

# Freescale Semiconductor

MPX2053  
Rev 8, 02/2009

## 50 kPa On-Chip Temperature Compensated and Calibrated Silicon Pressure Sensors

The MPX2053 series devices are silicon piezoresistive pressure sensors that provide a highly accurate and linear voltage output directly proportional to the applied pressure. A single, monolithic silicon diaphragm with the strain gauge and an integrated thin-film resistor network. Precise span and offset calibration with temperature compensation are achieved by laser trimming.

### Features

- Temperature Compensated Over 0°C to +85°C
- Easy-to-Use Chip Carrier Package Options
- Ratiometric to Supply Voltage
- Gauge Ported and Non Ported Options
- Available in Easy-to-Use Tape & Reel
- Differential and Gauge Pressure Options

### MPX2053 Series

0 to 50 kPa (0 to 7.25 psi)  
40 mV Full Scale  
(Typical)

### Application Examples

- Pump/Motor Control
- Robotics
- Level Detectors
- Medical Diagnostics
- Pressure Switching
- Blood Pressure Measurement

### ORDERING INFORMATION

ORDERING INFORMATION								
Device Name	Case No.	# of Ports			Pressure Type			Device Marking
		None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXV2053G Series)								
MPXV2053GP	1369		•		•			MPXV2053GP
MPXV2053DP	1351			•		•		MPXV2053DP
MPXV2053GVP	1368		•		•			MPXV2053GV
Unibody Package (MPX2053 Series)								
MPX2053D	344	•				•		MPX2053D
MPX2053DP	344C			•		•		MPX2053DP
MPX2053GP	344B		•		•			MPX2053GP
MPAK Package (MPXM2053 Series)								
MPXM2053D	1320	•				•		MPXM2053D
MPXM2053DT1	1320	•				•		MPXM2053D
MPXM2053GS	1320A		•		•			MPXM2053GS
MPXM2053GST1	1320A		•		•			MPXM2053GS

## UNIBODY PACKAGES



**MPX2053D**  
**CASE 344-15**

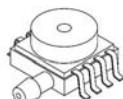


**MPX2053GP**  
**CASE 344B-01**

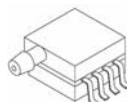


**MPX2053DP**  
**CASE 344C-01**

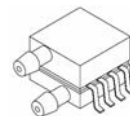
## SMALL OUTLINE PACKAGES



**MPXV2053GVP**  
**CASE 1368-01**

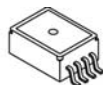


**MPXV2053GP**  
**CASE 1369-01**

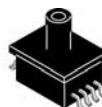


**MPXV2053DP**  
**CASE 1351-01**

## MPAK PACKAGES



**MPXM2053D/DT1**  
**CASE 1320-02**



**MPXM2053GS/GST1**  
**CASE 1320A-02**

## Operating Characteristics

**Table 1. Operating Characteristics** ( $V_S = 10 V_{DC}$ ,  $T_A = 25^\circ\text{C}$  unless otherwise noted,  $P_1 > P_2$ )

Characteristic	Symbol	Min	Typ	Max	Units
Pressure Range <sup>(1)</sup>	$P_{OP}$	0	—	50	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	—	10	16	$V_{DC}$
Supply Current	$I_O$	—	6.0	—	mAdc
Full Scale Span <sup>(3)</sup>	$V_{FS}$	38.5	40	41.5	mV
Offset <sup>(4)</sup>	—	-1.0	—	1.0	mV
Sensitivity	—	$\Delta V/\Delta P$	—	0.8	—
Non-Linearity	—	-0.6	—	0.4	% $V_{FS}$
Pressure Hysteresis (0 to 50 kPa)	—	—	$\pm 0.1$	—	% $V_{FS}$
Temperature Hysteresis (-40° to 125°C)	—	—	$\pm 0.5$	—	% $V_{FS}$
Temperature Coefficient of Full Scale	$TCV_{FS}$	-2.0	—	2.0	% $V_{FS}$
Temperature Coefficient of Offset	$TCV_{OFF}$	-1.0	—	1.0	mV
Input Impedance	$Z_{IN}$	1000	—	2500	$\Omega$
Output Impedance	$Z_{OUT}$	1400	—	3000	$\Omega$
Response Time <sup>(5)</sup> (10% to 90%)	$t_R$	—	1.0	—	ms
Warm-Up Time	—	—	20	—	ms
Offset Stability <sup>(6)</sup>	—	—	$\pm 0.5$	—	% $V_{FS}$

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. 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. 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<sup>(1)</sup>**

Rating	Max Value	Unit
Supply Voltage	16	V
Pressure ( $P_1 > P_2$ )	200	kPa
Storage Temperature	-40 to +125	$^\circ\text{C}$
Operating Temperature Range	-40 to +125	$^\circ\text{C}$

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.

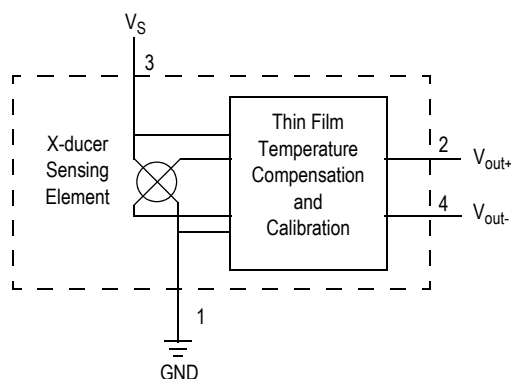


Figure 1. Temperature Compensated Pressure Sensor Schematic

## Voltage Output versus Applied Differential Pressure

The differential voltage output of the sensor is directly proportional to the differential pressure applied.

The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure

side relative to the vacuum side. Similarly, output voltage increases as increasing vacuum is applied to the vacuum side relative to the pressure side.

## On-Chip Temperature Compensation and Calibration

Figure 2 shows the minimum, maximum and typical output characteristics of the MPX2053 series at 25°C. The output is directly proportional to the differential pressure and is essentially a straight line.

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.

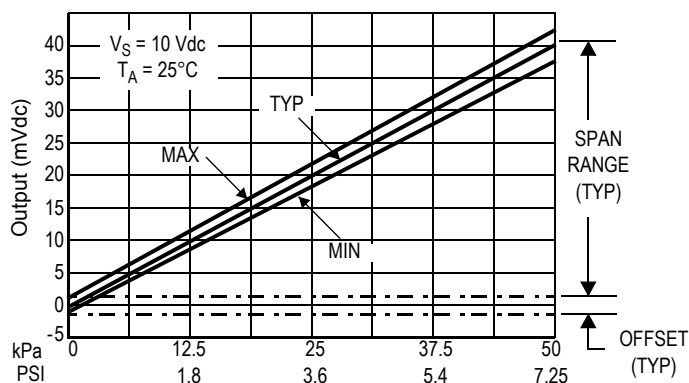
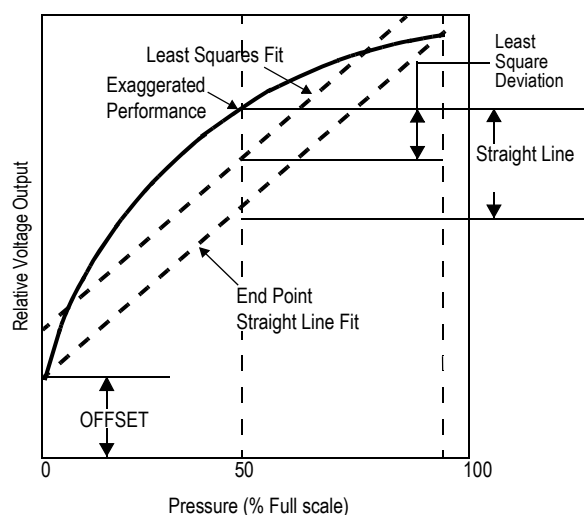


Figure 2. Output vs. Pressure Differential

### LINEARITY

Linearity refers to how well a transducer's output follows the equation:  $V_{out} = V_{off} + \text{sensitivity} \times P$  over the operating pressure range. There are two basic methods for calculating nonlinearity: (1) end point straight line fit (see Figure 3) 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. The specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

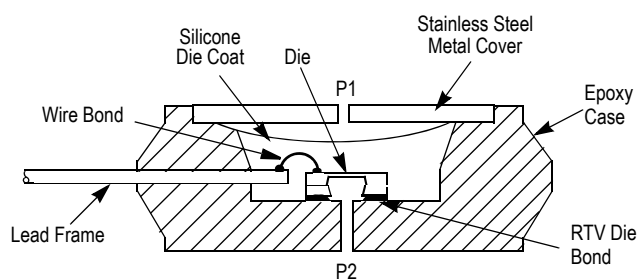


**Figure 3. Linearity Specification Comparison**

Figure 4 illustrates the differential or gauge configuration 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.

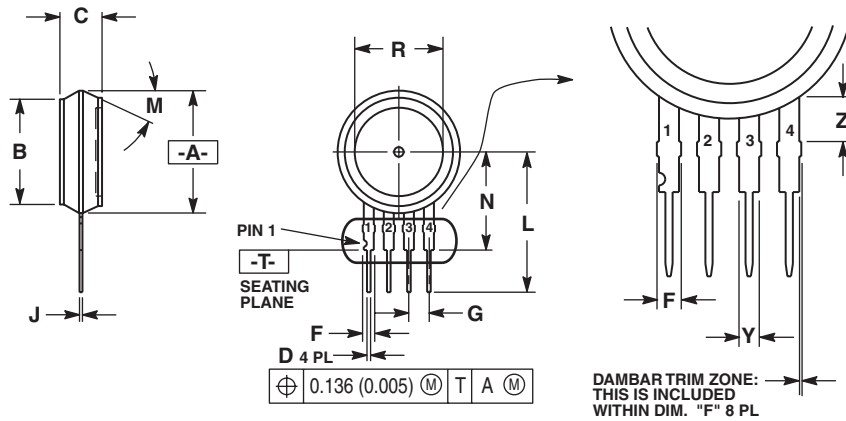
The MPX2053 series pressure sensor operating characteristics and internal reliability and qualification tests

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. Refer to application note AN3728, for more information regarding media compatibility.



**Figure 4. Unibody Package — Cross-Sectional Diagram (Not to Scale)**

## 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).

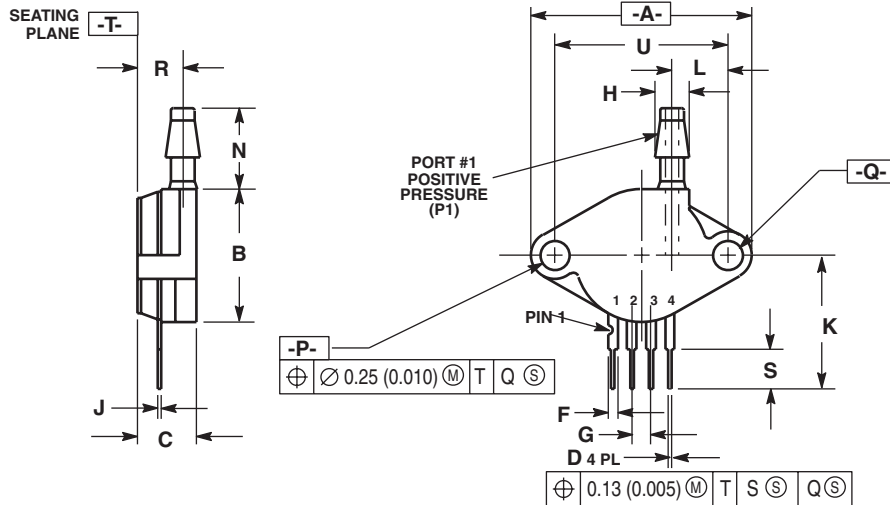
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.016	0.020	0.41	0.51
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92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

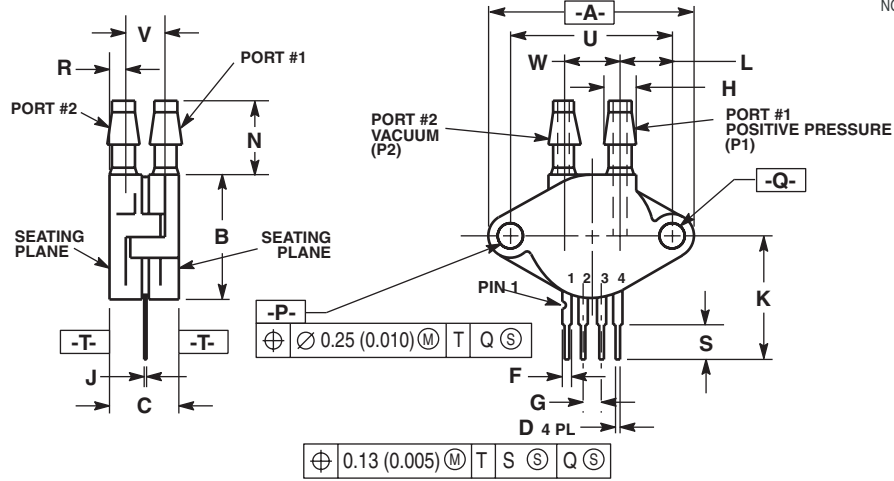
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	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



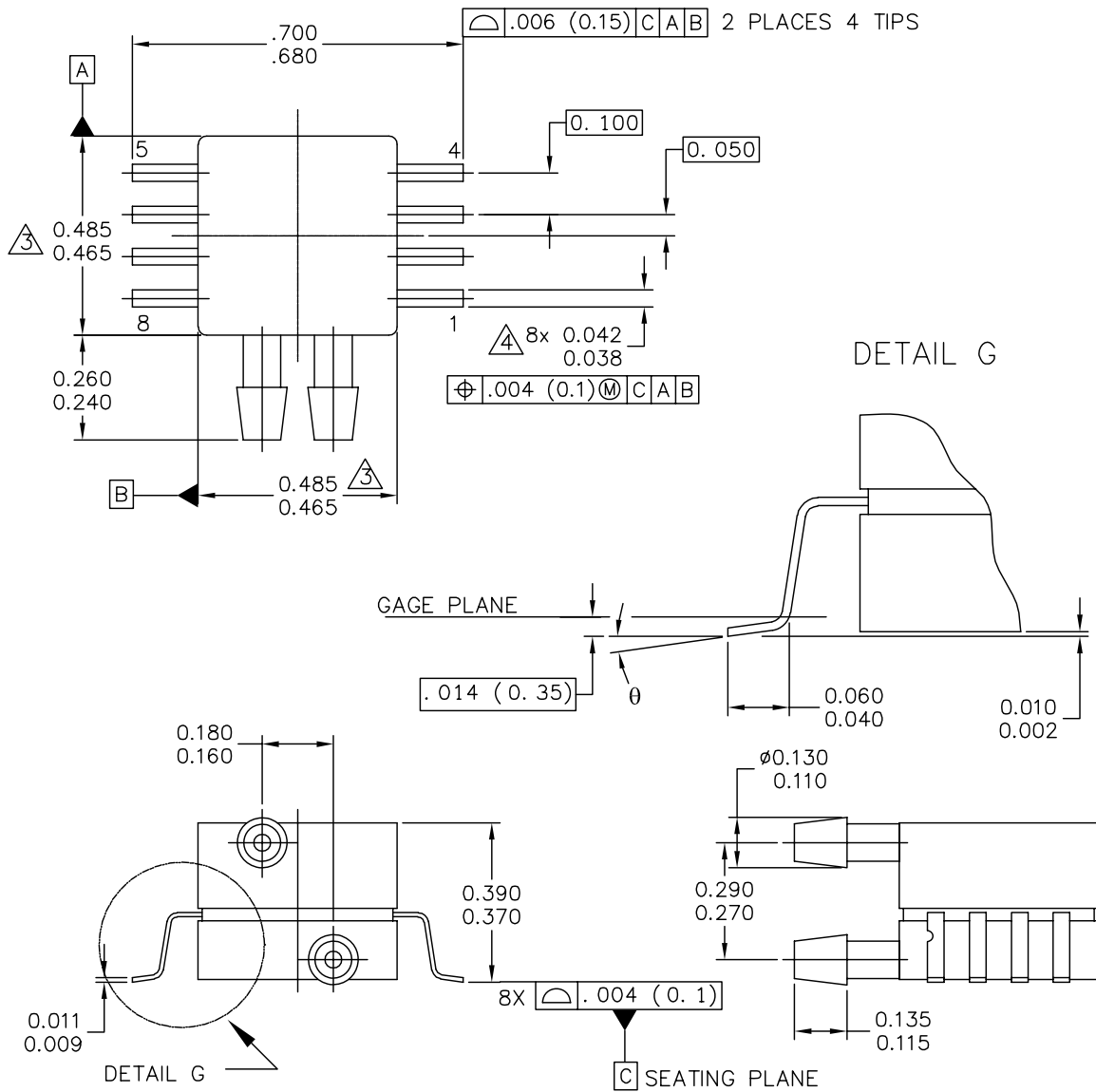
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	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:
1. GROUND
  2. + OUTPUT
  3. + SUPPLY
  4. - OUTPUT

### CASE 344C-01 ISSUE B UNIBODY PACKAGE

## PACKAGE DIMENSIONS



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TITLE:  8 LD SNSR, DUAL PORT		DOCUMENT NO: 98ASA99255D	REV: A
		CASE NUMBER: 1351-01	27 JUL 2005
		STANDARD: NON-JEDEC	

PAGE 1 OF 2

**CASE 1351-01  
ISSUE A  
SMALL OUTLINE PACKAGE**

**MPX2053**



## 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 PROTRUSIONS.  
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:

PIN 1: GND  
PIN 2: +V<sub>out</sub>  
PIN 3: V<sub>s</sub>  
PIN 4: -V<sub>out</sub>  
PIN 5: N/C  
PIN 6: N/C  
PIN 7: N/C  
PIN 8: N/C

#### STYLE 2:

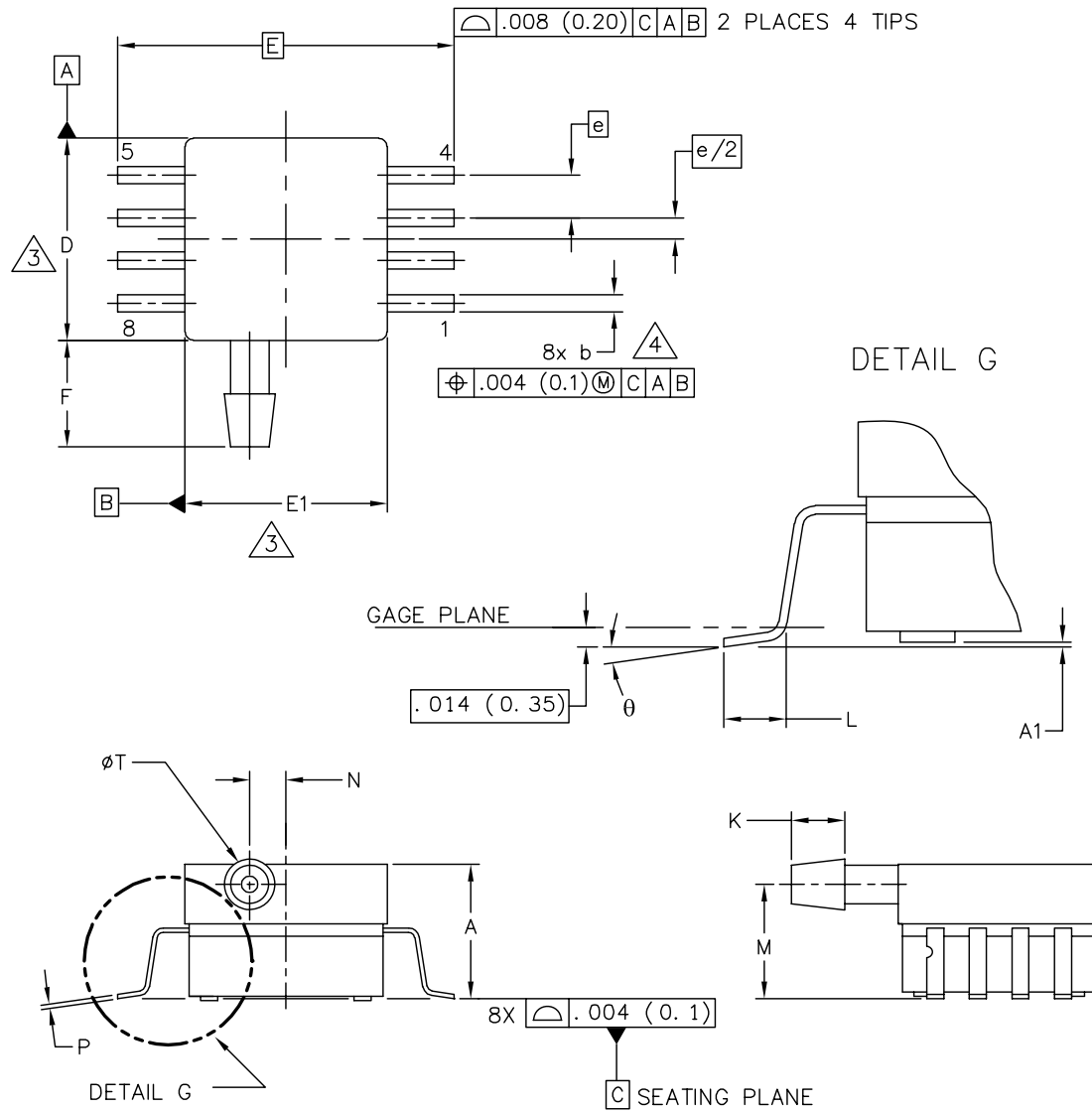
PIN 1: N/C  
PIN 2: V<sub>s</sub>  
PIN 3: GND  
PIN 4: V<sub>out</sub>  
PIN 5: N/C  
PIN 6: N/C  
PIN 7: N/C  
PIN 8: N/C

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

PAGE 2 OF 2

**CASE 1351-01  
ISSUE A  
SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS



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	CASE NUMBER: 1369-01	24 MAY 2005
	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 PROTRUSIONS.  
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.

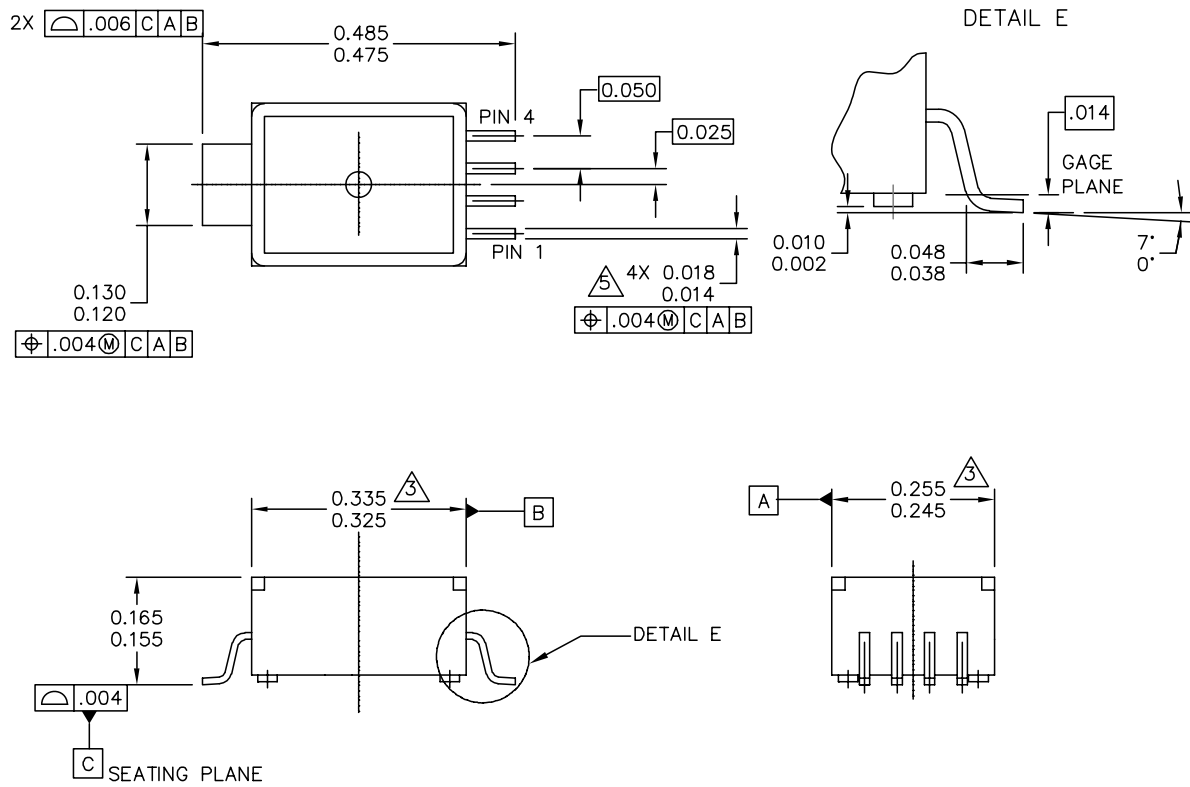
④ DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 (0.203) MAXIMUM.

DIM	INCHES		MILLIMETERS		DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	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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TITLE:  8 LD SOP, SIDE PORT					DOCUMENT NO: 98ASA99303D				REV: B
					CASE NUMBER: 1369-01				24 MAY 2005
					STANDARD: NON-JEDEC				

PAGE 2 OF 2

**CASE 1369-01  
ISSUE B  
SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS



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			CASE NUMBER: 1320-02		22 JUL 2005
			STANDARD: NON-JEDEC		

PAGE 1 OF 2

**CASE 1320-02  
ISSUE B**

**MPX2053**

## 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

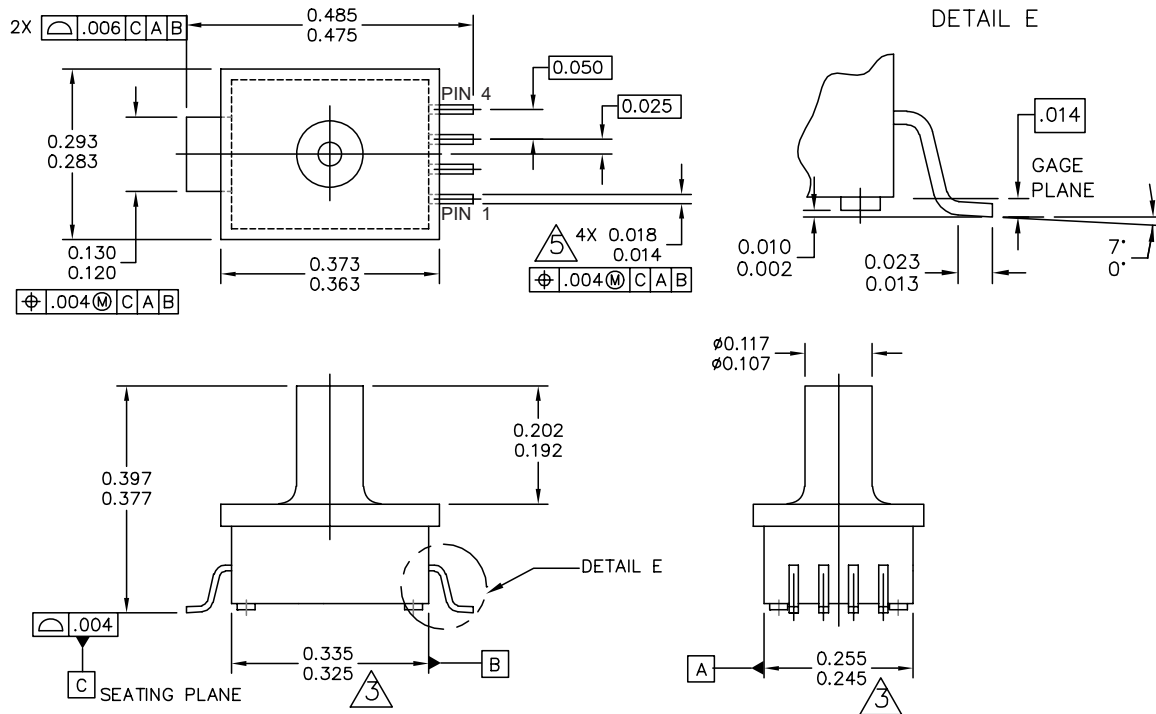
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	STANDARD: NON-JEDEC		

PAGE 2 OF 2

**CASE 1320-02  
ISSUE B**

**MPX2053**

## PACKAGE DIMENSIONS



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	CASE NUMBER: 1320A-02		22 JUL 2005
	STANDARD: NON-JEDEC		

PAGE 1 OF 2

**CASE 1320A-02  
ISSUE A**

**MPX2053**

## 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.

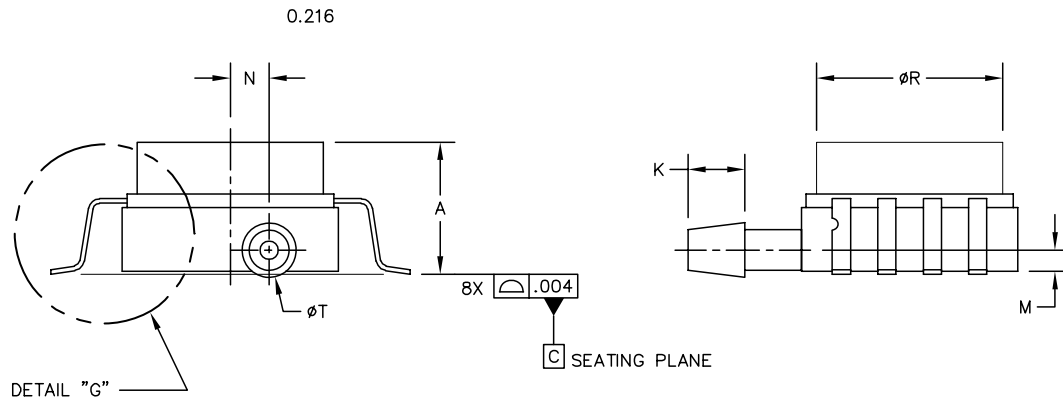
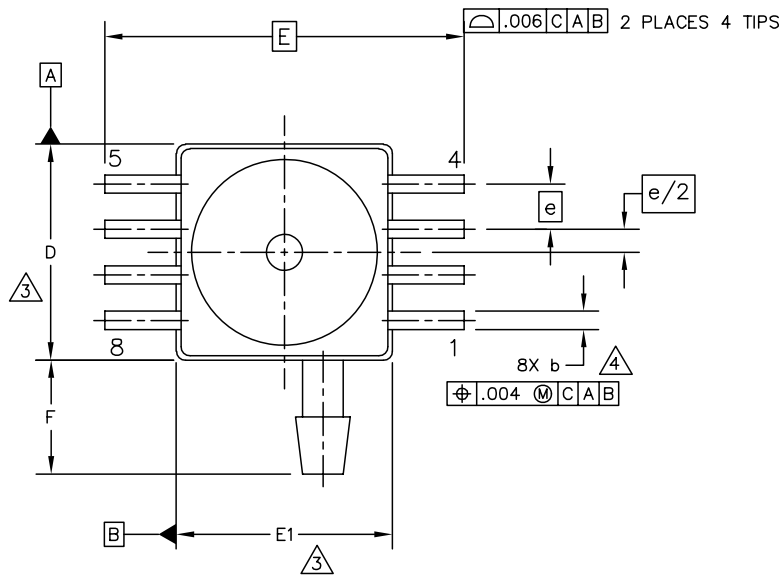
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	CASE NUMBER: 1320A-02		22 JUL 2005
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

**CASE 1320A-02  
ISSUE A**

**MPX2053**

## PACKAGE DIMENSIONS

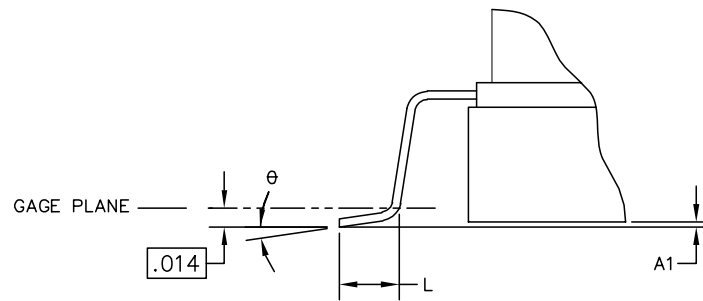


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TITLE:  8 LD SOP, GVP	DOCUMENT NO: 98ASA99302D	REV: B
	CASE NUMBER: 1368-01	23 MAY 2005
	STANDARD: NON-JEDEC	

**CASE 1368-01  
ISSUE B  
SMALL OUTLINE PACKAGE  
SURFACE MOUNT**



## PACKAGE DIMENSIONS



DETAIL "G"

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TITLE:  8 LD SOP, GVP			DOCUMENT NO: 98ASA99302D		REV: B
			CASE NUMBER: 1368—01		23 MAY 2005
			STANDARD: NON—JEDEC		

**CASE 1368-01  
ISSUE B  
SMALL OUTLINE PACKAGE  
SURFACE MOUNT**

## PACKAGE DIMENSIONS

### NOTES:

1. CONTROLLING DIMENSION: INCH

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

3. THIS DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 PER SIDE.

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

### STYLE 1:

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

### STYLE 2:

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

DIM	INCHES		MILLIMETERS		DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX		MIN	MAX	MIN	MAX
A	.280	.300	7.11	7.62	R	.405	.415	10.28	10.54
A1	.002	.010	0.05	0.25	Ø	0°	7°	0°	7°
b	.038	.042	0.96	1.07	—	---	---	---	---
D	.465	.485	11.81	12.32	—	---	---	---	---
E	.690 BSC		17.52 BSC		—	---	---	---	---
E1	.465	.485	11.85	12.32	—	---	---	---	---
e	.100 BSC		2.54 BSC		—	---	---	---	---
F	.240	.260	6.10	6.60	—	---	---	---	---
K	.115	.135	2.92	3.43	—	---	---	---	---
L	.040	.060	1.02	1.52	—	---	---	---	---
M	.035	.055	1.90	2.41	—	---	---	---	---
N	.075	.095	0.89	1.39	—	---	---	---	---
P	.009	.011	0.23	0.28	—	---	---	---	---
T	.110	.130	2.79	3.30	—	---	---	---	---

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TITLE:  8 LD SOP,     GVP			DOCUMENT NO: 98ASA99302D		REV: B
			CASE NUMBER: 1368-01		23 MAY 2005
			STANDARD: NON-JEDEC		

### CASE 1368-01 ISSUE B SMALL OUTLINE PACKAGE SURFACE MOUNT

**MPX2053**

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