RION TECH


V1.8

## HIGH ACCURACY 3D DIGITAL COMPASS

# HCM508B

## Technical Manual

## PRODUCTION EXECUTION STANDARD REFERENCE

○ Quality management system certification: GB/T19001-2016 idt ISO19001:2015 standard (Certificate No.: 128101)

○ Quality management system certification: IATF16949: 2016 (Certificate No.: T178487)

○ GJB9001C-2017 Standard Weaponry Quality Management System Certification (Registration number: 02622J31799R0M)

○ Intellectual property management system certification: GB/T29490-2013 standard (Certificate No.: 41922IP00281-06R0M)

○ High-tech Enterprise (Certificate No.: GR201844204379)

○ ShenZhen Professional Dedicated Unique Innovative Enterprice(No.: SZ20210879)

○ Revision time:2023-3-8

Note: Product functions, parameters, appearance, etc. will be adjusted as the technology upgrades. Please contact our pre-sales business to confirm when purchasing.


## ▶ GENERAL DESCRIPTION

HCM508B is a high-precision 3D compass independently developed by Rion Technology Co., Ltd. it is integrated with digital signal RS232 output and analog 4~20mA output. IP67 waterproof rating, more suitable for drilling measurement. It uses hard iron and soft iron calibration algorithms, so that any tool surface with a roll angle of 360 ° can still provide high-precision heading information. It has the characteristics of small size and low power consumption, suitable for miniaturized sensitive measurement systems.

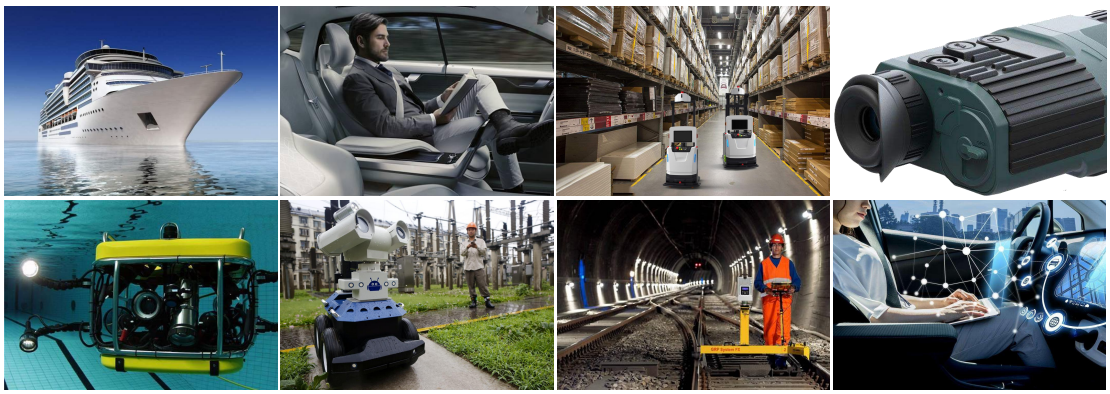
HCM508B integrates three-axis magnetic sensing technology, calculates heading data in real time through the central processing unit, and uses a three-axis accelerometer to compensate for a wide range of tilt angles. It is a high-performance and high-stability product. HCM508B is small, low power consumption and is widely used in many fields such as antenna stability, vehicles, and system integration.

## ▶ FEATURES

★ Heading accuracy: 0.3°~0.5°
★ Tilt angle resolution: 0.1°
★ Wide Temperature : -40℃~+85℃
★ Standard RS232/RS485/TTL output interface
★ With hard magnetic ,soft magnetic and angle compensation
★ Roll angle measuring range :±180°
★ Tilt angle accuracy: 0.2°
★ Size: L125×W22×H24 mm
★ Analog 4-20mA output

## ▶ 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

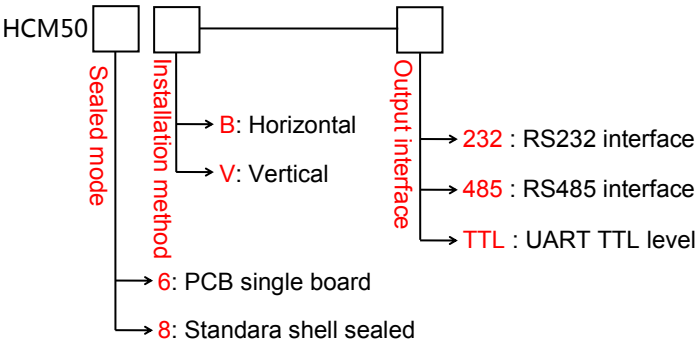


## PERFORMANCE

HCA508B

| | | PARAMETER |
|---|---|---|
| Compass heading parameter | The best heading accuracy | 0.3° |
| | Resolution | 0.1° |
| Compass tilt parameter | Pitch accuracy | 0.1°<15°（Measure range） |
| | | 0.1°<30°（Measure range） |
| | | 0.1°<60°（Measure range） |
| | | 0.2°<85°（Measure range） |
| | Pitch tilt range | ±85° |
| | Roll accuracy | 0.1°<15°（Measure range） |
| | | 0.1°<30°（Measure range） |
| | | 0.1°<60°（Measure range） |
| | | 0.2°<180°（Measure range） |
| | Roll tilt range | ±180° |
| | Resolution | 0.1° |
| Calibration | Hard iron calibration | Yes |
| | Soft iron calibration | Yes |
| | Magnetic field interference calibration method | 24 points(3D calibration) |
| Physical features | Dimension | L125*W22*H24mm |
| | Weight | 90g |
| | RS232/RS485/TTL interface connector | 5PIN connector |
| Interface features | Start delay | <50MS |
| | Maximum output rate | 20Hz/s |
| | Communication rate | 2400 to19200baud |
| | Output format | Binary high performance protocol |
| Analog output | 4-20mA FS(0-360deg) | Only for heading 4-20mA output |
| Power | Power supply | Default DC 12 V; 18~36v optional |
| | Current(Maximum) | 40mA |
| | Ideal mode | 28mA |
| | Sleep Mode | TBD |
| Enviroment | Operating range | -40℃～+85℃ |
| | Storage temperature | -40℃～+85℃ |
| | Resistance shock performance | 2500g |
| Electromagnetic compatibility | According to EN61000 and GBT17626 | |
| MTBF | ≥98000 hours/times | |
| Insulation resistance | ≥100M | |
| Shock resistance | 100g@11ms、3 Axial Direction (Half Sinusoid) | |
| Anti-vibration | 10grms、10～1000Hz | |

## ▶ ORDERING INFORMATION

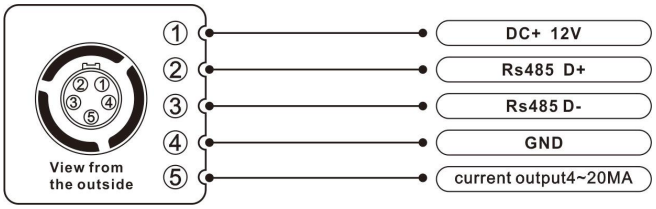



E.g: HCM508B-232: Standara shell sealed / Horizontal installation / RS232 output.

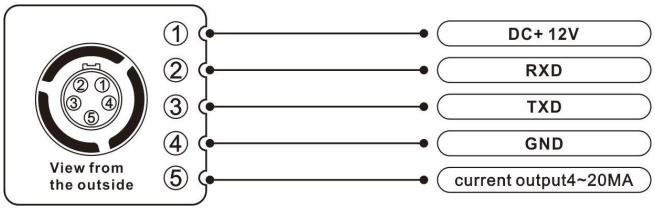
## ▶ ELECTRICAL CONNECTION

| COLOR FUNCTION | RED | WHITE | GREEN | BLACK | GRAY |
|---|---|---|---|---|---|
| | DC12V Power supply positive | TTL(RXD) RS232(RXD) RS485(D+) | TTL(TXD) RS232(TXD) RS485(D-) | GND Power Negative | CURRENT OUTPUT |

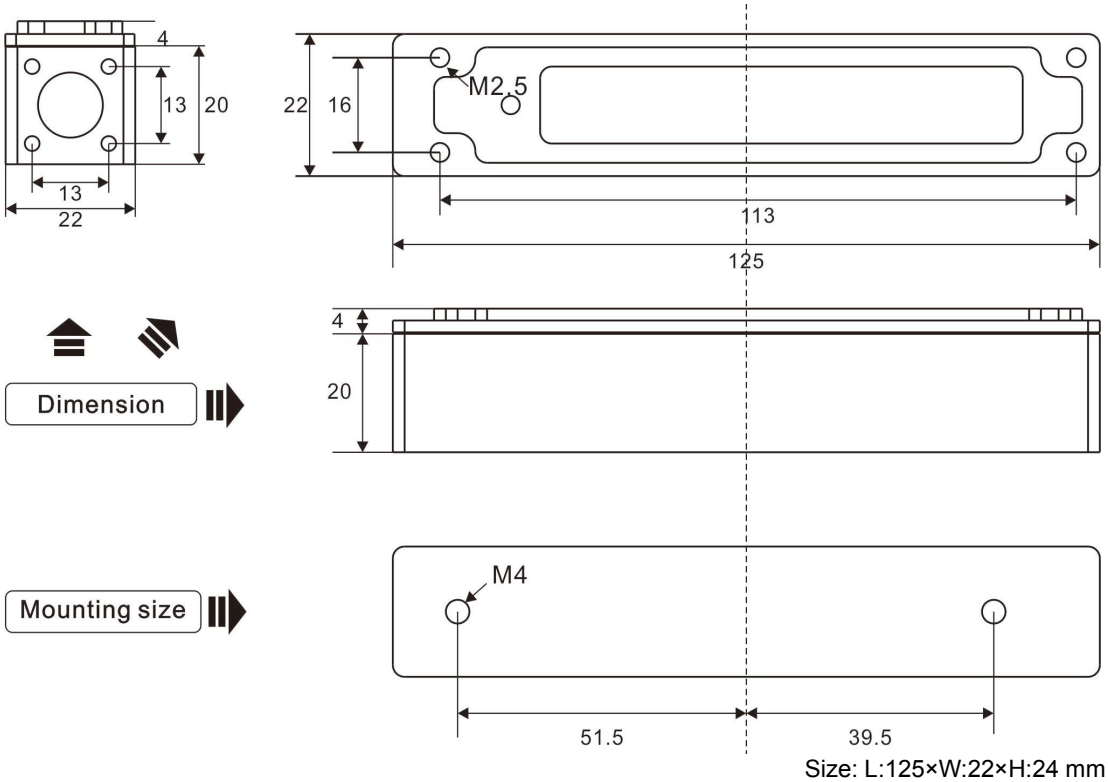
**RS485 Cable Connection Definition**




**RS232Cable Connection Definition**




## ▶ SIZE



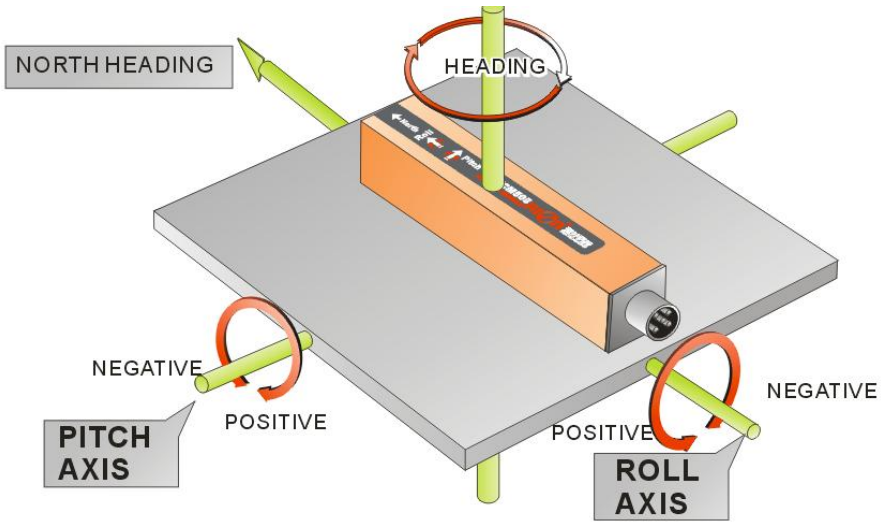

Size: L:125×W:22×H:24 mm

## ▶ 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 positon. 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 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 calibrate 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)

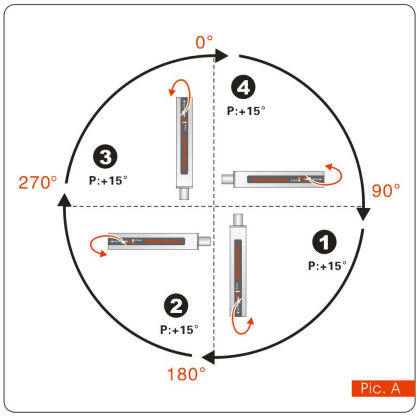
**8)** Repeat the above steps until the sample to 24 points, and then send the calibration stop button.

**9)** Send calibration save command to end the calibration .

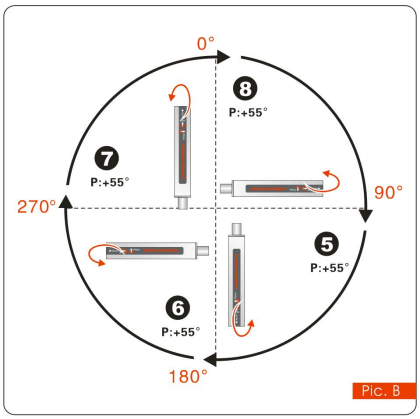
**When the user calibrate, if the distance from the magnetic interference source with the compass occur change , the percentage of the calibration will be lower, the precision will be poorer.**

**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 90degree 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 below12 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 starting point of the calibration can be in any place of 360°, as long as it keeps the about 90° for every angle change (not too precise). Example Pic.A: Starting point H=0°, R=0°, P=+15° (first adjust the pitch value P) Please keep this position for 2 to 3 seconds, and the system will take the first point. After taking the first point, rotate it 90° horizontally and keep this position for 2 to 3 seconds, and the system will take the second point. After taking the second point, rotate it 90° horizontally and keep this posture for 2 to 3, and the system will take the third point. After taking the 4th point, rotate it horizontally by 90° again, and keep this posture for 2 to 3, and the system will take the 4th point.**



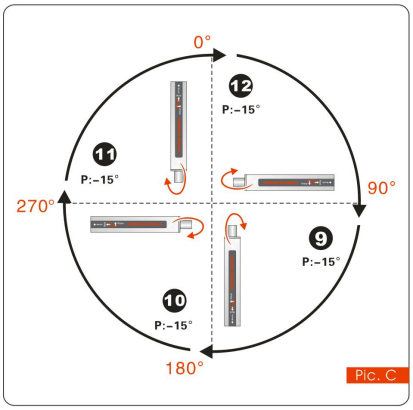

**After took the fourth point, keep no change for H and R, and increase + P angle value.**

**Refer to the left Pic.B: starting point H = 0° R = 0° P = +55°, please keep this posture for 2-3 seconds, 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, 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, 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, the system will take the eighth point.t.**




**After took the eighth point, keep no change for H and R, then calibrate –P angle.**

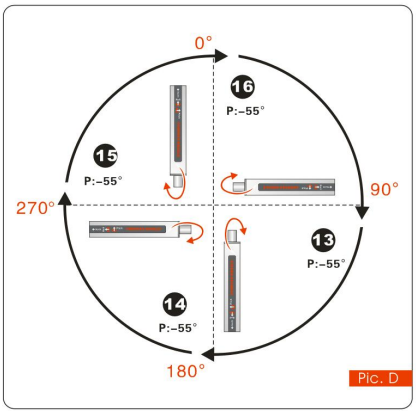
**Refer to the left Pic.C: starting point H=0°, R=0°, P=-15°,please keep this posture for 2-3 seconds, the system will take the ninth point.**

**After took the ninth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds, 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, 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, the system will take the twelfth point.**

**After took the twelfth point, keep no change for H and R, then increase –P angle value.**




**Refer to the left Pic.D: starting point H=0°, R=0°, P=-55°,please keep this posture for 2-3 seconds, the system will take the thirteenth point.**

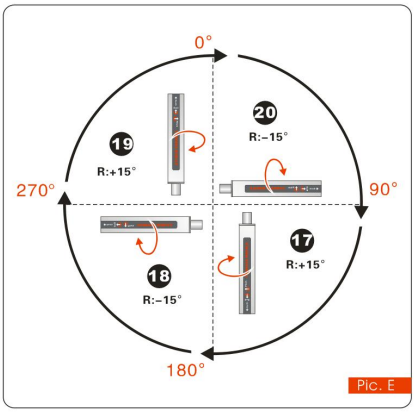
**After took the thirteenth point, again rotate 90 °horizontally, please keep this posture for 2 to 3 seconds, the system will take fourteenth point.**

**After took the fourteenth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds, the system will take the fifteenth point. .**

**After took the fifteenth point, again rotate 90° horizontally, please keep this posture for 2 to 3 seconds, the system will take the sixteenth point. .**

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

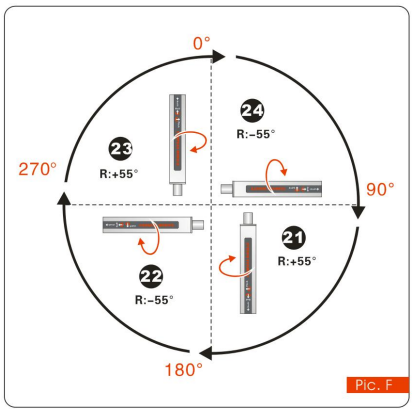
**Refer to the left Pic.E: starting point** H=0°, R=+15°, P=0°,**please keep this posture for 2-3 seconds don't move, the system will take the seventeenth point.**




**After took the seventeenth point, again rotate 90°horizontally, alternate the negative Roll value** R=-15°, **please keep this posture for 2 to 3 seconds, the system will take the eighteenth point.**

**After took the eighteenth point, again rotate 9° horizontally, alternate the positive Roll value R=+15,please keep this posture for 2 to 3 seconds, the system will take the nineteenth point.**

**After took the nineteenth point, again rotate 90° horizontally, alternate the negative Roll value R=-15, please keep this posture for 2 to 3 seconds, the system will take the twentieth point.**




**After took the twenty second point, again rotate 90° horizontally, alternate the positive Roll value R=+55, please keep this posture for 2 to 3 seconds, the system will take the twenty third point.**

**After took the twenty third point, again rotate 90° horizontally, alternate the negative Roll value R=-55, please keep this posture for 2 to 3 seconds, the system will take the twenty fourth point.**

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

## ▶ PRODUCT PROTOCOL

**1.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.
2.COMMAND word analysis

| Desc. | Meaning/Example | Description |
|---|---|---|
| ***0X04*** | Meanwhile **read Pitch、Roll、Heading Angle command** ***68 04 00 04 08*** | Data domain（0byte）<br>No Data domain command |
| ***0X84*** | Sensor answer reply<br>**E.g:68 0D 00 84 00 10 50 10 10 05 01 04 01 1C** | Data domain（9byte）<br>**AA AB BB CC CD DD EE EF FF**<br>**AA AB BB**:3 **RED** Characters is Pitch Axis<br>**CC CD DD**:3 **BULE** Characters is Roll Axis<br>**EE EF FF**: 3 **GREEN** Characters is Heading<br>Angle format with same analytic method as Pitch、Roll、Heading On the left example , the angle is :<br>Pitch:+010.50°,Roll:-010.05°，Heading+104.01°<br>**AA AA BB** is the return angle value of Pitch, which is the compressed BCD code,<br>**00 10 50** the **red** threebyte is the Pitch return angle value, which is the compressed BCD code. The high bit **0** of the first byte is the sign bit (0 is positive, 1 is negative) **01 0** is a three-digit integer value, and **50** is a two-digit decimal value. The analysis method of other axis data is the same, the pich angle is analyzed as +10.50°<br>**10 10 05** The blue threebyte is the return value of Roll, and the parsing method is the same as Pitch, The roll angle is analyzed as -010.05°<br>**01 04 01** the **green** threebyte is heading return value, the parsing method is the same as Pitch, and Heading angle is parsed as +104.01° |
| ***0X06*** | **Setting declination command** ***68 06 00 06 02 08 16*** | Data domain（2byte） SA AB<br>S is symbol 0 positive 1 negative<br>AA: two digits integer，B: a decimals<br>E.g：02 08 is +20.8 deg |
| ***0X86*** | Sensor answer reply<br>**E.g: 68 08 00 86 00 8E** | 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** ***68 04 00 07 0b*** | Data domain（0byte）<br>No Data domain command |
| ***0X87*** | Sensor answer reply<br>**E.g: 68 06 00 87 02 08 97** | Data do（2byte）<br>Data domain in the number means the sensor response result |
| ***0X08*** | **Start calibration command** ***68 04 00 08 0C*** | Data domain（0byte）<br>No Data domain command |
| ***0X88*** | Sensor answer reply<br>**E.g: 68 05 00 88 00 8D** | 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 following: | | |
| ***0X88*** | Sensor reply calibration taking points number<br>**E.g: 68 05 00 88 07 94** | Data domain（1byte）<br>Data domain in the number means the sensor took the calibration points number |

| | | |
|---|---|---|
| ***0X09*** | **Stop calibration command**<br>***68 04 00 09 0D*** | Data domain（0byte）<br>No data domain |
| ***0X89*** | Sensor answer reply<br>**E.g: 68 08 00 89 00 99 80 70 1A** | 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 |
| ***0X0A*** | **Save calibration command**<br>***68 04 00 0A 0E*** | Data domain（0byte）<br>No data domain |
| ***0X8A*** | Sensor answer reply command<br>**E.g: 68 05 00 8A 00 8F** | Data domain（1byte）<br>Data domain in the number means the sensor response result<br>00 Success FF Failure |
| ***0X0B*** | **Setting communication baud rate command**<br>***68 05 00 0B 02 12*** | Data domain（1byte）<br>Baud rate：default :9600<br>00 means 2400<br>01 means 4800<br>02 means 9600<br>03 means 19200 |
| ***0X8B*** | Sensor answer reply command<br>**E.g: 68 05 00 8B 00 90** | Data domain（1byte）<br>Data domain in the number means the sensor response result<br>00 Success FF Failure |
| ***0X0F*** | **Setting module address command**<br>***68 05 00 0F 01 15*** | Data domain（1byte）<br>XX module address, address from 00 to EF range<br>Note: Our products have a unified address: **FF, If forgot the set address when operating ,can use the FF address to operate the product, still normal response.** |
| ***0X8F*** | Sensor answer reply command<br>**E.g: 68 05 00 8F 94** | Data domain（1byte）<br>Data domain in the number means the sensor response result<br>00 Success FF Failure |
| ***0X0C*** | **Setting angle output mode**<br>**68 05 00 0C 00 11** | Data domain（1byte）Default : answer reply mode<br>00：answer reply mode 01：Auto output mode |
| ***0X8C*** | Sensor answer reply command<br>**E.g:68 05 00 8C 00 91** | Data domain（1byte），<br>Data domain in the number means the sensor response result<br>00 Success FF Failure |
| ***0X2A*** | 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 | | |
| ***0XAA*** | Sensor answer reply command<br>E.g:**68 05 00 AA 00 AF** | Data domain（1byte）<br>Data domain in the number means the sensor response result<br>00 Success FF Failure |
| ***0X41*** | Query mounting mode command<br>***68 04 00 41 45*** | Data domain（0byte） |
| ***0XC1*** | 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<br>01:Vertical mounting mode |
| ***0X42*** | Query output mode command<br>68 04 00 42 46 | Data domain（0byte） |
| ***0XC2*** | 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 |

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