

Integrated Silicon Pressure Sensor Manifold Absolute Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MPX4100 series 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 small form factor and high reliability of on-chip integration makes the MAP sensor a logical and economical choice for automotive system designers.

Features

- 1.8% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Ideally Suited for Microprocessor Interfacing
- Temperature Compensated Over -40°C to +125°C
- Durable Epoxy Unibody Element
- Ideal for Non-Automotive Applications

Typical Applications

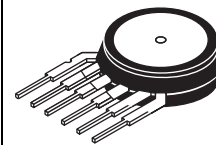
- Manifold Sensing for Automotive Systems

ORDERING INFORMATION ⁽¹⁾				
Device Type	Options	Case No.	MPX Series Order Number	Device Marking
Basic Element	Absolute, Element Only	867-08	MPX4100A	MPX4100A
Ported Elements	Absolute, Ported	867B-04	MPX4100AP	MPX4100AP
	Absolute, Stove Pipe Port	867E-03	MPX4100AS	MPX4100A
	Absolute, Axial Port	867F-03	MPX4100ASX	MPX4100A

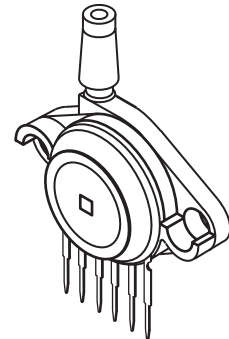
1. The MPX4100A series MAP silicon pressure sensors are available in the Basic Element, or with pressure port fittings that provide mounting ease and barbed hose connections.

MPX4100 SERIES

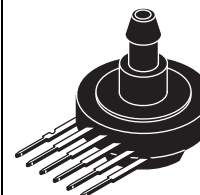
INTEGRATED
 PRESSURE SENSOR
 20 TO 105 kPA (2.9 TO 15.2 psi)
 0.3 TO 4.9 V OUTPUT



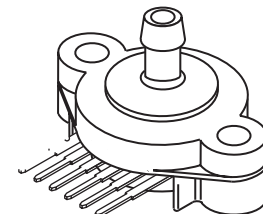
MPX4100A
 CASE 867-08



MPX4100AP
 CASE 867B-04



MPX4100AS
 CASE 867E-03



MPX4100ASX
 CASE 867F-03

PIN NUMBERS

1	V _{OUT}	4	NC
2	GND	5	NC
3	V _S	6	NC

The MPX4100 series piezoresistive transducer is a state-of-the-art, monolithic, signal conditioned, silicon pressure sensor. This sensor combines advanced micromachining techniques, thin film metallization, and bipolar semiconductor

processing to provide an accurate, high level analog output signal that is proportional to applied pressure.

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

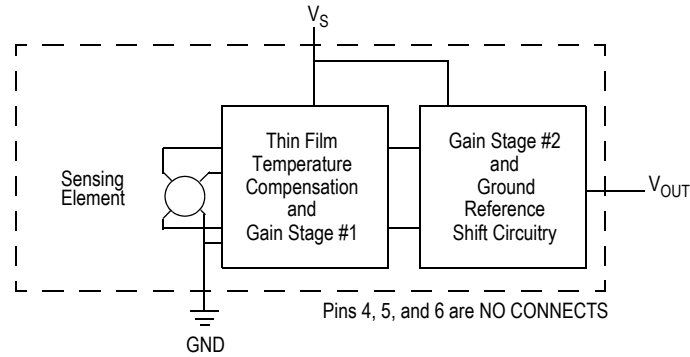


Figure 1. Fully Integrated Pressure Sensor Schematic

Table 1. MAXIMUM RATINGS⁽¹⁾

Rating	Symbol	Value	Unit
Overpressure ⁽²⁾ (P1 > P2)	P_{max}	400	kPa
Burst Pressure ⁽²⁾ (P1 > P2)	P_{burst}	1000	kPa
Storage Temperature	T_{stg}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

- $T_C = 25^\circ\text{C}$ unless otherwise noted.
- Exposure beyond the specified limits may cause permanent damage or degradation to the device.

Table 2. OPERATING CHARACTERISTICS (VS = 5.1 Vdc, TA = 25°C unless otherwise noted, P1 > P2)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range ⁽²⁾	P _{OP}	20	—	105	kPa
Supply Voltage ⁽²⁾	V _S	4.85	5.1	5.35	Vdc
Supply Current	I _O	—	7.0	10	mAdc
Minimum Pressure Offset ⁽³⁾ @ V _S = 5.1 V (0 to 85°C)	V _{off}	0.225	0.306	0.388	Vdc
Full Scale Output ⁽⁴⁾ @ V _S = 5.1 V (0 to 85°C)	V _{FSSO}	4.815	4.897	4.978	Vdc
Full Scale Span ⁽⁵⁾ @ V _S = 5.1 V (0 to 85°C)	V _{FSS}	—	4.59	—	Vdc
Accuracy ⁽⁶⁾ (0 to 85°C)	—	—	—	±1.8	%V _{FSS}
Sensitivity	V/P	—	54	—	mV/kPa
Response Time ⁽⁷⁾	t _R	—	1.0	—	ms
Output Source Current at Full Scale Output	I _{O+}	—	0.1	—	mAdc
Warm-Up Time ⁽⁸⁾	—	—	20	—	ms
Offset Stability ⁽⁹⁾	—	—	±0.5	—	%V _{FSS}

- Decoupling circuit shown in [Figure 3](#) required to meet electrical specifications.
- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Offset (V_{off}) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V_{FSSO}) is defined as the output voltage at the maximum or full rated pressure.
- 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.
- 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 0 to 85°C, relative to 25°C.
 - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 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.
- 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.
- Warm-up is defined as the time required for the product to meet the specified output voltage after the Pressure has been stabilized.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
- Device is ratiometric within this specified excitation range.

Table 3. MECHANICAL CHARACTERISTICS

Characteristic	Symbol	Min	Typ	Max	Unit
Weight, Basic Element (Case 867)	—	—	4.0	—	Grams
Common Mode Line Pressure ⁽¹⁾	—	—	—	690	kPa

- Common mode pressures beyond specified may result in leakage at the case-to-lead interface.

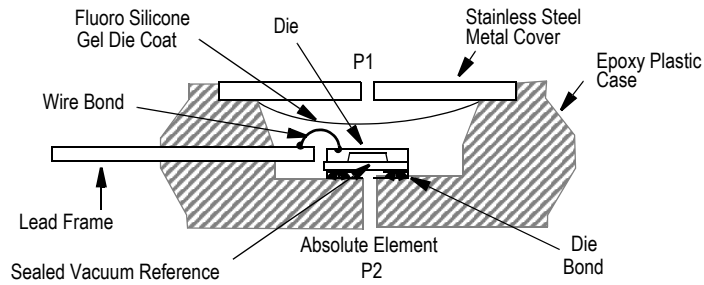


Figure 2. Cross-Sectional Diagram (Not to Scale)

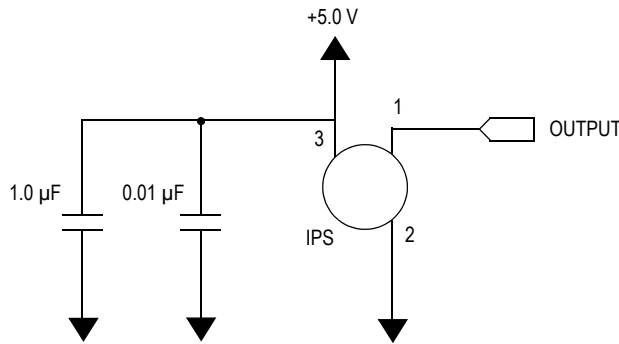


Figure 3. Recommended Power Supply Decoupling
(For output filtering recommendations, refer to Application Note AN1646.)

Figure 2 illustrates an absolute sensing chip in the basic chip carrier (Case 867). 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 MPX4100A 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 4 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° to 85°C. (The output will saturate outside of the specified pressure range.)

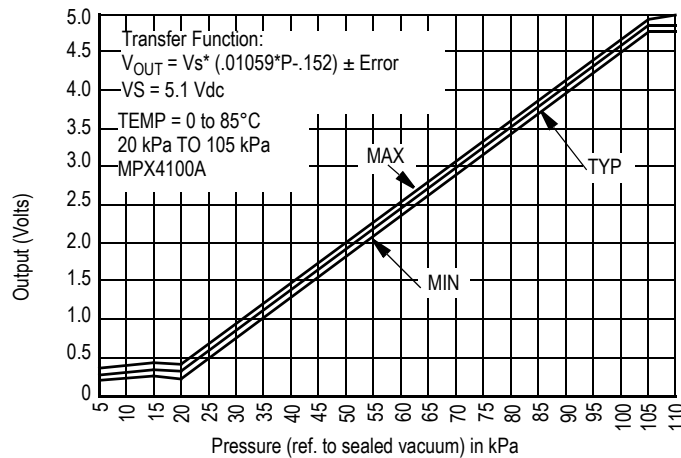
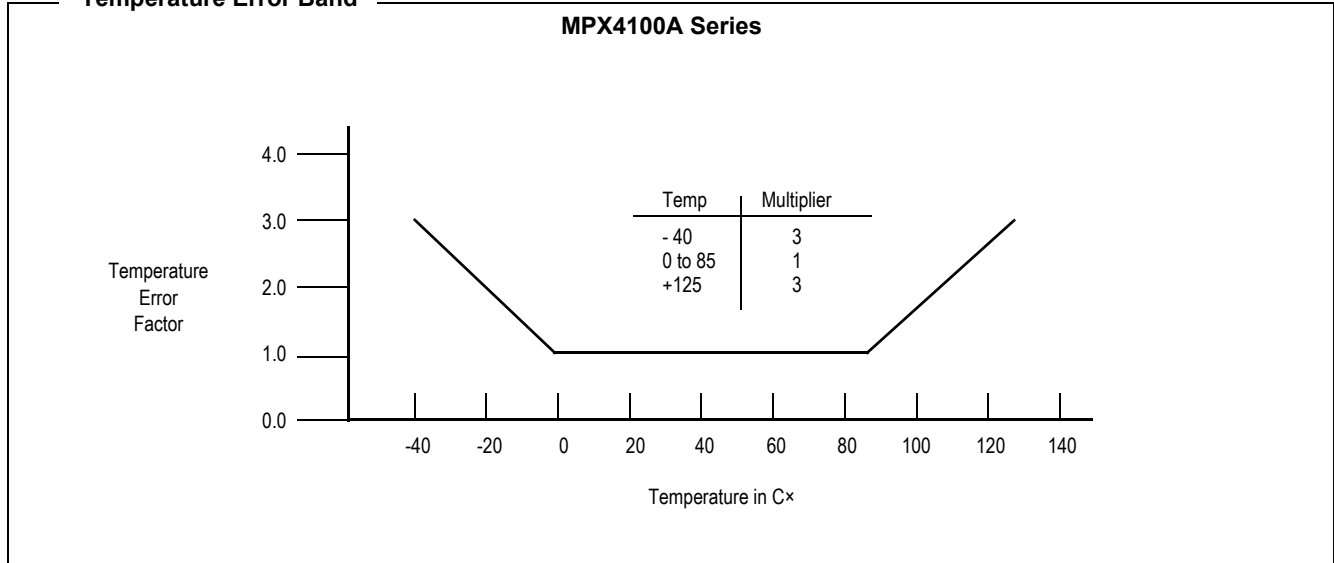


Figure 4. Output versus Absolute Pressure

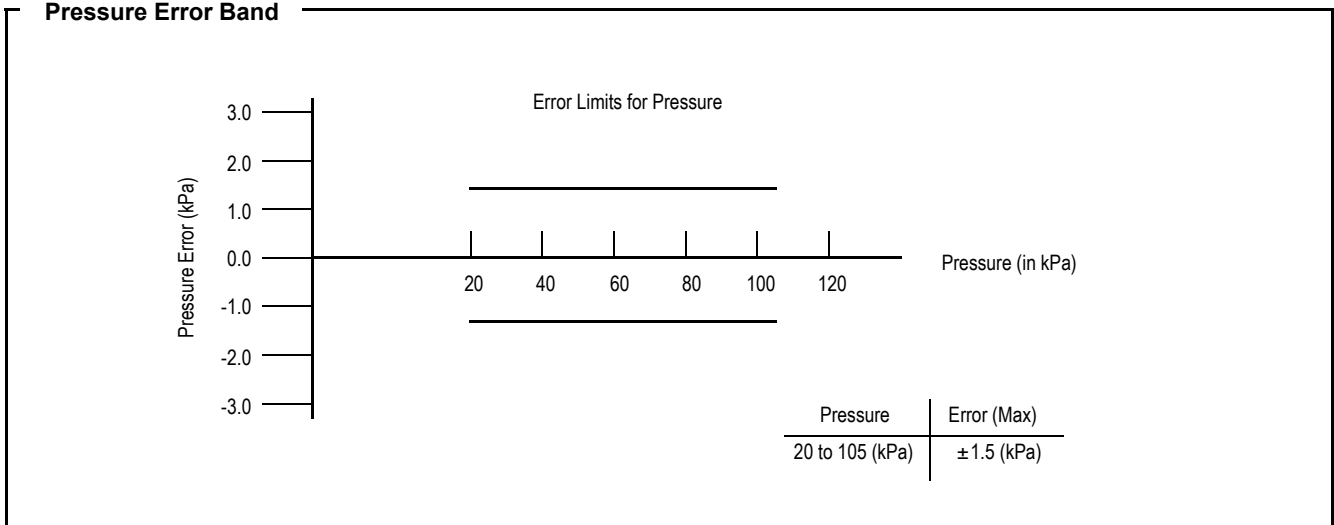
Transfer Function (MPX4100A)

Nominal Transfer Value: $V_{out} = V_S (P \times 0.01059 - 0.1518)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.01059 \times V_S)$
 $V_S = 5.1 \text{ V} \pm 0.25 \text{ Vdc}$

Temperature Error Band



Pressure Error Band



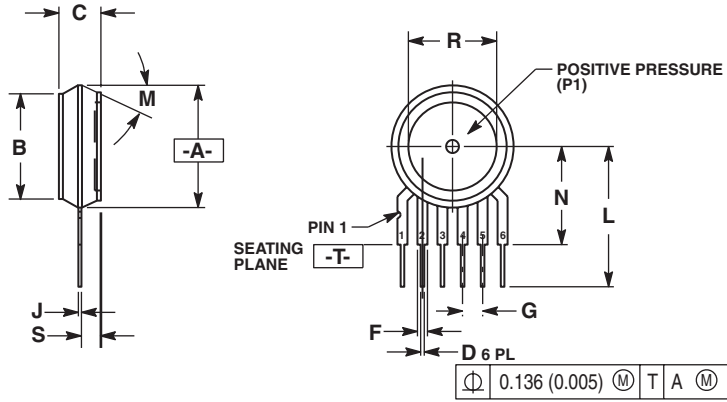
PRESSURE (P1)/VACUUM (P2) SIDE IDENTIFICATION TABLE

The two sides of the pressure sensor are designated as the Pressure (P1) side and the Vacuum (P2) side. The Pressure (P1) side is the side containing fluorosilicone gel, which protects the die from harsh media. The MPX pressure sensor is designed to operate with positive differential pressure applied, $P1 > P2$.

The Pressure (P1) side may be identified by using the table below:

Part Number	Case Type	Pressure (P1) Side Identifier
MPX4100A	867	Stainless Steel Cap
MPX4100AP	867B	Side with Port Marking
MPX4100AS	867E	Side with Port Attached
MPX4100ASX	867F	Side with Port Attached

PACKAGE DIMENSIONS



- 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).

DIM	INCHES		MILLIMETERS	
	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

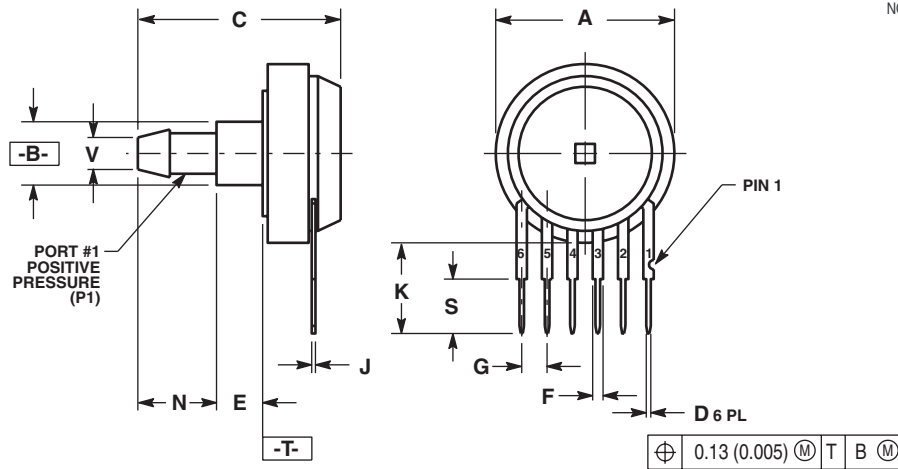
- STYLE 1:
 PIN 1. VOUT
 2. GROUND
 3. VCC
 4. V1
 5. V2
 6. VEX

- STYLE 2:
 PIN 1. OPEN
 2. GROUND
 3. -VOUT
 4. VSUPPLY
 5. +VOUT
 6. OPEN

- STYLE 3:
 PIN 1. OPEN
 2. GROUND
 3. +VOUT
 4. +VSUPPLY
 5. -VOUT
 6. OPEN

CASE 867-08 ISSUE N BASIC ELEMENT

PACKAGE DIMENSIONS



NOTES:

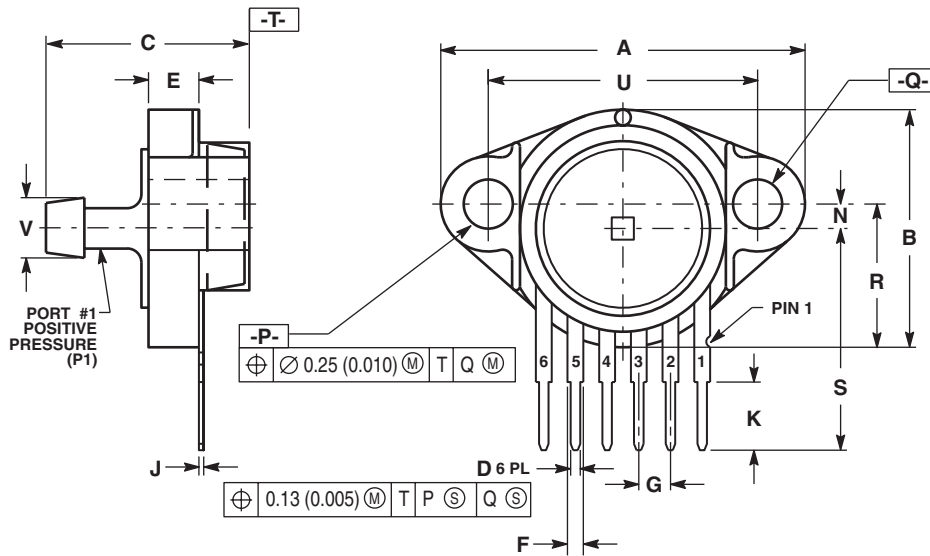
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.690	0.720	17.53	18.28
B	0.245	0.255	6.22	6.48
C	0.780	0.820	19.81	20.82
D	0.027	0.033	0.69	0.84
E	0.178	0.186	4.52	4.72
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.345	0.375	8.76	9.53
N	0.300	0.310	7.62	7.87
S	0.220	0.240	5.59	6.10
V	0.182	0.194	4.62	4.93

STYLE 1:

- PIN 1: V_{OUT}
 2. GROUND
 3. V_{CC}
 4. V_1
 5. V_2
 6. V_{EX}

CASE 867E-03 ISSUE D STOVE PIPE PORT (AS)



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.

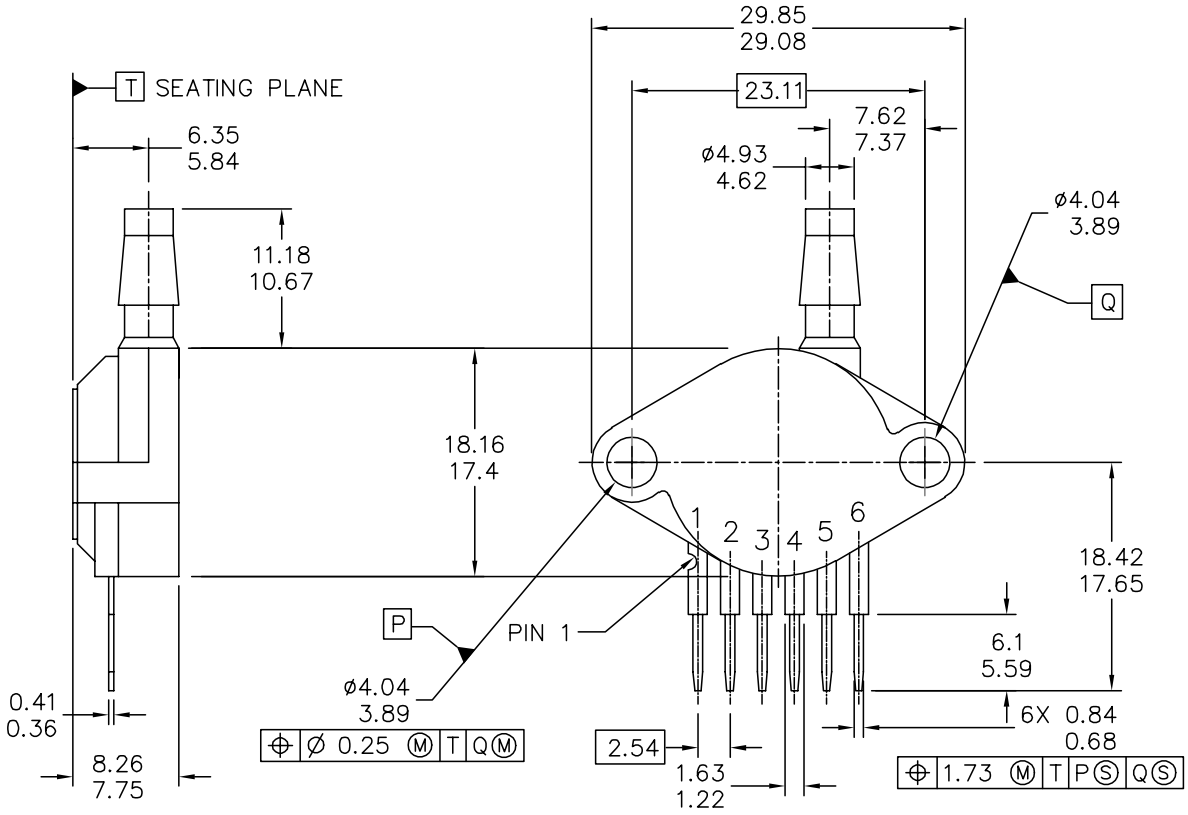
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	1.080	1.120	27.43	28.45
B	0.740	0.760	18.80	19.30
C	0.630	0.650	16.00	16.51
D	0.027	0.033	0.68	0.84
E	0.160	0.180	4.06	4.57
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.41
K	0.220	0.240	5.59	6.10
N	0.070	0.080	1.78	2.03
P	0.150	0.160	3.81	4.06
Q	0.150	0.160	3.81	4.06
R	0.440	0.460	11.18	11.68
S	0.695	0.725	17.65	18.42
U	0.840	0.860	21.34	21.84
V	0.182	0.194	4.62	4.93

STYLE 1:

- PIN 1: V_{OUT}
 2. GROUND
 3. V_{CC}
 4. V_1
 5. V_2
 6. V_{EX}

CASE 867F-03 ISSUE D AXIAL PORT (ASX)

PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: SENSOR, 6 LEAD UNIBODY CELL, AP & GP 01ASB09087B	DOCUMENT NO: 98ASB42796B	REV: G	
	CASE NUMBER: 867B-04	28 JUL 2005	
	STANDARD: NON-JEDEC		

**CASE 867B-04
ISSUE G
PORTED (AP)**

PACKAGE DIMENSIONS

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.

STYLE 1:

- PIN 1: V OUT
2: GROUND
3: VCC
4: V1
5: V2
6: V EX

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	MECHANICAL OUTLINE	PRINT VERSION NOT TO SCALE	
TITLE: SENSOR, 6 LEAD UNIBODY CELL, AP & GP 01ASB09087B	DOCUMENT NO: 98ASB42796B	REV: G	
	CASE NUMBER: 867B-04	28 JUL 2005	
	STANDARD: NON-JEDEC		

PAGE 2 OF 2

**CASE 867B-04
ISSUE G
PORTED (AP)**

MPX4100

How to Reach Us:

Home Page:

www.freescale.com

Web Support:

<http://www.freescale.com/support>

USA/Europe or Locations Not Listed:

Freescale Semiconductor, Inc.
Technical Information Center, EL516
2100 East Elliot Road
Tempe, Arizona 85284
+1-800-521-6274 or +1-480-768-2130
www.freescale.com/support

Europe, Middle East, and Africa:

Freescale Halbleiter Deutschland GmbH
Technical Information Center
Schatzbogen 7
81829 Muenchen, Germany
+44 1296 380 456 (English)
+46 8 52200080 (English)
+49 89 92103 559 (German)
+33 1 69 35 48 48 (French)
www.freescale.com/support

Japan:

Freescale Semiconductor Japan Ltd.
Headquarters
ARCO Tower 15F
1-8-1, Shimo-Meguro, Meguro-ku,
Tokyo 153-0064
Japan
0120 191014 or +81 3 5437 9125
support.japan@freescale.com

Asia/Pacific:

Freescale Semiconductor Hong Kong Ltd.
Technical Information Center
2 Dai King Street
Tai Po Industrial Estate
Tai Po, N.T., Hong Kong
+800 2666 8080
support.asia@freescale.com

For Literature Requests Only:

Freescale Semiconductor Literature Distribution Center
P.O. Box 5405
Denver, Colorado 80217
1-800-441-2447 or 303-675-2140
Fax: 303-675-2150
LDCForFreescaleSemiconductor@hibbertgroup.com

Information in this document is provided solely to enable system and software implementers to use Freescale Semiconductor products. There are no express or implied copyright licenses granted hereunder to design or fabricate any integrated circuits or integrated circuits based on the information in this document.

Freescale Semiconductor reserves the right to make changes without further notice to any products herein. Freescale Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Freescale Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation consequential or incidental damages. "Typical" parameters that may be provided in Freescale Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals", must be validated for each customer application by customer's technical experts. Freescale Semiconductor does not convey any license under its patent rights nor the rights of others. Freescale Semiconductor products are not designed, intended, or authorized for use as components in systems intended for surgical implant into the body, or other applications intended to support or sustain life, or for any other application in which the failure of the Freescale Semiconductor product could create a situation where personal injury or death may occur. Should Buyer purchase or use Freescale Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold Freescale Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that Freescale Semiconductor was negligent regarding the design or manufacture of the part.

Freescale™ and the Freescale logo are trademarks of Freescale Semiconductor, Inc. All other product or service names are the property of their respective owners.

© Freescale Semiconductor, Inc. 2006. All rights reserved.

