

Using Motors

■ Precautions

1. Precautions for Installation

- Do not use in a place where there is flammable gas and/or corrosive gas.
- When installing the motor into your equipment, ensure that the motor lead wires (cable) are fixed and do not move. In addition, do not apply any pressure to these lead wires.
- Motors and Drivers for use only in equipment of protection class I.
- The motor housing must be mounted with a screw and spring washer to the ground point of the equipment.
- Installation must be performed by a qualified installer.

2. Precautions for Operation

- The Motor case and the Driver enclosure temperature can exceed 70°C depending on operation conditions. In case the motor is accessible during operation, please attach the following warning label so that it is clearly visible.
- Always turn off the power to the motor before conducting checks or performing work on the motor. Thermally protected motors will restart automatically when motor temperature falls below a certain level.
- The electromagnetic brake is designed to activate when power is removed. However, it may not arrest all loads completely. If this motor is designed to hold in emergency situations then a second method of stopping the load must be used to ensure to load stops. If this is not used injury or machine damage may result.



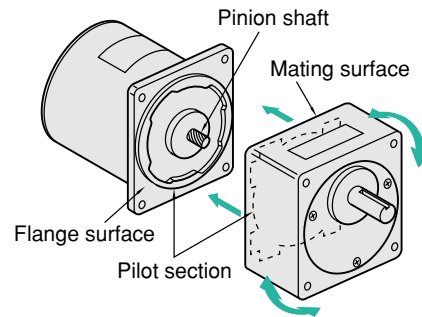
■ Connecting Gearheads to Motors

1. Connecting Gearheads

As the figure below shows, a gearhead is combined with a motor using the recessed areas on each unit as guides. The gearhead should be moved gently from side to side without forcing the pinion shaft against the plate on the gearhead or against the gear itself.

Note:

A tempting to put motor and gearhead together by force can result in damage to the gearhead.



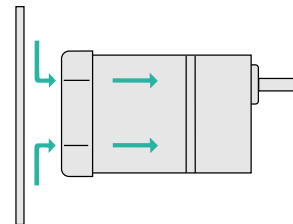
2. Mounting Motor /Gearhead to Machinery

The motor flange is provided with a recessed area that serves as a guide not only when assembling the motor and gearhead as shown in the above figure, but also when installing only the motor directly to the machinery.

The figures demonstrate how to install a motor and gearhead in machinery. In this example, the motor/gearhead unit is mounted directly to the machinery, but dedicated mounting brackets such as those shown can also be used.



When mounting motors that have a built-in cooling fan, leave a space of approximately 10mm behind the fan cover or make ventilation holes so as not to block the cooling intake.



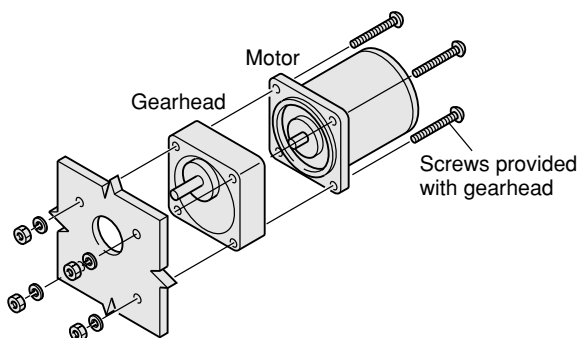
● Installation conditions

Install the motor and capacitor in a location that meets the following conditions. Using the motor and capacitor in a location that does not satisfy these conditions could damage it.

- Indoors (this product is designed and manufactured to be installed within another device)
 - Ambient temperature : $-10^{\circ}\text{C}\sim+40^{\circ}\text{C}$ (avoid freezing)
(Part of motor: $0^{\circ}\text{C}\sim+50^{\circ}\text{C}$)
 - Ambient humidity: 85% max. (avoid condensation)
 - Not exposed to explosive, flammable or corrosive gas
 - Not exposed to direct sunlight
 - Not exposed to dust
 - Not exposed to water or oil
 - Place where heat can escape easily
 - Not exposed to continuous vibration or excessive impact
 - 1000 meters or less above sea level.
 - Overvoltage Category II , Pollution Degree2, Class I (for EN/IEC standards)
- Some products are different.
Please refer to each product page.

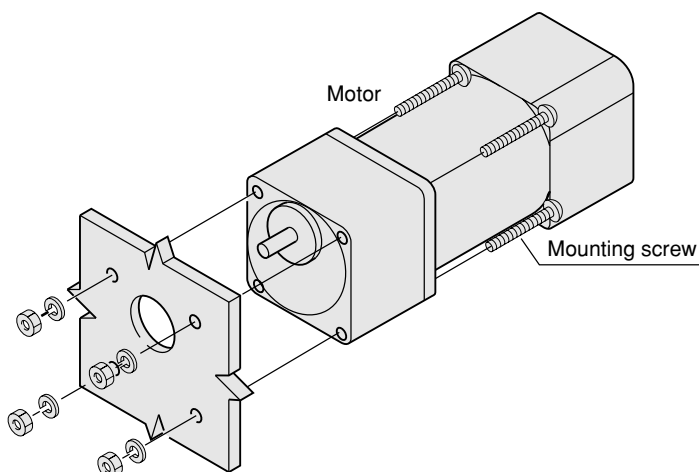
For GN and GU type Gearheads

Use the screws provided with the gearhead and secure all the parts so that there are no gaps between the motor flange face and the recessed area of the gearhead.



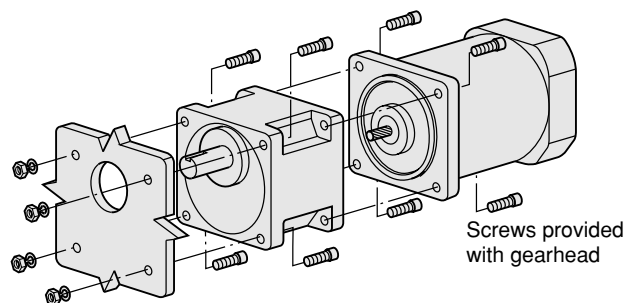
BH series

BH series motors are provided as a gearmotor for easy installation. Use the screws provided with the product to attach the unit from the motor side.



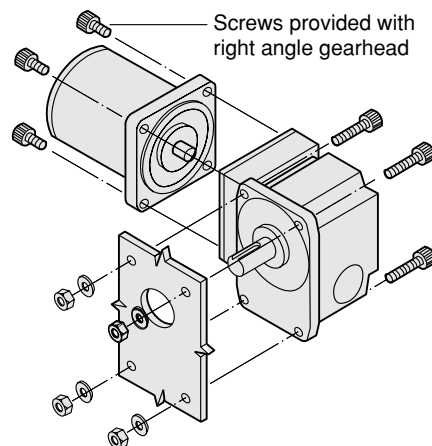
For 5GU□KBH type Gearheads

Before mounting the gearhead to machinery, assemble the motor and the gearhead using the screws provided.



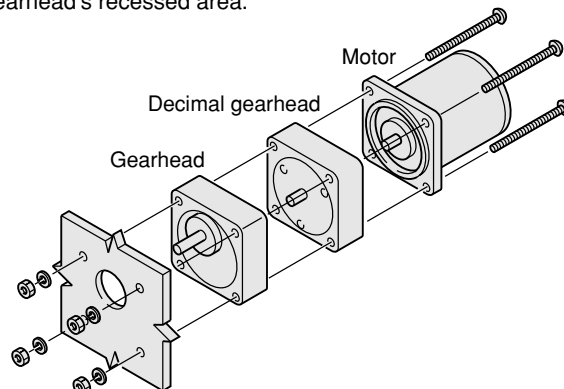
For Right Angle Gearheads

Before mounting the right angle gearhead to machinery, assemble the motor and the gearhead using the screws provided.



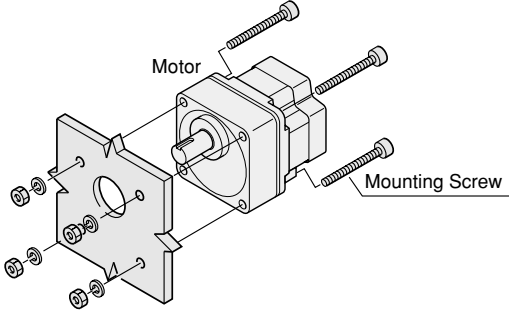
Mounting Decimal Gearhead to GN and GU type Gearheads

Use the screws provided with the decimal gearhead and secure all the parts so that there are no gaps between the motor flange face and the recessed area of the decimal gearhead, or between the decimal gearhead and the gearhead's recessed area.



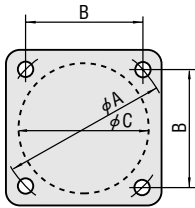
For FBL II, AXH, HBL Series

The **FBL II, AXH, HBL** series is the combination motor type in which the motor and gear head are pre-installed. Use the included installation screws to install on the device.



3. Dimensions of Mounting Holes

Each product's dimension drawing shows the mounting holes dimension with diametrical pitch. The distance between mounting holes is shown below.



Unit=mm

Motor Frame Size	A	B	C
42mm sq.	48(43.8)*	33.94(31)*	37.6
60mm sq.	70	49.50	54
70mm sq.	82	57.98	64
80mm sq.	94	66.47	73
90mm sq.	104	73.54	83
104mm sq.	120	84.85	94

* () shows dimension of geared type **AXH015**.

4. Securing Load to Output Shaft

The output shafts of high power gearheads are provided with a key way to secure the load, while the shafts of gearheads with comparatively low power have been given a shaft flat. Round shaft motors come in two types, those with and without a shaft flat on the motor output shaft.



Shaft Flat

2GN Type Gearheads
Round shaft motors with frame size of 80mm sq. and 90mm sq.
AXH015 Type

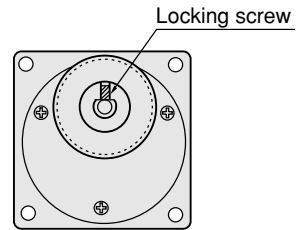
Key Way

3GN, 4GN, 5GN, 5GU type
BH162 □ T-□,
FBL575CY-□, **FBL5120CY**-□,
AXH230KC-□, **AXH450KC**-□
HBL560N-□, **HBL5100N**-□
gearheads

In round shaft types, the output shaft has a tolerance of h7 in diameter and is finished to a eccentricity of 2/100. Therefore, when connecting a load to the shaft, take measurements using a dial gauge or similar instrument. To couple to a shaft, use a helical coupling, to avoid unnecessary strain on the shaft. The same procedure applies when securing a load to gearheads.

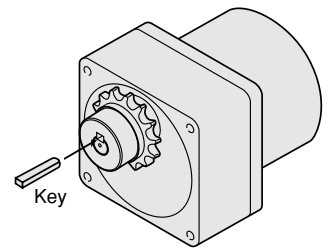
Securing Load to Shaft Flat

With a shaft flat, use a locking screw to ensure that the load does not slip. We recommend using double point screws or other screws with strong locking power.



Securing Load Using Key Way

Secure loads using the key provided with the gearhead, fitting it into a key way.

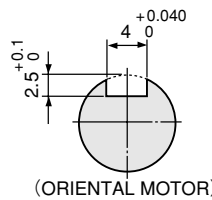


Note:

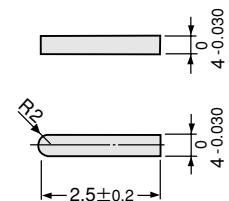
Ensure that the gearhead shaft is not subjected to shock in the axial direction, since this will have an adverse effect on the bearings. Be especially careful not to use a hammer when inserting the key.

The figure below shows the dimensions of a 4 mm key way. With a 5 mm key way, way size would be 5 +0.040, more accurate than the 4 mm groove.

Dimensions of Key Way



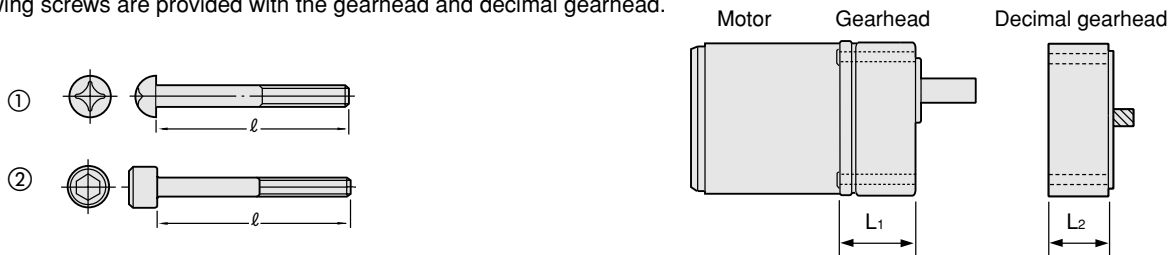
Dimensions of Key



5. Screw Dimensions

GN type, GU type, BH Series, FBLII Series, AXH Series, HBL Series, FPW Series, Gearheads

The following screws are provided with the gearhead and decimal gearhead.



Gearhead Model	Gearhead		Screws		
	L ¹ (mm)	L ¹ +L ² (mm)	ℓ (mm)	Size of Screws	Shape of Screws
2GN3K~18K (L ¹ =30)	37	—	50	M4 P0.7	
2GN25K~180K (L ¹ =40)	47	—	60		
3GN3K~18K	39	—	50	M5 P0.8	①
3GN25K~180K	49	—	65		
4GN3K~18K	39	—	50		
4GN25K~180K	49.5	—	65		
5GN3K~18K (L ¹ =42)	49.5	—	65	M6 P1.0	
5GN25K~180K (L ¹ =60)	67.5	—	80		
5GU□KB	72.5	—	95		②
2GN10XK (Decimal Gearhead)	—	73	85	M4 P0.7	
3GN10XK (Decimal Gearhead)	—	79	90	M5 P0.8	①
4GN10XK (Decimal Gearhead)	—	81.5	95		
5GN10XK (Decimal Gearhead)	—	104.5	120	M6 P1.0	
5GU10XKB (Decimal Gearhead)	—	112.5	140		
BHI62□T-3~150 (Combination type)	83	—	100		
FBL575CY-5~20, FBL5120CY-5~20 (Combination type)	55	—	75	M8 P1.25	
FBL575CY-30~100, FBL5120CY-30~100 (Combination type)	68	—	90		
FBL575CY-200, FBL5120CY-200 (Combination type)	74	—	95		
AXH230KC-5~20 (Combination type)	34	—	50	M4 P0.7	
AXH230KC-30~100 (Combination type)	38	—	55		
AXH230KC-200 (Combination type)	43	—	60		
AXH450KC-5~20 (Combination type)	41	—	65	M6 P1.0	②
AXH450KC-30~100 (Combination type)	46	—	70		
AXH450KC-200 (Combination type)	51	—	75		
HBL560N-5~20, HBL5100N-5~20 (Combination type)	55	—	75	M5 P0.8	
HBL560N-30~100, HBL5100N-30~100 (Combination type)	68	—	90		
HBL560N-200, HBL5100N-200 (Combination type)	74	—	95		
FPW425C-□E	59	—	80	M6 P1.0	
FPW540C-□E	72.5	—	90	M8 P1.25	
FPW560C-□E	74.5	—	90		
FPW690C-□E	82.5	—	100		

● The figures of L¹+L² refer to sizes when a decimal gearhead and a gearhead with gear reduction ratio of 25:1 or greater are connected.

● 4 washers and 4 hexagonal nuts are provided with the screws.

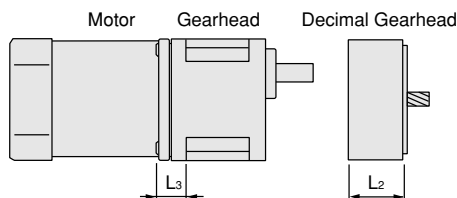
● Stainless steel screws are provided with the **FPW** series.

5GU□KBH Type and Right-Angle Gearhead

To assemble the motor and gearhead, use the screws provided with the gearhead. To mount an additional decimal gearhead, use the screws provided with the decimal gearhead. To attach the gearhead to other devices, obtain the screws separately.

Gearhead Model	Gearhead		Screws		
	L ³ (mm)	L ² +L ³ (mm)	ℓ (mm)	Size of Screws	Shape of Screws
5GU□KBH	17.5	—	20	M6 P1.0	
4GN□RH, 4GN□RA	—	—	15	M5 P0.8	②
5GN□RH, 5GN□RA	—	—	20	M6 P1.0	
5GU□RH, 5GU□RA	—	—	20		

● 4 Spring lock washers and 4 Plain washers are provided with the screws.



Control circuit installation

1. Control circuit installation method

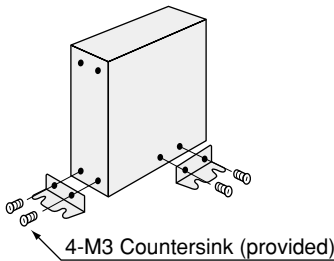
When installing the driver, speed control pack, control unit and other control circuits in the device, use the fittings and screws that are provided. (DIN rail installation plates are also available as an option. For details, refer to Page A-227.)

Note:

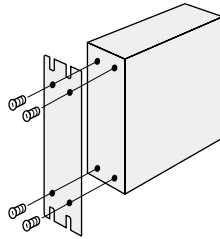
When attaching the driver in an enclosed space such as a control box, or somewhere close to a heat-radiating object, vent holes should be used to prevent the drivers from overheating. If the ambient temperature listed in the installation conditions for the control circuit is exceeded, use forced-air cooling with a fan.

● FBL II Series *

Base Mounting



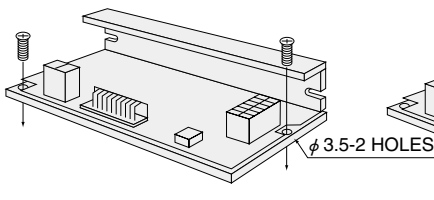
Back Mounting



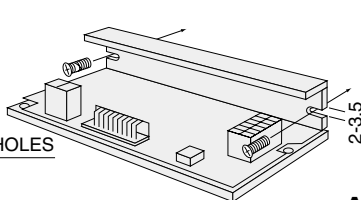
● AXH, HBL Series

Use M3 screws for mounting (not provided)

Base Mounting

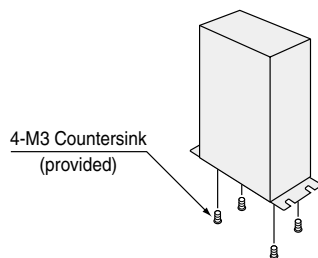


Back Mounting

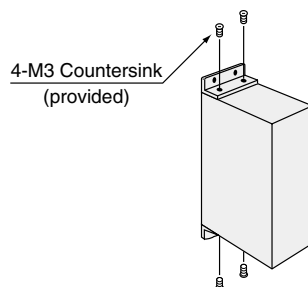


● MSS-W Series *

Base Mounting



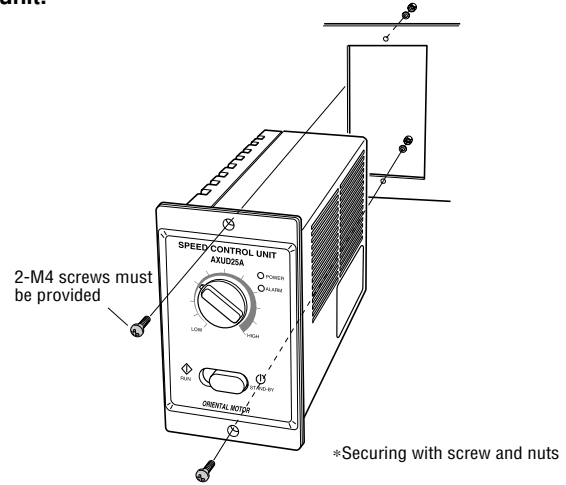
Back Mounting



* To improve ventilation, mount the speed control pack in an upright position as shown in the figures above.

● AXU, US Series Control unit

Secure the control unit, using the mounting holes, so that there are no gaps between the metal plate and the control unit.



2. Installation conditions

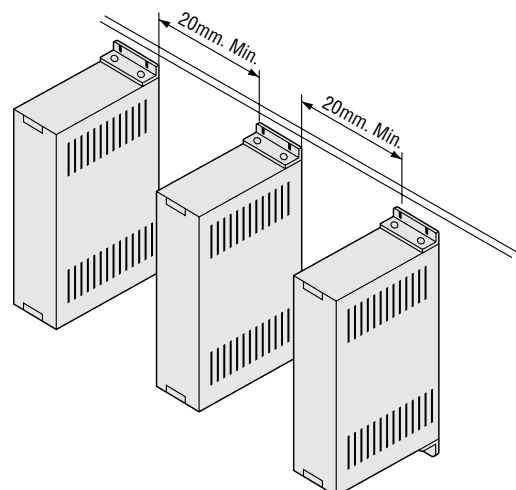
Install the driver, speed control pack and speed control unit in a location that meets the following conditions. Using the unit in a location that does not satisfy these conditions could cause damage.

- Indoors (this product is designed and manufactured to be installed within another device)
- Ambient temperature : Depends on the product, so see the appropriate page.
- Ambient humidity : 85% max. (avoid condensation)
- Not exposed to explosive, flammable or corrosive gas
- Not exposed to direct sunlight
- Not exposed to dust
- Not exposed to water or oil
- Place where heat can escape easily
- Not exposed to continuous vibration or excessive impact
- 1000 meters or less above sea level.
- Overvoltage Category II , Pollution Degree 2, Class I (for EN/IEC Standards)

AXH Series: Overvoltage Category I , Class III

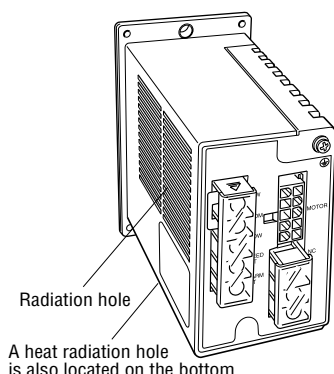
3. Mounting Two or More Drivers

When mounting two or more drivers, separate them by a space of at least 20mm. Leave at least 25mm between of space the driver and other devices or structures.



● **AXU Series**

When you want to mount the control unit inside the housing, mount it to ensure that one of two heat radiation holes of the control unit faces downward.



Mount the control unit 25mm or more away from the housing and other equipment inside the housing in the horizontal direction, and 50mm or more away in the vertical direction.

● **AXH, HBL Series**

Mount the driver 20mm or more away from the housing and other equipment inside the housing in the horizontal direction, and 50mm or more away in the vertical direction.

When actually installed in a device, the ambient temperature depends on the situations. Do not exceed the ambient temperature mentioned in installation conditions.

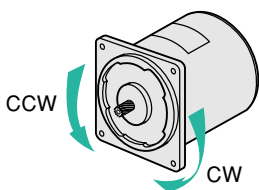
■ **Using Motors**

1. Power

Oriental Motor standard AC motors are available for single-phase 220V, 230V, 110V, 115V and three-phase 400V specifications. Capacitors must always be connected to single-phase motors.

2. Direction of Rotation

Clockwise (CW) and counterclockwise (CCW) direction of rotation, as referred to in the motor connection diagrams of this catalog, is defined as the direction of rotation when viewing the mounting face end of the motor. The direction of rotation of a gearhead used with the motor is determined by its design and, depending on the gear ratio, may be the same or the opposite of the direction of rotation of the motor. Changing the direction of rotation of the gearhead can be done by changing the direction of rotation of the motor.



● **Induction Motors**

Change the direction of motor rotation only after the motor comes to a complete stop. If an attempt is made to change the direction of rotation while the motor is rotating, the motor may ignore the reversing command or change its direction of rotation after some delay.

Example

Clockwise direction	Counterclockwise direction
<p>Single-Phase 220/230V, 110/115V</p>	<p>Single-Phase 220/230V, 110/115V</p>
<p>Three-Phase 400V</p>	<p>Three-Phase 400V</p>

● **Reversible Motors**

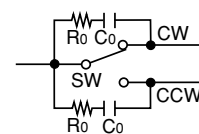
The direction of rotation can be reversed during motor rotation using a switch. Moving the switch to CW causes the motor to rotate clockwise; moving the switch to CCW causes the motor to rotate counterclockwise.

Example

Clockwise direction	Counterclockwise direction
<p>Single-Phase 220/230V, 110/115V</p>	<p>Single-Phase 220/230V, 110/115V</p>

● **Contact capacity**

Connect a CR circuit (surge suppressor) like that in the drawing in order to protect the contacts.



Code	Contact capacity, others	Remarks
SW	AC125V 5A mim. or AC250V 5A mim. (Induction load)	—
Ro · Co	Ro = 5 ~ 200Ω Co = 0.1 ~ 0.2μF 200WV (400WV)	Accessories EPCR1201-2 A-224

3. Grounding

Oriental Motor's products are designed as Class I apparatus. Therefore, a protective ground should be established to protect against electric shocks when mounting our products on other equipment.

A protective ground can be established by directly mounting the motor flange on a metal chassis that is grounded to the user's equipment. Also, in cases where the ground wire is provided, a protective ground can be set up according to the method indicated below.

● Lead Wire Type and Small Terminal Box Type

Any one of the four mounting bolts may be used to attach the ground wire to the motor casing when installing the unit. If necessary, remove all paint that may impede conductivity around the bolt mounting hole.



● Terminal Box Type (for 4IK, 4RK, 5IK, 5RK and BH types)

Connect the ground wire to the ground terminal inside the terminal box.



4. Terminal Box

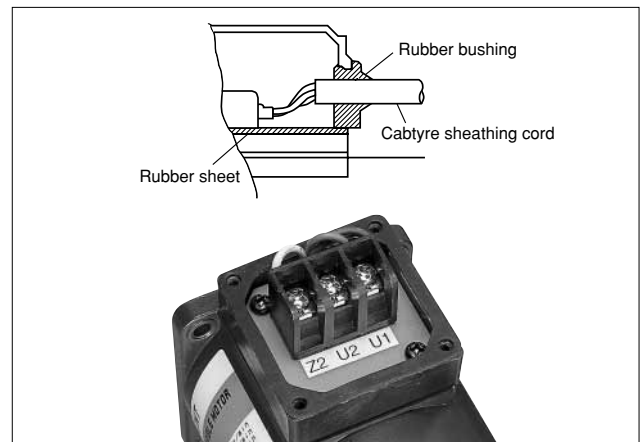
Induction motors and reversible motors are available with mounted terminal boxes for easy and secure connections of electrical wiring. They are suitable for automated and laborsaving applications where their ability to withstand rough operating conditions is essential, e.g. for machine tools and plant machinery.

● Types of Terminal Boxes

Depending on the motor model two types of terminal boxes are available: a small terminal box and a large terminal box, the latter being outfitted with a pressure sealing ring at the point of cord entry.

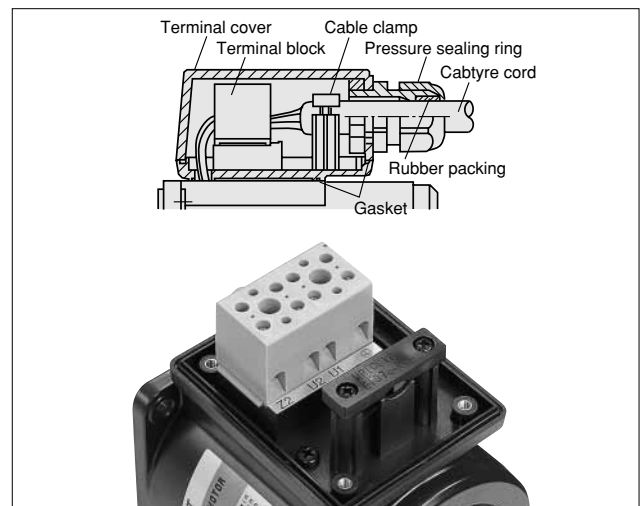
Small Terminal Box (for 2IK and 2RK types)

Light, compact and with in-line arrangement of terminals for ease of connection.



Terminal Box (for 4IK, 4RK, 5IK, 5RK and BH types)

A cable clamp and pressure sealing ring securely fasten the cable at two points.



The material of the terminal box is a PBT resin with excellent insulation performance. The terminal block has met safety standards and been recognized or certified by major certification bodies.

When connecting cables to the terminal block, unfasten the screw of the connector and insert the lead wire with a screw driver. Then insert the lead wire to the insert port and refasten the screw securely.

Diameter of the suitable cable: $\phi 6\text{mm} \sim \phi 12\text{mm}$.

Lead wires specifications

Thickness : $0.2\text{mm}^2 \sim 4.0\text{mm}^2$ (AWG 24 ~ 12)

Length of strip : 8mm

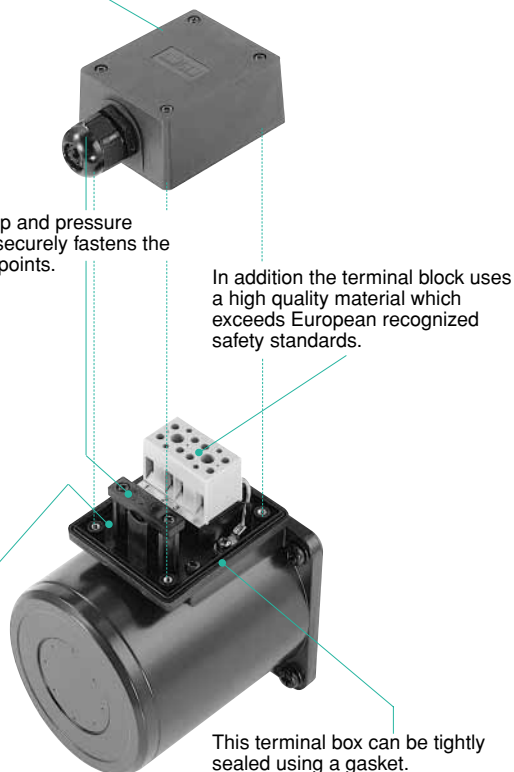
The terminal box cover uses a PBT resin with excellent insulation performance.

A cable clamp and pressure sealing ring securely fastens the cable at two points.

In addition the terminal block uses a high quality material which exceeds European recognized safety standards.

This terminal box can be tightly sealed using a gasket.

The terminal block and cable clamp can be opened to make the wiring simple.



5. Capacitor

Capacitor motors are wound so that the axis of the primary coil and the secondary coil poles are 90° apart. The capacitor is connected in series to the secondary coil and its function is to advance the phase of the current flowing in the secondary coil.

Our single-phase motors are capacitor motors. When using a capacitor with the motor, make sure that the rated capacitance and voltage as indicated on the capacitor correspond to the specifications on the motor and that all electrical connections are correct.

Capacitance

If a capacitor of the wrong value is used, motor vibration and heat generation will become abnormally large and operation will become unstable due to a loss of torque. For this reason, always use a capacitor of the correct capacitance. Capacitance is indicated by the unit of microfarads (μF).

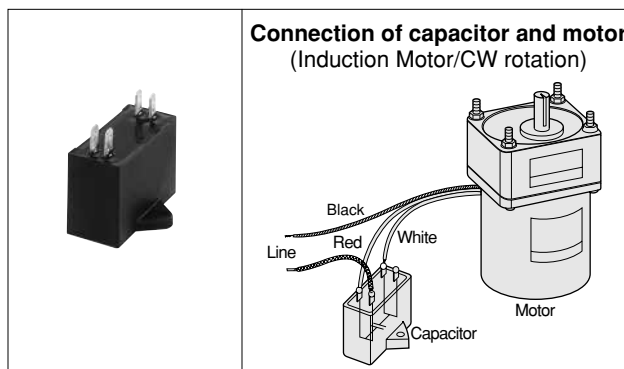
Rated Voltage

Using the motor beyond the rated voltage can drastically shorten the operating life of the capacitor. Always use a capacitor of proper voltage ratings. The voltage rating of the capacitor is indicated in the unit of Volts (VAC).

Type of Capacitor

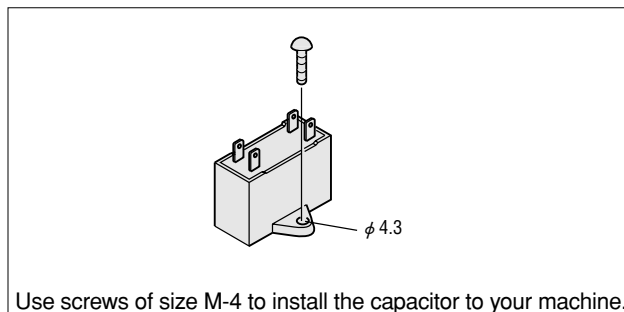
The capacitor used with Oriental Motor products are rectangular shape and meet either both of the VDE and UL safety standards or just the UL safety standard.

● Connecting the Capacitor



● Installing the Capacitor

Unit=mm



Note : When motors are running, a voltage of twice the motor power supply voltage is applied across the terminals of the capacitor. The terminals must therefore be insulated to ensure safety.

6. Ambient Temperature and Temperature Rise in Motor

The ambient temperature and the rise of the motor temperature are limiting parameters for the suitability of a motor in a given application.

Ambient Temperature

Use motors at ambient temperatures between -10°C and $+40^{\circ}\text{C}$. (Part of motor : between 0°C and $+50^{\circ}\text{C}$). When used at temperatures outside of this range, an additional rise in temperature caused by motor operation may lead to deterioration of the winding insulation of the motor or may drastically shorten the operating life of the ball bearings. Low ambient temperatures result in problems primarily with starting characteristics. Inner friction of the motor increases with the decrease in viscosity of gearhead and ball bearing lubricants resulting in a slower ramp-up of the motor or failure of the motor to start.

Temperature Rise in Motor

When a motor is operating, all energy losses of the motor are transformed into heat, causing the motor temperature to rise.

● Induction Motors

The induction motor, which is rated for continuous duty, reaches the saturation point of temperature rise after two or three hours of operation, whereupon the temperature stabilizes.

● Reversible Motors

Reversible motors reach their limit for temperature rise after 30 minutes of operation. If operation continues beyond that normal temperature rise, it may lead to damage or shortened life of the motor.

Measuring the Temperature Rise

The following is a description of the methods Oriental Motor uses for temperature measurement and for the determination of the maximum allowable temperature rise of a motor.

● Thermometer Method

The temperature at which the temperature rise during motor operation becomes saturated is measured using a thermometer or thermocouple attached to the center of the motor case. The temperature rise is defined as the difference between the ambient temperature and the measured temperature.

● Resistance Change Method

In this method, the coil resistance is measured before running and again after a period of running. The measurement should be taken at the point of maximum temperature rise.

The point of the highest motor temperature rise is the windings. For this reason, the maximum allowable temperature of the windings is the one stated in the EN/IEC, UL, CSA standards for the given type of insulation materials. Some Oriental Motor motors employ Class B insulation. According to EN/IEC, UL, CSA standards, the temperature of the windings is 130°C .*

Note that if the motor is started and stopped frequently, if the direction of motor rotation is frequently changed, or if the motor is frequently brought to an instantaneous stop using an electromagnetic brake or similar mechanism, the temperature of the motor may rise more than that of normal operation. The lower the temperature, the longer the life of the motor. Some of the motors are equipped with a thermal protector as overheat protection.

* Some of the motors have Type E insulation (120°C).

Although the motor case may become very hot while the motor is in operation, in some case as high as $90\sim 100^{\circ}\text{C}$, this does not indicate a malfunction. Take precautions against heat before touching the motor, and avoid accidents by keeping flammable materials away from the motor.

7. Service Life of an AC Motor

The service life of an AC motor is affected by a number of factors, but in most cases it is determined by the bearings. The useful life of a bearing is represented in terms of 1) mechanical life and 2) grease life, as described below.

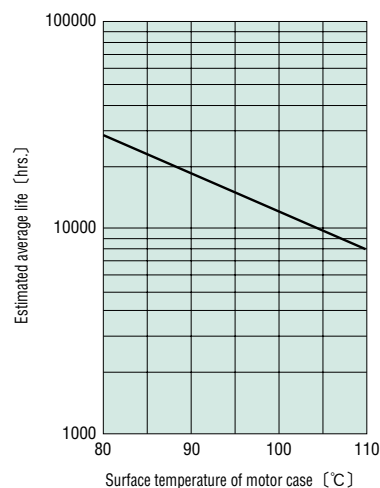
[Bearing life]

① Mechanical life affected by rolling fatigue

② Grease life affected by grease deterioration due to heat

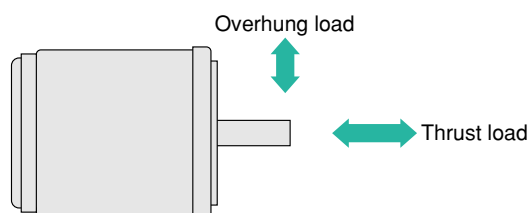
The AC motor's bearing life is estimated based on the grease life, since the bearing life is more affected by grease deterioration due to heat than the load applied to the bearing. Temperature is the primary determinant of grease life, meaning that grease life is significantly affected by temperature. Grease life will be more extended at a lower temperature as long as it is within the ambient temperature range specified in the motor's general specifications. Among the AC motors manufactured by Oriental Motor, the World **K** Series motor employs bearings that offer an especially high resistance to temperature. The graph below shows the estimated average life characteristic of the World **K** Series motor based on actual data measured with regard to the motor case's surface temperature.

According to this graph, the estimated average life is approximately 10,000 hours when the motor case's surface temperature is 105°C and 20,000 hours at 87°C . These results indicate that the service life doubles when the surface temperature of the motor case is lower by about 18°C . For the service life of a gearhead, see page A-22.



8. Permissible Overhung Load and Permissible Thrust Load

Thrust load and overhung load exceeding the permitted values invite short-term fatigue on the bearings and breakdown due to the repeated load on the output shaft.



Operate so that the overhung load does not exceed the permitted values in the table below. When a chain, belt, etc. is used as the transmission mechanism, the method for calculating the load on the output shaft is the same as for a gear head output shaft. For details, refer to Page A-22. Also, avoid thrust loads as much as possible. If thrust load is unavoidable, keep it to no more than half the motor mass.

■ Permissible Overhung Load on the Motor Shaft

● AC Motor

Motor			Permissible Overhung Load [N]	
Motor Frame Size [mm]	Motor Shaft Size [mm]	Series	10 mm from shaft end	20 mm from shaft end
60	6	K	50	110
70	6	K	40	60
80	8	K	90	140
90	10	K	140	200
	12	K (with fan)	240	270
104	14	BH	320	350

● Brushless DC Motor

Motor			Permissible Overhung Load [N]	
Motor Frame Size [mm]	Motor Shaft Size [mm]	Series	10mm from shaft end	20mm from shaft end
42	6	AXH	50	—
60	8	AXH	70	100
80	10	AXH	120	140
90	10	HBL (60W)	130	150
		FBL II (75W)	130	150
	12	HBL (100W)	160	170
		FBL II (120W)	160	170