

MPX2010 Series

10 kPa Temperature Compensated Pressure Sensors

Rev. 14 — 27 April 2021

Product data sheet

1 General Description

The MPX2010 series device is a silicon piezoresistive pressure sensor providing a highly accurate and linear voltage output directly proportional to the applied pressure. The sensor is a single monolithic silicon diaphragm with the strain gauge and a thin-film resistor network integrated on-chip. The chip is laser trimmed for precise span and offset calibration and temperature compensation.

2 Features and Benefits

- Ratiometric to Supply Voltage
- Differential and Gauge Options
- Temperature Compensated over 0 °C to 85 °C
- Easy-to-Use Chip Carrier Package Options

3 Applications

- Air Movement Control
- Respiratory Diagnostics
- Controllers
- Pressure Switching



4 Ordering Information

| Device name | Package options | Case number | Number of ports | | | Pressure type | | | Device marking |
|---|-----------------|-----------------------|-----------------|--------|------|---------------|--------------|----------|----------------|
| | | | None | Single | Dual | Gauge | Differential | Absolute | |
| Small Outline Package (MPXV2010 Series) | | | | | | | | | |
| MPXV2010GP | Tray | 1369 | | • | | • | | | MPXV2010GP |
| MPXV2010DP | Tray | 1351 | | | • | | • | | MPXV2010DP |
| Unibody Package (MPX2010 Series) | | | | | | | | | |
| MPX2010D | Tray | 344 | • | | | | • | | MPX2010D |
| MPX2010DP | Tray | 344C | | | • | | • | | MPX2010DP |
| MPX2010GP | Tray | 344B | | • | | • | | | MPX2010GP |
| MPX2010GSX | Tray | 344F | | • | | • | | | MPX2010D |
| MPAK Package (MPXM2010 Series) | | | | | | | | | |
| MPXM2010GS | Rail | 1320A | | • | | • | | | MPXM2010GS |
| MPXM2010GST1 | Tape & Reel | 1320A | | • | | • | | | MPXM2010GS |

Small outline packages



MPXV2010GP
Case 1369-01



MPXV2010DP
Case 1351-01

MPAK Packages

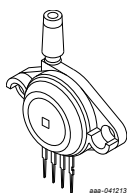


MPXM2010GS/GST1
Case 1320A-02

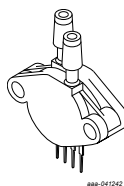
Unibody Packages



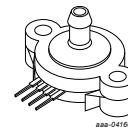
MPX2010D
Case 344-15



MPX2010GP
Case 344B-01



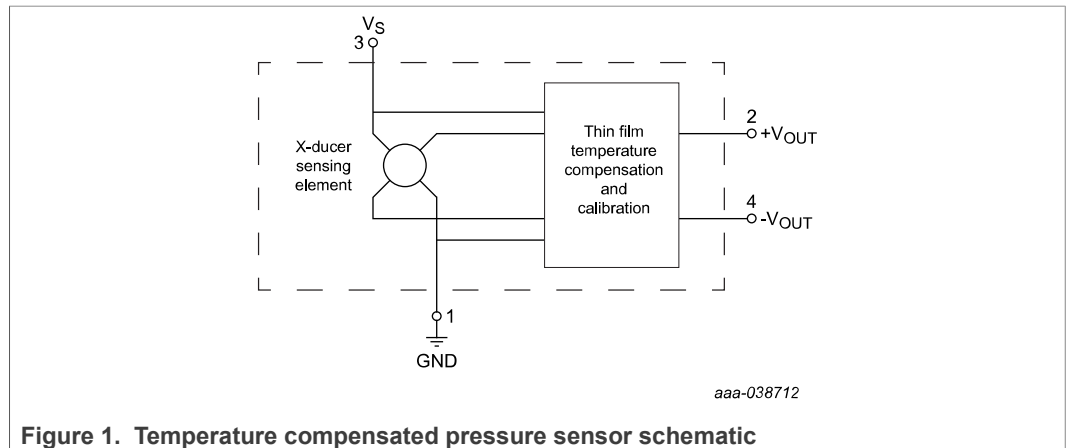
MPX2010DP
Case 344C-01



MPX2010GSX
Case 344F-01

5 Block Diagram

Figure 1 shows a block diagram of the internal circuitry on the stand-alone pressure sensor chip.



6 Pin Information

6.1 MPX2010D

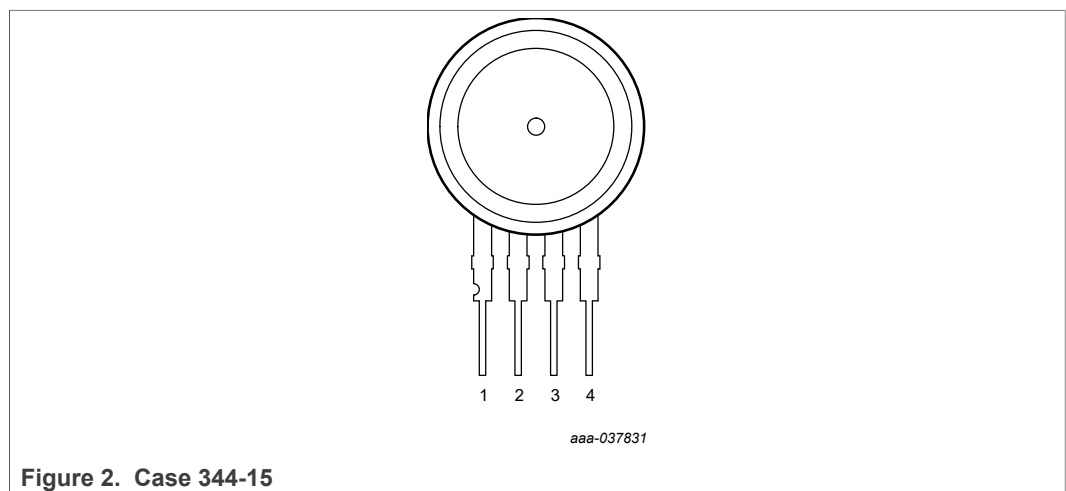


Table 1. Pin definitions - MPX2010D

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |

6.2 MPX2010DP

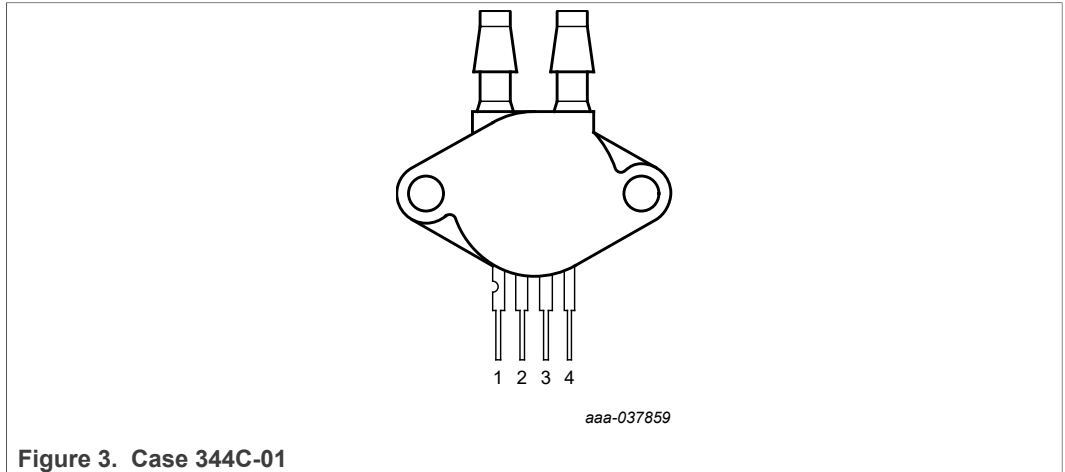


Figure 3. Case 344C-01

Table 2. Pin definitions - MPX2010DP

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |

6.3 MPX2010GP

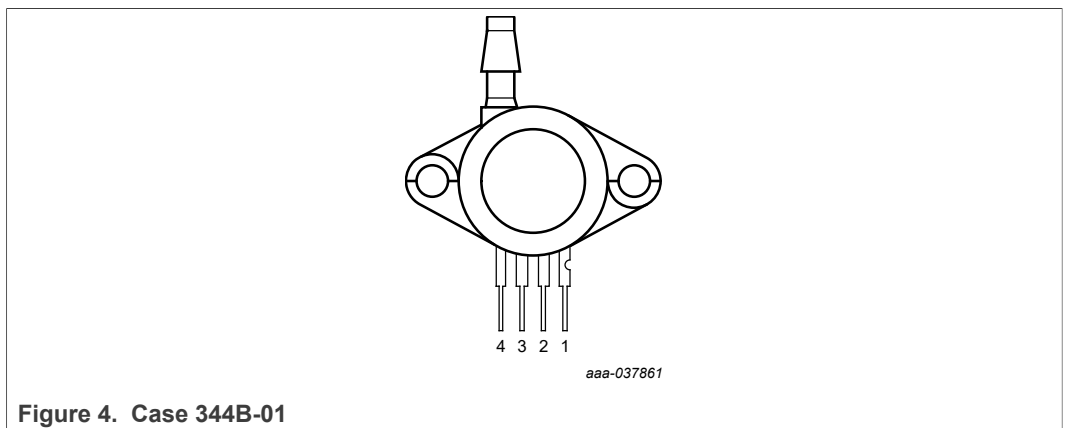


Figure 4. Case 344B-01

Table 3. Pin definitions - MPX2010GP

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |

6.4 MPXM2010GS/GST1

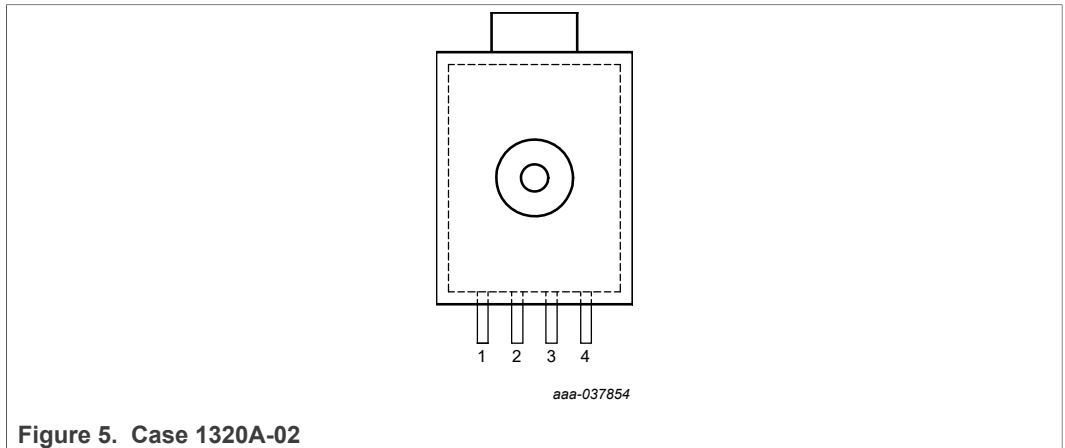


Figure 5. Case 1320A-02

Table 4. Pin definitions - MPXM2010GS/GST1

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |

6.5 MPXV2010GP

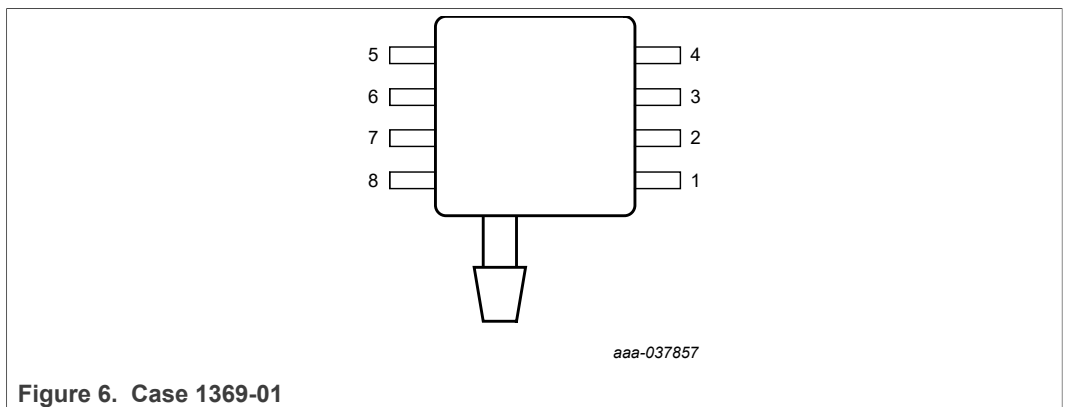


Figure 6. Case 1369-01

Table 5. Pin definitions - MPXV2010GP

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |
| n.a. | 5 | — |
| n.a. | 6 | — |
| n.a. | 7 | — |
| n.a. | 8 | — |

6.6 MPXV2010DP

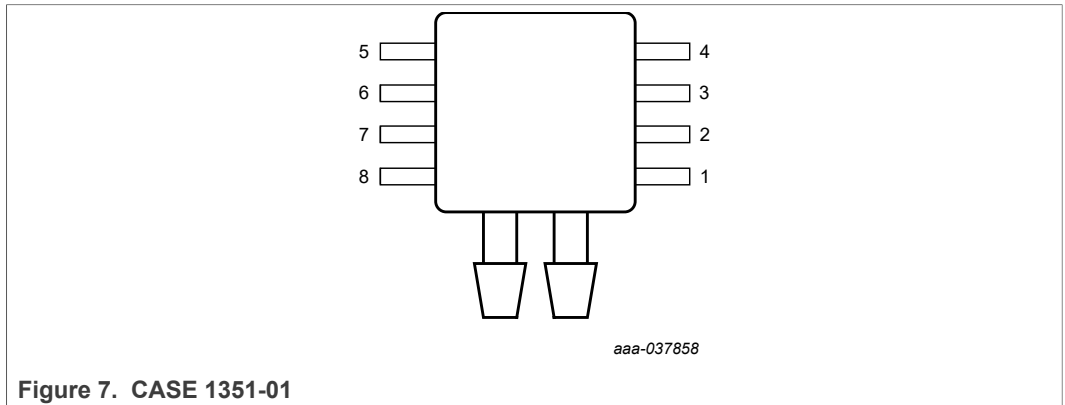


Figure 7. CASE 1351-01

Table 6. Pin definitions - MPXV2010DP

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |
| n.a. | 5 | — |
| n.a. | 6 | — |
| n.a. | 7 | — |
| n.a. | 8 | — |

6.7 MPX2010GSX

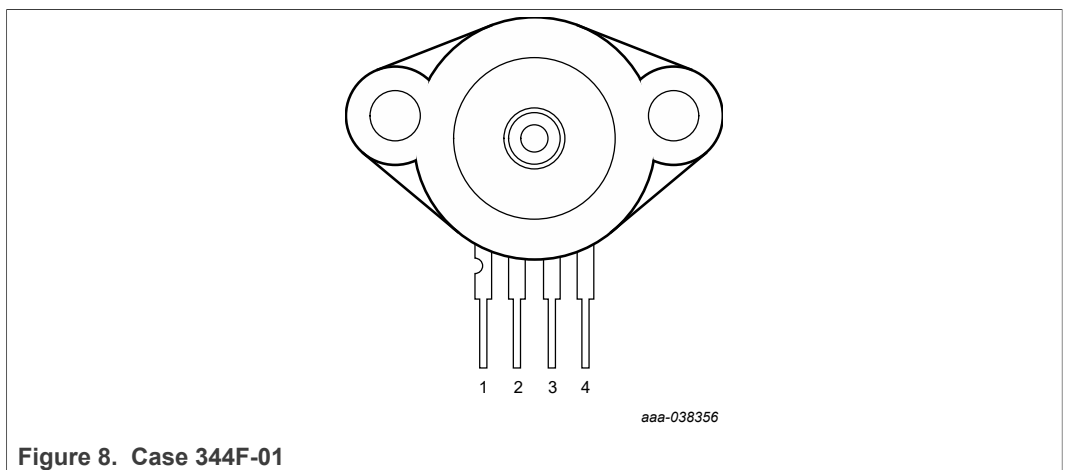


Figure 8. Case 344F-01

Table 7. Pin definitions - MPX2010GSX

| Symbol | Pin | Description |
|-------------------|-----|------------------|
| GND | 1 | Ground |
| +V _{OUT} | 2 | + Voltage output |
| V _S | 3 | Power supply |
| -V _{OUT} | 4 | - Voltage output |

7 Maximum Ratings

Table 8. Maximum ratings

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

In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|--------------------|-----------------------|------------|-----|-----|------|------|
| P_{\max} | Overpressure | $P1 > P2$ | — | — | 75 | kPa |
| P_{burst} | Burst Pressure | $P1 > P2$ | — | — | 100 | kPa |
| T_{stg} | Storage Temperature | | -40 | — | +125 | °C |
| T_A | Operating Temperature | | -40 | — | +125 | °C |

8 Operating Characteristics

Table 9. Operating characteristics ($V_S = 10$ Vdc, $T_A = 25$ °C unless otherwise noted, $P_1 > P_2$)

| Characteristic | Symbol | Min | Typ | Max | Units |
|--|---------------------|------|-----------|------|-------------|
| Operating Pressure Range [1] | P_{OP} | 0 | — | 10 | kPa |
| Supply Voltage [2] | V_S | — | 10 | 16 | Vdc |
| Supply Current | I_o | — | 6.0 | — | mAdc |
| Full Scale Span [3] | V_{FSS} | 24 | 25 | 26 | mV |
| Offset [4] | V_{off} | -1.0 | — | 1.0 | mV |
| Sensitivity | $\Delta V/\Delta P$ | — | 2.5 | — | mV/kPa |
| Linearity [5] | — | -1.0 | — | 1.0 | % V_{FSS} |
| Pressure Hysteresis (0 kPa to 10 kPa) [5] | — | — | ± 0.1 | — | % V_{FSS} |
| Temperature Hysteresis (-40 °C to +125 °C) [5] | — | — | ± 0.5 | — | % V_{FSS} |
| Temperature Coefficient of Full Scale Span [5] | TCV_{FSS} | -1.0 | — | 1.0 | % V_{FSS} |
| Temperature Coefficient of Offset [5] | TCV_{off} | -1.0 | — | 1.0 | mV |
| Input Impedance | Z_{in} | 1300 | — | 2550 | Ω |
| Output Impedance | Z_{out} | 1400 | — | 3000 | Ω |
| Response Time (10% to 90%) [6] | t_R | — | 1.0 | — | ms |
| Warm-Up Time [7] | — | — | 20 | — | ms |
| Offset Stability [8] | — | — | ± 0.5 | — | % V_{FSS} |

[1] 1.0 kPa equals 0.145 PSI.

[2] Device is ratiometric within this specified excitation range. Operating the device above the specified excitation range may induce additional error due to device self-heating.

[3] 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.

[4] Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.

[5] Accuracy (error budget) consists of the following:

- Linearity: Output deviation from a straight line relationship with pressure using the end point method 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 at full rated pressure over the temperature range of 0 °C to 85 °C, relative to 25 °C
- TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 °C to 85 °C, relative to 25 °C

[6] 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.

[7] Warm-Up Time is defined as the time required for the product to meet the specified output voltage after the pressure has been stabilized.

[8] Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure Temperature Cycling with Bias test.

9 Characteristics

9.1 Voltage output versus applied differential pressure

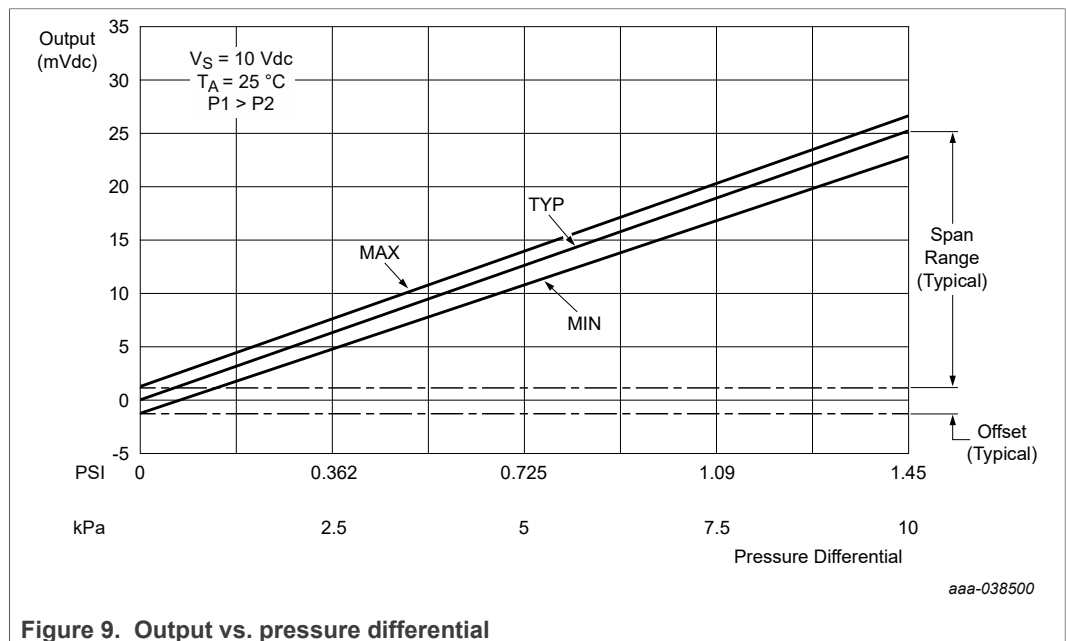
The output voltage of the differential or gauge sensor increases with increasing pressure applied to the pressure side (P1) relative to the vacuum side (P2). Similarly, output voltage increases as increasing vacuum is applied to the vacuum side (P2) relative to the pressure side (P1).

9.2 On-chip temperature compensation and calibration

Figure 9 shows the typical output characteristics of the MPX2010 series at 25 °C.

The effects of temperature on full scale span and offset are very small and are shown under Section 8 "Operating Characteristics".

This performance over temperature is achieved by having both the shear stress strain gauge and the thin-film resistor circuitry on the same silicon diaphragm. Each chip is dynamically laser trimmed for precise span and offset calibration and temperature compensation.



9.3 Linearity

Linearity refers to how well a transducer's output follows the equation $V_{out} = V_{off} + \text{Sensitivity} \times P$ over the operating pressure range (Figure 10). There are two basic methods for calculating nonlinearity:

- End point straight line fit
- Least squares best line fit

While a least squares fit gives the "best case" linearity error (lower numerical value), the calculations required are burdensome.

Conversely, an end point fit will give the "worst case" error (often more desirable in error budget calculations) and the calculations are more straightforward for the user.

NXP's specified pressure sensor linearities are based on the end point straight line method measured at the midrange pressure.

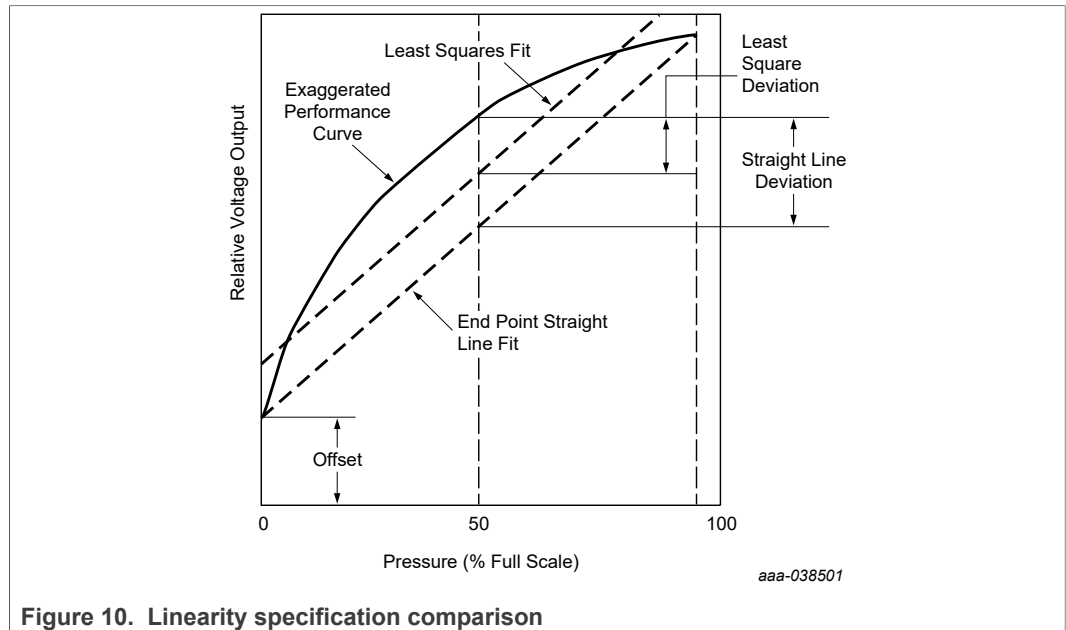


Figure 10. Linearity specification comparison

9.4 Pressure (P1) / Vacuum (P2) side identification

NXP 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 that isolates the die from the environment. The NXP MPX pressure sensor is designed to operate with positive differential pressure applied, $P1 > P2$.

The Pressure (P1) side may be identified by using [Table 10](#).

Table 10. Pressure (P1) side delineation table

| Part Number | Case Type | Pressure (P1) Side Identifier |
|-----------------|-----------|-------------------------------|
| MPX2010D | 344 | Stainless Steel Cap |
| MPX2010DP | 344C | Side with Part Marking |
| MPX2010GP | 344B | Side with Port Attached |
| MPX2010GSX | 344F | Side with Port Attached |
| MPXV2010GP | 1369 | Side with Port Attached |
| MPXV2010DP | 1351 | Side with Part Marking |
| MPXM2010GS/GSTI | 1320A | Side with Port Attached |

9.5 Media compatibility

[Figure 11](#) illustrates the differential or gauge configuration in a typical chip carrier. A silicone gel isolates the die surface and wire bonds from the environment while allowing the pressure signal to be transmitted to the silicon diaphragm.

Operating characteristics, internal reliability and qualification tests are based on the use of dry clean air as the pressure medium. Media other than dry clean air may have adverse effects on sensor performance and long term reliability. Contact the factory for information regarding media compatibility in your application.

For more information, refer to application note [AN3728](#).

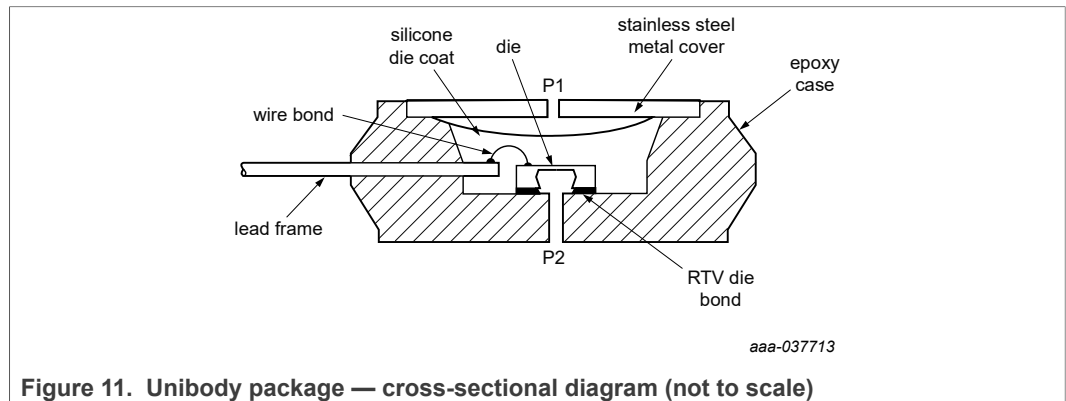
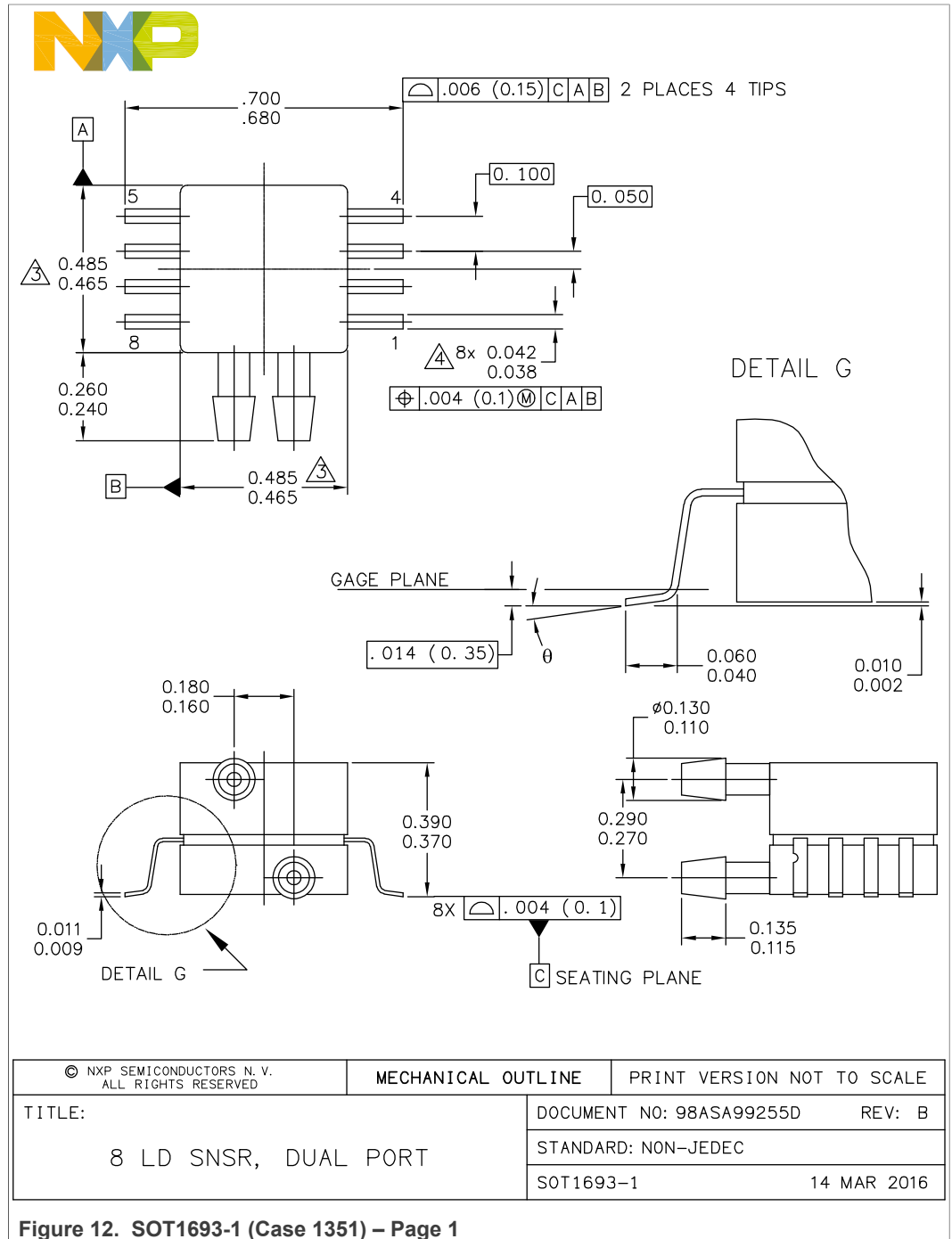


Figure 11. Unibody package — cross-sectional diagram (not to scale)

10 Package Outlines

Package dimensions are provided in package drawings. To find the most current package outline drawing, go to <https://www.nxp.com/> and perform a keyword search for the drawing's document number.

10.1 Small outline packages





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:

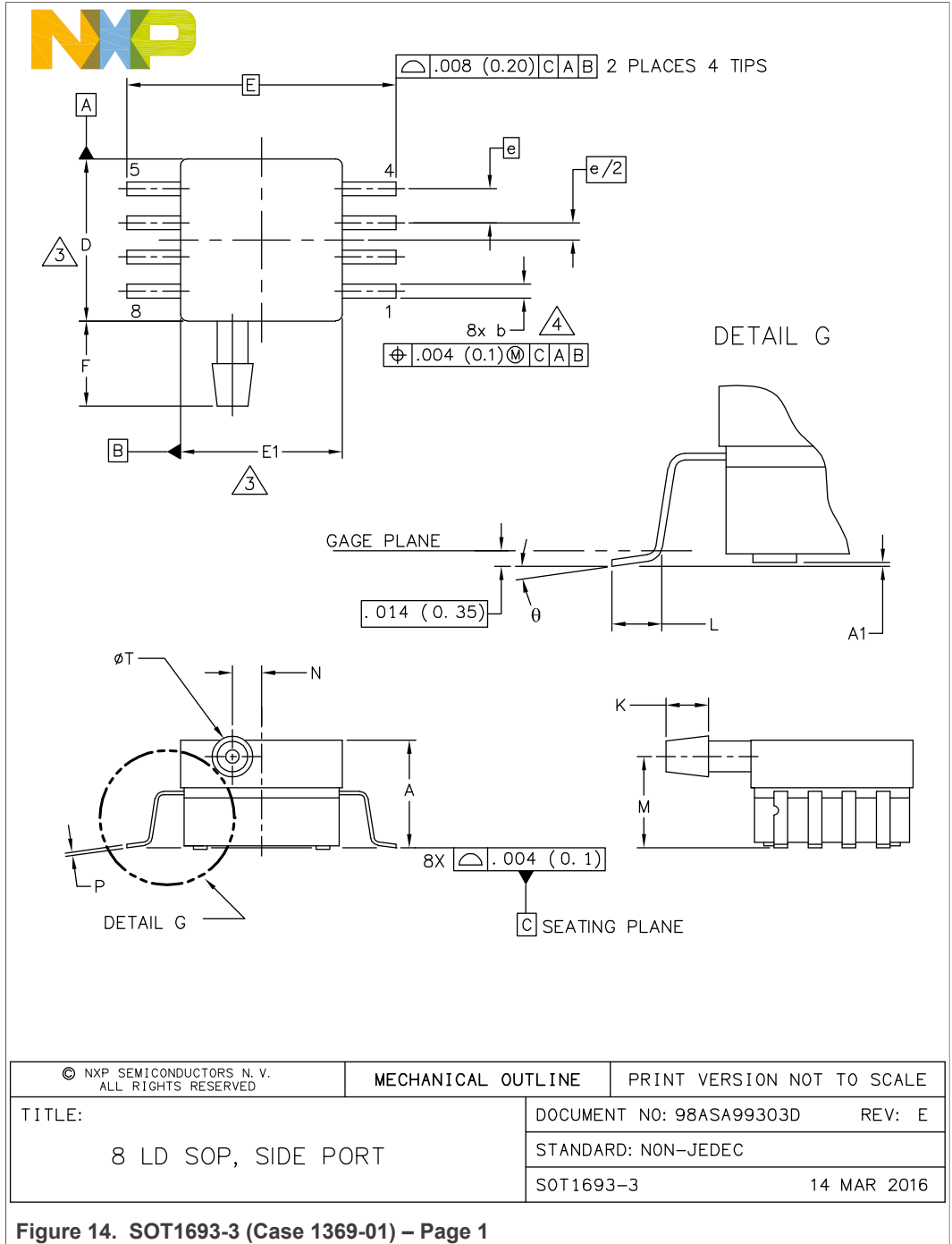
PIN 1: GND
 PIN 2: +Vout
 PIN 3: Vs
 PIN 4: -Vout
 PIN 5: N/C
 PIN 6: N/C
 PIN 7: N/C
 PIN 8: N/C

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

| | | |
|---|--------------------------|----------------------------|
| © NXP SEMICONDUCTORS N. V. ALL RIGHTS RESERVED | MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE |
| TITLE: 8 LD SNSR, DUAL PORT | DOCUMENT NO: 98ASA99255D | REV: B |
| | STANDARD: NON-JEDEC | |
| | SOT1693-1 | 14 MAR 2016 |

Figure 13. SOT1693-1 (Case 1351) – Page 2





NOTES:

- 1. CONTROLLING DIMENSION: INCH
- 2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
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- 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 | 7.62 | 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: | | DOCUMENT NO: 98ASA99303D | REV: E |
| 8 LD SOP, SIDE PORT | | STANDARD: NON-JEDEC | |
| | | SOT1693-3 | 14 MAR 2016 |

Figure 15. SOT1693-3 (Case 1369-01) – page 2

10.2 Unibody packages

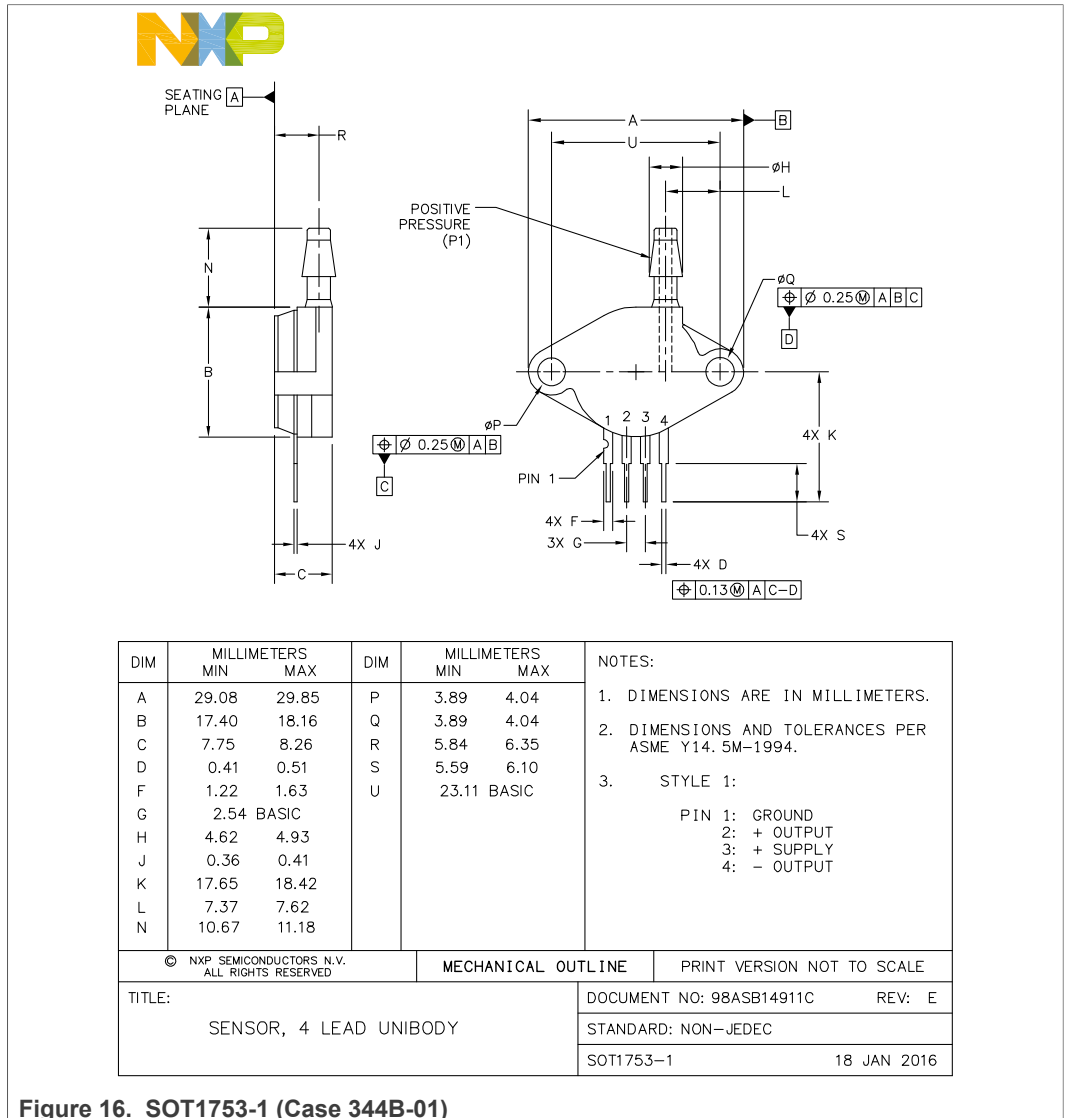


Figure 16. SOT1753-1 (Case 344B-01)

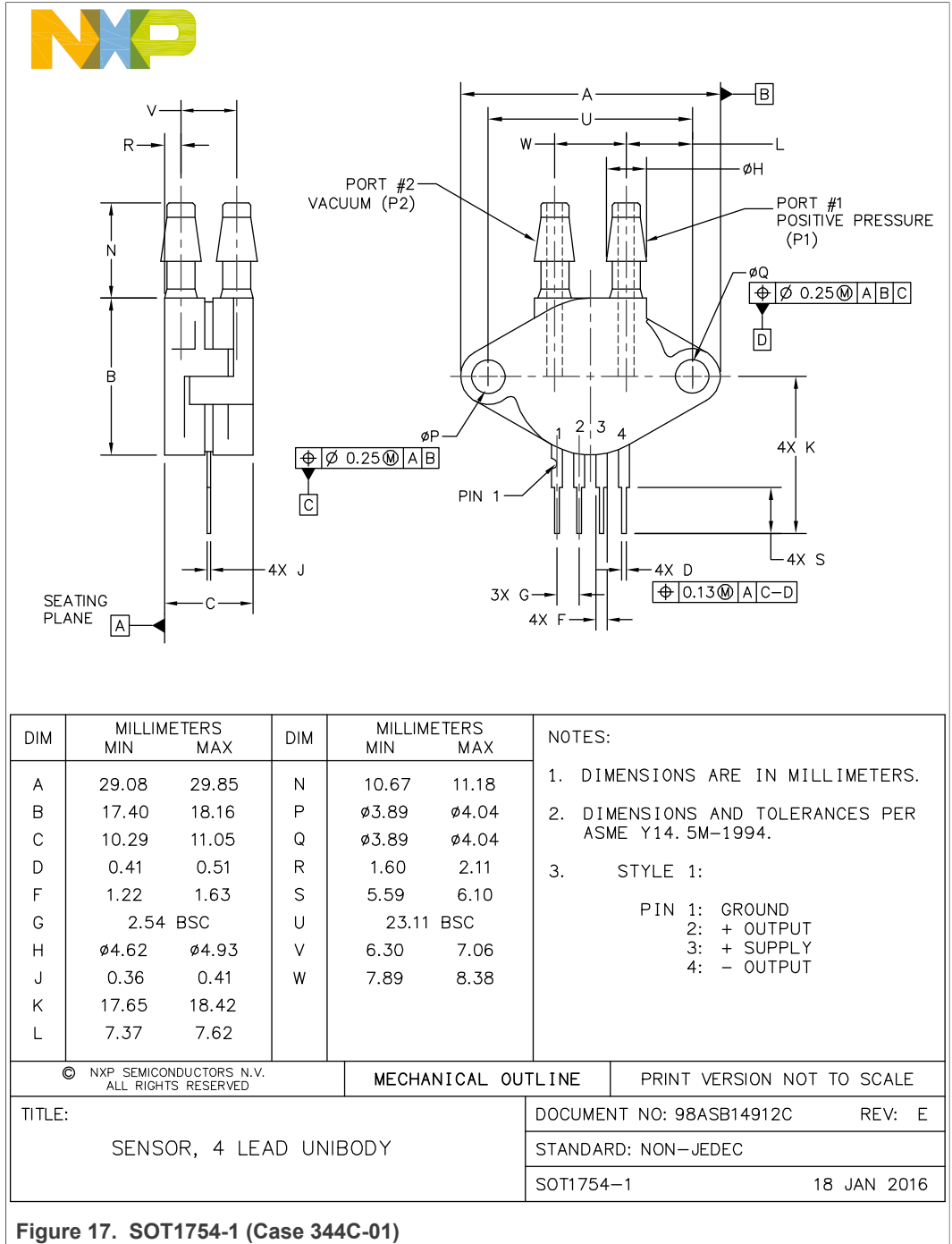
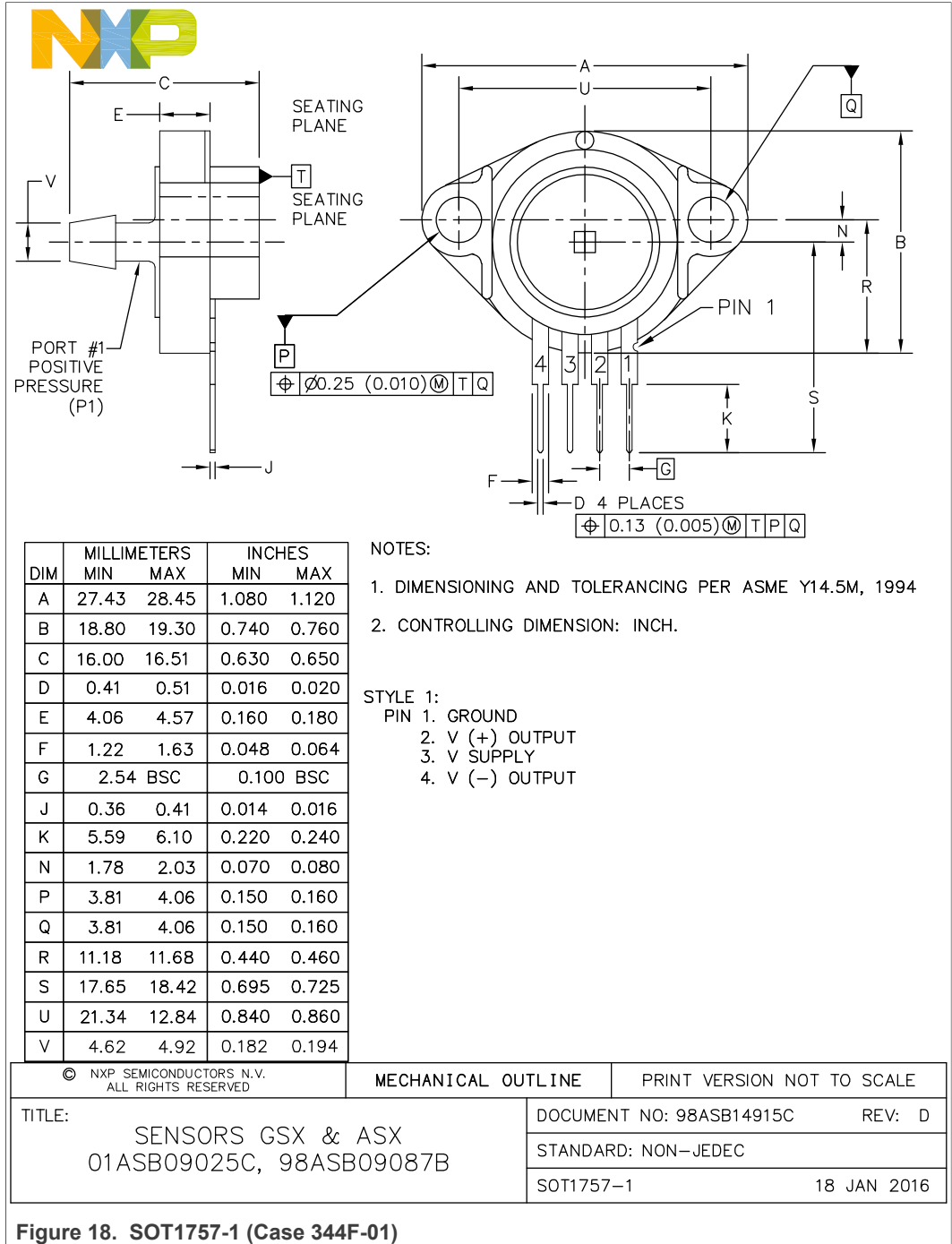


Figure 17. SOT1754-1 (Case 344C-01)



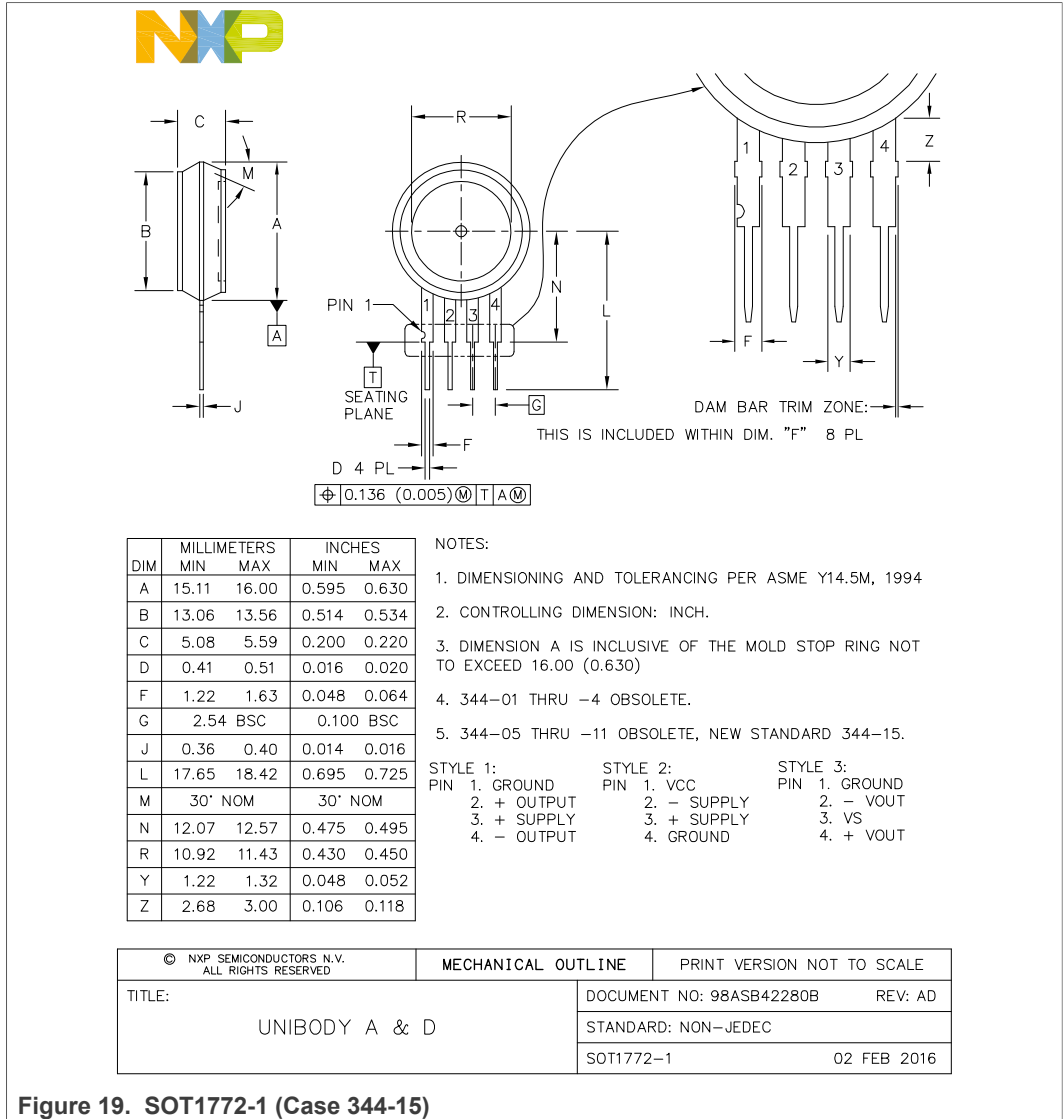
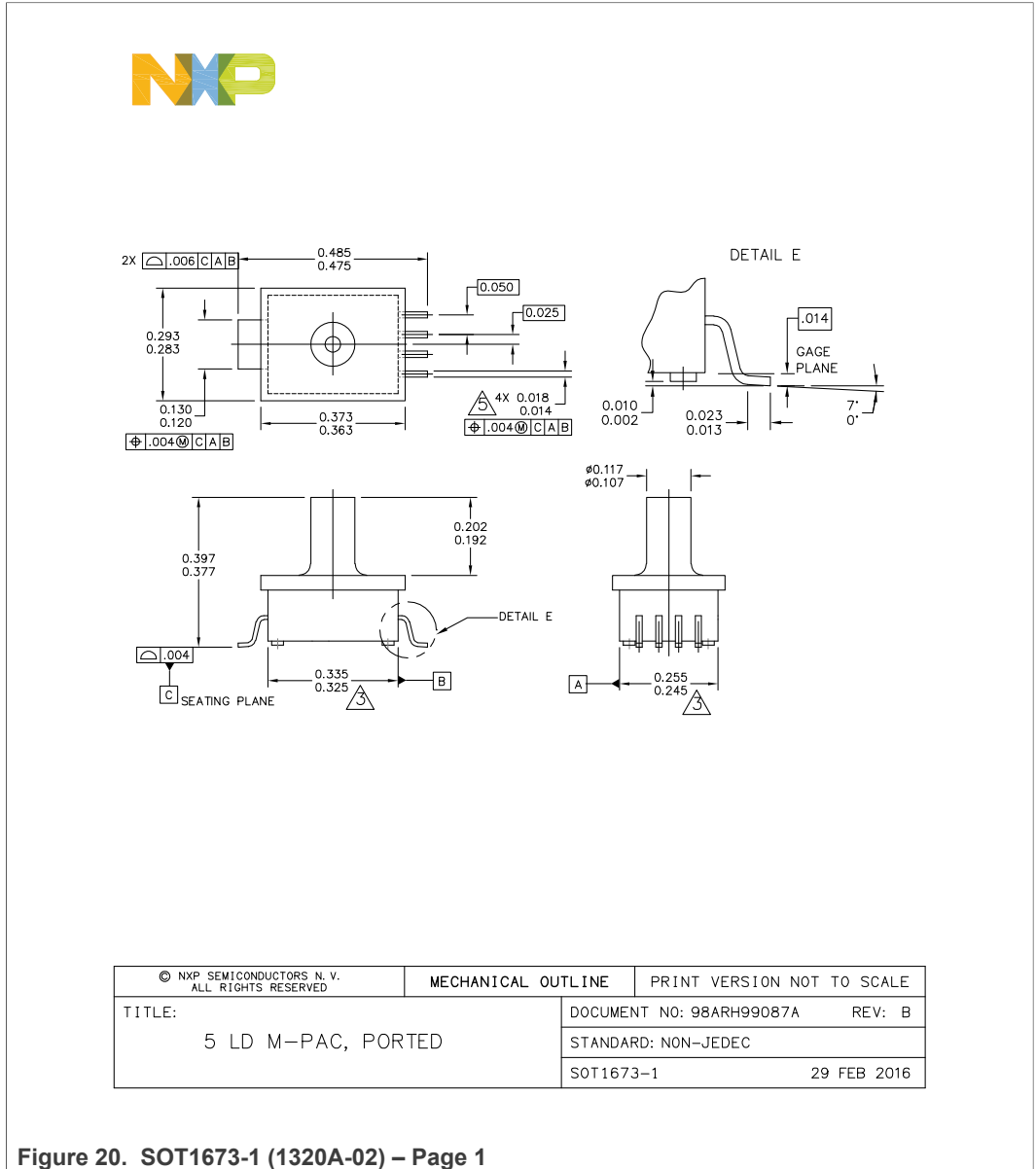


Figure 19. SOT1772-1 (Case 344-15)

10.3 MPAK packages





NOTES:

1. DIMENSIONS ARE IN INCHES.
2. INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
3. DIMENSIONS DOES NOT INCLUDE MOLD FLASH OR PROTRUSION. MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006" PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5" MAXIMUM.
5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 MAXIMUM.

| | | |
|--|--------------------------|----------------------------|
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| TITLE: 5 LD M-PAC, PORTED | DOCUMENT NO: 98ARH99087A | REV: B |
| | STANDARD: NON-JEDEC | |
| | SOT1673-1 | 29 FEB 2016 |

Figure 21. SOT1673-1 (1320A-02) – Page 2

11 References

- [1] AN840 – Temperature Compensation Methods For The Motorola X-ducer Pressure Sensor Element
<https://www.nxp.com/docs/en/application-note/AN840.pdf>
- [2] AN1984 – Handling Freescale Pressure Sensors
<https://www.nxp.com/docs/en/application-note/AN1984.pdf>
- [3] AN3150 – Soldering Recommendations for Pressure Sensor Devices
<https://www.nxp.com/docs/en/application-note/AN3150.pdf>
- [4] AN1318 Interfacing Semiconductor Pressure Sensors to Microcomputers
<https://www.nxp.com/docs/en/application-note/AN1318.pdf>
- [5] AN3728 Media Compatibility for IPS PRT Pressure Sensors
<https://www.nxp.com/docs/en/application-note/AN3728.pdf>

12 Revision history

Table 11. Revision history

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---------------|---|-------------------|---------------|--------------|
| MPX2010 v.14 | 20210427 | Released | — | MPX2010 v.13 |
| Modifications | <ul style="list-style-type: none"> • Redesignated the data sheet to comply with the new identity guidelines of NXP Semiconductors. Adapted legal texts to the new company name where appropriate. • Removed the following discontinued part numbers throughout: MPX2010GS | | | |
| MPX2010 v.13 | 200810 | Released | — | MPX2010 v.12 |

13 Legal information

13.1 Data sheet status

| Document status ^{[1][2]} | Product status ^[3] | 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".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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