Six-Axis Inclinometer /Transmitter (ZX-104)

User Manual

V1.1.0



Product Overview

This product integrates a three-axis MEMS accelerometer and a three-axis digital gyroscope, features a built-in 16-bit high-resolution ADC, and provides onboard temperature measurement, enabling full six-axis attitude sensing. Conventional single-accelerometer solutions are suitable only for static tilt measurement and are susceptible to external motion-induced acceleration during dynamic operation, which can distort the data. To address this limitation, this transmitter uses a multi-sensor data-fusion algorithm that combines the static reference of the accelerometer with the transient dynamic response of the gyroscope. This enables the device to provide highly stable, low-drift real-time attitude angles even under dynamic conditions such as complex vibration and motion impact. The product offers excellent environmental adaptability and long-term operating stability. It supports the standard Modbus-RTU communication protocol and can be seamlessly integrated into various industrial automation control systems.

Key Advantages

- 16-bit high-resolution ADC: Angular resolution is on the order of 0.05°, allowing even small tilt changes to be detected. Suitable for high-precision applications such as precision leveling and deformation monitoring.
- Excellent stability: Temperature compensation and factory calibration provide low long-term zero-point drift, reducing repeated on-site calibration and maintenance costs.
- Stable dynamic output: The algorithm suppresses vibration noise, delivering smooth output without jitter.

Specifications

- Wide supply voltage: 6 – 30 V
- Average operating current: 18 mA
- Communication protocol: Standard Modbus-RTU
- Data output rate: 125 Hz
- Temperature measurement accuracy: 0.5° C
- X-axis static accuracy: 0.05°
- Y-axis static accuracy: 0.05°
- X-axis dynamic accuracy: 0.4°
- Y-axis dynamic accuracy: 0.4°
- Angle output range: ±90°

MODBUS Command Description

MODBUS is a widely used master-slave serial communication protocol in industrial automation. It is designed around simplicity, openness, and reliability. As a typical application-layer protocol, MODBUS enables device-to-device data exchange through standardized command formats and is suitable for networked control and monitoring of industrial equipment such as PLCs, sensors, and instruments.

1. Basic Protocol Features

Transmission modes: RTU (binary encoding) and ASCII (text encoding) are supported. RTU is more commonly used because of its efficiency.

Communication method: Based on a request-response model. The master initiates a command, and the slave returns data or performs an action.

Function code: The key field in a command that defines the operation, such as reading coils or writing registers. The range is 1–127.

2. Key Fields in the Command Structure

Address field: Slave device ID (1–247), used to address a target on a multi-device bus.

Data field: Contains register addresses, operation data, etc. Its length and format are determined by the function code.

Check field: CRC (RTU) or LRC (ASCII) check, used to ensure transmission integrity.

3. Example of a Typical Command Sequence

[Master Request] 01 03 00 00 00 06 C5 C8 (Slave 1; read holding registers; starting address 00 00; read 6 registers; CRC check)

[Slave Response] 01 03 0C CD CC CC 3D 66 66 E6 BE C3 F5 CE 41 71 1C (returns data values for

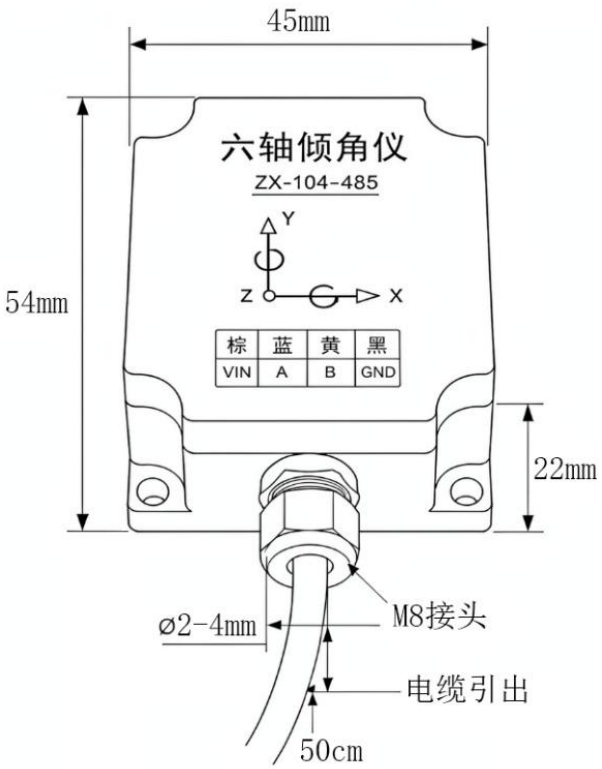
6 registers and the checksum)

CD CC CC 3D represents the X-angle data; 66 66 E6 BE represents the Y-angle data; C3 F5 CE 41 represents the temperature data. The data format is FLOAT_DCBA. For example, CD CC CC 3D converts to 0.1° .

4. Register Description

Register Name	Register Address	Register Type (R/W)	Quantity	Data Type	Unit
X Angle	00 00	R	2	FLOAT_DCBA	°
Y Angle	00 02	R	2	FLOAT_DCBA	°
Temperature	00 04	R	2	FLOAT_DCBA	°C
Vibration Status	00 06	R	1	UINT_AB	0 = Static; 1 = Dynamic
Reserved Registers	0007–000F	-	-	-	-
Device Address	00 10	W/R	1	UINT_AB	-
X-Angle Offset	00 11	W/R	1	UINT_AB	Divide by 100
Y-Angle Offset	00 12	W/R	1	UINT_AB	Divide by 100
XY Calibration	00 13	W/R	1	UINT_AB	1 = Calibrated; 0 = Raw

Dimensions and Structure



Parameter Configuration

The transmitter's default address is 01 (supports 0xFF broadcast addressing), and the default serial port settings are 9600, N, 8, 1. Other parameters can be configured using our configuration tool or MODBUS commands.



Serial baud rate: Communication rate between the transmitter and an RTU or host computer; configurable from 1200 to 115200.

Serial parity: NO, EVEN, or ODD.

Device address: MODBUS communication address; default is 01, and FF is used for broadcast addressing.

After the device has been securely installed and confirmed to be at the reference position and completely stationary, zeroing can be performed using the supplied configuration software. Click **"Zero Calibration"** to set the current attitude angle as the new zero reference. The X/Y output values will immediately become zero, and all subsequent measurements will be referenced to this position (relative-angle mode). This setting is stored in non-volatile memory and is retained after power is removed.

To cancel the user-defined zero position and return to the factory-calibrated reference, click "Factory Angle." The device will restore the factory default zero point, and angle output will switch to absolute-angle mode.

Note: Zeroing only compensates for installation-reference deviation; it is not an accuracy calibration. Before zeroing, ensure that the mounting surface is in good contact and that tightening torque is uniform. This helps prevent ongoing zero-point drift caused by deformation of the housing under mechanical stress.

Wiring

No.	Wire Color	Function
1	Brown	Power supply positive (6–30 V input)
2	Blue	RS485 differential signal positive (Data+ / A)
3	Yellow	RS485 differential signal negative (Data− / B)
4	Black	Power ground / signal reference ground (GND)

Warranty Terms

To ensure that customers can use our products with confidence and satisfaction, our after-sales service policy is established in accordance with applicable national laws and regulations.

[Warranty Period]

If a product malfunctions during normal use within 7 days of sale, the customer may choose a refund, replacement, or repair. For faults caused by non-human factors within one year of purchase, free warranty service is provided. For cases not eligible for free replacement or warranty, we still provide technical support; only the cost of replacement parts is charged when parts are required for repair.

Purchase date: Determined by the date on the product sales contract or purchase order (except for certain products with an unlimited warranty period).

[The "Three Guarantees" Do Not Apply in the Following Cases]

1. Damage caused by human factors, use in abnormal operating environments, failure to use the product according to this manual, or use outside the environments specified in the manual.
2. Unauthorized disassembly, repair, or modification of the product without our company's approval.
3. Damage caused by improper transportation after purchase (our company ensures product safety before dispatch).
4. Damage caused by force majeure, such as floods, lightning, earthquakes, or abnormal voltage.

[Replacement and Warranty Procedure]

If a product malfunctions during use, please contact your sales representative promptly. They will arrange after-sales service. (Newly purchased products are eligible for replacement within seven days.)