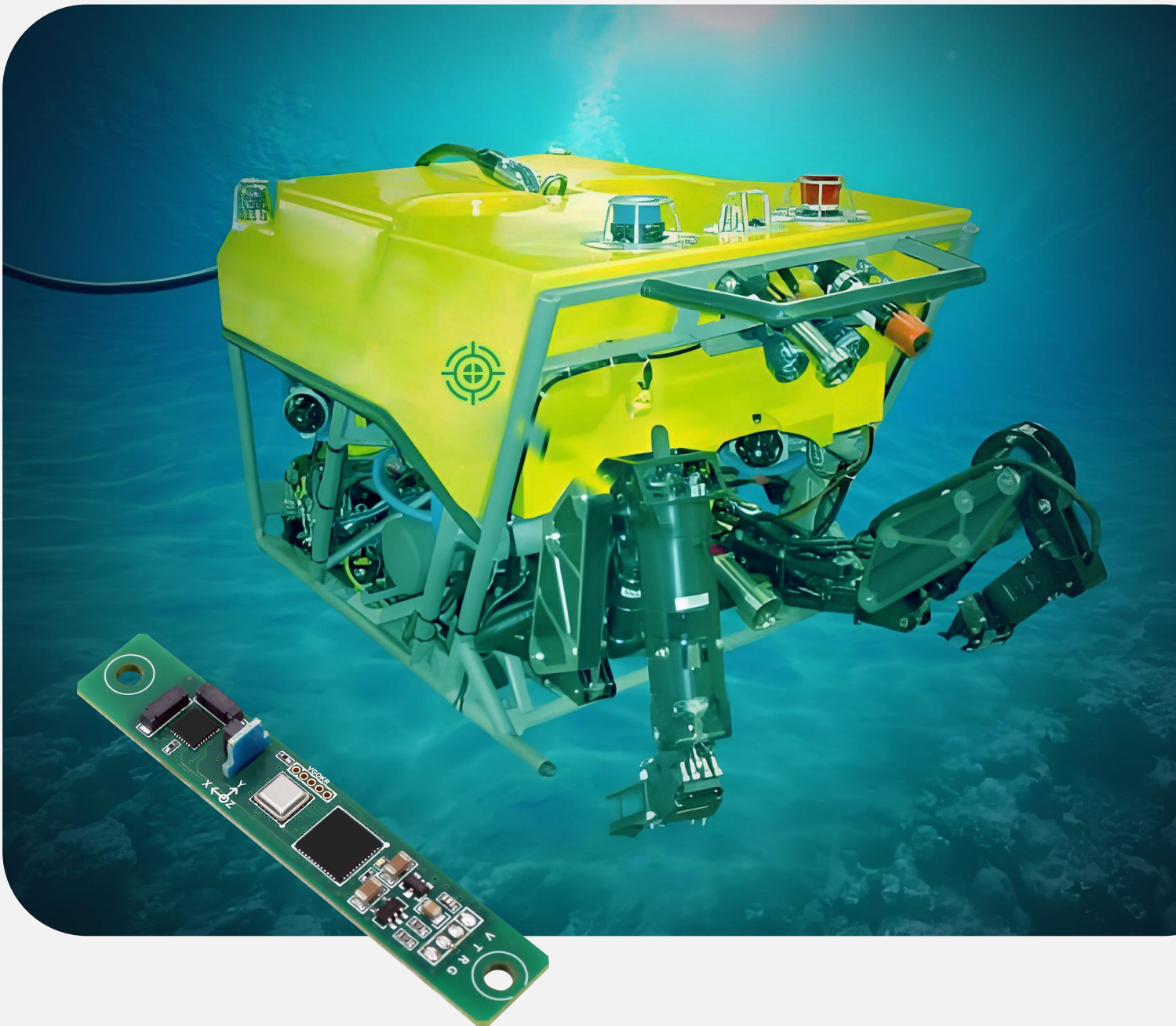




GCM370-MI-SJ Low Power Consumption High Precision 3D Electronic Compass Product Manual

V1.7-20260701

Technical Highlights

- ❖ Azimuth accuracy: 0.5°;
- ❖ Roll angle measurement range: $\pm 180^\circ$;
- ❖ Tilt resolution: 0.1°;
- ❖ Tilt accuracy: $< 0.2^\circ$ (full range);
- ❖ Standard TTL output interface.



Product Introduction

The GCM370-MI-SJ 3D compass features low power consumption and excellent measurement resolution, exhibiting balanced performance in noise suppression and temperature drift stability. Utilizing mature hard and soft iron calibration algorithms, and coupled with a high-performance accelerometer for tilt compensation, it provides reliable heading output across the entire 360° tool face range. Even in applications with fixed magnetic interference, it maintains high measurement consistency and accuracy.

This product integrates a triaxial magnetometer and a triaxial accelerometer. Leveraging a robust industrial-grade microcontroller with strong anti-interference capabilities, it calculates heading data in real time and uses the triaxial accelerometer for heading compensation over a wide range of tilt angles, resulting in excellent overall reliability and stability. Its compact structure and low power consumption make it particularly suitable for applications with strict size and energy consumption requirements, such as drilling measurements, and it can be easily integrated into various terminal devices. Currently, this product is widely used in handheld terminals, mobile devices, antenna attitude control, vehicle systems, and system integration.

Application Scope

- ❖ Marine Navigation and Surveying
- ❖ GPS Integrated Navigation System
- ❖ Antenna Servo Control
- ❖ Infrared Imager Integration
- ❖ Laser Ranging Equipment Collaboration
- ❖ Map Completion System Support
- ❖ ROV Underwater Robot Navigation
- ❖ Marine Survey Instrument Support
- ❖ Special Robot Applications





Performance Parameters

GCM370-MI-SJ		Parameter Indicators
Compass heading parameters	Optimal heading accuracy	0.5°
	Resolution	0.1°
Compass tilt parameters	Pitch accuracy	0.1°<15° (Measurement Range)
		0.1°<30° (Measurement Range)
		0.1°<60° (Measurement Range)
		0.2°<85° (Measurement Range)
	Pitch roll range	±85°
	Roll accuracy	0.1°<15° (Measurement Range)
		0.1°<30° (Measurement Range)
		0.1°<60° (Measurement Range)
		0.2°<180° (Measurement Range)
	Roll Tilt Range	±180°
	Resolution	0.1°
Calibration	Hard Iron Calibration	Yes
	Soft Iron Calibration	Yes
	Magnetic Field Interference Calibration Method	Planar rotation calibration / Multi-point calibration (optional)
Physical characteristics	Board Dimensions	L67×W12×H9mm
	Board Weight	≤10g (excluding terminal wire)
	Board Terminal Lines	30cm terminal wire
	Output Interface	TTL
Interface characteristics	Startup Delay	<50 ms
	Maximum Output Rate	20Hz/s
	Communication Rate	9600 to 115200baud (Default 9600)
	Output Format	Binary high-performance protocol
Power supply	Supply Voltage	DC +5V
	Operating Current	5mA
	Sleep Mode	343UA
Environment	Operating Range	-40℃~+85℃
	Storage Temperature	-40℃~+85℃
	Vibration Resistance	100g
Protection performance	IP67	
Electromagnetic compatibility	Compliant with EN61000 and GBT17626	
Mean time between failures (MTBF)	≥98000 hours/cycle	
Insulation resistance	≥100 megohms	

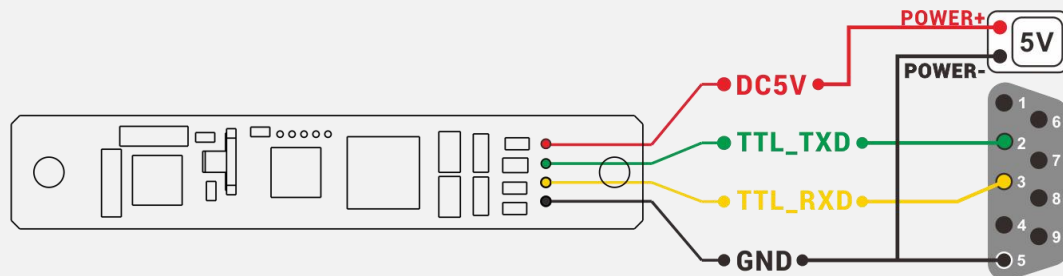
Shock resistance	100g@11ms, triaxial (half-sine wave)
Vibration resistance	10grms / 10~1000Hz

✓ Ordering and Selecting

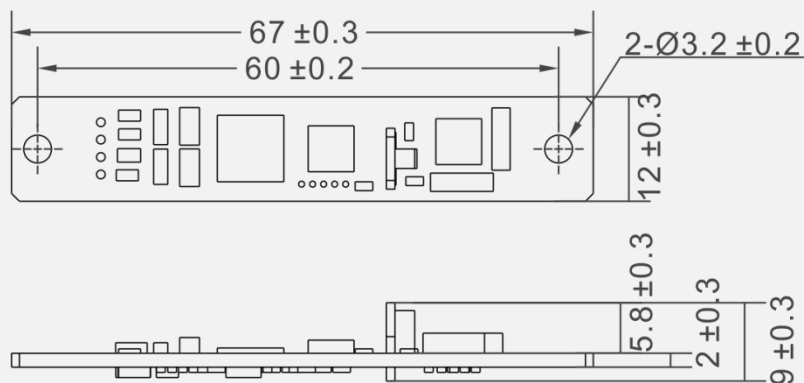
Model	Signal output	Communication Protocol	Installation Direction		
GCM370	- TTL: TTL	- SP: Serial communication protocol 500: 500 communication protocol	- H: Horizontal installation V: Vertical installation	-MI	-SJ
E.g: GCM370-TTL-SP-H-MI-SJ: TLL signal output / serial communication protocol / horizontal mounting					

✓ Interface Definition

Line color	Definition	Description
Red	DC 5V	Power supply positive terminal
Green	TTL_TXD	Transmit data
Yellow	TTL_RXD	Receive data
Black	GND	GND



✓ Product Dimensions



PCBA Size: L67×W12×H9mm

Installation Size: L60×H2mm

Recommended screws: 2 M3 screws (copper screws)

✓ Measurement direction and installation requirements

The 3D electronic compass azimuth measurement is based on the principle of geomagnetic induction. Installation requires an environment with minimal magnetic field interference. To ensure measurement accuracy, please follow these installation guidelines:

1. Magnetic Interference Protection Requirements:

- ❖ Keep away from ferrous materials, permanent magnets, motors, and other magnetic objects.
- ❖ Maintain a distance of at least 30cm from known sources of magnetic interference (the specific distance needs to be adjusted according to the magnetic field strength).
- ❖ Use copper fasteners for secure installation.

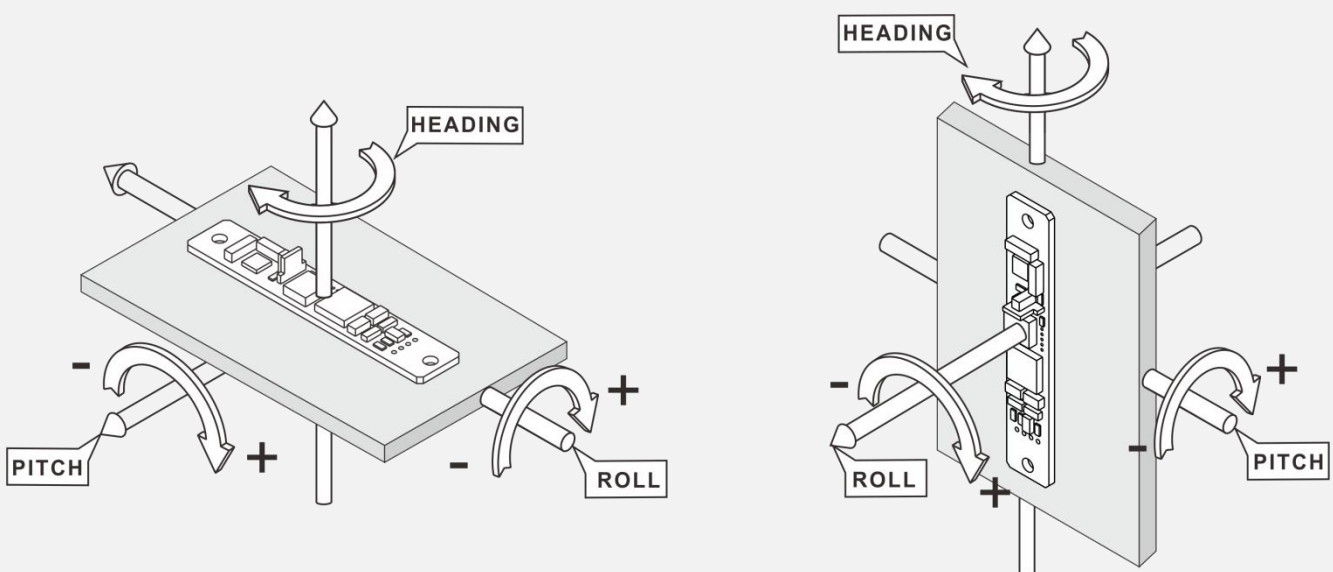
2. Cable and Electrical Precautions:

- ❖ A 20cm terminal cable is included as standard. It is recommended to shorten the cable length as needed to reduce signal noise.
- ❖ Pay special attention to electromagnetic interference generated by DC power supply lines.
- ❖ Avoid installation near batteries or other sources of variable magnetic fields.

3. Accuracy Optimization Recommendations:

- ❖ Optimal heading accuracy: 0.5° (typical value).
- ❖ Recommended testing method: Mount the compass on a vertical aluminum bracket (or other non-magnetic material) for heading measurement.
- ❖ During testing, keep the bracket perpendicular to the turntable to minimize the rotation radius and reduce external magnetic field interference.

Note: This product can compensate for deviations in stable magnetic field environments, but it is not suitable for scenarios with dynamic magnetic field interference. A comprehensive magnetic field assessment is required for actual installation based on the specific application environment. The above instructions are primarily for laboratory environments; on-site installation requires adjustments based on actual working conditions.





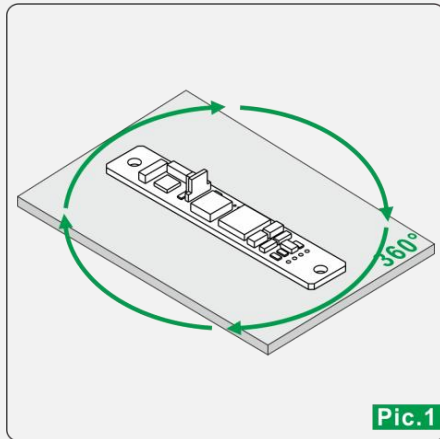
Calibration method

Calibration prerequisites:

- 1) The compass accuracy does not meet the requirements;
- 2) If there is a fixed magnetic field interference in the compass installation environment (e.g., installed on ferrous materials), the interference source and the compass must be rotated synchronously for calibration, and their relative positions must be kept fixed during use; otherwise, recalibration is required. If the size or distance of the interference source is not fixed (e.g., a variable iron component), calibration is not possible; a safe installation distance of at least 30cm should be maintained.

Horizontal installation calibration mode:

Connect the compass correctly to the communication port and turn on the power.



Pic.1

1) Rotate the plane more than 360° in one revolution:

As shown in Figure A

Horizontal Calibration Start Command

68 04 00 41 45

Data Field (0 bytes)

Rotate horizontally at a constant speed for more than one revolution, ensuring the time is more than 20 seconds. Values saved are only valid if the time is more than 20 seconds; values saved are invalid if the time is less than 20 seconds.

Horizontal Calibration Save Command

68 04 00 51 55

Data Field (0 bytes)

No Data Field Command

2) Rotate vertically upwards 360° as shown in Figure B.

Vertical Upwards Calibration Start

68 04 00 42 46

Data Field (0 bytes)

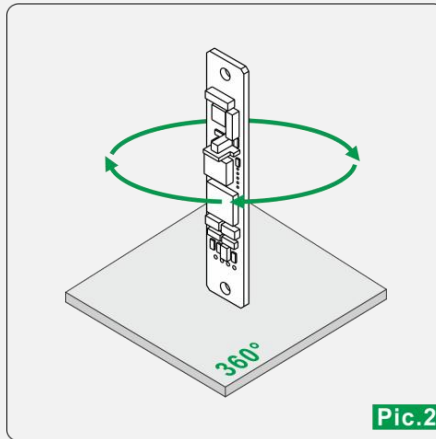
Rotate vertically at a constant speed full rotation, ensuring the time is at least 20 seconds. Values saved are only valid after 20 seconds; values saved after less than 20 seconds are invalid.

Vertical Upwards Save Calibration

68 04 00 52 56

Data Field (0 bytes)

No Data Field Command



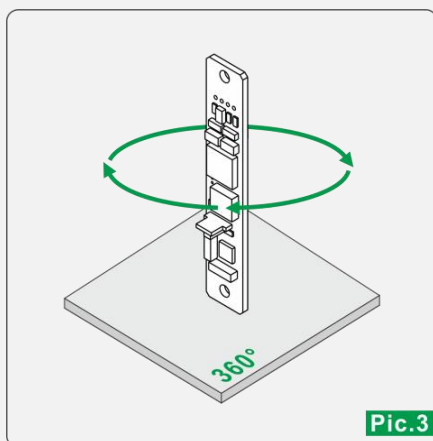
Pic.2

shown in

Command

for at least one
least 20
valid after 20
than 20

Command



Pic.3

3) Rotate vertically downwards 360° as shown in Figure C.

Vertical downwards start calibration command

68 04 00 43 47

Data field (0 bytes)

Rotate vertically and uniformly at least one full rotation, ensuring the time is at least 20 seconds. Values saved are only valid if the time is at least 20 seconds; values saved are invalid if the time is less than 20 seconds.

Vertical downwards save calibration command

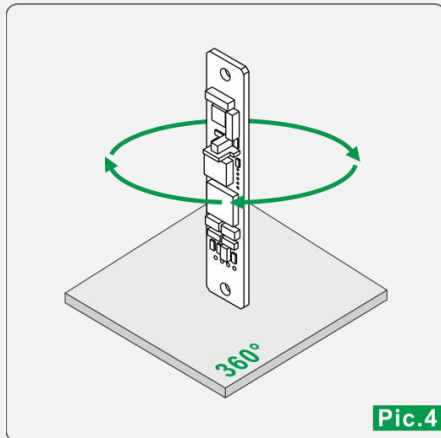
68 04 00 53 57

Data field (0 bytes)

No data field command

Vertical installation calibration mode:

Connect the LCM compass correctly to the communication port and turn on the power.



1) Rotate the plane more than 360° in one revolution:
As shown in Figure D

Horizontal Calibration Start Command

68 04 00 41 45

Data Field (0 bytes)

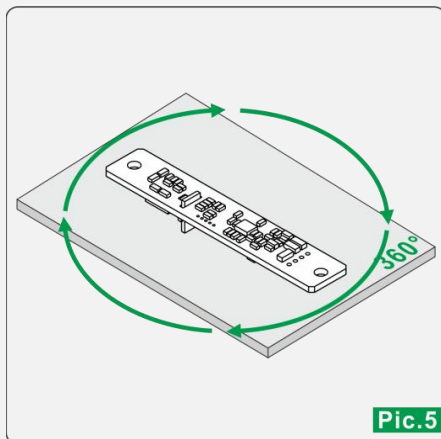
Rotate horizontally at a constant speed for more than one revolution, ensuring the time is more than 20 seconds. Values saved are only valid if the time is more than 20 seconds; values saved are invalid if the time is less than 20 seconds.

Horizontal Calibration Save Command

68 04 00 51 55

Data Field (0 bytes)

No Data Field Command



2) Rotate vertically upwards 360° as shown in Figure E.

Vertical Upwards Calibration Start Command

68 04 00 42 46

Data Field (0 bytes)

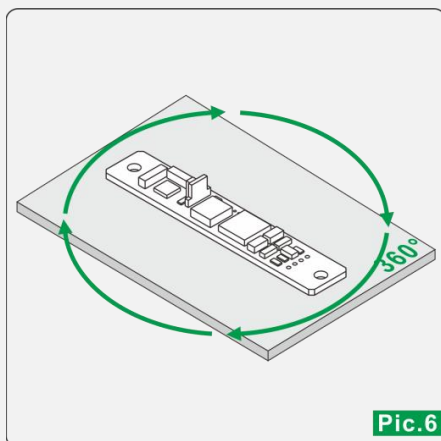
Rotate vertically upwards at a constant speed for at least one full rotation, ensuring the time is at least 20 seconds. Values saved are only valid if the time is at least 20 seconds; values saved are invalid if the time is less than 20 seconds.

Vertical Upwards Save Calibration Command

68 04 00 52 56

Data Field (0 bytes)

No Data Field Command



3) Rotate vertically downwards 360° as shown in Figure F.

Vertical downwards start calibration command

68 04 00 43 47

Data field (0 bytes)

Rotate vertically and uniformly at a speed of more than one revolution, ensuring the time is more than 20 seconds. Values saved are only valid if the time is more than 20 seconds; values saved are invalid if the time is less than 20 seconds.

Vertical downwards save calibration command

68 04 00 53 57

Data field (0 bytes)

No data field command

Multi-point calibration method

Calibration prerequisites:

1) The compass accuracy does not meet the requirements;
2) The compass installation environment has magnetic field interference. This interference is constant, and the distance between this interfering magnetic field and the compass will not change after installation (e.g., if the compass is installed on iron, the iron will cause magnetic interference. In this case, the iron and compass need to be rotated together for calibration, and they cannot be separated during use; if separated, recalibration is required. If the size of the iron is not fixed, or the distance between it and the compass is not constant, this interference cannot be calibrated. Install it as far away as possible, with a safe distance of at least 30cm).

- 1) Connect the electronic compass correctly to the signal output interface and turn on the power.
- 2) Select either automatic or manual calibration mode:
Automatic calibration mode: Send the command "68 04 00 44 48" (click the SET button after selecting automatic calibration);
Manual calibration mode: Send the command "68 04 00 43 47" (click the SET button after selecting manual calibration);
Send the calibration start command in hexadecimal format: "68 04 00 08 0C" (click the Start button).
- 3) The electronic compass will return a response command. It will also return a response for each point it acquires. Please refer to the communication protocol.
- 4) After acquiring 24 calibration points according to the calibration steps, send the stop calibration command: "68 04 00 09 0D" (click the Stop button). The electronic compass will pause for approximately 1 second while its internal CPU automatically calculates the sampled data and returns a set of data representing the score of the acquired data.
- 5) Save calibration command: Send the command "68 04 00 0A 0E" (click the save button). The compass will return a response command. If the save is successful, it can work normally. If an unsuccessful message is returned, the user needs to recalibrate.
- 6) Following step 2), send the calibration start command to begin calibration. Maintain the module's stable attitude and wait for the first point to be sampled.
- 7) After sampling the first point, rotate the module horizontally approximately 90°, maintaining stability, and wait for the next point to be sampled.
- 8) Repeat the above steps until 24 points have been sampled, then send the calibration stop button.
- 9) Send the calibration save command to end the calibration.

When calibrating, the accuracy will change if the distance between the source of magnetic interference and the compass itself changes.

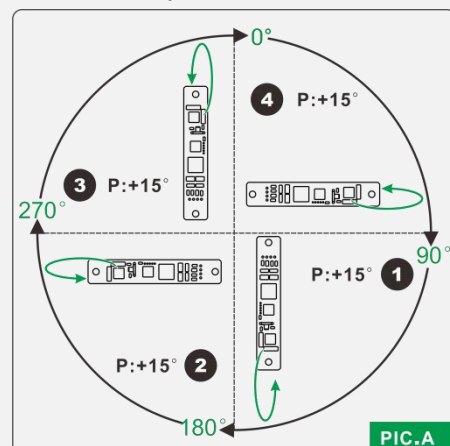
Note: When starting the calibration, calibrate the compass according to the series of calibration diagrams below. Please note that these points are not absolute headings, but rather relative heading changes based on the heading sampled from the first point. A certain degree of sampling angle error is allowed, and strict precision is not required.

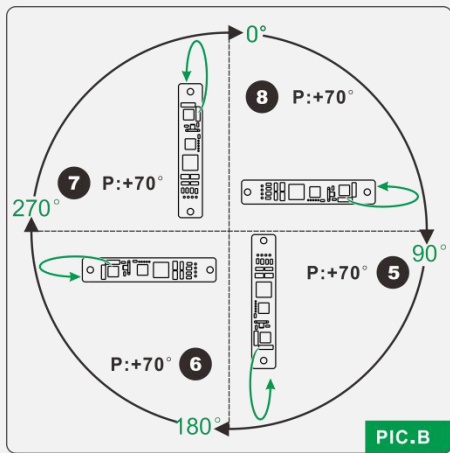
The calibration steps are as follows::

The calibration starting point can be any position within 360°, as long as it remains approximately horizontal for each angle change (precision is not required).

Example Pic.A: Starting point H=0°, R=0°, P=+15° (calibrate pitch value P first). Hold this position for 2-3 seconds; the system will acquire the first point.

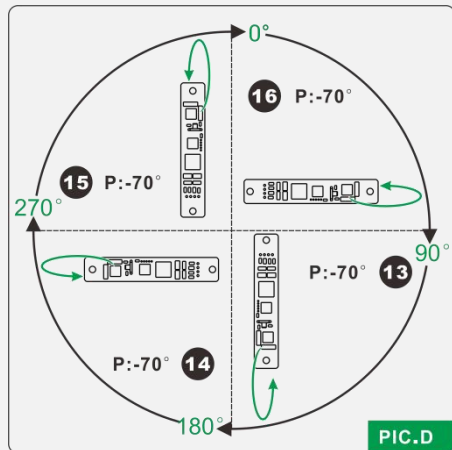
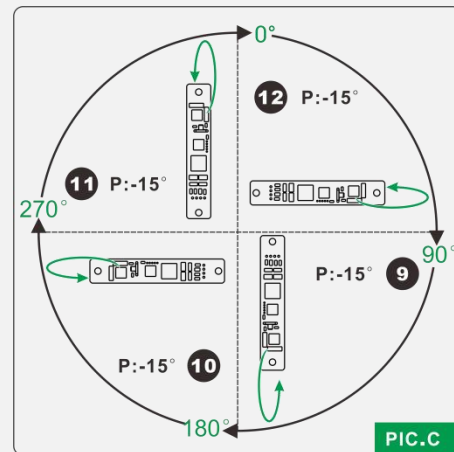
After acquiring the first point, rotate horizontally by 90°, holding this position for 2-3 seconds; the system will acquire the second point. Repeat this process for the second point. Finally, rotate horizontally by 90°, holding this position for 2-3 seconds; the system will acquire the fourth point.





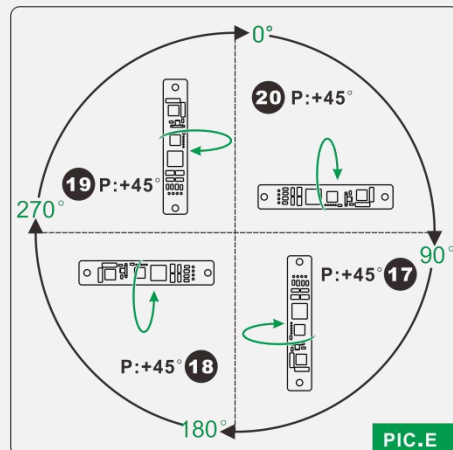
After acquiring the 4th point, keep H and R unchanged, then increase the angle value by +P. Refer to Figure B: Starting point $H=0^\circ$, $R=0^\circ$, $P=+70^\circ$. Hold this position for 2-3 seconds; the system will acquire the 5th point. After acquiring the 5th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 6th point. After acquiring the 6th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 7th point. After acquiring the 7th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 8th point.

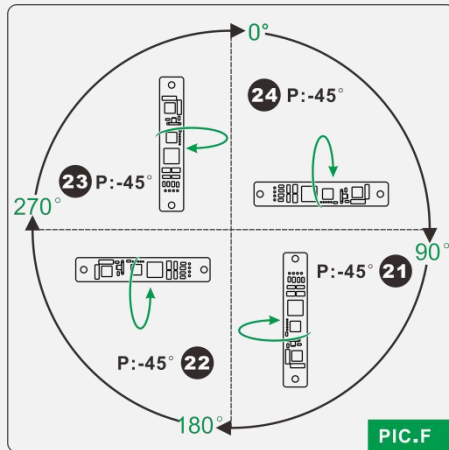
After acquiring the 8th point, keep H and R unchanged, then calibrate the -P angle. Refer to Figure Pic.C: Starting point $H=0^\circ$, $R=0^\circ$, $P=-15^\circ$. Hold this position for 2-3 seconds; the system will acquire the 9th point. After acquiring the 9th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 10th point. After acquiring the 10th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 11th point. After acquiring the 11th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 12th point.



After acquiring the 12th point, keep H and R unchanged, then increase the angle value by -P. Refer to Figure D: Starting point $H=0^\circ$, $R=0^\circ$, $P=-70^\circ$. Hold this position for 2-3 seconds; the system will acquire the 13th point. After acquiring the 13th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 14th point. After acquiring the 14th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 15th point. After acquiring the 15th point, rotate horizontally by 90° , holding this position for 2-3 seconds; the system will acquire the 16th point.

After acquiring the 16th point, P calibration is complete. Next, calibrate R (roll value). R can be calibrated alternately. Refer to Figure E: Starting point $H=0^\circ$, $R=+45^\circ$, $P=0^\circ$. Hold this position for 2-3 seconds; the system will acquire the 17th point. After acquiring the 17th point, rotate horizontally by 90° and hold this position for 2-3 seconds; the system will acquire the 18th point. After acquiring the 18th point, rotate horizontally by 90° and hold this position for 2-3 seconds; the system will acquire the 19th point. After acquiring the 19th point, rotate horizontally by 90° and hold this position for 2-3 seconds; the system will acquire the 20th point.





After acquiring the 20th point, increase the roll value (R) for calibration. Refer to Figure F: Starting point H=0°, R=-45°, P=0°. Maintain this posture for 2-3 seconds; the system will acquire the 21st point. After acquiring the 21st point, rotate horizontally by 90° and maintain this posture for 2-3 seconds; the system will acquire the 22nd point. After acquiring the 22nd point, rotate horizontally by 90° and maintain this posture for 2-3 seconds; the system will acquire the 23rd point. After acquiring the 23rd point, rotate horizontally by 90° and maintain this posture for 2-3 seconds; the system will acquire the 24th point. Send a stop command—the compass will respond with scoring data.



Communication protocol default parameter settings

Protocol	Serial communication protocol
Address Code	0
Broadcast Address	255
Serial Port Baud Rate	9600
Parity Bit	No parity
Serial Port Start Bit	1 Bit
Serial Port Data Bit Length	8 Bits
Serial Port Stop Bit	1 Bit
Output Mode	Question-and-answer mode
Calibration Method	Plane calibration
Data Verification Method	Accumulated sum verification
Setting Geomagnetic Threshold	4: 0.44/1.4~0.44*1.4



Serial communication protocol

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

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field	Checksum (1byte)
68H					

Number format: Hexadecimal;

Identifier: Fixed at 68H;

Data length: From data length to checksum (including checksum length);

Address code: Address of the acquisition module, default is 00;

Data fields vary according to the content and length of the command word;

Checksum: The sum of data length, address code, command word, and data fields, without considering carry-over.

Example: Sending an inquiry command 68 04 00 04 08.

Checksum calculation method: 04+00+04=08

2. Command Word Parsing

2.1. Simultaneously read Pitch, Roll, and Heading commands: command word 04H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field	Checksum (1byte)
68H	04H	00H	04H	No	08H

Sensor response (Pitch, Roll, Heading): Command word 0X84 (Response to selecting the standard protocol)

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (10byte)	Checksum (1byte)
68H	0EH	00H	84H	00 10 50 10 10 05 01 04 01 00	1DH

Data Field (10byte)

AA AB BB CC CD DD EE EF FF GG;

AA AB BB: Three red characters represent the Pitch axis return value;

CC CD DD: Three blue characters represent the Roll axis return value;

EE EF FF: Three green characters represent the Heading angle return value;

Example: 00 10 50 The three red bytes represent the Pitch return value, which is compressed BCD code. The high four bits of the first byte are 0 for the sign bit (0 for positive, 1 for negative) 01 0 for a three-digit integer value, and 50 for a two-digit decimal value. Other axis data is parsed in the same way; the Pitch angle is parsed as +10.50°;

10 10 05 The three blue bytes represent the Roll return value, parsed in the same way as Pitch, with the angle being -010.05°;

01 04 01 The three green bytes represent the Heading angle return value, parsed in the same way as Pitch, with the angle being +104.01°.

GG: Indicates a value of 1 when the magnetic field exceeds the threshold, and 0 when it does not. (Multi-point calibration byte modification is ineffective)

Sensor response: Pitch, Roll, Heading: Command word 84H (Reply with 500 protocol)

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (9byte)	Checksum (1byte)
68H	0DH	00H	84H	00 10 50 10 10 05 01 04 01	1CH

Data Field (9byte):

AA AB BB CC CD DD EE EF FF;

AA AB BB: Three red characters represent the Pitch axis return value;

CC CD DD: Three blue characters represent the Roll axis return value;

EE EF FF: Three green characters represent the Heading angle return value;

Example: 00 10 50 The three red bytes represent the Pitch return value, which is compressed BCD code. The high four bits of the first byte are 0 for the sign bit (0 for positive, 1 for negative), 01 0 for a three-digit integer value, and 50 for a two-digit decimal value.

Other axis data is parsed in the same way; the Pitch angle is parsed as +10.50°;

10 10 05 The three blue bytes represent the Roll return value, parsed in the same way as Pitch, with the angle being -010.05°;

01 04 01 The three green bytes represent the Heading angle return value, parsed in the same way as Pitch, with the angle being +104.01°.

2.2. Command to set magnetic declination: Command word 06H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (2byte)	Checksum (1byte)
68H	04H	00H	06H	02H 08H	16H

Data Field (2 bytes):

SA AB: S is sign (0 for positive, 1 for negative); AA: two-digit integer; B: one-digit decimal.

Example: 02 08 represents +20.8°.

Sensor Response: Command word 86H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	04H	00H	86H	00H	8BH

Data Field (1 byte)

The number in the data field represents the sensor's response.

00 Successful setup FF Failed setup

2.3. Read magnetic declination command: command word 07H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	07H	No	0BH

Data field (0 bytes)

No data field command

Sensor response reply: Command word 87H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (2byte)	Checksum (1byte)
68H	06H	00H	87H	02H 08H	97H

Data Field (2 bytes)

The numbers in the data field represent the sensor's response.

SA AB: S is the sign (0 for positive, 1 for negative); AA: two-digit integer, B: one-digit decimal.

Example: 02 08 represents +20.8°.

2.4. Calibration method setting command: Command word 2BH 00H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(2byte)	Data Field (1byte)	Checksum (1byte)
68H	06H	00H	2BH 00H	00H	31H

Data Field (1 byte)

00H: Set to planar calibration.

01H: Set to multi-point calibration. Configure as needed, then select the corresponding calibration command and method. Save settings upon power failure.

Sensor Response: Command word ABH 00H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(2byte)	Data Field (1byte)	Checksum (1byte)
68H	06H	00H	ABH 00H	00H/01H	B1H

Data field (1 byte)

00: Setting successful FF: Setting failed

2.5. Calibration method query : Command word 2BH01H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(2byte)	Data Field (1byte)	Checksum (1byte)
68H	06H	00H	2BH 01H	00H	32H

Data field (1 byte)

Sensor response: Command word ABH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(2byte)	Data Field (1byte)	Checksum (1byte)
68H	06H	00H	ABH 01H	00H/01H	B1H

Data field (1 byte)

Planar calibration response: 00H; Multi-point calibration response: 01H

2.6. Planar calibration and related instructions

2.6.1 Horizontal start calibration command: Command Word 41H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	41H	No	45H

Data field (0byte)

The sensor must rotate horizontally at a constant speed for at least one revolution, and the saved value must be at least 20 seconds; values saved less than 20 seconds are invalid.

Sensor response: Command word 41H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	41H	No	45H

Data field (0byte)

No data field command

2.6.2 Sensor calibration progress bar response reply: Command Word 41H01

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(2byte)	Data Field (1byte)	Checksum (1byte)
68H	06H	00H	41H01H	01H	49H

Data field (1byte)

The data field command shows progress 1-128, which represents a total of 128 points.

68H	06H	00H	41H01H	01H	49H
-----	-----	-----	--------	-----	-----

68H	06H	00H	41H01H	02H	4AH
-----	-----	-----	--------	-----	-----

68H	06H	00H	41H01H	80H	45H
-----	-----	-----	--------	-----	-----

2.6.3 Horizontal calibration save command: command word 51H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	51H	No	55H

Data field (0byte)

No data field command

Sensor response reply: Command word 51H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	51H	No	55H

Data field (0byte)

No data field command

2.6.4 Vertical upward calibration start command: command word 42H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	42H	No	46H

Data field (0byte)

The sensor must rotate vertically and uniformly for at least one revolution, with a time frame of at least 20 seconds, for the saved value to be valid. Values saved within 20 seconds are invalid.

Sensor response: Command word 42H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	42H	No	46H

Data field (0byte)

No data field command

2.6.5 Save calibration command vertically upwards: Command word 52H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	52H	No	56H

Data field (0byte)

No data field command

Sensor response reply: Command word 52H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	52H	No	56H

Data field (0byte)

No data field command

2.6.6 Vertical downward calibration start command: command word 43H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	43H	No	47H

Data field (0byte)

The sensor must rotate vertically and uniformly at least once, with a time limit of 20 seconds or more, for the saved value to be valid. Values saved less than 20 seconds are invalid.

Sensor response: Command word 43H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	43H	No	47H

Data field (0byte)

No data field command

2.6.7 Save calibration command vertically downwards: Command word 53H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	53H	No	57H

Data field (0byte)

No data field command

Sensor response: Command word 53H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	53H	No	57H

Data field (0byte)

No data field command

2.6.8 Clear calibration command: command word 5AH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	5AH	No	5EH

Data field (0byte)

Three attempts are required for the message to be effective (this clears current calibration data; factory calibration data will not be overwritten).

Sensor response: Command word 5aH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	5aH	无	5eH

Data field (0byte)

No data field command

2.6.9 Factory reset command: command word 0EH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	0EH	AAH	BDH

Data Field (1 byte)

Recall Factory Defaults (Current calibration data is overwritten)

Sensor Response: Command Word 0EH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	8EH	00H	93H

Data Field (1 byte)

00: Success FF: Failure

2.7. Multi-point calibration and related instructions

2.7.1 Start calibration command: command word 08H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
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68H	04H	00H	08H	No	0CH
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Data Field (0 bytes)

Multi-point calibration start command (responding to other commands will only be effective three seconds after calibration begins)

Sensor response: Command word 88H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	88H	00H	8DH

Data Field (1 byte)

00: Success FF: Failure

2.7.2 Calibration stop command: Command word 09H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	09H	No	0DH

Data Field (0 byte)

Example: **68 04 00 09 0D**

Sensor response: Command word 89H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (12byte)	Checksum (1byte)
68H	10H	00H	89H	00H 00H 78H 00H 01H 13H 00H 00H 40H 00H 64H 74H	93H

Data Field (12byte)Example: **68 10 00 89 00 00 78 00 01 13 00 00 40 00 64 74 3D**

Calibration scoring

SA AA BB SC CD DD SE EF FF SG GG HH

SA AA BB: The three characters represent the calibration residual coefficient of the sampling point. A value less than 1 indicates normal operation. The smaller the value, the more reliable the calibration.

SC CD DD: The three characters represent the uniformity of the 3D calibration sampling points in all directions. This score should be less than 6%. The smaller the value, the more uniform the distribution of the sampling points.

SE EF FF: The three characters represent the range of tilt angle distribution of the 3D calibration sampling points. The score should be between 0 and 1. The smaller the value, the wider the spatial coverage of the sampling points.

SG GG HH: The three characters represent the maximum single-sided amplitude of the pitch and roll angles of the compass calibration sampling points. This score should be greater than 45°. The larger this value, the more fully the spatial distribution of the calibration sampling points.

Note: The above scores are for reference only. Meeting the above score requirements indicates excellent sampling conditions for this calibration and represents accurate azimuth precision.

The first byte's high four bits are the sign bit (1 for negative, 0 for positive);

The first byte's low four bits are the hundreds digit;

The second byte's high four bits are the tens digit;

The second byte's low four bits are the ones digit;

The third byte's high four bits are the tenths digit;

The third byte's low four bits are the hundredths digit.

In the example on the left, the angle is:

SA AA BB : 0.78

SC CD DD : 1.31%

SE EF FF : 0.4

SG GG HH: 64.74°

2.7.3 Automatic calibration command: command word 44H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	44H	No	48H

Data Field (0 byte)

Example: **68 04 00 44 48**

Sensor response: Command word C4H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	C4H	00H	C9H

The numbers in the data field represent the sensor's response:

00 Success begins FF Failure begins

2.7.4 Manual calibration command: command word 43H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	43H	No	47H

Data Field (0 byte)

Example: **68 04 00 43 47**

Sensor response: Command word C4H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	C3H	00H	C8H

The numbers in the data field represent the sensor's response:

00 Success begins FF Failure begins

2.7.5 Manual data acquisition command: command word 45H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	45H	无	49H

Data Field (0 byte)

Example: **68 04 00 45 49**

Sensor response reply: Command word 88H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	88H	00H	8DH

Data Field (1 byte)

00: Success FF: Failure

Note: The module will return data for each point taken thereafter until calibration stops, in the following format:

0X88	24-point sampling response command: 68 05 00 88 01 8E (1) 68 05 00 88 02 8F (2) 68 05 00 88 03 90 (3) ... 68 05 00 88 18 A5 (24)	Data Field (1 byte) The number in the data field represents the digital (hexadecimal) value of the calibration point sampled by the sensor.
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2.7.6 Save calibration command: Command word 0AH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	0AH	No	0EH

Data field (0 bytes)

Sensor response: Command word 8AH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	8AH	00H	8FH

Data field (1 byte)

00: Success FF: Failure

2.7.7 Calibration abort command: Command word 46H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	46H	No	4AH

Data field (0 bytes)

Example: **68 04 00 46 4A**

Once calibration has started, the "stop calibration" command is effective only, and the magnetic calibration parameters will revert to the previously saved data. The "stop calibration" command is invalid after saving the calibration settings.

Sensor response: Command word C6H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	C6H	00H	CBH

Data field (1 byte)

00: Success FF: Failure

2.8. Command to set communication baud rate: Command word 0BH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	0BH	02H	12H

Data Field (1 byte) Baud Rate:

00 indicates TBD 01 indicates TBD **02 indicates 9600 (factory default)**

03 indicates 19200 04 indicates 38400 05 indicates 115200

Sensor Response: Command word 8BH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	8BH	00H	90H

Data field (1 byte)

00: Success FF: Failure

2.9. Command to set module address: Command word 0FH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	0FH	01H	15H

Data Field (1 byte)

Module address, ranging from 00 to FEH.

Note: Our products use the standard address FF. If you forget your address, you can use the FF address to operate the product; it will still respond normally.

Sensor Response: Command word 8FH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	8FH	00H	94H

Data Field (1 byte)

The number in the data field represents the sensor's response result:

00: Success FF: Failure

2.10. Set angle output command: Command word 0CH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	0CH	00H	11H

Data Field (1 byte)

00: Question-and-answer mode (factory default)

02: Automatic output mode 5Hz

04: Automatic output mode 25Hz

Sensor response: Command word 8CH

01: Automatic output mode 20Hz

03: Automatic output mode 10Hz

05: Automatic output mode 50Hz

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	8CH	00H	91H

Data Field (1 byte)

The number in the data field represents the sensor's response result:

00: Success FF: Failure

2.11. Command to set geomagnetic detection threshold: Command word 50H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	50H	01H	56H

Data Field (1 byte)

BYTE4 value range: 1~10. Values greater than the threshold are considered interference and are saved upon power loss.

Corresponding threshold table:

1: $0.44 \times 0.99 \sim 0.44 \times 0.9$ 2: $0.44 / 1.2 \sim 0.44 \times 1.2$

3: $0.44 / 1.3 \sim 0.44 \times 1.3$ **4: $0.44 / 1.4 \sim 0.44 \times 1.4$ (Factory default)**

5: $0.44 / 1.7 \sim 0.44 \times 1.7$ 6: $0.44 / 1.9 \sim 0.44 \times 1.9$

7: $0.44 / 2.3 \sim 0.44 \times 2.3$ 8: $0.44 / 2.5 \sim 0.44 \times 2.5$

9: $0.44 / 2.9 \sim 0.44 \times 2.9$ 10: $0.44 / 3.5 \sim 0.44 \times 3.5$

Other Value is 4: $0.44 / 1.4 \sim 0.44 \times 1.4$

Sensor response: Command word D0H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	D0H	00H	D5H

Data Field (1 byte)

The number in the data field represents the sensor's response result:

00: Success FF: Failure

2.12. Command to set installation mode: Command word 2AH (Set vertical)

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	2AH	01H	30H

Data Field (1 byte)

00: Horizontal 01: Vertical

Recalibration is required after changing the installation mode.

Sensor Response: Command word AAH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	AAH	00H	AFH

Data field (1 byte)

00: Success FF: Failure

2.13. Command to set installation mode: Command word 2AH (Set horizontal)

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	2AH	00H	2FH

Data Field (1 byte)

00: Horizontal 01: Vertical

Recalibration is required after changing the installation mode.

Sensor Response: Command word AAH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	AAH	00H	AFH

Data field (1 byte)

00: Success FF: Failure

2.14. Read accelerometer command: Command word 60H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	60H	No	64H

Data field (0 byte)

Sensor response: Command word E0H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (9byte)	Checksum (1byte)
68H	0DH	00H	E0H	00 00 01 10 00 00 00 01 02	01H

Data field (9 byte)

Parsing three bytes to represent an axis

AA AB BB CC CD DD EE EF FF

AA AB BB Represents X-axis acceleration

CC CD DD Represents Y-axis acceleration

EE EF FF Represents Z-axis acceleration

In the example on the left, the X-axis acceleration = 0.01g, the Y-axis acceleration = -0g, and the Z-axis acceleration = 1.02g.

The high four bits of the first byte are the sign bit.

The low four bits of the first byte are the hundreds digit.

The high four bits of the second byte are the tens digit.

The low four bits of the second byte are the units digit.

The high four bits of the third byte are the tenths digit.

The low four bits of the third byte are the hundredths digit.

2.15. Read magnetometer command: Command word 61H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	61H	No	65H

Data field (0 bytes)

Sensor response: Command word E1H

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (9byte)	Checksum (1byte)
68H	0DH	00H	E1H	00 04 15 10 31 48 00 12 93	35H

Data field (9byte)

AA AB BB CC CD DD EE EF FF

AA AB BB Indicates X-axis magnetometer

CC CD DD Indicates Y-axis magnetometer

EE EF FF Indicates Z-axis magnetometer

In the example on the left, the X-axis magnetometer value is 415, the Y-axis magnetometer value is -3148, and the Z-axis magnetometer value is 1293 (μT).

2.16. Enter low-power command: command word FAH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	04H	00H	FAH	No	FEH

Data Field (0 bytes) 68 04 00 FA FE

Entering low-power mode from normal mode, send once to enter

Sensor response reply: Command word AAH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	FAH	00H	FFH

Data Field (1byte)

00: Success FF: Failure

2.17. Command to exit low-power mode: command word EEH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (0byte)	Checksum (1byte)
68H	05H	00H	EEH	FF	F2H

Data Field (1 byte)

Sending data via the serial port will briefly wake the sensor. The compass will determine if it's a wake-up command. If not, it will automatically enter low-power mode after 3 seconds.

Sensor Response: Command word EEH

Identifier (1byte)	Data Length (1byte)	Address Code(1byte)	Command Word(1byte)	Data Field (1byte)	Checksum (1byte)
68H	05H	00H	EEH	FFH	F2H

Data Field (1byte)