



# MPX5100, 0 to 100 kPa, Differential, Gauge, and Absolute, Integrated, Pressure Sensors

The MPX5100 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
- Patented silicon shear stress strain gauge
- Available in absolute, differential and gauge configuration
- Durable epoxy unibody element
- Easy-to-use chip carrier option

## Typical applications

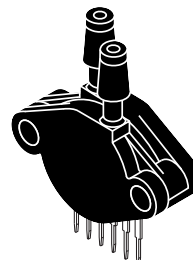
- Patient monitoring
- Process control
- Pump/motor control
- Pressure switching
- White goods

## MPX5100

### Unibody packages

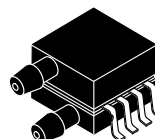


MPX5100AP/GP  
98ASB42796B

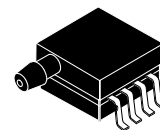


MPX5100DP  
98ASA42797B

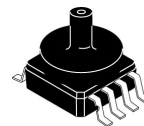
### Small outline packages



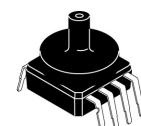
MPXV5100DP  
98ASA99255D



MPXV5100GP  
98ASA99303D



MPXV5100GC6U  
98ASB17757C



MPXV5100GC7U  
98ASB17759C

| Ordering information                    |          |             |            |        |      |               |              |          |                |
|-----------------------------------------|----------|-------------|------------|--------|------|---------------|--------------|----------|----------------|
| Device name                             | Shipping | Package     | # of Ports |        |      | Pressure type |              |          | Device marking |
|                                         |          |             | None       | Single | Dual | Gauge         | Differential | Absolute |                |
| Unibody Package (MPX5100 Series)        |          |             |            |        |      |               |              |          |                |
| MPX5100AP                               | Tray     | 98ASB42796B |            | •      |      |               |              | •        | MPX5100AP      |
| MPX5100DP                               | Tray     | 98ASB42797B |            |        | •    |               | •            |          | MPX5100DP      |
| MPX5100GP                               | Tray     | 98ASB42796B |            | •      |      | •             |              |          | MPX5100GP      |
| Small Outline Package (MPXV5100 Series) |          |             |            |        |      |               |              |          |                |
| MPXV5100DP                              | Tray     | 98ASA99255D |            |        | •    |               | •            |          | MPXV5100DP     |
| MPXV5100GC6U                            | Rail     | 98ASB17757C |            | •      |      | •             |              |          | MPXV5100G      |
| MPXV5100GC7U                            | Rail     | 98ASB17759C |            | •      |      | •             |              |          | MPXV5100G      |
| MPXV5100GP                              | Tray     | 98ASA99303D |            | •      |      | •             |              |          | MPXV5100GP     |

NXP reserves the right to change the detail specifications as may be required to permit improvements in the design of its products.

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## Related Documentation

The MPX5100 device features and operations are described in a variety of reference manuals, user guides, and application notes. To find the most-current versions of these documents:

1. Go to the NXP homepage at:  
<http://www.nxp.com/>
2. In the Keyword search box at the top of the page, enter the device number MPX5100.
3. In the Refine Your Result pane on the left, click on the Documentation link.

## MPX5100

# 1 General Description

## 1.1 MPX5100AP/DP/GP Block diagram

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

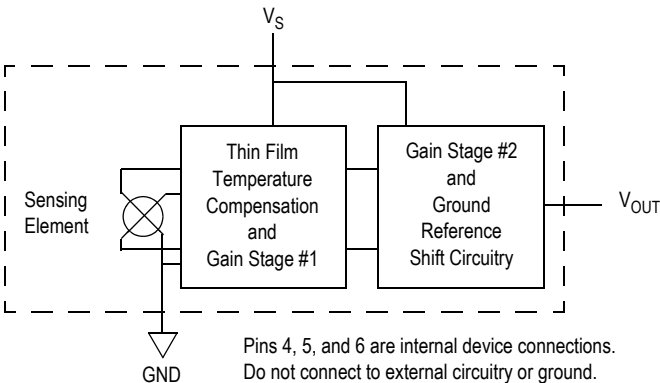


Figure 1. Integrated pressure sensor block diagram

## 1.2 MPX5100AP/DP/GP Pinout (Unibody)

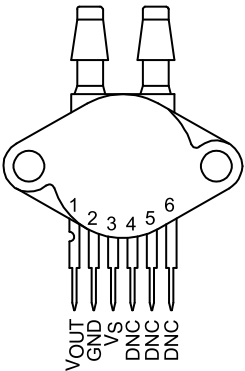


Figure 2. Device pinout (top view)

Table 1. Pin functions

| Pin | Name      | Function                                        |
|-----|-----------|-------------------------------------------------|
| 1   | $V_{OUT}$ | Output voltage                                  |
| 2   | GND       | Ground                                          |
| 3   | $V_S$     | Voltage supply                                  |
| 4   | DNC       | Do not connect to external circuitry or ground. |
| 5   | DNC       | Do not connect to external circuitry or ground. |
| 6   | DNC       | Do not connect to external circuitry or ground. |

### 1.3 MPXV5100DP/GC6U/GC7U/GP block diagram

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

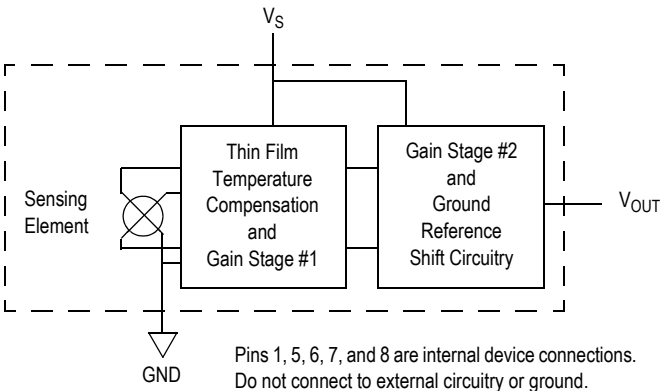


Figure 3. Integrated pressure sensor block diagram

### 1.4 MPXV5100DP/GC6U/GC7U/GP pinout (small outline package)

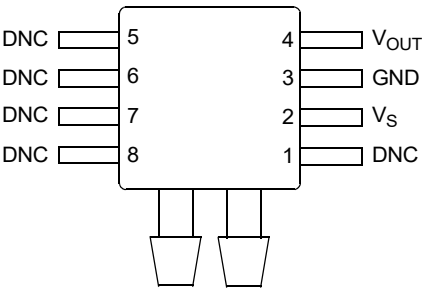


Figure 4. Device pinout (top view)

Table 2. Pin functions

| Pin | Name      | Function                                        |
|-----|-----------|-------------------------------------------------|
| 1   | DNC       | Do not connect to external circuitry or ground. |
| 2   | $V_S$     | Voltage supply                                  |
| 3   | GND       | Ground                                          |
| 4   | $V_{OUT}$ | Output voltage                                  |
| 5   | DNC       | Do not connect to external circuitry or ground. |
| 6   | DNC       | Do not connect to external circuitry or ground. |
| 7   | DNC       | Do not connect to external circuitry or ground. |
| 8   | DNC       | Do not connect to external circuitry or ground. |

## 2 Mechanical and Electrical Specifications

### 2.1 Maximum ratings

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

| Rating                | Symbol    | Value       | Unit |
|-----------------------|-----------|-------------|------|
| Maximum pressure      | $P_{max}$ | 400         | 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.

### 2.2 Operating characteristics

**Table 4. Operating characteristics ( $V_S = 5$  Vdc,  $T_A = 25$  °C.)**

| Characteristic                                                                                  | Symbol    | Min     | Typ    | Max        | Unit              |
|-------------------------------------------------------------------------------------------------|-----------|---------|--------|------------|-------------------|
| Pressure range <sup>(1)</sup><br>Gauge, differential: MPX5100G/MPXV5100G<br>Absolute: MPX5100AP | $P_{OP}$  | 0<br>15 | —<br>— | 100<br>115 | kPa               |
| Supply voltage <sup>(2)</sup>                                                                   | $V_S$     | 4.75    | 5.0    | 5.25       | V <sub>DC</sub>   |
| Supply current                                                                                  | $I_O$     | —       | 7.0    | 10         | mAdc              |
| Minimum pressure offset <sup>(3)</sup> , (0 to 85 °C)<br>@ $V_S = 5.0$ V                        | $V_{OFF}$ | 0.088   | 0.20   | 0.313      | V <sub>DC</sub>   |
| Full-scale output <sup>(4)</sup> , differential and absolute (0 to 85 °C)<br>@ $V_S = 5.0$ V    | $V_{FSO}$ | 4.587   | 4.700  | 4.813      | V <sub>DC</sub>   |
| Full-scale Span <sup>(5)</sup> , differential and absolute (0 to 85 °C)<br>@ $V_S = 5.0$ V      | $V_{FSS}$ | —       | 4.500  | —          | V <sub>DC</sub>   |
| Accuracy <sup>(6)</sup>                                                                         | —         | —       | —      | ±2.5       | %V <sub>FSS</sub> |
| Sensitivity                                                                                     | V/P       | —       | 45     | —          | 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>                                                                 | —         | —       | ±0.5   | —          | %V <sub>FSS</sub> |

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 minimum or maximum rated pressure at 25 °C.
- TcSpan: Output deviation over the temperature range of 0 to 85 °C, relative to 25 °C.
- TcOffset: Output deviation with minimum pressure applied over the temperature range of 0 to 85 °C, relative to 25 °C.
- Variation from nominal: The variation from nominal values, for offset or full-scale span, as a percent of  $V_{FSS}$  at 25 °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.

### 3 On-chip Temperature Compensation and Calibration

Figure 5 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 7. The output will saturate outside of the specified pressure range.

Figure 6 illustrates both the Differential/Gauge and the Absolute Sensing Chip in the basic chip carrier. 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 MPX5100 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.

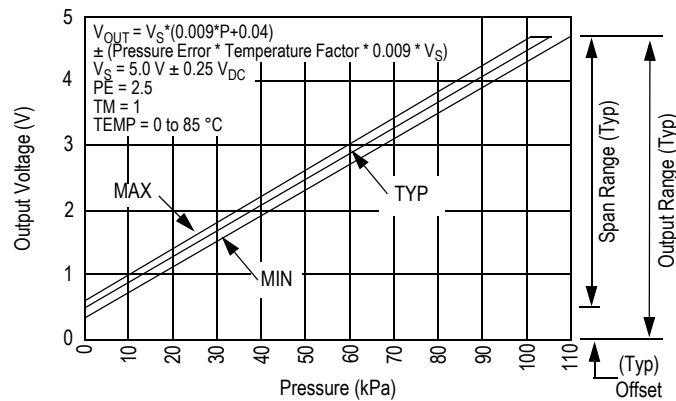


Figure 5. Output versus pressure differential

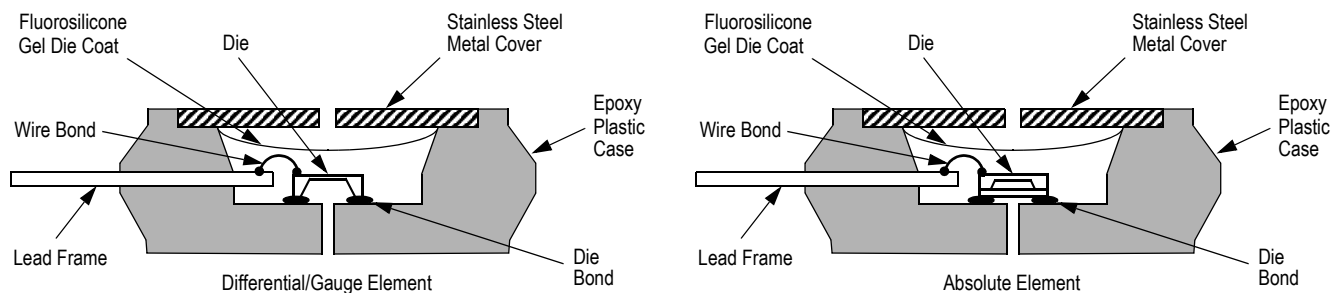


Figure 6. Cross-sectional diagrams (not-to-scale)

Figure 7 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.

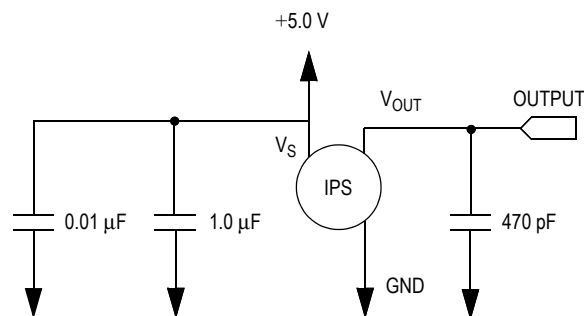
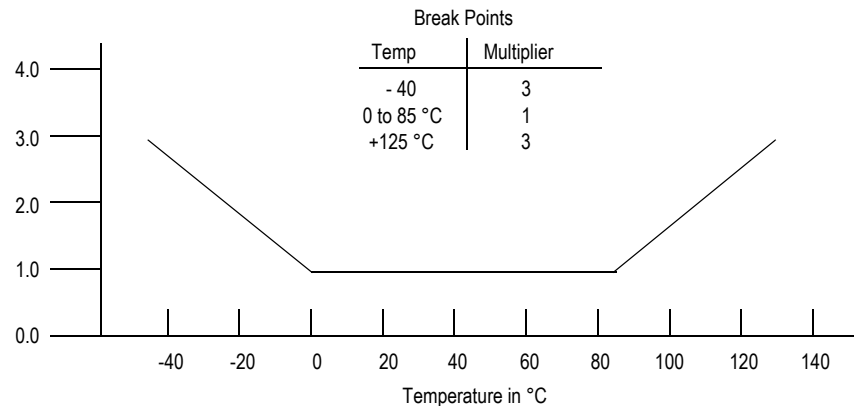


Figure 7. Recommended power supply decoupling and output filtering  
(For additional output filtering, please refer to application note AN1646.)

The following figures show the nominal transfer function, temperature and pressure error over the operating range for the MPX5100D,MPX5100G and MPXV5100G devices.

**Nominal Transfer Value:**  $V_{OUT} = V_S (P \times 0.009 + 0.04)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Mult.} \times 0.009 \times V_S)$   
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ V}$

Figure 8. Transfer function (MPX5100D, MPX5100G, MPXV5100G)



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

Figure 9. Temperature error multiplier (MPX5100D, MPX5100G, MPXV5100G)

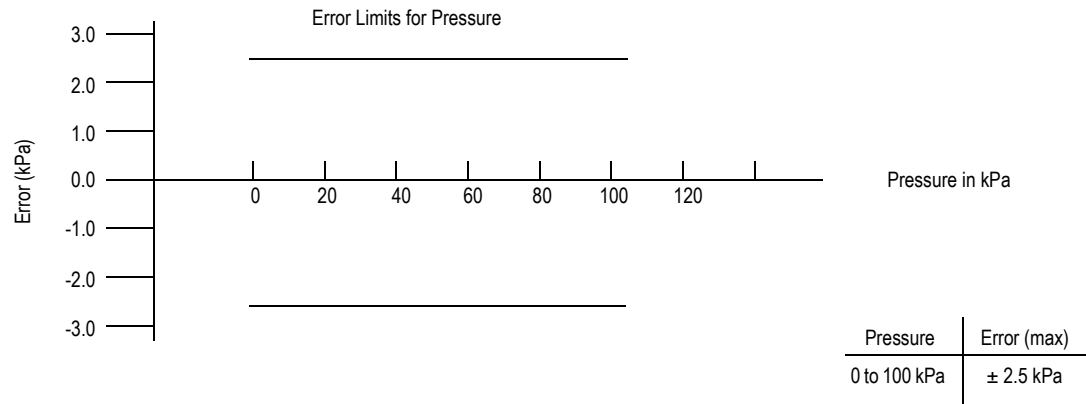


Figure 10. Pressure error band (MPX5100D, MPX5100G, MPXV5100G)

The following figures show the nominal transfer function, temperature and pressure error over the operating range for the MPX5100AP device.

**Nominal Transfer Value:**  $V_{OUT} = V_S (P \times 0.009 - 0.095)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Mult.} \times 0.009 \times V_S)$   
 $V_S = 5.0 \text{ V} \pm 0.25 \text{ V}$

Figure 11. Transfer function (MPX5100AP)

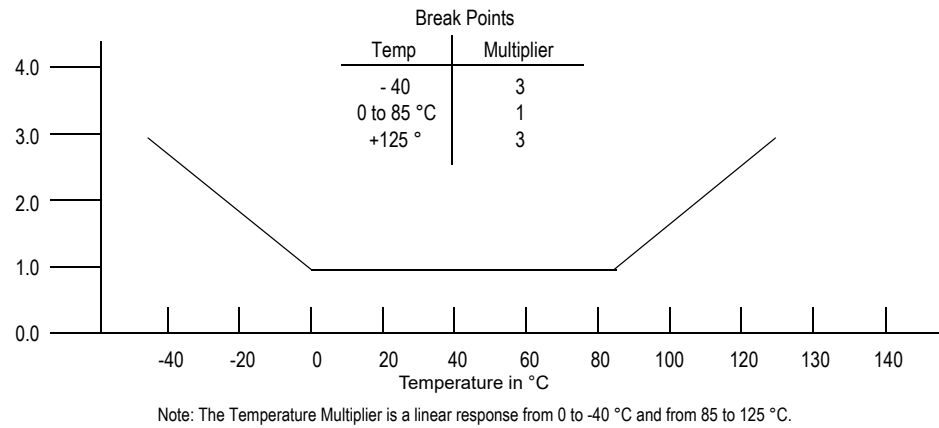


Figure 12. Temperature error multiplier (MPX5100AP)

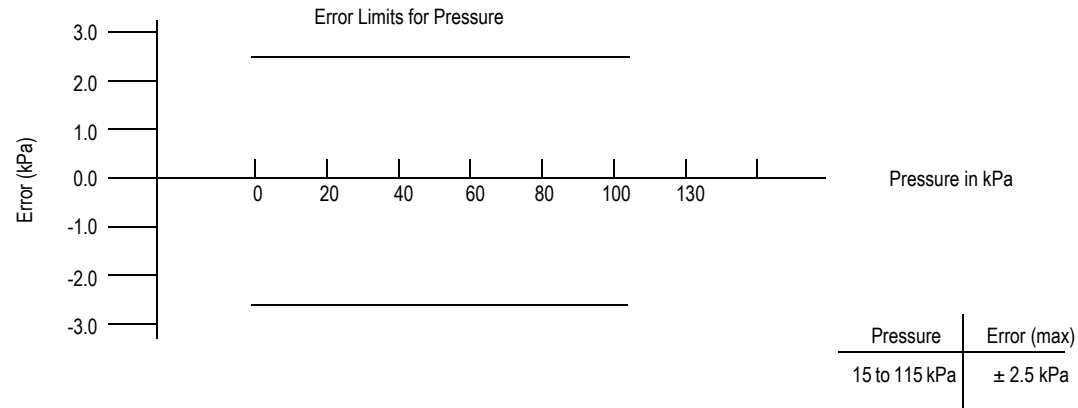


Figure 13. Pressure error band (MPX5100AP)

## 4 Package Information

### 4.1 Pressure (P1)/Gauge (P2) side identification table

NXP designates the two sides of the pressure sensor as the Pressure (P1) side and the Gauge (P2) side. The Pressure (P1) side is the side containing fluoro-silicone 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          | Package     | Pressure (P1) side identifier |
|----------------------|-------------|-------------------------------|
| MPX5100AP, MPX5100GP | 98ASB42796B | Side with port attached       |
| MPX5100DP            | 98ASB42797B | Side with part marking        |
| MPXV5100DP           | 98ASA99255D | Side with part marking        |
| MPXV5100GC6U         | 98ASB17757C | Side with port attached       |
| MPXV5100GC7U         | 98ASB17759C | Side with port attached       |
| MPXV5100GP           | 98ASA99303D | Side with port attached       |

### 4.2 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

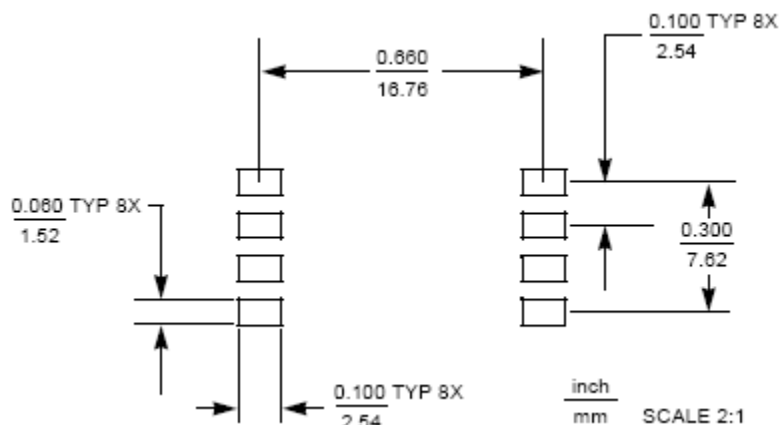
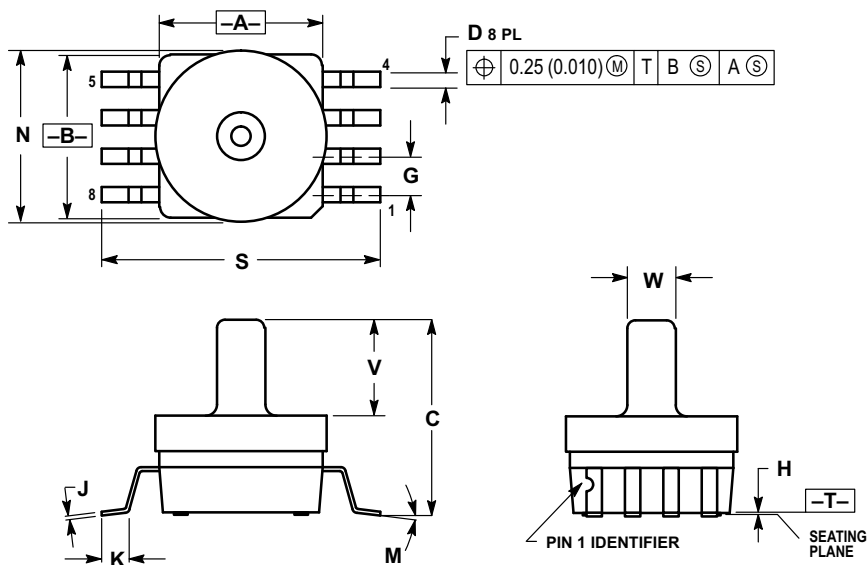


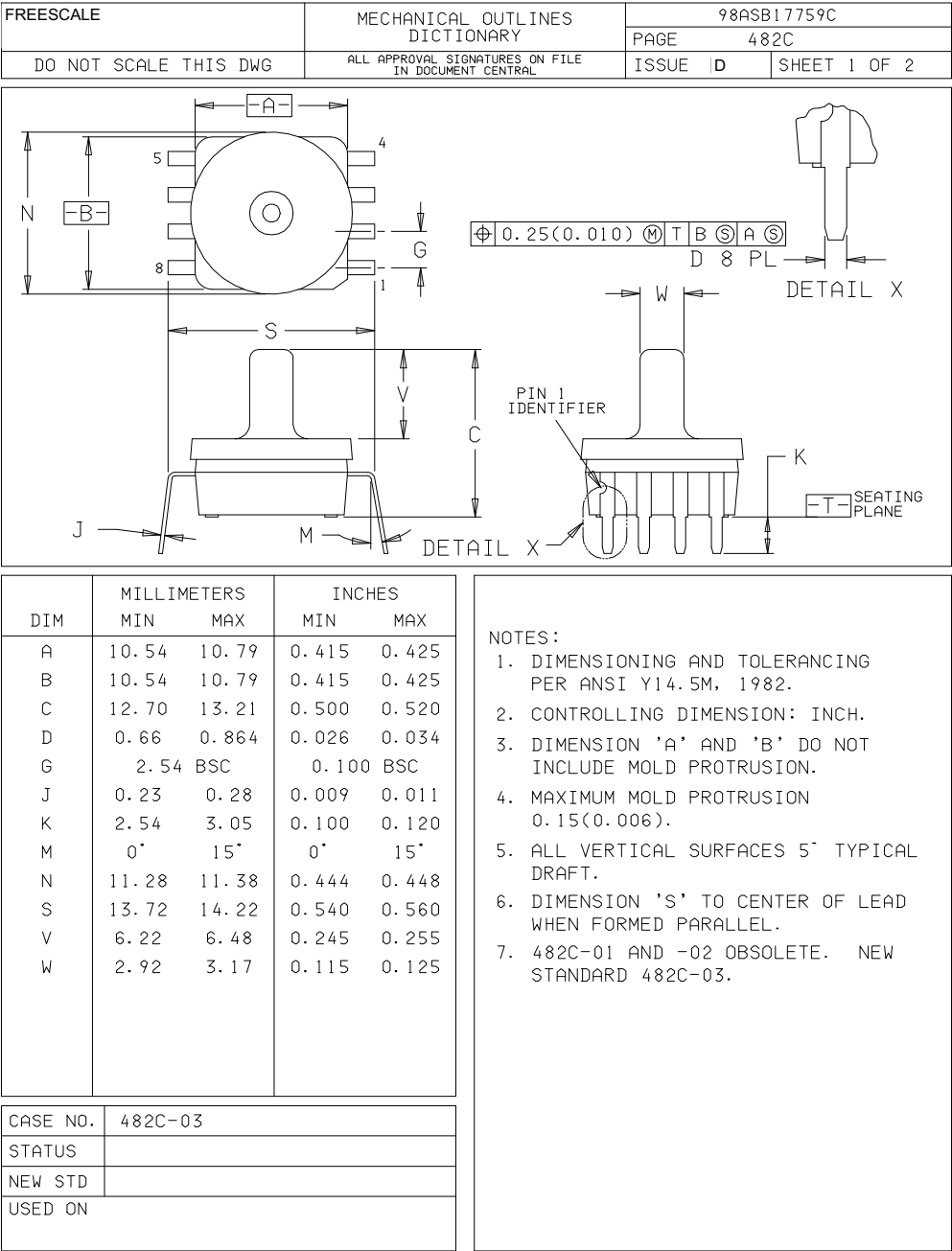
Figure 14. Small outline package footprint

### 4.3 Package dimensions

This drawing is located at [http://cache.NXP.com/files/shared/doc/package\\_info/98ASB17757C.pdf](http://cache.NXP.com/files/shared/doc/package_info/98ASB17757C.pdf).

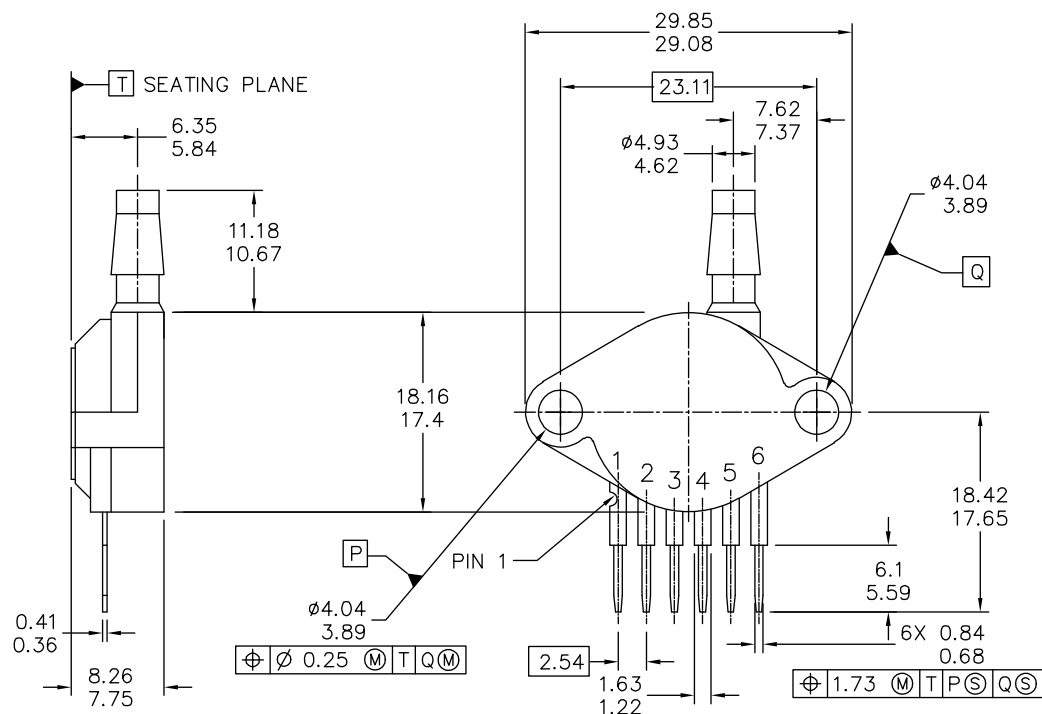


**Case 98ASB17757C, 8-lead small outline package**



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Case 98ASB17759C, 8-lead small outline package



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

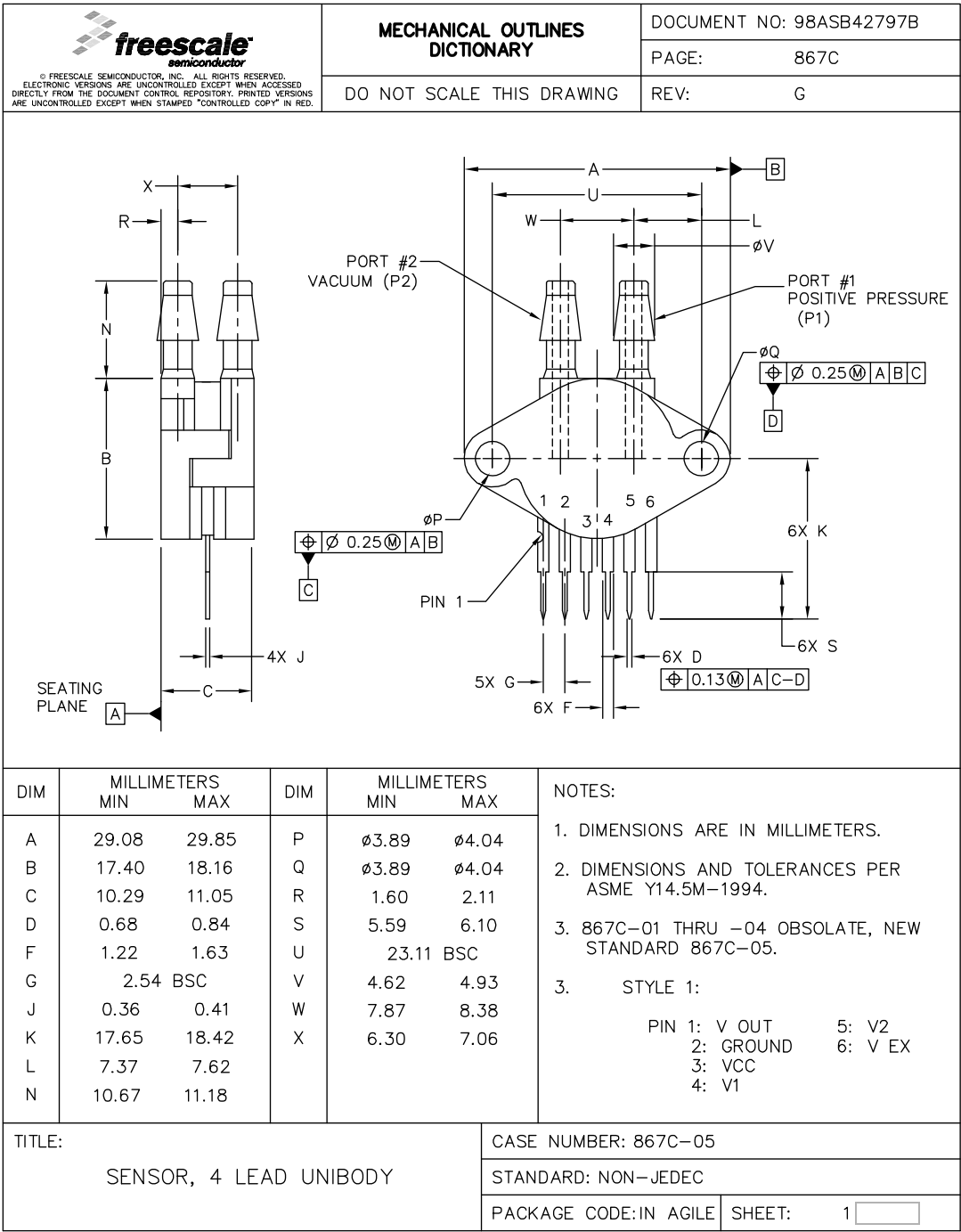
Case 98ASB42796B, 6-lead unibody package

NOTES:

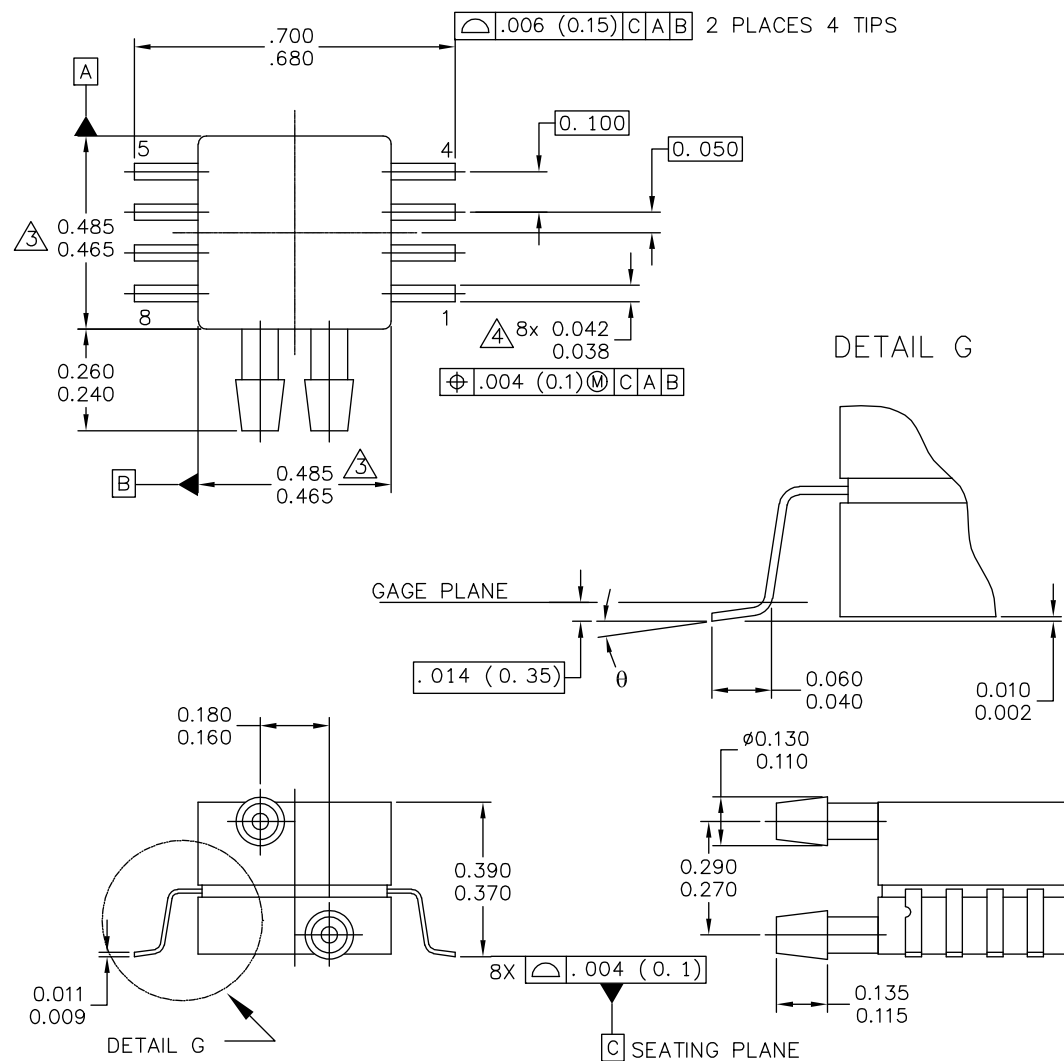
1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. 867B-01 THRU -3 OBSOLETE, NEW STANDARD 867B-04.

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

**Case 98ASB42796B, 6-lead unibody package**



Case 98ASB42797B, 6-lead unibody package



|                                                         |                           |                            |
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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       |                            |

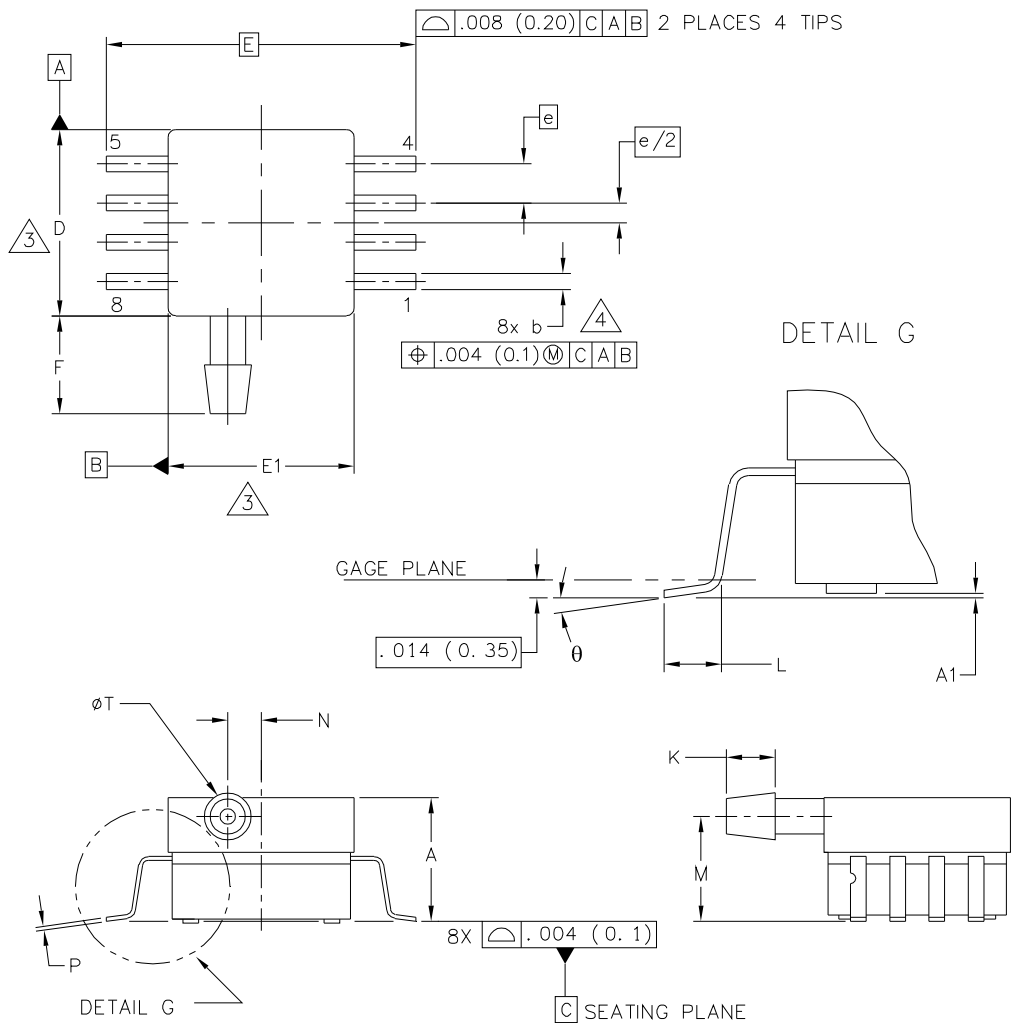
Case 98ASA99255D, 8-lead, dual port, small outline package

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.

|                                                         |                           |                            |             |
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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       |                            |             |

**Case 98ASA99255D, 8-lead, dual port, small outline package**



|                                                         |  |                          |                            |
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| TITLE:<br><br>8 LD SOP, SIDE PORT                       |  | DOCUMENT NO: 98ASA99303D | REV: D                     |
|                                                         |  | CASE NUMBER: 1369-01     | 13 DEC 2010                |
|                                                         |  | STANDARD: NON-JEDEC      |                            |

NOTES:

1. CONTROLLING DIMENSION: INCH

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

 DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH AND PROTRUSIONS SHALL NOT EXCEED .006 (0.152) PER SIDE.

 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 | 7.62               | 8.38  | Ø                        | 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: D      |     |
|                                                         |          |      |                    |       | CASE NUMBER: 1369-01     |                            |     | 13 DEC 2010 |     |
|                                                         |          |      |                    |       | STANDARD: NON-JEDEC      |                            |     |             |     |

**Case 98ASA99303D, 8-lead, side port, small outline package**

## 5 Revision History

Table 5. Revision history

| Revision number | Revision date | Description of changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|-----------------|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 14              | 12/2018       | <ul style="list-style-type: none"><li>Deleted obsolete part numbers MPX5100A and MPX5100D.</li><li>Changed format to new corporate format.</li><li>Added pinout for MPX5100AP/DP/GP in <a href="#">Figure 2</a>.</li><li>Added pin functions for MPX5100AP/DP/GP as <a href="#">Table 1</a>.</li><li>Added pinout for MPXV5100DP/GC6U/GC7U/GP as <a href="#">Figure 4</a>.</li><li>Added pin functions for MPXV5100DP/GC6U/GC7U/GP as <a href="#">Table 2</a>.</li><li>Moved section 5.1, Package dimensions to <a href="#">Section 4.3</a>.</li><li>Deleted section 5, duplicate Package Information information section.</li><li>Added revision history as <a href="#">Table 5</a>.</li></ul> |

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