

General-Purpose AC Servo



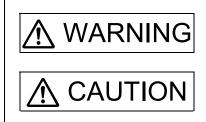
MODEL TM-RFM DIRECT DRIVE MOTOR INSTRUCTION MANUAL

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

Transport the products correctly according to their mass.

Stacking in excess of the specified number of product packages is not allowed.

•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.

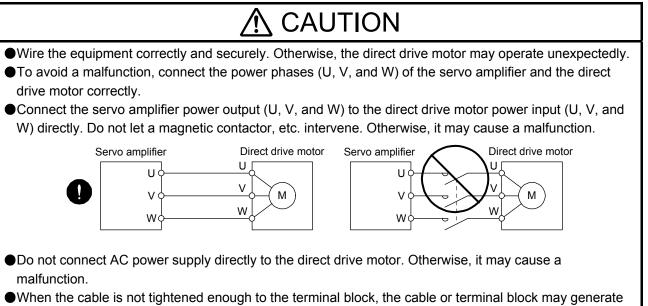
•The equipment must be installed in the specified direction.

•When you keep or use the equipment, please fulfill the following environment.

Item		Environment	
Ambient Operation		0 °C to 40 °C (non-freezing)	
temperatu	re Storage	-15 °C to 70 °C (non-freezing)	
Ambient	Operation	80 %RH or less (non-condensing)	
humidity 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	
TM-RFM_C20			
Vibration	TM-RFM_E20	X, Y: 49 m/s ²	
resistance	TM-RFM_G20		
	TM-RFM_J10	X, Y: 24.5 m/s ²	

- 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



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 ⁻⁴ kg•m ²)]	5.4675 [oz•inch ²]
Load (thrust load/axial load)	1 [N]	0.2248 [lbf]
Temperature	N [°C] × 9/5 + 32	N [°F]

MEMO

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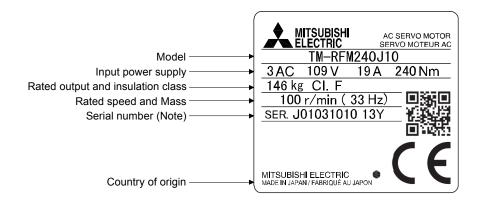
 App. 4
 Fabrication of the encoder cable......

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1. INTRODUCTION

1. INTRODUCTION

1.1 Rating plate

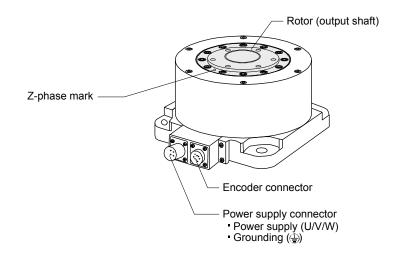


Note. Production year and month of the direct drive motor are indicated in a serial number on the rating plate.

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



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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. •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.

2.1 Equipment configuration

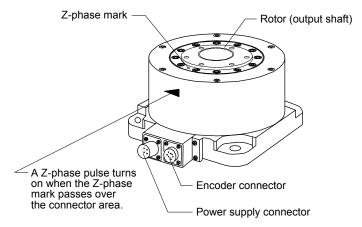
The following shows the configuration of a direct drive motor. When using the direct drive motor, note the following.

(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.

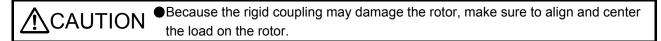
Direct drive motor series	Mounting direction	
TM-RFM	All directions	

2.3 Load mounting/dismounting precautions

POINT	
 During assembly may malfun 	mbling, the rotor must not be hammered. Otherwise, the encoder ction.

- (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



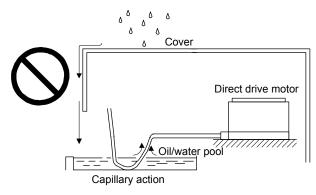
For the permissible rotor load specific to the direct drive motor, refer to section 7.3.

- (1) When coupling a load to the direct drive motor, the load applied to the rotor must be within the permissible load.
- (2) The load, which exceeds the permissible load, can cause the bearing life to reduce and the rotor to break.
- (3) The load indicated in this section is static load in a single direction and does not include eccentric load. Make eccentric load as small as possible. Not doing so can cause the direct drive motor to be damaged.

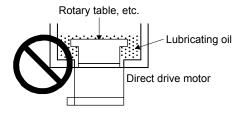
2.5 Protection from oil and water

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

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

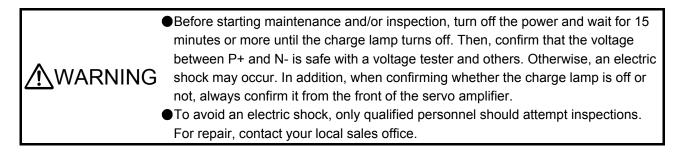


Provide measures so that the direct drive motor is not exposed to oil and water entering from the machine side, rotating table, etc.



- (3) If liquid such as coolant drops on the direct drive motor, the sealant, packing, cable and others may be affected depending on the liquid type.
- (4) In the environment where the direct drive motor is exposed to oil mist, steam, oil, water, grease, and/or the like, a standard specification direct drive motor cannot be used. Provide measures to prevent dust and/or water on the machine side.

2.6 Inspection



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

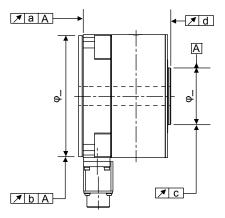
When the motor is run at rated speed under rated load, bearings change the bearings in 20,000 to 30,000 hours as a guideline. This differs on the operating conditions. The bearings must also be changed if unusual noise or vibration is found during inspection.

2.8 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)	а	0.05
Runout of fitting outer diameter of mounting surface	b	0.07
Runout of rotor (output shaft)	С	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 $^{\circ}$ C to 40 $^{\circ}$ C ambient temperature.

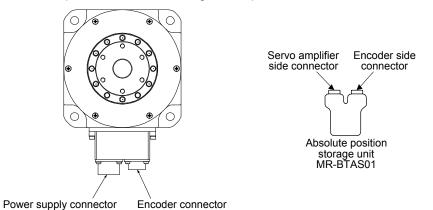
Mounting surface size [mm]	Direct drive motor
	TM-RFM002C20
400 × 400 × 20	TM-RFM004C20
	TM-RFM006C20
	TM-RFM006E20
450 × 450 × 12	TM-RFM012E20
	TM-RFM018E20
	TM-RFM012G20
550 × 550 × 12	TM-RFM048G20
	TM-RFM072G20
	TM-RFM040J10
750 × 750 × 45	TM-RFM120J10
	TM-RFM240J10

3. CONNECTORS USED FOR DIRECT DRIVE MOTOR WIRING

POINT	
●The IP rating	g 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 ratir	ng of the connector, servo amplifier, direct drive motor and absolute
position stor	age unit vary, the overall IP rating depends on the lowest IP rating of
all compone	nts.

3.1 Selection of connectors

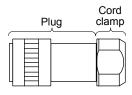
Use the connector configuration products given in the table as the connectors for connection with the direct drive motor. Refer to section 3.2 for the compatible connector configuration products.



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

Note. Used in the absolute position detection system

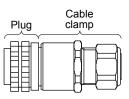
3.2 Wiring connectors (connector configurations A/B/C/D/E/F)



			Plug (Hirose Elec	ctric)	Recommended (Bando Dense	Direct drive motor encoder connector	
Connector configuration	Leature		Cord clamp	Model	Cable OD [mm] (reference)	or Absolute position storage unit connector (servo amplifier side) (Note 1)	
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.

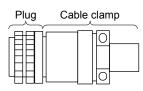
2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch



			Plug (DDK)	Ca	able clamp		
Connector configuration	Feature	Туре	Model	Cable OD [mm] (reference)	Model	Direct drive motor power connector (Note 2)	
				4 to 8	ACS-08RL-MS14F		
	IP67			4 10 8	(Nippon Flex)		
				8 to 12	ACS-12RL-MS14F		
			CE05-6A14S-2SD-D Applicable wire size: AWG 22 to 16	8 10 12	(Nippon Flex)	- CE05-2A14S-2PD-D	
В	EN compliant	Straight		5 to 8.3	YSO14-5 to 8		
Б		Straight		5 10 8.5	(Daiwa Dengyo)	GE05-2A145-2FD-D	
				8.3 to 11.3	YSO14-9 to 11		
				0.3 10 11.3	(Daiwa Dengyo)		
	General environment		D/MS3106B14S-2S	7.9 or less	D/MS3057-6A		
	(Note 1)		Applicable wire size: AWG 22 to 16	(bushing ID)	D/10133037-0A		

Note 1. Not comply with EN.

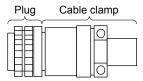
2. The connector to be mated.



			Plug (DDK)	Cable	clamp (DDK)		
Connector configuration	Feature	Туре	Model	Cable OD [mm] (reference)	Model	Direct drive motor power connector (Note 2)	
	IP67		CE05-6A18-10SD-D-BSS	8.5 to 11	CE3057-10A-2-D		
С	EN compliant	Straight	Applicable wire size: AWG 14 to 12	10.5 to 14.1	CE3057-10A-1-D	CE05-2A18-10PD-D	
C	General environment	Sualyni	D/MS3106B18-10S	14.3 or less	D/MS3057-10A	0L03-2A10-10FD-D	
	(Note 1)		Applicable wire size: AWG 14 to 12	(bushing ID)	D/10133037-10A		

Note 1. Not comply with EN.

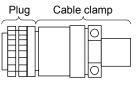
2. The connector to be mated.



			Plug (DDK)	Cable	clamp (DDK)		
Connector configuration	Feature	Туре	Model	Cable OD [mm] (reference)	Model	Direct drive motor power connector (Note 2)	
	IP67		CE05-6A22-22SD-D-BSS	9.5 to 13	CE3057-12A-2-D		
D	EN compliant	Straight	Applicable wire size: AWG 10 to 8	12.5 to 16	CE3057-12A-1-D	CE05-2A22-22PD-D	
D	General environment (Note 1)	Sualght	D/MS3106B22-22S Applicable wire size: AWG 10 to 8	15.9 or less (bushing ID)	D/MS3057-12A	CE00-2A22-22PD-D	

Note 1. Not comply with EN.

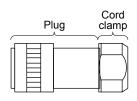
2. The connector to be mated.



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

Note 1. Not comply with EN.

2. The connector to be mated.



			Plug (Hirose Elec	ctric)	Recommended cable (B	Absolute position storage	
Connector configuration	Feature	Туре	Plug	Cord clamp	Model	Cable OD [mm] (reference)	unit connector (encoder side) (Note 1)
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

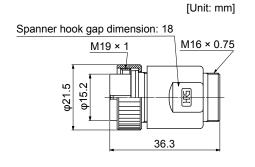
4. CONNECTOR DIMENSIONS

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)

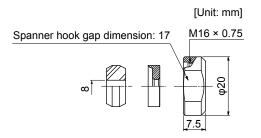
Model	Connector configuration (Note)
RM15WTPZK-12S	A
RM15WTPZ-12P(72)	F

Note. Refer to section 3.2 for the connector configuration.



(b) JR13WCCA-8(72)

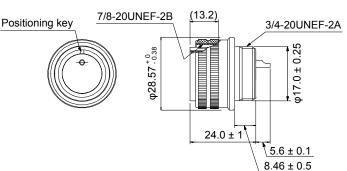
Refer to the connector configurations A and F of section 3.2 for the connector configuration.



(2) DDK

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

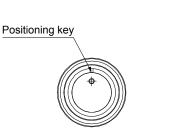
Refer to the connector configuration B of section 3.2 for the connector configuration.

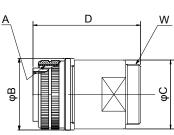


[Unit: mm]

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

[Unit: mm]



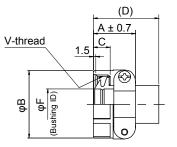


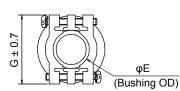
Model	А	B ⁺⁰ _{-0.38}	C ± 0.8	D or less	W	Connector configuration (Note)
CE05-6A18-10SD-D-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A	С
CE05-6A22-22SD-D-BSS	1 3/8-18UNEF-2B	40.48	38.3	61	1 3/16-18UNEF-2A	D
CE05-6A32-17SD-D-BSS	2-18UNS-2B	56.33	54.2	79	1 3/4-18UNS-2A	E

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	В	С	(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	С	
CE3057-10A- 2-D	10	23.0	30.1	10.5	(41.3)	15.9	11.0	31.7	1-200NEF-2D	CE3420-10-2	8.5 to 11	Ŭ	
CE3057-12A- 1-D	22	22.0	25	10.3	(41.2)	19	16.0	37.3	1 3/16-18UNEF-	CE342012-1	12.5 to 16	D	
CE3057-12A- 2-D	22	22 23.8	23.8 35	5 10.3	(41.3)	19	13.0	37.3	2B	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	

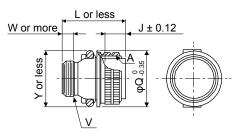
Note. Refer to section 3.2 for the connector configuration.

4. CONNECTOR DIMENSIONS

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

[Unit: mm]

[Unit: mm]

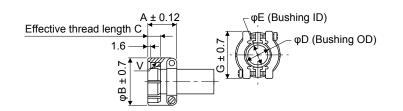


Model	A	J	L	Q	V	W	Y	Connector configuration (Note)
D/MS3106B14S-2S	7/8-20UNEF	13.49	42.88	28.57	3/4-20UNEF	8.00	30	В
D/MS3106B18-10S	1 1/8-18UNEF	18.26	52.37	34.13	1-20UNEF	9.53	42	С
D/MS3106B22-22S	1 3/8-18UNEF	18.26	56.57	40.48	1 3/16-18UNEF	9.53	50	D
D/MS3106B32-17S	2-18UNS	18.26	61.92	56.33	1 3/4-18UNS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



Model	Shell size	А	В	С	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	В
D/MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	31.7	1-20UNEF	AN3420-10	С
D/MS3057-12A	22	23.8	35.0	10.3	19.0	15.9	37.3	1 3/16-18UNEF-2A	AN3420-12	D
D/MS3057-20A	32	27.8	51.6	11.9	31.7	23.8	51.6	1 3/4-18UNS	AN3420-20	E

Note. Refer to section 3.2 for the connector configuration.

(3) Daiwa Dengyo

Hexagonal width across corners φD3 Hexagonal width across flats D Hexagonal width across flats φD2 O-ring Hexagonal width across corners φD ¥₽ L

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 YSO14-9 to	4 to 8.3	3/4-20UNEF-2B	44	23	25	26	28	В
11	7 to 11.3							

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

(4) Nippon Flex

(Note 1) L⁽¹⁾ (Note 1) L1(2) A, 15 рф

Nipple body

F'

Screw C

Е

Model	Screw C	cable OD	A	φd	Two- face width	Width across corners	Number of corners	Two- face width	Width across corners	Number of corners	L	L ₁	configuration (Note 2)
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	в
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	D

Tightening nut

F

G

E'

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.

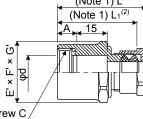
[Unit: mm]

[Unit: mm]

Connector

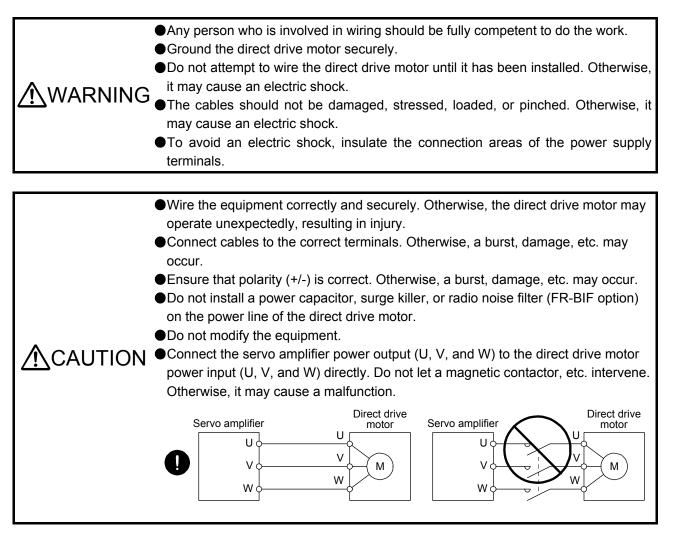
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G'



5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR



POINT

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

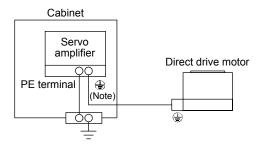
5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

5.1 Connection instructions

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.

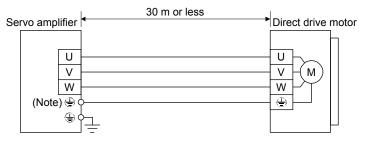


Note. The number of PE terminals of the servo amplifier differs depending on the amplifier type.

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_.

5.3 Selection example of wires

POINT	
-	ted in this section are separated wires.
	ndition of wire size is as follows.
	on condition: Single wire set in midair.
	a: 30 m or less
	Selection co Construction

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

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

Table 5.1 Wire size selection example (HIV wire)

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	s 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.

Convo amplifiar		Rated output											
Servo amplifier	10	20	40	60	70	100	200	350	500	700	11K	15K	22K
MR-J4A MR-J4A-RJ MR-J4B MR-J4B-RJ MR-J4GF MR-J4GF-RJ			Conne	ector A			Conne	ector B	N	one (Te	rminal b	ox) (Note	e)

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

Servo amplifier	Rated output					
Servo ampliner	10	40				
MR-J4A1						
MR-J4A1-RJ	Connector A					
MR-J4B1	Connector A					
MR-J4B1-RJ						

Servo amplifier	R	Rated output (Note)							
Servo ampliner	22 (222)	77	1010						
MR-J4W2B	Connector C								
MR-J4W3B	Conne								

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

(1) Connector details

(a) Connector A

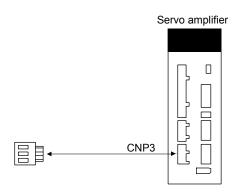


Table 5.2 Connector	r and applicable wire
---------------------	-----------------------

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

5. CONNECTION OF SERVO AMPLIFIER AND DIRECT DRIVE MOTOR

(b) Connector B

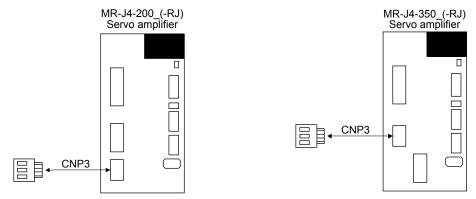
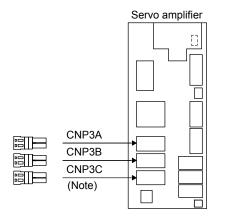


Table 5.3 Connector and applicable wire

ſ	Connector Receptacle assembly	Depenteele essembly	Applica	ble wire	Stripped	Open teel	Manufa
		Wire size	Insulator OD	length [mm]	Open tool	cturer	
	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.

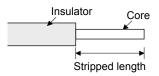
Table 5.4 Connector and applicable wire	Table !	5.4	Connector	and a	appli	icable	wire
---	---------	-----	-----------	-------	-------	--------	------

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

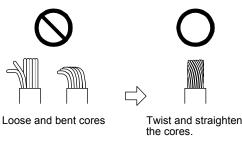
(2) Cable connection procedure

(a) Fabrication on cable insulator

Refer to tables 5.2 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.



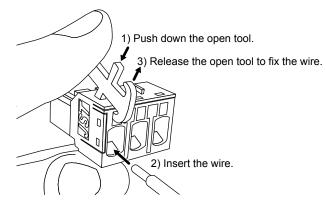
Twist strands lightly and straighten them as follows.



(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

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

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

POINT

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

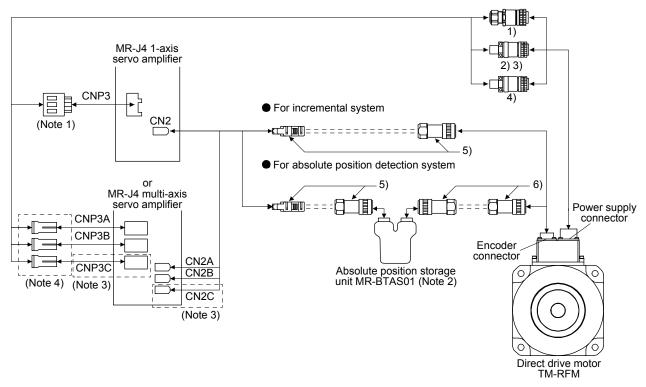
6.1 Connector set

POINT

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

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

6.1.1 Combinations of connector set



Note 1. Connectors for 3.5 kW or less. For 5 kW or more, it is a terminal block.

- 2. Always make connection for use in an absolute position detection system. (Refer to section 6.3.)
- 3. This connection is for the MR-J4 3-axis servo amplifier.
- 4. Refer to Appendix 3 for the crimp connector for CNP3_.

6.1.2 Connector list

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

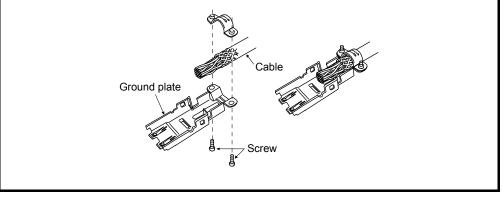
6.2 Encoder connector set

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.

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

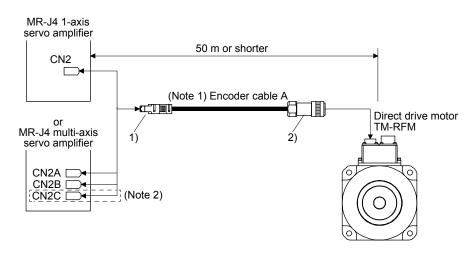
6.2.2 MR-J3DDSPS

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

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

6.2.3 Combinations for the encoder cable

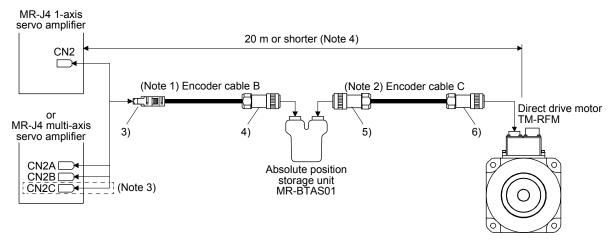
(1) For incremental system



Note 1. Refer to section 6.2.4 (1) for details.

2. This connection is for the MR-J4 3-axis servo amplifier.

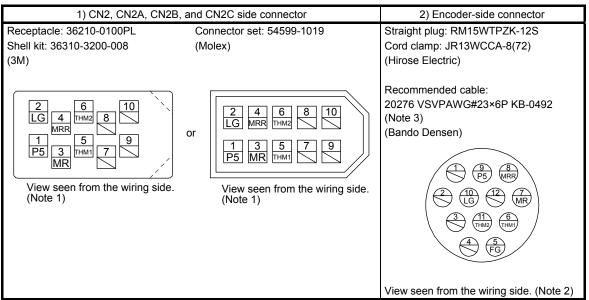
(2) For absolute position detection system



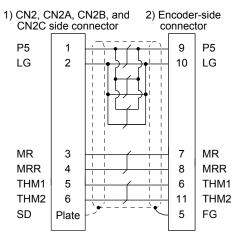
Note 1. Refer to section 6.2.4 (2) for details.

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

- 6.2.4 Fabrication of the encoder cable
- (1) Encoder cable A
 - (a) Connector details



- 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.
 - 2. Do not connect anything to the pins shown as \bigtriangledown .
 - 3. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch
- (b) Cable internal wiring diagram

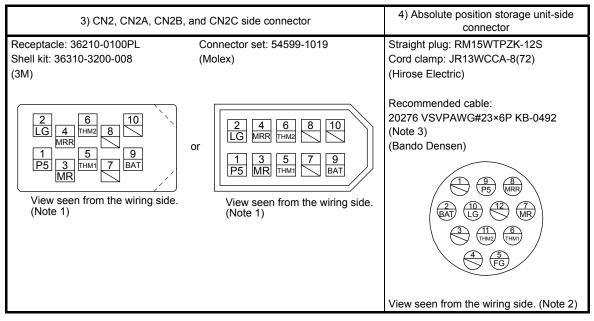


Refer to the following table for the required wires to fabricate the encoder cable.

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

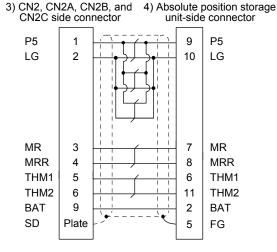
(2) Encoder cable B

(a) Connector details



- 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.
 - 2. Do not connect anything to the pins shown as \bigtriangledown .
 - 3. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch
- (b) Cable internal wiring diagram

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



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

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

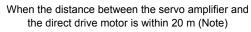
Core size [mm ²]	Conductor resistance of one core [Ω/km]	Cable OD [mm]
0.25	63.6 or less	8.2

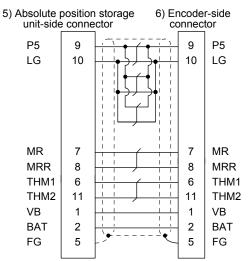
(3) Encoder cable C

(a) Connector details

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

- Note 1. Do not connect anything to the pins shown as .
 2. Purchase from Toa Electric Industrial Co. Ltd., Nagoya Branch
- (b) Cable internal wiring diagram





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

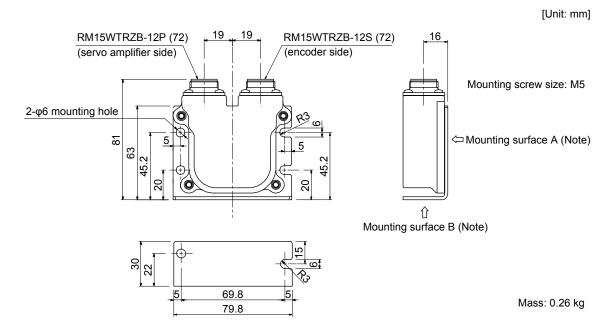
Refer to the following table for the wires required to fabricate the encoder cable.

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

6.3 Absolute position storage unit MR-BTAS01

POINT
 Replacing the MR-BTAS01 absolute position storage unit will erase the absolute position. Start up the direct drive motor again and perform home positioning according to each servo amplifier instruction manual.

- For absolute position detection system, refer to each servo amplifier instruction manual.
- •[AL. 25 Absolute position erased] will occur if the encoder cable is disconnected.
- (1) Connection method with the encoder cable Refer to section 6.2.3 (2).
- (2) Dimensions



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	Operation	0 °C to 55 °C (non-freezing)			
temperature	Storage	-20 °C to 65 °C (non-freezing)			
Ambient	Operation	90 %RH or less (non-condensing)			
humidity Storage		90 %RH or less (non-condensing)			
Ambience		Indoors (no direct sunlight),			
Ambience		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 ² (directions of X, Y, and Z axes) When the mounting surface B is fixed: 5.9 m/s ² (directions of X, Y, and Z axes)			

MEMO

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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.

100

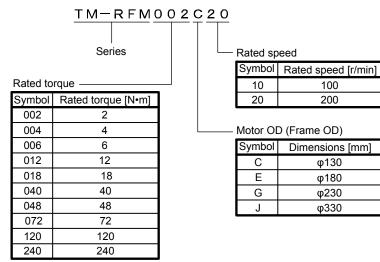
200

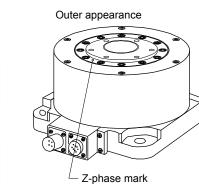
φ130

φ180

φ230

φ330





7 - 1

7.2 Combinations of servo amplifier and direct drive motor

		Servo	amplifier	
Direct drive motor		1 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-J4-20GF MR-J4-20GF-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-J4-40GF MR-J4-40GF-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			
TM-RFM006E20	MR-J4-60B MR-J4-60B-RJ MR-J4-60GF MR-J4-60GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM012E20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM018E20	MR-J4-100A MR-J4-100A-RJ MR-J4-100B MR-J4-100B-RJ MR-J4-100GF MR-J4-100GF-RJ		MR-J4W2-1010B	
TM-RFM012G20	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM048G20	MR-J4-350A MR-J4-350A-RJ			
TM-RFM072G20	MR-J4-350B MR-J4-350B-RJ MR-J4-350GF MR-J4-350GF-RJ			
TM-RFM040J10	MR-J4-70A MR-J4-70A-RJ MR-J4-70B MR-J4-70B-RJ MR-J4-70GF MR-J4-70GF-RJ		MR-J4W2-77B MR-J4W2-1010B	
TM-RFM120J10	MR-J4-350A MR-J4-350A-RJ MR-J4-350B MR-J4-350B-RJ MR-J4-350GF MR-J4-350GF-RJ			
TM-RFM240J10	MR-J4-500A MR-J4-500A-RJ MR-J4-500B MR-J4-500B-RJ MR-J4-500GF MR-J4-500GF-RJ			

7. TM-RFM SERIES

7.3 Specification list

	Direct	drive motor			TM-RFN	A series		
Item	002C20 004C20 006C20			006C20	006E20	012E20	018E20	
Motor OD (frame OD	Motor OD (frame OD) [mm]			φ130 φ180				
Power supply capac	ity		Refer to "U	Refer to "USING A DIRECT DRIVE MOTOR" of each servo amplifier instruction manual.				instruction
Continuous running	Rated output	[W]	42	84	126	126	251	377
duty (Note 1)	Rated torque	[N•m]	2	4	6	6	12	18
Maximum torque		[N•m]	6	12	18	18	36	54
Rated speed (Note 1	1)	[r/min]			20	00		
Maximum speed		[r/min]			50	00		
Instantaneous permi	issible speed	[r/min]			57	75		
Power rate at continu	uous rated torqu	e [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	[×	10 ⁻⁴ kg•m ²]	10.9	16.6	22.4	74.0	111	149
Recommended load to motor inertia ratio (Note 2)		50 times or less						
Absolute accuracy [s]		±15 ±12.5						
Speed/position detector (Note 3)			20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)					
Thermistor			Attached					
Insulation class			155 (F)					
Structure			Totally enclosed, natural cooling (IP rating: IP42 (Note 4))					
	Ambient	Operation			0 °C to 40 °C	(non-freezing)		
	temperature	Storage			-15 °C to 70 °C	(non-freezing)	
	Ambient	Operation		80	%RH or less (non-condensi	ng)	
Environment	humidity	Storage	90 %RH or less (non-condensing)					
(Note 5)	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 resis (Note 6)	tance	X: 49 m/s ² Y: 49 m/s ²					
Vibration rank (Note	7)				V	10		
Rotor permissible	Moment load	[N•m]		22.5			70	
load (Note 8)	Axial load	[N]		1100			3300	
Mass	·	[kg]	5.2	6.8	8.4	11	15	18

7. TM-RFM SERIES

	Direct	drive motor			TM-RFI	A series		
Item			012G20 048G20 072G20 040			040J10	120J10	240J10
Motor OD (frame OI	Motor OD (frame OD) [mm]			φ230 φ330				
Power supply capac	ity		Refer to "U	SING A DIRE	CT DRIVE MO mar		servo amplifier	instruction
Continuous running	Rated output	[W]	251	1005	1508	419	1257	2513
duty (Note 1)	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 perm	issible speed	[r/min]		575			230	
Power rate at contin	uous rated torqu	e [kW/s]	6.0	37.5	59.3	9.4	40.9	91.4
Rated current		[A]	3.6	11	16	4.3	11	19
Maximum current		[A]	11	33	48	13	33	57
Moment of inertia J	[×	10 ⁻⁴ kg•m ²]	238	615	875	1694	3519	6303
Recommended load to motor inertia ratio (Note 2)		50 times or less						
Absolute accuracy [s]		±12.5 ±10						
Speed/position dete	ctor (Note 3)		20-bit encoder common to absolute position and incremental detection systems (resolution per direct drive motor revolution: 1048576 pulses/rev)					
Thermistor			Attached					
Insulation class			155 (F)					
Structure			Totally enclosed, natural cooling (IP rating: IP42 (Note 4))					
	Ambient	Operation			0 °C to 40 °C	(non-freezing)		
	temperature	Storage			-15 °C to 70 °C	(non-freezing)	
	Ambient	Operation	80 %RH or less (non-condensing)					
Environment	humidity	Storage	90 %RH or less (non-condensing)					
(Note 5)	Ambience	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 ² Y: 49 m/s ² X: 24.5 m/s ² Y: 24.5 m/s ²				5 m/s ²	
Vibration rank (Note	7)				V	10		
Rotor permissible	Moment load	[N•m]		93			350	
load (Note 8)	Axial load	[N]		5500			16000	
Mass	·	[kg]	17	38	52	48	85	150

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

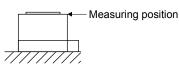
- 2. If the load inertia moment ratio exceeds the indicated value, contact your local sales office.
- 3. Always connect the following options to configure the absolute position detection system.

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)

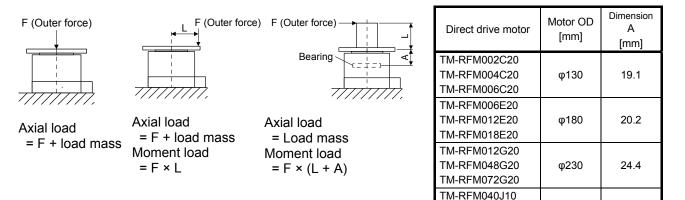
- 4. Shaft-through portion of the rotor and the connector area are excluded. IP classifies the degrees of protection provided against the intrusion of solid objects and water in electrical enclosures.
- 5. In the environment where the direct drive motor is exposed to oil mist, oil, and water, a standard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



TM-RFM120J10

TM-RFM240J10

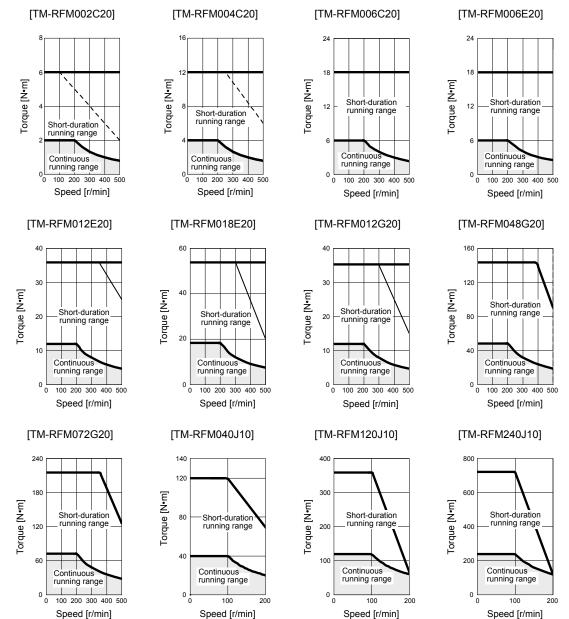
φ330

32.5

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	f
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.

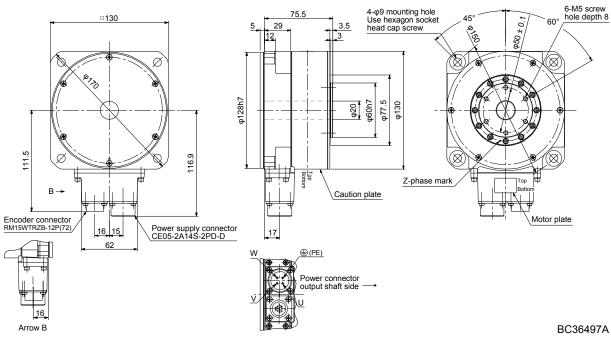


7. TM-RFM SERIES

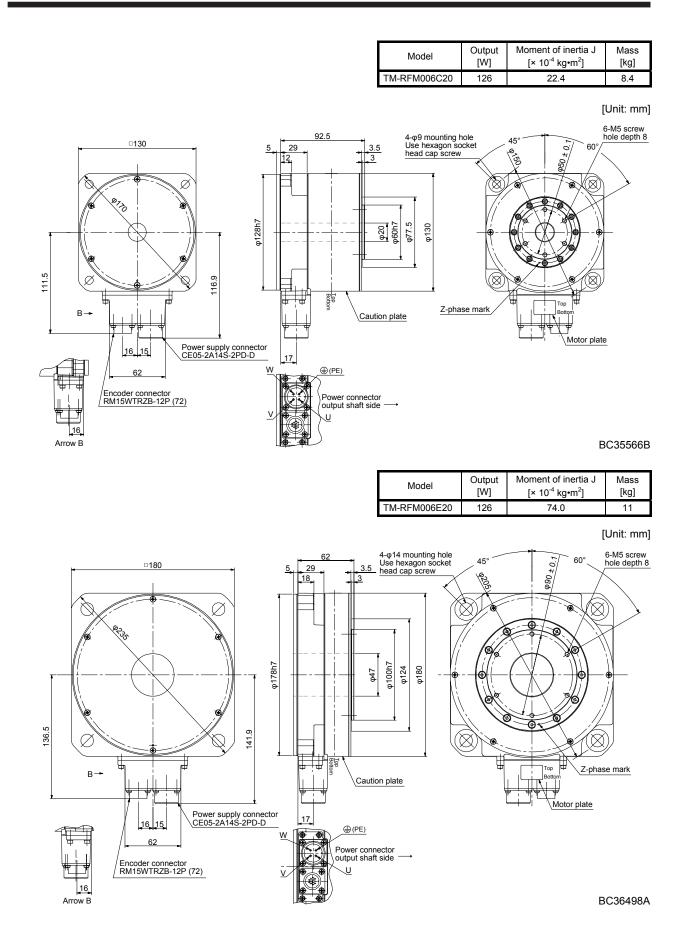
7.5 Dimensions

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.

		Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]
		TM-RFM002C20	42	10.9	5.2
Encoder connector RM15WTRZB-12P (72) L16 Arrow B		aution plate		60°	Unit: mm] -M5 screw ole depth 8
		Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]
		TM-RFM004C20	84	16.6	6.8
□130	75.5	4-φ9 mounting Use bexagon s	hole		Unit: mm] 6-M5 screw hole depth 8

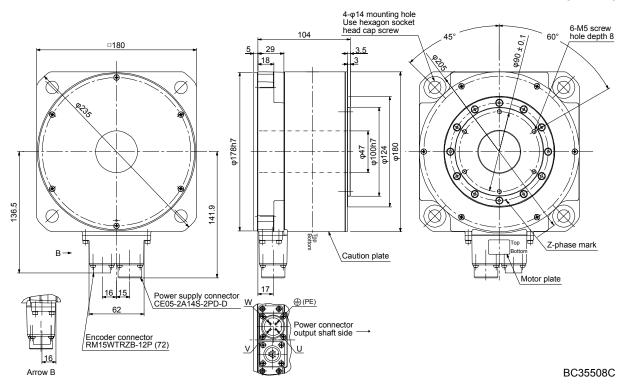


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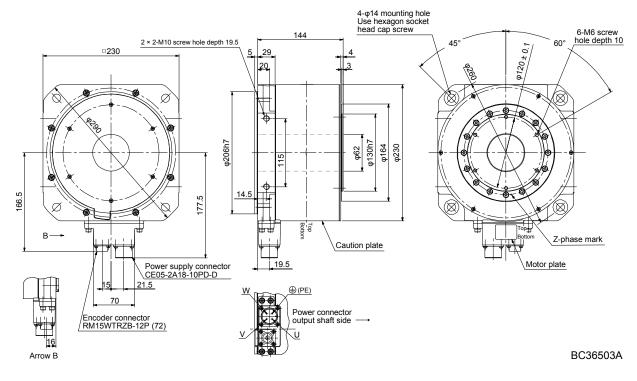
		Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]
		TM-RFM012E20	251	111	15 [Unit: mm]
Signed to the second se		4-914 mounting hole Use hexagon socket head cap screw			e mark
Encoder connector RM15WTRZB-12P (72)	Power connect output shaft sid	tor 		E	3C36499A

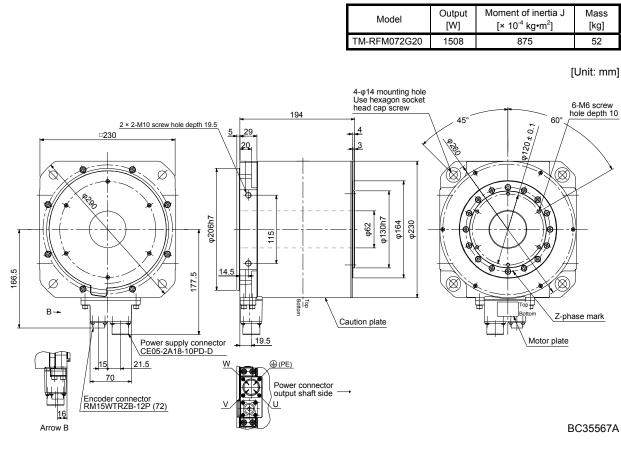
Model	Output	Moment of inertia J	Mass
	[W]	[× 10 ⁻⁴ kg•m ²]	[kg]
TM-RFM018E20	377	149	18



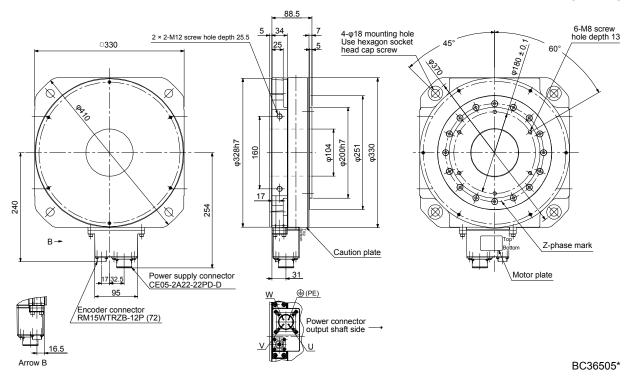
	Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]
L	TM-RFM012G20	251	238	17
			[Unit: mm]
□230 2 × 2-M10 screw hole depth 19.5 69 4 4 20 4 4 4 20 4 4 4 4 4 4 4 4 4 4 4 4	4-φ14 mounting hole Use hexagon socket head cap screw	45°		5-M6 screw hole depth 10
State of the second sec	90 00 00 00 00 00 00 00 00 00 00 00 00 0		A Contraction of the second se	ise mark
Arrow B	ector side →		Ε	3C36599*

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



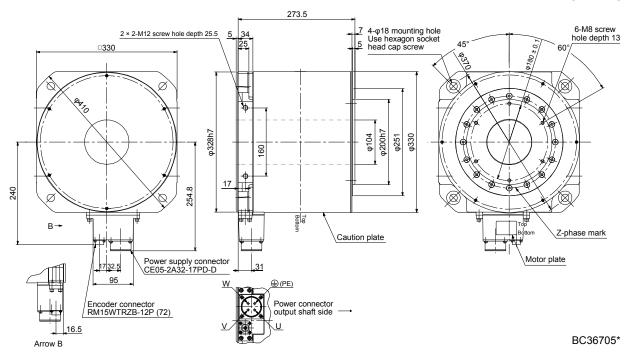


Model	Output	Moment of inertia J	Mass
	[W]	[× 10 ⁻⁴ kg•m ²]	[kg]
TM-RFM040J10	838	1694	53



		Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]
		TM-RFM120J10	2513	3519	91
2×2-M2 screw hole deptrived in the screw hole deptrived in	5 34 7 25 5 17 6 17 7 19 7 19 19 19 19 19 19 19 19 19 19 19 19 19	4-\overlap{18} mounting hole Use hexagon socket head cap screw		60° 60° 60° 60° 60° 60° 60° 60°	[Unit: mm] 6-M8 screw hole depth 13
		Model	Output [W]	Moment of inertia J [× 10 ⁻⁴ kg•m ²]	Mass [kg]

Model	Output	Moment of inertia J	Mass
	[W]	[× 10 ⁻⁴ kg•m ²]	[kg]
TM-RFM240J10	5027	6303	146



APPENDIX

App. 1 Selection example of direct drive motor

App. 1.1 Selection conditions

(1) Machine configuration

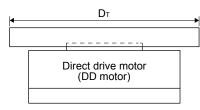
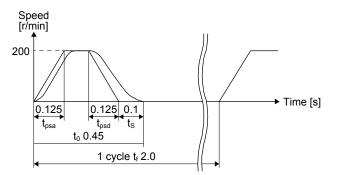


Table mass	W	= 19 [kg]
Rotary table diameter	D _T	= 300 [mm]
Rotation angle per cycle	θ	= 270 [degree]
Positioning time	to	= 0.45 [s] or less
Acceleration/deceleration time	$t_p = t_{psa} = t_{psc}$	= 0.125 [s]
Operation cycle	t _f	= 2.0 [s]
Load torque	Τ _L	= 0 [N•m]

(2) Direct drive motor speed

$$\begin{split} \mathsf{N}_{o} &= \frac{\theta}{360} \times \frac{60}{(t_{0} - t_{p} - t_{s})} \\ &= \frac{270}{360} \times \frac{60}{(0.45 - 0.125 - 0.1)} = 200 \text{ [r/min]} \\ &\quad t_{s}: \text{ Settling time (Here, this is assumed to be 0.1 s.)} \end{split}$$

(3) Operation pattern



App. 1.2 Selection of direct drive motor

(1) Load moment of inertia

$$J_{L} = \frac{1}{8} \times D_{T}^{2} \times W$$
$$= \frac{1}{8} \times (300 \times 10^{-3})^{2} \times 19 = 0.214 \text{ [kg·m2]}$$

(2) Acceleration/deceleration torques of load

$$T_{a} = J_{L} \times 2\pi \times \frac{N_{o} / 60}{t_{p}}$$
$$= \frac{J_{L} \times N_{o}}{\frac{60}{2\pi} \times t_{p}}$$
$$= \frac{0.214 \times 200}{9.55 \times 0.125}$$
$$= 35.9 [N \cdot m]$$

- (3) Temporary selection of direct drive motor
 - Selection conditions

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

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

J_R: Recommended load to motor inertia ratio

From the above, the following direct drive motor is temporarily selected. TM-RFM018E20 (rated torque: 18 [N•m], maximum torque: 54 [N•m], moment of inertia: 149×10^{-4} [kg•m²])

(4) Acceleration/deceleration torque Torque necessary for acceleration

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

Torque necessary for deceleration

$$T_{Md} = -\frac{(J_{L} + J_{M}) \times N_{o}}{9.55 \times t_{psd}} = -38.3 \text{ [N-m]}$$

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

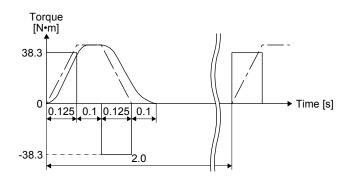
(5) Continuous effective load torque

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

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

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

(6) Torque pattern



(7) Selection results

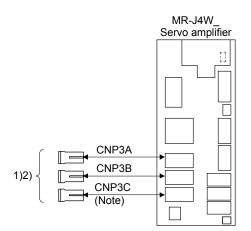
The following direct drive motor and servo amplifier are selected as the result of the calculation.Direct drive motorTM-RFM018E20Servo amplifierMR-J4-100B

App. 2 Manufacturer list

Names given in the table are as of February 2016.

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.

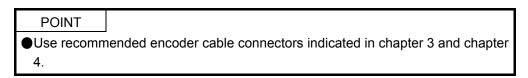
App. 3 Crimping connector for CNP3_



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

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

App. 4 Fabrication of the encoder cable



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

Cable fabrication	
Connector selection (1)	 Selection of connectors Check the cable clamp size to select a connector indicated in chapter 3 and chapter 4. Obtain the specification and wiring guide of the connector from the manufacturer. Purchase an assembly jig or others as necessary.
Cable selection (2)	 Selection of cables Select a shielded twisted pair cable. Select a cable having a diameter suitable to clamp to the connector cable clamp. Select a cable whose length, diameter, and bending life are appropriate.
Cable assembly (3)	 Assembly of the cable Check the wiring guide of the connector manufacturer to connect the connector properly. Check internal wiring described in chapter 6 to connect it properly. Perform a shielding process on the encoder cable properly. Do not connect anything to unused pins. For CN2, CN2A, CN2B, and CN2C side connectors, connect the external conductor of the shielded cable to the ground plate and fix it to the connector shell. For the servo motor-side connector, connect the external conductor of the SHD terminal. Check if the pin arrangement is correct. Connect the twisted pair cable in correct combination. Check if the number of pairs of P5/LG wirings connected in parallel is correct. Fix the cable to the connector with a proper clamping torque.
Completion (4)	 Inspection After assembly, perform conduction, insulation, and other inspections to check if the connection is correct. Check the surface for scratches and contamination. Check the connector pins for a distortion, bending, dent, etc. Check the connector pins for foreign matter adhesion, contamination, and discoloration.

REVISIONS

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

Print Data	*Manual Number		Revision
Mar. 2012		First adition	i tevision
	SH(NA)030112-A	First edition	The part of discuss is choosed
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		mplifier 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-ph	ase 200 V AC input is added.
		2. To prevent fire, note the	Partially added.
		following	
		4. Additional instructions	Partially added.
		Section 1.1	The diagram is changed.
		Section 1.2	Partially changed.
		Section 6.1.1	Partially added.
		Section 6.2.4	Partially changed.
		Section 7.4	Partially added and partially changed.
		App. 2	Partially changed.
		App. 4	Added.
Feb. 2016	SH(NA)030112-F	Model names MR-J4GF of	
		Section 5.4	Model names are added.
			Partially changed.
		Section 7.2	Model names are added.
		Section 7.3	Partially added.
		App. 2	Partially changed.

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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
 - a failure which may be regarded as avoidable, if your equipment in which the Product is incorporated is equipped with a safety device required by applicable laws and has any function or structure considered to be indispensable according to a common sense in the industry
 - (iv) a failure which may be regarded as avoidable if consumable parts designated in the instruction manual, etc. are duly maintained and replaced
 - (v) any replacement of consumable parts (battery, fan, smoothing capacitor, etc.)
 - (vi) a failure caused by external factors such as inevitable accidents, including without limitation fire and abnormal fluctuation of voltage, and acts of God, including without limitation earthquake, lightning and natural disasters
 - (vii) a failure generated by an unforeseeable cause with a scientific technology that was not available at the time of the shipment of the Product from our company
 - (viii) any other failures which we are not responsible for or which you acknowledge we are not responsible for
- 2. Term of warranty after the stop of production
- (1) We may accept the repair at charge for another seven (7) years after the production of the product is discontinued. The announcement of the stop of production for each model can be seen in our Sales and Service, etc.
- (2) Please note that the Product (including its spare parts) cannot be ordered after its stop of production.
- 3. Service in overseas countries

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

- 4. Exclusion of loss in opportunity and secondary loss from warranty liability Regardless of the gratis warranty term, Mitsubishi shall not be liable for compensation to:
- (1) Damages caused by any cause found not to be the responsibility of Mitsubishi.
- (2) Loss in opportunity, lost profits incurred to the user by Failures of Mitsubishi products.
- (3) Special damages and secondary damages whether foreseeable or not, compensation for accidents, and compensation for damages to products other than Mitsubishi products.
- (4) Replacement by the user, maintenance of on-site equipment, start-up test run and other tasks.
- 5. Change of Product specifications

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

- 6. Application and use of the Product
- (1) For the use of our General-Purpose AC Servo, its applications should be those that may not result in a serious damage even if any failure or malfunction occurs in General-Purpose AC Servo, and a backup or fail-safe function should operate on an external system to General-Purpose AC Servo when any failure or malfunction occurs.
- (2) Our General-Purpose AC Servo is designed and manufactured as a general purpose product for use at general industries. Therefore, applications substantially influential on the public interest for such as atomic power plants and other power plants of electric power companies, and also which require a special quality assurance system, including applications for railway companies and government or public offices are not recommended, and we assume no responsibility for any failure caused by these applications when used

In addition, applications which may be substantially influential to human lives or properties for such as airlines, medical treatments, railway service, incineration and fuel systems, man-operated material handling equipment, entertainment machines, safety machines, etc. are not recommended, and we assume no responsibility for any failure caused by these applications when used. We will review the acceptability of the abovementioned applications, if you agree not to require a specific quality for a specific application. Please contact us for consultation.

DIRECT DRIVEMOTOR

MITSUBISHI ELECTRIC CORPORATION

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