

# **HMR3100**

## **Digital Compass Solution**

### **User's Guide**

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## INTRODUCTION

The Honeywell HMR3100 is a electronic compassing solution for use in consumer electronics and personal navigation products. Honeywell's magnetoresistive sensors are utilized to provide enhanced reliability and accuracy in a small, solid state compass design. This compass solution is easily integrated into systems using a UART or SPI interface in ASCII format. Performance is optimized for a horizontal orientation.

## SPECIFICATIONS

Characteristics	Conditions	Min	Typ	Max	Units
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### Heading

Accuracy	Level		± 5		deg RMS
Resolution			0.5		deg
Repeatability			± 3		deg

### Magnetic Field

Range	Maximum Magnetic Flux Density		± 2		gauss
Resolution			6		milli-gauss

### Electrical

Input Voltage	Unregulated	2.6	3	5	volts DC
Current	Normal Mode (Average)	0.1	0.2	0.5	mA
	Sleep Mode			1	µA
	Calibration	6.1	7.3	17.3	mA

### Digital Interface

USART	USART 9600.N.8.1	2400	9600	19200	Baud
Update	Continuous or Polled	-	2	20	Hz
Connector	8-Pin				-

### Physical

Dimensions	Circuit Board Assembly		19 x 19 x 4.5		mm
Weight			2.3		grams

### Environment

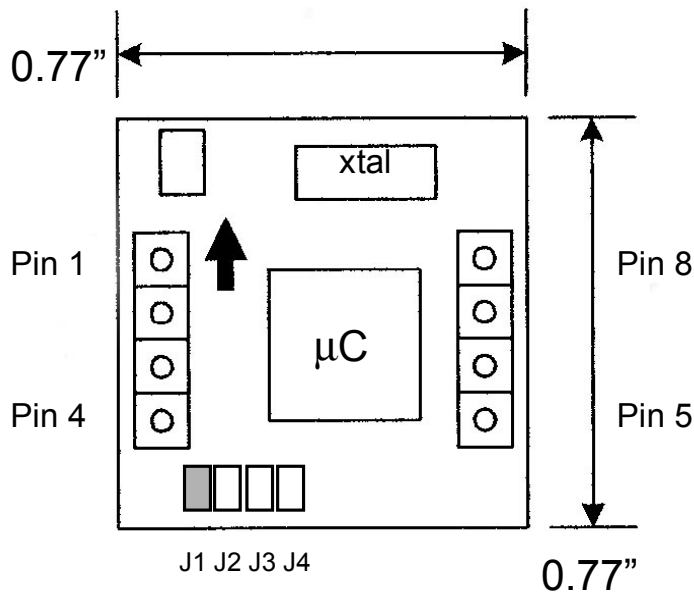
Temperature	Operating	0	-	+70	°C
	Storage	-40	-	+110	°C

## PIN CONFIGURATION

Pin Number	Pin Name	Description
1	VCC	Power Supply Input
2	NC	No Connection
3	RTS	Ready To Send Input
4	NC	No Connection
5	TXD	Transmit Data Output
6	RXD	Receive Data Input
7	GND	Power and Signal Ground
8	NC	No Connection

## PHYSICAL CHARACTERISTICS

The circuit board for the HMR3100 Digital Compassing Solutions is approximately 0.77 by 0.77 inches. Two 4-Pin headers protrude down on each edge of the board for a total of eight pins to become the user interface or the development kit intermediate board interface. Figure 1 shows a typical circuit board with dimensions.



Top Side

Figure 1  
HMR3100 Pinout

## CIRCUIT DESCRIPTION

The HMR3100 Digital Compass Solution circuit board includes the basic magnetic sensors and electronics to provide a digital indication of heading. The HMR3100 has a Honeywell HMC1022 two-axis magnetic sensor on board. The HMR3100 allows users to derive compassing (heading) measurements when the board is in a horizontal (flat) position.

The HMR3100 circuit starts with the HMC1022 two-axis magnetic sensors providing X and Y axis magnetic sensing of the earth's field. These sensors are supplied power by a switching transistor to conserve power with battery operated products. The sensor output voltages are provided to a dual operational amplifier and then to analog to digital converters (ADC) onboard a microcontroller ( $\mu$ C) integrated circuit. A microcontroller integrated circuit periodically samples the amplified sensor voltages, performs the offset corrections, and computes the heading. This microcontroller also performs the external serial data interface and other housekeeping functions such as the calibration routine.

The power supply for the HMR3100 circuit board is to be about a +3 to +5 volt range allowing the user to provide a single lithium battery to logic level supply voltages. The power supply architecture is a single ground system for single ended supply sources (+ and ground return)

## USART COMMUNICATION PROTOCOL

HMR3100 module communicates through binary data and ASCII characters at four selectable baud rates of 2400, 4800, 9600, or 19200. The default data bit format is USART 9600.N.8.1. The baud rate selection is determined by the position of jumpers J1 and J3. These jumpers are zero ohm SMT resistors (jumpers) and are normally high (logic 1) when removed, and grounded (logic 0) when in place. At 2400 baud, no jumpers are present for a 1,1 logic presentation. At 4800 baud J3 is present for a 1,0 logic presentation. The factory default setting of 9600 baud is created by a jumper present on J1 for a 0,1 logic presentation. With J1 and J3 jumpers present for a 0,0 logic presentation, the compass module works at 19200 baud. See Figure 1 for jumper locations. Jumper J2 is for factory testing, and J4 is for X-axis inverse should the end-item mount the HMR3100 module upside down.

The HMR3100 is ready to output heading information when the board is powered up. Note that when the device is first powered up, it may need calibration. The HMR3100 has three modes of operation described as normal, continuous, and calibration.

### Normal Mode

When the host processor (external to the HMR3100) sends a RTS low pulse to the RTS pin, the HMR3100 will send the heading data via the TXD pin. The host shall hold the RXD pin high during this mode. The RTS shall be held high when not pulsed. The HMR3100 will return to sleep status when RTS is left high after the data is sent. Up to 20 heading queries per second can be accomplished given fast enough baud rates. A caution is advised that average current draw is proportional to supply voltage and amount of queries handled. At the 20 Hz rate, 1 to 5 milliamperes of current is consumed with lesser query rates taking advantage of the less than one microampere sleep mode current draw between queries. Figure 2 shows the normal mode timing diagram.

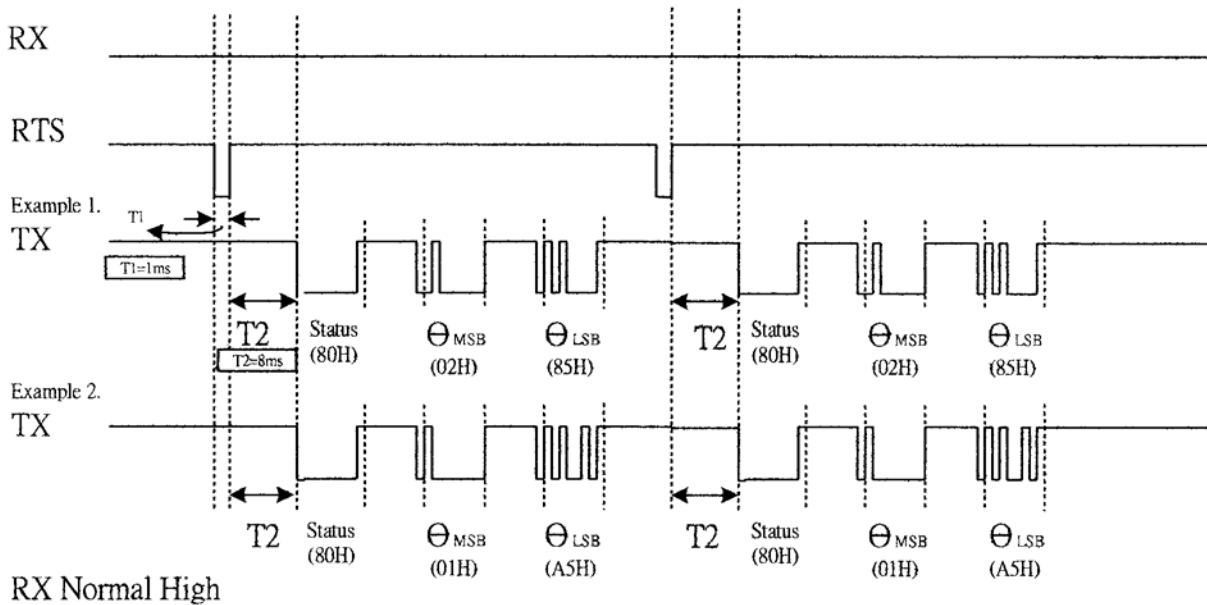


Figure 2  
Normal Mode Timing Diagram

### Continuous Mode

When the host processor sets the RTS pin to a low level position, the HMR3100 will continuously stream heading data via the TXD pin. Note that the processor does not return to sleep mode and outputs heading slightly below a 2 Hz rate. Figure 3 shows the continuous mode timing diagram.

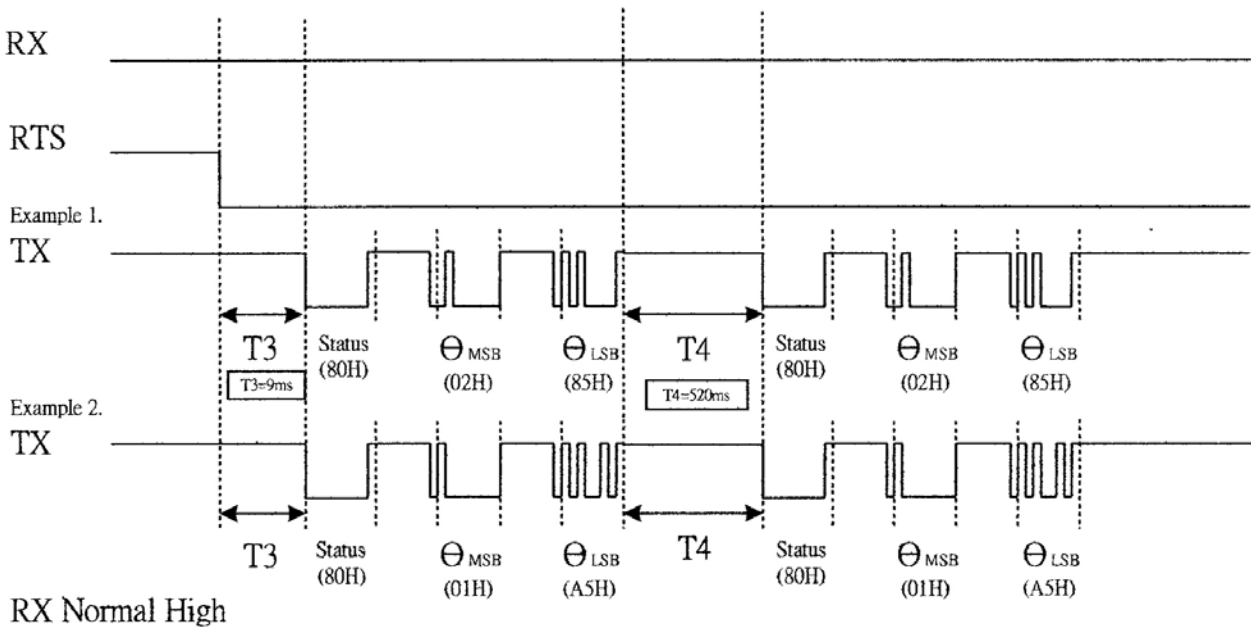


Figure 3  
Continuous Mode Timing Diagram

## Calibration Mode

When the host processor pulses the RTS pin, and sends the RXD pin to a low logic level, the HMR3100 is in calibration mode. At a moderate rate (2 to 5 seconds per rotation), rotate the HMR3100/host assembly two complete circles to allow the HMR3100 to take measurements for compass calibration. At the completion of the rotations, return the RXD to a high logic level. The HMR3100 will return to sleep status until another mode has been initiated. Upon initiation of the calibration mode, the microcontroller shall output a STA (53 54 41 hex) indicating a start of calibration and then RDY (52 44 59 hex) at the completion of the rotations and the RXD line returning high. Figure 4 shows the calibration mode timing diagram.

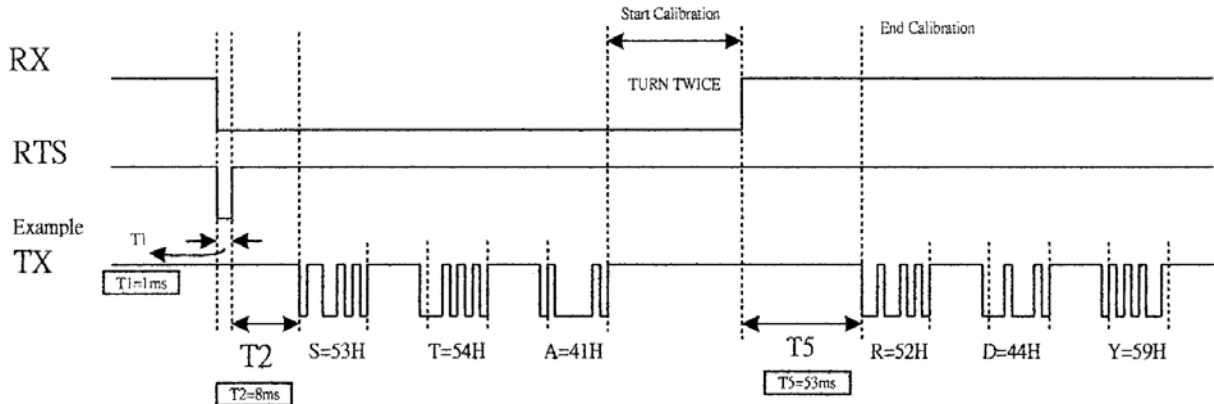


Figure 4  
Calibration Mode Timing Diagram

## Data Description

The HMR-3100 host processor uses a three byte reply as the RTS line is brought low. The data is formatted in hexadecimal (hex) fashion with the first byte being either 80(hex) or 81(hex). If that first byte LSbit is flagged high (81 hex), it means magnetic distortion maybe present and a calibration should be performed. The remaining two bytes are the heading (in degrees) in MSB to LSB format. There is some data interpretation needed to derive the heading. For example, an 80 02 85 (hex) Byte pattern correlates to 322.5 degrees.

This is done by taking the MSB hex value, converting it to decimal representation (e.g. 02 decimal) and multiplying it by 256. Then the LSB is decimalized (e.g. 85(hex) to 133(decimal)) and added to the 512(decimal) MSB. The total (512+133=645) is then divided by two to arrive at a 322.5 degree heading. This data format permits the 0.5° resolution.

## DEVELOPMENT KIT

The HMR3100 Development Kit includes additional hardware and Windows demo program software to form a development kit for electronic compassing. This kit includes the appropriate HMR3100 Printed Circuit Board (PCB) module soldered to an intermediate circuit board using a wide DIP-style (0.8" spacing) pin arrangement. The intermediate board assembly plugs into an RS-232 motherboard with a serial port connector. In addition, a four-foot serial port cable (RJ-11 to D-9F), nine-volt battery clip, demo program software, and this user's guide is included. The RS-232 motherboard incorporates a 5-volt regulator integrated circuit to provide the necessary voltages to the onboard RS-232 converter integrated circuit and the HMR3100 daughter-board. A nine-volt battery clip is included, but other DC input voltages between 7 and 15 volts may be used. Supply currents are nominally around 8 milliamperes plus the HMR3100 current draw.

The RS-232 motherboard also contains a six-contact modular jack (RJ-11) for a compact RS-232 interface to a personal computer serial port. Ground, RTS, RXD, and TXD data lines are brought out to the jack with two contacts left open. Figure 5 shows the kit board assemblies.

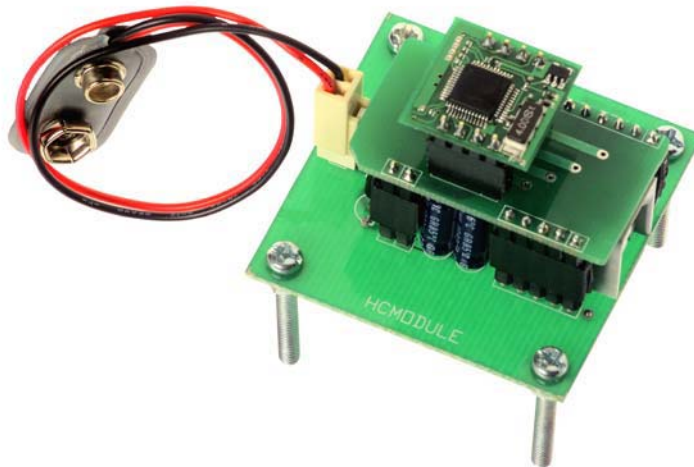


Figure 5  
HMR3100 Kit Hardware

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