MPX4250A, MPXA4250A

20 to 250 kPa, Manifold absolute pressure sensor, on-chip signal conditioned, temperature compensated and calibrated

Rev. 8.0 — 25 July 2017 Data sheet: technical data

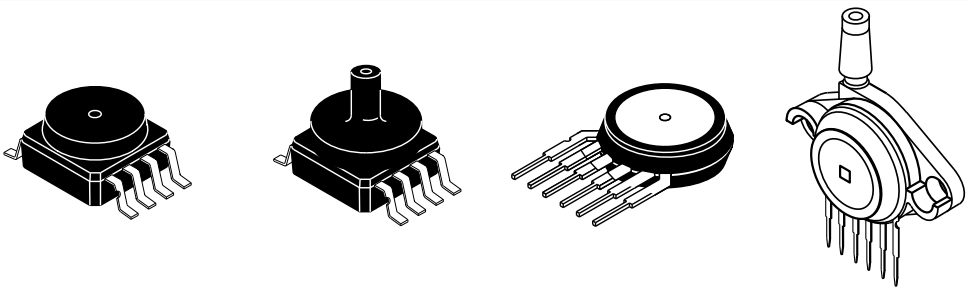
1 General description

The MPX4250A/MPXA4250A Manifold Absolute Pressure (MAP) sensor for engine control is designed to sense absolute air pressure within the intake manifold. This measurement can be used to compute the amount of fuel required for each cylinder.

The MPX4250A/MPXA4250A piezoresistive transducer is a state-of-the-art monolithic silicon pressure sensor designed for a wide range of applications, particularly those employing a microcontroller or microprocessor with A/D 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. The small form factor and high reliability of on-chip integration make the NXP sensor a logical and economical choice for the automotive system engineer.

2 Features

- 1.5 % maximum error over 0 °C to 85 °C
- Specifically designed for intake manifold absolute pressure sensing in engine control systems
- Patented silicon shear stress strain gauge
- Temperature compensated over –40 °C to +125 °C
- Offers reduction in weight and volume compared to existing hybrid modules
- Durable epoxy unibody element or thermoplastic small outline, surface mount package
- Ideal for non-automotive applications
- Available in three small outline packages and two unibody packages



MPXA4250A6U
98ASB17756C
CASE 482-01

MPXA4250AC6U/C6T1
98ASB17757C
CASE 482A-01

MPX4250A
98ASB42793B
CASE 867-08

MPX4250AP
98ASB42796B
CASE 867B-04

Figure 1. Small outline and unibody packages

3 Typical applications

- Turbo boost engine control
- Ideally suited for microprocessor or microcontroller-based systems

4 Ordering information

Table 1. Ordering information

Device name	Package Options	Package Name	# of Ports			Pressure type			Device marking
			None	Single	Dual	Gauge	Differential	Absolute	
Small outline package (MPXA4250A series)									
MPXA4250A6U	Rail	98ASB17756C	•					•	MPXA4250A
MPXA4250AC6U	Rail	98ASB17757C		•				•	MPXA4250A
MPXA4250AC6T1	Tape and Reel	98ASB17757C		•				•	MPXA4250A
Unibody package (MPX4250A series)									
MPX4250A	Tray	98ASB42793B	•					•	MPX4250A
MPX4250AP	Tray	98ASB42796B		•				•	MPX4250A

5 Block diagram

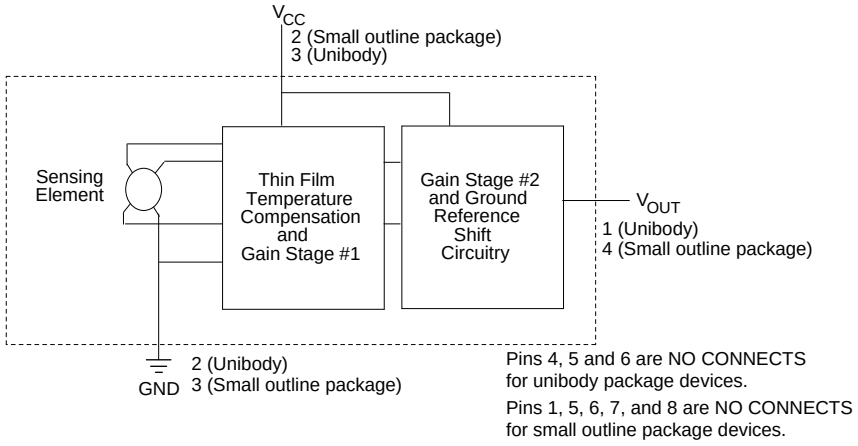


Figure 2. Block diagram

6 Pinning information

6.1 Pinning

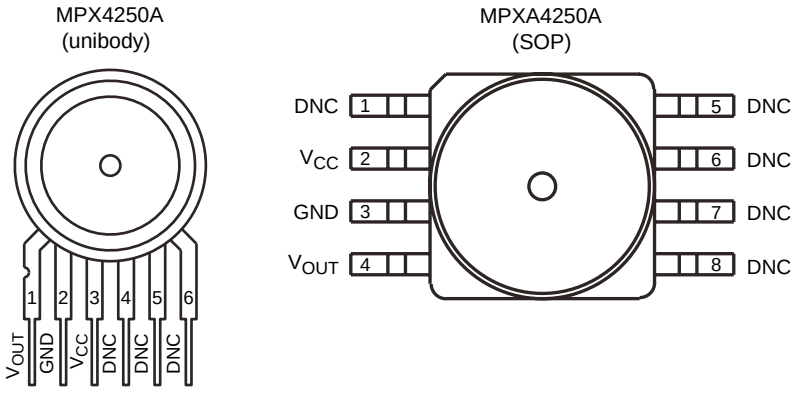


Figure 3. Pinning diagram

6.2 Pin description

Table 2. Pin descriptions — Unibody package

Symbol	Pin	Description
V_{OUT}	1	Output voltage
GND	2	Ground
V_{CC}	3	Voltage supply
DNC	4	Do not connect to external circuitry or ground
DNC	5	Do not connect to external circuitry or ground
DNC	6	Do not connect to external circuitry or ground

Table 3. Pin descriptions — Small outline package

Symbol	Pin	Description
DNC	1	Do no connect to external circuitry or ground
V_{CC}	2	Voltage supply
GND	3	Ground
V_{OUT}	4	Output voltage
DNC	5	Do not connect to external circuitry or ground
DNC	6	Do not connect to external circuitry or ground
DNC	7	Do not connect to external circuitry or ground
DNC	8	Do not connect to external circuitry or ground

7 Mechanical and electrical specifications

7.1 Maximum ratings

Table 4. Maximum ratings

T_A = 25 °C unless otherwise noted. Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Rating	Symbol	Value	Unit
Maximum pressure (P1 > P2)	P_{MAX}	1000	kPa
Storage temperature	T_{STG}	–40 to +125	°C
Operating temperature	T_A	–40 to +125	°C

Figure 2 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.

7.2 Operating characteristics

Table 5. Operating characteristics

(V_{CC} = 5.1 Vdc, T_A = 25 °C unless otherwise noted, P1 > P2. Decoupling circuit shown in Figure 5 required to meet electrical specifications.)

Symbol	Characteristic	Min	Typ	Max	Unit
P_{OP}	Pressure range[1]	20	—	250	kPa
V_{CC}	Supply voltage[2]	4.85	5.1	5.35	Vdc
I_o	Supply current	—	7.0	10	mAdc
V_{off}	Minimum pressure offset[3] (0 °C to 85 °C)	0.133	0.204	0.274	Vdc
V_{FSO}	Full scale output[4] (0 °C to 85 °C)	4.826	4.896	4.966	Vdc
V_{FSS}	Full scale span[5] (0 °C to 85 °C)	—	4.692	—	Vdc
—	Accuracy[6] (0 °C to 85 °C)	—	—	±1.5	$\%V_{FSS}$
ΔV/ΔP	Sensitivity	—	20	—-	mV/kPa
t_R	Response time[7]	—	1.0	—-	ms
I_{o+}	Output source current at full scale output	—	0.1	—-	mAdc
—	Warm-up time[8]	—	20	—-	ms
—	Offset stability[9]	—	± 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 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 rated 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.
[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.

8 On-chip temperature compensation and calibration

Figure 4 illustrates the absolute pressure sensing chip in the basic chip carrier (98ASB42793B). 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 MPX4250A/MPXA4250A 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 5 shows the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller.

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 5. The output will saturate outside of the specified pressure range.

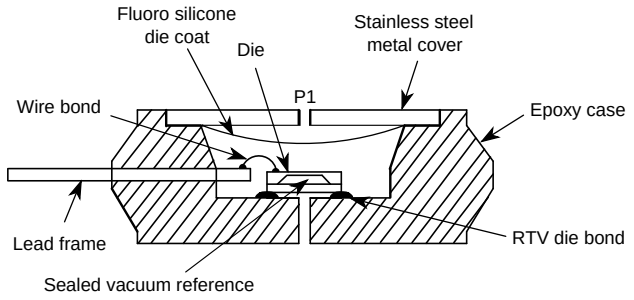
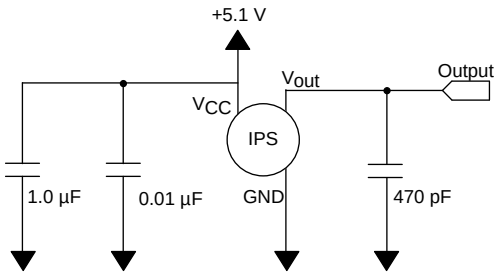


Figure 4. Cross sectional diagram (not to scale)



For additional output filtering, please refer to Application Note AN1646

Figure 5. Recommended power supply decoupling and output filtering

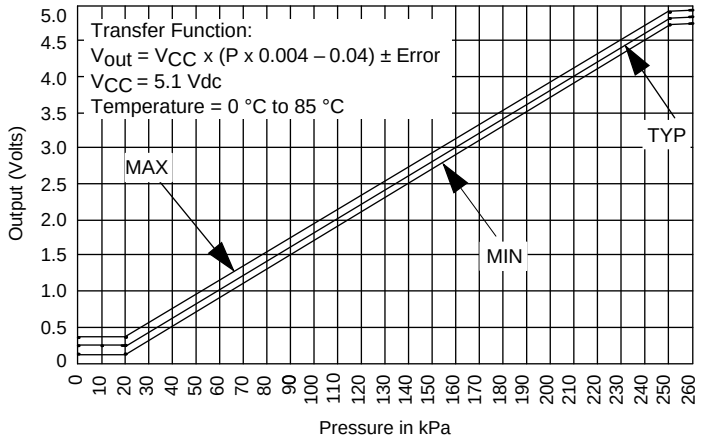
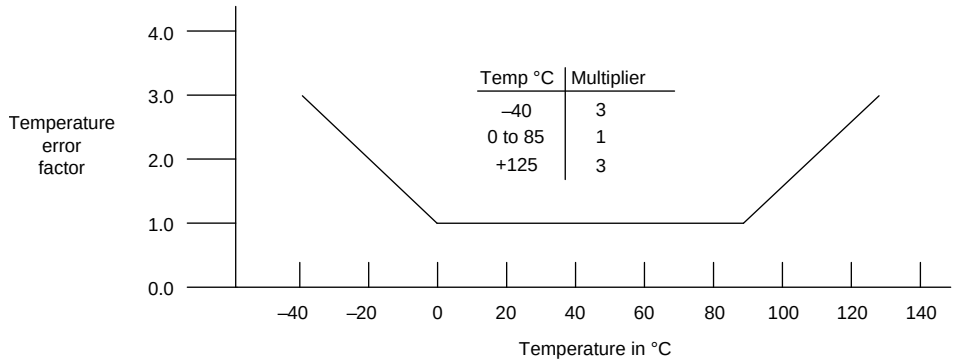


Figure 6. Output versus absolute pressure

Nominal transfer value: $V_{OUT} = V_{CC} \times (P \times 0.004 - 0.04) \pm (\text{Pressure error} \times \text{Temp. Factor} \times 0.004 \times V_{CC})$

$V_{CC} = 5.1 \pm 0.25$ Vdc

Figure 7. Transfer function



Note: *The temperature multiplier is a linear response from 0°C to –40°C and from 85°C to 125°C.*

Figure 8. Temperature error band

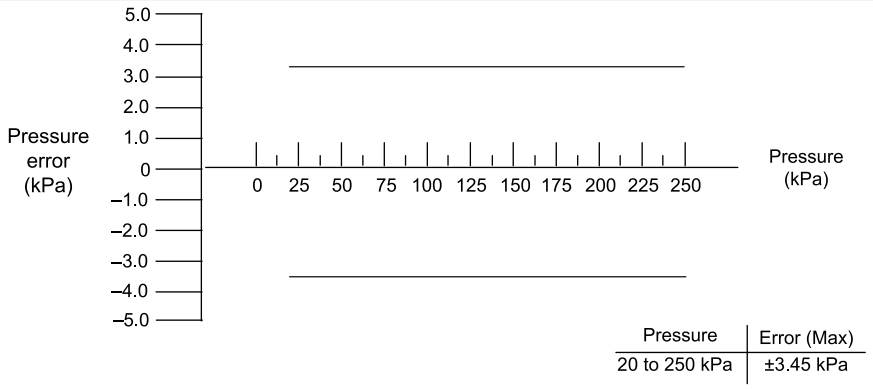


Figure 9. Pressure error band

9 Package information

9.1 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 will self align when subjected to a solder reflow process. It is always recommended to design boards with a solder mask layer to avoid bridging and shorting between solder pads.

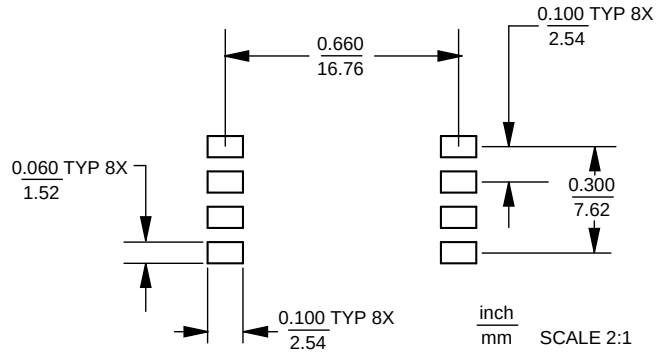
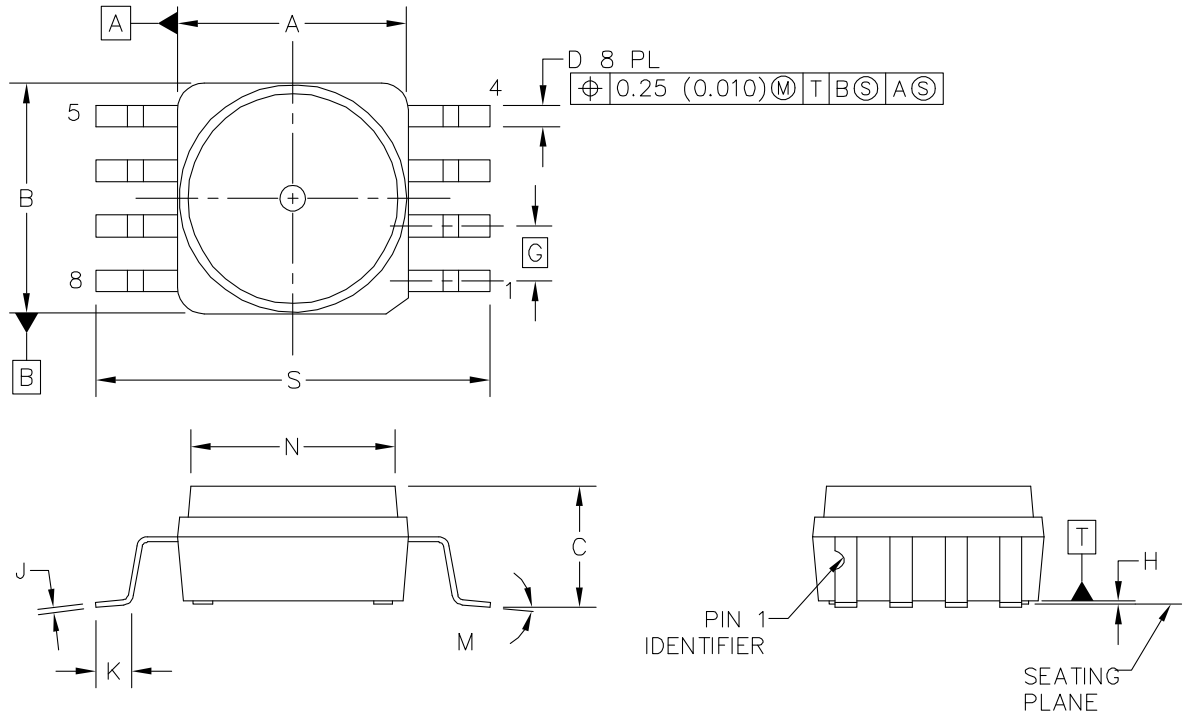


Figure 10. SOP footprint (Case 482)

9.2 Package description



DIM	MILLIMETERS MIN	MAX	INCHES MIN	MAX
A	10.54	10.79	0.415	0.425
B	10.54	10.79	0.415	0.425
C	5.38	5.84	0.212	0.230
D	0.96	1.07	0.038	0.042
G	2.54 BSC		0.100 BSC	
H	0.05	0.25	0.002	0.010
J	0.23	0.28	0.009	0.011
K	1.55	1.80	0.061	0.071
M	0°	7°	0°	7°
N	10.29	10.54	0.405	0.415
S	18.01	18.41	0.709	0.725

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994
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.

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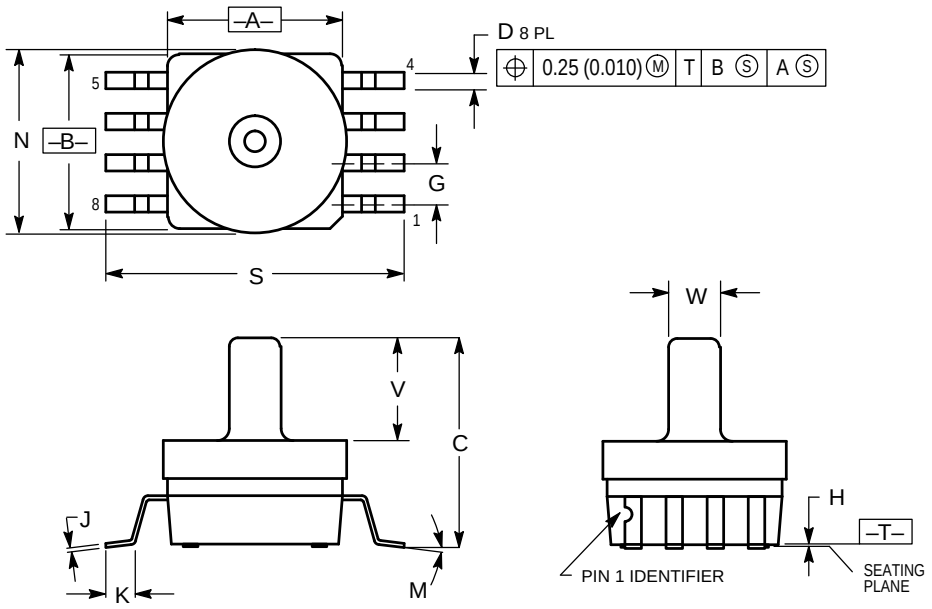
TITLE: 8 LD SENSOR SOP	DOCUMENT NO: 98ASB17756C	REV: B
	STANDARD: NON-JEDEC	
	SOT1694-1	02 FEB 2016

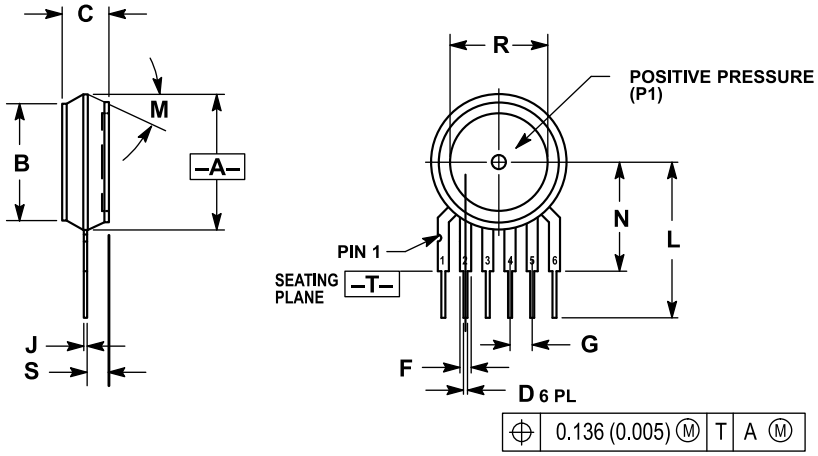
Figure 11. Package name 98ASB15576C, Case 482-01 Issue O, Small outline package



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.

	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

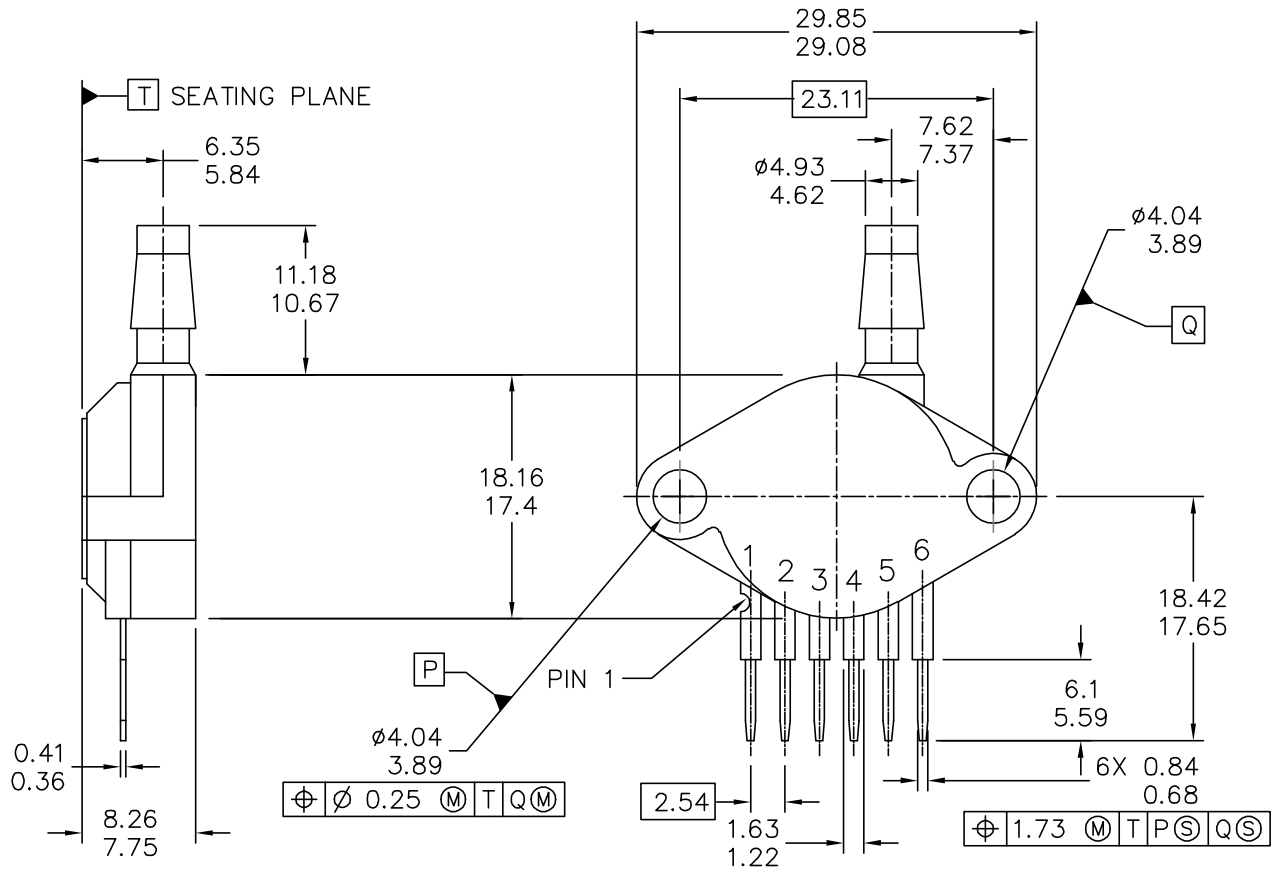
Figure 12. Package name 98ASB17757C, Case 482A-01, Issue A, small outline package



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION –A– IS INCLUSIVE OF THE MOLD STOP RING. MOLD STOP RING NOT TO EXCEED 16.00 (0.630).

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30 °NOM		30 °NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92	11.43
S	0.090	0.105	2.29	2.66

Figure 13. Package name 98ASB42793B, Case 867-08, Issue N, unibody package



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	STANDARD: NON-JEDEC	
	SOT1852-1	15 MAR 2016

NOTES:

1. DIMENSIONS ARE IN MILLIMETERS.
2. DIMENSIONS AND TOLERANCES PER ASME Y14.5M–1994.
3. 867B–01 THRU –3 OBSOLETE, NEW STANDARD 867B–04.

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	STANDARD: NON–JEDEC	
	SOT1852–1	15 MAR 2016

Figure 14. Package name 98ASB42796B, Case 867B-04, Issue J

10 Revision history

Table 6. Revision history

Document ID	Release date	Data sheet status	Change notice	Supercedes
MPX4250A v.8.0	20170725	Technical data	—	MPX4250A v.7.0
Modifications:	• 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. • Updated the document title from "Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated" to "0 to 250 kPa, Differential, gauge pressure sensor, on-chip signal conditioned, temperature compensated." • Added Figure 1 "Small outline and unibody packages" in Section 2 "Features". • Updated Table 1 "Ordering information" in Section 4 "Ordering information". • Revised Figure 2 "Block diagram " in Section 5 "Block diagram" as follows: – Changed V_S to V_{CC} • Added pinning illustration as Figure 3 "Pinning diagram" in Section 6.1 • Added pin descriptions in Table 2 "Pin descriptions — Unibody package" and Table 3 "Pin descriptions — Small outline package" in Section 6.2. • Changed V_S to V_{CC} in the description and within the body of Table 5 "Operating characteristics" in Section 7.2 "Operating characteristics". • Updated the figures in Section 8 "On-chip temperature compensation and calibration" as follows: – Figure 4 "Cross sectional diagram (not to scale)" – Figure 5 "Recommended power supply decoupling and output filtering" – Figure 6 "Output versus absolute pressure" – Figure 7 "Transfer function" – Figure 9 "Pressure error band" • Updated the figures and figure titles in Section 9.2 "Package description" as follows: – Figure 11 "Package name 98ASB15576C, Case 482-01 Issue O, Small outline package" – Figure 12 "Package name 98ASB17757C, Case 482A-01, Issue A, small outline package" – Figure 13 "Package name 98ASB42793B, Case 867-08, Issue N, unibody package" – Figure 14 "Package name 98ASB42796B, Case 867B-04, Issue J"			
MPX4250A v.7.0	20090131	Technical data	—	MPX4250A v.6.0

11 Legal information

11.1 Data sheet status

Document status[1][2]	Product status[3]	Definition
[short] Data sheet: product_preview	Development	This document contains certain information on a product under development. NXP reserves the right to change or discontinue this product without notice.
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Tables

Figures

MPX4250A, MPXA4250A

20 to 250 kPa, Manifold absolute pressure sensor, on-chip signal conditioned, temperature compensated and calibrated

Contents

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Document identifier: MPx4250A