

MPX10 Series

10 kPa Uncompensated Pressure Sensors

Rev. 15 — 22 April 2021

Product data sheet

1 General Description

The MPX10 series device is a silicon piezoresistive pressure sensor providing a very accurate and linear voltage output directly proportional to the applied pressure. This standard, low cost, uncompensated sensor permits manufacturers to design and add their own external temperature compensation and signal conditioning networks. Compensation techniques are simplified because of the predictability of NXP's single element strain gauge design.

2 Features and Benefits

- Low Cost
- Patented Silicon Shear Stress Strain Gauge Design
- Ratiometric to Supply Voltage
- Differential and Gauge Options
- Durable Epoxy Unibody Element or Thermoplastic (PPS) Surface Mount Package

3 Applications

- Air Movement Control
- Environmental Control Systems
- Level Indicators
- Leak Detection
- Medical Diagnostics
- Industrial Controls
- Pneumatic Control Systems
- Robotics

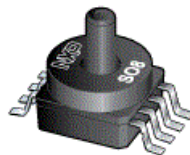


4 Ordering Information

Table 1. Ordering information

Device Name	Package options	Case number	Number of ports			Pressure type			Device marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small outline package (MPX10 Series)									
MPXV10GC6U	Rail	482A		•		•			MPXV10G
Unibody package (MPX10 Series)									
MPX10D	Tray	344	•				•		MPX10D
MPX10DP	Tray	344C			•		•		MPX10DP
MPX10GP	Tray	344B		•		•			MPX10GP

Small outline package

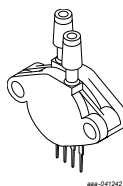


MPXV10GC6U
Case 482A-01

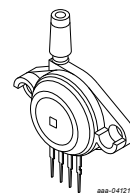
Unibody packages



MPX10D
Case 344-15



MPX10DP
Case 344C-01



MPX10GP
Case 344B-01

5 Block Diagram

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

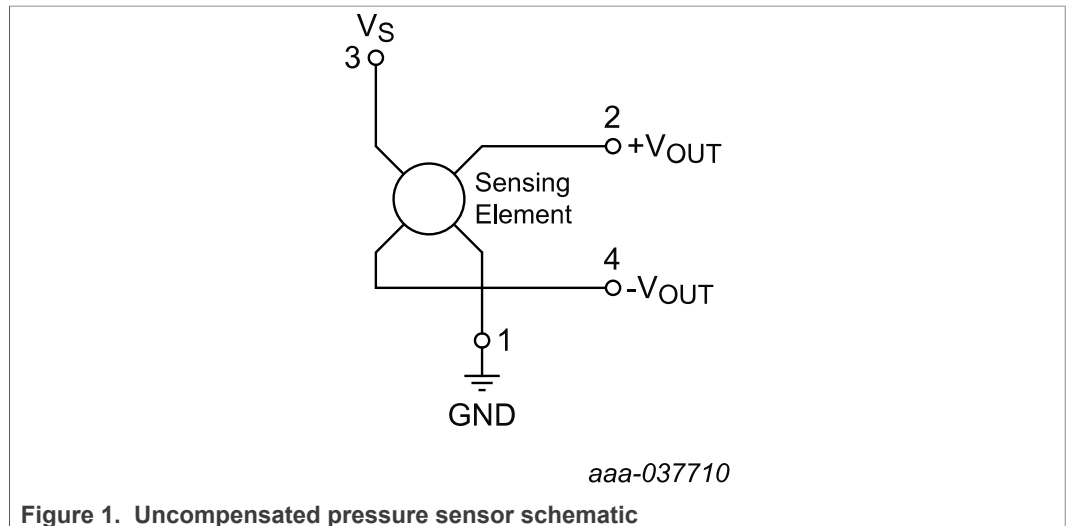


Figure 1. Uncompensated pressure sensor schematic

6 Pin Information

6.1 MPXV10GC6U

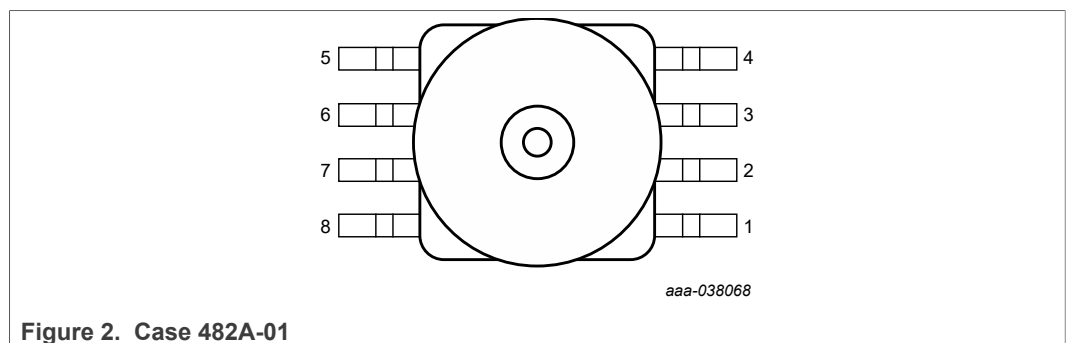


Figure 2. Case 482A-01

Table 2. Pin definitions - MPXV10GC6U

Symbol	Pin	Description
GND	1	Ground
+V _{OUT}	2	+Voltage output
V _S	3	Power supply
-V _{OUT}	4	-Voltage output
n.c.	5	Not connected
n.c.	6	Not connected
n.c.	7	Not connected
n.c.	8	Not connected

6.2 MPX10D

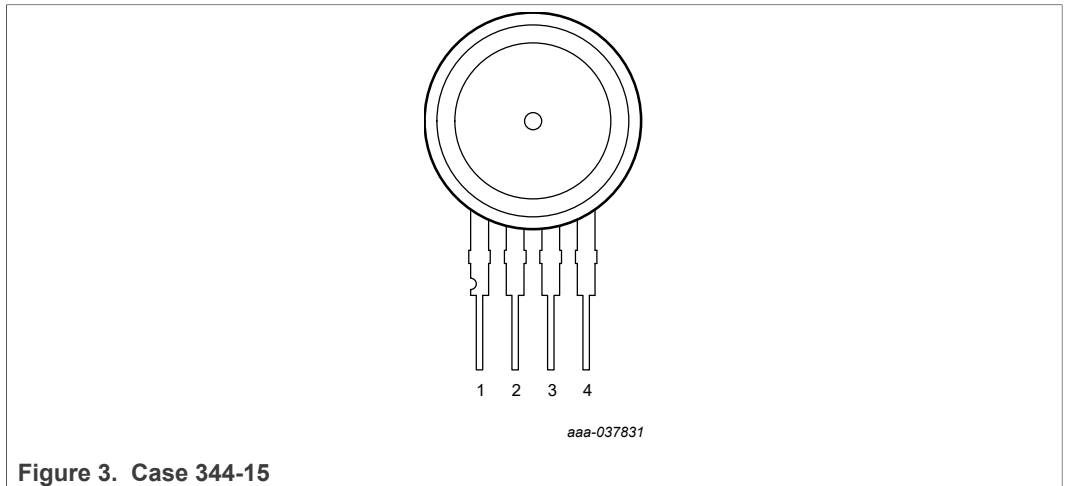


Figure 3. Case 344-15

Table 3. Pin definitions - MPX10D

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

6.3 MPX10DP

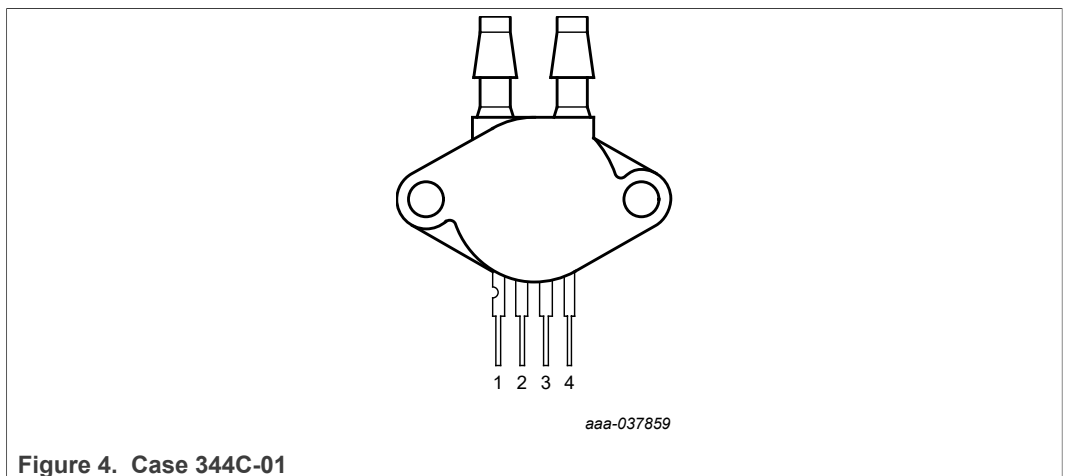


Figure 4. Case 344C-01

Table 4. Pin definitions - MPX10DP

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

6.4 MPX10GP

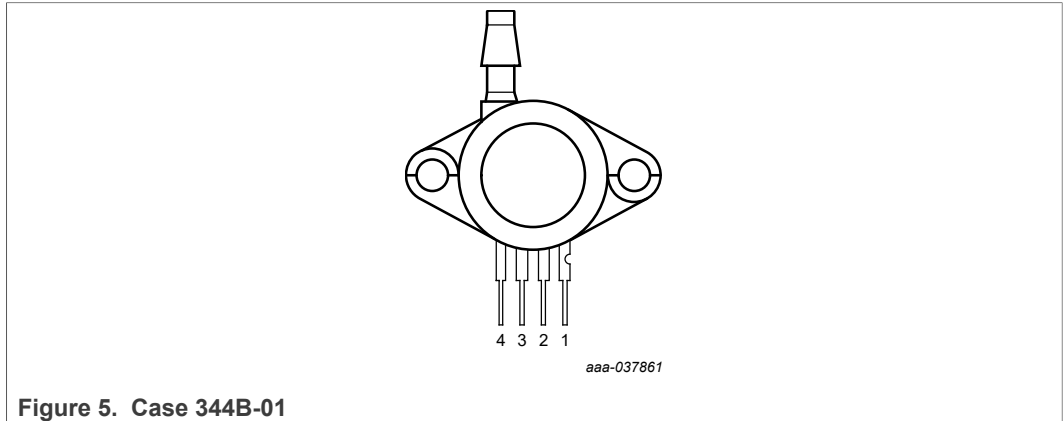


Figure 5. Case 344B-01

Table 5. Pin definitions - MPX10GP

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 6. 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 7. Operating Characteristics ($V_S = 3.0$ Vdc, $T_A = 25$ °C unless otherwise noted, $P1 > P2$)

Characteristic	Symbol	Min	Typ	Max	Unit
Operating Pressure Range [1]	P_{OP}	0	—	10	kPa
Supply Voltage [2]	V_S	—	3.0	6.0	V _{DC}
Supply Current	I_o	—	6.0	—	mAdc
Full Scale Span [3]	V_{FSS}	20	35	50	mV
Offset [4]	V_{off}	0	20	35	mV
Sensitivity	$\Delta V/\Delta P$	—	3.5	—	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}	-0.22	—	-0.16	% $V_{FSS}/^{\circ}C$
Temperature Coefficient of Offset [5]	TCV_{off}	—	± 15	—	$\mu V/^{\circ}C$
Temperature Coefficient of Resistance [5]	TCR	0.21	—	0.27	% $Z_{in}/^{\circ}C$
Input Impedance	Z_{in}	400	—	550	Ω
Output Impedance	Z_{out}	750	—	1250	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
- TCR: Z_{in} deviation with minimum rated pressure applied, over the temperature range of -40 °C to +125 °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).

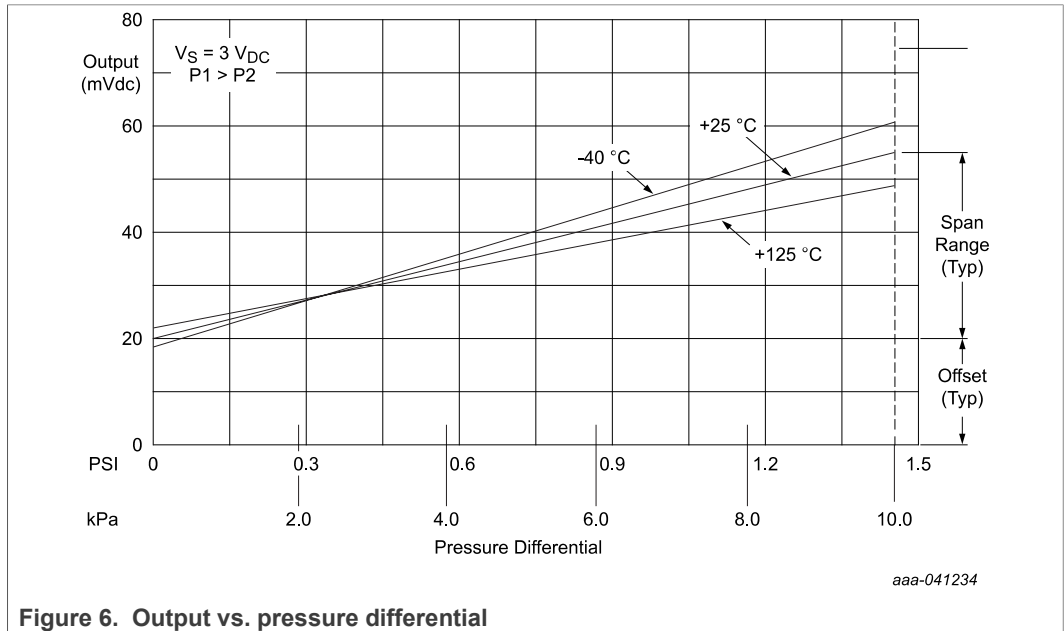
9.2 Temperature compensation

Figure 6 shows the typical output characteristics of the MPX10 series over temperature.

Because this strain gauge is an integral part of the silicon diaphragm, there are no temperature effects due to differences in the thermal expansion of the strain gauge and the diaphragm, as are often encountered in bonded strain gauge pressure sensors. However, the properties of the strain gauge itself are temperature dependent, requiring that the device be temperature compensated if it is to be used over an extensive temperature range.

Temperature compensation and offset calibration can be achieved rather simply with additional resistive components, or by designing your system using the MPX2010 series sensor.

Several approaches to external temperature compensation over both -40 °C to +125 °C and 0 °C to +80 °C ranges are presented in Application Note AN840



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 7). There are two basic methods for calculating nonlinearity:

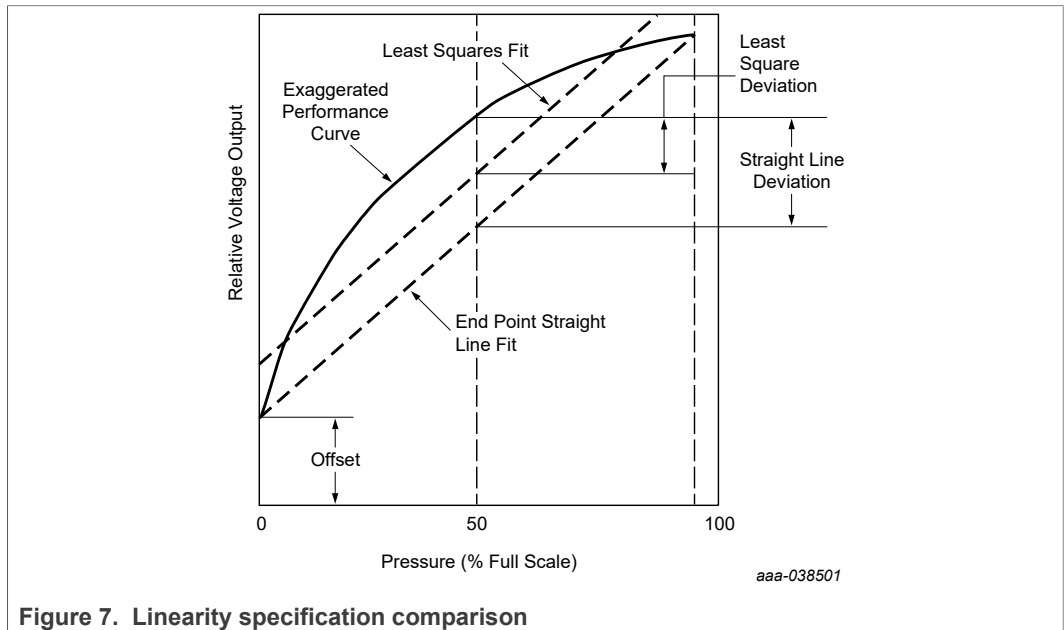
- End point straight line fit

- 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.



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 8](#).

Table 8. Pressure (P1) side delineation table

Part Number	Case Type	Pressure (P1) Side Identifier
MPX10D	344	Stainless Steel Cap
MPX10DP	344C	Side with Part Marking
MPX10GP	344B	Side with Port Attached
MPXV10GC6U	482A	Side with Port Attached

9.5 Media compatibility

[Figure 8](#) 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.

The MPX10 series pressure sensor 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](#).

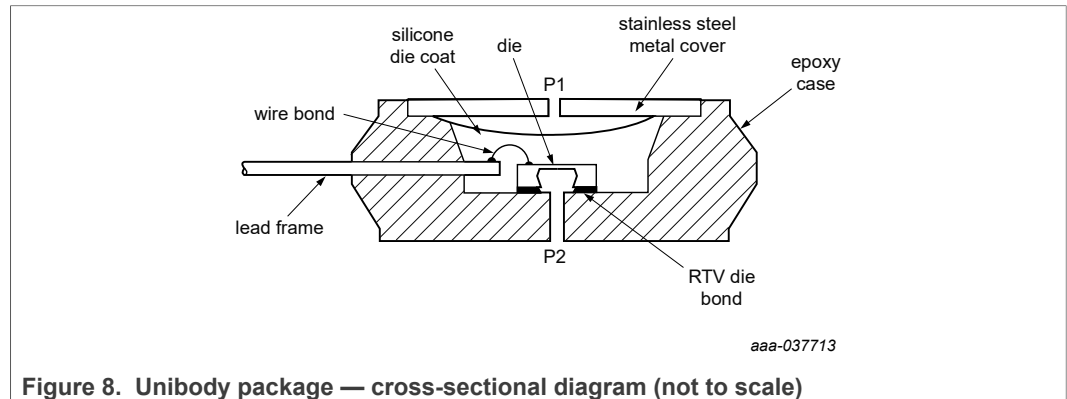


Figure 8. Unibody package — cross-sectional diagram (not to scale)

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

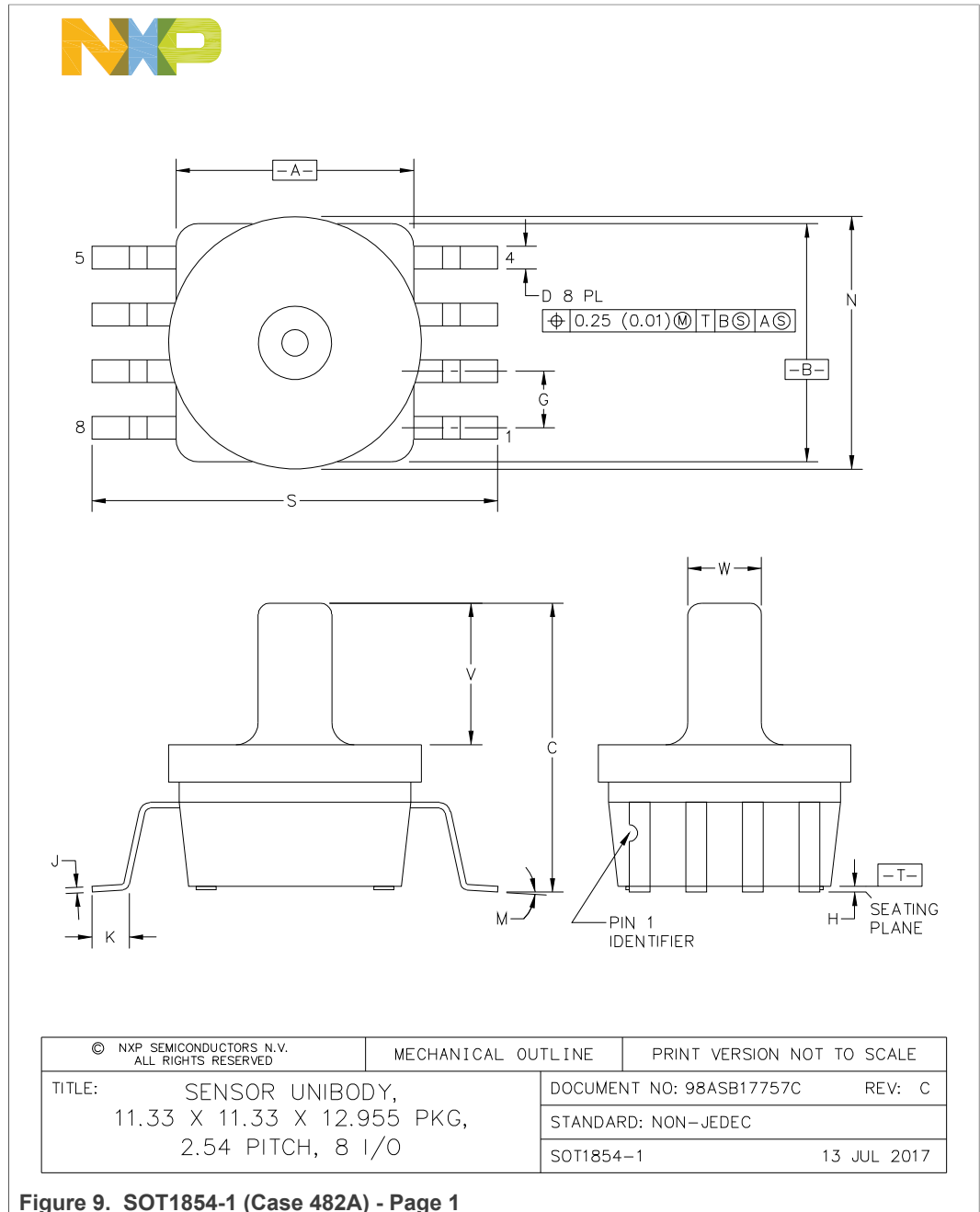


Figure 9. SOT1854-1 (Case 482A) - Page 1



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.

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

© NXP SEMICONDUCTORS N.V. ALL RIGHTS RESERVED		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 10. SOT1854-1 (Case 482A) - Page 2

10.2 Unibody packages

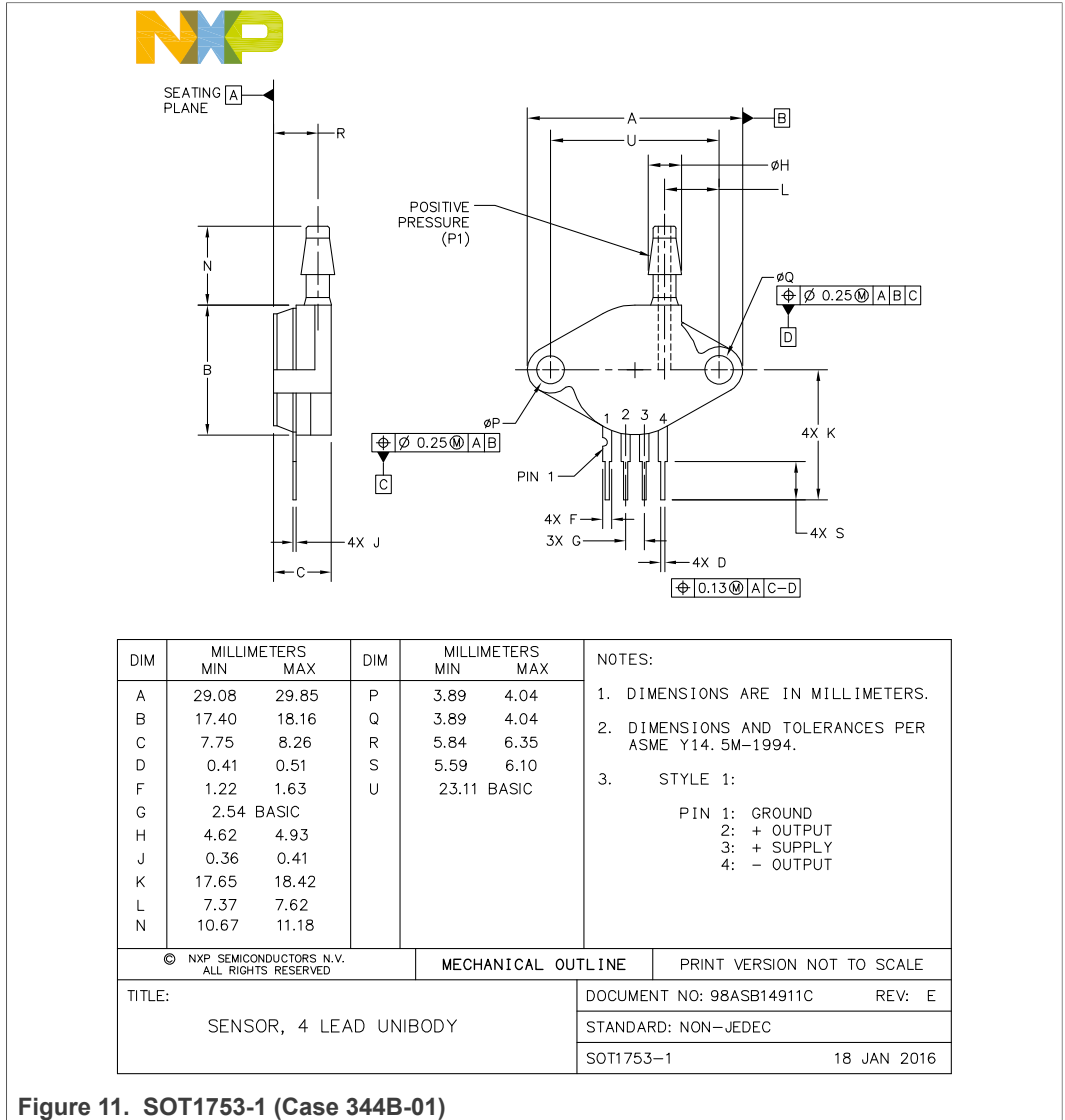
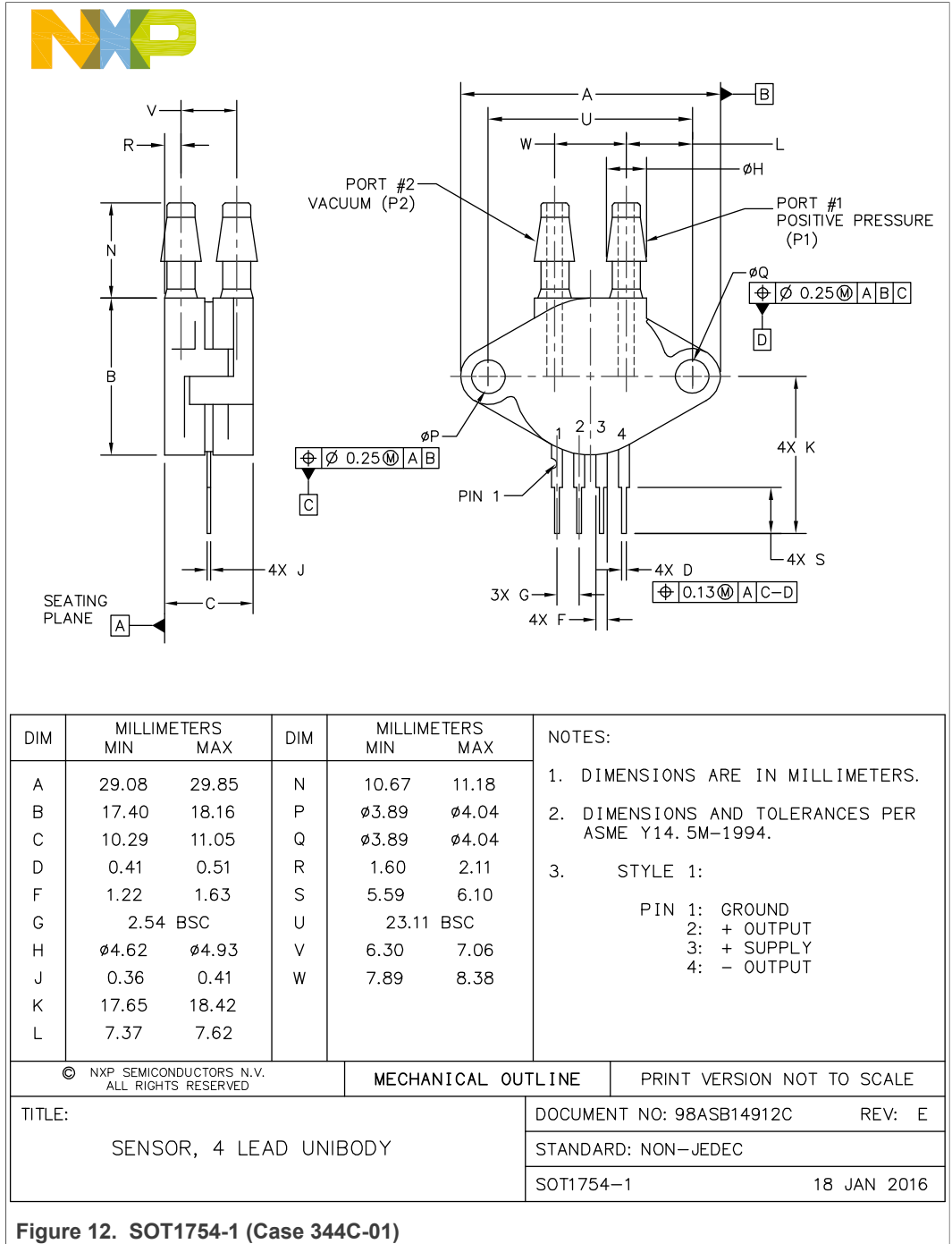


Figure 11. SOT1753-1 (Case 344B-01)



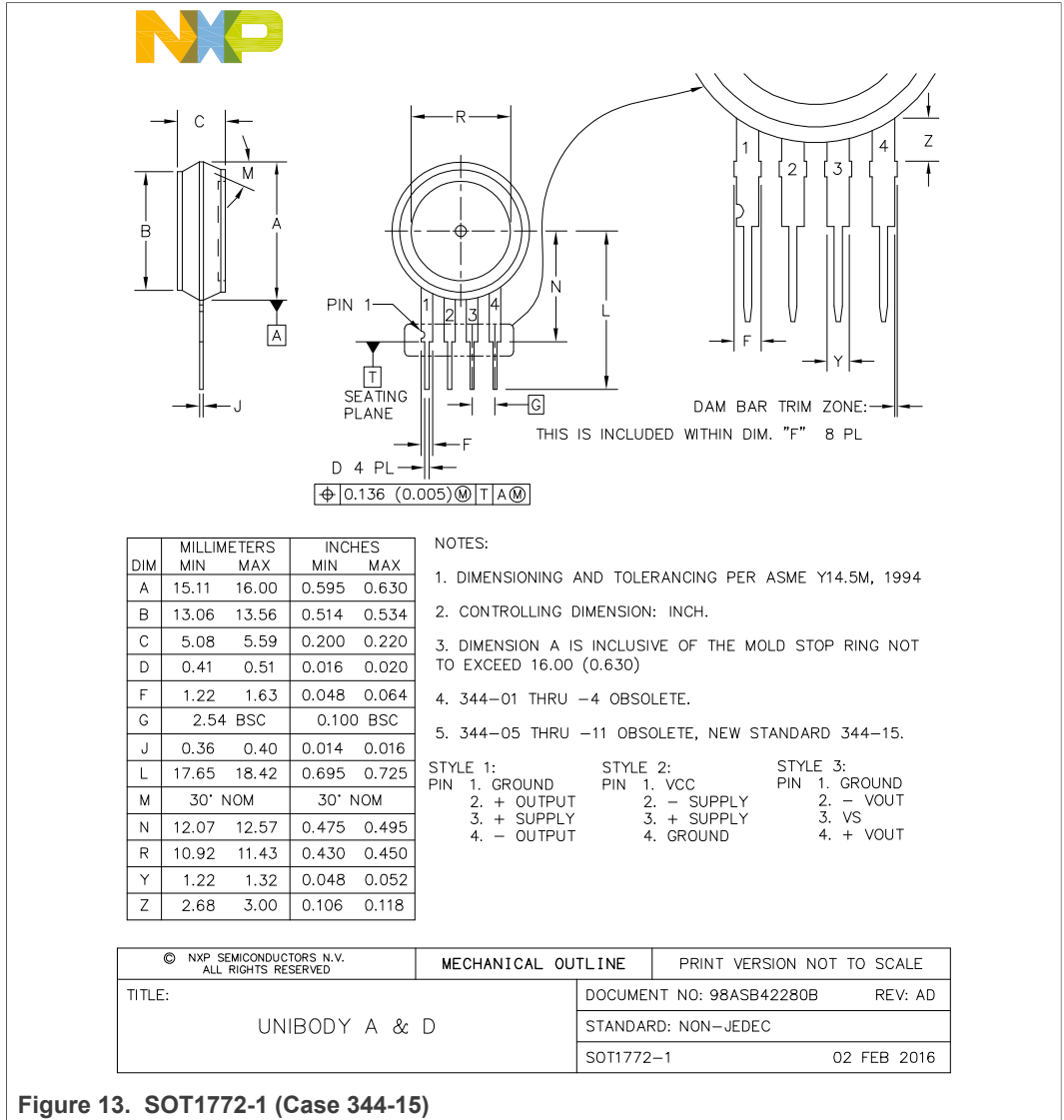


Figure 13. SOT1772-1 (Case 344-15)

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 9. Revision history

Document ID	Release date	Data sheet status	Change notice	Supersedes
MPX10 v.15	20210422	Product data sheet	-	MPX10 v.14
Modifications	<ul style="list-style-type: none"> • 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: MPXV10GC7U 			
MPX10 v.14	200810	Product data sheet	-	MPX10 v.13

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>.

13.2 Definitions

Draft — A draft status on a document indicates that the content is still under internal review and subject to formal approval, which may result in modifications or additions. NXP Semiconductors does not give any representations or warranties as to the accuracy or completeness of information included in a draft version of a document and shall have no liability for the consequences of use of such information.

Short data sheet — A short data sheet is an extract from a full data sheet with the same product type number(s) and title. A short data sheet is intended for quick reference only and should not be relied upon to contain detailed and full information. For detailed and full information see the relevant full data sheet, which is available on request via the local NXP Semiconductors sales office. In case of any inconsistency or conflict with the short data sheet, the full data sheet shall prevail.

Product specification — The information and data provided in a Product data sheet shall define the specification of the product as agreed between NXP Semiconductors and its customer, unless NXP Semiconductors and customer have explicitly agreed otherwise in writing. In no event however, shall an agreement be valid in which the NXP Semiconductors product is deemed to offer functions and qualities beyond those described in the Product data sheet.

13.3 Disclaimers

Limited warranty and liability — Information in this document is believed to be accurate and reliable. However, NXP Semiconductors does not give any representations or warranties, expressed or implied, as to the accuracy or completeness of such information and shall have no liability for the consequences of use of such information. NXP Semiconductors takes no responsibility for the content in this document if provided by an information source outside of NXP Semiconductors. In no event shall NXP Semiconductors be liable for any indirect, incidental, punitive, special or consequential damages (including - without limitation - lost profits, lost savings, business interruption, costs related to the removal or replacement of any products or rework charges) whether or not such damages are based on tort (including negligence), warranty, breach of contract or any other legal theory. Notwithstanding any damages that customer might incur for any reason whatsoever, NXP Semiconductors' aggregate and cumulative liability towards customer for the products described herein shall be limited in accordance with the Terms and conditions of commercial sale of NXP Semiconductors.

Right to make changes — NXP Semiconductors reserves the right to make changes to information published in this document, including without limitation specifications and product descriptions, at any time and without

notice. This document supersedes and replaces all information supplied prior to the publication hereof.

Suitability for use — NXP Semiconductors products are not designed, authorized or warranted to be suitable for use in life support, life-critical or safety-critical systems or equipment, nor in applications where failure or malfunction of an NXP Semiconductors product can reasonably be expected to result in personal injury, death or severe property or environmental damage. NXP Semiconductors and its suppliers accept no liability for inclusion and/or use of NXP Semiconductors products in such equipment or applications and therefore such inclusion and/or use is at the customer's own risk.

Applications — Applications that are described herein for any of these products are for illustrative purposes only. NXP Semiconductors makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification. Customers are responsible for the design and operation of their applications and products using NXP Semiconductors products, and NXP Semiconductors accepts no liability for any assistance with applications or customer product design. It is customer's sole responsibility to determine whether the NXP Semiconductors product is suitable and fit for the customer's applications and products planned, as well as for the planned application and use of customer's third party customer(s). Customers should provide appropriate design and operating safeguards to minimize the risks associated with their applications and products. NXP Semiconductors does not accept any liability related to any default, damage, costs or problem which is based on any weakness or default in the customer's applications or products, or the application or use by customer's third party customer(s). Customer is responsible for doing all necessary testing for the customer's applications and products using NXP Semiconductors products in order to avoid a default of the applications and the products or of the application or use by customer's third party customer(s). NXP does not accept any liability in this respect.

Limiting values — Stress above one or more limiting values (as defined in the Absolute Maximum Ratings System of IEC 60134) will cause permanent damage to the device. Limiting values are stress ratings only and (proper) operation of the device at these or any other conditions above those given in the Recommended operating conditions section (if present) or the Characteristics sections of this document is not warranted. Constant or repeated exposure to limiting values will permanently and irreversibly affect the quality and reliability of the device.

Terms and conditions of commercial sale — NXP Semiconductors products are sold subject to the general terms and conditions of commercial sale, as published at <http://www.nxp.com/profile/terms>, unless otherwise agreed in a valid written individual agreement. In case an individual agreement is concluded only the terms and conditions of the respective agreement shall apply. NXP Semiconductors hereby expressly objects to applying the customer's general terms and conditions with regard to the purchase of NXP Semiconductors products by customer.

No offer to sell or license — Nothing in this document may be interpreted or construed as an offer to sell products that is open for acceptance or the grant, conveyance or implication of any license under any copyrights, patents or other industrial or intellectual property rights.

Quick reference data — The Quick reference data is an extract of the product data given in the Limiting values and Characteristics sections of this document, and as such is not complete, exhaustive or legally binding.

Export control — This document as well as the item(s) described herein may be subject to export control regulations. Export might require a prior authorization from competent authorities.

Translations — A non-English (translated) version of a document is for reference only. The English version shall prevail in case of any discrepancy between the translated and English versions.

Security — Customer understands that all NXP products may be subject to unidentified or documented vulnerabilities. Customer is responsible for the design and operation of its applications and products throughout their lifecycles to reduce the effect of these vulnerabilities on customer's

applications and products. Customer's responsibility also extends to other open and/or proprietary technologies supported by NXP products for use in customer's applications. NXP accepts no liability for any vulnerability. Customer should regularly check security updates from NXP and follow up appropriately. Customer shall select products with security features that best meet rules, regulations, and standards of the intended application and make the ultimate design decisions regarding its products and is solely responsible for compliance with all legal, regulatory, and security related requirements concerning its products, regardless of any information or support that may be provided by NXP. NXP has a Product Security Incident Response Team (PSIRT) (reachable at PSIRT@nxp.com) that manages the investigation, reporting, and solution release to security vulnerabilities of NXP products.

13.4 Trademarks

Notice: All referenced brands, product names, service names and trademarks are the property of their respective owners.

NXP — wordmark and logo are trademarks of NXP B.V.

Tables

Tab. 1.	Ordering information	2	Tab. 7.	Operating Characteristics (VS = 3.0 Vdc, TA = 25 °C unless otherwise noted, P1 > P2)	7
Tab. 2.	Pin definitions - MPXV10GC6U	3	Tab. 8.	Pressure (P1) side delineation table	9
Tab. 3.	Pin definitions - MPX10D	4	Tab. 9.	Revision history	16
Tab. 4.	Pin definitions - MPX10DP	4			
Tab. 5.	Pin definitions - MPX10GP	5			
Tab. 6.	Maximum ratings	6			

Figures

Fig. 1.	Uncompensated pressure sensor schematic	3	Fig. 8.	Unibody package — cross-sectional diagram (not to scale)	10
Fig. 2.	Case 482A-01	3	Fig. 9.	SOT1854-1 (Case 482A) - Page 1	11
Fig. 3.	Case 344-15	4	Fig. 10.	SOT1854-1 (Case 482A) - Page 2	12
Fig. 4.	Case 344C-01	4	Fig. 11.	SOT1753-1 (Case 344B-01)	13
Fig. 5.	Case 344B-01	5	Fig. 12.	SOT1754-1 (Case 344C-01)	14
Fig. 6.	Output vs. pressure differential	8	Fig. 13.	SOT1772-1 (Case 344-15)	15
Fig. 7.	Linearity specification comparison	9			