

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

The MPXV4006G 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 sensor combines a highly sensitive implanted strain gauge with 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

- Temperature Compensated over 10° to 60°C
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Available in Gauge Surface Mount (SMT) or Through-hole (DIP) Configurations
- Durable Thermoplastic (PPS) Package

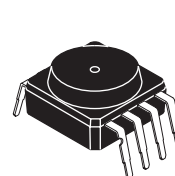
MPXV4006G series pressure sensors are available in the basic element package or with pressure ports. Two packing options are offered for the 482 and 482A case configurations.

| ORDERING INFORMATION |              |          |                      |                 |           |
|----------------------|--------------|----------|----------------------|-----------------|-----------|
| Device Type          | Options      | Case No. | MPX Series Order No. | Packing Options | Marking   |
| Basic Element        | Element Only | 482      | MPXV4006G6U          | Rails           | MPXV4006G |
|                      | Element Only | 482      | MPXV4006G6T1         | Tape & Reel     | MPXV4006G |
|                      | Element Only | 482B     | MPXV4006G7U          | Rails           | MPXV4006G |
| Ported Element       | Axial Port   | 482A     | MPXV4006GC6U         | Rails           | MPXV4006G |
|                      | Axial Port   | 482A     | MPXV4006GC6T1        | Tape & Reel     | MPXV4006G |
|                      | Axial Port   | 482C     | MPXV4006GC7U         | Rails           | MPXV4006G |
|                      | Side Port    | 1369     | MPXV4006GP           | Trays           | MPXV4006G |
|                      | Dual Port    | 1351     | MPXV4006DP           | Trays           | MPXV4006G |

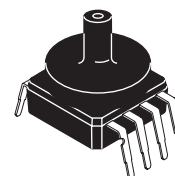
## MPXV4006G

**INTEGRATED  
PRESSURE SENSOR**  
0 to 6 kPa (0 to 0.87 psi)  
0.2 to 4.7 V OUTPUT

### SMALL OUTLINE PACKAGE THROUGH-HOLE

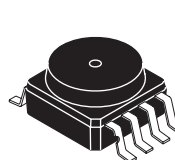


**MPXV4006G7U  
CASE 482B-03**

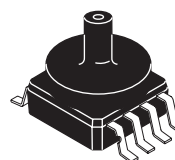


**MPXV4006GC7U  
CASE 482C-03**

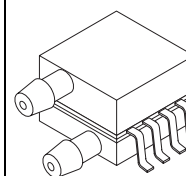
### SMALL OUTLINE PACKAGE SURFACE MOUNT



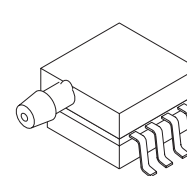
**MPXV4006G6U/6T1  
CASE 482-01**



**MPXV4006GC6U/C6T1  
CASE 482A-01**



**MPXV4006DP  
CASE 1351-01**

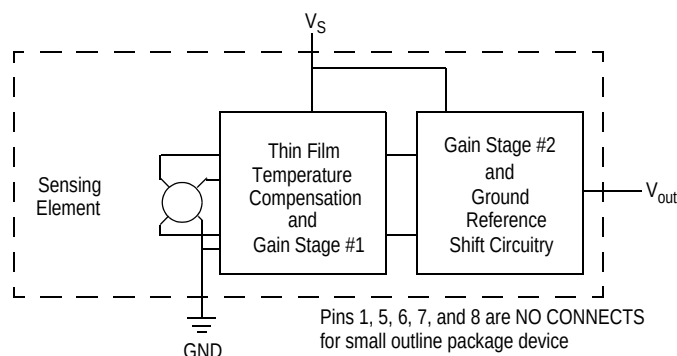


**MPXV4006GP  
CASE 1369-01**

### 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.



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

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

| Parameters                 | Symbol    | Value         | Units |
|----------------------------|-----------|---------------|-------|
| Maximum Pressure (P1 > P2) | $P_{max}$ | 24            | kPa   |
| Storage Temperature        | $T_{stg}$ | -30° to +100° | °C    |
| Operating Temperature      | $T_A$     | -10° to +60°  | °C    |

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

**Table 2. Operating Characteristics**

| Characteristic                               | Symbol    | Min   | Typ   | Max   | Unit        |
|----------------------------------------------|-----------|-------|-------|-------|-------------|
| Pressure Range                               | $P_{OP}$  | 0     | —     | 6.0   | kPa         |
| Supply Voltage <sup>(1)</sup>                | $V_S$     | 4.75  | 5.0   | 5.25  | Vdc         |
| Supply Current                               | $I_S$     | —     | —     | 10    | mAdc        |
| Full Scale Output <sup>(2)</sup> (RF = 51kΩ) | $V_{FSS}$ | —     | 4.6   | —     | V           |
| Offset <sup>(3)(5)</sup> (RF = 51kΩ)         | $V_{off}$ | 0.100 | 0.225 | 0.430 | V           |
| Sensitivity                                  | V/P       | —     | 766   | —     | mV/kPa      |
| Accuracy <sup>(4)(5)</sup> (10 to 60°C)      | —         | —     | —     | ±5.0  | % $V_{FSS}$ |

- Device is ratiometric within this specified excitation range.
- 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.
- Offset ( $V_{off}$ ) is defined as 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 minimum or maximum rated pressure, at 25°C.
  - Offset Stability: Output deviation, after 1000 temperature cycles, -30 to 100°C, and 1.5 million pressure cycles, with minimum rated pressure applied.
  - TcSpan: Output deviation over the temperature range of 10° to 60°C, relative to 25°C.
  - TcOffset: Output deviation with minimum pressure applied, over the temperature range of 10° to 60°C, relative to 25°C.
- Auto Zero at Factory Installation: Due to the sensitivity of the MPXV4006G, external mechanical stresses and mounting position can affect the zero pressure output reading. To obtain the 5% FSS accuracy, the device output must be "autozeroed" after installation. Autozeroing is defined as storing the zero pressure output reading and subtracting this from the device's output during normal operations.

## 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.

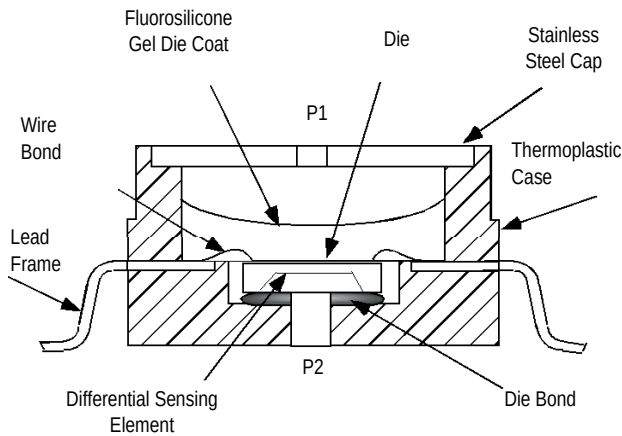
Figure 2 illustrates the gauge configuration in the basic chip carrier (Case 482). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the silicon diaphragm.

The MPXV4006G series sensor operating characteristics are based on use of dry air as pressure media. Media, other than dry air, may have adverse effects on sensor performance and long-term reliability. Internal reliability and qualification test for dry air, and other media, are available

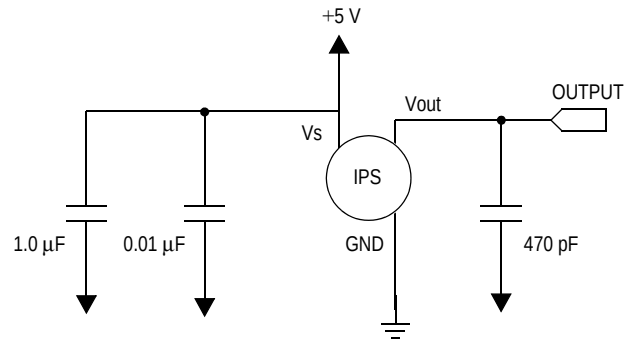
from the factory. Contact the factory for information regarding media tolerance in your application.

Figure 3 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.

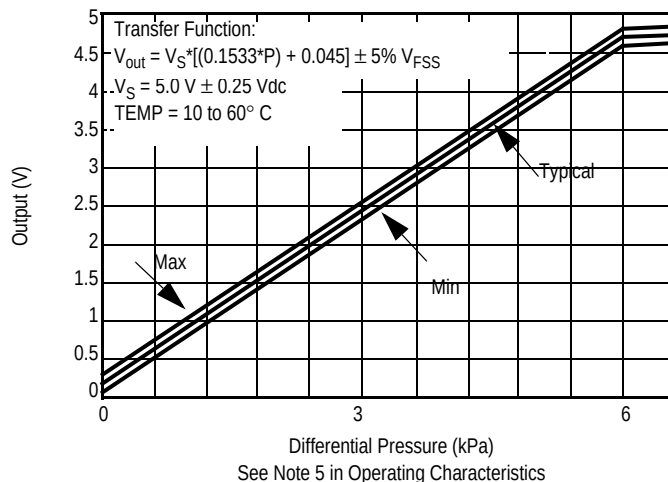
Figure 4 shows the sensor output signal relative to pressure input. Typical, minimum and maximum output curves are shown for operation over a temperature range of 10°C to 60°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.



**Figure 2. Cross Sectional Diagram SOP (Not to Scale)**



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



**Figure 4. Output versus Pressure Differential**

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

Freescall 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 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:

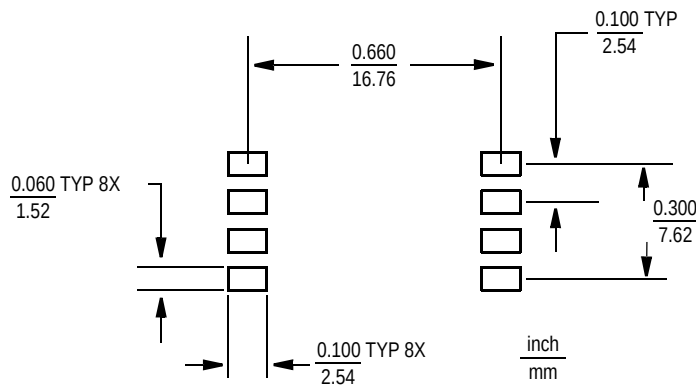
**Table 3. Pressure (P1)/Vacuum (P2) Side Identification Table**

| Part Number     | Case Type | Pressure (P1) Side Identifier |
|-----------------|-----------|-------------------------------|
| MPXV4006G6U/T1  | 482       | Stainless Steel Cap           |
| MPXV4006GC6U/T1 | 482A      | Side with Port Attached       |
| MPXV4006G7U     | 482B      | Stainless Steel Cap           |
| MPXV4006GC7U    | 482C      | Side with Port Attached       |
| MPXV4006GP      | 1369      | Side with Port Attached       |
| MPXV4006DP      | 1351      | Side with Part Marking        |

## MINIMUM RECOMMENDED FOOTPRINT FOR SURFACE MOUNTED APPLICATIONS

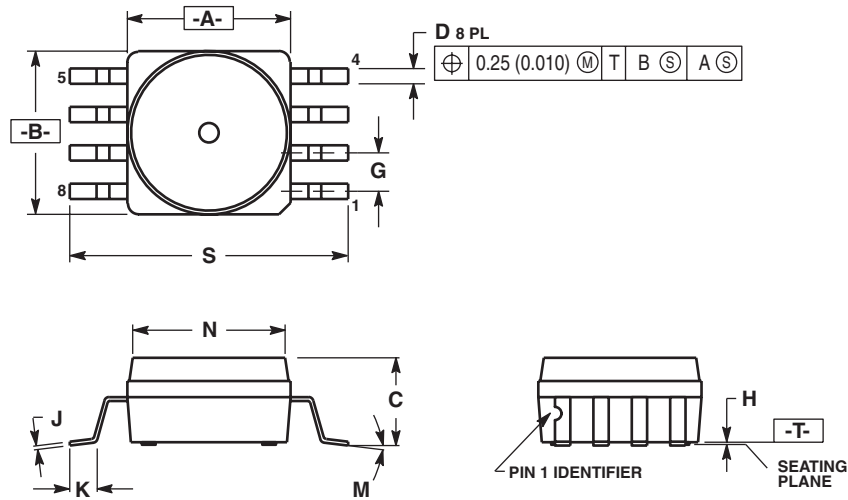
Surface mount board layout is a critical portion of the total design. The footprint for the surface mount packages must be the correct size to ensure proper solder connection interface between the board and the package. With the correct

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. SOP Footprint (Case 482)**

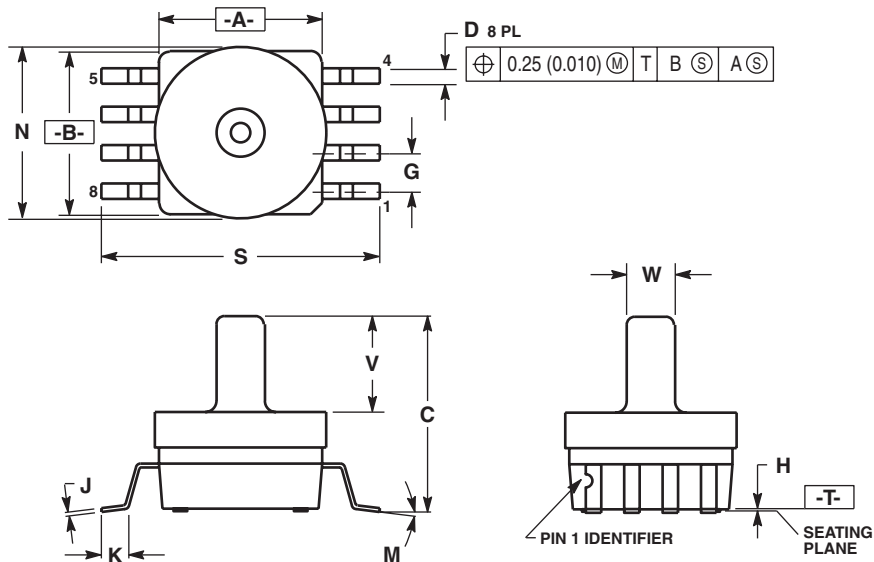
## PACKAGE DIMENSIONS



- 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   | 0.212     | 0.230 | 5.38        | 5.84  |
| 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   | 0.405     | 0.415 | 10.29       | 10.54 |
| S   | 0.709     | 0.725 | 18.01       | 18.41 |

### CASE 482-01 ISSUE O SMALL OUTLINE PACKAGE SURFACE MOUNT

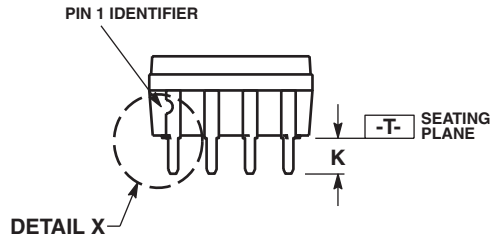
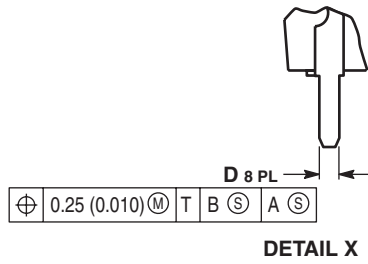
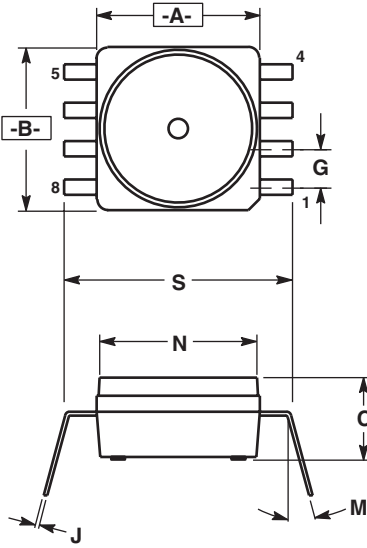


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
  4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
  5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

| 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 SURFACE MOUNT

## PACKAGE DIMENSIONS

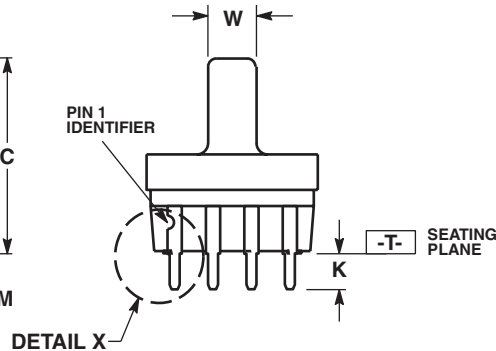
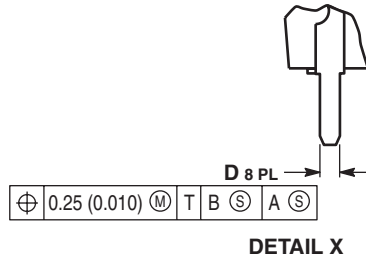
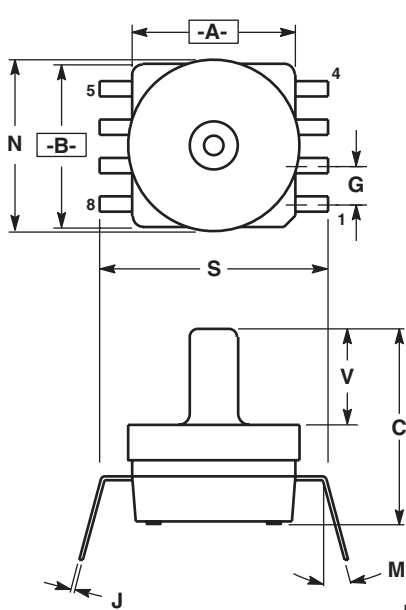


**CASE 482B-03  
ISSUE B  
SMALL OUTLINE PACKAGE  
THROUGH-HOLE**

### 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.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

| 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   | 0.210     | 0.220 | 5.33        | 5.59  |
| D   | 0.026     | 0.034 | 0.66        | 0.864 |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| J   | 0.009     | 0.011 | 0.23        | 0.28  |
| K   | 0.100     | 0.120 | 2.54        | 3.05  |
| M   | 0°        | 15°   | 0°          | 15°   |
| N   | 0.405     | 0.415 | 10.29       | 10.54 |
| S   | 0.540     | 0.560 | 13.72       | 14.22 |



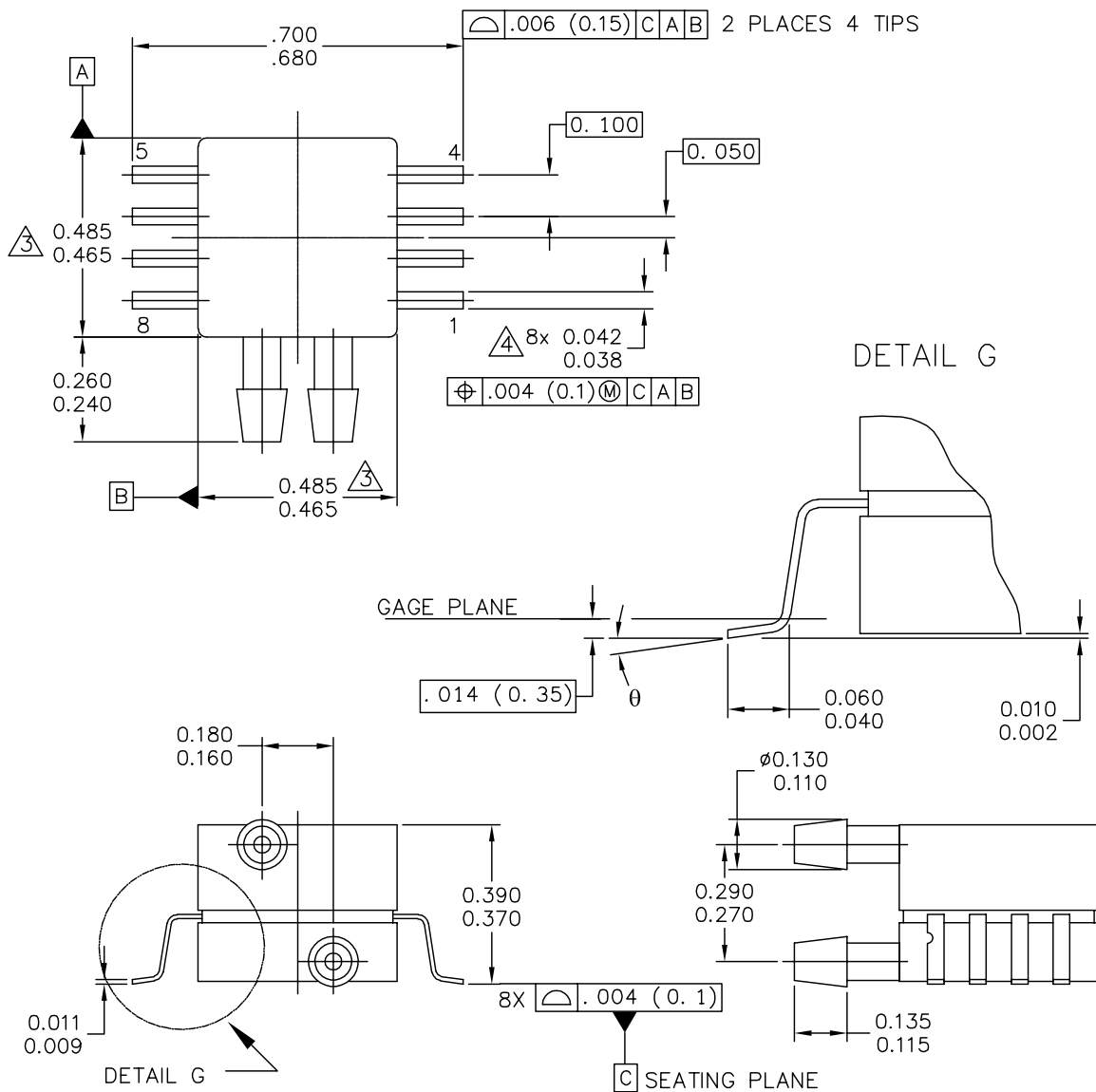
**CASE 482C-03  
ISSUE B  
SMALL OUTLINE PACKAGE  
THROUGH-HOLE**

### 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.
6. DIMENSION S TO CENTER OF LEAD WHEN FORMED PARALLEL.

| 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   | 0.026     | 0.034 | 0.66        | 0.864 |
| G   | 0.100 BSC |       | 2.54 BSC    |       |
| J   | 0.009     | 0.011 | 0.23        | 0.28  |
| K   | 0.100     | 0.120 | 2.54        | 3.05  |
| M   | 0°        | 15°   | 0°          | 15°   |
| N   | 0.444     | 0.448 | 11.28       | 11.38 |
| S   | 0.540     | 0.560 | 13.72       | 14.22 |
| V   | 0.245     | 0.255 | 6.22        | 6.48  |
| W   | 0.115     | 0.125 | 2.92        | 3.17  |

## PACKAGE DIMENSIONS



|                                                         |                    |                          |                            |             |
|---------------------------------------------------------|--------------------|--------------------------|----------------------------|-------------|
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| TITLE:<br><br>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  
SURFACE MOUNT**

**MPXV4006G**

## 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

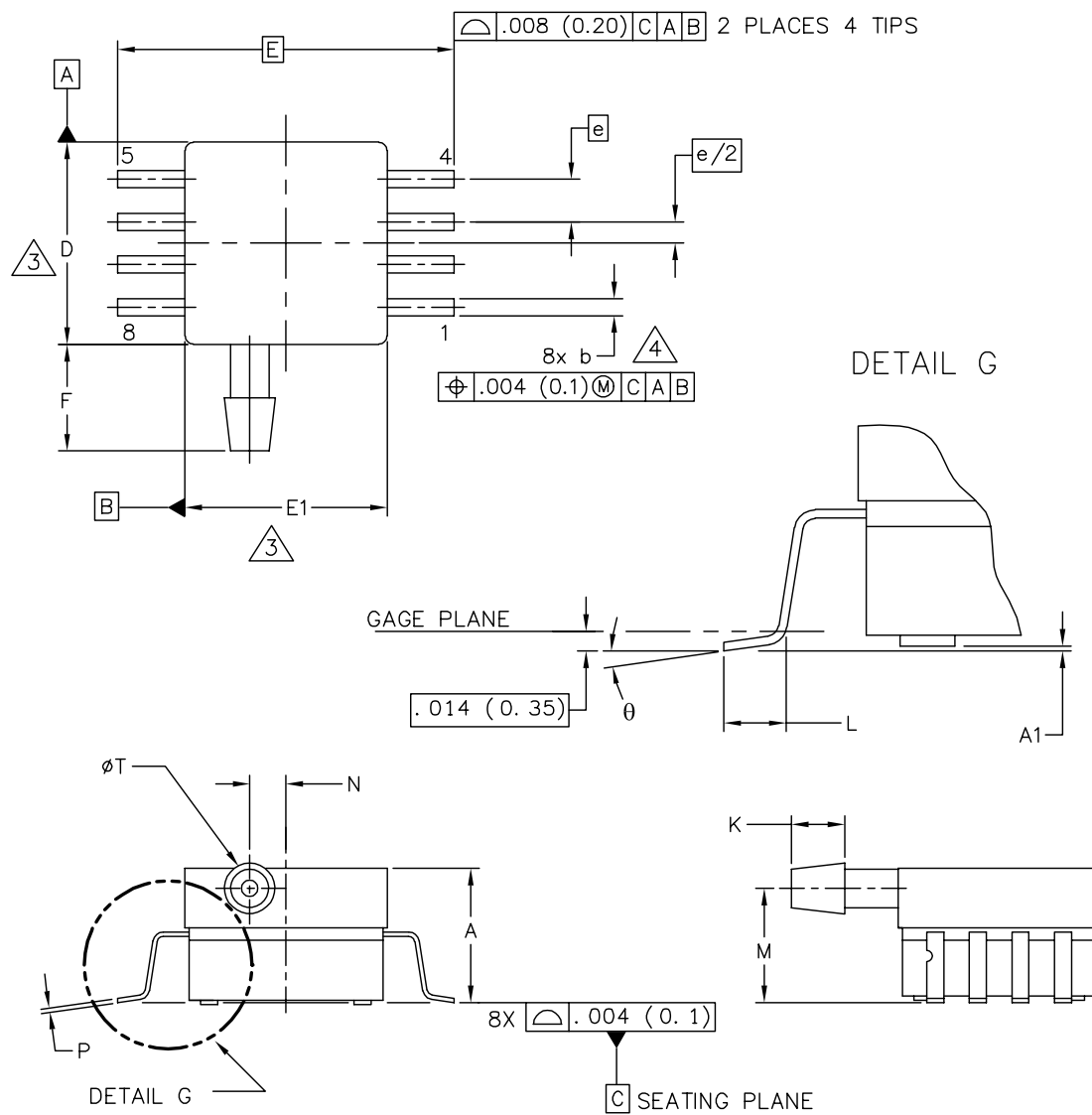
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| TITLE:<br><br>8 LD SNSR, DUAL PORT                      | DOCUMENT NO: 98ASA99255D  |                            | REV: A      |
|                                                         | CASE NUMBER: 1351-01      |                            |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

PAGE 2 OF 2

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



## PACKAGE DIMENSIONS



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

PAGE 1 OF 2

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

**MPXV4006G**

## 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:<br><br>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  
SURFACE MOUNT**

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