



Mitsubishi Electric AC Servo System

MITSUBISHI ELECTRIC SERVO SYSTEM  
**MELSERVO-*J5***

## Direct Drive Motor User's Manual

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-TM-RFM  
-TM-RG2M  
-TM-RU2M



# SAFETY INSTRUCTIONS

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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 manual, installation guide, and appended documents carefully. Do not use the equipment until you have a full knowledge of the equipment, safety information and instructions.

In this 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.

Note that the CAUTION level may lead to a serious consequence depending on conditions.


Please follow the instructions of both levels because they are important to personnel safety.

Forbidden actions and required actions are indicated by the following diagrammatic symbols.



Indicates a forbidden action. For example, "No Fire" is indicated by .



Indicates a required action. For example, grounding is indicated by .

In this manual, precautions for hazards that can lead to property damage, instructions for other functions, and other information are shown separately in the "POINT" area.

After reading this manual, keep it accessible to the operator.

## [Installation/wiring]

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### **WARNING**

- To prevent an electric shock, turn off the power and wait for 15 minutes or more before starting wiring and/or inspection.
  - To prevent an electric shock, ground the direct drive motor securely.
  - To prevent an electric shock, any person who is involved in wiring should be fully competent to do the work.
  - To prevent an electric shock, do not attempt to wire the direct drive motor until it has been mounted.
  - To prevent an electric shock, do not touch the conductive parts.
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## [Installation/wiring]

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### **Precautions**

- To prevent injury, do not touch the rotor of the direct drive motor during operation.
  - To prevent injury, transport the products correctly according to their mass.
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## [Maintenance]

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### **WARNING**

- To prevent an electric shock, any person who is involved in inspection should be fully competent to do the work.
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## **DISPOSAL OF WASTE**

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Please dispose of this product and other options according to your local laws and regulations.

# ABOUT THE MANUAL

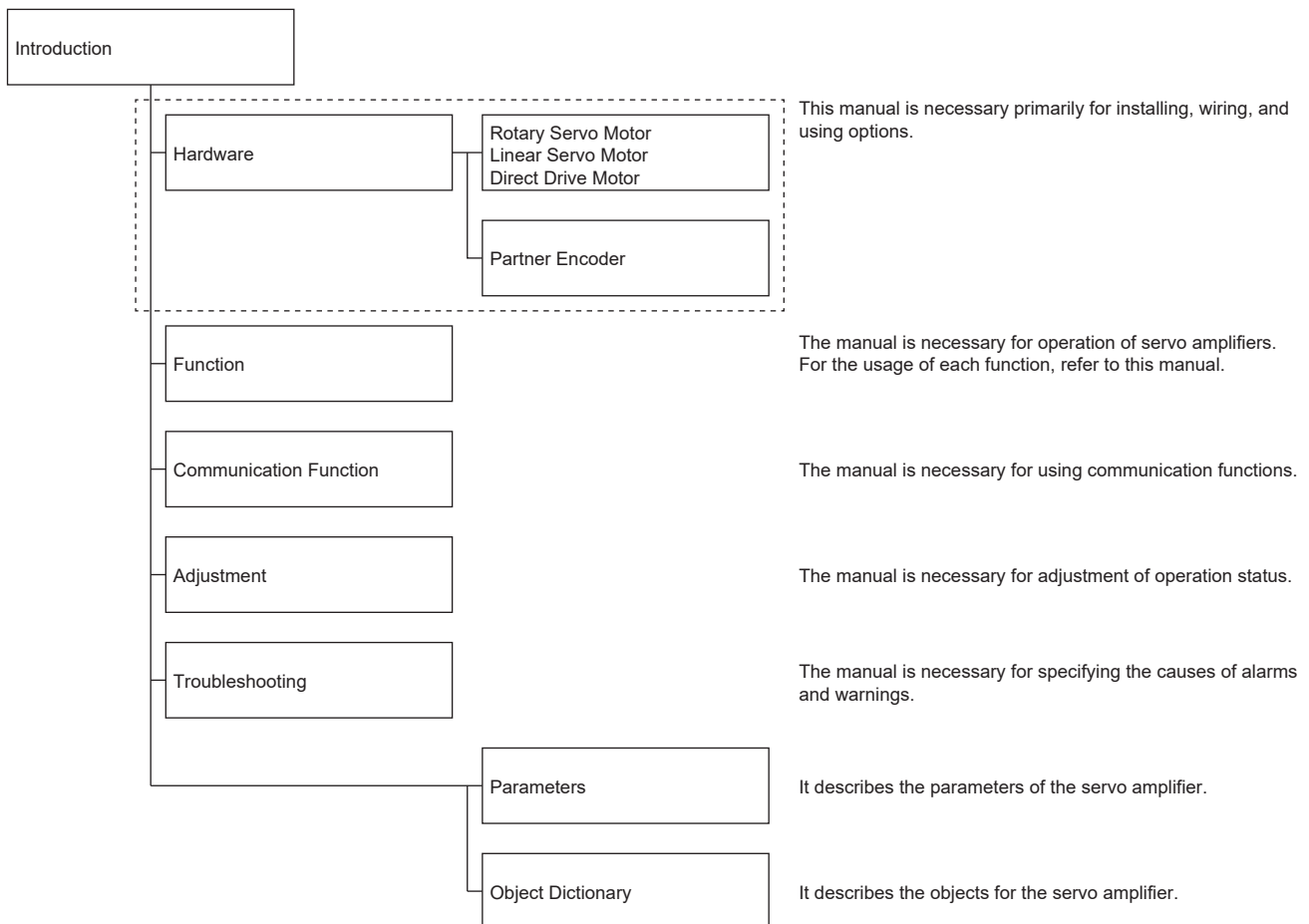
## Point

e-Manuals are Mitsubishi Electric FA electronic book manuals that can be browsed with a dedicated tool.

e-Manuals enable the following:

- Searching for desired information in multiple manuals at the same time (manual cross searching)
- Jumping from a link in a manual to another manual for reference
- Browsing for hardware specifications by scrolling over the components shown in product illustrations
- Bookmarking frequently referenced information
- Copying sample programs to engineering tools

If using the servo for the first time, prepare and use the following related manuals to ensure that the servo is used safely. The manuals used differ depending on the interface of the servo amplifier. For details, refer to the User's Manual (Introduction).



## CABLES USED FOR WIRING

Cables mentioned in this manual are selected based on an 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 [ $\times 10^{-4}$ kg•m <sup>2</sup> ]	5.4675 [oz•inch <sup>2</sup> ]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [ $^{\circ}$ C] $\times$ 9/5 + 32	N [ $^{\circ}$ F]

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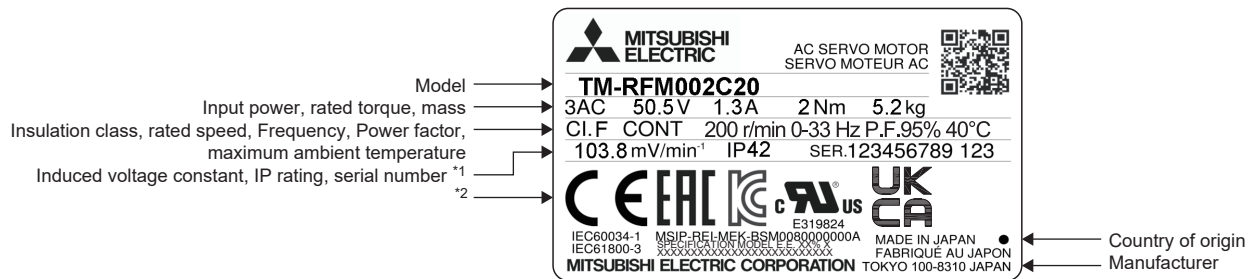
# 1 INTRODUCTION

## Precautions

- Use direct drive motors manufactured after June 2019.

## 1.1 Rating plate

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



- \*1 The date of manufacture of the direct drive motor are indicated in the serial number on the rating plate. For the date of manufacture, the last two digits of the year and the month in numerical format [1 to 9, X (10), Y (11), and Z (12)] are displayed.
- \*2 Products proven to comply with the standards set by a given Certification Body are marked with the appropriate certification marks. The marks vary for each Certification Body.

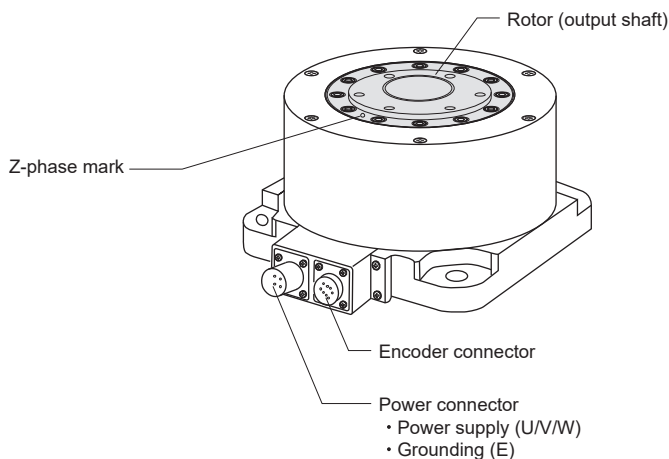
## 1.2 Environment

	Operation	Storage/transportation
Ambient temperature	0 °C to 60 °C (non-freezing) *2	-15 °C to 70 °C (non-freezing)
Ambient humidity	10 %RH to 80 %RH (non-condensing)	10 %RH to 90 %RH (non-condensing)
Ambience **4	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust	
Altitude	2000 m or less *3	
Vibration resistance	TM-RFM series ☞ Page 43 Specification list TM-RG2M series/TM-RU2M series ☞ Page 53 Specification list	

- \*1 Do not use in an environment where there is exposure to oil mist, oil, and water.
- \*2 Refer to the following for restrictions on the ambient temperature.
  - TM-RFM series
    - ☞ Page 46 Derating
  - TM-RG2M series/TM-RU2M series
    - ☞ Page 55 Derating
- \*3 Refer to the following for restrictions on using this product at an altitude exceeding 1000 m and up to 2000 m.
  - TM-RFM series
    - ☞ Page 46 Derating
  - TM-RG2M series/TM-RU2M series
    - ☞ Page 55 Derating
- \*4 Do not place the direct drive motor near magnetic sources such as magnets. When it is necessary to use the motor near magnetic sources, block the magnetic force by installing a shielding plate or other blocking agents.

## 1.3 Parts identification

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## 1.4 Instructions on storage

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### Precautions

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

- Always store the direct drive motor indoors in a clean and dry place.
- When storing in a dusty and humid area, take measures such as covering the whole product.
- If the insulation resistance of the magnet wire decreases, reconsider how the equipment is being stored.
- Although the servo motor has been given rust prevention treatment with paint and preventive oil before shipment, rust may still appear depending on the storage period and conditions. If the servo motor is to be stored for longer than six months, apply rust prevention oil again, especially to the machined surfaces of the rotor or other parts.
- Before using the product after an extended storage, hand-turn the rotor (output shaft) of the direct drive motor and check to ensure that there is no abnormality.
- When the product has been stored for an extended period of time, contact your local sales office.

## 1.5 Design instructions

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### Precautions

- If it is assumed that a power failure or product malfunction may result in a hazardous situation, provide an external brake system for holding purpose to prevent such hazard.

## 1.6 Instructions on maintenance

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### Precautions

- For repair and parts replacement, contact your local sales office.

# 2 INSTALLATION

## Precautions

- The cables should not be damaged, stressed, loaded, or pinched.
- Mount the direct drive motor on incombustible materials. Installing the direct drive motor either directly on or near combustibles may lead to smoke or a fire.
- Provide adequate protection so as to prevent conductive matter (such as screws and metal fragments) and combustible matter (such as oil) from entering the direct drive motor.
- The direct drive motor may be hot depending on the operating method. Take safety measures such as providing covers.
- Do not stack in excess of the specified number of product packages.
- Do not carry the direct drive motor by the cables, connectors, or encoder. Doing so may cause the direct drive motor to drop.
- Install the direct drive motor in a load-bearing place in accordance with the user's manual.
- The equipment must be installed in the specified direction.
- Use the product within the specified environment. For the environment, refer to the specifications of the direct drive motor.
- Securely fix the direct drive motor to the machine. If attached insecurely, the motor may come off during operation.
- Do not install or operate a direct drive motor that is missing parts or is damaged.
- To prevent an encoder malfunction from occurring, do not apply shocks, e.g. hit with a hammer, when coupling the rotor of the direct drive motor.
- To prevent the rotor from being damaged, do not subject the rotor of the direct drive motor to more than the permissible load.
- To prevent a connection failure, malfunction, or similar problem, do not strike the connector.
- Be sure to measure the vibration level with the direct drive motor mounted on the machine. A great vibration may cause early damage to a bearing and encoder. The great vibration may also cause the poor connector connection or screw 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 early damage to the direct drive motor.
- Some of the figures in the user's manuals may have been drawn without covers and safety guards in order to describe the details. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this user's manual.
- To prevent vibration during direct drive motor operation and to prevent damage to the bearings and encoder, the balance level of the load needs to be as even as possible. To prevent malfunction, do not use the direct drive motor where the shaft-through portion may be subject to pressure (e.g. compressed air).
- Take safety measures such as providing covers to avoid accidentally touching the rotor of direct drive motor during operation.
- Do not get on the equipment or put a heavy load on it.
- Do not drop or strike the direct drive motor.
- To prevent a fire or injury in the event of an earthquake or other natural disaster, securely install, mount, and wire the direct drive motor as stated in the user's manual.
- To prevent an electric shock or a fire, do not disassemble, repair, or modify the product. Disassembled, repaired, and/or modified products are not covered under warranty.
- When coupling a load to the direct drive motor, make sure to align and center the load on the motor flange rabbet. In particular, when a rigid coupling is used, even a slight center deviation may reduce position accuracy or damage the rotor.

# 2.1 Equipment configuration

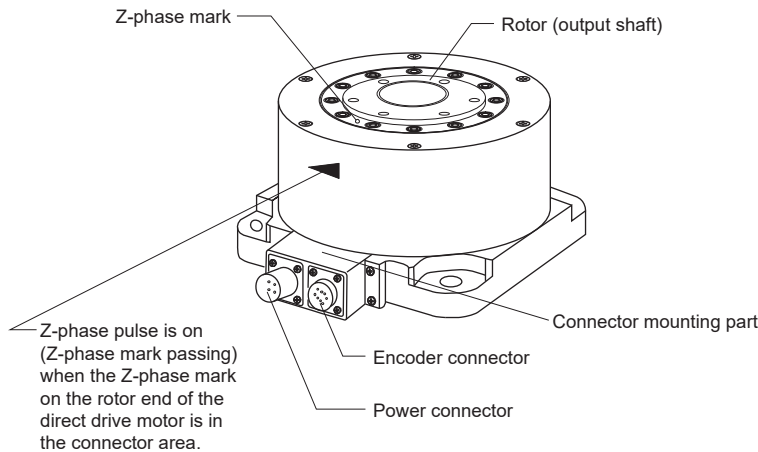
The following shows the configuration of a direct drive motor. When using the direct drive motor, note the following.

## Minimum oscillation angle

For a direct drive motor that performs a rotating oscillating motion within 70 °, rotate the motor more than 90 ° at least once a day to keep the bearings lubricated.

## Z-phase position

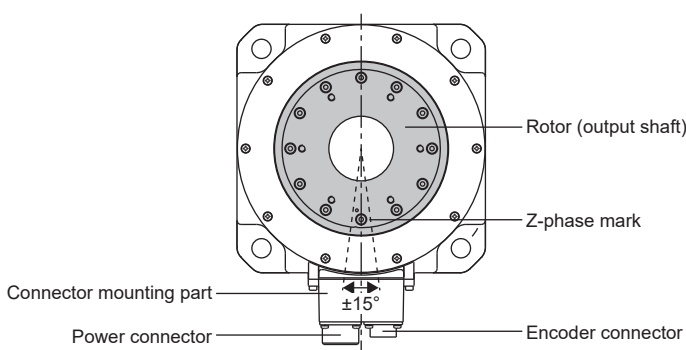
When the Z-phase mark on the rotor end of the direct drive motor is in the connector area, the Z-phase pulse is on (Z-phase mark passing). Keep the Z-phase position visible even after the direct drive motor is installed to a machine.



## 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 or more, install the direct drive motor in a position where the Z-phase mark can pass over the connector area.

To make the Z-phase mark pass the connector area, the Z-phase mark needs to be rotated  $\pm 15^\circ$  or more with respect to the center of the connector mounting part.



## For 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 poles detection is not required.

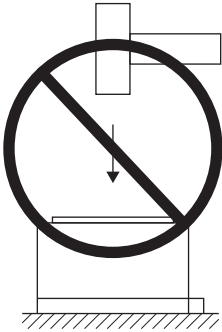
## 2.2 Mounting direction

The mounting direction of the direct drive motor is shown in the following table.

Direct drive motor series	Mounting direction
TM-RFM TM-RG2M TM-RU2M	Any direction

## 2.3 Load mounting/dismounting precautions

- To prevent a malfunction on the encoder, the rotor must not be hammered during assembling.



- The direction of the encoder on the direct drive motor cannot be changed.
- When mounting the direct drive motor, use spring washers or similar parts and fully tighten the bolts so that they do not become loose due to vibration.

## 2.4 Permissible load for the rotor

### Point

Do not use rigid coupling, as it may damage the rotor.

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

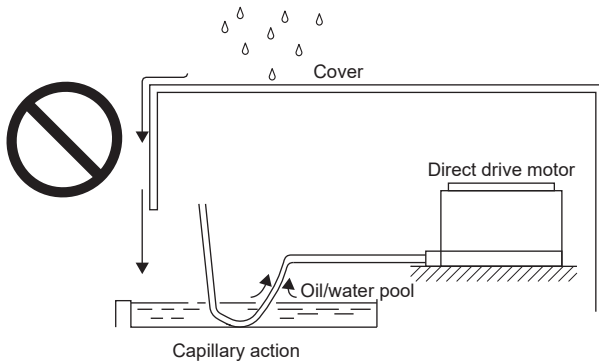
☞ Page 43 Specification list

- When coupling a load to the direct drive motor, the load applied to the rotor must be within the permissible load.
- Exceeding the permissible load can cause the deterioration of the bearing life and damage to the rotor.
- The load indicated in this section is a static load in a single direction and does not include eccentric loads. Make eccentric loads as small as possible. Not doing so can cause the direct drive motor to be damaged.

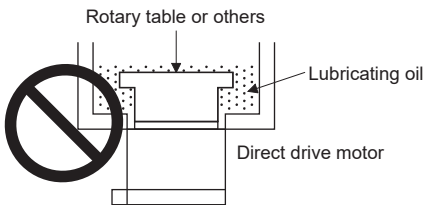
## 2.5 Protection from oil and water

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.

- Do not use the rotary servo 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.



- If liquid such as cutting oil drops on the direct drive motor, the sealant, packing, cable and others may be affected depending on the liquid type.
- 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 dust proof and waterproof measures on the machine side.

## 2.6 Inspection items

### Precautions

- To prevent a malfunction, do not perform an insulation resistance test (megger test) on the direct drive motor.
- Customers must not disassemble and/or repair the equipment.

### Periodic inspection

Perform the following inspections.

- Check the bearings and the like for unusual noise.
- Check the cables and the like for scratches or cracks. Inspect them periodically according to operating conditions especially when the junction cable is movable.
- Check the power connector and encoder connector tightening screws for looseness.

## 2.7 Parts with a service life

The service life of the following parts is listed below. If any fault is found in a part, replace it immediately because its service life varies. For parts replacement, contact your local sales office.

Part name	Recommended service life	Remark
Bearings	20,000 hours to 30,000 hours	The service lives in the "Recommended service life" column are reference times. 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	

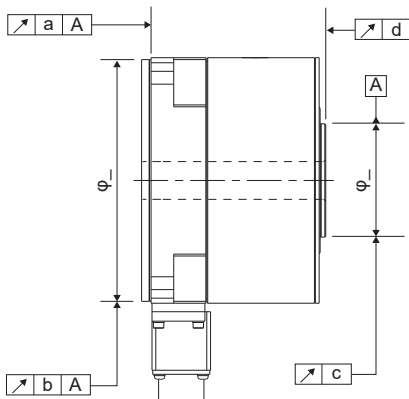
When the motor is run at rated speed and at rated load, bearings should be changed every 20,000 to 30,000 hours as a guideline. As this differs depending on the operating conditions, the bearings must also be changed if unusual noise or vibration occurs during inspection.

## 2.8 Machine accuracy

The following table indicates the machine accuracy 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 OD of mounting surface	b	0.07
Runout of rotor (output shaft)	c	0.04
Runout of rotor (output shaft) end surface	d	0.02

Reference diagram





## 2.9 Flange 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 flange specified in this table, made of aluminum, and used in an environment with an ambient temperature of 0 °C to 40 °C.

The temperature rise value of the direct drive motor changes depending on its mounting environment, operating conditions, and other factors. Make sure that alarms do not occur on the actual machine before operation.

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
650 × 650 × 35	TM-RFM018E20
	TM-RG2M009G30
	TM-RU2M009G30
	TM-RFM012G20
	TM-RFM048G20
750 × 750 × 45	TM-RFM072G20
	TM-RFM040J10
	TM-RFM120J10
950 × 950 × 50	TM-RFM240J10

## 2.10 Magnetic shielding

Do not place the direct drive motor near magnetic sources such as magnets. When it is necessary to use the motor near magnetic sources, block the magnetic force by installing a shielding plate or other blocking agents.

# 3 CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

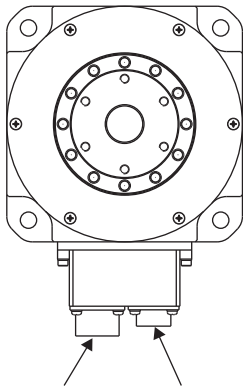
## Precautions

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

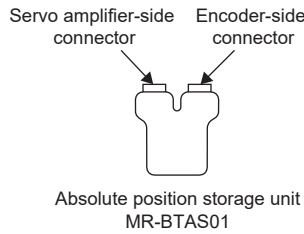
## 3.1 Selection of connectors

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

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)



Power connector Encoder connector



Absolute position storage unit MR-BTAS01

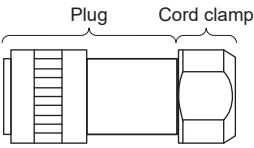
Direct drive motor	Wiring connector			
	For power supply	For encoder	Absolute position storage unit (option) *1	
			Servo amplifier side	Encoder side
TM-RFM_C20	Connector configuration B *2	Connector configuration A	Connector configuration A	Connector configuration F
TM-RFM_E20				
TM-RFM_G20	Connector configuration C			
TM-RFM040J10	Connector configuration D			
TM-RFM120J10				
TM-RFM240J10	Connector configuration E			
TM-RG2M002C30	Connector configuration B *2			
TM-RU2M002C30				
TM-RG2M004E30				
TM-RU2M004E30				
TM-RG2M009G30				
TM-RU2M009G30				

\*1 Used in the absolute position detection system

\*2 To make the motor comply with the UL/CSA standard, this connector configuration cannot be used. Refer to the following for details.

☞ Page 62 Compliance with UL/CSA standard

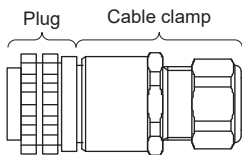
## 3.2 Wiring connectors (connector configurations A/B/C/D/E/F)



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

\*1 The connector to be mated.

\*2 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

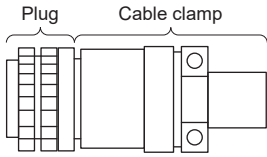


Connector configuration	Feature	Plug (DDK)		Cable clamp		Direct drive motor power supply connector *2
		Type	Model	Cable OD [mm] (reference)	Model	
B	IP67 EN compliant	Straight	CE05-6A14S-2SD-D Applicable wire size: AWG 22 to 16	4 to 8	C2KD0814 (Sankei Manufacturing *3)	CE05-2A14S-2PD-D
				8 to 12	C2KD1214 (Sankei Manufacturing *3)	
				5 to 8.3	YSO14-5 to 8 (Daiwa Dengyo)	
				8.3 to 11.3	YSO14-9 to 11 (Daiwa Dengyo)	
	General environment *1	D/MS3106B14S-2S Applicable wire size: AWG 22 to 16	7.9 or less (Bushing ID)	D/MS3057-6A		

\*1 Does not comply with EN.

\*2 The connector to be mated.

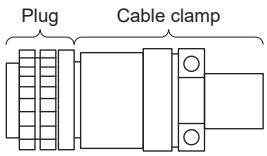
\*3 Service inquiries: Sankei Manufacturing Co., Ltd. and Mikuni Electric Co., Ltd.



Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power supply connector <sup>*2</sup>
		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
	General environment <sup>*1</sup>		D/MS3106B18-10S Applicable wire size: AWG 14 to 12	10.5 to 14.1	CE3057-10A-1-D	
			D/MS3106B18-10S Applicable wire size: AWG 14 to 12	14.3 or less (Bushing ID)	D/MS3057-10A	

\*1 Does not comply with EN.

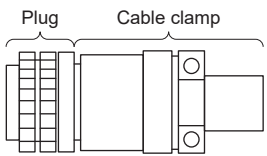
\*2 The connector to be mated.



Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power supply connector <sup>*2</sup>
		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
	General environment <sup>*1</sup>		D/MS3106B22-22S Applicable wire size: AWG 10 to 8	12.5 to 16	CE3057-12A-1-D	
			D/MS3106B22-22S Applicable wire size: AWG 10 to 8	15.9 or less (Bushing ID)	D/MS3057-12A	

\*1 Does not comply with EN.

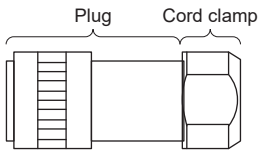
\*2 The connector to be mated.



Connector configuration	Feature	Plug (DDK)		Cable clamp (DDK)		Direct drive motor power supply connector <sup>*2</sup>
		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 <sup>*1</sup>		D/MS3106B32-17S Applicable wire size: AWG 6 to 4	23.8 or less (Bushing ID)	D/MS3057-20A	

\*1 Does not comply with EN.

\*2 The connector to be mated.



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

\*1 The connector to be mated.

\*2 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

# 4 CONNECTOR DIMENSIONS

The connector dimensions for wiring the direct drive motor are shown below.

## Hirose Electric

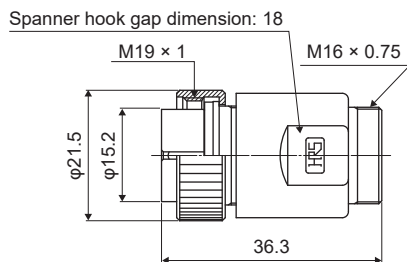
### ■RM15WTPZK-12S/RM15WTPZ-12P(72)

Model	Connector configuration *1
RM15WTPZK-12S	A
RM15WTPZ-12P(72)	F

\*1 Refer to the following for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

[Unit: mm]

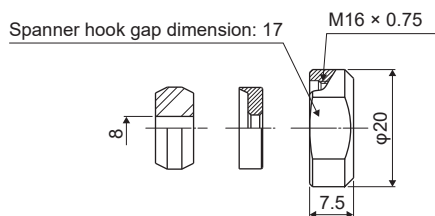


### ■JR13WCCA-8(72)

Refer to the following connector configurations A and F for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

[Unit: mm]

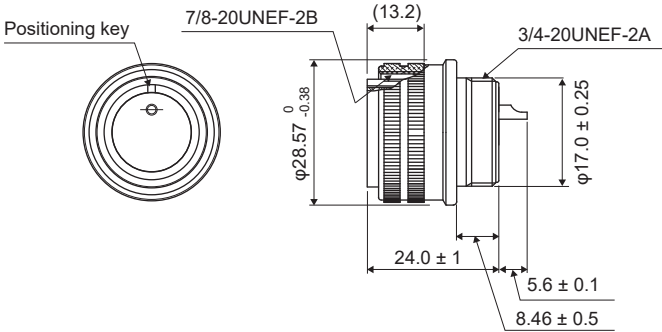


■CE05-6A14S-2SD-D

Refer to the following connector configuration B for the connector configuration.

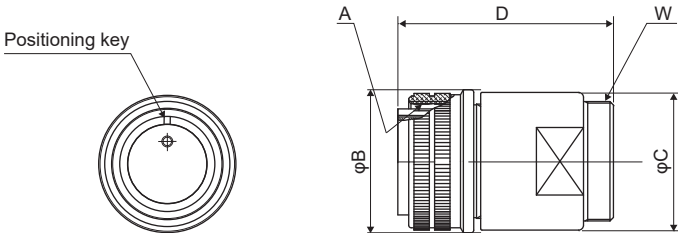
☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

[Unit: mm]



■CE05-6A18-10SD-D-BSS, CE05-6A22-22SD-D-BSS, CE05-6A32-17SD-D-BSS

[Unit: mm]



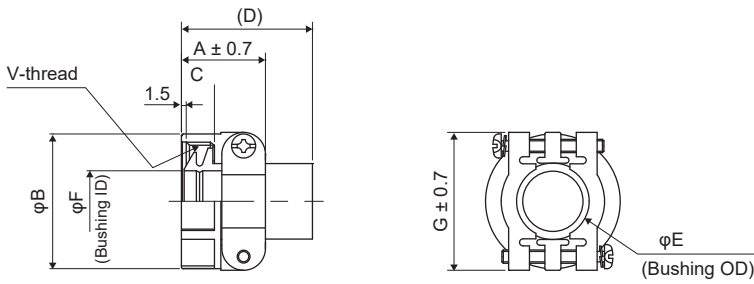
Model	A	$B_{-0.38}^{+0}$	$C \pm 0.8$	D or less	W	Connector configuration *1
CE05-6A18-10SD-D-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A	C
CE05-6A22-22SD-D-BSS	1 3/8-18UNEF-2B	40.48	38.3	61	1 3/16-18UNEF-2A	D
CE05-6A32-17SD-D-BSS	2-18UNS-2B	56.33	54.2	79	1 3/4-18UNS-2A	E

\*1 Refer to the following for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

■CE3057-10A-1-D, CE3057-10A-2-D, CE3057-12A-1-D, CE3057-12A-2-D, CE3057-20A-1-D

[Unit: mm]



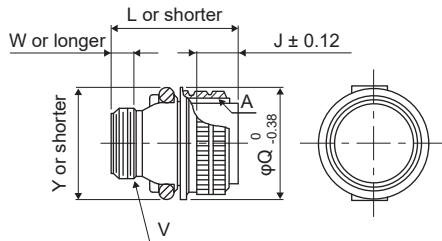
Model	Applicable shell size	A	B	C	(D)	E	F	G	V	Enclosed bushing model	Applicable cable OD (reference)	Connector configuration *1
CE3057-10A-1-D	18	23.8	30.1	10.3	(41.3)	15.9	14.1	31.7	1-20UNEF-2B	CE3420-10-1	10.5 to 14.1	C
CE3057-10A-2-D							11.0			CE3420-10-2	8.5 to 11	
CE3057-12A-1-D	22	23.8	35	10.3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

\*1 Refer to the following for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

■D/MS3106B14S-2S, D/MS3106B18-10S, D/MS3106B22-22S, D/MS3106B32-17S

[Unit: mm]



Model	A	J	L	Q	V	W	Y	Connector configuration *1
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

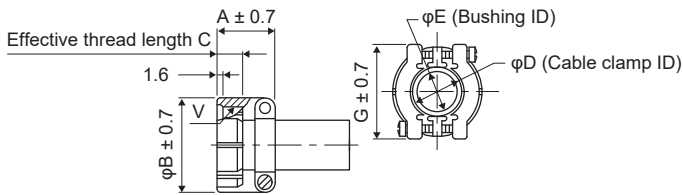
\*1 Refer to the following for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)



## ■D/MS3057-6A, D/MS3057-10A, D/MS3057-12A, D/MS3057-20A

[Unit: mm]



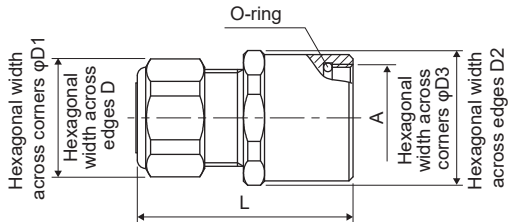
Model	Shell size	A	B	C	D	E	G	V	Bushing	Connector configuration *1
D/MS3057-6A	14S	22.2	24.6	10.3	11.2	7.9	27.0	3/4-20UNEF	AN3420-6	B
D/MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	31.7	1-20UNEF	AN3420-10	C
D/MS3057-12A	22	23.8	35.0	10.3	19.0	15.9	37.3	1 3/16-18UNEF-2A	AN3420-12	D
D/MS3057-20A	32	27.8	51.6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

\*1 Refer to the following for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

## Daiwa Dengyo

[Unit: mm]



Model	Applicable cable OD	A	Length L before tightening	Width across flats D	Width across corners D1	Width across flats D2	Width across corners D3	Connector configuration *1
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							

\*1 Refer to the following connector configuration B for the connector configuration.

☞ Page 17 Wiring connectors (connector configurations A/B/C/D/E/F)

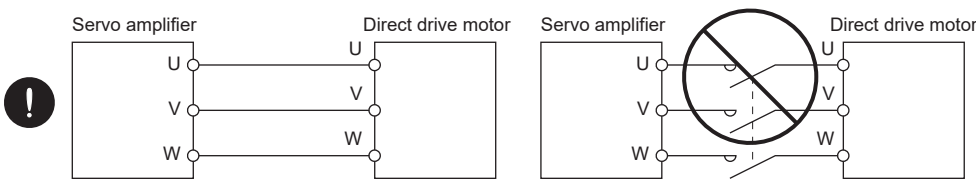
## Sankei Manufacturing

For the connector dimensions, contact Sankei Manufacturing Co., Ltd. or Mikuni Electric Co., Ltd.

# 5 CONNECTING THE SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

## Precautions

- Insulate the conductive parts of the terminals.
- To prevent unexpected operation of the direct drive motor, wire the equipment correctly and securely.
- Make sure to connect the cables and connectors by using the fixing screws and the locking mechanism. Failing to do so may cause the cables and connectors to disconnect during operation.
- Do not install a power capacitor, surge killer, or radio noise filter (optional FR-BIF) on the power wire of the direct drive motor.
- To prevent abnormal operation and malfunction, connect the servo amplifier power outputs (U/V/W) to the direct drive motor power inputs (U/V/W) directly. Do not connect a magnetic contactor or the like between the servo amplifier power output and the direct drive motor power input.



- When the wires are not properly secured to the terminal block, the wires or terminal block may generate heat because of the poor contact. Be sure to secure the wires with the specified torque.
- Use the direct drive motor with the specified servo amplifier.
- Do not modify the equipment.
- To prevent malfunction, eliminate static electricity before wiring, switch operation, or similar operations.
- To prevent failure and malfunction, only the power/signal specified in the user's manual should be connected to each terminal.
- We recommend using HIV wires to connect the servo amplifier to the direct drive motor. Therefore, the recommended wire sizes may differ from those of the wires used for previous generation direct drive motors.

# 5.1 Precautions for wiring

## Precautions

- To prevent malfunction of the direct drive motor, connect the power phases (U/V/W) of the servo amplifier and the direct drive motor correctly.
- To prevent malfunction, do not connect the AC power supply directly to the direct drive motor.

### Point

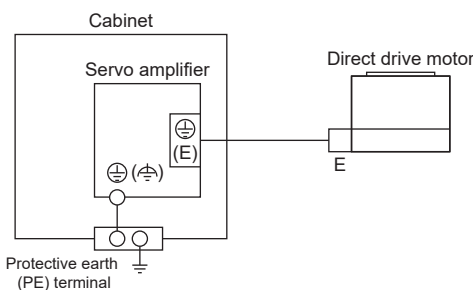
Refer to the following for the encoder cable.

☞ Page 28 WIRING OPTION

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 the following for details of the options.

☞ Page 28 WIRING OPTION

To ground the direct drive motor, connect the grounding lead wire to the servo amplifier, then connect the wire from the servo amplifier to the ground via the protective earth (PE) terminal of the cabinet. Do not connect the wire directly to the protective earth (PE) terminal of the cabinet.



# 5.2 Direct drive motor power cable wiring diagram

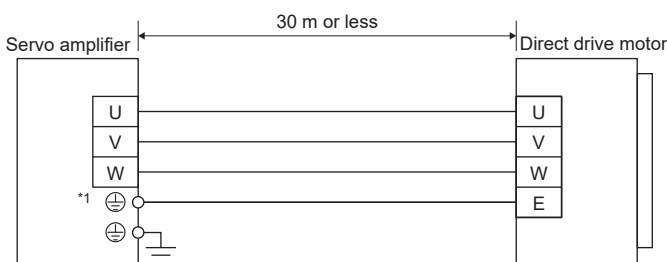
To wire to the servo amplifier, use connectors packed with the servo amplifier or optional connectors. For connectors, refer to "Wiring CNP1, CNP2, and CNP3" in the following manual.

📖 MR-J5 User's Manual (Hardware)

Fabricate a cable as shown below.

Refer to the following for the wires used for the cable.

☞ Page 27 Selection example of wires




\*1 This grounding is for the MR-J5 1-axis servo amplifier. For the MR-J5 multi-axis servo amplifier, ground it to CNP3\_ connector.

## 5.3 Selection example of wires

When cables are fabricated by the customer, wires should be selected in accordance with the application.

### Point

To make the motor comply with the UL/CSA standard, refer to the following.

 Page 62 Compliance with UL/CSA standard

Wires indicated in this section are separated wires.

Selection requirements for the wire size are as follows.

- Construction requirements: Single wire set in midair
- Wiring length: 30 m or less

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

### TM-RFM series

Direct drive motor	Wire [mm <sup>2</sup> ]
	U/V/W/E
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)

### TM-RG2M series and TM-RU2M series

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

# 6 WIRING OPTION

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When cables are fabricated by the customer, wires should be selected in accordance with the application.

## Precautions


- To prevent malfunction and a fire, use the specified peripheral equipment and options.
- To prevent an electric shock, fire, or injury, correctly wire options and peripheral equipment, etc. in the correct combination.
- We recommend using HIV wires to wire the servo amplifiers, direct drive motors, options, and peripheral equipment.  
Therefore, the recommended wire sizes may differ from those of the wires used for previous generation direct drive motors.

## 6.1 Connector set

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For the connectors used with this direct drive motor, please purchase the options indicated in this section.

When fabricating an encoder cable, refer to the following.

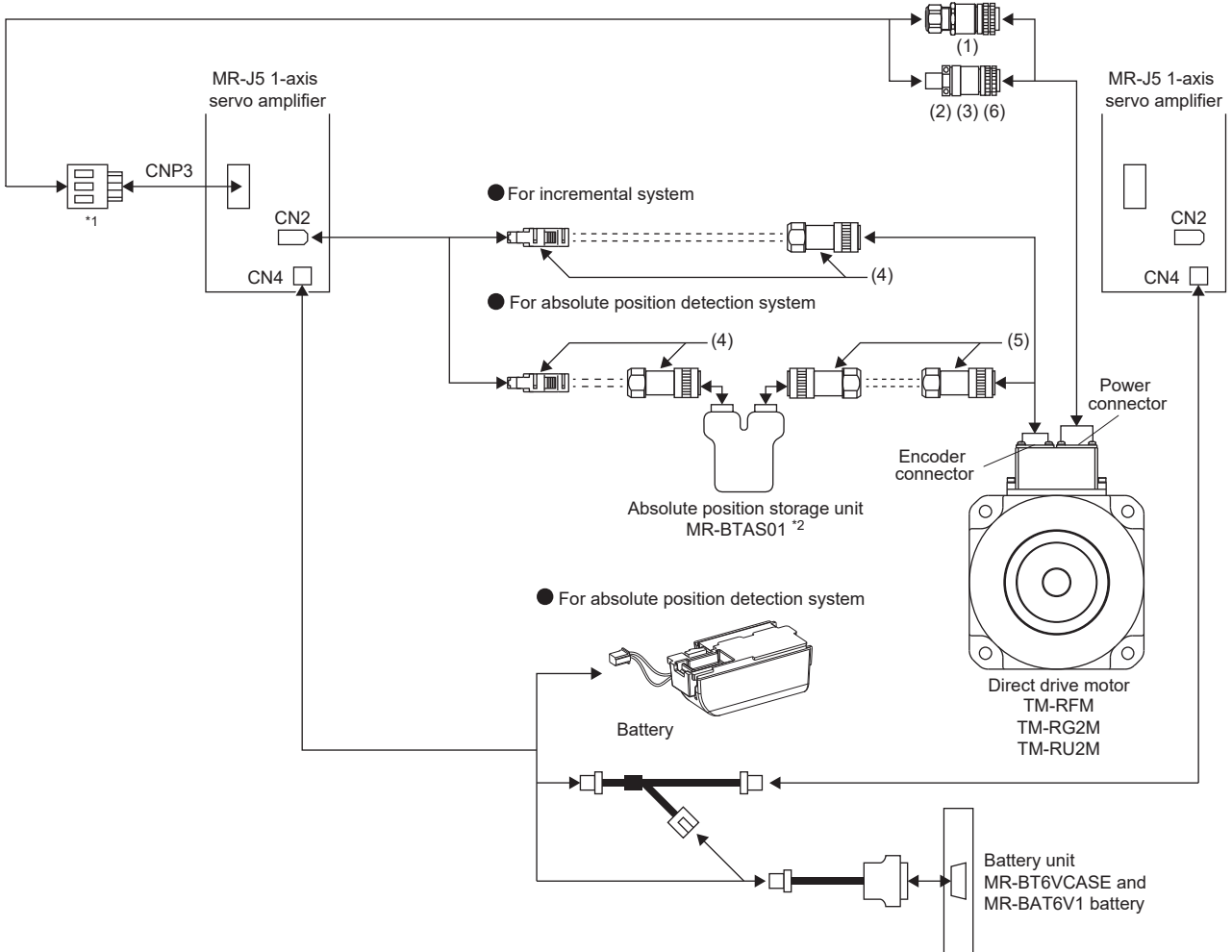
 Page 64 Fabricating the encoder cable

## Precautions

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

# Combinations of connector sets

## MR-J5 1-axis servo amplifier



\*1 Connectors for 3.5 kW or less.

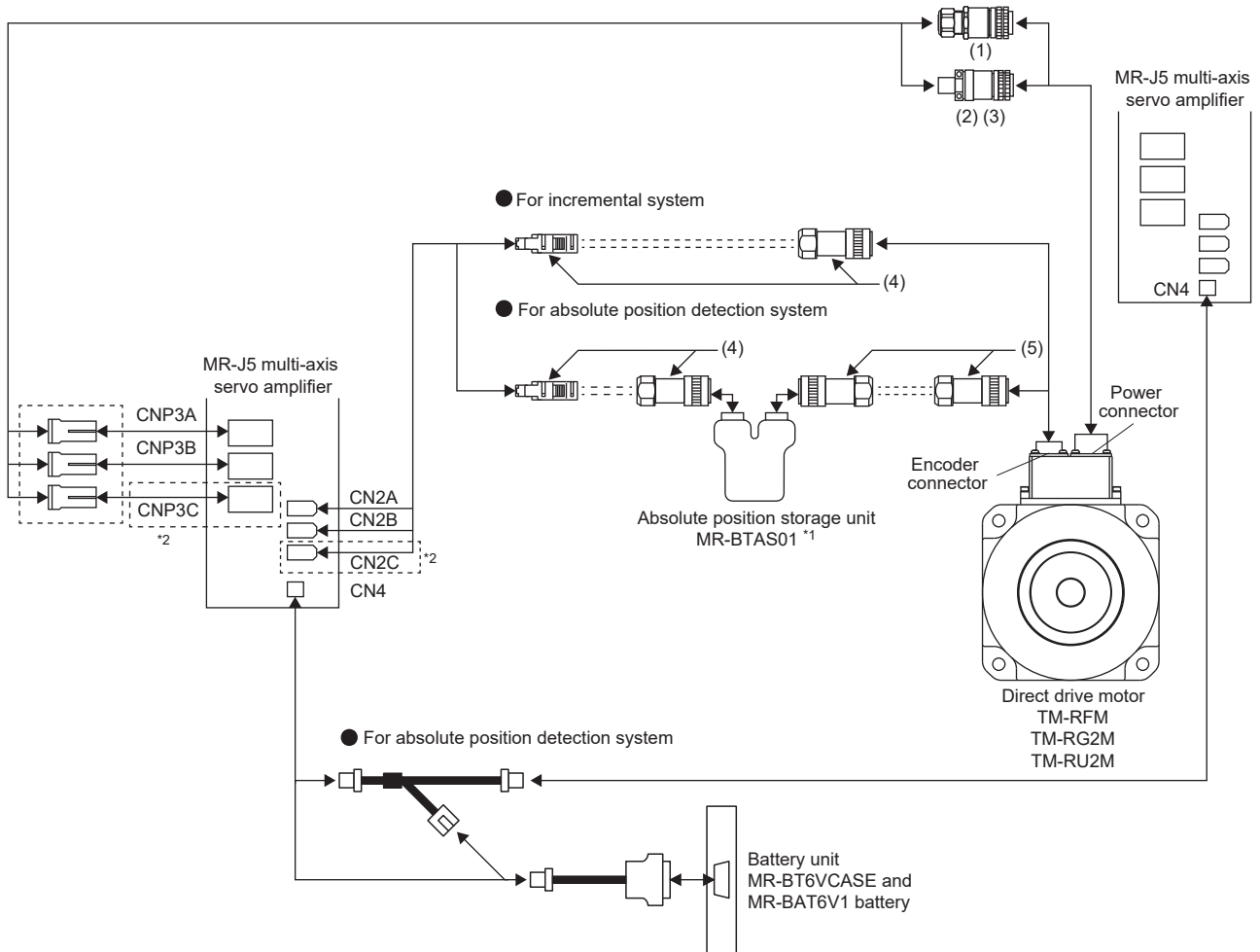
\*2 To configure the absolute position detection system, connect to a battery unit and an absolute position storage unit. Refer to the following for the absolute position storage unit.

Page 41 Absolute position storage unit MR-BTAS01

For the battery, refer to "Battery" in the following manual.

MR-J5 User's Manual (Hardware)

## MR-J5 multi-axis servo amplifier











\*1 To configure the absolute position detection system, connect to a battery unit and an absolute position storage unit. Refer to the following for the absolute position storage unit.

☞ Page 41 Absolute position storage unit MR-BTAS01  
For the battery, refer to "Battery" in the following manual.  
📖 MR-J5 User's Manual (Hardware)

\*2 This connection is for the MR-J5 3-axis servo amplifier.



# Connector list

No.	Product name	Model	Description	Supported direct drive motor	Remark
(1)	Power connector set	MR-PWCNF *1	 <p>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> to 1.25 mm<sup>2</sup> (AWG 22 to 16) Cable OD: 8.3 mm to 11.3 mm</p>	For the TM-RFM_C20 For the TM-RFM_E20 For the TM-RG2M_C30 For the TM-RG2M_E30 For the TM-RG2M_G30 For the TM-RU2M_C30 For the TM-RU2M_E30 For the TM-RU2M_G30	IP67 EN compliant
(2)	Power connector set	MR-PWCNS4	 <p>Plug: CE05-6A18-10SD-D-BSS Cable clamp: CE3057-10A-1-D (DDK) Applicable cable Applicable wire size: 2 mm<sup>2</sup> to 3.5 mm<sup>2</sup> (AWG 14 to 12) Cable OD: 10.5 mm to 14.1 mm</p>	For the TM-RFM_G20	IP67 EN compliant
(3)	Power connector set	MR-PWCNS5	 <p>Plug: CE05-6A22-22SD-D-BSS Cable clamp: CE3057-12A-1-D (DDK) Applicable cable Applicable wire size: 5.5 mm<sup>2</sup> to 8 mm<sup>2</sup> (AWG 10 to 8) Cable OD: 12.5 mm to 16 mm</p>	For the TM-RFM040J10 For the TM-RFM120J10	IP67 EN compliant
(4)	Encoder connector set	MR-J3DDCNS	  <p>For connection between servo amplifier and direct drive motor For connection between servo amplifier and absolute position storage unit Refer to the following for details. ☞ Page 32 Encoder connector set</p>	—	IP67
(5)	Encoder connector set	MR-J3DDSPS	  <p>For connection between absolute position storage unit and direct drive motor Refer to the following for details. ☞ Page 32 Encoder connector set</p>	—	IP67
(6)	Power connector set	MR-PWCNS3	 <p>Plug: CE05-6A32-17SD-D-BSS Cable clamp: CE3057-20A-1-D (DDK) Applicable cable Applicable wire size: 14 mm<sup>2</sup> to 22 mm<sup>2</sup> (AWG 6 to 4) Cable OD: 22 mm to 23.8 mm</p>	For the TM-RFM240J10	IP67 EN compliant

\*1 To make the motor comply with the UL/CSA standard, the MR-PWCNF cannot be used. Refer to the following for details.


☞ Page 63 Selection example of wires

## 6.2 Encoder connector set

Encoder cables are to be fabricated by the customer. Refer to the following for fabrication.

 Page 32 MR-J3DDCNS

 Page 33 MR-J3DDSPS

 Page 34 Combinations of encoder cables

For fabrication, refer to the following wiring diagram.

 Page 35 Fabricating the encoder cable

Fabricate the encoder cable to be 50 m or less between the servo amplifier and the direct drive motor.

To configure the absolute position detection system, connect to a battery unit and an absolute position storage unit. Refer to the following for the absolute position storage unit.

 Page 41 Absolute position storage unit MR-BTAS01

For the battery, refer to "Battery" in the following manual.

 MR-J5 User's Manual (Hardware)

### 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).

Applicable wire size: 0.25 mm<sup>2</sup> to 0.5 mm<sup>2</sup> (AWG 23 to 20)

#### ■ Servo amplifier-side connector



Receptacle: 36210-0100PL

Shell kit: 36310-3200-008

(3M)

or

Connector set: 54599-1019

(Molex)

#### ■ Encoder-side connector or absolute position storage unit-side (connected from servo amplifier) connector



Plug: RM15WTPZK-12S

Cord clamp: JR13WCCA-8(72)

(Hirose Electric)

## 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).

Applicable wire size: 0.25 mm<sup>2</sup> to 0.5 mm<sup>2</sup> (AWG 23 to 20)

### ■Absolute position storage unit-side connector



Plug: RM15WTPZ-12P(72)

Cord clamp: JR13WCCA-8(72)

(Hirose Electric)

### ■Encoder-side connector



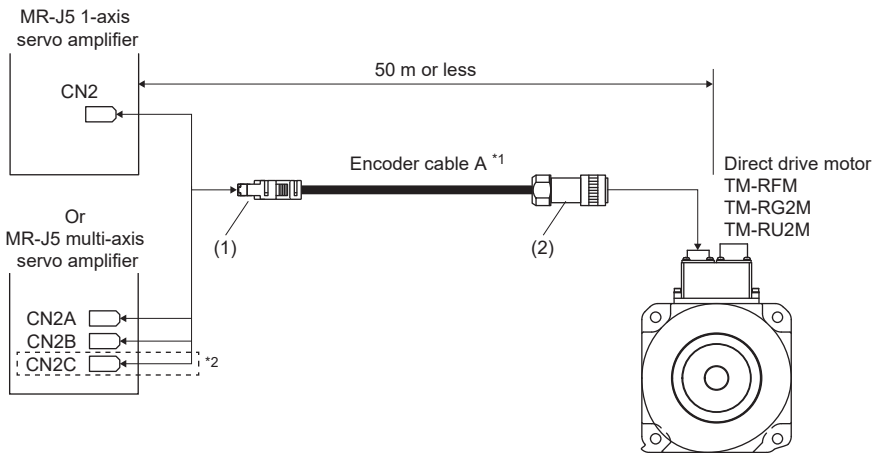
Plug: RM15WTPZK-12S

Cord clamp: JR13WCCA-8(72)

(Hirose Electric)

# Combinations of encoder cables

## For incremental system

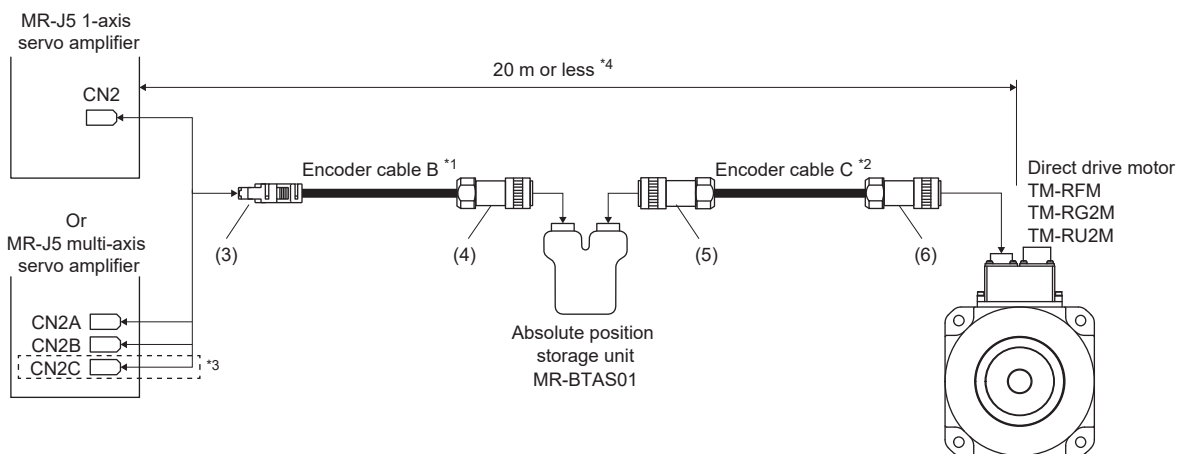


\*1 Refer to the following for details.

☞ Page 35 Detail of the encoder cable A connector

\*2 This connection is for the MR-J5 3-axis servo amplifier.

## For absolute position detection system



\*1 Refer to the following for details.

☞ Page 36 Detail of the encoder cable B connector

\*2 Refer to the following for details.

☞ Page 38 Detail of the encoder cable C connector

\*3 This connection is for the MR-J5 3-axis servo amplifier.

\*4 If the distance exceeds 20 m, contact your local sales office.

# Fabricating the encoder cable

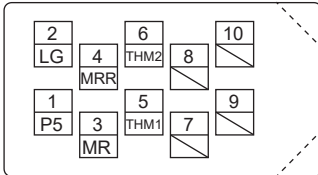
## Detail of the encoder cable A connector

### ■CN2, CN2A, CN2B, and CN2C side connector (1)

Receptacle: 36210-0100PL

Shell kit: 36310-3200-008

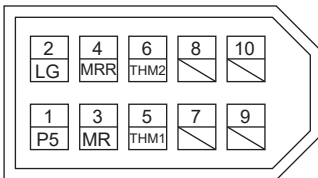
(3M)



The following shows the view from the wiring side. \*1

Connector set: 54599-1019

(Molex)



The following shows the view from the wiring side. \*1

\*1 Do not connect anything to the pins that are marked with a diagonal line. Refer to the following.

☞ Page 40 Shielding CN2, CN2A, CN2B, and CN2C connectors

### ■Encoder-side connector (2)

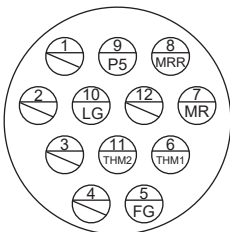
Straight plug: RM15WTPZK-12S

Cord clamp: JR13WCCA-8(72)

(Hirose Electric) Recommended cable: 20276 VSVP AWG#23×6P

KB-0492 \*2

(Bando Densen)

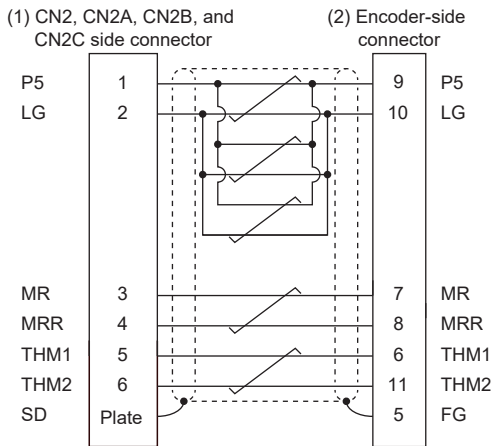


The following shows the view from the wiring side. \*1

\*1 Do not connect anything to the pins that are marked with a diagonal line.

\*2 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

## Encoder cable A cable internal wiring diagram



Refer to the following table for the wires that can be used 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

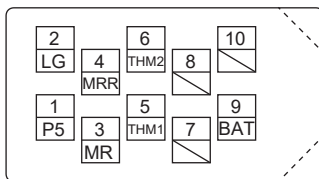
## Detail of the encoder cable B connector

### ■CN2, CN2A, CN2B, and CN2C side connector (3)

Receptacle: 36210-0100PL

Shell kit: 36310-3200-008

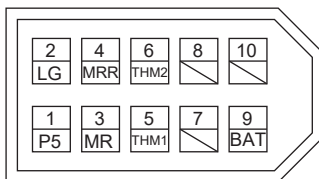
(3M)



The following shows the view from the wiring side. \*1

Connector set: 54599-1019

(Molex)



The following shows the view from the wiring side. \*1

\*1 Do not connect anything to the pins that are marked with a diagonal line. Refer to the following.

☞ Page 40 Shielding CN2, CN2A, CN2B, and CN2C connectors

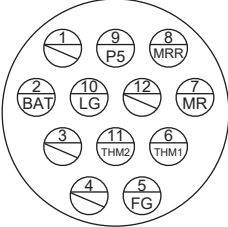
## ■Absolute position storage unit-side connector (4)

Straight plug: RM15WTPZK-12S

Cord clamp: JR13WCCA-8(72)

(Hirose Electric) Recommended cable: 20276 VSVP AWG#23×6P  
KB-0492 \*2

(Bando Densen)



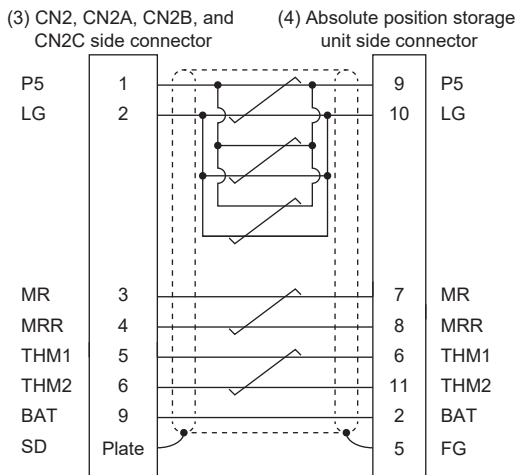
The following shows the view from the wiring side. \*1

\*1 Do not connect anything to the pins that are marked with a diagonal line.

\*2 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

## Encoder cable B cable internal wiring diagram

When the distance between the servo amplifier and the direct drive motor is within 20 m <sup>\*1</sup>



<sup>\*1</sup> If the distance exceeds 20 m, contact your local sales office.

Refer to the following table for the wires that can be used 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

## Detail of the encoder cable C connector

### ■ Absolute position storage unit-side connector (5)

Straight plug: RM15WTPZ-12P(72)

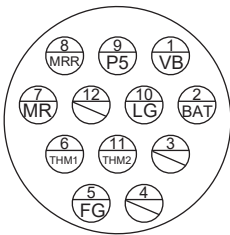
Cord clamp: JR13WCCA-8(72)

(Hirose Electric)

Recommended cable: 20276 VSVPAWG#23×6P

KB-0492 <sup>\*2</sup>

(Bando Densen)



The following shows the view from the wiring side. <sup>\*1</sup>

<sup>\*1</sup> Do not connect anything to the pins that are marked with a diagonal line.

<sup>\*2</sup> Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch



## Encoder-side connector (6)

Straight plug: RM15WTPZK-12S

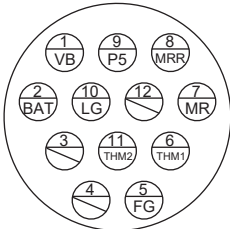
Cord clamp: JR13WCCA-8(72)

(Hirose Electric)

Recommended cable: 20276 VSVPAWG#23×6P

KB-0492 \*2

(Bando Densen)



The following shows the view from the wiring side. \*1

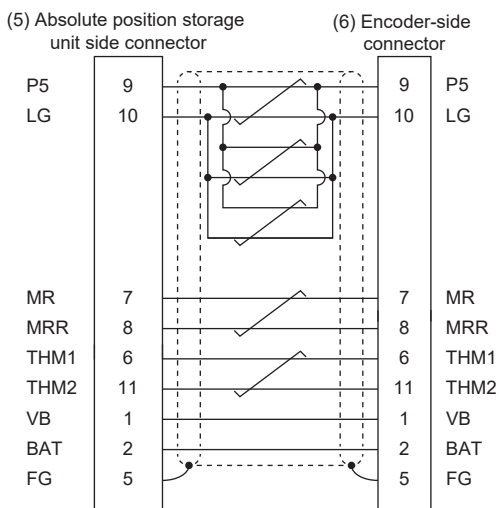
\*1 Do not connect anything to the pins that are marked with a diagonal line.

\*2 Supplier: Toa Electric Industrial Co. Ltd., Nagoya Branch

## Encoder cable C cable internal wiring diagram

When the distance between the servo amplifier and the direct drive motor is within 20 m \*1

6



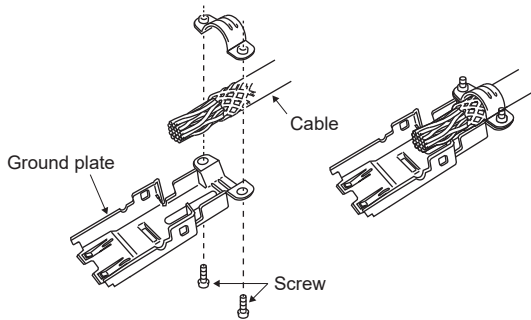
\*1 If the distance exceeds 20 m, contact your local sales office.

Refer to the following table for the wires that can be used 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

## Shielding CN2, CN2A, CN2B, and CN2C connectors

When wiring the 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.



# 6.3 Absolute position storage unit MR-BTAS01

## Precautions

- If the absolute position storage unit MR-BTAS01 is replaced, the absolute position is erased. For details, refer to "ABSOLUTE POSITION DETECTION SYSTEM" in the following manual.

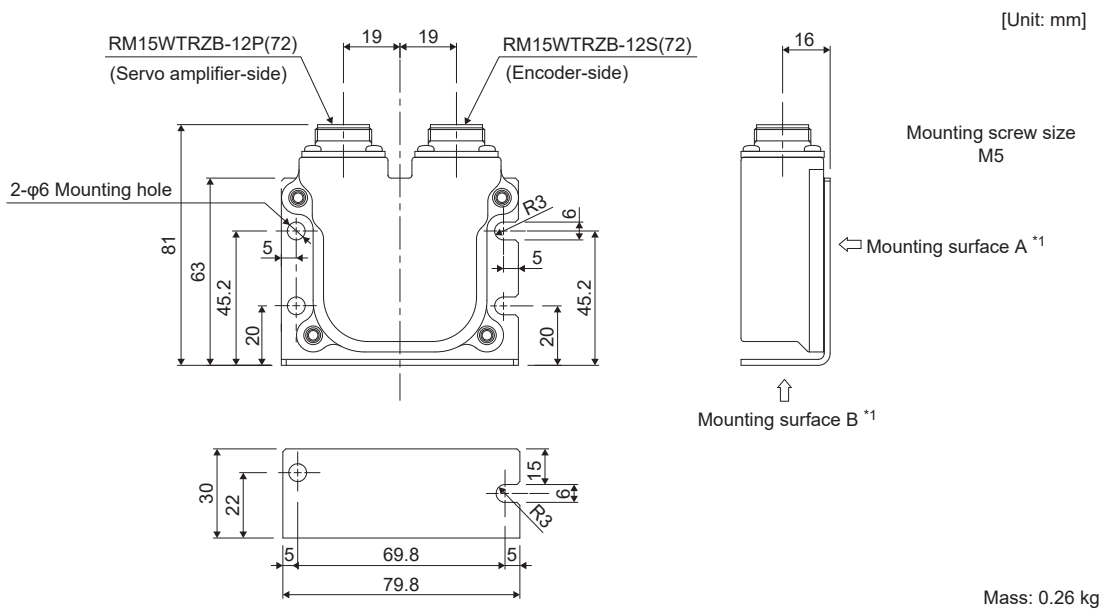
MR-J5 User's Manual (Hardware)

- If the encoder cable is disconnected, [AL. 025 Absolute position erased] occurs.

## Connection method with the encoder cable

Page 34 For absolute position detection system

## Dimensions



\*1 When mounting the unit outside the cabinet, fix mounting surface A with four screws. When mounting the unit inside the cabinet, mounting surface B can be fixed with two screws.

## Environment

The following table indicates the environment for the absolute position storage unit.

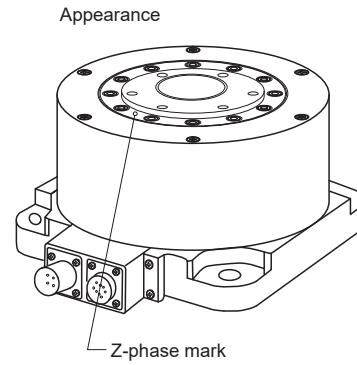
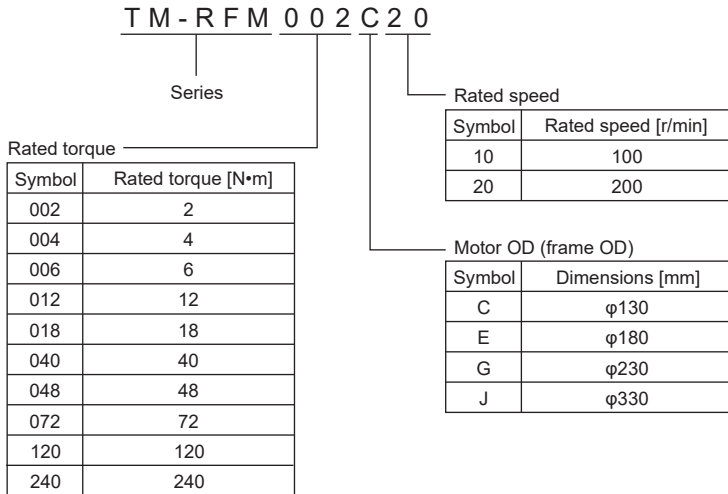
Item		Environment
Ambient temperature	Operation	0 °C to 55 °C (non-freezing)
	Storage	-20 °C to 65 °C (non-freezing)
Ambient humidity	Operation	10 %RH to 90 %RH (non-condensing)
	Storage	10 %RH to 90 %RH (non-condensing)
Ambience		Indoors (no direct sunlight), free from corrosive gas, flammable gas, oil mist, dust, dirt, oil and water
Altitude		2000 m or less
Vibration resistance [m/s <sup>2</sup> ]	When mounting surface A is fixed	X, Y, Z: 49
	When mounting surface B is fixed	X, Y, Z: 5.9

# 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, read the Safety Instructions at the front this manual in addition to this chapter.

## 7.1 Model designation

This section describes the model designation. Not all combinations of the symbols are available.



## 7.2 Specification list

### TM-RFM series

Item	TM-RFM series					
	002C20	004C20	006C20	006E20	012E20	018E20
Motor OD (frame OD) [mm]	φ130			φ180		
Power supply capacity	Refer to "Power supply capacity and generated loss" in the following manual. □□IMR-J5 User's Manual (Hardware)					
Continuous running duty *1	Rated output [W]	42	84	126	251	377
	Rated torque [N·m]	2	4	6	6	12
Maximum torque [N·m]	6	12	18	18	36	54
Rated speed [r/min] *1	200					
Maximum speed [r/min]	500					
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 [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	10.9	16.6	22.4	74.0	111	149
Recommended load to motor inertia ratio *2	50 times or less					
Absolute accuracy [s] *8	±15			±12.5		
Speed/position detector *3	20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)					
Type	Permanent magnet synchronous motor					
Thermistor	Built-in					
Insulation class	155 (F)					
Structure	Totally enclosed, natural cooling (IP rating: IP42 *4)					
Vibration resistance [m/s <sup>2</sup> ] *5	X: 49, Y: 49					
Vibration rank *6	V10					
Rotor permissible load *7	Moment load [N·m]	22.5			70	
	Axial load [N]	1100			3300	
Mass [kg]	5.2	6.8	8.4	11	15	18

Item	TM-RFM series						
	012G20	048G20	072G20	040J10	120J10	240J10	
Motor OD (frame OD) [mm]	φ230			φ330			
Power supply capacity	Refer to "Power supply capacity and generated loss" in the following manual. □□IMR-J5 User's Manual (Hardware)						
Continuous running duty *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 [r/min] *1	200			100			
Maximum speed [r/min]	500			200			
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 [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	238	615	875	1694	3519	6303	
Recommended load to motor inertia ratio *2	50 times or less						
Absolute accuracy [s] *8	±12.5			±10			
Speed/position detector *3	20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)						
Type	Permanent magnet synchronous motor						
Thermistor	Built-in						
Insulation class	155 (F)						
Structure	Totally enclosed, natural cooling (IP rating: IP42 *4)						

Item	TM-RFM series					
	012G20	048G20	072G20	040J10	120J10	240J10
Vibration resistance [m/s <sup>2</sup> ] <sup>*5</sup>	X: 49, Y: 49			X: 24.5, Y: 24.5		
Vibration rank <sup>*6</sup>	V10					
Rotor permissible load <sup>*7</sup>	Moment load [N·m]	93			350	
	Axial load [N]	5500			16000	
Mass [kg]	17	36	52	53	91	146

\*1 When the power supply voltage drops, the output and the rated speed cannot be guaranteed.

\*2 If the load to motor inertia ratio exceeds the indicated value, contact your local sales office.

\*3 To configure the absolute position detection system, connect to a battery unit and an absolute position storage unit. Refer to the following for the absolute position storage unit.

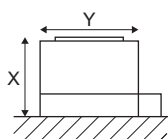
☞ Page 41 Absolute position storage unit MR-BTAS01

For the battery, refer to "Battery" in the following manual.

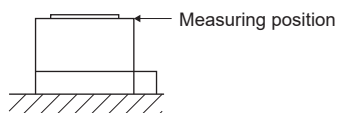
📖 MR-J5 User's Manual (Hardware)

\*4 The shaft-through portion of the rotor and the connector area are excluded. IP classifies the degree of protection provided against the intrusion of solid objects and water in electrical enclosures.

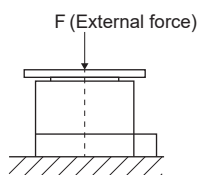
\*5 The vibration direction is as shown in the figure. The numerical value indicates the maximum value. When the direct drive motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value.



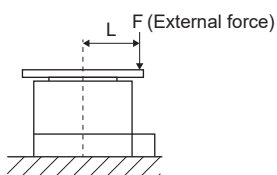
\*6 V10 indicates that the amplitude of a direct drive motor as a single unit is 10 μm or less. The following figure shows the direct drive motor mounting position for measurement and the measuring position.



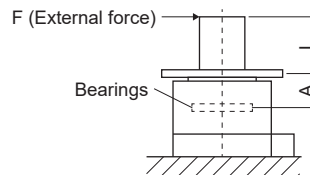
\*7 The axial and moment loads, which are applied to the direct drive motor's rotor (output shaft) during operation, must be maintained to be equal to or below the permissible value. The following figure shows an example of the load applied during operation.



Axial load =  $F + \text{mass of load}$



Axial load =  $F + \text{mass of load}$   
Moment load =  $F \times L$



Axial load =  $\text{mass of load}$   
Moment load =  $F \times (L + A)$

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

\*8 The absolute accuracy changes depending on the mounting condition of the load and the surrounding environment.

# 7.3 Torque characteristics



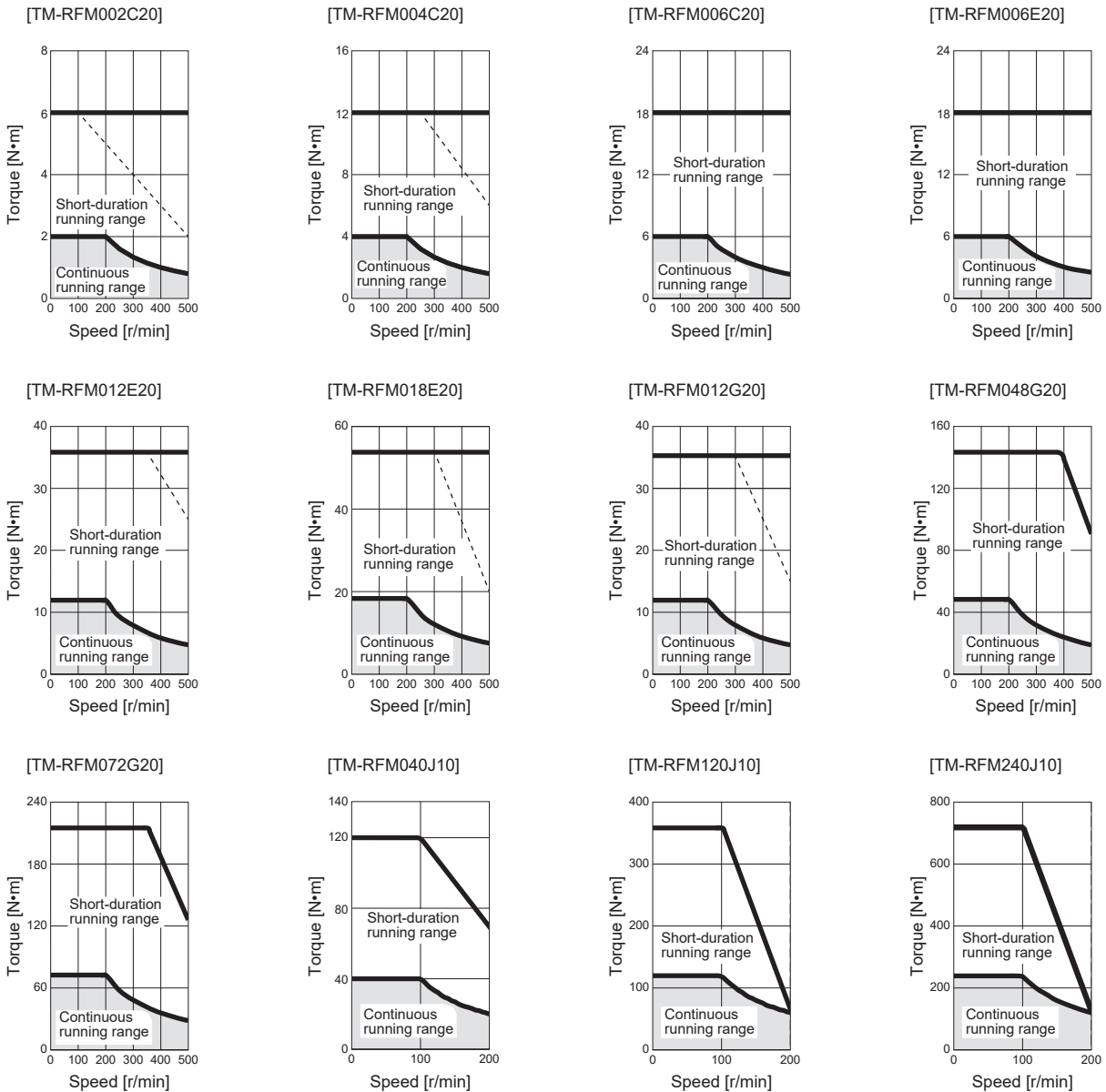
For machines where unbalanced torque occurs, such as a vertical axis system, use the absolute position detection system.

Page 11 For vertical axis (lift)

The unbalanced torque of the machine should be kept at 70 % or lower of the motor's rated torque.

— : 3-phase 200 VAC and 1-phase 230 VAC  
 - - - : 1-phase 200 VAC

The single-phase power input is for the TM-RFM002C20, TM-RFM004C20, TM-RFM006C20, TM-RFM006E20, TM-RFM012E20, TM-RFM018E20, TM-RFM012G20, and TM-RFM040J10.



# 7.4 Derating

The derating condition is the reference value at the rated speed. As the temperature rise value of the direct drive motor changes depending on operation conditions such as speed, confirm that [AL. 0E2 Servo motor overheat warning] and [AL. 046 Servo motor overheat] do not occur on the actual machine before use.

If a warning or alarm occurs, consider taking the following measures:

- Lower the effective load ratio of the direct drive motor.
- Review the heat dissipation conditions.

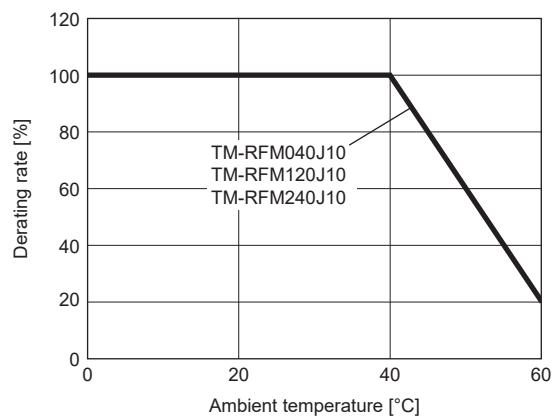
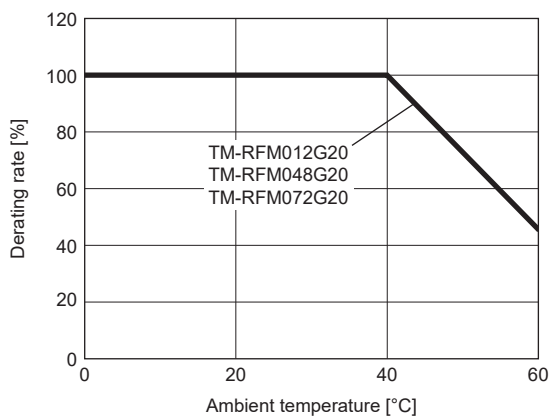
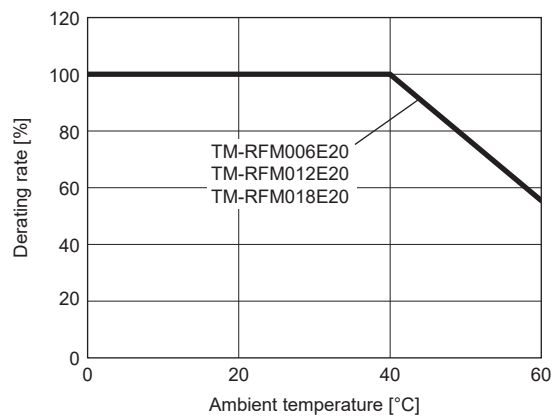
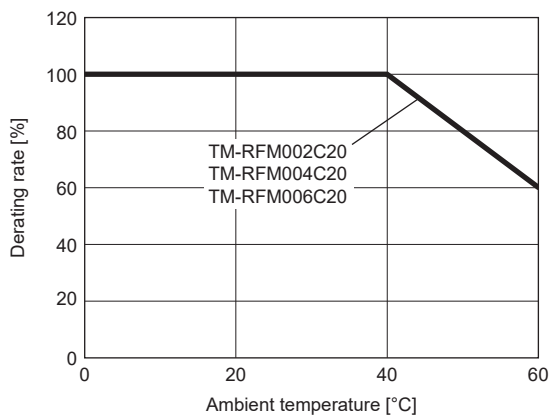
To use this product under conditions with multiple derating, calculate the multiplication of each derating rate, and use at the calculated derating rate or lower.

For machines where unbalanced torque occurs, such as a vertical axis system, the unbalanced torque should be kept at 70 % or lower of the rated torque.

When applying the derating rate in the conditions above, calculate the multiplication of the derating rate of 70 % in the unbalanced torque and the derating rate of each condition, and use this product at the calculated derating rate or lower.

## Restrictions on the ambient temperature

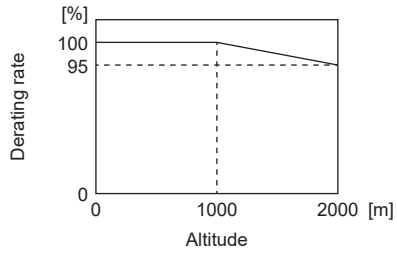
When using this product in an environment with a high ambient temperature, derate the product in accordance with the following conditions:





# Restrictions on the altitude

To use this product at an altitude between 1000 m and 2000 m, derate the product in accordance with the following conditions:



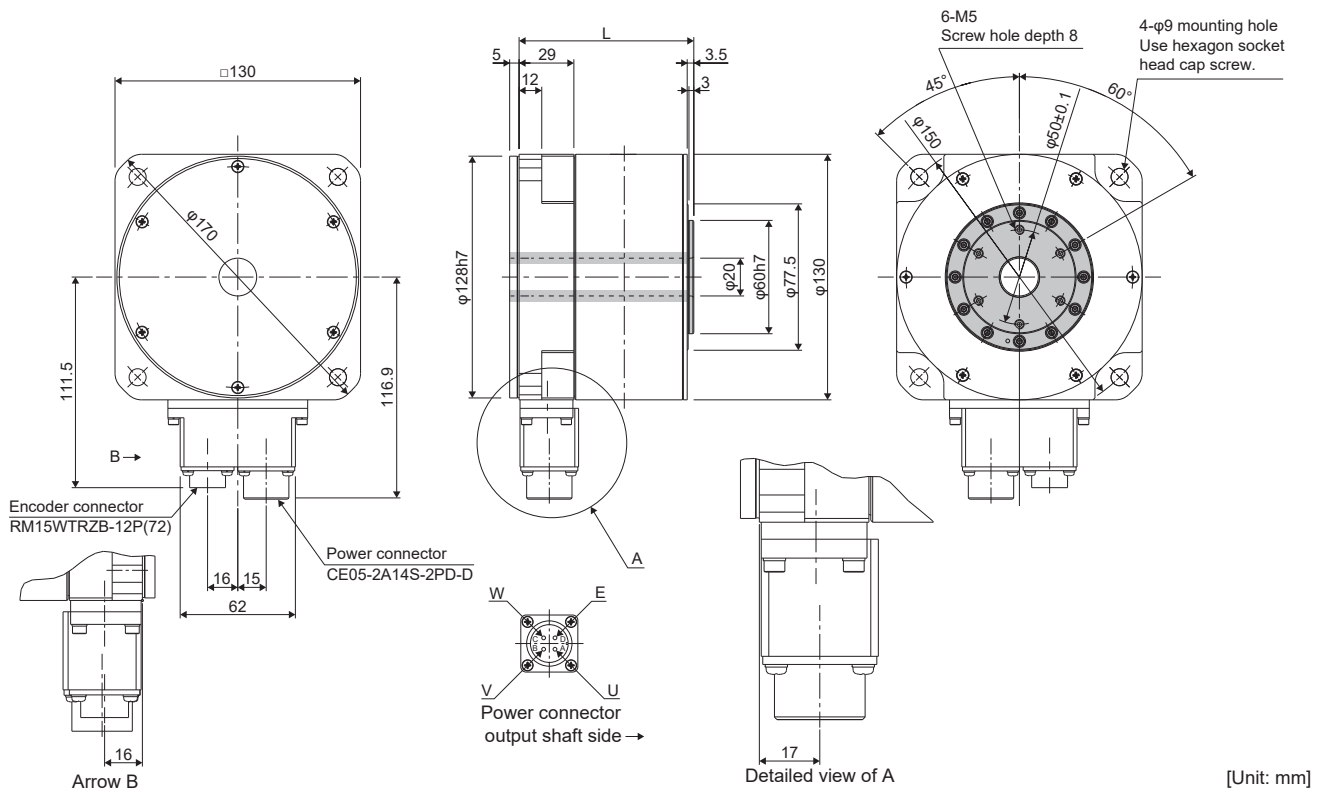
# 7.5 Dimensions

The actual dimensions may be a maximum of approximately 3 mm larger than those in the drawings. Design the machine side with margin.

— indicates the rotor.

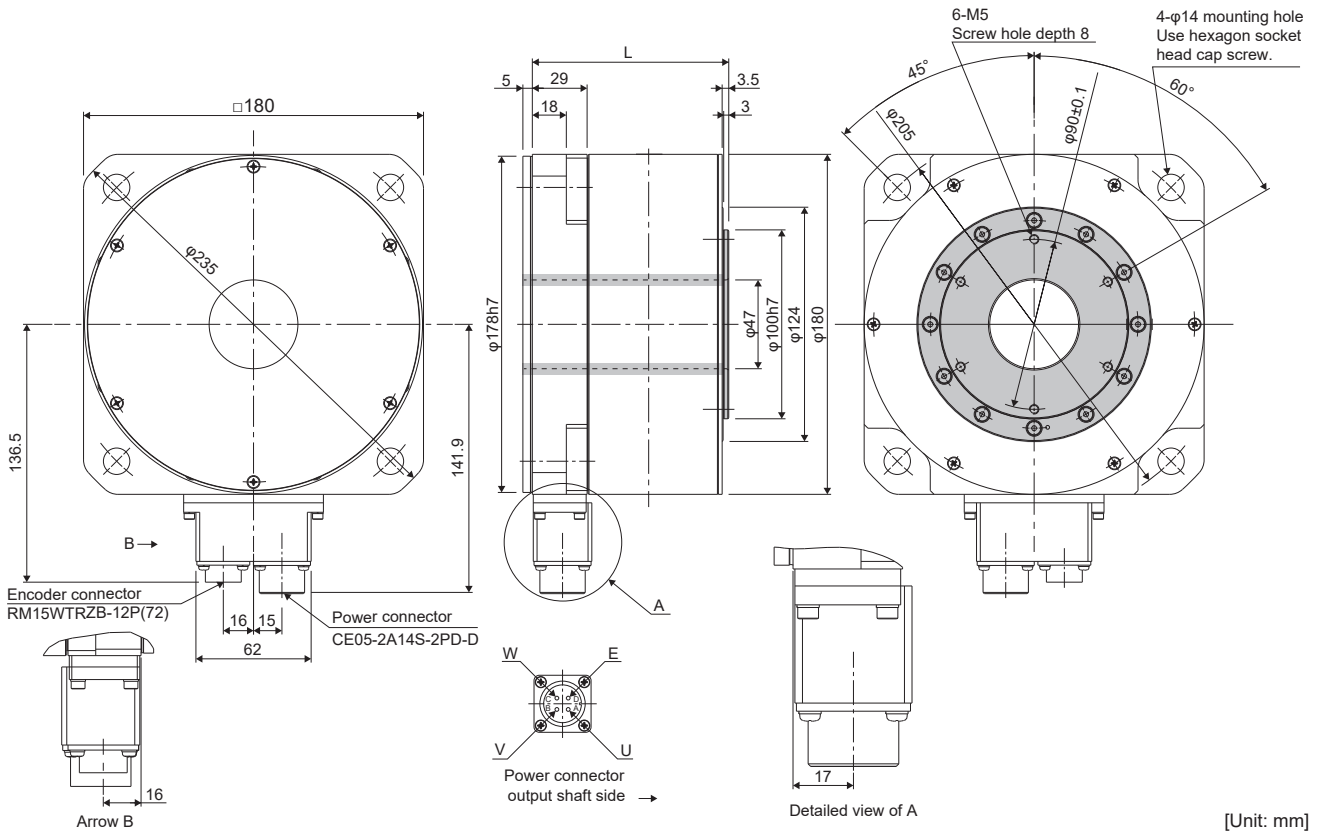
## TM-RFM002C20, TM-RFM004C20, TM-RFM006C20

Model	Variable dimensions L
TM-RFM002C20	58.5
TM-RFM004C20	75.5
TM-RFM006C20	92.5



# TM-RFM006E20, TM-RFM012E20, TM-RFM018E20

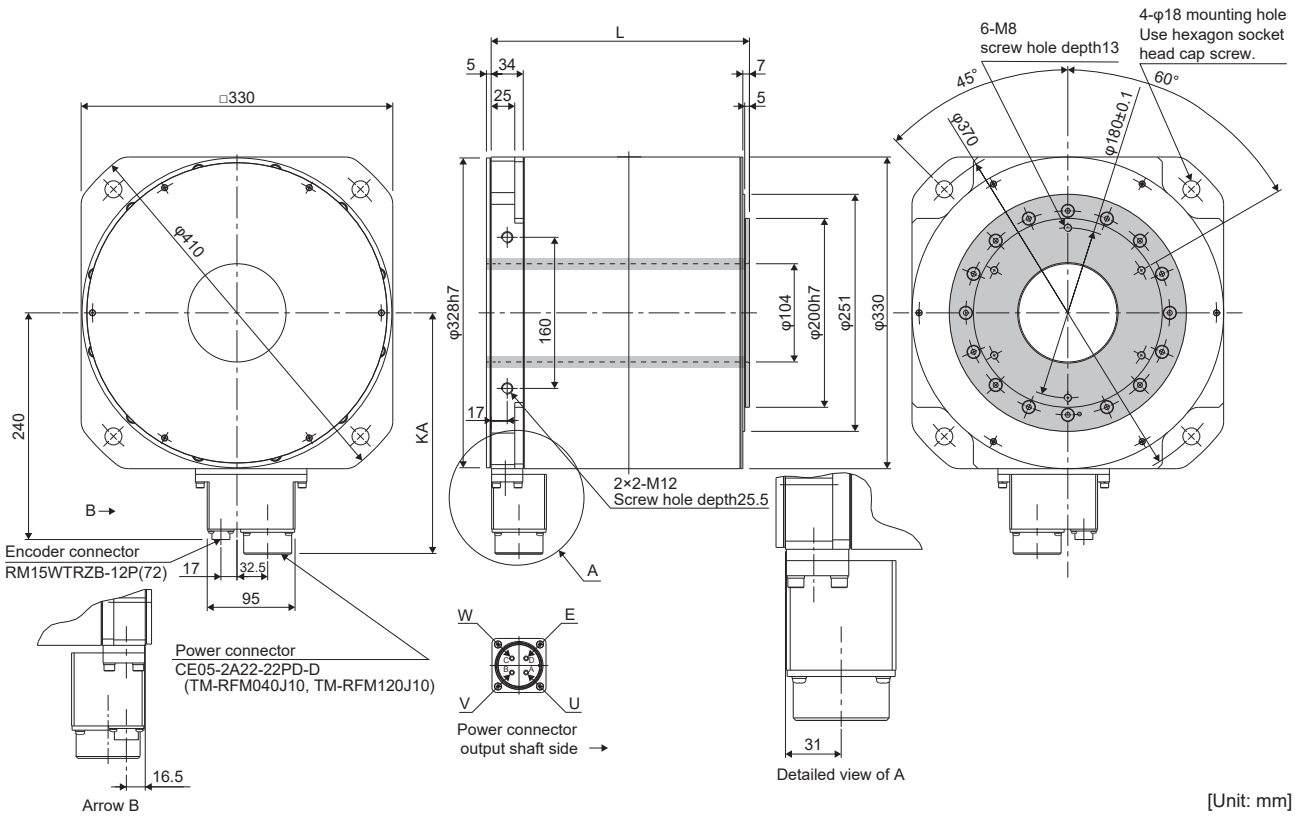
Model	Variable dimensions L
TM-RFM006E20	62
TM-RFM012E20	83
TM-RFM018E20	104





# TM-RFM040J10, TM-RFM120J10, TM-RFM240J10

Model	Variable dimensions	
	L	KA
TM-RFM040J10	88.5	254
TM-RFM120J10	162.5	
TM-RFM240J10	273.5	254.8



7

# 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, read the Safety Instructions at the front of this manual in addition to this chapter.

## 8.1 Model designation

This section describes the model designation. Not all combinations of the symbols are available.

### 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

Z-phase mark

### 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)

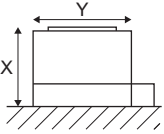
Symbol	Dimensions [mm]
C	φ130
E	φ180
G	φ230

## 8.2 Specification list

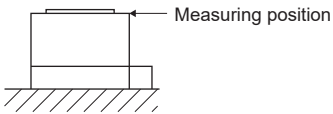
### TM-RG2M/RU2M series

Item	TM-RG2M/RU2M series			
	002C30	004E30	009G30	
Motor OD (frame OD) [mm]	φ130	φ180	φ230	
Power supply capacity	Refer to "Power supply capacity and generated loss" in the following manual. □□IMR-J5 User's Manual (Hardware)			
Continuous running duty *1	Rated output [W] *8	69	141 (188)	283
	Rated torque [N·m] *8	2.2	4.5 (6)	9
Maximum torque [N·m] *8	8.8	13.5 (18)	27	
Rated speed [r/min] *1	300			
Maximum speed [r/min]	600			
Power rate at continuous rated torque [kW/s] *8	6.1	3.4 (6.0)	5.5	
Rated current [A] *8	1.2	1.3 (1.7)	2.2	
Maximum current [A] *8	4.9	4.0 (5.3)	6.7	
Moment of inertia J [ $\times 10^{-4}$ kg·m <sup>2</sup> ]	7.88	60.2	147	
Recommended load to motor inertia ratio *2	50 times or less	20 times or less		
Absolute accuracy [s] *9	±15	±12.5		
Speed/position detector *3	Common to absolute position and incremental detection systems	21-bit encoder	22-bit encoder	
	Resolution per direct drive motor revolution	2097152 pulses/rev	4194304 pulses/rev	
Type	Permanent magnet synchronous motor			
Thermistor	Built-in			
Insulation class	155 (F)			
Structure	Totally enclosed, natural cooling (IP rating: IP40 *4)			
Vibration resistance [m/s <sup>2</sup> ] *5	X: 49, Y: 49			
Vibration rank *6	V10			
Rotor permissible load *7	Moment load [N·m]	15	49	65
	Axial load [N]	770	2300	3800
Mass [kg]	2.7	5.5	8.3	

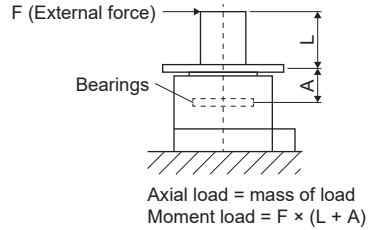
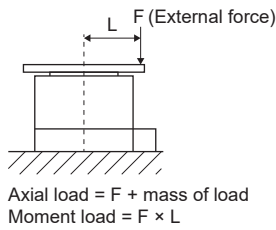
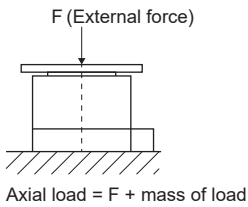
- \*1 When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
- \*2 If the load to motor inertia ratio exceeds the indicated value, contact your local sales office.
- \*3 To configure the absolute position detection system, connect to a battery unit and an absolute position storage unit. Refer to the following for the absolute position storage unit.  
 ☞ Page 41 Absolute position storage unit MR-BTAS01  
 For the battery, refer to "Battery" in the following manual.  
 📖 MR-J5 User's Manual (Hardware)
- \*4 The shaft-through portion of the rotor and the connector area are excluded. IP classifies the degree of protection provided against the intrusion of solid objects and water in electrical enclosures.
- \*5 The vibration direction is as shown in the figure. The numerical value indicates the maximum value. When the direct drive motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value.



- \*6 V10 indicates that the amplitude of a direct drive motor as a single unit is 10 μm or less. The following figure shows the direct drive motor mounting position for measurement and the measuring position.



- \*7 The axial and moment loads, which are applied to the direct drive motor's rotor (output shaft) during operation, must be maintained to be equal to or below the permissible value. The following figure shows an example of the load applied during operation.



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

- \*8 The value inside ( ) applies when the torque is increased. The rated torque and maximum torque can be increased by changing the servo amplifier to be combined with.  
 For the servo amplifier/motor combinations, refer to "Servo amplifier/motor combinations" in the following manual.  
 📖 MR-J5 User's Manual (Hardware)
- \*9 The absolute accuracy changes depending on the mounting condition of the load and the surrounding environment.



## 8.3 Torque characteristics

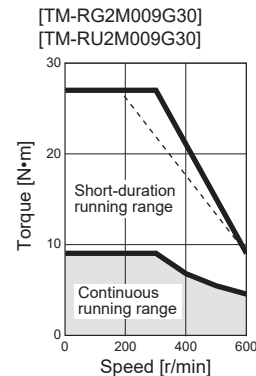
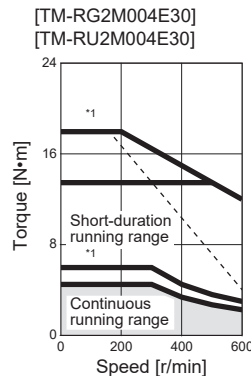
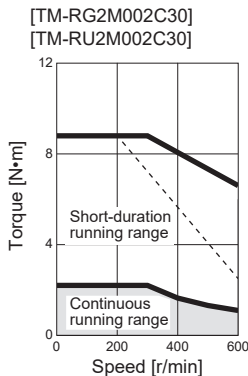
### Point

For machines where unbalanced torque occurs, such as a vertical axis system, use the absolute position detection system.

☞ Page 11 For vertical axis (lift)

The unbalanced torque of the machine should be kept at 70 % or lower of the motor's rated torque.

— : 3-phase 200 VAC and 1-phase 230 VAC  
 - - - : 1-phase 200 VAC



\*1 The rated torque and maximum torque can be increased by changing the servo amplifier to be combined with.  
 For the servo amplifier/motor combinations, refer to "Servo amplifier/motor combinations" in the following manual.  
 ☞ MR-J5 User's Manual (Hardware)

## 8.4 Derating

The derating condition is the reference value at the rated speed. As the temperature rise value of the direct drive motor changes depending on operation conditions such as speed, confirm that [AL. 0E2 Servo motor overheat warning] and [AL. 046 Servo motor overheat] do not occur on the actual machine before use.

If a warning or alarm occurs, consider taking the following measures:

- Lower the effective load ratio of the direct drive motor.
- Review the heat dissipation conditions.

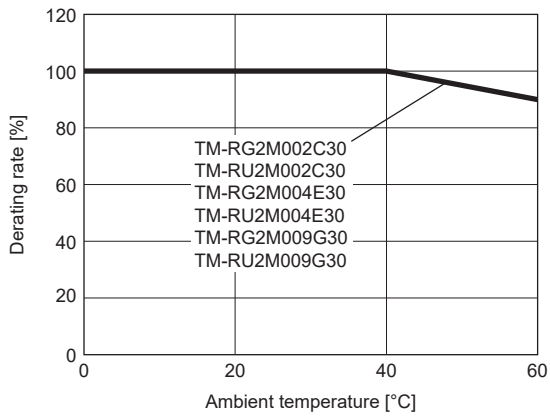
To use this product under conditions with multiple derating, calculate the multiplication of each derating rate, and use at the calculated derating rate or lower.

For machines where unbalanced torque occurs, such as a vertical axis system, the unbalanced torque should be kept at 70 % or lower of the rated torque.

When applying the derating rate in the conditions above, calculate the multiplication of the derating rate of 70 % in the unbalanced torque and the derating rate of each condition, and use this product at the calculated derating rate or lower.

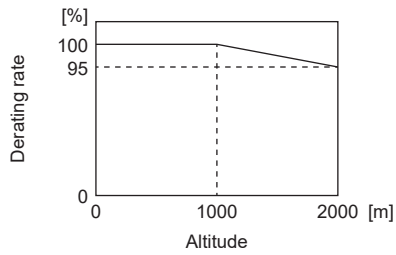
## Restrictions on the ambient temperature

When using this product in an environment with a high ambient temperature, derate the product in accordance with the following conditions:

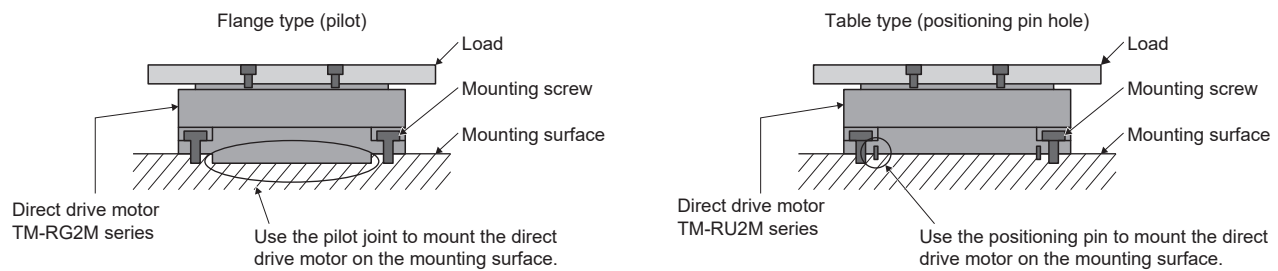


## Restrictions on the altitude

To use this product at an altitude between 1000 m and 2000 m, derate the product in accordance with the following conditions:



## 8.5 Installation method

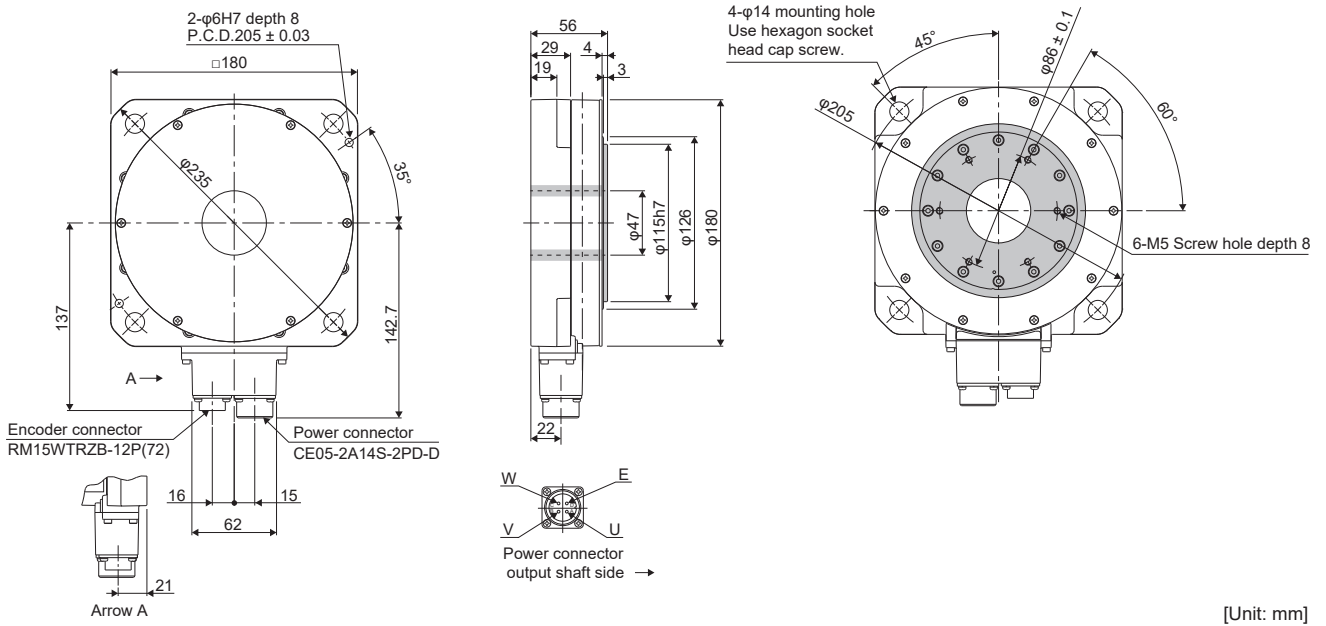


- As machine resonance may occur if the rigidity of the mounting surface is low, securely fix the direct drive motor to the highly rigid surface.
- To maintain sufficient rigidity, securely tighten the mounting screws of the direct drive motor and rotating table.
- To secure the heat dissipation path and to ensure the mounting accuracy of the direct drive motor, mount the direct drive motor to the highly rigid surface that has sufficient heat dissipation area, and the bottom of direct drive motor completely rested on the mounting surface.
- The flange type has higher mounting accuracy than the table type. When higher mounting accuracy is required, select the flange type.
- For the machine accuracy of each direct drive motor, refer to the following.  
☞ Page 14 Machine accuracy
- For the dimension tolerances, refer to the following.  
☞ Page 58 Dimensions

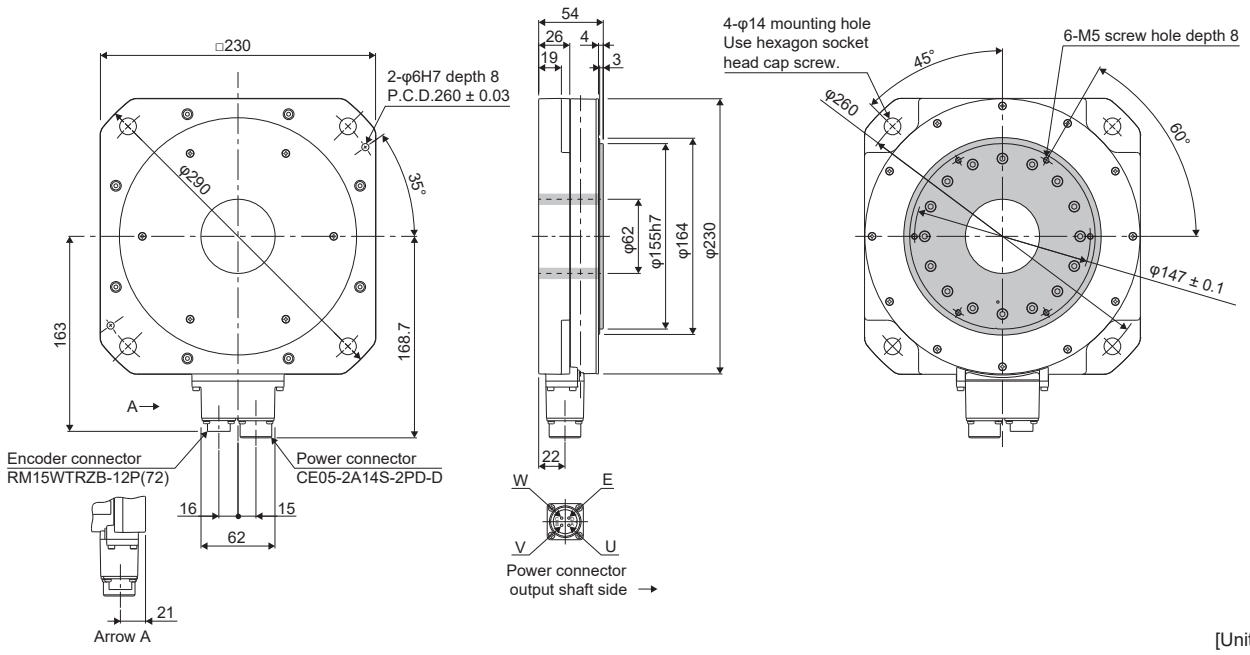




# TM-RU2M004E30



# TM-RU2M009G30



# 9 COMPLIANCE WITH EACH REGION

## 9.1 Compliance with CE/UKCA marking

### CE/UKCA marking

The CE/UKCA marking is mandatory and must be affixed to specific products placed on the European Union area and the United Kingdom. When a product conforms to the requirements by category as defined in the EU directive, UK rules, etc., the CE/UKCA marking must be affixed to the product. The CE/UKCA marking also applies to the machines and equipment that are for sale with the servo motors in the European Union area and the United Kingdom. Each manual is available in different languages. For details, refer to our website or contact our local sales office.

#### EMC directive

The EMC directive also applies to the direct drive motor as a single unit. Therefore, the direct drive motor is designed to comply with the EMC directive. The EMC directive also applies to machines and equipment incorporating direct drive motors. The TM-RFM, TM-RG2M, and TM-RU2M series comply with EN/BS EN IEC 61800-3 Category 3. These series are not intended to be used on a low-voltage public network which supplies domestic premises. When used on such network, radio frequency interference may occur. The installer must provide a guide for installation and use, including the recommended mitigation devices.

#### Low-voltage directive

The low-voltage directive also applies to the direct drive motor as a single unit. The direct drive motor is designed to comply with the low-voltage directive.

#### Machinery directive

The direct drive motor as a single unit falls under Article 1 2. (k), and therefore is not subject to the Machinery directive. However, the Machinery directive does apply to machines and equipment that incorporate the direct drive motor. Please check if the machines and equipment as a whole are in compliance.

### For compliance

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

#### Wiring

Use EN compliant products for wiring the power supply of the direct drive motor. Products that comply with EN are available as options. Refer to the following for details of the options.

☞ Page 28 WIRING OPTION

#### Performing EMC tests

The EMC test of machines and devices that incorporate servo amplifiers and direct drive motors must meet electromagnetic compatibility (immunity/emission) standards and satisfy the environment and electrical equipment specifications to be used. For EMC directive compliance methods relating to servo amplifiers and direct drive motors, refer to "EMC Installation Guidelines".

## 9.2 Compliance with UL/CSA standard

Use a direct drive motor that complies with the UL/CSA standard. For the latest information of compliance, contact your local sales office.

Unless otherwise specified, the handling, performance, specifications, etc., of the UL/CSA compliant products are the same as those of the standard models.

### Flange size

The direct drive motor complies with the UL/CSA standard when it is mounted on the flanges made of aluminum whose sizes are 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 an environment with a specified ambient temperature (0 °C to 40 °C). Therefore, to comply with the UL/CSA standard, mount the direct drive motor on a machine 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



## Selection example of wires

When cables are fabricated by the customer, wires should be selected in accordance with the application.

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

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

### ■TM-RFM series

Direct drive motor	Wire [AWG]
	U/V/W/E
TM-RFM002C20	Use cables manufactured by Mitsubishi Electric System & Service Co., Ltd. (SC-PWCFCBL_M-L or SC-PWCFCBL_M-H). For the SC-PWCFCBL_M-L and SC-PWCFCBL_M-H, contact your local sales office.
TM-RFM004C20	
TM-RFM006C20	
TM-RFM006E20	
TM-RFM012E20	
TM-RFM018E20	
TM-RFM012G20	14
TM-RFM048G20	12
TM-RFM072G20	
TM-RFM040J10	14
TM-RFM120J10	12
TM-RFM240J10	10

### ■TM-RG2M series and TM-RU2M series

Use cables manufactured by Mitsubishi Electric System & Service Co., Ltd. (SC-PWCFCBL\_M-L or SC-PWCFCBL\_M-H). For the SC-PWCFCBL\_M-L and SC-PWCFCBL\_M-H, contact your local sales office.

# 10 APPENDIX

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## 10.1 Fabricating the encoder cable

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

When fabricating encoder cables, note the descriptions in chapter 9, in order to ensure the reliability of communication.

Fabricate cables with the following procedure.

### 1. Selection of connectors

- Check the cable clamp size, then select a connector shown in chapter 3 and chapter 4.
- Obtain the specification, wiring guide for the connector, and other documents from the manufacturer.
- Purchase assembly jigs and similar parts as necessary.

### 2. Selection of cables

- Select a shielded twisted pair cable.
- Select a cable with a diameter that can be clamped with the connector cable clamp.
- Select a cable whose length, diameter, and bending life are appropriate.

### 3. Assembly of the cable

- Check the wiring guide of the connector manufacturer, then 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.
- When wiring the 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.
- When wiring the connector on the direct drive motor-side, connect the external conductor of the shielded cable to the SHD terminal.
- Check if the pin arrangement is correct.
- Connect the twisted pair cable using the correct combination.
- Check if the number of pairs of P5/LG wiring connected in parallel is correct.
- Fix the cable to the connector with a proper clamping torque.

### 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 distortions, bending, dents, and other problems.
- Check the connector pins for foreign matter adhesion, contamination, and discoloration.

### 5. Complete



# REVISIONS

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

Revision date	*Manual number	Description
July 2019	SH(NA)-030318ENG-A	First edition
July 2020	SH(NA)-030318ENG-B	■The following direct drive motor is added: TM-RFM240J10 ■Environment requirements are changed. ■Deleted: Section 2.10 ■Edited: Section 1.1, Section 7.3, Section 8.3 ■Added: Section 7.5, Section 8.5
December 2021	SH(NA)-030318ENG-C	■Complied with UKCA ■Edited: Section 1.1, Section 3.2, Chapter 4, Section 5.3, Section 9.1, Section 9.2

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# WARRANTY

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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]

For terms of warranty, please contact your original place of purchase.

[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;

1. a failure caused by your improper storing or handling, carelessness or negligence, etc., and a failure caused by your hardware or software problem
2. a failure caused by any alteration, etc. to the Product made on your side without our approval
3. 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
4. a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
5. any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
6. 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
7. 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
8. 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 AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in AC Servo, and a backup or fail-safe function should operate on an external system to AC Servo when any failure or malfunction occurs.
- (2) Our 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.

# TRADEMARKS

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SH(NA)-030318ENG-C(2112)MEE

MODEL:

MODEL CODE:

## **mitsubishi electric corporation**

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NAGOYA WORKS : 1-14, YADA-MINAMI 5-CHOME, HIGASHI-KU, NAGOYA, JAPAN

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