SEC380 Series

Inclination compensation 3D electronic compass

Technical Manual

V3.0

SEC380
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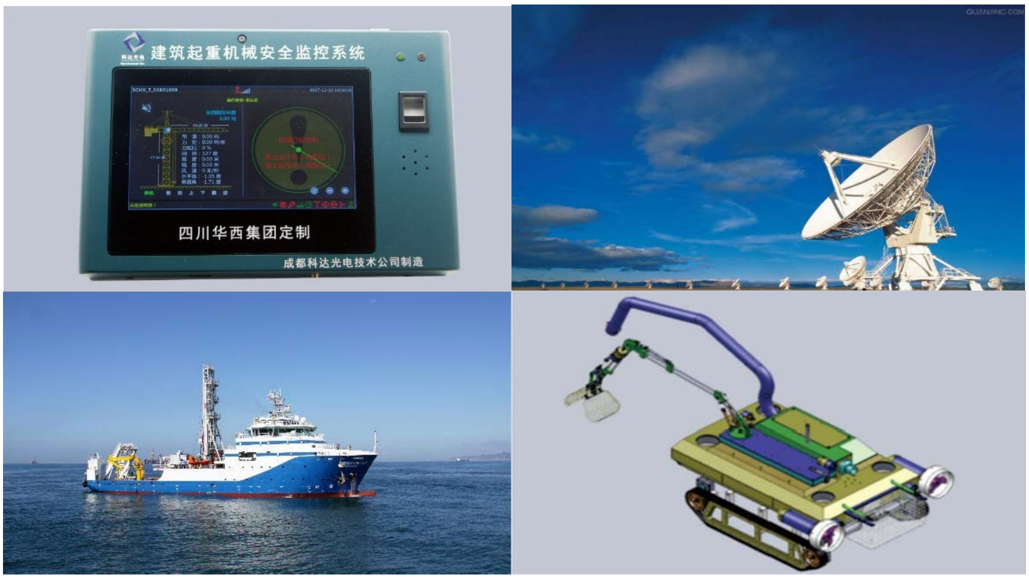


Introduction

SEC380 is a cost-effective three-dimensional electronic compass developed and produced by Bewis Sensing. The product adopts the hard iron and soft iron calibration algorithm of Bewis Sensing patent technology, so that it can still provide high-precision heading information when its inclination reaches 90°. It has the advantages of small size and low power consumption, and is suitable for miniaturized, high-precision sensitive measurement systems.

SEC380 integrates a three-axis magnetic sensor. When the heading is calculated by the central processing unit in real time, a three-axis accelerometer is used to compensate the tilt angle, so that it can provide accurate heading data even in extremely harsh environments. It supports RS232, RS485 and TTL level output interfaces. The output baud rate is 2400-115200, the output angle is 0°～360°, there are two types of hexadecimal and Modbus protocol. It can be adapted to the needs of different application scenarios, and the electronic compass function can be integrated into various systems very conveniently and quickly.

Feature

- Accuracy：0.5°(RMS)
- -40℃～+85℃ wide temperature work
- Small size：L45 x W36 x H13 (mm)
- Power supply：9-36V
- Resolution：0.1°
- Pitch/Roll：0.1°
- With hard magnetic, soft magnetic and tilt compensation
- Standard RS232/RS485/TTL Output optional

Application

- Satellite tracking
- Petroleum geological survey
- Optical rangefinder
- GPS assisted navigation
- Individual combat equipment
- Marine survey
- Underwater navigation
- Mechanical control

Product Feature

Electrical Index

Power voltage	9-36V DC
Working current	30mA (40mA max)
Operating temperature	-40℃~85℃
Storage temperature	-55℃~100℃

Performance Index

Compass heading parameters	Heading accuracy	0.5° (Pitch<40°) 0.7° (Pitch<60°) 1° (Pitch<80°)
	Resolution	0.01°
	Repeatability	0.1°
Compass tilt parameters	Pitch accuracy	0.1°
	Roll accuracy	0.1° for pitch <80°
	Resolution	0.01°
	Tilt range	±80°
Calibration	Hard magnetic calibration	Yes
	Soft magnetic calibration	Yes
	Limited tilt user calibration	Yes
Physical properties	Dimension	L33 x W27 x H5 (mm)
	Weight	25g
	Output form	RS232/485/TTL interface
Interface characteristics	Start-up delay	<3s
	Maximum output frequency	50Hz
	RS232 communication rate	2400 to 115200 baud rate
Environment	Anti-vibration performance	2000g

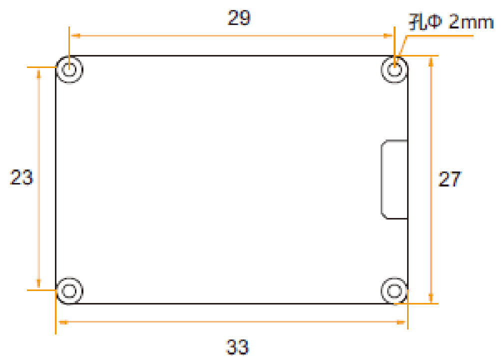
Resolution: The smallest change value of the measured value that the sensor can detect and distinguish within the measurement range.
Accuracy: The root mean square error of the actual angle and the sensor measuring angle for multiple (≥16 times) measurements.

Mechanical properties

Connector	Cable socket (30cm cable)
Installation	Four M2 non-magnetic screws

PCBA size

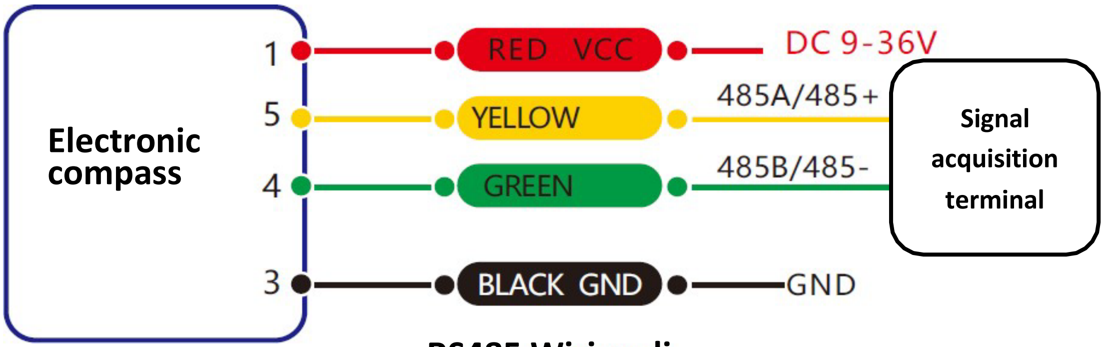
Product size：L45*W36*H13（mm）



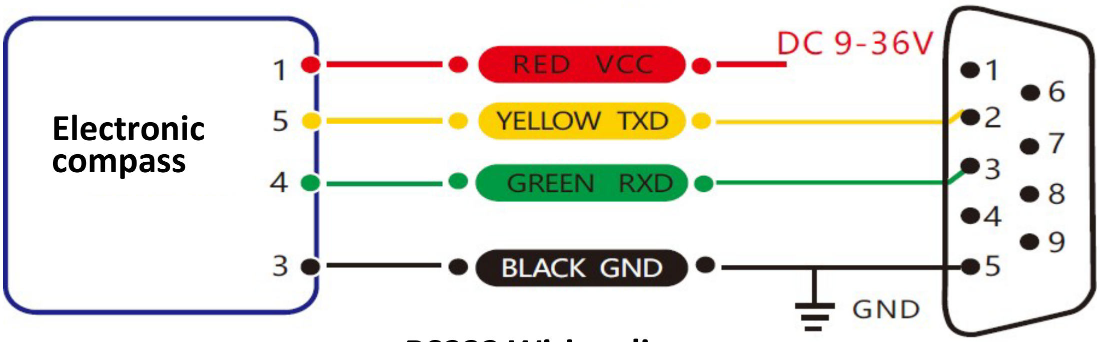
Electrical Interface

Wiring definition

Wiring color function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 9-36V	NC	GND	RXD (B、D-)	TXD (A、D+)



RS485 Wiring diagram



RS232 Wiring diagram

Measurement installation

The main sensitive devices of SEC380 sensor are magnetometer and accelerometer. The compass uses a magnetometer to sense the earth's magnetic field to calculate the sensor's pointing, uses an accelerometer to measure the angle between the compass and gravity, and provides inclination compensation when the compass calculates the azimuth angle. The geomagnetic field is easily interfered by external magnetic fields. Users still need to pay attention to the surrounding magnetic field when installing, ensure that the sensor is exposed to the geomagnetic field, and try to avoid using it near ferromagnetic materials and changing magnetic fields, such as engines, iron plates, Install sensors near ferrous bolts and nuts, wires, motors, horns, and antennas. Be sure to strictly avoid magnets, motors and other strong magnetic materials within 10cm of the compass, which may cause an irreversible decrease in the measurement accuracy of the compass.

We strongly recommend to calibrate the magnetic field after the installation is complete and after each change in the magnetic field environment. After the calibration is completed according to the method in the manual, the firmware and program in SEC380 can effectively eliminate the interference of the magnetic field after calibration. As long as the position of the compass and the surrounding magnetic field environment do not change, there is no need to compensate the sensor.

The test shows that if the user performs the calibration operation in accordance with the requirements of the user manual, the compass can meet the above requirements when installing, and the sensor is calibrated correctly, the heading accuracy of the sensor will be less than 0.5 degrees (RMS). Our recommended test method is to install the SEC380 sensor horizontally on a non-magnetic material away from the interference to measure the heading angle. Please avoid additional magnetic field interference during the measurement.

Calibration

The electronic compass has been calibrated in the factory. In places where the magnetic field environment has little influence, there is no need to perform environmental calibration during use, and it can be used directly. In actual use, it is recommended to calibrate.
Azimuth calibration steps:
Plane calibration:
1. Connect the product to the system and place the product in a horizontal state;
2. Open the serial debugging assistant and send 77 04 00 11 15;
3. Rotate the product in the horizontal plane (both pitch and roll angles are within ±5°) around the z-axis (z-axis is the vertical direction), and rotate 2-3 times. The rotation process should be as slow and close as possible Rotate at a constant speed, and the time for one revolution is controlled between 10 seconds and 15 seconds;
4. Rotate the compass around the X-axis or Y-axis. The rotation process can be slow and nearly uniform. It rotates 2-3 times around each axis, and the time for one rotation is about 15 seconds;
5. After completing the calibration, send 77 04 00 12 16 to save the calibration.

Multi-faceted calibration
1. Fix the electronic compass in the use environment, and try not to carry magnetic objects such as keys and mobile phones during calibration;
2. Place the compass in a horizontal state (within ±5°);
3. Send the following calibration command in hexadecimal format: 77 04 00 08 0C, the return value is 77 05 00 88 00 8D;
4. The product is placed in a horizontal state, the front is facing upwards (both pitch and roll are within ±5°), the myopia rotates one circle at a constant speed, and it takes more than 10 seconds to rotate one circle;
5. The product is placed on the screen with the installation side facing up (both pitch and roll are within ±5°), and the myopia rotates at a constant speed, and it takes more than 10 seconds to rotate once;
6. The product is placed in a vertical position, with the smooth side of the shell facing down (both pitch and roll are within ±5°), and the myopia rotates one circle at a constant speed, and it takes more than 10 seconds to rotate one circle;
7. The product is placed in a vertical state, the other smooth side of the shell faces downwards (both pitch and roll are within ±5°), and the myopia rotates at a constant speed, and it takes more than 10 seconds to rotate once; among them, 4, 5, 6, 7 Steps can be exchanged;
8. After the four faces are rotated, send the hexadecimal command 77 04 00 09 0D to save the calibration and return to 77 05 00 89 XX YY. Where XX represents the calibration error coefficient, the smaller the value, the better, less than 1 is ideal, FF represents the calibration failure, YY is the checksum of the command;
9. The calibration is complete.

Order information

Product model	Communication mode	Package situation
SEC380-232	RS232	PCBA
SEC380-485	RS485	PCBA
SEC380-TTL	TTL	PCBA

Executive standard

- Enterprise Quality System Standard: ISO9001:2015 Standard (Certificate No.064-21-Q-3290-RO-S)
- CE certification (certificate number: M.2019.103. U Y1151)
- ROHS (certificate Number: G 190930099)
- GB/T 191 SJ 20873-2003 General specification for inclinometer and level
- GBT 18459-2001 The calculation method of the main static performance index of the sensor
- JJF 1059.1-2012 Evaluation and expression of measurement uncertainty
- GBT 14412-2005 Mechanical vibration and shock Mechanical installation of accelerometer
- GJB 450A-2004 General requirements for equipment reliability
- GJB 909A Quality control of key parts and important parts
- GJB899 Reliability appraisal and acceptance test
- GJB150-3A High temperature test
- GJB150-4A Low temperature test
- GJB150-8A Rain test
- GJB150-12A Sand and dust experiment
- GJB150-16A Vibration test
- GJB150-18A Impact test
- GJB150-23A Tilt and rock test
- GB/T 17626-3A Radio frequency electromagnetic field radiation immunity test
- GB/T 17626-5A Surge (impact) immunity test
- GB/T 17626-8A Power frequency magnetic field immunity test
- GB/T 17626-11A Immunity to voltage dips, short-term interruptions and voltage changes

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