



# BWL315S

## Low Cost Single-Axis CAN Output Inclinometer Technical Manual



## Introduction

Designed by Bewis Sensing Technology LLC, BWL315S is a low cost single-axis CAN output inclinometer, adopting the latest industrial level MEMS accelerometer. Its measuring range is  $\pm 180^\circ$ , highest accuracy is  $0.1^\circ$ , working temperature is  $-40^\circ\text{C} \sim +85^\circ\text{C}$ , the product with a small size and low weight, can meet space-restricted application requirements.

This product converts static gravity field changes into angle changes, It outputs horizontal angle values directly by digital, this product has the advantages of low cost, small temperature drift, simple to use, and strong resistance to external disturbances. It is an ideal option for attitude measurement in photovoltaic power (PV), PTZ control, tower turbines monitoring and other industries.

## Features

- Single-axis inclinometer measurement
- Resolution:  $0.01^\circ$
- Voltage input: 9~35VDC
- Product size: L55\*W37\*H24(mm)
- Accuracy:  $0.1^\circ$
- Measuring range:  $\pm 180^\circ$
- Output mode: CAN
- IP67 protection

## Applications

- Industrial automatic leveling
- Medical devices
- PV automatic tracking
- Tower tilt monitoring
- Special valves
- Oil drilling equipment
- Industrial converters
- Crane tilt angle control

## 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	°C
Store temperature		-55		+100	°C

### Performance Specifications

Measuring range(°)	Conditions		0 ~ ±180
Measuring axis			X
Accuracy(°)	Indoor		0.1
Resolution(°)			0.01
Zero temperature drift(°/°C)	-40 ~ +85°C		±0.01
Power on time			<3s
Frequency response (Hz)			100
MTBF	≥ 100000 h		
Electromagnetic compatibility	According to GBT17626		
Insulation resistance	≥100MΩ		
Shock resistance	2000g,0.5ms,3times/axis		
Weight (g)	210g		

**Resolution:** The measured minimum change value that the sensor can detect and resolve within the measurement range.

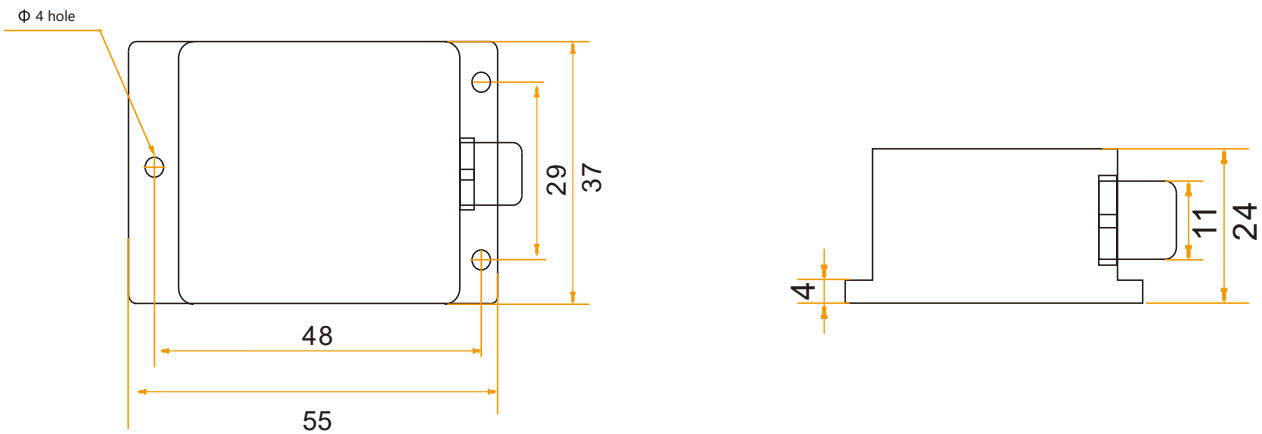
**Accuracy:** The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).


**Mechanical Characteristic**

Connector	Metal connector
Protection level	IP67
Shell material	Magnesium alloy sanding oxidation
Installation	Three M4 screws


**Package size**

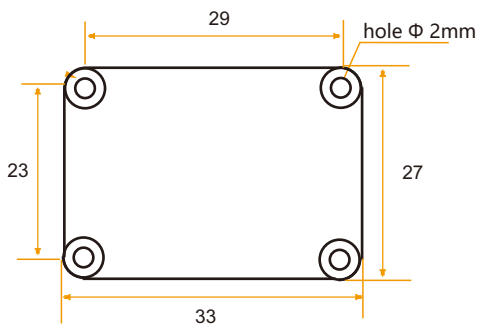
Product Size: L55\*W37\*H24 (mm)



**Bare plate product size**

Product size: L33\*W27\*H6(mm)

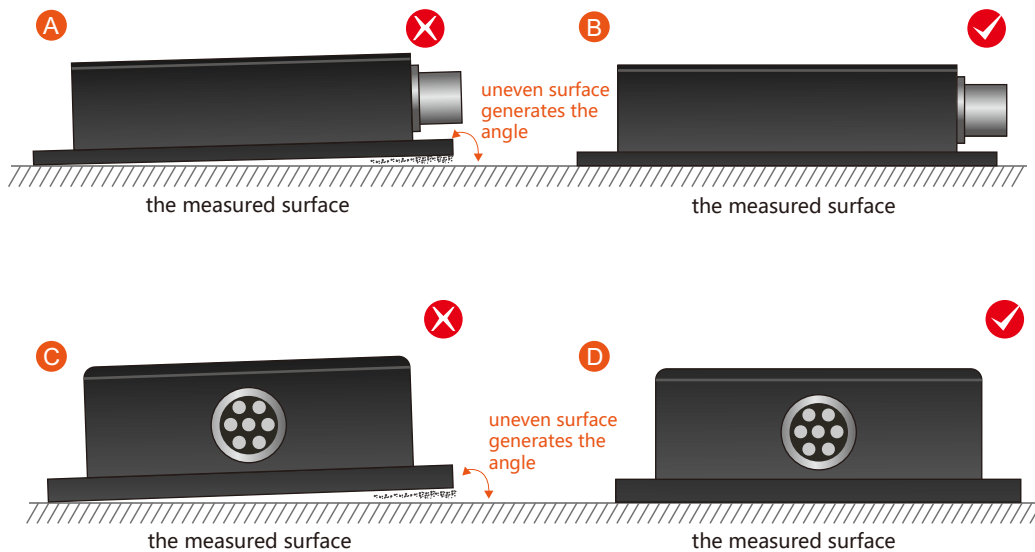
**Note:** ±1mm error for length and width dimensions, please refer to actual size.



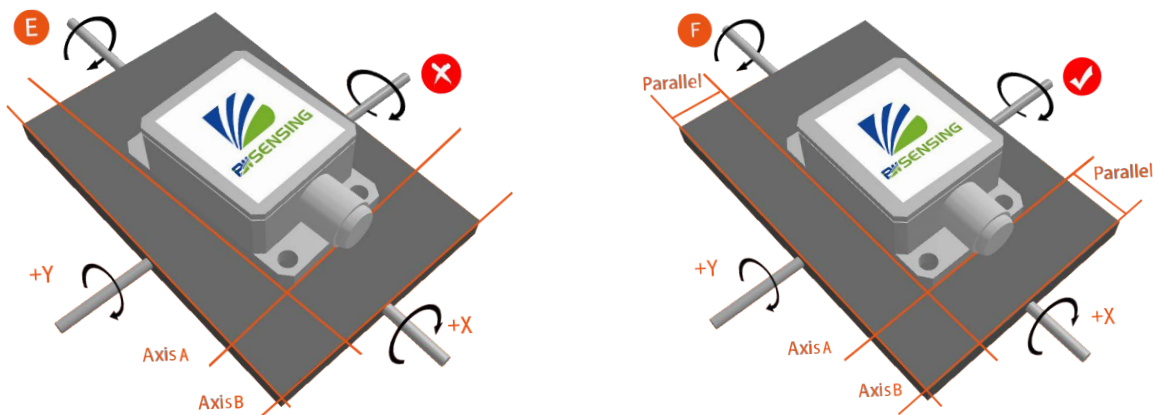
## Installation direction

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.

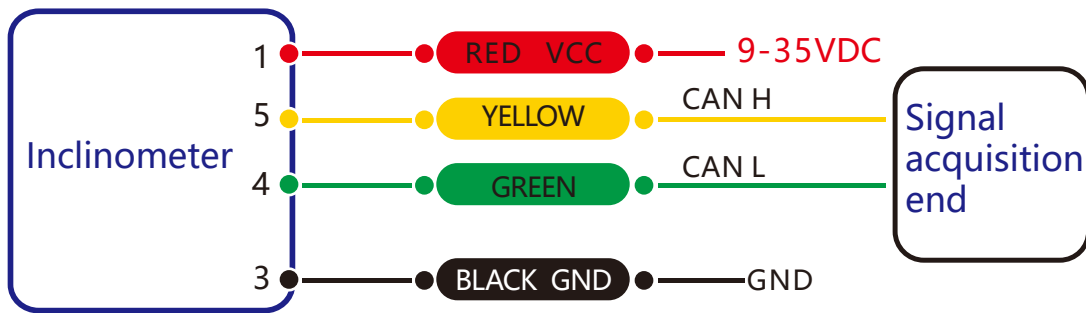


Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

## Electrical connections

### Electrical interfaces

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



**CAN BUS Wiring diagram**

No termination resistor between CAH L and CAN H by default

# Protocol

CAN includes 8 bytes. It will add 0 to it when the data bytes is not enough. When the CAN-ID is 600, it is a broadcast address. Default: CAN baud rate is 125K, 100HZ auto output, absolute zero, node number is 05.

## 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). At this time, the CAN-ID needs to be changed to 0x610 (0x600+0x10) to send the other naming. Modify the node number, you do not need to send a save command.

## 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.

## 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-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	0xSX	0xXX	0xYY	0x00	0x00	0x00	0x00	0x00

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

The first, second and third bytes are the X-axis angle values.

Among them, S represents a sign bit (0 is a positive value, 1 is a negative value), XXX represents a 3-bit integer bit of the angle, and YY represents an angle of 2 decimal places.

For example, if the returned data is 585 11 23 45 00 00 00 00 00, the X-axis angle is -123.45°.

#### 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: 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)

**Note:** 5Hz Data Rate means 5 times of data is output automatically every second. Sending other names should be done in Q&A mode.(Auto mode is the current angle of the output axial output at a specific frequency. In the answer mode, it is easier to see the return value of other commands).



### 8) Inclinometer sensor automatically outputs the angle

When the sensor is set to the automatic mode output, the angle value is automatically output to the outside according to a certain frequency after the sensor is powered on. The default is automatic 100Hz mode. Set to the answer mode, the sensor must receive the read angle command and the sensor outputs the angle.

	CAN-ID	The first byte	second	third	fourth	fifth	sixth	seventh	eighth
send									
response	0x580+0x05	0xSX	0xXX	0xYY	0x00	0x00	0x00	0x00	0x00

**Note:** The format of the output angle is same with reading the angle of X-axis and Y-axis under the response mode.

### 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 is 00, 01. 00 represents standard ID (11-bit) type, 01 represents extended ID (27-bit) type. The default is standard.

Before setting the standard ID and extension ID, you need to send this command to switch to the corresponding type.

Setting the CAN-ID type, standard CAN-ID address, and extended CAN-ID address do not need to send a save command.

After the setting is completed, power on again will become the result of the setting.

### 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	0xXHXL+0x05								

**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 "Modify the 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 re-powered 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 7FFFFFFF. 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 7FF.

### 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.

## Executive standard

- Enterprise Quality System Standard: ISO9001:2008 Standard (Certificate No. 10114Q16846ROS)
- CE certification (certificate number: 3854210814)
- RoHS (certificate number: G190930099)

# BWL315S

Low Cost Single-Axis  
CAN Output Inclinator

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