



BWM426

Cost-effective Dual-Axis Digital Output Inclinator Technical Manual



Introduction

Designed by Bewis Sensing Technology LLC, BWM426 is a cost-effective dual-axis digital output inclinometer with MEMS technology. It has a measuring range of $\pm 88^\circ$ and a full-scale accuracy of 0.01° and a operating temperature of $-40^\circ\text{C} \sim +85^\circ\text{C}$. The product has 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
- Resolution: 0.001°
- Product size: L90*W40.5*H26(mm)
- Voltage input: 9~35VDC
- Accuracy: 0.01°
- Measuring range: $\pm 88^\circ$
- IP67 protection
- Communication: RS232/485/TTL optional

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)		9	12	35	V
Operating current	Non-loaded	20	30	40	mA
Operating temperature		-40	25	+85	°C
Store temperature		-55	25	+100	°C

Performance Specifications

Parameters	Conditions	BWM426-88	Units
Measuring range		±88	°
Measuring axis		X-Y	
Accuracy	Indoor	0.01	°
Resolution		0.001	°
Repeatability		0.01	°
Zero temperature drift	-40~+85°C	±0.005	°/°C
Frequency response	Max	100	Hz
Shock resistance	2000g,0.5ms,3times/axis		
N.W.	150g(Excludes box)		
MTBF	≥100000 h		
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).



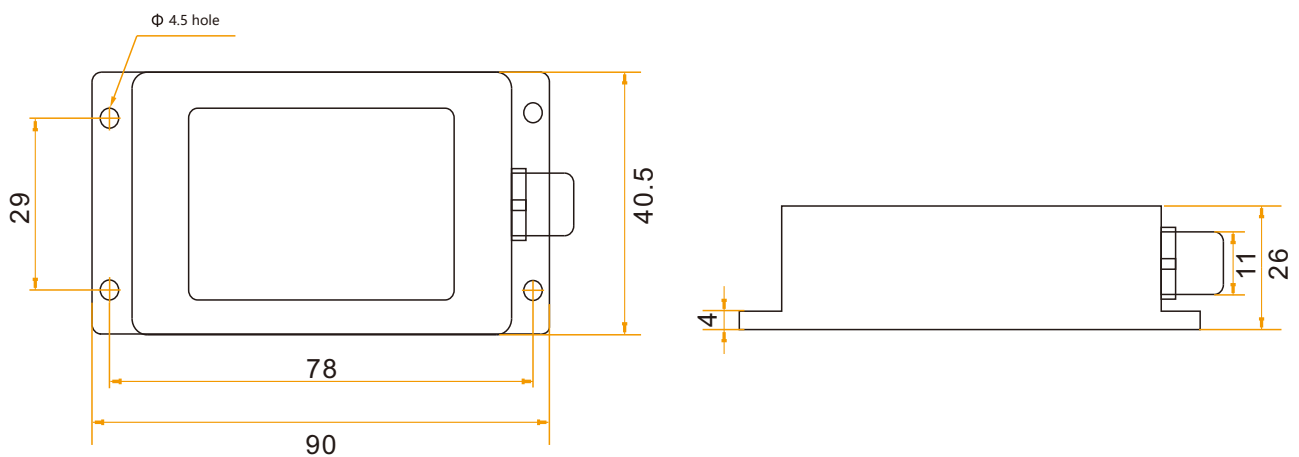
Mechanical Characteristic

Connector	Metal connector
Protection level	IP67
Shell material	Magnesium alloy anodizing
Installation	Four M4 screws



Package size

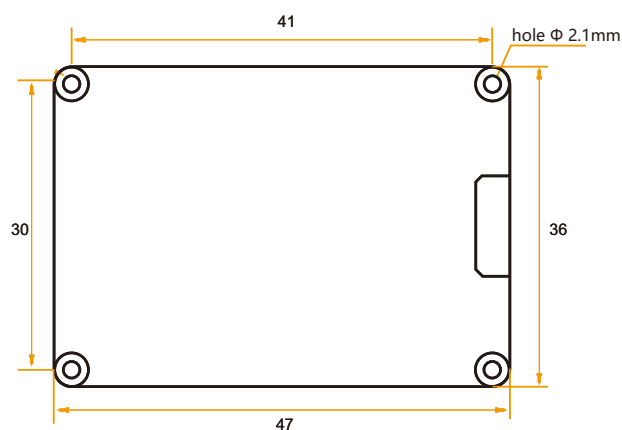
Product Size: L90*W40.5*H26 (mm)



Bare plate product size

Product size: L47*W36*H15(mm)

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

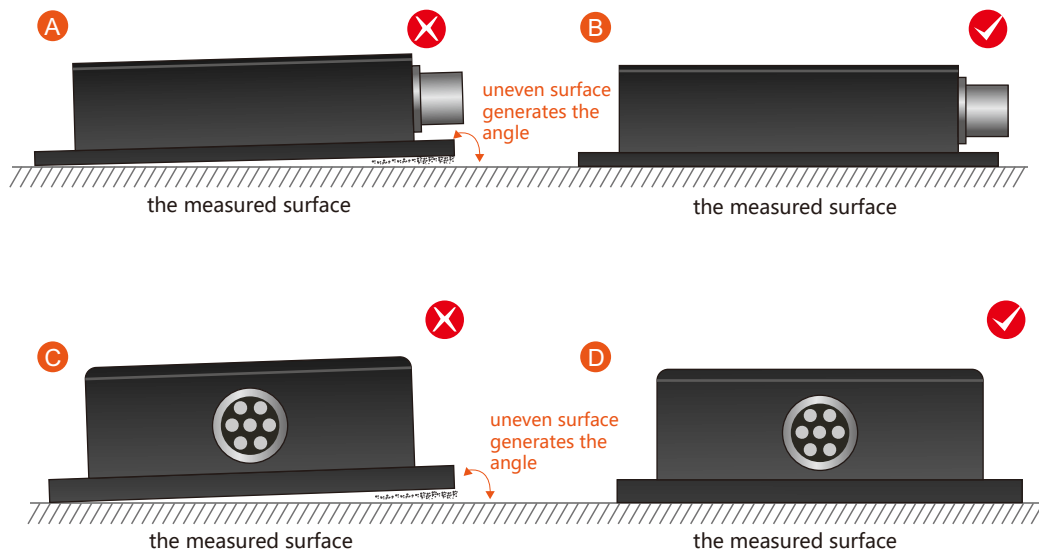




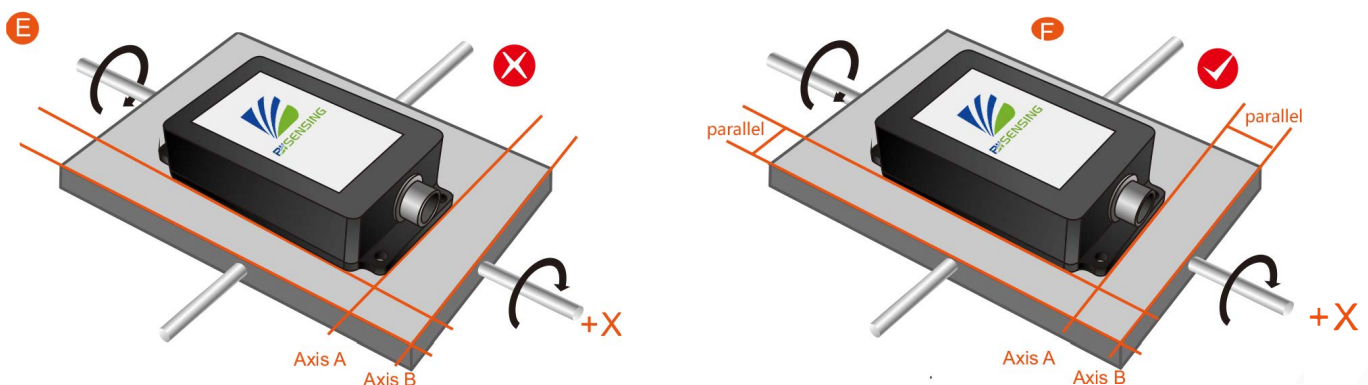
Installation direction

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.



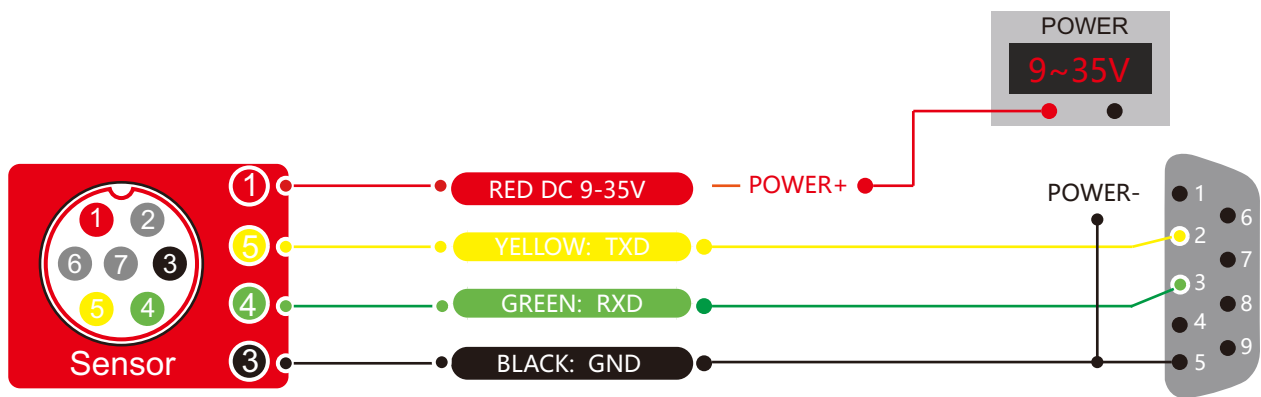
Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.



Electrical connections

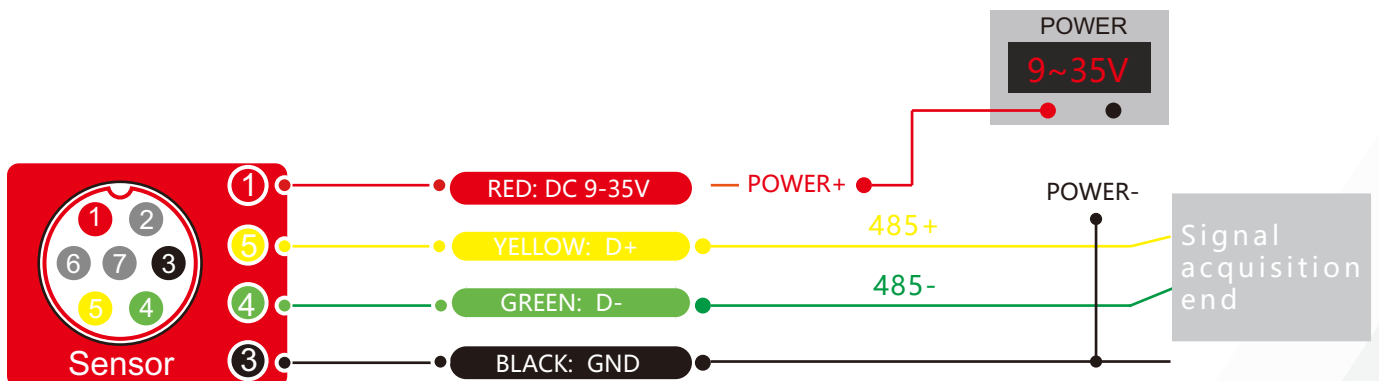
RS232 Electrical interfaces

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



RS485 Electrical interfaces

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





Debug software

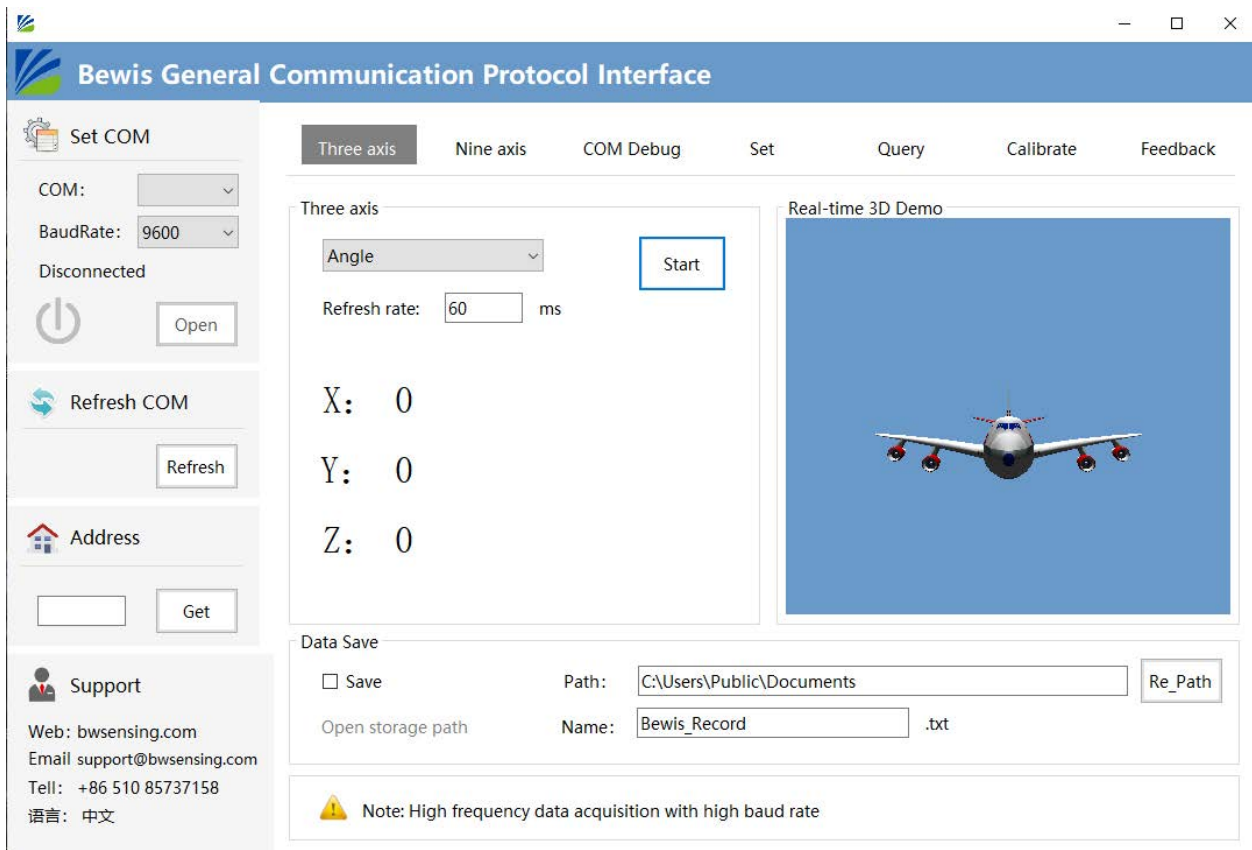
Users can directly download serial assistant on official website (Supports-Download). You can also use more convenient and intuitive PC software.

BWM426 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

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

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	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 04 00 01 05

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x04	0x00	0x01		0x05

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (4byte)	Checksum (1byte)
0x77	0x08	0x00	0x81	SXXX.YYYY	

Note: Data represents 4 byte angle value in format of compressed BCD code. S is the sign bit (0 positive, 1 negative), XXX is the three digit integer part, YYYY is the fractional part. The Data of other axis is the same format. For example, 10 26 80 70 means -26.8070 °; 00 34 77 70 means +34.7770°.

2.2 Read angle of Y axis Command: 77 04 00 02 06

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x04	0x00	0x02		0x06

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (4byte)	Checksum (1byte)
0x77	0x08	0x00	0x82	SXXX.YYYY	



2.3 Read angle of X,Y axis Command: 77 04 00 04 08

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (0byte)	Checksum (1byte)
0x77	0x04	0x00	0x04		0x08

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (12byte)	Checksum (1byte)
0x77	0x10	0x00	0x84	SXXX.YYYY	

Note: Note: The data field is a 12-byte return angle value, which is a compressed BCD code. The first to fourth bytes are the X-axis angle values, the fifth to eighth bytes are the Y-axis angle values, and the ninth to twelfth bytes are invalid. S is a sign bit (0 positive, 1 negative), XXX is a three-digit integer value, and YYYY is a decimal value. For example: 10345670 00456780 00000000 means that the X-axis angle is -34.5670° and the Y-axis angle is +45.6780°.

2.4 Set absolute/relative zero point 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.

2.5 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, 05: 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 (0byte)	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		

**2.9 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	

2.10 Set address Command: 77 05 00 0F 01 15

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x0F	XX Address	

Command response:

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (1byte)	Checksum (1byte)
0x77	0x05	0x00	0x8F	0x00: success 0xFF: failure	



BWSENSING

BWM 426

Cost-effective Dual-Axis Digital Output Inclinometer

Executive standard

- Enterprise quality system standard: ISO9001:2015 standard (certificate number: 23919Q10455R0S)
- CE certification (certificate number:M.2019.103.UY1151)
- RoHS (Certificate: G190930099)

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Digital Output Inclinometer**

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