



## SPECIFICATIONS

Item No.: HCM508B

Description: High Accuracy 3D Digital Compass

### **Production implementation standard reference**

- Enterprise quality system standards: ISO9001: 2008 standard (certification number: 128101)
- Tilt sensor production standards: GB / T 191 SJ 20873-2003 inclinometer general specification of Level
- The Academy of metrology and quality inspection Calibrated in accordance to: JJF1119-2004 Electronic Level calibration Specification
- Gyro accelerometer test standard: QJ 2318-92 Gyro accelerometer test methods
- Software development reference standard: GJB 2786A-2009 military software development General requirements
- Product environmental testing standards: GJB150
- Electromagnetic anti-interference test standards: GB / T 17626
- Version: Ver.10
- Date:2014.7.2

# HCM508B-High Accuracy 3D Digital Compass



## General Description

HCM508B is a high accuracy 3D compass single board sealed in aluminum enclosure with IP67 water-proof grade, more suitable for drilling measurement. It uses advanced hard iron and soft iron calibration algorithm, it can still provide the high precision heading information in the roll angle 360 ° to any tool's surface. It has the characteristics of small and low power consumption, and more suited to today's miniaturization sensitive measurement system.

HCM508B integrated patented three-axis fluxgate technology, real-time solver heading data through CPU, and use a three-axis accelerometer to proceed with heading compensation for a wide range tilt angle, belongs to the high-performance, high stability military grade products, HCM508B with small size, low power consumption, widely used in the antenna securely, vehicle and system integration etc. many fields.

## Features:

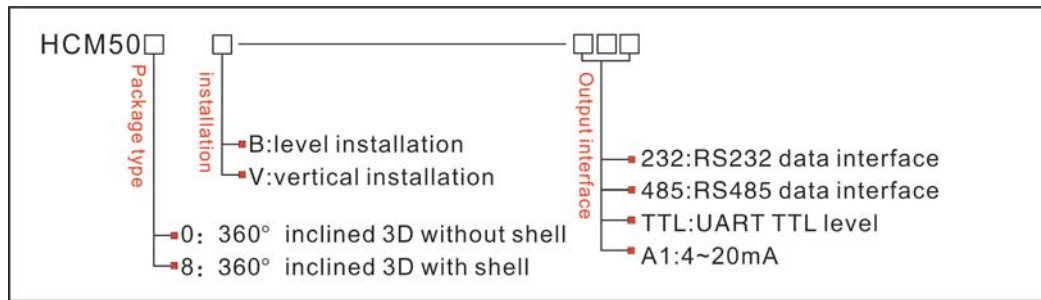
- Heading accuracy: 0.3°~0.5°
- Tilt angle resolution: 0.1°
- With hard magnetic, soft magnetic and angle compensation
- Standard RS232/RS485/TTL output interface
- Roll angle measuring range: ±180°
- Tilt angle accuracy: 0.2°
- Size: L: 125 × W: 22 × H: 24 mm
- Wide temperature: -40°C~+85°C

## Application :

- Satellite antenna search satellite
- GPS integrated navigation
- Gun emission system
- Laser range finder
- ROV underwater robot navigation
- Special occasion robot
- Marine navigation surveying and mapping
- Antenna servo control
- Infrared imager
- Map for plotter
- Oceanography measurement instruments
- Unmanned aircraft



## Ordering information:



E.g: HCM508B-232: 360tilt 3D sealed with enclosure /RS232 output

## Electrical Characteristics

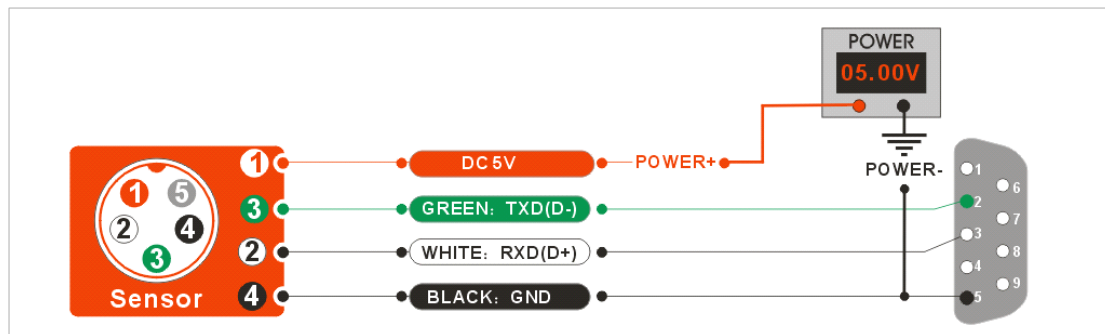
| HCM508B Technical Data      |   |                                  |
|-----------------------------|---|----------------------------------|
| Compass heading parameter   | The best heading accuracy               | 0.3° tilt <10°                   |
|                             |   | 1.0° tilt <180°                  |
|                             | Resolution                              | 0.1°                             |
| Compass tilt parameter      | Pitch accuracy                          | 0.1°<15° (Measuring range)       |
|                             |   | 0.1°<30° (Measuring range)       |
|                             |   | 0.1°<60° (Measuring range)       |
|                             |   | 0.2°<90° (Measuring range)       |
|                             | Pitch tilt range                        | ±85°                             |
|                             | Roll accuracy                           | 0.1°<15° (Measuring range)       |
|                             |   | 0.1°<30° (Measuring range)       |
|                             |   | 0.1°<60° (Measuring range)       |
| 0.2°<180° (Measuring range) |   |                                  |
| Roll tilt range             | ±180°                                   |                                  |
| Resolution                  | 0.1°                                    |                                  |
| Calibration                 | Hard iron calibration                   | Yes                              |
|                             | Soft iron calibration                   | Yes                              |
|                             | Magnetic field interference calibration | 24 points(3D calibration)        |
| Physical features           | Dimension                               | L: 125×W: 22×H: 24 mm            |
|                             | Weight                                  | 20g                              |
|                             | RS-232/RS485/TTL interface connector    | 5PIN connector                   |
| Interface features          | Start delay                             | <50MS                            |
|                             | Maximum output rate                     | 20Hz/s                           |
|                             | Communication rate                      | 2400 to 19200baud                |
|                             | Output format                           | Binary high performance protocol |
| Power                       | Power supply                            | (Default) DC+5V                  |
|                             |   | (Customized) DC9~36V             |
|                             | Current(Maximum)                        | 20mA                             |
|                             | Ideal mode                              | 18mA                             |
| Sleep Mode                  | TBD                                     |                                  |

# HCM508B-High Accuracy 3D Digital Compass

|                 |                                      |            |
|-----------------|--------------------------------------|------------|
| Environment     | Operating range                      | -40℃~+85℃  |
|                 | Storage temperature                  | -40℃~+100℃ |
|                 | Resistance shock performance         | 2500g      |
| Electromagnetic | According to EN61000 and GBT17626    |            |
| MTBF            | ≥40000 hours/times                   |            |
| Insulation      | ≥100M                                |            |
| Shock           | 100g@11ms、3Times/Axis(half sinusoid) |            |
| Anti-vibration  | 10grms、10~1000Hz                     |            |
| Weight          | 80g(without cable)                   |            |

## Electrical Connection

| Line color | BLACK          | WHITE        | GREEN        | RED                   | YELLOW  |
|------------|----------------|--------------|--------------|-----------------------|---------|
| function   | GND            | RS232(RXD)   | RS232(TXD)   | Vcc 5V                | CURRENT |
|            | Power Negative | Or RS485(D+) | Or RS485(D-) | Power supply positive | OUTPUT  |



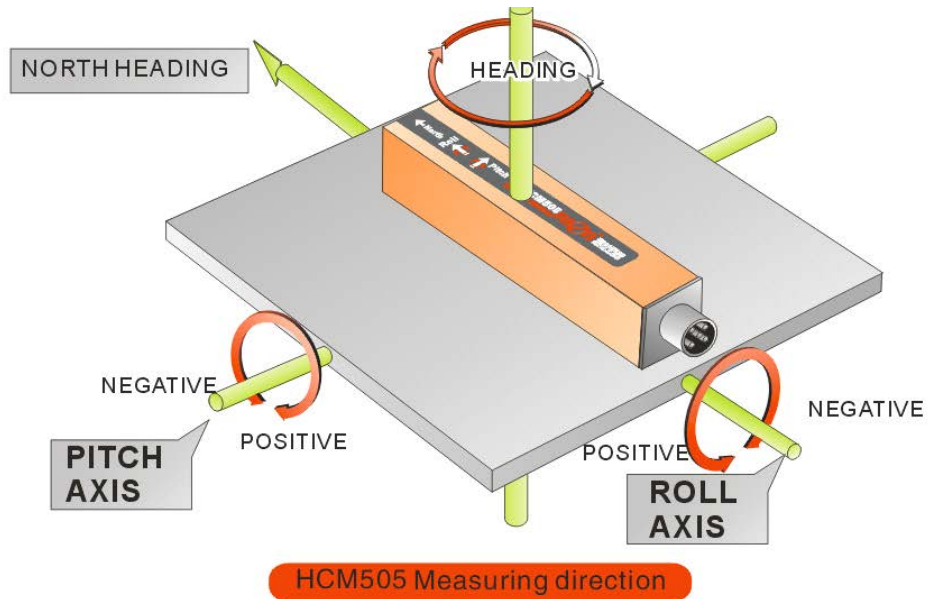
## HCM508B Measuring Directions&Fix

The HCM508B 3D electronic compass azimuth is using geomagnetic principle, so it is very important to select a minimum magnetic interference environment for installation position. Please place and install the HCM508B away from the iron, magnets, engines and other magnetic objects as much possible as you can. Need control over 30CM distance(different magnetic interfere with the compass in different distance ) at least even there are these magnetic medium around . In order to ensure optimal measurement environment please must use the **M4 anti-interference screws** for installation .

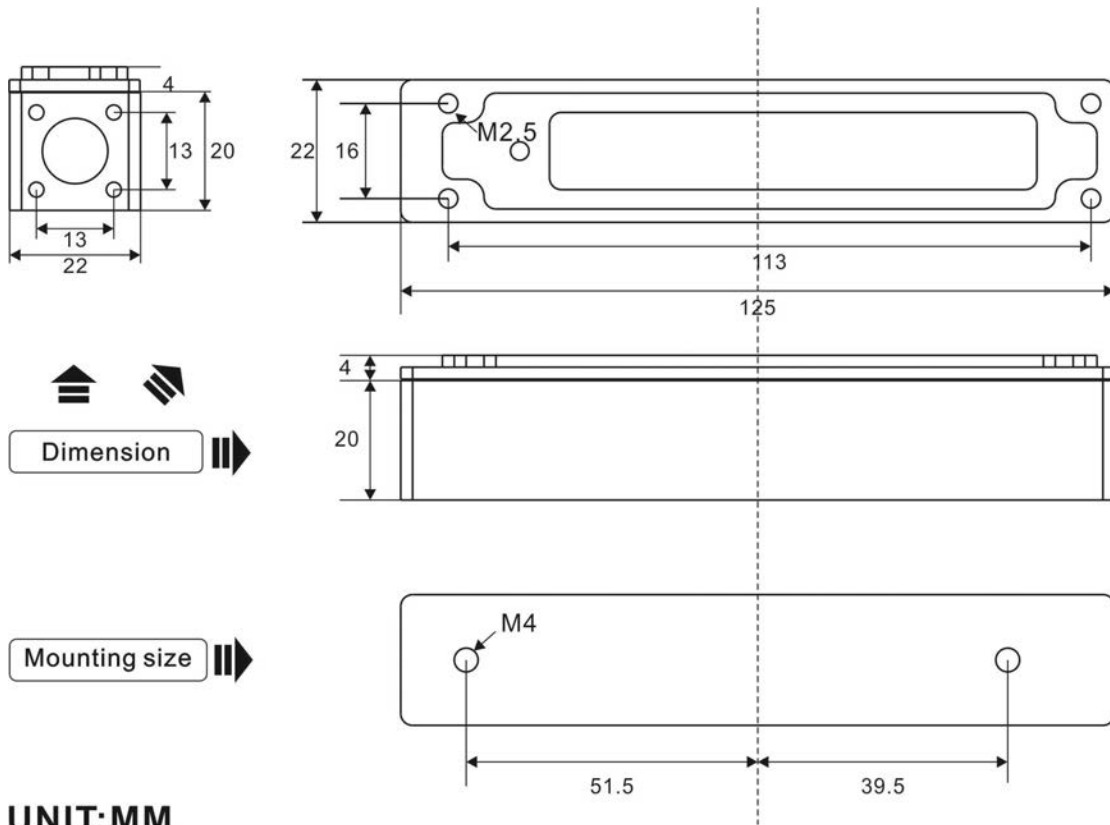
Although HCM508B can compensate the moderate deviation in the stable magnetic environment, but it can not compensate the changed magnetic interference. Please pay much attention to the wire with DC will generates a magnetic field , because if the DC change then the magnetic field will also change in size . The battery also is another interference source of changing . Each installation is different, and the user must evaluate the feasibility of installation under all possible operating environment.

The optimal heading accuracy of HCM508B can reach 0.3°~0.5°, this undergo a rigorous validation indisputable, the most scientific test method is equally crucial. The test method we recommend is: Please install the HCM508B electronic compass to a vertical and erect aluminum pole (non-magnetic material), then proceed with heading accuracy measurement (of course the rotating rod perpendicular to the rotating platform, as much as possible to avoid large external magnetic field interference). Doing so can reduce the compass turning radius, to scientifically improve the measurement accuracy. This is just to provide the installation of the laboratory, must be flexible to deal with the specific situation.E.g: is mounted in the car, HCM508B should do its installation in the perpendicular to the movement direction.

# HCM508B-High Accuracy 3D Digital Compass



## Dimension:



UNIT:MM

Size: L:125\*W:22\*H:24 mm



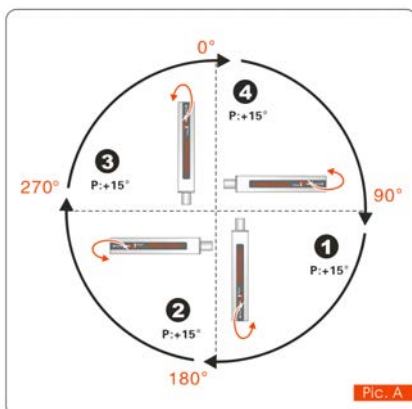
## HCM508B Calibration methods:

### Calibration lemmas:

1) The accuracy of testing compass can not reach the requirements;  
2) compass installation environment have magnetic interference, the interference is fixed, and the interference magnetic field and compass installation will not happen again in distance changes (example: compass to be installed above an iron material, because the iron will have magnetic interference, at this time then need to rotate and callbrate the iron and compass, and the iron and compass will not be separated when using , once they are separated then need to recalibrate. If the iron size is not fixed, or with a compass distance change is not fixed, the interference can not be calibrated,only can install it in a very far away , safe distance control in above 30cm).

- 1) Correctly connect the HCM compass to the RS232 communication port , turn on the power.
- 2) Send **the calibration start command: 68 04 00 08 0C** in hexadecimal format. **(Or click the Rion's 3D debugging software "CALI-START" button)**
- 3) HCM compass will return the response command, at the same time the compass take each point will return a response, please refer to the communication protocol.
- 4) With the following rotation rules after minimum taking the 12 calibration points, then send **the stop calibration command: 68 04 00 09 0D** (or click the **RION 3D debugging software "CALI-STOP" button**) , the compass will pause about 2 seconds, the internal CPU automatically calculate just sampling data, after the calculation will return a set of data, is the percentage value of the data just gain.
- 5) Then send the **save calibration command: 68 04 00 0A 0E** "(or click **RION 3D debugging software" CALI-SAVE "Save button**), the compass will return the answer reply command, you can work properly if successfully saved, if return unsuccessful information, the user can repeat the above calibration steps also can return to the compass factory default calibration data work.
- 6) **Following 2)** Send a calibration start command to begin calibration, keep the stability of the module posture, waiting for the first point is sampled.
- 7) after the first point sampling, rotate module around 90 degrees horizontally, to keep the module stability, wait for the next point is sampled. (Refer to the below diagram calibration steps)
- 8) Repeat the above steps until the sample to 24 points, and then send the calibration stop button.
- 9) Send calibration save command to end the calibration .

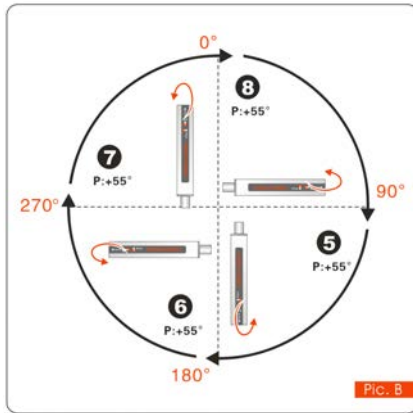
**When the user callbrate, if the distance from the magnetic interference source with the compass occur change , the percentage of the calibration will be lower, the precision will be poorer.**



**Note:** When you start the calibration and take points, move the compass to the following location, please note that these points are not absolute heading orientation, but with reference to the first point sampling heading orientation relative orientation change value. That is, you do not need to know which position the real North Pole is in. Further for example, the 90 degree rotation and 15 degrees pitch only one reference value, to allow a certain sampling angle value error, unnecessarily strictly require very precise. Take at least below 12 points calibration, it is recommended that 24 points, the user can sample more points in order to improve the accuracy, up to 50 points at most,

the same sampling principle with the following methods, just a sampling of the pitch angle and roll angle point will increase.

The calibration steps are as follows:



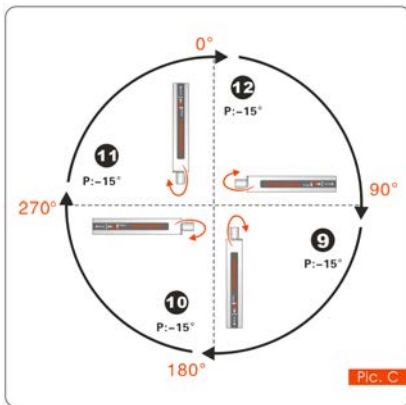
The standard starting point can be anyone azimuth of 360°, as long as each change angle to keep the basic level about 90° to change (do not require too precise). Example as left Pic.A: starting point for  $H = 0^\circ$ ,  $R = 0^\circ$ ,  $P = +15^\circ$  (firstly calibrate the pitch value P) please keep this posture for 2 to 3 seconds don't move, the system will take the first point.

After took the first point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the second point.

After took the second point, again rotate 90° horizontally,

please keep this posture for 2 to 3 seconds don't move, the system will take the third point.

After took the third point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the fourth point.



After took the fourth point, H and R are the same, and then increase + P angle value.

Refer to the left Pic.B: starting point  $H = 0^\circ$ ,  $R = 0^\circ$ ,  $P = +55^\circ$ , please keep this posture for 2-3 seconds don't move, the system will take the fifth point.

After took the fifth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the sixth point.

After took the sixth point, again rotate 90° horizontally,

please keep this posture for 2 to 3 seconds don't move, the system will take the seventh point.

After took the seventh point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the eighth point.

After took the eighth point, H and R are the same, then calibrate -P angle.

Refer to the left Pic.C: starting point  $H = 0^\circ$ ,  $R = 0^\circ$ ,

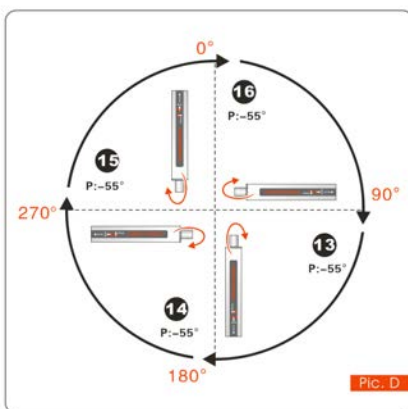
$P = -15^\circ$ , please keep this posture for 2-3 seconds don't move, the system will take the ninth point.

After took the ninth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the tenth point.

After took the tenth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the eleventh point.

After took the eleventh point, again rotate 90° horizontally, please keep this posture for 2 to 3

seconds don't move, the system will take the twelfth point.



After took the twelfth point, H and R are the same , then increase  $-P$  angle value .

Refer to the left Pic.D: starting point  $H=0^\circ$  ,  $R=0^\circ$  ,  $P=-55^\circ$ , please keep this posture for 2-3 seconds don't move, the system will take the thirteenth point.

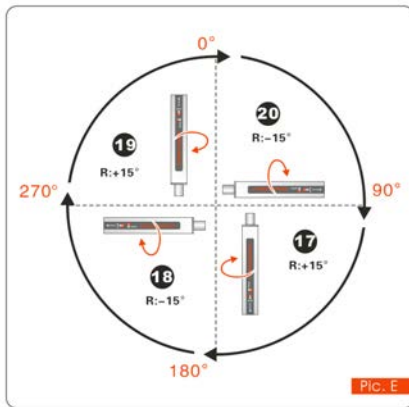
After took the thirteenth point, again rotate  $90^\circ$  horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take fourteenth point.

After took the fourteenth point, again rotate  $90^\circ$  horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the fifteenth point.

After took the fifteenth point, again rotate  $90^\circ$  horizontally, please keep this posture for 2 to 3 seconds don't move, the system will take the sixteenth point.

After took the sixteenth point then finished P calibration, then calibrate R,R(Roll value)can callbrate alternately .

Refer to the left Pic.E: starting point  $H=0^\circ$  ,  $R=+15^\circ$  ,  $P=0^\circ$  , please keep this posture for 2-3 seconds don't move, the system will take the seventeenth point.

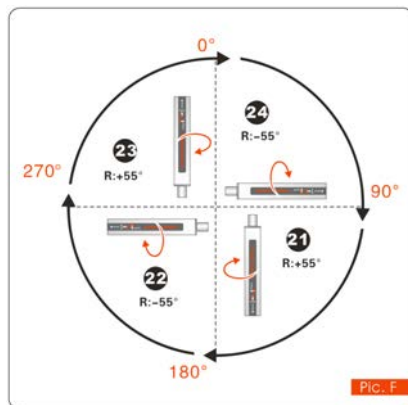


After took the seventeenth point, again rotate  $90^\circ$  horizontally, alternate the negative Roll value  $R=-15^\circ$  , please keep this posture for 2 to 3 seconds don't move, the system will take the eighteenth point.

After took the eighteenth point, again rotate  $90^\circ$  horizontally, alternate the positive Roll value  $R=+15^\circ$  , please keep this posture for 2 to 3 seconds don't move, the system will take the nineteenth point.

After took the nineteenth point, again rotate  $90^\circ$  horizontally, alternate the negative Roll value  $R=-15^\circ$  ,

please keep this posture for 2 to 3 seconds don't move, the system will take the twentieth point.



After took the twenty second point, again rotate  $90^\circ$  horizontally, alternate the positive Roll value  $R=+55^\circ$  , please keep this posture for 2 to 3 seconds don't move, the system will take the twenty third point.

After took the twenty third point, again rotate  $90^\circ$  horizontally, alternate the negative Roll value  $R=-55^\circ$  , please keep this posture for 2 to 3 seconds don't move, the system will take the twenty fourth point.

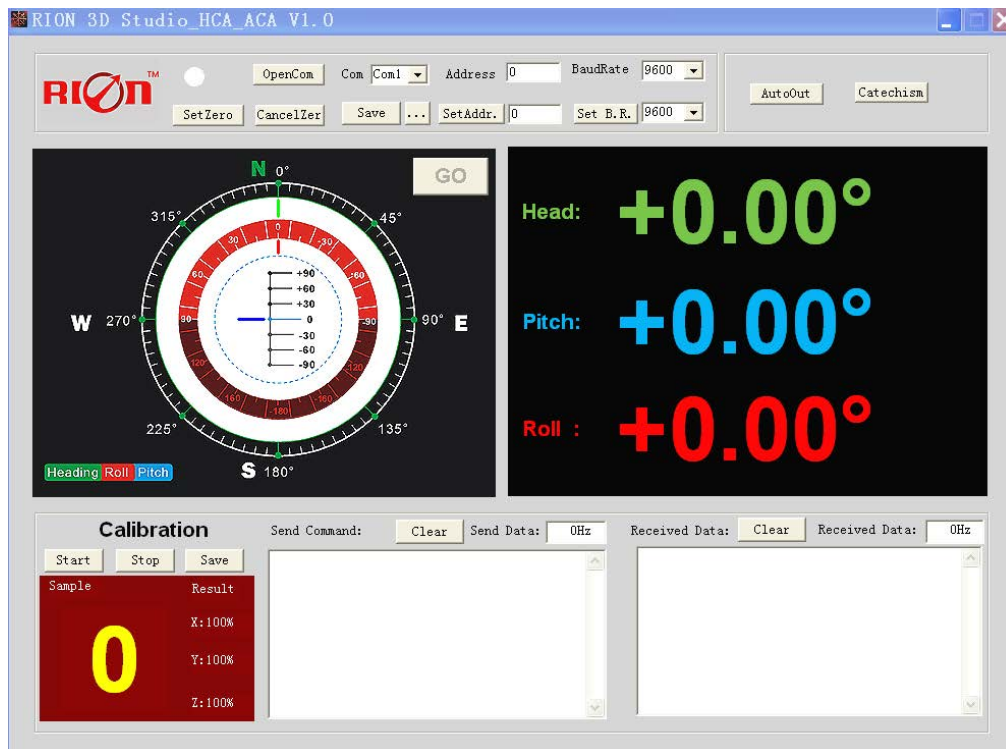
Sending stop command---compass response---Re-sending save command---compass response save successfully.

## RION's 3D Software

You can download the RION angle debugging software from RION's official website for the preliminary angle debugging, also you Can download public version of the comassistant software on line for using



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Open/Close: Open and close COM port;

Com: Select the the device corresponding to the COM port

Address: Fill in the sensor current address code, the factory default is 00

Set Address: Set the sensor address code input box on the right to enter the desired address code, click Set Addr button

Save Data: Save the data, click here data can be synchronized Save angle data, the file is stored by default in the C: ---- COMDATA file

Set Zero: Set relative zero, the sensor current angle is 00.00 degrees

Cancel Zero: Unset the relative zero, to restore the sensor to the factory absolute zero;

Baud Rate: Select the sense baud rate , the factory default is 9600;

Set Baud Rate: Set the sensor baud rate, on the right of the selection box to select corresponding baud rate then click SetB.R. button;

Auto Output: Switch the sensor to automatically output mode, in the automatic output mode can be filled with different output frequency in Hz;

Catechism: The sensor switch to answer pattern, such as choosing the answer type, must input "send command "( command, please refer to the specification ) on the left of "Send Command" input box, but also can fill in the transmit frequency in the Send Data, the unit Hz;

Mag. Dec.: Magnetic declination setting, in the right box directly enter the local magnetic declination, click "Mag.Dec." Button to confirm .

Calibration: compass calibration forum

Start: Start calibration

Stop: Stop the calibration (Click this button, keep the compass shaking state to avoid incorrect calibration of the acquisition)

Save: stop calibration and save data. (Specific calibration method please refer to this specification calibration description)

Note: after install the RION's debugging software, if can not open, please operate by the following steps

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( please appear to the administrator status to operate ):

- 1) Copy these three files mscomm.srg、mscomm32.ocx、mscomm32.dep from the folder to C:/Windows/system32 path below.
- 2) Click “Start” –“run” --regsvr32 mscomm32.ocx, You are prompted to install successful dialog.

## Product Protocol

### 一、 DATA FRAME FORMAT : (8 bits date, 1 bit stop, No check, Default baud rate 9600)

| Identifier (1byte) | Date Length (1byte) | Address code (1byte) | Command word (1byte) | Date domain | Check sum (1byte) |
|--------------------|---------------------|----------------------|----------------------|-------------|-------------------|
| 68                 |                     |                      |                      |             |                   |

Identifier: Fixed68H

Data length: From data length to check sum (including check sum) length

Address code: Accumulating module address, Default :00

Date domain will be changed according to the content and length of command word

Check sum: Data length、Address code、Command word and data domain sum, No carry.

### 二、 COMMAND word analysis

| Desc. | Meaning/Example   | Description  |
|-------|---|--|
| 0X04  | Meanwhile read Pitch、 Roll、 Heading Angle command<br><b>68 04 00 04 08</b>  | Data domain (0byte)<br>No Data domain command  |
| 0X84  | Sensor answer reply<br><b>E.g:68 0D 00 84 00 10 50 10 10 05 01 04 01 22</b> | Data domain (9byte)<br>AA AB BB CC CD DD EE EF FF<br>AA AB BB:3 Characters is Pitch Axis<br>CC CD DD:3 Characters is Roll Axis<br>EE EF FF: 3 Characters is Heading<br>Angle format with same analytic method as Pitch、 Roll、 Heading<br>On the left example , the angle is : Pitch:<br>+010.50°, Roll:-010.05°, Heading+104.01° |
| 0X06  | Setting declination command<br><b>68 06 00 06 02 08 16</b>                  | Data domain (2byte) SA AB<br>S is symbol 0 positive 1 negative<br>AA: two digits integer, B: two digits decimals<br>E.g: 02 08 is +20.8 deg  |
| 0X86  | Sensor answer reply<br><b>E.g: 68 08 00 86 00 8E</b>                        | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Setting successfully FF Setting failure  |
| 0X07  | Read declination command<br><b>68 04 00 07 0b</b>                           | Data domain (0byte)<br>No Data domain command  |
| 0X87  | Sensor answer reply<br><b>E.g: 68 06 00 87 02 08 97</b>                     | Data do (2byte)<br>Data domain in the number means the sensor response result  |
| 0X08  | Start calibration command<br><b>68 04 00 08 0C</b>                          | Data domain (0byte)<br>No Data domain command  |
| 0X88  | Sensor answer reply<br><b>E.g: 68 05 00 88 00 8D</b>                        | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Start success FF Start failure   |

Note: In future the module to take each point then return one data, until stop calibration, the format as

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|             |  |  |
|-------------|--|--|
| following:  |  |  |
| <b>0X88</b> | Sensor reply calibration taking points number<br><b>E.g: 68 05 00 88 07 94</b>   | Data domain (1byte)<br>Data domain in the number means the sensor took the calibration points number   |
| <b>0X09</b> | <b>Stop calibration command</b><br><b>68 04 00 09 0D</b>   | Data domain (0byte)<br>No data domain  |
| <b>0X89</b> | Sensor answer reply<br><b>E.g: 68 08 00 89 00 99 80 70 1A</b>  | Data domain (4byte)<br>AA XX YY ZZ<br>Note: AA is wrong code, 00 Correct, FF Error<br>XX X axis percentage YY Y axis percentage ZZ Z axis percentage   |
| <b>0X0A</b> | <b>Save calibration command</b><br><b>68 04 00 0A 0E</b>   | Data domain (0byte)<br>No data domain  |
| <b>0X8A</b> | Sensor answer reply command<br><b>E.g: 68 05 00 8A 00 8F</b>   | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Success FF Failure   |
| <b>0X0B</b> | <b>Setting communication baud rate command</b><br><b>68 05 00 0B 02 12</b>   | Data domain (1byte)<br>Baud rate: default :9600<br>00 means 2400<br>01 means 4800<br>02 means 9600<br>03 means 19200<br>04 means 38400<br>05 means 115200  |
| <b>0X8B</b> | Sensor answer reply command<br><b>E.g: 68 05 00 8B 00 90</b>   | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Success FF Failure   |
| <b>0X0F</b> | <b>Setting module address command</b><br><b>68 05 00 0F 01 15</b>  | Data domain (1byte)<br>XX module address, address from 00 to EF range<br>Note: Our products have a unified address: <b>FF, If forgot the set address when operating ,can use the FF address to operate the product, still normal response.</b> |
| <b>0X8F</b> | Sensor answer reply command<br><b>E.g: 68 05 00 8F 94</b>  | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Success FF Failure   |
| <b>0X0C</b> | <b>Setting angle output mode</b><br><b>68 05 00 0C 00 11</b>   | Data domain (1byte)<br>00: answer reply mode 01: Auto output mode<br>Default : answer reply mode   |
| <b>0X8C</b> | Sensor answer reply command<br><b>E.g:68 05 00 8C 00 91</b>  | Data domain (1byte) ,<br>Data domain in the number means the sensor response result<br>00 Success FF Failure   |
| <b>0X2A</b> | Setting angle output mode<br>68 05 00 2A 00 2F   | Data domain (1byte)<br>00: Horizontal mounting measurement 01: Vertical mounting measurement (the connector down)<br>Default : Horizontal mounting measurement   |
|             | Horizontal mounting mode: mounting the compass horizontally, the roll and pitch angle output 0<br>Vertical mounting mode: mounting the compass vertically, the roll and pitch angle output 0 |  |
| <b>0XAA</b> | Sensor answer reply command  | Data domain (1byte)  |

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|             |  |  |
|-------------|--|--|
|             | E.g: <b>68 05 00 AA 00 AF</b>                        | Data domain in the number means the sensor response result<br>00 Success FF Failure  |
| <b>0X41</b> | Query mounting mode command<br><b>68 04 00 41 45</b> | Data domain (0byte)  |
| <b>0XC1</b> | Sensor answer reply command<br>E.g:68 05 00 C1 00 C6 | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Horizontal mounting mode 01 Vertical mounting mode |
| <b>0X42</b> | Query output mode command<br>68 04 00 42 46          | Data domain (0byte)  |
| <b>0XC2</b> | Sensor answer reply command<br>E.g:68 05 00 C2 00 C7 | Data domain (1byte)<br>Data domain in the number means the sensor response result<br>00 Answer reply mode 01 Auto output mode              |



※More products information, please refer to the company's Website : [www.rion-tech.net](http://www.rion-tech.net)



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CHINA SHENZHEN RION TECHNOLOGY CO.,LTD.

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T: 0755-29657137 / 29761269 F: 0755-29123494  
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