0 to 100 kPa (0 to 14.5 PSI) On-Chip Signal Conditioned, 0.2 V to 4.7 V Output, Temperature Compensated & Calibrated, Silicon Pressure Sensors

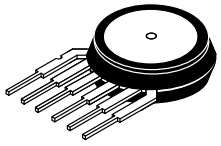
MPX5100 SERIES

Motorola Preferred Devices

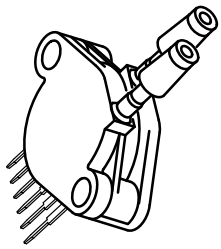
MPX5100D: 0–100 kPa
MPX5100A: 15–115 kPa
X–ducer™
SILICON
PRESSURE SENSORS

Features

- 2.5% Maximum Error Over 0–85°C
- Durable Epoxy Unibody Element
- Ideally Suited for Microprocessor or Microcontroller Based Systems
- Patented Silicon Shear Stress Strain Gauge
- Easy to use Chip Carrier Package Options
- Available in Absolute, Differential and Gauge Configurations



BASIC CHIP CARRIER ELEMENT CASE 867–04 Style 1



DIFFERENTIAL PORT OPTION CASE 867C–03 Style 1

Pin Number					
1	2	3	4	5	6
V_{out}	Ground	V_S	N/C	N/C	N/C

NOTE: Pins 4, 5 and 6 are internal device connections. Do not connect to external circuitry or ground.

MAXIMUM RATINGS (T_C = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
Overpressure(7) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(7) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	–50 to +150	°C
Operating Temperature	T_A	– 40 to 125	°C

The MPX5100 series piezoresistive transducer is a state–of–the–art, monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element X–ducer combines advanced micromachining techniques, thin–film metallization and bipolar semiconductor processing to provide an accurate, high level analog output signal that is proportional to applied pressure.

Figure 1 shows a block diagram of the internal circuitry integrated on the stand–alone pressure sensing chip.

X–ducer is a trademark of Motorola, Inc.

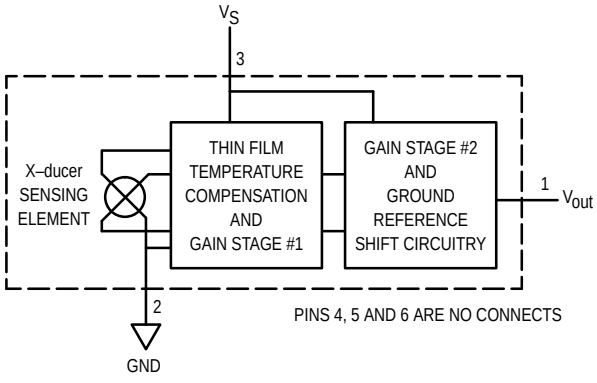


Figure 1. Fully Integrated Pressure Sensor Schematic

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

OPERATING CHARACTERISTICS (V_S = 5.0 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range	Gauge, Differential: MPX5100D Absolute: MPX5100A	P_{OP}	0 15	— —	100 115	kPa
Supply Voltage(1)		V_S	4.75	5.0	5.25	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Full Scale Span(2)	(0 to 85°C)	V_{FSS}	4.388	4.5	4.613	V
Offset(3)	(0 to 85°C)	Voff	0.088	0.200	0.313	V
Sensitivity		$\Delta V/\Delta P$	—	45	—	mV/kPa
Accuracy(4)	(0 to 85°C)	—	—	—	± 2.5	$\%V_{FSS}$
Response Time(5)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{o+}	—	0.1	—	mA

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Warm–Up	—	—	15	—	Sec
Cavity Volume	—	—	—	0.01	IN^3
Volumetric Displacement	—	—	—	0.001	IN^3
Common Mode Line Pressure(6)	—	—	—	690	kPa

NOTES:

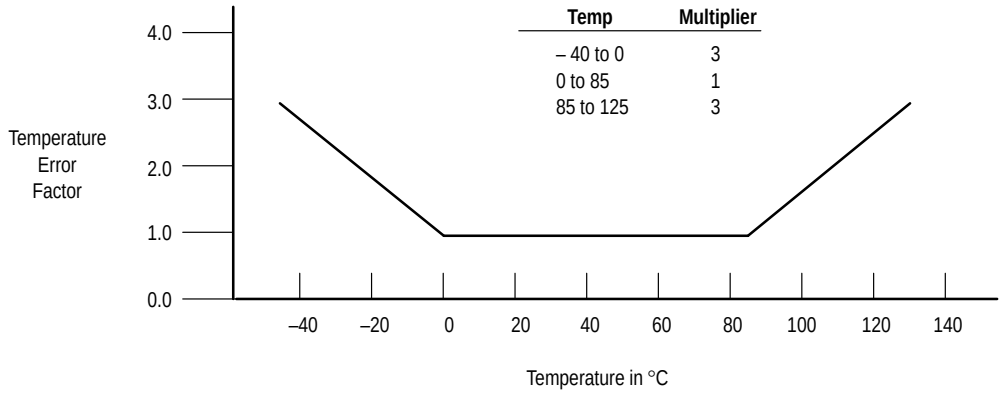
1. Device is ratiometric within this specified excitation range.
2. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. Accuracy (error budget) consists of the following:
   - Linearity: Output deviation from a straight line relationship with pressure 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 minimum rated pressure applied.
   - TcSpan: Output deviation 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.
   - Variation from nominal: The variation from nominal values, for offset or full scale span, as a percent of V_{FSS}, at 25°C.
5. 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.
6. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.
7. Exposure beyond these limits may cause permanent damage or degradation to the device.

Transfer Function (MPX5100D)

Nominal Transfer Value: $V_{out} = V_S (P \times 0.009 + 0.04)$
+/– (Pressure Error x Temp. Factor x 0.009 x V_S)
$V_S = 5.0 V \pm 0.25$ Vdc

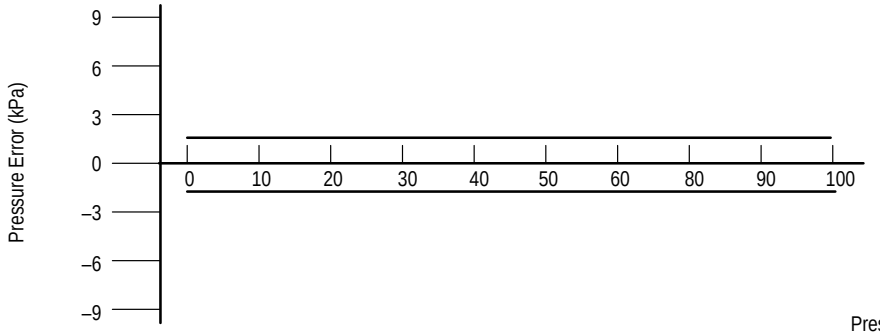
Temperature Error Band

MPX5100D Series



Temp	Multiplier
– 40 to 0	3
0 to 85	1
85 to 125	3

Pressure Error Band



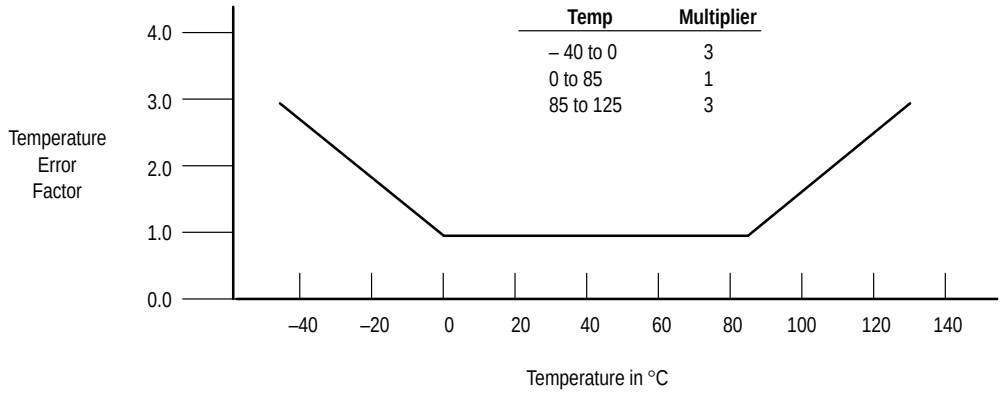
Pressure	Error (Max)
0 to 100 kPa	± 2.5 kPa

Transfer Function (MPX5100A)

Nominal Transfer Value: $V_{out} = V_S (P \times 0.009 - 0.095)$
+/– (Pressure Error x Temp. Factor x 0.009 x V_S)
$V_S = 5.0\ V \pm 0.25\ Vdc$

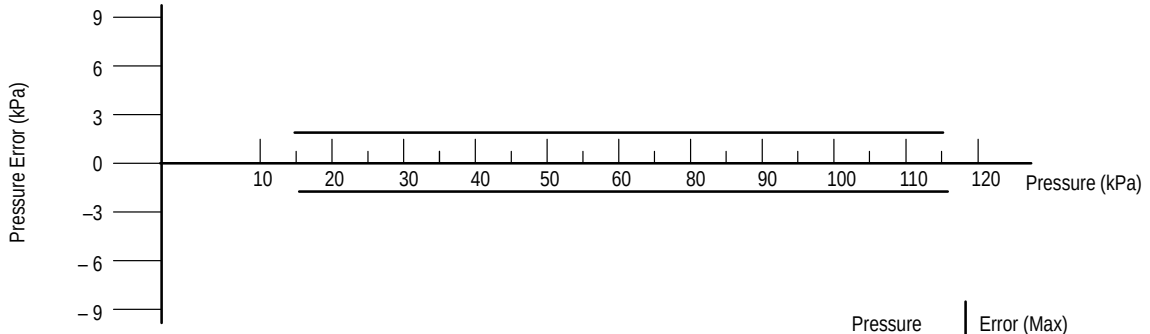
Temperature Error Band

MPX5100A Series



Temp	Multiplier
– 40 to 0	3
0 to 85	1
85 to 125	3

Pressure Error Band



Pressure	Error (Max)
15 to 115 kPa	± 2.5 kPa

ON–CHIP TEMPERATURE COMPENSATION, CALIBRATION and SIGNAL CONDITIONING

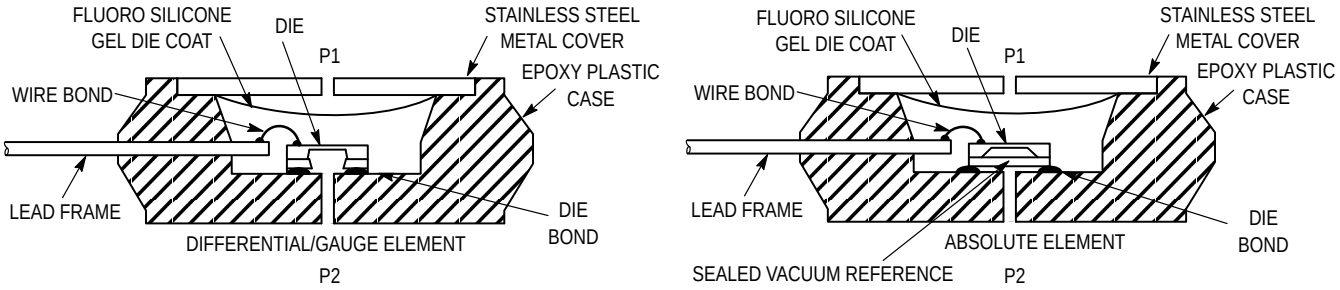


Figure 2. Cross–Sectional Diagrams (Not to Scale)

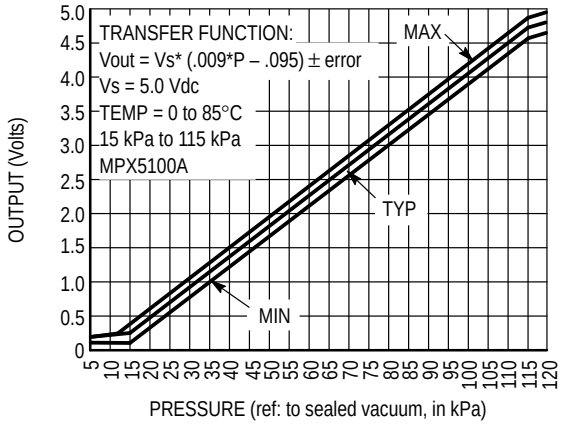


Figure 3. Output versus Absolute Pressure

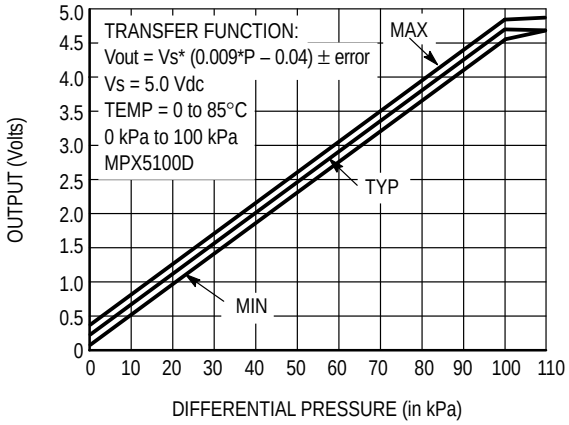


Figure 4. Output versus Pressure Differential

Figure 2 illustrates the absolute sensing configuration (right) and the differential or gauge configuration in the basic chip carrier (Case 867). A fluoro 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 MPX5100A and MPX5100D 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.

Figures 3 and 4 show the sensor output signal relative to pressure input. Typical, minimum and maximum output curves are shown for operation over 0°C to 85°C. (Device output may be non–linear outside of the rated pressure range.)

Figure 5 shows a typical decoupling circuit for interfacing the output of the MPX5100 to the A/D input of a microprocessor. Proper decoupling of the power supply is also recommended.

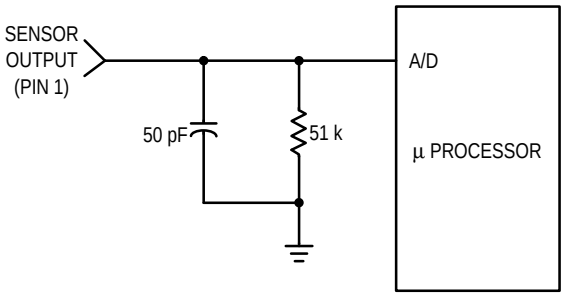


Figure 5. Typical Decoupling Filter for Sensor to Microprocessor Interface

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 fluoro silicone gel which protects the die from harsh media. The differential and gauge sensor is designed to operate with positive differential pressure applied, P1 > P2. The absolute sensor is designed for vacuum on P1 side.

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

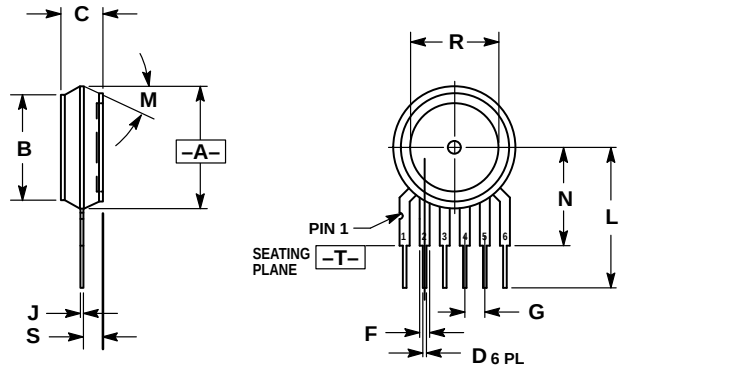
Part Number	Case Type	Pressure (P1) Side Identifier
MPX5100A, MPX5100D	867–04	Stainless Steel Cap
MPX5100DP	867C–03	Side with Part Marking
MPX5100AP, MPX5100GP	867B–03	Side with Port Attached
MPX5100GVP	867D–03	Stainless Steel Cap
MPX5100AS, MPX5100GS	867E–02	Side with Port Attached
MPX5100GVS	867A–03	Stainless Steel Cap
MPX5100ASX, MPX5100GSX	867F–02	Side with Port Attached
MPX5100GVSX	867G–02	Stainless Steel Cap

ORDERING INFORMATION:

The MPX5100 pressure sensor is available in absolute, differential and gauge configurations. Devices are available in the basic element package or with pressure port fittings that 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	867–04	MPX5100A	MPX5100A
	Differential	867–04	MPX5100D	MPX5100D
Ported Elements	Differential Dual Ports	867C–03	MPX5100DP	MPX5100DP
	Absolute, Single Port	867B–03	MPX5100AP	MPX5100AP
	Gauge, Single Port	867B–03	MPX5100GP	MPX5100GP
	Gauge Vacuum Port	867D–03	MPX5100GVP	MPX5100GVP
	Absolute Axial	867E–02	MPX5100AS	MPX5100A
	Gauge, Axial	867E–02	MPX5100GS	MPX5100D
	Gauge Vacuum Axial	867A–03	MPX5100GVS	MPX5100D
	Absolute Axial PC Mount	867F–02	MPX5100ASX	MPX5100A
	Gauge, Axial PC Mount	867F–02	MPX5100GSX	MPX5100D
	Gauge Vacuum Axial PC Mount	867G–02	MPX5100GVSX	MPX5100D

PACKAGE DIMENSIONS



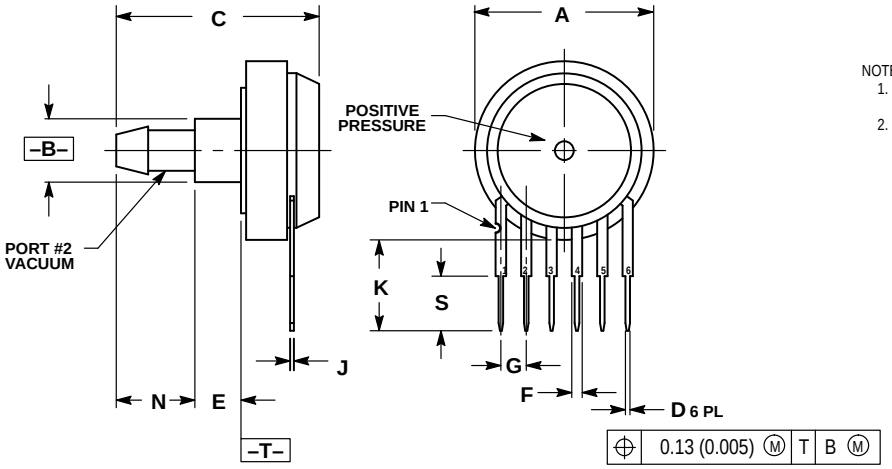
NOTES:
8. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
9. CONTROLLING DIMENSION: INCH.
10. DIMENSION –A– DOES NOT INCLUDE MOLDED FLASH RING. MOLDED FLASH RING NOT TO EXCEED 16.00 (0.630).

	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	0.027	0.033	0.68	0.84
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	0.490	0.510	12.45	12.95
R	0.420	0.450	10.67	11.43
S	0.090	0.105	2.29	2.66

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867–04
ISSUE H

BASIC ELEMENT (A, D)



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

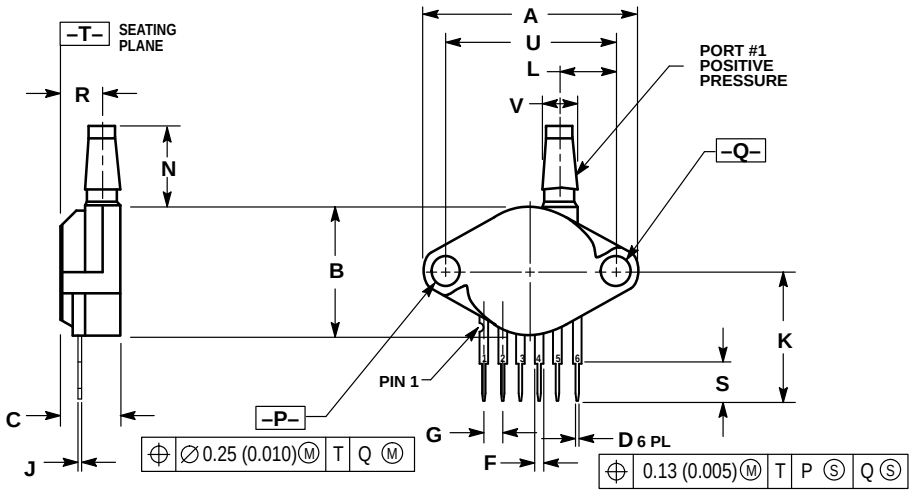
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.247	0.253	6.28	6.42
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.68	0.84
E	0.178	0.185	4.52	4.69
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.335	0.360	8.51	9.14
N	0.305	0.315	7.75	8.00
S	0.220	0.240	5.59	6.10

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867A–03
ISSUE C

VACUUM SIDE PORTED (GVS)

PACKAGE DIMENSIONS–CONTINUED



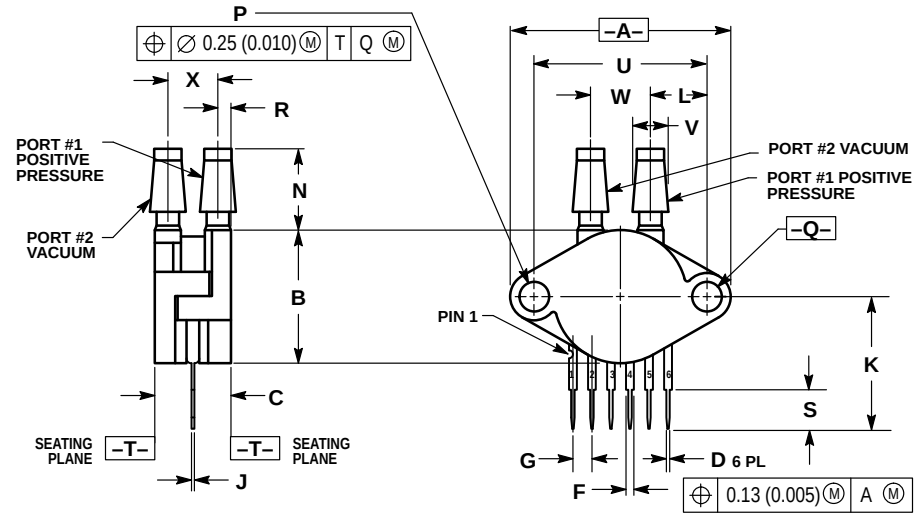
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.310	0.325	7.87	8.26
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.231	0.250	5.87	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867B–03
ISSUE C

PRESSURE SIDE PORTED (AP, GP)



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

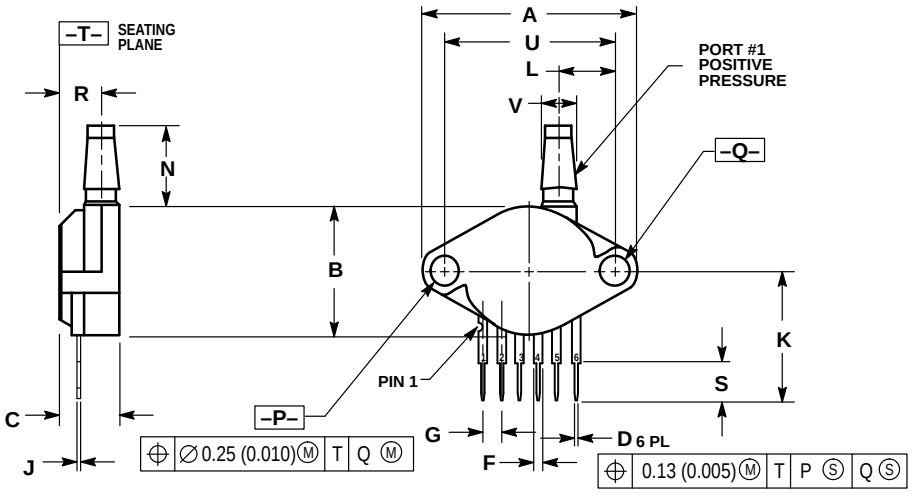
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.380	0.420	9.65	10.60
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.063	0.083	1.60	2.11
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93
W	0.310	0.330	7.87	8.38
X	0.248	0.278	6.30	7.06

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867C–03
ISSUE C

PRESSURE AND VACUUM SIDES PORTED (DP)

PACKAGE DIMENSIONS–CONTINUED



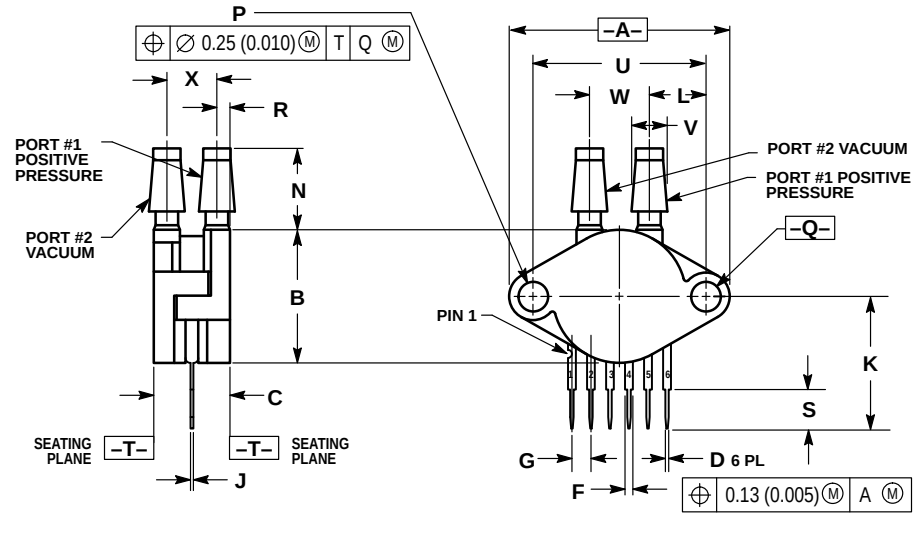
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.310	0.325	7.87	8.26
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.231	0.250	5.87	6.35
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867D–03
ISSUE D

VACUUM SIDE PORTED (GVP)



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

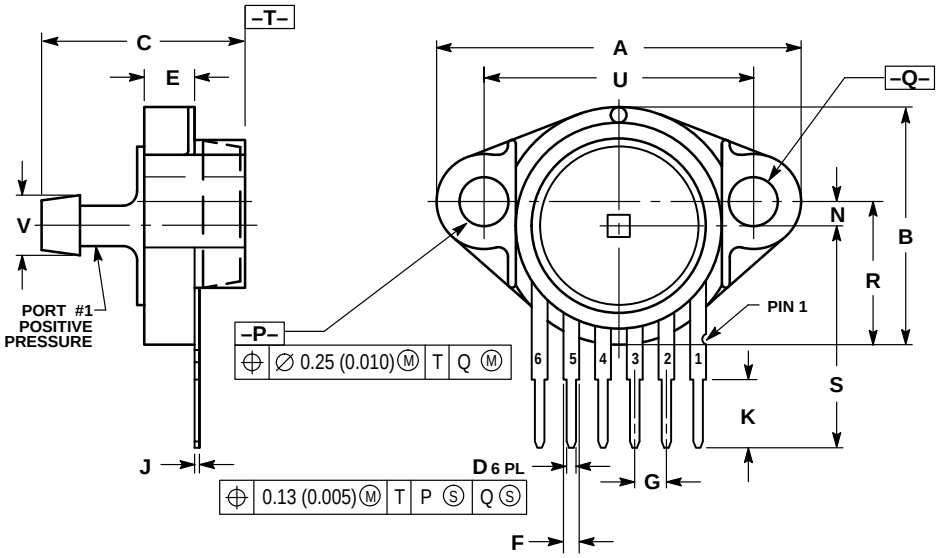
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.380	0.420	9.65	10.60
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.063	0.083	1.60	2.11
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93
W	0.310	0.330	7.87	8.38
X	0.248	0.278	6.30	7.06

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867E–02
ISSUE B

PRESSURE SIDE PORTED (AS, GS)

PACKAGE DIMENSIONS–CONTINUED



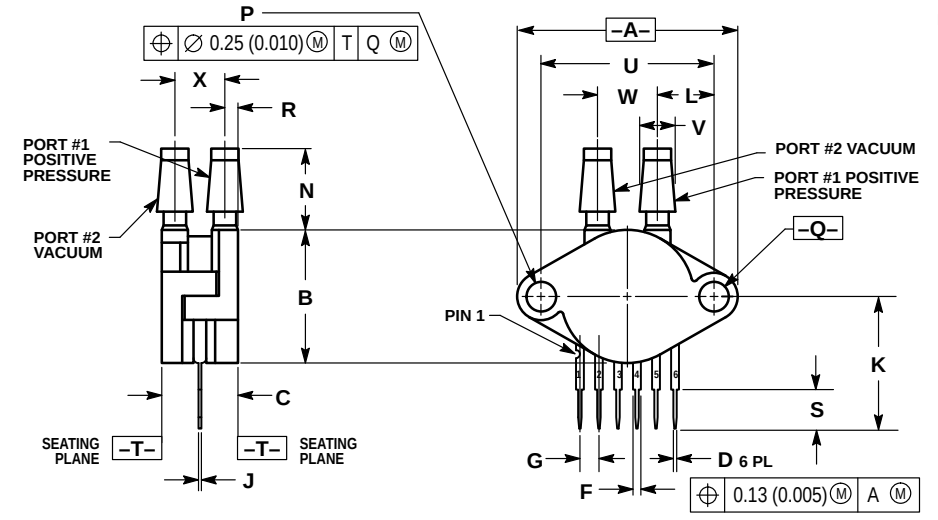
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.075	1.130	27.30	28.70
B	0.740	0.760	18.80	19.30
C	0.635	0.670	16.13	17.02
D	0.027	0.033	0.68	0.84
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. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867F–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	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.380	0.420	9.65	10.60
D	0.027	0.033	0.68	0.84
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	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	3.89	4.03
Q	0.153	0.159	3.89	4.03
R	0.063	0.083	1.60	2.11
S	0.230 REF		5.84 REF	
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93
W	0.310	0.330	7.87	8.38
X	0.248	0.278	6.30	7.06

STYLE 1:
PIN 1. V_{OUT}
2. GROUND
3. V_{CC}
4. V1
5. V2
6. V_{EX}

CASE 867G–02
ISSUE B

VACUUM SIDE PORTED (GVSX)

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