MOSRAC
Mosrac motor

C SERIES ABSOLUTE ROTARY ENCODERS

Indigenous R&D, secure and controllable

Product Ordering Instructions

C – 25 – 60 – A – 19 – 01 – 05 – S

Product Series

C: single absolute encoder

Product inner diameter

25: Inner diameter 25mm

Product outer diameter

60: Outer diameter 60mm

Output type

A: Single-turn absolute

Encoder output resolution

15：15-bit（32768 ）
17：17-bit（131072）
18：18-bit（262144）
19：19-bit（524288）
20：20-bit（1048576）
21：21-bit（2097152）
22：22-bit（4194304）

Communication protocol

B: BiSS-C interface
S: SSI interface
R: RS-422 serial interface
E: RS-485

Power supply voltage

05: 5V (default)
12: 12V
24: 24V

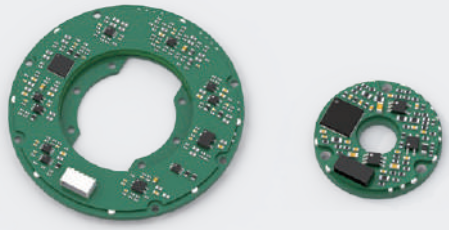
Operating temperature

01: -30℃ ~ +85℃ (default)
02: -40℃ ~ +125℃

Illustrated by example

C–25–60–A–19–01–05–S indicates a C-series single-turn absolute encoder with a 25 mm bore diameter and 60 mm outer diameter. “19” denotes 19-bit single-turn absolute resolution. The operating temperature range is −40 °C to ~+125 °C, the power supply is 5~30 V, and the output communication protocol is SSI.

C-series single encoder



C: Cost-efficient, easy to integrate

Ultra-thin, large hollow-shaft, and non-contact frictionless design make it ideal for space-constrained applications. Its compact structure allows seamless integration into robot joints and multi-axis automation equipment. It can be used both for position feedback and for optimizing the commutation of frameless motors. Tested and proven, the non-contact absolute C encoder meets stringent industrial environmental requirements.
The C is a cost-effective, precise, and reliable position sensor, with customization options available.

Industry Applications

- Collaborative robots
- Robot joints
- Laser scanner
- Projection system
- Agriculture

Product Model	Outer diameter / Inner diameter / Thickness	Weight (approx.)	Resolution	Accuracy	Maximum rotational speed	Moment of inertia
C0214	14.8\2\3.6mm	2g	15~17 bit	±0.03°	6000 rpm	0.006 kg·mm²
C0216	16.8\2\3.6mm	2.5 g	15~17 bit	±0.025°	6000 rpm	0.008 kg·mm²
C0218	18.8\2\3.6mm	3 g	15~17 bit	±0.02°	6000 rpm	0.01 kg·mm²
C0420	20\4\6.5mm	4g	15~17 bit	±0.05°	4000 rpm	0.01 kg·mm²
C1040	40\10\8mm	10 g	17~18 bit	±0.015°	6000 rpm	0.4 kg·mm²
C1752	52\17\7.6mm	13g	18~20 bit	±0.01°	8000 rpm	1.18 kg·mm²
C2560	60\25\8mm	18g	18~20 bit	±0.008°	8000 rpm	2.43 kg·mm²
C3580	80\35\8 mm	30 g	18~20 bit	±0.008°	8000 rpm	8.6 kg·mm²
C48100	100\48\8 mm	40 g	19~21 bit	±0.006°	6000 rpm	19.7 kg·mm²
C70120	120\70\8mm	50g	19~21 bit	±0.006°	6000 rpm	40 kg·mm²
C90140	140\90\9 mm	75 g	19~21 bit	±0.006°	6000 rpm	99 kg·mm²
C120180	180\120\9 mm	120 g	20~22 bit	±0.006°	4000 rpm	239.2 kg·mm²
C172247	247\172\9 mm	180 g	20~22 bit	±0.006°	4000 rpm	795.6 kg·mm²

Power supply voltage	Electrical interface	Output protocol	Operating temperature	Highest level of protection
5-30V	RS-422 shielded cable	SSi, BiSS-C, RS-422 serial ports	-40°C ~ +125°C	IP 40

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.

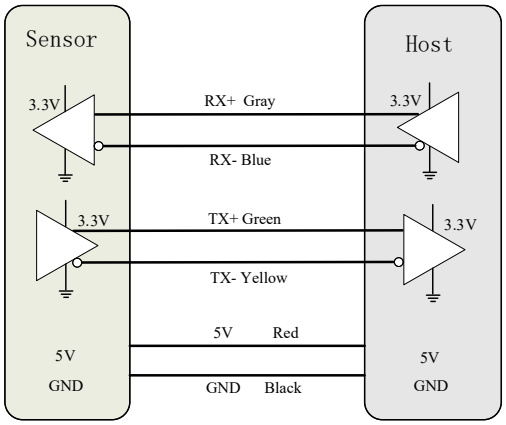
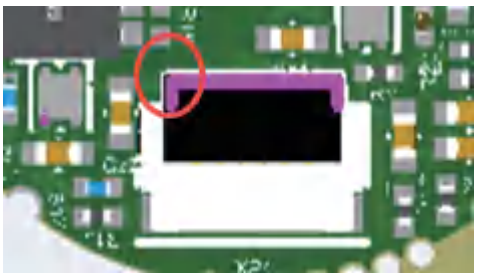


Table 5. Definitions of SSI/BiSS/RS-422/RS-485 Serial Interface Cables

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:

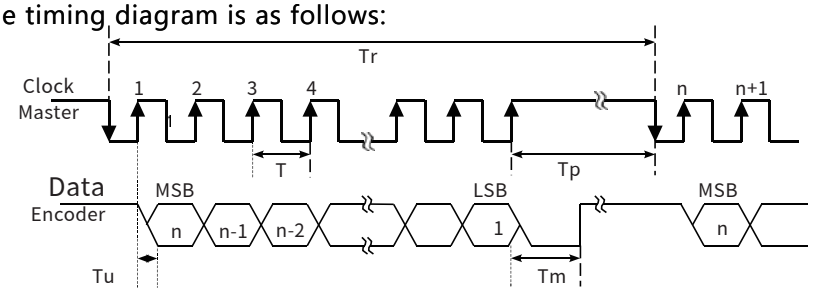


Table 7 Timing Diagram Parameter Description

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:

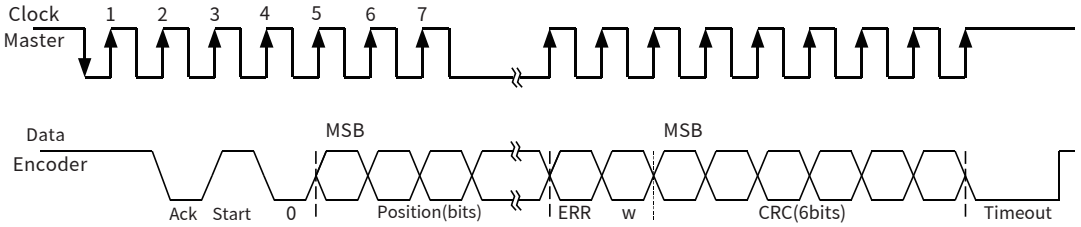


Table 8 Timing Diagram Parameter Description

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

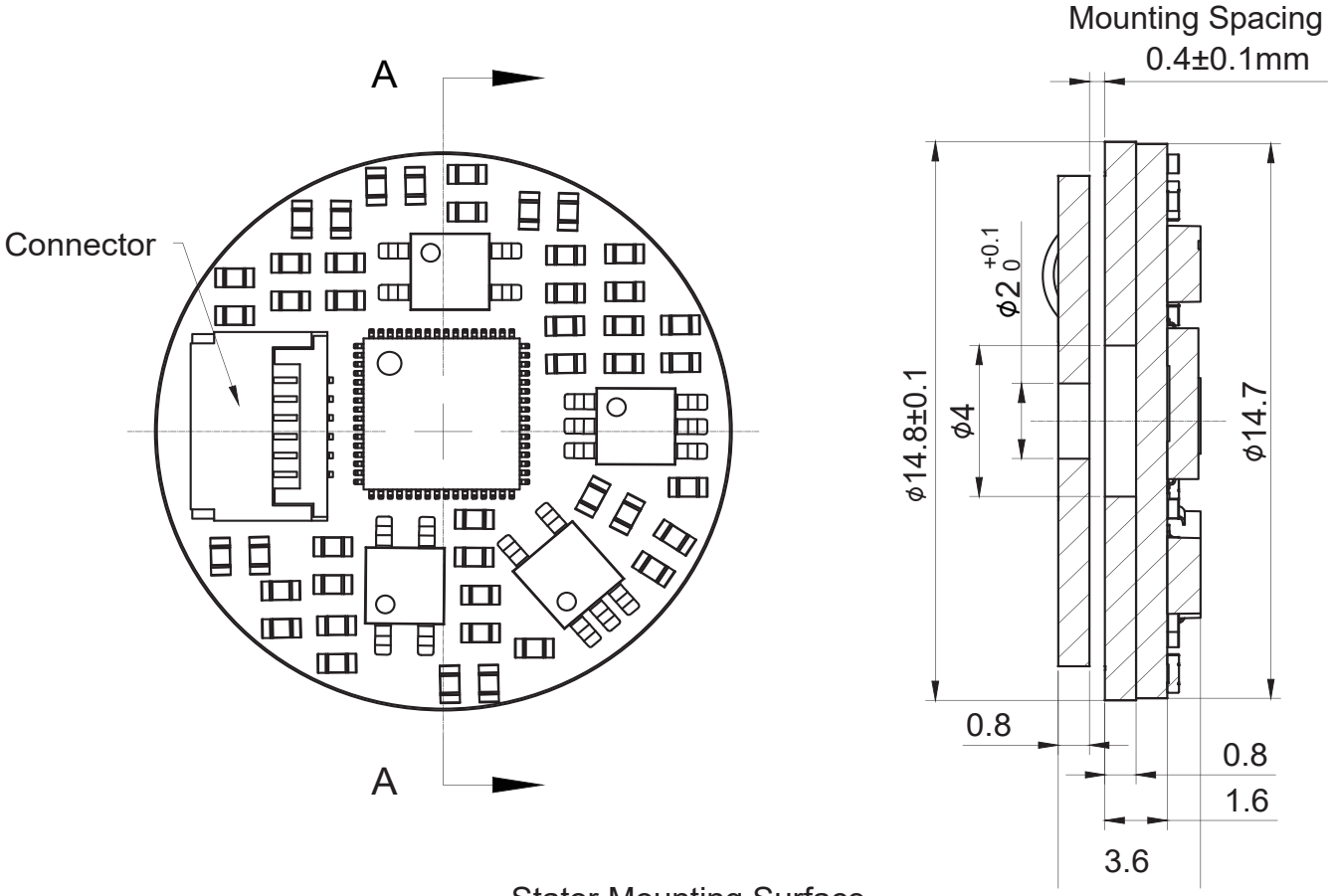
1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0xC2
The reset command is repeated 10 times at least 40μs intervals to reset the single-turn angle value;

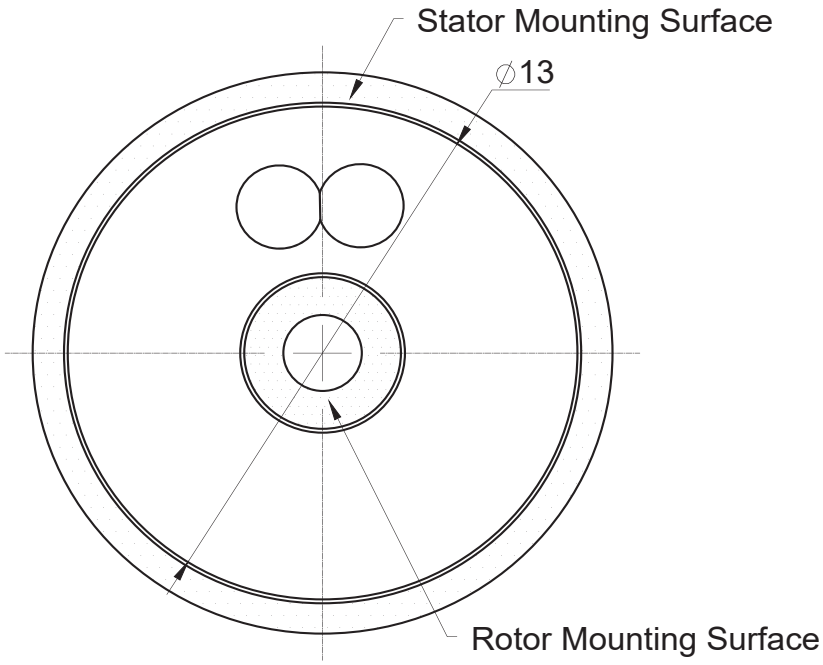
2. Master Control Terminal Receives Data Frame from Encoder:
Receive Data (HEX): 0xC2 0x20 0x00 0x00 0x00 0xE2

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);

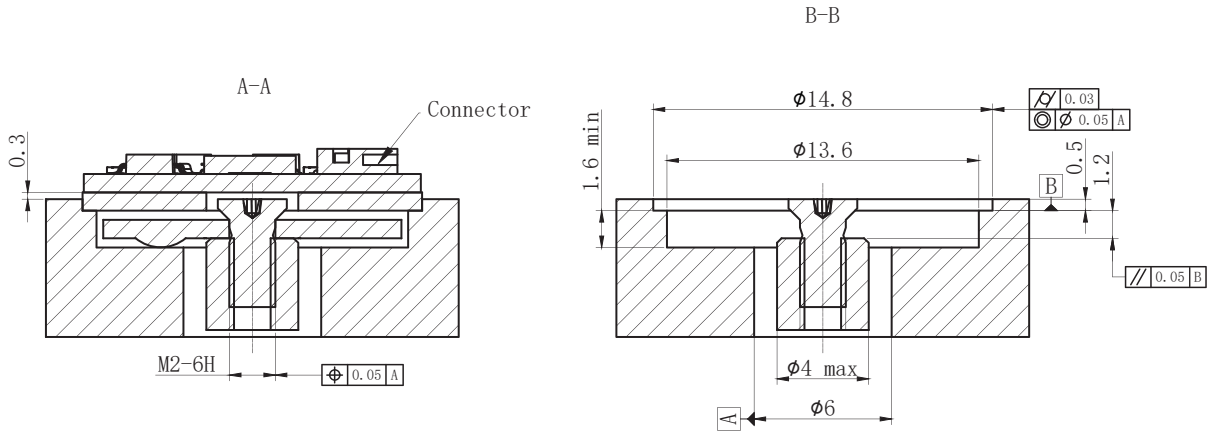
IV. Mechanical Interface

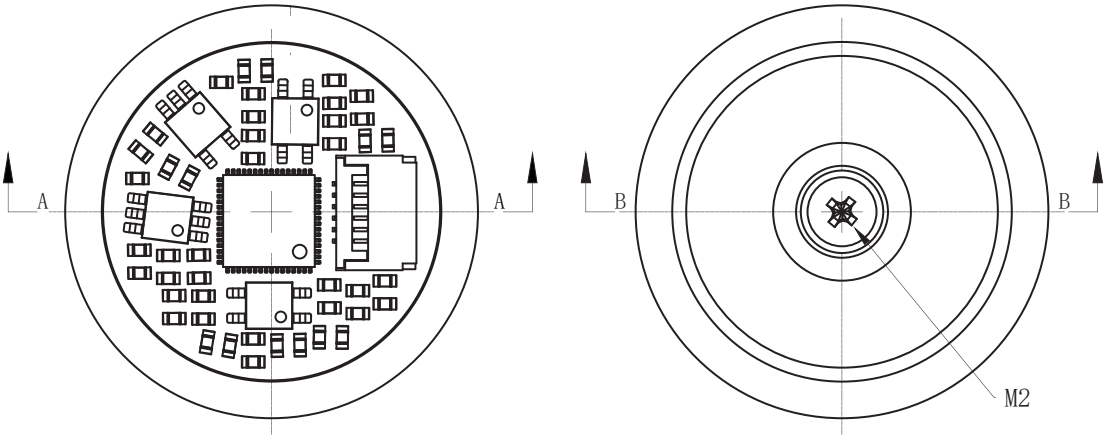
4.1 Product Dimensions

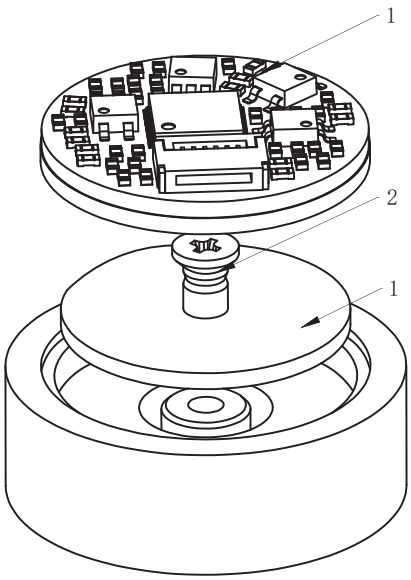




4.2 Product Installation Recommendations







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

2、Technical Specifications

Table 1 Encoder Basic Performance Parameters

Angular Resolution	15~17 bit
Maximum static error	±0.025°
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	16.8\2\3.6mm
Permissible Installation Eccentricity	±0.1 mm
Stator and rotor installation gap	0.4±0.1 mm
Rotor Inertia	0.008 kg·mm^2
Weight (Approx.)	2.5g
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 Connection

3.1 Hardware Interface

The C0216 thin-profile inductive encoder consists of a stator and a rotor. The stator integrates angle calculation circuitry and encoding output circuitry. The encoder employs connector output (as shown below), with angle output utilizing SSi, BiSS-C, RS-422, and RS-485 serial protocols.

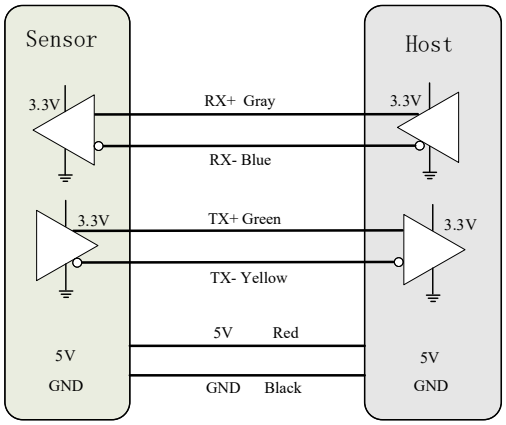
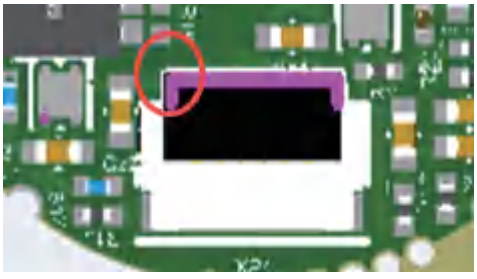


Table 5. Definitions of SSI/BiSS/RS-422/RS-485 Serial Interface Cables

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:

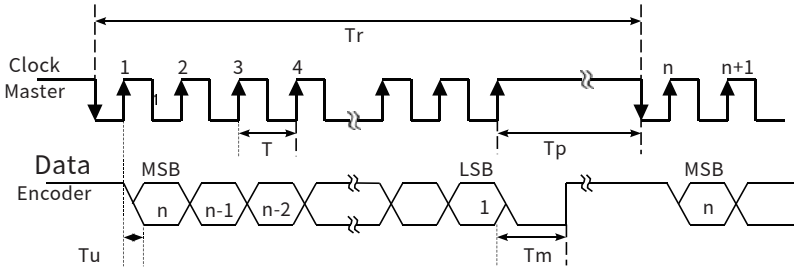


Table 7 Timing Diagram Parameter Description

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:

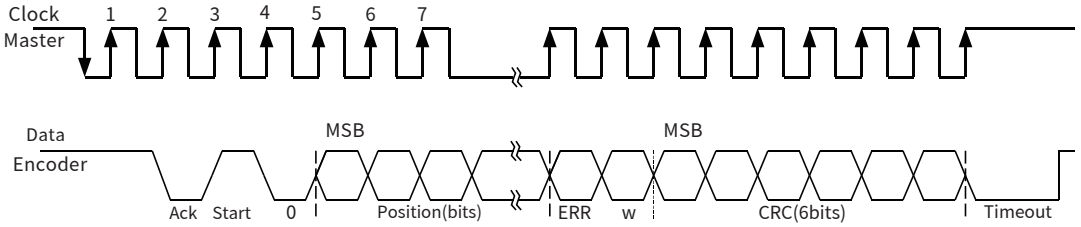


Table 8 Timing Diagram Parameter Description

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. Clock 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 Interval: ≥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

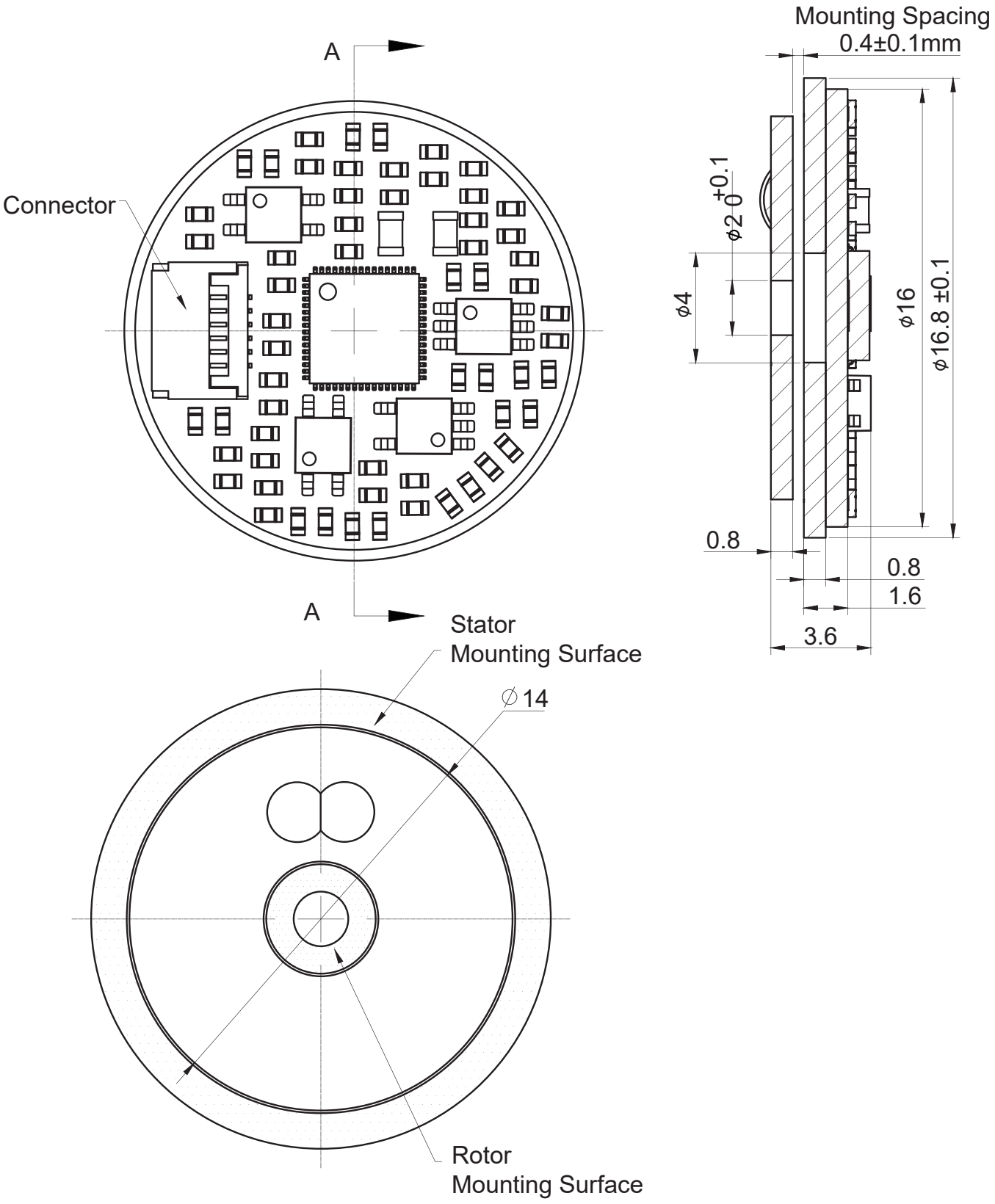
1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0xC2
The reset command is repeated 10 times at least 40μs intervals to reset the single-turn angle value;

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

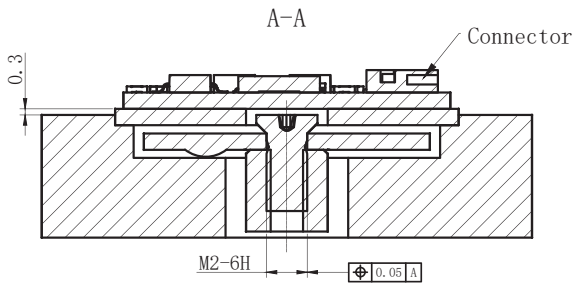
Where: 0xC2: Returns the same command CF; 0x20: Status byte SF;
0x00 0x00 0x00: Single-turn data value DF (lowest bit first);
0xE2: CRC check (XOR operation on all preceding bytes);

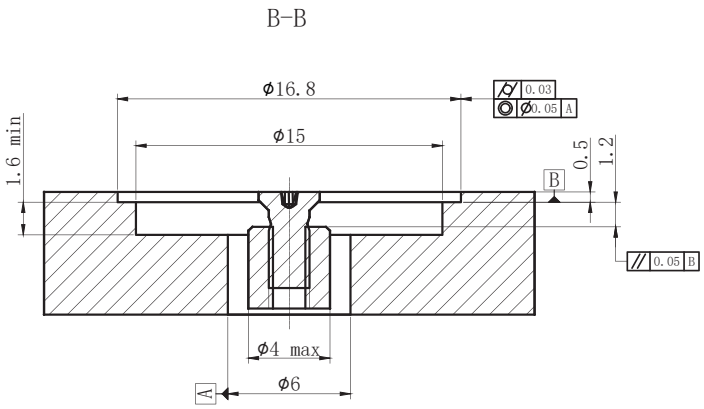
IV. Mechanical Interface

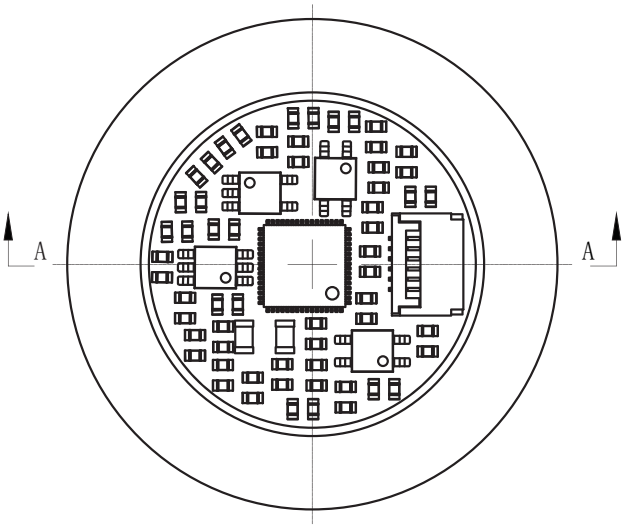
4.1 Product Dimensions

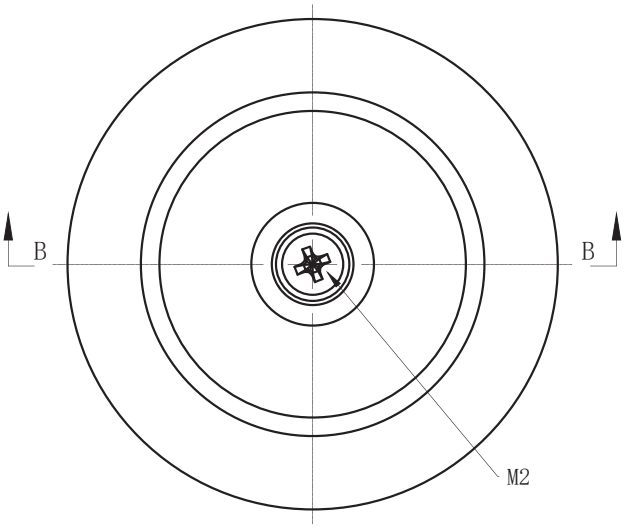


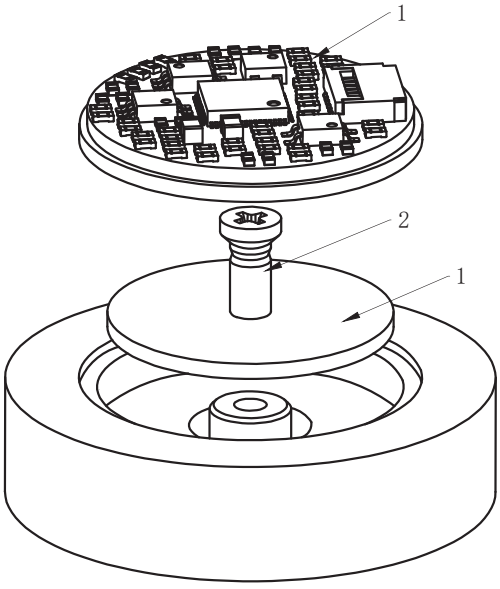
4.2 Product Installation Recommendations











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

Serial Number	Name	Quantity	Remarks
1	C0216	1	Product
2	M2x5 Phillips head countersunk screws	1	Product Installation Accessories

2、Technical Specifications

Table 1 Encoder Basic Performance Parameters

Angular Resolution	15~17 bit
Maximum static error	±0.02°
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	18.8\2\3.6mm
Permissible Installation Eccentricity	±0.1 mm
Stator and rotor installation gap	0.4±0.1 mm
Rotor Inertia	0.01kg·mm^2
Weight (Approx.)	3g
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 C0218 thin-profile inductive encoder consists of a stator and a rotor. The stator integrates angle calculation circuitry and encoding output circuitry. The encoder employs connector output (as shown below), with angle output utilizing SSi, BiSS-C, RS-422, and RS-485 serial protocols.

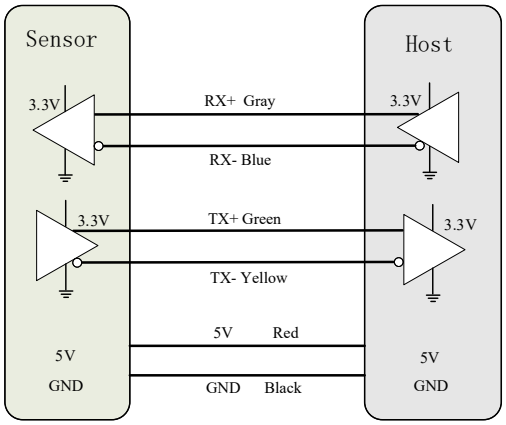
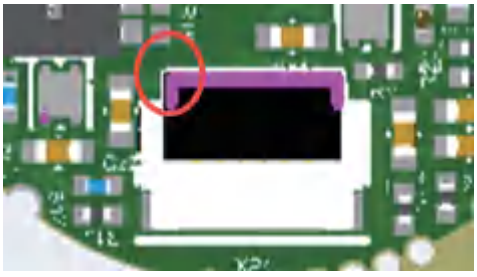


Table 5. Definitions of SSI/BiSS/RS-422/RS-485 Serial Interface Cables

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:

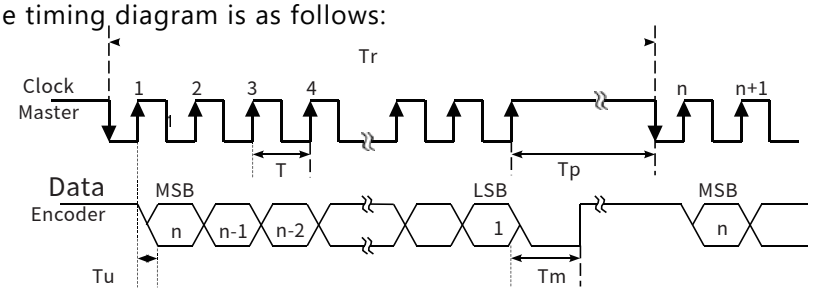


Table 7 Timing Diagram Parameter Description

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:

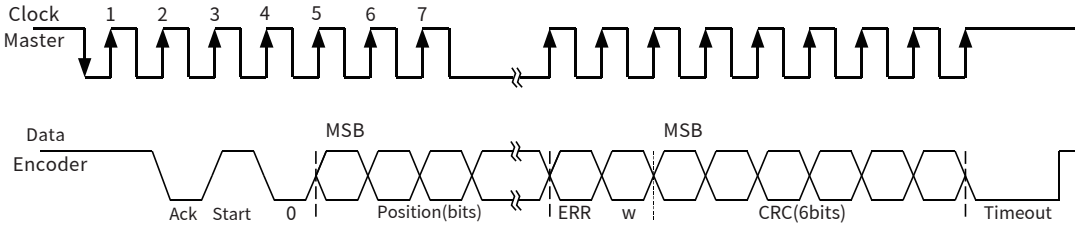


Table 8 Timing Diagram Parameter Description

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. Clock 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 Interval: ≥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

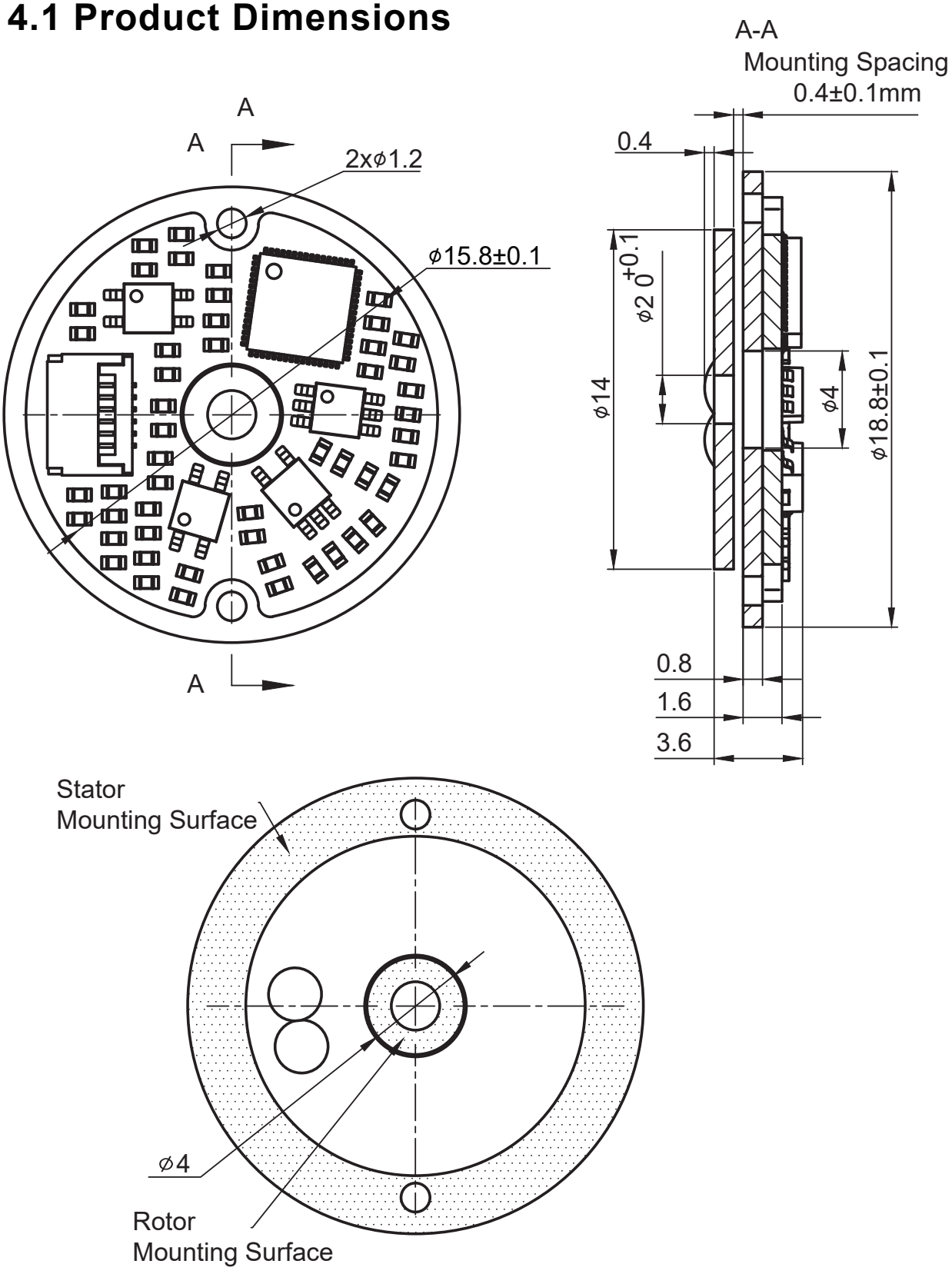
1. Master Control Terminal Sends Command Frame: Send Data (HEX): 0xC2
The reset command is repeated 10 times at least 40μs intervals to reset the single-turn angle value;

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

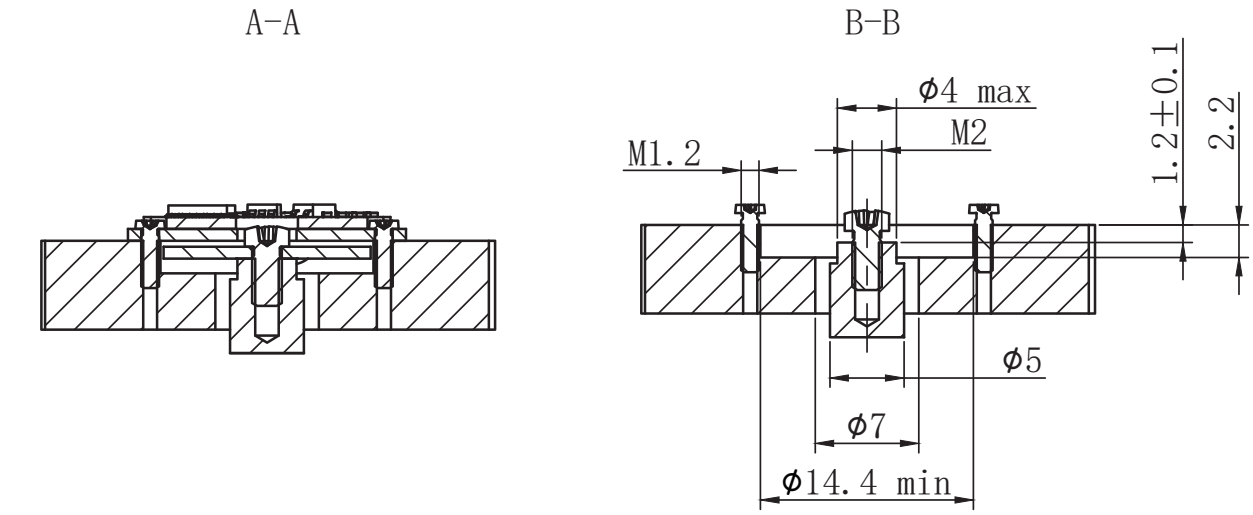
Where: 0xC2: Returns the same command CF; 0x20: Status byte SF;
0x00 0x00 0x00: Single-turn data value DF (lowest bit first);
0xE2: CRC check (XOR operation on all preceding bytes);

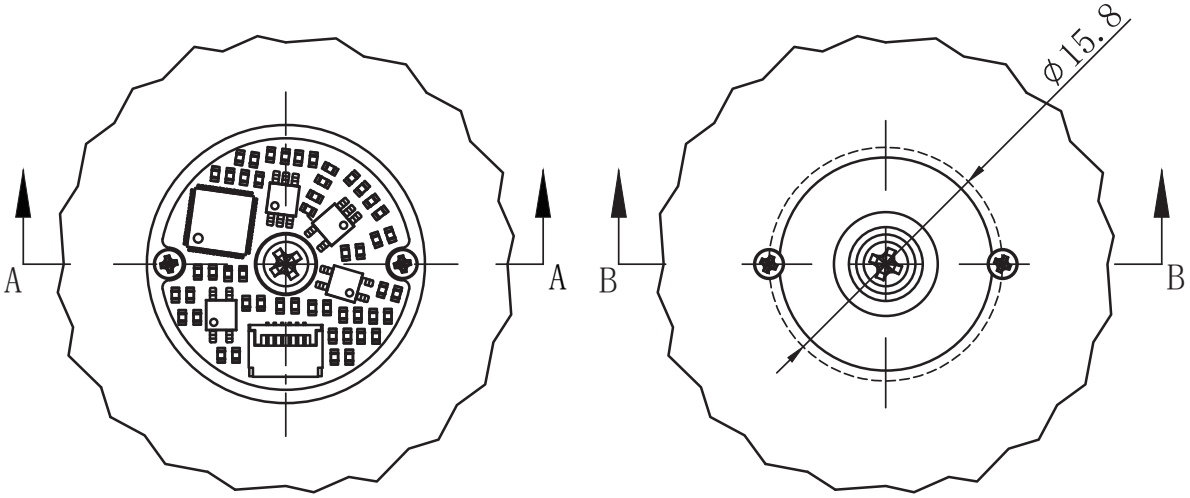
IV. Mechanical Interface

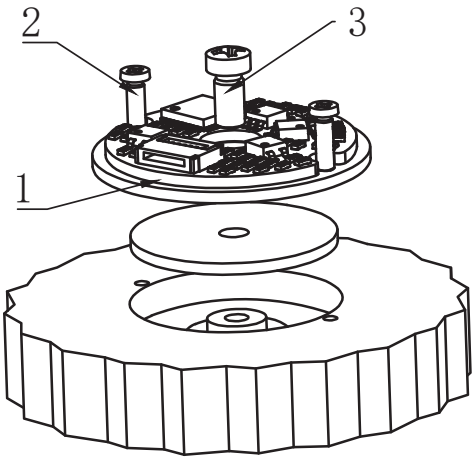
4.1 Product Dimensions



4.2 Product Installation Recommendations







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

Serial Number	Name	Quantity	Remarks
1	C0218	1	Product
2	M1.2x4 bolts	2	Product Installation Accessories
3	M2x4 Phillips head ountersunk screws	1	

2、Technical Specifications

General

Resolution	15-17 bit
Maximum static error	±0.05°
Repetitive error	±2 LSB
Maximum operational speed	4000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	20\4\6.5 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	0.01 kg·mm^2
Weight (stator / rotor)	4 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5V
Current consumption	< 80 mA
Serial output	6-pin connector、6-core cable
Communication	SSi、BiSS-C、RS-422 (UART)

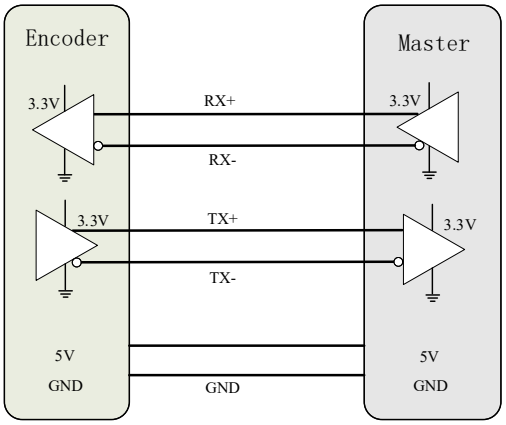
Environmental

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 functional	20 g (10 - 2000 Hz)
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C0420 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi, BiSS-C, RS-422(UART).



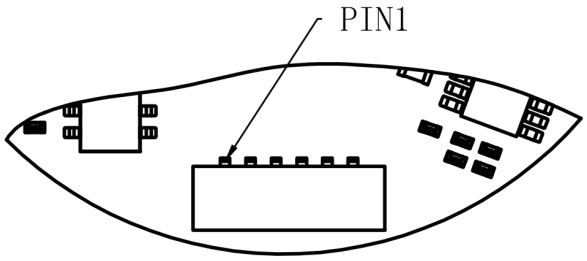
SSI/BiSS/RS-422 connections

NO	SSi	BiSS-C	RS-422	RS-485	Colour	Remarks
1	VCC				Red	VCC
2	GND				Black	GND
3	CLK+	MA+	RX+	\	Grey	CLK
4	CLK-	MA-	RX-	\	Blue	
5	DATA-	SLO-	TX-	B-	Yellow	DATA
6	DATA+	SLO+	TX+	A+	Grey	

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

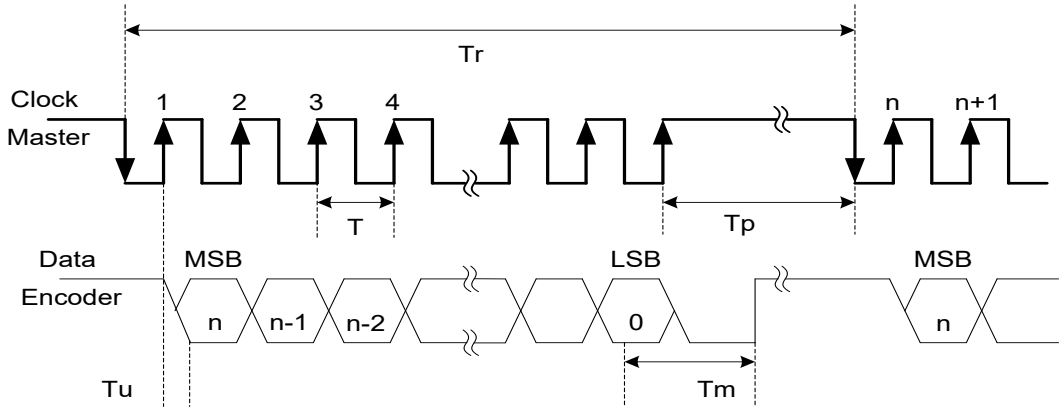
Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD



6-Pin thin needle： M0611RS-06-GB　Plastic case： X0600HI-06G-LPHF

3.2 SSi Interface

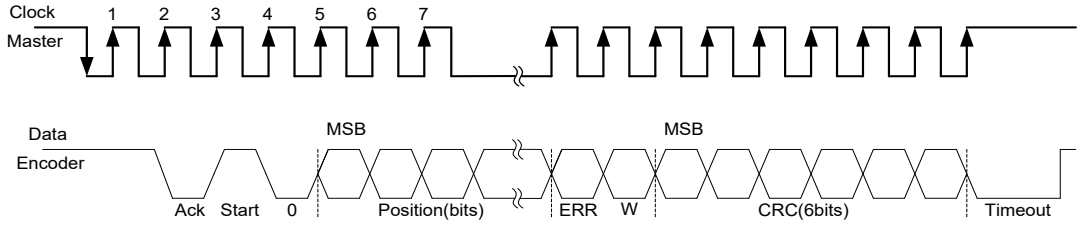
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 30 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

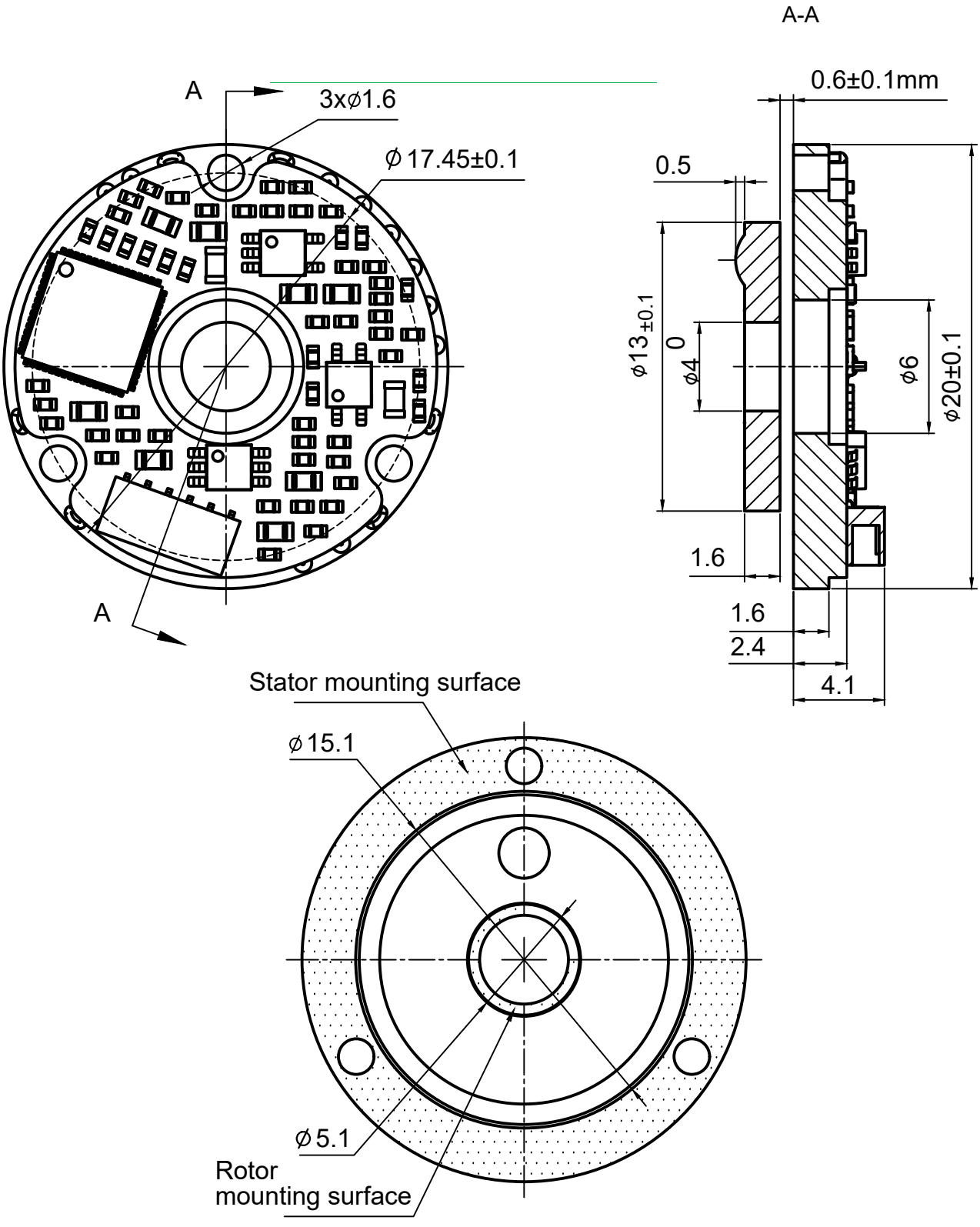
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

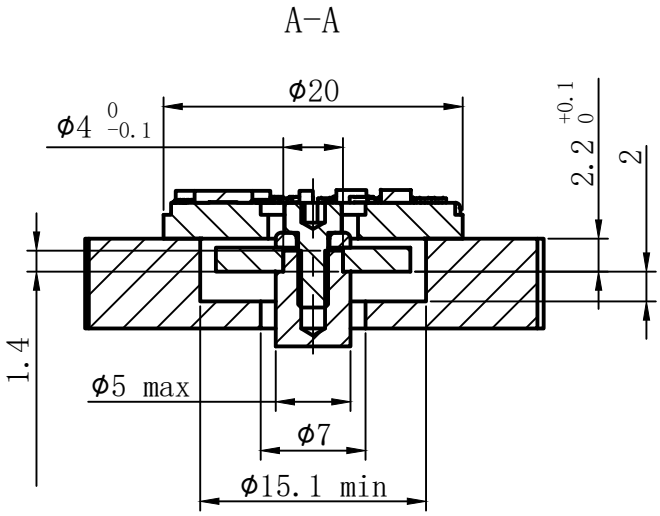
	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

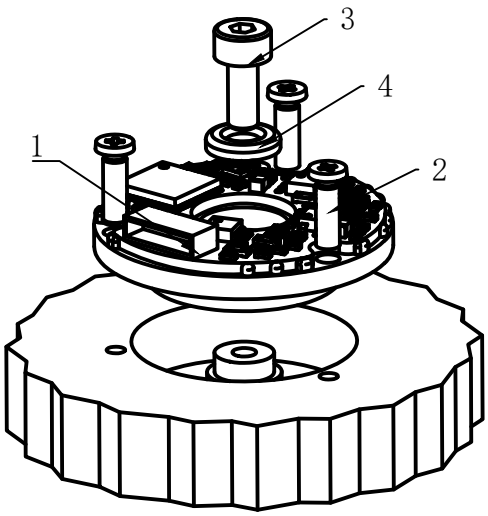
4、Mechanical Mounting

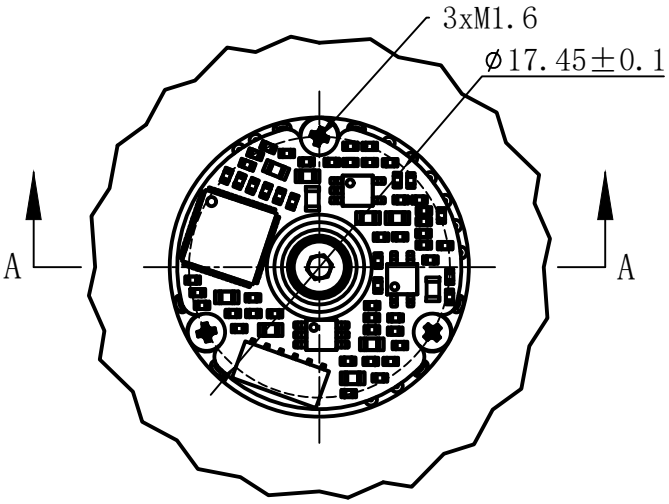
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50～	±0.1mm

NO.		QTY	Description
1	C0420	1	Product
2	M1.6x5 screw	3	Install accessories
3	M2x5 screw	1	
4	C0420 shaft spring	1	

2、Technical Specifications

General

Resolution	17-18bit (21 bit extension)
Maximum static error	±0.015°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	40\10\8 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	0.4 kg·mm^2
Weight (stator / rotor)	10 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C1040 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

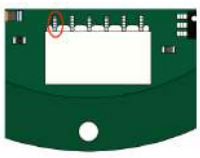
Interface wires color code

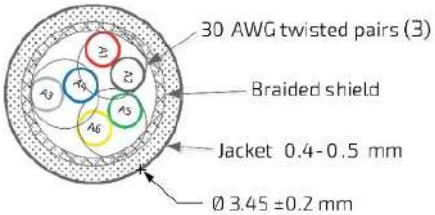
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	30 kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

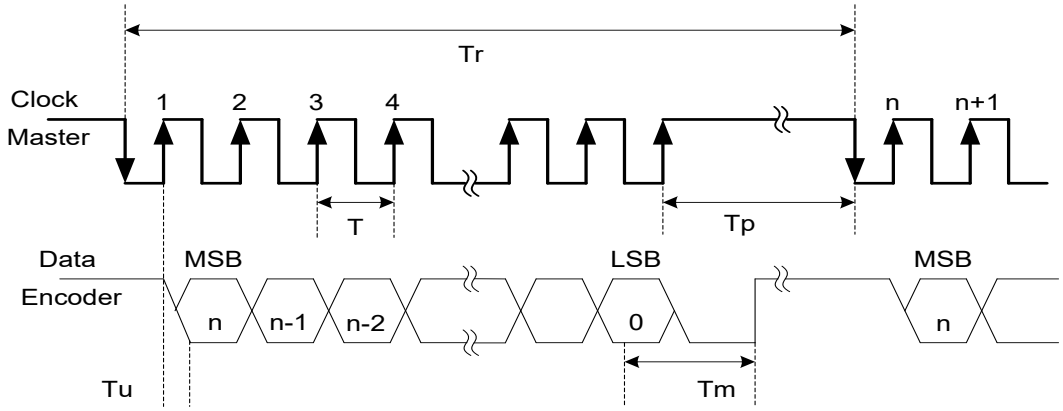
Corresponding plug: ZX-SH1.0-6PJK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT（differential ABZ version）

Corresponding standard plug： HC-1.25-8Y (standard version）
HC-0.8-8PY（differential ABZ version）

3.2 SSi Interface

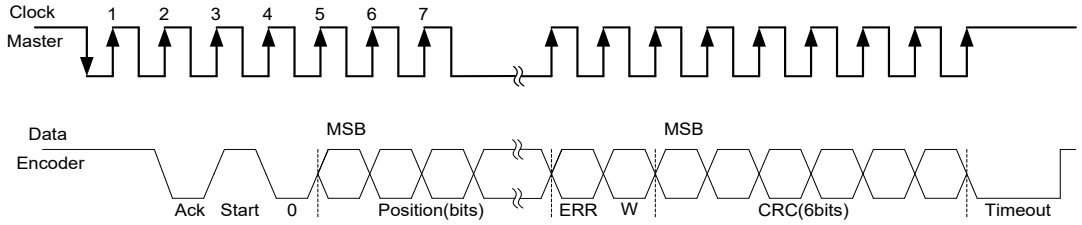
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 30 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

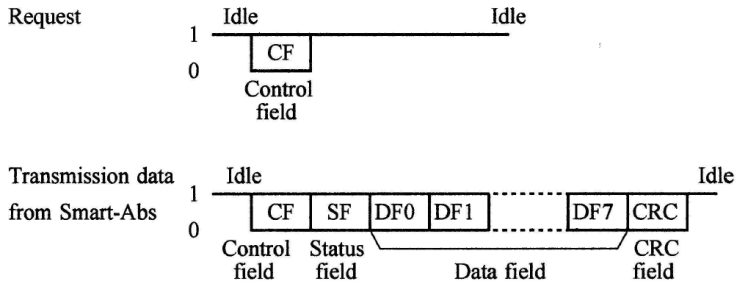
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command　　Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

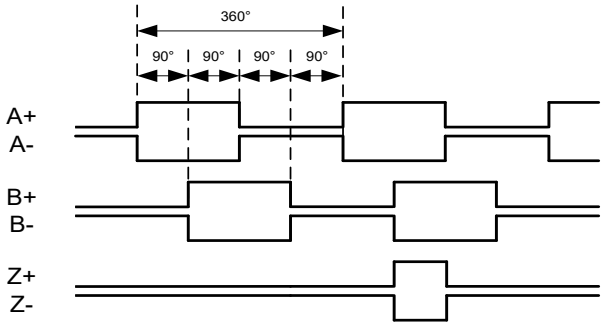
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command　　Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

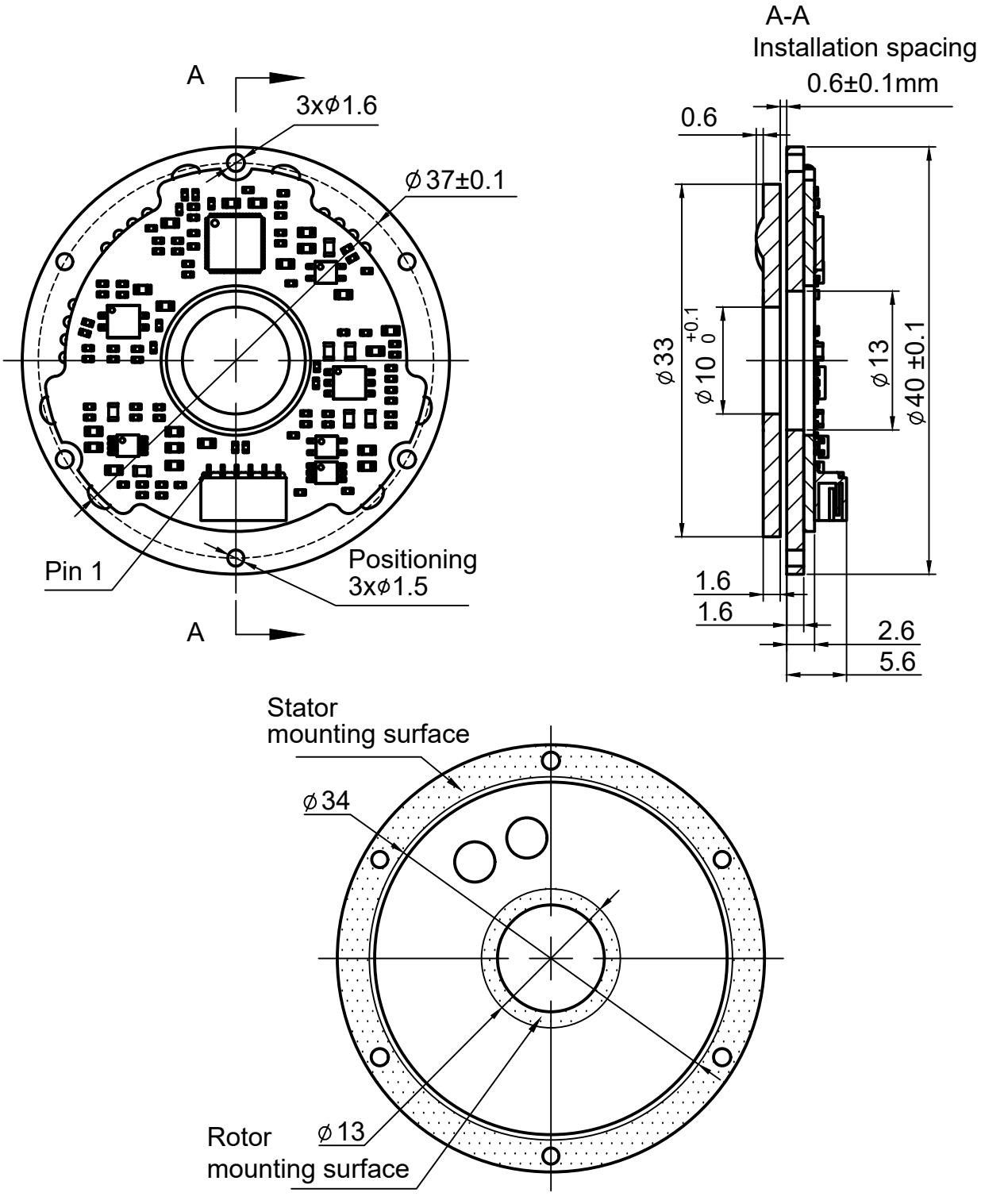
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



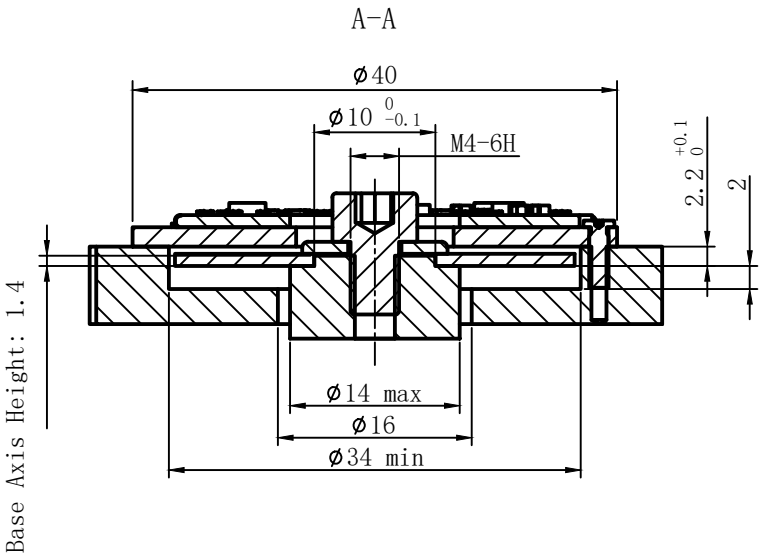
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

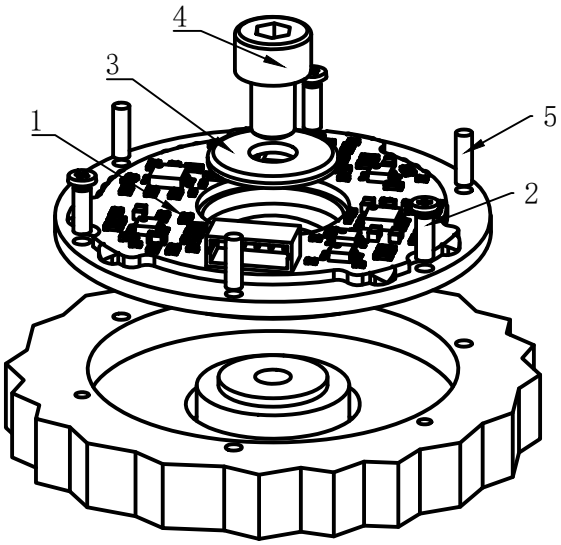
4、Mechanical Mounting

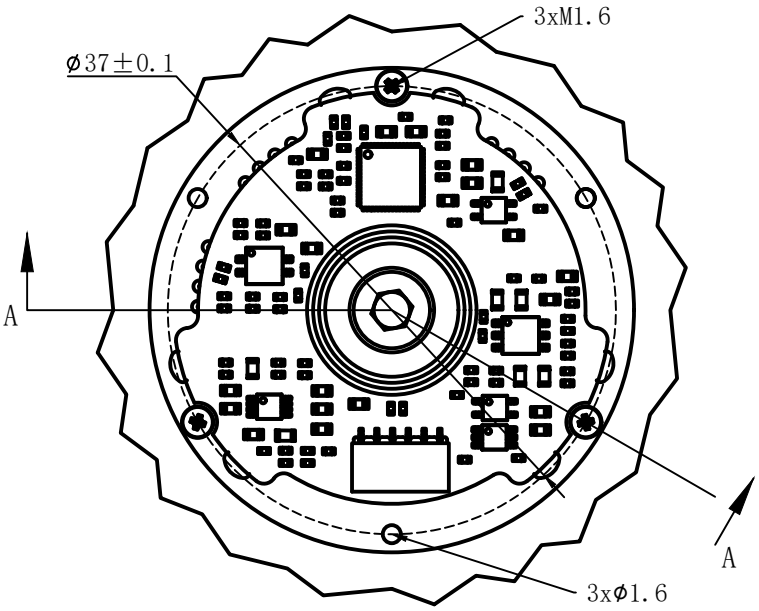
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C1040	1	Product
2	M1.6x5 countersunk head cross screw	3	Install accessories
3	C1040 shaft spring ⌀	1	
4	M4x6 socket head cap screw	1	
5	1.5x4 dowel pin	3	

2、Technical Specifications

Table 1 Encoder Basic Performance Parameters

Angular Resolution	18~20 bit
Maximum static error	±0.01°
Repetitive error	±2 LSB
Maximum operational speed	8000 rpm
Measurement range	Single turn
Rotation direction	Default: Clockwise Increment (Adjustable)

Table 2 Mechanical Dimensions and Installation

Outer Diameter\Inner Diameter\Thickness	52\17\7.6mm
Permissible Installation Eccentricity	±0.1 mm
Stator and rotor installation gap	0.6±0.1 mm
Rotor Inertia	1.18kg·mm^2
Weight (Approx.)	13g
Flame Resistance Rating of Rotor and Stator Materials	FR-4

Table 3 Electrical and Interface Specifications

Power Supply Voltage	5~24V
Current	120~130 mA
Electrical Interface	Six-core connector, six-core shielded cable, eight-core connector (for ABZ protocol use)
Output Protocol	SSi, BiSS-C, RS-422, RS-485, Differential ABZ

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	100 g / 11 ms
Vibration	20 g（10 ~2000 Hz）
Highest Protection Level	IP 40

II. Electrical Interface

3.1 Hardware Interface

The C1752 thin-profile inductive encoder consists of a stator and a rotor. The stator integrates angle calculation circuitry and encoding output circuitry. The encoder employs connector output (as shown below), with angle output utilizing SSi, BiSS-C, RS-422, and RS-485 serial protocols.

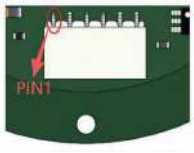
Table 5 Communication Interface Cable Definitions

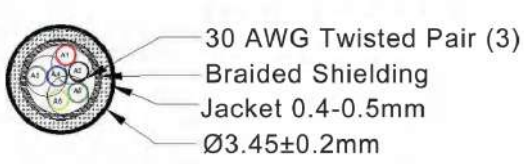
Serial Number	RS-422	SSi	BiSS-C	RS-485	ABZ	Color
1	VCC					Red
2	GND					Black
3	RX+	CLK+	MA+	\	A+	Gray
4	RX-	CLK-	MA-	\	A-	Blue
5	TX-	DATA-	SLO-	B-	B-	Yellow
6	TX+	DATA+	SLO+	A+	B+	Green
7	The default 6-pin connector does not include this feature.				Z+	White
8					Z-	Orange

Table 6 SSi/BiSS Signal Output Parameters

Digital Output Parameters	
Signal Delay	＜50us
Output Code	Binary
Fastest Data Update Rate	25kHz
Interface Level	Differential RS-422
Power Consumption	＜100mA
When using digital signal acquisition, the sampling rate and clock frequency are related to the communication protocol selected by the user.	

The cable interior features three pairs of 30AWG twisted-pair wires. Each individual conductor consists of 25 strands of 0.05mm tinned copper, with ETFE insulation. The cable shielding employs a thin copper braid with over 95% coverage; the outer jacket is made of 0.4-0.5mm silicone rubber.





6-pin thin plug：ZX-SH1.0-6PWT
Matching mating plug：ZX-SH1.0-6PJK

Cable Diameter：Ø3.45±0.2mm
Temperature Range：-50°~+150°C

8-pin slim plug：HC-1.25-8PWT (Standard version)
HC-0.8-8PWT(Differential ABZ version)

Matching mating plug：HC-1.25-8Y(Standard version)
HC-0.8-8Y (Differential ABZ version)

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:

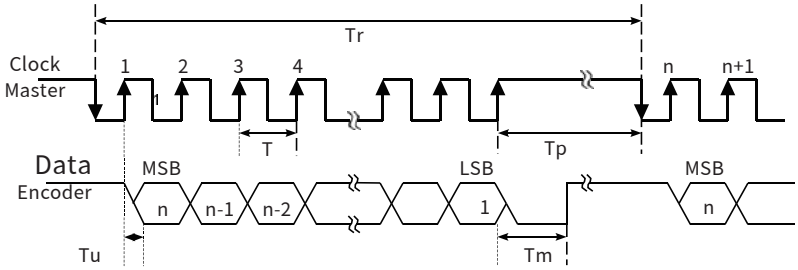


Table 7 Timing Diagram Parameter Description

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

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 BiSS-C interface configured for point-to-point connection, conforming to the requirements of a unidirectional BiSS-C interface. The timing diagram is as follows:

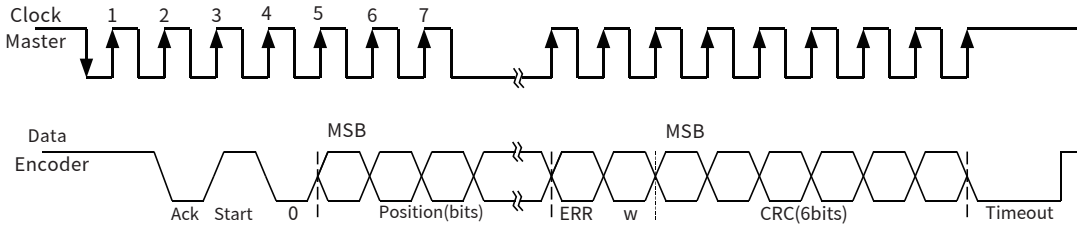


Table 8 Timing Diagram Parameter Description

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. Clock Synchronization: The master device sends CLK, the encoder latches data on the rising edge of the clock, and updates the output on the falling edge (consistent with the "master sends clock, slave responds passively" mechanism of SSI).
2. 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.

3.4 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);

3.6 ABZ Interface Protocol

3.6.1 Introduction to Communication Protocol

The ABZ interface is a commonly used interface for angle encoders. In the encoder's A-phase, B-phase, and Z-phase signals, the signals of channels A and B are generally orthogonal (i.e., 90° out of phase) pulse signals; while the Z-phase is a zero-pulse signal. When the spindle rotates clockwise, the output pulse signal of channel A precedes that of channel B; when the spindle rotates counterclockwise, the signal of channel A follows that of channel B.

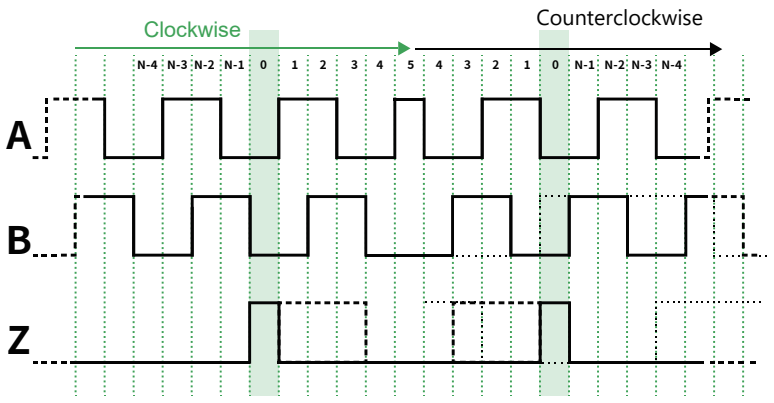
In addition to the A and B phases (the signal sequences of channels A and B have a 90-degree phase difference), the encoder output signal typically also outputs a zero-position pulse or marker pulse (i.e., the Z-phase signal) per revolution to determine the zero position or marker position.

3.6.1 Introduction to Communication Protocol

1. Strong Anti-Environmental Interference: Non-optical design, unaffected by dust, oil, or vibration, suitable for harsh industrial environments.
2. Precise Direction Identification via Quadrature Pulses: Real-time 90° phase difference between AB phases determines rotation direction, combined with pulse counting for angle increment measurement.
3. Zero-Point Calibration Mechanism: Z-phase outputs a single pulse per revolution for mechanical zero-point calibration, eliminating accumulated errors.
4. High-Speed Response and High Cost-Effectiveness: High pulse output frequency supports high-speed rotation detection; simple hardware decoding; lower cost than absolute encoders.
5. Compact Structure and Low Power Consumption: No photoelectric components; small size and low power consumption, suitable for integration into small devices or multi-axis systems.

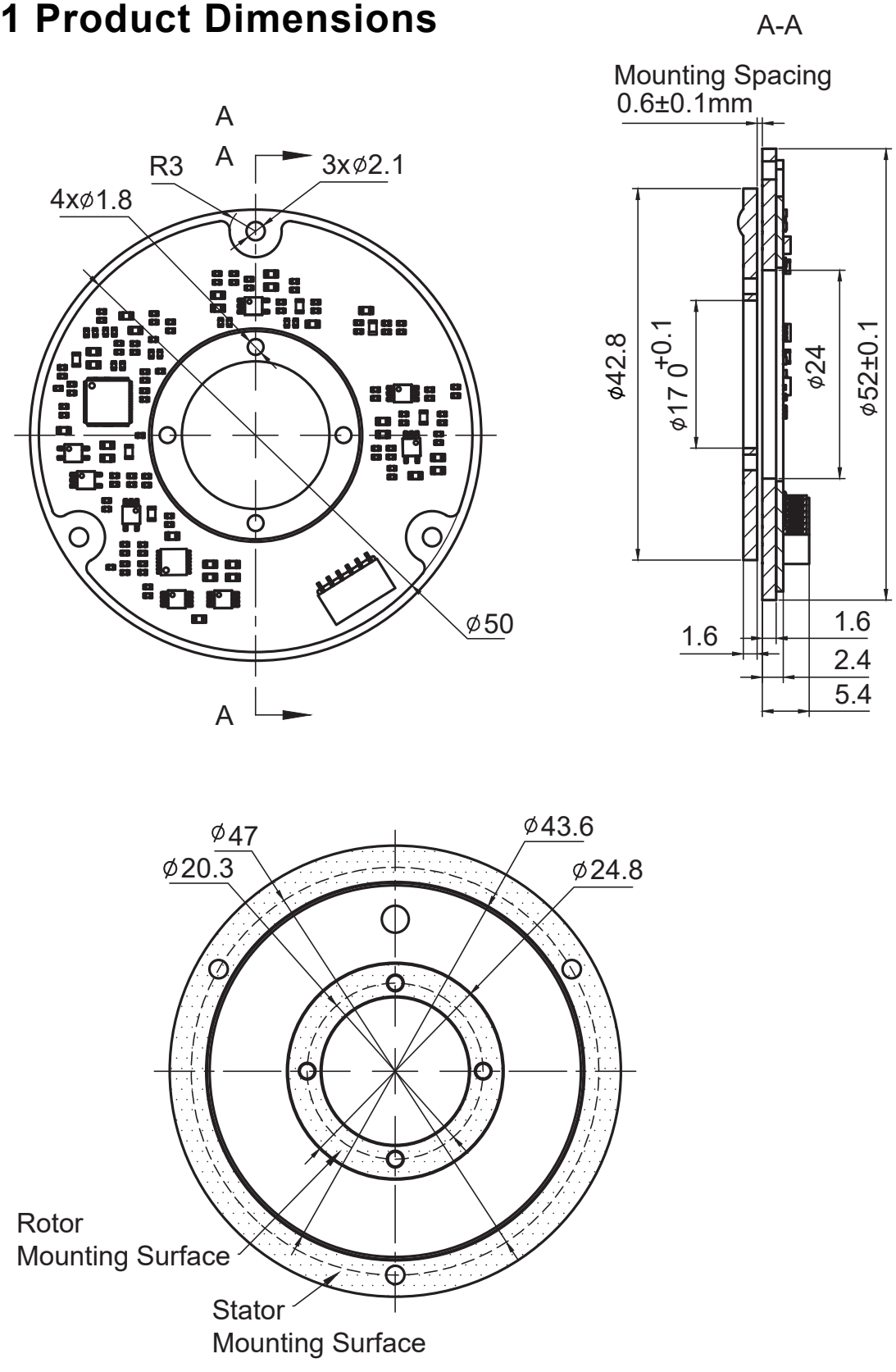
3.7.2 Communication Protocol Characteristics

The ABZ protocol, based on "orthogonal pulses + zero-point calibration," achieves incremental angle measurement through extremely simple pulse signals. Its advantages include simple hardware decoding, strong real-time performance, and resistance to environmental interference (magnetic encoder, non-optical design). However, it requires an external mechanism to handle power-off reset issues. This protocol is widely used in cost-sensitive motion control scenarios with medium-precision requirements and is one of the mainstream communication solutions for industrial angle sensors.

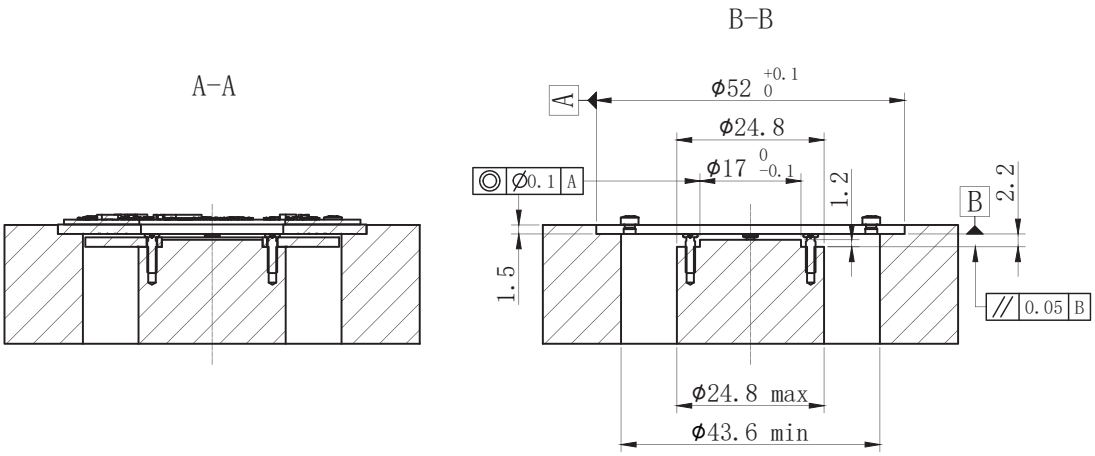


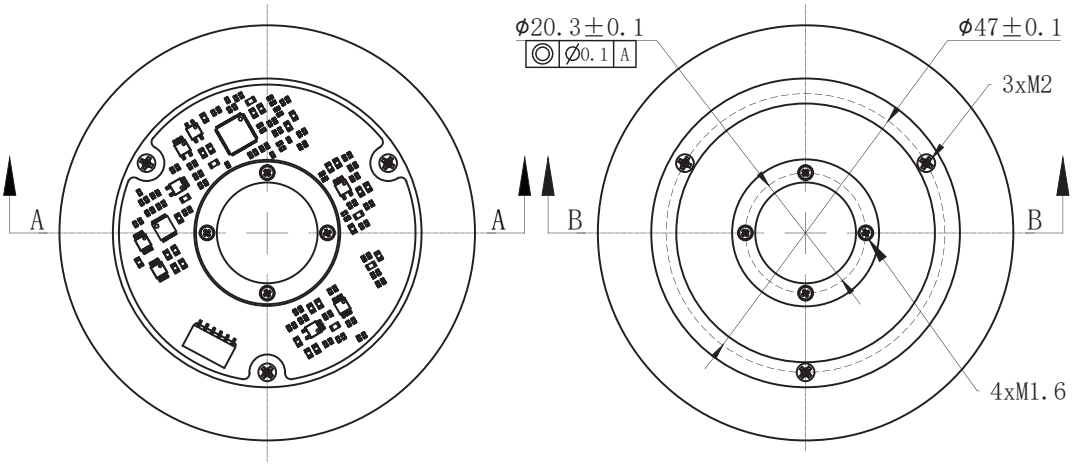
IV. Mechanical Interface

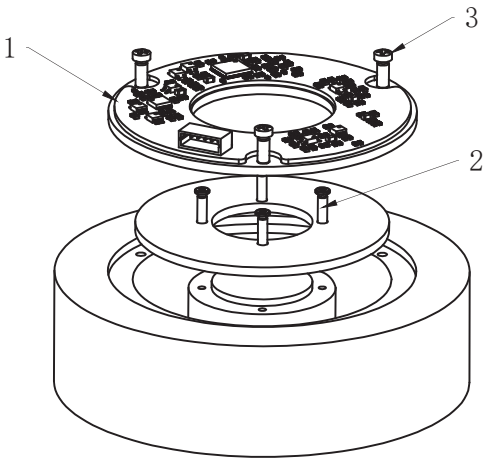
4.1 Product Dimensions



4.2 Product Installation Recommendations







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

Serial Number	Name	Quantity	Remarks
1	C1752	1	Product
2	M1.6X5 small head bolt	2	Product Installation Accessories
3	M2X5 small head bolt	1	

2、Technical Specifications

General

Resolution	18-20 bit (23 bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	8000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	60\25\8 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	2.43 kg·mm^2
Weight (stator / rotor)	18 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C2560 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

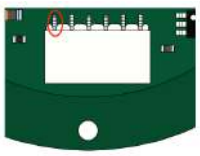
Interface wires color code

No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

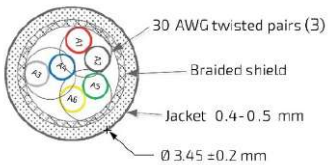
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD

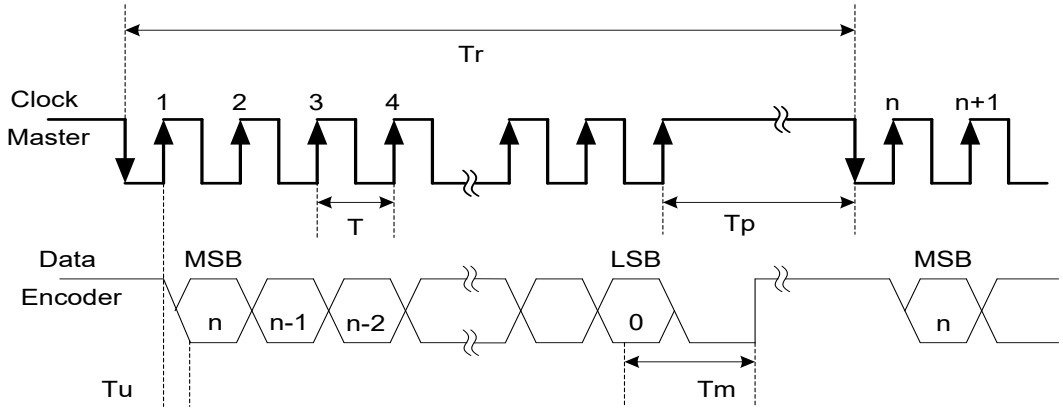


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

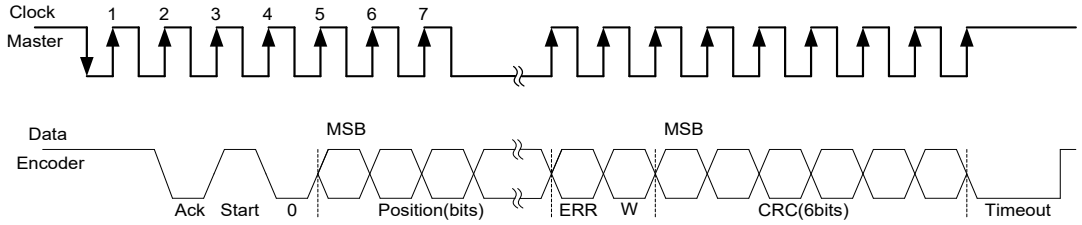
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 25 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 26 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

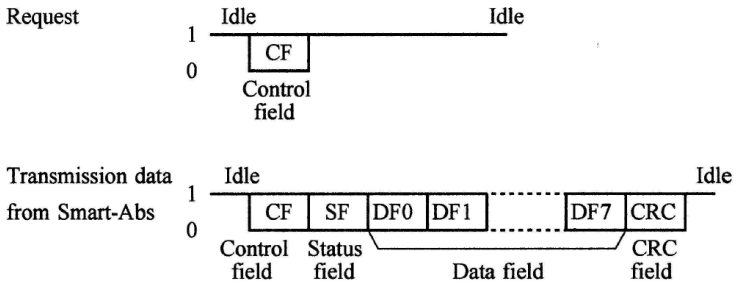
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

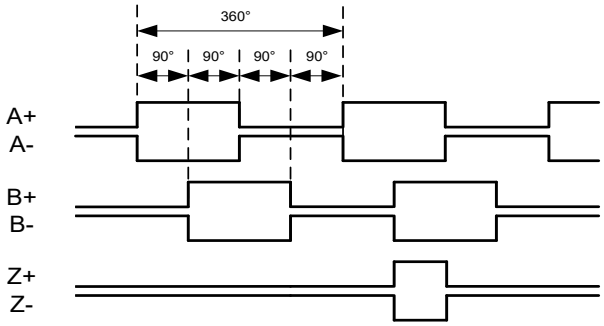
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

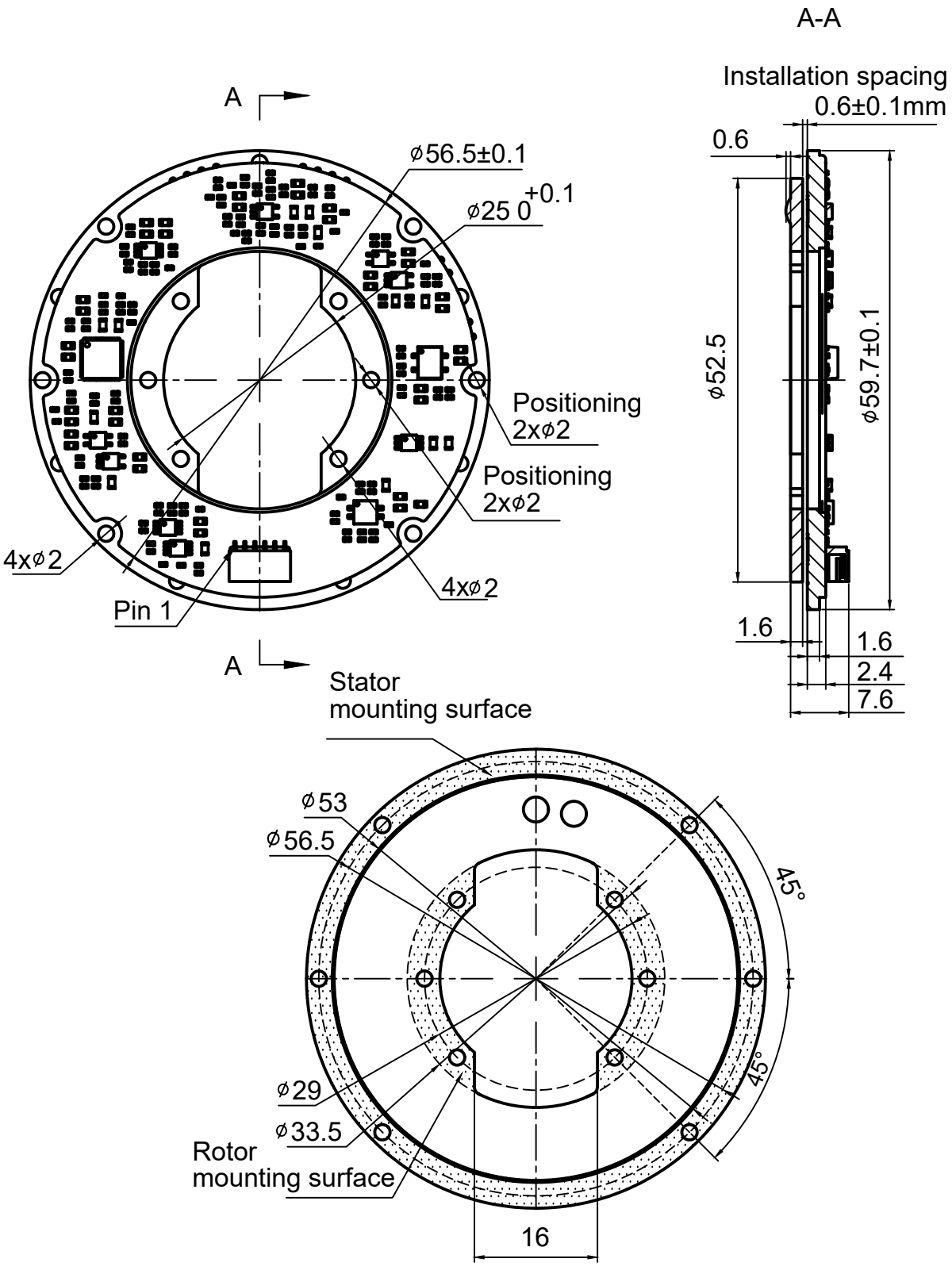
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



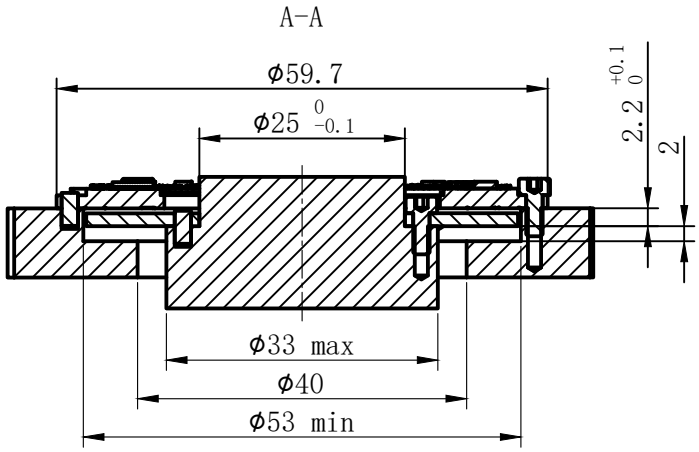
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

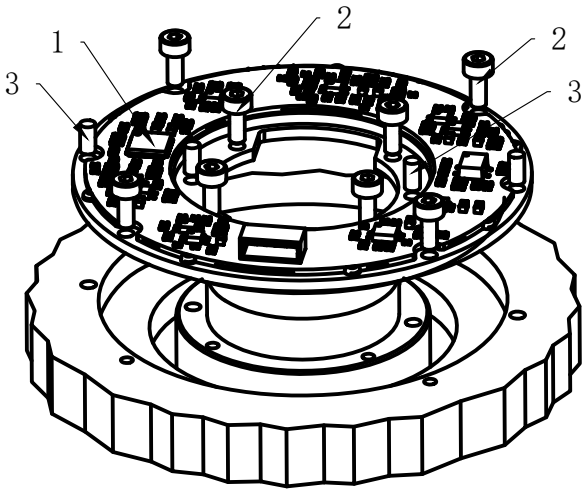
4、Mechanical Mounting

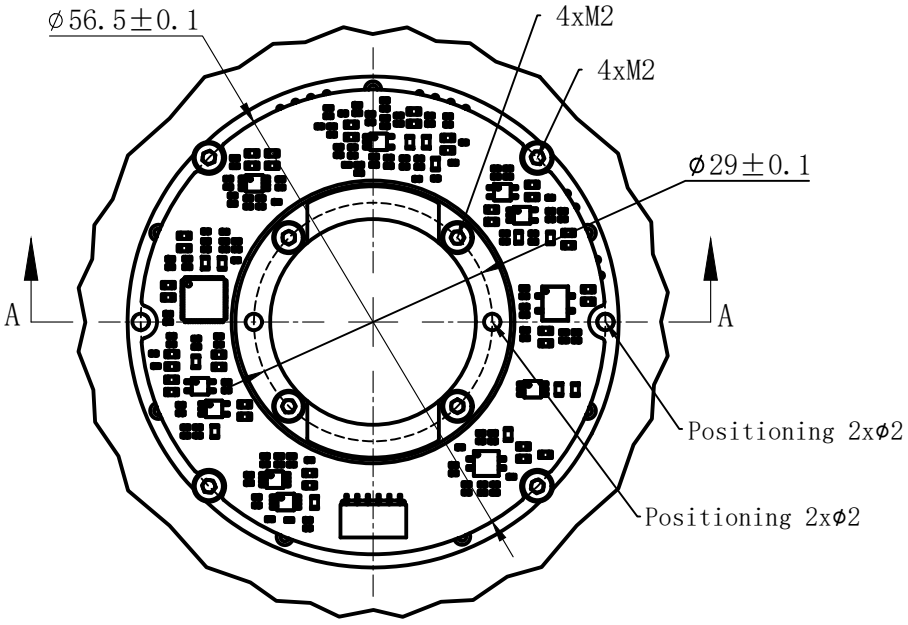
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C2560	1	Product
2	M2×5 screw	8	Install accessories
3	⌀2×4 dowel pin	3	

2、Technical Specifications

General

Resolution	18-20 bit (23 bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	8000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	80\35\8 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	8.6 kg·mm^2
Weight (stator / rotor)	30 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C3580 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

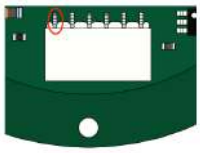
Interface wires color code

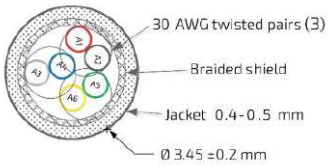
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

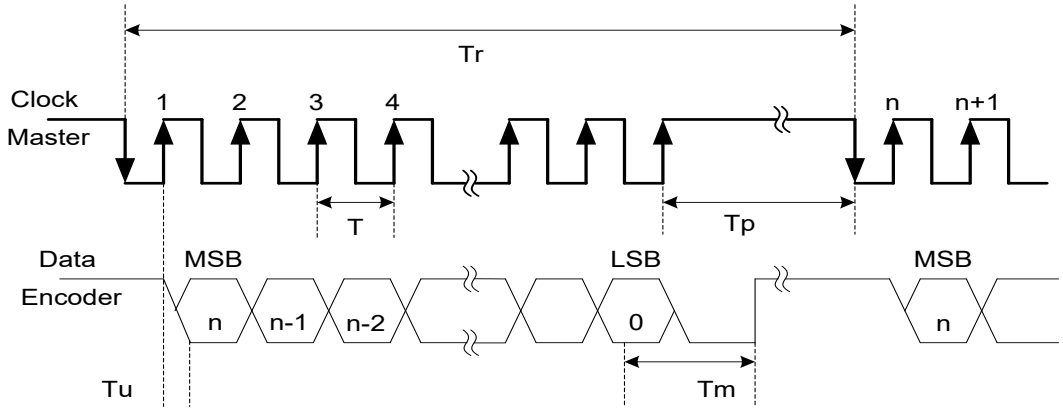
Corresponding plug: ZX-SH1.0-6PJK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT（differential ABZ version）

Corresponding standard plug： HC-1.25-8Y (standard version）
HC-0.8-8PY（differential ABZ version）

3.2 SSi Interface

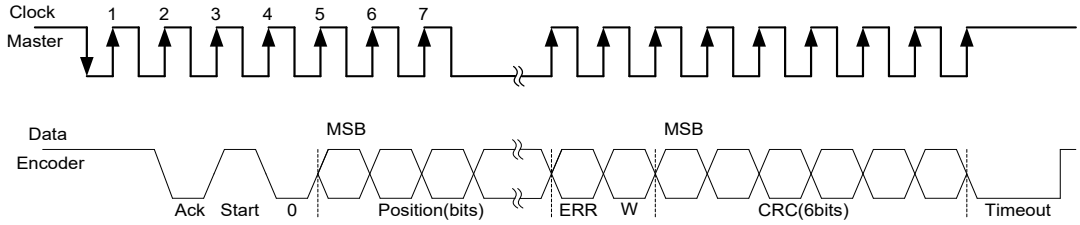
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 25 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 26 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

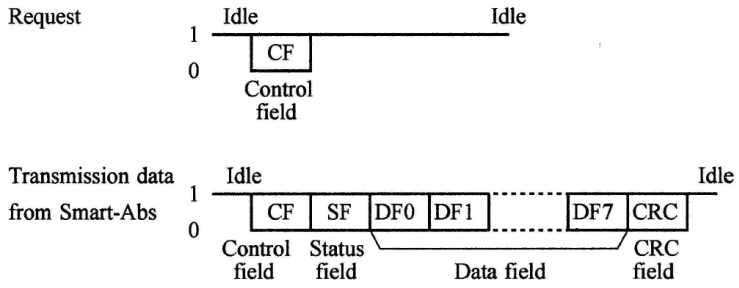
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

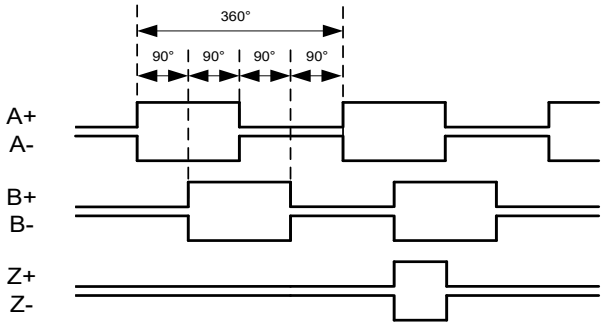
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

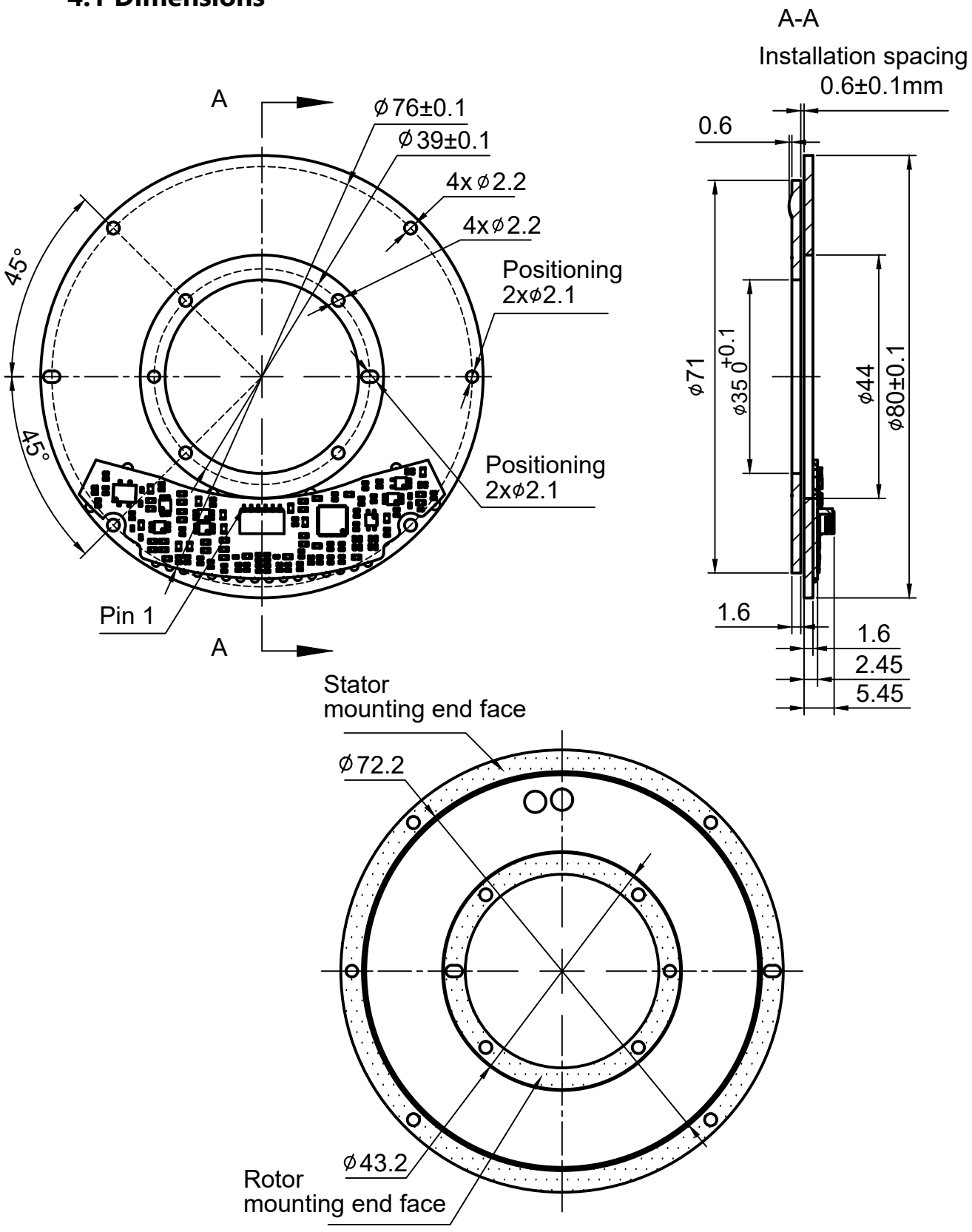
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



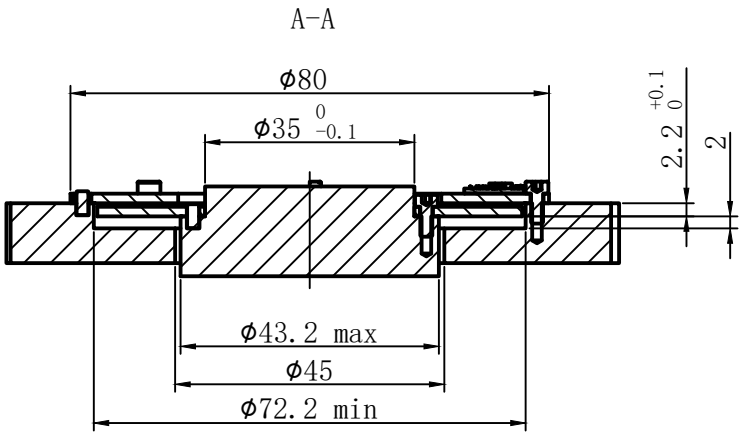
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

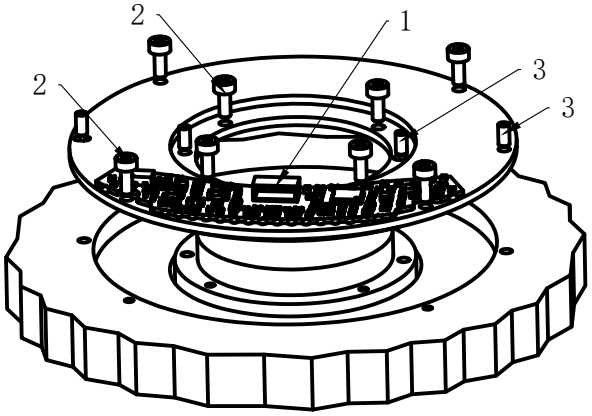
4、Mechanical Mounting

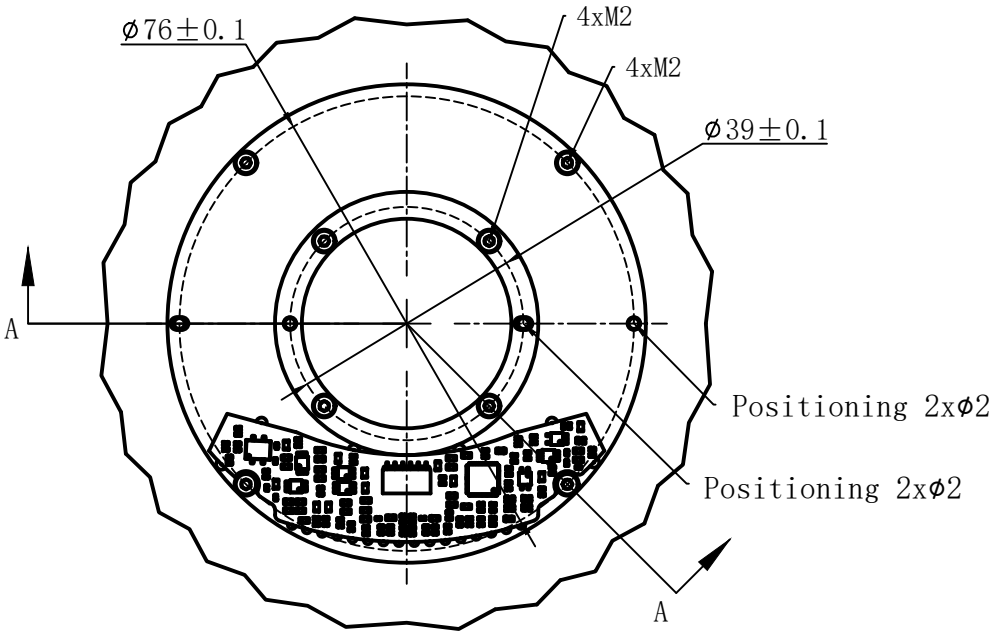
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C3580	1	Product
2	M2x5 screw	8	Install accessories
3	⌀2x4 dowel pin	4	

2、Technical Specifications

General

Resolution	19-21 bit (23 bit extension)
Maximum static error	±0.006°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	100\48\8 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	1±0.1 mm
Rotor inertia	19.7 kg·mm^2
Weight (stator / rotor)	40 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130 mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C48100 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

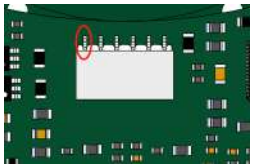
Interface wires color code

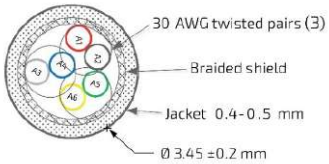
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

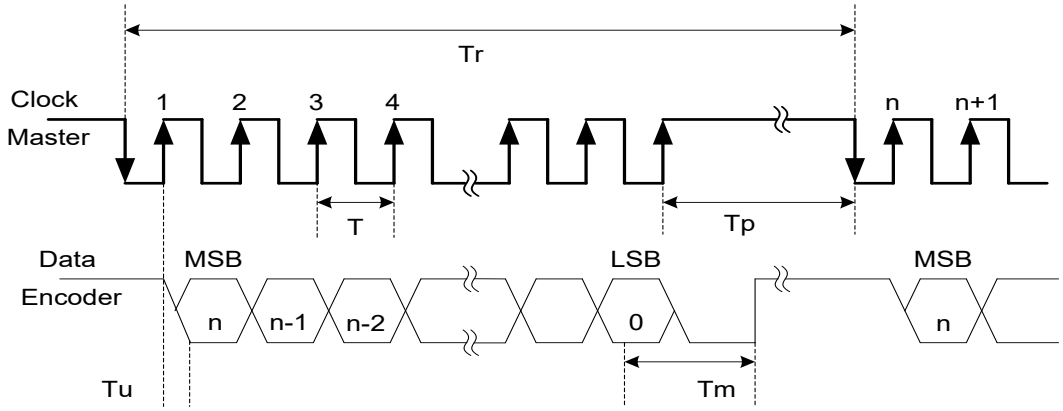
Corresponding plug: ZX-SH1.0-6P JK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT （differential ABZ version)

Corresponding standard plug： HC-1.25-8Y (standard version）
HC-0.8-8PY （differential ABZ version）

3.2 SSi Interface

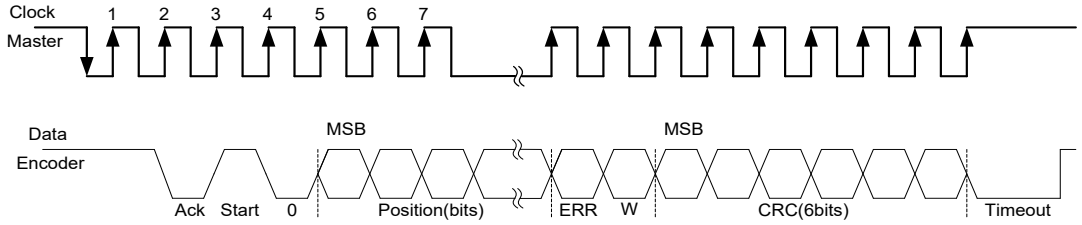
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 ~16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 26 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

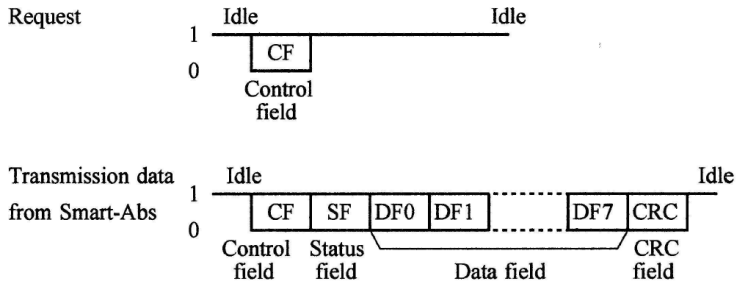
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

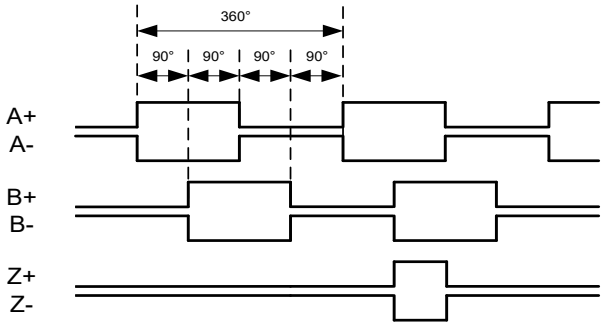
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

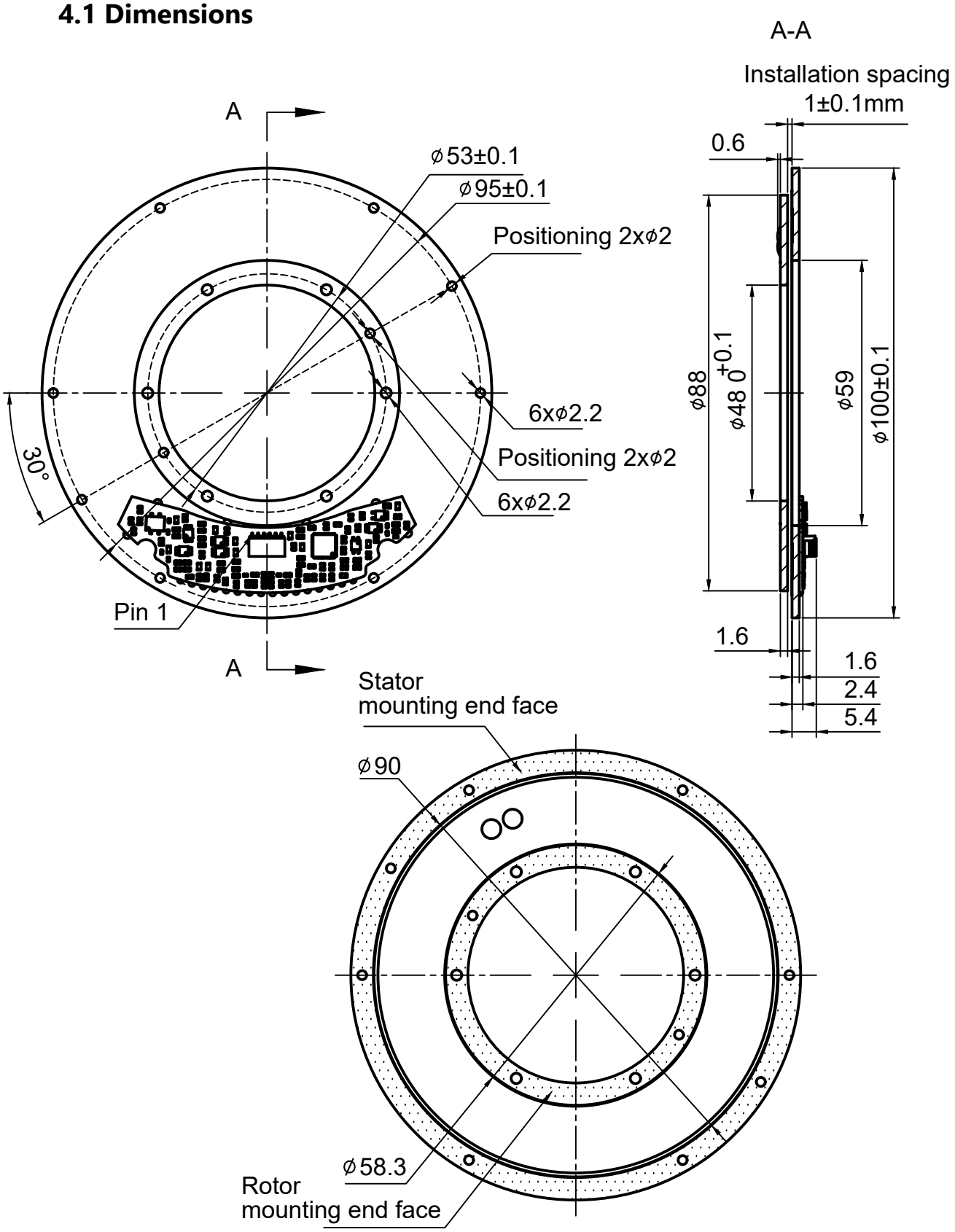
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



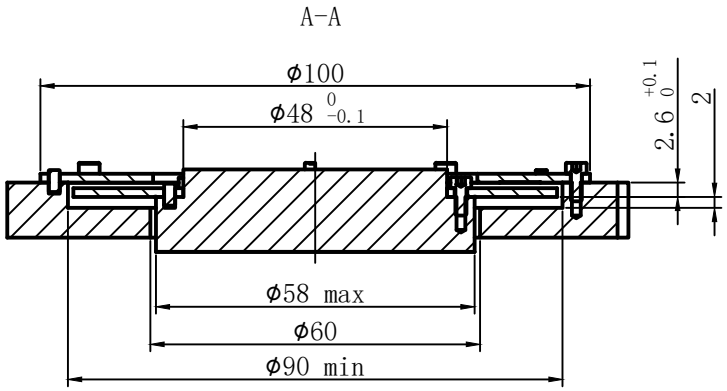
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

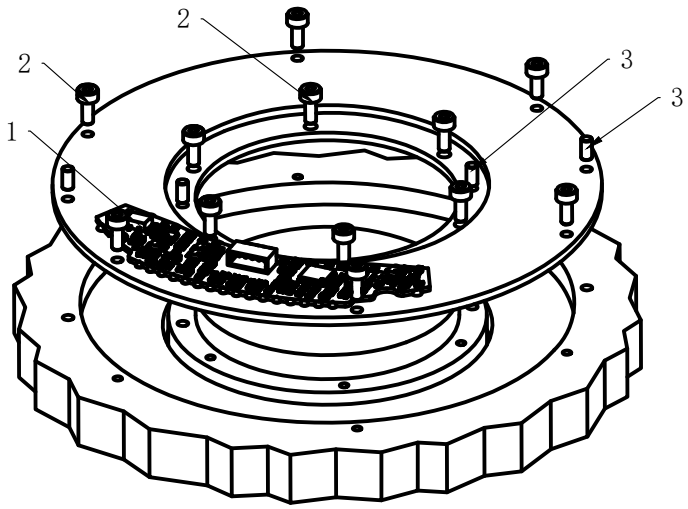
4、Mechanical Mounting

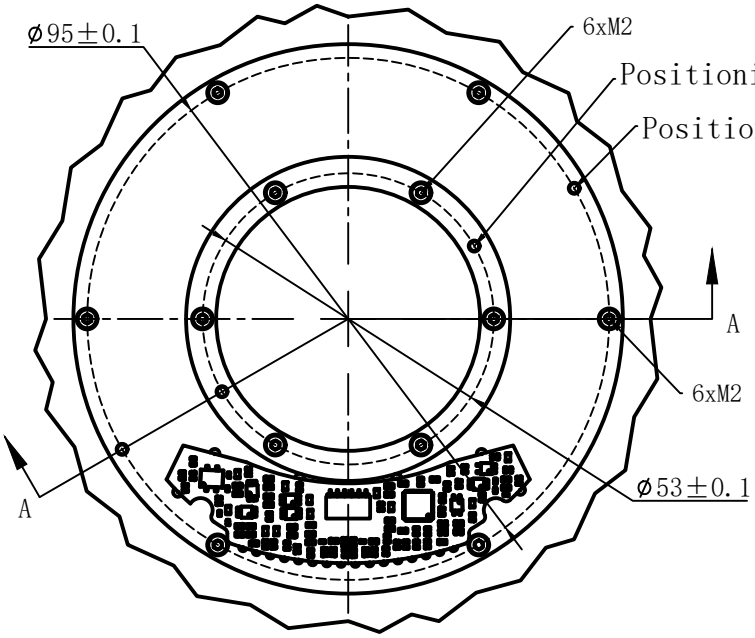
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C48100	1	Product
2	M2x5 screw	12	Install accessories
3	⌀2x4 dowel pin	4	

2、Technical Specifications

General

Resolution	19-21 bit (23 bit extension)
Maximum static error	±0.006°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	120\70\8 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	1±0.1 mm
Rotor inertia	40 kg·mm^2
Weight (stator / rotor)	50 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130 mA
Electrical Interface	6/8-pin connector
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 / 11ms
Vibration functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C70120 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

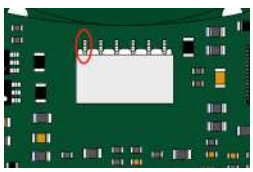
Interface wires color code

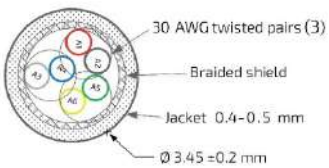
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD

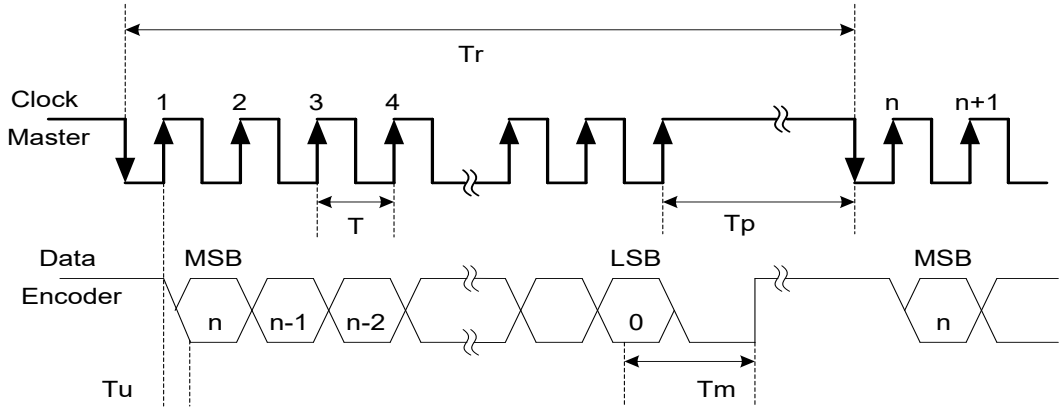




6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK
8-pin thin plug: HC-1.25-8PWT、HC-0.8-8PWT（ABZ version）
Corresponding plug: HC-1.25-8Y、HC-0.8-8Y（ABZ version）

3.2 SSi Interface

SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:

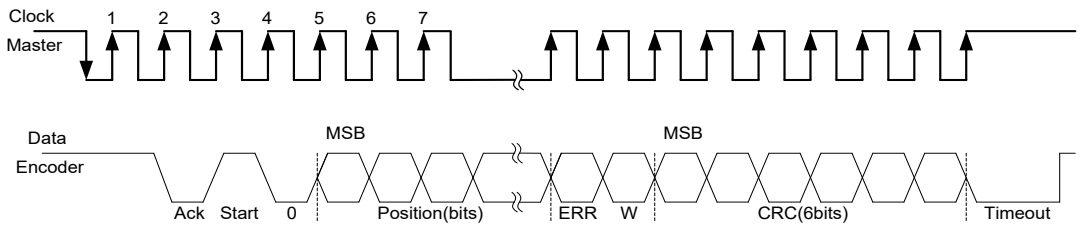


n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

Selecting multi-turn products, the multi-turn angle data is positioned before the single-turn angle data MSB, with the MSB first and the LSB last.

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 30 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

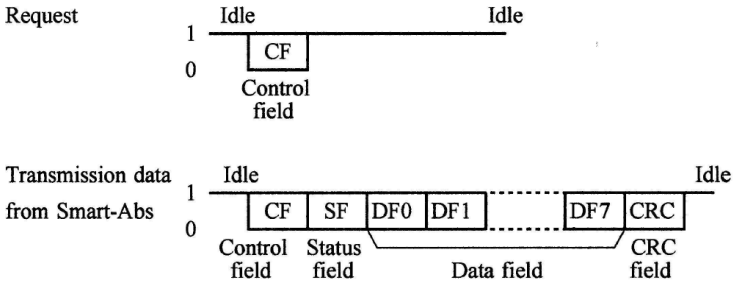
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command
Sent data（HEX）：0x02
2. The master receives data frames from the encoder
Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16
0x02: CF return the same command
0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error
EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error
CA0=1 Communication parity error
CA1=1 Communication stop bit error
0x03 0x02 0x01: DF single turn position（LSB first）
0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command Sent data（HEX）: 0x92
2. The master receives data frames from the encoder：
Received data（HEX）：0x92 0x20 0x11 0xA3
0x92: CF return the same command
0x20: SF

0x11: Encoder ID, fixed 0x11
0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

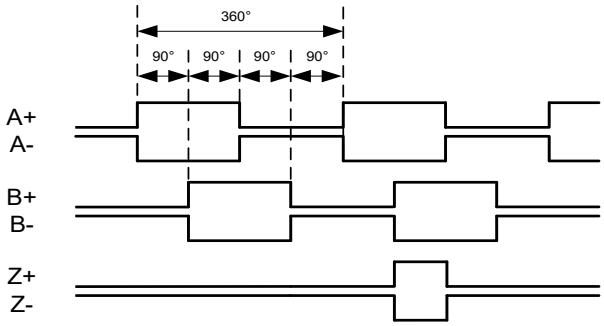
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

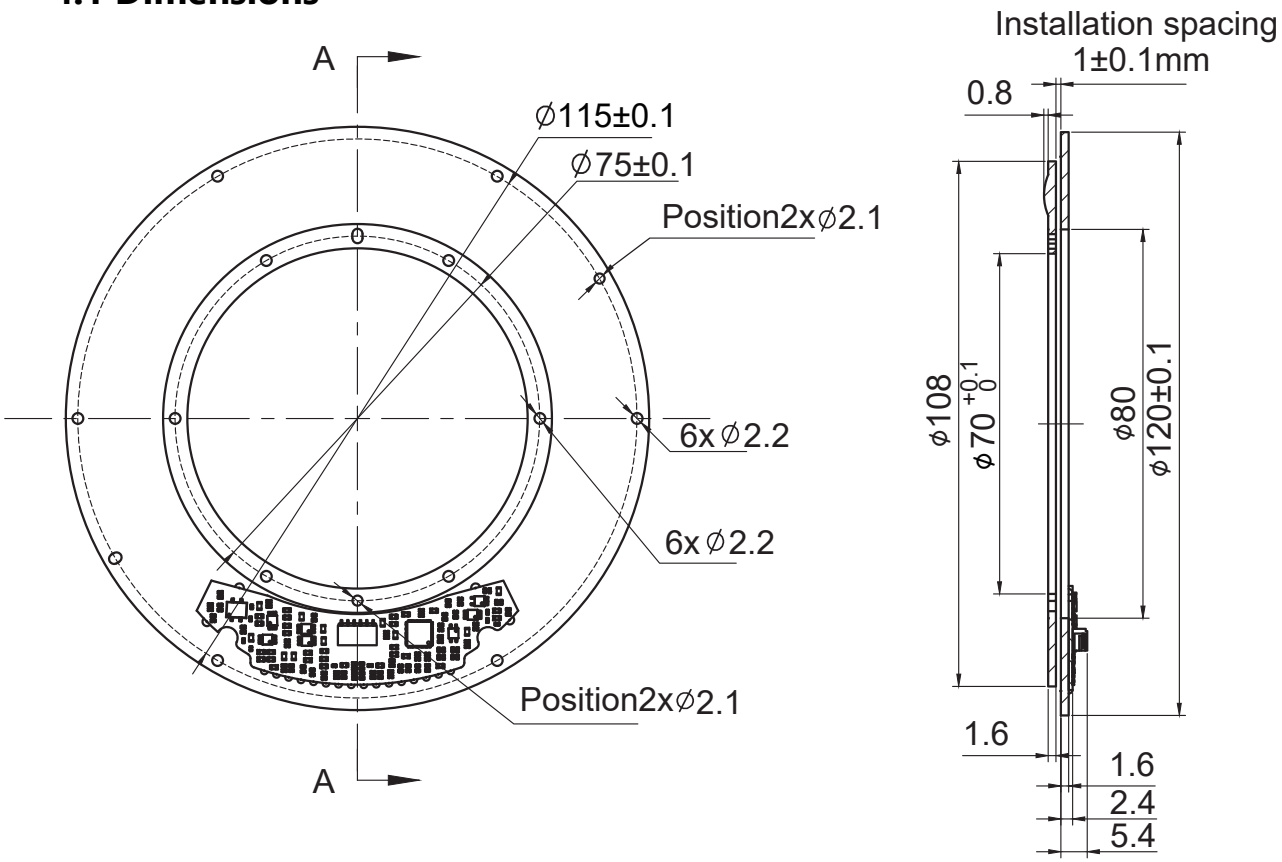
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.

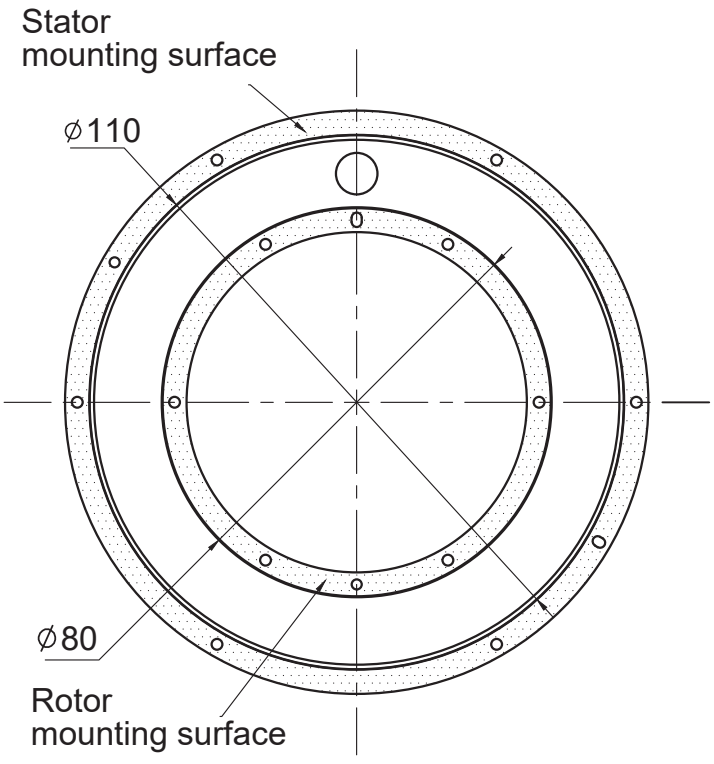


The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

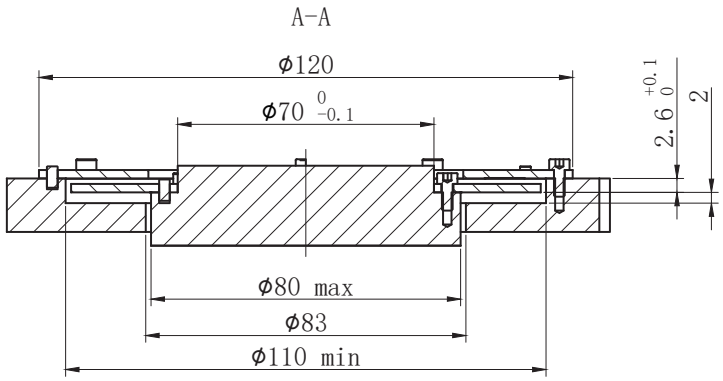
4、Mechanical Mounting

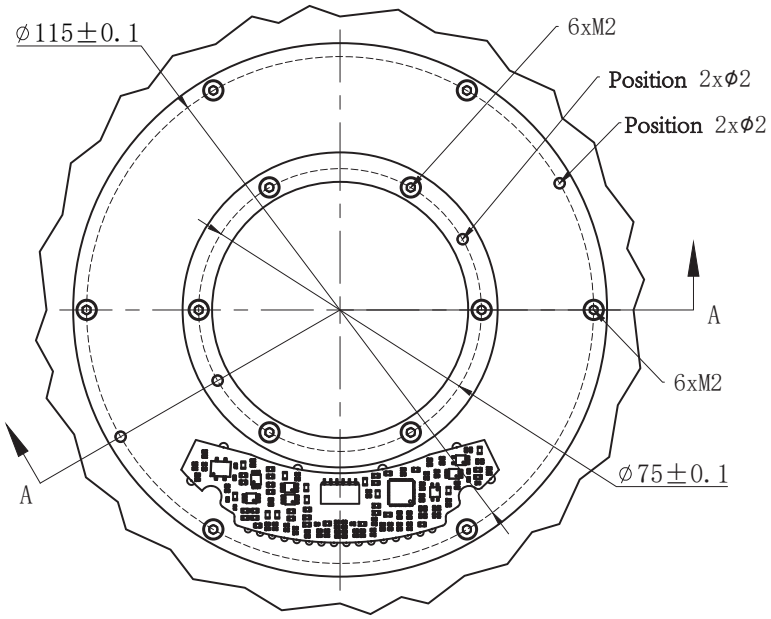
4.1 Dimensions

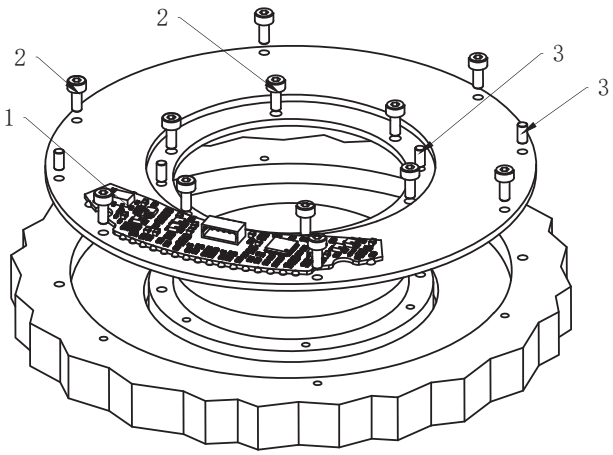




4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C70120	1	Product
2	M2x5 screw	12	Install accessories
3	⌀2x4 dowel pin	4	

2、Technical Specifications

General

Resolution	19-21 bit (23 bit extension)
Maximum static error	±0.006°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	140\90\9 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	1±0.1 mm
Rotor inertia	99 kg·mm^2
Weight (stator / rotor)	75 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C90140 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

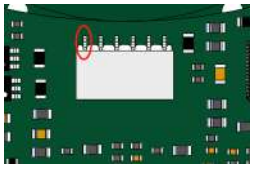
Interface wires color code

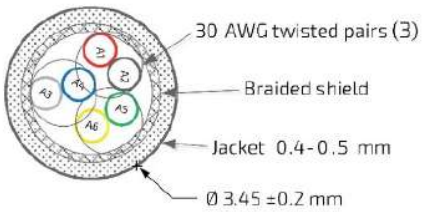
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

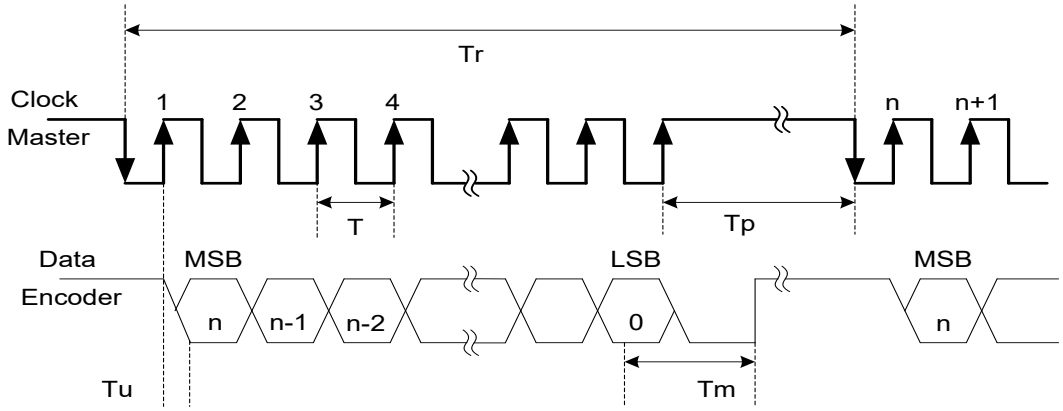
Corresponding plug: ZX-SH1.0-6PJK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT（differential ABZ version）

Corresponding standard plug： HC-1.25-8Y (standard version)

3.2 SSi Interface

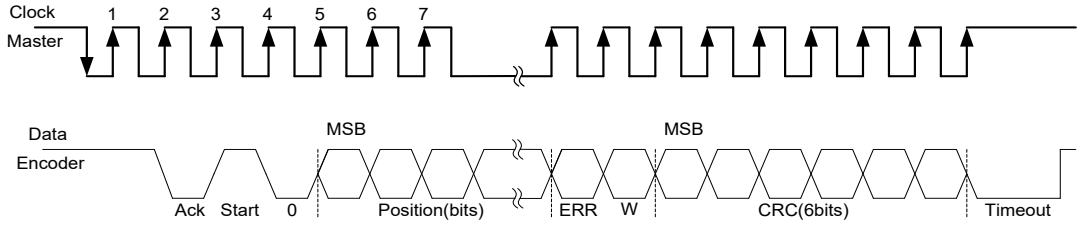
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 30 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

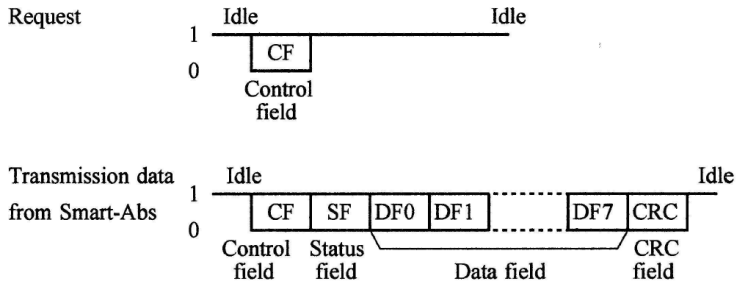
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command
Sent data（HEX）：0x02
2. The master receives data frames from the encoder
Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16
0x02: CF return the same command
0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error
EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error
CA0=1 Communication parity error
CA1=1 Communication stop bit error
0x03 0x02 0x01: DF single turn position（LSB first）
0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command Sent data（HEX）: 0x92
2. The master receives data frames from the encoder：
Received data（HEX）：0x92 0x20 0x11 0xA3
0x92: CF return the same command
0x20: SF
0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

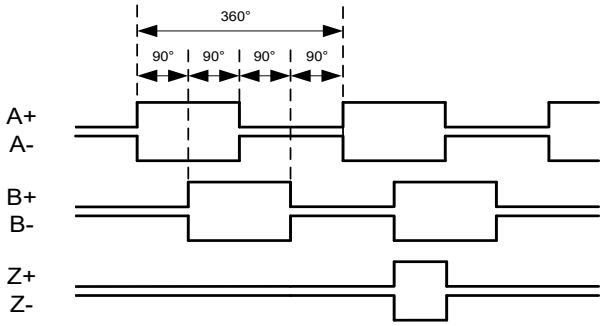
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

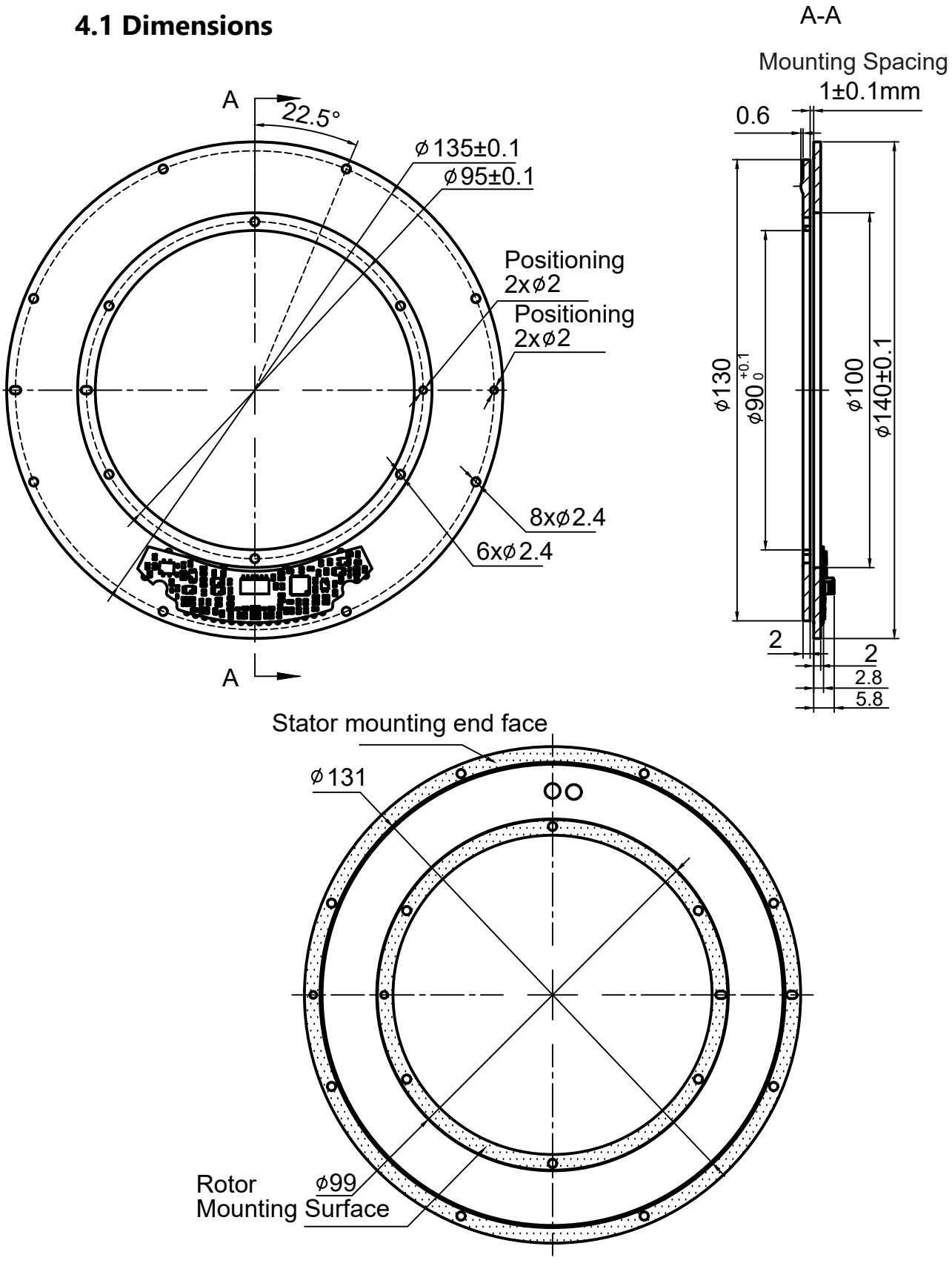
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



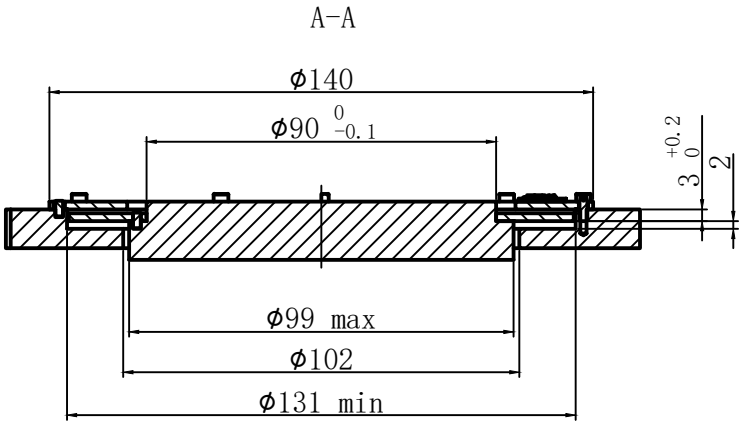
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

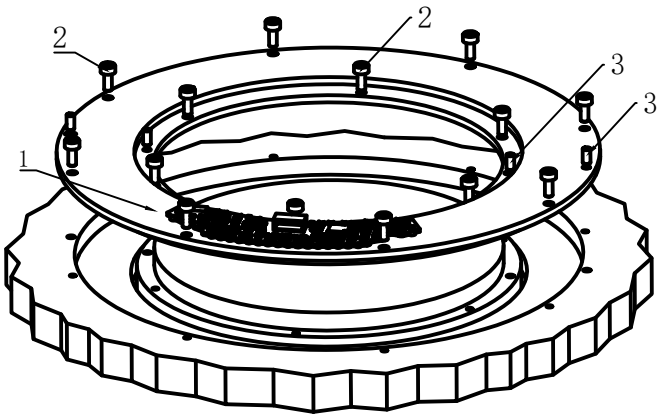
4、Mechanical Mounting

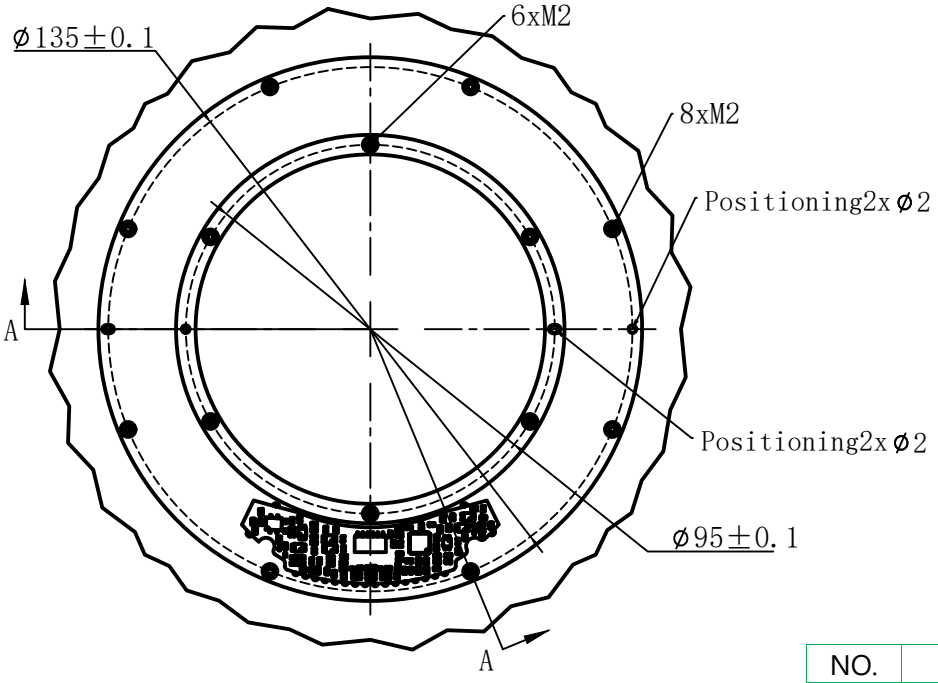
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C90140	1	Product
2	M2x5 screw	14	Install accessories
3	⌀2x4 dowel pin	4	

2、Technical Specifications

General

Resolution	20-22 bit (24 bit extension)
Maximum static error	±0.006°
Repetitive error	±2 LSB
Maximum operational speed	4000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	180\120\9 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	239.2 kg·mm^2
Weight (stator / rotor)	120g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130 mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C120180 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

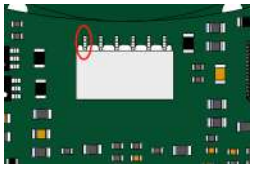
Interface wires color code

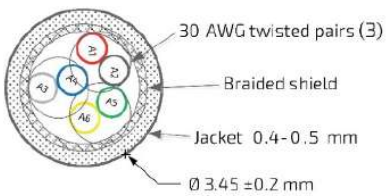
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

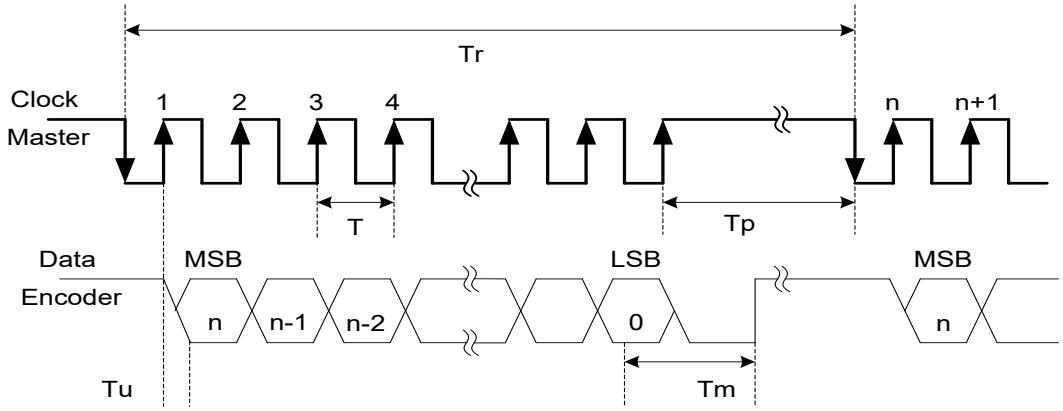
Corresponding plug: ZX-SH1.0-6PJK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT（differential ABZ version）

Corresponding standard plug： HC-1.25-8Y (standard version）
HC-0.8-8PY（differential ABZ version）

3.2 SSi Interface

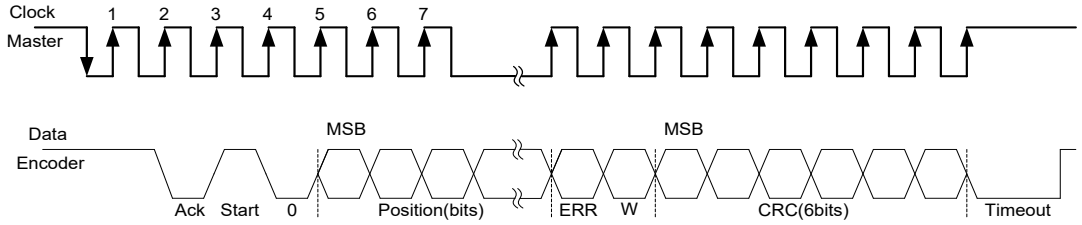
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for “start” data transmit	1	1 bit
26	“0”	“Start” bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential “start” request cycle’s		> 30 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and “0” bit are omitted from the CRC calculation.

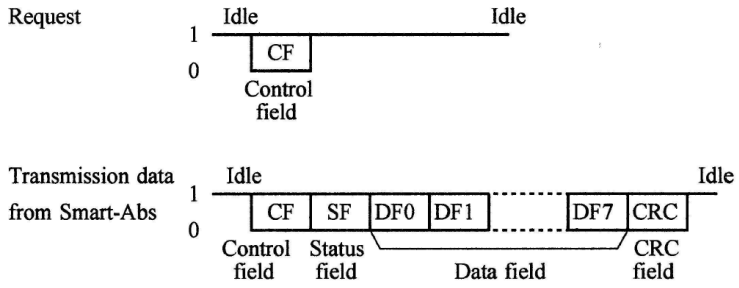
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

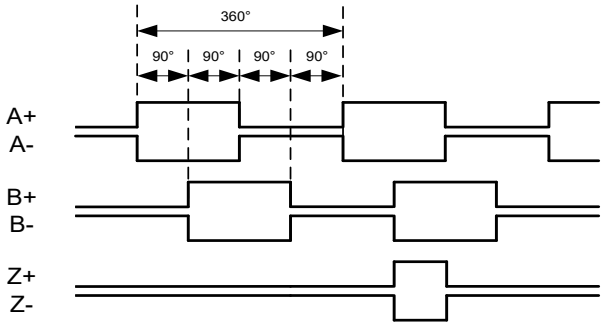
3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:

   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

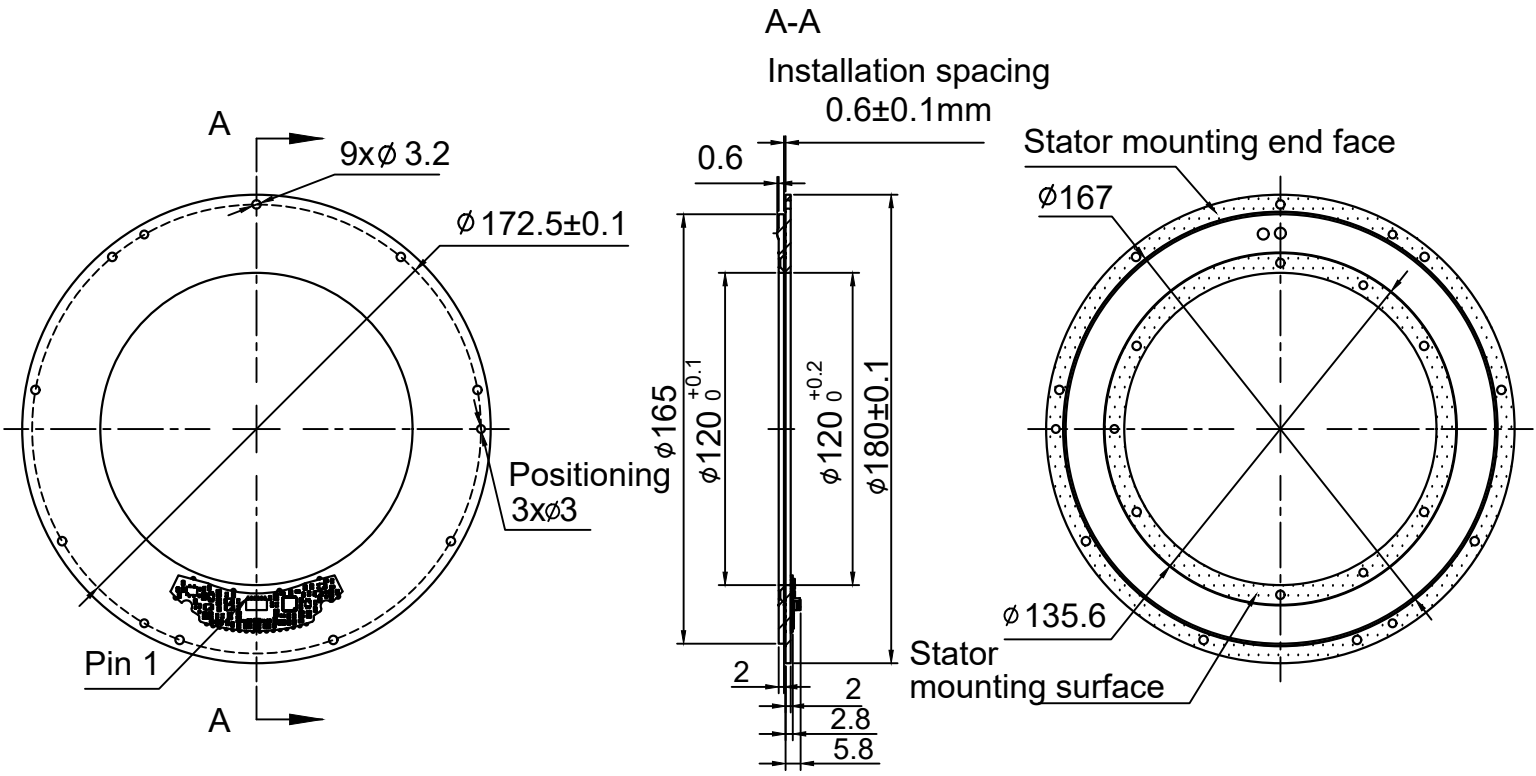
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



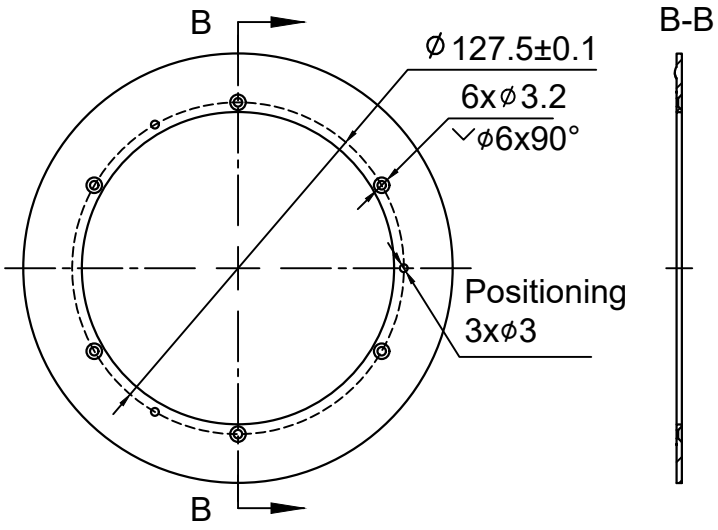
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

4、Mechanical Mounting

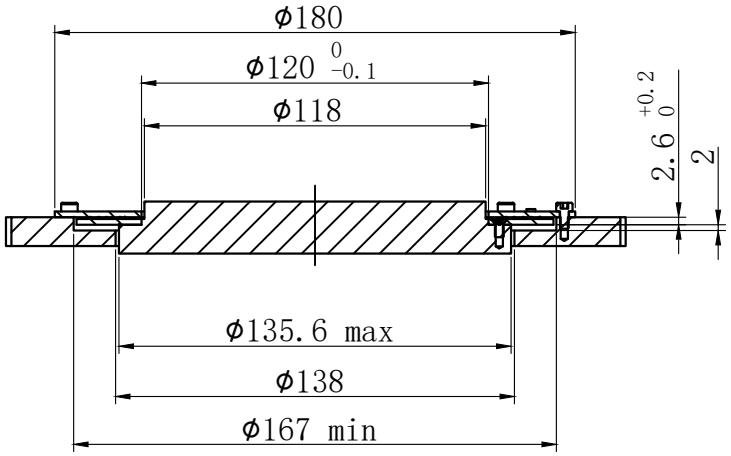
4.1 Dimensions

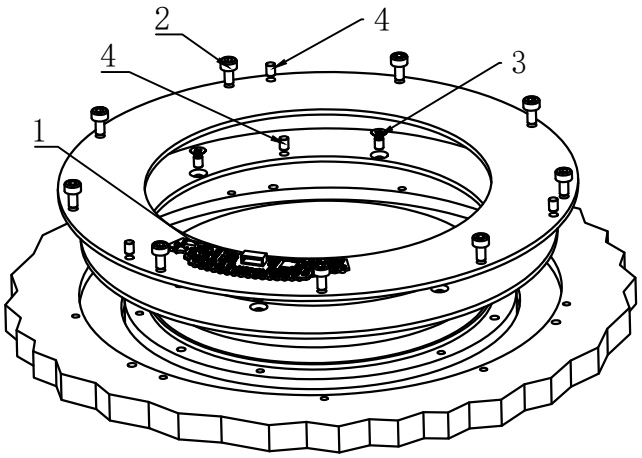


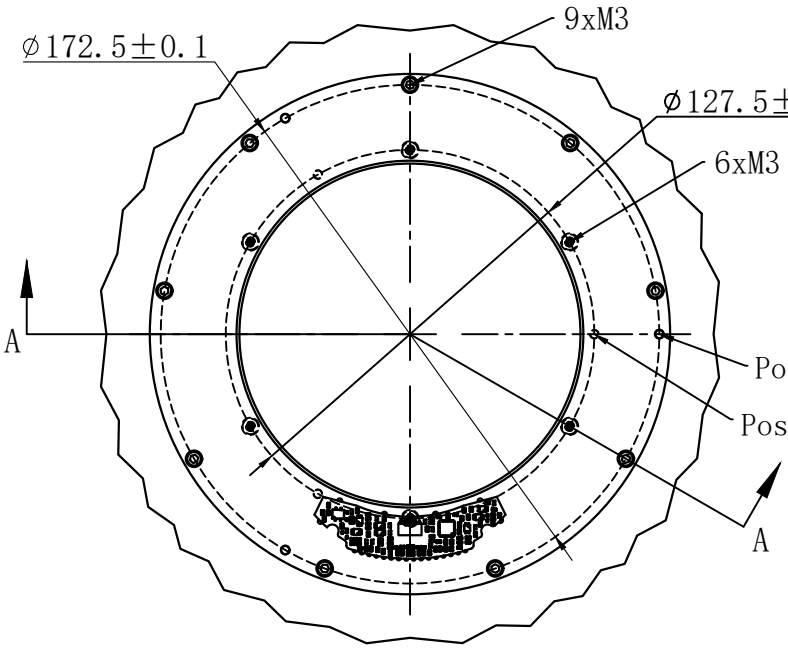
C/C120180 - Rotor part



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C120180	1	Product
2	M3x6 screw	9	Install accessories
3	M3x6 countersunk head cross screw	6	
4	ϕ3x4 dowel pin	6	

2、Technical Specifications

General

Resolution	20-22 bit (24 bit extension)
Maximum static error	±0.006°
Repetitive error	±2 LSB
Maximum operational speed	4000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	247\172\9 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	1±0.1 mm
Rotor inertia	795.6 kg·mm^2
Weight (stator / rotor)	180g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	120~130 mA
Electrical Interface	6/8-pin connector、6/8-core cable
Communication	SSi、BiSS-C、RS-422、RS-485、Differential ABZ

Environmental

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 functional	20 g（10 - 2000 Hz）
Protection	IP 40

3、Electrical Connection

3.1 Hardware Interface

C172247 encoder consists of a stator and a rotor, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485、Differential ABZ.

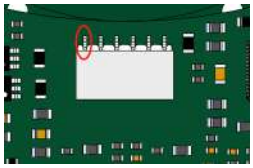
Interface wires color code

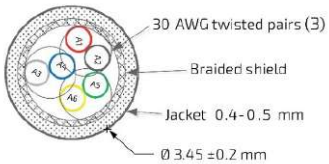
No.	SSI	RS-422	BiSS-C	RS-485	ABZ	Colour
1	VCC					Red
2	GND					Black
3	CLK+	RX+	MA+	/	A+	Grey
4	CLK-	RX-	MA-	/	A-	Blue
5	DADT-	TX-	SLO-	B-	B-	Yellow
6	DADT+	TX+	SLO+	A+	B+	Green
7	/ (6-pin connector)				Z+	White
8	/ (6-pin connector)				Z-	Orange

SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25kHz
Clock/ Serial output	Differential RS-422

Cable: 30 AWG twisted 3 pairs
(30 AWG 25/0.05 tinned copper, Insulation: ETFE Ø 0.12-0.15 to Ø 0.6 ± 0.05 OD)
Temperature rating: -50° to +150° C
Braided shield: Thinned copper braided 95% min. coverage
Jacket: 0.4-0.5 silicon rubber Ø3.45 ±0.2 OD





6-pin thin plug: ZX-SH1.0-6PWT

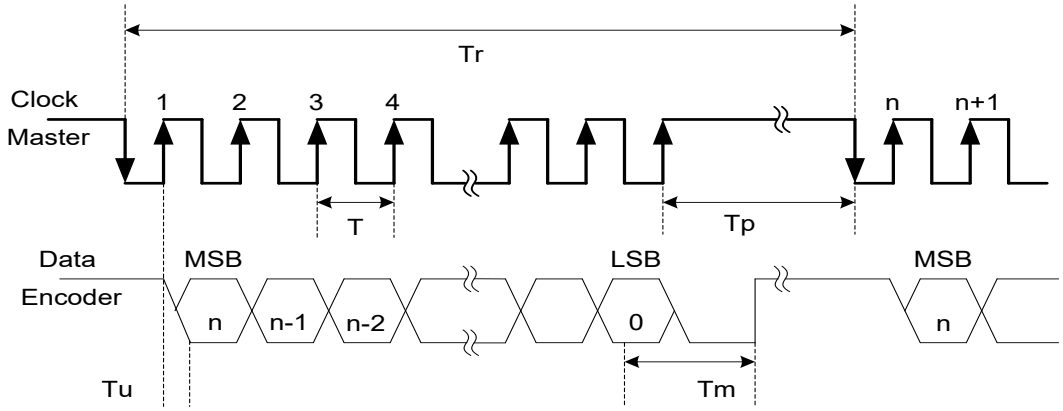
Corresponding plug: ZX-SH1.0-6P JK

8-pin thin plug: HC-1.25-8PWT (standard version)
HC-0.8-8PWT（differential ABZ version）

Corresponding standard plug： HC-1.25-8Y (standard version）
HC-0.8-8PY（differential ABZ version）

3.2 SSi Interface

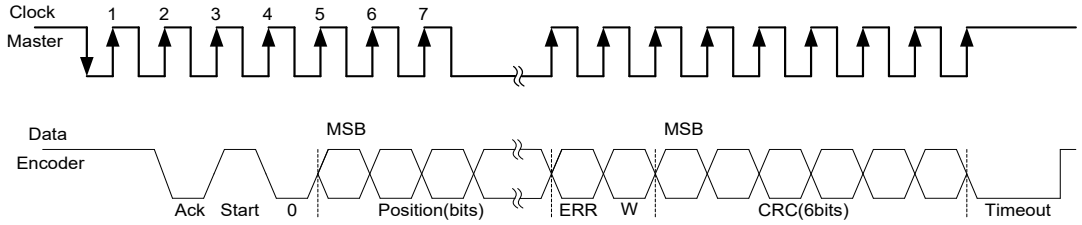
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits the angle data to the master in sequence according to the clock. The timing diagram is as follows:



n	Position resolution	12 - 16
f（T）	Clock frequency (Clock period)	0.5 - 5.0 MHz
Tu	Bit update time	50 ns
Tp	Pause time	＞ 25 us
Tm	Monoflop time	＞ 3 us
Tr	Time between 2 adjacent requests	Tr ＞ n*T +25 us
fr=1/Tr	Data request frequency	

3.3 BiSS-C Interface

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 high-precision position control absolute encoders. The product uses BiSS-C as a point-to-point configured unidirectional interface, which can serve as one or more slaves connecting to the master, meeting the requirements of BiSS-C unidirectional interface. The timing diagram is as follows:



Bit/n		Description	Default Length	Default Length
28	Ack	Period during which the encoder calculates the absolute position, one clock cycle	0	1 bit
27	Start	Encoder signal for "start" data transmit	1	1 bit
26	"0"	"Start" bit follower	0	1 bit
8-25	Position	Absolute Position encoder data		Per resolution
7	Error	BIT (Built In Test option)	1	1 bit
6	Warn	Warning (non active)	1	1 bit
0-5	CRC	*The CRC polynomial		6 bit
--	Timeout	Elapse between the sequential "start" request cycle's		> 26 us

*The CRC polynomial for position, error and warning data is: $x^6 + x^1 + x^0$. It is transmitted MSB first and inverted. The start bit and "0" bit are omitted from the CRC calculation.

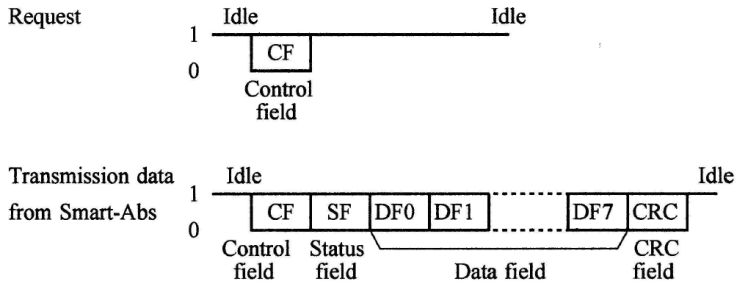
3.4 RS-422 UART Interface

Asynchronous serial communication interface over RS422 (UART), by default, the master does not need to send requests, and the encoder automatically outputs data to the master. The update rate of the encoder data is 2000Hz, the baud rate is 460800bps, and the data format is 1 start bit, 8 data bits, 1 even check bit, and 1 stop bit. Each frame of data contains 10 bytes, and the format is shown in the table below.

	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check	9	Most Significant 8 Bits	Accumulate the 3th4th, 5th6th, and 7th8th bytes, taking the lower 16 bits
	10	Least Significant 8 Bits	

3.5 RS-485 UART Interface

RS-485 serial interface, half duplex communication protocol, requires the master to send commands to get the angle position. The data update rate is related to the master request rate. The baud rate is 2.5Mbps, and the data format is 1 start bit, 8 data bits, 0 even check bits, and 1 stop bit. Frame format for reading-out data is as follows:



3.5.1 Single turn position request command:

1.Master send command

Sent data（HEX）：0x02

2. The master receives data frames from the encoder

Received data（HEX）：0x02 0x20 0x03 0x02 0x01 0x16

0x02: CF return the same command

0x20: SF defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
0	0	0	0	EA0	EA1	CA0	CA1

EA0=1 Single turn counting error

EA1=1 Overtemperature, multiturn counting error, battery alarm, or battery error

CA0=1 Communication parity error

CA1=1 Communication stop bit error

0x03 0x02 0x01: DF single turn position（LSB first）

0x16: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.2 Encoder ID data request command

1. Master send command　　Sent data（HEX）: 0x92

2. The master receives data frames from the encoder：

Received data（HEX）：0x92 0x20 0x11 0xA3

0x92: CF return the same command

0x20: SF

0x11: Encoder ID, fixed 0x11

0xA3: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.3 Encoder all data request command

1. Master send command Sent data（HEX）: 0x1A
2. The master receives data frames from the encoder：
   Received data（HEX）：0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08
   0x1A: CF return the same command
   0x20: SF
   0x03 0x02 0x01: DF single turn position（LSB first）
   0x11: Encoder ID, fixed 0x11
   0x05 0x04 0x00: DF multiturn position（LSB first）（0x0405 = 1029, Max.65535）
   0x22: Encoder error, defined as follows (LSB first)

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Overspeed	Full absolute status	Counting error	Counter overflow	"0"	Multiturn error	Battery error	Battery alarm

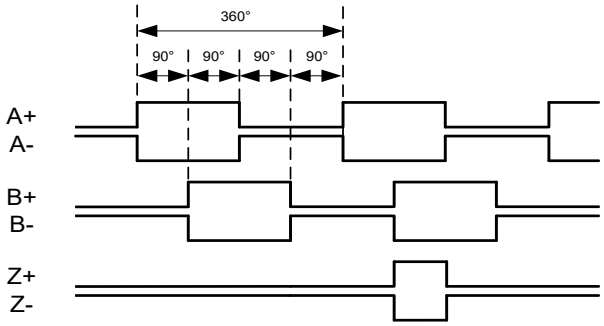
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.5.4 Single turn position reset request command:

1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   0x20: SF
   0x00 0x00 0x00: DF single turn position（LSB first）
   0xE2: CRC G(X) = X^8 + 1, The code is calculated from all bits

3.6 ABZ Incremental Interface

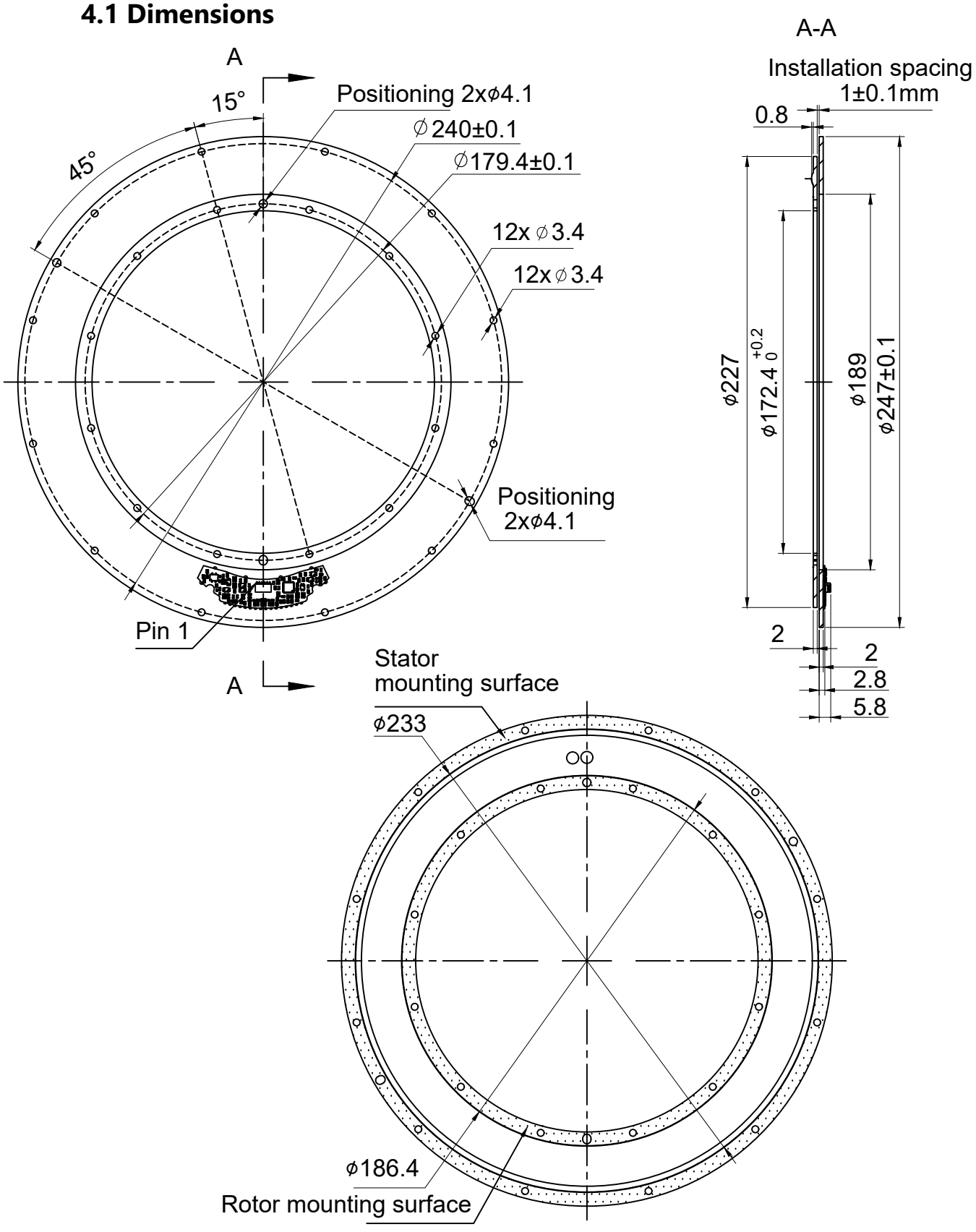
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, the signal of channel A lags behind that of channel B. The encoder also outputs a Z pulse for each revolution, which is used to determine the zero position or the index position.



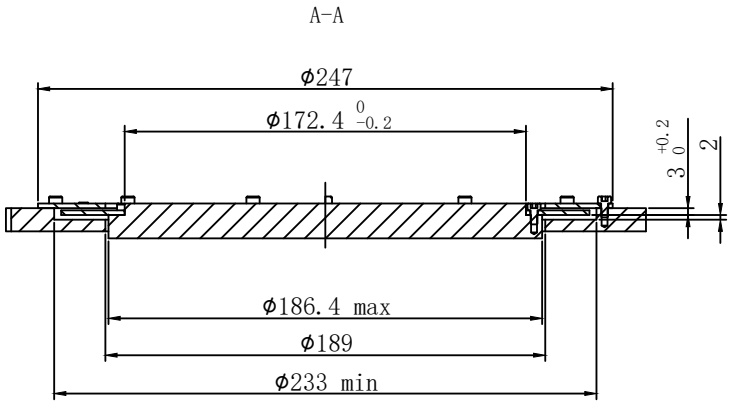
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive end of the differential interface.

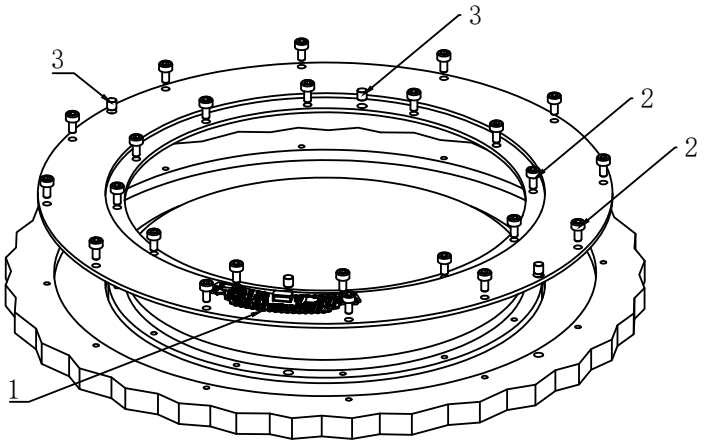
4、Mechanical Mounting

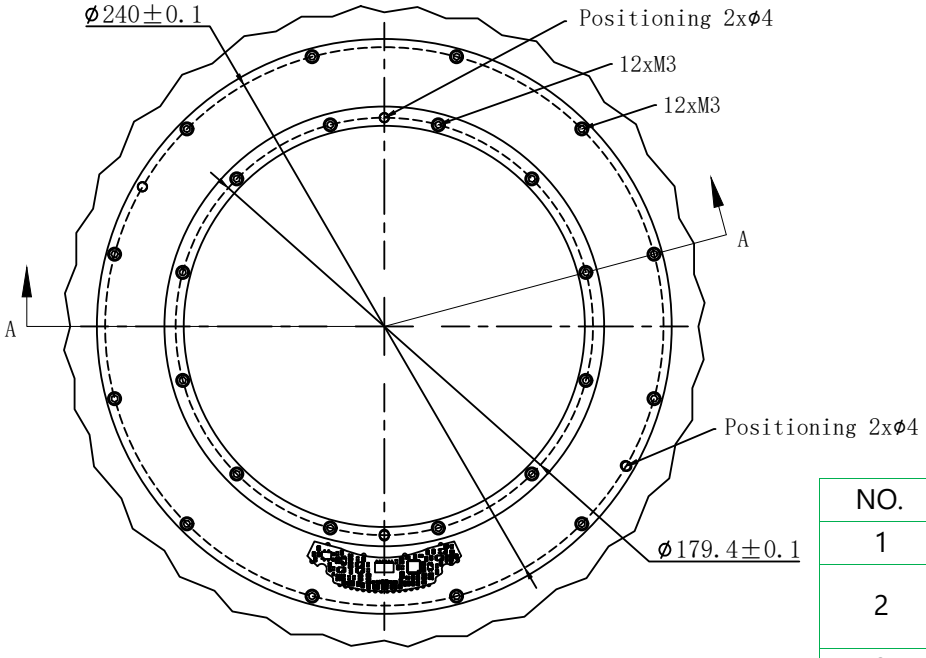
4.1 Dimensions



4.2 Installation Diagram







Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	C172247	1	Product
2	M3x6 screw	24	Install accessories
3	ø4x5 dowel pin	4	

5、Software Tool

The encoder of the SSi/BiSS-C/RS-422 interface can use the Encoder Test Calibration software for position data readout and installation calibration. The Encoder Test Calibration software owns functions such as position data readout, installation verification, calibration, and user zero position setting.

Domestic website

International website

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