

Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from Europe, America and south Asia, supplying obsolete and hard-to-find components to meet their specific needs.

With the principle of "Quality Parts, Customers Priority, Honest Operation, and Considerate Service", our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip, ALPS, ROHM, Xilinx, Pulse, ON, Everlight and Freescale. Main products comprise IC, Modules, Potentiometer, IC Socket, Relay, Connector. Our parts cover such applications as commercial, industrial, and automotives areas.

We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: [info@chipsmall.com](mailto:info@chipsmall.com) Web: [www.chipsmall.com](http://www.chipsmall.com)

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China

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

The Freescale MPX4101A/MPXA4101A/MPXH6101A 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 Freescale MAP sensor a logical and economical choice for automotive system designers.

The MPX4101A/MPXA4101A/MPXH6101A 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.

## Features

- 1.72% Maximum Error Over 0° to 85°C
- Specifically Designed for Intake Manifold Absolute Pressure Sensing in Engine Control Systems
- Temperature Compensated Over -40°C to +125°C
- Durable Epoxy Unibody Element or Thermoplastic (PPS) Surface Mount Package

## Typical Applications

- Manifold Sensing for Automotive Systems
- Ideally Suited for Microprocessor or Microcontroller-Based Systems
- Also Ideal for Non-Automotive Applications

UNIBODY PACKAGE PIN NUMBERS <sup>(1)</sup>			
1	V <sub>OUT</sub>	4	N/C
2	GND	5	N/C
3	V <sub>S</sub>	6	N/C

1. Pins 4, 5, and 6 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

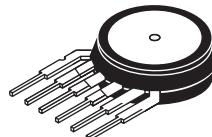
SMALL OUTLINE PACKAGE PIN NUMBERS <sup>(1)</sup>			
1	N/C	5	N/C
2	V <sub>S</sub>	6	N/C
3	GND	7	N/C
4	V <sub>OUT</sub>	8	N/C

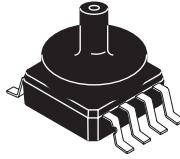
1. Pins 1, 5, 6, 7, and 8 are internal device connections. Do not connect to external circuitry or ground. Pin 1 is noted by the notch in the lead.

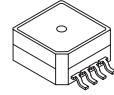
SUPER SMALL OUTLINE PACKAGE PIN NUMBERS <sup>(1)</sup>			
1	N/C	5	N/C
2	V <sub>S</sub>	6	N/C
3	GND	7	N/C
4	V <sub>OUT</sub>	8	N/C

MPX4101A MPXA4101A MPXH6101A SERIES
--

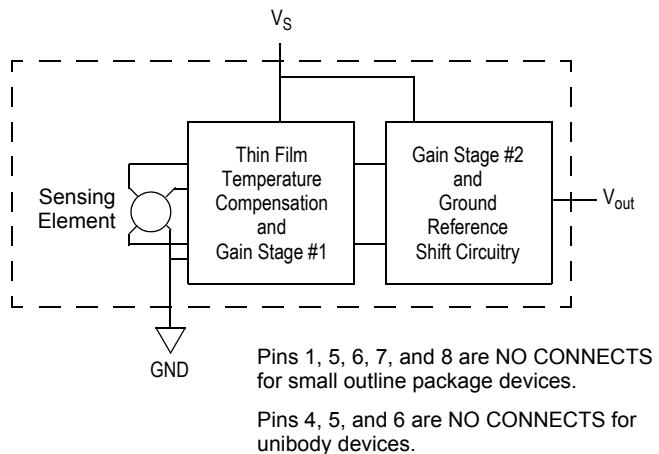
INTEGRATED PRESSURE SENSOR 15 TO 102 kPa (2.18 TO 14.8 psi) 0.25 TO 4.95 V OUTPUT
---

UNIBODY PACKAGE
 MPX4101A CASE 867-O8

SMALL OUTLINE PACKAGE
 MPXA4101AC6U CASE 482A-01

SUPER SMALL OUTLINE PACKAGE
 MPXH6101A6U/6T1 CASE 1317-04

ORDERING INFORMATION					
Device Type	Options	Case No.	MPX Series Order No.	Packing Options	Device Marking
UNIBODY PACKAGE (MPX4101A SERIES)					
Basic Element	Absolute, Element Only	867	MPX4101A	—	MPX4101A
SMALL OUTLINE PACKAGE (MPXA4101A SERIES)					
Ported Element	Absolute, Axial Port	482A	MPXA4101AC6U	Rails	MPXA4101A
SUPER SMALL OUTLINE PACKAGE (MPXA6101A SERIES)					
Basic Element	Absolute, Element Only	1317	MPXH6101A6U	Rails	MPXH6101A
	Absolute, Element Only	1317	MPXH6101A6T1	Tape and Reel	MPXH6101A



**Figure 1. Temperature Compensated and Calibrated Pressure Sensor Schematic**

**Table 1. Maximum Ratings<sup>(1)</sup>**

Rating	Symbol	Value	Unit
Maximum Pressure (P1 > P2)	P <sub>MAX</sub>	400	kPa
Storage Temperature	T <sub>STG</sub>	-40 to +125	°C
Operating Temperature	T <sub>A</sub>	-40 to +125	°C

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

**Table 2. Operating Characteristics** ( $V_S = 5.1$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted,  $P1 > P2$ . Decoupling circuit shown in [Figure 3](#) required to meet electrical specifications.)

Characteristic	Symbol	Min	Typ	Max	Unit
Pressure Range <sup>(1)</sup>	$P_{OP}$	15	—	102	kPa
Supply Voltage <sup>(2)</sup>	$V_S$	4.85	5.1	5.35	Vdc
Supply Current	$I_o$	—	7.0	10	mAdc
Minimum Pressure Offset @ $V_S = 5.1$ Volts <sup>(3)</sup> (0 to $85^\circ\text{C}$ )	$V_{off}$	0.171	0.252	0.333	Vdc
Full Scale Output @ $V_S = 5.1$ Volts <sup>(4)</sup> (0 to $85^\circ\text{C}$ )	$V_{FSO}$	4.870	4.951	5.032	Vdc
Full Scale Span @ $V_S = 5.1$ Volts <sup>(5)</sup> (0 to $85^\circ\text{C}$ )	$V_{FSS}$	—	4.7	—	Vdc
Accuracy <sup>(6)</sup> (0 to $85^\circ\text{C}$ )	—	—	—	$\pm 1.72$	% $V_{FSS}$
Sensitivity	V/P	—	54	—	mV/kPa
Response Time <sup>(7)</sup>	$t_R$	—	15	—	ms
Output Source Current at Full Scale Output	$I_{o+}$	—	0.1	—	mAdc
Warm-Up Time <sup>(8)</sup>	—	—	20	—	ms
Offset Stability <sup>(9)</sup>	—	—	$\pm 0.5$	—	% $V_{FSS}$

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 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  $25^\circ\text{C}$ .
  - TcSpan: Output deviation over the temperature range of 0 to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0 to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of  $V_{FSS}$ , at  $25^\circ\text{C}$ .
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.

## ON-CHIP TEMPERATURE COMPENSATION AND CALIBRATION

Figure 2 illustrates an absolute sensing chip in the super small outline package (Case 1317).

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.

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 MPX4101A/

MPXA4101A/MPXH6101A 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 3 shows the recommended decoupling circuit for interfacing the output of the integrated sensor to the A/D input of a microprocessor or microcontroller. Proper decoupling of the power supply is recommended.

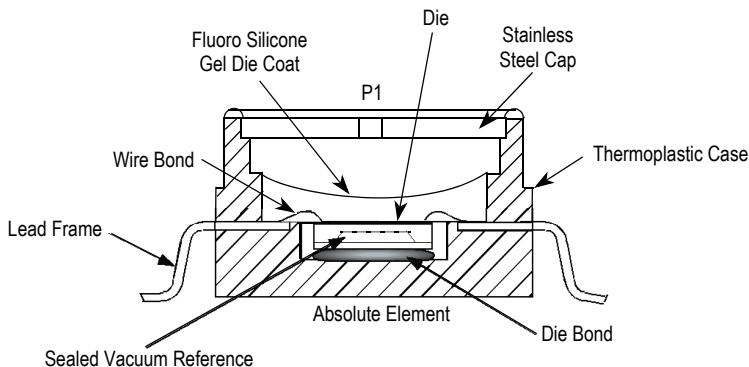


Figure 2. Cross Sectional Diagram SSOP (not to scale)

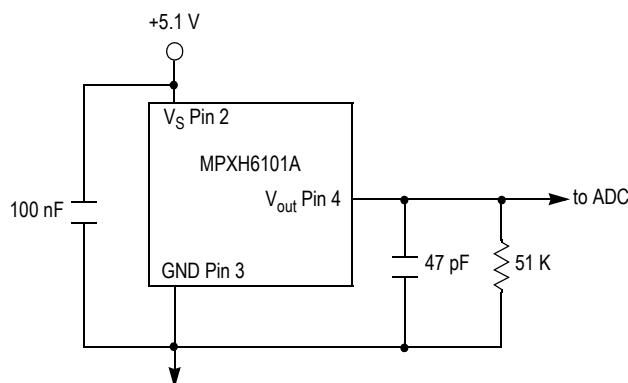


Figure 3. Recommended Power Supply Decoupling and Output Filtering

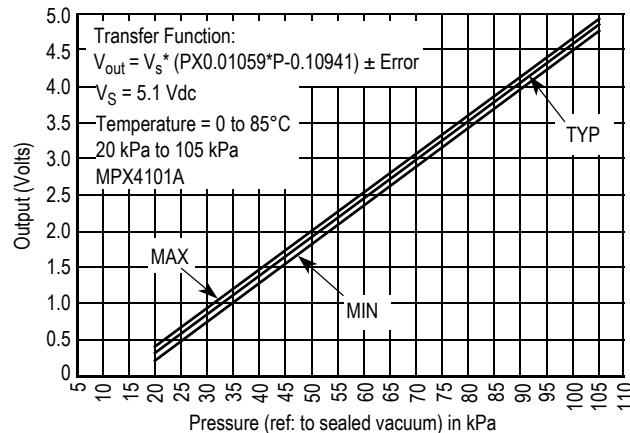


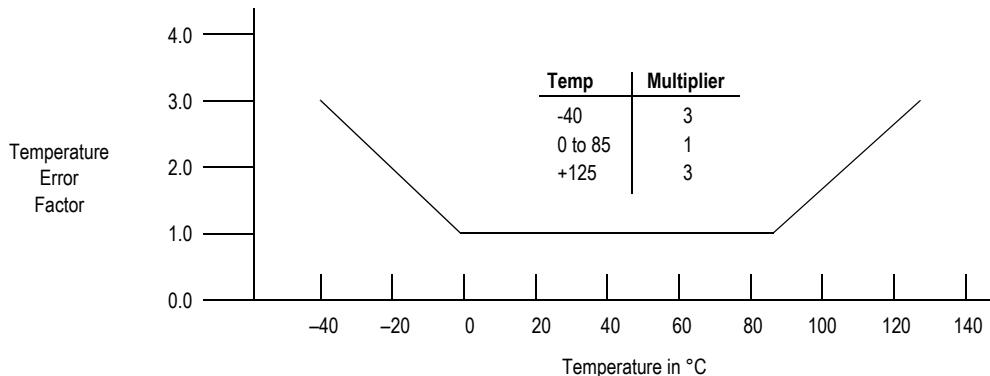
Figure 4. Output versus Absolute Pressure

## Transfer Function (MPX4101A, MPXA4101A, MPXH6101A)

**Nominal Transfer Value:**  $V_{out} = V_S (P \times 0.01059 - 0.10941)$   
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.01059 \times V_S)$   
 $V_S = 5.1 \text{ V} \pm 0.25 \text{ Vdc}$

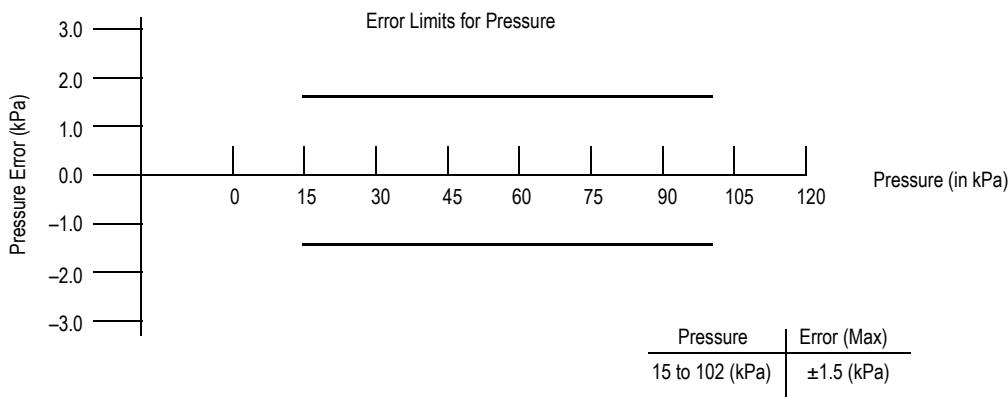
## Temperature Error Band

### MPX4101A, MPXA4101A MPXH6101A SERIES



NOTE: The Temperature Multiplier is a linear response from 0°C to -40°C and from 85°C to 125°C.

## Pressure Error Band



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

Freescale 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 fluorosilicone gel which protects the die from harsh media. The Freescale 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
MPX4101A	867	Stainless Steel Cap
MPXA4101AC6U	482A	Side with Port Attached
MPXH6101A6U	1317	Stainless Steel Cap
MPXH6101A6T1	1317	Stainless Steel Cap

## INFORMATION FOR USING THE SMALL OUTLINE PACKAGES

### 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.

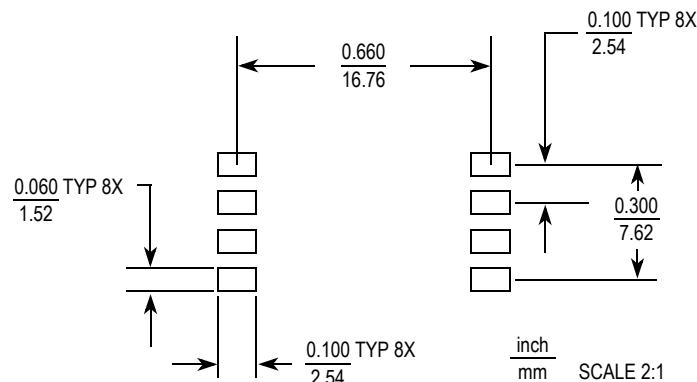


Figure 5. SOP Footprint (Case 482)

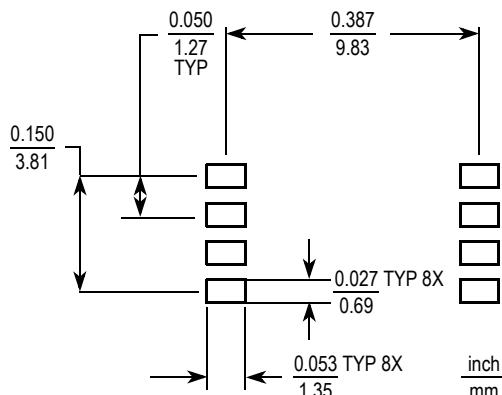
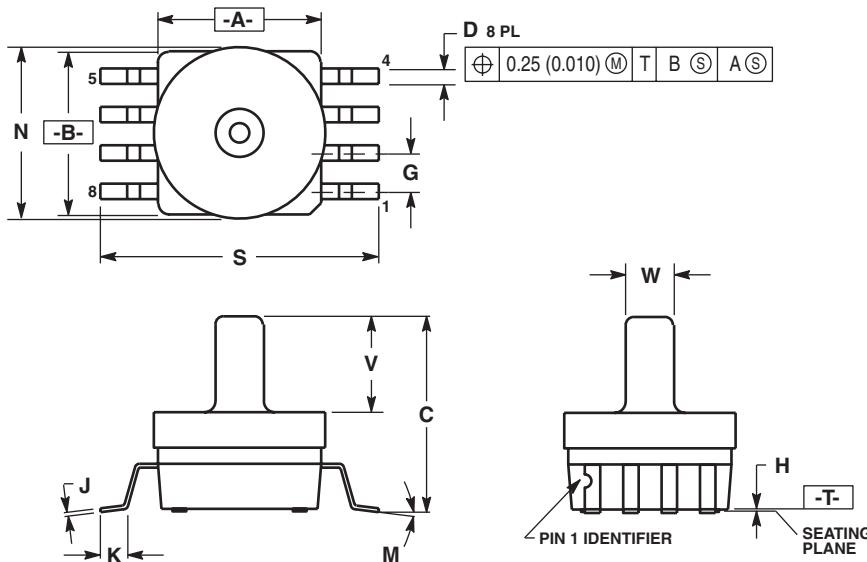


Figure 6. SSOP Footprint (Case 1317)

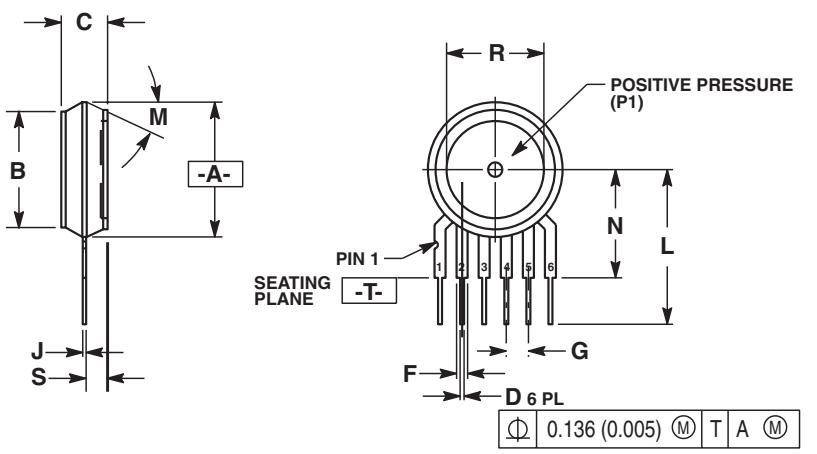
## PACKAGE DIMENSIONS



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.

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

## 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).

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

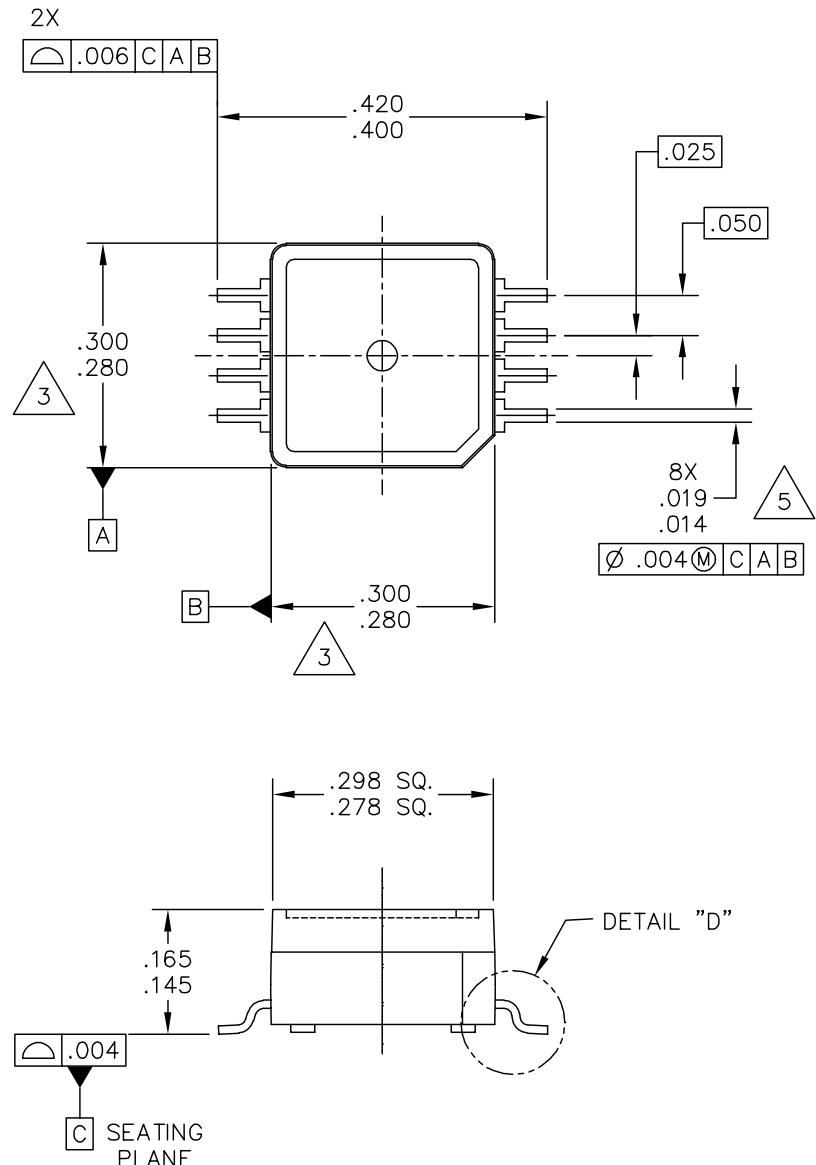
STYLE 2:  
 PIN 1. OPEN  
 2. GROUND  
 3. -VOUT  
 4. VSUPPLY  
 5. +VOUT  
 6. OPEN

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

## CASE 867-08 ISSUE N UNIBODY PACKAGE

MPX4101A

## PACKAGE DIMENSIONS

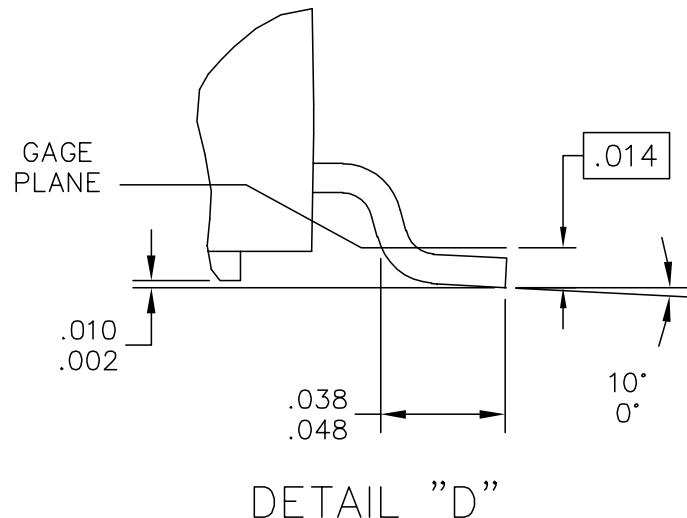


© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	<b>MECHANICAL OUTLINE</b>	PRINT VERSION NOT TO SCALE
TITLE:  8 LEAD SSOP	DOCUMENT NO: 98ARH99066A  CASE NUMBER: 1317-04  STANDARD: NON-JEDEC	REV: F  24 MAY 2005

PAGE 1 OF 3

**CASE 1317-04  
ISSUE F  
SUPER SMALL OUTLINE PACKAGE**

## PACKAGE DIMENSIONS



© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	<b>MECHANICAL OUTLINE</b>	PRINT VERSION NOT TO SCALE
TITLE: 8 LEAD SSOP	DOCUMENT NO: 98ARH99066A CASE NUMBER: 1317-04 STANDARD: NON-JEDEC	REV: F 24 MAY 2005

PAGE 2 OF 3

**CASE 1317-04  
ISSUE F  
SUPER SMALL OUTLINE PACKAGE**

**MPX4101A**

## PACKAGE DIMENSIONS

### NOTES:

1. ALL DIMENSIONS IN INCHES.
2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M-1994.
3.  DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS.  
MOLD FLASH OR PROTRUSION SHALL NOT EXCEED .006 INCHES PER SIDE.
4. ALL VERTICAL SURFACES TO BE 5° MAXIMUM.
5.  DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.  
ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 INCHES MAXIMUM.

© FREESCALE SEMICONDUCTOR, INC. ALL RIGHTS RESERVED.	<b>MECHANICAL OUTLINE</b>	PRINT VERSION NOT TO SCALE
TITLE:  8 LEAD SSOP	DOCUMENT NO: 98ARH99066A  CASE NUMBER: 1317-04  STANDARD: NON-JEDEC	REV: F  24 MAY 2005

PAGE 3 OF 3

**CASE 1317-04  
ISSUE F  
SUPER SMALL OUTLINE PACKAGE**

## NOTES

## **How to Reach Us:**

### **Home Page:**

[www.freescale.com](http://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](http://www.freescale.com/support)

### **Europe, Middle East, and Africa:**

Freescale Halbleiter Deutschland GmbH  
Technical Information Center  
Schatzbogen 7  
8129 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](http://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](mailto: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](mailto: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](mailto: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.

