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

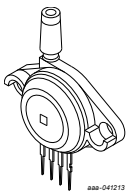
MPXV2010DP
Case 1351-01

MPAK Packages

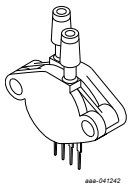
MPXM2010GS/GST1
Case 1320A-02

Unibody Packages

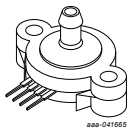
MPX2010D
Case 344-15



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.

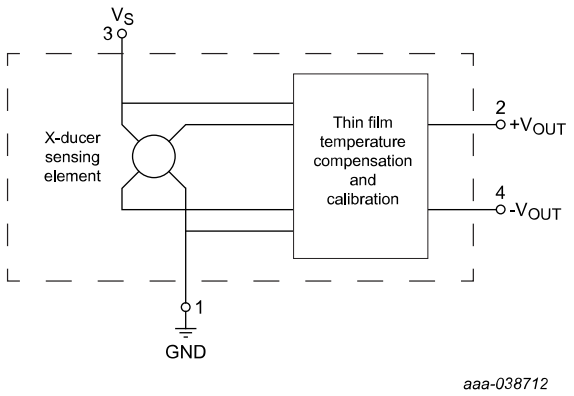


Figure 1. Temperature compensated pressure sensor schematic

6 Pin Information

6.1 MPX2010D

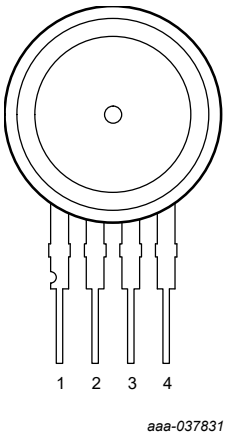


Figure 2. Case 344-15

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

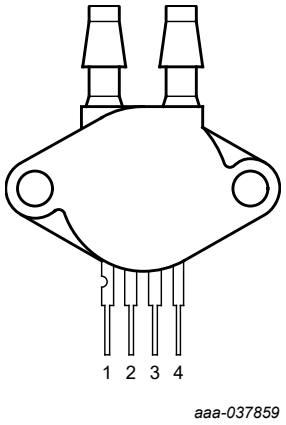


Figure 3. Case 344C-01

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

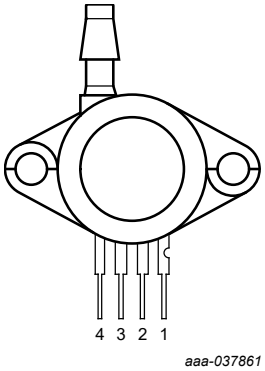


Figure 4. Case 344B-01

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

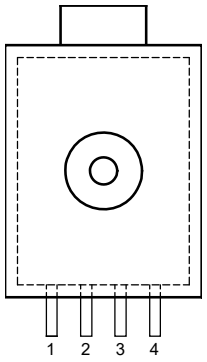


Figure 5. Case 1320A-02

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

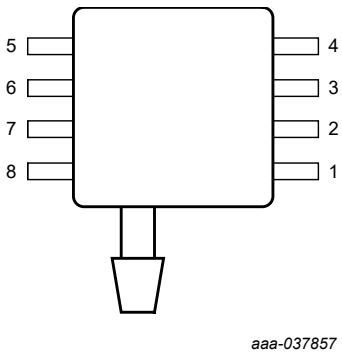


Figure 6. Case 1369-01

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

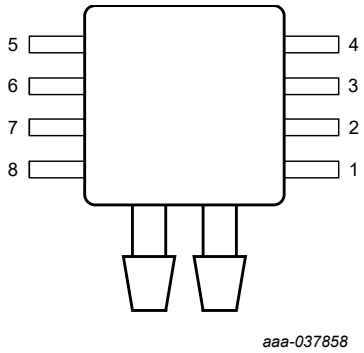


Figure 7. CASE 1351-01

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

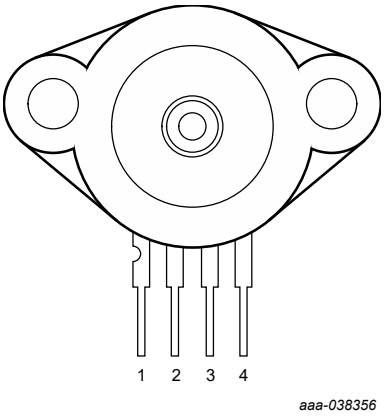


Figure 8. Case 344F-01

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, P1 > P2)

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		ΔV/ΔP	—	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.

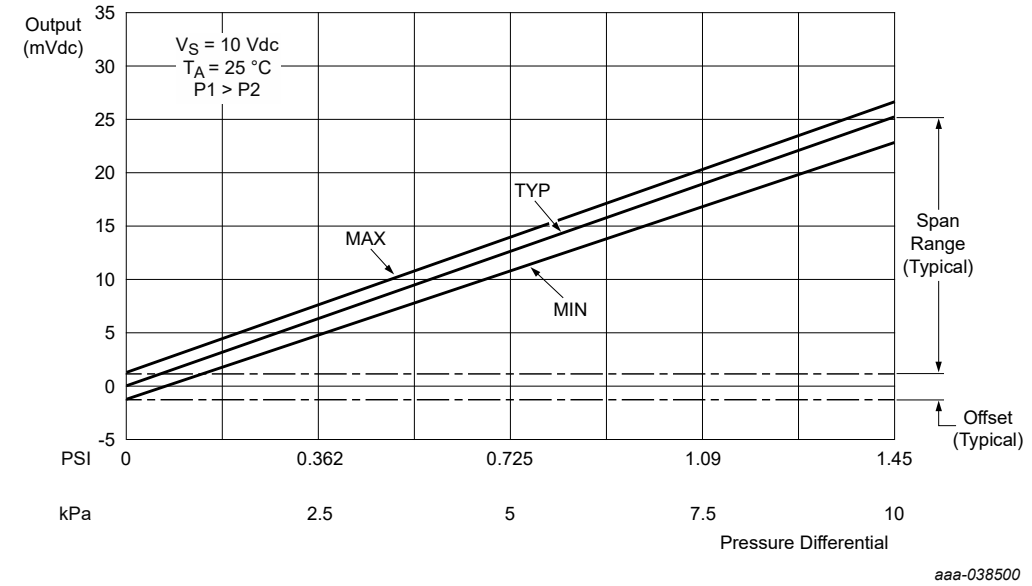


Figure 9. Output vs. pressure differential

9.3 Linearity

Linearity refers to how well a transducer's output follows the equation $V_{out} = V_{off}$ + Sensitivity x 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.

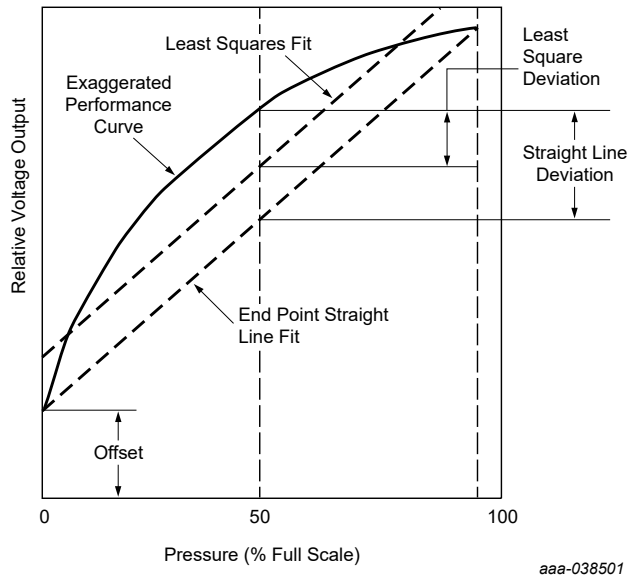


Figure 10. Linearity specification comparison

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.

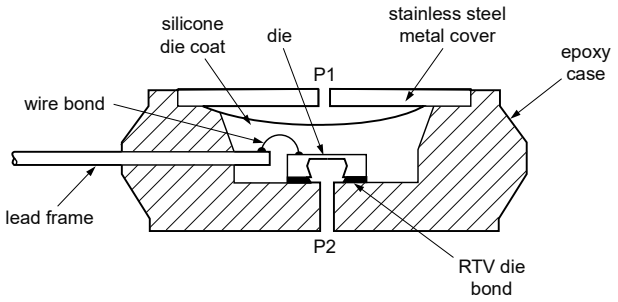


Figure 11. Unibody package — cross-sectional diagram (not to scale)

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

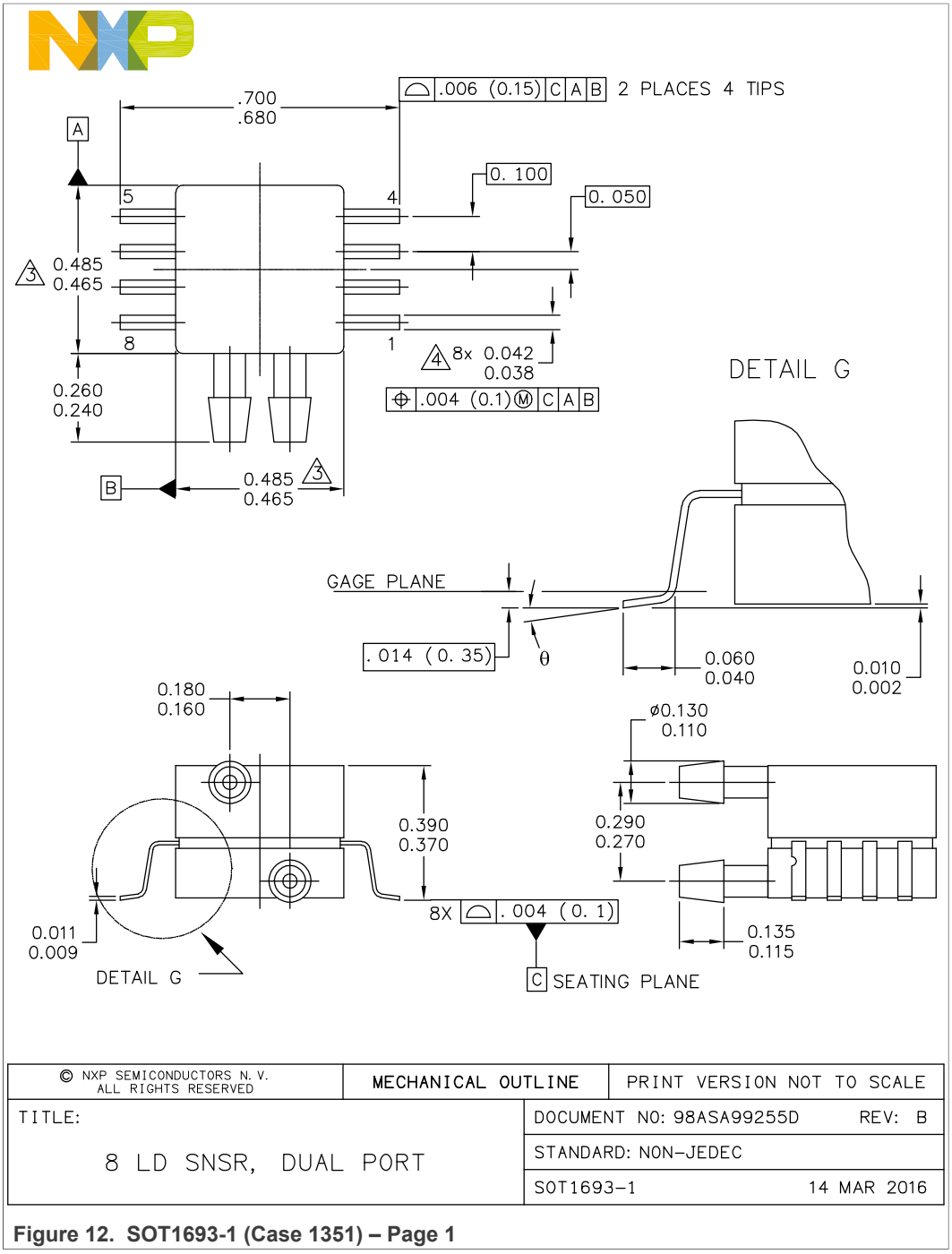
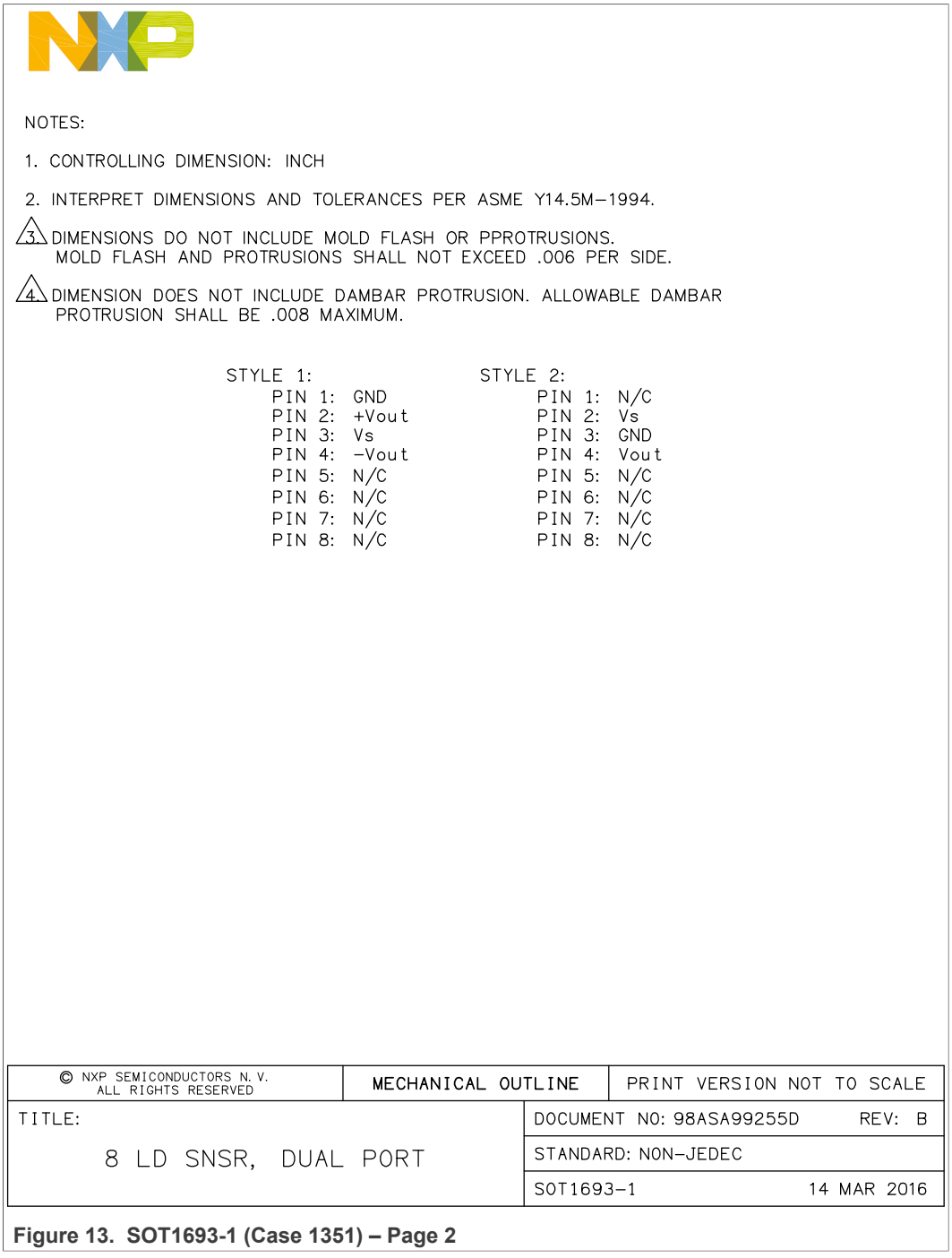


Figure 12. SOT1693-1 (Case 1351) – Page 1



NOTES:

1. CONTROLLING DIMENSION: INCH

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

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
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:		STYLE 2:	
PIN 1:	GND	PIN 1:	N/C
PIN 2:	+Vout	PIN 2:	Vs
PIN 3:	Vs	PIN 3:	GND
PIN 4:	–Vout	PIN 4:	Vout
PIN 5:	N/C	PIN 5:	N/C
PIN 6:	N/C	PIN 6:	N/C
PIN 7:	N/C	PIN 7:	N/C
PIN 8:	N/C	PIN 8:	N/C

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:

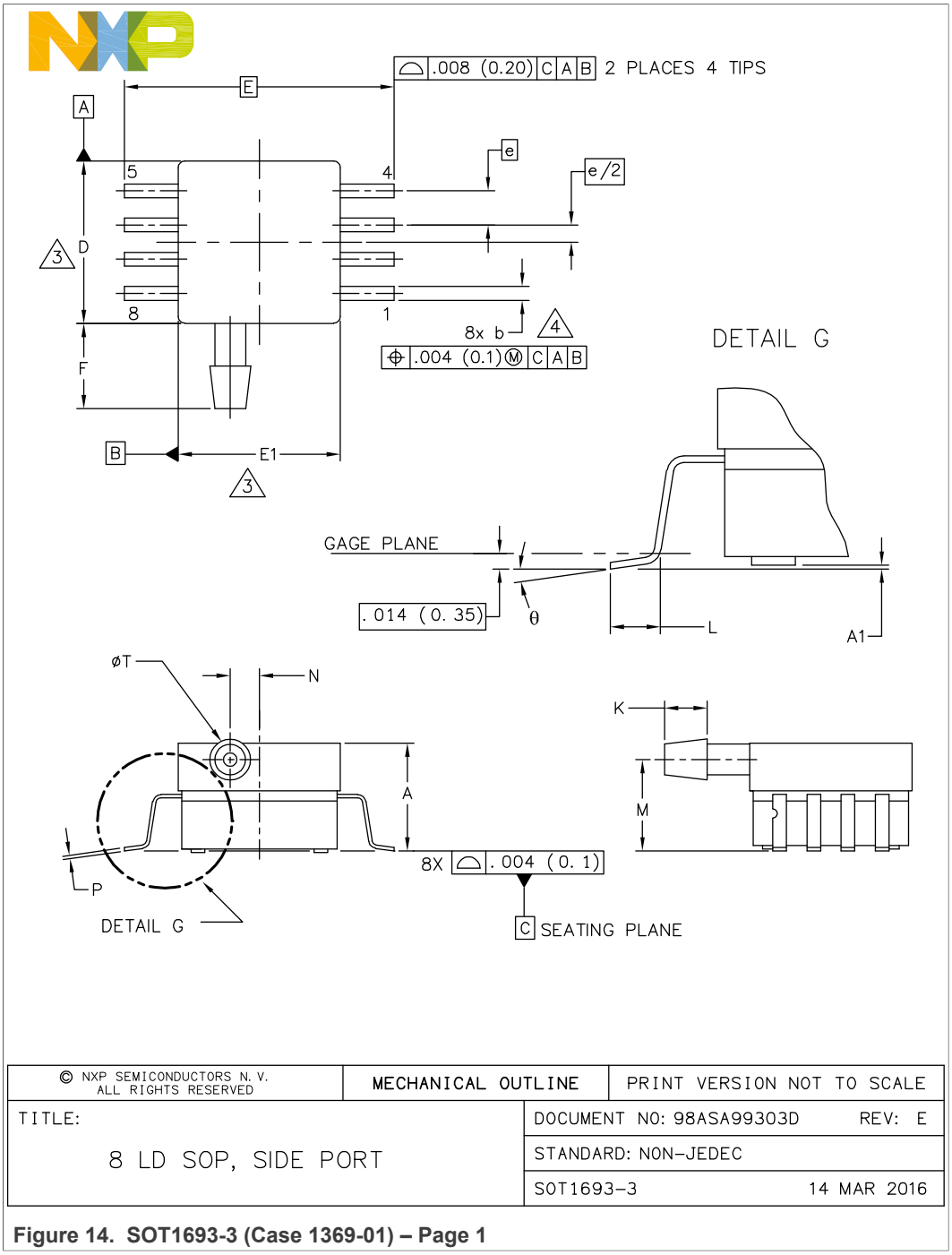
8 LD SNSR, DUAL PORT

DOCUMENT NO: 98ASA99255D REV: B

STANDARD: NON–JEDEC

SOT1693–1 14 MAR 2016

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



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

Figure 14. SOT1693-3 (Case 1369-01) – Page 1

NOTES:
1. CONTROLLING DIMENSION: INCH

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

3. DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PPROTRUSIONS.
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 MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS MAX	DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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	–	---	---	---	---

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

TITLE:

8 LD SOP, SIDE PORT

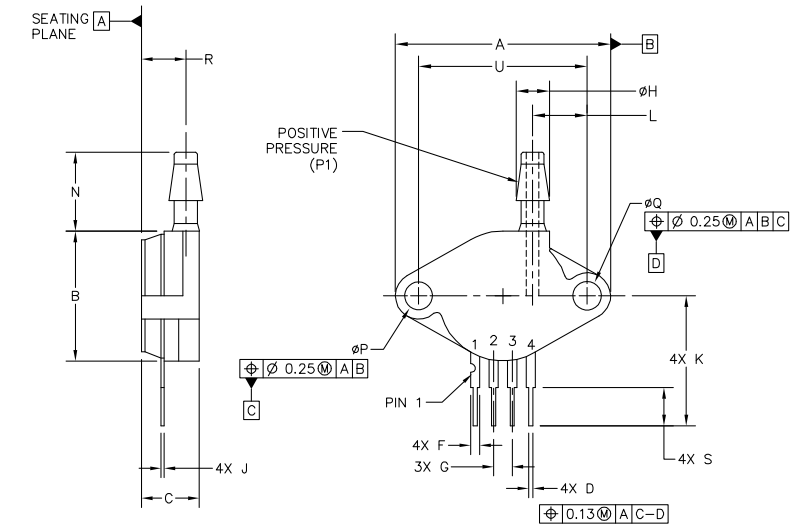
DOCUMENT NO: 98ASA99303D REV: E

STANDARD: NON–JEDEC

SOT1693–3 14 MAR 2016

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

10.2 Unibody packages



DIM	MILLIMETERS MIN	MAX	DIM	MILLIMETERS MIN	MAX
A	29.08	29.85	P	3.89	4.04
B	17.40	18.16	Q	3.89	4.04
C	7.75	8.26	R	5.84	6.35
D	0.41	0.51	S	5.59	6.10
F	1.22	1.63	U	23.11 BASIC	
G	2.54 BASIC				
H	4.62	4.93			
J	0.36	0.41			
K	17.65	18.42			
L	7.37	7.62			
N	10.67	11.18			

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. STYLE 1:

PIN 1: GROUND
2: + OUTPUT
3: + SUPPLY
4: – OUTPUT

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

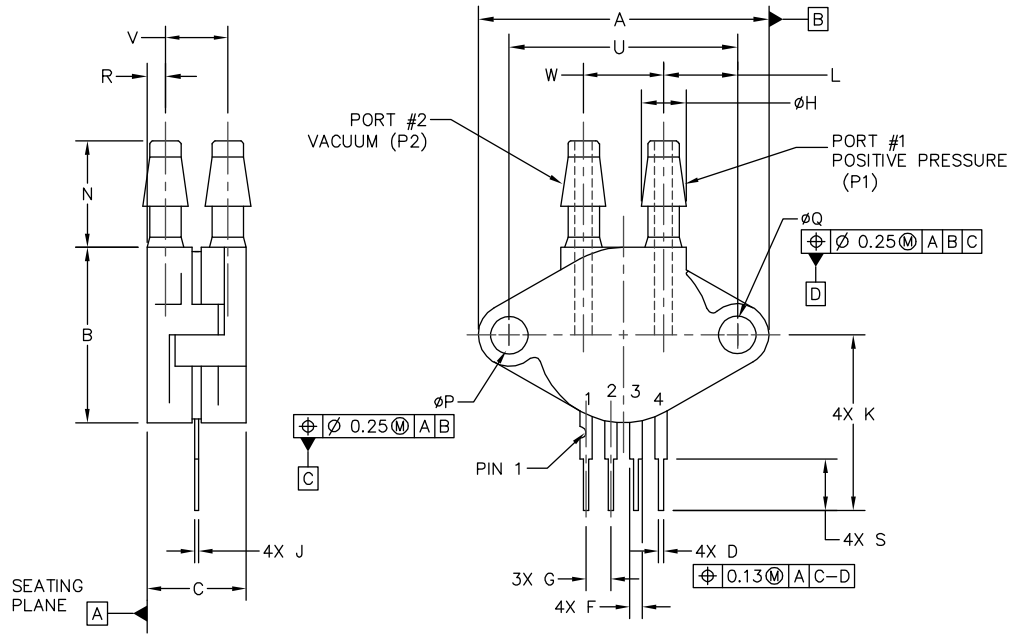
TITLE: SENSOR, 4 LEAD UNIBODY

DOCUMENT NO: 98ASB14911C REV: E

STANDARD: NON–JEDEC

SOT1753–1 18 JAN 2016

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



DIM	MILLIMETERS MIN	MAX	DIM	MILLIMETERS MIN	MAX
A	29.08	29.85	N	10.67	11.18
B	17.40	18.16	P	ø3.89	ø4.04
C	10.29	11.05	Q	ø3.89	ø4.04
D	0.41	0.51	R	1.60	2.11
F	1.22	1.63	S	5.59	6.10
G	2.54 BSC		U	23.11 BSC	
H	ø4.62	ø4.93	V	6.30	7.06
J	0.36	0.41	W	7.89	8.38
K	17.65	18.42			
L	7.37	7.62			

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. STYLE 1:

PIN 1: GROUND
2: + OUTPUT
3: + SUPPLY
4: – OUTPUT

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

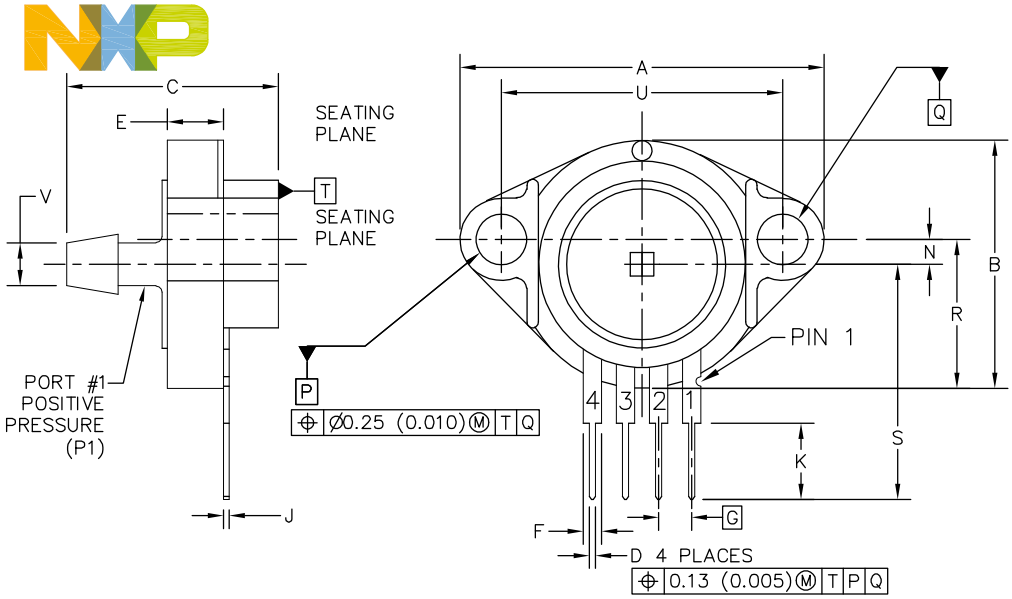
TITLE: SENSOR, 4 LEAD UNIBODY

DOCUMENT NO: 98ASB14912C REV: E

STANDARD: NON–JEDEC

SOT1754–1 18 JAN 2016

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



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	27.43	28.45	1.080	1.120
B	18.80	19.30	0.740	0.760
C	16.00	16.51	0.630	0.650
D	0.41	0.51	0.016	0.020
E	4.06	4.57	0.160	0.180
F	1.22	1.63	0.048	0.064
G	2.54 BSC		0.100 BSC	
J	0.36	0.41	0.014	0.016
K	5.59	6.10	0.220	0.240
N	1.78	2.03	0.070	0.080
P	3.81	4.06	0.150	0.160
Q	3.81	4.06	0.150	0.160
R	11.18	11.68	0.440	0.460
S	17.65	18.42	0.695	0.725
U	21.34	12.84	0.840	0.860
V	4.62	4.92	0.182	0.194

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCH.

STYLE 1:
PIN 1. GROUND
2. V (+) OUTPUT
3. V SUPPLY
4. V (−) OUTPUT

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

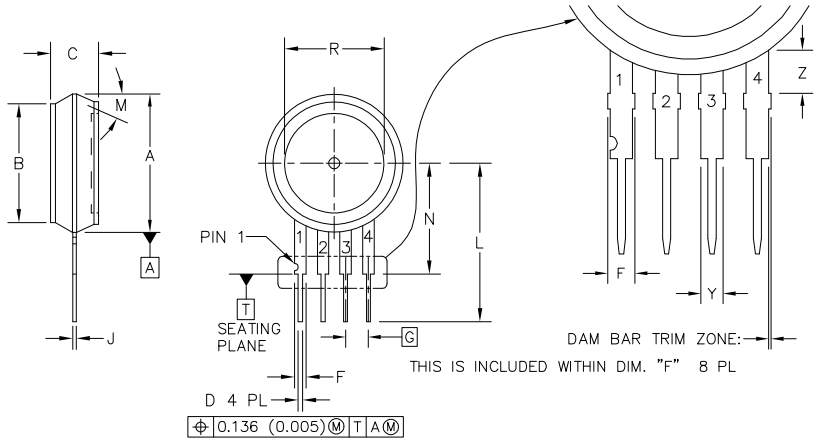
TITLE: SENSORS GSX & ASX
01ASB09025C, 98ASB09087B

DOCUMENT NO: 98ASB14915C REV: D

STANDARD: NON−JEDEC

SOT1757−1 18 JAN 2016

Figure 18. SOT1757-1 (Case 344F-01)



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	15.11	16.00	0.595	0.630
B	13.06	13.56	0.514	0.534
C	5.08	5.59	0.200	0.220
D	0.41	0.51	0.016	0.020
F	1.22	1.63	0.048	0.064
G	2.54 BSC		0.100 BSC	
J	0.36	0.40	0.014	0.016
L	17.65	18.42	0.695	0.725
M	30° NOM		30° NOM	
N	12.07	12.57	0.475	0.495
R	10.92	11.43	0.430	0.450
Y	1.22	1.32	0.048	0.052
Z	2.68	3.00	0.106	0.118

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION A IS INCLUSIVE OF THE MOLD STOP RING NOT TO EXCEED 16.00 (0.630)
4. 344–01 THRU –4 OBSOLETE.
5. 344–05 THRU –11 OBSOLETE, NEW STANDARD 344–15.

STYLE 1:
PIN 1. GROUND
2. + OUTPUT
3. + SUPPLY
4. – OUTPUT

STYLE 2:
PIN 1. VCC
2. – SUPPLY
3. + SUPPLY
4. GROUND

STYLE 3:
PIN 1. GROUND
2. – VOUT
3. VS
4. + VOUT

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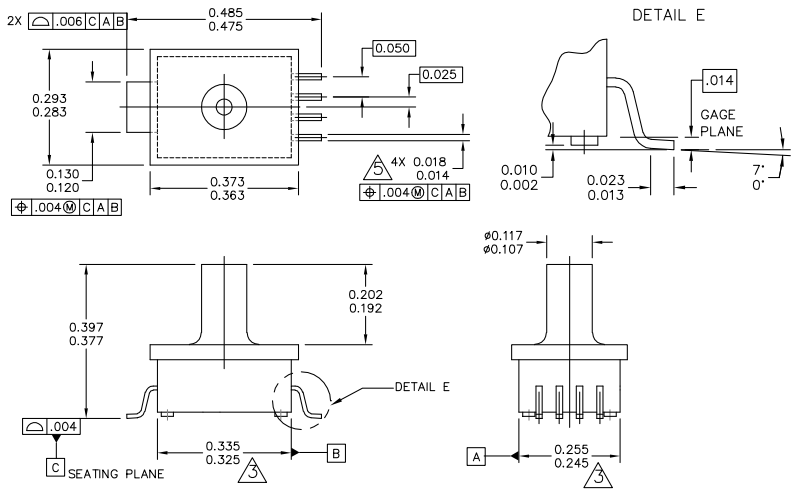
	STANDARD: NON–JEDEC	
	SOT1772–1	02 FEB 2016

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

10.3 MPAK packages



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	STANDARD: NON–JEDEC	
	SOT1673–1	29 FEB 2016

Figure 20. SOT1673-1 (1320A-02) – Page 1

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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	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	• Redesigned 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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Date of release: 27 April 2021
Document identifier: MPX2010