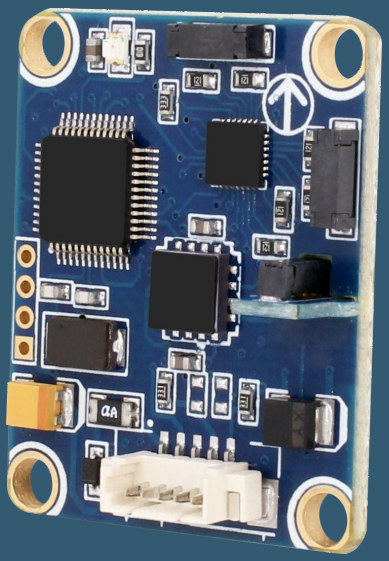



V2.9

## HIGH ACCURACY 3D DIGITAL COMPASS

# DCM250B/260B

## Technical Manual

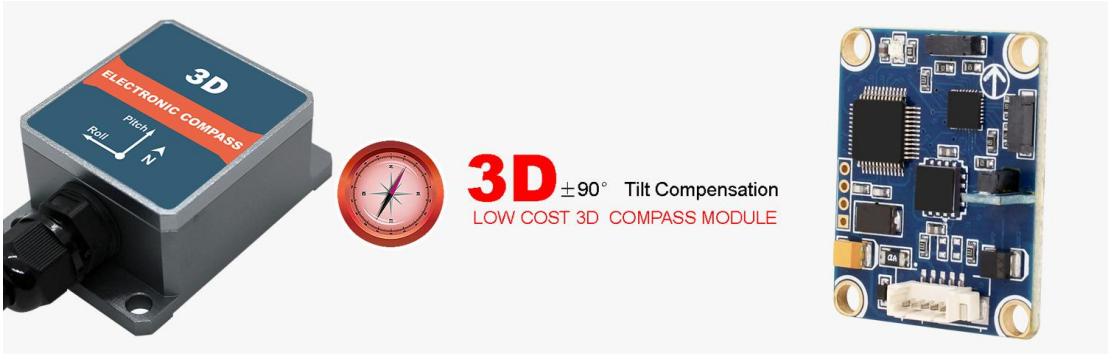
○ Revision date: 2025-2-25

Note: Product functions, parameters, appearance, etc. will be adjusted with technical upgrades. Please contact our pre-sales business for confirmation when purchasing.

**Disclaimer**

This product is developed exclusively for commercial applications and is prohibited from being used for illegal purposes, such as military activities, research related to nuclear, chemical, or biological weapons, or any other actions that violate laws and regulations. It is strictly forbidden to engage in activities related to goods embargoed by the United Nations, the European Union, or the OSCE, as well as any other activities prohibited by the Export Administration Regulations.

Without the written consent of our company, this product must not be transferred to any third party. Purchasing this product signifies your acceptance of this disclaimer and your agreement to sign the related liability agreement. If these regulations are violated, all responsibilities will be borne by the purchaser, and our company will not be held liable.




## ▶ INTRODUCTION

DCM250B/260B is a low-cost three-dimensional electronic compass, using hard and soft magnetic calibration algorithm, so that the compass can eliminate the influence of magnetic field through the calibration algorithm in the environment with magnetic field interference. The DCM250B&260B integrates a three-axis fluxgate sensor, calculates the heading in real time through the central processor, and uses a three-axis accelerometer to perform heading compensation for a wide range of tilt angles, ensuring that the compass can also provide high accuracy at tilt angles up to ±85° Heading data. The electronic compass integrates high-precision MCU control and diversified output methods. The standard interfaces include RS232/RS485/TTL and other interfaces, and other communication interfaces can be customized.

The DCM250B/260B is small size, low in power consumption, and can be used in many fields such as stable antennas, vehicles, system integration, etc. The high shock resistance and high reliability also make the compass work normally in extremely harsh environments, and is more suitable for today's Precision measurement integrated control system.

## ▶ MAIN FEATURES

★ Heading accuracy: 0.8°
★ Inclination measurement range: ±85°
★ Inclination resolution: 0.1°
★ Inclination accuracy: 0.2°
★ Temperature range: -40℃ ~ +85℃
★ DC 5V power supply
★ With hard magnetic, soft magnetic and tilt compensation
★ Standard RS232/RS485/TTL output interface

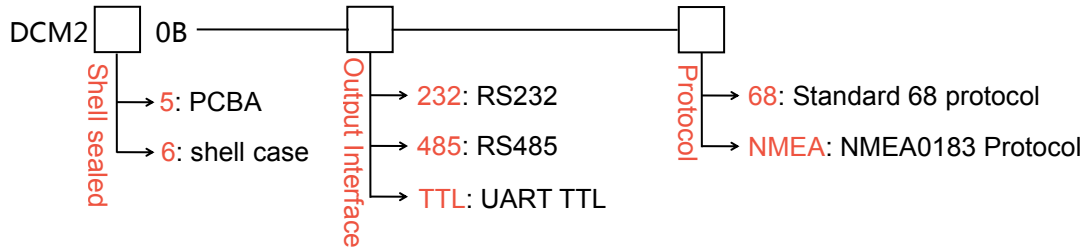
## ▶ APPLICATION

★ Navigation surveying ★ Satellite antenna searching ★ GPS combined navigation
★ Antenna servo control ★ Infrared imager ★ Special occasion robots
★ ROV underwater robot navigation ★ Laser rangefinder
★ Mapping ★ Oceanographic survey instrument

## SPECIFICATIONS

| DCM250B | | Parameters |
|---|---|---|
| Compass heading parameters | Heading accuracy | 0.8° |
| | Resolution | 0.1° |
| Compass inclination parameter | Pitch accuracy | 0.1°<15°(measure range) |
| | | 0.2°<30°(measure range) |
| | | 0.3°<60°(measure range) |
| | Pitch range | ±85° |
| | Rolling accuracy | 0.1°<15°(measure range) |
| | | 0.2°<30°(measure range) |
| | | 0.3°<60°(measure range) |
| | Roll range | ±85° |
| | Resolution | 0.1° |
| | Tilt compensation angle range | <40° |
| calibration | Hard iron calibration | Yes |
| | Soft iron calibration | Yes |
| | Magnetic field interference calibration method | Rotate horizontally one round (2D calibration) |
| | PCBA size | L33×W27×H9mm |
| | RS232/RS485/TTL | PCBA: 4PIN 30cm terminal cable |
| Interface | Start delay | <50mS |
| | Output rate | 20Hz/s |
| | Baud rate | 2400 to 19200baud |
| | Output format | Binary high-performance protocol |
| Power supply | Supply voltage | (default) DC+5V |
| | | (optional ) DC 9～36V |
| | Current (MAX) | 45mA |
| | Ideal mode | 35mA |
| | Sleep mode | TBD |
| Environment | Operating range | -40℃～+85℃ |
| | Storage temperature | -40℃～+85℃ |
| | Anti-vibration performance | 2500g |
| EMC | According to EN61000 and GBT17626 | |
| MTBF | ≥98000 hours/time | |
| Insulation resistance | ≥100MΩ | |
| Impact resistance | 100g@11ms, three direction (half sinusoid) | |
| Anti-vibration | 10grms\10～1000Hz | |
| Weight | PCBA:≤25g (excluding cable) | |

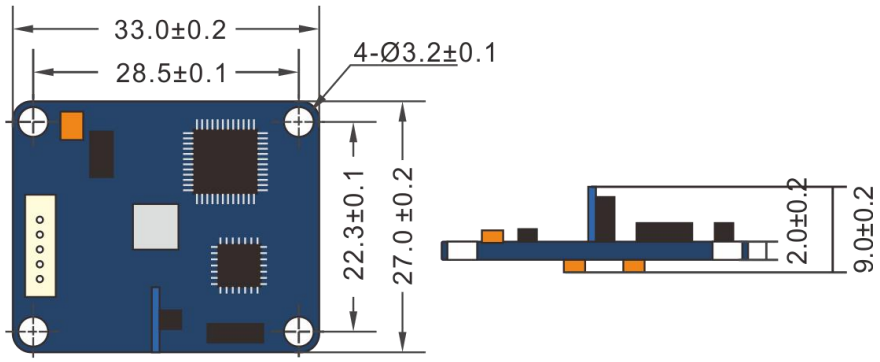
## ▶ ORDER INFORMATION




E.g.: DCM260B-232-68: Enclosure/RS232 output/Standard 68 protocol.

## ▶ PRODUCT SIZE

**PCBA SIZE**

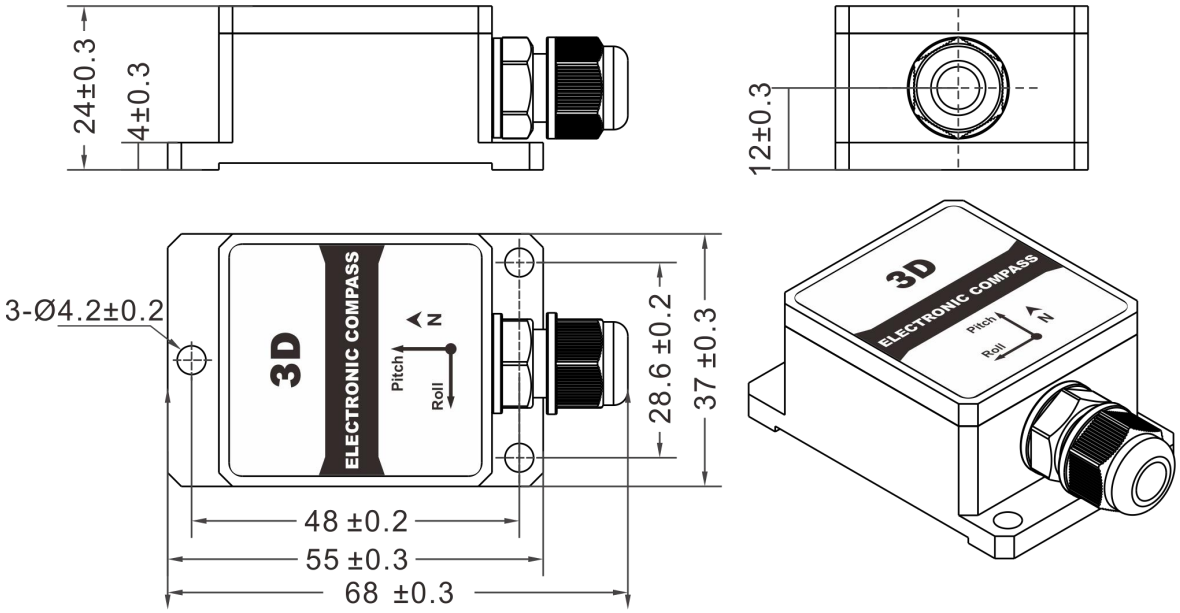



PCBA size: L33×W27×H9mm

Installation size: L28.3×W22.3×H2mm

Ounting screws: 4 M3 screws**(Copper screw)**

**SHELL SIZE**



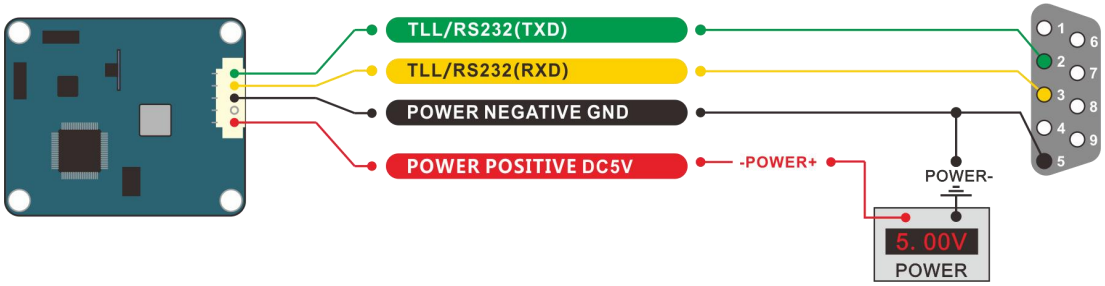

Shell size: L68×W37×H24mm

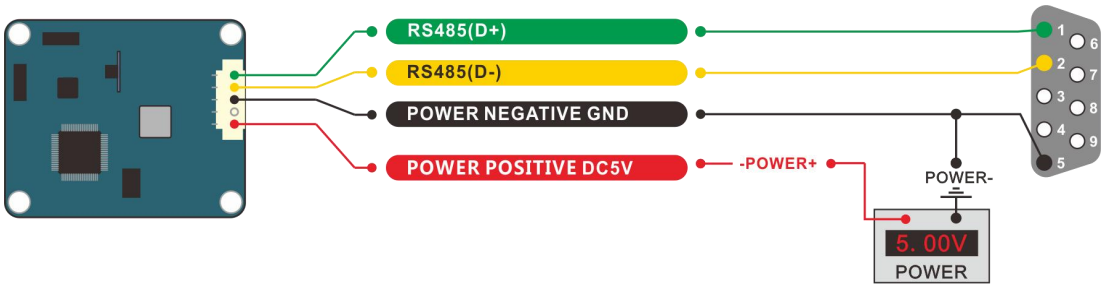
Installation size: L48×W28.6×H4mm

ounting screws: 3 M4 screws**(Copper screw)**

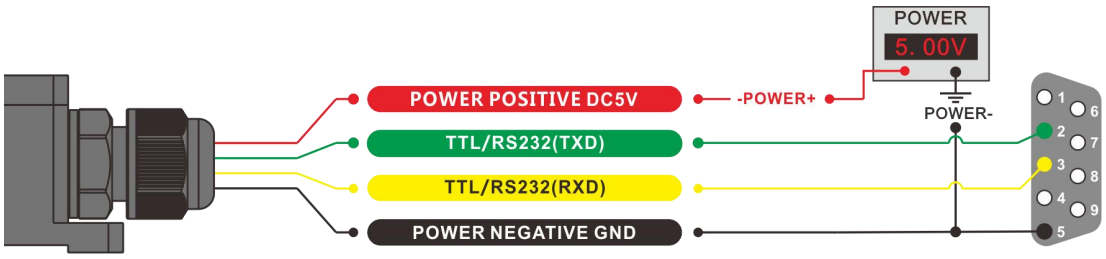
## CONNECTION

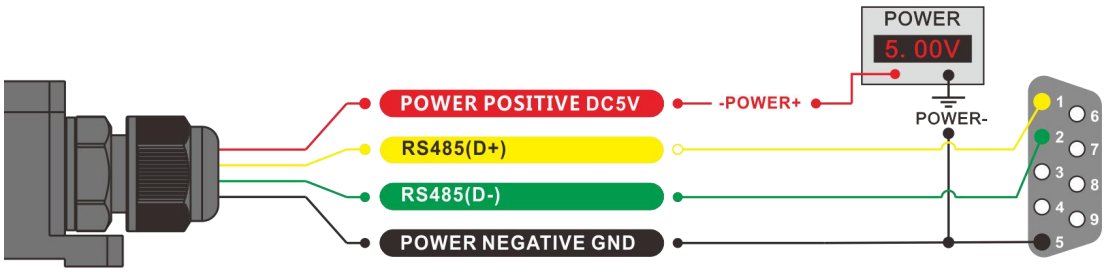
| Color Function | RED | BLACK | YELLOW | GREEN |
|---|---|---|---|---|
| | DC 5V | GND | RS232(RXD)<br>TTL(RXD)<br>RS485(D-) | RS232(TXD)<br>TTL(TXD)<br>RS485(D+) |




| Color Function | RED | BLACK | YELLOW | GREEN |
|---|---|---|---|---|
| | DC 5V | GND | RS232(RXD)<br>TTL(RXD)<br>RS485(D+) | RS232(TXD)<br>TTL(TXD)<br>RS485(D-) |



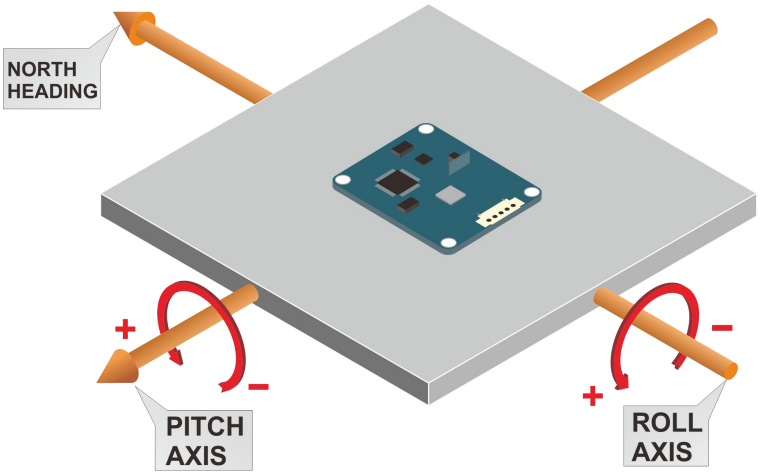



## MEASUREMENT AND INSTALLATION

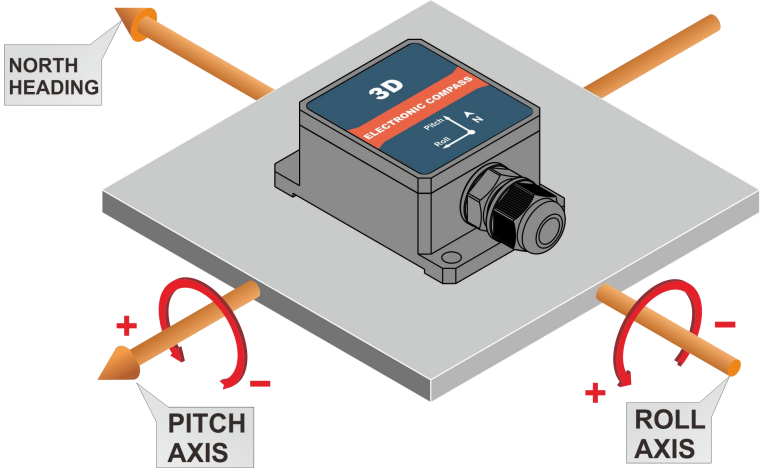
Because the azimuth of the DCM250B&260B three-dimensional electronic compass uses the principle of geomagnetism, it is necessary to choose the environment installation location with the smallest magnetic interference. Please install the product away from iron, magnets, motors and other magnetic objects. Even if there are these magnetic sources around, it needs to be kept away at least 40CM (different magnetic fields have different interference distance). In order to ensure product measurement accuracy, M3 anti-interference copper screws must be used during installation.

This product can compensate for moderate deviations in a stable magnetic environment, but cannot compensate for changing magnetic interference. Please pay attention to the magnetic field generated by the DC wire, because the magnitude of the magnetic field will change with the DC current. The battery is also a source of interference. Each installation is different and the user must evaluate the installation feasibility under all possible operating environments.

In a non-interference environment, the measured heading accuracy of this product is ≤1°, but scientific test methods are also crucial. Our recommended test method is: install this electronic compass on a vertical aluminum (non-magnetic other material) rod to make heading accuracy measurements (of course the rotating rod is perpendicular to the rotating platform, try to avoid large external magnetic fields interference). Doing so can reduce the radius of compass rotation, scientifically improve the measurement accuracy. This is only to provide laboratory installations, which must be handled flexibly for specific situations. For example: when installed on a car, this product is installed perpendicular to the direction of movement.




**DCM250B installation and measurement direction**



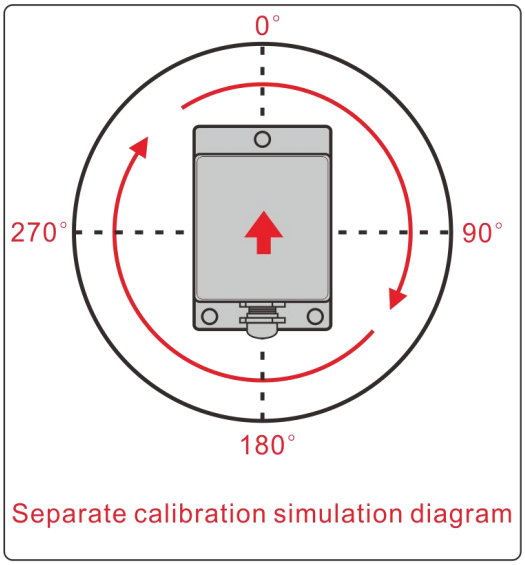

**DCM260B installation and measurement direction**

## ▶ CALIBRATION METHOD

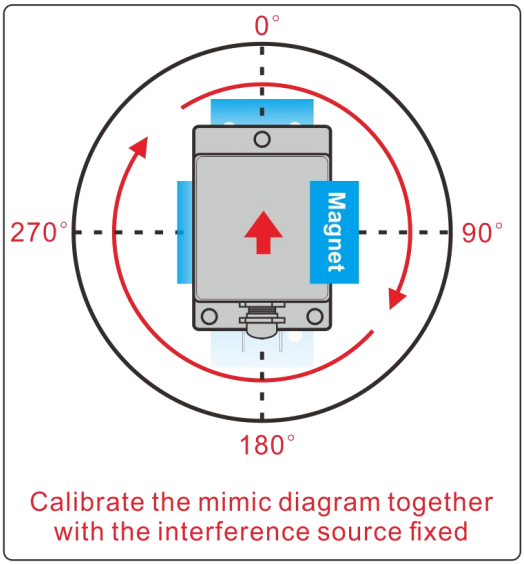
**Prerequisites :**
1) The accuracy of the test compass does not meet the requirements;
2) There is magnetic field interference in the compass installation environment.
This interference is fixed, and the distance between the interference magnetic field and the compass will not change after installation (for example: the compass is installed on an iron material, because iron will have magnetic field interference, which It is necessary to rotate and calibrate the iron together with the compass, and the iron will not be separated from the compass during use again. Once separated, it needs to be re-calibrated. If the size of the iron is not fixed, or the distance from the compass changes It is not fixed, this kind of interference cannot be calibrated, it can only be installed away from the distance, the safety distance is controlled above 40CM).

1) Use the DCM compass to properly connect to the RS232 communication port and turn on the power.
2) Send the calibration start command in hexadecimal format: "68 04 00 08 0C" (or click the "CALI-START" start button of RION 3D debugging software)
3) The DCM compass will return a response command.
4) Rotate the compass one circle from 0° to 360° in situ to collect the magnetic field data around the compass. (The rotation speed should not be too fast, and it should be more than 40 seconds per circle.)
5) After returning to 0°, send the stop calibration command in hexadecimal format: "68 04 00 0A 0E", the calibration is successful. (or click the "CALI-SAVE" button of RION 3D debugging software)

Note: If the compass is installed in other supporting equipment, which has magnetic interference, please install the compass and rotate it with the supporting equipment to collect the interference data to ensure that the compass can accurately measure.



Separate calibration simulation diagram



Calibrate the mimic diagram together with the interference source fixed

The starting point can be at any point of 360°, and it can rotate more than 1 circle on the spot Within 2 laps, the speed of rotation should be as uniform as possible, not too fast!

## ▶ COMMUNICATION PROTOCOL

1. Data frame format: (8 data bits, 1 stop bit, no check, default rate 9600)

| Identifier (1byte) | Data length (1byte) | Add. code (1byte) | Commandword (1byte) | Data field | checksum (1byte) |
|---|---|---|---|---|---|
| 68h | | | | | |

Identifier: fixed at 68H.

Data length: the length from data length to checksum (including checksum).

Address code: the address of the acquisition module, the default is 00.

The data field changes according to the different content and length of the command word.

Checksum: The sum of data length, address code, command word and data field does not consider carry.

2. Command word analysis

| Command | Meaning/ Example | Explanation |
|---|---|---|
| ***0X04*** | **Read Roll, Pitch, Heading at the same time**<br>**Angle command**<br>**68 04 00 04 08** | Data field (0byte)<br>No data field command |
| ***0X84*** | **Sensor replies**<br>**E.g: 68 0D 00 84 00 10 50 10 10 05 01 04 01 1C** | **DCM250**: data domain ( 9byte )<br>**AA AB BB CC CD DD EE EF FF**<br>**AA AB BB**:3 red bytes indicate Pitch;<br>**CC CD DD**:3 blue bytes indicate Roll;<br>**EE EF FF**:3 green bytes indicate Heading;<br>**AA AA BB** are returned angle value of Pitch，is compress BCD code.<br>**00 10 50** The three red bytes are the angle value returned by Pitch, which is the compressed BCD code. The high-order 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 pitch angle is +10.50°;<br>**10 10 05** The three blue bytes are the return value of Roll, and the parsing method is the same as that of Pitch, the analytical angle is Roll: -010.05°;<br>**01 04 01** Green three-byte Heading return value, the parsing method is the same as Pitch, and the parsing angle is Heading: +104.01°. |
| ***0X84*** | **Sensor replies**<br>**E.g: 68 0D 00 84 00 10 50 10 10 05 01 04 01 1C** | **DCM260**:data domain ( 9byte )<br>**AA AB BB CC CD DD EE EF FF**<br>**AA AB BB**:3 red characters represent the Roll;<br>**CC CD DD**:3 blue characters represent the pitch;<br>**EE EF FF**:3 green characters for Heading angle;<br>**AA AA BB**:Returns the angle value for Roll, the compressed BCD code;<br>**00 10 50** The three red bytes are the angle value returned by Roll, which is the compressed BCD code. The high-order 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, and the Roll angle is analyzed as +10.50°;<br>**10 10 05** The three blue bytes are the return value of Pitch, the parsing method is the same as that of Roll, the analytical angle is Pitch:-010.05°;<br>**01 04 01** Green three-byte Heading return value, the parsing method is the same as Pitch, and the parsing angle is Heading: +104.01°. |
| ***0X06*** | **Set magnetic declination command** ***68 06 00 06 02 08 16*** | Data field ( 2byte ) SA AB<br>S is the sign 0 positive 1 negative<br>AA: two integers, B: a decimals<br>E.g: 02 08 is +20.8° |
| ***0X86*** | **Sensor response reply E.g: 68 05 00 86 00 8B** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:setting successfully FF:setting failed |
| ***0X07*** | **Read magnetic declination command** ***68 04 00 07 0b*** | Data field (0byte)<br>No data field command |
| ***0X87*** | **Sensor response reply E.g: 68 06 00 87 02 08 97** | Data field (2byte)<br>The number in the data field indicates the result of the sensor response |
| ***0X08*** | **Start calibration command** ***68 04 00 08 0C*** | Data field (0byte)<br>No data field command |
| ***0X88*** | **Sensor response reply E.g: 68 05 00 88 00 8D** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:Start success FF:start failure |
| ***0X0A*** | **Save calibration command 68 04 00 0A 0E** | Data field (0byte)<br>No data field command |
| ***0X8A*** | **Sensor response reply command E.g: 68 05 00 8A 00 8F** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:setting successfully FF:setting failed |
| ***0X0B*** | **Set communication baud rate command** ***68 05 00 0B 02 12*** | Data field (1byte)<br>Baud rate:00 means 2400 01 means 4800<br>**02 means 9600(default )** 03 means 19200<br>04 means 38400 05 means 115200 |
| ***0X8B*** | **Sensor response reply command E.g: 68 05 00 8B 00 90** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:setting successfully FF:setting failed |
| ***0X0F*** | **Set module address command** ***68 05 00 0F 01 15*** | Data field (1byte)<br>XX module address, the address ranges from 00 to EF.<br>Note: Our products have a unified address: **FF. If you forget the address you set during the** |

| | | |
|---|---|---|
| | | **operation, you can use the FF address to operate the product and it will respond normally.** |
| ***0X8F*** | **Sensor response reply command**<br>**E.g: 68 05 00 8F 00 94** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:setting successfully FF:setting failed |
| ***0X0C*** | **Set angle output mode**<br>**68 05 00 0C 00 11** | Data field (1byte)<br>00: Q&A 01: Automatic output type Factory default: Q&A |
| ***0X8C*** | **Sensor response reply command**<br>**E.g: 68 05 00 8C 00 91** | Data field (1byte)<br>The number in the data field indicates the result of the sensor response<br>00:setting successfully FF:setting failed |

## ▶ NMEA0183 COMMUNICATION PROTOCOL

Communication NMEA0183（ASCII）
Baud rate 4800 \9600\19200, could set(default as 19200, one start bit + 8 data bit+non-parity +1 stop bit)
Data protocol
Communicate use NMEA special sentence (ASCII).
After power on module, baud rate is 19200 as default and 0 data output.
During operation, compass output sentence as below:
$PTNTHPR,X.X,A,X.X,A,X.XA*hh<cr><lf>
Heading ,pitch,roll

**Set data refresh rate**

| Command | Description |
|---|---|
| #BAD=0*4A<CR><LF> | set 0-readouts per minute |
| #BAD=1*4B<CR><LF> | set 1-readout per minute |
| #BAD=2*48<CR><LF> | set 2-readouts per minute |
| #BAD=3*49<CR><LF> | set 3-readouts per minute |
| #BAD=4*4E<CR><LF> | set 6-readouts per minute |
| #BAD=5*4F<CR><LF> | set 12-readouts per minute |
| #BAD=6*4C<CR><LF> | set 20-readouts per minute |
| #BAD=7*4D<CR><LF> | set 30-readouts per minute |
| #BAD=8*42<CR><LF> | set 60-readouts per minute |
| #BAD=9*43<CR><LF> | set 120-readouts per minute |
| #BAD=10*7B<CR><LF> | set 180-readouts per minute |
| #BAD=11*7A<CR><LF> | set 300-readouts per minute |

**Baud rate set command**

| Command | Description |
|---|---|
| #BA4H=8T*2E<CR><LF> | Set baud rate as 4800 |
| #BA4H=16T*11<CR><LF> | Set baud rate as 9600 |
| #BA4H=32T*17<CR><LF> | Set baud rate as 19200 |

**Activation message**

#F33.6=1*52 When the baud rate is set, send this command to reset and activate.

**Heading angle calibration command**

| Start command | Response | Remark |
|---|---|---|
| #F33.4=0*51<CR><lf> | #F33.4=0*51<CR><lf> | Horizontal command |
| **Store command** | **Response** | **Remark** |
| #F2FE.2=1*67<CR><lf> | #F2FE.2=1*67<CR><lf> | Horizontal command |

**Power off save function ( This command takes effect only before the setting of baud rate and frequency )**

| Start command | Response | Remark |
|---|---|---|
| #BA6S=1*6A | #BA6S=1*6A | send the command, the setting for baud rate and output rate will be saved after power off |
| #BA6S=0*6B | #BA6S=0*6B | send the command, the setting for baud rate and output rate will be invalid after power off |