MITSUBISHI

General-Purpose AC Servo

MELSERVO-J2 Series

SSC-NET Compatible
MR-J2-□B
Specifications and Installation Guide

MITSUBISHI ELECTRIC

Thank you for choosing this Mitsubishi AC servo. This Specifications and Installation Guide gives handling information and precautions for using the servo amplifier and servo motor. Incorrect handling may cause an unexpected fault. Before using the servo amplifier and servo motor, please read this Specifications and Installation Guide carefully to use the equipment to its optimum.
Please forward this Specifications and Installation Guide to the end user.

Safety Instructions

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this Specifications and Installation Guide and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this Specifications and Installation Guide, the safety instruction levels are classified into "WARNING" and "CAUTION".

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

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

What must not be done and what must be done are indicated by the following diagrammatic symbols:

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

● : Indicates what must be done. For example, grounding is indicated by  .

After reading this Specifications and Installation Guide, always keep it accessible to the operator.

In this Specifications and Installation Guide, instructions at a lower level than the above, instructions for other functions, and so on are classified into "NOTICE", "INFORMATION" and "MEMORANDUM".

NOTICE	Indicates that incorrect handling may cause the servo amplifier to be faulty and may not lead to physical damage.
INFOR-MATION	Indicates that parameter setting change, etc. will provide another function or there are other usages.
MEMO-RANDUM	Indicates information needed for use of this equipment

SAFETY INSTRUCTIONS

1. To prevent electric shock, note the following:

⚠ WARNING

- Before wiring or inspection, switch power off and wait for more than 10 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.
- Connect the servo amplifier and servo motor to ground.
- 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 servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed loaded, or pinched. Otherwise, you may get an electric shock.

2. To prevent fire, note the following:

⚠ CAUTION

- Do not install the servo amplifier, servo motor and regenerative brake resistor on or near combustibles. Otherwise a fire may cause.
- When the servo amplifier has become faulty, switch off the main servo amplifier power side. Continuous flow of a large current may cause a fire.
- When a regenerative brake resistor is used, use an alarm signal to switch main power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor, causing a fire.

3. To prevent injury, note the follow

⚠ CAUTION

- Only the voltage specified in the Installation guide should be applied to each terminal, Otherwise, a burst, damage, etc. may occur.
- Connect the terminals correctly to prevent a burst, damage, etc.
- Ensure that polarity (+, −) is correct. Otherwise, a burst, damage, etc. may occur.
- During power-on or for some time after power-off, do not touch or close a parts(cable etc.) to the servo amplifier heat sink, regenerative brake resistor, servo motor, etc.
  Their temperatures may be high and you may get burnt or parts may damaged.

4. Additional instructions

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

(1) Transportation and installation

⚠ CAUTION

- Transport the products correctly according to their weights.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the controller. The controller may drop.
- Install the servo amplifier in a load-bearing place in accordance with the Installation guide.
- Do not climb or stand on servo equipment. Do not put heavy objects on equipment.
- The controller and servo motor must be installed in the specified direction.
- Leave specified clearances between the servo amplifier and control enclosure walls or other equipment.
- Do not install or operate the servo amplifier and servo motor which has been damaged or has any parts missing.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier.
- Do not drop or strike servo amplifier or servo motor. Isolate from all impact loads.
- Use the servo amplifier and servo motor under the following environmental conditions:

Environment		Conditions			
		Servo Amplifier	Servo Motor		
Ambient temperature	[℃]	0 to +55 (non-freezing)	0 to +40 (non-freezing)		
	[°F]	32 to 131 (non-freezing)	32 to 104 (non-freezing)		
Ambient humidity		90%RH or less (non-condensing)	80%RH or less (non-condensing)		
Storage temperature	[℃]	−20 to +65 (non-freezing)	−15 to +70 (non-freezing)		
	[°F]	−4 to 149 (non-freezing)	5 to 158 (non-freezing)		
Storage humidity		90%RH or less (non-condensing)			
Ambience		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt			
Altitude		Max. 1000m (3280 ft) above sea level			
Vibration	[m/s^2]	5.9 or less	MC-MF series HA-FF series	HU-UF13 to 73	X・Y: 19.6
			HC-SF81 HC-SF52 to 152 HC-SF53 to 153	HC-RF series HC-UF72・152	X: 9.8 Y: 24.5
			HC-SF121・201 HC-SF202・352	HC-SF203・353 HC-UF202	X: 19.6 Y: 49
			HC-SF301		X: 11.7 Y: 29.4
	[ft/s^2]	19.4 or less	MC-MF series HA-FF series	HU-UF13 to 73	X・Y: 64
			HC-SF81 HC-SF52 to 152 HC-SF53 to 153	HC-RF series HC-UF72・152	X: 32 Y: 80
			HC-SF121・201 HC-SF202・352	HC-SF203・353 HC-UF202	X: 64 Y: 161
			HC-SF301		X: 38 Y: 96

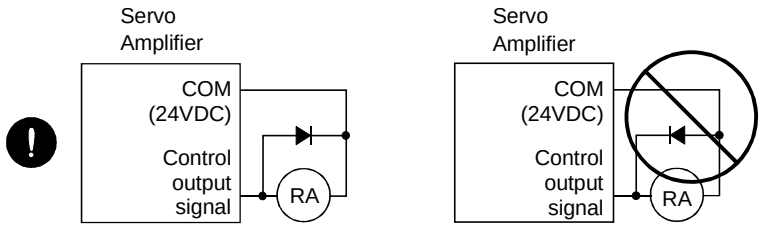
⚠ CAUTION

- Securely attach the servo motor to the machine. If attach insecurely, the servo motor may come off during operation.
- The servo motor with reduction gear must be installed in the specified direction to prevent oil leakage.
- For safety of personnel, always cover rotating and moving parts.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.
- When the equipment has been stored for an extended period of time, consult Mitsubishi.

(2) Wiring

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate.
- Do not install a power capacitor, surge absorber or radio noise filter (FR-BIF option) between the servo motor and servo amplifier.
- Connect the output terminals (U, V, W) correctly. Otherwise, the servo motor will operate improperly.
- Do not connect AC power directly to the servo motor. Otherwise, a fault may occur.
- The surge absorbing diode installed on the DC output signal relay must be wired in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



(3) Test run adjustment

⚠ CAUTION

- Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- The parameter settings must not be changed excessively. Operation will be instable.

(4) Usage

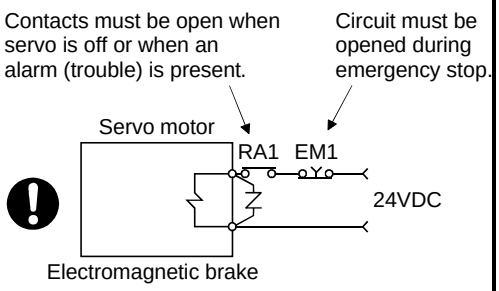
⚠ CAUTION

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- Any person who is involved in disassembly and repair should be fully competent to do the work.
- Before resetting an alarm, make sure that the run signal is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.
- Do not modify the equipment.
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo amplifier.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ballscrew and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may take place at the occur due to a power failure or a product fault, use a servo motor with electromagnetic brake or an external brake mechanism for the purpose of prevention.
- Configure the electromagnetic brake circuit so that it is activated not only by the servo amplifier signals but also by an external emergency stop signal.



- When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, before restarting operation.
- When power is restored after an instantaneous power failure, keep away from the machine because the machine may be restarted suddenly (design the machine so that it is secured against hazard if restarted).

(6) Maintenance, inspection and parts replacement

⚠ CAUTION
⚠ With age, the electrolytic capacitor will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment. Please consult our sales representative.

(7) Disposal

⚠ CAUTION
⚠ Dispose of the product as general industrial waste.

(8) General instruction

To illustrate details, the equipment in the diagrams of this Specifications and Installation Guide 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 Installation Guide.

COMPLIANCE WITH EC DIRECTIVES

1. WHAT ARE EC DIRECTIVES?

The EC Directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the Machinery Directive (effective in January, 1995), EMC Directive (effective in January, 1996) and Low Voltage Directive (effective in January, 1997) of the EC Directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies to machines and equipment into which servo amplifiers have been installed.

(1) EMC Directive

The EMC Directive applies to a machine/equipment which incorporates the servo, not to the servo alone. Hence, the EMC filter must be used to make this machine/equipment which incorporates the servo comply with the EMC Directive. For specific methods to comply with the EMC Directive, refer to the "EMC Installation Guidelines" (IB(NA)67310).

This servo has been approved by TUV, third-party evaluation organization, which confirmed that it can comply with the EMC Directive in the methods given in the "EMC Installation Guidelines".

(2) Low Voltage Directive

The Low Voltage Directive applies also to the servo alone. Therefore, our servo is designed to comply with the Low Voltage Directive.

This servo has been approved by TUV, third-party evaluation organization, which confirmed that it complies with the Low Voltage Directive.

(3) Machinery Directive

Since the servo amplifiers are not machines, they need not comply with this directive.

2. PRECAUTIONS FOR COMPLIANCE

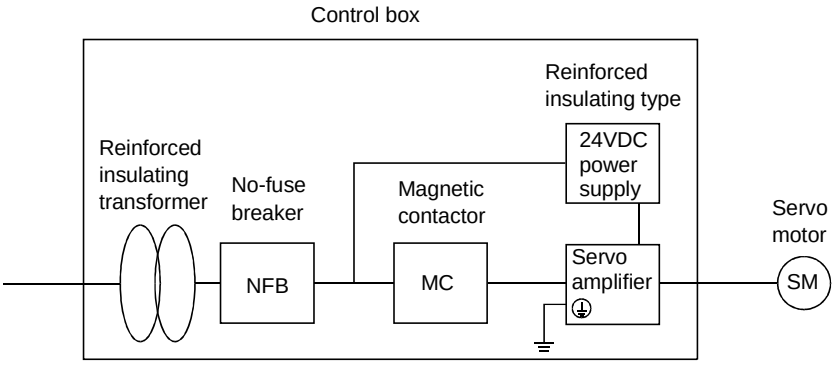
(1) Servo amplifiers and servo motors used

Use the following models of servo amplifiers and servo motors:

Servo amplifier series: MR-J2-10B to MR-J2-350B

Servo motor series : HC-FF□C-UE
HC-MF□-UE
HC-SF□
HC-RF□
HC-UF□

(2) Structure



(3) Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC664. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(4) Power supply

1) Operate the servo amplifier to meet the requirements of the overvoltage category II set forth in IEC664.
For this purpose, a reinforced insulating transformer conforming to the IEC or EN Standard should be used in the power input section.

2) When supplying interface power from external, use a 24VDC power supply which has been insulation-reinforced in I/O.

(5) Grounding

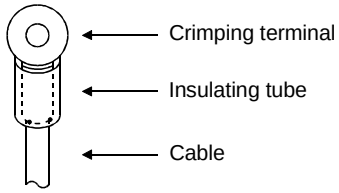
1) To prevent an electric shock, always connect the protective earth (PE) terminals (marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.

2) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect the cables to the terminals one-to-one.

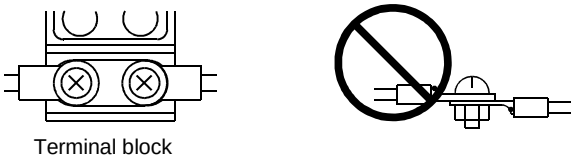
3) If a leakage current breaker is used to prevent an electric shock, the protective earth (PE) terminals of the servo amplifier must be connected to the corresponding earth terminals.

(6) Wiring

1) The cables to be connected to the terminal block of the servo amplifier must have crimping terminals provided with insulating tubes to prevent contact with adjacent terminals.



2) When the servo motor has a power supply lead, use a fixed terminal block to connect it with the servo amplifier. Do not connect cables directly.



(7) Auxiliary equipment and options

1) The no-fuse breaker and magnetic contactor used should be the EN or IEC Standard-compliant products of the models described in Section 6-2-1.

2) The sizes of the cables described in Section 6-2-1 meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in EN60204-1.
- Ambient temperature: 40 (104) [℃ (℉)]
- Sheath: PVC (polyvinyl chloride)
- Installed on wall surface or open table tray

3) When the EMC filter is used, the radio noise filter (FR-BIF) described in (5), Section 6-2-6 is not required.

(8) Servo motor

For outline dimension drawings not shown, contact Mitsubishi.

(9) Performing EMC tests

When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

For the other EMC Directive guidelines on the servo amplifier, refer to the "EMC INSTALLATION GUIDELINES(IB(NA)67310)".

CONFORMANCE WITH UL/C-UL STANDARD

(1) Servo amplifiers and servo motors used

Use the following models of servo amplifiers and servo motors:

Servo amplifier series: MR-J2-10B to MR-J2-350B

Servo motor series : HC-FF□C-UE
HC-MF□-UE
HC-SF□
HC-RF□
HC-UF□

(2) Installation

Install a fan of 100CFM air flow 10.16 cm (4 in) above the servo amplifier or provide cooling of at least equivalent capability.

(3) Short circuit rating

Having been subjected to UL tests in the alternating-current circuit whose peak current is limited to 5000A or less, this servo amplifier conforms to this circuit.

(4) Flange

Mount the servo motor on a flange which has the following size or produces an equivalent or higher heat dissipation effect:

Flange Size [mm]	Servo Motor				
	HC-MF□-UE	HA-FF□C-UE	HC-SF	HC-RF	HC-UF
150×150×6	053・13	053・13			13
250×250×6	23	23・33			23
250×250×12	43	43・63	81 52 to 152 53 to 153	103 to 203	43
300×300×12	73				73
300×300×20			121・201 202・352 203・353		
500×550×30					72・152
650×650×35			301		202

(5) Capacitor discharge time

The capacitor discharge time is as listed below. To ensure safety, do not touch the charging section for 10 minutes after power-off.

Servo Amplifier	Discharge Time [min]
MR-J2-10B・20B	1
MR-J2-40B・60B	2
MR-J2-70B to 350B	3

(6) Options and auxiliary equipment

Use products which conform to the UL/C-UL Standard.

CONTENTS

1. INTRODUCTION

1 - 1 Inspection at delivery

After unpacking, check the name plate to make sure that the servo amplifier and servo motor received are as ordered by the customer.

1 - 1 - 1 Packing list

1) Servo amplifier

Item	Qty
Servo amplifier	1
(Note) Control circuit connector	1
Specifications and installation guide	1

2) Servo motor

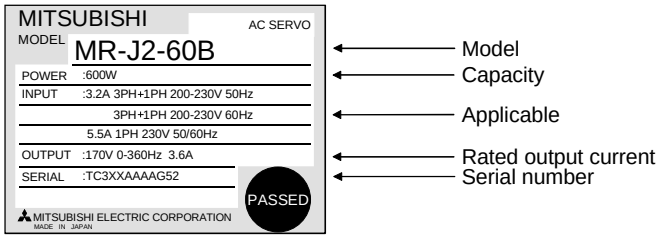
Item	Qty
Servo motor	1
Safety Instructions for Use of AC Servo	1

Note: Not supplied to the servo amplifier of MR-J2-200B or more.

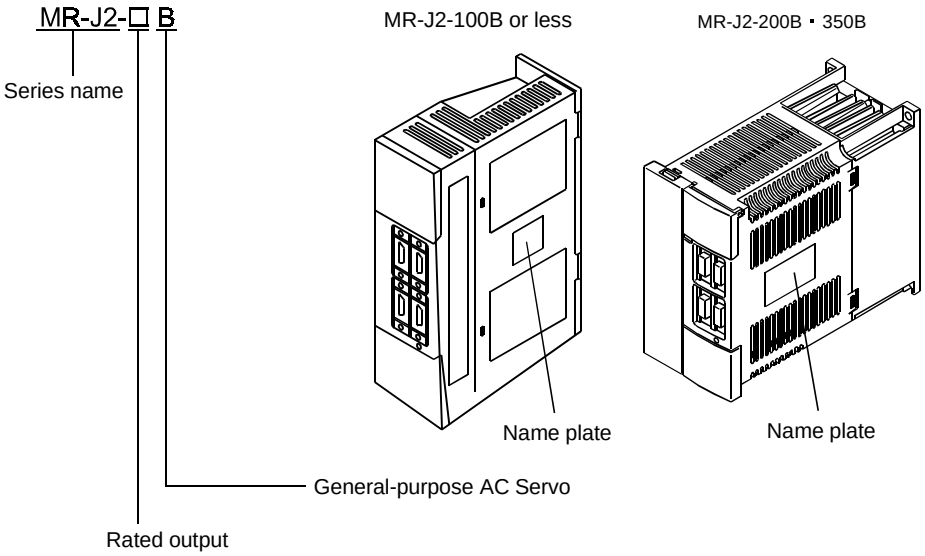
1 - 1 - 2 Model definition

(1) Servo amplifier

1) Name plate



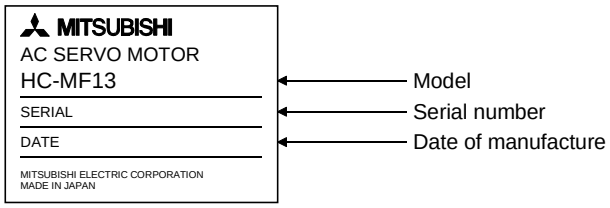
2) Model



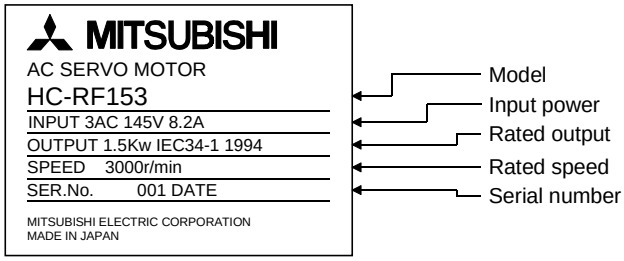
Symbol	Rated Output [W]	Symbol	Rated Output [W]
10	100	70	700
20	200	100	1000
40	400	200	2000
60	600	350	3500

(2) Servo motors

1) Name plate



or



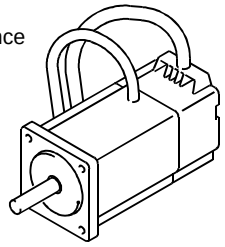
2) Model

a HC-MF series (ultra low inertia, small capacity)

HC-MF □ 3 □ □ □ □

Series name

Appearance



1) Compliance with Standard

Symbol	Specifications
None	Standard model (Japan)
-UE	EN • UL/C-UL Standard

2) Shaft type

Symbol	Shaft Shape	HC-MF□
None	Standard (Straight shaft)	053 to 73
K	(Note) With keyway	23 to 73
D	D-cut shaft	53 • 13

Note: With key

3) Reduction gear

Symbol	Reduction Gear
None	Without
G1	For general industrial machine
G2	For precision application

4) Electromagnetic brake

Symbol	Electromagnetic Brake
None	Without
B	With

5) Rated speed
3000 [r/min]

6) Rated output

Symbol	Rated Output [W]
05	50
1	100
2	200
4	400
7	750

b HA-FF series (low inertia, small capacity)

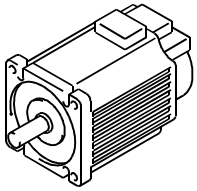
HA-FF □ 3 □ □ □ □ □

Series name

1) Compliance with Standard

Symbol	Specifications
None	Standard model (Japan)
-UE	EN · UL/C-UL Standard

Appearance



2) Shaft type

Symbol	Shaft Shape	HA-FF□
None	(Note) Standard	053 to 63
D	D-cut shaft	053 · 13

Note: The Standard shafts of the HA-FF23 to 63 are with keys and those of the other models are straight shafts.

3) Reduction gear

Symbol	Reduction Gear
None	Without
G1	For general industrial machine
G2	For precision application

4) Electromagnetic brake

Symbol	Electromagnetic Brake
None	Without
B	With

5) Input power supply form

Symbol	Standard model	EN · UL/C-UL Standard-compliant model
None	Lead	
C		Cannon connector

6) Rated speed
3000 [r/min]

7) Rated output

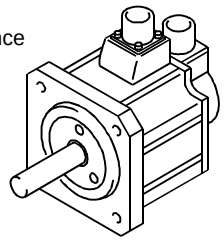
Symbol	Rated Output [W]	Symbol	Rated Output [W]
05	50	3	300
1	100	4	400
2	200	6	600

c HC-SF series (middle inertia, middle capacity)

HC-SF □ □ □ □ □

Series name

Appearance



1) Shaft type

Symbol	Shaft Shape
None	Standard (Straight shaft)
K	With keyway

Note: Without key

2) Reduction gear

Symbol	(Note) Reduction Gear
None	Without
G1	For general industrial machine (flange type)
G1H	For general industrial machine (leg type)
G2	For precision application

Note: Not provided for 1000r/min and 3000r/min series.

3) Electromagnetic brake

Symbol	Electromagnetic Brake
None	Without
B	With

4) Rated speed

Symbol	Speed [r/min]
1	1000
2	2000
3	3000

5) Rated output

Symbol	Rated Output [W]	1000 [r/min]	2000 [r/min]	3000 [r/min]
5	500		○	
8	850	○		
10	1000		○	○
12	1200	○		
15	1500		○	○
20	2000	○	○	○
30	3000	○		
35	3500		○	○
50	5000		○	
70	7000		○	

d HC-RF series (low inertia, middle capacity)

HC-RF □ 3 □ □ □

Series name

1) Shaft type

Symbol	Shaft Shape
None	Standard (Straight shaft)
K	With keyway

Note: Without key

2) Reduction gear

Symbol	Reduction Gear
None	Without
G2	For precision application

3) Electromagnetic brake

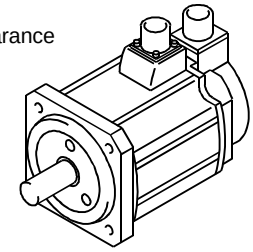
Symbol	Electromagnetic Brake
None	Without
B	With

4) Rated speed
3000 [r/min]

5) Rated output

Symbol	Rated Output [W]
10	1000
15	1500
20	2000
35	3500
50	5000

Appearance



e HC-UF series (pancake type small capacity)

HC-UF □ 3 □ □

Series name

1) Shaft type

Symbol	Shaft Shape	HC-UF□
None	Standard (Straight shaft)	13 to 43 72 to 202
K	(Note) With keyway	
D	D-cut shaft	13

Note: HC-UF 23 to 73 are provided with keys.

2) Electromagnetic brake

Symbol	Electromagnetic Brake
None	Without
B	With

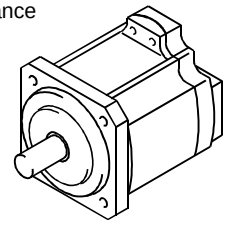
3) Rated speed

Symbol	Speed [r/min]
2	2000
3	3000

4) Rated output

Symbol	Rated Output [W]
1	100
2	200
4	400
7	750
15	1500
20	2000
35	3500
50	5000

Appearance



1 - 1 - 3 Combination with servo motor

The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the models with electromagnetic brakes, the models with reduction gears, the EN Standard-compliant models and the UL/C-UL Standard-compliant models.

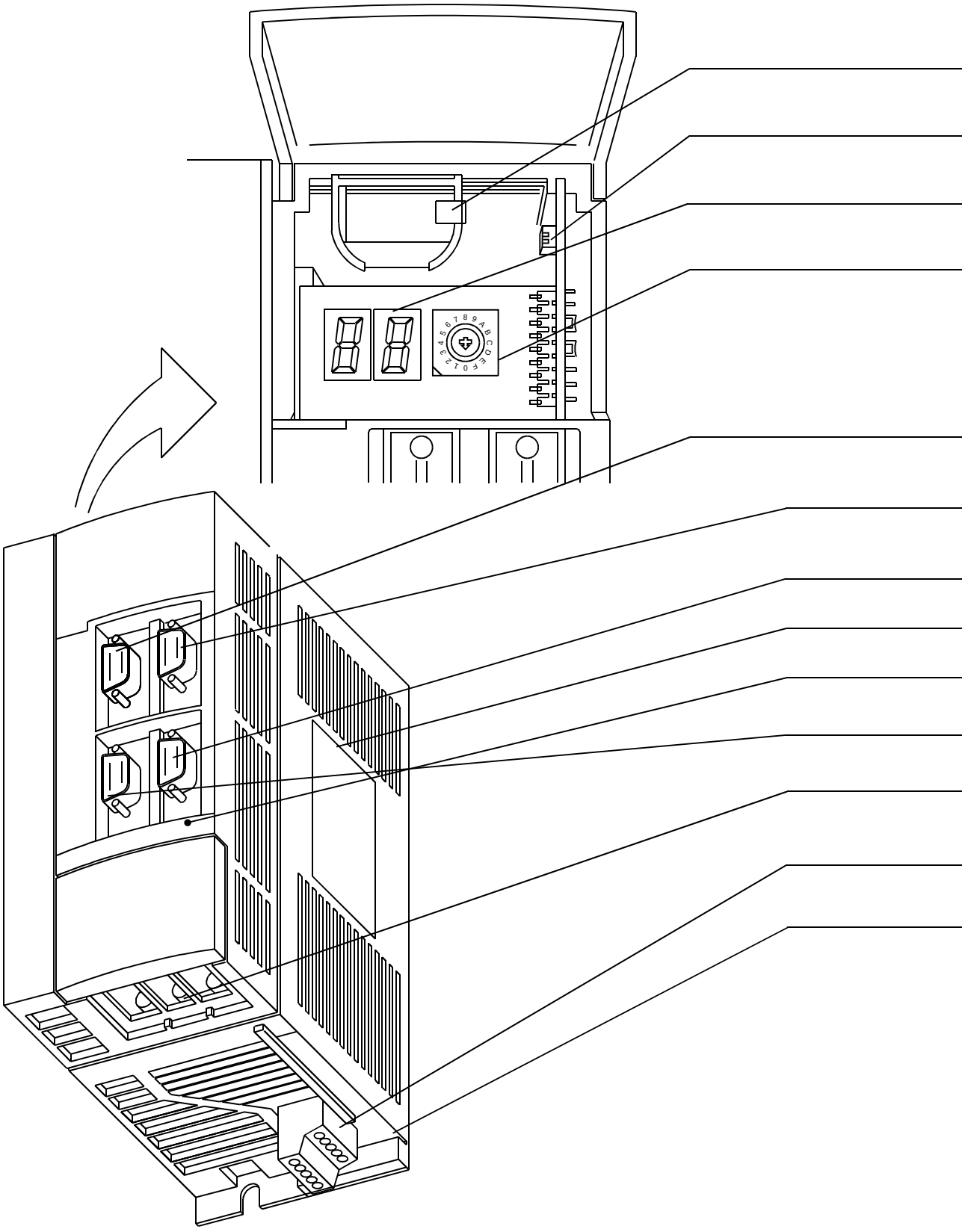
Servo Amplifier	Servo Motors							
	HC-MF□	HA-FF□	HC-SF□ (Note)			HC-RF□	HC-UF□ (Note)	
			1000r/min	2000r/min	3000r/min		2000r/min	3000r/min
MR-J2-10B	053・13	053・13						13
MR-J2-20B	23	23						23
MR-J2-40B	43	33・43						43
MR-J2-60B		63		52	53			
MR-J2-70B	73						72	73
MR-J2-100B			81	102	103			
MR-J2-200B			121・201	152・202	153・203	103・153	152	
MR-J2-350B			301	352	353	203	202	

Note. The HC-UF73, HC-SF203 and 353 may not be connected depending on the production timing of the servo amplifier. Please contact us.

1 - 2 Parts identification and applications

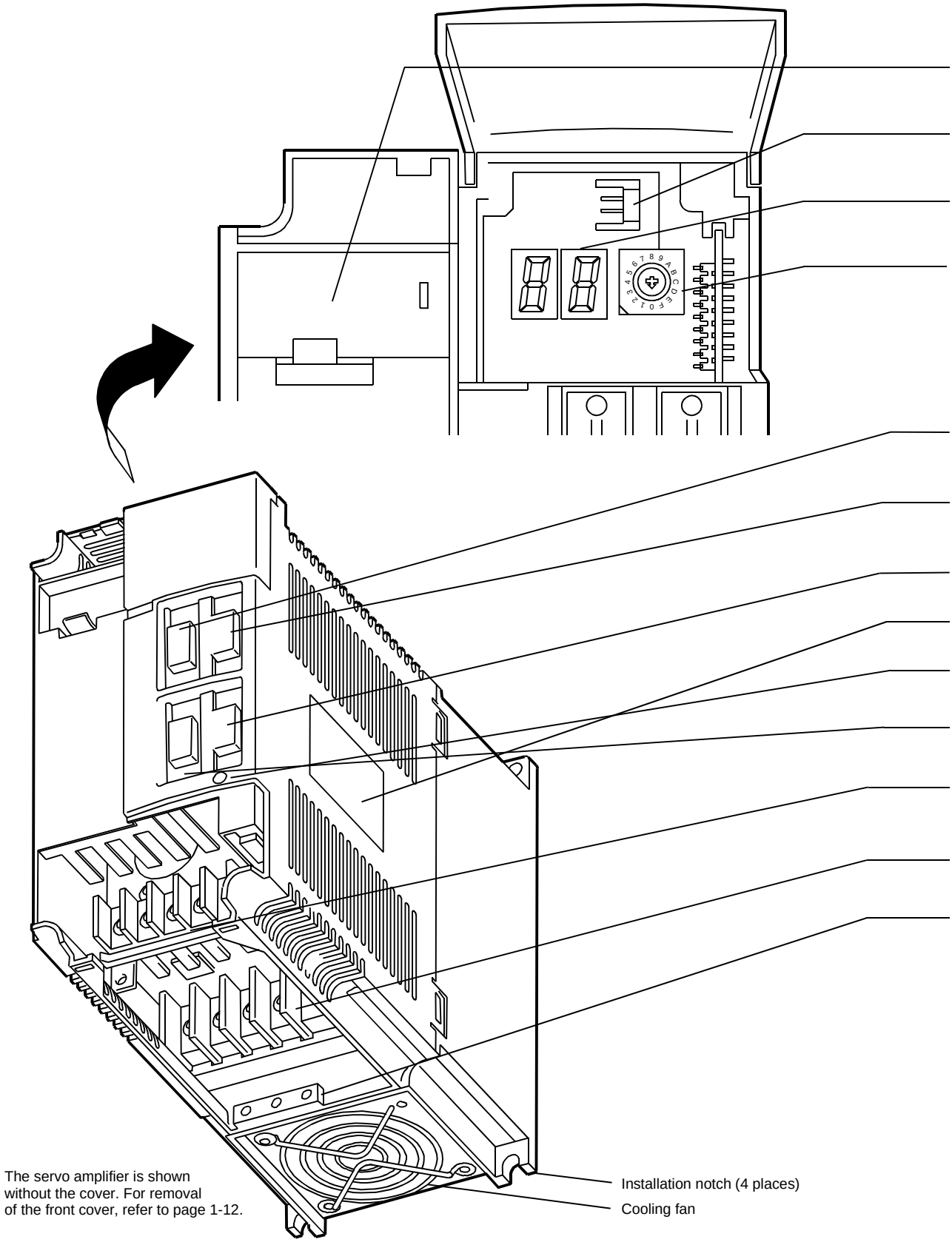
1 - 2 - 1 Servo amplifier

(1) MR-J2-200B or less



Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5(5)
Battery connector (CON1) Used to connect the battery for absolute position data backup.	Chapter 5(5) Section 6-2-8
Display The two-digit, seven-segment LED shows the servo status and alarm number.	Section 2-3
Axis select switch (CS1) CS1  Used to set the axis number of the servo amplifier.	Section 3-1-4
Bus cable connector (CN1A) Used to connect the servo system controller or preceding axis servo amplifier.	Section 3-1-2
Bus cable connector (CN1B) Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM).	Section 3-1-2
Communication connector (CN3) Used to connect a personal computer or output analog monitor.	Section 3-1-2 Section 6-1-4
Name plate	Section 1-1
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Encoder connector (CN2) Connector for connection of the servo motor encoder	Section 3-1-2
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section 3-1-1
Control circuit terminal block (TE2) Used to connect the control circuit power supply and regenerative brake option.	Section 3-1-1
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3-4

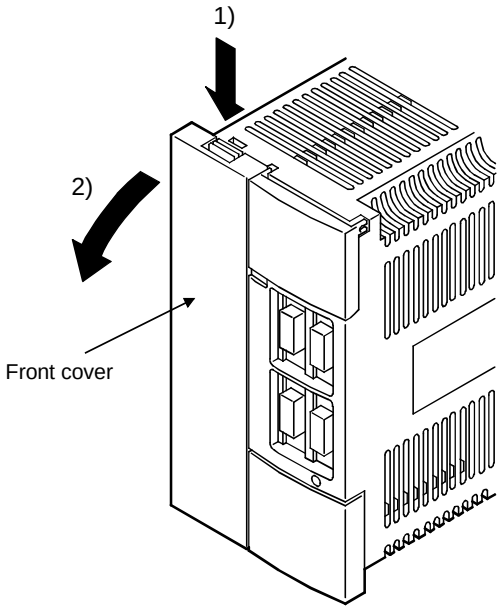
(2) MR-J2-200B or more



The servo amplifier is shown without the cover. For removal of the front cover, refer to page 1-12.

Name/Application	Refer To
Battery holder Contains the battery for absolute position data backup.	Chapter 5(5)
Battery connector (CON1) Used to connect the battery for absolute position data backup.	Chapter 5(5) Section 6-2-8
Display The four-digit, seven-segment LED shows the servo status and alarm number.	Section 2-3
Axis select switch (CS1) CS1  Used to set the axis number of the servo amplifier.	Section 3-1-4
Bus cable connector (CN1A) Used to connect the servo system controller or preceding axis servo amplifier.	Section 3-1-2
Bus cable connector (CN1B) Used to connect the subsequent axis servo amplifier or termination connector (MR-A-TM).	Section 3-1-2
Communication connector (CN3) Used to connect a personal computer or output analog monitor.	Section 3-1-2 Section 6-1-4
Name plate	Section 1-1
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Encoder connector (CN2) Connector for connection of the servo motor encoder	Section 3-1-2
Control circuit terminal block (TE2) Used to connect the control circuit power supply and regenerative brake option.Control circuit terminal	Section 3-1-1
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section 3-1-1
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3-4

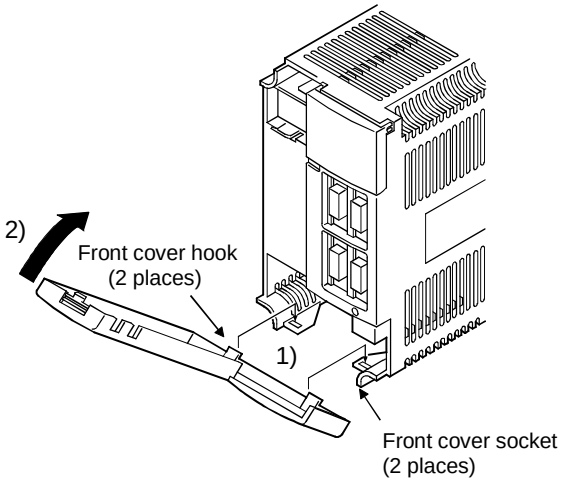
Removal of the front cover



1) Hold down the removing knob.

2) Pull the front cover toward you.

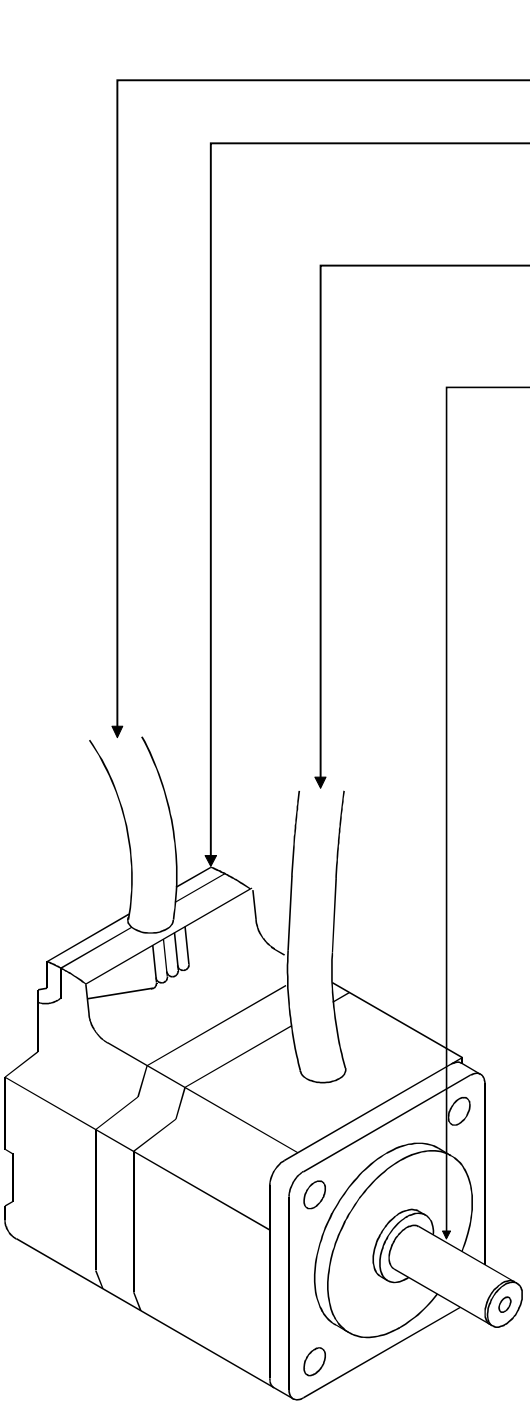
Reinstallation of the front cover



1) Insert the front cover hooks into the front cover sockets of the servo amplifier.

2) Press the front cover against the servo amplifier until the removing knob clicks.

1 - 2 - 2 Servo motor



Name/Application	Refer To
Encoder cable Encoder connector for HC-SF/HC-RF	Section 6-1-2
Encoder	Section 3-2 Section 10-1
Power cable ・Power leads (U, V, W) ・Earth lead ・Brake lead (For motor with electromagnetic brake) Power supply connector for HC-SF/HC-RF	Section 3-2
Servo motor shaft	Section 4-2 (4) Section 10-4

1 - 3 Function list

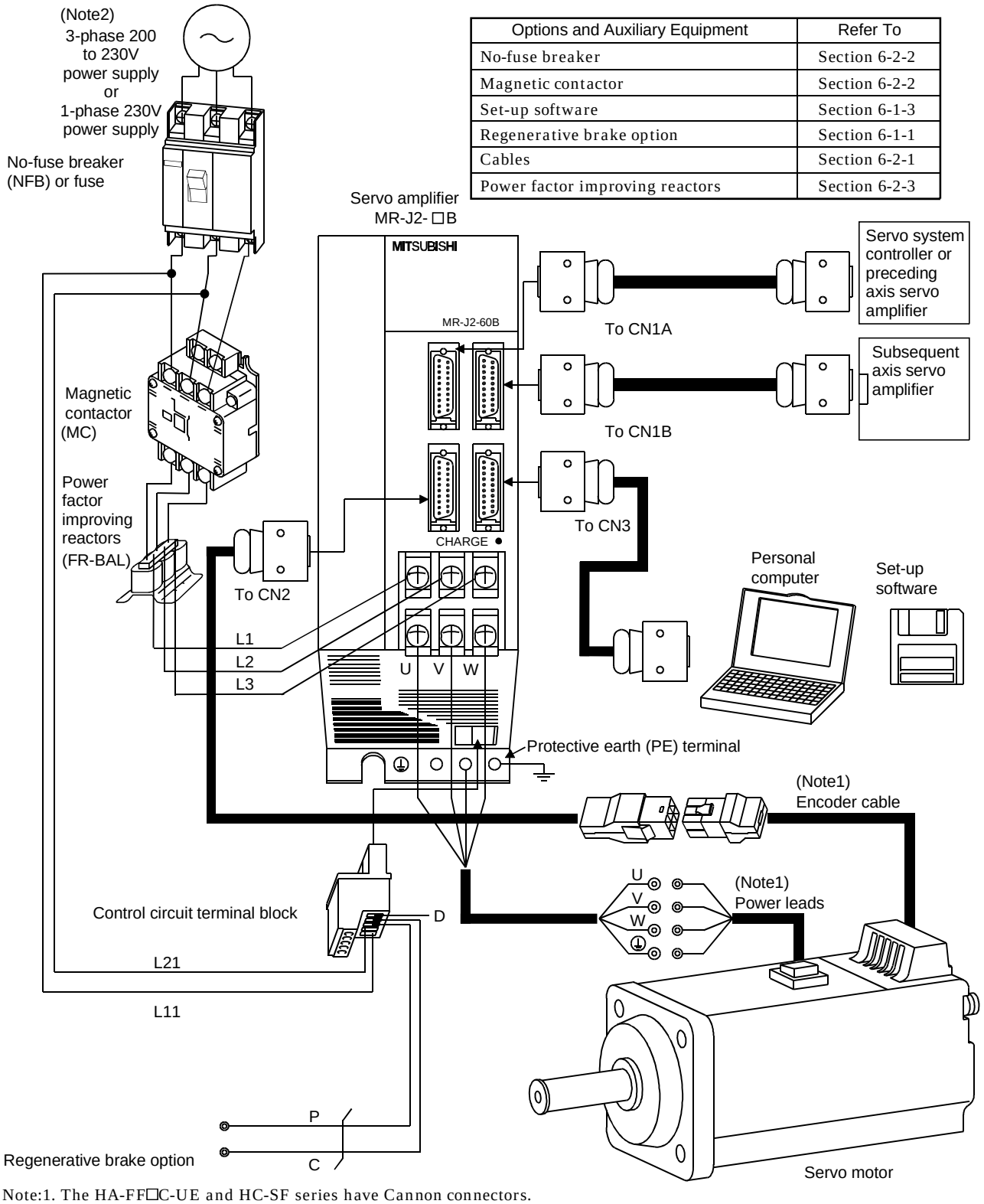
Function	Description	Refer To
Absolute position detection system	Return to home position is not required at each power on after it has been made once.	Chapter 5
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	Section 2-6-3
Real-time auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	Parameter No.8, 9
Analog monitor output	Servo status is output in terms of voltage in real time.	Parameter No.22
External emergency stop signal automatic ON	External emergency stop signal (EM1) can be automatically switched on internally to invalidate it.	Parameter No.23
Output signal forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	Section 2-5
Test operation mode	Servo motor can be run from the operation section of the servo amplifier without the start signal entered.	Section 2-5
Regenerative brake option	Used when the built-in regenerative brake resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	Section 6-1-1
Set-up software	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	Section 6-1-4

1 - 4 Basic configuration

> **⚠ WARNING** To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.

(1) MR-J2-100B or less

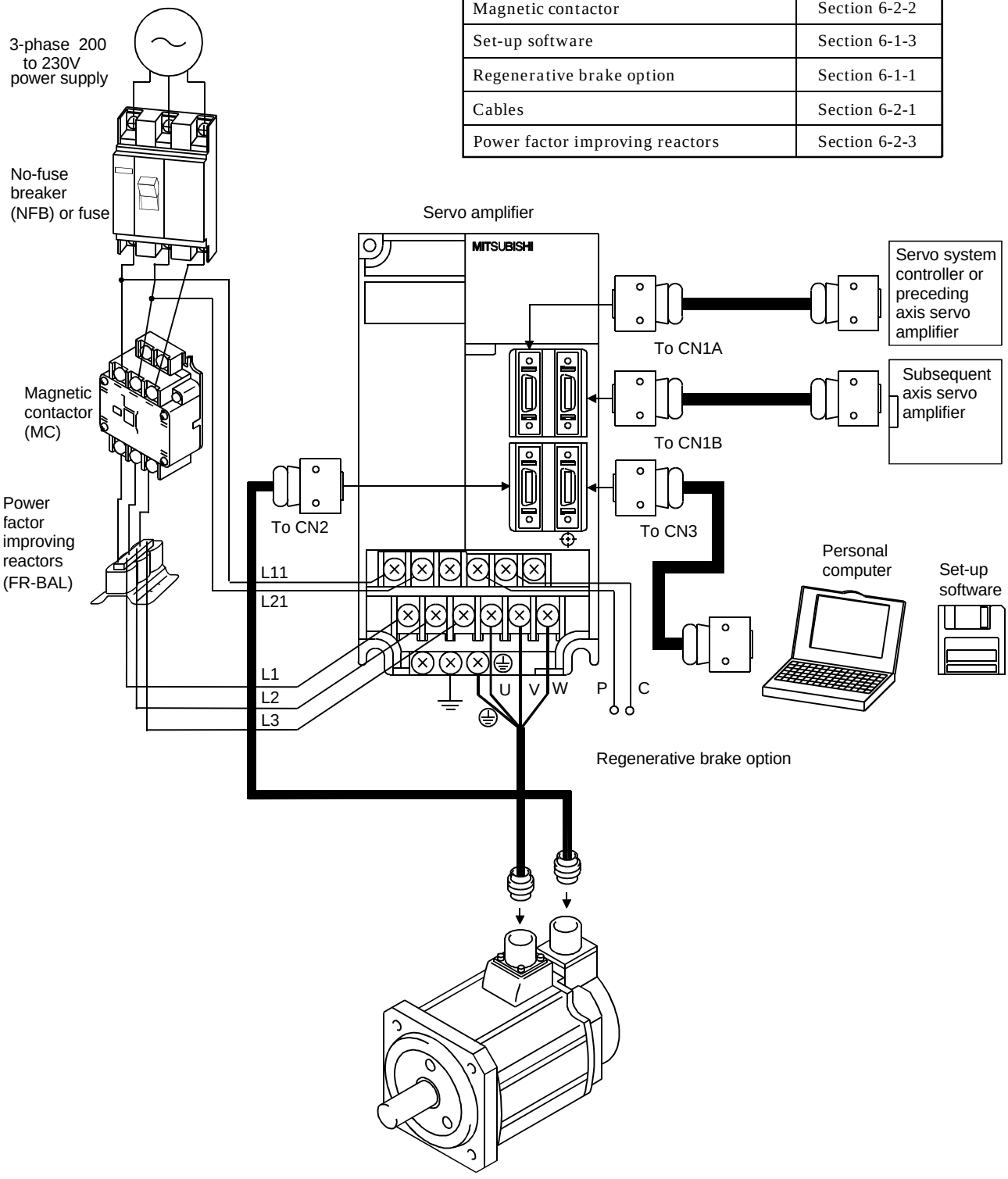
Options and Auxiliary Equipment	Refer To
No-fuse breaker	Section 6-2-2
Magnetic contactor	Section 6-2-2
Set-up software	Section 6-1-3
Regenerative brake option	Section 6-1-1
Cables	Section 6-2-1
Power factor improving reactors	Section 6-2-3



Note:1. The HA-FF□C-UE and HC-SF series have Cannon connectors.
2. A single-phase 230V power supply may be used with the servo amplifier of MR-J2-70B or less. Connect the power supply to L1 and L2 terminals and leave L3 open.

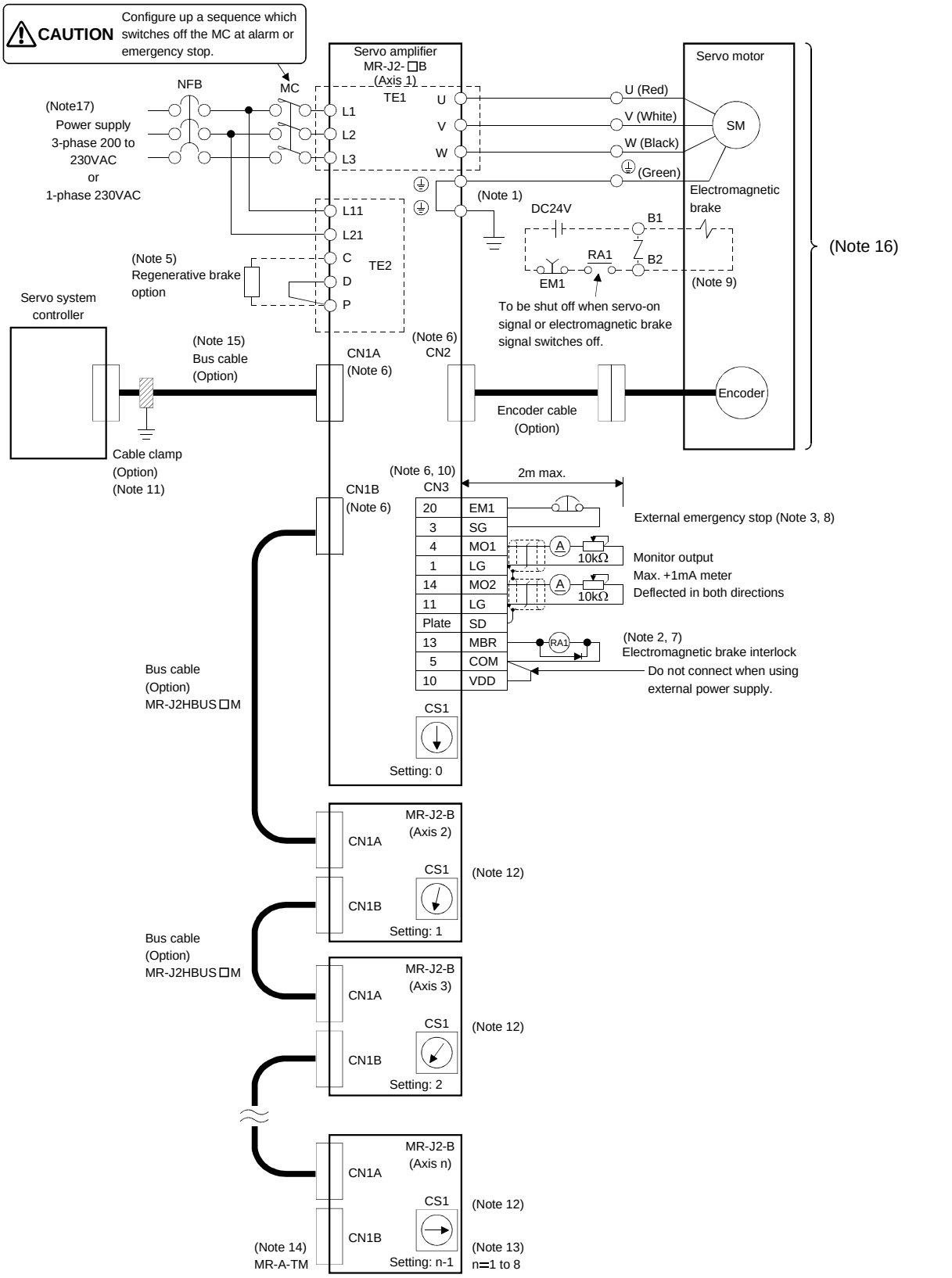
(2) MR-J2-200B or more

Options and Auxiliary Equipment	Refer To
No-fuse breaker	Section 6-2-2
Magnetic contactor	Section 6-2-2
Set-up software	Section 6-1-3
Regenerative brake option	Section 6-1-1
Cables	Section 6-2-1
Power factor improving reactors	Section 6-2-3



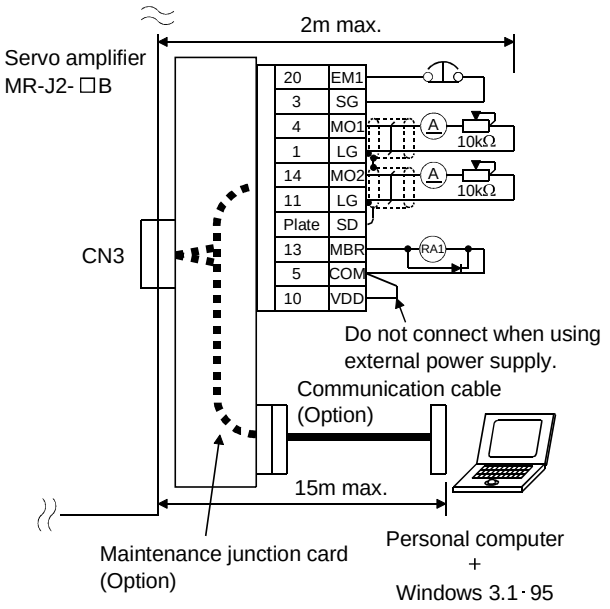
2 - 1 Standard connection example

CAUTION Always follow the instructions in Chapter 3.



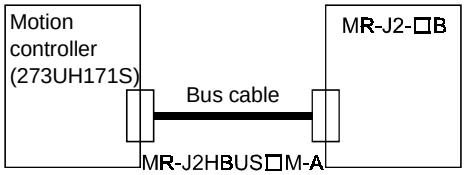
For notes, refer to the next page.

(Note 4) When using a personal computer during operation, always use the maintenance junction card.

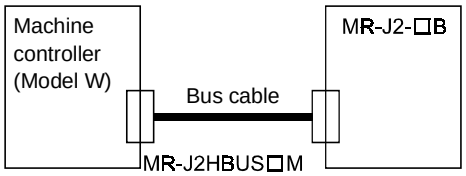


(Note 15)

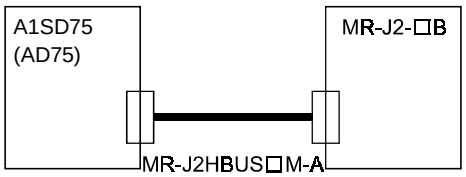
・Connection with motion controller



・Connection with machine controller



・Connection with A1SD75 (AD75)



⚠WARNING

Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.

⚠CAUTION

Note:2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.

3. Install the emergency stop switch as required.

4. When a personal computer is connected for use of the test operation mode, always use the maintenance junction card (MR-J2CN3TM) to enable the use of the external emergency stop (EM1).

NOTICE

Note:5. When using the regenerative brake option, always remove the lead from across D-P.

6. CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault.

7. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external.

MEMO
RANDUM

Note:8. When starting operation, always connect the external emergency stop (EM1) and SG. (Normally closed contacts) By setting 0001 in parameter No. 23, the external emergency stop signal can be made invalid.
9. Applies to the servo motor with electromagnetic brake.
10. The personal computer and monitor outputs 1, 2 cannot be connected together.
11. Total length of the bus cables used should be within 30m. To improve noise immunity, it is recommended to use a cable clamp or data line filters (3 or 4 pcs. connected in series) near the connector lead-out.
12. The wiring for the second and subsequent axes is omitted.
13. Up to 8 axes may be connected in the same system.
14. Always fit the termination connector (MR-A-TM) to CN1B of the last servo amplifier.
15. The bus cables used depend on the servo system controller to be connected.
16. The connection method depends on the servo motor series. Refer to Section 3-2-2.
17. A single-phase 230V power supply may be used with the servo amplifier of MR-J2-70B or less. Connect the power supply to L1 and L2 terminals and leave L3 open.

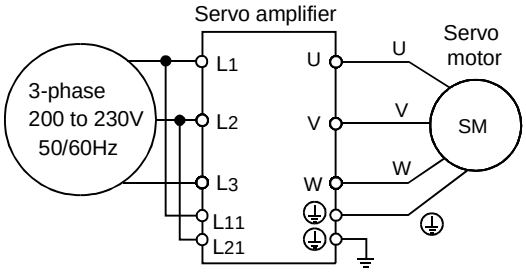
2 - 2 Operation

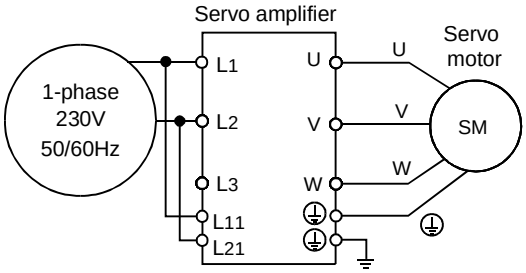
2 - 2- 1 Pre-operation checks

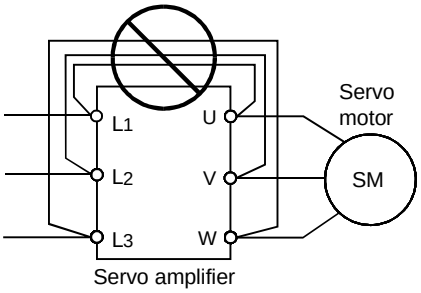
Before starting operation, check the following:

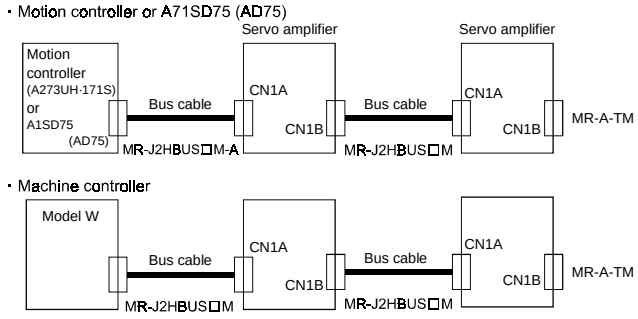
(1) Wiring

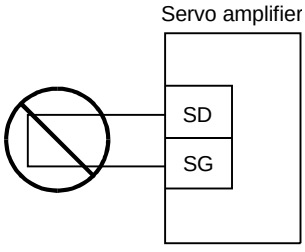
1) A correct power supply is connected to the power input terminals (L1, L2, L3, L11, L21) of the servo amplifier.
2) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W) of the servo motor.
3) The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals (L1, L2, L3).
4) The servo amplifier and servo motor are grounded securely.
5) When the regenerative brake option is used, the lead has been removed across D-P of the control circuit terminal block. Also, twisted cables are used for its wiring.
6) 24VDC or higher voltages are not applied to the pins of connectors CN3.
7) SD and SG of connectors CN3 are not shorted.
8) The wiring cables are free from excessive force.
9) CN1A should be connected with the bus cable connected to the controller or preceding axis servo amplifier, and CN1B should connected with the bus cable connected to the subsequent axis servo amplifier or with the termination connector MR-A-TM.











(2) Axis number

The axis number setting of CS1 should be the same as that of the servo system controller. (Refer to 3 - 1 -4)

(3) Parameters

On the servo system controller screen or using the set-up software, make sure that correct values have been set in the parameters.

(4) Environment

Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

(5) Machine

1) The screws in the servo motor installation part and shaft-to-machine connection are tight.
2) The servo motor and the machine connected with the servo motor can be operated.

2 - 2 - 2 Power on

By switching on the main circuit/control circuit power, the display as shown on the right is provided and the servo amplifier enters a servo on state. If the servo system controller is not switched on, the servo amplifier cannot go into the servo on state. If an alarm or warning occurs, refer to Chapter 8 and remove its cause.

Display
(For axis No. 1)

For the absolute position detection system

1) When power is switched on for the first time, the absolute position erasure (25) alarm occurs and the servo cannot be switched on but this is not a fault. Reset the alarm in the following procedure:
   a. Keep power on for a few minutes in the alarm status.
   b. Switch power off once, then switch it on again.
   If the alarm still persists, repeat steps a and b.

2) A position shift or other fault may occur if you switch on the servo amplifier or servo system controller power or reset the CPU while the servo motor is running at 500r/min or higher. During a stop, use brakes or the like to keep the servo motor stopped.

2 - 2 - 3 Stop

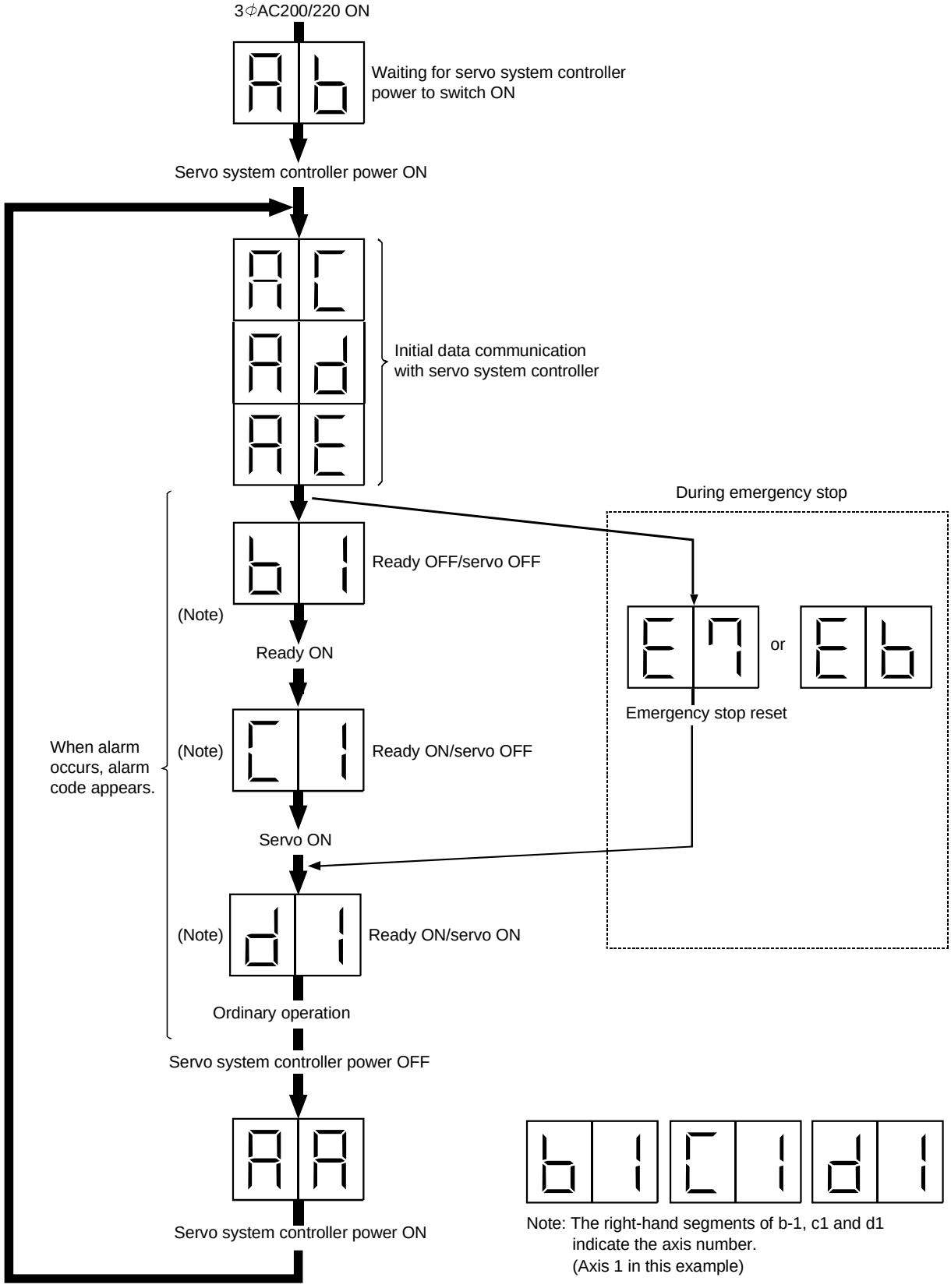
When any of the following conditions occurs, the servo amplifier suspends operation and comes to a stop. When the servo motor with electromagnetic brake is used, the motor is braked by the following operation/command. (Refer to Section 3-7):

	Operation/Command	Stopping State
Servo system controller	Servo off command	The base circuit is shut off and the servo motor coasts.
	Emergency stop command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a sudden stop. E7 appears on the servo amplifier display.
Servo amplifier	Alarm occurrence	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a sudden stop.
	Emergency stop signal OFF (EM1)	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a sudden stop. E6 appears on the servo amplifier display.

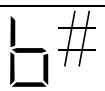
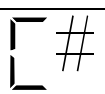
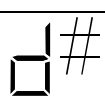
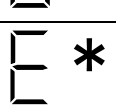
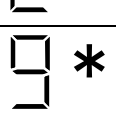
MEMO RANDUM	A sudden stop indicates that a stop is made with the droop pulses erased.

2 - 3 Display

Use the display (2-digit, 7-segment display) to view the communication condition with the servo system controller at power on, confirm numbers, and diagnose a fault at alarm occurrence.



Indication list

Indication	State	Description
	Initializing	Servo system controller power is off after the servo amplifier power has been switched on.
	Initializing	Servo system controller power was switched off while the servo amplifier power was on. (Note 4)
	Initializing	Communication between servo system controller and servo amplifier started.
	Initializing	Initial parameters were received.
	Initialized	
(Note 1) 	Ready off	Ready off command was received.
(Note 1) 	Servo off	Servo off command was received.
(Note 1) 	Servo on	Servo on command was received.
(Note 2) 	Warning	Warning number which occurred is shown.
(Note 2) 		
(Note 3) 	Alarm	Alarm number which occurred is shown.
	CPU error	
	(Note 5) Test operation mode	Jog operation, positioning operation, programmed operation, DO forced output
(Note 1) 		Motor-less operation

Note:1. # : Axis number (1 to 8: Axis number, 0: Test operation mode)

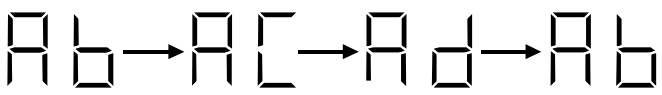
2. * : Warning number

3. ** : Alarm number

4. If Ab remains shown after the servo system controller power is switched on, possible causes are as follows:

1) The axis number set to the servo system controller is not the same as the axis number set with SW1 of the servo amplifier.

2) PWB fault in the servo amplifier or communication fault with the servo system controller. In this case, indications change as follows:



3) Bus cable fault

4) Servo system controller failure

5. Requires the set-up software.

2 - 4 Parameters

(1) Parameter list

Change the parameter settings as required when using the regenerative option or when adjusting the gains, for example.

Set the parameter values with the servo system controller or the personal computer which uses the set-up software MRZJW3-SETUP41E or later.

When the servo system controller is connected, all parameter settings are the values set with the servo system controller and the values set on the servo amplifier side are invalid.

When using the set-up software to change the adjustment/extension parameter settings, set 000E in parameter No. 40.

When changing the parameter settings from the servo system controller, the parameter No. 40 value need not be set. Among the parameters given in this section, some may not be set to some servo system controllers.

Parameter No. 40 Setting

Setting	Reference/Write Using Servo System Controller	Reference/Write Using Set-Up Software
0000 (Initial value)	No.1 to 39	No.1 to 11・40
000A	No.1 to 39	No.40
000E	No.1 to 39	No.1 to 40

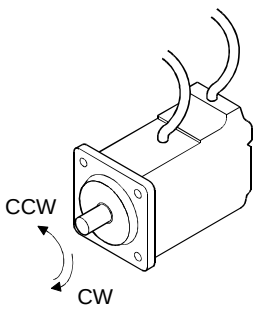
The initial values of the manufacturer setting parameters must not be changed.

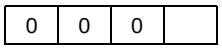
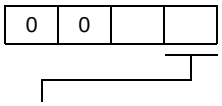
For the parameters whose codes are marked *, set their values, switch power off once, then switch it on again to make them valid.

	No.	Code	Name and Function	Initial Value	Unit	Customer Setting
Basic parameters	1	*AMS	Amplifier setting	0000		
	2	*REG	Regenerative brake resistor	0000		
	3		For manufacturer setting	0080		
	4		For manufacturer setting	0		
	5		For manufacturer setting	1		
	6		For manufacturer setting	0		
	7	*POL	Motor rotation direction	0		
	8	ATU	Auto tuning	0001		
	9	RSP	Servo response setting	0001		
	10	TLP	Forward rotation torque limit	300	%	
	11	TLN	Reverse rotation torque limit	300	%	
Adjustment parameters	12	GD2	Ratio of load inertia to servo motor inertia (load inertia)	70	0.1 times	
	13	PG1	Position control gain 1	70	rad/s	
	14	VG1	Speed control gain 1	1200	rad/s	
	15	PG2	Position control gain 2	25	rad/s	
	16	VG2	Speed control gain 2	600	rad/s	
	17	VIC	Speed integral compensation	20	ms	
	18	NCH	Machine resonance suppression filter	0	%	
	19	FFC	Feed forward gain	0	pulse	
	20	INP	In-position range	100	ms	
	21	MBR	Electromagnetic brake sequence output	100		
	22	MOD	Monitor output mode	0001		
	23	*OP1	Optional function 1	0000		
	24	*OP2	Optional function 2	0000		
	25		For manufacturer setting	0000		
	26		For manufacturer setting	0000		
Extension parameters	27	MO1	Monitor output 1 offset	0	mv	
	28	MO2	Monitor output 2 offset	0	mv	
	29	MOA	For manufacturer setting	0001		
	30	ZSP	Zero speed	50	r/min	
	31	ERZ	Error excessive alarm level	80	kpulse	
	32	OP5	Optional function 5	0000		
	33	OP6	For manufacturer setting	0000		
	34	VPI	PI-PID switch-over position droop	0	pulse	
	35	TTT	For manufacturer setting	0		
	36	VDC	Speed differential compensation	980		
	37		For manufacturer setting	0		
	38		For manufacturer setting	0		
	39		For manufacturer setting	0		
	40	*BLK	Parameter block	0000		

(2) Detailed explanation of the parameters

To make the * marked parameter valid, set its value and switch power off once, then switch it on again.

Class	No.	Code	Name and Function	Initial Value	Unit	Setting Range
Basic parameters	1	*AMS	Amplifier setting: Used to select the absolute position detection system. 0 0 0 [ ] Positioning system 0: Used in incremental system. 1: Used in absolute position detection system.	0000		0000h to 0001h
	2	*REG	Regenerative brake resistor: Used to select the regenerative brake option used. 0 0 [ ] [ ] Selection of regenerative brake option 00: Not used 05: MR-RB32 08: MR-RB30 09: MR-RB50 10: MR-RB032 11: MR-RB12 NOTICE Wrong setting may cause the regenerative brake option to burn. MEMO RANDUM If the regenerative brake option selected is not for use with the servo amplifier, parameter error (37) occurs.	0000		0000h to 0011h
	3		For manufacturer setting Must not be changed.	0080		
	4		For manufacturer setting Must not be changed.	0		
	5		For manufacturer setting Must not be changed.	1		
	6		For manufacturer setting Must not be changed.	0		
	7	*POL	Motor rotation direction setting: Used to set the rotation direction of the servo motor. 0: Forward rotation (CCW) with the increase of positioning address 1: Reverse rotation (CW) with the increase of positioning address  	0		0, 1

<table>
<tr><th>Class</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td rowspan="4">Basic parameters</td><td>8</td><td>ATU</td><td>Auto tuning:
Used to select auto tuning.
 
</td><td>0001</td><td></td><td>0000h
to
0002h</td></tr>
<tr><td>9</td><td>RSP</td><td>Servo response setting:
Used to set the response of auto tuning.
 

Optimum response can be selected according to the rigidity of the machine. As machine rigidity is higher, faster response can be set to improve tracking performance in response to a command and to reduce settling time. When changing the setting, look at the vibration and stop settling of the servo motor and machine immediately before they stop and during their stop, and always increase the setting in sequence, beginning with the slower response.

<table>
<tr><th rowspan="2">Machine Type</th><th rowspan="2">Setting</th><th colspan="3">Description</th><th rowspan="2">Guideline for Position Settling Time
GDL^2/GDM^2 guideline = within 5 times</th></tr>
<tr><th>Response</th><th>Guideline for corresponding machine rigidity</th><th>GDL^2/GDM^2 guideline for load inertia</th></tr>
<tr><td rowspan="5">Normal</td><td rowspan="5">1
2
3
4
5</td><td rowspan="5">Low response

Middle response

High response</td><td rowspan="5">Low rigidity
to
Medium rigidity
to
High rigidity</td><td rowspan="10">1 to 10 times</td><td>50 to 300ms</td></tr>
<tr><td>10 to 70ms</td></tr>
<tr><td>10 to 30ms</td></tr>
<tr><td rowspan="5">Large friction</td><td rowspan="5">8
9
A
B
C</td><td rowspan="5">Low response

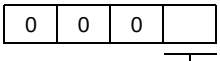
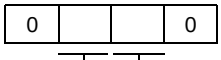
Middle response

High response</td><td rowspan="5">Low rigidity
to
Medium rigidity
to
High rigidity</td><td>70 to 400ms</td></tr>
<tr><td>10 to 100ms</td></tr>
<tr><td>10 to 50ms</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>TLP</td><td>Forward rotation torque limit:
Assume that the rated torque is 100[%]. Set this parameter to limit the torque generated in the forward rotation driving mode/reverse rotation regenerative mode.</td><td>300</td><td>%</td><td>0 to 500</td></tr>
<tr><td>11</td><td>TLN</td><td>Reverse rotation torque limit:
Assume that the rated torque is 100[%]. Set this parameter to limit the torque generated in the reverse rotation driving mode/forward rotation regenerative mode.</td><td>300</td><td>%</td><td>0 to 500</td></tr>
</table>

<table>
<tr><th>Class</th><th>No.</th><th>Code</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th></tr>
<tr><td rowspan="7">Adjustment parameters</td><td>12</td><td>GD2</td><td>Ratio of load inertia to servo motor inertia (load inertia):
Used to set the ratio of load inertia to servo motor inertia.</td><td>70</td><td>0.1 times</td><td>0 to 1000</td></tr>
<tr><td>13</td><td>PG1</td><td>Position control gain 1:
Used to set the gain of position loop 1.Increase the gain to improve trackability performance in response to the position command.</td><td>70</td><td>rad/s</td><td>4 to 1000</td></tr>
<tr><td>14</td><td>VG1</td><td>Speed control gain 1:
Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise.</td><td>1200</td><td>rad/s</td><td>20 to 5000</td></tr>
<tr><td>15</td><td>PG2</td><td>Position control gain 2:
Used to set the gain of the position loop.
Set this parameter to increase position response to load disturbance.
Higher setting increases the response level but is liable to generate vibration and/or noise.</td><td>25</td><td>rad/s</td><td>1 to 500</td></tr>
<tr><td>16</td><td>VG2</td><td>Speed control gain 2:
Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise.</td><td>600</td><td>rad/s</td><td>20 to 8000</td></tr>
<tr><td>17</td><td>VIC</td><td>Speed integral compensation:
Used to set the constant of integral compensation.</td><td>20</td><td>ms</td><td>1 to 1000</td></tr>
<tr><td>18</td><td>NCH</td><td>Machine resonance suppression filter:
Used to set the frequency that matches the resonance frequency of the mechanical system. (Refer to Section 2.6.2.)

<table><tr><th>Setting</th><th>Machine Resonance Suppression Frequency [Hz]</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>1</td><td>1125</td></tr><tr><td>2</td><td>563</td></tr><tr><td>3</td><td>375</td></tr><tr><td>4</td><td>282</td></tr><tr><td>5</td><td>225</td></tr><tr><td>6</td><td>188</td></tr><tr><td>7</td><td>161</td></tr></table></td><td>0</td><td></td><td>0 to 7</td></tr>
</table>

Class	No.	Code	Name and Function	Initial Value	Unit	Setting Range
Adjustment parameters	19	FFC	Feed forward gain: By setting 100% for constant-speed operation, droop pulses will not be generated. Note that sudden acceleration/deceleration will increase overshoot. (As a guideline, acceleration/deceleration time to/from the rated speed is 1s or longer when the set value is 100.) MEMO RANDUM: When setting this parameter, always set auto tuning to "No"(parameter No. 8).	0	%	0 to 100
	20	INP	In-position range: Used to set the droop pulse range in which the in-position signal will be output to the servo system controller.	100	pulse	0 to 10000
	21	MBR	Electromagnetic brake sequence output: Used to set the delay time from when the electromagnetic brake interlock signal (MBR) switches off until the base circuit is shut off.	100	ms	0 to 1000
	22	MOD	Monitor output mode: Used to set the signal output for analog monitor. 0 [ ] 0 [ ] Analog monitor CH2 output selection. The set values and their definitions are as in analog monitor CH1. Analog monitor CH1 output selection. 0: Servo motor speed (±8V/max. speed) 1: Torque (±8V/max. torque) 2: Servo motor speed (+8V/max. speed) 3: Torque (+8V/max. torque) 4: Current command output (±8V/max. command current) 5: Command pulse frequency (±8/400kpps) 6: Droop pulses 1/1 (±10V/128 pulse) 7: Droop pulses 1/16 (±10V/2048 pulse) 8: Droop pulses 1/64 (±10V/8192 pulse) 9: Droop pulses 1/256 (±10V/32768 pulse) A: Droop pulses 1/1024 (±10V/131072 pulse)	0001		0000h to 0A0A

Class	No.	Code	Name and Function	Initial Value	Unit	Setting Range
Adjustment parameters	23	*OP1	Optional function 1: Used to make the external emergency stop signal (EM1) invalid.  External emergency stop signal (EM1) 0: Used 1: Not used (Automatically switched on internally)	0000		0000h to 0001h
	24	*OP2	Optional function 2: Used to select slight vibration suppression control and motor-less operation.  Slight vibration suppression control Used to suppress vibration at a stop. 0: Invalid 1: Valid Selection of motor-less operation 0: Invalid 1: Makes motor-less operation valid. When motor-less operation is made valid, signal output or status display can be provided as if the servo motor is running actually in response to the servo system controller command, without the servo motor being connected. Motor-less operation is performed as in the motor-less operation using the set-up software. (Refer to section 2.5, (1) Motor-less operation.)	0000		0000h to 0110h
	25		For manufacturer setting Must not be changed.	0000		
	26		For manufacturer setting Must not be changed.	0000		
	27	MO1	Analog monitor 1 offset: Used to set the offset value of the monitor 1 output.	0	mv	−999 to 999
	28	MO2	Analog monitor 2 offset: Used to set the offset value of the monitor 2 output.	0	mv	−999 to 999
	29	MOA	For manufacturer setting Must not be changed.	0001		

Class	No.	Code	Name and Function	Initial Value	Unit	Setting Range
Extension parameters	30	ZSP	Zero speed: Used to set the output range of the zero speed signal (ZSP).	50	r/min	0 to 10000
	31	ERZ	Error excessive alarm level: Used to set the output range of the error excessive alarm (52).	80	kpulse	1 to 1000
	32	OP5	Optional function 5: Used to select PI-PID control switch-over. 0 0 0 [ ] PI-PID control switch-over 0: Invalid (PI control invalid) 1: PI control is switched over to PID control when the droop value reduced to or below the value set in parameter No.34 in the position control mode. 2: Normally PID control	0000		0000h to 0002h
	33	OP6	For manufacturer setting Must not be changed.	0000		
	34	VPI	PI-PID control switch-over position droop: Used to set the position droop value (number of pulses) at which PI control is switched over to PID control. Set 0001 in parameter No. 32 to make this function valid.	0	pulse	0 to 50000
	35		For manufacturer setting Must not be changed.	0		
	36	VDC	Speed differential compensation: Used to set the differential compensation value.	980		0 to 1000
	37		For manufacturer setting Must not be changed.	0		
	38 39		For manufacturer setting Must not be changed.	0		
	40	*BLK	Parameter blocks: Used to select the reference and write ranges of the parameters. Reference and write ranges	0000		0000h to 000Eh

Setting	Operation from Controller	Operation from Set-Up Software
0000	Parameter No. 1 to 39	Parameter No. 1 to 11,40
000A	Parameter No. 1 to 39	Parameter No. 40
000E	Parameter No. 1 to 39	Parameter No. 1 to 40

2 - 5 Test operation mode

> **CAUTION**
>
> 1. The test operation mode is designed for servo operation confirmation and not for machine operation confirmation. Do not use this mode with the machine. Always use it with the servo motor alone.
> 2. If an operation fault occurred, use the external emergency stop (EM1) to make a stop.

By using a personal computer and the set-up software (MRZJW3-SETUP41E or later), you can execute jog operation, positioning operation, motor-less operation and forced output without connecting the motion controller.

(1) Test operation mode list

<table>
<tr><th>Test Operation Mode</th><th>Description</th></tr>
<tr><td>Jog operation</td><td>Jog operation can be performed without using the servo system controller. Use this operation with the external emergency stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
Exercise control on the jog operation screen of the set-up software.
1) Operation pattern
<table>
<tr><th>Item</th><th>Initial Value</th><th>Setting Range</th></tr>
<tr><td>Speed [r/min]</td><td>200</td><td>0 to max. speed</td></tr>
<tr><td>Acceleration/deceleration time constant [ms]</td><td>1000</td><td>1 to 20000</td></tr>
</table>
2) Operation method
<table>
<tr><th>Operation</th><th>Screen Control</th></tr>
<tr><td>Forward rotation start</td><td>Press [Forward (G)] button.</td></tr>
<tr><td>Reverse rotation start</td><td>Press [Reverse (R)] button.</td></tr>
<tr><td>Stop</td><td>Press [Stop (O)] button.</td></tr>
</table></td></tr>
<tr><td>Positioning operation</td><td>Positioning operation can be performed without using the servo system controller. Use this operation with the external emergency stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
Exercise control on the positioning operation screen of the set-up software.
1) Operation pattern
<table>
<tr><th>Item</th><th>Initial Value</th><th>Setting Range</th></tr>
<tr><td>Travel [pulse]</td><td>100000</td><td>0 to 9999999</td></tr>
<tr><td>Speed [r/min]</td><td>200</td><td>0 to max. speed</td></tr>
<tr><td>Acceleration/deceleration time constant [ms]</td><td>1000</td><td>1 to 50000</td></tr>
</table>
2) Operation method
<table>
<tr><th>Operation</th><th>Screen Control</th></tr>
<tr><td>Forward rotation start</td><td>Press [Forward (G)] button.</td></tr>
<tr><td>Reverse rotation start</td><td>Press [Reverse (R)] button.</td></tr>
<tr><td>Pause</td><td>Press [Pause (O)] button.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Test Operation Mode</th><th>Description</th></tr>
<tr><td>Programmed operation</td><td>Positioning operation can be performed in two or more operation patterns combined, without using the servo system controller. Use this operation with the external emergency stop reset. This operation may be used independently of whether the servo is on or off and whether the servo system controller is connected or not.
Exercise control on the programmed operation screen of the set-up software. For full information, refer to the Set-up Software (MRZJW3-SETUP41E or later) Installation Guide.
Operation method
<table>
<tr><th>Operation</th><th>Screen Control</th></tr>
<tr><td>Start</td><td>Press [Start (G)] button.</td></tr>
<tr><td>Stop</td><td>Press [Reset (O)] button.</td></tr>
</table></td></tr>
<tr><td>Motor-less operation</td><td>
<table>
<tr><td>MEMORANDUM</td><td>Motor-less operation may be used with the set-up software. Usually, however, use motor-less operation which is available by making the servo system controller parameter setting.</td></tr>
</table>
Without connecting the servo motor, output signals or status displays can be provided in response to the servo system controller commands as if the servo motor is actually running. This operation may be used to check the servo system controller sequence. Use this operation with the external emergency stop reset. Use this operation with the servo amplifier connected to the servo system controller.
Exercise control on the motor-less operation screen of the set-up software.
1) Load conditions
<table>
<tr><th>Load Item</th><th>Condition</th></tr>
<tr><td>Load torque</td><td>0</td></tr>
<tr><td>Load inertia moment ratio</td><td>Same as servo motor inertia moment</td></tr>
</table>
2) Alarms
The following alarms and warning do not occur. However, the other alarms and warnings occur as when the servo motor is connected:
・Encoder error 1 (16)
・Encoder error 2 (20)
・Absolute position erasure (25)
・Battery cable breakage warning (92)</td></tr>
<tr><td>DO forced output</td><td>Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc.
Exercise control on the DO forced output screen of the set-up software.</td></tr>
</table>

(2) Configuration

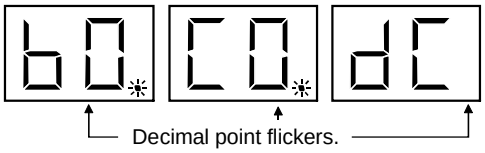
Configuration should be as in Section 2-1 or Section 6-1-3. Always install an external emergency stop switch to enable a stop at occurrence of an alarm.

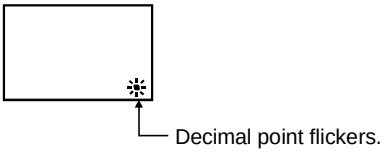
(3) Operation procedure

<table>
<tr><th>Test Operation Mode</th><th>Operation Procedure</th><th>Connection with Servo System Controller</th></tr>
<tr><td>Jog operation

Positioning operation

Programmed operation

DO forced output</td><td>1) Switch power off.
2) Set CS1 to F.
When CS1 is set to the axis number and operation is performed by the servo system controller, the test operation mode screen is displayed on the personal computer, but no function is performed.
3) Switch servo amplifier power on.
When initialization is over, the display shows the following screen:
 

4) Perform operation with the personal computer.</td><td>Not required</td></tr>
<tr><td>Motor-less operation</td><td>1) Switch off the servo amplifier.
2) Perform motor-less operation with the personal computer.
The display shows the following screen:
 
</td><td>Required</td></tr>
</table>

2 - 6 Adjustments

2 - 6 - 1 Auto tuning

In general machines, gains are automatically adjusted by auto tuning. As the corresponding parameter is factory-set to make auto tuning valid, merely running the servo motor will automatically set the optimum gains for the machine without special operation or setting.
However, if you are not satisfied with machine motions during operation, change and adjust the response level setting (parameter No. 9) of auto tuning in the following procedure.

Actual Machine Motion	Ideal Machine Motion	Parameter No. 9 Setting Method
Settling time is long (Note)	Shorter settling time	Increase the set value of the response level.
Overshoot occurs at a stop.	Less overshoot	Decrease the set value of the response level. Select "large friction" in machine selection.
Gear noise is generated from the machine.	Smaller gear noise	Decrease the set value of the response level.

Note: Settling time indicates a period of time from when the command pulse value is zeroed to when the servo motor comes to a stop.

2 - 6 - 2 Manual gain adjustment

In most machines, gains can be adjusted automatically by auto tuning.
In the following cases, however, the gains should be adjusted manually.

Manual Gain Adjustment Is Required When		Phenomenon	Adjustment Procedure
1)	The machine vibrates at a low-range resonance frequency.	The servo motor shaft vibrates at a high frequency (10Hz or more) a. When the machine generates large noise and vibrates, the motion of the servo motor shaft is invisible. b. When the response level setting is increased by auto tuning, vibration increases.	Adjustment 1 Adjustment 2
2)	The servo motor vibrates on a machine whose ratio of load inertia moment to servo motor inertia moment is 20 or more times.	The servo motor shaft vibrates at a low frequency (5Hz or less). a. When vibration occurs, the lateral vibration of the servo motor shaft is visible. b. The ratio of load inertia moment to servo motor inertia moment is extremely large.	Adjustment 3
3)	The settling time provided by auto tuning should be further decreased.		Adjustment 4
4)	The position control gain of each axis should be set to the same for interpolation operation with two or more axes.		Adjustment 5

The following parameters are used for manual gain adjustment.

Parameter No.	Name
No. 8	Auto tuning
No. 9	Servo response setting
No.12	Ratio of load inertia moment to servo motor inertia moment
No.18	Machine resonance suppression filter
No.13	Position loop gain 1
No.15	Position loop gain 2
No.14	Speed loop gain 1
No.16	Speed loop gain 2
No.17	Speed integral compensation

Adjustment 1

Step	Operation	Description
1	Set 0001 in parameter No. 8.	Auto tuning is selected.
2	Set 0001 in parameter No. 9.	Response is set to low level.
3	Set 0001 in parameter No. 18.	Machine resonance frequency: 1125Hz
4	Switch servo on and perform operation several times.	Auto tuning is performed. Check to see if vibration reduced.
5	Increase the setting of parameter No. 18 sequentially and execute step 3.	The optimum value is achieved just before vibration begins to increase.
6	To reduce the settling time, increase the parameter No. 9 value sequentially and execute steps 2 to 4.	

Adjustment 2

Step	Operation	Description
1	Set 0001 in parameter No. 8.	Auto tuning is selected.
2	Set 0001 in parameter No. 9.	Response is set to low level.
3	Set the machine's load inertia moment to servo motor inertia moment in parameter No. 12. (When it is unclear, set an approximate value.)	When this parameter value is set, the following parameter values are set automatically. Each value provides an ideal, hunting-less gain for parameter No. 12 if machine resonance does not occur. ・Parameter No. 13 ・Parameter No. 14 ・Parameter No. 15 ・Parameter No. 16 ・Parameter No. 17
4	Set 0002 in parameter No. 8.	Auto tuning is made invalid to enable manual setting of parameters No. 13 to 17.
5	In parameter No. 16, set a value about 100 smaller than the value set automatically in step 3.	The optimum value is achieved just before vibration begins to increase.
6	Execute steps 2 to 4 of Adjustment 1.	
7	When machine response does not occur any more, confirm the operating status, and at the same time, gradually increase the setting of parameter No. 16 reduced in step 4.	Set a value which is about 50 to 100 smaller than the set value at which gear noise and/or vibration begins to be generated by machine resonance.
8	To reduce the settling time, increase the response level of parameter No. 9 sequentially and execute steps 1 to 6.	

Adjustment 3

Step	Operation	Description
1	Set 0001 in parameter No. 8.	Auto tuning is selected.
2	Set 0001 in parameter No. 9.	Response is set to low level.
3	Set the machine's load inertia moment to servo motor inertia moment in parameter No. 12. (When it is unclear, set an approximate value.)	When this parameter value is set, the following parameter values are set automatically. Each value provides an ideal, hunting-less gain for parameter No. 12 if machine resonance does not occur. ・Parameter No. 13 ・Parameter No. 14 ・Parameter No. 15 ・Parameter No. 16 ・Parameter No. 17
4	Switch servo on and perform operation several	Auto tuning is performed.
5	If vibration still persists, execute steps 2 and 3.	
6	If vibration occurs due to machine resonance, make adjustment in the procedure of Adjustment 1 or 2.	

Adjustment 4

Step	Operation	Description
1	Set 0001 in parameter No. 8.	Auto tuning is selected.
2	Set 0001 in parameter No. 9.	Response is set to low level.
3	Switch servo on and perform operation several times.	Auto tuning is performed. Check to see if vibration reduced.
4	Make gain adjustment in either of the following methods 1) and 2).	Temporary adjustment
	1) Set the machine's load inertia moment to servo motor inertia moment in parameter No. 12. (When it is unclear, set an approximate value.)	When this parameter value is set, the following parameter values are set automatically. Each value provides an ideal, hunting-less gain for parameter No. 12 if machine resonance does not occur. ・Parameter No. 13 ・Parameter No. 14 ・Parameter No. 15 ・Parameter No. 16 ・Parameter No. 17
	2) Switch servo on and perform operation	Auto tuning is performed.
5	Set 0002 in parameter No. 8.	Auto tuning is made invalid to enable manual setting of parameters No. 13 to 17.
6	While confirming the operating status, adjust the following parameters:	The optimum value is achieved just before vibration begins to increase.
	・Parameter No. 13 ・Parameter No. 15	Increase the setting to reduce the settling time. Note that overshoot is more liable to occur.
	・Parameter No. 14 ・Parameter No. 16	Increase the setting to improve servo response. Note that vibration is more liable to occur.
	・Parameter No. 17	Decrease the setting to keep the speed constant to load disturbance and increase holding force at a stop (servo rigidity). Note that overshoot

Adjustment 5

Step	Operation	Description
1	Adjust the gains of all axes in any of Adjustment 1 to 4 procedures. The gains of each axis are adjusted.	The gains of each axis are adjusted.
2	Set 0001 or 0002 in parameter No. 8.	0001 "interpolation axis control": The values of parameters No. 12・14 will change in subsequent operation. 0002 "no": Auto tuning is made invalid to enable manual setting of parameters No. 13 to 17.
3	Set the following parameter of each axis to the minimum value of all interpolation-controlled axes: ・Parameter No. 13	The gains for operation of all axes are set to the same value.

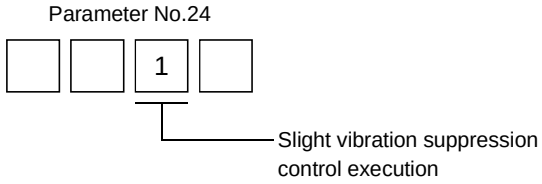
2 - 6 - 3 Slight vibration suppression control

The slight vibration suppression control mode is used to reduce servo-specific ±1 pulse vibration at the time of a stop. This mode produces an effect especially when the ratio of load inertia moment to servo motor inertia moment is small (2 to 5 times). Note that when vibration is attributable to looseness (such as gear backlash) or machine resonance, use the machine resonance suppression filter in parameter No. 18. The slight vibration suppression control mode should be used after real-time auto tuning or manual gain adjustment.

Usage

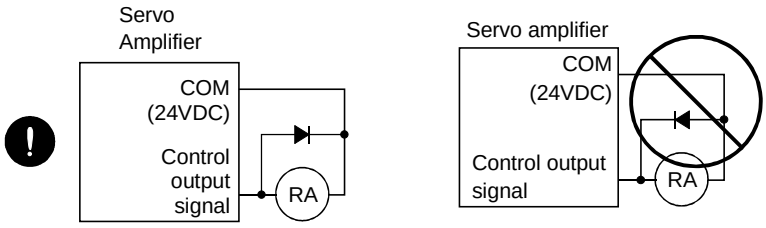
First, perform real-time auto tuning or manual gain adjustment so that vibration falls within ±2 to 3 pulses.

Set □□1□ in parameter No. 24 to enter the slight vibration suppression mode at the time of a stop.



3. WIRING

⚠ WARNING	1. Any person who is involved in wiring should be fully competent to do the work. 2. Before starting wiring, make sure that the voltage is safe in the tester more than 10 minutes after power-off. Otherwise, you may get an electric shock. 3. Ground the servo amplifier and the servo motor securely. 4. Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock. 5. The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, you may get an electric shock.

⚠ CAUTION	1. Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate, resulting in injury. 2. Connect cables to correct terminals to prevent a burst, fault, etc. 3. Ensure that polarity (+, —) is correct. Otherwise, a burst, damage, etc. may occur. 4. The surge absorbing diode installed to the DC relay designed for control output should be fitted in the specified direction. Otherwise, the signal is not output due to a fault, disabling the emergency stop and other protective circuits.  5. Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier. 6. Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) with the power line of the servo motor. 7. When using the regenerative brake resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative brake resistor, causing a fire. 8. Do not modify the equipment.

NOTICE	CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a failure. Connect them correctly.

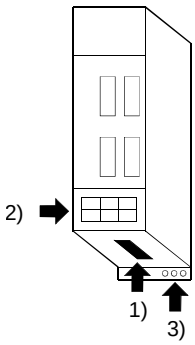
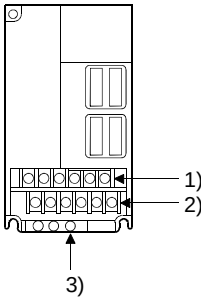
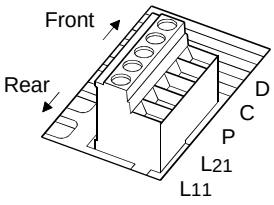
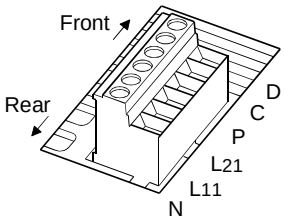
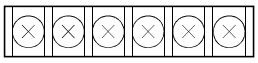
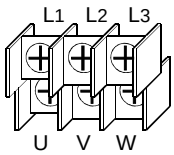
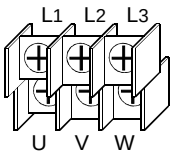
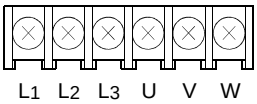
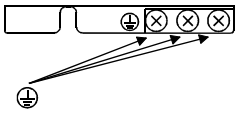
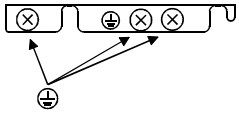
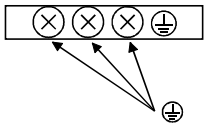
3 - 1 Servo amplifier

CAUTION	Only the specified voltage should be applied to each terminal. Otherwise, a burst, damage, etc. may occur.

3 - 1 - 1 Terminal blocks

(1) Signal arrangement

Terminal block signals are as listed below:

Servo Amplifiers / Terminals			MR-J2-10B to MR-J2-60B	MR-J2-70B MR-J2-100B	MR-J2-200B MR-J2-350B
Terminal positions					
Terminal signals	1)	Control circuit terminal block (TE2)	 (Phoenix Contact make)	 (Phoenix Contact make)	
	2)	Main circuit terminal block (TE1)			
	3)	Protective earth(PE) terminals			

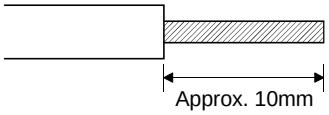
(2) Signals

<table>
<tr><th>Symbol</th><th>Signal</th><th>Description</th></tr>
<tr><td>L1, L2, L3</td><td>Main circuit power supply</td><td>Main circuit power input terminals
Supply L1, L2 and L3 with the following power:
For single-phase 230VAC, connect the power supply L1/L2 and leave L3 open.
<table>
<tr><th>Servo amplifier
Power supply</th><th>MR-J2-10B to 70B</th><th>MR-J2-100B to 350B</th></tr>
<tr><td>3-phase 200 to 230VAC, 50/60Hz</td><td colspan="2">L1・L2・L3</td></tr>
<tr><td>Single-phase 230VAC, 50/60Hz</td><td>L1・L2</td><td></td></tr>
</table>
Note: Cannot be used for combination with the servo motor HC-SF52.</td></tr>
<tr><td>L11, L21</td><td>Control circuit power supply</td><td>Control circuit power input terminals
Supply L11 and L21 with single-phase 200-230VAC, 50/60Hz power.
L11 and L21 should be in phase with L1 and L2, respectively.</td></tr>
<tr><td>P, C, D</td><td>Regenerative brake option</td><td>Regenerative brake option connection terminals
C and D are factory-connected.
When using the regenerative brake option, always remove wiring from across P-D and connect the regenerative brake option across P-C.</td></tr>
<tr><td>U, V, W</td><td>Servo motor output</td><td>Servo motor power output terminals
Connect to the servo motor power supply terminals (U, V, W).</td></tr>
<tr><td>N</td><td></td><td>Do not connect.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Ground terminal
Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.</td></tr>
</table>

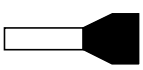
(3) How to use the control circuit terminal block (Phoenix Contact make)

1) Termination of the cables

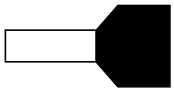
Solid wire: After the sheath has been stripped, the cable can be used as it is. (Cable size: 0.2 to 2.5mm^2)



Twisted wire: Use the cable after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. (Cable size: 0.2 to 2.5mm^2) Alternatively, a bar terminal may be used to put the wires together.(Phoenix Contact make)



Bar terminal for 1 cable
(Bar terminal ferrule with insulation



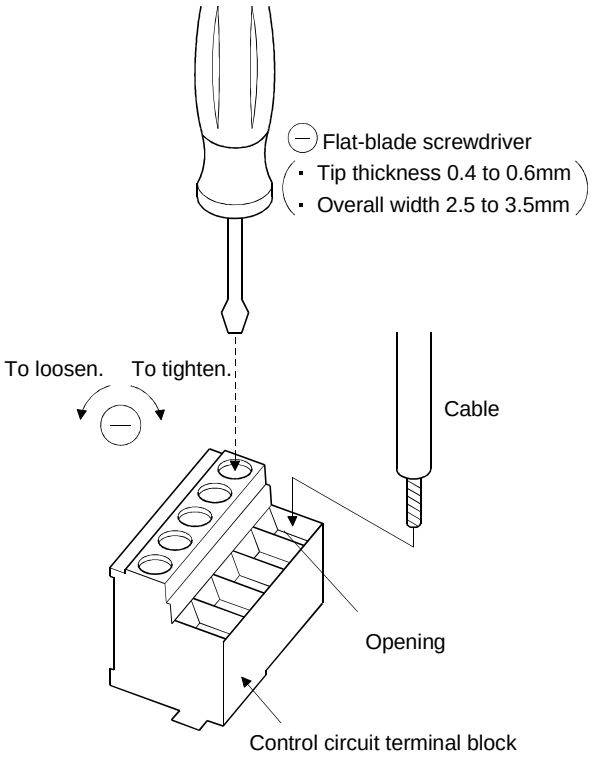
Bar terminal for 2 cables
(Twin ferrule with insulation sleeve)

Cable Size		Bar Terminal Type		Crimping tool
[mm^2]	AWG	For 1 cable	For 2 cables	
0.25	24	Al0.25-6YE Al0.25-8YE		CRIMPFOX-UD6
0.5	20	Al0.5-6WH Al0.5-8WH		
0.75	18	Al0.75-6GY Al0.75-8GY	Al-TWIN2×0.75-8GY Al-TWIN2×0.75-10GY	
1	18	Al1-6RD Al1-8RD	Al-TWIN2×1-8RD Al-TWIN2×1-10RD	
1.5	16	Al1.5-6BK Al1.5-8BK	Al-TWIN2×1.5-8BK Al-TWIN2×1.5-12BK	
2.5	14	Al2.5-8BU Al2.5-8BU-1000	Al-TWIN2×2.5-10BU Al-TWIN2×2.5-13BU	

2) Connection

Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver so that the cable does not come off. (Tightening torque: 0.5 to 0.6N・m) Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose.

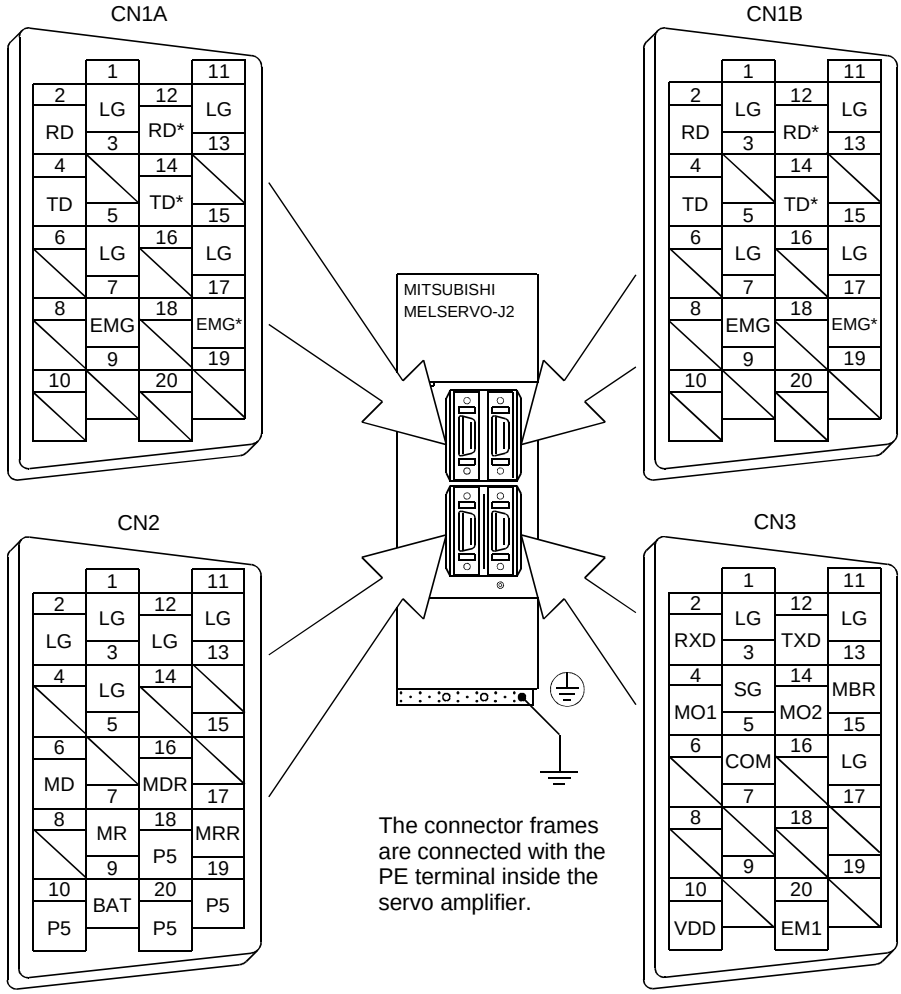
When using a cable of 1.5mm^2 or less, two cables may be inserted into one opening.



3 - 1 - 2 Signal connectors

(1) Signal arrangement

All connectors are half-pitch connectors (Molex 52986-2011 or equivalent). CN1A and CN1B signals change with the control mode. Refer to (2) in this section.



MEMORANDUM	The connector pin-outs shown above are viewed from the cable connector wiring section side.

(2) Connector applications

Connector	Name	Function/Application
CN1A	Connector for bus cable from preceding axis.	Used for connection with the controller or preceding-axis servo amplifier.
CN1B	Connector for bus cable to next axis	Used for connection with the next-axis servo amplifier or for connection of the termination connector (MR-A-TM)
CN2	Encoder connector	Used for connection with the servo motor encoder.
CN3	Communication connector (I/O signal connector)	Used for connection with the personal computer. Serves as an I/O signal connector when the personal computer is not used.

(3) I/O signals

1) Input signal

Signal	Code	Connector Pin No.	Function/Application	I/O Division (Note)
External emergency stop	EM1	CN3 20	Disconnect EM1-SG to bring the servo motor to an emergency stop state, in which the servo is switched off and the dynamic brake is operated. In the emergency stop state, connect EM1-SG to reset that state.	DI-1

Note: Refer to Section 3.1.3.

2) Output signals

Signal	Code	Connector Pin No.	Function/Application	I/O Division (Note)
Electromagnetic brake interlock	MBR	CN3 13	In the servo-off or alarm status, MBR-SG are disconnected. When an alarm occurs, they are disconnected at zero or less speed, independently of the base circuit status.	DO-1
Monitor output 1	MO1	CN3 4	Data specified for CH1 in parameter No. 22 is output to across MO1-LG in analog form.	Analog output
Monitor output 2	MO2	CN3 14	Data specified for CH2 in parameter No. 22 is output to across MO2-LG in analog form.	Analog output

Note: Refer to Section 3.1.3.

3) Power supply

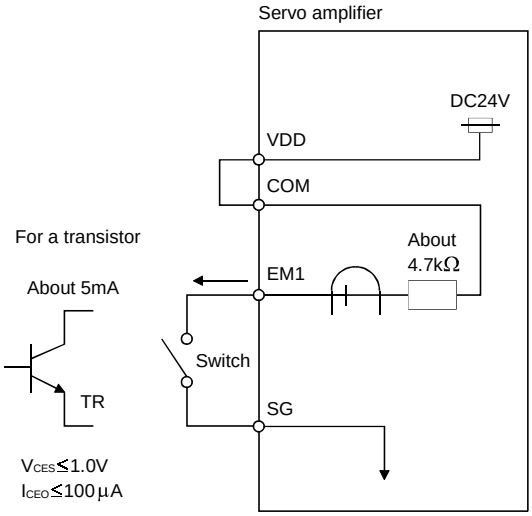
Signal	Code	Connector Pin No.	Function/Application
Internal power output for interface	VDD	CN3 10	Used to output 24VDC for input interface. Connect with COM to use this power supply. Permissible current: 80mA
Power input for digital interface	COM	CN3 5	Used to input 24VDC for input interface. Connect the positive terminal of the 24VDC external power supply. Connect with VDD to use the internal power supply. 24VDC±10%
Common for digital interface	SG	CN3 3	Common terminal to VDD and COM. Pins are connected internally. Separated from LG.
Control common	LG	CN3 1 11	Common terminal to MO1 and MO2.
Shield	SD	Plate	Connect the external conductor of the shield cable.

3 - 1 - 3 Interfaces

The details of the interfaces (refer to I/O Division in the table) to the signals indicated in Section 3.1.2 are given below. Refer to the following information and connect the interfaces with the external equipment.

(1) Digital input interface DI-1

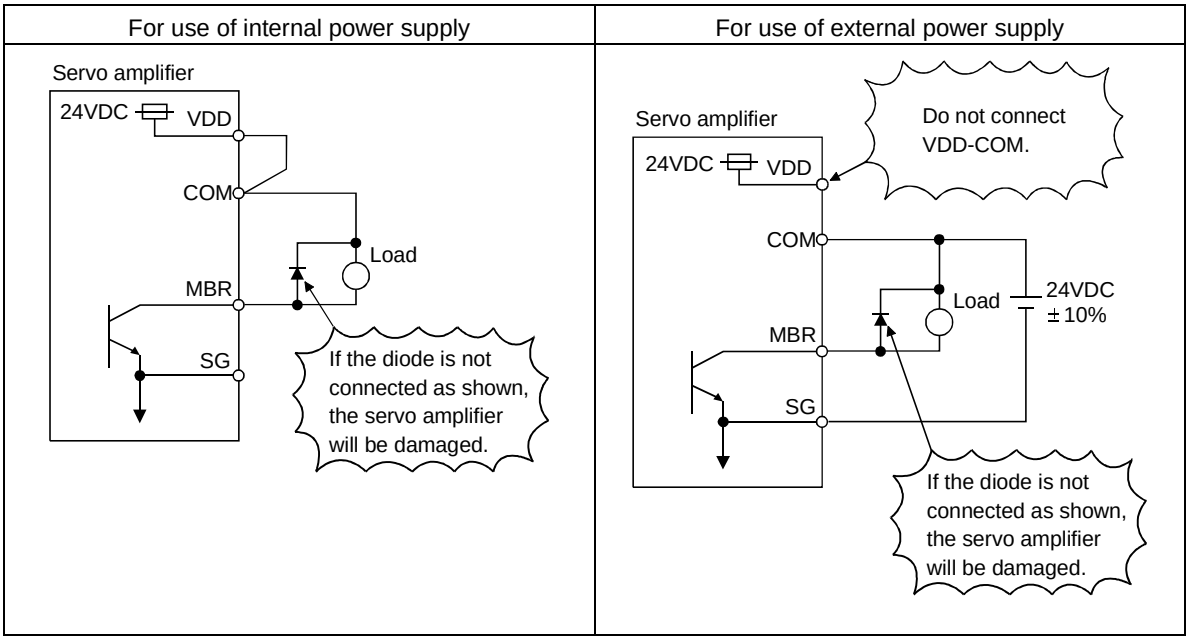
Give a signal with a relay or open collector transistor.



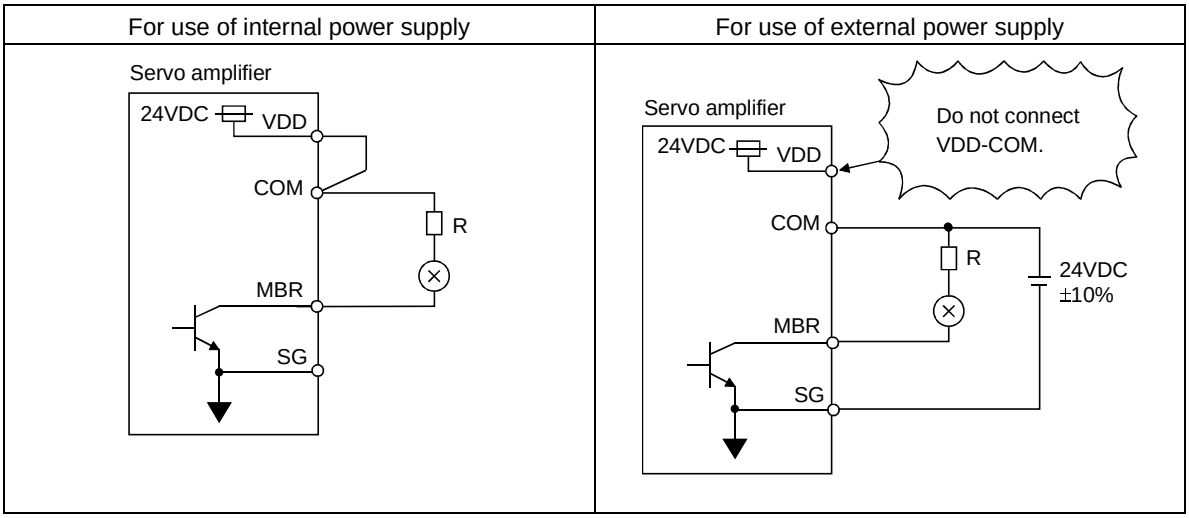
(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Provide a diode (D) for an inductive load, or an inrush current suppressing resistor (R) for a lamp load.
(Permissible current: 40mA or less, inrush current: 100mA or less)

1) Inductive load

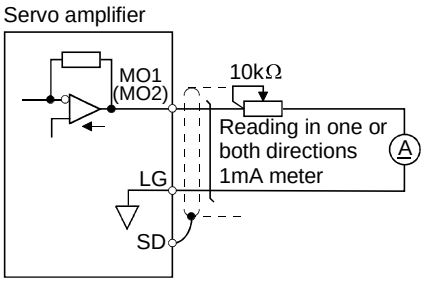


2) Lamp load



(3) Analog output

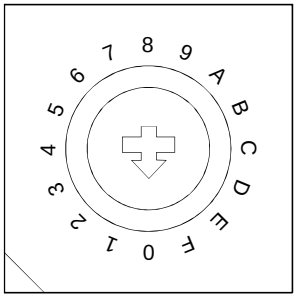
Output ±10V Max.1mA



3 - 1 - 4 Control axis selection

Use the axis select switch (CS1) to set the control axis number for the servo. The control axis number set to CS1 should be the same as the one set to the servo system controller. If the same numbers are set to different control axes in a single communication system, the system will not operate properly. The control axes may be set independently of the bus cable connection sequence.
Set this switch to "F" when the set-up software is used to execute the test operation mode.

Axis select switch (CS1)



No.	Description
0	Axis 1
1	Axis 2
2	Axis 3
3	Axis 4
4	Axis 5
5	Axis 6
6	Axis 7
7	Axis 8
8	Not used
9	Not used
A	Not used
B	Not used
C	Not used
D	Not used
E	Not used
F	Test operation mode

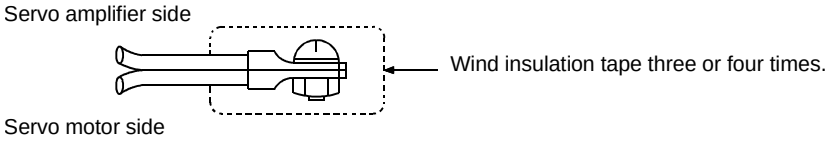
3 - 2 Connection of servo amplifier and servo motor

3 - 2 - 1 Connection instructions

⚠ WARNING	Insulate the connections of the power supply terminals to prevent an electric shock.

⚠ CAUTION	1. Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and servo motor. Otherwise, the servo motor will operate improperly. 2. Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur.

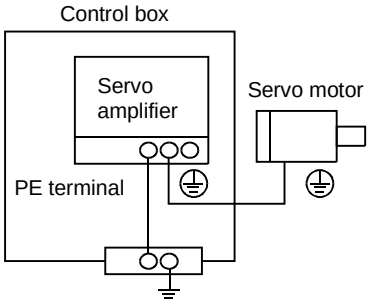
(1) Wind an insulation tape around the connection several times. For the EN Standard-compliant model, connect via a fixed terminal block.



(2) For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal of the servo amplifier and connect the ground cable of the servo amplifier to the earth via the protective earth of the control box.
Do not connect it directly to the protective earth of the control box.

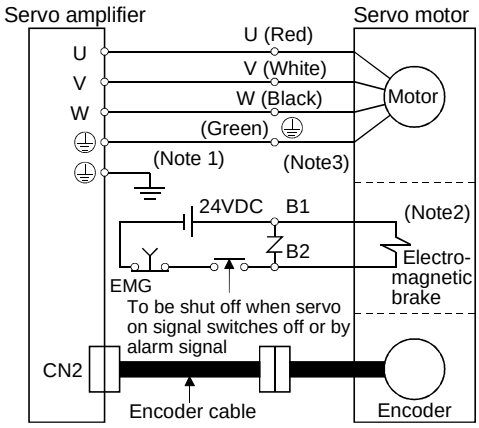
(3) Supply exclusive 24VDC power to the brake lead of the servo motor with electromagnetic brake. Do not connect it directly to the protective earth of the control box.

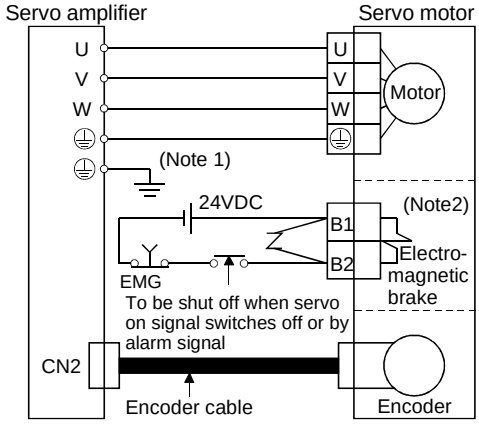
(4) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.

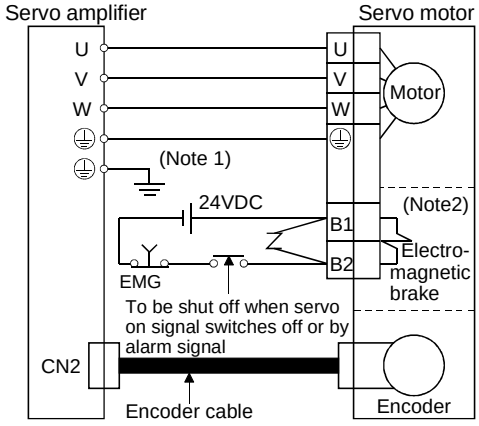


3 - 2 - 2 Connection diagram

The following table lists wiring methods according to the servo motor types. Use the connection diagram which conforms to the servo motor used. For cables required for wiring, refer to Section 6-2-1.
For the servo motor connection diagram, refer to Section 6-1-2.

<table>
<tr><th>Servo Motor</th><th>Connection Diagram</th></tr>
<tr><td>HC-MF053 (B) (-UE) to
73 (B) (-UE)
HA-FF053 (B) to 63 (B)
HC-UF13 (B) to 73 (B)</td><td> 

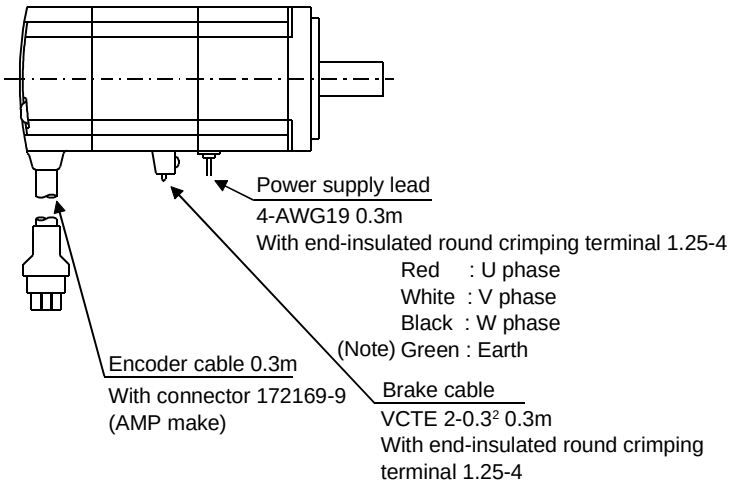
Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.
2. This circuit applies to the servo motor with electromagnetic brake.
3. For the HA-FF series, connect the ground cable to the earth terminal of the servo motor.</td></tr>
<tr><td>HA-FF053 (B)-UE to 63 (B)-UE
HC-SF121 (B) to 301 (B)
HC-SF202 (B) • 352 (B)
HC-SF203 (B) • 353 (B)
HC-UF202 (B)</td><td> 

Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.
2. This circuit applies to the servo motor with electromagnetic brake.</td></tr>
<tr><td>HC-SF81 (B)
HC-SF52 (B) to 152 (B)
HC-SF53 (B) to 153 (B)
HC-RF103 (B) to 203 (B)
HC-UF72 (B) • 152 (B)</td><td> 

Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.
2. This circuit applies to the servo motor with electromagnetic brake.</td></tr>
</table>

3 - 2 - 3 I/O terminals

(1) HC-MF(-EC/-UL) series

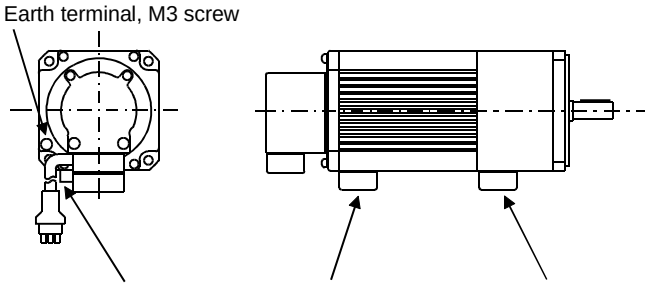


Encoder connector signal arrangement

1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	
7	8	9
P5	LG	SHD

Note: Green/yellow for HC-MF-EC/-UL.

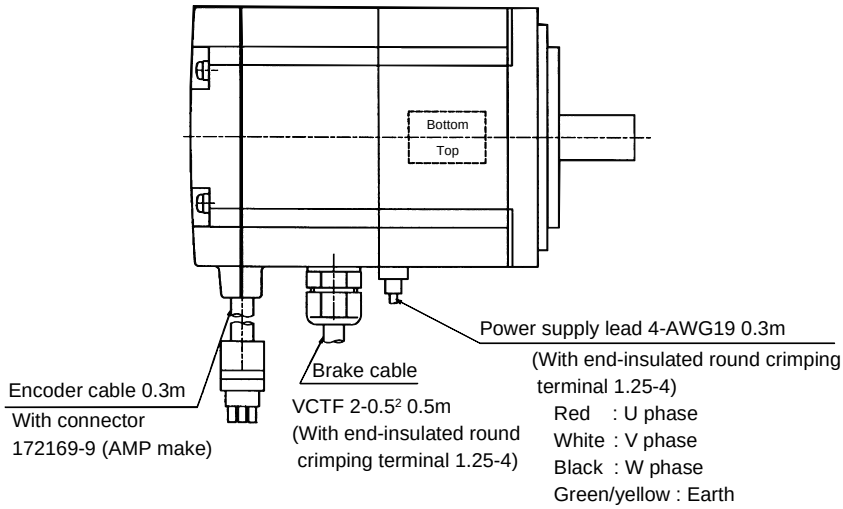
(2) HA-FF(-UL) series



Encoder connector signal arrangement

1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	
7	8	9
P5	LG	SHD

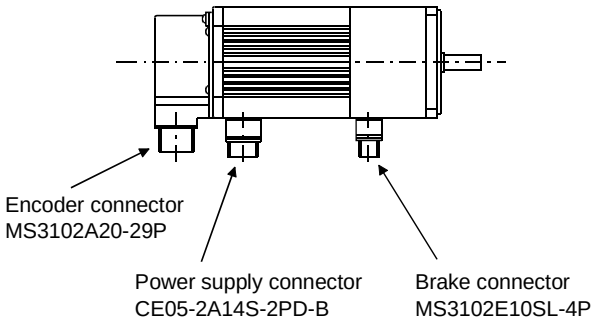
(3) HC-UF 3000r/min series



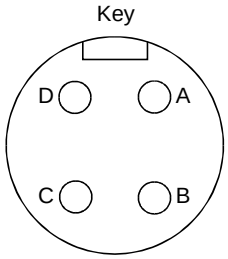
Encoder connector signal arrangement

1	2	3
MR	MRR	BAT
4	5	6
MD	MDR	
7	8	9
P5	LG	SHD

(4) HA-FF-EC series



Power supply connector signal arrangement
CE05-2A14S-2PD-B

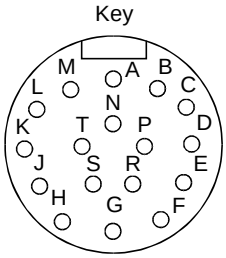


Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)

Servo Motor	Connector		
	For power supply	For encoder	For brake
HA-FF053C(B)-UE to HA-FF63C(B)-UE	CE05-2A14S-2PD-B	MS3102A20-29	MS3102E10SL-4P

Encoder connector signal arrangement

MS3102A20-29P

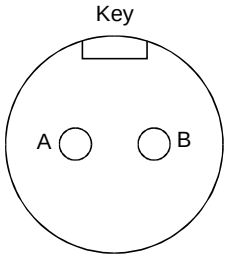


Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	
F	BAT
G	LG
H	
J	

Pin	Signal
K	
L	
M	
N	SHD
P	
R	LG
S	P5
T	

Brake connector signal arrangement

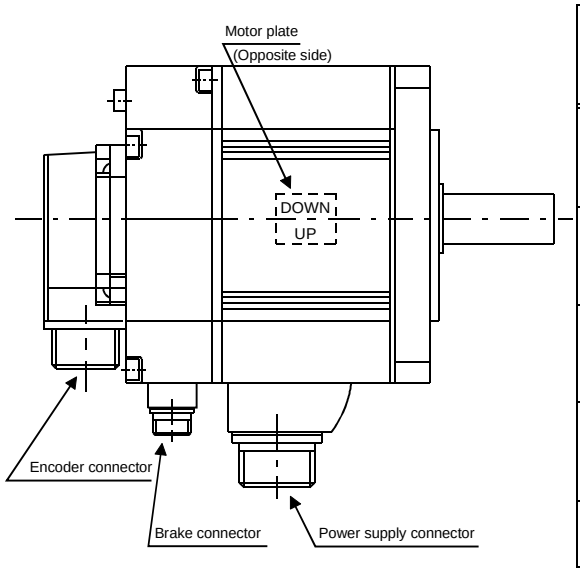
MS3102E10SL-4P



Pin	Signal
A	(Note) B1
B	(Note) B2

Note: 24VDC without polarity.

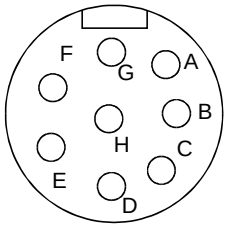
(5) HC-SF · HC-RF · HC-UF2000 r/min series



Servo Motor	Servo Motor Side Connectors		
	For power supply	For encoder	Electromagnetic Brake Connector
HC-SF81(B) HC-SF52(B) to 152(B) HC-SF53(B) to 153(B)	CE05-2A22-23PD-B	MS3102A20-29P	The connector for power is shared.
HC-SF121(B) to 301(B) HC-SF202(B) · 352(B) HC-SF203(B) · 353(B)	CE05-2A24-10PD-B		MS3102A10SL-4P
HC-RF103(B) to 203 (B)	CE05-2A22-23PD-B	MS3102A20-29P	The connector for power is shared.
HC-UF72(B) · 152(B)	CE05-2A22-23PD-B	MS3102A20-29P	The connector for power is shared.
HC-UF202(B)	CE05-2A24-10PD-B		MS3102A10SL-4P

Power supply connector signal arrangement

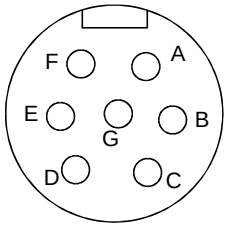
CE05-2A22-23PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	
F	
G	(Note)B1
H	(Note)B2

Note:24VDC,without polarity

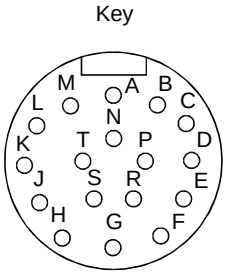
CE05-2A24-10PD-B



Pin	Signal
A	U
B	V
C	W
D	⏚ (Earth)
E	
F	
G	

Encoder connector signal arrangement

MS3102A20-29P

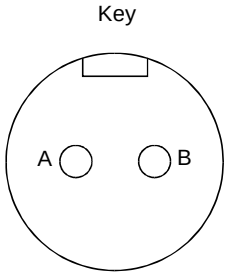


Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	
F	BAT
G	LG
H	
J	

Pin	Signal
K	
L	
M	
N	SHD
P	
R	LG
S	P5
T	

Electromagnetic brake connector signal pin-outs

MS3102E10SL-4P



Pin	Signal
A	(Note)B1
B	(Note)B2

Note:24VDC without polarity

3 - 2 - 4 Connectors used for servo motor wiring

This section gives connector makeups on an operating environment basis. Use the models of the manufacturers given or equivalent.

(1) HC-MF(-UE), HA-FF, HC-UF 3000r/min series

Use round crimping terminals (1.25-4) for connection of the power supply and electromagnetic brake. For connection of the encoder, use the connector indicated in this section or equivalent. This connector may be used with the EN Standard and UL/C-UL Standard but is not waterproof.

Servo Motor	Servo Motor Side Connector (AMP)	Encoder Cable Connector		
		Housing (AMP)	Connector Pin (AMP)	Cable Clamp (Toa Denki Kogyo)
HC-MF □(B) HC-MF □(B) -UE HA-FF □(B) HC-UF13 to 73(B)	1-172169-9	1-172161-9	170363-1	MTI-0002

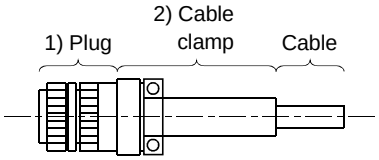
(2) HA-FF□C-UE series

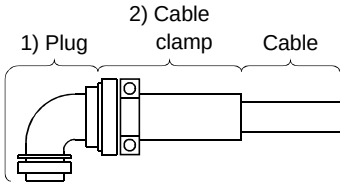
If used with a waterproof connector, the HA-FF□C(B)-UE does not improve in ingress protection (IP54).

1) Non-waterproof, UL/C-UL Standard-compliant

a When using cabtyre cables

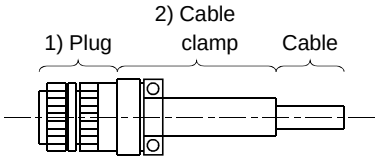
▪ For connection of power supply

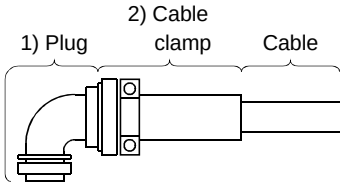




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)		2) Cable clamp (Daiichi Denshi Kogyo)
		Type	Model	
HA-FF□C(B)-UE	CE05-2A14S-2PD-B	Straight	MS3106B14S-2S	MS3057-6A
		Angle	MS3108B14S-2S	

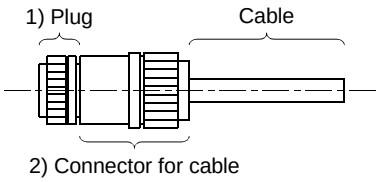
・For connection of encoder

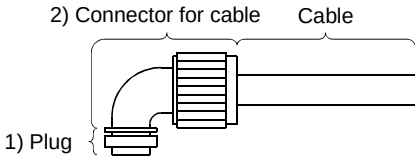




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)		2) Cable clamp (Daiichi Denshi Kogyo)
		Type	Model	
HA-FF□C(B) -UE	MS3102A20-29P	Straight	MS3106B20-29S	MS3057-12A
		Angle	MS3108B20-29S	

・For connection of brake

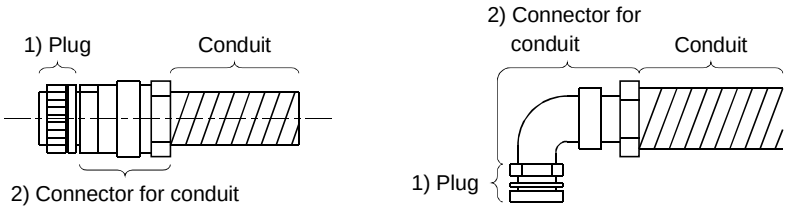




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector			
			Type	Maker	Cable OD	Model
HA-FF□C(B) -UE	MS3102A10SL-4P	MS3106A10SL-4S(D190)	Straight	Nippon flex	4 to 8	ACS-08RL-MS10F
					8 to 12	ACS-12RL-MS10F
				Daiwa Dengyo	5 to 8.3	YS010-5 to 8
			Angle	Nippon flex	4 to 8	ACA-08RL-MS10F
					8 to 12	ACA-12RL-MS10F
				Daiwa Dengyo	5 to 8.3	YL010-5 to 8

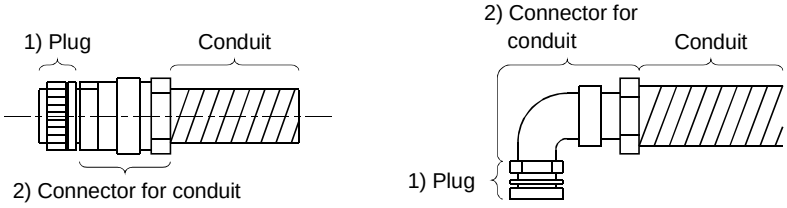
b When using flexible conduits

- For connection of power supply



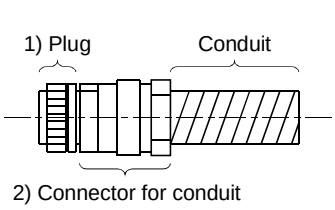
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B)-UE	CE05-2A14S-2PD-B	MS3106A14S-2S(D190)	Straight	Nippon flex	1/4	RCC-102RL-MS14F	VF-02	8.3
					3/8	RCC-103RL-MS14F	VF-03	10.6
					1/2	RCC-104RL-MS14F	VF-04	14.0
				Daiwa Dengyo	10	MSA-10-14	FCV10	10.0
					12	MSA-12-14	FCV12	12.3
			Angle	Nippon flex	1/4	RCC-302RL-MS14F	VF-02	8.3
					3/8	RCC-303RL-MS14F	VF-03	10.6
					1/2	RCC-304RL-MS14F	VF-04	14.0
				Daiwa Dengyo	10	MAA-10-14	FCV10	10.0
					12	MAA-12-14	FCV12	12.3

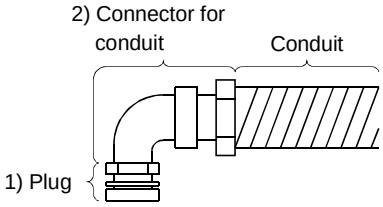
- For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B)-UE	MS3102A20-29P	MS3106A20-29S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS20F	VF-04	14.0
					3/4	RCC-106RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MSA-16-20	FCV16	15.8
					22	MSA-22-20	FCV22	20.8
			Angle	Nippon flex	1/2	RCC-304RL-MS20F	VF-04	14.0
					3/4	RCC-306RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MAA-16-20	FCV16	15.8
					22	MAA-22-20	FCV22	20.8

· For connection of brake



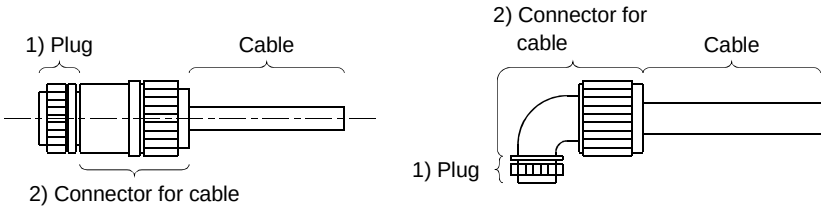


Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B) -UE	MS3102A10SL-4P	MS3106A10SL-4S(D190)	Straight	Nippon flex	1/4	RCC-102RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MSA-10-10	FCV10	10.0
			Angle	Nippon flex	1/4	RCC-302RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MAA-10-10	FCV10	10.0

2) EN Standard, UL/C-UL Standard-compliant

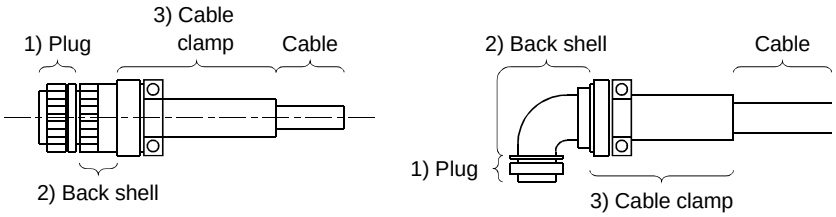
a When using cabtyre cables

・For connection of power supply



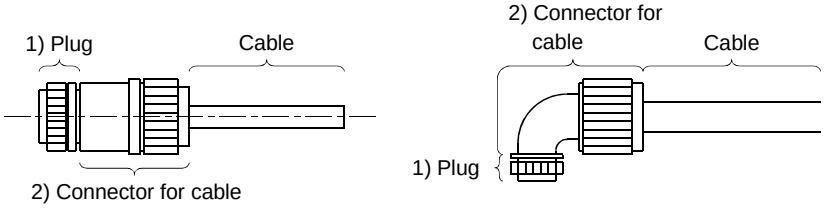
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for Cable			
			Maker	Type	Cable OD	Model
HA-FF□C(B) -UE	CE05-2A14S-2PD-B	CE05-6A14S-2SD-B	Nippon flex	Straight	4 to 8	ACS-08RL-MS14F
					8 to 12	ACS-12RL-MS14F
				Angle	4 to 8	ACA-08RL-MS14F
					8 to 12	ACA-12RL-MS14F
			Daiwa Dengyo	Straight	5 to 8.3	YSO14-5 to 8
					8.3 to 11.3	YSO14-9 to 11
				Angle	5 to 8.3	YLO14-5 to 8
					8.3 to 11.3	YLO14-9 to 11

・For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Back Shell (Daiichi Denshi Kogyo)		3) Cable Clamp (Daiichi Denshi Kogyo)	
			Type	Model	Cable OD	Model
HA-FF□C(B) -UE	MS3102A20-29P	MS3106A20-29S(D190)	Straight	CE02-20BS-S	6.8 to 10	CE3057-12A-3
			Angle	CE-20BA-S		

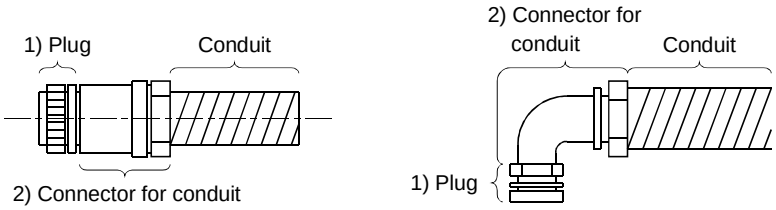
・For connection of brake



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for Cable			
			Type	Maker	Cable OD	Model
HA-FF□C(B) -UE	MS3102A10SL-4P	MS3106A10SL-4S(D190)	Straight	Nippon flex	4 to 8	ACS-08RL-MS10F
					8 to 12	ACS-12RL-MS10F
				Daiwa Dengyo	5 to 8.3	YSO-10-5 to 8
			Angle	Nippon flex	4 to 8	ACA-08RL-MS10F
					8 to 12	ACA-12RL-MS10F
				Daiwa Dengyo	5 to 8.3	YLO10-5 to 8

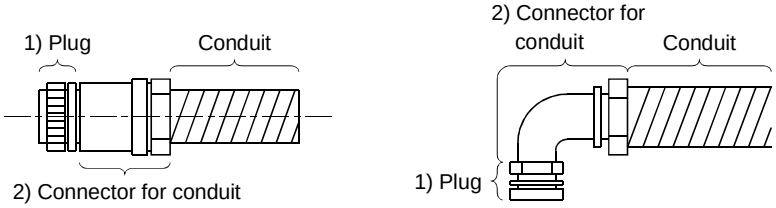
b When using flexible conduits

- For connection of power supply



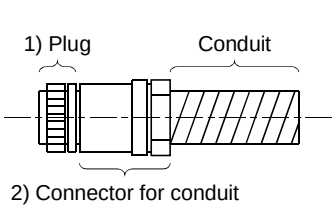
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B)-UE	CE05-2A14S-2PD-B	CE05-6A14S-2SD-B	Straight	Nippon flex	1/4	RCC-102RL-MS14F	VF-02	8.3
					3/8	RCC-103RL-MS14F	VF-03	10.6
					1/2	RCC-104RL-MS14F	VF-04	14.0
				Daiwa Dengyo	10	MSA-10-14	FCV10	10.0
					12	MSA-12-14	FCV12	12.3
			Angle	Nippon flex	1/4	RCC-302RL-MS14F	VF-02	8.3
					3/8	RCC-303RL-MS14F	VF-03	10.6
					1/2	RCC-304RL-MS14F	VF-04	14.0
				Daiwa Dengyo	10	MAA-10-14	FCV10	10.0
					12	MAA-12-14	FCV12	12.3

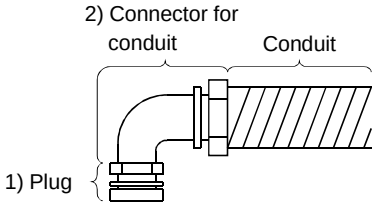
- For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B)-UE	MS3102A20-29P	MS3106A20-29S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS20F	VF-04	14.0
					3/4	RCC-106RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MSA-16-20	FCV16	15.8
					22	MSA-22-20	FCV22	20.8
			Angle	Nippon flex	1/2	RCC-304RL-MS20F	VF-04	14.0
					3/4	RCC-306RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MAA-16-20	FCV16	15.8
					22	MAA-22-20	FCV22	20.8

· For connection of brake





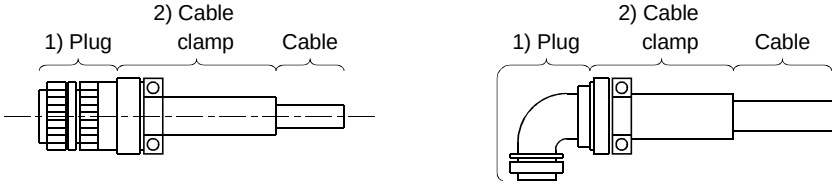
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Cable Connector				Conduit	
			Type	Maker	Size	Model	Model	ID
HA-FF□C(B)-UE	MS3102A10SL-4P	MS3106A10-SL-4S(D190)	Straight	Nippon flex	1/4	RCC-102RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MSA-10-10	FCV10	10.0
			Angle	Nippon flex	1/4	RCC-302RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MAA-10-10	FCV10	10.0

(3) HC-SF, HC-RF, HC-UF2000r/min series

1) Non-waterproof, UL/C-UL Standard-compliant

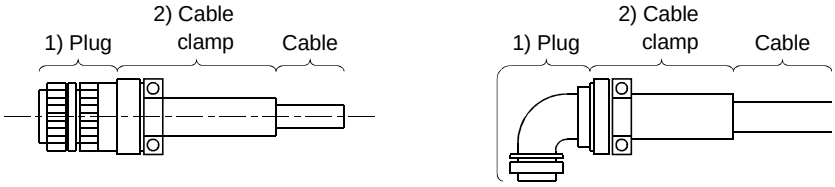
a When using cabtyre cables

・For connection of power supply



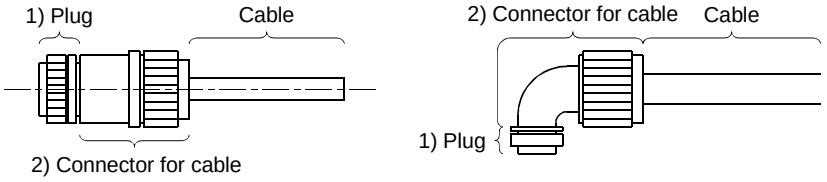
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)		2) Cable clamp (Daiichi Denshi Kogyo)
		Type	Model	
HC-SF52(B) to 152(B) HC-RF103(B) to 203(B) HC-UF72(B)・152(B)	CE05-2A22-23PD-B	Straight	MS3106B22-23S	MS3057-12A
		Angle	MS3108B22-23S	
HC-SF202(B)・352(B) HC-UF202(B)	CE05-2A24-10PD-B	Straight	MS3106B24-10S	MS3057-16A
		Angle	MS3108B24-10S	
HC-SF702(B)	CE05-2A32-17PD-B	Straight	MS3106B32-17S	MS3057-20A
		Angle	MS3108B32-17S	

・For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)		2) Cable clamp (Daiichi Denshi Kogyo)
		Type	Model	
HC-SF52(B) to 352(B) HC-RF103(B) to 203(B) HC-UF72(B) to 202(B)	MS3102A20-29P	Straight	MS3106B20-29S	MS3057-12A
		Angle	MS3108B20-29S	

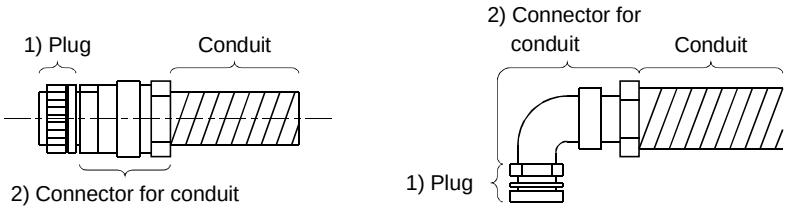
・For connection of brake



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for Cable			
			Type	Maker	Cable OD	Model
HC-SF202(B) HC-UF202(B)	MS3102A10SL-4P	MS3106A10SL-4S	Straight	Nippon flex	4 to 8	ACS-08RL-MS10F
					8 to 12	ACS-12RL-MS10F
			Angle	Daiwa Dengyo	5 to 8.3	YSO10-5 to 8
			Straight	Nippon flex	4 to 8	ACA-08RL-MS10F
					8 to 12	ACA-12RL-MS10F
			Angle	Daiwa Dengyo	5 to 8.3	YLO10-5 to 8

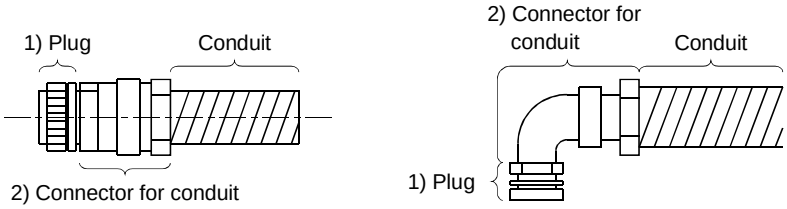
b When using flexible conduits

・For connection of power supply



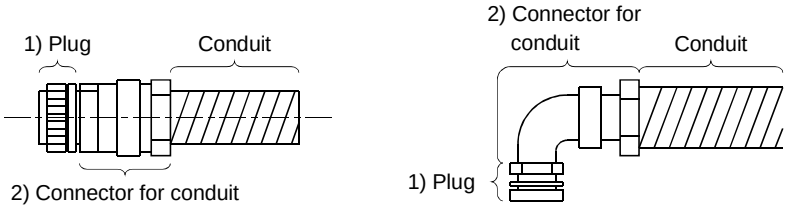
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF52(B) to 152(B) HC-RF103(B) to 203(B) HC-UF72(B)・152(B)	CE05-2A22-23PD-B	MS3106A22-23S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS22F	VF-04	14.0
					3/4	RCC-106RL-MS22F	VF-06	19.0
					1	RCC-108RL-MS22F	VF-08	24.4
				Daiwa Dengyo	16	MSA-16-22	FCV16	15.8
					22	MSA-22-22	FCV22	20.8
					28	MSA-28-22	FCV28	26.4
			Angle	Nippon flex	1/2	RCC-304RL-MS22F	VF-04	14.0
					3/4	RCC-306RL-MS22F	VF-06	19.0
					1	RCC-308RL-MS22F	VF-08	24.4
				Daiwa Dengyo	16	MAA-16-22	FCV16	15.8
					22	MAA-22-22	FCV22	20.8
					28	MAA-28-22	FCV28	26.4
HC-SF202(B)・352(B) HC-RF353(B) HC-UF202(B)	CE05-2A24-10PD-B	MS3106A24-10S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS24F	VF-04	14.0
					3/4	RCC-106RL-MS24F	VF-06	19.0
					1	RCC-108RL-MS24F	VF-08	24.4
				Daiwa Dengyo	16	MSA-16-24	FCV16	15.8
					22	MSA-22-24	FCV22	20.8
					28	MSA-28-24	FCV28	26.4
			Angle	Nippon flex	1/2	RCC-304RL-MS24F	VF-04	14.0
					3/4	RCC-306RL-MS24F	VF-06	19.0
					1	RCC-308RL-MS24F	VF-08	24.4
				Daiwa Dengyo	16	MAA-16-24	FCV16	15.8
					22	MAA-22-24	FCV22	20.8
					28	MAA-28-24	FCV28	26.4

・For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF52(B) to 352(B) HC-RF103(B) to 203(B) HC-UF72(B) to 202(B)	MS3102A20-29P	MS3106A20-29S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS20F	VF-04	14.0
					3/4	RCC-106RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MSA-16-20	FCV16	15.8
					22	MSA-22-20	FCV22	20.8
			Angle	Nippon flex	1/2	RCC-304RL-MS20F	VF-04	14.0
					3/4	RCC-306RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MAA-16-20	FCV16	15.8
					22	MAA-22-20	FCV22	20.8

・For connection of brake

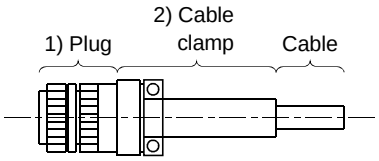


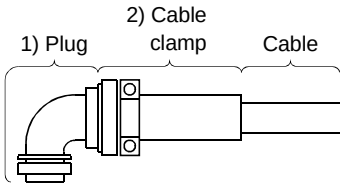
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF202(B)・352(B) HC-UF202(B)	MS3102A10SL-4P	MS3106A10-SL-4S(D190)	Straight	Nippon flex	1/4	RCC-102RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MSA-10-10	FCV10	10
			Angle	Nippon flex	1/4	RCC-302RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MAA-10-10	FCV10	10

2) Waterproof (IP65), EN Standard, UL/C-UL Standard-compliant

a When using cabtyre cables

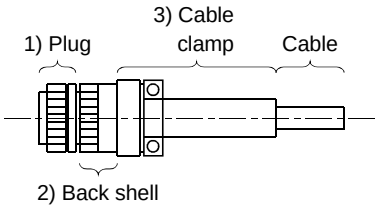
・For connection of power supply

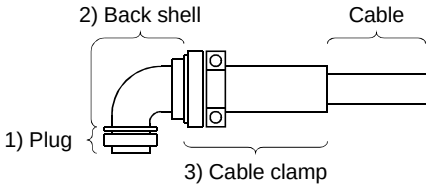




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)		2) Cable clamp (Daiichi Denshi Kogyo)	
		Type	Model	Cable OD	Model
HC-SF52(B) to 152(B) HC-RF103(B) to 203(B) HC-UF72(B)・152(B)	CE05-2A22-23PD-B	Straight	CE05-6A22-23SD-B-BSS	9.5 to 13	CE3057-12A-2(D265)
		Angle	CE05-8A22-23SD-B-BAS	12.5 to 16	CE3057-12A-1(D265)
HC-SF202(B) to 352(B) HC-UF202(B)	CE05-2A24-10PD-B	Straight	CE05-6A24-10SD-B-BSS	13 to 15.5	CE3057-16A-2(D265)
		Angle	CE05-8A24-10SD-B-BAS	15 to 19.1	CE3057-16A-1(D265)

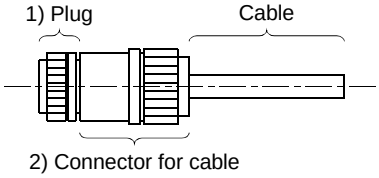
・For connection of encoder

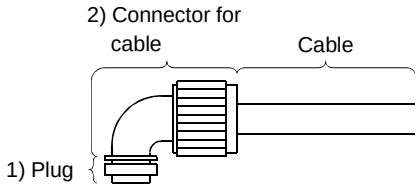




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Back shell		3) Cable clamp (Daiichi Denshi Kogyo)	
			Type	Model	Cable OD	Model
HC-SF52(B) to 352(B) HC-RF103(B) to 203(B) HC-UF72(B) to 202(B)	MS3102A20-29P	MS3106A20-29S(D190)	Straight	CE02-20BS-S	6.8 to 10	CE3057-12A-3(D265)
			Angle	CE-20BA-S		

・For connection of brake

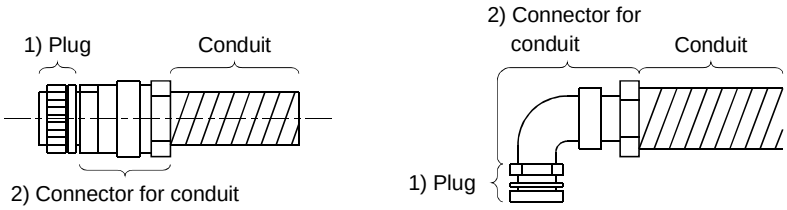




Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for Cable			
			Type	Maker	Cable OD	Model
HC-SF202(B) to 352(B) HC-UF202(B)	MS3102A10SL-4P	MS3106A10SL-4S(D190)	Straight	Nippon flex	4 to 8	ACS-08RL-MS10F
					8 to 12	ACS-12RL-MS10F
				Daiwa Dengyo	5 to 8.3	YSO-10-5 to 8
			Angle	Nippon flex	4 to 8	ACA-08RL-MS10F
				Daiwa Dengyo	8 to 12	ACA-12RL-MS10F
					5 to 8.3	YLO-10-5 to 8

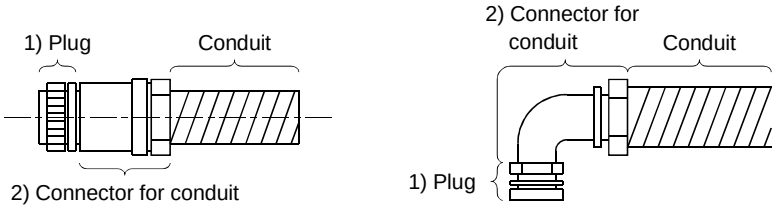
b When using flexible conduits

・For connection of power supply



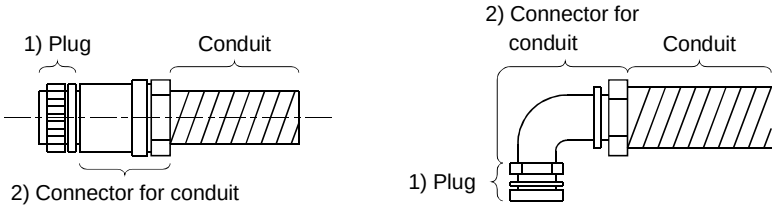
Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF52(B) to 152(B) HC-RF103(B) to 203(B) HC-UF72(B)・152(B)	CE05-2A22-23PD-B	CE05-6A22-23SD-B	Straight	Nippon flex	1/2	RCC-104RL-MS22F	VF-04	14.0
					3/4	RCC-106RL-MS22F	VF-06	19.0
					1	RCC-108RL-MS22F	VF-08	24.4
				Daiwa Dengyo	16	MSA-16-22	FCV16	15.8
					22	MSA-22-22	FCV22	20.8
					28	MSA-28-22	FCV28	26.4
			Angle	Nippon flex	1/2	RCC-304RL-MS22F	VF-04	14.0
					3/4	RCC-306RL-MS22F	VF-06	19.0
					1	RCC-308RL-MS22F	VF-08	24.4
				Daiwa Dengyo	16	MAA-16-22	FCV16	15.8
					22	MAA-22-22	FCV22	20.8
					28	MAA-28-22	FCV28	26.4
HC-SF202(B) to 352(B) HC-RF203(B)・353(B) HC-UF202(B)	CE05-2A24-10PD-B	CE05-6A24-10SD-B	Straight	Nippon flex	1/2	RCC-104RL-MS24F	VF-04	14.0
					3/4	RCC-106RL-MS24F	VF-06	19.0
					1	RCC-108RL-MS24F	VF-08	24.4
				Daiwa Dengyo	16	MSA-16-24	FCV16	15.8
					22	MSA-22-24	FCV22	20.8
					28	MSA-28-24	FCV28	26.4
			Angle	Nippon flex	1/2	RCC-304RL-MS24F	VF-04	14.0
					3/4	RCC-306RL-MS24F	VF-06	19.0
					1	RCC-308RL-MS24F	VF-08	24.4
				Daiwa Dengyo	16	MAA-16-24	FCV16	15.8
					22	MAA-22-24	FCV22	20.8
					28	MAA-28-24	FCV28	26.4

・For connection of encoder



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF52(B) to 352(B) HC-RF103(B) to 203(B) HC-UF72(B) to 202(B)	MS3102A20-29P	MS3106A20-29S(D190)	Straight	Nippon flex	1/2	RCC-104RL-MS20F	VF-04	14.0
					3/4	RCC-106RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MSA-16-20	FCV16	15.8
					22	MSA-22-20	FCV22	20.8
			Angle	Nippon flex	1/2	RCC-304RL-MS20F	VF-04	14.0
					3/4	RCC-306RL-MS20F	VF-06	19.0
				Daiwa Dengyo	16	MAA-16-20	FCV16	15.8
					22	MAA-22-20	FCV22	20.8

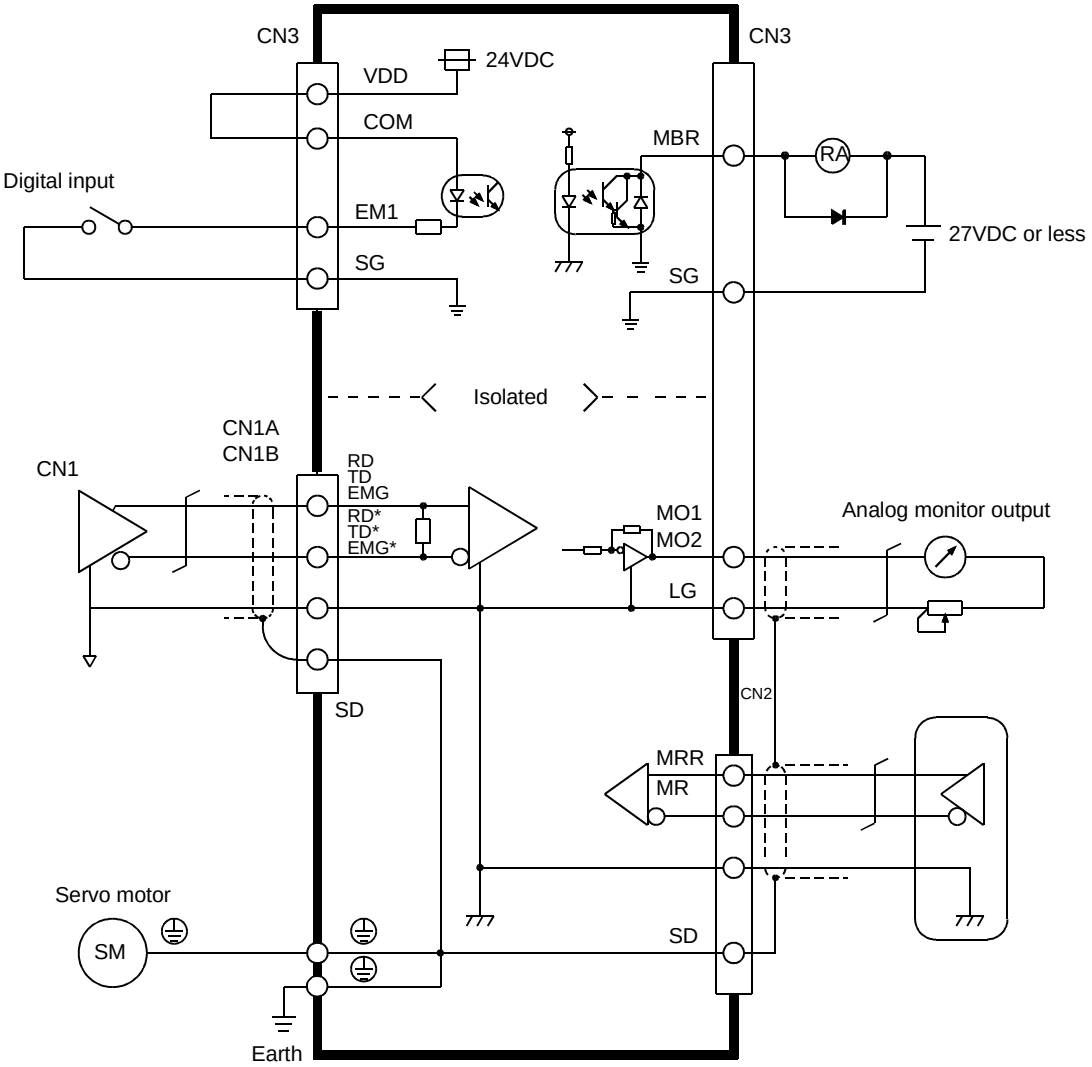
・For connection of brake



Servo Motor	Connector Supplied for Servo Motor	1) Plug (Daiichi Denshi Kogyo)	2) Connector for conduit				Conduit	
			Type	Maker	Size	Model	Model	ID
HC-SF202(B)・352(B) HC-UF202(B)	MS3102E10SL-4P	MS3106A10SL-4S(D190)	Straight	Nippon flex	1/4	RCC-102RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MSA-10-10	FCV10	10
			Angle	Nippon flex	1/4	RCC-302RL-MS10F	VF-02	8.3
				Daiwa Dengyo	10	MAA-10-10	FCV10	10

3 - 3 Common line

The power supply and its common line are shown below.
To conform to the EMC Directive, refer to the EMC INSTALLATION GUIDELINES (IB(NA)67310).

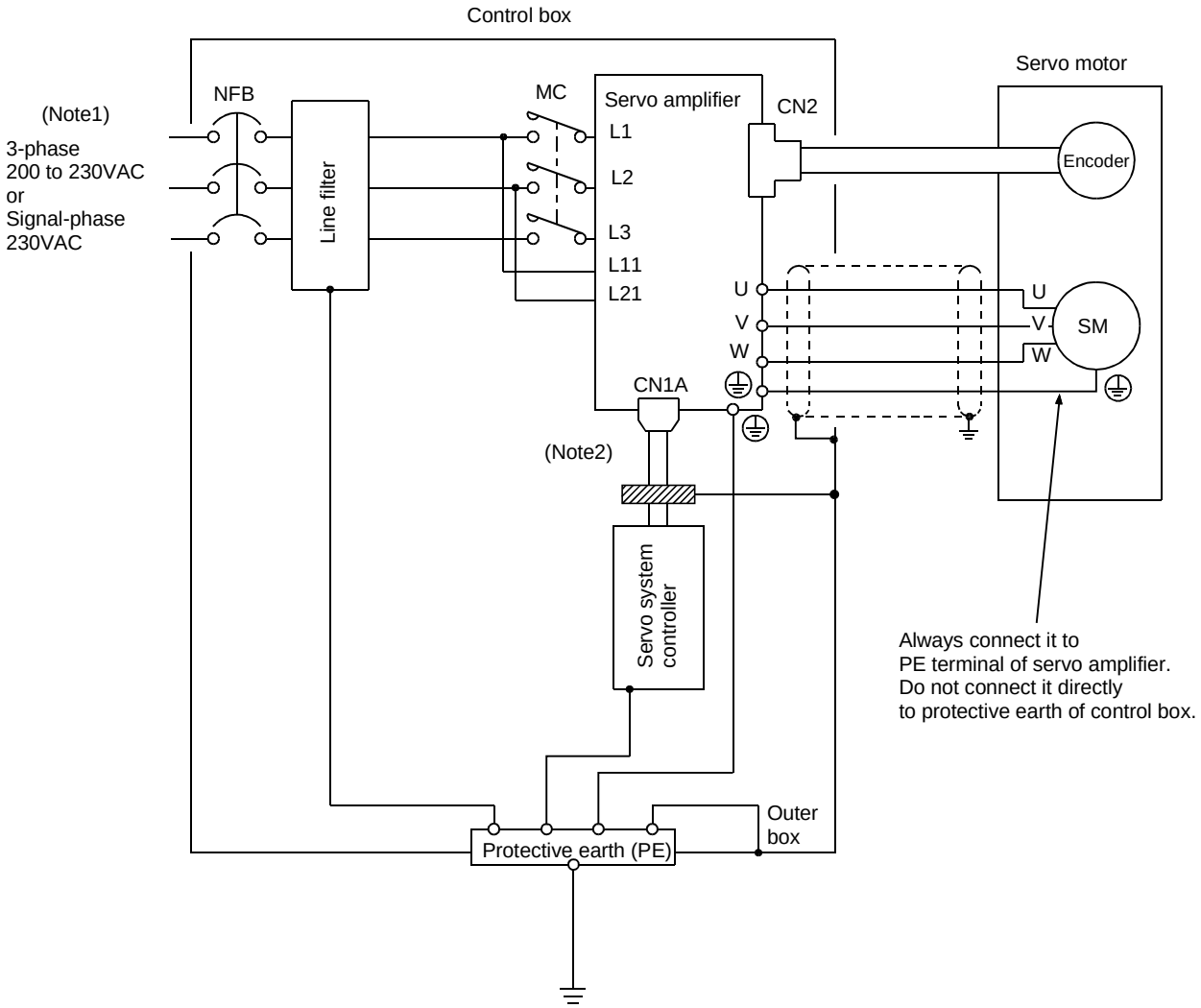


3 - 4 Grounding

⚠ WARNING	1. Ground the servo amplifier and servo motor securely. 2. To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier with the protective earth (PE) of the control box.

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cablerouting, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.

To conform to the EMC Directive, refer to the EMC INSTALLATION GUIDELINES (IB(NA)67310).



Note:1. For a single-phase 230VAC power supply, connect the power supply to L_1 and L_2 and do not connect it to L_3.
2. To reduce the influence of external noise, it is recommended to ground the bus cable using a cable clamping fixture near the controller or to connect three or four data line filters in series.

3 - 5 Power supply circuit

⚠ CAUTION	1. When the servo amplifier has become faulty, switch power off on the servo amplifier power side. Continuous flow of a large current may cause a fire. 2. Use the trouble signal to switch power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor, causing a fire.

(1) Power-on sequence

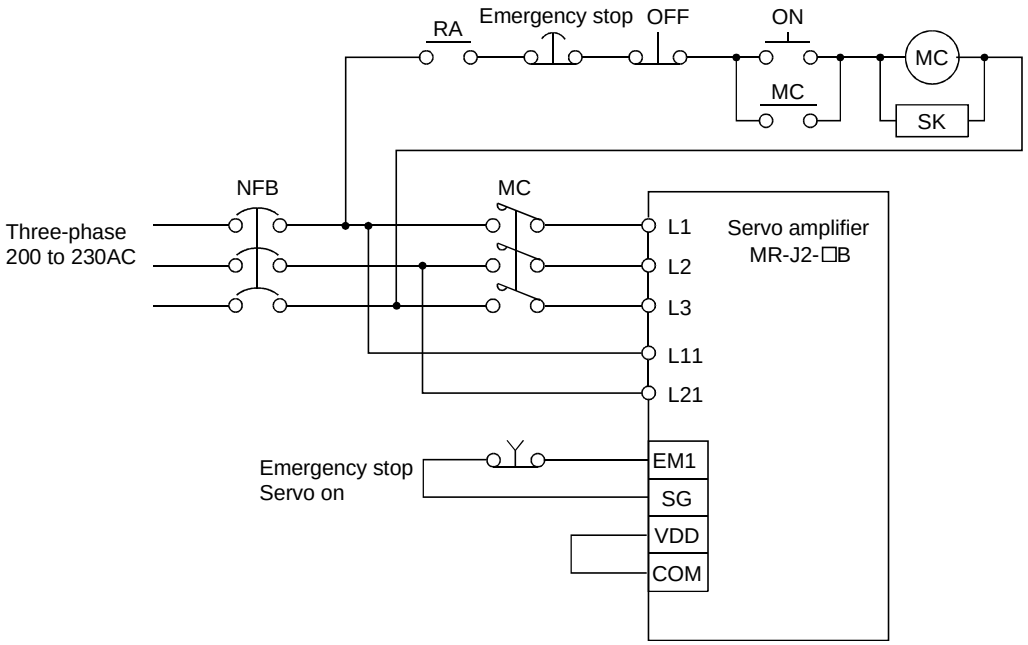
1) Always wire the power supply as shown below using magnetic contactors with the main circuit power supply (L1, L2, L3). Configure up an external sequence to switch off the magnetic contactors as soon as an alarm occurs.
2) Switch on the control circuit power supply L11, L21 simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.
3) The servo amplifier can accept the servo-on signal (SON) about 1 second after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the three-phase power supply, the base circuit will switch on in about 1 second, making the servo amplifier ready to operate. (Refer to paragraph (2) in this section.)
4) For the structure of the external circuit, refer to Section 2-1.

(2) Connection example

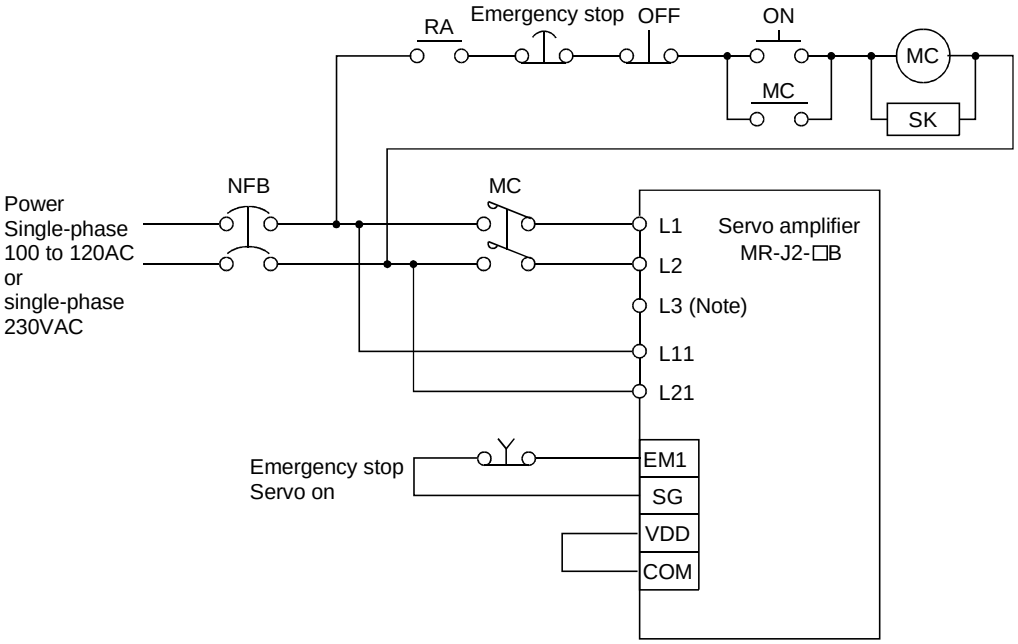
Wire the power supply and main circuits as shown below. A no-fuse breaker (NFB) must be used with the input cables of the power supply.

Wire the circuits so that detection of alarm occurrence switches on power and simultaneously turns off the servo on signal.

1) For three-phase 200 to 230VAC power supply

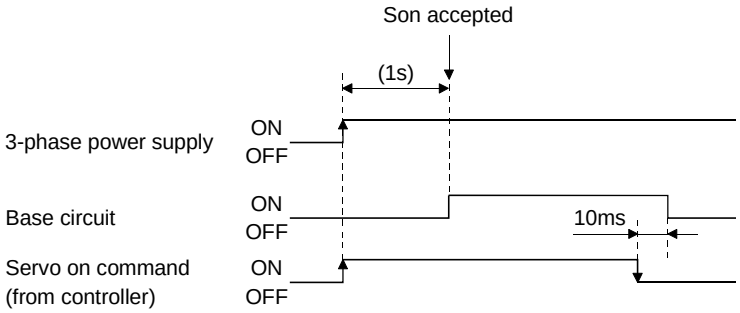


2) For single-phase 100V to 120VAC/single-phase 230VAC power supply



Note: Not provided for single-phase 100V to 120VAC.

(3) Timing chart

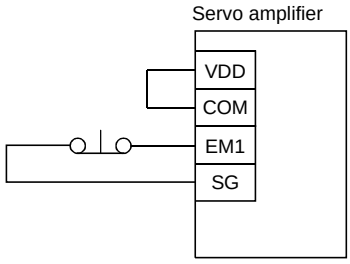


Power ON Timing Chart

(4) Emergency stop

To ensure safety, always install an external emergency stop switch across EM1-SG. By disconnecting EM1-SG, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (E6).

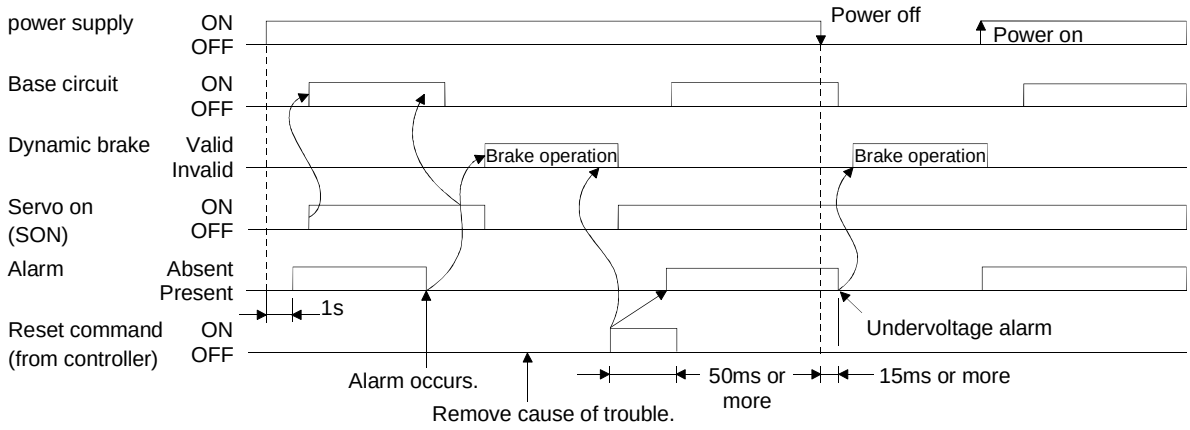
During ordinary operation, do not use the external emergency stop signal to alternate stop and run. Doing so may shorten the life of the servo amplifier.



3 - 6 Alarm occurrence timing chart

⚠ CAUTION	When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. At this time, switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply off, then on. However, the alarm cannot be reset unless its cause of occurrence is removed.



Precautions for alarm occurrence

1) Overcurrent, overload 1 or overload 2

   If operation is repeated by switching control circuit power off, then on to reset the overcurrent (32), overload 1 (50) or overload 2 (51) alarm after its occurrence, without removing its cause, the servo amplifier and servo motor may become faulty due to temperature rise. Securely remove the cause of the alarm and also allow about 30 minutes for cooling before resuming operation.

2) Regenerative alarm

   If operation is repeated by switching control circuit power off, then on to reset the regenerative (30) alarm after its occurrence, the external regenerative brake resistor will generate heat, resulting in an accident.

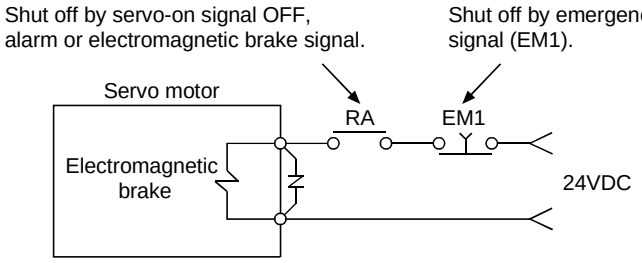
3) Instantaneous power failure

   Undervoltage (10) occurs if power is restored after a 100ms or longer power failure of the control power supply or after a drop of the bus voltage to or below 200VDC. If the power failure persists further, the control power switches off. When the power failure is reset in this state, the alarm is reset and the servo amplifier returns to the initial state.

3 - 7 Servo motor with electromagnetic brake

⚠ CAUTION

1. Make up the electromagnetic brake operation circuit so that it is activated not only by the servo amplifier signals but also by an external emergency stop signal.

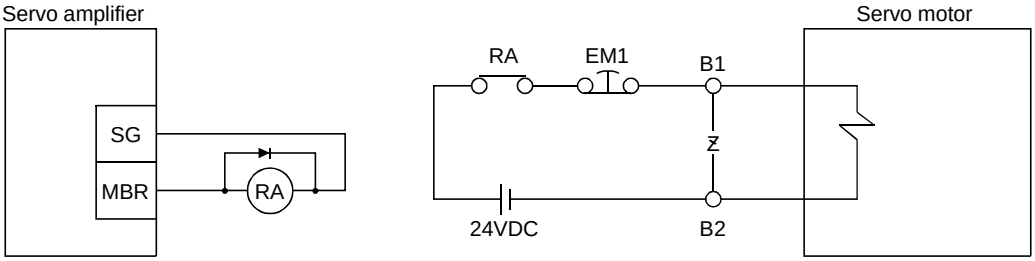


2. The electromagnetic brake is designed for holding and should not be used for ordinary braking.

Note the following when the servo motor equipped with electromagnetic brake is used for applications requiring a brake to hold the motor shaft (vertical lift applications):

1) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.
2) The brake will operate when the power (24VDC) switches off.
3) Turn off the servo on signal after the servo motor has stopped.

(1) Connection diagram



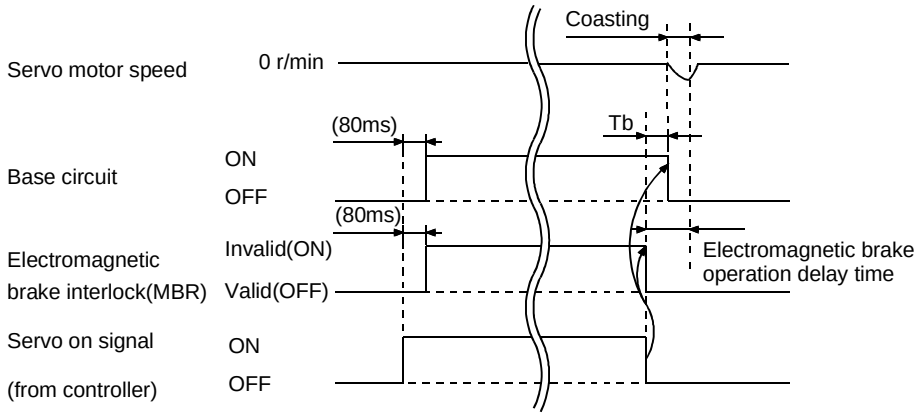
(2) Setting procedure

1) In parameter No. 21 (electromagnetic brake sequence output), set the time delay (Tb) from electromagnetic brake operation to base circuit shut-off at a servo off time as in the timing chart in (3) in this section.

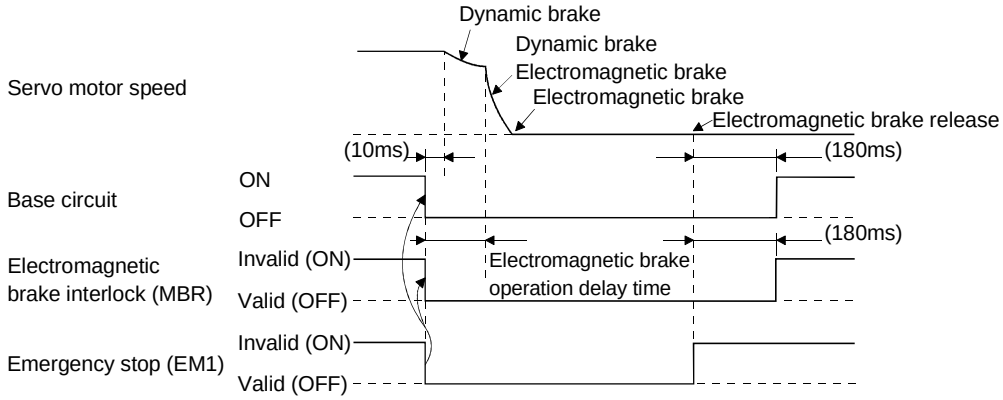
(3) Timing charts

1) Servo on signal command (from controller) ON/OFF

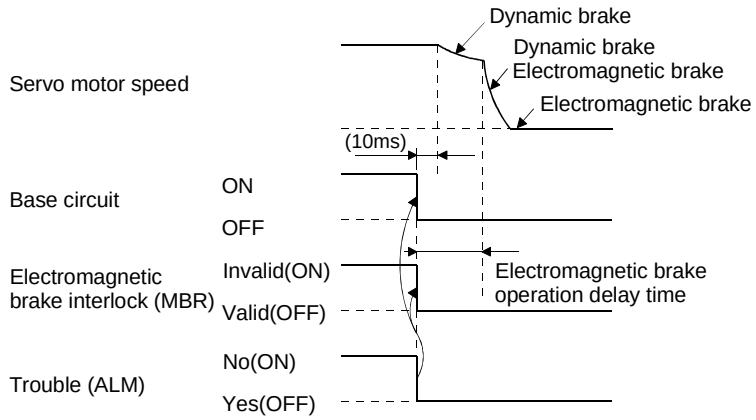
Tb (ms) after the servo-on (SON) signal is switched off, the servo lock is released and the servo motor coasts. If the electromagnetic brake is made valid in the servo lock status, the brake life may be shorter. Therefore, when using the electromagnetic brake in a vertical lift application or the like, set Tb to about the same as the electromagnetic brake operation delay time to prevent a drop.



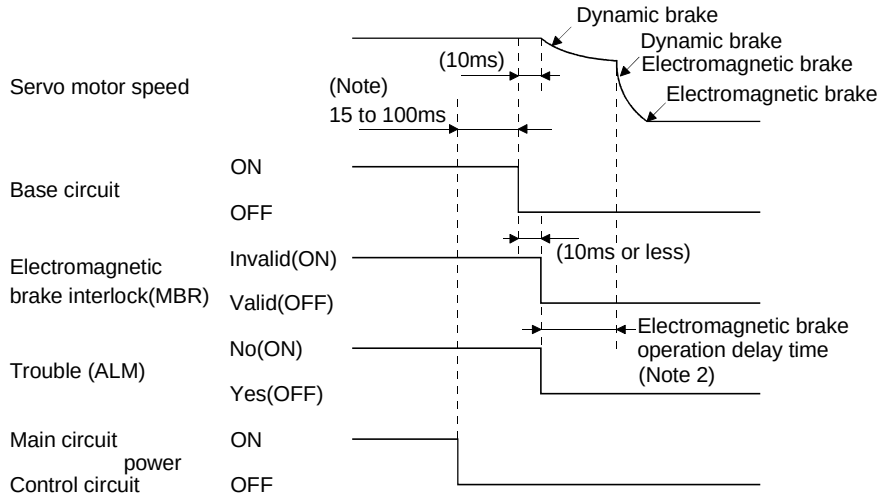
2) Emergency stop signal (EM1) ON/OFF



3) Alarm occurrence

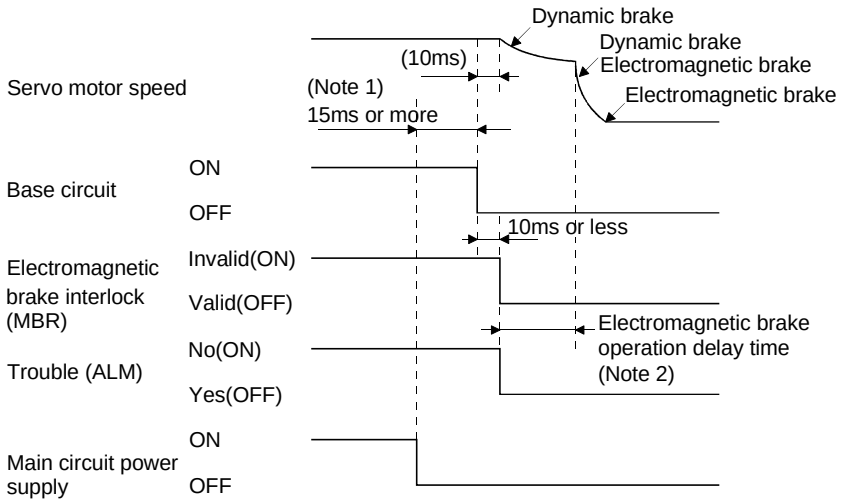


4) Both main and control circuit power supplies off



Note: Changes with the operating status.

5) Only main circuit power supply off (control circuit power supply remains on)



Note: 1. Changes with the operating status.
2. When the main circuit power supply is off in a motor stop status, the main circuit off warning (A.E9) occurs and the ALM signal does not turn off.

4. INSTALLATION

⚠ CAUTION	1. Stacking in excess of the limited number of products is not allowed. 2. Install the equipment to incombustibles. Installing them directly or close to combustibles will led to a fire. 3. Install the equipment in a load-bearing place in accordance with this Installation Guide. 4. Do not get on or put heavy load on the equipment to prevent injury. 5. Use the equipment within the specified environmental condition range. 6. Provide an adequate protection to prevent screws, metallic detritus and other conductive matter or oil and other combustible matter from entering the servo amplifier. 7. Do not block the intake/exhaust ports of the servo amplifier. Otherwise, a fault may occur. 8. Do not subject the servo amplifier and servo motor to drop impact or shock loads as they are precision equipment. 9. Do not install or operate a faulty servo amplifier or servo motor. 10. When the product has been stored for an extended period of time, consult Mitsubishi.

4 - 1 Servo amplifier

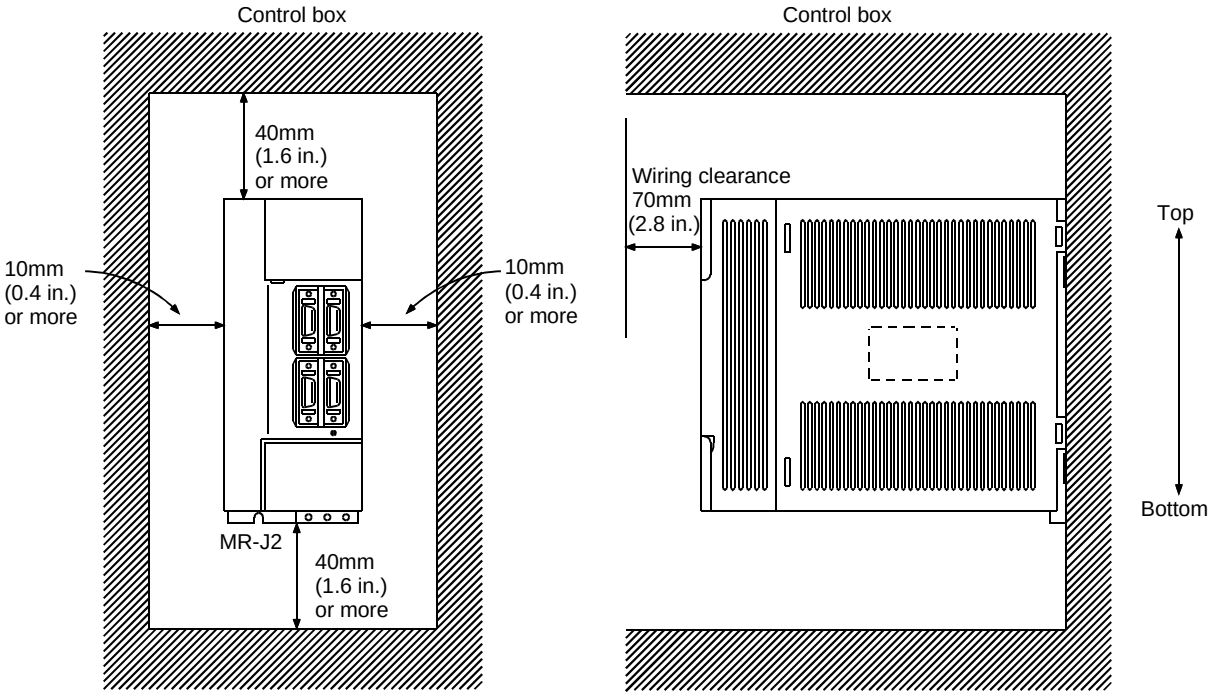
⚠ CAUTION	1. The equipment must be installed in the specified direction. Otherwise, a fault may occur. 2. Leave specified clearances between the servo amplifier and control box inside walls or other equipment.

(1) Environmental conditions

Environment	Conditions
Ambient temperature	0 to +55 [℃] (non-freezing)
	32 to +131 [℉] (non-freezing)
Ambient humidity	90%RH or less (non-condensing)
Storage temperature	−20 to +65 [℃] (non-freezing)
	−4 to +149 [℉] (non-freezing)
Storage humidity	90%RH or less (non-condensing)
Ambient	Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt
Altitude	Max. 1000m (3280 ft) above sea level
Vibration	5.9 [m/s^2] or less
	19.4 [ft/s^2] or less

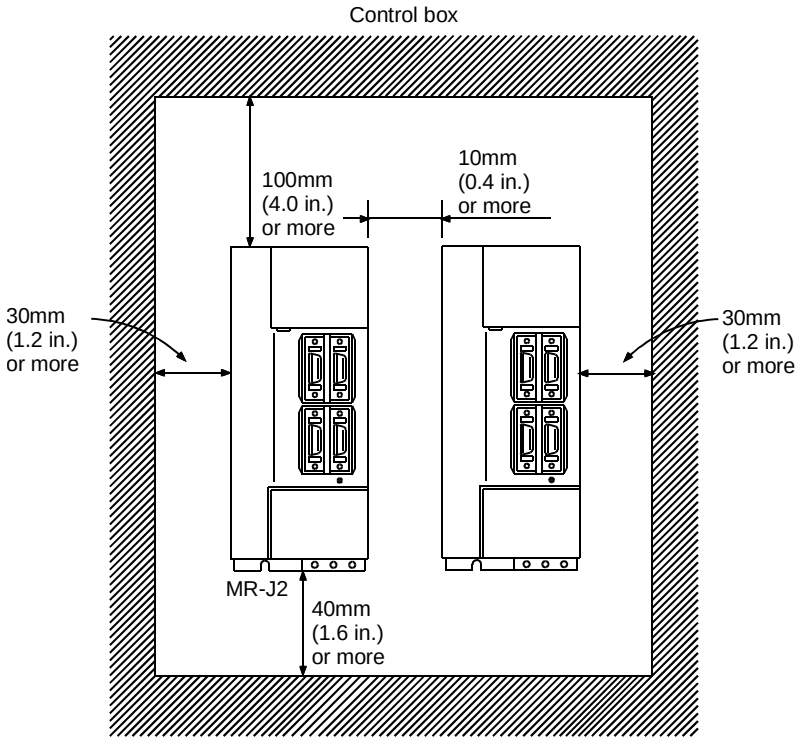
(2) Installation direction and clearances

1) Installation of one servo amplifier



2) Installation of two or more servo amplifiers

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box, and install a fan to prevent the internal temperature of the control box from exceeding the environmental conditions.



3) Others

When using heat generating equipment such as the regenerative brake option, install them with full consideration of heat generation so that the servo amplifier is not affected.

Install the servo amplifier on a perpendicular wall in the correct vertical direction.

(3) Keep out foreign materials

1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.
2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box or a fan installed on the ceiling.
3) When installing the control box in a place where there are toxic gas, dirt and dust, provide positive pressure in the control box by forcing in clean air to prevent such materials from entering the control box.

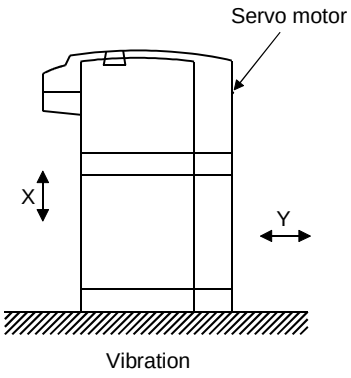
4 - 2 Servo motor

CAUTION

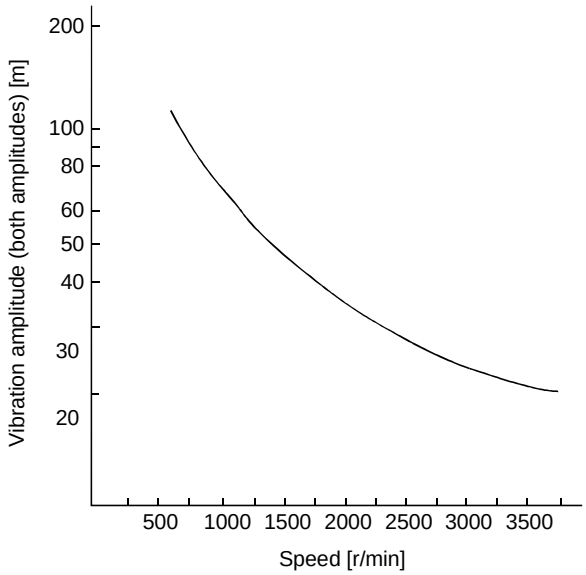
1. Do not hold the cable, shaft or encoder to carry the servo motor. Otherwise, a fault or injury may occur.
2. The lifting eyebolts of the servo motor may only be used to transport the servo motor.
   They must not be used to transport the servo motor when it is mounted on a machine.
3. The servo motor with reduction gear must be installed in the specified direction. Otherwise, it can leak oil, leading to a fire or fault.
4. Securely fix the servo motor to the machine. If fixed insecurely, the servo motor will come off during operation, leading to injury.
5. When coupling the shaft end of the servo motor, do not subject the shaft end to impact, such as hammering. The encoder may become faulty.
6. Cover the shaft of the servo motor to make its rotary part completely inaccessible during operation.
7. Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break, leading to injury.

(1) Environmental conditions

Environment		Conditions		
Ambient temperature	[℃]	0 to +40 (non-freezing)		
	[°F]	32 to +104 (non-freezing)		
Ambient humidity		80%RH or less (non-condensing)		
Storage temperature	[℃]	−15 to +70 (non-freezing)		
	[°F]	5 to 158 (non-freezing)		
Storage humidity		90%RH or less (non-condensing)		
Ambient		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt		
Altitude		Max. 1000m (3280ft) above sea level		
Vibration	[m/s²]	MC-MF series HA-FF series	HU-UF13 to 73	X・Y: 19.6
		HC-SF81 HC-SF52 to 152 HC-SF53 to 153	HC-RF series HC-UF72・152	X: 9.8 Y: 24.5
		HC-SF121・201 HC-SF202・352	HC-SF203・353 HC-UF202	X: 19.6 Y: 49
		HC-SF301		X: 11.7 Y: 29.4
	[ft/s²]	MC-MF series HA-FF series	HC-UF13 to 73	X・Y:64
		HC-SF81 HC-SF52 to 152 HC-SF53 to 153	HC-RF series HC-UF72・152	X: 32 Y: 80
		HC-SF121・201 HC-SF202・352	HC-SF203・353 HC-UF202	X: 64 Y: 161
		HC-SF301		X: 38 Y: 96



Graph of vibration servo amplitude vs. speed

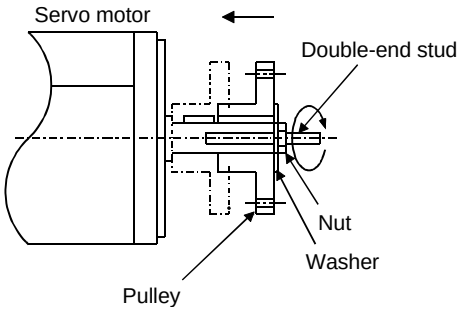


(2) Transportation

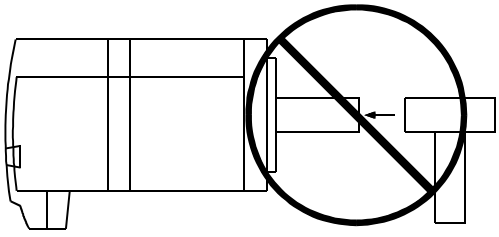
Do not hold the encoder or shaft to carry the servo motor.

(3) Load mounting precautions (Prevention of impact on shaft)

1) When mounting a pulley to the servo motor shaft provided with a keyway, use the screw hole in the shaft end. To fit the pulley, first insert a double-end stud into the screw hole of the shaft, put a washer against the end face of the coupling, and insert and tighten a nut to force the pulley in.



2) For the servo motor shaft with a keyway, use the screw hole in the shaft end. For the shaft without a keyway, use a friction coupling or the like.
3) When removing the pulley, use a pulley remover to protect the shaft from impact.
4) To ensure safety, fit a protective cover or the like on the rotary area, such as the pulley, mounted to the shaft.
5) When a threaded shaft end part is needed to mount a pulley on the shaft, please contact us.
6) During assembling, the shaft end must not be hammered.



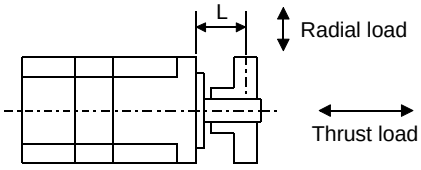
7) The orientation of the encoder on the servo motor cannot be changed.
8) For installation of the servo motor, use spring washers, etc. and fully tighten the bolts so that they do not become loose due to vibration.

(4) Permissible load for the shaft

1) Use a flexible coupling and make sure that the misalignment of the shaft is less than the permissible radial load.
2) When using a pulley, sprocket or timing belt, select a diameter that will fit into the permissible radial load.
3) Do not use a rigid coupling as it may apply excessive bending load to the shaft, leading to shaft breakage.

Servo Motor		L		Permissible Radial Load		Permissible Thrust Load	
		[mm]	[in]	[N]	[lb]	[N]	[lb]
HC-MF	053・13	25	0.98	88	20	59	13
	23・43	30	1.18	245	55	98	22
	73	40	1.57	392	88	147	33
HA-FF	053	30	1.18	108	24	98	22
	13	30	1.18	118	27	98	22
	23・33	30	1.18	176	40	147	33
	43・63	40	1.57	323	73	284	64
HC-SF	81	55	2.17	980	220	490	110
	121 to 301	79	3.11	2058	463	980	220
	52 to 152	55	2.17	980	220	490	110
	202・352	79	3.11	2058	463	980	220
	53 to 153	55	2.17	980	220	490	110
	203・353	79	3.11	2058	463	980	220
HC-RF	103 to 203	45	1.77	686	154	196	44
HC-UF	72・152	55	2.17	637	143	490	110
	202	65	2.56	882	198	784	176
	13	25	0.98	88	20	59	13
	23・43	30	1.18	245	55	98	22
	73	40	1.57	392	88	147	33

Note: For the symbols in the table, refer to the following diagram:

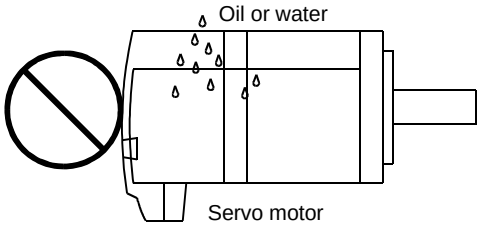


L: Distance from flange mounting surface to load center

(5) Protection from oil and water

1) The HC-MF/HA-FF Series servo motor is not waterproof (IP44). Do not subject the servo motor to oil and water.

Servo Motor Series	Protection
HC-MF · HA-FF	IP44
HC-SF · HC-RF	IP65

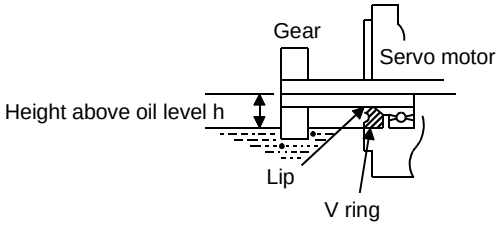


2) When the gear box is mounted horizontally, the oil level in the gear box should always be lower than the oil seal lip on the servo motor shaft. If it is higher than the oil seal lip, oil will enter the servo motor, leading to a fault. Also, provide a breathing hole in the gear box to hold the internal pressure low.

The HC-MF series servo motor is not equipped with a V ring or an oil seal and cannot be used with the gear box as described above. Oil should be shut off on the gear box side.

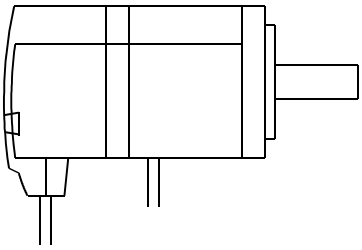
Some HA-FF series servo motors are equipped with an oil seal. Please contact Mitsubishi.

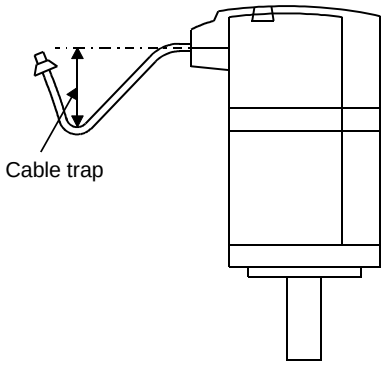
The HA-FF series servo motor equipped with an oil seal is available. Please contact Mitsubishi.



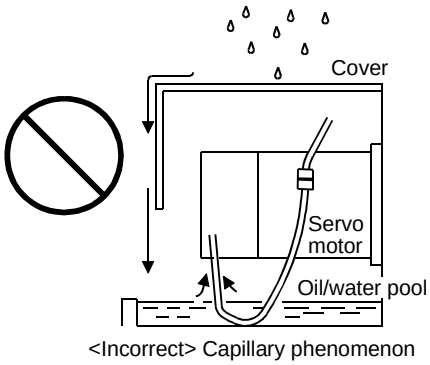
Servo Motor		Height above Oil Level h	
		[mm]	[in]
HA-FF	053 · 13	8	0.31
	23 · 33	12	0.47
	43 · 63	14	0.55
HC-SF	81	20	0.79
	121 to 301	25	0.98
	52 to 152	20	0.79
	202 · 352	25	0.98
	53 to 153	20	0.79
	203 · 353	25	0.98
HC-RF	103 to 203	20	0.79
HC-UF	72 · 152	20	0.79
	202	25	0.98
	13	12	0.47
	23 · 43	14	0.55
	73	20	0.79

3) When installing the servo motor horizontally, face the power cable and encoder cable downward. When installing the servo motor vertically or obliquely, provide a trap for the cable.



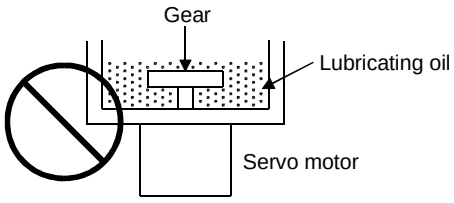


4) Do not use the servo motor with its cable soaked in oil or water. (Figure on the right)



<Incorrect> Capillary phenomenon

5) When the servo motor is to be installed with the shaft end at top, provide measures to prevent oil from entering the servo motor from the gear box, etc.

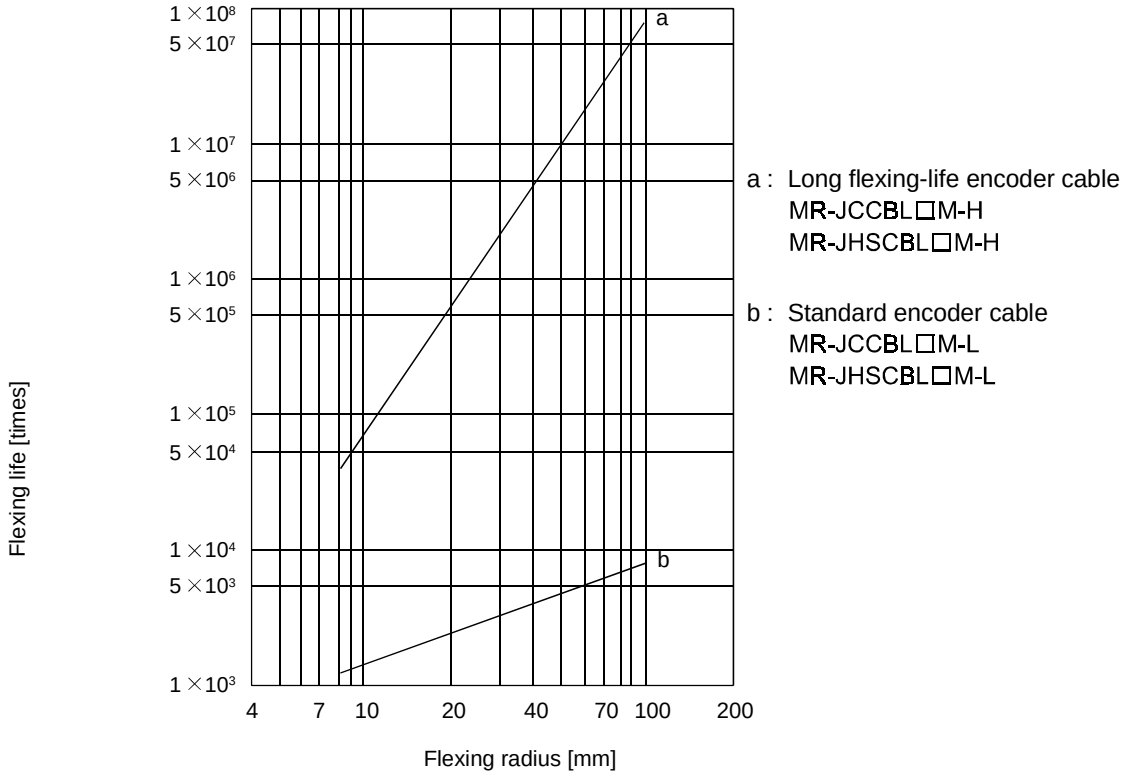


(6) Installation orientation

The servo motor may be installed in any orientation. When the servo motor with electromagnetic brake is installed with the shaft end at top, the brake plate may generate sliding sound but it is not a fault. Refer to Section 10.3 for the installation orientation of the servo motor with reduction gear.

(7) Cable stress

1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.
2) In any application where the servo motor moves, the cables should be free from excessive stress. For use in any application where the servo motor itself will move, run the cables so that their flexing portions fall within the flexing life range of the encoder cable. Fix the encoder cable and power cable of the servo motor.
3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.
4) The flexing lives of the cables are shown below. In actuality, provide a little allowance for these values. For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible.



Note: This graph gives calculated values which are not guaranteed.

Flexing Lives of Encoder Cables

5. ABSOLUTE POSITION DETECTION SYSTEM

(1) Specifications

Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal + 3.6V) Type: MR-BAT or A6BAT
Encoder resolution	Refer to (2) in Section 10-1.
Maximum revolution range	Home position ± 32767 rev.
(Note 1) Maximum speed at power failure	500r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
(Note 3) Data holding time during battery replacement	2 hours at delivery, 1 hour in 5 years after delivery
Battery storage period	5 years from date of manufacture

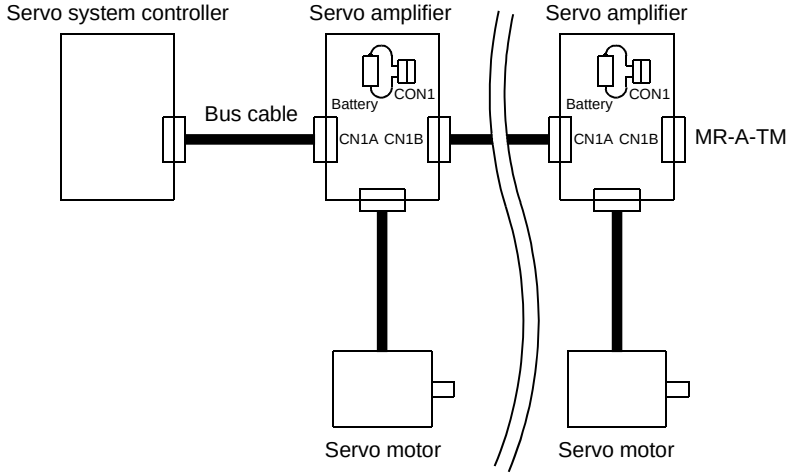
Note: 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.
2. Time to hold data by a battery with power off.
3. Period during which data can be held by the super capacitor in the encoder after power-off, with the battery voltage low or the battery removed, or during which data can be held with the encoder cable disconnected. Battery replacement should be finished within this period.

(2) Structure

1) Components

Component	Description
Servo amplifier	Use standard models.
Servo motor	
Battery	MR-BAT or A6BAT
Encoder cable	Use a standard model. When fabricating, refer to (2), Section 6-1-2.
Bus cable	Use MR-J2HBUS □M-A/MR-J2HBUS □M.
Servo system controller	273UH/171S/Model W/AD75M

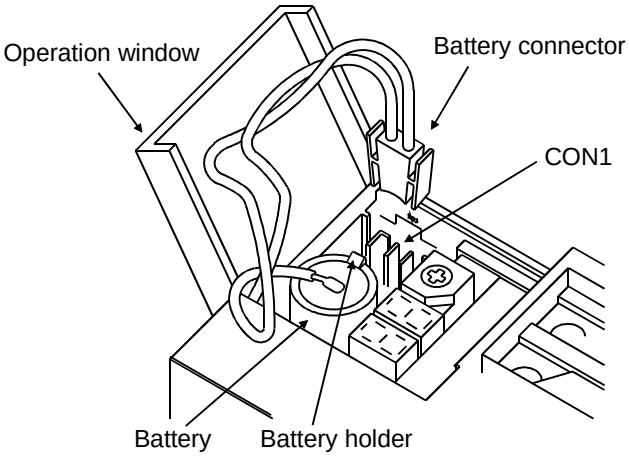
2) Configuration



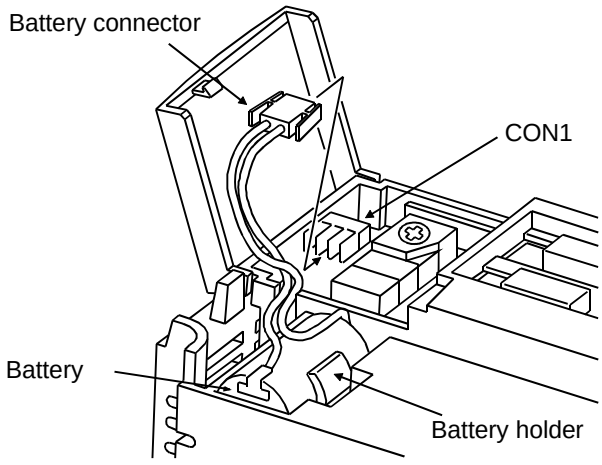
(3) Battery installation procedure

NOTICE	The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions: 1. Ground human body and work bench. 2. Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

1) Open the operation window. (When the model used is the MR-J2-200B or more, also remove the front cover.)
2) Install the battery in the battery holder.
3) Insert the battery connector into CON1 until it clicks.



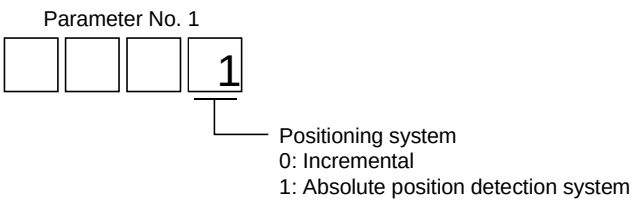
For MR-J2-200B or less



For MR-J2-200B or more

(4) Parameter setting

Set □□□1 in parameter No. 1 to make the absolute position detection system valid.



6. OPTION AND AUXILIARY EQUIPMENT

⚠ WARNING	Before connecting any option or auxiliary equipment, make sure that the charge lamp is off more than 10 minutes after power-off, then confirm the voltage with a tester or the like. Otherwise, you may get an electric shock.

⚠ CAUTION	Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.

6 - 1 Dedicated options

6 - 1 - 1 Regenerative brake options

⚠ CAUTION	The specified combinations of regenerative brake options and servo amplifiers may only be used. Otherwise, a fire may occur.

(1) Combination and regenerative power

Servo Amplifier Model	(Note) Regenerative Power[W]					
	Built-in regenerative brake resistor	MR-RB032 [40Ω]	MR-RB12 [40Ω]	MR-RB32 [40Ω]	MR-RB30 [13Ω]	MR-RB50 [13Ω]
MR-J2-10B	Without	30				
MR-J2-20B	10	30	100			
MR-J2-40B	10	30	100			
MR-J2-60B	10	30	100			
MR-J2-70B	20	30	100	300		
MR-J2-100B	20	30	100	300		
MR-J2-200B	100				300	500
MR-J2-350B	100				300	500

Note: This value is the regenerative power of the resistor and is not the rated power.

(2) Selection of the regenerative brake option

1) Simple selection method

In horizontal motion applications, select the regenerative brake option as described below:

When the servo motor is run without load in the regenerative mode from the running speed to a stop, the permissible duty is as indicated in the standard specifications (Section 10-1). For the servo motor with a load, the permissible duty changes according to the inertia moment of the load and can be calculated by the following formula:

$$\text{Permissible duty} = \frac{\text{permissible duty for servo motor with no load (value indication Section 10-1)}}{(m+1)} \times \left(\frac{\text{ratedspeed}}{\text{running speed}} \right)^2 \text{[times/minute]}$$

From the permissible duty, find whether the regenerative brake option is required or not.

Permissible duty < number of positioning times n1

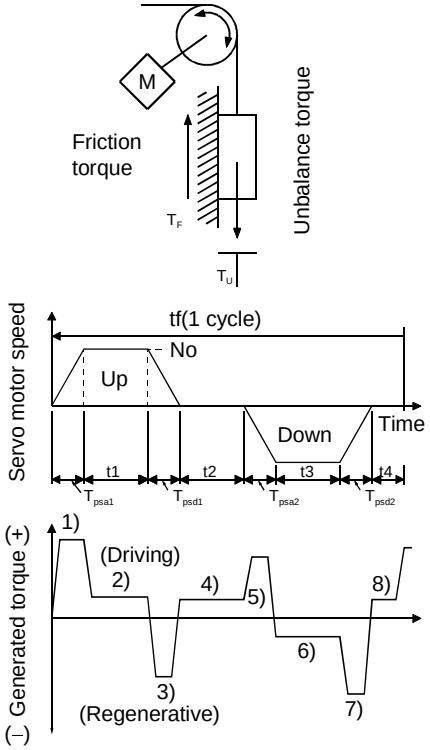
Select the regenerative brake option out of the combinations in (1) in this section.

2) To make selection according to regenerative energy

Use the following method when regeneration occurs continuously in vertical motion applications or when it is desired to make an in-depth selection of the regenerative brake option:

a. Regenerative energy calculation

Use the following table to calculate the regenerative energy.



Formulas for Calculating Torque and Energy in Operation

Regenerative Power	Torque applied to servo motor [N • m]	Energy [J]
1)	$T_1=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psa1}}+T_U+T_F$	$E_1=\frac{0.1047}{2}\cdot No\cdot T_1\cdot T_{Psa1}$
2)	$T_2=T_U+T_F$	$E_2=0.1047\cdot No\cdot T_2\cdot t_1$
3)	$T_3=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psd1}}+T_U+T_F$	$E_3=\frac{0.1047}{2}\cdot No\cdot T_3\cdot T_{Psd1}$
4), 8)	$T_4=T_U$	$E_4\geqq0$ (No regeneration)
5)	$T_5=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psa2}}-T_U+T_F$	$E_5=\frac{0.1047}{2}\cdot No\cdot T_5\cdot T_{Psa2}$
6)	$T_6=T_U+T_F$	$E_6=0.1047\cdot No\cdot T_6\cdot t_3$
7)	$T_7=\frac{(J_L+J_M)\cdot No}{9.55\times10^4}\cdot\frac{1}{T_{Psd2}}-T_U+T_F$	$E_7=\frac{0.1047}{2}\cdot No\cdot T_7\cdot T_{Psd2}$
Sum total of regenerative energies		Sum total of negative energies in 1) to 8)

b. Losses of servo motor and servo amplifier in regenerative mode

The following table lists the efficiencies and other data of the servo motor and servo amplifier in the regenerative mode.

Servo Amplifier	Inverse Efficiency[%]	Capacitor Charging[J]
MR-J2-10B	55	9
MR-J2-20B	70	9
MR-J2-40B	85	11
MR-J2-60B	85	11
MR-J2-70B	80	18
MR-J2-100B	80	18
MR-J2-200B	85	40
MR-J2-350B	85	40

Inverse efficiency (η) :Efficiency including some efficiencies of the servo motor and servo amplifier when rated (regenerative) torque is generated at rated speed. Since the efficiency varies with the speed and generated torque, allow for about 10%.

Capacitor charging (Ec) :Energy charged into the electrolytic capacitor in the servo amplifier.

Subtract the capacitor charging from the result of multiplying the sum total of regenerative energies by the inverse efficiency to calculate the energy consumed by the regenerative brake option.

$$ER\ [J] = \eta \cdot Es - Ec$$

Calculate the power consumption of the regenerative brake option on the basis of single-cycle operation period tf [s] to select the necessary regenerative brake option.

$$PR\ [W] = ER/tf \quad \text{.....(6-1)}$$

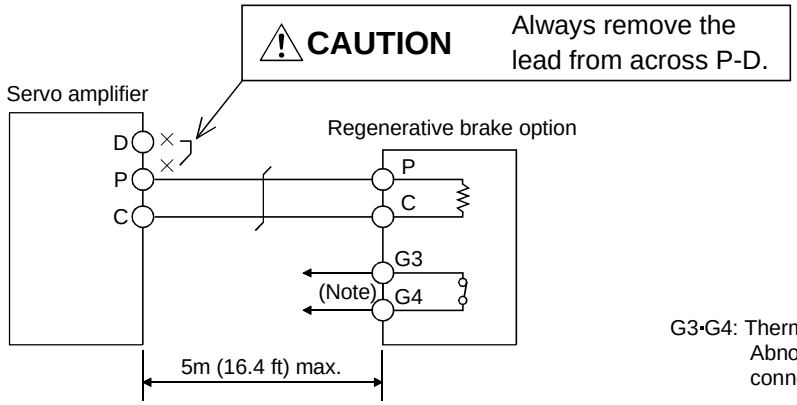
(3) Connection of the regenerative brake option

When using the regenerative brake option, always remove wiring from across P-D and install the regenerative brake option across P-C. Set parameter No.2 according to the option to be used. The regenerative brake option will generate heat of about 100℃. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use fire-retarding cables and keep them clear of the regenerative brake option body. Always use twisted cables of max. 5m length for connection with the servo amplifier.

Parameter No. 2

0	0		

Selection of regenerative brake option
00:Not used.
05:MR-RB 32
08:MR-RB 30
09:MR-RB 50
10:MR-RB 032
11:MR-RB 12



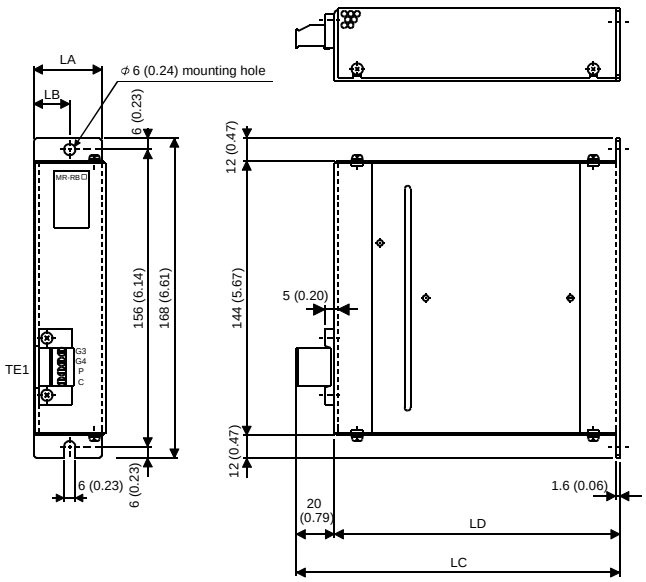
G3•G4: Thermal protector terminals. Abnormal heating will disconnect G3-G4.

Note: Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.

(4) Outline drawing

1) MR-RB032 · MR-RB12

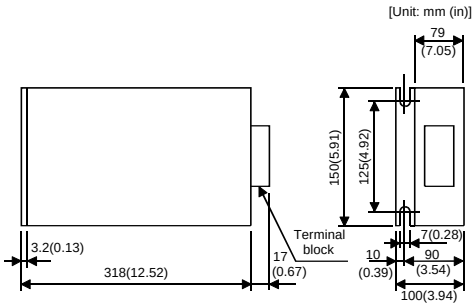
[Unit: mm (in)]



Regenerative Brake Option	Regenerative Power[W]	Resistance [Ω]	Variable Dimensions				Weight	
			LA	LB	LC	LD	[kg]	[lb]
MR-RB032	30	40	30 (1.18)	15 (0.59)	119 (4.69)	99 (3.9)	0.5	1.1
MR-RB12	100	40	40 (1.57)	15 (0.59)	169 (6.69)	149 (5.87)	1.1	2.4

2) MR-RB32 · MR-RB30

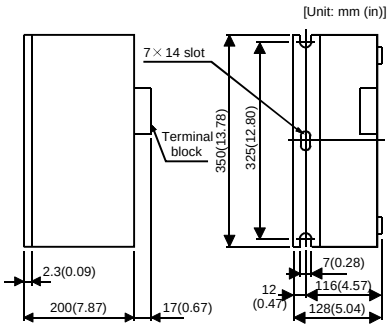
[Unit: mm (in)]



Regenerative Brake Option	Regenerative Power [W]	Resistance [Ω]	Weight	
			[kg]	[lb]
MR-RB32	300	40	2.9	6.4
MR-RB30	300	13	2.9	6.4

3) MR-RB50

[Unit: mm (in)]



Regenerative Brake Option	Regenerative Power [W]	Resistance [Ω]	Weight	
			[kg]	[lb]
MR-RB50	500	13	5.6	12.3

6 - 1 - 2 Cable connectors

(1) Cable selection

Use the encoder cable 1), 2), 3) or 4) after confirming the servo motor series and required wiring length. When fabricating the encoder cable, use the encoder connector set 5) or 6) and refer to (2) in this section.

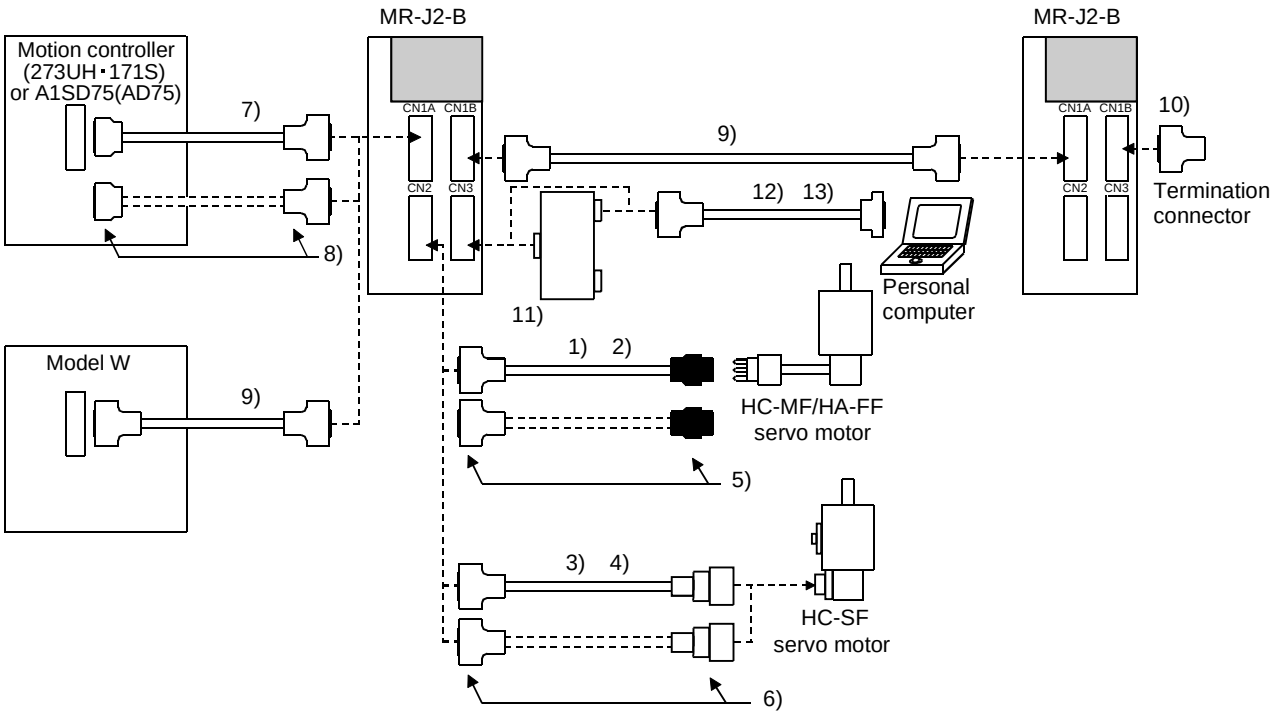
Use the bus cable 7) or 9) for connection with the servo system controller, and 9) for connection between the servo amplifiers.

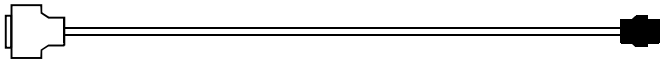
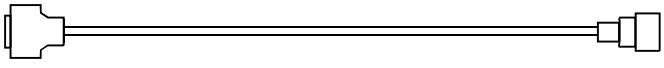
When using the personal computer during operation, use the maintenance junction card 11) and also use the communication cable 12) or 13).

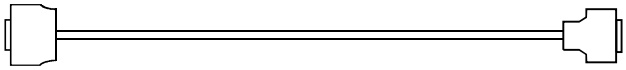
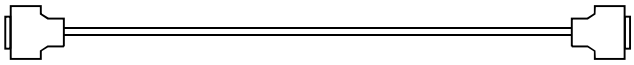
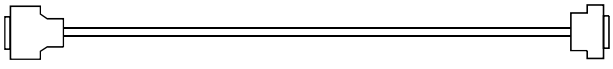
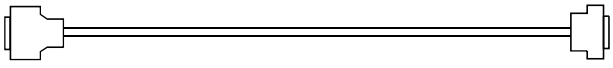
Use 7) for connection of the MR-J2-B and MR-H-B or MR-J2-B and MR-J-B.

For the servo amplifier at the termination, connect 10) to CN1B.

For the outline drawing of each connector, refer to Section 10-5-4.



Product			Model	Description
For CN2	1)	Standard encoder cable for HC-MF/HA-FF HC-UF 3000r/min	MR-JCCBL□M-L Cable length in □ : 2, 5, 10, 20, 30[m]	Servo amplifier side connector (3M or equivalent) 10120-3000VE (Connector) 10320-52F0-008 (Shell kit) / Servo motor encoder side connector (AMP) 1-172161-9 (Connector)
	2)	Long flexing-life encoder cable for HC-MF/HA-FF HC-UF 3000r/min	MR-JCCBL□M-H Cable length in □ : 2, 5, 10, 20, 30, 40, 50[m]	
	3)	Standard encoder cable for HC-SF/HC-RF HC-UF 2000r/min	MR-JHSCBL□M-L Cable length in □ : 2, 5, 10, 20, 30, 40, 50[m]	Servo amplifier side connector (3M or equivalent) 10120-3000VE (Connector) 10320-52F0-008 (Shell kit) / Servo motor encoder side connector (Japan Aviation Electronics) MS3106B20-29S (Straight plug) MS-3057-12A (Cable clamp)
	4)	Long flexing-life encoder cable for HC-SF/HC-RF HC-UF 2000r/min	MR-JHSCBL□M-H Cable length in □ : 2, 5, 10, 20, 30, 40, 50[m]	

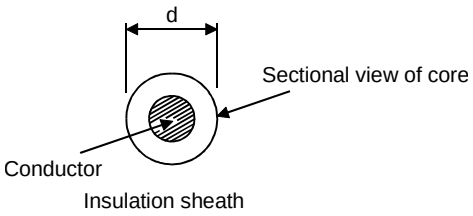
Product			Model	Description
For CN2	5)	Encoder connector set for HC-MF/HA-FF	MR-J2CNM	Servo amplifier side connector (3M or equivalent) 0120-3000VE (Connector) 10320-52F0-008 (Shell kit)  Servo motor encoder side connector (AMP) 1-172161-9 (Housing) 170359-1 (Connector pin) MTI-0002 (Clamp) 
	6)	Encoder connector set for HC-SF	MR-J2CNS	Servo amplifier side connector (3M or equivalent) 10120-3000VE (Connector) 10320-52F0-008 (Shell kit)  Servo motor encoder side connector (Japan Aviation Electronics) MS3106B20-29S (Straight plug) MS-3057-12A (Cable clamp) 
For CN1A CN1B	7)	Controller to amplifier bus cable	MR-J2HBUS□M-A Cable length within □ :0.5, 1, 5[m]	Controller side connector (Honda Tsushin) PCR-S20FS (Connector) PCR-LS20LA1 (Shell kit) Servo amplifier side connector (3M or equivalent) 10120-3000VE (Connector) 10320-3210-000 (Shell kit) 
	8)	Controller to amplifier connector set	MR-J2CN1-A	Controller side connector (Honda Tsushin) PCR-S20FS (Connector) PCR-LS20LA1 (Shell kit) Servo amplifier side connector (3M or equivalent) 10120-3000VE (Connector) 10320-520F0-008 (Shell kit) 
	9)	Amplifier to amplifier bus cable	MR-J2HBUS□M Cable length in □ :0.5, 1, 5[m]	10120-6000EL (Connector) 10320-3210-000 (Shell kit) 10120-6000EL (Connector) 10320-3210-000 (Shell kit) 
	10)	Termination connector	MR-A-TM	
For CN3	11)	Maintenance junction card	MR-J2CN3TM	Refer to Section 6-1-4.
	12)	Communication cable for PC98	MR-CPC98CBL3M Cable length: 3[m]	Servo amplifier side connector (3M or equivalent) 10120-6000EL (Connector) 10320-3210-000 (Shell kit) Personal computer side connector (Japan Aviation Electronics Industry) Connector: DE-25PF-N Case: DB-C2-J9 
	13)	Communication cable for DOS/V	MR-CPCATCBL3M Cable length: 3[m]	Servo amplifier side connector (3M or equivalent) 10120-6000EL (Connector) 10320-3210-000 (Shell kit) Personal computer side connector (Japan Aviation Electronics Industry) Connector: DE-9SF-N Case: DE-C1-J6-S6 

(2) Standard encoder cable

The specifications and connection of each cable are indicated below. A fabricated cable should be as specified in the following table or equivalent and connected correctly.

Core Size [mm^2] ×Pair	Core Insulation Sheath OD (Note) d [mm]	Recommended Cable Model	Cable Type
0.08×7	0.9 to 1.27	UL20276 AWG28 7pair (BLACK)	Standard encoder cable Communication cable
0.08×10		UL20276 AWG28 10pair (BLACK)	Bus cable
0.2×7		UL20276 AWG24 7pair (BLACK)	Standard encoder cable
0.3×7		UL20276 AWG22 7pair (BLACK)	Standard encoder cable

Note: d is as shown below.

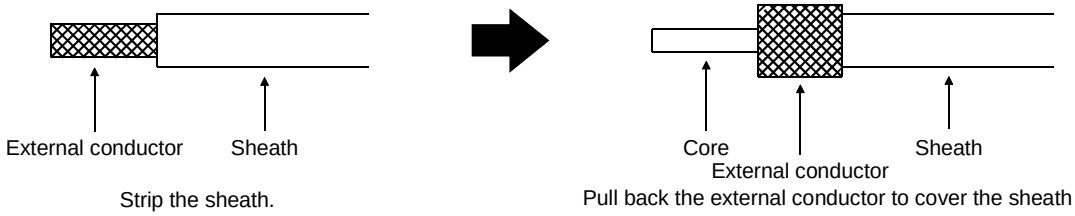


Core Size [mm^2] ×Pair	Characteristics of One Core		Recommended Cable Model	Cable Type
	Structure [pcs./mm]	Conductor resistance[Ω/km]		
0.2×6	40/0.08	105 max.	(Note) A14B2343	Flexing, long-life encoder cable

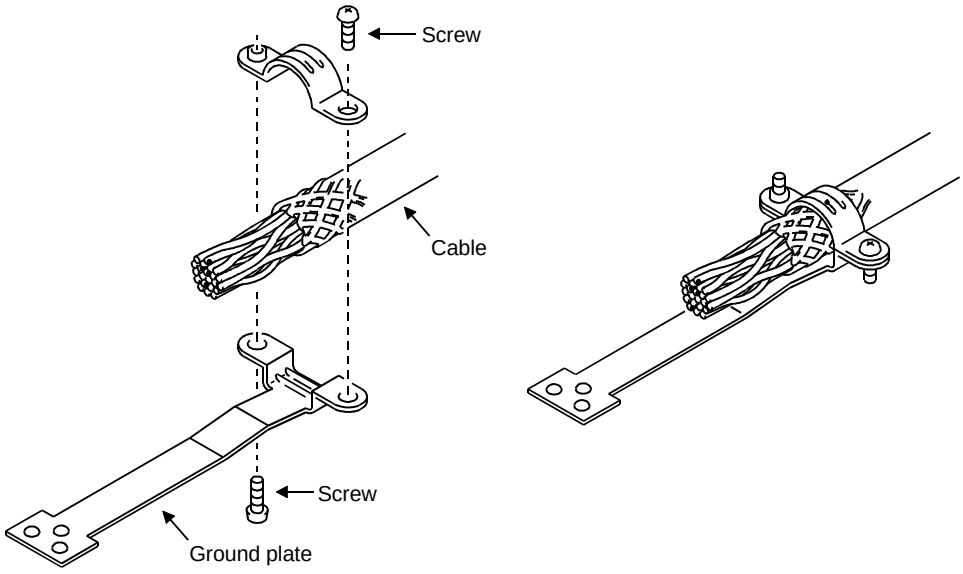
Note: Junkosha make, purchased from Toa Electric

For the control signal connector, connect the external conductor of the shielded cable to the ground plate securely as shown below.

a. Termination of external conductor



b. Fitting of the ground plate



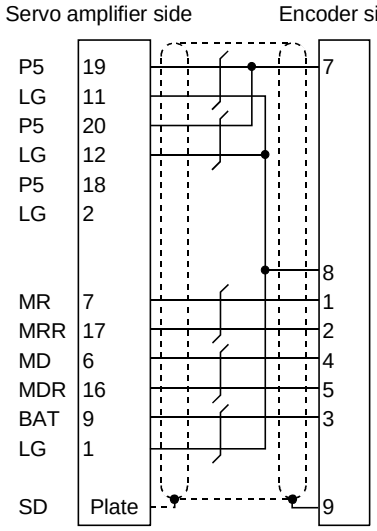
1) Encoder cable connection diagrams

⚠ CAUTION	If you have fabricated the encoder cable, connect it correctly. Otherwise, misoperation or explosion may occur.

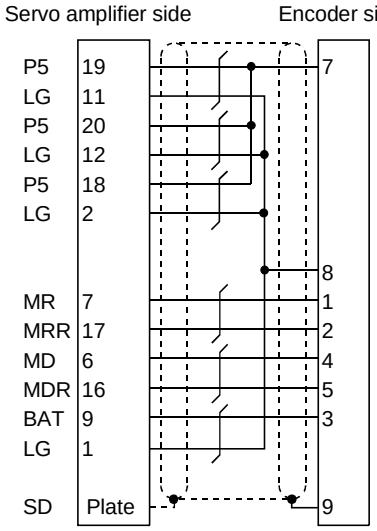
a. For HC-MF/HA-FF

Optional cables

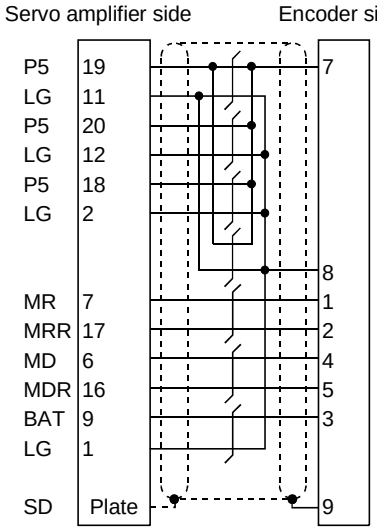
MR-JCCBL2M-L
MR-JCCBL5M-L
MR-JCCBL2M-H
MR-JCCBL5M-H



MR-JCCBL10M-L
to
MR-JCCBL30M-L



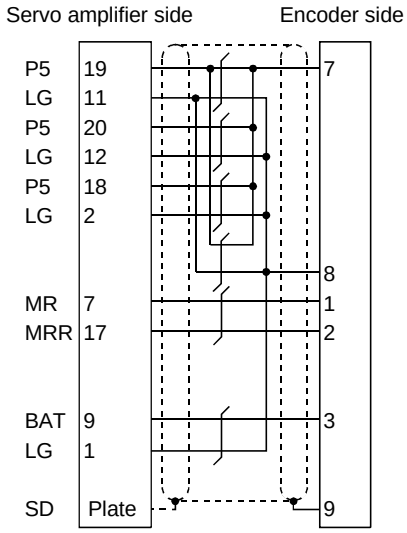
MR-JCCBL10M-H
to
MR-JCCBL50M-H



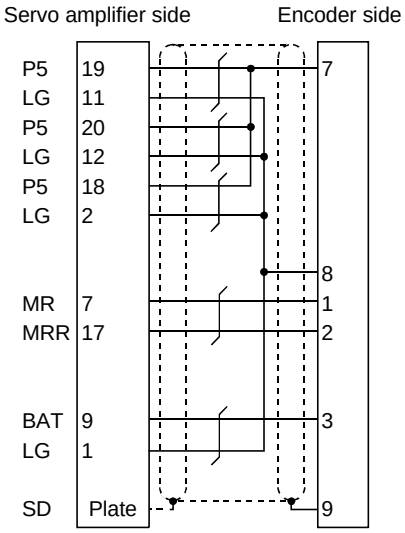
For fabrication

When fabricating an encoder cable, fabricate it as shown below. The cable of max. 50m length may be fabricated. When the encoder cable is to be fabricated by the customer, MD and MDR need not be wired.

For use of AWG24



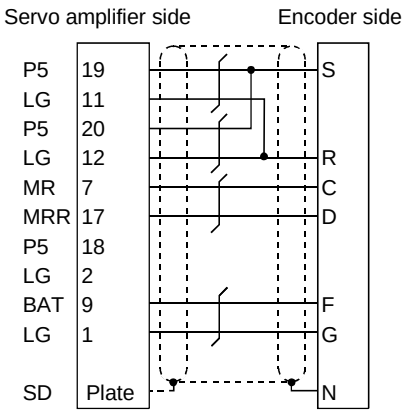
For use of AWG22



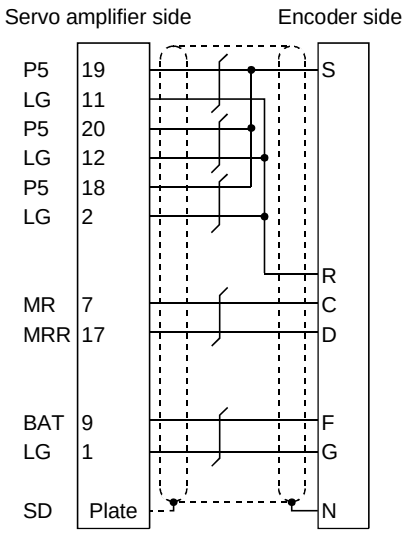
b. For HC-SF/HC-RF

When fabricating an encoder cable, fabricate it as shown below:

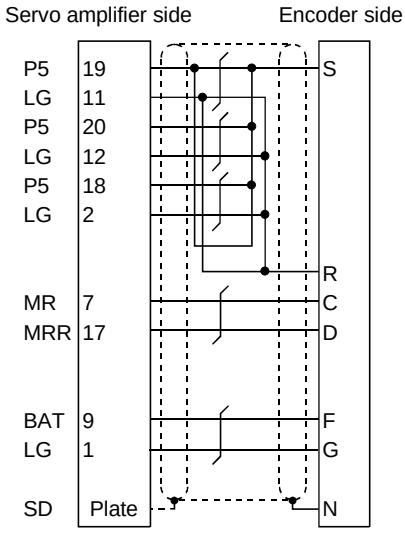
MR-JHSCBL2M-L MR-JHSCBL5M-L MR-JHSCBL2M-H MR-JHSCBL5M-H	MR-JHSCBL10M-L to MR-JHSCBL50M-L	MR-JHSCBL10M-H to MR-JHSCBL50M-H



AWG24 used
(For less than 10m)



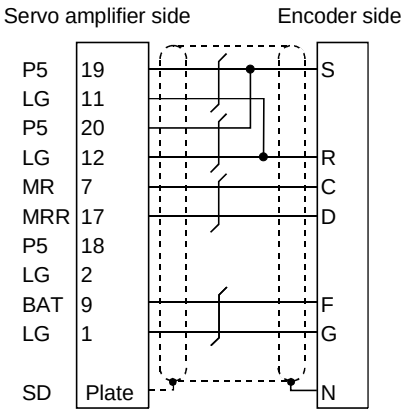
AWG22 used
(For 10 to 50m)



AWG24 used
(For 10 to 50m)

In addition to the above, the customer may also fabricate the cable of the following length:

For use of AWG28 (5m or less)

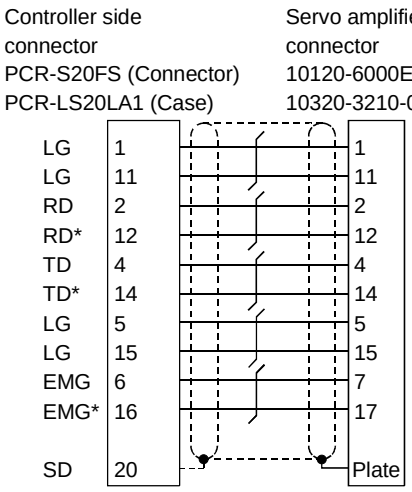


2) Bus Cable

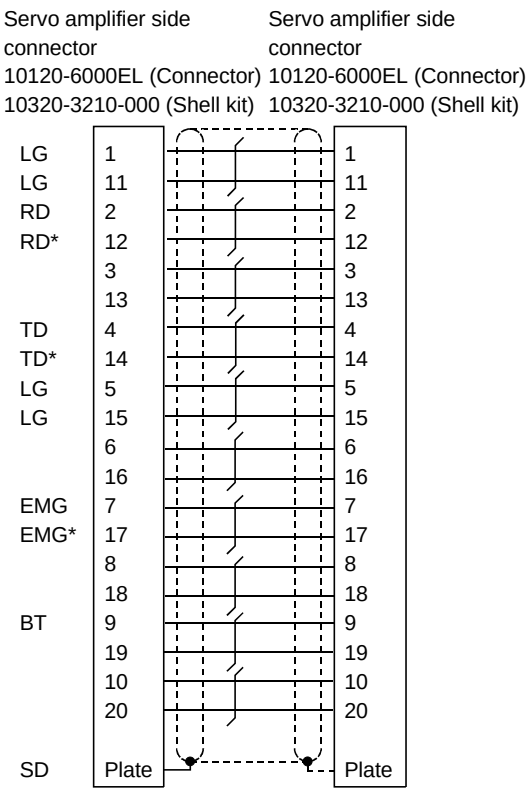
⚠ CAUTION	When you fabricate the bus cable, connect it correctly. Otherwise, misoperation or explosion may occur.

For the optional bus cable, pins not used normally are connected. When the customer fabricates the bus cable, pins without signals need not be connected. The total length of the bus cables in a single system is up to 30m.

MR-J2HBUS05M-A
MR-J2HBUS1M-A
MR-J2HBUS5M-A



MR-JHBUS05M-A
MR-J2HBUS1M-A
MR-J2HBUS5M-A



3) Communication cable

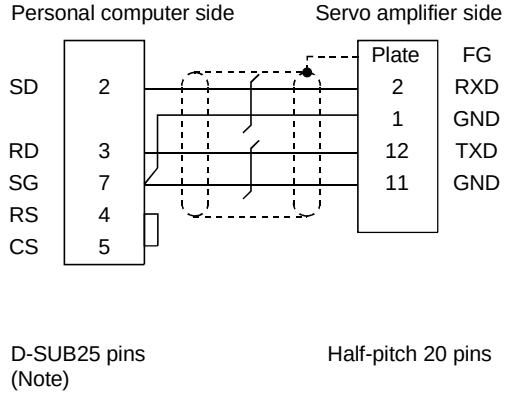
NOTICE	This cable may not be used with some personal computers. After fully examining the signals of the RS-232C connector, refer to this section and fabricate the cable.

Select the communication cable according to the shape of the RS-232C connector of the personal computer used. When fabricating the cable, refer to the connection diagram in this section. The following must be observed in fabrication:

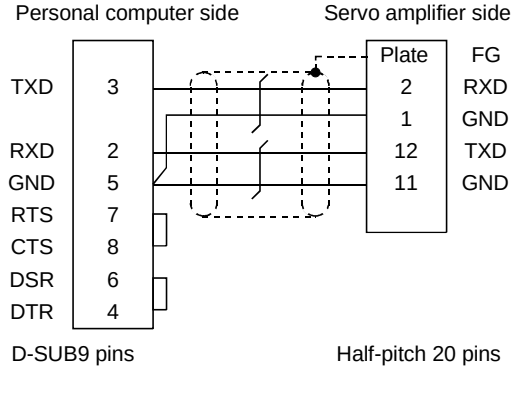
- Always use a shielded, multi-core cable and connect the shield with FG securely.
- The optional communication cable is 3m (10 ft) long. When the cable is fabricated, its maximum length is 15m (49 ft) in offices of good environment with minimal noise.

Connection diagram

- MR-CPC98CBL3M



- MR-CPCATCBL3M

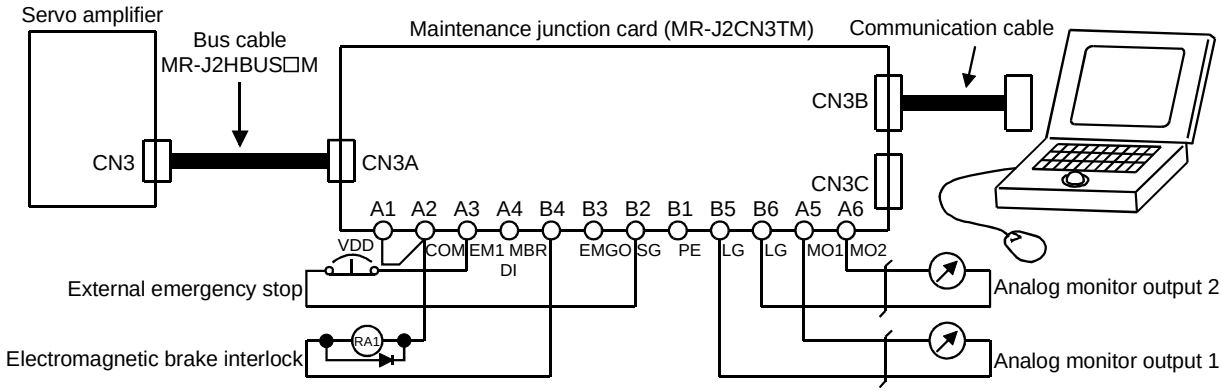


Note: The PC98 Notes having the connector of half-pitch 14 pins are also available. Confirm the shape of the RS-232C connector of the personal computer used.

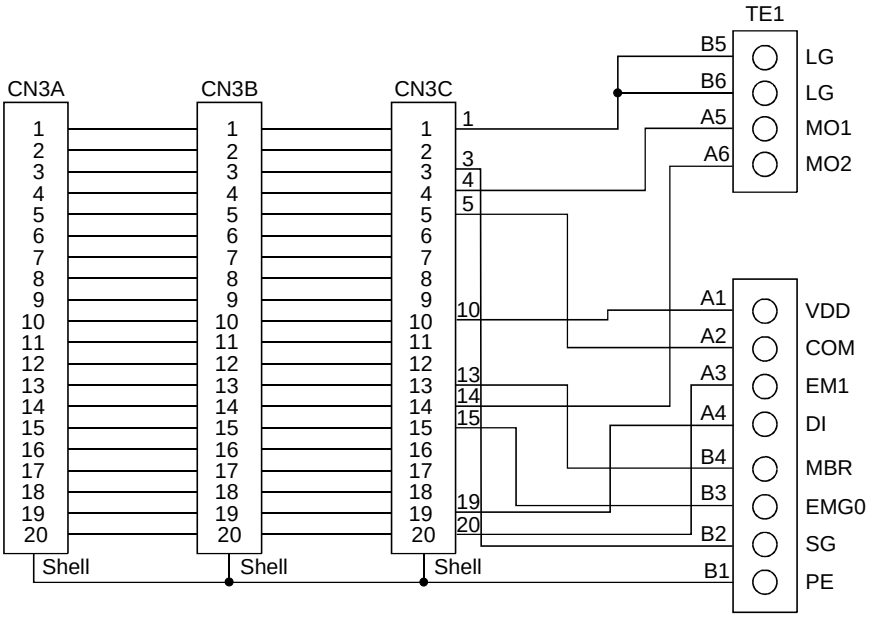
6 - 1 - 3 Maintenance junction card

(1) Usage

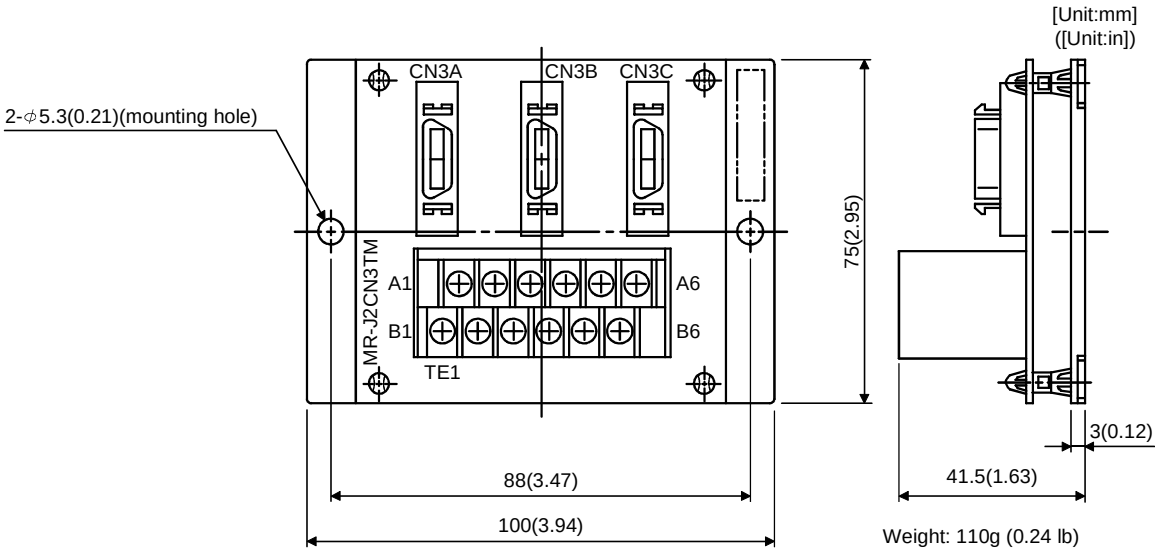
The maintenance junction card (MR-J2CN3TM) is designed for use when a personal computer and analog monitor outputs are used at the same time.



(2) Connection diagram



(3) Outline drawing



6 - 1 - 4 Set-up software (will be released soon)

NOTICE	Some functions of the setup software may not be available for some versions. Contact us for details.

The setup software (MRZJW3-SETUP41E or later) uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

(1) Specifications

Item	(Note1) Description
Communication signal	Conforms to RS-232C.
Baudrate	19200bps, 9600bps
Monitor	Batch display, high-speed display, graph display
Alarm	Alarm display, alarm history, data display at alarm occurrence (Minimum resolution changes according to the processing speed of the personal computer)
Diagnostic	External I/O signal display, no-rotation reason display, cumulative power-on time display, software number display, tuning data display, ABS data display, automatic VC offset display
Parameters	Data setting, list display, change list display, detailed information display
Test operation	Jog mode, positioning mode, motor-less operation, output signal forced output, program operation in simple language
File operation	Data read, save, print
Others	Automatic operation, help display

Note 1: On some personal computers, this software may not run properly.
2: Minimum resolution changes with the processing speed of the personal computer.

(2) System configuration

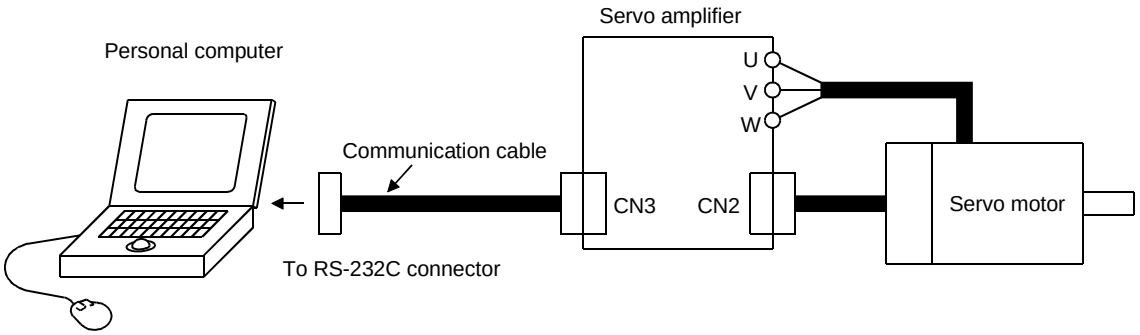
1) Components

To use this software, the following components are required in addition to the servo amplifier and servo motor:

Model	Description
Personal computer	Which contains a 80386 or higher CPU and on which Windows 3.1・95 runs (80486 or higher recommended).Memory: 8MB or more, hard disk free space: 1MB or more, serial port used.
OS	Windows 3.1・95
Display	640×400 or more color or 16-scale monochrome display which can be used with Windows 3.1・95.
Keyboard	Which can be connected to the personal computer.
Mouse	Which can be used with Windows 3.1・95. Note that a serial mouse is not used.
Printer	Which can be used with Windows 3.1・95.
Communication cable	MR-CPC98CBL3M・MR-CPCATCBL3M When these cannot be used, refer to Section 6-1-2 and fabricate.

Note: Windows is a trade mark of Microsoft Corporation.

2) Configuration diagram



6 - 2 Auxiliary equipment

The auxiliary equipment used must be those indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL Standard, use the auxiliary equipment which conform to the corresponding standard.

6 - 2 - 1 Cables

Servo Amplifier model	(Note 1) Cables [mm²]					(Note 3) Crimping Terminal	
	L1・L2・L3	L11・L21	U・V・W・⏚	P・C	B1・B2	Model	Tool
MR-J2-10B	2 (AWG14)	1.25 (AWG16)	1.25 (AWG16)	(Note 2) 2 (AWG14)	1.25 (AWG16)	32959	47387
MR-J2-20B							
MR-J2-40B							
MR-J2-60B			2(AWG14)				
MR-J2-70B							
MR-J2-100B							
MR-J2-200B	3.5(AWG12)		3.5(AWG12)			32968	59239
MR-J2-350B	5.5(AWG10)		5.5(AWG10)				

Note 1. The cables are based on the 600V vinyl cables. The cables (U, V, W) in the table assume that the distance between the servo motor and servo amplifier is 30m or less.
2. Twist the cables for connection of the regenerative brake option (P,C).
3. Used with the UL/C-UL Standard-compliant models. (AMP make)

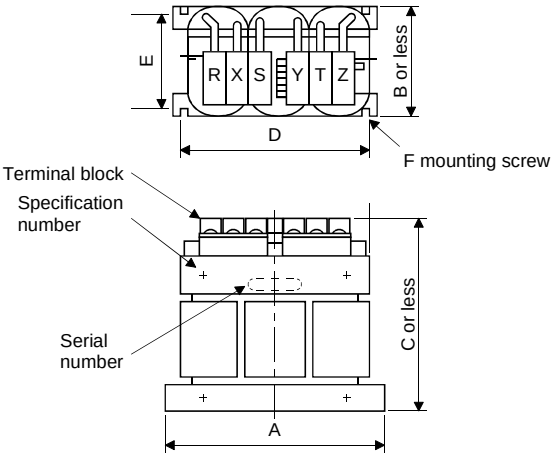
6 - 2 - 2 No-fuse breakers, fuses, magnetic contactors

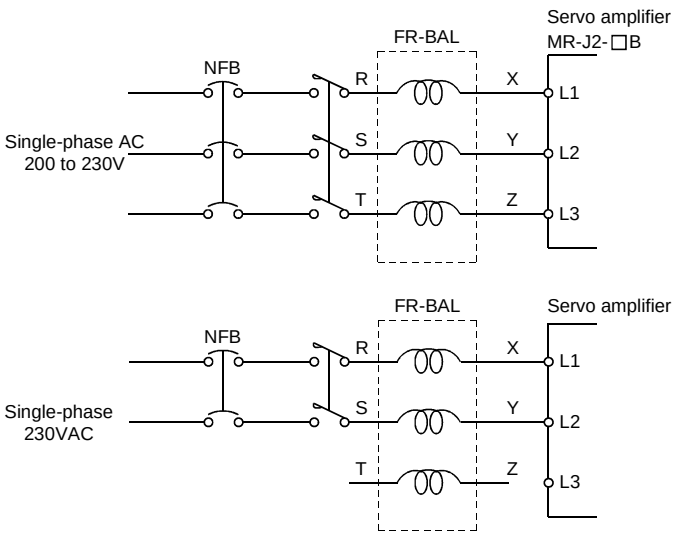
Always use one no-fuse breaker and one magnetic contactor with one servo amplifier. When using a fuse instead of the no-fuse breaker, use the one having the specifications given in this sections.

Servo Amplifier	No-Fuse Breaker	Fuse			Magnetic Contactor
		Class	Current [A]	Voltage [V]	
MR-J2-10B	NF30 type 5A	K5	10	AC250	S-N10
MR-J2-20B	NF30 type 5A	K5	10		
MR-J2-40B	NF30 type 10A	K5	15		
MR-J2-60B	NF30 type 15A	K5	20		
MR-J2-70B	NF30 type 15A	K5	20		
MR-J2-100B	NF30 type 15A	K5	25		
MR-J2-200B	NF30 type 20A	K5	40		S-N18
MR-J2-350B	NF30 type 30A	K5	70		S-N20

6 - 2 - 3 Power factor improving reactors

The input power factor is improved to be about 90%. For use with a single-phase power supply, it may be slightly lower than 90%. Make selection in the auxiliary equipment selection table according to the motor to which the reactor will be applied.





Servo Amplifier	Model	Dimensions [mm (in)]						Weight
		A	B	C	D	E	F	[kg (lb)]
MR-J2-10B/20B	FR-BAL-0.4K	135 (5.31)	64 (2.25)	120 (4.72)	120 (4.72)	45 (1.77)	M4	2 (4.4)
MR-J2-40B	FR-BAL-0.75K	135 (5.31)	74 (2.91)	120 (4.72)	120 (4.72)	57 (2.24)	M4	3 (6.6)
MR-J2-60B/70B	FR-BAL-1.5K	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4	4 (8.8)
MR-J2-100B	FR-BAL-2.2K	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4	6 (13.2)
MR-J2-200B	FR-BAL-3.7K	220 (8.66)	95 (3.74)	200 (7.87)	200 (7.87)	70 (2.76)	M5	8.5 (18.7)
MR-J2-350B	FR-BAL-7.5K	220 (8.66)	125 (4.92)	205 (8.07)	200 (7.87)	100 (3.94)	M5	14.5 (32.0)

6 - 2 - 4 Relays

The following relays should be used with the interfaces:

Interface	Selection Example
Relay used especially for switching on-off analog input command and input command (interface DI-1) signals	To prevent defective contacts , use a relay for small signal (twin contacts). (Ex.) OMRON : type G2A , MY
Relay used for digital output signals (interface DO-1)	Small relay with 12VDC or 24VDC of 40mA or less (Ex.) OMRON : type MY

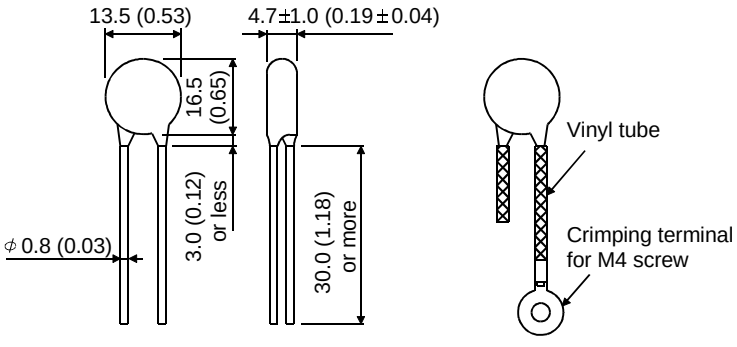
6 - 2 - 5 Surge absorbers

A surge absorber is required for the electromagnetic brake. Use the following surge absorber or equivalent.
Insulate the wiring as shown in the diagram.

Maximum Rating					Maximum Limit Voltage		Static Capacity (Reference value)	Varistor Voltage Rating (Range) V1mA
Permissible circuit voltage		Surge immunity	Energy immunity	Rated power				
AC[Vma]	DC[V]	[A]	[J]	[W]	[A]	[V]	[pF]	[V]
140	180	(Note) 500/time	5	0.4	25	360	300	220 (198 to 242)

Note: 1 time = 8×20μs

(Example) ERZV10D221 (Matsushita Electric)
TNR-12G221K (Marcon Electronics)
Outline drawing [mm] ([in]) (ERZ-C10DK221)



6 - 2 - 6 Noise reduction techniques

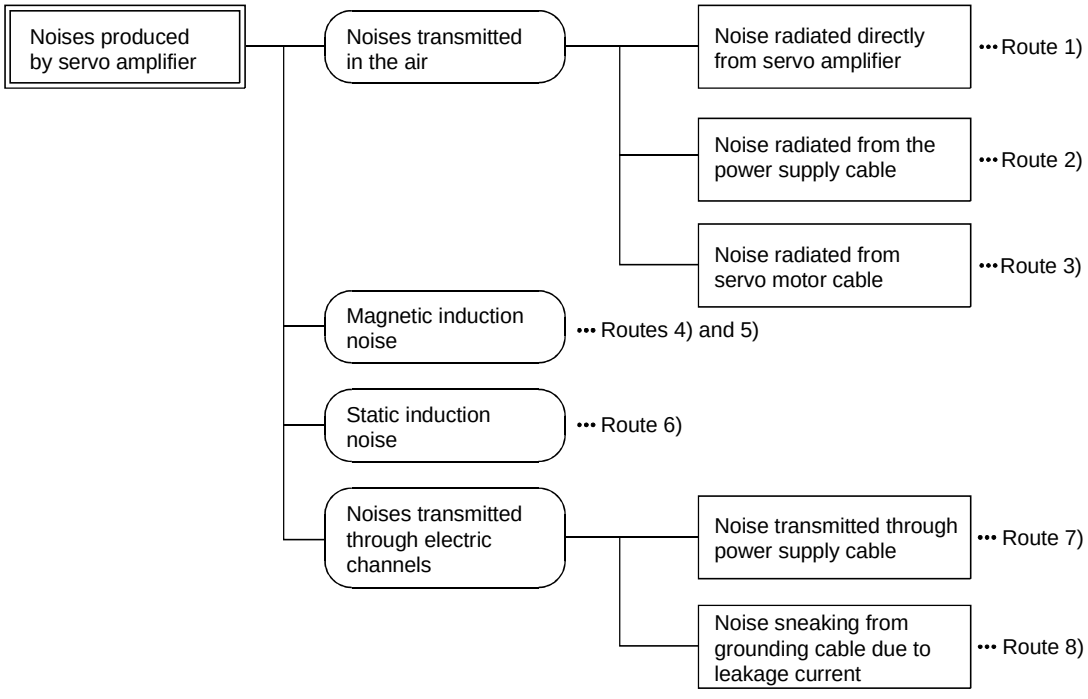
Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral devices to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required.

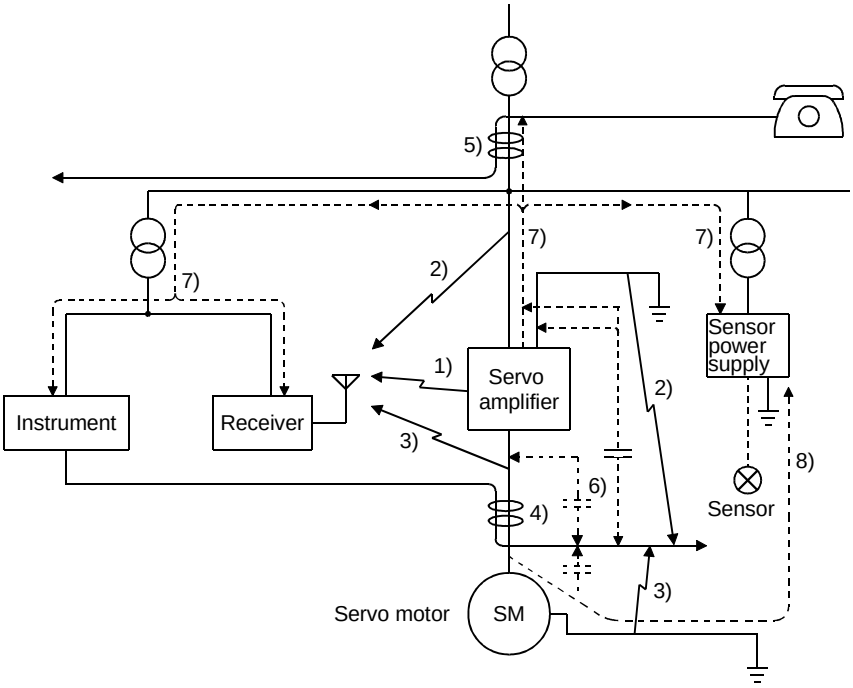
Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices malfunction due to noises produced by the servo amplifier, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

1) General reduction techniques
   - Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
   - Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
   - Ground the servo amplifier, servo motor, etc. together at one point (refer to Section 3-4).

2) Reduction techniques for external noises that cause the servo amplifier to malfunction
   If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.
   - Provide surge absorbers on the noise sources to suppress noises.
   - Attach data line filters to the signal cables.
   - Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.

3) Techniques for noises radiated by the servo amplifier that cause peripheral devices to malfunction
   Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.





Noise Transmission Route	Suppression Techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line. (5) Use shielded wires for signal and power cables or put cables in separate metal conduits.
4) 5) 6)	When the power lines and the signal cables are laid side by side or bundled together, magnetic induction noise and static induction noise will be transmitted through the signal cables and malfunction may occur. The following techniques are required. (1) Provide maximum clearance between easily affected devices and the servo amplifier. (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. (3) Avoid laying the power lines (I/O cables of the servo amplifier) and signal cables side by side or bundling them together. (4) Use shielded wires for signal and power cables or put the cables in separate metal conduits.
7)	When the power supply of peripheral devices is connected to the power supply of the servo amplifier system, noises produced by the servo amplifier may be transmitted back through the power supply cable and the devices may malfunction. The following techniques are required. (1) Insert the radio noise filter (FR-BIF) on the power cables (input cables) of the servo amplifier. (2) Insert the line noise filter (FR-BSF01) on the power cables of the servo amplifier.
8)	When the cables of peripheral devices are connected to the servo amplifier to make a closed loop circuit, leakage current may flow to malfunction the peripheral devices. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

(1) Data line filter

Noise can be prevented by installing a data line filter onto the encoder cable, etc.

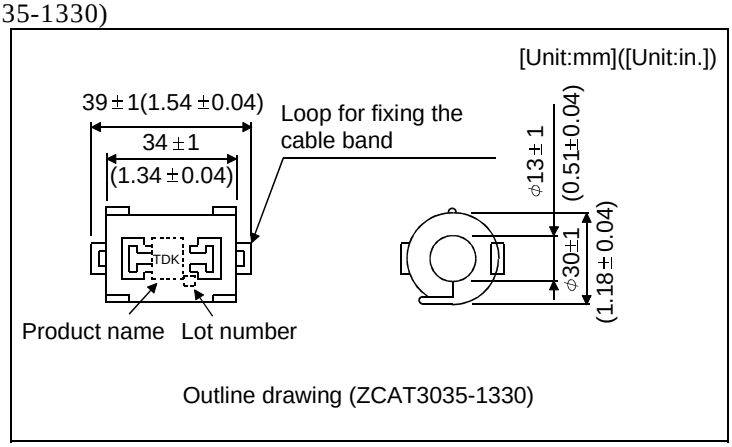
Example: Data line filter: ZCAT3035-1330 [TDK]

ESD-SR-25 [Tokin]

Impedance specifications (ZCAT3035-1330)

Impedance[Ω]	
10 to 100MHZ	100 to 500MHZ
80	150

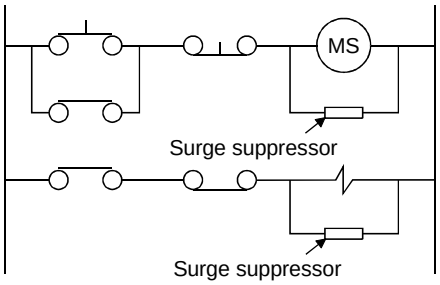
The above impedances are reference values and not guaranteed values.

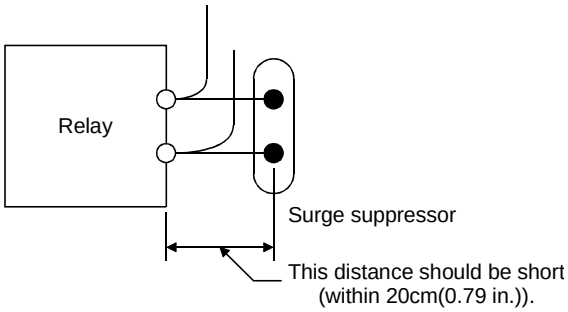


Outline drawing (ZCAT3035-1330)

(2) Surge suppressor

The recommended surge suppressor for installation to an AC relay, AC valve, AC electromagnetic brake or the like near the servo amplifier is shown below. Use this product or equivalent.



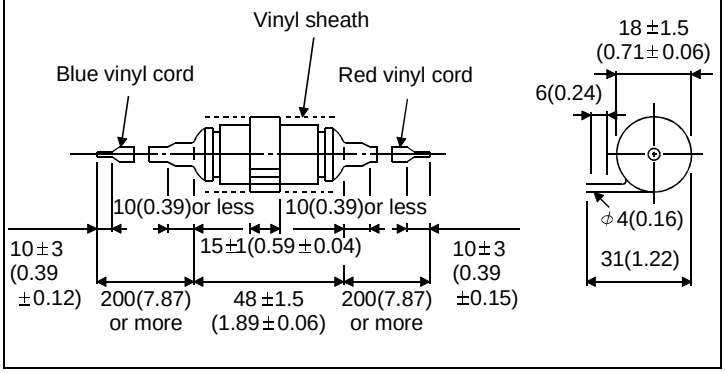


(Ex.) 972A.2003 504 11

(Matsuo Electric Co.,Ltd.-200VAC rating)

Rated Voltage AC[V]	C [μF]	R [Ω]	Test Voltage AC[V]
200	0.5	50 (1W)	Across T-C 1000(1 to 5s)

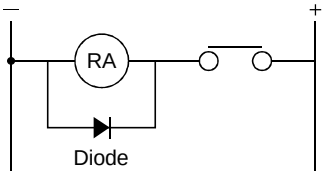
Outline Drawing [Unit: mm] ([Unit: in.])



Note that a diode should be installed to a DC relay, DC valve or the like.

Maximum voltage: Not less than 4 times the drive voltage of the relay or the like

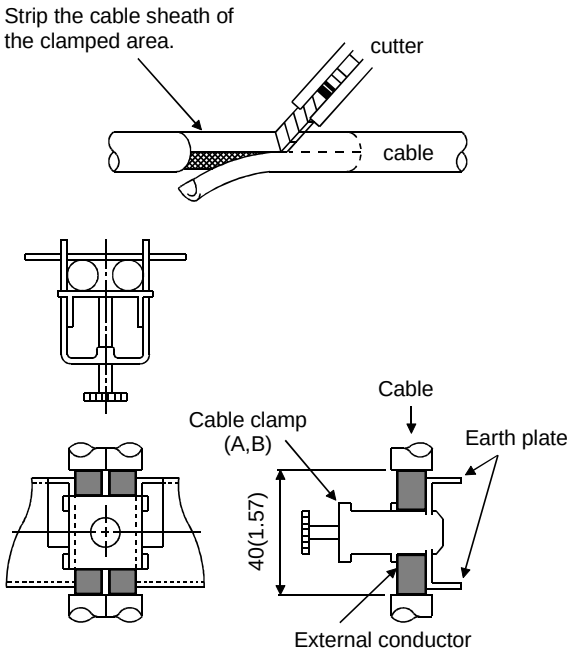
Maximum current: Not less than twice the drive current of the relay or the like



(3) Cable clamp fitting (AERSBAN-□SET)

Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below.

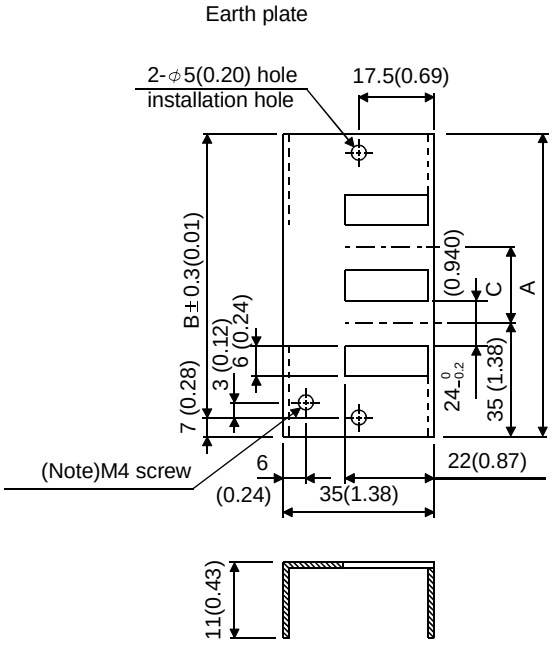
Install the earth plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp. If the cable is thin, clamp several cables in a bunch. The clamp comes as a set with the earth plate.

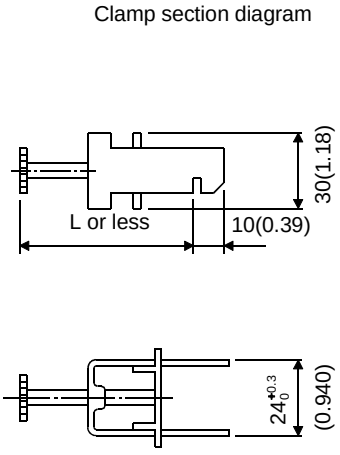


Clamp section diagram

[Unit: mm]
([Unit: in.])

Outline drawing





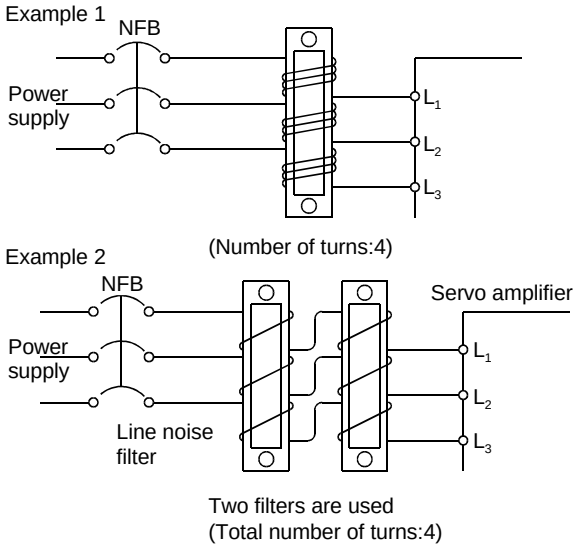
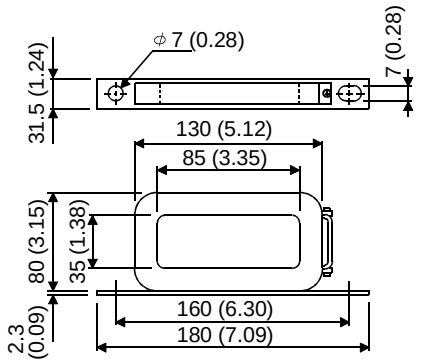
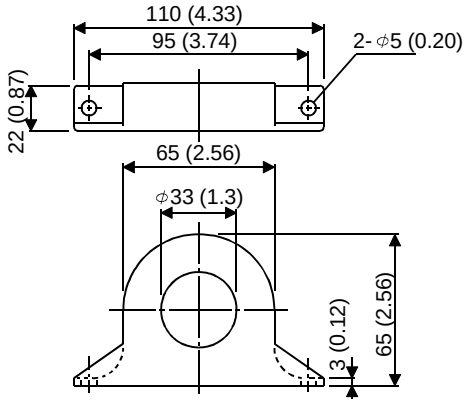
Note: Screw hole for grounding. Connect it to the earth plate of the control box.

Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

Clamp Fitting	L
A	70 (2.76)
B	45 (1.77)

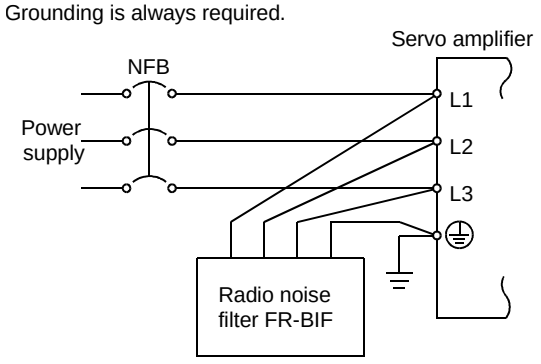
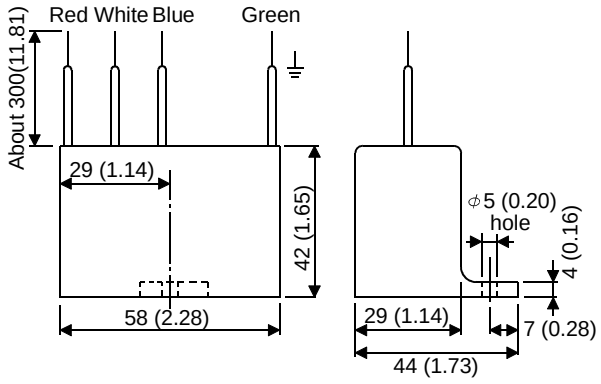
(4) Line noise filter (FR-BLF, FR-BSF01)

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5MHz to 5MHz band.

Connection Diagram	Outline Drawing [Unit: mm] ([Unit: in.])
Wind the three-phase wires by the equal number of times in the same direction, and connect the filter to the power supply side and output side of the servo amplifier. The effect of the filter on the power supply side is higher as the number of winds is larger. The number of turns is generally four. On the output side, the number of turns must be four or less. If the wires are too thick to be wound, use two or more filters and make the total number of turns as mentioned above. On the output side, the number of turns must be four or less. Do not wind the grounding wire together with the three-phase wires. The filter effect will decrease. Use a separate wire for grounding. 	FR-BLF(MR-J2-350B)  FR-BSF01(for MR-J2-200B or less) 

(5) Radio noise filter (FR-BIF)...for the input side only

This filter is effective in suppressing noises radiated from the power supply side of the servo amplifier especially in 10MHz and lower radio frequency bands. The FR-BIF is designed for the input only.

Connection Diagram	Outline Drawing (Unit: mm) ([Unit: in.])
Make the connection cables as short as possible. Grounding is always required. 	Leakage current:4mA 

6 - 2 - 7 Leakage current breaker

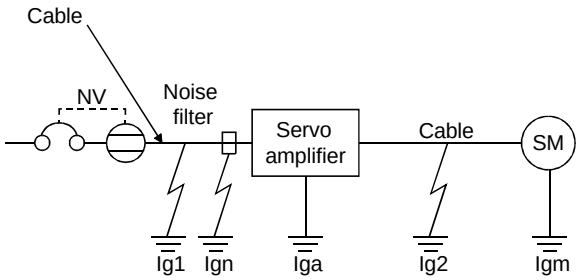
(1) Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor which is run with a commercial power supply.

Select a leakage current breaker according to the following formula, and ground the servo amplifier, servo motor, etc. securely.

Make the input and output cables as short as possible, and also make the grounding cable as long as possible (about 30cm (11.8 in)) to minimize leakage currents.

$$\text{Rated sensitivity current} \geq 10 \cdot \{Ig1+Ign+Iga+K \cdot (Ig2+Igm)\}\ [mA] \quad \text{.....(6-2)}$$



K: Constant considering the harmonic contents

Leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SF NV-CF	1
General models	NV-CA NV-CS NV-SS	3

Ig1: Leakage current on the electric channel from the leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 6-1.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 6-1.)

Ign: Leakage current when a filter is connected to the input side (4.4mA per one FR-BIF)

Iga: Leakage current of the servo amplifier (Found from Table 6-2.)

Igm: Leakage current of the servo motor (Found from Table 6-1.)

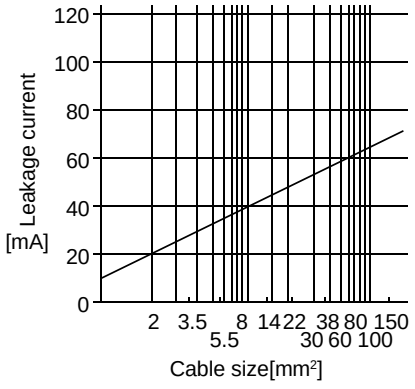


Fig. 6-1 Leakage Current Example (Ig1, Ig2) for CV Cable Run in Metal Conduit

Table 6-1 Servo Motor's Leakage Current Example (Igm)

Servo Motor Output [kW]	Leakage Current [mA]
0.05 to 0.5	0.1
0.6 to 1.0	0.1
1.2 to 2.2	0.2
3 to 3.5	0.3

Table 6-2 Servo Amplifier's Leakage Current Example (Iga)

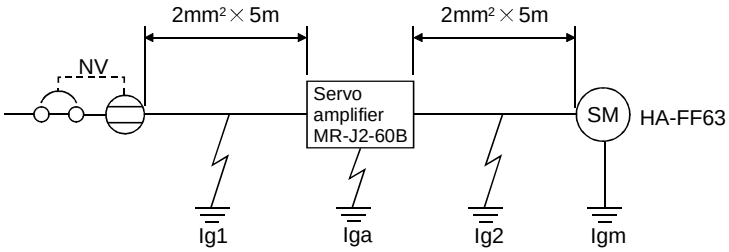
Servo Amplifier Capacity [kW]	Leakage Current [mA]
0.1 to 0.6	0.1
0.7 to 3.5	0.15

Table 6-3 Leakage Circuit Breaker Selection Example

Servo Amplifier	Rated Sensitivity Current of Leakage Circuit Breaker
MR-J2-10B to MR-J2-350B	15 [mA]

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions:



Use a leakage current breaker generally available.
Find the terms of Equation (6-2) from the diagram:

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1[mA]$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1[mA]$$

Ign=0 (not used)

Iga=0.1[mA]

Igm=0.1[mA]

Insert these values in Equation (6-2):

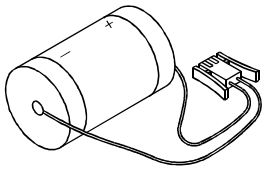
$$Ig \geqq 10 \cdot \{0.1+0+0.1+3 \cdot (0.1+0.1)\}$$

$$\geqq 8.0[mA]$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 8.0[mA] or more. A leakage current breaker having Ig of 15[mA] is used with the NV-CA/CS/SS series.

6 - 2 - 8 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



7. INSPECTION

⚠WARNING	1. Before starting maintenance and/or inspection, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock. 2. Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.

NOTICE	1. Do not test the servo amplifier with a megger (measure insulation resistance), or it may become faulty. 2. Do not disassemble and/or repair the equipment on customer side.

(1) Inspection

It is recommended to make the following checks periodically:

1) Check for loose terminal block screws. Retighten any loose screws.
2) Check the servo motor bearings, brake section, etc. for unusual noise.
3) Check the cables and the like for scratches and cracks. Perform periodic inspection according to operating conditions.
4) Check the servo motor shaft and coupling for misalignment.

(2) Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. Also, when using the servo motor in the atmosphere where there are many oil mists, dust particles and others, perform cleaning/inspection every three months. For parts replacement, please contact your sales representative.

Part Name		Standard Life
Servo amplifier	Smoothing capacitor	10 years
	Relay	
	Cooling fan	10,000 to 30,000 hours (2 to 3 years)
	Absolute position battery	Refer to Chapter 5(1)
Servo motor	Bearings	20,000 to 30,000 hours
	Encoder	20,000 to 30,000 hours
	Oil seal, V ring	5,000 hours

1) Smoothing capacitor : Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment.

2) Relays : Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life at 100,000 power-on times, which depend on the power supply capacity.

3) Servo amplifier cooling fan : The cooling fan bearings reach the end of their life in 10,000 to 30,000 hours. Normally, therefore, the fan must be changed in a few years of continuous operation as a guideline.
It must also be changed if unusual noise or vibration is found during inspection.

4) Servo motor bearings : When the servo motor is run at rated speed under rated load, 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.

5) Servo motor oil seal, V ring : Must be changed in 5,000 hours of operation at rated speed as a guideline. This differs on the operating conditions. These parts must also be changed if oil leakage, etc. is found during inspection.

8. TROUBLESHOOTING

8 - 1 Alarm and warning lists

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to Section 8.2 or 8.3 and take the appropriate action.

Alarms

Display	Name
10	Undervoltage
11	Board error 1
12	Memory error 1
13	Clock error
15	Memory error 2
16	Encoder error 1
17	Board error 2
18	Board error 3
20	Encoder error 2
24	Ground fault
25	Absolute position erase
30	Regenerative error
31	Overspeed
32	Overcurrent
33	Overvoltage
34	CRC error
35	Command F△T error
36	Transfer error
37	Parameter error
46	Servo motor overheat
50	Overload 1
51	Overload 2
52	Error excessive
8E	RS-232C error
88	Watchdog

Warnings

Display	Name
92	Open battery cable warning
96	Zero setting error
E0	Excessive regenerative load warning
E1	Overload warning
E3	Absolute position counter warning
E4	Parameter warning
E6	Servo emergency stop
E7	Controller emergency stop
E9	Main circuit off warning

8 - 2 Remedies for alarms

⚠WARNING	When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur. When the absolute position erase alarm (25) has occurred, always make home position setting again. Not doing so can cause runaway.

NOTICE	When any of the following alarms has occurred, always remove its cause and allow about 30 minutes for cooling before resuming operation. If operation is repeated by switching control circuit power off, then on to reset the alarm, the servo amplifier, servo motor and regenerative brake option may become faulty. ・Regenerative error (30) ・Overload 1 (50) ・Overload 2 (51)

When an alarm occurs, the display shows the corresponding alarm number, and the servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. The optional set-up software may be used to refer to the cause.

Display	Name	Definition	Cause	Action
10	Undervoltage	Power supply voltage dropped to 160V or less	1. Power supply voltage is low.	Review the power supply.
			2. Power failed instantaneously for 100ms or longer.	
			3. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
			4. Power was restored after the bus voltage had dropped to 200VDC. (Main circuit power switched on within 5S after it had switched off.)	
			5. Faulty parts in the servo amplifier Checking method Alarm (10) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.	Change the servo amplifier.
11	Board error 1	Printed board faulty	Faulty parts in the servo amplifier Checking method Alarm (any of 11 to 13 and 15) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.	Change the servo amplifier.
12	Memory error 1	RAM, ROM memory fault		
13	Clock error	Printed board fault		
15	Memory error 2	EEP-ROM fault		
16	Encoder error 1	Communication error occurred between encoder and servo amplifier.	1. Encode connector disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. Encoder cable faulty (Wire breakage or short)	Repair or change cable.
			4. Combination of servo amplifier and servo motor is not proper.	Use correct combination.
17	Board error 2	CPU/parts fault	Faulty parts in the servo amplifier Checking method Alarm (17 or 18) occurs if power is switched on after CN1A, CN1B and CN3 connectors have been disconnected.	Change the servo amplifier.
18	Board error 3			

Display	Name	Definition	Cause	Action
20	Encoder error 2	Communication error occurred between encoder and servo amplifier.	1. Encoder connector disconnected.	Connect correctly.
			2. Encoder cable faulty (wire breakage or short)	Repair or change the cable.
24	Output side ground fault	Servo motor outputs (U, V, W phases) of servo amplifier resulted in ground fault.	Contact of power supply input cables and servo motor outputs in main circuit terminal block.	Correct wiring.
			Sheathes of servo motor power cables deteriorated, resulting in ground fault.	Change cables.
			Main circuit of servo amplifier failed. Checking method 24 occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	Change servo amplifier.
25	Absolute position erase	Absolute position data in error	1. Reduced voltage of super capacitor in encoder	After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position return again.
			2. Battery voltage low	Always change battery. Make home position return again
			3. Battery cable or battery is faulty.	
		Power was switched on for the first time in the absolute position detection system.	4. Super capacitor of the absolute position encoder is not charged.	After leaving the alarm occurring for a few minutes, switch power off, then on again. Home position setting must be made again.
30	Regenerative alarm	Permissible regenerative power of the built-in regenerative brake resistor or regenerative brake option is exceeded.	1. Wrong setting of parameter No. 0	Set correctly.
			2. Built-in regenerative brake resistor or regenerative brake option is not connected.	Connect correctly
			3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative brake option to be exceeded. Checking method Call the status display and check the regenerative load ratio.	1. Reduce the frequency of positioning. 2. Use the regenerative brake option of larger capacity. 3. Reduce the load.
			4. Power supply voltage increased to 260V or more.	Review power supply
		Regenerative transistor fault	5. Regenerative transistor faulty. Checking method 1) The regenerative brake option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.	Change the servo amplifier.
			6. Built-in regenerative brake resistor or regenerative brake option faulty.	Change servo amplifier or regenerative brake option.

Display	Name	Definition	Cause	Action
31	Overspeed	Speed has exceeded the instantaneous permissible speed.	1. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/ deceleration time constant.
			2. Servo system is instable to cause overshoot.	1. Re-set servo gain to proper value. 2. If servo gain cannot be set to proper value: 1) Reduce load inertia moment ratio; or 2) Reexamine acceleration/ deceleration time constant.
			3. Encoder faulty.	Change the servo motor.
32	Overcurrent	Current that flew is higher than the permissible current of the servo amplifier.	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring.
			2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (32) occurs if power is switched on after U, V and W are disconnected.	Change the servo amplifier.
			3. Ground fault occurred in servo amplifier output phases U, V and W.	Correct the wiring.
			4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
33	Overvoltage	Converter bus voltage exceeded 400V.	1. Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected.	1. Change lead. 2. Connect correctly.
			2. Regenerative transistor faulty.	Change servo amplifier.
			3. Wire breakage of built-in regenerative brake resistor or regenerative brake option	1. For wire breakage of built-in regenerative brake resistor, change servo amplifier. 2. For wire breakage of regenerative brake option, change regenerative brake option.
			4. Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Add regenerative brake option or increase capacity.
34	CRC error	Bus cable is faulty.	1. Bus cable connector disconnected.	Connect correctly.
			2. Bus cable fault (Wire breakage or short)	Repair or change cable.
			3. Noise entered bus cable.	Take measures against noise.
			4. Termination connector disconnected.	Connect termination connector.
35	Command F△T error	Input command frequency exceeded 2.5Mpps.	1. Command pulse frequency exceeded 2.5Mpps.	Reconsider operation program.
			2. Noise entered bus cable.	Take measures against noise.
			3. Command unit faulty.	Change the command unit.
36	Transfer error	Bus cable is faulty.	1. Bus cable connector disconnected.	Connect correctly.
			2. Bus cable fault (Wire breakage or short)	Repair or change cable.
			3. Termination connector disconnected	Connect termination connector.
		Printed board is faulty.	Faulty parts in servo amplifier	Change servo amplifier.

Display	Name	Definition	Cause	Action
37	Parameter error	Parameter setting is wrong.	1. Servo amplifier fault caused the parameter setting to be rewritten.	Change the servo amplifier.
			2. Regenerative brake option not used with servo amplifier was selected in parameter No. 2.	Set parameter No. 2 correctly.
46	Servo motor overheat	Servo motor temperature rise actuated the thermal protector.	1. Ambient temperature of servo motor is over 40℃.	Review environment so that ambient temperature is 0 to 40℃.
			2. Servo motor is overloaded.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			3. Thermal protector in encoder is faulty.	Change servo motor.
50	Overload 1	Load exceeded overload protection characteristic of servo amplifier. Load ratio 300%: 2.5s or more Load ratio 200%: 100s or more	1. Servo amplifier is used in excess of its continuous output current.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			2. Servo system is instable and hunting.	1. Repeat acceleration/deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			3. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			4. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			5. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.

Display	Name	Definition	Cause	Action
51	Overload 2	Machine collision or the like caused max. output current to flow successively for several seconds. Servo motor locked: 1s or more	1. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			2. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			3. Servo system is instable and hunting.	1. Repeat acceleration/deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. Checking method When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.	Change the servo motor.
52	Error excessive	Droop pulse value of the deviation counter exceeded the parameter No. 31 value (initial value: 80k pulses).	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/deceleration time constant.
			2. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Review the power supply capacity. 2. Use servo motor which provides larger output.
			3. Position control gain 1 (parameter No. 13) value is small.	Increase set value and adjust to ensure proper operation.
			4. Servo motor shaft was rotated by external force.	1. When torque is limited, increase the limit value. 2. Reduce load. 3. Use servo motor that provides larger output.
			5. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			6. Encoder faulty.	Change the servo motor.
			7. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
8E	RS-232C alarm	Communication fault occurred between servo amplifier and personal computer.	1. Communication connector is disconnected.	Connect correctly.
			2. Communication cable faulty. (Wire breakage or short)	Repair or change cable.
			3. Personal computer faulty.	Change personal computer.
88	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier Checking method Alarm (88) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.	Change servo amplifier.

8 - 3 Remedies for warnings

If a warning occurs, the servo amplifier does not go into a servo off status. However, if operation is continued in the warning status, an alarm may occur or proper operation not performed. Eliminate the cause of the warning according to this section. Use the optional set-up software to refer to the cause of warning.

Display	Name	Definition	Cause	Action
92	Open battery cable warning	Absolute position detection system battery voltage is low.	1. Battery cable is open.	Repair cable or change battery.
			2. Battery voltage dropped to 2.8V or less.	Change battery.
96	Zero setting error	1. Zeroing could not be executed in the incremental system. 2. Home position setting could not be made in the absolute position detection system.	1. Zeroing was executed during run command.	After droop pulses are cleared, lock the servo motor.
			2. Droop pulses remaining are greater than in-position range setting.	
			3. Creep speed is high.	Reduce creep speed.
E0	Excessive regenerative load warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative brake resistor or regenerative brake option.	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative brake resistor or regenerative brake option. Checking method Call the status display and check regenerative load ratio.	1. Reduce frequency of positioning. 2. Change regenerative brake option for the one with larger capacity 3. Reduce load.
E1	Overload warning	There is a possibility that overload alarm 1 or 2 may occur.	Load increased to 85% or more of overload alarm 1 or 2 occurrence level. Cause, checking method Refer to 50, 51.	Refer to 50, 51.
E3	Absolute position counter warning	Absolute position encoder pulses faulty.	1. Noise entered the encoder.	Take noise suppression measures.
			2. Encoder faulty.	Change servo motor.
E4	Parameter warning	Parameter outside setting range.	Parameter value set from servo system controller is outside setting range.	Set it correctly.
E6	Servo emergency stop	EM1-SG are open.	External emergency stop was made valid. (EM1-SG opened.)	After ensuring safety, reset emergency stop. (Note)
E7	Controller emergency stop	Emergency stop command was received from servo system controller.		
E9	Main circuit off warning	Servo was switched on with main circuit power off.	Servo was switched on with main circuit power off.	Switch on main circuit power.

Note: The emergency stop signal (EM1) can be made invalid by setting□□□1in parameter No. 23.

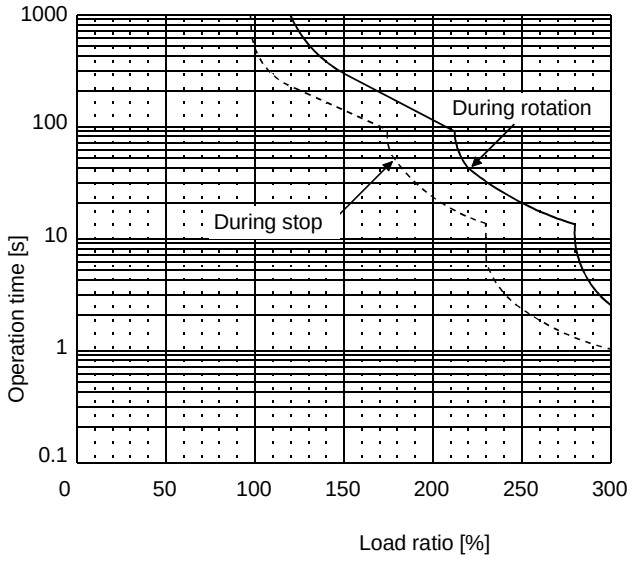
9. CHARACTERISTICS

9 - 1 Overload protection characteristics

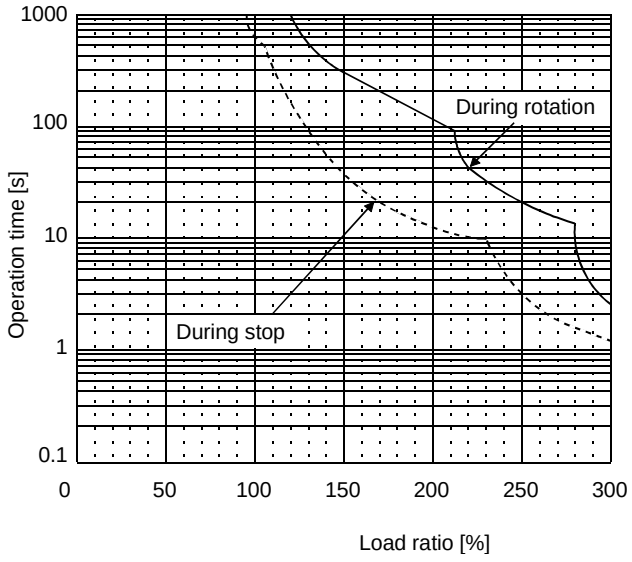
An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. Overload 1 alarm (50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. Overload 2 alarm (51) occurs if the maximum current flew continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.
In machine like the one for vertical lift application where unbalanced torque will be produced, it is recommended to use the machine so that the unbalanced torque is 70% or less of the rated torque.

(1) Characteristics of MR-J2-10B to MR-J2-100B

a: HC-MF series
HA-FF series
(300W or more)
HC-SF series
HC-RF series

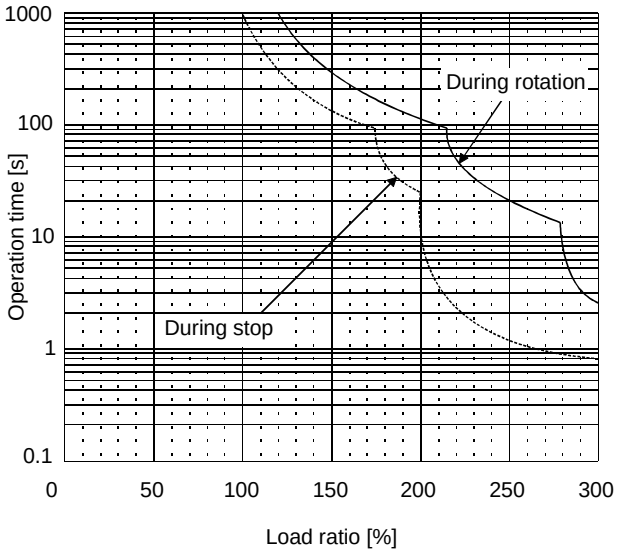


b: HA-FF series
(200W or less)



(2) MR-J2-200B and MR-J2-350B

HC-SF series
HC-RF series
HC-UF series



9 - 2 Losses generated in the servo amplifier

(1) Amount of heat generated by the servo amplifier

Table 9-1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 9-1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and zero torque according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Table 9-1 Power Supply Capacity and Generated Heat Per Servo Amplifier at Rated Output

Servo Amplifier	Servo Motor	(Note 1) Power Supply Capacity[kVA]	(Note 2) Servo Amplifier-Generated Heat[W]		Area Required for Heat Dissipation	
			At rated torque	With servo off	[m^2]	[ft^2]
MR-J2-10B	HC-MF053・13	0.3	25	15	0.5	5.4
	HA-FF053・13	0.3	25	15	0.5	5.4
	HC-UF13	0.3	25	15	0.5	5.4
MR-J2-20B	HC-MF23	0.5	25	15	0.5	5.4
	HA-FF23	0.5	25	15	0.5	5.4
	HC-UF23	0.5	25	15	0.5	5.4
MR-J2-40B	HC-MF43	0.9	35	15	0.7	7.5
	HA-FF33	0.7	35	15	0.7	7.5
	HA-FF43	0.9	35	15	0.7	7.5
	HC-UF43	0.9	35	15	0.7	7.5
MR-J2-60B	HA-FF63	1.1	40	15	0.8	8.6
	HC-SF52	1.0	40	15	0.8	8.6
	HC-SF53	1.0	40	15	1.0	10.8
MR-J2-70B	HC-MF73	1.3	50	15	1.0	10.8
	HC-UF72・73	1.3	50	15	1.0	10.8
MR-J2-100B	HC-SF81	1.7	50	15	1.0	10.8
	HC-SF102・103	1.7	50	15	1.0	10.8
MR-J2-200B	HC-SF121	2.1	90	20	1.8	19.4
	HC-SF201	3.5	90	20	1.8	19.4
	HC-SF152・153	2.5	90	20	1.8	19.4
	HC-SF202・203	3.5	90	20	1.8	19.4
	HC-RF103	1.7	90	20	1.8	19.4
	HC-RF153	2.5	90	20	1.8	19.4
	HC-UF152	2.5	90	20	1.8	19.4
MR-J2-350B	HC-SF301	4.8	120	20	2.7	29.1
	HC-SF352・353	5.5	130	20	2.7	29.1
	HC-RF203	3.5	90	20	1.8	19.4
	HC-UF202	3.5	90	20	1.8	19.4

Note: 1. Note that the power supply capacity will vary according to the power supply impedance.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative brake option, use Equation 6-1 in Section 6-1-1.

(2) Heat dissipation area for enclosed servo amplifier

An enclosure or control box for the servo amplifier should be designed to operate at the ambient temperature of 40℃(104℉) within a temperature rise of 10℃ (50℉). (With a 5℃ (41℉) safety margin, the system should operate within a maximum 55℃ (131℉) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 9-1:

$$A = \frac{P}{K \cdot \Delta T} \cdots\cdots\cdots\cdots\cdots\cdots (9\text{-}1)$$

where, A: Heat dissipation area [m^2]
P: Loss generated in the control box [W]
△T: Difference between internal and ambient temperatures [℃]
K: Heat dissipation coefficient [5 to 6]

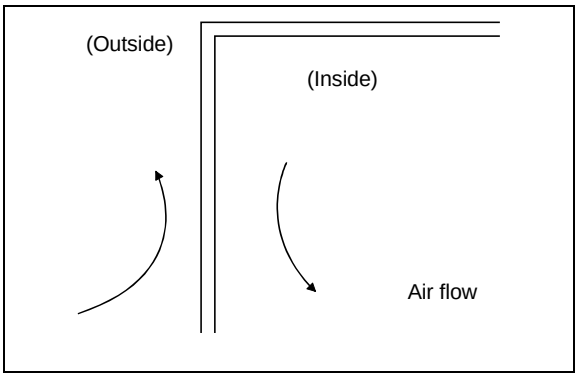


Fig. 9-1 Temperature Distribution in Enclosure

When calculating the heat dissipation area with Equation 9-1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 9-1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the enclosure is directly installed on an insulated wall, that extra amount must be added to the enclosure's surface area.

When air flows along the outer wall of the enclosure, effective heat exchange will be possible, because the temperature slope inside and outside the enclosure will be steeper.

The required heat dissipation area will vary wit the conditions in the enclosure. If convection in the enclosure is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the enclosure and the use of a fan should be considered.

Table 9-1 lists the enclosure dissipation area for each servo amplifier when the servo amplifier is operated at the ambient temperature of 40℃ (104℉) under rated load.

9 - 3 Electromagnetic brake characteristics

> **CAUTION** The electromagnetic brake is designed to hold a load. Do not use it for braking.

The characteristics of the electromagnetic brake provided for the servo motor with electromagnetic brake are indicated below:

Though the brake lining may rattle during operation, it poses no functional problem.

A leakage magnetic flux will occur at the shaft end of the servo motor equipped with electromagnetic brake.

(1) Characteristics

Table 9-2 Electromagnetic Brake Characteristics

Item \ Servo Motor			HC-MF Series			HA-FF Series			HC-SF Series	
			053B 13B	23B 43B	73B	053B 13B	23B 33B	43B 63B	81B 52B to 152B 53b to 153B	121B to 301B 202B・352B 203B・353B
(Note 1) Type			Spring-loaded safety brake							
(Note 4) Rated voltage			$24V^{0}_{-10\%}$ DC							
Rated current at 20℃ [A]			0.26	0.33	0.42	0.22	0.31	0.46	0.8	1.4
Excitation coil resistance at 20℃ [Ω]			91	73	57	111	78	52	29	16.8
Capacity [W]			6.3	7.9	10	7	7.4	11	19	34
ON current [A]			0.18	0.18	0.2	0.15	0.2	0.3	0.2	0.4
OFF current [A]			0.06	0.11	0.12	0.06	0.06	0.1	0.08	0.2
Static friction torque	[N・m]		0.32	1.3	2.4	0.39	1.18	2.3	8.3	43.1
	[oz・in]		45.3	184	340	55.3	167	326	1176	6103
(Note 2) Release delay time [S]			0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.1
Braking delay time (Note 2) [s]	AC off (Fig. a)		0.08	0.1	0.12	0.08	0.1	0.12	0.12	0.12
	DC off (Fig.s b, c)		0.01	0.02	0.03	0.01	0.03	0.03	0.03	0.03
Permissible braking work	Per braking	[J]	5.6	22.0	64.0	3.9	18.0	46.0	400	4500
		[oz・in]	793.6	3117.6	9069.3	552.7	2550.7	6518.6	56683.3	637687.1
	Per hour	[J]	56	220	640	39	180	460	4000	45000
		[oz・in]	7936	31176	90693	5527	25507	65186	566833	6376871
Brake looseness at servo motor shaft [degrees]			0.19 to 2.5	0.12 to 1.2	0.1 to 0.9	0.3 to 3.5	0.2 to 2.0	0.2 to 1.3	0.2 to 0.6	0.2 to 0.6
Brake life (Note 3)	Number of braking cycles [times]		20000	20000	20000	30000	30000	30000	20000	20000
	Work per braking	[J]	4	15	32	4	18	47	200	1000
		[oz・in]	567	2126	4535	567	2551	6660	28342	141708

Item \ Servo Motor			HC-RF Series	HC-UF Series				
			103B to 203B	13B	23B・43B	73B	72B・152B	202B
(Note 1) Type			Spring-loaded safety brake					
(Note 4) Rated voltage			$24V^{0}_{-10\%}$ DC					
Rated current at 20℃		[A]	0.8	0.26	0.33	0.42	0.8	1.4
Excitation coil resistance at 20℃		[Ω]	30	91	73	57	29	16.8
Capacity		[W]	19	6.3	7.9	10	19	34
ON current		[A]	0.25	0.18	0.18	0.2	0.2	0.4
OFF current		[A]	0.085	0.06	0.11	0.12	0.08	0.2
Static friction torque		[N・m]	6.8	0.32	1.3	2.4	8.3	43.1
		[oz・in]	964	45	184	340	1176	6103
(Note 2) Release delay time		[S]	0.03	0.03	0.03	0.03	0.04	0.1
Braking delay time (Note 2) [s]	AC off (Fig. a)		0.12	0.08	0.1	0.12	0.12	0.12
	DC off (Fig. b, c)		0.03	0.01	0.02	0.03	0.03	0.03
Permissible braking work	Per braking	[J]	400	5.6	22	64	400	4500
		[oz・in]	56683.3	793.6	3117.6	9069.3	56683.3	637687.1
	Per hour	[J]	4000	56	220	640	4000	45000
		[oz・in]	566833	7936	31176	90693	566833	6376871
Brake looseness at servo motor shaft [degrees]			0.2 to 0.6	0.19 to 2.5	0.12 to 1.2	0.1 to 0.9	0.2 to 0.6	0.2 to 0.6
Brake life (Note3)	Number of braking cycles [times]		20000	20000	20000	20000	20000	20000
	Work per braking	[J]	200	4	15	32	200	1000
		[oz・in]	28342	567	2126	4535	28342	141708

Note: 1. There is no manual release mechanism. When it is necessary to hand-turn the servo motor shaft for machine centering, etc., use a separate 24VDC power supply to release the brake electrically.

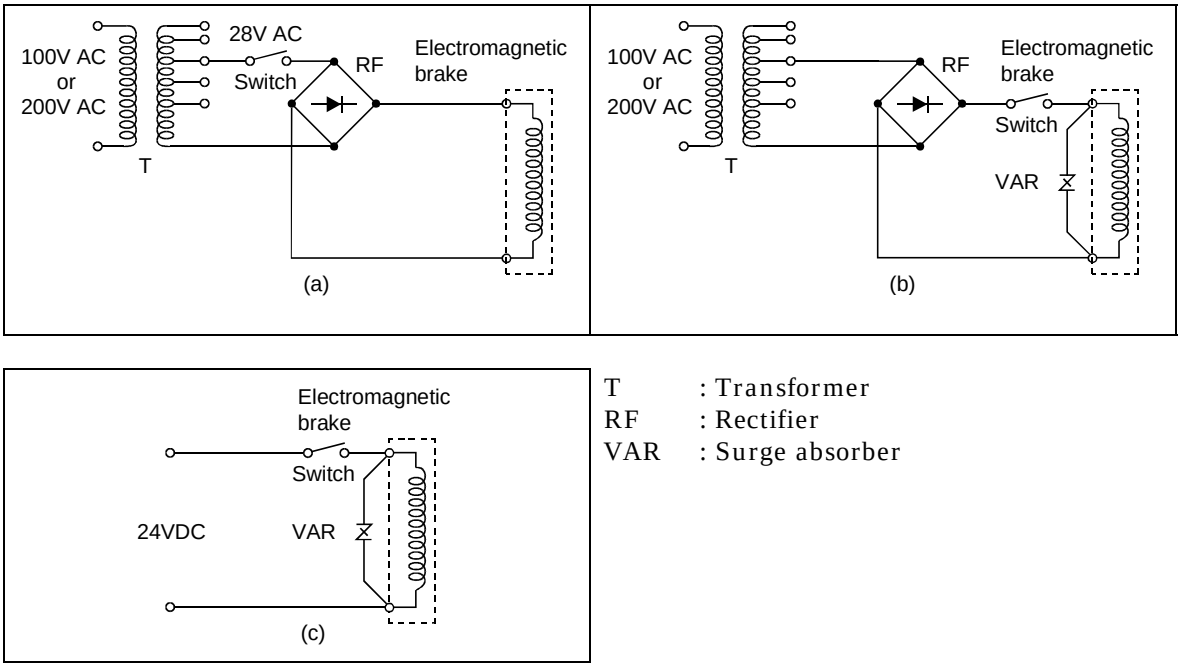
2. The value for initial ON gap at 20℃.

3. The brake gap will increase as the brake lining wears, but the gap is not adjustable. The brake life indicated is the number of braking cycles after which adjustment will be required.

4. 24VDC of the internal power output for interface (VDD) cannot be used. Always use a separate power supply.

(2) Electromagnetic brake power supply

24VDC of the internal power output for interface (VDD) cannot be used. Prepare the following power supply for use with the electromagnetic brake only. Examples of connection of the brake exciting power supply are shown in Fig. 9-2 (a) to (c). (a) is for AC off, and (b) and (c) for DC off. When DC is switched off, the braking delay time will be shortened, but a surge absorber must be installed on the brake terminal. For the selection of the surge absorber, refer to Section 6-2-5.



T : Transformer
RF : Rectifier
VAR : Surge absorber

Fig. 9-2 Connection Examples

(3) Coasting distance

At an emergency stop, the servo motor will decelerate to a stop in the pattern shown in Fig. 9-4. Here, the maximum coasting distance (during fast feed), Lmax, will be the area shown with the diagonal line in the figure and can be calculated approximately with Equation 9-2. The effect of the load torque is greater near the stopping area. When the load torque is large, the servo motor will stop faster than the value obtained in the equation.

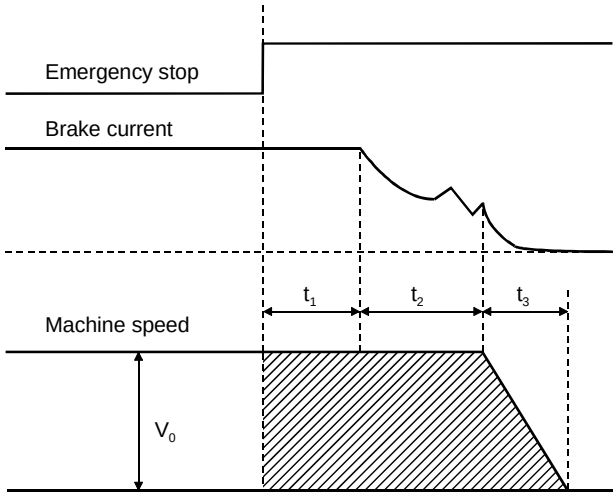


Fig. 9-3 Coasting Distance at Emergency Stop

$$L\ max = \frac{Vo}{60} \cdot \left(t1 + t2 + \frac{t3}{2} \right) \cdots\cdots (9\text{-}2)$$

Where,

L max :	Maximum coasting distance	[mm]
Vo:	Machine's fast feed speed	[mm/min]
t_1:	Delay time of control section	[sec]
t_2:	Braking delay time of brake (Note)	[sec]
t_3:	Braking time	[sec]
	$t_3 = \frac{(J_L + J_M) \cdot No}{9.55 \times 10^4 \cdot (T_L + 0.8T_B)}$	
JL	: Load inertia moment converted into equivalent value on servo motor shaft	[kg・cm²]
JM	: Servo motor inertia moment	[kg・cm²]
No	: Servomotor speed during fast feed	[r/min]
TL	: Load torque converted into equivalent value on servo motor shaft	[N・m]
TB	: Brake static friction torque (Note)	[N・m]

Note: t_2 and TB are the values noted in Table 9-2 Characteristics. JL is the machine's inertia moment at the servo motor shaft.

9 - 4 Dynamic brake characteristics

When an alarm, emergency stop or power failure occurs, the dynamic brake is operated to bring the servo motor to a sudden stop. Fig. 9-4 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 9-3 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds as indicated in Table 9-3 and as shown in Fig. 9-5 to 9-11.

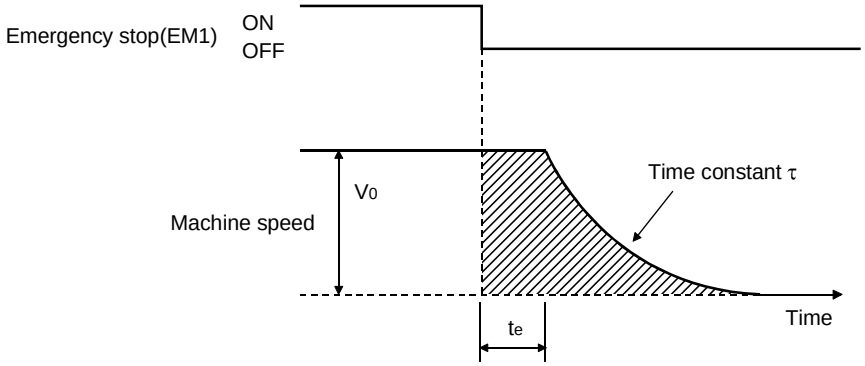


Fig. 9-4 Dynamic Brake Operation Diagram

$$L\,max = \frac{Vo}{60} \cdot \left\{ te + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (9\text{-}3)$$

L max	: Maximum coasting distance	[mm][in]
Vo	: Machine rapid feedrate	[mm/min][in/min]
JM	: Servo motor inertial moment	[kg · cm²][oz · in²]
JL	: Load inertia moment converted into equivalent value on servo motor shaft	[kg · cm²][oz · in²]
τ	: Brake time constant (Fig. 9-5 to 9-11 · Table 9-3)	[s]
te	: Delay time of control section (Fig. 9-5) (There is internal relay delay time of about 30ms.)	[s]

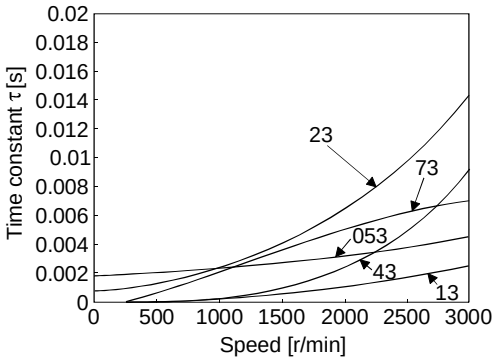


Fig. 9-5 HC-MF Series
Dynamic Brake Time Constant

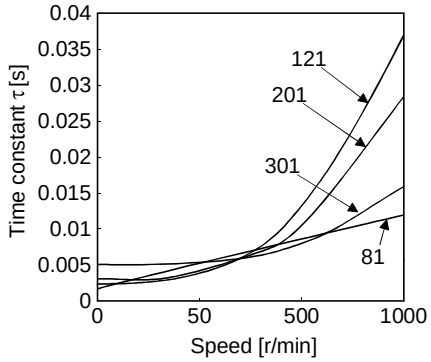


Fig. 9-6 HC-SF 1000r/min Series
Dynamic Brake Time Constant

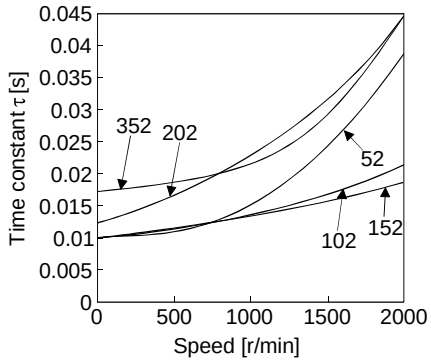


Fig. 9-7 HC-SF 2000r/min Series
Dynamic Brake Time Constant

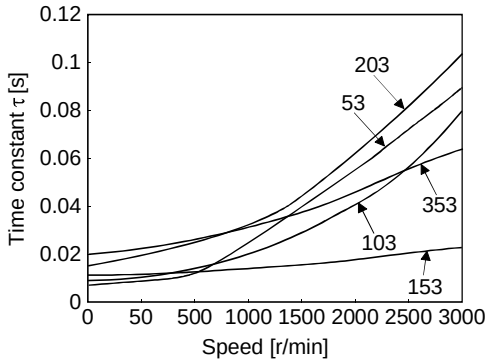


Fig. 9-8 HC-SF 3000r/min Series
Dynamic Brake Time Constant

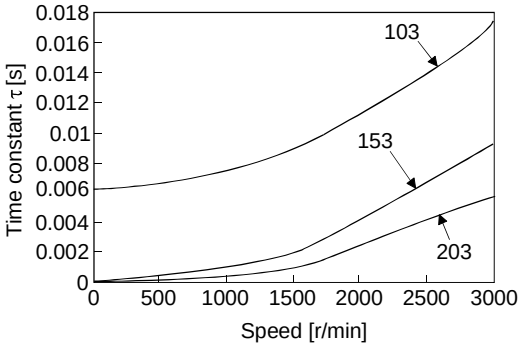


Fig. 9-9 HC-RF Series
Dynamic Brake Time Constant

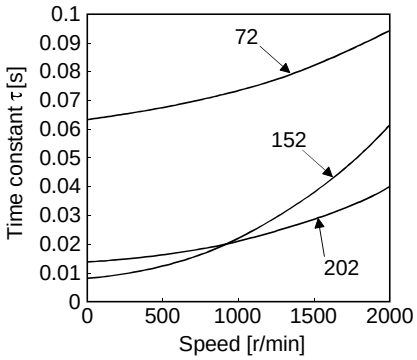


Fig. 9-10 HC-UF 2000r/min Series
Dynamic Brake Time Constant

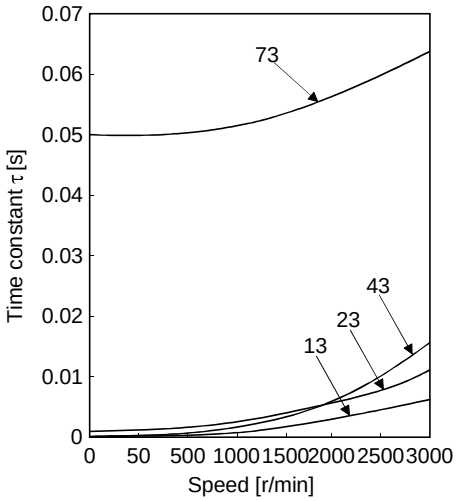


Fig. 9-11 HC-UF 3000r/min Series
Dynamic Brake Time Constant

Dynamic Brake Time Constant

Table 9-3 HA-FF Dynamic Brake Time Constant

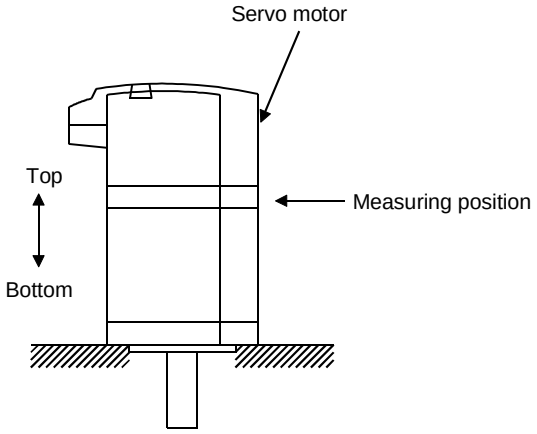
Servo Motor	Brake Time Constant τ [s]
HA-FF053・13	0.02
HA-FF23	0.05
HA-FF33	0.07
HA-FF43	0.09
HA-FF63	0.12

Use the dynamic brake at the load inertia moment indicated on the right. If the load inertia moment is higher than this value, the built-in dynamic brake may burn. If there is a possibility that the load inertia moment may exceed, contact Mitsubishi.

Servo Amplifier	Load Inertia Moment Ratio [times]
MR-J2-10B to MR-J2-200B	30
MR-J2-350B	16

9 - 5 Vibration rank

The vibration rank of the servo motor is V-10 at the rated speed. Measure vibration in the following position with the servo motor installed as shown below.



Servo Motor Vibration
Measuring Conditions

10. SPECIFICATIONS

10 - 1 Standard specifications

(1) Servo amplifiers

Item \ Servo Amplifier MR-J2- □		10B	20B	40B	60B	70B	100B	200B	350B
Power supply	Voltage/frequency	Three-phase 200 to 230VAC, 50/60Hz or single-phase 230VAC, 50/60Hz (Note1)					Three-phase 200 to 230VAC, 50/60Hz		
	Permissible voltage fluctuation	Single-phase 230VAC: 207 to 253VAC Three-phase 200 to 230VAC: 170 to 253VAC					Three-phase 170 to 253VAC		
	Permissible frequency fluctuation	±5%							
System		Sine-wave PWM control, current control system							
Dynamic brake		Built-in							
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder fault protection, regenerative fault protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection							
Speed frequency response		250Hz or more							
Structure [A]		Open (IP00)							
Environmental condition		Refer to (1) in Section 4.1							
Weight	[kg]	0.7	0.7	1.1	1.1	1.7	1.7	2.0	2.0
	[lb]	1.5	1.5	2.4	2.4	3.75	3.75	4.4	4.4

Note: The single-phase 230VAC power supply applies to a combination with the HC-MF/HA-FF series servo motor.

(2) Servo motors

The same specifications also apply to the EN Standard- and UL/C-UL Standard-compliant models.

Item \ Servo Motor			HC-MF Series (Ultra low inertia, small capacity)					HA-FF Series (Low inertia, middle capacity)					
			053	13	23	43	73	053	13	23	33	43	63
Applicable servo amplifier MR-J2-□B			10		20	40	70	10		20	40	60	
(Note 1) Continuous running duty	Rated output	[kW]	0.05	0.1	0.2	0.4	0.75	0.05	0.1	0.2	0.3	0.4	0.6
	Rated torque	[N・m]	0.16	0.32	0.64	1.3	2.4	0.16	0.32	0.64	0.95	1.3	1.9
		[oz・in]	22.7	45.3	90.7	184	340	22.7	45.3	90.7	135	184	269
Rated speed (Note 1)		[r/min]	3000					3000					
Maximum speed		[r/min]	4500					4000					
Permissible instantaneous speed		[r/min]	5175					4600					
Maximum torque		[N・m]	0.48	0.95	1.9	3.8	7.2	0.48	0.95	1.9	2.9	3.8	5.7
		[oz・in]	68.0	135	269	538	1020	68.0	135	269	411	538	808
Power rate at continuous rated torque [kW/s]			13.47	34.13	41.8	116.55	94.43	4.0	10.2	11.7	18.1	17.2	30.1
(Note 7) Inertia moment		J[kg・cm^2]	0.019	0.03	0.088	0.143	0.6	0.063	0.095	0.35	0.50	0.98	1.2
		WK[oz・in]	0.104	0.16	0.48	0.78	3.28	0.344	0.52	1.91	2.73	5.36	6.56
Recommended ratio of load inertia moment to servo motor shaft inertia moment (Note 6)			30 times or less					10 times or less					
(Note4) Regenerative brake duty	Servo amplifier' built-in regenerative brake resistor		(Note 5)	(Note 5)	(Note 5)	1010	400	(Note 5)	(Note 5)	(Note 5)	320	150	120
	MR-RB032(30W)					3000	600				950	450	360
	MR-RB12(30W)					(Note 5)	2400				3200	1500	1200
(Note 3) Power supply capacity		[kVA]	0.3	0.3	0.5	0.9	1.3	0.3	0.3	0.5	0.7	0.9	1.1
Rated current		[A]	0.85		1.5	2.8	5.1	0.6	1.1	1.3	1.9	2.5	3.6
Maximum current		[A]	2.6		5.0	9.0	18	1.8	3.3	3.9	5.7	7.5	10.8
Speed/position detector			Encoder (resolution 8192 pulses/rev)										
Accessories			Encoder					Encoder, V ring					
Structure			Totally-enclosed, self-cooled (protection type: IP44 with the exception of through-shaft portion(Note8))					Totally-enclosed, self-cooled (protection type: IP44)					
(Note 2) Environmental conditions			Refer to (1), Section 4-2.										
(Note 7) Weight		[kg]	0.4	0.53	0.99	1.45	3.0	1.3	1.5	2.3	2.6	4.2	4.8
		[lb]	0.88	1.17	2.18	3.2	6.6	2.87	3.31	5.07	5.73	9.26	10.6

Item \ Servo Motor			HC-SF 1000r/min Series (Middle inertia, middle capacity)				HC-SF 2000r/min Series (Middle inertia, middle capacity)				
			81	121	201	301	52	102	152	202	352
Applicable servo amplifier	MR-J2-□B		100	200	200	350	60	100	200	200	350
(Note 1) Continuous running duty	Rated output	[kW]	0.85	1.2	2.0	3.0	0.5	1.0	1.5	2.0	3.5
	Rated torque	[N・m]	8.12	11.5	19.1	28.6	2.39	4.78	7.16	9.55	16.7
		[oz・in]	1151	1630	2707	4053	339	677	1015	1353	2367
(Note 1) Rated speed		[r/min]	1000				2000				
Maximum speed		[r/min]	1500	1200			3000				2500
Permissible instantaneous speed		[r/min]	1725	1380			345				2850
Maximum torque		[N・m]	24.4	34.4	57.3	85.9	7.16	14.4	21.6	28.5	50.1
		[oz・in]	3458	4875	8120	12173	1015	2041	3061	4039	7100
Power rate at continuous rated torque		[kW/s]	32.9	30.9	44.5	81.3	8.7	16.7	25.6	21.5	34.1
(Note 7) Inertia moment	J	[$\times 10^{-4}$kg・m^2]	20.0	42.5	82	101	6.6	13.7	20.0	4.5	82.0
	WK^2	[oz・in^2]	109	232	448	552	36.1	74.9	109	232	448
(Note 6) Recommended ratio of load inertia moment to servo motor shaft inertia moment			15 times or less				15 times or less				
(Note4) Regenerative brake duty [times/min]	Servo amplifier' built-in regenerative brake resistor		140	70	100	84	56	54	136	64	31
	MR-RB032(30W)		220	110			165	80			
	MR-RB12(100W)		740	350			560	270			
	MR-RB32(300W)		2220	1040				810			
	MR-RB30(300W)				330	250			408	192	95
	MR-RB50(500W)				550	430			680	320	158
Power supply capacity (Note 3)		[kVA]	1.5	2.1	3.5	4.8	1.0	1.7	2.5	3.5	5.5
Rated current		[A]	5.1	7.1	9.6	16	3.2	6	9	11	17
Maximum current		[A]	15.3	21.3	28.8	48	9.6	18	27	33	51
Speed/position detector			Encoder (resolution: 16384 pulse/rev)				Encoder (resolution: 16384 pulse/rev)				
Accessories			Encoder・Oil seal				Encoder・Oil seal				
Structure			Totally-enclosed, self-cooled (protection type: IP65)				Totally-enclosed, self-cooled (protection type: IP65)				
(Note 2) Environmental conditions			Refer to (1), section 4.2				Refer to (1), section 4.2				
(Note 7) Weight		[kg]	9.0	12	19	23	5.0	7.0	9.0	12.0	19.0
		[lb]	19.8	26.5	41.9	50.7	11.0	15.4	19.8	26.5	41.9

Item \ Servo Motor			HC-SF 3000r/min Series (Middle inertia, middle capacity)					HC-RF Series (Low inertia, small capacity)		
			53	103	153	(Note9) 203	(Note9) 353	103	153	203
Applicable servo amplifier	MR-J2-□B		60	100	200	200	350	200	200	350
(Note 1) Continuous running duty	Rated output	[kW]	0.5	1.0	1.5	2.0	3.5	1.0	1.5	2.0
	Rated torque	[N・m]	1.59	3.18	4.78	6.37	11.1	3.18	4.78	6.37
		[oz・in]	225	451	677	903	1573	451	677	903
(Note 1) Rated speed		[r/min]	3000					3000		
Maximum speed		[r/min]	3000					4500		
Permissible instantaneous speed		[r/min]	3450					5175		
Maximum torque		[N・m]	4.77	9.55	14.3	19.1	33.4	7.95	11.9	15.9
		[oz・in]	676	1353	2026	2707	4733	1127	1686	2253
Power rate at continuous rated torque		[kW/s]	3.8	7.4	11.4	9.5	15.1	67.4	120	176
(Note 7) Inertia moment	J	[$\times 10^{-4}$kg・m^2]	6.6	13.7	20.0	42.5	82.0	1.5	1.9	2.3
	WK2	[oz・in^2]	36.1	74.9	109.3	232.4	448.3	8.2	10.4	12.6
(Note 6) Recommended ratio of load inertia moment to servo motor shaft inertia moment			15 times or less					5 times or less		
(Note4) Regenerative brake duty [times/min]	Servo amplifier' built-in regenerative brake resistor		25	24	82	24	14	1090	860	710
	MR-RB032(30W)		73	36						
	MR-RB12(100W)		250	120						
	MR-RB32(300W)			360						
	MR-RB30(300W)				250	70	42	3270	2580	2130
	MR-RB50(500W)				410	110	70	5450	4300	3550
(Note 3) Power supply capacity		[kWA]	1.0	1.7	2.5	3.5	5.5	1.8	2.5	3.5
Rated current		[A]	3.2	5.3	8.6	10.4	16.4	6.1	8.8	14
Maximum current		[A]	9.6	15.9	25.8	31.2	49.2	18.4	23.4	37
Speed/position detector			Encoder (resolution : 16384 pulse/rev)					Encoder (resolution : 16384 pulse/rev)		
Accessories			Encoder・Oil seal					Encoder・Oil seal		
Structure			Totally-enclosed, self-cooled (protection type: IP65)					Totally-enclosed, self-cooled (protection type: IP65)		
(Note 2) Environmental conditions			Refer to (1), section 4.2					Refer to (1), section 4.2		
(Note 7) Weight		[kg]	5.0	7.0	9.0	12	19	3.9	5.0	6.2
		[lb]	11.0	15.4	19.8	26.5	41.9	8.6	11.0	13.7

Item \ Servo Motor			HC-UF 2000r/min Series (Pancake type middle capacity)			HC-UF 3000r/min Series (Pancake type small capacity)			
			72	152	202	13	23	43	(Note9) 73
Applicable servo amplifier	MR-J2-□B		70	200	350	10	20	40	70
(Note 1) Continuous running duty	Rated output	[kW]	0.75	1.5	2.0	0.1	0.2	0.4	0.75
	Rated torque	[N・m]	3.58	7.16	9.55	0.32	0.64	1.3	2.4
		[oz・in]	507	1015	1353	45	91	184	340
(Note 1) Rated speed		[r/min]	2000			3000			
Maximum speed		[r/min]	3000			4500			
Permissible instantaneous speed		[r/min]	3450			5175			
Maximum torque		[N・m]	10.7	21.6	28.5	0.95	1.9	3.8	7.2
		[oz・in]	1516	3061	4039	135	269	538	1020
Power rate at continuous rated torque		[kW/s]	12.3	23.2	23.9	15.5	19.2	47.7	9.66
(Note 7) Inertia moment	J	[$\times 10^{-4}$kg・m^2]	10.4	22.1	38.2	0.066	0.241	0.365	5.90
	WK^2	[oz・in^2]	56.9	120.8	208.9	0.4	1.3	2.0	32.3
(Note 6) Recommended ratio of load inertia moment to servo motor shaft inertia moment			15 times or less			15 times or less			
(Note4) Regenerative brake duty [times/min]	Servo amplifier' built-in regenerative brake resistor		53	124	68	(Note5)	(Note5)	410	41
	MR-RB032(30W)		79					1230	62
	MR-RB12(100W)		87					4106	206
	MR-RB32(300W)		791						
	MR-RB30(300W)			372	203				
	MR-RB50(300W)			620	338				
(Note 3) Power supply capacity		[kWA]	1.3	2.5	3.5	0.3	0.5	0.9	1.3
Rated current		[A]	5.4	9.7	14	0.76	1.5	2.8	4.3
Maximum current		[A]	16.2	29.1	42	2.5	4.95	9.24	12.9
Speed/position detector			Encoder (resolution : 16384 pulse/rev)			Encoder (resolution : 8192 pulse/rev)			
Accessories			Encoder・Oil seal			Encoder・Oil seal			
Structure			Totally-enclosed, self-cooled (protection type: IP65(Note9))			Totally-enclosed, self-cooled (protection type: IP65(Note9))			
(Note 2) Environmental conditions			Refer to (1), section 4.2			Refer to (1), section 4.2			
(Note 7) Weight		[kg]	8.0	11.0	16.0	0.8	1.5	1.7	5.0
		[lb]	17.6	24.3	35.3	1.8	3.3	3.7	11.0

Note:1. When the power supply voltage drops, we cannot guarantee the output and rated speed.

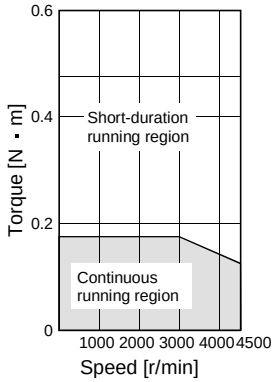
2. When the equipment is to be used in places where it is subjected to oil and/or water, such as on machine field sites, optional features apply to the equipment. Please contact.
3. The power supply capacity depends on the power supply impedance.
4. The regenerative brake duty indicated is the permissible duty when the servo motor running without load at the rated speed is decelerated to a stop. When a load is connected, the value in the table is multiplied by 1/(m + 1), where m = load inertia moment/motor inertia moment. At the speed higher than the rated, the permissible number of times is in inverse proportion to the square of (running speed/rated speed). When the running speed varies frequently or when the regenerative mode continues as in vertical feed, calculate regenerative heat generated during operation. Provisions must be made to keep this generated heat below the permissible value.
5. If the effective torque is within the rated torque range, there are no restrictions on the regenerative duty.
6. If the load inertia moment ratio exceeds the indicated value, please consult us.
7. When the servo motor is equipped with reduction gear or electromagnetic brake, refer to the corresponding outline dimension drawing. For the EN Standard- and UL/C-UL Standard-compliant models, please consult us.
8. Except for the shaft-through portion and connector.
9. The HC-UF73, HC-SF203 and HC-SF353 may not be connected depending on the production time of the servo amplifier. Contact us.

10 - 2 Torque characteristics

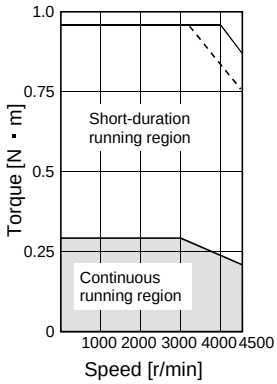
NOTICE	・If load is applied during a stop (during servo lock), 70% of the rated torque should not be exceeded. ・The broken line in the graph applies to the case the motor is used with the servo amplifier having the single-phase 100VAC power supply feature.

(1) HC-MF series

[HC-MF053]



[HC-MF13]



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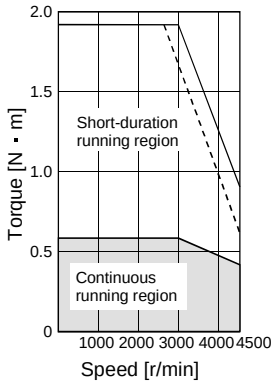

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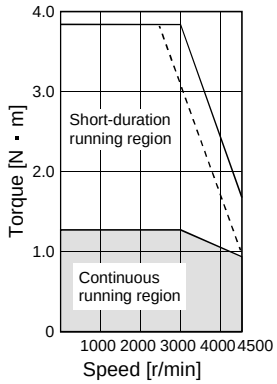

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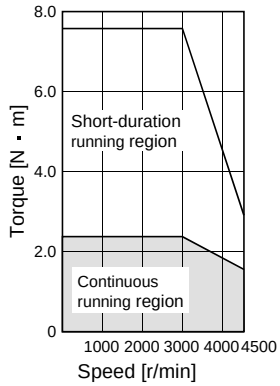
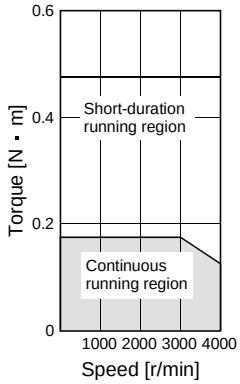
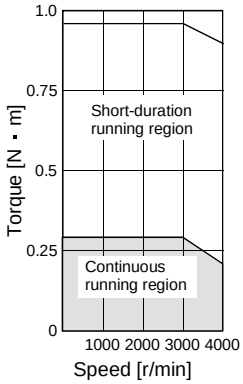


(2) HA-FF series

[HA-FF053]



[HA-FF13]



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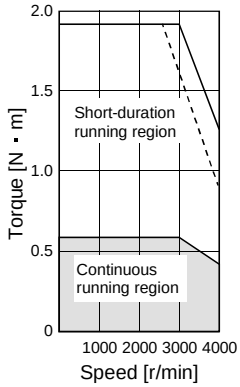
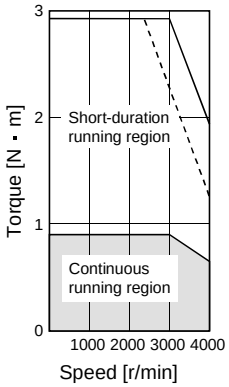


[HA-FF33]



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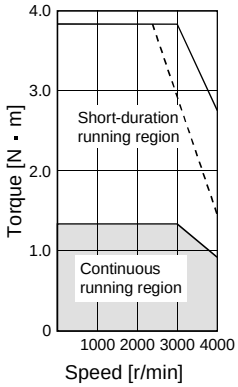
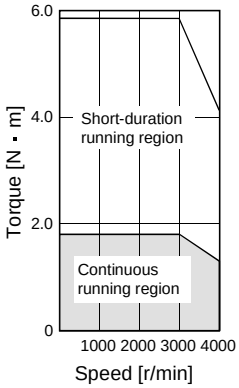
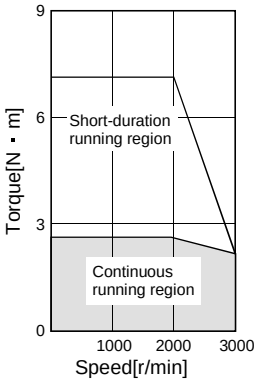


[HA-FF63]



(3) HC-SF series

[HC-SF52]



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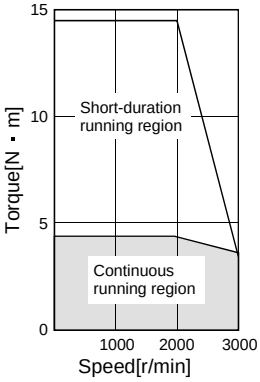

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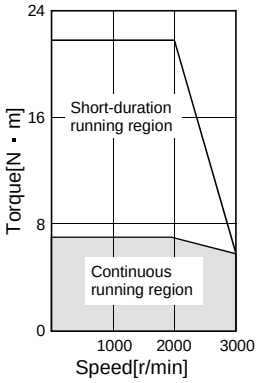

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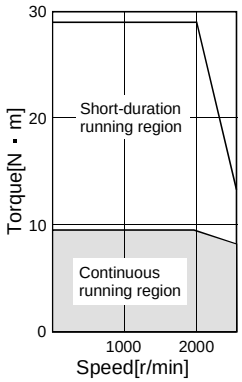

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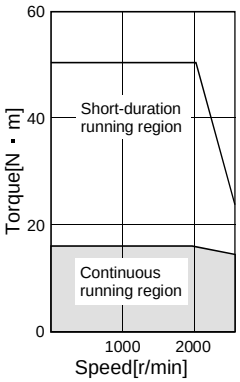

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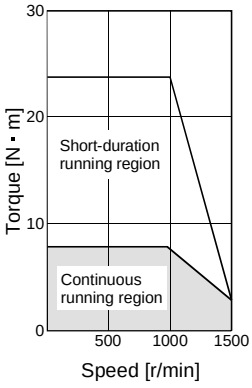

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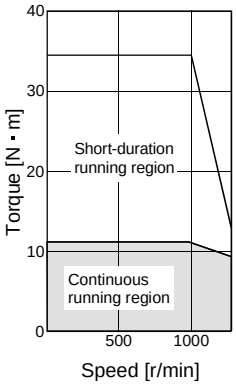

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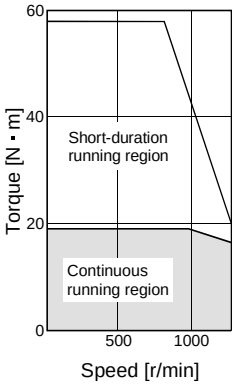

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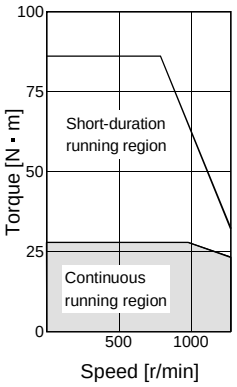

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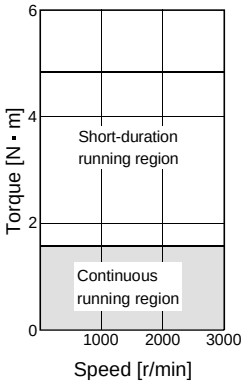

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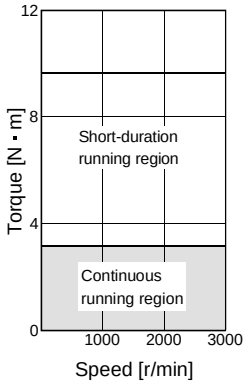

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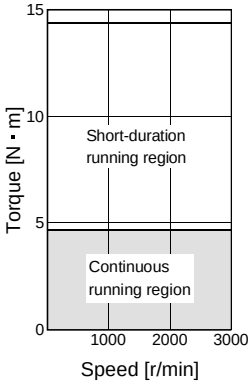

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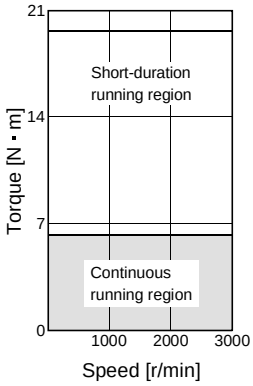

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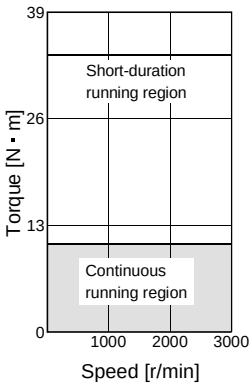
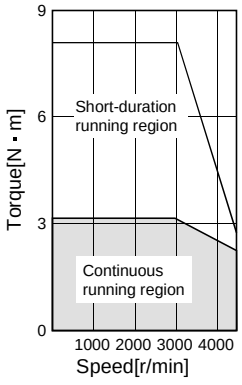


(4) HC-RF series

[HC-RF103]



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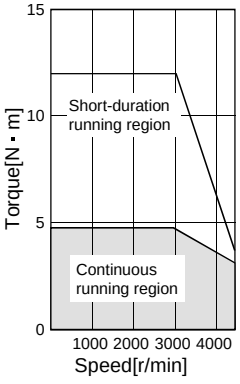

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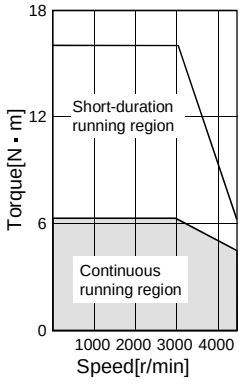
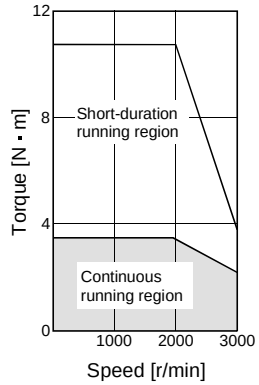


(5) HC-UF series

[HC-UF72]



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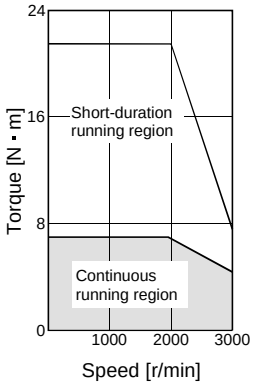

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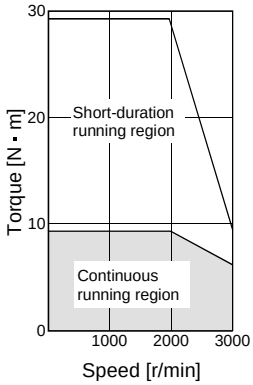

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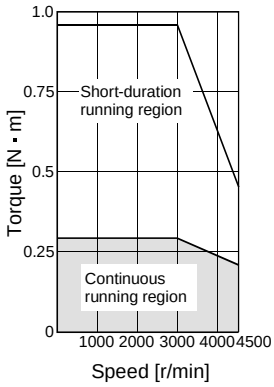

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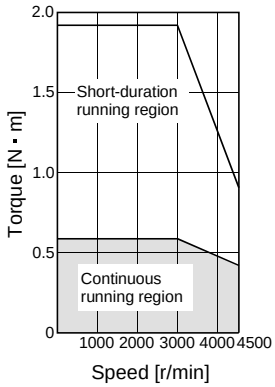

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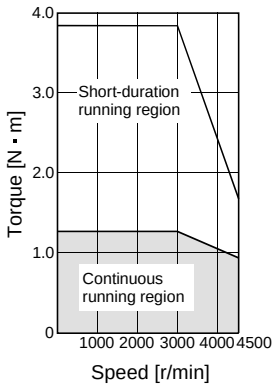

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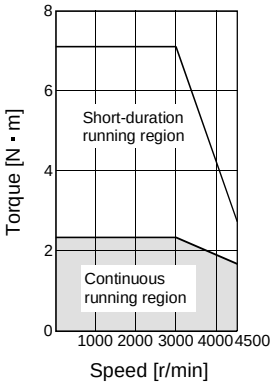


10 - 3 Servo motors with reduction gears

> **CAUTION** The servo motor with reduction gear must be installed in the specified direction. Otherwise , it can leak oil, leading to a fire or fault.

Servo motors are available with reduction gears designed for: 1) general industrial machines; and 2) precision applications.
Servo motors with electromagnetic brakes are also available.

(1) Manufacturing range of servo motor with reduction gear

Servo motors with reduction gears that may be manufactured are indicated by symbols (G1(H), G2) in the following table. G1 (H) and G2 are symbols appended to the servo motor models. (Refer to 2), (2) in Section 1-1.)

Reduction Gear Series / Reduction ratio / Servo Motor	For General Industrial Machines												For Precision Applications							
	(Note) 1/5	1/6	(Note) 1/10	1/11	(Note) 1/12	1/17	(Note) 1/20	1/29	(Note) 1/30	1/35	1/43	1/59	1/5	1/9	1/10	1/15	1/20	1/25	1/29	1/45
HC-MF053□ to 73□	G1				G1		G1						G2	G2			G2		G2	
HA-FF053□	G1		G1						G1				G2		G2	G2		G2		
HA-FF13□	G1		G1						G1				G2		G2	G2		G2		G2
HA-FF23□	G1		G1						G1				G2		G2	G2	G2		G2	G2
HA-FF33□	G1		G1						G1				G2		G2		G2		G2	G2
HA-FF43□・63□	G1		G1						G1				G2	G2			G2		G2	G2
HC-SF52□ to 202□		G1 (H)		G1 (H)		G1 (H)		G1 (H)		G1 (H)	G1 (H)	G1 (H)	G2	G2			G2		G2	G2
HC-SF352□		G1 (H)		G1 (H)		G1 (H)		G1 (H)		G1 (H)	G1 (H)	G1 (H)	G2	G2			G2			
HC-RF103□ to 203□													G2	G2			G2		G2	G2

Note : Reduction ratios for general industrial machines are nominal values. For actual reduction ratios, refer to (2) and (3) in this section.

(2) HC-MF series

Reduction Gear Series		For General Industrial Machines (HC-MF□G1)		For Precision Applications (HC-MF□G2)
Mounting Method		Flange mounting		
Mounting direction		In any directions		
Lubrication		Grease lubrication (Already packed)		Grease lubrication (Already packed)
	Recommended grease	50・100W	200 to 750W	LDR101BV American Oil Center Research
		Mobilplex 46 Mobil Oil	Mobiltac 81 Mobil Oil	
Output shaft rotating direction		Same as the servo motor output shaft direction.		
With electromagnetic brake		Available		
Backlash		60 minutes or less at reduction gear output shaft		3 minutes or less at reduction gear output shaft
Permissible load inertia moment ratio (when converting into the servo motor shaft)		25 times or less		5 times or less
Permissible speed (at servo motor shaft)		4500 r/min		

The actual reduction ratios of the servo motors with reduction gears designed for general industrial machines are as listed below:

Servo Motor / Nominal Reduction Ratio	HC-MF053(B)G1	HC-MF13(B)G1	HC-MF23(B)G1	HC-MF43(B)G1	HC-MF73(B)G1
1/5	9/44		19/96		1/5
1/12	49/576		25/288		525/6048
1/20	25/484		253/5000		625/12544

(3) HA-FF series

Reduction Gear Series		For General Industrial Machines (HA-FF□G1)		For Precision Applications (HA-FF□G2)
Mounting Method		Flange mounting		
Mounting direction		In any directions		
Lubrication		Grease lubrication (Already packed)		Grease lubrication (Already packed)
	Recommended grease	50・100W	200 to 600W	LDR101BJ American Oil Center Research
		SUMICO LUBRICANT MOLY PS GREASE No.2	PYRONOC UNIVERSAL No.000 NIPPON PETRQLEUM	
Output shaft rotating direction		Servo motor shaft and reduction gear output shaft rotate in the same direction. For the HA-FF053G1 1/30 and HA-FF3G1 1/30, how-ever, the servo motor shaft and reduction gear output shaft rotate in the opposite directions.		Servo motor shaft and reduction gear output-shaft rotate in the same direction.
With electromagnetic brake		Available		
Backlash		40 minutes to 1.5°		Within 3 minutes
Permissible load inertia moment ratio (when converting into the servo motor shaft)		5 times or less		
Permissible speed (at servo motor shaft)		3000 r/min		

The actual reduction ratios of the servo motors with reduction gears designed for general industrial machines are as listed below:

Servo Motor / Nominal Reduction Ratio	HA-FF053G1	HA-FF13G1	HA-FF23G1	HA-FF33G1	HA-FF43G1	HA-FF63G1
1/5	9/44		57/280	19/94		10/49
1/10	3/29		39/400	39/376		243/2401
1/30	144/4205		1/30	11/329		27/784

(4) HC-SF series

Reduction Gear Series		For General Industrial Machines (HC-SF□G1(H))	For Precision Applications (HC-SF□G2)
Mounting method		As in 1) in this section	Flange mounting
Mounting direction		As in 1) in this section	In any directions
Lubrication		As in 1) in this section	Grease lubrication (Already packed)
	Recommended grease	As in 2) in this section	LDR101BJ of American Oil Center Research make
Output shaft rotating direction		Opposite direction to the servo motor shaft	Same direction as the servo motor shaft
With electromagnetic brake		Available	
Backlash		40 minutes to 2° at reduction gear output shaft	3 minutes or less at reduction gear output shaft
Permissible load inertia moment ratio (when converting into the servo motor shaft)		4 times or less	5 times or less
Permissible speed (at servo motor shaft)		2000[r/min]	0.5 to 1.5kW:3000[r/min] 2 to 3.5kW:2500[r/min]

1) Lubrication of reduction gears for general industrial machines

Oil lubrication cannot be used in applications where the servo motor will move. Specify grease lubrication.

For grease lubrication, the reduction gear is already grease-packed.

For oil lubrication, pack the reduction gear with oil on the customer side.

Mounting Direction / Reduction gear model / Reduction gear frame No.	Shaft in Any Direction		Shaft Horizontal		Shaft Downward		Shaft Upward	
	CNHM (leg type)	CNVM (flange type)	CHHM (leg type)	CHVM (flange type)	CVHM (leg type)	CVVM (flange type)	CWHM (leg type)	CWVM (flange type)
4105	Grease	Grease						
4115	Grease	Grease						
4135			(Note) Oil	(Note) Oil	(Note) Oil	(Note) Oil	Grease	Grease
4165			(Note) Oil	(Note) Oil	(Note) Oil	(Note) Oil	Grease	Grease
4175			Oil	Oil	Oil	Oil		

Note: Grease-lubricated type is also available.

The reduction gear frame numbers are as follows:

Servo Motor	Reduction Ratio						
	1/6	1/11	1/17	1/29	1/35	1/43	1/59
HC-SF52(B)G1 (H)	4105				4115		
HC-SF102(B)G1 (H)	4115					4135	4165
HC-SF152(B)G1 (H)	4115			4135		4165	
HC-SF202(B)G1 (H)	4115			4165			
HC-SF352(B)G1 (H)	4135			4165		4175	

2) Recommended lubricants

a. Grease: Albania Grease/Shell OIL

b. Lubricating oil

Ambient Temperature ℃	COSMO OIL	Nisseki-Mitsubishi Oil	IDEMITSU KOSAN CO., LTD	GENERAL OIL	Shell OIL	ESSO OIL	Mobil OIL	Japan Energy
−10 to 5	COSMO GEAR SE 68	BONNOC SP 68 DIAMOND GEAR LUBE SP 68	DAPHNE CE 68S DAPHNE SUPER GEAR OIL 68		Omala Oils 68	SPARTAN EP 68	Mobilgear 626 (ISO VG68)	JOMO. Reductus 68
0 to 35	COSMO GEAR SE 100,150	BONNOC SP 100,150 DIAMOND GEAR LUBE SP 100,150	DAPHNE CE 100S,150S DAPHNE SUPER GEAR OIL 100,150	GENERAL SP GEAROL 100,150	Omala Oils 100,150	SPARTAN EP150	Mobilgear 629 (ISO VG150)	JOMO. Reductus 100,150
30 to 50	COSMO GEAR SE 200,320,460	BONNOC SP 200 to 460	DAPHNE CE 220S to 460S	GENERAL SP GEAROL 200 to 260	Omala Oils 200 to 460	SPARTAN EP 220 to 460	Mobilgear 630 to 634 (ISO VG 220 to 460)	JOMO. Reductus 200 to 460

Lubricating oil fill amount (ℓ)

Reduction gear frame No.		4135	4165	4175
Fill amount	Horizontal type	0.7	1.4	1.9
	Vertical type	1.1	1.0	1.9

c. Lubricating product changing intervals

1) Grease: 20000 hours or 4 to 5 years

2) Lubricant

Changing intervals	Operation hours per day	
	Less than 10 hours	10 to 24 hours
First time	500 hours	
Second time and later	Half year	2500 hours

(5) HC-RF series

Reduction Gear Series		For Precision Applications (HC-RF□G2)
Mounting method		Flange mounting
Mounting direction		In any directions
Lubrication		Grease lubrication (Already packed)
	Recommended grease	LDR101BJ of American Oil Center Research make
Output shaft rotating direction		Same direction as the servo motor shaft
With electromagnetic brake		Available
Backlash		Within 3 minutes at reduction gear output shaft
Permissible load inertia moment ratio (when converting into the servo motor shaft)		5 times or less
Permissible speed (at servo motor shaft)		4000[r/min]

10 - 4 Servo motors with special shafts

The standard shaft of the servo motor is straight without a keyway. Shafts with keyway and D cut are also available.
These shafts are not appropriate for applications where the servo motor is started and stopped frequently. Use a friction coupling or the like with such keys since we cannot guarantee such trouble as broken shafts due to loose keys.

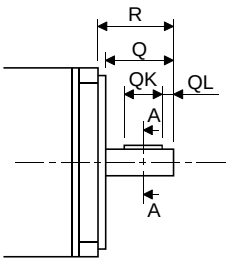
Servo Motor	Shaft Shape	
	Keyway	D cut
HC-MF053・13		○
HC-MF23 to 73	(Note 1) ○	
HA-FF053・13		○
HA-FF23 to 63	(Note 2)	
HC-SF81 to 301 HC-SF52 to 702 HC-SF53 to 353	○	

Servo Motor Model	Shaft Shape	
	Keyway	D cut
HC-RF103 to 503	○	
HC-UF72 to 502	○	
HC-UF13		○
HC-UF23 to 73	(Note 1) ○	

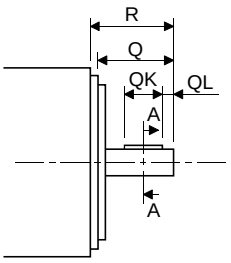
Note: 1. With a key.
2. Standard with a key. For shape, refer to Section 10-5-2.

Machining Dimension Diagram

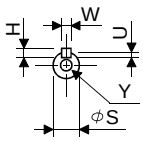
With key



HC-MF23K to 73K



HC-UF23K to 73K



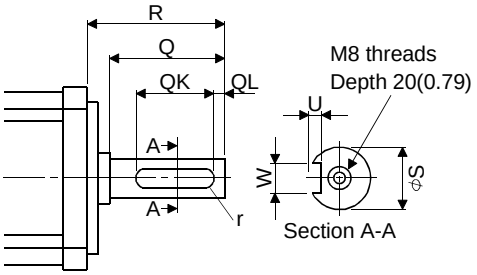
Section A-A

[Unit: mm]
([Unit: in])

Servo Motor Model	Variable Dimensions								
	S	R	Q	W	QK	QL	U	H	Y
HC-MF23K・43K	14h6 (14)	30 (1.18)	27 (1.06)	5 (0.20)	20 (0.79)	3 (0.12)	3 (0.12)	5 (0.20)	M4 Depth 15 (0.59)
HC-MF73K	19h6 (19)	40 (1.57)	37 (1.46)	6 (0.24)	25 (0.98)	5 (0.20)	3.5 (0.14)	6 (0.24)	M5 Depth 20 (0.79)
HC-UF23K・43K	14h6 (14)	30 (1.18)	23.5 (0.93)	5 (0.20)	20 (0.79)	3 (0.12)	3 (0.12)	5 (0.20)	M4 Depth 15 (0.59)
HC-UF73K	19h6 (19)	40 (1.57)	36.5 (1.44)	6 (0.24)	25 (0.98)	5 (0.20)	3.5 (0.14)	6 (0.24)	M5 Depth 20 (0.79)

Keyway

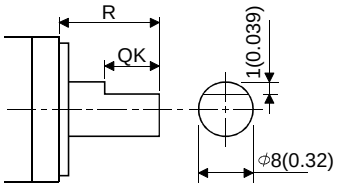
[Unit: mm]
([Unit: in])



Servo Motor Model	Variable Dimensions							
	S	R	Q	W	QK	QL	U	r
HC-SF81K HC-SF52K to 152K HC-SF53K to 153K	24h6 (0.94)	55 (2.17)	50 (1.97)	$8^{0}_{-0.036}$ (0.31)	36 (1.42)	5 (0.20)	$4^{+0.2}_{0}$ (0.16)	4 (0.16)
HC-SF121K to 301K HC-SF202K to 702K HC-SF203K・353K	35 (1.38)	79 (3.11)		$10^{0}_{-0.036}$ (0.39)	55 (2.17)	5 (0.20)	$5^{+0.2}_{0}$ (0.20)	5 (0.20)
HC-RF103K to 203K	24h6 (0.94)	45 (1.77)	40 (1.57)	$8^{0}_{-0.036}$ (0.31)	25 (0.98)	5 (0.20)	$4^{+0.2}_{0}$ (0.16)	4 (0.16)
HC-RF353K to 503k	28h6 (1.10)	63 (2.48)	58 (2.28)	$8^{0}_{-0.036}$ (0.31)	53 (2.09)	3 (0.12)	$4^{+0.2}_{0}$ (0.16)	4 (0.16)
HC-UF72K	22h6 (0.87)	55 (2.17)	50 (1.97)	$6^{0}_{-0.030}$ (0.24)	42 (1.65)	3 (0.12)	$3.5^{+0.2}_{0}$ (0.14)	3 (0.12)
HC-UF152K	28h6 (1.10)	55 (2.17)	50 (1.97)	$8^{0}_{-0.036}$ (0.31)	45 (1.77)	5 (0.20)	$4^{+0.2}_{0}$ (0.16)	4 (0.16)
HC-UF202K to 502K	35h6 (1.38)	65 (2.56)	60 (2.36)	$10^{0}_{-0.036}$ (0.39)	55 (2.17)	5 (0.20)	$5^{+0.2}_{0}$ (0.20)	5 (0.20)

D cut

[Unit: mm]
([Unit: in])



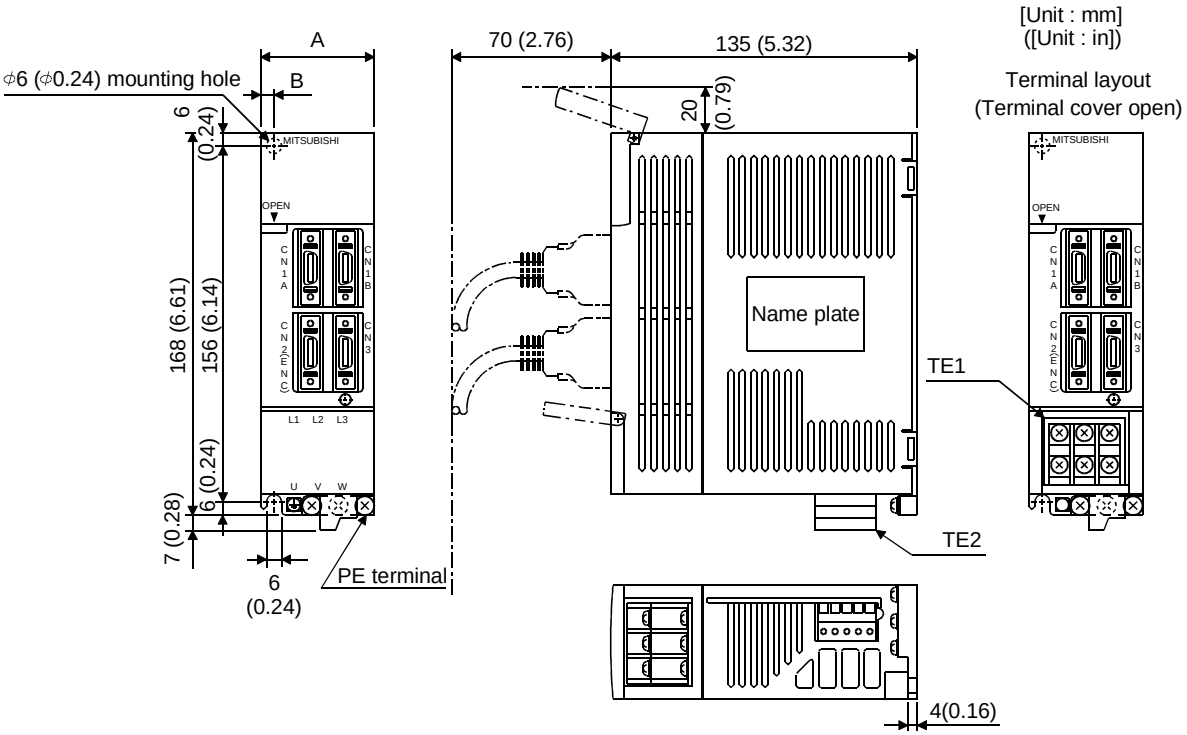
Servo Motor Model	Variable Dimensions	
	R	QK
HC-MF053D・13D	25(0.98)	20.5(0.81)
HA-FF053D・13D	30(1.178)	25.5(1.00)
HC-UF13D	25(0.98)	17.5(0.69)

10 - 5 Outline dimension drawings

10 - 5 - 1 Servo amplifiers

(1) MR-J2-10B to MR-J2-60B

[Unit : mm]
([Unit : in])



Servo Amplifier Model	Variable Dimensions		Weight [kg]([lb])
	A	B	
MR-J2-10B	50 (1.97)	6 (0.24)	0.7 (1.54)
MR-J2-20B			
MR-J2-40B	70 (2.76)	22 (0.87)	1.1 (2.43)
MR-J2-60B			

TE1

L1	L2	L3
U	V	W

Terminal screw: M4 × 0.7
Tightening torque: 1.24 [N・m] (175.6 [oz・in])

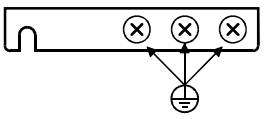
TE2

←Front

D	C	P	L21	L11

Tightening torque: 0.5 to 0.6 [N・m] (70.8 to 85.0 [oz・in])
FRONT MSTB2,5/5-ST-5,08
(Phoenix Contact make)

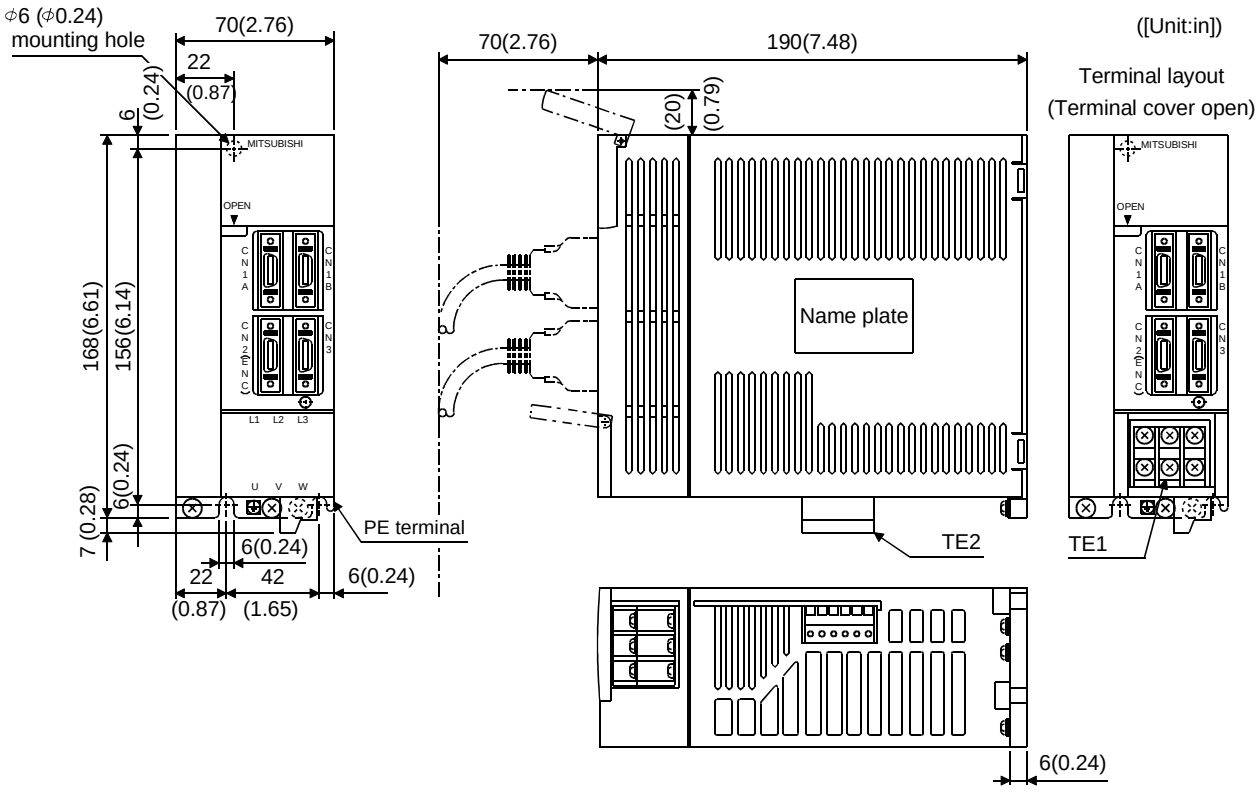
PE terminals



Terminal screw: M4 × 0.7
Tightening torque: 1.24 [N・m] (175.6 [oz・in])

(2) MR-J2-70B・MR-J2-100B

[Unit: mm]
([Unit:in])



Servo Amplifier Model	Weight [kg]([lb])
MR-J2-70B	1.7
MR-J2-100B	(3.75)

TE1

L1	L2	L3
U	V	W

Terminal screw: M4×0.7

Tightening torque: 1.24 [N・m] (175.6 [oz・in])

TE2

←Front

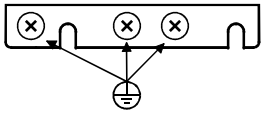
D	C	P	L21	L11	N

FRONT MSTB2,5/6-ST-5,08

(Phoenix Contact make)

Tightening torque: 0.5 to 0.6 [N・m] (70.8 to 85.0 [oz・in])

PE terminals

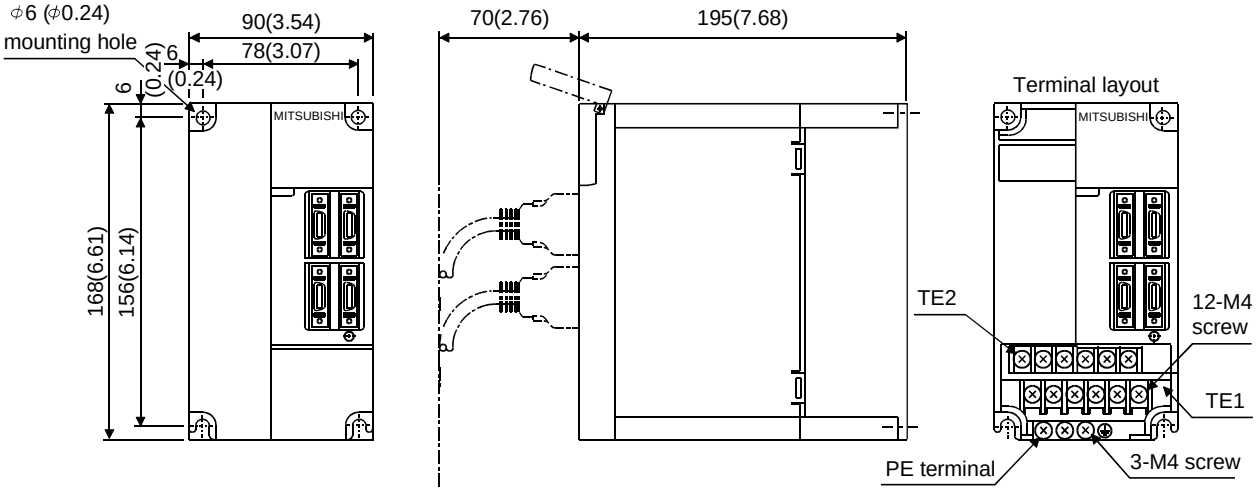


Terminal screw: M4×0.7

Tightening torque: 1.24 [N・m] (175.6 [oz・in])

(3) MR-J2-200B・MR-J2-350B

[Unit: mm]
([Unit: in])



Servo Amplifier Model	Weight [kg]([lb])
MR-J2-200B	2.0
MR-J2-350B	(4.41)

TE1

L1	L2	L3	U	V	W

Terminal screw: M4×0.7

Tightening torque: 1.24 [N・m] (175.6 [oz・in])

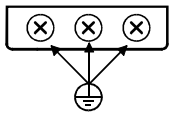
TE2

L11	L21	D	P	C	N

Terminal screw: M4×0.7

Tightening torque: 1.24 [N・m] (175.6 [oz・in])

PE terminals



Terminal screw: M4×0.7

Tightening torque: 1.24 [N・m] (175.6 [oz・in])

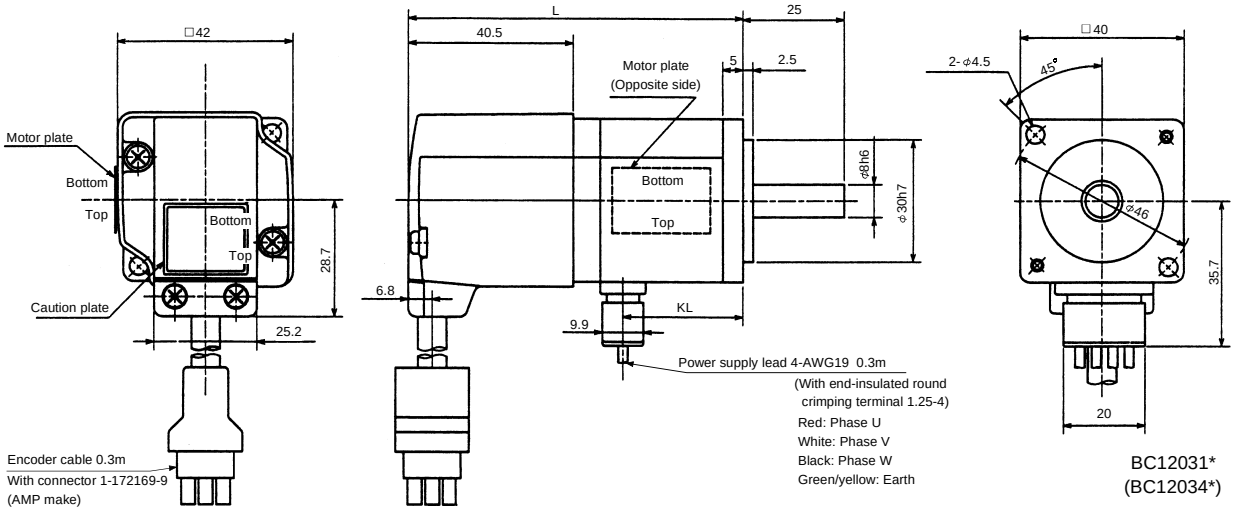
10 - 5 - 2 Servo motors

(1) HC-MF series

1) Standard (without electromagnetic brake, without reduction gear)

Model	Output (W)	Variable Dimensions		Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
		L	KL		
HC-MF053	50	81.5	29.5	0.019	0.40
HC-MF13	100	96.5	44.5	0.03	0.53

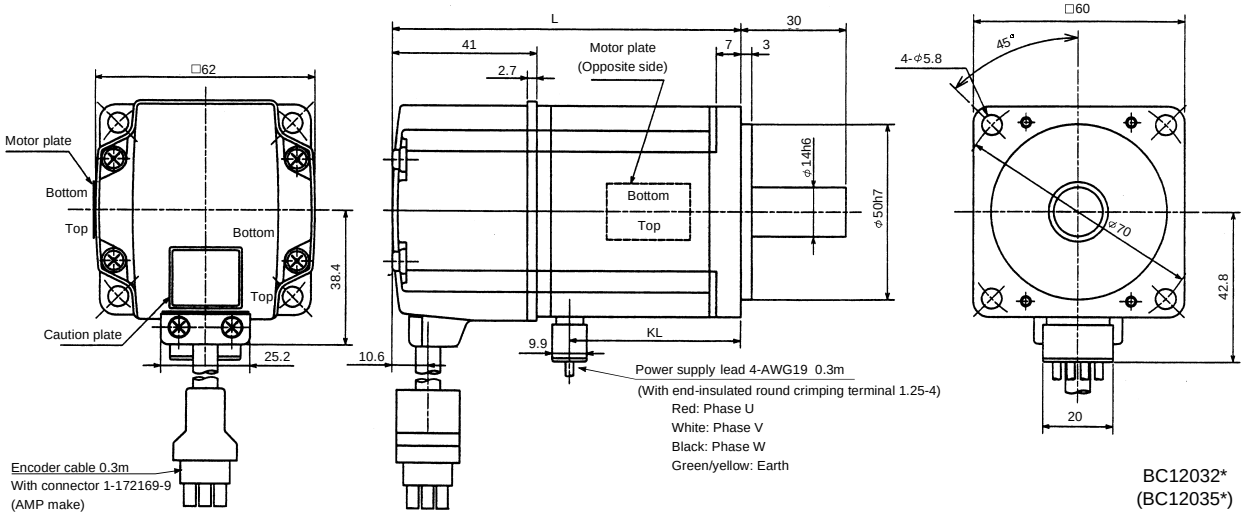
[Unit: mm]



BC12031*
(BC12034*)

Model	Output (W)	Variable Dimensions		Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
		L	KL		
HC-MF23	200	99.5	49.1	0.088	0.99
HC-MF43	400	124.5	72.1	0.143	1.45

[Unit: mm]

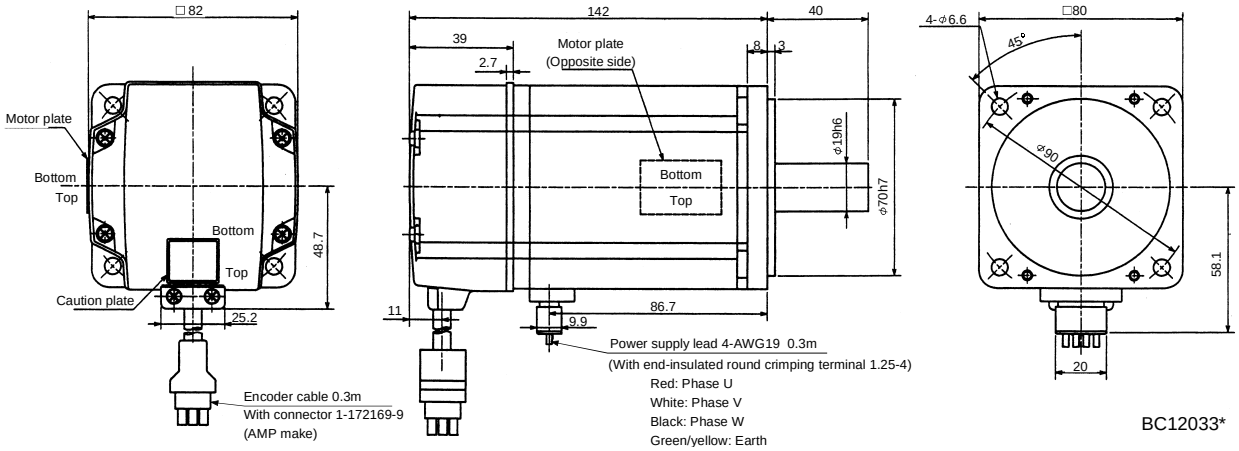


BC12032*
(BC12035*)

10. SPECIFICATIONS

Model	Output (W)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF73	750	0.6	3

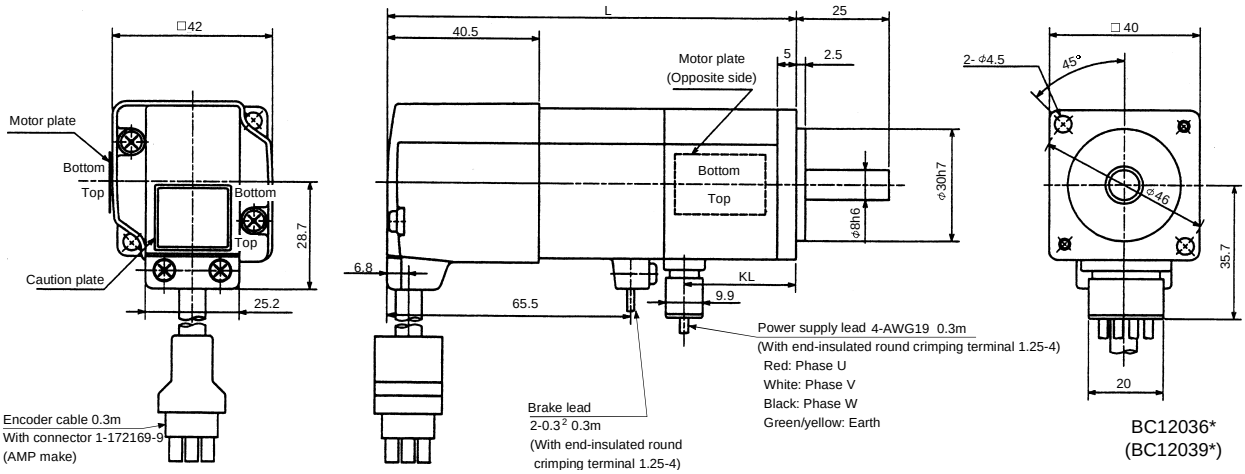
[Unit: mm]



2) With electromagnetic brake

Model	Output (W)	Variable Dimensions		Braking Force (N・m)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL			
HC-MF053B	50	109.5	29.5	0.32	0.022	0.75
HC-MF13B	100	124.5	44.5	0.32	0.032	0.89

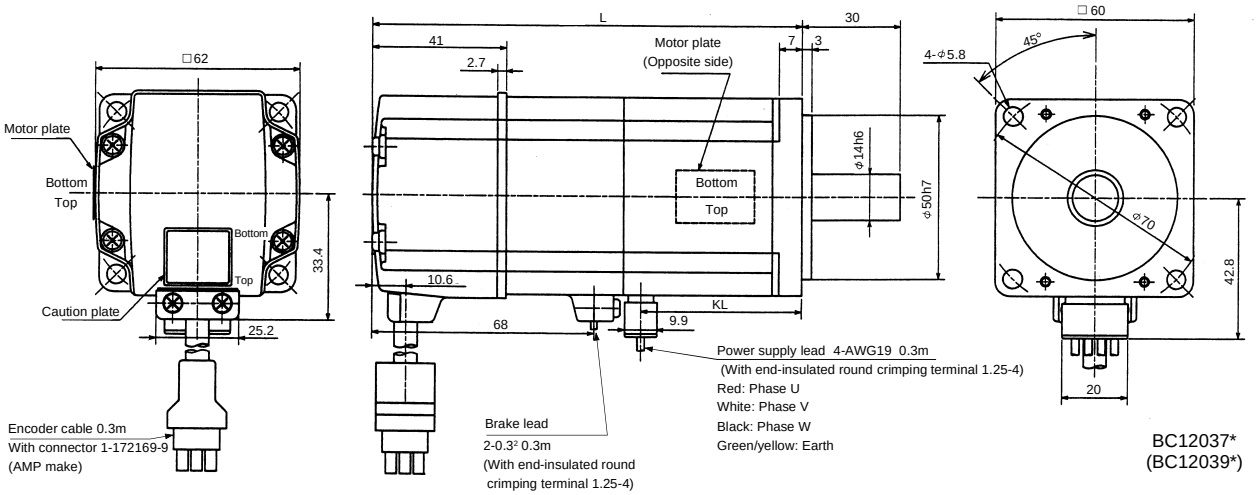
[Unit: mm]



10. SPECIFICATIONS

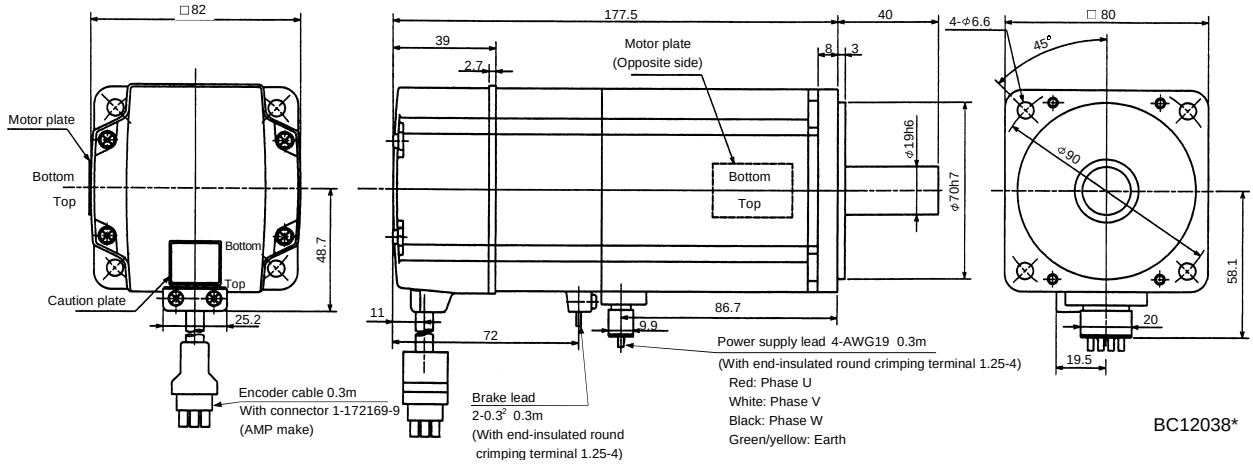
Model	Output (W)	Variable Dimensions		Braking Force (N・m)	Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
		L	KL			
HC-MF23B	200	131.5	49.1	1.3	0.136	1.6
HC-MF43B	400	156.5	72.1	1.3	0.191	2.1

[Unit: mm]



Model	Output (W)	Braking Force (N・m)	Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
HC-MF73B	750	2.4	0.725	4.0

[Unit: mm]

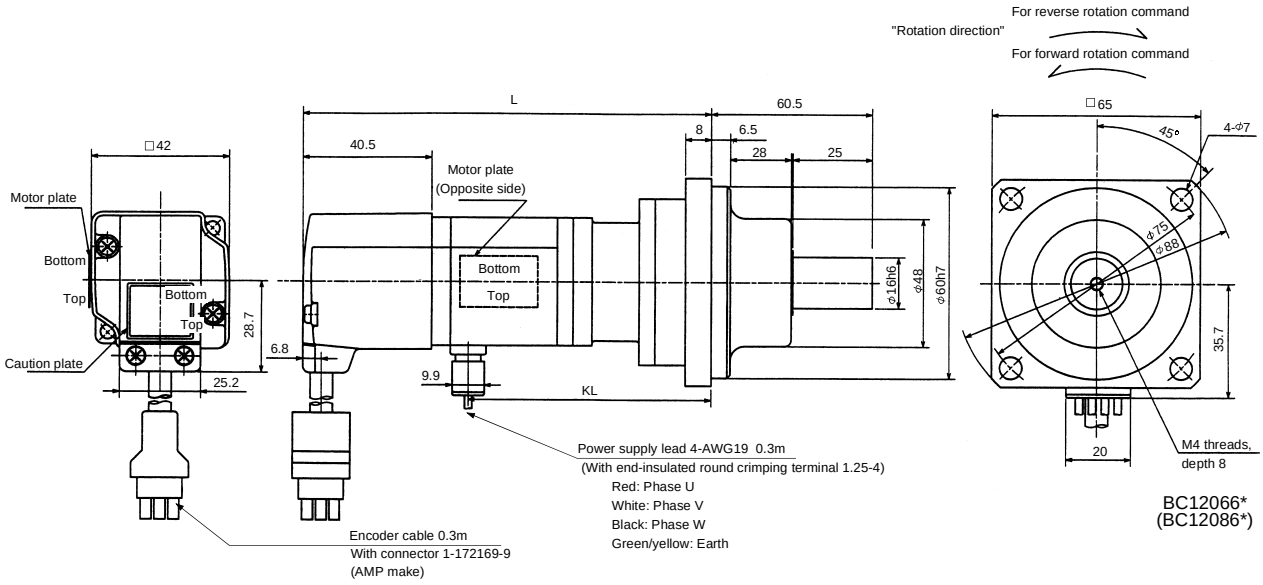


3) With reduction gear for general industrial machine

a) Without electromagnetic brake

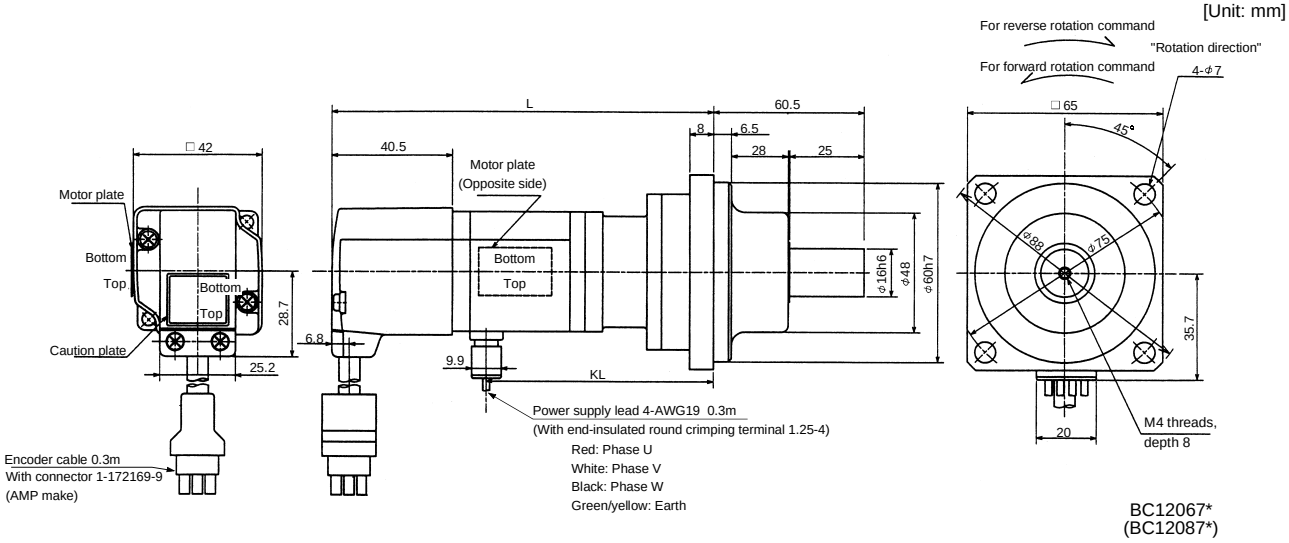
Model	Output (W)	Variable Dimensions L	Variable Dimensions KL	Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
HC-MF053G1	50	126	74	K6505	1/5(9/44)	0.055	60min. max.	1.4
HC-MF053G1	50	144	92	K6512	1/12(49/576)	0.077	60min. max.	1.8
HC-MF053G1	50	144	92	K6520	1/20(25/484)	0.059	60min. max.	1.8

[Unit: mm]



Model	Output (W)	Variable Dimensions L	Variable Dimensions KL	Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
HC-MF13G1	100	141	89	K6505	1/5(9/44)	0.067	60min. max.	1.5
HC-MF13G1	100	159	107	K6512	1/12(49/576)	0.089	60min. max.	1.9
HC-MF13G1	100	159	107	K6520	1/20(25/484)	0.071	60min. max.	1.9

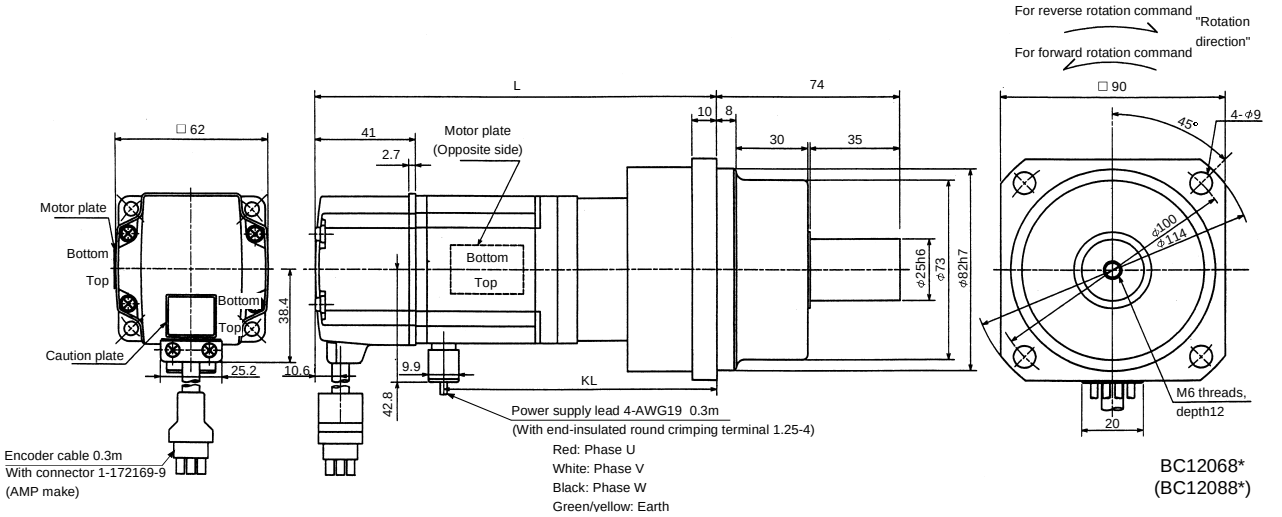
[Unit: mm]



10. SPECIFICATIONS

Model	Output (W)	Variable Dimensions		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL				
HC-MF23G1	200	153	102.6	K9005	1/5(19/96)	0.249	3.3
HC-MF23G1	200	173	122.6	K9012	1/12(25/288)	0.293	3.9
HC-MF23G1	200	173	122.6	K9020	1/20(253/5000)	0.266	3.9

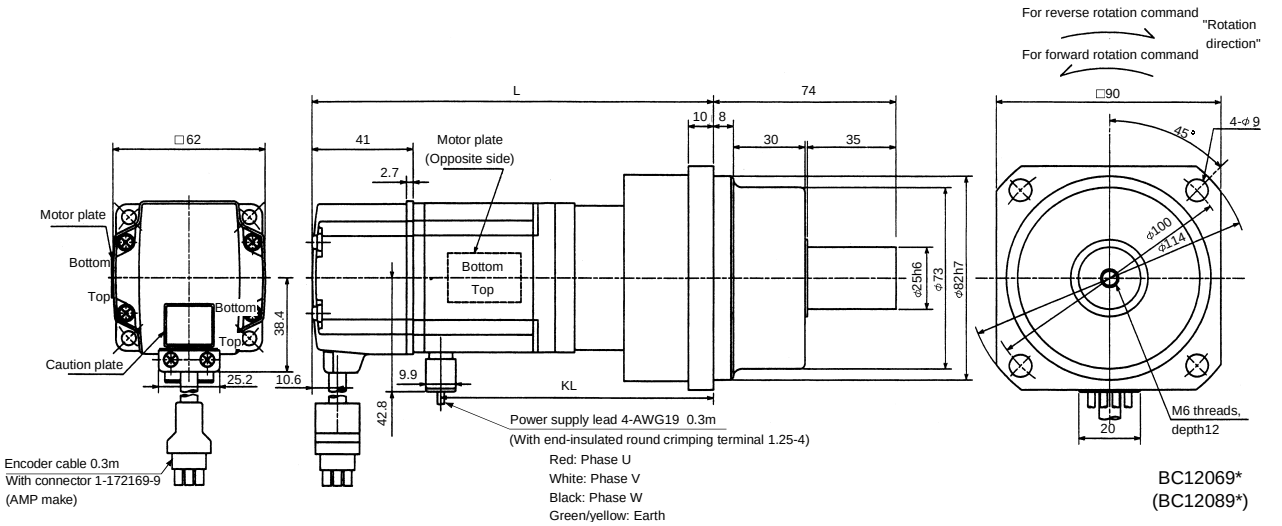
[Unit: mm]



BC12068*
(BC12088*)

Model	Output (W)	Variable Dimensions		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL				
HC-MF43G1	400	178	125.6	K9005	1/5(19/96)	0.296	3.8
HC-MF43G1	400	198	145.6	K9012	1/12(25/288)	0.339	4.4

[Unit: mm]



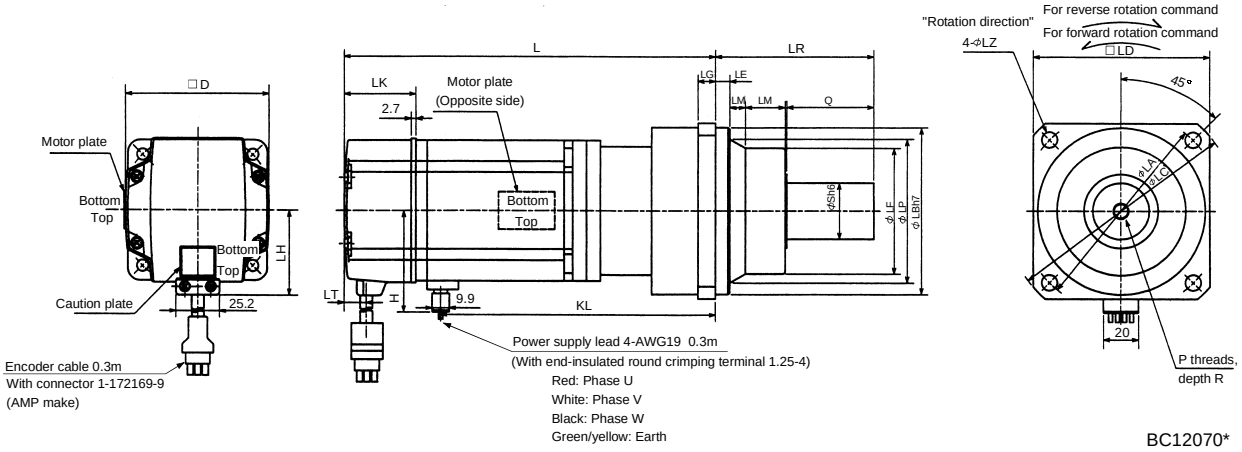
BC12069*
(BC12089*)

10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio		Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
			Normal Reduction ratio	Actual Reduction Ratio			
HC-MF43G1	400	K10020	1/20	253/5000	0.653	60min. max.	5.5
HC-MF73G1	750	K10005	1/5	1/5	1.02	60min. max.	6.2
HC-MF73G1	750	K10012	1/12	525/6048	1.686	60min. max.	7.3
HC-MF73G1	750	K12020	1/20	625/12544	1.75	60min. max.	10.1

Model	Output (W)	Variable Dimensions																					(Reduction Ratio)
		D	LH	LK	LT	H	LA	LB	LC	LD	LE	LF	LG	LM	LN	LP	L	LR	KL	LZ	Q	S	P	R	
HC-MF43G1	400	62	38.4	41	10.6	42.8	115	95	132	100	10	73	10	13	16	86	201.5	90	149.1	9	50	32	M8	16	1/20
HC-MF73G1	750	82	48.7	39	11	58.1	115	95	132	100	10	73	10	13	16	86	207	90	151.7	9	50	32	M8	16	1/5
HC-MF73G1	750	82	48.7	39	11	58.1	115	95	132	100	10	73	10	13	16	86	229	90	173.7	9	50	32	M8	16	1/12
HC-MF73G1	750	82	48.7	39	11	58.1	140	115	162	120	12	90	15	13	20	104	242	106	186.7	14	60	40	M10	20	1/20

[Unit: mm]

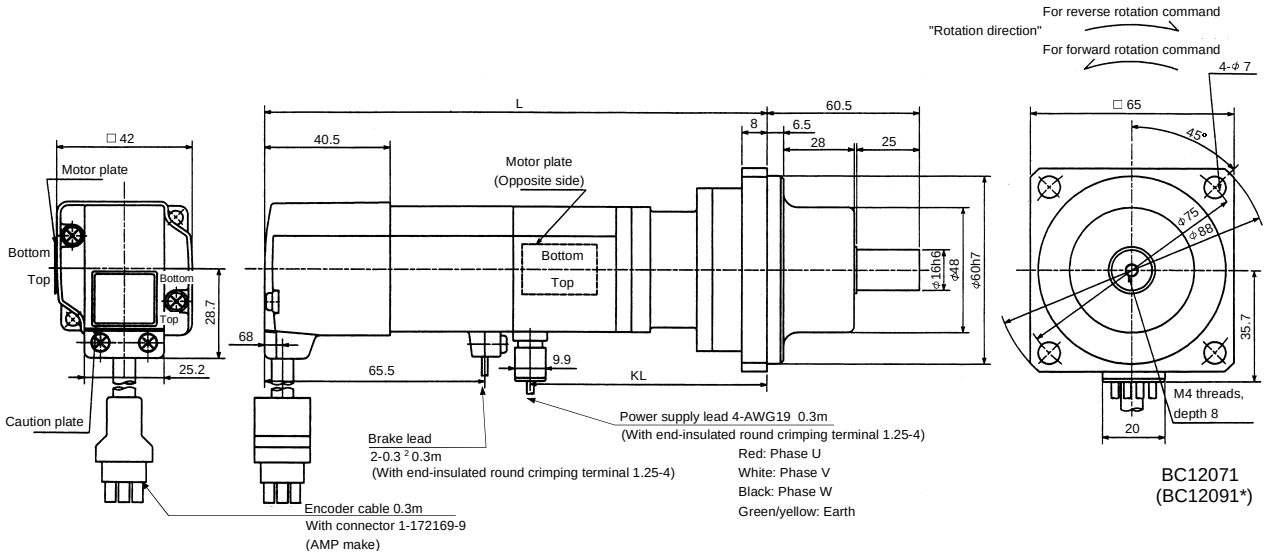


BC12070*

b) With electromagnetic brake

Model	Output (W)	Variable Dimensions L	Variable Dimensions KL	Braking Force (N • m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg • m^2)	Backlash	Weight (kg)
HC-MF053BG1	50	154	74	0.32	K6505	1/5(9/44)	0.058	60min. max.	1.8
HC-MF053BG1	50	172	92	0.32	K6512	1/12(49/576)	0.080	60min. max.	2.2
HC-MF053BG1	50	172	92	0.32	K6520	1/20(25/484)	0.062	60min. max.	2.2

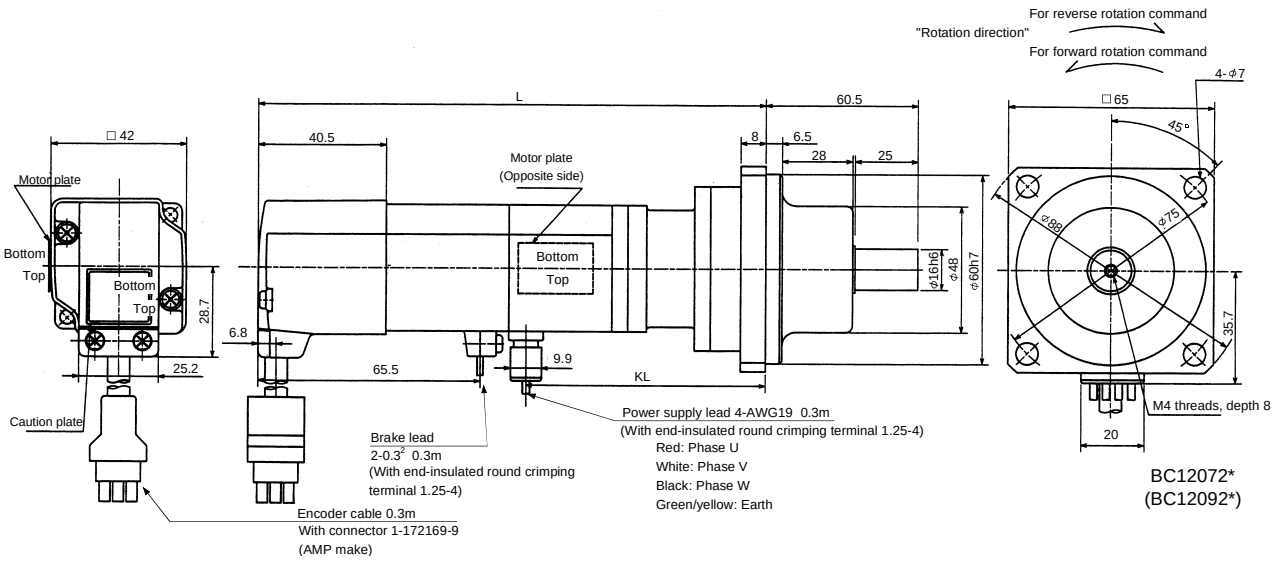
[Unit: mm]



BC12071
(BC12091*)

Model	Output (W)	Variable Dimensions L	Variable Dimensions KL	Braking Force (N • m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg • m^2)	Backlash	Weight (kg)
HC-MF13BG1	100	169	89	0.32	K6505	1/5(9/44)	0.069	60min. max.	1.9
HC-MF13BG1	100	187	107	0.32	K6512	1/12(49/576)	0.091	60min. max.	2.3
HC-MF13BG1	100	187	107	0.32	K6520	1/20(25/484)	0.073	60min. max.	2.3

[Unit: mm]

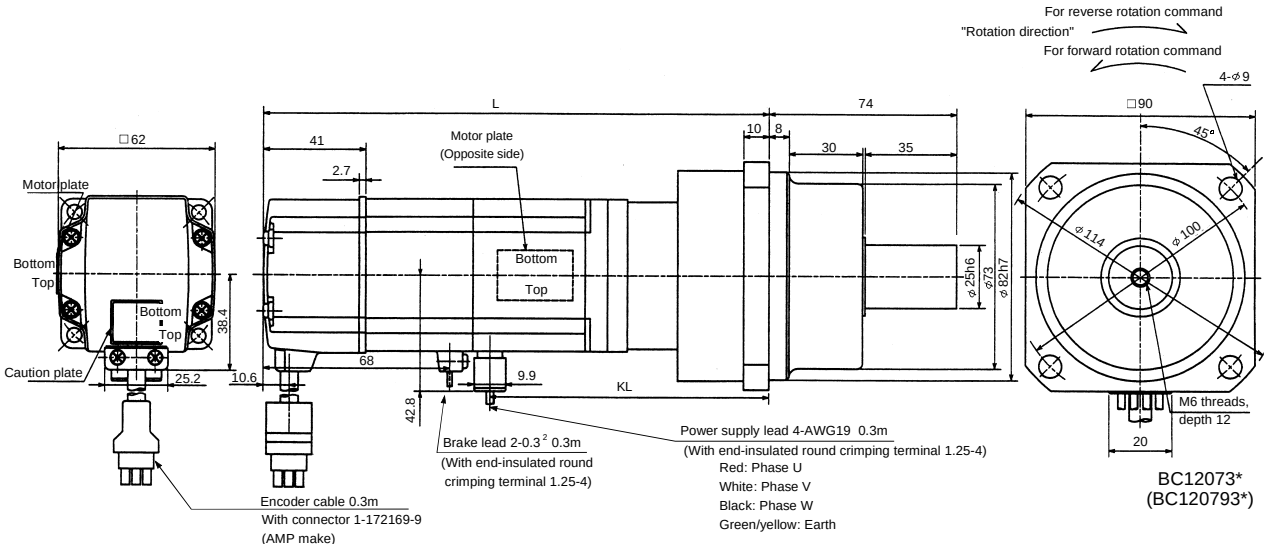


BC12072*
(BC12092*)

10. SPECIFICATIONS

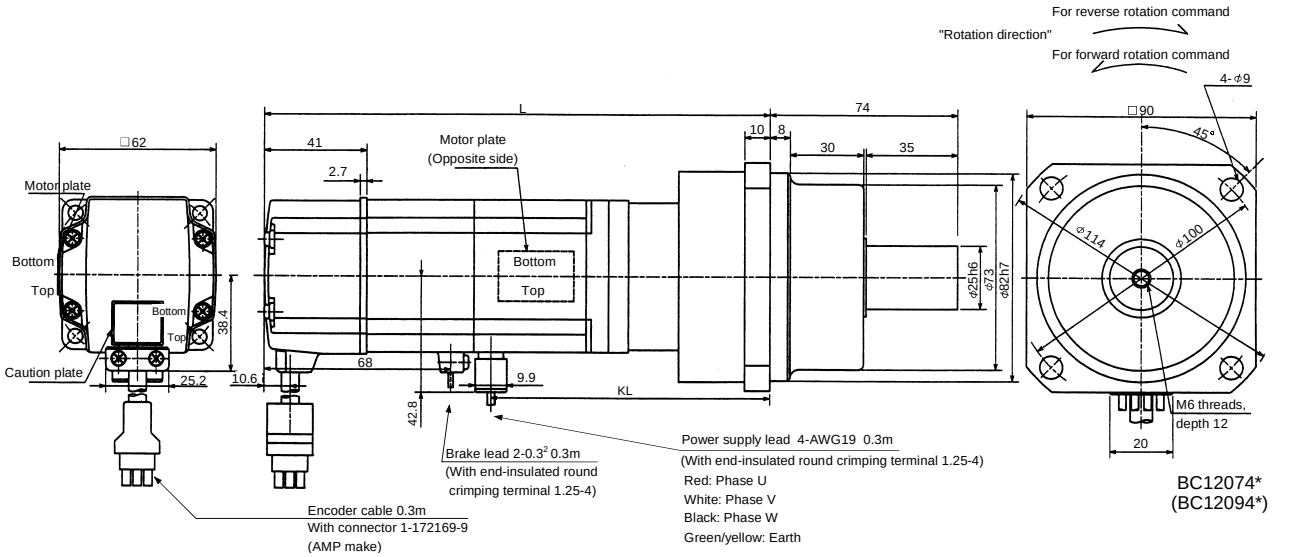
Model	Output (W)	Variable Dimensions		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL				
HC-MF23BG1	200	185	102.6	K9005	1/5(19/96)	0.289	3.9
HC-MF23BG1	200	205	122.6	K9012	1/12(25/288)	0.333	4.5
HC-MF23BG1	200	205	122.6	K9020	1/20(253/5000)	0.306	4.5

[Unit: mm]



Model	Output (W)	Variable Dimensions		Braking Force (N・m)	Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL					
HC-MF43BG1	400	210	125.6	1.3	K9005	1/5(19/96)	0.344	4.4
HC-MF43BG1	400	230	145.6	1.3	K9012	1/12(25/288)	0.388	5.0

[Unit: mm]

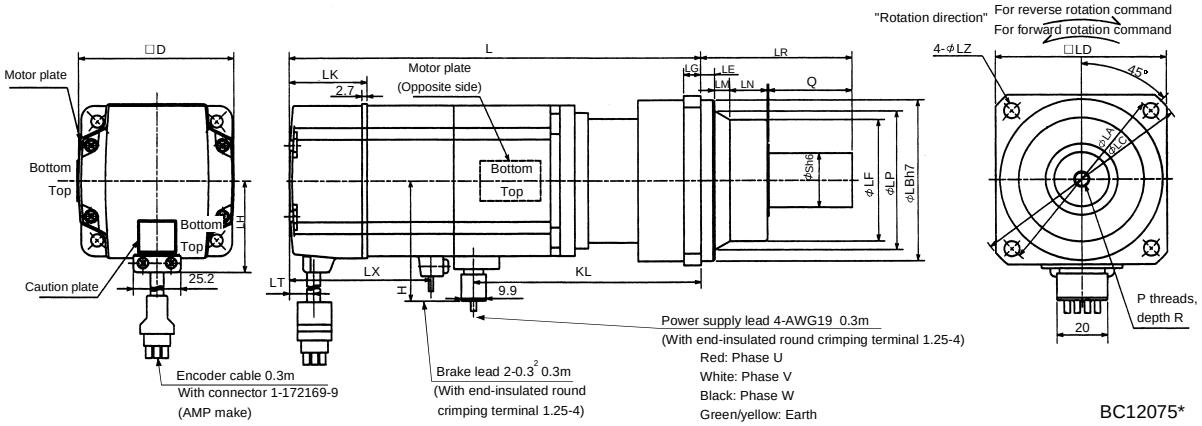


10. SPECIFICATIONS

Model	Output (W)	Brake Force (N • m)	Reduction Gear Model	Reduction Ratio		Inertia Moment J($\times 10^{-4}$kg • m^2)	Backlash	Weight (kg)
				Normal Reduction ratio	Actual Reduction Ratio			
HC-MF43BG1	400	1.3	K10020	1/20	253/5000	0.700	60min. max.	6.1
HC-MF73BG1	750	2.4	K10005	1/5	1/5	1.145	60min. max.	7.2
HC-MF73BG1	750	2.4	K10012	1/12	525/6048	1.811	60min. max.	8.3
HC-MF73BG1	750	2.4	K12020	1/20	625/12544	1.875	60min. max.	11.1

Model	Output (W)	Variable Dimensions																								(Reduction Ratio)
		D	LH	LK	LT	LX	H	LA	LB	LC	LD	LE	LF	LG	LM	LN	LP	L	LR	KL	LZ	Q	S	P	R	
HC-MF43BG1	400	62	38.4	41	10.6	68	42.8	115	95	132	100	10	73	10	13	16	86	232.5	90	149.1	9	50	32	M8	16	1/20
HC-MF73BG1	750	82	48.7	39	11	72	58.1	115	95	132	100	10	73	10	13	16	86	242.5	90	151.7	9	50	32	M8	16	1/5
HC-MF73BG1	750	82	48.7	39	11	72	58.1	115	95	132	100	10	73	10	13	16	86	264.5	90	173.7	9	50	32	M8	16	1/12
HC-MF73BG1	750	82	48.7	39	11	72	58.1	140	115	162	120	12	90	15	13	20	104	277.5	106	186.7	14	60	40	M10	20	1/20

[Unit: mm]

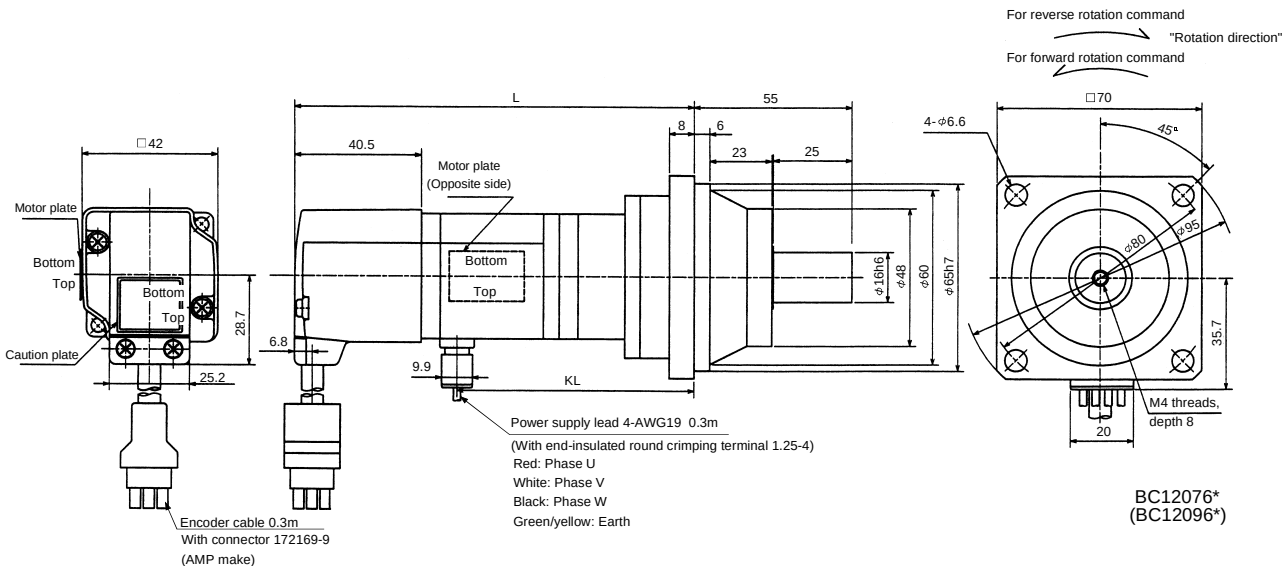


4) With reduction gear for precision application

a) Without electromagnetic brake

Model	Output (W)	Variable Dimensions		Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
		L	KL					
HC-MF053G2	50	130	78	BK1-05B-A5MEKA	1/5	0.067	3 min. max.	1.4
HC-MF053G2	50	146	94	BK1-09B-A5MEKA	1/9	0.060	3 min. max.	1.7
HC-MF053G2	50	146	94	BK1-20B-A5MEKA	1/20	0.069	3 min. max.	1.8
HC-MF053G2	50	146	94	BK1-29B-A5MEKA	1/29	0.057	3 min. max.	1.8

[Unit: mm]

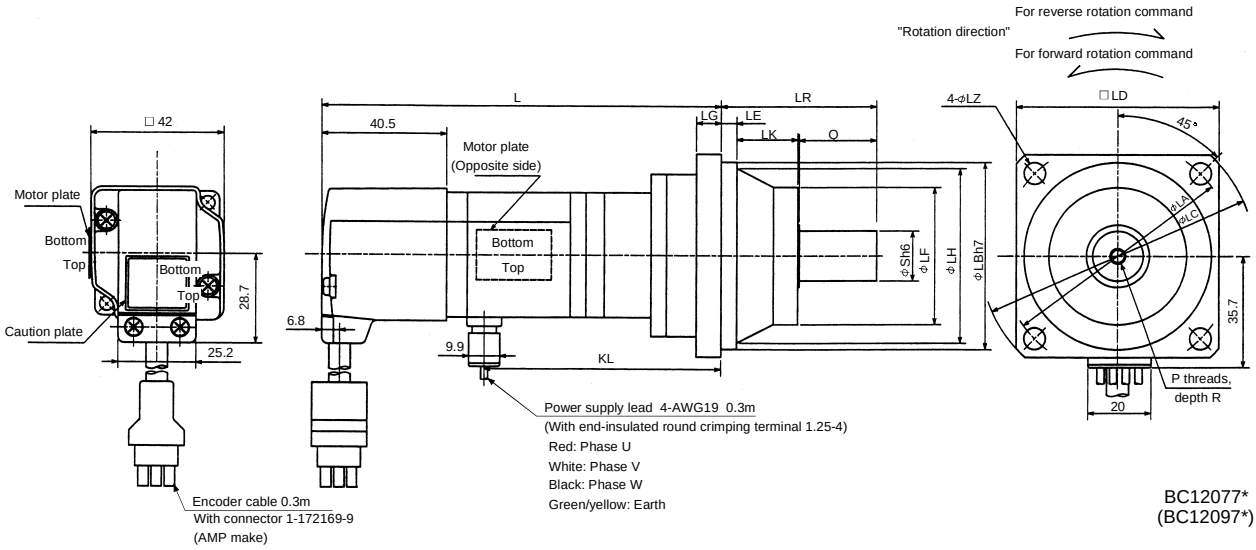


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
HC-MF13G2	100	BK1-05B-01MEKA	1/5	0.078	3 min. max.	1.5
HC-MF13G2	100	BK1-09B-01MEKA	1/9	0.072	3 min. max.	1.8
HC-MF13G2	100	BK1-20B-01MEKA	1/20	0.122	3 min. max.	3.0
HC-MF13G2	100	BK1-29B-01MEKA	1/29	0.096	3 min. max.	3.0

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF13G2	100	80	65	95	70	6	48	8	60	23	145	55	93	6.6	25	16	M4	8	1/5
HC-MF13G2	100	80	65	95	70	6	48	8	60	23	161	55	109	6.6	25	16	M4	8	1/9
HC-MF13G2	100	100	80	115	85	6	65	10	74	33	167	75	115	6.6	35	20	M5	10	1/20
HC-MF13G2	100	100	80	115	85	6	65	10	74	33	167	75	115	6.6	35	20	M5	10	1/29

[Unit: mm]



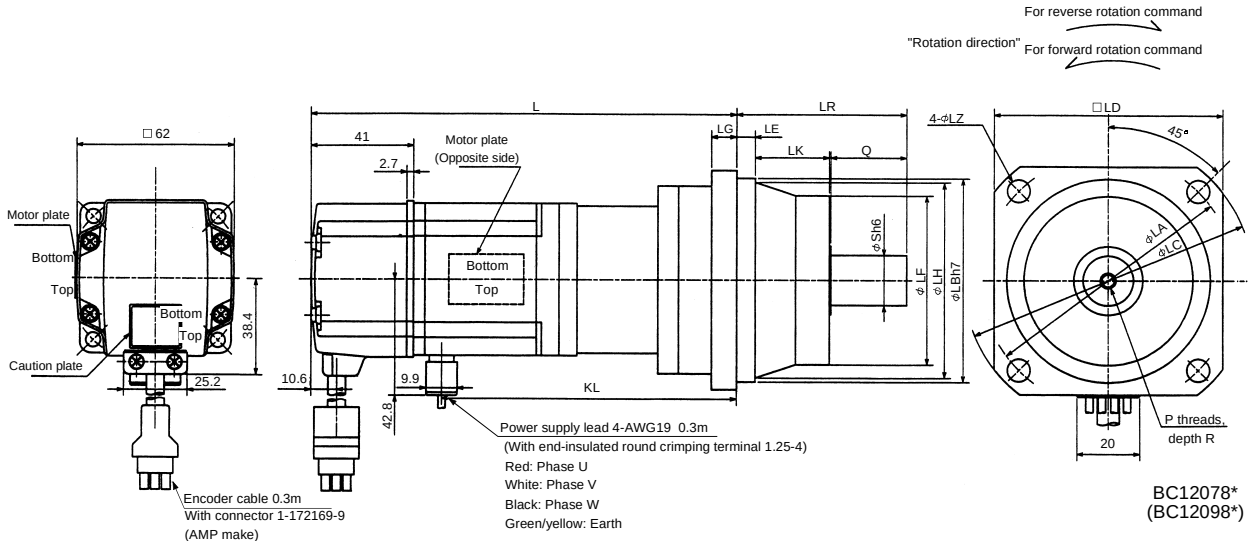
BC12077*
(BC12097*)

10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF23G2	200	BK1-05B-02MEKA	1/5	0.191	2.1
HC-MF23G2	200	BK2-09B-02MEKA	1/9	0.208	3.5
HC-MF23G2	200	BK3-20B-02MEKA	1/20	0.357	5.0
HC-MF23G2	200	BK3-29B-02MEKA	1/29	0.276	5.0

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF23G2	200	80	65	95	70	6	48	8	60	23	157	55	106.6	6.6	25	16	M4	8	1/5
HC-MF23G2	200	100	80	115	85	6	65	10	74	33	175	75	124.6	6.6	35	20	M5	10	1/9
HC-MF23G2	200	115	95	135	100	8	75	10	85	35	180	85	129.6	9	40	25	M6	12	1/20
HC-MF23G2	200	115	95	135	100	8	75	10	85	35	180	85	129.6	9	40	25	M6	12	1/29

[Unit: mm]

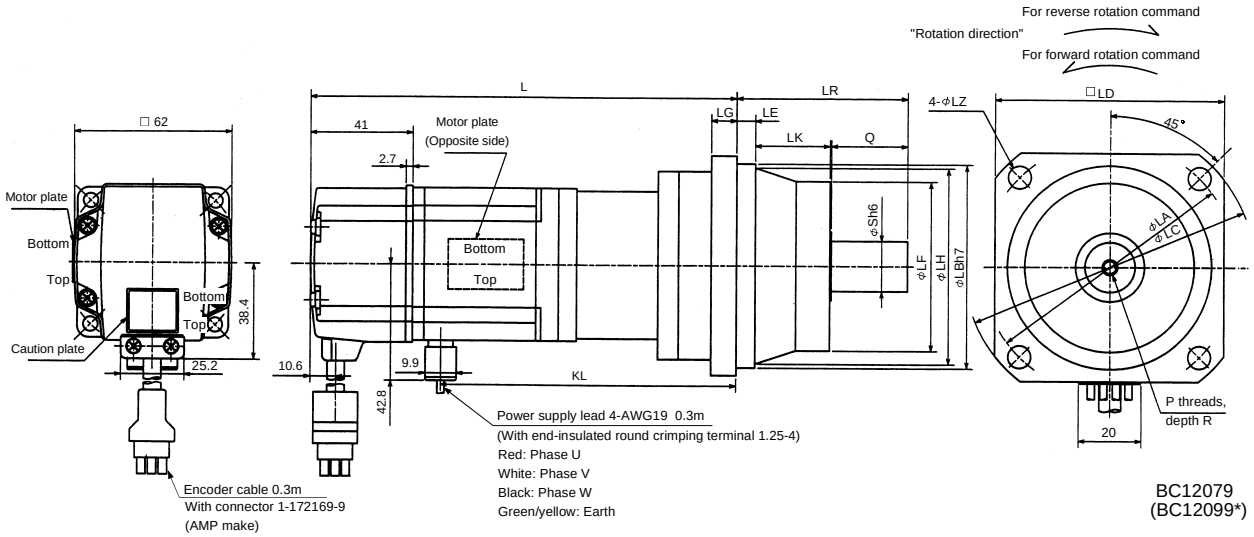


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF43G2	400	BK2-05B-04MEKA	1/5	0.295	3.7
HC-MF43G2	400	BK3-09B-04MEKA	1/9	0.323	5.3
HC-MF43G2	400	BK4-20B-04MEKA	1/20	0.426	7.5
HC-MF43G2	400	BK4-29B-04MEKA	1/29	0.338	7.5

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF43G2	400	100	80	115	85	6	65	10	74	33	184	75	131.6	6.6	35	20	M5	10	1/5
HC-MF43G2	400	115	95	135	100	8	75	10	85	35	205	85	152.6	9	40	25	M6	12	1/9
HC-MF43G2	400	135	110	155	115	8	90	12	100	40	211	100	158.6	11	50	32	M8	16	1/20
HC-MF43G2	400	135	110	155	115	8	90	12	100	40	211	100	158.6	11	50	32	M8	16	1/29

[Unit: mm]

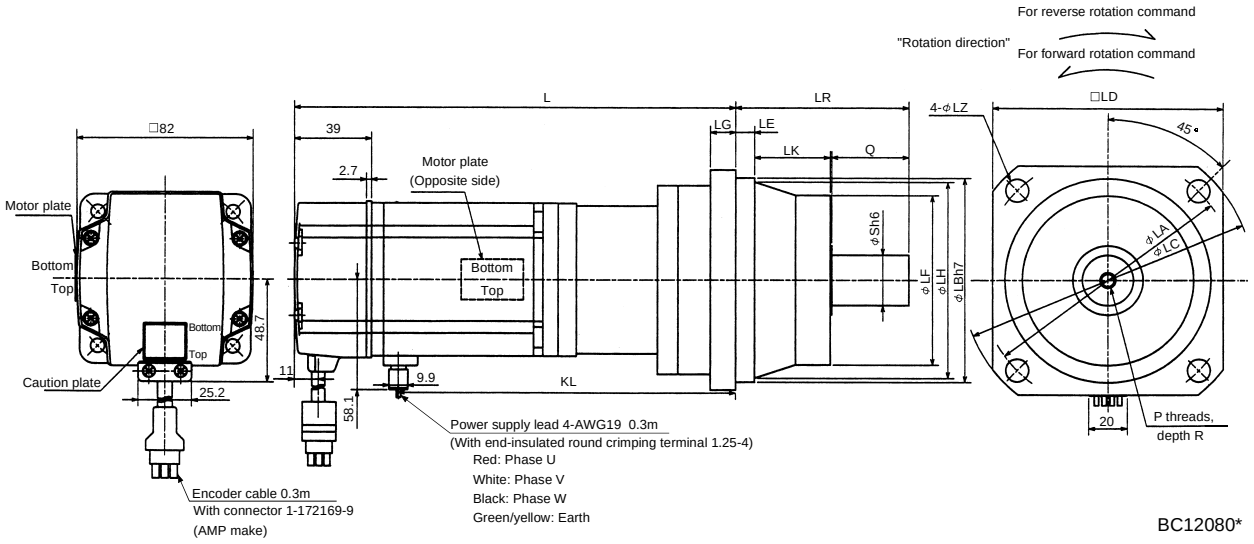


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF73G2	750	BK3-05B-08MEKA	1/5	0.973	6.3
HC-MF73G2	750	BK4-09B-08MEKA	1/9	0.980	8.6
HC-MF73G2	750	BK5-20B-08MEKA	1/20	1.016	12.0
HC-MF73G2	750	BK5-29B-08MEKA	1/29	0.910	12.0

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF73G2	750	115	95	135	100	8	75	10	85	35	212	85	156.7	9	40	25	M6	12	1/5
HC-MF73G2	750	135	110	155	115	8	90	12	100	40	248	100	192.7	11	50	32	M8	16	1/9
HC-MF73G2	750	150	125	175	130	10	105	15	115	43	248	115	192.7	14	60	40	M10	20	1/20
HC-MF73G2	750	150	125	175	130	10	105	15	115	43	248	115	192.7	14	60	40	M10	20	1/29

[Unit: mm]

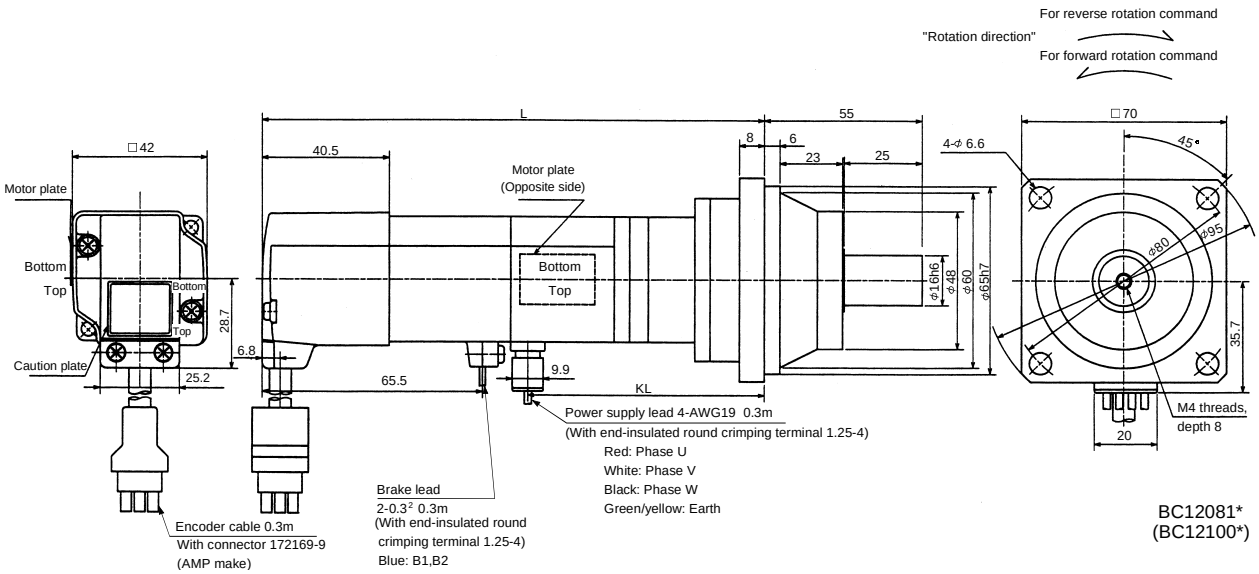


BC12080*

b) With electromagnetic brake

Model	Output (W)	Variable Dimensions L	Variable Dimensions KL	Braking Force (N・m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
HC-MF053G2	50	158	78	0.32	BK1-05B-A5MEKA	1/5	0.070	3 min. max.	1.8
HC-MF053G2	50	174	94	0.32	BK1-09B-A5MEKA	1/9	0.063	3 min. max.	2.1
HC-MF053G2	50	174	94	0.32	BK1-20B-A5MEKA	1/20	0.072	3 min. max.	2.2
HC-MF053G2	50	174	94	0.32	BK1-29B-A5MEKA	1/29	0.060	3 min. max.	2.2

[Unit: mm]

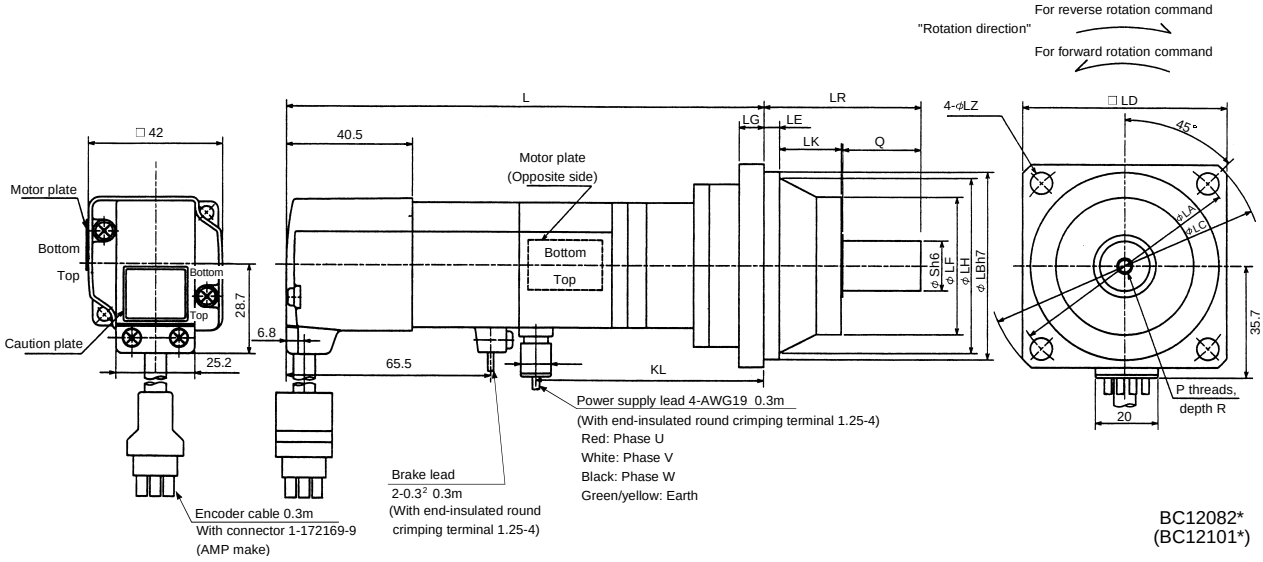


10. SPECIFICATIONS

Model	Output (W)	Braking Force (N・m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Backlash	Weight (kg)
HC-MF13BG2	100	0.32	BK1-05B-01MEKA	1/5	0.080	3 min. max.	1.9
HC-MF13BG2	100	0.32	BK1-09B-01MEKA	1/9	0.074	3 min. max.	2.2
HC-MF13BG2	100	0.32	BK2-20B-01MEKA	1/20	0.124	3 min. max.	3.4
HC-MF13BG2	100	0.32	BK2-29B-01MEKA	1/29	0.098	3 min. max.	3.4

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF13BG2	100	80	65	95	70	6	48	8	60	23	173	55	93	6.6	25	16	M4	8	1/5
HC-MF13BG2	100	80	65	95	70	6	48	8	60	23	189	55	109	6.6	25	16	M4	8	1/9
HC-MF13BG2	100	100	80	115	85	6	65	10	74	33	195	75	115	6.6	35	20	M5	10	1/20
HC-MF13BG2	100	100	80	115	85	6	65	10	74	33	195	75	115	6.6	35	20	M5	10	1/29

[Unit: mm]



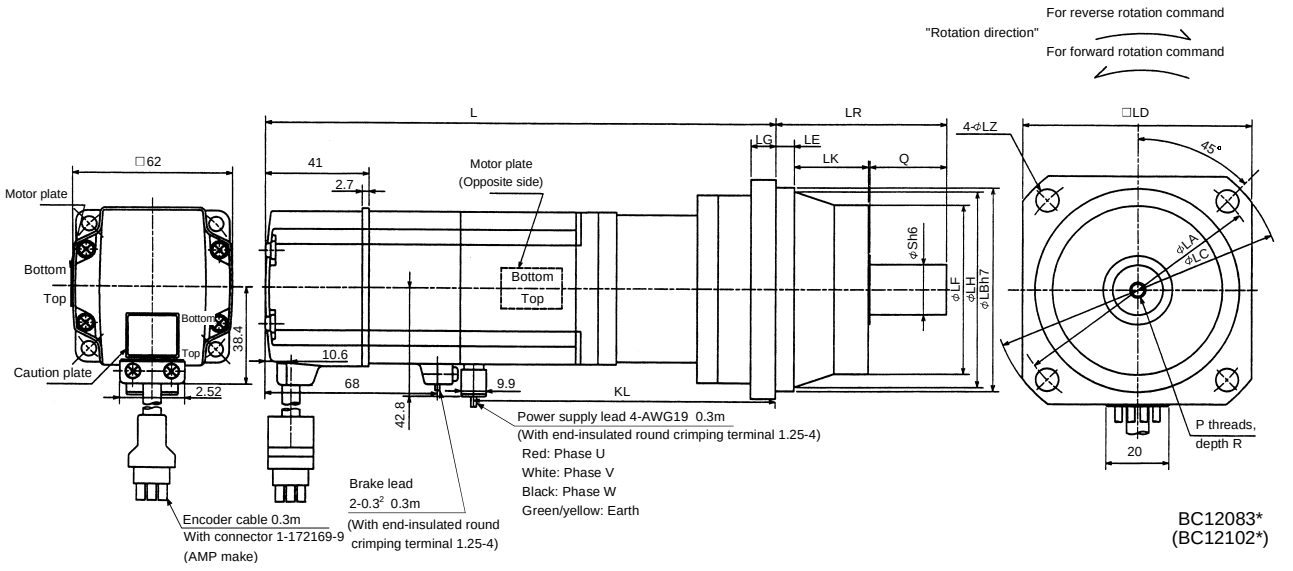
BC12082*
(BC12101*)

10. SPECIFICATIONS

Model	Output (W)	Braking Force (N・m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF23BG2	200	1.3	BK1-05B-02MEKA	1/5	0.239	2.7
HC-MF23BG2	200	1.3	BK2-09B-02MEKA	1/9	0.256	4.1
HC-MF23BG2	200	1.3	BK3-20B-02MEKA	1/20	0.405	5.6
HC-MF23BG2	200	1.3	BK3-29B-02MEKA	1/29	0.324	5.6

Model	Output (W)	Variable Dimensions																	(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF23BG2	200	80	65	95	70	6	48	8	60	23	189	55	106.6	6.6	25	16	M4	8	1/5
HC-MF23BG2	200	100	80	115	85	6	65	10	74	33	207	75	124.6	6.6	35	20	M5	10	1/9
HC-MF23BG2	200	115	95	135	100	8	75	10	85	35	212	85	129.6	9	40	25	M6	12	1/20
HC-MF23BG2	200	115	95	135	100	8	75	10	85	35	212	85	129.6	9	40	25	M6	12	1/29

[Unit: mm]

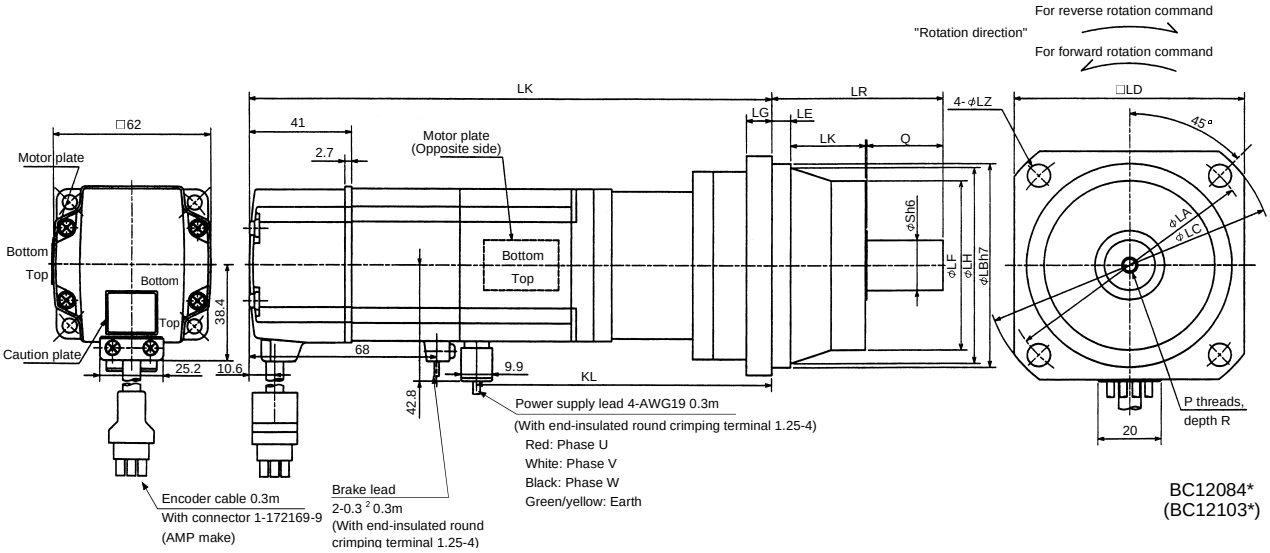


10. SPECIFICATIONS

Model	Output (W)	Braking Force (N・m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF43BG2	400	1.3	BK2-05B-04MEKA	1/5	0.344	4.3
HC-MF43BG2	400	1.3	BK3-09B-04MEKA	1/9	0.372	5.9
HC-MF43BG2	400	1.3	BK4-20B-04MEKA	1/20	0.475	8.1
HC-MF43BG2	400	1.3	BK4-29B-04MEKA	1/29	0.386	8.1

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF43BG2	400	100	80	115	85	6	65	10	74	33	216	75	131.6	6.6	35	20	M5	10	1/5
HC-MF43BG2	400	115	95	135	100	8	75	10	85	35	237	85	152.6	9	40	25	M6	12	1/9
HC-MF43BG2	400	135	110	155	115	8	90	12	100	40	243	100	158.6	11	50	32	M8	16	1/20
HC-MF43BG2	400	135	110	155	115	8	90	12	100	40	243	100	158.6	11	50	32	M8	16	1/29

[Unit: mm]

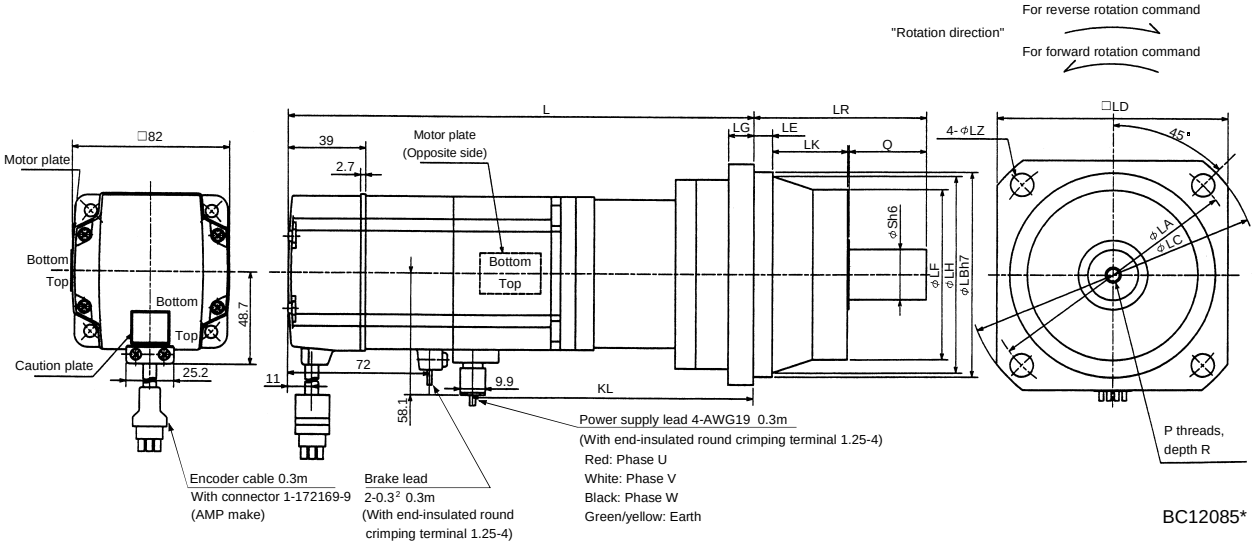


10. SPECIFICATIONS

Model	Output (W)	Braking Force (N・m)	Reduction Gear Model	Reduction Ratio	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-MF73BG2	750	2.4	BK3-05B-08MEKA	1/5	1.098	7.3
HC-MF73BG2	750	2.4	BK4-09B-08MEKA	1/9	1.105	9.6
HC-MF73BG2	750	2.4	BK5-20B-08MEKA	1/20	1.141	13.0
HC-MF73BG2	750	2.4	BK5-29B-08MEKA	1/29	1.035	13.0

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF73BG2	750	115	95	135	100	8	75	10	85	35	247.5	85	156.7	9	40	25	M6	12	1/5
HC-MF73BG2	750	135	110	155	115	8	90	12	100	40	283.5	100	192.7	11	50	32	M8	16	1/9
HC-MF73BG2	750	150	125	175	130	10	105	15	115	43	283.5	115	192.7	14	60	40	M10	20	1/20
HC-MF73BG2	750	150	125	175	130	10	105	15	115	43	283.5	115	192.7	14	60	40	M10	20	1/29

[Unit: mm]



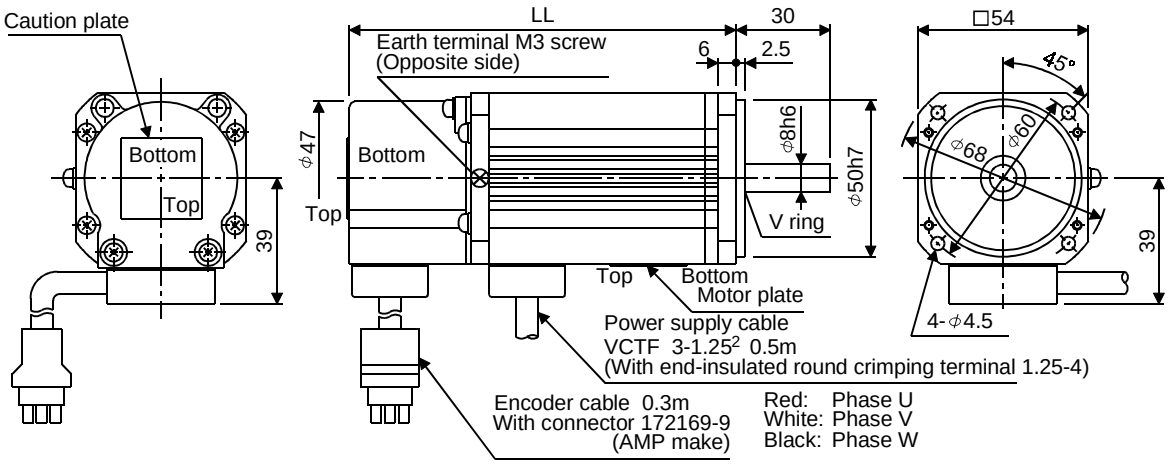
BC12085*

(2) HA-FF series

1) Standard

HA-FF053 • HA-FF13

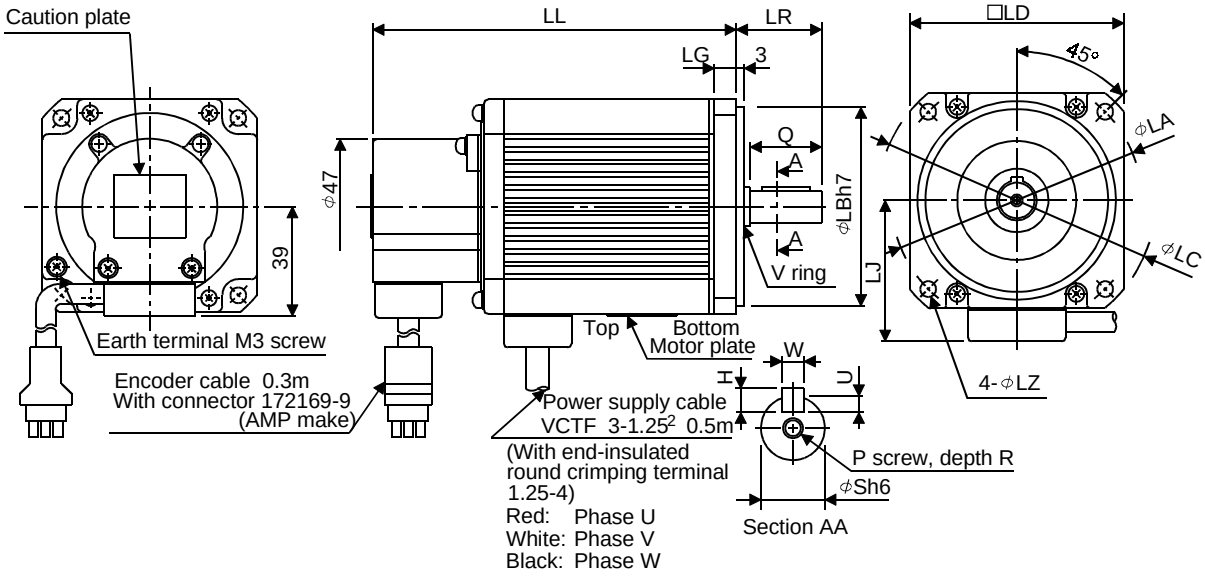
[Unit: mm]



Servo Motor Model	Inertia Moment J[×10⁻⁴kg • m²]	Variable Dimensions LL	Weight [kg]
HA-FF053	0.063	106	1.3
HA-FF13	0.10	123	1.5

HA-FF23 to HA-FF63

[Unit: mm]

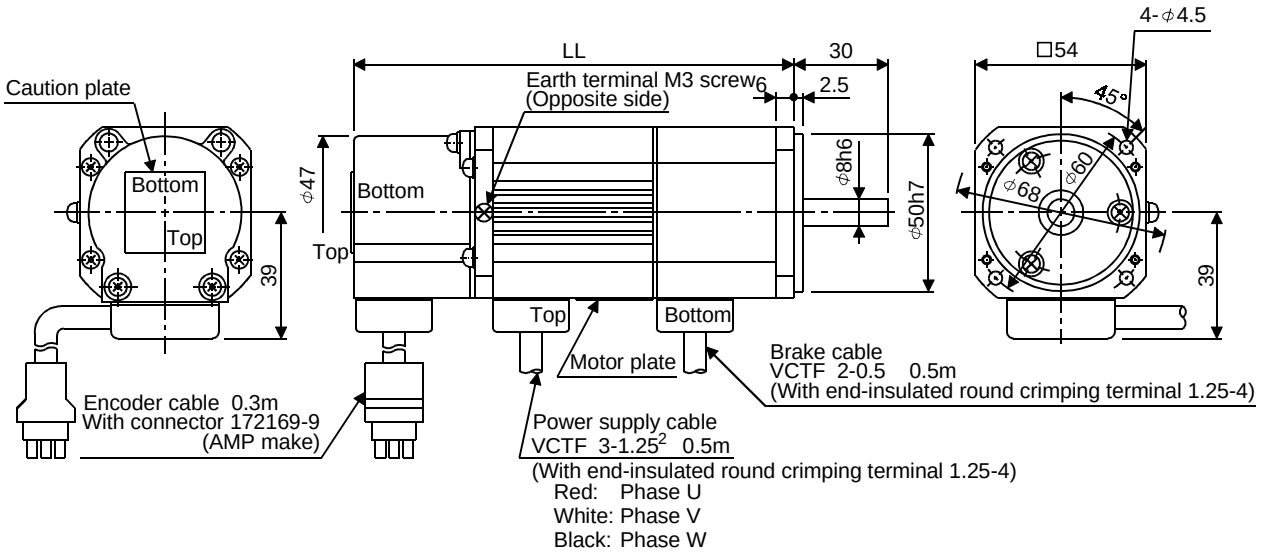


Servo Motor Model	Inertia Moment J[×10⁻⁴kg • m²]	Variable Dimensions																Weight [kg]
		LA	LB	LC	LD	LG	LJ	LL	LR	LZ	H	Q	S	U	W	P	R	
HA-FF23	0.35	90	70	100	76	8	50	131	30	5.5	4	25	11	2.5	4	M4×0.7	15	2.3
HA-FF33	0.5	90	70	100	76	8	50	148	30	5.5	4	25	11	2.5	4	M4×0.7	15	2.6
HA-FF43	0.98	115	95	135	100	10	62	154.5	40	9	5	35	16	3	5	M5×0.8	20	4.2
HA-FF63	1.2	115	95	135	100	10	62	169.5	40	9	5	35	16	3	5	M5×0.8	20	4.8

2) With electromagnetic brake

HA-FF053B · HA-FF13B

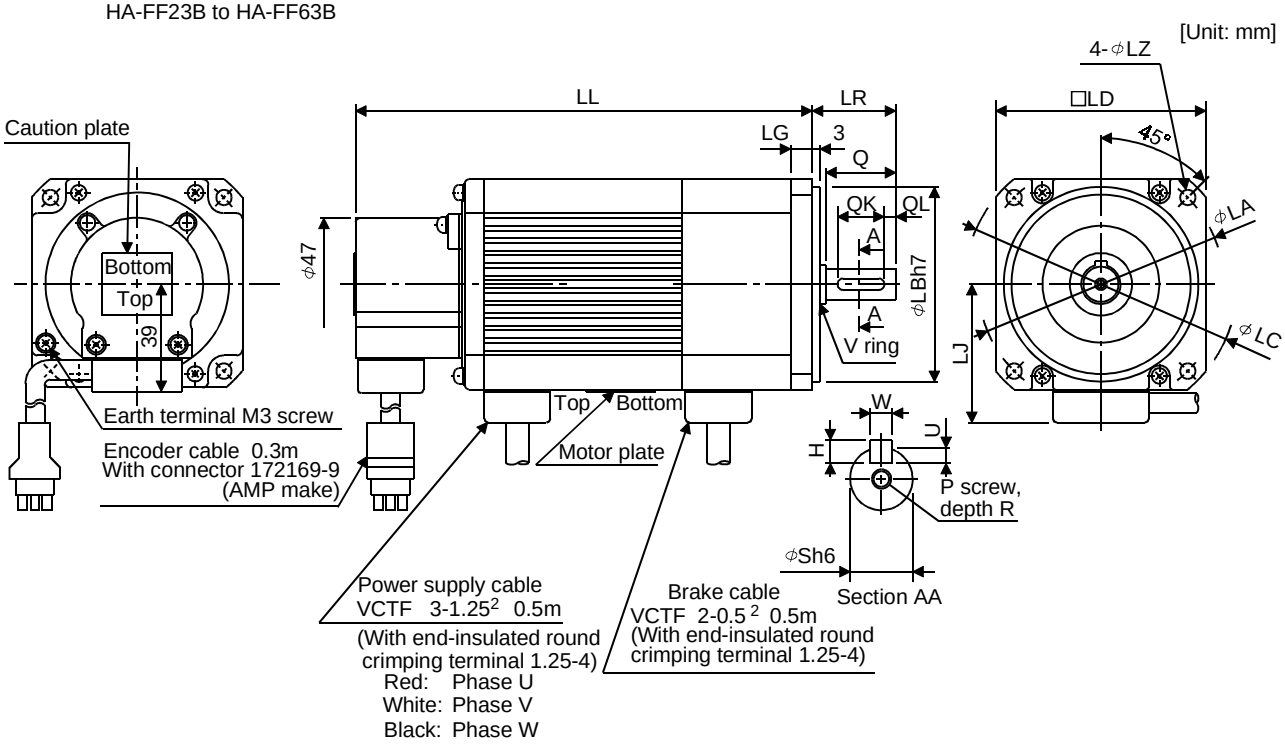
[Unit: mm]



Servo Motor Model	Inertia Moment J[×10⁻⁴kg · m²]	Variable Dimensions LL	Weight [kg]
HA-FF053B	0.08	140.5	1.6
HA-FF13B	0.11	157.5	1.8

HA-FF23B to HA-FF63B

[Unit: mm]

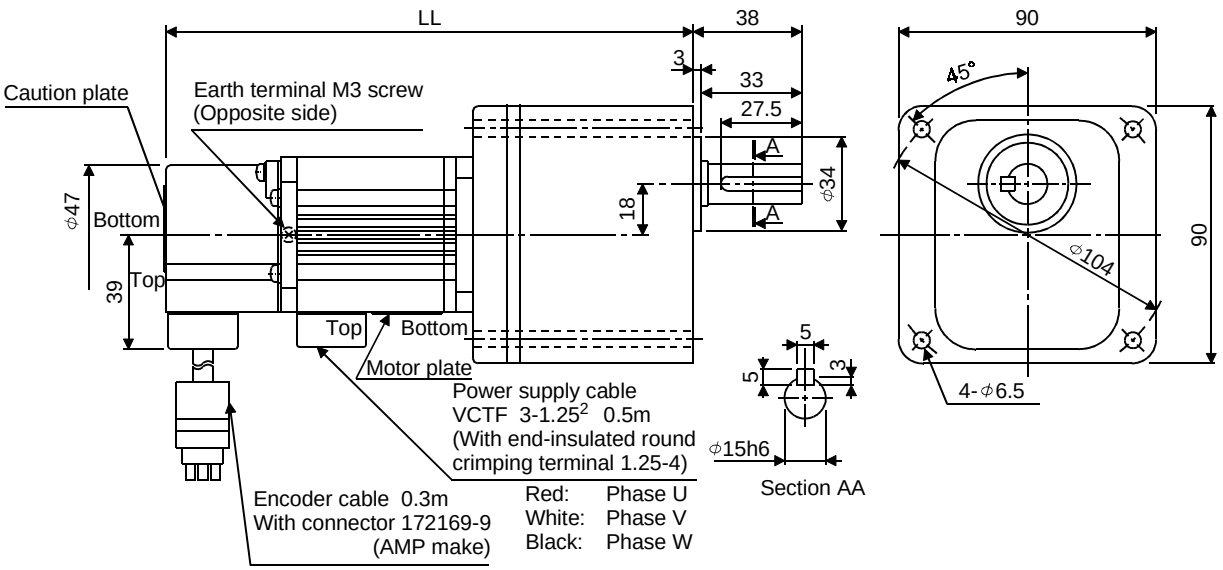


Servo Motor Model	Inertia Moment J[×10⁻⁴kg · m²]	Variable Dimensions																		Weight [kg]
		LA	LB	LC	LD	LG	LJ	LL	LR	LZ	H	Q	S	U	W	QK	QL	P	R	
HA-FF23B	0.48	90	70	100	76	8	50	167.5	30	5.5	8	25	11	2.5	4	16	4	M4×0.7	15	2.9
HA-FF33B	0.63	90	70	100	76	8	50	185	30	5.5	8	25	11	2.5	4	16	4	M4×0.7	15	3.2
HA-FF43B	1.33	115	95	135	100	10	62	191.5	40	9	5	35	16	3	5	25	5	M5×0.8	20	5.0
HA-FF63B	1.55	115	95	135	100	10	62	206.5	40	9	5	35	16	3	5	25	5	M5×0.8	20	5.6

3) With reduction gear for general industrial machine

HA-FF053(B)G1 · HA-FF13(B)G1

[Unit: mm]

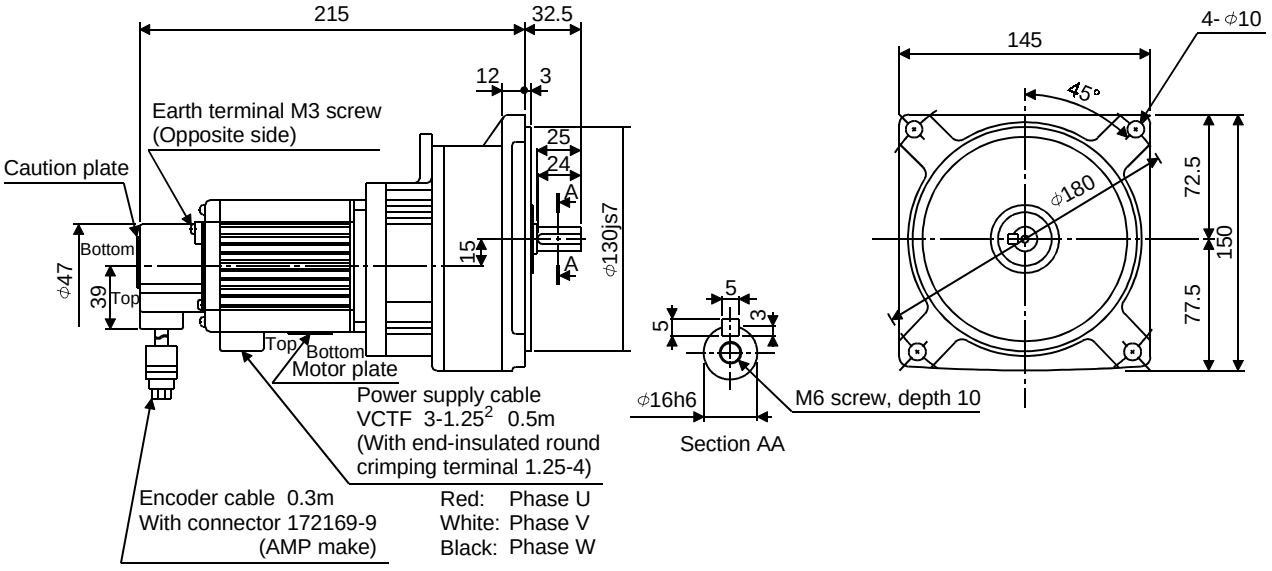


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg · m²]	(Note 1) Variable Dimensions LL	(Note 1) Weight [kg]
HA-FF053 (B)G1	1/5	GR-S-10	0.068 (0.084)	183 (217.5)	2.5 (2.8)
	1/10		0.068 (0.084)	183 (217.5)	2.5 (2.8)
	1/30		0.063 (0.080)	183 (217.5)	2.5 (2.8)
HA-FF13 (B)G1	1/5	GR-S-10	0.10 (0.115)	200 (234.5)	2.7 (3.0)
	1/10		0.10 (0.115)	200 (234.5)	2.7 (3.0)
	1/30		0.095 (0.11)	200 (234.5)	2.7 (3.0)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF23(B)G1

[Unit: mm]

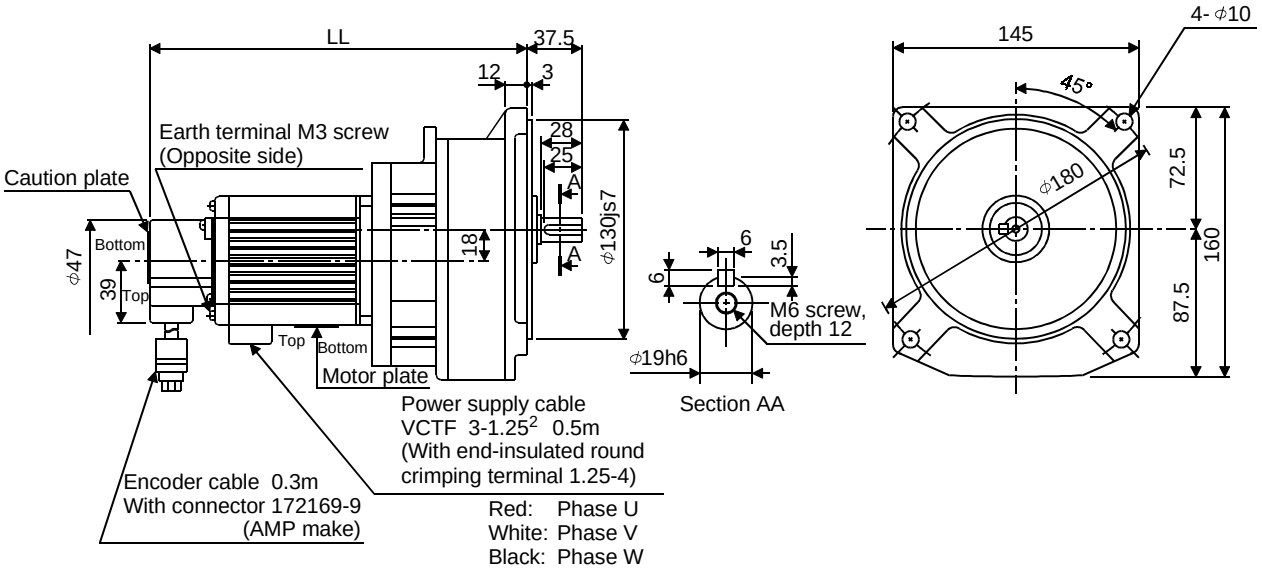


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg · m²]	(Note 1) Weight [kg]
HA-FF23 (B)G1	1/5	GR-S-20	0.373 (0.502)	5.0 (5.6)
	1/10		0.373 (0.502)	5.0 (5.6)
	1/30		0.37 (0.50)	5.0 (5.6)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF33(B)G1 · HA-FF43(B)G1

[Unit: mm]

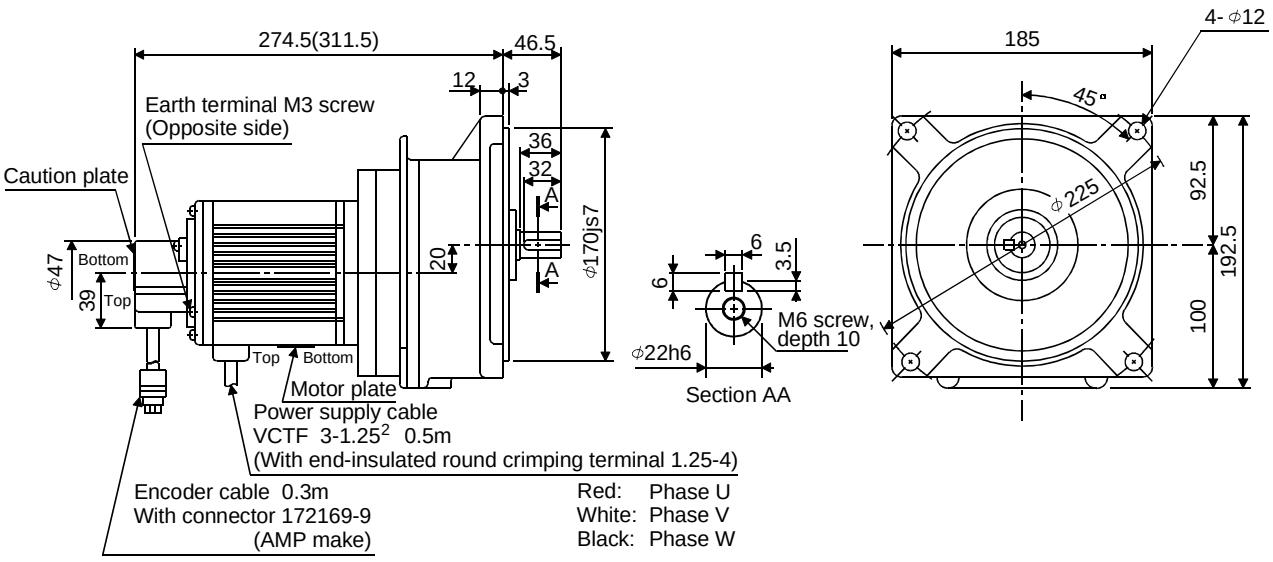


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg · m²]	(Note 1) Variable Dimensions LL	(Note 1) Weight [kg]
HA-FF33 (B)G1	1/5	GR-S-30	0.545 (0.678)	250 (287)	6.5 (7.2)
	1/10		0.545 (0.678)	250 (287)	6.5 (7.2)
	1/30		0.538 (0.670)	250 (287)	6.5 (7.2)
HA-FF43 (B)G1	1/5	GR-S-40	1.02 (1.37)	259 (295.5)	8.0 (8.9)
	1/10		1.02 (1.37)	259 (295.5)	8.0 (8.9)
	1/30		1.01 (1.36)	259 (295.5)	8.0 (8.9)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF63(B)G1

[Unit: mm]

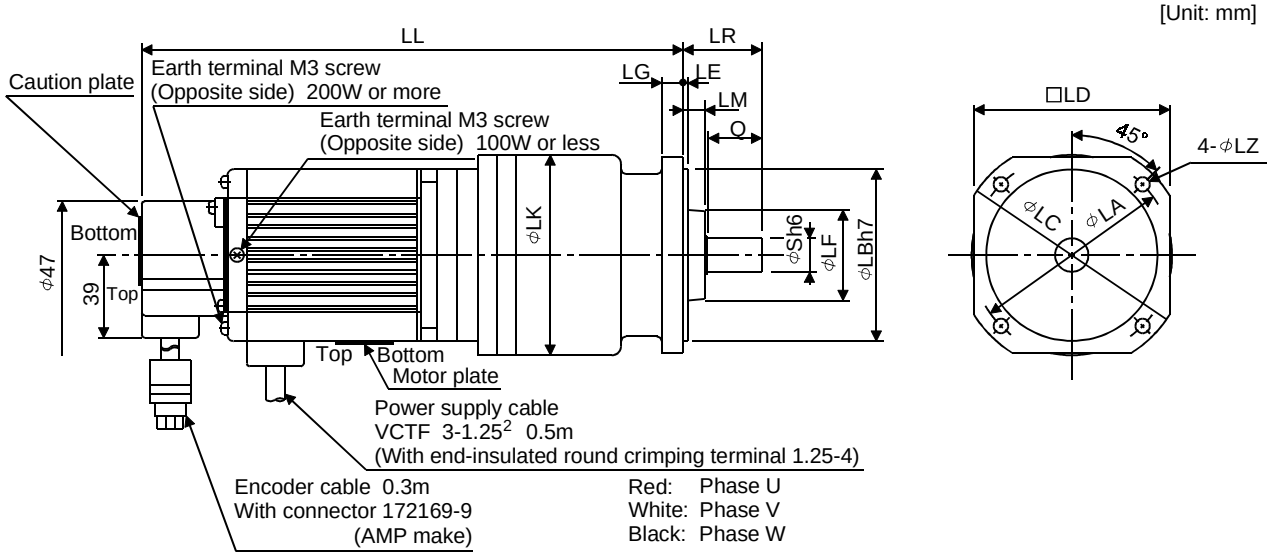


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg · m²]	(Note 1) Weight [kg]
HA-FF63 (B)G1	1/5	GR-S-60	1.34 (1.69)	13.0 (13.9)
	1/10		1.34 (1.69)	13.0 (13.9)
	1/30		1.32 (1.67)	13.0 (13.9)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

4) With reduction gear for precision application

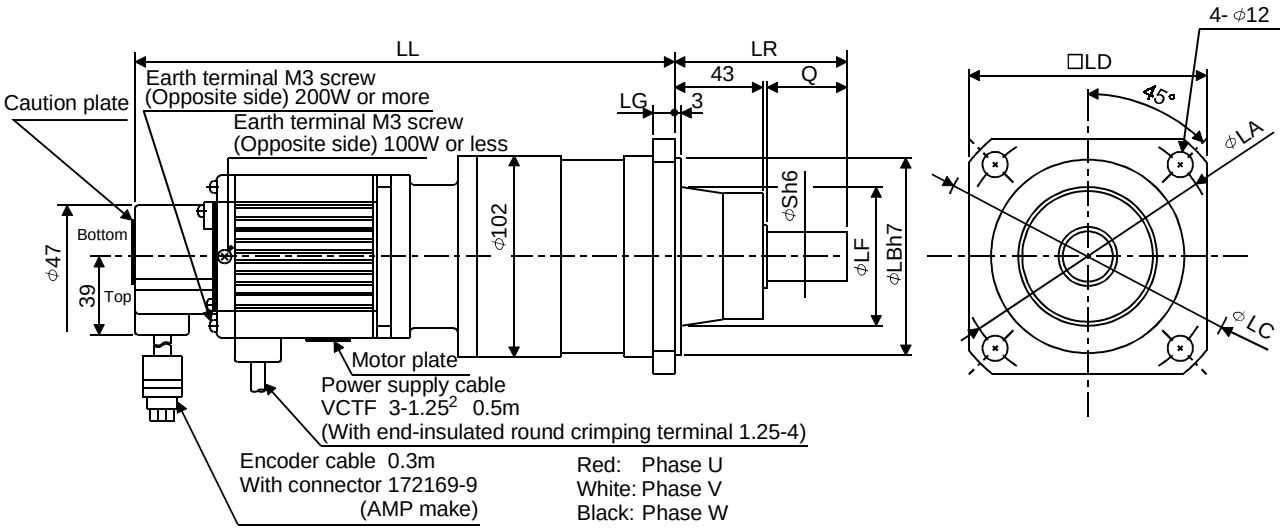
[Unit: mm]



Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg・m²]	(Note 1) Variable Dimensions														(Note 1) Weight [kg]
				LA	LB	LC	LD	LE	LF	LG	LK	LL	LM	LR	LZ	Q	S	
HA-FF053 (B)G2	1/5	BM2-05B-A5MES	0.11 (0.128)	78	62	89	74	2	33	6	75	205 (240)	9	30	4.5	20	10	2.3 (2.6)
	1/10	BM2-10B-A5MES	0.108 (0.125)	78	62	89	74	2	33	6	75	205 (239.5)	9	30	4.5	20	10	2.3 (2.6)
	1/15	BM2-15B-A5MES	0.105 (0.123)	78	62	89	74	2	33	6	75	205 (239.5)	9	30	4.5	20	10	2.3 (2.6)
	1/25	BM3-25B-A5MES	0.111 (0.120)	90	76	102	87	2	41	8	87	213 (247.5)	9	35	5.5	25	14	2.8 (3.2)
HA-FF13 (B)G2	1/5	BM2-05B-01MES	0.143 (0.160)	78	62	89	74	2	33	6	75	222 (256.5)	9	30	4.5	20	10	2.5 (2.8)
	1/10	BM3-10B-01MES	0.165 (0.160)	90	76	102	87	2	41	8	87	230 (264.5)	9	35	5.5	25	14	3.0 (3.4)
	1/15	BM3-15B-01MES	0.155 (0.153)	90	76	102	87	2	41	8	87	230 (264.5)	9	35	5.5	25	14	3.0 (3.4)
	1/25	BM4-25B-01MES	0.29 (0.308)	122	100	140	118	3	61	10	118	262 (296.5)	14	55	6.6	40	22	5.0 (5.3)
HA-FF23 (B)G2	1/5	BM3-05B-02MES	0.425 (0.558)	90	76	102	87	2	41	8	87	240 (277)	9	35	5.5	25	14	3.8 (4.4)
	1/10	BM4-10B-02MES	0.645 (0.778)	122	100	140	118	3	61	10	118	270 (306.5)	14	55	6.6	40	22	5.8 (6.4)
	1/15	BM4-15B-02MES	0.618 (0.75)	122	100	140	118	3	61	10	118	270 (306.5)	14	55	6.6	40	22	5.8 (6.4)
HA-FF33 (B)G2	1/5	BM4-05B-03MES	0.818 (0.95)	122	100	140	118	3	61	10	118	287 (324.5)	14	55	6.6	40	22	6.1 (6.7)
	1/10	BM4-10B-03MES	0.795 (0.928)	122	100	140	118	3	61	10	118	287 (324.5)	14	55	6.6	40	22	6.1 (6.7)
HA-FF43 (B)G2	1/5	BM4-05B-04MES	1.293 (1.643)	122	100	140	118	3	61	10	118	304 (340.5)	14	55	6.6	40	22	7.7 (8.5)

Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

[Unit: mm]

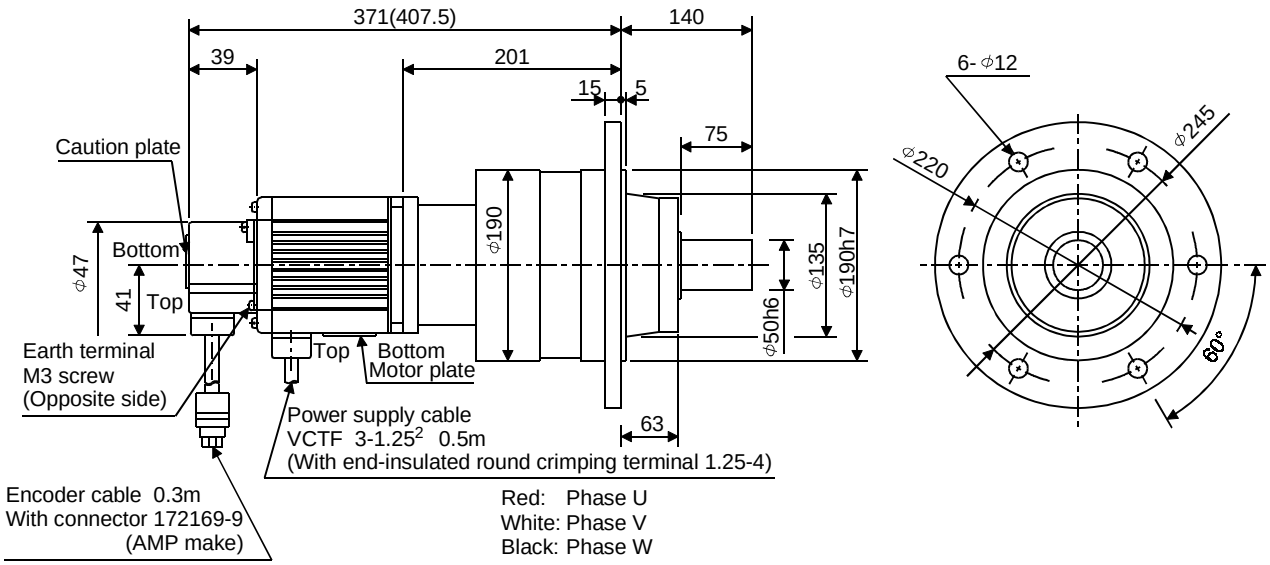


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	(Note 1) Inertia Moment J[×10⁻⁴kg·m²]	(Note 1) Variable Dimensions											(Note 1) Weight [kg]
				LA	LB	LC	LD	LF	LG	LK	LL	LR	Q	S	
HA-FF13 (B)G2	1/45	BL1-45B-01MES	0.293 (0.298)	130	100	155	120	70	10	102	274 (308.5)	85	40	25	6 (6.3)
HA-FF23 (B)G2	1/20	BL1-20B-02MES	0.730 (0.885)	130	100	155	120	70	10	102	278 (311.5)	85	40	25	6.8 (7.4)
	1/29	BL1-29B-02MES	0.633 (0.765)	130	100	155	120	70	10	102	278 (314.5)	85	40	25	6.8 (7.4)
	1/45	BL2-45B-02MES	0.763 (0.895)	160	130	185	140	94	12	132	299 (336)	100	55	35	12.3 (12.9)
HA-FF33 (B)G2	1/20	BL1-20B-03MES	0.880 (1.013)	130	100	155	120	70	10	102	295 (329.5)	85	40	25	7.1 (7.7)
	1/29	BL2-29B-03MES	1.535 (1.668)	160	130	185	140	94	12	132	316 (353.5)	100	55	35	12.6 (13.2)
	1/45	BL2-45B-03MES	0.913 (1.045)	160	130	185	140	94	12	132	316 (363.5)	100	55	35	12.6 (13.2)
HA-FF43 (B)G2	1/9	BL1-09B-04MES	1.193 (1.543)	130	100	155	120	70	10	102	295.5 (332.5)	85	40	25	8.2 (9.0)
	1/20	BL2-20B-04MES	2.378 (2.623)	160	130	185	140	94	12	132	323.5 (360.5)	100	55	35	14.2 (15)
	1/29	BL2-29B-04MES	2.01 (2.36)	160	130	185	140	94	12	132	323.5 (360.5)	100	55	35	14.2 (15)
	1/45	BL2-45B-04MES	1.388 (1.738)	160	130	185	140	94	12	132	333.5 (370.5)	100	55	35	14.2 (15)
HA-FF63 (B)G2	1/5	BL1-05B-06MES	1.283 (1.858)	130	100	155	120	70	10	102	300.5 (337.5)	85	40	25	8.8 (9.6)
	1/9	BL1-09B-06MES	1.418 (1.768)	130	100	155	120	70	10	102	310.5 (347.5)	85	40	25	8.8 (9.6)
	1/20	BL2-20B-06MES	2.603 (2.953)	160	130	185	140	94	12	132	338.5 (375.5)	100	55	35	14.8 (15.6)
	1/29	BL2-29B-06MES	2.235 (2.585)	160	130	185	140	94	12	132	338.5 (375.5)	100	55	35	14.8 (15.6)

Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

HA-FF63(B)G2 1/45

[Unit: mm]



Reduction Gear Model	Reduction Ratio	(Note) Inertia Moment J[$\times 10^{-4}$kg ▪ m^2]	(Note) Weight [kg]
BL3-45B-06MES	1/45	3.13 (3.475)	29.8 (33.7)

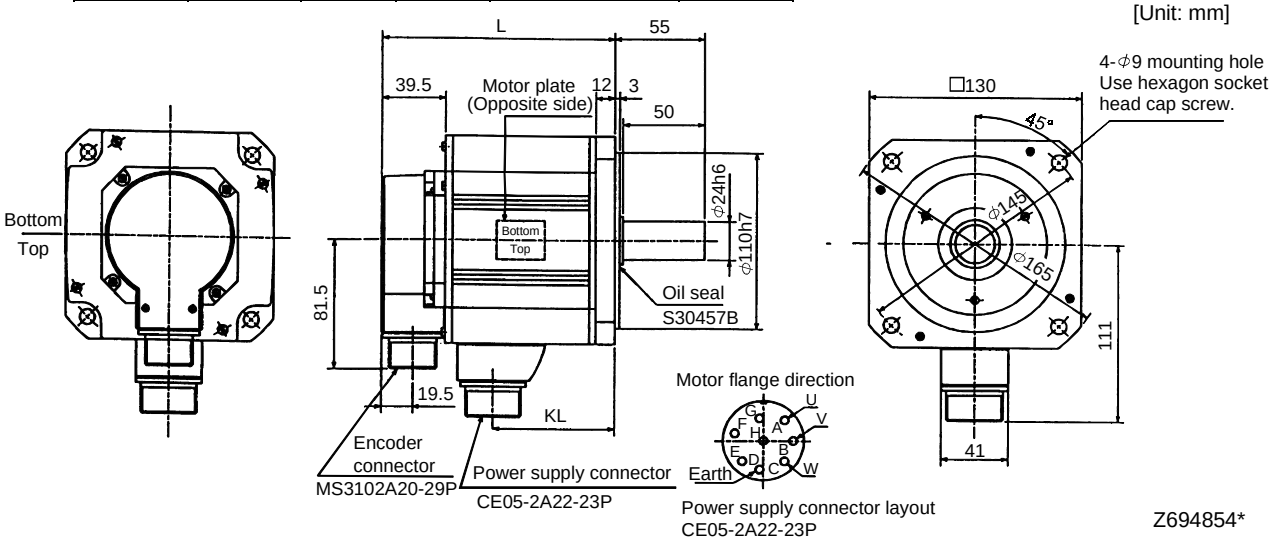
Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

(3) HC-SF Series

1) Standard (without electromagnetic brake, without reduction gear)

Model	Output (kW)	Variable Dimensions L	Variable Dimensions KL	Inertia Moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-SF52 HC-SF53	0.5	120	51.5	6.6	5.0
HC-SF102 HC-SF103	1.0	145	76.5	13.7	7.0
HC-SF81	0.85	170	101.5	20	9.0
HC-SF152 HC-SF153	1.5				

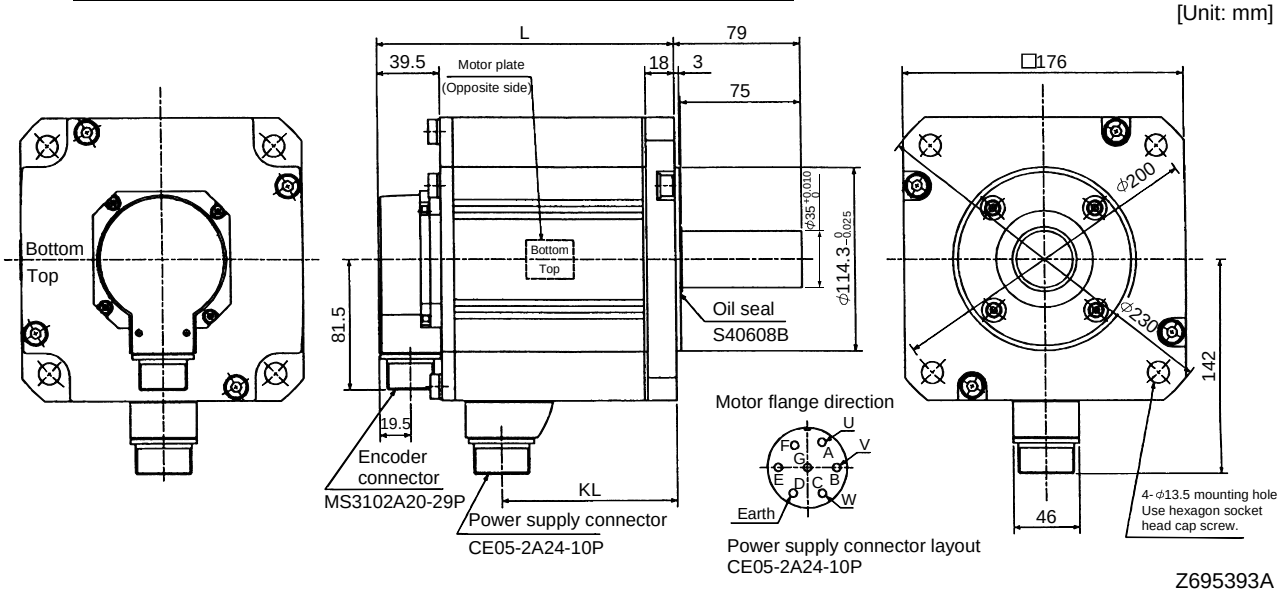
[Unit: mm]



Z694854*

Model	Output (kW)	Variable Dimensions L	Variable Dimensions KL	Inertia Moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-SF121	1.2	145	68.5	42.5	12.0
HC-SF202 HC-SF203	2.0				
HC-SF201	2.0	187	110.5	82.0	19.0
HC-SF352 HC-SF353	3.5				

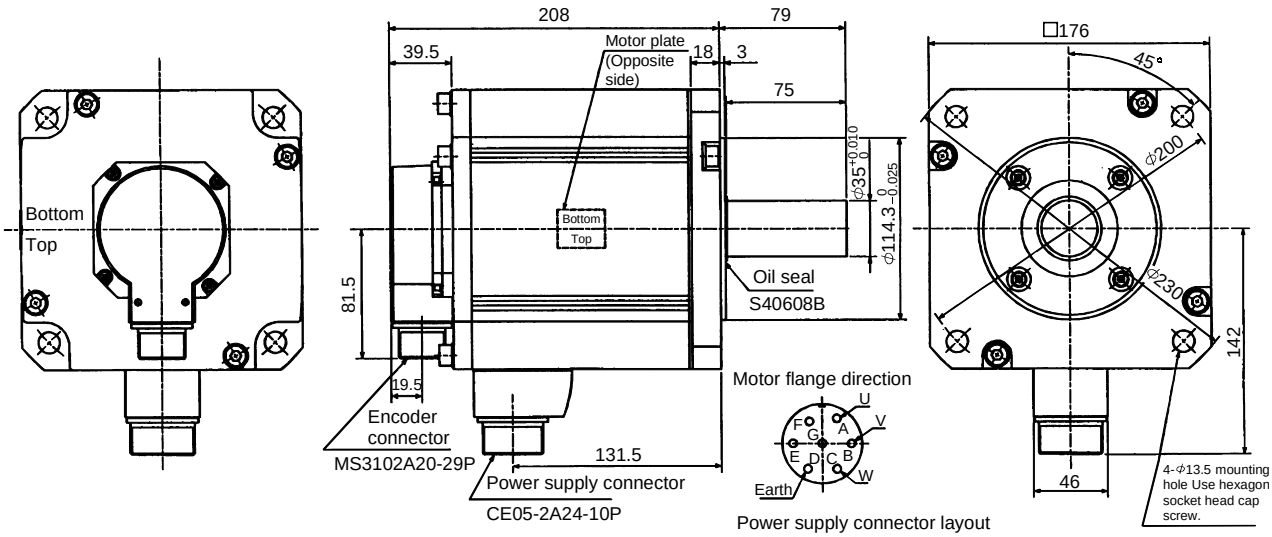
[Unit: mm]



Z695393A

Model	Output (kW)	Inertia Moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-SF301	3.0	101	23

[Unit: mm]

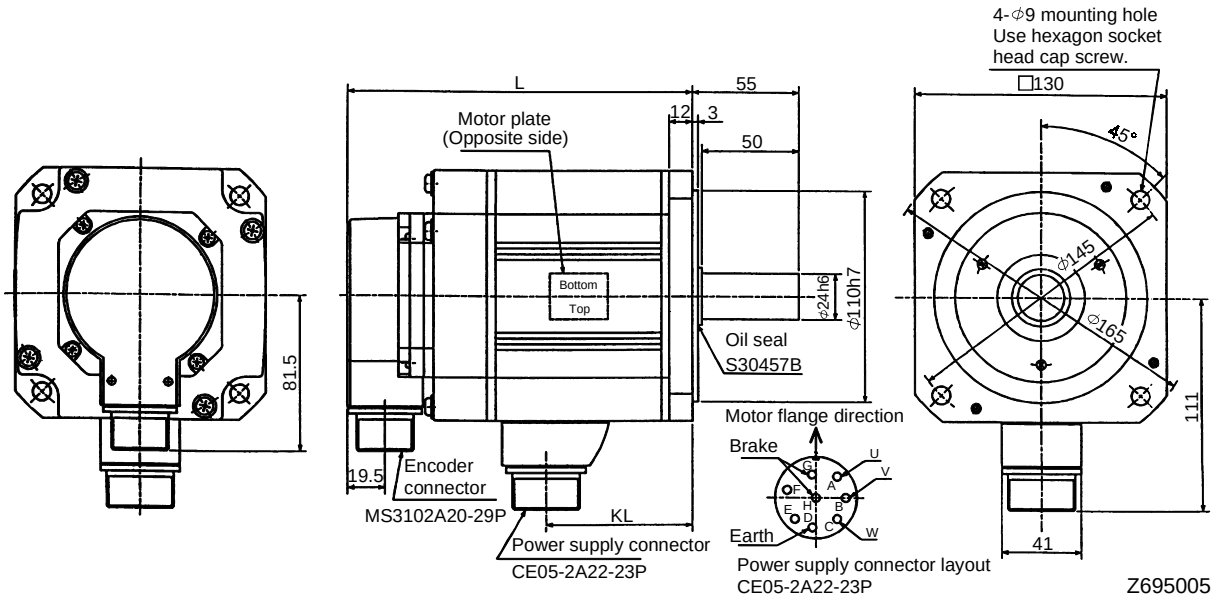


Note: 1. For connection with a load, use a locking element or the like.

2) With electromagnetic brake

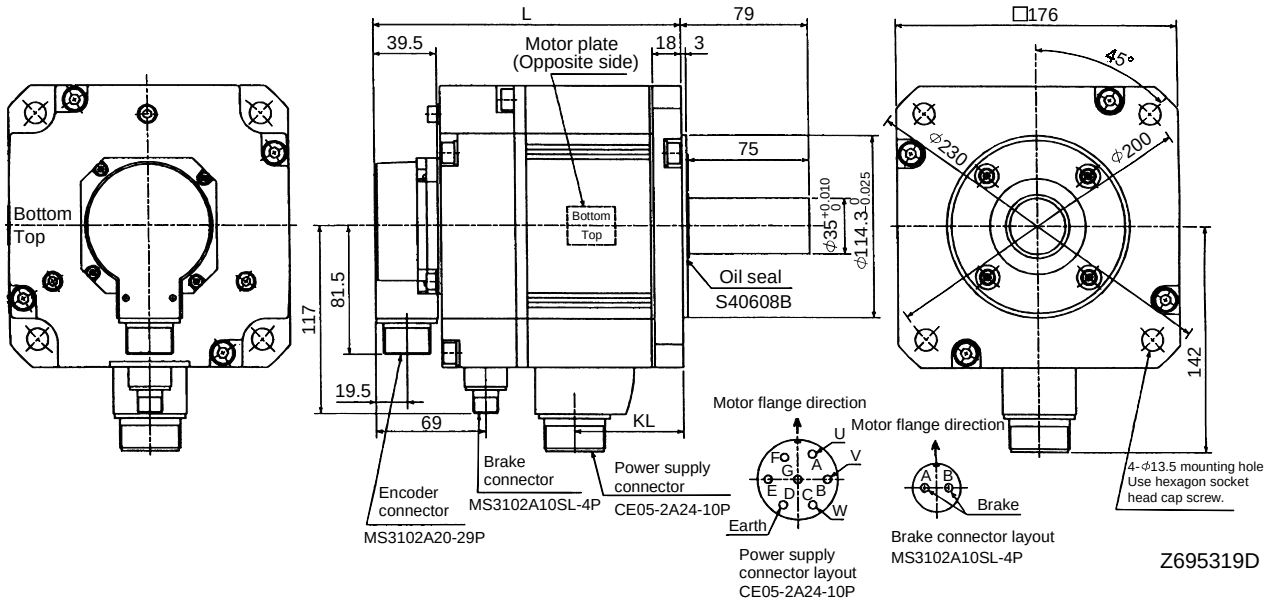
Model	Output (kW)	Variable Dimensions L	Variable Dimensions KL	Braking Force (N • m)	Inertia Moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-SF52B HC-SF53B	0.5	153	51.5	8.5	8.3	7.5
HC-SF102B HC-SF103B	1.0	178	76.5	8.5	15.4	9.5
HC-SF81B	0.85	203	101.5	8.5	21.7	11.5
HC-SF152B HC-SF153B	1.5					

[Unit: mm]



Model	Output (kW)	Variable Dimensions		Braking Force (N・m)	Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
		L	KL			
HC-SF121B	1.2	193	68.5	43.1	52.5	18.0
HC-SF202B HC-SF203B	2.0					
HC-SF201B	2.0	235	110.5	43.1	92.0	25.0
HC-SF352B HC-SF353B	3.5					

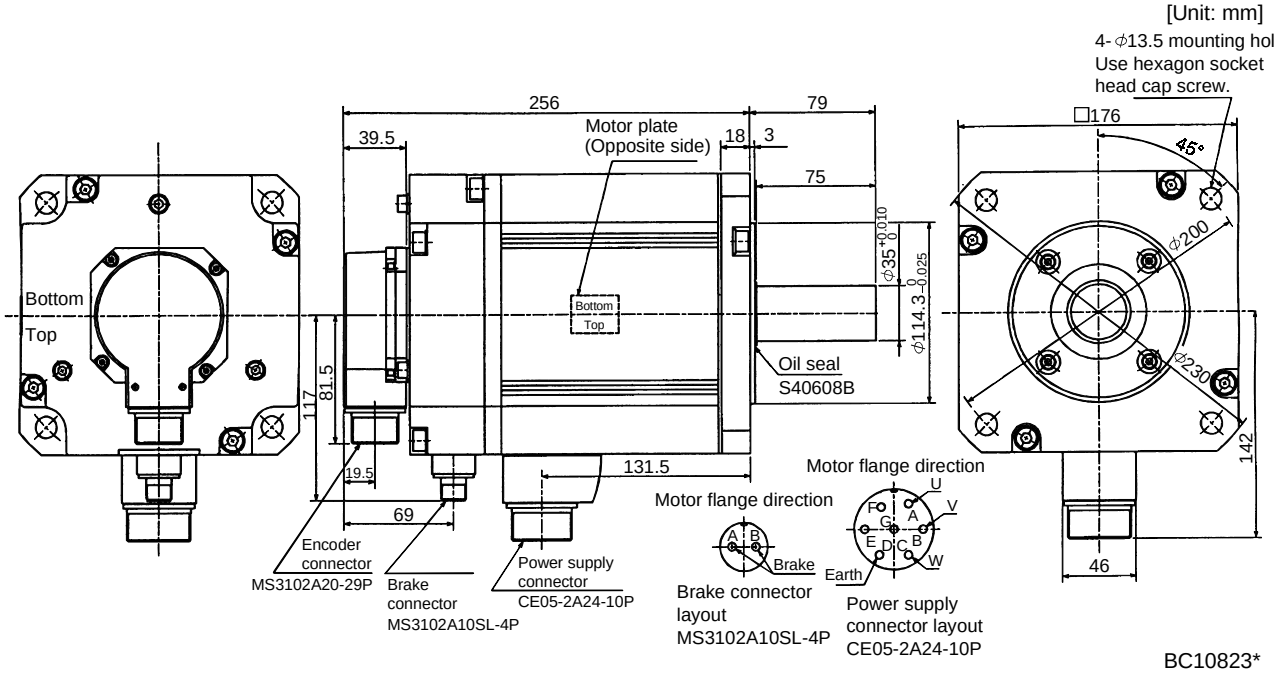
[Unit: mm]



Z695319D

Model	Output (kW)	Braking Force (N・m)	Inertia Moment J(×10^{-4}kg・m^2)	Weight (kg)
HC-SF301B	3.0	43.1	111	29.0

[Unit: mm]



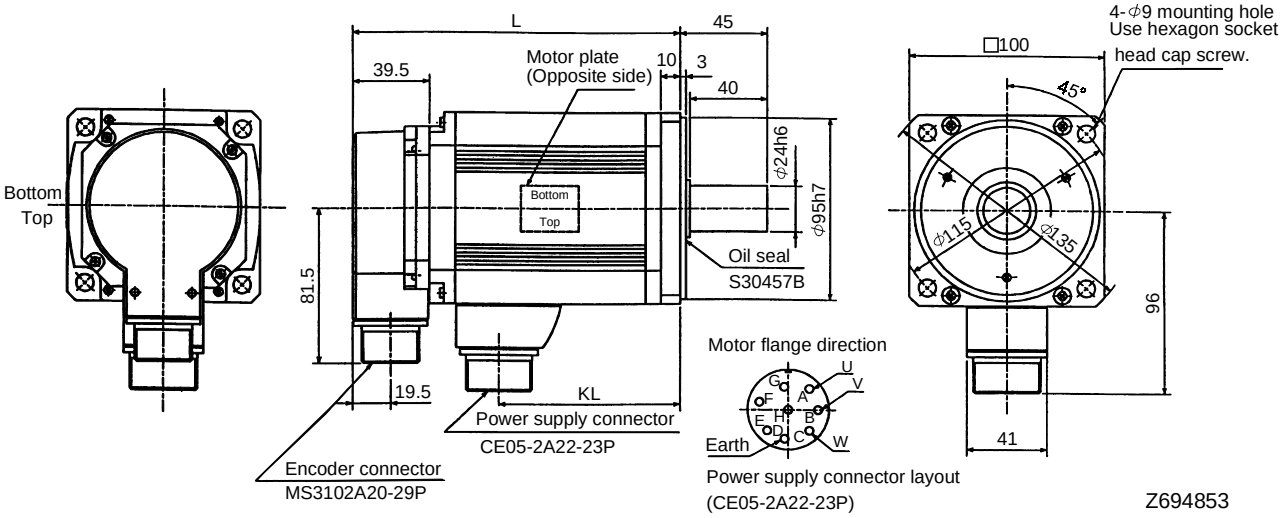
BC10823*

(4) HC-RF Series

1) Standard (without electromagnetic brake, without reduction gear)

Model	Output (kW)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Variable Dimensions		Weight (kg)
			L	KL	
HC-RF103	1.0	1.5	147	71	3.9
HC-RF153	1.5	1.9	172	96	5.0
HC-RF203	2.0	2.3	197	121	6.2

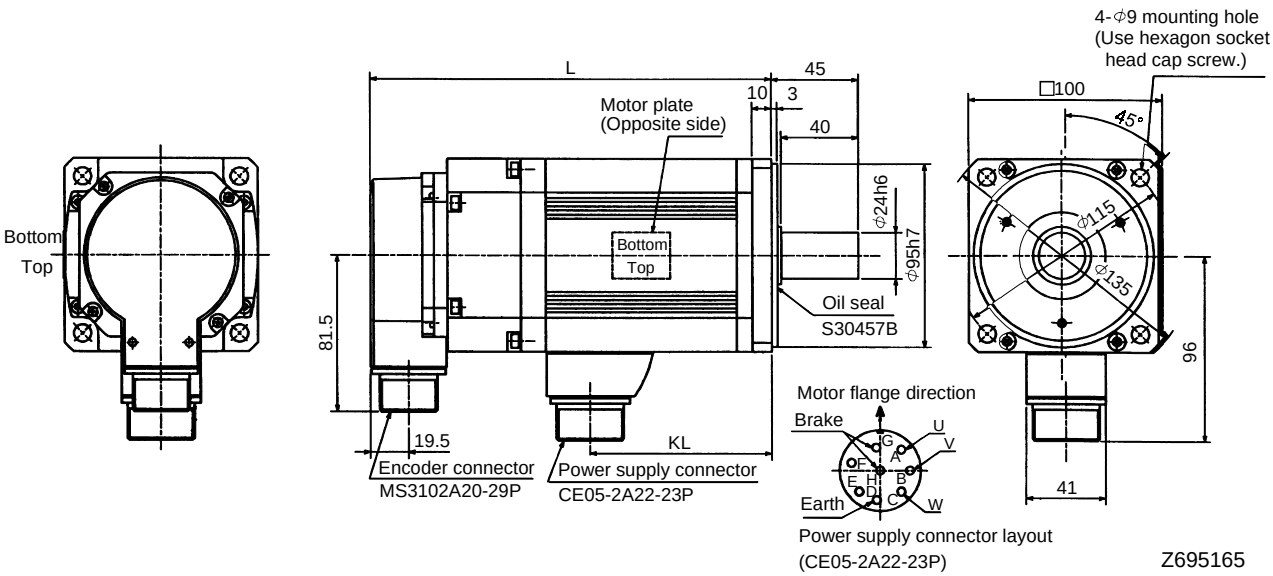
[Unit: mm]



2) With electromagnetic brake

Model	Output (kW)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Variable Dimensions		Braking Force (N・m)	Weight (kg)
			L	KL		
HC-RF103B	1.0	1.85	185	71	7	6.0
HC-RF153B	1.5	2.25	210	96	7	7.0
HC-RF203B	2.0	2.65	235	121	7	8.3

[Unit: mm]

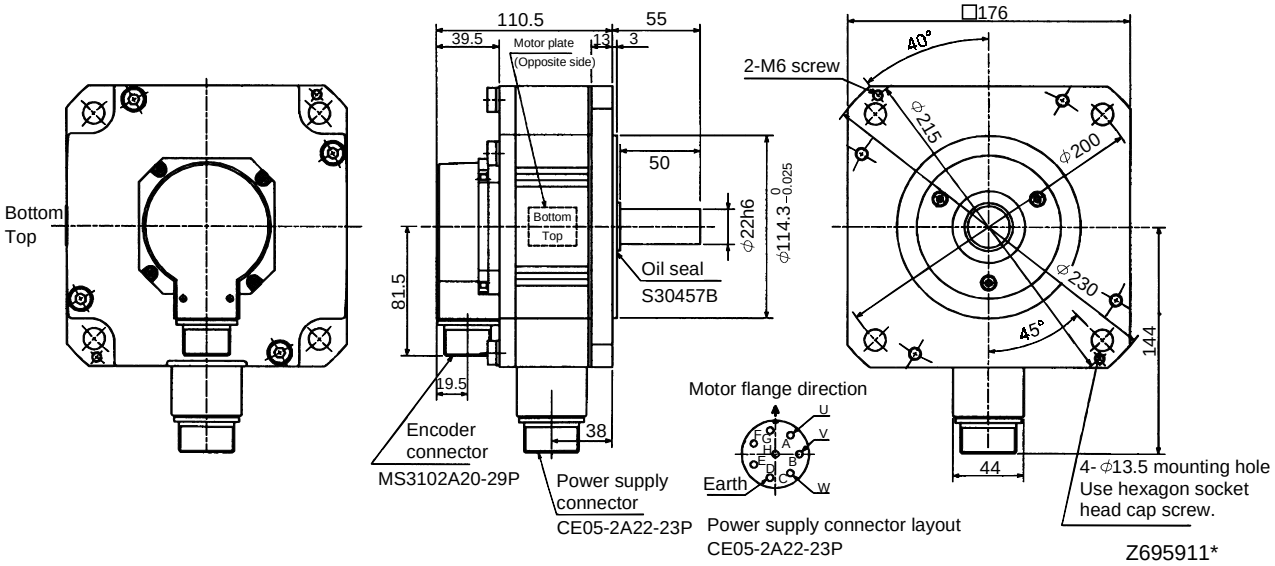


(5) HC-UF Series

1) Standard (without electromagnetic brake)

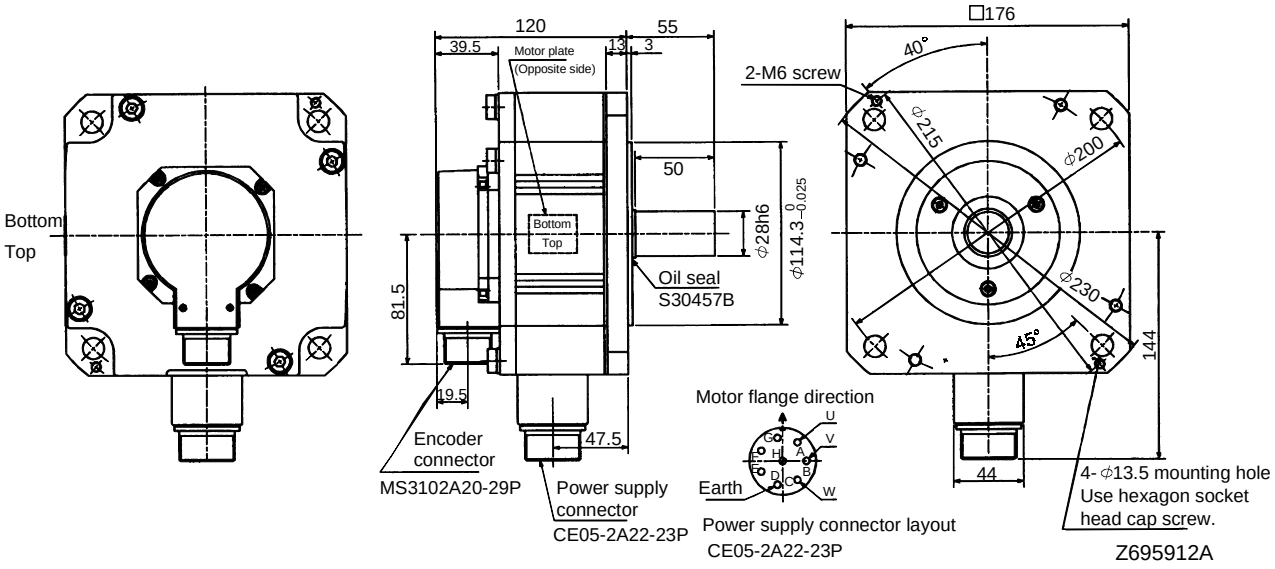
Model	Output (kW)	Inertia moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-UF72	0.75	10.4	8

[Unit: mm]



Model	Output (kW)	Inertia moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-UF152	1.5	22.1	11

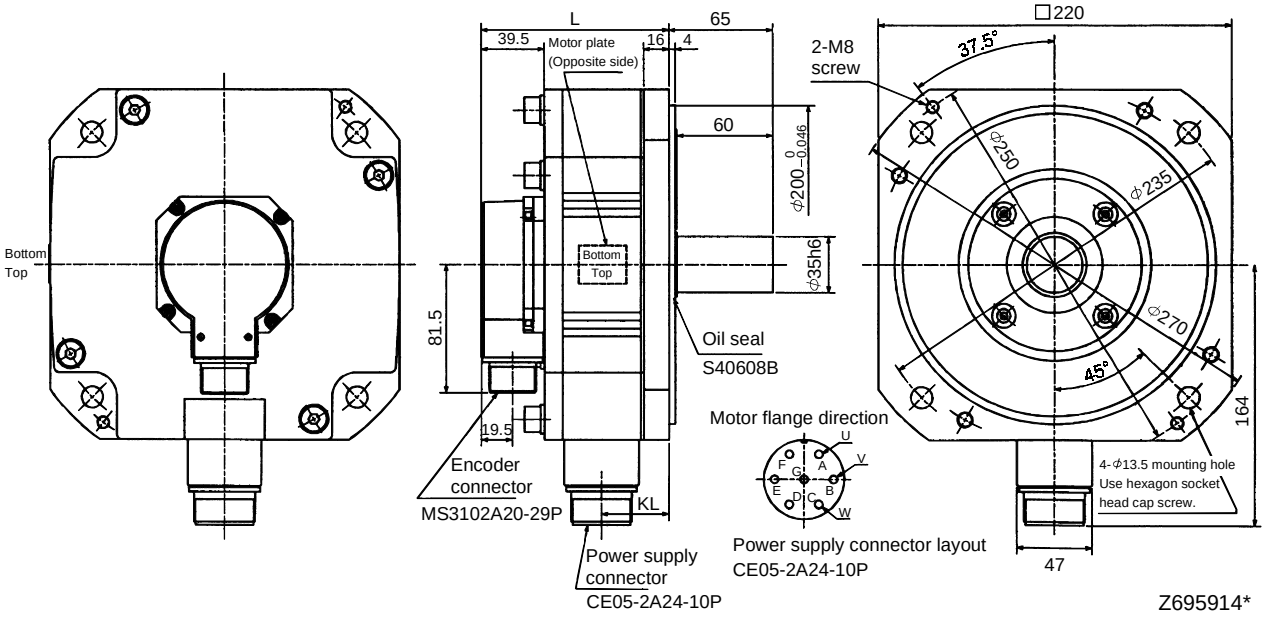
[Unit: mm]



10. SPECIFICATIONS

Model	Output (kW)	Variable Dimensions		Inertia moment $J(\times 10^{-4}kg \cdot m^2)$	Weight (kg)
		L	KL		
HC-UF202	2.0	118	42.5	38.2	16

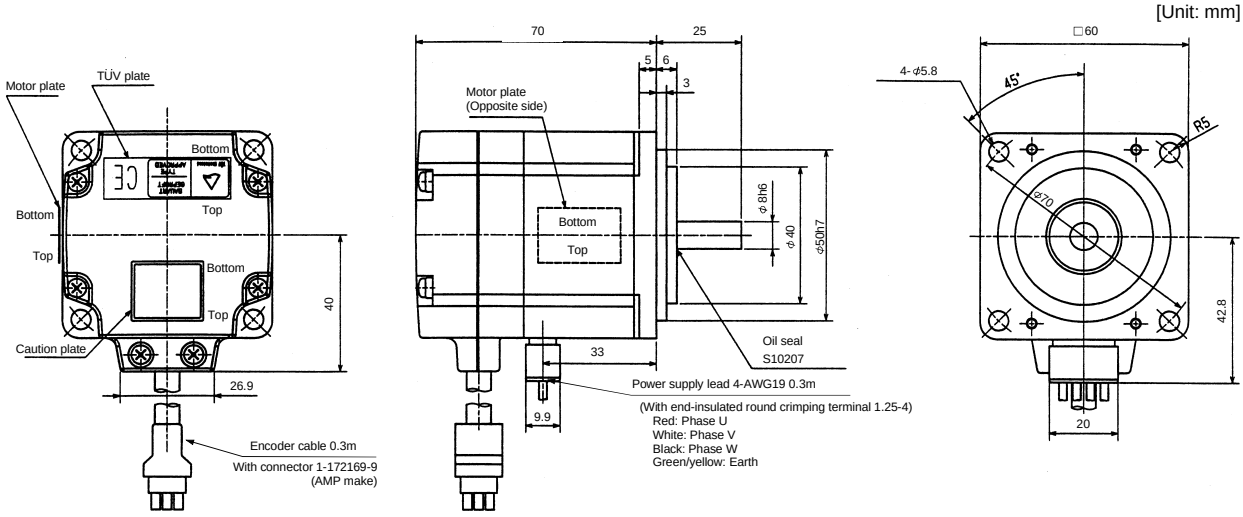
[Unit: mm]



Z695914*

Model	Output (W)	Inertia Moment $J(\times 10^{-4}kg \cdot m^2)$	Weight (kg)
HC-UF13	100	0.66	0.8

[Unit: mm]

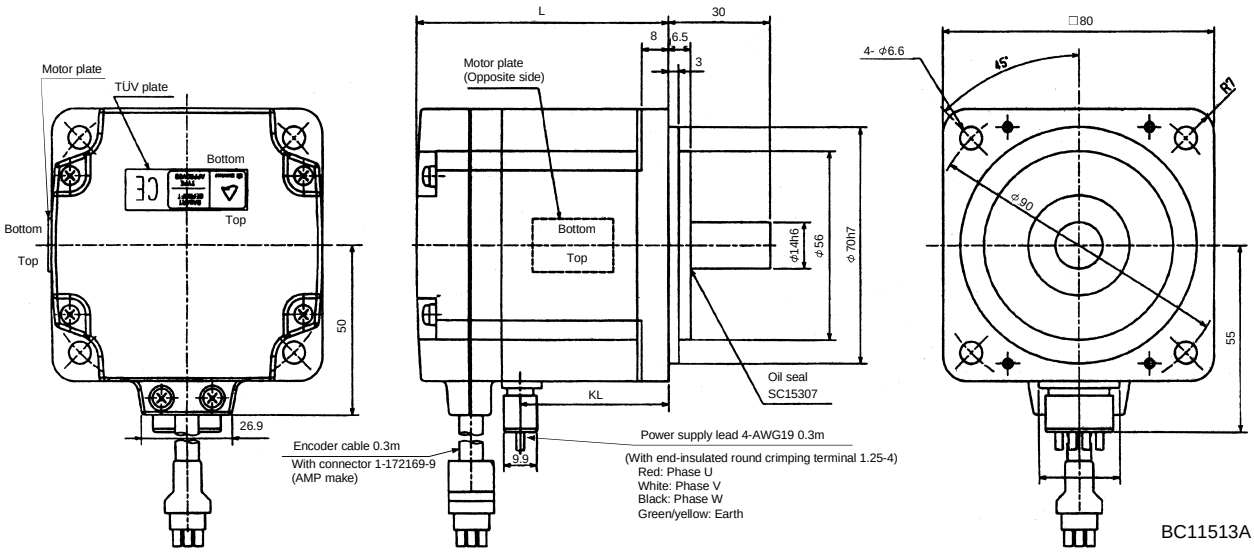


BC11740A

10. SPECIFICATIONS

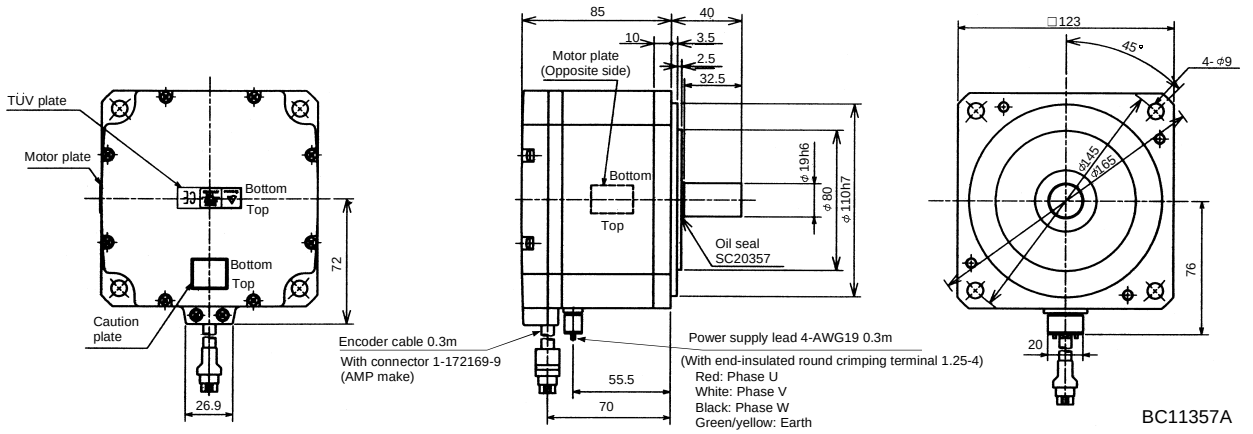
Model	Output (W)	Variable Dimensions		Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL		
HC-UF23	200	77	43.8	0.241	1.5
HC-UF43	400	92	58.8	0.365	1.7

[Unit: mm]



Model	Output (W)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-UF73	750	5.9	5.0

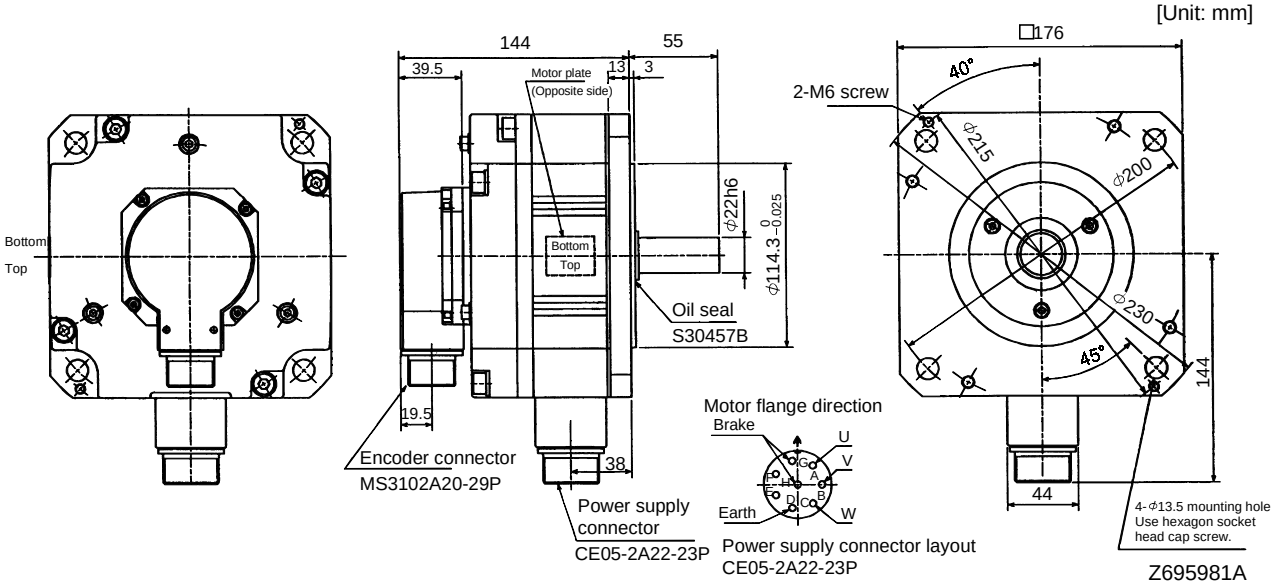
[Unit: mm]



2) With electromagnetic brake

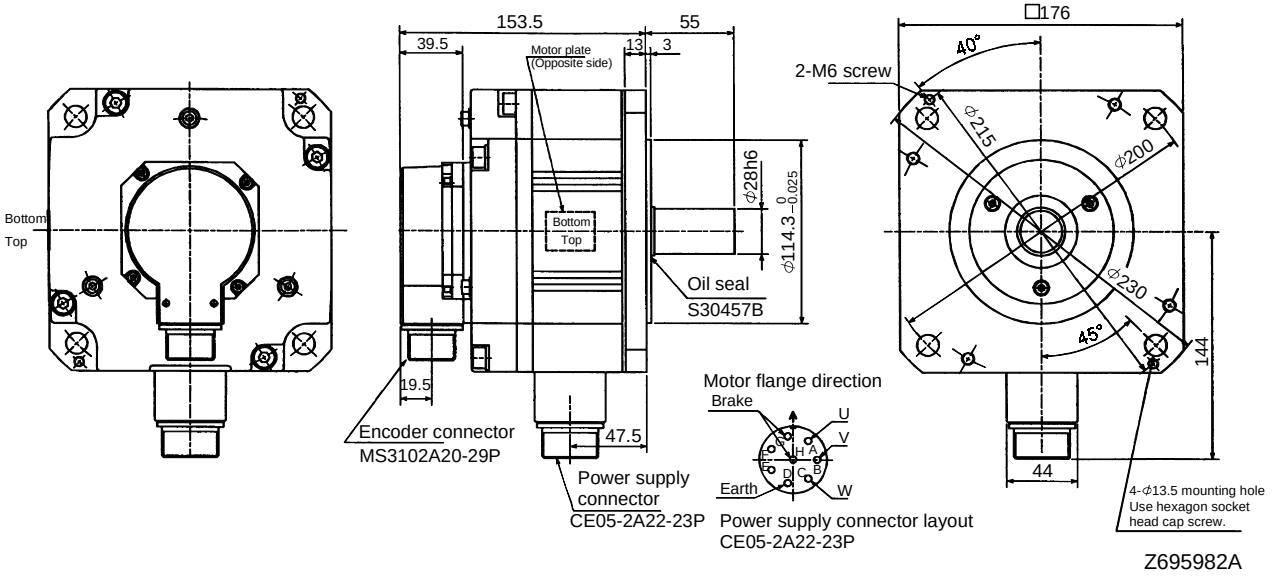
Model	Output (kW)	Braking Force (N • m)	Inertia moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-UF72B	0.75	8.5	12.4	10

[Unit: mm]



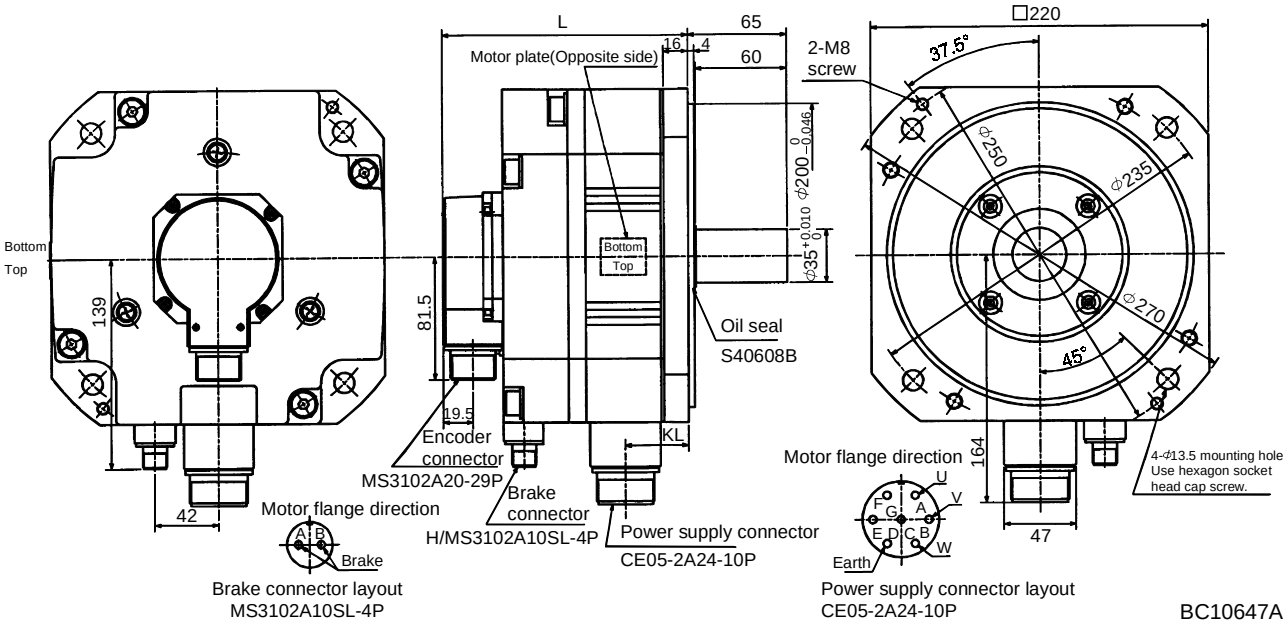
Model	Output (kW)	Braking Force (N • m)	Inertia moment J($\times 10^{-4}$kg • m^2)	Weight (kg)
HC-UF152B	1.5	8.5	28.9	13

[Unit: mm]



Model	Output (kW)	Variable Dimensions		Braking Force (N・m)	Inertia moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
		L	KL			
HC-UF202B	2.0	161	42.5	43.1	46.8	22

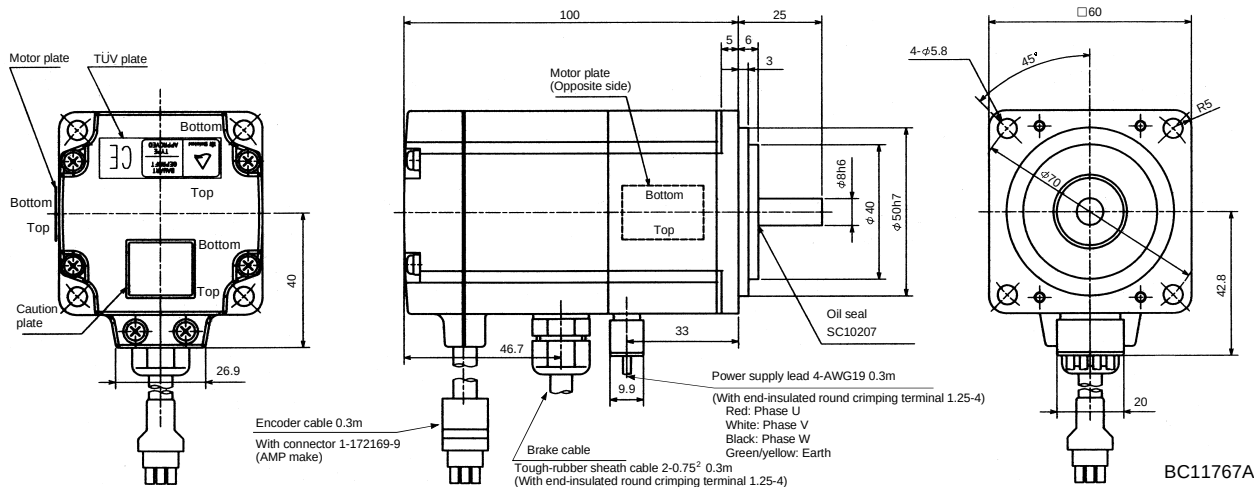
[Unit: mm]



BC10647A

Model	Output (W)	Braking Force (N・m)	Inertia Moment J($\times 10^{-4}$kg・m^2)	Weight (kg)
HC-UF13B	100	0.32	0.074	1.2

[Unit: mm]

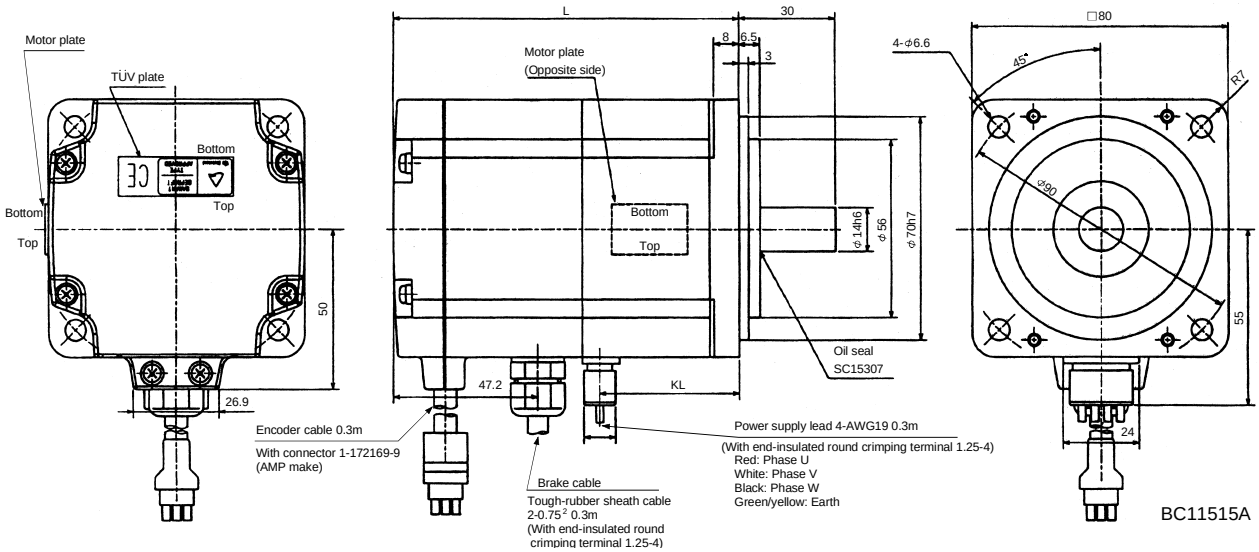


BC11767A

10. SPECIFICATIONS

Model	Output (W)	Variable Dimensions		Braking Force (N・m)	Inertia moment J(×10^{-4}kg・m^2)	Weight (kg)
		L	KL			
HC-UF23B	200	111	43.8	1.3	0.323	2.2
HC-UF43B	400	123	58.8	1.3	0.477	2.4

[Unit: mm]



CONTENTS

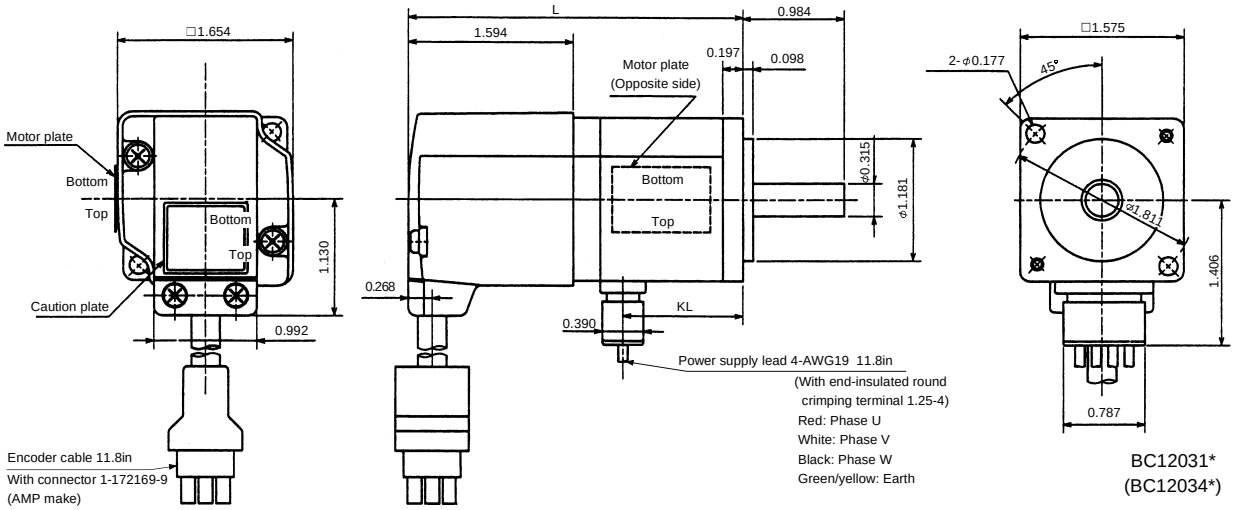
10 - 5 - 3 Servo motors (in inches)

(1) HC-MF Series

1) Standard (without electromagnetic brake, without reduction gear)

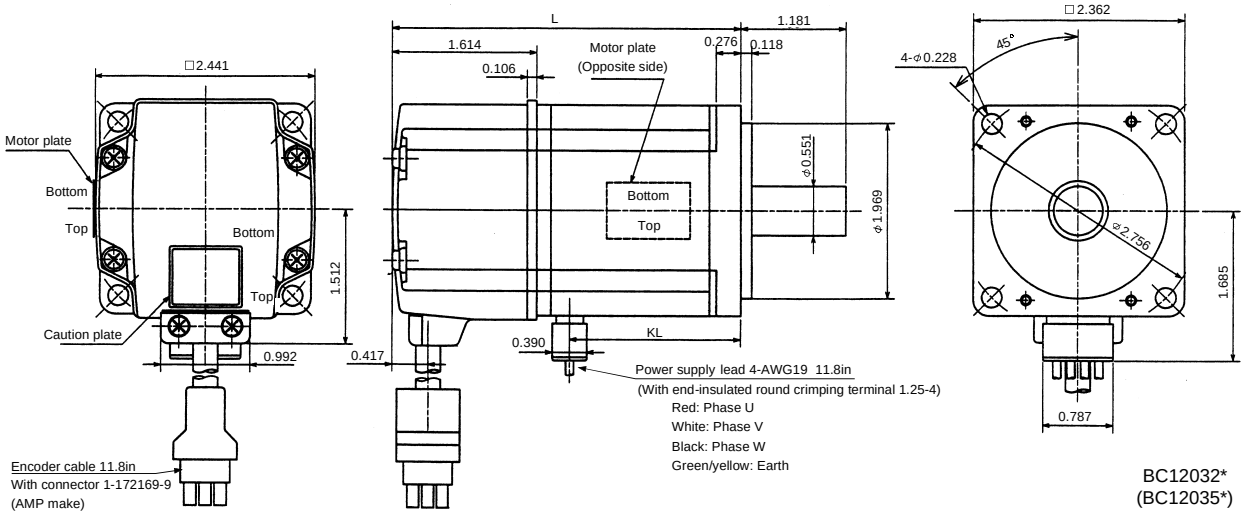
Model	Output (W)	Variable Dimensions(in)		Inertia Moment WK^2(oz • in^2)	Weight (lb)
		L	KL		
HC-MF053	50	3.21	1.16	0.10	0.9
HC-MF13	100	3.80	0.18	0.16	1.2

[Unit: in]



Model	Output (W)	Variable Dimensions(in)		Inertia Moment WK^2(oz • in^2)	Weight (lb)
		L	KL		
HC-MF23	200	3.92	1.93	0.48	2.2
HC-MF43	400	4.90	0.06	0.78	3.2

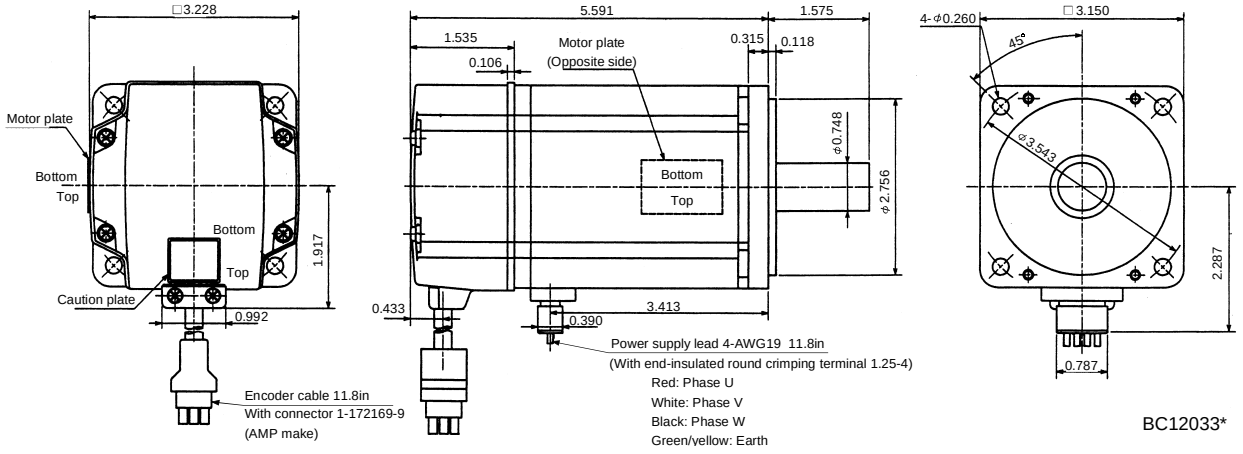
[Unit: in]



10. SPECIFICATIONS

Model	Output (W)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-MF73	750	3.28	6.6

[Unit: in]

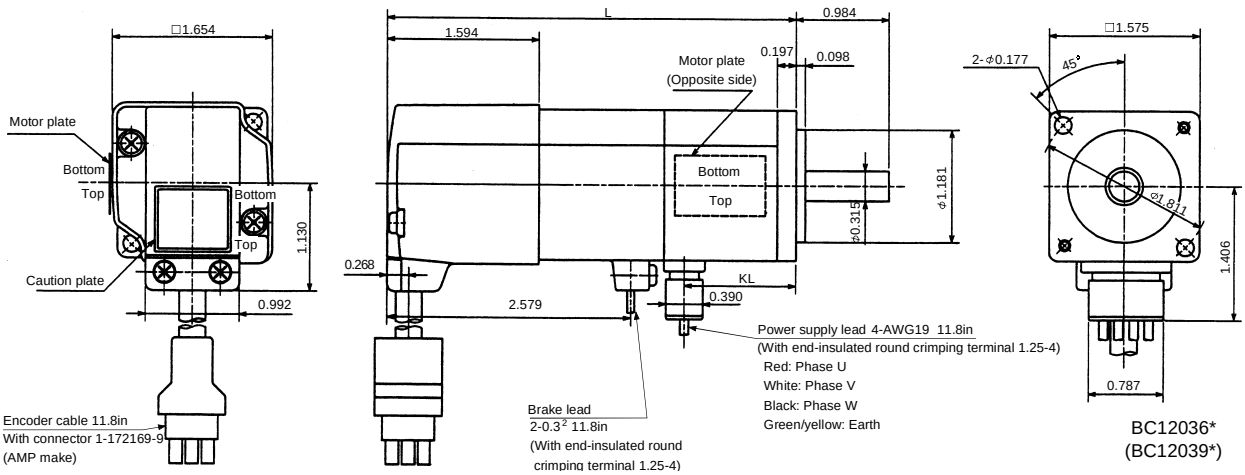


BC12033*

2) With electromagnetic brake

Model	Output (W)	Variable Dimensions (in)		Braking Force (oz ▪ in)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL			
HC-MF053B	50	4.31	1.16	45.32	0.12	1.7
HC-MF13B	100	4.90	1.75	45.32	0.18	2.0

[Unit: in]

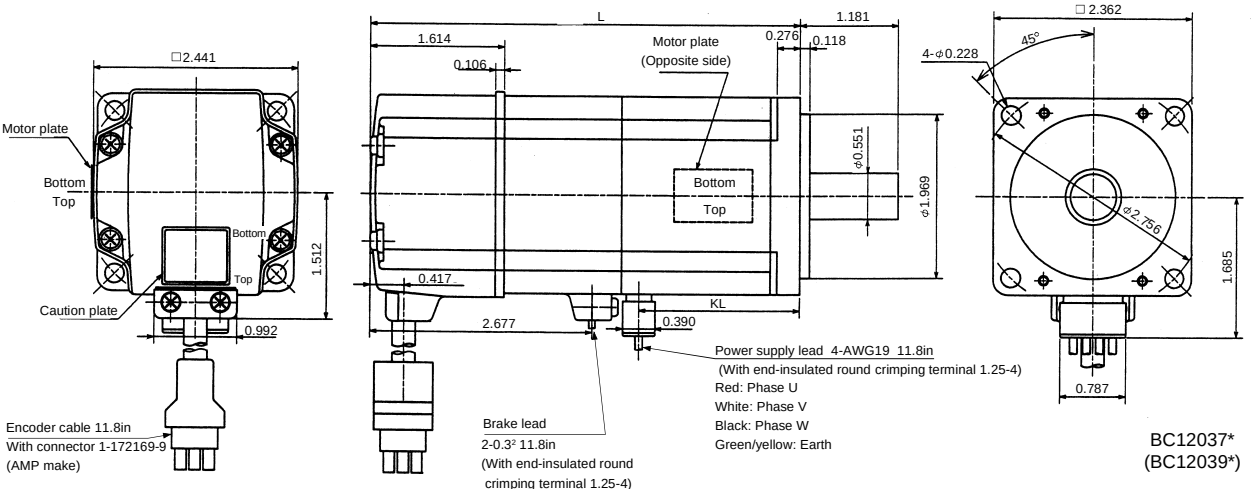


BC12036*
(BC12039*)

10. SPECIFICATIONS

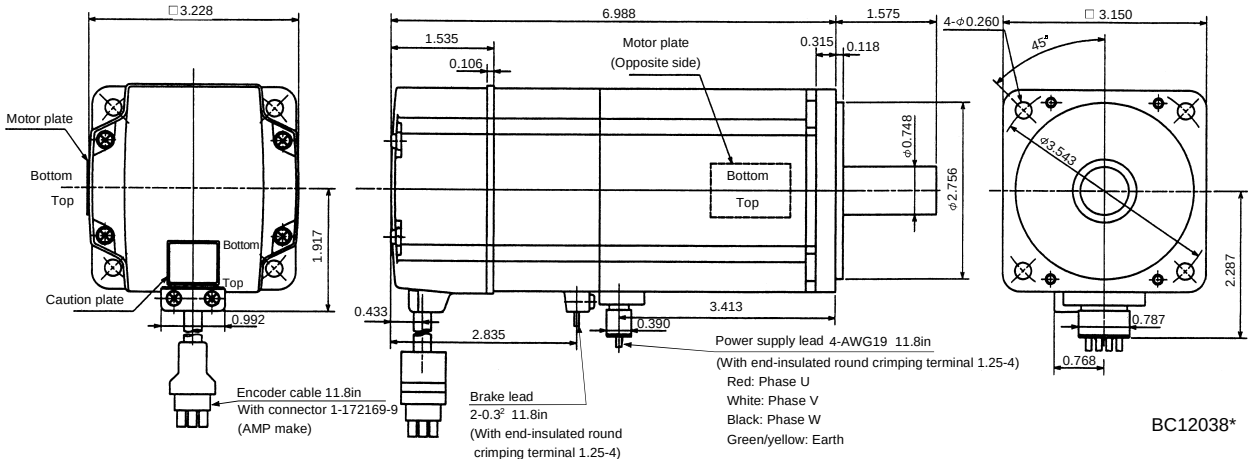
Model	Output (W)	Variable Dimensions (in)		Braking Force (oz ▪ in)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL			
HC-MF23B	200	5.18	1.93	184	0.74	3.5
HC-MF43B	400	6.16	2.84	184	1.04	4.6

[Unit: in]



Model	Output (W)	Braking Force (oz ▪ in)	Inertia Moment KW^2(oz ▪ in^2)	Weight (lb)
HC-MF73B	750	340	3.96	8.8

[Unit: in]

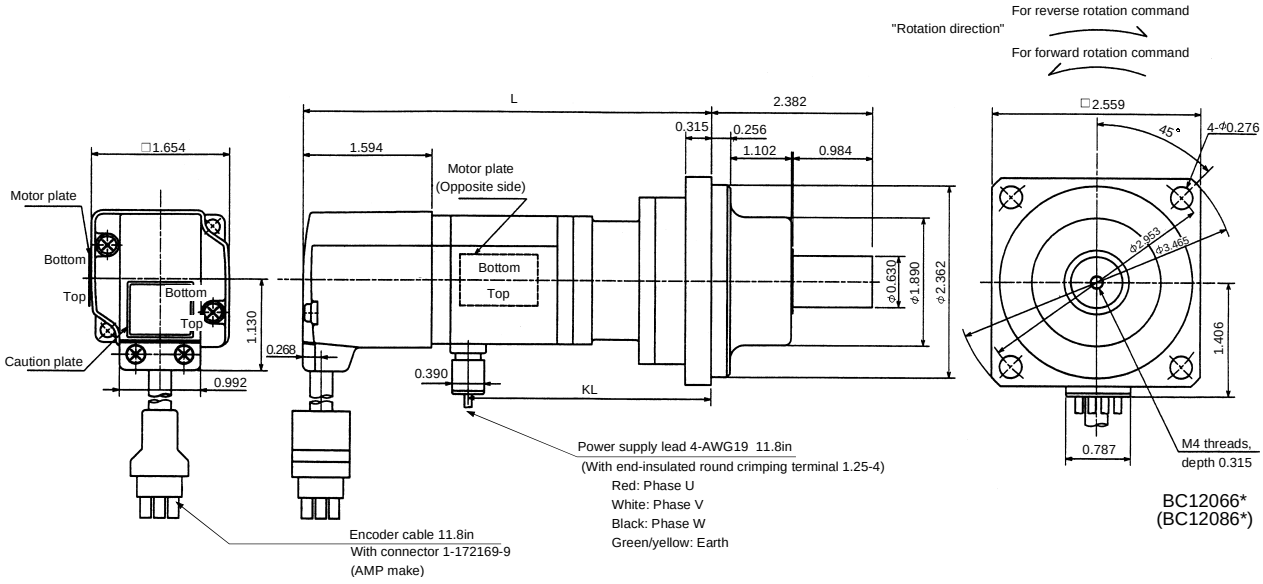


3) With reduction gear for general industrial machine

a) Without electromagnetic brake

Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz • in^2)	Backlash	Weight (lb)
		L	KL					
HC-MF053G1	50	4.96	2.91	K6505	1/5(9/44)	0.30	60min. max.	3.1
HC-MF053G1	50	5.669	3.62	K6512	1/12(49/576)	0.42	60min. max.	4.0
HC-MF053G1	50	5.669	3.62	K6520	1/20(25/484)	0.32	60min. max.	4.0

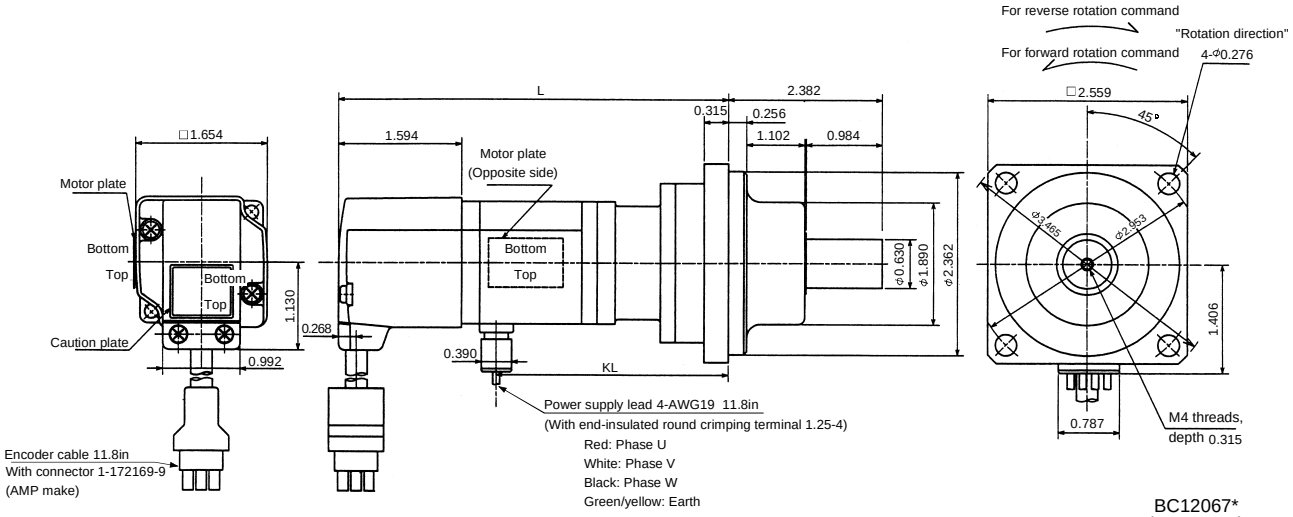
[Unit: in]



BC12066*
(BC12086*)

Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz • in^2)	Backlash	Weight (lb)
		L	KL					
HC-MF13G1	100	5.551	3.5	K6505	1/5(9/44)	0.36	60min. max.	3.3
HC-MF13G1	100	6.26	4.21	K6512	1/12(49/576)	0.48	60min. max.	4.2
HC-MF13G1	100	6.26	4.21	K6520	1/20(25/484)	0.38	60min. max.	4.2

[Unit: in]

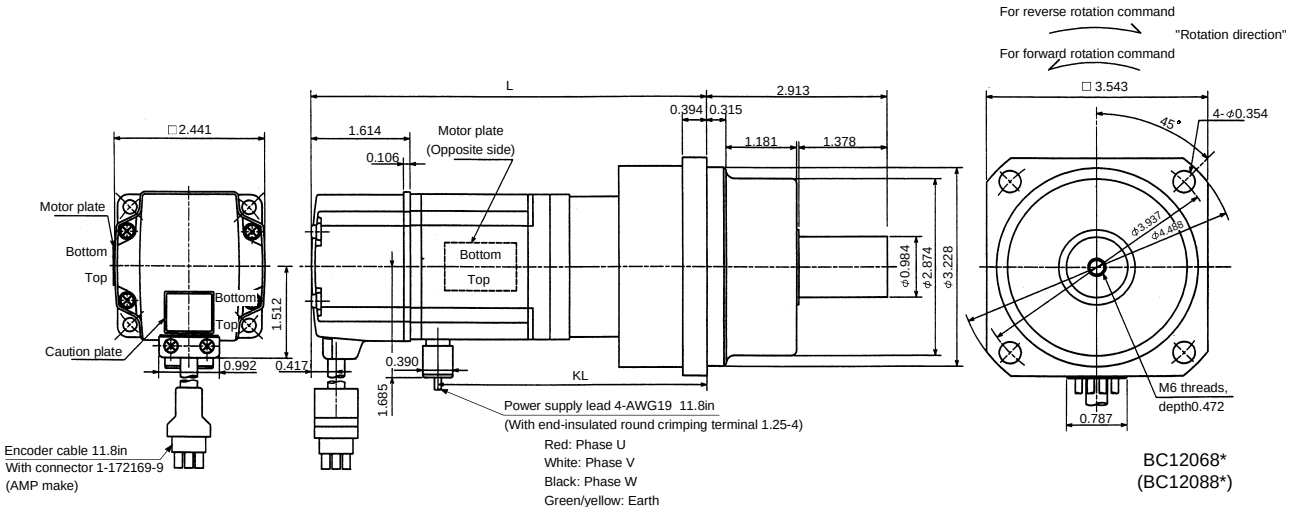


BC12067*
(BC12087*)

10. SPECIFICATIONS

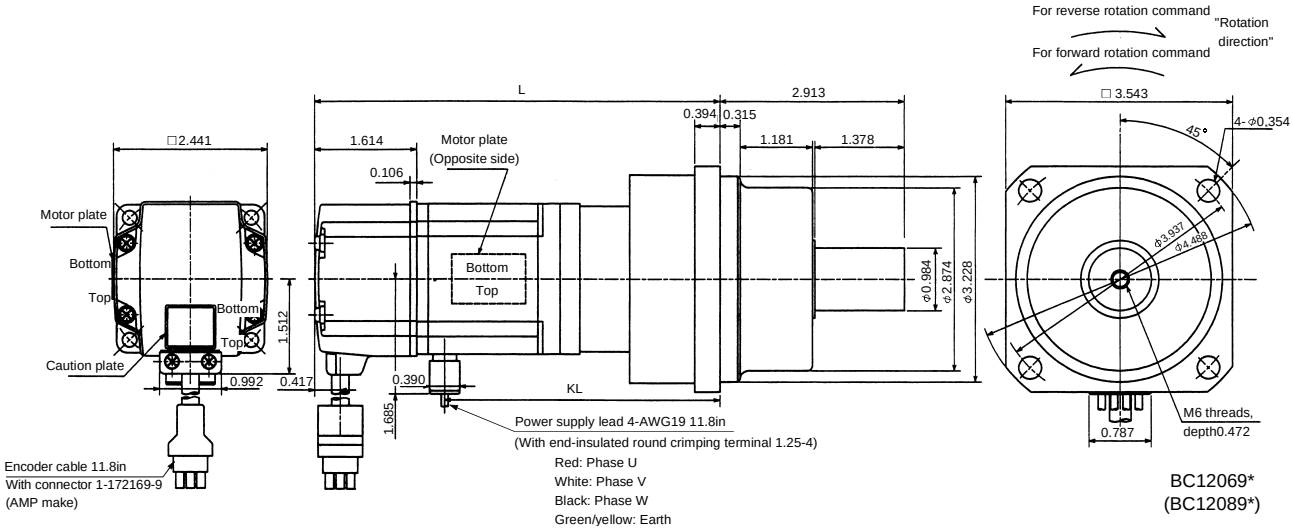
Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz・in^2)	Weight (lb)
		L	KL				
HC-MF23G1	200	6.02	4.04	K9005	1/5(19/96)	1.36	7.3
HC-MF23G1	200	6.81	4.83	K9012	1/12(25/288)	1.60	8.6
HC-MF23G1	200	6.81	4.83	K9020	1/20(253/5000)	1.45	8.6

[Unit: in]



Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz・in^2)	Weight (lb)
		L	KL				
HC-MF43G1	400	7.01	4.95	K9005	1/5(19/96)	1.62	8.4
HC-MF43G1	400	7.80	5.73	K9012	1/12(25/288)	1.85	9.7

[Unit: in]

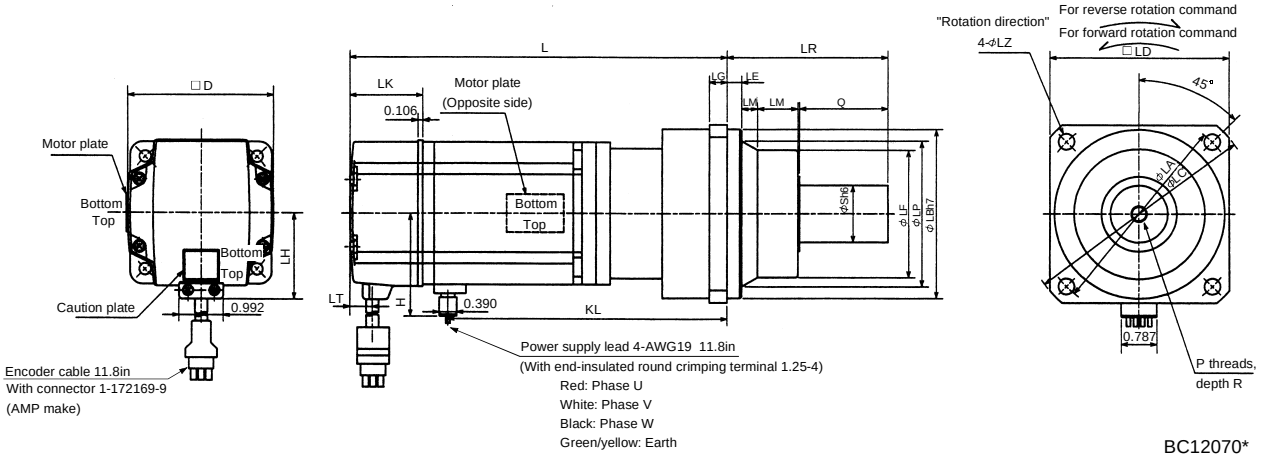


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio		Inertia Moment WK^2(oz ▪ in^2)	Backlash	Weight (lb)
			Normal Reduction ratio	Actual Reduction Ratio			
HC-MF43G1	400	K10020	1/20	253/5000	3.57	60min. max.	12.13
HC-MF73G1	750	K10005	1/5	1/5	5.58	60min. max.	13.67
HC-MF73G1	750	K10012	1/12	525/6048	9.22	60min. max.	16.09
HC-MF73G1	750	K12020	1/20	625/12544	9.57	60min. max.	22.27

Model	Output (W)	Variable Dimensions (in)																						(Reduction Ratio)
		D	LH	LK	LT	H	LA	LB	LC	LD	LE	LF	LG	LM	LN	LP	L	LR	KL	LZ	Q	S	P	R	
HC-MF43G1	400	2.362	1.50	1.61	0.42	1.69	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	7.933	3.54	5.87	0.35	1.97	1.26	M8	0.63	1/20
HC-MF73G1	750	3.15	1.89	1.54	0.43	2.29	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	8.15	3.54	5.97	0.35	1.97	1.26	M8	0.63	1/5
HC-MF73G1	750	3.15	1.89	1.54	0.43	2.29	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	9.016	3.54	6.84	0.35	1.97	1.26	M8	0.63	1/12
HC-MF73G1	750	3.15	1.89	1.54	0.43	2.29	5.51	4.53	6.38	4.72	0.47	3.54	0.59	0.512	0.787	4.09	9.528	4.17	7.35	0.55	2.36	1.57	M10	0.79	1/20

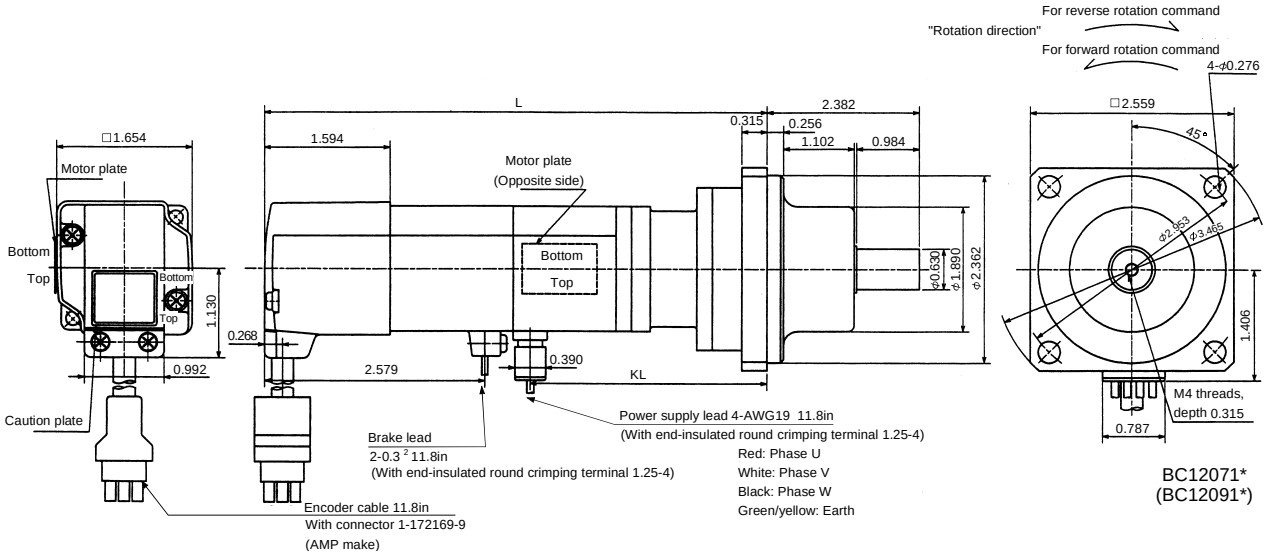
[Unit: in]



b) With electromagnetic brake

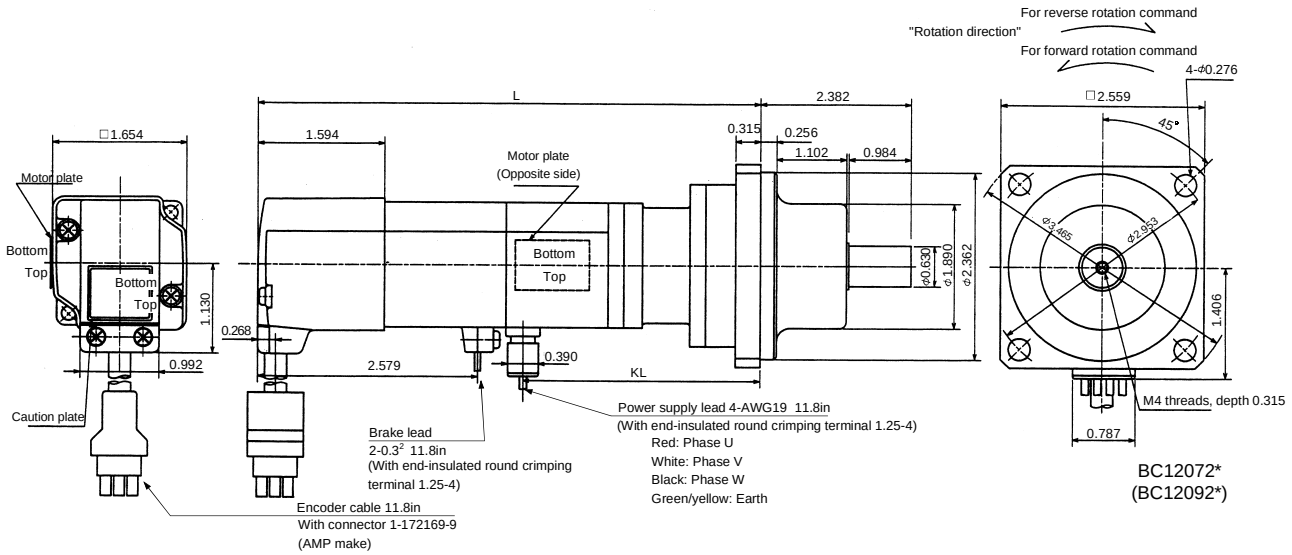
Model	Output (W)	Variable Dimensions (in) L	Variable Dimensions (in) KL	Braking Force (oz・in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz・in^2)	Backlash	Weight (lb)
HC-MF053BG1	50	6.06	2.91	45	K6505	1/5(9/44)	0.32	60min. max.	4.0
HC-MF053BG1	50	6.77	3.62	45	K6512	1/12(49/576)	0.44	60min. max.	4.9
HC-MF053BG1	50	6.77	3.62	45	K6520	1/20(25/484)	0.34	60min. max.	4.9

[Unit: in]



Model	Output (W)	Variable Dimensions (in) L	Variable Dimensions (in) KL	Braking Force (oz・in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz・in^2)	Backlash	Weight (lb)
HC-MF13BG1	100	6.65	3.43	45	K6505	1/5(9/44)	0.38	60min. max.	4.2
HC-MF13BG1	100	7.36	4.21	45	K6512	1/12(49/576)	0.50	60min. max.	5.1
HC-MF13BG1	100	7.36	4.21	45	K6520	1/20(25/484)	0.40	60min. max.	5.1

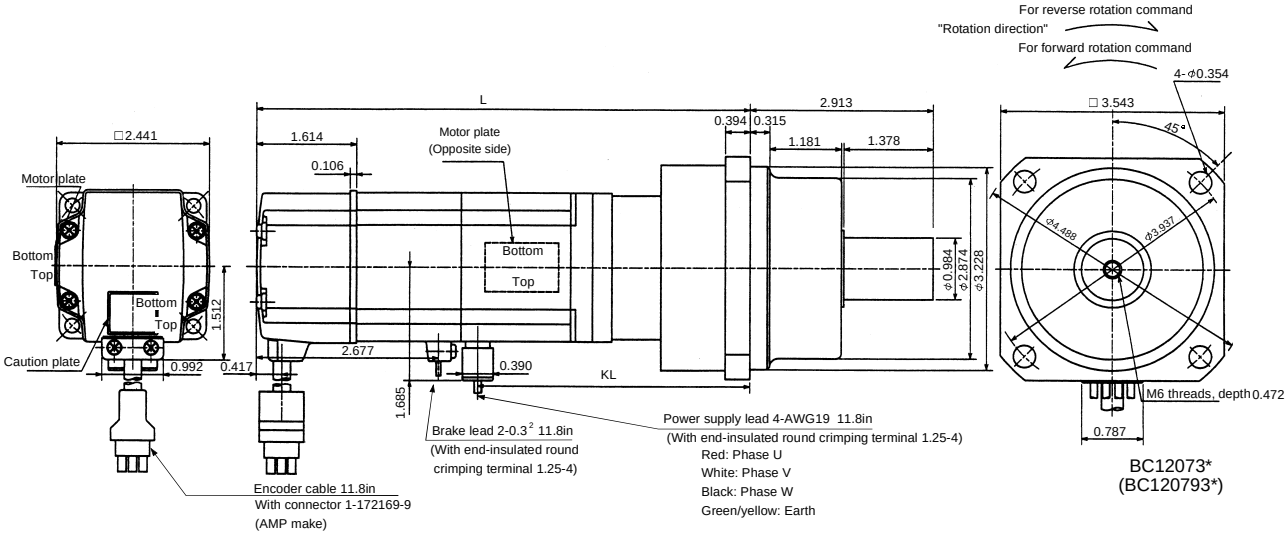
[Unit: in]



10. SPECIFICATIONS

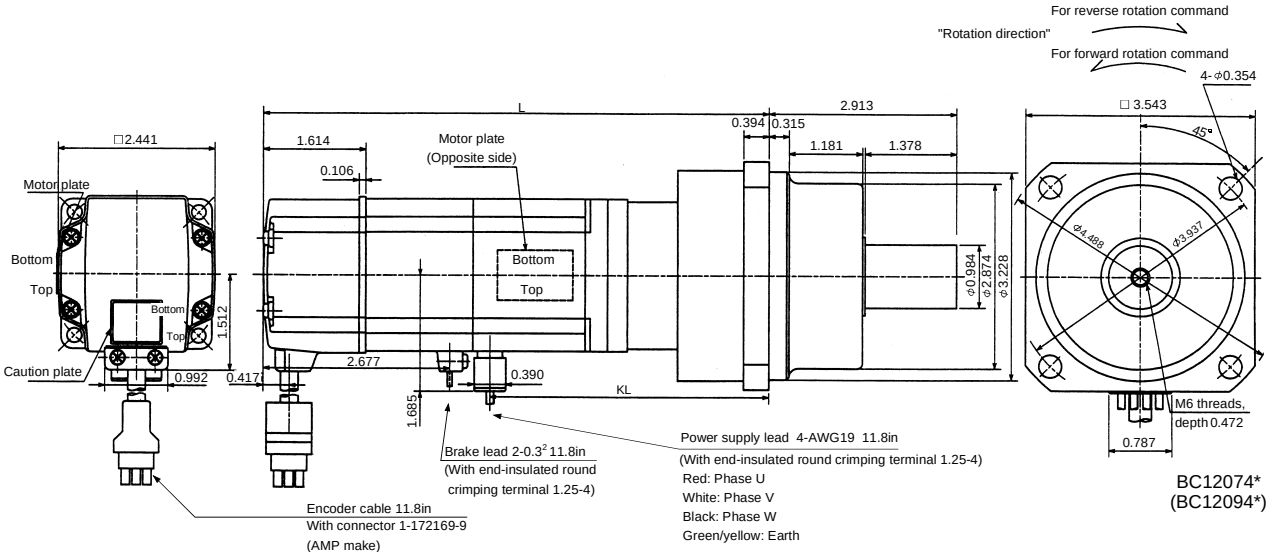
Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL				
HC-MF23BG1	200	6.65	4.04	K9005	1/5(19/96)	1.58	8.6
HC-MF23BG1	200	7.36	4.23	K9012	1/12(25/288)	1.82	9.9
HC-MF23BG1	200	7.36	4.23	K9020	1/20(253/5000)	1.67	9.9

[Unit: in]



Model	Output (W)	Variable Dimensions (in)		Braking Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio (Actual Reduction Ratio)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL					
HC-MF43BG1	400	8.27	4.95	184	K9005	1/5(19/96)	1.88	9.7
HC-MF43BG1	400	9.06	5.73	184	K9012	1/12(25/288)	2.12	11.0

[Unit: in]

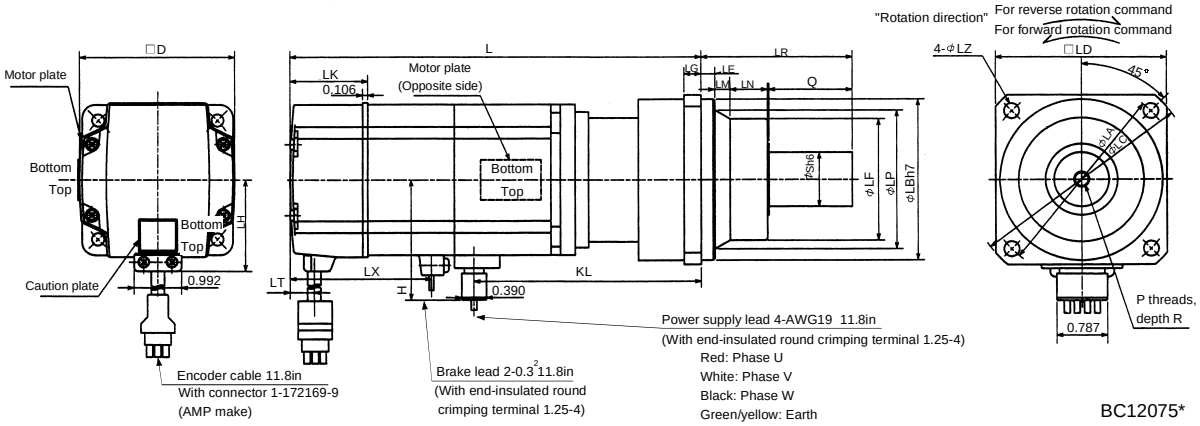


10. SPECIFICATIONS

Model	Output (W)	Brake Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio		Inertia Moment WK^2(oz ▪ in^2)	Backlash	Weight (lb)
				Normal Reduction ratio	Actual Reduction Ratio			
HC-MF43BG1	400	184	K10020	1/20	253/5000	3.83	60min. max.	13.4
HC-MF73BG1	750	340	K10005	1/5	1/5	6.26	60min. max.	15.9
HC-MF73BG1	750	340	K10012	1/12	525/6048	9.90	60min. max.	18.3
HC-MF73BG1	750	340	K12020	1/20	625/12544	10.25	60min. max.	25.8

Model	Output (W)	Variable Dimensions (in)																							(Reduction Ratio)
		D	LH	LK	LT	LX	H	LA	LB	LC	LD	LE	LF	LG	LM	LN	LP	L	LR	KL	LZ	Q	S	P	R	
HC-MF43BG1	400	2.44	1.51	1.64	0.14	2.68	1.69	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	9.19	3.54	5.87	0.35	1.97	1.26	M8	0.63	1/20
HC-MF73BG1	750	3.23	1.92	1.54	0.43	2.84	1.69	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	9.55	3.54	5.92	0.35	1.97	1.26	M8	0.63	1/5
HC-MF73BG1	750	3.23	1.92	1.54	0.43	2.84	1.69	4.53	3.74	5.20	3.94	0.39	2.87	0.39	0.512	0.63	3.39	10.41	3.54	6.84	0.35	1.97	1.26	M8	0.63	1/12
HC-MF73BG1	750	3.23	1.92	1.54	0.43	2.84	1.69	5.51	4.53	6.38	4.72	0.47	3.54	0.59	0.512	0.787	4.09	10.93	4.17	7.35	0.55	2.36	1.57	M10	0.79	1/20

[Unit: in]

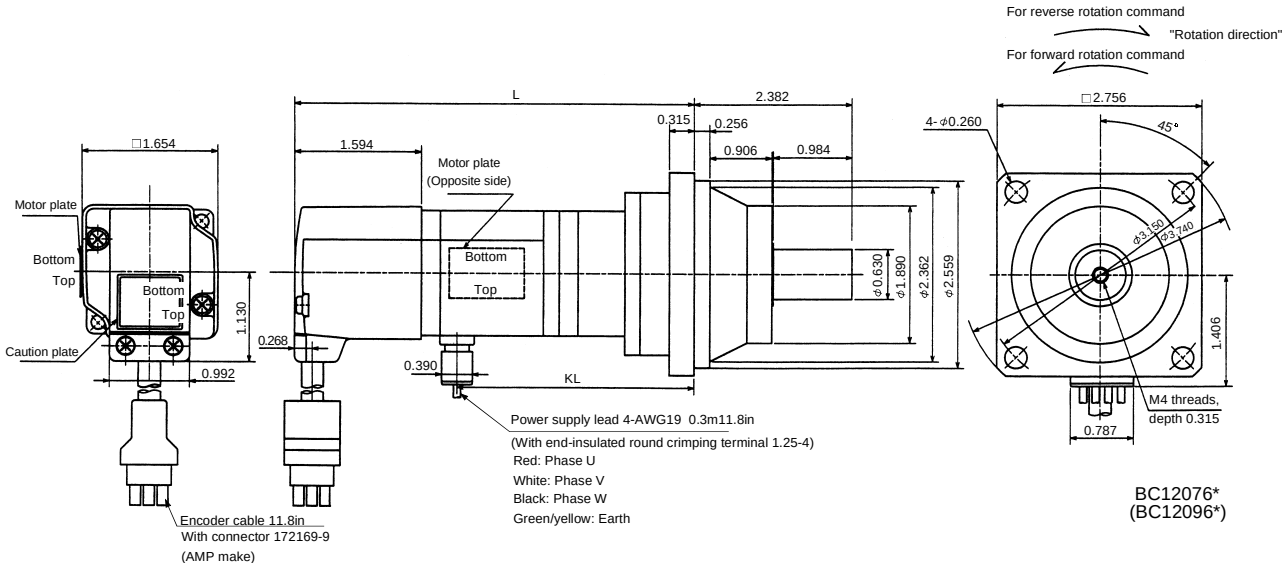


4) With reduction gear for precision application

a) Without electromagnetic brake

Model	Output (W)	Variable Dimensions (in)		Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz ▪ in^2)	Backlash	Weight (lb)
		L	KL					
HC-MF053G2	50	5.12	3.07	BK1-05B-A5MEKA	1/5	0.36	3 min. max.	3.1
HC-MF053G2	50	5.75	3.70	BK1-09B-A5MEKA	1/9	0.33	3 min. max.	3.7
HC-MF053G2	50	5.75	3.70	BK1-20B-A5MEKA	1/20	0.38	3 min. max.	4.0
HC-MF053G2	50	5.75	3.70	BK1-29B-A5MEKA	1/29	0.31	3 min. max.	4.0

[Unit: in]

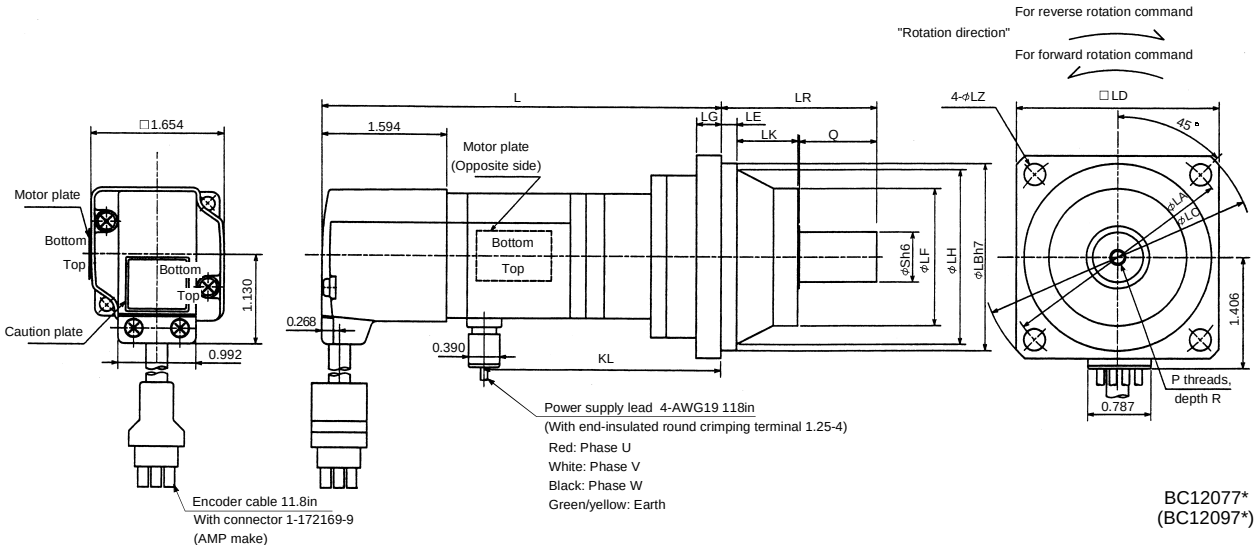


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz · in^2)	Backlash	Weight (lb)
HC-MF13G2	100	BK1-05B-01MEKA	1/5	0.43	3 min. max.	3.3
HC-MF13G2	100	BK1-09B-01MEKA	1/9	0.39	3 min. max.	4.0
HC-MF13G2	100	BK2-20B-01MEKA	1/20	0.66	3 min. max.	6.6
HC-MF13G2	100	BK2-29B-01MEKA	1/29	0.52	3 min. max.	6.6

Model	Output (W)	Variable Dimensions																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF13G2	100	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	5.71	2.17	3.66	0.26	0.98	0.63	M4	0.31	1/5
HC-MF13G2	100	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	6.34	2.17	4.29	0.26	0.98	0.63	M4	0.31	1/9
HC-MF13G2	100	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	6.57	2.95	4.53	0.26	1.38	0.79	M5	0.39	1/20
HC-MF13G2	100	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	6.57	2.95	4.53	0.26	1.38	0.79	M5	0.39	1/29

[Unit: in]

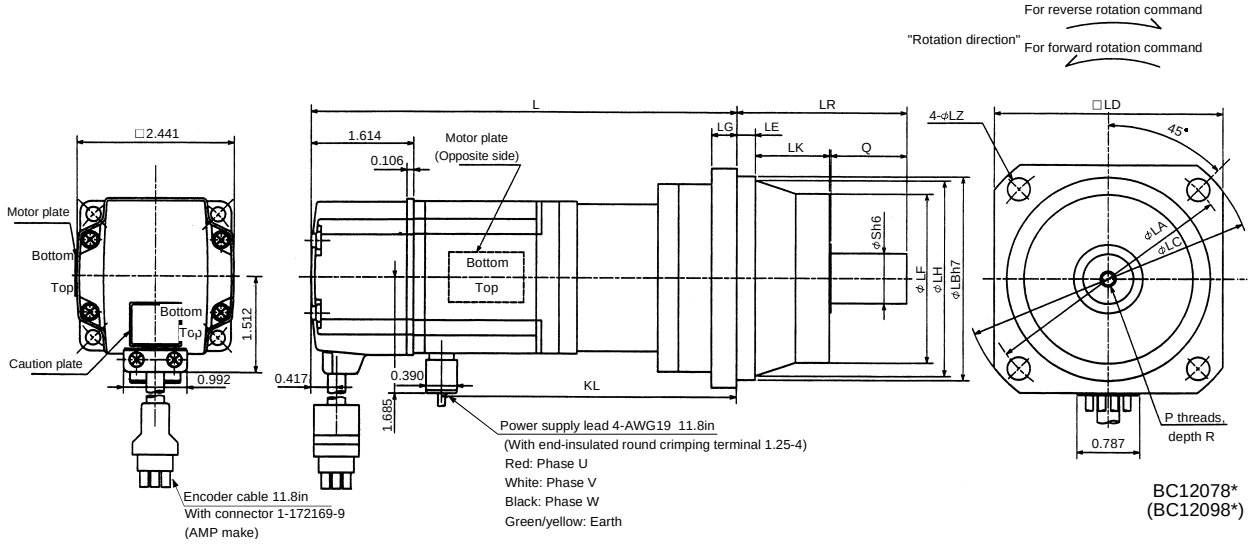


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz • in^2)	Weight (lb)
HC-MF23G2	200	BK1-05B-02MEKA	1/5	1.04	4.6
HC-MF23G2	200	BK2-09B-02MEKA	1/9	1.14	7.7
HC-MF23G2	200	BK3-20B-02MEKA	1/20	1.95	11.0
HC-MF23G2	200	BK3-29B-02MEKA	1/29	1.51	11.0

Model	Output (W)	Variable Dimensions (in)																	(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF23G2	200	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	6.18	2.17	4.20	0.26	0.98	0.63	M4	0.31	1/5
HC-MF23G2	200	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	6.89	2.95	4.91	0.26	1.38	0.79	M5	0.39	1/9
HC-MF23G2	200	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	7.09	3.35	5.10	0.35	1.57	0.98	M6	0.47	1/20
HC-MF23G2	200	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	7.09	3.35	5.10	0.35	1.57	0.98	M6	0.47	1/29

[Unit: in]

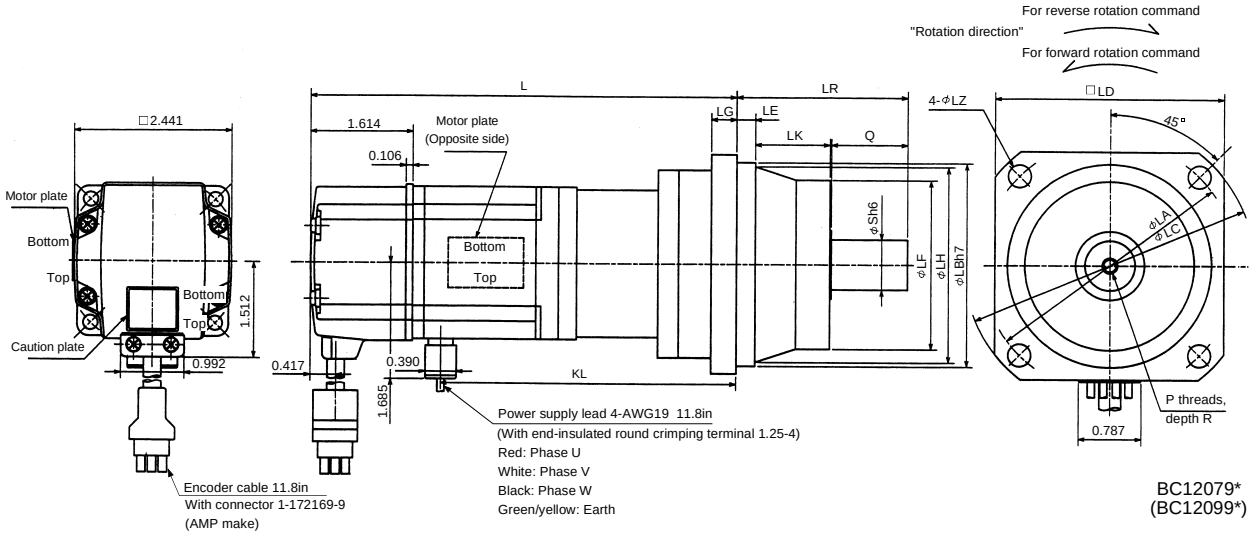


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz · in^2)	Weight (lb)
HC-MF43G2	400	BK2-05B-04MEKA	1/5	1.61	8.2
HC-MF43G2	400	BK3-09B-04MEKA	1/9	1.77	11.7
HC-MF43G2	400	BK4-20B-04MEKA	1/20	2.33	16.5
HC-MF43G2	400	BK4-29B-04MEKA	1/29	1.85	16.5

Model	Output (W)	Variable Dimensions (in)																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF43G2	400	3.94	3.15	4.53	3.35	0.24	2.56	0.39	2.91	1.3	7.24	2.95	5.18	0.26	1.38	0.79	M5	0.39	1/5
HC-MF43G2	400	4.53	3.74	5.32	3.94	0.31	2.95	0.39	3.35	1.38	8.07	3.35	6.01	0.35	1.58	0.98	M6	0.47	1/9
HC-MF43G2	400	5.32	3.94	6.10	4.53	0.31	3.54	0.47	3.94	1.58	8.31	3.94	6.24	0.43	1.97	1.26	M8	0.63	1/20
HC-MF43G2	400	5.32	4.33	6.10	4.53	0.31	3.54	0.47	3.94	1.58	8.31	3.94	6.24	0.43	1.97	1.26	M8	0.63	1/29

[Unit: in]

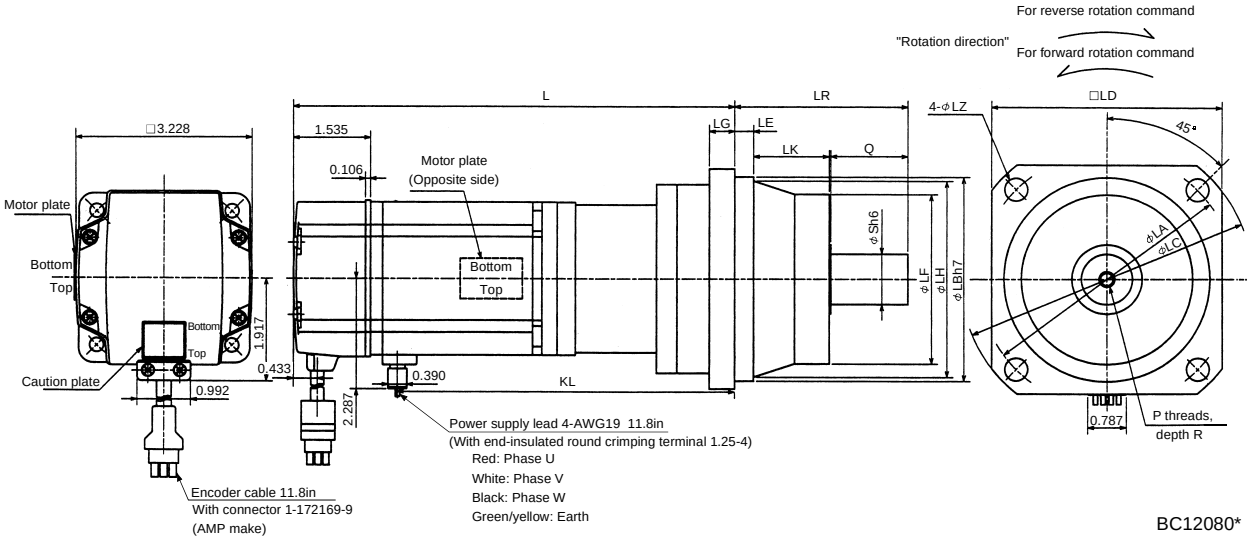


10. SPECIFICATIONS

Model	Output (W)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz · in^2)	Weight (lb)
HC-MF73G2	750	BK3-05B-08MEKA	1/5	5.32	13.89
HC-MF73G2	750	BK4-09B-08MEKA	1/9	5.36	18.96
HC-MF73G2	750	BK5-20B-08MEKA	1/20	5.55	26.46
HC-MF73G2	750	BK5-29B-08MEKA	1/29	4.97	26.46

Model	Output (W)	Variable Dimensions (in)																	(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF73G2	400	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	8.35	3.35	6.17	0.35	1.57	0.98	M6	0.47	1/5
HC-MF73G2	400	5.31	4.33	6.10	4.53	0.31	3.543	0.47	3.937	1.575	9.76	3.94	7.59	0.43	1.97	1.26	M8	0.63	1/9
HC-MF73G2	400	5.91	4.92	6.89	5.12	0.39	4.134	0.59	4.528	1.693	9.76	4.53	7.59	0.55	2.36	1.57	M10	0.79	1/20
HC-MF73G2	400	5.91	4.92	6.89	5.12	0.39	4.134	0.59	4.528	1.693	9.76	4.53	7.59	0.55	2.36	1.57	M10	0.79	1/29

[Unit: in]

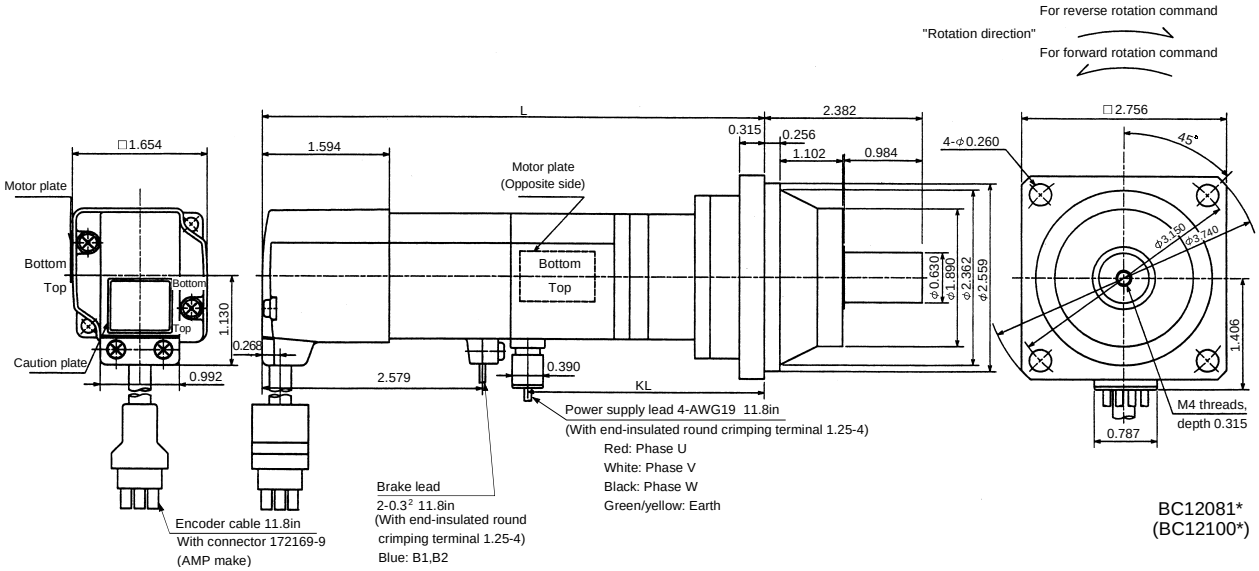


BC12080*

b) With electromagnetic brake

Model	Output (W)	Variable Dimensions (in)		Braking Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz ▪ in^2)	Backlash	Weight (lb)
		L	KL						
HC-MF053G2	50	6.22	3.07	45	BK1-05B-A5MEKA	1/5	0.38	3 min. max.	4.0
HC-MF053G2	50	6.85	3.70	45	BK1-09B-A5MEKA	1/9	0.34	3 min. max.	4.6
HC-MF053G2	50	6.85	3.70	45	BK1-20B-A5MEKA	1/20	0.39	3 min. max.	4.9
HC-MF053G2	50	6.85	3.70	45	BK1-29B-A5MEKA	1/29	0.33	3 min. max.	4.9

[Unit: in]

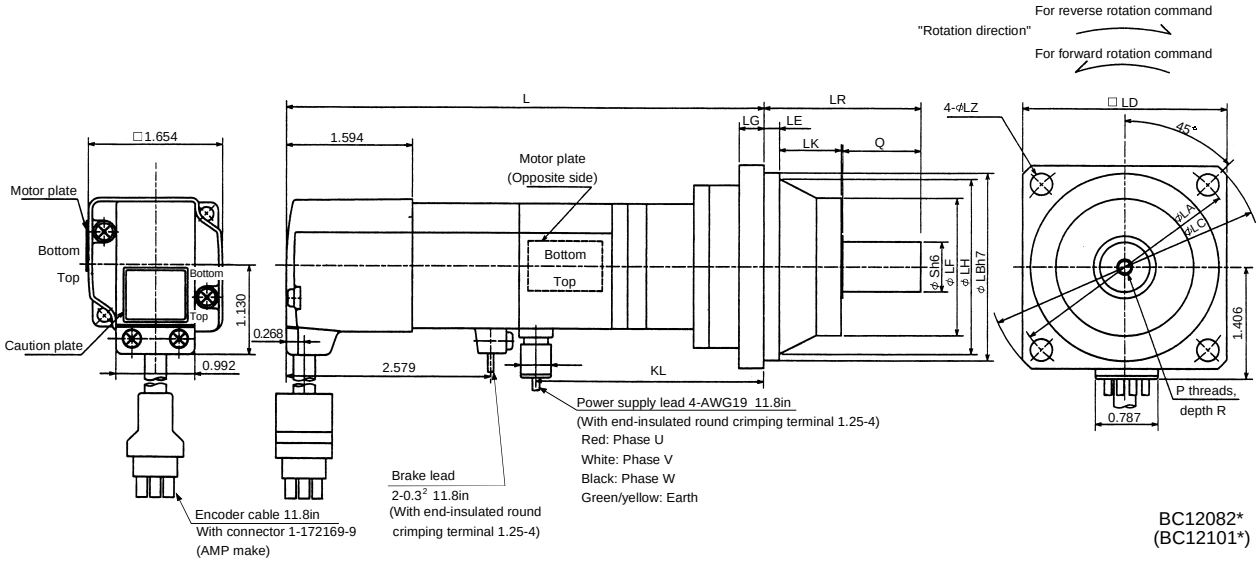


10. SPECIFICATIONS

Model	Output (W)	Braking Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz ▪ in^2)	Backlash	Weight (lb)
HC-MF13BG2	100	45	BK1-05B-01MEKA	1/5	0.44	3 min. max.	4.2
HC-MF13BG2	100	45	BK1-09B-01MEKA	1/9	0.40	3 min. max.	4.9
HC-MF13BG2	100	45	BK2-20B-01MEKA	1/20	0.68	3 min. max.	7.5
HC-MF13BG2	100	45	BK2-29B-01MEKA	1/29	0.53	3 min. max.	7.5

Model	Output (W)	Variable Dimensions (in)																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF13BG2	100	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	6.81	2.17	3.66	0.26	0.98	0.63	M4	0.31	1/5
HC-MF13BG2	100	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	7.44	2.17	4.29	0.26	0.98	0.63	M4	0.31	1/9
HC-MF13BG2	100	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	7.68	2.95	4.53	0.26	1.38	0.79	M5	0.39	1/20
HC-MF13BG2	100	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	7.68	2.95	4.53	0.26	1.38	0.79	M5	0.39	1/29

[Unit: in]

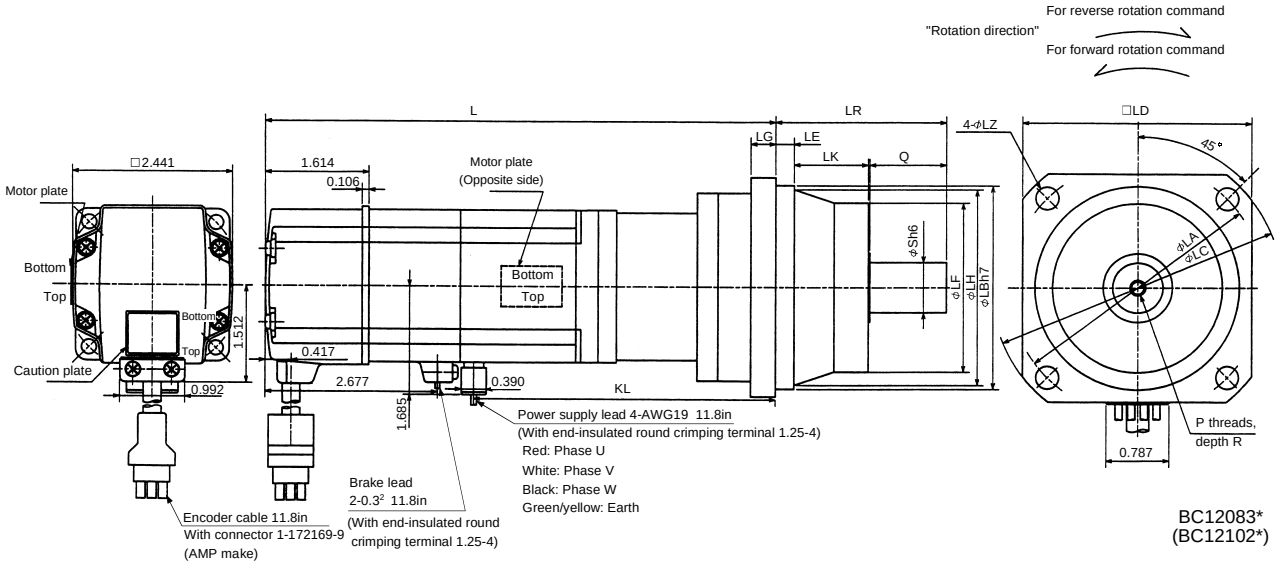


10. SPECIFICATIONS

Model	Output (W)	Braking Force (oz • in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz • in^2)	Weight (lb)
HC-MF23BG2	200	184	BK1-05B-02MEKA	1/5	1.31	6.0
HC-MF23BG2	200	184	BK2-09B-02MEKA	1/9	1.40	9.0
HC-MF23BG2	200	184	BK3-20B-02MEKA	1/20	2.21	12.3
HC-MF23BG2	200	184	BK3-29B-02MEKA	1/29	1.77	12.3

Model	Output (W)	Variable Dimensions (in)																(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF23BG2	200	3.15	2.56	3.74	2.76	0.24	1.89	0.31	2.362	0.906	7.44	2.17	4.20	0.26	0.98	0.63	M4	0.31	1/5
HC-MF23BG2	200	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	8.15	2.95	4.91	0.26	1.38	0.79	M5	0.39	1/9
HC-MF23BG2	200	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	8.35	3.35	5.10	0.35	1.57	0.98	M6	0.47	1/20
HC-MF23BG2	200	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	8.35	3.35	5.10	0.35	1.57	0.98	M6	0.47	1/29

[Unit: in]

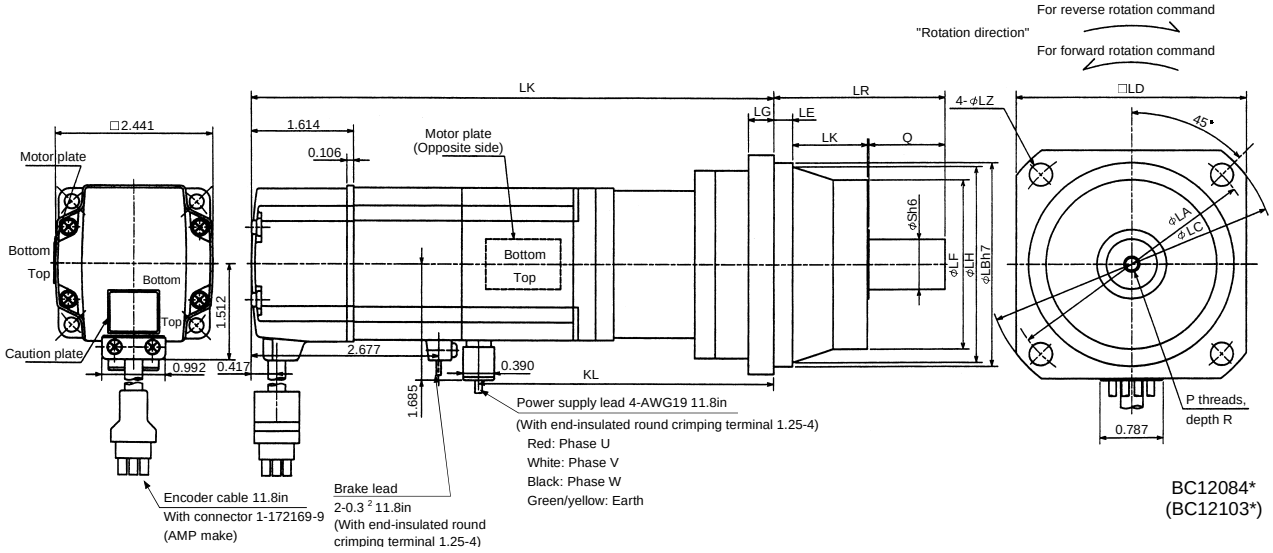


10. SPECIFICATIONS

Model	Output (W)	Braking Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-MF43BG2	400	184	BK2-05B-04MEKA	1/5	1.88	9.5
HC-MF43BG2	400	184	BK3-09B-04MEKA	1/9	2.03	13.0
HC-MF43BG2	400	184	BK4-20B-04MEKA	1/20	2.59	17.9
HC-MF43BG2	400	184	BK4-29B-04MEKA	1/29	2.11	17.9

Model	Output (W)	Variable Dimensions (in)																	(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF43BG2	400	3.94	3.15	4.53	3.35	0.24	2.559	0.39	2.913	1.299	8.50	2.95	5.18	0.26	1.38	0.79	M5	0.39	1/5
HC-MF43BG2	400	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	9.33	3.35	6.01	0.35	1.57	0.98	M6	0.47	1/9
HC-MF43BG2	400	5.31	4.33	6.10	4.53	0.31	3.543	0.47	3.937	1.575	9.57	3.94	6.24	0.43	1.97	1.26	M8	0.63	1/20
HC-MF43BG2	400	5.31	4.33	6.10	4.53	0.31	3.543	0.47	3.937	1.575	9.57	3.94	6.24	0.43	1.97	1.26	M8	0.63	1/29

[Unit: in]

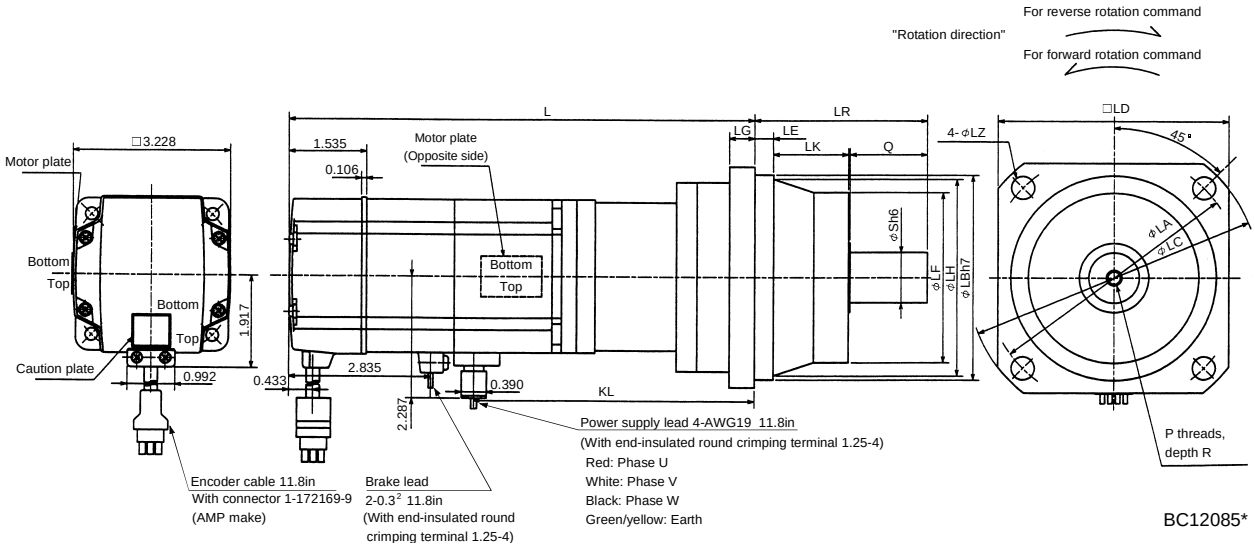


10. SPECIFICATIONS

Model	Output (W)	Braking Force (oz ▪ in)	Reduction Gear Model	Reduction Ratio	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-MF73BG2	750	340	BK3-05B-08MEKA	1/5	6.00	16.1
HC-MF73BG2	750	340	BK4-09B-08MEKA	1/9	6.04	21.2
HC-MF73BG2	750	340	BK5-20B-08MEKA	1/20	6.24	28.7
HC-MF73BG2	750	340	BK5-29B-08MEKA	1/29	5.66	28.7

Model	Output (W)	Variable Dimensions (in)																	(Reduction Ratio)
		LA	LB	LC	LD	LE	LF	LG	LH	LK	L	LR	KL	LZ	Q	S	P	R	
HC-MF73BG2	750	4.53	3.74	5.31	3.94	0.31	2.953	0.39	3.346	1.378	9.74	3.35	6.17	0.35	1.57	0.98	M6	0.47	1/5
HC- MF73BG2	750	5.31	4.33	6.10	4.53	0.31	3.543	0.47	3.937	1.575	11.16	3.94	7.59	0.43	1.97	1.26	M8	0.63	1/9
HC- MF73BG2	750	5.91	4.92	6.89	5.12	0.39	4.134	0.59	4.528	1.693	11.16	4.53	7.59	0.55	2.36	1.57	M10	0.79	1/20
HC- MF73BG2	750	5.91	4.92	6.89	5.12	0.39	4.134	0.59	4.528	1.693	11.16	4.53	7.59	0.55	2.36	1.57	M10	0.79	1/29

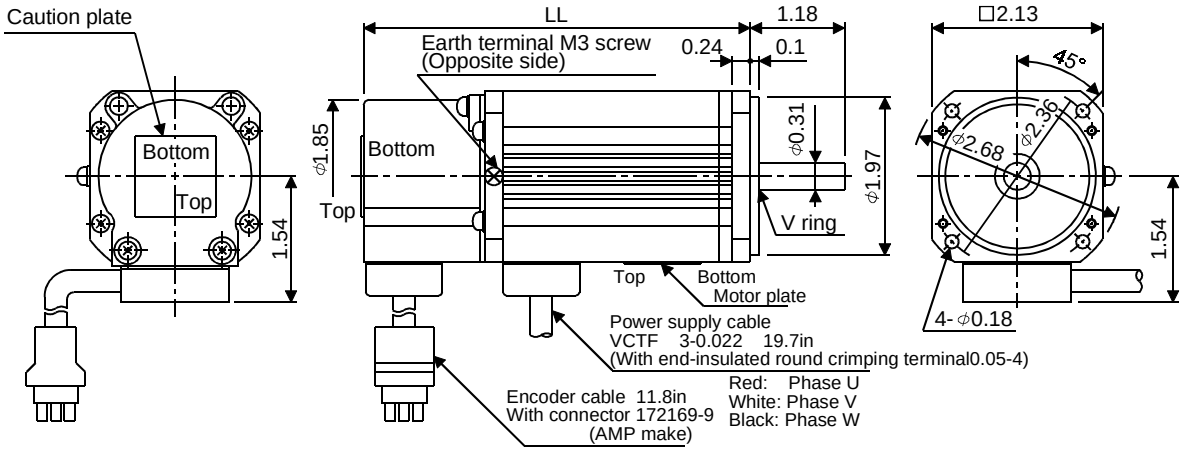
[Unit: in]



(2) HA-FF series

1) Standard

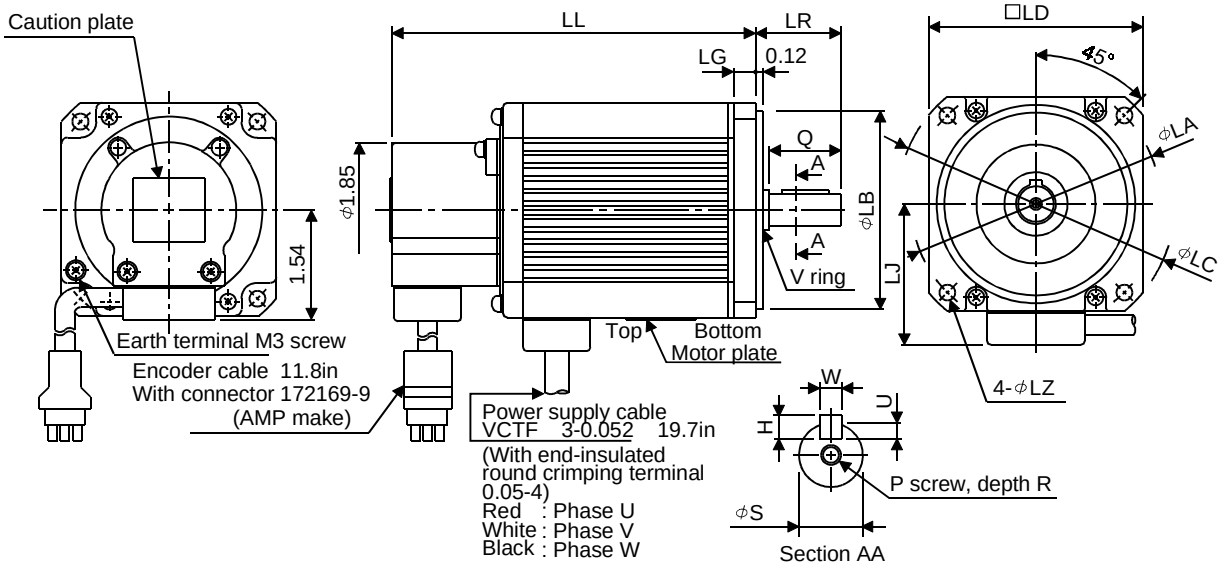
1) HA-FF053 • HA-FF13 [Unit:in]



Servo Motor Model	Inertia Moment WK^2[oz • n^2]	Variable Dimensions LL	Weight [kg]
HA-FF053	0.342	4.17	2.9
HA-FF13	0.519	4.84	3.3

HA-FF23 to HA-FF63

[Unit:in]

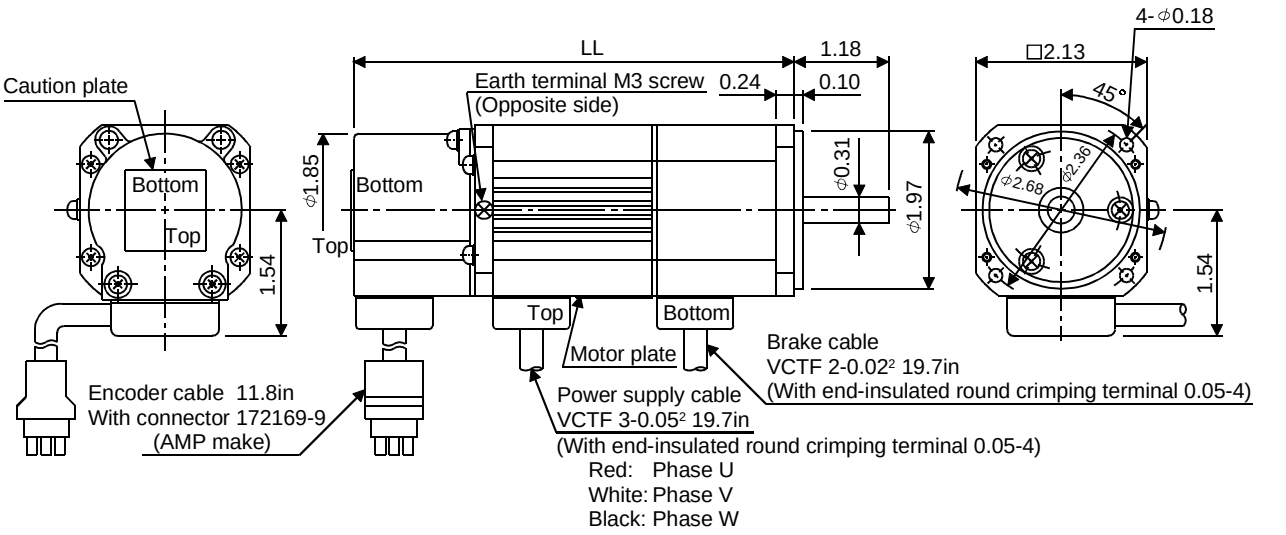


Servo Motor Model	Inertia Moment WK^2[oz • in^2]	Variable Dimensions																Weight [kg]
		LA	LB	LC	LD	LG	LJ	LL	LR	LZ	H	Q	S	U	W	P	R	
HA-FF23	1.91	3.54	2.76	3.94	2.99	0.31	1.97	5.16	1.18	0.22	0.16	0.98	0.43	0.10	0.16	M4	0.59	5.1
HA-FF33	2.73	3.54	2.76	3.94	2.99	0.31	1.97	5.83	1.18	0.22	0.16	0.98	0.43	0.10	0.16	M4	0.59	5.7
HA-FF43	5.33	4.53	3.74	5.31	3.94	0.39	2.44	6.08	1.57	0.35	0.20	1.38	0.63	0.12	0.20	M5	0.79	9.3
HA-FF63	6.56	4.53	3.74	5.31	3.94	0.39	2.44	6.67	1.57	0.35	0.20	1.38	0.63	0.12	0.20	M5	0.79	10.6

2) With electromagnetic brake

HA-FF053B • HA-FF13B

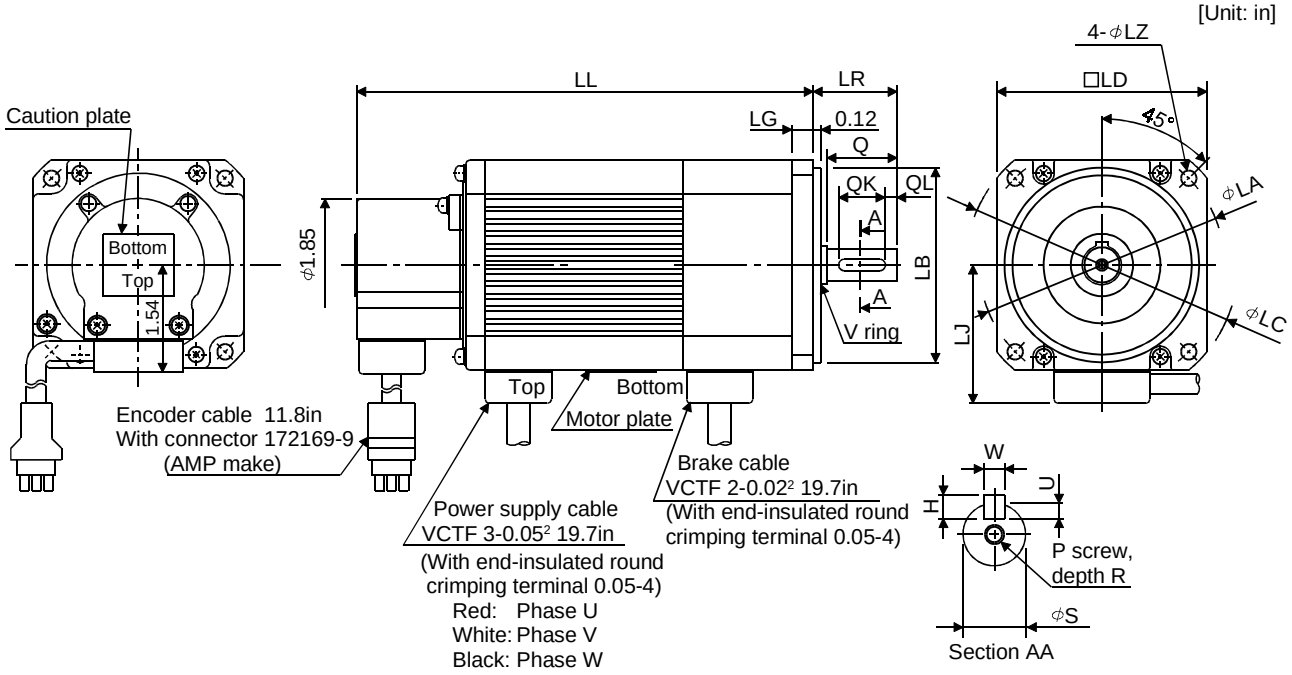
[Unit: in]



Servo Motor Model	Inertia Moment WK^2[oz • in^2]	Variable Dimensions LL	Weight [kg]
HA-FF053	0.437	5.53	3.5
HA-FF13B	0.615	6.20	4.0

HA-FF23B to HA-FF63B

[Unit: in]

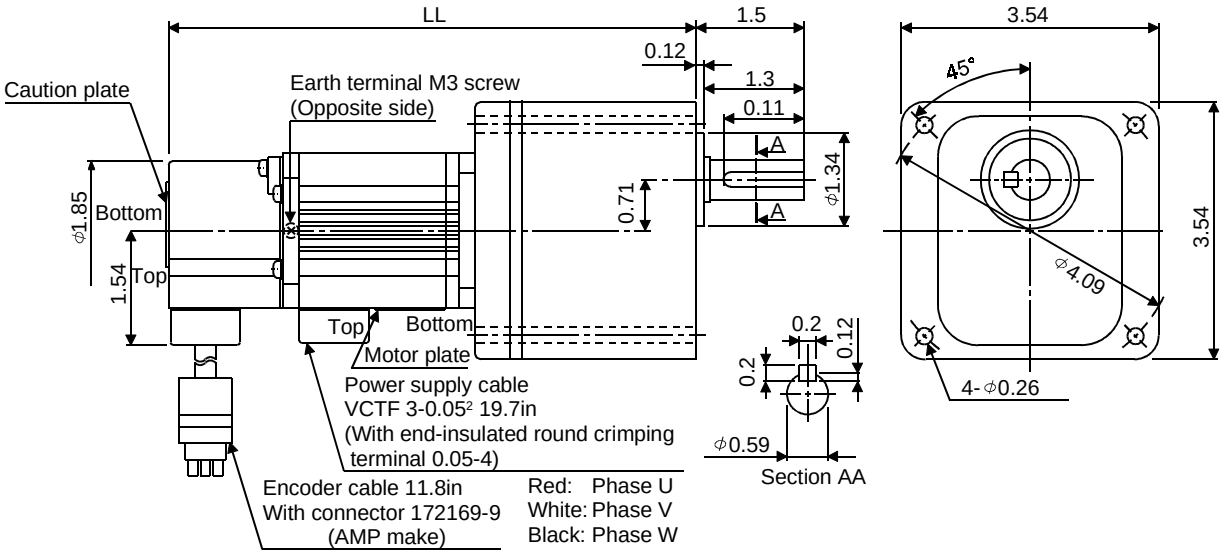


Servo Motor Model	Inertia Moment WK^2[oz • in^2]	Variable Dimensions																Weight [kg]
		LA	LB	LC	LD	LG	LJ	LL	LR	LZ	H	Q	S	U	W	P	R	
HA-FF23B	2.64	3.54	2.76	3.94	2.99	0.31	1.97	6.59	1.18	0.22	0.16	0.98	0.43	0.10	0.16	M4	0.59	6.4
HA-FF33B	3.46	3.54	2.76	3.94	2.99	0.31	1.97	7.28	1.18	0.22	0.16	0.98	0.43	0.10	0.16	M4	0.59	7.1
HA-FF43B	7.24	4.53	3.74	5.31	3.94	0.39	2.44	7.54	1.57	0.35	0.20	1.38	0.63	0.12	0.20	M5	0.79	11.0
HA-FF63B	8.47	4.53	3.74	5.31	3.94	0.39	2.44	8.13	1.57	0.35	0.20	1.38	0.63	0.12	0.20	M5	0.79	12.3

3) With reduction gear for general industrial machine

HA-FF053(B)G1 • HA-FF13(B)G1

[Unit: in]

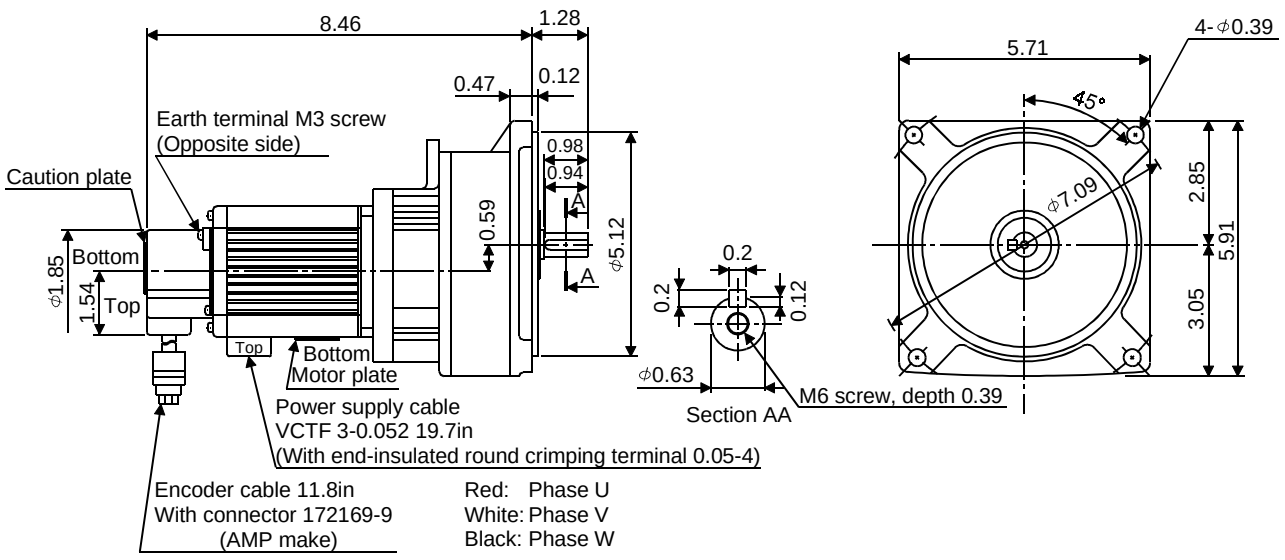


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	Inertia Moment WK^2[oz • in^2]	(Note 1) Variable Dimensions LL	(Note 1) Weight [lb]
HA-FF053 (B)G1	1/5	GR-S-10	0.369 (0.465)	7.20 (8.56)	5.5 (6.2)
	1/10		0.369 (0.465)	7.20 (8.56)	5.5 (6.2)
	1/30		0.342 (0.437)	7.20 (8.56)	5.5 (6.2)
HA-FF13 (B)G1	1/5	GR-S-10	0.547 (0.629)	7.87 (9.23)	6.0 (6.6)
	1/10		0.547 (0.629)	7.87 (9.23)	6.0 (6.6)
	1/30		0.519 (0.601)	7.87 (9.23)	6.0 (6.6)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF23(B)G1

[Unit: in]

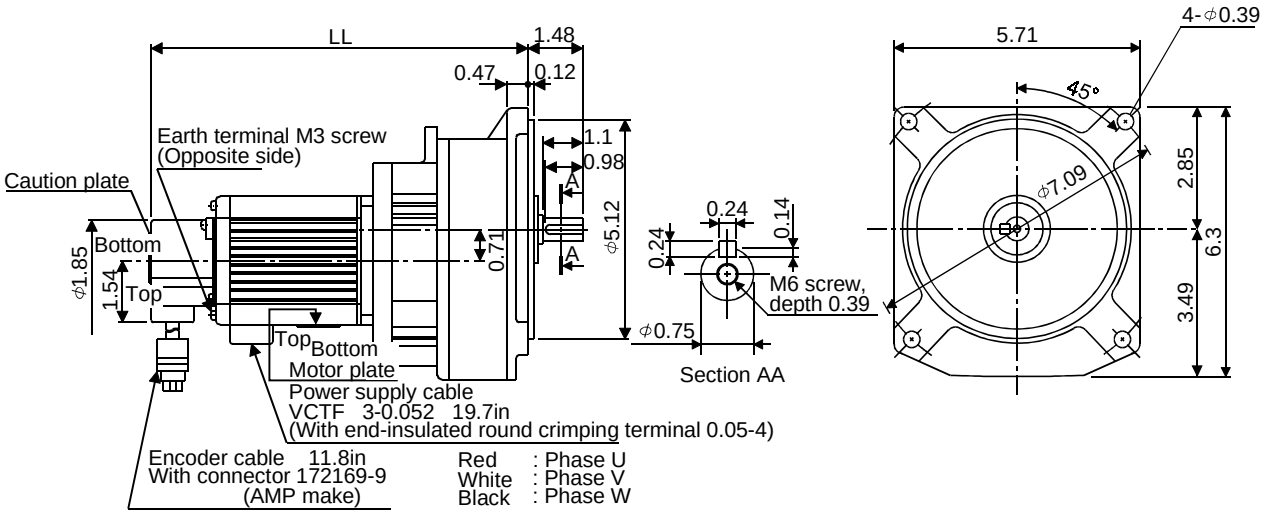


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	Inertia Moment WK^2[oz • in^2]	(Note 1) Weight [lb]
HA-FF23 (B)G1	1/5	GR-S-20	2.037 (4.114)	11 (12.3)
	1/10		2.037 (4.114)	11 (12.3)
	1/30		2.037 (4.114)	11 (12.3)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF33(B)G1 · EHA-FF43(B)G1

[Unit:in]

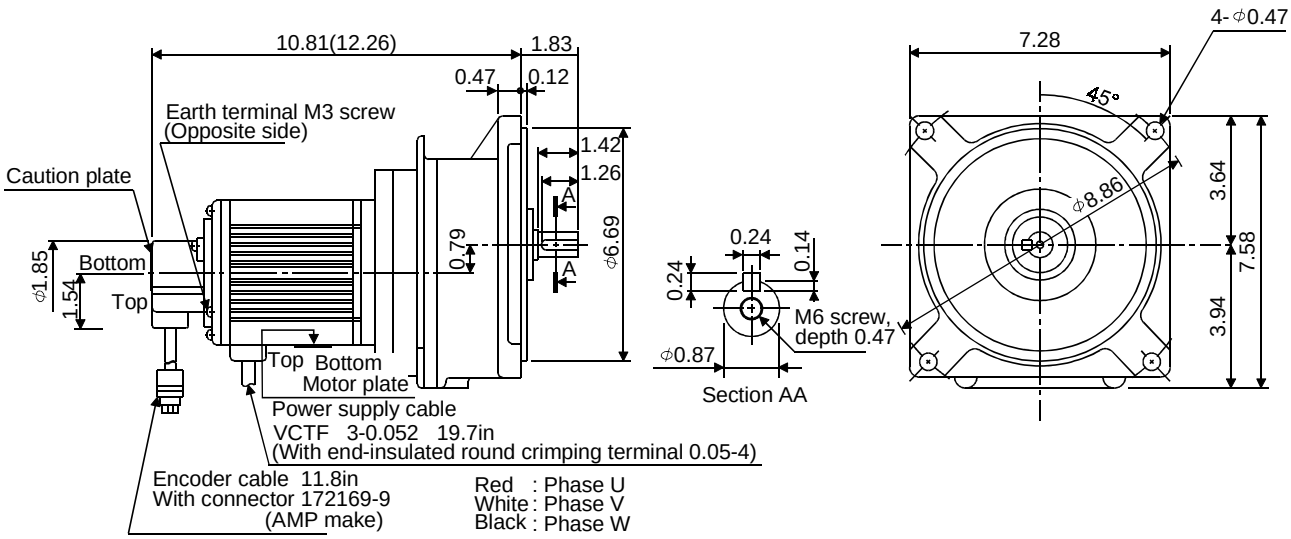


Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	Inertia Moment WK^2[oz · in^2]	(Note 1) Variable Dimensions LL	(Note 1) Weight [lb]
HA-FF33 (B)G1	1/5	GR-S-30	2.980 (3.704)	9.84 (11.3)	14.3 (15.9)
	1/10		2.980 (3.704)	9.84 (11.3)	14.3 (15.9)
	1/30		2.989 (3.663)	9.84 (11.3)	14.3 (15.9)
HA-FF43 (B)G1	1/5	GR-S-40	5.577 (7.490)	10.2 (11.63)	17.6 (19.6)
	1/10		5.577 (7.490)	10.2 (11.63)	17.6 (19.6)
	1/30		5.536 (7.449)	10.2 (11.63)	17.6 (19.6)

Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

HA-FF63(B)G1

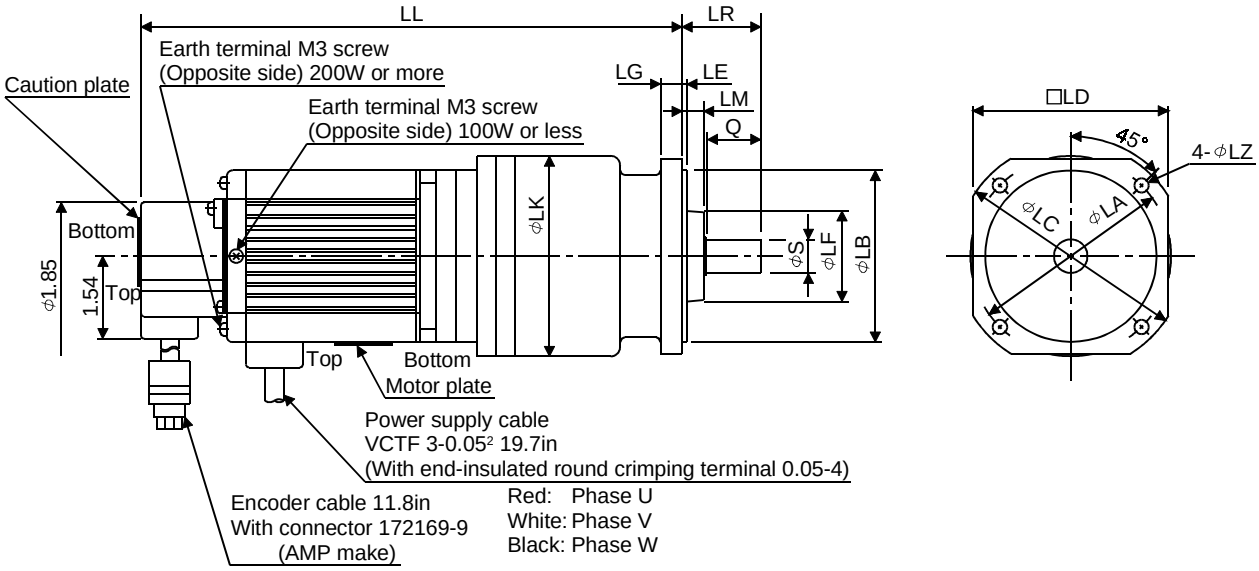
[Unit:in]



Servo Motor Model	(Note 2) Reduction Ratio	Reduction Gear Model	Inertia Moment WK^2[oz · in^2]	(Note 1) Weight [lb]
HA-FF63 (B)G1	1/5	GR-S-60	7.326 (9.240)	28.7 (30.6)
	1/10		7.326 (9.240)	28.7 (30.6)
	1/30		7.217 (9.131)	28.7 (30.6)

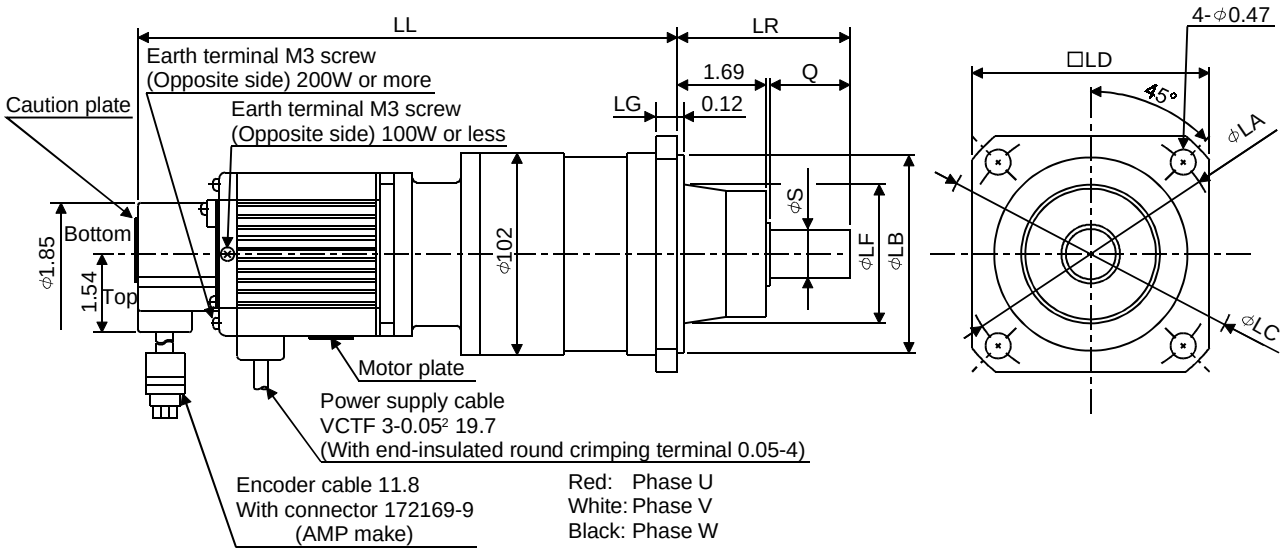
Note: 1. Values in parentheses are those for the servo motors with electromagnetic brakes.
2. Nominal reduction ratios. For actual reduction ratios, refer to Section 10-3.

4) With reduction gear for precision application



Servo Motor Model	Reduction Ratio	Reduction Gear Model	(Note) Inertia Moment WK^2[oz · in^2]	(Note) Variable Dimensions [in]														(Note) Weight [lb]
				LA	LB	LC	LD	LE	LF	LG	LK	LL	LM	LR	LZ	Q	S	
HA-FF053 (B)G2	1/5	BM2-05B-A5MES	0.60 (0.70)	3.07	2.44	3.50	2.91	0.08	1.30	0.24	2.95	8.07 (9.45)	0.35	1.18	0.18	0.79	10.0	5.1 (5.7)
	1/10	BM2-10B-A5MES	0.59 (0.68)	3.07	2.44	3.50	2.91	0.08	1.30	0.24	2.95	8.07 (9.43)	0.35	1.18	0.18	0.79	10.0	5.1 (5.7)
	1/15	BM2-15B-A5MES	0.57 (0.67)	3.07	2.44	3.50	2.91	0.08	1.30	0.24	2.95	8.07 (9.43)	0.35	1.18	0.18	0.79	10.0	5.1 (5.7)
	1/25	BM3-25B-A5MES	0.60 (0.66)	3.54	2.99	4.02	3.43	0.08	1.61	0.31	3.54	8.39 (9.74)	0.35	1.38	0.22	0.98	14.0	6.2 (7.1)
HA-FF13 (B)G2	1/5	BM2-05B-01MES	0.78 (0.87)	3.07	2.44	3.50	2.91	0.08	1.30	0.24	2.95	8.74 (10.10)	0.35	1.18	0.18	0.79	10.0	5.5 (6.2)
	1/10	BM3-10B-01MES	0.90 (0.87)	3.54	2.99	4.02	3.43	0.08	1.61	0.31	3.54	9.06 (10.41)	0.35	1.38	0.22	0.98	14.0	6.6 (7.5)
	1/15	BM3-15B-01MES	0.85 (0.83)	3.54	2.99	4.02	3.43	0.08	1.61	0.31	3.54	9.06 (10.41)	0.35	1.38	0.22	0.98	14.0	6.6 (7.5)
	1/25	BM4-25B-01MES	1.59 (1.68)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	10.31 (11.67)	0.55	2.17	0.26	1.57	22.0	11.0 (11.7)
HA-FF23 (B)G2	1/5	BM3-05B-02MES	2.32 (3.05)	3.54	2.99	4.02	3.43	0.08	1.61	0.31	3.54	9.45 (10.91)	0.35	1.38	0.22	0.98	14.0	8.4 (9.7)
	1/10	BM4-10B-02MES	3.53 (4.25)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	10.63 (12.07)	0.55	2.17	0.26	1.57	22.0	12.8 (14.1)
	1/15	BM4-15B-02MES	3.38 (4.10)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	10.63 (12.07)	0.55	2.17	0.26	1.57	22.0	12.8 (14.1)
HA-FF33 (B)G2	1/5	BM4-05B-03MES	4.47 (5.19)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	11.30 (12.78)	0.55	2.17	0.26	1.57	22.0	13.4 (14.8)
	1/10	BM4-10B-03MES	4.35 (5.07)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	11.30 (12.78)	0.55	2.17	0.26	1.57	22.0	13.4 (14.8)
HA-FF43 (B)G2	1/5	BM4-05B-04MES	7.07 (8.98)	4.80	3.94	5.51	4.65	0.12	2.40	0.39	4.65	11.97 (13.41)	0.55	2.17	0.26	1.57	22.0	17.0 (18.7)

Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

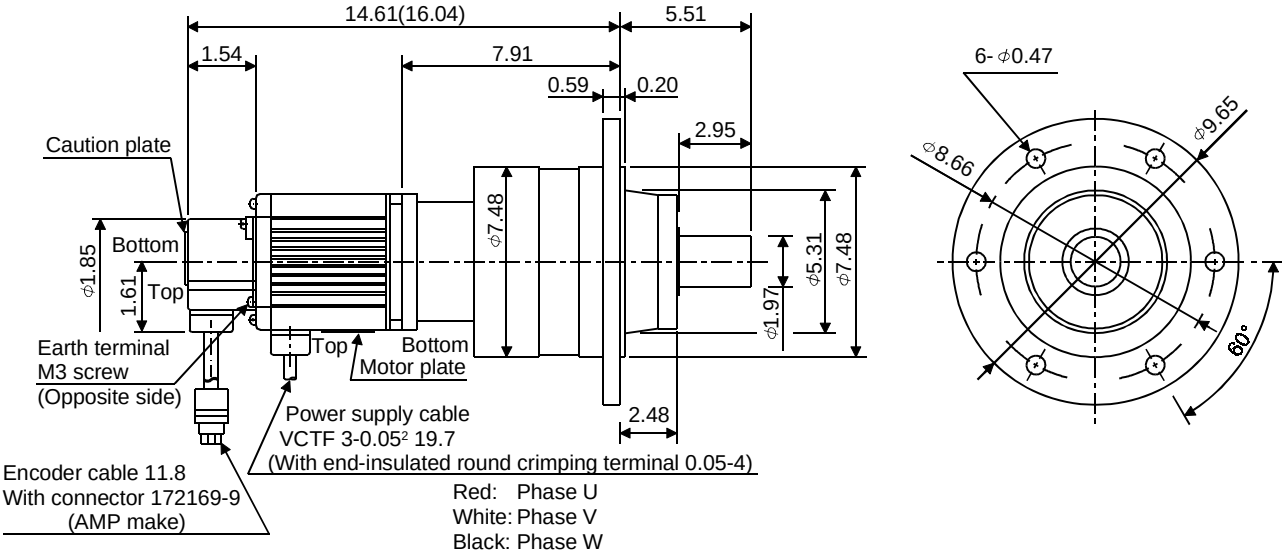


Servo Motor Model	Reduction Ratio	Reduction Gear Model	(Note) Inertia Moment WK^2[oz • in^2]	Variable Dimensions [in]											Weight [lb]
				LA	LB	LC	LD	LF	LG	LK	LL	LR	Q	S	
HA-FF13 (B)G2	1/45	BL1-45B-01MES	1.60 (1.63)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	10.79 (12.15)	3.35	1.57	0.98	13.2 (13.9)
HA-FF23 (B)G2	1/20	BL1-20B-02MES	3.99 (4.84)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	10.94 (12.26)	3.35	1.57	0.98	15.0 (16.3)
	1/29	BL1-29B-02MES	3.46 (4.18)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	10.94 (12.38)	3.35	1.57	0.98	15.0 (16.3)
	1/45	BL2-45B-02MES	4.17 (4.89)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	11.77 (13.23)	3.94	2.17	1.38	27.1 (28.4)
HA-FF33 (B)G2	1/20	BL1-20B-03MES	4.81 (5.54)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	11.61 (12.97)	3.35	1.57	0.98	15.7 (17.0)
	1/29	BL2-29B-03MES	8.39 (9.12)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	12.44 (13.92)	3.94	2.17	1.38	27.8 (29.1)
	1/45	BL2-45B-03MES	4.99 (5.71)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	12.44 (14.31)	3.94	2.17	1.38	27.8 (29.1)
HA-FF43 (B)G2	1/9	BL1-09B-04MES	6.52 (8.43)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	11.63 (13.09)	3.35	1.57	0.98	18.1 (19.8)
	1/20	BL2-20B-04MES	13.00 (14.91)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	12.74 (14.19)	3.94	2.17	1.38	31.3 (33.1)
	1/29	BL2-29B-04MES	10.99 (12.90)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	12.74 (14.19)	3.94	2.17	1.38	31.3 (33.1)
	1/45	BL2-45B-04MES	7.59 (9.50)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	13.13 (14.59)	3.94	2.17	1.38	31.3 (33.1)
HA-FF63 (B)G2	1/5	BL1-05B-06MES	7.01 (10.16)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	11.83 (13.29)	3.35	1.57	0.98	19.4 (21.2)
	1/9	BL1-09B-06MES	7.75 (9.66)	5.12	3.94	6.10	4.72	2.76	0.39	4.02	12.22 (13.68)	3.35	1.57	0.98	19.4 (21.2)
	1/20	BL2-20B-06MES	14.23 (16.14)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	13.33 (14.78)	3.94	2.17	1.38	32.6 (34.4)
	1/29	BL2-29B-06MES	12.22 (14.13)	6.30	5.12	7.28	5.51	3.70	0.47	5.20	13.33 (14.78)	3.94	2.17	1.38	32.6 (34.4)

Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

HA-FF63(B)G2 1/45

[Unit: in]



Reduction Gear Model	Reduction Ratio	(Note) Inertia Moment WK^2[oz • in^2]	(Note) Weight [lb]
BL3-45B-06MES	1/45	17.11 (19.00)	65.7 (74.3)

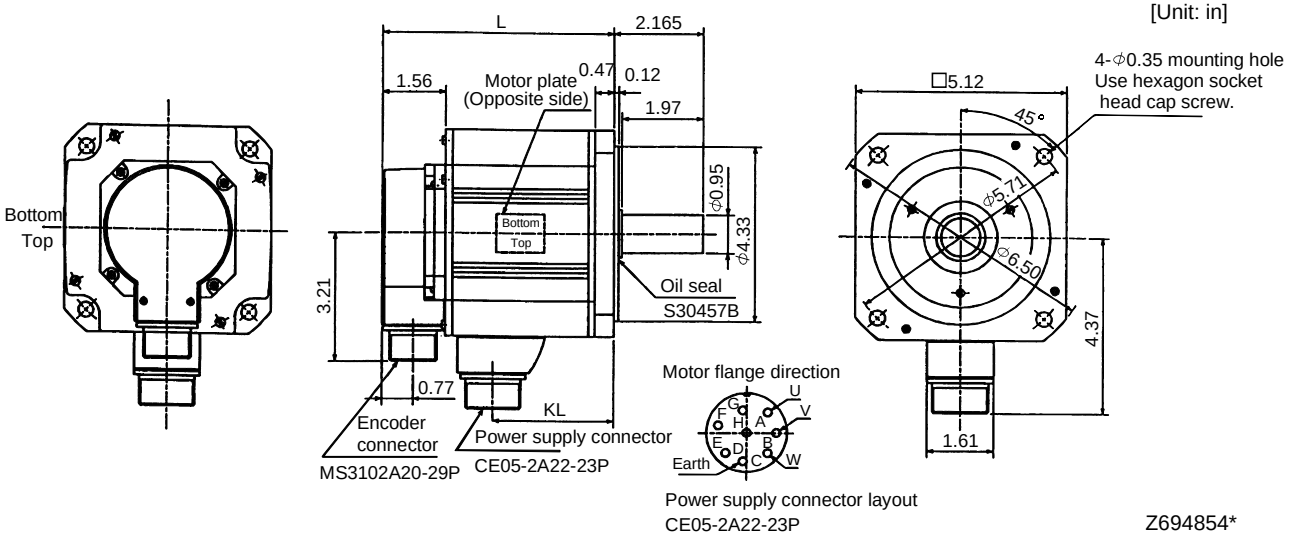
Note: Values in parentheses are those for the servo motors with electromagnetic brakes.

(3) HC-SF Series

1) Standard (without electromagnetic brake, without reduction gear)

Model	Output (kW)	Variable Dimensions (in) L	Variable Dimensions (in) KL	Inertia Moment WK^2(oz · in^2)	Weight (lb)
HC-SF52 HC-SF53	0.5	4.72	2.03	36.22	11.0
HC-SF102 HC-SF103	1.0	5.71	3.02	74.90	15.4
HC-SF81	0.85	6.69	4.00	109.08	19.8
HC-SF152 HC-SF153	1.5				

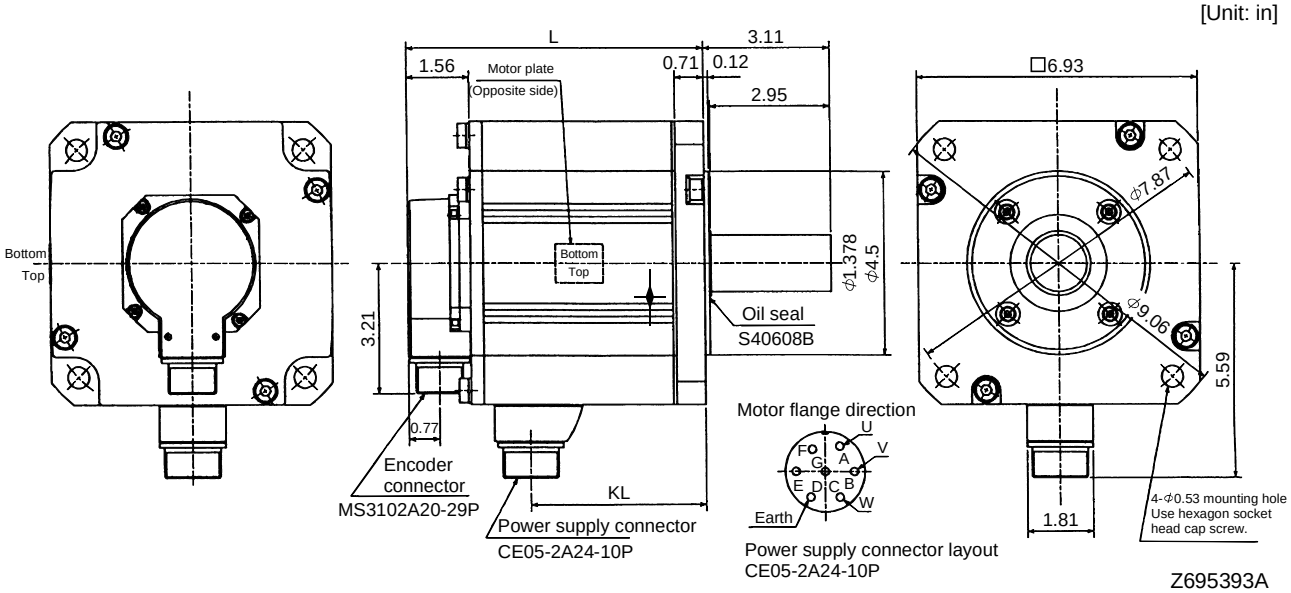
[Unit: in]



Z694854*

Model	Output (W)	Variable Dimensions (in) L	Variable Dimensions (in) KL	Inertia Moment WK^2(oz · in^2)	Weight (lb)
HC-SF121	1.2	5.71	2.70	232.37	26.5
HC-SF202 HC-SF203	2.0				
HC-SF201	2.0	7.36	4.35	448.33	41.9
HC-SF352 HC-SF353	3.5				

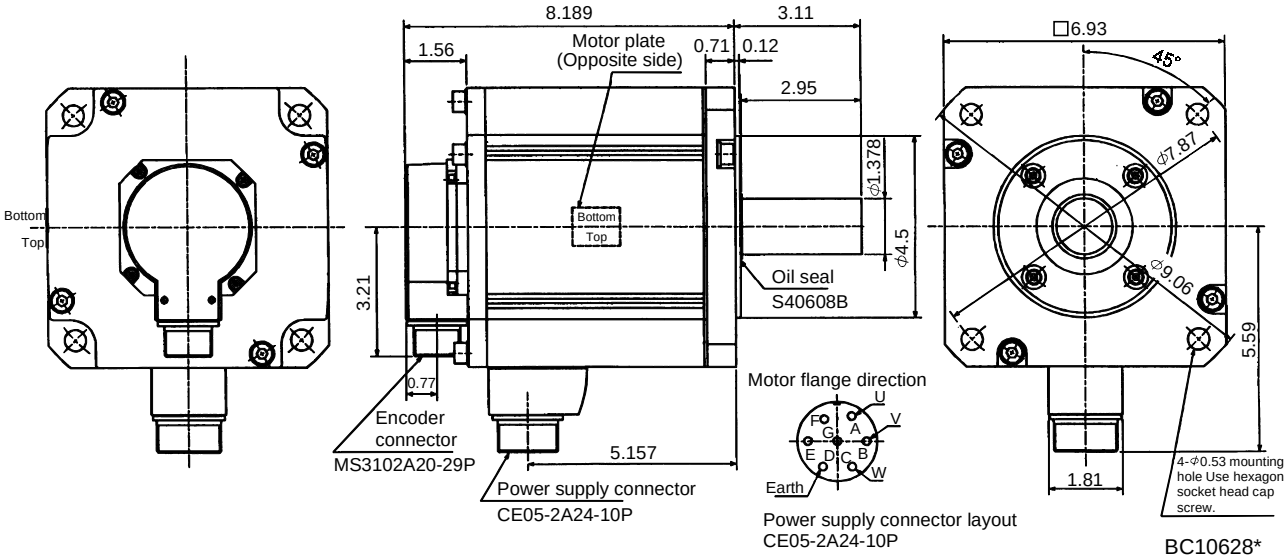
[Unit: in]



Z695393A

Model	Output (kW)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-SF301	3.0	552.212	50.7

[Unit: in]

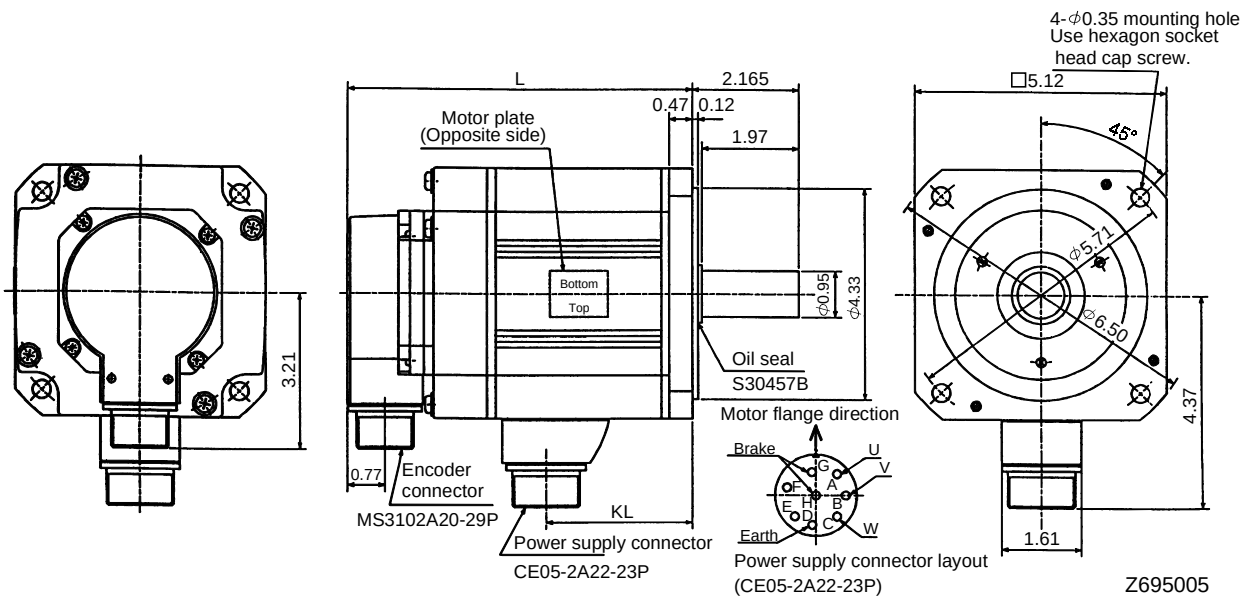


BC10628*

2) With electromagnetic brake

Model	Output (kW)	Variable Dimensions (in)		Braking Force (oz ▪ n)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL			
HC-SF52B HC-SF53B	0.5	6.02	2.03	1204	45.52	16.535
HC-SF102B HC-SF103B	1.0	7.01	3.02	1204	84.20	20.944
HC-SF81B	0.85	7.99	4.00	1204	118.37	25.353
HC-SF152B HC-SF153B	1.5					

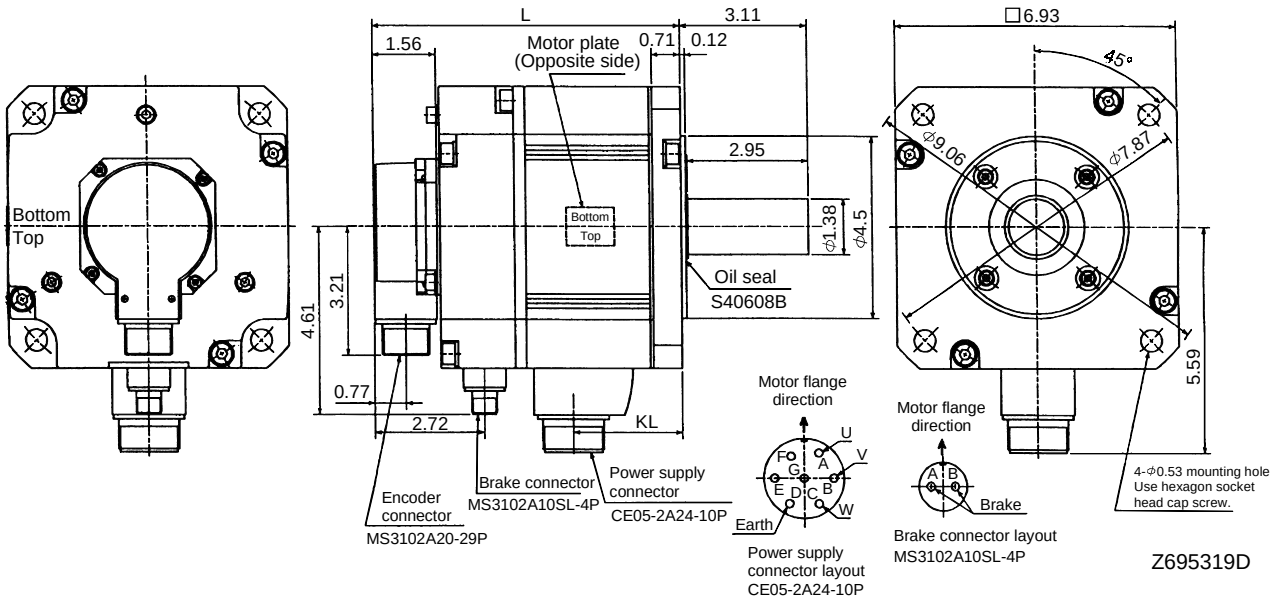
[Unit: in]



Z695005

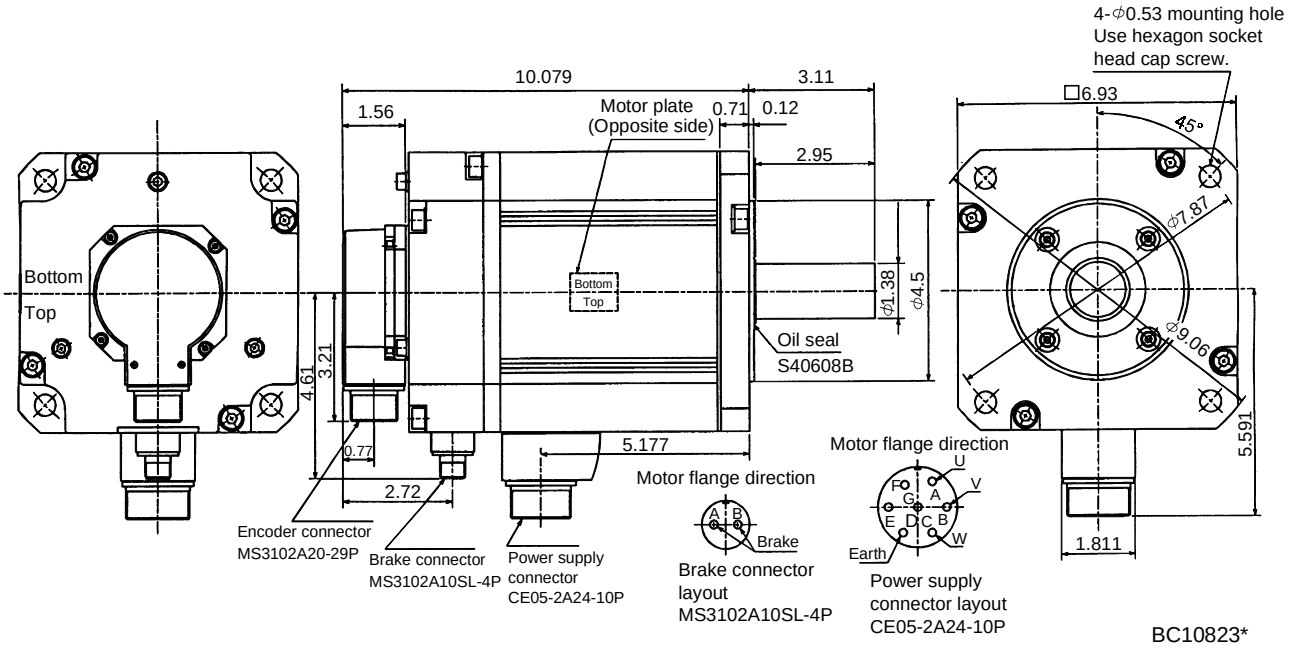
Model	Output (kW)	Variable Dimensions (in)		Braking Force (oz • in)	Inertia Moment WK^2(oz • in^2)	Weight (lb)
		L	KL			
HC-SF121B	1.2	7.60	2.70	6103	287.04	39.683
HC-SF202B HC-SF203B	2.0					
HC-SF201B	2.0	9.25	4.35	6103	503.01	55.115
HC-SF352B HC-SF253B	3.5					

[Unit: in]



Model	Output (kW)	Braking Force (oz • in)	Inertia Moment WK^2 (oz • in^2)	Weight (lb)
HC-SF301B	3.0	6103	606.886	63.9

[Unit: in]

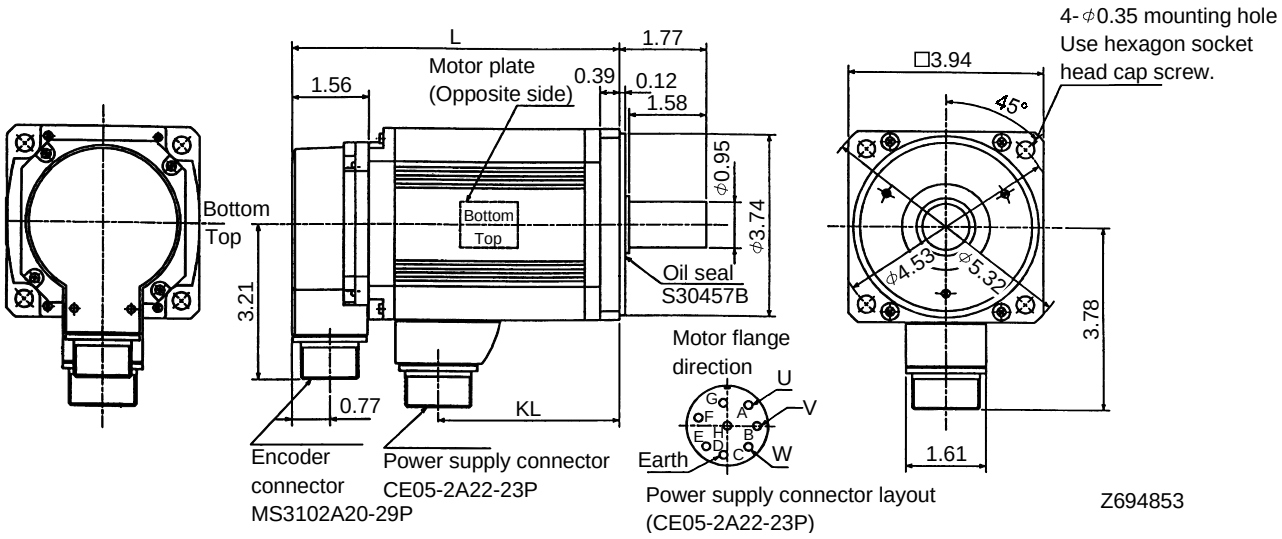


(4) HC-RF Series

1) Standard (without electromagnetic brake, without reduction gear)

Model	Output (kW)	Inertia Moment WK^2[oz · in^2]	Variable Dimensions [in]		Weight [lb]
			L	KL	
HC-RF103	1.0	8.20	5.79	2.80	8.6
HC-RF153	1.5	10.39	6.77	3.78	11.0
HC-RF203	2.0	12.58	7.76	4.76	13.7

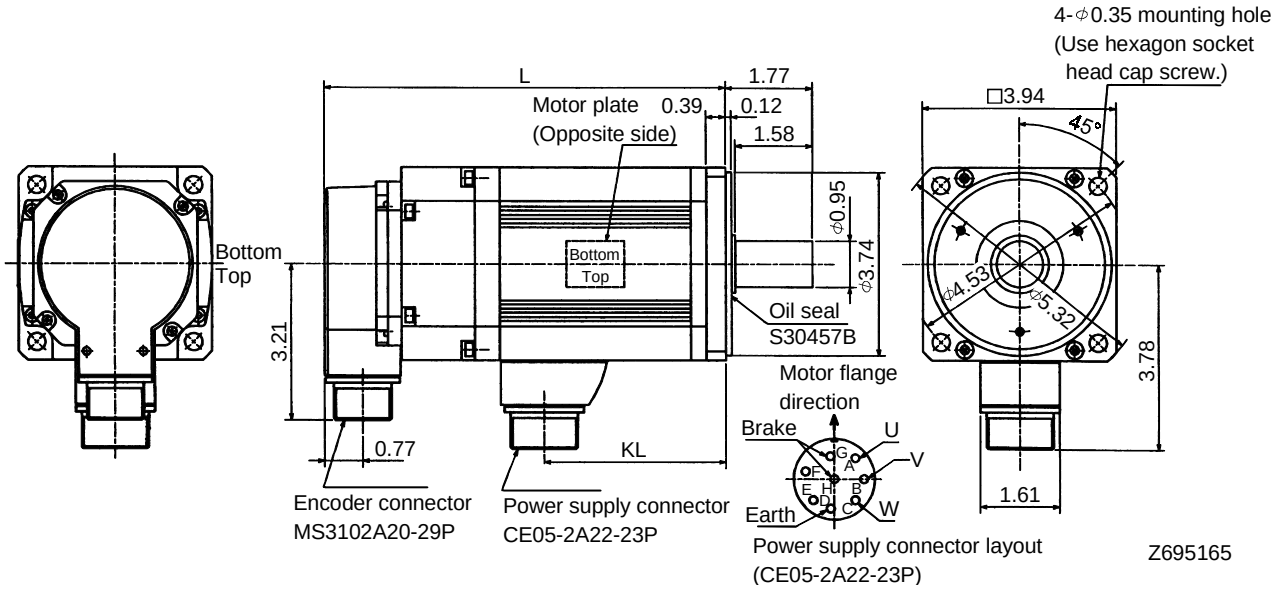
[Unit: in]



2) With electromagnetic brake

Model	Output (kW)	Inertia Moment WK^2[oz · in^2]	Variable Dimensions [in]		Braking Force [oz · in]	Weight [lb]
			L	KL		
HC-RF103B	1.0	10.12	7.28	2.80	991	13.2
HC-RF153B	1.5	12.30	8.27	3.78	991	15.4
HC-RF203B	2.0	14.49	9.25	4.76	991	18.3

[Unit: in]

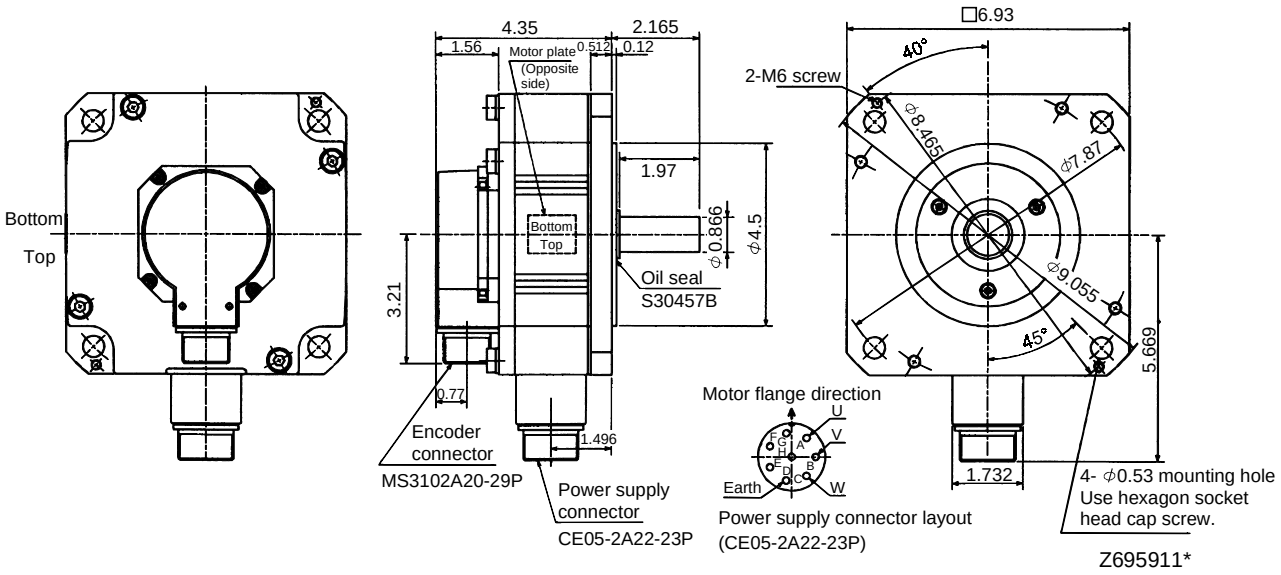


(5) HC-UF Series

1) Standard (Without electromagnetic brake)

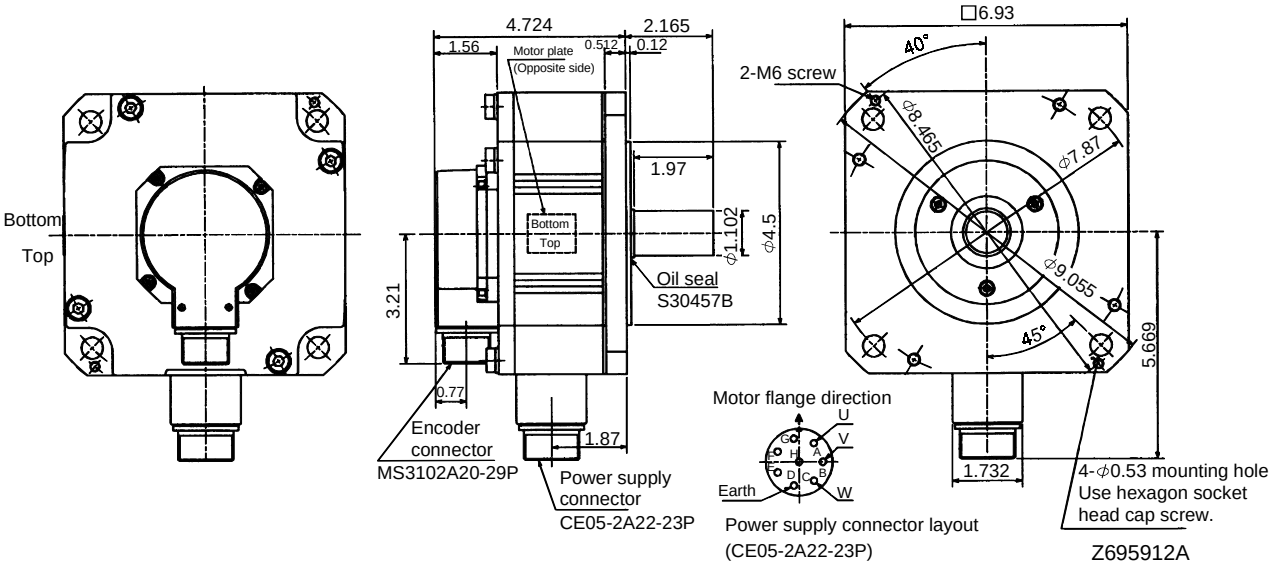
Model	Output (kW)	Inertia Moment WK^2(oz ▪ n^2)	Weight (lb)
HC-UF72	0.75	56.861	17.6

[Unit: in]



Model	Output (kW)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-UF152	1.5	120.831	24.3

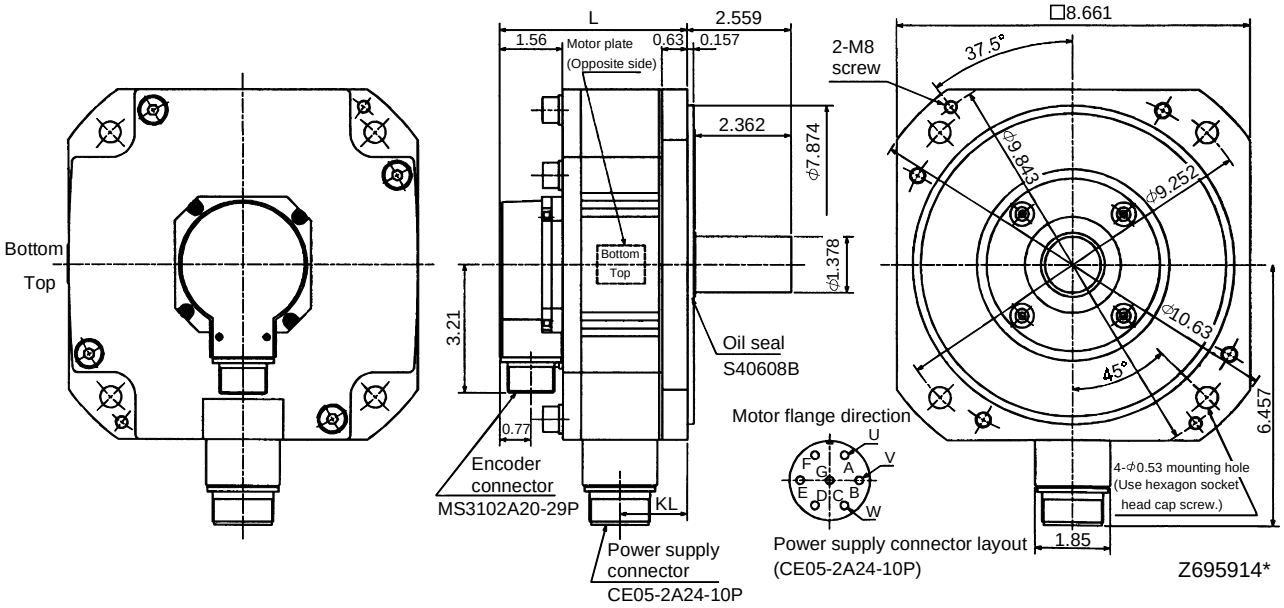
[Unit: in]



10. SPECIFICATIONS

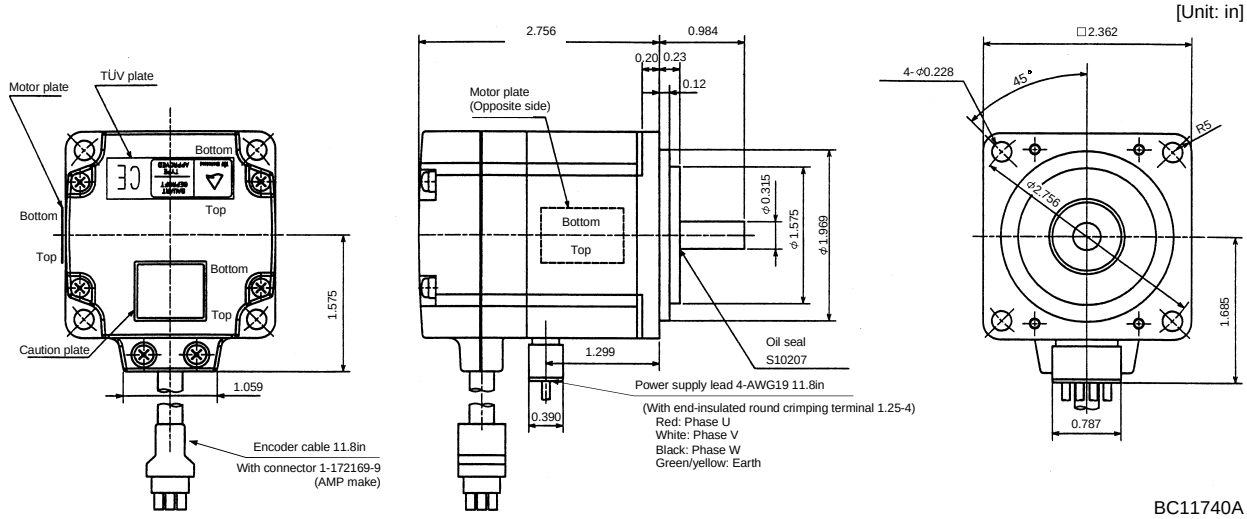
Model	Output (kW)	Variable Dimensions (in)		Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL		
HC-UF202	2.0	4.646	1.673	208.856	35.3

[Unit: in]



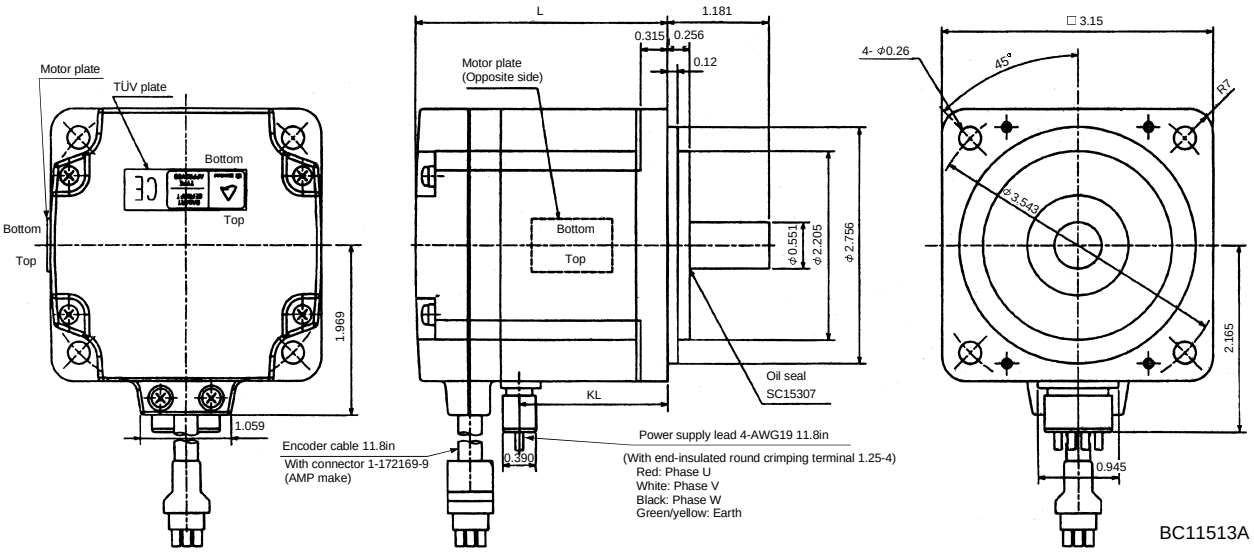
Model	Output (W)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-UF13	100	0.361	1.8

[Unit: in]



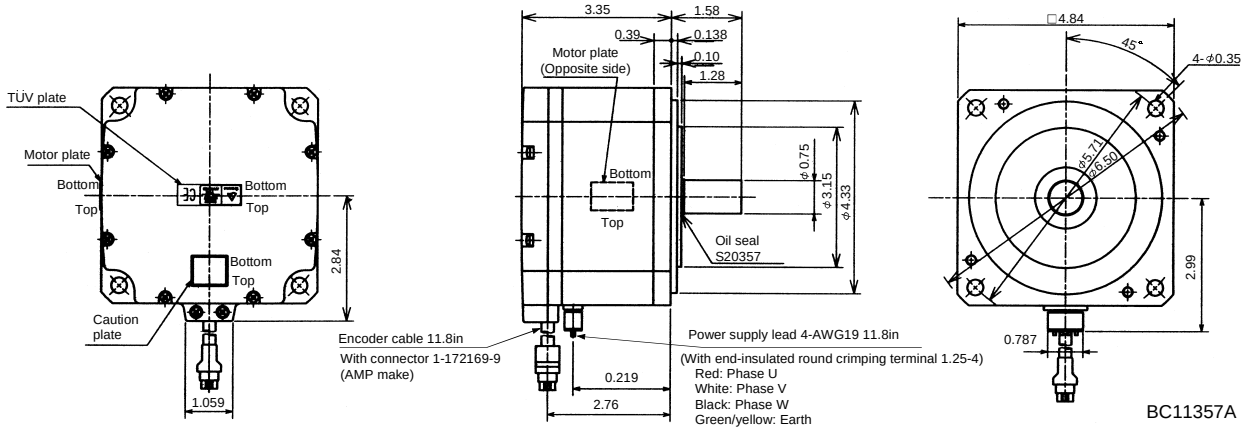
Model	Output (W)	Variable Dimensions (in)		Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL		
HC-UF23	200	2.953	1.724	1.318	3.3
HC-UF43	400	3.543	2.315	1.996	3.7

[Unit: in]



Model	Output (W)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
HC-UF73	750	32.258	11.0

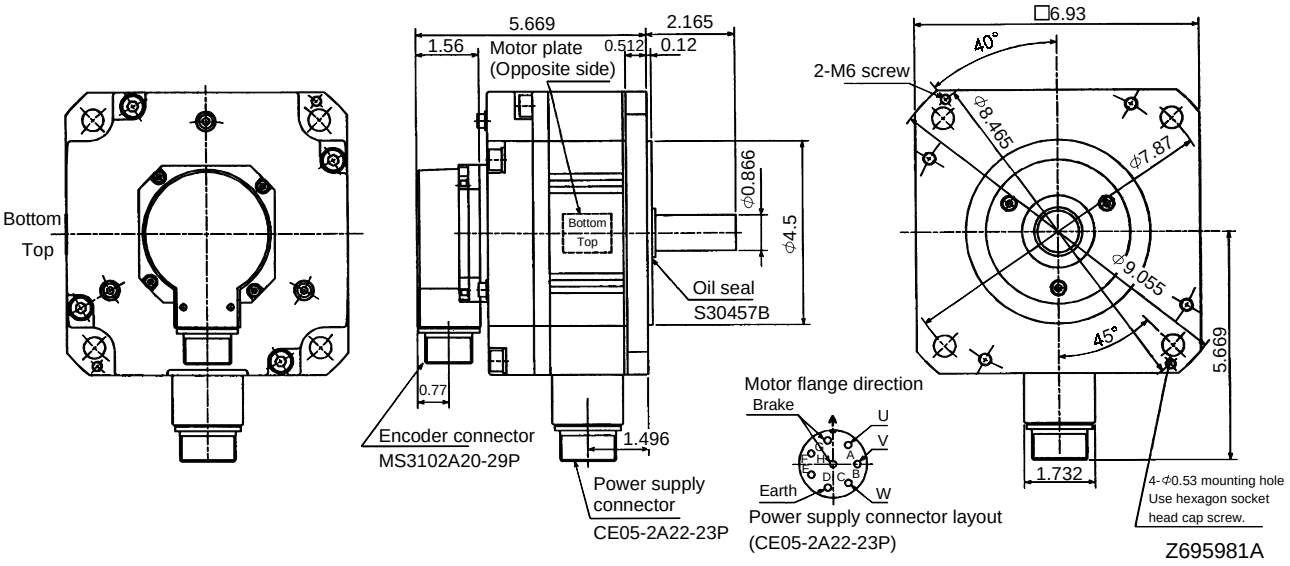
[Unit: in]



2) With electromagnetic brake

Model	Output (kW)	Braking Force (oz • in)	Inertia Moment WK^2(oz • in^2)	Weight (lb)
HC-UF72B	0.75	1204	67.796	22.0

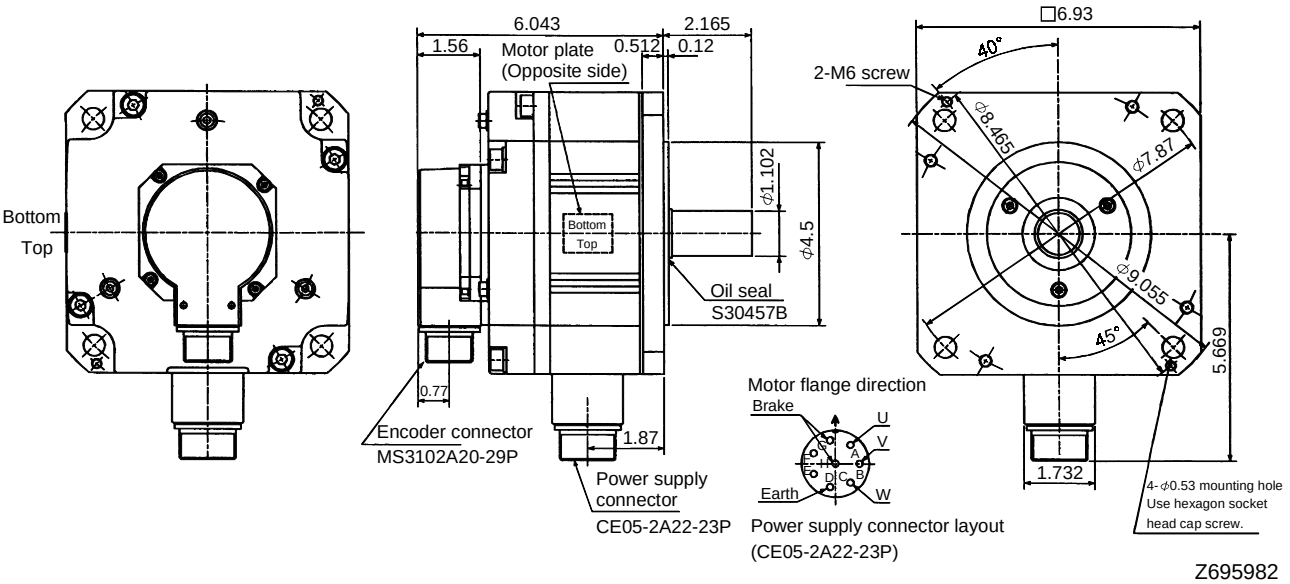
[Unit: in]



Z695981A

Model	Output (kW)	Braking Force (oz • in)	Inertia Moment WK^2(oz • in^2)	Weight (lb)
HC-UF152B	1.5	1204	158.009	28.7

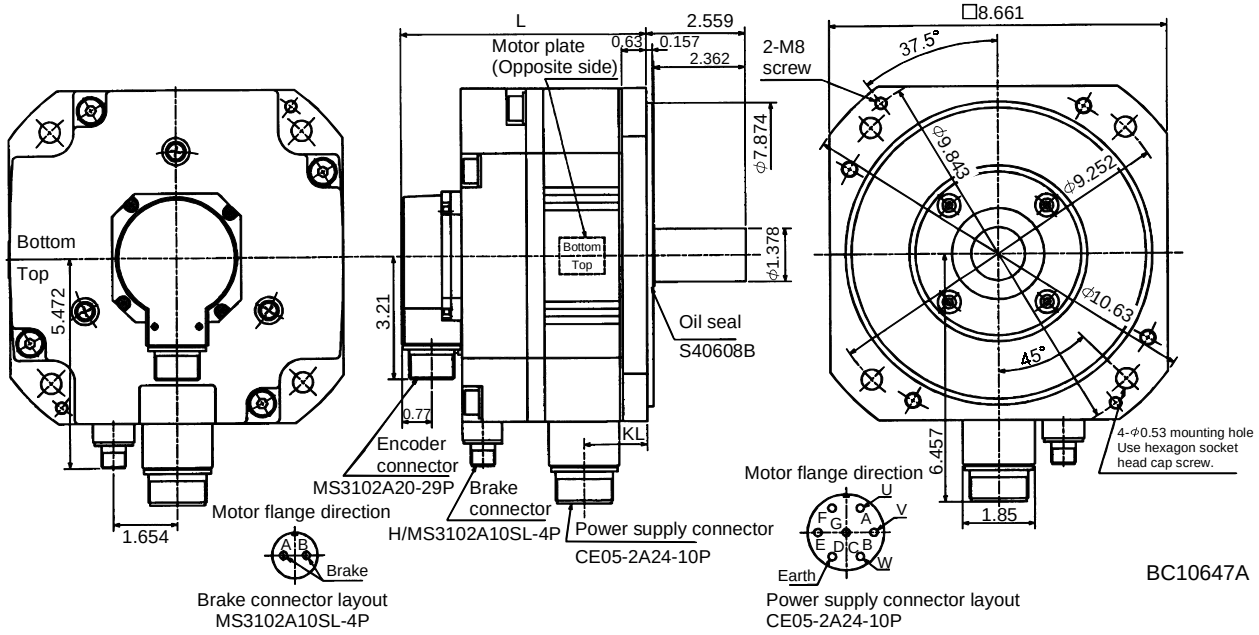
[Unit: in]



Z695982

Model	Output (kW)	Variable Dimensions (in)		Braking Force (oz • in)	Inertia Moment WK^2(oz • in^2)	Weight (lb)
		L	KL			
HC-UF202B	2.0	6.339	1.673	6103	255.876	48.5

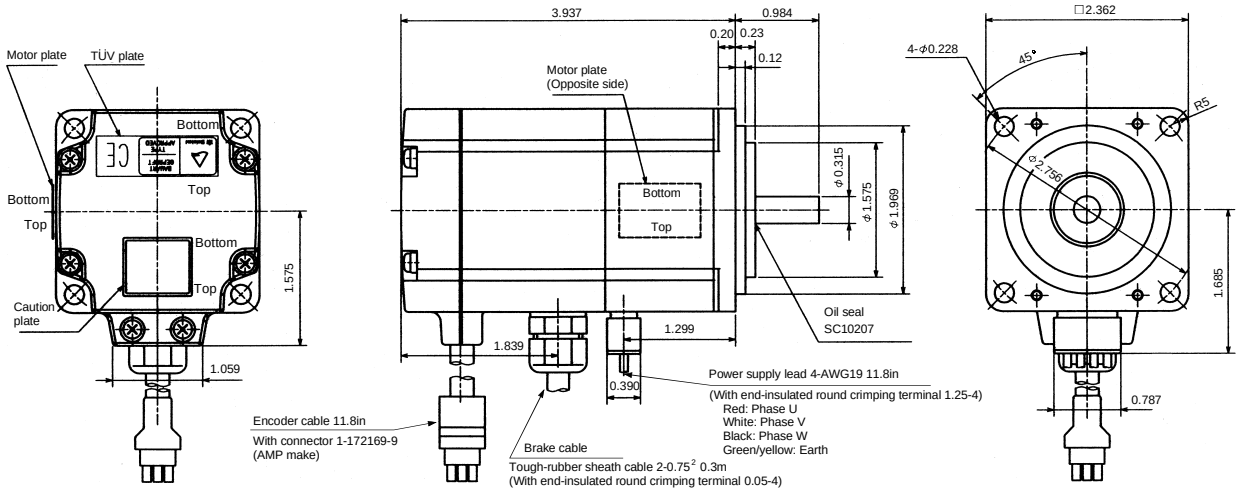
[Unit: in]



BC10647A

Model	Output (W)	Braking Force (oz • in)	Inertia Moment WK^2(oz • in^2)	Weight (lb)
HC-UF13B	100	45	0.405	2.6

[Unit: in]

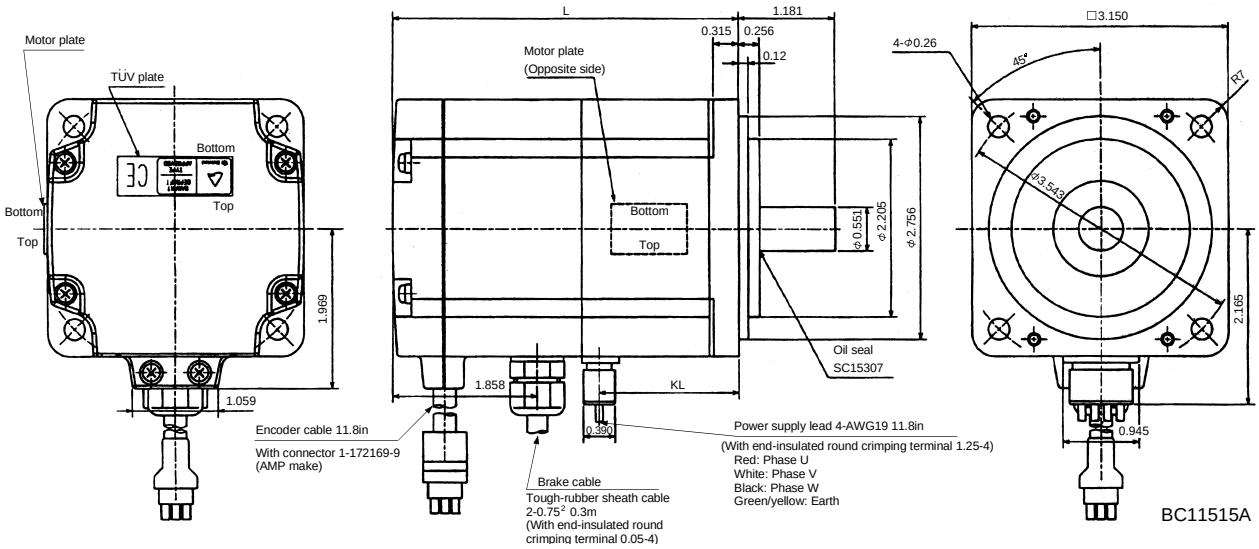


BC11767A

10. SPECIFICATIONS

Model	Output (W)	Variable Dimensions (in)		Braking Force (oz ▪ in)	Inertia Moment WK^2(oz ▪ in^2)	Weight (lb)
		L	KL			
HC-UF23B	200	4.291	1.724	184	1.766	4.9
HC-UF43B	400	4.882	2.315	184	2.444	5.3

[Unit: in]



10 - 5 - 4 Cable side plugs

(1) Servo amplifier connector

Signal connector

a) Soldering type

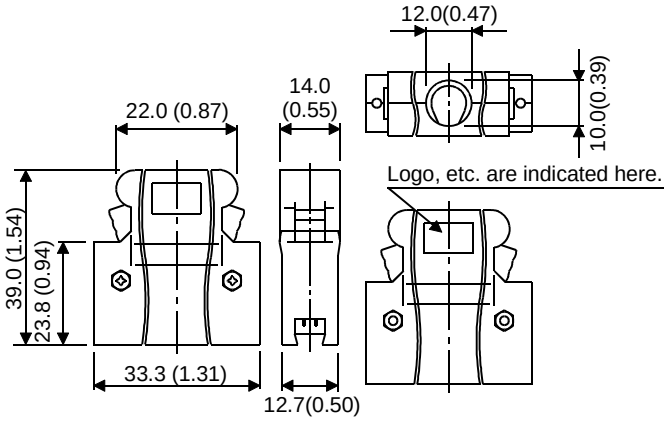
Model

Connector : 10120-3000VE

Shell kit : 10320-52F0-008

[Unit: mm]

([Unit: in])



b) Insulation displacement type

Model

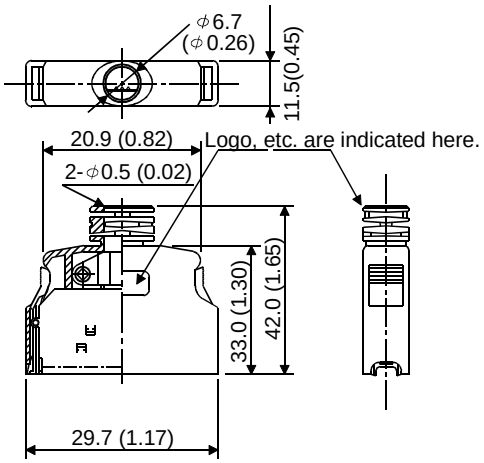
Connector : 10120-6000EL

Shell kit : 10320-3210-000

[Unit: mm]

([Unit: in])

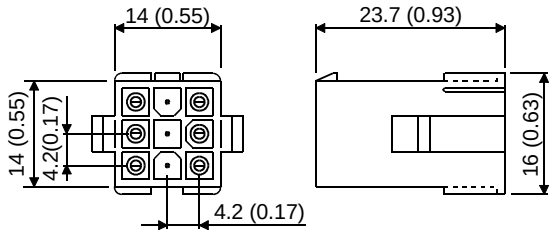
NOTICE	This connector is not optional.



(2) HC-MF/HA-FF encoder junction connector

Model
Housing : 1-172161-9
Connector pin : 170359-1
Crimping tool : 755330-1

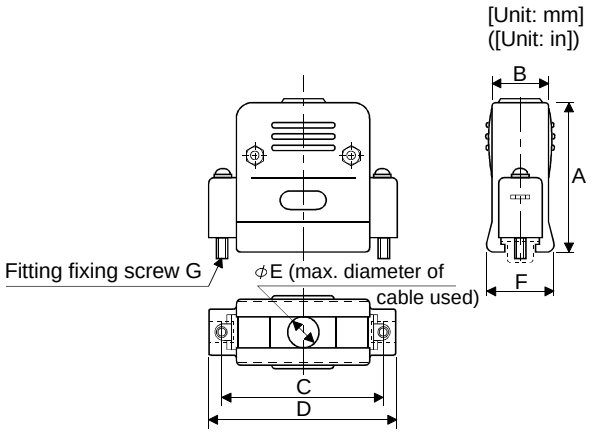
[Unit: mm]
([Unit: in])



(3) Communication cable connector

<Japan Aviation Electronics Industry make>

[Unit: mm]
([Unit: in])



Type	A ±1	B ±1	C ±0.25	D ±1	ϕE	F Reference	G
DE-C1-J6-S6	34.5(1.36)	19(0.75)	24.99(0.98)	33(1.30)	6(0.24)	18(0.71)	#4-40
DE-C2-J9	46(1.81)	21(0.83)	47.04(1.85)	55(2.17)	10(0.39)	20(0.79)	M2.6

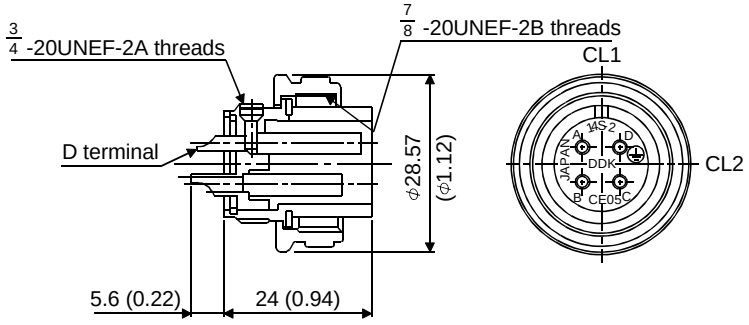
(4) Cannon connector type

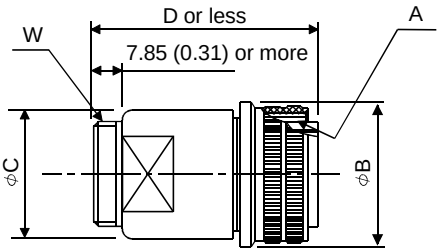
(a) Connectors

<Daiichi Denshi Kogyo make>

CE05-6A14S-2SD-B

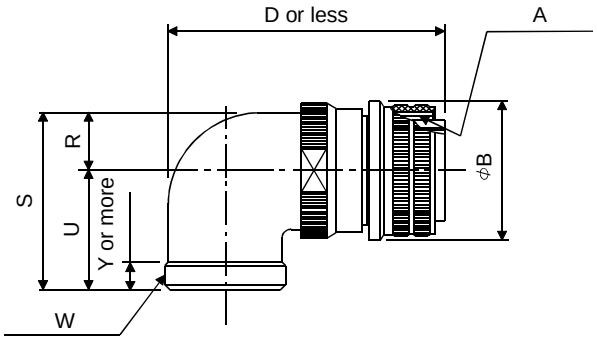
[Unit: mm]
([Unit: in])





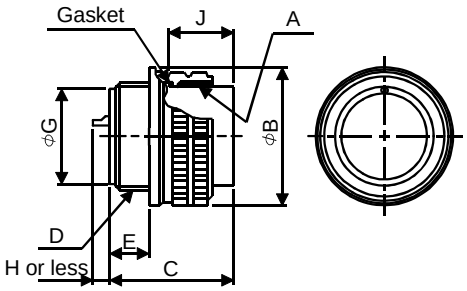
[Unit: mm]
([Unit: in])

Model	A	B	C	D	W
CE05-6A22-23SD-B-BSS	1 3/8-18UNEF-2B	40.48 (1.59)	38.3 (1.51)	61 (2.40)	1 3/16-18UNEF-2A
CE05-6A24-10SD-B-BSS	1 1/2-18UNEF-2B	43.63 (1.72)	42.0 (1.65)	68 (2.68)	1 7/16-18UNEF-2A
OE05-6A32-17SD-B-BSS	2-18UNS-2S	56.33 (2.22)	54.2 (2.13)	79 (3.11)	1 3/4-18UNS-2A



[Unit: mm]
([Unit: in])

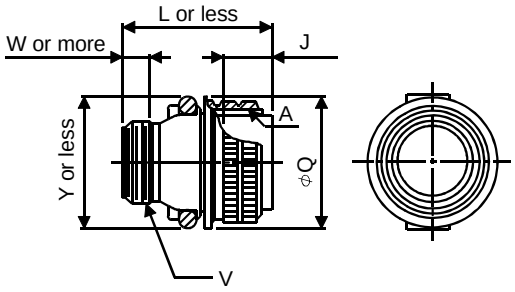
Model	A	B	D	W	R	U	S	Y
CE05-8A22-23SD-B-BAS	1 3/8-18UNEF-2B	40.48 (1.59)	75.5 (2.97)	1 3/16-18UNEF-2A	16.3 (0.64)	33.3 (1.31)	49.6 (1.95)	7.5 (0.30)
CE05-8A24-10SD-B-BAS	1 1/2-18UNEF-2B	43.63 (1.72)	86.3 (3.40)	1 7/16-18UNEF-2A	18.2 (0.72)	36.5 (1.44)	54.7 (2.15)	7.5 (0.30)
CE05-8A32-17SD-B-BAS	2-18UNS-2B	56.33 (2.22)	93.5 (3.68)	1 3/4-18UNS-2A	24.6 (0.97)	44.5 (1.75)	61.9 (2.44)	8.5 (0.34)



[Unit: mm]
([Unit: in])

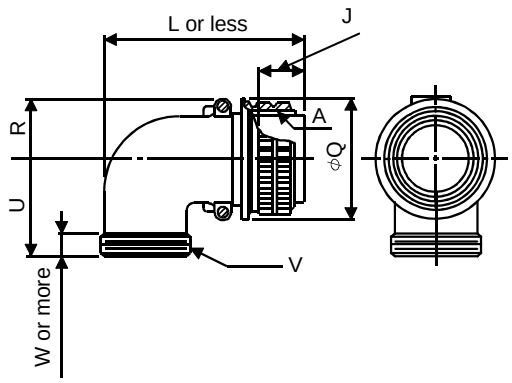
Model	A	B	C	D	E	G	J
MS3106A10SL-4S(D190)	5/8-24UNEF-2B	22.22 (0.87)	23.3 (0.92)	9/16-24UNEF-2A	7.5 (0.30)	12.5 (0.49)	13.49 (0.53)
MS3106A14S-2S(D190)	7/8-20UNEF-2B	28.57 (1.13)	24.34 (0.96)	3/4-20UNEF-2A	8.46 (0.33)	17.0 (0.67)	13.49 (0.53)
MS3106A20-29S(D190)	1 1/4-18UNEF-2B	37.28 (1.47)	34.11 (1.34)	1 1/8-18UNEF-2A	12.16 (0.48)	26.8 (1.06)	18.26 (0.72)
MS3106A22-23S(D190)	1 3/8-18UNEF-2B	40.48 (1.59)	34.11 (1.34)	1 1/4-18UNEF-2A	12.15 (0.48)	29.9 (1.18)	18.26 (0.72)
MS3106A24-10S(D190)	1 1/2-18UNEF-2B	43.63 (1.72)	36.58 (1.44)	1 3/8-18UNEF-2A	13.42 (0.53)	32.9 (1.30)	18.26 (0.72)
MS3106A32-17S(D190)	2-18UNS-2B	56.33 (2.22)	36.95 (1.46)	1 7/8-16UN-2A	13.14 (0.52)	45.3 (1.78)	18.26 (0.72)

	Contact Size				
	#16	#12	#8	#4	#0
H	8 or less	8 or less	10 or less	13 or less	13 or less



[Unit: mm]
([Unit: in])

Model	A	J	L	Q	V	W	Y
MS3106B14S-2S	7/8-20UNEF	13.49 (0.53)	42.88 (1.69)	28.57 (1.13)	3/4-20UNEF	8.0 (0.32)	30 (1.18)
MS3106B20-29S	1 1/4-18UNEF	18.26 (0.72)	55.57 (2.19)	37.28 (1.47)	1 3/16-18UNEF	9.53 (0.38)	47 (1.85)
MS3106B22-23S	1 3/8-18UNEF	18.26 (0.72)	55.57 (2.19)	40.48 (1.59)	1 3/16-18UNEF	9.53 (0.38)	50 (1.97)
MS3106B24-10S	1 1/2-8UNEF	18.26 (0.72)	58.72 (2.31)	43.63 (1.72)	1 7/16-18UNEF	9.53 (0.38)	53 (2.09)
MS3106B32-17S	2-18UNS	18.26 (0.72)	61.92 (2.44)	56.33 (2.22)	1 3/4-18UNS	11.13 (0.44)	66 (2.60)



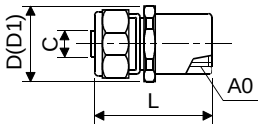
[Unit: mm]
([Unit: in])

Model	A	J	L	Q	R	U	V	W
MS3106B14S-2S	7/8-20UNEF	13.49 (0.53)	53.97 (2.13)	28.57 (1.13)	14.9 (0.59)	27.0 (1.06)	3/4-20UNEF	9.53 (0.38)
MS3106B20-29S	1 1/4-18UNEF	18.26 (0.72)	76.98 (3.03)	37.28 (1.47)	22.5 (0.89)	33.3 (1.31)	1 3/16-18UNEF	9.53 (0.38)
MS3106B22-23S	1 3/8-18UNEF	18.26 (0.72)	76.98 (3.03)	40.48 (1.59)	24.1 (0.95)	33.3 (1.31)	1 3/16-18UNEF	9.53 (0.38)
MS3106B24-10S	1 1/2-8UNEF	18.26 (0.72)	86.51 (3.41)	43.63 (1.72)	25.6 (1.01)	36.5 (1.44)	1 7/16-18UNEF	9.53 (0.38)
MS3106B32-17S	2-18UNS	18.26 (0.72)	95.25 (3.75)	56.33 (2.22)	32.8 (1.29)	44.4 (1.75)	1 3/4-18UNS	11.13 (0.44)

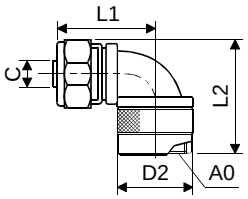
(b) Flexible conduit connectors

<Daiwa Dengyo make>

MSA



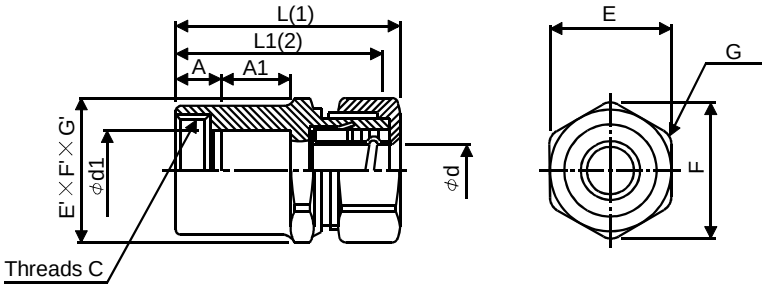
MAA



[Unit: mm]
([Unit: in])

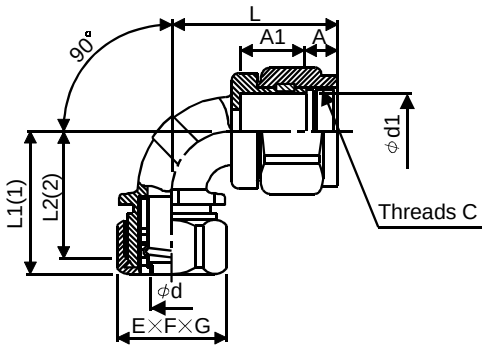
Model	A_0	C	L	L_1	L_2	D	D_1	D_2
MSA-10-10 · MAA-10-10	9/16-24UNEF-2B	8.2 (0.32)	44 (1.73)	35.5 (1.40)	45 (1.77)	27 (1.06)	29 (1.14)	26 (1.02)
MSA-10-14 · MAA-10-14	3/4-20UNEF-2B	8.2 (0.32)	45 (1.77)	39.5 (1.56)	46 (1.18)	27 (1.06)	29 (1.14)	35 (1.38)
MSA-12-14 · MAA-12-14	3/4-20UNEF-2B	10.7 (0.42)	45 (1.77)	39.5 (1.56)	46 (1.18)	27 (1.06)	29 (1.14)	35 (1.38)
MSA-16-20 · MAA-16-20	1 1/8-18UNEF-2B	14 (0.55)	49.5 (1.95)	47 (1.85)	52 (2.05)	36 (1.42)	38 (1.50)	39 (1.54)
MSA-16-22 · MAA-16-22	1 1/4-18UNEF-2B	14 (0.55)	49.5 (1.95)	47 (1.85)	52 (2.05)	38 (1.50)	42 (1.65)	39 (1.54)
MSA-16-24 · MAA-16-24	1 3/8-18UNEF-2B	14 (0.55)	49.5 (1.95)	51 (2.01)	54 (2.13)	41 (1.61)	43 (1.69)	47 (1.85)
MSA-22-20 · MAA-22-20	1 1/8-18UNEF-2B	18.9 (0.74)	49.5 (1.95)	47 (1.85)	54 (2.13)	36 (1.42)	39 (1.54)	39 (1.54)
MSA-22-22 · MAA-22-22	1 1/4-18UNEF-2B	18.9 (0.74)	49.5 (1.95)	47 (1.85)	54 (2.13)	38 (1.50)	42 (1.65)	39 (1.54)
MSA-22-24 · MAA-22-24	1 3/8-18UNEF-2B	18.9 (0.74)	49.5 (1.95)	51 (2.01)	56 (2.21)	41 (1.61)	43 (1.69)	47 (1.85)
MSA-28-22 · MAA-28-22	1 1/4-18UNEF-2B	24.5 (0.97)	51 (2.01)	53 (2.09)	64 (2.52)	46 (1.18)	50 (1.97)	47 (1.85)
MSA-28-24 · MAA-28-24	1 3/8-18UNEF-2B	24.5 (0.97)	51 (2.01)	53 (2.09)	66 (2.60)	46 (1.18)	50 (1.97)	47 (1.85)

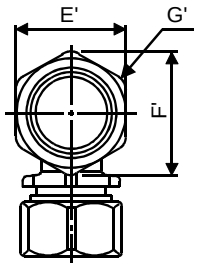
10. SPECIFICATIONS



[Unit: mm]
([Unit: in])

Model	Threads C	A	A_1	d	d_1	Jam Nut			Lock Nut			L	L_1
						E Width Across Flats	F Width Across Corners	G Number Of Corners	E' Width Across Flats	F' Width Across Corners	G' Number Of Corners		
RCC-102RL-MS10F	9/16-24UNEF-2B	6 (0.24)	15 (0.59)	8.3 (0.33)	11.0 (0.43)	24 (0.95)	26.4 (1.04)	6	24 (0.95)	26.4 (1.04)	6	39 (1.54)	36 (1.42)
RCC-102RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	8.3 (0.33)	15.0 (0.59)	24 (0.95)	26.4 (1.04)	6	24 (0.95)	26.4 (1.04)	6	40 (1.58)	37 (1.46)
RCC-103RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	10.6 (0.42)	15.0 (0.59)	27 (1.06)	29.7 (1.17)	6	26 (1.02)	28.6 (1.13)	6	44 (1.73)	41 (1.61)
RCC-104RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	14.0 (0.55)	15.0 (0.59)	30 (1.18)	33.0 (1.30)	6	30 (1.18)	33.0 (1.30)	6	45 (1.77)	42 (1.65)
RCC-104RL-MS20F	1・1/8-18UNEF-2B	9 (0.35)	15 (0.59)	14.0 (0.55)	24.0 (0.95)	30 (1.18)	33.0 (1.30)	6	32 (1.26)	35.2 (1.39)	6	47 (1.85)	44 (1.73)
RCC-104RL-MS22F	1・1/4-18UNEF-2B	9 (0.35)	15 (0.59)	14.0 (0.55)	27.0 (1.06)	30 (1.18)	33.0 (1.30)	6	36 (1.42)	39.6 (1.56)	6	47 (1.85)	44 (1.73)
RCC-104RL-MS24F	1・3/8-18UNEF-2B	10 (0.39)	20 (0.79)	14.0 (0.55)	30.0 (1.18)	30 (1.18)	33.0 (1.30)	6	40 (1.58)	42.5 (1.67)	8	54 (2.13)	50 (1.97)
RCC-106RL-MS20F	1・1/8-18UNEF-2B	9 (0.35)	15 (0.59)	19.0 (0.75)	24.0 (0.95)	37 (1.46)	40.7 (1.60)	6	36 (1.42)	39.6 (1.56)	6	50 (1.97)	46 (1.81)
RCC-106RL-MS22F	1・1/4-18UNEF-2B	9 (0.35)	15 (0.59)	19.0 (0.75)	27.0 (1.06)	37 (1.46)	40.7 (1.60)	6	36 (1.42)	39.6 (1.56)	6	50 (1.97)	46 (1.81)
RCC-106RL-MS24F	1・3/8-18UNEF-2B	10 (0.39)	20 (0.79)	19.0 (0.75)	30.0 (1.18)	37 (1.46)	40.7 (1.60)	6	40 (1.58)	42.5 (1.67)	8	56 (2.21)	52 (2.05)
RCC-106RL-MS32F	1・7/8-16UN-2B	11 (0.43)	20 (0.79)	19.0 (0.75)	42.5 (1.67)	37 (1.46)	40.7 (1.60)	6	52 (2.05)	54.5 (2.15)	8	57 (2.24)	53 (2.09)
RCC-108RL-MS22F	1・1/4-18UNEF-2B	9 (0.35)	15 (0.59)	24.4 (0.96)	27.0 (1.06)	45 (1.77)	47.3 (1.86)	8	44 (1.73)	46.3 (1.82)	8	55 (2.17)	50 (1.97)
RCC-108RL-MS24F	1・3/8-18UNEF-2B	10 (0.39)	20 (0.79)	24.4 (0.96)	30.0 (1.18)	45 (1.77)	47.3 (1.86)	8	44 (1.73)	46.3 (1.82)	8	60 (2.36)	55 (2.17)
RCC-108RL-MS32F	1・7/8-16UN-2B	11 (0.43)	20 (0.79)	24.4 (0.96)	42.5 (1.67)	45 (1.77)	47.3 (1.86)	8	52 (2.05)	54.5 (2.15)	8	61 (2.40)	56 (2.21)





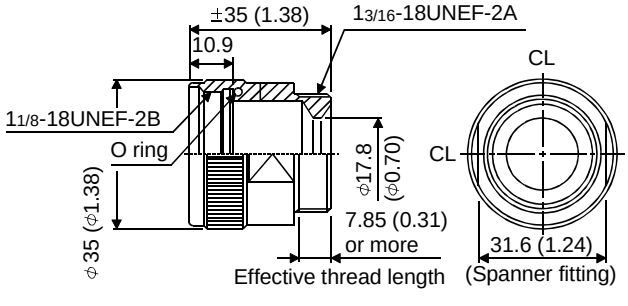
[Unit: mm]
([Unit: in])

Model	Threads C	A	A1	d	d1	Jam Nut			Lock Nut			L	L1	L2
						E Width Across Flats	F Width Across Corners	G Number Of Corners	E' Width Across Flats	F' Width Across Corners	G' Number Of Corners			
RCC-302RL-MS10F	9/16-24UNEF-2B	6 (0.24)	15 (0.59)	8.3 (0.33)	10.0 (0.39)	24 (0.95)	26.4 (1.04)	6	20 (0.79)	22.0 (0.87)	6	35 (1.38)	33 (1.30)	30 (1.18)
RCC-302RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	8.3 (0.33)	13.8 (0.54)	24 (0.95)	26.4 (1.04)	6	23 (0.91)	25.3 (1.0)	6	35 (1.38)	33 (1.30)	30 (1.18)
RCC-303RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	10.6 (0.42)	13.8 (0.54)	27 (1.06)	29.7 (1.17)	6	23 (0.91)	25.3 (1.0)	6	37 (1.46)	37 (1.46)	34 (1.34)
RCC-304RL-MS14F	3/4-20UNEF-2B	7 (0.28)	15 (0.59)	14.0 (0.55)	13.8 (0.54)	30 (1.18)	33.0 (1.30)	6	23 (0.91)	25.3 (1.0)	6	39 (1.54)	38 (1.50)	35 (1.38)
RCC-304RL-MS20F	1 1/8-18UNEF-2B	9 (0.35)	15 (0.59)	14.0 (0.55)	23.2 (0.91)	30 (1.18)	33.0 (1.30)	6	32 (1.26)	35.2 (1.39)	6	41 (1.61)	38 (1.50)	35 (1.38)
RCC-304RL-MS22F	1 1/4-18UNEF-2B	9 (0.35)	15 (0.59)	14.0 (0.55)	26.5 (1.04)	30 (1.18)	33.0 (1.30)	6	36 (1.42)	39.6 (1.56)	6	41 (1.61)	38 (1.50)	35 (1.38)
RCC-304RL-MS24F	1 3/8-18UNEF-2B	10 (0.39)	20 (0.79)	14.0 (0.55)	28.7 (1.13)	30 (1.18)	33.0 (1.30)	6	40 (1.58)	42.5 (1.67)	8	47 (1.85)	46 (1.81)	43 (1.69)
RCC-306RL-MS20F	1 1/8-18UNEF-2B	9 (0.35)	15 (0.59)	19.0 (0.75)	23.2 (0.91)	37 (1.46)	40.7 (1.60)	6	32 (1.26)	35.2 (1.39)	6	45 (1.77)	44 (1.73)	40 (1.58)
RCC-306RL-MS22F	1 1/4-18UNEF-2B	9 (0.35)	15 (0.59)	19.0 (0.75)	26.5 (1.04)	37 (1.46)	40.7 (1.60)	6	36 (1.42)	39.6 (1.56)	6	45 (1.77)	44 (1.73)	40 (1.58)
RCC-306RL-MS24F	1 3/8-18UNEF-2B	10 (0.39)	20 (0.79)	19.0 (0.75)	28.7 (1.13)	37 (1.46)	40.7 (1.60)	6	40 (1.58)	42.5 (1.67)	8	51 (2.01)	49 (1.93)	45 (1.77)
RCC-306RL-MS32F	1 7/8-16UN-2B	11 (0.43)	20 (0.79)	19.0 (0.75)	40.6 (1.60)	37 (1.46)	40.7 (1.60)	6	54 (2.13)	56.7 (2.23)	8	52 (2.05)	49 (1.93)	45 (1.77)
RCC-308RL-MS22F	1 1/4-18UNEF-2B	9 (0.35)	15 (0.59)	24.4 (0.96)	26.5 (1.04)	45 (1.77)	47.3 (1.86)	8	36 (1.42)	39.6 (1.56)	6	49 (1.93)	50 (1.97)	45 (1.77)
RCC-308RL-MS24F	1 3/8-18UNEF-2B	10 (0.39)	20 (0.79)	24.4 (0.96)	28.7 (1.13)	45 (1.77)	47.3 (1.86)	8	40 (1.58)	42.5 (1.67)	8	56 (2.21)	50 (1.97)	45 (1.77)
RCC-308RL-MS32F	1 7/8-16UN-2B	11 (0.43)	20 (0.79)	24.4 (0.96)	40.6 (1.60)	45 (1.77)	47.3 (1.86)	8	54 (2.13)	56.7 (2.23)	8	62 (2.44)	50 (1.97)	45 (1.77)

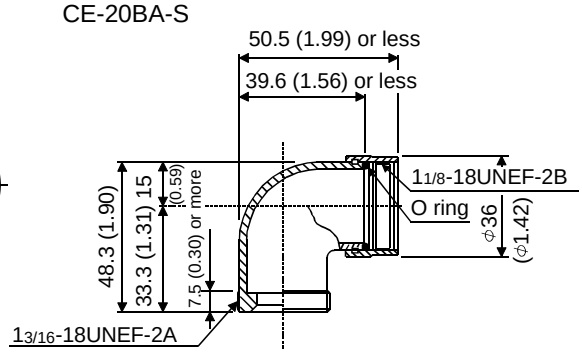
(c) Back shell

<Daiichi Denshi Kogyo make>

CE02-20BS-S

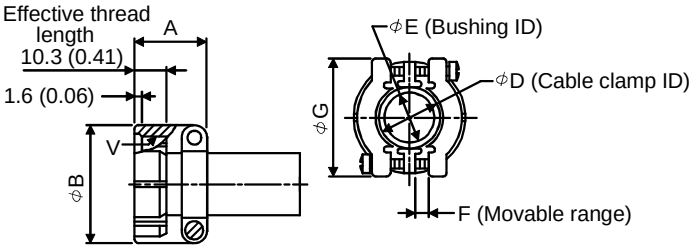


CE-20BA-S



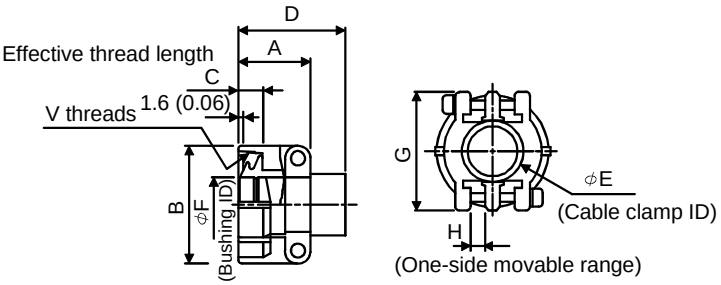
(d) Cable clamps

<Daiichi Denshi Kogyo make>



[Unit: mm]
([Unit: in])

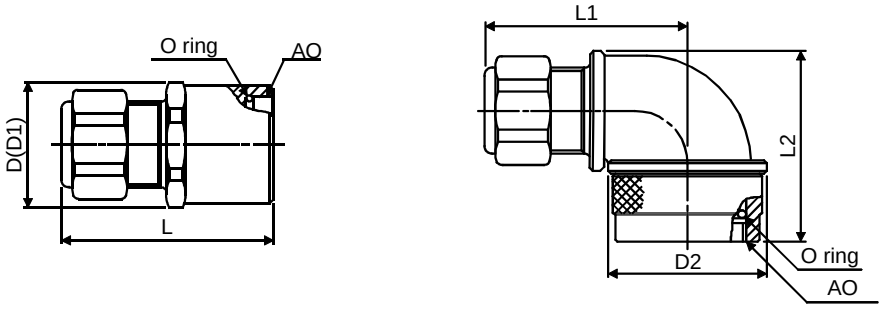
Model	Shell Size	A	B	C	D	E	F	G	V	Bushing
MS3057-6A	14S	22.2 (0.87)	24.6 (0.97)	10.3 (0.41)	11.2 (0.44)	7.9 (0.31)	2.0 (0.08)	27.0 (1.06)	3/4-20UNEF	AN3420-6
MS3057-12A	20,22	23.8 (0.94)	35.0 (1.38)	10.3 (0.41)	19.0 (0.75)	15.9 (0.63)	4.0 (0.16)	37.3 (1.47)	1 3/16-18UNEF	AN3420-12
MS3057-16A	24,28	26.2 (1.03)	42.1 (1.66)	10.3 (0.41)	23.8 (0.94)	15.9 (0.63) 19.1 (0.75)	4.8 (0.19)	42.9 (1.69)	1 7/16 18UNEF	AN3420-12 AN3420-16
MS3057-20A	32	27.8 (1.09)	51.6 (2.03)	11.9 (0.47)	31.7 (1.25)	19.1 (0.75) 23.8 (0.94)	6.3 (0.25)	51.6 (2.03)	1 3/4-18UNS	AN3420-16 AN3420-20



[Unit: mm]
([Unit: in])

Model	Shell Size	A	B	C	D	E	F	G	H	V	Bushing	Cable Range
CE3057-12A-1	20 22	23.8 (0.94)	35.0 (1.38)	10.3 (0.41)	41.3 (1.63)	19.0 (0.75)	16 (0.63)	37.3 (1.47)	4 (0.16)	1 3/16-18UNEF-2B	CE3420-12-1	ϕ12.5 to ϕ16
CE3057-12A-2							13 (0.51)				CE3420-12-2	ϕ9.5 to ϕ13
CE3057-12A-3							10 (0.39)				CE3420-12-3	ϕ6.8 to ϕ10
CE3057-16A-1	24	26.2 (1.03)	42.1 (1.66)	10.3 (0.41)	41.3 (1.63)	23.8 (0.94)	19.1 (0.75)	42.9 (1.69)	4.8 (0.19)	1 7/16-18UNEF-2B	CE3420-16-1	ϕ15 to ϕ19.1
CE3057-16A-2							15.5 (0.61)				CE3420-16-2	ϕ13 to ϕ15.5
CE3057-20A-1	32	27.8 (1.09)	51.6 (2.03)	11.9 (0.47)	43 (1.69)	31.7 (1.25)	23.8 (0.94)	51.6 (2.03)	6.3 (0.25)	1 3/4-18UNS-2B	CE3420-20-1	ϕ22 to ϕ23.8

<Daiwa Dengyo make>

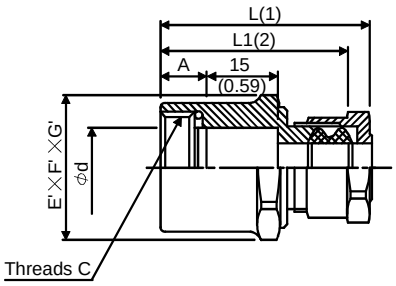


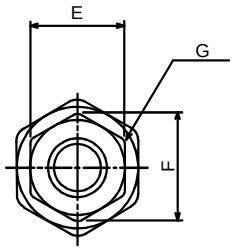
[Unit: mm]
([Unit: in])

Model	Acceptable OD	AO	L	L1	L2	D	D1	D2
YSO10-5 to 8 • YLO10-5 to 8	ϕ5 to 8.3 (ϕ0.20 to 0.33)	9/16-24UNEF-2B	43 (1.69)	39 (1.54)	42.5 (1.67)	24 (0.94)	26 (1.02)	26 (1.02)
YSO14-5 to 8 • YLO14-5 to 8	ϕ5 to 8.3 (ϕ0.20 to 0.33)	3/4-20UNEF-2B	44 (1.73)	43.5 (1.71)	44.5 (1.75)	26 (1.02)	28 (1.10)	35 (1.38)
YSO14-9 to 11 • YLO14-9 to 11	ϕ8.3 to 11.3 (ϕ0.33 to 0.45)							

10. SPECIFICATIONS

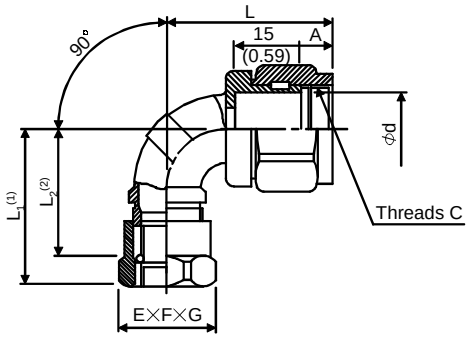
<Nippon Flex make>

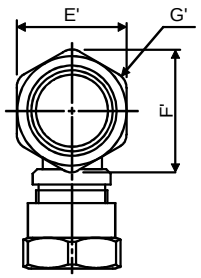




[Unit: mm]
([Unit: in])

Model	Threads C	Applicable Cable Diameter	A	d	Tightening Nut			Nipple Body			L	L1
					E Width Across Flats	F Width Across Corners	G Number Of Corners	E' Width Across Flats	F' Width Across Corners	G' Number Of Corners		
ACS-08RL-MS10F	9/16-24UNEF-2B	ϕ4.0 to ϕ8.0 (ϕ0.16 to 0.32)	6 (0.24)	11.0 (0.43)	20 (0.79)	22.0 (0.87)	6	20 (0.79)	22.0 (0.87)	6	45 (1.77)	40 (1.57)
ACS-08RL-MS14F	3/4-20UNEF-2B	ϕ4.0 to ϕ8.0 (ϕ0.16 to 0.32)	7 (0.28)	15.0 (0.59)	20 (0.79)	22.0 (0.87)	6	22 (0.87)	24.2 (0.95)	6	46 (1.81)	41 (1.61)
ACS-12RL-MS10F	9/16-20UNEF-2B	ϕ8.0 to ϕ12.0 (ϕ0.32 to 0.47)	6 (0.24)	11.0 (0.43)	24 (0.94)	26.4 (1.04)	6	24 (0.94)	26.4 (1.04)	6	46 (1.81)	41 (1.61)
ACS-12RL-MS14F	3/4-20UNEF-2B	ϕ8.0 to ϕ12.0 (ϕ0.32 to 0.47)	7 (0.28)	15.0 (0.59)	24 (0.94)	26.4 (1.04)	6	36 (1.42)	28.6 (1.13)	6	46 (1.81)	41 (1.61)





[Unit: mm]
([Unit: in])

Model	Threads C	Applicable Cable Diameter	A	d	Tightening Nut			Nipple Body			L	L1	L2
					E Width Across Flats	F Width Across Corners	G Number Of Corners	E' Width Across Flats	F' Width Across Corners	G' Number Of Corners			
ACA-08RL-MS10F	9/16-24UNEF-2B	ϕ4.0 to ϕ8.0 (ϕ0.16 to 0.32)	6 (0.24)	10.0 (0.39)	20 (0.79)	22.0 (0.87)	6	20 (0.79)	22.0 (0.87)	6	35 (1.38)	37 (1.46)	32 (1.26)
ACSA-08RL-MS14F	3/4-20UNEF-2B	ϕ4.0 to ϕ8.0 (ϕ0.16 to 0.32)	7 (0.28)	13.8 (0.54)	20 (0.79)	22.0 (0.87)	6	23 (0.91)	25.3 (1.00)	6	36 (1.42)	37 (1.46)	32 (1.26)
ACA-12RL-MS10F	9/16-20UNEF-2B	ϕ8.0 to ϕ12.0 (ϕ0.32 to 0.47)	6 (0.24)	10.0 (0.39)	24 (0.94)	26.4 (1.04)	6	20 (0.79)	22.0 (0.87)	6	40 (1.57)	43 (1.69)	38 (1.50)
ACA-12RL-MS14F	3/4-20UNEF-2B	ϕ8.0 to ϕ12.0 (0.32 to 0.47)	7 (0.28)	13.8 (0.54)	24 (0.94)	26.4 (1.04)	6	23 (0.91)	25.3 (1.00)	6	41 (1.61)	43 (1.69)	38 (1.50)

11. SELECTION

11 - 1 Specification symbol list

The following symbols are required for selecting the proper servo:

T_a	: Acceleration torque	[N・m]
T_b	: Deceleration torque	[N・m]
T_{Ma}	: Servo motor torque necessary for acceleration	[N・m]
T_{Mb}	: Servo motor torque necessary for deceleration	[N・m]
T_{LH}	: Torque applied during servo motor stop	[N・m]
T_L	: Load torque converted into equivalent value on servo motor shaft	[N・m]
T_{LM}	: Load torque converted into equivalent value on servo motor shaft during stop	[N・m]
T_U	: Unbalance torque	[N・m]
T_F	: Load friction torque	[N・m]
T_{LO}	: Load torque on load shaft	[N・m]
T_{rms}	:Continuous effective load torque converted into equivalent value on servo motor shaft	[N・m]
J_L	: Load inertia moment converted into equivalent value on servo motor shaft	[kg・cm^2]
J_{LO}	: Load inertia moment on load shaft	[kg・cm^2]
J_M	: Servo motor's rotor inertia moment	[kg・cm^2]
N	: Servo motor speed	[r/min]
N_o	: Servo motor speed during fast feed	[r/min]
N_{LO}	: Load shaft speed during fast feed	[r/min]
V	: Moving part speed	[mm/min]
V_o	: Moving part speed during fast feed	[mm/min]
P_b	: Ball screw lead	[mm]
Z_1	: Number of gear teeth on servo motor shaft	
Z_2	: Number of gear teeth on load gear	
n	: Gear ratio $n=\frac{Z_2}{Z_1}$ Speed reduced when $n > 1$, Speed increased when $n < 1$	
η	: Drive system efficiency	
g	: Gravitational acceleration (9.8[m/s^2])	
μ	: Friction coefficient	
π	: Circle ratio	
P_t	: Number of feedback pulses	[pulse/rev]
T_{psa}	: Acceleration time constant	[s]
T_{psb}	: Deceleration time constant	[s]
K_p	: Position control gain 1	[rad/s]
T_p	: Position control time constant (T_p=1/K_p)	[s]
K_v	: Speed control gain	[rad/s]
T_v	: Speed control time constant (T_v=1/K_v)	[s]
ℓ	: Feed	[mm]
P	: Number of input command pulses in position control mode	[pulse]
t_s	: Settling time in position control mode	[s]
t_o	: Positioning time	[s]
t_c	: Time at constant speed of servo motor in 1 cycle	[s]
$t\ell$	: Stopping time in 1 cycle	[s]
$\triangle\varepsilon$	: Positioning accuracy	[mm]
ε	: Number of droop pulses	[pulse]
$\triangle\theta$	: Load shaft rotation angle per pulse in position control mode	[degree/pulse]
e	: Euler constant = 2.718278	
$\triangle S$	: Feed per servo motor revolution	[mm/rev]

11 - 2 Stopping characteristics

(1) Droop pulses (ε)

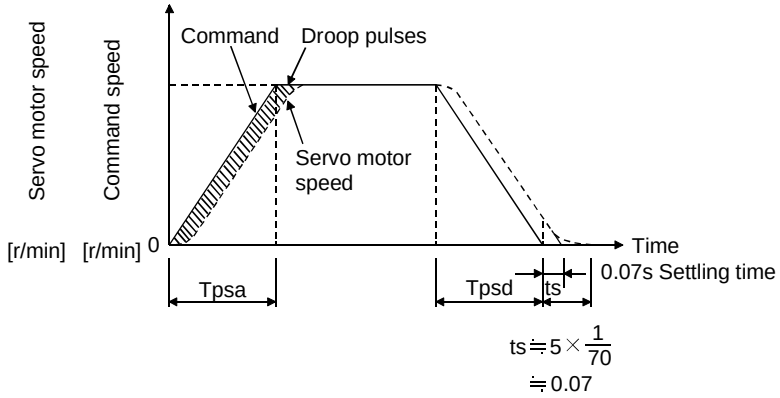
When the servo motor is run, there is a relationship between the command and servo motor speed as shown in the figure below.

The difference between the command pulses and feedback pulses during acceleration are called droop pulses, which are accumulated in the servo amplifier's deviation counter. Equation 11-1 defines a relationship between the speed and position control gain 1(Kp):

$$\varepsilon \cong \frac{N \cdot Pt}{60 \cdot Kp} [pulse] \quad \cdots\cdots (11\text{-}1)$$

Supposing that the value of position control gain 1 is 70 [rad/s], the droop pulses during operation will be as follows at the servo motor speed of 3000 [r/min] and the feedback pulses of 8192 [pulses/rev] according to Equation 11-1:

$$\varepsilon \cong \frac{3000 \times 8192}{60 \times 70} \cong 5851 [pulse]$$



$$ts \fallingdotseq 5 \times \frac{1}{70} \fallingdotseq 0.07$$

(2) Settling time (ts) during linear acceleration/deceleration

Since droop pulses still exist when the command is 0 [r/min], settling time (ts) is required until the servo motor stops. Set the operation pattern in consideration for the settling time.

The ts value is obtained according to Equation 11-2:

$$ts \cong 0.5 \cdot Tp$$

$$= 5 \cdot \frac{1}{Kp} [s] \quad \cdots\cdots (11\text{-}2)$$

*When Kp=70 [rad/s], ts=0.07 [s]. (Refer to the above diagram.)

Note: The settling time (ts) indicates the time required for the servo motor to stop in the necessary positioning accuracy range. This does not always mean that the servo motor has stopped completely. Thus, especially when the servo motor is used in high-duty operation and positioning accuracy has no margin for travel per pulse ($\triangle \ell$), the value obtained by Equation 11-2 must be increased.

ts will vary with the moving part conditions. Especially when the load friction torque is large, movement may be unstable near the stopping position.

11 - 3 Capacity selection

As a first step, temporarily select the servo motor capacity by calculating the load conditions. Next, determine the command pattern, calculate required torques according to the following equations, and confirm that the servo motor of the initially selected capacity may be used for operation.

(1) Initial selection of servo motor capacity

After calculating the load torque (T_L) and load inertia moment (J_L), select a servo motor which will satisfy the following two relationships:

Servo motor's rated torque > T_L

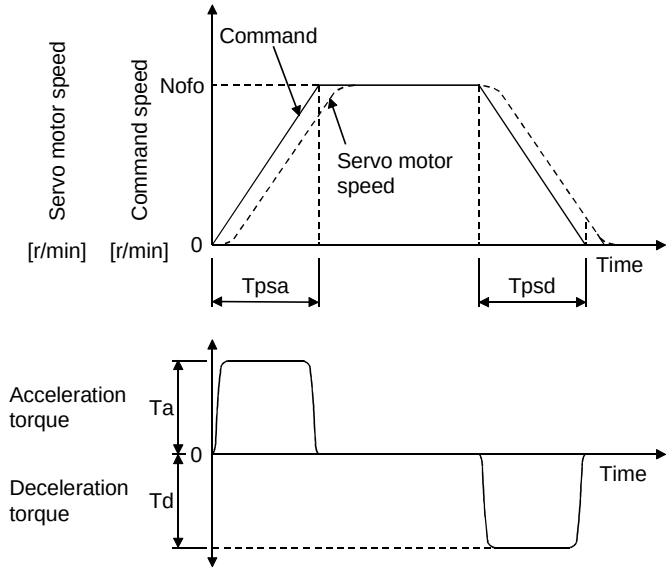
Servo motor $J_M > J_L/m$

m=3	: High duty (more than 100 times/min.) Settling time 40ms or less
m=5	: Middle duty (60 to 100 times/min.) Settling time 100ms or less
m=permissible load inertia moment	: Low duty (less than 60 times/min.) Settling time more than 100ms

Find the acceleration and deceleration torques and continuous effective load torque as described in (2) to make a final selection. For high-duty positioning, the JL value should be as small as possible. If positioning is infrequent as in line control, the JL value may be slightly larger than in the above conditions.

(2) Acceleration and deceleration torques

The following equations are used to calculate the acceleration and deceleration torques in the following operation pattern:

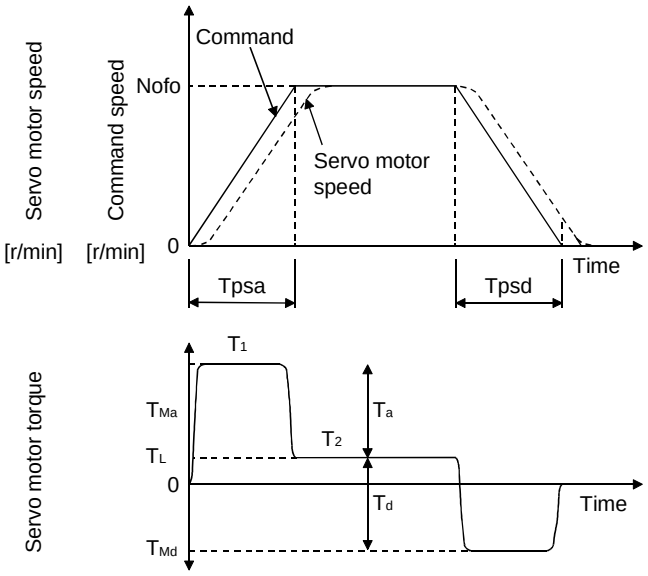


- Acceleration torque $T_a = \frac{(J_L+J_M)\cdot N_o}{9.55\times10^4}\cdot\frac{1}{T_{psa}}$ ..... (11-3)

- Deceleration torque $T_b = \frac{(J_L+J_M)\cdot N_o}{9.55\times10^4}\cdot\frac{1}{T_{psa}}$ ..... (11-4)

(3) Torques required for operation

Torques required for the servo motor are the highest during acceleration. If any of the torques obtained with Equations 11-3 to 11-7 exceeds the maximum servo motor torque, the servo motor speed cannot be increased as commanded. Confirm that the calculated value is lower than the servo motor's maximum torque. Since a friction load is normally applied during deceleration, only the acceleration torque needs to be considered.



$T_1=T_{Ma}=Ta+T_L$ ..... (11-5)

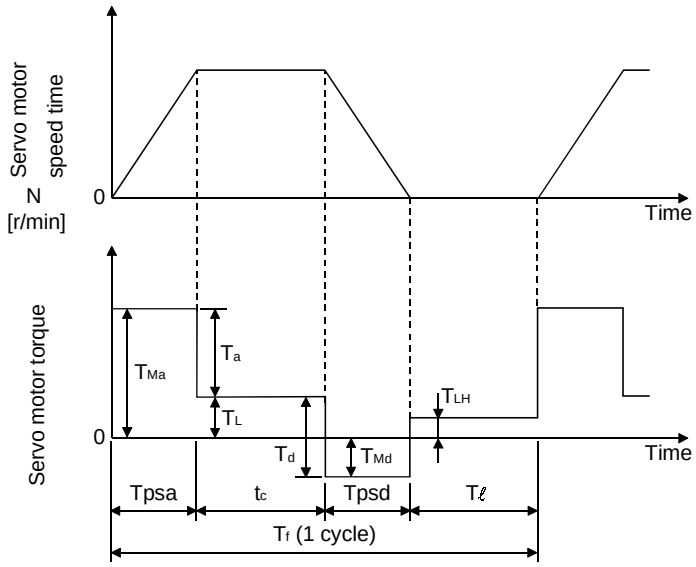
$T_2=T_L$ ..... (11-6)

$T_3=T_{Md}=-Td+T_L$ ..... (11-7)

Note: In the regenerative mode, the value found by Equation 11-7 is negative.

(4) Continuous effective load torque

If the torque required for the servo motor changes with time, the continuous effective load torque should be lower than the rated torque of the servo motor. There may be a servo motor torque delay at the start of acceleration or deceleration due to a delay in the control system. To simplify the calculation, however, it is assumed that constant acceleration and deceleration torques are applied during Tpsa and Tpsd. The following equation is used to calculate the continuous effective load torque in the following operation pattern:



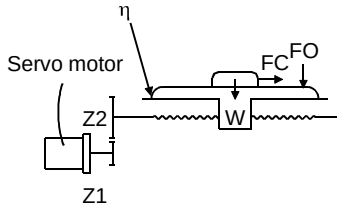
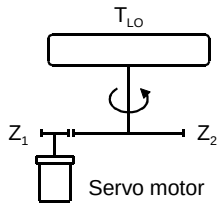
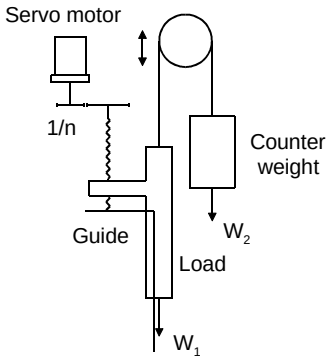
$$Tms=\sqrt{\frac{T^2_{Ma}\cdot T_{psa}+T^2_{L}\cdot tc+T^2_{Md}\cdot T_{psd}+T_{LH}\cdot t\ell}{tf}} \quad \text{.....(11-8)}$$

Note: T_{LH} indicates the torque applied during a servo motor stop. A large torque may be applied especially during a stop in vertical motion applications, and this must be fully taken into consideration. During vertical drive, the unbalanced torque T_U will become T_{LH}.

11 - 4 Load torque equations

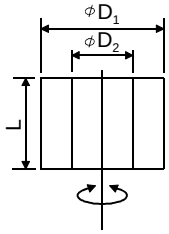
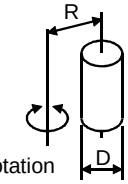
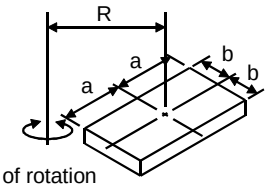
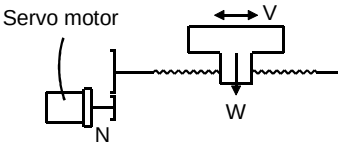
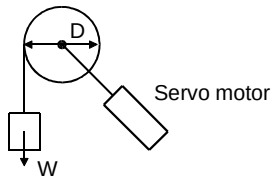
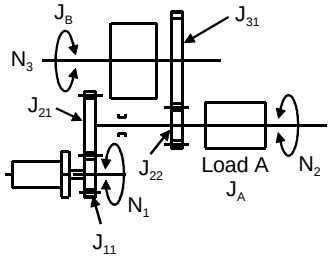
Typical load torque equations are indicated below:

Load Torque Equations

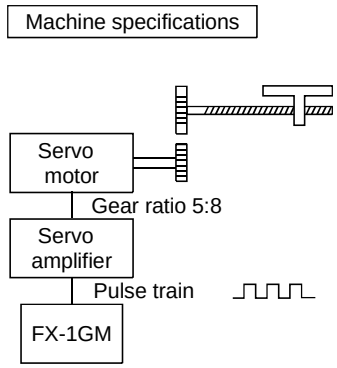
Type	Mechanism	Equation
Linear movement		$T_L=\frac{F}{2\times10^3\cdot\pi\cdot\eta}\cdot\frac{V}{N}=\frac{F\cdot\Delta S}{2\times10^3\cdot\pi\cdot\eta}$ .....(11-9) F : Force in the axial direction of the machine in linear motion [N] F in Equation 11-9 is obtained with Equation 11-10 when the table is moved, for example, as shown in the left diagram. $F=Fc+\mu\cdot(W\cdot g+Fo)$ .....(11-10) Fc : Force applied in the axial direction of the moving part [N] FG : Tightening force of the table guide surface [N] W : Full weight of the moving part [kg]
Rotary movement		$T_L+\frac{1}{n}\cdot\frac{1}{\eta}\cdot T_{LO}+T_F$ .....(11-11) T_F : Load friction torque converted into equivalent value on servo motor shaft [N ▪ m]
Vertical movement		During rise $T_L=T_U+T_F$ .....(11-12) During fall $T_L=-T_U\cdot\eta^2+T_F$ .....(11-13) T_F : Friction torque of the moving part [N ▪ m] $T_U=\frac{(W_1-W_2)\cdot g}{2\times10^3\cdot\pi\cdot\eta}\cdot\frac{V}{N}=\frac{(W_1-W_2)\cdot g\cdot\Delta S}{2\times10^3\cdot\pi\cdot\eta}$ .....(11-14) $T_F=\frac{\mu(W_1+W_2)\cdot g\cdot\Delta S}{2\times10^3\cdot\pi\cdot\eta}$ .....(11-15) W1 : Weight of load [kg] W2 : Weight of counterweight [kg]

11 - 5 Load inertia moment equations

Typical load inertia moment equations are indicated below:
Load Inertia Moment Equations

Type	Mechanism	Equation
Cylinder	Axis of rotation is on the cylinder center 	$J_{LO}=\frac{\pi\cdot\rho\cdot L}{32}\cdot(D_1^4-D_2^4)=\frac{W}{8}\cdot(D_1^2+D_2^2)$ ..... (11-16) ρ : Cylinder material density [kg/cm3] L : Cylinder length [cm] D1 : Cylinder outside diameter [cm] D2 : Cylinder inside diameter [cm] W : Cylinder weight [kg] Reference data: material density Iron : 7.8×10^{-3} [kg/cm3] Aluminum : 2.7×10^{-3} [kg/cm3] Copper : 8.96×10^{-3} [kg/cm3]
	Axis of rotation is off the cylinder center 	$J_{LO}=\frac{W}{8}\cdot(D^2+8R^2)$ ..... (11-17)
Square block		$J_{LO}=W\cdot\left(\frac{a^2+b^2}{3}+R^2\right)$ ..... (11-18) W : Square block weight [kg] a, b, R : Left diagram [cm]
Object which moves linearly		$J_L=W\cdot\frac{V}{600\cdot\omega}=W\cdot\left(\frac{1}{2\cdot\pi\cdot N}\cdot\frac{V}{10}\right)^2=W\cdot\left(\frac{\Delta S}{20\cdot\pi}\right)^2$ ..... (11-19) V : Speed of object moving linearly [mm/min] ΔS : Moving distance of object moving linearly per servo motor revolution [mm/rev] W : Object weight [kg]
Object that is hung with pulley		$J_L=W\cdot\left(\frac{D}{2}\right)^2+Jp$ ..... (11-20) JP : Pulley inertia moment [kg ▪ cm2] D : Pulley diameter [cm] W : Object weight [kg]
Converted load		$J_L=J_{11}+(J_{21}+J_{22}+J_A)\cdot\left(\frac{N_2}{N_1}\right)^2+(J_{31}+J_B)\cdot\left(\frac{N_3}{N_1}\right)^2$ ..... (11-21) JA, JB : Inertia moments of loads A, B [kg ▪ cm2] J11 to J31 : Inertia moments [kg ▪ cm2] N1 to N3 : Speed of each shaft [r/min]

11 - 6 Selection example



Speed of moving part during fast feed	Vo	=30000mm/min
Travel per pulse	$\Delta\ell$	=0.005mm
Travel	ℓ	=400mm
Positioning time	to	=within 1s
Number of feeds	40 times/min.	
(Operation cycle	tf	=1.5 s)
Gear ratio	n	=8/5
Moving part weight	W	=60kg
Drive system efficiency	η	=0.8
Friction coefficient	μ	=0.2
Ball screw lead	Pb	=16mm
Ball screw diameter		20mm
Ball screw length		500mm
Gear diameter (servo motor)		25mm
Gear diameter (load shaft)		40mm
Gear face width		10mm

(1) Servo motor speed

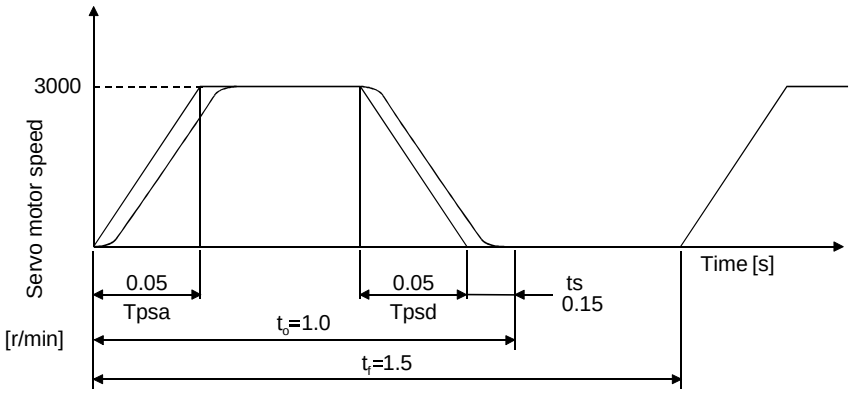
$$No = \frac{Vo}{Pb} \cdot n = 3000[r/min]$$

(2) Acceleration/deceleration time constant

$$Tpsa = Tpsd = to - \frac{\ell}{Vo/60} - ts = 0.05[s]$$

*ts: settling time.(Here, this is assumed to be 0.15s.)

(3) Operation pattern



(4) Load torque (converted into equivalent value on servo motor shaft)

Travel per servo motor revolution

$$\Delta S = P_b \cdot \frac{1}{n} = 10[mm]$$

$$T_L = \frac{\mu \cdot W \cdot g \cdot \Delta S}{2 \times 10^3 \cdot \pi \cdot \eta} = 0.23[N \cdot m]$$

(5) Load inertia moment (converted into equivalent value on servo motor shaft)

Moving part

$$J_{L1} = W \cdot \left(\frac{\Delta S}{20\pi}\right)^2 = 1.52[kg \cdot cm^2]$$

Ball screw

$$J_{L2} = \frac{\pi \cdot \rho \cdot L}{32} \cdot D^4 \cdot \left(\frac{1}{n}\right)^2 = 0.24[kg \cdot cm^2]$$

$*\rho = 7.8 \times 10^{-3}$ [kg · cm3]

Gear (servo motor shaft)

$$J_{L3} = \frac{\pi \cdot \rho \cdot L}{32} \cdot D^4 = 0.03[kg \cdot cm^2]$$

Gear (load shaft)

$$J_{L4} = \frac{\pi \cdot \rho \cdot L}{32} \cdot D^4 \cdot \left(\frac{1}{n}\right)^2 = 0.8[kg \cdot cm^2]$$

Full load inertia moment (converted into equivalent value on servo motor shaft)

$$J_L = J_{L1} + J_{L2} + J_{L3} + J_{L4} = 1.9[kg \cdot cm^2]$$

(6) Temporary selection of servo motor

Selection conditions

1) Load torque < servo motor's rated torque
2) Full load inertia moment < 30 × servo motor inertia moment

From the above, the HC-MF23 (200W) is temporarily selected.

(7) Acceleration and deceleration torques

Torque required for servo motor during acceleration

$$T_{Ma}=\frac{(J_L+J_M)\cdot N_o}{9.55\times10^4\cdot T_{psa}}+T_L=1.7[N\cdot m]$$

Torque required for servo motor during deceleration

$$T_{Md}=\frac{(J_L+J_M)\cdot N_o}{9.55\times10^4\cdot T_{psd}}+T_L=-1.2[N\cdot m]$$

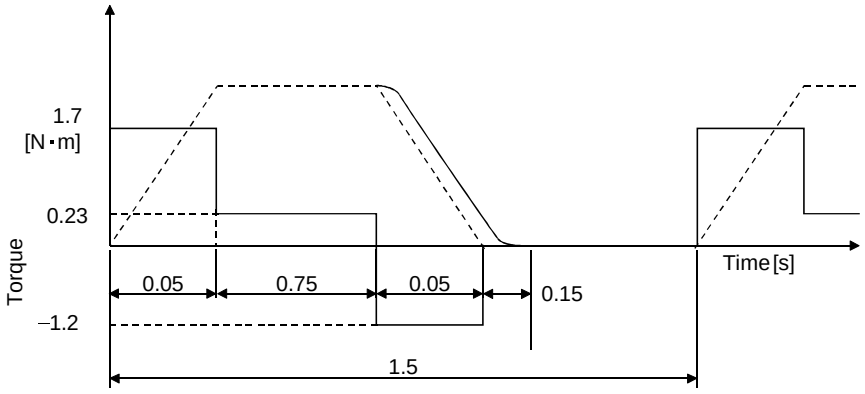
The torque required for the servo motor during deceleration must be lower than the servo motor's maximum torque.

(8) Continuous effective load torque

$$Trms=\sqrt{\frac{T_{Ma}^2\cdot T_{psa}+T_L^2\cdot tc+T_{Md}^2\cdot T_{psd}}{tf}}=0.41[N\cdot m]$$

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

(9) Torque pattern



(10) Selection results

The HC-MF23 servo motor and MR-J2-20B servo amplifier are selected.

1) During rapid feed

- Servo motor speed..... $N_o = 3000$ [r/min]
- Input pulse train frequency..... $f_o = 100$ [kpps]

2) Acceleration/deceleration time constant

$T_{psa} = T_{psd} = 0.05$[s]

REVISIONS

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

Print Data	*Manual Number	Revision
Nov.,1997	IB(NA)67288-A	First edition
Dec.,1998	IB(NA)67288-B	Section 1.1, (2) : Deletion of model explanation Section 1.1.2 : Addition of model make-up Section 2.4, (2) : Changing of the initial values of the parameters Section 3.2.2 : Table modification Section 3.2.3, (3) : Addition of HC-UF3000r/min series Section 3.2.3, (5) : Addition of HC-UF2000r/min series Section 3.2.4 : Overall change Section 6.1.2, (1) : Table modification Section 9.1, (2) : Addition of the characteristics of MR-J2-200A and MR-J2-350A Section 9.2, (1) : Table modification Section 9.3, (1) : Addition of HC-UF series Section 9.4 : Graph modification Section 10.1, (2) : Table addition Section 10.2 : Graph addition Section 10.4 : Machining dimension diagram modification Section 10.5.2, (3) : HC-SF series modification
Sep.,2000	IB(NA)67288-C	COMPLIANCE WITH EC DIRECTIVES 1 : (1), (2), (3) addition COMPLIANCE WITH EC DIRECTIVES 2 : (1) addition UL-C-UL Standard : (1) addition Flange table change (6) addition Section 1-1-2 (1) 1) : Rating plate change Section 1-4 (1) (2) : Addition of power factor improving reactors Section 2-2-3 : MEMO addition Section 2-4 (1) : Parameter list No. 10 initial value changed to 300 Parameter list No. 11 initial value changed to 300 Section 3-1-3 (2) 1) : Partial addition of diagram for use of external power supply Section 3-1-3 (2) 2) : Partial addition of diagram for lamp load Section 3-1-3 (3) : Modification of diagram for analog output Section 3-4 : Note 2 addition Section 3-5 : Connection diagram modification Section 3-7 3) : Addition Section 3-7 (1) : Connection diagram modification Section 3-7 (3) (b) : Partial addition Section 3-7 (3) (c) : Partial addition Section 3-7 (3) (d) : Modification Section 3-7 (3) (e) : Addition Section 6-1-4 : NOTICE addition Section 6-2-2 : Sentence addition Section 6-2-3 : Outline drawing change Section 6-2-6 (2) : Diode mounting diagram modification Section 6-2-6 (4) : Connection diagram description change Section 6-2-7 (2) : Rated sensitivity current changed to 8.0

Print Data	*Manual Number	Revision
		Chapter 7 (2) : Sentence addition Section 8-2 : Alarm 24 definition, cause and action changed. Alarm 25 definition, cause and action added. Partial addition to alarm 51 definition Section 8-3 : Warning 96 definition 1, 2 addition Section 9-1 : Sentence addition Section 9-2 (1) : HC-RF203, HC-UF202 - area values required for heat dissipation changed Section 9-2 (2) : Enclosed control box temperature gradient chart - temperature deleted Section 9-4 : Dynamic brake time constant chart changed Section 10-1 (2) : Addition of Note to HC-SF203, 353 HC-UF152 regenerative brake duty changed Section 10-2 : NOTICE addition Section 10-3 (4) 2) : Company changed to Nisseki-Mitsubishi Section 10-5-2 (1) : HC-MF series outline drawing changed Section 10-5-2 (5) : HC-UF3000 series outline drawing changed Section 10-5-3 (1) : HC-MF series outline drawing changed Section 10-5-3 (5) : HC-UF3000 series outline drawing changed Section 10-5-4 (3) : Changed Section 10-5-4 (4) : Changed Section 11-6 : All deleted from gravitational systems of units