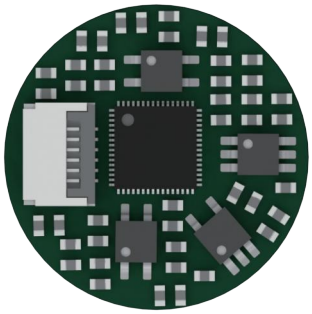
MOSRAC
Mosrac motor



MINIATURE ENCODER SERIES
C0214 PRODUCT MANUAL

https://www.mosrac.cn

I. verview

The C0214 thin inductive encoder is an inductive angle encoder designed based on the non-contact electromagnetic induction principle with wireless power transmission technology.

The product consists of a stator and a rotor. After the stator is powered, it wirelessly transmits energy to the rotor and induces the rotor's electromagnetic field. The rotor requires no independent power supply, receives energy from the stator in real time and applies it to the coil to form a regular electromagnetic field.

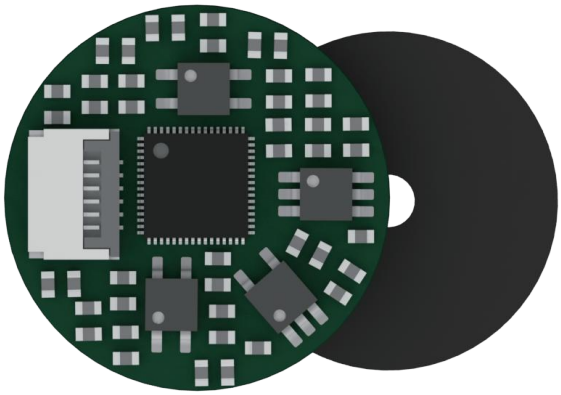
Adopting a dual-code track design for absolute angle output, the rotor and stator feature non-contact operation with no friction. The stator integrates an angle calculation circuit, and proprietary technology is applied to achieve low power consumption and integrate a variety of high-speed digital interfaces.

Both the rotor and stator are of circular thin-sheet structure. For use, the stator and rotor need to be installed coaxially and parallel to facilitate energy transmission and electromagnetic field induction between them.

The product has no built-in bearing, requires no coupling during installation, and has no precision installation requirements. Without ball bearings, glass code discs, light sources and other components, the inductive encoder enables highly reliable angle measurement in harsh environments.

MOSRAC thin inductive encoders are widely applicable in medical, national defense, aerospace, industrial automation and robotics fields.

- √ **Non-contact**
- √ **Hollow shaft**
- √ **Compact Design**
- √ **High Precision**
- √ **Absolute Value**
- √ **Low Power Consumption**
- √ **Maintenance-free**
- √ **Coupling-free**
- √ **Easy Installation**
- √ **Anti-magnetic Interference**
- √ **Vibration and Shock Resistant**
- √ **Customizable**



2、Technical Specifications

Table 1 Encoder Basic Performance Parameters

Angular Resolution	15~17 bit
Maximum static error	±0.03°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Default: Clockwise Increment (Adjustable)

Table 2 Mechanical Dimensions and Installation

Outer Diameter\Inner Diameter\Thickness	14.8\2\3.6mm
Permissible Installation Eccentricity	±0.1 mm
Stator and rotor installation gap	0.4±0.1 mm
Rotor Inertia	0.006kg·mm²
Weight (Approx.)	2g
Flame Resistance Rating of Rotor and Stator Materials	FR-4

Table 3 Electrical and Interface Specifications

Power Supply Voltage	5V
Current	＜ 80 mA
Electrical Interface	6-pin connector、6-core cable
Output Protocol	SSi、BiSS-C、RS-422、RS-485

Table 4 Environmental Adaptability

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-40℃ ~ 125℃
Storage temperature	-50℃ ~ +100℃
Relative humidity	0 - 99%
Shock endurance / functional	100 g / 11 ms
Vibration	20 g（10 ~2000 Hz）
Protection	IP 40

3、Electrical Interface

3.1 Hardware Interface

The C0214 thin inductive encoder consists of a stator and a rotor. The stator integrates the angle calculation circuit and the encoding output circuit. The encoder uses a connector for output (as shown in the figure below), and the angle output uses SSi, BiSS-C, RS-422, and RS-485 serial port protocols.

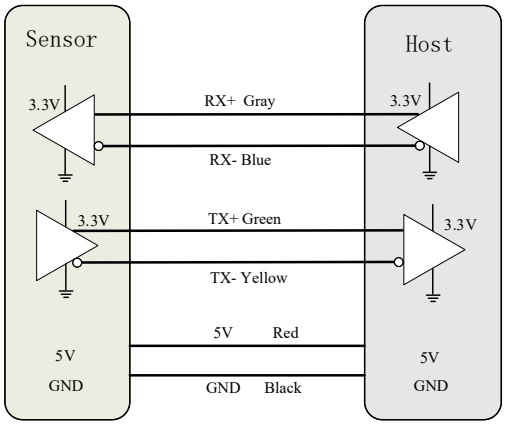
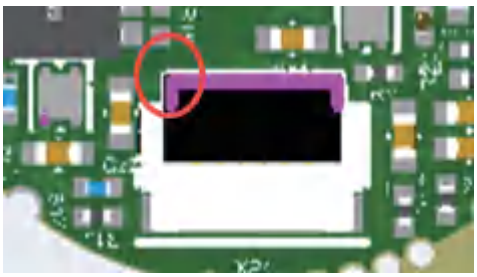


Table 5. Definitions of SSI/BiSS/RS-422/RS-485 Serial Interface Cables

Serial Number	Definition		Color	Remarks	485
1	5V	5V	Red	Power supply	
2	GND	GND	Black	Ground	
3	CLK+	RX+	Gray	Clock input	
4	CLK-	RX-	Blue		
5	DADT-	TX-	Yellow	Data input	B-
6	DADT+	TX+	Green		A+

Table 6 SSi/BiSS Signal Output Parameters

Digital Output Parameters	
Signal Delay	＜50us
Output Code	Binary
Fastest Data Update Rate	30kHz
Interface Level	Differential RS-422
Power Consumption	＜80mA
When using digital signal acquisition, the sampling rate and clock frequency are related to the communication protocol selected by the user.	



Single-turn 6-pin flat connector : HC-FPC-05-09-6RLTAG Cable：HC-FFC05-6P-50-A-02

Single-turn 8-pin flat connector : HC-FPC-05-09-8RLTAG Cable：HC-FFC05-8P-50-A-02

3.2 SSI Interface Protocol

3.2.1 Introduction to Communication Protocol

SSI is an abbreviation for Synchronous Serial Interface, a widely used serial interface between position sensors and a controller. SSI is a unidirectional serial protocol based on RS-422. The unidirectional clock is generated by the master frequency and specified from 0.5MHz to 5.0MHz. Data reception is also unidirectional; SSI does not support propagation delay compensation. The clock is high when inactive. To initiate data transmission, the clock goes low and stores the position. On the first rising edge of the clock signal, the MSB is shifted out at the SSI encoder. On the second rising edge, MSB-1 is shifted out, and so on, until the last bit (LSB) is shifted out. After another clock cycle, the clock remains high until the next data transmission begins. Depending on the timeout, the current latched position or the new position value will be transmitted in the next transmission. The timing diagram is as follows:

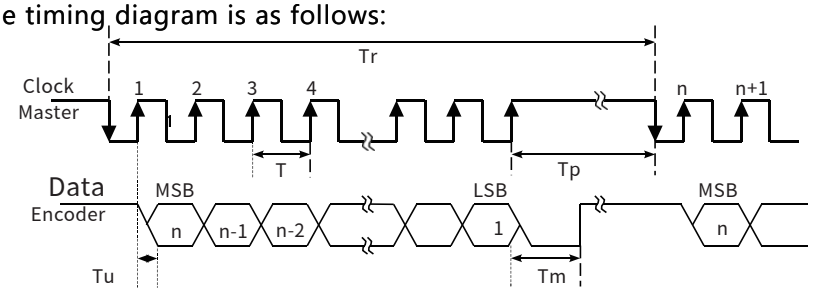


Table 7 Timing Diagram Parameter Description

n	Total Number of Bits in a Frame	12-21
f (T)	Clock Frequency (Clock Cycles)	0.5-5.0MHz
Tu	Update Time for a Single Data Bit	50ns
Tp	Interval Between Data Frames	＞25us
Tm	Single Frame Trigger Time	＞3us
Tr	Interval Between Two Frames	Tr＞nT+25us
fr=1/Tr	Data Frame Frequency	

When selecting a multi-turn product, the multi-turn angle data is placed before the single-turn angle data (MSB), with the higher digit first and the lower digit second.

3.2.2 Communication Protocol Characteristics

The SSI protocol's core advantage in angle sensors lies in its "synchronous serial + differential transmission" mechanism. By standardizing timing, it lowers the development threshold, making it suitable for scenarios with moderate real-time requirements but demanding high-precision angle calculations. While its unidirectional communication mechanism requires continuous clock driving from the host, it is compatible with traditional industrial controllers (such as PLCs), achieving a balance between cost and performance. This makes it particularly suitable for low-to-medium speed, high-precision industrial automation and medical equipment applications.

3.3 BiSS-C Interface Protocol

3.3.1 Introduction to Communication Protocol

The BiSS-C communication protocol is a full-duplex, bidirectional, high-speed, synchronous serial communication protocol. This interface is also based on the RS-422 hardware standard and is compatible with the SSi interface. It is widely used in absolute encoders for high-precision position control. The product uses a unidirectional interface with BiSS-C configured for point-to-point connection, which can be connected to the master device as one or more slave devices, conforming to the requirements of a BiSS-C unidirectional interface. The timing diagram is as follows:

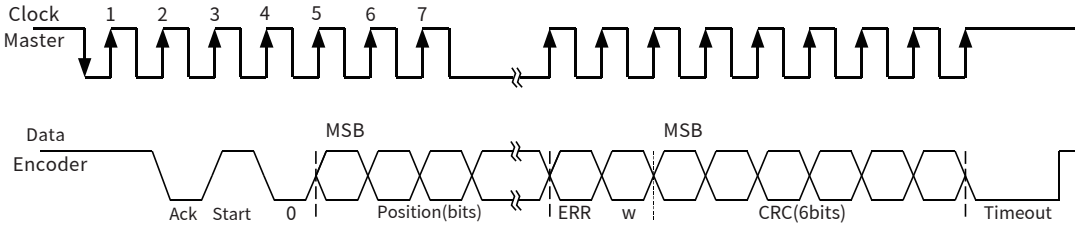


Table 8 Timing Diagram Parameter Description

Bit/n	Code	Meaning	Default Value	Length
28	Ack	Acknowledge Bit	0	1bit
27	Start	Start Bit	1	1bit
26	“0”	Start Bit Follow Bit	0	1bit
8-25	Position	Absolute Position Encoder Data		18bit
7	Error	Error Bit	1	1bit
6	Warn	Warning Bit	1	1bit
0-5	CRC	Checksum		6bit
--	Timeout	Interval Between Data Frames		＞30us

The CRC polynomial for position, error, and warning is $x_6 + x_1 + x_0$. The start bit and the "0" bit are not included in the CRC calculation. When a multi-turn product is selected, the absolute position encoder data includes multi-turn angle data and single-turn angle data. The multi-turn angle data precedes the single-turn angle data MSB, following the rule of high-order bits first and low-order bits last.

3.3.2 Timing Characteristics

1. C ck Synchronization: The master device sends a CLK (Clock Array), the encoder latches data on the rising edge of the clock, and updates the output on the falling edge (consistent with the SSI's "master sends clock, slave responds passively" mechanism).
2. Frame Inte al: ≥30μs is required to avoid data conflicts and ensure the real-time performance of angle data (e.g., at a high-speed rotation of 6000rpm, the angle change per frame is <0.02 degrees).
3. Multi-Turn Support Multi-turn angle data is directly embedded in the Positon bit field (high bit area), requiring no additional instructions and simplifying angle calculation.

3.3.3 Communication Protocol Characteristics

The core value of the BISS protocol for angle sensors lies in its standardized, high-speed, and highly reliable communication framework, which directly encapsulates the "data + status" of angle measurement while remaining compatible with traditional interfaces, thus reducing the design complexity of high-precision angle systems.

3.4 RS-422 Serial Interface Protocol

3.4.1 Introduction to the Communication Protocol

RS-422 is commonly known as a full-duplex serial interface protocol. It uses four-wire differential transmission (two pairs of twisted pairs), one pair for transmitting data (TX+ and TX-), and the other pair for receiving data (RX+ and RX-). This differential design effectively suppresses common-mode interference and improves the stability of signal transmission. By default, it automatically transmits data to the host without requiring a command from the host. The data update rate is fixed at 2000Hz, the baud rate is 460800bps, and the data format consists of 1 start bit, 8 data bits, 1 even parity bit, and 1 stop bit. Each data frame contains 10 bytes, as shown in the table below.

Table 9 Frame Data Format

	Sequence Number	Data Type	Remarks
Frame Header	1	5E	Fixed frame header
	2	AD	
Status Bits	3	01	Status Bits
Angle Data	4	Angle Data High Eight Bits	Low bits valid, high bits padded with zeros
	5	Angle Data Middle Eight Bits	
	6	Angle Data Low Eight Bits	
Frame Count	7	Frame Count High Eight Bits	Accumulated value from 0 to 65535
	8	Frame Count Low Eight Bits	
Checksum	9	Checksum High Eight Bits	Accumulated value of 34, 56, and 78 bytes, taking the lower 16 bits
	10	Checksum Low Eight Bits	

3.4.2 Core Advantages

1. Strong Anti-interference Capability: Differential transmission effectively resists electromagnetic interference and common-mode interference, ensuring the accuracy of angle data during transmission. It is particularly suitable for environments with strong electromagnetic interference, such as industrial automation and robotics.
2. Long Transmission Distance: At a certain baud rate, the transmission distance can reach hundreds of meters, ensuring flexibility in the installation location of the angle sensor within the equipment.
3. High Real-Time Performance and Reliability: A fixed data update rate and a robust verification mechanism enable real-time and reliable transmission of angle data, allowing the system to acquire accurate angle information promptly for control and adjustment.

3.4.3 Communication Protocol Characteristics

The RS-422 protocol, in angle sensors, boasts the core advantages of "high-speed full-duplex transmission + strong interference design." Through a fixed frame structure and automatic data transmission mechanism, it balances real-time performance with ease of development, making it particularly suitable for industrial control scenarios with stringent requirements for angle accuracy, response speed, and environmental adaptability.

3.5 RS-485 Serial Interface Protocol

3.5.1 Introduction to Communication Protocol

The RS-485 serial interface protocol is a half-duplex communication protocol that requires the host to send commands to read angle information. The data update rate is related to the host's request rate. The baud rate is 2.5 Mbps, and the data format consists of 1 start bit, 8 data bits, 0 even parity bits, and 1 stop bit. The encoder commands are as follows:

① Encoder Single-Turn Data Request Command:

1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0x02
2. Master Control Terminal Receives Data Frame from Encoder:
Receive Data (HEX): 0x02 0x20 0x03 0x02 0x01 0x16

Where: 0x02: Returns the same command CF;
0x20: Status byte SF is defined as follows (lowest bit first);

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit6
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single-cycle count error;
EA1=1 1 One of the following: over-temperature, cycle count error, battery alarm, or battery error;
CA0=Communication parity error;
CA1=1 Communication stop bit error;
0x03 0x02 0x01:Single-cycle data value DF (lowest bit first);
0x16:CRC check (XOR operation on all preceding bytes);

② Encoder ID Data Request Command:

1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0x92
2. Master Control Terminal Receives Data Frame from Encoder:
Receive Data (HEX): 0x92 0x20 0x11 0xA3

Where: 0x92: Returns the same command CF; 0x20: Status byte SF;
0x11: Encoder ID, fixed value = 0x11;
0xA3: CRC checksum (XOR operation performed on all preceding bytes)

③ Encoder Data Request Commands:

1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0x1A
2. Master Control Terminal Receives Data Frame from Encoder:
Receive Data (HEX): 0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08

Where: 0x1A: Returns the same command CF; 0x20: Status byte SF;
0x03 0x02 0x01: Single-turn data value DF (lowest bit first);
0x11: Encoder ID, fixed value = 0x11;

0x05 0x04 0x00: Cycle count data value DF
(lowest bit first)
(0x0405=1029, max.65535);

0x22: Fault content byte ALMC is defined as follows (lowest bit first);

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Low resolution	Single lap count error	Multiple lap count overflow	Over temperature	Multiple lap count error	Battery error	Battery alarm

0x08: CRC check (XOR operation on all preceding bytes);

④ Encoder Single-Turn Reset Request Command

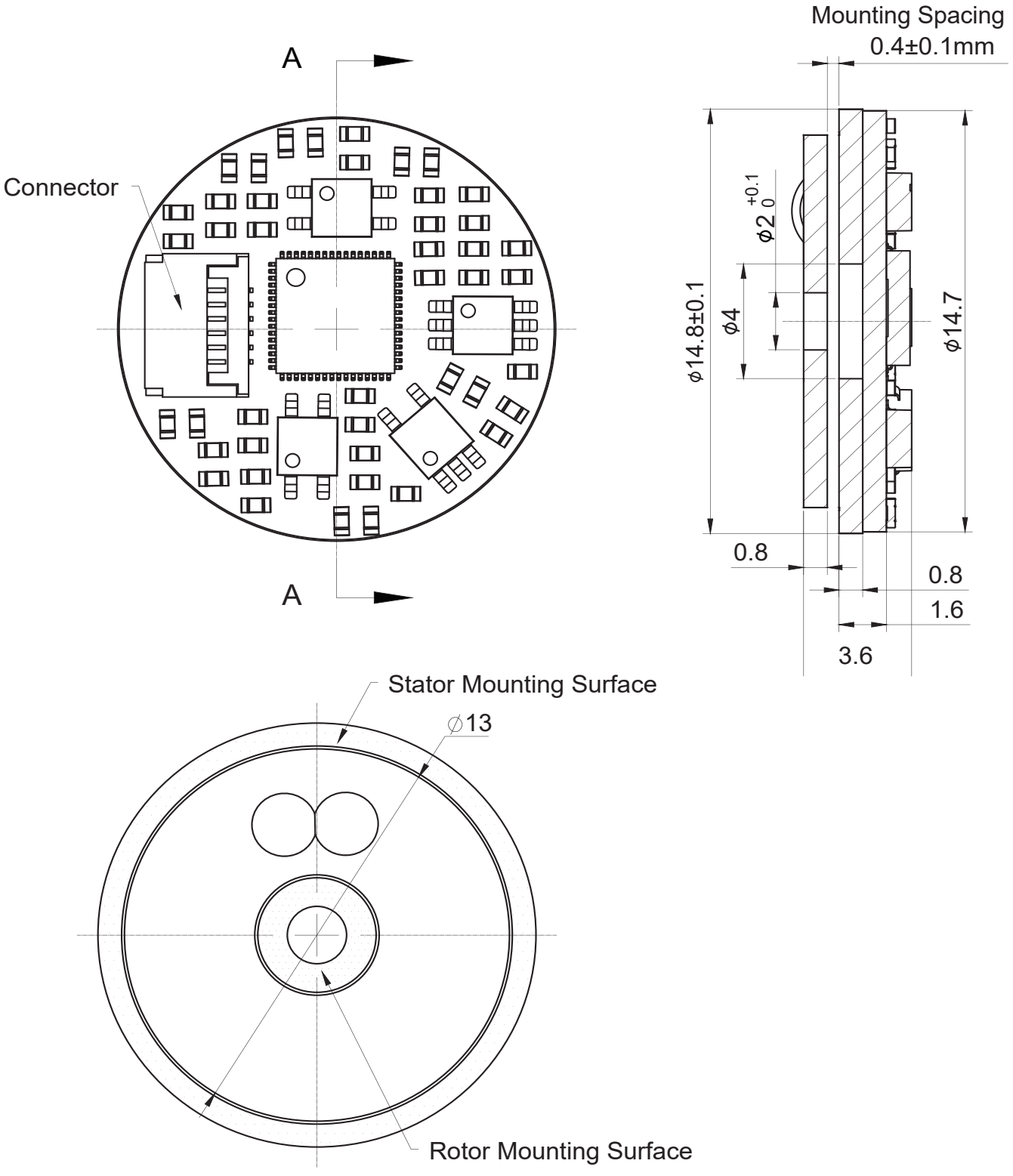
1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0xC2
The reset command is repeated 10 times at least 40μs intervals to reset the single-turn angle value;

2. Master Control Terminal Receives Data Frame from Encoder:
Receive Data (HEX): 0xC2 0x20 0x00 0x00 0x00 0xE2

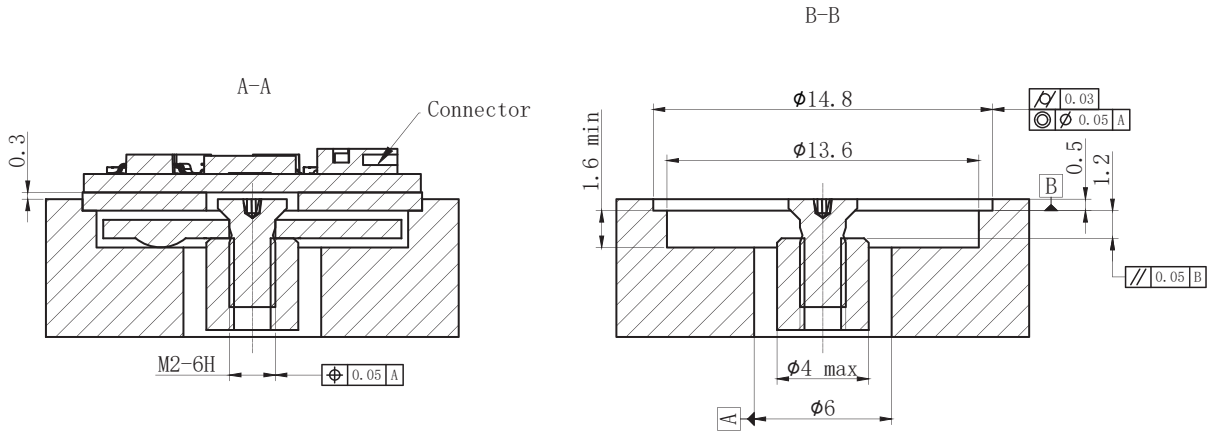
Where: 0xC2: Returns the same command CF; 0x20: Status byte SF;
0x00 0x00 0x00: Single-turn data value DF (lowest bit first);
0xE2: CRC check (XOR operation on all preceding bytes);

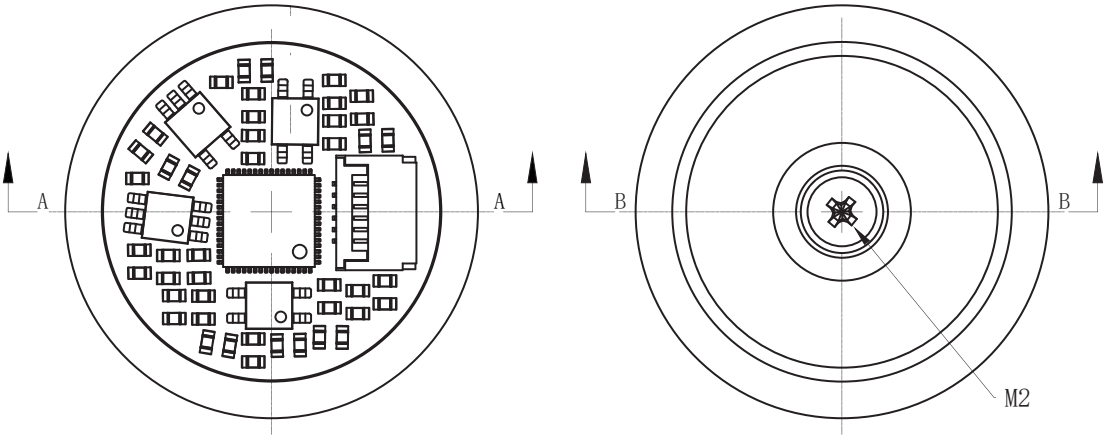
IV. Mechanical Interface

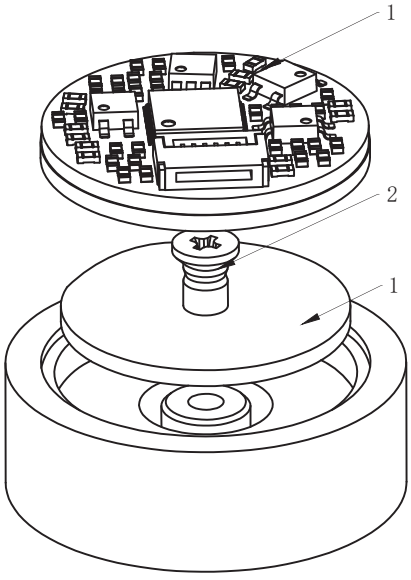
4.1 Product Dimensions



4.2 Product Installation Recommendations





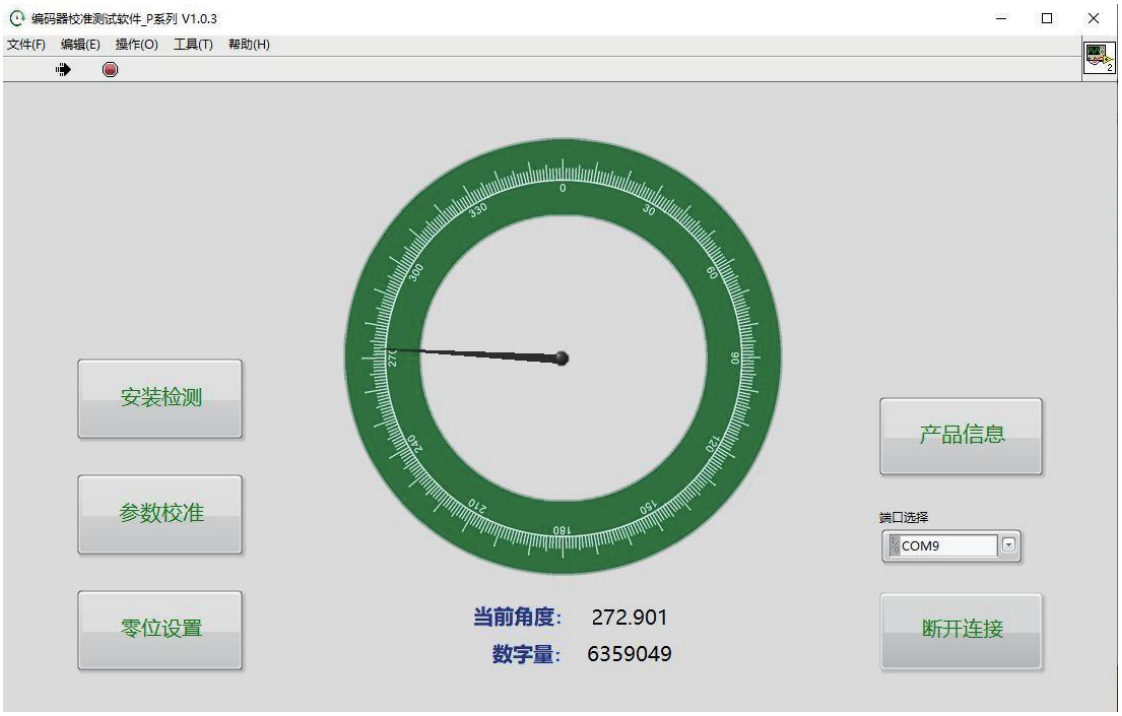


In-diagram tolerances	
0~50	±0.05mm
50~	±0.1mm

Serial Number	Name	Quantity	Remarks
1	C0214	1	Product
2	M2x5 Phillips head ountersunk screws	1	Product Installation Accessories

V. Software Too

Encoder data monitoring and installation calibration can be performed using the encoder calibration and testing software provided by the manufacturer.
The encoder calibration and testing software can perform functions such as data monitoring, installation testing, parameter calibration, and zero-point setting.



Domestic website

International website

ShenZhen Mosrac Motor Co., Ltd

E-mail: sales12@mosrac.com
Tel: +8618100274370 Fax: 0755-23091465
Company address: Building 1, COFCO (Fu'an) Robot Technology Park, No. 90 Dayang Road, Bao'an District, Shenzhen,518103, China
Factory Address: No. 36, Xingda Road, Yanluo Street, Bao'an District, Shenzhen
Website: http://www.mosrac.com