Product Manual

Inclination Sensor

Model · ATS03

Product version · V1.0



1. Product Overview

The ATS03 displacement sensor is a standard industrial dual-axis measurement device that uses the Kalman filter algorithm to determine equipment status by detecting the inclination angle in the application environment. The product features high precision, high stability, and RS485 signal output, making it suitable for long-term outdoor industrial measurement and structural health monitoring.

2. Functional Features

- Adopts the Kalman filter algorithm, combined with a three-axis gyroscope and three-axis accelerometer, to ensure accurate and stable angle data.
- Features a wide angle measurement range and good output signal linearity, meeting the requirements of the vast majority of environments.
- Uses a dedicated 485 circuit, supports the standard Modbus-RTU communication protocol, and allows configuration of the communication address and baud rate.
- Employs three-level filtering for data processing, offering strong resistance to external interference and high long-term stability.
- Features an ABS housing, equipped with a PG7 waterproof connector and a four-core waterproof shielded cable, providing a high protection rating.
- Supports the optional HA version for integration with Home Assistant (HA small box power supply is DC 12-24V)

3. Application Scenarios

- Industrial inclination measurement and tilt compensation for weighing systems.
- Monitoring of dangerous buildings and protection monitoring of ancient architecture.
- Inclination measurement of bridge towers and tunnel monitoring.
- Dam monitoring and drilling inclination control.

4. Structural Interface

- Dimensions: Length 90mm × Width 58mm × Height 36mm.
- Interface Description: The device comes with a four-core waterproof shielded cable; the RS485 version supports wide voltage power input (5~30V); when wiring the 485 signal lines, note that the A and B lines must not be reversed, and the addresses of multiple devices on the bus must not conflict.

5. Technical Parameters

- Product Model: ATS03
- Supply Voltage: DC 5~30V (RS485 version), HA version supply is DC12-24V
- Dimensions: 90 × 58 × 36 mm
- Weight: 500g
- Maximum Power Consumption: ≤0.15W
- Operating Temperature: -40℃ ~ 80℃, 0~95%RH (non-condensing)
- Range: X-axis -180°~180°; Y-axis -90°~90°; Z-axis -180°~180°
- Resolution: 0.01°
- Typical Accuracy: X, Y-axis static accuracy ±0.1°, dynamic accuracy ±0.5°; Z-axis static accuracy ±0.5°, dynamic has integration error
- Temperature Drift: ±(0.5°~1°) (-40℃~+60℃)
- Response Time: <1s
- Protection Rating: IP65

6. Installation and Wiring

6.1 Installation Method

- Horizontal Installation (Default): The default installation direction of the module is horizontal. Simply place the device upright on the surface to be measured.
- Vertical Installation: Rotate the module 90° around the X-axis and place it vertically. Select "Vertical" in the "Installation Direction" configuration field of the host computer. Calibration must be performed after configuration before use.
- Installation Precautions:

1. The mounting surface and the surface to be measured must be fixed tightly, flatly, and stably to avoid measurement angle errors.

2. The sensor axis must be parallel to the measured axis.

3. After powering on the device, it must remain stationary for 5s. When performing zero-point calibration, the device must also remain stationary.

6.2 Wiring Instructions

Wire Color	Description	Remarks
Brown	Power Positive	5~30V DC

Black	Power Ground	GND
Yellow	485-A	485-A
Blue	485-B	485-B

7. Configuration and Usage

1. Open the debugging software "Modbus poll".

2. Select the correct COM port (can be viewed in Device Manager).

3. Connect only one device individually and power it on, then select the correct baud rate and address (default baud rate is 4800bit/s, default address is 0x01).

4. Modify the address, baud rate, and installation direction according to usage requirements, and simultaneously query the current functional status of the device.

5. If the test is unsuccessful, please re-check the device wiring, product address, product baud rate, and the installation status of the 485 driver.

8. Communication Protocol

8.1 Basic Communication Parameters

- Encoding: 8-bit binary
- Data bits: 8 bits
- Parity bit: None
- Stop bits: 1 bit
- Error check: CRC (Cyclic Redundancy Check)
- Baud rate: Configurable, RS485 version factory default is 4800bit/s

8.2 Data Frame Format Definition

Adopts the standard Modbus-RTU communication protocol, with the format as follows:

- Initial structure: ≥ 4 bytes of time
- Address code: 1 byte (factory default 0x01)
- Function code: 1 byte
- Data area: N bytes (Note: for 16bits data, the high byte is first)
- Error check: 16-bit CRC code (low byte first, high byte last)
- End structure: ≥ 4 bytes of time

Master inquiry frame structure: Address code (1 byte) + Function code (1 byte) + Register start address (2 bytes) + Register length (2 bytes) + Checksum low byte (1 byte) + Checksum high byte (1 byte)

Slave response frame structure: Address code (1 byte) + Function code (1 byte) + Valid byte count (1 byte) + Data area one (2 bytes) + Data area two (2 bytes) + ... + Checksum low byte (1 byte) + Checksum high byte (1 byte)

8.3 Register Address (Part of Core)

Register Address	Content	Operation Definition	Description
0000 H	X-axis angle	Read-only	Read x-axis inclination angle, multiplied by one hundred
0001 H	Y-axis angle	Read-only	Read y-axis inclination angle, multiplied by one hundred
0002 H	Z-axis angle	Read-only	Reads the z-axis inclination angle, multiplied by 100
0003 H	X-axis angle	Read-only	Reads the x-axis inclination angle, multiplied by 10
0004 H	Y-axis angle	Read-only	Reads the y-axis inclination angle, multiplied by 10
0005 H	Z-axis angle	Read-only	Reads the z-axis inclination angle, multiplied by 10
0052 H	Installation method	Read/Write	65H: Horizontal installation (default); 66H: Vertical installation
0053 H	XY-axis calibration	Write-only	67H: XY-axis zero-point calibration
0054 H	Z-axis calibration	Write-only	52H: Z-axis zero-point calibration
07D0 H	Device address	Read/Write	1~254 (factory default 1)

07D1 H	Device baud rate	Read/Write	0 represents 2400; 1 represents 4800 (default); 2 represents 9600; 3 represents 19200; 4 represents 38400; 5 represents 57600; 6 represents 115200; 7 represents 1200

8.4 Communication Example

Read X-axis angle (address 0x01):

- Query frame: 0x01 0x03 0x00 0x00 0x00 0x01 0x84 0x0A
- Response frame: 0x01 0x03 0x02 0x04 0x7E 0x3A 0xA4
- Parsing: X-axis angle data is 047EH (hexadecimal) = 1150, divided by 100, i.e., X-axis angle = 11.50°.

9. Application Conditions and Limitations

1. Warning: It is strictly prohibited to use this device as a safety device, emergency stop device, or in any situation where personal injury may result from device failure.

2. Usage Limitations: This device is limited to use within its design purpose and authorized scope. The relevant instructions in the technical manual must be carefully read and understood before installation, operation, or maintenance.

3. Measurement Blind Zone: When the Y-axis is near 90°, it is the device's Euler angle blind zone, at which time the X output angle is inaccurate. Care should be taken to avoid this angle during installation and use.

4. Drift Phenomenon: The yaw angle (Z-axis angle) of this device is calculated through pure integration, which inevitably leads to drift. Cumulative errors will occur in vibration environments; specific results are subject to actual testing.

10. Troubleshooting

Device cannot connect to PLC or computer:

1) The computer has multiple COM ports, and the selected port is incorrect.

2) Device address is incorrect, or there are devices with duplicate addresses (factory default is all 0x01).

3) Baud rate, parity, data bits, or stop bits are incorrect.

4) The 485 bus is disconnected, or the A and B lines are connected in reverse.

5) There are too many devices or the wiring is too long; power should be supplied nearby, a 485 booster should be added, and a 120Ω terminal resistor should be added simultaneously.

6) The USB to 485 driver is not installed or is damaged.

7) The device is damaged.

11. Safety Maintenance

- Warranty period: 12 months from the date of purchase (based on valid purchase proof).
- Warranty scope: Under normal use and maintenance, if a failure is caused by product material or process defects, the manufacturer provides free repair or part replacement services. After the warranty period ends, lifetime paid repair services are provided.
- The following situations are not covered by the warranty:

1. Damage to the device caused by incorrect installation or operation of the product.

2. The device has been disassembled, repaired, modified, retrofitted, or had any internal parts replaced by unauthorized technicians or by the user themselves.

3. Damage caused by negligent use or by water or other substances entering the device.

4. Failures or damage caused by accidental events or natural disasters.

5. Failures or damage caused by exceeding the operating parameter ranges listed in the product parameters.

12. Others

- The performance data in this manual is obtained under specific test system and software conditions. The manufacturer reserves the right to change design functions and specifications without prior notice.
- For vertical installation, the X-axis is horizontal to the left, the Y-axis is perpendicular to the wall and inward, and the Z-axis is in the counter-clockwise rotation direction of the module.

13. Packing List

- Sensor device: 1 unit