Freescale Semiconductor

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

Freescale’s MP3H6115A series 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 pressure sensor a logical and economical choice for the system designer.

The MP3H6115A 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

• Improved Accuracy at High Temperature
• Available in Super Small Outline Package
• 1.5% Maximum Error over 0° to 85°C
• Ideally suited for Microprocessor or Microcontroller-Based Systems
• Temperature Compensated from -40° to +125°C
• Durable Thermoplastic (PPS) Surface Mount Package

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Packaging Options</th>
<th>Case No.</th>
<th># of Ports</th>
<th>Pressure Type</th>
<th>Device Marking</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP3H6115A6U</td>
<td>Rail</td>
<td>1317</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP3H6115A6T1</td>
<td>Tape &amp; Reel</td>
<td>1317</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP3H6115AC6U</td>
<td>Rail</td>
<td>1317A</td>
<td></td>
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</tr>
<tr>
<td>MP3H6115AC6T1</td>
<td>Tape &amp; Reel</td>
<td>1317A</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Application Examples

• Aviation Altimeters
• Industrial Controls
• Engine Control/Manifold Absolute Pressure (MAP)
• Weather Station and Weather Reporting Device Barometers

SUPER SMALL OUTLINE PACKAGES

MP3H6115A6U/T1
CASE 1317-04

MP3H6115AC6U/T1
CASE 1317A-04
### Pressure Characteristics

**Table 1. Operating Characteristics**  
(V<sub>S</sub> = 3.0 V<sub>dc</sub>, T<sub>A</sub> = 25°C unless otherwise noted, P<sub>1</sub> > P<sub>2</sub>.)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure Range</td>
<td>P&lt;sub&gt;OP&lt;/sub&gt;</td>
<td>15</td>
<td>—</td>
<td>115</td>
<td>kPa</td>
</tr>
<tr>
<td>Supply Voltage&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>V&lt;sub&gt;S&lt;/sub&gt;</td>
<td>2.7</td>
<td>3.0</td>
<td>3.3</td>
<td>V&lt;sub&gt;dc&lt;/sub&gt;</td>
</tr>
<tr>
<td>Supply Current</td>
<td>I&lt;sub&gt;o&lt;/sub&gt;</td>
<td>—</td>
<td>4.0</td>
<td>8.0</td>
<td>mA&lt;sub&gt;dc&lt;/sub&gt;</td>
</tr>
<tr>
<td>Minimum Pressure Offset&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>V&lt;sub&gt;off&lt;/sub&gt;</td>
<td>0.079</td>
<td>0.12</td>
<td>0.161</td>
<td>V&lt;sub&gt;dc&lt;/sub&gt;</td>
</tr>
<tr>
<td>@ V&lt;sub&gt;S&lt;/sub&gt; = 3.0 Volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale Output&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>V&lt;sub&gt;FSO&lt;/sub&gt;</td>
<td>2.780</td>
<td>2.82</td>
<td>2.861</td>
<td>V&lt;sub&gt;dc&lt;/sub&gt;</td>
</tr>
<tr>
<td>@ V&lt;sub&gt;S&lt;/sub&gt; = 3.0 Volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Scale Span&lt;sup&gt;(4)&lt;/sup&gt;</td>
<td>V&lt;sub&gt;FSS&lt;/sub&gt;</td>
<td>2.660</td>
<td>2.70</td>
<td>2.741</td>
<td>V&lt;sub&gt;dc&lt;/sub&gt;</td>
</tr>
<tr>
<td>@ V&lt;sub&gt;S&lt;/sub&gt; = 3.0 Volts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>±1.5</td>
<td>%V&lt;sub&gt;FSS&lt;/sub&gt;</td>
</tr>
<tr>
<td>(0 to 85°C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity</td>
<td>V/P</td>
<td>—</td>
<td>27</td>
<td>—</td>
<td>mV/kPa</td>
</tr>
<tr>
<td>Response Time&lt;sup&gt;(5)&lt;/sup&gt;</td>
<td>t&lt;sub&gt;R&lt;/sub&gt;</td>
<td>—</td>
<td>1.0</td>
<td>—</td>
<td>ms</td>
</tr>
<tr>
<td>Warm-Up Time&lt;sup&gt;(6)&lt;/sup&gt;</td>
<td>—</td>
<td>—</td>
<td>20</td>
<td>—</td>
<td>ms</td>
</tr>
<tr>
<td>Offset Stability&lt;sup&gt;(7)&lt;/sup&gt;</td>
<td>—</td>
<td>—</td>
<td>±0.25</td>
<td>—</td>
<td>%V&lt;sub&gt;FSS&lt;/sub&gt;</td>
</tr>
</tbody>
</table>

1. Device is ratiometric within this specified excitation range.
2. Offset (V<sub>off</sub>) is defined as the output voltage at the minimum rated pressure.
3. Full Scale Output (V<sub>FSO</sub>) is defined as the output voltage at the maximum or full rated pressure.
4. Full Scale Span (V<sub>FSS</sub>) is defined as the algebraic difference between the output voltage at full rated pressure and the output voltage at the minimum rated pressure.
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 cycles of Pulsed Pressure, Temperature Cycling with Bias Test.
Maximum Ratings

Table 2. Maximum Ratings(1)

<table>
<thead>
<tr>
<th>Parametrics</th>
<th>Symbol</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Pressure (P1 &gt; P2)</td>
<td>P_{\text{max}}</td>
<td>400</td>
<td>kPa</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>T_{\text{stg}}</td>
<td>-40° to +125°</td>
<td>°C</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>T_A</td>
<td>-40° to +125°</td>
<td>°C</td>
</tr>
<tr>
<td>Output Source Current @ Full Scale Output(2)</td>
<td>I_o^+</td>
<td>0.5</td>
<td>mAdc</td>
</tr>
<tr>
<td>Output Sink Current @ Minimum Pressure Offset(2)</td>
<td>I_o^-</td>
<td>-0.5</td>
<td>mAdc</td>
</tr>
</tbody>
</table>

1. Exposure beyond the specified limits may cause permanent damage or degradation to the device.
2. Maximum Output Current is controlled by effective impedance from V_{out} to Gnd or V_{out} to V_S in the application circuit.

Figure 1 shows a block diagram of the internal circuitry integrated on a pressure sensor chip.
On-chip Temperature Compensation and Calibration

Figure 2 illustrates the absolute sensing chip in the basic Super Small Outline chip carrier (Case 1317).

Figure 3 shows a typical application circuit (output source current operation).

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 MP3H6115A series 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.
**Transfer Function (MP3H6115A)**

**Normal Transfer Value:**

\[ V_{OUT} = V_S \times (0.009 \times P - 0.095) \]

\[ \pm (\text{Pressure Error} \times \text{Temp. Factor} \times 0.009 \times V_S) \]

\[ V_S = 3.0 \pm 0.3 \text{ VDC} \]

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**Temperature Error Band**

**MP3H6115A Series**

<table>
<thead>
<tr>
<th>Temperature Error Factor</th>
<th>-40</th>
<th>0 to 85</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplier</td>
<td>3</td>
<td>1</td>
<td>1.75</td>
</tr>
</tbody>
</table>

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

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**Pressure Error Band**

**Error Limits for Pressure**

<table>
<thead>
<tr>
<th>Pressure (in kPa)</th>
<th>Pressure</th>
<th>Error (Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 to 115 (kPa)</td>
<td>± 1.5 (kPa)</td>
<td></td>
</tr>
</tbody>
</table>
MINIMUM RECOMMENDED FOOTPRINT FOR SMALL AND SUPER SMALL PACKAGES

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. SSOP Footprint (Case 1317 and 1317A)
NOTES:

1. ALL DIMENSIONS IN INCHES.


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.

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M E C H A N I C A L  O U T L I N E

| TITLE: 8 LEAD SSOP |
| DOCUMENT NO: 98ARH99066A | REV: F |
| CASE NUMBER: 1317-04 | 24 MAY 2005 |
| STANDARD: NON-JEDEC |

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CASE 1317-04
ISSUE F
SUPER SMALL OUTLINE PACKAGE

MP3H6115A
NOTES:

1. ALL DIMENSIONS IN INCHES.


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 .005 MAXIMUM.

5. DIMENSION DOES NOT INCLUDE DAMBAR PROTRUSION.
   ALLOWABLE DAMBAR PROTRUSION SHALL BE .008 INCHES MAXIMUM.

MECHANICAL OUTLINE

TITLE:

8 LD, PORTED SSOP

DOCUMENT NO: 98ARH99089A
CASE NUMBER: 1317A–04
STANDARD: NON-JEDEC

REV: D
26 OCT 2006

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