AIT



EC-2143-R02 Series
Inclination Compensation 3D Electronic Compass
Technical Manual

V1.0

Inclination Compensation 3D Electronic Compass

EC-2143-R02

FEATURES

- Accuracy：2°(RMS)
- -40℃～+85℃ wide operating temperature
- Size：2.16 × 1.46 × 0.94 (inch)
  L55 x W37 x H24 (mm)
- Resolution：0.1°
- Roll/ pitch accuracy：0.2°
- With hard and soft magnetic interface compensation
- RS232/RS485/TTL Output optional
- Mechanical control

APPLICATIONS

- Power supply：5-12V
- Satellite tracking
- Petroleum geological survey
- Optical rangefinder
- GPS assisted navigation
- Handheld devices
- Marine survey
- Underwater navigation

DESCRIPTION

The EC-2143-R02 from AIT Sensing is a cost-effective 3D electronic compass, which can measure the heading angle of an object according to the changes in the earth's magnetic field. The Independent research and development technology of hard magnetic interference and soft magnetic interference compensation is suitable for miniaturized intelligent systems with small size, low power consumption and certain cost requirements.

EC-2143-R02 supports RS232, RS485 and TTL level output interfaces. The output baud rate is 2400-115200, the output angle is 0°～360°, and 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.

SPECIFICATIONS

Table 1.

Parameter	Test Conditions	Min.	Typ.	Max.	Unit/Note
Power Supply Voltage		5		12	V
Operating Current	No load		30	40	mA
Operating Temperature Range		−40		85	°C
Storage Temperature Range		−55		100	°C

Table 2.

Compass heading parameters	Heading accuracy	2°(RMS)
	Resolution	0.1°
	Repeatability	0.5°
Compass tilt parameters	Pitch accuracy	0.15°
	Roll accuracy	0.15°
	Resolution	0.01°

	Inclination	±30°
Calibration	Hard magnetic calibration	Yes
	Soft magnetic calibration	Yes
Physical properties	Dimension	L55 x W37 x H24 (mm)
	Weight	115g
	Output mode	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.

ELECTRICAL INTERFACE

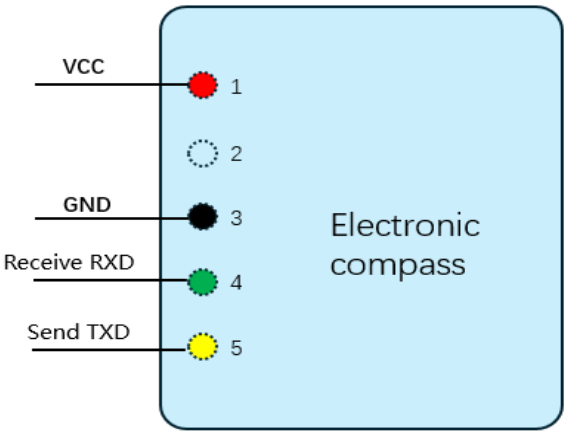
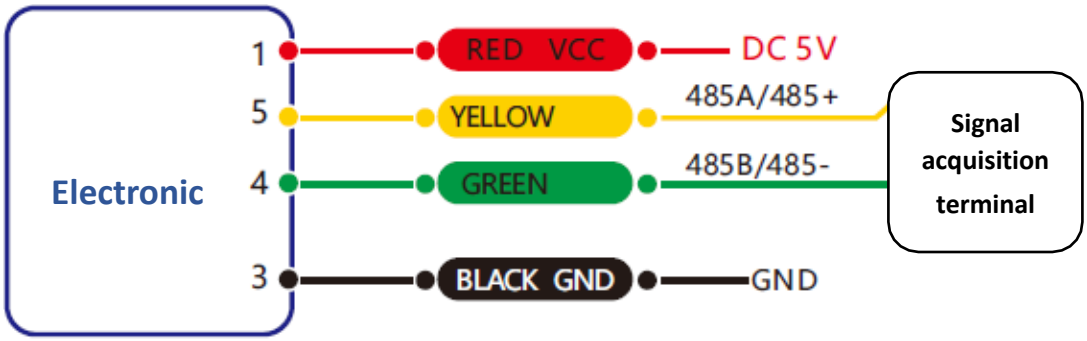


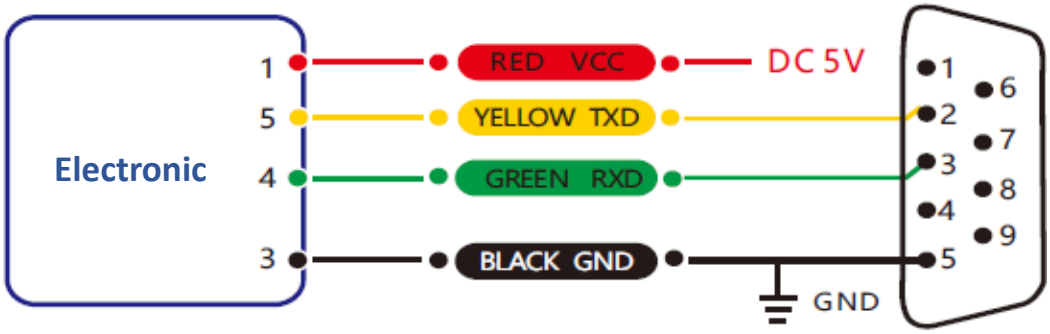
Figure 1. Pin Names

Table 3. Pin Number, Colors and Functions

No.	Color		Functions
1		Red	VCC: DC 5V ~ 12V
2		Blue	-
3		Black	Ground
4		Green	Receive RXD（B、D-）
5		Yellow	Send TXD（A、D+）



RS 485 Wiring diagram



RS232 Wiring diagram

Figure 2. RS 232/485 Wiring Diagram

INSTALLATION

The main sensitive components of EC-2143-R02 are magnetometer and accelerometer. The compass uses a magnetometer to sense the earth's magnetic field to calculate the sensor's pointing, and uses an accelerometer to measure the angle between the compass and gravity. It provides inclination compensation when the compass calculates the azimuth. The earth's magnetic field is easily disturbed by external magnetic fields. Users still need to pay attention to the surrounding magnetic field when installing. It is necessary to ensure that the sensor is exposed to the earth's magnetic field, and try to avoid using it near ferromagnetic materials and changing magnetic fields, such as engines, iron plates, Install sensors near iron 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. This 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 every change in the magnetic field environment. After the calibration is completed according to the method in the manual, the firmware and program in EC-2143-R02 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 2 degrees (RMS). Our recommended test method is to install the

EC-2143-R02 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 port 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°), and 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 surface facing upwards (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;

6. The product is placed in a vertical state 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 position with the other smooth side of the shell facing down (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.

DIMENSIONS

Outline Dimensions

Top View	Side View
Unit	mm (inch)

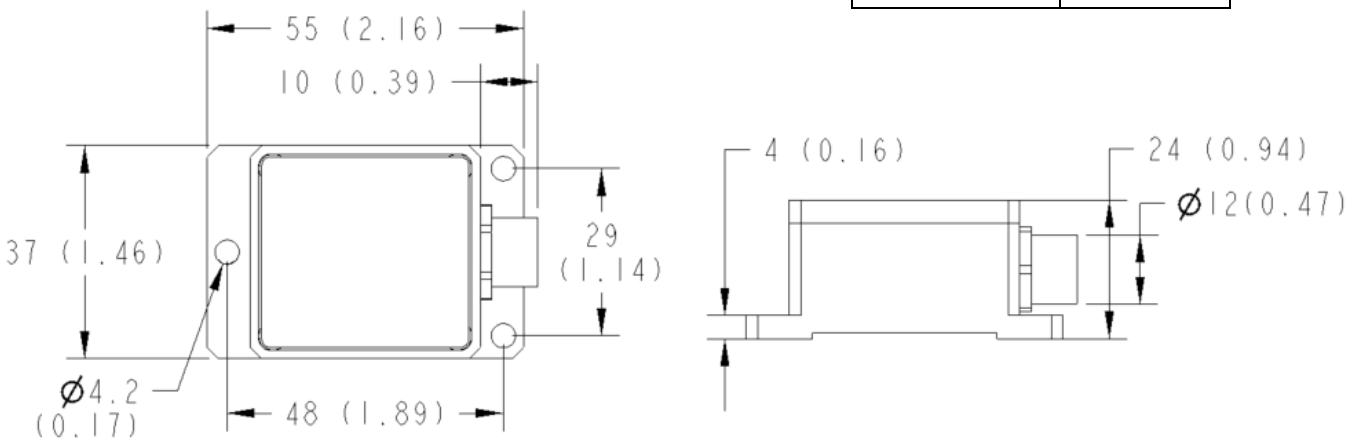


Figure 3. Outline Dimensions



Figure 4. Top View of TS-2143-R02

Table 4. Mechanical Index

Connector	Aviation connector (cable length 1.5m)
Protection level	IP67
Shell material	Magnesium aluminum alloy anodizing
Installation	Three M4 screws