Freescale Semiconductor
Data Sheet: Technical Data

Document Number: MPX2202
Rev 8, 10/2012

200 kPa On-Chip Temperature Compensated Silicon Pressure Sensors

MPX2202 Series

0 to 200 kPa (0 to 29 psi)
40 mV Full Scale
(Typical)

The MPX2202 devices series are silicon piezoresistive pressure sensor providing a highly accurate and linear voltage output directly proportional to the applied pressure. The sensor is a single monolithic silicon diaphragm with the strain gauge and a thin-film resistor network integrated on chip. The chip is laser trimmed for precise span and offset calibration and temperature compensation. They are designed for use in applications such as pump/motor controllers, robotics, level indicators, medical diagnostics, pressure switching, barometers, altimeters, etc.

Features

- Temperature Compensated Over 0°C to +85°C
- Easy-to-Use Chip Carrier Package Options
- Available in Absolute, Differential and Gauge Configurations
- Ratiometric to Supply Voltage
- Available in Easy-to-Use Tape and Reel

Application Examples

- Pump/Motor Controllers
- Robotics
- Level Indicators
- Medical Diagnostics
- Pressure Switching
- Barometers
- Altimeters

ORDERING INFORMATION								
Device Name	Case No.	# of Ports			Pressure Type			Device Marking
		None	Single	Dual	Gauge	Differential	Absolute	
Unibody Package (MPX2202 Series)								
MPX2202A	344	•					•	MPX2202A
MPX2202DP	344C			•		•		MPX2202DP
MPX2202AP	344B		•				•	MPX2202AP
MPX2202GP	344B		•		•			MPX2202GP
MPX2202ASX	344F		•				•	MPX2202A
Small Outline Package (MPXV2202 Series)								
MPXV2202GP	1369		•		•			MPXV2202GP
MPXV2202DP	1351			•		•		MPXV2202DP
MPXV2202GC6TI	482A		•		•			MPXV2202G
MPAK Package (MPXM2202 Series)								
MPXM2202D	1320	•				•		MPXM2202D
MPXM2202DT1	1320	•				•		MPXM2202D
MPXM2202A	1320	•					•	MPXM2202A
MPXM2202GS	1320A		•		•			MPXM2202GS
MPXM2202GST1	1320A		•		•			MPXM2202GS
MPXM2202AS	1320A		•				•	MPXM2202AS

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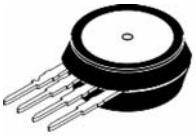
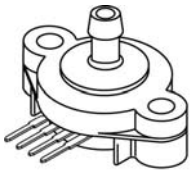
UNIBODY PACKAGES



MPX2202A
CASE 344-15

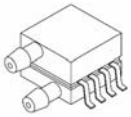
MPX2202AP/GP
CASE 344B-01

MPX2202DP
CASE 344C-01

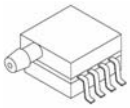


MPX2202ASX
CASE 344F-01

SMALL OUTLINE PACKAGES



MPXV2202DP
CASE 1351-01



MPXV2202GP
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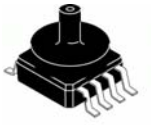
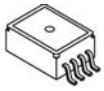
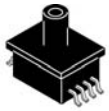


MPXV2202GC6T1
CASE 482A-01

MPAK



MPXM2202A
CASE 1320-02



MPXM2202GS/AS
CASE 1320A-02

Operating Characteristics

Table 1. Operating Characteristics

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

Characteristics	Symbol	Min	Typ	Max	Unit
Pressure Range[1] Absolute Pressure Range MPX2202A Differential Pressure Range MPX2202D	 P_{OP} P_{OP}	 20 0	 — —	 200 200	 kPa kPa
Supply Voltage[2]	V_S	—	10	16	Vdc
Supply Current	I_o	—	6.0	—	mAdc
Full Scale Span[3]	V_{FSS}	38.5	40	41.5	mV
Offset[4] MPX2202D, MPXM2202D/G Series MPX2202A, MPXM2202A Series	 V_{off}	 -1.0 -2.0	 — —	 1.0 2.0	 mV
Sensitivity	ΔV/ΔP	—	0.2	—	mV/kPa
Linearity[5] MPXM2202D/G, MPX2202D Series MPXM2202A, MPX2202A Series	 —	 -0.6 -1.0	 — —	 0.4 1.0	 $\%V_{FSS}$
Pressure Hysteresis[5] (0 to 200 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}	-2.0	—	2.0	$\%V_{FSS}$
Temperature Effect on Offset[5]	TCV_{off}	-1.0	—	1.0	mV
Input Impedance	Z_{in}	1000	—	2500	Ω
Output Impedance	Z_{out}	1400	—	3000	Ω
Response Time[6] (10% to 90%)	t_R	—	1.0	—	ms
Warm-Up	—	—	20	—	ms
Offset Stability[7]	—	—	±0.5	—	$\%V_{FSS}$

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.

   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. Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Maximum Ratings

Table 2. Maximum Ratings(1)

Rating	Max Value	Unit
Maximum Pressure (P1 > P2)	400	kPa
Storage Temperature	-40 to 125	°C
Operating Temperature	-40 to 125	°C

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Voltage Output versus Applied Differential

The differential voltage output of the sensor 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 block diagram of the internal circuitry on the stand-alone pressure sensor chip.

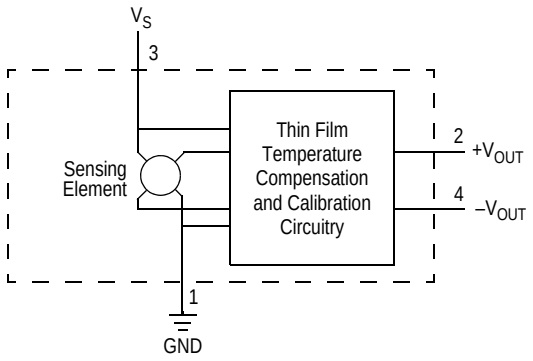


Figure 1. Temperature Compensated and Calibrated Pressure Sensor Schematic

On-Chip Temperature Compensation and Calibration

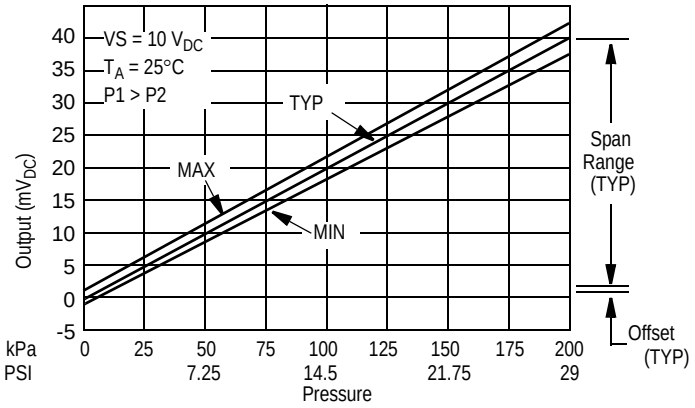


Figure 2. Output vs. Pressure Differential

Figure 2 shows the output characteristics of the MPX2202 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.

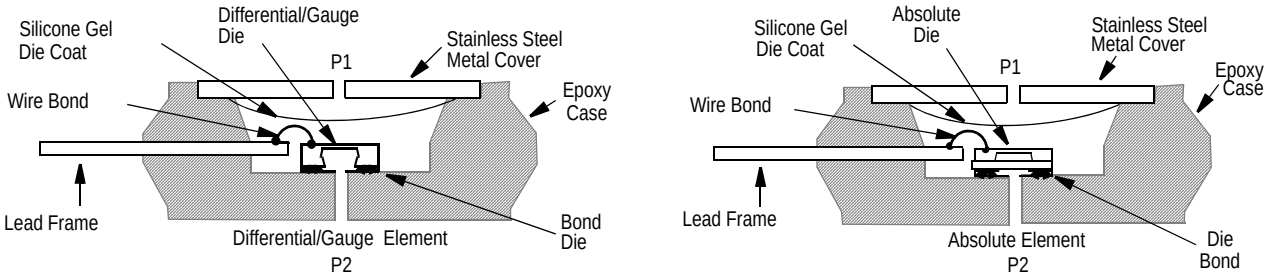


Figure 3. Cross Sectional Diagram (not to scale)

Figure 3 illustrates the differential/gauge die in the basic chip carrier (Case 344). A silicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPX2202 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.

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 4) 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. Freescale’s specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

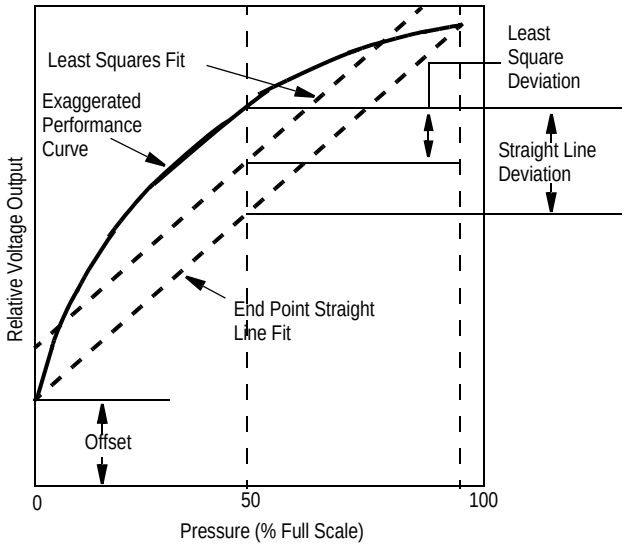


Figure 4. Linearity Specification Comparison

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

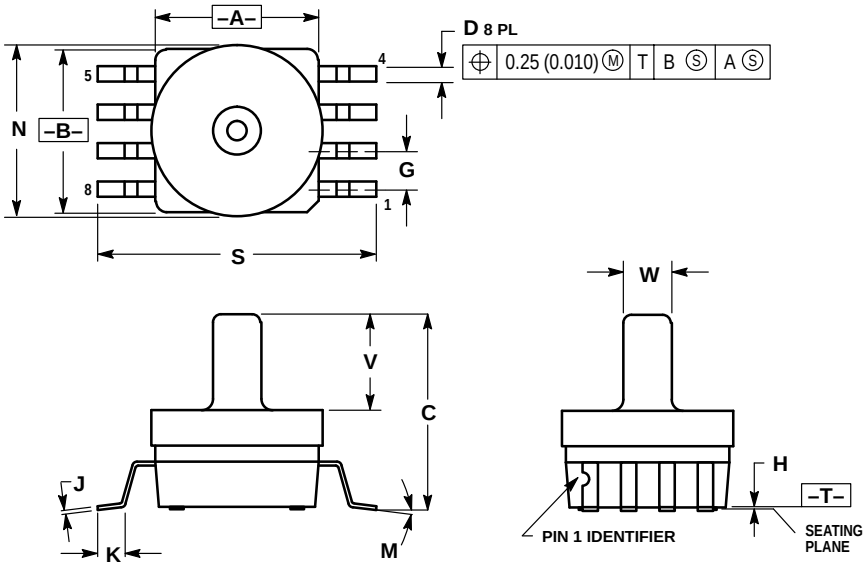
Freescale designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing silicone gel which isolates the die from the environment. The Freescale MPX pressure sensor is designed to operate with positive differential pressure applied, P1 > P2.

The Pressure (P1) side may be identified by using the following table.

Table 3. Pressure (P1) Side Delineation

Part Number	Case Type	Pressure (P1) Side Identifier
MPX2202A	344	Stainless Steel Cap
MPX2202DP	344C	Side with Part Marking
MPX2202GP/AP	344B	Side with Port Attached
MPX2202ASX	344F	Side with Port Attached
MPX2202GP	1369	Side with Port Attached
MPX2202DP	1351	Side with Part Marking
MPXV2202GP	1369	Side with Port Attached
MPXV2202DP	1351	Side with Part Marking
MPXV2202GC6TI	482A	Side with Port Attached
MPXM2202A/ATI/DT/DTI	1320	Side with Part Marking
MPXM2202GS/GSTI/AS/ASTI	1320A	Side with Port Attached

PACKAGE DIMENSIONS

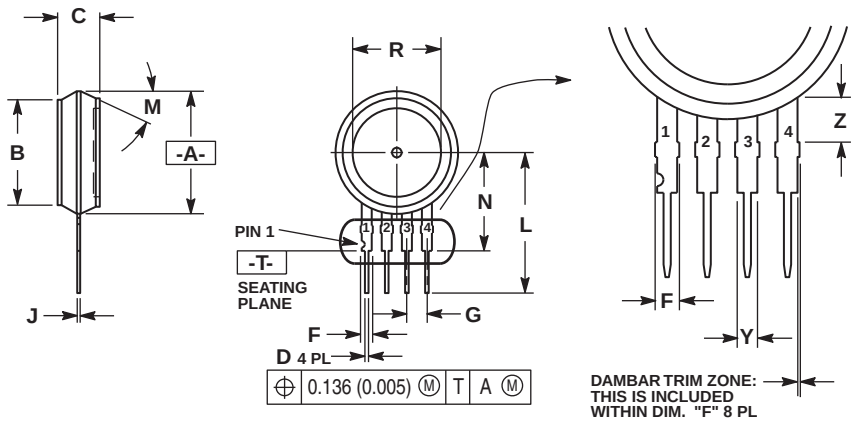


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

	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	0.500	0.520	12.70	13.21
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	0.444	0.448	11.28	11.38
S	0.709	0.725	18.01	18.41
V	0.245	0.255	6.22	6.48
W	0.115	0.125	2.92	3.17

CASE 482A–01
ISSUE A

PACKAGE DIMENSIONS



NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION -A- IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

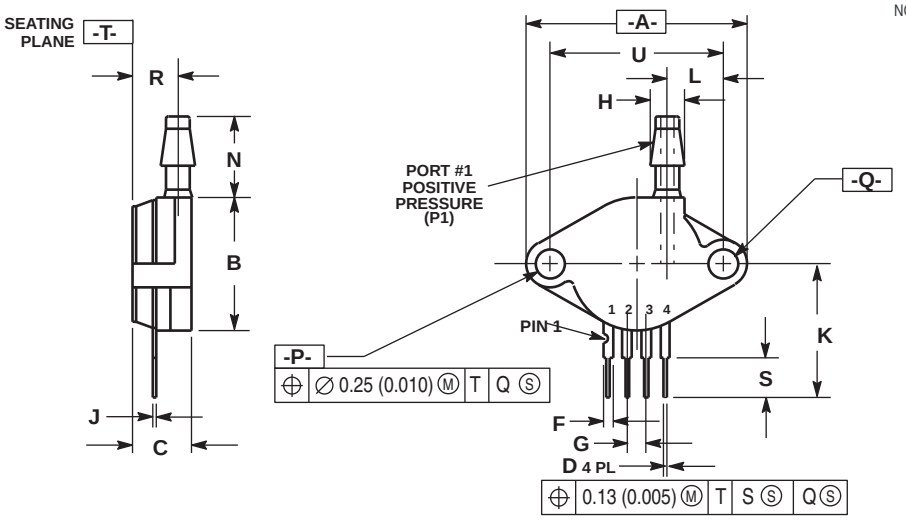
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	11.43
Y	0.048	0.052	1.22	1.32
Z	0.106	0.118	2.68	3.00

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

STYLE 2:
PIN 1. V_{CC}
2. - SUPPLY
3. + SUPPLY
4. GROUND

STYLE 3:
PIN 1. GND
2. -VOUT
3. VS
4. +VOUT

CASE 344-15
ISSUE AA
UNIBODY PACKAGE



NOTES:
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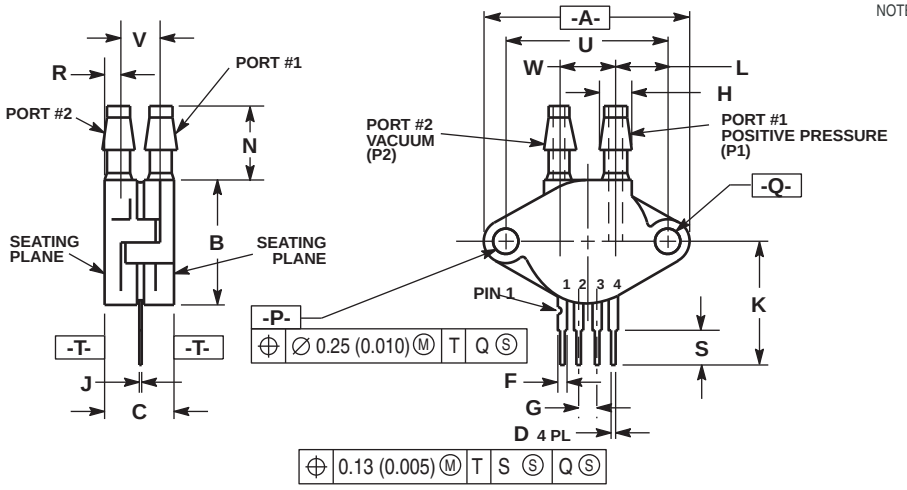
2. CONTROLLING DIMENSION: INCH.

	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	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.93
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	

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

CASE 344B-01
ISSUE B
UNIBODY PACKAGE

PACKAGE DIMENSIONS



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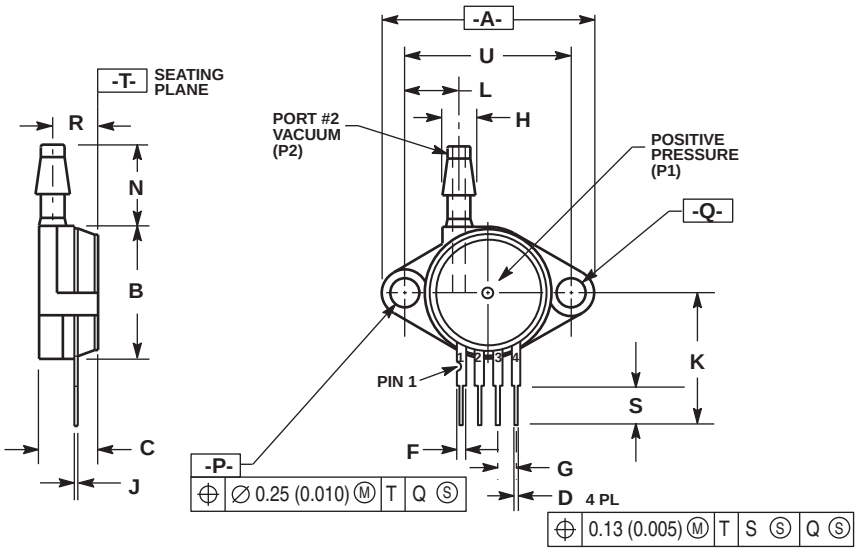
B	0.685	0.715	17.40	18.16
C	0.405	0.435	10.29	11.05
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.93
J	0.014	0.016	0.36	0.41
K	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.159	3.89	4.04
R	0.063	0.083	1.60	2.11
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	
V	0.248	0.278	6.30	7.06
W	0.310	0.330	7.87	8.38

CASE 344C-01
ISSUE B
UNIBODY PACKAGE



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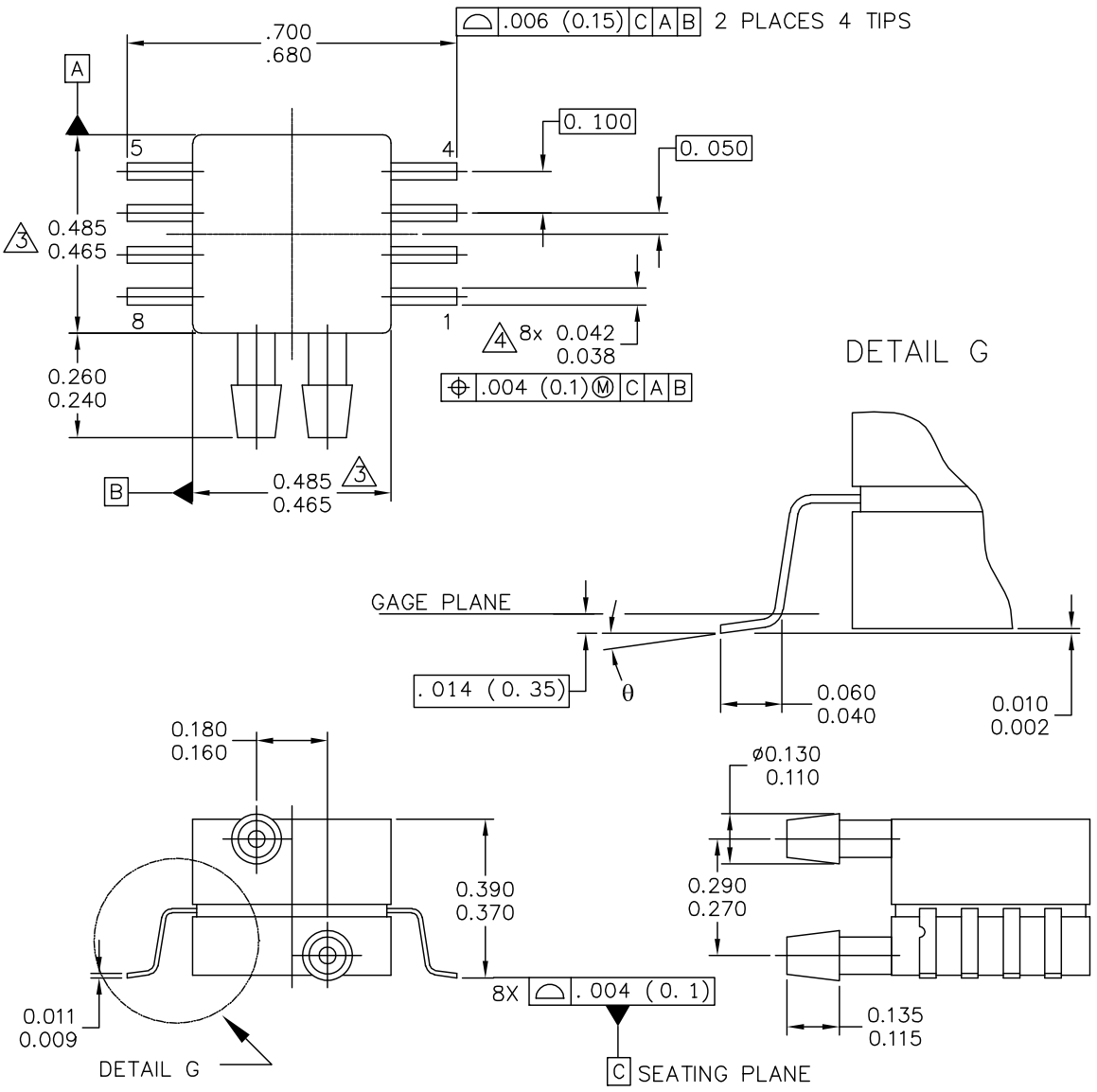
G	0.100 BSC		2.54 BSC	
H	0.182	0.194	4.62	4.93
J	0.014	0.016	0.36	0.41
K	0.695	0.725	17.65	18.42
L	0.290	0.300	7.37	7.62
N	0.420	0.440	10.67	11.18
P	0.153	0.159	3.89	4.04
Q	0.153	0.158	3.89	4.04
R	0.230	0.250	5.84	6.35
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	

CASE 344D-01
ISSUE B
UNIBODY PACKAGE

PACKAGE DIMENSIONS



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	CASE NUMBER: 1351-01	27 JUL 2005
	STANDARD: NON-JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE

NOTES:

1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

STYLE 1:	STYLE 2:
PIN 1: GND	PIN 1: N/C
PIN 2: +Vout	PIN 2: Vs
PIN 3: Vs	PIN 3: GND
PIN 4: –Vout	PIN 4: Vout
PIN 5: N/C	PIN 5: N/C
PIN 6: N/C	PIN 6: N/C
PIN 7: N/C	PIN 7: N/C
PIN 8: N/C	PIN 8: N/C

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MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

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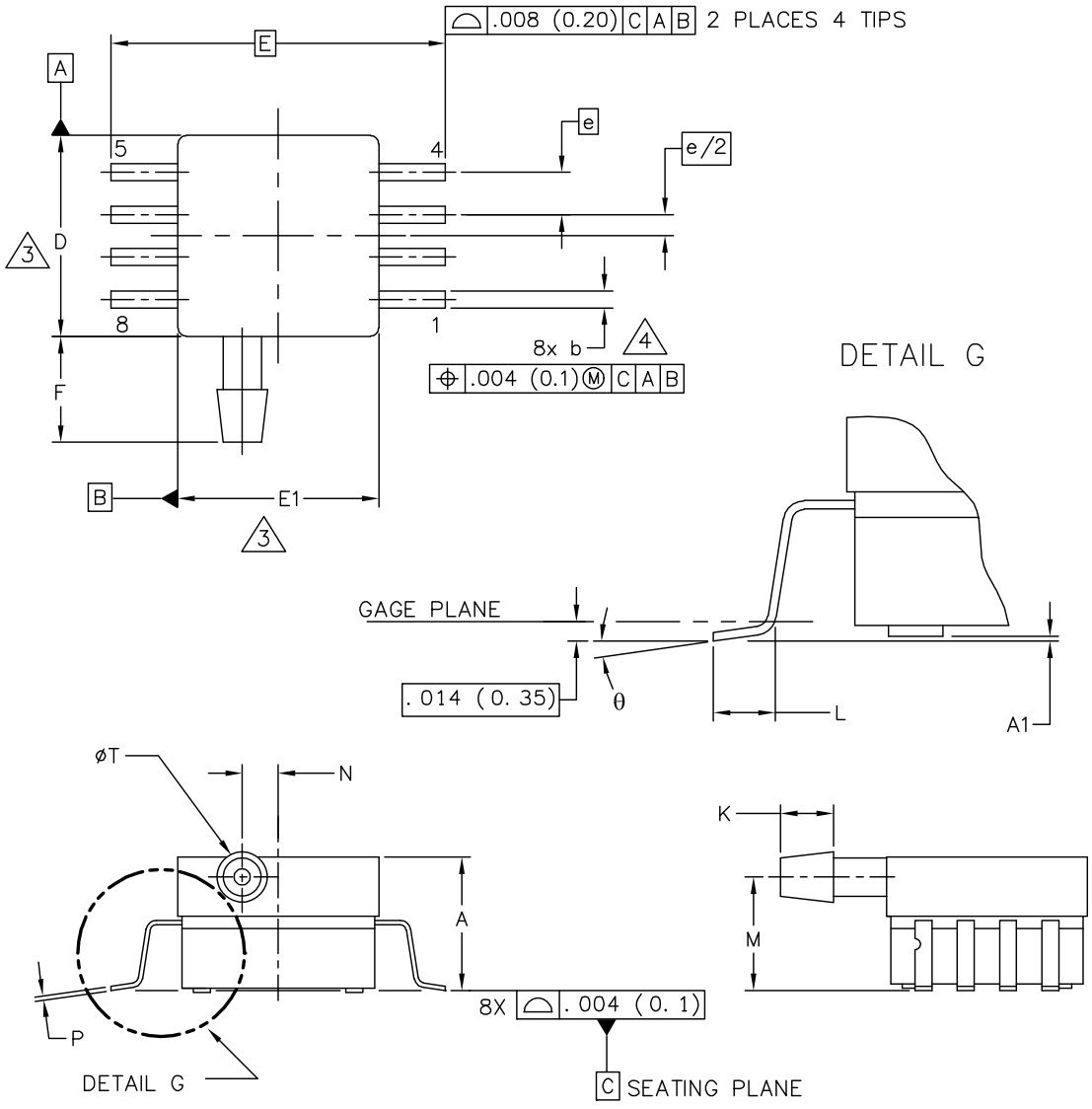
	STANDARD: NON–JEDEC	

CASE 1351-01
ISSUE A
SMALL OUTLINE PACKAGE



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	STANDARD: NON-JEDEC	

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

NOTES:
1. CONTROLLING DIMENSION: INCH

2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.

4. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR
PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX
A	.300	.330	7.11	7.62	θ	0°	7°	0°	7°
A1	.002	.010	0.05	0.25	–	---	---	---	---
b	.038	.042	0.96	1.07	–	---	---	---	---
D	.465	.485	11.81	12.32	–	---	---	---	---
E	.717 BSC		18.21 BSC		–	---	---	---	---
E1	.465	.485	11.81	12.32	–	---	---	---	---
e	.100 BSC		2.54 BSC		–	---	---	---	---
F	.245	.255	6.22	6.47	–	---	---	---	---
K	.120	.130	3.05	3.30	–	---	---	---	---
L	.061	.071	1.55	1.80	–	---	---	---	---
M	.270	.290	6.86	7.36	–	---	---	---	---
N	.080	.090	2.03	2.28	–	---	---	---	---
P	.009	.011	0.23	0.28	–	---	---	---	---
T	.115	.125	2.92	3.17	–	---	---	---	---

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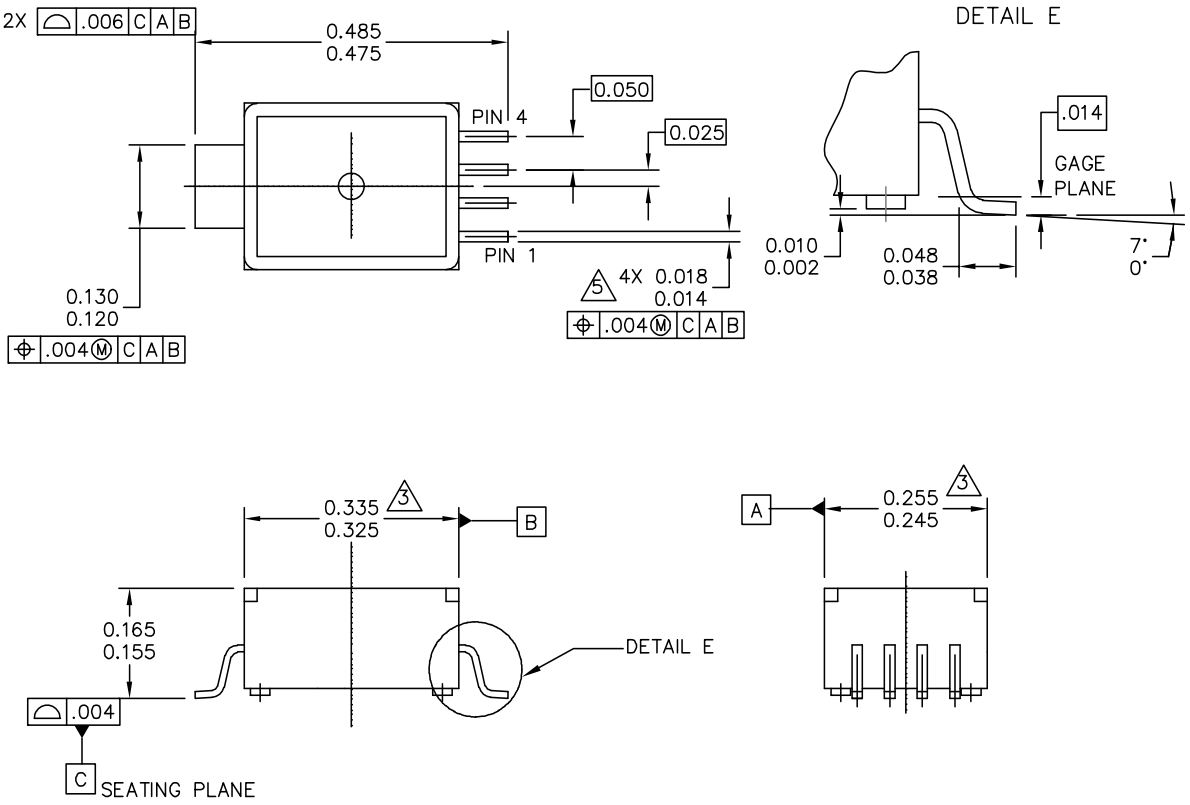
MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ASA99303D	REV: B
8 LD SOP, SIDE PORT	CASE NUMBER: 1369–01	24 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1369-01
ISSUE B
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



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TITLE: 5 LD M–PAC	DOCUMENT NO: 98ARH99088A	REV: B
	CASE NUMBER: 1320-02	22 JUL 2005
	STANDARD: NON-JEDEC	

CASE 1320-02
ISSUE B
MPAK

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSION DOES NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

PIN 1: GND
PIN 2: +Vout
PIN 3: Vs
PIN 4: –Vout

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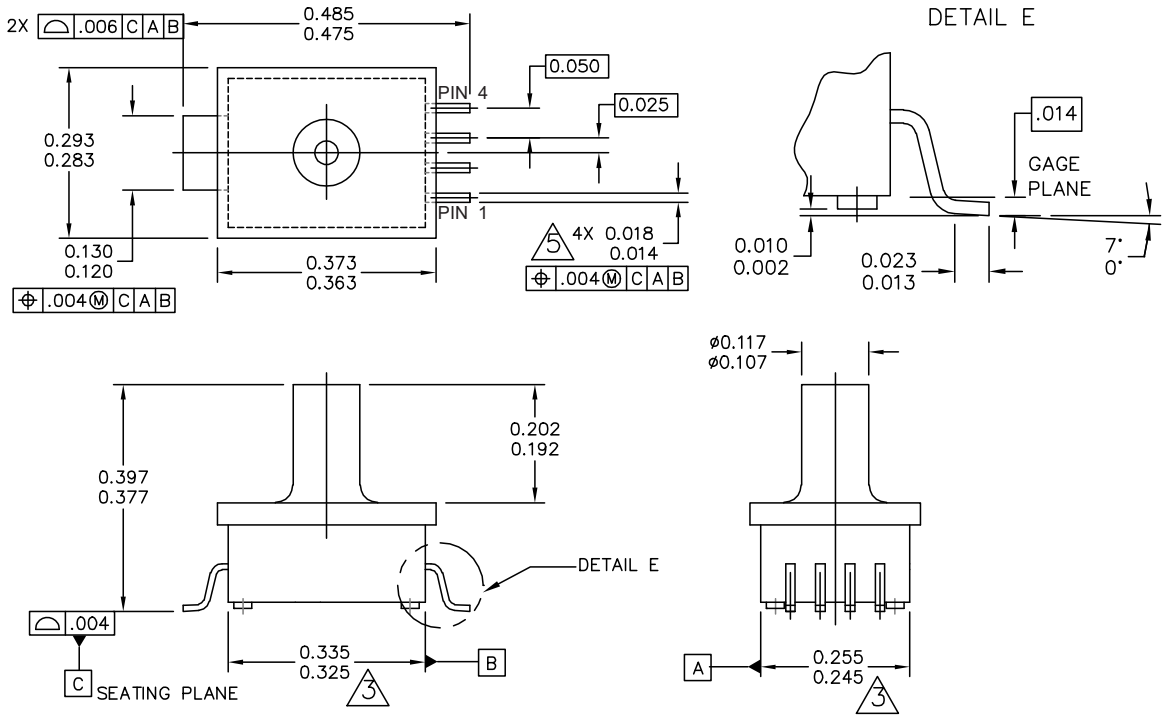
MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE

TITLE:	DOCUMENT NO: 98ARH99088A	REV: B
5 LD M–PAC	CASE NUMBER: 1320–02	22 JUL 2005
	STANDARD: NON–JEDEC	

CASE 1320-02
ISSUE B
MPAK

PACKAGE DIMENSIONS



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TITLE: 5 LD M–PAC, PORTED	DOCUMENT NO: 98ARH99087A	REV: A
	CASE NUMBER: 1320A–02	22 JUL 2005
	STANDARD: NON–JEDEC	

CASE 1320A-02
ISSUE A
MPAK

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5" MAXIMUM.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

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TITLE: 5 LD M–PAC, PORTED	DOCUMENT NO: 98ARH99087A	REV: A
	CASE NUMBER: 1320A–02	22 JUL 2005
	STANDARD: NON–JEDEC	

CASE 1320A-02
ISSUE A
MPAK

REVISION HISTORY

Revision number	Revision date	Description of changes
7	01/2012	• In Table 1. Operating Characteristics, in the Characteristic column under Pressure Range, added rows for Absolute Pressure Range MPX2202A and Differential Pressure Range MPX2202D devices
8	10/2012	• Deleted references to device number MPXV2022GC6U throughout the document

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MPX2202
Rev. 8
10/2012