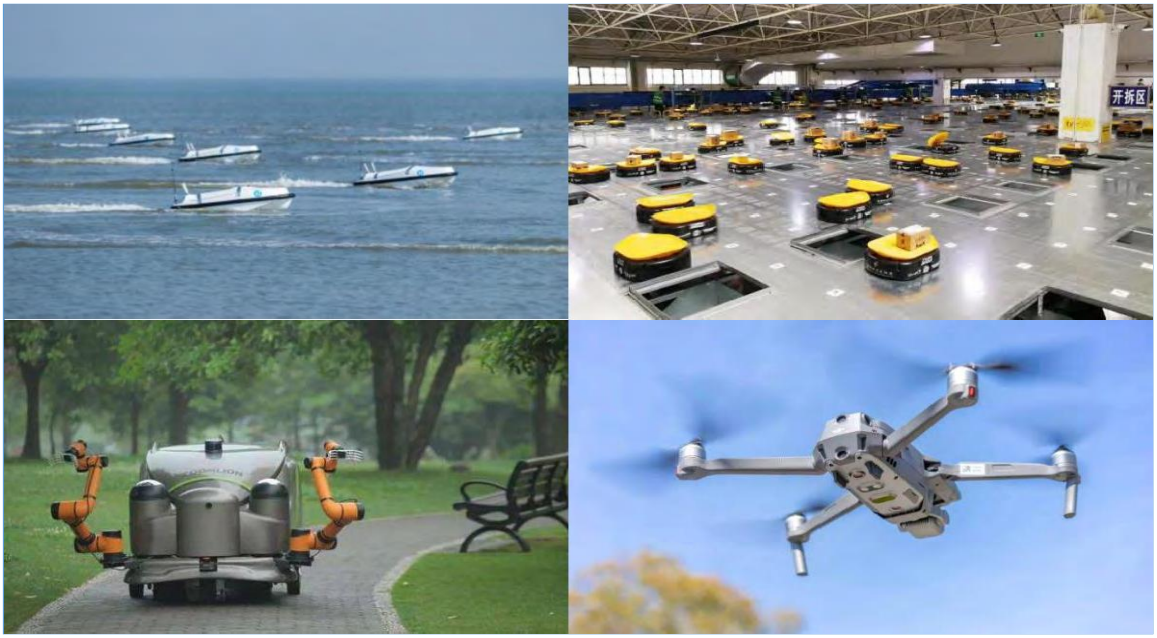
BW-AH50 Series

Low-cost Attitude Heading Reference System

Technical Manual

V3.0

BW-AH50
Low-cost Attitude Heading Reference System



Introduction

The BW-AH50 heading and attitude reference system product is a low-cost inertial measurement device that can measure the attitude parameters (roll and pitch), angular velocity, acceleration information and heading angle of the moving carrier. The attitude and angular velocity deviation are estimated by the 6-state Kalman filter with appropriate gain, which is suitable for dynamic measurement of navigation and positioning. BW-AH50 uses industrial-grade MEMS accelerometers, gyroscopes and magnetometers, and uses algorithms to ensure measurement accuracy. At the same time, the sealing design and strict process ensure that the product can accurately measure the angular velocity, acceleration, and attitude of the carrier in harsh environment. Through various compensations such as nonlinear compensation, quadrature compensation, temperature compensation and drift compensation, the error source of BW-AH50 can be greatly eliminated and the product accuracy level can be improved. BW-AH50 has a digital interface, which can be easily integrated into the user's system.

Feature

- Non-linear compensation, quadrature compensation
- Dynamic static measurement
- Special offset tracking algorithm eliminates drift
- Gyro drift compensation
- Output RS232/RS485/TTL optional
- Wide temperature range: -40℃~+85℃, Temperature compensation
- High-performance Kalman filter algorithm
- Small size: L55 x W37 x H24 (mm)

Application

- Satellite tracking
- High-voltage power line tower monitoring
- Aerial work truck
- ROV underwater robot navigation
- Drilling equipment measurement and control
- Ocean Surveyor
- Robot control
- Unmanned aerial vehicle

Electrical index

Power voltage	5-12VDC
Working current	30mA (40mA max)
Operating temperature	-40~85℃
Storage temperature	-55~100℃

Performance index

Attitude parameters	Pitch accuracy	3° (RMS, dynamic) 0.5° (RMS, static)
	Roll accuracy	3° (RMS, dynamic) 0.5° (RMS, static)
	Resolution	0.01°
	Tilt range	Pitch ±90°, Roll ±180°
Heading parameters	Heading accuracy	3°
	Resolution	0.01°
Physical characteristics	Dimension	L55 x W37 x H24 (mm)
	Weight (with cable)	60g
	Output mode	Output RS232/RS485/TTL/CAN
Interface characteristics	Start-up delay	<3s
	Maximum output frequency	100Hz
	Serial communication rate	2400 to 115200 Baud rate
	Digital output format	Binary high-performance protocol
Environment	Impact resistance	2000g

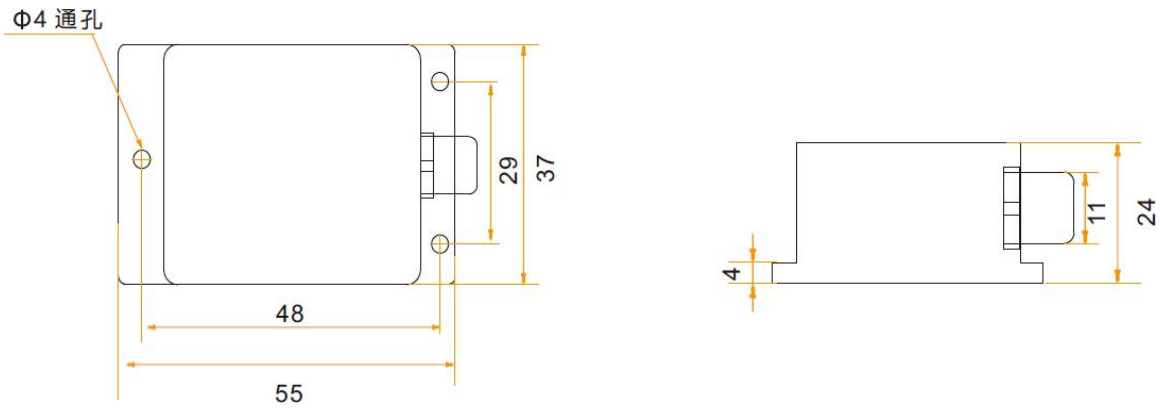
Resolution: The smallest change value of the measured value that the sensor can detect and distinguish within the measurement range.
Accuracy: The root mean square error of the actual angle and the sensor measuring angle for multiple (≥16 times) measurements.

Mechanical Index

Connector	Metal joint（Cable length 1.5m)
Protection level	IP67
Shell material	Magnesium aluminum alloy anodizing
Installation	Three M4 screws

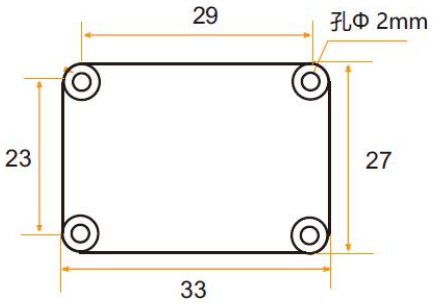
Product package size

Product size：L55*W37*H24（mm）



PCB size

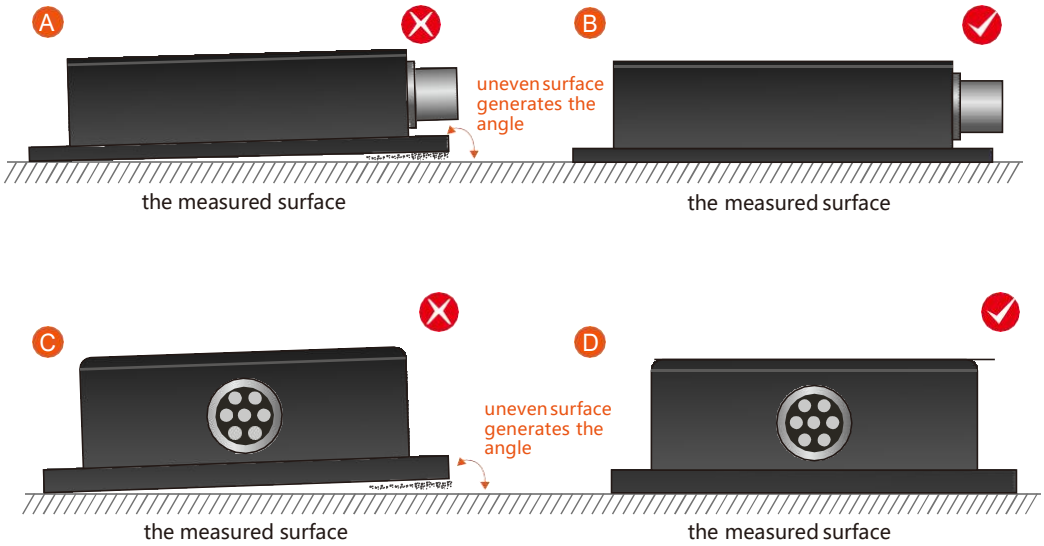
Product size：L33*W27*H6（mm） The length and width may have an error of ±1mm, please refer to the actual product



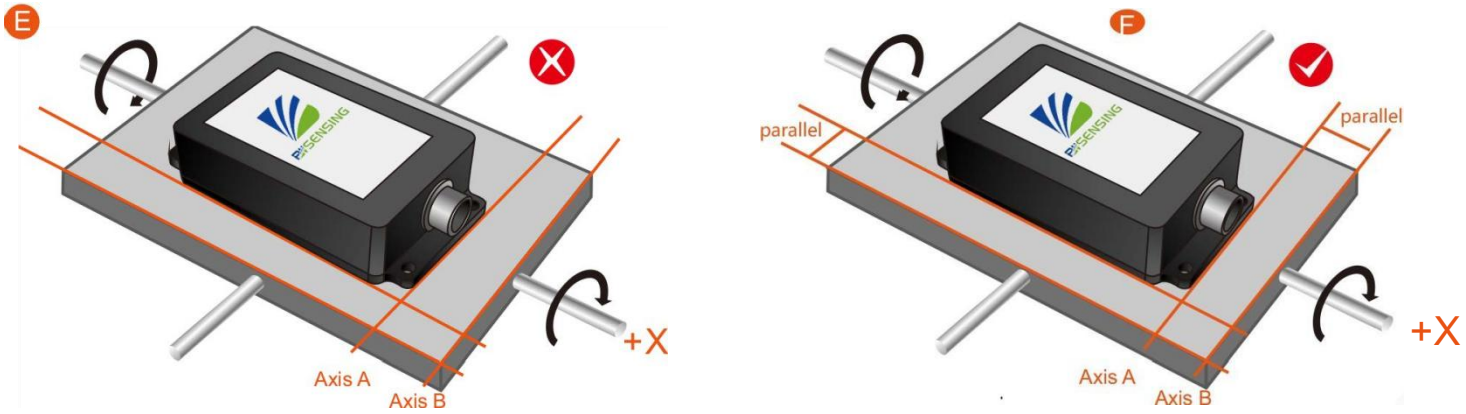
Installation

The correct installation method can avoid measurement errors. When installing the sensor, please do the following:

First of all, make sure that the sensor mounting surface is completely close to the measured surface, and the measured surface should be as level as possible. There should be no included angles as shown in Figure A and Figure C. The correct installation method is shown in Figure B and Figure D.



Secondly, the bottom line of the sensor and the axis of the measured object cannot have an angle as shown in Figure E, and the bottom line of the sensor should be kept parallel or orthogonal to the axis of rotation of the measured object during installation. This product can be installed horizontally or vertically (vertical installation needs to be customized), and the correct installation method is shown in Figure F.



Finally, the mounting surface of the sensor and the surface to be measured must be tightly fixed, smooth in contact, and stable in rotation, and measurement errors due to acceleration and vibration must be avoided.

Measurement installation

Although the AH50 can compensate for magnetic interference, users should choose an environment with the least magnetic interference to install and use. As far as possible, choose to place AH50 away from iron, nickel, magnets, motors and other magnetic materials.

Be sure to strictly avoid strong magnetic materials such as magnets and motors from approaching the product, which may cause irreversible degradation of the product's measurement accuracy.

Each AH50 provides a 1.5-meter cable, and the length of the cable is optional. The magnetic field environment of each installation location is different, and the user must evaluate the feasibility of installation in this operating environment.

The test method we recommend is to install the AH50 on a vertically erected aluminum (or other non-magnetic material) pole to measure the heading accuracy (the rotating pole is perpendicular to the rotating platform, and try to avoid large external magnetic field interference).

Calibration

The product 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:

Method 1——Plane calibration

1. Connect the product to the system and place the product in a horizontal state;
2. Open the serial port debugging assistant, send 77 04 00 11 15, and return to 77 05 00 91 00 96 to start plane calibration;
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, and return to 77 05 00 92 XX SUM (the data field is meaningless), the calibration is successful.

Method two-multi-faceted calibration

1. Fix the product in the use environment, and try not to carry magnetic objects such as keys and mobile phones during calibration;
2. Place the product 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 in a horizontal state, the installation surface is facing upwards (the pitch is within 0±5 degrees, the roll is within 180±5 degrees), 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 (pitch within 0±5 degrees, roll within 90±5 degrees), 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 with the other smooth side of the shell facing downwards (pitch within 0±5 degrees, roll within -90±5 degrees), and the myopia rotates one circle at a constant speed, and it takes more than 10 seconds to rotate one circle;

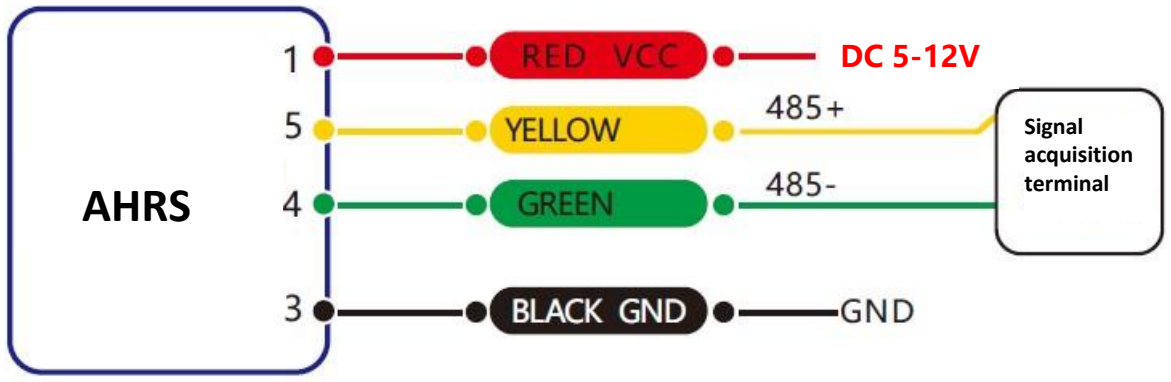
Among them, step 4.5.6.7 can be exchanged;

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 is, the better, less than 10 is ideal, FF represents the calibration failure, YY is the checksum of the command;

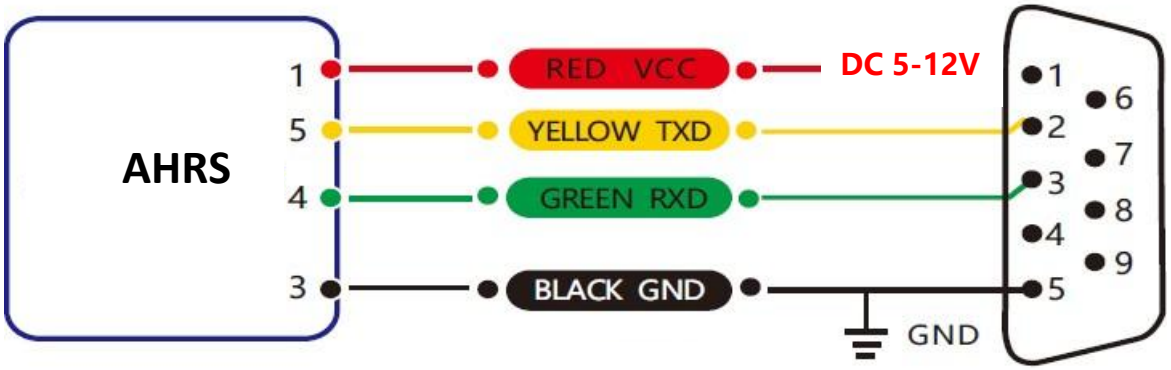
9. The calibration is complete.

Electric Interface

Wiring definition					
Wire color	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
function	VCC DC 5-12V	NC	GND	RXD (B、D-)	TXD (A、D+)



RS 485 Wiring diagram



RS 232 Wiring diagram

Order information

Model	Communication code	Package situation
BW-AH50-485	RS485	IP67 package/metal joint
BW-AH50-232	RS232	IP67 package/metal joint
BW-AH50-TTL	TTL	IP67 package/metal joint

Executive standard

- National Standard for Static Calibration Specifications for Dual-Axis Inclination Sensors (Draft)
- GB/T 191 SJ 20873-2003 General Specification for Inclinometers and Levels

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Wuxi Bewis Sensing Technology LLC

Add：Building 30, NO. 58, Xiuxi Road, Binhu District, Wuxi City, Jiangsu Province, China

Tel：+86 18921292620

Mail：sales@bwsensing.com

Web：www.bwsensing.com