Honeywell

SENSOR PRODUCTS

HMR3200/HMR3300

Digital Compass Solutions

User's Guide

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INTRODUCTION

The Honeywell HMR3200/HMR3300 are electronic compassing solutions for use in navigation and guidance systems. Honeywell's magnetoresistive sensors are utilized to provide the reliability and accuracy of these small, solid state compass designs. These compass solutions are easily integrated into systems using a UART or SPI interface in ASCII format.

The HMR3200 is a two-axis compass, and can be used in either vertical or horizontal orientations.

The HMR3300 is a three-axis, tilt compensated compass that uses a two-axis accelerometer for enhanced performance up to a ±60° tilt range.

SPECIFICATIONS

Characteristics	Conditions	Min	Typ	Max	Units
Heading					
Accuracy	Level		1.0		deg RMS
	0° to ±30° (HMR3300 only)		3.0		
	±30° to ±60° (HMR3300 only)		4.0		
Resolution			0.1		deg
Hysteresis	HMR3200		0.1	0.2	deg
	HMR3300		0.2	0.4	
Repeatability	HMR3200		0.1	0.2	deg
	HMR3300		0.2	0.4	
Pitch and Roll **(HMR3300 only)**					
Range	Roll and Pitch Range		± 60		deg
Accuracy	0° to ± 30°		0.4	0.5	deg
	± 30° to ± 60°		1.0	1.2	
Null Accuracy*	Level		0.4		deg
	-20°C to+70°C Thermal Hysterisis		1.0		
	-40°C to +85°C Thermal Hysterisis		5.0		
Resolution			0.1		deg
Hysteresis			0.2		deg
Repeatability			0.2		deg
Magnetic Field					
Range	Maximum Magnetic Flux Density		± 2		gauss
Resolution			0.1		milli-gauss
Electrical					
Input Voltage	Unregulated	6	-	15	volts DC
Current	HMR3200		18	20	mA
	HMR3300		22	24	mA

Characteristics	Conditions	Min	Typ	Max	Units
Digital Interface					
UART	ASCII (1 Start, 8 Data, 1 Stop, 0 Parity) User Selectable Baud Rate	2400	-	19200	Baud
SPI	CKE = 0, CKP = 0 Psuedo Master				
Update	Continuous/Strobed/Averaged				Hz
	HMR3200		15		
	HMR3300		8		
Connector	In-Line 8-Pin Block (0.1" spacing)				
Physical					
Dimensions	Circuit Board Assembly		25.4 x 36.8 x 11		mm
Weight	HMR3200		7.25		grams
	HMR3300		7.5		
Environment					
Temperature	Operating (HMR3200)	-40	-	+85	°C
	Operating (HMR3300)	-20	-	+70	
	Storage	-55	-	+125	

PIN CONFIGURATION

Pin Number	Pin Name	Description
1	SCK	Serial Clock Output for SPI Mode
2	RX/SDI	UART Receive Data/SPI Data Input
3	TX/SDO	UART Transmit Data/SPI Data Output
4	CS	Chip Select for SPI Mode (Input) trailing edge
5	CAL	Calibration ON/OFF Toggle (Input) trailing edge
6	+5VDC*	Optional +5 VDC Power (Input)
7	GND	Power and Signal Ground
8	+V*	Unregulated Power Input (+6 to +15 VDC)

*Note: Use either pin 6 (+5VDC) or pin 8 (+V) to power the circuit board. Hold the board with pin header edge close to you and pins pointing DOWN. Then PIN 1 is the left most pin.

CIRCUIT DESCRIPTION

The HMR3200/HMR3300 Digital Compass Solutions circuit boards include all the basic sensors and electronics to provide a digital indication of heading. The HMR3200 has all three axis of magnetic sensors on board, but allows the user to select which pair of sensors for compassing (PCB horizontal or upright with the connector pins down and horizontal). The HMR3300 uses all three magnetic sensors plus includes an accelerometer to provide tilt (pitch and roll) sensing relative to the board's horizontal (flat) position.

The HMR3200/HMR3300 circuit starts with Honeywell HMC1021 and HMC1022 single and two-axis magnetic sensors providing X, Y, and Z axis magnetic sensing of the earth's field. These sensors are supplied power by a

constant current source to maintain best accuracy over temperature. The sensor output voltages and constant current sensor supply voltage are provided to multiplexed Analog to Digital Converter (ADC) integrated circuit. A microcontroller integrated circuit periodically queries the multiplexed ADC and 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. An onboard EEPROM integrated circuit is employed to retain necessary data variables for best performance.

For the HMR3300, an additional pair of data inputs from the ±2g accelerometer is received by the microcontroller. These tilt inputs (pitch and roll) are added to sensor data inputs to form a complete data set for a three dimensional computation of heading.

The power supply for the HMR3200/HMR3300 circuit is regulated +5 volt design allowing the user to directly provide the regulated supply voltage or a +6 to +15 volt unregulated supply voltage. If the unregulated supply voltage is provided, then the linear voltage regulator integrated circuit drops the excess supply voltage to a stable +5 volts. The power supply is a dual ground (analog and digital) system to control internal noise and maximize measurment accuracy. The factory default condition for the power supply is pin 8; the unregulated input. To use pin 6 and provide a regulated +5 volt supply, turn the switch (SW1 in Figure 1) near pins 6 and 7 to the opposite (fully counter-clockwise) position.

PHYSICAL CHARACTERISTICS

The circuit board for the HMR3200/HMR3300 Digital Compassing Solutions is approximately 1.45 by 1 inches. An 8-Pin header protrudes down on one edge of the board for the user interface or the demo board. The header pins extend 5/16" below the board plane with the bottom-side mounted magnetic sensor integrated circuits (HMC1021 and HMC1022) extending 3/16" below the board plane. Components on the top-side have a maximum height of 1/8". Figure 1 shows a typical circuit board with dimensions.
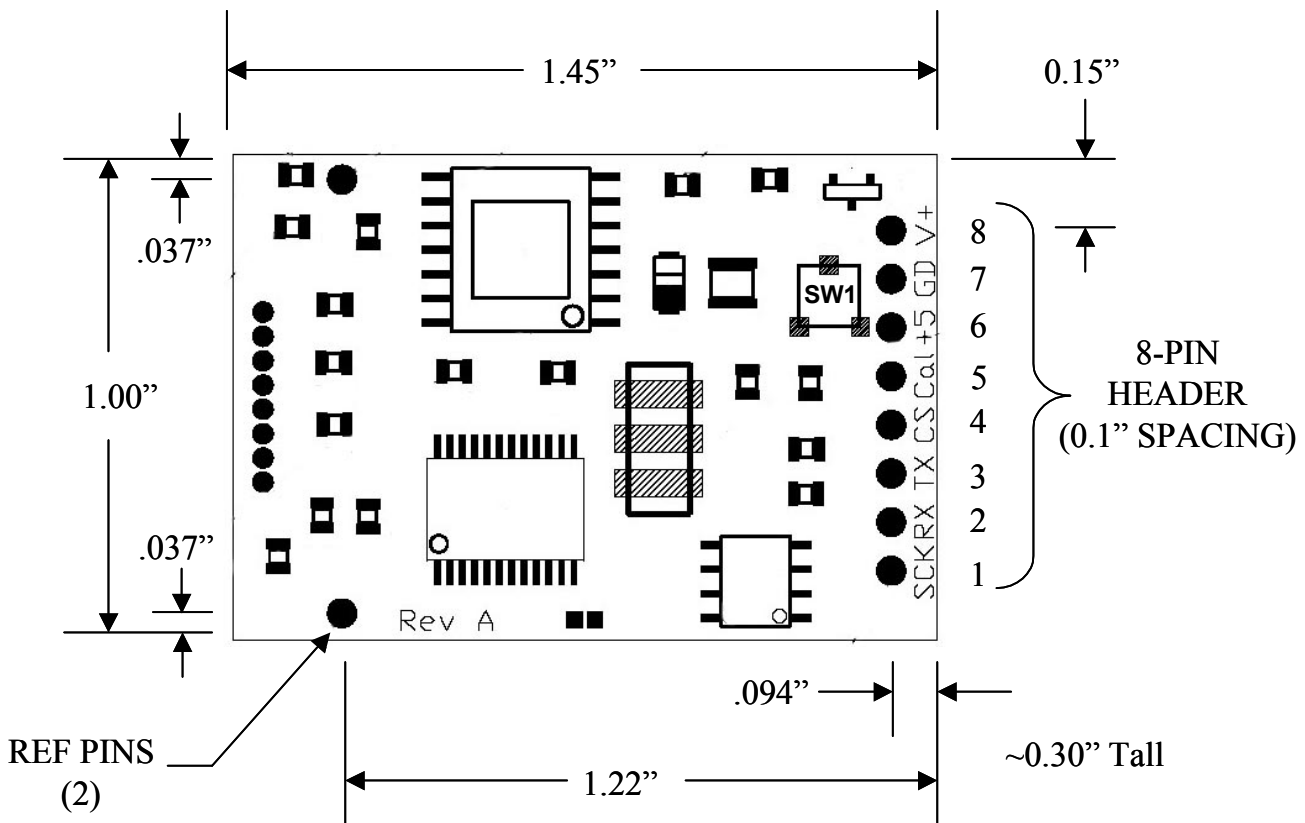

Figure 1

Split Filter Toggle

> ***F<cr><lf>**
> Toggles the split filter bit. The parameter setting is saved in the EEPROM immediately. Requires power cycling or a reset command to activate.

Reset

> ***R<cr><lf>**
> Resets compass to power-up condition.

User Calibration

> ***C<cr><lf>**
> Command to be issued to enter and exit the calibration mode.

Once in the calibration mode, the device will send magnetometer data appended by a "C" character to indicate the Calibration Mode operation.

Eg. 123,834,1489,C

During the calibration procedure, the compass and the platform to which the compass is attached is rotated at a reasonably steady speed through 360 degrees. This process should at least take one minute for best accuracy. In case of HMR3200, the rotation should be in the horizontal flat plane. For HMR3300, the rotation should include as much pitch and roll orientations possible. At the completion of the rotations, issue another *C<cr><lf> to exit the calibration mode.

Configuration Commands

Syntax: #Dev=±xxxx<cr><lf> Sets parameter value
> **#Dev?<cr><lf>**   Queries for the parameter value

Variation Input (Declination Angle Correction)

> **#Var=±nnnn<cr><lf>**   where the variation is ± nnn.n degrees
> Sets the angle between magnetic north and geographic north.
> Eg: #Var=-203<cr><lf> sets the declination angle to –20.3 degrees.
> Eg: #Var=?<cr><lf>returns the declination angle; –20.3

Deviation Input (Platform Angle Correction)

> **#Dev=±nnnn<cr><lf>** where the angle is ± nnn.n degrees
> Sets or returns the angle between compass forward direction and that of the mounting platform.
> Eg: #Dev=23<cr><lf> sets the deviation angle to +2.3 degrees.
> Eg: #Dev=?<cr><lf>returns the deviation angle; +2.3

User Magnetic offset values (X, Y and Z)

> **#Xof, #Yof, #Zof**
> Sets or returns the user offset values for each magnetic axis.
> Eg: #Xof=+47<cr><lf> sets the x offset value to +47.
> Eg: #Xof=?<cr><lf> returns the x offset value; +47.

Baud Rate

> **#Bau**
> Sets the compass baud rate. 19200, 9600, 4800 and 2400 are the only allowed values. Baud rate can not be queried.

System Filter

#SFL

Sets and reads the system IIR filter setting. When the Split Filter bit is cleared, this parameter value will become the default value for Magnetic and Tilt Filters. When the Split Filter bit is set, SFL parameter setting will control the Tilt filter value only. The parameter input is saved in the EEPROM immediately. Requires power cycling or a Reset command (*R) to become effective. The setting of the Split Filter bit can be queried via the #CON? command.

Eg: #SFL=3<cr><lf> Sets the system filter value of 3.

MAGNETIC FILTER

#MFL

The MFL command sets and reads the Magnetic Filter setting. When the Split Filter bit is cleared, this parameter value will default to the value of SFL, the system filter. When the Split Filter bit is set, MFL parameter setting will control the Magnetic Filter value. The parameter input is saved in the EEPROM immediately. Requires power cycling or a Reset command (*R) to become effective.

Configuration

#CON?

This command queries for the configuration status of the compass module. The output of the configuration value is in decimal representation (in ASCII format) of which the 16-bit binary pattern is defined below.

bit 15	bit 14	bit 13	bit 12	bit 11	bit 10	bit 9	bit 8
N/A	N/A	N/A	N/A	N/A	SplitFilter	Alarm	Warn

bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
N/A	N/A	1	N/A	H Out	N/A	Mag Out	N/A

Parameter Name	Bit Value Reported	Effect
Mag Out	1	Magnetic Sensor Output Sentence selected
H Out	1	Heading Output Sentence selected
Warn	1	Device temperature has fallen below -10 C during this session of operation.
Alarm	1	Device temperature has fallen below -20 C during this session of operation.
SplitFilter	1	Independent Filter values for Magnetic and Tilt are used

Eg: #CON?   Returns a response of #D=1028<cr><lf> meaning independent filters used for magnetic and tilt data (bit 10 set) and the compass module is sending heading data (bit 3 set).

Command RESPONSES

These are compass module generated responses to commands issued by the host processor. These responses follow in format to the commands issued.

#Dxxx<cr><lf>
Returns data requested.

#I<cr><lf>
Invalid command response. Response to any invalid command.

SPI Interface

SPI operating Mode is as follows: SCK idles low
                                        Data Output after falling edge of SCK
                                        Data sampled before rising edge of SCK

(MODE CKP=0, CKE=0)

Synchronous Communication Protocol

The HMR3200/HMR3300 module controls the synchronous clock (SCK) and synchronous data output (SDO) pins and the host controller controls synchronous data input (SDI) and chip select (CS) pins. The host controller shall lower the HMR module's CS pin for at least 20 microseconds to initiate the SPI communication. In response the HMR module will send the ASCII bit pattern for 's', and the host shall transmit a valid command character simultaneously. The HMR module will evaluate the command character received from the host controller and send the appropriate data if the command is recognized and valid. After transmitting the required data, the HMR module will end the SPI session. If the command is invalid or was not recognized, then the HMR module will transmit ASCII bit pattern for 'e' and end the SPI session.

SPI Commands

Heading Output: In response to an ASCII H or h command, the HMR3200/HMR3300 shall send two bytes of data. The MSByte is transmitted first. These two bytes represent the integer value equal to 10*Heading. The MSbit is transmitted first for each byte. SCK shall be high for 16, and low for 22 microseconds, respectively. There is a 50 microsecond delay between consecutive bytes transmitted.

| Command Character	Action	SPI Data Output	Parameter Value
H or h	Sends heading data	0000 to 3599	Heading: 000.0 to 359.9

Data Representation

Heading Output: In response to an H or h command, HMR3200/HMR3300 module shall send two bytes of data. The MSByte is transmitted first. These two bytes represent the integer value equal to 10*Heading. The MSbit is transmitted first for each byte.

SPI Timing

The SCK shall be high for 16, and low for 22 microseconds, respectively. There is a 50 microsecond delay between consecutive bytes transmitted.

CS

Th ~ 16μsec

SCK

Tl ~ 22μsec

SDO

MS bit

SDI
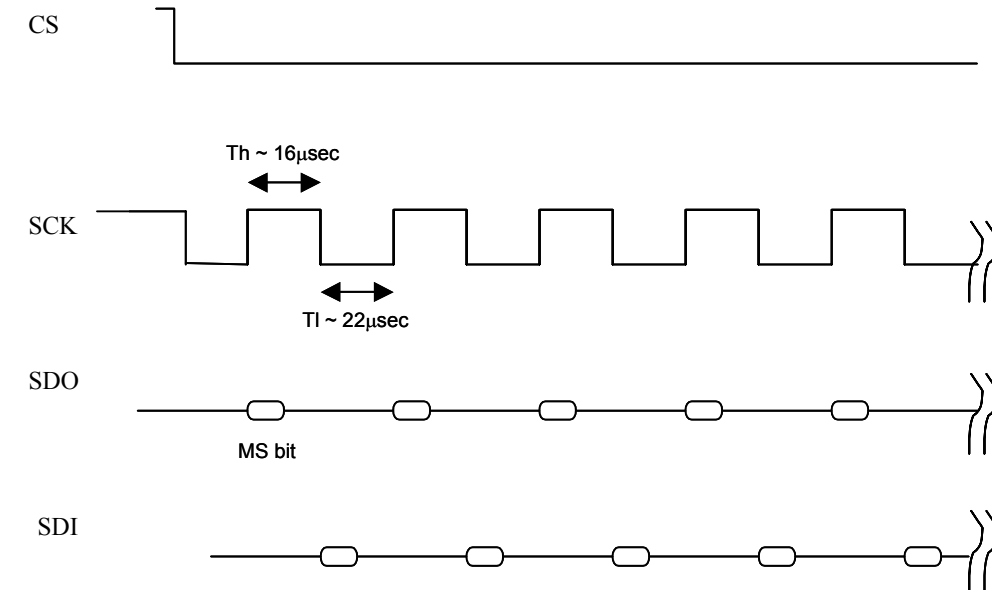
SPI Timing Diagram

MS Byte

LS Byte

Tb = 50μsec
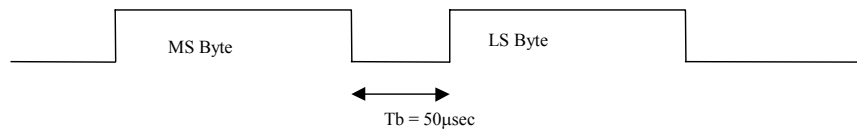
SPI Heading Output

Demonstration PCB Module Kit

Development Kit Communication

The HMR3200 (HMR3300) Demo Module when purchased as part of a development kit, includes additional hardware and Windows software to form development kit for electronic compassing. This kit includes the HMR3200 (HMR3300) Printed Circuit Board (PCB) module, a RS-232 motherboard with D9 serial port connector, serial port cable with attached AC adapter power supply, interface demo software, and documentation. The table below shows the D9 connector interface pinout.

Pin Number	Pin Name	Description
2	TX	USART transmit Out (output)
3	RX	USART receive In (input)
5	GND	Power and Signal ground
9	+V	Unregulated 6 -15 Vdc (input)

Development Kit Setup

The following steps are to be performed for setup of the development kit:

1. Load and install demo Windows software provided within the kit on your PC.

2. Insert the HMR3200 or HMR3300 header pins into the 8-pin connector provided on the motherboard. Make sure the two alignment pins at the opposite end of the HMR PCB fit into the sockets on the motherboard as well.

3. Connect the motherboard to the serial port cable and complete the cable connection at the serial port on your PC. Ensure that the PC serial port is setup as COM 1. For ease of use, choose the serial port cable end where the AC adapter cable interfaces, for insertion to your PC.

4. If you substitute the AC adapter for an alternate DC supply source for the HMR/motherboard circuits, ensure a +6 to +15 volt supply is applied to pin 9 of the connectors on the serial port cable.

HMR3200 Demo Program Operation

The following steps are to be performed for HMR3200 demonstration program operation:

1. Close down other programs on your PC that would potentially interfere with rapid serial port communication of the compass. Typically, most program hangs will occur in servicing the port and necessitate a power down reset to resume compass communication.

2. From the Windows Start Menu, go to Programs and select HMR3200 Demo. Alternately, you could browse the directories for Program Files\HMR3200 and run HMR3200.exe at that directory location.

3. Click on the green Start button to begin data flow, and click on the yellow Quit button to end.

4. Choose the Heading (default) or the Magnetic data selections as desired.

HMR3300 Demo Program Operation

The following steps are to be performed for HMR3300 demonstration program operation:

1. Close down other programs on your PC that would potentially interfere with rapid serial port communication of the compass. Typically, most program hangs will occur in servicing the port and necessitate a power down reset to resume compass communication.

2. From the Windows Start Menu, go to Programs and select HMR3300 Compass Demo. Alternately, you could browse the directories for Program Files\HMR3300 and run HMR3300.exe at that directory location.

3. Choose COM1 and 19200 as the default port and baud rate selections for communication. Press OK.

3. Click on the Run button to begin data flow, and click on the same button to Stop.

4. Choose the aviation Gauges (default) or the Text Output screens as desired.

5. On the Text Output screen you have HPR (heading, pitch, roll) or MAG (XYZ magnetometer vectors) as selectable options. Data can be cleared and stored into text files (*.txt) as desired.

Thank you for your purchase. For additional information and datasheets, visit our website at:
www.magneticsensors.com
Or contact us at:

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