



# BWK228 雙軸傾角傳感器

雙軸傾角傳感器 ; 雙軸傾角傳感器  
Technical Manual



## Introduction

Designed by Bewis Sensing Technology LLC, BWK228 is a current output low cost dual-axis inclinometer, adopting the latest industrial level MEMS accelerometer. Its measuring range is  $\pm 90^\circ$ , highest accuracy is  $0.2^\circ$ , 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 current, 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

- Dual-axis inclinometer measurement
- Resolution:  $0.02^\circ$
- Voltage input: 12~35V
- Product size: L90mm×W40.5mm×H26mm (customizable)
- Accuracy:  $0.2^\circ$
- Measuring range:  $\pm 90^\circ$
- IP67 protection
- Output interface: 4-20mA/0-20mA/0-24mA

## Applications

- Industrial automatic leveling
- Medical devices
- The automatic tracking system of solar angle
- 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		12		35	V
Operating current	Non-loaded	20(35V power supply)	50	60	mA
Output load	Max			500	KΩ
Operating temperature		-40		+85	°C
Store temperature		-55		+100	°C

### Performance Specifications

Measuring range(°)	Conditions	±10	±30	±60	±90
Measuring axis		X-Y	X-Y	X-Y	X-Y
Accuracy(°)	Indoor	0.2	0.2	0.2	0.2
Resolution(°)		0.02	0.02	0.02	0.02
Zero temperature drift(°/°C)	-40 ~ 85°C	±0.01	±0.01	±0.01	±0.01
Cross axis error(°)		0.1	0.1	0.1	0.2
Power on time		≤3s	≤3s	≤3s	≤3s
The highest frequency output(Hz)		100	100	100	100
MTBF	≥ 30000 hours/time				
Electromagnetic compatibility	according to GBT17626				
Insulation resistance	≥100MΩ				
Shock resistance	2000g,0.5ms,3times/axis				
Weight	210g (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).



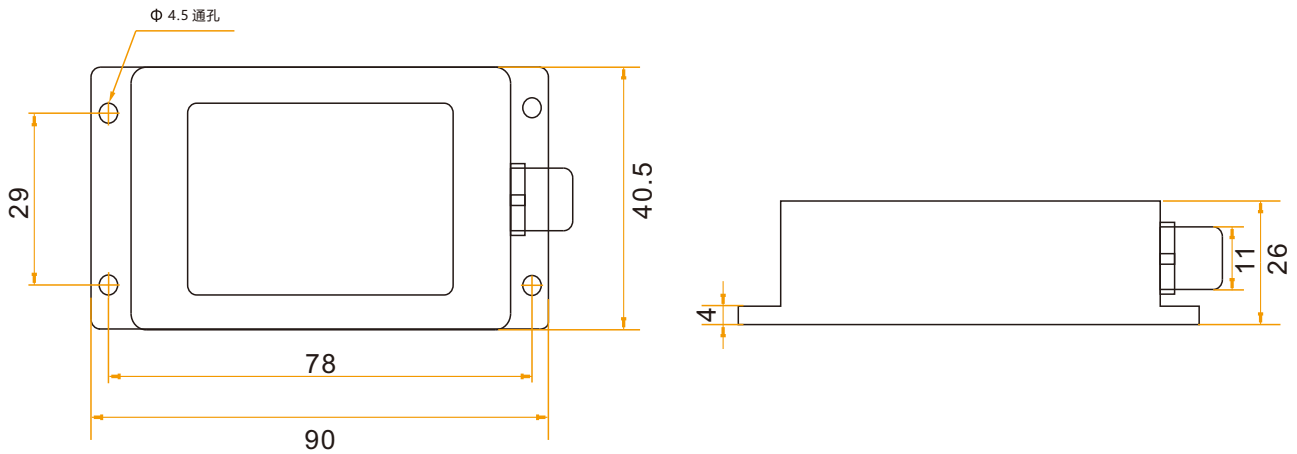
### Mechanical Characteristic

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



### Package size

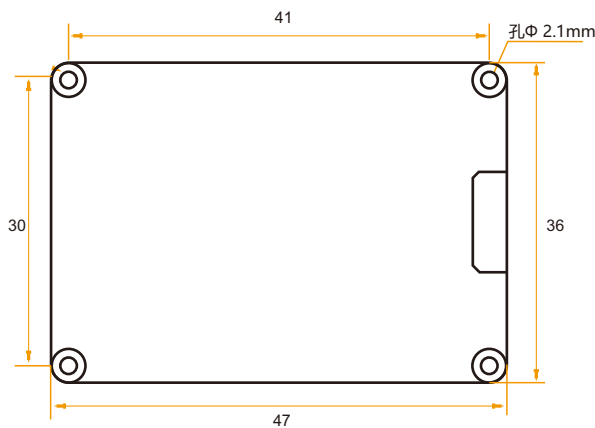
Product Size: L90\*W40.5\*H26 (mm)



### Bare plate product size

Product size: L47\*W36\*H15(mm)

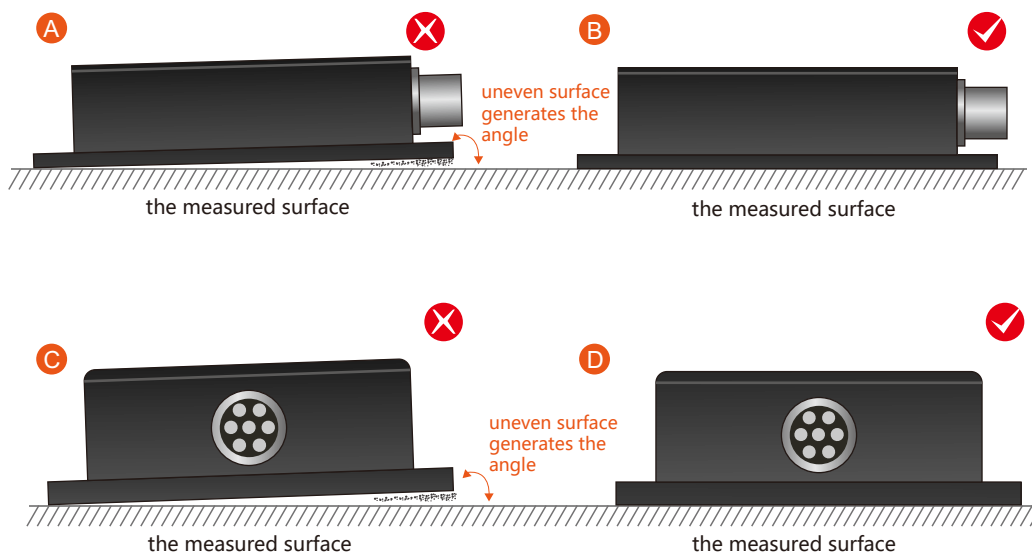
**Note:** ±1mm error for length and width dimensions, please refer to actual size.



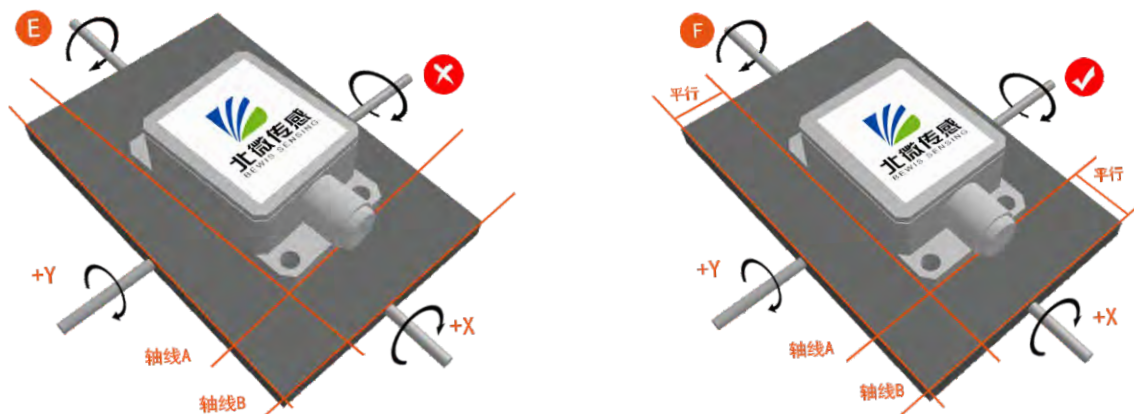
## Installation direction

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.



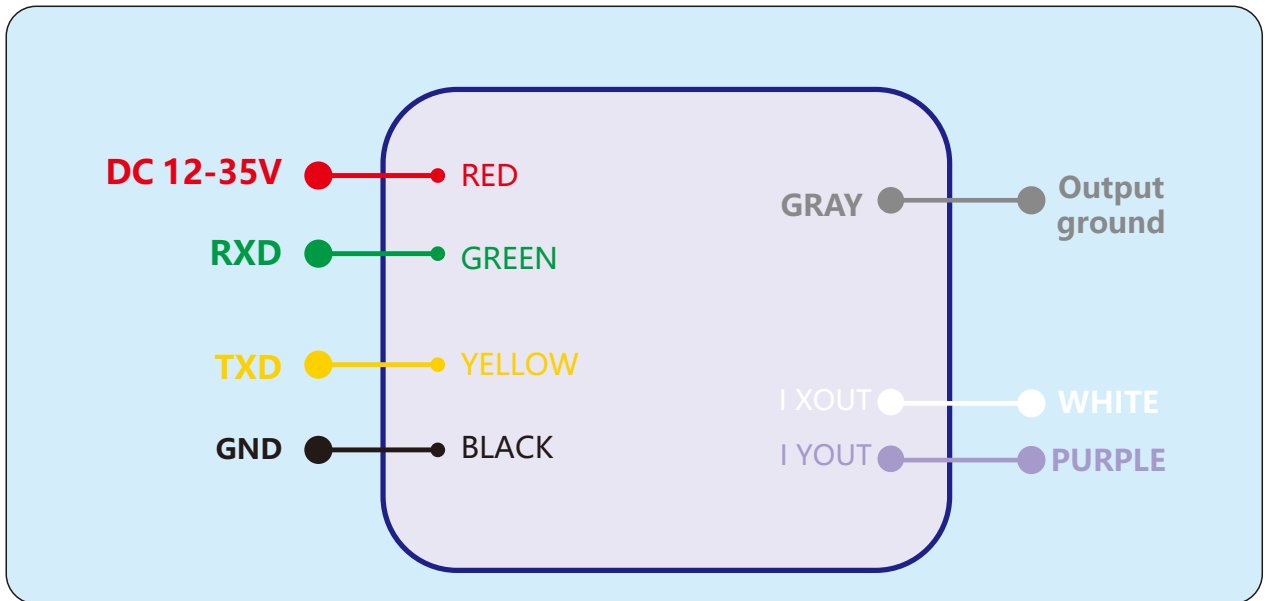
Finally, the installation surface of the sensor must be fixed with the measured surface tightly and smoothly, to avoid measurement error that may be caused by the acceleration and vibration.



## Electrical connections

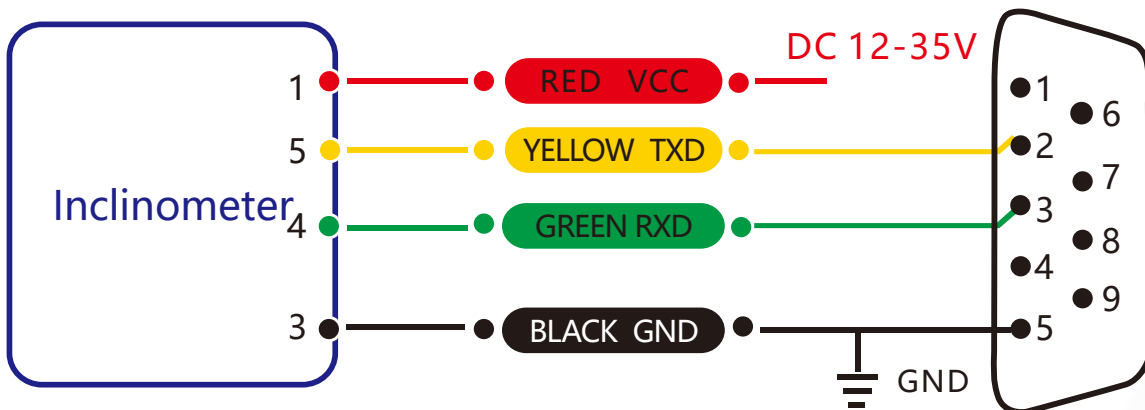
### Electrical interfaces

Cable color & Function	RED	BLACK	GREEN	YELLOW	WHITE	PURPLE	GRAY
	1	3	4	5	6	7	10
	VCC DC 12-35V	GND	RXD	TXD	I XOUT	I YOUT	Output ground



### Electrical interfaces

Cable color & Function	RED	BLUE	BLACK	GREEN	YELLOW
	1	2	3	4	5
	VCC DC 12-35V	NC	GND	RXD	TXD



**RS 232 wiring diagram**



## Debug software

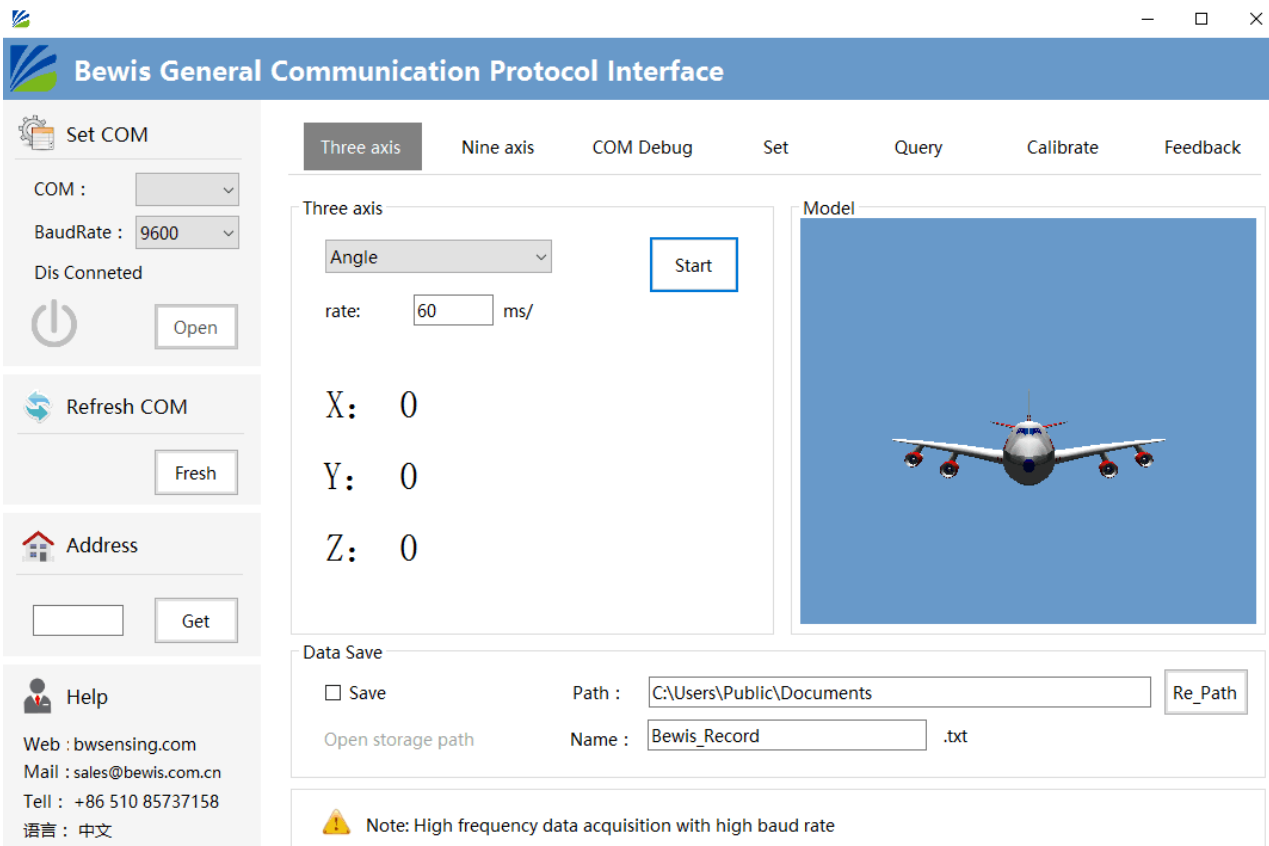
Users can directly download serial assistant on official website (Supports-Download). You can also use more convenient and intuitive PC software.

BWK228 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	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			0x01		

**Command response:**

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (3byte)	Checksum (1byte)
0x77	0x07		0x81	SXXX.YY	

**Note:** Data represents 3 byte angle value in format of compressed BCD code. S is the sign bit (0 means positive, 1 means negative), XXX is the three digit integer part, YY is the fractional part. The Data of other axis is the same format. For example, 10 27 70 means -027.7 °.

**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			0x02		

**Command response:**

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (3byte)	Checksum (1byte)
0x77			0x82		



**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		

**Command response:**

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	Command (1byte)	Data (9byte)	Checksum (1byte)
0x77			0x84		

**Note:** The returned 9 bytes are divided into three groups, which are the x-axis angle, the y-axis angle, and the z-axis angle. (The z-axis characterizes the angle between the product's vertical line and the vertical line);

See the directive 2.1 for the format.

**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: absolute zero 0x01: relative zero	

**Command response:**

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	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 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			0x0D		

**Command response:**

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

**2.6 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			0x0B	0x00:2400 0x01:4800 0x02:9600 0x03:19200 0x04:115200	

**Command response:**

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

**Note:** For data, 00: 2400, 01: 4800, 02: 9600, 03: 19200, 04: 115200, Default 02:9600.**Note:** Setting the baud rate does not require sending a save command.**2.7 Set address Command: 77 05 00 0F 01 15**

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

**Command response:**

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

**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			0x1F		

**Command response:**

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

**2.9 Save setting Command: 77 04 00 0A 0E**

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

**Command response:**

Identifier (1byte)	Frame Length (1byte)	Address Code (1byte)	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.

**2.10 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			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			0x8C	0x00: success 0xFF: failure	

**Note:** Set to the response mode, it must receive the read angle command to output the angle. Set to automatic output system, it will automatically output the angle when power is turned on.



## Ordering Information

Product number	Way of communication	Package condition
BWK228-90-420	Current/RS232	IP67 Package/Metal Connector
BWK228-90-020	Current/RS232	IP67 Package/Metal Connector
BWK228-90-024	Current/RS232	IP67 Package/Metal Connector

## Executive standard

- Enterprise Quality System Standard: ISO9001:2008 Standard (Certificate No.:23919Q1045IR0S)
- CE certification (certificate number: M.2019.103.UY1151)
- ROHS (certificate number: G190930099)

# BWK228 Serials

Current Output Dual-Axis Inclinator

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