
6. Go to the Orifice Selection Graph (Figure 2) and locate your Index Number along the bottom axis.
7. Draw a vertical line at your Index Number. This line will intersect with the Maximum Flow Rate lines for the valve orifices available.
8. Choose the orifice whose maximum flow rate exceeds your requirements. If the point on the graph falls close to the maximum flow rate for an orifice, you may choose the next largest orifice number.

Note: The above procedure is provided as a reference guide to sizing the orifice for most typical applications. To assure proper orifice size selection for the specific application conditions, particularly those where the procedure results in an orifice selection near the limit lines in the graph, please contact our Applications Engineers for assistance in selecting the proper valve orifice.

Pressure Range

In the 640 Controller, the Baratron pressure transducer measures absolute pressure; in the 641 model, it measures gauge pressure (pressure relative to ambient barometric pressure). In both models, Full Scale ranges of 10, 100, or 1000 Torr, or 60 or 100 psi are available. Each 640/641 can control pressure from Full Scale to less than 2% of Full Scale. Prudent design suggests choosing the lowest possible Full Scale for the application, taking into consideration the overpressure to which the sensor may be exposed (both normal and accidental).

Example 1

You want to control your process pressure at 5 psia, with a flow rate of 1000 sccm of N_2. Your inlet pressure is 15 psig (30 psia) giving a differential pressure (delta P) of 25 psi. Approximating your delta P as 30 psi gives an Index Number value of 175. Drawing a vertical line on the Orifice Selection Chart at 175 indicates Orifice #2 would be sufficient but Orifice #3 would be the best choice.

Example 2

You want to control a vacuum process at a pressure of 0.5 psia, with a flow rate of 2000 sccm of He. Your inlet pressure is 15 psia, giving a differential pressure (delta P) of 15 psi, resulting in an uncorrected Index Number value of 90. The gas density correction for He is calculated as $\sqrt{N_2 \text{ density/He density}} = \sqrt{1.250/0.179} = 2.6$.

Multiplying 2.6 by 90 gives a density-corrected Index Number of 234. Drawing a vertical line on the Orifice Selection Chart at 234 indicates Orifice #3 would be the best choice.

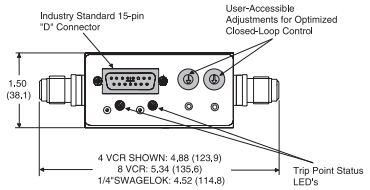
Specifications

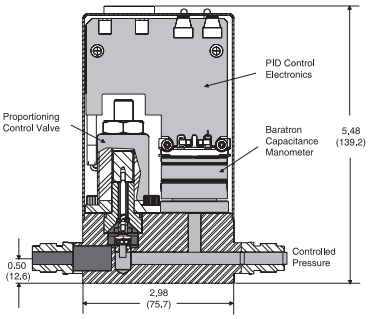
Physical	
Pressure Transducer Type	
Baratron Absolute Pressure	640B
Baratron Gauge Pressure	641B
Pressure Ranges (Full Scales)	10, 100, 1000 mmHg (Torr) 60, 100 psi
Transducer Overpressure Limit	45 psia or 2x F.S., whichever is greater
Orifice Full Scale Ranges	50, 200, 1000, 5000, 10000, 20000, 50000 sccm (nominal F.S. flow rates for N_2 with 15 psig on inlet and atm. on outlet)
Maximum Differential Pressure (consistent with transducer overpressure limit)	150 psi for 50 to 10,000 sccm orifices 30 psi for 20,000 and 50,000 sccm orifices
Control Mode	Downstream standard; Upstream optional
Performance	
Pressure Reading	
Accuracy	±0.5% of Reading (includes linearity, hysteresis, and repeatability)
Temp. Coefficients	Zero: ±0.02% of F.S./°C Span: ±0.04% of Reading/°C
Time Response	<100 msec
Pressure Control	
Range	>2 to 100% of F.S.
Accuracy	±0.2% of F.S.
Time Response	<1.0 sec (excluding system time constant)
Environmental	
Operating Temperature	0° to 50°C (32° to 122°F)
Storage Temperature	-20° to 80°C (-4° to 176°F)
Electrical	
Power Required	±15 VDC ±5%, 200 mA max.
Input/Output Signals	0-5 VDC standard; 0-10 VDC optional
Connector	15-pin male type “D”
Cable Length	100 ft. (30 m) max.
RFI Sensitivity	SAMA 33.1, 1-abc: <0.2% of F.S.
Trip Points	Two open-collector transistors
Rated	250 mA @ 30 VDC
Adjustable	1 to 100% of F.S.
Hysteresis	3% of F.S.
Indicators	Green LED’s on when actuated
Compliance	CE
Mechanical	
Materials Exposed to Gas	
Standard	316L S.S., 316L/VAR S.S., Inconel, Nickel
Optional	Viton®, Kalrez®, Kel-F®
Leak Integrity	
External	$<10^{-9}$ scc/sec He
Internal (through closed valve)[1,2]	Elastomer valve: $<10^{-4}$ scc/sec He Metal valve: <1% of F.S. (N_2 @ 1 atm. ΔP) Kel-F valve: <0.5% of F.S. (N_2 @ 1 atm. ΔP)
Fittings	Swagelok® 4 VCR®, 8 VCR, or 1/4” Swagelok, Surface Mount
Dimensions	1.5” (38.1 mm) x 4.88” (124 mm) (4 VCR) x 5.50” (140 mm) max.
Weight	2.54 lbs. (1.15 kg)

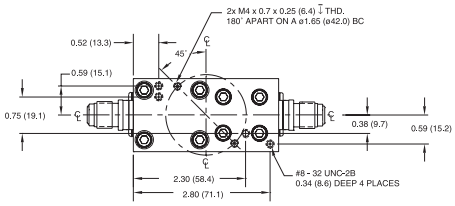
[1] 640/641 Control Valves should not be used for positive shutoff. Where positive shutoff is required, a separate valve should be installed. When selecting the location of an external shutoff valve, consideration should be given to the maximum pressure rating of the internal transducer and to the possibility that leakage across the internal valve over time can build up and result in a sudden surge of gas. The 640 Series controllers require flow to operate, and cannot control pressure in “dead-ended” (zero flow) applications.

[2] Leak specification “through closed valve” applies when the device is controlling pressure at its outlet which is the standard, as built configuration. If the device is to be configured for controlling pressure at its inlet, the leak rate will be higher. Please consult with Applications Engineering to determine if special set up and testing is required.

Ordering Information



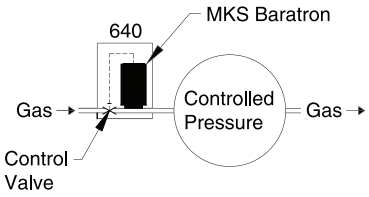




Dimensional Drawing —

Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced).

DOWNSTREAM CONFIGURATION



Ordering Code Example: 640B13TW1V42V	Code	Configuration
Absolute or Gauge Pressure Controller		
Absolute	640B	640B
Gauge	641B	
Pressure Range Full Scale *(Note: For other pressure units or ranges, please consult factory.)*		
10 Torr (mmHg)	11T	13T
100 Torr (mmHg)	12T	
1000 Torr (mmHg)	13T	
60 psi	61P	
100 psi	12P	
Fittings		
Swagelok 1/4"	S	W
Swagelok 4 VCR male	W	
Swagelok 8 VCR male	T	
Surface Mount*		
W-Seal (2787.3F)	H	
C-Seal (2787.1)	C	
Valve		
Normally closed	1	1
Seal Materials		
Viton	V	V
Kalrez	D	
Metal	M	
Valve Orifice # (nominal F.S. flow range for N_2 at 1 atm. ΔP)		
A (50 sccm)	A	4
#1 (200 sccm)	1	
#2 (1000 sccm)	2	
#3 (5000 sccm)	3	
#4 (10000 sccm)	4	
#5 (20000 sccm)	5	
#6 (50000 sccm)*	6	
Trip Points		
With	2	2
Valve Plug Material		
Viton	V	V
Kalrez	D	
Metal**	M	
Kel-F	F	

**Larger differential pressures may be required for Full Scale Flow.*
***Metal valve plug available on 200 sccm and larger valve orifice.*

Optional Accessories	
246C single-channel power supply/readout/set point control	246C
247D four-channel power supply/readout/set point control	247D
647C four-channel power supply/readout/set point control/RS-232	647C4R0N
647C eight-channel power supply/readout /set point control/RS-232	647C8R0N
Cables	
640/641 to 246, 247	CB259-5-10
640/641 to 647 (includes open/close lines)	CB147-1-10

Contact Applications Engineering for shielded cables for CE Compliance.
*Fitting options C and H are available only with metal sealed product versions

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