



BWM410 Serials

Voltage Single-Axis Inclinometer Technical Manual



Introduction

Designed by Bewis Sensing Technology LLC, BWM410 is a cost-effective single-axis inclinometer with MEMS technology and voltage output. It has a measuring range of $\pm 180^\circ$ and a full-scale accuracy of 0.05° and a operating temperature of $-40^\circ\text{C} \sim +85^\circ\text{C}$. The product uses a high-accuracy MEMS accelerometer and 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 horizontal angle value through voltage mode. It has high long-term stability, small temperature drift, simple use and strong resistance to external interference. It apply to military equipment, industrial automation, surveying and mapping, etc.

Features

- Single-axis inclination measurement
- Resolution: 0.001°
- Output mode: 0-5V/0-10V optional
- Voltage input: 12~35V
- Max accuracy: 0.05°
- Measuring range: $\pm 180^\circ$
- Way of communication: RS232
- IP67 protection

Applications

- Industrial automatic leveling
- Medical devices
- The automatic tracking system of solar angle
- Tower tilt monitoring
- Hoisting angle control
- Structural deformation monitoring
- Measuring and mapping instrument
- Military equipment automation

Specifications

Electrical Specifications

Parameters	Conditions	Min	Typical	Max	Units
Power supply(DC)		12		35	V
Operating current	Non-loaded	20	50	60	mA
Output load	Resistivity	10			KΩ
	Capacitive			20	nF
Operating temperature		-40	25	+85	°C
Store temperature		-55	25	+100	°C

Performance Specifications

Parameters	Conditions	BWM410	Units
Measuring range		0~±180	°
Measuring axis		X	
Accuracy	Indoor	0.05	°
Resolution		0.001	°
Zero temperature drift		±0.005	°/°C
Full scale output voltage		0-5V/0-10V optional	
Frequency response		100	Hz
Shock resistance	2000g,0.5ms,3times/axis		
N.W.	225g(Includes standard 1.5m cable, no box)		
MTBF	≥30000 hours/time		
Electromagnetic compatibility	according to GBT17626		
Insulation resistance	≥100 MΩ		

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).

Note: The output voltage and corresponding angle are adjustable.

For example, the output variation range is $\pm 15^\circ$, corresponding to -15° output voltage 0V, and 15° output voltage 5V (10V).

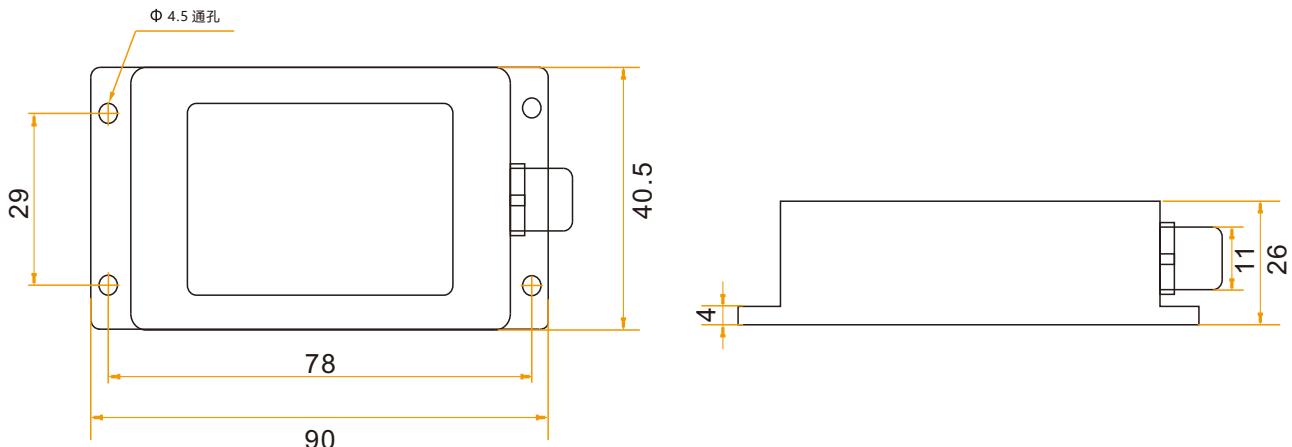
For example, the output variation range is $\pm 137^\circ$, corresponding to -137° output voltage 0V, and 137° output voltage 5V (10V).

Mechanical Characteristic

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

Package size

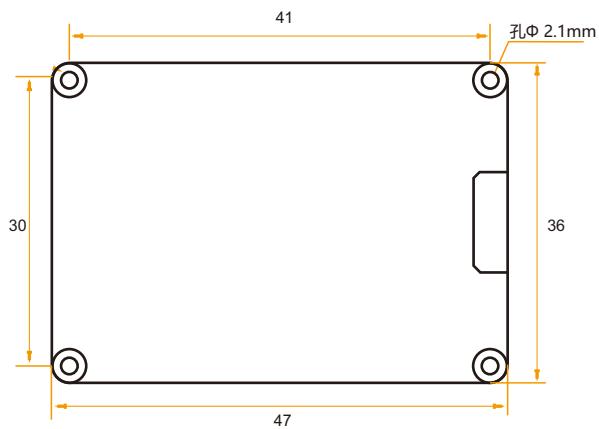
Product Size: L90*W40.5*H26(mm)



Bare plate product size

Product size: L47*W36*H15(mm)

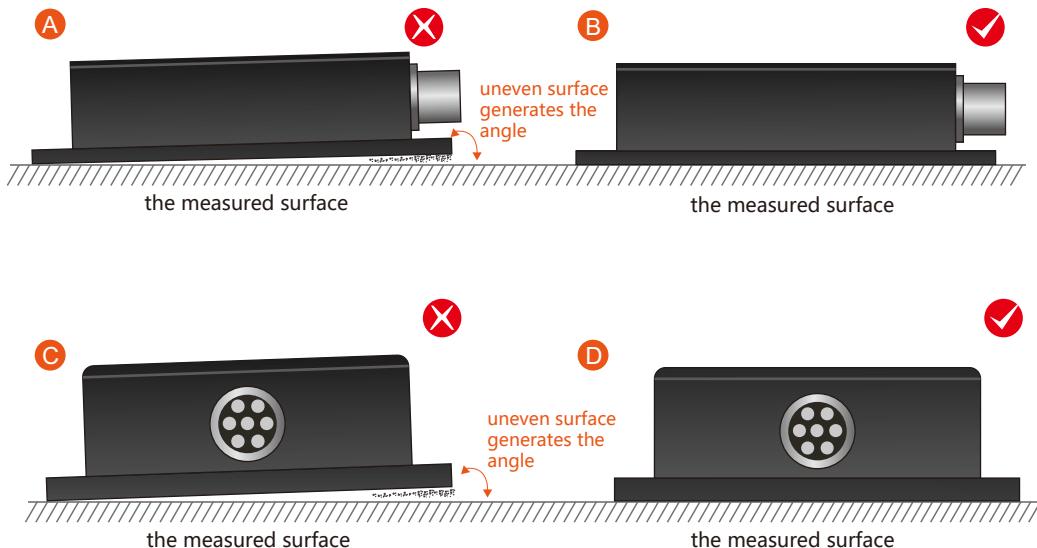
Note: ±1mm error for length and width dimensions, please refer to actual size.



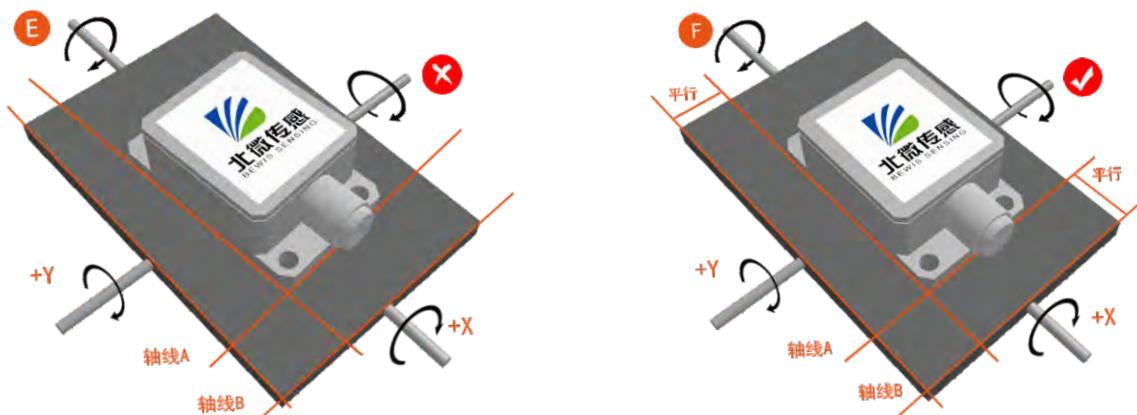
Installation direction

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.

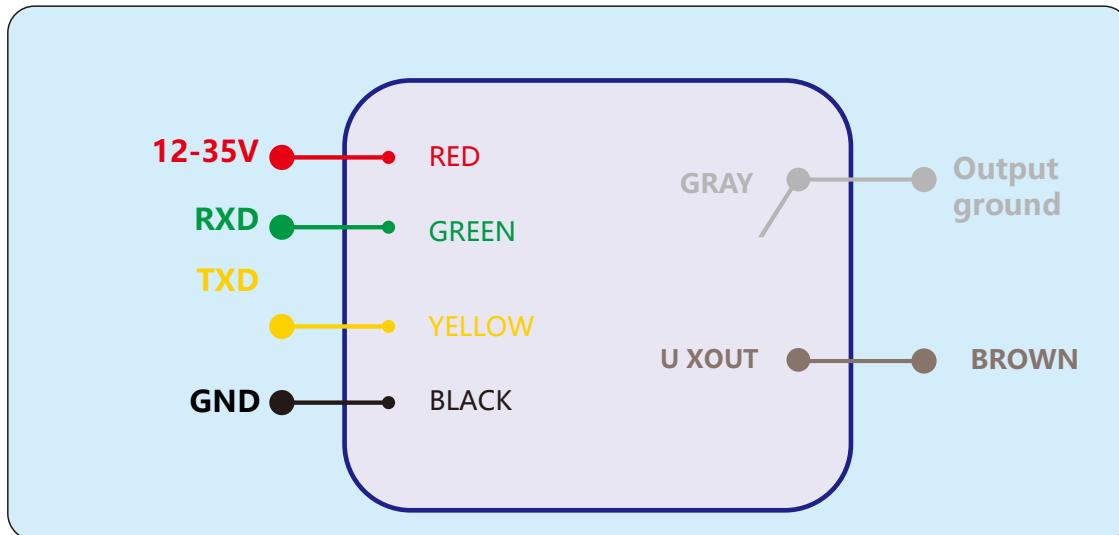


Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

Electrical connections

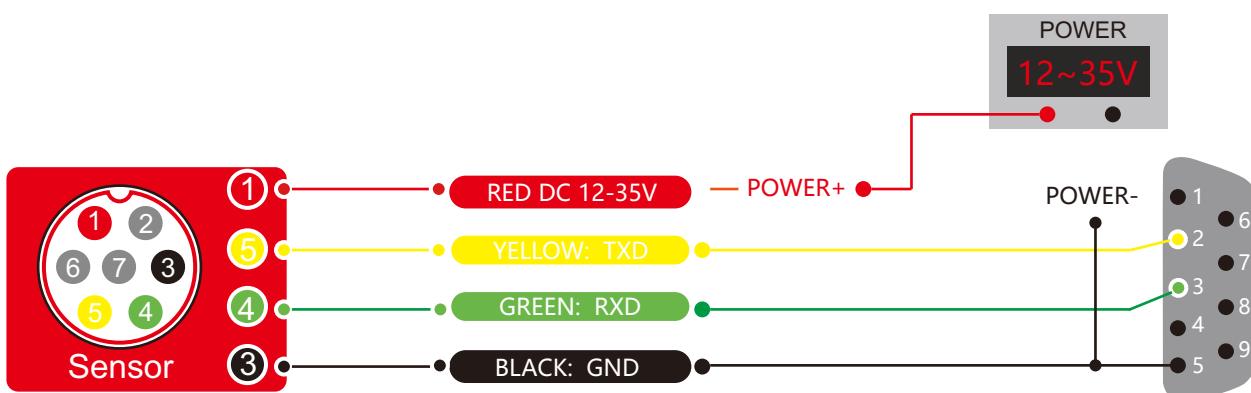
Electrical interfaces

Cable color & Function	RED	BLACK	GREEN	YELLOW	BROWN	GRAY
	1 VCC DC 12-35V	3 GND	4 RS232 RXD	5 RS232 TXD	8 U XOUT	10 Output ground



RS232 Electrical interfaces

Cable color & Function	RED	BLUE	BLACK	GREEN	YELLOW
	1 VCC DC 9-35V	2 NC	3 GND	4 B 485-	5 A 485+



Debug software

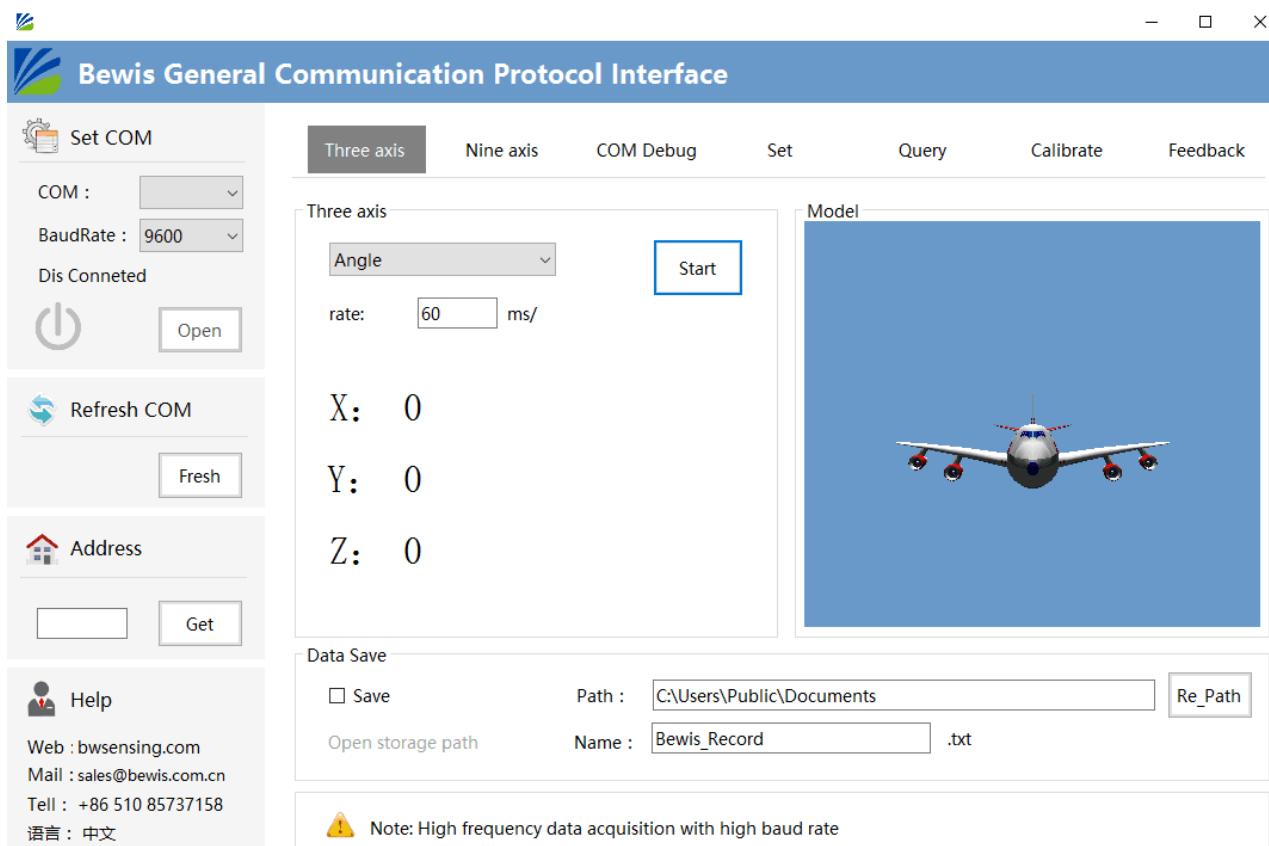
Users can directly download serial assistant on official website (Supports-Download). You can also use more convenient and intuitive PC software.

BWM410 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 Correctly connect the inclinometer serial port hardware and connect the power supply.
- ② Select the computer serial port and baud rate and click connect Serial Port.
- ③ Click Start and the tilt angle of the tilter in the X direction will be displayed on the screen.

Note: You can switch to Chinese or English version by the bottom left button.



2.3 Set relative / absolute zero Command: 77 05 00 05 00 0A

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x05	0x00: absolute zero 0x01: relative zero	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x85	0x00: success 0xFF: failure	

Note: absolute zero: Based on the factory-calibrated zero point.

relative zero: Reference to the zero after the current installation.

2.4 Query relative / absolute zero Command: 77 04 00 0D 11

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x04	0x00	0x0D		0x11

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x8D	0x00: absolute zero 0xFF: relative zero	

2.5 Set baud rate Command: 77 05 00 0B 03 13

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x0B	0x03	0x13

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x8B	0x00: success 0xFF: failure	

Note: For data, 00: 2400, 01: 4800, 02: 9600, 03: 19200, 04: 115200, Default 02:9600.

Note: Set baud rate to 115200 in high speed mode. When the Set baud rate command is executed successfully, the command response will be return in the original baud rate and then communicate with new baud rate.



2.6 Set output mode Command: 77 05 00 0C 00 11

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x0C	0x00: question and 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	

Note: The default output mode is 00(when setting 100HZ output frequency).
Set baud rate to 115200 in high speed mode.

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x8C	0x00: success 0xFF: failure	

Note: 5Hz Data Rate means that 5 sets of angle data are automatically output every second, and so on.

2.7 Save setting Command: 77 04 00 0A 0E

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x04	0x00	0x0A		0x0E

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x8A	0x00: success 0xFF: failure	

Note: If Save setting command is not executed, all setting will be invalid after power off.

2.8 Query address Command: 77 04 00 1F 23

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x04		0x1F		0x23

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x1F		

Ordering Information

Product number	Way of communication	Package condition
BWM410-180-05	Voltage/RS232	IP67 Package/Metal Connector
BWM410-180-10	Voltage/RS232	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

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