Freescale Semiconductor

MPX12
Rev 9, 10/2008

10 kPa Uncompensated Silicon Pressure Sensors

The MPX12 series silicon piezoresistive pressure sensors provide a very accurate and linear voltage output, directly proportional to the applied pressure. This standard, low cost, uncompensated sensor permits manufacturers to design and add their own external temperature compensating and signal conditioning networks. Compensation techniques are simplified because of the predictability of Freescale's single element strain gauge design.

Features

- Low Cost
- Patented Silicon Shear Stress Strain Gauge Design
- Ratiometric to Supply Voltage
- Easy to Use Chip Carrier Package Options
- Gauge Options
- Durable Epoxy Package

MPX12 Series

0 to 10 kPa (0 to 1.45 psi)
55 mV Full Scale Span
(Typical)

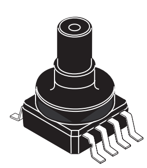
Application Examples

- Air Movement Control
- Environmental Control Systems
- Level Indicators
- Leak Detection
- Medical Instrumentation
- Industrial Controls
- Pneumatic Control Systems
- Robotics

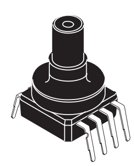
ORDERING INFORMATION

Device Name	Package Options	Case No.	# of Ports			Pressure Type			Device Marking
			None	Single	Dual	Gauge	Differential	Absolute	
Unibody Package (MPX12 Series)									
MPX12D	Tray	344	•				•		MPX12D
MPX12DP	Tray	344C			•		•		MPX12DP
MPX12GP	Tray	344B		•		•			MPX12GP
Small Outline Package (MPXV12G Series)									
MPXV12GW6U	Rail	1735		•		•			MPXV12GW
MPXV12GW7U	Rail	1560		•		•			MPXV12GW

SMALL OUTLINE PACKAGE

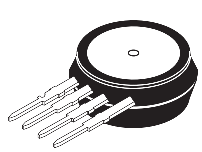


MPXV12GW6U
CASE 1735-01

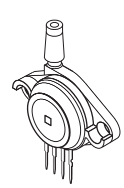


MPXV12GW7U
CASE 1560-02

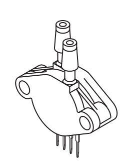
UNIBODY PACKAGES



MPX12D
CASE 344-15



MPX12GP
CASE 344B-01



MPX12DP
CASE 344C-01

Operating Characteristics

Table 1. Operating Characteristics (V_S = 3.0 Vdc, T_A = 25°C unless otherwise noted, P1 > P2)

Characteristic	Symbol	Min	Typ	Max	Unit
Differential Pressure Range[1]	P_{OP}	0	—	10	kPa
Supply Voltage[2]	V_S	—	3.0	6.0	Vdc
Supply Current	I_o	—	6.0	—	mAdc
Full Scale Span[3]	V_{FSS}	45	55	70	mV
Offset[4]	V_{off}	0	20	35	mV
Sensitivity	ΔV/ΔP	—	5.5	—	mV/kPa
Linearity	—	–0.5	—	5.0	$\%V_{FSS}$
Pressure Hysteresis[6] (0 to 10 kPa)	—	—	±0.1	—	$\%V_{FSS}$
Temperature Hysteresis (–40°C to +125°C)	—	—	±0.5	—	$\%V_{FSS}$
Temperature Coefficient of Full Scale Span	TCV_{FSS}	–0.22	—	–0.16	$\%V_{FSS}$/°C
Temperature Coefficient of Offset	TCV_{off}	—	±15	—	μV/°C
Temperature Coefficient of Resistance	TCR	0.21	—	0.27	$\%Z_{in}$/°C
Input Impedance	Z_{in}	400	—	550	Ω
Output Impedance	Z_{out}	750	—	1250	Ω
Response Time[5] (10% to 90%)	t_R	—	1.0	—	ms
Warm-Up Time[6]	—	—	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 related pressure.
4. Offset (V_{OFF}) is defined as the output voltage at the minimum rated pressure.
5. Response Time is defined as the time form 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. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the pressure is stabilized.
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	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P_{MAX}	75	kPa
Burst Pressure (P1 > P2)	P_{BURST}	100	kPa
Storage Temperature	T_{STG}	–40 to +125	°C
Operating Temperature	T_A	–40 to +125	°C

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

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

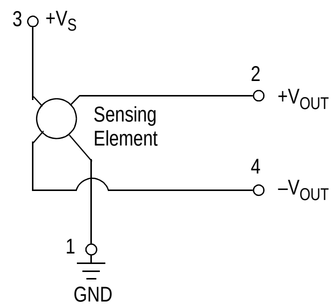


Figure 1. Uncompensated Pressure Sensor Schematic

Voltage Output versus Applied Differential Pressure

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

Temperature Compensation

Figure 2 shows the typical output characteristics of the MPX12 series over temperature.

Because this strain gauge is an integral part of the silicon diaphragm, there are no temperature effects due to differences in the thermal expansion of the strain gauge and the diaphragm, as are often encountered in bonded strain gauge pressure sensors. However, the properties of the strain gauge itself are temperature dependent, requiring that the device be temperature compensated if it is to be used over an extensive temperature range.

Temperature compensation and offset calibration can be achieved rather simply with additional resistive components, or by designing your system using the MPX2010D series sensor.

Several approaches to external temperature compensation over both –40 to +125°C and 0 to +80°C ranges are presented in Applications Note AN840.

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 (Figure 3). There are two basic methods for calculating nonlinearity: (1) end point straight line fit 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.

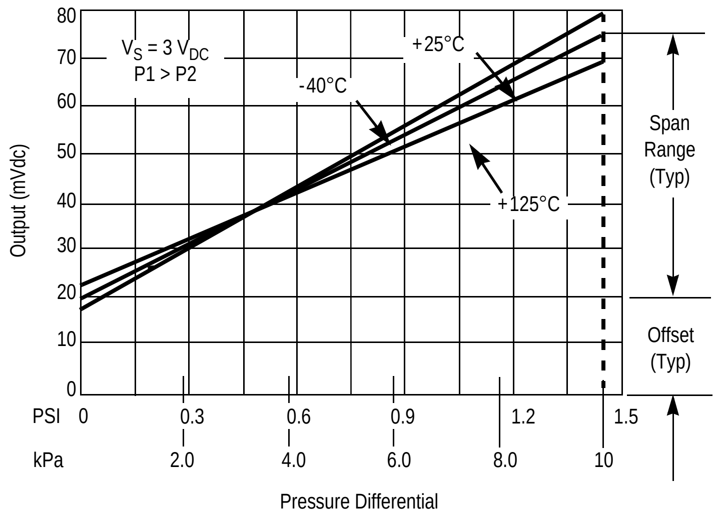


Figure 2. Output vs. Pressure Differential

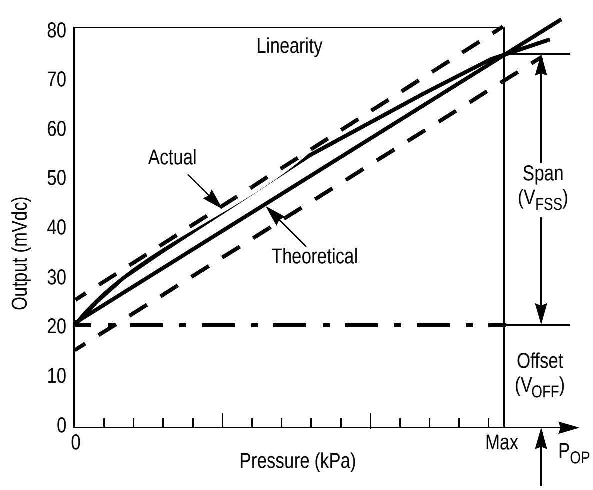


Figure 3. Linearity Specification Comparison

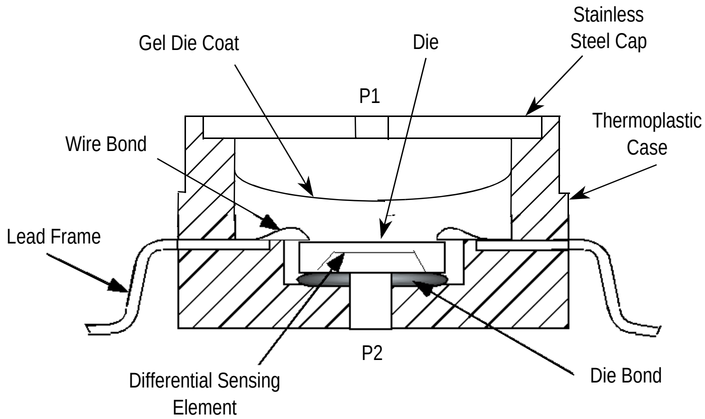


Figure 4. Cross-Sectional Diagram (not to scale)

Figure 4 illustrates the differential/gauge die. A gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

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

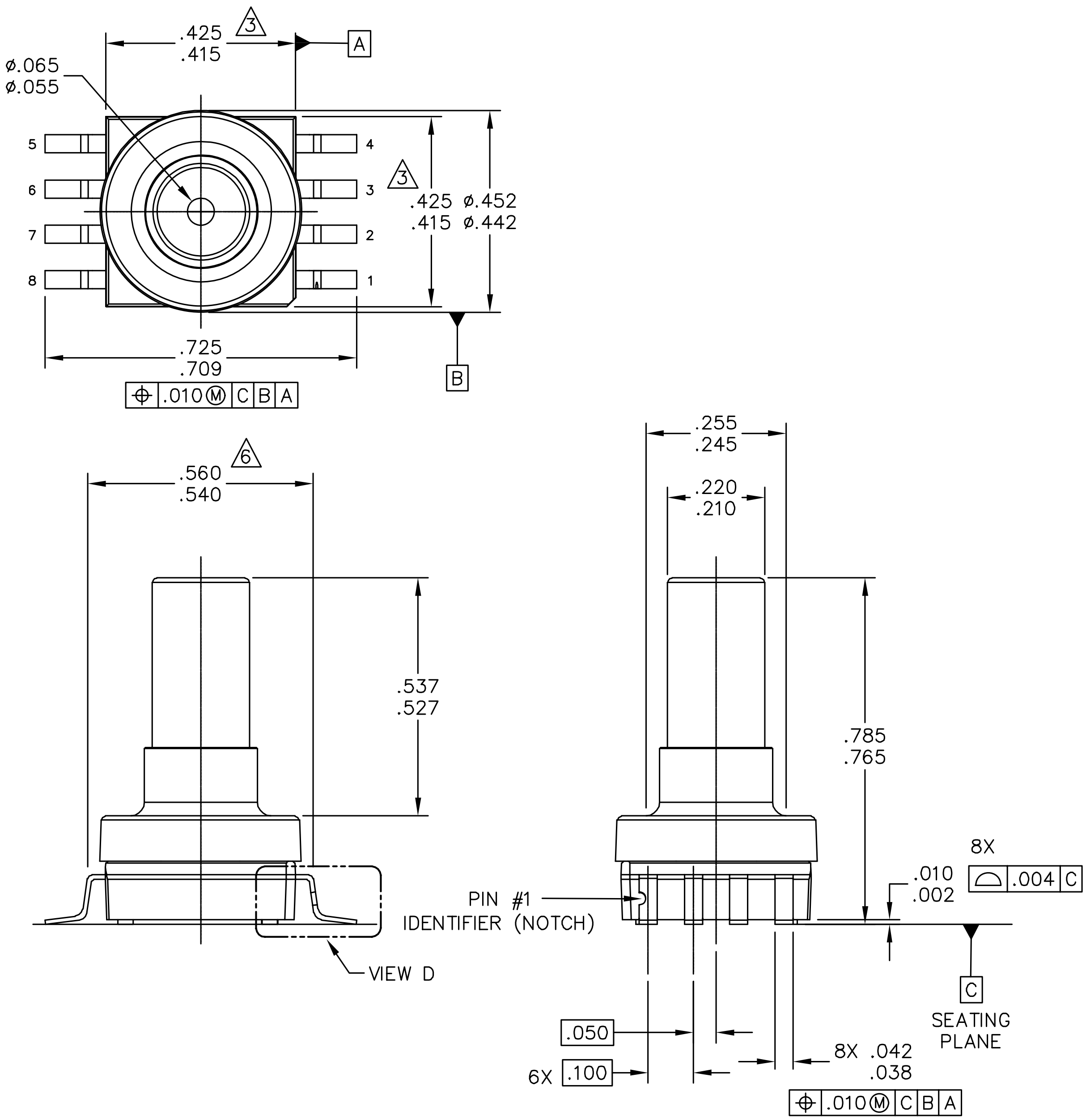
PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

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 gel which isolates the die from the environment. The Freescale MPVZ12 series is designed to operate with positive differential pressure applied, P1 > P2.

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

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV12GW6U	1735	Side with Port
MPXV12GW7U	1560	Side with Port
MPX12D	344	Stainless Steel Cap
MPX12DP	344C	Side with Part Marking
MPX12GP	344B	Side with Port Attached

PACKAGE DIMENSIONS



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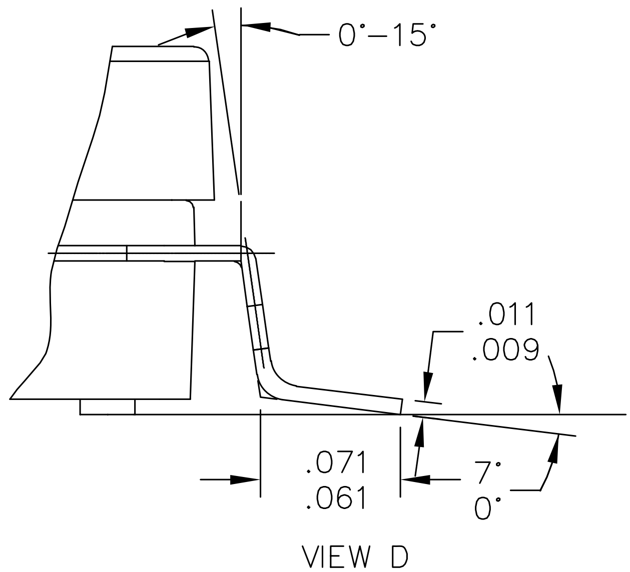
TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10686D		REV: A
	CASE NUMBER: 1735–01		16 AUG 2005
	STANDARD: NON–JEDEC		

CASE 1735-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



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	CASE NUMBER: 1735–01	18 AUG 2005
	STANDARD: NON–JEDEC	

CASE 1735-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.
2. CONTROLLING DIMENSION: INCH.
3. (△) DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION IS .006.
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. (△) DIMENSION TO CENTER OF LEAD WHEN FORMED PARALLEL.

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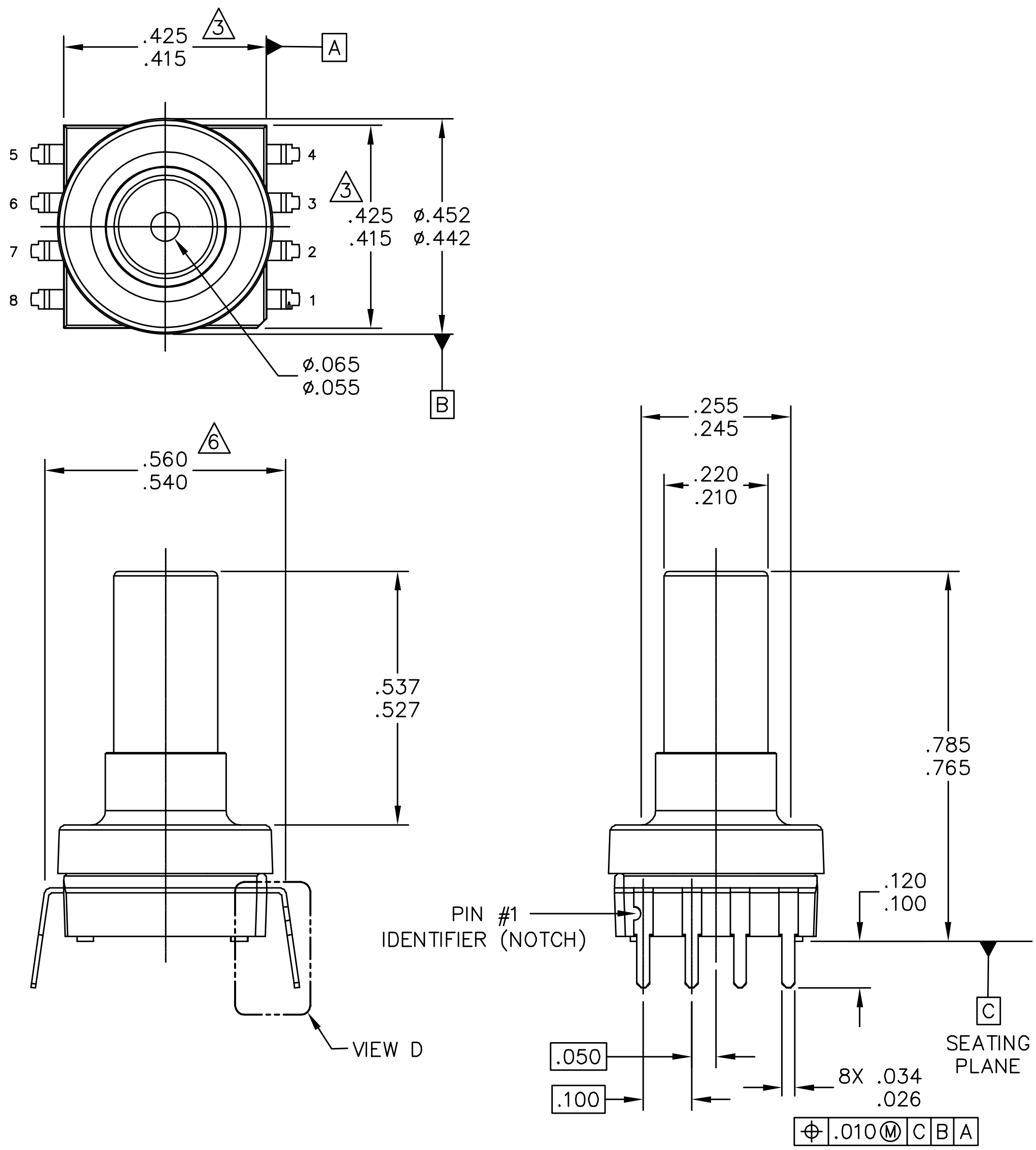
	STANDARD: NON–JEDEC		

CASE 1735-01
ISSUE A
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



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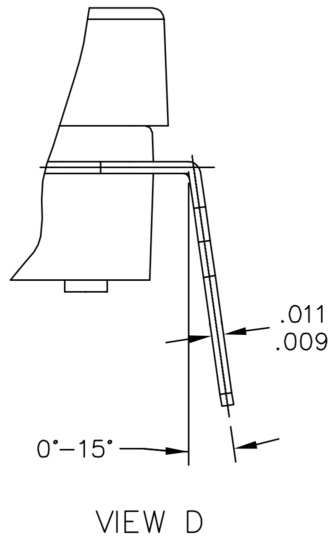
TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10611D	REV: C
	CASE NUMBER: 1560–02	26 MAY 2005
	STANDARD: NON–JEDEC	

CASE 1560-02
ISSUE C
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS



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	CASE NUMBER: 1560–02		26 MAY 2005
	STANDARD: NON–JEDEC		

CASE 1560-02
ISSUE C
SMALL OUTLINE PACKAGE

PACKAGE DIMENSIONS

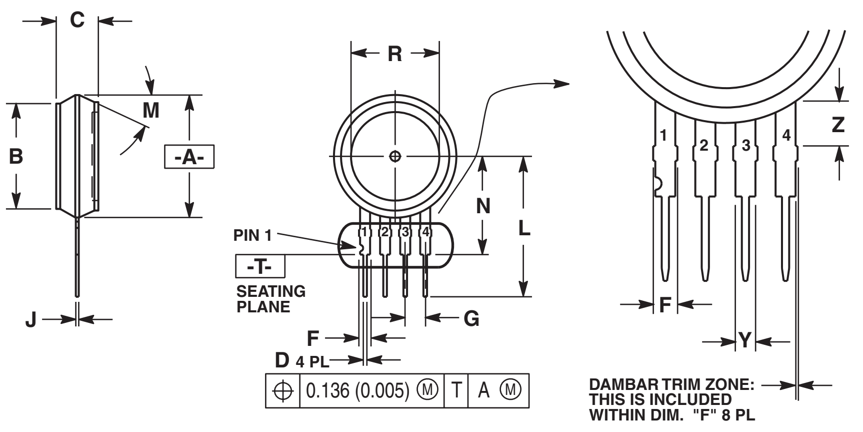
NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M – 1994.
2. CONTROLLING DIMENSION: INCH.
3. (△) DIMENSIONS DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION IS .006.
5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.
6. (△) DIMENSION TO CENTER OF LEAD WHEN FORMED PARALLEL.

	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: SO, 8 I/O, .420 X .420 PKG, .100 IN PITCH	DOCUMENT NO: 98ASA10611D		REV: C
	CASE NUMBER: 1560–02		26 MAY 2005
	STANDARD: NON–JEDEC		

CASE 1560-02
ISSUE C
SMALL OUTLINE PACKAGE

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).

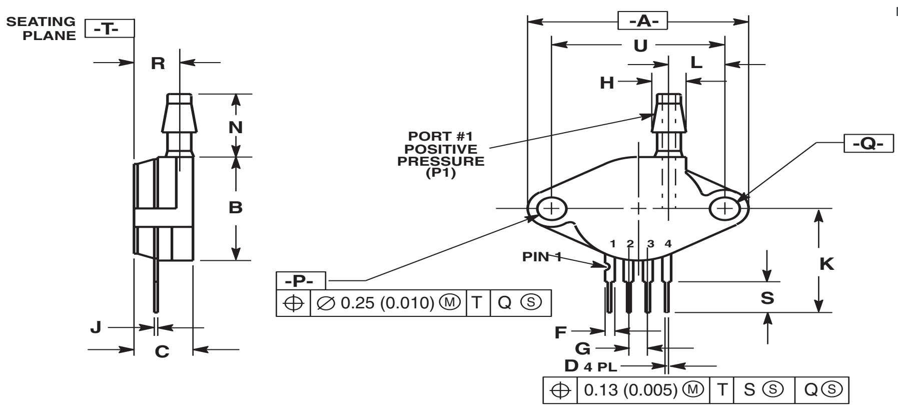
	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30˚ NOM		30˚ NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92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



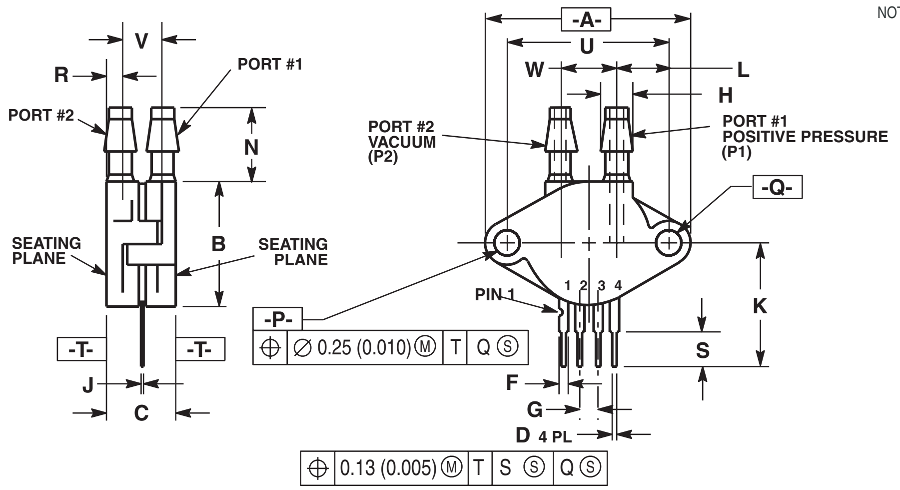
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

	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	0.016	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



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	0.405	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

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

CASE 344C-01
ISSUE B
UNIBODY PACKAGE

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