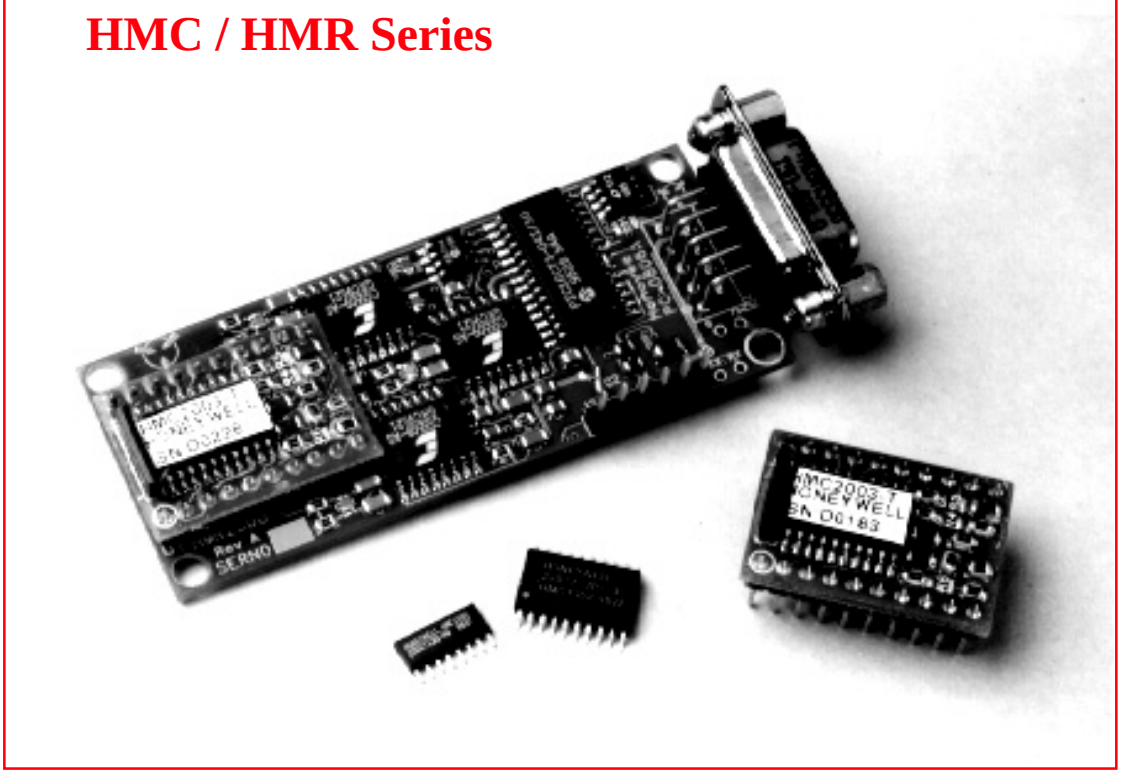
Honeywell

Magnetic Sensor Products

HMC / HMR Series



♦ Honeywell's magnetoresistive sensors can determine the change in earth's magnetic field due to the presence of a ferromagnetic object or position within earth's magnetic field. ♦ The high bandwidth allows detection of vehicles and other ferrous objects at high speeds. ♦ The sensors are contactless and the working distance is dependent on the ferromagnetic mass it is measuring.

Used To Measure

- Presence of a magnetic field
- Magnitude of a magnetic field
- Direction of a magnetic field
- Change in magnetic field due to presence of a ferromagnetic object
- Earth's field for navigation and compassing
- Current flow

Application Areas

- Compassing
- Traffic Detection
- Navigation Systems
- Virtual Reality
- Laboratory Instruments
- Medical Instruments
- Mineral Prospecting
- Food Processing
- Agricultural Equipment
- Underground Boring Equipment
- Position Sensing

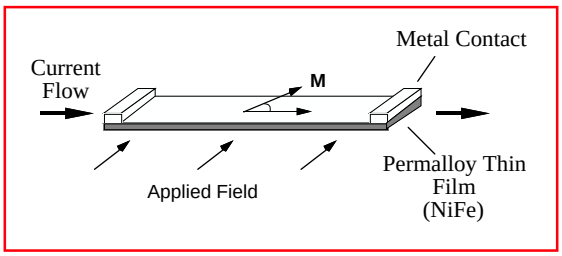


Figure 1. Principle of operation for MR sensors.

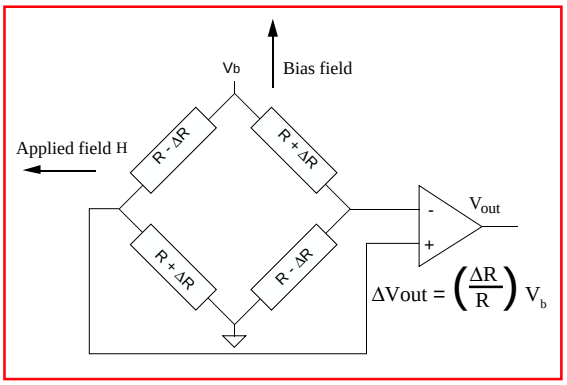


Figure 2. Magnetoresistive transducers.

What is a Magnetoresistive Sensor?

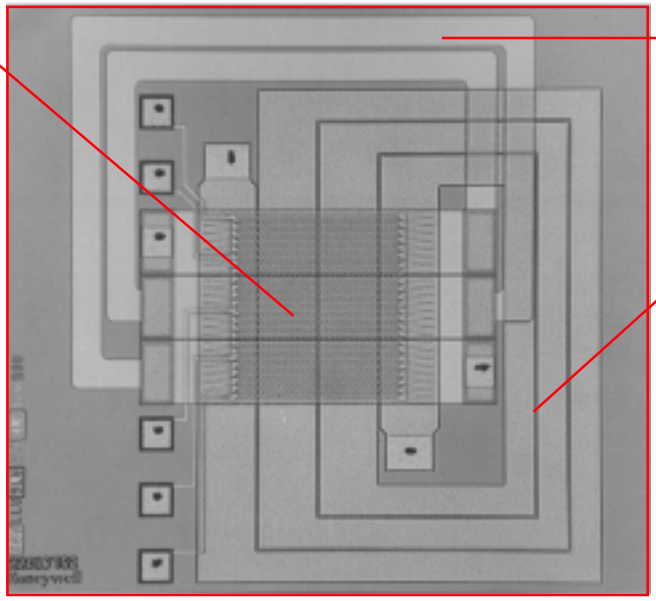
Anisotropic magnetoresistance (AMR) occurs in ferrous materials. It is a change in resistance when a magnetic field is applied perpendicular to the current flow in a thin strip of ferrous material (Figure 1). The transducer is in the form of a Wheatstone bridge (Figure 2). The resistance, R, of all four magnetoresistors is the same. The bridge supply, V_b, causes current to flow through the resistors. A crossed applied field, H, causes the magnetization in two of the oppositely placed resistors to rotate towards the current, resulting in an increase in the resistance, R. In the remaining two oppositely-placed resistors magnetization rotates away from the current resulting in a decrease in the resistance, R. In the linear range the output becomes proportional to applied field $\Delta V=S\ H\ Vb$. The range of linearity of the transfer function is inversely proportional to the sensitivity. For Honeywell's MR sensors the sensitivity is typically 3 mV/(V/Oe) and the range of linearity is within 2 Oe.

Magnetoresistive Sensing Element

Honeywell's magnetoresistive sensing elements (Figure 3), are made of NiFe thin films deposited onto a silicon substrate forming a Wheatstone resistor bridge. Patented on-chip current straps are included, which can be used to electrically "set" or "reset" the polarity of the output and for applying an offset field to compensate for ambient magnetic fields.

Magnetic field sensing bridge

- Magnetic thin film nickel-iron (permalloy)
- 4-legged Wheatstone bridge
- Self-biasing (barber pole pattern)



Aluminum offsetting field strap

- Compensation for ambient magnetic fields
- Calibration
- Closed loop operation

Aluminum set/reset strap

- Reset after upset field
- Polarity set

Figure 3. Magnetoresistive sensing element.

Honeywell offers the most sensitive magnetoresistive (MR) sensors within the earth's magnetic field range. The Honeywell MR sensors measure magnetic fields in the tens of µGauss range for sensitive applications that Hall effect sensors cannot handle. Due to their small size and ability to withstand rugged applications, these sensors are often used to replace flux gate sensors. The MR sensors product family includes:

HMC1001/2—Discrete Sensors for low cost applications

HMC2003—Hybrid for easy-to-use analog output applications

HMR2300—Smart digital magnetometer for high performance and easy-to-use, end user applications.

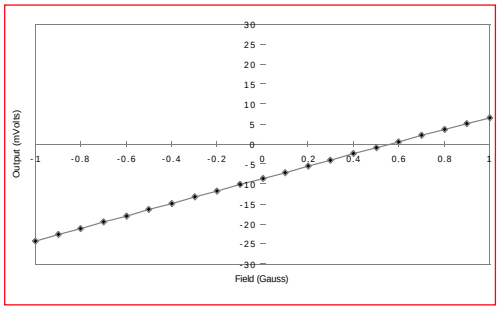


Figure 4. Sensitivity of HMC1001/1002

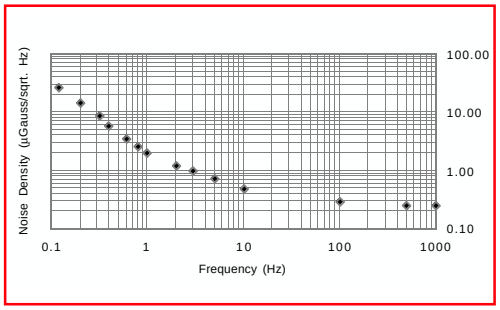


Figure 5. Noise data of HMC 1001/1002

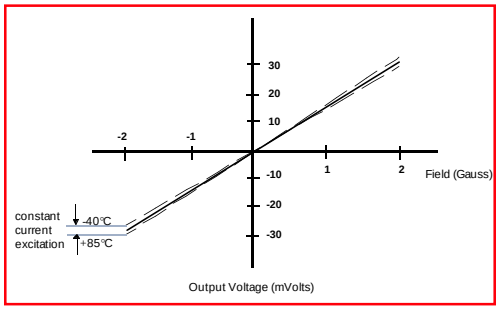


Figure 6. Temperature effects of HMC2003

Features and Benefits

Honeywell's magnetic sensors provide an easy-to-use, high performance, high reliability solution. Honeywell's sensors provide the following advantages:

High Sensitivity—This provides a linear, highly sensitive output at a low field range. It allows the sensor to be a long distance from the item being sensed, dependent on its ferromagnetic mass, or accurately measures changes, relative to the earth's field (Figure 4).

Low Noise—Provides high resolution leading to fast response and stable reading with less jitter than alternate technologies. Filters are not needed, thus reducing board level costs (Figure 5).

Automatically Calibrated—Use of the offset strap can eliminate the need for trimming. Manufacturing costs can be reduced.

On-Chip Integrated Straps—To maximize the resolution of a magnetic sensor, a technique for flipping the film magnetization is used—set/reset and offset. Honeywell's patented on-chip current straps are used to set/reset the film. This eliminates the need for external coils wrapped around the sensors, reducing manufacturing costs.

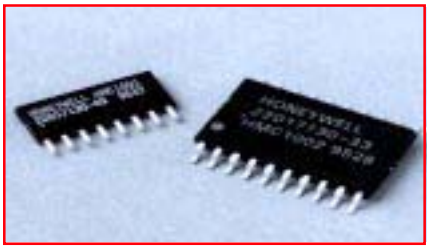
Easy to Mount—HMC1001/HMC1002 components can easily be mounted onto a printed circuit board. Honeywell's two-axis component includes two sensors in a 20-pin SOIC package. The one-axis component is packaged in an 8-pin modified SIP. When placed next to the two-axis sensor, it can be used for three-axis sensing on one circuit board.

Easy to Use—The HMR2300 magnetometer interfaces directly to a PC serial port with easy-to-use demonstration software.

Temperature Compensated—To reduce effects of temperature inherent to magnetoresistive devices, the hybrid and magnetometer include electronics that compensate for temperature effects (Figure 6).

High Reliability—Totally solid state.

HMC1001/1002

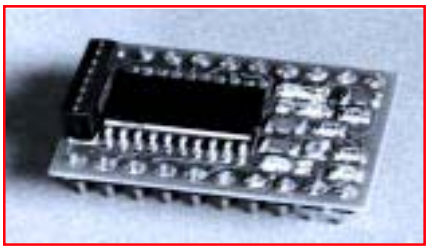


Honeywell's single- and dual-axis chip set, the HMC1001 and 1002, offer low cost and small size for high volume OEM applications. The sensitivity of these components is unsurpassed for their size and versatility. They are designed to work together to provide full three-axis (x, y, z) capability or alone for one- and two-axis sensing.

The HMC1001/2 provide the basic MR bridge circuit(s) that sense magnetic fields and convert it to a differential output voltage. In addition to the MR bridge, there are two "straps", OFFSET and SET/RESET, that can be electrically driven to couple a magnetic field onto the sensor bridge. These patented straps eliminate the need for external coils as required for other MR sensors.

Sensitivity	3mV/V/Gauss
Field Resolution	40 µGauss
Field Range	± 2 Gauss
Linearity	± 0.5-1% full scale
Output Voltage	15 mV/Gauss
Bandwidth	over 1MHertz

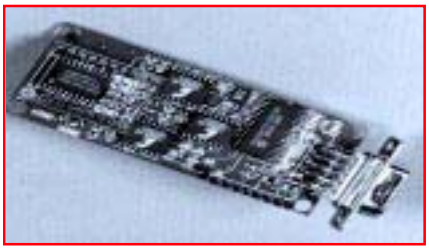
HMC2003



The HMC2003 is a three-axis magnetic sensor hybrid built using a HMC1001 and HMC1002 magnetic sensor. This device includes instrumentation grade amplifiers which provide three analog 0.5 to 4.5 volt outputs. The hybrid has a temperature compensation circuit to maintain bridge sensitivity. The magnetic sensor is sensitive to fields along the length, width and height (x, y and z axis) of the 20-pin dual-in-line package. The small size, 1" x 0.75" allows insertion into system level boards.

Sensitivity	1V/Gauss
Field Resolution	40 µGauss
Field Range	± 2 Gauss
Linearity	± 0.5 -1% full Scale
Output Voltage	2.5 ± 2 Volts
Bandwidth	1 KHertz

HMR2300



The HMR2300 is a three-axis smart digital magnetometer that detects the strength and direction of a magnetic field and communicates the x, y, and z component directly to a computer. The magnetic field is converted to three 16-bit values using the magnetic sensor hybrid, HMC2003, three 16-bit A/D converters and a microprocesssor. The data is serially output at a rate of 10 to 154 Hertz using either the RS-232 or RS-485 standard at either 9600 or 19,200 baud. A command set is provided to configure the data sample rate, the output format, averaging and zero offset. An on board EEPROM stores any configuration changes for the next time power-up.

Field Resolution	70 µGauss
Field Range	± 2 Gauss
Accuracy	±1% full scale
Digital Output	RS232 or RS485
Output Rate	10 to 154 samples/second

Data sheets and application notes are available on all of these Honeywell products.
Visit our web site at http://www.ssec.honeywell.com or call 1-800-323-8295.

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