0 to 100 kPa (0 to 14.5 PSI) High Z_{in}, On-Chip Temperature Compensated & Calibrated, Silicon Pressure Sensors

MPX7100 SERIES

Motorola Preferred Devices

X–ducer™ HIGH Z_{in} SILICON PRESSURE SENSORS

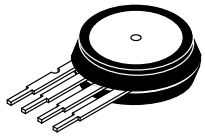
The new MPX7100 series pressure sensor incorporates all the innovative features of Motorola's MPX2000 series family including the patented, single piezoresistive strain gauge (X–ducer) and on–chip temperature compensation and calibration. In addition, the MPX7100 series has a high input impedance of typically 10 kΩ for those portable, low power and battery–operated applications. This device is suitable for those systems in which users must have a dependable, accurate pressure sensor that will not consume significant power. The MPX7100 series device is a logical and economical choice for applications such as portable medical instrumentation, remote sensing systems with 4 – 20 mAmp transmission and field barometers/altimeters.

Features

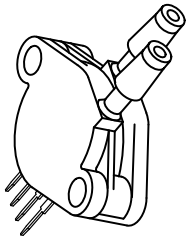
- Temperature Compensated Over 0°C to +85°C
- Unique Silicon Shear Stress Strain Gauge
- Full Scale Span Calibrated to 40 mV (typical)
- Easy to Use Chip Carrier Package Options
- Available in Differential and Gauge Configurations
- Ratiometric to Supply Voltage

Application Examples

- Portable Medical Instrumentation
- Field Altimeters
- Field Barometers



BASIC CHIP CARRIER ELEMENT CASE 344–08 Style 1



DIFFERENTIAL PORT OPTION CASE 352–02 Style 1

Pin Number			
1	2	3	4
Ground	$+V_{out}$	V_S	$-V_{out}$

MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Overpressure(8) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(8) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	–50 to +150	°C
Operating Temperature	T_A	–40 to +125	°C

VOLTAGE OUTPUT versus APPLIED DIFFERENTIAL PRESSURE

The differential voltage output of the X–ducer is directly proportional to the differential pressure applied.

The absolute sensor has a built–in reference vacuum. The output voltage will decrease as vacuum, relative to ambient, is drawn on the pressure (P1) side.

The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure (P1) side relative to the vacuum (P2) side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum (P2) side relative to the pressure (P1) side.

Figure 1 illustrates a schematic of the internal circuitry on the stand–alone pressure sensor chip.

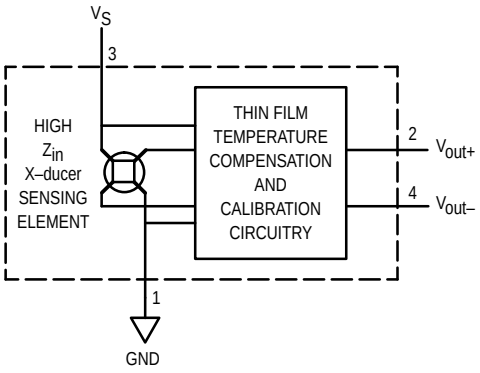


Figure 1. Temperature Compensated Pressure Sensor Schematic

X–ducer is a trademark of Motorola, Inc.

Preferred devices are Motorola recommended choices for future use and best overall value.

OPERATING CHARACTERISTICS (V_S = 10 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range(1)		P_{OP}	0	—	100	kPa
Supply Voltage(2)		V_S	—	10	16	Vdc
Supply Current		I_o	—	1.0	—	mAdc
Full Scale Span(3)	MPX7100A, MPX7100D	V_{FSS}	38.5	40	41.5	mV
Offset(4)	MPX7100D MPX7100A	V_{off}	–1.0 –2.0	— —	1.0 2.0	mV
Sensitivity		ΔV/ΔP	—	0.4	—	mV/kPa
Linearity(5)	MPX7100D MPX7100A	— —	–0.25 –1.0	— —	0.25 1.0	$\%V_{FSS}$
Pressure Hysteresis(5) (0 to 100 kPa)		—	—	±0.1	—	$\%V_{FSS}$
Temperature Hysteresis(5) (–40°C to +125°C)		—	—	±0.5	—	$\%V_{FSS}$
Temperature Effect on Full Scale Span(5)		TCV_{FSS}	–1.0	—	1.0	$\%V_{FSS}$
Temperature Effect on Offset(5)		TCV_{off}	–1.0	—	1.0	mV
Input Impedance		Z_{in}	5000	10,000	15,000	Ω
Output Impedance		Z_{out}	2500	3100	6000	Ω
Response Time(6) (10% to 90%)		t_R	—	1.0	—	ms
Offset Stability(5)		—	—	±0.5	—	$\%V_{FSS}$

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight (Basic Element Case 344)	—	—	2.0	—	Grams
Warm–Up	—	—	15	—	Sec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure(7)	—	—	—	690	kPa

NOTES:

1. 1.0 kPa (kiloPascal) equals 0.145 psi.
2. Device is ratiometric within this specified excitation range. Operating the device above the specified excitation range may induce additional error due to device self–heating.
3. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
4. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
5. Accuracy (error budget) consists of the following:
   - Linearity: Output deviation from a straight line relationship with pressure, using end point method, over the specified pressure range.
   - Temperature Hysteresis: Output deviation at any temperature within the operating temperature range, after the temperature is cycled to and from the minimum or maximum operating temperature points, with zero differential pressure applied.
   - Pressure Hysteresis: Output deviation at any pressure within the specified range, when this pressure is cycled to and from the minimum or maximum rated pressure, at 25°C.
   - Offset Stability: Output deviation, after 1000 temperature cycles, – 40 to 125°C, and 1.5 million pressure cycles, with zero differential pressure applied.
   - TcSpan: Output deviation at full rated pressure over the temperature range of 0 to 85°C, relative to 25°C.
   - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 to 85°C, relative to 25°C.
6. Response Time is defined as the time for the incremental change in the output to go from 10% to 90% of its final value when subjected to a specified step change in pressure.
7. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.
8. Exposure beyond these limits may cause permanent damage or degradation to the device.

LINEARITY

Linearity refers to how well a transducer's output follows the equation: $V_{out} = V_{off}$ + sensitivity x P over the operating pressure range. There are two basic methods for calculating nonlinearity: (1) end point straight line fit (see Figure 2) or (2) a least squares best line fit. While a least squares fit gives the "best case" linearity error (lower numerical value), the calculations required are burdensome.

Conversely, an end point fit will give the "worst case" error (often more desirable in error budget calculations) and the calculations are more straightforward for the user. Motorola's specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

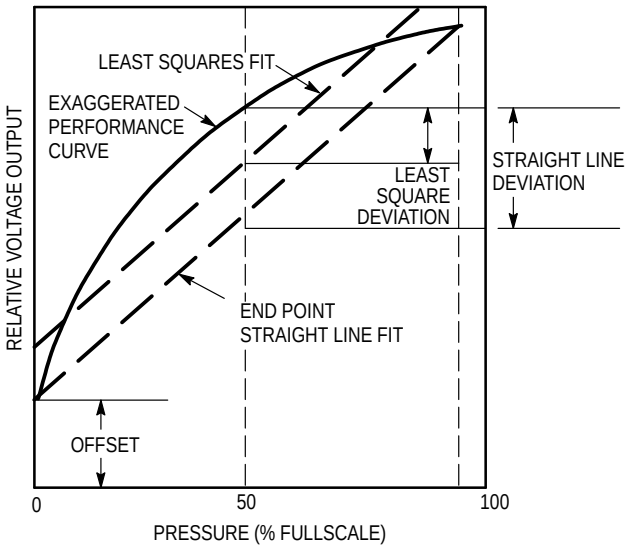


Figure 2. Linearity Specification Comparison

ON–CHIP TEMPERATURE COMPENSATION and CALIBRATION

Figure 3 shows the output characteristics of the MPX7100 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

The effects of temperature on Full Scale Span and Offset are very small and are shown under Operating Characteristics.

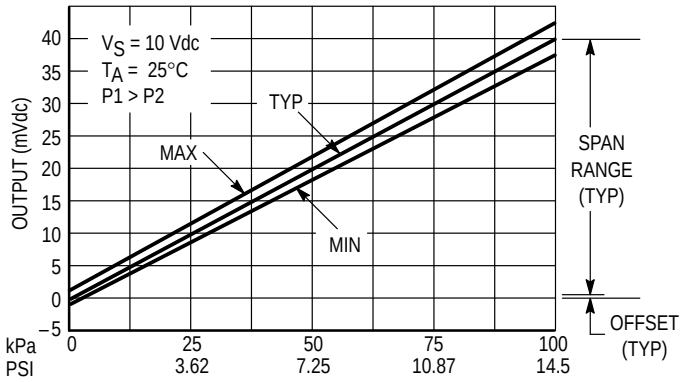


Figure 3. Output versus Pressure Differential

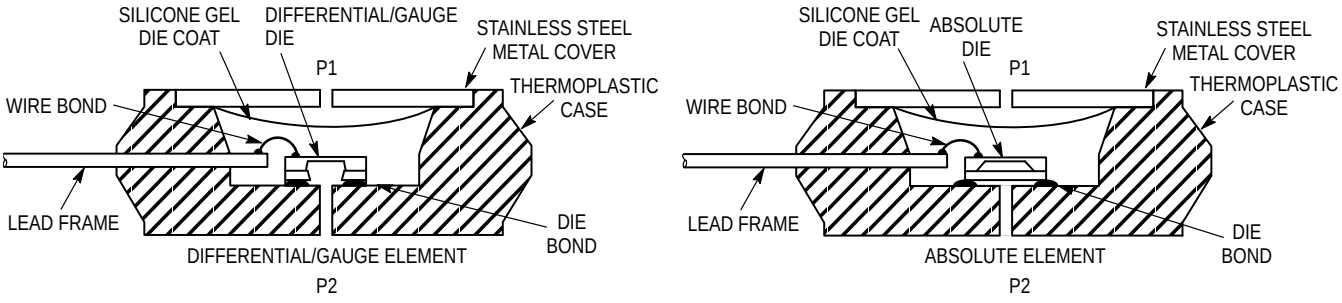


Figure 4. Cross–Sectional Diagrams (Not to Scale)

Figure 4 illustrates the absolute sensing configuration (right) and the differential or gauge configuration in the basic chip carrier (Case 344). A silicone gel isolates the die surface and wire bonds from harsh environments, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPX7100 series pressure sensor operating characteristics and internal reliability and qualification tests are based on use of dry air as the pressure media. Media other than dry air may have adverse effects on sensor performance and long term reliability. Contact the factory for information regarding media compatibility in your application.

PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

Motorola designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing the silicone gel which protects the die from harsh media. The differential or gauge sensor is designed to operate with positive differential pressure applied, P1 > P2. The absolute sensor is designed for vacuum applied to P1 side.

The Pressure (P1) side may be identified by using the table below:

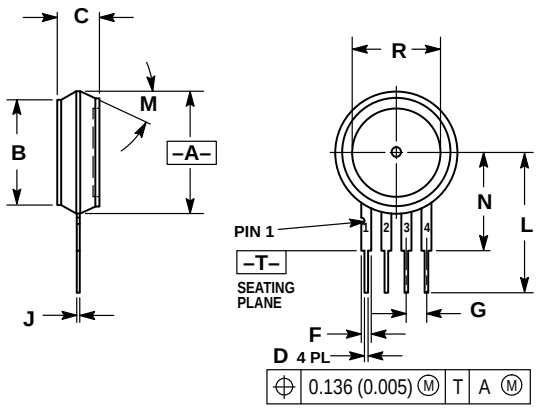
Part Number		Case Type	Pressure (P1) Side Identifier
MPX7100A	MPX7100D	344–08	Stainless Steel Cap
MPX7100DP		352–02	Side with Part Marking
MPX7100AP	MPX7100GP	350–03	Side with Port Attached
MPX7100GVP		350–04	Stainless Steel Cap
MPX7100AS	MPX7100GS	371–06	Side with Port Attached
MPX7100GVS		371–05	Stainless Steel Cap
MPX7100ASX	MPX7100GSX	371C–02	Side with Port Attached
MPX7100GVSX		371D–02	Stainless Steel Cap

ORDERING INFORMATION

MPX7100 series pressure sensors are available in absolute, differential and gauge configurations. Devices are available in the basic element package or with pressure port fittings which provide printed circuit board mounting ease and barbed hose pressure connections.

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Absolute, Differential	Case 344–08	MPX7100A MPX7100D	MPX7100A MPX7100D
Ported Elements	Differential, Dual Ported	Case 352–02	MPX7100DP	MPX7100DP
	Absolute, Gauge	Case 350–03	MPX7100AP MPX7100GP	MPX7100AP MPX7100GP
	Gauge Vacuum	Case 350–04	MPX7100GVP	MPX7100GVP
	Absolute, Gauge Stove Pipe	Case 371–06	MPX7100AS MPX7100GS	MPX7100A MPX7100D
	Gauge Vacuum Stove Pipe	Case 371–05	MPX7100GVS	MPX7100D
	Absolute, Gauge Axial	Case 371C–02	MPX7100ASX MPX7100GSX	MPX7100A MPX7100D
	Gauge Vacuum Axial	Case 371D–02	MPX7100GVSX	MPX7100D

PACKAGE DIMENSIONS



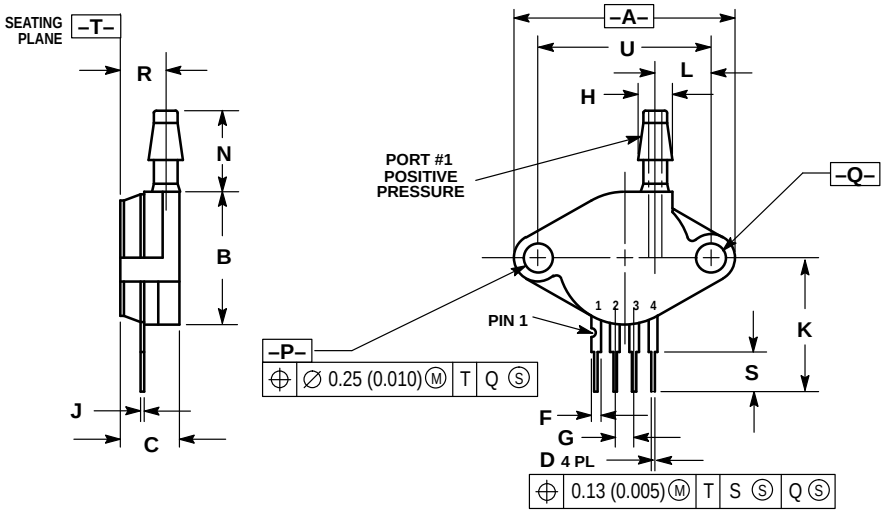
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.590	0.615	14.99	15.62
B	0.505	0.525	12.83	13.34
C	0.195	0.225	4.95	5.72
D	0.016	0.020	0.41	0.51
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.685	0.715	17.40	18.16
M	30° NOM		30° NOM	
N	0.480	0.500	12.19	12.70
R	0.420	0.450	10.67	11.43

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 344–08
ISSUE M

BASIC ELEMENT (A, D)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.
2. CONTROLLING DIMENSION: INCH.

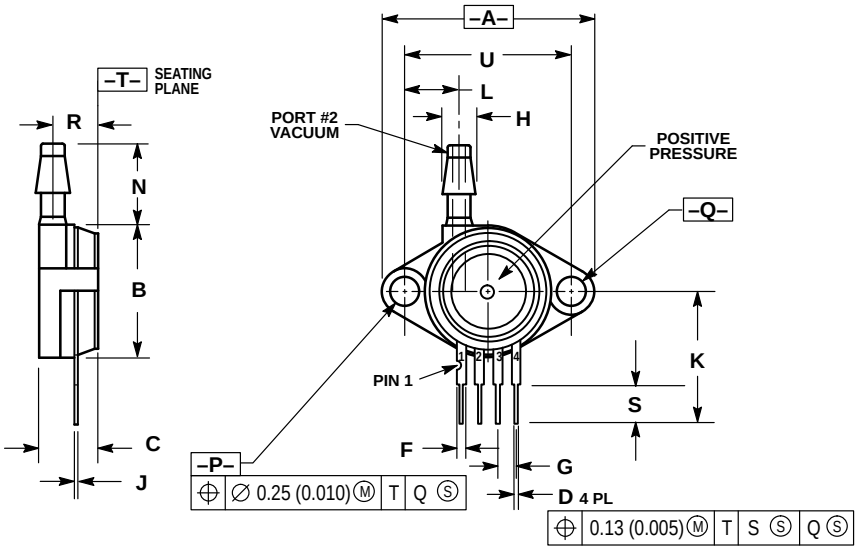
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.751	17.39	18.16
C	0.305	0.321	7.74	8.15
D	0.016	0.020	0.40	0.50
F	0.048	0.052	1.21	1.32
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.92
J	0.014	0.016	0.35	0.40
K	0.685	0.715	17.39	18.16
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.158	3.88	4.01
Q	0.153	0.158	3.88	4.01
R	0.231	0.250	5.86	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 350–03
ISSUE H

PRESSURE SIDE PORTED (AP, GP)

PACKAGE DIMENSIONS — CONTINUED



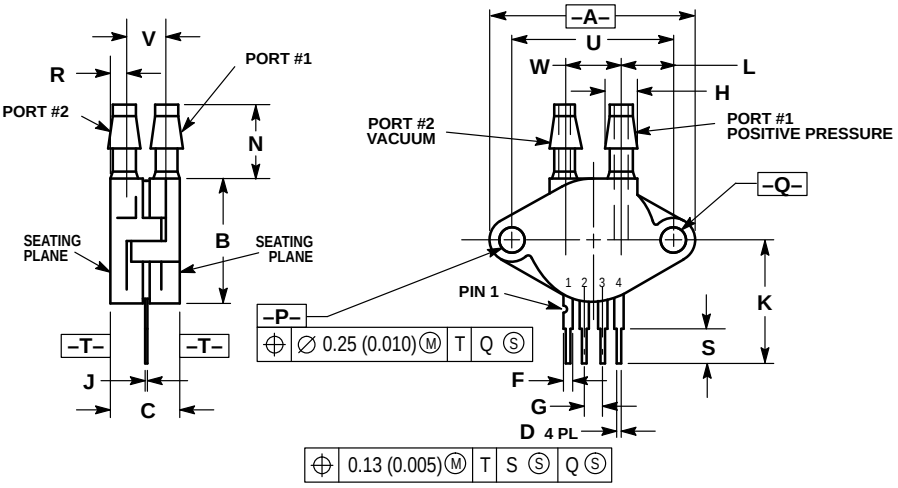
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.751	17.39	18.16
C	0.305	0.321	7.74	8.15
D	0.016	0.020	0.40	0.50
F	0.048	0.052	1.21	1.32
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.92
J	0.014	0.016	0.35	0.40
K	0.685	0.715	17.39	18.16
L	0.290	0.300	7.34	7.62
N	0.420	0.430	10.67	10.92
P	0.153	0.158	3.88	4.01
Q	0.153	0.158	3.88	4.01
R	0.231	0.250	5.86	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 350–04
ISSUE H

VACUUM SIDE PORTED (GVP)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

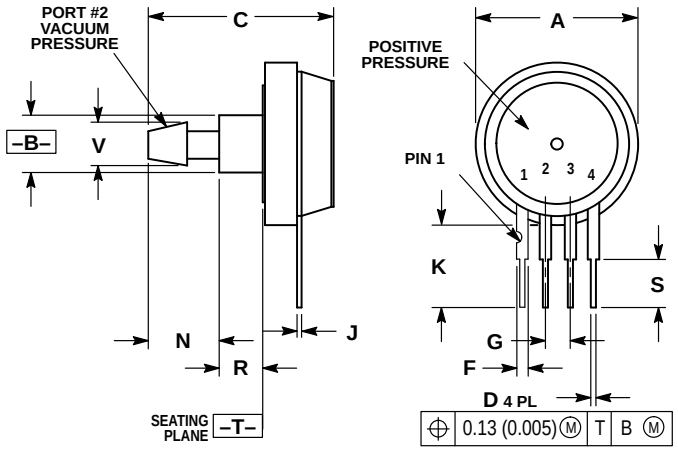
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.39	18.16
C	0.380	0.420	9.65	10.66
D	0.016	0.020	0.40	0.50
F	0.048	0.052	1.21	1.32
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.92
J	0.014	0.016	0.35	0.40
K	0.685	0.715	17.39	18.16
L	0.290	0.300	7.34	7.62
N	0.420	0.430	10.67	10.92
P	0.153	0.158	3.88	4.01
Q	0.153	0.158	3.88	4.01
R	0.063	0.083	1.60	2.10
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.243	0.273	6.17	6.93
W	0.310	0.330	7.87	8.38

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 352–02
ISSUE F

PRESSURE AND VACUUM SIDES PORTED (DP)

PACKAGE DIMENSIONS — CONTINUED



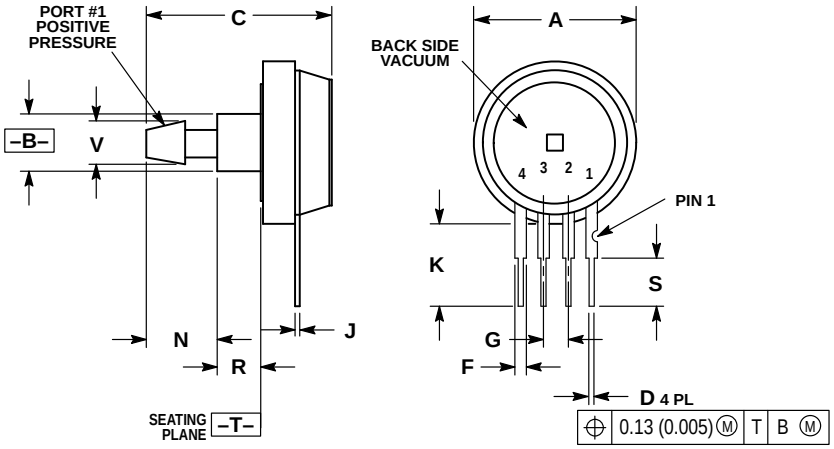
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.247	0.253	6.28	6.42
C	0.780	0.820	19.81	20.82
D	0.016	0.020	0.41	0.50
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.335	0.365	8.51	9.27
N	0.305	0.315	7.75	8.00
R	0.178	0.185	4.53	4.69
S	0.230 REF		5.84 REF	
V	0.182	0.194	4.63	4.92

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 371–05
ISSUE D

VACUUM SIDE PORTED (GVS)



NOTES:
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2. CONTROLLING DIMENSION: INCH.

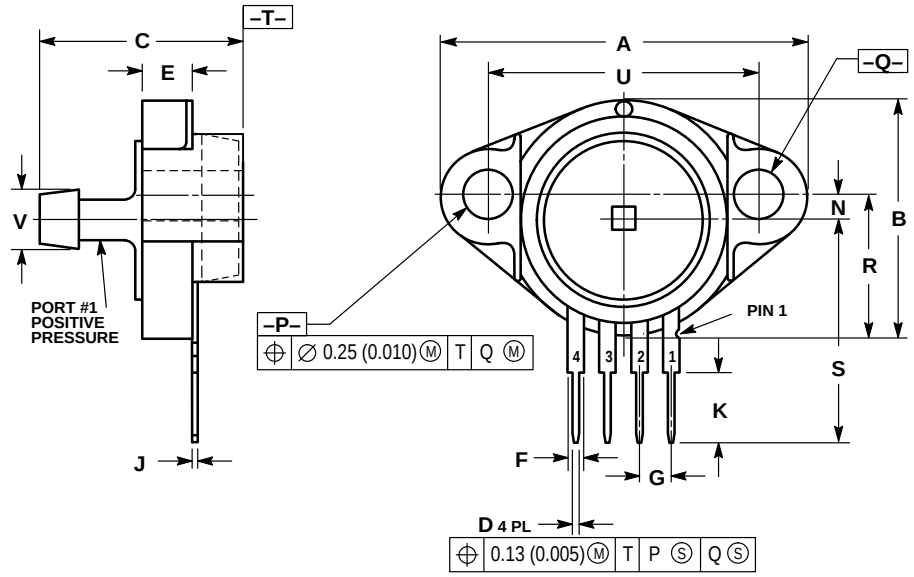
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.247	0.253	6.28	6.42
C	0.780	0.820	19.81	20.82
D	0.016	0.020	0.41	0.50
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.335	0.365	8.51	9.27
N	0.305	0.315	7.75	8.00
R	0.178	0.185	4.53	4.69
S	0.230 REF		5.84 REF	
V	0.182	0.194	4.63	4.92

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

CASE 371–06
ISSUE D

PRESSURE SIDE PORTED (AS, GS)

PACKAGE DIMENSIONS — CONTINUED



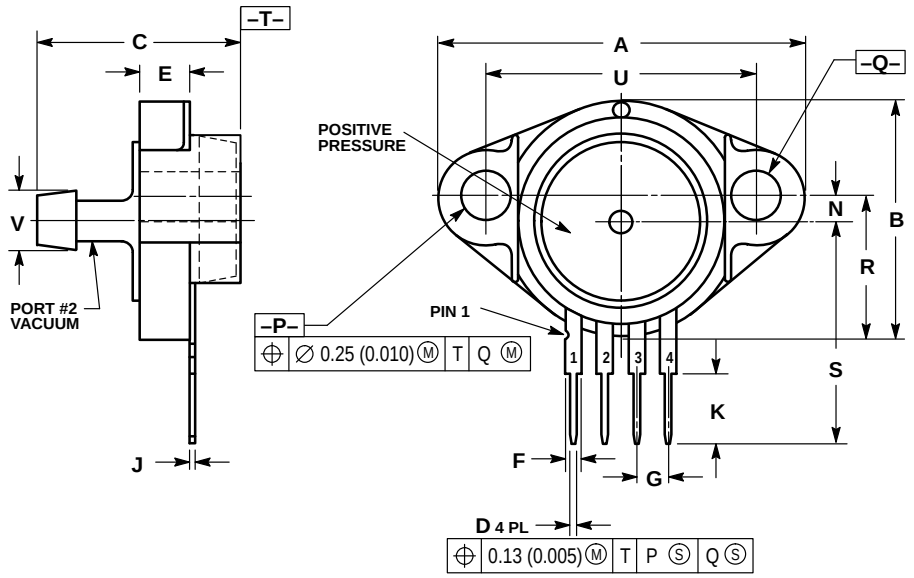
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.100	1.200	27.94	30.48
B	0.740	0.760	18.80	19.30
C	0.635	0.650	16.13	16.51
D	0.016	0.020	0.41	0.50
E	0.160	0.180	4.06	4.57
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.230 REF		5.84 REF	
N	0.070	0.080	1.78	2.03
P	0.150	0.160	3.81	4.06
Q	0.150	0.160	3.81	4.06
R	0.445	0.460	11.30	11.68
S	0.685	0.715	17.40	18.16
U	0.840	0.860	21.33	21.84
V	0.185	0.195	4.69	4.95

STYLE 1:
PIN 1. GROUND
2. V (+) OUT
3. V SUPPLY
4. V (–) OUT

CASE 371C–02
ISSUE B

PRESSURE SIDE PORTED (ASX, GSX)



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.100	1.200	27.94	30.48
B	0.740	0.760	18.80	19.30
C	0.635	0.650	16.13	16.51
D	0.016	0.020	0.41	0.50
E	0.160	0.180	4.06	4.57
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.230 REF		5.84 REF	
N	0.070	0.080	1.78	2.03
P	0.150	0.160	3.81	4.06
Q	0.150	0.160	3.81	4.06
R	0.445	0.460	11.30	11.68
S	0.685	0.715	17.40	18.16
U	0.840	0.860	21.33	21.84
V	0.185	0.195	4.69	4.95

STYLE 1:
PIN 1. GROUND
2. V (+) OUT
3. V SUPPLY
4. V (–) OUT

CASE 371D–02
ISSUE B

VACUUM SIDE PORTED (GVSX)

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ASIA PACIFIC: Motorola Semiconductors H.K. Ltd.; Silicon Harbour Center, No. 2 Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.