BWM826

Gigital Dual-Axis Inclinometer

Technical Manual

BWM 826
Digital Dual-Axis Inclinometer




Introduction

Designed by Bewis Sensing Technology LLC, BWM826 is a cost-effective dual-axis inclinometer with MEMS technology and digital output. It has a measuring range of ± 30° and a full-scale accuracy of 0.005° and a operating temperature of -40℃~+85℃. 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 digital 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

- Dual-axis inclination measurement
- Measuring range: ±30°
- Max accuracy: 0.005°
- Voltage input: 9~35V
- Output mode: RS485/RS232/TTL optional
- Operating temperature: -40℃~+85℃
- IP67 protection
- High vibration resistance>2000g
- High resolution: 0.001°
- Product size: L90*W40.5*H26（mm）

Applications

- Dangerous building monitoring
- Bridge monitoring
- Satellite antenna positioning
- Laser level
- Slope monitoring
- High-speed rail monitoring
- Piling monitoring
- Ancient building protection monitoring

Specifications

Electrical Specifications

Parameters	Conditions	Min	Typical	Max	Units
Power supply		9	12	35	V
Operating current	Non-loaded	20	30	40	mA
Operating temperature		-40	25	+85	℃
Store temperature		-55	25	+100	℃

Performance Specifications

Parameters	Conditions	BWM826-5	BWM826-15	BWM826-30	Units
Measuring range		±5	±15	±30	°
Measuring axis		X-Y	X-Y	X-Y	
Accuracy	Indoor	0.005	0.008	0.01	°
Resolution		0.001	0.001	0.001	°
Zero temperature drift	-40～85℃	±0.001	±0.001	±0.001	°/℃
Cross axis error	25℃	0.005	0.008	0.01	°
Frequency response		100	100	100	Hz
MTBF	≥90000 hours/time				
Electromagnetic compatibility	according to GBT17626				
Insulation resistance	≥100 MΩ				
Shock resistance	2000g, 0.5ms, 3 times/axis				
Weight（g）	150(package excluded)				

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

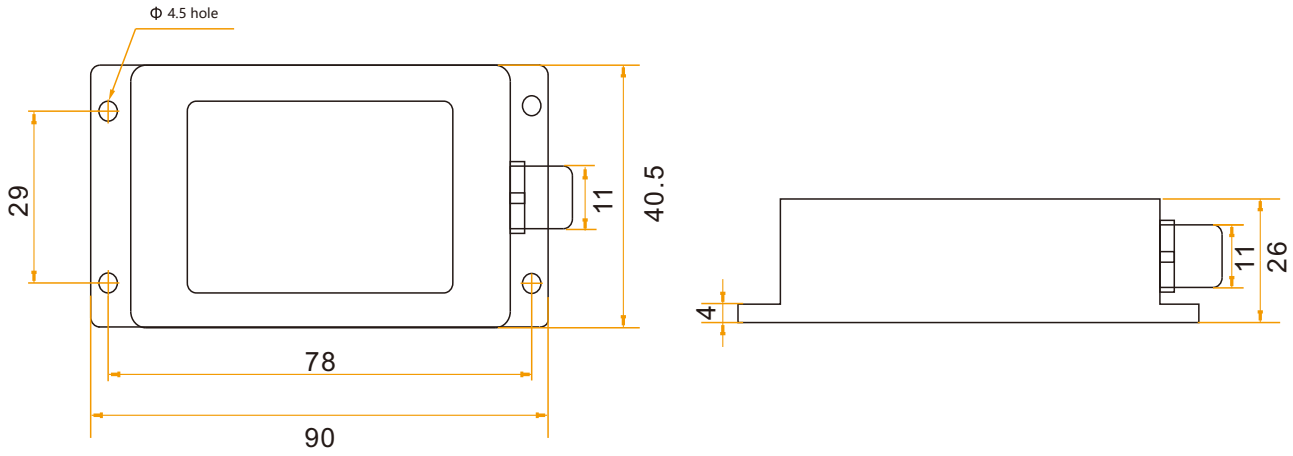
Accuracy: The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

Mechanical Characteristic

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

Package size

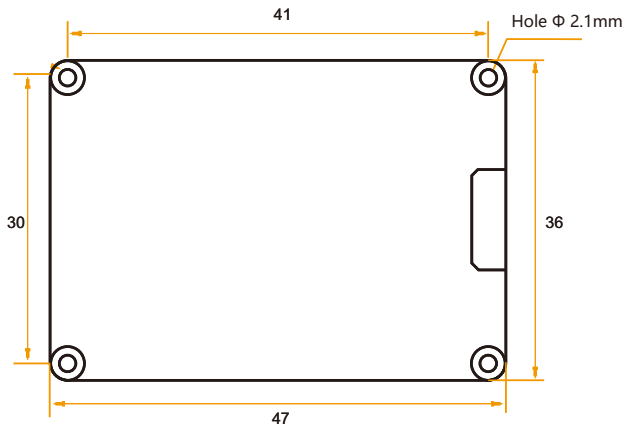
Product Size: L90*W40.5*H26(mm)



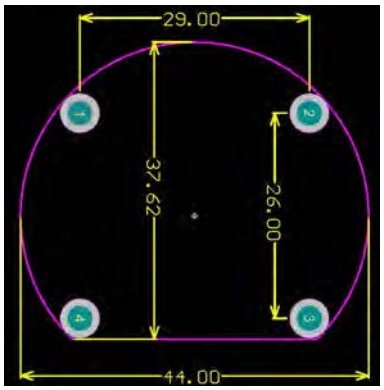
Bare plate product size

Product size: L47*W36*H15(mm)

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



RS232 output

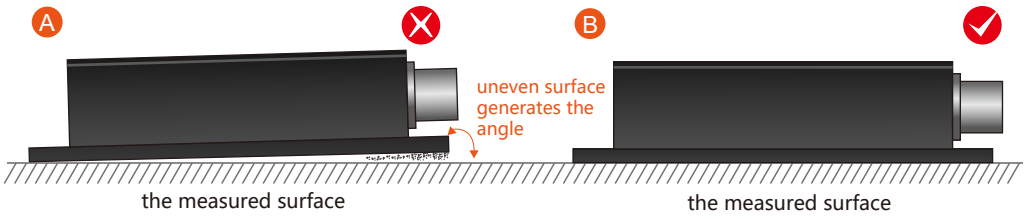


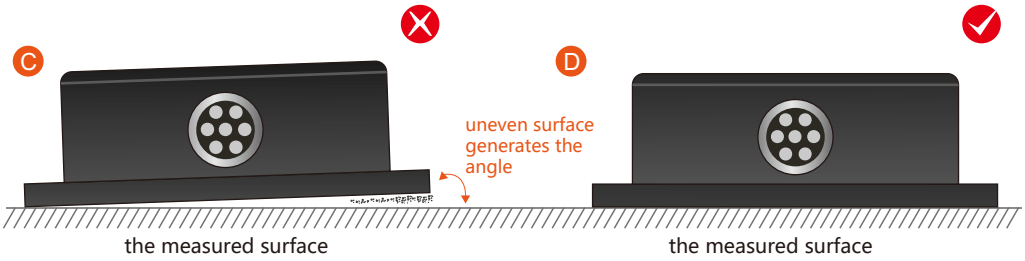
RS485/TTL output

Installation direction

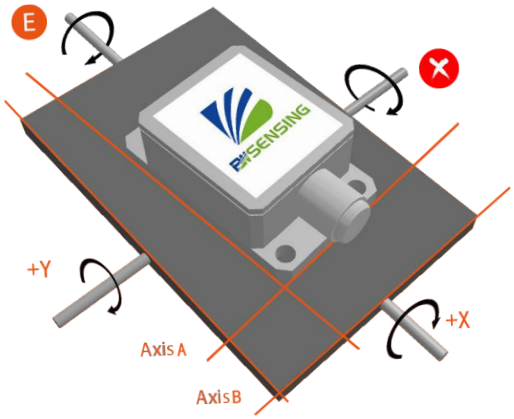
The correct installation method can avoid measurement error. The following points should be made when installing the sensor:

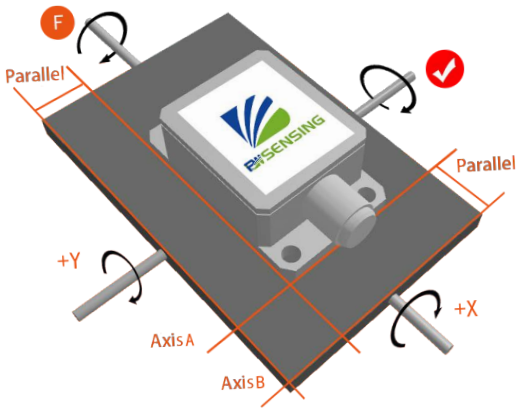
First of all, to ensure that the sensor mounting surface and the measured surface completely close, the measured surface should be as horizontal as possible, can not have the angle shown in Figure A and Figure C, the correct installation is shown in Figure B and Figure D.





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.



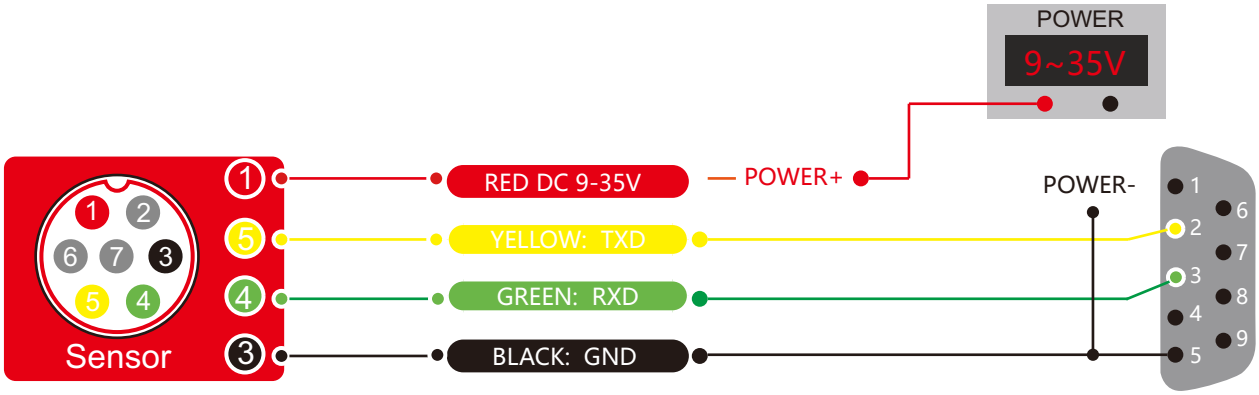


Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.

Electrical connections

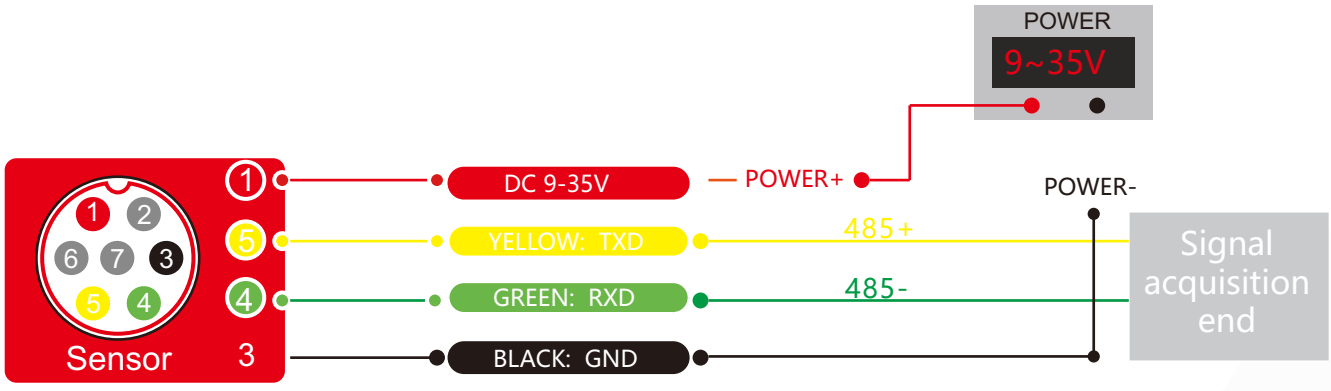
RS232 Electrical interfaces

Cable color & Function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 9-35V	NC	GND	RXD	TXD



RS 485 Electrical interfaces

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

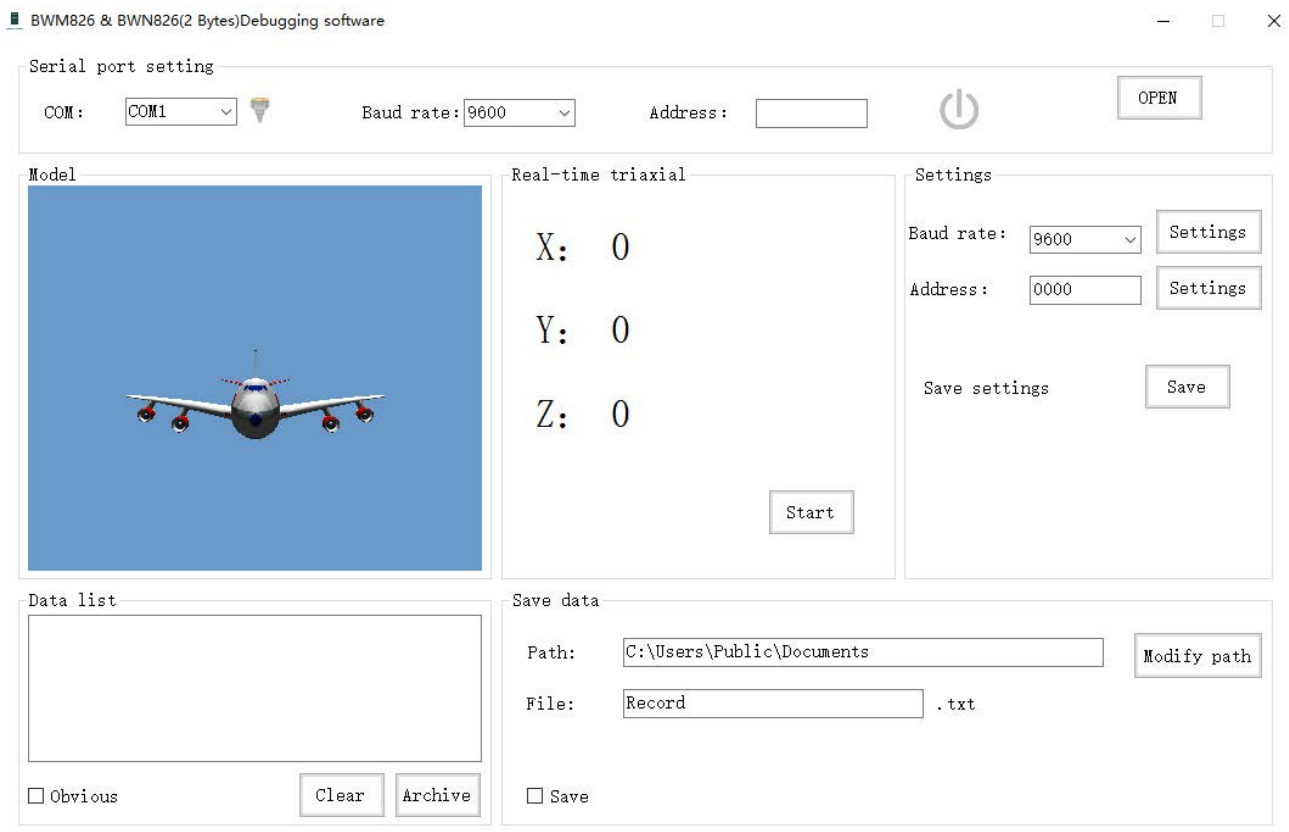
BWM826 supporting serial debugging software can be connected to the inclinometer on the computer for angle display. The software debugging interface is as shown in the figure below. Using the debug software, it can conveniently display the current X-direction tilt angle, and you can also modify and set 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 X, Y Axis will be displayed on the screen.



Protocol

1Data Frame Format: (8 data bits, 1 stop bit, No parity check, default baud rate 9600)

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (nbyte)	Checksum (1byte)
0x77					

Data Format: Hexadecimal
Identifier: Fixed to 77
Frame Length: Length from Frame Length to Checksum (included)
Address Code: Address of acquiring module, default 0x00
Data: Content and length variable according to Command
Checksum: Sum of Frame Length, Address Code, Command and Data. (Please pay attention that when the command or data changes, the checksum will change.)

2 Command Format

2.1 Read angle of X axis Command: 77 05 00 00 01 06

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77			0x01		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (4byte)	Checksum (1byte)
0x77	0x07		0x81	SXXX.YYY0	

Note: The data field is a 4-byte return angle value, which is a compressed BCD code, S is a sign bit (0 positive, 1 negative), XXX is a three-digit integer value, and YYY is a decimal value. The Data of other axis is the same format. For example, 10 26 80 70 means -026.8070 °.

2.2 Read angle of Y axis Command: 77 05 00 00 02 07

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77			0x02		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (4byte)	Checksum (1byte)
0x77			0x82	SXXX.YYY0	

2.3 Read angle of X,Y axis Command: 77 05 00 00 04 09

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77			0x04		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (12byte)	Checksum (1byte)
0x77			0x84		

Note: The data field is a 12-byte return angle value, divided into three groups, each group of four compressed BCD codes. They are the X-axis angle, the Y-axis angle, and the Z-axis (all 0). Each axis data format SXXX.YYY0, S is a sign bit (0 positive, 1 negative) XXX is a three-digit integer value, YYY is a three-digit decimal value. The other axis data is the same. For example, 10 26 87 60 means -026.8760°.
Such as: 77 11 00 00 84 00 02 01 30 10 00 51 20 00 00 00 00 49
Where 00 02 01 30 represents the X-axis angle of +2.013°, and 10 00 51 20 represents the Y-axis angle of -0.512°.

2.4 Set absolute/relative zero point Command: 77 06 00 00 05 01 0C

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x05	0x00: absolute zero 0x01: relative zero	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			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.

2.5 Set baud rate Command: 77 06 00 00 0B 04 15

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x0B	0x00	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x8B	0x00: success 0xFF: failure	

Note: 00:2400 01 :4800 02:9600 03:19200 04:115200, the default is 9600
Each time the communication baud rate is changed successfully, the response command is sent back at the original baud rate, and then the device communication baud rate is changed immediately.
Note: If high frequency output is required, set the baud rate to 115200.

2.6 Save setting Command: 77 05 00 00 0A 0F

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x0A		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x8A	0x00: success 0xFF: failure	

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

2.7 Query address Command: 77 05 00 00 1F 24

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x05	00x00	0x1F		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (2byte)	Checksum (1byte)
0x77			0x1F		

2.8 Query relative / absolute zero Command: 77 05 00 00 0D 12

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77			0x0D		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			0x8D	0x00: absolute zero 0xFF: relative zero	

Note: This command refers to whether the zero point reference used in the current state is relative zero or absolute zero;

2.9 Set address Command: 77 05 00 0F 01 17

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (2byte)	Checksum (1byte)
0x77	0x07	xxxx	0x0F	YYYY	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (2byte)	Checksum (1byte)
0x77	0x06	YYYY	0x8F	0x00	

Note: XX represents the address before modification, YY represents the modified address.

2.10 Set output Angle mode Command: 77 06 00 00 0C 01 13

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x06		0x0C	0 x00: quiz 0x01:5 hz Data Rate 0x02:10 hz DataRate 0x03:20 hz Data Rate 0x04:25 hz Data Rate 0x05:50 hz Data Rate 0x06:100 hz Data Rate 07:(1/300)Hz (output once every 5 minutes)	

Note: The default output mode is 00. When setting the output frequency of 100Hz, the baud rate needs to be adjusted to 115200.

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (2byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77		0x00	0x8C	0x00: success 0xFF: failure	

Note: Set as response mode, the output Angle must receive the read Angle command; set as automatic output mode, the output Angle of X and Y will be automatically when power is on. After setting, it needs to be sentSave the command.
For example, when the address is 0, set the automatic output to 100Hz, send: 77 06 00 00 0C 06 18, return: 77 06 00 00 8C 00 92.

Ordering Information

Product number	Way of communication	Package condition
BWM826-30-232	RS232	IP67 Package/Metal Connector
BWM826-30-485	RS485	IP67 Package/Metal Connector
BWM826-30-TTL	TTL	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

BWM826

Digital Dual-Axis Inclinometer

Wuxi Bewis Sensing Technology LLC

Address: Building 30, No. 58 Xiuxi Road, Binhu District, Wuxi City, Jiangsu Province, China

Tel: +86 510 85737178-801

Email: support@bwsensing.com

Website: www.bwsensing.com