Magnetic Encoder

OME45

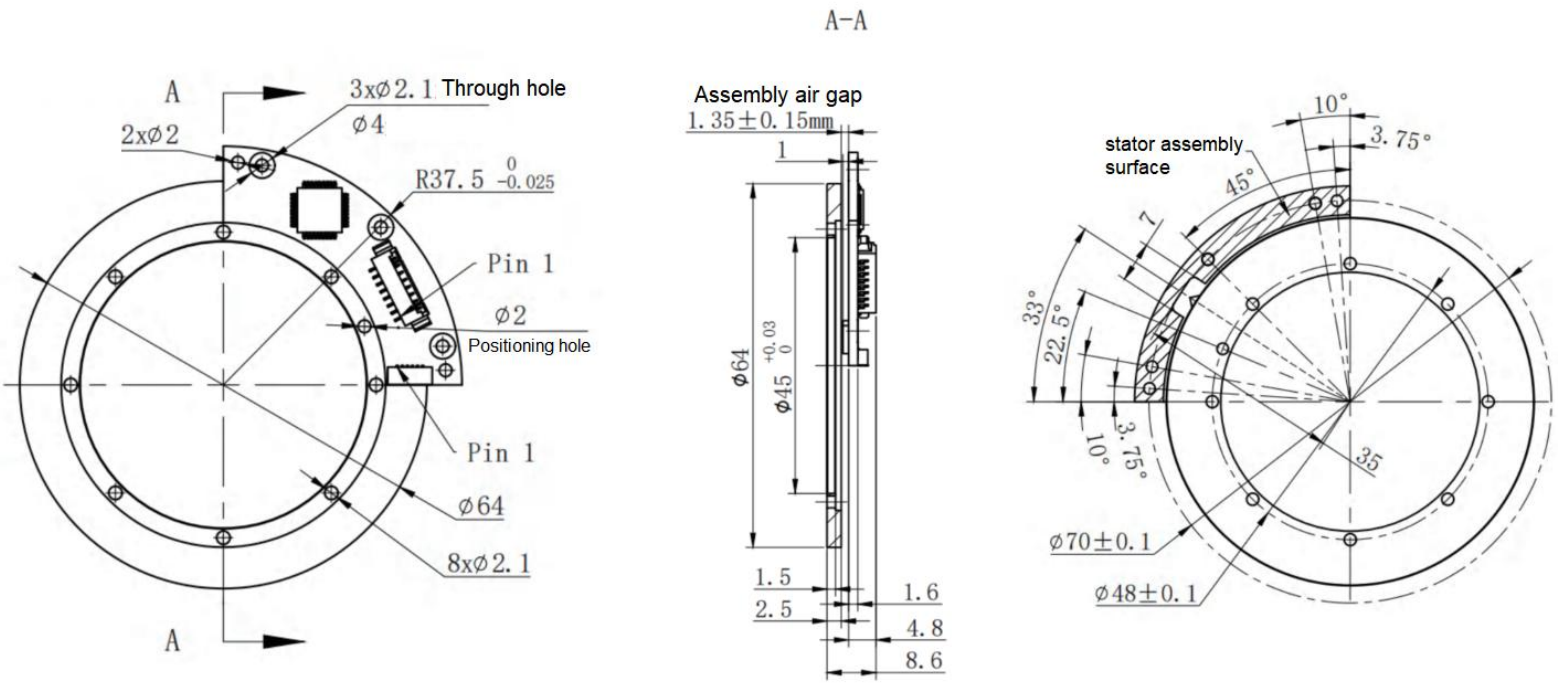
The OME45 absolute magnetic encoder consists of a stator and a rotor. The stator integrates angle calculation and encoder output circuits, with multi-pin output connectors (see interface diagram below) located on its outer edge. Two connectors are used for angle output, supporting SSi, BiSS- C, UART, SPI, and ABZ interface protocols.



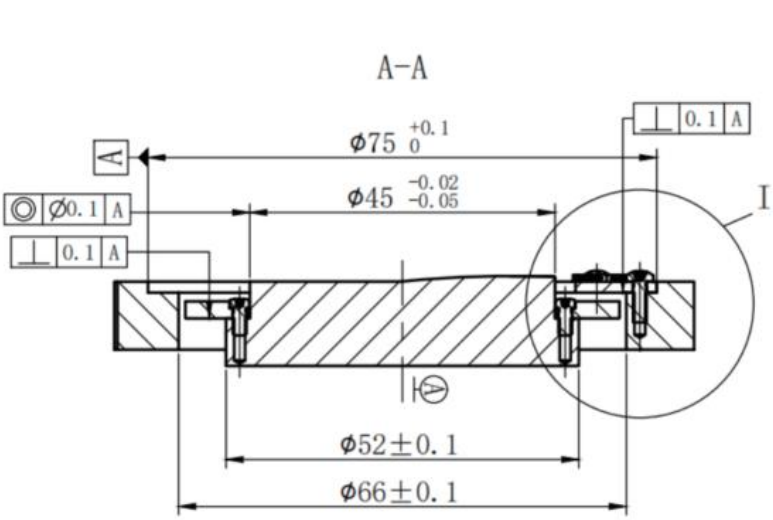
1. Technical Parameters

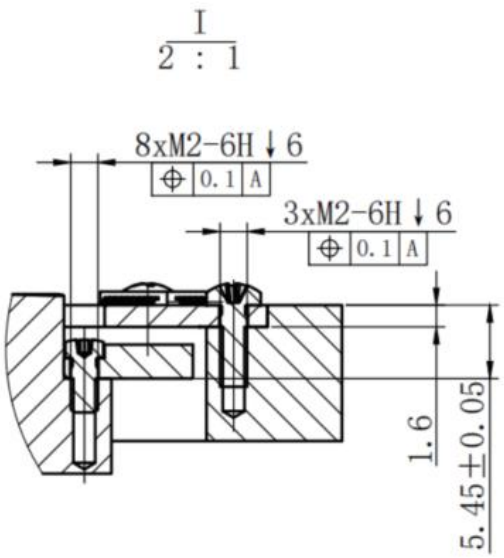
Model	OME45
Basic Performance	
Angular Resolution	17~20 bit
Maximum Static Error	±0.1°
Repeatability Error	±2 LSB
Maximum Operating Speed	6000 rpm
Measurement Range	Single-turn / Muti-turn
Rotation Direction	Default CW Increment (Adj.)
Mechanical Dimensions & Installation	
OD \ ID \ Thickness	75\45\8.6 mm
Allowable Eccentricity	±0.1 mm
Stator-Rotor Gap	1.35±0.15 mm
Rotor Inertia	18.9 kg·mm²
Weight (Approx.)	25 g
Rotor & Stator Material	FR-4
Application Environment	
EMC	IEC 61000-6-2、IEC 61000-6-4
Operating Temperature	-30℃ - +100℃
Relative Humidity	0 - 99%
Shock	100 g / 11 ms
Vibration	20 g (10 - 2000 Hz)
Electrical & Interface	
Supply voltage	5 - 30V
Working current	< 100 mA
Output Protocol	SSi, BiSS-C, UART, SPI, ABZ

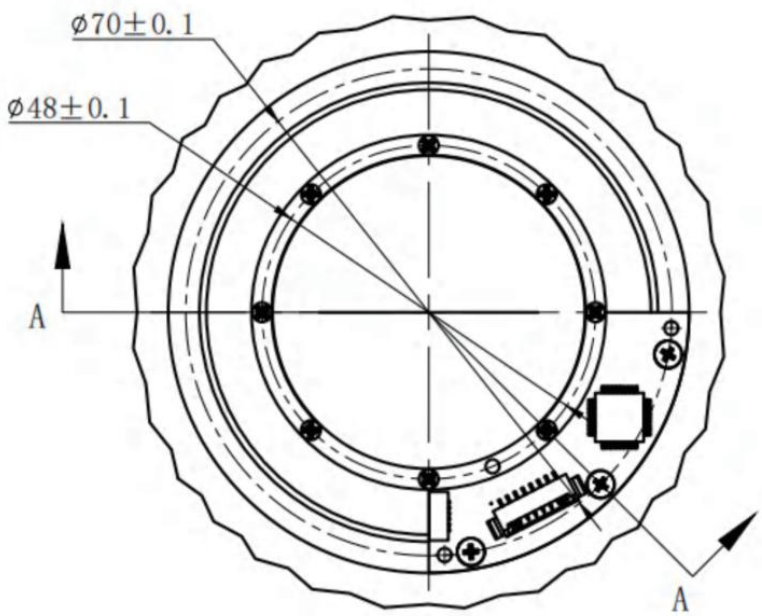
2.OME45 External Dimensions

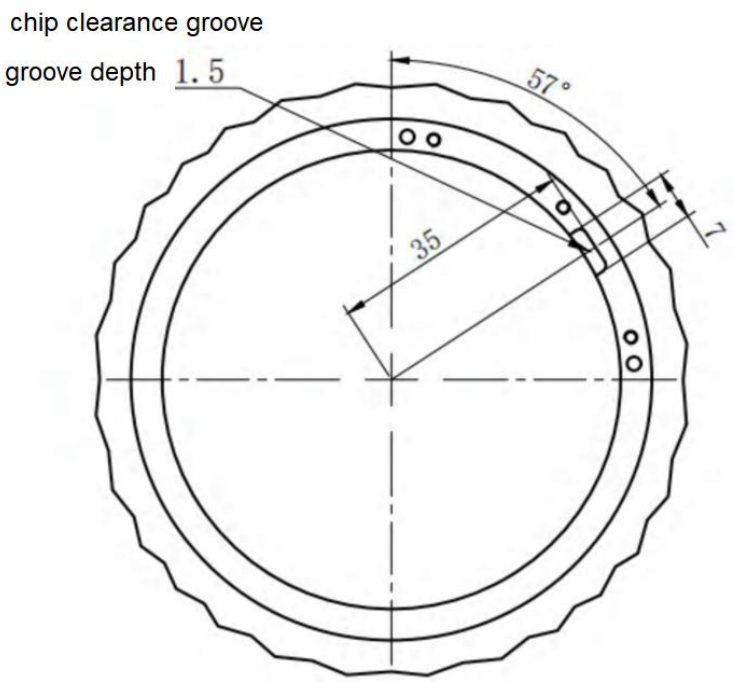


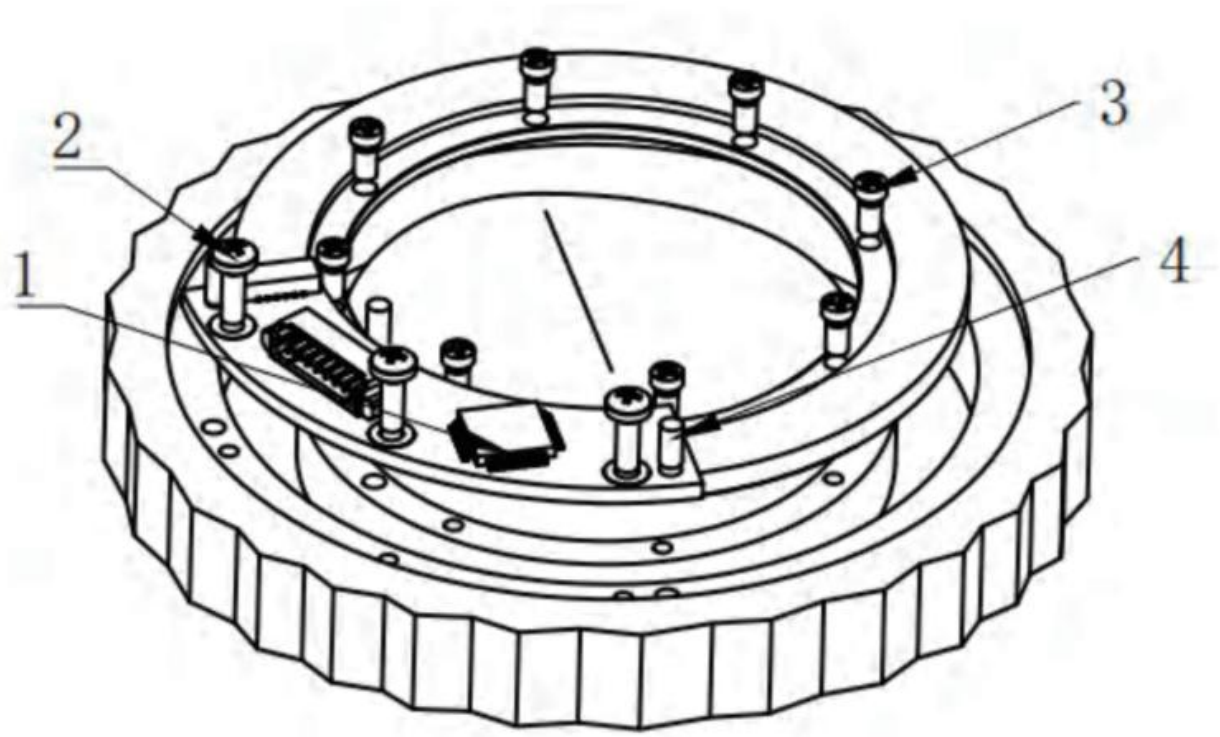
2. **OME45 Installation Dimensions**









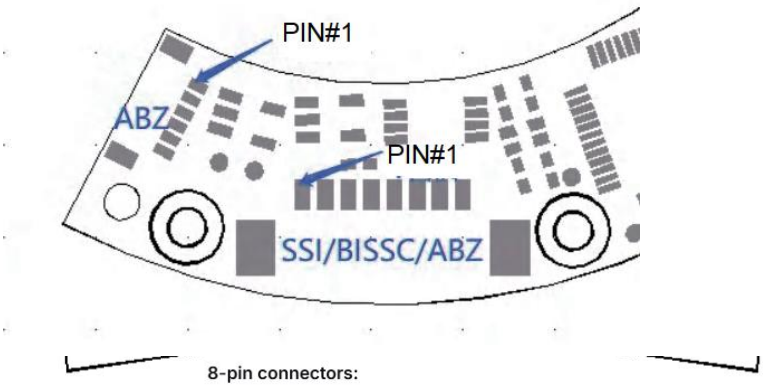


Drawing Tolerances

Range (mm)	Tolerance
0-20	±0.05 mm
20-100	±0.1 mm

Item No.	Description	Qty	Remarks
1	SMEM045	1	Product
2	Non-standard Phillips Pan Head Screw M2×6	3	Assembly structural part
3	Non-standard Phillips Pan Head Screw M2×5	8	
4	Cylindrical Pin Φ2×4	3	

4.OME45 Electrical Interface



8-pin connectors:

- FCI-10114830-11108LF (standard version)
- HDGC0601WR-S-8P (differential ABZ version)

Matching plugs:

- 10114826-00008LF (for standard version)

6-pin connector:

- HDGC0601WR-S-6P

Matching plug:

- X0600HI-6P

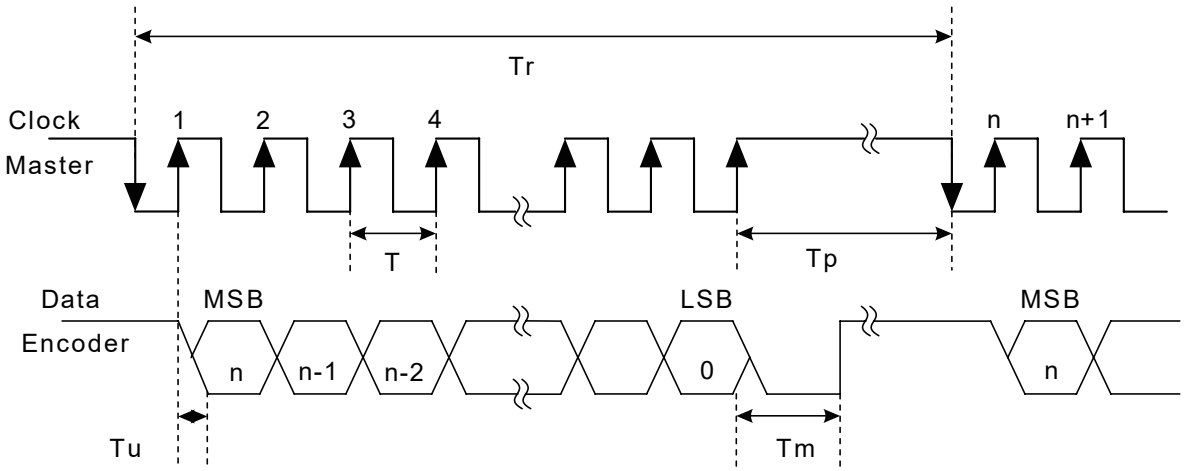
Connector Pinout for SSI / BiSS-C / RS-422 / RS-485 / Differential ABZ (8-Pin Socket)						Connector Pinout for SPI / Single-Ended ABZ (6-Pin Socket)		
Pin No.	RS-422	SSI	BiSS-C	RS-485	Differential ABZ	Pin No.	SPI	Single-Ended ABZ
1	VCC					1	CS	N/C
2	GND					2	CLK	A
3	/				Z-	3	MISO	Z
4	/				Z+	4	MOSI	B
5	RX+	CLK+	MA+	A+	B+	5	GND (Battery Negative for Multi-turn)	
6	RX-	CLK-	MA-	B-	B-	6	VCC (Battery Positive for Multi-turn)	
7	TX-	DATA-	SLO-	VCC	A-			
8	TX+	DATA+	SLO+	N/C	A+			

Digital Output Parameters	
Signal Delay	< 50 us
Output Code Format	Binary
Max Data Update Rate	25kHz
Interface Level	Differential RS-422
Power Consumption	< 100 mA
Sampling rate and clock frequency depend on the selected communication protocol.	

5.Output Protocols

5.1 SSI Interface Protocol

SSi (Synchronous Serial Interface) is based on the RS-422 hardware standard and is a commonly used interface for angle encoders. The controller sends a clock signal, and the angle encoder transmits data synchronously. The default clock port is high; the first low level initiates data transmission. The angle encoder sends angle data to the controller in sequence according to the clock, as shown in the timing diagram below:

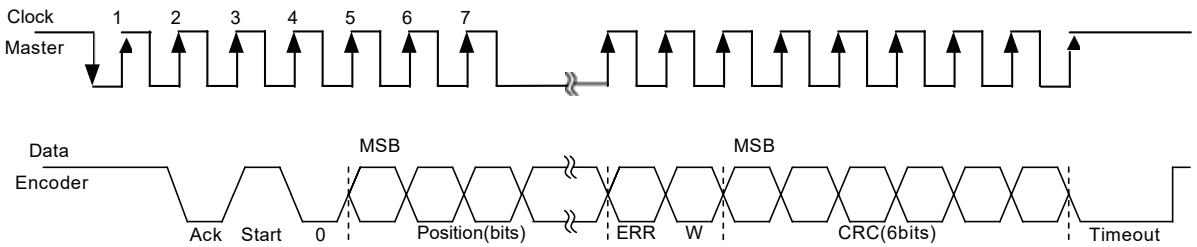


Timing Diagram Parameter Description

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

5.2 BiSS-C Interface Protocol

BiSS-C is a full-duplex, bidirectional, high-speed, synchronous serial communication protocol. The interface is also based on the RS-422 hardware standard and is compatible with the SSi interface. It is widely used in absolute encoders for high-precision position control. The BiSS-C implementation in this product is a point-to-point unidirectional interface that can connect one or more slave devices to the master, conforming to BiSS-C unidirectional interface requirements. The timing diagram is shown below:



Timing Diagram Parameter Description

Bit/n	Code	Meaning	Default	Length
28	Ack	Acknowledge Bit	0	1bit
27	Start	Start Bit	1	1bit
26	"0"	Start Bit Follower	0	1bit
8-25	Position	Absolute Position Encoder Data		18bit
7	Error	Error Bit	1	1bit
6	Warn	Warning Bit	1	1bit
0-5	CRC	CRC		6bit
--	Timeout	Inter-Frame Interval Time		>30us

5.3 RS-422 Serial Interface Protocol

RS-422 serial interface protocol. By default, the encoder automatically transmits data to the host without requiring host commands. The data update rate is fixed at 2000 Hz, baud rate is 460800 bps. The data format is 1 start bit, 8 data bits, 1 even parity bit, 1 stop bit. Each frame contains 10 bytes, formatted as shown in the table below.

Frame Data Format

	No.	Data Type	Note
Frame Header	1	5E	Fixed Frame Header
	2	AD	
Protocol Flag	3	01	Single Byte
Angle Data	4	Angle Data High Byte	LSB Valid, High Bits Zero-Padded
	5	Angle Data Middle Byte	
	6	Angle Data Low Byte	
Frame Count	7	Frame Count High Byte	0-65535 Cumulative Count
	8	Frame Count Low Byte	
Checksum	9	Checksum High Byte	Accumulated Sum of Bytes 3-8, Lower 16 Bits
	10	Checksum Low Byte	

When selecting a multi-turn product, each frame contains 10 bytes. The angle data occupies 5 bytes: bytes 4-5 are multi-turn angle data, bytes 6-8 are single-turn angle data, high byte first, low byte last. There is no frame count byte; the checksum byte definition is the same as for single-turn products.

5.4 RS-485 Serial Interface Protocol

RS-485 serial interface protocol, a half-duplex communication protocol requiring the host to send commands to read angle information. The data update rate depends on the host request rate. Baud rate is 2.5 Mbps. Data format: 1 start bit, 8 data bits, 0 even parity bits, 1 stop bit. Encoder commands are as follows:

Encoder Single-Turn Data Request Command:

1. Host sends command frame: Data (HEX): 0x02
2. Host receives data frame from encoder: Data (HEX):
   0x02 0x20 0x03 0x02 0x01 0x16 —
   Where: 0x02: Echo command CF;
   0x20: Status byte 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 count error;
EA1=1 — Over-temperature, turn count error, battery alarm, or battery error; CA0=1 — Communication parity error; CA1=1 — Communication stop bit error; 0x03 0x02 0x01: Single-turn data value DF (LSB first);
0x16: CRC checksum (XOR of all preceding bytes);

Encoder All Data Request Command:

1. Host sends command frame: Data (HEX): 0x1A
2. Host receives data frame from encoder: Data (HEX):
   0x1A 0x20 0x03 0x02 0x01 0x11 0x05 0x04 0x00 0x22 0x08 — Where:
   0x1A: Echo command CF; 0x20: Status byte SF;
   0x03 0x02 0x01: Single-turn data value DF (LSB first);
   0x11: Encoder ID, fixed value = 0x11;
   0x05 0x04 0x00: Turn count data value DF (LSB first) (0x0405 = 1029, max. 65535);
   0x22: Fault content byte ALMC defined as follows (LSB first);

Bit0	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7
Over-Speed	Low Resolution	Single-Turn Count Error	Multi-Turn Count	Over-Temperat	Multi-Turn Count Error	Battery Error	Battery Alarm

0x08: CRC checksum (XOR of all preceding bytes);

Encoder ID Data Request Command:

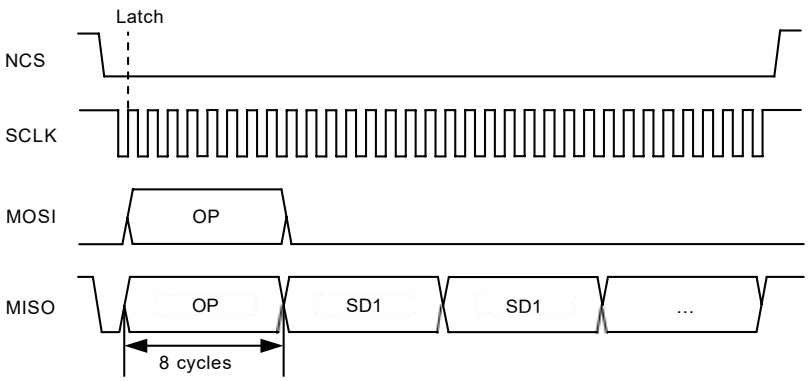
1. Host sends command frame: Data (HEX): 0x92
2. Host receives data frame from encoder:
   Received data (HEX): 0x92 0x20 0x11 0xA3 —
   Where: 0x92: Echo command CF; 0x20: Status byte SF;
   0x11: Encoder ID, fixed value = 0x11;
   0xA3: CRC checksum (XOR of all preceding bytes);

Encoder Single-Turn Reset Request Command:

1. Host sends command frame: Data (HEX): 0xC2
   Repeat the reset command at least 10 times with 40 us intervals to reset the single-turn angle value;
2. Host receives data frame from encoder:
   Receive data（HEX）:
   0xC2 0x20 0x00 0x00 0x00 0xE2 — Where:
   0xC2: Echo command CF; 0x20: Status byte SF;
   0x00 0x00 0x00: Single-turn data value DF (LSB first);
   0xE2: CRC checksum (XOR of all preceding bytes);

5.5 SPI Interface Protocol

SPI (Serial Peripheral Interface) is a high-speed, high-efficiency, full-duplex communication bus. The encoder can use the SPI interface for short-distance serial data communication with a CPU, using a synchronous clock signal for simultaneous transmit and receive operations to achieve full-duplex. The hardware uses a 4-wire SPI interface including two data lines, one chip select line, and one clock line, corresponding to MOSI, MISO, NCS, and SCLK in the SPI protocol. The timing diagram is shown below:



NCS and SCLK are controlled by the host. The encoder's SPI interface is passive (receive and send). After the encoder detects NCS pulled low, it monitors the clock signal, receives command bytes via the MOSI line, and synchronously sends command bytes and data bytes together to the host via MISO. Communication configuration is as follows:

SPI Communication Configuration

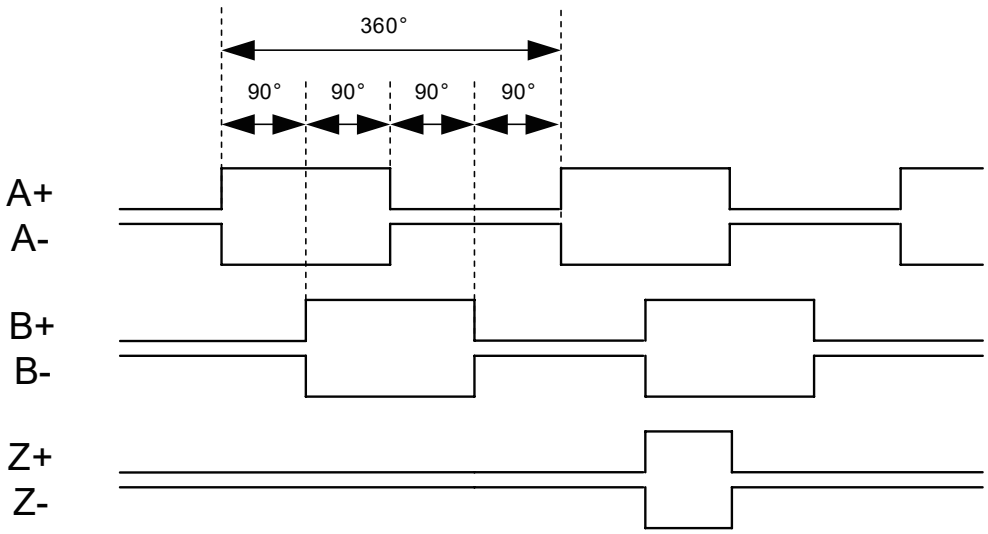
SPI Interface	Configuration
Idle Clock Level	High
Data Sampling Edge	Second Edge (Rising)
Number of Clocks	32
Clock Frequency	0.1MHz - 2MHz
Frame Interval	20 us
Total Data Length	4 Bytes (6 Bytes for Multi-Turn)
Alignment Mode	Left-Aligned
Angle Bit Definition	MSB First, LSB Zero-Padded

For single-turn products, the OP command byte is 0xA6. Host MOSI configuration: 0xA6, 0x00, 0x00, 0x00. Encoder response: 0xA6, 0xXX, 0xXX, 0xXX (XX = 8-bit angle data).

5.6 ABZ Interface Protocol

The ABZ interface is a commonly used interface for angle encoders. Among the A-phase, B-phase, and Z-phase signals, the A and B channel signals are generally quadrature (90deg phase-shifted) pulse signals, while the Z-phase is a zero pulse signal. When the shaft rotates clockwise, the A channel output pulse precedes the B channel. When rotating counter-clockwise, the A channel signal follows the B channel.

In addition to the A and B phases (whose signal sequences have a 90deg phase difference), the encoder outputs one zero-position pulse or index pulse (Z-phase signal) per revolution, used to determine the zero or index position.



The product can output via differential or single-ended ABZ interfaces. The differential ABZ interface is compatible with RS-422 interface levels, with protocol definition as shown above. The single-ended ABZ interface uses LVTTL interface levels, retaining only the non-inverting signals from the differential interface.

6.Status LED Indicator

The LED indicator provides intuitive feedback on magnetic ring signal strength and error status for installation and diagnostic purposes. A continuously lit LED indicates the encoder is powered on. There are five status states: red steady, red flashing, orange steady, orange flashing, and green steady. The meaning of each state is as follows:

LED Indicator	Status
Green	Normal operation: Position data valid
Orange	Warning: Position valid, but resolution and/or accuracy may not be optimal. Steady: Stator-rotor installation gap too large. Flashing: Stator-rotor installation gap too small
Red	Error: Position data invalid alarm Steady: Stator-rotor installation gap too large. Flashing: Stator-rotor installation gap too small
Off	Not powered

Installation Adjustment:

The nominal gap between the mounting area on the bottom side of the PCB and the rubber ring of the magnetic ring is 1.3 mm ±0.1 mm. It is recommended to use the bottom surface of the PCB as the reference for mounting the readhead. Using the top surface of the readhead to adjust the gap is not recommended. The integrated LED indicator can serve as a guide: when the correct gap is achieved, the LED lights up green, and when the magnetic ring is rotated slowly for one full turn, the LED color does not change.

1. Gap height adjustment
During installation, based on the LED steady- on / blinking status, increase or decrease the mounting gap between the stator and rotor. If no red light appears when the rotor is rotated for one revolution, you may proceed to the next step. If higher product accuracy is required, use the uniform- speed calibration function. Perform the calibration before normal operation.

2. Gap parallelism adjustment
If red, yellow and green lights flash alternately during rotation, the parallelism of the rotor needs to be adjusted.
The center of the magnetic ring and the center of the readhead arc must be coaxial. The allowable tolerances are shown in the table below.

Axial Displacement (Air Gap)	1.3mm±0.1mm
Readhead-to-Magnetic Ring Distance	0.4mm±0.1mm
Radial Displacement	±0.3mm
Tangential Displacement	±0.3mm
Non-Parallel Installation	±0.05mm

7.External Magnetic Field Recommendations

The SMED series magnetic encoder operates by sensing magnetic field changes on the magnetic ring. External magnetic fields generated by permanent magnets, motors, coils, electromagnetic brakes, etc., can affect encoder operation.

1. When the magnetic field strength perpendicular to the readhead is in the range of 0 to 25 mT, it may affect encoder angle accuracy.

2. When the magnetic field strength exceeds 25 mT, it may cause encoder malfunction.

3. Magnetic fields above 50 mT may cause permanent damage to the magnetic ring.

Therefore, unnecessary magnetic field sources must be blocked. If blocking is not possible, ferromagnetic metal plates can be used to shield the encoder. The magnetic ring can also be used for local shielding.

It is recommended to install the magnetic ring with its bottom facing the leakage magnetic field source, while the readhead faces away from the magnetic field source.