

1. ST65 Sin/Cos Incremental Optical Encoder (Tapered Shaft)

1.1 Introduction:

ST65 is a rotary encoder installed in the motor. It has multiple output signals to choose from, including analog signals, analog and digital signals, and TTL/HTL digital signals. It is installed with a expansion flange, has a compact structure and high safety, and is widely used in elevators and high-resolution segments.

1.2 Feature:

- Encoder external diameter Ø65mm、thickness 40mm、diameter of shaft of Ø9.25mm (taper 1:10);
- Taper shaft, built-in bearing, expansion flange installation;
- Adopting non-contact photoelectric principle;
- Analog signal (A+B+Z+C+D): 1Vpp or 0.5Vpp signal;
- Analog signal (A+B+Z): 1Vpp or 0.5Vpp signal;
- Analog+ digital signal (A+B+Z): 1Vpp or 0.5Vpp signal;
- Digital signal): can output up to 32768 PPR per cycle;
- Reverse polarity protection;
- Short circuit protection.

1.3 Application:

Elevator, motor, CNC and other automation control fields.

1.4 Connection:

- Analog signal A+B+Z+C+D (PCB connector, 14pin);
- Analog signal A+B+Z (PCB connector, 12pin);
- Analog + digital signal (PCB connector, 12pin);
- Digital signal (PCB connector, 12pin).

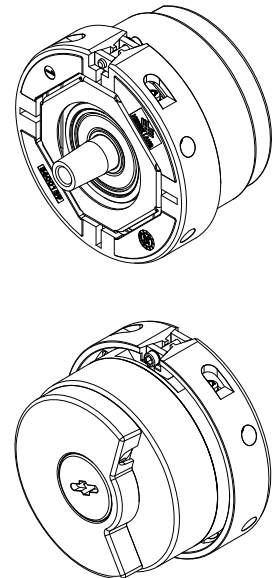
1.5 Protection:

IP 40 (after installation)

1.6 Weight:

About 255g

ST65



2. Model Selection Guide

Model composition(select parameters)

ST65-	AD	2048			-	000
Product model series	Output signal: 1. Analog signal:  AD=1Vpp (A+B+Z+C+D) BD=0.5Vpp (A+B+Z+C+D) 2. Analog signal:  AZ=1Vpp (A+B+Z) BZ=0.5Vpp (A+B+Z) 3. Analog+ Digital signal:  AS=1Vpp (A+B+Z) BS=0.5Vpp (A+B+Z) 4. Digital signal:  L=TTL(differential) H=HTL(differential)	Resolution PPR: AD / BD:  2048 AZ / BZ:  1024; 2048; 2500 AS / BS:  1024; 2048 L / H:  500; 512; 1000; 1024; 2000; 2048; 2500; 3600; 4000; 4096; 5000; 7200; 8000; 8192; 10000; 16000; 16384; 32000; 32768	Supply voltage: Blank=DC5V H=DC8-30V	Sepcial specifications	Management No.	

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3. Technical Parameter**3.1 Electrical parameter**

Parameter Item	Signal	 :1Vpp (A+B+Z+C+D)	 :0.5Vpp (A+B+Z+C+D)	 :1Vpp (A+B+Z)	 :0.5Vpp (A+B+Z)	 +  : 1Vpp (A+B+Z)	 +  : 0.5Vpp (A+B+Z)	 :TTL	 :HTL
Supply voltage		DC5V±0.25V; DC8V-30V±0.25V						DC5V±0.25V	DC8-30V±0.25V
Current consumption		≤130 mA (No load)							
Resolution		2048 (line No.)		1024; 2048; 2500 (line No.)		1024; 2048(line No.)		500～32768PPR	
Interface signal						 +  (Z phase)			
Position value/RPM		Z1 track							
Reference point signal		One							
Cut-off frequency -3 dB		≥210 kHz				-			
System accuracy		2048±20"		1024±60"; 2500±15"		1024±120"; 2048±80"		±1/8T	
Electrical connection		PCB connector, 14-pin		PCB connector, 12-pin					
Allowable ripple		-						≤3%rms	
Max. response frequency		≤300KHz							≤500KHz
Output current		-						≤±20mA	≤±50mA
Output voltage "H"		-						≥2.5V	≥Vcc-3 Vdc
Output voltage "L"		-						≤0.5V	≤ 1V Vdc
Phase shift between A & B		90°±10° potential angle (at low speed frequency)							
		90°±20° potential angle (at high speed frequency)							
Mark to space ratio		-						45% to 55%	
Rise & Fall time		-						Less than 1us (Cable length: 2m)	
Reverse polarity protection		✔							
Short-circuit protection		-						✔①	
Insulation strength		AC500V 60s							
Insulation resistance		10MΩ							
GND		Not connect to encoder							

① Short-circuit to another channel, permitted for max 30s.

3.2 Mechanical parameter

Diameter of shaft	Tapered shaft Ø9.25mm; taper 1:10
Material of shaft	Stainless steel
Starting torque	≤0.01 Nm (at 20°C)
Moment of inertia	$2.6 \cdot 10^{-6} \text{ kgm}^2$
Allowable shaft force	Radial 30N; Axial 20N
Allowable static shaft displacement	±0.13mm (radial) ; ±0.50mm (axial)
Allowable dynamic shaft displacement	±0.13mm (radial) ; ±0.50mm (axial)
Mechanical allowable speed	≤15000 min ⁻¹
Operating speed	≤6000min ⁻¹ ❶
Bearing life	3.6×10^9 ❷
Housing material	Aluminum alloy
Weight	About 255g

❶. Compatible with self-heating of approximately 3.0K/1000min⁻¹ in the permissible operating temperature range.

❷. At maximum speed and temperature.

3.3 Environment parameter

Enclosure protection grade	IP40(after installation)
Permitted relative humidity	35~85%RH (no condensation)
Operating temperature range	-40°C...+115°C
Storage temperature range	-40°C...+115°C
Shock resistance	≤1000 m/s ² (6ms)
Frequency range of vibration resistance	≤300 m/s ² (55-2000 Hz)

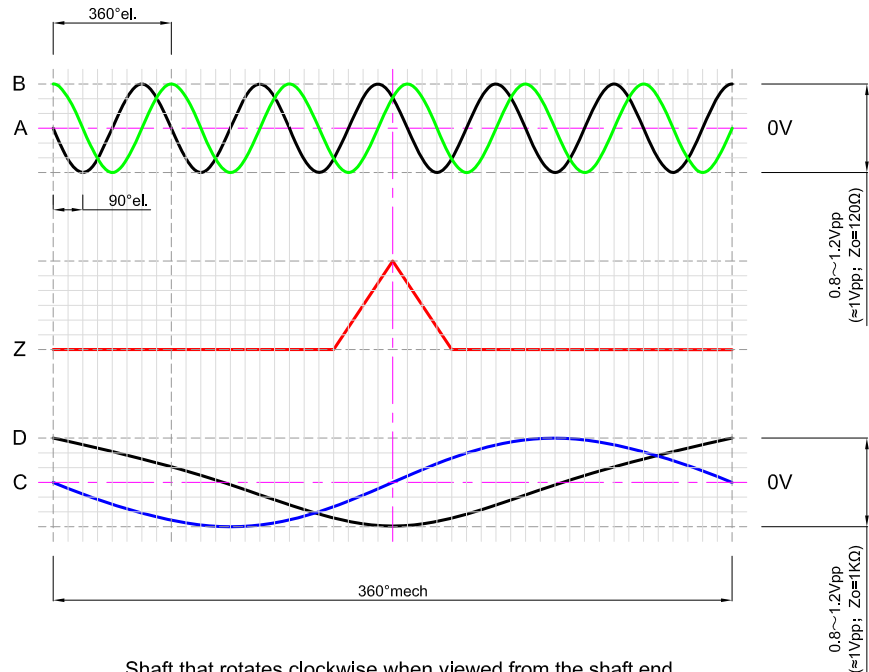
4. Output Waveform

4.1 Analog signal: $\sim 1V_{pp}$ (A+B+Z+C+D)

Incremental signals A and B, as well as the zero signal Z, are differential signals with a level of 1Vpp.

The zero signal occurs once per revolution and reaches its max value at the angle where the amplitudes of the A and B signals are equal.

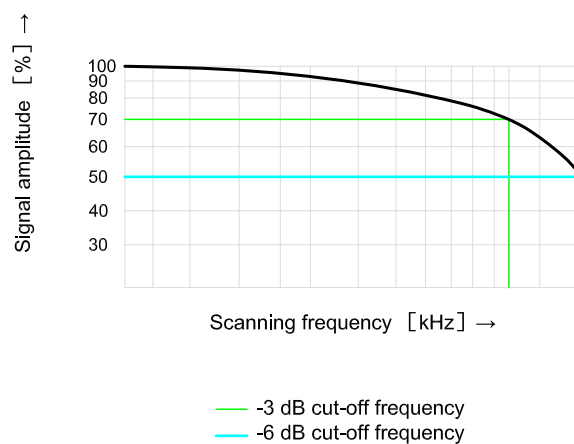
Coarse tracks C and D provide one sine and cosine cycle per revolution, which is used to determine the absolute rotor position for starting commutation of the brushless DC motor. All signals have a DC offset of 0V.



Shaft that rotates clockwise when viewed from the shaft end.
(see dimensional drawing)

CW direction
→

Cut-off frequency: Typical signal amplitude and scanning frequency relationship curve

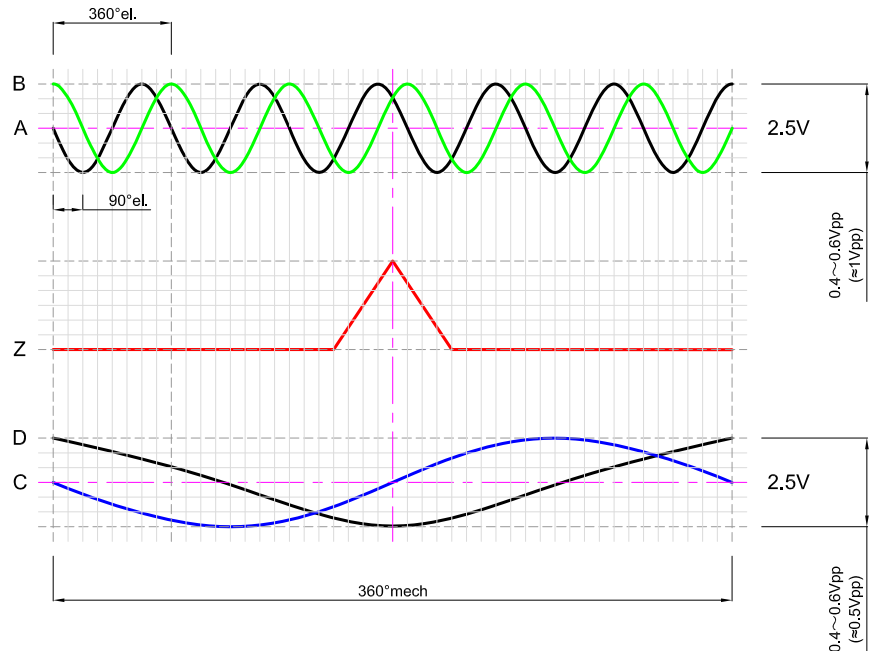


4.2 Analog signal: $\sim$ 0.5Vpp (A+B+Z+C+D)

Incremental signals A and B, as well as the zero signal Z, are differential signals with a level of 0.5 Vpp.

The zero signal occurs once per revolution and reaches its max value at the angle where the amplitudes of the A and B signals are equal.

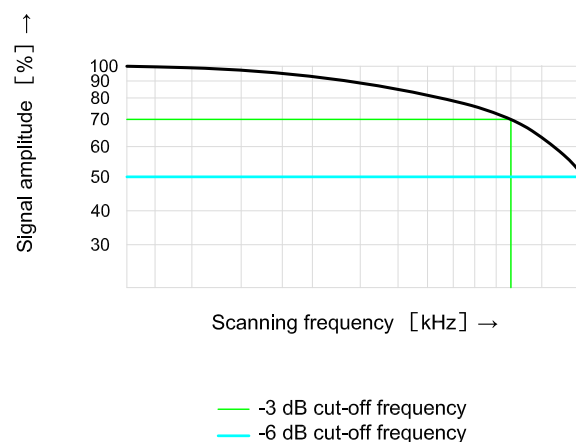
Corase tracks C and D provide one sine and cosine cycle per revolution, which is used to determine the absolute rotor position for starting commutation of the brushless DC motor. All signals have a DC offset of 2.5 V.



Shaft that rotates clockwise when viewed from the shaft end.
(see dimensional drawing)

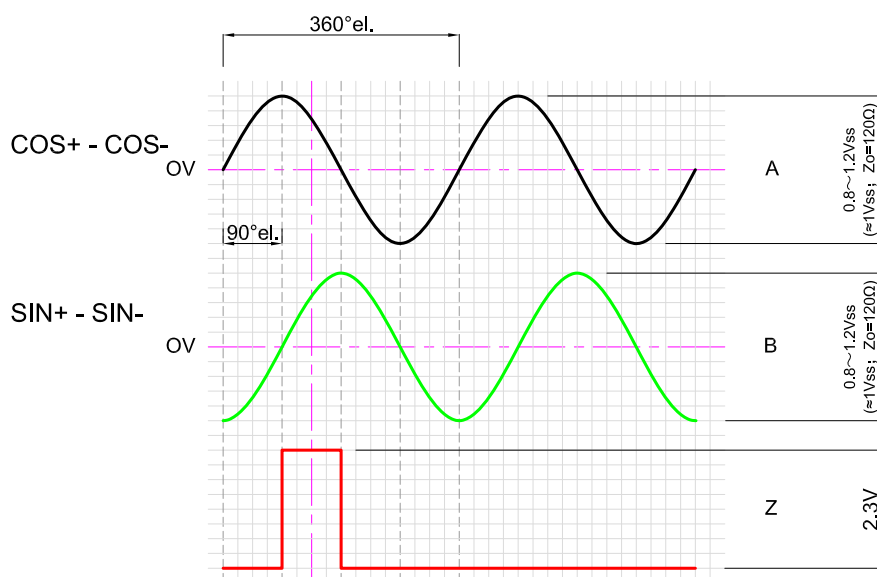
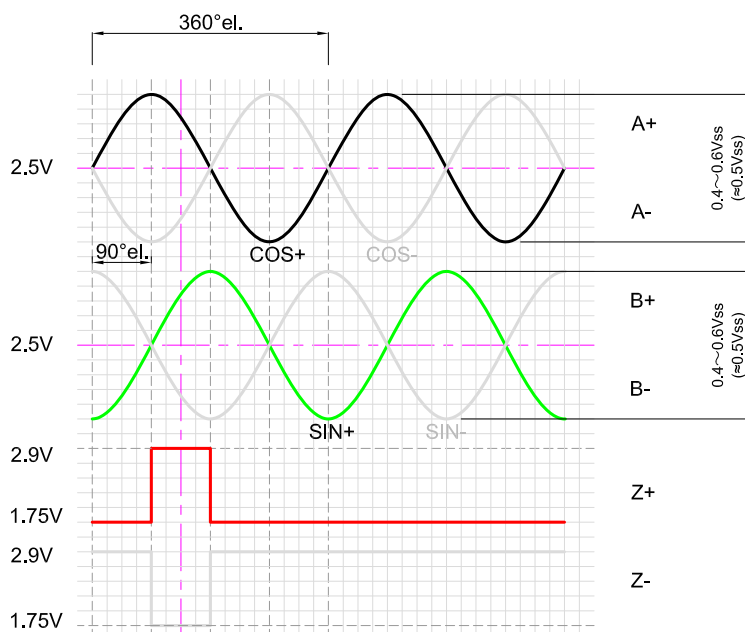
CW direction
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Cut-off frequency: Typical signal amplitude and scanning frequency relationship curve



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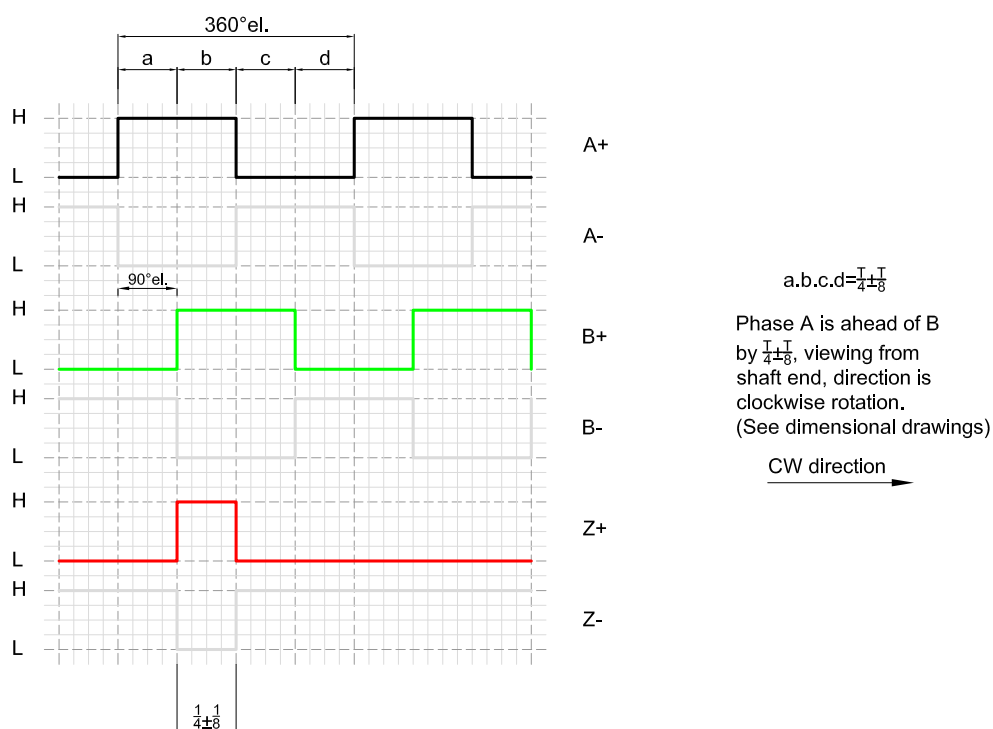
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4.3 Analog + digital signal: $\sim + \square$ 1Vpp (A+B+Z)4.4 Analog + digital signal: $\sim + \square$ 0.5Vpp (A+B+Z)

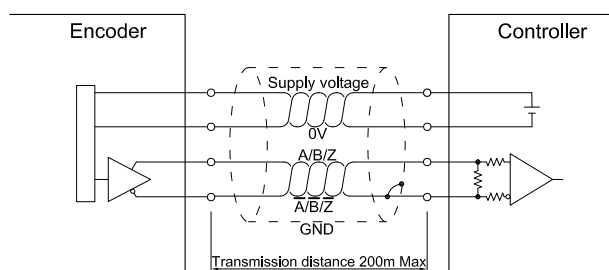
4.5 Basic parameter table before and after generation

Supply voltage	Signal	Interface signals	Interface signals after differential generation		Interface signals before differential generation	
			Output	Signal offset	Output	Signal offset
DC5V; DC8V...30V	A+ A- B+ B-	Analog,differential	SIN/COS 1.0 Vss	0V±10%	0.5Vss±20%	2.5V±10%
	Z+ Z-	Digital,differential	High:1.15V±15%, Low:-1.15V±15%		High:2.9V±15%, Low:1.75V±15%	

4.6 TTL/HTL differential incremental signal: 



5. Electrical Interface

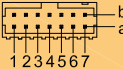


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6. Connection Definition Table of PCB Connector

6.1 Analog signal (A+B+Z+C+D) : 0.5Vpp / 1Vpp

	Supply voltage				Signal									
	1b	7a	5b	3a	6b	6a	3b	5a	4b	4a	7b	1a	2b	6a
PCB connector (pin No.)														
Function	Up	Sensor Up	OV	Sensor OV	A+	A-	B+	B-	Z+	Z-	C+	C-	D+	D-

6.2 Analog signal (A+B+Z): 0.5Vpp / 1Vpp

	Supply voltage				Signal							
PCB connector (pin No.)	2a	2b	1a	1b	6a	6b	5b	5a	4b	4a	3b	3a
Function	Up	Sensor _{Up}	OV	Sensor _{Up}	A+	A-	B+	B-	Z+	Z-	/	/

6.3 Analog + digital signal (A+B+Z) : 0.5Vpp / 1Vpp

	Supply voltage				Signal							
PCB connector (pin No.)	2a	2b	1a	1b	6a	6b	5b	5a	4b	4a	3b	3a
Function	Up	Sensor _{Up}	OV	Sensor _{Up}	A+	A-	B+	B-	Z+	Z-	/	/

6.4 TTL/HTL differential digital incremental signal

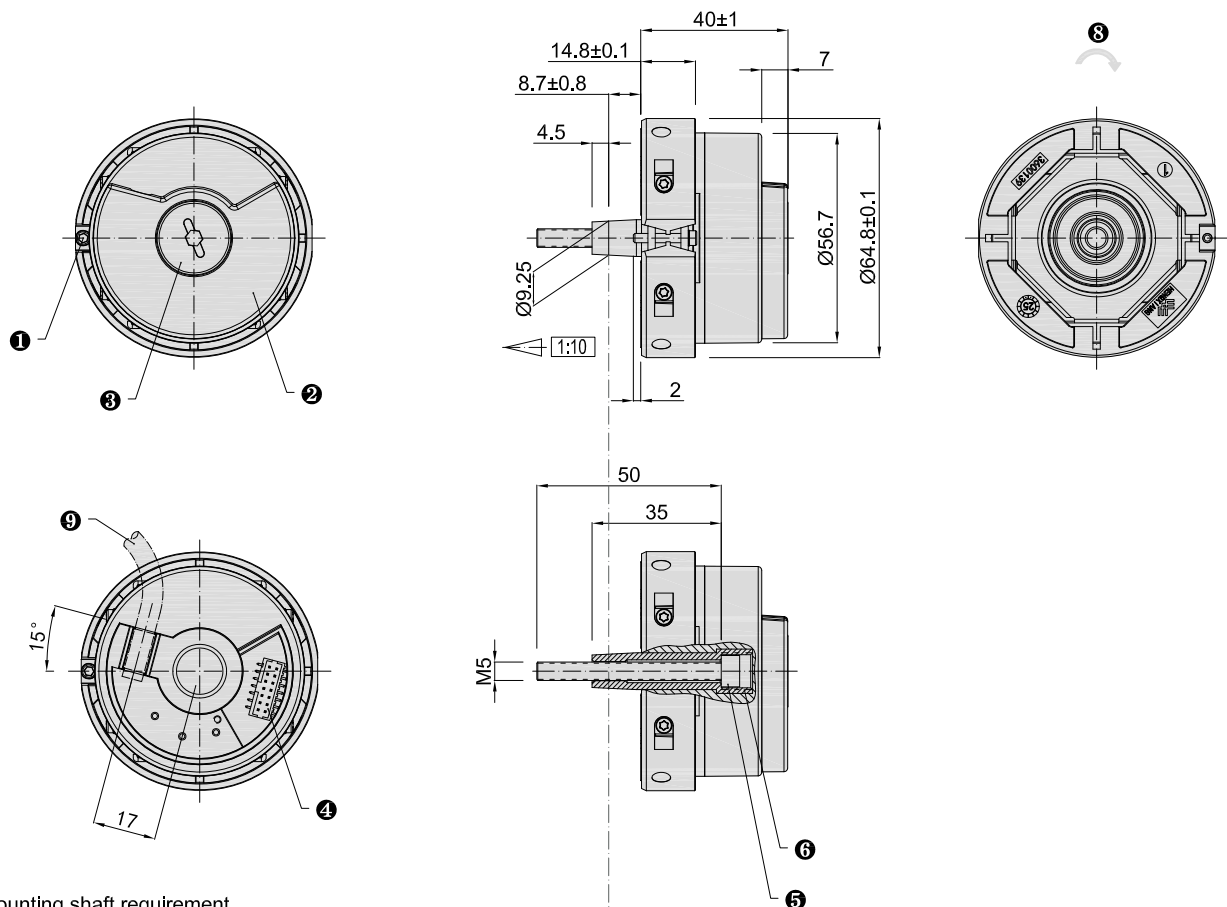
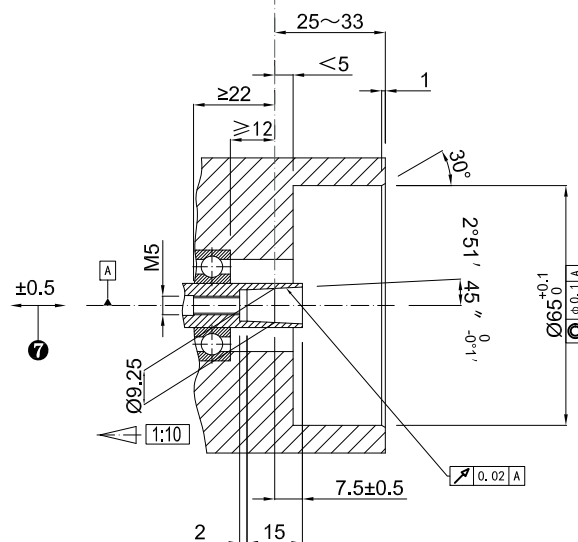
	Supply voltage				Signal							
PCB connector (pin No.)	2a	2b	1a	1b	6b	6a	5b	5a	4b	4a	3b	3a
Function	Up	Sensor _{Up}	OV	Sensor _{Up}	A+	A-	B+	B-	Z+	Z-	/	/

Up=Power supply voltage positive.

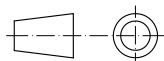
The shielded wire is not connected to the internal circuit of the encoder.

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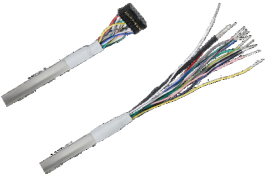
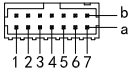
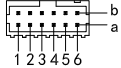
7. Basic Dimension**7.1 Dimension****7.2 Mounting shaft requirement**

Unit: mm



- ① = Ring expansion bolt M2.5*12
- ② = Die-cast cover
- ③ = Sealed cover
- ④ = PCB connector
- ⑤ = Bolt M5*50
- ⑥ = Screw hole M10
- ⑦ = Mounting tolerance and thermal expansion compensation, dynamic movement is not allowed
- ⑧ = Shaft rotation direction for incremental signal output
- ⑨ = Cable, see P10 (recommended accessories)

8. Recommended Accessories

Image	Connection function definition	Brief description	Serial No.	Order No.
	Connector: A2005HB-N-2X7P-FI  1b=Red=Up 1a=BL/BK=C- 2b=Gray=D+ 2a=WH/BK=A- 3b=Green=B+ 3a=PK/BK=Sensor(0V) 4b=Yellow=Z+ 4a=YL/BK=Z- 5b=Black=0V 5a=GN/BK=B- 6b=White=A+ 6a=GY/BK=D- 7b=Blue=C+ 7a=PK=Sensor(Up)	C1=Connection method A head: 14pin(female); Connection method B head: bare wire end; Cable length: 1M, 14 cores with shielding (0.14mm ²), Ø6mm	ST65C1	44400051
		C2=Connection method A head: 14pin(female); Connection method B head: bare wire end; Cable length: 2M, 14 cores with shielding (0.14mm ²), Ø6mm	ST65C2	44400052
		C5=Connection method A head: 14pin(female); Connection method B head: bare wire end; Cable length: 5M, 14 cores with shielding (0.14mm ²), Ø6mm	ST65C5	44400053
	Connector: A2005HB-N-2X6P-FI  1b=PK/BK=Sensor(0V) 1a=BK=0V 2b=PK=Sensor(Up) 2a=RD=Up 3b=Dangling 3a=Dangling 4b=YL=Z+ 4a=YL/BK=Z- 5b=GN=B+ 5a=GN/BK=B- 6b=WH=A+ 6a=WH/BK=A-	E1=Connection method A head: 12pin(female); Connection method B head: bare wire end; Cable length: 1M, 10 cores with shielding (0.14mm ²), Ø6mm	ST65E1	44400054
		E2=Connection method A head: 12pin(female); Connection method B head: bare wire end; Cable length: 2M, 10 cores with shielding (0.14mm ²), Ø6mm	ST65E2	44400055
		E5=Connection method A head: 12pin(female); Connection method B head: bare wire end; Cable length: 5M, 10 cores with shielding (0.14mm ²), Ø6mm	ST65E3	44400056

9. Caution

9.1 Caution for operation

- The working temperature shall not exceed the storage temperature.
- The working humidity shall not exceed the storage humidity.
- Do not use where the temperature changes dramatically and have fog.
- Do not close to corrosive and flammable gas.
- Keep away from dust, salt and metal powder.
- Keep away from places where you will use water, oil, or medicine.
- Undue vibration and shock will impact the encoder.

9.2 Caution for Installation

- Electrical components should not be subjected to excessive pressure, etc., and electrostatic assessment of the installation environment should be conducted.
- Do not close the cable of the motor power to the encoder.
- The FG wire of the motor and mechanical device should be grounded.
- The shielding wire must be effectively grounded since the shielding is not connected to the encoder.

9.3 Caution for wiring

- Use the encoder under the specified supply voltage. Please note that the supply voltage range may drop due to the wiring length.
- Do not put the encoder wiring and other power lines through the same duct, and do not use them by bundling in parallel.
- Please use twisted pair wires for the signal and power wires of encoder.
- Please do not apply excessive force to the cable of encoder, or it will may be damaged.