MPXV7002

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

Rev. 5 — 5 May 2021 Product data sheet

1 General description

The MPXV7002 series piezoresistive transducers are monolithic silicon pressure sensors. The MPXV7002 is designed for a wide range of applications, particularly applications employing a microcontroller, or microprocessor with analog-to-digital inputs. This 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 Features and benefits

- Ideally suited for microprocessor or microcontroller-based systems
- Thermoplastic (PPS) surface mount package
- Temperature compensated over +10 °C to +60 °C
- Patented silicon shear stress strain gauge
- Available in differential and gauge configurations

3 Applications

- Hospital beds
- HVAC
- Respiratory systems
- Process control

4 Ordering information

Table 1. Ordering information

Type number	Package		
	Name	Description	Version
MPXV7002DP	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
MPXV7002GC	SO8	Plastic, small outline package, 8 terminals, 2.54 mm pitch, 10.67 mm x 10.67 mm x 12.96 mm body	SOT1854-1
MPXV7002GP	SO8	Plastic, small outline package, 8 terminals, 2.54 mm pitch, 12.06 mm x 12.06 mm x 8.38 mm body	SOT1693-3

4.1 Ordering options

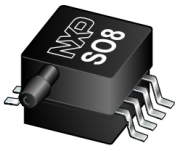
Table 2. Ordering options

Device name	Package options	SOT no.	# of Ports			Pressure type			Device marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small Outline Package (MPXV7002 Series)									
MPXV7002DP	Trays	SOT1693-1			•		•		MPXV7002DP
MPXV7002DPT1	Tape & Reel	SOT1693-1			•		•		MPXV7002DP
MPXV7002GC6U	Rails	SOT1854-1		•		•			MPXV7002G
MPXV7002GP	Trays	SOT1693-3		•		•			MPXV7002G

Small outline packages

MPXV7002DP/DPT1
CASE 1351-01
SOT1693-1

MPXV7002GC6U/C6T1
CASE 482A-01
SOT1854-1



MPXV7002GP
CASE 1369-01
SOT1693-3

5 Block diagram

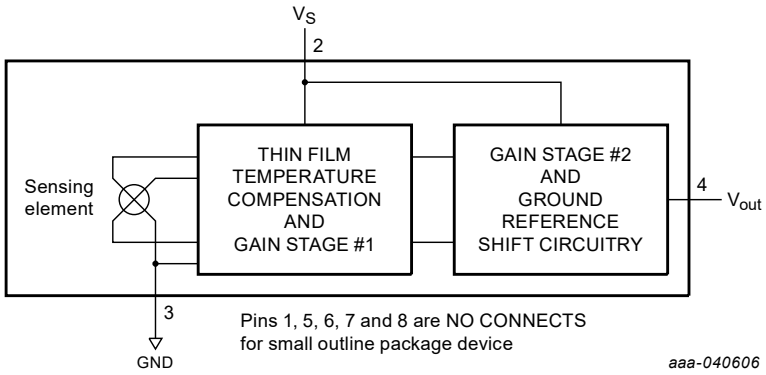


Figure 1. Integrated pressure sensor schematic

6 Pinning information

6.1 Pinning

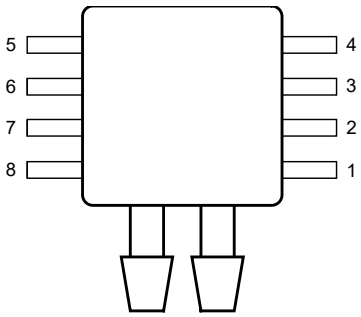


Figure 2. MPXV7002DP/DPT1 pin diagram

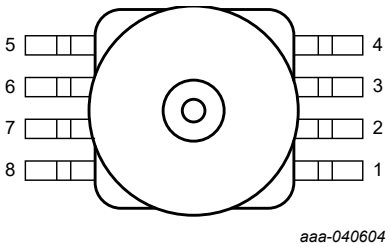


Figure 3. MPXV7002GC6U/C6T1 pin diagram

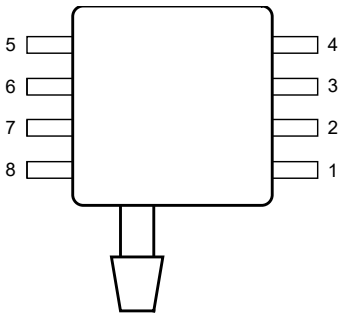


Figure 4. MPXV7002GP pin diagram

6.2 Pin description

This device family uses the style 2 pin configuration documented in Table 3 and shown in Figure 10.

Table 3. Pin description

Symbol	Pin[1]	Description
n.c.	1	—[2]
V_S	2	Supply voltage
GND	3	Ground
V_{out}	4	Voltage output
n.c.	5	—[2]
n.c.	6	—[2]
n.c.	7	—[2]
n.c.	8	—[2]

[1] The notch in the lead indicates pin 1.
[2] Internal device connection. Do not connect to external circuitry or ground

7 Maximum Ratings

Table 4. Maximum Ratings[1]

Rating	Symbol	Value	Unit
Maximum pressure (P1 > P2)	P_{max}	75	kPa
Storage temperature	T_{stg}	–30 to +100	° C
Operating temperature	T_A	10 to 60	° C

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

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

8 Operating Characteristics

Table 5. Operating Characteristics

(V_S = 5.0 Vdc, T_A = 25 °C unless otherwise noted. Decoupling circuit shown in Figure 6 required to meet specification.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure rRange[1]	P_{OP}	–2.0	—	2.0	kPa
Supply voltage[2]	V_S	4.75	5.0	5.25	Vdc
Supply current	I_o	—	—	10	mAdc
Pressure offset[3] (10 °C to 60 °C) @ V_S = 5.0 Volts	V_{off}	0.25	0.5	0.75	Vdc
Full scale output[4] (10 °C to 60 °C) @ V_S = 5.0 Volts	V_{FSO}	4.25	4.5	4.75	Vdc
Full Scale Span[5] (10 °C to 60 °C) @ V_S = 5.0 Volts	V_{FSS}	3.5	4.0	4.5 V	Vdc
Accuracy[6] (10 °C to 60 °C)	—	—	± 2.5[7]	± 6.25	$\%V_{FSS}$
Sensitivity	V/P	—	1.0	—-	V/kPa
Response time[8]	t_R	—	1.0	—-	ms
Output source current at full scale output	I_{O+}	—	0.1	—-	mAdc
Warm-up time[9]	—	—	20	—-	ms

[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 10° to 60 °C, relative to 25 °C.
- TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 10° to 60 °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] Auto Zero at Factory Installation: Due to the sensitivity of the MPXV7002 Series, external mechanical stresses and mounting position can affect the zero pressure output reading. Auto zero is defined as storing the zero pressure output reading and subtracting this from the device's output during normal operations. Reference AN1636[1] for specific information. The specified accuracy assumes a maximum temperature change of ± 5 °C between auto zero and measurement.
[8] 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.
[9] 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 Characteristics

9.1 On-chip temperature compensation, calibration, and signal conditioning

The performance over temperature is achieved by integrating the shear-stress strain gauge, temperature compensation, calibration, and signal conditioning circuitry onto a single monolithic chip.

Figure 5 illustrates the differential or gauge configuration in the basic chip carrier (Case 482). A fluorosilicone gel isolates the die surface and wire bonds from the environment, while allowing the pressure signal to be transmitted to the sensor diaphragm.

The MPXV7002 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 recommended decoupling circuit for interfacing the integrated sensor to the analog-to-digital input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

Figure 7 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over a temperature range of 10° to 60° C using the decoupling circuit shown in Figure 6. The output saturates outside the specified pressure range.

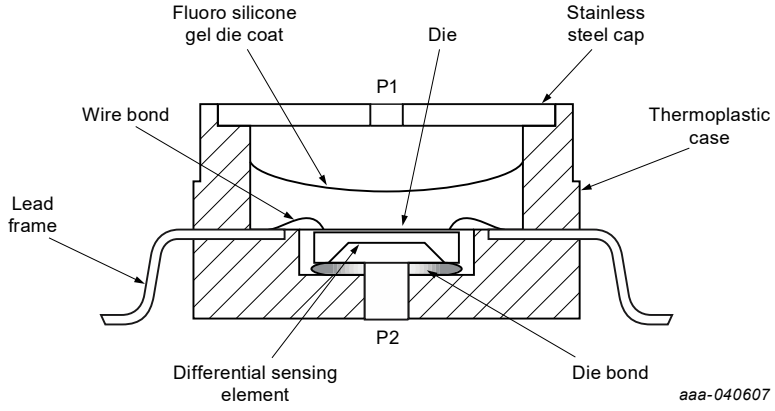


Figure 5. Cross-Sectional Diagram SOP (not to scale)

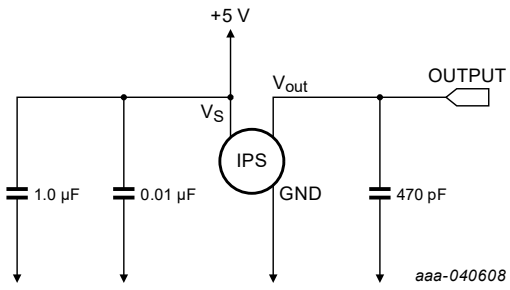


Figure 6. Recommended Power Supply Decoupling and Output Filtering

For additional output filtering, refer to Application Note AN1646[1].

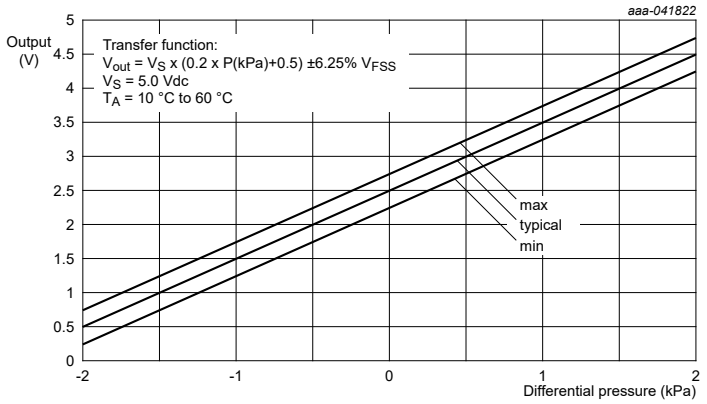


Figure 7. Output versus Pressure Differential

9.2 Pressure (P1)/Vacuum (P2) Side Identification Table

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 a gel die coat which protects the die from harsh media.

The Pressure (P1) side may be identified by using Table 6.

Table 6. Pressure side identification

Part Number	Case Type	Pressure (P1) Side Identifier
MPXV7002GC6U/GC6T1	482A-01	Side with Port Attached
MPXV7002GP	1369-01	Side with Port Attached
MPXV7002DP	1351-01	Side with Part Marking

9.3 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 self-align when subjected to a solder reflow process. NXP recommends designing boards with a solder mask layer to avoid bridging and shorting between solder pads.

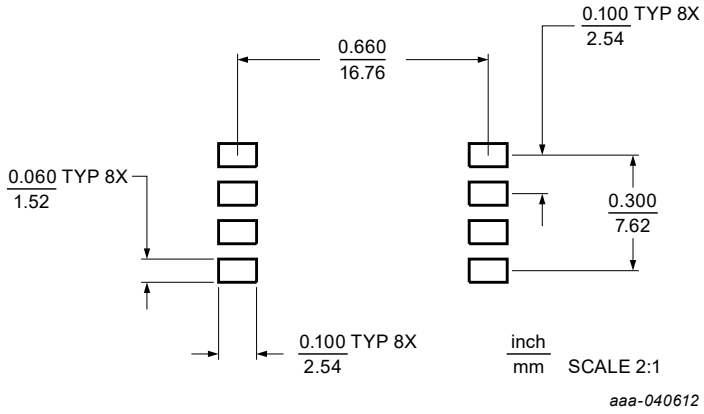


Figure 8. Small outline package footprint

10 Package outline

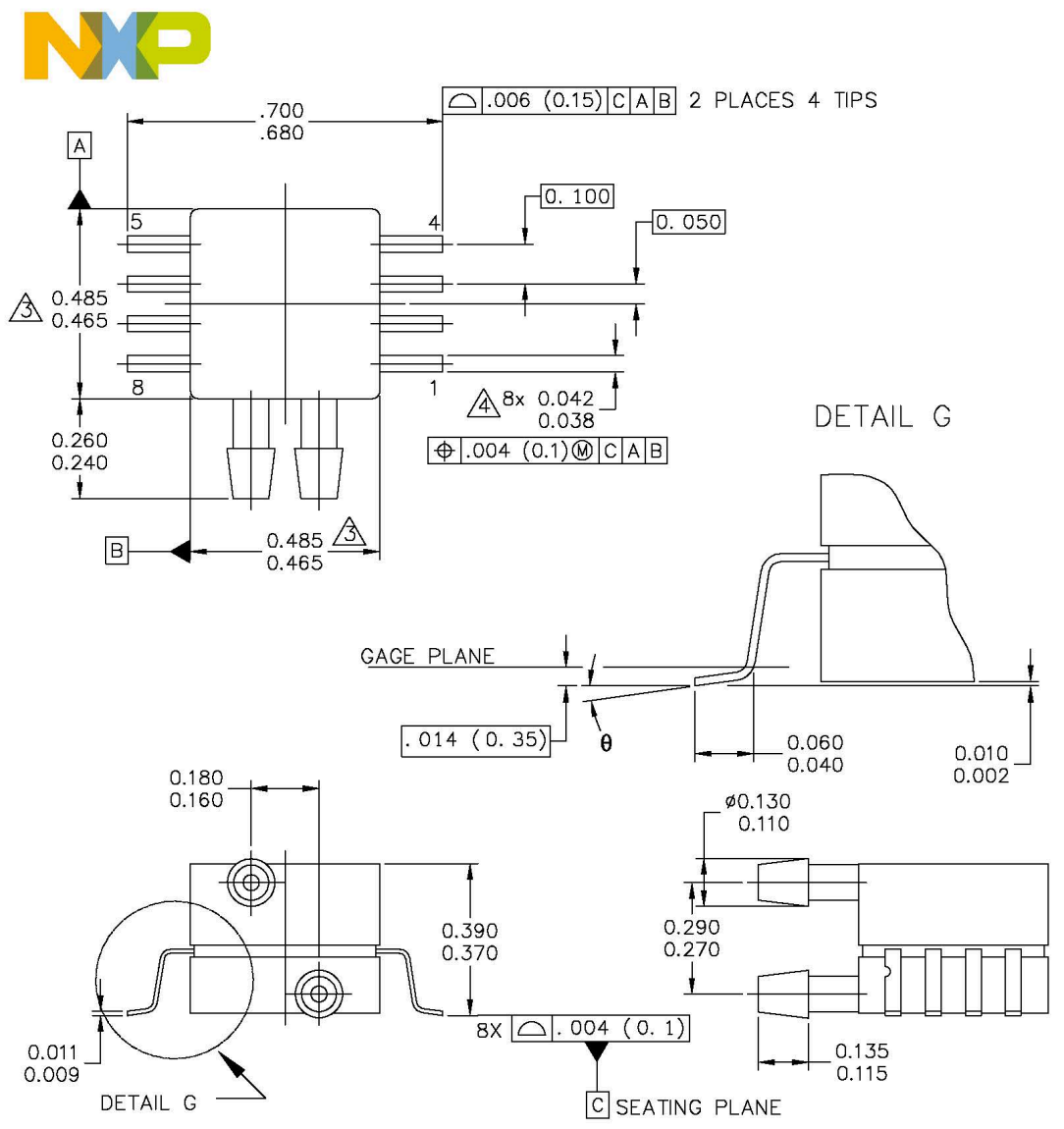


Figure 9. SOT1693-1, 8 Lead sensor, dual port package outline, 98ASA99255D, Rev. B

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

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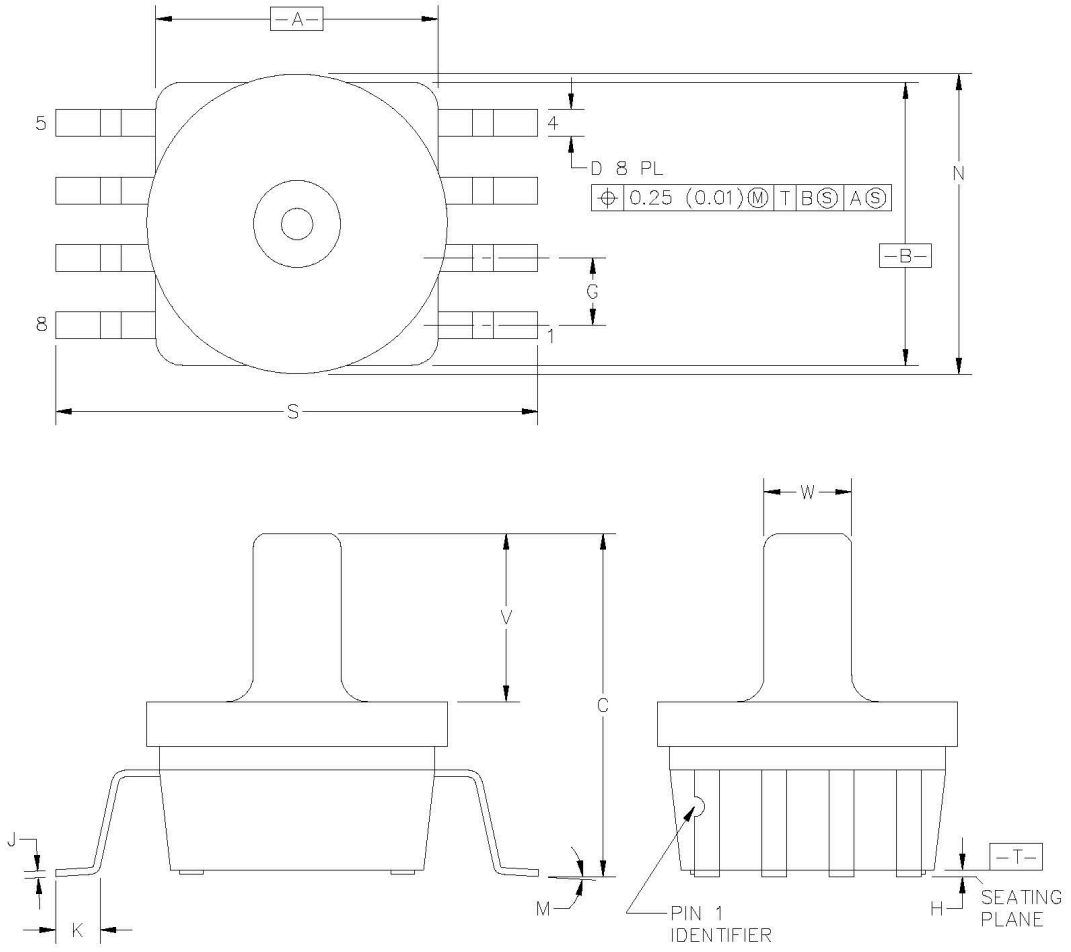
TITLE: 8 LD SNSR, DUAL PORT	DOCUMENT NO: 98ASA99255D	REV: B
	STANDARD: NON–JEDEC	
	SOT1693–1	14 MAR 2016

Figure 10. SOT1693-1, 8 Lead sensor, dual port package outline notes, 98ASA99255D, Rev. B



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

Figure 11. SOT1854-1, Unibody sensor package outline, 98ASB17757C, Rev. C

NOTES:

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

	INCHES		MILLIMETERS	
DIM	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

MECHANICAL OUTLINE | PRINT VERSION NOT TO SCALE

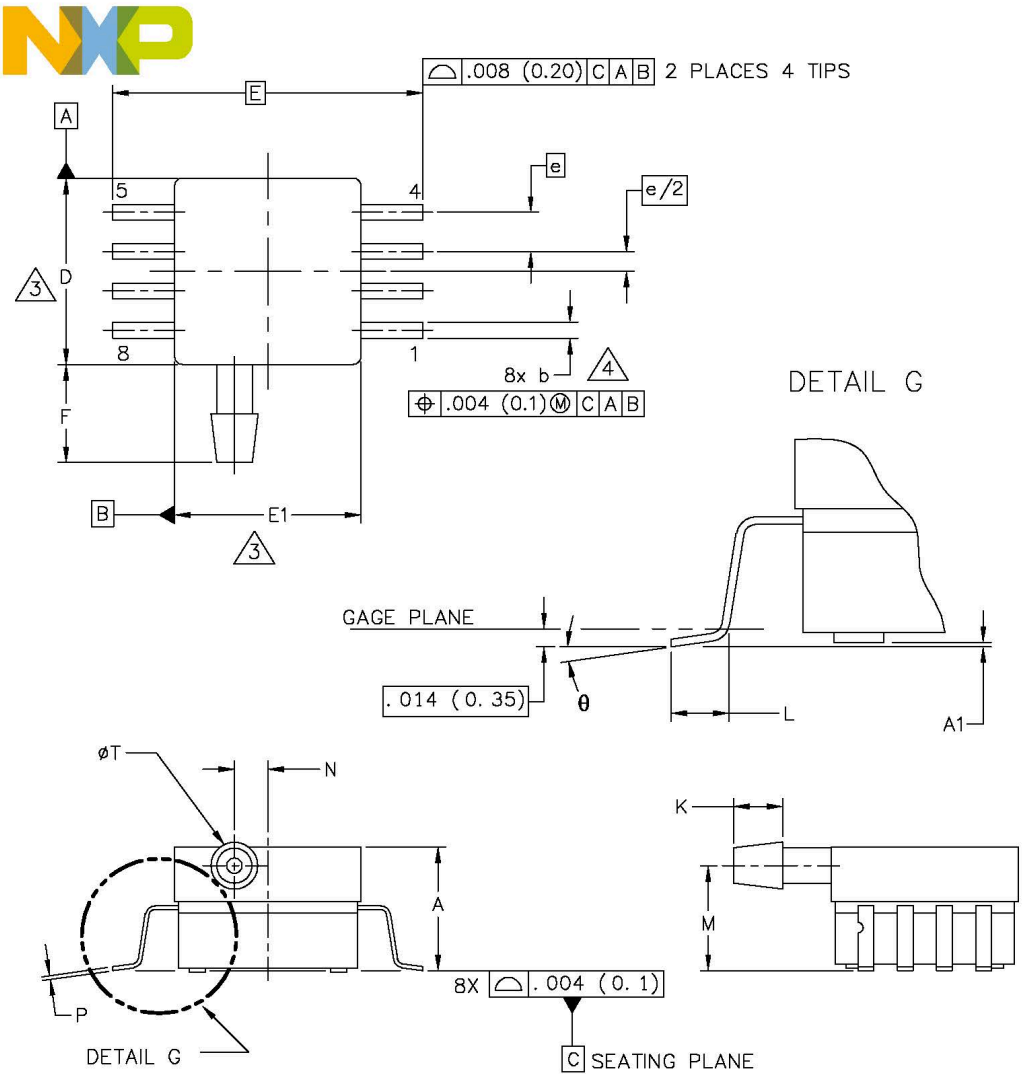
TITLE: SENSOR UNIBODY, 11.33 X 11.33 X 12.955 PKG, 2.54 PITCH, 8 I/O

DOCUMENT NO: 98ASB17757C REV: C

STANDARD: NON–JEDEC

SOT1854–1 13 JUL 2017

Figure 12. SOT1854-1, Unibody sensor package outline notes, 98ASB17757C, Rev. C



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

Figure 13. SOT1693-3, 8 Lead SOP, Side port package out line, 98ASA99303D, Rev. E

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 14. SOT1693-3, 8 Lead SOP, Side port package out line notes, 98ASA99303D, Rev. E

11 References

[1] AN1646 – Noise considerations for integrated pressure sensors
https://www.nxp.com/docs/en/application-note/AN1646.pdf

12 Revision History

Table 7. Revision History

Document ID	Release Date	Data sheet status	Change notice	Supercedes
MPXV7002 Rev. 5	20210505	Product	—	MPXV7002 Rev. 4
Modifications	• The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors, N.V. Legal texts have been adapted to the new company name where appropriate. • Global changes, revised as follows: – Revised all images including the package outline drawings to comply with NXP Semiconductor graphic standards. – Performed minor grammar, content, and typographical changes throughout. • Section 1, revised the first paragraph. • Section 2, removed two bullets starting with "2.5 % typical..." and "6.25 % maximum" from the list of features. • Section 3, added new section. • Section 4.1, removed row for "MPXV7002GC6T1". • Section 6.2, added clarification stating this device family uses the style 2 pin configuration as shown in Figure 10. • Section 9.1, revised "A gel die coat..." to "A fluorosilicone gel...." • Section 10, updated the package information section. • Section 11, added new reference section. • Cover page and Section 12, revised data sheet status to use current terminology "Product" which replaces the term "Technical data" to describe the data sheet status. This change is a terminlogy update.			
MPXV7002 Rev. 4	2017 March	Technical data	—	MPXV7002 Rev. 3.0
MPXV7002 Rev. 3.0	2015 January	Technical data	—	MPXV7002 Rev. 2.0
MPXV7002 Rev. 2.0	2009 January	Technical data	—	MPXV7002 Rev. 1.0
MPXV7002 Rev. 1.0	2008 September	Technical data	—	MPXV7002 Rev. 0
MPXV7002 Rev. 0	2005 September	Technical data	—	—

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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13.4 Trademarks

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Tables

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

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