MPX4100A MPXS4100A MPXT4100A MPXA4100A SERIES

Integrated Silicon Pressure Sensor Manifold Absolute Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

INTEGRATED PRESSURE SENSOR
20 to 105 kPa (2.9 to 15.2 psi)
0.3 to 4.9 V Output

The Motorola MPX4100A/MPXS4100A/MPXT4100A series Manifold Absolute Pressure (MAP) sensor for engine control is designed to sense absolute air pressure within the intake manifold. This measurement can be used to compute the amount of fuel required for each cylinder. The small form factor and high reliability of on–chip integration makes the Motorola MAP sensor a logical and economical choice for automotive system designers.

Features

- 1.8% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Ideally Suited for Microprocessor Interfacing
- Temperature Compensated Over –40°C to +125°C
- Durable Epoxy Unibody Element or Surface Mount Package
- Also Ideal for Non–Automotive Applications

Application Examples

- Manifold Sensing for Automotive Systems

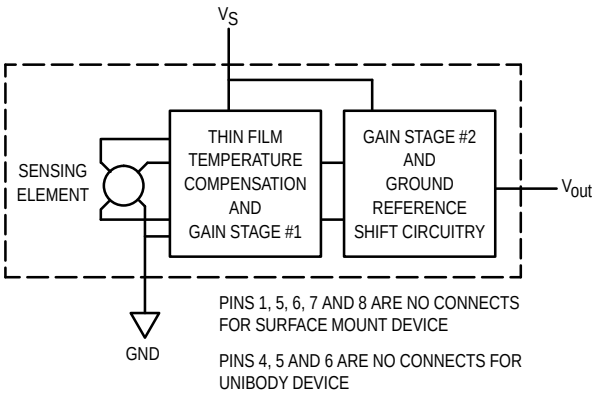
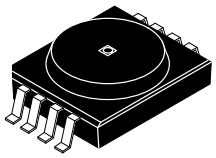


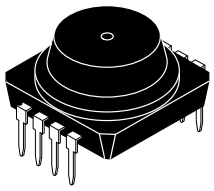
Figure 1. Fully Integrated Pressure Sensor Schematic

SURFACE MOUNT PACKAGE



MPXS4100A
CASE 471–01, STYLE 1

TOP PISTON FIT PACKAGE

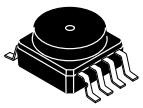


MPXT4100A
BASIC ELEMENT
CASE 473A–01, STYLE 2

PIN NUMBER							
1	N/C	3	Gnd	5	N/C	7	N/C
2	V_S	4	V_{out}	6	N/C	8	N/C

NOTE: Pins 1, 5, 6, 7, and 8 are not device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the Lead.

SMALL OUTLINE PACKAGE

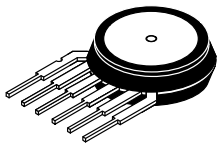


MPXA4100A
CASE 482–01

PIN NUMBER			
1	N/C	5	N/C
2	V_S	6	N/C
3	Gnd	7	N/C
4	V_{out}	8	N/C

NOTE: Pins 1, 5, 6, 7, and 8 are not device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the Lead.

UNIBODY PACKAGE



MPX4100A
BASIC CHIP CARRIER ELEMENT
CASE 867–08, STYLE 1

PIN NUMBER			
1	V_{out}	4	N/C
2	Gnd	5	N/C
3	V_S	6	N/C

NOTE: Pins 4, 5, and 6 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the Lead.

The MPX4100A/MPXS4100A/MPXT4100A series piezoresistive transducer is a state–of–the–art, monolithic, signal conditioned, silicon pressure sensor. This sensor 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 a pressure sensor chip.

MAXIMUM RATINGS(1)

Parametric	Symbol	Value	Unit
Overpressure(2) (P1 > P2)	P_{max}	400	kPa
Burst Pressure(2) (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	–40 to +125	°C
Operating Temperature	T_A	–40 to +125	°C

1. T_C = 25°C unless otherwise noted.
2. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

OPERATING CHARACTERISTICS (V_S = 5.1 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range(1)		P_{OP}	20	—	105	kPa
Supply Voltage(1)		V_S	4.85	5.1	5.35	Vdc
Supply Current		I_o	—	7.0	10	mAdc
Minimum Pressure Offset(3) @ V_S = 5.1 Volts	(0 to 85°C)	V_{off}	0.225	0.306	0.388	Vdc
Full Scale Output(4) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSO}	4.870	4.951	5.032	Vdc
Full Scale Span(5) @ V_S = 5.1 Volts	(0 to 85°C)	V_{FSS}	—	4.59	—	Vdc
Accuracy(6)	(0 to 85°C)	—	—	—	±1.8	$\%V_{FSS}$
Sensitivity		V/P	—	54	—	mV/kPa
Response Time(7)		t_R	—	1.0	—	ms
Output Source Current at Full Scale Output		I_{o+}	—	0.1	—	mAdc
Warm–Up Time(8)		—	—	20	—	ms
Offset Stability(9)		—	—	±0.5	—	$\%V_{FSS}$

Decoupling circuit shown in Figure 3 required to meet electrical specifications.

MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 473)	—	—	2.0	—	Grams
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Common Mode Line Pressure(10)	—	—	—	690	kPa

NOTES:

1. 1.0 kPa (kiloPascal) equals 0.145 psi.
2. Device is ratiometric within this specified excitation range.
3. Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
4. Full Scale Output (V_{FSO}) is defined as the output voltage at the maximum or full rated pressure.
5. 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.
6. 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.
   - 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.
7. 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.
8. Warm–up is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
9. Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
10. Common mode pressures beyond specified may result in leakage at the case–to–lead interface.

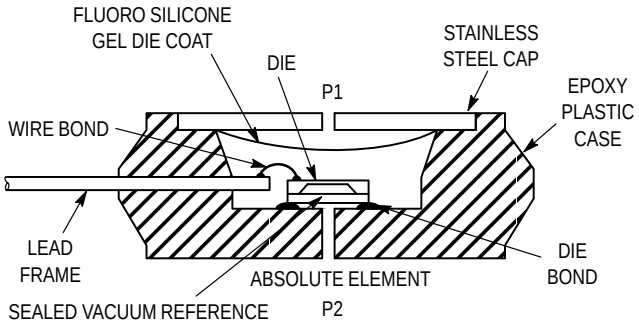


Figure 2. Cross Sectional Diagram (not to scale)

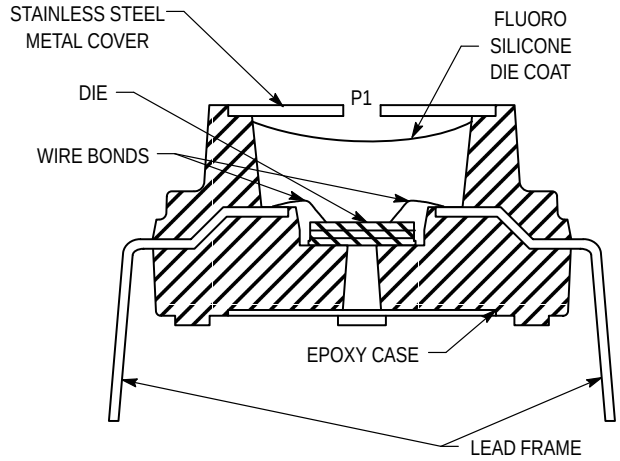


Figure 3. Cross–Sectional Diagram (not to scale)

Figure 2 illustrates an absolute sensing chip in the basic chip carrier (Case 867).

Figure 3 illustrates an absolute sensing chip in surface mount carrier (Case 473).

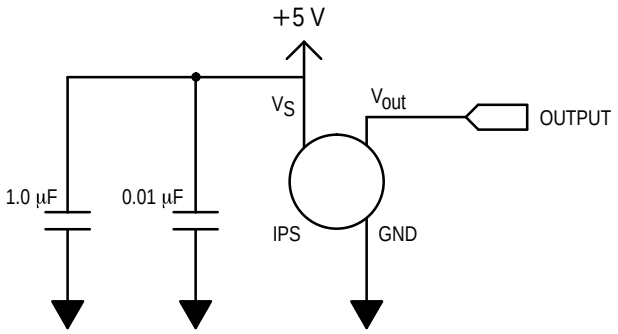


Figure 4. Recommended Power Supply Decoupling. For output filtering recommendations, please refer to Application Note AN1646.

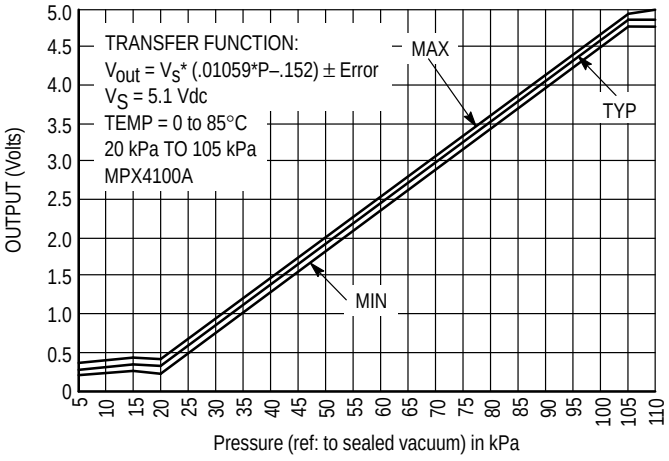


Figure 5. Output versus Absolute Pressure

Figure 5 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 0° to 85°C. (The output will saturate outside of the specified pressure range.)

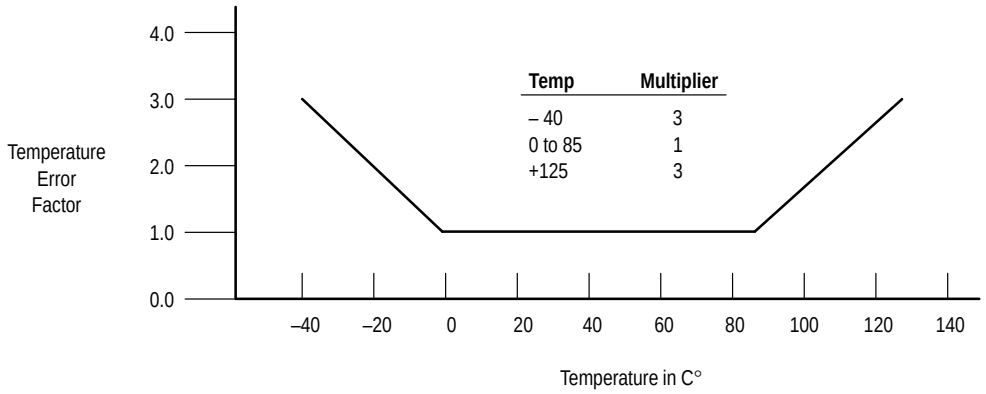
A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm. The MPX4100A/MPXS4100A/MPXT4100A series pressure sensor operating characteristics, and internal reliability and qualification tests are based 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.

Transfer Function (MPX4100A, MPXS4100A, MPXT4100A)

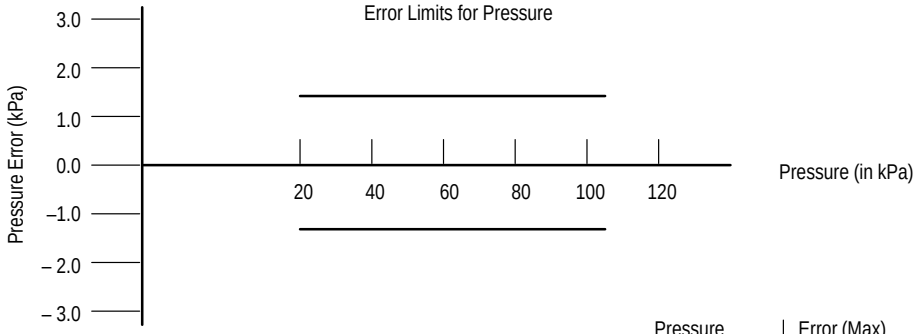
Nominal Transfer Value: $V_{out} = V_S (P \times 0.01059 - 0.1518)$
+/– (Pressure Error x Temp. Factor x 0.01059 x V_S)
$V_S = 5.1\ V \pm 0.25\ Vdc$

Temperature Error Band

MPX4100A, MPXS4100A, MPXT4100A Series



Pressure Error Band



Pressure	Error (Max)
20 to 105 (kPa)	± 1.5 (kPa)

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 fluorosilicone gel which protects the die from harsh media. The Motorola MPX pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

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

Part Number	Case Type	Pressure (P1) Side Identifier
MPX4100A	867–08	Stainless Steel Cap
MPX4100AP	867B–04	Side with Port Marking
MPX4100AS	867E–03	Side with Port Attached
MPX4100ASX	867F–03	Side with Port Attached

ORDERING INFORMATION — UNIBODY PACKAGE

The MPX4100A series MAP silicon pressure sensors are available in the Basic Element, or with pressure port fittings that provide mounting ease and barbed hose connections.

Device Type	Options	Case Type	MPX Series	
			Order Number	Device Marking
Basic Element	Absolute, Element Only	867–08	MPX4100A	MPX4100A
Ported Elements	Absolute, Ported	867B–04	MPX4100AP	MPX4100AP
	Absolute, Stove Pipe Port	867E–03	MPX4100AS	MPX4100A
	Absolute, Axial Port	867F–03	MPX4100ASX	MPX4100A

ORDERING INFORMATION — SURFACE MOUNT PACKAGE

The MPXS4100A series BAP silicon pressure sensors are available shipped in sleeves or tape and reeled.

Device Type Options	Case No.	MPX Series Order No.	Marking
Sleeve Pack	471–01	MPXS4100A6U	MPXS4100A
Tape and Reel	471–01	MPXS4100A6T1	MPXS4100A
Sleeve Pack	471B–01	MPXS4100AC6U	MPXS4100A

Device	Reel Size	Tape Width	Quantity
MPXS4100A6T1	13” dia.	44 mm	250

ORDERING INFORMATION — TOP PISTON FIT PACKAGE

The MPXT4100A series MAP silicon pressure sensors are available to be shipped in rails.

Packing Options	Port Options	Leadform	Case No.	MPXT Series Order No.	Marking
Rails	Element	84°	473A–01	MPXT4100A7U	MPXT4100A

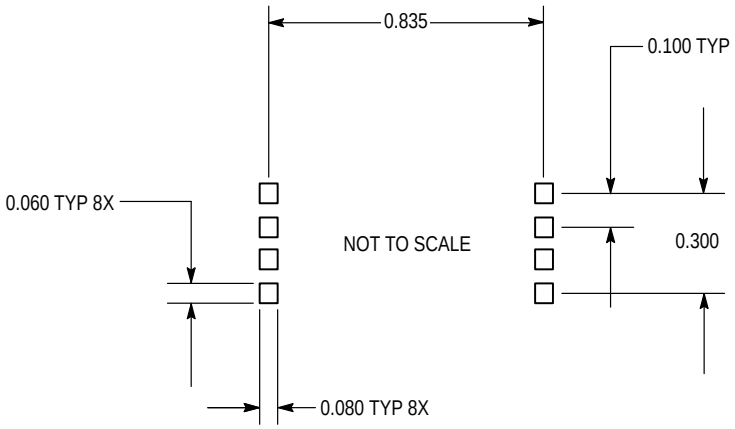
ORDERING INFORMATION — SMALL OUTLINE PACKAGE

Device	Case No.	Packing Options	Marking
MPXA4100A6U	482–01	Rails	MPXA4100A
MPXA4100A6T1	482–01	Tape and Reel	MPXA4100A

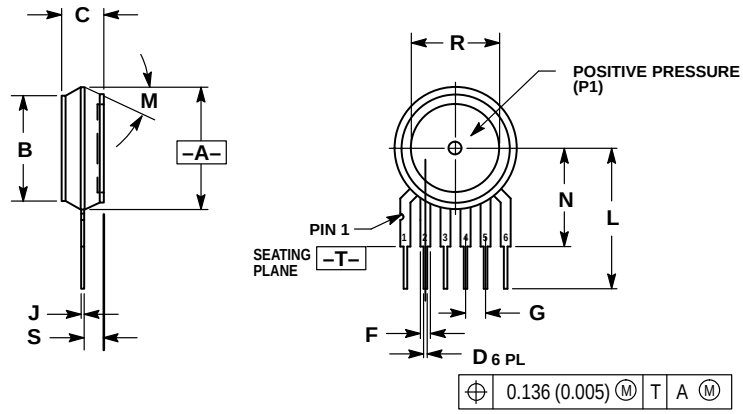
INFORMATION FOR USING THE SURFACE MOUNT PACKAGE

MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self align when subjected to a solder reflow process.



UNIBODY PACKAGE DIMENSIONS



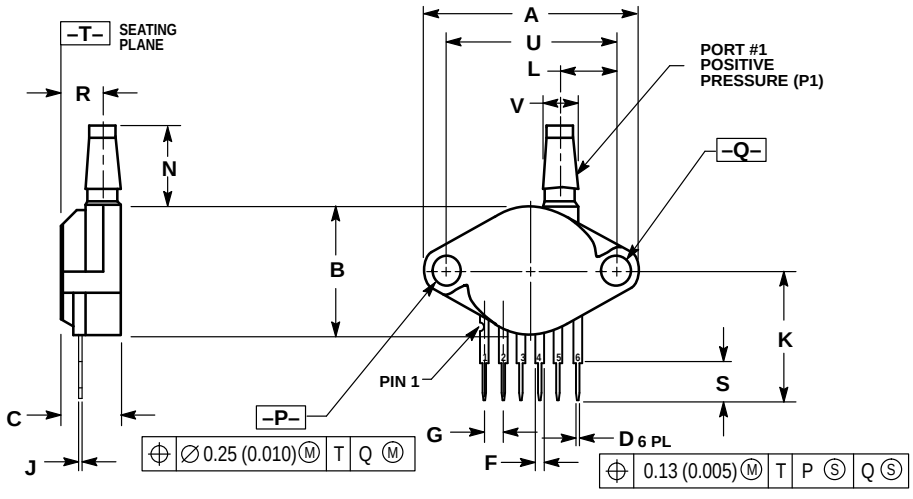
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION –A– IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30 °NOM		30 °NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	11.43
S	0.090	0.105	2.29	2.66

STYLE 1:
PIN 1. VOUT
2. GROUND
3. VCC
4. V1
5. V2
6. VEX

CASE 867–08
ISSUE N

BASIC ELEMENT (A, D)



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

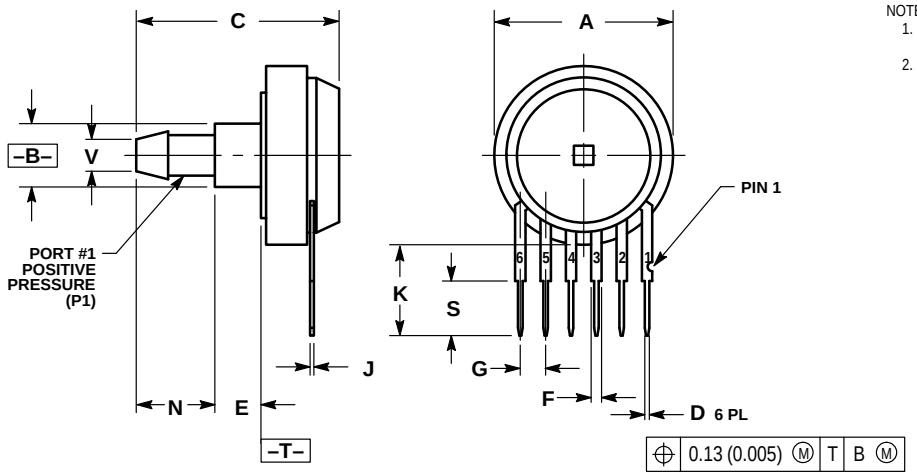
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.145	1.175	29.08	29.85
B	0.685	0.715	17.40	18.16
C	0.305	0.325	7.75	8.26
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.159	3.89	4.04
R	0.230	0.250	5.84	6.35
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. VOUT
2. GROUND
3. VCC
4. V1
5. V2
6. VEX

CASE 867B–04
ISSUE E

PRESSURE SIDE PORTED (AP, GP)

UNIBODY PACKAGE DIMENSIONS—CONTINUED



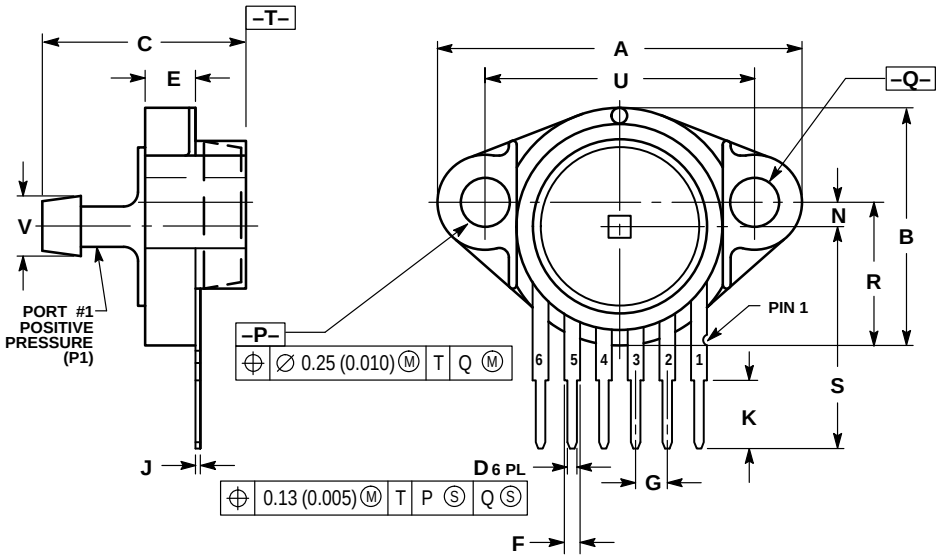
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.245	0.255	6.22	6.48
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.69	0.84
E	0.178	0.186	4.52	4.72
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.345	0.375	8.76	9.53
N	0.300	0.310	7.62	7.87
S	0.220	0.240	5.59	6.10
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. VOUT
2. GROUND
3. VCC
4. V1
5. V2
6. VEX

CASE 867E–03
ISSUE D

PRESSURE SIDE PORTED (AS, GS)



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

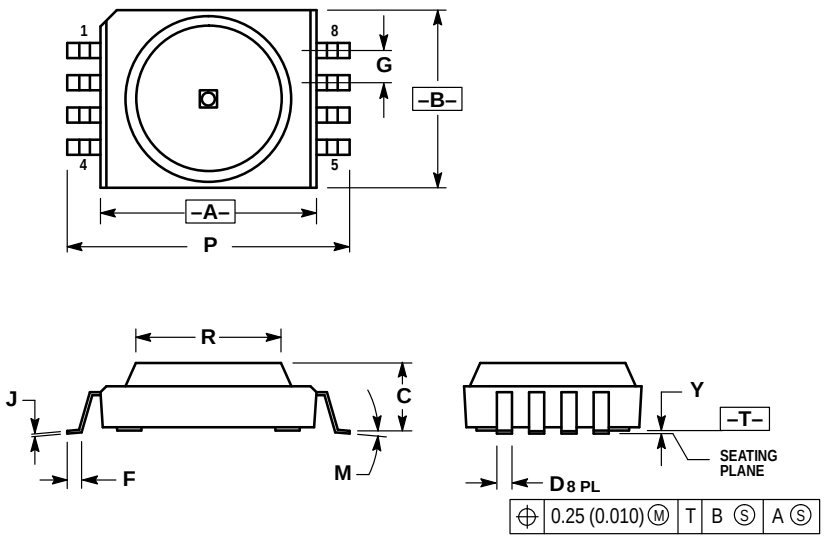
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.080	1.120	27.43	28.45
B	0.740	0.760	18.80	19.30
C	0.630	0.650	16.00	16.51
D	0.027	0.033	0.68	0.84
E	0.160	0.180	4.06	4.57
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.220	0.240	5.59	6.10
N	0.070	0.080	1.78	2.03
P	0.150	0.160	3.81	4.06
Q	0.150	0.160	3.81	4.06
R	0.440	0.460	11.18	11.68
S	0.695	0.725	17.65	18.42
U	0.840	0.860	21.34	21.84
V	0.182	0.194	4.62	4.93

STYLE 1:
PIN 1. VOUT
2. GROUND
3. VCC
4. V1
5. V2
6. VEX

CASE 867F–03
ISSUE D

PRESSURE SIDE PORTED (ASX, GSX)

SURFACE MOUNT PACKAGE DIMENSIONS

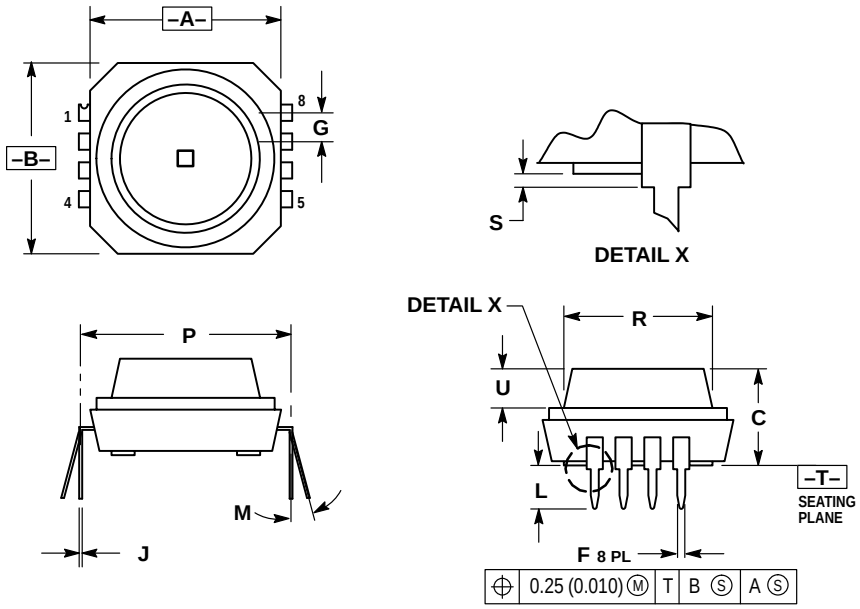


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.541	0.551	13.74	13.99
C	0.209	0.231	5.31	5.87
D	0.046	0.054	1.17	1.37
F	0.037	0.053	0.94	1.34
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
M	0°	7°	0°	7°
P	0.856	0.880	21.74	22.35
R	0.503	0.523	12.78	13.28
Y	0.002	0.010	0.05	0.25

STYLE 1:
PIN 1. NC
2. VSUPPLY
3. GROUND
4. VOUT
5. NC
6. NC
7. NC
8. NC

CASE 471–01
ISSUE O



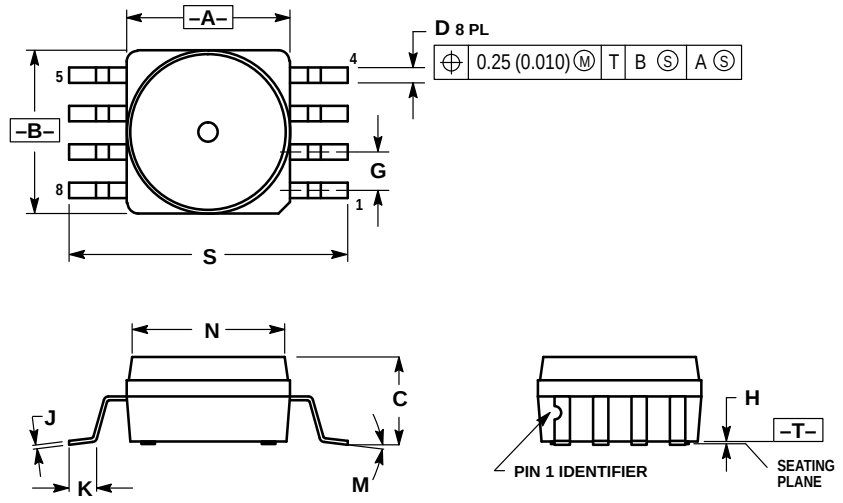
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5°TYPICAL DRAFT.
6. DIMENSION P TO CENTER OF LEAD WHEN FORMED PARALLEL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.658	0.668	16.71	16.97
B	0.658	0.668	16.71	16.97
C	0.329	0.357	8.36	9.07
F	0.026	0.034	0.660	0.864
G	0.100 BSC		2.54 BSC	
J	0.009	0.011	0.23	0.28
L	0.138	0.150	3.81	3.51
M	0°	15°	0°	15°
P	0.738	0.748	18.75	19.00
R	0.503	0.523	12.78	13.28
S	0.002	0.020	0.05	0.51
U	0.135	0.145	3.43	3.68

STYLE 2:
PIN 1. GROUND
2. +VOUT
3. VSUPPLY
4. –VOUT
5. N/C
6. N/C
7. N/C
8. N/C

CASE 473A–01
ISSUE A

SMALL OUTLINE PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.415	0.425	10.54	10.79
B	0.415	0.425	10.54	10.79
C	0.212	0.230	5.38	5.84
D	0.038	0.042	0.96	1.07
G	0.100 BSC		2.54 BSC	
H	0.002	0.010	0.05	0.25
J	0.009	0.011	0.23	0.28
K	0.061	0.071	1.55	1.80
M	0 °	7 °	0 °	7 °
N	0.405	0.415	10.29	10.54
S	0.709	0.725	18.01	18.41

CASE 482–01
ISSUE O

NOTES

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JAPAN: Motorola Japan Ltd.; SPD, Strategic Planning Office, 141,
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2, Dai King Street, Tai Po Industrial Estate, Tai Po, N.T., Hong Kong.
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