



Figure 1.1. Top View of TS-2312-R05



Figure 1.2. Side View of TS-2312-R05



Figure 1.3. Top View of TS-2312-R05



## FEATURES

- Single Axis Inclination Measurement
- Resolution: 0.02°
- Power Supply: 12-36V
- Size: 3.54 × 1.59 × 1.02 (inch)  
90 × 40.5 × 26 (mm)
- Highest Accuracy: 0.2°
- Measurement Range: ±180°
- Output: 4-20mA/0-20mA/0-24mA Optional
- IP67 Protection Level

## APPLICATIONS

- Industrial Automatic Leveling
- Medical Instruments
- Photovoltaic Automatic Tracking
- Tower Tilt Monitoring
- Special Valve
- Oil Drilling Equipment
- Industrial Converter
- Lifting Equipment Inclination Control

## DESCRIPTION

The TS-2312-R05, is a low-cost single-axis inclinometer with current output. It uses a mature industrial-grade MEMS accelerometer, with a measurement range of ±180°, the highest accuracy of 0.2°, and an operating temperature of -40°C ~ +85°C.

This product is small in size and light in weight, which can meet the application requirements with limited space. It converts the change of the static gravity field into the change of the inclination angle, and directly outputs the horizontal inclination value through the current mode.

It has the advantages of low cost, small temperature drift, simple use, and strong anti-interference ability. It is an ideal choice of photovoltaic power generation, pan-tilt control, tower monitoring and other industries inclination measurement!

During installation, users can employ the AIT serial port debugging assistant tool or AIT test and calibration software for on - site calibration. This helps correct any angle misalignment at the installation site.

## SPECIFICATIONS

Table 1.

| Parameter                   | Test Conditions  | Min. | Typ. | Max. | Unit/Note |
|-----------------------------|------------------|------|------|------|-----------|
| Power Supply Voltage        |                  | 12   |      | 36   | V         |
| Operating Current           | No load          | 20   | 50   | 60   | mA        |
| Output Load                 | Resistive        |      |      | 500  | Ω         |
| Operating Temperature Range |                  | -40  |      | 85   | °C        |
| Storage Temperature Range   |                  | -55  |      | 100  | °C        |
| Measurement Range           |                  |      | ±180 |      | °         |
| Measurement Axis            |                  | X    |      |      |           |
| Accuracy                    | Room temperature |      | 0.2  |      | °         |
| Resolution                  | Completely still |      | 0.02 |      | °         |
| Start-Up Time               |                  |      |      | 3    | s         |



| Parameter                       | Test Conditions           | Min.                       | Typ. | Max. | Unit/Note |
|---------------------------------|---------------------------|----------------------------|------|------|-----------|
| Output Frequency                |                           |                            | 100  |      | Hz        |
| Current Output at Zero          | Output: 0 ~ 20mA          |                            | 10   |      | V         |
|                                 | Output: 0 ~ 24/4-20mA     |                            | 12   |      |           |
| Full-Scale Output Voltage Range | 0 ~ 20/0-24mA<br>Optional | 4                          |      | 20   | V         |
| 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 ( $\geq 16$  times) measurements.



## ELECTRICAL INTERFACE

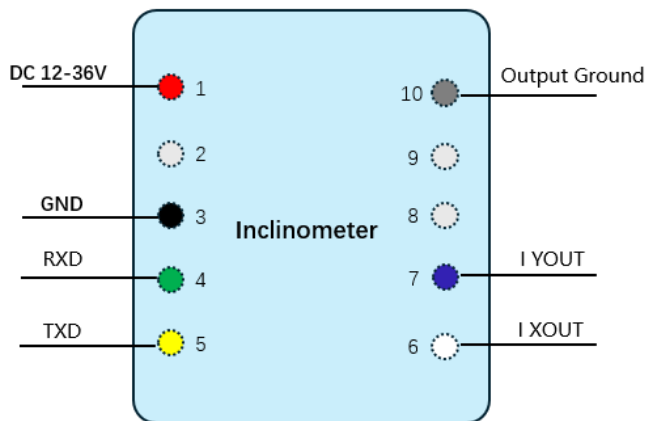


Figure 2. Pin Names

Table 2. Pin Number, Colors and Functions

| No. | Color  |        | Functions         |
|-----|--------|--------|-------------------|
| 1   | Red    | Red    | VCC: DC 12V ~ 36V |
| 2   | Blue   | Blue   | NC                |
| 3   | Black  | Black  | Ground            |
| 4   | Green  | Green  | RXD               |
| 5   | Yellow | Yellow | TXD               |
| 6   | White  | White  | I XOUT            |
| 7   | Purple | Purple | I YOUT            |
| 10  | Grey   | Grey   | Output Ground     |

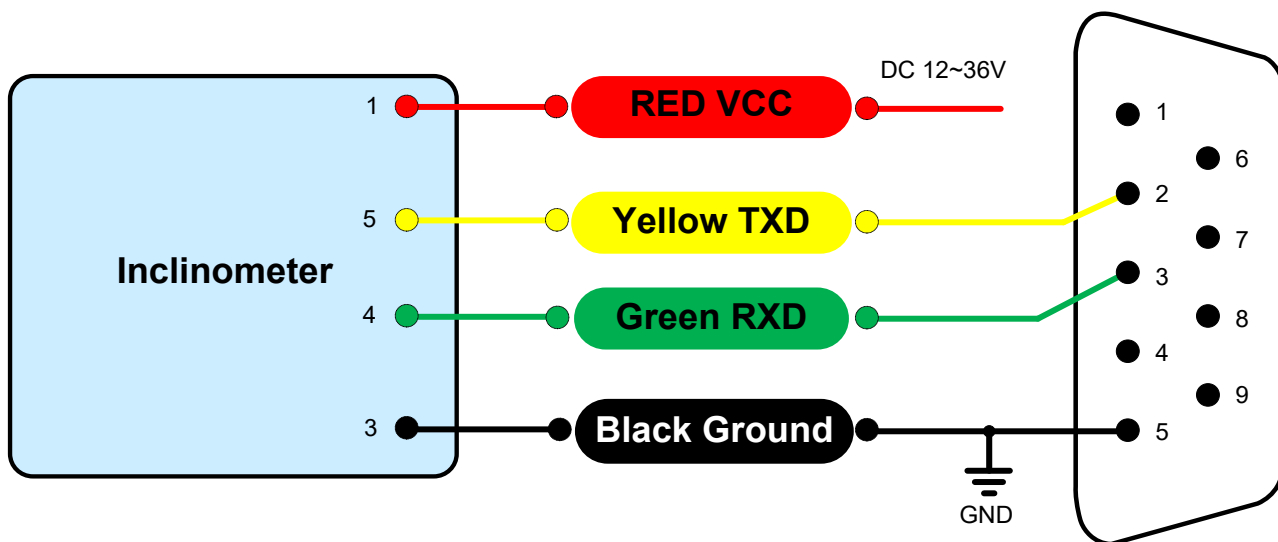


Figure 3. RS232 Wiring Diagram



## 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-2312-R05 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 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.

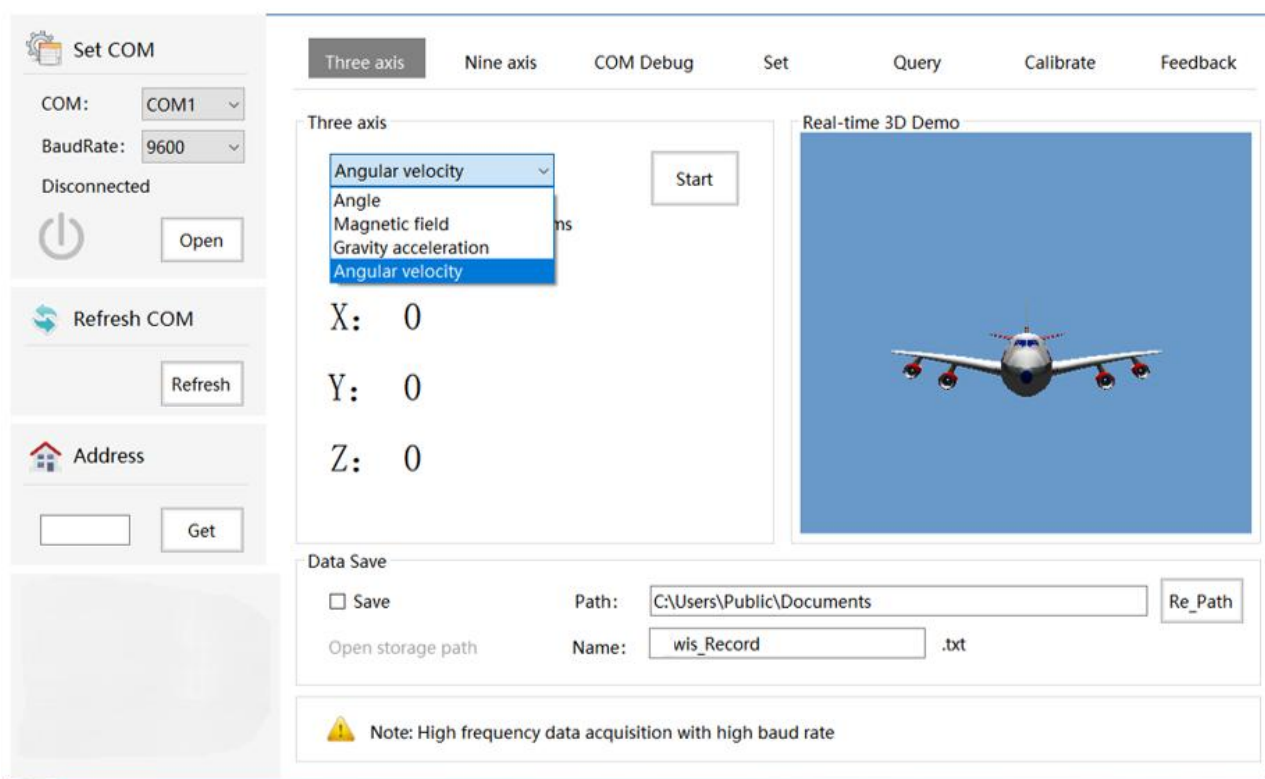


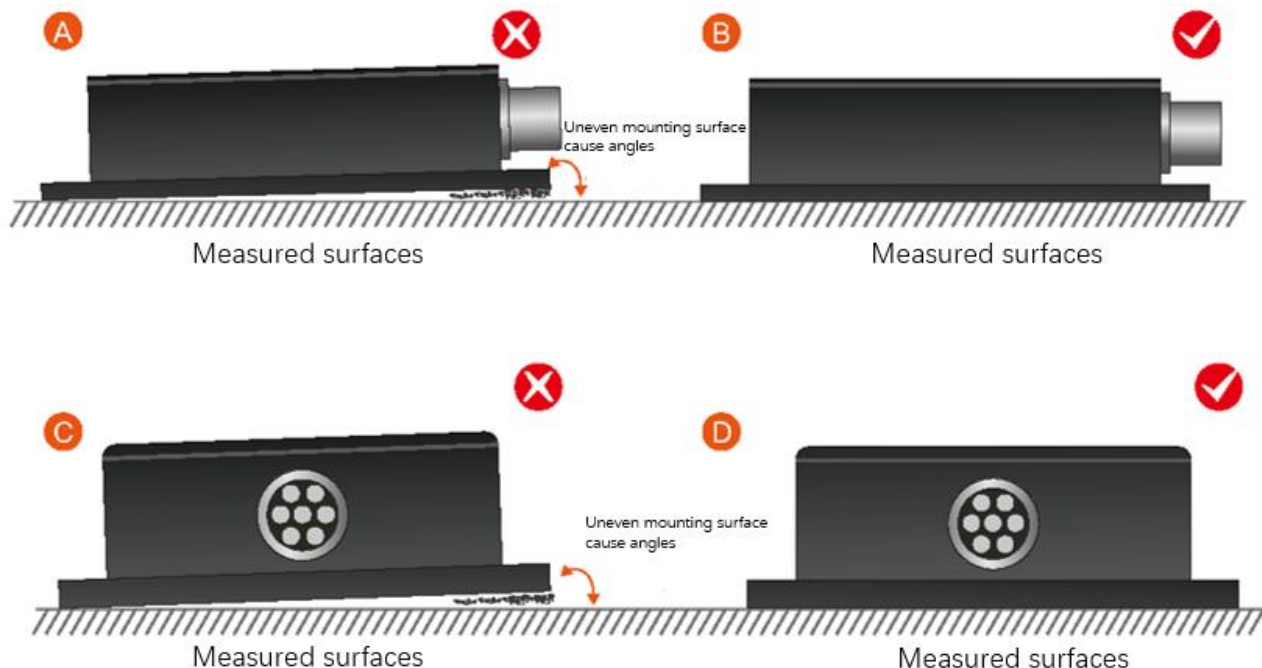
Figure 4. Software Debugging Interface



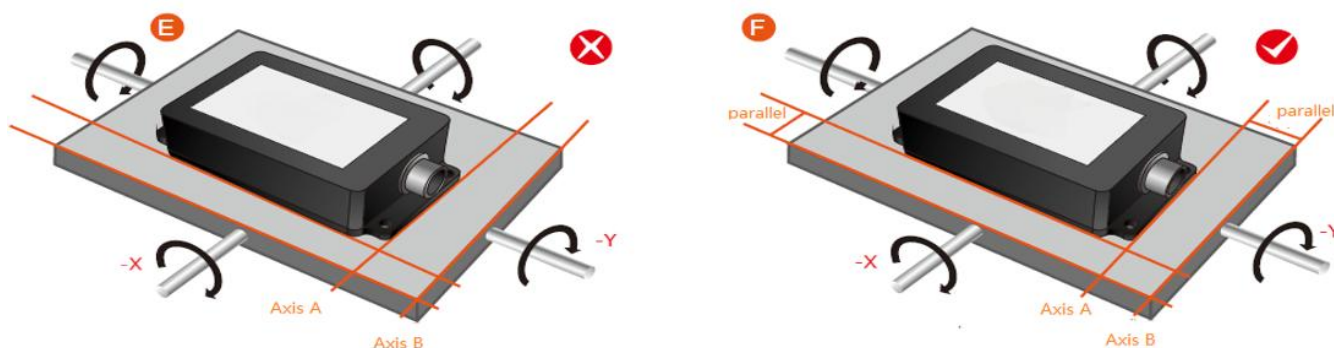
## INSTALLATION

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

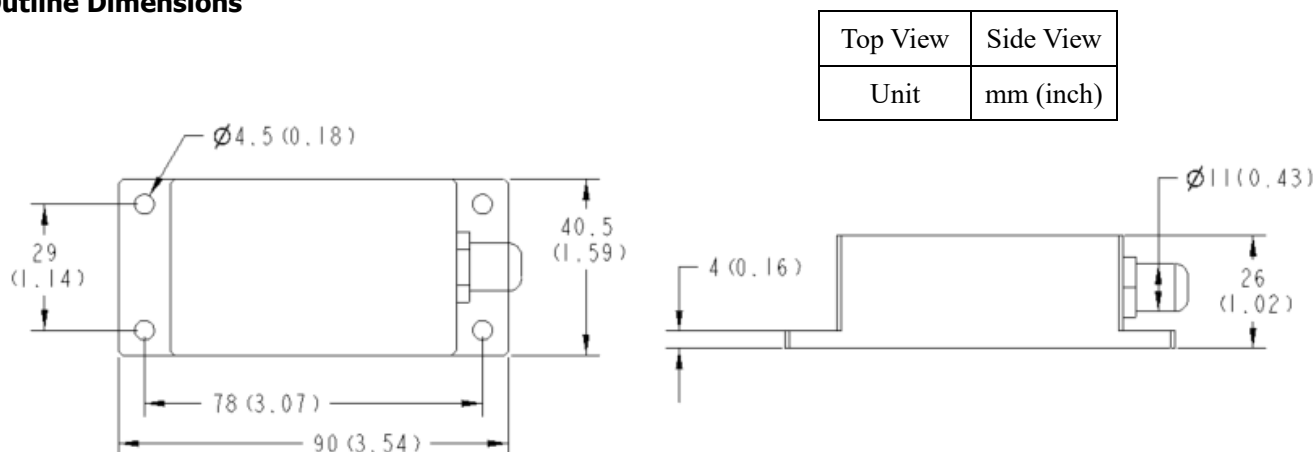


Figure 5. Outline Dimensions

### PCB Dimensions

The length and width may have an error of  $\pm 1\text{mm}$ , please refer to the actual product.

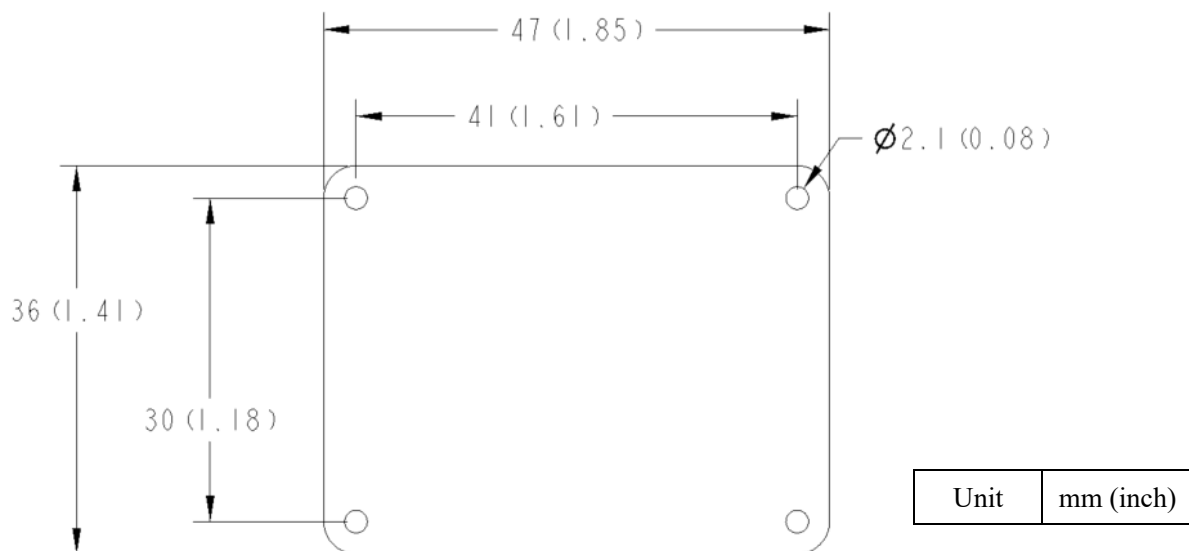


Figure 6. PCB Dimensions



Table 3. Mechanical Index

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

## ORDERING INFORMATION

| Part Number     | Buy Now                                                                                                                                                                 | Description                  |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| TS-2312-R05-420 |  *  * | Output: 4-20mA Current/RS232 |
| TS-2312-R05-020 |  *  * | Output: 0-20mA Current/RS232 |
| TS-2312-R05-024 |  *  * | Output: 0-24mA Current/RS232 |

\*: both  and  are our online store icons. Our products can be ordered from either one of them with the same pricing and delivery time.

## NOTICE

1. It is important to carefully read and follow the warnings, cautions, and product-specific notes provided with electronic components. These instructions are designed to ensure the safe and proper use of the component and to prevent damage to the component or surrounding equipment. Failure to follow these instructions could result in malfunction or failure of the component, damage to surrounding equipment, or even injury or harm to individuals. Always take the necessary precautions and seek professional assistance if unsure about proper use or handling of electronic components.
2. Please note that the products and specifications described in this publication are subject to change without prior notice as we continuously improve our products. Therefore, we recommend checking the product descriptions and specifications before placing an order to ensure that they are still applicable. We also reserve the right to discontinue the production and delivery of certain products, which means that not all products named in this publication may always be available.
3. This means that while ATI may provide information about the typical requirements and applications of their products, they cannot guarantee that their products will be suitable for all customer applications. It is the responsibility of the customer to evaluate whether an ATI product with the specified properties is appropriate for their particular application.
4. ATI warrants its products to perform according to specifications for one year from the date of sale, except when damaged due to excessive abuse. If a product fails to meet specifications within one year of the sale, it can be exchanged free of charge.
5. ATI reserves the right to make changes or discontinue products or services without notice. Customers are advised to obtain the latest information before placing orders.



6. All products are sold subject to terms and conditions of sale, including those pertaining to warranty, patent infringement, and limitation of liability. Customers are responsible for their applications using ATI products, and ATI assumes no liability for applications assistance or customer product design.
7. ATI does not grant any license, either express or implied, under any patent right, copyright, mask work right, or other intellectual property right of ATI.
8. ATI's publication of information regarding third-party products or services does not constitute approval, warranty, or endorsement.
9. ATI retains ownership of all rights for special technologies, techniques, and designs for its products and projects, as well as any modifications, improvements, and inventions made by ATI.
10. Despite operating the electronic modules as specified, malfunctions or failures may occur before the end of their usual service life due to the current state of technology. Therefore, it is crucial for customer applications that require a high level of operational safety, especially in accident prevention or life-saving systems where the malfunction or failure of electronic modules could pose a risk to human life or health, to ensure that suitable measures are taken. The customer should design their application or implement protective circuitry or redundancy to prevent injury or damage to third parties in the event of an electronic module malfunction or failure.