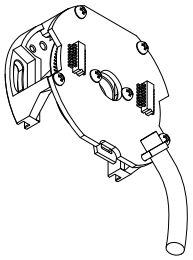
1. Z48 Incremental Bearing-less Optical Encoder (Through Shaft)

1.1 Introduction:

Z48 is a through shaft bearing-less encoder with easy installation and no adjustment. It has multiple electrical interfaces and no dust protection. It is mostly used for low-cost solutions for private service motors.

1.2 Feature:

- Encoder external diameter Ø48mm、thickness min 23mm、diameter of shaft up to Ø8mm;
- Adopt non-contact photoelectric principle;
- Reverse polarity protection;
- Short circuit protection;
- Multiple electrical interfaces available;
- Resolution per turn up to 5000PPR.



1.3 Application:

Servo motor, robot and automation control fields.

1.4 Connection:

- Radial cable (standard length 0.3M)

1.5 Protection:

None

1.6 Weight:

About 60g

2. Model Selection Guide

2.1 Model composition(select parameters)

Z48-	J	12	C	2500/8	Q8			-	000
Product model series	Connection method: J=Radial cable	Output phase: 1=A 2=A+B 3=A+B+Z (Wiring table 7.1) 4=A+$\overline{A}$+B+$\overline{B}$ 6=A+B+Z +$\overline{A}$+$\overline{B}$+$\overline{Z}$ (Wiring table 7.2) For servo motor: 6=Less wiring type (Wiring table 7.2) 12=A/$\overline{A}$/B/$\overline{B}$/Z/$\overline{Z}$/U/$\overline{U}$/V/$\overline{V}$/W/$\overline{W}$ (Wiring table 7.3)	Electrical interface: N=OC(NPN)❶ NH=OC(NPN)❷ V=Voltage❷ VL=Voltage❶ F=Push-pull❶ FH=Push-pull❷ C=TTL (26LS31) E=HTL L=TTL (26C31) S=TTL(Less wiring type)	Resolution PPR: 1000; 1024; 2000; 2048; 2500; 4000; 4096; 5000 For servo motor: Resolution/pole 1000/4, /6, /8; 1024/4, /6, /8; 2048/4, /6, /8; 2500/4, /6, /8; 4096/4, /6, /8; 5000/4, /6, /8;	Diameter of shaft: Q6=Ø6mm Q8=Ø8mm	Supply voltage: Blank=DC5V H=DC8-30V	Special requirement: Blank=❸	Management No.

2. 2 Note

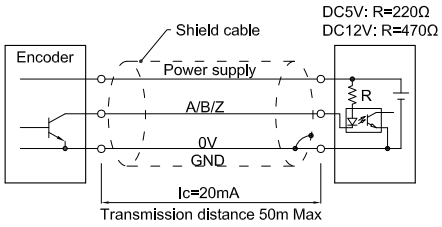
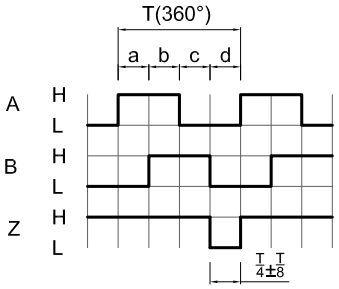
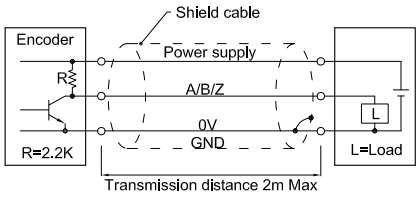
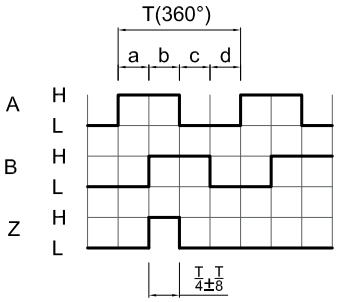
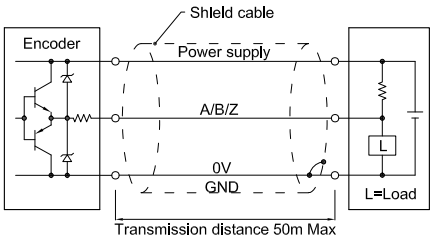
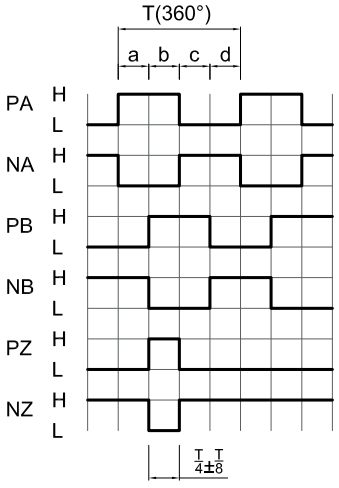
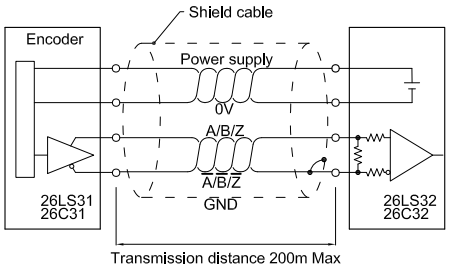
❶. Z signal is low level active.

❷. Z signal is high level active.

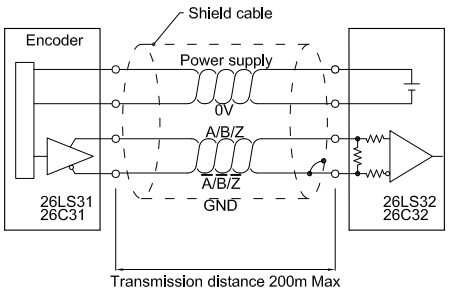
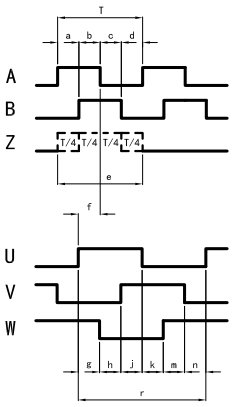
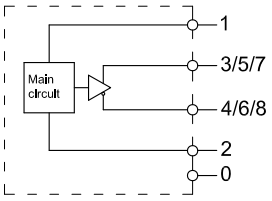
❸. Blank means IP00, cable length is 0.3M, if need to change the length C+number, the longest is 100M (expressed by C100). For the specific length of use, pls refer to page P2 -P3 of the provision of output circuit.

3. Output Method

3.1 Incremental signal

Electrical interface	Output circuit	Output wave form
OC NPN open collector circuit		 a.b.c.d=T/4±T/8 Phase A is ahead of B by T/4±T/8, viewing from encoder front side, direction is counterclockwise rotation. (See dimensional drawings) CCW direction Z signal is low level active
Voltage		 a.b.c.d=T/4±T/8 Phase A is ahead of B by T/4±T/8, viewing from encoder front side, direction is counterclockwise rotation. (See dimensional drawings) CCW direction Z signal is high level active
Push-pull		 a.b.c.d=T/4±T/8 Phase A is ahead of B by T/4±T/8, viewing from encoder front side, direction is clockwise rotation. (See dimensional drawings) CW direction
TTL (DC5V) HTL (DC8-30V)		

3.2 For servo motor(with UVW）

Electrical interface	Output circuit	Output wave form
TTL (DC5V)		
TTL (DC5V) (Less wiring type)		Reverse signal not shown

26LS31, 26C31
Transmission distance 200m Max

No.	Function / Color	Mode 1	2	3
1	white	HZ	U	A
2	white/ black	HZ	$\overline{U}$	$\overline{A}$
3	green	HZ	V	B
4	green/ black	HZ	$\overline{V}$	$\overline{B}$
5	yellow	HZ	W	Z
6	yellow/ black	HZ	$\overline{W}$	$\overline{Z}$
7	red	DC+5V		
8	black	OV		
0	shielding	GND		

pole	g.h.j.k.m.n	r
4	30±1°	180°
6	20±1°	120°
8	15±1°	90°

Symbol signification

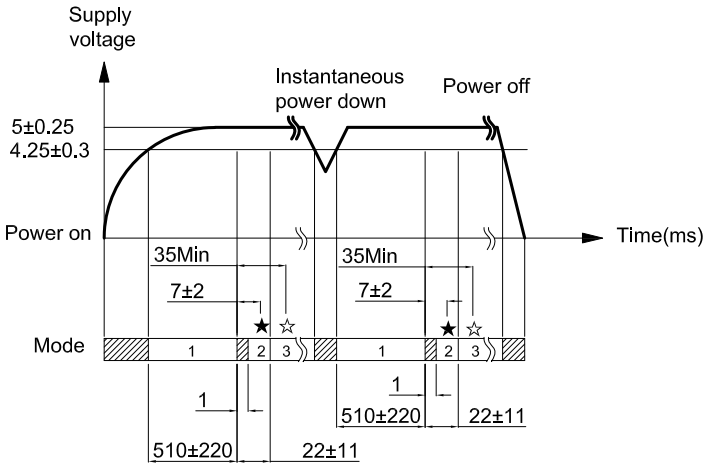
★: indicate position of UVW channel
☆: position to start counting ABZ channel
▨: non-using zone
HZ: high impedance

a.b.c.d=$\frac{T}{4}\pm\frac{T}{8}$
e=$T\pm\frac{T}{2}$
f: center of phase Z to rise point of phase U,that is ±1°

CW direction →

Viewed from encoder front side direction is clockwise rotation. (See dimensional drawings)

Timing Chart



4. Electrical Parameter

Parameter / Output type / Item			OC	Voltage	Push-pull	TTL	TTL (Less wiring type)	HTL
Supply voltage			DC+5V±5%；DC8V-30V±5%			DC+5V±5%		DC8-30V±5%
Consumption current			100mA Max			120mA Max		
Allowable ripple			≤3%rms					
Top response frequency			100KHz			300KHz		500KHz
Output capacity	Output current	Input	≤30mA	Load resistance 2.2K	≤30mA	≤±20mA		≤±50mA
		Output	—		≤10mA			
	Output voltage	"H"	—	—	≥[(Supply voltage) -2.5V]	≥2.5V		≥Vcc-3 VDC
		"L"	≤0.4V	≤0.7V(less than 20mA)	≤0.4V(30mA)	≤0.5V		≤ 1V VDC
	Load voltage		≤DC30V	—		—		
Rise & Fall time			Less than 2us(cable length：2m)			Less than 1us(Cable length：2m)		
Insulation strength			AC500V 60s					
Insulation resistance			10MΩ					
Mark to space ratio			45% to 55%					
Reverse polarity protection			✔					
Short-circuit protection			—		✔❶			
Phase shift between A & B			90°±10° (frequency in low speed)					
			90°±20° (frequency in high speed)					
Delay motion time ❷			—				510±220ms	—
GND			Not connect to encoder					

❶ Short-circuit to another channel or GND permitted for max.30s.
❷ Phase A.B.Z are back of phase U.V.W when power on.

5. Mechanical Specification

Diameter of shaft	Ø6mm; Ø8mm(optional)
Dimension of collar	$Ø30^{+0.005}_{+0.025}$; depth 2.4mm
Slew speed	≤5000 rpm
Material	Base: Die cast aluminum
Weight	About 60g

6. Environmental Parameter

Environmental temperature	Operating:—20～+85°C(repeatable winding cable: -10°C); Storage:—20～+90°C
Environmental humidity	Operating and storage：35～85％RH(noncondensing)
Vibration(Endurance)	Amplitude 0.75mm,5~55Hz,2h for X,Y,Z direction individually
Shock(Endurance)	490m/s² 11ms three times for X,Y,Z direction individually
Protection	None

7. Wiring Table

7.1 OC / Voltage

	Incremental signal			Supply voltage	
Wire color	White	Green	Yellow	Red	Black
Function	A	B	Z	Up	0V

7.2 TTL / HTL / Push-pull / Less wiring type

	Incremental signal						Supply voltage	
Wire color	White	White/BK	Green	Green/BK	Yellow	Yellow/BK	Red	Black
Function	A+ (U+)*	A- (U-)*	B+ (V+)*	B- (V-)*	Z+ (W+)*	Z- (W-)*	Up	0V
Twisted-paired cable								

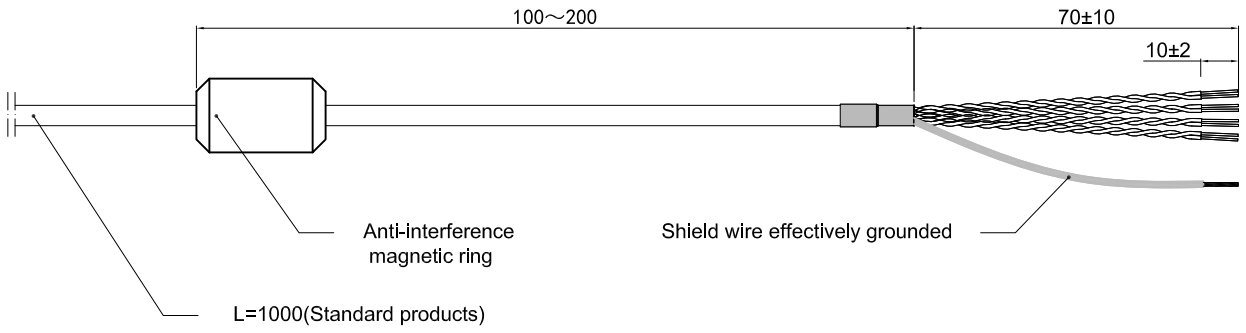
* For the functional status in less wiring mode, refer to the functional mode wiring table for output circuit on page 3.

7.3 For servo motor

	Incremental signal												Supply voltage	
Wire color	Blue	Blue/BK	Grey	Grey/BK	Pink	Pink/BK	Yellow	Yellow/BK	Green	Green/BK	White	White/BK	Black	Red
Function	U+	U-	V+	V-	W+	W-	Z+	Z-	B+	B-	A+	A-	0V	Up
Twisted-paired cable														

Up=Supply voltage.
Shield wire is not connected to the internal circuit of encoder.

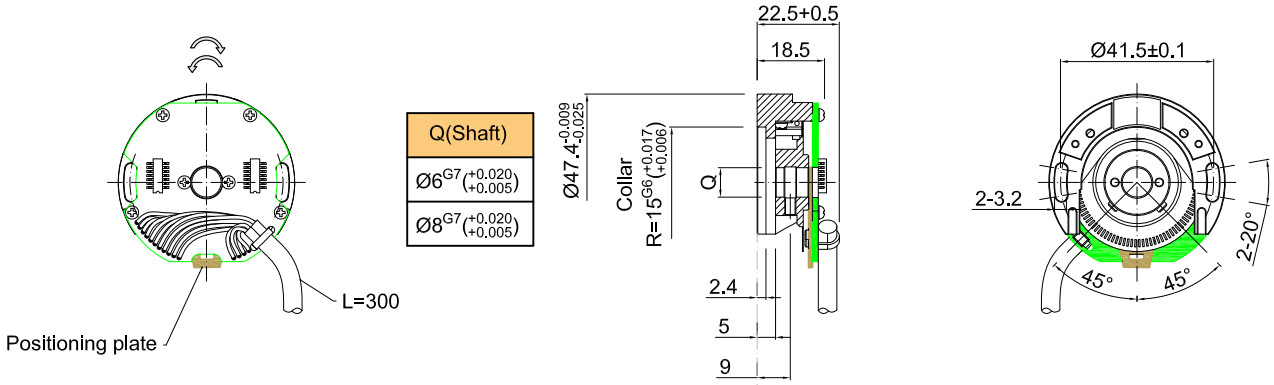
7. 4 Radial cable schematic



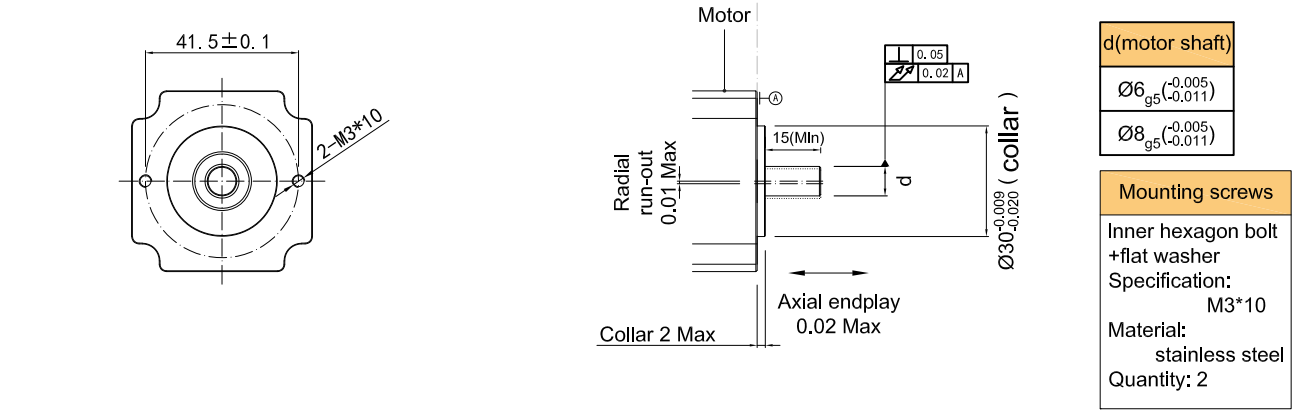
Unit: mm

8. Basic Dimension

8.1 Encoder size



8. 2 Installation shaft specification



Unit: mm

= Shaft rotate direction of TTL & HTL signal output
= Shaft rotate direction of OC signal output

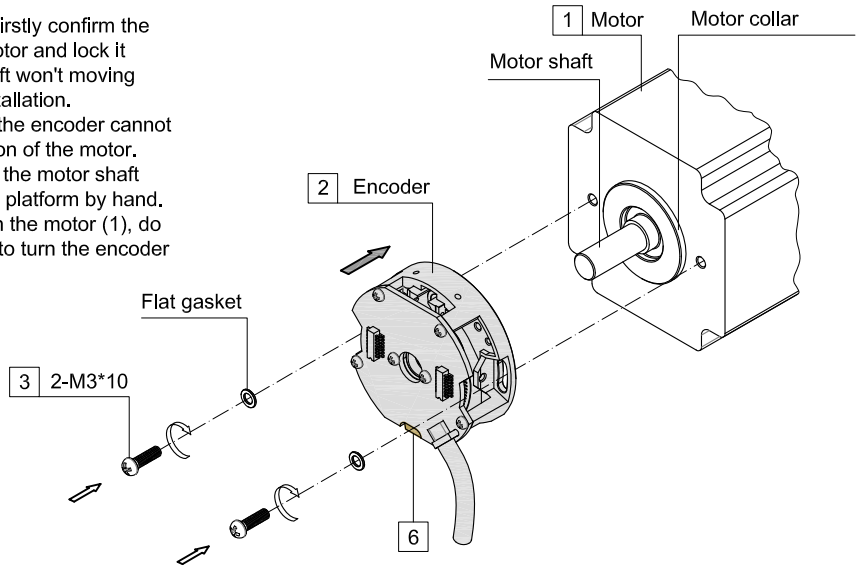
9. Assembly Steps

9.1 Assembling steps for encoder with UVW

Step 1

a. Before installing the encoder, firstly confirm the starting zero position of the motor and lock it tightly to ensure the motor shaft won't moving until the encoder complete installation. otherwise the zero position of the encoder cannot be aligned with the zero position of the motor.
b. Put the encoder (2) directly on the motor shaft and gently push it to the motor platform by hand.
c. Fix the two hexagon screws on the motor (1), do not be too tightly ,just enough to turn the encoder by hand.

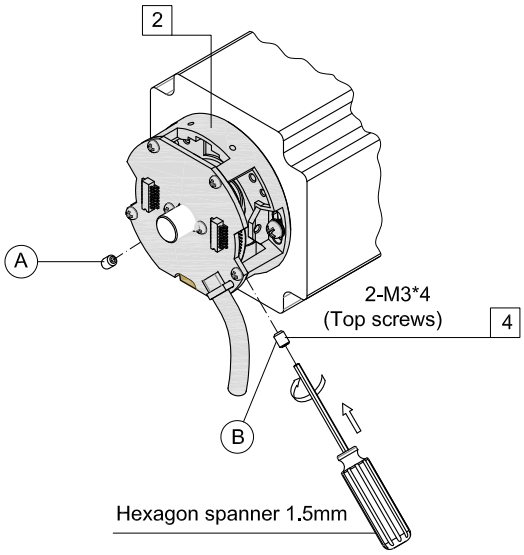
Note:
For the matching tolerance among encoder shaft sleeve, the motor shaft collar and limiting slot,
please refer to page 7.



Step 2

Apply thread adhesive to the front ends of the two M3*4 top screws (4) on the side of the encoder (2) and tighten to fix the encoder disk on the motor shaft.

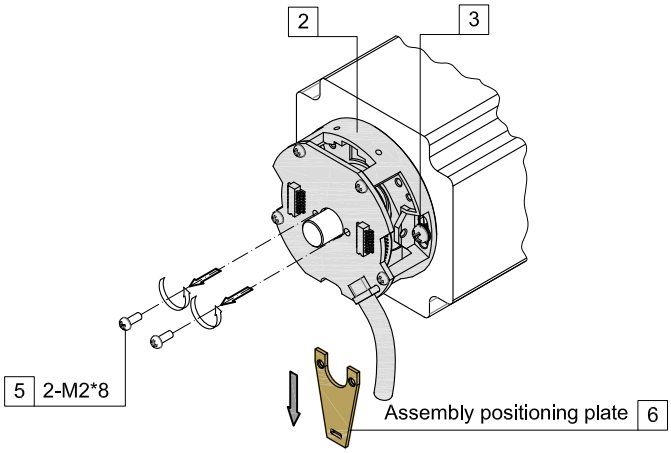
Note:
Follow the tightening sequence of the two screws as figure (A first, then B)
Recommended tightening force is 0.6N.m



Step 3

a. Remove the two M2*8 screws (5) and the positioning plate
b. Connect the signal wires of the encoder, power on, and connect to the oscilloscope or other testing equipment that can read the zero signal of the motor and the encoder.
c. Centered on the collar and turn the encoder (2) from left to right by hand,and observe the testing equipment until the alignment of zero position for encoder and motor meets the requirements,then tighten the two M3*10 bolts (3).
d. Unlock the zero position of the motor to complete the encoder's installation.

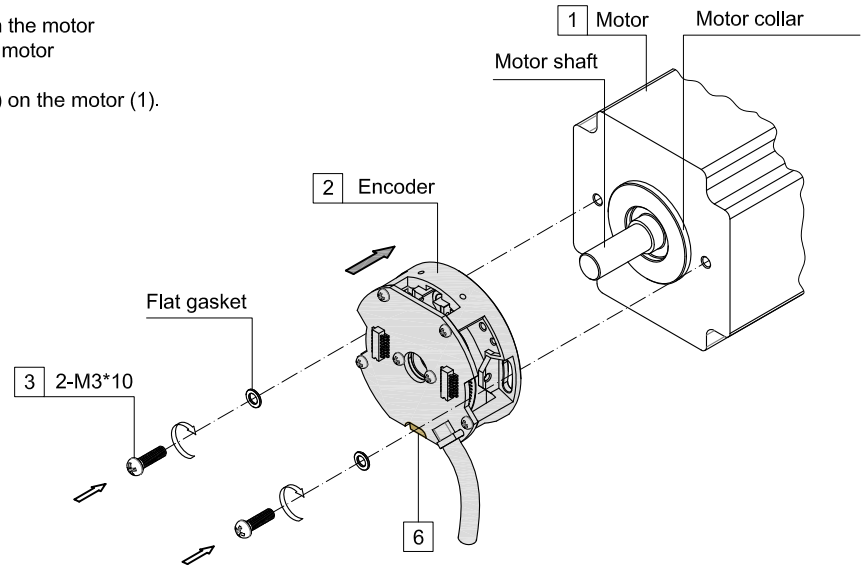
Note:
If want to re-zero or disassemble the encoder (2), must reinstall the assembly positioning plate (6) in reverse order.



9.2 Assembling steps for encoder without UVW

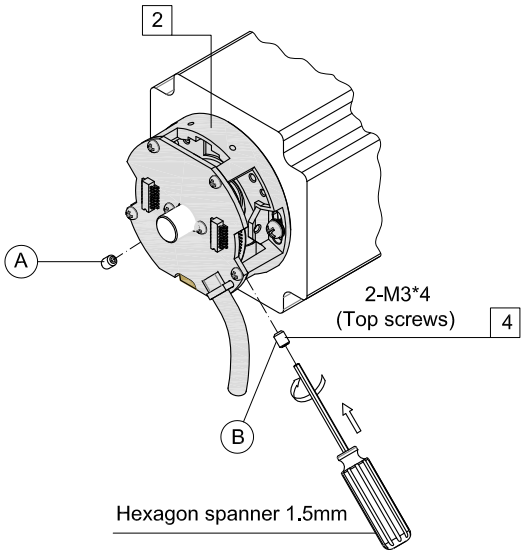
Step 1
a. Put the encoder (2) directly on the motor shaft and gently push it to the motor platform by hand.
b. Tighten the two M3 screws (3) on the motor (1).

Note:
For the matching tolerance among encoder shaft sleeve, the motor shaft and collar, please refer to page 7.



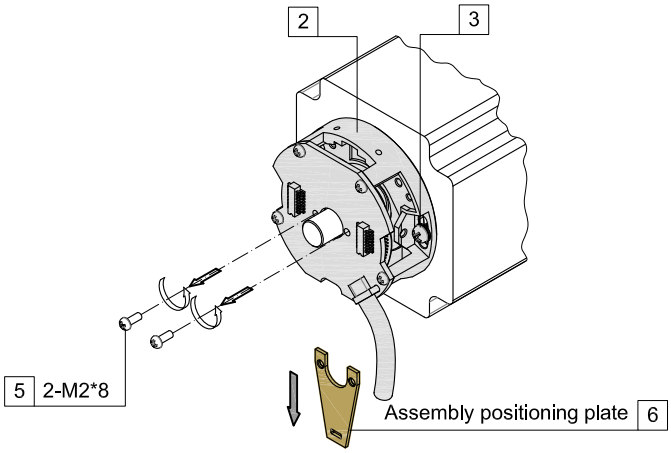
Step 2
Apply thread adhesive to the front ends of the two M3*4 top screws (4) on the side of the encoder (2) and tighten to fix the encoder disk on the motor shaft.

Note:
Follow the tightening sequence of the two screws as figure (A first, then B).
Recommended tightening force is 0.6N.m



Step 3
a. Remove the two M2*8 screw (5).
b. Remove the positioning plate (6) and the encoder is ready to use.

Note:
If want to remove the encoder (2), must reinstall the positioning plate (6) in reverse order.



10. Caution

10.1 About vibration

Vibration act on encoder always cause wrong pulse, so we should pay attention to working place.More pulse per revolution, narrower groovy spacing of grating, more effect to encoder by vibration, when rev is low or stop, vibration act on shaft or main body would cause grating vibrating, so encoder might make wrong pulse.

10.2 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 do not apply excessive force to the cable of encoder, or it will may be damaged.

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