

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

The MPX5050/MPXV5050G series piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This patented, single element transducer combines advanced micromachining techniques, thin-film metallization, and bipolar processing to provide an accurate, high level analog output signal that is proportional to the applied pressure.

## Features

- 2.5% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated Over -40° to +125°C
- Patented Silicon Shear Stress Strain Gauge
- Durable Epoxy Unibody Element
- Easy-to-Use Chip Carrier Option

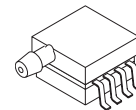
## ORDERING INFORMATION

Device Type	Options	Case No.	MPX Series Order No.	Packing Options	Device Marking
SMALL OUTLINE PACKAGE (MPXV5050G SERIES)					
Ported Element	Side Port	1369	MPXV5050GP	Trays	MPXV5050G
	Dual Port	1351	MPXV5050DP	Trays	MPXV5050G
	Axial Port	482A	MPXV5050GC6U	Trays	MPXV5050G
		482A	MPXV5050GC6T1	Tape & Reel	MPXV5050G
UNIBODY PACKAGE (MPX5050 SERIES)					
Basic Element	Differential	867	MPX5050D	—	MPX5050D
Ported Element	Differential Dual Ports	867C	MPX5050DP	—	MPX5050DP
	Gauge	867B	MPX5050GP	—	MPX5050GP

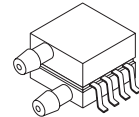
## MPX5050 MPXV5050G SERIES

**INTEGRATED  
 PRESSURE SENSOR**  
 0 to 50 kPa (0 to 7.25 psi)  
 0.2 to 4.7 V Output

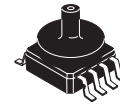
### SMALL OUTLINE PACKAGE SURFACE MOUNT



MPXV5050GP  
 CASE 1369-01



MPXV5050DP  
 CASE 1351-01



MPXV5050GC6U  
 CASE 482A-01

### SMALL OUTLINE PACKAGE PIN NUMBERS<sup>(1)</sup>

1	N/C	5	N/C
2	V <sub>S</sub>	6	N/C
3	Gnd	7	N/C
4	V <sub>out</sub>	8	N/C

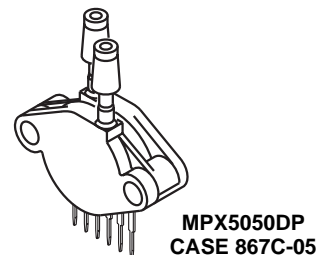
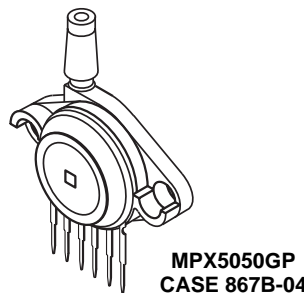
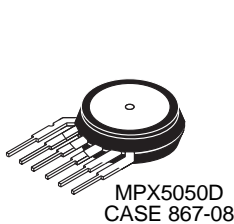
1. Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

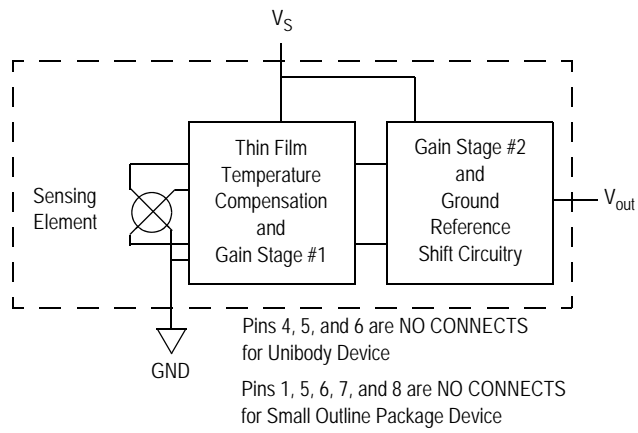
### UNIBODY PACKAGE PIN NUMBERS<sup>(1)</sup>

1	V <sub>out</sub>	4	N/C
2	Gnd	5	N/C
3	V <sub>S</sub>	6	N/C

1. 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.

## UNIBODY PACKAGES





**Figure 1. Fully Integrated Pressure Sensor Schematic**

**Table 1. Maximum Ratings<sup>(1)</sup>**

Rating	Symbol	Value	Unit
Maximum Pressure ( $P_1 > P_2$ )	$P_{max}$	200	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.

**Table 2. . Operating Characteristics** ( $V_S = 5.0$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted,  $P1 > P2$ . Decoupling circuit shown in Figure 4 required to meet electrical specifications.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	$P_{OP}$	0	—	50	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	4.75	5.0	5.25	Vdc
Supply Current	$I_o$	—	7.0	10	mAdc
Minimum Pressure Offset <sup>(3)</sup> @ $V_S = 5.0$ Volts	$V_{off}$	0.088	0.2	0.313	Vdc
Full Scale Output <sup>(4)</sup> @ $V_S = 5.0$ Volts	$V_{FSO}$	4.587	4.7	4.813	Vdc
Full Scale Span <sup>(5)</sup> @ $V_S = 5.0$ Volts	$V_{FSS}$	—	4.5	—	Vdc
Accuracy <sup>(6)</sup>	—	—	—	$\pm 2.5$	$\%V_{FSS}$
Sensitivity	V/P	—	90	—	mV/kPa
Response Time <sup>(7)</sup>	$t_R$	—	1.0	—	ms
Output Source Current at Full Scale Output	$I_{o+}$	—	0.1	—	mAdc
Warm-Up Time <sup>(8)</sup>	—	—	20	—	ms
Offset Stability <sup>(9)</sup>	—	—	$\pm 0.5$	—	$\%V_{FSS}$

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset ( $V_{off}$ ) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output ( $V_{FSO}$ ) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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  $25^\circ\text{C}$ .
  - TcSpan: Output deviation over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - TcOffset: Output deviation with minimum pressure applied, over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of  $V_{FSS}$  at  $25^\circ\text{C}$ .
- 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.
- Warm-up Time is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
- Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

**Figure 3** illustrates the Differential/Gauge Sensing Chip in **Table 3. Mechanical Characteristics**

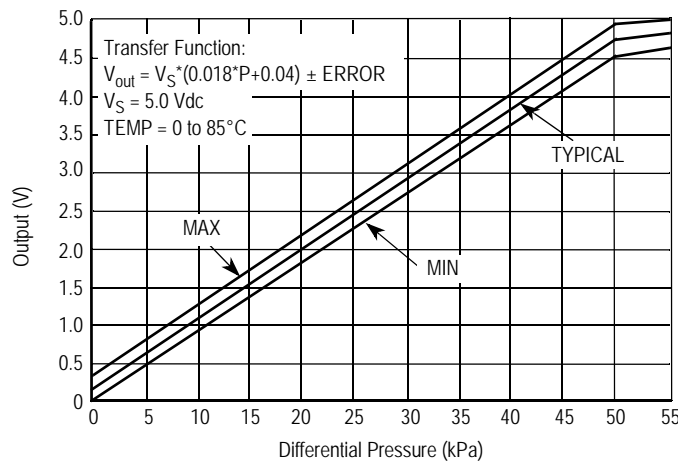
Characteristics	Typ	Unit
Weight, Basic Element (Case 867)	1.8	grams
Weight, Basic Element (Case 1369)	3.376	grams
Weight, Basic Element (Case 482A)		grams

the basic chip carrier (Case 867). 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.

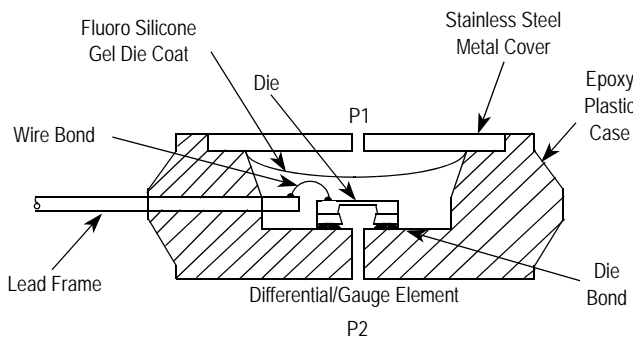
The MPX5050/MPXV5050G series pressure sensor operating characteristics, and internal reliability and qualification tests are based on use of dry air as the pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Contact the factory for information regarding media compatibility in your application.

**Figure 2** shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 0x to 85xC using the decoupling circuit shown in **Figure 4**. The output will saturate outside of the specified pressure range.

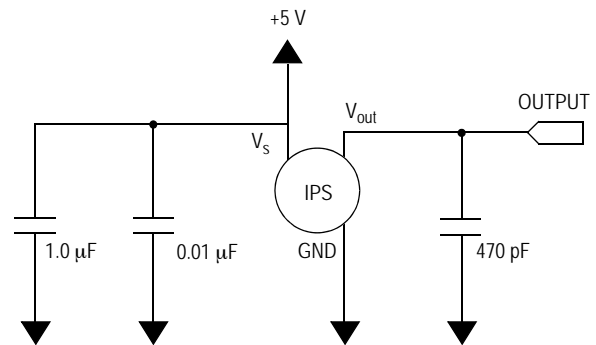
**Figure 4** shows the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.



**Figure 2. Output versus Pressure Differential**



**Figure 3. Cross-Sectional Diagram (not to scale)**



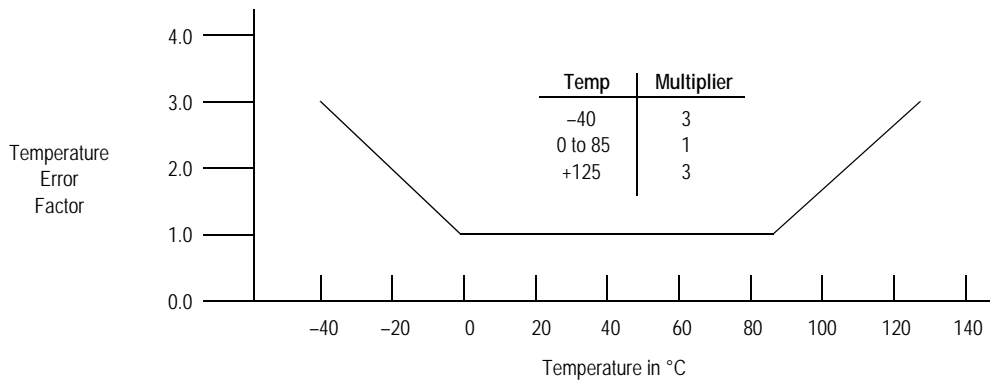
**Figure 4. Recommended Power Supply Decoupling and Output Filtering**  
 (For additional output filtering, please refer to Application Note AN1646.)

## Transfer Function

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

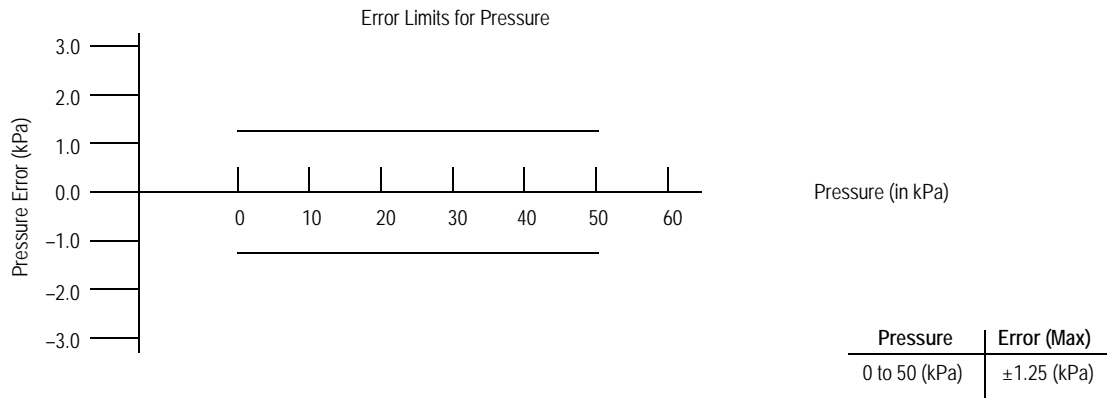
## Temperature Error Band

### MPX5050/MPXV5050G SERIES



NOTE: The Temperature Multiplier is a linear response from 0° to -40°C and from 85° to 125°C.

## Pressure Error Band



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

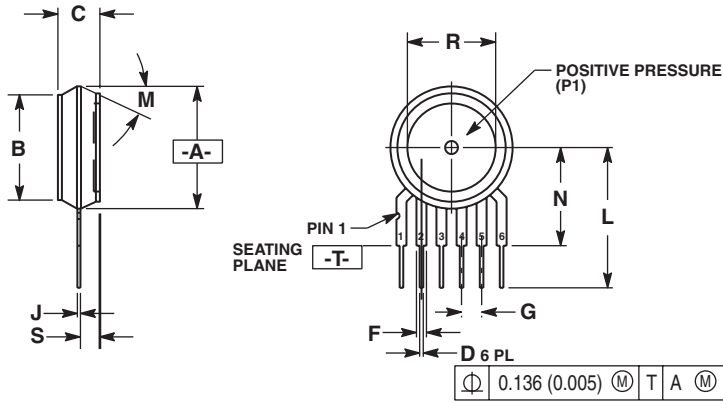
Freescale designates the two sides of the pressure sensor as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing fluorosilicone gel which protects the die from harsh media. The MPX pressure

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	Stainless Steel Cap
MPX5050DP	867C	Side with Part Marking
MPX5050GP	867B	Side with Port Attached
MPXV5050GP	1369	Side with Port Attached
MPXV5050DP	1351	Side with Part Marking
MPXV5050GC6U/T1	482A	Vertical Port Attached

## 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).

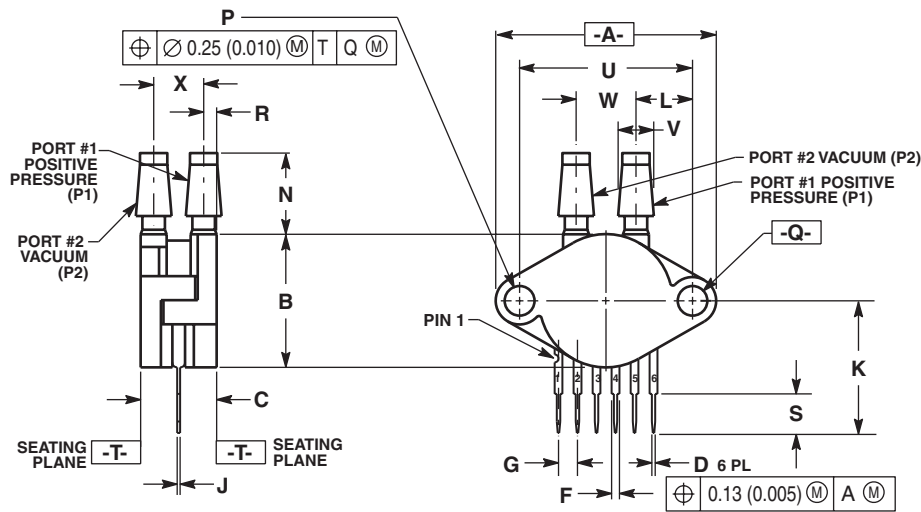
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30° NOM		30° NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92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

STYLE 2:  
 PIN 1. OPEN  
 2. GROUND  
 3. -VOUT  
 4. +VSUPPLY  
 5. +VOUT  
 6. OPEN

STYLE 3:  
 PIN 1. OPEN  
 2. GROUND  
 3. +VOUT  
 4. +VSUPPLY  
 5. -VOUT  
 6. OPEN

### CASE 867-08 ISSUE N UNIBODY PACKAGE



### NOTES:

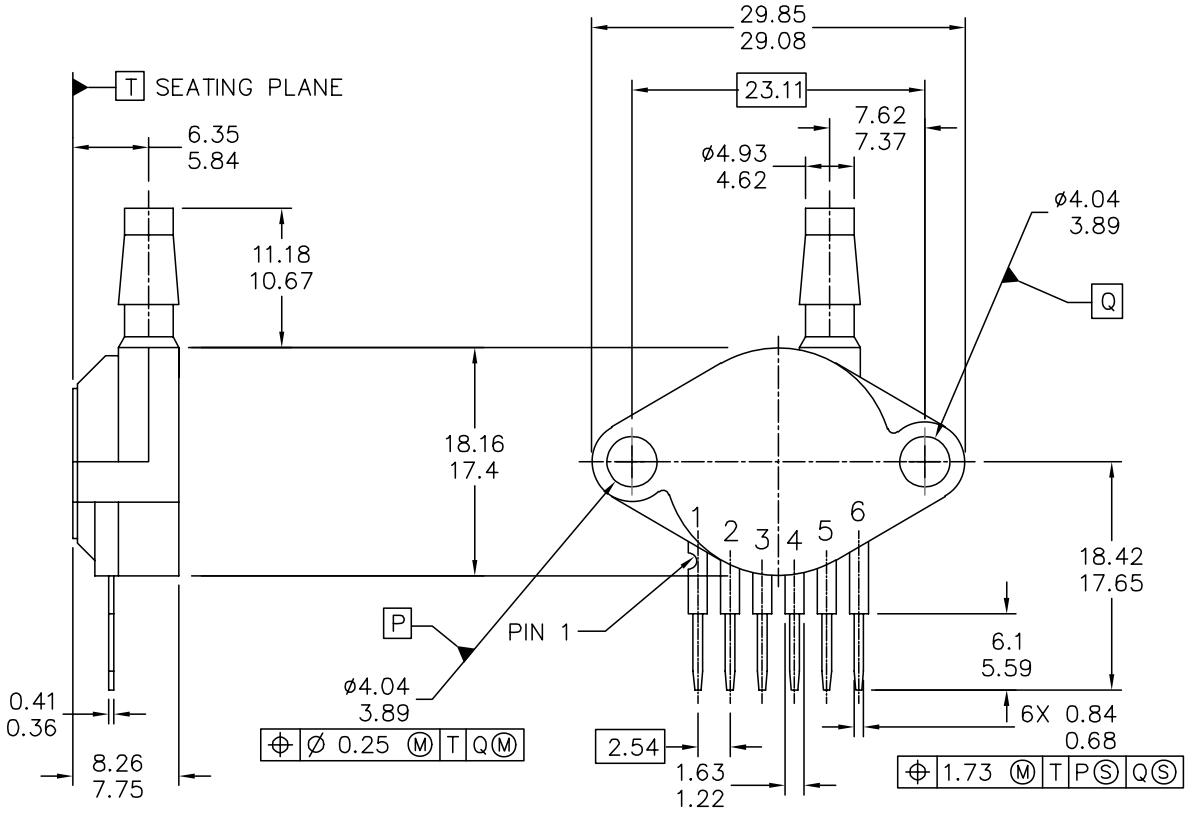
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: INCH.

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	0.027	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	0.063	0.083	1.60	2.11
S	0.220	0.240	5.59	6.10
U	0.910 BSC		23.11 BSC	
V	0.182	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. VOUT  
 2. GROUND  
 3. VCC  
 4. V1  
 5. V2  
 6. VEX

### CASE 867C-05 ISSUE F UNIBODY PACKAGE

# PACKAGE DIMENSIONS



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TITLE: SENSOR, 6 LEAD UNIBODY CELL, AP & GP 01ASB09087B	DOCUMENT NO: 98ASB42796B	REV: G	
	CASE NUMBER: 867B-04	28 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 1 OF 2

**CASE 867B-04  
ISSUE G  
UNIBODY PACKAGE**

**MPX5050**

## PACKAGE DIMENSIONS

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. 867B-01 THRU -3 OBSOLETE, NEW STANDARD 867B-04.

STYLE 1:

- PIN 1: V OUT  
2: GROUND  
3: VCC  
4: V1  
5: V2  
6: V EX

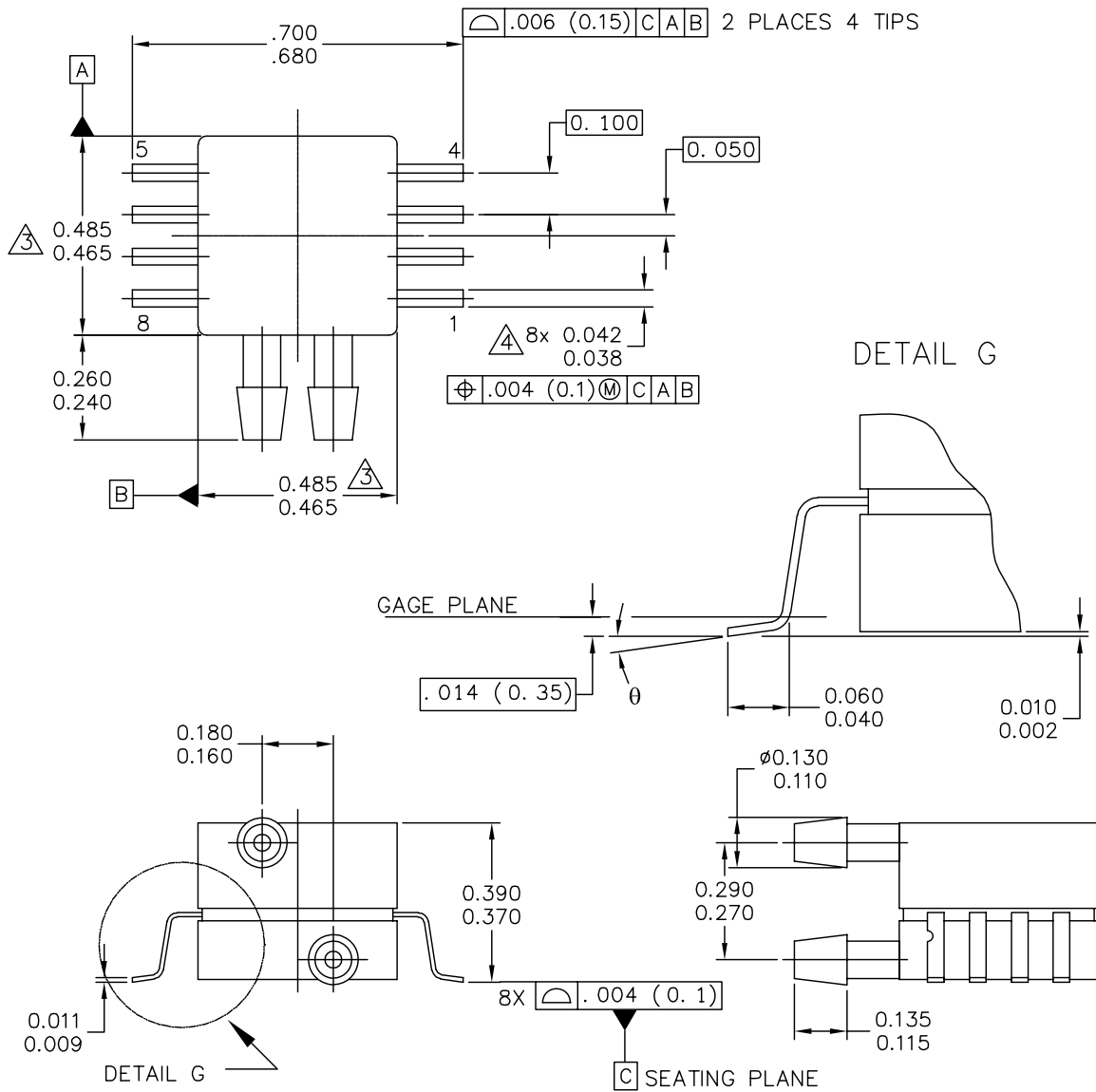
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TITLE: SENSOR, 6 LEAD UNIBODY CELL, AP & GP 01ASB09087B	DOCUMENT NO: 98ASB42796B	REV: G	
	CASE NUMBER: 867B-04	28 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

**CASE 867B-04  
ISSUE G  
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**

**MPX5050**

## 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: +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:

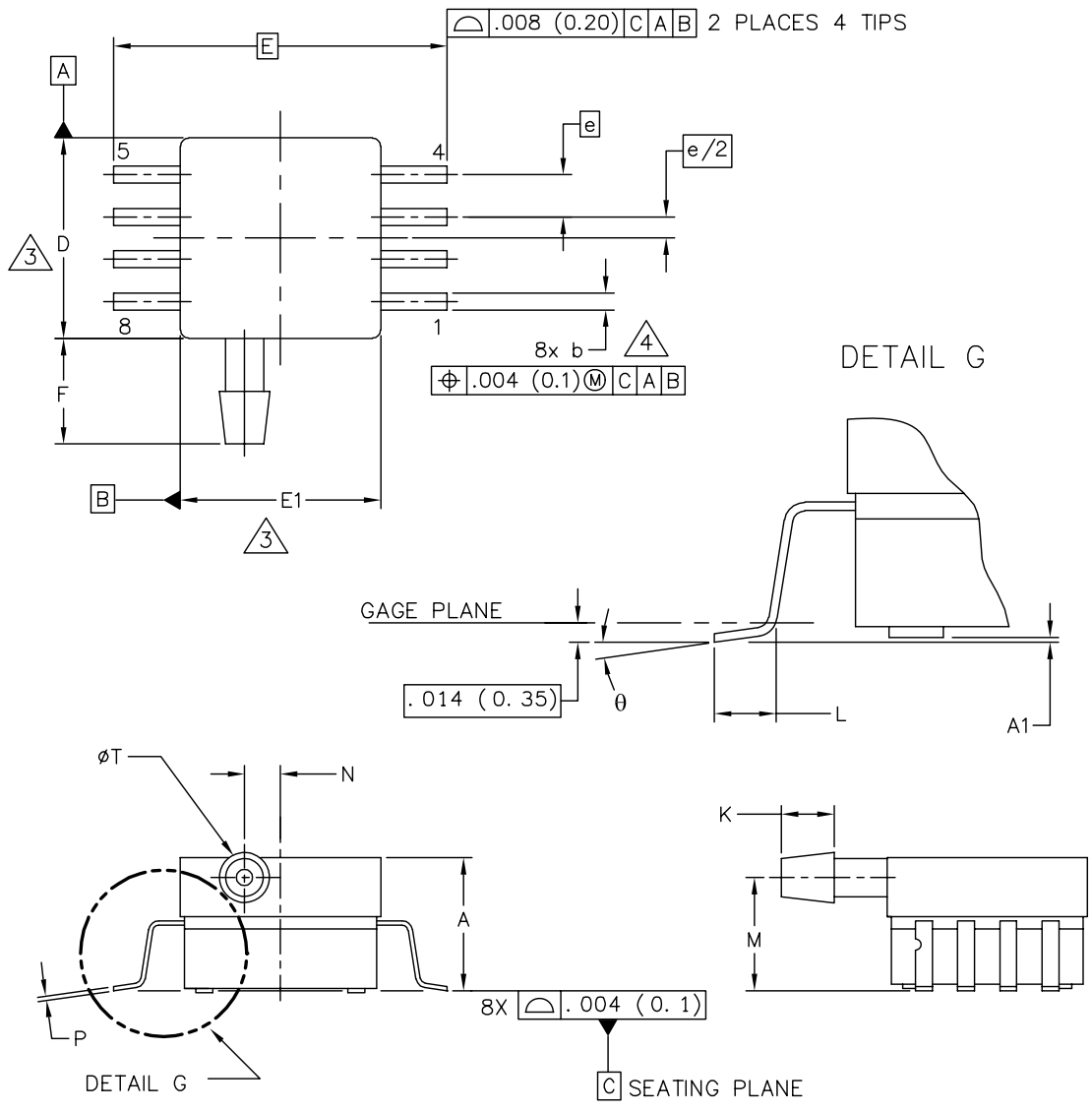
PIN 1: N/C  
 PIN 2: Vs  
 PIN 3: GND  
 PIN 4: Vout  
 PIN 5: N/C  
 PIN 6: N/C  
 PIN 7: N/C  
 PIN 8: N/C

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

PAGE 2 OF 2

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

# PACKAGE DIMENSIONS



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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			

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

## PACKAGE DIMENSIONS

NOTES:

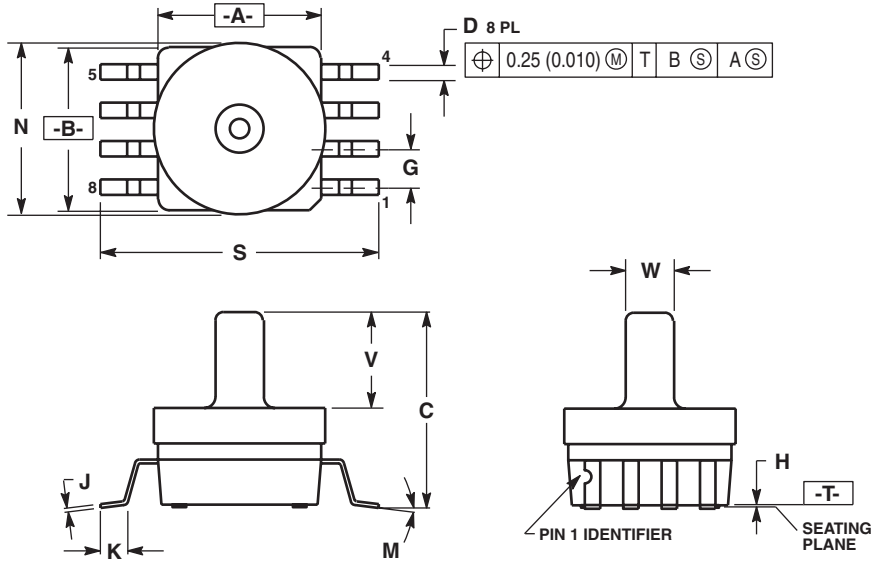
1. CONTROLLING DIMENSION: INCH
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- ③ DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.
- ④ DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL 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



- 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.

DIM	INCHES		MILLIMETERS	
	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  
SMALL OUTLINE PACKAGE**

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