ISO 9001 2008

CE

ROHS

BW-VG225 Serials

Low Cost CAN open
Dynamic Inclination Sensor

Technical Manual

Introduction

The BW-VG225 Dynamic Inclination Sensor is a low-cost inertial measurement device that measures the attitude parameters (roll and pitch) of the motion carrier. The attitude deviation is estimated by a 6-state Kalman filter with appropriate gain and is suitable for tilt measurement in motion or vibration.

The BW-VG225 uses high-quality and reliable MEMS accelerometers and gyroscopes, and guarantees measurement accuracy through algorithms. At the same time, the seal design and strict process ensure that the product can accurately measure the roll angle and pitch angle of the carrier under harsh environment. Through various compensations such as nonlinear compensation, quadrature compensation, temperature compensation and drift compensation, the error caused by interference can be greatly eliminated, and the product precision level can be improved. The BW-VG225 has a digital interface that can be easily integrated into the user's system.

Features

- Nonlinear compensation, quadrature compensation
- Dynamic static measurement
- Special offset tracking algorithm eliminates the drift
- Gyro drift compensation

- CAN open output
- Operating temperature: -40°C~+85°C
- High performance Kalman filter algorithm
- Small size: L60 × W59× H29(mm)

Applications

- Ships
- Construction machinery
- Platform stability
- Agricultural machinery

- Special vehicles
- Unmanned driving
- Robot
- Aircraft

Specifications

⚡ Electrical Specifications

Power supply	9-35V DC
Operating current	30mA（Max40mA）
Operating temperature	-40℃~85℃
Store temperature	-55℃~100℃

🛠 Performance Specifications

Attitude parameter	Dynamic accuracy	1°
	Static accuracy	0.1°
	Resolution	0.01°
	Tilt range	Pitch ± 90°, Roll ±180°
Physical characteristics	Size	L60 × W59× H29（mm）
	Weight (including cable)	280g
	Weight (including package)	360g
Interface characteristics	Start delay	<50ms
	Maximum output frequency	100Hz
	Serial communication rate	2400 to 115200 baud rate
	Digital output format	Binary high performance protocol
MTBF	≥90000 hours/time	
Electromagnetic compatibility	According to GBT17626	
Insulation resistance	≥100 MΩ	
Impact resistance	2000g , 0.5ms , 3 times / axis	

Resolution: The measured minimum change value that the sensor can detect and resolve within the measurement range.
Accuracy: The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

Gyro	Resolution	0.02°/sec
	Range	±400°/sec
	Zero instability	50 °/h
	ARW	3.6 °/√h
	Noise density	0.005 °/s/√Hz
	Zero absolute error	±0.2 °/sec
Accelerometer	Range: X,Y,Z	±2 g/±3.6g
	Resolution	1 mg
	Bias stability	±4 mg

Mechanical Characteristic

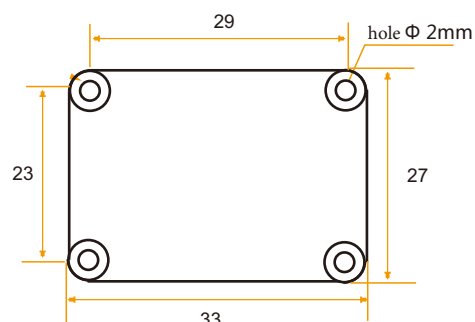|	
Connector	Metal connector (standard cable is 1.5m)
Protection level	IP67
Shell material	Magnesium alloy anodizing
Installation	Four M4 screws

Package size

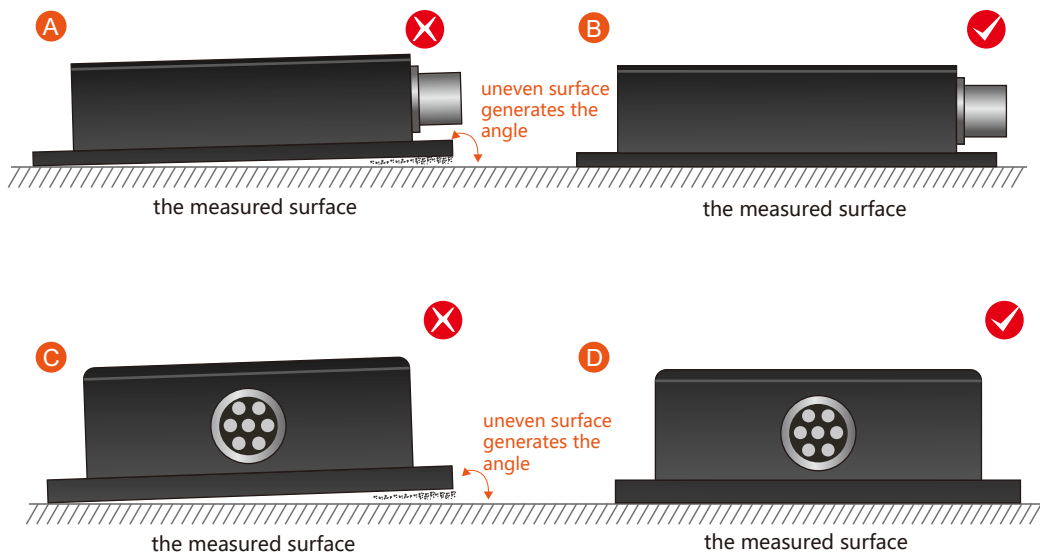Product Size: L60*W59*H29（mm）
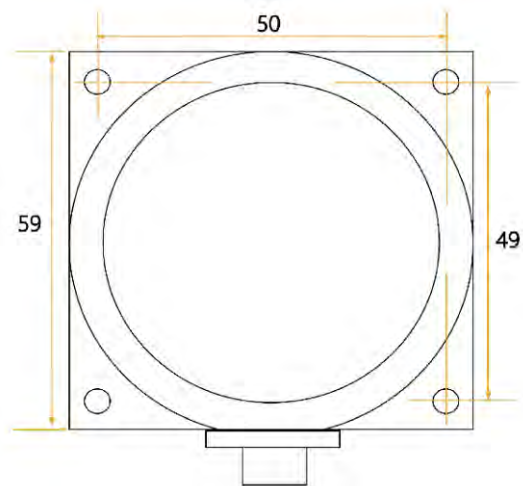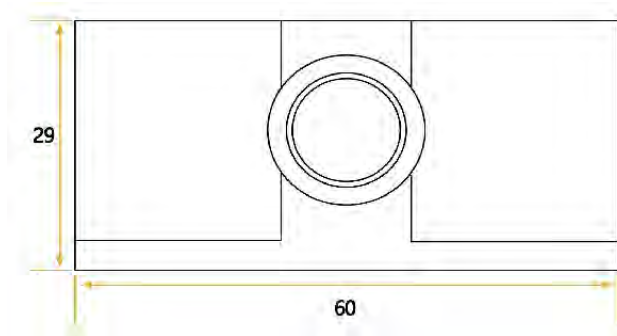
Bare plate product size

Product Size: L44*W35*H11（mm），±1mm error for lengh and width dimensions, please refer to actual size
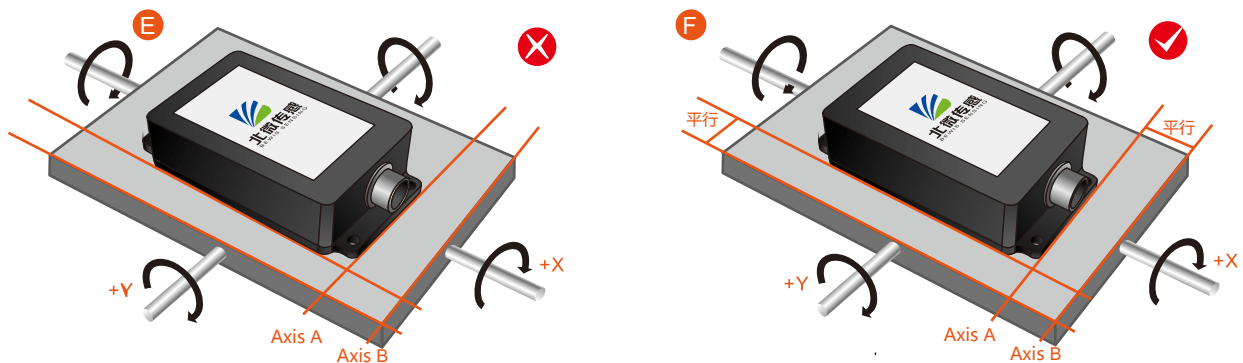
Installation direction

The correct installation method can avoid measurement error. The following points should be made when installing the sensor:

First of all, to ensure that the sensor mounting surface and the measured surface completely close, the measured surface should be as horizontal as possible, can not have the angle shown in Figure A and Figure C, the correct installation is shown in Figure B and Figure D.

A ❌

uneven surface generates the angle

the measured surface

B ✅

the measured surface

C ❌

uneven surface generates the angle

the measured surface

D ✅

the measured surface

Secondly, the bottom cable of the sensor and the axis of the measured object shouldn't generate the angle shown in E. When installing, the bottom cable of the sensor should be kept parallel or orthogonal to the rotation axis of the measured object. This product can be installed horizontally or vertically (vertical installation requires customization). The correct installation method is shown in Figure F.

E ❌

+Y   +X
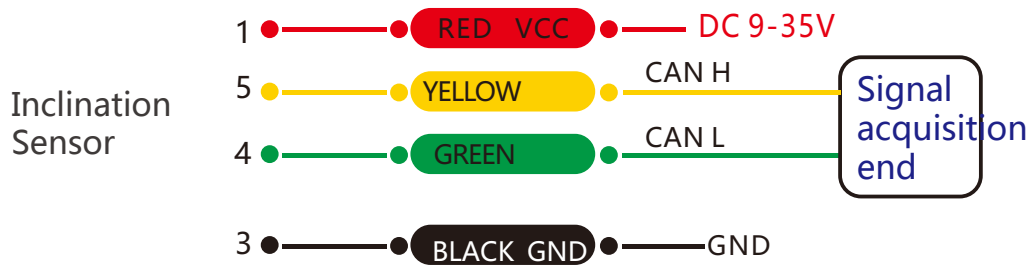Axis A
Axis B

F ✅

平行   平行
+Y   +X
Axis A
Axis B

Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

Electrical connections

CAN Electrical interfaces

Cable color & function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 9-35V	NC	GND	CAN L	CAN H

Inclination Sensor

1 ●———● RED VCC ●——— DC 9-35V
5 ●———● YELLOW ●——— CAN H
4 ●———● GREEN ●——— CAN L

Signal acquisition end

3 ●———● BLACK GND ●——— GND

CAN open

wiring diagram

Debug software

Users can directly download serial assistant on official website (Supports-Download). You can also use more convenient and intuitive PC software.

BW-VG225 supporting serial debugging software can be connected to the inclinometer on the computer for angle display. The software debugging interface is as shown in the figure below. Using the debug software, it can conveniently display the current X-direction tilt angle, and you can also modify and set other parameters by yourself.

Software use steps:

① Connect the serial port hardware of the inclinometer correctly and connect the power supply.

② Select the correct device model (select azimuth series).

③ Select the computer serial port and baud rate and click to connect to the serial port.

④ Click Start and the tilt angle of the inclinometer in the X and Y directions will be displayed on the screen.
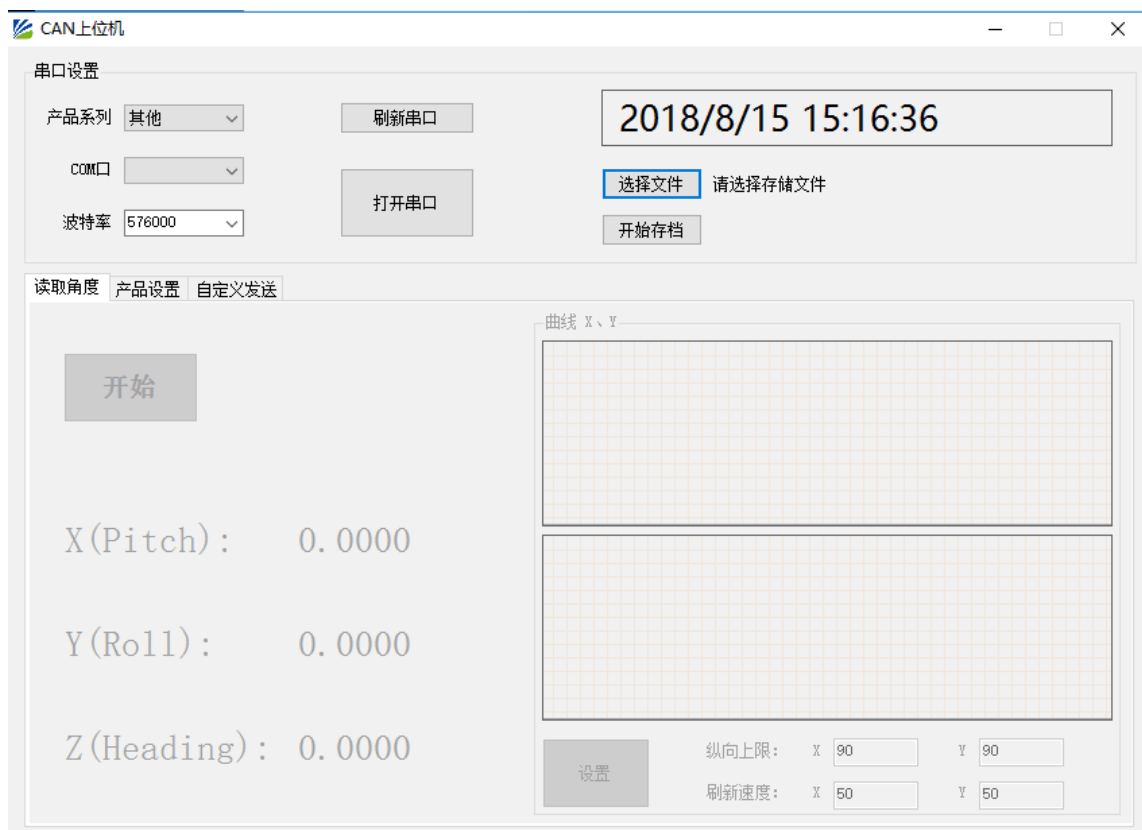
Protocol

The CAN includes 8 bytes, and add 0 to it if the data byte is not enough . Sending the first byte 0x40 indicates a write command, returning the first byte 0x40 indicates that the write was successful. The ID is the CAN communication node number.

1)Modify node number :

（ID=0x01～0x7F）, The default node number (ID) is 0x05

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x10	0x10	0x00	ID	0x00	0x00	0x00
Respond	0x580+0xID	0x40	0x10	0x10	0x00	ID	0x00	0x00	0x00

Note: If the controller sends CAN-ID=0x600+0x05 (default), send data: 40 10 10 00 10 00 00 00,The sensor returns CAN-ID=0x580+0x10 and returns data: 40 10 10 00 10 00 00 00,
      The CAN-ID is 0x590 (0x580+0x10), indicating that the ID modification is successful. At this time, when sending other naming, the CAN-ID needs to be changed to 0x610 to be successfully transmitted.

2) Set the CAN baud rate：

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x20	0x10	0x00	Baud	0x00	0x00	0x00
Respond									

Note: The fifth byte (Baud) is 0x01, 0x02, 0x03, 0x04, 0x05, 0x06.
0x01 represents the setting baud rate of 500K bps
0x02 represents the setting baud rate of 250K bps
0x03 represents the setting baud rate of 125K bps
0x04 represents the setting baud rate of 100K bps
0x05 represents the setting baud rate of 50K bps
0x06 represents the setting baud rate of 25K bps

The default baud rate is 125K bps. After modifying the baud rate, the sensor needs to be powered on again, and the baud rate modification can be successful. The lower the baud rate, the shorter the communication distance. The communication distance can reach more than 1000m at 25K bps.

3) Set relative \ absolute zero

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x05	0x10	0x00	Type	0x00	0x00	0x00
Respond	0x580+0x05	0x40	0x05	0x10	0x00	0x00	0x00	0x00	0x00

Note: The 5th byte Type is 0x00, 0x01. 0x00 means set to absolute zero, 0x01 means set to relative zero,
      After setting the zero point, you need to enter the save command to set the success (the default is absolute zero).

4) Query relative\absolute zero

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x0d	0x10	0x00	0x00	0x00	0x00	0x00
Respond	0x580+0x05	0x40	0x05	0x10	0x00	Type	0x00	0x00	0x00

Note: The 5th byte Type is 0x00, 0x01. 0x00 is represented as absolute zero, and 0x01 is represented as relative zero.

5)Store

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x0a	0x10	0x00	0x00	0x00	0x00	0x00
Respond	0x580+0x05	0x40	0x0a	0x10	0x00	0x00	0x00	0x00	0x00

Note: After some parameters are modified, you need to send a save command to take effect.

6) Read the X and Y axis angles

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x04	0x10	0x00	0x00	0x00	0x00	0x00
Respond	0x580+0x05	0xSX	0xXX	0xYY	0xSX	0xXX	0xYY	0x00	0x00

Note: The read angle command needs to be valid in the answer mode.The first, second and third bytes are the X-axis angle; the fourth, fifth and sixth bytes are the Y-axis angle;Where S is a sign bit (0 represents a positive value, 1 represents a negative value), XXX represents a 3-digit integer bit of the angle, and YY represents a 2-digit decimal place of the angle. For example, the returned data is 585 00 12 34 10 12 34 00 00, which means that the X-axis angle is +12.34 degrees and the Y-axis is -12.34 degrees.

7) Set the output frequency

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x0c	0x10	0x00	mode	0x00	0x00	0x00
Respond	0x580+0x05	0x40	0x0c	0x10	0x00	mode	0x00	0x00	0x00

Note: The fifth byte mode is 0x00, 0x01, 0x02, 0x03, 0x04, 0x05, 0x06. 0x00 represents the answer mode,
0x01：5Hz Data Rate，0x02：10Hz Data Rate
0x03：20Hz Data Rate，0x04：25Hz Data Rate
0x05：50Hz Data Rate，0x06：100Hz Data Rate (default)
And sending other names should be recommended in the answer mode (automatic mode is the current angle of the output axis that is not stopped, and it is easier to see the return value of other commands in the answer mode). The 5Hz Data Rate means 5 times of automatic output per second, and so on.

8)Inclination sensor automatic output angle

Setting the sensor to the automatic mode output provides an angular output when the sensor is powered up. The default is automatic mode.

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x04	0x10	0x00	0x00	0x00	0x00	0x00
Respond	0x580+0x05	0xSX	0xXX	0xYY	0xSX	0xXX	0xYY	0x00	0x00

Note: The output angle format is the same as the answer mode read X and Y axis angles.

9) Set the CAN-ID type

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x70	0x10	0x00	xx	0x00	0x00	0x00
Respond									

Note: XX is 00, 01.00 represents the standard ID (11-bit) type, and 01 represents the extended ID (27-bit) type. The default is standard.

10) Set the standard CAN-ID address

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x71	0x10	0x00	XH	XL	0x00	0x00
Respond									

Note: The standard CAN-ID defaults to 0X580+05 and the maximum value cannot exceed 7FF. The modification here is 580,05 in 0X580+05 can be modified by the previous

The node number is modified. After the modification, the CAN-ID is re-powered to become 0x XHXL+0x05. For example, if the data is sent: 605 40 71 10 00 01 23 00 00, the CAN-ID becomes 123+5=128 after power-off and power-on.

11) Set the extended CAN-ID address

When setting the extended CAN-ID address, you need to divide the address into two segments, first send a high 16 address, and then lower the 16-bit address. When the power is turned back on, the CAN-ID becomes the changed address (the CAN-ID received here does not need to be added with the node number). The maximum value cannot exceed 7FFFFFF. The default is 0x 18fa0216.

I Set the extended CAN-ID high 16-bit address

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x72	0x10	0x00	XH	XL	0x00	0x00
Respond									

Note: The extended CAN-ID high 16-bit address cannot be greater than 7FF.

ⅡSet the extended CAN-ID low 16-bit address

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x73	0x10	0x00	XH	XL	0x00	0x00
Respond									

Note: The extended CAN-IDd low 16-bit address cannot be greater than FFFF.For example, if you send 605 40 72 10 00 01 23 00 00, 605 40 73 10 00 45 67 00 00 twice, the CAN-ID will be 01234567 after power-off.

12)   Set Kalman filter parameters

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x80	0x10	0x00	XX	YY	YY	0x00
Respond	0x580+0x05	0x00	XX	YY	YY	0x00	0x00	0x00	0x00

Note: Set the parameter to XX.YYYY and save it automatically after setting. The parameter range is 1.0~1.5 (excluding 1.0 and 1.5).
For example: Send 605 40 80 10 00 01 00 02 00, then set the Kalman filter parameter to 1.0002 and save it automatically.

13)Query Kalman filter parameters

	CAN-ID	First byte	Second byte	Third byte	Fourth byte	Fifth byte	Sixth byte	Seventh byte	Eighth byte
Send	0x600+0x05	0x40	0x81	0x10	0x00	0x00	0x00	0x00	0x00
Respond	0x580+0x05	0x00	XX	YY	YY	0x00	0x00	0x00	0x00

For example: returning 585 00 01 00 02 00 00 00 00, the Kalman filter parameter is 1.0002.

Ordering Information

Product number	Way of communication	Package condition
BW-VG225-CAN	CAN	IP67 Package/Metal Connector

Executive standard

- Enterprise Quality System Standard: ISO9001:2008 Standard (Certificate No.:23919Q1045IROS)
- CE certification (certificate number: M.2019.103.UY1151)
- ROHS (certificate number:G 190930099)

BW-VG225

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