

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

The MPXV7007 series piezoresistive transducers are state-of-the-art monolithic silicon pressure sensors designed for a wide range of applications, but particularly those employing a microcontroller or microprocessor with A/D inputs. This 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

- 5.0% Maximum Error Over 0° to 85°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated Over -40° to +125°C
- Thermoplastic (PPS) Surface Mount Package
- Patented Silicon Shear Stress Strain Gauge
- Available in Differential and Gauge Configurations

## MPXV7007 Series

-7 to 7 kPa (-1 to 1 psi)  
0.5 to 4.5 V Output

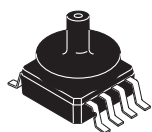
## Application Examples

- Hospital Beds
- HVAC
- Respiratory Systems
- Process Control

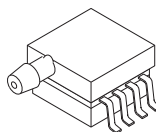
## ORDERING INFORMATION

ORDERING INFORMATION									
Device Name	Package Options	Case No.	# of Ports			Pressure Type			Device Marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package									
MPXV7007DP	Trays	1351			•		•		MPXV7007DP
MPXV7007DPT1	Tape & Reel	1351			•		•		MPXV7007DP
MPXV7007GC6U	Rails	482A		•		•			MPXV7007G
MPXV7007GC6T1	Tape & Reel	482A		•		•			MPXV7007G
MPXV7007GP	Trays	1369		•		•			MPXV7007GP

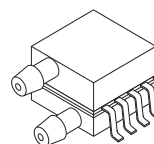
## SMALL OUTLINE PACKAGE



MPXV7007GC6U/C6T1  
CASE 482A-01



MPXV7007GP  
CASE 1369-01



MPXV7007DP/DPT1  
CASE 1351-01

Table 1. Pin Numbers<sup>(1)</sup>

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

## Operating Characteristics

**Table 2. Operating Characteristics** ( $V_S = 5.0$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted. Decoupling circuit shown in [Figure 3](#) required to meet specification.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	$P_{OP}$	-7	—	7	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	$V_{off}$	0.33	0.5	0.67	Vdc
Full Scale Output <sup>(4)</sup> @ $V_S = 5.0$ Volts	$V_{FSO}$	4.3	4.5	4.7	Vdc
Full Scale Span <sup>(5)</sup> @ $V_S = 5.0$ Volts	$V_{FSS}$	—	4.0	—	Vdc
Accuracy <sup>(6)</sup>	—	—	—	$\pm 5.0$	% $V_{FSS}$
Sensitivity	V/P	—	286	—	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. 1.0 kPa (kiloPascal) equals 0.145 psi.

2. Device is ratiometric within this specified excitation range.

3. Offset ( $V_{off}$ ) is defined as the output voltage at the minimum rated pressure.

4. Full Scale Output ( $V_{FSO}$ ) is defined as the output voltage at the maximum or full rated pressure.

5. 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.

6. 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 rated 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  $25^\circ\text{C}$ .

7. 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.

8. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.

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

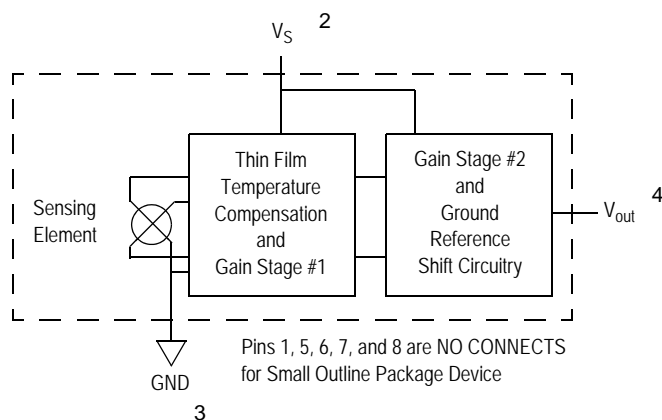
## Maximum Ratings

**Table 3. Maximum Ratings<sup>(1)</sup>**

Rating	Symbol	Value	Unit
Maximum Pressure	$P_{\max}$	75	kPa
Storage Temperature	$T_{\text{stg}}$	-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. Integrated Pressure Sensor Schematic**

## ON-CHIP TEMPERATURE COMPENSATION, CALIBRATION AND SIGNAL CONDITIONING

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration and signal conditioning circuitry onto a single monolithic chip.

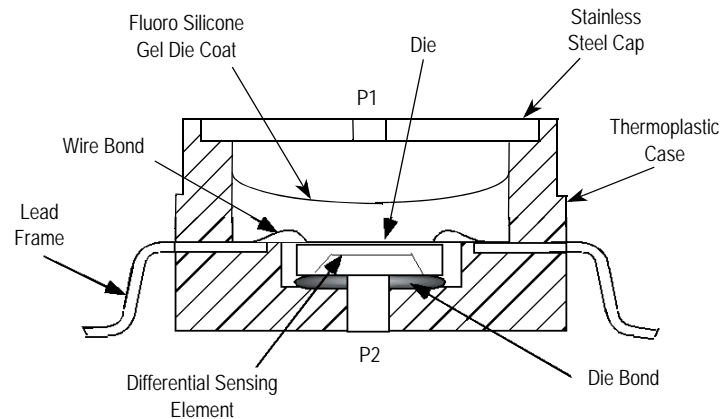
Figure 2 illustrates the Differential or Gauge configuration in the basic chip carrier (Case 482). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm.

The MPXV7007 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

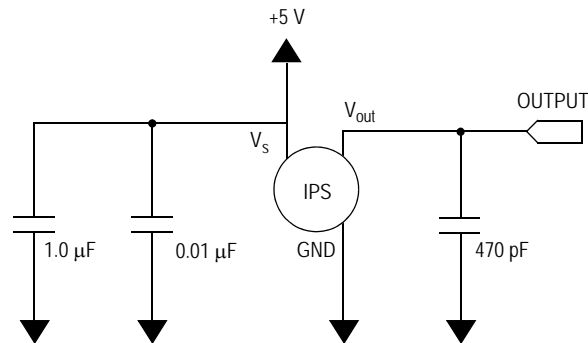
performance and long-term reliability. Contact the factory for information regarding media compatibility in your application.

Figure 3 shows the recommended decoupling circuit for interfacing the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Figure 4 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 0° to 85°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.



**Figure 2. Cross-Sectional Diagram SOP (not to scale)**



**Figure 3. Recommended Power Supply Decoupling and Output Filtering**  
(For additional output filtering, please refer to Application Note AN1646.)

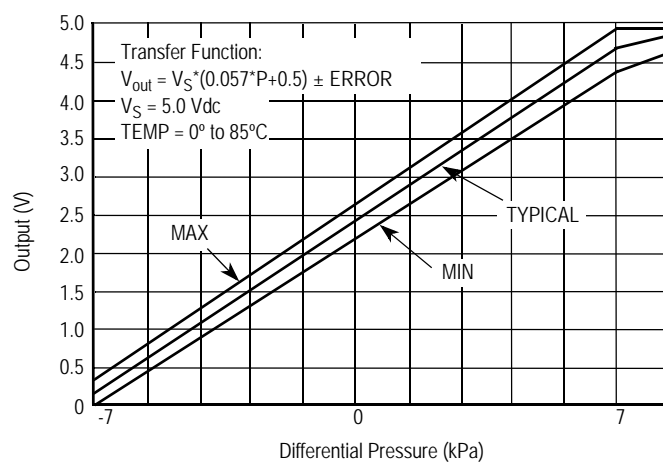


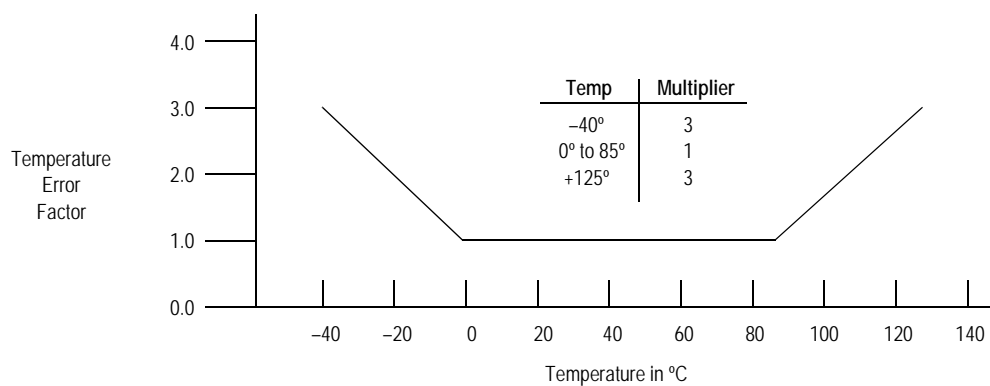
Figure 4. Output versus Pressure Differential

## Transfer Function

**Nominal Transfer Value:**  $V_{out} = V_S \times (0.057 \times P + 0.5)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.057 \times V_S)$   
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ Vdc}$

## Temperature Error Band

## MPXV7007 SERIES



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



## 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 fluoro silicone gel which protects the die from harsh media. The pressure

sensor is designed to operate with both positive and negative differential pressure applied,  $P_1 > P_2$  or  $P_1 < P_2$ .

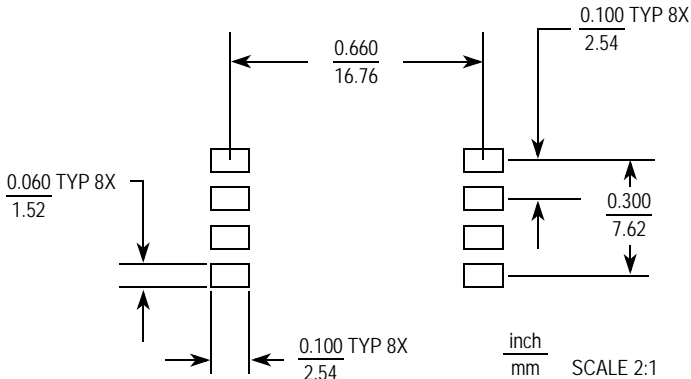
The Pressure (P1) side may be identified by using the following table:

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV7007GC6U/C6T1	482A	Side with Port Attached
MPXV7007GP	1369	Side with Port Attached
MPXV7007DP/DPT1	1351	Side with Part Marking

## MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

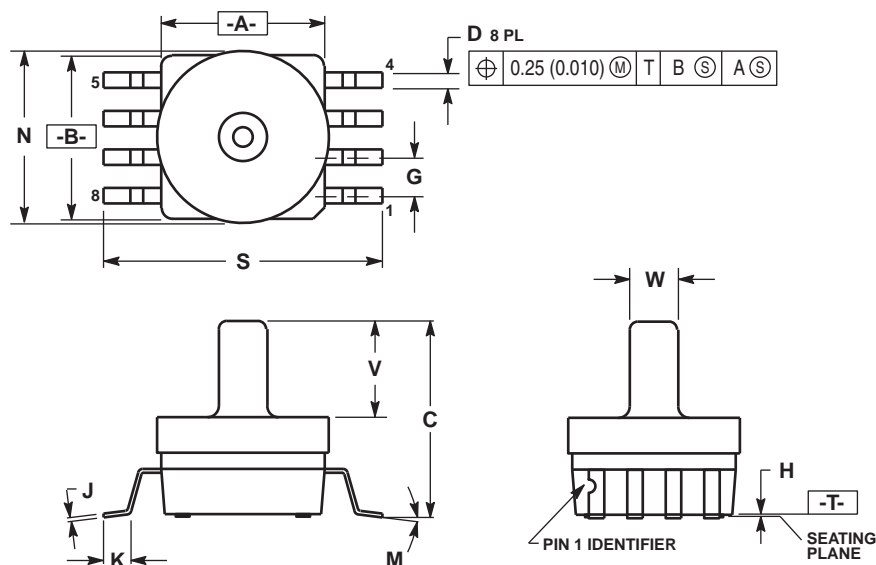
Surface mount board layout is a critical portion of the total design. The footprint for the surface mount packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct

footprint, the packages will self align when subjected to a solder reflow process. It is always recommended to design boards with a solder mask layer to avoid bridging and shorting between solder pads.



### Figure 5. Small Outline Package Footprint

## PACKAGE DIMENSIONS



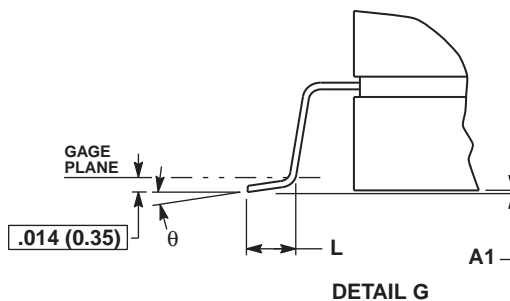
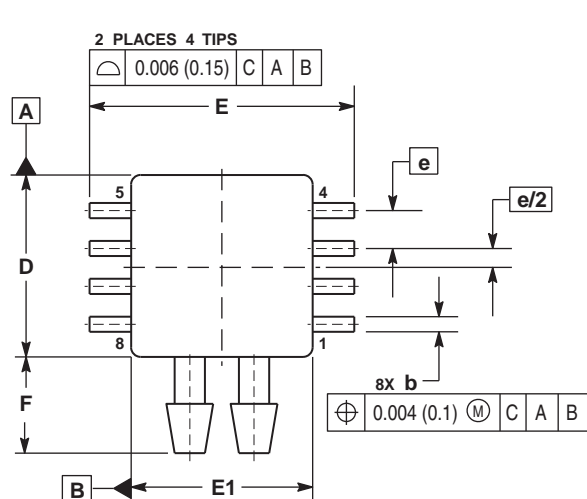
## NOTES:

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

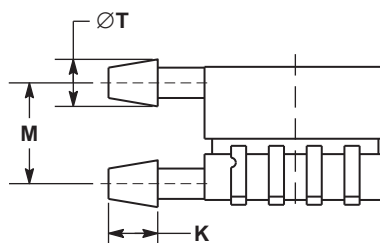
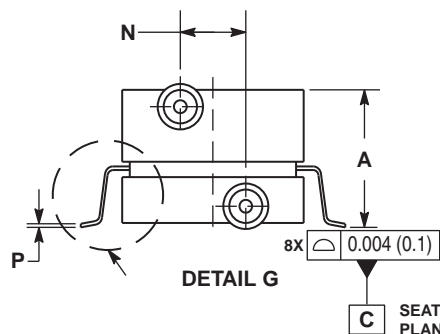
**CASE 482A-01**  
**ISSUE A**  
**SMALL OUTLINE PACKAGE**

# PACKAGE DIMENSIONS



## NOTES:

1. CONTROLLING DIMENSION: INCH.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 (0.152) PER SIDE.
4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.008 (0.203) MAXIMUM.

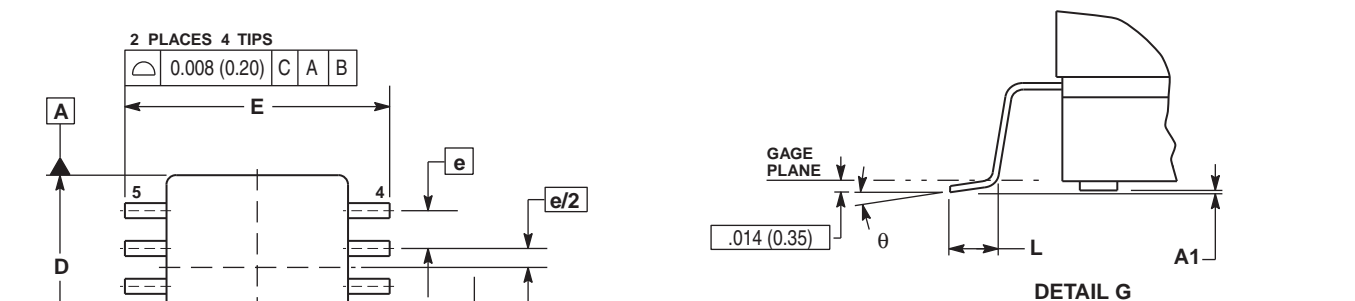
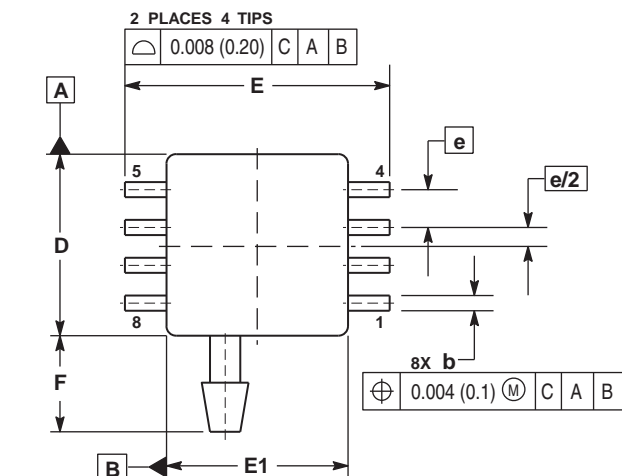


DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.370	0.390	9.39	9.91
A1	0.002	0.010	0.05	0.25
b	0.038	0.042	0.96	1.07
D	0.465	0.485	11.81	12.32
E	0.680	0.700	17.27	17.78
E1	0.465	0.485	11.81	12.32
e	0.100 BSC		2.54 BSC	
F	0.240	0.260	6.10	6.60
K	0.115	0.135	2.92	3.43
L	0.040	0.060	1.02	1.52
M	0.270	0.290	6.86	7.37
N	0.160	0.180	4.06	4.57
P	0.009	0.011	0.23	0.28
T	0.110	0.130	2.79	3.30
$\theta$	0°	7°	0°	7°

## CASE 1351-01 ISSUE O SMALL OUTLINE PACKAGE



## PACKAGE DIMENSIONS



- 
- NOTES:
1. CONTROLLING DIMENSION: INCH.
  2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M, 1994.
  3. DIMENSIONS "D" AND "E1" DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006 (0.152) PER SIDE.
  4. DIMENSION "b" DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.008 (0.203) MAXIMUM.

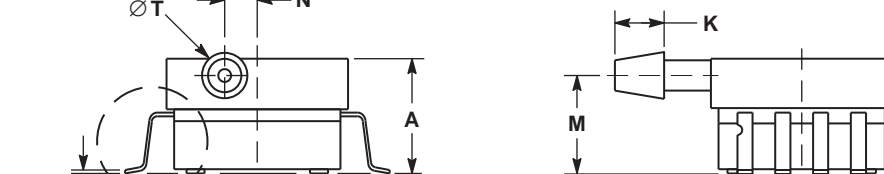
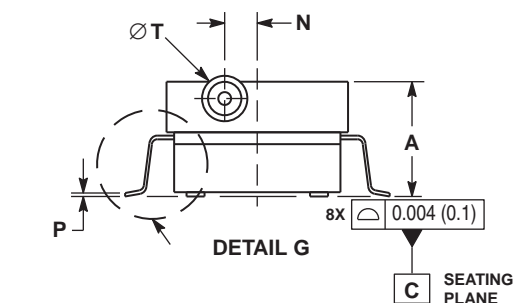
**DETAIL G**

**C SEATING PLANE**

**INCHES**

DIM	MIN	MAX	MIN	MAX
<b>A</b>	0.300	0.330	7.11	7.62
<b>A1</b>	0.002	0.010	0.05	0.25
<b>b</b>	0.038	0.042	0.96	1.07
<b>D</b>	0.465	0.485	11.81	12.32
<b>E</b>	0.717 BSC		18.21 BSC	
<b>E1</b>	0.465	0.485	11.81	12.32
<b>e</b>	0.100 BSC		2.54 BSC	
<b>F</b>	0.245	0.255	6.22	6.47
<b>K</b>	0.120	0.130	3.05	3.30
<b>L</b>	0.061	0.071	1.55	1.80
<b>M</b>	0.270	0.290	6.86	7.36
<b>N</b>	0.080	0.090	2.03	2.28
<b>P</b>	0.009	0.011	0.23	0.28
<b>T</b>	0.115	0.125	2.92	3.17
<b>θ</b>	0°	7°	0°	7°

**MILLIMETERS**



CASE 1369-01  
ISSUE O  
SMALL OUTLINE PACKAGE

**Table 4. Revision History**

Revision number	Revision date	Description of changes
3	10/2012	<ul style="list-style-type: none"><li>Deleted references to device numbers MPXV7007G6T1/U, MPXV7007G6U/T1 and MPXV7007GPT1 throughout the document, deleted Case 482-01 Issue O Small Outline Package diagram on page 7</li></ul>

## ***How to Reach Us:***

**Home Page:**  
[freescale.com](http://freescale.com)

**Web Support:**  
[freescale.com/support](http://freescale.com/support)

Information in this document is provided solely to enable system and software implementers to use Freescale products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits based on the information in this document.

Freescale reserves the right to make changes without further notice to any products herein. Freescale makes no warranty, representation, or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale data sheets and/or specifications can and do vary in different applications, and actual performance may vary over time. All operating parameters, including "typicals," must be validated for each customer application by customer's technical experts. Freescale does not convey any license under its patent rights nor the rights of others. Freescale sells products pursuant to standard terms and conditions of sale, which can be found at the following address: [freescale.com/salestermsandconditions](http://freescale.com/salestermsandconditions).

Freescale, the Freescale logo, Energy Efficient Solutions logo, are trademarks of Freescale Semiconductor, Inc., Reg. U.S. Pat. & Tm. Off. Xtrinsic is a trademark of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© 2012 Freescale Semiconductor, Inc.

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Freescale Semiconductor:](#)

[MPXV7007GP](#) [MPXV7007DP](#) [MPXV7007GC6T1](#) [MPXV7007GC6U](#) [MP3V7007DP](#) [MPXV7007DPT1](#)  
[MP3V7007GC6U](#) [MP3V7007GP](#)