

# MPX5050

Integrated silicon pressure sensor, on-chip signal conditioned, temperature compensated and calibrated

Rev. 12 — 9 June 2023

Product data sheet

## 1 General description

The MPXx5050 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.

## 2 Feature and benefits

- 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

## 3 Ordering information

Table 1. Ordering information

| Type number   | Package  |   |            |
|---------------|----------|---|------------|
|               | Name     | Description   | Version    |
| MPX5050DP     | SENSOR4F | Pressure sensor, 5 V, 0/50 kPa, Port; Unibody package, 4 terminals; 2.54 mm pitch; 17.78 mm x 29.48 mm x 10.67 mm body                    | SOT1756-1  |
| MPXV5050DP    | SENSOR6F | Pressure sensor, 5 V, 0/50 kPa, Port, SO8, plastic, small outline package; 8 terminals; 2.54 mm pitch; 12.06 mm x 12.06 mm x 7.62 mm body | SOT1693-1  |
| MPXV5050GP    | SO8      | Pressure sensor, 5 V, 0/50 kPa, Port, 8 terminals; 2.54 mm pitch; 12.06 mm x 12.06 mm x 3.38 mm body                                      | SOT1693-3  |
| MPXV5050GC6T1 | SO8      | Pressure sensor, 5 V, 0/540 kPa, small outline package, Port, 8 terminals; 2.54 mm pitch; 10.67 mm x 10.67 mm x 12.96 mm body             | SOT18454-1 |



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### 3.1 Ordering options

Table 2. Ordering options

| ORDERING INFORMATION                           |          |            |        |      |               |              |          |                |
|--|----------|------------|--------|------|---------------|--------------|----------|----------------|
| Device Name                                    | Case No. | # of Ports |        |      | Pressure Type |              |          | Device Marking |
|  |          | None       | Single | Dual | Gauge         | Differential | Absolute |                |
| <b>Unibody Package (MPX5050 Series)</b>        |          |            |        |      |               |              |          |                |
| MPX5050DP                                      | 867C     |            |        | •    |               | •            |          | MPX5050DP      |
| <b>Small Outline Package (MPXV5050 Series)</b> |          |            |        |      |               |              |          |                |
| MPXV5050GP                                     | 1369     |            | •      |      | •             |              |          | MPXV5050GP     |
| MPXV5050DP                                     | 1351     |            |        | •    |               | •            |          | MPXV5050DP     |
| MPXV5050GC6T1                                  | 482A     |            | •      |      | •             |              |          | MPXV5050G      |

## 4 Pinning information

### 4.1 Pinning

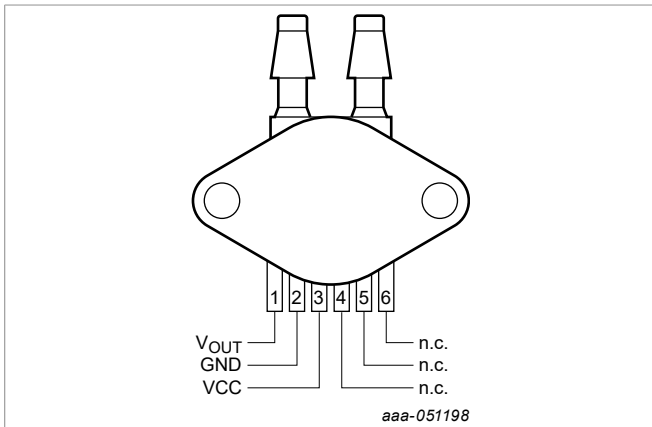


Figure 1. MPX5050DP - SOT1756-1 - Case 867C-05

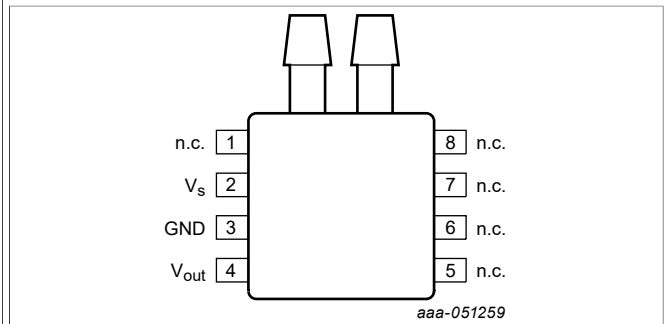


Figure 2. MPXV5050DP Case 1351-01 <sup>[1]</sup>

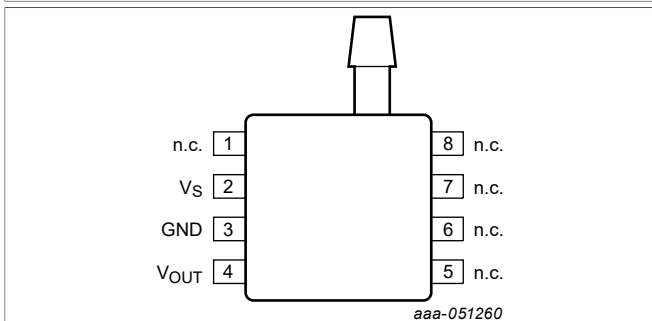


Figure 3. MPXV5050GP Case 1369-01

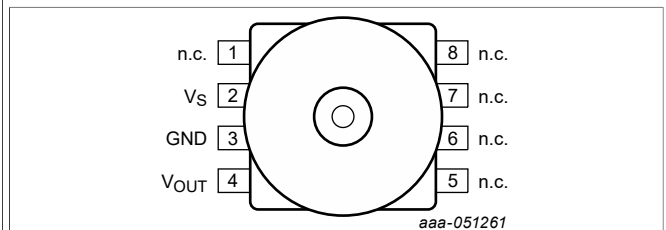


Figure 4. MPXV5050GC6T1 – Case 482A-01

[1] Refer to [Table 4](#) and style 2 in [Figure 13](#) in [Section 7 "Package outline"](#)

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## 4.2 Pin description

Table 3. Pin descriptions - MPX5050DP

| Symbol           | Pin | Description      |
|------------------|-----|------------------|
| V <sub>OUT</sub> | 1   | V <sub>OUT</sub> |
| Ground           | 2   | Ground           |
| V <sub>CC</sub>  | 3   | Supply voltage   |
| N.C.             | 4   | No connection.   |
| N.C.             | 5   | No connection.   |
| N.C.             | 6   | No connection.   |

Table 4. Pin descriptions - MPXV5050GC6T1, MPXV5050DP, and MPXV5050GP

| Symbol           | Pin | Description      |
|------------------|-----|------------------|
| N.C.             | 1   | No connect       |
| V <sub>S</sub>   | 2   | Supply voltage   |
| Ground           | 3   | Ground           |
| V <sub>OUT</sub> | 4   | V <sub>OUT</sub> |
| N.C.             | 5   | No connect       |
| N.C.             | 6   | No connect       |
| N.C.             | 7   | No connect       |
| N.C.             | 8   | No connect       |

## 5 Limiting values

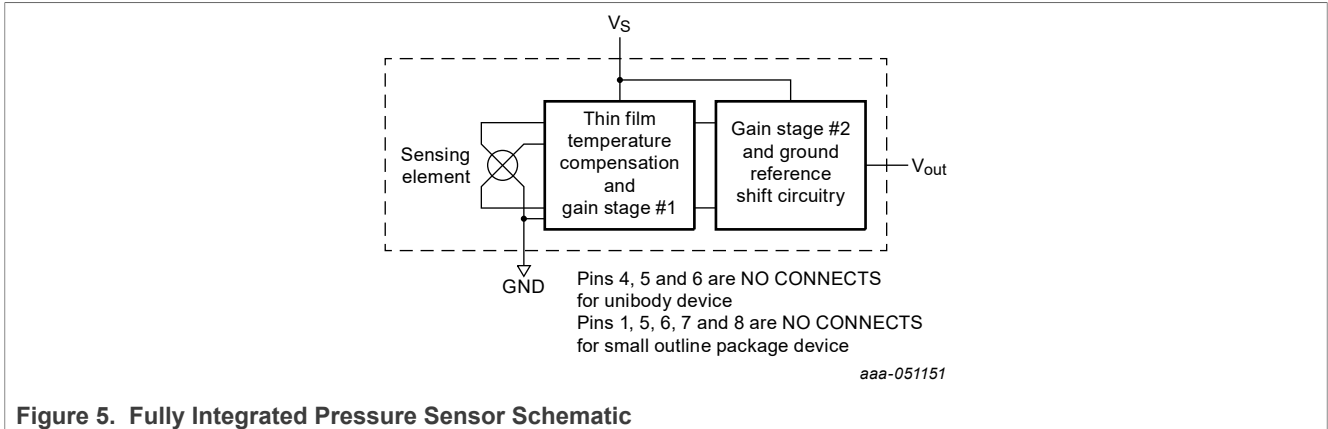
Table 5. Limiting values <sup>[1]</sup>

| Rating                     | Symbol           | Value       | Unit |
|----------------------------|------------------|-------------|------|
| Maximum pressure (P1 > P2) | P <sub>max</sub> | 200         | kPa  |
| Storage temperature        | T <sub>stg</sub> | -40 to +125 | °C   |
| Operating temperature      | T <sub>A</sub>   | -40 to +125 | °C   |

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

[Figure 5](#) shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

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6 Recommended operating conditions

Table 6. Recommended operating conditions

( $V_S = 5.0\text{ Vdc}$ ,  $T_A = 25\text{ °C}$  unless otherwise noted,  $P1 > P2$ . Decoupling circuit shown in Figure 8 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> (0 °C to 85 °C)<br>@ $V_S = 5.0\text{ Volts}$ | $V_{off}$ | 0.088 | 0.2   | 0.313 | Vdc         |
| Full Scale Output <sup>[4]</sup> (0 °C to 85 °C)<br>@ $V_S = 5.0\text{ Volts}$       | $V_{FSO}$ | 4.587 | 4.7   | 4.813 | Vdc         |
| Full Scale Span <sup>[5]</sup> (0 °C to 85 °C)<br>@ $V_S = 5.0\text{ Volts}$         | $V_{FSS}$ | —     | 4.5   | —     | Vdc         |
| Accuracy <sup>[6]</sup> (0 °C to 85 °C)  | —         | —     | —     | ±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>  | —         | —     | ± 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 °C.  
 TcSpan: Output deviation over the temperature range of 0 °C to 85 °C, relative to 25 °C.  
 TcOffset: Output deviation with minimum pressure applied, over the temperature range of 0 °C 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.

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- [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.

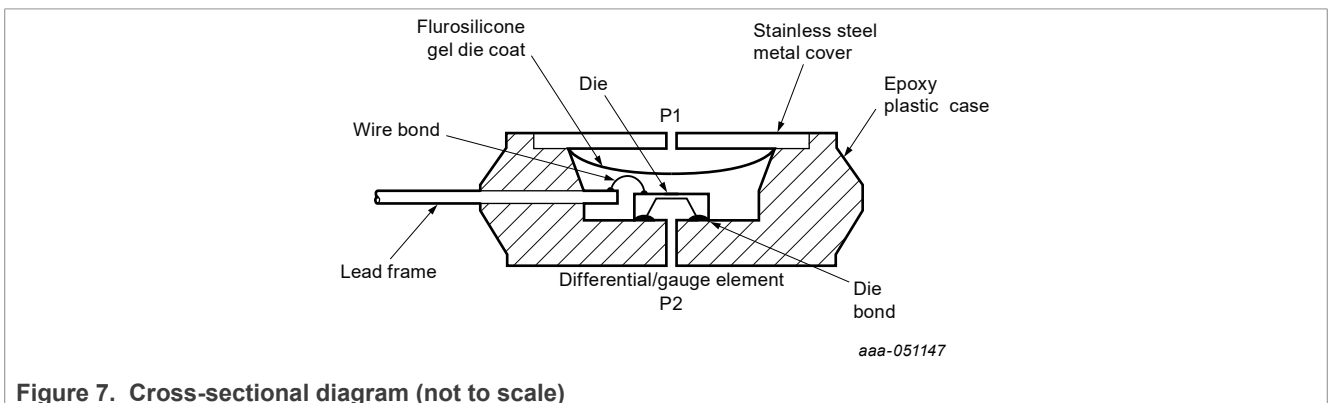
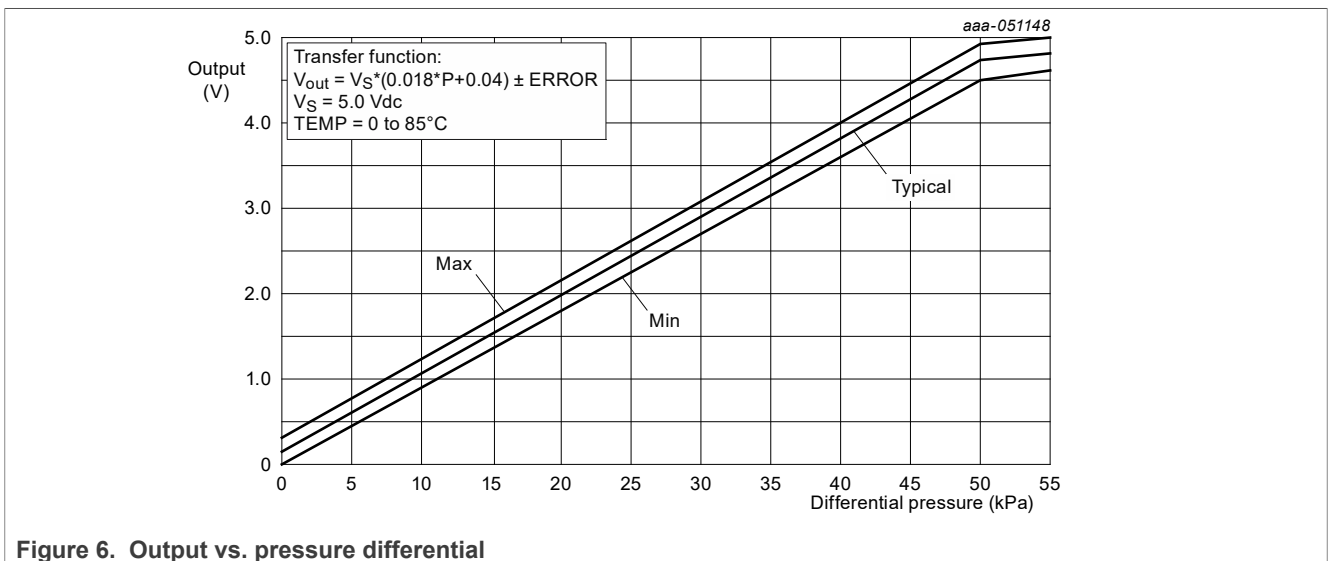
6.1 On-chip Temperature Compensation and Calibration

Figure 7 illustrates the Differential/Gauge Sensing Chip in 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 6 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 °C to 85 °C using the decoupling circuit shown in Figure 8. The output will saturate outside of the specified pressure range.

Figure 8 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.



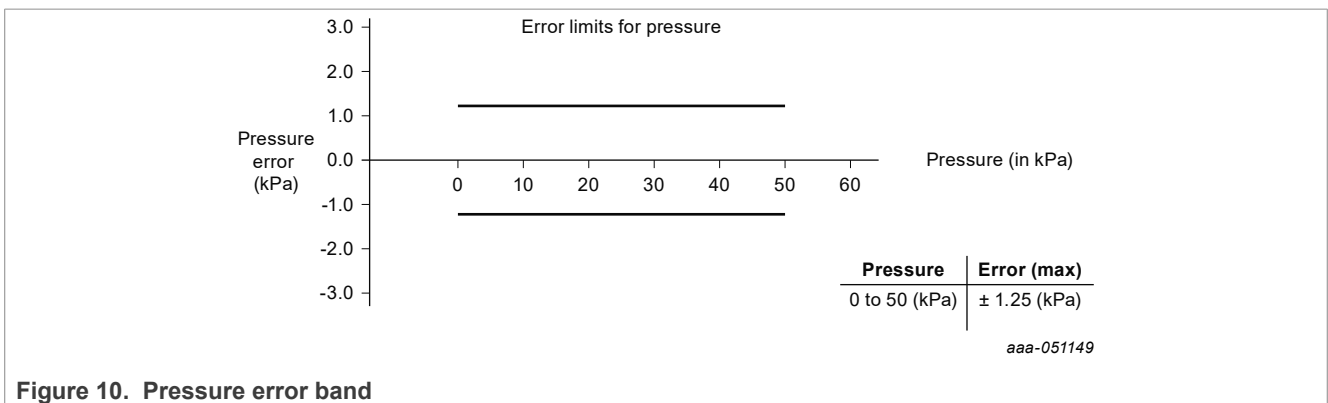
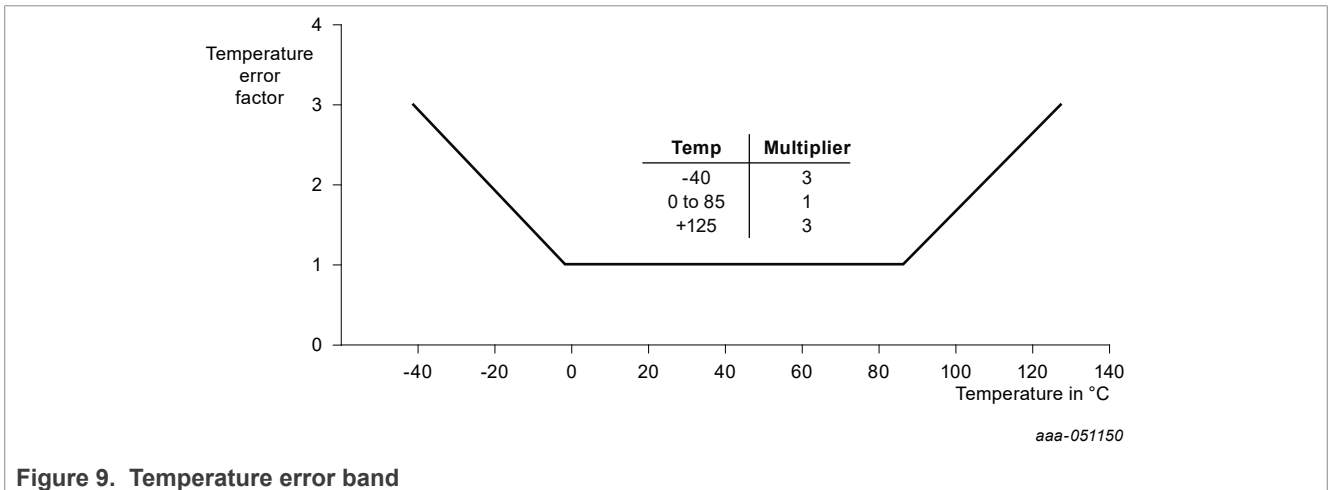
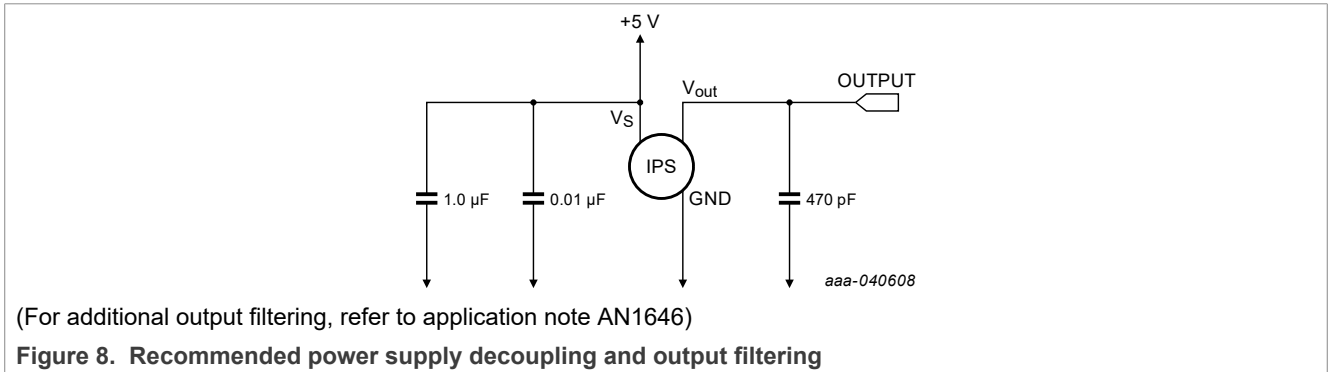
Nominal Transfer Value:

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$$V_{OUT} = V_S (P \times 0.018 + 0.04)$$

$$\pm (Pressure\ Error \times Temp.\ Factor \times 0.018\ V_S)$$

$$V_S = 5.0\ V \pm 0.25\ Vdc$$



**6.2 Pressure (P1)/Vacuum (P2) side identification table**

NXP Semiconductors 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.

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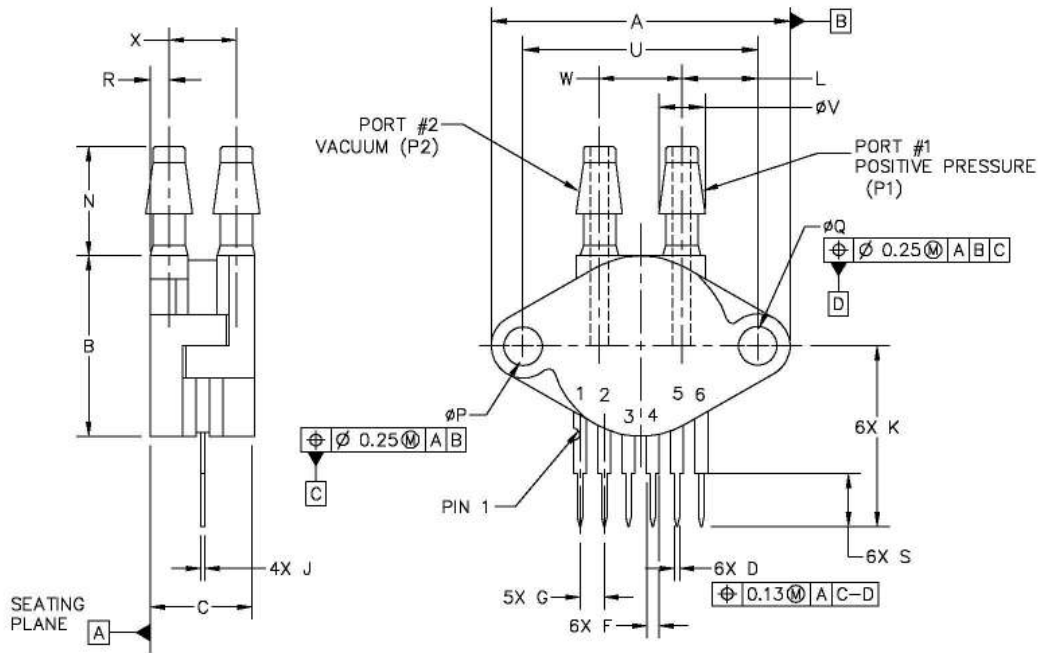
The Pressure (P1) side may be identified by using [Table 7](#):

**Table 7. Pressure (P1) side identification**

| Part Number    | Case Type | Pressure (P1) Side Identifier |
|----------------|-----------|-------------------------------|
| MPX5050DP      | 867C      | Side with Part Marking        |
| MPXV5050GP     | 1369      | Side with Port Attached       |
| MPXV5050DP     | 1351      | Side with Part Marking        |
| MPXV5050GC6/T1 | 482A      | Vertical Port Attached        |

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7 Package outline



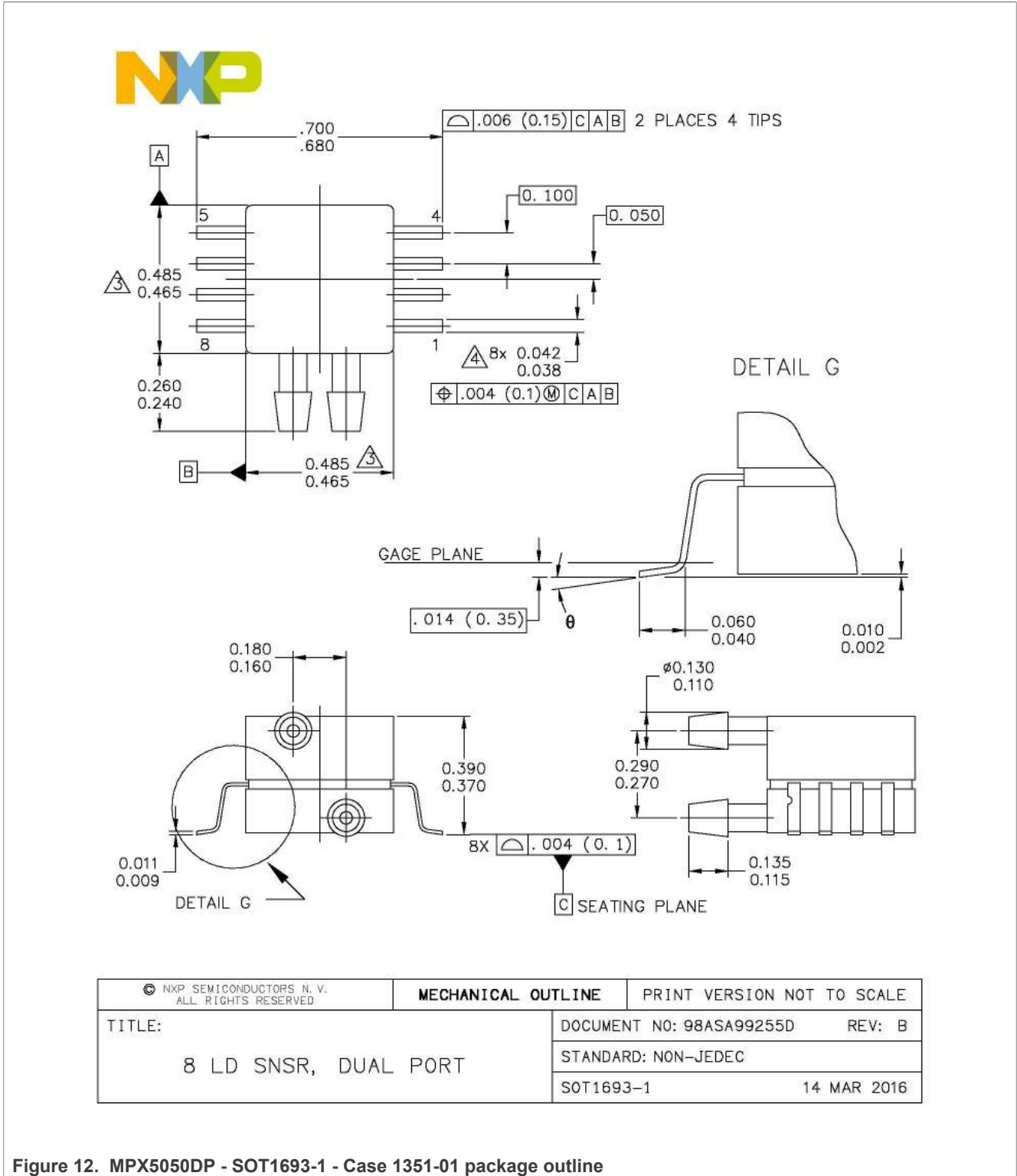
| DIM  | MILLIMETERS<br>MIN | MILLIMETERS<br>MAX | DIM                       | MILLIMETERS<br>MIN | MILLIMETERS<br>MAX                               | NOTES: |
|--|--------------------|--------------------|---------------------------|--------------------|--|--------|
| A  | 29.08              | 29.85              | P                         | $\phi 3.89$        | $\phi 4.04$                                      |        |
| B  | 17.40              | 18.16              | Q                         | $\phi 3.89$        | $\phi 4.04$                                      |        |
| C  | 10.29              | 11.05              | R                         | 1.60               | 2.11   |        |
| D  | 0.68               | 0.84               | S                         | 5.59               | 6.10   |        |
| F  | 1.22               | 1.63               | U                         | 23.11 BSC          |  |        |
| G  | 2.54 BSC           |                    | V                         | 4.62               | 4.93   |        |
| J  | 0.36               | 0.41               | W                         | 7.87               | 8.38   |        |
| K  | 17.65              | 18.42              | X                         | 6.30               | 7.06   |        |
| L  | 7.37               | 7.62               |                           |                    |  |        |
| N  | 10.67              | 11.18              |                           |                    |  |        |
| © NXP SEMICONDUCTORS N.V.<br>ALL RIGHTS RESERVED |                    |                    | <b>MECHANICAL OUTLINE</b> |                    | PRINT VERSION NOT TO SCALE                       |        |
| TITLE:   |                    |                    | SENSOR, 4 LEAD UNIBODY    |                    | DOCUMENT NO: 98ASB42797B    REV: H               |        |
|  |                    |                    |                           |                    | STANDARD: NON-JEDEC                              |        |
|  |                    |                    |                           |                    | SOT1756-1                            29 JAN 2016 |        |

Figure 11. MPX5050DP - SOT17560-1 - Case 867C package outline <sup>1</sup>

<sup>1</sup> Refer to [Section 4.2 "Pin description", Table 3](#)



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Integrated silicon pressure sensor, on-chip signal conditioned, temperature compensated and calibrated



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.

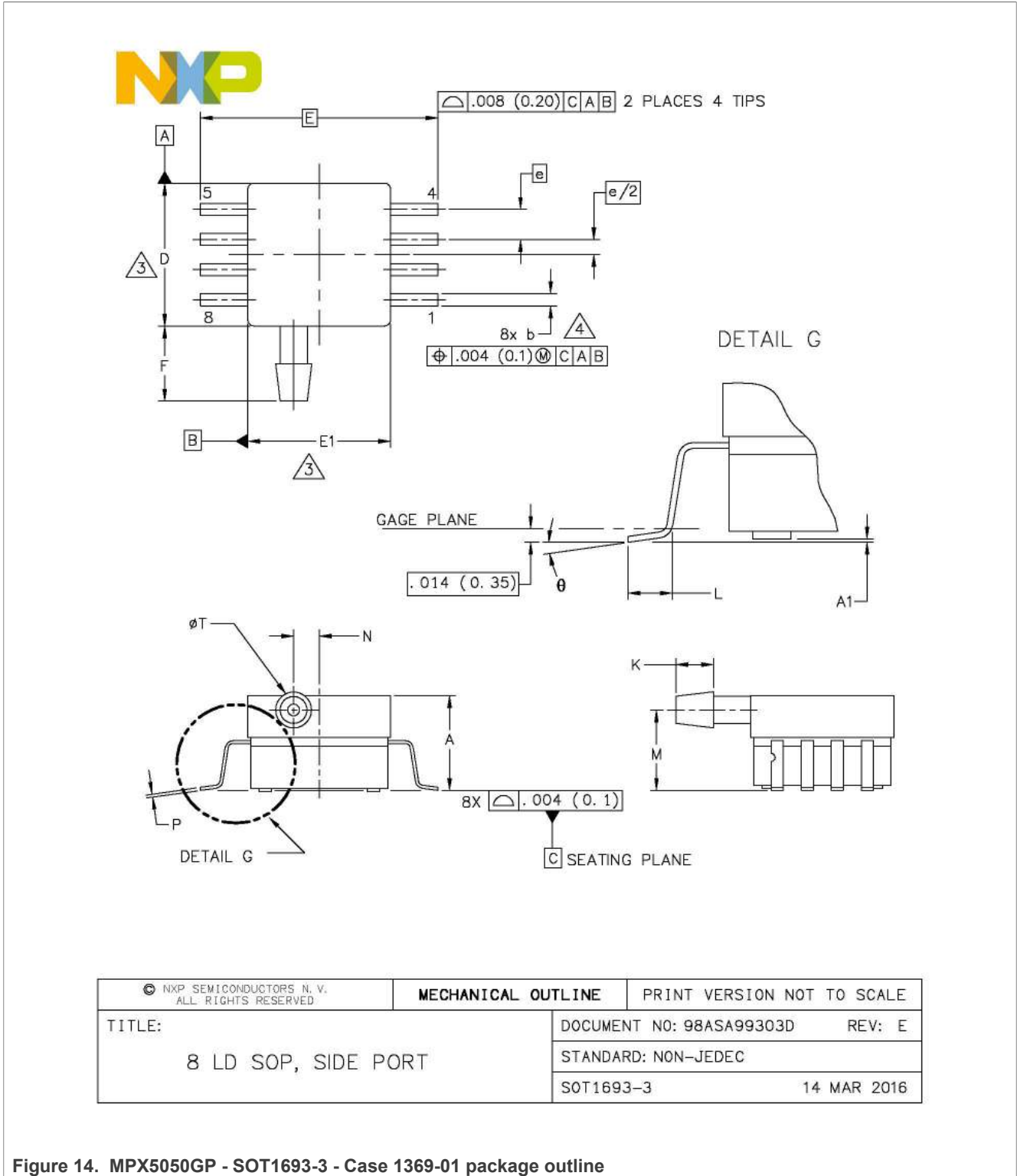
|  |   |
|--|---|
| <p>STYLE 1:</p> <p>PIN 1: GND</p> <p>PIN 2: +Vout</p> <p>PIN 3: Vs</p> <p>PIN 4: -Vout</p> <p>PIN 5: N/C</p> <p>PIN 6: N/C</p> <p>PIN 7: N/C</p> <p>PIN 8: N/C</p> | <p>STYLE 2:</p> <p>PIN 1: N/C</p> <p>PIN 2: Vs</p> <p>PIN 3: GND</p> <p>PIN 4: Vout</p> <p>PIN 5: N/C</p> <p>PIN 6: N/C</p> <p>PIN 7: N/C</p> <p>PIN 8: N/C</p> |
|--|---|

|  |                                    |                            |
|--|------------------------------------|----------------------------|
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| TITLE:<br><br>8 LD SNSR, DUAL PORT                               | DOCUMENT NO: 98ASA99255D    REV: B |                            |
|  | STANDARD: NON-JEDEC                |                            |
|  | SOT1693-1                          | 14 MAR 2016                |

Figure 13. MPX5050DP - SOT1693-1 - Case 1351-01 package outline notes <sup>2</sup>

<sup>2</sup> Style 1 is not applicable for the parts covered by this data sheet.

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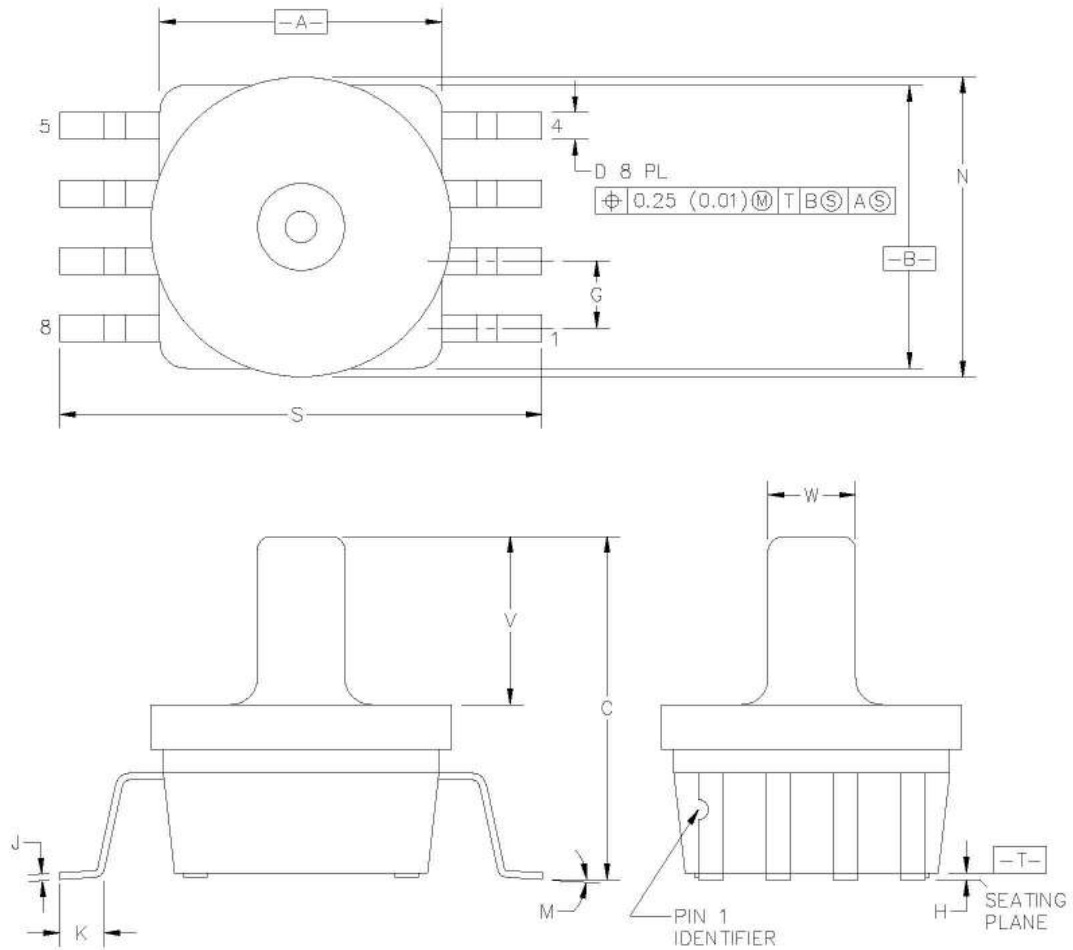
NOTES:

- 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  | 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>8 LD SOP, SIDE PORT                    |          |      |                    |       | DOCUMENT NO: 98ASA99303D |                            | REV: E      |             |     |
|  |          |      |                    |       | STANDARD: NON-JEDEC      |                            |             |             |     |
|  |          |      |                    |       | SOT1693-3                |                            | 14 MAR 2016 |             |     |

Figure 15. MPX5050GP - SOT1693-3 - Case 1369-01 package outline notes

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|  |                           |                            |
|--|---------------------------|----------------------------|
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| TITLE:       SENSOR UNIBODY,<br>11.33 X 11.33 X 12.955 PKG,<br>2.54 PITCH, 8 I/O | DOCUMENT NO: 98ASB17757C  | REV: C                     |
|  | STANDARD: NON-JEDEC       |                            |
|  | SOT1854-1                 | 13 JUL 2017                |

Figure 16. MPXV5050GC6T1 - SOT1854-1, Case 482-A package outline

Integrated silicon pressure sensor, on-chip signal conditioned, temperature compensated and calibrated



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  |

|  |   |                            |
|--|---|----------------------------|
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| TITLE:           SENSOR UNIBODY,<br>11.33 X 11.33 X 12.955 PKG,<br>2.54 PITCH, 8 I/O | DOCUMENT NO: 98ASB17757C      REV: C<br>STANDARD: NON-JEDEC<br>SOT1854-1                              13 JUL 2017 |                            |

Figure 17. MPXV5050GC6T1 - SOT1854-1, Case 482-A package outline notes

## 8 Revision history

Table 8. Revision history

| Document ID   | Release date   | Data sheet status  | Change notice | Supersedes   |
|---------------|--|--------------------|---------------|--------------|
| MPX5050 v.12  | 20230609   | Product data sheet | —             | MPX5050 v.11 |
| Modifications | <ul style="list-style-type: none"> <li>• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors. Legal texts have been adapted to the new company name where appropriate.</li> <li>• Revised all images to conform to NXP Semiconductor image guidelines.</li> <li>• <a href="#">Section 3</a>, removed MPX505D, MPX505GP, MPX505GP1, MPXV5050GC6U and MPVZ5050GW7U from the table.</li> <li>• <a href="#">Section 3.1</a>, inserted new table.</li> <li>• <a href="#">Section 4</a>, <a href="#">Section 4.1</a>, and <a href="#">Section 4.2</a>, inserted new sections.</li> <li>• <a href="#">Section 5</a>, renamed "Maximum ratings" section to "Limiting values" to conform to NXP Semiconductors document heirarchy for data sheets.</li> <li>• <a href="#">Section 6</a>, renamed "Operating characteristics" to "Recommended operating conditions".</li> <li>• <a href="#">Section 6.2</a>, <a href="#">Table 7</a>, removed MPX5050D and MPX5050GP from the table.</li> <li>• <a href="#">Section 7</a>, updated the package outline images.</li> </ul> |                    |               |              |

## 9 Legal information

### 9.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition  |
|-----------------------------------|-------------------------------|---|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

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**Integrated silicon pressure sensor, on-chip signal conditioned, temperature compensated and calibrated**

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