AIT

TS-9827-R02 Series
Digital Output High-precision Dual Axis Inclinometer
Technical Manual

V1.0

FEATURES

- High Accuracy: 0.001°
- Dual Axis Inclination Measurement
- Cross Axis Error: 0.001°
- Baud Rate: 2400 ~ 115200 Adjustable
- IP67 Protection Level
- Wide Voltage Input: 9-36VDC
- Output Frequency: 5 ~ 100Hz Adjustable
- RS485/232/TTL Optional

APPLICATIONS

- Bridge Deflection Monitoring
- Building Health Monitoring
- Precision Platform Automatic Leveling
- Military Equipment Automation
- Tunnel And Dam Monitoring
- Tower Tilt Monitoring
- Surveying And Mapping Instruments
- Wind Turbine Tower Monitoring

DESCRIPTION

TS-9827-R02, a high - precision dual - axis inclinometer introduced by AIT Sensing, harnesses MEMS technology and features digital output. Its remarkable precision is evident in its measurement range of ±30° with a maximum accuracy of 0.001°, making it the most accurate offering in the industry to date.

Precision is at the heart of the design. The sensor incorporates a high - resolution differential digital - to - analog converter, complemented by built - in automatic compensation and filtering algorithms. These elements work in tandem to minimize errors induced by environmental fluctuations. The process involves converting the change in the static gravity field into the change of the inclination angle, and then directly outputting the current roll angle and pitch angle via a digital approach.

Factory calibration is a crucial step in ensuring the inclinometer's performance. Before every product leaves the factory, it undergoes pre - calibration to the Cartesian axis of the product package box. This meticulous calibration process checks and nulls out the cross - axis error of the MEMS chips and any misalignment, guaranteeing the sensor's accuracy.

Temperature compensation is another key aspect. The sensor is fully temperature compensated across its entire operating range. This comprehensive temperature compensation significantly reduces temperature sensitivity, ensuring that the device maintains its high - precision performance regardless of temperature variations.

Housed in a robust, ruggedized industrial casing with an IP67 rating, the TS-9827-R02 is not only highly accurate but also practical. It is easy to install, simple to use, compact in size, and exhibits excellent resistance to external electromagnetic interference, as well as strong vibration and impact resistance. For these reasons, it is the recommended choice for inclination measurement in industrial automation and surveying and mapping industries.

SPECIFICATIONS

Table 1.

Parameter	Test Conditions	Min.	Typ.	Max.	Unit/Note
Power Supply Voltage		9		36	VDC
Working Current	VPS = 12V		50		mA
	VPS = 24V		40		
Operating Temperature Range		−40		85	°C
Storage Temperature Range		−55		100	°C
Measurement Range		±5	±15	±30	°
Measurement Axis	Mutually perpendicular	X-Y			
Accuracy	Room temperature	0.001	0.003	0.005	°
Cross-Axis Error	−40°C ~ 85°C	0.001	0.003	0.005	°
Resolution	Completely still		0.0005		°
Zero Point Temperature Drift	−40°C ~ 85°C	-0.0007		+0.0007	°/°C
Power-on Start-Up Time				3	s
Output Frequency	5 ~ 100Hz adjustable		100		Hz
Baud	Tunable	2400 ~ 115200			
Mean Time Between Failures MTBF		90000			h
Electromagnetic Compatibility		According to GBT17626			
Insulation Resistance		100			MΩ
Impact Resistance		2000g, 0.5ms, 3 times/axis			
Weight			230		g
			0.51		lbs
			8.11		Oz

*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

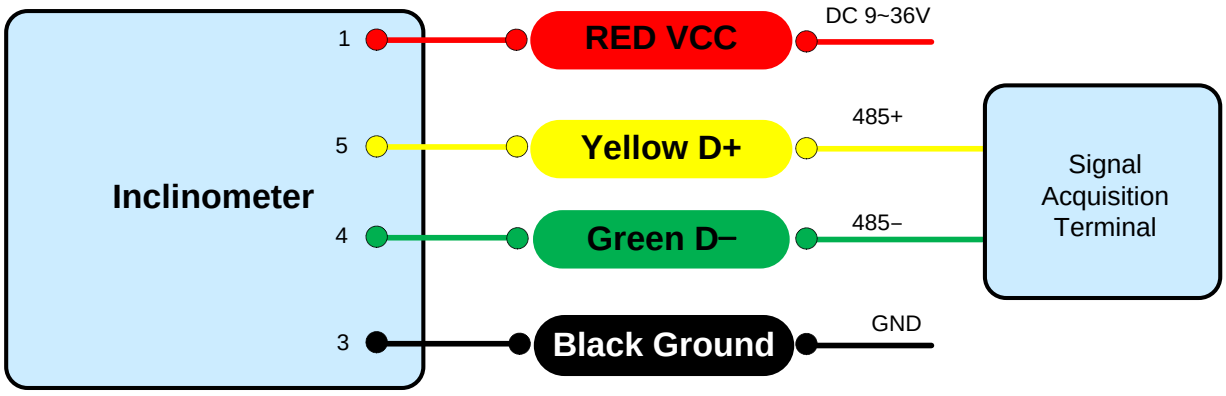


Figure 1. RS 485 Wiring Diagram

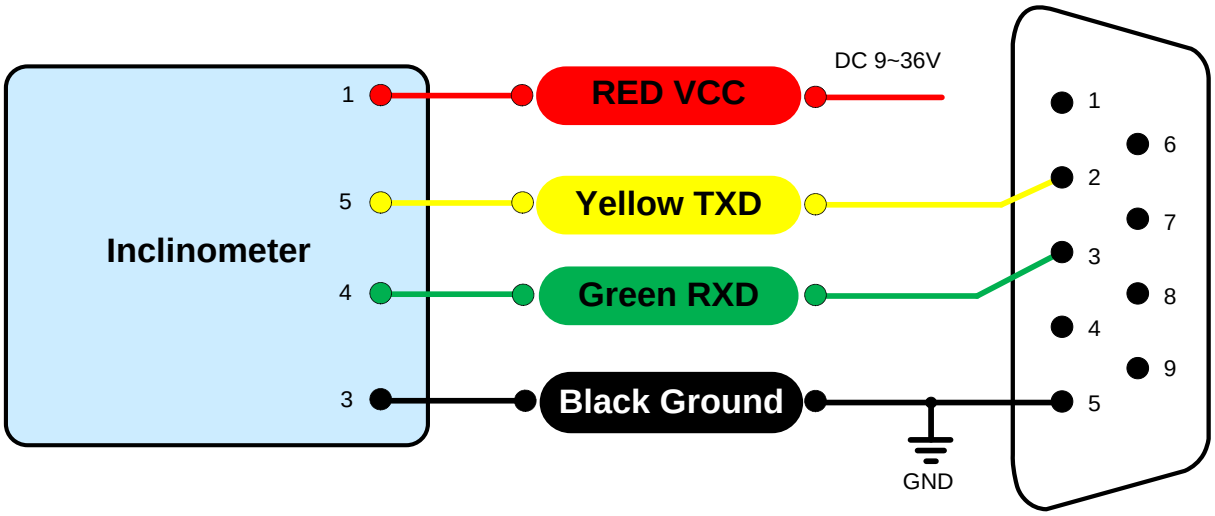


Figure 2. RS 232 Wiring Diagram

Table 2. Pin Number, Colors and Functions

No.	1	2	3	4	5
Color					
	RED	BLUE	BLACK	GREEN	YELLOW
Functions	VCC DC 9~36V	NC	GND	RXD (B, D-)	TXD (A, D+)

DEBUGGING SOFTWARE

You can download the serial debugging assistant directly on the official website (technical service -> download area), or you can use the more convenient and intuitive host computer software.

TS – 9827 – R02 supporting serial port debugging software can connect the inclination sensor on the computer to display the angle. The software debugging interface is shown in the figure below. Using the tilt angle to debug the host computer, you can conveniently display the current X direction and Y direction tilt angle, and you can also modify and set other parameters.

Steps:

(1). Correctly connect the serial port hardware of the inclinometer and connect the power supply.

(2). Select the computer serial port and baud rate and click to connect to the serial port.

(3). Click Start, the current tilt angle of the inclinometer in the X and Y directions will be displayed on the screen.

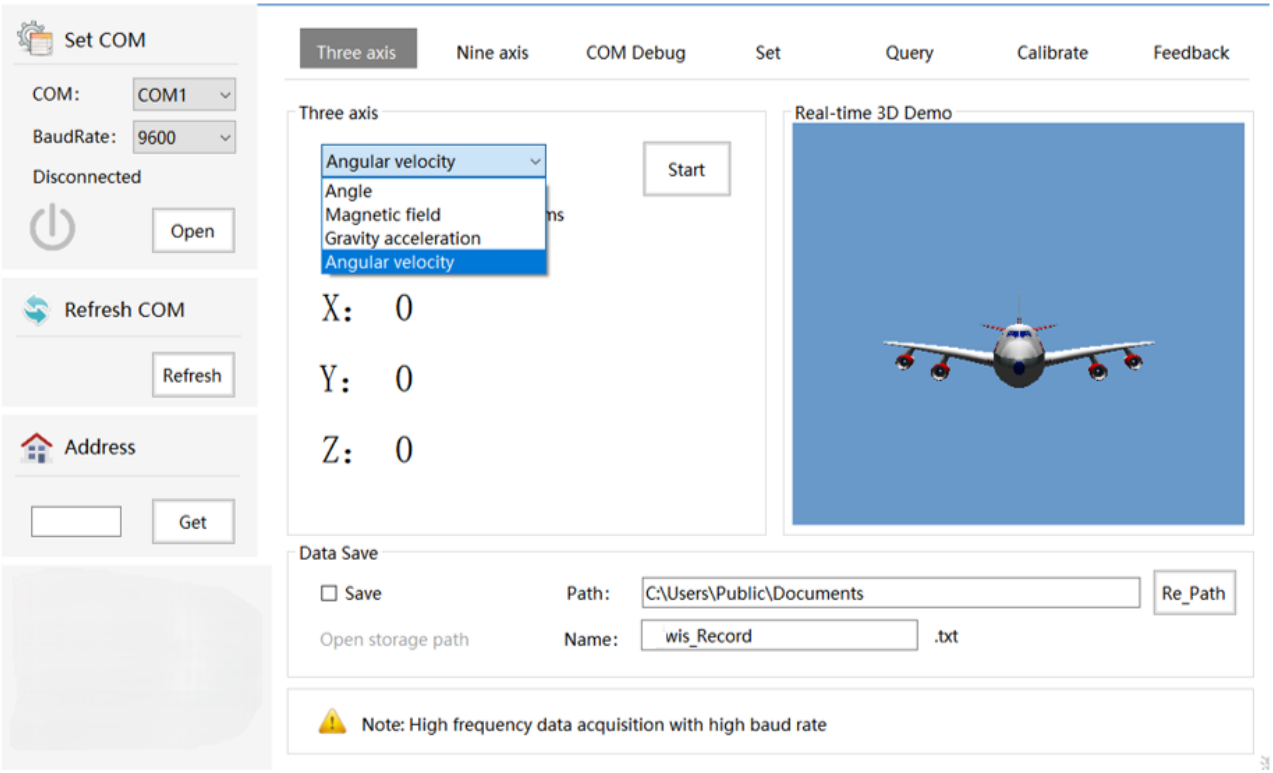
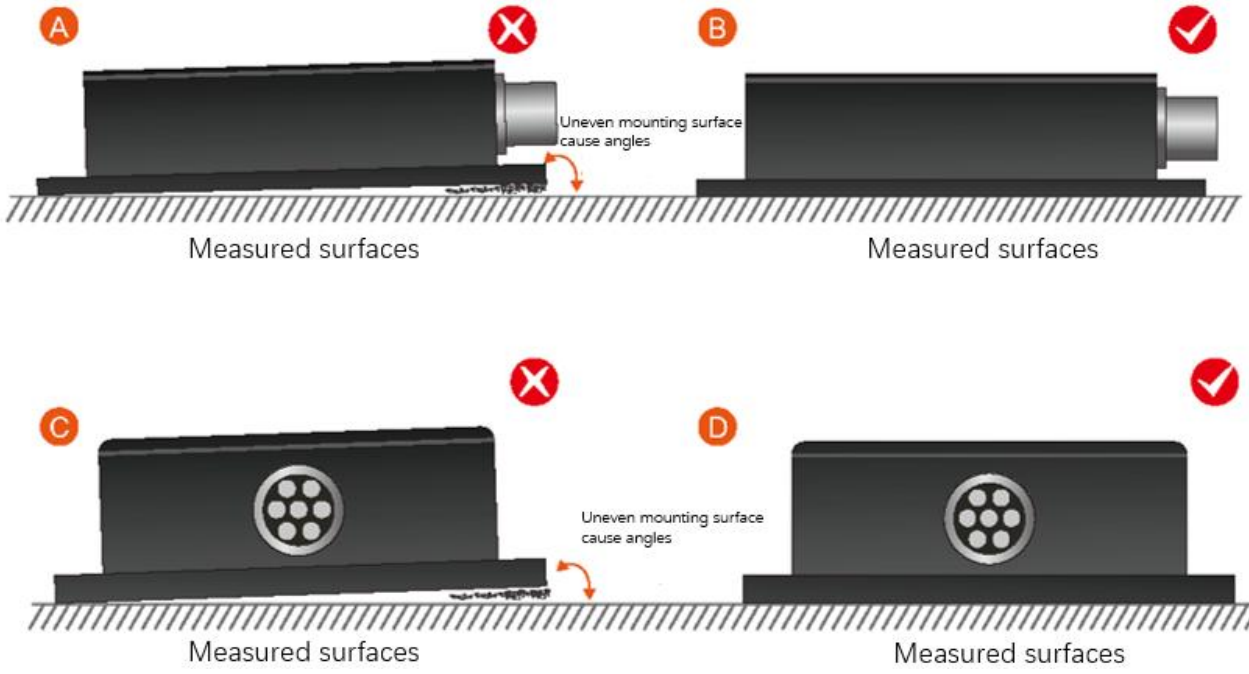


Figure 3. Software Debugging Interface

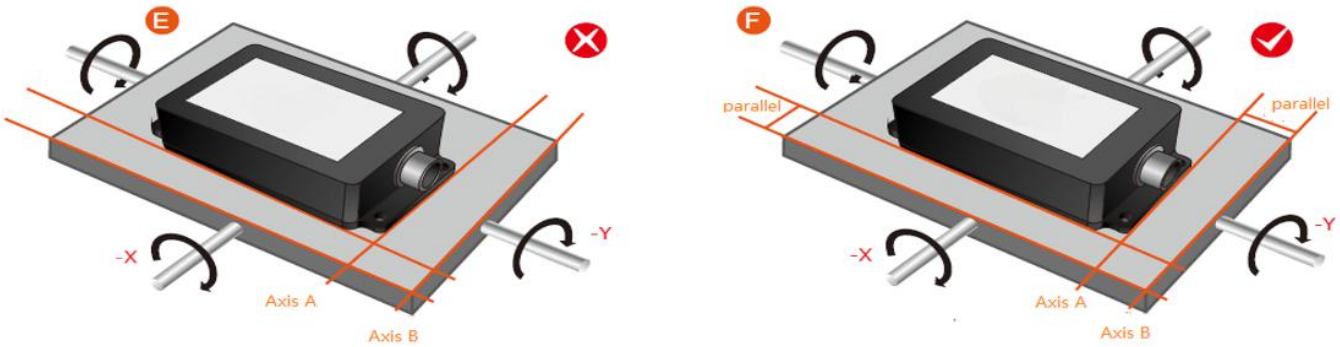
INSTALLATION

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.

DIMENSIONS

Outline Dimensions

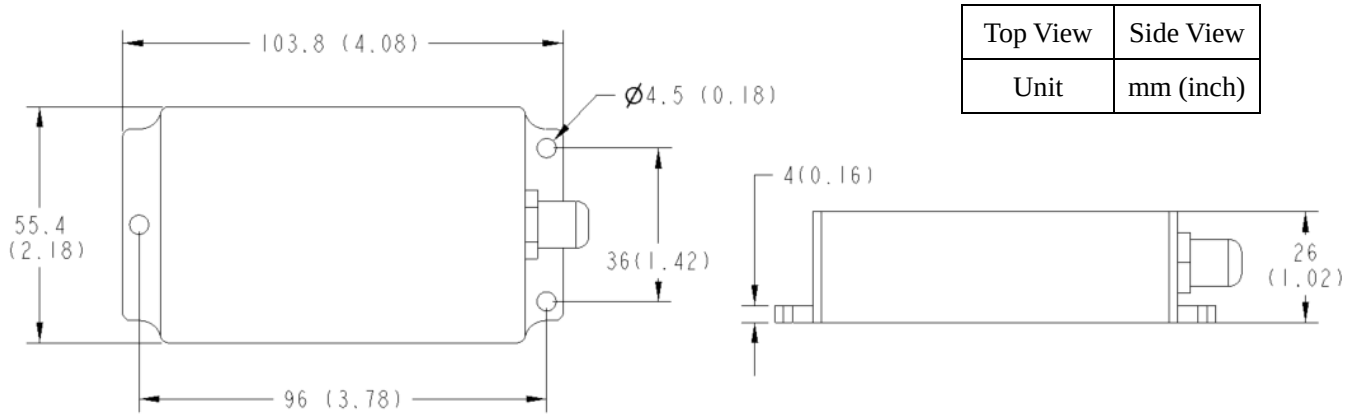


Figure 4. Outline Dimensions

PCB Dimensions

The length and width may have an error of ±1mm, please refer to the actual product.

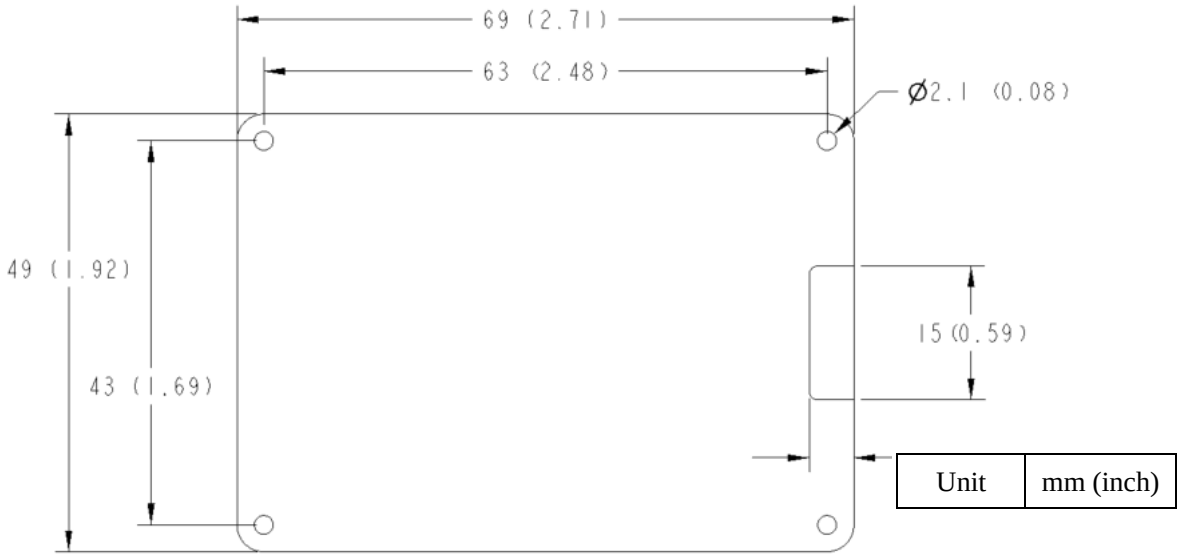


Figure 5. PCB Dimensions

Figure 6. Top View of TS-9827-R02

Table 3. Mechanical Index

Connector	Metal joint（Cable 1.5m)
Protection level	IP67
Shell material	Magnesium aluminum alloy oxidation
Installation	Four M4 screws

EXECUTIVE STANDARD

- Specification for Static Calibration of Biaxial Inclination Sensors National Standard (Draft)
- GB/T 191 SJ 20873-2003 General Specification for Tiltmeters and Levels
- GJB150-3A High temperature test
- GJB150-4A Low temperature test