0 to 50 kPa (0 to 7.25 PSI) On-Chip Signal Conditioned, 0.2 V to 4.7 V Output, Temperature Compensated & Calibrated, Silicon Pressure Sensors

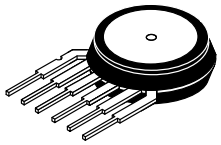
MPX5050 SERIES

Motorola Preferred Devices

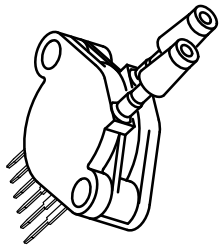
X–ducer™ SILICON PRESSURE SENSORS

Features

- 2.5% Maximum Error Over 0–85°C
- Ideally Suited for Microprocessor or Microcontroller Based Systems
- Temperature Compensated Over – 40 to 125°C.
- Patented Silicon Shear Stress Strain Gauge
- Easy–to–Use Chip Carrier Package Options
- Available in Differential and Gauge Configurations
- Durable Epoxy Unibody Element



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)[1]

Rating	Symbol	Value	Unit
Overpressure[7] (P1 > P2)	P_{max}	200	kPa
Burst Pressure[7] (P1 > P2)	P_{burst}	700	kPa
Storage Temperature	T_{stg}	–50 to +150	°C
Operating Temperature	T_A	–40 to +125	°C

The MPX5050 series piezoresistive transducer is a state–of–the–art pressure sensor designed for a wide range of applications. This sensor with its 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.

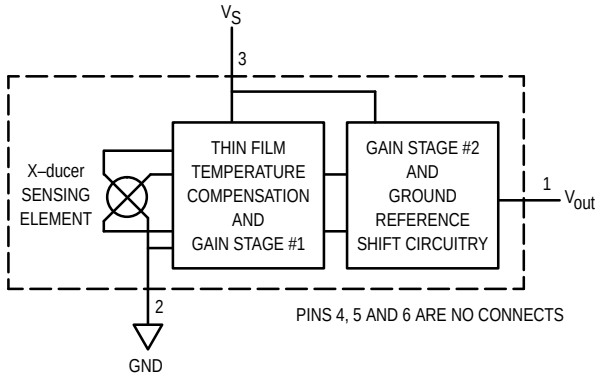


Figure 1. Fully Integrated Pressure Sensor Schematic

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 = 5.0 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic		Symbol	Min	Typ	Max	Unit
Pressure Range		P_{OP}	0	—	50	kPa
Supply Voltage(1)		V_S	4.75	5.0	5.25	Vdc
Supply Current		I_o	—	7.0	10.0	mAdc
Full Scale Span(2)	(0 to 85°C)	V_{FSS}	4.388	4.5	4.613	V
Zero Pressure Offset(3)	(0 to 85°C)	V_{off}	0.088	0.2	0.313	V
Sensitivity		V/P	—	90	—	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:

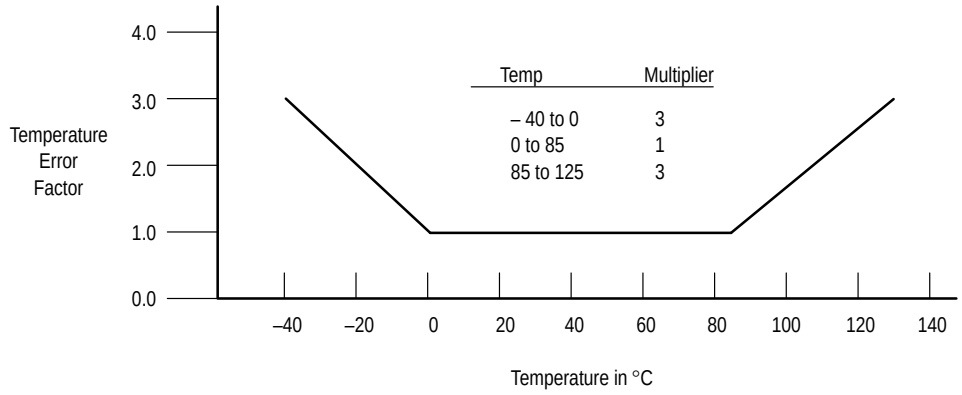
1. Device is ratiometric within this specified excitation range.
2. Full Scale Span (V_{FSS}) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
3. Offset (V_{off}) is defined as the output voltage at the minimum 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

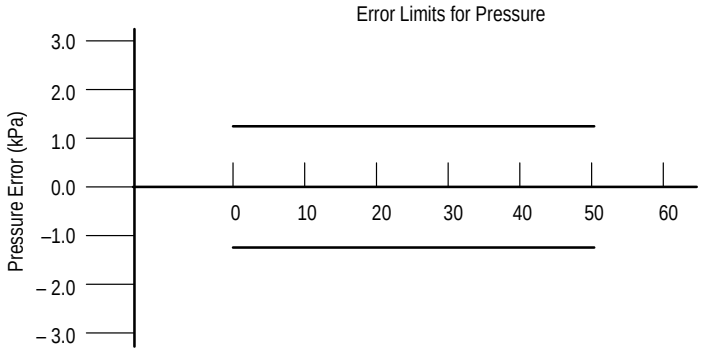
Nominal Transfer Value: $V_{out} = V_S (P \times 0.018 + 0.04)$
+/– (Pressure Error x Temp. Factor x 0.018 x V_S)
$V_S = 5.0\ V \pm 0.25\ Vdc$

Temperature Error Band

MPX5050 Series



Pressure Error Band



Pressure	Error (Max)
0 to 50 kPa	± 1.25 kPa

ON–CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

Figure 2 shows 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 nonlinear outside of the rated pressure range.)

Figure 3 illustrates 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 MPX5050 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 stability. Contact the factory for information regarding media compatibility in your application.

Figure 4 shows a typical decoupling circuit for interfacing the output of the MPX5050 to the A/D input of a microprocessor. Proper decoupling of the power supply is recommended.

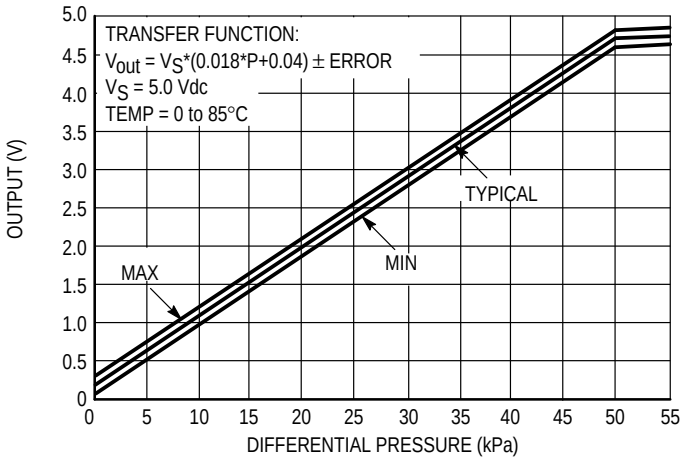


Figure 2. Output versus Pressure Differential

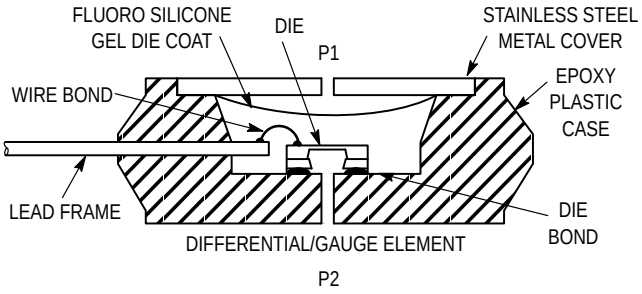


Figure 3. Cross–Sectional Diagram (Not to Scale)

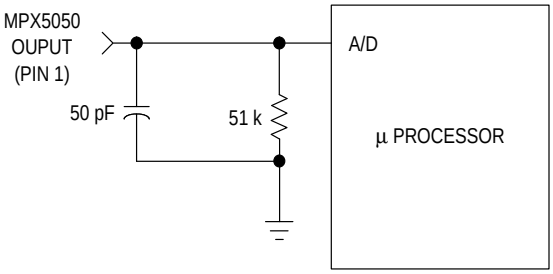


Figure 4. Typical Decoupling Filter for Sensor to Microprocessor Interface

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 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:

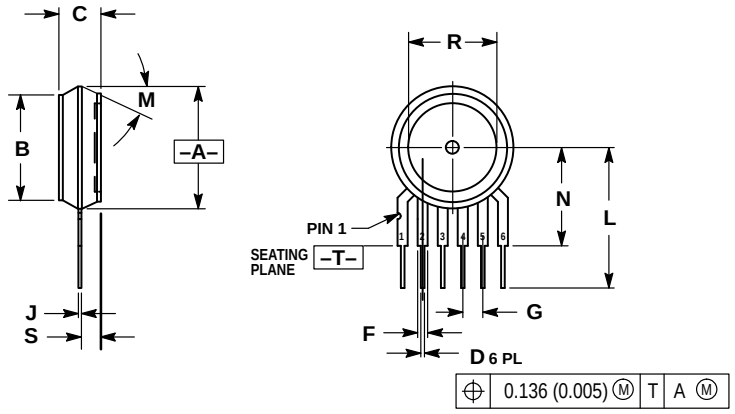
Part Number	Case Type	Pressure (P1) Side Identifier
MPX5050D	867–04	Stainless Steel Cap
MPX5050DP	867C–03	Side with Part Marking
MPX5050GP	867B–03	Side with Port Attached
MPX5050GVP	867D–03	Stainless Steel Cap
MPX5050GS	867E–02	Side with Port Attached
MPX5050GVS	867A–03	Stainless Steel Cap
MPX5050GSX	867F–02	Side with Port Attached
MPX5050GVSX	867G–02	Stainless Steel Cap

ORDERING INFORMATION

The MPX5050 pressure sensor is available in 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	Differential	867–04	MPX5050D	MPX5050D
Ported Elements	Differential Dual Ports	867C–03	MPX5050DP	MPX5050DP
	Gauge	867B–03	MPX5050GP	MPX5050GP
	Gauge Vacuum Port	867D–03	MPX5050GVP	MPX5050GVP
	Gauge, Axial	867E–02	MPX5050GS	MPX5050D
	Gauge Vacuum Axial	867A–03	MPX5050GVS	MPX5050D
	Gauge, Axial PC Mount	867F–02	MPX5050GSX	MPX5050D
	Gauge Vacuum Axial PC Mount	867G–02	MPX5050GVSX	MPX5050D

PACKAGE DIMENSIONS



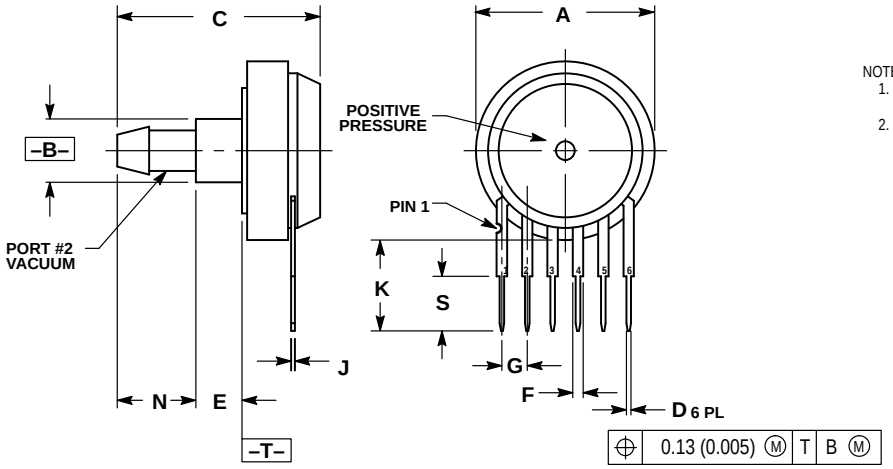
NOTES:
8. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
9. CONTROLLING DIMENSION: INCH.
10. DIMENSION –A– DOES NOT INCLUDE MOLDED FLASH RING. MOLDED FLASH RING NOT TO EXCEED 16.00 (0.630).

	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.

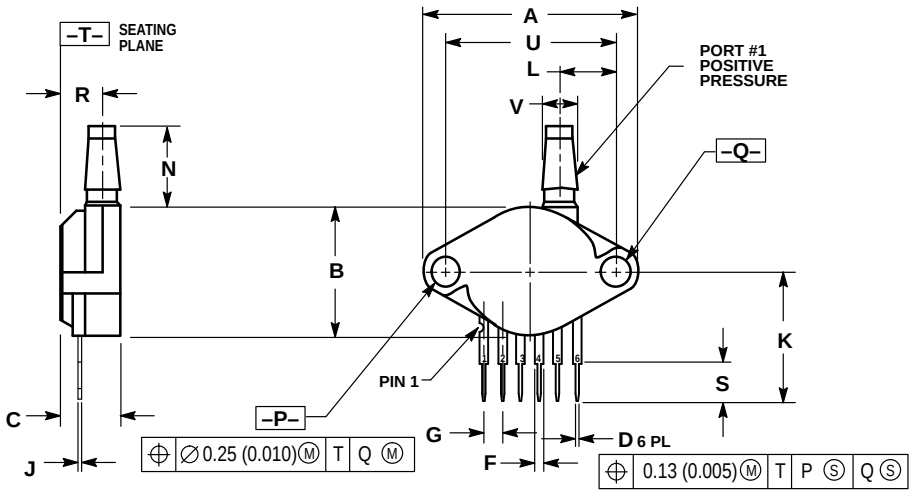
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.247	0.253	6.28	6.42
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.68	0.84
E	0.178	0.185	4.52	4.69
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.335	0.360	8.51	9.14
N	0.305	0.315	7.75	8.00
S	0.220	0.240	5.59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



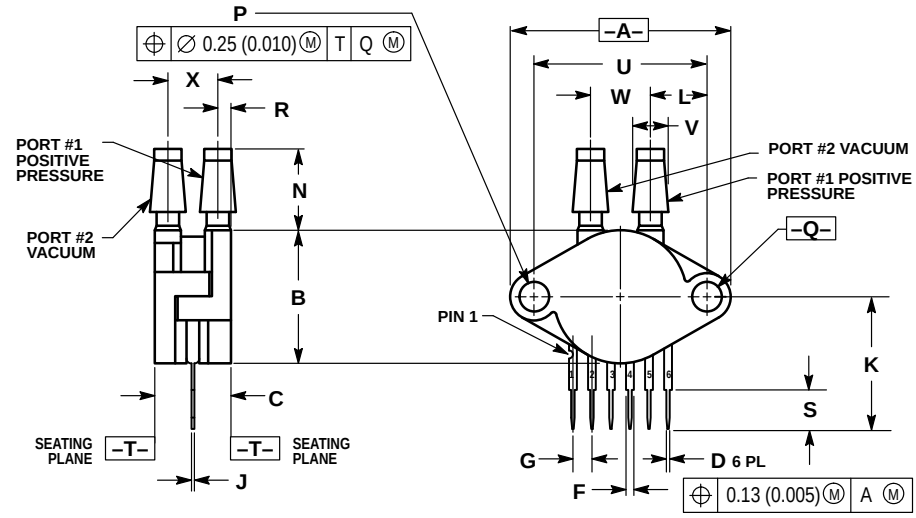
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	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.

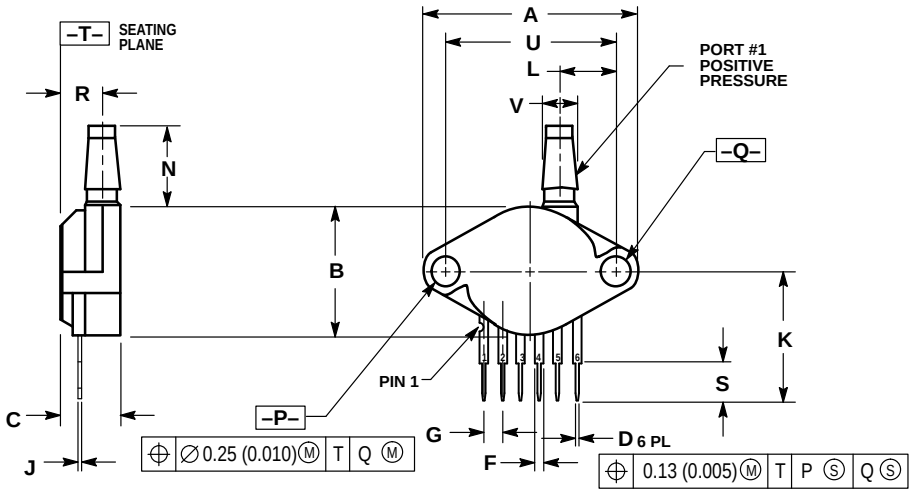
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.380	0.420	9.65	10.60
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	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



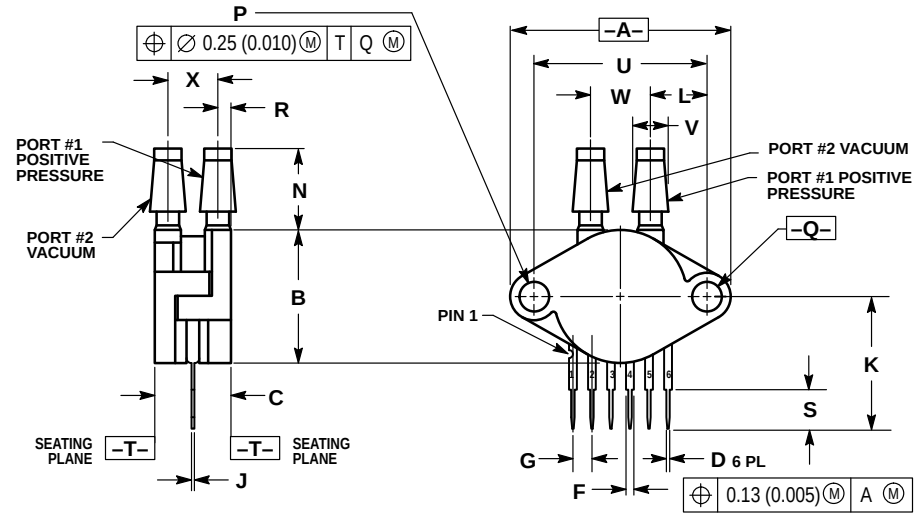
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	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.

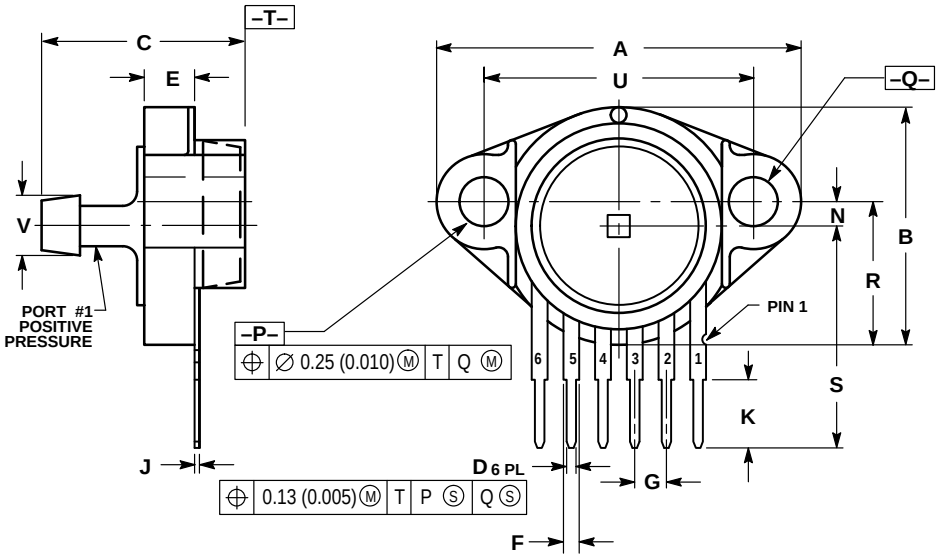
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	1.140	1.180	28.95	29.97
B	0.685	0.715	17.40	18.16
C	0.380	0.420	9.65	10.60
D	0.027	0.033	0.68	0.84
F	0.048	0.052	1.22	1.32
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
K	0.680	0.710	17.27	18.03
L	0.290	0.300	7.34	7.62
N	0.420	0.440	10.67	11.12
P	0.153	0.159	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



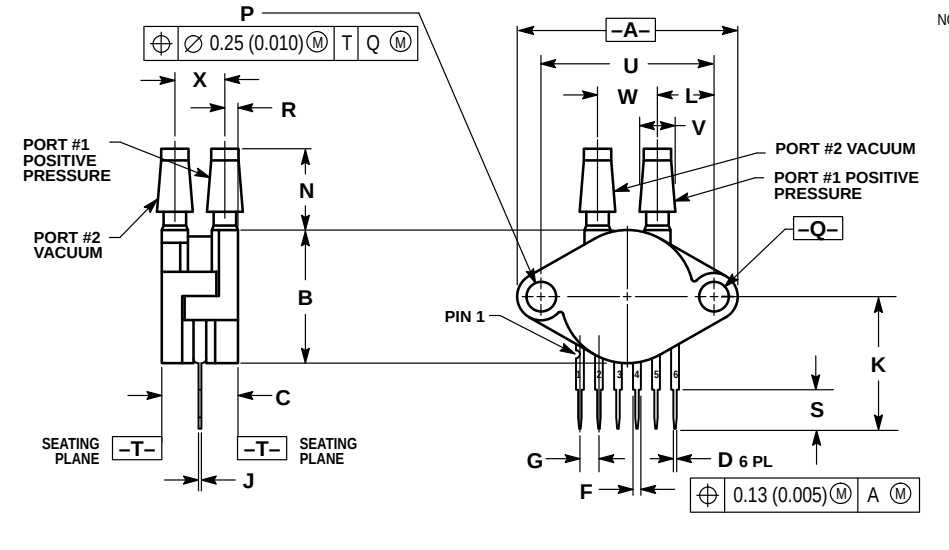
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	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)

Literature Distribution Centers:
USA: Motorola Literature Distribution; P.O. Box 20912; Phoenix, Arizona 85036.
EUROPE: Motorola Ltd.; European Literature Centre; 88 Tanners Drive, Blakelands, Milton Keynes, MK14 5BP, England.
JAPAN: Nippon Motorola Ltd.; 4–32–1, Nishi–Gotanda, Shinagawa–ku, Tokyo 141, Japan.
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.