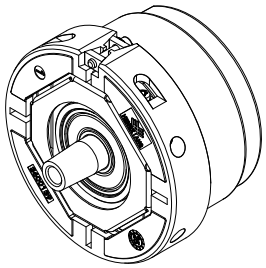
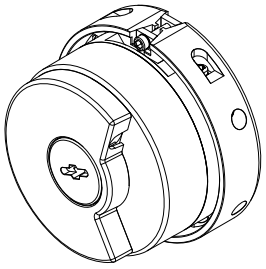
1. ST65 Sin/Cos Incremental Optical Encoder (Tapered Shaft)

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.

ST65





1.2 Feature：

- Encoder external diameter Ø65mm、thickness 42mm、diameter of shaft of Ø9.25mm (taper 1:10)；
- Taper shaft, bulit-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

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 signall: ⎍
L=TTL(differential)
H=HTL(differential)

Resolution PPR:
AD / BD: ∿
2048

AZ / BZ: ∿
1000； 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.

3. Technical Parameter

3.1 Electrical parameter

Parameter / Signal / Item	∿ :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.)		1000; 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	–						✔❶	
Insulation strength	AC500V 60s							
Insulation resistance	10MΩ							
GND	Not connect to encoder							

❶ 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	$2.6 \cdot 10^{-6}$ kgm²
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	$3.6x10^9$ 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.

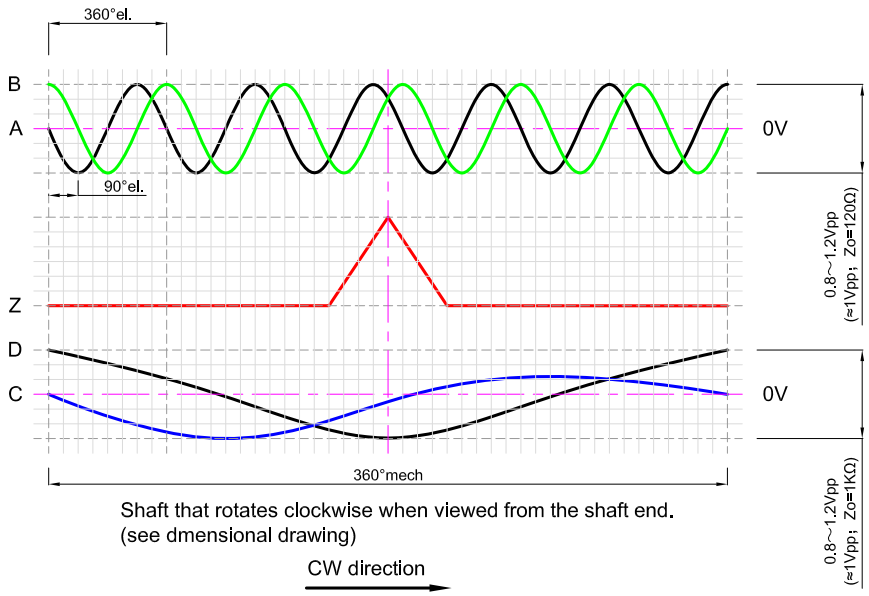
3.3 Environment parameter

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/s² (6ms)
Frequency range of vibration resistance	≤300 m/s² (55-2000 Hz)

4. Output Waveform

4.1 Analog signal： ∿ 1Vpp (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.
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 0V.

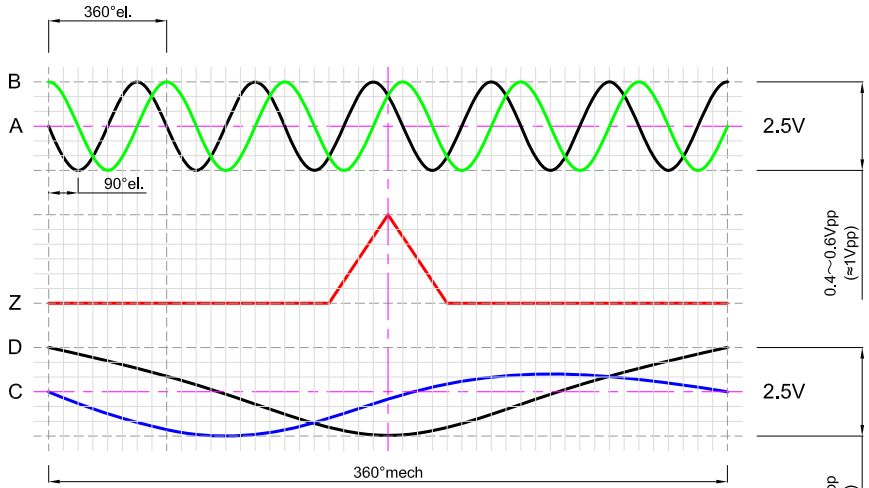


Shaft that rotates clockwise when viewed from the shaft end.
(see dmensional drawing)

CW direction

4.2 Analog signal： ∿ 0.5Vpp (A+B+Z+C+D)

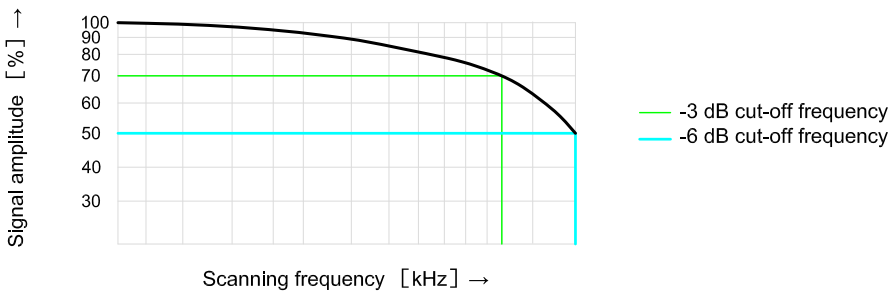
Incremental signals A and B , as well as the zero signal Z, are differential signals with a level of 0.5 Vpp.
The zero signal occurs once per revolution and reaches its max value at the angle where the amplitudes of the A and B signals are equal.
Corase tracks C and D provide one sine and cosine cycle 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 dmensional drawing)

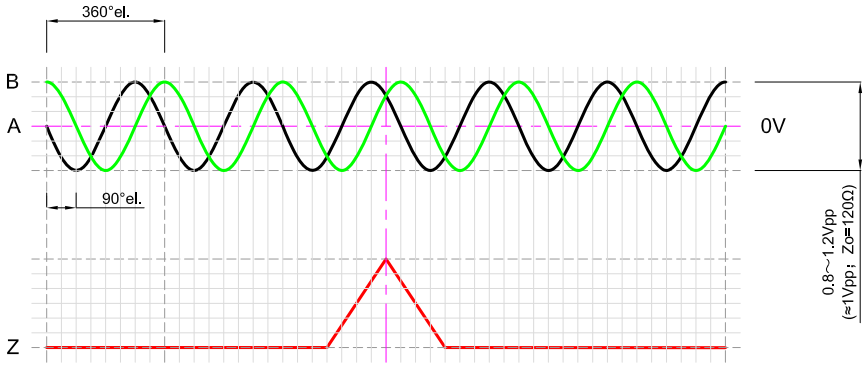
CW direction

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



4. 3 Analog signal： ∿ 1Vpp (A+B+Z)

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.
All signals have a DC offset of 0V.

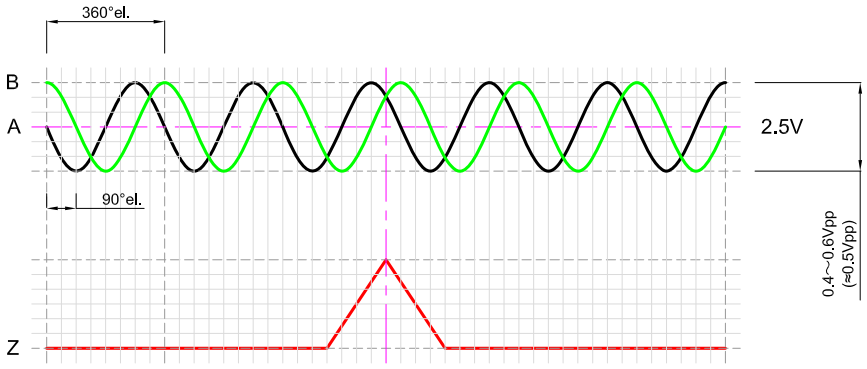


Shaft that rotates clockwise when viewed from the shaft end.
(see dmensional drawing)

CW direction

4. 4 Analog signal： ∿ 0.5Vpp (A+B+Z)

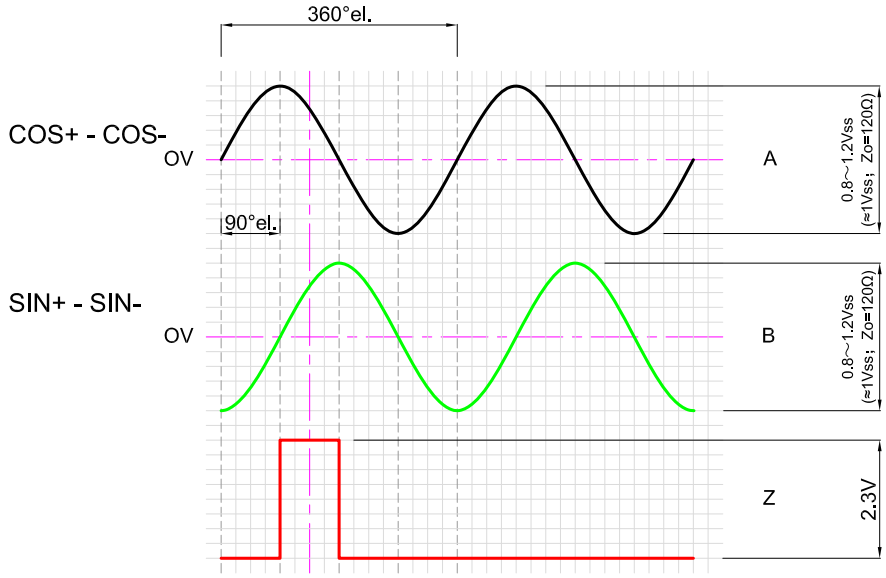
Incremental signals A and B , as well as the zero signal Z, are differential signals with a level of 0.5 Vpp.
The zero signal occurs once per revolution and reaches its max value at the angle where the amplitudes of the A and B signals are equal.
All signals have a DC offset of 2.5 V.



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

CW direction

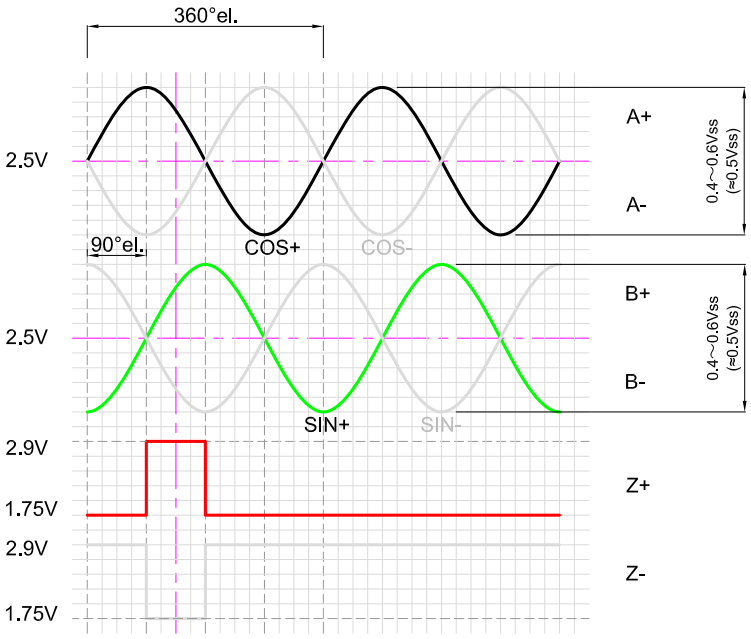
4.5 Analog + digital signal：∿+⎍ 1Vpp (A+B+Z)



Clockwise rotation of the shaft as viewed from the shaft end (see dmensional drawing)

CW direction

4. 6 Analog + digital signal：∿+⎍ 0. 5Vpp （A+B+Z）



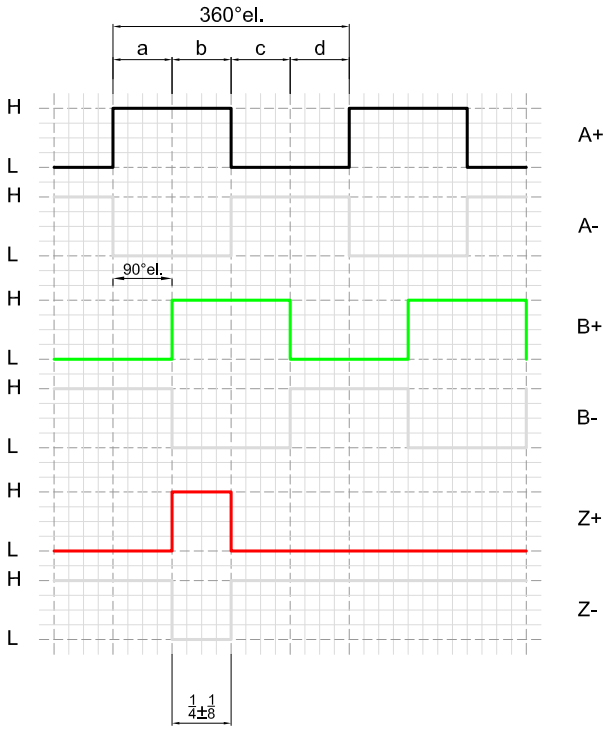
Clockwise rotation of the shaft as viewed from the shaft end (see dmensional drawing)

CW direction

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%	

4.7 TTL/HTL differential incremental signal:

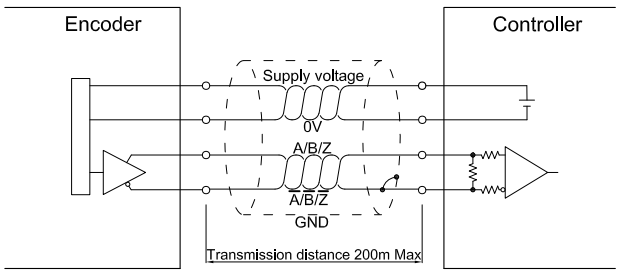


a.b.c.d=$\frac{T}{4}\pm\frac{T}{8}$

Phase A is ahead of B by $\frac{T}{4}\pm\frac{T}{8}$, viewing from shaft end, direction is clockwise rotation.
(See dimensional drawings)

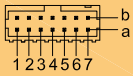
CW direction

5. Electrical Interface



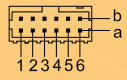
6. Connection Definition Table of PCB Connector

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



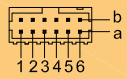
	Supply voltage				Signal									
PCB connector (pin No.)	1b	7a	5b	3a	6b	6a	3b	5a	4b	4a	7b	1a	2b	6a
Function	Up	Sensor Up	OV	Sensor OV	A+	A−	B+	B−	Z+	Z−	C+	C−	D+	D−

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



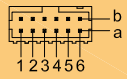
	Supply voltage				Signal							
PCB connector (pin No.)	2a	2b	1a	1b	6a	6b	5b	5a	4b	4a	3b	3a
Function	Up	Sensor Up	OV	Sensor Up	A+	A−	B+	B−	Z+	Z−	/	/

6.3 Analog + ditigal 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

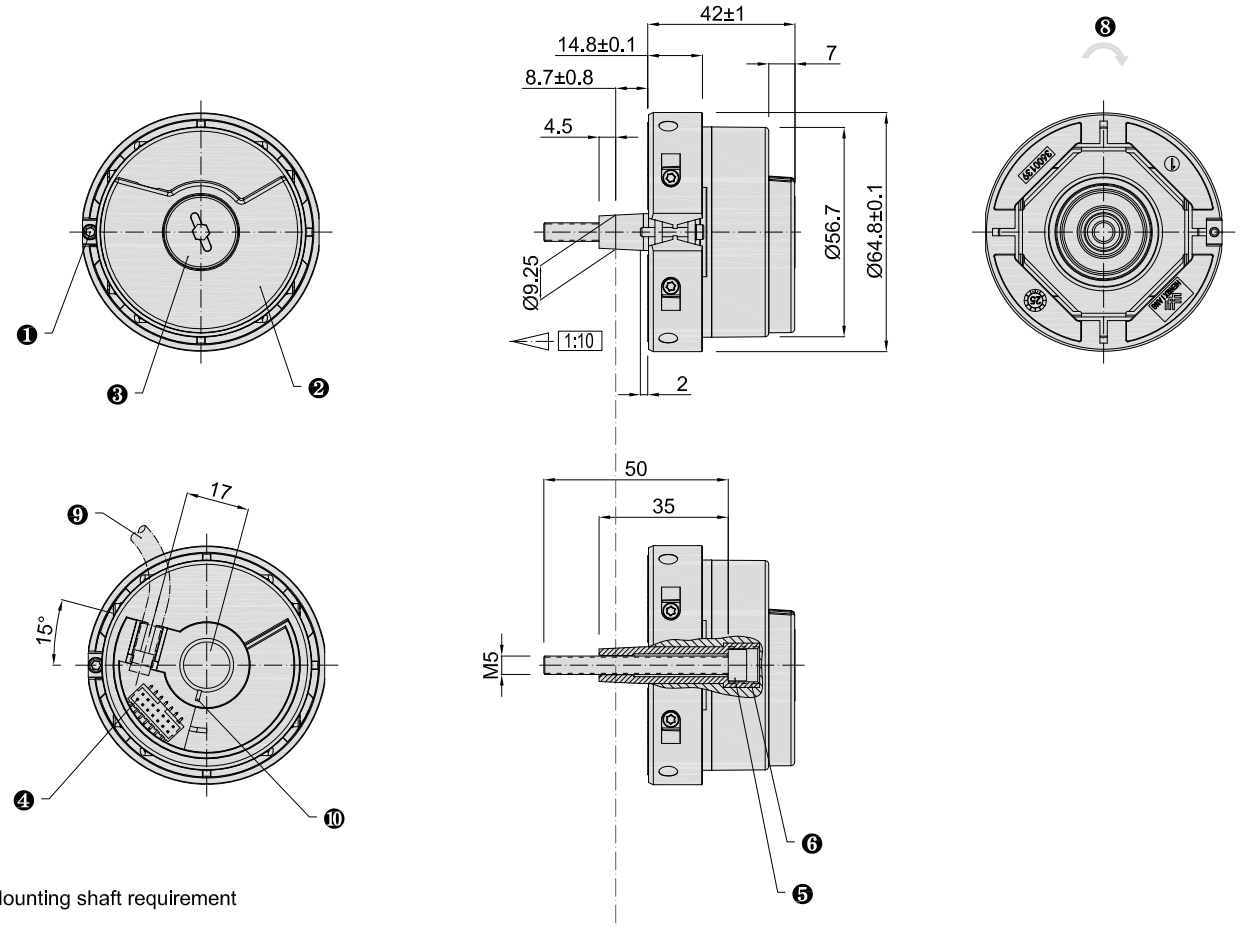


	Supply voltage				Signal							
PCB connector (pin No.)	2a	2b	1a	1b	6b	6a	5b	5a	4b	4a	3b	3a
Function	Up	Sensor Up	OV	Sensor Up	A+	A−	B+	B−	Z+	Z−	/	/

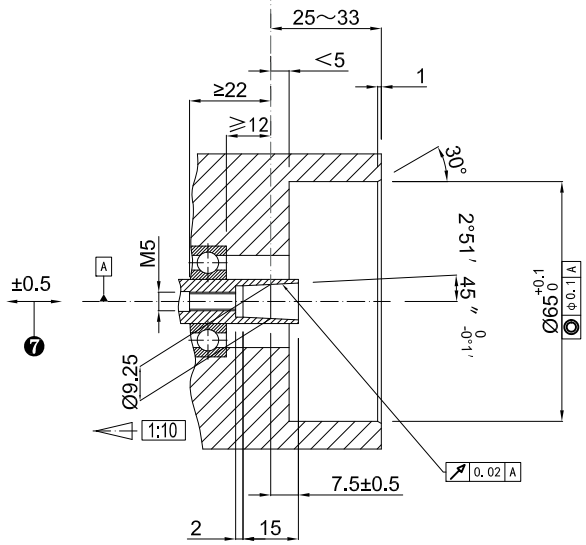
Up=Power supply voltage positive.
The shielded wire is not connected to the internal circuit of the encoder.

7. Basic Dimension

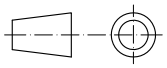
7.1 Dimension



7.2 Mounting shaft requirement

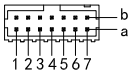
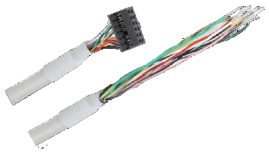
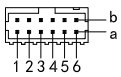


Unit: mm



❶ = Ring expansion bolt M2.5*12
❷ = Die-cast cover
❸ = Sealed cover
❹ = PCB connector
❺ = Bolt M5*50
❻ = Screw hole M10
❼ = Mounting tolerance and thermal expansion compensation, dynamic movement is not allowed
❽ = Shaft rotation direction for incremental signal output
❾ = Cable, see P10 (recommended accessories)
❿ = Mechanical zero-position alignment reference point

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 (0.14mm²), Ø6mm	ST65C1	44400051
		C2=Connection method A head: 14pin(female); Connection method B head: bare wire end; Cable length: 2M, 14 cores with shielding (0.14mm²), Ø6mm	ST65C2	44400052
		C5=Connection method A head: 14pin(female); Connection method B head: bare wire end; Cable length: 5M, 14 cores with shielding (0.14mm²), 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 (0.14mm²), Ø6mm	ST65E1	44400054
		E2=Connection method A head: 12pin(female); Connection method B head: bare wire end; Cable length: 2M, 10 cores with shielding (0.14mm²), Ø6mm	ST65E2	44400055
		E5=Connection method A head: 12pin(female); Connection method B head: bare wire end; Cable length: 5M, 10 cores with shielding (0.14mm²), 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.

www.shhxgd.com fang@shhxgd.com Tel: 86-21-54613487 We reserve the final interpretation right of this specifications,subject to change without notice .