BWS4500 Vhuld0v

High Accuracy FDQ Bus Dual0Dxis Inclinometer

Technical Manual

BWS 4500
High Accuracy CAN Bus Dual-Axis Inclinometer

Introduction

Designed by Bewis Sensing Technology LLC, BWS4500 is a dual-axis super high-accuracy inclinometer with MEMS technology and CAN output. It has a measuring range of ± 90° and a full-scale accuracy of 0.008°. It is a highly accurate product in the industry for now. The product uses a high-resolution differential digital-to-analog converter with built-in automatic compensation and filtering algorithms to reduce errors caused by environmental changes. It measures the change of static gravitational field and converts it into angle change. The change directly outputs the current roll angle and pitch angle through digital mode. It is easy to install and simple to use, small in size, resistant to external electromagnetic interference, and capable of withstanding vibration shock. It apply to military equipment, industrial automation, surveying and mapping, etc.

Features

- Dual-axis inclination measurement
- Accuracy: 0.008°
- Output mode: CAN
- IP67 protection
- Baud rate: 25k~500k
- Measuring range: ± 90°
- Voltage input: 9~35V(DC)
- Operating temperature: -40~+85℃
- Output frequency: 5~100Hz(Adjustable)
- Accept OEM customization

Applications

- Bridge deflection monitoring
- Building health monitoring
- Precision platform automatic leveling
- Military equipment automation
- Tunnel and dam monitoring
- Tower tilt monitoring
- Measuring and mapping instrument
- Wind tower monitoring

Specifications

Electrical Specifications

Parameters	Conditions	Min	Typical	Max	Units
Power supply(DC)		9	12	35	V
Operating current	Non-loaded	20	30	40	mA
Operating temperature		-40		+85	℃
Store temperature		-55		+100	℃

Performance Specifications

Measuring range(°)	Conditions	±30	±60	±90
Measuring axis	Vertically	X-Y	X-Y	X-Y
Accuracy(°)	Indoor	0.008	0.008	0.008
Resolution(°)	Completely static	0.001	0.001	0.001
Zero temperature drift(°/℃)	-40～85℃	±0.0007	±0.0007	±0.0007
Cross axis error(°)	Max	0.008	0.008	0.008
Power-on time		<3s	<3s	<3s
Frequency response (Hz)	5～100Hz (Adjustable)	100	100	100
Baud rate	Adjustable	2400~115200	2400~115200	2400~115200
MTBF	≥90000 hours/time			
Electromagnetic compatibility	according to GBT17626			
Insulation resistance	≥100 MΩ			
Shock resistance	2000g,0.5ms,3times/axis			
Weight（g）	320（Metal connector）/350（Aviation connector）			

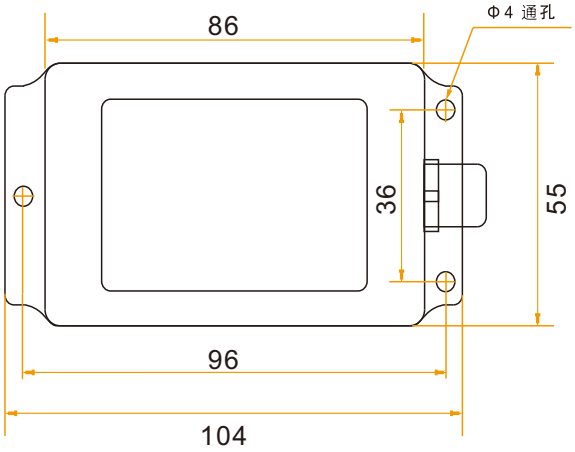
Resolution: The measured minimum change value that the sensor can detect and resolve within the measurement range.
Accuracy: The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

Mechanical Characteristic

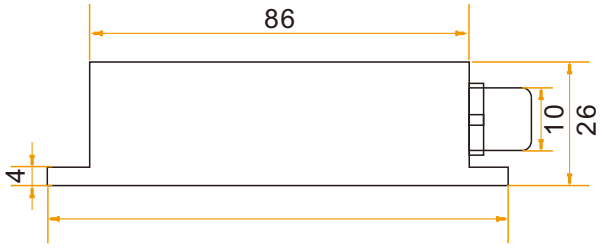
Connector	Metal connector（standard cable is 1.5m）
Protection level	IP67
Shell material	Magnesium alloy oxidation
Installation	Three M4 screws

Package size

Product Size：L103.8*W55.4*H26（mm）



Top view

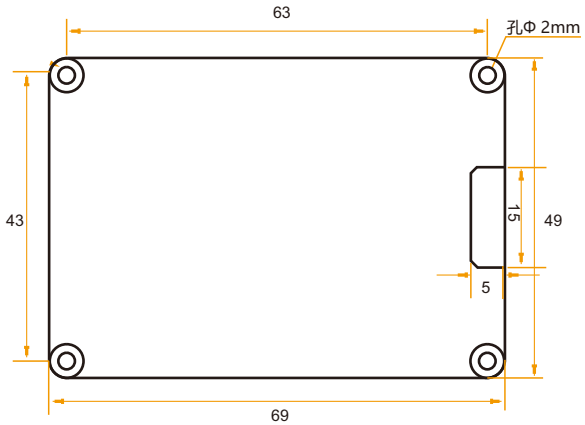


Aviation connector：116
Metal connector：105

Bare plate product size

Product size: L69*W49*H12(mm)

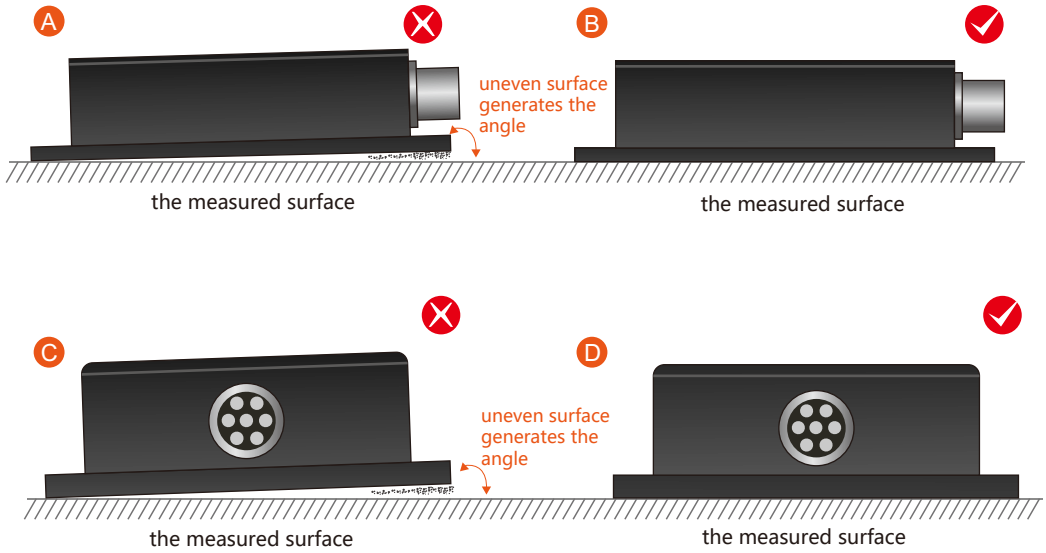
Note: ±1mm error for length and width dimensions, please refer to actual size.



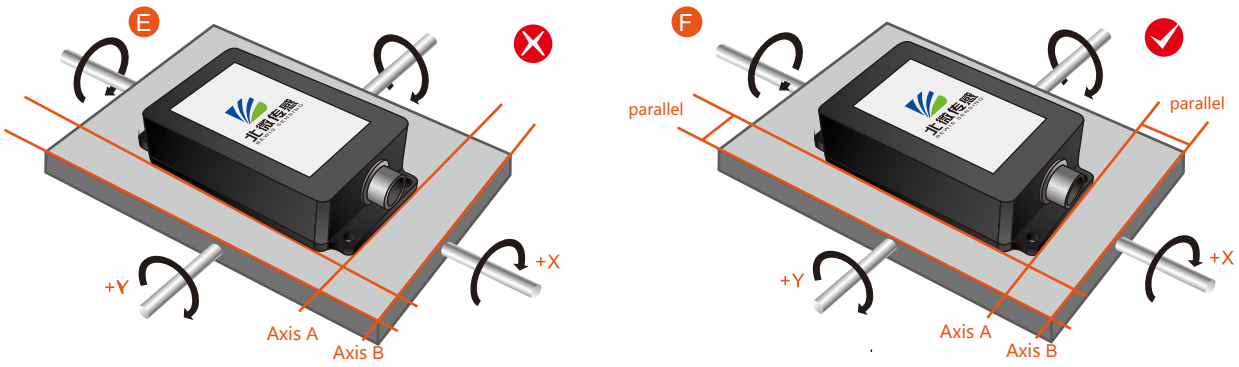
Installation direction

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.



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.

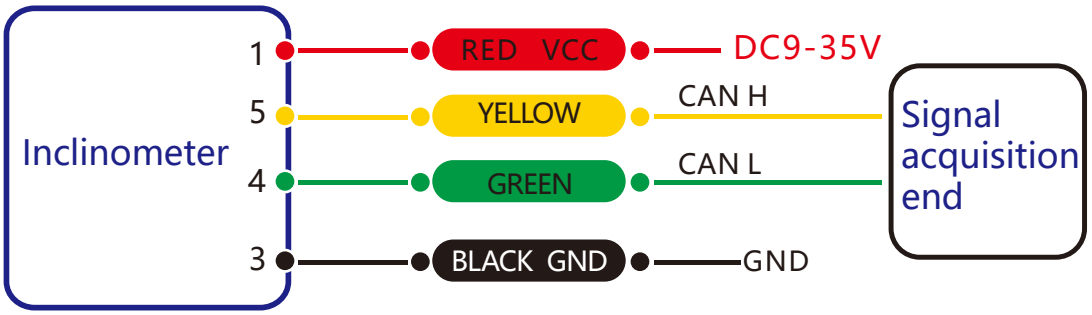


Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

Electrical connections

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



CAN BUS wiring diagram

Protocol

CAN includes 8 bytes. It will adds 0 to it when the date bytes is not enough. Sending the first byte 0x40 indicates a write command, and returning the first byte 0x40 indicates that the write was successful. The ID is the CAN communication node number.

1)Modify the nodes

(ID=0x01~0x7F),default ID=0x05

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x10	0x10	0x00	ID	0x00	0x00	0x00
response	0x580+0xID	0x40	0x10	0x10	0x00	ID	0x00	0x00	0x00

Note: If the controller send CAN-ID=0x600+0x05(default), send data:40 10 10 00 10 00 00 00

If the sensor return CAN-ID=0x580+0x10, return 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 CAN's baud rate

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x20	0x10	0x00	Baud	0x00	0x00	0x00
response									

Note: the fifth byte (Baud) means 0x01,0x02, 0x03, 0x04.

0x01 means to set 500k bps as the baud rate.
0x02 means to set 250k bps as the baud rate.
0x03 means to set 125k bps as the baud rate.
0x04 means to set 100k bps as the baud rate.

The default baud rate is 125k bps. Once you revise the baud rate and want to make a success revise, the sensor need to be re-powered.
The lower the baud rate, the shorter the communication distance. The communication distance can reach 1000m or more at 25K bps.

3) Set relative / absolute zero

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x05	0x10	0x00	Type	0x00	0x00	0x00
response	0x580+0x05	0x40	0x05	0x10	0x00	0x00	0x00	0x00	0x00

Note: the fifth byte means 0x00 and 0x01.
0x00 indicates the setting is an absolute zero,0x01 indicates a relative zero.
After setting the zero point, you need to enter the save command to set it successfully. (Default is absolute zero)
Absolute zero: Based on the factory-calibrated zero point.
Relative zero: Reference to the zero after the current installation.

4) Query relative/ absolute zero

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x0d	0x10	0x00	0x00	0x00	0x00	0x00
response	0x580+0x05	0x40	0x0d	0x10	0x00	Type	0x00	0x00	0x00

Note: the fifth byte means 0x00 and 0x01. 0x00 indicates an absolute zero and 0x01 indicates a relative zero.

5) Save the setting

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x0a	0x10	0x00	0x00	0x00	0x00	0x00
response	0x580+0x05	0x40	0x0a	0x10	0x00	0x00	0x00	0x00	0x00

Note: For some parameter, revised parameter doesn't work until you send the saving command.

6)Read angle of X,Y axis

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x04	0x10	0x00	0x00	0x00	0x00	0x00
response	0x580+0x05	Xsign	XH	XL	XL	Ysign	YH	YL	YL

Note: Reading angle command can be effective under the response mode.

Xsign and Ysign are the sign positions of the X and Y axes, respectively, 00 is positive and 10 is negative;

XH and YH are integer numbers (2 integer bits) of the X-axis and Y-axis angles, respectively;

XL and YL are the decimal places (4 decimal places) of the X-axis and Y-axis angles, respectively.

For example, the returned data is 585 00 12 34 50 10 12 34 50, which means that the X-axis angle is +12.3450 degrees and the Y-axis is -12.3450 degrees.

7) Set the output mode

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x0c	0x10	0x00	mode	0x00	0x00	0x00
response	0x580+0x05	0x40	0x0c	0x10	0x00	mode	0x00	0x00	0x00

Note: The fifth byte mode is 0x00,0x01,and the 0x00 is 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)

5Hz Data Rate means that 5 sets of angle data are automatically output every second, other modes are similar to this. Sending other naming should be recommended in the answer mode (automatic mode is non-stop output the current angle of the axis, in the answer mode to make it easier to see other command return values).

8) Inclinometer sensor automatically outputs the angle

When the sensor is set to automatic mode output, the sensor automatically outputs the angle according to a certain frequency after the sensor is powered on.

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send									
response	0x580+0x05	Xsign	XH	XL	XL	Ysign	YH	YL	YL

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

9) Set the type of CAN-ID

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x70	0x10	0x00	XX	0x00	0x00	0x00
response									

Note: XX means 00 and 01. 00 means the standard ID type (11 bits) and 01 means extended ID type (27 bits). The default type is the standard one.

10) Set the standard address of CAN-ID

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x71	0x10	0x00	XH	XL	0x00	0x00
response									

Note: The default standard CAN-ID is 0x580+05 and the maximum is not more than 7FF. Here we revise'580' in '0x580+05', 05 can be modified through the front nodes. After revise, the CAN-ID will become 0xXHXL+0x05 when re-powered on.
For example, send the data: 605 40 71 10 00 01 23 00 00, the CAN-ID will become 123+5=128 when it is repowered on.

11) Set the extended address of CAN-ID

We need to divide the address into two when setting the address of extended CAN-ID. First send high 16 address, then send the low 16 address. The CAN-ID address will change into new one (here the CAN-ID address we receive do not need to add the nodes) after being re-powered on. The maximum can not be more than 0x1FFFFFFF. The default is 0x18fa0216.

Ⅰ Set high 16 extended address of CAN-ID

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x72	0x10	0x00	XH	XL	0x00	0x00
response									

Note: the high 16 address can not surpass 0X1FFF.

Ⅱ Set low 16 extended address of CAN-ID

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x73	0x10	0x00	XH	XL	0x00	0x00
response									

Note: Low 16 address can not surpass FFFF.
For example, send the data respectively as follows, 605 40 72 10 00 01 23 00 00 and 605 40 73 10 00 45 67 00 00. CAN-ID will change into 01234567 after being re-powered on.

12) Reading temperature

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send	0x600+0x05	0x40	0x23	0x10	0x00	0x00	0x00	0x00	0x00
response	0x585+0x05	Xsign	XH	XL	XL	Ysign	YH	YL	YL

Note: Note: The first digits of Xsign and Ysign are the sign positions of the X and Y axes, respectively，00 is positive and 10 is negative;
XH and YH are integer numbers of X-axis and Y-axis temperatures, respectively;
XL and YL are the decimal places of the X-axis and Y-axis temperatures, respectively.
For example, if the returned data is 585 00 36 12 53 00 35 20 52, the X-axis temperature is 36.1253 degrees, the Y-axis temperature is 35.2052 degrees.

Ordering Information

Product number	Way of communication	Package condition
BWS4500-90-CAN	CAN	IP67 Package/Metal Connector

Executive standard

- Enterprise Quality System Standard: ISO9001:2008 Standard (Certificate No.:10114Q16846ROS)
- CE certification (certificate number: 3854210814)
- ROHS (certificate number: SO81426003)
- GB/T 191 SJ 20873-2003 General specifications for tiltmeters and spirit levels
- GBT 18459-2001 sensor main static performance index calculation method
- JF 1059-1999 Evaluation and Expression of Measurement Uncertainty
- GBT 14412-2005 mechanical vibration and shock mechanical installation of accelerometer
- General requirements for GJB 450A-2004 equipment reliability
- Quality control of key parts and important parts of GJB 909A
- GJB 899 Reliability Qualification and Acceptance Test
- GJB 150-3A high temperature test
- GJB 150-4A low temperature test
- GJB 150-8A rain test
- GJB 150-12A dust test
- GJB 150-16A vibration test
- GJB 150-18A impact test
- GJB 150-23A Tilt and Swing Test
- GB/T 17626-3A RF electromagnetic radiation immunity test
- GB/T 17626-5A surge (hit) impulse immunity test
- GB/T 17626-8A power frequency magnetic field immunity test
- GB/T 17626-11A voltage dips, short interruptions and voltage changes immunity

BWS4500 Serials

High Accuracy CAN Bus Dual-Axis Inclinometer

Wuxi Bewis Sensing Technology LLC
Address: Building 30, No. 58 Xiuxi Road, Binhu District, Wuxi City
Hotline: 400-618-0510
Tel: +86 510 85737178-801
Email: sales@bwsensing.com
Website: www.bwsensing.com