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Contact us

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

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

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

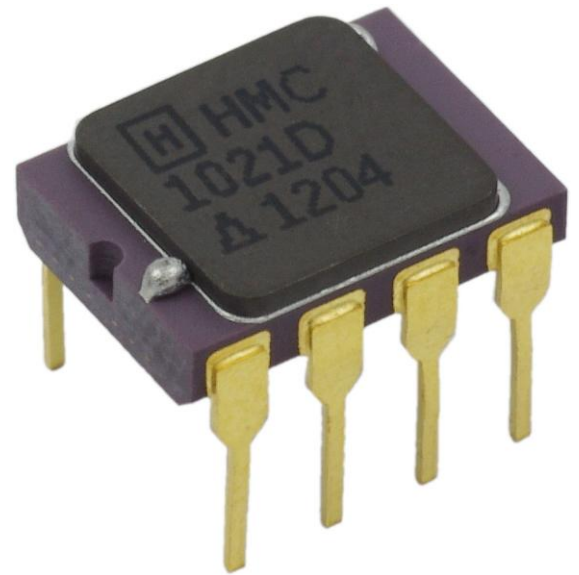


One-Axis Magnetic Sensor HMC1021D

The Honeywell HMC1021D is a one-axis magnetoresistive sensor design in an 8-pin ceramic DIP package. The advantages of the HMC1021D include high-temperature operation, low magnetic field detection range, and a non-magnetic package.

Honeywell's Anisotropic Magneto-Resistive (AMR) sensor technology provides the HMC1021D advantages over other magnetic sensors with a wheatstone bridge to convert magnetic fields to differential output voltage. Capable of sensing magnetic field strength and direction down to 85 micro-gauss, this sensor offers a compact and highly reliable solution for low field magnetic sensing.

Honeywell continues to maintain product excellence and performance by introducing innovative solid-state magnetic sensor solutions. These are highly reliable, top performance products that are delivered when promised. Honeywell's magnetic sensor solutions provide real solutions you can count on.



FEATURES

- ▶ High Temperature Operating Range
- ▶ One-Axis DIP Package
- ▶ On-Chip Set/Reset Straps
- ▶ On-Chip Offset Straps
- ▶ High Sensitivity
- ▶ High Reliability
- ▶ Available in High Volumes

BENEFITS

- ▶ From -55°C to +225°C, Perfect for Downhole Applications
- ▶ Easy to Assemble Component.
- ▶ Reduces Temperature Effects, High Field Upset Resistance
- ▶ Counters Hard-Iron Distortion
- ▶ Low-Noise Signals for Amplification and Detection
- ▶ Compact Solid State Design with Repeatable Results.
- ▶ Easy Transition to Production

HMC1021D

SPECIFICATIONS

| Characteristics | Conditions* | Min | Typ | Max | Units |
|------------------------|--|------------|--------------------|------------|-----------------------|
| Bridge Elements | | | | | |
| Supply | Vbridge referenced to GND | 1.8 | 5.0 | 12 | Volts |
| Resistance | Bridge current = 5mA, Vbridge to GND | | 1100 | | ohms |
| Operating Temperature | Ambient | -55 | | 225 | °C |
| Storage Temperature | Ambient, unbiased | -55 | | 175 | °C |
| Humidity | | | | 100 | % |
| Field Range | Full scale (FS) – total applied field | -6 -0.6 | | +6 +0.6 | Gauss milli-Tesla |
| Linearity Error | Best fit straight line ± 1 gauss ± 3 gauss ± 6 gauss | | 0.05 0.4 1.6 | | %FS |
| Hysteresis Error | 3 sweeps across ±3 gauss | | 0.08 | | %FS |
| Repeatability Error | 3 sweeps across ±3 gauss | | 0.08 | | %FS |
| Bridge Offset | Offset = (OUT+) – (OUT-) Field = 0 gauss after Set pulse, Vbridge = 5V | | ±2.5 | | mV |
| Sensitivity | Set/Reset Current = 2.0A | | 1.0 0.01 | | mV/V/gauss μV/V/nT |
| Noise Density | @ 1kHz, Vbridge=5V | | 48 | | nV/sqrt Hz |
| Resolution | 50Hz Bandwidth, Vbridge=5V | | 85 8.5 | | μgauss nT |
| Bandwidth | Magnetic signal (lower limit = DC) | | 5 | | MHz |
| Disturbing Field | Sensitivity starts to degrade. Use S/R pulse to restore sensitivity. | 20 2 | | | Gauss milli-Tesla |
| Sensitivity Tempco | T _A = -40 to 225°C, Vbridge=5V T _A = -40 to 225°C, Ibridge=5mA | -2800 | -3000 -600 | -3200 | ppm/°C |
| Bridge Offset Tempco | T _A = -40 to 225°C, No Set/Reset T _A = -40 to 225°C, With Set/Reset | | ±500 ±10 | | ppm/°C |
| Bridge Ohmic Tempco | Vbridge=5V, T _A = -40 to 225°C | 2100 | 2500 | 2900 | ppm/°C |
| Cross-Axis Effect | Cross field = 1 gauss, Happlied = ±1 gauss | | +0.3 | | %FS |
| Max. Exposed Field | No perming effect on zero reading | | | 200 20 | Gauss milli-Tesla |

Set/Reset Strap

| | | | | | |
|-------------------|---|------|------|------|--------|
| Resistance | Measured from S/R+ to S/R- | 5.5 | 7.7 | 9.0 | ohms |
| Current | 0.1% duty cycle, or less, 2μsec current pulse | 0.5 | 0.5 | 4.0 | Amp |
| Resistance Tempco | T _A = -55°C to +225°C | 3300 | 3700 | 4100 | ppm/°C |

Offset Straps

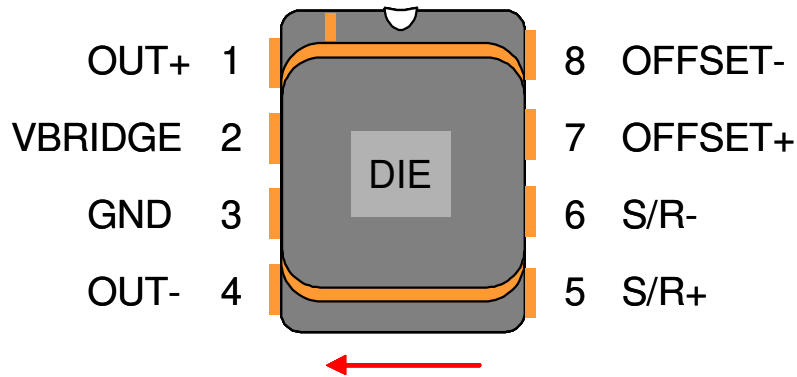
| | | | | | |
|-------------------|--|------|------|------|----------|
| Resistance | Measured from OFFSET+ to OFFSET- | 40 | 50 | 60 | ohms |
| Offset Constant | DC Current Field applied in sensitive direction | 4.0 | 4.6 | 6.0 | mA/gauss |
| Resistance Tempco | T _A = -55°C to +225°C | 3500 | 3900 | 4300 | ppm/°C |

* Tested at 25°C except stated otherwise.

HMC1021D

PIN CONFIGURATION

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



BASIC DEVICE OPERATION

The Honeywell HMC1021D magneto-resistive sensor is composed of a Wheatstone bridge element to measure magnetic fields for both field strength and direction. With power applied to the bridge, the sensor element converts any incident magnetic field in the element's sensitive axis direction to a differential voltage output. In addition to the bridge element, the sensor has two types of 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 sensor is made of a nickel-iron (Permalloy) thin-film deposited on a silicon wafer and patterned as a resistive strip element die. Using semiconductor processes, the wafer is diced and packaged in a custom ceramic DIP IC package with a low magnetic lead frame. In the presence of a magnetic field, a change in the bridge resistive element causes a corresponding change in voltage across the bridge output (OUT – and OUT+ pins).

This resistive element is aligned to have a sensitive axis (indicated by the arrow on the pinout) 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 or three orthogonal axis configurations permit applications such as compassing and magnetometry.

The sensor 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) null-ing 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.

Noise Characteristics

The noise density for the HMR1021D is around 50nV/sqrt Hz at the 1 Hz corner, and drops below 10nV/sqrt Hz at 20Hz and begins to fit the Johnson Noise value at around 5nV/sqrt Hz beyond 100Hz. The 10Hz noise voltage averages around 0.58 micro-volts with a 0.16 micro-volts standard deviation. These values are provided with a 5-volt supply.

Offset Strap

The offset strap is a spiral of metallization that couples in the sensor element's sensitive axis. The offset strap measures nominally 50 ohms, and requires about 4.6mA for each gauss of induced field. The strap will easily handle currents to buck or boost fields through the ± 6 gauss linear measurement range, but designers should note the extreme thermal heating on the sensor 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 positive and negative strap connections together of the same strap to avoid shorted turn magnetic circuits.

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Set/Reset Strap

The set/reset strap is another spiral of metallization that couples to the sensor element's easy axis (perpendicular to the sensitive axis on the sensor die). The set/reset strap connections have a nominal resistance of 7.7 ohms with a minimum required peak current of 0.5A for reset or set pulses. 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 sensor bridge's polarity is a negative slope with positive fields on the sensitive axis result in negative voltages across the bridge output connections.

ORDERING INFORMATION

| Ordering Number | Product |
|-----------------|---|
| HMC1021D | One-Axis High Temperature Magnetic Sensor |

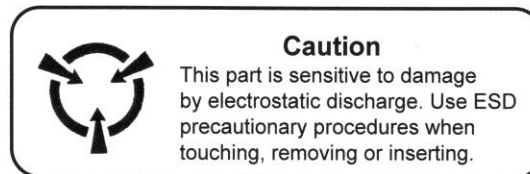
FIND OUT MORE

For more information on Honeywell's Magnetic Sensors visit us online at www.magneticsensors.com or contact us at 800-323-8295 (763-954-2474 internationally).

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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



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