The Honeywell HMC1041Z is a z-axis surface mount option designed for low field magnetic sensing. By adding the HMC1041Z to other 2-axis magneto-resistive sensors, a cost effective and space-efficient 3-axis magnetometer or compassing solution is enabled. This compact, low cost solution is easy to assemble for high volume, cost effective OEM designs. Applications for the HMC1041Z include Compassing, Navigation Systems, Magnetometry, and Current Sensing.

The HMC1041Z utilizes Honeywell's Anisotropic Magnetoresistive (AMR) technology that provides advantages over coil based magnetic sensors. They are extremely sensitive, low field, solid-state magnetic sensors designed to measure direction and magnitude of Earth’s magnetic fields, from tens of micro-gauss to 6 gauss. Honeywell’s Magnetic Sensors are among the most sensitive and reliable low-field sensors in the industry.

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<th>FEATURES</th>
<th>BENEFITS</th>
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<tr>
<td>Low Height Magnetic Sensors</td>
<td>Narrow Dimensions and Small Size for Low Profile Vertical Sensing Applications and Mounting, No Layout Constraints</td>
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<tr>
<td>Surface Mount Z-Axis Sensor</td>
<td>Easy to Assemble &amp; Compatible with High Speed SMT Assembly</td>
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<tr>
<td>Low Voltage Operations</td>
<td>Compatible for Battery Powered Applications</td>
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<td>Low Cost</td>
<td>Designed for High Volume, Cost Effective OEM Designs</td>
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<tr>
<td>Available in Tape &amp; Reel Packaging</td>
<td>High Volume OEM Assembly</td>
</tr>
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<td>Lead Free Package Construction</td>
<td>Complies with Current Environmental Standards</td>
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<tr>
<td>Wheatstone Bridge</td>
<td>Low Noise Passive Element Design</td>
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<tr>
<td>Wide Magnetic Field Range</td>
<td>Sensor Can Be Used in Strong Magnetic Field Environments</td>
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<tr>
<td>Patented Offset and Set/Reset Straps</td>
<td>Stray Magnetic Field Compensation</td>
</tr>
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</table>
## SPECIFICATIONS

### Characteristics | Conditions* | Min | Typ | Max | Units
---|---|---|---|---|---

#### Bridge Elements

| Supply<sup>(3)</sup> | VBRIDGE referenced to GND | 2.0 | 5.0 | 20 | Volts
| Resistance<sup>(2)</sup> | | 800 | 1050 | 1300 | ohms
| Field Range<sup>(3)</sup> | Full scale (FS) – total applied field | -6 | +6 | | gauss
| Sensitivity<sup>(2)</sup> | Set/Reset Current = 0.5A | 0.8 | 1.0 | 1.25 | mV/V/ gauss
| Resolution<sup>(3)</sup> | Offset = (OUT+) – (OUT-) Field = 0 gauss after Set pulse | 0.16 | 1.44 | | milli-gauss (RMS) milli-gauss (pk – pk)
| Bridge Offset<sup>(2)</sup> | Offset = (OUT+) – (OUT-) Field = 0 gauss after Set pulse | -2.0 | ±0.5 | +2.0 | mV/V
| Resistance<sup>(2)</sup> | Magnetic signal (lower limit = DC) | 5 | | | MHz
| Field Range<sup>(3)</sup> | Sensitivity starts to degrade. Use S/R pulse to restore sensitivity. | | | 20 | gauss
| Operating Temperature<sup>(3)</sup> | Ambient | -40 | 125 | | °C
| Storage Temperature<sup>(3)</sup> | Ambient, unbiased | -55 | 125 | | °C
| Sensitivity Tempco<sup>(3)</sup> | T<sub>A</sub> = -40 to 125°C, Vbridge=5V | -3500 | -3100 | -2000 | ppm/°C
| Bridge Offset Tempco<sup>(3)</sup> | T<sub>A</sub> = -40 to 125°C, No Set/Reset | ±500 | | ±10 | ppm/°C
| Bridge Ohmic Tempco<sup>(3)</sup> | Vbridge=5V, T<sub>A</sub> = -40 to 125°C | 2100 | 2500 | 2900 | ppm/°C
| Cross-Axis Sensitivity<sup>(3)</sup> | Cross field = 0.5 gauss, Happlied = ±3 gauss | | ±0.5% | | %FS/ gauss
| Linearity Error<sup>(3)</sup> | Best fit straight line | | 0.17 | 0.42 | 0.80 | %FS
| Hysteresis Error<sup>(3)</sup> | 3 sweeps across ±3 gauss | | 0.15 | | %FS
| Repeatability Error<sup>(3)</sup> | 3 sweeps across ±3 gauss | | 0.11 | | %FS
| Weight<sup>(3)</sup> | | 9.4 | | | milli-grams

### Set/Reset Strap

| Resistance<sup>(2)</sup> | Measured from S/R+ to S/R- | 3 | 5 | 6 | ohms
| Current<sup>(3)</sup> | 0.1% duty cycle, or less, 2µsec current pulse | 0.4 | 0.5 | 2 | Amp
| Resistance Tempco<sup>(3)</sup> | T<sub>A</sub>=-40 to 125°C | 3000 | 3900 | 4500 | ppm/°C

### Offset Straps

| Resistance<sup>(2)</sup> | Measured from OFFSET+ to OFFSET- | 5 | 8 | 11 | ohms
| Offset Constant<sup>(3)</sup> | DC Current Field applied in sensitive direction | 10 | | | mA/ gauss
| Resistance Tempco<sup>(3)</sup> | T<sub>A</sub>=-40 to 125°C | 1800 | 2700 | 4500 | ppm/°C

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1. By Design
2. Tested at 25°C and 5.0Vdc except stated otherwise
3. Characterized
SCHEMATIC DIAGRAM

(Arrow indicates direction of applied field that generates a positive output voltage after a SET pulse.)

PIN CONFIGURATIONS

<table>
<thead>
<tr>
<th>PIN NUMBER</th>
<th>FUNCTION</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>OFFSET-</td>
</tr>
<tr>
<td>2</td>
<td>VBRIDGE</td>
</tr>
<tr>
<td>3</td>
<td>OFFSET+</td>
</tr>
<tr>
<td>4</td>
<td>OUT+</td>
</tr>
<tr>
<td>5</td>
<td>OUT-</td>
</tr>
<tr>
<td>6</td>
<td>GND</td>
</tr>
<tr>
<td>7</td>
<td>S/R-</td>
</tr>
<tr>
<td>8</td>
<td>S/R+</td>
</tr>
</tbody>
</table>

PACKAGE OUTLINES

PACKAGE DRAWING HMC1041Z (8-PIN LPCC, dimensions in millimeters)

Dimensions:

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Min</th>
<th>Nom</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>0.95</td>
<td>1.05</td>
<td>1.15</td>
</tr>
<tr>
<td>E</td>
<td>4.00</td>
<td>4.10</td>
<td>4.20</td>
</tr>
<tr>
<td>A</td>
<td>0.91</td>
<td>1.08</td>
<td>1.25</td>
</tr>
<tr>
<td>b</td>
<td>0.17</td>
<td>0.20</td>
<td>0.23</td>
</tr>
<tr>
<td>L</td>
<td>0.37</td>
<td>0.40</td>
<td>0.43</td>
</tr>
<tr>
<td>e</td>
<td></td>
<td>0.5</td>
<td>basic</td>
</tr>
</tbody>
</table>
MOUNTING CONSIDERATIONS

The following is the recommended printed circuit board (PCB) footprint for the HMC1041Z. The two small (0.5mm by 0.5mm) leveling pads are to hold the part square to the PCB and should receive the same pad finish as the rest of the pads but without additional solder paste. The goal is to hold the parts vertical surfaces perpendicular to the board surface. All dimensions are nominal and in millimeters.

Stencil Design and Solder Paste

A 4 mil stencil and 100% paste coverage is recommended for the eight electrical contact pads. Do not apply paste on the leveling pads. The HMC1041Z has been tested successfully with no-clean solder paste.

Pick and Place

Placement is machine dependent and no restrictions are recommended. Placement force should be equivalent to placing 1206 SMT resistors and enough force should be used to squeeze the paste out from the package/contact pad overlap and to keep the package pin contacts vertical. The low mass of the HMC1041Z ensures that very little paste is required to hold the part until reflow.

Reflow and Rework

The HMC1041Z has been qualified at MSL3 with a maximum reflow temperature of 250°C. Honeywell recommends the adherence to solder paste manufacturer’s guidelines. The HMC1041Z may be reworked with soldering irons, but extreme care must be taken not to overheat the copper pads from the part’s fiberglass substrate. Irons with a tip temperature no greater than 315°C should be used. Excessive rework risks the copper pads pulling away into the molten solder.
BASIC DEVICE OPERATION

The Honeywell HMC1041Z magnetoresistive sensor is a Wheatstone bridge device to measure magnetic fields. With
power supply applied to a bridge, the sensor converts any incident magnetic field in the sensitive axis direction to a
differential voltage output. In addition to the bridge circuit, the sensor has two on-chip magnetically coupled straps; the
offset strap and the set/reset strap. These straps are Honeywell patented features for incident field adjustment and
magnetic domain alignment; and eliminate the need for external coils positioned around the sensors.

The magnetoresistive sensors are made of a nickel-iron (Permalloy) thin-film deposited on a silicon wafer and patterned
as a resistive strip element. In the presence of a magnetic field, a change in the bridge resistive elements causes a
corresponding change in voltage across the bridge outputs.

These resistive elements are aligned together to have a common sensitive axis (indicated by arrows on the pinout
diagram) that will provide positive voltage change with magnetic fields increasing in the sensitive direction. Because the
output only is in proportion to the one-dimensional axis (the principle of anisotropy) and its magnitude, additional sensor
bridges placed at orthogonal directions permit accurate measurement of arbitrary field direction. The combination of
sensor bridges in two and three orthogonal axis permit applications such as compassing and magnetometry.

The offset strap allows for several modes of operation when a direct current is driven through it. These modes are: 1) Subtraction (bucking) of an unwanted external magnetic field, 2) nulling of the bridge offset voltage, 3) Closed loop field
cancellation, and 4) Auto-calibration of bridge gain.

The set/reset strap can be pulsed with high currents for the following benefits: 1) Enable the sensor to perform high
sensitivity measurements, 2) Flip the polarity of the bridge output voltage, and 3) Periodically used to improve linearity,
lower cross-axis effects, and temperature effects.

Offset Strap

The offset strap is a spiral of metallization that couples in the sensor element’s sensitive axis. The straps will easily
handle currents to buck or boost fields through the linear measurement range, but designers should note the extreme
thermal heating on the die when doing so.

With most applications, the offset strap is not utilized and can be ignored. Designers can leave one or both strap
connections (Off- and Off+) open circuited, or ground one connection node. Do not tie both strap connections together to
avoid shorted turn magnetic circuits.

Set/Reset Strap

The set/reset strap is another spiral of metallization that couples to the sensor elements easy axis (perpendicular to the
sensitive axis on the sensor die. With rare exception, the set/reset strap must be used to periodically condition the
magnetic domains of the magneto-resistive elements for best and reliable performance.

A set pulse is defined as a positive pulse current entering the S/R+ strap connection. The successful result would be the
magnetic domains aligned in a forward easy-axis direction so that the sensor bridge’s polarity is a positive slope with
positive fields on the sensitive axis result in positive voltages across the bridge output connections.

A reset pulse is defined as a negative pulse current entering the S/R+ strap connection. The successful result would be the
magnetic domains aligned in a reverse easy-axis direction so that the sensor bridge’s polarity is a negative slope with
positive fields on the sensitive axis result in negative voltages across the bridge output connections.

Typically a reset pulse is sent first, followed by a set pulse a few milliseconds later. By shoving the magnetic domains in
completely opposite directions, any prior magnetic disturbances are likely to be completely erased by the duet of pulses.
For simpler circuits with less critical requirements for noise and accuracy, a single polarity pulse circuit may be employed
(all sets or all resets). With these uni-polar pulses, several pulses together become close in performance to a set/reset
pulse circuit. Figure 1 shows a quick and dirty manual pulse circuit for uni-polar application of pulses to the set/reset strap.
**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>Ordering Number</th>
<th>Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMC1041Z TR</td>
<td>Tape and Reel 3k pieces/reel</td>
</tr>
</tbody>
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**FIND OUT MORE**

For more information on Honeywell’s Magnetic Sensors visit us online at [www.magneticsensors.com](http://www.magneticsensors.com) or contact us at 800-323-8295.

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U.S. Patents 4,441,072, 4,533,872, 4,569,742, 4,681,812, 4,847,584 and 6,529,114 apply to the technology described.