Inclination Sensor

WGS00-2

User manual

Version: Av4

Document number:0000192997

Contents

User manual

Inclination Sensor

Catalogs

1. Version overview

Version	Date	Release	Editor	Description
Av1	2020/8/21	N	Chenmo	First version
Av2	2020/8/26	N	Chenmo	Add filter coefficients and power-on self-start settings
Av3	2020/12/16	N	Chenmo	Add product order number
Av4	2020/12/17	Y	Chenmo	Modify rotary axis definition picture

2. Safety instructions

2.1. Copyright

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2.2. Preface

Our inclination sensor products are designed in full compliance with the relevant mechanical and electrical safety regulations, but unregulated operation may still cause injury to the operator or other people's lives or limbs, and at the same time may have a negative impact on the equipment or even property damage. Any malfunction of the inclination sensor should please contact our service personnel for troubleshooting in a timely manner, it is strictly prohibited to continue using the inclination sensor in case of malfunction.

Inclination sensor can only be used in the manual listed in the job description, other non-applicable occasions or more than the use of the range of occasions can not use the inclination sensor. If you are unsure about the application of the product, consult with our technical staff before selecting a model for use. If the inclination sensor is used inappropriately or unprofessionally, it will not provide effective protection against injury and the user will be exposed to the same injuries as if the inclination sensor had not been used.

This manual has been verified and reviewed for accuracy. The instructions and descriptions contained in this manual are accurate for the WGS00-2 Series Inclination Sensor at the time of publication. However, future WGS00-2 Series Inclination Sensors and their manuals are subject to change without notice. Xuzhou Mook Electro-Hydraulic Control Co.,Ltd. shall not be liable for damages arising directly or indirectly from errors, omissions or discrepancies between the product and the manual.

2.3. Marking of notices

Icon	Meaning	Detailed instructions
	DANGEROUS	It can be predicted to cause unavoidable serious injury, death or property damage
	WARNING	May result in unavoidable serious injury, death or property damage

	NOTE	This may result in minor injuries and losses
	INSTRUCTION	Non-safety-related usage guidance and information
	ANNOTATION	Additional instructions or usage recommendations

3. Introduction

3.1. Product Briefing

WGS00-2 series inclination sensors use MEMS technology to non-contact measure the attitude inclination of the target object with the help of earth's gravity. It outputs analog current signals through high-resolution differential digital-to-analog converter, and also supports standardized CANOpen interface output. Compact and rugged structure, -40℃~85℃ working range, IP67 protection grade, good resistance to external electromagnetic interference and vibration suppression characteristics, is the ideal choice for industrial field control, platform measurement field, can be adapted to work in harsh environments for a long time.

3.2. Product Characteristics

- Dual-axis measurement;
- Compact structural design and small dimensions for easy installation;
-MEMS measuring capacitance principle, stable and accurate measurement results;
-Compensated cross sensitivity, compensated temperature coefficient;
-Configurable vibration suppression parameters;
-Reliable hardware design, protected against lightning strikes, surges, static electricity and port reversal;
- CE certified.

3.3. Technical Parameters

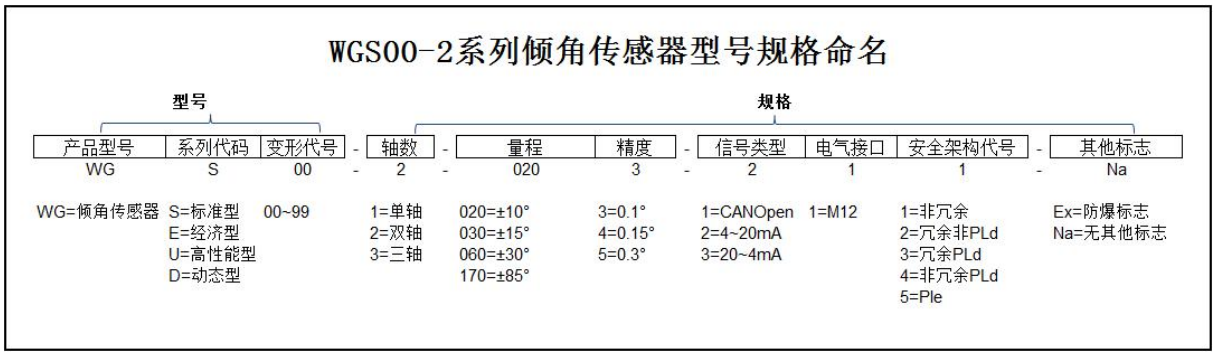
Technical Parameters	
Operating Voltage	10～36V
Storage Temperature	-40～85℃
Operating Temperature	-40～85℃
Resolution	0.02°
Range	±10°/±15°/±30°/±85°
Accuracy	Products for ±10°, ±15° and ±30° have an accuracy of ±0.1°; ±85° products: Accuracy of ±0.1° in the ±30° range; Accuracy of ±0.2° in the ±30° to ±60° range; Accuracy of ±0.3° in the range of ±60° to ±85°.
Repeatability	±0.1 ° @ +25 °C
Temperature Error	±0.008°/K (Typ.)
Vibration suppression	0~20Hz (Filter)
Operating Current	≤40mA（24V DC）
Initialization Response Time	300ms
Protection class	IP66/IP67
Weight	240g

Environmental testing	
Low temperature test	Execution standard：GB/T2423.01/IEC60068-2-1
High temperature test	Execution standard：GB/T2423.02/IEC60068-2-2
Temperature shock	Execution standard: GB/T2423.22/IEC60068-2-14
Temperature and humidity cycle	Executive standard: GB/T2423.34/IEC60068-2-38
Vibration test	Execution standard of sinusoidal vibration: GB/T2423.10/IEC60068-2-6 Random vibration executive standard: GB/T2423.56/IEC60068-2-64
Shock test	Executive standard: GB/T2423.5/IEC60068-2-27
Drop test	Execution standard: GB/T2423.8/IEC60068-2-32
Salt spray test	Implementation standard: GB/T2423.17/IEC60068-2-11
EMC	EMC emission: EN 61000-6-4:2007+A1:2011 EMC Immunity: EN 61000-6-2:2005 ISO 7637 immunity, ISO11452 immunity, ISO16750 immunity

3.4. Order No.

Serial No.	Management No.	Material Description	Signal Type	Range
1	230186	Inclination Sensor,WGS00-2-0203-211-Na	4~20mA	±10°
2	230184	Inclination Sensor,WGS00-2-0603-111-Na	CAN	±30°
3	230185	Inclination Sensor,WGS00-2-0603-211-Na	4~20mA	±30°
4	230183	Inclination Sensor,WGS00-2-1705-111-Na	CAN	±85°
5	230182	Inclination Sensor,WGS00-2-0303-112-Na	CAN	±15°

3.5. Product Code Description



3.6. Transportation and storage

(1) Strong impact and brutal loading and unloading should be avoided during transportation;
(2) Storage environment: -40℃～+85℃ (0～90%RH);
(3) Store in a dry and ventilated environment;
(4) No corrosive volatile substances should be present in the room.

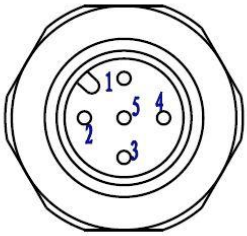
4. Port Description

4.1. Electrical interface

WGS00-2 series inclination sensor connector adopts M12 five-pole pin plug.

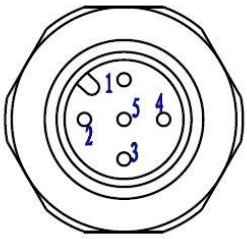
4.2. Pin Definition

- CAN type inclination sensor:



Pin	Pin Definition
1	Shielded
2	Power
3	Ground
4	CAN_H
5	CAN_L

- Current type inclination sensor:



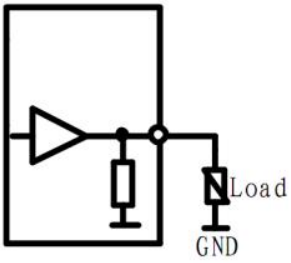
Pin	Pin Definition
1	Power supply
2	AO (Y-axis signal)
3	Ground
4	AO (X-axis signal)
5	Empty

4.3. List of connectors

Serial No.	Connectors	Model No.	Material No.	Qty.
1	M12 5 pole hole socket	M12BZPA2-5F	507722	1

4.4. Port detailed parameters

- AO：

AO	Parameters
Pin	2, 4 (current-type inclination sensors)
Schematic	
Signal Type	Analog Outputs
Output Range	4~20mA
Resolution	12bit

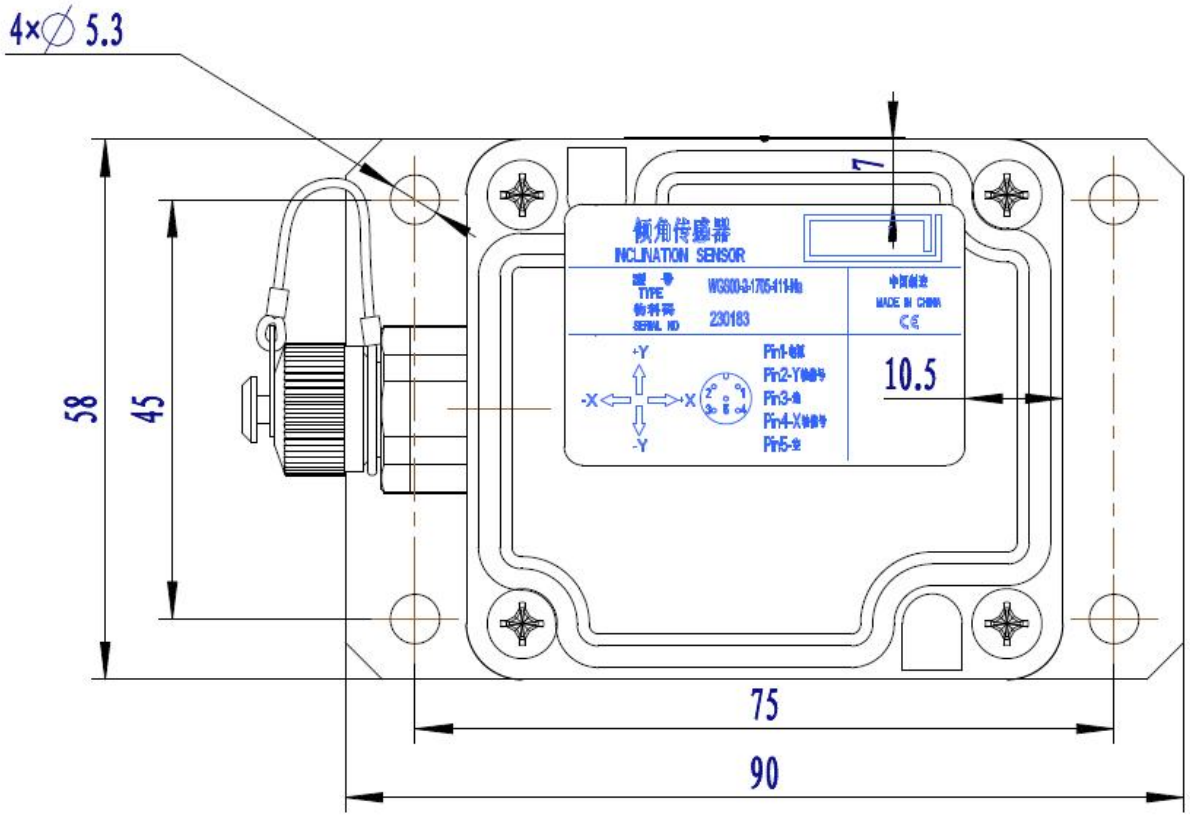
5. Installation instructions

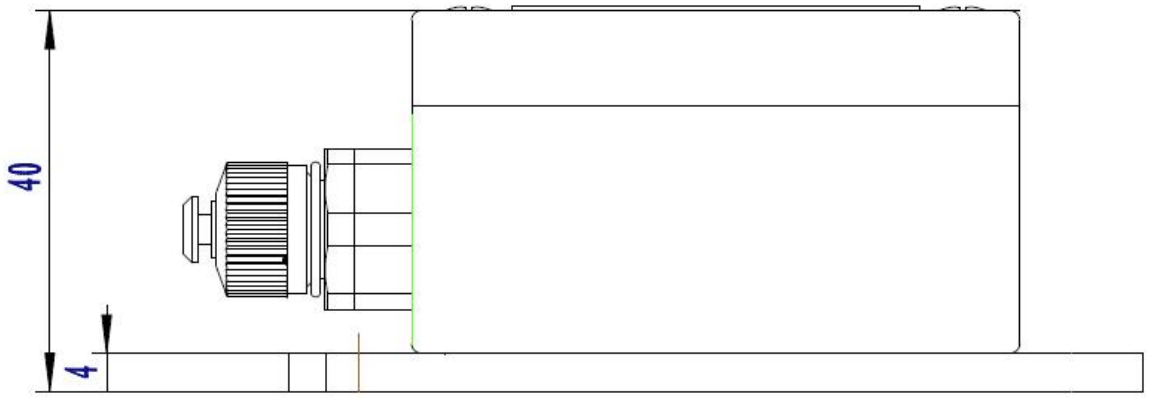
5.1. Pre-installation inspection

Before installation, please check whether the power supply and wiring are complete and correspond to each other, and whether the product is in good condition and free of bumps.

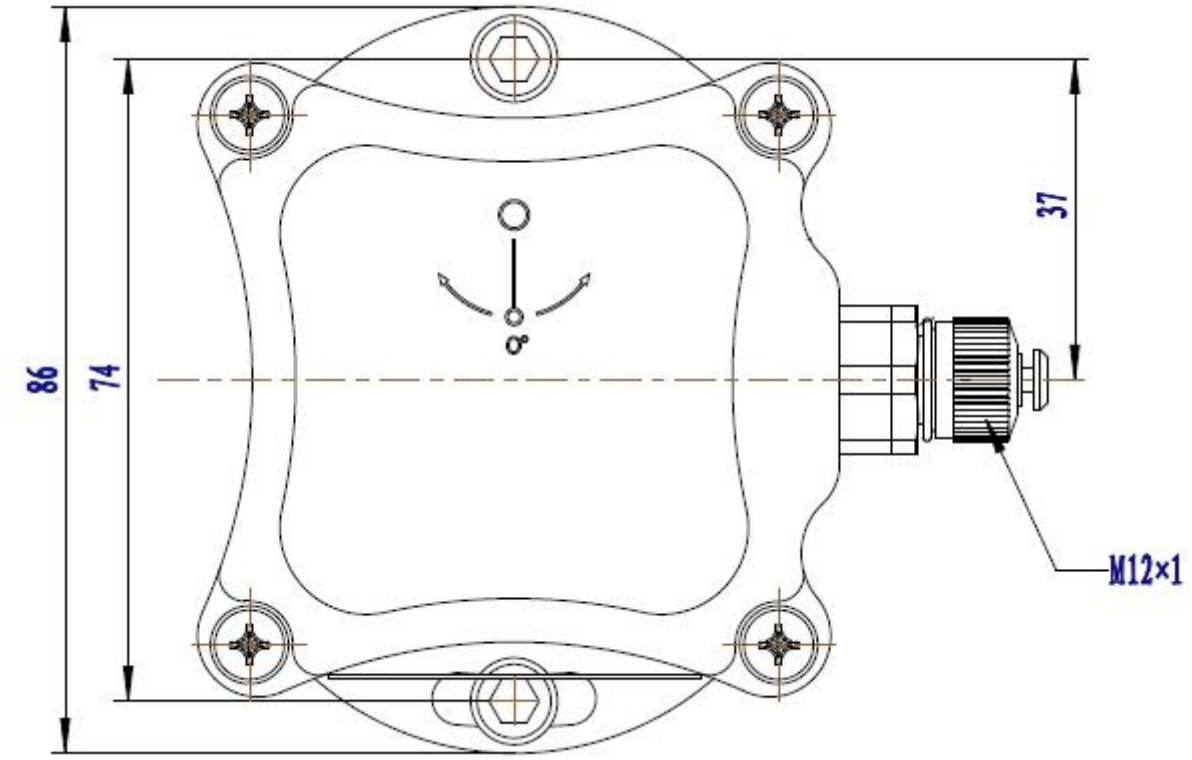
5.2. Outline and Installation Dimension Drawing

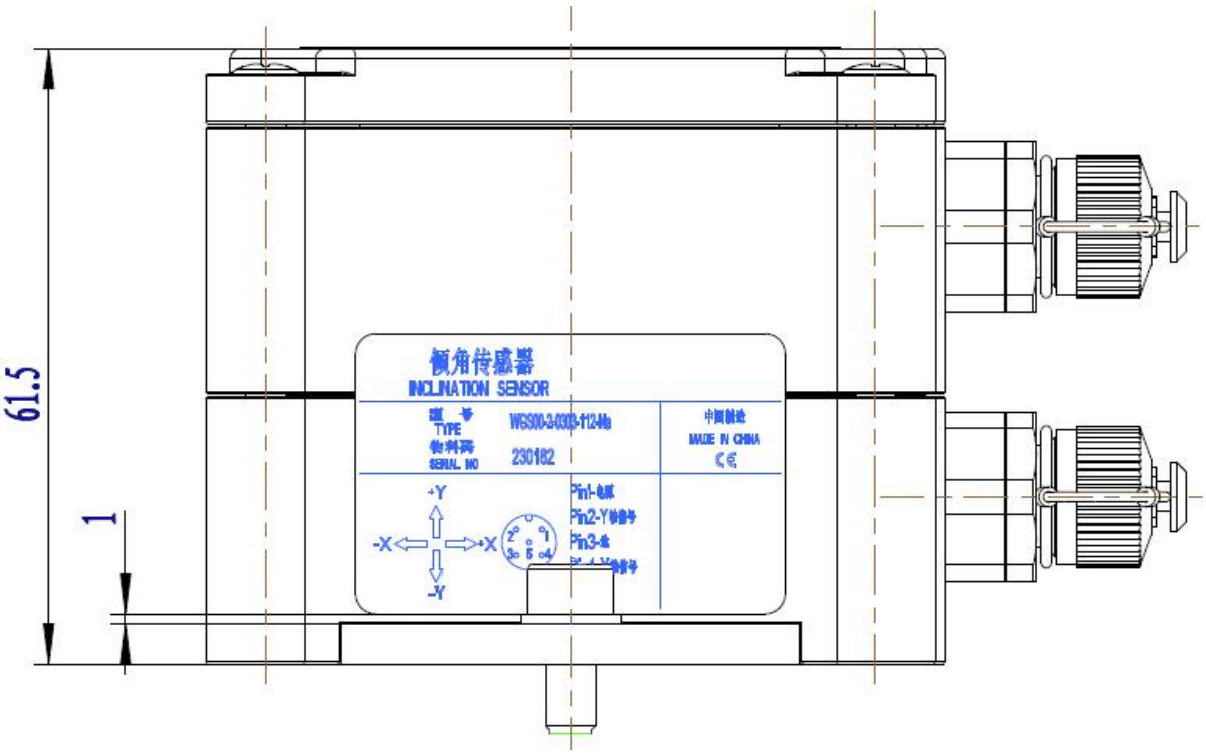
- Non-redundant sensors:




40
4

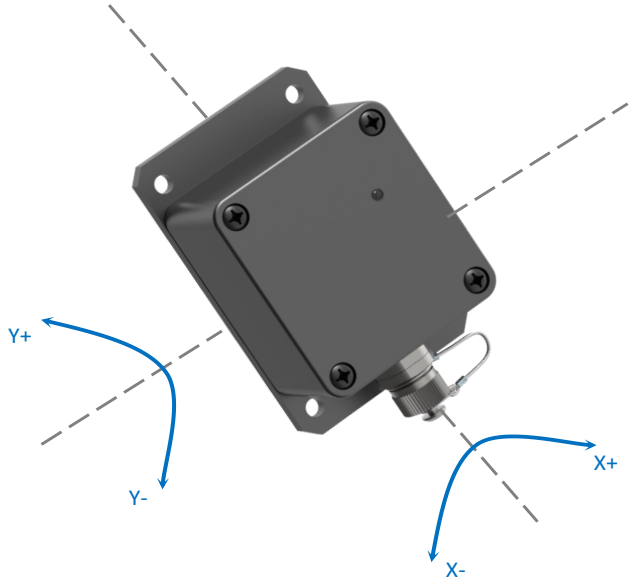
- Redundant sensors:



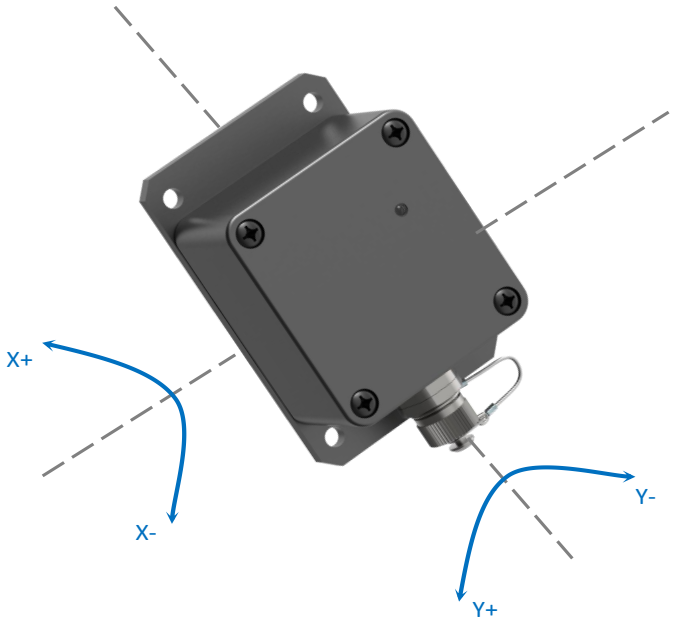


5.3. Definition of rotary axis

5.3.1. CAN type inclination sensor



5.3.2. Current Inclination Sensor

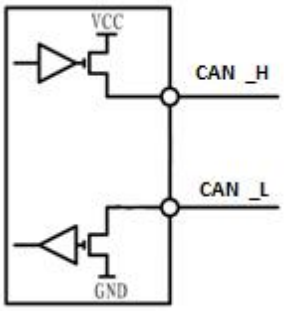


5.4. Mounting accessories

WGS00-2 series inclination sensor use 4 M4 bolts for fixed mounting, make sure the mounting surface is flat and smooth before mounting.

6. Communications port

6.1. CAN

CAN	Parameters
Pin	4, 5 (CAN-type inclination sensors)
Schematic	
Baud Rate Range	100 Kbit/s~500Kbit/s
Default Baud Rate	250Kbit/s
Protocol	CANOpen
Port Protection	CAN_H and CAN_L have short circuit protection for UB and GND respectively.
Termination Resistor	No built-in termination resistor

7. Parameter Configuration Description

7.1. Configuration method

CAN type inclination sensor needs to be configured on site through CAN device, one end of the CAN device is connected to the M12 five-pole pin socket on the product through CAN cable, and one end is connected to the configuration computer through USB to configure the parameters through the CAN device software on the computer.

7.2. Default configuration

Default Node Number	Non-redundant sensors: 7 Redundant sensors: 1617
Default Baud Rate	250Kbit/s
Default Cyclic Transmission Period	100ms
Default Heartbeat Cycle	600ms

7.3. PDO message

7.3.1. Heartbeat message

➢ Heartbeat messages are sent periodically after initialization is complete.

COB-ID	BYTE0
0x700+node_id	Node states

Node states definition:

0: startup;

5: normal mode;

7F: pre-run mode;

After CAN initialization is completed, Node states = 5, it automatically enters normal mode and starts sending PDO data.

7.3.2. Angle Calculation

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x180+ node_id	Xdata_L	Xdata_H	Ydata_L	Ydata_H	0x00	0x00	0x00	0x00

➢ Formulas for ±10° and ±30° inclination sensor angles:

X-axis angle calculation: (Xdata_H*256+ Xdata_L)*0.02

Y-axis angle calculation: (Ydata_H*256+ Ydata_L)*0.02

The range of Xdata_H*256+ Xdata_L and Ydata_H*256+ Ydata_L is ±1500. If the value of Xdata_H*256+ Xdata_L, or Ydata_H*256+ Ydata_L is greater than 32769, then it is a negative angle, and you need to subtract the value from 65535.

- ±85° inclination sensor angle calculation formula:

X-axis angle calculation: (Xdata_H*256+ Xdata_L)*0.05

Y-axis angle calculation: (Ydata_H*256+ Ydata_L)*0.05

7.4. SDO message

7.4.1. Startup command

- If the WGS00-2 series inclination sensors are not set to power on and self-start, this series of sensors will need to receive a startup command after power up in order to operate, the startup command is:

COB-ID	BYTE0	BYTE1
00	01	00

- Similarly, closing requires sending the close command, which is:

COB-ID	BYTE0	BYTE1
00	02	00

7.4.2. Save command

- Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

- The following message is received to indicate a successful save:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x10	0x10	0x01	0x00	0x00	0x00	0x00

7.4.3. Heartbeat period

7.4.3.1. Modify heartbeat

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x17	0x10	0x00	Heart_ Time_L	Heart_ Time_H	0x00	0x00

➢ The following message is received to indicate successful modification of the heartbeat period:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x17	0x10	0x00	0x00	0x00	0x00	0x00

Example: Heartbeat period is modified to 100ms:

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x17	0x10	0x00	0x64	0x00	0x00	0x00

（2）Save command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

7.4.3.2. Query Heartbeat

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x40	0x17	0x10	0x00	0x00	0x00	0x00	0x00

➢ Read the heartbeat period in the following message received:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x42	0x17	0x10	0x00	Heart_ Time_L	Heart_ Time_H	0x00	0x00

7.4.4. Modify the zero value

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x0B	0x20	0x00	零点 L	零点 H	0x00	0x00

➢ The following message is received to indicate successful modification of the zero value:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x0B	0x20	0x00	0x00	0x00	0x00	0x00

7.4.5. Node number

7.4.5.1. Modify the node number

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x20	0x23	0x00	node_id	0x00	0x00	0x00

- The following message is received to indicate successful modification of the node number:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x20	0x23	0x00	0x00	0x00	0x00	0x00

Example: the node number is modified to 0x18:

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x20	0x23	0x00	0x18	0x00	0x00	0x00

（2）Save command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

7.4.5.2. Query node number

- Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x40	0x20	0x23	0x00	0x00	0x00	0x00	0x00

- The node number is read from the following message received:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x42	0x20	0x23	0x00	node_id	0x00	0x00	0x00

7.4.6. Modify boot-up settings

- Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x18	0x10	0x0C	0xAA	0x55	0x00	0x00

When BTYE4 of this send message is 0xAA and BYTE5 is 0x55, the device will be set to power-on self-start; if BTYE4 and BYTE5 are other data, the device will cancel power-on self-start.

- The following message is received to indicate successful modification:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x18	0x10	0x0C	0x00	0x00	0x00	0x00

7.4.7. Sending Cycle

7.4.7.1. Modifying the send cycle

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x00	0x18	0x05	Transmit_PDO_time_L	Transmit_PDO_time_H	0x00	0x00

➢ The following message is received to indicate successful modification of the transmit period:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x00	0x18	0x05	0x00	0x00	0x00	0x00

Example: The sending period is modified to 500ms:

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x00	0x18	0x05	0xF4	0x01	0x00	0x00

（2）Save command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

7.4.7.2. Query Send Cycle

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x40	0x00	0x18	0x05	0x00	0x00	0x00	0x00

➢ The following message is received to read out the transmit cycle:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x42	0x00	0x18	0x05	Transmit_PDO_time_L	Transmit_PDO_time_H	0x00	0x00

7.4.8. Baud rate

7.4.8.1. Modify baud rate

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x21	0x23	0x00	baudrate	0x00	0x00	0x00

Baud rate correspondence table:

4	5	6	7
100K	125K	250K	500K

➢ The following message is received to indicate successful baud rate modification:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x21	0x23	0x00	0x00	0x00	0x00	0x00

Example: The baud rate is modified to 125K:

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x21	0x23	0x00	0x05	0x00	0x00	0x00

（2）Save command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

7.4.8.2. Query Baud Rate

➢ Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x40	0x21	0x23	0x00	0x00	0x00	0x00	0x00

➢ The baud rate is read from the following message received:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x42	0x21	0x23	0x00	baudrate	0x00	0x00	0x00

7.4.9. Filter coefficients

- Send the message:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x08	0x20	0x0B	coff	0x00	0x00	0x00

Filter coefficient (coff) range: 1~20 , the smaller the filter, the deeper the filter, the better the anti-vibration effect. The default value is 1.

- The following message is received to indicate successful modification of the coefficients:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	0x08	0x20	0x0B	0x00	0x00	0x00	0x00

Example: the filter coefficient is modified to 2:

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x08	0x20	0x0B	0x02	0x00	0x00	0x00

（2）Save command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x22	0x10	0x10	0x01	0x73	0x61	0x76	0x65

8. Precautions for use

(1) The inclination sensor is a precision instrument, inappropriate high strength mechanical shock and vibration, will most likely reduce the immunity and reliability of the sensor signal, or even damage the inclination sensor.

(2) It is strictly prohibited to step on, knock and process the inclination sensor shell.

(3) found that the inclination sensor work abnormally, should promptly contact the company's service personnel for troubleshooting, it is strictly prohibited for users to disassemble the sensor privately without the guidance of service personnel.

9. Common Troubleshooting

9.1. Indicator light description

- The indicator light of WGS00-2 series inclination sensor is a red and green dual-color indicator light. The function of this indicator is defined as follows:

No.	Indicator status	Description
1	Off	No power on or abnormal power supply
2	Red Lamp Flashing, 1Hz	CAN communication failure
3	Green light blinking, 1Hz	Normal working condition
4	Green Lamp Long On	X-axis and Y-axis are at 0°.