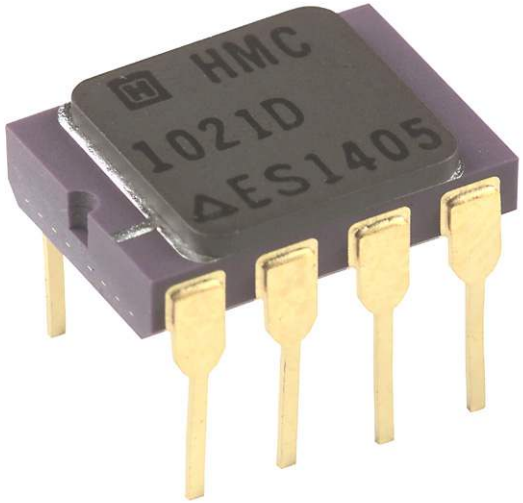
Single-Axis Magnetic Sensor HMC1021D

The Honeywell HMC1021D is a single-axis magneto-resistive 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	BENEFITS
High Temperature Operating Range	From -55°C to +225°C, Perfect for Downhole Applications
Single-Axis DIP Package	Easy to Assemble Component.
On-Chip Set/Reset Straps	Reduces Temperature Effects, High Field Upset Resistance
On-Chip Offset Straps	Counters Hard-Iron Distortion
High Sensitivity	Low-Noise Signals for Amplification and Detection
High Reliability	Compact Solid State Design with Repeatable Results.
Available in High Volumes	Easy Transition to Production

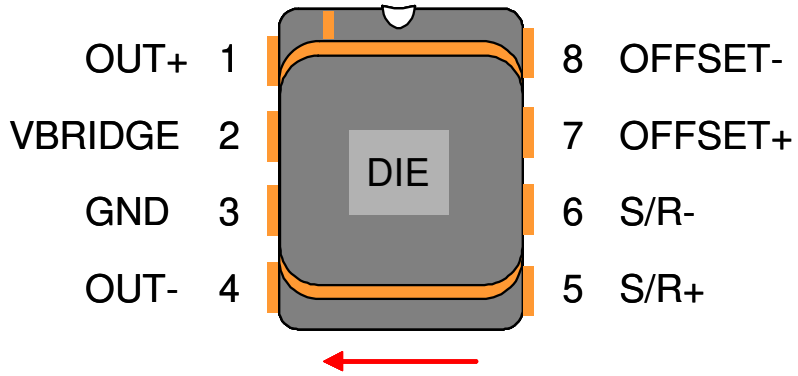
SPECIFICATIONS

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.

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.

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.

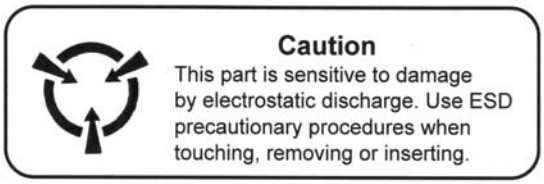
A set pulse is defined as a positive pulse current entering the S/R+ strap connection. The successful result would be the magnetic domains aligned in a forward easy-axis direction so that the sensor bridge's polarity is a positive slope with positive fields on the sensitive axis result in positive voltages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



CAUTION: ESDS CAT. 1B

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