Dynamic Inclination Sensor

WGD00

Catalogs

User's Manual

Version: Av2

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User's Manual

Dynamic Inclination Sensor

Catalogs

Versions

Versions	Date	Release	Author	Change
Av1	2023/5/31	N	Chen Mo	First Edition
Av2	2023/5/31	Y	Chen Mo	Adding communication protocols

1. Security instructions

1.1. Copyright

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1.2. Statement

This manual has been verified and reviewed for accuracy. The instructions and descriptions contained in this manual are accurate for the WGD00 Series Inclination Sensor at the time of publication. However, future WGD00 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.

1.3. Signs and meanings used in the manual

Logo	Meaning	Detailed description
	Danger	Predictable leading to unavoidable serious injury, death or property damage
	WARNING	Likely to result in unavoidable serious injury, death or property damage
	Caution	May result in minor injuries and damages
	Hints	Non-safety related use instructions and information
	Note	Additional instructions or recommendations for use

2. Products

2.1. Products

MOOK dynamic inclination sensor is the use of gyroscope and acceleration sensor together, coupled with the production process and software aspects of the algorithm correction compensation and other optimization measures, can be very accurate measurement of the angle of the object in motion. Support standardized CANopen interface output, compact and rugged structure, -40 ℃ ~ 85 ℃ operating 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 long-term work in harsh environments.

MOOK dynamic inclination sensor is suitable for working conditions with high acceleration and strong vibration or strong shock working environment, such as excavators, pumps, cranes and so on.

2.2. Technical Parameter

Technical Parameter	
Operating Voltage	9～36V
Operating Temperature	-40～85℃
Measuring range	Single-axis: 0~360° /Dual-axis: ±90°
Accuracy	Static: 0.3° ; dynamic: 0.5°
Repeatability Error	±0.1 ° @ +25 °C
Temperature Error	±0.008°/K (Typ.)
Output Signal	CANopen
Housing material	ADC12
Protection class	IP67
Test Standards	
Low temperature test	**Execution standard: GB/T2423.01/IEC60068-2-1** -40℃ low temperature start test, 10 times, start normal -40℃ low temperature working test 16h -40℃ low temperature storage test 72h
High temperature test	**Execution standard: GB/T2423.02/IEC60068-2-2** +85℃ high temperature full load working test 16h +85℃ high temperature storage test 72h
Temperature shock test	**Execution standard: GB/T2423.22/IEC60068-2-14** Low temperature -40℃, high temperature 85℃, high and low temperature conversion time 3min, cycle times 10 times
Temperature and humidity cycle test	**Execution standard: GB/T2423.34/IEC60068-2-38** High temperature 65±2℃, 93±3%; room temperature 25±2℃, 93±3%; low temperature -10℃, 24h for a cycle, for ten cycles
Vibration test	**Execution standard: GB/T2423.10/IEC60068-2-6 sinusoidal vibration** Vibration (sinusoidal) 30Hz, 4g, 4h vertically, 2h horizontally left and right, front and back, total 8h
Shock test	**Execution standard: GB/T2423.5/IEC60068-2-27** 10g/6ms, half-sine wave, 100 times in each of the three axes
Drop test	**Executive standard: GB/T2423.8/IEC60068-2-32** Transportation status with packaging, drop height 1000mm, 2 times
Salt spray test	**Execution standard: GB/T2423.17/IEC60068-2-11** Under 35 ℃, 5% sodium chloride salt spray environment, 120h test in uncharged state, no rust and corrosion of shell, connector and other parts

	after the test, and work normally after connecting to the test voltage.
EMC	**EN 61000-6-2:2005; EN 61000-6-4: 2011;** **ISO 7637 immunity; ISO 11452 immunity; ISO 16750 immunity**

2.3. Order number

No.	Management No.	Material Description
1	236367	Inclination Sensor, WGD00-1-3607-111-Na
2	236366	Inclination Sensor, WGD00-1-3607-151-Na
3	236368	Inclination Sensor, WGD00-2-1807-111-Na
4	236369	Inclination Sensor, WGD00-2-1807-151-Na

2.4. Product Code Description

WGD 00 – 1 – 360 7 – 1 1 1 – Na

Product Code
WGD: Dynamic Inclination Sensor

Series Code

Axis code
1：Single shaft
2：Double shaft

Measurement range
180：±90°
360：0°~360°

Accuracy
7：0.5°

Signal Type
1：CANopen

Electrical Interface
1: M12
5: Two M12 sockets, one front and one rear

Security Architecture Designators
1: Non-redundant

Other symbols
Na: No other special markings

2.5. 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;

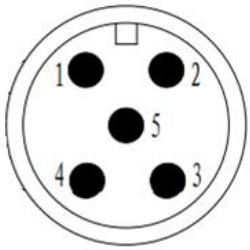
(4) No corrosive volatile substances should be present in the room.

3. Port Description

3.1. Electrical interface

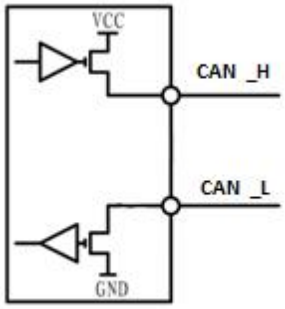
WGD00 series inclination sensor connector adopts M12 five-prong plug.

3.2. Pin Definition



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

3.3. Communications port

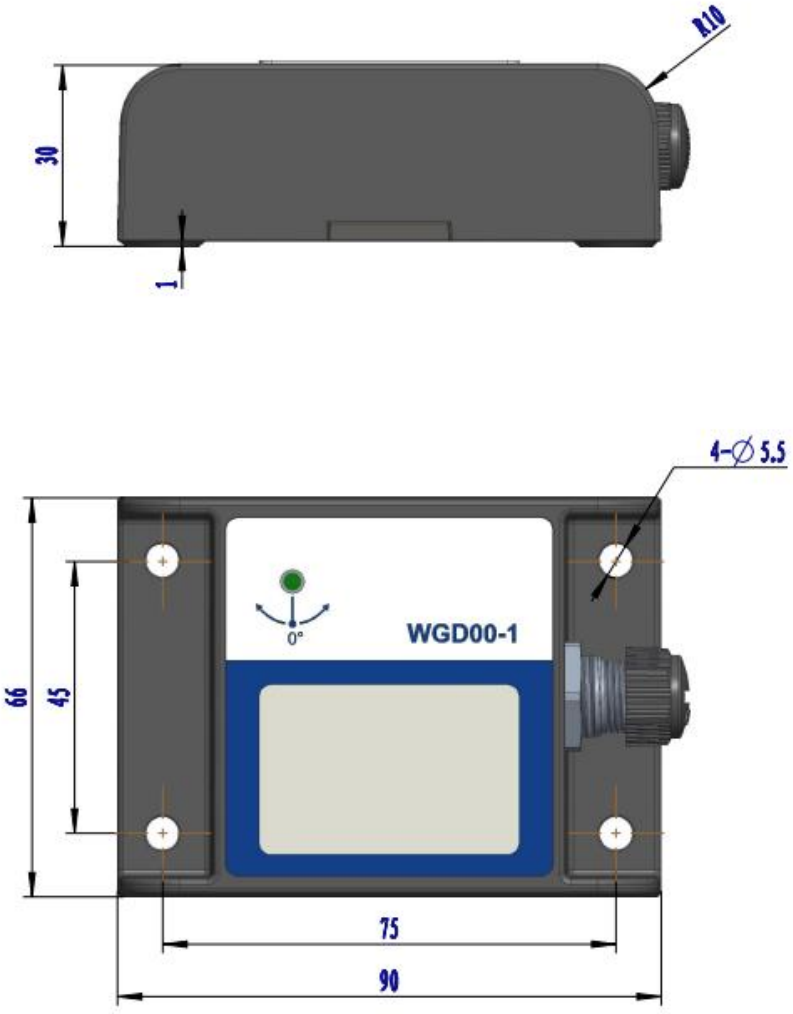
CAN	parameters
Pin	4、5
Schematic	
Baud Rate Range	10 Kbit/s~1 Mbit/s
Default Baud Rate	250Kbit/s
Protocol	CANOpen
Port Protection	CAN_H and CAN_L have short circuit protection for UB and GND respectively.
Termination Resistor	No built-in termination resistor

4. Installation Instructions

4.1. Pre-installation inspection

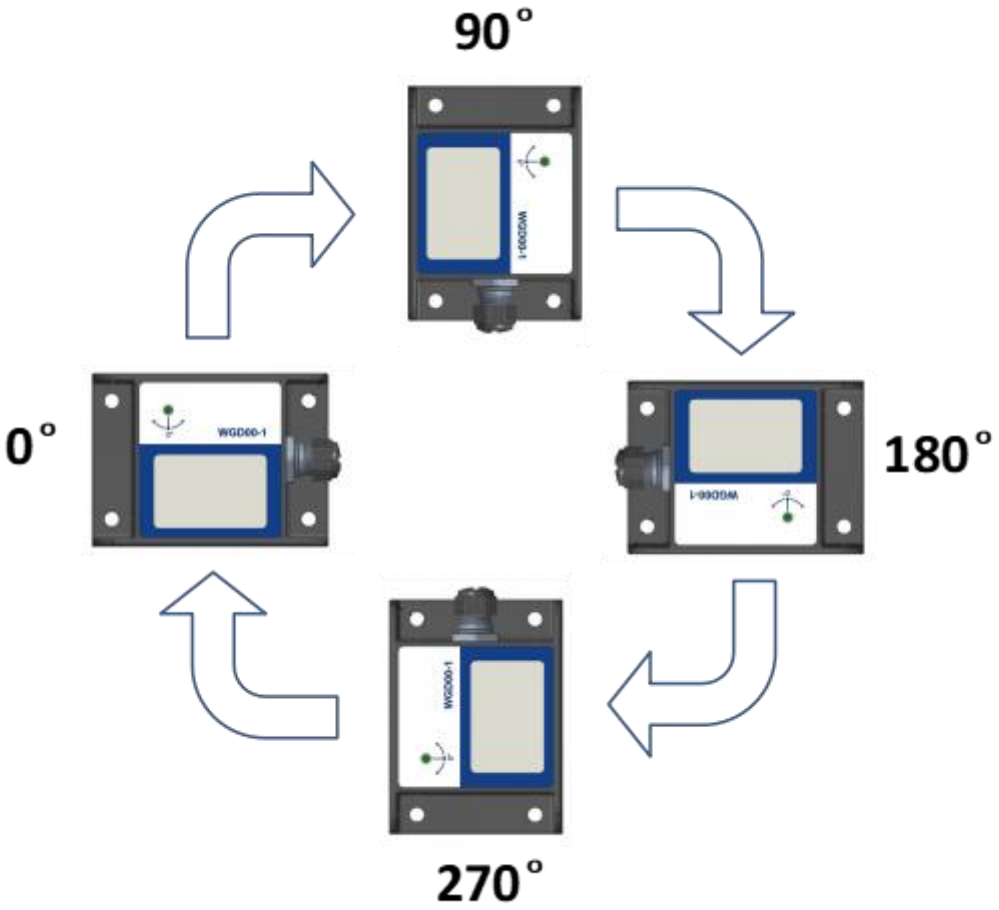
	Tip.
	Before installation, please check whether the power supply and wiring are complete and correspond to each other, and whether the product is in good condition and free of bumps.

4.2. Outline and Installation Dimension Drawing

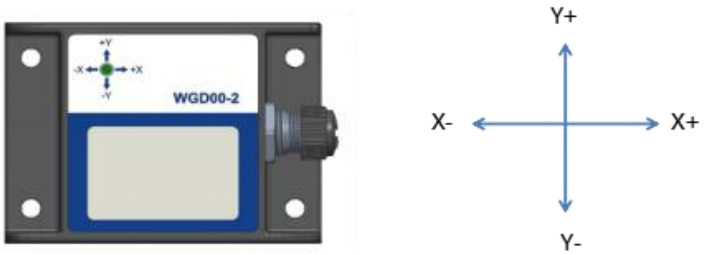


4.3. Rotary Axis Definition

4.3.1. Single Axis Inclination Sensor



4.3.2. Biaxial Inclination Sensor



4.4. Mounting accessories

WGE00 series inclination sensor use 4 M5 bolts for fixed mounting, make sure the mounting surface is flat and smooth before mounting.

5. Parameter Configuration

5.1. 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.

5.2. Default configuration

Default Node Number	0x05
Default Baud Rate	250Kbit/s
Default Cyclic Transmission Period	100ms
Default Heartbeat Cycle	500ms

5.3. PDO message

5.3.1. Heartbeat message

- Heartbeat messages are sent periodically after initialization is complete.

COB-ID	BYTE0
0x700+node_id	heartbeat

	Notes.
	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.

5.3.2. Angle reading

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x180+node_id	X-axis Euler angle low 8 bits	X-axis Euler angle high 8 bits	Y-axis Euler angle low 8 bits	Y-axis Euler angle high 8 bits	0x00	0x00	0x00	0x00

5.4. SDO message

5.4.1. Object Dictionaries

Main Index	Sub-index	Command Description	Default Value	Read/Write
0x1000	00	Device Type	00	R
0x1001	00	Error Register	00	R
0x1003	0x00	Number of errors	00	W/R
	0x01	Pre-defined Error Field_1	00	R
	0x02	Pre-defined Error Field_2	00	R
	0x03	Pre-defined Error Field_3	00	R
	0x04	Pre-defined Error Field_4	00	R
0x1005	0x00	COB-ID SYNC	0x00000080	W/R
0x1007	0x00	Sync Windows Length	0x00001000	W/R
0x1008	0x00	Device name	CANOPEN DEVICE	R
0x1009	0x00	Hardware version	V1.0	R
0x100A	0x00	Software version	V1.0	R
0X100C	0x00	Guard Time	00	W/R
0x100D	0x00	Life Time Factor	00	W/R
0x1010	0x00	Largest supported Sub-Index	0x03	R
	0x01	Store Parameters_1	0	W/R
	0x02	Store Parameters_2	0	W/R
	0x03	Store Parameters_3	0	W/R
0x1011	0x00	Largest supported Sub-Index	0x03	R
	0x01	restore default parameters_1	0	W/R
	0x02	restore default parameters_2	0	W/R
	0x03	restore default parameters_3	0	W/R
0x1014	0x00	COB-ID Emergency message	0x85	W/R
0x1017	0x00	Producer Heartbeat Time	0x1F4	W/R
0x1018	0x00	Number of entries	0x04	R
	0x01	Vender-id	0	R
	0x02	Product code	0	R
	0x03	Revision number	0	R
	0x04	Serial number	0x01	R
0x1019	0x00	SYNC Counter Overflow	0	W/R
0x1800	0x00	Largest supported Sub-Index	0x06	R
	0x01	COB-Id used	0x185	W/R
	0x02	transmission type	0xFE	W/R
	0x03	inhibit time	0x14	W/R
	0x05	Event timer	0x64	W/R
	0x06	SYNC start value	0x00	W/R
0x1801	0x00	Largest supported Sub-Index	0x06	R
	0x01	COB-Id used	0XC0000285	W/R
	0x02	transmission type	0xFE	W/R
	0x03	inhibit time	0x14	W/R
	0x05	Event timer	0x64	W/R
	0x06	SYNC start value	0x00	W/R
0x1A00	0x00	Number Of Mapped Objects	0x04	W/R
	0x01	1. transmit PDO mapping parameter 1	0x31000110	W/R
	0x02	1. transmit PDO mapping parameter 2	0x31000210	W/R
	0x03	1. transmit PDO mapping parameter 3	0	W/R
	0x04	1. transmit PDO mapping parameter 4	0	W/R

	0x05	1. transmit PDO mapping parameter 5	0	W/R
	0x06	1. transmit PDO mapping parameter 6	0	W/R
	0x07	1. transmit PDO mapping parameter 7	0	W/R
	0x08	1. transmit PDO mapping parameter 8	0	W/R

（Continued from previous page）

Main Index	Sub-index	Command Description	Default Value	Read/Write
0x1A01	0x00	Number Of Mapped Objects	0x04	W/R
	0x01	2. transmit PDO mapping parameter 1	0x21000510	W/R
	0x02	2. transmit PDO mapping parameter 2	0x21000610	W/R
	0x03	2. transmit PDO mapping parameter 3	0x21000710	W/R
	0x04	2. transmit PDO mapping parameter 4	0x21000810	W/R
	0x05	2. transmit PDO mapping parameter 5	0	W/R
	0x06	2. transmit PDO mapping parameter 6	0	W/R
	0x07	2. transmit PDO mapping parameter 7	0	W/R
	0x08	2. transmit PDO mapping parameter 8	0	W/R
0x2002	0x00	IsAutoStart	1	W/R
0x2003	0x00	Largest supported Sub-Index	0x10	R
	0x01	C00	0	W/R
	0x02	C01	0	W/R
	0x03	C02	0	W/R
	0x04	C10	0	W/R
	0x05	C11	0	W/R
	0x06	C12	0	W/R
	0x07	C20	0	W/R
	0x08	C21	0	W/R
	0x09	C22	0	W/R
	0x0A	URFR_SET	0	W/R
	0x0B	GCN_VAL	0	W/R
	0x0C	GCN_SET	0	W/R
	0x0D	ACC_BW_VAL	0	W/R
	0x0E	ACC_BW_SET	200	W/R
	0x0F	GYR_BW_VAL	200	W/R
	0x10	GYR_BW_SET	3000	W/R
0x3100	0x00	TPO Mapping Parameters Euler Angle		
	0x01	Eul_x(x-axis Euler angle)		
	0x02	Eul_y(y-axis Euler angle)		
0x3101	0x00	TPDO mapping parameter Quaternion		
	0x01	qw		
	0x02	qx		
	0x03	qy		
	0x04	qz		
0x3102	0x00	PDO mapping parameters (acceleration)		
	0x01	Acc_x		
	0x02	Acc_y		
	0x03	Acc_z		
0x3103	0x00	PDO mapping parameters (angular velocity and magnetic field strength)		
	0x01	Gyr_x		
	0x02	Gyr_y		
	0x03	Gyr_z		

	0x04	magx		
	0x05	magy		
	0x06	magz		
	0x07	pars		

	Comment
	GCN, ACC and BW are to set the filtering parameters, the larger the value setting, the deeper the filtering, the setting method refer to the setting of the installation direction.

SDO message is read and modified according to the index and sub-index address of the object dictionary, customized modification of the parameter part of the 0x2003 index under the 0x01~0x0A for the setting of the installation direction , first set 0x01~0x09 for the installation of the direction of the value, and then set 0x0A to 1 after the installation of the direction of the value will be written to the module, and then re-power down the installation of the direction of the validity of the installation, if you do not perform the sub-index of the 0x0A is set to 1, the parameter settings will not take effect.

	Caution
⚠	Single-axis can only set the parameters for X-axis rotation, setting the Y-axis rotation parameters will be problematic.

The new sensor coordinate system is a 90° rotation around the original X-axis (for vertical mounting: Y-axis facing down):
C00~C22 :1,0,0,0,0,0,1,0,-1,0

The new sensor coordinate system is Rotate -90° around the X-axis of the original coordinate system (for vertical mounting: Y-axis positive direction facing up):
C00~C22 :1,0,0,0,0,0,-1,0,1,0

The new sensor coordinate system is Rotate 180° around the X-axis of the original coordinate system:
C00~C22 :1,0,0,0,0,-1,0,0,0,0,-1

The new sensor coordinate system is Rotate 90° around the original coordinate system Y-axis (for vertical mounting: X-axis positive direction is facing up):
C00~C22 :0,0,-1,0,1,0,1,0,0,0

The new sensor coordinate system is Rotate -90° around the Y-axis of the original coordinate system (for vertical mounting: X-axis positive direction is facing down):
C00~C22 :0,0,1,0,1,0,-1,0,0,0

The new sensor coordinate system is Rotate 180° around the Y-axis of the original coordinate system:
C00~C22 :-1,0,0,0,0,1,0,0,0,-1

5.4.2. Object Dictionary Usage

（1）Modify the command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7

0x600+node_id	0x22	Index address two digits lower	Index address two digits high	subindex	Enter the appropriate value

When the following command is received, the modification is successful:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x60	Same index address as above in the lower two digits	Same index address as above two digits higher	Same subindex as above	0x00	0x00	0x00	0x00

（2）Read command:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x600+node_id	0x40	Index address two digits lower	Index address two digits high	subindex	0x00	0x00	0x00	0x00

When the following command is received, it indicates the reading result:

COB-ID	BYTE0	BYTE1	BYTE2	BYTE3	BYTE4	BYTE5	BYTE6	BYTE7
0x580+node_id	0x43	Same index address as above in the lower two digits	Same index address as above two digits higher	Same subindex as above	The corresponding value (look up the specific result in the object dictionary)			

	Comment:
☞	Based on the data of BYTE0 you can read out the number of BTYEs occupied by the corresponding value. For example, when the data of BTYE0 is 0x43, the corresponding value occupies 4 BYTE (BYTE4, BYTE5, BYTE6, BYTE7). Their correspondence is as follows: 4F：1 个 BYTE（BYTE4） 4B：2 个 BYTE（BYTE4、BYTE5） 47：3 个 BYTE（BYTE4、BYTE5、BYTE6） 43：4 个 BYTE（BYTE4、BYTE5、BYTE6、BYTE7）

5.4.3. 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

	Comment:
☞	After making changes based on the index and sub-index addresses of the object dictionary, you need to save the modified values, and you need to send the save command as above.

5.5. LSS protocol

5.5.1. Node number

5.5.1.1. Modify the node number

- Send the message:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E5	0x11	Node ID	0x00	0x00	0x00	0x00	0x00	0x00

- The following message can be received to determine whether the modification of the node number is successful:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E4	0x11	Error Code	0x00	0x00	0x00	0x00	0x00	0x00

Name	Position	Size	Description
Error Code	D1	8	0x00 – Success 0x01 – node ID out of range

5.5.1.2. Save the modified node number

- Send the message:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E5	0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00

- The following message can be received to determine whether saving the node number is successful:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E4	0x17	Error Code	0x00	0x00	0x00	0x00	0x00	0x00

Name	Position	Size	Description
Error Code	D1	8	0x00 – Success 0x01 – Operation not supported 0x02 – Storage media access error

5.5.2. Baud rate

5.5.2.1. Modify baud rate

- Send the message:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E5	0x13	0x00	Table Indx	0x00	0x00	0x00	0x00	0x00

Name	Position	Size	Description
Table Indx	D2	8	Use the following values to specify the CAN bit timing to set the battery pack to: 0x0 – 1000 kbit/s 0x1 – 800 kbit/s 0x2 – 500 kbit/s 0x3 – 250 kbit/s 0x4 – 125 kbit/s 0x5 – 100 kbit/s 0x6 – 50 kbit/s 0x7 – 20 kbit/s 0x8 – 10 kbit/s

- The following message can be received to determine whether the baud rate has been successfully modified:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E4	0x13	Error Code	0x00	0x00	0x00	0x00	0x00	0x00

Name	Position	Size	Description
Error Code	D1	8	0x00 – Success 0x01 – Bit timing not supported

5.5.2.2. Save the modified baud rate

- Send the message:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E5	0x17	0x00	0x00	0x00	0x00	0x00	0x00	0x00

- The following message can be received to determine whether saving the node number is successful:

COB-ID	D0	D1	D2	D3	D4	D5	D6	D7
0x7E4	0x17	Error Code	0x00	0x00	0x00	0x00	0x00	0x00

Name	Position	Size	Description
Error Code	D1	8	0x00 – Success 0x01 – Operation not supported 0x02 – Storage media access error

6. 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.