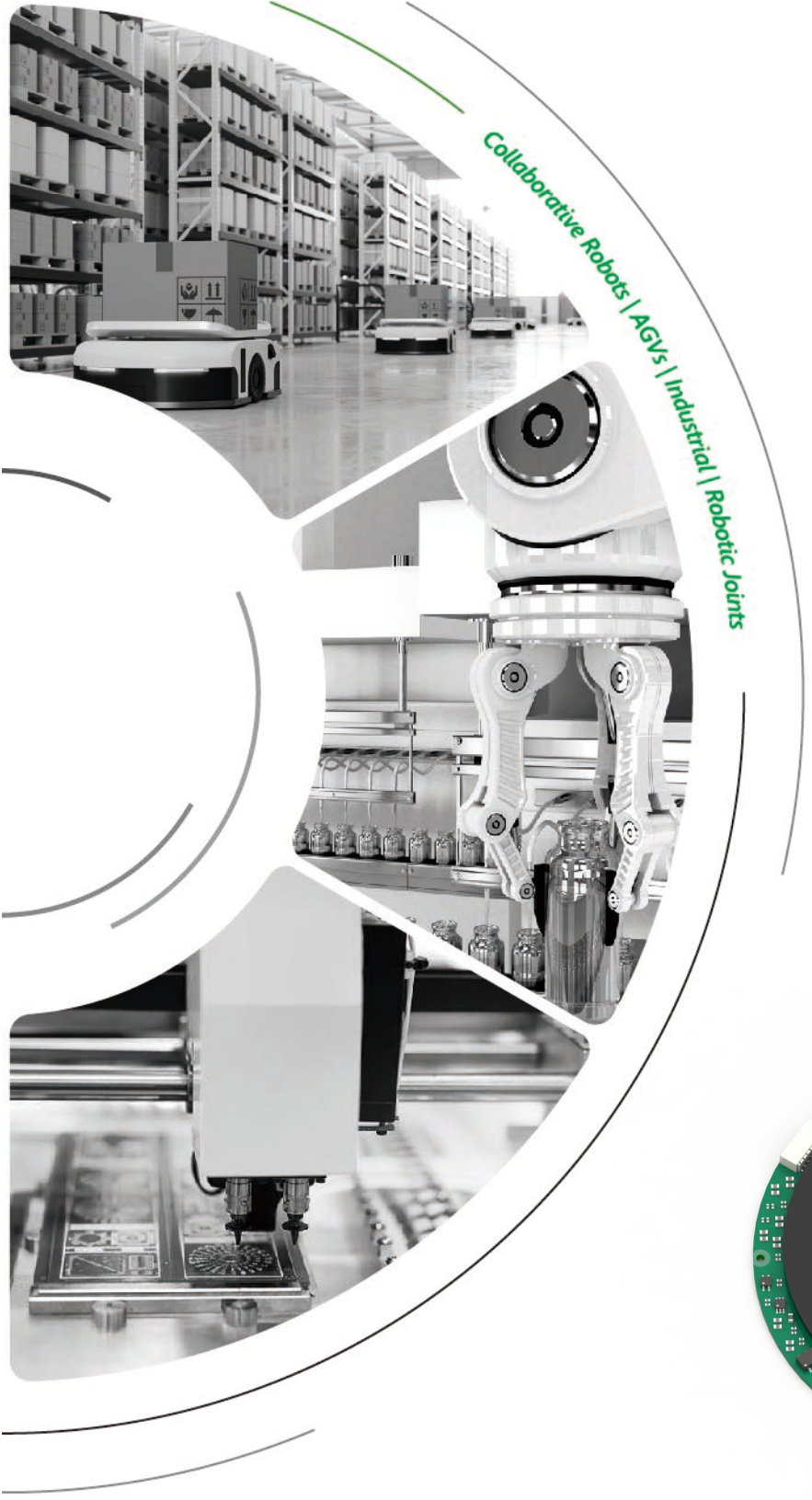
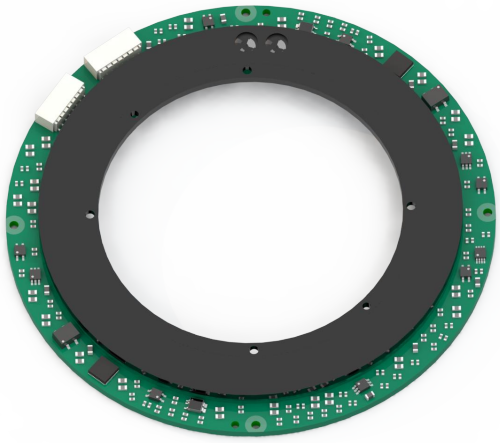


MOSRAC
Mosrac motor



THIN INDUCTIVE ENCODER
PRODUCT GUIDE

High Accuracy | Hollow Shaft | Low Profile | Non-contact

Model

C – 25 – 60 – A – 19 – 01 – 05 – S

Product series
C: Absolute single encoder
D: Absolute dual encoder

Product ID
25：ID 25mm

Product OD
60：OD 60mm

Output Type
A： single-turn absolute value
B： multi-turn absolute value

Encoder output resolution
17 :17bits (131072)
18 :18bits (262144)
19 :19bits (524288)
20: 20bits (1048576)
21: 21bits (2097152)
22: 22bits (4194304)

Communication Protocol
B：BiSS-C interface
S：SSi interface
R：RS-422 serial interface
E：RS-485
A: ABZ interface (default 4096)

Input voltage
05：5V (Default)
12：12V
24：24V

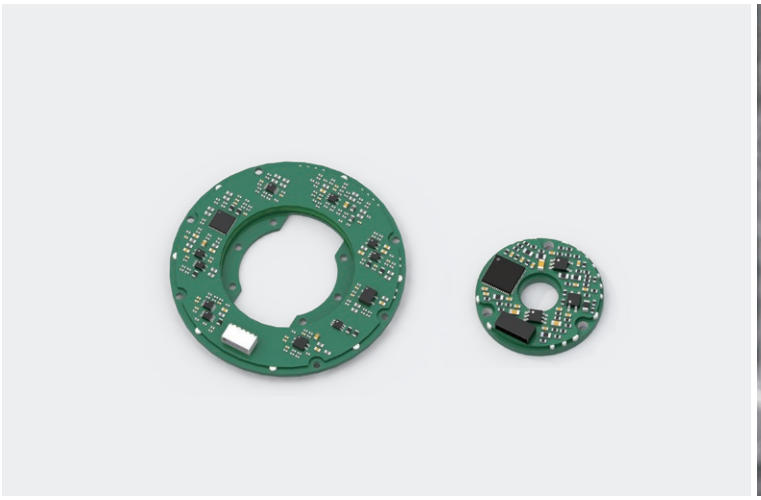
Operating temperature
01：-20℃ ~+60℃ (Default)
02：-40℃ ~+85℃

Example

C–25–60–A–19–01–05–S indicates C series absolute single encoder, inner hole 25mm, outer diameter 60mm, 19 is single turn absolute value,temperature -20℃ ~+60℃, 5V power supply, output communication protocol is SSI interface.

D–21–58–A–19–02–05–E indicates D series absolute dual encoder, inner hole 21mm, outer diameter 58mm, 19 is single turn absolute value,temperature -40℃ ~+85℃, 5V power supply, output communication protocol RS-485 interface.

C Series absolute single encoder



C-Cost-effective and easy to integrate

Economically efficient and easy integration into OEM assemblies

Non-contact, high precision, hollow shaft and ture absolute position features

Using both for position feedback and for optimizing the commutation of the frameless motor

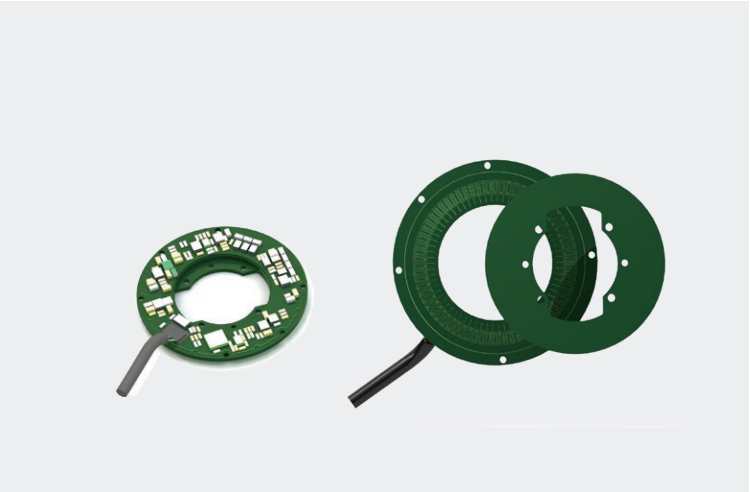
Ultra compact structure, perfect for installation in robot joints or multi axis automation applications

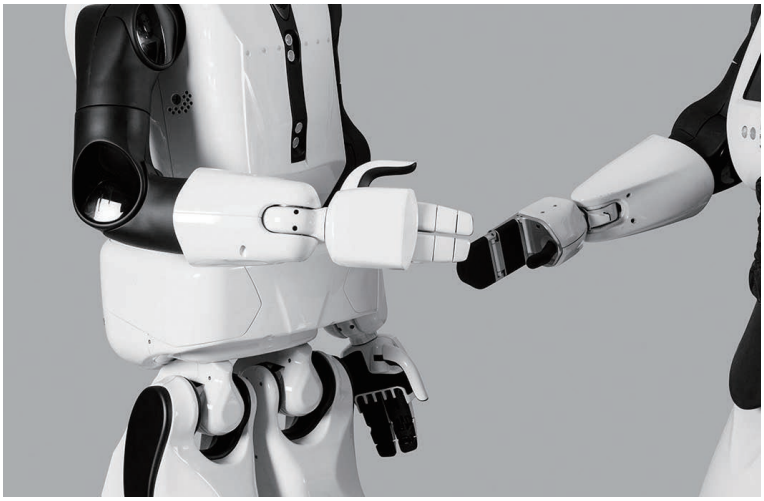
Multiple communication protocols and connections, providing customized extension options

Product	OD / ID / Height	Weight	Resolution	Accuracy	Max. operational speed	Rotor inertia
C0420	20\4\6.5 mm	4 g	15-17 bit	±0.05°	4000 rpm	0.01 kg·mm²
C1040	40\10\8 mm	10 g	17-19 bit	±0.015°	6000 rpm	0.4 kg·mm²
C2560	60\25\8 mm	18 g	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
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	±0.003°	4000 rpm	239.2 kg·mm²
C172247	247\172\9 mm	180 g	20-22 bit	±0.003°	4000 rpm	795.6 kg·mm²

Supply voltage	Electrical interface	Communication	Operating temp.	Protection
5-30V	RS-422 Shielded cable	SSi、BiSS-C、UART	-20℃ - +60℃	IP 67

D Series absolute dual encoder





D- Dual-Output Redundant Inductive Encoder

Non-contact, high precision, hollow shaft and ture absolute position features

Using both for position feedback and for optimizing the commutation of the frameless motor

Ultra compact structure, perfect for installation in robot joints or multi axis automation applications

Multiple communication protocols and connections, providing customized extension options

Equipped with two independent position-detection and signal-output mechanisms.

Product	OD / ID / Height	Weight	Resolution	Accuracy	Max. operational speed	Rotor inertia
D1034	34\10\7.6 mm	10 g	17-19 bit	±0.015°	6000 rpm	0.11 kg·mm²
D2050	50 \ 20 \ 7.6mm	20 g	18-20bit	±0.008°	6000 rpm	0.7 kg·mm²
D2158	58\ (21-18) \7.6mm	25 g	18-20 bit	±0.008°	6000 rpm	1.4 kg·mm2
D3670	70 \ 36 \ 7.6mm	35 g	18-20bit	±0.008°	6000 rpm	3.4 kg·mm²
D3178	78\ (35-31) \7.6mm	55g	18-20 bit	±0.008°	6000 rpm	5.5kg·mm²
D5690	90 \ 56 \ 7.6 mm	50 g	19-21bit	±0.006°	6000 rpm	9.8 kg·mm²
D76110	110 \ 76 \ 7.6mm	65g	19-21bit	±0.006°	6000 rpm	21.2kg·mm²

Supply voltage	Electrical interface	Communication	Operating temp.	Storage temp.	Protection
5-30V	RS-422 Shielded cable	SSi、BiSS-C、UART	-40℃ - +85℃	-50℃ - +100℃	IP 67

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)

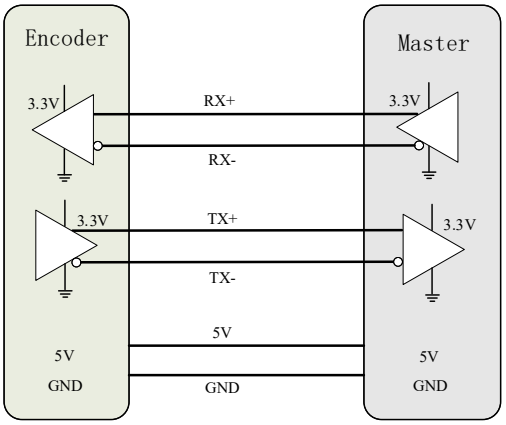
Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
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).



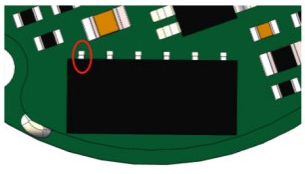
SSI/BiSS/RS-422 connections

No.	Description		Colour
1	5V	5V	Red
2	GND	GND	Black
3	CLK+	RX+	Grey
4	CLK-	RX-	Blue
5	DADT-	TX-	Yellow
6	DADT+	TX+	Green

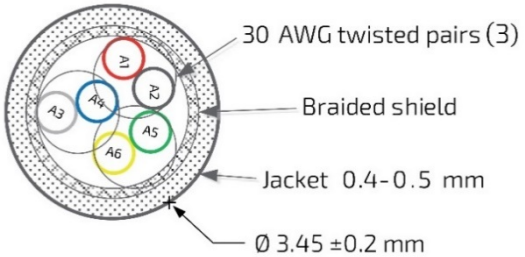
SSi/BiSS output signal parameters

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

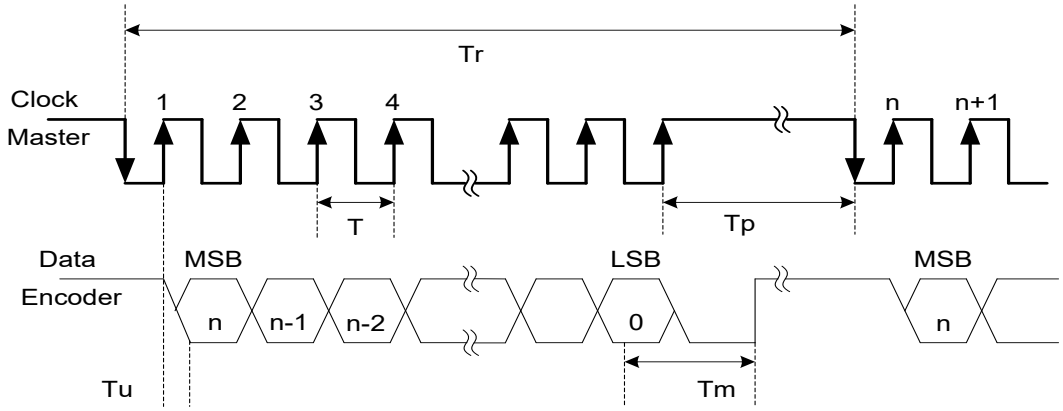


6-pin thin plug: HDGC0601WR-S-6P
Cable diameter: Ø 3.45 ± 0.2mm
Corresponding pairing plug: X0600HI-6P



3.2 SSi Interface

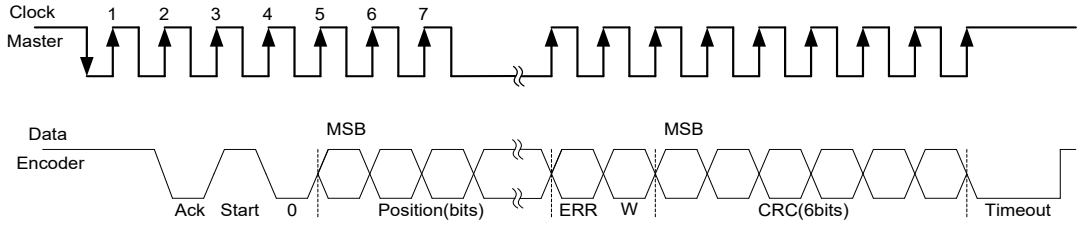
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

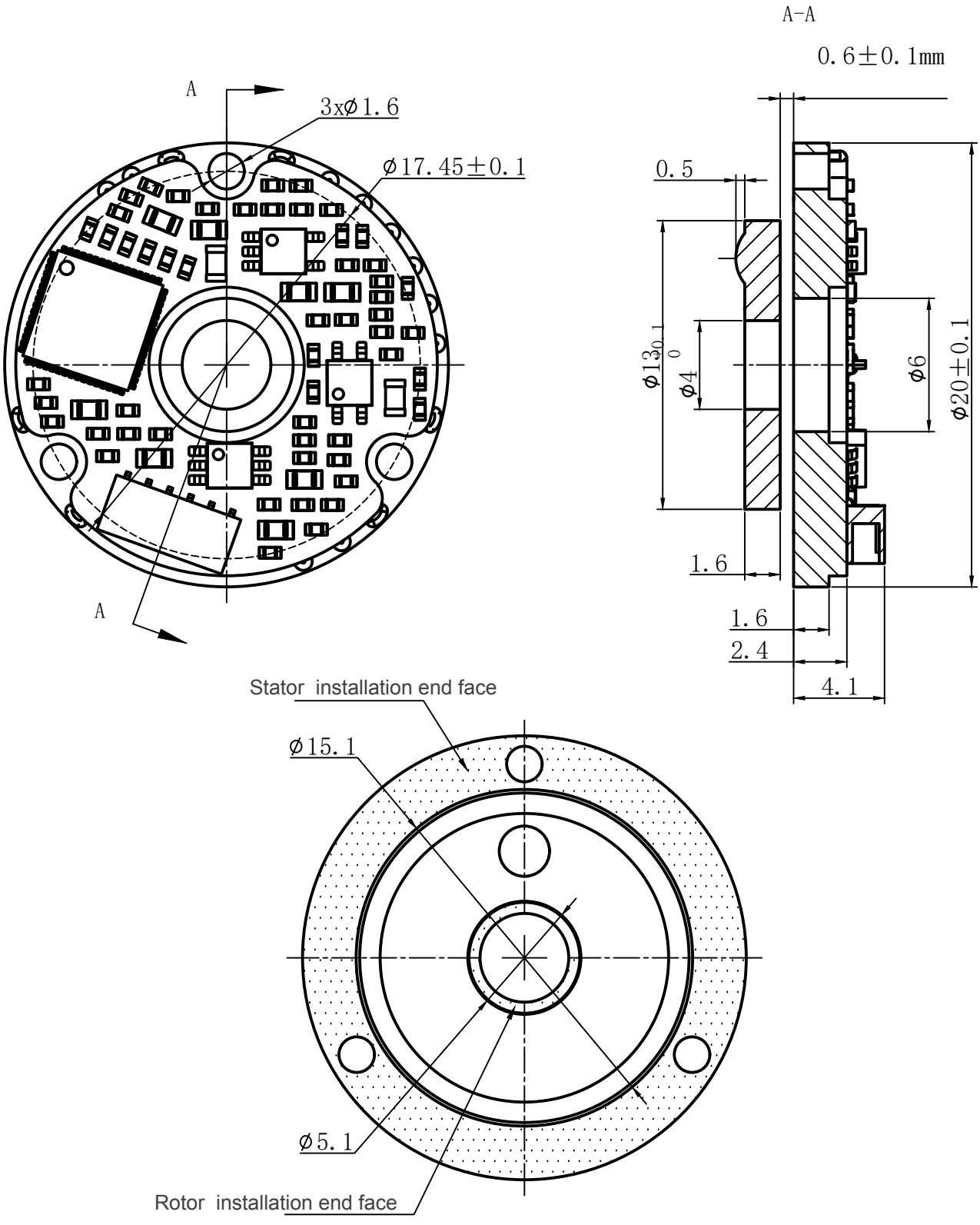
3.4 RS-422 UART Interface

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.

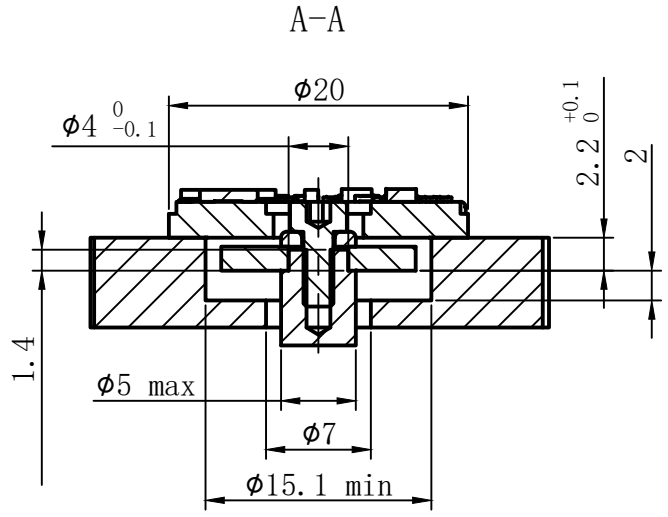
	BIT	Description	Note
Header	1	5E	Defined Header
	2	AD	
Protocol Flag Bit	3	01	Single byte
Position	4	Most Significant 8 Bits	LSB effective, MSB padding 0
	5	Middle Significant 8 Bits	
	6	Least Significant 8 Bits	
Frame Count	7	Most Significant 8 Bits	0-65535 Accumulate
	8	Least Significant 8 Bits	
Check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

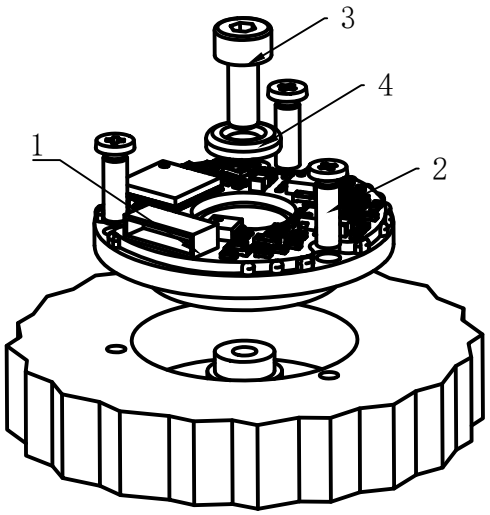
4、Mechanical Mounting

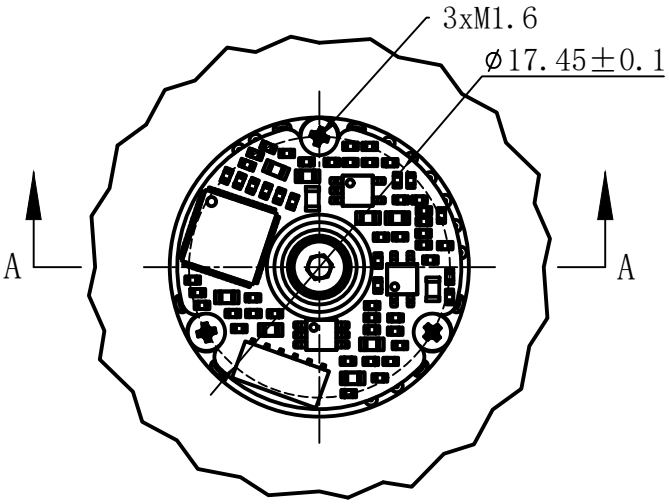
4.1 Dimensions



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	17-19 bit (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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

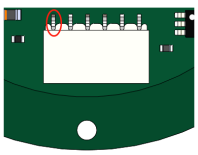
Interface wires color code

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

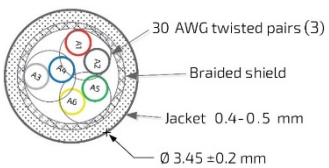
SSi/BiSS output signal parameters

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

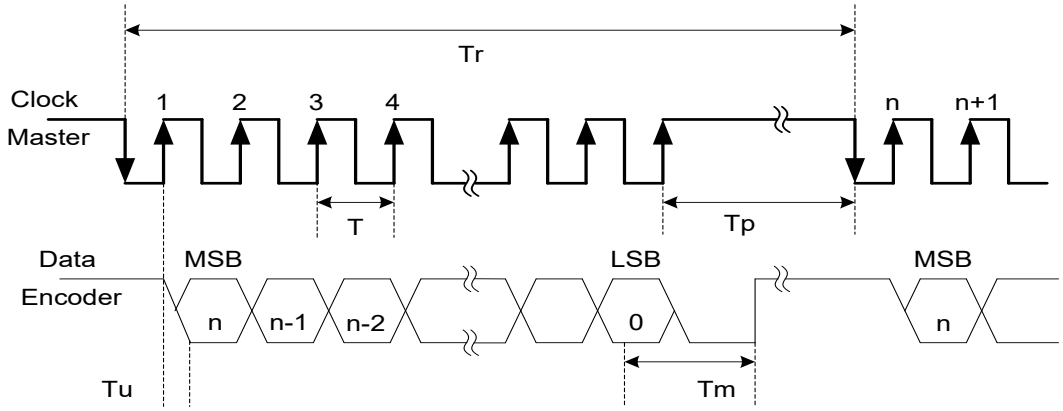


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

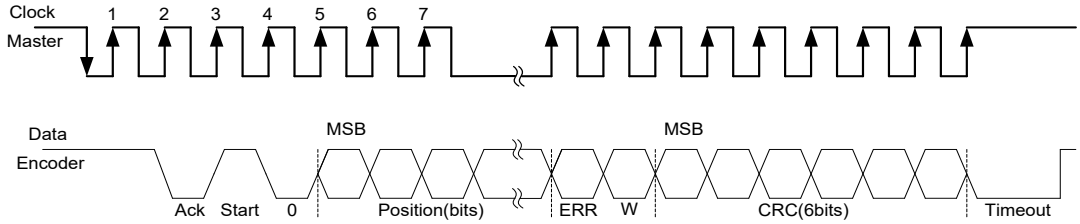
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

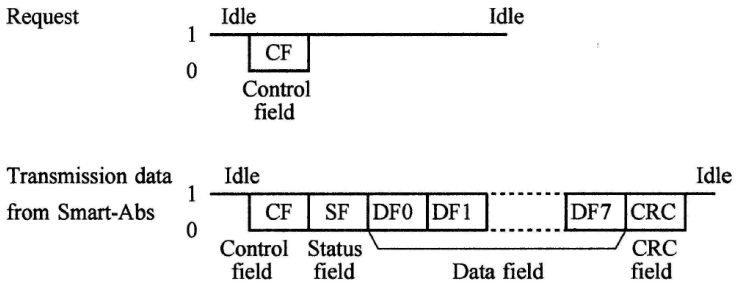
3.4 RS-422 UART Interface

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

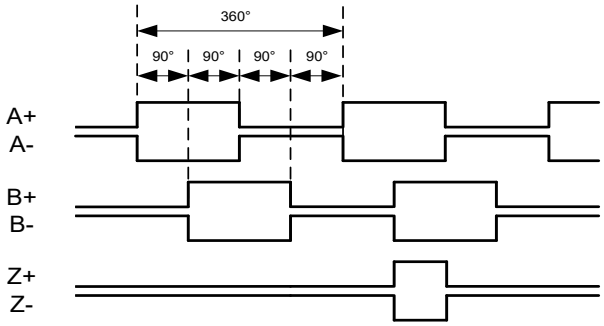
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

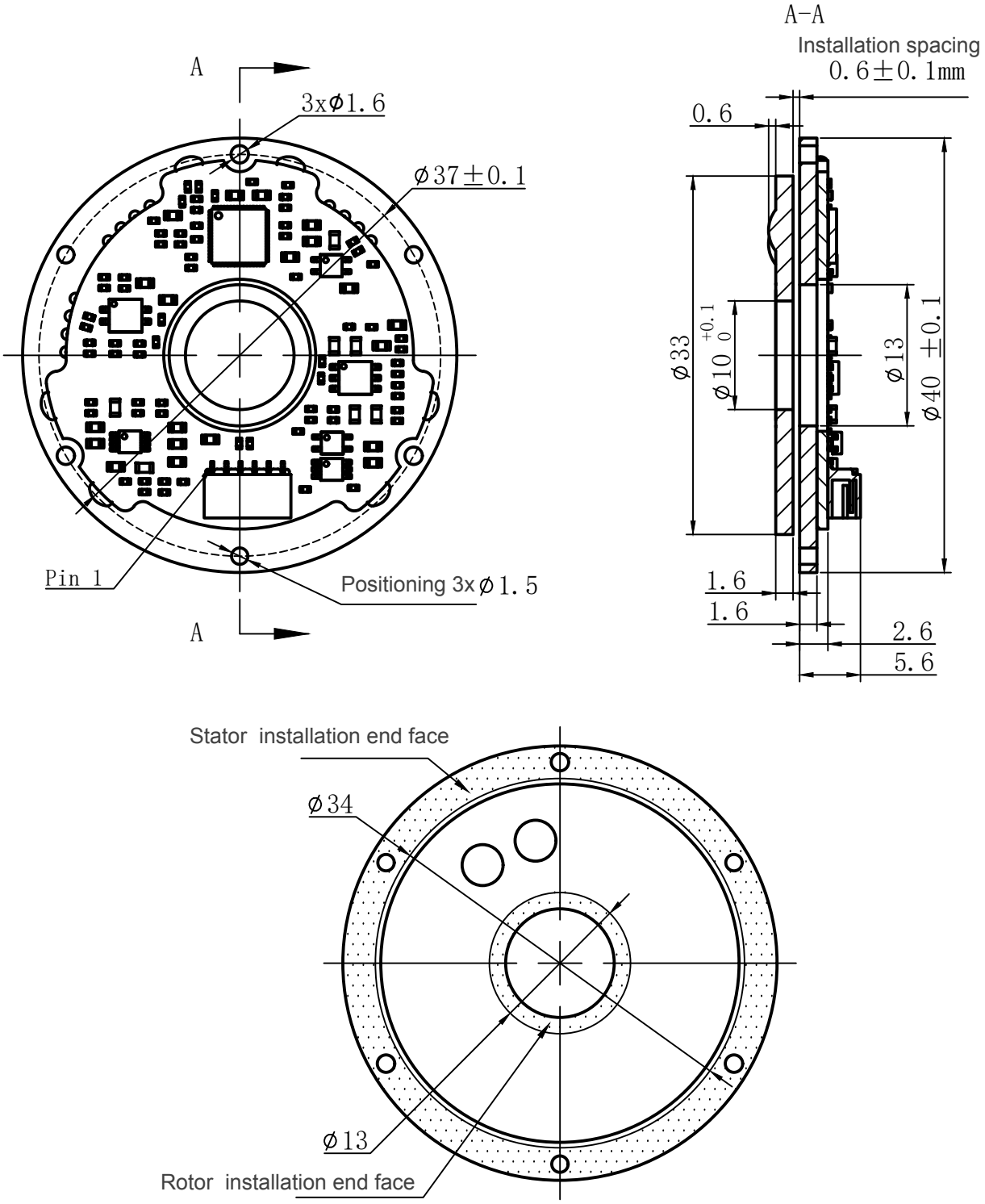
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



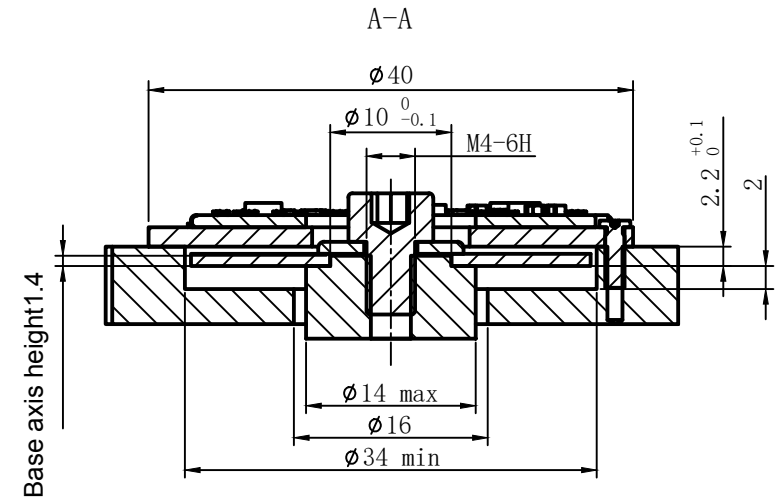
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

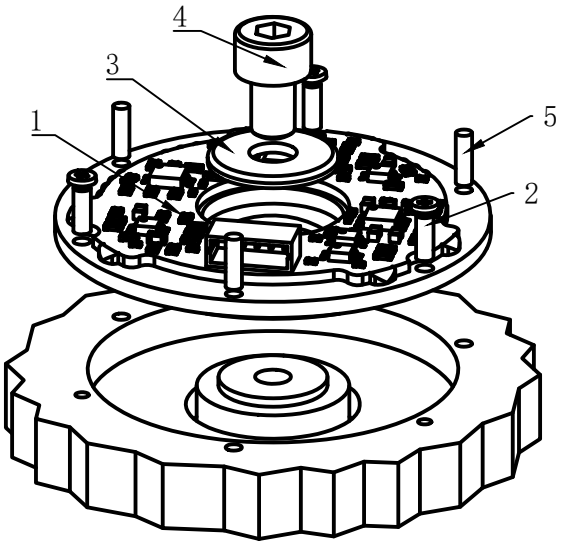
4、Mechanical Mounting

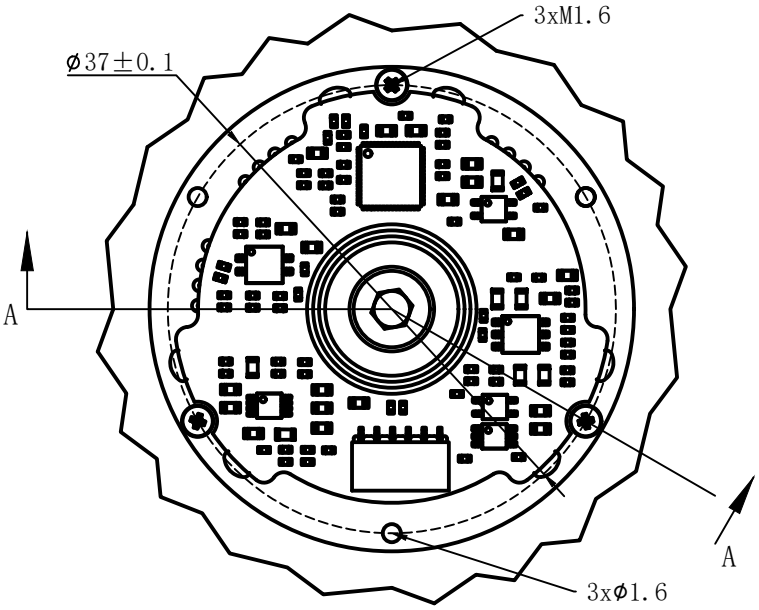
4.1 Dimensions



4.2 Installation Diagram







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

NO.		QTY	Description
1	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

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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

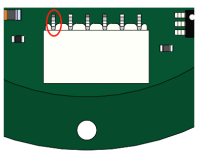
Interface wires color code

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

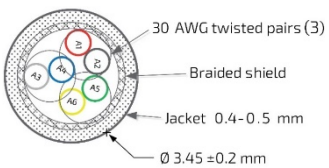
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

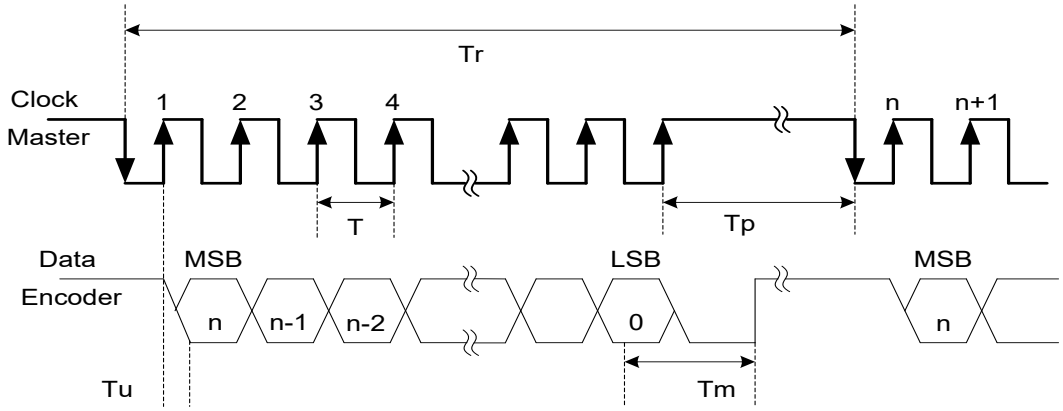


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

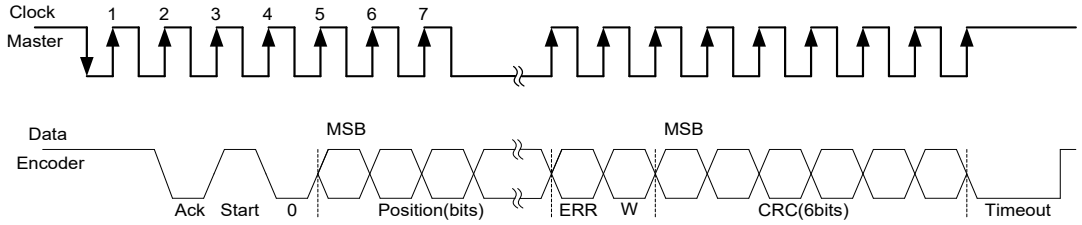
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

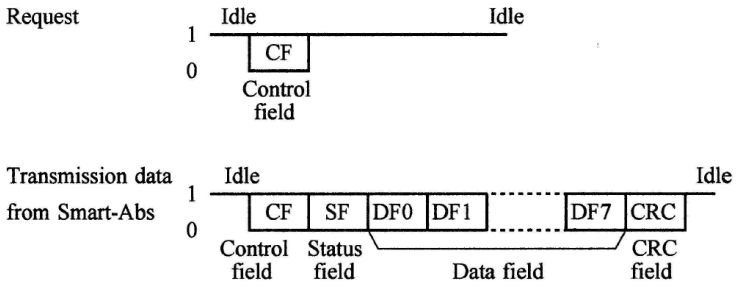
3.4 RS-422 UART Interface

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

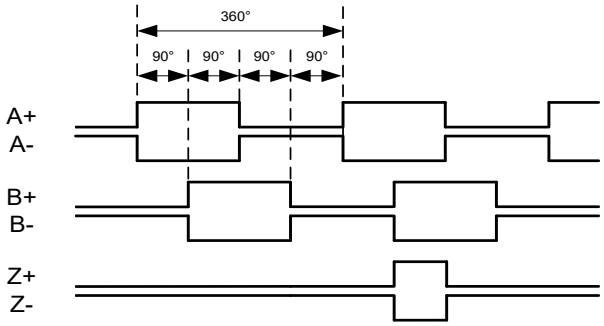
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

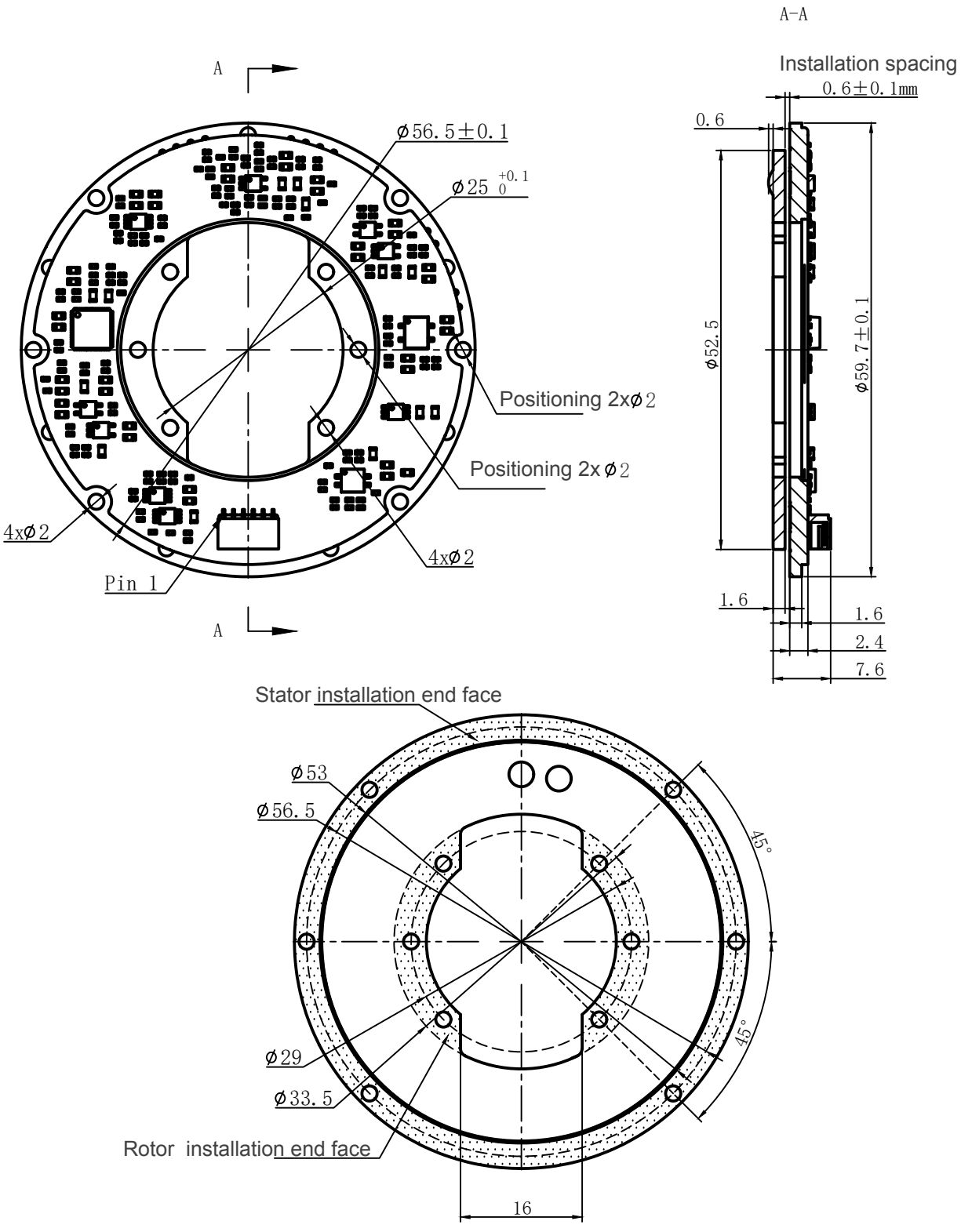
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



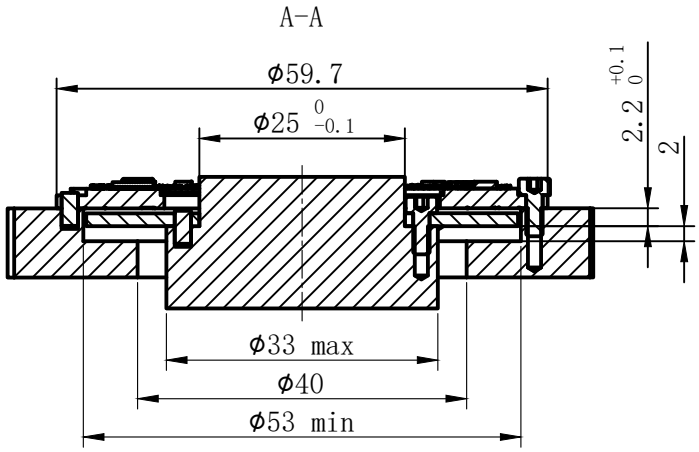
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

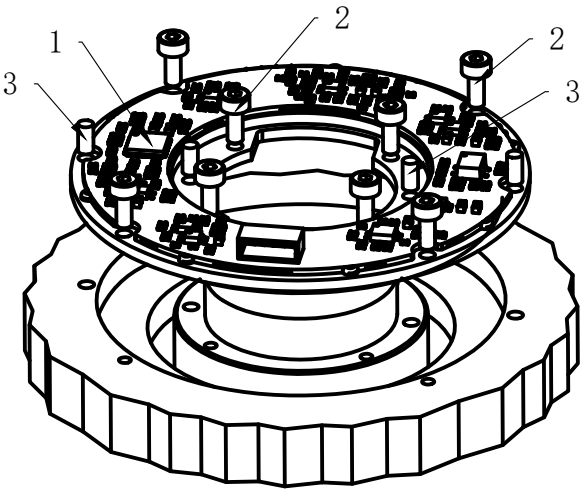
4、Mechanical Mounting

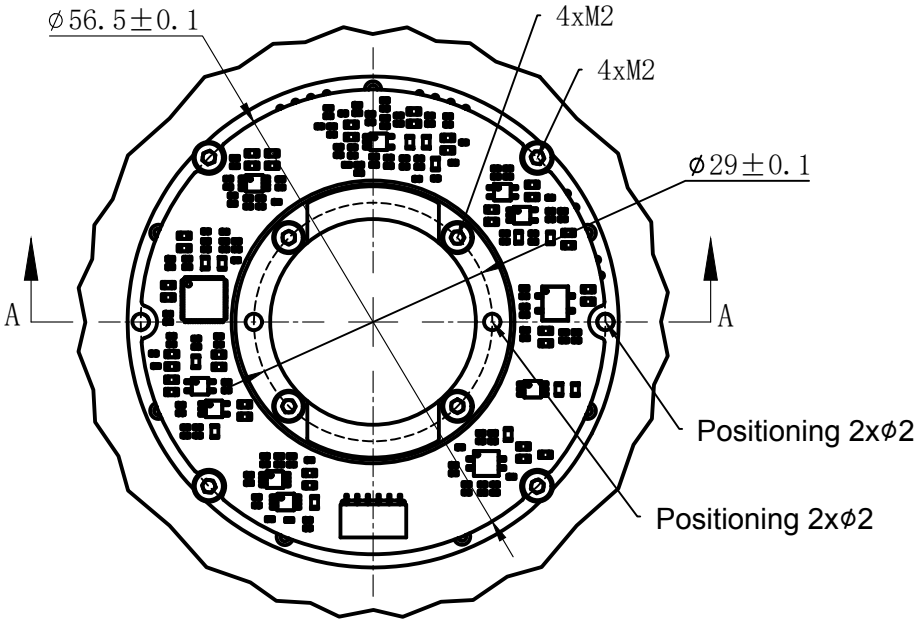
4.1 Dimensions



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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

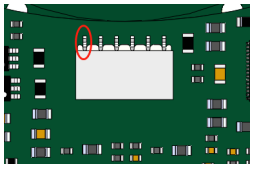
Interface wires color code

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

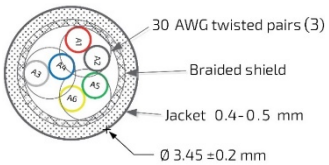
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

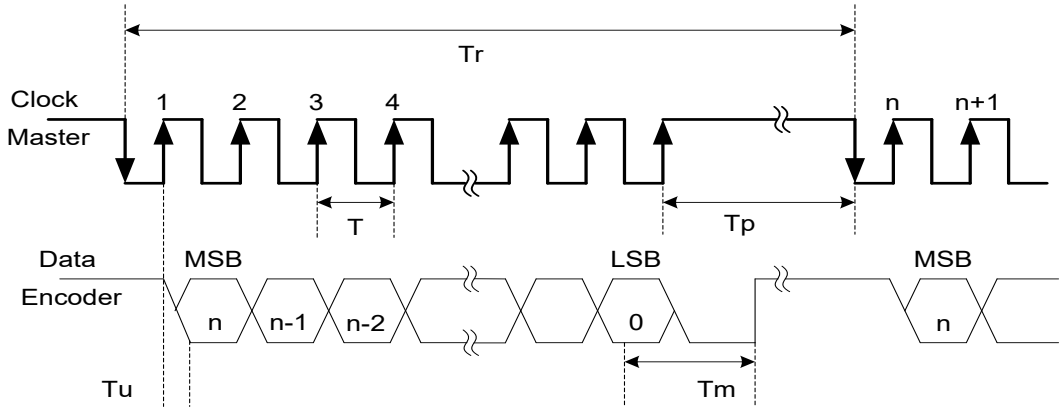


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

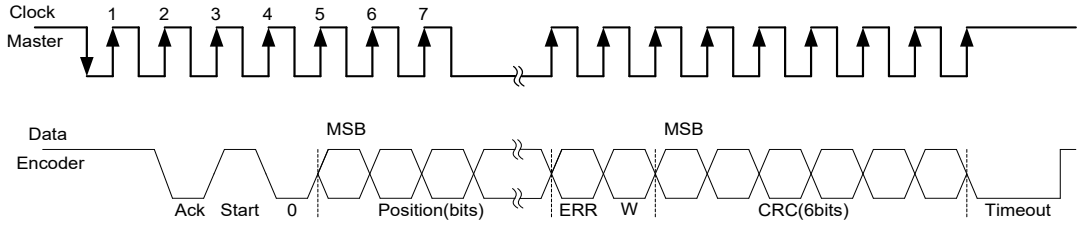
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

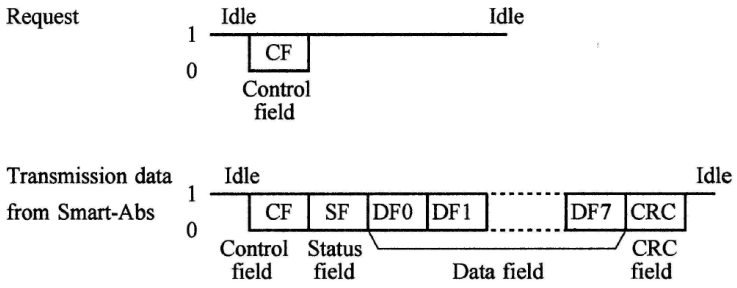
3.4 RS-422 UART Interface

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

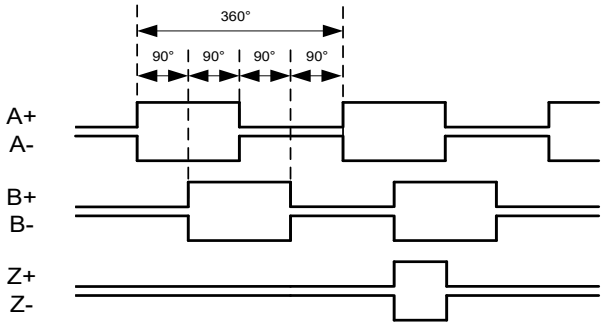
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

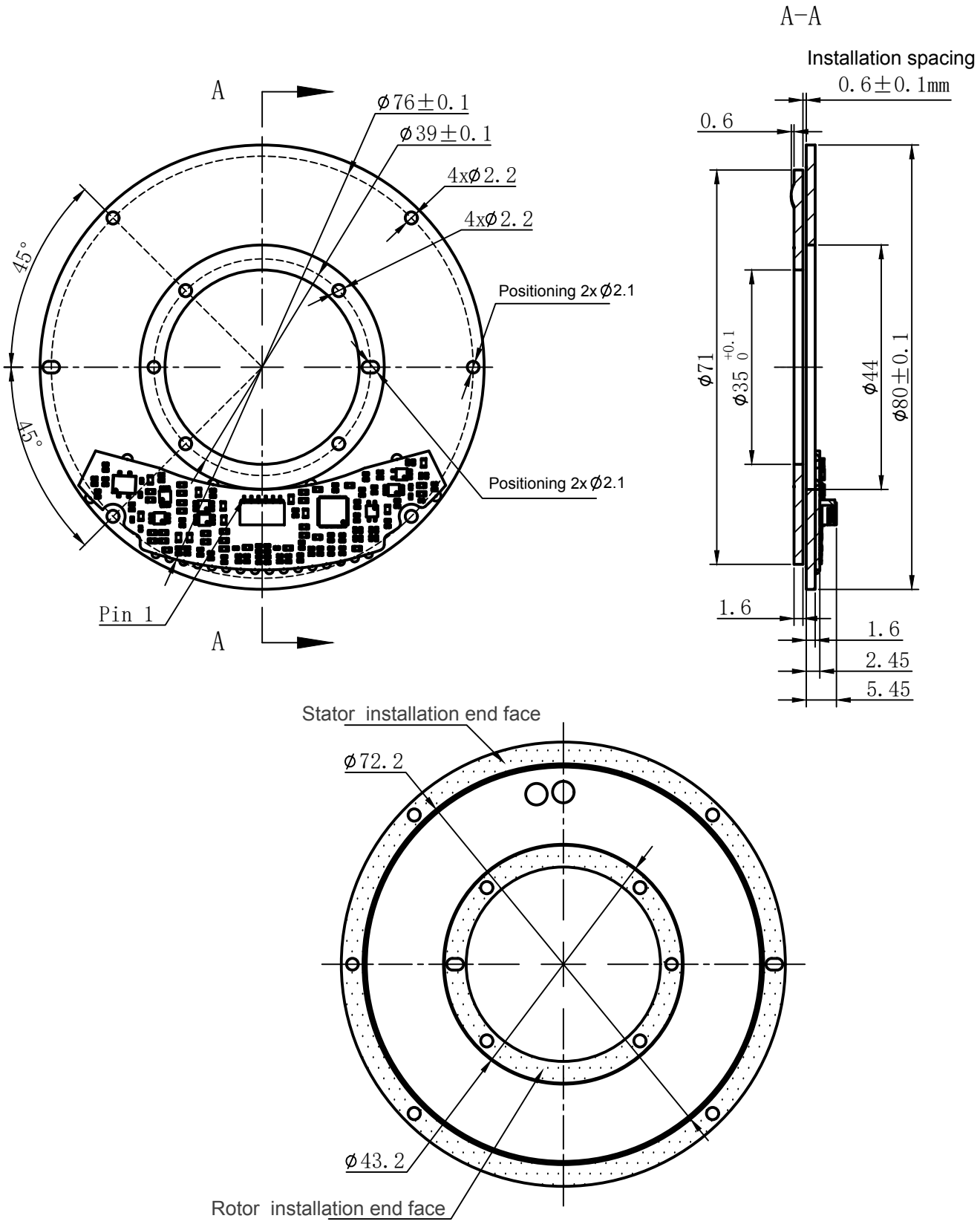
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



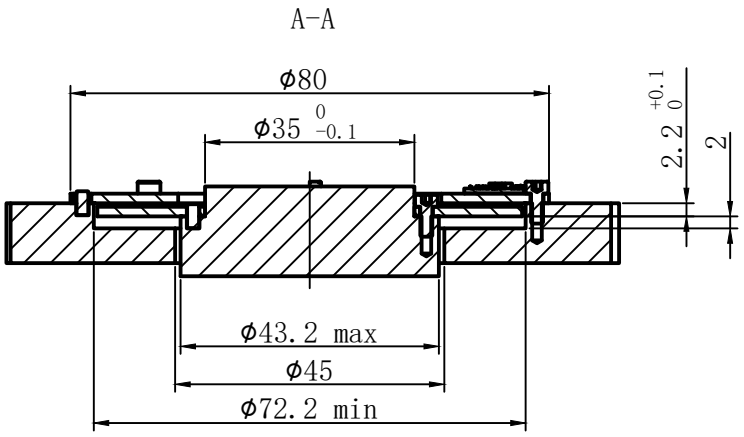
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

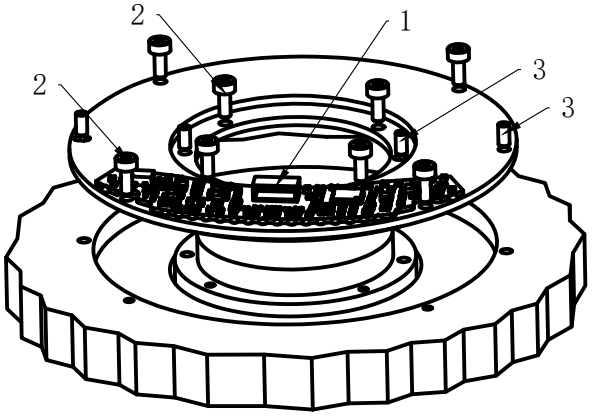
4、Mechanical Mounting

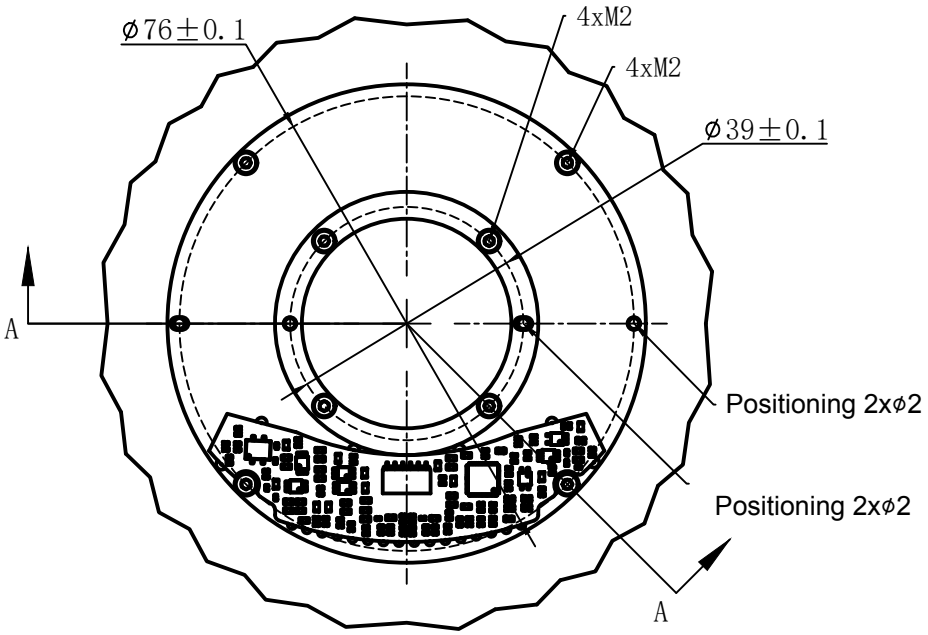
4.1 Dimensions



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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

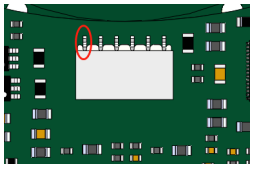
Interface wires color code

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

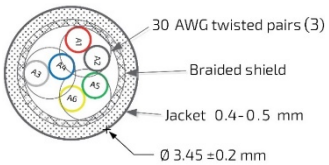
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

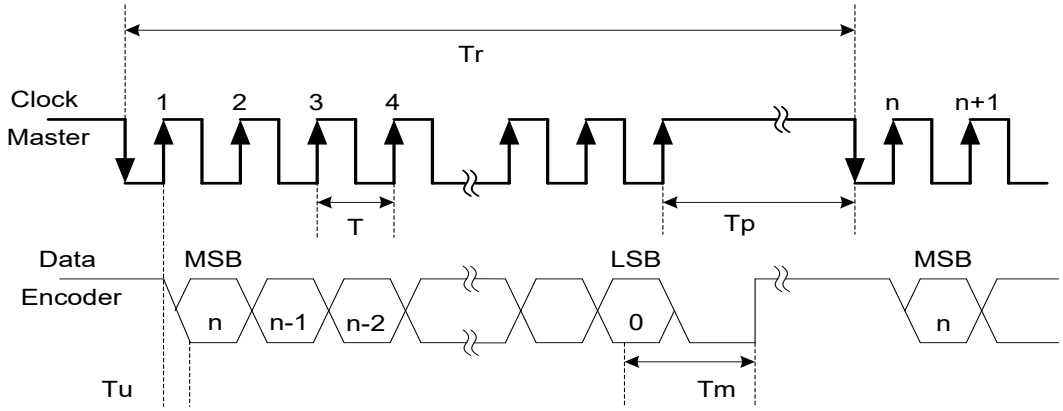


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

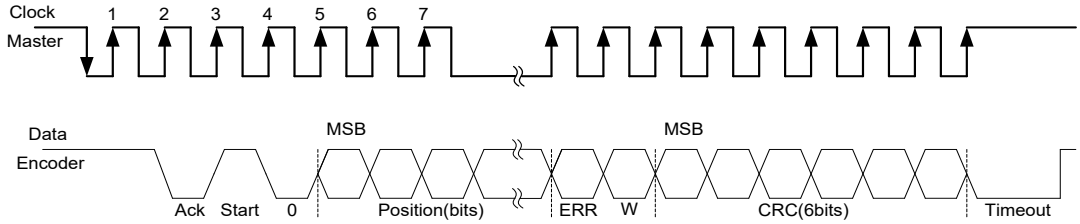
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

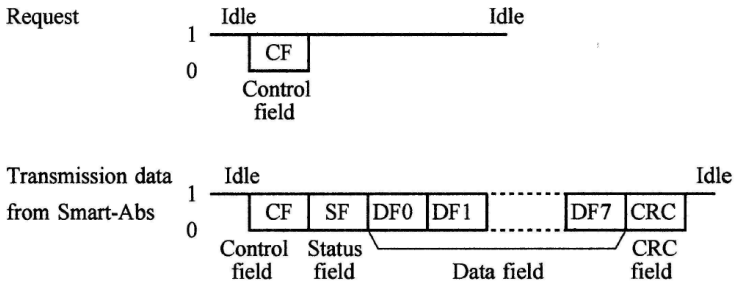
3.4 RS-422 UART Interface

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

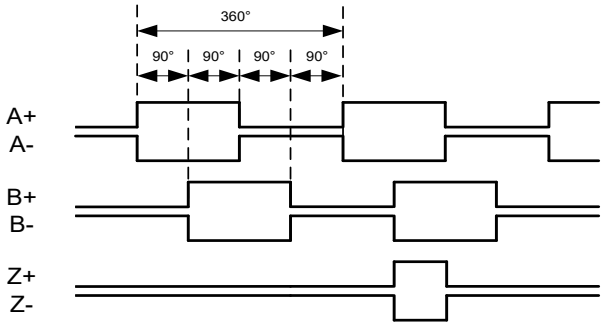
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

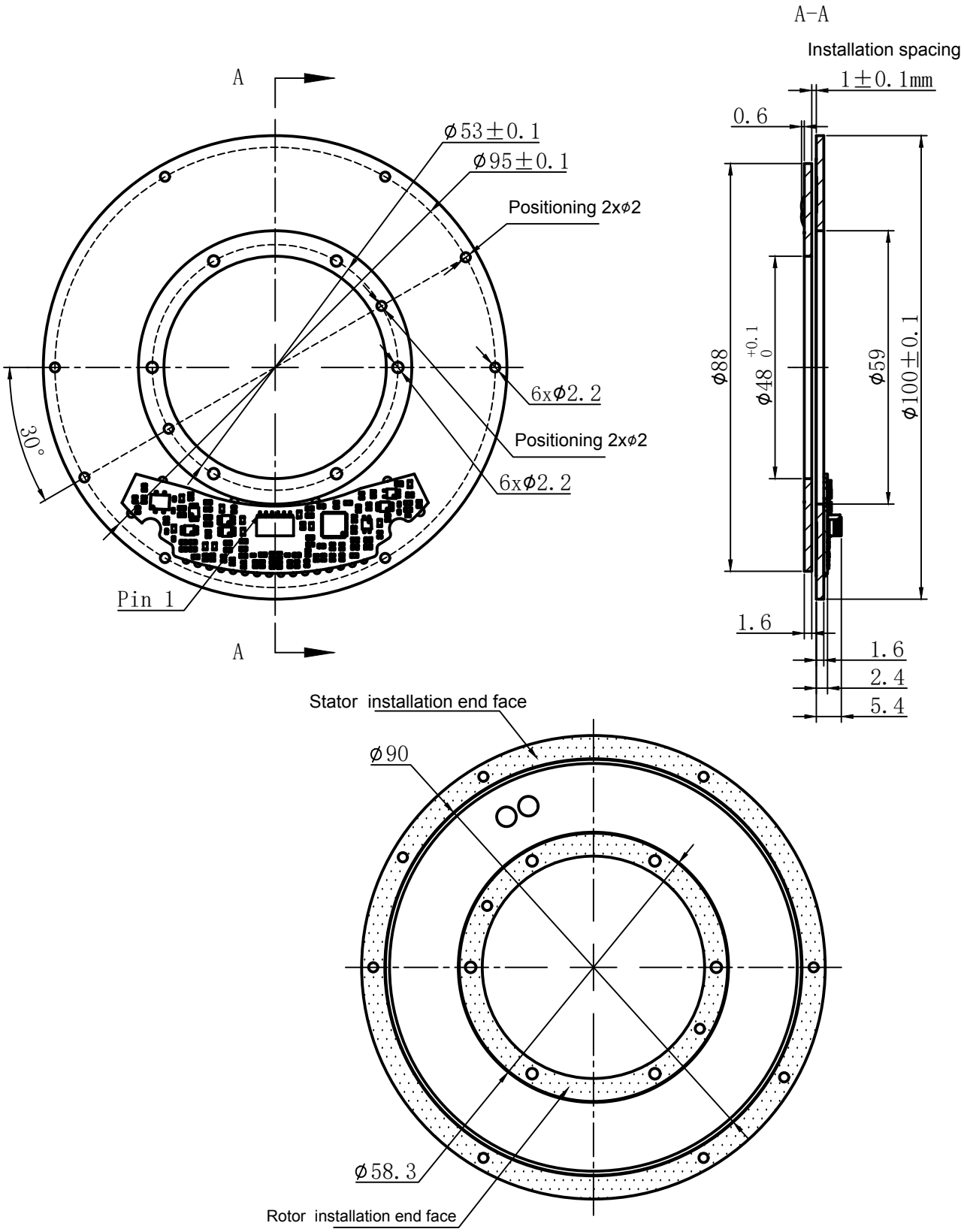
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



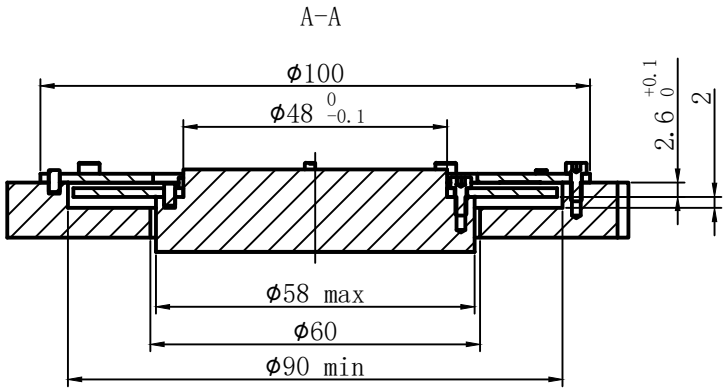
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

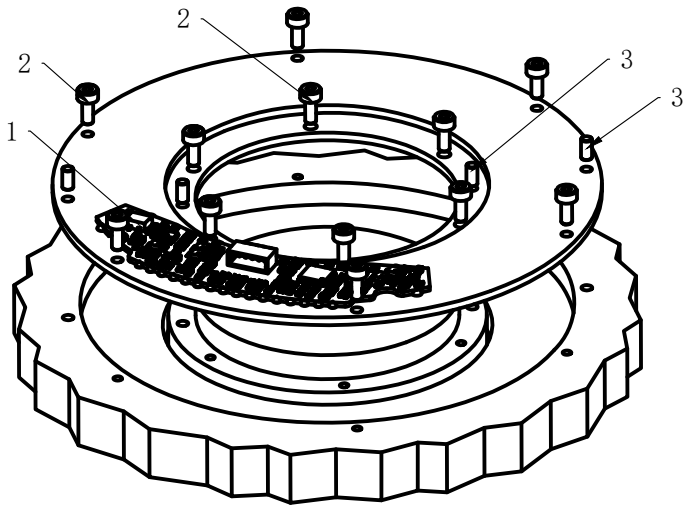
4、Mechanical Mounting

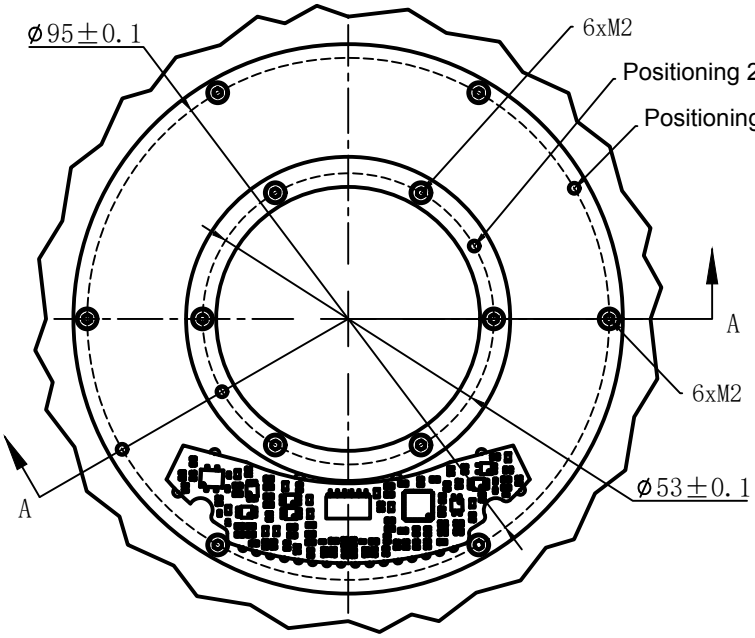
4.1 Dimensions



4.2 Installation Diagram







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

NO.		QTY	Description
1	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	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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

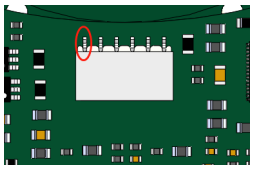
Interface wires color code

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

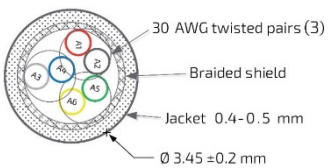
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

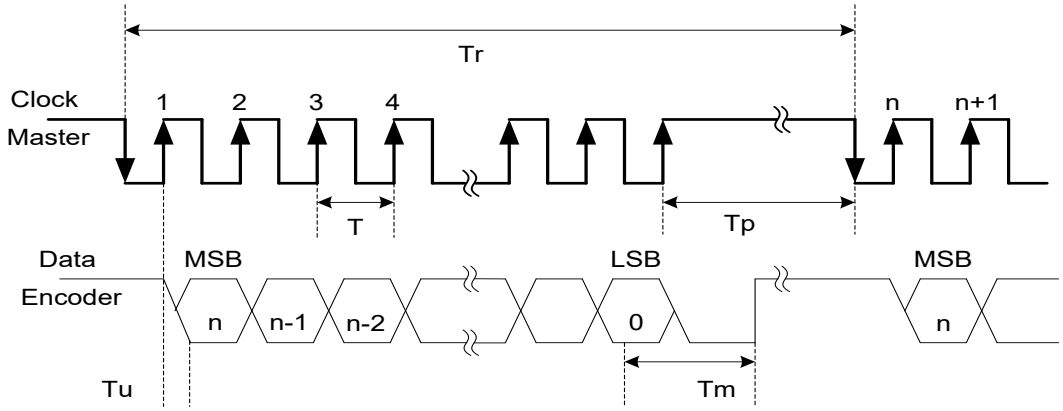


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

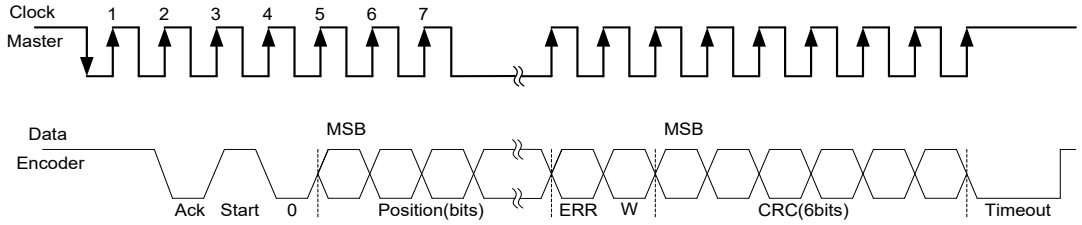
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

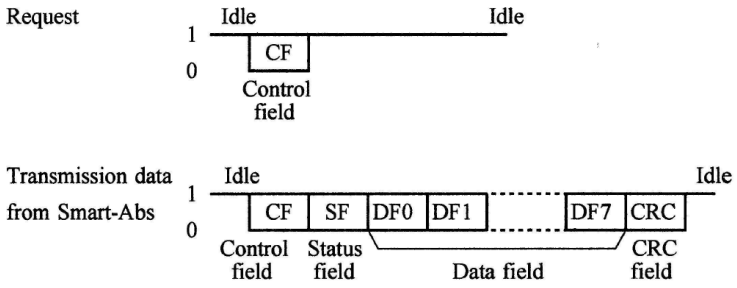
3.4 RS-422 UART Interface

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

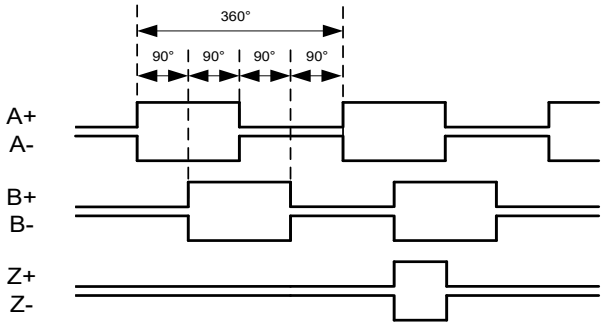
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

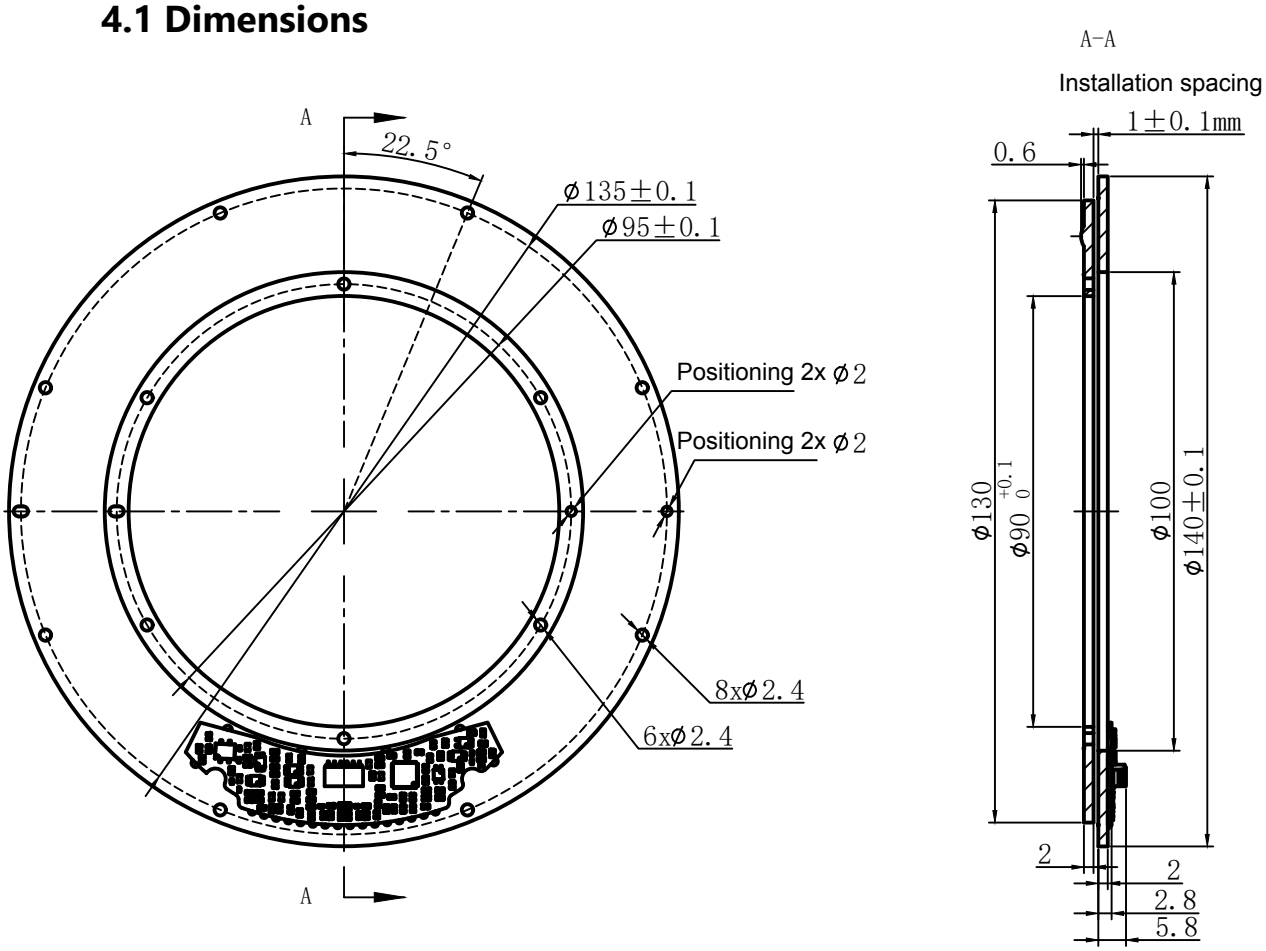
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

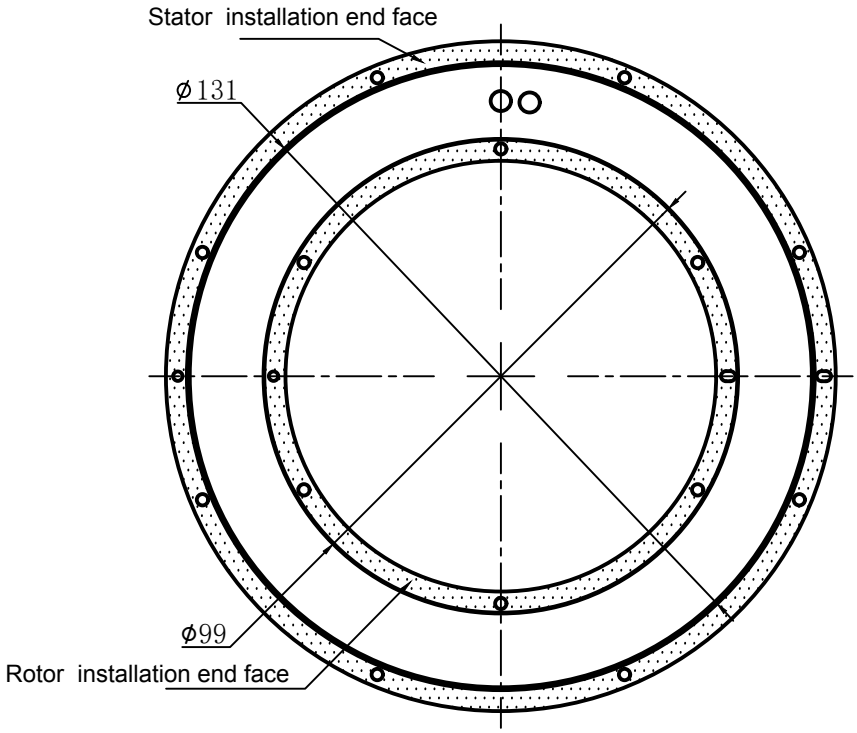


The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

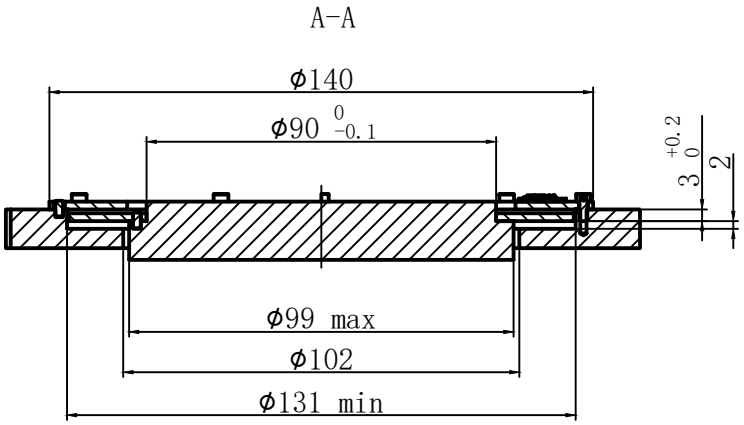
4、Mechanical Mounting

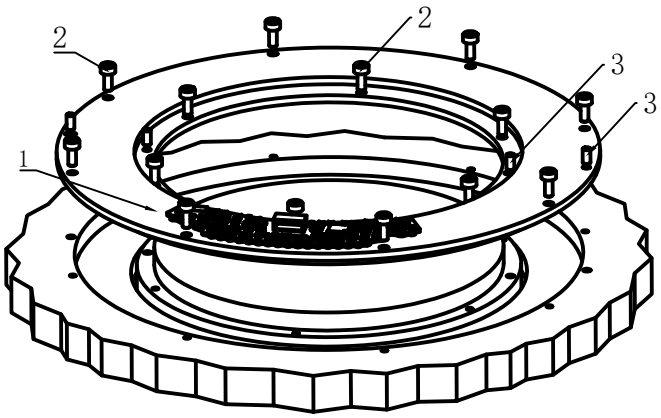
4.1 Dimensions

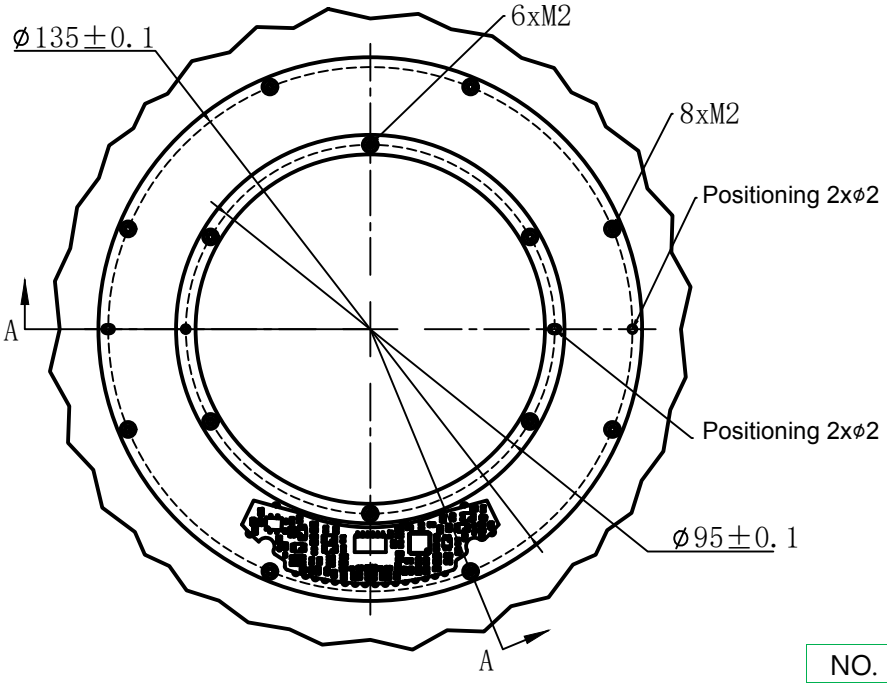




4.2 Installation Diagram







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

NO.		QTY	Description
1	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	±0.003°
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	1±0.1 mm
Rotor inertia	239.2 kg·mm^2
Weight (stator / rotor)	120g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

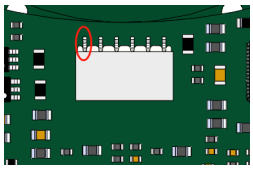
Interface wires color code

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

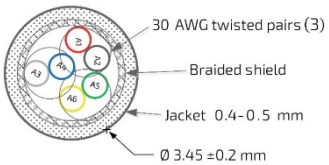
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

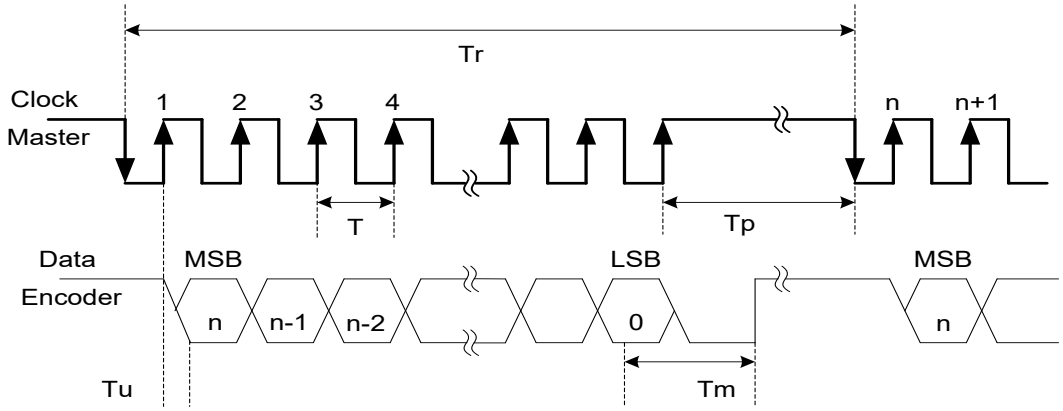


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

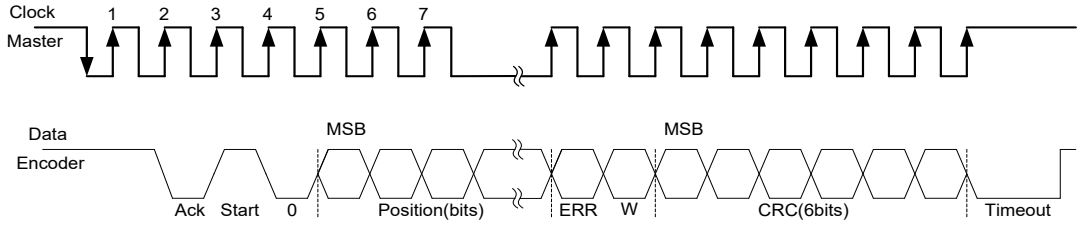
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

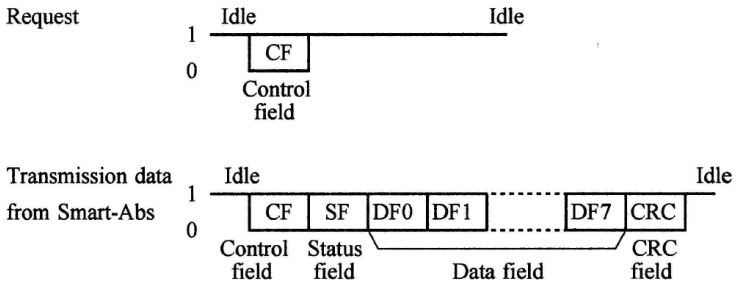
3.4 RS-422 UART Interface

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

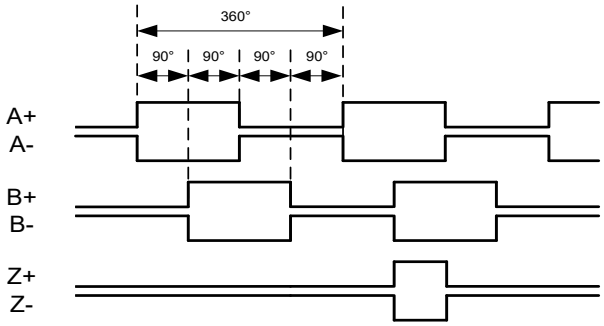
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

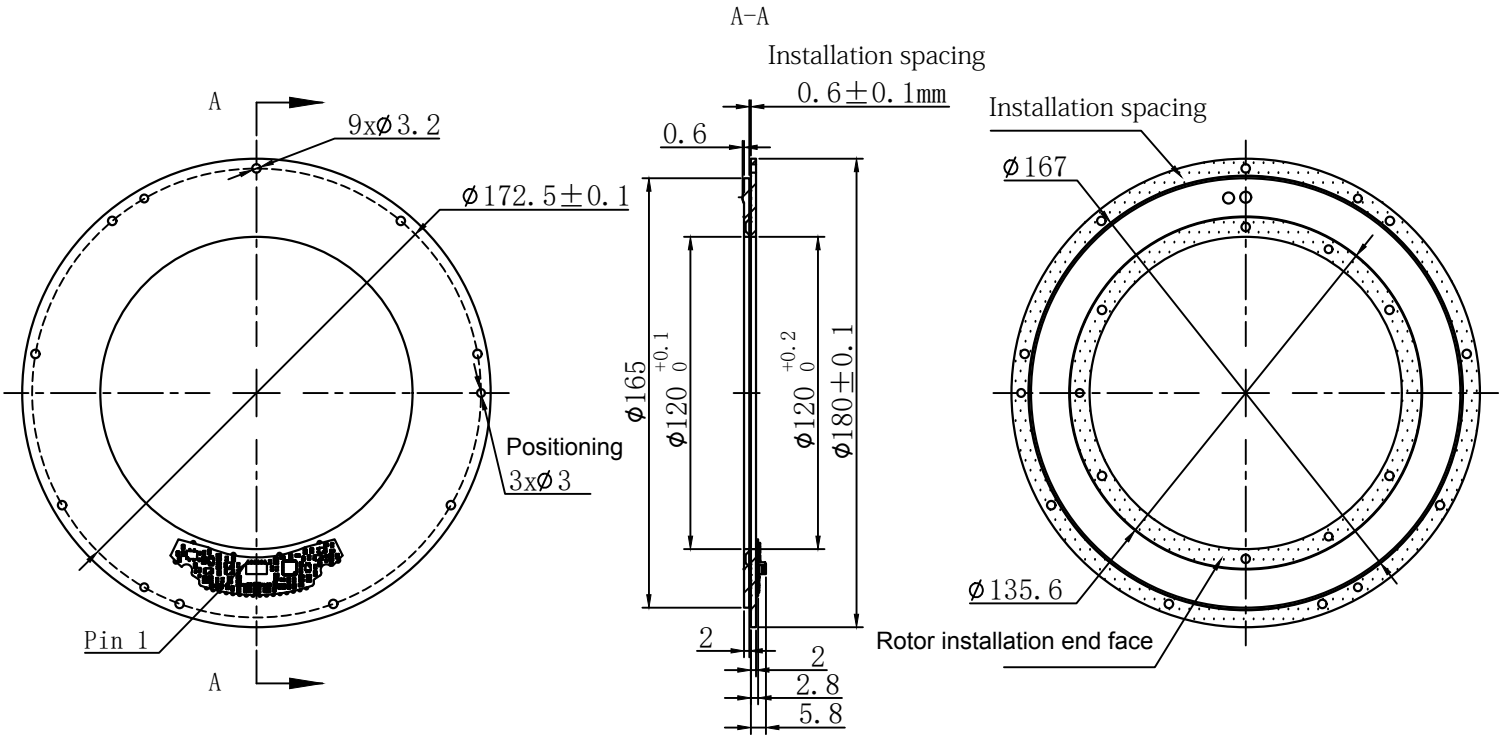
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



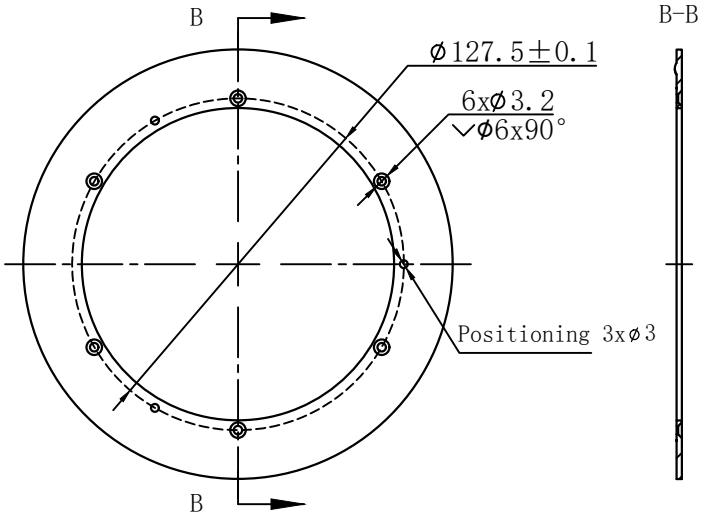
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

4、Mechanical Mounting

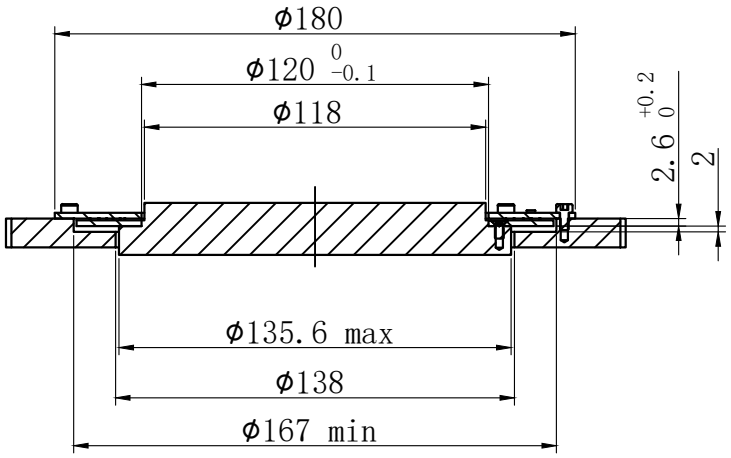
4.1 Dimensions

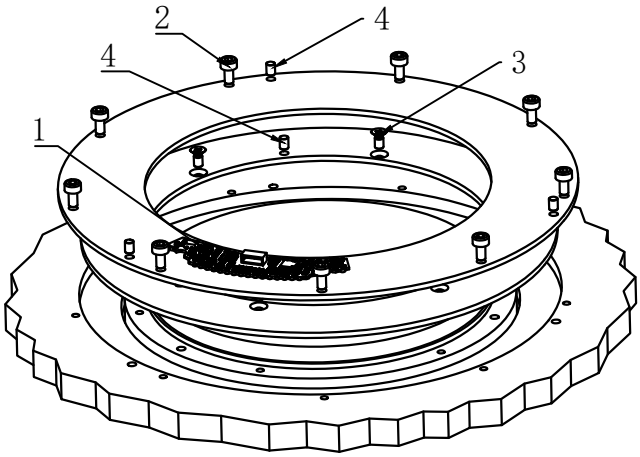


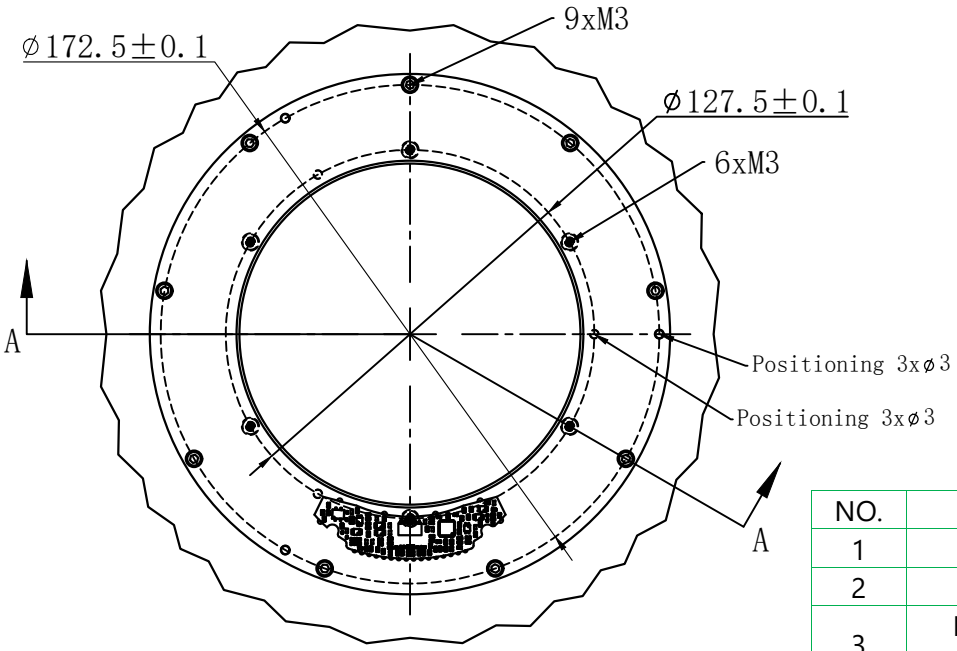
CAP/IAP180 - Rotor part



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	ø3x4 dowel pin	6	

2、Technical Specifications

General

Resolution	20-22 bit (24 bit extension)
Maximum static error	±0.003°
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 - 30V
Current consumption	< 100 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	-20℃ - +60℃
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.

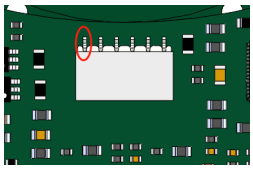
Interface wires color code

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

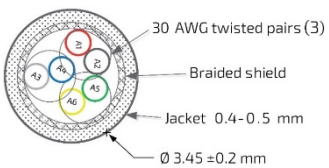
SSi/BiSS output signal parameters

Signal delay	< 50 us
Output code	Binary
Maximum data request rate	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

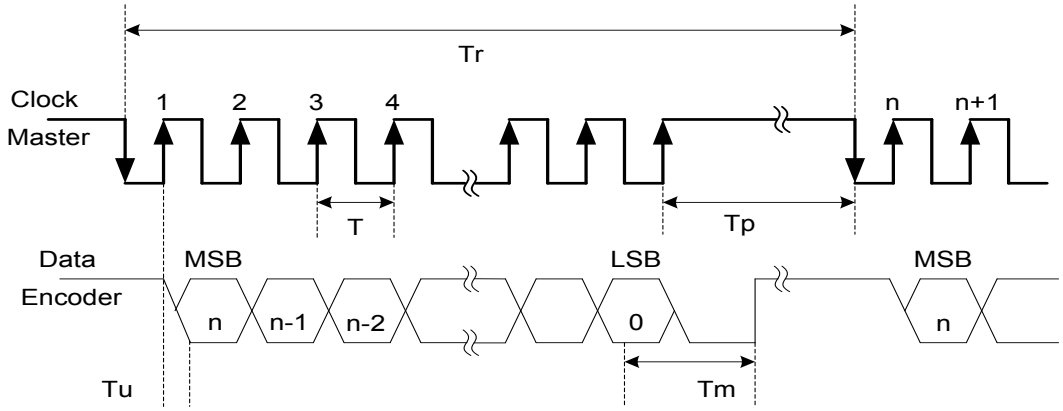


6-pin thin plug: ZX-SH1.0-6PWT
Corresponding plug: ZX-SH1.0-6PJK



3.2 SSi Interface

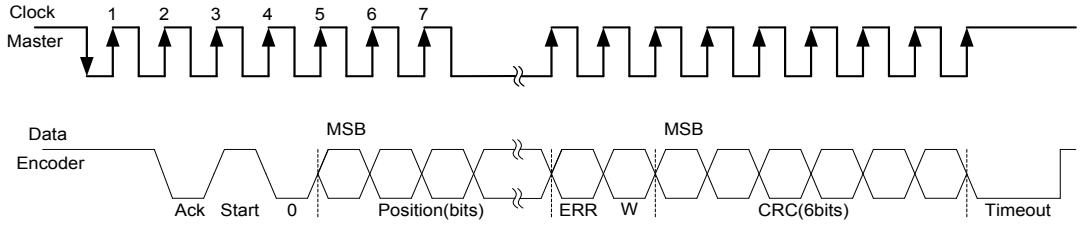
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

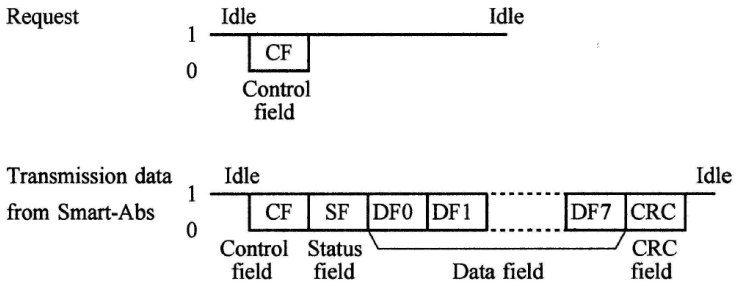
3.4 RS-422 UART Interface

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

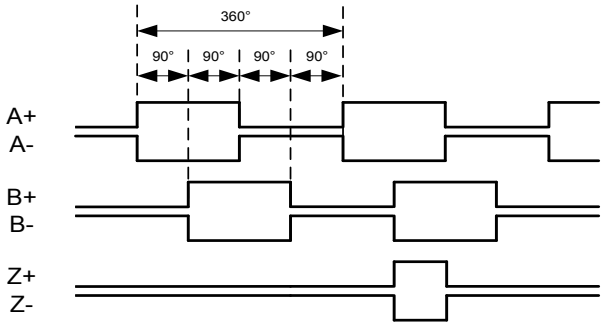
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

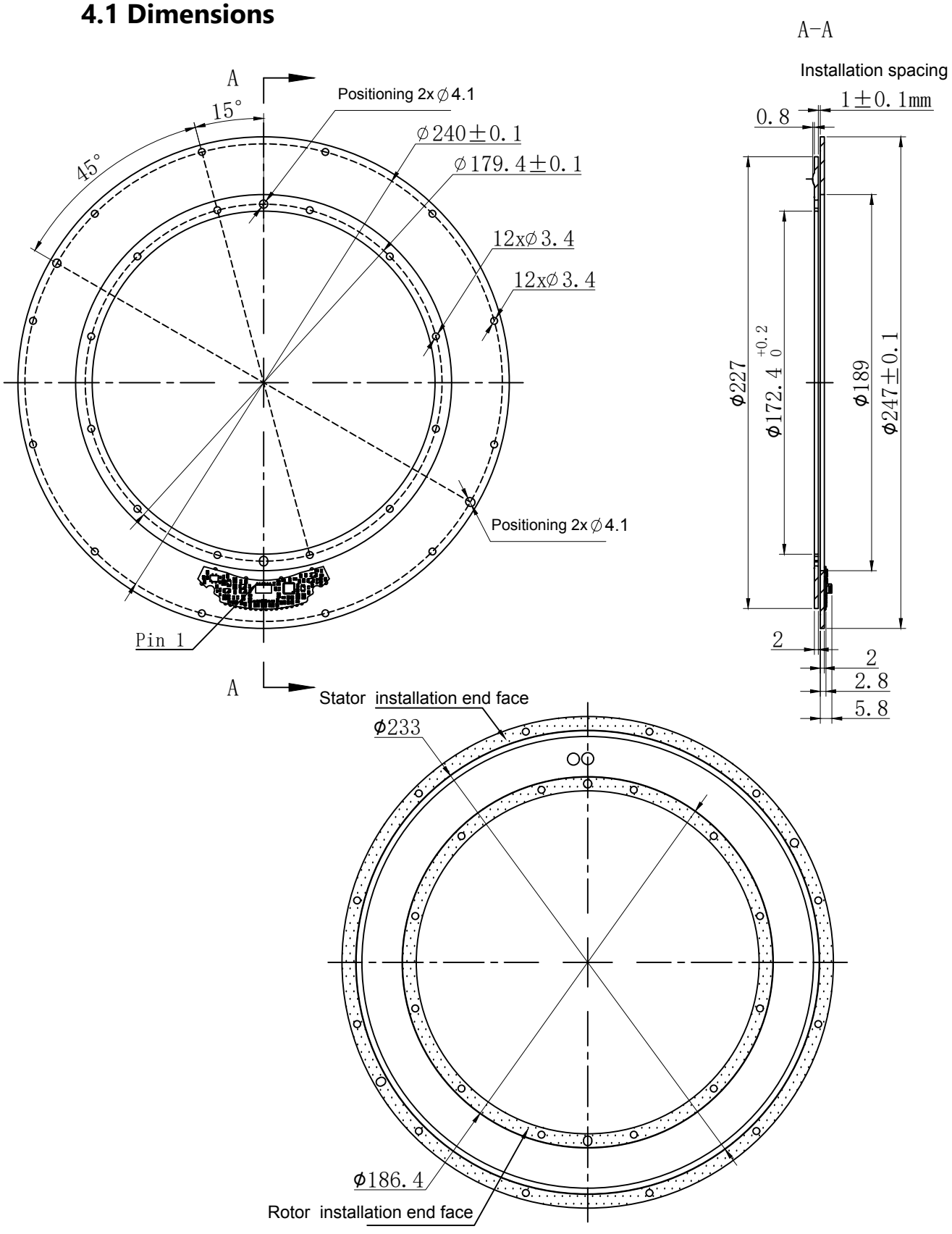
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.



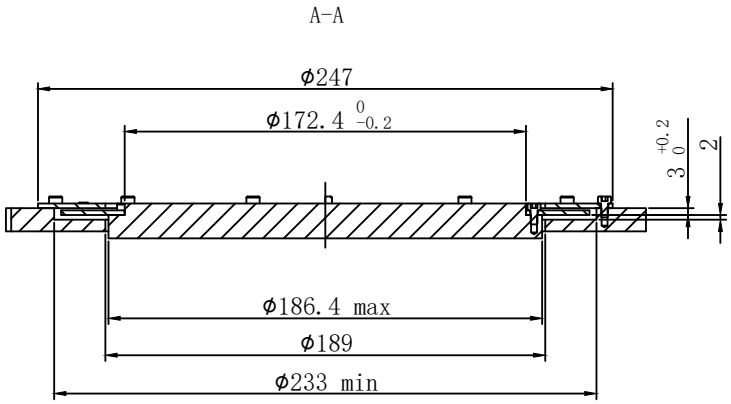
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

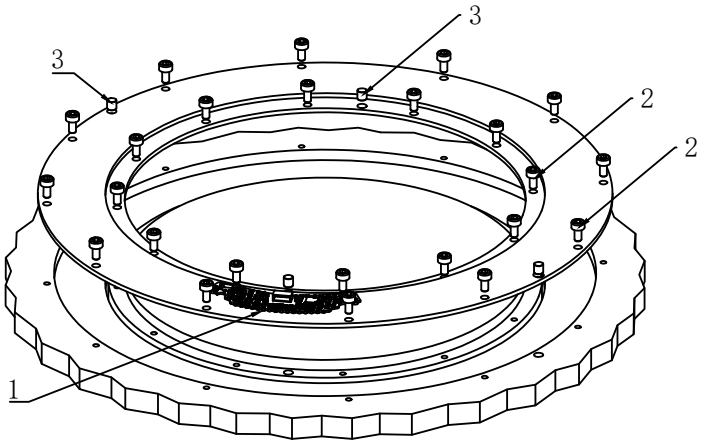
4、Mechanical Mounting

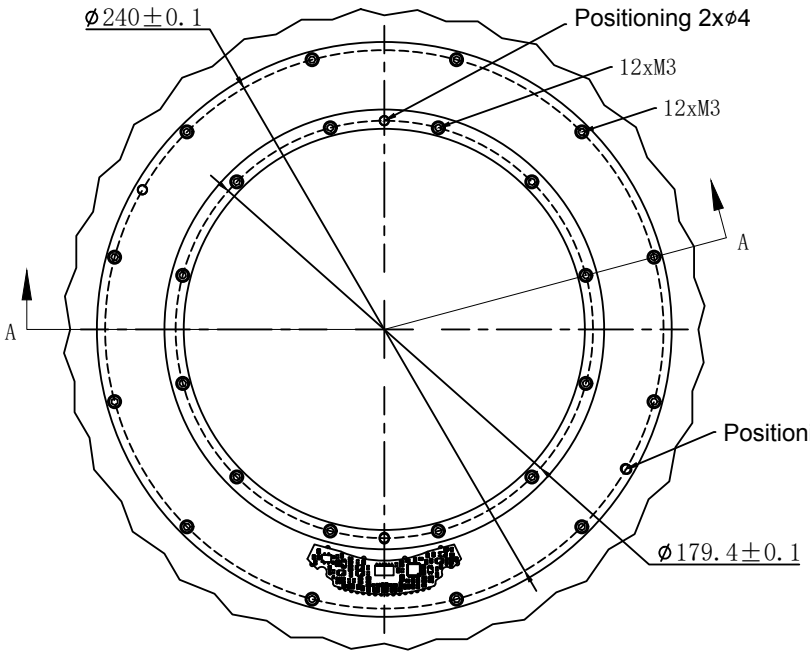
4.1 Dimensions



4.2 Installation Diagram







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

NO.		QTY	Description
1	C172247	1	Product
2	M3x6 screw	24	Install accessories
3	ϕ4x5 dowel pin	4	

2、Technical Specifications

General

Resolution	17-19bit (22bit 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	34 \ 10 \ 7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	0.11 kg·mm2
Weight (stator / rotor)	10 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	ZX-SH1.0-6PWT connector
Communication	SSi、BiSS-C、RS-422、RS-485

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

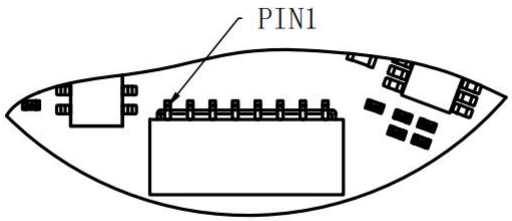
D1034 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. The angle output uses two connectors, and can choose to output interface protocols such as SSi、BiSS-C、RS-422、RS-485.

Interface definition

No.	SSI	RS-422	BiSS-C	RS-485
1	VCC			
2	GND			
3	CLK+	RX+	MA+	/
4	CLK-	RX-	MA-	/
5	DADT-	TX-	SLO-	B-
6	DADT+	TX+	SLO+	A+

SSi/BiSS output signal parameters

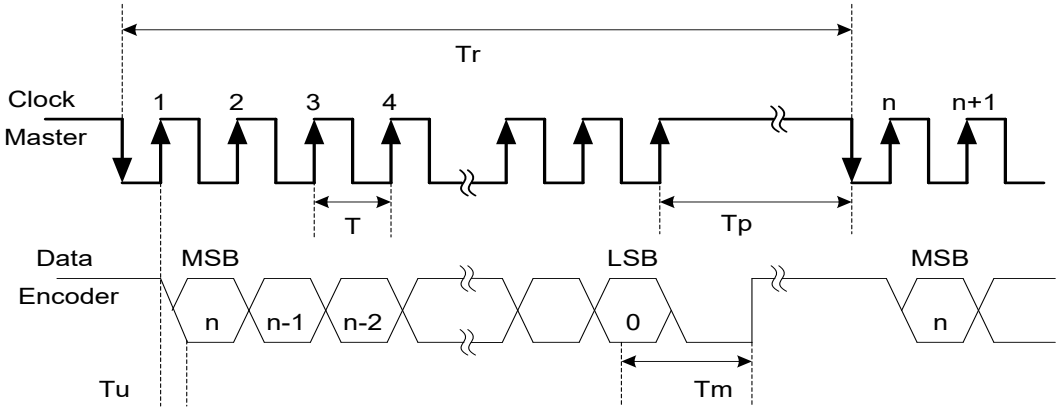
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
6-pin Connector: HC-0.8-6PWT、ZX-0.8-6PJK（Standard）

3.2 SSi Interface

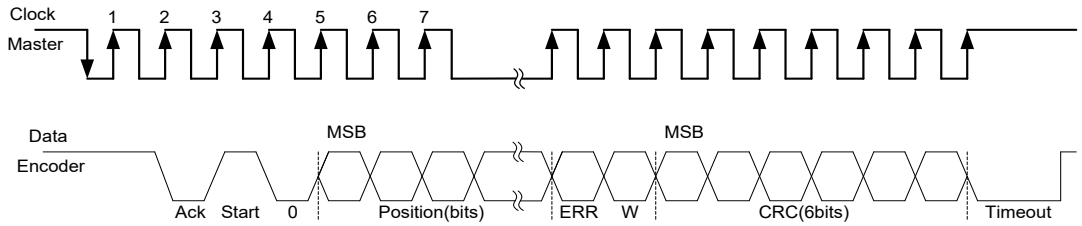
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

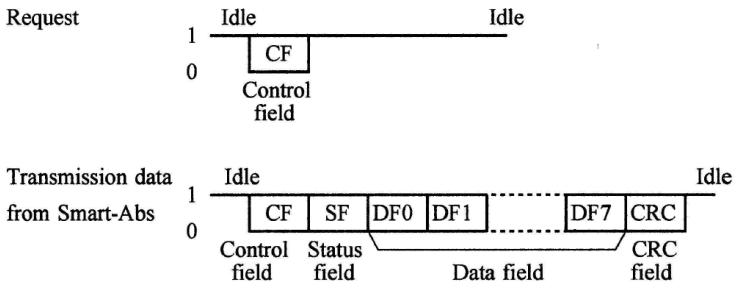
3.4 RS-422 UART Interface

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

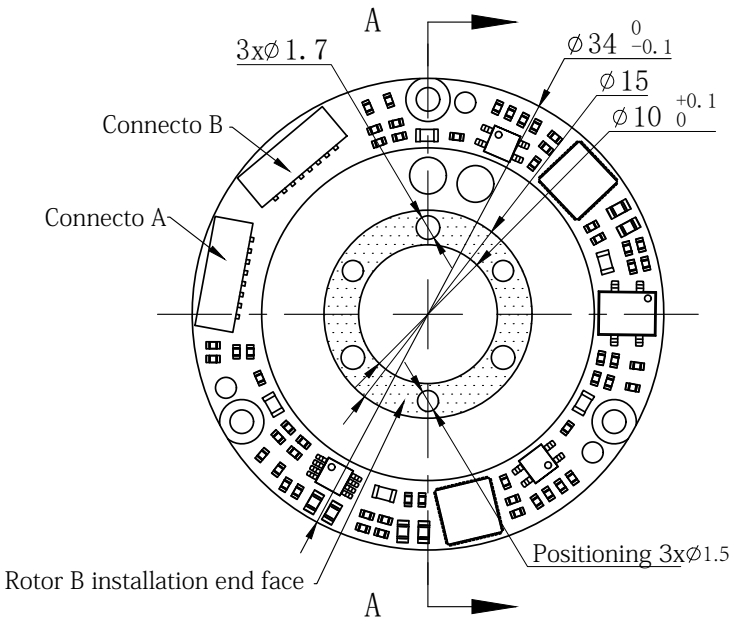
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

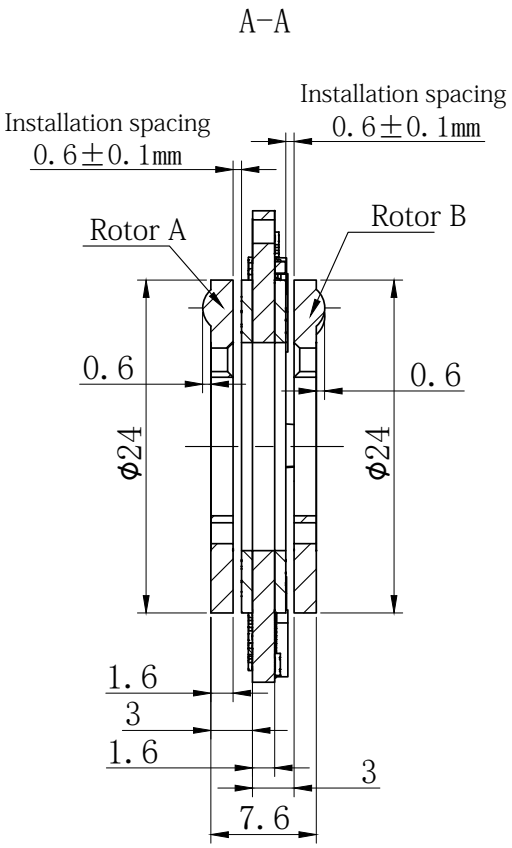
3.5.4 Single turn position reset request command:

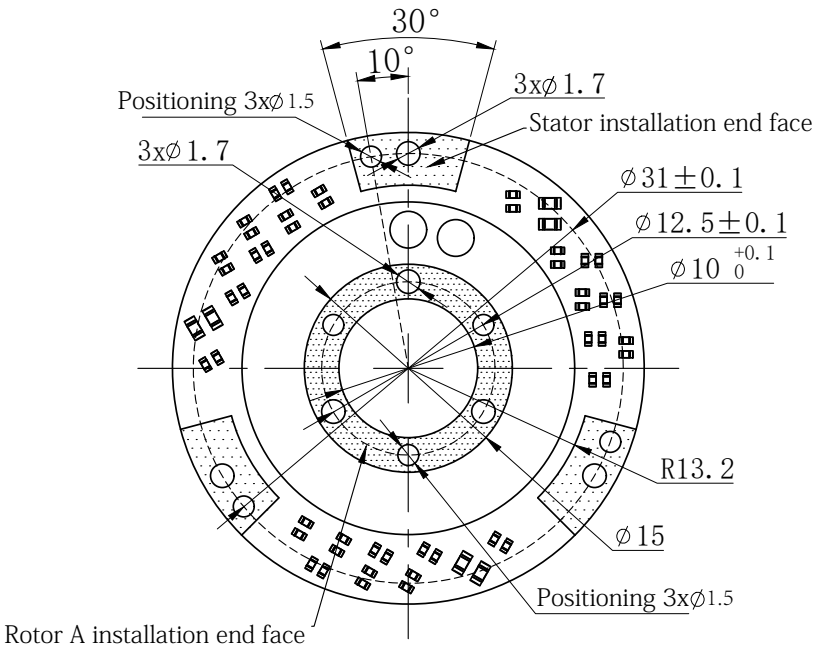
1. Master send command Sent data（HEX）: 0xC2
   The reset command should be repeated at least 10 times with a 40us interval to reset the single turn position.
2. The master receives data frames from the encoder:
   Received data（HEX）：0xC2 0x20 0x00 0x00 0x00 0xE2
   0xC2: CF return the same command
   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

4、Mechanical Mounting

4.1 Dimensions

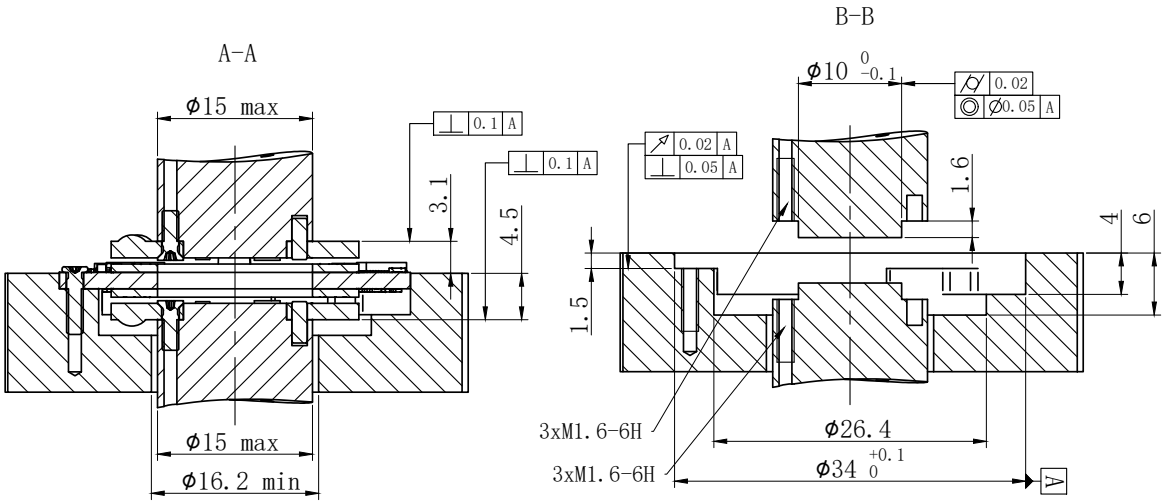


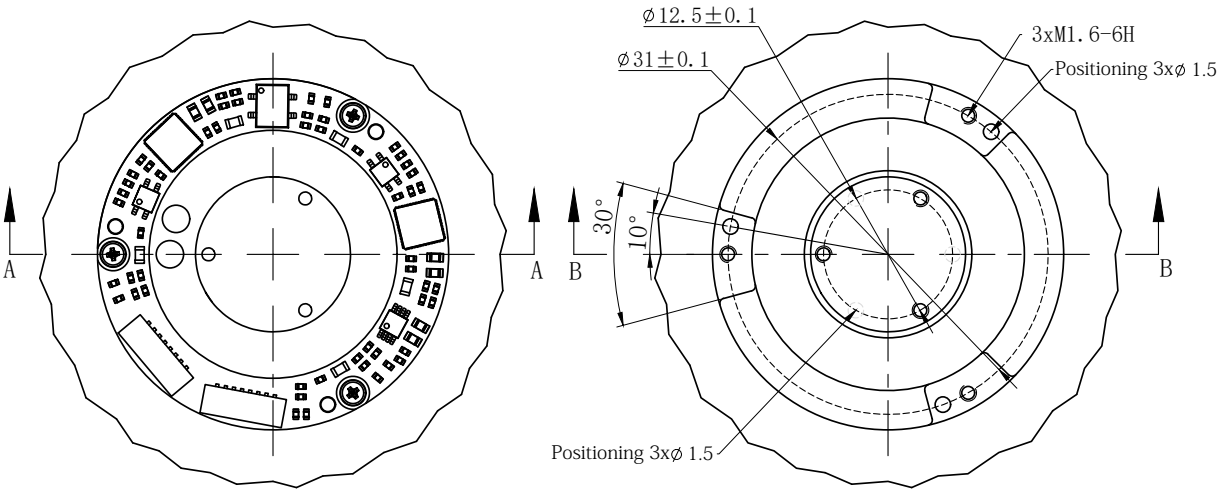


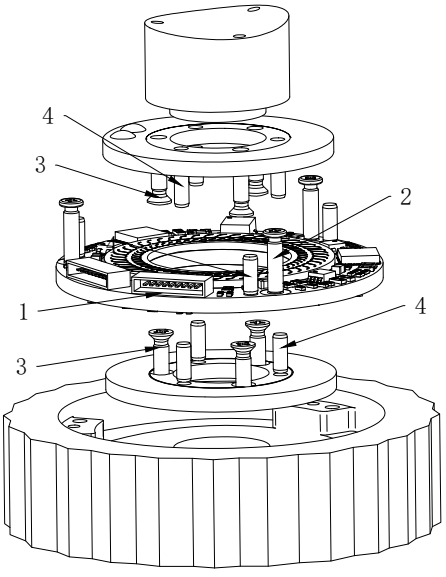


4.2 Installation Diagram

Sensing on the different side:



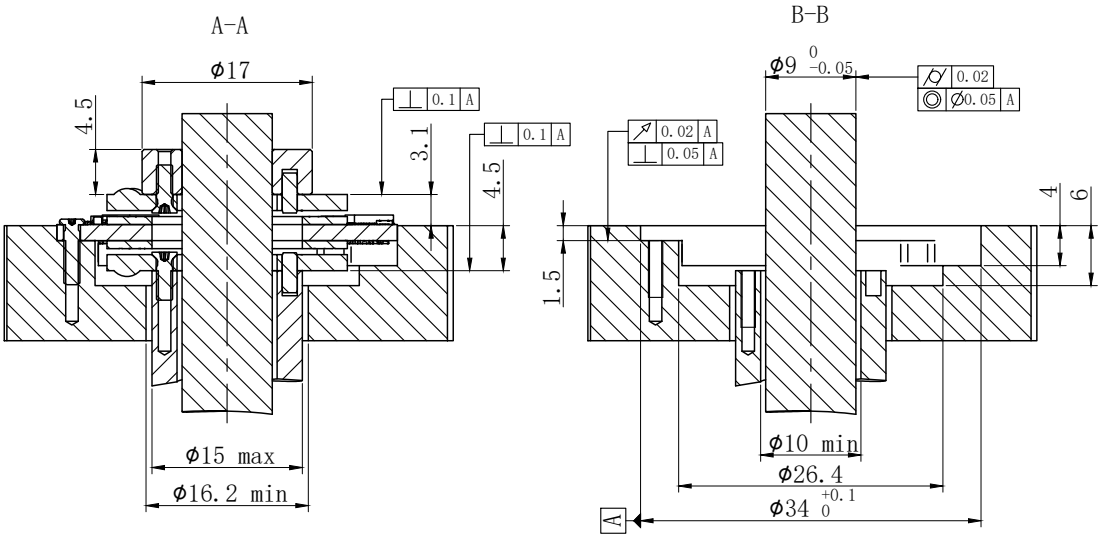


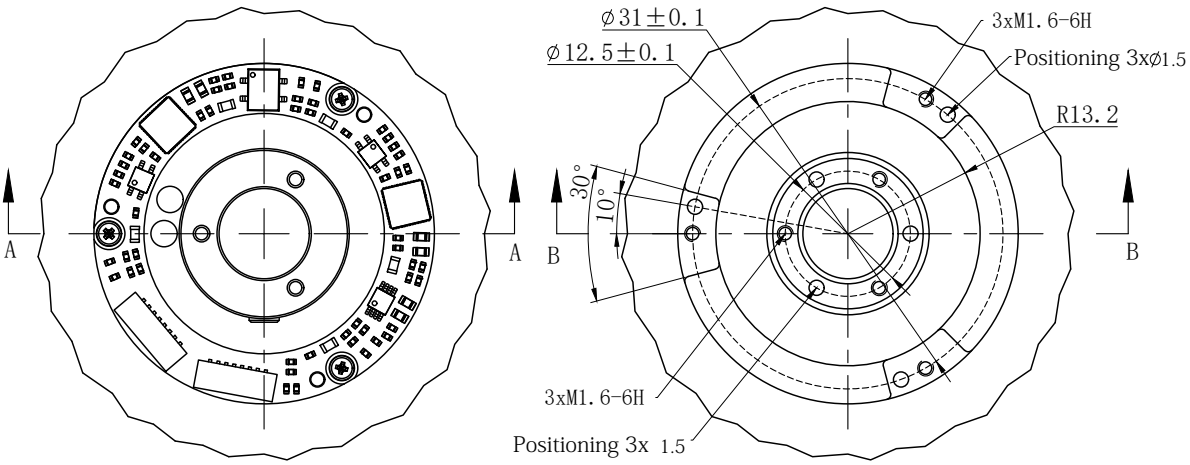


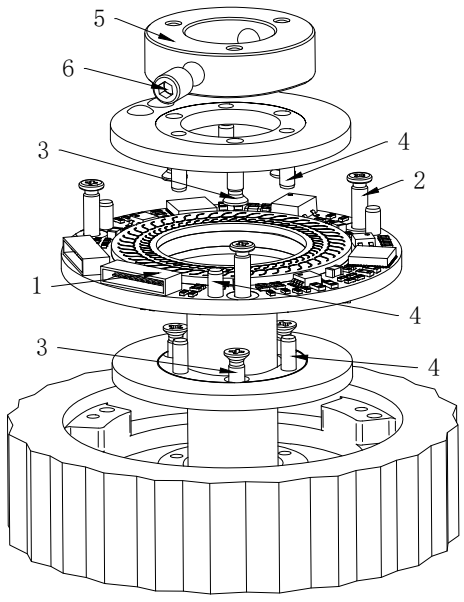
Linear tolerances	
0-50	±0.05mm
50~	±0.1mm

NO.		QTY	Description
1	D1034	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	6	
4	⌀1.5x4 dowel pin	9	

Sensing on the same side:







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

NO.		QTY	Description
1	D1034	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	4	
4	⌀1.5x4 dowel pin	9	
5	D1034 Rotor clamping ring	1	Customized accessories
6	M3x4 Screw	1	

2、Technical Specifications

General

Resolution	4096 \18-20bit (22bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	50 \ 20 \ 7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	0.7 kg·mm2
Weight (stator / rotor)	20 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	ZX-SH1.0-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

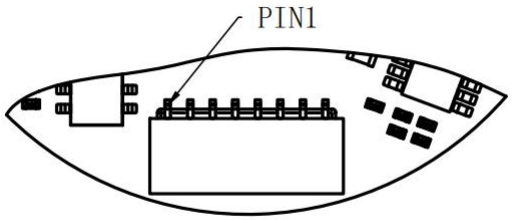
D2050 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

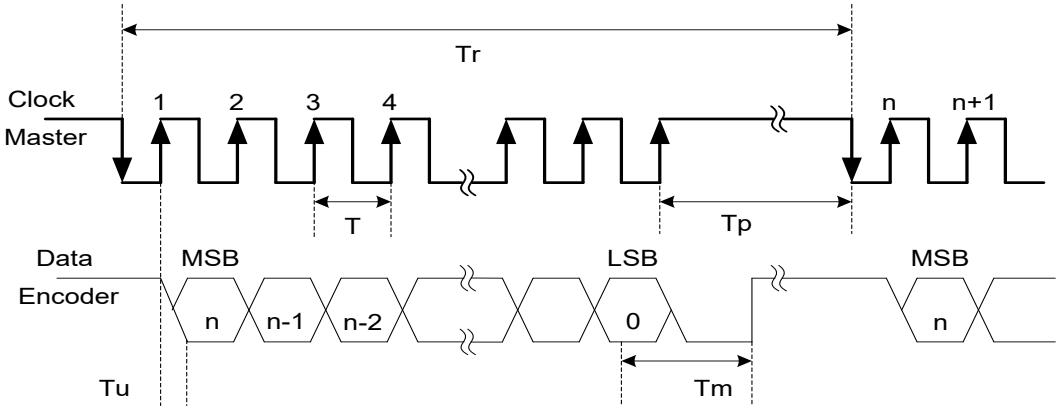
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector:ZX-SH1.0-8PWT、ZX-SH1.0-8PJK (Standard)

3.2 SSi Interface

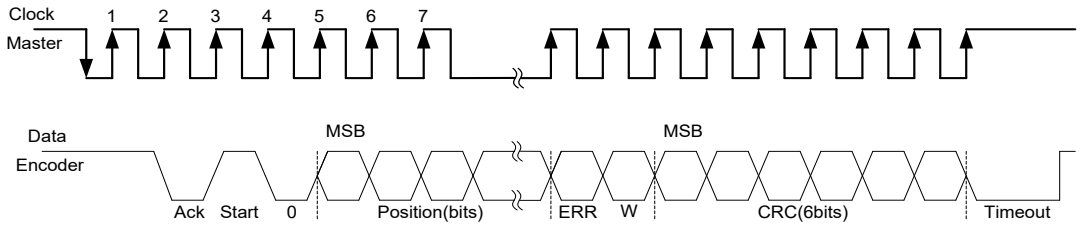
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

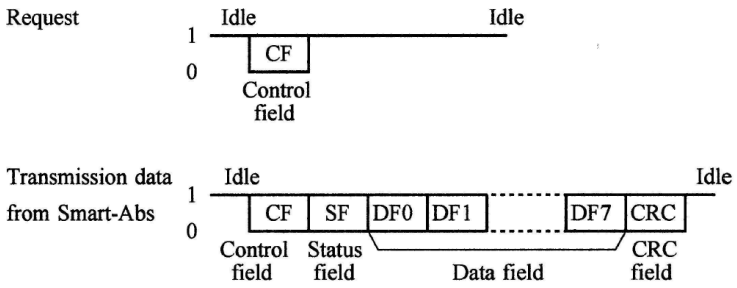
3.4 RS-422 UART Interface

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

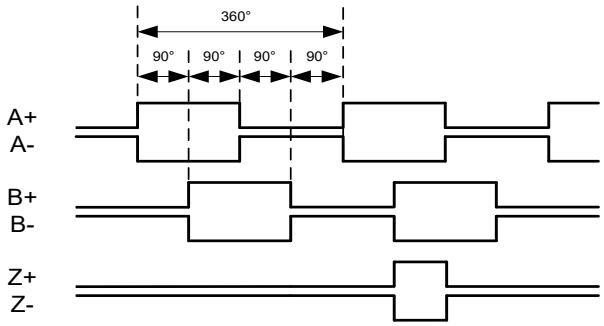
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

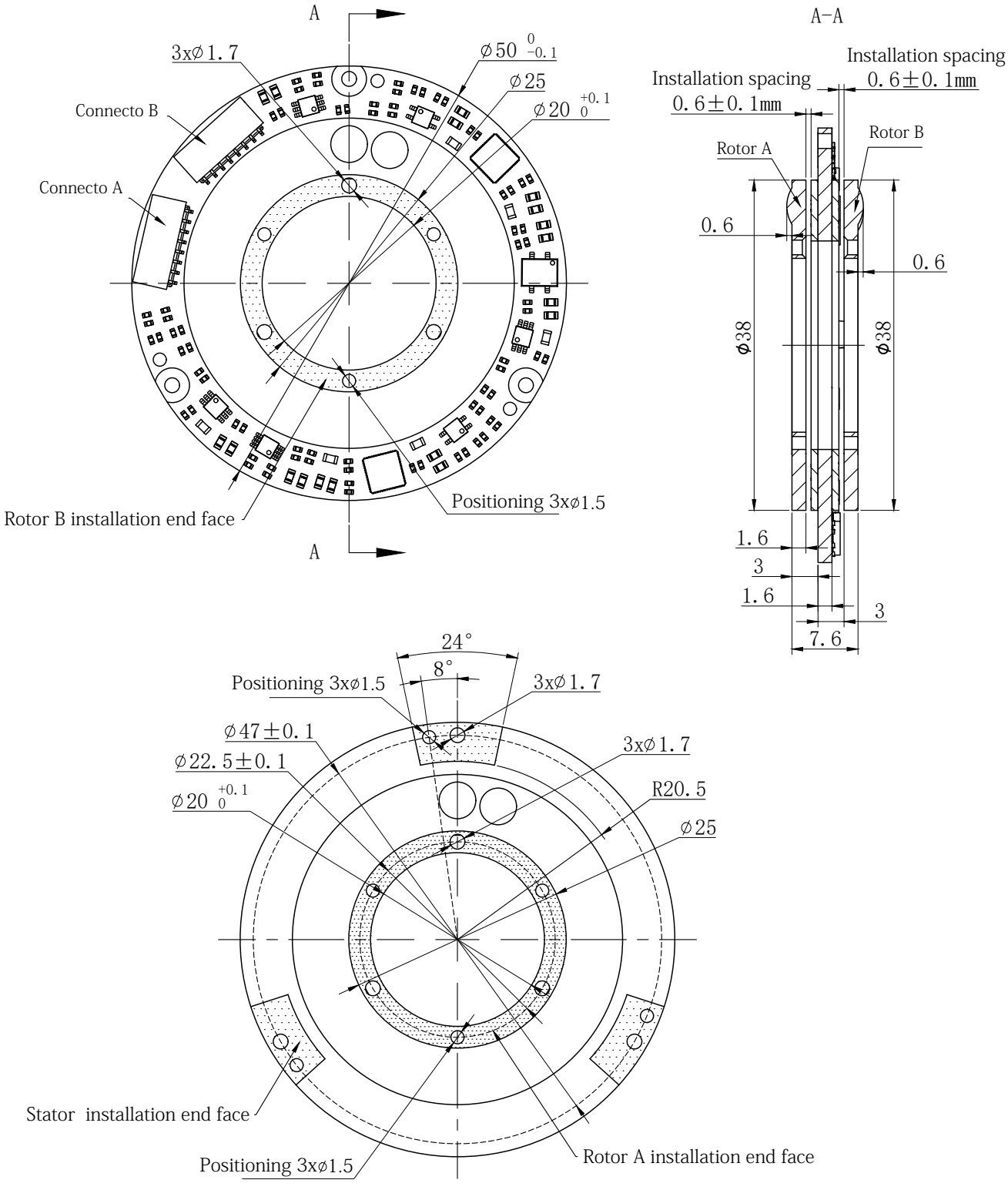
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

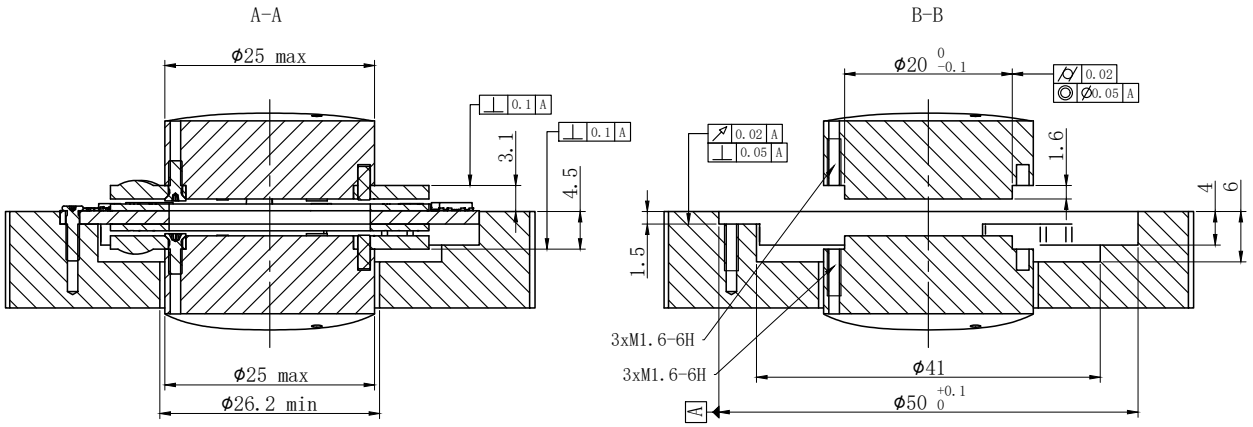
4、Mechanical Mounting

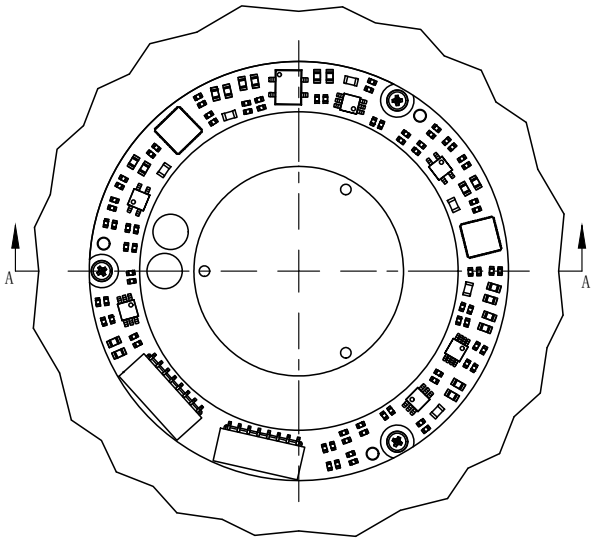
4.1 Dimensions

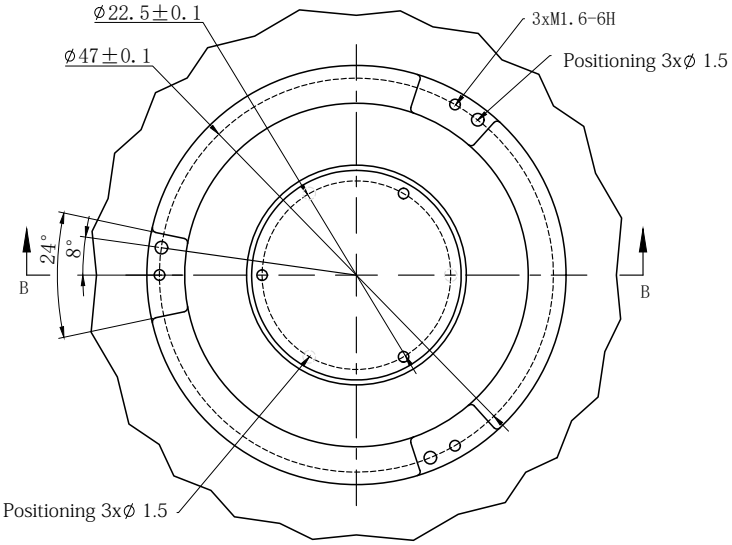


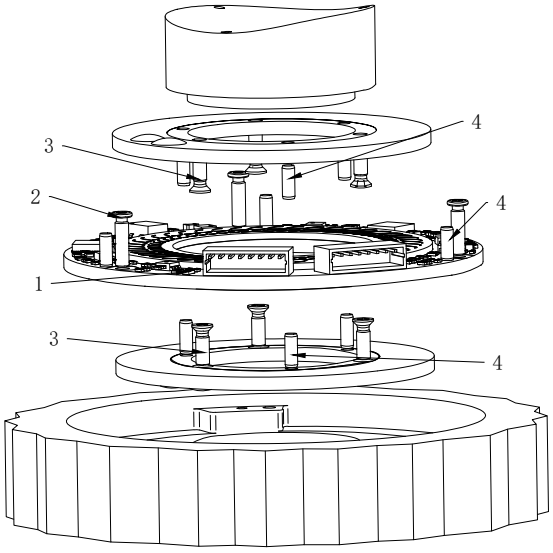
4.2 Installation Diagram

Sensing on the different side:





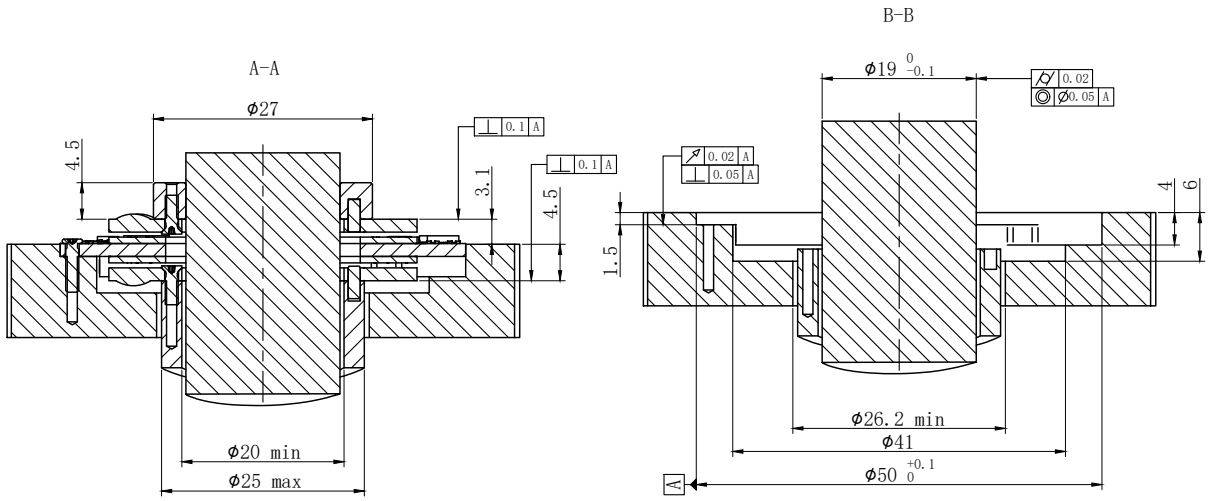


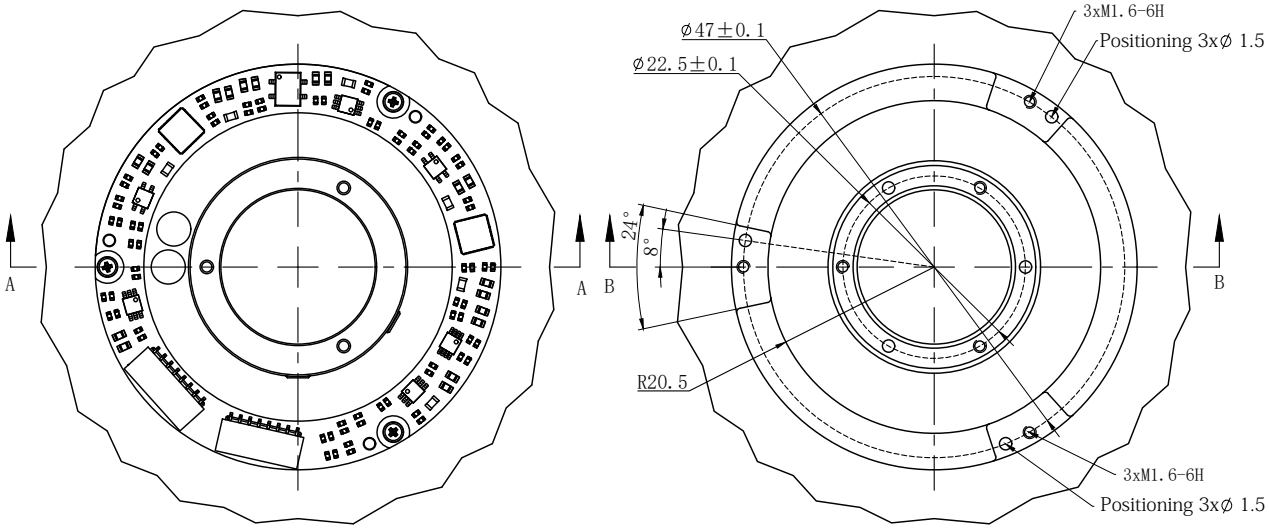


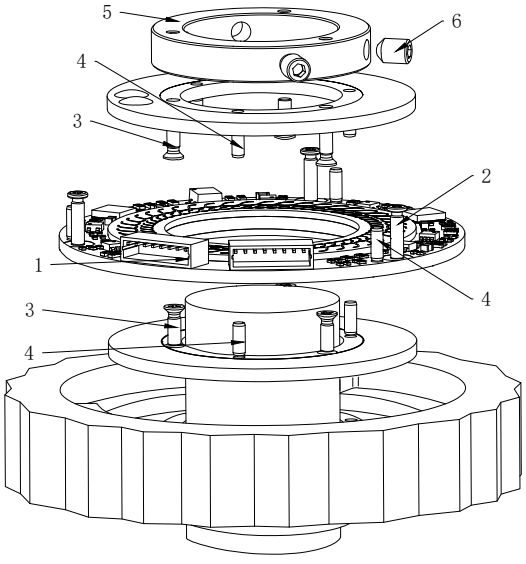
Linear tolerances	
0-50	±0.05mm
50	±0.1mm

NO.		QTY	Description
1	D2050	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	6	
4	⌀1.5x4 dowel pin	9	

Sensing on the same side:







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

NO.		QTY	Description
1	D2050	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	6	
4	⌀1.5x4 dowel pin	9	
5	D2050 Rotor clamping ring	1	Customized accessories
6	M3x4 Screw	2	

2、Technical Specifications

General

Resolution	4096 \18-20bit (22bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	58\ (21-18) \7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	1.4 kg·mm2
Weight (stator / rotor)	25 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	HC-1.25-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

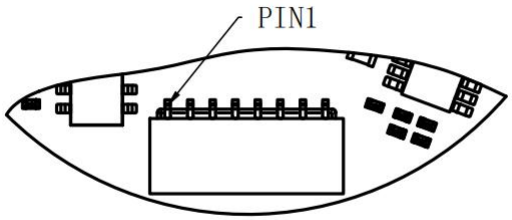
D2158 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

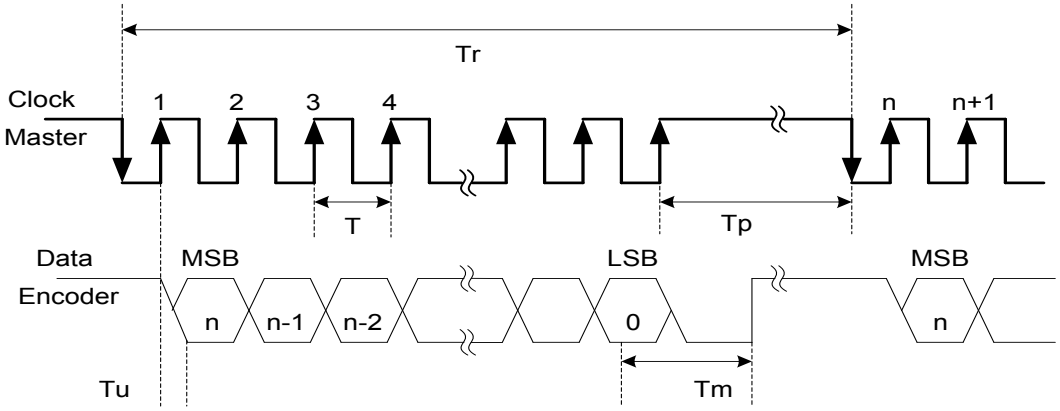
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector: HC-1.25-8PWT (Standard)

3.2 SSi Interface

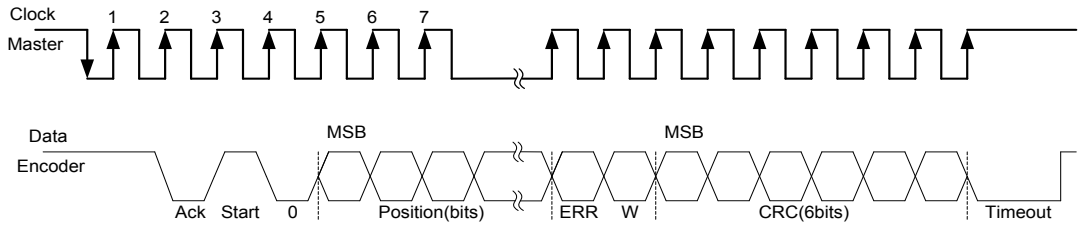
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

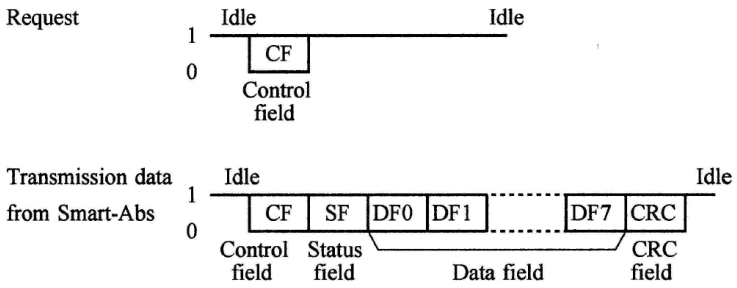
3.4 RS-422 UART Interface

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

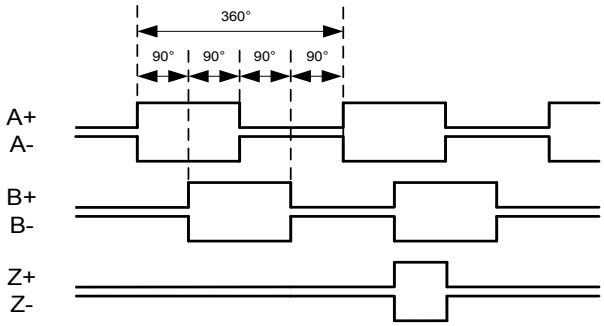
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

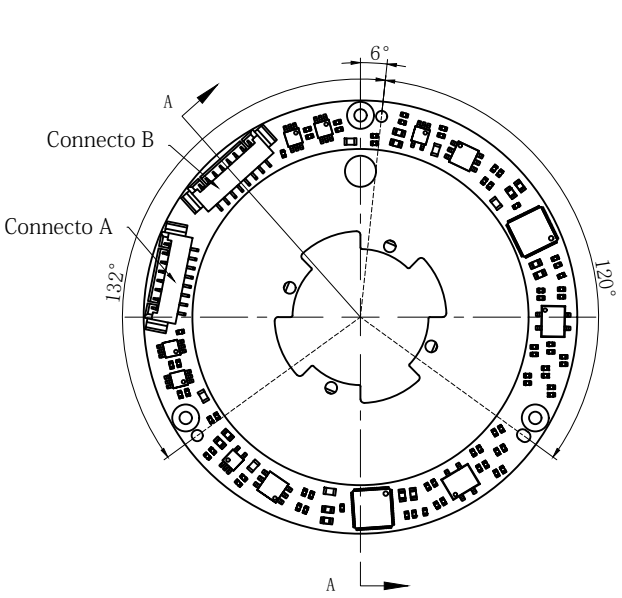
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

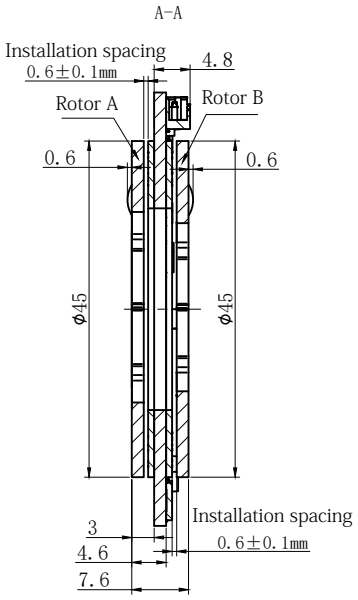


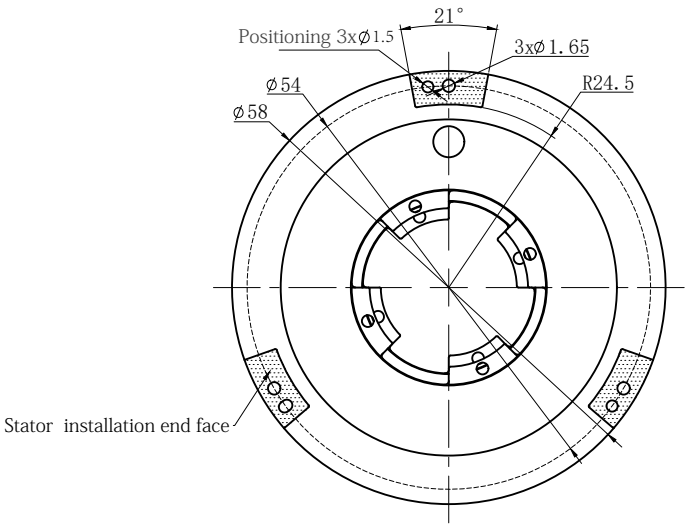
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

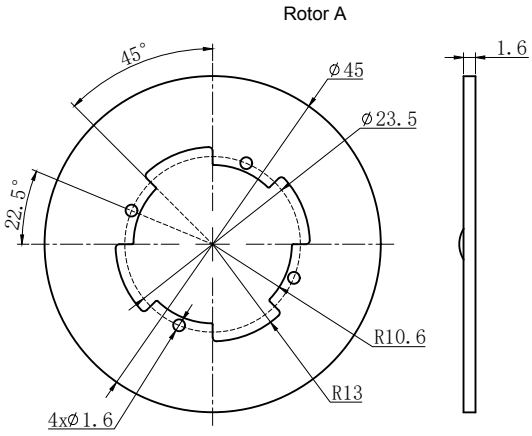
4、Mechanical Mounting

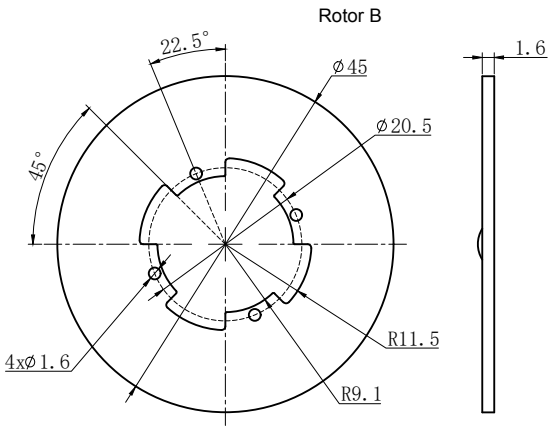
4.1 Dimensions





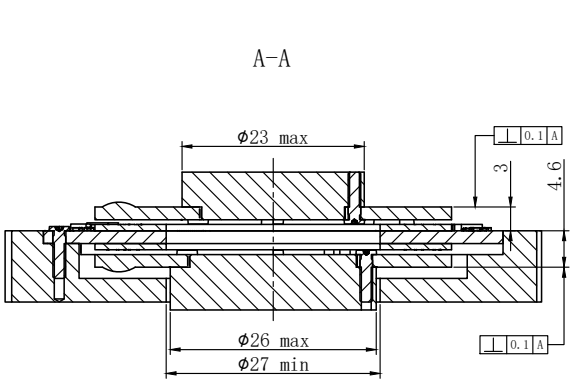


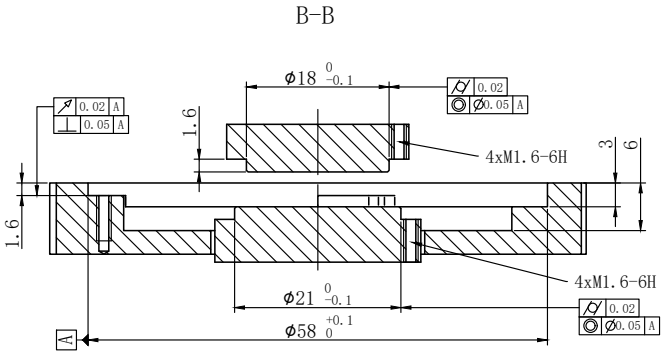


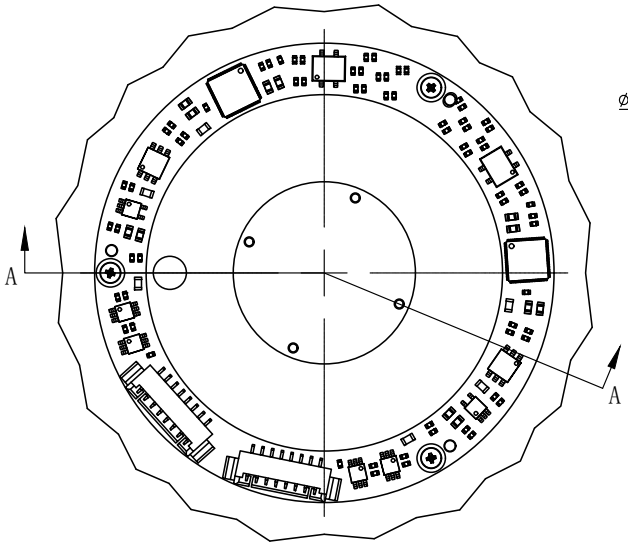


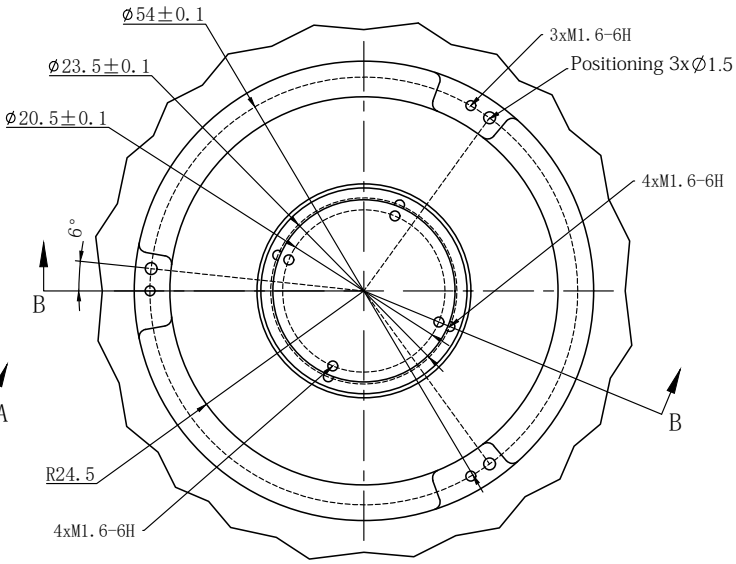
4.2 Installation Diagram

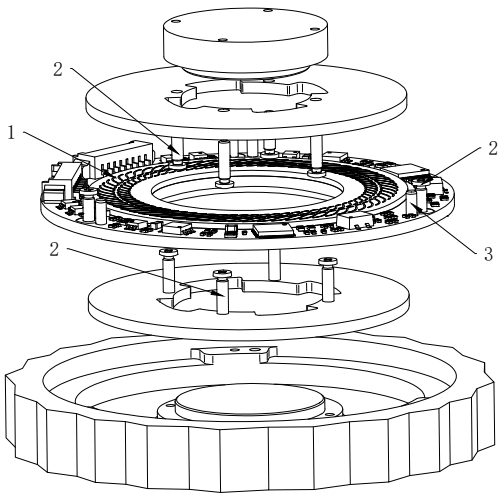
Sensing on the different side:







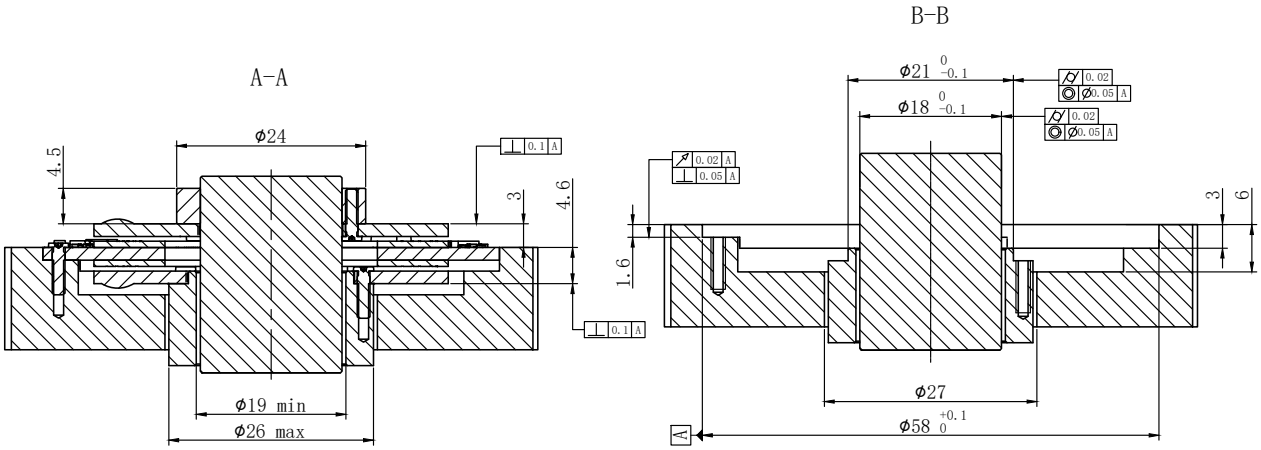


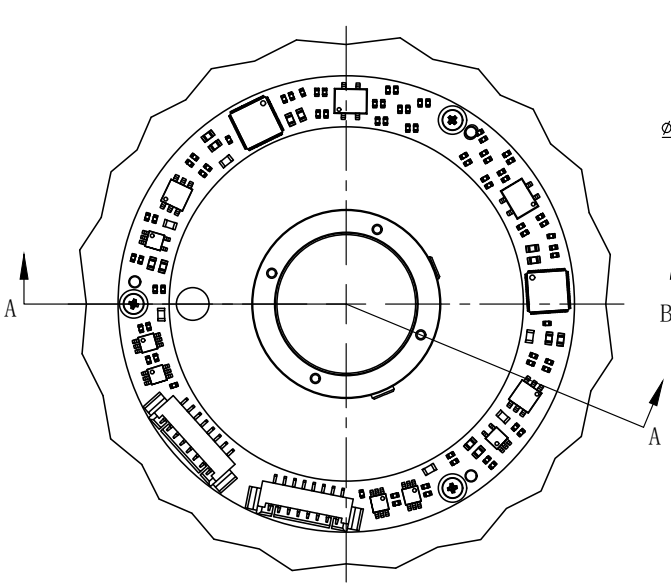


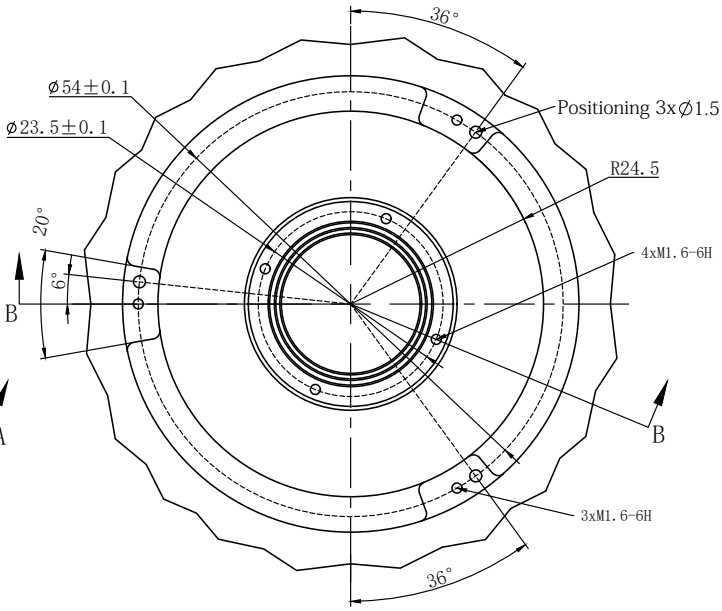
Linear tolerances	
0-50	±0.05mm
50-200	±0.1mm

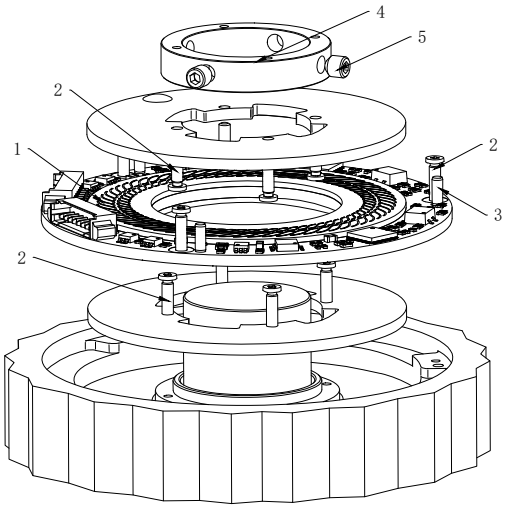
NO.		QTY	Description
1	D2158	1	Product
2	M1.6x6 pan head cross screw	3	Install accessories
3	⌀1.5 dowel pin	3	
4	M2 screw	4	

Sensing on the same side:









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

NO.		QTY	Description
1	D2158	1	Product
2	M1.6x6 round head cross screw	11	Install accessories
3	⌀1.5x4 dowel pin	3	
4	D2158 Rotor clamping ring	1	Customized accessories
5	M3x3 Screw	2	

2、Technical Specifications

General

Resolution	4096 \18-20bit (23bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	70 \ 36 \ 7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	3.4kg·mm2
Weight (stator / rotor)	35 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	ZX-SH1.0-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

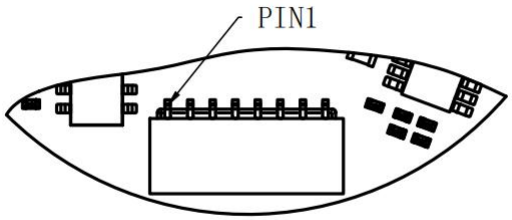
D3670 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

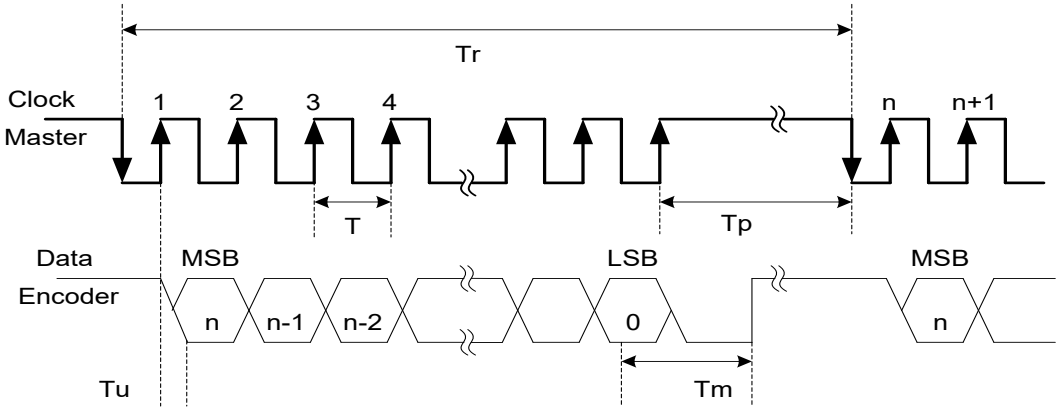
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector: ZX-SH1.0-8PWT、ZX-SH1.0-8PJK (Standard)

3.2 SSi Interface

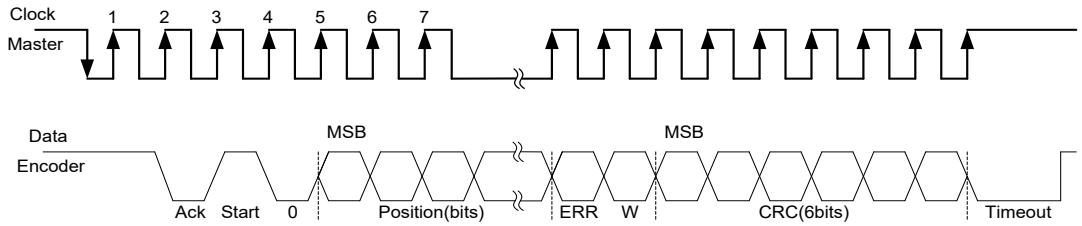
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

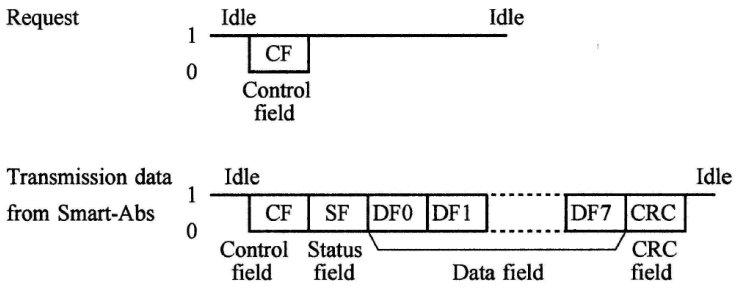
3.4 RS-422 UART Interface

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

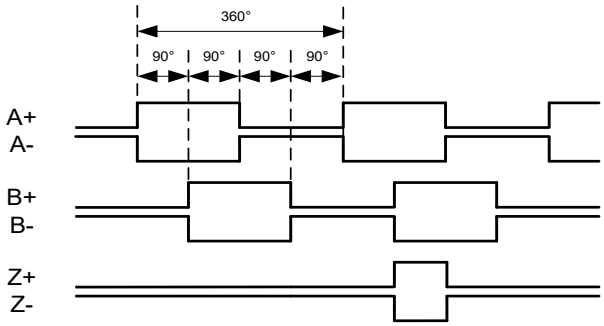
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

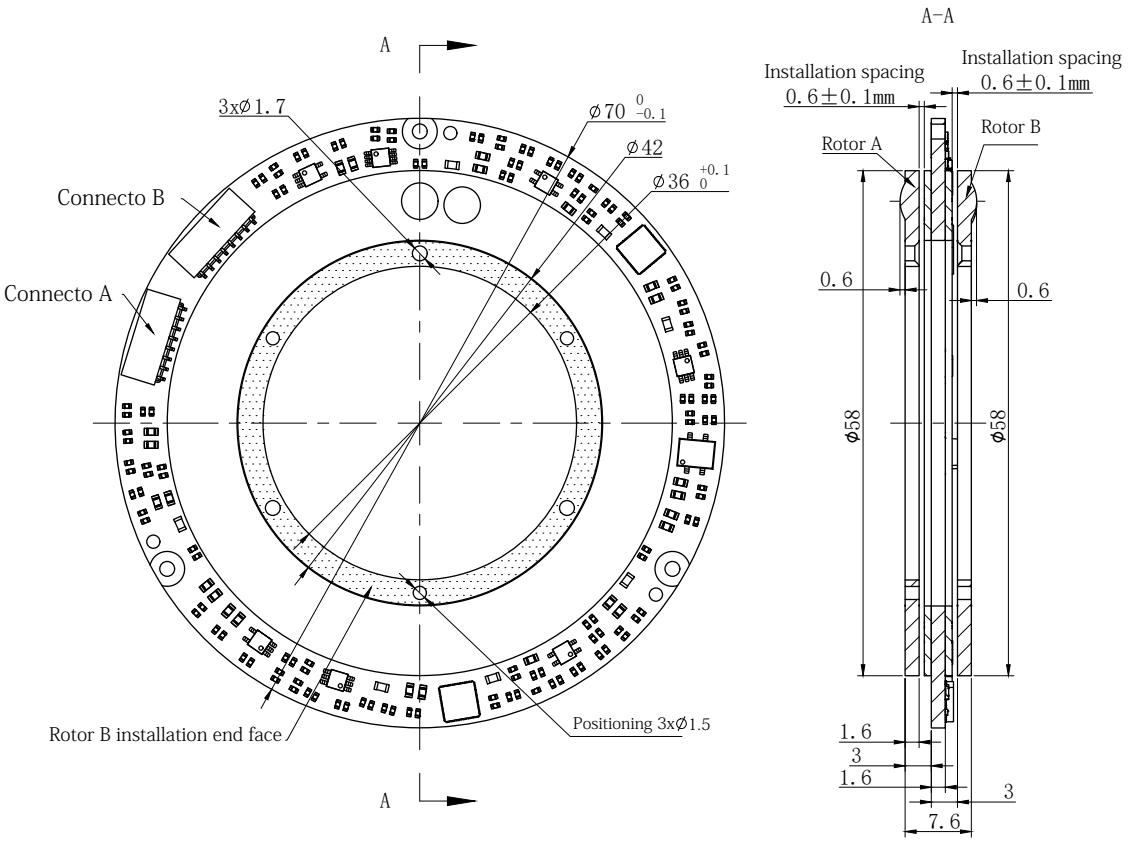
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

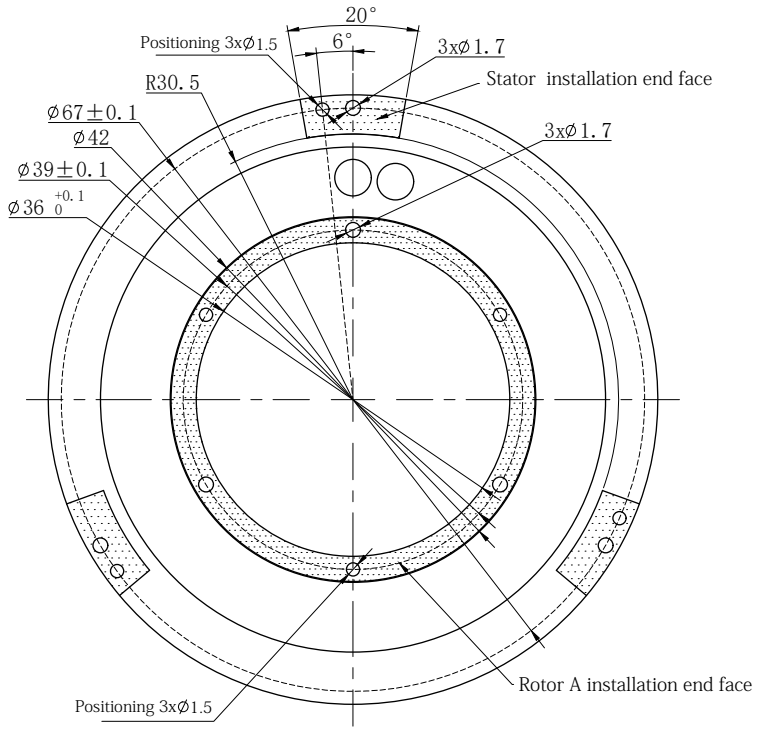


The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

4、Mechanical Mounting

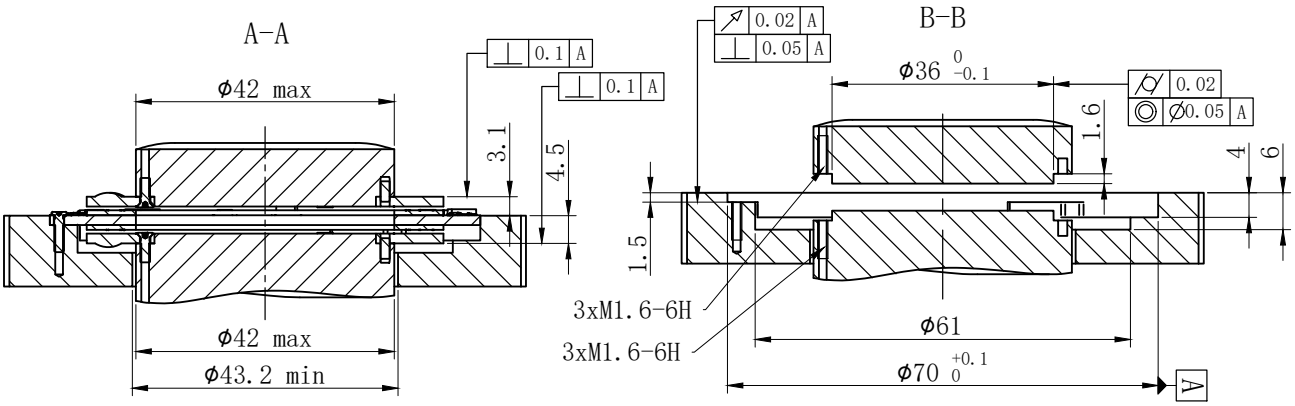
4.1 Dimensions

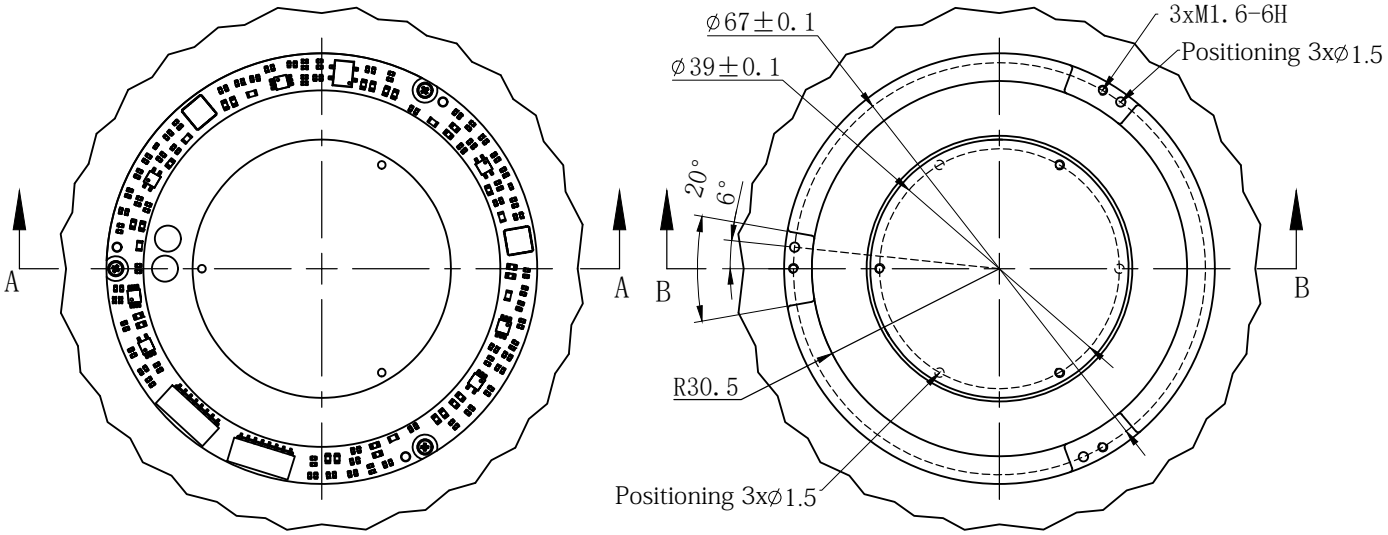


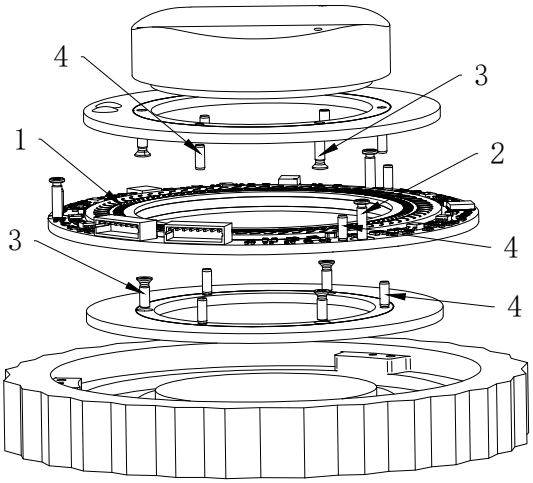


4.2 Installation Diagram

Sensing on the different side:



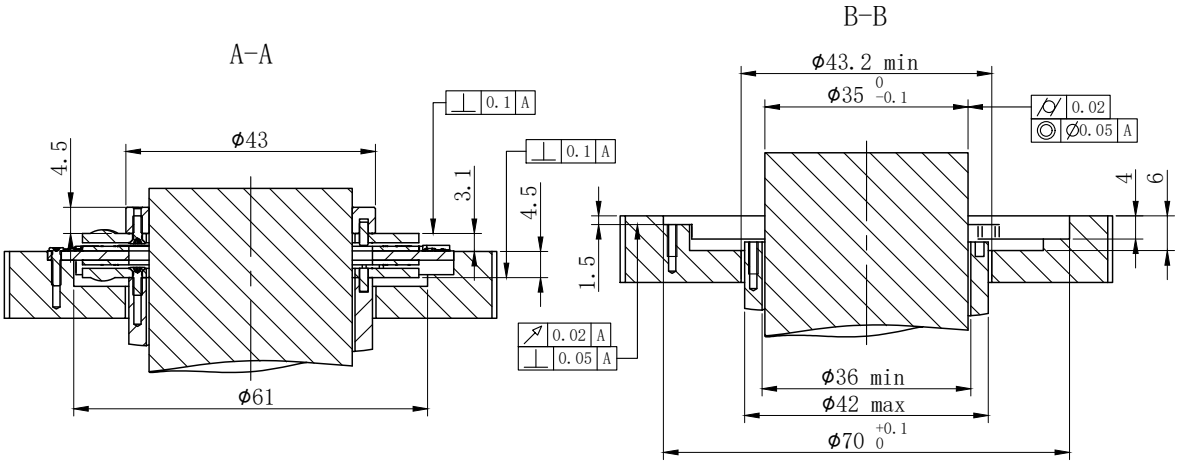


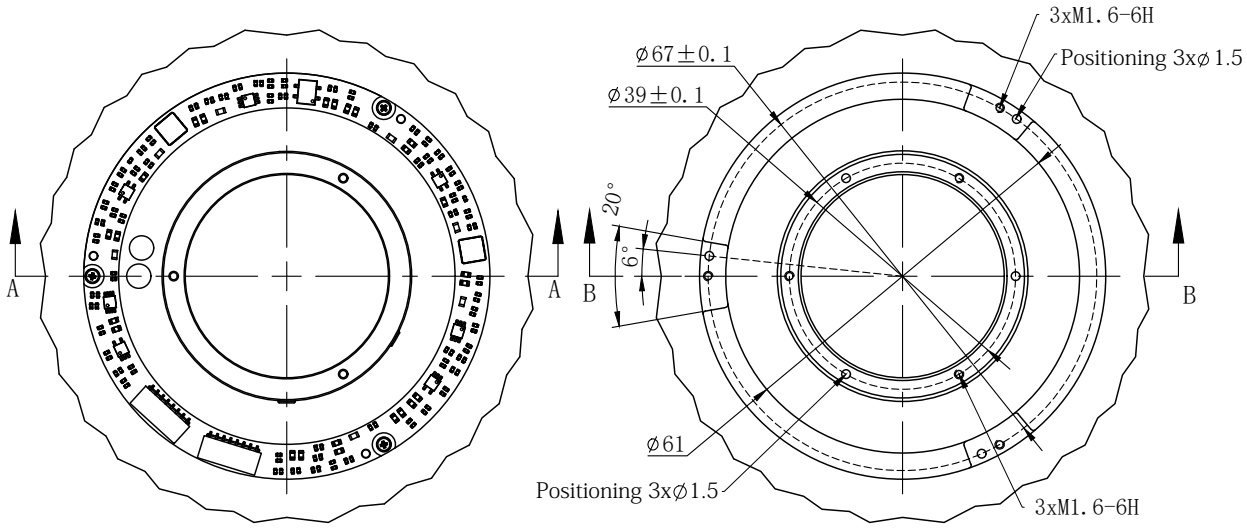


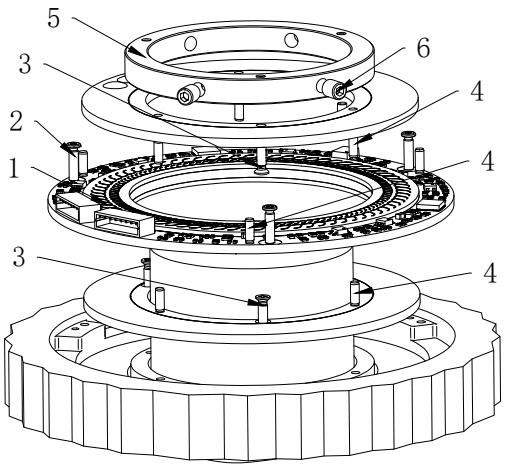
Linear tolerances	
0-50	±0.05mm
50-200	±0.1mm

NO.		QTY	Description
1	D3670	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	6	
4	⌀1.5x4 dowel pin	9	

Sensing on the same side:







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

NO.		QTY	Description
1	D3670	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	6	
4	⌀1.5x4 dowel pin	9	
5	D3670 Rotor clamping ring	1	Customized accessories
6	M3x4 Screw	2	

2、Technical Specifications

General

Resolution	4096 \18-20bit (23bit extension)
Maximum static error	±0.008°
Repetitive error	±2 LSB
Maximum operational speed	6000 rpm
Measurement range	Single turn
Rotation direction	Adjustable CW/CCW

Mechanical

Outer\Inner\Height	78\ (31/35) \7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	5.5 kg·mm2
Weight (stator / rotor)	55 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	HC-1.25-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

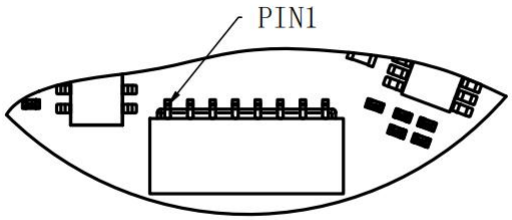
D3178 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

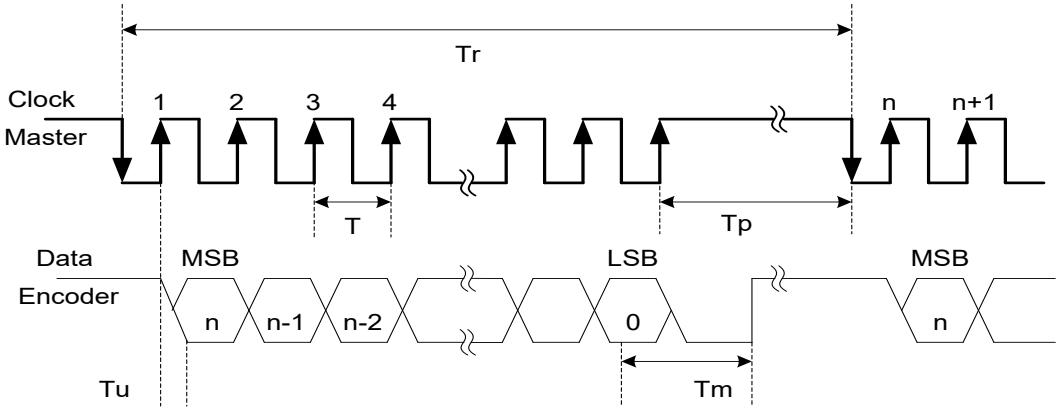
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector: HC-1.25-8PWT（Standard)

3.2 SSi Interface

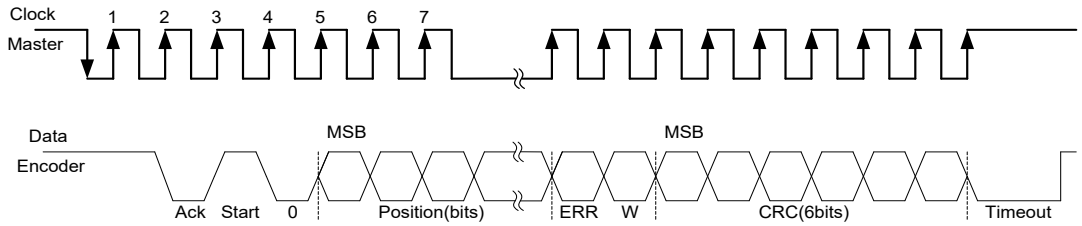
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

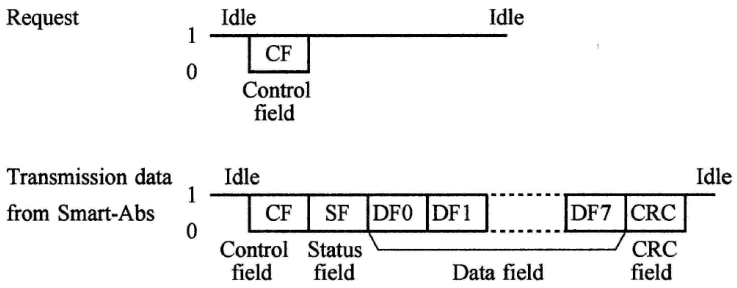
3.4 RS-422 UART Interface

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

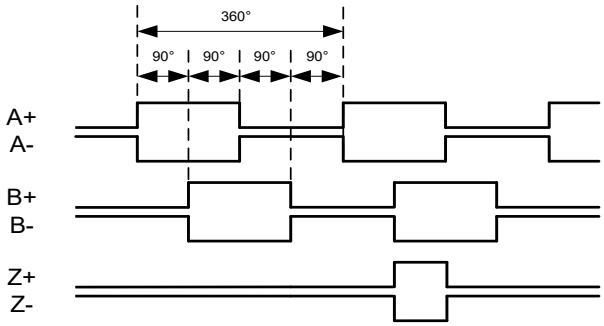
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

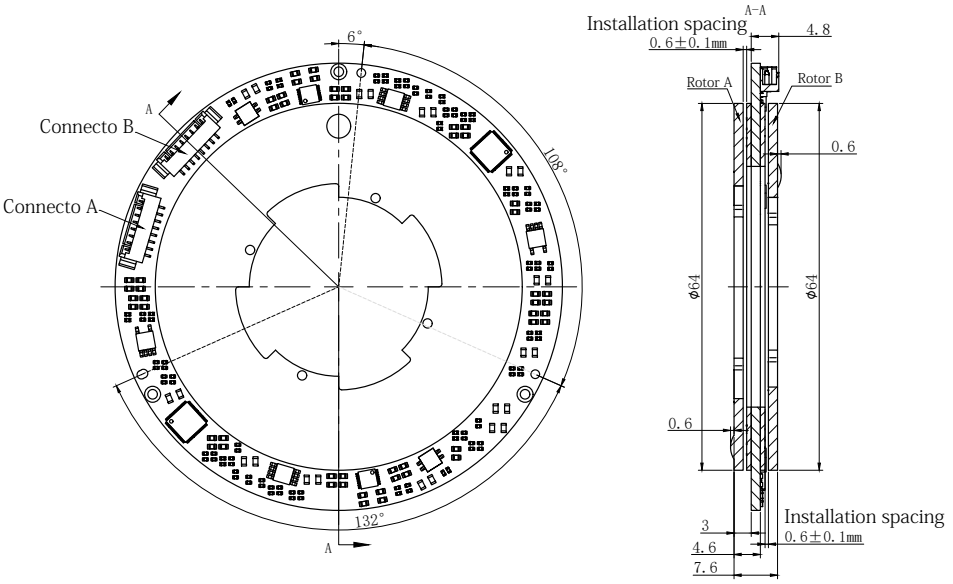
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

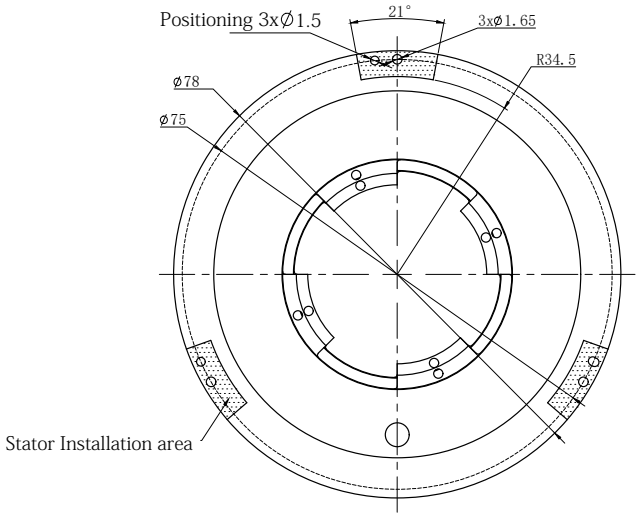


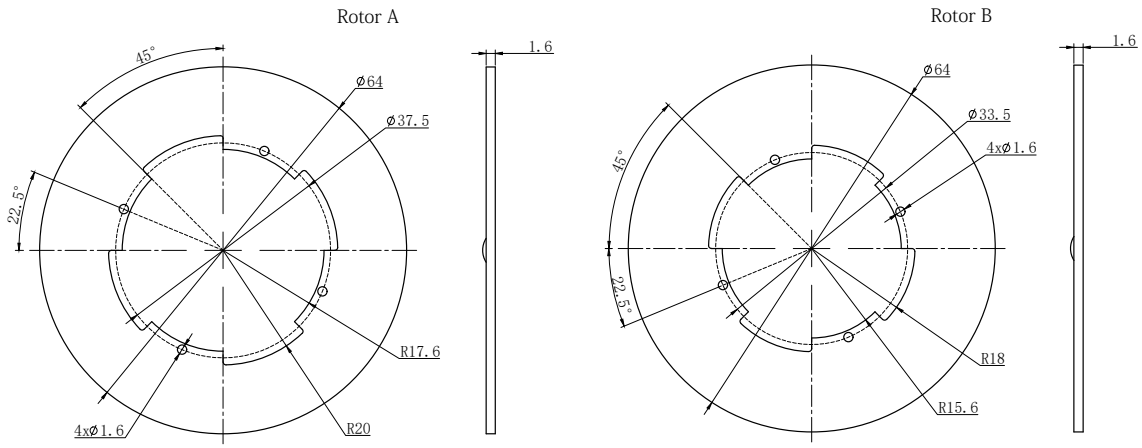
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

4、Mechanical Mounting

4.1 Dimensions

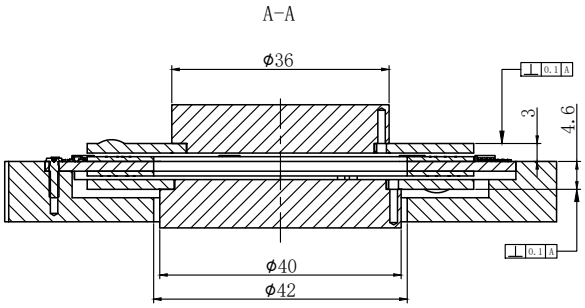


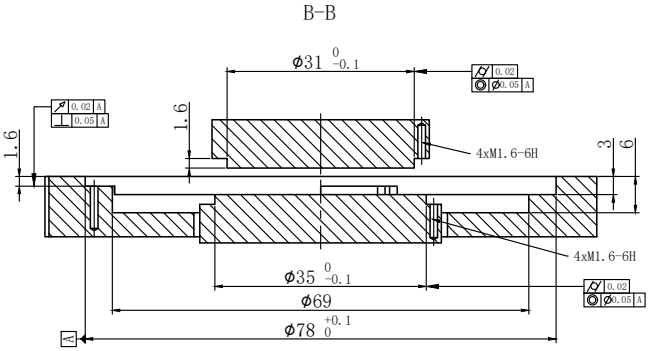


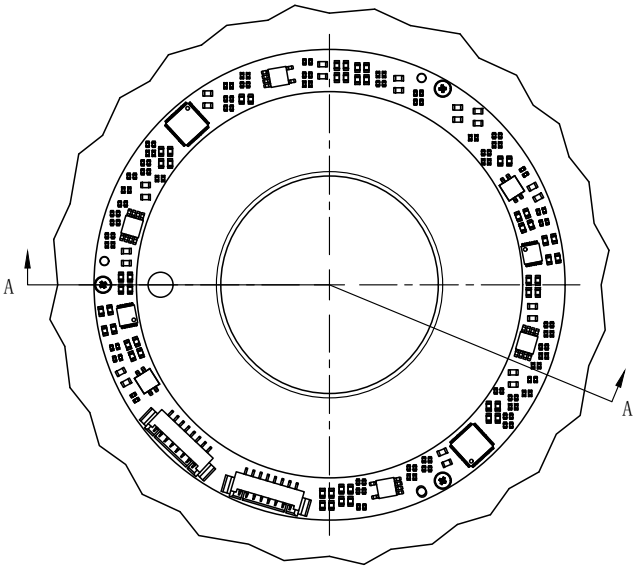


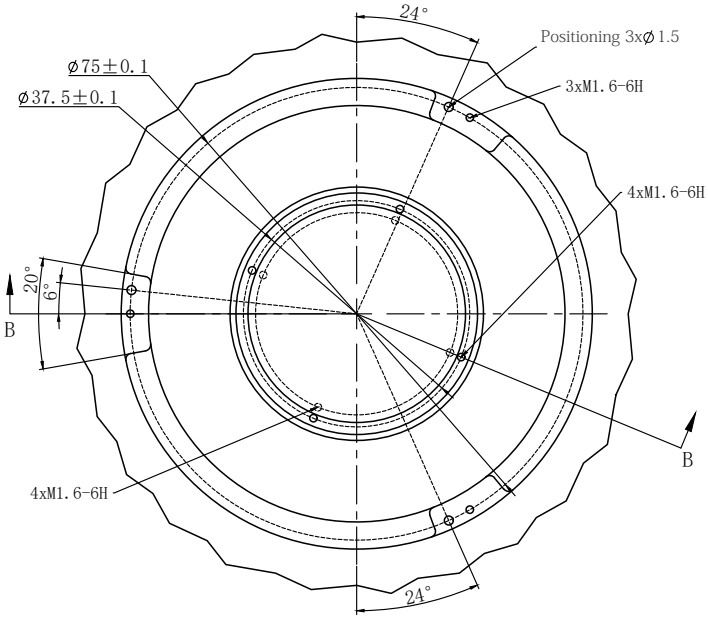
4.2 Installation Diagram

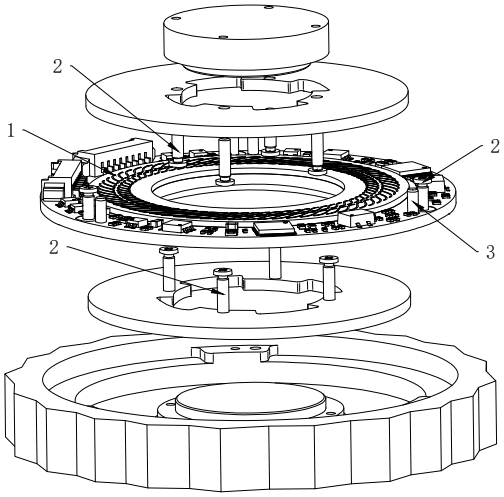
Sensing on the different side:







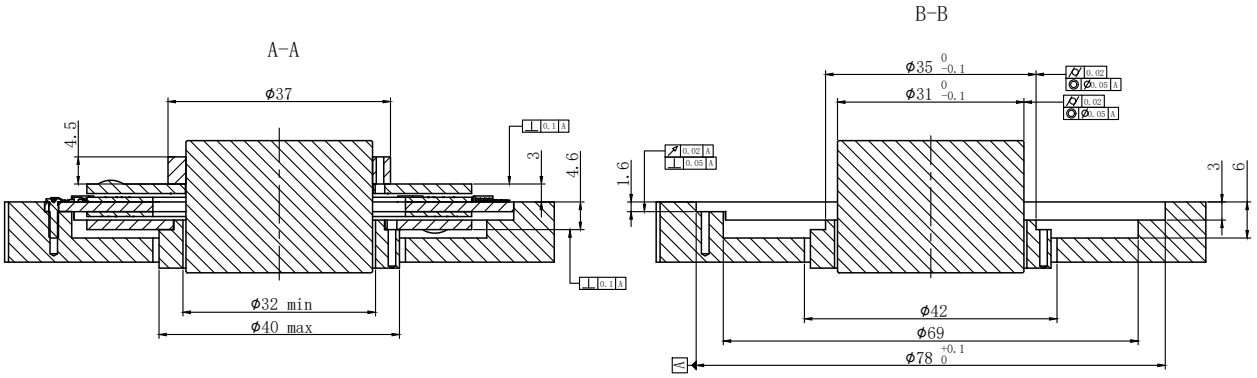


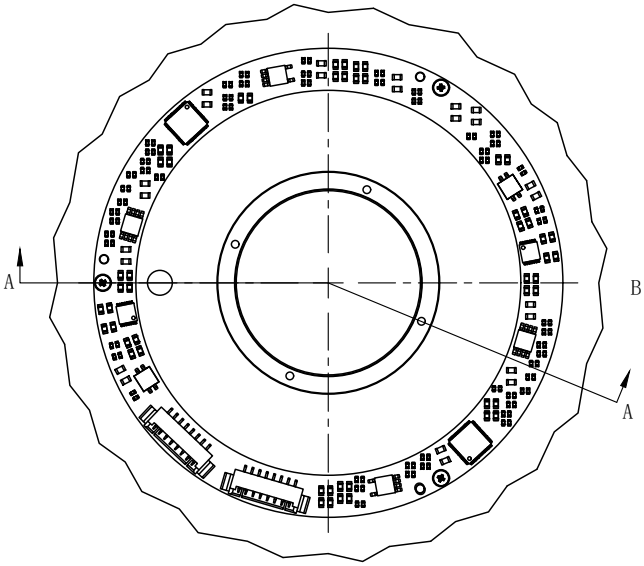


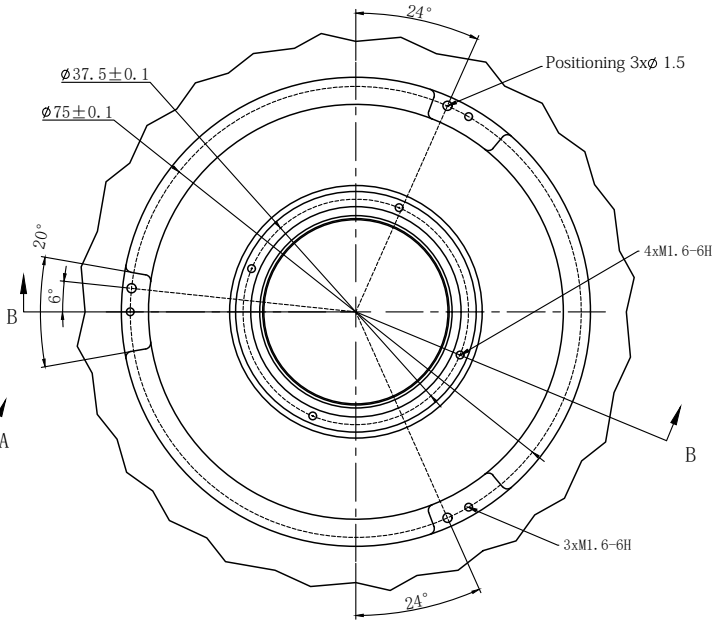
Linear tolerances	
0-50	±0.05mm
50-100	±0.1mm

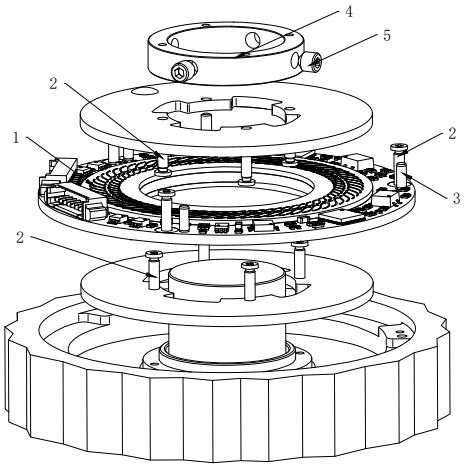
NO.		QTY	Description
1	D3178	1	Product
2	M1.6x6 pan head cross screw	3	Install accessories
3	⌀1.5 dowel pin	3	
4	M1.6 Tightening screws	2	

Sensing on the same side:









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

NO.		QTY	Description
1	D3178	1	Product
2	M1.6x6 round head cross screw	11	Install accessories
3	⌀1.5x4 dowel pin	3	
4	D3178 Rotor clamping ring	1	Customized accessories
5	M3x3 Screw	2	

2、Technical Specifications

General

Resolution	4096 \19-21bit (24bit 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	90 \ 56 \ 7.6 mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	9.8kg·mm2
Weight (stator / rotor)	50 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	ZX-SH1.0-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

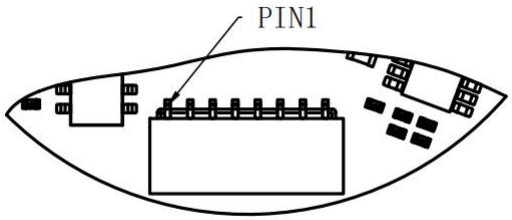
D5690 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

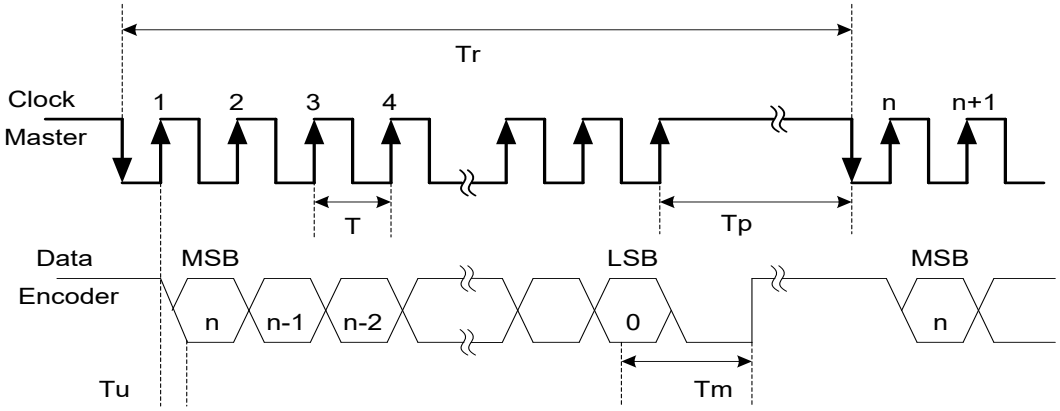
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector:ZX-SH1.0-8PWT、ZX-SH1.0-8PJK (Standard)

3.2 SSi Interface

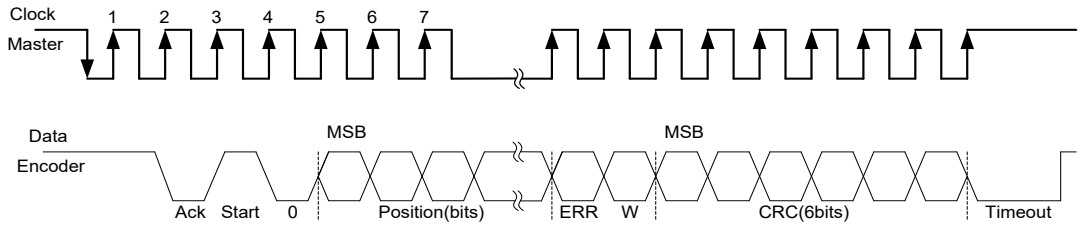
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

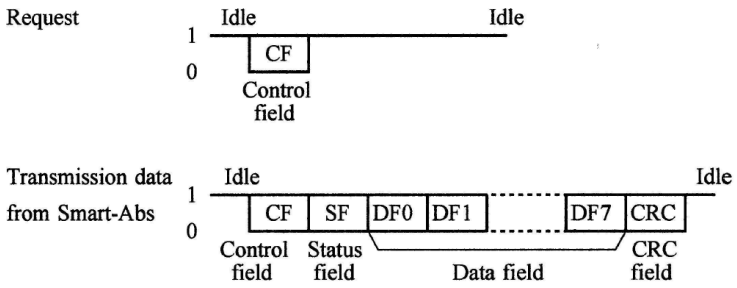
3.4 RS-422 UART Interface

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

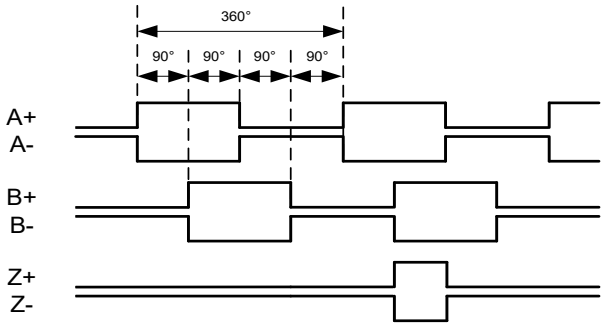
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

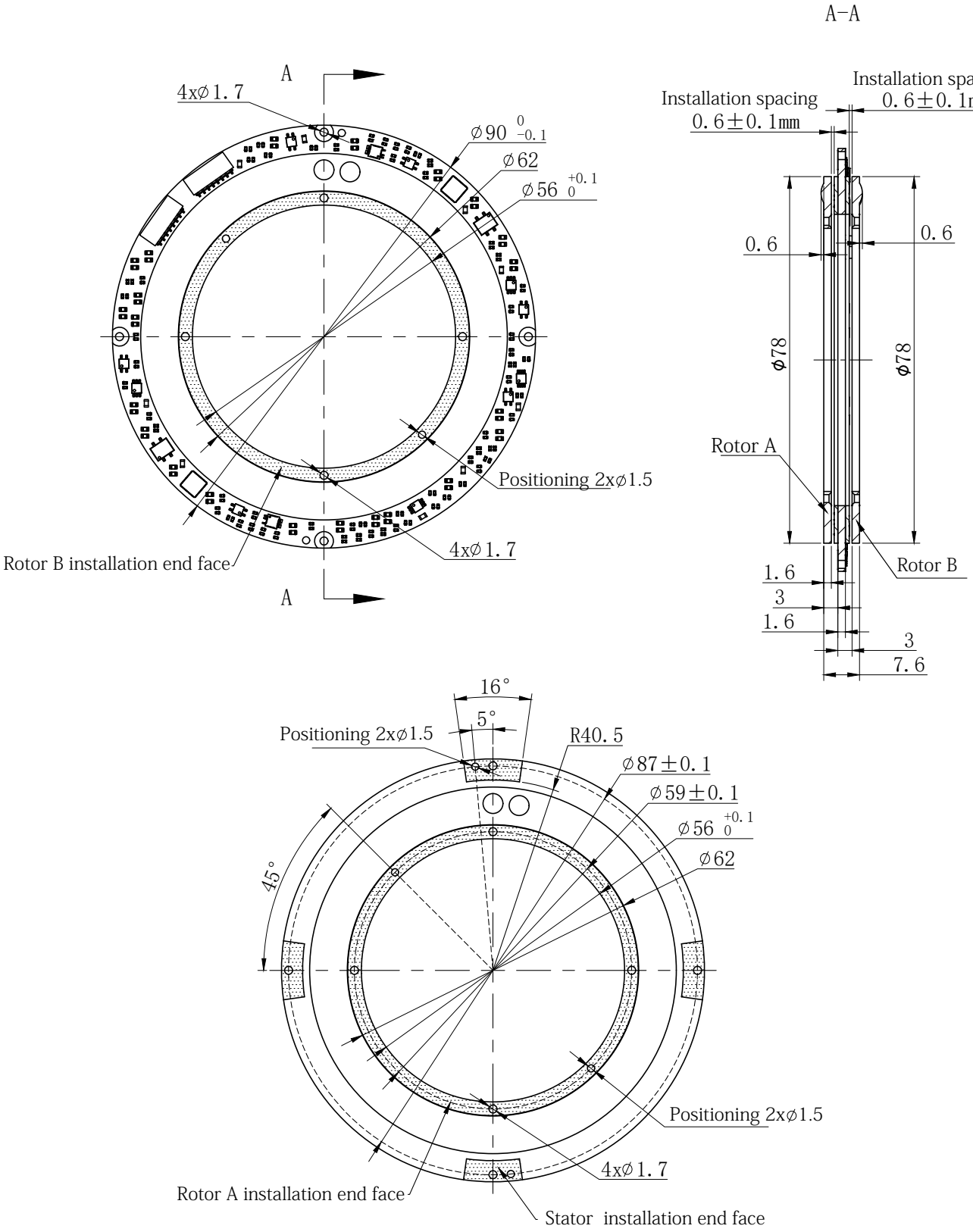
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

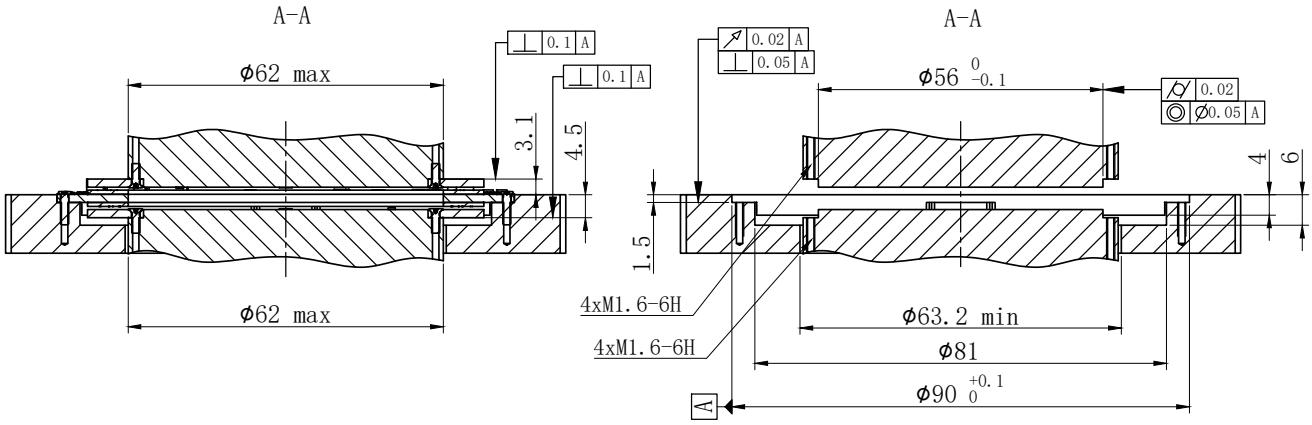
4、Mechanical Mounting

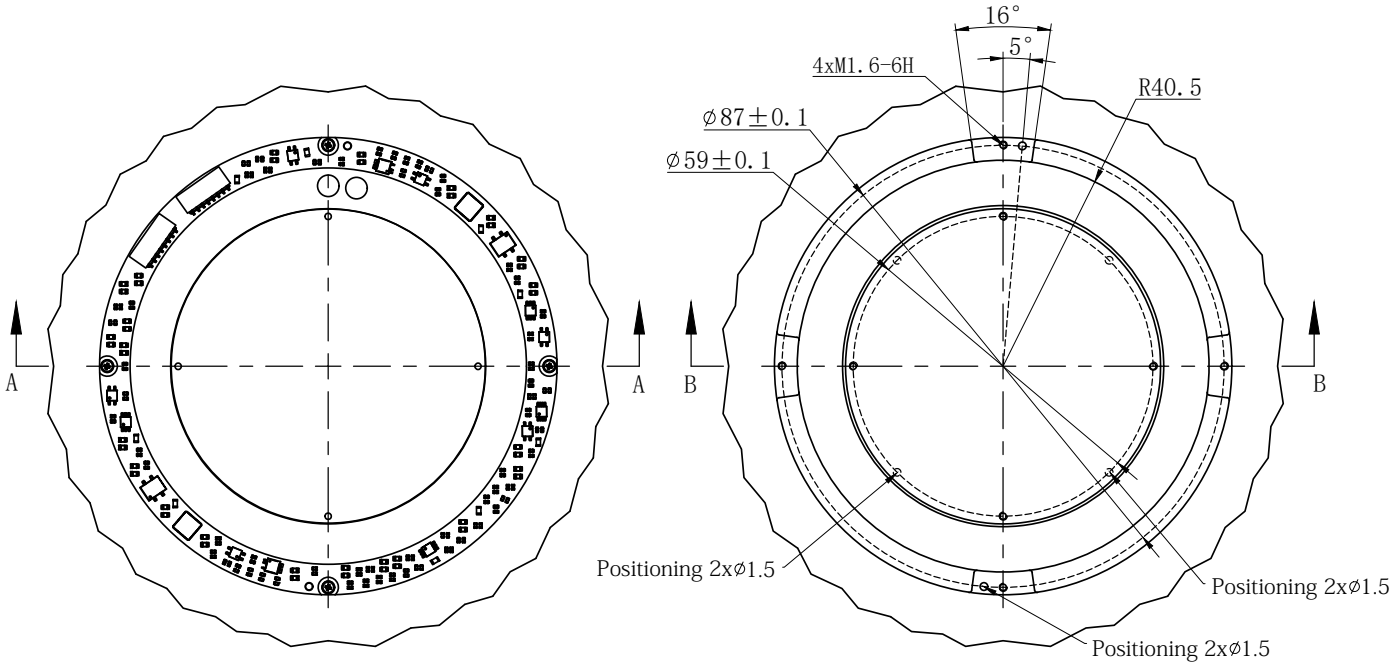
4.1 Dimensions

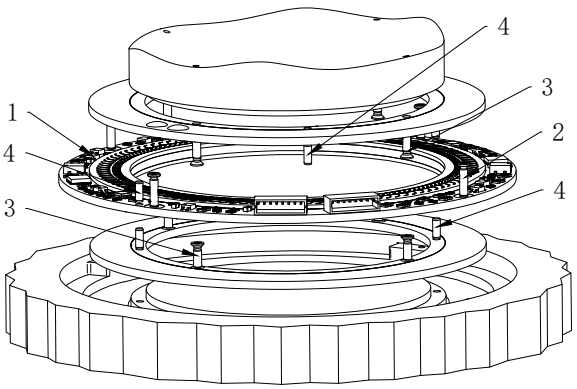


4.2 Installation Diagram

Sensing on the different side:



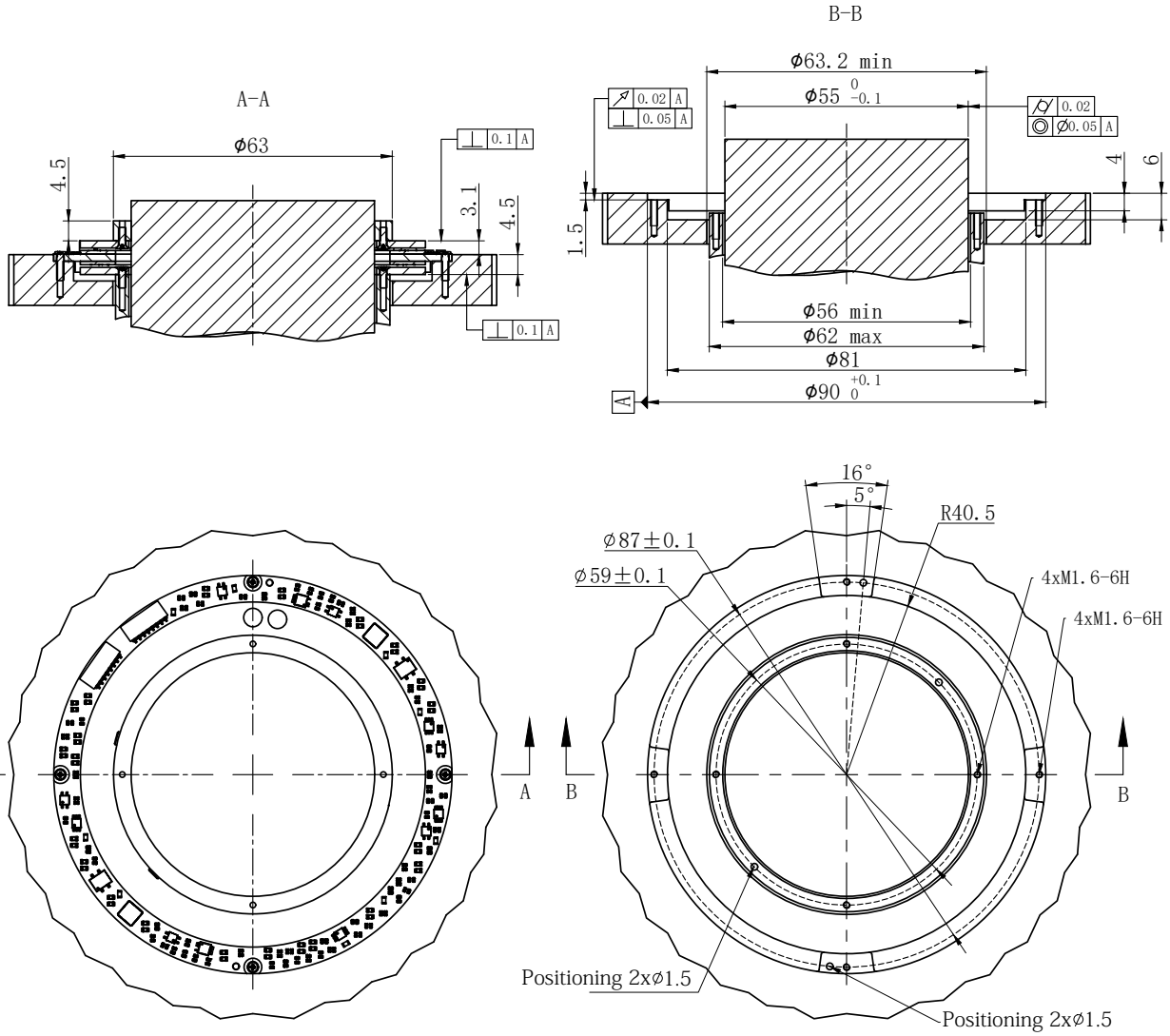


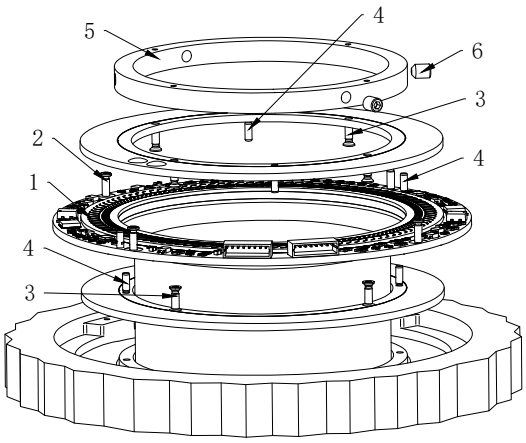


Linear tolerances	
0-50	±0.05mm
50-200	±0.1mm

NO.		QTY	Description
1	D5690	1	Product
2	M1.6x6 round head cross screw	3	Install accessories
3	M1.6x6 countersunk head cross screw	8	
4	⌀1.5x4 dowel pin	9	

Sensing on the same side:





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

NO.		QTY	Description
1	D5690	1	Product
2	M1.6x6 round head cross screw	4	Install accessories
3	M1.6x6 countersunk head cross screw	8	
4	⌀1.5x4 dowel pin	6	
5	D5690 Rotor clamping ring	1	Customized accessories
6	M3x4 Screw	2	

2、Technical Specifications

General

Resolution	4096 \19-21bit (24bit 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	110 \ 76 \ 7.6mm
Allowable mounting eccentricity	±0.1 mm
Allowable axial mounting tolerance	0.6±0.1 mm
Rotor inertia	21.2 kg·mm2
Weight (stator / rotor)	65 g
Material (stator / rotor)	FR-4

Electrical

Supply voltage	5 - 24V
Current consumption	< 240 mA
Electrical Interface	ZX-SH1.0-8PWT connector
Communication	SSi、BiSS-C、UART、ABZ

Environmental

EMC	IEC 61000-6-2、IEC 61000-6-4
Operating temperature	-20℃ - +60℃
Storage temperature	-50℃ - +85℃
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

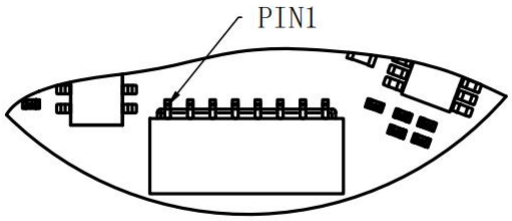
D76110 encoder consists of a stator and two rotors, the stator integrates an angle calculation circuit and an encoding output circuit. The encoder uses a multi-core connector for output (connector interface as shown in the figure below), with the output connector located on the outer edge of the stator. 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 definition

No.	SSI	RS-422	BiSS-C	RS-485	ABZ
1	VCC				
2	GND				
3	CLK+	RX+	MA+	/	A+
4	CLK-	RX-	MA-	/	A-
5	DADT-	TX-	SLO-	B-	B-
6	DADT+	TX+	SLO+	A+	B+
7	/				Z+
8	/				Z-

SSi/BiSS output signal parameters

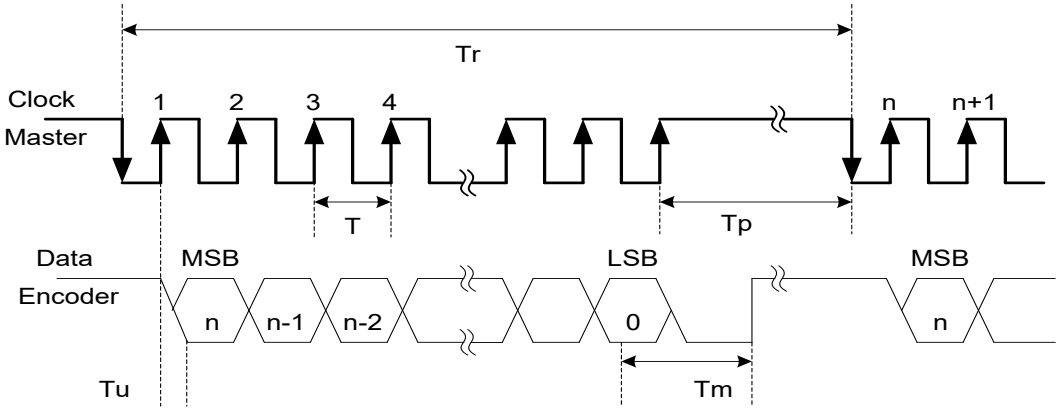
Signal delay	< 50 us
Output code	Binary
Maximum data request rate	25 kHz
Clock/ Serial output	Differential RS-422



Connector and pin1 position
8-pin Connector:ZX-SH1.0-8PWT、ZX-SH1.0-8PJK (Standard)

3.2 SSi Interface

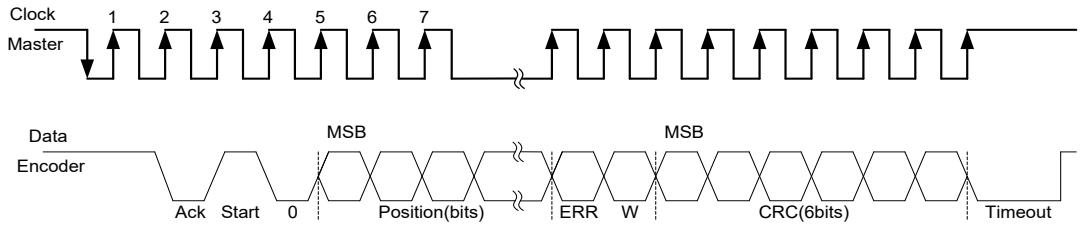
SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The master sends clock and angle encoder synchronized output data. The default clock is high level. The first low level starts data transmission, and the angle encoder transmits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



n	Position resolution	12 - 21
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.

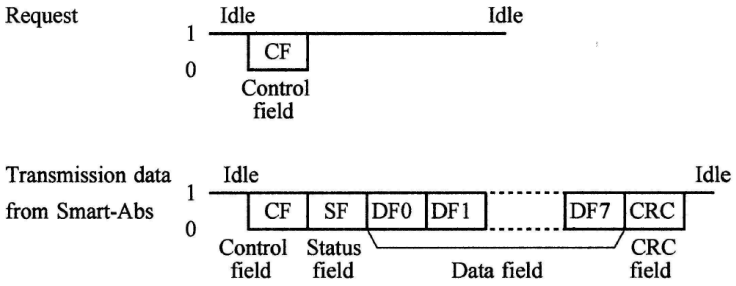
3.4 RS-422 UART Interface

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

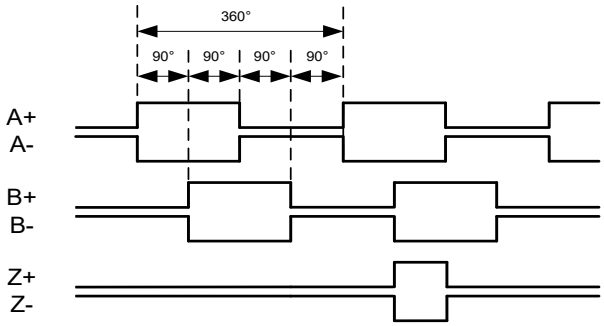
0x08: CRC G(X) = X^8 + 1, The code is calculated from all bits

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

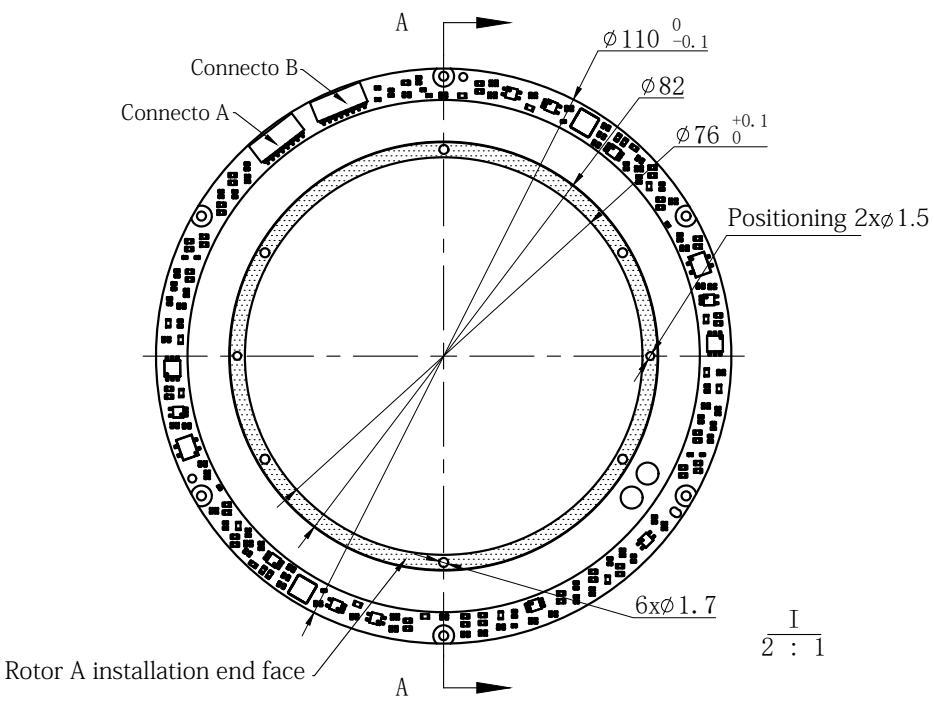
The ABZ interface is a commonly used interface for angle encoders. In the A, B, and Z signals of the encoder, the signal pulse phases of channels A and B differ by 90 degrees. When the rotor rotates clockwise, the output pulse signal of channel A exceeds that of channel B. When the rotor rotates counterclockwise, 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.

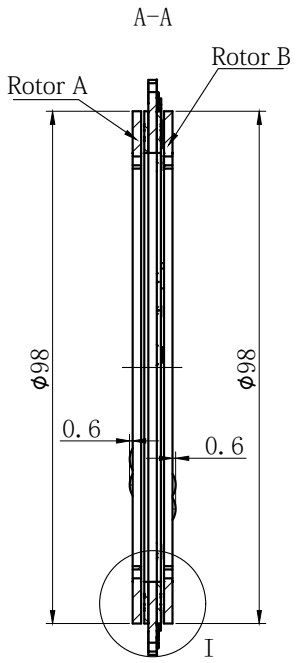


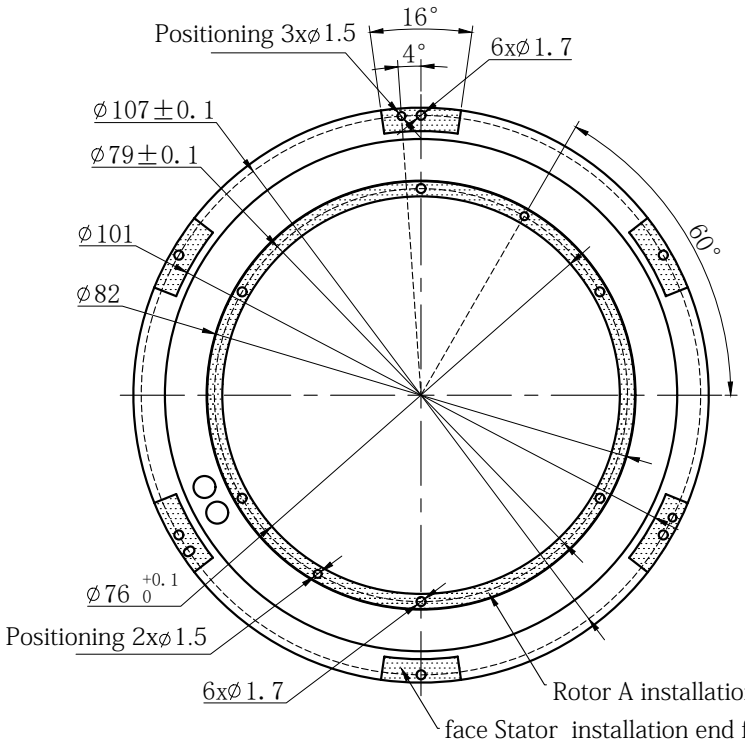
The product can choose differential or single ended ABZ interface output. The differential ABZ interface is compatible with RS422 interface level, and the protocol definition is shown in the above figure. The single ended ABZ interface adopts LVTTL interface level, and the protocol only retains the positive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

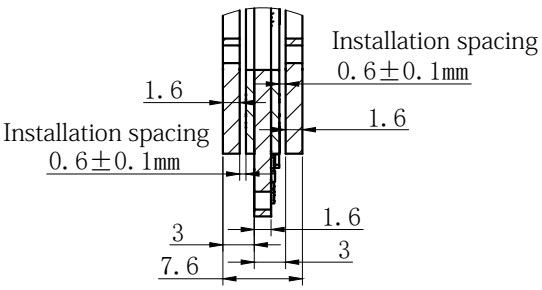
4、Mechanical Mounting

4.1 Dimensions



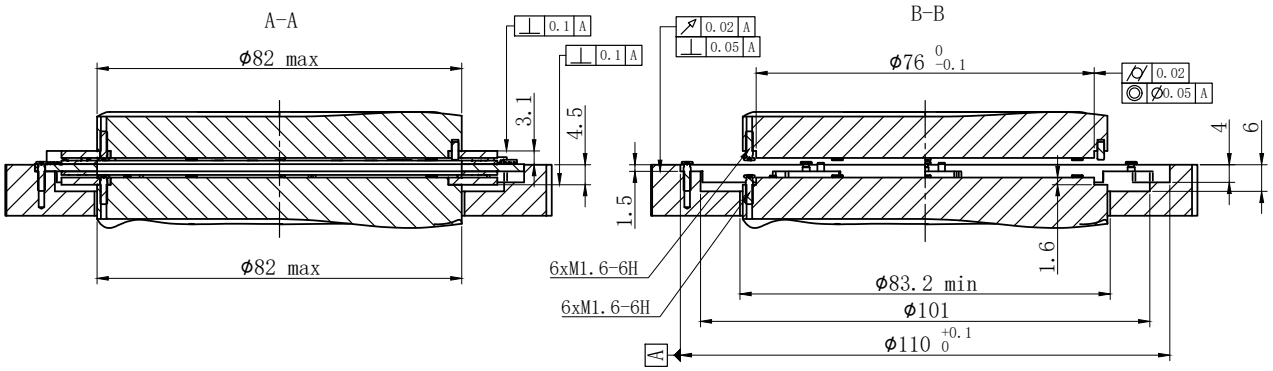


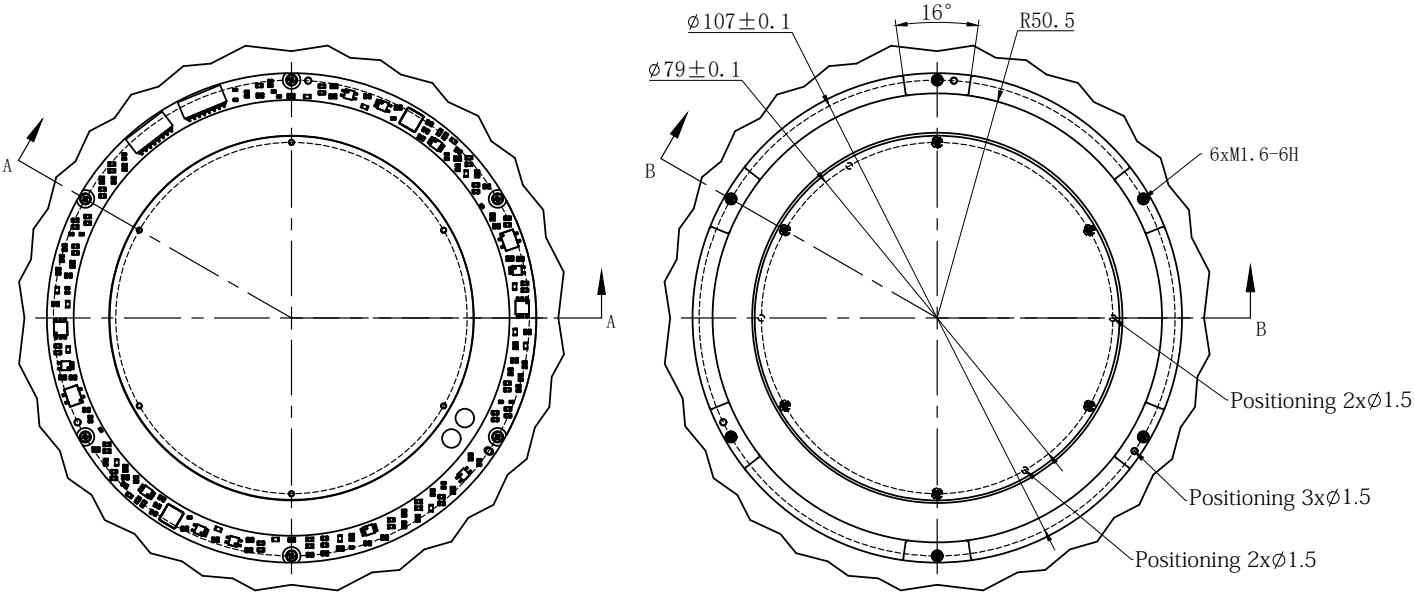


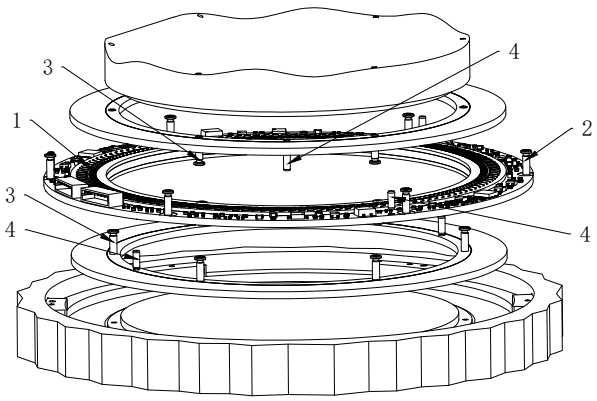


4.2 Installation Diagram

Sensing on the different side:



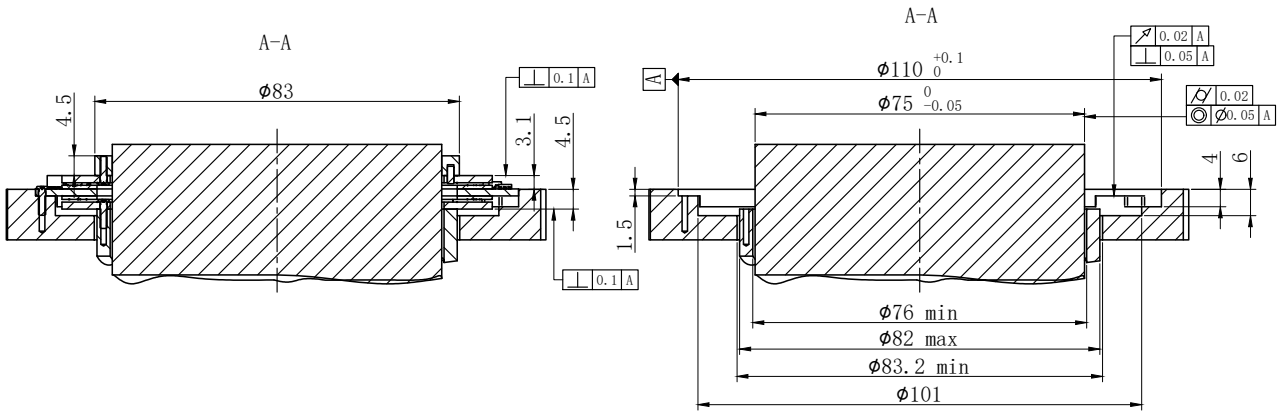


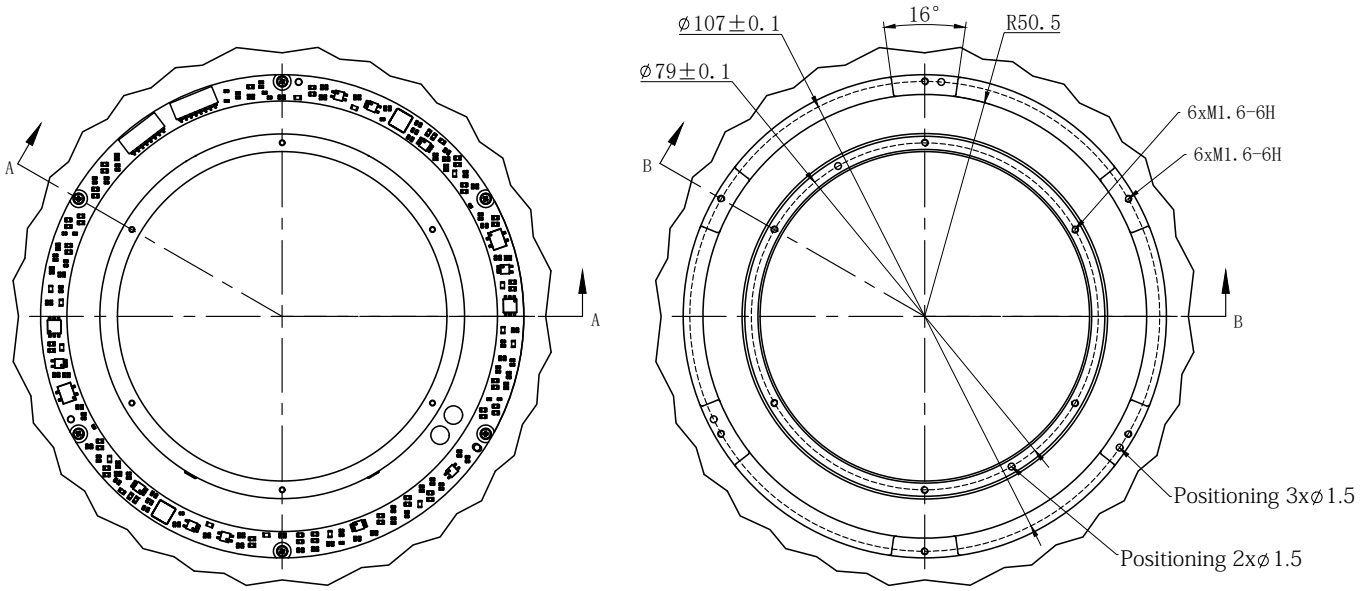


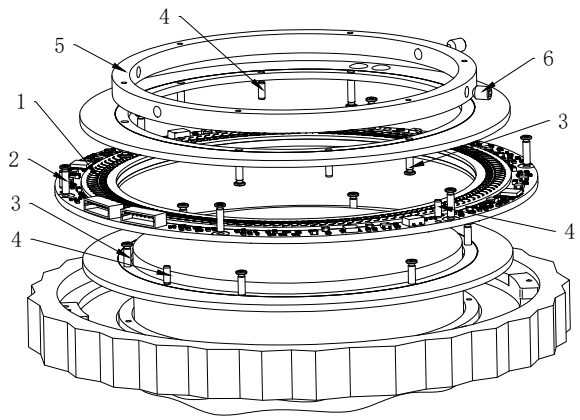
Linear tolerances	
0-50	±0.05mm
50-200	±0.1mm

NO.		QTY	Description
1	D76110	1	Product
2	M1.6x6 round head cross screw	6	Install accessories
3	M1.6x6 countersunk head cross screw	12	
4	⌀1.5x4 dowel pin	7	

Sensing on the same side:







Linear tolerances	
0-50	±0.05mm
50-200	±0.1mm

NO.		QTY	Description
1	D76110	1	Product
2	M1.6x6 round head cross screw	6	Install accessories
3	M1.6x6 countersunk head cross screw	12	
4	⌀1.5x4 dowel pin	7	
5	D76110 Rotor clamping ring	1	Customized accessories
6	M3x4 Screw	2	

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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