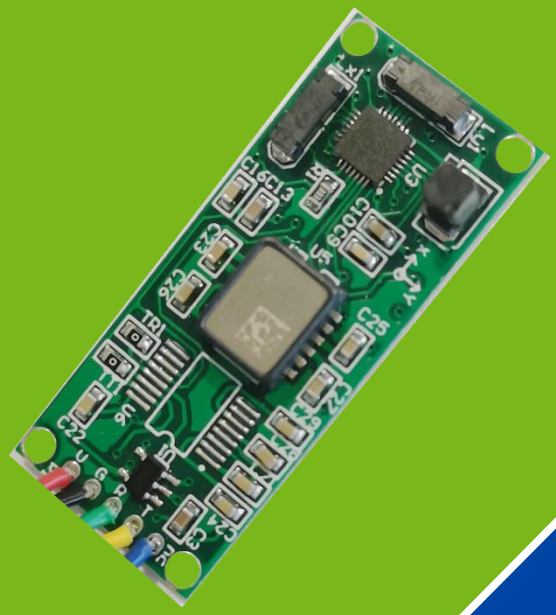
PWSENSING



HEC303 Series

3D High-precision

Electronic Compass

Technical Manual

V3.0

HEC303
3D High-precision Electronic Compass

Introduction

The HEC303 high-precision electronic compass is composed of an industrial-grade single-chip microcomputer with high reliability and strong anti-interference ability, and a high-precision magnetic sensor and drive chip. At the same time, it integrates the hard magnetic and soft magnetic calibration algorithms of Bewis Sensing patented technology, and uses a three-axis accelerometer to compensate the tilt angle, so that accurate heading data can be provided in extremely harsh environments. Through the optimized extended Kalman filter algorithm, the product outputs high-precision attitude information in real time. A new twelve-position calibration algorithm is integrated, making calibration more convenient and flexible.

HEC303 is specially designed to improve the static measurement accuracy of magnetic compass. For fixed interference, HEC303 can still maintain high measurement accuracy. It can be customized according to customer needs, and the electronic compass function can be integrated into various products very conveniently and quickly.

Feature

- Three-axis gyroscope, three-axis accelerometer, three-axis magnetometer
- Static measurement accuracy up to 0.2°
- offset tracking algorithm eliminates drift
- High precision, low cost
- Wide temperature range: -40℃~+85℃
- Dimension: L40*W17*H5.5 (mm)
- Hard magnetic, soft magnetic and tilt compensation
- Standard RS232/TTL output interface

Application

- Satellite tracking
- Petroleum geological exploration
- Optical range finder
- GPS-assisted navigation
- Individual combat equipment
- Ocean test
- Underwater navigation
- Mechanical control

Product Feature

Electrical index

Power supply	5V DC
Working current	≤100mA
Operating temperature	-40℃~70℃
Storage temperature	-55℃~85℃

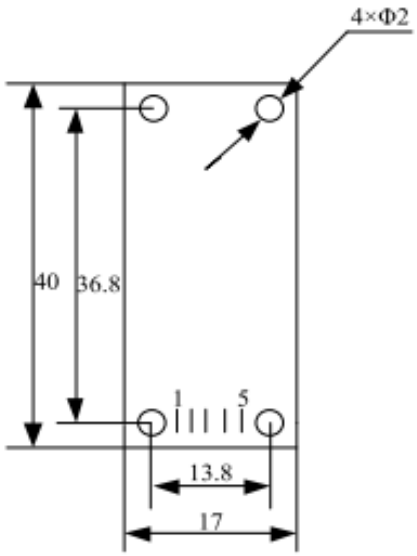
Performance index

Azimuth	Measurement range	0~360°
	Accuracy	After spatial calibration ≤0.3°(RMS) (tilt range -20°~20°)
	Resolution	0.01°
	Repeatability	0.05°（RMS）
Pitch	Measurement angle	-90°~90°
	Accuracy	≤0.2°（RMS）
	Resolution	0.01°
	Repeatability	0.05°（RMS）
Roll	Measurement range	-90°~90°
	Accuracy	≤0.2°（RMS）
	Resolution	0.01°
	Repeatability	0.05°（RMS）
Environment	Baud rate	9600~115200（Default 38400）

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).

Package product size

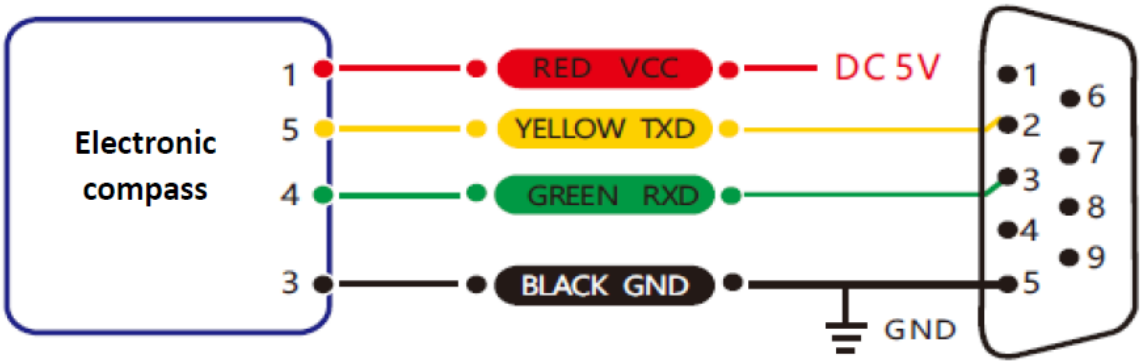
Product size：L40*W17*H5.5（mm）



Electrical connection

Wiring definition

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



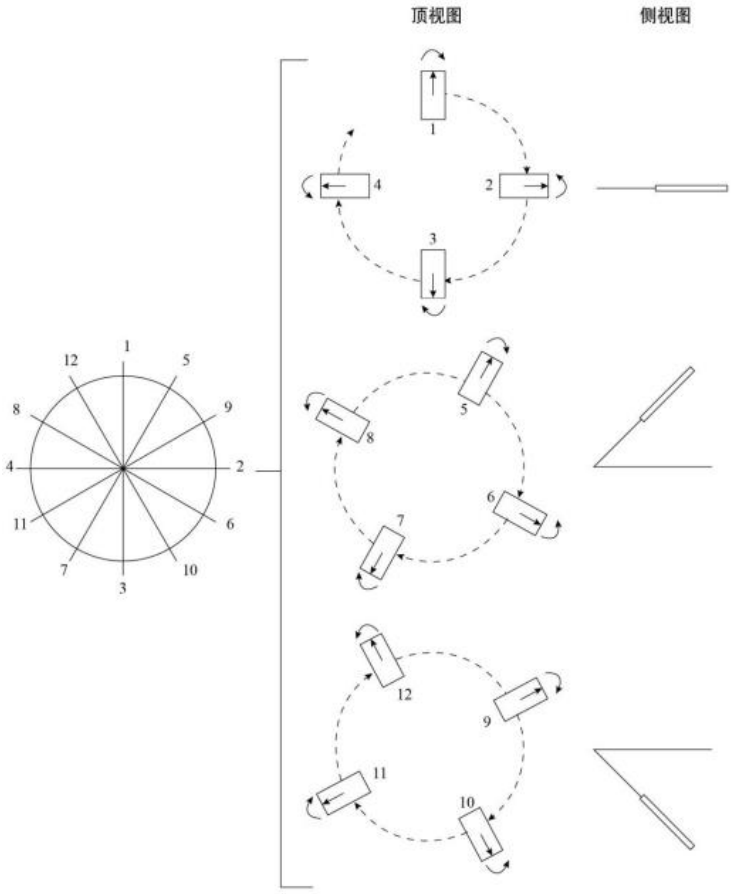
RS232 Wiring diagram

Calibration

The magnetic field calibration method can not only calibrate the magnetometer, but also effectively correct the hard magnetic interference, soft magnetic interference and various manufacturing and installation errors that exist on the installation equipment. After the calibration is completed, it can ensure that the magnetic field is under various large tilt angles. The angle measurement accuracy of the compass.

When the user chooses to use the magnetic field calibration method, in order to ensure the accuracy of the angle measurement of the magnetic compass, the user can perform the calibration regularly (6-12 months) according to the actual situation and accuracy requirements.

When the user equipment cannot realize the various postures required by the spatial calibration method, but can realize the various postures required by the magnetic field spatial calibration method, it is recommended to use the magnetic field spatial calibration method. When calibrating the magnetic field space, it is recommended to collect the data in the following 12 postures. As shown in the figure, the main points of the various postures are introduced as follows:



Calibration 1: Applicable for plane use

Attitude 1: Point the magnetic compass to 0°, the pitch angle is 0°, and the roll angle is 0°;
Attitude 2: Point the magnetic compass to 90°, the pitch angle is 0°, and the roll angle is 0°;
Attitude 3: Point the magnetic compass to 180°, the pitch angle is 0°, and the roll angle is 0°;
Attitude 4: Point the magnetic compass to 270°, the pitch angle is 0°, and the roll angle is 0°;
Attitude 5: Point the magnetic compass to 30°, the pitch angle is 45°, and the roll angle is 0°;
Attitude 6: Point the magnetic compass to 120°, the pitch angle is 45°, and the roll angle is 0°;
Attitude 7: Point the magnetic compass to 210°, the pitch angle is 45°, and the roll angle is 0°;
Attitude 8: Point the magnetic compass to 300°, the pitch angle is 45°, and the roll angle is 0°;
Attitude 9: Point the magnetic compass to 60°, the pitch angle is -45°, and the roll angle is 0°;
Attitude 10: Point the magnetic compass to 150°, the pitch angle is -45°, and the roll angle is 0°;
Attitude 11: Point the magnetic compass to 240°, pitch angle -45°, roll angle 0°;
Attitude 12: Point the magnetic compass to 330°, the pitch angle -45°, and the roll angle 0°.

The azimuth angle mentioned in the introduction to the above posture placement is not an absolute azimuth angle, but a relative angle. For example, in posture 1, the azimuth angle of the magnetic compass can point to any angle, such as 42°, but in posture 2, The azimuth angle of the magnetic compass needs to be placed at about 132°, and so on, while the pitch angle and roll angle refer to absolute angles. When placing the above postures, the azimuth, pitch, and roll angles do not need to be particularly strict, and the error of each angle is acceptable within ±15°.

Calibration 2: If the user needs to use the roll and pitch angles in practical applications, and the above methods cannot obtain better accuracy, you can choose the following calibration methods.

Attitude 1: Point the magnetic compass to 0°, the pitch angle is 0°, and the roll angle is 45°;
Attitude 2: Point the magnetic compass to 90°, the pitch angle is 0°, and the roll angle is -45°;
Attitude 3: Point the magnetic compass to 180°, the pitch angle is 0°, and the roll angle is 45°;
Attitude 4: Point the magnetic compass to 270°, the pitch angle is 0°, and the roll angle is -45°;
Attitude 5: Point the magnetic compass to 30°, the pitch angle is 45°, and the roll angle is 45°;
Attitude 6: Point the magnetic compass to 120°, the pitch angle is 45°, and the roll angle is -45°;
Attitude 7: Point the magnetic compass to 210°, the pitch angle is 45°, and the roll angle is 45°;
Attitude 8: Point the magnetic compass to 300°, the pitch angle is 45°, and the roll angle is -45°;
Attitude 9: Point the magnetic compass to 60°, the pitch angle is -45°, and the roll angle is 45°;
Attitude 10: Point the magnetic compass to 150°, the pitch angle is -45°, and the roll angle is -45°;
Attitude 11: Point the magnetic compass to 240°, pitch angle -45°, roll angle 45°;
Attitude 12: Point the magnetic compass to 330°, the pitch angle -45°, and the roll angle -45°.

Note:

1. When calibrating, please ensure that the electronic compass is tightly fixed on the device, if possible, please fix it with screws.
2. When calibrating, the electronic compass needs to be calibrated together with the device to obtain an accurate heading value instead of just calibrating the electronic compass
3. After each single point turning to the position, the sensor needs to be in a static state before sending command.

Start magnetic field calibration

Send command: 77 04 00 3C 40
Return: 77 05 00 3C 00 41
Send after the first point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 00 43
Send after the second point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 01 44
Send after the third point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 02 45
Send after the fourth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 03 46
Send after the fifth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 04 47
Send after the sixth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 05 48
Send after the seventh point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 06 49
Send after the eighth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 07 4A
Send after the ninth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 08 4B
Send after the tenth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 09 4C
Send after the eleventh point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 0A 4D
Send after the twelfth point is in place: 77 04 00 3E 42
Return: 77 05 00 3E 0B 4E

3F is the command word, and the data field is 3 bytes to return the score value, which is a compressed BCD code, with four integer digits and two decimal places. For example, 00 03 means a score of 0.03. The closer the score is to 0, the better the calibration effect. It is recommended to re-calibrate if it is greater than 1. If you want to terminate the calibration sending during the calibration process:

send 77 04 00 3D 41

Return: 77 05 00 3D 00 42

If you want to clear the calibration data after the calibration is completed:

Send 77 04 00 10 14

Return: 77 05 00 90 00 95

Order information

Product model	Communication mode	Package situation
HEC303-232	RS232	IP67 package
HEC303-TTL	TTL	IP67 package

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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