

# Digital Compass Solution HMR3000

The Honeywell HMR3000 is a digital compass module that provides heading, pitch, and roll outputs for navigation. Three Honeywell's magneto-resistive sensors are oriented in orthogonal directions to measure the vector components of earth's magnetic field. A fluid tilt sensor is employed to determine a gravitational reference. These solid-state sensors create a strapdown compass that is both rugged and reliable. The data output is serial full-duplex RS-232 or half-duplex RS-485 with 1200 to 19,200 data rates.



Applications include: Compassing & Navigation, Dead Reckoning Backup to GPS Systems, Marine Navigation, Antenna Positioning, and Land Surveying

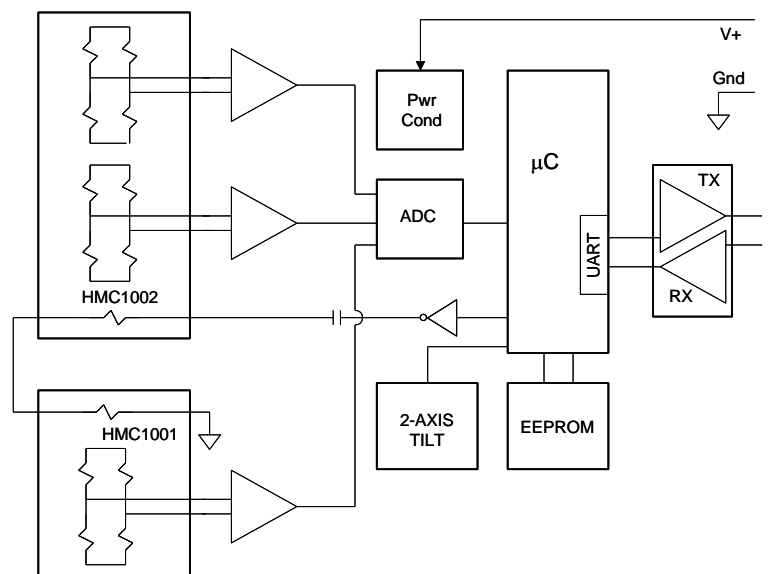
A RS-232 development kit version is available that includes a windows compatible demo program (does not work with RS-485 devices), interface cable, AC adapter and carrying case.

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 Accuracy, <math><0.5^\circ</math> with 0.1° Resolution
- ▶ Wide Tilt Range of  $\pm 40^\circ$
- ▶ Up to 20 Updates per Second
- ▶ NMEA Standard Sentence Outputs
- ▶ Hard Iron Calibration Routine
- ▶ RS-232 or RS-485 Serial Data Interfaces
- ▶ PCB or Aluminum Enclosure Options
- ▶ 6-15 volt DC Unregulated Power Supply Interface

## BLOCK DIAGRAM



# HMR3000

## SPECIFICATIONS

Characteristics	Conditions	Min	Typ	Max	Units
-----------------	------------	-----	-----	-----	-------

### Power Supply

Supply Voltage <sup>(1)</sup>	Pin 9 referenced to Pin 5 (Ground) Pin 8 referenced to Pin 5 (Ground)	+6.0 +4.75	+5.0	+15 +5.25	Volts
Supply Current <sup>(3)</sup>	Vsupply = +6V (Pin 9) Normal Operation STOP Mode SLEEP Mode		35 13 2.0		mA

### Temperature

Operating <sup>(3)</sup>	Ambient	-20		+70	°C
Storage <sup>(3)</sup>	Ambient, Unpowered	-35		100	°C

### Heading

Accuracy <sup>(2)</sup>	Dip < 50°, Tilt < 20° Dip < 75°, Tilt < 20° <sup>(4)</sup>			0.5 <sup>(1)</sup> 1.5	°RMS
Resolution <sup>(3)</sup>			0.1		degrees
Repeatability <sup>(3)</sup>			±0.3		degrees

### Magnetic Field

Dynamic Range <sup>(1)</sup>	Adjustable		±1.0		gauss
Resolution <sup>(3)</sup>	±0.5 gauss range		1.0		milli-gauss

### Tilt

Range <sup>(2)</sup>	Pitch, Roll <sup>(4)</sup>			±40	degrees
Accuracy <sup>(2)</sup>	Tilt < 20° <sup>(4)</sup> Tilt ≥ 20° <sup>(4)</sup>		±0.4 ±0.6		degrees
Repeatability <sup>(3)</sup>			±0.2		degrees
Resolution <sup>(3)</sup>			0.1		degrees

### Interface

Format <sup>(1)</sup>	RS-232 Full Duplex or RS-485 Half Duplex <sup>(5)</sup>				
Baud Rate <sup>(1)</sup>	Full or Half Duplex	1200		19,200	bps
Update Rate <sup>(3)</sup>	Continuous, per NMEA Sentence	1		20	Hz

### Mechanical

Weight <sup>(3)</sup>	PCB Only PCB and Flanged Enclosure		22 92		grams
Shock <sup>(3)</sup>	MIL-STD-810E; TM 516.4 drop test		30		inches
Vibration <sup>(3)</sup>	20 to 2000Hz, Random for 2 Hours/axis MIL-STD-810E; TM514.4				

(1) By Design

(2) Tested at 25°C except stated otherwise.

(3) Characterized

(4) Parts stationary for 24 hours before testing

(5) The HMR3000 Demo Kit is not available with the RS-485 interface because the software does not support half-duplex protocol

# HMR3000

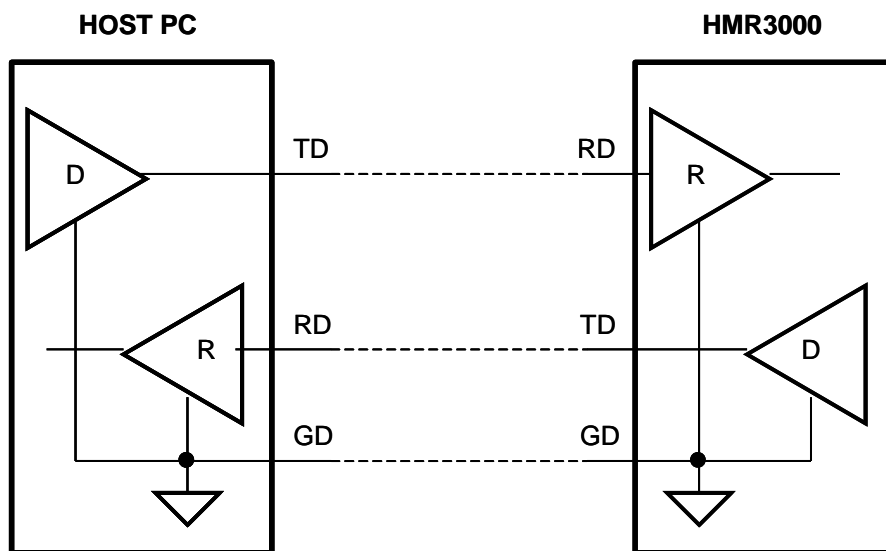
## PIN CONFIGURATION

Pin Number	Pin Name	Description
1	OP/CAL	Operate/Calibrate (open = operate)
2	TD	Transmit Data, RS-485 (B+)
3	RD	Receive Data, RS-485 (A-)
4	RDY/SLP	Ready/Sleep Input (open = ready)
5	GND	Power and Signal Ground
6	RN/STP	Run/Stop Input (open = run)
7	CT/RST	Continue/Reset (open = continue)
8 <sup>(1)(2)</sup>	+5V	Regulated Power Input (+5 volts)
9 <sup>(1)</sup>	V+	Unregulated Power Input (+6 to +15 VDC)

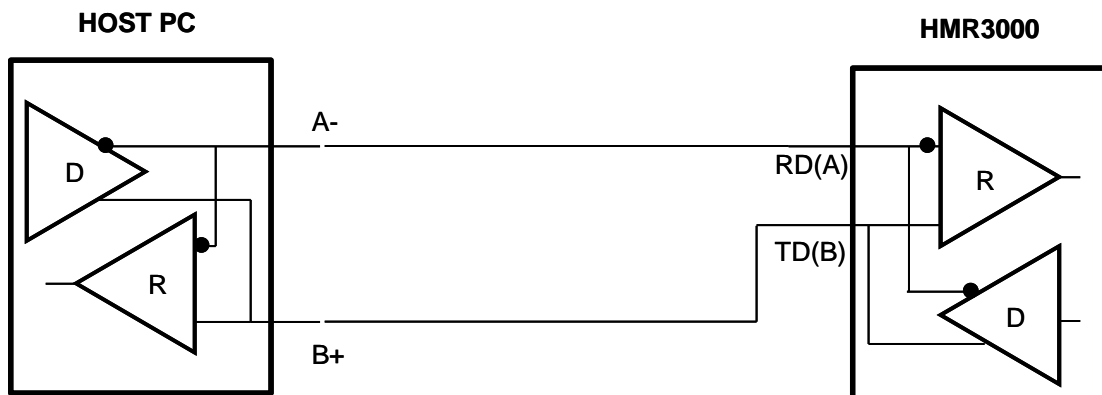
Pin assignments for 9-pin "D" connector.

- (1) Power input shall only be applied to either Pin 8 (+5VDC) or Pin 9 (Unregulated +6 to +15VDC).
- (2) Exceeding the voltage specifications for Pin 8 may damage the HMR3000.

## RS-232 UNBALANCED I/O INTERCONNECTS



## RS-485 BALANCED I/O INTERCONNECTS



# HMR3000

## DATA COMMUNICATIONS

The HMR3000 serial communications are governed by a simple asynchronous, ASCII protocol modeled after the NMEA 0183 standard. Either an RS-232 or an RS-485 electrical interface can be ordered. ASCII characters are transmitted and received using 1 start bit, 8 data bits (LSB first), no parity (MSB always 0), and 1 stop bit; 10 bits total per character. The baud rate defaults to 19,200 and can be reconfigured to 1200, 2400, 4800, 9600, 19200, 38400 bits per second. The HMR3000 supports both standard NMEA 0183 and proprietary messages. Unsolicited NMEA messages are sent by the HMR3000 in Continuous Mode at the rates programmed in the EEPROM. HMR3000 also responds to all input messages from the host. An HMR3000 response to a command input may be delayed due to transmission of an unsolicited output. The host computer must wait for HMR3000 to respond to the last command input before sending another command message. All communication from and to HMR3000 contain a two-character Checksum Field at the end of the data fields, and are denoted in the sentences by 'hh'. The checksum assures the accuracy of the message transmitted. This checksum is also calculated per NMEA 0183 Standard.

The RS-232 signals are single-ended unidirectional levels that are sent received simultaneously (full duplex). One signal is from the host personal computer (PC) transmit (TD) to the HMR3000 receive (RD) data line, and the other is from the HMR3000 TD to the PC RD data line. When a logic one is sent, either the TD or RD line will drive to about +6 Volts referenced to ground. For a logic zero, the TD or RD line will drive to about -6 Volts below ground. Since the signals are transmitted and dependent on an absolute voltage level, this limits the distance of transmission due to line noise and signal to about 60 feet.

When using RS-485<sup>(1)</sup>, the signals are balanced differential transmissions sharing the same lines (half-duplex). This means that logic one the transmitting end will drive the B line at least 1.5 Volts higher than the A line. For a logic zero, the transmitting end will drive the B line at least 1.5 Volts lower than the A line. Since the signals are transmitted as difference voltage level, these signals can withstand high noise environments or over very long distances where line loss may be a problem; up to 4000 feet. Note that long RS-485 lines should be terminated at both ends with 120-ohm resistors.

Specific measurement descriptions and interface commands are not included in this datasheet but are included in the companion HMR3000 User's Guide document.

*(1) Demonstration software for the HMR3000 does not support the RS-485(half-duplex) protocol. The software is only available with the RS-232 interface.*

## CIRCUIT DESCRIPTION

The HMR3000 Digital Compass Module contains all the basic sensors and electronics to provide digital indication of heading and tilt. The HMR3000 has all three axis of magnetic sensors on the far end of the printed circuit board, away from the connector interface. The HMR3000 uses the circuit board mounting holes or the enclosure surfaces as the reference mechanical directions. The complete HMR3000 PCB assembly consists of a mother board and the 9-pin D-connector.

The HMR3000 circuit starts with the Honeywell HMC1001 1-Axis Magnetic Sensor and the HMC1002 2-Axis Magnetic Sensor elements to provide the X, Y, and Z axis magnetic sensing of the earth's field. These sensor output voltages are then amplified and converted to a digital representation. A microcontroller integrated circuit receives the digitized magnetic field values (readings) by periodically querying the Analog to Digital Converter (ADC) and performs the necessary offset value corrections provided by the EEPROM via the calibration routine. This microcontroller also performs the external serial data interface and other housekeeping functions. The onboard EEPROM integrated circuit also is employed to retain necessary setup variables for best performance.

A liquid filled two-axis (pitch, roll) tilt sensor is also used to create tilt compensated heading data. This tilt sensor performs an electronic gimbaling function and is normally mounted flat (PCB horizontal) for maximum tilt range.

# HMR3000

## APPLICATIONS PRECAUTIONS

Several precautions should be observed when using magnetic compasses in general:

- The presence of ferrous materials, such as nickel, iron, steel, and cobalt near the magnetometer will create disturbances in the earth's magnetic field that will distort the X, Y, and Z field measurements.
- Perming effects on the HMR3000 circuit board need to be taken into account. If the HMR3000 is exposed to fields greater than 10 gauss, then it is recommended that the enclosure/circuit boards be degaussed for highest sensitivity and resolution. A possible result of perming is a high zero-field output indication that exceeds specification limits. Degaussing wands are readily available from local electronics tool suppliers and are inexpensive. Severe field offset values could result if not degaussed.

## NON-FERROUS MATERIALS

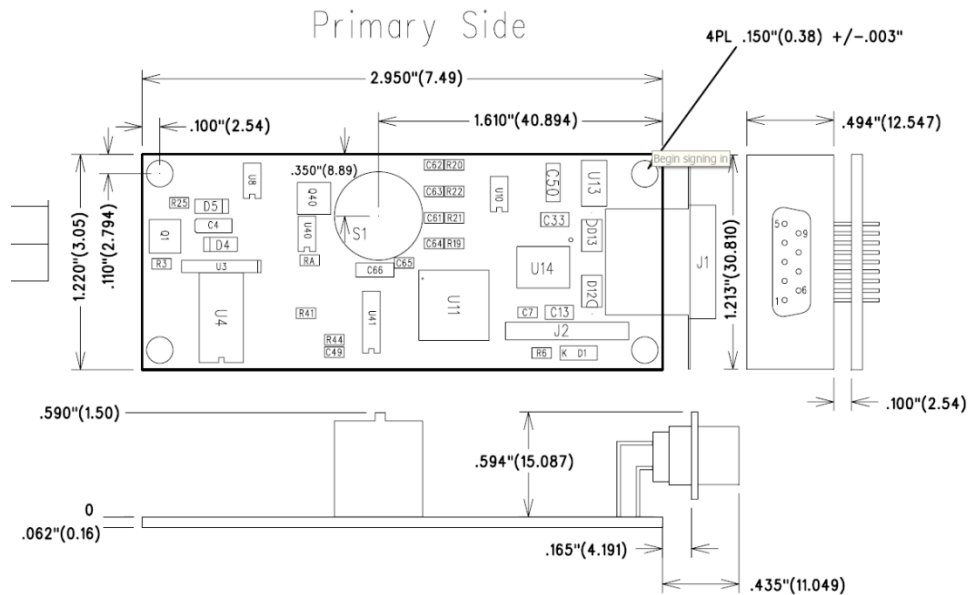
Materials that do not affect surrounding magnetic fields are: copper, brass, gold, aluminum, some stainless steels, silver, tin, silicon, and most non-metals.

## HANDLING PRECAUTIONS

The HMR3000 Digital Compass Module measures fields within 1 gauss in magnitude. Computer floppy disks (diskettes) store data with field strengths of approximately 10 gauss. This means that the HMR3000 is many times more sensitive than common floppy disks. Please treat the compass with at least the same caution as your diskettes by avoiding motors, CRT video monitors, and magnets. Even though the loss of performance is recoverable, these magnetic sources will interfere with measurements.

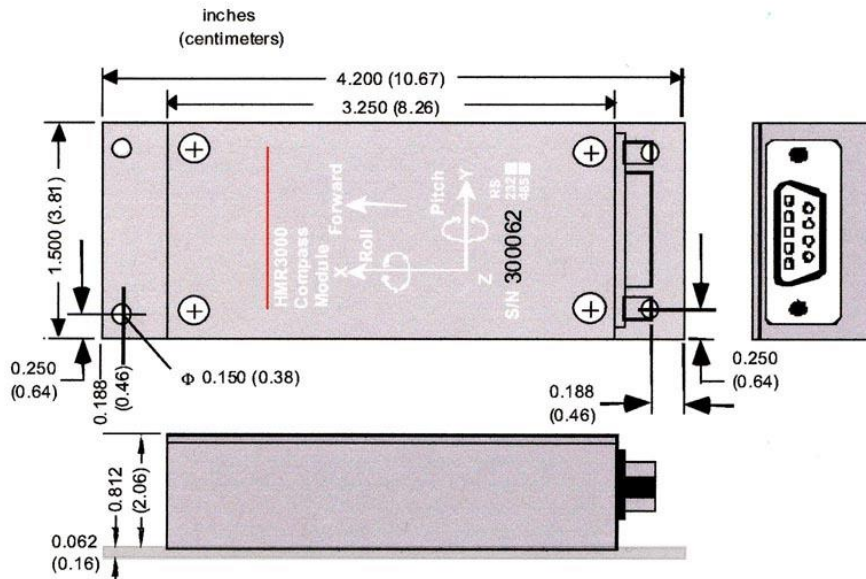
The fluidic tilt sensor works best when kept near level, and in calm to moderate vibration conditions. If turned upside down or violently jarred, not all the fluid will immediately return to the bottom of the tilt sensor's glass ampoule. Accurate tilt and tilt compensated headings may be unavailable for a minute or two to allow for the fluid to transit to the bottom of the ampoule.

## PCB DIMENSIONS AND PINOUT



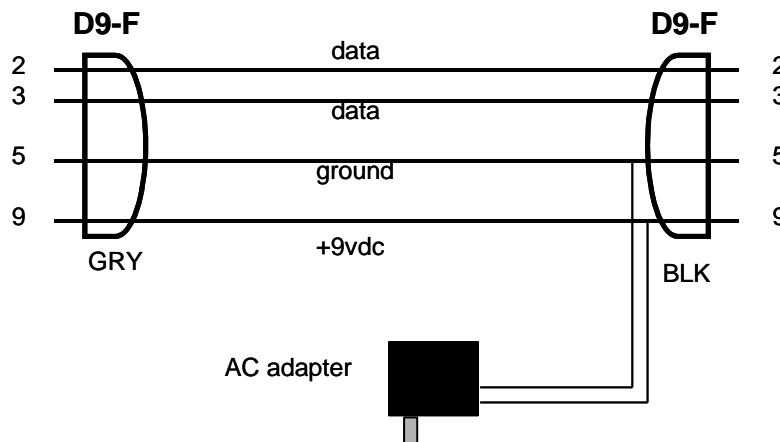
# HMR3000

## CASE DIMENSIONS



## DEMONSTRATION PCB MODULE KIT

The HMR3000 Demonstration Kit includes additional hardware and Windows software to form a development kit for the digital compass module. This kit includes the HMR3000 PCB and enclosure, serial port cable with attached AC adapter power supply, and demo software plus documentation on a compact disk (CD). The figure below shows the schematic of the serial port cable with integral AC adapter. There will be three rotary switches on the AC adapter. These should be pointed towards the positive (+) polarity, +9 volts, and 120 or 240 VAC; depending your domestic supply of power.



# HMR3000

## ORDERING INFORMATION

Ordering Number	Product
HMR3000-D00-232 HMR3000-D00-485	PCB Only (No Enclosure), RS-232 I/O PCB Only (No Enclosure), RS-485 I/O
HMR3000-D21-232 HMR3000-D21-485	Extended-Base Enclosure, RS-232 I/O Extended-Base Enclosure, RS-485 I/O
HMR3000-D21-232-DEMO	Demo Kit, Extended-Base Enclosure, RS-232 I/O

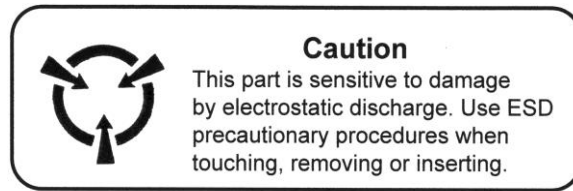
## FIND OUT MORE

For more information on Honeywell's Magnetic Sensors visit us online at [www.magneticsensors.com](http://www.magneticsensors.com).

The application circuits herein constitute typical usage and interface of Honeywell product. Honeywell does not warranty or assume liability of customer-designed circuits derived from this description or depiction.

Honeywell reserves the right to make changes to improve reliability, function or design. Honeywell does not assume any liability arising out of the application or use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.

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



**CAUTION: ESDS CAT. 1B**