Type 2000

I/P & E/P Transducers

Description

The Marsh Bellofram Type 2000 is a robust electronic instrument that regulates an incoming supply pressure down to a precise output pressure which is directly proportional to an electrical control signal. The secret to the Type 2000's precise, reliable performance under a variety of demanding environmental conditions is a patented piezo-ceramic actuator with many industry-wide firsts.

The Type 2000 has been designed to meet the electro-pneumatic needs of the world:

- Field-selectable inputs and direct/reverse/split ranging
- Multiple input/output/mounting configurations
- Precise, reliable performance under extreme conditions of temperature, vibration, orientation, supply pressure changes, supply voltage changes, RFI/EMI, humid / oil-laden media, and corrosive surroundings

Applications

The Type 2000's precisely regulated pneumatic output can be used to operate:

- Valve Actuators
- Louver and Damper Actuators
- Valve Positioners
- Relays
- Clutches and Brakes
- Controllers
- Air Cylinders

Industry Applications Include

- Chemical and Petrochemical Industries
- Petroleum Production
- Pipeline Transmission
- Electric Utilities
- Water and Wastewater Systems
- Pulp and Paper
- Textiles
- Semiconductor Industry
- Food and Beverage
- Environmental Control Systems
- Construction Equipment
- Agricultural Equipment
- Machine Tool
- Material Handling
- Automotive Testing and Assembly
- Medical Equipment

Principle of Operation

The Type 2000 I/P and E/P transducers utilize closed-loop pressure feedback-control for precision pressure output and minimized effects of temperature, supply pressure changes, supply voltage changes, and mounting angle.

Supply pressure is reduced by the supply valve to provide an output pressure which is internally routed to a precision temperature compensated piezo-resistive pressure sensor. Supply pressure is also routed to an externally removable orifice which provides a reduced pilot pressure to a chamber containing a servo diaphragm and nozzle. Pilot pressure is controlled by modulating the gap between the face of a nozzle and an adjacent piezo-ceramic actuator, which is part of a unique patented mechanism.

The piezo-ceramic actuator serves as a control link between electrical input and pressure output as follows:

- The input current (I/P) or voltage (E/P) signal is conditioned to provide a normalized control signal directly proportional to the desired pressure output.
- Simultaneously the output of the pressure sensor is amplified and conditioned to produce a feedback signal.
- The sum of the control signal and the feedback signal produce a command signal which is delivered as a DC voltage to the piezo-ceramic actuator.
- As voltage increases, the force applied by the actuator increases, so as to restrict nozzle bleed and thus increase pilot pressure.
- Increased pilot pressure applied to the servo diaphragm directly causes opening of the supply valve and an increase in the output pressure until the output feedback signal and control signal combine to produce the correct command signal.

Fine-Tuning Your Application

For optimal performance in your application, the calibration of the Type 2000 can be fine-tuned in the field. An easily-removable cover provides access to the isolated electronics. All potentiometers, connections, jumpers, and switches are clearly marked on the circuit board or on the handy chart located on the inside of the cover. The three elements of calibration (Gain, Zero, and Span) are described below. Consult the Type 2000 User's Manual for detailed calibration procedures, cautions, and instrumentation requirements.

Gain (Damping) Adjustment

The output response of the Type 2000 can be optimized for varying downstream volumes by adjusting the system gain of the control circuit. Adjust the Gain Pot counterclockwise for increased gain; clockwise for increased oscillation damping. For maximum allowable gain in your application, the pot should be turned clockwise until oscillation just disappears.

Zero and Span Adjustments

The Type 2000 contains multi-turn Coarse-Zero, Fine-Zero, and Span adjustment potentiometers which are clockwise positive. Adjustment of either Zero Pot changes the unit's minimum output while the Span Pot changes the maximum output. The adjustments are interactive, so it may take iterations to reach the desired calibration.

Wide Rangeability

The Type 2000 can be field calibrated to pressure ranges other than the standard ones by combinations of recalibration, pressure range switching, and split high/low ranging. A unit should not be switched to a range outside its pressure sensor family (eg., a 0-15 PSIG can be switched to a 3-15 PSIG, but not to 0-30 PSIG). (Caution: Do not exceed the range of the onboard pressure sensor.) For example, the easiest way to recalibrate a 0-30 PSIG unit to 3-15 psig would be to change the switch setting to 3-27 PSIG, then switch to split range low.

Field-Selectable Features

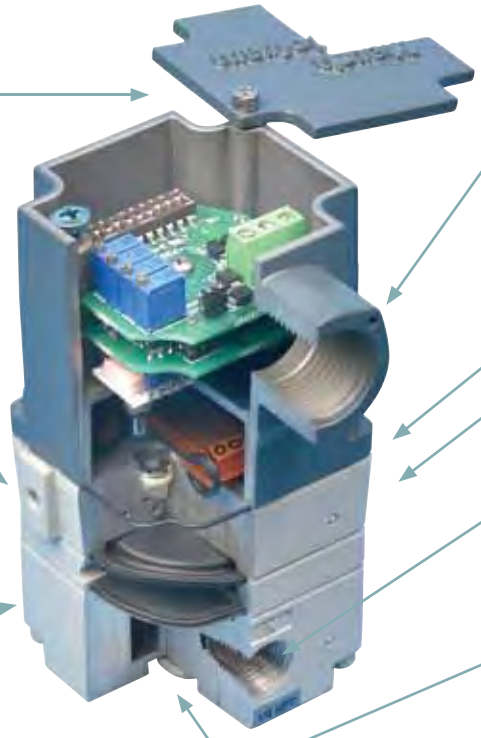
Onboard switches allow the user to easily reconfigure the Type 2000 for any of several electrical inputs, direct/reverse acting, or output split-ranging high/low. Fine tuning of the unit's calibration may be necessary after a reconfiguration.

Direct/Reverse Acting

Direct Acting transducers regulate to their minimum output when supplied with minimum input; maximum out with maximum in. Reverse Acting transducers regulate to their maximum output at minimum input.

Split Ranging (High or Low)

The Type 2000 can be configured to regulate either half (top or bottom) of its normal output range, when supplied with its normal full-ranging electrical input. For example, a 0-10V 0-30 PSI unit set to split range low will regulate 0-15 PSI @ 0-10V. It will regulate 15-30 PSI @ 0-10V if set to split range high.



Easy Access Top Cover
1) Isolated electronics
2) Calibration adjustments
3) Configuration switches
4) Switch information on inside of cover

Mounting Options
1) In-Line
2) Direct: Holes on left rear and bottom faces
3) Bracket Mounting options: Panel, Pipe, Valve, DIN-Rail

Integral Booster
Flows up to 21 scfm for quick system response

Gauge Port
1/8 NPT on all models
(Not shown; rear face)

Electrical Port Options
1) 1/2 NPT Conduit
2) 20mm Conduit
3) Hirschmann® (DIN 43 650-A)
4) Terminal Block

Easy Access Orifice

Output Port
Same as Input Port
(Not shown; rear face)

Input Port Options
1) 1/4 NPT
2) 1/4 BSPP
3) 1/4 BSPT

Manifold-Mounting Option
Supply and Output ports on the bottom face rather than "through the body"

Agency Approvals - Applies only to units ordered with approvals

Factory Mutual
T-2000 I/P & E/P Transducers Explosion Proof / Intrinsically Safe Model
Explosion Proof: Class I, Division 1, Groups A, B, C, & D, T6 Ta = 60°C
Dust-Ignition Proof: Classes II & III, Division 1, Groups E, F, & G , T6 Ta = 60°C; Type 4X **NEMA 4X**, IP66
Intrinsically Safe: Classes I, II, & III, Division 1, Groups A, B, C, D, E, F, & G , T4 Ta = 60°C; Entity; Type 4X **NEMA 4X**, IP66
Non-Incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Suitable: Class II, Division 2, Groups F & G , T4 Ta = 60°C
Suitable: Class III, Division 2, T4 Ta = 60°C, Type 4X, IP66
Entity Parameters:
Input Option b = 42: V_{Max} = 30 V, I_{Max} = 200 mA, P_{Max} = 1 W, C_i = 0, L_i = 0.
Input Option b = 01, 05, 11, 15 or 19: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.
Special Conditions of Use:
The T-2000 Non-Incendive not for use with natural gas or other non-inert gases as a process medium.

T-2000 E/P or I/P Transducers Intrinsically Safe Model
Intrinsically Safe: Classes I, II, & III, Division 1, Groups A, B, C, D, E, F, & G, T4 Ta = 60°C; Entity;
Non-Incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Suitable: Class II, Division 2, Groups F & G, T4 Ta = 60°C
Suitable: Class III, Division 2, T4 Ta = 60°C Type 4X **NEMA 4X**
Entity Parameters:
When Electrical Input Option *c* = 42: VMax = 30 V, IMax = 200 mA, PMax = 1 W, C_i = 0, L_i = 0.
When Electrical Input Option *c* = 05, 15, 19, 11 or 01: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.

T-2000 E/P or I/P Transducers Intrinsically Safe with Terminal Block Model
Intrinsically Safe: Class I, Division 1, Groups A, B, C, & D, T4 Ta = 60°C Entity;
Non-Incendive: Class I, Division 2, Groups A, B, C, & D, T4 Ta = 60°C
Entity Parameters:
When Electrical Input Option c = 42: V_{Max} = 30 V, I_{Max} = 200 mA, P_{Max} = 1 W, C_i = 0, L_i = 0.
When Electrical Input Option c = 05, 15, 19, 11 or 01: V_{Max} = 30 V, I_{Max} = 100 mA, P_{Max} = 0.75 W, C_i = 0, L_i = 0.

Canadian Standards Association - T-2000 I/P & E/P Transducers
Hazardous Locations: Class I, Division 1, Groups A, B, C, & D; Class II, Groups E, F & G; Class III.

Explosion proof I/P & E/P Transducer, Rated: 28Vdc, 8mA; T-Code T6; Enclosure Type 4X **NEMA 4X**, IP66;
Max Ambient Temperature: +60°C. IN COMPLIANCE WITH STD C22.2 No 213.

T-2000 I/P & E/P Transducers
Intrinsically Safe, Entity - Hazardous Locations: Class I, Divisions 1 & 2, Groups A , B, C, & D; Class II, Division 1, Groups E, F, & G, Division 2, Groups F & G; Class III Hazardous Locations
Electro-Pneumatic I/P and E/P Transducers. Maximum Ambient Temperature: +60°C. Enclosure Type 4X **NEMA 4X**, T4. Intrinsically Safe when installed.
Explosion proof: Class I, Division 1, Groups A, B, C & D; Class II, Groups E, F, & G; Class III. **NEMA 4X**
Rated: 28Vdc, 8mA; T-Code T6; Enclosure Type 4X, IP66; Max Ambient Temperature: +60°C. Intrinsically Safe when installed. Two sets of Entity Parameters may be used in the installation of this product.
Entity Parameters
I/P: V_{Max} = 30V I_{max} = 200mA P_{Max} = 1.0W C_i = 0mF L_i = 0mH
E/P: V_{Max} = 30V I_{Max} = 100mA P_{Max} = 0.75W C_i = 0mF L_i = 0mH

ATEX (EUROPEAN MODEL)
T-2000 I/P & E/P Transducers
INTRINSIC SAFETY: II 1 G EEx ia IIC T4 (-20<Ta<+60) EN 50014:1997 (A2) EN 50020:1994 EN 500284:1999

ENTELA
T-2000 I/P Transducers
Explosion Proof: Class I, Division I, Groups C and D, T3.
Exia IIB Ci=0 Li=0, 24VDC, 25mA
Note: Meets the requirements for CSA Class I Div. 1, Group D media gas (Natural Gas Use) Also includes factory conduit seal. EN 50081-1 Residential, commercial & light industry, EN-50082-2 Heavy Industrial. Certified to CSA C22.2 No 30,14,157,1010

The Bellofram T-2000 Transducers were tested and found to comply with Electromagnetic Compatibility Directive effective January 1, 1996. The relevant EMC specifications tested were the following: EN 50081-1 (1992) and EN 50082-1 (1992). A Technical Construction File, Serial #107 was written and Certificate of Conformity issued by a Competent Body.

Type 2000 Specifications

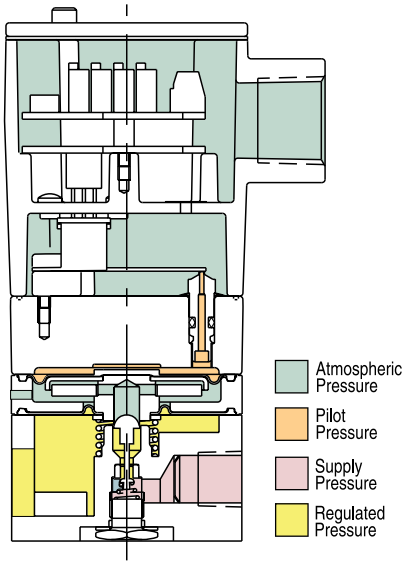
Accuracy	0.1% of full-scale output typical (0.25% guaranteed); includes effects of hysteresis, dead band, and repeatability
Electrical	
Inputs	Switch-Selectable 4-20mA. 0-5, 1-5, 1-9, 1-10, or 0-10VDC
Connections	1/2 NPT or 20mm Conduit DIN Hirschmann (S model only) External Terminal Block (S model only)
Power Supply	5-28VDC (with voltage inputs only)
Direct/Reverse Acting	Switch-Selectable
Pneumatic	
Outputs	0-5, 0-15, 3-15, 1-17, 0-30, 6-30, 3-27, 0-60, 0-100, or 120 PSIG 0-0.1, 0-0.3, 0-1.0, 0.2-1.0, 0.07-1.2, 0-2.1, 0.4-2.1, 0.2-1.9, 0-4.1, 0-6.9, 0-8.3 BAR
Ports (Input/Output)	1/4" (NPT, BSPT, or BSPP threads) Bottom-ported for Manifold Mounting
Exhaust	(Explosion proof only) 1/8 - 27 NPT
Ports (Gauge)	1/8 NPT
Supply	For 0–5 PSIG (0.3 BAR) Through 0–60 PSIG From 5 PSIG (0.3 BAR) above maximum output to 100 PSIG maximum For 0-100 PSIG and 0–120 PSIG Ranges From 5 PSIG (0.3 BAR) above maximum output to 140 PSIG maximum
Split-Ranging	Switch-Selectable, Full-Range or Split-Range High or Split-Range Low
Consumption	4 SCFH maximum (1.9 LPM)

Flow Capacity

Range		Sensor		Flow	
PSIG	BAR	PSIG	BAR	SCFM	LPM
0-5	0-0.3	5	0.3	11	312
0-15	0-1.0	15	1.0	15	423
3-15	0.2-1.0	15	1.0	15	423
1-17	0.07-1.2	15	1.0	15	423
0-30	0-2.1	30	2.1	15	423
3-27	0.2-1.9	30	2.1	15	423
6-30	0.4-2.1	30	2.1	15	423
0-60	0-4.1	50	3.5	17	480
(Typical Flow @ 100 PSIG (6.9 BAR) in and maximum out)					
0-100	0-6.9	100	6.9	21	595
0-120	0-8.3	100	6.9	21	595
(Typical Flow @ 140 PSIG (9.7 BAR) in and maximum out)					

Exhaust Capacity	3 SCFM (85 LPM) @ 5 PSIG (0.3 BAR) above setpoint (0-15 PSIG range unit set at mid range)
Stability	
Supply Voltage Effect	None
Supply Pressure Effect	None
Vibration Effect	<1% FS (+/-1G; 5-1000Hz)
Mounting Position Effect	None
RFI/EMI	CE-Compliant
Temperature Effect	0.02% FS/˚F (-40˚ to 180˚F [-40˚ to 82˚C])
Storage Temperature	-40˚to 200˚F (-40 to 93˚C)
Approximate Weight	3.0 lbs, 1.35 kg

The secret to the Type 2000's precise, reliable performance under a variety of demanding environmental conditions is a patented piezo-ceramic actuator with many industry-wide firsts.

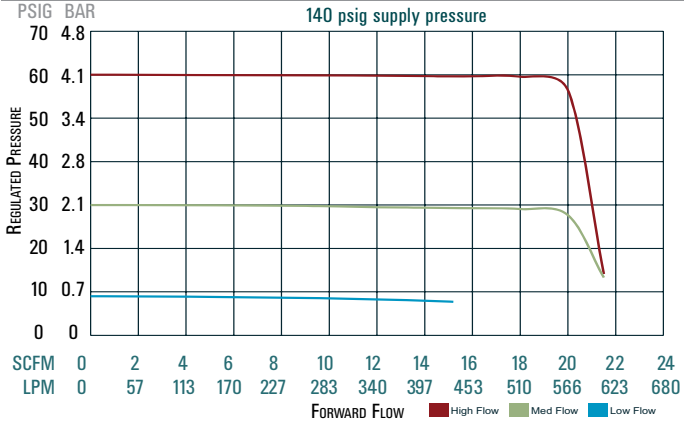


Air Quality

Instrument-quality air consists of:

a. A dew point less than 35º F
b. No particles larger than three microns
c. Maximum oil content of 1 ppm

TYPE 2000: REGULATED PRESSURE VS. FLOW



Type 2000 Mounting Options

Mounting Method	Intrinsically-Safe (S) Model	Explosion-Proof (E) Model
In-Line	Yes	Yes
Direct Mounting	Side or Bottom Holes	Side or Bottom Holes
Panel Bracket	Supplied	Accessory
Valve Bracket	Accessory	Supplied
Pipe Bracket	Accessory	Accessory
DIN-Rail Bracket	Accessory	Accessory
Manifold Plate	Accessory	Accessory

Mounting: The Type 2000 can be mounted in-line, or directly to a panel via mounting holes located in the side and bottom of the unit. In addition, the S model includes a panel-mounting bracket; while the E model includes a valve-mounting bracket. Kits are available for mounting of either model to panel, valve, pipe, or DIN-Rail. A custom plate is available for mounting of the bottom-ported version to a manifold. (See Accessories)

Type 2000 Ordering Information

2 K										
										Enclosure
	S									Intrinsically Safe
	E									Explosion Proof
										Electrical Port[1]
		N								1/2 NPT Conduit
		M								20mm Conduit "S" Unit Only
		H								Hirschmann[5]
		T								Terminal Block[2] "S" Unit Only
										Pneumatic Ports
			N							NPT
			T							BSPT
			P							BSPP
			M							Manifold Mount[3]
										Agency Approval[6]
				F						FM/CSA
				C						ATEX "S" Unit Only
				G						Certified to CSA Standards[4]
										Electrical Input
					42					4-20 mA
					05					0-5 V
					15					1-5 V
					19					1-9 V
					11					1-10 V
					01					0-10 V
										Mode
						D				Direct Acting
						R				Reverse Acting
										Mode
							F			Full Range
							H			Split Range High
							L			Split Range Low
										Pneumatic Output
								005		0-5 PSIG 0-0.3 BAR
								015		0-15 PSIG 0-1.0 BAR
								315		3-15 PSIG 0.2-1.0 BAR
								117		1-17 PSIG 0.07-1.2 BAR
								030		0-30 PSIG 0-2.1 BAR
								630		6-30 PSIG 0.4-2.1 BAR
								327		3-27 PSIG 0.2-1.9 BAR
								060		0-60 PSIG 0-4.1 BAR
								100		0-100 PSIG 0-6.9 BAR
								120		0-120 PSIG 0-8.3 BAR
										Special
									00	None

Maximum Supply for these regulators is 100 PSIG

Maximum Supply for these regulators is 140 PSIG

Type 2000 Accessories

	Part Number
Panel Mounting Kit	010-135-000
Valve Mounting Kit	010-134-000
2" Pipe Mounting Kit (Valve Mounting Kit is required)	010-143-000
DIN Rail Adapter	010-115-000
Manifold Adapter Kit	971-158-000
Filter Kit, 60 microns	010-139-000
Pressure Gauge Kit 15 PSIG (1 BAR)	010-138-000
Pressure Gauge Kit 30 PSIG (2.1 BAR)	010-138-001
Pressure Gauge Kit 60 PSIG (4.1 BAR)	010-138-002
Pressure Gauge Kit 160 PSIG (11 BAR)	010-138-003

Type 2000 Notes

[1] Availability			Enclosure S	Enclosure E
Electrical Port		N	Yes	Yes
		M	Yes	Yes
		H	Yes	No
		T	Yes	No

[2] NEMA 4X / IP66 not available

[3] Bottom O-Ring Ports

[4] "E" Enclosure and "N" Electrical port required

[5] Not Agency Approved

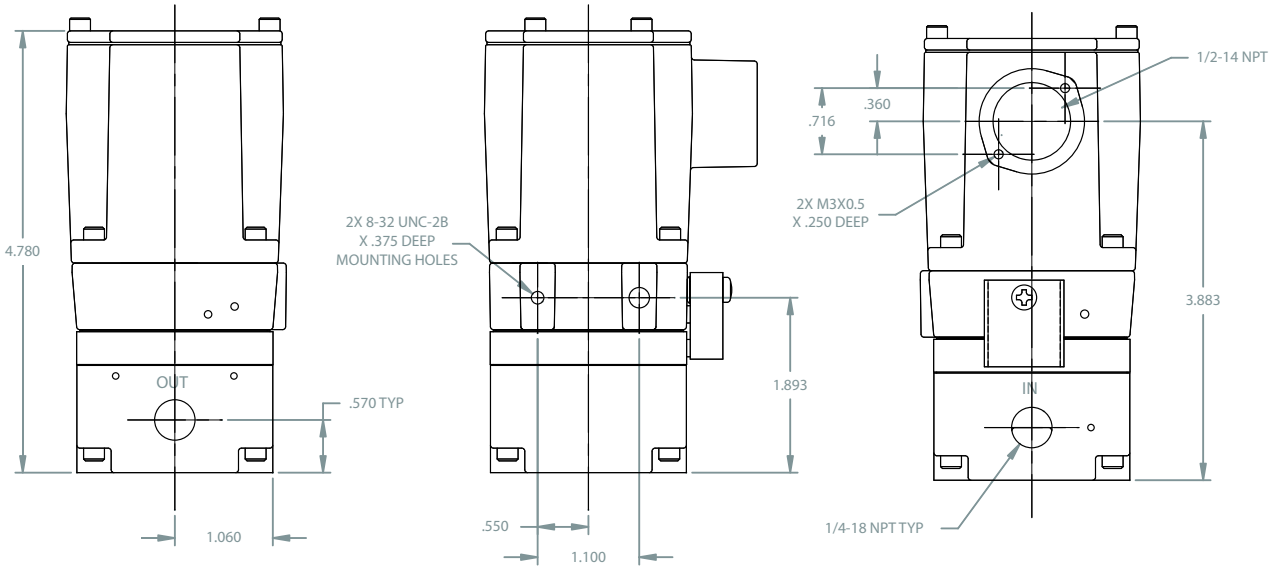
[6] Agency Approval			F FM/CSA	C ATEX	G Gas
Enclosure	S	Intrinsic Safety	Yes	Yes	No
	E	Explosion Proof	Yes	No	Yes

Terminal Block	I/P Transducer	E/P Transducer
S	N/C	+ Signal
+	+ Signal	+ Power Supply
-	- Signal	Common

Type 2000 Wiring Connections and Switch Positions

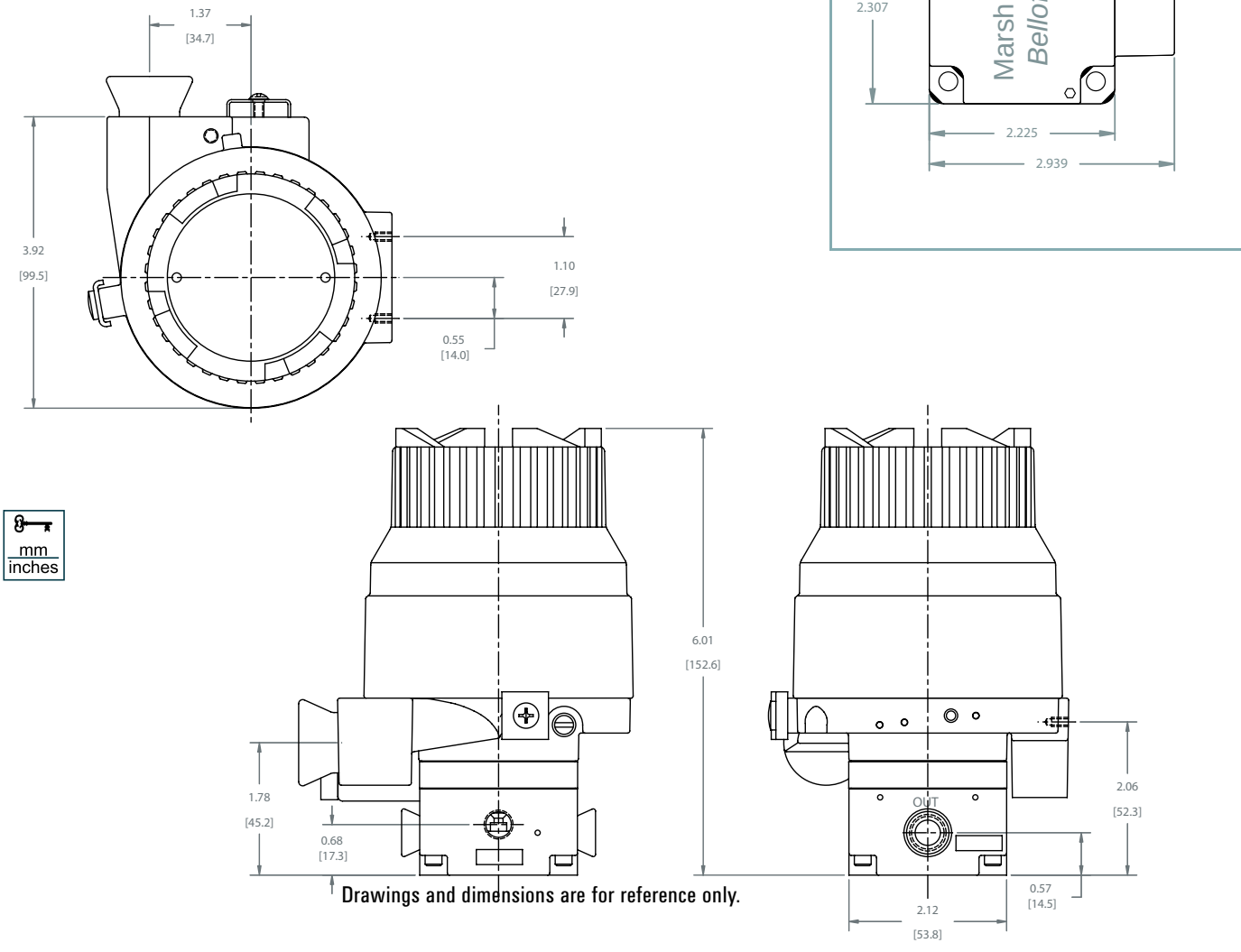
Switch #	1: PSIG	BAR	2	3	4	5	6: psig	BAR	7	8	9
ON	0-15 3-15 1-17 0-30 3-27 6-30 0-100	0-1.0 0.2-1.0 0.07-1.2 0-2.1 0.2-1.9 0.4-2.1 0-6.9	1-5 VDC 0-5 VDC	Split Low	Voltage Input (E/P)	Split Low Full	0-15 1-17 0-30 0-60 0-100 0-120	0-1.0 0.07-1.2 0-2.1 0-4.1 0-6.9 0-8.3	Reverse Acting	Full	I/P
Switch #	1: PSIG	BAR	2	3	4	5	6: psig	BAR	7	8	9
OFF	0-60 0-120	0-4.1 0-8.3	1-9 VDC 0-10 VDC 4-20 mA	Full Split High	Current Input (I/P)	Split High	3-15 3-27 6-30	0.2-1.0 0.2-1.9 0.4-2.1	Direct Acting	Split Low Split High	E/P

Type 2000 Dimensions



mm
inches

Type 2000 Explosion Proof Dimensions



mm
inches

Drawings and dimensions are for reference only.