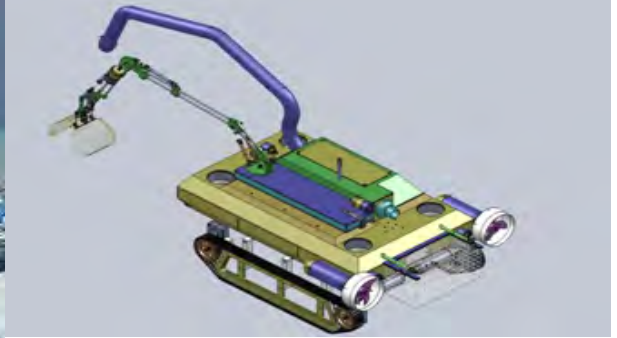BWSENSING

SEC385M Serials

Inclination Compensation 3D Electronic Compass

Technical Manual

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SEC385M is a cost-effective 3D electronic compass developed by Bewis Sensing Technology LLC. The product adopts the patented hard iron and soft iron calibration algorithm of Beiwei Sensing Technology LLC, which can provide high-precision heading information when its inclination reaches 40°. It has the advantages of small size and low power consumption, and is suitable for sensitive measurement systems with small size and high precision. The SEC385M integrates a three-axis magnetic sensor that compensates for the tilt angle with a three-axis accelerometer when the heading is solved in real time by the central processor, providing accurate heading data in very harsh environments. The SEC385M supports RS232, RS485 and TTL level output interfaces. The output baud rate is 2400-115200, and the output angle is 0°~360°. There are two types of hexadecimal and Modbus protocols. It can be adapted to different application scenarios and can integrate the electronic compass function into various systems very conveniently and quickly.

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- Accuracy (max):0.5° (RMS)
- Operating temperature: -40 ° C ~ +85 ° C
- Small size: L60 x W59x H29(mm)
- Supply voltage: 9-35V

- Hard magnetic, soft magnetic and tilt compensation
- Resolution: 0.1°
- Rolling pitch accuracy: 0.1°
- RS232/RS485/TTL interface optional

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- Satellite tracking
- Petroleum geological exploration
- Optical range finder
- GPS-assisted navigation

- Individual combat equipment
- Ocean test
- Underwater navigation
- Mechanical control

Specifications

⚡ Electrical Specifications

Power supply	9-36V DC
Operating current	30mA（Max40mA）
Operating temperature	-40~85℃
Store temperature	-55~100℃

🛠 Performance Specifications

Compass heading parameter	Heading accuracy	0.5°（Pitch<40°）0.7°（Pitch<60°）1°（Pitch<80°）
	Resolution	0.01°
	Repeatability	0.1°
Compass tilt parameter	Pitch accuracy	0.1°
	Rolling accuracy	0.1° for Pitch < 80°
	Dip resolution	0.01°
	Tilt range	±80°
Calibration	Hard magnetic calibration	Yes
	Soft magnetic calibration	Yes
	Tilt calibration	Yes
Physical specifications	Size	L60 x W59 x H29(mm)
	Weight	180g
	Output form	RS232/485/TTL Optional
Interface specifications	Start delay	<3s
	Frequency response	50Hz
	RS-232Communication rate	2400-115200 Baud rate
Environment	Anti-vibration performance	2000g

Resolution: The measured minimum change value that the sensor can detect and resolve within the measurement range.
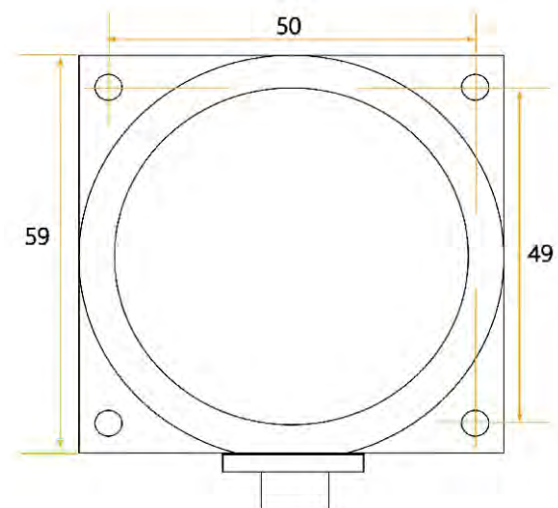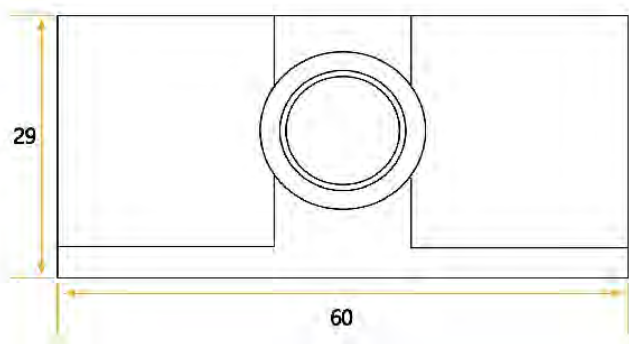**Accuracy:** The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

Mechanical Characteristic

Connector	Metal connector (standard cable is 1.5m)
Protection level	IP67
Shell material	Magnesium alloy anodizing
Installation	Four M4 screws

Package size

Product Size:L60*W59*H29(mm)

6. The product is placed in a vertical state, the smooth side of the casing is facing downward (the pitch and the roll are both within ±5°), rotate one revolution at a constant speed approximately and use for more than 10 seconds.

7. The product is placed in a vertical state, and the other smooth side of the casing faces downward (the pitch and the roll are both within ±5°), rotate one revolution at a constant speed approximately and use for more than 10 seconds.

Where step 4.5.6.7 can be exchanged;

8. After the four faces have been rotated, send the hexadecimal command 77 04 00 09 0D to save the calibration and return to 77 05 00 89 XX YY. (XX represents the calibration error coefficient, the smaller the value, the better, less than 1 is ideal, FF indicates calibration failure, and YY is the checksum of the command);

9. Calibration completed

Electrical connections

Electrical interfaces

Cable color & function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 9-35V	NC	GND	RXD (B、D-)	TXD (A、D+)
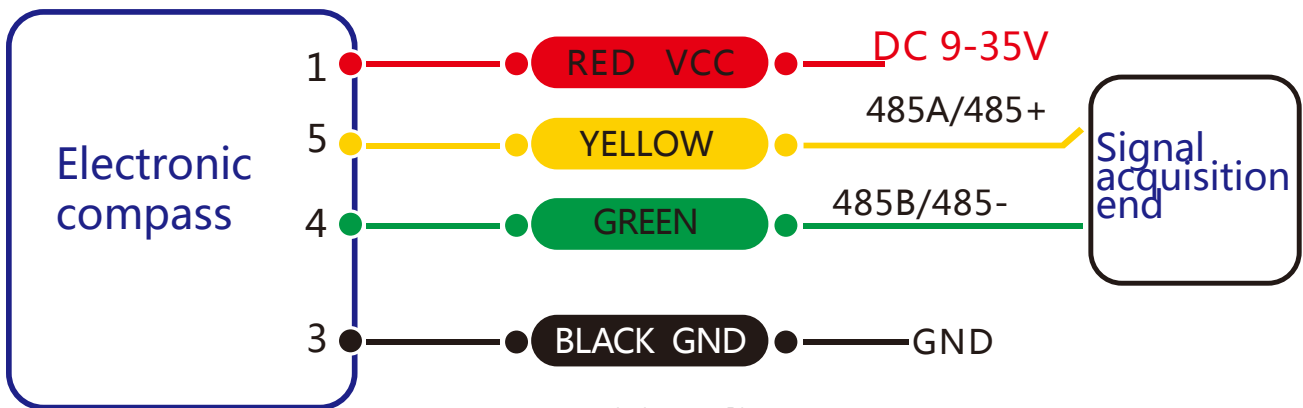
RS 485 wiring diagram
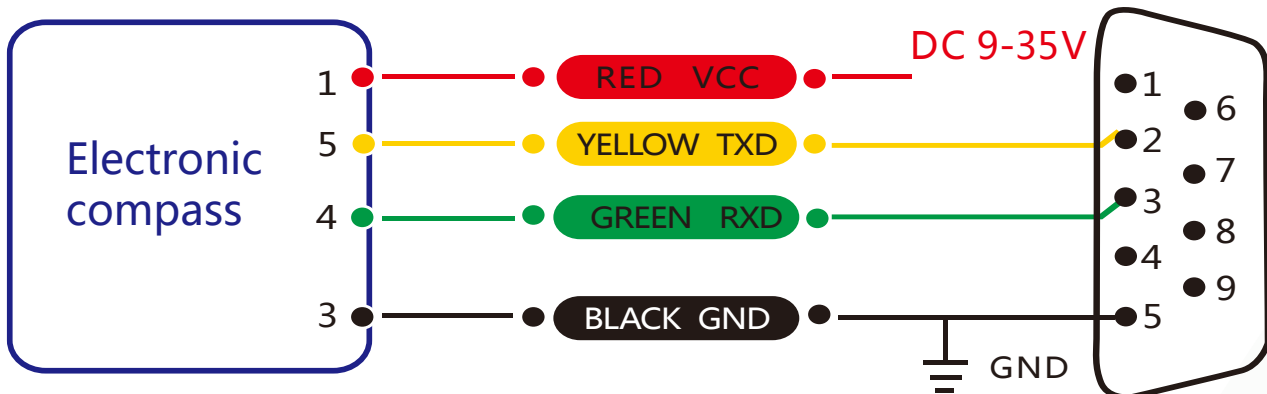
RS 232 wiring diagram

Communacation Protocol

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

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
0x77	03(read) 06(write)	XX XX	XX XX	XX XX

Data Format: Hexadecimal.
Address code: default 01 (note: address must not exceed FFF).
Function code: 03 for read register, 06 for prefabricated register.
Address of register: the starting address of the register that needs to be operated.
Number of registers: the number of registers to operate on.
CRC check: Through the calculation of the host computer. (suggested using CRC software)

2 Command format :

2.1 Read the PITCH angle   Command : 01 03 00 01 00 01 D5 CA

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
01	03	00 01	00 01	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Number of bytes of data (1 byte)	Data (2byte)	CRC check (2 byte)
01	03	02	XX XX	ZZ ZZ

XX XX denotes pitch angle with an angle value of hexadecimal number. (PLC or configuration software read out the number is directly the decimal number). The angle is calculated as follows:
Actual angle = (data converted to decimal -20000 / 100).
For example: the return value of the angle value is 3D52, turning it into decimal is 15698,
The real data is (15698-20000) /100=-43.02°, and the other axes are the same.

2.2 Read the ROLL angle   Command : 01 03 00 02 00 01 25 CA

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
01	03	00 02	00 01	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Number of bytes of data (1 byte)	Data (2byte)	CRC check (2 byte)
01	03	02	XX XX	ZZ ZZ

2.3 Read the HEADING angle   Command : 01 03 00 03 00 01 74 0A

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
01	03	00 03	00 01	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Number of bytes of data (1 byte)	Data (2byte)	CRC check (2 byte)
01	03	02	XX XX	ZZ ZZ

2.4 Read the Heading, Pitch and Roll angle   Command : 01 03 00 01 00 03 54 0B

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
01	03	00 01	00 03	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Number of bytes of data (2 byte)	Data (2byte)	CRC check (2 byte)
01	03	06	XX XX YY YY ZZ ZZ	ZZ ZZ

XX XX means PITCH angle YY YY means ROLL angle ZZ ZZ denotes HEADING angle

2.5 Set relative / absolute zero   Command : 01 06 00 0A 00 00 A9 C8 / 01 06 00 0A 00 01 68 08

Address Code (1byte)	Function Code (1byte)	Function Code (1byte)	Zero Point Type (2byte)	CRC check (2 byte)
01	06	00 0A	00 00(Absolute) 00 01(Relative)	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Function Code (1byte)	Zero Point Type (2byte)	CRC check (2 byte)
01	06	00 0A	00 00(Absolute) 00 01(Relative)	XX XX

Note: The measured angle is referred to the zero point calibrated in factory if absolute zero point is set. The measured angle is referred to the current angle if relative zero point is set. The zero point is the zero point of the dip Angle, and when installing, try to install it in the zero attachment. The Angle changes more, which will cause the change of azimuth.

2.6 Query the relative /Absolute zero point   Command : 01 03 00 05 00 01 94 0B

Address Code (1byte)	Function Code (1byte)	The first address of the read register (2 byte)	Number of read registers (2byte)	CRC check (2 byte)
01	03	00 05	00 01	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Number of bytes of data (1 byte)	Data (2byte)	CRC check (2 byte)
01	03	02	00 00(Absolute) 00 01(Relative)	ZZ ZZ

2.7 Set baud rate   Command : 01 06 00 0B 00 02 79 C9

	Address Code (1byte)	Function Code (1byte)	Function Code (2byte)	Baud rate type (2byte)	CRC check (2 byte)
Send	01	06	00 0B	XX XX	XX XX
Response	01	06	00 0B	XX XX	XX XX

Note: if XX XX in the baud rate type is
0000, the baud rate is revised to 2400;
0001 indicates that the baud rate is revised to 4800;
0002 indicates that the baud rate is revised to 9600 (the default value);
0003 indicates that the baud rate is revised to 19200;
0004 indicates that the baud rate is revised to 115200;
If the baud rate is changed immediately after the command is sent, the return value is generally confusing.

2.8 Set address   Command : 01 06 00 0D 00 02 99 CB

	Address Code (1byte)	Function Code (1byte)	Function Code (2byte)	Modified address (2byte)	CRC check (2 byte)
Send	01	06	00 0D	HH LL	XX XX
Response	LL	06	00 0D	HH LL	XX XX

Note: HH LL represents the address of the product to be changed, HH represents the high position of the address, and LL represents the status of the address, which is 00 00-00 FF. In the example, the address of the product is changed to 0002.

2.9 Query address   Command : 77 04 00 2F 33

	Identifier (1byte)	Function Length (1byte)	Product custom protocol address (1byte)	Function Length (1byte)	MODBUS address (1byte)	Checksum (1byte)
Send	77	04	00	2F		33
Response	77	05	00	2F	XX	XX

Note: Because the MODBUS protocol specifies that the product can communicate only when it knows the address of the module, when the MODBUS protocol communication, the address is known in advance and can not be queried. This product uses custom protocols to query the address of the MODBUS protocol. You can see the product introduction of a custom protocol about related custom protocol. And the command is valid for 10 seconds before power.
The XX in the MODBUS address is the product address of the protocol.

2.10 Save setting   Command : 01 06 00 0F 00 00 78 09

Address Code (1byte)	Function Code (1byte)	Function Code (1byte)	(2byte)	CRC check (2 byte)
01	06	00 0F	00 00	XX XX

Command response :

Address Code (1byte)	Function Code (1byte)	Function Code (1byte)	(2byte)	CRC check (2 byte)
01	06	00 0F	00 00	XX XX

Note: command should be sent without a power outage after all previous settings that need to be changed are changed. Otherwise, there is no memory function.

Ordering Information

Product No.	Protocol	Encapsulation
SEC385M-232-Modbus	RS 232	IP67
SEC385M-485-Modbus	RS 485	IP67
SEC385M-TTL-Modbus	TTL	IP67

Implementation Standards

- Enterprise Quality System Standard: ISO9001:2008 Standard (Certificate No.:23919Q1045IROS)
- CE certification (certificate number: M.2019.103.UY1151)
- RoHS (certificate number:G 190930099)

SEC385M

Inclination compensation 3D electronic compass MODBUS

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