AIT

ARS630R Series
Compact, High-Precision 3-Axis AHRS with Integrated Electronic Compass

Technical Manual

V1.0

Compact, High-Precision 3-Axis AHRS with Integrated Electronic Compass

ARS630R

FEATURES

- **3-Axis Fusion**: Accelerometer, magnetometer, gyroscope for **1° heading / 0.2° pitch-roll accuracy**.
- **Zero-Drift Algorithm**: Auto-compensates for magnetic interference and tilt (±45°).
- **Extreme Range**: Operates at **−40°C to +85°C**; survives harsh industrial environments.
- **Ultra-Compact**: **33×31×12 mm**; integrates into drones, robots, IoT devices.
- **IAP-Upgradable**: Add CAN/RS232 interfaces or firmware via In-Application Programming.

APPLICATIONS

- **Energy & Mining**: Drill head orientation; solar panel tilt tracking.
- **Marine & Offshore**: ROV navigation; buoy stability monitoring.
- **Robotics & Logistics**: AGV path correction; robotic arm calibration.
- **Construction**: Crane anti-sway; bridge/tower tilt detection.
- **Agriculture**: Autonomous tractor guidance.
- **Telecom & Geospatial**: Satellite tracking, LiDAR alignment

DESCRIPTION

The **ARS630R** is a **high-precision Attitude and Heading Reference System (AHRS)** designed for industrial automation and harsh-environment sensing. Built with an industrial-grade microcontroller and AIT-patented algorithms, it delivers **sub-degree accuracy** for mission-critical orientation tasks.

Key Innovations for Industry:

- **Plug-and-Play Calibration**: Achieve optimal accuracy in 15 minutes with automated 16-point spatial calibration.
- **Tilt & Interference Resistance**: Maintains heading accuracy even when mounted on vibrating machinery or near high-current equipment.
- **Firmware Flexibility**: Update protocols (e.g., CAN bus) or add custom interfaces via **In-Application Programming (IAP)**, minimizing downtime.

Built for Reliability:

- **Ruggedized Design**: Magnesium-aluminum housing withstands dust, moisture, and thermal shocks.
- **Low-Power Efficiency**: 40 mA at 9V for continuous operation in remote or solar-powered systems.

SPECIFICATIONS

Table 1.

Parameter		Min.	Typ.	Max.	Unit/Note
Power Supply Voltage		5		24	VDC
Operating Current			40		mA (@ 9V)
Operating Temperature Range		−40		85	°C
Storage Temperature Range		−55		100	°C
Azimuth	Measurement Range	0		360	°
	Accuracy	after spatial calibration≤1°(RMS)			
	Resolution		0.1		°
	Repeatability		0.5		° (RMS)
Pitch	Measurement Range	−90		90	°
	Accuracy	≤0.2°(RMS)			
	Resolution		0.05		°(RMS)
	Repeatability		0.05		° (RMS)
Roll	Measurement Range	−180		180	°
	Accuracy	≤0.2°(RMS)			
	Resolution		0.05		°(RMS)
	Repeatability		0.05		° (RMS)
Range	Accelerometer range	-2		2	g
	Gyroscope range	-250		250	° /s
User Calibration	Calibration	16-point calibration			
Environment	Baud Rate	9600 ~ 460800 (default 9600)			

*Resolution: The smallest change in 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 CONNECT

The communication interface of this product adopts Phoenix Contact (FP 1,27/ 16-MV 1,75 – 1714936)

Table 2.

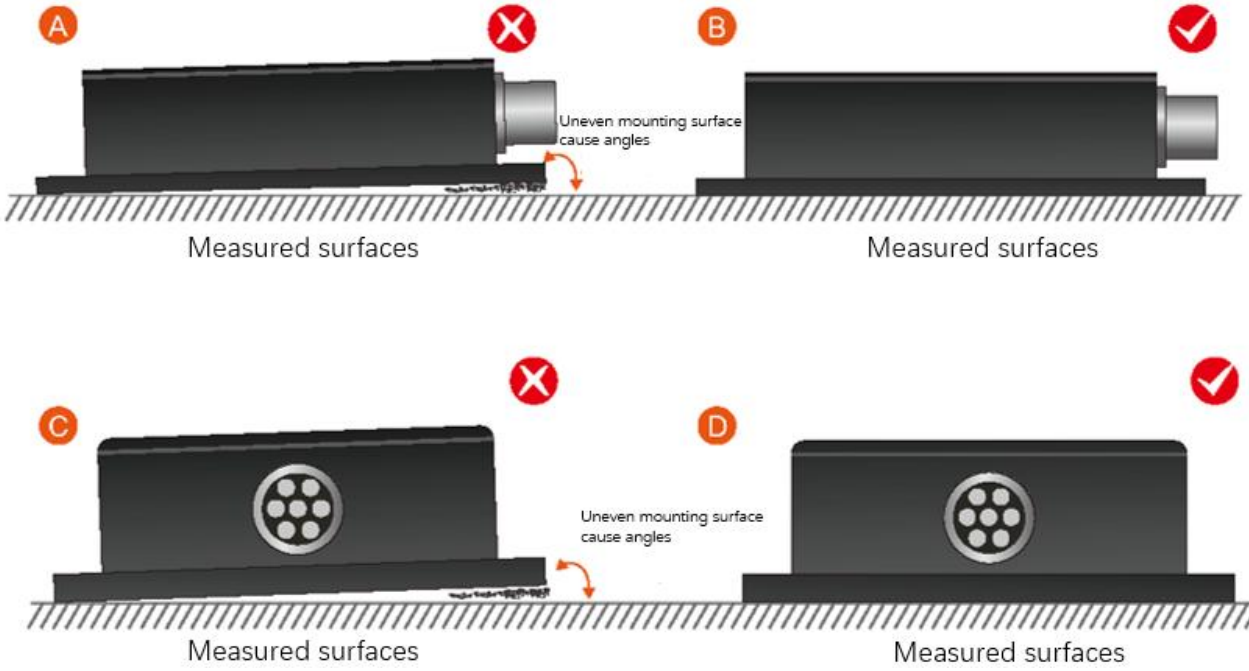
Pinout	Definition	Interface	Description	Opening Situation
1	VIN	Power supply	Power Input	OK
2	GND	Power supply	Power Ground	OK
3	CAN_H	I/O	CAN High	OK
4	CAN_L	I/O	CAN low	OK
5	232 TXD	O	232 Send data	OK
6	232 RTS	O	232 Request to send	
7	232 RXD	I	232 Accept data	OK
8	232 CTS	I	232 Clear Transmit	
9	SYNC IN1	I	Synchronized input 1	
10	SYNC IN2	I	Synchronized input 2	
11	GNSS TXD	O	Sending data in GNSS mode	
12	GNSS RXD	I	Accepting data in GNSS mode	
13	SYNC OUT	O	Synchronized output	
14	GND	Power supply	Power ground	OK
15	TTL TXD	O	TTL output	OK
16	TTL RXD	I	TTL input	OK

Currently only the pins labelled OK are open for use, the rest of the pins will be opened gradually in subsequent updates.

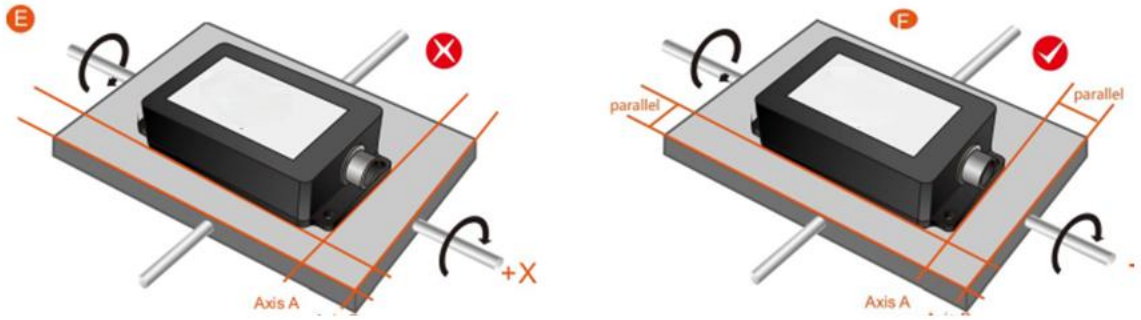
INSTALLATION

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.

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 energization, 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 METHOD

1.1 Calibration Method 1 - Calibration is performed using the 16-position calibration method as follows:

1. Fix the e-compass in the environment where it will be used, and try not to carry magnetic objects such as keys and mobile phones when calibrating.
2. Plug the product into the system with the product placed in a horizontal position (within ±5°);
3. First send the command to start calibration: 77 04 00 A5 A9, return: 77 04 00 A5 A9, indicating that the calibration has begun, please be careful not to have additional interference introduced into the calibration at this time, otherwise the quality of the calibration will be affected.
4. Rotate the heading angle to a constant near 0 degrees, then rotate the transducer pitch to +45 degrees (±15 degrees), keeping the roll angle at 0 degrees. Send an acquisition command for every ninety degrees of rotation of the heading angle, wait for a return command and then continue to rotate until the product has rotated around the Z-axis once, collecting a total of four points;
5. Rotate the heading angle to near 0 degrees, then rotate the sensor's pitch angle to -45 degrees (±15 degrees), and keep the roll angle at 0 degrees. Send an acquisition command for every ninety degrees of heading angle rotation, wait for a return command and then continue to rotate until the product has rotated once around the Z-axis, collecting a total of four points.
6. Rotate the heading angle to near 0 degrees, then rotate the roll angle of the sensor to +45 degrees (±15 degrees), and keep the pitch angle at 0 degrees. Send an acquisition command for every ninety degrees of heading angle rotation, wait for a return command and then continue to rotate until the product has rotated once around the Z-axis, collecting a total of four points.
7. Rotate the heading angle to near 0 degrees, then rotate the roll angle of the sensor to -45 degrees (±15 degrees), and keep the pitch angle at 0 degrees. Send the acquisition command every ninety degrees of rotation of the heading angle, wait for the return command and then continue to rotate until the product rotates around the Z-axis once, collecting a total of four points.
8. Acquisition command: 77 04 00 A6 AA, return command: 77 05 00 A6 XX YY, XX is the hexadecimal number of the corresponding acquisition point, if it returns FF, it indicates that the acquisition point fails, and it is necessary to re-stabilize the sensor and sample again, the return value corresponding to the last point is 10, and YY is the checksum of the current acquisition.
9. When finished, send the End Calibration command: 77 04 00 A7 AB to indicate that calibration is complete. The sensor returns: 77 05 00 A7 XX AC, where XX is the calibration result, less than 10 is better, if it

returns FF, it indicates that the calibration has failed and needs to be recalibrated.

10. Calibration is complete.

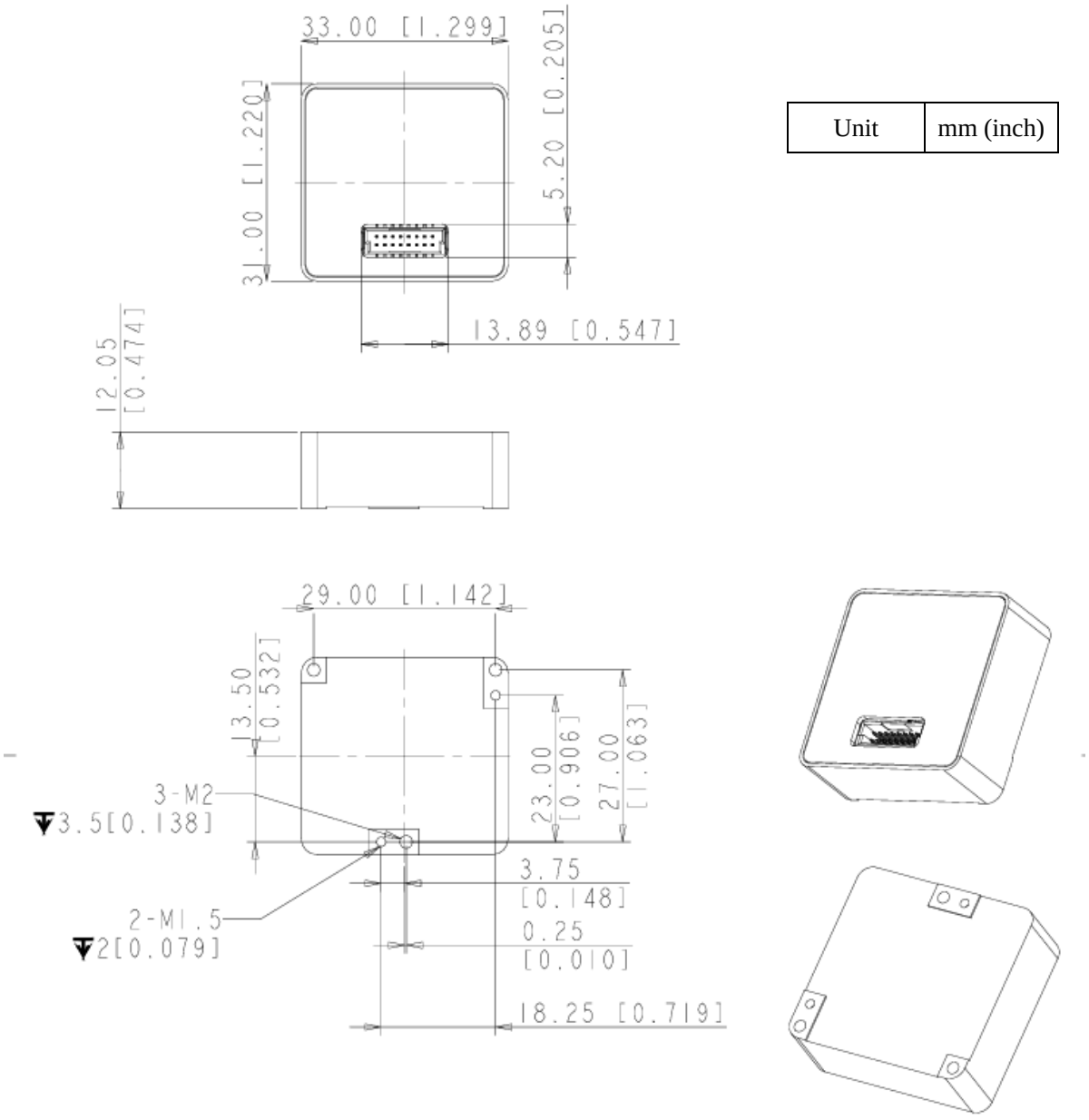
1.2. Calibration method 2 - planar calibration, the steps are as follows:

1. Connect the product to the system, the product is placed in the horizontal state;
2. Open the serial port debugging assistant and send 77 04 00 11 15.
3. Rotate the product around the z-axis (z-axis is the vertical direction) in the horizontal plane (the pitch angle and roll angle are within ±5°), rotate 2-3 times to rotate the process as far as possible to use a slow and nearly uniform rotation, rotate for a week to control the time between 10 seconds and 15 seconds
4. Rotate the compass around the X-axis or Y-axis, the rotation process can be used to slow and nearly uniform rotation, rotating around each axis 2-3 times, the rotation time of about 15 seconds.
5. To complete the calibration, send 77 04 00 12 16 to save the calibration.

DIMENSIONS

Outline Dimensions

Length and width may have ±1mm error, please refer to the actual product.



Unit	mm (inch)

Figure 1. Outline Dimensions

MECHANICAL INDEX

Connector	Phoenix Contact (FP 1,27/ 16-MV 1,75 – 1714936)
Protection level	Not available (does not represent the final product protection level)
Housing Material	Magnesium aluminum alloy anodized
Product weight	< 20g (not filled with glue)
Mounting	3pcs M2 copper bolts

ORDER

Model	Communication	Communication
ARS630R	TTL (RS232/CAN under upgrade)	Phoenix Contact

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