BWN466

Dual-Axis Inclinometer
Digital output

Technical Manual

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Introduction

Designed by Bewis Sensing Technology LLC, BWN466 is a cost-effective digital dual-axis inclinometer which output mode is RS485 and TTL optional. It adopts the latest technology MEMS manufacturing process tilting unit, with small size, low power consumption, high consistency and stability. Because it is a digital inclinometer, the linearity is more easily corrected. The operating temperature reaches the industrial grade -40 °C ~ +85 °C.

When multi-section cascading is used, we provide a multi-section slanting algorithm, which can accurately measure the displacement of large length and deep depth, and provides an automatic calibration algorithm.

Features

- Dual-axis inclination measurement
- Measuring range: ±30°
- Accuracy: 0.01°
- Voltage input: 9~35V DC
- Output mode: RS485/TTL optional
- Multi-section cascade
- Operating temperature: -40℃~+85℃
- High vibration resistance>2000g
- Resolution: 0.001°
- Bare board size: 67*20*8 (mm)

Applications

- Foundation pit monitoring
- Soil monitoring
- Dam tailings monitoring
- Exploration well monitoring
- Slope monitoring
- High-speed rail monitoring
- Piling monitoring
- Deep displacement

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		BWN466-30	Units
Measuring range	Conditions	±30	°
Measuring axis		X-Y	
Accuracy	Indoor	0.01	°
Resolution		0.001	°
Zero temperature drift	-40～85℃	±0.001	°/℃
Cross axis error	25℃	0.01	°
Frequency response		100	Hz
MTBF	≥90000 hours/time		
Electromagnetic compatibility	according to GBT17626		
Insulation resistance	≥100 MΩ		
Shock resistance	2000g, 0.5ms, 3times/axis		

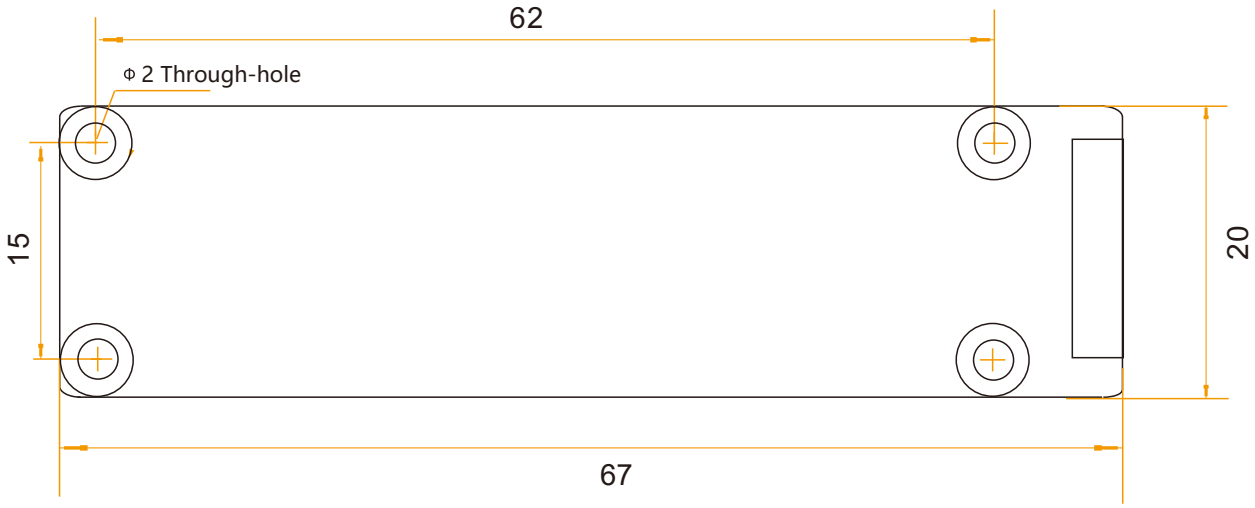
Resolution: The measured minimum change value that the sensor can detect and resolve within the measurement range.
Accuracy: The error between the actual angle and the Root mean square(RMS) of the measured angle of the sensor (≥16 times).

Mechanical Characteristic

Connector	Cable hole
Protection level	PCB
Shell material	PCB
Installation	Four M2 screws

Package size

Product size: L67*W20*H8（mm）

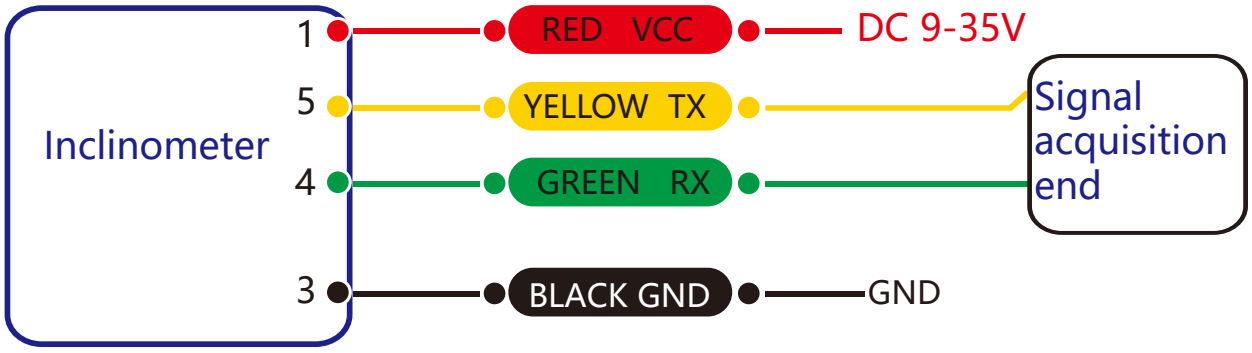


Board schematic

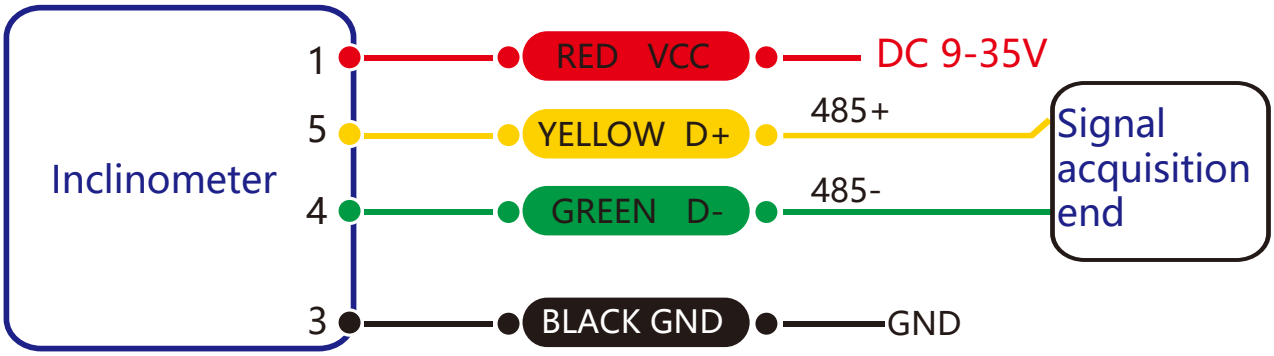
Electrical connections

Electrical interfaces

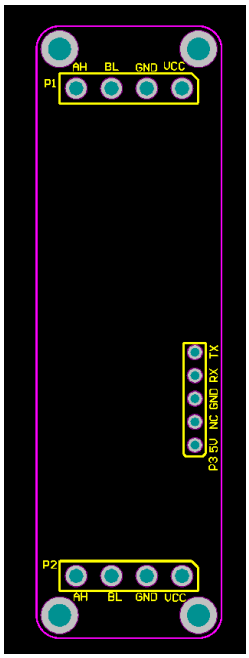
Cable color & Function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 9-35V	NC	GND	B 485-	A 485+



TTL wiring diagram



RS485 wiring diagram



Note: P1 and P2 are the same for the numbered wiring, and RX and TX of P3 are the receiving and transmitting ends of TTL;
When RS485 is selected, VCC (9~35V) of P1 or P2, GND, AH(485+), BL(485-) can be connected;
When TTL is selected, connect VCC (9~35V) of P1 or P2, GND, RX and TX of P3, TX (transmitting end) of the receiving end is connected to RX (receiving end) of sensor P3, and RX (receiving end) of receiving end is connected to TX of sensor P3 (transmitting end)

Debug software

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

BWN466 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.

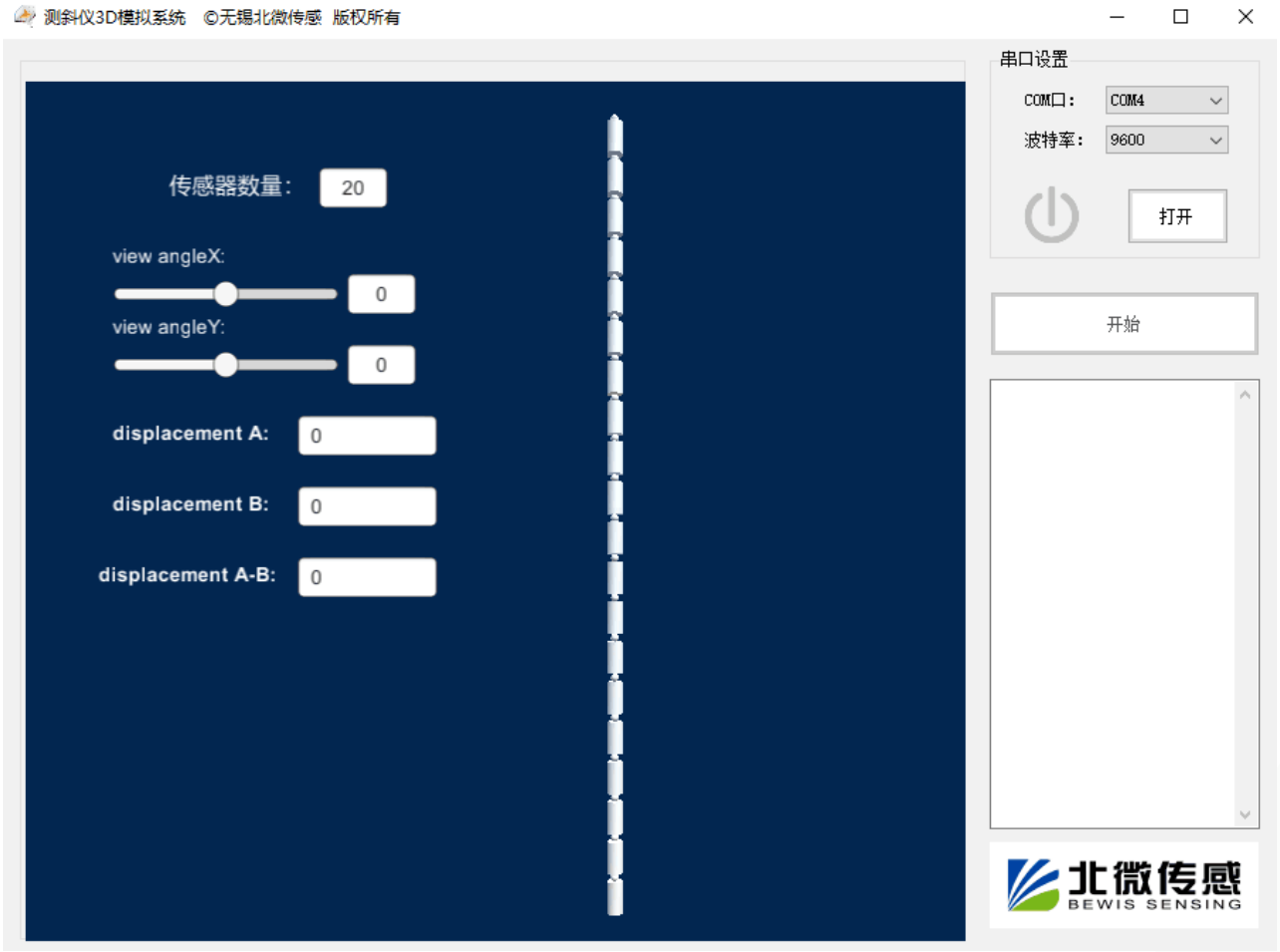
Software use steps:

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.



Protocol

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

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	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 07 00 00 00 00 01 08

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			01		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (3byte)	Checksum (1byte)
77			81	SXXX.YYY0	

Note: The data field is a 4-byte return angle value, which is a compressed BCD code, S is the sign bit (0 positive, 1 negative), XXX is a three-digit integer value, and YYY is a decimal value. Other axis data are the same. For example, 102680 means -26.8 degrees.

2.2 Read angle of Y axis Command: 77 07 00 00 00 00 02 09

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			02		0x06

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (3byte)	Checksum (1byte)
77			82	SXXX.YYY0	

2.3 Read angle of X,Y axis Command: 77 07 00 00 00 00 04 0B

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			04		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (12byte)	Checksum (1byte)
77			84		

Note: The data field is 16 bytes to return the angle value, divided into three groups, each group contains four compressed BCD codes. They are X-axis angle, Y-axis angle and temperature. The data format of each axis is SXXX.YYY0, S is the sign bit (0 is positive, 1 is negative) XXX is a three-digit integer value, and 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 13 00 00 00 00 84 10 09 15 50 00 07 54 10 00 23 08 40 EB
Wherein 10 09 15 50 represents the X-axis angle is -9.155°, and 00 07 54 10 represents the Y-axis angle is 7.541°.

2.4 Set absolute/relative zero point Command: 77 08 00 00 00 00 05 01 0E

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77			05	0x00: absolute zero 0x01: relative zero	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			85	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 Query relative / absolute zero Command: 77 07 00 00 00 00 0D 14

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			0D		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77			8D	0x00: absolute zero 0xFF: relative zero	

2.6 Set the response mode Command: 77 08 00 00 00 00 0C 00 14

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77	05		0C	00: Question and answer 01: 5Hz Data Rate 02: 10Hz Data Rate 03: 20Hz Data Rate 04: 25Hz Data Rate 05: 50Hz Data Rate 06:100Hz Data Rate	

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

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77	05		8C	0x00: success 0xFF: failure	

Note: Set to the response mode, you must receive the read angle command to output the angle, set to the automatic output mode, the X, Y axis angle and temperature will be automatically output after power-on. After setting, you need to send the save command (77 07 00 00 00 00 0A 11).

Such as: set automatic output 5Hz sending: 77 08 00 00 00 00 0C 01 15, return: 77 08 00 00 00 00 8C 00 94.

2.7 Set communication rate Command: 77 08 00 00 00 00 0B 00 13

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77			0B	00:2400 01:4800 02:9600 03:19200	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77			8B	0x00: success 0xFF: failure	

Note: 00 means 2400，01 means 4800，02 means 9600，03 means 19200，04 means 115200, the default value is 9600.

2.8 Set address Command: 77 0B 00 00 00 00 0F 12 34 56 78 2E

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			0F	XXXX	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
77			8F	0x00: success 0xFF: failure	

2.9 Save Settings Command: 77 07 00 00 00 00 0A 11

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77			0A		

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77			8A	0x00: success 0xFF: failure	

2.10 Save setting Command: 77 07 00 00 00 00 1F 26

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
77	07		1F		

Command response: 77 0B 12 34 56 78 1F 12 34 56 78 52

Identifier (1byte)	Frame Length (1byte)	Address Code (4byte)	Command (1byte)	Data (4byte)	Checksum (1byte)
77			1F		

Ordering Information

Product number	Way of communication	Package condition
BWN466-60-485	RS485	Bare board
BWN466-60-TTL	TTL	Bare board

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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Wuxi Bewis Sensing Technology LLC
Address: Building 30, No. 58 Xiuxi Road, Binhu District, Wuxi City, Jiangsu Province, China
Tel: +86 510 85737158
Email: sales@bwsensing.com
Website: www.bwsensing.com