

## 1. KN40 Incremental Optical Encoder (Hollow shaft)

### 1.1 Introduction:

KN40 is a ultra-thin multiple shaft type encoder, compact, and miniaturized, commonly used in servo motors and industrial automations.

### 1.2 Feature:

- Encoder external diameter  $\varnothing 40\text{mm}$ , thickness 20mm, diameter of shaft up to  $\varnothing 10\text{mm}$ ;
- Adopt non-contact photoelectric principle;
- Reverse polarity protection;
- Short circuit protection;
- Multiple electrical interfaces available;
- Resolution per turn up to 40000PPR.

### 1.3 Application:

Servo motor, underground, elevator, CNC and other automation control fields.

### 1.4 Connection:

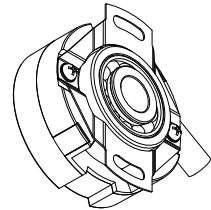
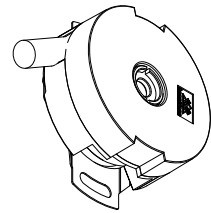
- Radial cable (length 500mm)

### 1.5 Protection:

IP40

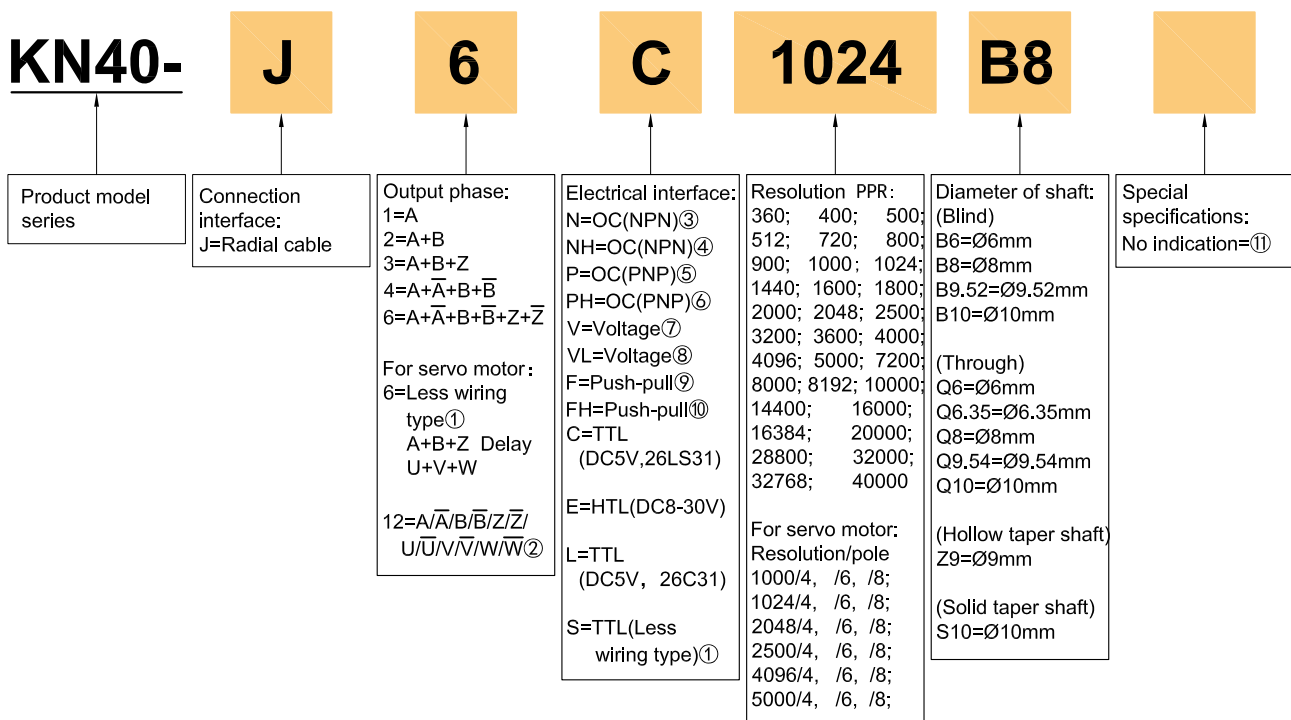
### 1.6 Weight:

about 90g



## 2. Model Selection Guide

### 2.1 Model composition(select parameters)



### 2.2 Note

- Servo motor-specific less wiring mode with 6 signal wires, A.B.Z.A.B.Z delayed by U.V.W.U.V.W, electrical interface TTL, DC5V.
- Servo motor-specific with 12 signal wires, A.B.Z.A.B.Z U.V.W.U.V.W, electrical interface TTL, DC5V.
- ⑤⑧⑨. Resolution selection is recommended to be below 5000ppr, Z signal is low level active.
- ④⑥⑦⑩. Resolution selection is recommended to be below 5000ppr, Z signal is high level active.
- ⑪. None indicated for the cable length of 0.5m, 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 2 and 3 of the provision of output circuit.

### 3. Output Mode

#### 3.1 Incremental signal

Electrical interface	Output circuit	Output wave form
OC NPN open collector circuit		<p> <math>a.b.c.d = \frac{T}{4} \pm \frac{T}{8}</math>                      Phase A is ahead of B by <math>\frac{T}{4} \pm \frac{T}{8}</math>, viewing from shaft end, direction is clockwise rotation. (See dimensional drawings)                      CW direction →                      Z signal is low level active                 </p>
OC PNP open collector circuit		<p> <math>a.b.c.d = \frac{T}{4} \pm \frac{T}{8}</math>                      Phase A is ahead of B by <math>\frac{T}{4} \pm \frac{T}{8}</math>, viewing from shaft end, direction is clockwise rotation. (See dimensional drawings)                      CW direction →                      Z signal is high level active                 </p>
Push-pull		<p> <math>a.b.c.d = \frac{T}{4} \pm \frac{T}{8}</math>                      Phase A is ahead of B by <math>\frac{T}{4} \pm \frac{T}{8}</math>, viewing from shaft end, direction is clockwise rotation. (See dimensional drawings)                      CW direction →                      Z signal is high level active                 </p>
Voltage		<p> <math>a.b.c.d = \frac{T}{4} \pm \frac{T}{8}</math>                      Phase A is ahead of B by <math>\frac{T}{4} \pm \frac{T}{8}</math>, viewing from shaft end, direction is clockwise rotation. (See dimensional drawings)                      CW direction →                      Z signal is high level active                 </p>
TTL (DC5V)  HTL (DC8-30V)		<p> <math>a.b.c.d = \frac{T}{4} \pm \frac{T}{8}</math>                      Phase A is ahead of B by <math>\frac{T}{4} \pm \frac{T}{8}</math>, viewing from shaft end, direction is clockwise rotation. (See dimensional drawings)                      CW direction →                 </p>

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;"> <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>3</td> <td>white</td> <td>HZ</td> <td>U</td> <td>A</td> </tr> <tr> <td>4</td> <td>white/black</td> <td>HZ</td> <td><math>\bar{U}</math></td> <td><math>\bar{A}</math></td> </tr> <tr> <td>5</td> <td>green</td> <td>HZ</td> <td>V</td> <td>B</td> </tr> <tr> <td>6</td> <td>green/black</td> <td>HZ</td> <td><math>\bar{V}</math></td> <td><math>\bar{B}</math></td> </tr> <tr> <td>7</td> <td>yellow</td> <td>HZ</td> <td>W</td> <td>Z</td> </tr> <tr> <td>8</td> <td>yellow/black</td> <td>HZ</td> <td><math>\bar{W}</math></td> <td><math>\bar{Z}</math></td> </tr> <tr> <td>1</td> <td>red</td> <td colspan="3">DC+5V</td> </tr> <tr> <td>2</td> <td>black</td> <td colspan="3">0V</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	3	white	HZ	U	A	4	white/black	HZ	$\bar{U}$	$\bar{A}$	5	green	HZ	V	B	6	green/black	HZ	$\bar{V}$	$\bar{B}$	7	yellow	HZ	W	Z	8	yellow/black	HZ	$\bar{W}$	$\bar{Z}$	1	red	DC+5V			2	black	0V			0	shielding	GND			<table border="1" style="width: 100%; border-collapse: collapse;"> <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>  <math>e = 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>CCW direction <math>\rightarrow</math></p> <p>Viewed from shaft end when installing. (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	$15 \pm 1^\circ$	$90^\circ$
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<p><b>Timing Chart</b></p>																																																																			

4. Electrical Characteristics

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			500KHz		800KHz
Output capacity	Output current	Input	≤30mA	Load resistance 2.2K	≤30mA	≤±20mA	≤±50mA
		Output	—		≤10mA		
	Output voltage	"H"	—	—	≥ $\lfloor \frac{\text{Supply voltage}}{2.5} \rfloor$	≥2.5V	≥V <sub>CC</sub> -3 V <sub>DC</sub>
		"L"	≤0.4V	≤0.7V (less than 20mA)	≤0.4V (30mA)	≤0.5V	≤ 1V V <sub>DC</sub>
Load voltage		≤DC30V	—	—			
Rise & Fall time		Less than 2us (cable length: 2m)			Less than 1us (Cable length: 2m)		≤100ns
Insulation strength		AC500V 60s					
Insulation resistance		10MΩ					
Mark to space ratio		45% to 55%					
Reverse polarity protection		✓					
Short-circuit protection		—			✓①		
Phase shift between A & B		90°±10° ( frequency in low speed)					
		90°±20° ( frequency in high speed)					
Delay motion time ②		—				510±220ms	—
GND		Not connect to encoder					

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

② Phase A.B.Z are back of phase U.V.W when power on.

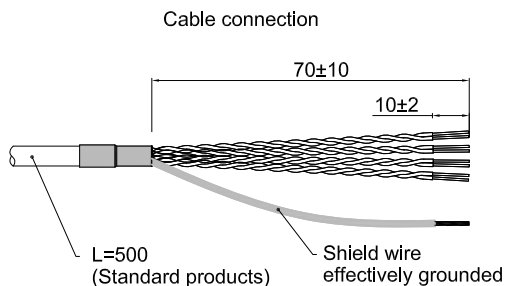
## 5. Mechanical Characteristics

Diameter of shaft	Ø6mm; Ø6.35mm; Ø8mm; Ø9.52mm; Ø9.54mm; Ø10mm; Ø9mm taper shaft; Ø10mm taper shaft (optional)
Starting torque	Less than $5.9 \times 10^{-3} \text{N} \cdot \text{m}$
Inertia moment	Less than $1.5 \times 10^{-6} \text{kg} \cdot \text{m}^2$
Shaft load	Radial 30N; Axial 20N
Slew speed	≤5000 rpm
Bearing Life	$1.5 \times 10^9$ revs at rated load(100000hrs at 2500RPM)
Shell	Aluminium alloy
Weight	about 90g

## 6. Environmental Specifications

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	IP40

7. Wiring table



7.1 OC/Voltage/Push-pull (Table 1)

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

7.2 TTL/HTL/Less wiring type (Table 2)

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

\* For the functional status in less wiring mode, refer to the functional mode wiring table for output circuit on page3.

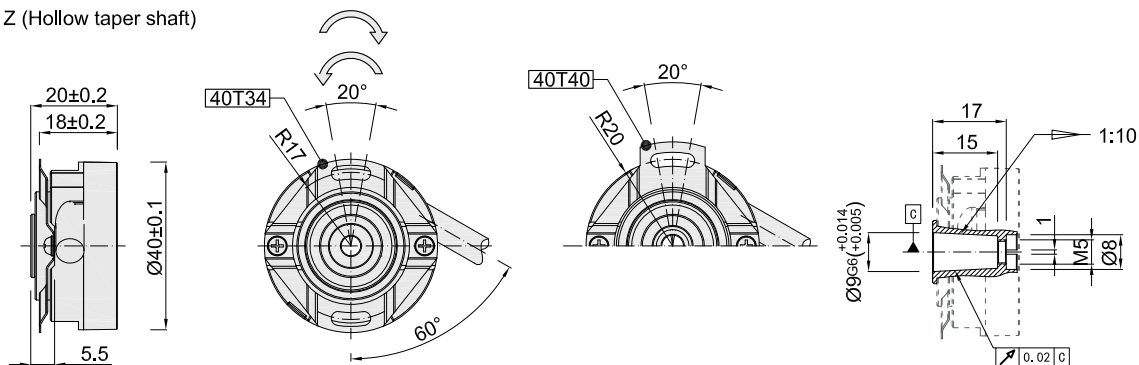
7.3 For servo motor (Table 3)

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

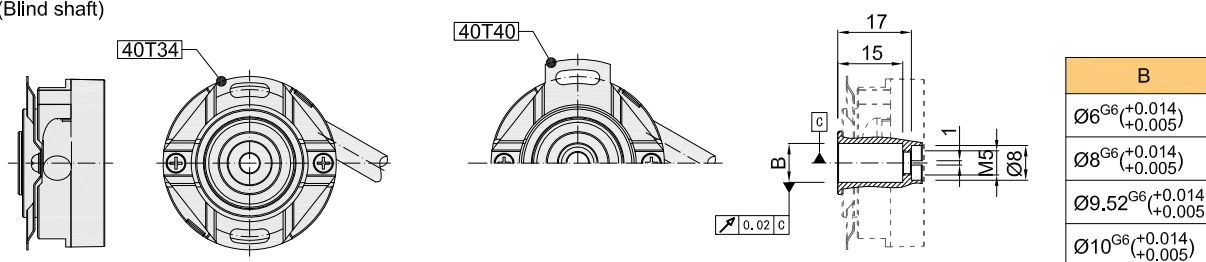
Up=Supply voltage.  
Shield wire is not connected to the internal circuit of encoder.

8. Basic Dimensions

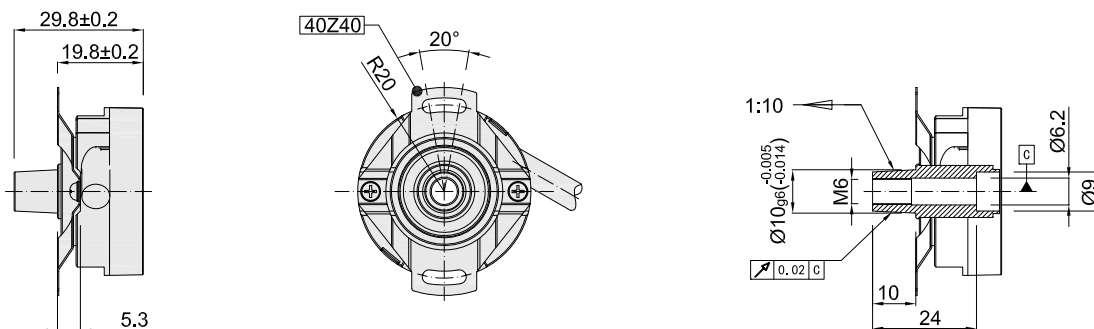
8.1 Z (Hollow taper shaft)



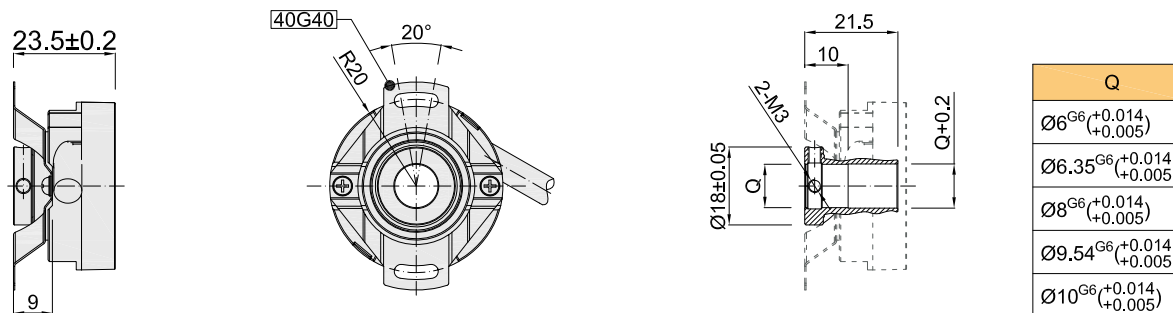
8.2 B (Blind shaft)



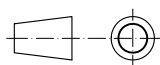
8.3 S (Solid taper shaft)



8.4 Q (Through shaft)



Unit: mm



= Direction of shaft rotation for incremental signal output

= Direction of shaft rotation for servo motor-specific signal output

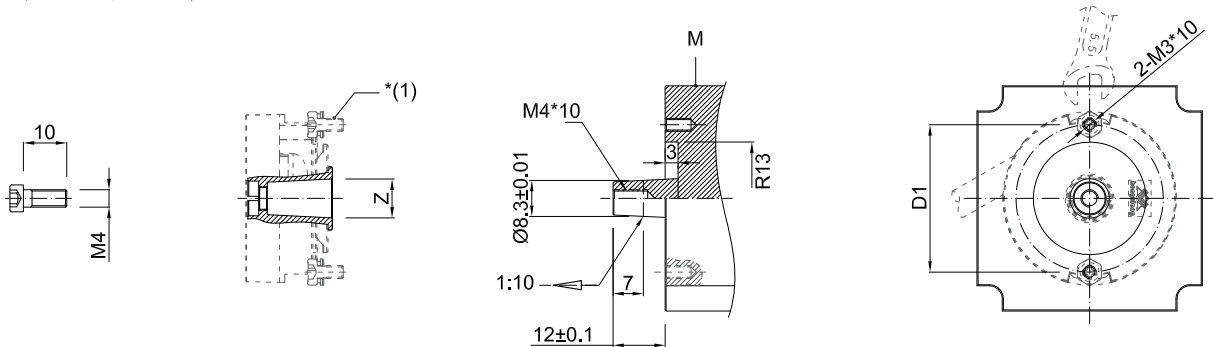
40T34 40T40 40Z40 40G40 = Leaf Spring (Please refer to the specifications 9)

About vibration

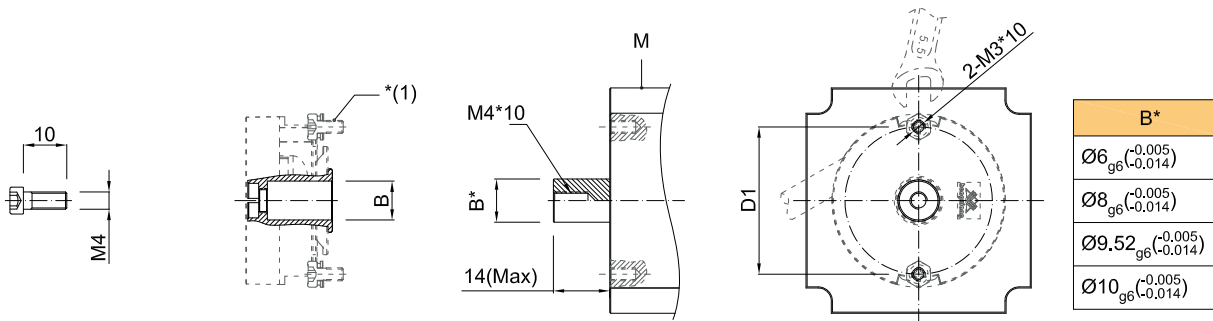
Vibration act on encoder always cause wrong pulse, so we should pay attention to working place. More pulse per revolution, narrower groovy spacing of grating, more effect to encoder by vibration, when rev is low or stop, vibration act on shaft or main body would cause grating vibrating, so encoder might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

9. Mounting shaft requirements

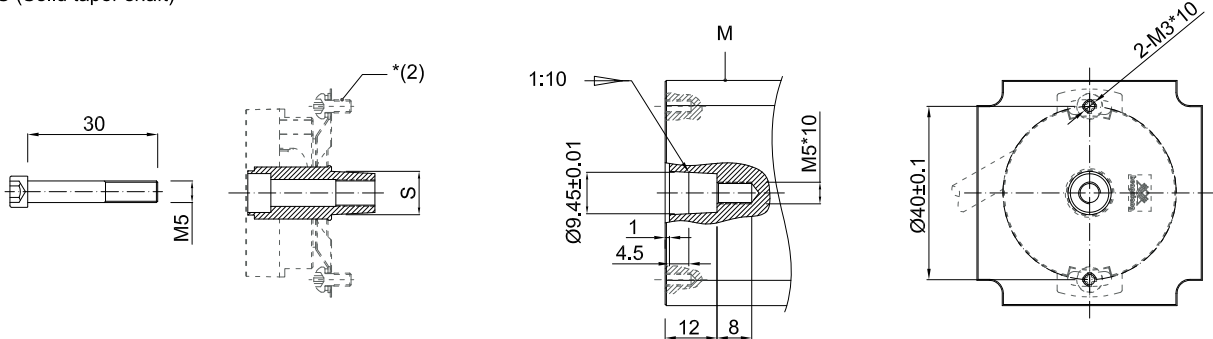
9.1 Z (Hollow taper shaft)



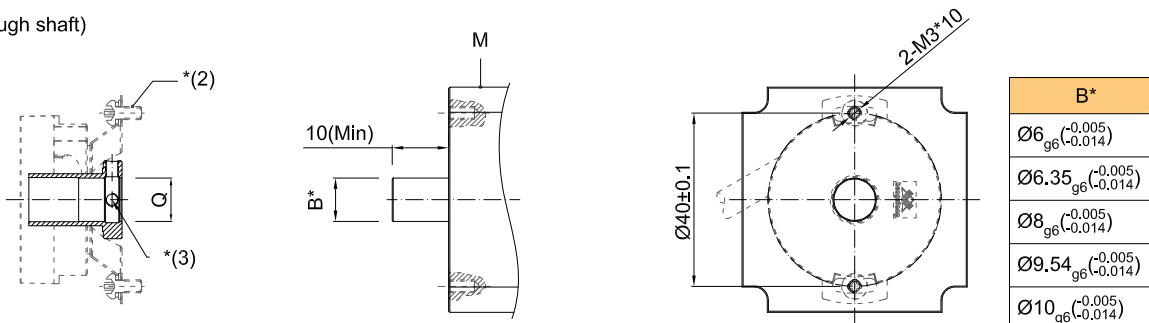
9.2 B (Blind shaft)



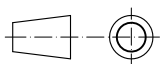
9.3 S (Solid taper shaft)



9.4 Q (Through shaft)



Unit: mm



M=Motor

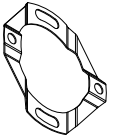
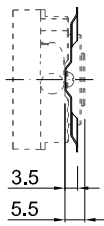
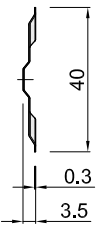
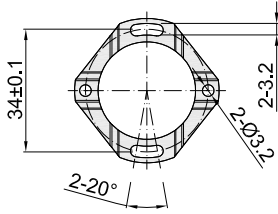
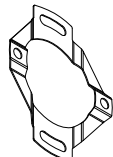

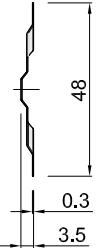
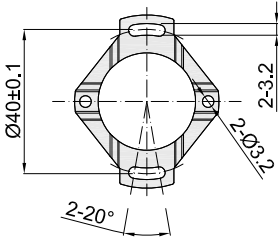
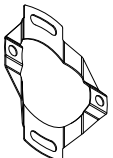
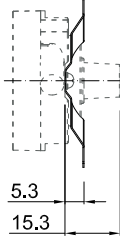
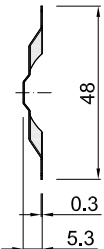
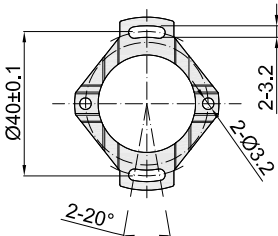
\* Motor shaft radial runout max. 0.3mm;  
axial runout max.0.1mm

Note:

- \*(1): Outer hexagon screw M3\*10 with flat gasket and spring ring is recommended to use
  - \*(2): Round-headed screw M3\*10 with flat gasket and spring ring is recommended to use
  - \*(3): Apply threadglue to the surface of the two M3\*3 screws Tightening force is 0.6N.m
- D1: Ø34±0.1 & Ø40±0.1 (Choose the spring plate to determine the installation size)



10. Accessory (Spring plate options)

<p><b>40T34</b> No:03700112</p> 			
<p><b>40T40</b> No:03700111</p> 			
<p><b>40Z40</b> No:03700121</p> 			
<p><b>40G40</b> No:03700113</p> 