

# Freescale Semiconductor

MP3V5050V  
Rev 2, 06/2010

## High Temperature Accuracy Integrated Silicon Pressure Sensor On-Chip Signal Conditioned, Temperature Compensated and Calibrated

The MP3V5050V sensor integrates on-chip, bipolar op amp circuitry and thin film resistor networks to provide a high output signal and temperature compensation. The small form factor and high reliability of on-chip integration make the Freescale Semiconductor, Inc. pressure sensor a logical and economical choice for the system designer.

The MP3V5050V 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

- 2.5% Maximum Error over 0° to 85°C
- Ideally suited for Microprocessor or Microcontroller-Based Systems
- Temperature Compensated Over -40° to +125°C
- Patented Silicon Shear Stress Strain Gauge
- Durable Thermoplastic (PPS) Surface Mount Package
- Ideal for Automotive and Non-Automotive Applications

## MP3V5050V Series

-50 to 0 kPa (-7.25 to 0 psi)  
0.1 to 2.8 V Output

### Typical Applications

- Vacuum Pump Monitoring

### ORDERING INFORMATION

| Device Name                                     | Package Options | Case No. | # of Ports |        |      | Pressure Type |              |          | Device Marking |
|---|-----------------|----------|------------|--------|------|---------------|--------------|----------|----------------|
|   |                 |          | None       | Single | Dual | Gauge         | Differential | Absolute |                |
| <b>Small Outline Package (MP3V5050V Series)</b> |                 |          |            |        |      |               |              |          |                |
| MP3V5050VC6U                                    | Rail            | 482A     |            | •      |      | •             |              |          | MP3V5050V      |
| MP3V5050VC6T1                                   | Tape & Reel     | 482A     |            | •      |      | •             |              |          | MP3V5050V      |

### SMALL OUTLINE PACKAGE



MP3V5050VC6U/6T1  
CASE 482A

## Operating Characteristics

**Table 1. Operating Characteristics** ( $V_S = 3.0$  Vdc,  $T_A = 25^\circ\text{C}$  unless otherwise noted,  $P_1 > P_2$ )

| Characteristic   | Symbol    | Min  | Typ       | Max       | Unit        |
|--|-----------|------|-----------|-----------|-------------|
| Pressure Range   | $P_{OP}$  | -50  | —         | 0         | kPa         |
| Supply Voltage <sup>(1)</sup>  | $V_S$     | 2.7  | 3.0       | 3.3       | Vdc         |
| Supply Current   | $I_o$     | —    | 7.0       | 10        | mAdc        |
| Full Scale Output <sup>(2)</sup> ( $0^\circ$ to $85^\circ\text{C}$ )<br>@ $V_S = 3.0$ Volts<br>( $P_{diff} = 0$ kPa) | $V_{FSO}$ | 2.7  | 2.8       | 2.9       | Vdc         |
| Full Scale Span <sup>(3)</sup><br>@ $V_S = 3.0$ Volts<br>( $0^\circ$ to $85^\circ\text{C}$ )                         | $V_{FSS}$ | —    | 2.7       | —         | Vdc         |
| Accuracy <sup>(4)</sup><br>( $0^\circ$ to $85^\circ\text{C}$ )   | —         | —    | —         | $\pm 2.5$ | % $V_{FSS}$ |
| Sensitivity  | V/P       | —    | 54        | —         | mV/kPa      |
| Response Time <sup>(5)</sup>   | $t_R$     | —    | 1.0       | —         | ms          |
| Warm-Up Time <sup>(6)</sup>  | —         | —    | 20        | —         | ms          |
| Offset Stability <sup>(7)</sup>  | —         | —    | $\pm 0.5$ | —         | % $V_{FSS}$ |
| Pressure Offset <sup>(8)</sup><br>( $0^\circ$ to $85^\circ\text{C}$ )  | $V_{off}$ | 0.06 | 0.12      | 0.19      | Vdc         |

1. Device is ratiometric within this specified excitation range.
2. Full Scale Output ( $V_{FSO}$ ) is defined as the output voltage at the maximum or full rated pressure.
3. 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.
4. Accuracy is the deviation in actual output from nominal output over the entire pressure range and temperature range as a percent of span at  $25^\circ\text{C}$  due to all sources of errors, including 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 minimum or maximum rated pressure at  $25^\circ\text{C}$ .
  - TcSpan: Output deviation over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
  - TcOffset: Output deviation with minimum pressure applied, over the temperature range of  $0^\circ$  to  $85^\circ\text{C}$ , relative to  $25^\circ\text{C}$ .
5. 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.
6. Warm-up Time is defined as the time required for the product to meet the specified output voltage after the pressure has been stabilized.
7. Offset Stability is the product's output deviation when subjected to 1000 hours of Pulsed Pressure, Temperature Cycling with Bias Test.
8. Offset ( $V_{off}$ ) is defined as the output voltage at the minimum rated pressure.

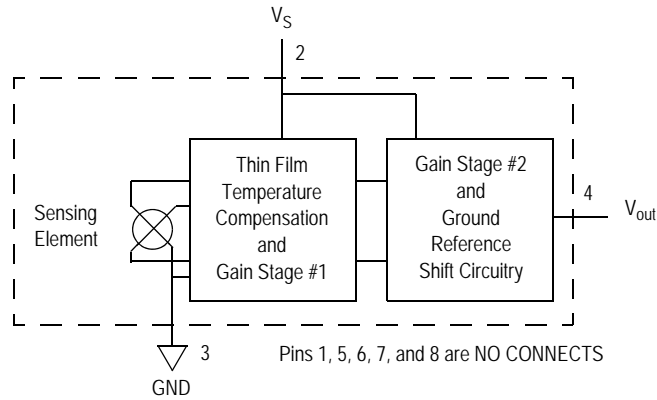
## Maximum Ratings

**Table 2. Maximum Ratings<sup>(1)</sup>**

| Rating                           | Symbol    | Value         | Unit |
|----------------------------------|-----------|---------------|------|
| Maximum Pressure ( $P_1 > P_2$ ) | $P_{max}$ | 200           | kPa  |
| Storage Temperature              | $T_{stg}$ | -40° to +125° | °C   |
| Operating Temperature            | $T_A$     | -40° to +125° | °C   |

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

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



**Figure 1. Fully Integrated Pressure Sensor Schematic**

## On-chip Temperature Compensation and Calibration

Figure 2 illustrates the Differential/Gauge Sensing Chip in the basic chip carrier.

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 4 shows the sensor output signal relative to pressure input. Typical minimum and maximum output curves are shown for operation over 0° to 85°C temperature range. The output will saturate outside of the rated 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 silicon diaphragm. The MP3V5050V pressure sensor operating characteristics, 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.

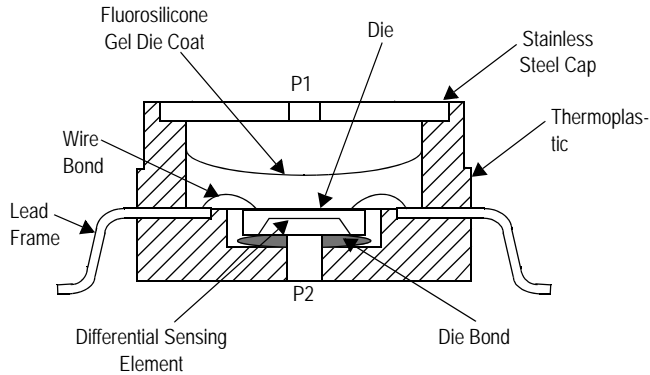


Figure 2. Cross-Sectional Diagram SOP (not to scale)

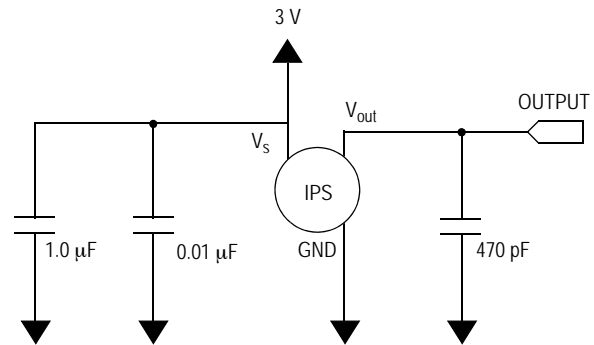


Figure 3. Recommended Power Supply Decoupling and Output Filtering

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

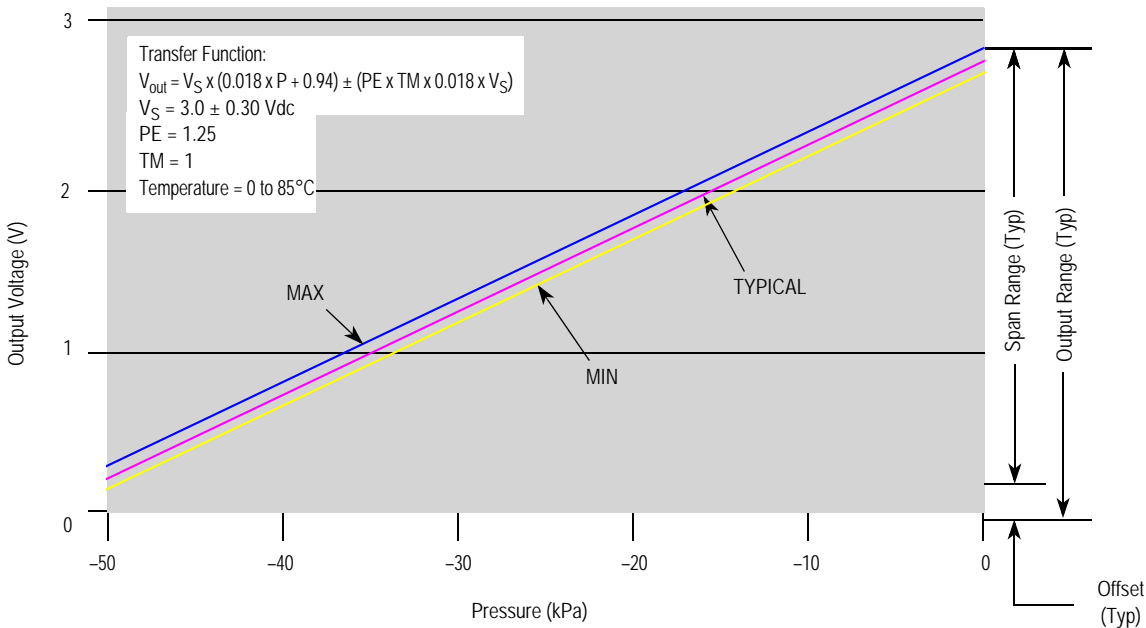
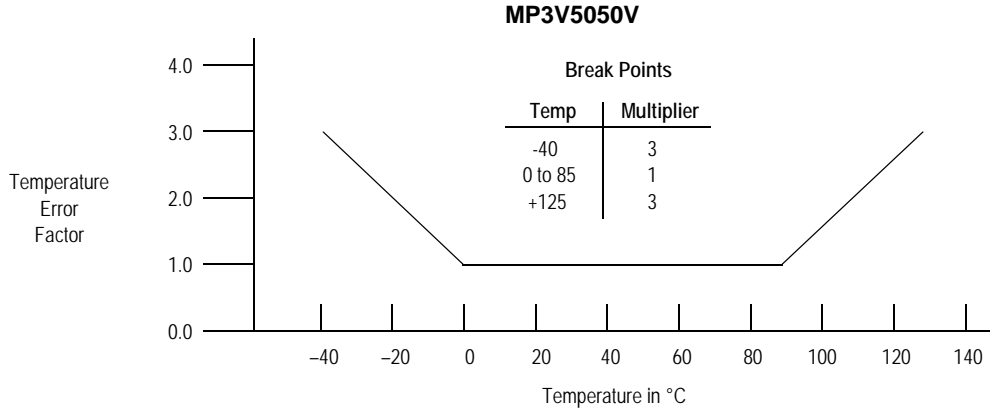


Figure 4. Output vs. Pressure Differential

### Transfer Function (MP3V5050V Series)

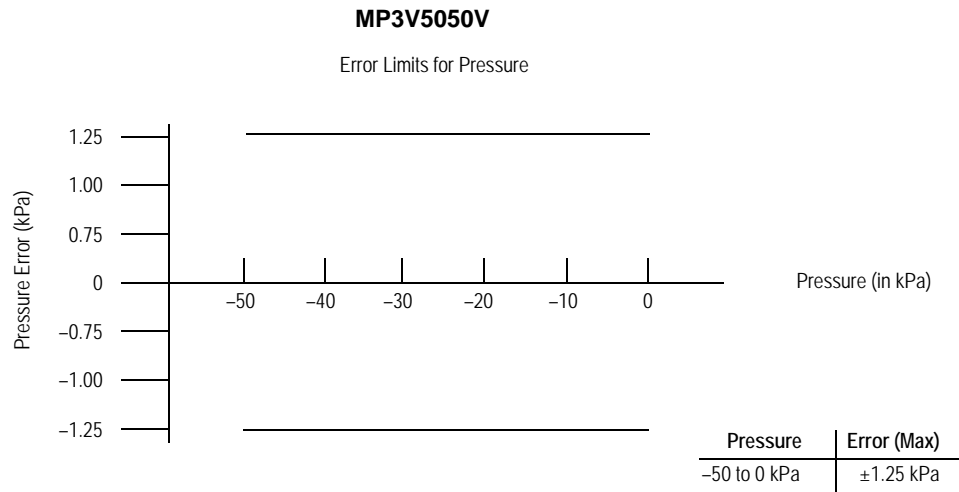
**Nominal Transfer Value:**  $V_{out} = V_S \times (0.018 \times P + 0.94)$   
 $\pm (\text{Pressure Error} \times \text{Temp Multi} \times 0.018 \times V_S)$   
 $V_S = 3.0 \pm 0.3 \text{ V}$

### Temperature Error Band



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

### Pressure Error Band



## MINIMUM RECOMMENDED FOOTPRINT FOR SMALL OUTLINE PACKAGE

Surface mount board layout is a critical portion of the total design. The footprint for the semiconductor package must be the correct size to ensure proper solder connection interface between the board and the package. With the correct pad geometry, the packages will self-align when subjected to a

solder reflow process. It is always recommended to fabricate boards with a solder mask layer to avoid bridging and/or shorting between solder pads, especially on tight tolerances and/or tight layouts.

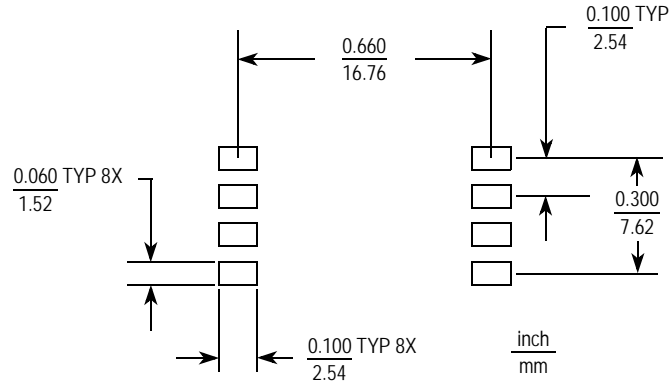
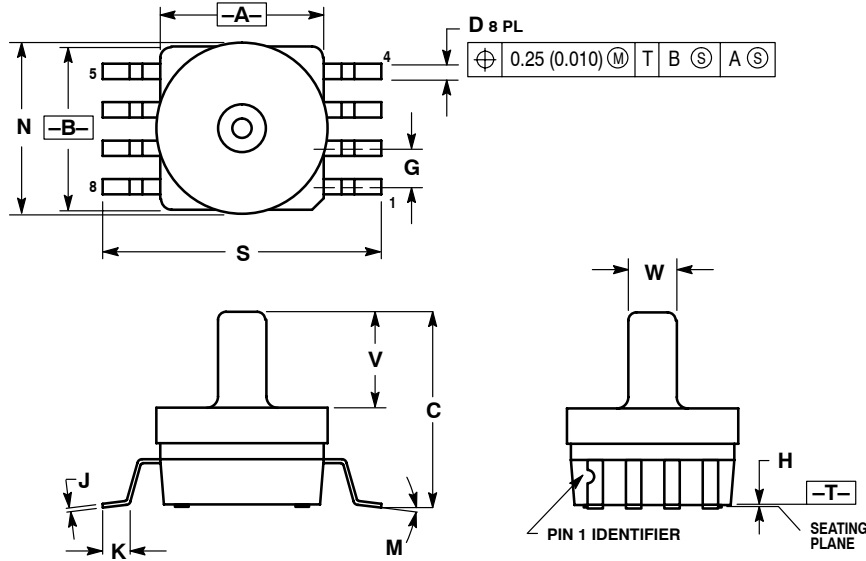


Figure 5. SOP Footprint

### 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  
 UNIBODY PACKAGE**

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