

## 1. PC48 Incremental Optical Encoder (Hollow Shaft)

### 1.1 Introduction:

PC48 with its unique through-shaft concentric locking device, single-bearing ultra-thin design, mechanical hard connection, multiple electrical interfaces, protection grade IP50, can solve the installation problem of low space restrictions.

### 1.2 Feature:

- Encoder external diameter  $\varnothing 48\text{mm}$ , thickness min 14mm, diameter of shaft up to  $\varnothing 14\text{mm}$ ;
- 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 socket (8P & 14P)
- Radial cable (standard length 1.0M)

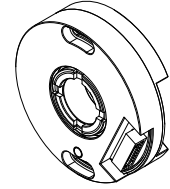
### 1.5 Protection:

IP50

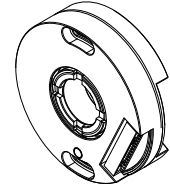
### 1.6 Weight:

About 70g

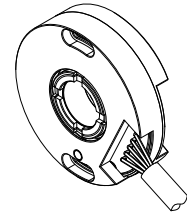
PC48-E



PC48-F

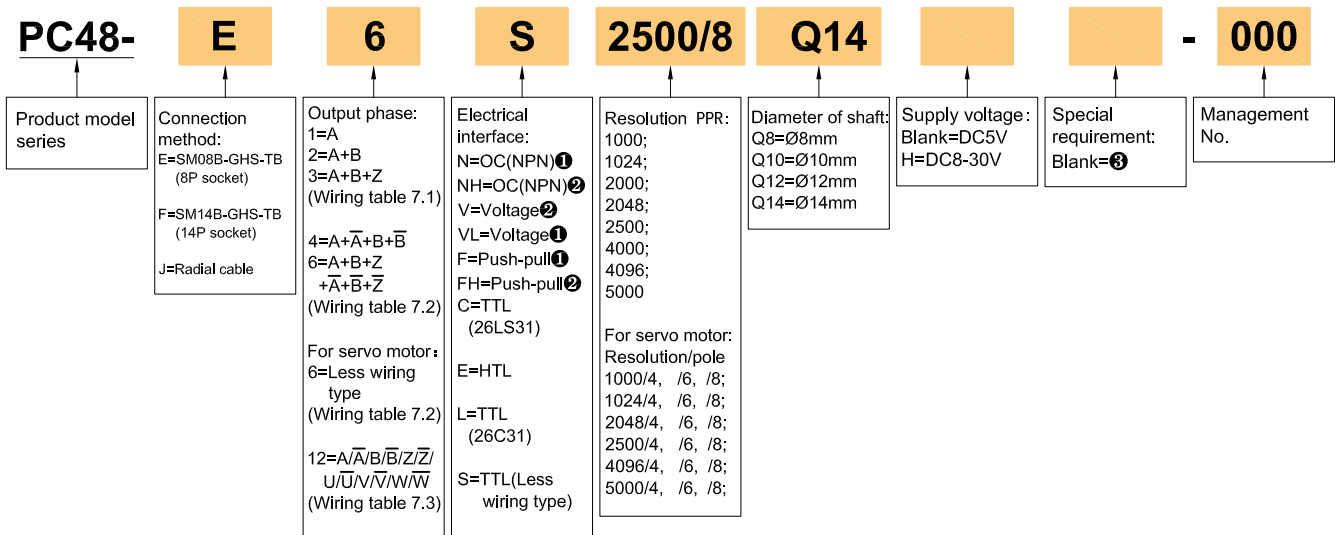


PC48-J



## 2. Model Selection Guide

### 2.1 Model composition(select parameters)



### 2.2 Note

- Z signal is low level active.
- Z signal is high level active.
- Blank means IP50, cable length is 1.0M, 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 Mode

3.1 Incremental signal

Electrical interface	Output circuit	Output wave form
<p>OC NPN open collector circuit</p>		
<p>Voltage</p>		
<p>Push-pull</p>		
<p>TTL (DC5V)  HTL (DC8-30V)</p>		

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3.2 For servo motor(with UVW)

Electrical interface	Output circuit	Output wave form																																																																	
<p>TTL (DC5V)</p>																																																																			
<p>TTL (DC5V) (Less wiring type)</p>	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>26LS31, 26C31 Transmission distance 200m Max</p> <p><b>Symbol signification</b></p> <ul style="list-style-type: none"> <li>★: indicate position of UVW channel</li> <li>☆: position to start counting ABZ channel</li> <li>□: non-using zone</li> <li>HZ: high impedance</li> </ul> </div> <div style="width: 50%;"> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">No.</th> <th rowspan="2">Function Color</th> <th colspan="3">Mode</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>white</td> <td>HZ</td> <td>U</td> <td>A</td> </tr> <tr> <td>2</td> <td>white/black</td> <td>HZ</td> <td><math>\bar{U}</math></td> <td><math>\bar{A}</math></td> </tr> <tr> <td>3</td> <td>green</td> <td>HZ</td> <td>V</td> <td>B</td> </tr> <tr> <td>4</td> <td>green/black</td> <td>HZ</td> <td><math>\bar{V}</math></td> <td><math>\bar{B}</math></td> </tr> <tr> <td>5</td> <td>yellow</td> <td>HZ</td> <td>W</td> <td>Z</td> </tr> <tr> <td>6</td> <td>yellow/black</td> <td>HZ</td> <td><math>\bar{W}</math></td> <td><math>\bar{Z}</math></td> </tr> <tr> <td>7</td> <td>red</td> <td colspan="3">DC+5V</td> </tr> <tr> <td>8</td> <td>black</td> <td colspan="3">OV</td> </tr> <tr> <td>0</td> <td>shielding</td> <td colspan="3">GND</td> </tr> </tbody> </table> </div> </div>	No.	Function Color	Mode			1	2	3	1	white	HZ	U	A	2	white/black	HZ	$\bar{U}$	$\bar{A}$	3	green	HZ	V	B	4	green/black	HZ	$\bar{V}$	$\bar{B}$	5	yellow	HZ	W	Z	6	yellow/black	HZ	$\bar{W}$	$\bar{Z}$	7	red	DC+5V			8	black	OV			0	shielding	GND			<p>Reverse signal not shown</p> <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>pole</th> <th>g.h.j.k.m.n</th> <th>r</th> </tr> </thead> <tbody> <tr> <td>4</td> <td><math>30 \pm 1^\circ</math></td> <td><math>180^\circ</math></td> </tr> <tr> <td>6</td> <td><math>20 \pm 1^\circ</math></td> <td><math>120^\circ</math></td> </tr> <tr> <td>8</td> <td><math>15 \pm 1^\circ</math></td> <td><math>90^\circ</math></td> </tr> </tbody> </table> <p>a.b.c.d = <math>\frac{T}{4} \pm \frac{T}{8}</math>  e = <math>T \pm \frac{T}{2}</math>  f: center of phase Z to rise point of phase U, that is <math>\pm 1^\circ</math></p> <p>CW direction <math>\rightarrow</math></p> <p>Viewed from encoder front side direction is clockwise rotation. (See dimensional drawings)</p>	pole	g.h.j.k.m.n	r	4	$30 \pm 1^\circ$	$180^\circ$	6	$20 \pm 1^\circ$	$120^\circ$	8	$15 \pm 1^\circ$	$90^\circ$
No.	Function Color			Mode																																																															
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<p><b>Timing Chart</b></p>																																																																			

4. Electrical Parameter

Parameter / Item	Output type	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 Vbc
		"L"	≤0.4V	≤0.7V (less than 20mA)	≤0.4V(30mA)	≤0.5V	≤ 1V Vbc
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	Ø8mm; Ø10mm; Ø12mm; Ø14mm(optional)
Starting torque	Less than $9.8 \times 10^{-3} \text{N}\cdot\text{m}$
Inertia moment	Less than $6.5 \times 10^{-6} \text{kg}\cdot\text{m}^2$
Shaft load	Radial 20N; Axial 10N
Slew speed	≤5000 rpm
Bearing Life	$1.5 \times 10^9$ revs at rated load(100000hrs at 2500RPM)
Material	Base: Die cast aluminum
Weight	About 70g

## 6. Environmental Parameter





Environmental temperature	Operating: $-20 \sim +85^\circ\text{C}$ (repeatable winding cable: $-10^\circ\text{C}$ ); Storage: $-20 \sim +90^\circ\text{C}$
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)	$490\text{m/s}^2$ 11ms three times for X,Y,Z direction individually
Protection	IP50

### 7. Wiring Table

#### 7.1 OC / Voltage








Socket pin No.	Incremental signal						Supply voltage	
	1	2	3	4	5	6	7	8
Wire color	White	-	Green	-	Yellow	-	Red	Black
Function	A	-	B	-	Z	-	Up	0V

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

Socket pin No.	Incremental signal						Supply voltage	
	1	2	3	4	5	6	7	8
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 page3.

#### 7.3 For servo motor

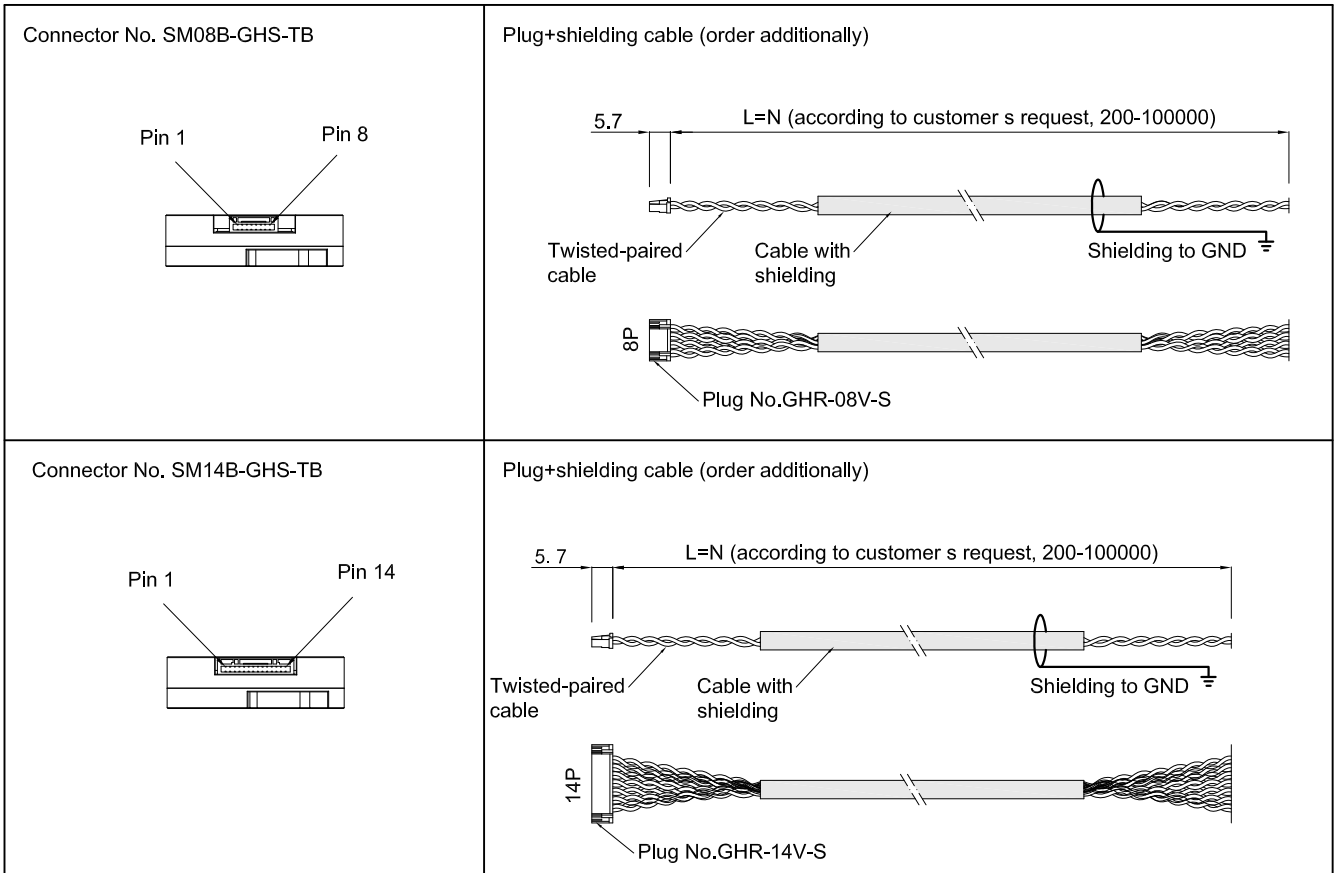
Socket pin No.	Incremental signal												Supply voltage	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Wire color	Blue	Blue/Bk	Grey	Grey/Bk	Pink	Pink/Bk	Yellow	Yellow/BK	Green	Green/BK	White	White/BK	Black	Red
Function	U+	U-	V+	V-	W+	W-	Z+	Z-	B+	B-	A+	A-	0V	Up
Twisted-paired cable														

Up=Supply voltage.

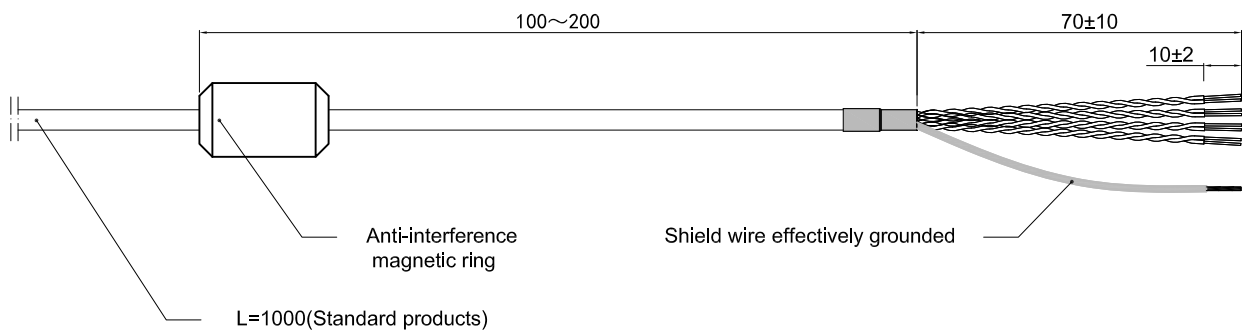
Shield wire is not connected to the internal circuit of encoder.

8. Socket & Cable

8.1 Socket pin definition



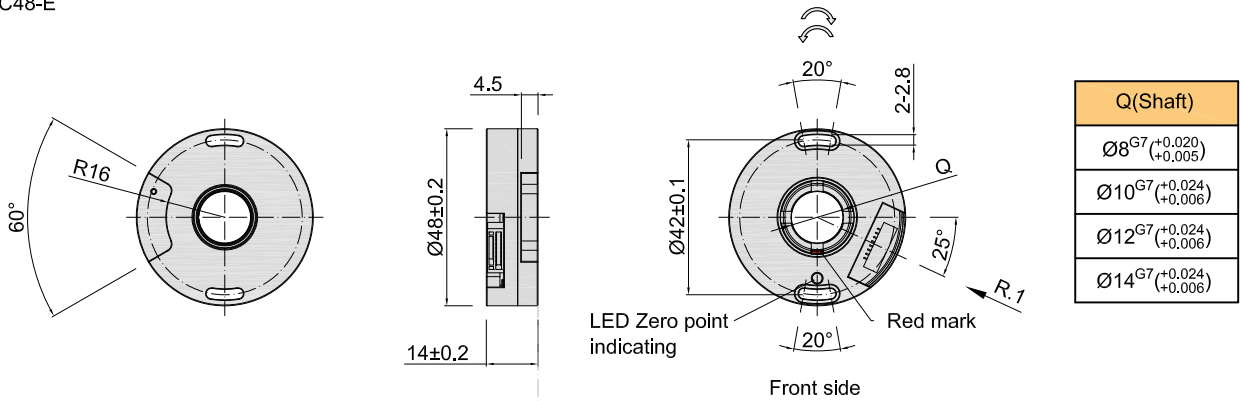
8.2 Radial Cable Schematic



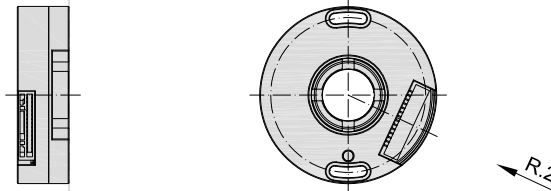
Unit: mm

9. Basic Dimension

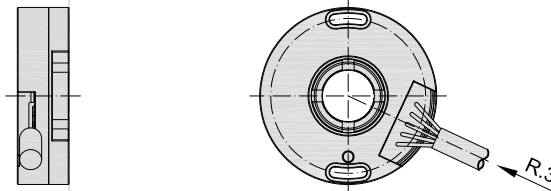
9.1 PC48-E



9.2 PC48-F (other dimension are the same as PC48-E)

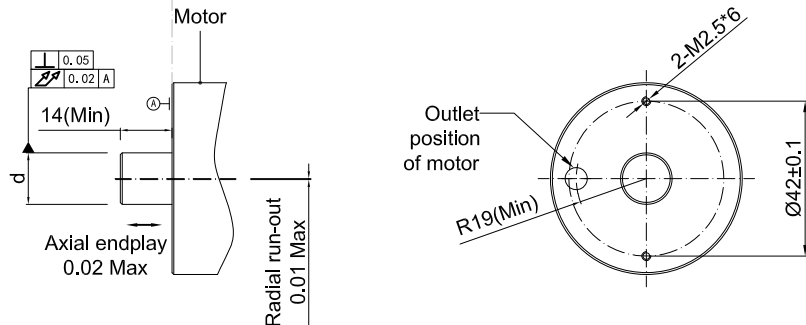


9.3 PC48-J (other dimension are the same as PC48-E)

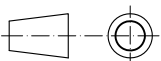


9.4 Installation shaft specification

d(motor shaft)	Mounting screws
Ø8 <sub>g4</sub> <sup>(-0.005/-0.009)</sup>	Inner hexagon bolt +flat washer Specification: M2.5*15
Ø10 <sub>g4</sub> <sup>(-0.006/-0.011)</sup>	
Ø12 <sub>g4</sub> <sup>(-0.006/-0.011)</sup>	Material: stainless steel Quantity: 2
Ø14 <sub>g4</sub> <sup>(-0.006/-0.011)</sup>	



Unit: mm



↻ = Rotate direction of incremental TTL & HTL signal output shaft

↻ = Rotate direction of OC signal output shaft

R1 = Radial socket 8P (SM08B-GHS-TB).  
R2 = Radial socket 14P (SM14B-GHS-TB).  
R3 = Radial cable(standard length 1M).

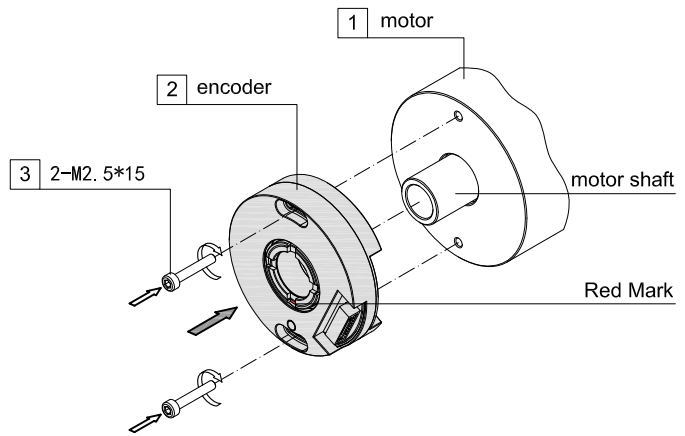


### 10. Assembly Steps for Servo Motor Encoder

#### 10.1 Encoder installation and zero position alignment with U.V.W

**Step 1**

- a. Before installing the encoder, first to confirm the starting zero position of the motor and lock it tightly to ensure that the motor shaft is not moving until the encoder is finished installation, otherwise the encoder and the motor's zero position cannot be aligned.
- b. Put the encoder (2) directly on the motor shaft and gently push it to the motor platform by hand.
- c. Screwed the two M2.5\*15 bolts (3) at the same time, but do not tighten, just enough to rotate the encoder by hand.

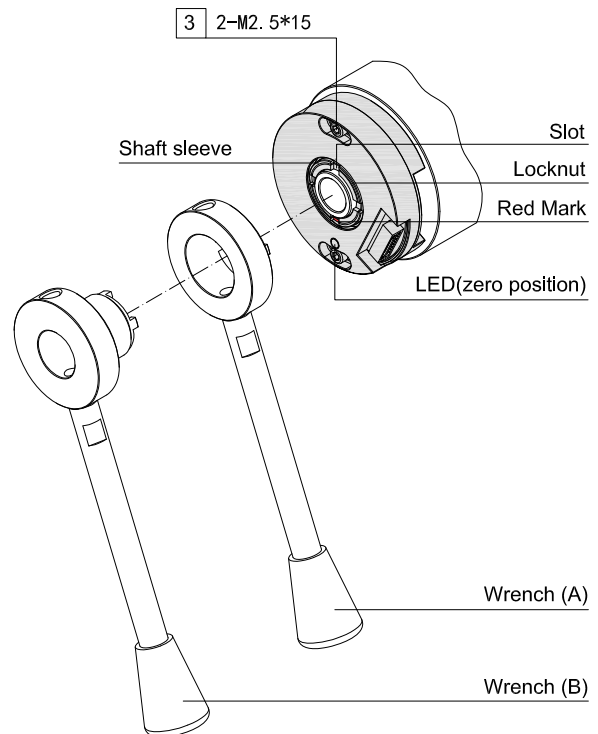


**Note:**

Please refer to page 8 for the matching tolerance of the encoder shaft sleeve and the motor shaft.

**Step 2**

- a. Fix the spanner (A) on the slot of the encoder shaft sleeve (outer ring) and then use the spanner (B) to tighten the lock nut (recommended tightening force is 8-13nm).
- b. Pls refer to the cable connection table on page 6-7, power on after checking all are correct, please confirm again that the motor is in the zero locked state, and then turn the encoder (2) left and right by hand, observe the LED on the encoder, when it is on, the zero signal is aligned, then tighten the two M2.5\*15 bolts (3) and keep the LED on.



**Note:**

- \*. The red mark on the shaft sleeve is always aligned with the LED indicator.
- \*. After making sure that the lock nut has been tightened, put thread glue on the inner thread of the slot to prevent the screw from loosening.
- \*. Because the width of the zero signal is relatively narrow, it is easy to cause displacement during the tightening process and the LED may not light up, please be patient to debug or use other testing equipments as auxiliary observation.

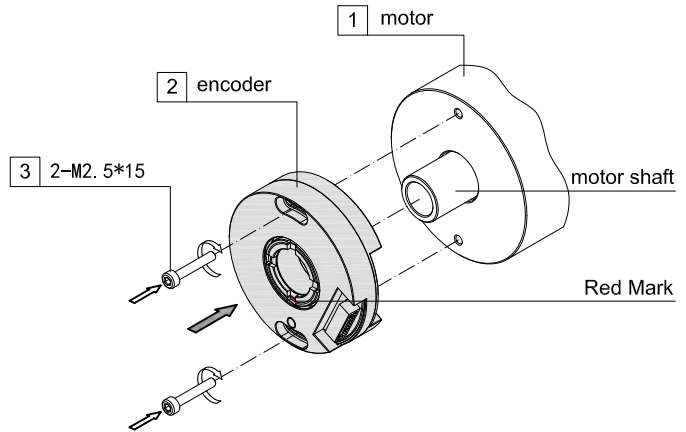
10.2 Incremental encoder installation steps

Step 1

Put the encoder (2) directly on the motor shaft (1) and gently push it to the motor platform, then tighten the two M2.5\*15 bolts (3) at the same time.

Note:

Please refer to page 8 for the matching tolerance of the encoder shaft sleeve and the motor shaft.

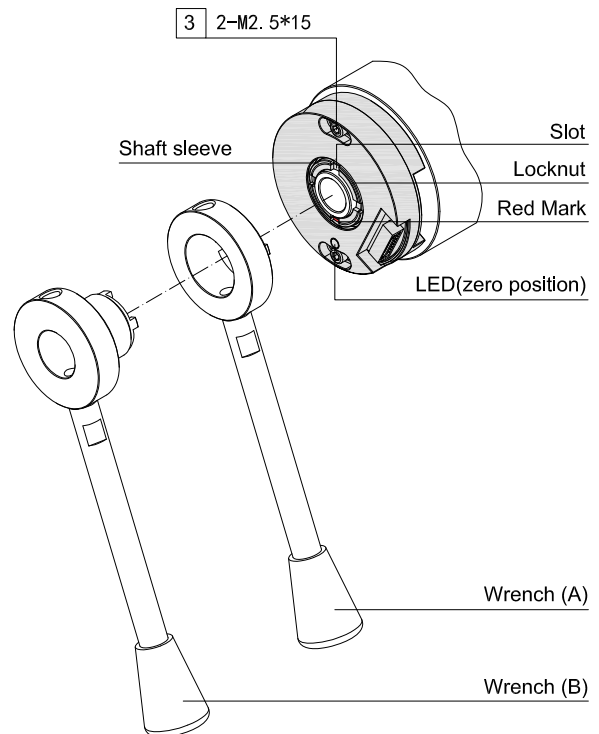


Step 2

Fix the spanner (A) on the slot of the encoder shaft sleeve (outer ring) and then use the spanner (B) to tighten the lock nut (recommended tightening force is 8-13nm).

Note:

- \*. The red mark on the shaft sleeve aligned with the LED indicator is regarded as the zero primary position. when the LED light is on, this will be the final precise zero position.
- \*. After making sure that the lock nut has been tightened, put thread glue on the inner thread of the slot to prevent the screw from loosening.



## 11. Caution

### 11.1 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.

### 11.2 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.

