AIT



Small Size High Precision Attitude Heading Reference System ARS-4847-R12

Technical Manual

V1.5

Small Size High Precision Attitude Heading Reference System

ARS-4847-R12

FEATURES

- Nine-axis AHRS sensor intelligent fusion algorithm
- Maximum heading accuracy ≤0.1°/circle,
- pitch and roll accuracy ≤0.05°
- AEC-Q100 certification and manufacturing process
- Accuracy is CNAS traceable
- Wide temperature range: -40℃~ +85℃
- Volume: L24.05*W22.4*H9.41 (mm)
  L0.95×W0.88×H0.37 (inch)
- ISO26262 automotive-grade functional safety certification
- 1000Hz raw data output frequency

APPLICATIONS

- Humanoid robots
- Rotary-wing drones
- Motion capture
- Quadruped robots
- Low-speed unmanned vehicles
- Observation and aiming equipment
- Fixed-wing unmanned aerial vehicles

DESCRIPTION

The ARS-4847-R12 is a high-precision attitude sensor developed for embodied intelligent robots. It integrates self-developed rapid calibration and anti-interference algorithms of AIT's Sensing. Calibrated via aerospace-grade turntable before delivery, it can automatically eliminate cross-axis errors caused by installation. Regular self-calibration is available without factory return, delivering accurate attitude data even in extremely complex environments.

It supports IAP firmware upgrade, enabling online firmware update during device operation. When intense magnetic interference such as high-torque output of robot motors is detected, the algorithm reduces magnetometer weight in data fusion, raises weights of gyroscope and accelerometer, or automatically switches to 6-axis mode. Magnetometer data fusion resumes after interference subsides, making it an ideal choice for embodied robots.

Device performance parameters

Table 1.

Accelerometer	Measurement Range	±8g
	Noise Density	100 μg/√Hz
	Bandwidth (-3dB)	100Hz
	Zero-Bias Stability (10s Smoothing)	0.15mg
	Zero-Bias Stability (ALLAN)	55ug
	Zero-Point Temperature Drift	±5mg
Gyroscope	Measurement Range	±1000°/s
	Noise Density	8 mdps/√Hz
	Bandwidth (-3dB)	100Hz
	Zero-Bias Stability (10s Smoothing)	12 °/h
	Zero-Bias Stability (ALLAN)	4.5 °/h (1σ, Relevant time130s-260s)
	Zero-Point Temperature Drift	±0.5°/s
Magnetometer	Measurement Range	±8Gauss
	Noise Density	1.5 mGauss/√Hz

Performance Index

Table 2.

Azimuth Angle	Measurement Range	0~360°	
	Accuracy [1]	Magnetic reference	Non-magnetic reference
		≤2° (RMS) [2]	≤0.1°/circle[3]
	Resolution	0.1°	0.02°
	Power-On Repeatability	0.5° (RMS)	
Pitch angle	Measurement Range	±90°	
	Accuracy	Static≤0.05° (1σ)	Low-level dynamics [4]
			≤ 0.05° (1σ)
			Medium-level dynamics [5]
			≤ 0.5° (1σ)
			High-level dynamics [6]
			≤ 1° (1σ)
	Resolution	0.02°	
	Power-on repeatability	0.05° (RMS)	
Roll angle	Measurement Range	±180° (Pitch angle≤±75°时)	
	Accuracy	Static≤0.05° (1σ)	Low-level dynamics [4]
			≤ 0.05° (1σ)
			Medium-level dynamics [5]
			≤ 0.5° (1σ)
			High-level dynamics [6]
			≤ 1° (1σ)
	Resolution	0.02°	
	Power-On Repeatability	0.05° (RMS)	
Environments	Baud Rate	9600~921600 (default 115200)	
Output frequency	Raw Data Mode	Max 1000Hz	
	Integration Mode	Max 500Hz	

1 Accuracy: Root mean square error of the actual angle compared to the sensor's measured angle after multiple measurements (≥16 times) at 25℃.

2 Magnetic Reference Heading Accuracy: Measured after spatial calibration in a favorable magnetic environment. This product defaults to using a self-developed algorithm to determine the reliability of magnetic data and automatically switches the heading data source.

3 Non-Magnetic Reference Heading Accuracy: Measured in a laboratory environment by rotating 360° at 100°/s.

4 Low-Level Dynamics: Motion frequency below 0.2Hz, harmful acceleration below 0.01g.

5 Medium-Level Dynamics: Motion frequency below 1Hz, harmful acceleration below 0.05g.

6 High-Level Dynamics: Motion frequency below 5Hz, harmful acceleration below 0.2g.

Electrical Connect

Table 3.

Pin Definition of USB Interface (Front view with axial label upward; pins numbered 1 to 6 from left to right)

RED	BLACK	WHITE	GREEN	YELLOW	BLUE
6	5	4	3	2	1
VCC 5V	GND	USB_DM /PPS_In	USB_DP /PPS_Out	TXD /PPS_Out	RXD /PPS_In

Pin Definition of RS485 Interface (Front view with axial label facing up; pins numbered 1 to 6 from left to right)

RED	BLACK	WHITE	GREEN	YELLOW	BLUE
6	5	4	3	2	1
VCC 5V	GND	485-A	485-B	TXD /PPS_Out	RXD /PPS_In

Pin Definition of CAN Interface (Front view with axial label upward; pins numbered 1 to 6 from left to right)

RED	BLACK	WHITE	GREEN	YELLOW	BLUE
6	5	4	3	2	1
VCC 5V	GND	CAN H	CAN L	TXD /PPS_Out	RXD /PPS_In

One end of the USB Type-A male cable for ARS-4847-R12 is a female connector matching the ARS-4847-R12 port, and the other end is a USB Type-A male plug.

The bare wire cable compatible with ARS-4847-R10（485 and CAN） is equipped with a matching female connector at one end and bare wire terminals at the other.

All USB, RS485 and CAN interfaces support TTL signals. Both USB and TTL pins of the USB version can be multiplexed for PPS input and output, while only TTL pins of RS485 and CAN versions support PPS signal multiplexing. Please contact our technical team for detailed operation methods.

Product Package Size

Product size: L24.05*W22.4*H9.41 (mm) The length and width may have an error of ±1mm, please refer to the actual product

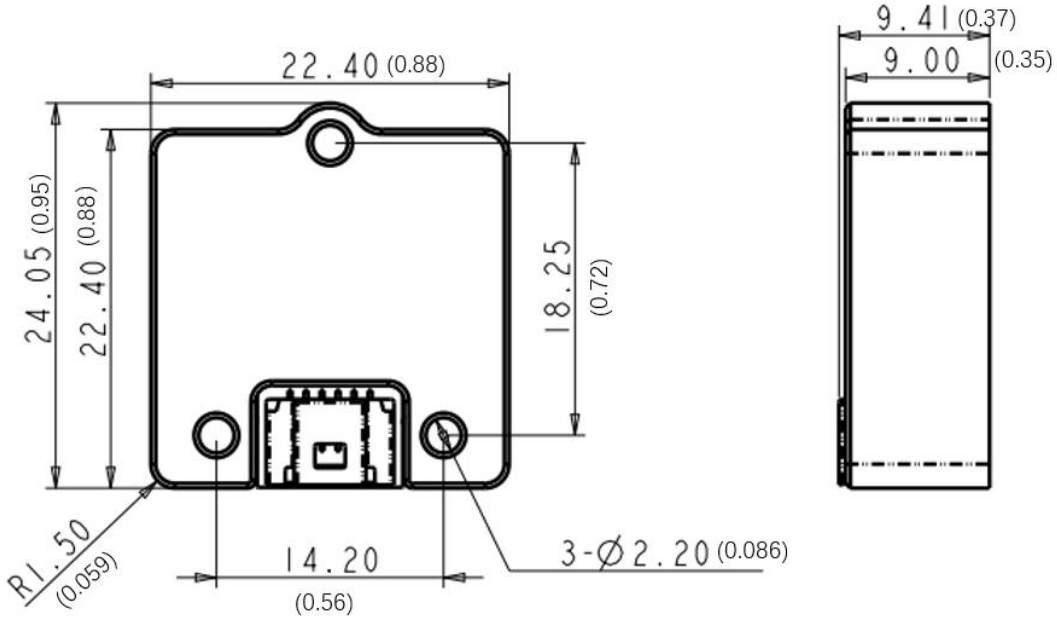
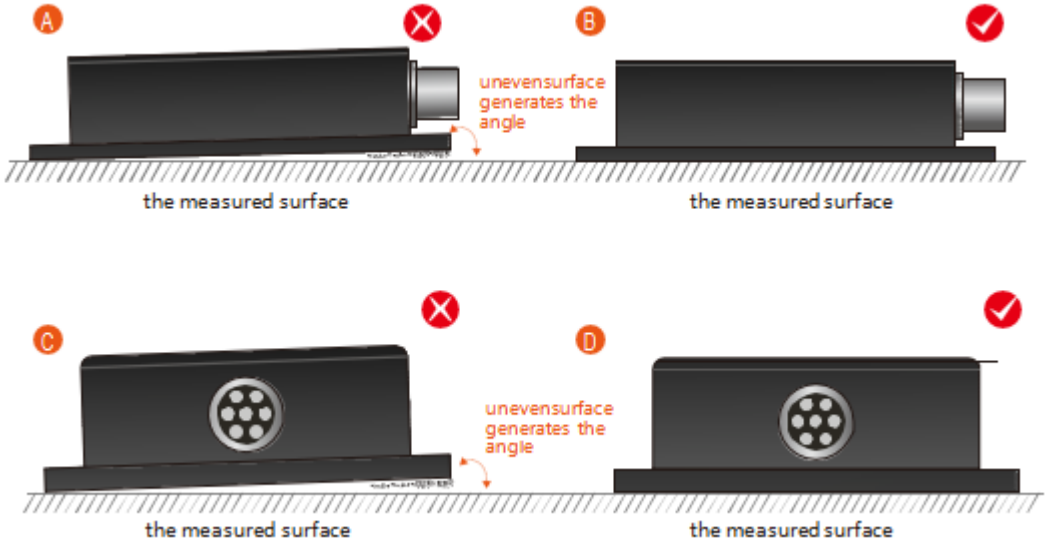


Figure 1. Outline Dimensions

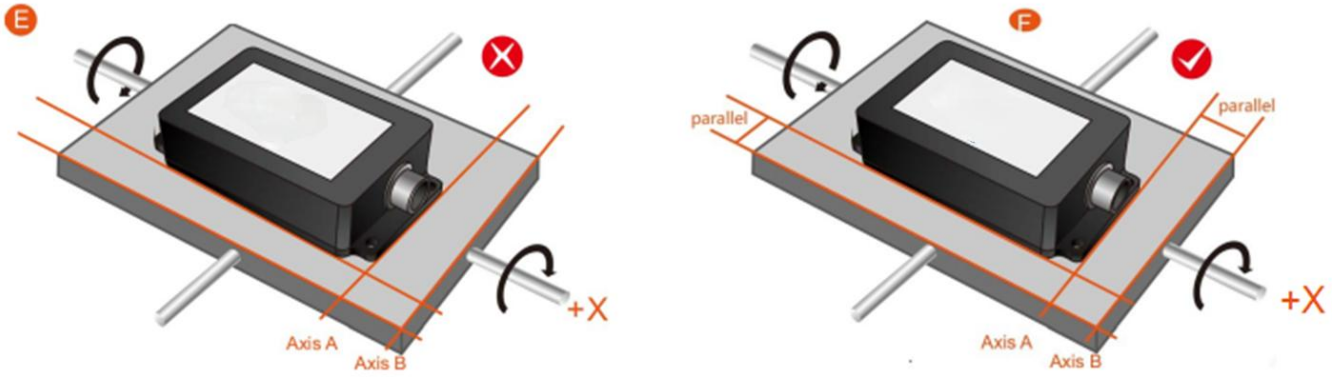
Installation

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.



Note:It should be kept away from strong magnetic field materials such as magnets, iron, nickel, etc. to avoid irreversible damage to the product's magnetic field sensitive components.

It should be far away from electric motors, wires, capacitors, inductors and other materials that can easily generate magnetic fields due to electric currents, so as to avoid changes in the electromagnetic field of these parts due to energisation, which will affect the heading accuracy of the sensors during continuous measurements.

Keep away from moving iron parts, such as mechanical arms, flywheels, engines, etc., to avoid the magnetic field changes caused by the movement of its ferromagnetic parts, which will affect the heading accuracy of the sensor.

Calibration

Adopt fast calibration method. Steps are as follows:

1.Open serial port, set HEX transmit and receive mode, and switch sensor to response mode.

2.Place the sensor at 0° pitch and 0° roll, heading north as reference. Any direction is acceptable if north is unidentified. Keep stationary and send calibration start command. Calibration count updates dynamically during movement and rises steadily at rest. Results are invalid if count increases while static.

3.Rotate the sensor one full circle slowly around X-axis.

4.Rotate the sensor one full circle slowly around Y-axis.

5.Rotate the sensor one full circle slowly around Z-axis to finish rotation.

6.Keep the sensor still until the returned calibration count reaches no less than 0x0A.

7.Send calibration end command to complete the process.

Mechanical Characteristic

Table 4.

Connector	MOLEX，5015680607，1*6P，SMD,P=1mm
House Material	Magnesium-Aluminum Alloy Anodized
Installation	3 M2 Copper Bolts
Weight	7g±1g