MITSUBISHI ELECTRIC

General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS

MELSERVO

MODEL

TM-RFM
TM-RG2M
TM-RU2M

DIRECT DRIVE MOTOR INSTRUCTION MANUAL

J

● Safety Instructions ●

Please read the instructions carefully before using the equipment.

To use the equipment correctly, do not attempt to install, operate, maintain or inspect the equipment until you have read through this Instruction Manual and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

⚠ WARNING	Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.
⚠ CAUTION	Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions.
Please follow the instructions of both levels because they are important to personnel safety.
What must not be done and what must be done are indicated by the following diagrammatic symbols.

⃠	Indicates what must not be done. For example, "No Fire" is indicated by ⃠ .
●	Indicates what must be done. For example, grounding is indicated by ⏚ .

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".
After reading this Instruction Manual, keep it accessible to the operator.

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring and inspections, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others.
- Ground the servo amplifier and direct drive motor securely.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and direct drive motor until they have been installed. Otherwise, it may cause an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock.
- To avoid an electric shock, insulate the connections of the power supply terminals.

2. To prevent fire, note the following

⚠ CAUTION

- Install the servo amplifier, direct drive motor, and regenerative resistor on incombustible material. Installing them directly or close to combustibles will lead to a fire or smoke generation.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier and direct drive motor.

3. To prevent injury, note the following

⚠ CAUTION

- Only the power/signal specified in the Instruction Manual should be applied to each terminal. Otherwise, it may cause an electric shock, fire, injury, etc.
- Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.
- Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.
- The servo amplifier heat sink, regenerative resistor, direct drive motor, etc. may be hot while power is on or for some time after power-off. Take safety measures, e.g. provide covers, to avoid accidentally touching the parts (cables, etc.) by hand.
- During operation, never touch the rotor of the direct drive motor. Otherwise, it may cause injury.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a malfunction, injury, electric shock, fire, etc.

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their mass.
- Stacking in excess of the specified number of product packages is not allowed.
- Do not hold the cables, rotor, encoder, or connector when carrying the direct drive motor. Otherwise, it may drop.
- Install the servo amplifier and the direct drive motor in a load-bearing place in accordance with the Instruction Manual.
- Do not get on or put heavy load on the equipment. Otherwise, it may cause injury.
- The equipment must be installed in the specified direction.
- When you keep or use the equipment, please fulfill the following environment.

Item		Environment
Ambient temperature	Operation	0 °C to 40 °C (non-freezing)
	Storage	-15 °C to 70 °C (non-freezing)
Ambient humidity	Operation	10 %RH to 80 %RH (non-condensing)
	Storage	10 %RH to 90 %RH (non-condensing)
Ambience		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, dust, and dirt
Altitude	TM-RFM_J10 TM-RFM_C20 TM-RFM_E20 TM-RFM_G20 TM-RG2M_C30 TM-RG2M_E30 TM-RG2M_G30 TM-RU2M_C30 TM-RU2M_E30 TM-RU2M_G30	Max. 2000 m above sea level (Note)
Vibration resistance	TM-RFM_C20 TM-RFM_E20 TM-RFM_G20 TM-RG2M_C30 TM-RG2M_E30 TM-RG2M_G30 TM-RU2M_C30 TM-RU2M_E30 TM-RU2M_G30	X, Y: 49 m/s^2
	TM-RFM_J10	X, Y: 24.5 m/s^2

Note. Contact your local sales office for the altitude for options.

- Securely fix the direct drive motor to the machine. If being attached insecurely, the motor may come off during operation.
- Do not install or operate a servo amplifier or direct drive motor, which has been damaged or has any parts missing.
- Do not drop or strike the direct drive motor. Otherwise, it may cause injury, malfunction, etc.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotor of the direct drive motor during operation.

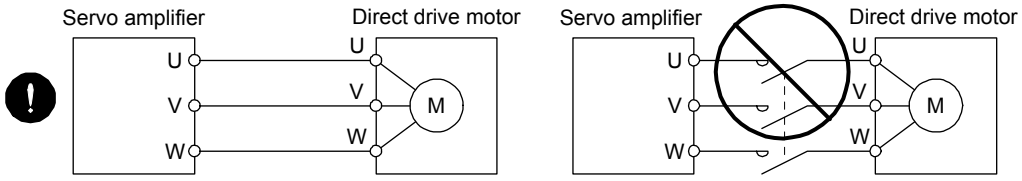
⚠ CAUTION

- ●Do not apply shocks, e.g. hit with a hammer, when coupling the rotor of the direct drive motor. Otherwise, the encoder may malfunction.
- ●Do not subject the rotor of the direct drive motor to more than the permissible load. Otherwise, the rotor may break.
- ●When the product has been stored for an extended period of time, contact your local sales office.
- ●When handling the direct drive motor, be careful about the edged parts such as corners of the direct drive motor.
- ●Do not strike the connector. Otherwise, it may cause a connection failure, malfunction, etc.
- ●Be sure to check the vibration level with the direct drive motor mounted on the machine. A great vibration may cause the early damage of a bearing and encoder. The great vibration may also cause the poor connector connection or bolt looseness.
- ●For the gain adjustment at the equipment startup, check the torque waveform and the speed waveform with a measurement device to check that no vibration occurs. If the vibration occurs due to high gain, the vibration may cause the early damage of the direct drive motor.
- ●To prevent a fire or injury in case of an earthquake or other natural disasters, securely install, mount, and wire the servo motor in accordance with the Instruction Manual.

(2) Wiring

⚠ CAUTION

- ●Wire the equipment correctly and securely. Otherwise, the direct drive motor may operate unexpectedly.
- ●Make sure to connect the cables and connectors by using the fixing screws and the locking mechanism. Otherwise, the cables and connectors may be disconnected during operation.
- ●Do not install a power capacitor, surge killer, or radio noise filter (FR-BIF option) on the power wire of the direct drive motor.
- ●To avoid a malfunction, connect the power phases (U/V/W) of the servo amplifier and the direct drive motor correctly.
- ●Connect the servo amplifier power output (U/V/W) to the direct drive motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.



- ●Do not connect AC power supply directly to the direct drive motor. Otherwise, it may cause a malfunction.
- ●When the cable is not tightened enough to the terminal block, the cable or terminal block may generate heat because of the poor contact. Be sure to tighten the cable with specified torque.

(3) Test run and adjustment

⚠ CAUTION
●Before operation, check the parameter settings. Improper settings may cause some machines to operate unexpectedly. ●Never make a drastic change to the parameter values as doing so will make the operation unstable.

(4) Usage

⚠ CAUTION
●Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately. ●For equipment in which the moving part of the machine may collide against the load side, install a limit switch or stopper to the end of the moving part. The machine may be damaged due to a collision. ●Do not disassemble, repair, or modify the product. Otherwise, it may cause an electric shock, fire, injury, etc. Disassembled, repaired, and/or modified products are not covered under warranty. ●Use the direct drive motor with the specified servo amplifier. ●Wire options and peripheral equipment, etc. correctly in the specified combination. Otherwise, it may cause an electric shock, fire, injury, etc. ●If the dynamic brake is activated at power-off, alarm occurrence, etc., do not rotate the servo motor by an external force. Otherwise, it may cause a fire.

(5) Corrective actions

⚠ CAUTION
●When it is assumed that a hazardous condition may occur due to a stop or product malfunction, use a motor with an external brake to prevent the condition. ●When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation. ●Provide an adequate protection to prevent unexpected restart after an instantaneous power failure. ●After an earthquake or other natural disasters, ensure safety by checking the conditions of the installation, mounting, wiring, and equipment before switching the power on to prevent an electric shock, injury, or fire.

(6) Storage

⚠ CAUTION

Note the followings when storing the direct drive motor for an extended period of time (guideline: three months or more).

- ●Always store the direct drive motor indoors in a clean and dry place.
- ●If it is stored in a dusty or damp place, make adequate provision, e.g. cover the whole product.
- ●If the insulation resistance of the winding decreases, check how to store the equipment.
- ●Though the motor is rust-proofed before shipment using paint or rust prevention oil, rust may be produced depending on the storage conditions or storage period.
  If the direct drive is to be stored for longer than six months, apply rust prevention oil again especially to the machine processing surfaces of the rotor, etc.
- ●Before using the product after storage for an extended period of time, hand-turn the direct drive motor rotor (output shaft) to confirm that nothing is wrong with the direct drive motor.
- ●When the product has been stored for an extended period of time, contact your local sales office.

(7) General instruction

- ●To illustrate details, the equipment in the diagrams of this Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Specifications and Instruction Manual.

● DISPOSAL OF WASTE ●

Please dispose a direct drive motor and other options according to your local laws and regulations.

«About the manual»

This Instruction Manual is required if you use this direct drive motor for the first time. Ensure to keep this manual accessible to use the direct drive motor safely.

«Cables used for wiring»

The wiring cables mentioned in this Instruction Manual are selected based on the ambient temperature of 40 °C.

«U.S. customary units»

U.S. customary units are not shown in this manual. Convert the values if necessary according to the following table.

Quantity	SI (metric) unit	U.S. customary unit
Mass	1 [kg]	2.2046 [lb]
Length	1 [mm]	0.03937 [inch]
Torque	1 [N•m]	141.6 [oz•inch]
Moment of inertia	1 [(× 10^{-4} kg•m^2)]	5.4675 [oz•$inch^2$]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]

CONTENTS

1. INTRODUCTION 1 - 1 to 1 - 2

1.1 Rating plate ..... 1 - 1
1.2 Parts identification ..... 1 - 1

2. INSTALLATION 2 - 1 to 2 - 8

2.1 Equipment configuration ..... 2 - 2
2.2 Mounting direction ..... 2 - 3
2.3 Load mounting/dismounting precautions ..... 2 - 3
2.4 Permissible load for the rotor ..... 2 - 3
2.5 Protection from oil and water ..... 2 - 4
2.6 Inspection items ..... 2 - 5
2.7 Parts having service life ..... 2 - 5
2.8 Machine accuracies ..... 2 - 6
2.9 Flange size ..... 2 - 6
2.10 Restrictions when using this product at altitudes exceeding 1000 m and up to 2000 m above sea level ..... 2 - 7
2.11 Magnetic shielding ..... 2 - 7

3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING 3 - 1 to 3 - 4

3.1 Selection of connectors ..... 3 - 1
3.2 Wiring connectors (connector configurations A/B/C/D/E/F) ..... 3 - 2

4. CONNECTOR DIMENSIONS 4 - 1 to 4 - 4

5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR 5 - 1 to 5 - 8

5.1 Connection instructions ..... 5 - 2
5.2 Direct drive motor power cable wiring diagram ..... 5 - 2
5.3 Selection example of wires ..... 5 - 3
5.4 Servo amplifier terminal section ..... 5 - 4

6. WIRING OPTION 6 - 1 to 6 -10

6.1 Connector set ..... 6 - 1
6.1.1 Combinations of connector set ..... 6 - 2
6.1.2 Connector list ..... 6 - 3
6.2 Encoder connector set ..... 6 - 4
6.2.1 MR-J3DDCNS ..... 6 - 4
6.2.2 MR-J3DDSPS ..... 6 - 5
6.2.3 Combinations for the encoder cable ..... 6 - 5
6.2.4 Fabrication of the encoder cable ..... 6 - 6
6.3 Absolute position storage unit MR-BTAS01 ..... 6 - 9

7. TM-RFM SERIES 7 - 1 to 7 -14

7.1 Model code definition ..... 7 - 1
7.2 Combinations of servo amplifier and direct drive motor ..... 7 - 2
7.3 Specification list ..... 7 - 3
7.4 Torque characteristics ..... 7 - 6
7.5 Dimensions ..... 7 - 7

8. TM-RG2M SERIES/TM-RU2M SERIES 8 - 1 to 8 -12

8.1 Model designation ..... 8 - 1
8.2 Combinations of servo amplifier and direct drive motor ..... 8 - 2
8.3 Specification list ..... 8 - 3
8.4 Torque characteristics ..... 8 - 5
8.5 Mounting method ..... 8 - 5
8.6 Dimensions ..... 8 - 6

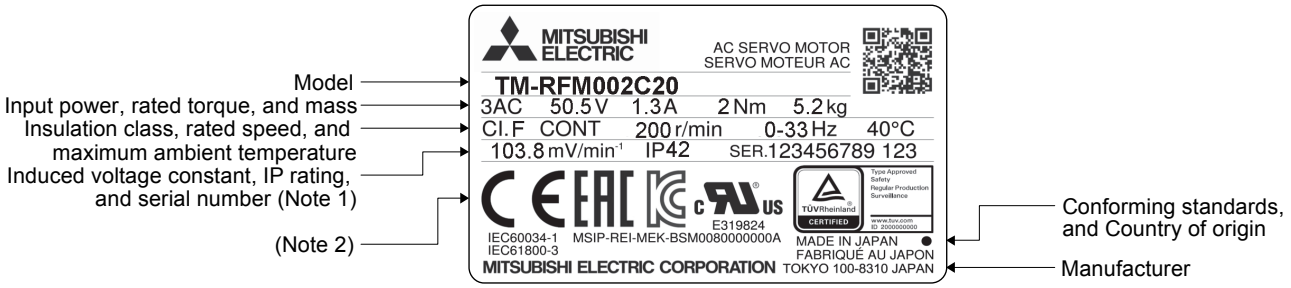
APPENDIX App. - 1 to App. - 7

App. 1 Selection example of direct drive motor ..... App. - 1
App. 2 Manufacturer list ..... App. - 3
App. 3 Crimping connector for CNP3_ ..... App. - 3
App. 4 Fabrication of the encoder cable ..... App. - 4
App. 5 Compliance with the CE marking ..... App. - 5
App. 6 Compliance with UL/CSA standard ..... App. - 6

1. INTRODUCTION

1.1 Rating plate

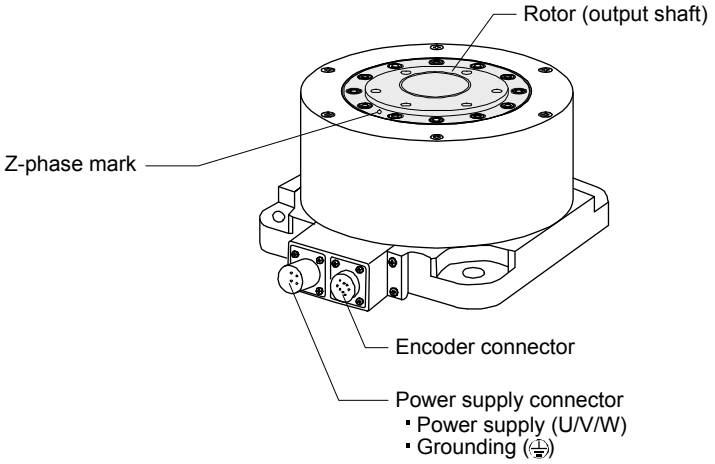
The following shows an example of rating plate for explanation of each item.



Note 1. Production year and month of the direct drive motor are indicated in a serial number on the rating plate.
The year and month are indicated by the last two digits of the year and one digit of the month [1 to 9, X (10), Y (11), and Z (12)].
For January 2012, the Serial No. is like, "SER. _ _ _ _ _ _ _ _ _ 121".

2. Products approved by Certification Bodies are marked. The marks depends on the Certification Bodies.

1.2 Parts identification



MEMO

2. INSTALLATION

⚠WARNING ●To prevent electric shock, ground each equipment securely.

⚠CAUTION

●Stacking in excess of the specified number of product packages is not allowed.
●Install the direct drive motor on incombustible material. Installing them directly or close to combustibles will lead to smoke or a fire.
●Install the servo amplifier and the direct drive motor in a load-bearing place in accordance with the Instruction Manual.
●Do not get on or put heavy load on the equipment. Otherwise, it may cause injury.
●Use the equipment within the specified environment. For the environment, refer to section 7.3.
●Do not drop or strike the direct drive motor as it is precision equipment.
●Do not install or operate a direct drive motor, which has been damaged or has any parts missing.
●Do not hold the cables, rotor, encoder, or connector when carrying the direct drive motor. Otherwise, it may drop.
●Securely fix the direct drive motor to the machine. If being attached insecurely, the motor may come off during operation, leading to injury.
●Do not apply shocks, e.g. hit with a hammer, when coupling the rotor of the direct drive motor. Otherwise, the encoder may malfunction.
●When coupling a load to the direct drive motor, make sure to align and center the load on the motor flange rabbet. Particularly, when a rigid coupling is used, even a slight center deviation may reduce position accuracy or damage the rotor.
●Balance the load to the extent possible. Not doing so can cause vibration during direct drive motor operation or damage the bearings and encoder.
●Take safety measures, e.g. provide covers, to prevent accidental access to the rotor of the direct drive motor during operation.
●Do not subject the rotor of the direct drive motor to more than the permissible load. Otherwise, the rotor may break, leading to injury.
●When the product has been stored for an extended period of time, contact your local sales office.
●Be sure to check the vibration level with the direct drive motor mounted on the machine. A great vibration may cause the early damage of a bearing and encoder. The great vibration may also cause the poor connector connection or bolt looseness.
●For the gain adjustment at the equipment startup, check the torque waveform and the speed waveform with a measurement device to check that no vibration occurs. If the vibration occurs due to high gain, the vibration may cause the early damage of the direct drive motor.
●Do not use the direct drive motor where the shaft-through portion may be subject to pressure (e.g. compressed air). Applying air pressure to the inside of the direct drive motor may cause a malfunction.

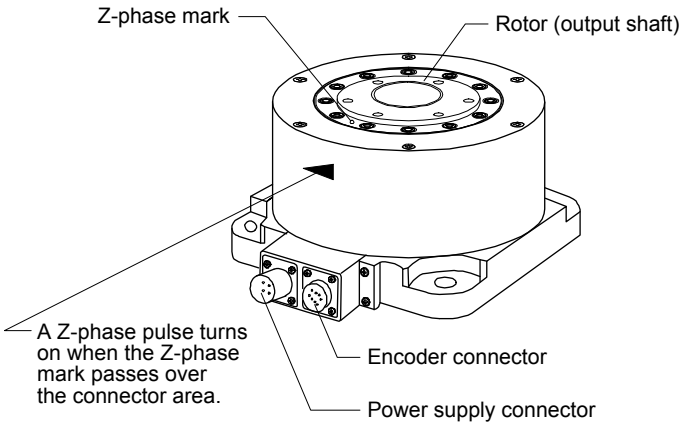
2. INSTALLATION

2.1 Equipment configuration

The following shows the configuration of a direct drive motor. When using the direct drive motor, note the following.

(1) Minimum oscillation angle
If the direct drive motor rotates repeatedly by a small angle (by 70° or less), make the direct drive motor rotate by 90° or more at least once a day in order to keep the bearing lubricated.

(2) Z-phase position
A Z-phase pulse turns on (Z-phase mark passing) when the Z-phase mark on the rotor end of the direct drive motor passes over the connector area. Keep the Z-phase position visible even after the direct drive motor is installed to a machine.



(3) Precautions for Z-phase mark passing
After power on, the Z-phase mark of the direct drive motor must pass the connector area once. In a system which prevents the direct drive motor from making a full rotation, install the direct drive motor in a position where the Z-phase mark can pass over the connector area.

(4) Vertical axis (lift)
For the system where the unbalanced torque occurs, such as a vertical axis system (lift), use the direct drive motor in the absolute position detection system. In the absolute position detection system, the absolute position is established when the Z-phase mark passes the connector area once. Therefore, at system startup, make the Z-phase mark pass over the connector area, and switch the servo amplifier's power supply from off to on.
If the direct drive motor can be rotated manually, make the Z-phase mark pass over the connector area while only the servo amplifier's control circuit power supply is on. After that, switch the servo amplifier's power supply from off to on.
If the direct drive motor cannot be rotated manually, detect the magnetic poles while the torque is balanced, then run the direct drive motor in the test mode to make its Z-phase mark pass over the connector area. After that, switch the servo amplifier's power supply from off to on. After the Z-phase mark passes over the connector area once, magnetic pole detection is not required.

2.2 Mounting direction

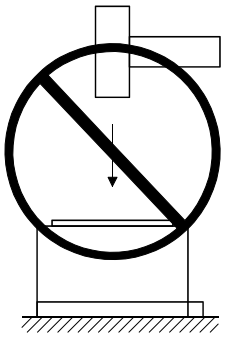
The following table indicates the mounting direction of the direct drive motor.

Direct drive motor series	Mounting direction
TM-RFM TM-RG2M TM-RU2M	All directions

2.3 Load mounting/dismounting precautions

POINT

●During assembling, the rotor must not be hammered. Otherwise, the encoder may malfunction.



(1) The direction of the encoder on the direct drive motor cannot be changed.

(2) When mounting the direct drive motor, use spring washers, etc. and fully tighten the bolts so that they do not become loose due to vibration.

2.4 Permissible load for the rotor

⚠CAUTION ●Because the rigid coupling may damage the rotor, make sure to align and center the load on the rotor.

For the permissible rotor load specific to the direct drive motor, refer to section 7.3.

(1) When coupling a load to the direct drive motor, the load applied to the rotor must be within the permissible load.

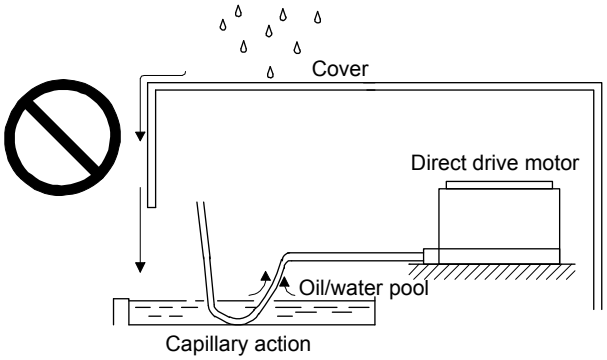
(2) The load, which exceeds the permissible load, can cause the bearing life to reduce and the rotor to break.

(3) The load indicated in this section is static load in a single direction and does not include eccentric load. Make eccentric load as small as possible. Not doing so can cause the direct drive motor to be damaged.

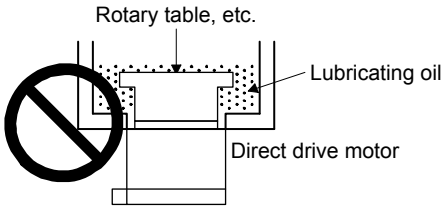
2.5 Protection from oil and water

Provide adequate protection to prevent foreign matter, such as oil and water, from entering the rotor of the direct drive motor. When mounting the direct drive motor, consider the items in this section.

(1) Do not use the direct drive motor with its cable soaked in oil or water.



Provide measures so that the direct drive motor is not exposed to oil and water entering from the machine side, rotating table, etc.



(3) If liquid such as coolant drops on the direct drive motor, the sealant, packing, cable and others may be affected depending on the liquid type.

(4) In the environment where the direct drive motor is exposed to oil mist, steam, oil, water, grease, and/or the like, a standard specification direct drive motor cannot be used. Provide measures to prevent dust and/or water on the machine side.

2.6 Inspection items

⚠WARNING	●Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier. ●To avoid an electric shock, only qualified personnel should attempt inspections. For repair, contact your local sales office.

⚠CAUTION	●Do not perform insulation resistance test on the direct drive motor. Otherwise, it may cause a malfunction. ●Do not disassemble and/or repair the equipment on customer side.

It is recommended that the following points to be periodically checked.

(1) Check the bearings, etc. for unusual noise.

(2) Check the cables and the like for scratches or cracks. Especially when the junction cable is movable, perform periodic inspection according to operating conditions.

(3) Check the power connector and encoder connector connections for looseness.

2.7 Parts having service life

Service life of the following parts is listed below. However, the service life varies depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service life. For parts replacement, contact your local sales office.

Part name	Life guideline	Remark
Bearings	20,000 hours to 30,000 hours	The Guideline of Life field gives the reference time. If any fault is found before this time is reached, the part must be changed.
Encoder	20,000 hours to 30,000 hours	
Absolute position storage unit (option)	20,000 hours to 30,000 hours	

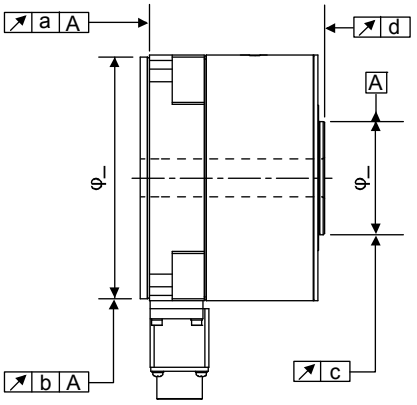
When the motor is run at rated speed under rated load, bearings should be exchanged in 20,000 to 30,000 hours as a guideline. This differs on the operating conditions. The bearings must also be changed if unusual noise or vibration is found during inspection.

2.8 Machine accuracies

The following table indicates the machine accuracies of the rotor (output shaft) and the mounting area of the direct drive motor (except special products).

Item	Measuring position	Accuracy [mm]
Runout of mounting surface to rotor (output shaft)	a	0.05
Runout of fitting outer diameter of mounting surface	b	0.07
Runout of rotor (output shaft)	c	0.04
Runout of rotor (output shaft) end	d	0.02

Reference diagram



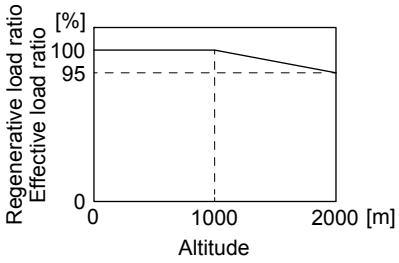
2.9 Flange size

The rated torque of the direct drive motor indicates the continuous permissible torque value that can be generated when the motor is mounted on the aluminum flange specified in this table and used in the environment of 0 °C to 40 °C ambient temperature.

Flange size [mm]	Direct drive motor
400 × 400 × 20	TM-RG2M002C30
	TM-RU2M002C30
	TM-RFM002C20
	TM-RFM004C20
	TM-RFM006C20
550 × 550 × 35	TM-RG2M004E30
	TM-RU2M004E30
	TM-RFM006E20
	TM-RFM012E20
	TM-RFM018E20
650 × 650 × 35	TM-RG2M009G30
	TM-RU2M009G30
	TM-RFM012G20
	TM-RFM048G20
	TM-RFM072G20
750 × 750 × 45	TM-RFM040J10
	TM-RFM120J10
950 × 950 × 50	TM-RFM240J10

2.10 Restrictions when using this product at altitudes exceeding 1000 m and up to 2000 m above sea level

As heat dissipation effects decrease in proportion to the decrease in air density, use the product within the effective load ratio and regenerative load ratio shown in the following figure.



2.11 Magnetic shielding

Do not place the direct drive motor near magnetic sources, such as a magnet. If it is unavoidable, block the magnetic force by installing a shielding plate, etc.

MEMO

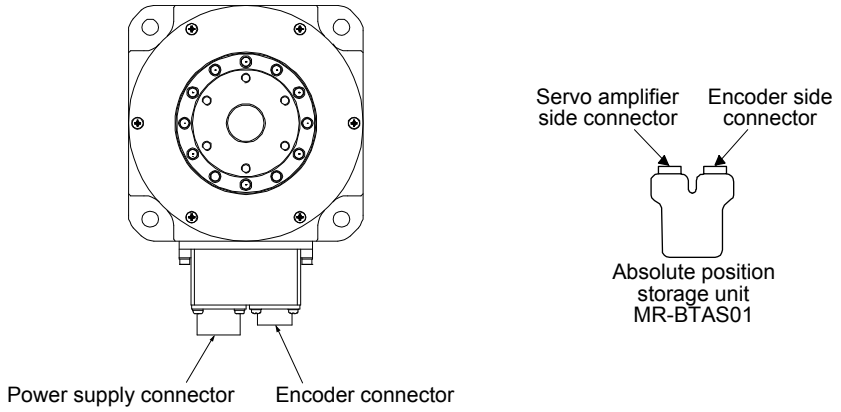
3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

POINT

- The IP rating indicated is the connector's protection against ingress of dust and water when the connector is connected to a servo amplifier, direct drive motor, or absolute position storage unit.
  If the IP rating of the connector, servo amplifier, direct drive motor and absolute position storage unit vary, the overall IP rating depends on the lowest IP rating of all components.

3.1 Selection of connectors

Use the connector configuration products given in the table as the connectors for connection with the direct drive motor. Refer to section 3.2 for the compatible connector configuration products.

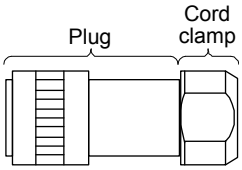


Direct drive motor	Wiring connector			
	For power supply	For encoder	Absolute position storage unit (option) (Note)	
			Servo amplifier side	Encoder side
TM-RFM_C20	Connector configuration B	Connector configuration A	Connector configuration A	Connector configuration F
TM-RFM_E20				
TM-RFM_G20	Connector configuration C			
TM-RFM040J10	Connector configuration D			
TM-RFM120J10				
TM-RFM240J10	Connector configuration E			
TM-RG2M002C30	Connector configuration B			
TM-RU2M002C30				
TM-RG2M004E30				
TM-RU2M004E30				
TM-RG2M009G30				
TM-RU2M009G30				

Note. Used in the absolute position detection system

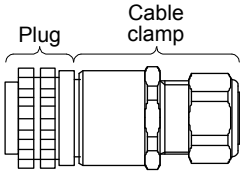
3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

3.2 Wiring connectors (connector configurations A/B/C/D/E/F)



Connector configuration	Feature	Plug (Hirose Electric)			Recommended cable (Bando Densen)		Direct drive motor encoder connector or Absolute position storage unit connector (servo amplifier side) (Note 1)
		Type	Plug	Cord clamp	Model	Cable OD [mm] (reference)	
A	IP67	Straight	RM15WTPZK-12S	JR13WCCA-8(72)	20276 VSVPAWG#23×6P KB-0492 (Note 2)	8.2	RM15WTRZB-12P(72)

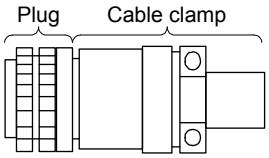
Note 1. The connector to be mated.
2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch



Connector configuration	Feature	Plug (DDK)		Cable clamp		Direct drive motor power connector (Note 2)
		Type	Model	Cable OD [mm] (reference)	Model	
B	IP67 EN compliant	Straight	CE05-6A14S-2SD-D Applicable wire size: AWG 22 to 16	4 to 8	ACS-08RL-MS14F (Nippon Flex)	CE05-2A14S-2PD-D
				8 to 12	ACS-12RL-MS14F (Nippon Flex)	
				5 to 8.3	YSO14-5 to 8 (Daiwa Dengyo)	
				8.3 to 11.3	YSO14-9 to 11 (Daiwa Dengyo)	
	General environment (Note 1)		D/MS3106B14S-2S Applicable wire size: AWG 22 to 16	7.9 or less (bushing ID)	D/MS3057-6A	

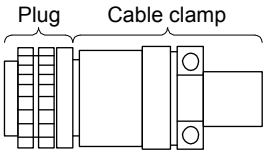
Note 1. Not comply with EN.
2. The connector to be mated.

3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING



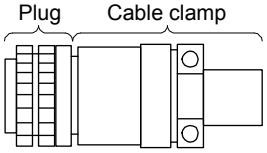
Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power connector (Note 2)
		Type	Model	Cable OD [mm] (reference)	Model	
C	IP67 EN compliant	Straight	CE05-6A18-10SD-D-BSS Applicable wire size: AWG 14 to 12	8.5 to 11	CE3057-10A-2-D	CE05-2A18-10PD-D
				10.5 to 14.1	CE3057-10A-1-D	
	General environment (Note 1)		D/MS3106B18-10S Applicable wire size: AWG 14 to 12	14.3 or less (bushing ID)	D/MS3057-10A	

Note 1. Not comply with EN.
2. The connector to be mated.



Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power connector (Note 2)
		Type	Model	Cable OD [mm] (reference)	Model	
D	IP67 EN compliant	Straight	CE05-6A22-22SD-D-BSS Applicable wire size: AWG 10 to 8	9.5 to 13	CE3057-12A-2-D	CE05-2A22-22PD-D
				12.5 to 16	CE3057-12A-1-D	
	General environment (Note 1)		D/MS3106B22-22S Applicable wire size: AWG 10 to 8	15.9 or less (bushing ID)	D/MS3057-12A	

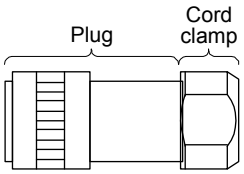
Note 1. Not comply with EN.
2. The connector to be mated.



Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power connector (Note 2)
		Type	Model	Cable OD [mm] (reference)	Model	
E	IP67 EN compliant	Straight	CE05-6A32-17SD-D-BSS Applicable wire size: AWG 6 to 4	22 to 23.8	CE3057-20A-1-D	CE05-2A32-17PD-D
	General environment (Note 1)		D/MS3106B32-17S Applicable wire size: AWG 6 to 4	23.8 or less (bushing ID)	D/MS3057-20A	

Note 1. Not comply with EN.
2. The connector to be mated.

3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING



Connector configuration	Feature	Plug (Hirose Electric)			Recommended cable (Bando Densen)		Absolute position storage unit connector (encoder side) (Note 1)
		Type	Plug	Cord clamp	Model	Cable OD [mm] (reference)	
F	IP67	Straight	RM15WTPZ-12P(72)	JR13WCCA-8(72)	20276 VSVPAWG#23×6P KB-0492 (Note 2)	8.2	RM15WTRZB-12S(72)

Note 1. The connector to be mated.
2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch

4. CONNECTOR DIMENSIONS

The following shows the dimensions of the connectors used for wiring the direct drive motor.

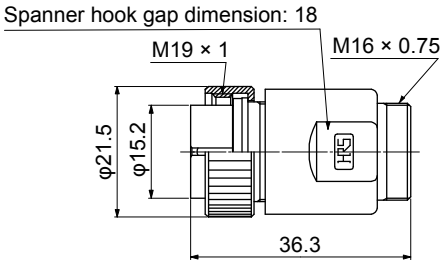
(1) Hirose Electric

(a) RM15WTPZK-12S/RM15WTPZ-12P(72)

Model	Connector configuration (Note)
RM15WTPZK-12S	A
RM15WTPZ-12P(72)	F

Note. Refer to section 3.2 for the connector configuration.

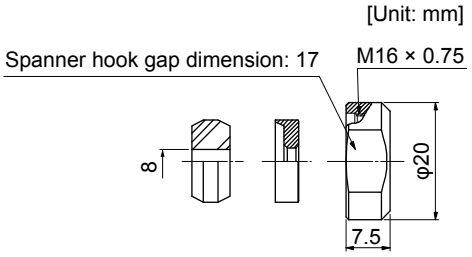
[Unit: mm]



(b) JR13WCCA-8(72)

Refer to the connector configurations A and F of section 3.2 for the connector configuration.

[Unit: mm]

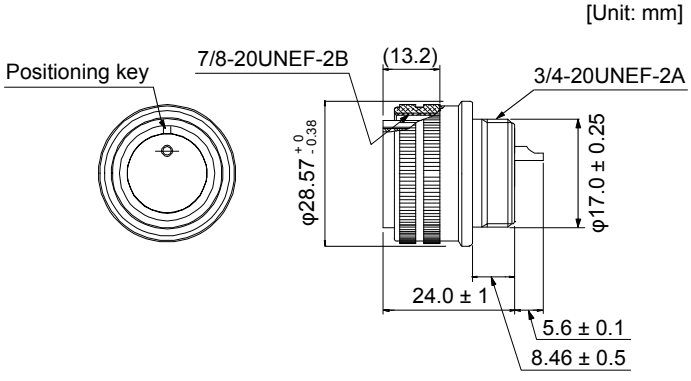


(2) DDK

(a) CE05-6A14S-2SD-D

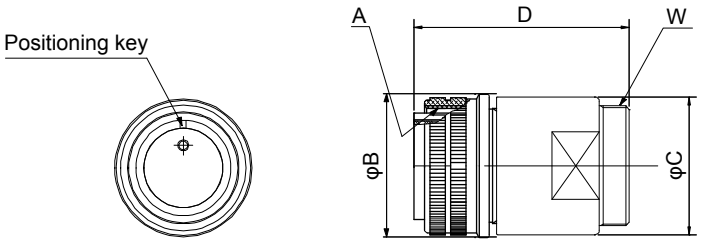
Refer to the connector configuration B of section 3.2 for the connector configuration.

[Unit: mm]



(b) CE05-6A18-10SD-D-BSS
CE05-6A22-22SD-D-BSS
CE05-6A32-17SD-D-BSS

[Unit: mm]

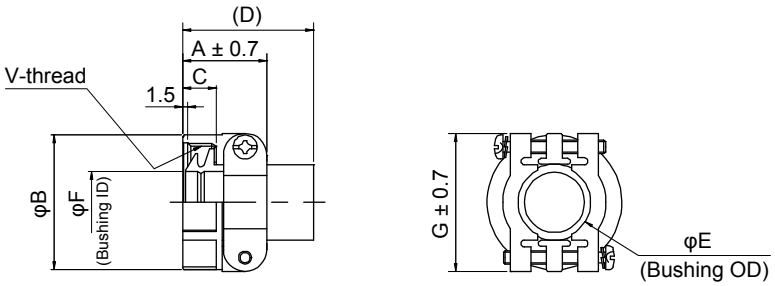


Model	A	$B^{+0}_{-0.38}$	C ± 0.8	D or less	W	Connector configuration (Note)
CE05-6A18-10SD-D-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A	C
CE05-6A22-22SD-D-BSS	1 3/8-18UNEF-2B	40.48	38.3	61	1 3/16-18UNEF-2A	D
CE05-6A32-17SD-D-BSS	2-18UNS-2B	56.33	54.2	79	1 3/4-18UNS-2A	E

Note. Refer to section 3.2 for the connector configuration.

(c) CE3057-10A-1-D
CE3057-10A-2-D
CE3057-12A-1-D
CE3057-12A-2-D
CE3057-20A-1-D

[Unit: mm]

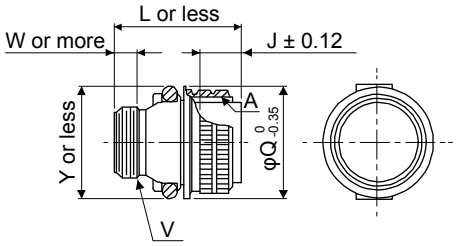


Model	Applicable shell size	A	B	C	(D)	E	F	G	V	Enclosed bushing model	Applicable cable OD (reference)	Connector configuration (Note)
CE3057-10A-1-D	18	23.8	30.1	10.3	(41.3)	15.9	14.1	31.7	1-20UNEF-2B	CE3420-10-1	10.5 to 14.1	C
CE3057-10A-2-D							11.0			CE3420-10-2	8.5 to 11	
CE3057-12A-1-D	22	23.8	35	10.3	(41.3)	19	16.0	37.3	1 3/16-18UNEF-2B	CE342012-1	12.5 to 16	D
CE3057-12A-2-D							13.0			CE342012-2	9.5 to 13	
CE3057-20A-1-D	32	27.8	51.6	11.9	(43.0)	32.0	23.8	51.6	1 3/4-18UNS-2B	CE3420-20-1	22.0 to 23.8	E

Note. Refer to section 3.2 for the connector configuration.

(d) D/MS3106B14S-2S
D/MS3106B18-10S
D/MS3106B22-22S
D/MS3106B32-17S

[Unit: mm]

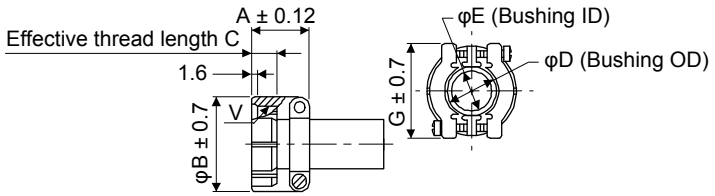


Model	A	J	L	Q	V	W	Y	Connector configuration (Note)
D/MS3106B14S-2S	7/8-20UNEF	13.49	42.88	28.57	3/4-20UNEF	8.00	30	B
D/MS3106B18-10S	1 1/8-18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42	C
D/MS3106B22-22S	1 3/8-18UNEF	18.26	56.57	40.48	1 3/16-18UNEF	9.53	50	D
D/MS3106B32-17S	2-18UNS	18.26	61.92	56.33	1 3/4-18UNS	11.13	66	E

Note. Refer to section 3.2 for the connector configuration.

(e) D/MS3057-6A
D/MS3057-10A
D/MS3057-12A
D/MS3057-20A

[Unit: mm]

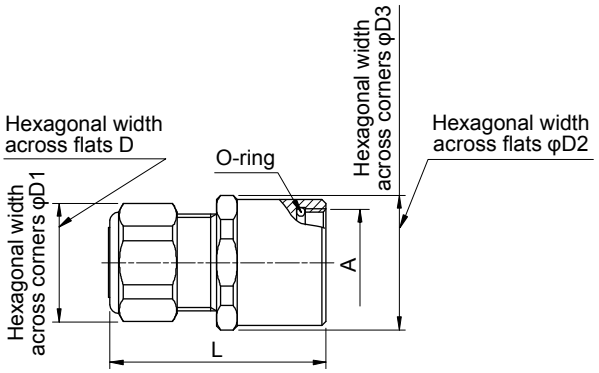


Model	Shell size	A	B	C	D	E	G	V	Bushing	Connector configuration (Note)
D/MS3057-6A	14S	22.2	24.6	10.3	11.2	7.9	27.0	3/4-20UNEF	AN3420-6	B
D/MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	31.7	1-20UNEF	AN3420-10	C
D/MS3057-12A	22	23.8	35.0	10.3	19.0	15.9	37.3	1 3/16-18UNEF-2A	AN3420-12	D
D/MS3057-20A	32	27.8	51.6	11.9	31.7	23.8	51.6	1 3/4-18UNS	AN3420-20	E

Note. Refer to section 3.2 for the connector configuration.

(3) Daiwa Dengyo

[Unit: mm]

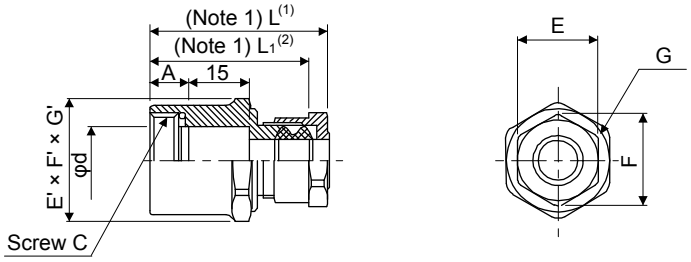


Model	Applicable cable OD	A	Length before tightening L	Width across flats D	Width across corners D1	Width across flats D2	Width across corners D3	Connector configuration (Note)
YSO14-5 to 8	4 to 8.3	3/4-20UNEF-2B	44	23	25	26	28	B
YSO14-9 to 11	7 to 11.3							

Note. Refer to the connector configuration B of section 3.2 for the connector configuration.

(4) Nippon Flex

[Unit: mm]



Model	Screw C	Applicable cable OD	A	φd	Tightening nut			Nipple body			L	L1	Connector configuration (Note 2)
					E Two-face width	F Width across corners	G Number of corners	E' Two-face width	F' Width across corners	G' Number of corners			
ACS-08RL-MS14F	3/4-20UNEF-2B	4.0 to 8.0	7	15.0	20	22.0	6	22	24.2	6	46	41	B
ACS-12RL-MS14F	3/4-20UNEF-2B	8.0 to 12.0	7	15.0	24	26.4	6	36	28.6	6	46	41	

Note 1. (1) indicates the reference dimension before assembling, and (2) indicates the reference dimension after assembling.
2. Refer to the connector configuration B of section 3.2 for the connector configuration.

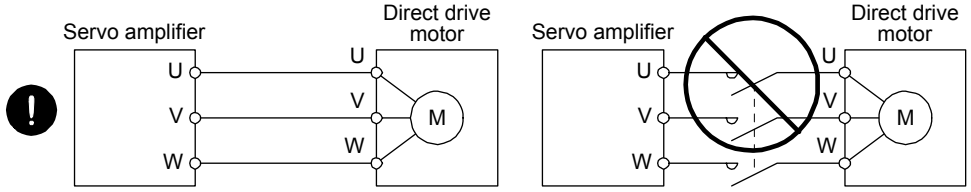
5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

⚠WARNING

- Any person who is involved in wiring should be fully competent to do the work.
- Ground the direct drive motor securely.
- Do not attempt to wire the direct drive motor until it has been installed. Otherwise, it may cause an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, it may cause an electric shock.
- To avoid an electric shock, insulate the connection areas of the power supply terminals.

⚠CAUTION

- Wire the equipment correctly and securely. Otherwise, the direct drive motor may operate unexpectedly, resulting in injury.
- Connect cables to the correct terminals. Otherwise, a burst, damage, etc. may occur.
- Ensure that polarity (+/-) is correct. Otherwise, a burst, damage, etc. may occur.
- Do not install a power capacitor, surge killer, or radio noise filter (FR-BIF option) on the power line of the direct drive motor.
- Do not modify the equipment.
- Connect the servo amplifier power output (U/V/W) to the direct drive motor power input (U/V/W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.



- Before wiring, switch operation, etc., eliminate static electricity. Otherwise, it may cause a malfunction.

POINT

- We recommend using HIV wires to connect the servo amplifier to the direct drive motor. Therefore, recommended wire sizes may different from those of the used wires for the previous direct drive motors.

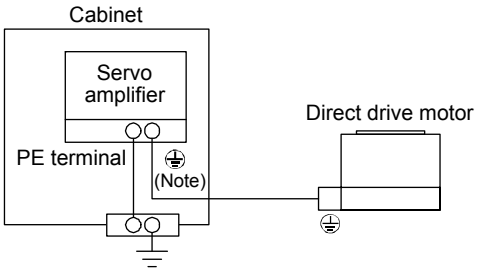
5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

5.1 Connection instructions

⚠CAUTION	●To avoid a malfunction, connect the power supply phases (U/V/W) of the servo amplifier and the direct drive motor correctly. ●Do not connect AC power supply directly to the direct drive motor. Otherwise, it may cause a malfunction.

POINT
●Refer to chapter 6 for the encoder cable.

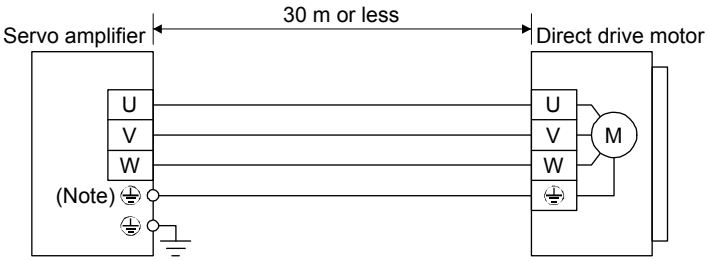
This section explains the connection of the direct drive motor power (U/V/W). Use of the optional connector is recommended for connection between the servo amplifier and direct drive motor. Refer to chapter 6 for details of the options.
For grounding, connect the grounding lead wire from the direct drive motor to the protective earth (PE) terminal of the servo amplifier, and then connect the wire from the servo amplifier to the ground via the protective earth of the cabinet. Do not connect the wire directly to the protective earth of the cabinet.



Note. The number of PE terminals of the servo amplifier differs depending on the amplifier type.

5.2 Direct drive motor power cable wiring diagram

Fabricate a cable as shown below.
Refer to section 5.3 for the wires used for the cable.



Note. This grounding is for the MR-J4 1-axis servo amplifier. For the MR-J4 multi-axis servo amplifier, connect the grounding lead wire to the connector for CNP3_.

5.3 Selection example of wires

POINT

- Wires indicated in this section are separated wires.
- Selection condition of wire size is as follows.
  Construction condition: Single wire set in midair.
  Wire length: 30 m or less

The following shows examples for using the 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire).

(1) TM-RFM series

Direct drive motor	Wire [mm^2]
	U/V/W/⏚
TM-RFM002C20	1.25 (AWG 16)
TM-RFM004C20	
TM-RFM006C20	
TM-RFM006E20	
TM-RFM012E20	
TM-RFM018E20	
TM-RFM012G20	
TM-RFM048G20	3.5 (AWG 12)
TM-RFM072G20	
TM-RFM040J10	1.25 (AWG 16)
TM-RFM120J10	3.5 (AWG 12)
TM-RFM240J10	5.5 (AWG 10) (Note)

Note. Refer to each servo amplifier instruction manual for crimp terminals used for connection with the servo amplifier.

(2) TM-RG2M series/TM-RU2M series

Direct drive motor	Wire [mm^2]
	U/V/W/⏚
TM-RG2M002C30	0.75 (AWG 18)
TM-RU2M002C30	
TM-RG2M004E30	
TM-RU2M004E30	
TM-RG2M009G30	
TM-RU2M009G30	

5.4 Servo amplifier terminal section

POINT
●For the sizes of wires used for wiring, refer to section 5.3.
●When wiring, remove the power connectors from the servo amplifier.
●Insert only one wire or ferrule to each wire insertion hole.

To wire to the servo amplifier, use connectors packed with the servo amplifier or optional connectors.
The following table shows the connectors to be connected to the servo amplifiers. The numbers in the rated output field of the table indicate the symbol filling the underline "_" in the servo amplifier model. For details of the connectors, refer to (1) in this section. For wiring, refer to (2) in this section.

Servo amplifier	Rated output												
	10	20	40	60	70	100	200	350	500	700	11K	15K	22K
MR-J4-_A MR-J4-_A-RJ MR-J4-_B MR-J4-_B-RJ MR-J4-_GF MR-J4-_GF-RJ	Connector A						Connector B		None (Terminal box) (Note)				

Note. For details on the terminal block, refer to each servo amplifier instruction manual.

Servo amplifier	Rated output		
	10	20	40
MR-J4-_A1 MR-J4-_A1-RJ MR-J4-_B1 MR-J4-_B1-RJ	Connector A		

Servo amplifier	Rated output (Note)			
	22 (222)	44 (444)	77	1010
MR-J4W2-_B	Connector C			
MR-J4W3-_B	Connector C			

Note. The numbers in parentheses are for the MR-J4 3-axis servo amplifier.

(1) Connector details

(a) Connector A

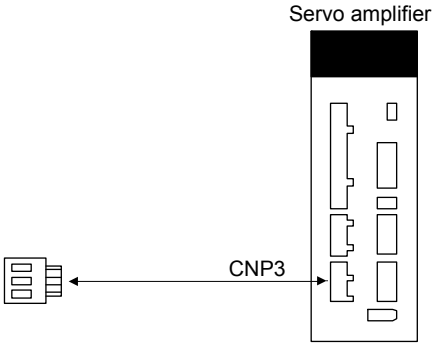


Table 5.1 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Wire size	Insulator OD			
CNP3	03JFAT-SAXGDK-H7.5	AWG 18 to 14	3.9 mm or shorter	9	J-FAT-OT (N) or J-FAT-OT	JST

(b) Connector B

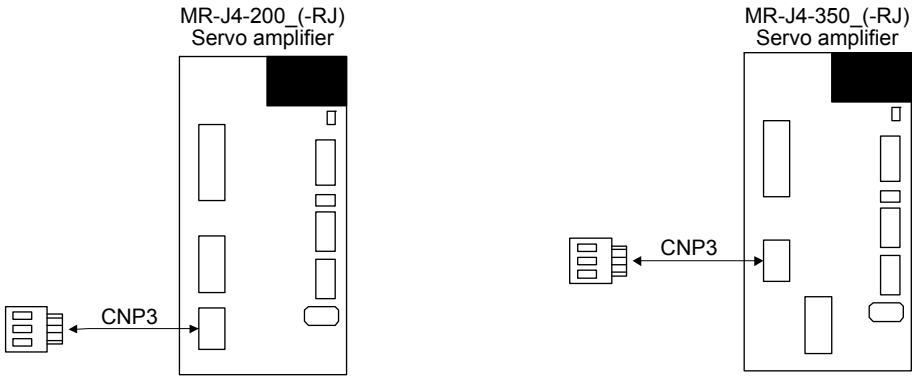
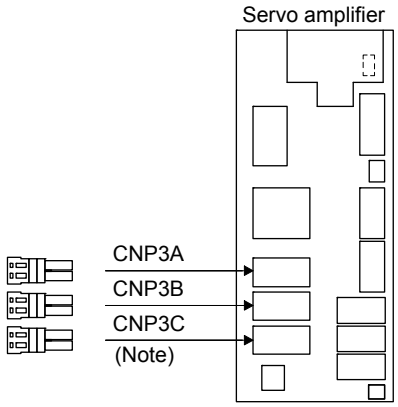


Table 5.2 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire		Stripped length [mm]	Open tool	Manufacturer
		Wire size	Insulator OD			
CNP3	03JFAT-SAXGFK-XL	AWG 16 to 10	4.7 mm or shorter	11.5	J-FAT-OT-EXL	JST

(c) MR-J4W_ - _B



Note. For the 3-axis servo amplifier.

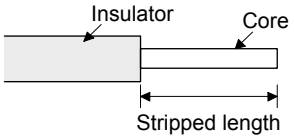
Table 5.3 Connector and applicable wire

Connector	Receptacle assembly	Applicable wire size	Stripped length [mm]	Open tool	Manufacturer
CNP3A CNP3B CNP3C	04JFAT-SAGG-G-KK	AWG 18 to 14	9	J-FAT-OT-EXL	JST

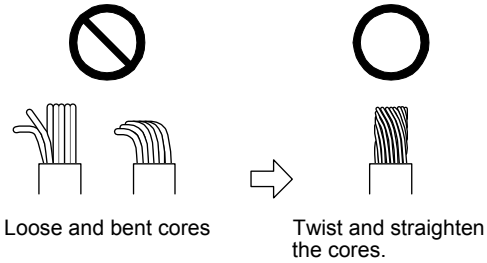
(2) Cable connection procedure

(a) Fabrication on cable insulator

Refer to tables 5.1 to 5.3 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their fabrication status.



Twist strands lightly and straighten them as follows.



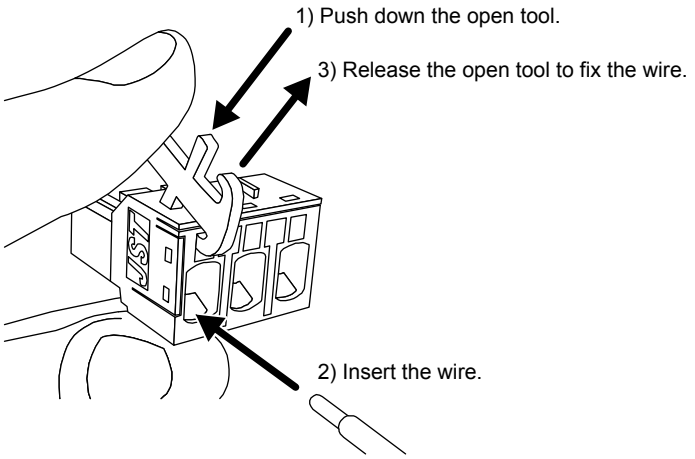
(b) Inserting wire

Insert the open tool as follows and push down it to open the spring.

While the open tool is pushed down, insert the stripped wire into the wire insertion hole. Check the wire insertion depth, and make sure that the cable insulator will not be caught by the spring and that the conductive part of the stripped wire will not be exposed.

Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected. In addition, make sure that no conductor wire sticks out of the connector.

The following shows a connection example of the CNP3 connector for 2 kW and 3.5 kW of MR-J4 1-axis servo amplifier.



MEMO

6. WIRING OPTION

⚠WARNING	●Before connecting any option or peripheral equipment, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P+ and N- is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, when confirming whether the charge lamp is off or not, always confirm it from the front of the servo amplifier.

⚠CAUTION	●Use specified auxiliary equipment and options. Otherwise, it may cause a malfunction or fire.

POINT

●We recommend using HIV wires to wire the servo amplifiers, direct drive motors, options, and peripheral equipment. Therefore, recommended wire sizes may different from those of the used wires for the previous direct drive motors.

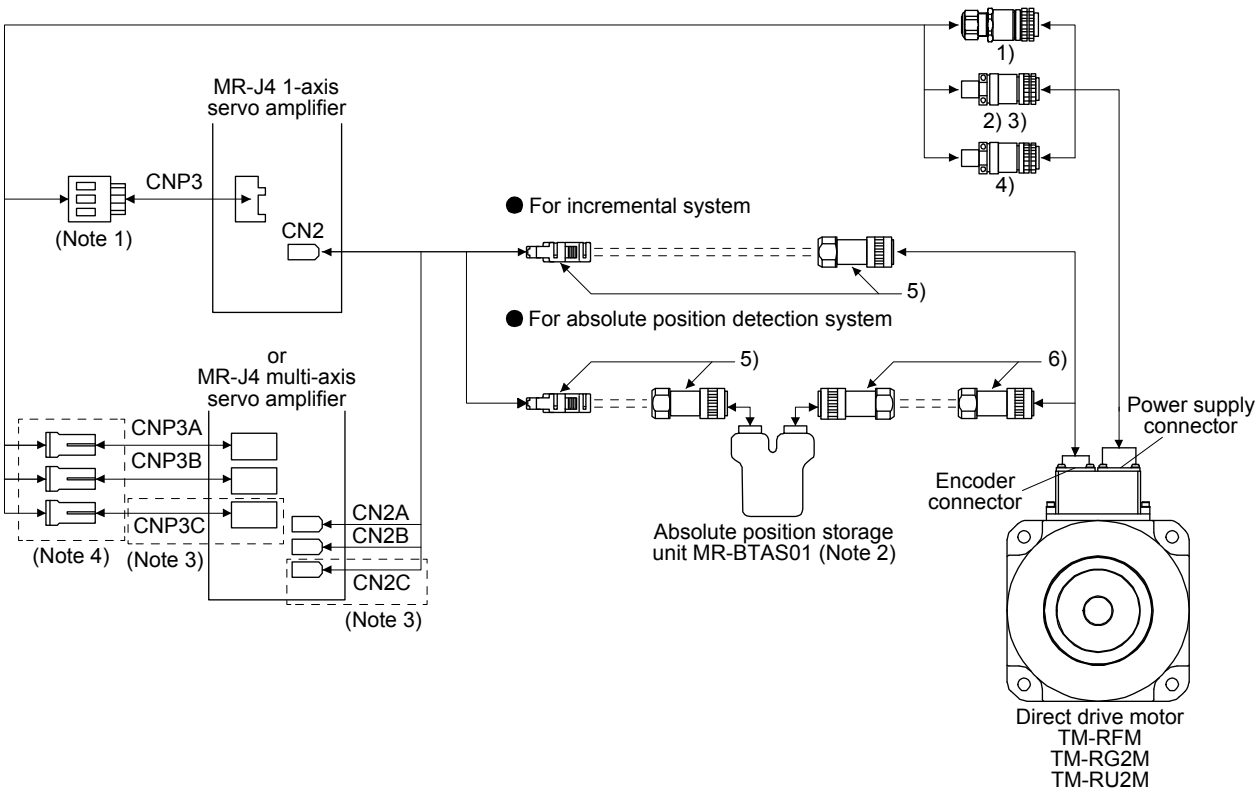
6.1 Connector set

POINT

●The IP rating indicated is the connector's protection against ingress of dust and water when the connector is connected to a servo amplifier, direct drive motor, or absolute position storage unit. If the IP rating of the connector, servo amplifier, direct drive motor, and absolute position storage unit vary, the overall IP rating depends on the lowest IP rating of all components.

For the connectors used with this direct drive motor, purchase the options indicated in this section. When fabricating an encoder cable, refer to app. 4.

6.1.1 Combinations of connector set



Note 1. Connectors for 3.5 kW or less. For 5 kW or more, it is a terminal block.
2. Always make connection for use in an absolute position detection system. (Refer to section 6.3.)
3. This connection is for the MR-J4 3-axis servo amplifier.
4. Refer to Appendix 3 for the crimp connector for CNP3_.

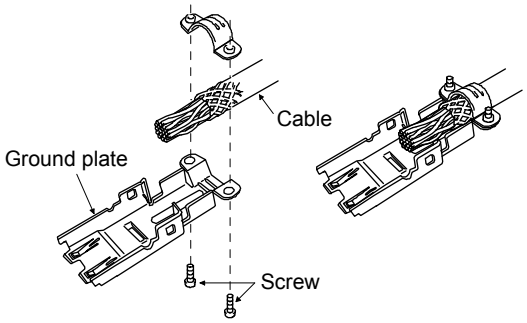
6.1.2 Connector list

No.	Product	Model	Description	Remark
1)	Power connector set	MR-PWCNF	Plug: CE05-6A14S-2SD-D (DDK) Cable clamp: YSO14-9 to 11 (Daiwa Dengyo) Applicable cable Applicable wire size: 0.3 mm^2 (AWG 22) to 1.25 mm^2 (AWG 16) Cable outer diameter: 8.3 mm to 11.3 mm  For TM-RFM_C20 For TM-RFM_E20 For TM-RG2M_C30 For TM-RG2M_E30 For TM-RG2M_G30 For TM-RU2M_C30 For TM-RU2M_E30 For TM-RU2M_G30	IP67 EN compliant
2)	Power connector set	MR-PWCNS4	Plug: CE05-6A18-10SD-D-BSS Cable clamp: CE3057-10A-1-D (DDK) Applicable cable Applicable wire size: 2 mm^2 (AWG 14) to 3.5 mm^2 (AWG 12) Cable outer diameter: 10.5 mm to 14.1 mm  For TM-RFM_G20	IP67 EN compliant
3)	Power connector set	MR-PWCNS5	Plug: CE05-6A22-22SD-D-BSS Cable clamp: CE3057-12A-1-D (DDK) Applicable cable Applicable wire size: 5.5 mm^2 (AWG 10) to 8 mm^2 (AWG 8) Cable outer diameter: 12.5 mm to 16 mm  For TM-RFM040J10 For TM-RFM120J10	IP67 EN compliant
4)	Power connector set	MR-PWCNS3	Plug: CE05-6A32-17SD-D-BSS Cable clamp: CE3057-20A-1-D (DDK) Applicable cable Applicable wire size: 14 mm^2 (AWG 6) to 22 mm^2 (AWG 4) Cable outer diameter: 22 mm to 23.8 mm  For TM-RFM240J10	IP67 EN compliant
5)	Encoder connector set	MR-J3DDCNS	 For connection between servo amplifier and direct drive motor. For connection between servo amplifier and absolute position storage unit. Refer to section 6.2 for details.	IP67
6)	Encoder connector set	MR-J3DDSPS	  For connection between absolute position storage unit and direct drive motor. Refer to section 6.2 for details.	IP67

6.2 Encoder connector set

POINT

- The encoder cable should be fabricated by the customer. Fabricate the encoder cable according to section 6.2.1 to section 6.2.3 and the wiring diagram in section 6.2.4.
- Fabricate the encoder cable to be 50 m or shorter between the servo amplifier and the direct drive motor.
- To configure the absolute position detection system, always connect the battery and absolute position storage unit to the servo amplifier. For details of the battery, refer to each servo amplifier instruction manual. Refer to section 6.3 for details of the absolute position storage unit.
- For absolute position detection system, refer to each servo amplifier instruction manual.
- For CN2, CN2A, CN2B, and CN2C side connectors, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.



6.2.1 MR-J3DDCNS

This connector set is used to fabricate an encoder cable for the incremental system or the absolute position detection system (between the servo amplifier and the absolute position storage unit).

Parts	Description
Connector set	MR-J3DDCNS  Servo amplifier side connector Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)  Encoder-side or absolute position storage unit-side connector (connected from the servo amplifier) Plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric) Applicable wire size: 0.25 mm^2 (AWG 23) to 0.5 mm^2 (AWG 20)

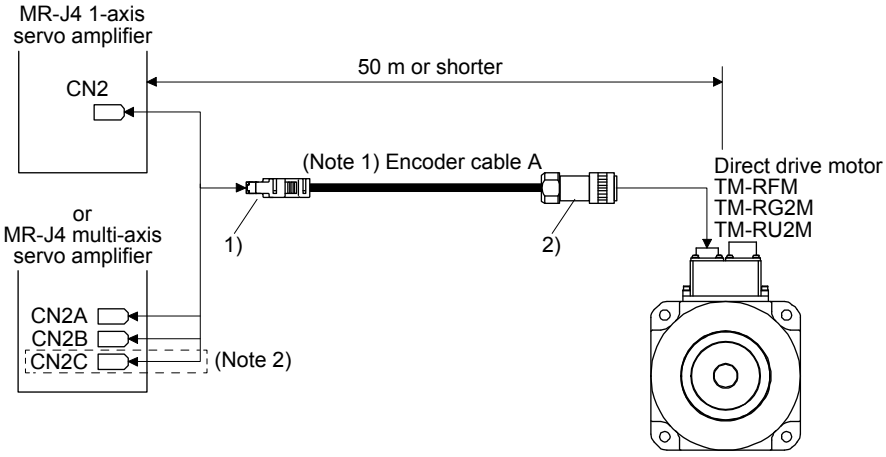
6.2.2 MR-J3DDSPS

This connector set is used to fabricate an encoder cable for the absolute position detection system (between the absolute position storage unit and the direct drive motor).

Parts	Description
Connector set	MR-J3DDSPS   Absolute position storage unit-side connector Plug: RM15WTPZ-12P(72) Cord clamp: JR13WCCA-8(72) (Hirose Electric) Encoder-side connector Plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric) Applicable wire size: 0.25 mm^2 (AWG 23) to 0.5 mm^2 (AWG 20)

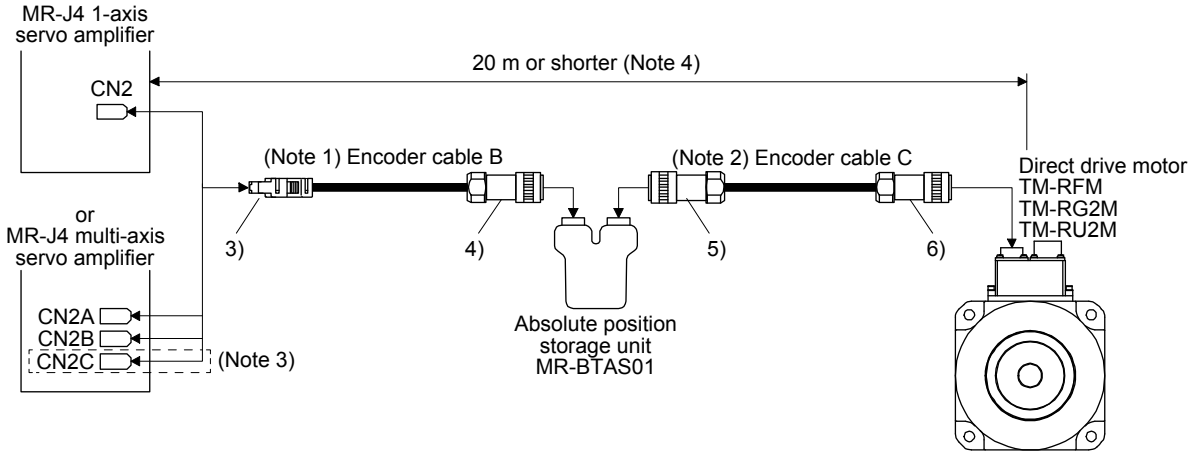
6.2.3 Combinations for the encoder cable

(1) For incremental system



Note 1. Refer to section 6.2.4 (1) for details.
2. This connection is for the MR-J4 3-axis servo amplifier.

(2) For absolute position detection system

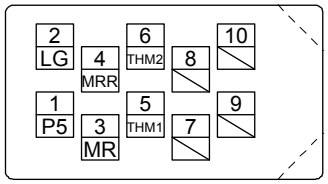
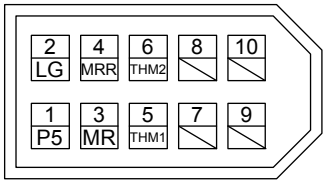
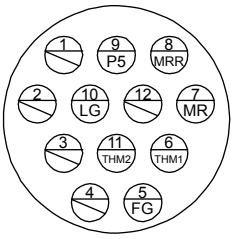


Note 1. Refer to section 6.2.4 (2) for details.
2. Refer to section 6.2.4 (3) for details.
3. This connection is for the MR-J4 3-axis servo amplifier.
4. For cable of 20 m or more, contact your local sales office.

6.2.4 Fabrication of the encoder cable

(1) Encoder cable A

(a) Connector details

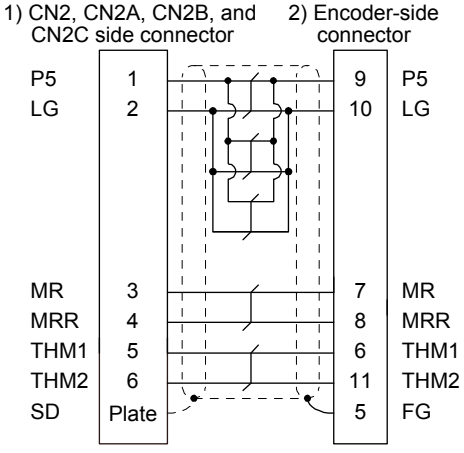
1) CN2, CN2A, CN2B, and CN2C side connector	2) Encoder-side connector
Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) Connector set: 54599-1019 (Molex)	Straight plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric) Recommended cable: 20276 VSVPAWG#23×6P KB-0492 (Note 3) (Bando Densen)
 View seen from the wiring side. (Note 1) or  View seen from the wiring side. (Note 1)	 View seen from the wiring side. (Note 2)

Note 1. Do not connect anything to the pins shown as ▨. Especially, the pin 10 is for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally. Referring to POINT of section 6.2, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.

2. Do not connect anything to the pins shown as ◡.

3. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch

(b) Cable internal wiring diagram

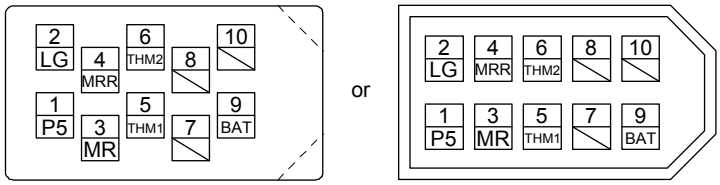
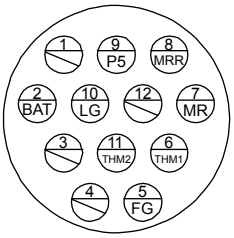


Refer to the following table for the required wires to fabricate the encoder cable.

Core size [mm^2]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

(2) Encoder cable B

(a) Connector details

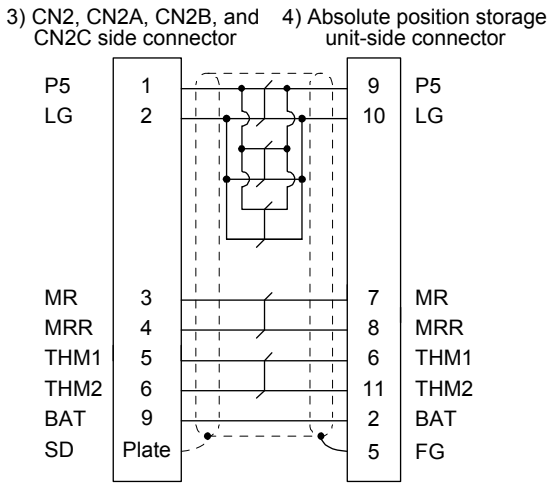
3) CN2, CN2A, CN2B, and CN2C side connector	4) Absolute position storage unit-side connector
Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) Connector set: 54599-1019 (Molex)  View seen from the wiring side. (Note 1) View seen from the wiring side. (Note 1)	Straight plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric) Recommended cable: 20276 VSVPAWG#23×6P KB-0492 (Note 3) (Bando Densen)  View seen from the wiring side. (Note 2)

Note 1. Do not connect anything to the pins shown as ▨. Especially, the pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally. Referring to POINT of section 6.2, securely connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.

2. Do not connect anything to the pins shown as ◡.
3. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch

(b) Cable internal wiring diagram

When the distance between the servo amplifier and the direct drive motor is within 20 m (Note)



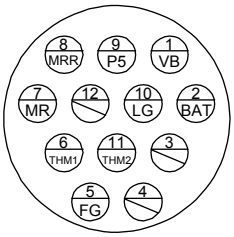
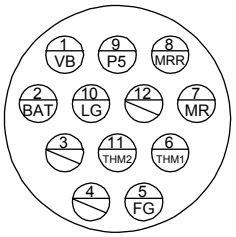
Note. For the cable of 20 m or longer, contact your local sales office.

Refer to the following table for the required wires to fabricate the encoder cable.

Core size [mm^2]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

(3) Encoder cable C

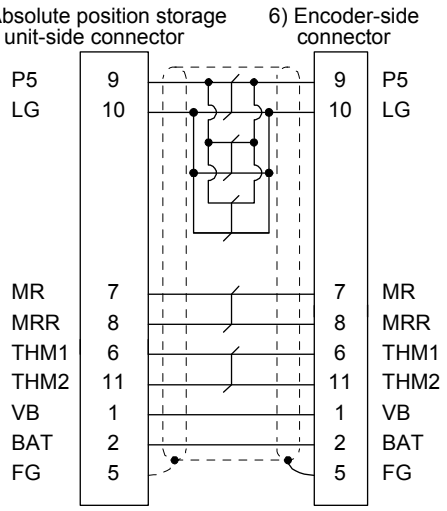
(a) Connector details

5) Absolute position storage unit-side connector	6) Encoder-side connector
Straight plug: RM15WTPZ-12P(72) Cord clamp: JR13WCCA-8(72) (Hirose Electric) Recommended cable: 20276 VSVPAWG#23×6P KB-0492 (Note 2) (Bando Densen)	Straight plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric) Recommended cable: 20276 VSVPAWG#23×6P KB-0492 (Note 2) (Bando Densen)
	
View seen from the wiring side. (Note 1)	View seen from the wiring side. (Note 1)

Note 1. Do not connect anything to the pins shown as ⌓.
2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch

(b) Cable internal wiring diagram

When the distance between the servo amplifier and the direct drive motor is within 20 m (Note)



Note. For the cable of 20 m or longer, contact your local sales office.

Refer to the following table for the wires required to fabricate the encoder cable.

Core size [mm^2]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

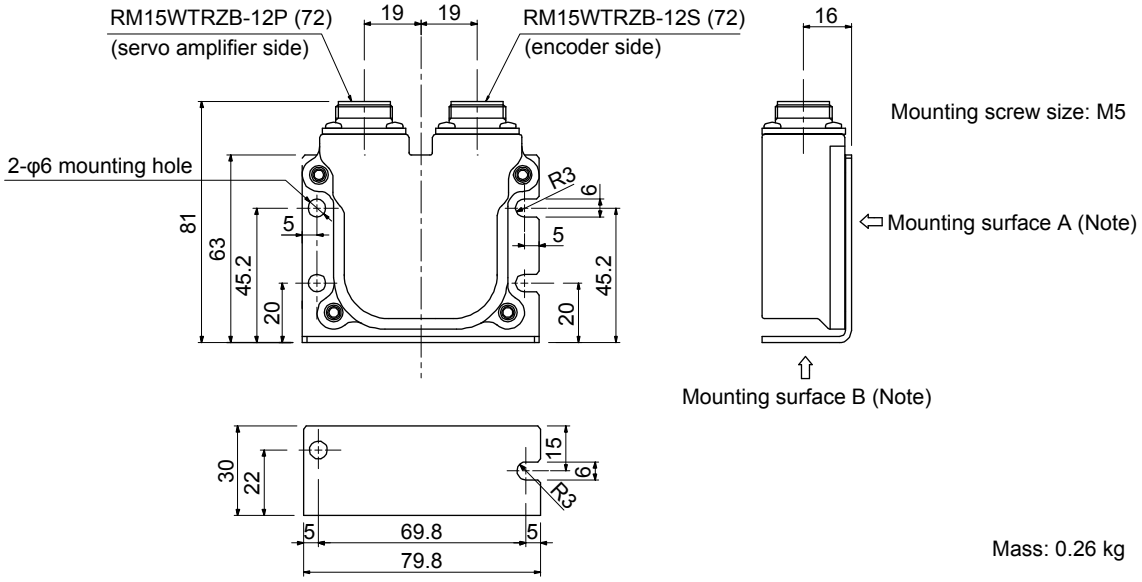
6.3 Absolute position storage unit MR-BTAS01

POINT
●Replacing the MR-BTAS01 absolute position storage unit will erase the absolute position. Start up the direct drive motor again and perform home positioning according to each servo amplifier instruction manual. ●For absolute position detection system, refer to each servo amplifier instruction manual. ●[AL. 25 Absolute position erased] will occur if the encoder cable is disconnected.

(1) Connection method with the encoder cable
Refer to section 6.2.3 (2).

(2) Dimensions

[Unit: mm]



Note. When mounting the unit outside the cabinet, fix the mounting surface A with four screws. When mounting the unit inside the cabinet, you can also fix the mounting surface B with two screws.

(3) Environment
The following table indicates the environment for the absolute position storage unit.

Item		Environment
Ambient temperature	Operation	0 ˚C to 55 ˚C (non-freezing)
	Storage	-20 ˚C to 65 ˚C (non-freezing)
Ambient humidity	Operation	10 %RH to 90 %RH (non-condensing)
	Storage	10 %RH to 90 %RH (non-condensing)
Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.
Altitude		Max. 2000 m above sea level
Vibration resistance		When the mounting surface A is fixed: 49 m/s^2 (directions of X, Y, and Z axes) When the mounting surface B is fixed: 5.9 m/s^2 (directions of X, Y, and Z axes)

MEMO

7. TM-RFM SERIES

This chapter provides information on the direct drive motor specifications and characteristics. When using the TM-RFM series direct drive motor, always read the Safety Instructions in the beginning of this manual in addition to this chapter.

7.1 Model code definition

The following describes what each block of a model name indicates. Note that not all the combinations of the symbols exist.

TM-RFM 002C20

Series

Rated torque

Symbol	Rated torque [N•m]
002	2
004	4
006	6
012	12
018	18
040	40
048	48
072	72
120	120
240	240

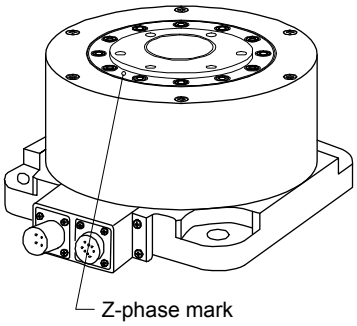
Rated speed

Symbol	Rated speed [r/min]
10	100
20	200

Motor OD (Frame OD)

Symbol	Dimensions [mm]
C	φ130
E	φ180
G	φ230
J	φ330

Outer appearance



7.2 Combinations of servo amplifier and direct drive motor

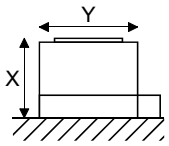
Direct drive motor	Servo amplifier			
	1-axis		2-axis	3-axis
	200 V class	100 V class		
TM-RFM002C20	MR-J4-20A MR-J4-20A-RJ MR-J4-20B MR-J4-20B-RJ MR-J4-20GF MR-J4-20GF-RJ	MR-J4-20A1 MR-J4-20A1-RJ MR-J4-20B1 MR-J4-20B1-RJ MR-J4-20GF1 MR-J4-20GF1-RJ	MR-J4W2-22B MR-J4W2-44B	MR-J4W3-222B MR-J4W3-444B
TM-RFM004C20	MR-J4-40A MR-J4-40A-RJ MR-J4-40B MR-J4-40B-RJ MR-J4-40GF MR-J4-40GF-RJ	MR-J4-40A1 MR-J4-40A1-RJ MR-J4-40B1 MR-J4-40B1-RJ MR-J4-40GF1 MR-J4-40GF1-RJ	MR-J4W2-44B MR-J4W2-77B MR-J4W2-1010B	MR-J4W3-444B
TM-RFM006C20	MR-J4-60A MR-J4-60A-RJ MR-J4-60B MR-J4-60B-RJ MR-J4-60GF MR-J4-60GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM006E20				
TM-RFM012E20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM018E20	MR-J4-100A MR-J4-100A-RJ MR-J4-100B MR-J4-100B-RJ MR-J4-100GF MR-J4-100GF-RJ		MR-J4W2-1010B	
TM-RFM012G20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM048G20	MR-J4-350A MR-J4-350A-RJ MR-J4-350B MR-J4-350B-RJ MR-J4-350GF MR-J4-350GF-RJ			
TM-RFM072G20				
TM-RFM040J10	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM120J10	MR-J4-350A MR-J4-350A-RJ MR-J4-350B MR-J4-350B-RJ MR-J4-350GF MR-J4-350GF-RJ			
TM-RFM240J10	MR-J4-500A MR-J4-500A-RJ MR-J4-500B MR-J4-500B-RJ MR-J4-500GF MR-J4-500GF-RJ			

7.3 Specification list

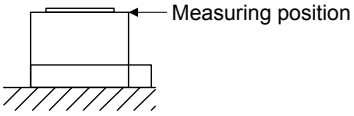
Item \ Direct drive motor			TM-RFM series					
			002C20	004C20	006C20	006E20	012E20	018E20
Motor OD (frame OD)		[mm]	φ130			φ180		
Power supply capacity			Refer to "USING A DIRECT DRIVE MOTOR" of each servo amplifier instruction manual.					
Continuous running duty (Note 1)	Rated output	[W]	42	84	126	126	251	377
	Rated torque	[N•m]	2	4	6	6	12	18
Maximum torque		[N•m]	6	12	18	18	36	54
Rated speed (Note 1)		[r/min]	200					
Maximum speed		[r/min]	500					
Instantaneous permissible speed		[r/min]	575					
Power rate at continuous rated torque		[kW/s]	3.7	9.6	16.1	4.9	12.9	21.8
Rated current		[A]	1.3	2.2	3.2	3.0	3.8	6.0
Maximum current		[A]	3.9	6.6	9.6	9.0	12	18
Moment of inertia J		[× 10^{-4} kg•m^2]	10.9	16.6	22.4	74.0	111	149
Recommended load to motor inertia ratio (Note 2)			50 times or less					
Absolute accuracy (Note 9)		[s]	±15			±12.5		
Speed/position detector (Note 3)			20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)					
Thermistor			Built-in					
Insulation class			155 (F)					
Structure			Totally enclosed, natural cooling (IP rating: IP42 (Note 4))					
Environment (Note 5)	Ambient temperature	Operation	0 ˚C to 40 ˚C (non-freezing)					
		Storage	-15 ˚C to 70 ˚C (non-freezing)					
	Ambient humidity	Operation	10 %RH to 80 %RH (non-condensing)					
		Storage	10 %RH to 90 %RH (non-condensing)					
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.					
	Altitude		Max. 2000 m above sea level (Note 10)					
	Vibration resistance (Note 6)		X: 49 m/s^2 Y: 49 m/s^2					
Vibration rank (Note 7)			V10					
Rotor permissible load (Note 8)	Moment load	[N•m]	22.5			70		
	Axial load	[N]	1100			3300		
Mass		[kg]	5.2	6.8	8.4	11	15	18

Item \ Direct drive motor			TM-RFM series					
			012G20	048G20	072G20	040J10	120J10	240J10
Motor OD (frame OD)		[mm]	φ230			φ330		
Power supply capacity			Refer to "USING A DIRECT DRIVE MOTOR" of each servo amplifier instruction manual.					
Continuous running duty (Note 1)	Rated output	[W]	251	1005	1508	419	1257	2513
	Rated torque	[N•m]	12	48	72	40	120	240
Maximum torque		[N•m]	36	144	216	120	360	720
Rated speed (Note 1)		[r/min]	200			100		
Maximum speed		[r/min]	500			200		
Instantaneous permissible speed		[r/min]	575			230		
Power rate at continuous rated torque		[kW/s]	6.0	37.5	59.3	9.4	40.9	91.4
Rated current		[A]	3.6	11	16	4.3	11	19
Maximum current		[A]	11	33	48	13	33	57
Moment of inertia J		[× 10^{-4} kg•m^2]	238	615	875	1694	3519	6303
Recommended load to motor inertia ratio (Note 2)			50 times or less					
Absolute accuracy (Note 9)		[s]	±12.5			±10		
Speed/position detector (Note 3)			20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)					
Thermistor			Built-in					
Insulation class			155 (F)					
Structure			Totally enclosed, natural cooling (IP rating: IP42 (Note 4))					
Environment (Note 5)	Ambient temperature	Operation	0 ˚C to 40 ˚C (non-freezing)					
		Storage	-15 ˚C to 70 ˚C (non-freezing)					
	Ambient humidity	Operation	10 %RH to 80 %RH (non-condensing)					
		Storage	10 %RH to 90 %RH (non-condensing)					
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.					
	Altitude		Max. 2000 m above sea level (Note 10)					
	Vibration resistance (Note 6)		X: 49 m/s^2 Y: 49 m/s^2			X: 24.5 m/s^2 Y: 24.5 m/s^2		
Vibration rank (Note 7)			V10					
Rotor permissible load (Note 8)	Moment load	[N•m]	93			350		
	Axial load	[N]	5500			16000		
Mass		[kg]	17	36	52	53	91	146

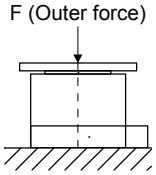
Note 1. When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
2. If the load inertia moment ratio exceeds the indicated value, contact your local sales office.
3. To configure the absolute position detection system, always connect the battery and absolute position storage unit to the servo amplifier. For details of the battery, refer to each servo amplifier instruction manual. Refer to section 6.3 for details of the absolute position storage unit.
4. Shaft-through portion of the rotor and the connector area are excluded. IP classifies the degrees of protection provided against the intrusion of solid objects and water in electrical enclosures.
5. In the environment where the direct drive motor is exposed to oil mist, oil, and water, a standard specification direct drive motor cannot be used. Provide measures to prevent dust and/or water on the machine side.
6. The following figure shows the vibration direction. The indicated values are the maximum values. When the direct drive motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about the half the permissible value.



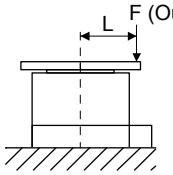
7. V10 indicates that the amplitude of a direct drive motor alone is 10 μm or less. The following figure shows the direct drive motor installation position for measurement and the measuring position.



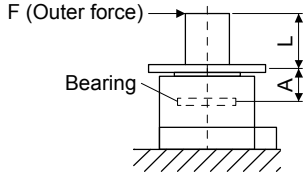
8. Axial and moment loads, which are applied to the direct drive motor's rotor (output shaft) during operation, can be calculated as below. The axial and moment loads must be maintained to be equal to or below the permissible value.



Axial load
= F + load mass



Axial load
= F + load mass
Moment load
= F × L



Axial load
= Load mass
Moment load
= F × (L + A)

Direct drive motor	Motor OD [mm]	Dimension A [mm]
TM-RFM002C20 TM-RFM004C20 TM-RFM006C20	φ130	19.1
TM-RFM006E20 TM-RFM012E20 TM-RFM018E20	φ180	20.2
TM-RFM012G20 TM-RFM048G20 TM-RFM072G20	φ230	24.4
TM-RFM040J10 TM-RFM120J10 TM-RFM240J10	φ330	32.5

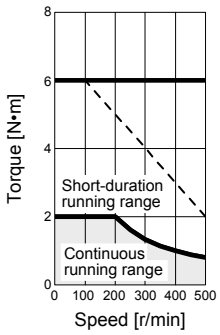
9. Absolute accuracy changes depending on the mounting condition of the load and the surrounding environment.
10. Follow the restrictions in section 2.10 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.

7.4 Torque characteristics

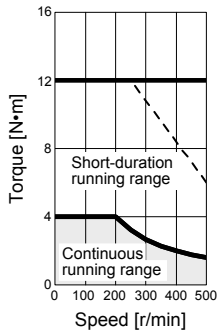
> POINT
>
> ●For the machine where the unbalanced torque occurs, such as a vertical axis system (lift), use the absolute position detection system. (Refer to section 2.1 (4).) The unbalanced torque of the machine should be kept at 70% or lower of the motor's rated torque.

Bold lines indicate the torque characteristics with the 3-phase 200 V AC power supply input or 1-phase 230 V AC power supply input to the servo amplifier. For the 1-phase 200 V AC power supply input, part of the torque characteristic is indicated by thin lines. The 1-phase power supply input is available for: TM-RFM002C20, TM-RFM004C20, TM-RFM006C20, TM-RFM006E20, TM-RFM012E20, TM-RFM018E20, TM-RFM012G20, and TM-RFM040J10. For the 1-phase 100 V AC power supply, part of the torque characteristic is indicated by the broken line.

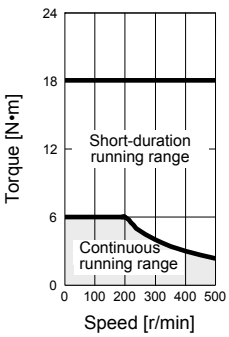
[TM-RFM002C20]



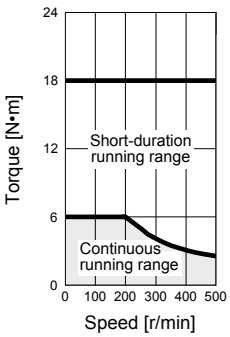
[TM-RFM004C20]



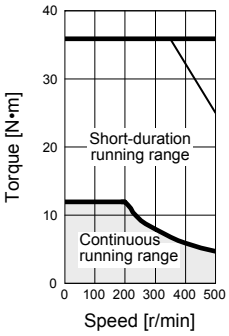
[TM-RFM006C20]



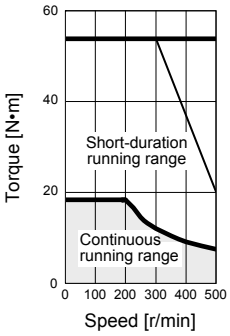
[TM-RFM006E20]



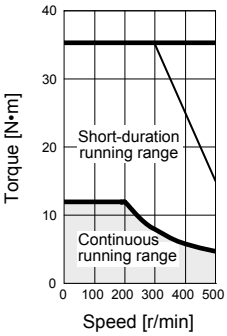
[TM-RFM012E20]



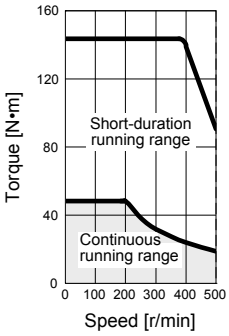
[TM-RFM018E20]



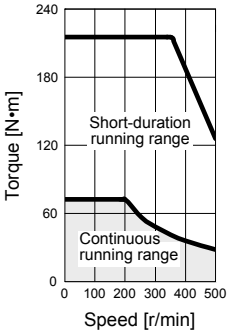
[TM-RFM012G20]



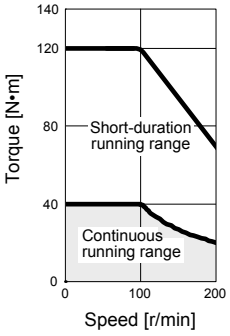
[TM-RFM048G20]



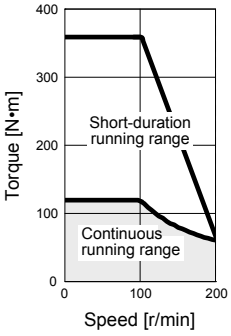
[TM-RFM072G20]



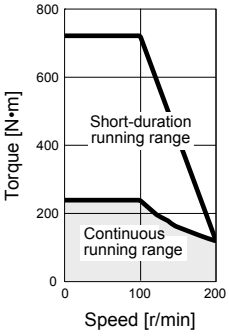
[TM-RFM040J10]



[TM-RFM120J10]



[TM-RFM240J10]

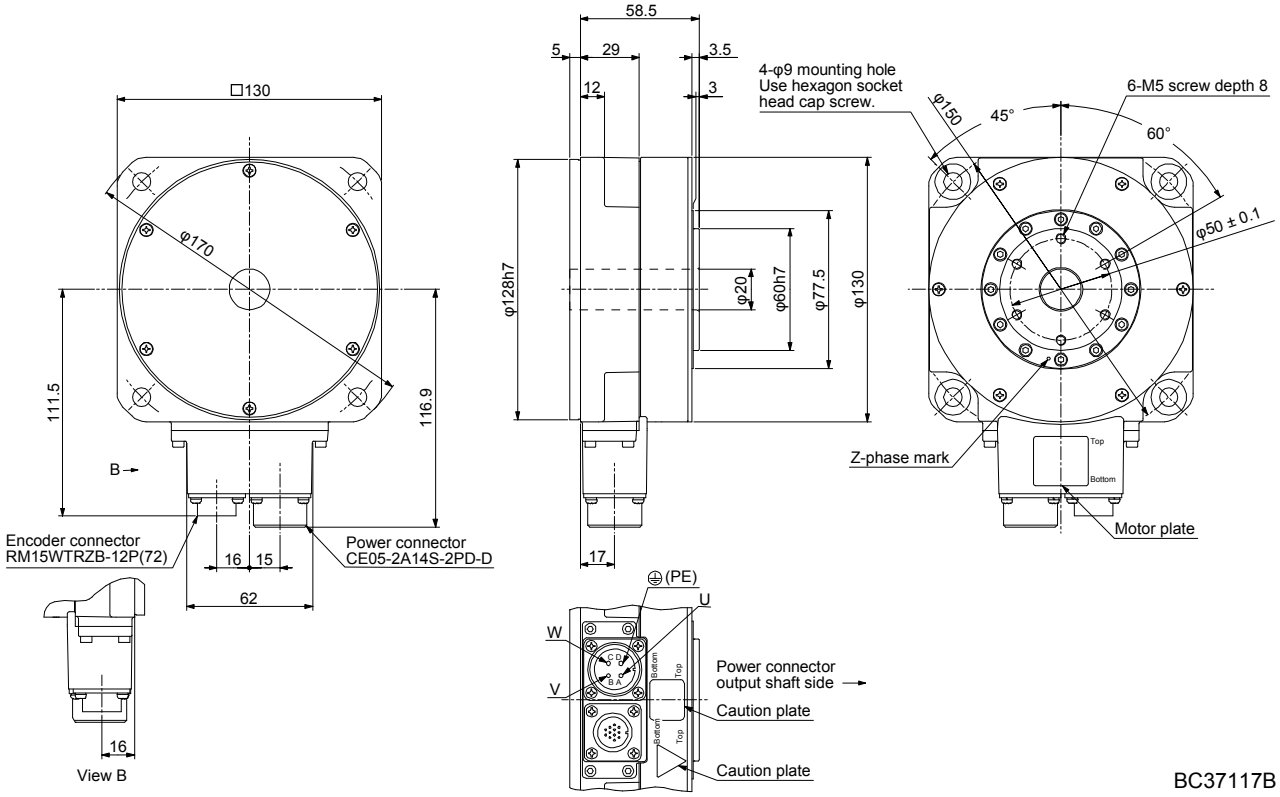


7.5 Dimensions

The actual dimensions may be 1 mm to 3 mm larger. Design the machine side with some allowances.
Apply general tolerances for the dimensions without tolerances.

Model	Output [W]	Moment of inertia J [$\times 10^{-4}$ kg•m^2]	Mass [kg]
TM-RFM002C20	42	10.9	5.2

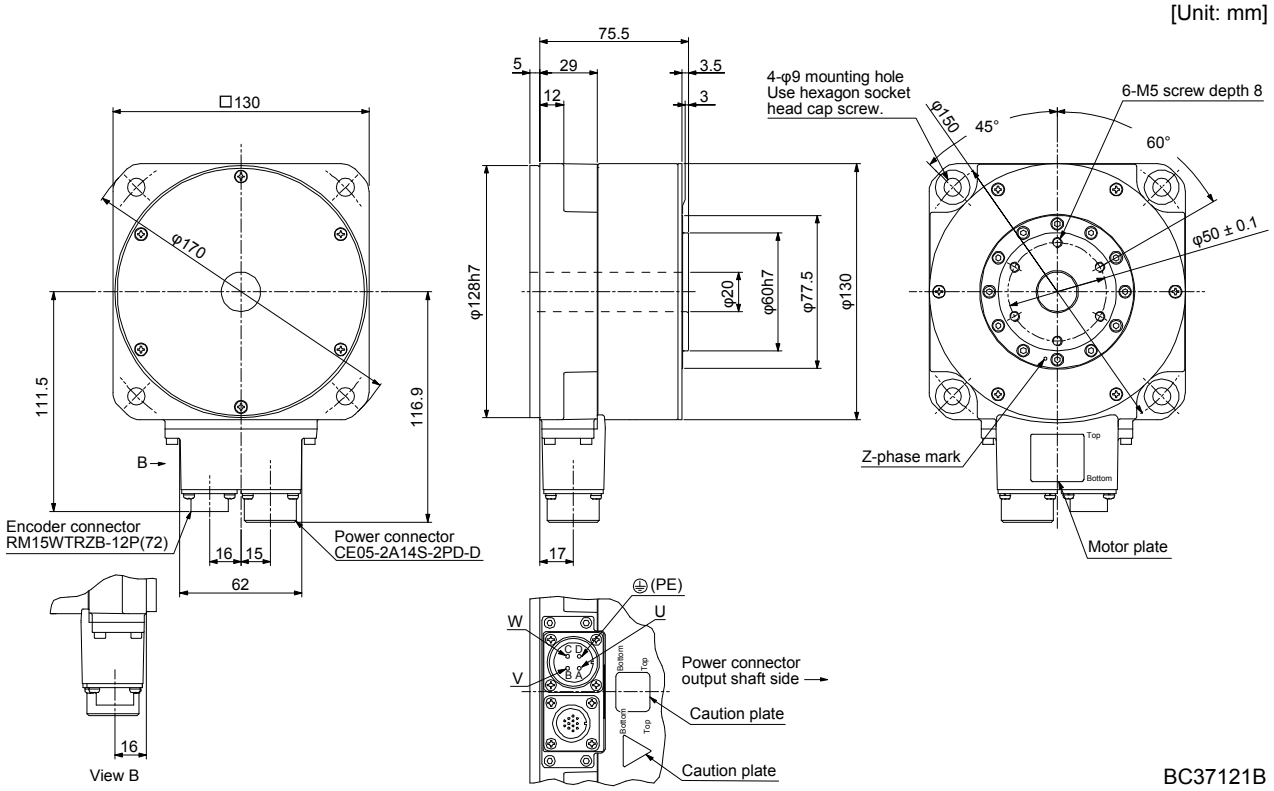
[Unit: mm]



BC37117B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM004C20	84	16.6	6.8

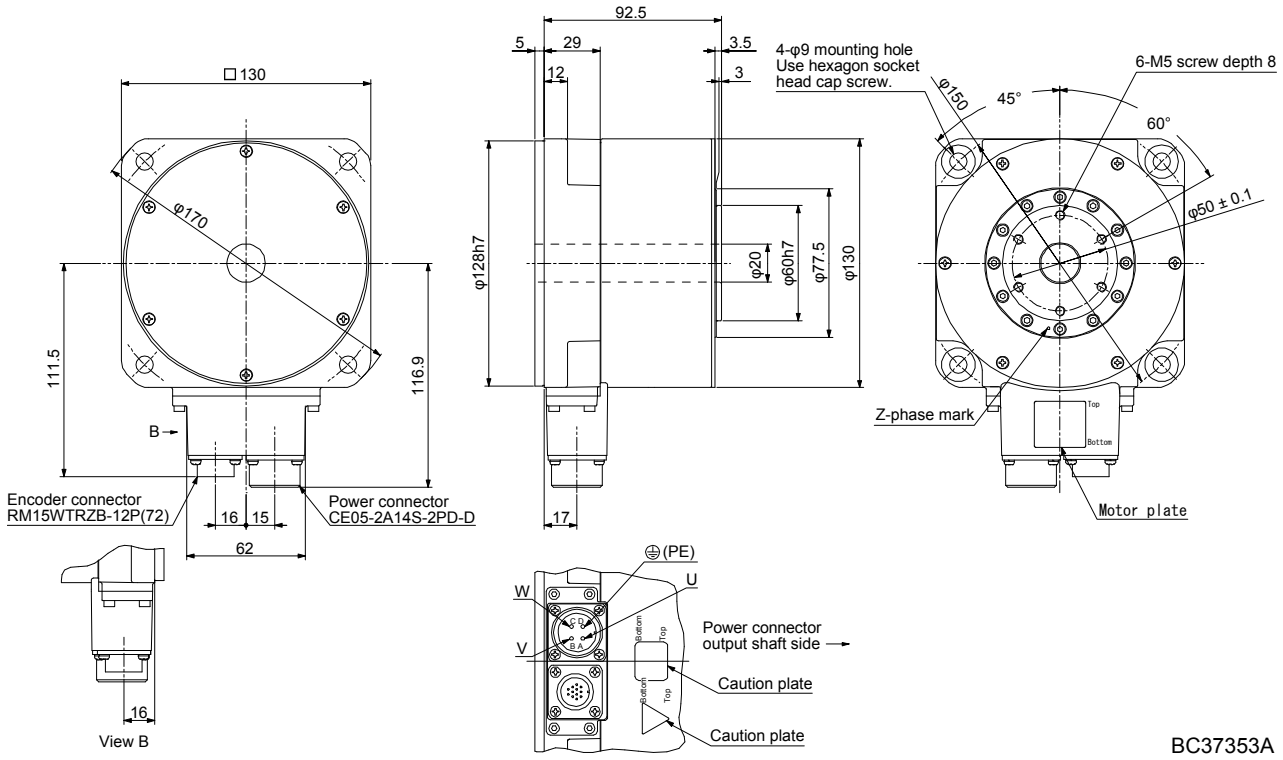
[Unit: mm]



BC37121B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM006C20	126	22.4	8.4

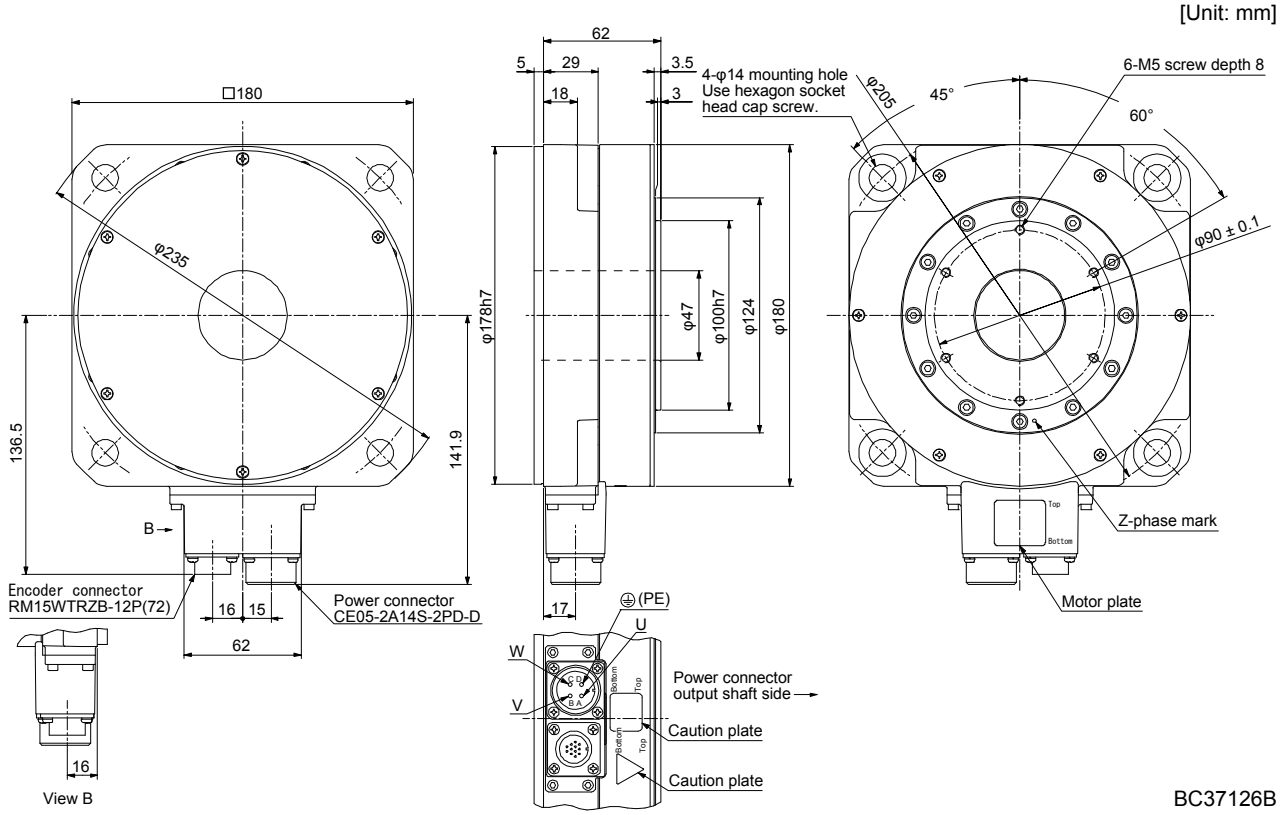
[Unit: mm]



BC37353A

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM006E20	126	74.0	11

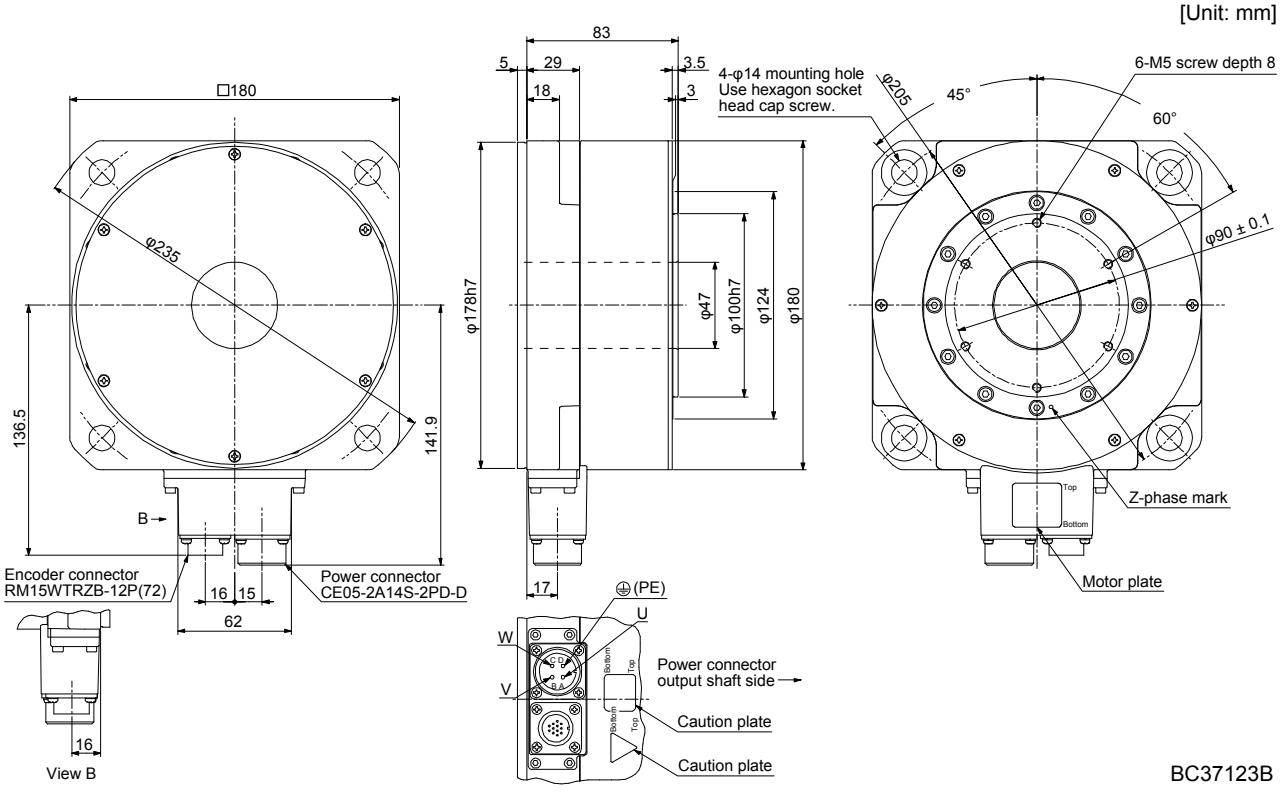
[Unit: mm]



BC37126B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM012E20	251	111	15

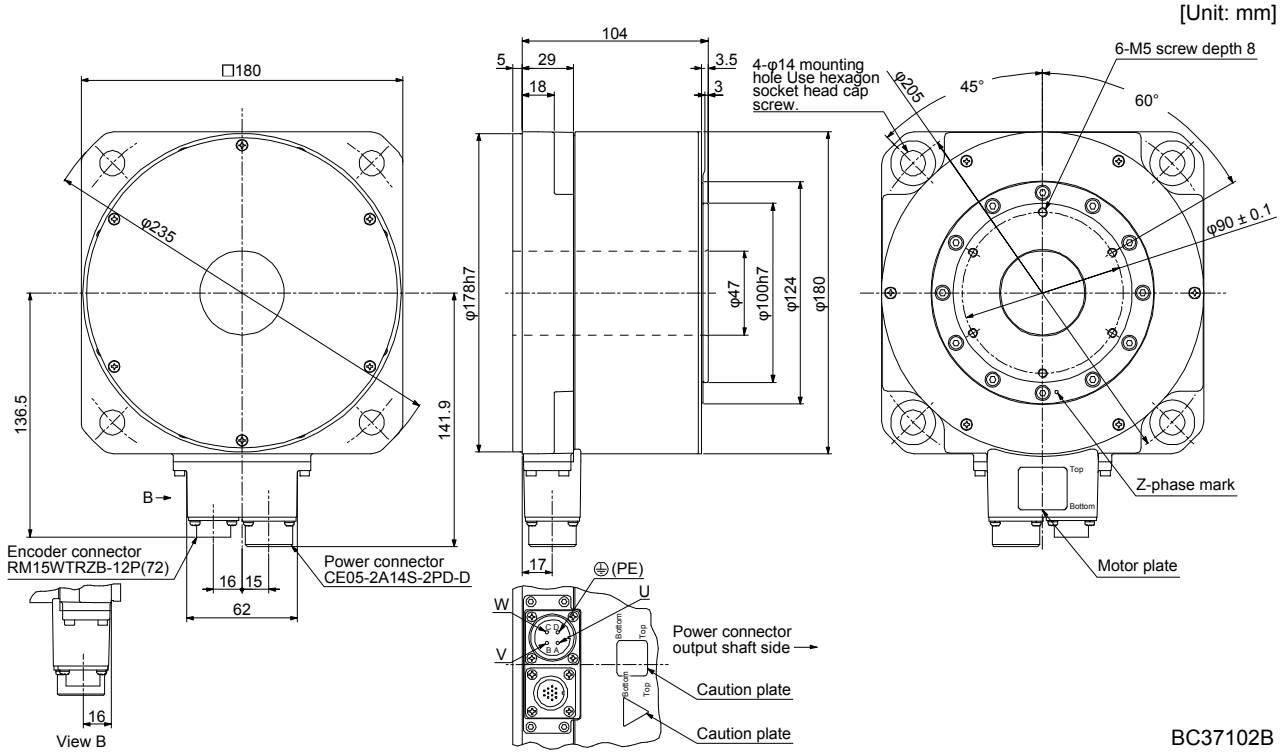
[Unit: mm]



BC37123B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM018E20	377	149	18

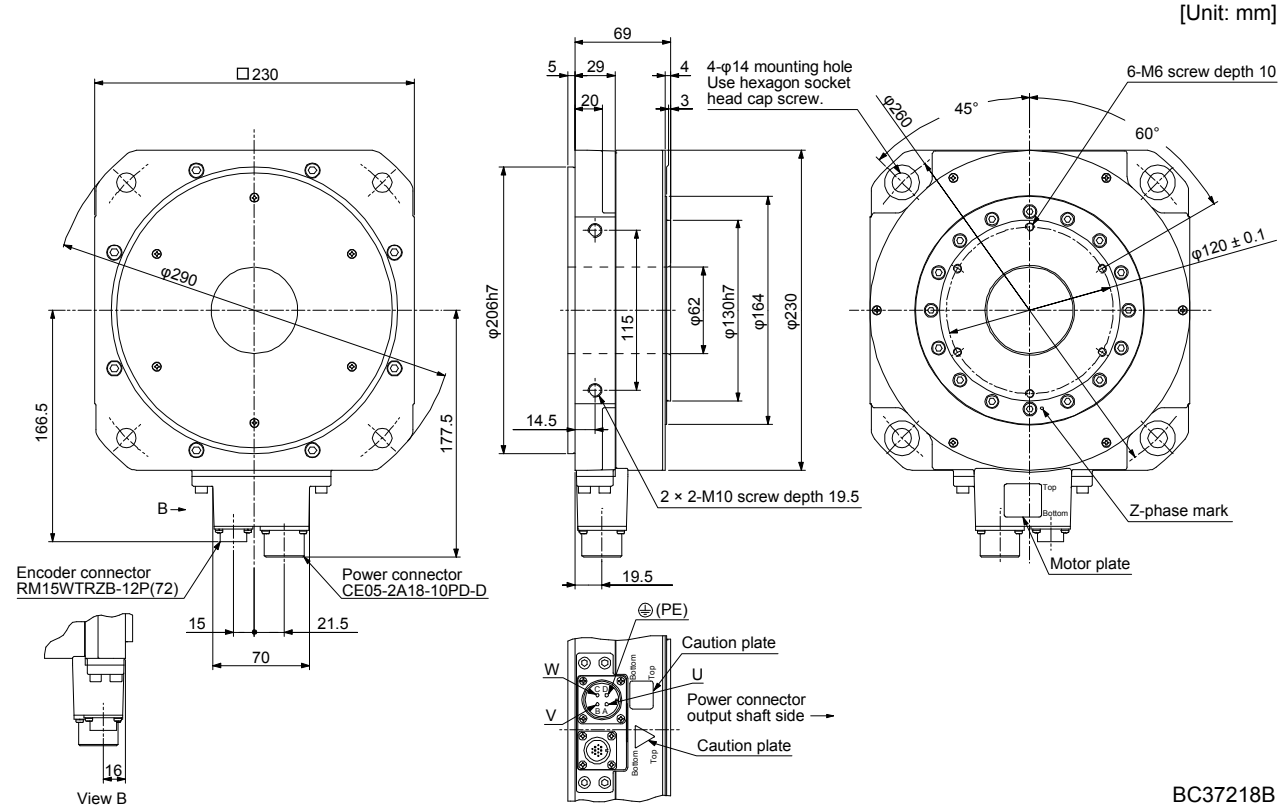
[Unit: mm]



BC37102B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM012G20	251	238	17

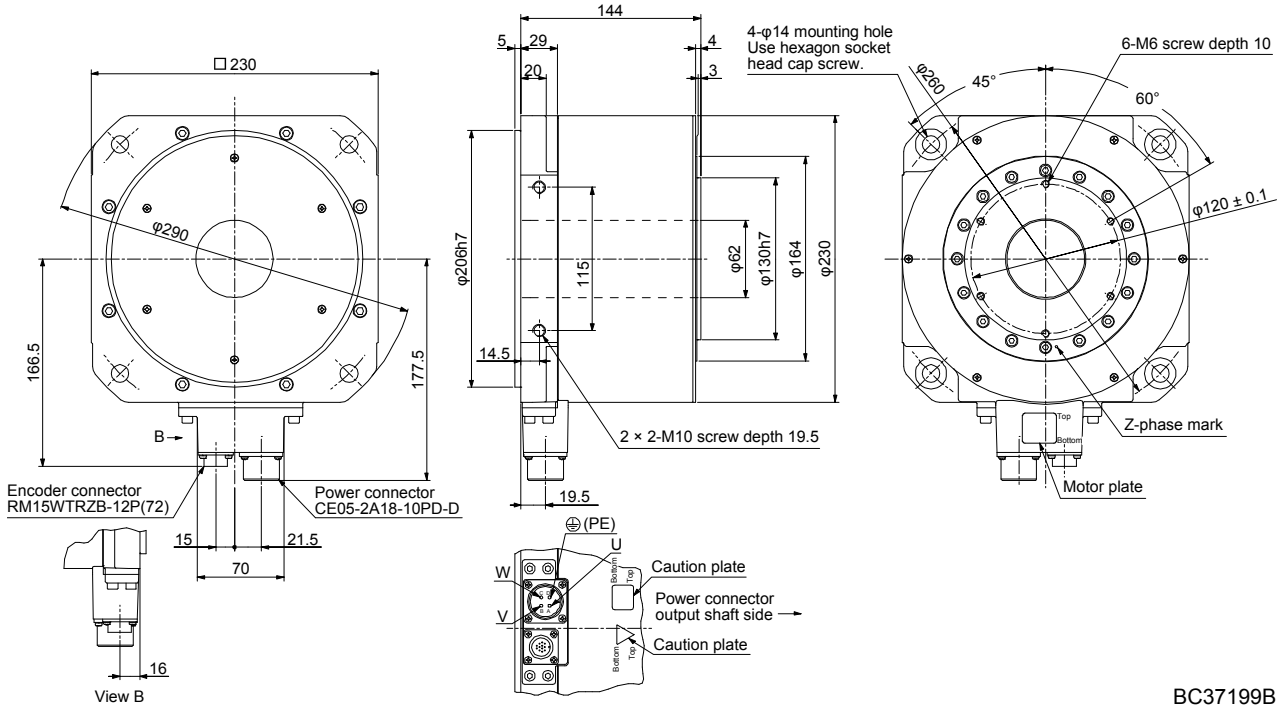
[Unit: mm]



BC37218B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM048G20	1005	615	36

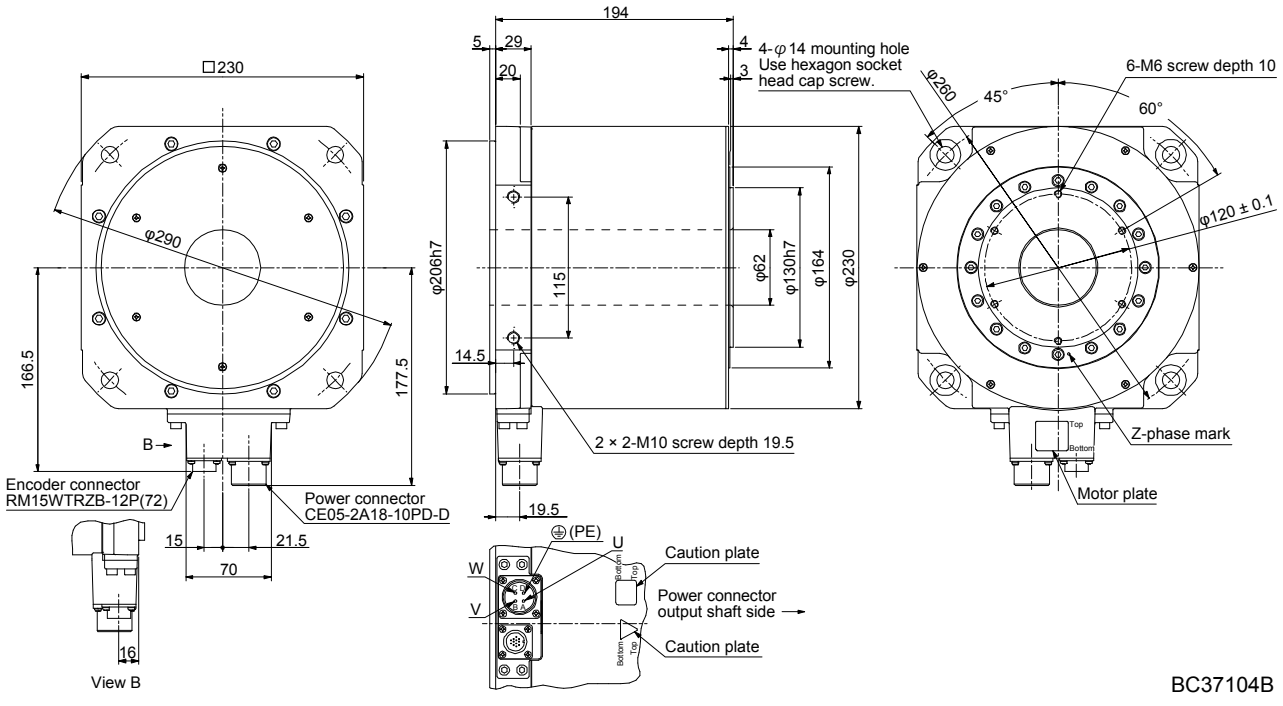
[Unit: mm]



BC37199B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM072G20	1508	875	52

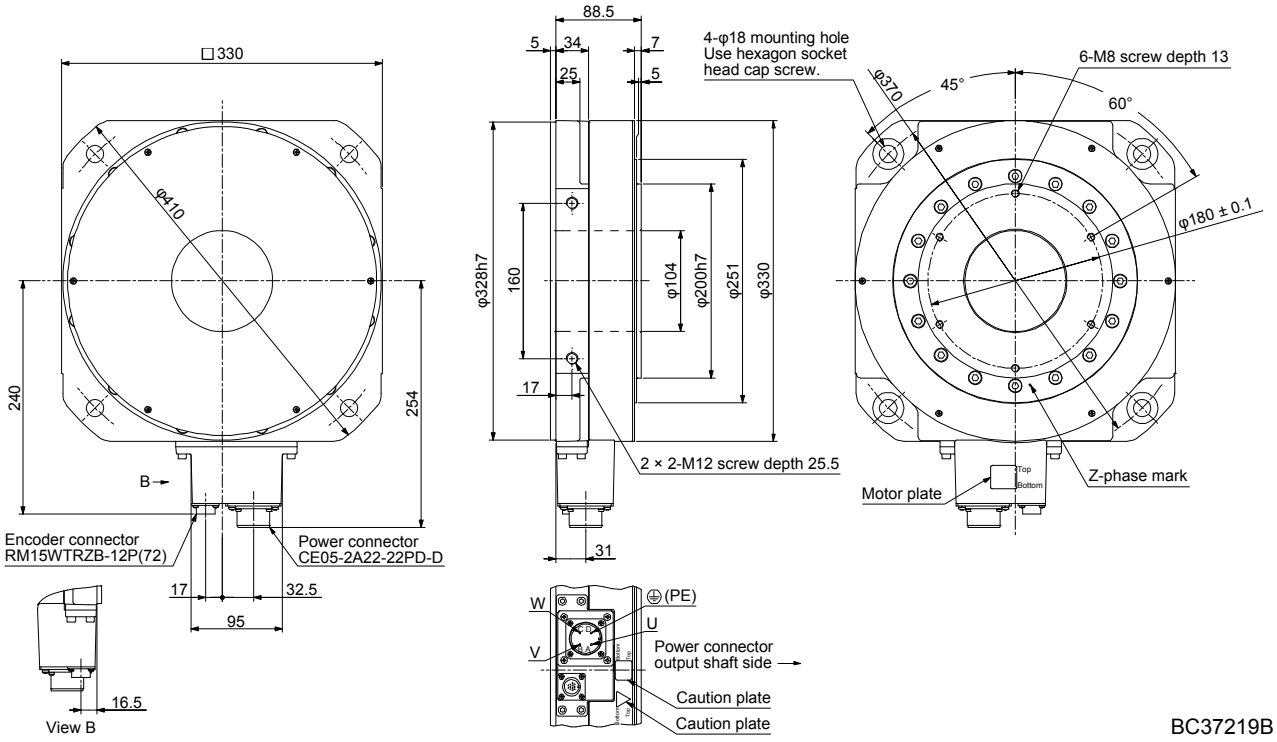
[Unit: mm]



BC37104B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM040J10	419	1694	53

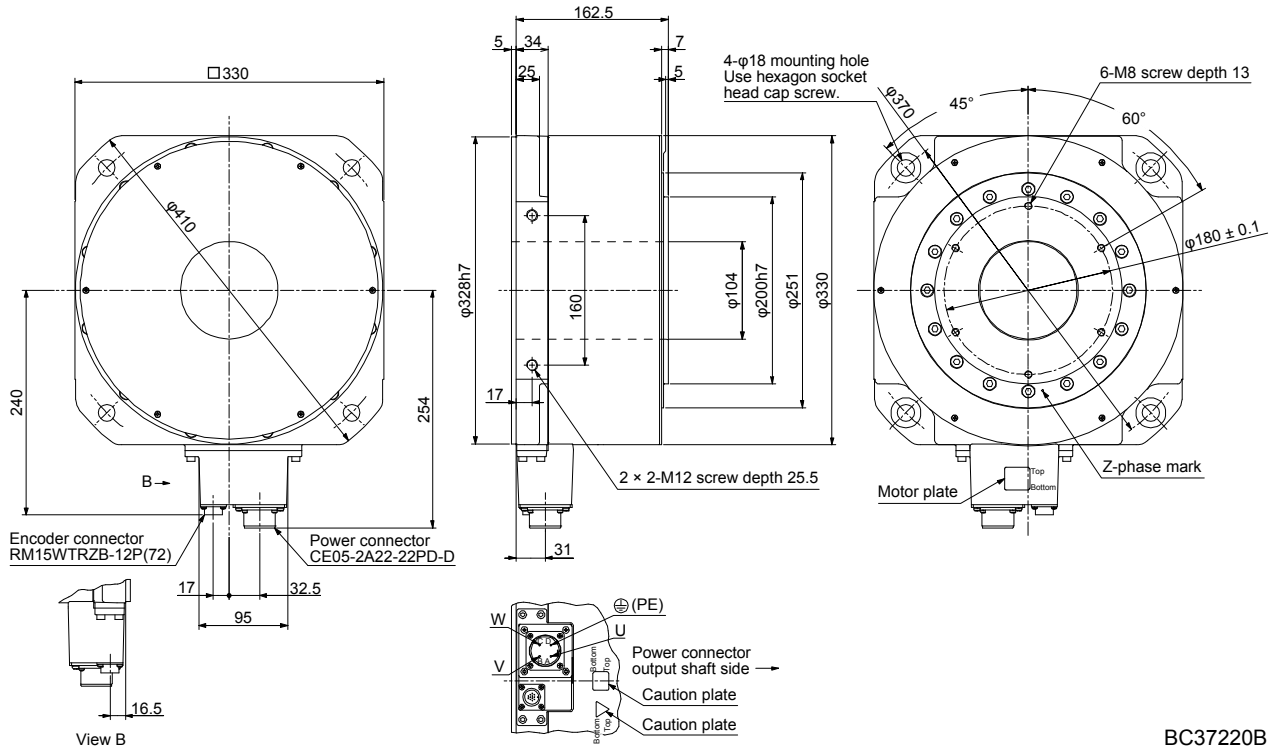
[Unit: mm]



BC37219B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM120J10	1257	3519	91

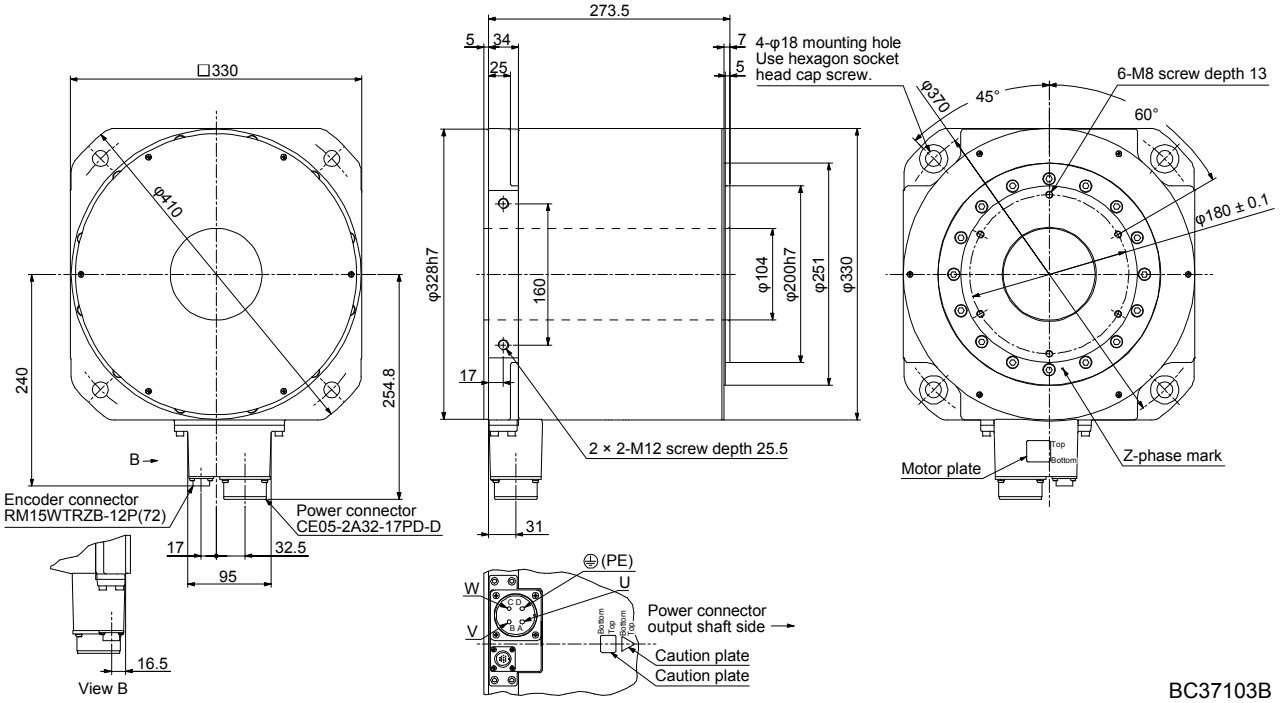
[Unit: mm]



BC37220B

Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RFM240J10	2513	6303	146

[Unit: mm]



BC37103B

MEMO

8. TM-RG2M SERIES/TM-RU2M SERIES

This chapter provides information on the direct drive motor specifications and characteristics. When using the TM-RG2M series or TM-RU2M series direct drive motor, always read the Safety Instructions in the beginning of this manual in addition to this chapter.

8.1 Model designation

The following describes model designation. Not all combinations of the symbols are available.

(1) Flange type

TM-RG2M 0 0 4 E 3 0

Series

Rated torque

Symbol	Rated torque [N•m]
002	2.2
004	4.5
009	9

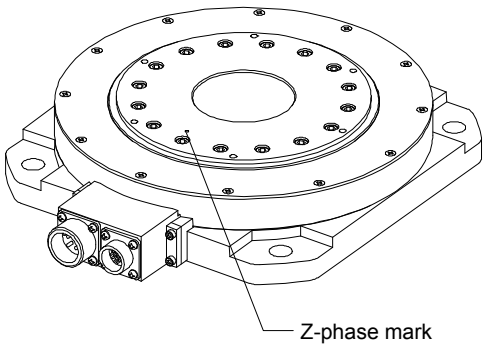
Rated speed

Symbol	Rated speed [r/min]
30	300

Motor OD (frame OD)

Symbol	Dimensions [mm]
C	φ130
E	φ180
G	φ230

Appearance



(2) Table type

TM-RU2M 0 0 4 E 3 0

Series

Rated torque

Symbol	Rated torque [N•m]
002	2.2
004	4.5
009	9

Rated speed

Symbol	Rated speed [r/min]
30	300

Motor OD (frame OD)

Symbol	Dimensions [mm]
C	φ130
E	φ180
G	φ230

8.2 Combinations of servo amplifier and direct drive motor

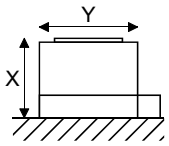
Direct drive motor	Servo amplifier					
	1-axis		2-axis		3-axis	
	Standard	For increasing the rated torque/maximum torque (Note)	Standard	For increasing the rated torque/maximum torque (Note)	Standard	For increasing the rated torque/maximum torque (Note)
TM-RG2M002C30 TM-RU2M002C30	MR-J4-20A MR-J4-20A-RJ MR-J4-20A1 MR-J4-20A1-RJ MR-J4-20B MR-J4-20B-RJ MR-J4-20B1 MR-J4-20B1-RJ MR-J4-20GF MR-J4-20GF-RJ MR-J4-20GF1 MR-J4-20GF1-RJ		MR-J4W2-22B MR-J4W2-44B		MR-J4W3-222B MR-J4W3-444B	
TM-RG2M004E30 TM-RU2M004E30	MR-J4-20A MR-J4-20A-RJ MR-J4-20A1 MR-J4-20A1-RJ MR-J4-20B MR-J4-20B-RJ MR-J4-20B1 MR-J4-20B1-RJ MR-J4-20GF MR-J4-20GF-RJ MR-J4-20GF1 MR-J4-20GF1-RJ	MR-J4-40A MR-J4-40A-RJ MR-J4-40A1 MR-J4-40A1-RJ MR-J4-40B MR-J4-40B-RJ MR-J4-40B1 MR-J4-40B1-RJ MR-J4-40GF MR-J4-40GF-RJ MR-J4-40GF1 MR-J4-40GF1-RJ	MR-J4W2-22B	MR-J4W2-44B	MR-J4W3-222B	MR-J4W3-444B
TM-RG2M009G30 TM-RU2M009G30	MR-J4-40A MR-J4-40A-RJ MR-J4-40A1 MR-J4-40A1-RJ MR-J4-40B MR-J4-40B-RJ MR-J4-40B1 MR-J4-40B1-RJ MR-J4-40GF MR-J4-40GF-RJ MR-J4-40GF1 MR-J4-40GF1-RJ		MR-J4W2-44B		MR-J4W3-444B	

Note. The rated torque and the maximum torque can be increased by changing the servo amplifier.

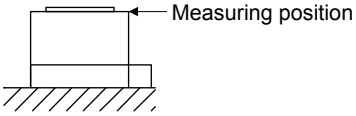
8.3 Specification list

Item \ Direct drive motor			TM-RG2M/RU2M series		
			002C30	004E30	009G30
Motor OD (frame OD)		[mm]	φ130	φ180	φ230
Power supply capacity			Refer to "USING A DIRECT DRIVE MOTOR" of each servo amplifier instruction manual.		
Continuous running duty (Note 1)	Rated output (Note 9)	[W]	69	141 (188)	283
	Rated torque (Note 9)	[N•m]	2.2	4.5 (6)	9
Maximum torque (Note 9)		[N•m]	8.8	13.5 (18)	27
Rated speed (Note 1)		[r/min]	300		
Maximum speed		[r/min]	600		
Instantaneous permissible speed		[r/min]	690		
Power rate at continuous rated torque (Note 9)		[kW/s]	6.1	3.4 (6.0)	5.5
Rated current (Note 9)		[A]	1.2	1.3 (1.7)	2.2
Maximum current (Note 9)		[A]	4.9	4.0 (5.3)	6.7
Moment of inertia J		[× 10^{-4} kg•m^2]	7.88	60.2	147
Recommended load to motor inertia ratio (Note 2)			50 times or less	20 times or less	
Absolute accuracy (Note 11)		[s]	±15	±12.5	
Speed/position detector (Note 3)	Common to absolute position/incremental systems		21-bit encoder	22-bit encoder	
	Resolution per direct drive motor revolution		2097152 pulses/rev	4194304 pulses/rev	
Thermistor			Built-in		
Insulation class			155 (F)		
Structure			Totally-enclosed, natural-cooling (IP rating: IP40 (Note 4))		
Environment (Note 5)	Ambient temperature	Operation	0 ˚C to 40 ˚C (non-freezing)		
		Storage	-15 ˚C to 70 ˚C (non-freezing)		
	Ambient humidity	Operation	10 %RH to 80 %RH (non-condensing)		
		Storage	10 %RH to 90 %RH (non-condensing)		
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.		
	Altitude		2000 m or less above sea level (Note 10)		
	Vibration resistance (Note 6)		X: 49 m/s^2 Y: 49 m/s^2		
Vibration rank (Note 7)			V10		
Rotor permissible load (Note 8)	Moment load	[N•m]	15	49	65
	Axial load	[N]	770	2300	3800
Mass		[kg]	2.7	5.5	8.3

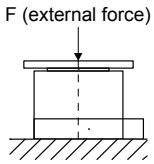
Note 1. When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
2. If the load inertia moment ratio exceeds the indicated value, contact your local sales office.
3. To configure the absolute position detection system, always connect the battery and absolute position storage unit to the servo amplifier. For details of the battery, refer to each servo amplifier instruction manual. For details of the absolute position storage unit, refer to section 6.3.
4. Shaft-through portion of the rotor and the connector area are excluded. IP classifies the degrees of protection provided against the intrusion of solid objects and water in electrical enclosures.
5. In the environment where the direct drive motor is exposed to oil mist, oil, and water, a standard specification direct drive motor cannot be used. Provide measures to prevent dust and/or water on the machine side.
6. The vibration direction is as shown below. The indicated values are the maximum values. When the direct drive motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about the half of the permissible value.



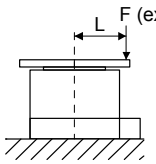
7. V10 indicates that the amplitude of a direct drive motor alone is 10 μm or less. The following figure shows the direct drive motor mounting position for measurement and the measuring position.



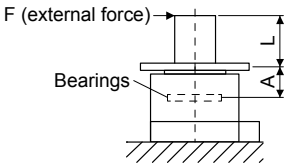
8. Axial and moment loads, which are applied to the direct drive motor's rotor (output shaft) during operation, can be calculated as below. The axial and moment loads must be maintained to be equal to or below the permissible value.



Axial load
= F + load mass



Axial load
= F + load mass
Moment load
= F × L



Axial load
= Load mass
Moment load
= F × (L + A)

Direct drive motor	Motor OD [mm]	Dimension A [mm]
TM-RG2M002C30 TM-RU2M002C30	φ130	20.6
TM-RG2M004E30 TM-RU2M004E30	φ180	20.7
TM-RG2M009G30 TM-RU2M009G30	φ230	18.0

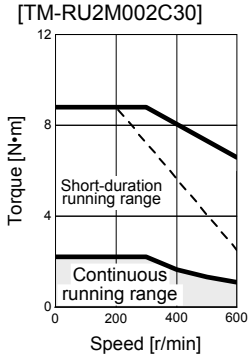
9. The value inside ( ) applies when the torque is increased. The rated torque and the maximum torque can be increased by changing the servo amplifier.
Refer to section 8.2 for the combinations.
10. Follow the restrictions in section 2.10 when using this product at altitude exceeding 1000 m and up to 2000 m above sea level.
11. Absolute accuracy changes depending on the mounting condition of the load and the surrounding environment.

8.4 Torque characteristics

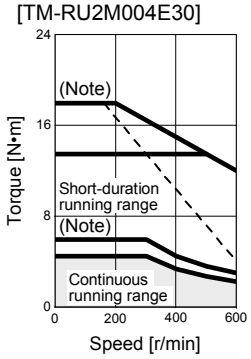
POINT
●For the machine where the unbalanced torque occurs, such as a vertical axis system (lift), use the absolute position detection system. (Refer to section 2.1 (4).) The unbalanced torque should be kept at 70% or less of the rated torque.

When the power supply input of the servo amplifier is 3-phase 200 V AC or 1-phase 230 V AC, the torque characteristic is indicated by the heavy line. For the 1-phase 100 V AC power supply, part of the torque characteristic is indicated by the broken line.

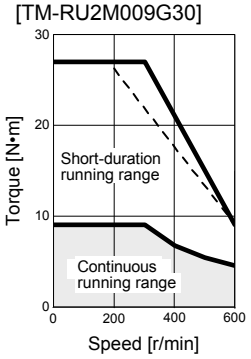
[TM-RG2M002C30]
[TM-RU2M002C30]



[TM-RG2M004E30]
[TM-RU2M004E30]



[TM-RG2M009G30]
[TM-RU2M009G30]



Note. The rated torque and the maximum torque can be increased by changing the servo amplifier.
Refer to section 8.2 for the combinations.

8.5 Mounting method

Flange type (pilot)

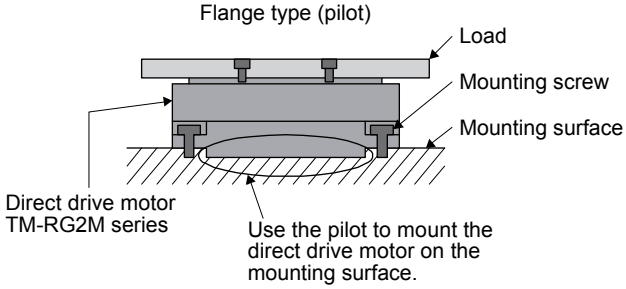
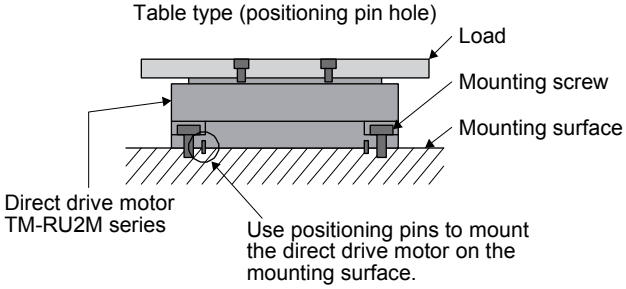


Table type (positioning pin hole)



Mounting precautions

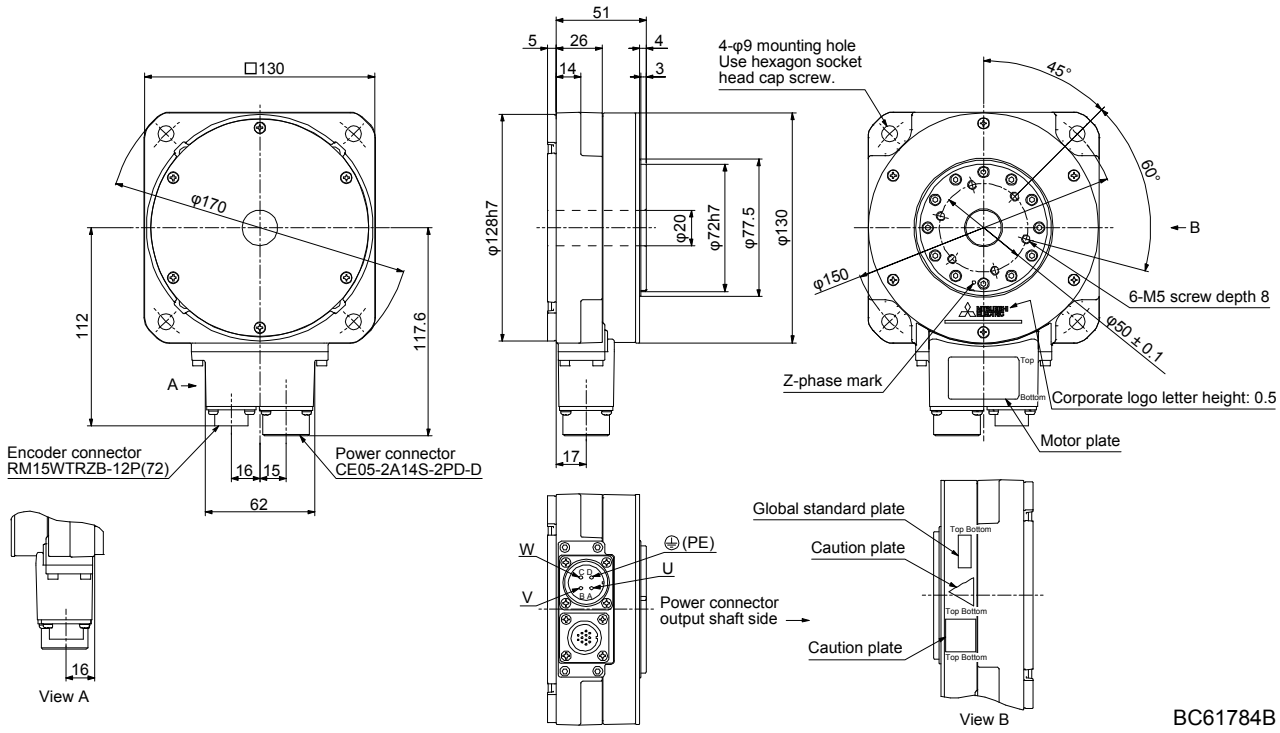
- If the mounting surface has low rigidity, machine resonance may occur. Securely mount the direct drive motor on the mounting surface having high rigidity.
- To ensure sufficient rigidity, fully tighten the mounting screws for the direct drive motor and rotary table.
- To ensure the accuracy and heat dissipation of the direct drive motor, closely mount the motor on the mounting surface having a sufficient heat dissipation area and high rigidity. Do not leave a gap between the mounting surface and the bottom of the direct drive motor.
- The mounting accuracy of the flange type is higher than that of the table type. If the direct drive motor needs to be mounted with high accuracy, select the flange type.
  For the machine accuracies of each direct drive motor, refer to section 2.8. For the dimension tolerance, refer to section 8.6.

8.6 Dimensions

The actual dimensions may be 1 mm to 3 mm larger. Design the machine side with some allowances. The dimensions without tolerances are general tolerance.

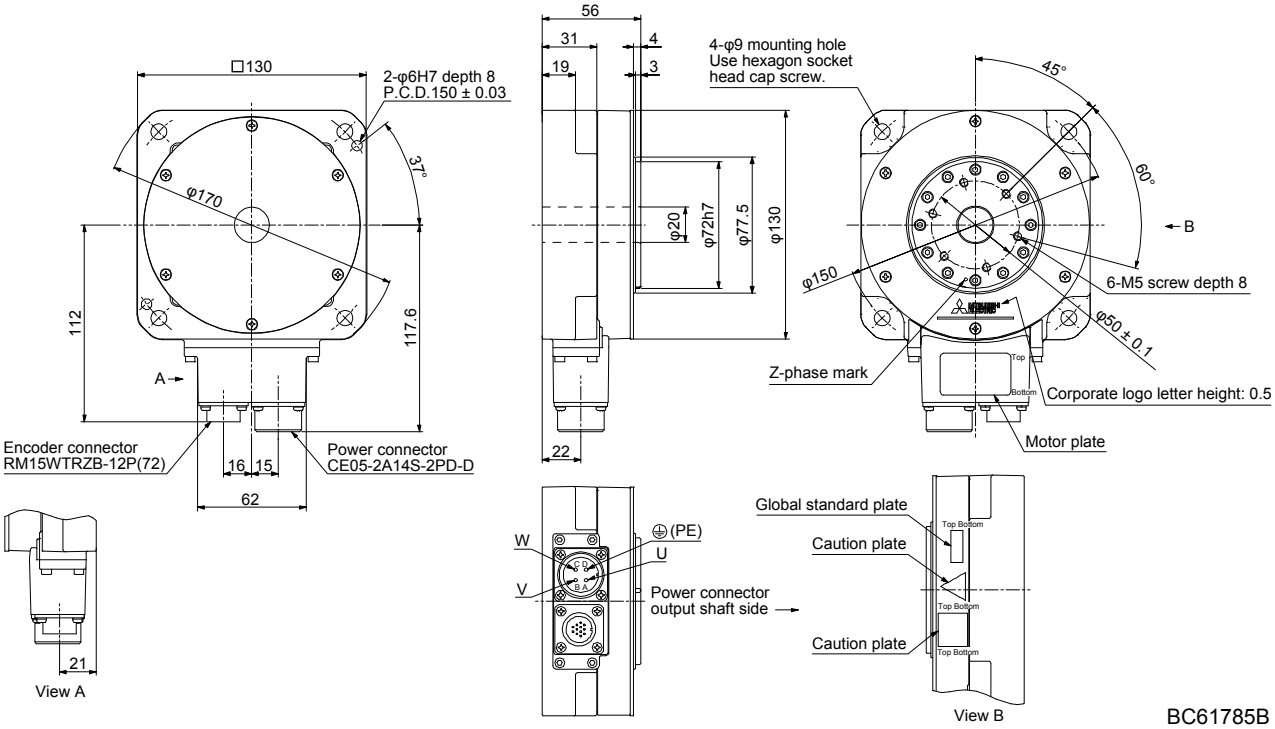
Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RG2M002C30	69	7.88	2.7

[Unit: mm]



Model	Output [W]	Moment of inertia J [$\times 10^{-4}$ kg•m^2]	Mass [kg]
TM-RU2M002C30	69	7.88	2.7

[Unit: mm]

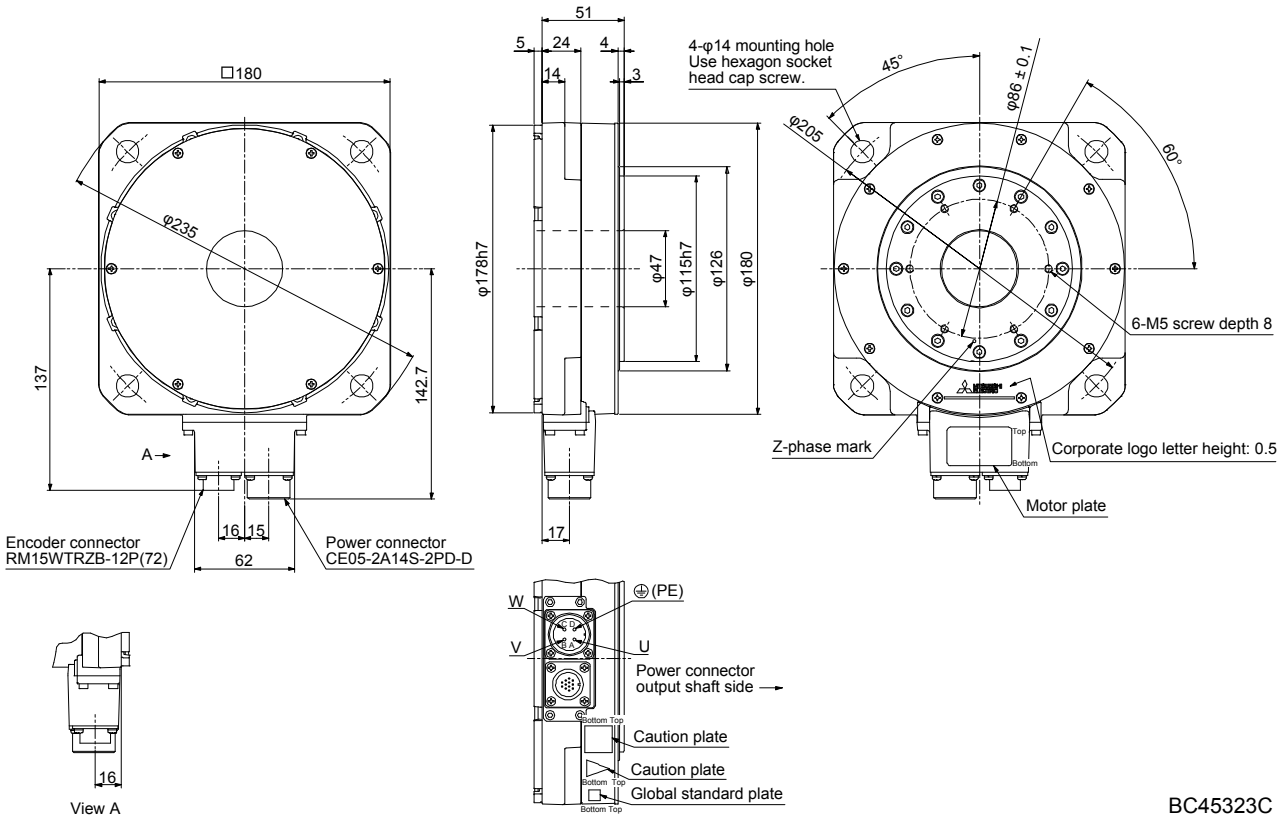


BC61785B

Model	Output [W] (Note)	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RG2M004E30	141 (188)	60.2	5.5

Note. The value inside ( ) applies when the torque is increased.

[Unit: mm]

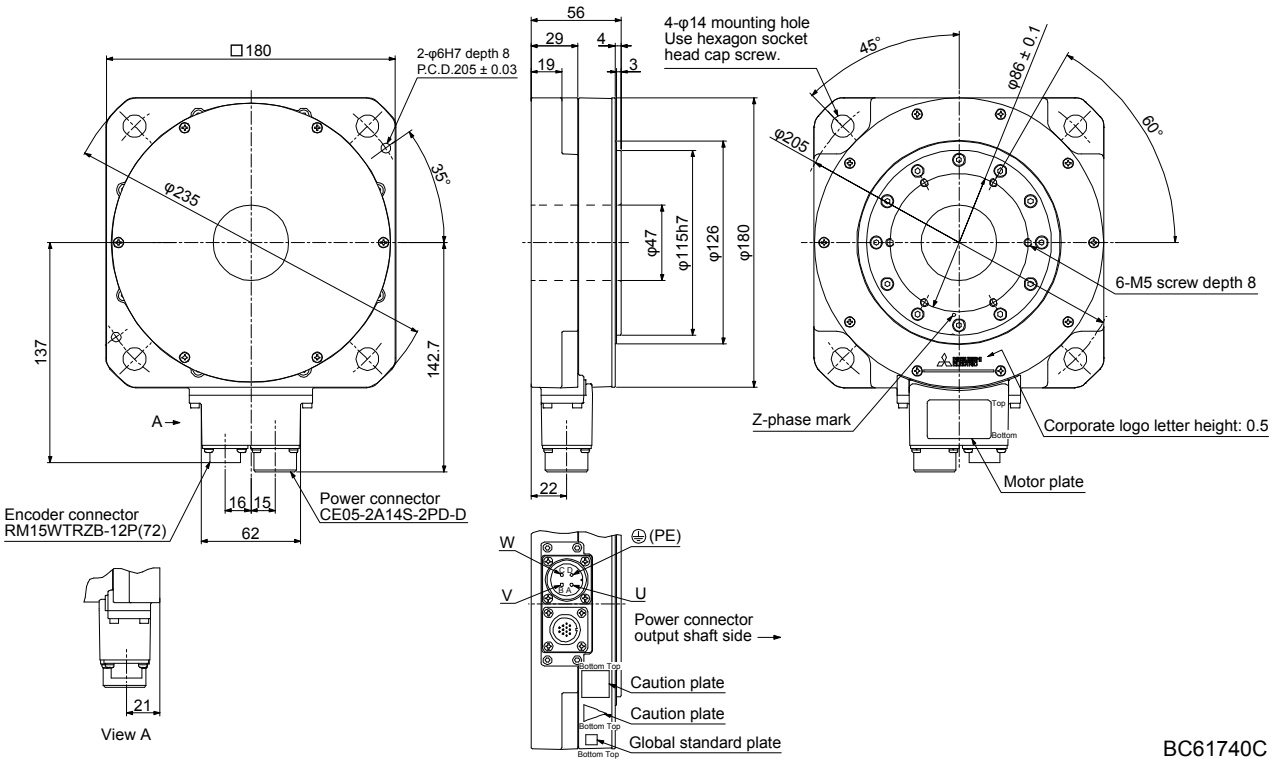


BC45323C

Model	Output [W] (Note)	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RU2M004E30	141 (188)	60.2	5.5

Note. The value inside ( ) applies when the torque is increased.

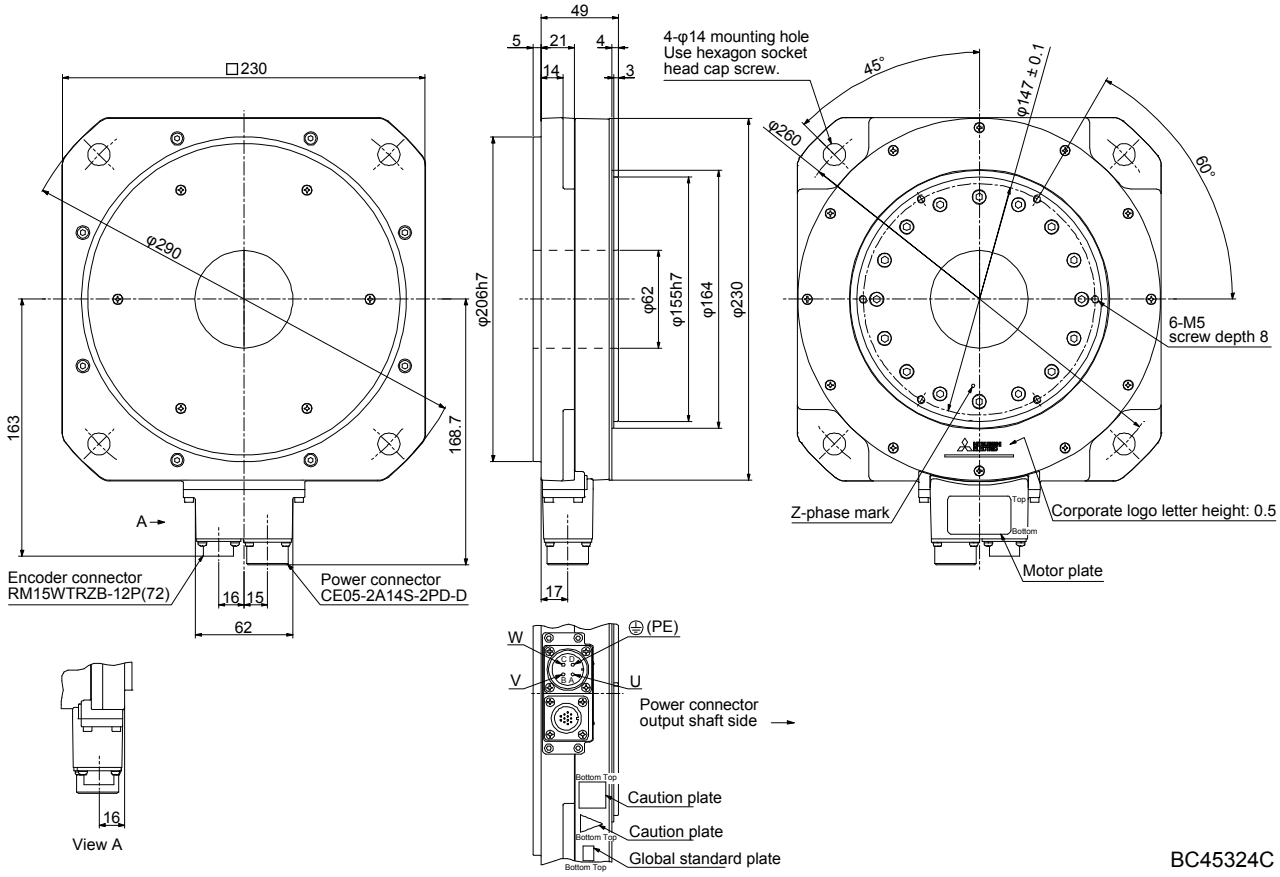
[Unit: mm]



BC61740C

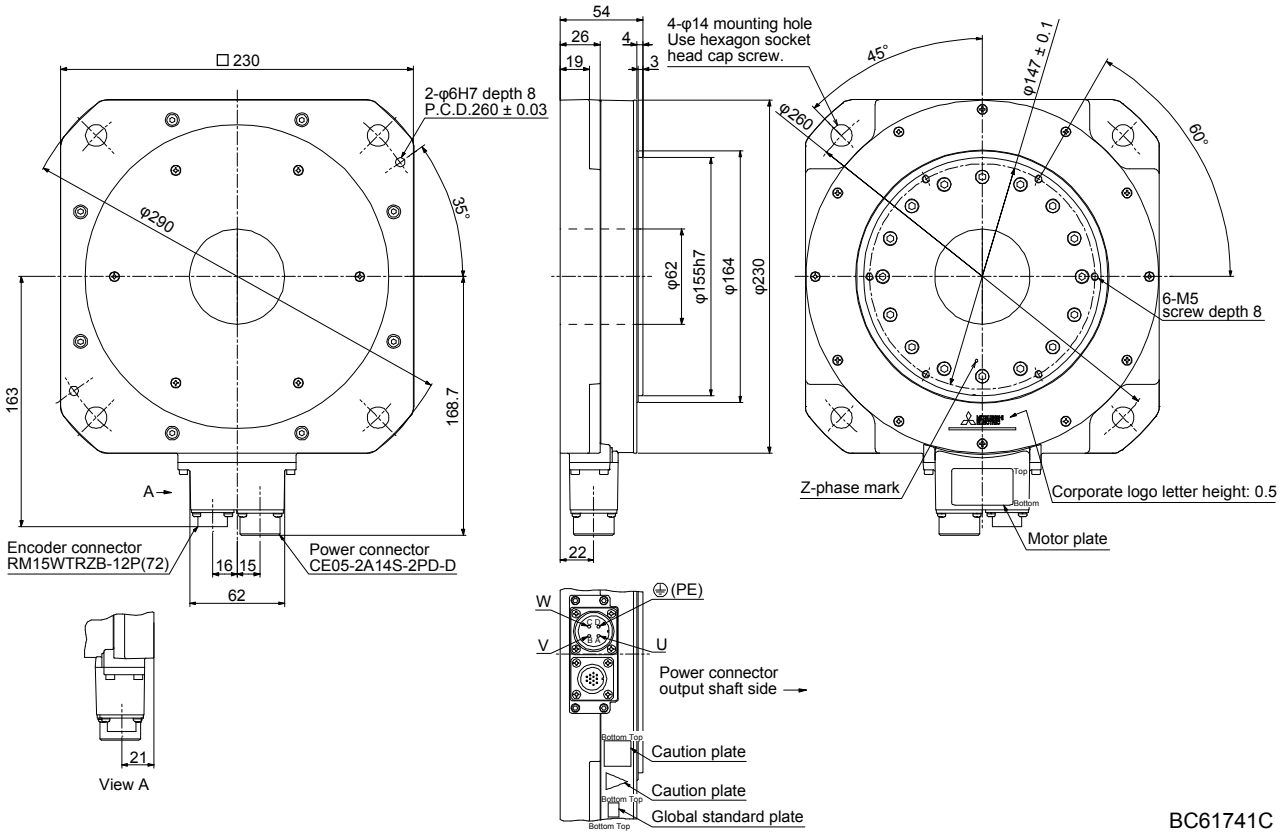
Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RG2M009G30	283	147	8.3

[Unit: mm]



Model	Output [W]	Moment of inertia J [× 10^{-4} kg•m^2]	Mass [kg]
TM-RU2M009G30	283	147	8.3

[Unit: mm]



BC61741C

MEMO

APPENDIX

App. 1 Selection example of direct drive motor

App. 1.1 Selection conditions

(1) Machine configuration

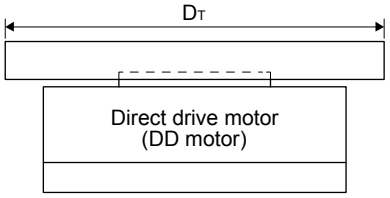


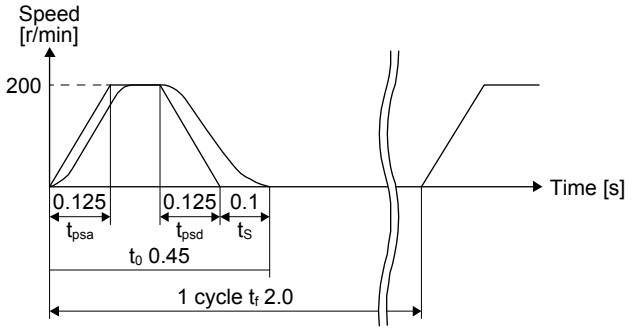
Table mass	W	= 19 [kg]
Rotary table diameter	D_T	= 300 [mm]
Rotation angle per cycle	θ	= 270 [degree]
Positioning time	t_0	= 0.45 [s] or less
Acceleration/deceleration time	$t_p = t_{psa} = t_{psd}$	= 0.125 [s]
Operation cycle	t_f	= 2.0 [s]
Load torque	T_L	= 0 [N•m]

(2) Direct drive motor speed

$$N_o = \frac{\theta}{360} \times \frac{60}{(t_0 - t_p - t_s)}$$
$$= \frac{270}{360} \times \frac{60}{(0.45 - 0.125 - 0.1)} = 200 \text{ [r/min]}$$

t_s: Settling time (Here, this is assumed to be 0.1 s.)

(3) Operation pattern



App. 1.2 Selection of direct drive motor

(1) Load moment of inertia

$$J_L = \frac{1}{8} \times D_T^2 \times W$$
$$= \frac{1}{8} \times (300 \times 10^{-3})^2 \times 19 = 0.214 \text{ [kg•m}^2\text{]}$$

(2) Acceleration/deceleration torques of load

$$T_a = J_L \times 2\pi \times \frac{N_o / 60}{t_p}$$
$$= \frac{J_L \times N_o}{\frac{60}{2\pi} \times t_p}$$
$$= \frac{0.214 \times 200}{9.55 \times 0.125}$$
$$= 35.9 \text{ [N•m]}$$

(3) Temporary selection of direct drive motor

Selection conditions

Acceleration/deceleration torques of load < maximum torque of DD motor

Load moment of inertia < J_R × moment of inertia of DD motor

J_R: Recommended load to motor inertia ratio

From the above, the following direct drive motor is temporarily selected.

TM-RFM018E20 (rated torque: 18 [N•m], maximum torque: 54 [N•m], moment of inertia: 149 × 10^{-4} [kg•m^2])

(4) Acceleration/deceleration torque

Torque necessary for acceleration

$$T_{Ma} = \frac{(J_L + J_M) \times N_o}{9.55 \times t_{psa}} = 38.3 \text{ [N•m]}$$

J_M: Moment of inertia of DD motor

Torque necessary for deceleration

$$T_{Md} = -\frac{(J_L + J_M) \times N_o}{9.55 \times t_{psd}} = -38.3 \text{ [N•m]}$$

The torque required for acceleration/deceleration must be lower than the DD motor's maximum torque.

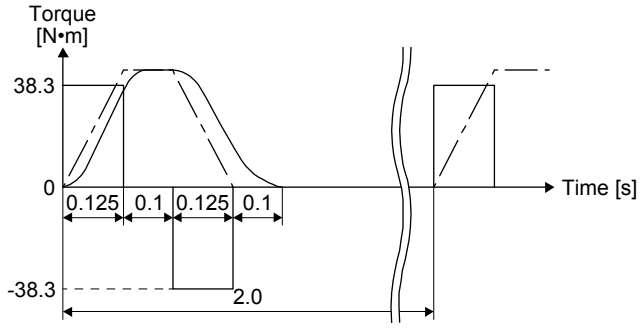
(5) Continuous effective load torque

$$Tr_{ms} = \sqrt{\frac{T_{Ma}^2 \times t_{psa} + T_L^2 \times t_c + T_{Md}^2 \times t_{psd}}{t_f}} = 13.5 \text{ [N•m]}$$

t_c: $t_0 - t_s - t_{psa} - t_{psd}$

The continuous effective load torque must be lower than the DD motor's rated torque.

(6) Torque pattern



(7) Selection results

The following direct drive motor and servo amplifier are selected as the result of the calculation.

Direct drive motor TM-RFM018E20

Servo amplifier MR-J4-100B

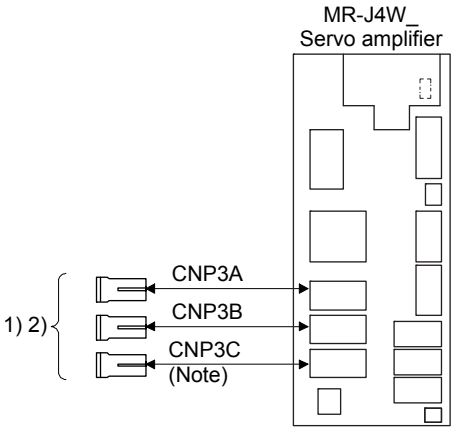
App. 2 Manufacturer list

Names given in the table are as of April 2018.

For information, such as the delivery time, price, and specifications of the recommended products, contact each manufacturer.

Manufacturer	Contact information
DDK	DDK Ltd.
Daiwa Dengyo	Daiwa Dengyo Co., Ltd.
Nippon Flex	Nippon Flex Co., Ltd.
JST	J.S.T. Mfg. Co., Ltd.
3M	3M
Molex	Molex
Hirose Electric	Hirose Electric Co., Ltd.

App. 3 Crimping connector for CNP3_



Note. This figure shows the 3-axis servo amplifier.

No.	Name	Model	Description	Application
1)	Connector set	MR-J3WCNP3-D2L	 For CNP3A/CNP3B/CNP3C Receptacle housing: F35FDC-04V-K Receptacle contact: BF3F-71GF-P2.0 (JST)	Quantity: 1 For thick wires
2)	Connector set	MR-J3WCNP3-D2L-20P	Applicable wire Wire size: 1.25 mm^2 (AWG 6) to 2.0 mm^2 (AWG 14) Insulator OD: 2.4 mm to 3.4 mm The crimping tool (YRF-1070) is required.	Quantity: 20 For thick wires

App. 4 Fabrication of the encoder cable

POINT
●Use recommended encoder cable connectors indicated in chapter 3 and chapter 4.

When you fabricate an encoder cable, the descriptions in this appendix should be noted to ensure reliability of communication.

Cable fabrication

Connector selection

(1) Selection of connectors

- Check the cable clamp size to select a connector indicated in chapter 3 and chapter 4.
- Obtain the specification and wiring guide of the connector from the manufacturer.
- Purchase an assembly jig or others as necessary.

Cable selection

(2) Selection of cables

- Select a shielded twisted pair cable.
- Select a cable having a diameter suitable to clamp to the connector cable clamp.
- Select a cable whose length, diameter, and bending life are appropriate.

Cable assembly

(3) Assembly of the cable

- Check the wiring guide of the connector manufacturer to connect the connector properly.
- Check internal wiring described in chapter 6 to connect it properly.
- Perform a shielding process on the encoder cable properly.
- Do not connect anything to unused pins.
- For CN2, CN2A, CN2B, and CN2C side connectors, connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell.
- For the direct drive motor-side connector, connect the external conductor of the shielded cable to the SHD terminal.
- Check if the pin arrangement is correct.
- Connect the twisted pair cable in correct combination.
- Check if the number of pairs of P5/LG wirings connected in parallel is correct.
- Fix the cable to the connector with a proper clamping torque.

Inspection

(4) Inspection

- After assembly, perform conduction, insulation, and other inspections to check if the connection is correct.
- Check the surface for scratches and contamination.
- Check the connector pins for a distortion, bending, dent, etc.
- Check the connector pins for foreign matter adhesion, contamination, and discoloration.

Completion

App. 5 Compliance with the CE marking

App. 5.1 What is CE marking?

The CE marking is mandatory and must be affixed to specific products placed on the European Union. When a product conforms to the requirements, the CE marking must be affixed to the product. The CE marking also applies to machines and equipment incorporating servos.
A manual is available in different languages. For details, contact your local sales office.

(1) EMC directive
The EMC directive applies to the direct drive motor alone. Therefore direct drive motor is designed to comply with the EMC directive. The EMC directive also applies to machines and equipment incorporating direct drive motors. TM-RFM, TM-RG2M, TM-RU2M series comply with EN61800-3 Category 3. They are not intended to be used on a low-voltage public network which supplies domestic premises; radio frequency interference is expected if it is used on such a network. The installer shall provide a guide for installation and use, including recommended mitigation devices.

(2) Low voltage directive
The low voltage directive also applies to the direct drive motor alone. The direct drive motor is designed to comply with the low voltage directive.

(3) Machinery directive
The direct drive motor as a single unit does not comply with the Machinery directive due to correspondence with article1 2. (k). However, machines and equipment incorporating direct drive motors will be complied. Please check your machines and equipment as a whole if they are complied.

App. 5.2 For compliance

Be sure to perform an appearance inspection of every unit before installation. In addition, have a final performance inspection on the entire machine/system, and keep the inspection record.

(1) Wiring
Use wirings which complies with EN for the direct drive motor power. Complying EN products are available as options. Refer to chapter 6 for details of the options.

(2) Performing EMC tests
When EMC tests are run on a machine and device into which the direct drive motor and direct drive motor have been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment and electrical equipment specifications.
For EMC directive conforming methods about servo amplifiers and direct drive motors, refer to "EMC Installation Guidelines" and each Servo Amplifier Instruction Manual.

App. 6 Compliance with UL/CSA standard

Use the UL/CSA standard-compliant direct drive motor. For the latest information of compliance, contact your local sales office.
Unless otherwise specified, the handling, performance, specifications, etc. of the UL/CSA standard-compliant models are the same as those of the standard models.

(1) Flange size

The direct drive motor is compliant with the UL/CSA standard when the motor is mounted on the aluminum flange of the same size as indicated in the following table.
The rated torque of the direct drive motor under the UL/CSA standard indicates the continuous permissible torque value that can be generated when the motor is mounted on the flange specified in this table and used in the environment of 0 °C to 40 °C ambient temperature. Therefore, to conform to the UL/CSA standard, mount the direct drive motor on a flange with a heat radiating effect equivalent to that of this flange.

Flange size [mm]	Direct drive motor
400 × 400 × 20	TM-RG2M002C30
	TM-RU2M002C30
	TM-RFM002C20
	TM-RFM004C20
	TM-RFM006C20
550 × 550 × 35	TM-RG2M004E30
	TM-RU2M004E30
	TM-RFM006E20
	TM-RFM012E20
	TM-RFM018E20
650 × 650 × 35	TM-RG2M009G30
	TM-RU2M009G30
	TM-RFM012G20
	TM-RFM048G20
	TM-RFM072G20
750 × 750 × 45	TM-RFM040J10
	TM-RFM120J10
950 × 950 × 50	TM-RFM240J10

(2) Selection example of wires

To comply with UL 1004-1 and CSA-C22.2 No. 100, use UL-approved copper wires rated at 75 °C for wiring.

The following table shows the wire size [AWG] rated at 75 °C, which is used for wiring of TM-RFM, TM-RG2M and TM-RU2M series.

(a) TM-RFM series

Direct drive motor	Wire [AWG]
	U/V/W/⏚
TM-RFM002C20	16 (Note 2)
TM-RFM004C20	
TM-RFM006C20	
TM-RFM006E20	
TM-RFM012E20	
TM-RFM018E20	
TM-RFM012G20	
TM-RFM048G20	12
TM-RFM072G20	
TM-RFM040J10	16 (Note 2)
TM-RFM120J10	12
TM-RFM240J10	10 (Note 1)

Note 1. Refer to each servo amplifier instruction manual for crimp terminals used for connection with the servo amplifier.
2. To comply with UL 508A and NFPA 79, AWG 14 or more is required.

(b) TM-RG2M series and TM-RU2M series

Direct drive motor	Wire [AWG]
	U/V/W/⏚
TM-RG2M002C30	18 (Note)
TM-RU2M002C30	
TM-RG2M004E30	
TM-RU2M004E30	
TM-RG2M009G30	
TM-RU2M009G30	

Note. To comply with UL 508A and NFPA 79, AWG 14 or more is required.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Revision Date	* Manual Number	Revision	
Mar. 2012	SH(NA)030112ENG-A	First edition	
May 2012	SH(NA)030112ENG-B	Chapter 4 (3)	The part of diagram is changed.
Feb. 2013	SH(NA)030112ENG-C	Section 1.1	The part of diagram is changed.
		Section 2.1 (2)	The part of sentences are changed.
		Section 2.9	The part of sentences are changed.
		Chapter 5	POINT is added.
		Section 5.4	A part is newly added, construction of sentences is changed.
		Chapter 6	POINT is added.
		Section 6.2.4 (1) to (2)	The part of diagram is changed.
		Section 7.2	The part of table is changed.
		Section 7.5	The part of diagram is changed.
Jan. 2015	SH(NA)030112ENG-D	1-phase 100 V AC of servo amplifier power supply input is added to torque characteristics of the direct drive motor.	
		Section 1.1	The diagram is changed.
		Section 5.4	The table is added.
		Section 6.2.4 (1) to (2)	Note 1 is changed.
		Section 7.2	The part of table is changed.
		Section 7.3	Note 4 is changed.
		Section 7.4	POINT is changed. The sentences are added. The part of diagram is changed.
Sep. 2015	SH(NA)030112ENG-E	Torque characteristic at 1-phase 200 V AC input is added.	
		2. To prevent fire, note the following	Partially added.
		4. Additional instructions	Partially added.
		Section 1.1	The diagram is changed.
		Section 1.2	Partially changed.
		Section 6.1.1	Partially added.
		Section 6.2.4	Partially changed.
		Section 7.4	Partially added and partially changed.
		App. 2	Partially changed.
		App. 4	Added.
Feb. 2016	SH(NA)030112ENG-F	Model names MR-J4-_GF of servo amplifiers are added.	
		Section 5.4	Model names are added.
			Partially changed.
		Section 7.2	Model names are added.
		Section 7.3	Partially added.
		App. 2	Partially changed.
Mar. 2017	SH(NA)030112ENG-G	TM-RG2M/TM-RU2M series direct drive motors are added.	
		4. Additional instructions	Partially changed.
		Section 1.1	Changed.
		Chapter 2	CAUTION is added.
		Section 2.2	TM-RG2M/TM-RU2M are added.
		Section 2.6	Partially changed.
		Section 2.7	Partially changed.
		Section 2.9	Partially changed.
		Section 2.10	Added.
		Section 3.1	TM-RG2M/TM-RU2M are added.
		Section 5.3	TM-RG2M/TM-RU2M are added.
		Section 6.1	TM-RG2M/TM-RU2M are added.
		Section 6.2	POINT is changed.
		Section 6.2.3	TM-RG2M/TM-RU2M are added.
		Section 6.3	Partially changed.

Revision Date	*Manual Number	Revision
Mar. 2017	SH(NA)030112ENG-G	Section 7.3 Partially changed. Chapter 8 Added. App. 2 Partially changed. App. 5 Added. App. 6 Added.
Oct. 2017	SH(NA)030112ENG-H	TM-RG2M002C30/TM-RU2M002C30 direct drive motors are added. 4. Additional instructions Partially changed. Section 2.9 Partially changed. Section 3.1 Partially changed. Section 5.3 TM-RG2M002C30/TM-RU2M002C30 are added. Section 6.1.2 TM-RG2M002C30/TM-RU2M002C30 are added. Chapter 8 TM-RG2M002C30/TM-RU2M002C30 are added. App. 6 Partially changed.
Apr. 2018	SH(NA)030112ENG-J	MR-J4-_GF1(-RJ) servo amplifier is added to TM-RFM series, MR-J4-_GF_(-RJ) servo amplifier is added to TM-RG2M series/TM-RU2M series, and the dimensions are entirely changed. Section 7.2 Partially changed. Section 7.5 Entirely changed. Section 8.2 Partially changed. Section 8.6 Entirely changed.

MEMO

Warranty

1. Warranty period and coverage

We will repair any failure or defect hereinafter referred to as "failure" in our FA equipment hereinafter referred to as the "Product" arisen during warranty period at no charge due to causes for which we are responsible through the distributor from which you purchased the Product or our service provider. However, we will charge the actual cost of dispatching our engineer for an on-site repair work on request by customer in Japan or overseas countries. We are not responsible for any on-site readjustment and/or trial run that may be required after a defective unit are repaired or replaced.

[Term]

The term of warranty for Product is twelve (12) months after your purchase or delivery of the Product to a place designated by you or eighteen (18) months from the date of manufacture whichever comes first ("Warranty Period"). Warranty period for repaired Product cannot exceed beyond the original warranty period before any repair work.

[Limitations]

(1) You are requested to conduct an initial failure diagnosis by yourself, as a general rule.
It can also be carried out by us or our service company upon your request and the actual cost will be charged. However, it will not be charged if we are responsible for the cause of the failure.

(2) This limited warranty applies only when the condition, method, environment, etc. of use are in compliance with the terms and conditions and instructions that are set forth in the instruction manual and user manual for the Product and the caution label affixed to the Product.

(3) Even during the term of warranty, the repair cost will be charged on you in the following cases;
(i) a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
(ii) a failure caused by any alteration, etc. to the Product made on your side without our approval
(iii) a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
(iv) a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
(v) any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
(vi) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
(vii) a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
(viii) any other failures which we are not responsible for or which you acknowledge we are not responsible for

2. Term of warranty after the stop of production

(1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.

(2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.

3. Service in overseas countries

Our regional FA Center in overseas countries will accept the repair work of the Product. However, the terms and conditions of the repair work may differ depending on each FA Center. Please ask your local FA center for details.

4. Exclusion of loss in opportunity and secondary loss from warranty liability

Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:

(1) Damages caused by any cause found not to be the responsibility of Mitsubishi.

(2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.

(3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.

(4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.

5. Change of Product specifications

Specifications listed in our catalogs, manuals or technical documents may be changed without notice.

6. Application and use of the Product

(1) For the use of our General-Purpose AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in General-Purpose AC Servo, and a backup or fail-safe function should operate on an external system to General-Purpose AC Servo when any failure or malfunction occurs.

(2) Our General-Purpose AC Servo is designed and manufactured as a general purpose product for use at general industries.
Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used
In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used.
We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

MODEL	DIRECT DRIVEMOTOR INSTRUCTIONMANUAL
MODEL CODE	1CW948

MITSUBISHI ELECTRIC CORPORATION

HEAD OFF ICE: TOKYO BLDG MARUNOUCHI TOKYO 100-8310

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This Instruction Manual uses recycled paper.
Specifications are subject to change without notice.