

Operation Instruction

DK-INC-100

Dual-axis Inclinator Sensor



Thank you for selecting Drksir industrial inclinometer products.

To ensure safe operation and full performance of the device, please read this manual thoroughly before installation and commissioning.

- All structural drawings, electrical specifications and communication protocols are described in this document. Operate the sensor only within the specified operating environment.
- Store this manual properly for future maintenance and troubleshooting reference.

1. Overview

The DK-INC-100 is an industrial-grade Modbus dual-axis inclinometer sensor. Equipped with a high-precision core sensing unit, the device captures subtle changes in the gravity field in real time and performs intelligent compensation and error correction through self-developed high-order filtering fusion algorithms to output accurate and smooth angle measurement results.

The whole machine adopts a full industrial-grade hardware design, with a wide operating temperature range of -40°C to $+85^{\circ}\text{C}$. It features a high measurement accuracy of 0.1° and a resolution of up to 0.01° , enabling precise detection of minimal angle deviations. The product is equipped with standard Modbus RTU (RS485) communication by default, and other serial communication modes can be customized according to project requirements.

For complex industrial scenarios, the device is designed with a dedicated anti-electromagnetic interference hardware circuit, which effectively shields on-site electromagnetic interference, ensures long-term, continuous and stable operation of the equipment, and greatly improves measurement reliability under harsh working conditions.

The product features a compact and small structure, rich interface configurations, and simple installation and debugging, making it extremely easy to integrate into various automated monitoring systems and equipment. It is widely used in structural safety monitoring and early warning, equipment attitude detection, mechanical vibration monitoring, and various high-precision industrial measurement and control scenarios.

2. Applications

- ◆ Precision machine tool leveling control
- ◆ PTZ leveling and aerial work platforms
- ◆ Fan vibration and attitude monitoring
- ◆ Slope and geological disaster monitoring
- ◆ Towers and wind power equipment
- ◆ Ship navigation attitude measurement

- ◆ Bridge health monitoring
- ◆ Angle control for various engineering machinery
- ◆ High-precision laser platforms
- ◆ Health monitoring of dilapidated and ancient buildings



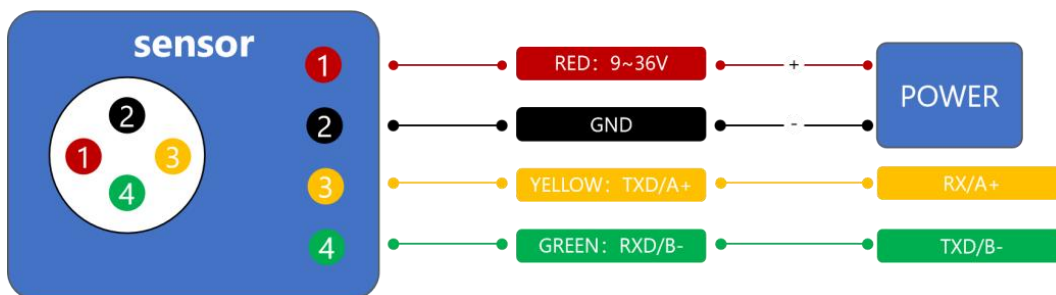
3. Main Technical Parameters

Item	DK-INC-100-1 0	DK-INC-100-3 0	DK-INC-100-6 0	DK-INC-100-9 0	Unit	Condition
Measuring Range	±10	±30	±60	±90	°	
Measuring Axis	X、Y Axis	X、Y 轴	X、Y Axis	X、Y Axis		
Absolute Accuracy	0.1	0.1	0.1	0.1	°	
Resolution	0.01	0.01	0.01	0.01	°	
Long-term Stability	<0.12	<0.12	<0.12	<0.12	°	@25°C
Sampling Frequency	100	100	100	100	Hz	
Zero Temperature Coefficient	±0.01	±0.01	±0.01	±0.01	°/°C	-40~+85°C
Supply Voltage	DC5V or DC9~36V					
Operating Current	45mA				DC12V	
Communication Interface	Default: MODBUS (RS485), others optional					

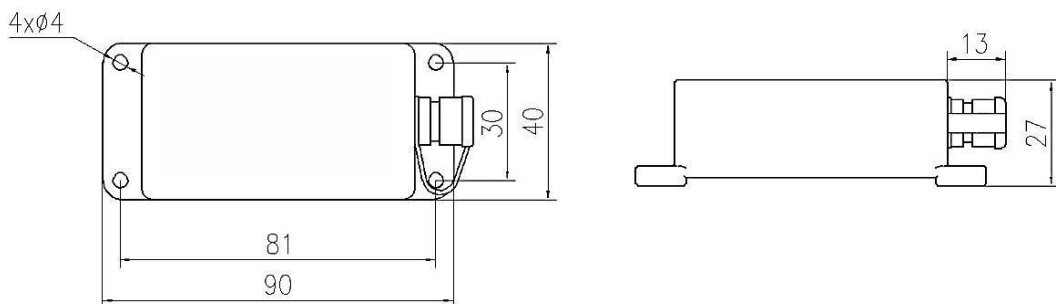
Mean Time Between Failures	≥55000hours
Shock Resistance	>20000g,0.5ms,3times/axis
Vibration Resistance	10grms、10~1000Hz
Insulation Resistance	≥100MΩ
Ingress Protection	IP67 or IP68
Cable	Default: 4-core shielded cable, 1.5m
Weight	180g(excluding packaging box)

4. Electrical Connection

Function	RED	BLACK	YELLOW	GREEN
Interface	1	2	3	4
RS232	VCC	GND	TXD	RXD
RS485	VCC	GND	(A、D+)	(B、D-)
TTL	VCC	GND	TXD	RXD



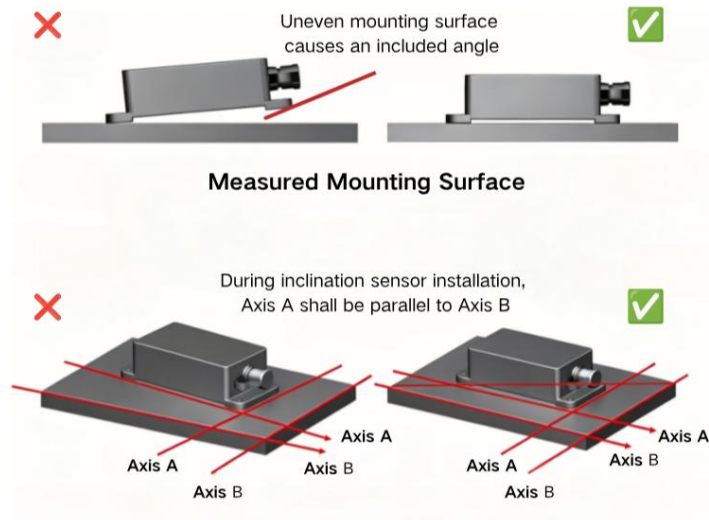
5. Outline Dimensions



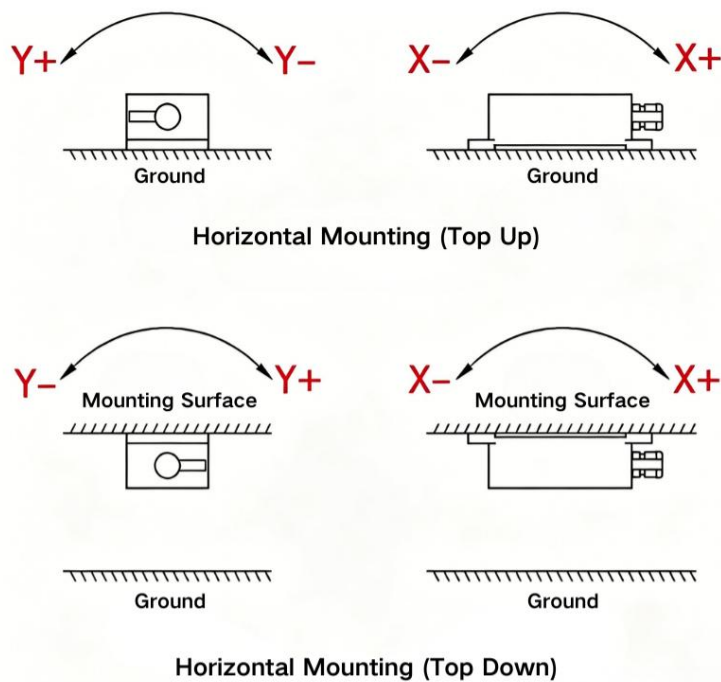
Product Dimension Drawing (L90W40H27mm)

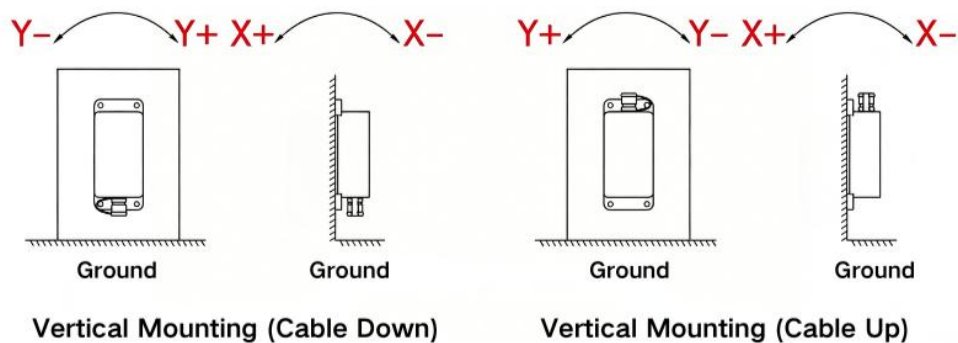
6. Installation and Operation Instructions

6.1. Installation Instructions



6.2. Axis Description





7. Data Transmission Protocol

7.1. Data Frame Format

- Data bits: 8
- Stop bit: 1
- Parity: None
- Default baud rate: 9600 bps

Address Code	Function Code	Register Address		Number of Registers		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Num H (1 byte)	Num L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03 Read 0x06 Write	XX	XX	XX	XX	XX	XX

7.2. Field Description

- **Data Format:** Hexadecimal
- **Address Code:** Factory default 0x01 (user-configurable, max 0xFF)
- **Function Code**
 - 0x03: Read holding registers
 - 0x06: Write single register
- **Register Start Address:** Starting address of registers to read/write
- **Number of Registers:** Total registers to read/write
- **CRC Check:** Calculated from address code, function code, register start address and register count using a standard CRC16 tool.

Note: CRC checksum changes with address code, function code or register address. Please update CRC accordingly when modifying commands.

7.3. Important Notes

- When using Modbus serial assistant, CRC checksum is not required.
- When using a general serial debugger, CRC checksum is required.
- Please read carefully before use:

According to the Modbus protocol, the interval between two data frames shall be greater than 3.5 byte times (e.g. 0.004 s at 9600 baud). For reliability, this sensor requires a minimum interval of 10 ms:

Host command → 10 ms idle → Slave response → 10 ms idle → Host command...

7.4. CRC16 Calculation Code (C Language)

If users need to implement CRC16 Modbus calculation, the following code is provided for reference:

```
unsigned short ModBusCRC(unsigned char *ptr, unsigned char size)
{
    unsigned short a, b, tmp, CRC16, V;
    CRC16 = 0xffff;
    for (a = 0; a < size; a++)
    {
        CRC16 = *ptr ^ CRC16;
        for (b = 0; b < 8; b++)
        {
            tmp = CRC16 & 0x0001;
            CRC16 = CRC16 >> 1;
            if (tmp)
                CRC16 = CRC16 ^ 0xa001;
        }
        ptr++;
    }
    V = ((CRC16 & 0x00FF) << 8) | ((CRC16 & 0xFF00) >> 8);
    return V;
}
```

Example: Checksum of 01 06 00 0B 00 02 is 79 C9.

7.5. Command Format

7.5.1. Read X-Axis Angle

Transmit Command: 01 03 00 01 00 02 95 CB

Address Code	Function Code	Register Address	Number of Registers	CRC16 Check
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Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Num H (1 byte)	Num L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x00	0x01	0x00	0x02	0x95	0xCB

Response Command:

Address Code	Function Code	Byte Count	Register Data		CRC16 Check	
Address (1 byte)	Function (1 byte)	Byte Count (1 byte)	Data H (2 bytes)	Data L (2 bytes)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x04	XXXX	XXXX	XX	XX

Note:

Example Response Frame: 01 03 04 BF C7 AE 14 12 75

The X-axis angle is represented by the 1st–4th bytes of register data (32-bit floating-point number, IEEE 754 standard).

Bytes 1–2: High byte

Bytes 3–4: Low byte

High byte first, low byte second.

According to the Modbus RTU standard protocol and IEEE 754:

X-axis angle (0xBF C7 AE 14) = -1.560000°

7.5.2. Read Y-Axis Angle

Transmit Command: 01 03 00 03 00 02 34 0B

Address Code	Function Code	Register Address		Number of Registers		CRC16 Check	
Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Num H (1 byte)	Num L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x00	0x03	0x00	0x02	0x34	0x0B

Response Command:

Address Code	Function Code	Byte Count	Register Data		CRC16 Check	
Address (1 byte)	Function (1 byte)	Byte Count (1 byte)	Data H (2 bytes)	Data L (2 bytes)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x04	XXXX	XXXX	XX	XX

Note:

Example response frame: 01 03 04 3F 5C ED 91 BA C9

The Y-axis angle is represented by the 1st–4th bytes of register data (32-bit floating-point

number, IEEE 754 standard).

Bytes 1–2: High byte

Bytes 3–4: Low byte

High byte first, low byte second.

According to Modbus RTU protocol and IEEE 754:

Y-axis angle (0x3F 5C ED 91) = 0.86300°

7.5.3. Read X & Y-Axis Angles

Transmit Command: 01 03 00 01 00 04 15 C9

Address Code (1 byte)	Function Code (1 byte)	Register Address		Number of Registers		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Num H (1 byte)	Num L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x00	0x01	0x00	0x04	0x15	0xC9

Response Command:

Address Code (1 byte)	Function Code (1 byte)	Byte Count (1 byte)	Register Data		CRC16 Check	
			X Angle (4byte)	Y Angle (4byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x03	0x08	XXXX XXXX	XXXX XXXX	XX	XX

Note:

Example response frame: 01 03 08 BF C7 AE 14 3F 5C ED 91 01 58

Registers store 32-bit floating-point values (IEEE 754 standard).

X-axis angle: Bytes 1–4

Y-axis angle: Bytes 5–8

High byte first, low byte second.

According to Modbus RTU protocol and IEEE 754:

X-axis angle (0xBF C7 AE 14) = -1.560000°

Y-axis angle (0x3F 5C ED 91) = 0.86300°

7.5.4. Communication Baud Rate

Transmit Command: 01 06 00 0C 00 04 48 0A

Address	Function	Register Address	Register Data	CRC16 Check
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Code	Code						
Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0C	0x00	0x04	0x48	0x0A

Response Command:

Address Code	Function Code	Register Address		Register Data		CRC16 Check	
Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0C	0x00	0x04	0x48	0x0A

Note:

- 0x0000 = 2400 bps
- 0x0001 = 4800 bps
- 0x0002 = 9600 bps
- 0x0003 = 19200 bps
- 0x0004 = 115200 bps
- Default value: 0x02 (9600 bps)

After successfully changing the baud rate, send a save command; the device will reply at the original baud rate.

The new baud rate takes effect after power cycling.

Remember to send the flash save command.

7.5.5. Module Address

Transmit Command: 01 06 00 0D 00 02 99 C8

Address Code	Function Code	Register Address		Register Data		CRC16 Check	
Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0D	0x00	0x02	0x99	0xC8

Note: Default sensor address is 01.

Address Code	Function Code	Register Address		Register Data		CRC16 Check	
Address (1 byte)	Function (1 byte)	Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x02	0x06	0x00	0x0D	0x00	0x02	0x99	0xFB

Response Command

1. If multiple sensors are connected to the same bus, assign a unique address to each sensor for independent control and response.
2. Valid module address range: 0x00 to 0xFE.
3. Remember to send the flash save command after setting.

7.5.6. Set Relative / Absolute Zero Point

Transmit Command: 01 06 00 0B 00 01 39 C8

Address Code (1 byte)	Function Code (1 byte)	Register Address		Register Data		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0B	0x00	0x01	0x39	0xC8

Example: Send 01 06 00 0B 00 00 F8 08 to set absolute zero.

Response Command:

Address Code (1 byte)	Function Code (1 byte)	Register Address		Register Data		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0B	0x00	0x01	0x39	0xC8

Note:

- 0x0000: Absolute zero (reference: factory-calibrated zero)
- 0x0001: Relative zero (reference: current position)

Remember to send the flash save command after setting.

7.5.7. Update Flash (Power-Off Save)

Transmit Command: 01 06 00 0F 00 00 B9 C9

Address Code (1 byte)	Function Code (1 byte)	Register Address		Register Data		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
0x01	0x06	0x00	0x0F	0x00	0x00	0xB9	0xC9

Response Command:

Address Code (1 byte)	Function Code (1 byte)	Register Address		Register Data		CRC16 Check	
		Addr H (1 byte)	Addr L (1 byte)	Data H (1 byte)	Data L (1 byte)	CRC16 L (1 byte)	CRC16 H (1 byte)
Address	Function	Addr H	Addr L	Data H	Data L	CRC16 L	CRC16 H

(1 byte)	(1 byte)	(1 byte)	(1 byte)	(1 byte)	(1 byte)	(1 byte)	(1 byte)
0x01	0x06	0x00	0x0F	0x00	0x04	0xB8	0x0A

Important Tip: All parameter configurations will be erased after power loss if you do not send the Flash Save command after setting.

Appendix: IEEE 754 Conversion

1) Convert Single-Precision Floating-Point to Standard 4-Byte Data

// Convert float to 4-byte big-endian data in IEEE 754 format

// Reverse the bdat array first if the compiler uses little-endian mode

```
void float2byte(float fdat, unsigned char *bdat)
{
    unsigned char i;
    // Get the 4-byte address of the float data
    unsigned char *tmp = (unsigned char*)&fdat;
    // Indirect addressing to obtain values in the 4-byte address of float
    for(i = 0; i < sizeof(float); i++)
        *(bdat + i) = *(tmp + i);
}
```

2) Convert 4-Byte Data to Standard Single-Precision Floating-Point

// Convert 4-byte big-endian data in IEEE 754 format to float

// Reverse the bdat array first if the compiler uses little-endian mode

```
float byte2float(unsigned char *bdat)
{
    return *((float*)bdat);
}
```

8. Unpacking and Inspection Notes

1. Before unpacking, check if the outer package is damaged or wet.
2. After opening the package, inspect the detector for any damage, cracks, paint peeling, etc.
3. Check the completeness of the packaged items according to the table below.

Packing List

Item	Quantity
Sensor	1
User Manual	1
Certificate of Conformity	1

9. Warranty Service

1. This product comes with a 1-year limited warranty effective from the date of purchase.
2. Operate the sensor strictly per this manual. Contact our technical support promptly if any failure occurs.
3. This warranty shall become void if any of the following situations occur during the warranty period:
 - a) Damage or malfunctions caused by improper operation against manual requirements;
 - b) Equipment failure or damage resulting from unauthorized disassembly, modification or repair;
 - c) Damage induced by Force Majeure, including flood, fire, earthquake and lightning strike;
 - d) Use of non-original third-party accessories incompatible with our sensor;
 - e) Damage caused by improper storage, maintenance or harsh operating conditions (high temperature, water immersion, chemical corrosion, etc.);
 - f) Artificial physical damage.
4. After the warranty expires, repair services are available at component cost only.
5. The product renderings in this manual may have minor visual differences from the physical product due to printing deviation. The actual delivered sensor shall prevail.
6. This document is for reference only and does not constitute any binding commercial commitment.
7. All intellectual property rights reserved. No individual or organization may copy, excerpt, distribute all or part of this manual without written authorization from Hangzhou Drksir Intelligent Technology Co., Ltd.

Standard Compliance Reference

- Production Standard for Inclinometer: GB/T 191, SJ 20873-2003 General Specification for Inclinometers and Levels
- Metrology Calibration Standard: JJF 1119-2004 Calibration Specification for Electronic Levels
- Gyro Angle Meter Test Standard: QJ 2318-92 Test Methods for Gyro Angle Meters
- Fiber Optic Gyroscope Test Standard: GJB 2426A-2004
- Environmental Test Standard for Products: GJB 150
- Electromagnetic Immunity Test Standard: GB/T 17626
- VT(2024-2025)
- Revised Date: 2022.08.02

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