



General-Purpose AC Servo

MITSUBISHI SERVO AMPLIFIERS & MOTORS  
**MELSERVO**

MODEL

**TM-RFM**

DIRECT DRIVE MOTOR INSTRUCTION MANUAL

## ● 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".



Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.




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 voltage specified in the Instruction Manual should be applied to each terminal. Otherwise, a burst, damage, etc. may occur.
- 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.

## ⚠ CAUTION

- Do not carry the direct drive motor by holding the cables, rotor, encoder, or connector.
- 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.
- The equipment must be installed in the specified direction.
- When you keep or use the equipment, please fulfill the following environment.

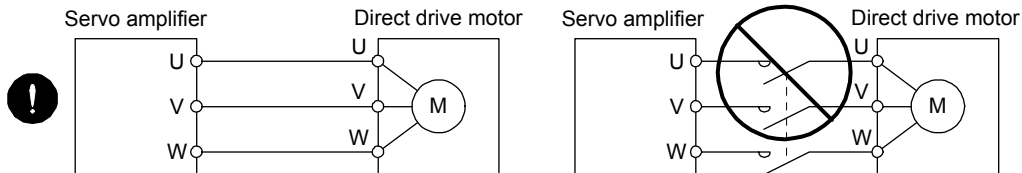
Item		Environment
Ambient temperature	Operation	0 °C to 40 °C (non-freezing)
	Storage	-15 °C to 70 °C (non-freezing)
Ambient humidity	Operation	80 %RH or less (non-condensing)
	Storage	90 %RH or less (non-condensing)
Ambience		Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist, dust, and dirt
Altitude		Max. 1000 m above sea level
Vibration resistance	TM-RFM_C20	X, Y: 49 m/s <sup>2</sup>
	TM-RFM_E20	
	TM-RFM_G20	
	TM-RFM_J10	X, Y: 24.5 m/s <sup>2</sup>

- 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 servo amplifier and direct drive motor as they are precision equipment.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotor of the direct drive motor during operation.
- 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 equipment 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.
- 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.

## (2) Wiring

### ⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the direct drive motor may operate unexpectedly.
- To avoid a malfunction, connect the power phases (U, V, and W) of the servo amplifier and the direct drive motor correctly.
- Connect the servo amplifier power output (U, V, and W) to the direct drive motor power input (U, V, and 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.
- Do not disassemble, repair, or modify the equipment.
- Use the direct drive motor with the specified servo amplifier.

## (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.

## (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 <sup>-4</sup> kg·m <sup>2</sup> )]	5.4675 [oz·inch <sup>2</sup> ]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]



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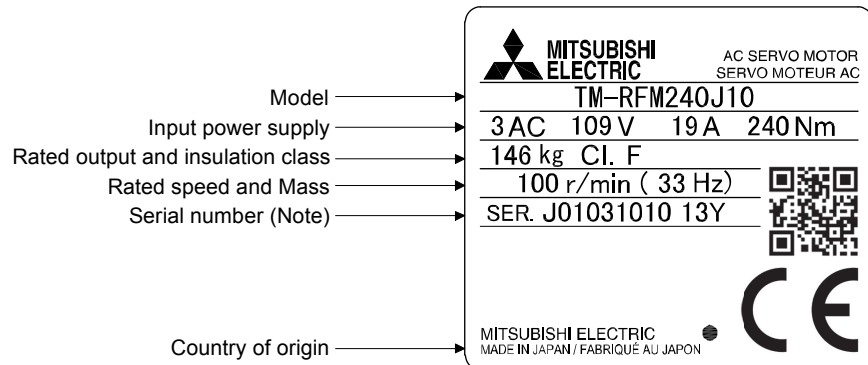
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# 1. INTRODUCTION

## 1. INTRODUCTION

### 1.1 Rating plate

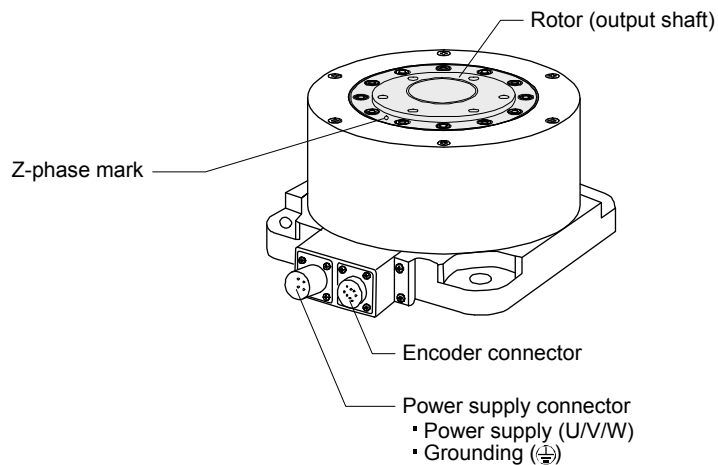


Note. Production year and month of the direct drive motor are indicated in a serial number on the rating plate.

The year and month of manufacture 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. No. \_\_\_\_\_ 121".

### 1.2 Parts identification



1. INTRODUCTION

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MEMO

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## 2. INSTALLATION

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### 2. INSTALLATION

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

- Stacking in excess of the specified number of product packages is not allowed.
- Install the equipment on incombustible material. Installing it directly or close to combustibles will lead to 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 carry the direct drive motor by holding the cables, rotor, encoder, or connector. Otherwise, it may cause a malfunction or injury.
- 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.

 **CAUTION**

- 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.

## 2. INSTALLATION

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### 2.1 Equipment configuration

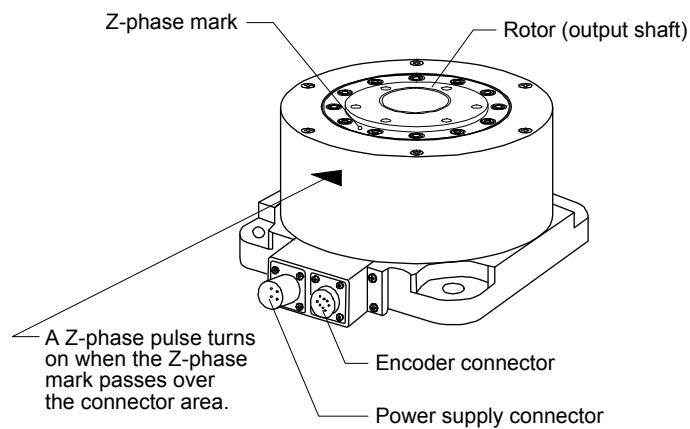
The following shows the configuration of a direct drive motor. When using the direct drive motor, note the following.

(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.

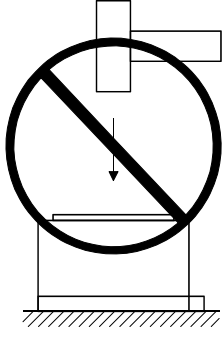
## 2. INSTALLATION

### 2.2 Mounting direction

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

Direct drive motor series	Mounting direction
TM-RFM	All directions

### 2.3 Load mounting/dismounting precautions

POINT
<p>● During assembling, the rotor must not be hammered. Otherwise, the encoder may malfunction.</p> 

- (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

<p><b>CAUTION</b> ● Because the rigid coupling may damage the rotor, make sure to align and center the load on the rotor.</p>
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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.

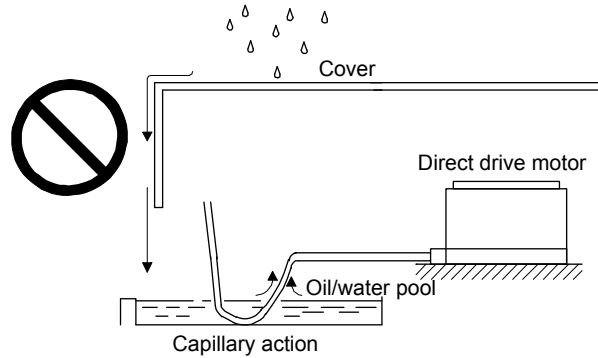
## 2. INSTALLATION

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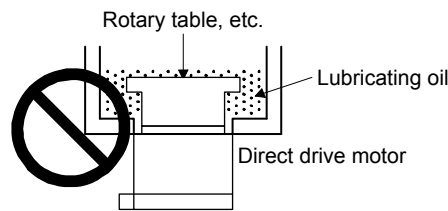
### 2.5 Protection from oil and water

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. INSTALLATION

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### 2.6 Inspection

#### 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 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 Life

Service lives of the following parts are listed below. However, the service lives vary depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service lives. 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 change the bearings 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.



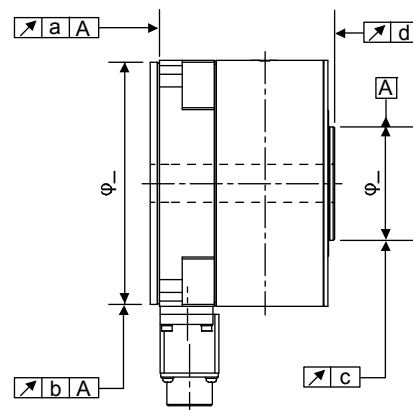
## 2. INSTALLATION

### 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 Mounting surface size

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

Mounting surface size [mm]	Direct drive motor
400 × 400 × 20	TM-RFM002C20
	TM-RFM004C20
	TM-RFM006C20
450 × 450 × 12	TM-RFM006E20
	TM-RFM012E20
	TM-RFM018E20
550 × 550 × 12	TM-RFM012G20
	TM-RFM048G20
	TM-RFM072G20
750 × 750 × 45	TM-RFM040J10
	TM-RFM120J10
	TM-RFM240J10

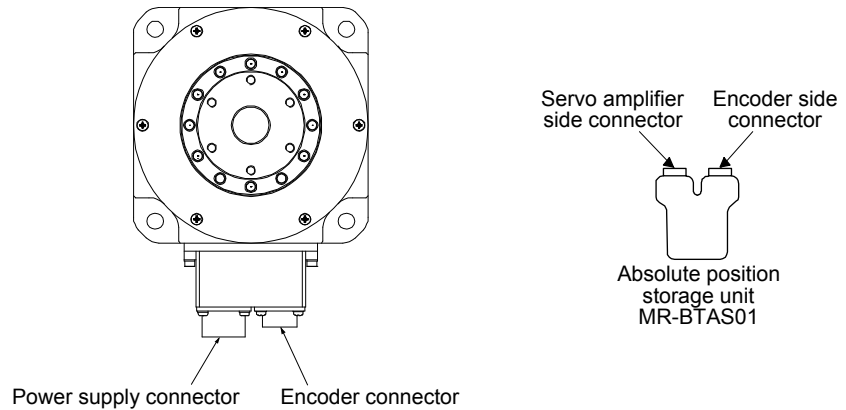
### 3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

#### 3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

POINT
<p>● 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.</p> <p>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.</p>

#### 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.

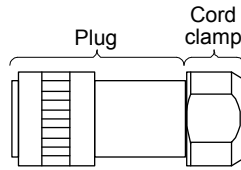


Direct drive motor	Wiring connector			
	For power supply	For encoder	Absolute position storage unit (option) (Note)	
			Servo amplifier side	Encoder side
TM-RFM_C20	Connector configuration B	Connector configuration A	Connector configuration A	Connector configuration F
TM-RFM_E20				
TM-RFM_G20	Connector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

Note. Used in the absolute position detection system

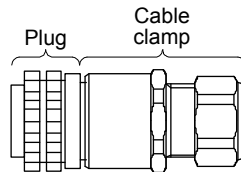
### 3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

#### 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)

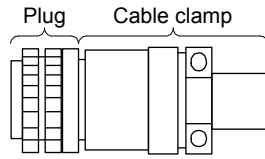
- Note 1. The connector to be mated.  
 2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch



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		

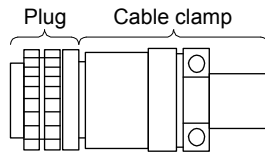
- Note 1. Not comply with EN.  
 2. The connector to be mated.

### 3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING



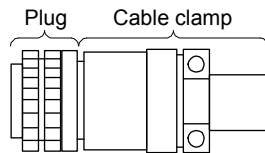
Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power connector (Note 2)
		Type	Model	Cable OD [mm] (reference)	Model	
C	IP67	Straight	CE05-6A18-10SD-D-BSS	8.5 to 11	CE3057-10A-2-D	CE05-2A18-10PD-D
	EN compliant		Applicable wire size: AWG 14 to 12	10.5 to 14.1	CE3057-10A-1-D	
	General environment (Note 1)		D/MS3106B18-10S	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	Straight	CE05-6A22-22SD-D-BSS	9.5 to 13	CE3057-12A-2-D	CE05-2A22-22PD-D
	EN compliant		Applicable wire size: AWG 10 to 8	12.5 to 16	CE3057-12A-1-D	
	General environment (Note 1)		D/MS3106B22-22S	15.9 or less (bushing ID)	D/MS3057-12A	

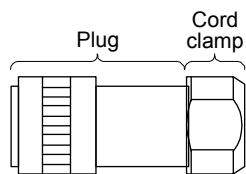
Note 1. Not comply with EN.  
2. The connector to be mated.



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

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

## 4. CONNECTOR DIMENSIONS

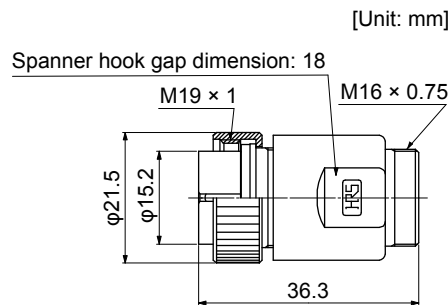
The following shows the dimensions of the connectors used for wiring the direct drive motor.

(1) Hirose Electric

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

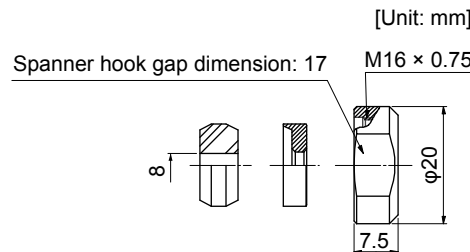
Model	Connector configuration (Note)
RM15WTPZK-12S	A
RM15WTPZ-12P(72)	F

Note. Refer to section 3.2 for the connector configuration.



(b) JR13WCCA-8(72)

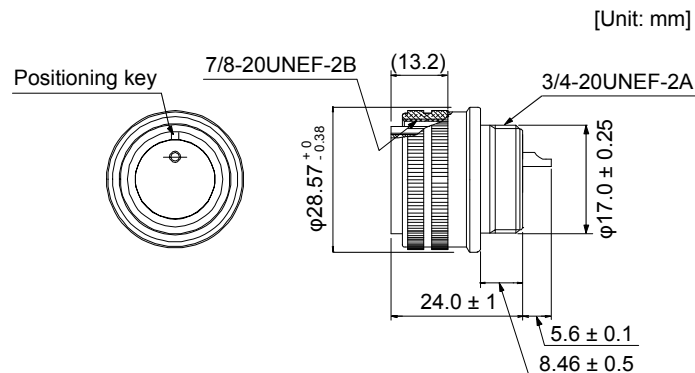
Refer to the connector configurations A and F of section 3.2 for the connector configuration.



(2) DDK

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

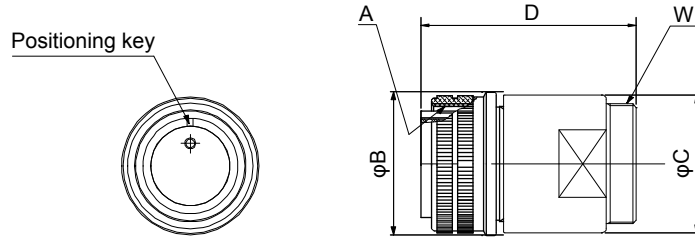
Refer to the connector configuration B of section 3.2 for the connector configuration.



## 4. CONNECTOR DIMENSIONS

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

[Unit: mm]

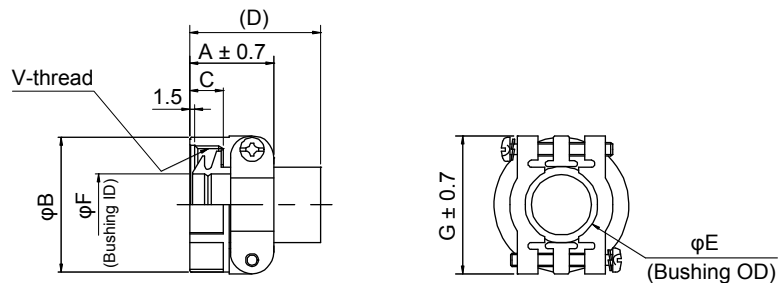


Model	A	$B_{-0.38}^{+0}$	$C \pm 0.8$	D or less	W	Connector configuration (Note)
CE05-6A18-10SD-D-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A	C
CE05-6A22-22SD-D-BSS	1 3/8-18UNEF-2B	40.48	38.3	61	1 3/16-18UNEF-2A	D
CE05-6A32-17SD-D-BSS	2-18UNS-2B	56.33	54.2	79	1 3/4-18UNS-2A	E

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]



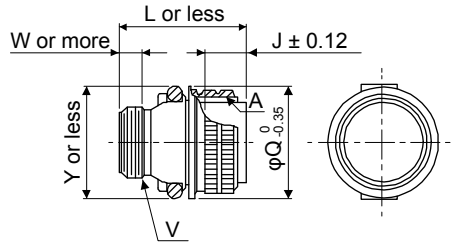
Model	Applicable shell size	A	B	C	(D)	E	F	G	V	Enclosed bushing model	Applicable cable OD (reference)	Connector configuration (Note)
CE3057-10A-1-D	18	23.8	30.1	10.3	(41.3)	15.9	14.1	31.7	1-20UNEF-2B	CE3420-10-1	10.5 to 14.1	C
CE3057-10A-2-D							11.0			CE3420-10-2	8.5 to 11	
CE3057-12A-1-D	22	23.8	35	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.

## 4. CONNECTOR DIMENSIONS

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

[Unit: mm]

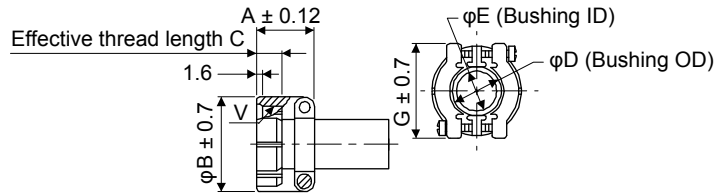


Model	A	J	L	Q	V	W	Y	Connector configuration (Note)
D/MS3106B14S-2S	7/8-20UNEF	13.49	42.88	28.57	3/4-20UNEF	8.00	30	B
D/MS3106B18-10S	1 1/8-18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42	C
D/MS3106B22-22S	1 3/8-18UNEF	18.26	56.57	40.48	1 3/16-18UNEF	9.53	50	D
D/MS3106B32-17S	2-18UNS	18.26	61.92	56.33	1 3/4-18UNS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

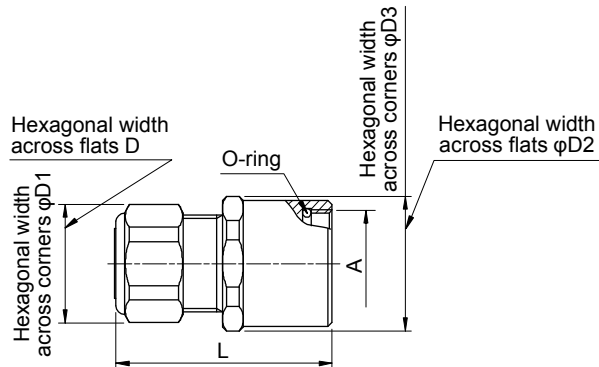
Note. Refer to section 3.2 for the connector configuration.



## 4. CONNECTOR DIMENSIONS

### (3) Daiwa Dengyo

[Unit: mm]

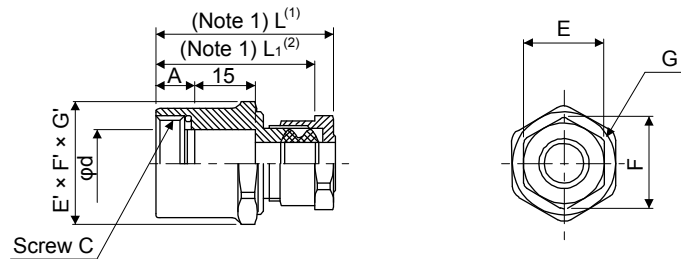


Model	Applicable cable OD	A	Length before tightening L	Width across flats D	Width across corners D1	Width across flats D2	Width across corners D3	Connector configuration (Note)
YSO14-5 to 8	4 to 8.3	3/4-20UNEF-2B	44	23	25	26	28	B
YSO14-9 to 11	7 to 11.3							

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	L <sub>1</sub>	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

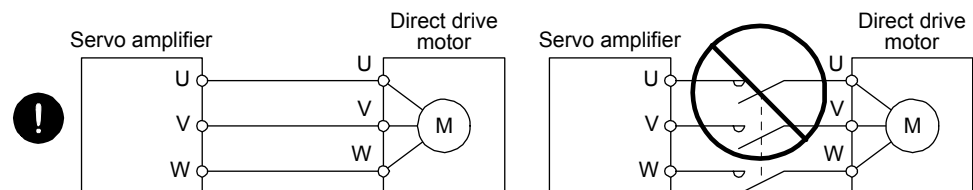
### 5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

#### ⚠ 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, and W) to the direct drive motor power input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. 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 differ 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



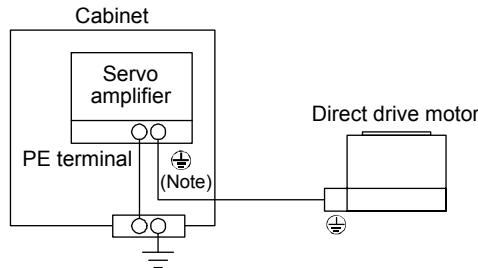
- To avoid a malfunction, connect the power supply phases (U, V, and W) of the servo amplifier and the direct drive motor correctly.
- Do not connect AC power supply directly to the direct drive motor. Otherwise, it may cause a malfunction.

### POINT

- Refer to chapter 6 for the encoder cable.

This section explains the connection of the direct drive motor power (U, V, and 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.

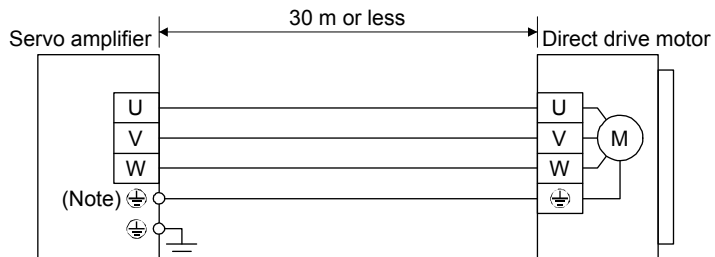


Note. The number of PE terminals of the servo amplifier differs depending on the amplifier type.

## 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. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

### 5.3 Selection example of wires

POINT
<ul style="list-style-type: none"> <li>● Wires indicated in this section are separated wires.</li> <li>● Selection condition of wire size is as follows.            Construction condition: Single wire set in midair.            Wire length: 30 m or less</li> </ul>

When using the 600 V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire) Wire size selection examples for HIV wires are indicated below.

Table 5.1 Wire size selection example (HIV wire)

Direct drive motor	Wire [mm <sup>2</sup> ]
	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.

# 5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

## 5.4 Servo amplifier terminal section

POINT
● For the sizes of wires used for wiring, refer to section 5.3.

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) of this section. For wiring, refer to (2) of 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	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 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

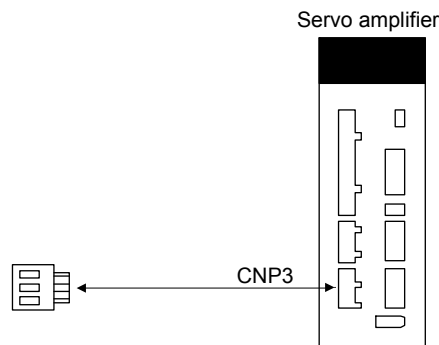


Table 5.2 Connector and applicable wire

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	JST

# 5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

## (b) Connector B

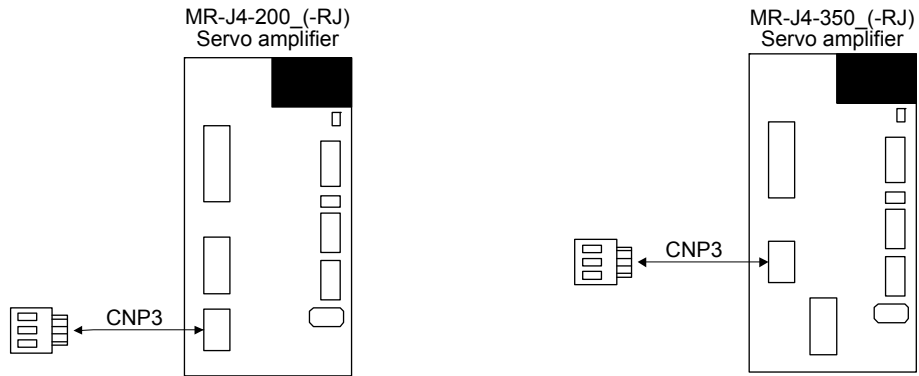
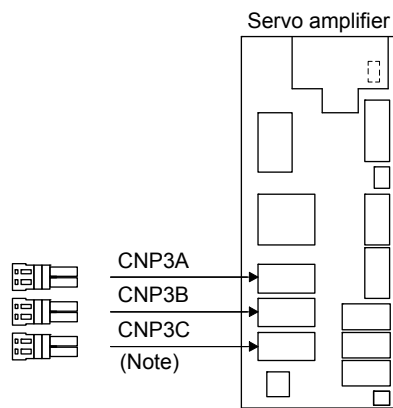


Table 5.3 Connector and applicable wire

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 5.4 Connector and applicable wire

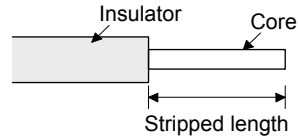
Connector	Receptacle assembly	Applicable wire size	Stripped length [mm]	Open tool	Manufacturer
CNP3A CNP3B CNP3C	04JFAT-SAGG-G-KK	AWG 18 to 14	9	J-FAT-OT-EXL	JST

## 5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

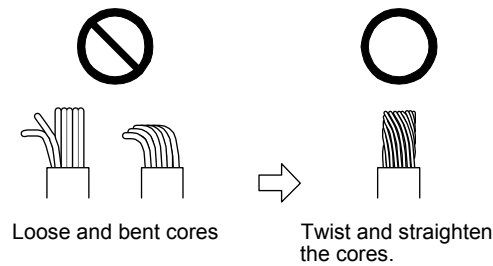
### (2) Cable connection procedure

#### (a) Fabrication on cable insulator

Refer to tables 5.2 to 5.4 for stripped length of cable insulator. The appropriate stripped length of cables depends on their type, etc. Set the length considering their fabrication status.



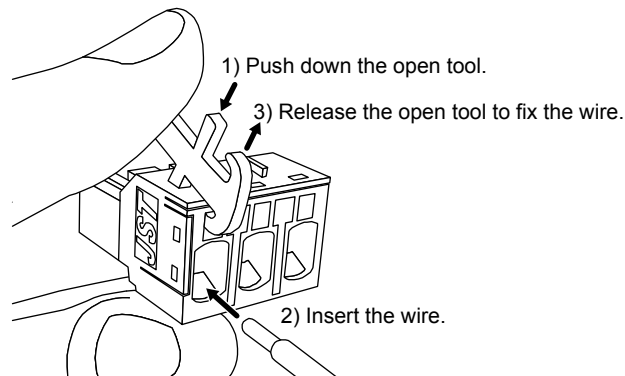
Twist strands lightly and straighten them as follows.



#### (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 insertion depth so that the wire insulator does not get caught by the spring.

Release the open tool to fix the wire. Pull the wire lightly to confirm that the wire is surely connected. The following shows a connection example of the CNP3 connector for 2 kW and 3.5 kW of MR-J4 1-axis servo amplifier.



## 6. WIRING OPTION

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### 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 differ from those of the used wires for the previous direct drive motors.

### 6.1 Connector set

#### POINT

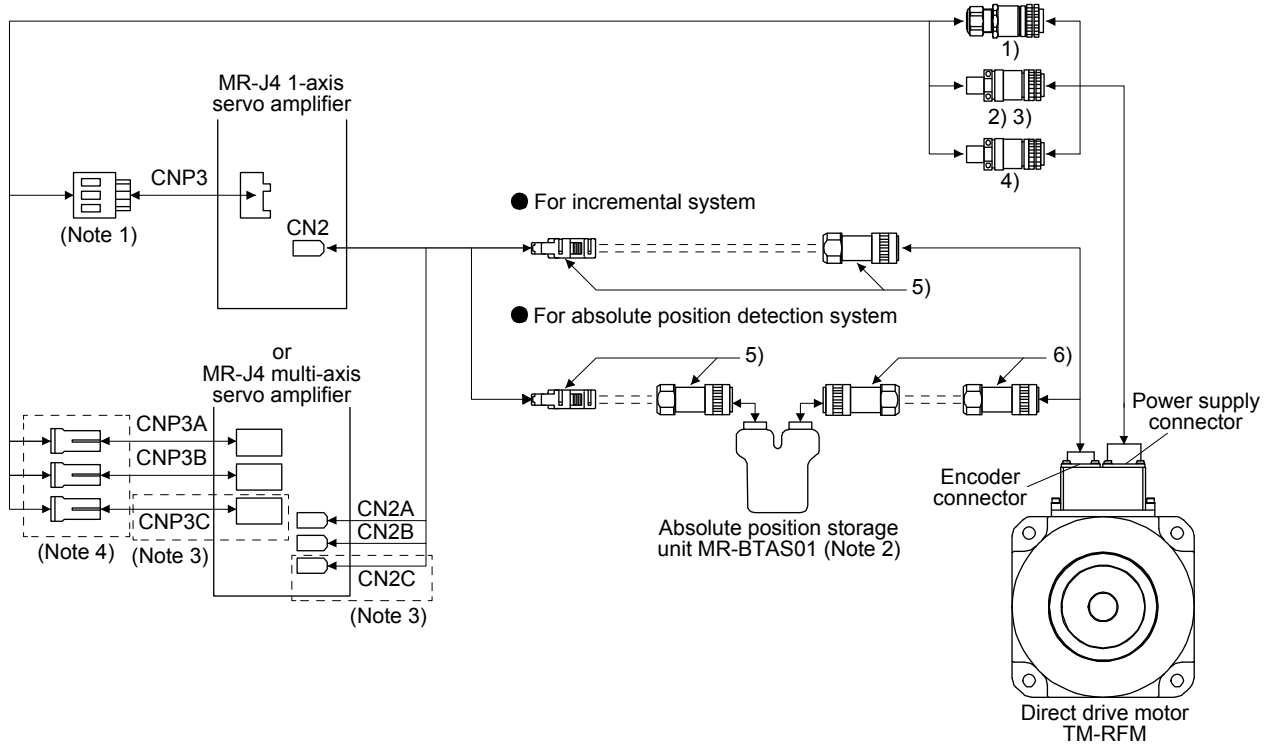
- The IP rating indicated is the connector's protection against ingress of dust and water when the connector is connected to a servo amplifier, direct drive motor, or absolute position storage unit. If the IP rating of the connector, servo amplifier, direct drive motor, and absolute position storage 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 appendix 4.



## 6. WIRING OPTION









### 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.  
 Note 2. Always make connection for use in an absolute position detection system. (Refer to section 6.3.)  
 Note 3. This connection is for the MR-J4 3-axis servo amplifier.  
 Note 4. Refer to Appendix 3 for the crimp connector for CNP3\_.

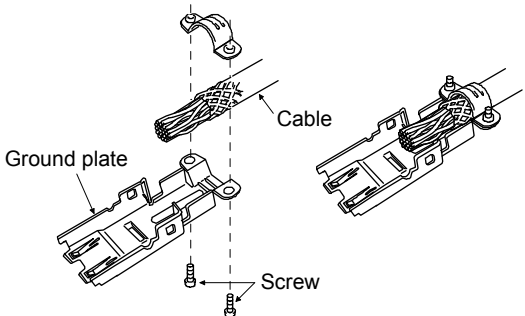
## 6. WIRING OPTION

### 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 <sup>2</sup> (AWG 22) to 1.25 mm <sup>2</sup> (AWG 16) Cable outer diameter: 8.3 mm to 11.3 mm	 For TM-RFM_C20 For TM-RFM_E20	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 <sup>2</sup> (AWG 14) to 3.5 mm <sup>2</sup> (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 <sup>2</sup> (AWG 10) to 8 mm <sup>2</sup> (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 <sup>2</sup> (AWG 6) to 22 mm <sup>2</sup> (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. WIRING OPTION

### 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.						
●	Always connect the following options to configure the absolute position detection system.						
	<table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th style="width: 30%;">Servo amplifier</th> <th>Option</th> </tr> </thead> <tbody> <tr> <td>MR-J4 1-axis</td> <td>Battery (MR-BAT6V1SET) Absolute position storage unit (MR-BTAS01)</td> </tr> <tr> <td>MR-J4 multi-axis</td> <td>Battery unit (MR-BT6VCASE and five MR-BAT6V1) Absolute position storage unit (MR-BTAS01)</td> </tr> </tbody> </table>	Servo amplifier	Option	MR-J4 1-axis	Battery (MR-BAT6V1SET) Absolute position storage unit (MR-BTAS01)	MR-J4 multi-axis	Battery unit (MR-BT6VCASE and five MR-BAT6V1) Absolute position storage unit (MR-BTAS01)
Servo amplifier	Option						
MR-J4 1-axis	Battery (MR-BAT6V1SET) Absolute position storage unit (MR-BTAS01)						
MR-J4 multi-axis	Battery unit (MR-BT6VCASE and five MR-BAT6V1) Absolute position storage unit (MR-BTAS01)						
●	For absolute position detection system, refer to each servo amplifier instruction manual.						
●	For CN2, CN2A, CN2B, and CN2C side connectors, securely connect the shielded external conductor of the 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	Encoder-side or absolute position storage unit-side connector (connected from the servo amplifier)
	Receptacle: 36210-0100PL	Plug: RM15WTPZK-12S
	Shell kit: 36310-3200-008 (3M)	Cord clamp: JR13WCCA-8(72) (Hirose Electric)
	or	
	Connector set: 54599-1019 (Molex)	
	Applicable wire size: 0.25 mm <sup>2</sup> (AWG 23) to 0.5 mm <sup>2</sup> (AWG 20)	

## 6. WIRING OPTION

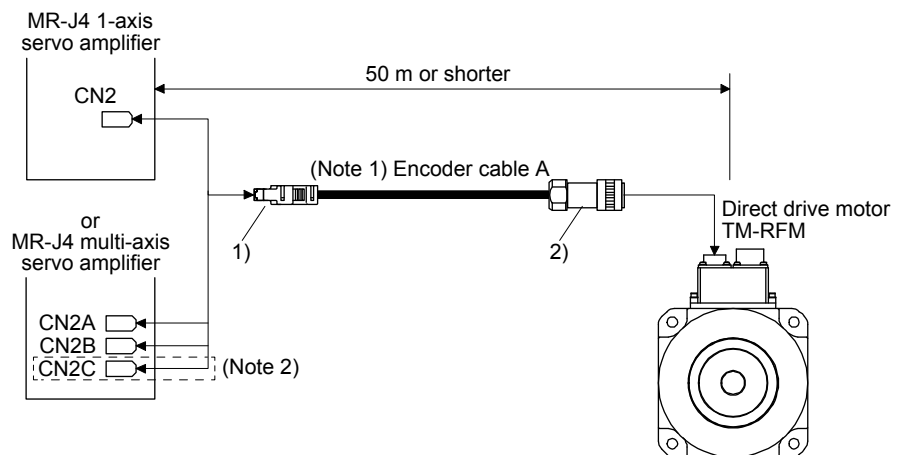
### 6.2.2 MR-J3DDSPS

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 <sup>2</sup> (AWG 23) to 0.5 mm <sup>2</sup> (AWG 20)

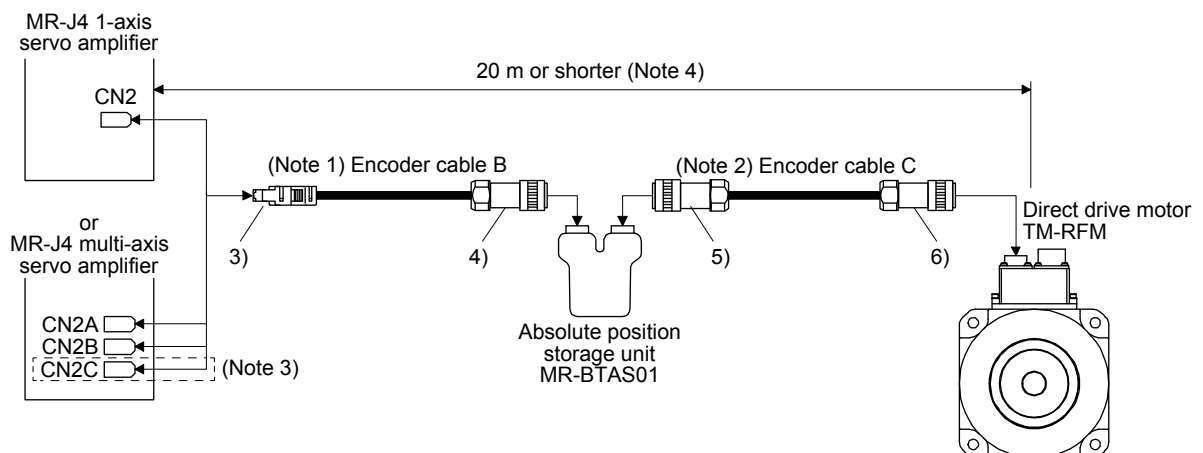
### 6.2.3 Combinations for the encoder cable

#### (1) For incremental system



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

#### (2) For absolute position detection system



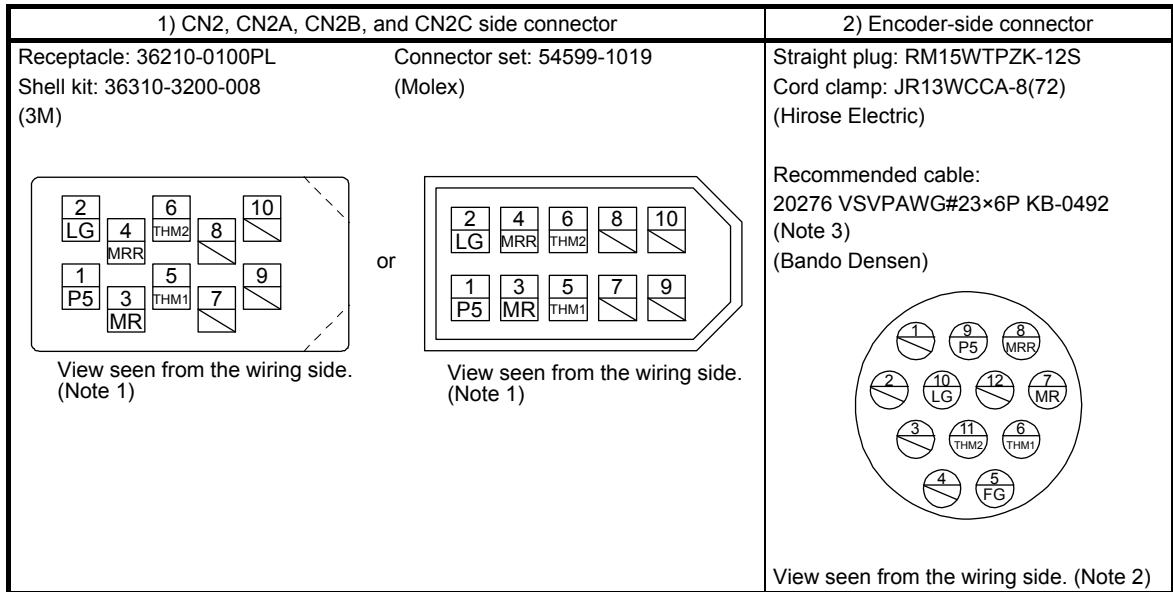
- Note 1. Refer to section 6.2.4 (2) for details.  
 Note 2. Refer to section 6.2.4 (3) for details.  
 Note 3. This connection is for the MR-J4 3-axis servo amplifier.  
 Note 4. For cable of 20 m or more, contact your local sales office.

## 6. WIRING OPTION

### 6.2.4 Fabrication of the encoder cable

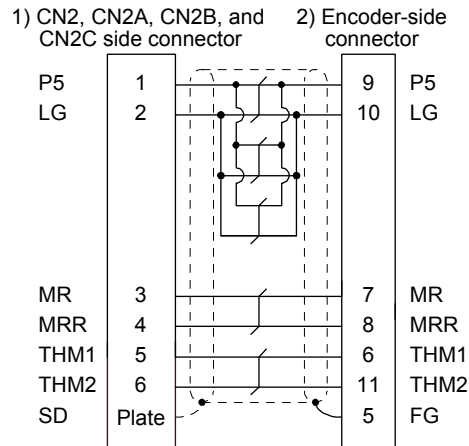
#### (1) Encoder cable A

##### (a) Connector details



- 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 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.
- Note 2. Do not connect anything to the pins shown as .
- Note 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 <sup>2</sup> ]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

## 6. WIRING OPTION

### (2) Encoder cable B

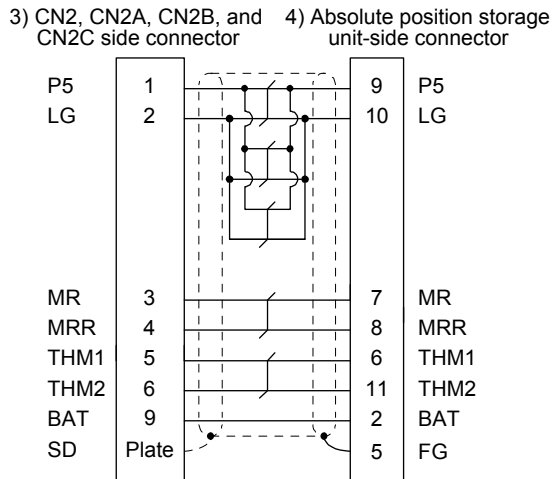
#### (a) Connector details

3) CN2, CN2A, CN2B, and CN2C side connector		4) Absolute position storage unit-side connector
Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M)		Straight plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric)  Recommended cable: 20276 VSVPAWG#23*6P KB-0492 (Note 3) (Bando Densen)
Connector set: 54599-1019 (Molex)		
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 provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally. Referring 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.
- Note 2. Do not connect anything to the pins shown as .
- Note 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 <sup>2</sup> ]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

## 6. WIRING OPTION

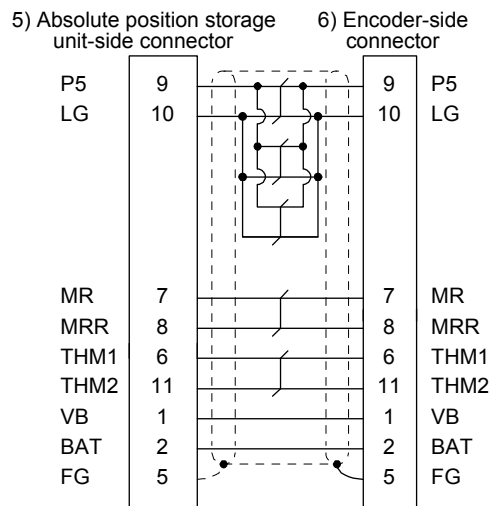
### (3) Encoder cable C (a) Connector details

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 VSVPAGW#23×6P KB-0492 (Note 2) (Bando Densen)	Straight plug: RM15WTPZK-12S Cord clamp: JR13WCCA-8(72) (Hirose Electric)  Recommended cable: 20276 VSVPAGW#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 .  
 Note 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 <sup>2</sup> ]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

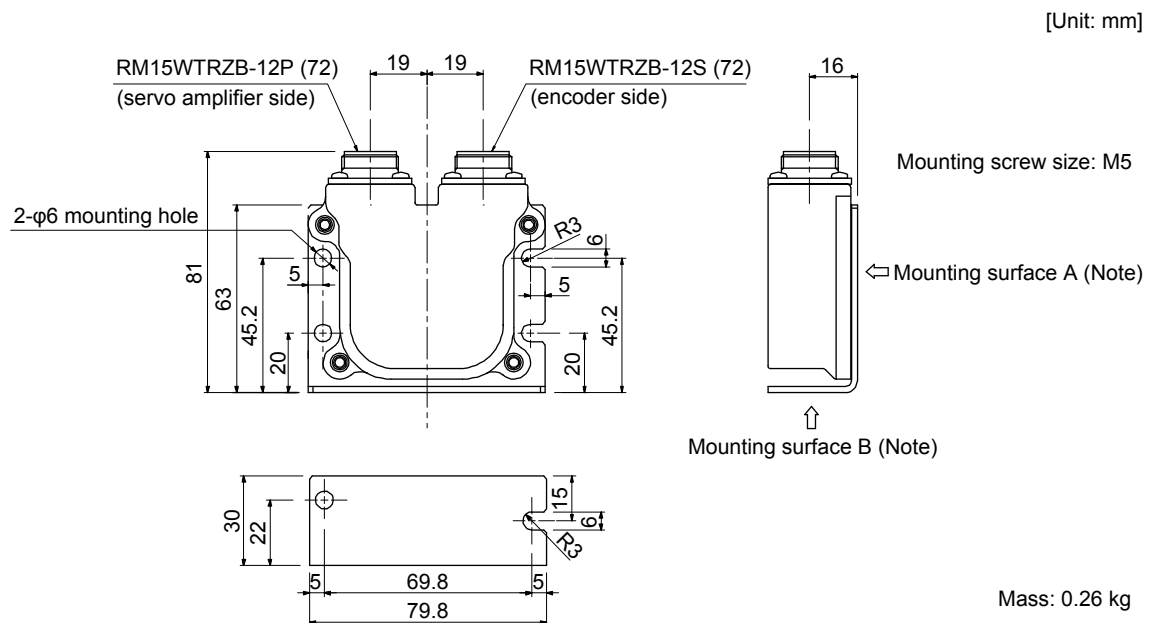
## 6. WIRING OPTION

### 6.3 Absolute position storage unit MR-BTAS01

POINT
<ul style="list-style-type: none"> <li>● 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.</li> <li>● For absolute position detection system, refer to each servo amplifier instruction manual.</li> <li>● [AL. 25 Absolute position erased] will occur if the encoder cable is disconnected.</li> </ul>

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

(2) Dimensions



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	90 %RH or less (non-condensing)
	Storage	90 %RH or less (non-condensing)
Ambience	Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.	
Altitude	Max. 1000 m above sea level	
Vibration resistance	When the mounting surface A is fixed: 49 m/s <sup>2</sup> (directions of X, Y, and Z axes) When the mounting surface B is fixed: 5.9 m/s <sup>2</sup> (directions of X, Y, and Z axes)	





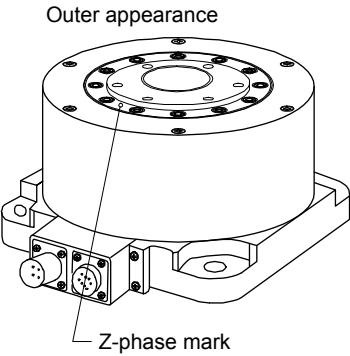
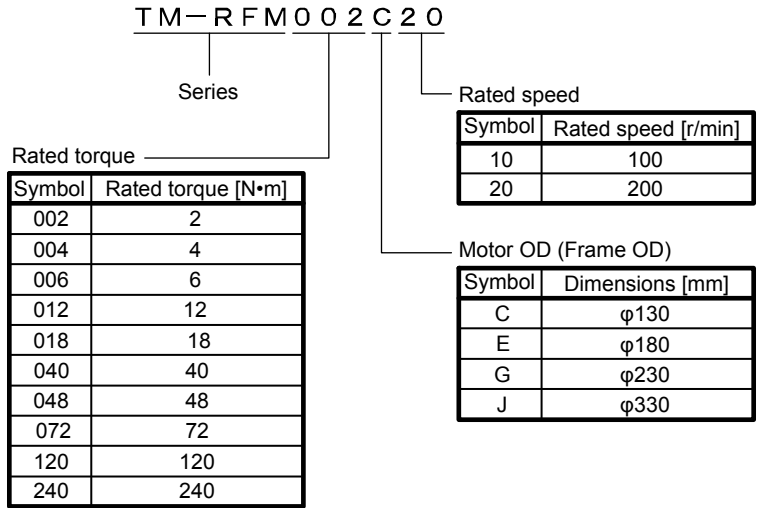
# 7. TM-RFM SERIES

## 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.



## 7. TM-RFM SERIES

### 7.2 Combinations of servo amplifier and direct drive motor

Direct drive motor	Servo amplifier			
	MR-J4 1-axis		MR-J4 2-axis	MR-J4 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-J4-20A1 MR-J4-20A1-RJ MR-J4-20B1 MR-J4-20B1-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-J4-40A1 MR-J4-40A1-RJ MR-J4-40B1 MR-J4-40B1-RJ	MR-J4W2-44B MR-J4W2-77B MR-J4W2-1010B	MR-J4W3-444B
TM-RFM006C20	MR-J4-60A MR-J4-60A-RJ	/	MR-J4W2-77B MR-J4W2-1010B	/
TM-RFM006E20	MR-J4-60B MR-J4-60B-RJ			
TM-RFM012E20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM018E20	MR-J4-100A MR-J4-100A-RJ MR-J4-100B MR-J4-100B-RJ		MR-J4W2-1010B	
TM-RFM012G20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM048G20	MR-J4-350A MR-J4-350A-RJ		/	
TM-RFM072G20	MR-J4-350B MR-J4-350B-RJ			
TM-RFM040J10	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM120J10	MR-J4-350A MR-J4-350A-RJ MR-J4-350B MR-J4-350B-RJ		/	
TM-RFM240J10	MR-J4-500A MR-J4-500A-RJ MR-J4-500B MR-J4-500B-RJ			

## 7. TM-RFM SERIES

### 7.3 Specification list

Direct drive motor			TM-RFM series					
			002C20	004C20	006C20	006E20	012E20	018E20
Item								
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	2.1	3.2	3.2	3.8	5.9
Maximum current [A]			3.9	6.3	9.6	9.6	12	18
Moment of inertia J [ $\times 10^{-4}$ kg•m <sup>2</sup> ]			10.9	16.6	22.4	74.0	111	149
Recommended load to motor inertia ratio (Note 2)			50 times or less					
Absolute accuracy [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)					
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	80 %RH or less (non-condensing)					
		Storage	90 %RH or less (non-condensing)					
	Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.					
	Altitude		Max. 1000 m above sea level					
Vibration resistance (Note 6)		X: 49 m/s <sup>2</sup> Y: 49 m/s <sup>2</sup>						
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

## 7. TM-RFM SERIES

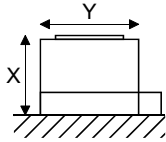
Direct drive motor			TM-RFM series					
			012G20	048G20	072G20	040J10	120J10	240J10
Item			φ230			φ330		
Motor OD (frame OD)	[mm]		φ230			φ330		
Power supply capacity	Refer to "USING A DIRECT DRIVE MOTOR" of each servo amplifier instruction manual.							
Continuous running duty (Note 1)	Rated output	[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 <sup>-4</sup> kg•m <sup>2</sup> ]		238	615	875	1694	3519	6303
Recommended load to motor inertia ratio (Note 2)	50 times or less							
Absolute accuracy	[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)							
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	80 %RH or less (non-condensing)					
		Storage	90 %RH or less (non-condensing)					
	Ambience	Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, oil and water.						
	Altitude	Max. 1000 m above sea level						
Vibration resistance (Note 6)	X: 49 m/s <sup>2</sup> Y: 49 m/s <sup>2</sup>			X: 24.5 m/s <sup>2</sup> Y: 24.5 m/s <sup>2</sup>				
Vibration rank (Note 7)	V10							
Rotor permissible load (Note 8)	Moment load	[N•m]	93			350		
	Axial load	[N]	5500			16000		
Mass	[kg]		17	38	52	48	85	150

# 7. TM-RFM SERIES

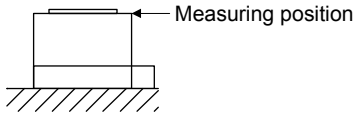
- Note
1. When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
  2. If the load inertia moment ratio exceeds the indicated value, contact your local sales office.
  3. Always connect the following options to configure the absolute position detection system.

Servo amplifier	Option
MR-J4 1-axis	Battery (MR-BAT6V1SET) Absolute position storage unit (MR-BTAS01)
MR-J4 multi-axis	Battery unit (MR-BT6VCASE and five MR-BAT6V1) Absolute position storage unit (MR-BTAS01)

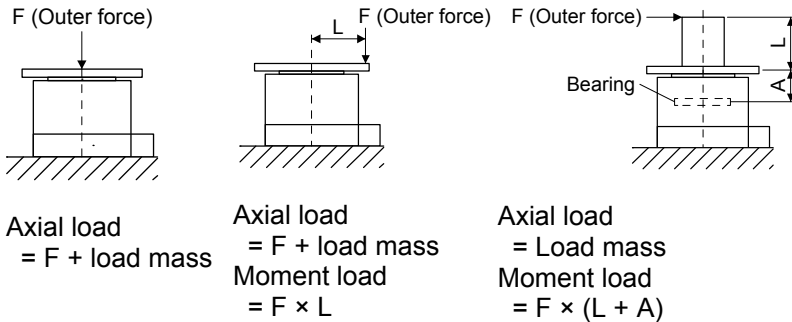
4. Shaft-through portion of the rotor and the connector area are excluded. IP classifies the degrees of protection provided against the intrusion of solid objects and water in electrical enclosures.
5. In the environment where the direct drive motor is exposed to oil mist, oil, and water, a standard 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.



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

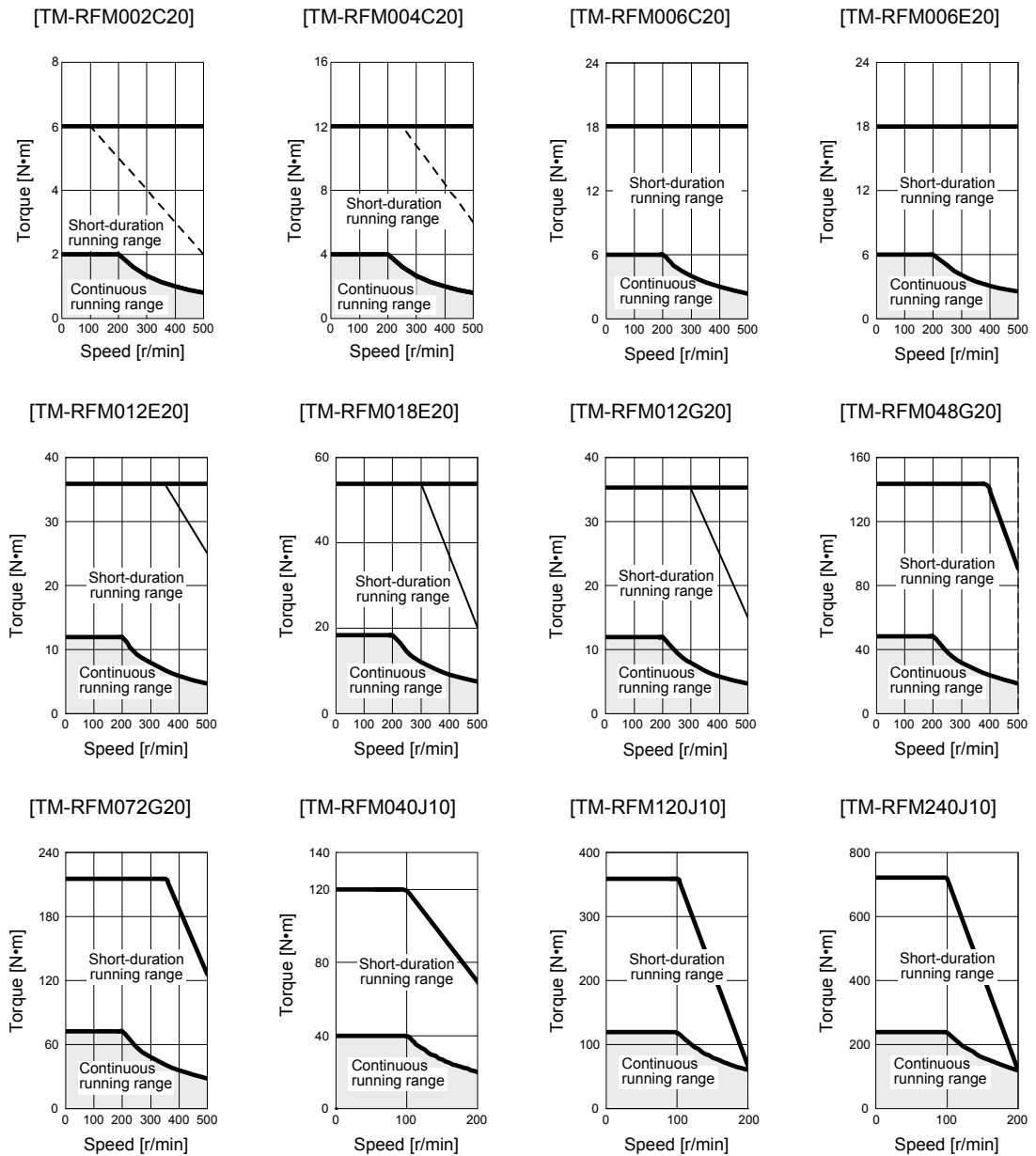
# 7. TM-RFM SERIES

## 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.

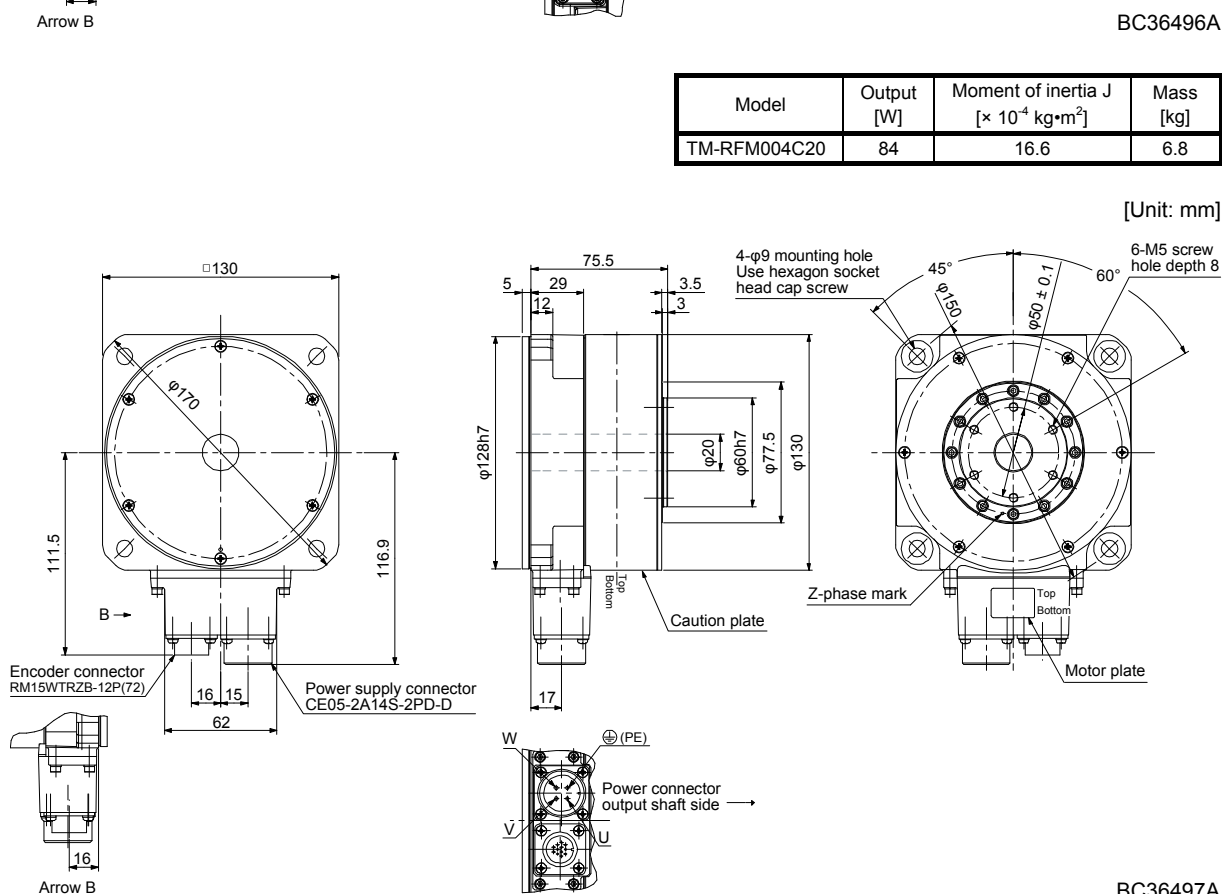
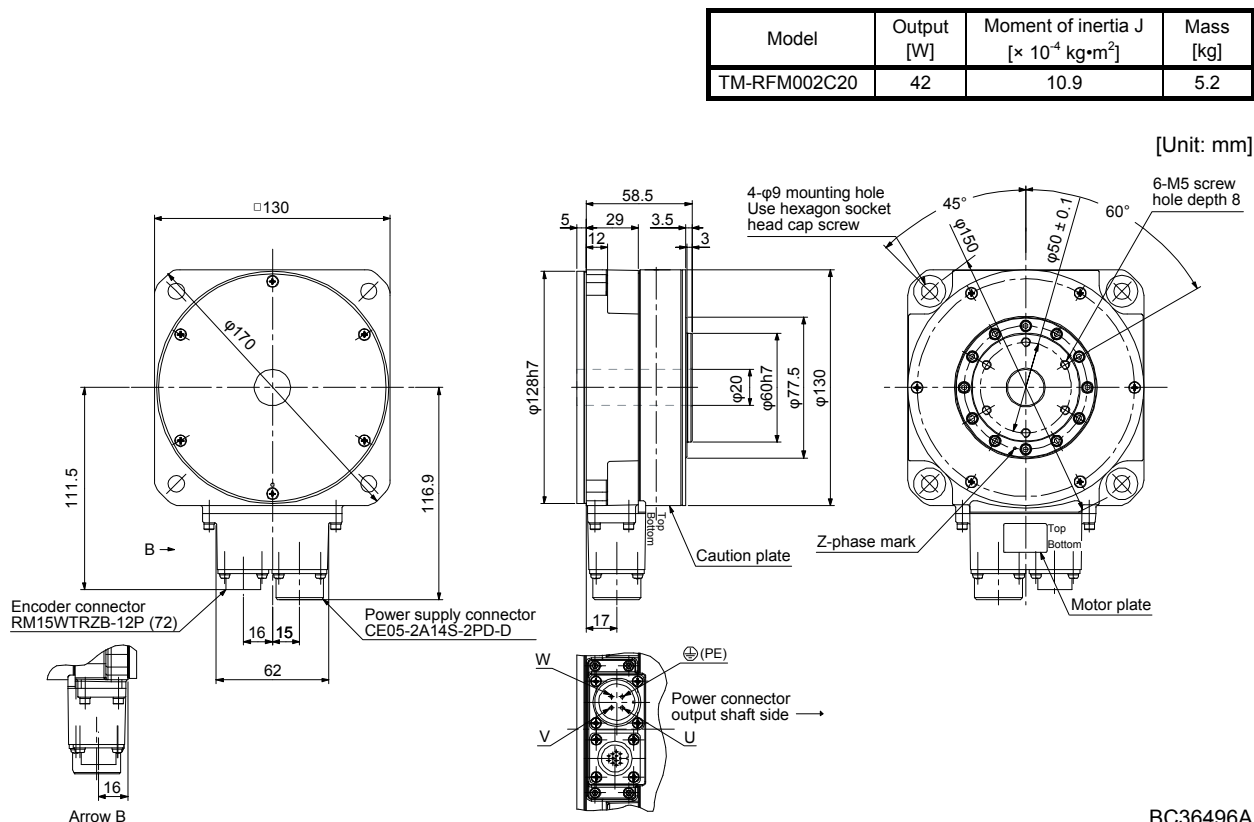
Bold lines indicate the torque characteristics with the 3-phase 200 V AC power supply input or 1-phase 230 V AC power supply input to the servo amplifier. For the 1-phase 200 V AC power supply input, part of the torque characteristic is indicated by thin lines. The 1-phase power supply input is available 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.



## 7. TM-RFM SERIES

### 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.

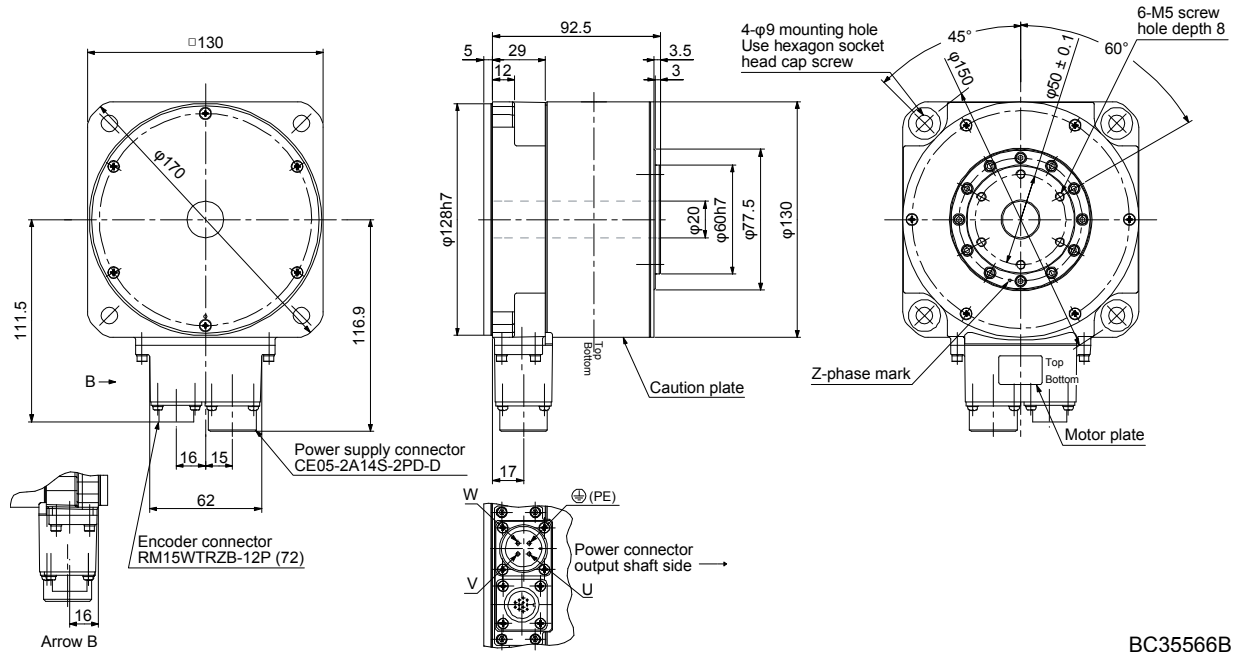




# 7. TM-RFM SERIES

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM006C20	126	22.4	8.4

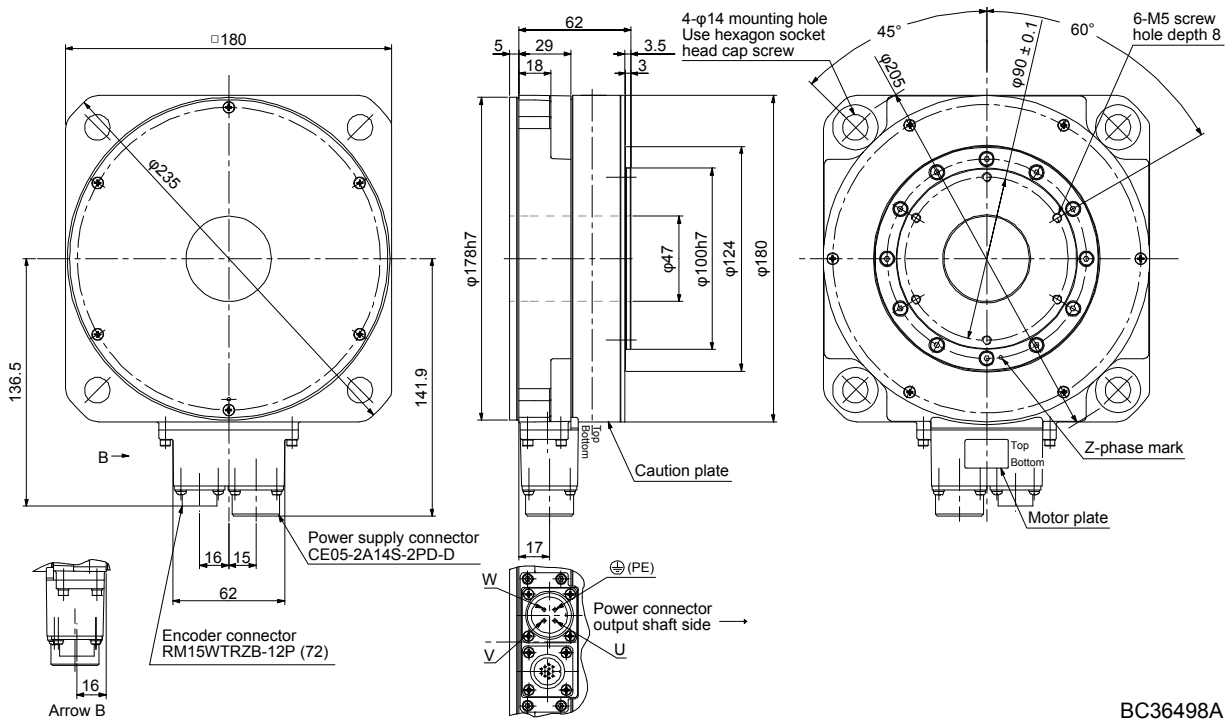
[Unit: mm]



BC35566B

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM006E20	126	74.0	11

[Unit: mm]

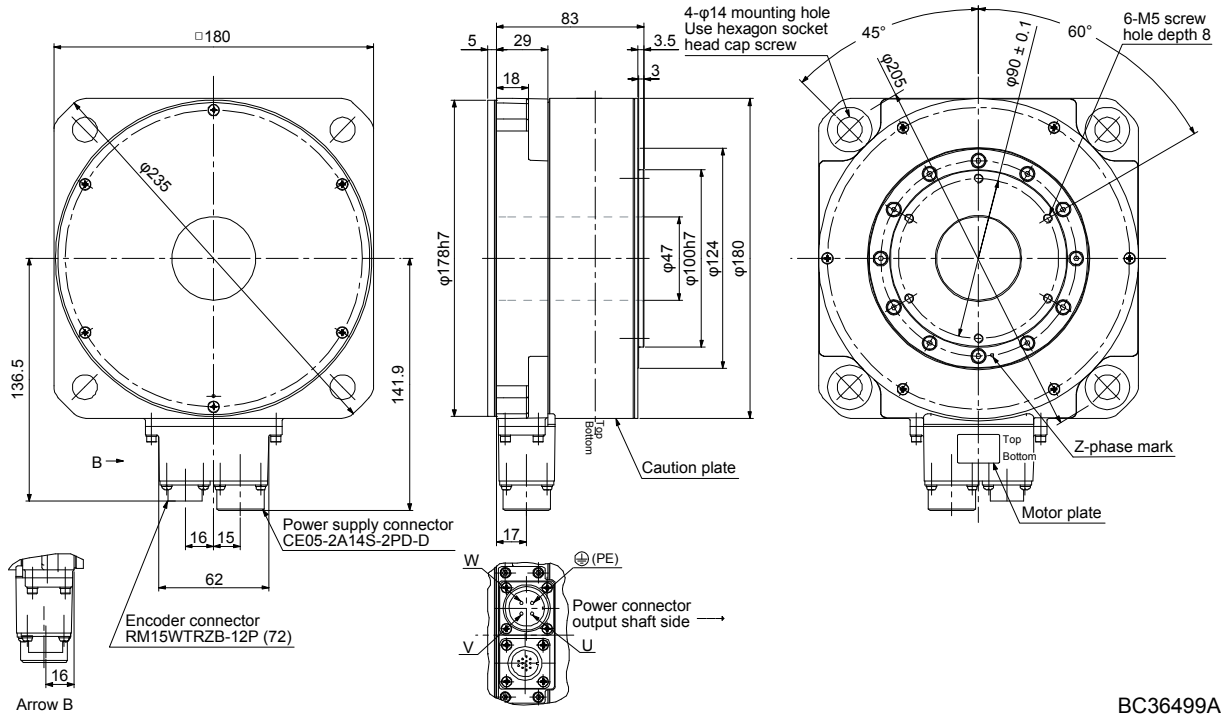


BC36498A

# 7. TM-RFM SERIES

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM012E20	251	111	15

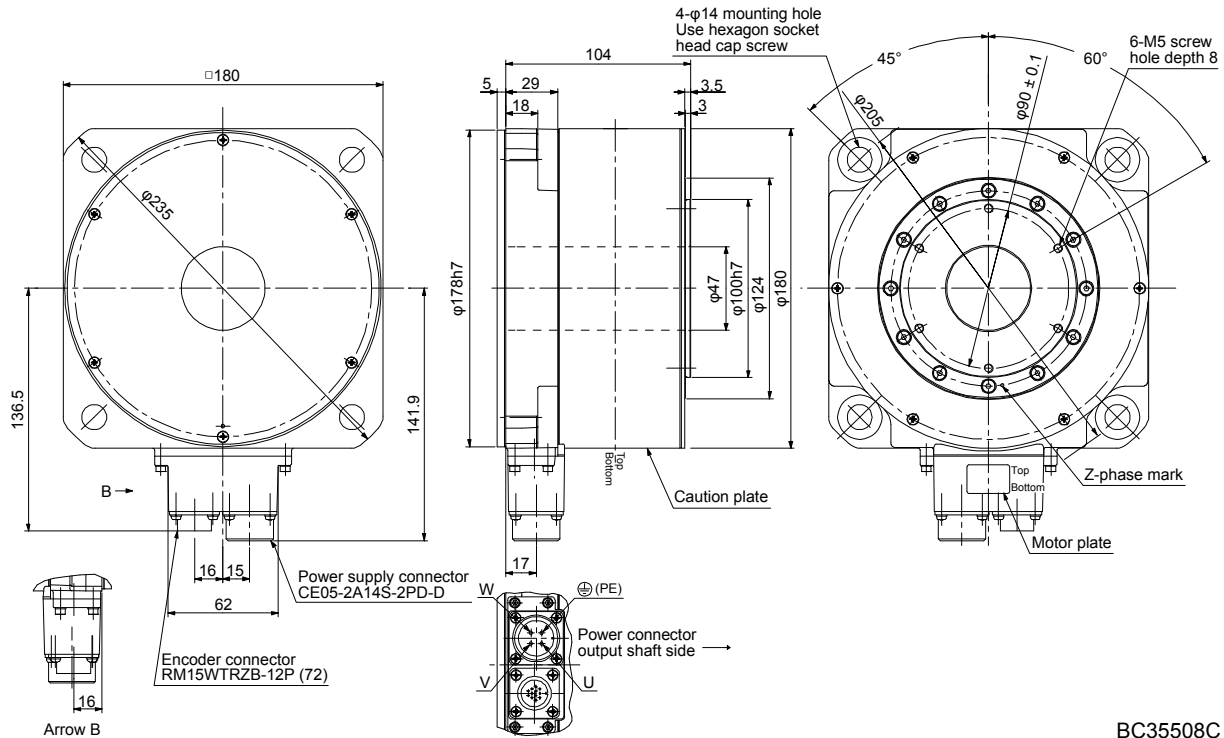
[Unit: mm]



BC36499A

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM018E20	377	149	18

[Unit: mm]

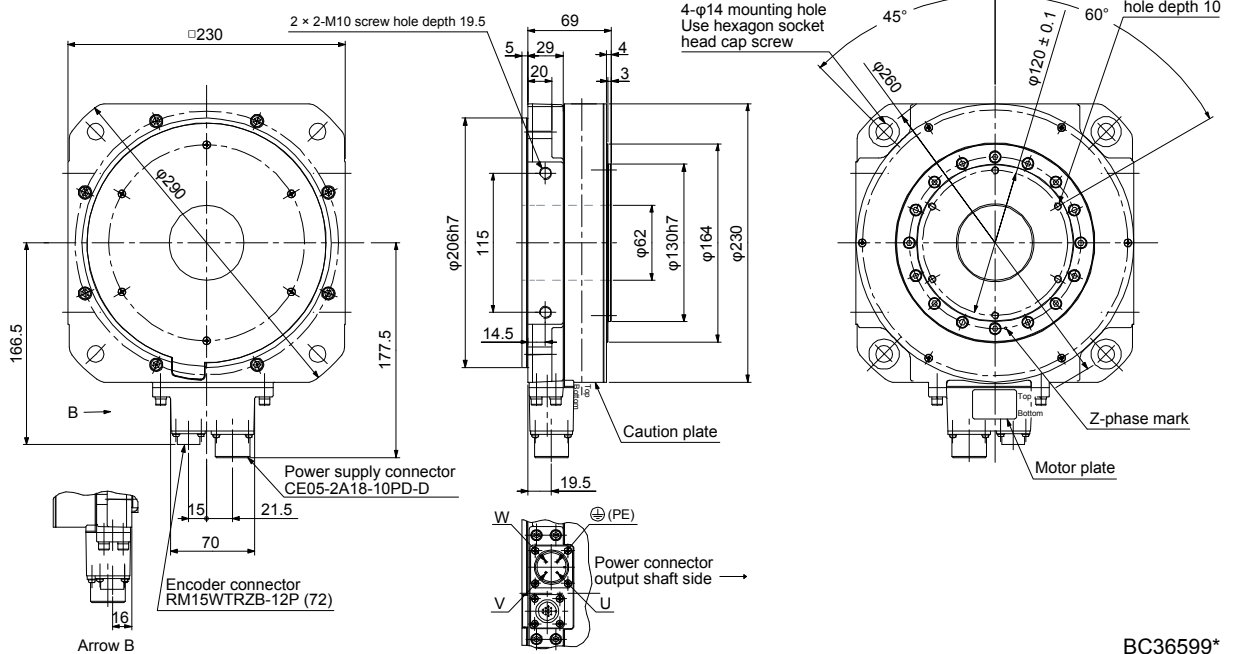


BC35508C

# 7. TM-RFM SERIES

Model	Output [W]	Moment of inertia J [ $\times 10^{-4} \text{ kg}\cdot\text{m}^2$ ]	Mass [kg]
TM-RFM012G20	251	238	17

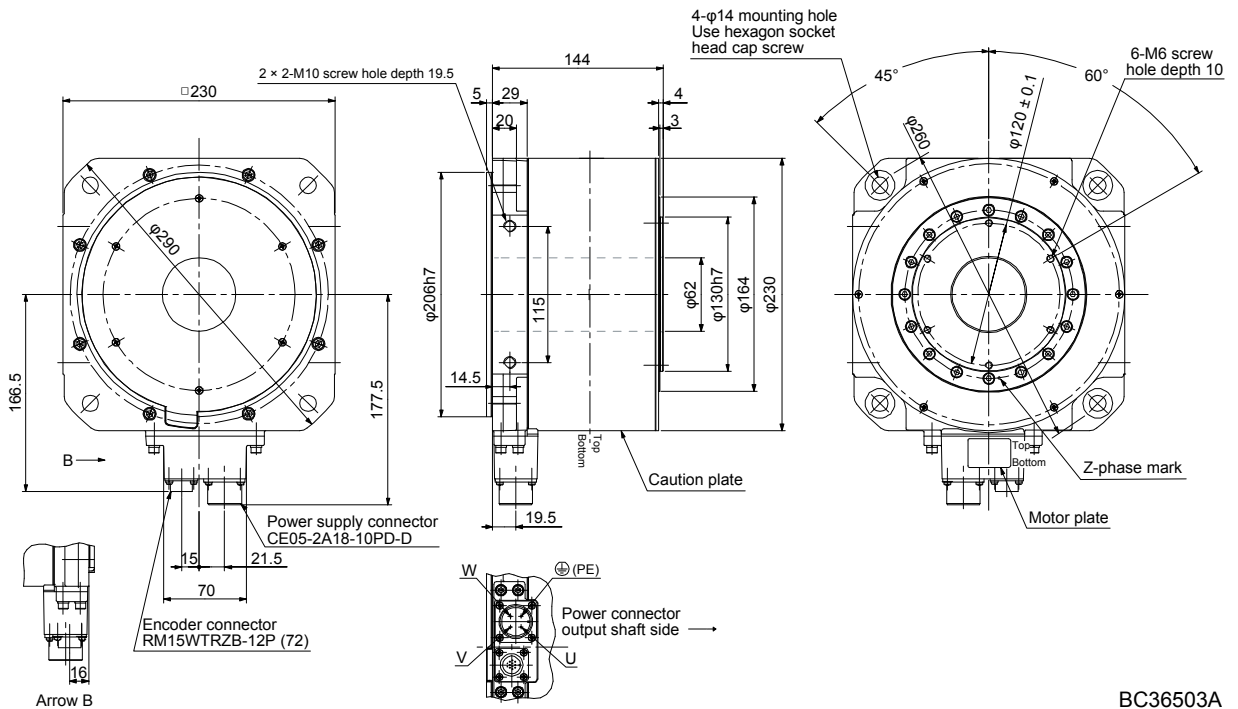
[Unit: mm]



BC36599\*

Model	Output [W]	Moment of inertia J [ $\times 10^{-4} \text{ kg}\cdot\text{m}^2$ ]	Mass [kg]
TM-RFM048G20	1005	615	36

[Unit: mm]

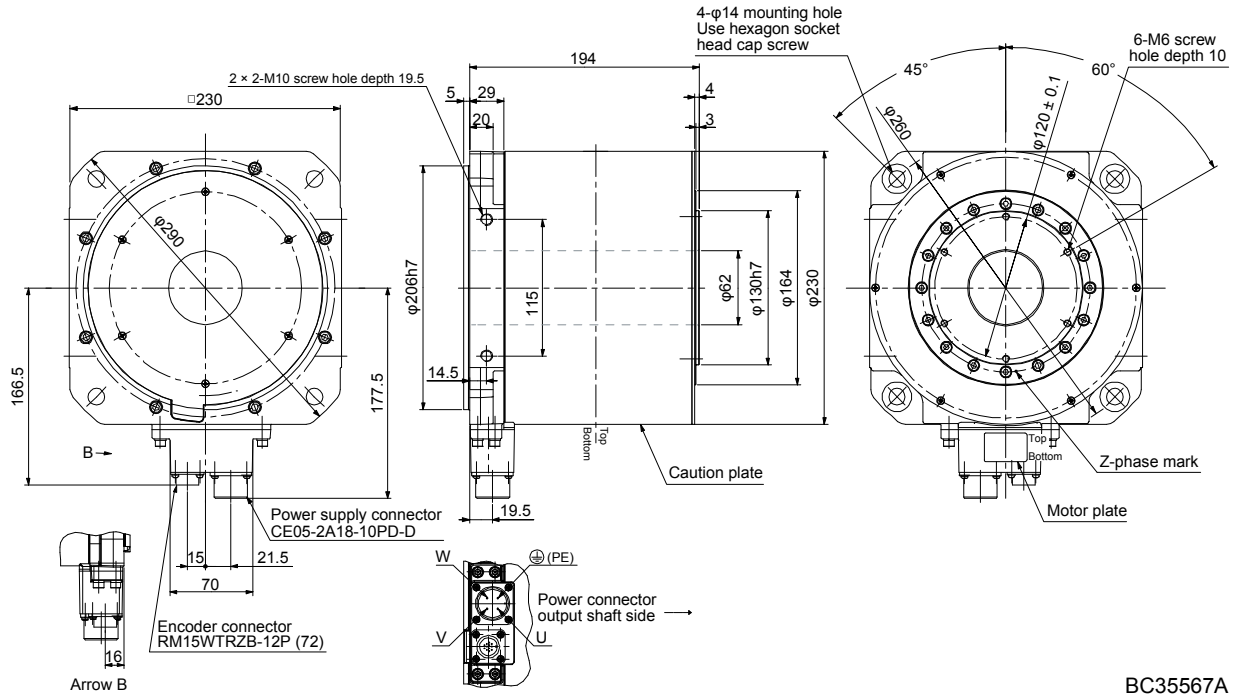


BC36503A

# 7. TM-RFM SERIES

Model	Output [W]	Moment of inertia J [ $\times 10^{-4} \text{ kg}\cdot\text{m}^2$ ]	Mass [kg]
TM-RFM072G20	1508	875	52

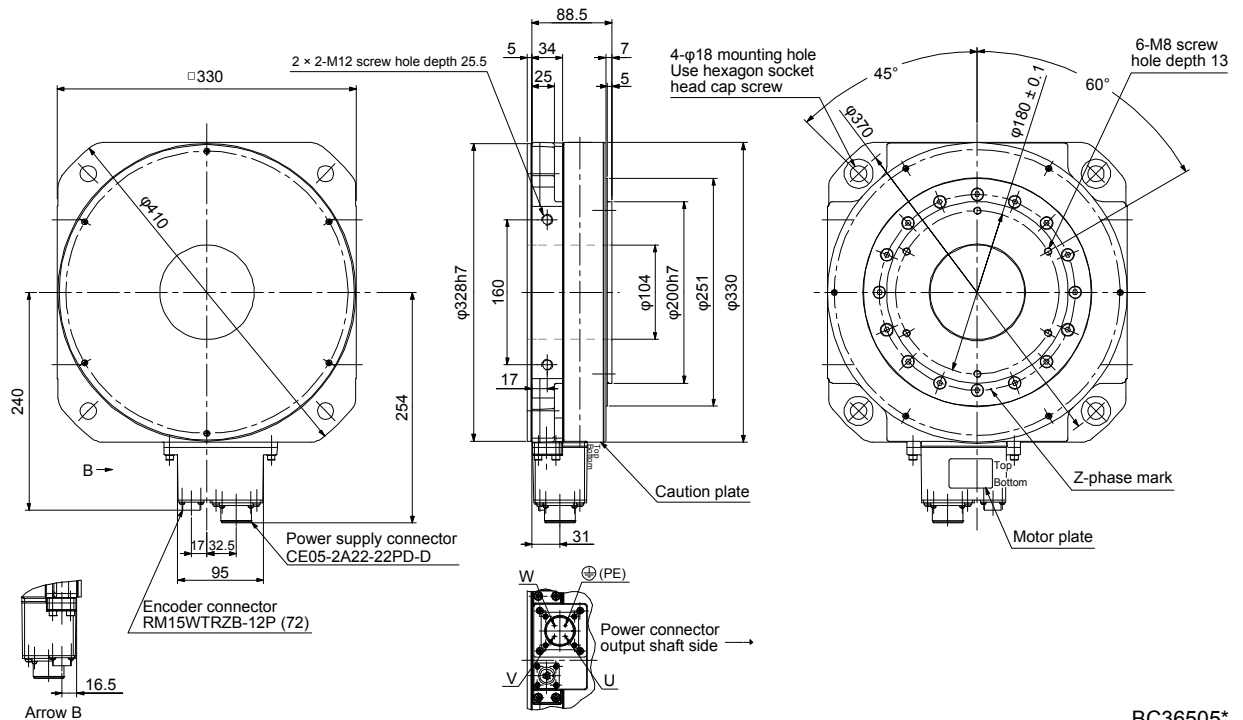
[Unit: mm]



BC35567A

Model	Output [W]	Moment of inertia J [ $\times 10^{-4} \text{ kg}\cdot\text{m}^2$ ]	Mass [kg]
TM-RFM040J10	838	1694	53

[Unit: mm]

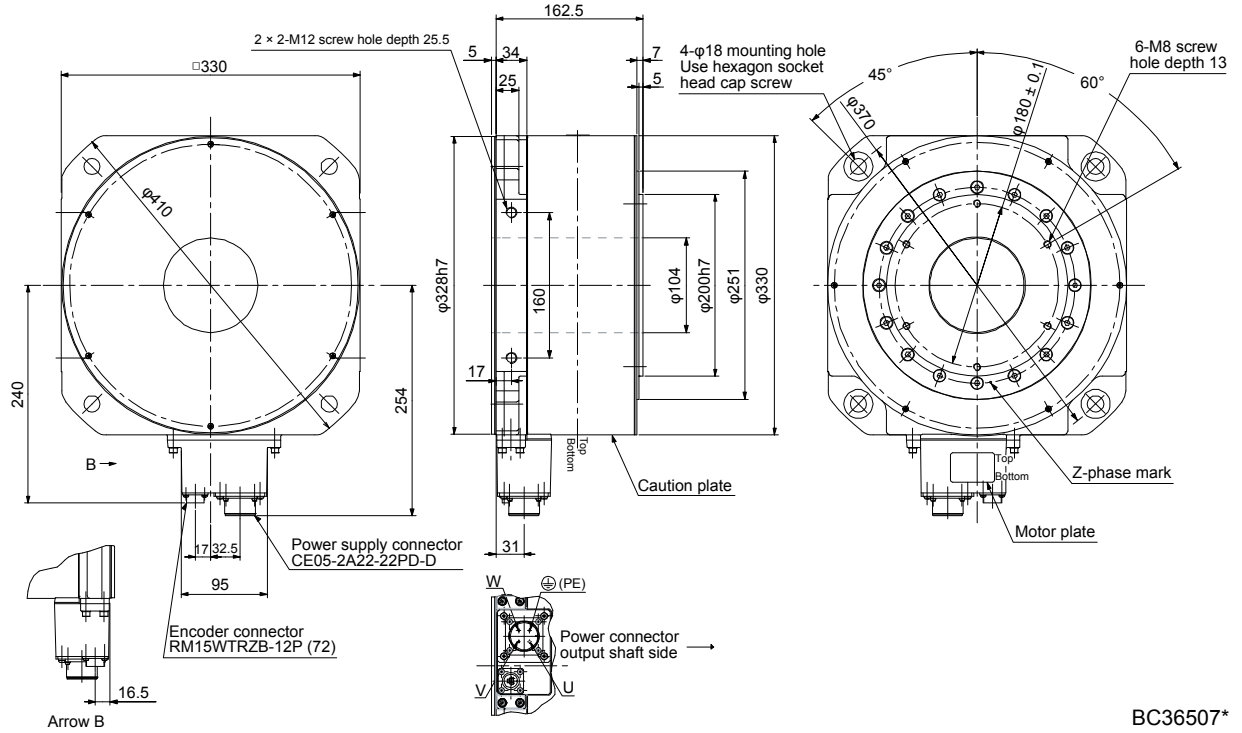


BC36505\*

# 7. TM-RFM SERIES

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM120J10	2513	3519	91

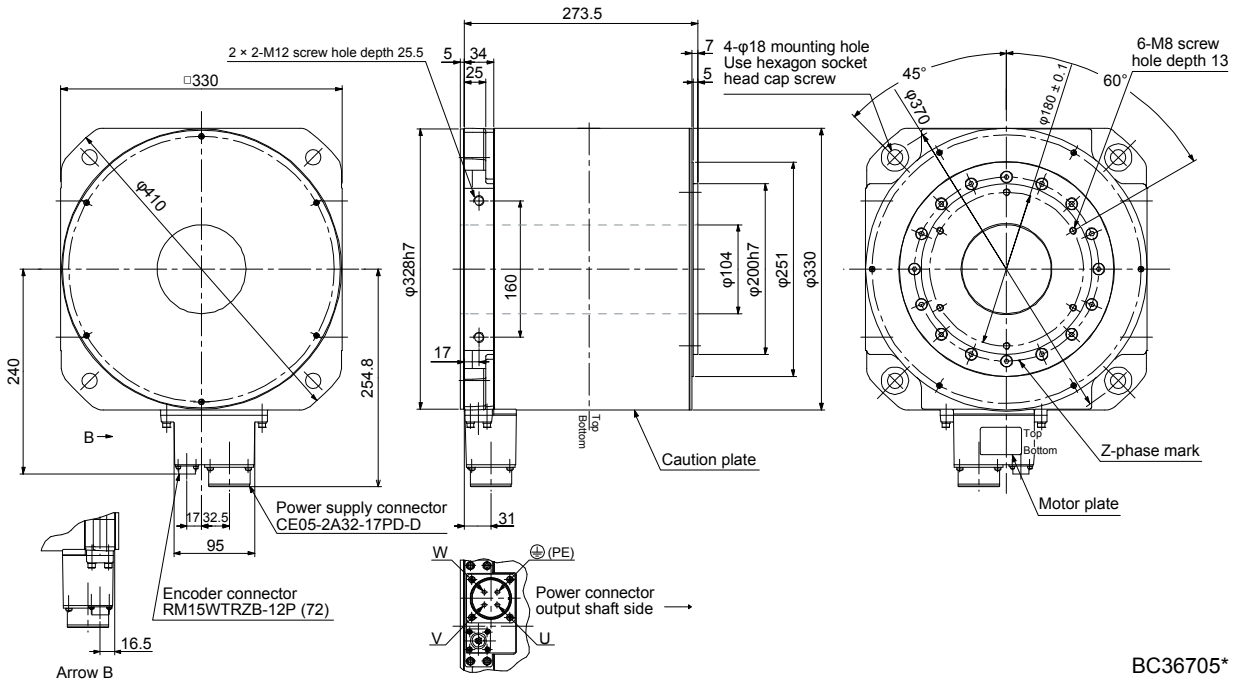
[Unit: mm]



BC36507\*

Model	Output [W]	Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	Mass [kg]
TM-RFM240J10	5027	6303	146

[Unit: mm]



BC36705\*

# APPENDIX

## App. 1 Selection example of direct drive motor

### App. 1.1 Selection conditions

#### (1) Machine configuration

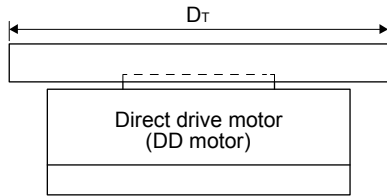


Table mass	W	= 19 [kg]
Rotary table diameter	$D_T$	= 300 [mm]
Rotation angle per cycle	$\theta$	= 270 [degree]
Positioning time	$t_0$	= 0.45 [s] or less
Acceleration/deceleration time	$t_p = t_{psa} = t_{psd}$	= 0.125 [s]
Operation cycle	$t_f$	= 2.0 [s]
Load torque	$T_L$	= 0 [N·m]

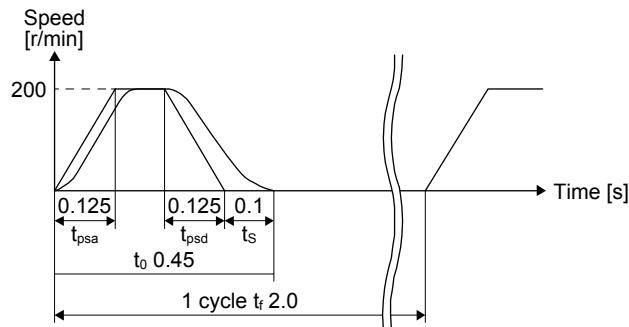
#### (2) Direct drive motor speed

$$N_o = \frac{\theta}{360} \times \frac{60}{(t_0 - t_p - t_s)}$$

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

$t_s$ : 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

$$T_a = J_L \times 2\pi \times \frac{N_o / 60}{t_p}$$

$$= \frac{J_L \times N_o}{\frac{60}{2\pi} \times t_p}$$

$$= \frac{0.214 \times 200}{9.55 \times 0.125}$$

$$= 35.9 \text{ [N·m]}$$

# APPENDIX

(3) Temporary selection of direct drive motor

Selection conditions

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

Load moment of inertia <  $J_R \times$  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:  $149 \times 10^{-4}$  [kg•m<sup>2</sup>])

(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.

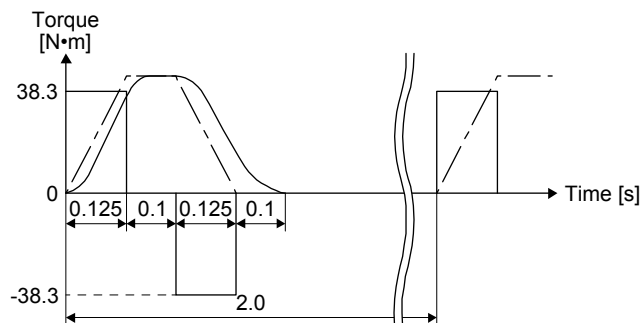
(5) Continuous effective load torque

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

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

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

(6) Torque pattern



# APPENDIX

## (7) Selection results

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

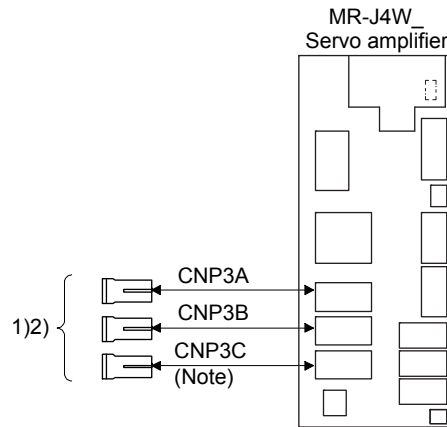
Direct drive motor            TM-RFM018E20  
 Servo amplifier                MR-J4-100B

## App. 2 Manufacturer list


Names given in the table are as of September 2015.

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.

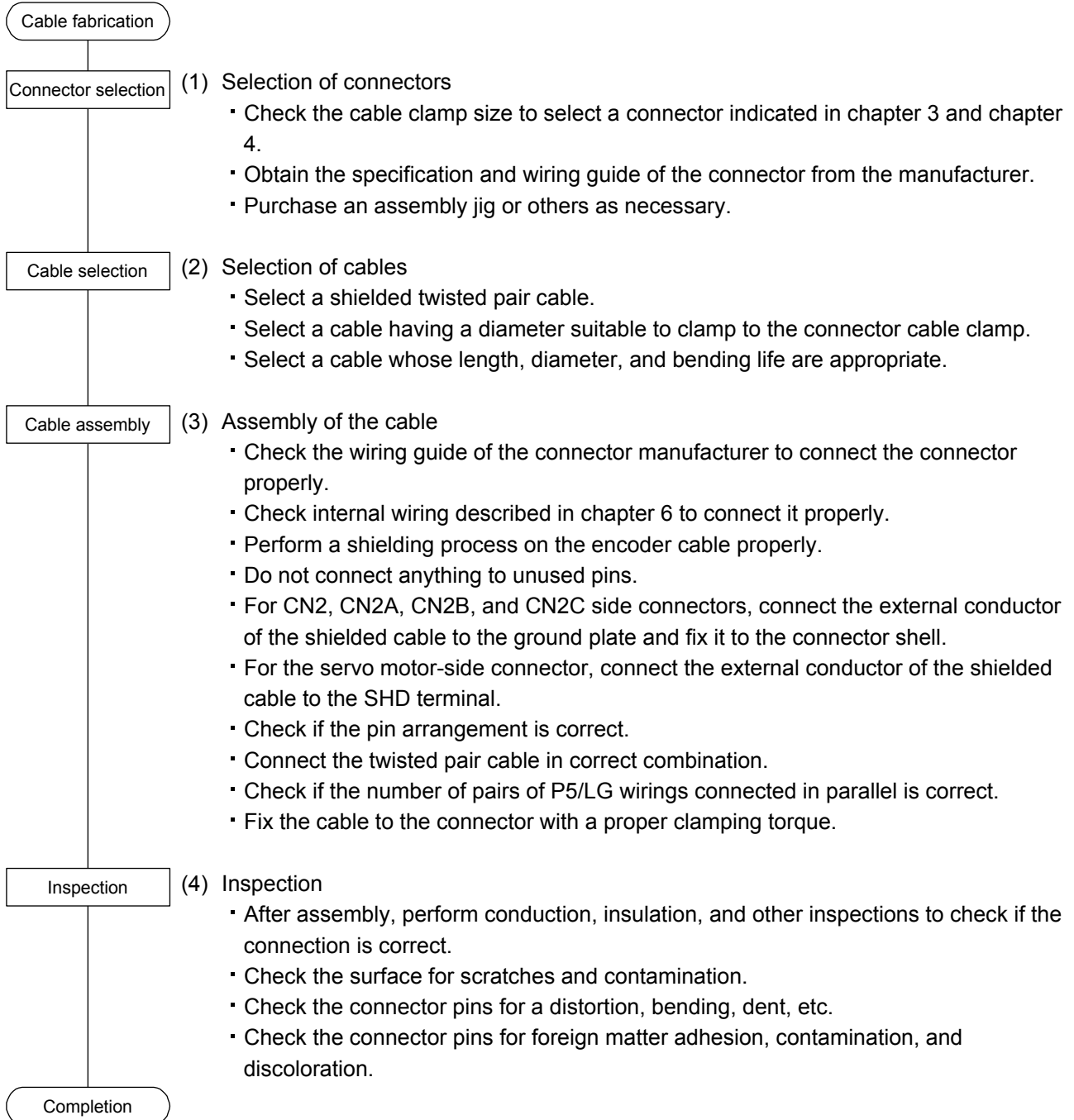
No.	Name	Model	Description	Application
1)	Connector set	MR-J3WCNP3-D2L	 For CNP3A/CNP3B/CNP3C Receptacle housing: F35FDC-04V-K Receptacle contact: BF3F-71GF-P2.0 (JST)	Quantity: 1 For thick wires
2)	Connector set	MR-J3WCNP3-D2L-20P	Applicable wire Wire size: 1.25 mm <sup>2</sup> (AWG 6) to 2.0 mm <sup>2</sup> (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.



## REVISIONS

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

Print Data	*Manual Number	Revision	
Mar. 2012	SH(NA)030112-A	First edition	
May 2012	SH(NA)030112-B	Chapter 4 (3)	The part of diagram is changed.
Feb. 2013	SH(NA)030112-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)030112-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)030112-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.

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## 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 responsibility for compensation against loss of opportunity, secondary loss, etc.

Whether under or after the term of warranty, we assume no responsibility for any damages arisen from causes for which we are not responsible, any losses of opportunity and/or profit incurred by you due to a failure of the Product, any damages, secondary damages or compensation for accidents arisen under a specific circumstance that are foreseen or unforeseen by our company, any damages to products other than the Product, and also compensation for any replacement work, readjustment, start-up test run of local machines and the Product and any other operations conducted by you.

### 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.

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MODEL CODE	1CW948

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