MPX4250D

0 to 250 kPa, Differential, gauge pressure sensor, on-chip signal conditioned, temperature compensated and calibrated

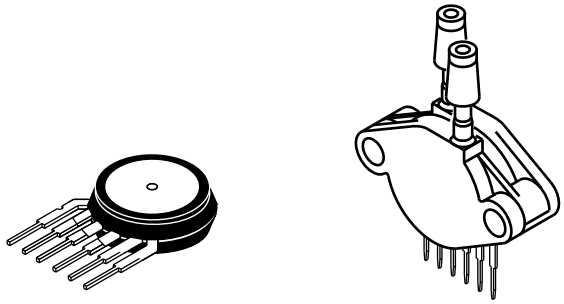
Rev. 8.0 — 25 July 2017 Data sheet: technical data

1 General description

The MPX4250D series 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

- Differential and gauge applications available
- 1.4 % maximum error over 0 °C to 85 °C
- 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
- Available in two unibody packages



MPX4250D
98ASB42793B
CASE 867

MPX4250DP
98ASB42797B
CASE 867C

Figure 1. Unibody packages

3 Typical applications

- 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	
MPX4250D	Tray	98ASB42793B	•				•		MPX4250D
MPX4250DP	Tray	98ASB42797B			•		•		MPX4250DP

5 Block diagram

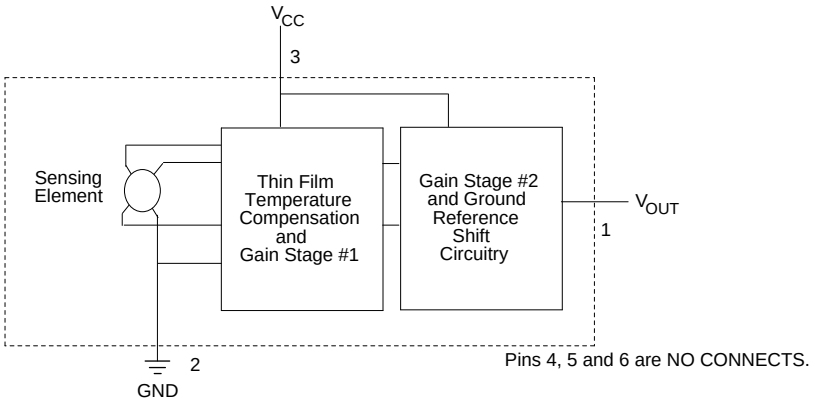


Figure 2. Block diagram

6 Pinning information

6.1 Pinning

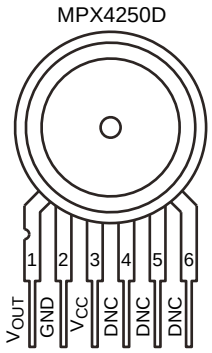


Figure 3. Pinning diagram

6.2 Pin description

Table 2. Pin descriptions

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

7 Mechanical and electrical specifications

7.1 Maximum ratings

Table 3. Maximum ratings

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 4. 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]	0	—	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)	0.139	0.204	0.269	Vdc
V_{FSO}	Full scale output[4] (0 °C to 85 °C)	4.844	4.909	4.974	Vdc
V_{FSS}	Full scale span[5] (0 °C to 85 °C)	—	4.705	—	Vdc
—	Accuracy[6] (0 °C to 85 °C)	—	—	±1.4	$\%V_{FSS}$
ΔV/ΔP	Sensitivity	—	18.8	—-	mV/kPa
t_R	Response time[7]	—	1.0	—-	ms
I_{o+}	Output source current at full scale output	—	0.1	—-	mAdc

Symbol	Characteristic	Min	Typ	Max	Unit
—	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 differential/gauge 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 MPX4250D 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 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.

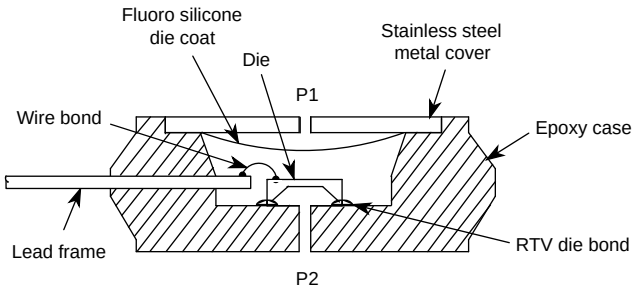
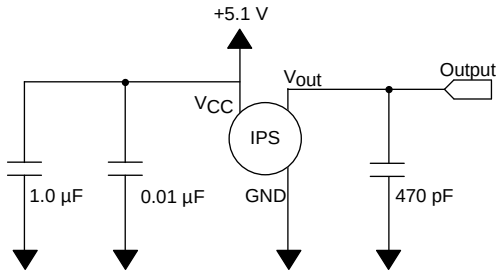


Figure 4. Cross sectional diagram (not to scale)



For additional output filtering, please refer to Application Note AN1535

Figure 5. Recommended power supply decoupling and output filtering

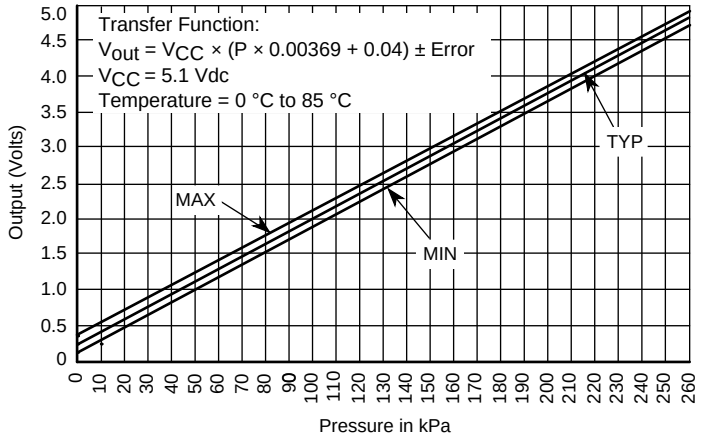
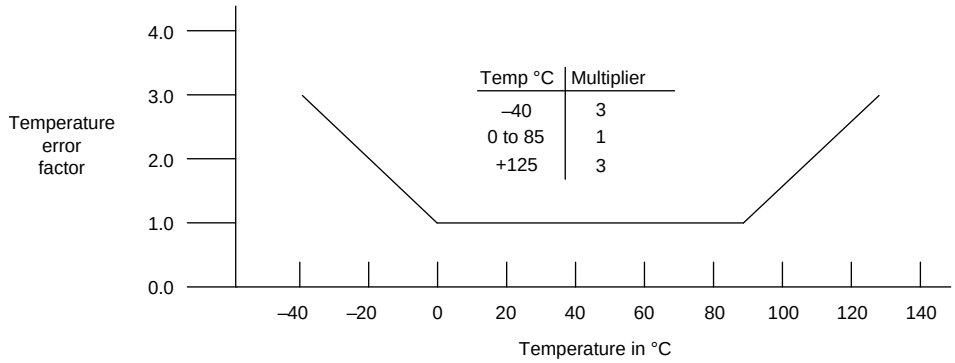


Figure 6. Output versus differential pressure

Nominal transfer value: $V_{OUT} = V_{CC} \times (P \times 0.00369 + 0.04) \pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.00369 \times V_{CC})$

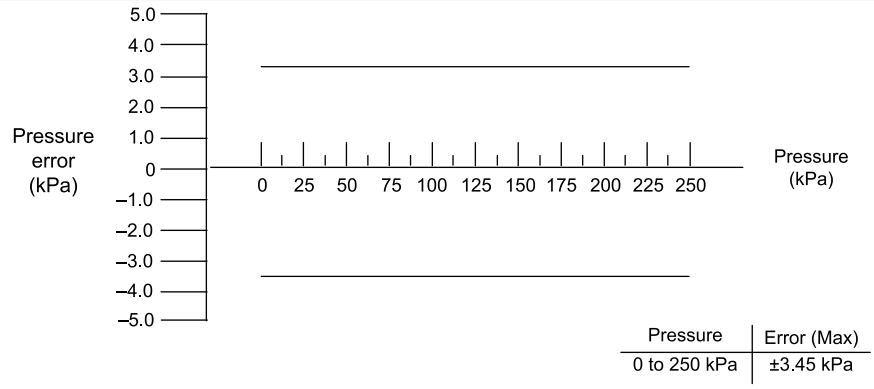
$V_{CC} = 5.1 \pm 0.25$ Vdc

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

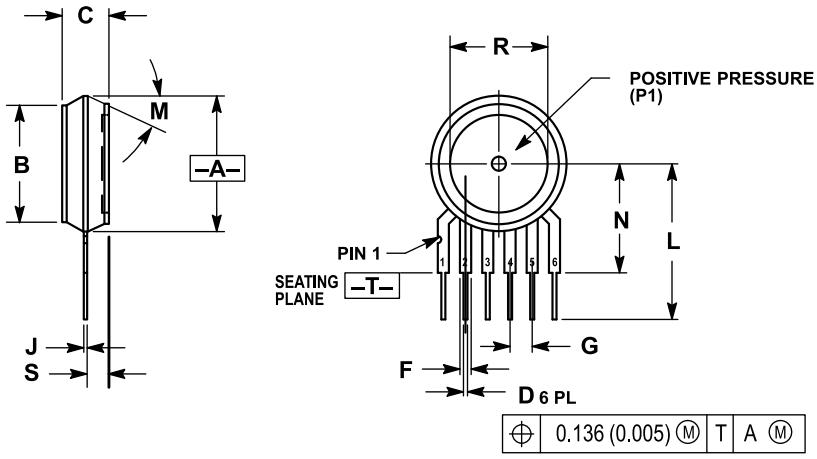


Pressure	Error (Max)
0 to 250 kPa	±3.45 kPa

Figure 9. Pressure error band

9 Package information

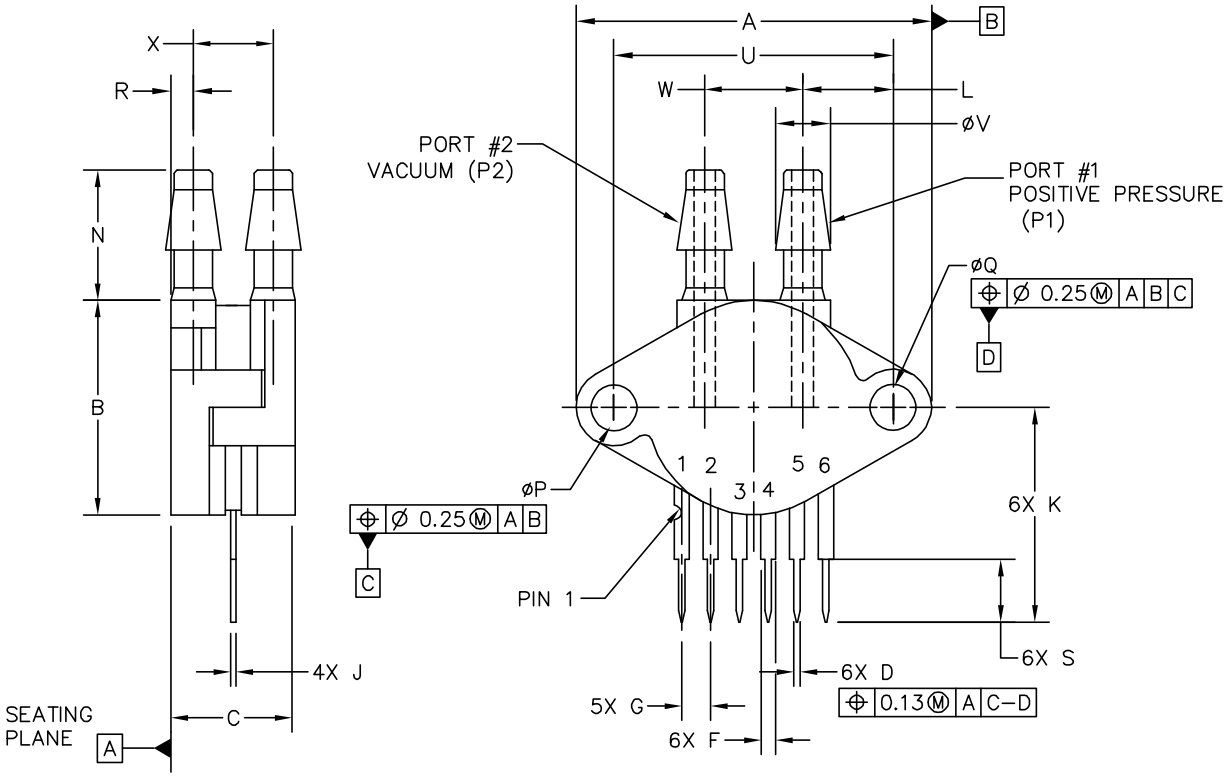
9.1 Package description



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 10. Package name 98ASB42793B, Case 867-08, Issue N



DIM	MILLIMETERS MIN	MAX	DIM	MILLIMETERS MIN	MAX
A	29.08	29.85	P	ø3.89	ø4.04
B	17.40	18.16	Q	ø3.89	ø4.04
C	10.29	11.05	R	1.60	2.11
D	0.68	0.84	S	5.59	6.10
F	1.22	1.63	U	23.11 BSC	
G	2.54 BSC		V	4.62	4.93
J	0.36	0.41	W	7.87	8.38
K	17.65	18.42	X	6.30	7.06
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. 867C–01 THRU –04 OBSOLATE, NEW STANDARD 867C–05.

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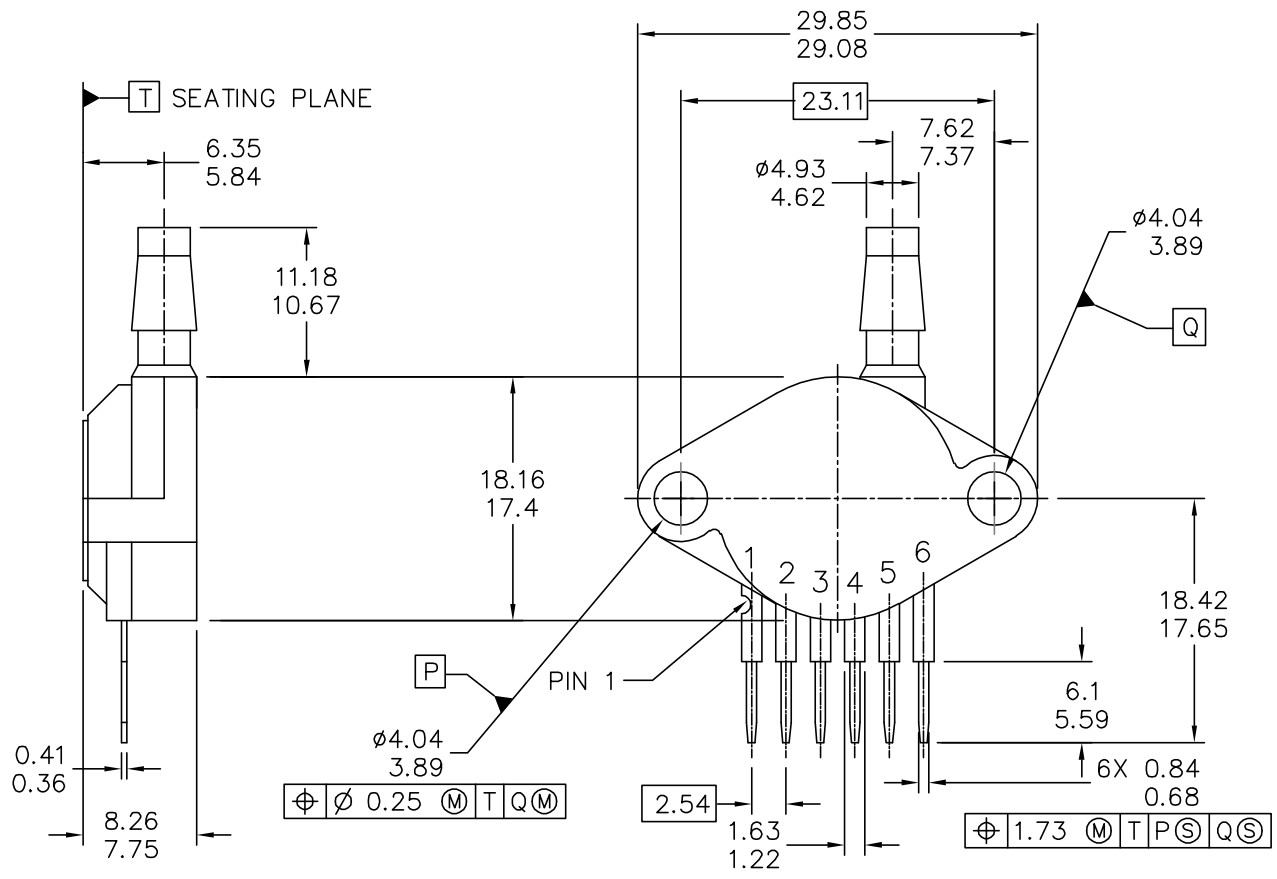
TITLE: SENSOR, 4 LEAD UNIBODY

DOCUMENT NO: 98ASB42797B REV: H

STANDARD: NON–JEDEC

SOT1756–1 29 JAN 2016

Figure 11. Package name 98ASB42797B, Case 867C-05, Issue H



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	STANDARD: NON-JEDEC	
	SOT1852-1	15 MAR 2016

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	STANDARD: NON–JEDEC	
	SOT1852–1	15 MAR 2016

Figure 12. Package name 98ASB42796B, Case 867B-04, Issue J

10 Revision history

Table 5. Revision history

Document ID	Release date	Data sheet status	Change notice	Supercedes
MPX4250D v.8.0	20170725	Technical data	—	MPX4250 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. • Revised "MPX4250" to "MPX4250D." • Updated the document title from "Integrated Silicon Pressure Sensor Manifold Absolute Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated" to "20 to 250 kPa, Manifold absolute pressure sensor, on-chip signal conditioned, temperature compensated and calibrated." • Added Figure 1 "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} – Revised the note to read "Pins 4, 5 and 6 are NO CONNECTS" • Added pinning illustration as Figure 3 "Pinning diagram" in Section 6.1 "Pinning". • Added pin descriptions in Table 2 "Pin descriptions" in Section 6.2 "Pin description". • Changed V_S to V_{CC} in the description and within the body of Table 4 "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 differential pressure" – Figure 7 "Transfer function" – Figure 9 "Pressure error band" • Updated the figures and figure titles in Section 9.1 "Package description" as follows: – Figure 10 "Package name 98ASB42793B, Case 867-08, Issue N" – Figure 11 "Package name 98ASB42797B, Case 867C-05, Issue H" – Figure 12 "Package name 98ASB42796B, Case 867B-04, Issue J"			
MPX4250 v.7.0	20090131	Technical data	—	MPX4250 v.6.0

11 Legal information

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Tables

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0 to 250 kPa, Differential, gauge pressure sensor, on-chip signal conditioned, temperature compensated and calibrated

Contents

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Date of release: 25 July 2017
Document identifier: MPX4250D