

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

The MPX4250A/MPXA4250A 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 MPX4250A/MPXA4250A 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 Freescale sensor a logical and economical choice for the automotive system engineer.

Features

- 1.5% Maximum Error Over 0° 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° 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

Typical Applications

- Turbo Boost Engine Control
- Ideally Suited for Microprocessor or Microcontroller-Based Systems

ORDERING INFORMATION

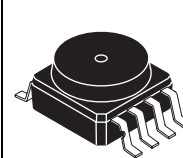
Device Type	Options	Case No.	MPX Series Order Number	Packing Options	Device Marking
SMALL OUTLINE PACKAGE ⁽¹⁾ (MPXA4250A SERIES)					
Basic Elements	Absolute, Element Only	482	MPXA4250A6U	Rails	MPXA4250A
		482	MPXA4250A6T1	Tape & Reel	MPXA4250A
Ported Elements	Absolute, Axial Port	482A	MPXA4250AC6U	Rails	MPXA4250A
		482A	MPXA4250AC6T1	Tape & Reel	MPXA4250A
UNIBODY PACKAGE ⁽²⁾ (MPX4250A SERIES)					
Basic Element	Absolute, Element Only	867	MPX4250A	—	MPX4250A
Ported Elements	Absolute, Ported	867B	MPX4250AP	—	MPX4250AP

1. The MPXA4250A series pressure sensors are available in the basic element package or with pressure port fitting. Two packing options are offered for each type.
2. The MPX4250A series pressure sensors are available in the basic element package or with pressure port fittings providing mounting ease and barbed hose connections.

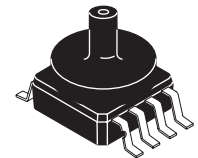
MPX4250A MPXA4250A SERIES

INTEGRATED
PRESSURE SENSOR
20 TO 250 kPA (2.9 TO 36.3 psi)
0.2 TO 4.9 V OUTPUT

SMALL OUTLINE PACKAGES



MPXA4250A6U/6T1
CASE 482-01



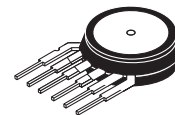
MPXA4250AC6U/C6T1
CASE 482A-01

SMALL OUTLINE PACKAGE PIN NUMBERS

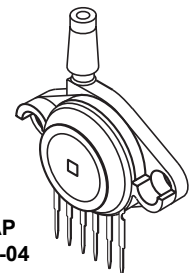
1	N/C ⁽¹⁾ , ⁽²⁾	5 ⁽²⁾	N/C
2	V _S	6 ⁽²⁾	N/C
3	GND	7 ⁽²⁾	N/C
4	V _{OUT}	8	N/C

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

UNIBODY PACKAGES



MPX4250A
CASE 867-08



MPX4250AP
CASE 867B-04

UNIBODY PACKAGE PIN NUMBERS

1	V _{OUT} ⁽¹⁾	4	N/C ⁽²⁾
2	GND	5	N/C ⁽²⁾
3	V _S	6	N/C ⁽²⁾

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

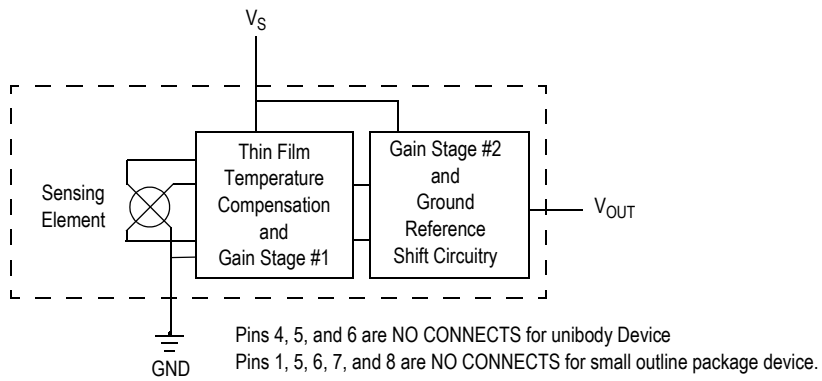


Figure 1. Fully Integrated Pressure Sensor Schematic

Table 1. Maximum Ratings⁽¹⁾

Rating	Symbol	Value	Unit
Maximum Pressure ⁽²⁾ ($P_1 > P_2$)	P_{MAX}	1000	kPa
Storage Temperature	T_{STG}	-40 to +125	°C
Operating Temperature	T_A	-40 to +125	°C

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

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

Characteristic	Symbol	Min	Typ	Max	Units
Differential Pressure Range ⁽¹⁾	P_{OP}	20	—	250	kPa
Supply Voltage ⁽²⁾	V_S	4.85	5.1	5.35	V_{DC}
Supply Current	I_O	—	7.0	10	mAdc
Minimum Pressure Offset ⁽³⁾ @ $V_S = 5.1$ Volts	V_{OFF}	0.133	0.204	0.264	V_{DC}
Full Scale Output ⁽⁴⁾ @ $V_S = 5.1$ Volts	V_{FSO}	4.826	4.896	4.966	V_{DC}
Full Scale Span ⁽⁵⁾ @ $V_S = 5.1$ Volts	V_{FSS}	—	4.692	—	V_{DC}
Accuracy ⁽⁶⁾	—	—	—	± 1.5	% V_{FSS}
Sensitivity	$\Delta V/\Delta P$	—	20	—	mV/kPa
Response Time ⁽⁷⁾	t_R	—	1.0	—	msec
Output Source Current at Full Scale Output	I_{O+}	—	0.1	—	mAdc
Warm-Up Time ⁽⁸⁾	—	—	20	—	msec
Offset Stability ⁽⁹⁾	—	—	± 0.5	—	% V_{FSS}

- 1.0 kPa (kiloPascal) equals 0.145 psi.
- Device is ratiometric within this specified excitation range.
- Offset (V_{OFF}) is defined as the output voltage at the minimum rated pressure.
- Full Scale Output (V_{FSO}) 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 at any temperature 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 $25^\circ C$.
 - TcSpan: Output deviation over the temperature range of 0° to $85^\circ C$, relative to $25^\circ C$.
 - TcOffset: Output deviation with minimum rated pressure applied, over the temperature range of 0° to $85^\circ C$, relative to $25^\circ C$.
 - Variation from Nominal: The variation from nominal values, for Offset or Full Scale Span, as a percent of V_{FSS} , at $25^\circ C$.
- Response Time is defined as the time from 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 Time is defined as the time required for the product to meet the specified output voltage after the pressure is stabilized.
- Offset stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.

Table 3. Mechanical Characteristics

Characteristics	Typ	Unit
Weight, Basic Element (Case 867)	4.0	Grams
Weight, Small Outline Package (Case 482)	1.5	Grams

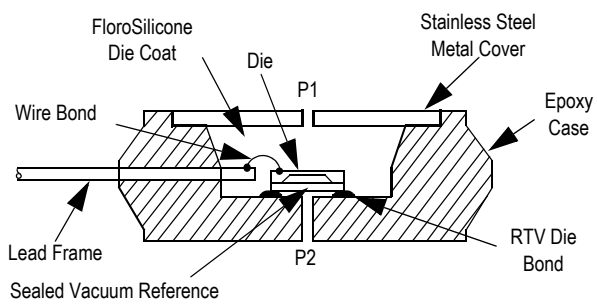


Figure 2. Cross Sectional Diagram (Not to Scale)

Figure 2 illustrates the absolute pressure 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 MPX4250A/MPXA4250A 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.

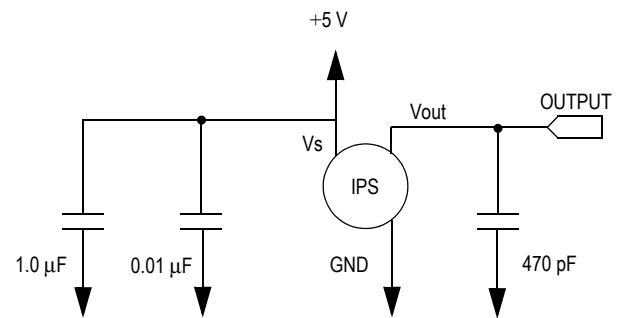


Figure 3. Recommended Power Supply Decoupling and Output Filtering

(For additional output filtering, please refer to Application Note AN1646.

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.

Figure 4 shows the sensor output signal relative to pressure input. Typical, minimum, and maximum output curves are shown for operation over temperature range of 0° to 85°C using the decoupling circuit shown in Figure 3. The output will saturate outside of the specified pressure range.

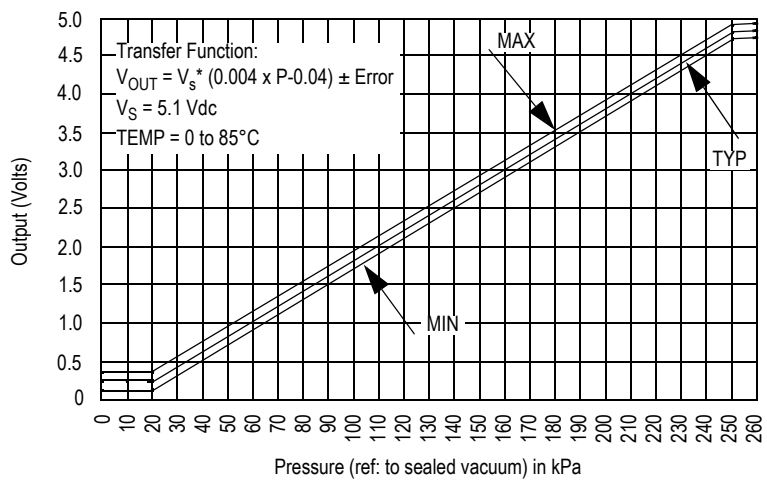
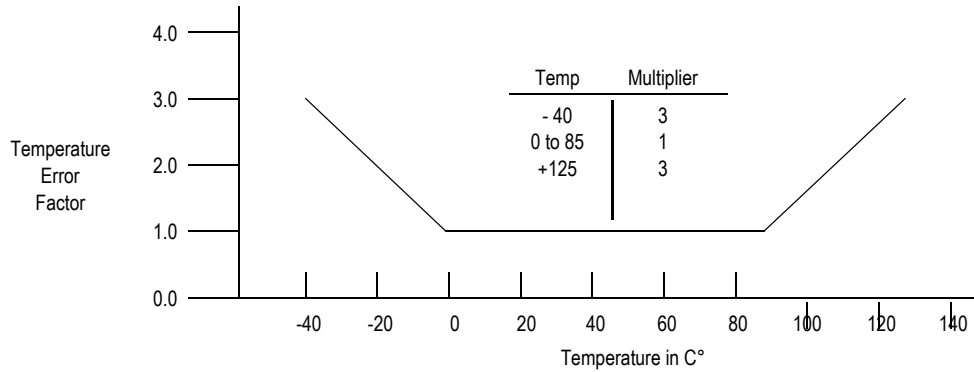


Figure 4. Output vs. Absolute Pressure

Transfer Function

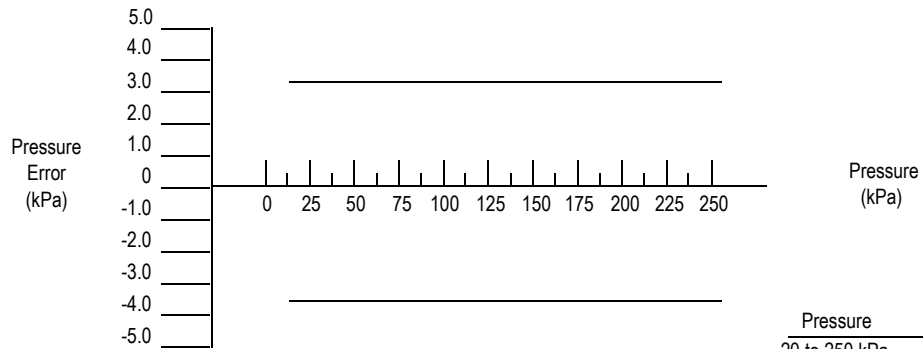
Nominal Transfer Value: $V_{OUT} = V_S (P \times 0.004 - 0.04)$
 $\pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.004 \times V_S)$
 $V_S = 5.1 \text{ V} \pm 0.25 V_{DC}$

Temperature Error Band



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

Pressure Error Band



INFORMATION FOR USING THE SMALL OUTLINE PACKAGE (CASE 482)

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.

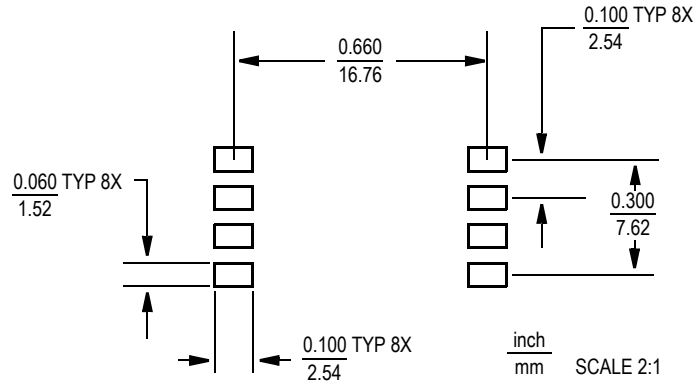
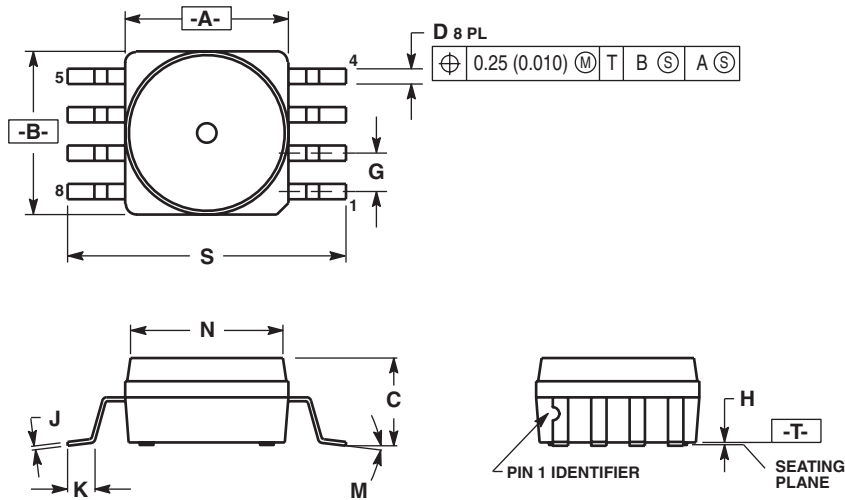


Figure 5. SOP Footprint (Case 482)

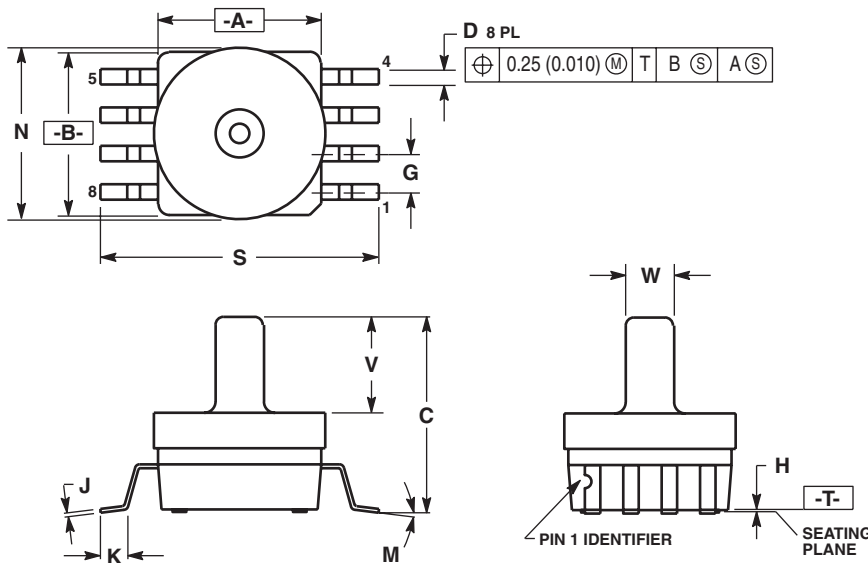
PACKAGE DIMENSIONS



- 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	0.212	0.230	5.38	5.84
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	0.405	0.415	10.29	10.54
S	0.709	0.725	18.01	18.41

**CASE 482-01
 ISSUE O
 SMALL OUTLINE PACKAGE**

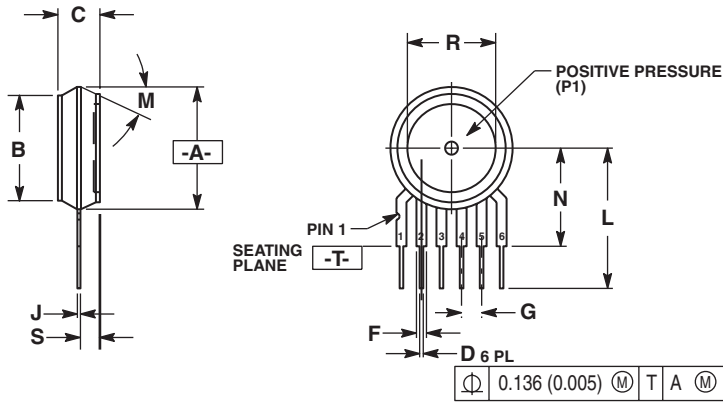


- NOTES:
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006).
 5. ALL VERTICAL SURFACES 5° TYPICAL DRAFT.

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**

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).

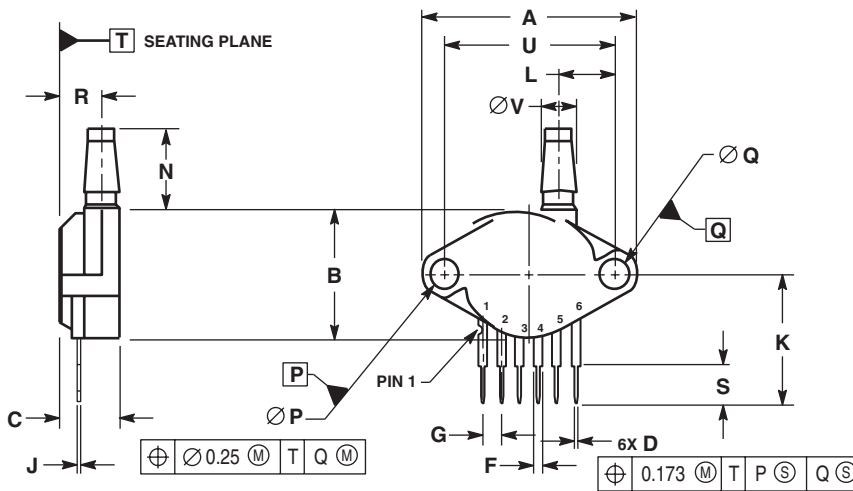
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.595	0.630	15.11	16.00
B	0.514	0.534	13.06	13.56
C	0.200	0.220	5.08	5.59
D	0.027	0.033	0.68	0.84
F	0.048	0.064	1.22	1.63
G	0.100 BSC		2.54 BSC	
J	0.014	0.016	0.36	0.40
L	0.695	0.725	17.65	18.42
M	30' NOM		30' NOM	
N	0.475	0.495	12.07	12.57
R	0.430	0.450	10.92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



- NOTES:
1. DIMENSIONS ARE IN MILLIMETERS.
 2. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.

DIM	MILLIMETERS	
	MIN	MAX
A	29.08	29.85
B	17.4	18.16
C	7.75	8.26
D	0.68	0.84
F	1.22	1.63
G	2.54 BSC	
J	0.36	0.41
K	17.65	18.42
L	7.37	7.62
N	10.67	11.18
P	3.89	4.04
Q	3.89	4.04
R	5.84	6.35
S	5.59	6.1
U	23.11 BSC	
V	4.62	4.93

- STYLE 1:
 PIN 1. Vout
 2. GROUND
 3. Vcc
 4. V1
 5. V2
 6. Vex

CASE 867B-04 ISSUE F UNIBODY PACKAGE

NOTES



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USA/Europe or Locations Not Listed:

Freescale Semiconductor
Technical Information Center, CH370
1300 N. Alma School Road
Chandler, Arizona 85224
+1-800-521-6274 or +1-480-768-2130
support@freescale.com

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)
support@freescale.com

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

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