MITSUBISHI ELECTRIC

General-Purpose AC Servo

MELSERVO-J3 Series

SSCNETⅢ interface

Drive Safety integrated

MODEL

MR-J3-□B Safety

SERVO AMPLIFIER

INSTRUCTION MANUAL

F

● Safety Instructions ●

Please read the instructions carefully before using the equipment.

Do not attempt to install, operate, maintain or inspect the converter unit, servo amplifier (drive unit) and servo motor until you have read through this Instruction Manual, Installation guide, Servo motor Instruction Manual (Vol.2) and appended documents carefully and can use the equipment correctly. Do not use the converter unit, servo amplifier (drive unit) and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

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

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

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

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

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

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring or inspection, turn off the power and wait for 15 minutes or more (20 minutes or for drive unit 30kW or more) until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) (L＋ and L－ for drive unit 30kW or more) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier (converter unit), whether the charge lamp is off or not.
- Connect the converter unit, servo amplifier (drive unit) 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 converter unit, servo amplifier (drive unit) and servo motor until they have been installed. Otherwise, it may cause 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, it may cause an electric shock.
- During power-on or operation, do not open the front cover. Otherwise, it may cause an electric shock.
- Do not operate the converter unit and servo amplifier (drive unit) with the front cover removed. High-voltage terminals and charging area are exposed and you may get an electric shock.
- Except for wiring or periodic inspection, do not remove the front cover even if the power is off. The converter unit and servo amplifier (drive unit) is charged and you may get an electric shock.
- To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
- When using a residual current device (RCD), select type B.
- To avoid an electric shock, insulate the connections of the power supply terminals.

2. To prevent fire, note the following

⚠ CAUTION

- Install the converter unit, servo amplifier (drive unit), servo motor and regenerative resistor on incombustible material. Installing them directly or close to combustibles will lead to a fire.
- Always connect a magnetic contactor between the main circuit power supply and L_1, L_2, and L_3 of the converter unit, servo amplifier (drive unit), to configure a circuit that shuts down the power supply on the side of the converter unit, servo amplifier (drive unit) power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the converter unit, servo amplifier (drive unit) malfunctions.
- When a regenerative resistor is used, use an alarm signal to switch main power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the converter unit, servo amplifier (drive unit), and servo motor.
- Always connect a molded-case circuit breaker to the power supply of the servo amplifier (converter unit).

3. To prevent injury, note the following.

⚠ CAUTION

- Only the voltage specified in the instruction manual should be applied to each terminal, Otherwise, a burst, damage, etc. may occur.
- Connect the terminals correctly to prevent a burst, damage, etc.
- Ensure that polarity (＋, －) is correct. Otherwise, a burst, damage, etc. may occur.
- Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the converter unit and servo amplifier (drive unit) heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off.
- During operation, never touch the rotating parts of the servo motor. Otherwise, it may cause injury.

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 mass.
- Stacking in excess of the specified number of product packages is not allowed.
- Do not carry the servo motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the converter unit and servo amplifier (drive unit). The converter unit and servo amplifier (drive unit) may drop.
- Install the converter unit and servo amplifier (drive unit) in a load-bearing place in accordance with the Instruction Manual.
- Do not get on or put heavy load on the equipment.
- The converter unit, servo amplifier (drive unit), and servo motor must be installed in the specified direction.
- Leave specified clearances between the converter unit, servo amplifier (drive unit), and control enclosure walls or other equipment.
- Do not install or operate the converter unit, servo amplifier (drive unit), and servo motor which has been damaged or has any parts missing.
- Do not block intake and exhaust areas of the converter unit, the servo amplifier (drive unit) and the servo motor with a cooling fan. Otherwise, it may cause a malfunction.
- Do not drop or strike converter unit, servo amplifier (drive unit), or servo motor. Isolate from all impact loads.
- 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.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. Otherwise, the encoder may malfunction.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.

<table>
<tr><th colspan="6">⚠ CAUTION</th></tr>
</table>

・When you keep or use it, please fulfill the following environmental conditions.

<table>
<tr><td colspan="3" rowspan="2">Item</td><td colspan="3">Environmental conditions</td></tr>
<tr><td>Converter unit・servo amplifier (drive unit)</td><td colspan="2">Servo motor</td></tr>
<tr><td rowspan="4">Ambient temperature</td><td rowspan="2">In operation</td><td>[°C]</td><td>0 to 55 (non-freezing)</td><td colspan="2">0 to 40 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>32 to 131 (non-freezing)</td><td colspan="2">32 to 104 (non-freezing)</td></tr>
<tr><td rowspan="2">In storage</td><td>[°C]</td><td>−20 to 65 (non-freezing)</td><td colspan="2">−15 to 70 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>−4 to 149 (non-freezing)</td><td colspan="2">5 to 158 (non-freezing)</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td colspan="2">In operation</td><td>90%RH or less (non-condensing)</td><td colspan="2">80%RH or less (non-condensing)</td></tr>
<tr><td colspan="2">In storage</td><td colspan="3">90%RH or less (non-condensing)</td></tr>
<tr><td colspan="3">Ambience</td><td colspan="3">Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt</td></tr>
<tr><td colspan="3">Altitude</td><td colspan="3">Max. 1000m above sea level</td></tr>
<tr><td rowspan="8">(Note) Vibration</td><td colspan="2" rowspan="8">[m/s^2]</td><td rowspan="8">5.9 or less at 10 to 55Hz (directions of X, Y and Z axes)</td><td>HF-MP series HF-KP series</td><td>X, Y: 49 m/s^2</td></tr>
<tr><td>HF-SP51・81 HF-SP52 to 152
HF-SP524 to 1524 HC-RP Series
HC-UP72・152
HF-JP53 to 503・11K1M・15K1M
HF-JP534 to 5034・11K1M4・15K1M4</td><td>X, Y: 24.5 m/s^2</td></tr>
<tr><td>HF-SP121・201 HF-SP202・352
HF-SP2024・3524 HC-UP202 to 502</td><td>X: 24.5 m/s^2 Y: 49 m/s^2</td></tr>
<tr><td>HF-SP301・421 HF-SP502・702
HF-SP5024・7024
HF-JP703・903
HF-JP7034・9034</td><td>X: 24.5 m/s^2 Y: 29.4 m/s^2</td></tr>
<tr><td>HC-LP52 to 152</td><td>X: 9.8 m/s^2 Y: 24.5 m/s^2</td></tr>
<tr><td>HC-LP202 to 302</td><td>X: 19.6 m/s^2 Y: 49 m/s^2</td></tr>
<tr><td>HA-LP601 to 12K1 HA-LP701M to 15K1M
HA-LP502 to 22K2 HA-LP6014・12K14
HA-LP701M4・15K1M4 HA-LP11K24 to 22K24</td><td>X: 11.7 m/s^2 Y: 29.4 m/s^2</td></tr>
<tr><td>HA-LP15K1 to 37K1 HA-LP22K1M to 37K1M
HA-LP30K2・37K2 HA-LP15K14 to 37K14
HA-LP22K1M4 to 50K1M4 HA-LP30K24 to 55K24</td><td>X, Y: 9.8 m/s^2</td></tr>
</table>

Note. Except the servo motor with reduction gear.

・When the equipment has been stored for an extended period of time, contact your local sales office.
・When treating the servo amplifier be careful about the edged parts such as the corners of the servo amplifier.
・The servo amplifier must be installed in the metal cabinet.

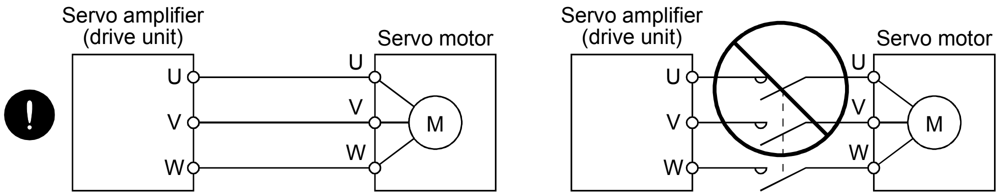
(2) Wiring

<table>
<tr><th>⚠ CAUTION</th></tr>
</table>

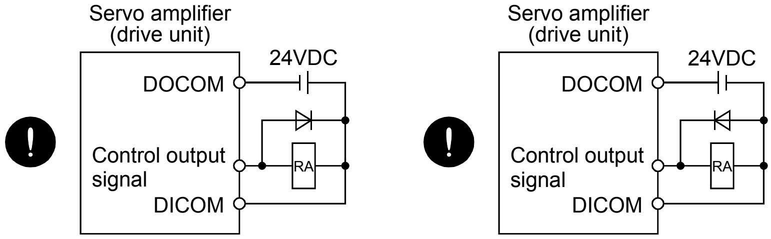
・Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly.
・Do not install a power capacitor, surge killer or radio noise filter (FR-BIF(-H) option) on the output side of the servo motor and servo amplifier (drive unit).
・Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier (drive unit) and servo motor.

CAUTION

- Connect the servo motor power terminal (U, V, W) to the servo motor power input terminal (U, V, W) directly. Do not let a magnetic contactor, etc. intervene.



- Do not connect AC power directly to the servo motor. Otherwise, it may cause a malfunction.
- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.



- When the cable is not tightened enough to the terminal block (connector), the cable or terminal block (connector) may generate heat because of the poor contact. Be sure to tighten the cable with specified torque.

(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 of the servo amplifier (drive unit) 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 converter unit and servo amplifier (drive unit).
- Burning or breaking a converter unit and servo amplifier (drive unit) may cause a toxic gas. Do not burn or break a converter unit and servo amplifier (drive unit).
- Use the converter unit and servo amplifier (drive unit) with the specified servo motor.

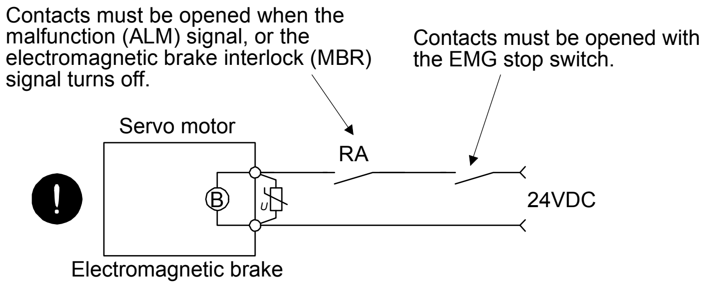
⚠ CAUTION

- 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 ball screw 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 an electromagnetic brake or an external brake mechanism for the purpose of prevention.
- Configure a electromagnetic brake circuit so that it is activated also by an external EMG stop switch.



- When any alarm has occurred, eliminate its cause, ensure safety, and deactivate the alarm before restarting operation.
- Provide an adequate protection to prevent unexpected restart after an instantaneous power failure.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- With age, the electrolytic capacitor of the converter unit and servo amplifier (drive unit) 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 contact your local sales office.

(7) General instruction

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

● DISPOSAL OF WASTE ●

Please dispose a converter unit, servo amplifier (drive unit), battery (primary battery) and other options according to your local laws and regulations.

⚠ EEP-ROM life

The number of write times to the EEP-ROM, which stores parameter settings, etc., is limited to 100,000. If the total number of the following operations exceeds 100,000, the converter unit, servo amplifier (drive unit) and/or converter unit may fail when the EEP-ROM reaches the end of its useful life.

・Write to the EEP-ROM due to parameter setting changes
・Write to the EEP-ROM due to device changes

Precautions for Choosing the Products

Mitsubishi will not be held liable for damage caused by factors found not to be the cause of Mitsubishi; machine damage or lost profits caused by faults in the Mitsubishi products; damage, secondary damage, accident compensation caused by special factors unpredictable by Mitsubishi; damages to products other than Mitsubishi products; and to other duties.

STO function of MR-J3-□B Safety servo amplifier

When using the STO function of the MR-J3-□B Safety servo amplifier, refer to chapter 15.
For the MR-J3-D05 safety logic unit, refer to App. 10.

COMPLIANCE WITH THE EUROPEAN EC DIRECTIVES

Refer to App. 8 for the compliance with EC Directives.

COMPLIANCE WITH UL/CSA STANDARD

Refer to App. 9 for the compliance with UL/CSA standard.

<<About the manuals>>

This Instruction Manual and the MELSERVO Servo Motor Instruction Manual (Vol.2) are required if you use the General-Purpose AC servo MR-J3-□S for the first time. Always purchase them and use the MR-J3-□S safely.

Relevant manuals

Manual name	Manual No.
MELSERVO-J3 Series Instructions and Cautions for Safe Use of AC Servos (Enclosed in converter unit and servo amplifier (drive unit).)	IB(NA)0300077
MELSERVO Servo Motor Instruction Manual (Vol.2)	SH(NA)030041
SSCNETⅢ Compatible Linear Servo MR-J3-□B-RJ004 Instruction Manual (Note)	SH(NA)030054
EMC Installation Guidelines	IB(NA)67310

Note. To use the servo as the fully closed loop system, refer to this manual regarding the linear encoder.

Details of MR-J3-CR55K(4) and MR-J3-DU30K□S(4) to MR-J3-DU55K□S4 are described in chapter 13 of this instruction manual.
For the products of 30kW or more, refer to chapter 13.

<<Wiring>>

Wires mentioned in this instruction manual are selected based on the ambient temperature of 40℃ (104℉).

CONTENTS

1. FUNCTIONS AND CONFIGURATION 1 - 1 to 1 -30

1.1 Summary 1 - 1
1.2 Function block diagram 1 - 2
1.3 Servo amplifier standard specifications 1 - 5
1.4 Function list 1 - 8
1.5 Model code definition 1 - 9
1.6 Combination with servo motor 1 -10
1.7 Structure 1 -12
1.7.1 Parts identification 1 -12
1.7.2 Removal and reinstallation of the front cover 1 -19
1.8 Configuration including auxiliary equipment 1 -22

2. INSTALLATION 2 - 1 to 2 - 8

2.1 Installation direction and clearances 2 - 1
2.2 Keep out foreign materials 2 - 4
2.3 Cable stress 2 - 4
2.4 SSCNETⅢ cable laying 2 - 4
2.5 Inspection items 2 - 6
2.6 Parts having service lives 2 - 7

3. SIGNALS AND WIRING 3 - 1 to 3 -62

3.1 Input power supply circuit 3 - 2
3.2 I/O signal connection example 3 -13
3.2.1 Sink I/O interface 3 -13
3.2.2 Source I/O interface 3 -15
3.3 Explanation of power supply system 3 -16
3.3.1 Signal explanations 3 -16
3.3.2 Power-on sequence 3 -17
3.3.3 CNP1, CNP2, CNP3 wiring method 3 -18
3.4 Connectors and signal arrangements 3 -26
3.5 Signal (device) explanations 3 -27
3.6 Function explanation 3 -31
3.6.1 Forced stop deceleration function (SS1) 3 -31
3.6.2 Base cut delay time function 3 -32
3.6.3 Vertical axis freefall prevention function 3 -33
3.6.4 Residual risks of the forced stop function (EM2) 3 -33
3.7 Alarm occurrence timing chart 3 -34
3.7.1 When the forced stop deceleration function is valid 3 -34
3.7.2 When the forced stop deceleration function is invalid 3 -35
3.7.3 When SSCNETⅢ communication brake occurs 3 -35
3.8 Interfaces 3 -36
3.8.1 Internal connection diagram 3 -36
3.8.2 Detailed description of interfaces 3 -37

3.8.3 Source I/O interfaces .... 3 -39
3.9 Treatment of cable shield external conductor .... 3 -40
3.10 SSCNETⅢ cable connection .... 3 -41
3.11 Connection of servo amplifier and servo motor .... 3 -43
3.11.1 Connection instructions .... 3 -43
3.11.2 Power supply cable wiring diagrams .... 3 -44
3.12 Servo motor with an electromagnetic brake .... 3 -54
3.12.1 Safety precautions .... 3 -54
3.12.2 Timing charts .... 3 -55
3.12.3 Wiring diagrams (HF-MP series・HF-KP series servo motor) .... 3 -58
3.13 Grounding .... 3 -60
3.14 Control axis selection .... 3 -61

4. STARTUP 4 - 1 to 4 -14

4.1 Switching power on for the first time .... 4 - 1
4.1.1 Startup procedure .... 4 - 2
4.1.2 Wiring check .... 4 - 3
4.1.3 Surrounding environment .... 4 - 4
4.2 Startup .... 4 - 5
4.3 Servo amplifier display .... 4 - 7
4.4 Test operation .... 4 - 9
4.5 Test operation mode .... 4 -10
4.5.1 Test operation mode in MR Configurator .... 4 -10
4.5.2 Motor-less operation in controller .... 4 -13

5. PARAMETERS 5 - 1 to 5 -42

5.1 Basic setting parameters (No.PA□□) .... 5 - 1
5.1.1 Parameter list .... 5 - 2
5.1.2 Parameter write inhibit .... 5 - 3
5.1.3 Selection of regenerative option .... 5 - 4
5.1.4 Using absolute position detection system .... 5 - 5
5.1.5 Forced stop 1 (EM1) and forced stop 2 (EM2) selection .... 5 - 6
5.1.6 Auto tuning .... 5 - 9
5.1.7 In-position range .... 5 -10
5.1.8 Selection of servo motor rotation direction .... 5 -11
5.1.9 Encoder output pulse .... 5 -12
5.1.10 Selecting a control mode .... 5 -13
5.2 Gain/filter parameters (No.PB□□) .... 5 -15
5.2.1 Parameter list .... 5 -15
5.2.2 Detail list .... 5 -16
5.3 Extension setting parameters (No.PC□□) .... 5 -23
5.3.1 Parameter list .... 5 -23
5.3.2 List of details .... 5 -24
5.3.3 Analog monitor .... 5 -29
5.3.4 Alarm history clear .... 5 -33
5.4 I/O setting parameters (No.PD□□) .... 5 -34
5.4.1 Parameter list .... 5 -34

5.4.2 List of details.......... 5 -35
5.5 Extension control parameters (No.PE□□).......... 5 -38
5.5.1 Parameter list.......... 5 -38
5.5.2 List of details.......... 5 -39

6. GENERAL GAIN ADJUSTMENT 6 - 1 to 6 -12

6.1 Different adjustment methods.......... 6 - 1
6.1.1 Adjustment on a single servo amplifier.......... 6 - 1
6.1.2 Adjustment using MR Configurator.......... 6 - 2
6.2 Auto tuning.......... 6 - 3
6.2.1 Auto tuning mode.......... 6 - 3
6.2.2 Auto tuning mode basis.......... 6 - 4
6.2.3 Adjustment procedure by auto tuning.......... 6 - 5
6.2.4 Response level setting in auto tuning mode.......... 6 - 6
6.3 Manual mode.......... 6 - 7
6.4 Interpolation mode.......... 6 -11
6.5 Differences between MELSERVO-J2-Super and MELSERVO-J3 in auto tuning.......... 6 -12

7. SPECIAL ADJUSTMENT FUNCTIONS 7 - 1 to 7 -18

7.1 Function block diagram.......... 7 - 1
7.2 Adaptive filter Ⅱ.......... 7 - 2
7.3 Machine resonance suppression filter.......... 7 - 4
7.4 Advanced vibration suppression control.......... 7 - 6
7.5 Low-pass filter.......... 7 -11
7.6 Gain changing function.......... 7 -11
7.6.1 Applications.......... 7 -11
7.6.2 Function block diagram.......... 7 -12
7.6.3 Parameters.......... 7 -13
7.6.4 Gain changing procedure.......... 7 -15
7.7 Vibration suppression control filter 2.......... 7 -17

8. TROUBLESHOOTING 8 - 1 to 8 -16

8.1 Alarms and warning list.......... 8 - 1
8.2 Remedies for alarms.......... 8 - 3
8.3 Remedies for warnings.......... 8 -13
8.4 Detailed explanation of linear encoder error 1 (2A).......... 8 -16

9. OUTLINE DRAWINGS 9 - 1 to 9 -12

9.1 Servo amplifier.......... 9 - 1
9.2 Connector.......... 9 -10

10. CHARACTERISTICS 10- 1 to 10-12

10.1 Overload protection characteristics.......... 10- 1
10.2 Power supply equipment capacity and generated loss.......... 10- 3
10.3 Dynamic brake characteristics.......... 10- 7

10.3.1 Dynamic brake operation 10- 7
10.3.2 The dynamic brake at the load inertia moment 10-11
10.4 Cable flexing life 10-12
10.5 Inrush currents at power-on of main circuit and control circuit 10-12

11. OPTIONS AND AUXILIARY EQUIPMENT 11- 1 to 11-108

11.1 Cable/connector sets 11- 1
11.1.1 Combinations of cable/connector sets 11- 2
11.1.2 Encoder cable/connector sets 11-12
11.1.3 Motor power supply cables 11-27
11.1.4 Motor brake cables 11-29
11.1.5 MR-D05UDL3M-B STO cable 11-31
11.1.6 SSCNET cable 11-32
11.2 Regenerative options 11-34
11.3 FR-BU2-(H) Brake unit 11-48
11.3.1 Selection 11-49
11.3.2 Brake unit parameter setting 11-49
11.3.3 Connection example 11-50
11.3.4 Outline dimension drawings 11-57
11.4 Power regenerative converter 11-59
11.5 Power regeneration common converter 11-62
11.6 External dynamic brake 11-70
11.7 Junction terminal block PS7DW-20V14B-F (recommended) 11-75
11.8 MR Configurator 11-76
11.9 Battery MR-J3BAT 11-78
11.10 Heat sink outside mounting attachment (MR-J3ACN) 11-79
11.11 Selection example of wires 11-81
11.12 Molded-case circuit breakers, fuses, magnetic contactors 11-87
11.13 Power factor improving DC reactors 11-88
11.14 Power factor improving AC reactors 11-90
11.15 Relays (recommended) 11-91
11.16 Noise reduction techniques 11-92
11.17 Earth-leakage current breaker 11-100
11.18 EMC filter (recommended) 11-103

12. ABSOLUTE POSITION DETECTION SYSTEM 12- 1 to 12- 6

12.1 Features 12- 1
12.2 Specifications 12- 2
12.3 Battery installation procedure 12- 3
12.3.1 When replacing battery with the control circuit power ON 12- 3
12.3.2 When replacing battery with the control circuit power OFF 12- 3
12.4 Battery installation procedure 12- 4
12.5 Procedure to replace battery with the control circuit power OFF 12- 4
12.5.1 Preparation for battery replacement 12- 4
12.5.2 Replacement procedure 12- 5
12.6 Confirmation of absolute position detection data 12- 6

13. SERVO AMPLIFIERS WITH A LARGE CAPACITY (30k TO 55kW)	13- 1 to 13-104

13.1 Functions and menus 13- 1
13.1.1 Function block diagram 13- 2
13.1.2 Packing list 13- 4
13.1.3 Standard specifications 13- 5
13.1.4 Model definition 13- 8
13.1.5 Combinations of converter units, drive units and servo motors 13- 9
13.1.6 Parts identification 13-10
13.1.7 Removal and reinstallation of the terminal block cover 13-13
13.1.8 Servo system with auxiliary equipment 13-19
13.2 Installation 13-20
13.2.1 Installation direction and clearances 13-21
13.2.2 Inspection 13-22
13.3 Signals and wiring 13-23
13.3.1 Magnetic contactor control connector (CNP1) 13-24
13.3.2 Input power supply circuit 13-26
13.3.3 Terminal 13-32
13.3.4 How to use the connection bars 13-33
13.3.5 Connectors and signal arrangements 13-34
13.3.6 Converter unit signal (device) explanations 13-36
13.3.7 Timing chart 13-38
13.3.8 Servo motor-side details 13-48
13.4 Display section and operation section of the converter unit 13-50
13.4.1 Display flowchart 13-50
13.4.2 Status display mode 13-51
13.4.3 Diagnostic mode 13-52
13.4.4 Alarm mode 13-54
13.4.5 Parameter mode 13-55
13.5 Parameters for converter unit 13-56
13.5.1 Parameter list 13-56
13.5.2 List of details 13-57
13.6 Troubleshooting 13-58
13.6.1 Converter unit 13-58
13.6.2 Drive unit 13-63
13.7 Outline drawings 13-65
13.7.1 Converter unit (MR-J3-CR55K(4)) 13-65
13.7.2 Drive unit 13-66
13.8 Characteristics 13-68
13.8.1 Overload protection characteristics 13-68
13.8.2 Power supply equipment capacity and generated loss 13-69
13.8.3 Dynamic brake characteristics 13-70
13.8.4 Inrush currents at power-on of main circuit and control circuit 13-73
13.9 Options 13-73
13.9.1 Cables and connectors 13-73
13.9.2 Regenerative option 13-76
13.9.3 External dynamic brake 13-81

13.9.4 Selection example of wires 13-84
13.9.5 Molded-case circuit breakers, fuses, magnetic contactors 13-86
13.9.6 Power factor improving DC reactor 13-87
13.9.7 Line noise filter (FR-BLF) 13-88
13.9.8 Earth-leakage current breaker 13-89
13.9.9 EMC filter (recommended) 13-91
13.9.10 FR-BU2-(H) Brake Unit 13-93

14. FULLY CLOSED LOOP SYSTEM 14- 1 to 14-28

14.1 Functions and configuration 14- 1
14.1.1 Control block diagram 14- 1
14.1.2 Selecting procedure of control mode 14- 3
14.1.3 System configuration 14- 4
14.2 Load-side encoder 14- 5
14.2.1 Compatible linear encoder list 14- 5
14.2.2 Configuration diagram 14- 6
14.3 Operation and functions 14- 7
14.3.1 Startup 14- 7
14.3.2 Home position return 14-14
14.3.3 Operation from controller 14-19
14.3.4 Fully closed loop control error detection functions 14-21
14.3.5 Absolute position detection system under fully closed loop system 14-23
14.3.6 About MR Configurator 14-24

15. USING STO FUNCTION OF MR-J3-□B SAFETY 15- 1 to 15-12

15.1 Introduction 15- 1
15.1.1 Summary 15- 1
15.1.2 Terms related to safety 15- 1
15.1.3 Cautions 15- 2
15.1.4 Residual risk 15- 2
15.1.5 Specifications 15- 4
15.1.6 Maintenance 15- 4
15.2 STO I/O signal connectors (CN8) 15- 5
15.2.1 Signal layouts 15- 5
15.2.2 Signal (device) explanations 15- 5
15.2.3 How to pull out the STO cable 15- 6
15.3 Connection example 15- 7
15.3.1 Connection example for CN8 connector 15- 7
15.3.2 External I/O signal connection example using an MR-J3-D05 safety logic unit 15- 8
15.3.3 External I/O signal connection example using a motion controller 15- 9
15.3.4 I/O signal connection example using an external safety relay unit 15-10
15.4 Detailed description of interfaces 15-11
15.4.1 Sink I/O interface 15-11
15.4.2 Source I/O interfaces 15-12

APPENDIX	App.- 1 to App.-39

App. 1 Parameter list..App.- 1
App. 2 Signal layout recording paper ....App.- 3
App. 3 Twin type connector: Outline drawing for 721-2105/026-000(WAGO)..App.- 4
App. 4 Selection example of servo motor power cable ....App.- 5
App. 5 Handling of AC servo amplifier batteries for the United Nations
Recommendations on the Transport of Dangerous Goods...App.- 6
App. 6 Symbol for the new EU Battery Directive ....App.- 7
App. 7 Differences among MR-J3-□B, MR-J3-□B-RJ006 and MR-J3-□S..App.- 8
App. 8 Compliance with the European EC directives ....App.- 9
App. 9 Conformance with UL/CSA standard.. App.-12
App. 10 MR-J3-D05 Safety logic unit App.-20
App. 11 EC declaration of conformity.. App.-38

MEMO

1. FUNCTIONS AND CONFIGURATION

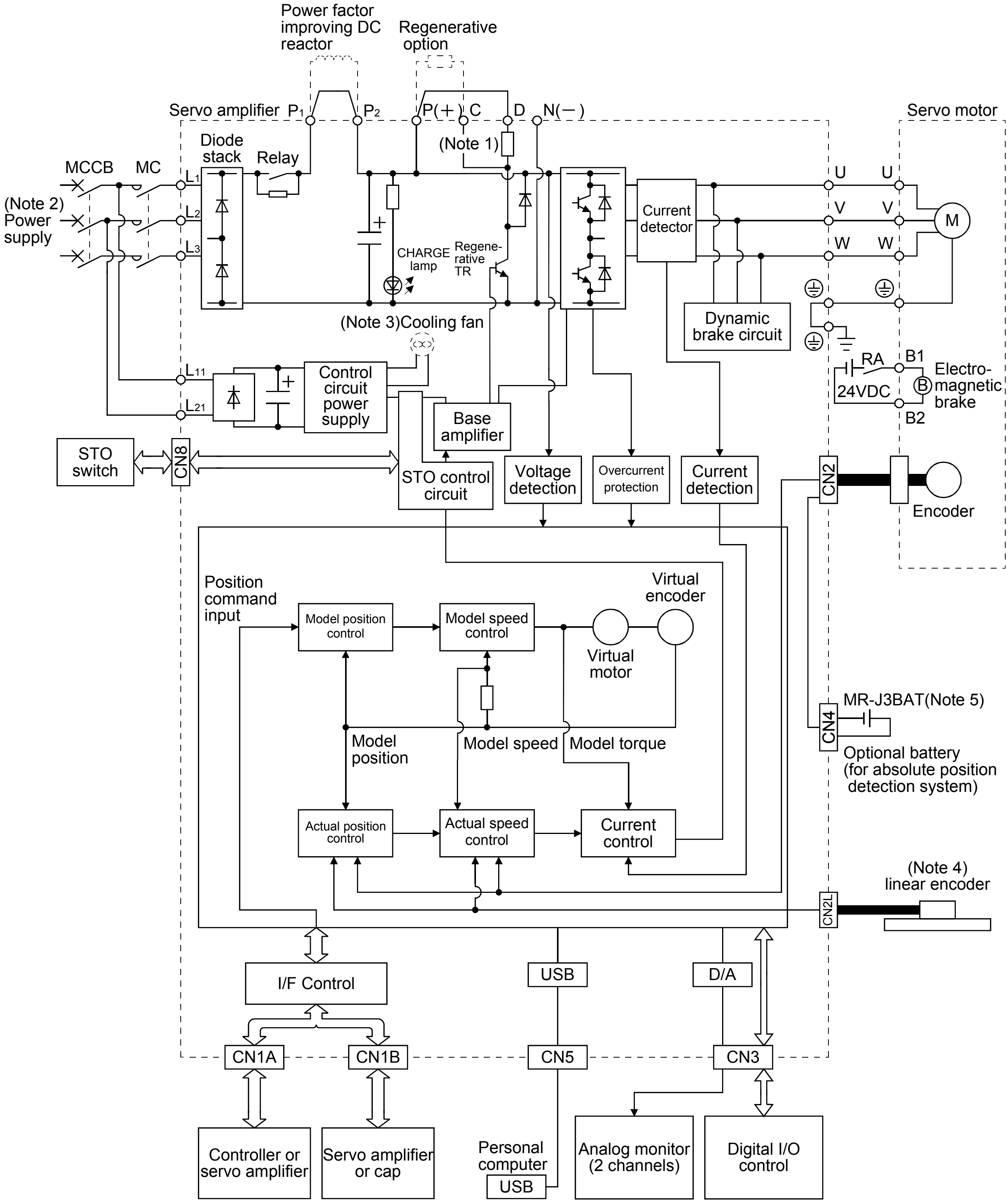
1.1 Summary

- MR-J3-□S and MR-J3-D05 meet IEC/EN 61508 SIL 2 and ISO/EN ISO 13849-1 category 3 PL d. Safe torque off (STO) function is integrated into the MR-J3-□S. Safe stop 1 (SS1) function can be realized by adding the MR-J3-D05.
- User's system can satisfy stop category 0 by using the safe torque off (STO) function.
- User's system can satisfy stop category 0 and 1 by using the safe torque off (STO) and safe stop 1 (SS1) functions.
- Mounting, wiring and connectors are compatible with those of MR-J3-B. Thus, MR-J3-B can be easily replaced by the MR-J3-□S using the existing connections. The safety functions are accessible via the new CN8 connector on the MR-J3-□S.

1.2 Function block diagram

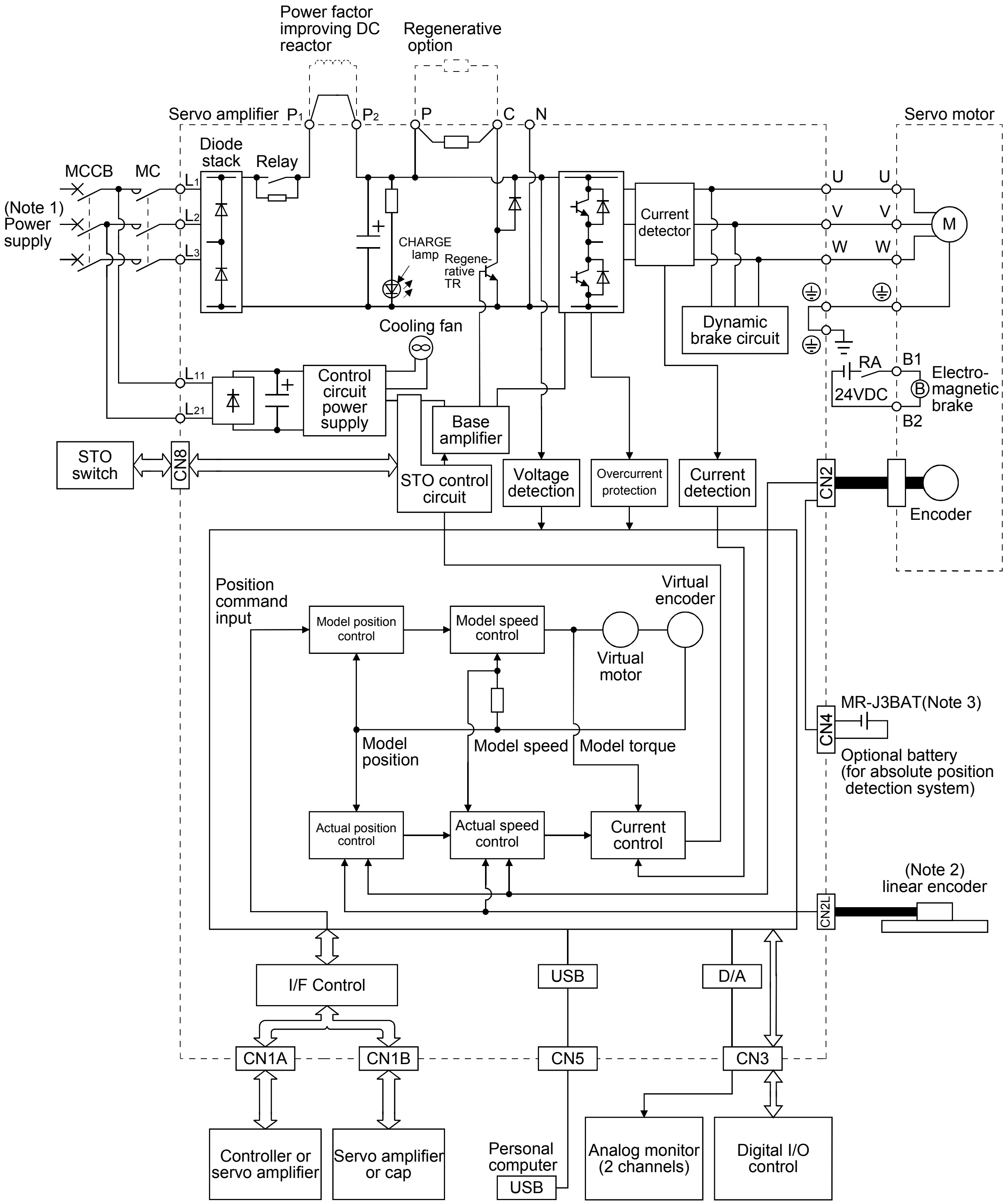
The function block diagram of this servo is shown below.

(1) MR-J3-350□S or less・MR-J3-200□S4 or less



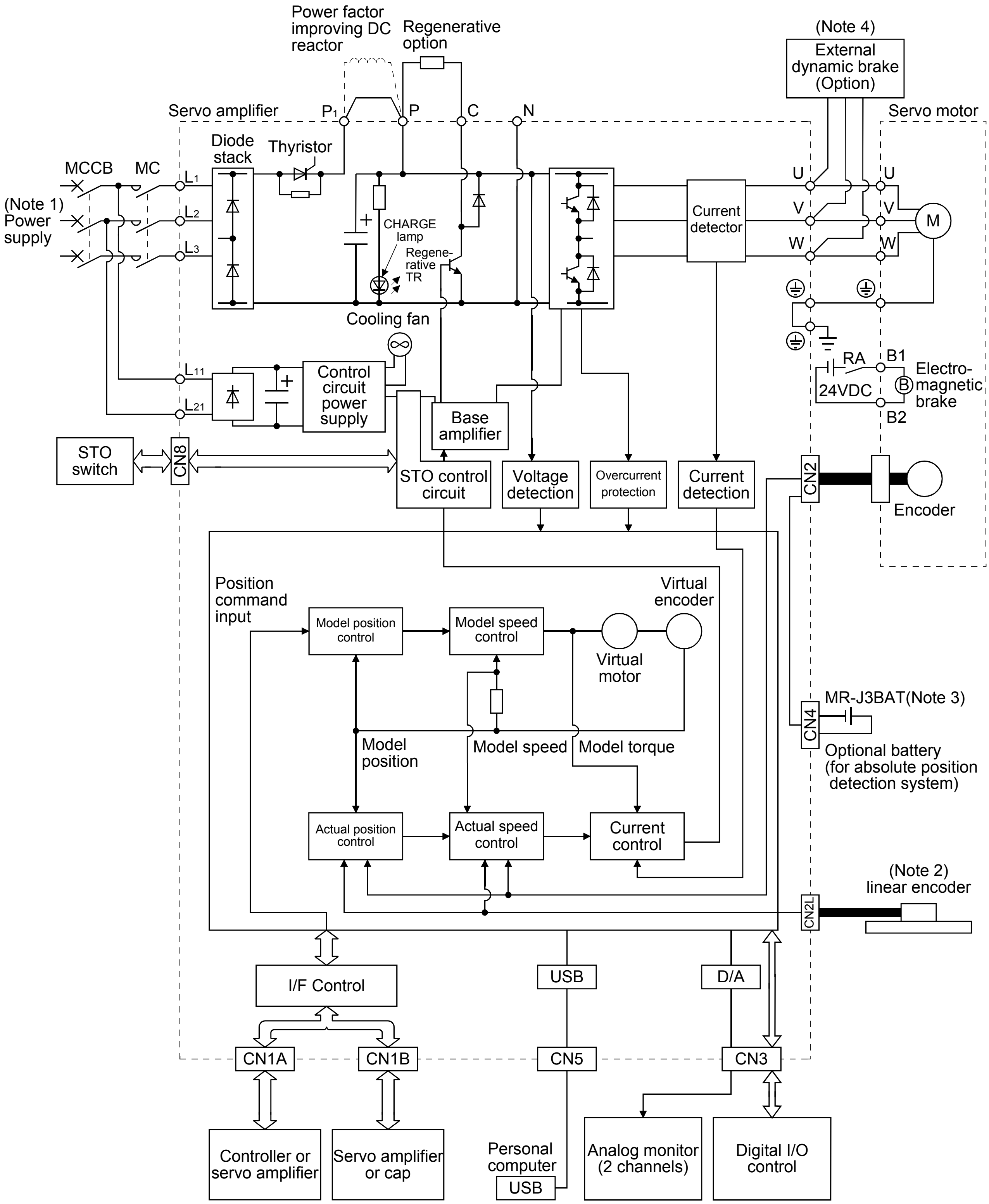
Note 1. The built-in regenerative resistor is not provided for the MR-J3-10□S(1).
2. For 1-phase 200 to 230VAC, connect the power supply to L_1, L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. Refer to section 1.3 for the power supply specification.
3. Servo amplifiers MR-J3-70□S or greater have a cooling fan.
4. When fully closed control is used.
5. When configuring absolute position detection system in fully closed control, battery is not required.

(2) MR-J3-350□S4 · MR-J3-500□S(4) · MR-J3-700□S(4)



Note 1. Refer to section 1.3 for the power supply specification.
2. When fully closed control is used.
3. When configuring absolute position detection system in fully closed control, battery is not required.

(3) MR-J3-11K□S(4) to 22K□S(4)



Note 1. Refer to section 1.3 for the power supply specification.
2. When fully closed control is used.
3. When configuring absolute position detection system in fully closed control, battery is not required.
4. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

1.3 Servo amplifier standard specifications

(1) 200V class, 100V class

Servo amplifier / Item		MR-J3-□S													MR-J3-□S1		
Item		10B	20B	40B	60B	70B	100B	200B	350B	500B	700B	11KB	15KB	22KB	10B	20B	40B
Output	Rated voltage	3-phase 170VAC															
Output	Rated current [A]	1.1	1.5	2.8	3.2	5.8	6.0	11.0	17.0	28.0	37.0	68.0	87.0	126.0	1.1	1.5	2.8
Main circuit power supply	Voltage/frequency	3-phase or 1-phase 200 to 230VAC, 50/60Hz					3-phase 200 to 230VAC, 50/60Hz								1-phase 100V to 120VAC, 50/60Hz		
Main circuit power supply	Rated current [A]	0.9	1.5	2.6	(Note 3) 3.2	3.8	5.0	10.5	16.0	21.7	28.9	46.0	64.0	95.0	3.0	5.0	9.0
Main circuit power supply	Permissible voltage fluctuation	3-phase or 1-phase 200 to 230VAC: 170 to 253VAC					3-phase 170 to 253VAC								1-phase 85 to 132VAC		
Main circuit power supply	Permissible frequency fluctuation	Within±5%															
Main circuit power supply	Power supply capacity	Refer to section 10.2															
Main circuit power supply	Inrush current	Refer to section 10.5															
Control circuit power supply	Voltage, frequency	1-phase 200 to 230VAC, 50/60Hz													1-phase 100 to 120VAC, 50/60Hz		
Control circuit power supply	Rated current [A]	0.2								0.3					0.4		
Control circuit power supply	Permissible voltage fluctuation	1-phase 170 to 253VAC													1-phase 85 to 132VAC		
Control circuit power supply	Permissible frequency fluctuation	Within±5%															
Control circuit power supply	Power consumption [W]	30								45					30		
Control circuit power supply	Inrush current	Refer to section 10.5															
Interface power supply	Voltage	24VDC±10%															
Interface power supply	Power supply capacity	(Note 1) 0.2A (including CN8 connector signals)															
Control System		Sine-wave PWM control, current control system															
Dynamic brake		Built-in										External option (Note 4)			Built-in		
Protective functions		Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection.															
Response performance		8ms or less (STO input OFF → energy shut off)															
(Note 5) Test pulse input (STO)		Test pulse interval: 1 to 25Hz Test pulse off time: Up to 1ms															
Safety function		STO (IEC/EN 61800-5-2)															
Safety performance		ISO/EN ISO 13849-1 PL d (category 3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2															
Compliance to standards		CE (LVD: EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)															
Structure		Natural-cooling, open (IP rating: IP00)				Force-cooling, open (IP rating: IP00)									Natural-cooling, open (IP rating: IP00)		
Side-by-side installation		○													○		
Environmental conditions	Ambient temperature, In operation [°C]	(Note 2) 0 to 55 (non-freezing)															
Environmental conditions	Ambient temperature, In operation [°F]	32 to 131 (non-freezing)															
Environmental conditions	Ambient temperature, In storage [°C]	−20 to 65 (non-freezing)															
Environmental conditions	Ambient temperature, In storage [°F]	−4 to 149 (non-freezing)															
Environmental conditions	Ambient humidity, In operation / In storage	90%RH or less (non-condensing)															
Environmental conditions	Ambient	Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt															
Environmental conditions	Altitude	Max. 1000m above sea level															
Environmental conditions	Vibration	5.9 [m/s^2] or less, 10 to 55Hz (directions of X, Y and Z axes)															
Mass	[kg]	0.8	0.8	1.0	1.0	1.4	1.4	2.1	2.3	4.6	6.2	18	18	19	0.8	0.8	1.0
Mass	[lb]	1.76	1.76	2.21	2.21	3.09	3.09	4.63	5.07	10.1	13.7	39.7	39.7	41.9	1.76	1.76	2.21

Note 1. 0.2A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.
2. When closely mounting the servo amplifier of 3.5kW or less, operate them at the ambient temperatures of 0 to 45℃ or at 75% or smaller effective load ratio.
3. When a UL/CSA-compliant servo motor is used in combination, the value is 2.9A.
4. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.
5. This function diagnoses malfunction of contacts including an external circuit by shortly turning OFF signals from a controller to the servo amplifier at a constant period while input signals of the servo amplifier are ON.

(2) 400V class

Item			Servo amplifier MR-J3-□S4								
			60B	100B	200B	350B	500B	700B	11KB	15KB	22KB
Output	Rated voltage		3-phase 323VAC								
Output	Rated current	[A]	1.5	2.8	5.4	8.6	14.0	17.0	32.0	41.0	63.0
Main circuit power supply	Voltage/frequency		3-phase 380 to 480VAC, 50/60Hz								
Main circuit power supply	Rated current	[A]	1.4	2.5	5.1	7.9	10.8	14.4	23.1	31.8	47.6
Main circuit power supply	Permissible voltage fluctuation		3-phase 323 to 528VAC								
Main circuit power supply	Permissible frequency fluctuation		Within±5%								
Main circuit power supply	Power supply capacity		Refer to section 10.2								
Main circuit power supply	Inrush current		Refer to section 10.5								
Control circuit power supply	Voltage, frequency		1-phase 380 to 480VAC, 50/60Hz								
Control circuit power supply	Rated current	[A]	0.1			0.2					
Control circuit power supply	Permissible voltage fluctuation		1-phase 323 to 528VAC								
Control circuit power supply	Permissible frequency fluctuation		Within±5%								
Control circuit power supply	Power consumption	[W]	30			45					
Control circuit power supply	Inrush current		Refer to section 10.5								
Interface power supply	Voltage		24VDC±10%								
Interface power supply	Power supply capacity		(Note 1) 0.2A (including CN8 connector signals)								
(Note 3) Test pulse input (STO)			Test pulse interval: 1 to 25Hz Test pulse off time: Up to 1ms								
Control System			Sine-wave PWM control, current control system								
Dynamic brake			Built-in						External option (Note 2)		
Protective functions			Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection.								
Response performance			8ms or less (STO input OFF → energy shut off)								
Safety function			STO (IEC/EN 61800-5-2)								
Safety performance			ISO/EN ISO 13849-1 PL d (category 3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2								
Compliance to standards			CE (LVD: EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)								
Structure			Natural-cooling, open (IP rating: IP00)		Force-cooling, open (IP rating: IP00)						
Environmental conditions	Ambient temperature	In operation [°C]	0 to 55 (non-freezing)								
Environmental conditions	Ambient temperature	In operation [°F]	32 to 131 (non-freezing)								
Environmental conditions	Ambient temperature	In storage [°C]	−20 to 65 (non-freezing)								
Environmental conditions	Ambient temperature	In storage [°F]	−4 to 149 (non-freezing)								
Environmental conditions	Ambient humidity	In operation In storage	90%RH or less (non-condensing)								
Environmental conditions	Ambient		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt								
Environmental conditions	Altitude		Max. 1000m above sea level								
Environmental conditions	Vibration		5.9 [m/s^2] or less, 10 to 55Hz (directions of X, Y and Z axes)								
Mass		[kg]	1.7	1.7	2.1	4.6	4.6	6.2	18	18	19
Mass		[lb]	3.75	3.75	4.63	10.14	10.14	13.67	39.68	39.68	41.88

Note 1. 0.2A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

3. This function diagnoses malfunction of contacts including an external circuit by shortly turning OFF signals from a controller to the servo amplifier at a constant period while input signals of the servo amplifier are ON.

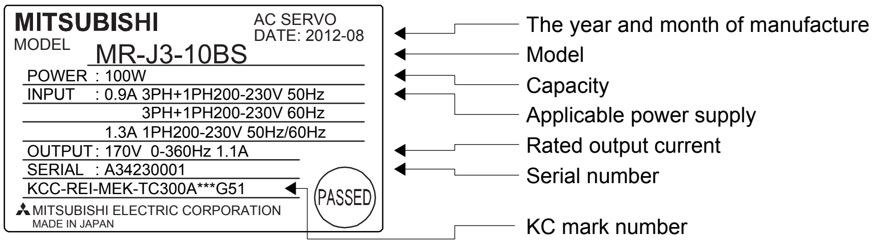
1.4 Function list

The following table lists the functions of this servo. For details of the functions, refer to the reference field.

Function	Description	Reference
Position control mode	This servo is used as position control servo.	
Speed control mode	This servo is used as speed control servo.	
Torque control mode	This servo is used as torque control servo.	
High-resolution encoder	High-resolution encoder of 262144 pulses/rev is used as a servo motor encoder.	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	Chapter 12
Gain changing function	You can switch between gains during rotation and gains during stop or use an input device to change gains during operation.	Section 7.6
Advanced vibration suppression control	This function suppresses vibration at the arm end or residual vibration.	Section 7.4
Adaptive filterⅡ	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	Section 7.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	Section 7.5
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting an MR Configurator installed personal computer and servo amplifier. MR Configurator is necessary for this function.	
Machine simulation	Can simulate machine motions on a personal computer screen on the basis of the machine analyzer results. MR Configurator is necessary for this function.	
Gain search function	Personal computer which installed MR Configurator changes gains automatically and searches for overshoot-free gains in a short time. MR Configurator is necessary for this function.	
Robust disturbance compensation	This function provides better disturbance response in case of low response level due to high load inertia moment ratio for the roll send axes. MR Configurator is necessary for this function.	
Advanced Gain search	Advanced Gain search automatically searches for the optimum parameter for settle time to be short. The gain can be adjusted by setting sequentially in accordance with wizard screens. MR Configurator is necessary for this function.	
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	Parameters No.PB24
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies. Higher in performance than MR-J2-Super series servo amplifier.	Chapter 6
Brake unit	Used when the regenerative option cannot provide enough regenerative power. Can be used the 5kW or more servo amplifier.	Section 11.3
Regenerative converter	Used when the regenerative option cannot provide enough regenerative power. Can be used the 5kW or more servo amplifier.	Section 11.4
Regenerative option	Used when the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	Section 11.2
Alarm history clear	Alarm history is cleared.	Parameter No.PC21
Output signal selection (Device settings)	The pins that output the output devices, including the malfunction (ALM) and the dynamic brake interlock (DB), can be changed to certain pins of the CN3 connectors.	Parameter No.PD07 to PD09
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	Section 4.5.1 (1) (d)
Test operation mode	JOG operation・positioning operation・DO forced output However, MR Configurator is necessary for positioning operation.	Section 4.5
Analog monitor output	Servo status is output in terms of voltage in real time.	Parameter No.PC09
MR Configurator	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	Section 11.8
Fully closed loop system	Fully closed system can be configured using the load-side encoder.	Chapter 14

1.5 Model code definition

(1) Rating plate



(2) Model

The following explains the models. Not all combinations of the symbols are available.

MR－J3－□B□□□

Series

Rated output

Symbol	Rated output [kW]
10	0.1
20	0.2
40	0.4
60	0.6
70	0.75
100	1
200	2
350	3.5
500	5
700	7
11K	11
15K	15
22K	22

SSCNETⅢ interface

Symbol	Safety
None	Standard
S	Drive safety compatible

Power supply

Symbol	Power supply
None	3-phase or 1-phase 200 to 230VAC
1	1-phase 100 to 120VAC
4	3-phase 380 to 480VAC

Special specification

Symbol	Special specification	Regenerative resistor equipped as standard
-PX	Servo amplifiers of 11k to 22kW (Except the ones that support the HF-JP series servo motors)	Not available
-LR	HF-JP series Servo amplifiers dedicated to the 11kW and 15kW servo motors	Equipped
-LW	HF-JP series Servo amplifiers dedicated to the 11kW and 15kW servo motors	Not available

1.6 Combination with servo motor

The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the models with an electromagnetic brake and the models with a reduction gear.

Servo amplifier	Servo motors						
	HF-MP□	HF-KP□	HF-SP□		HC-RP□	HC-UP□	HC-LP□
			1000r/min	2000r/min			
MR-J3-10□S(1)	053・13	053・13					
MR-J3-20□S(1)	23	23					
MR-J3-40□S(1)	43	43					
MR-J3-60□S			51	52			52
MR-J3-70□S	73	73				72	
MR-J3-100□S			81	102			102
MR-J3-200□S			121・201	152・202	103・153	152	152
MR-J3-350□S			301	352	203	202	202
MR-J3-500□S			421	502	353・503	352・502	302
MR-J3-700□S				702			

Servo amplifier	Servo motor				
	HA-LP□			HF-JP□	
	1000r/min	1500r/min	2000r/min	1500r/min	3000r/min
MR-J3-60□S					53
MR-J3-70□S					73
MR-J3-100□S					103
MR-J3-200□S					153・203
MR-J3-350□S					353
MR-J3-500□S			502		503
MR-J3-700□S	601	701M	702		703
MR-J3-11K□S	801・12K1	11K1M	11K2	11K1M (Note)	903
MR-J3-15K□S	15K1	15K1M	15K2	15K1M (Note)	
MR-J3-22K□S	20K1・25K1	22K1M	22K2		

Servo amplifier	Servo motor					
	HF-SP□	HA-LP□			HF-JP□	
		1000r/min	1500r/min	2000r/min	1500r/min	3000r/min
MR-J3-60□S4	524					534
MR-J3-100□S4	1024					734・1034
MR-J3-200□S4	1524・2024					1534・2034
MR-J3-350□S4	3524					3534
MR-J3-500□S4	5024					5034
MR-J3-700□S4	7024	6014	701M4			7034
MR-J3-11K□S4		8014・12K14	11K1M4	11K24	11K1M4 (Note)	9034
MR-J3-15K□S4		15K14	15K1M4	15K24	15K1M4 (Note)	
MR-J3-22K□S4		20K14	22K1M4	22K24		

Note. The servo amplifiers, which support these servo motors, have "-LR" at the end of their model names.

Servo amplifiers supporting the 400% maximum torque setting (Note)	Servo motor (Note)
	HF-JP□
MR-J3-100□S	53
MR-J3-200□S	73
	103
MR-J3-350□S	153
	203
MR-J3-500□S	353
MR-J3-700□S	503

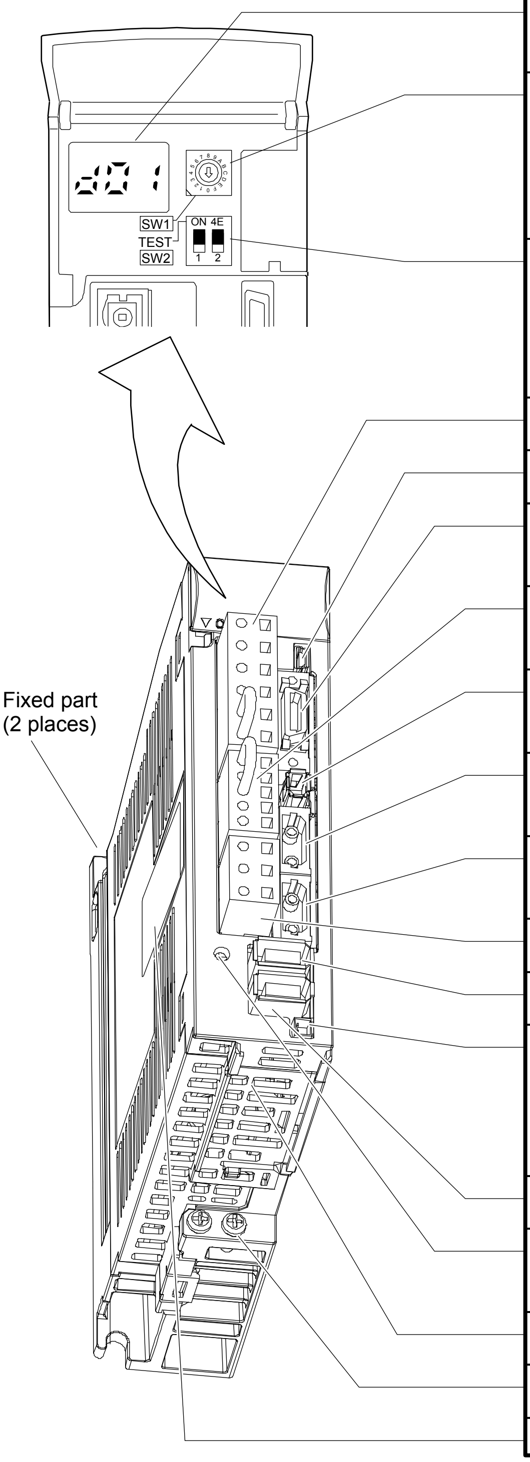
Servo amplifiers supporting the 400% maximum torque setting (Note)	Servo motor (Note)
	HF-JP□
MR-J3-100□S4	534
MR-J3-200□S4	734
	1034
MR-J3-350□S4	1534
	2034
MR-J3-500□S4	3534
MR-J3-700□S4	5034

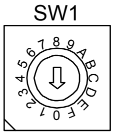
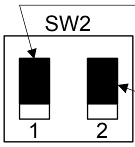
Note. The 400% maximum torque setting is supported by the combination of the servo amplifiers manufactured in August 2009 or later (software version C4 or later) and the HF-JP series servo motors manufactured in April 2010 or later.

1.7 Structure

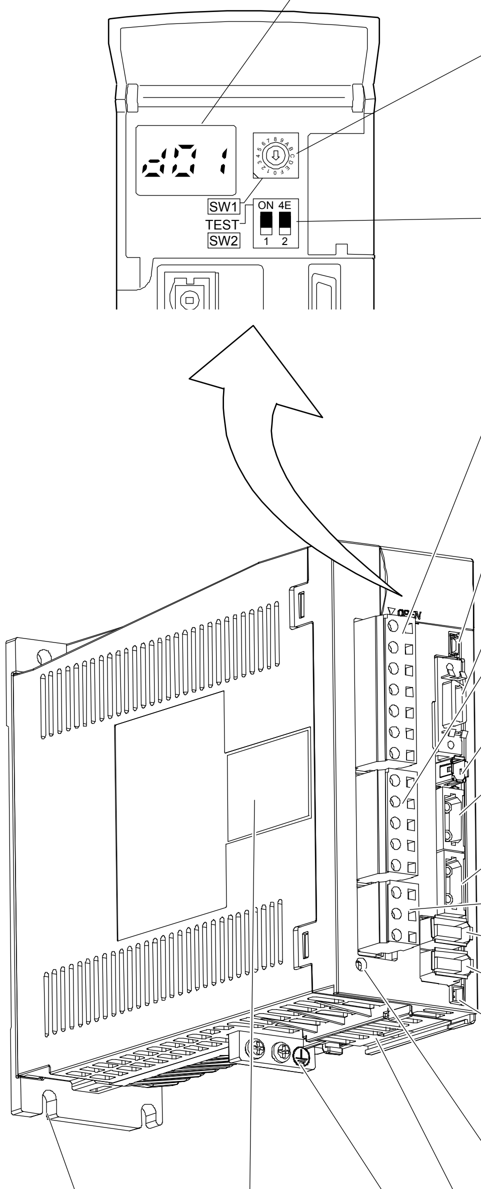
1.7.1 Parts identification

(1) MR-J3-100□S or less

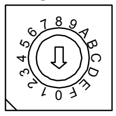
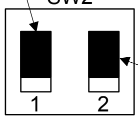


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1)  Used to set the axis No. of servo amplifier.	Section 3.14
 Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Battery holder Install the MR-J3BAT battery.	Section 12.4
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

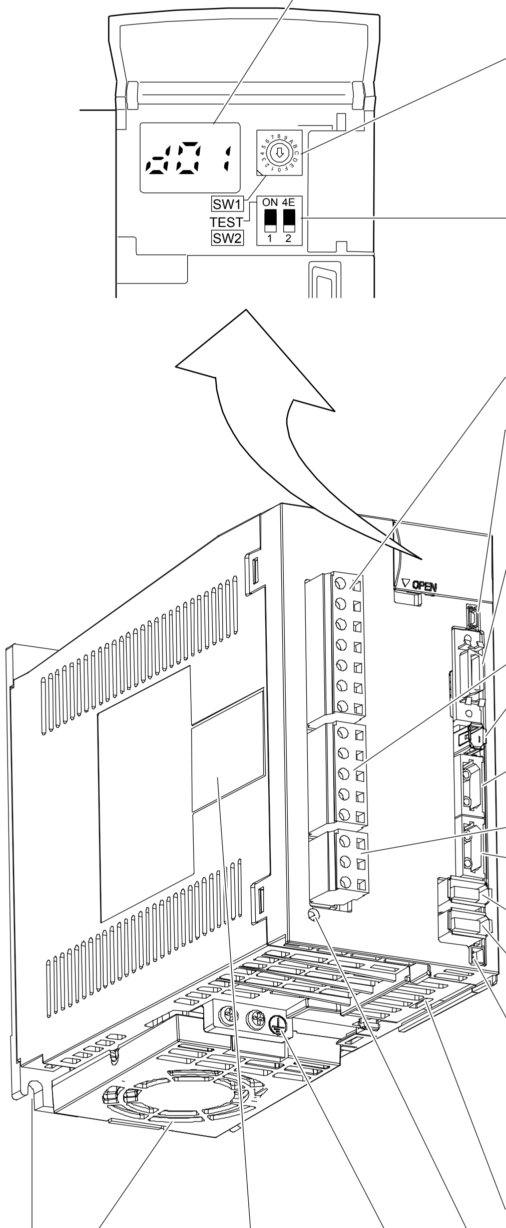
(2) MR-J3-60□S4・MR-J3-100□S4

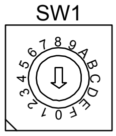
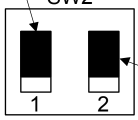


Fixed part
(3 places)

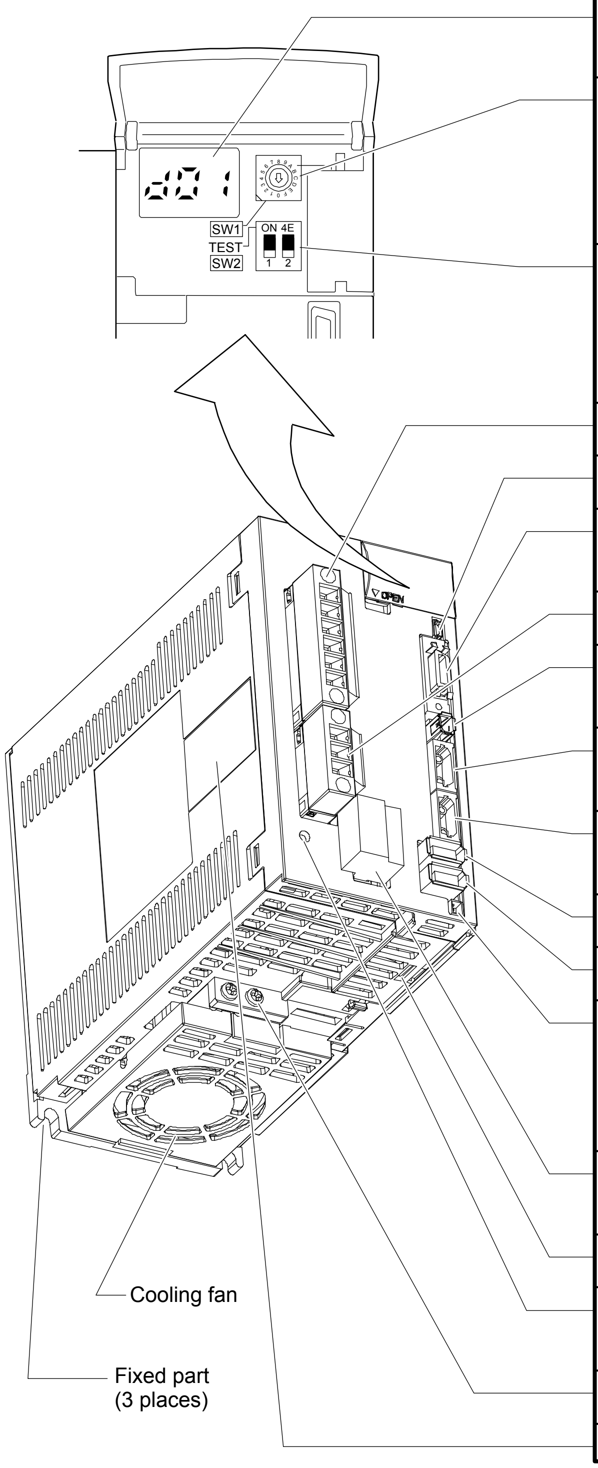
Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Battery holder Install the MR-J3BAT battery.	Section 12.4
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

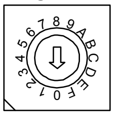
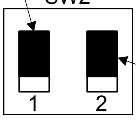
(3) MR-J3-200□S(4)



Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	Section 3.10
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Battery holder Install the MR-J3BAT battery.	Section 12.4
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

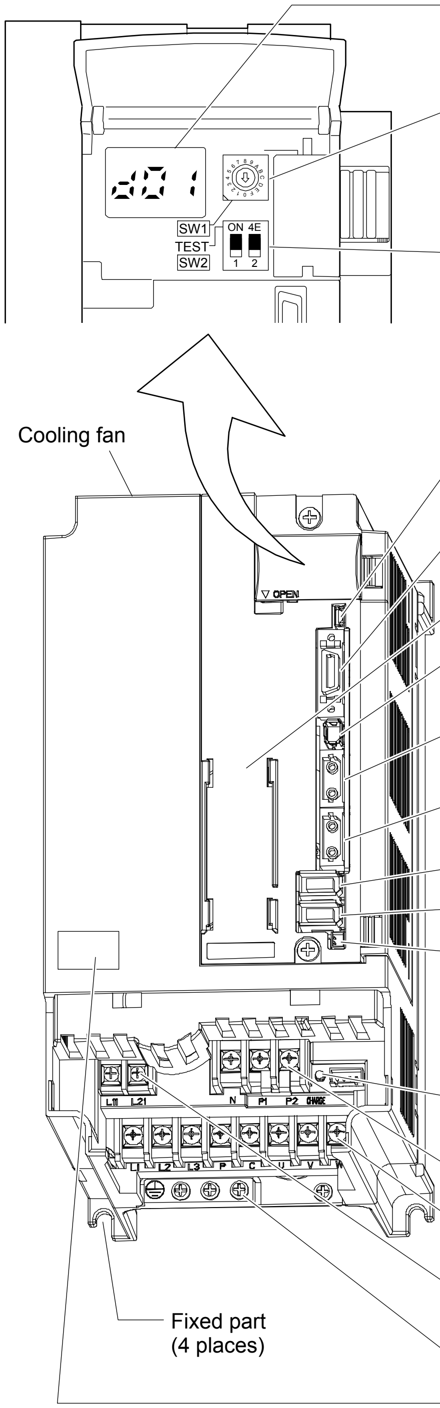
(4) MR-J3-350□S

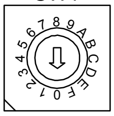
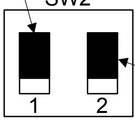


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
Battery holder Install the MR-J3BAT battery.	Section 12.4
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

(5) MR-J3-350□S4 ・ MR-J3-500□S(4)

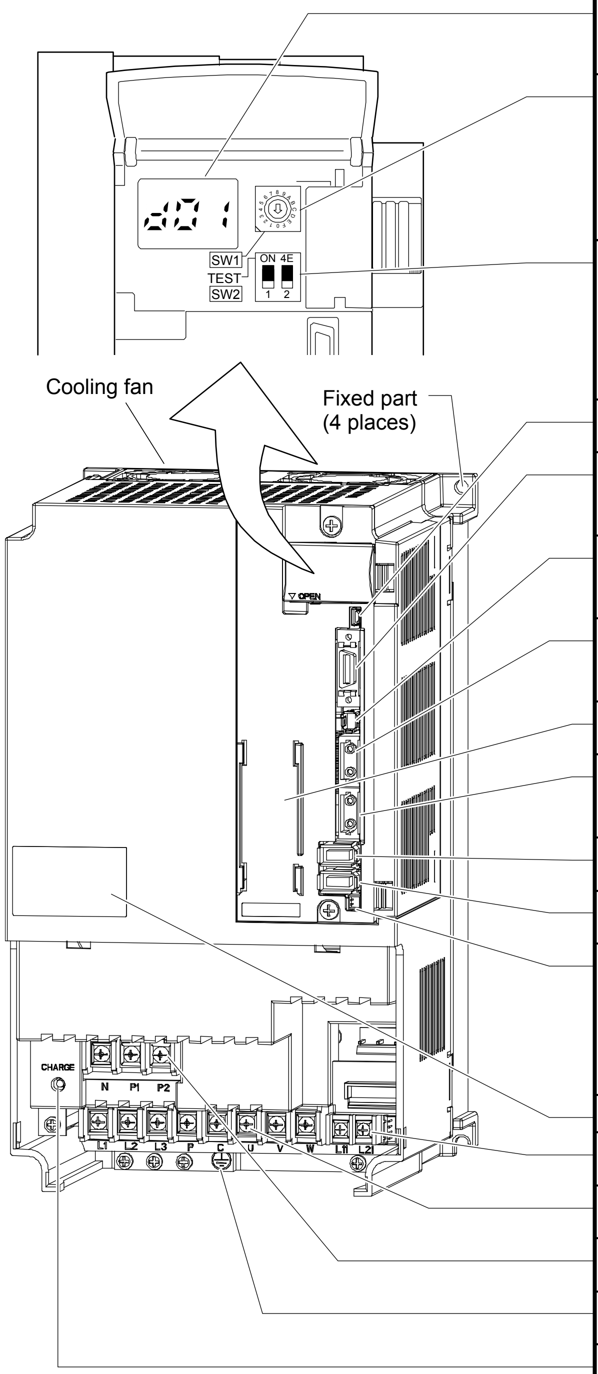
POINT
・The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.

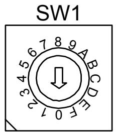
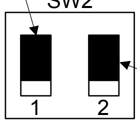


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Battery holder Install the MR-J3BAT battery.	Section 12.4
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Power factor improving DC reactor terminal block (TE3) Used to connect the power factor improving DC reactor.	Section 3.1 Section 3.3
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	
Control circuit terminal block (TE2) Used to connect the control circuit power supply.	
Protective earth (PE) terminal (⏚) Ground terminal.	
Rating plate	Section 1.5

(6) MR-J3-700□S(4)

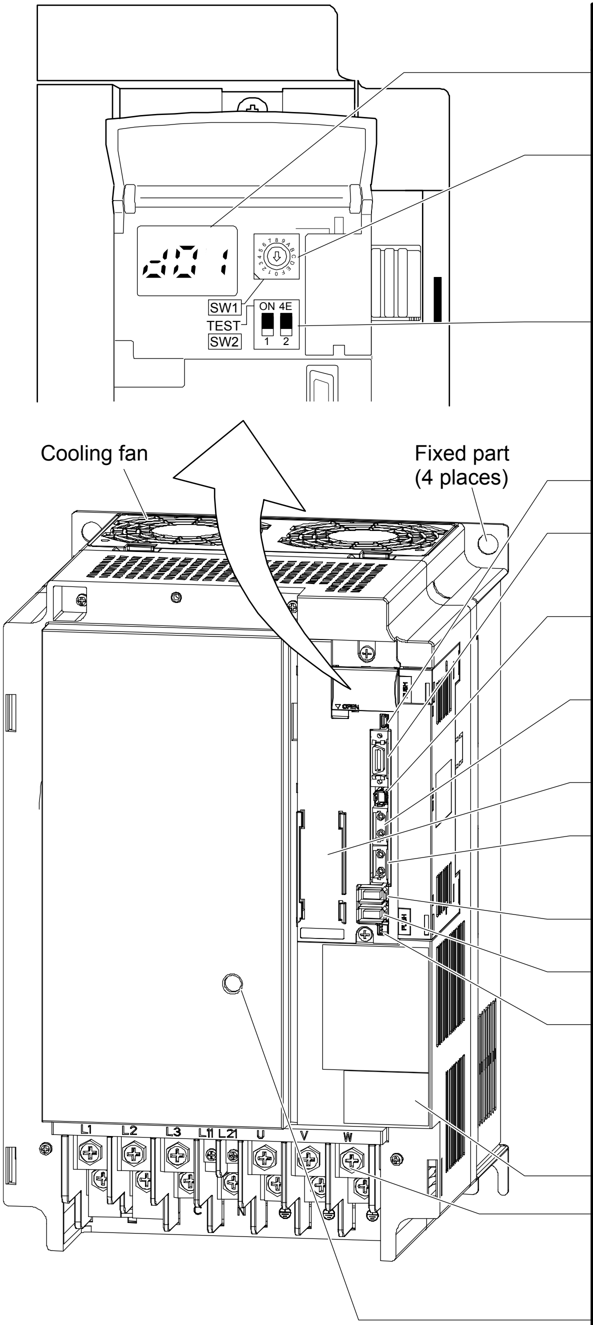
> **POINT**
>
> - The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.

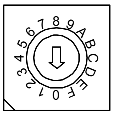
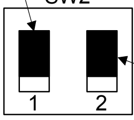


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
Battery holder Install the MR-J3BAT battery.	Section 12.4
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	Section 3.10
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Rating plate	Section 1.5
Control circuit terminal block (TE2) Used to connect the control circuit power supply.	Section 3.1 Section 3.3
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	
Power factor improving DC reactor terminal block (TE3) Used to connect the power factor improving DC reactor.	
Protective earth (PE) terminal (⏚) Ground terminal.	
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	

(7) MR-J3-11K□S(4) to MR-J3-22K□S(4)

POINT
・The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.

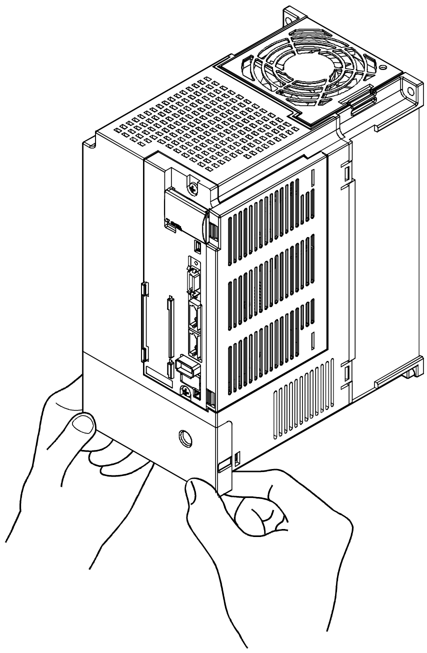


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of servo amplifier.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
USB communication connector (CN5) Connect the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis servo amplifier.	Section 3.10
Battery holder Install the MR-J3BAT battery.	Section 12.4
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis servo amplifier. For the final axis, puts a cap.	Section 3.10
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Used to connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Rating plate	Section 1.5
Main circuit terminal block・control circuit・protective earth (TE) Used to connect the input power supply, servo motor, regenerative option and ground.	Section 3.1 Section 3.3
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	

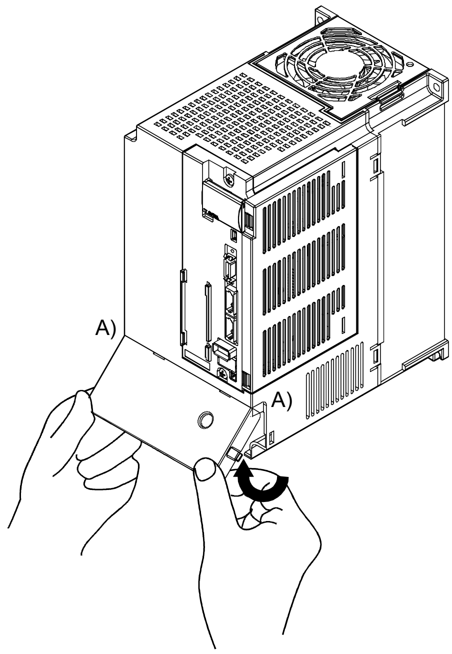
1.7.2 Removal and reinstallation of the front cover

⚠CAUTION	・Before removing or installing the front cover, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not.

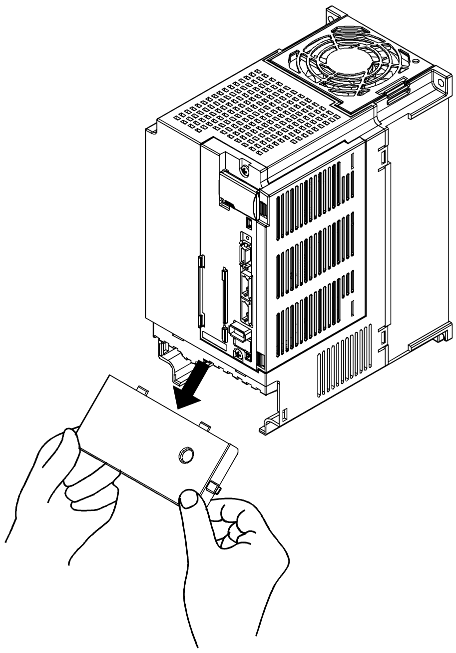
(1) For MR-J3-350□S4・MR-J3-500□S(4)・MR-J3-700□S(4)
Removal of the front cover



1) Hold the ends of lower side of the front cover with both hands.

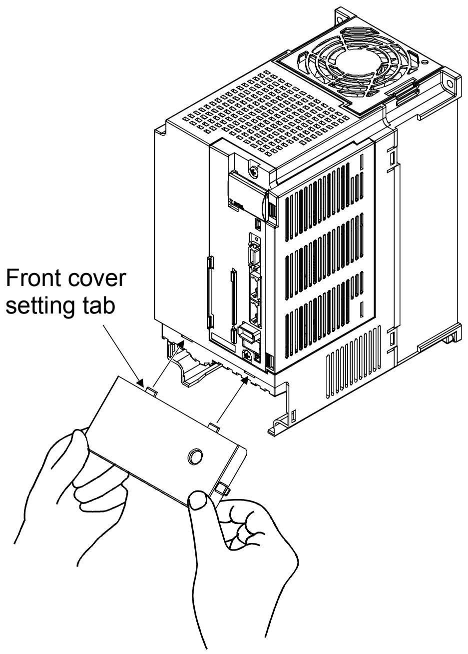


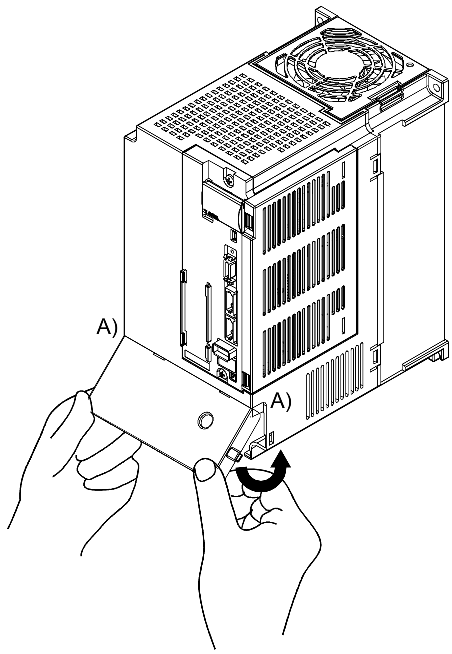
2) Pull up the cover, supporting at point A).



3) Pull out the front cover to remove.

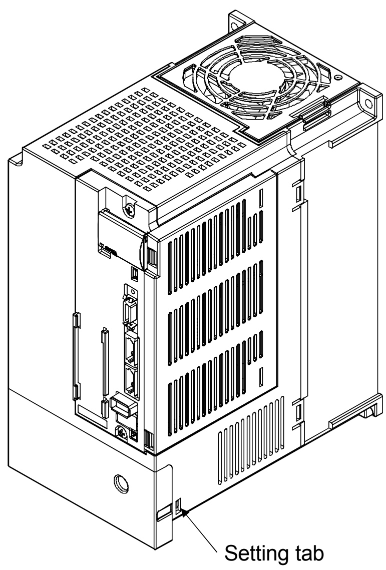
Reinstallation of the front cover





1) Insert the front cover setting tabs into the sockets of servo amplifier (2 places).

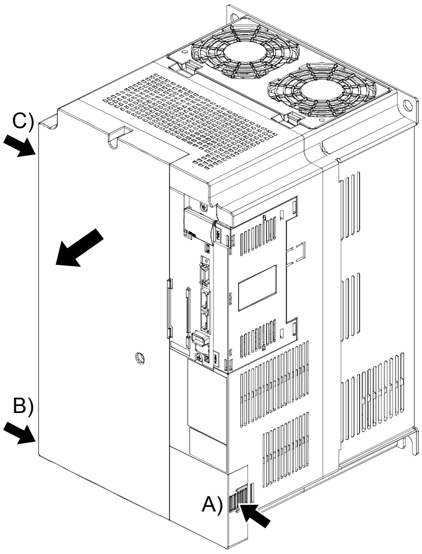
2) Push down the cover, supporting at point A).

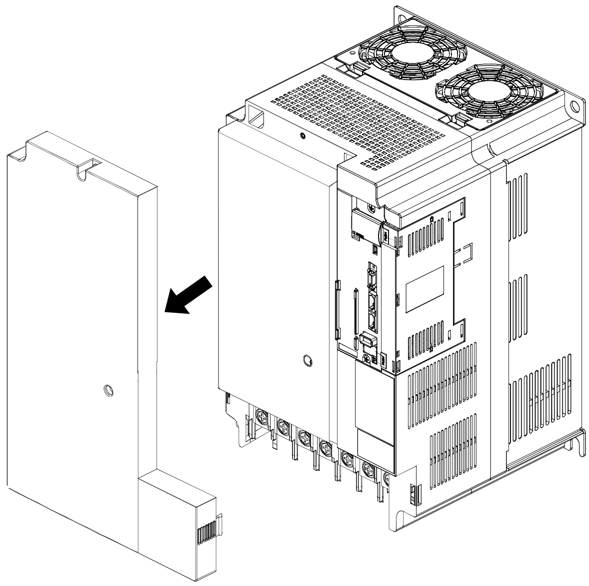


3) Push the setting tabs until they click.

(2) For MR-J3-11K□S(4) to MR-J3-22K□S(4)

Removal of the front cover

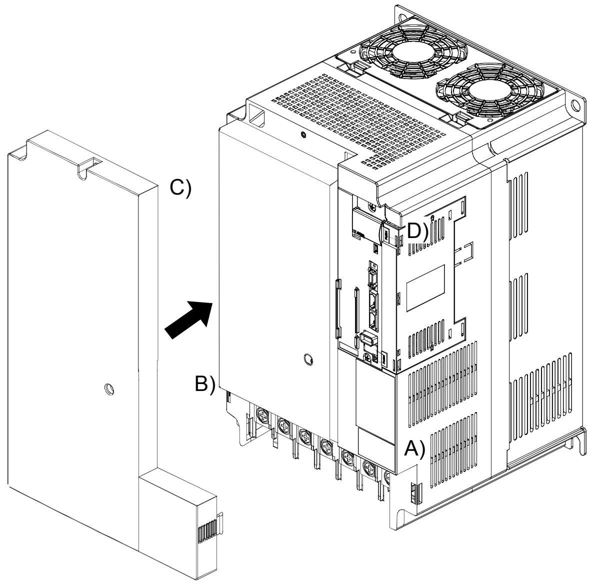


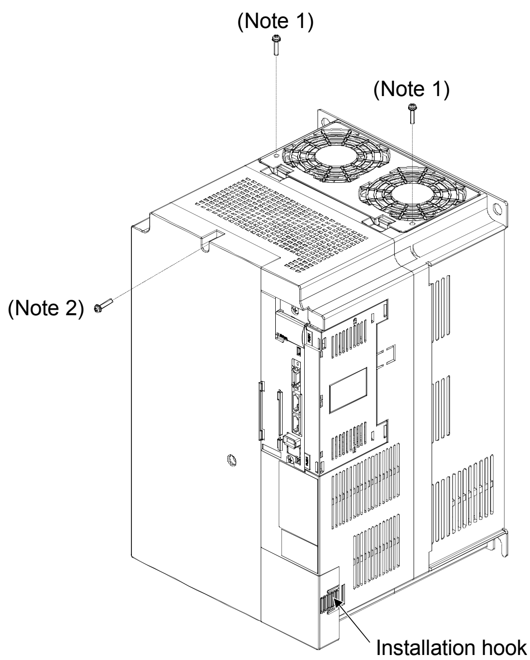


1) Press the removing knob on the lower side of the front cover (A) and B)) and release the setting tabs.
2) Press the removing knob of C) and release the setting tabs.

3) Pull it to remove the front cover.

Reinstallation of the front cover





1) Fit the front cover setting tabs on the sockets of body cover (A) to D)) to reinstall it.

2) Push the front cover until you hear the clicking noise of the setting tabs.

Note 1. The cooling fan cover can be locked with enclosed screws (M4 × 40).

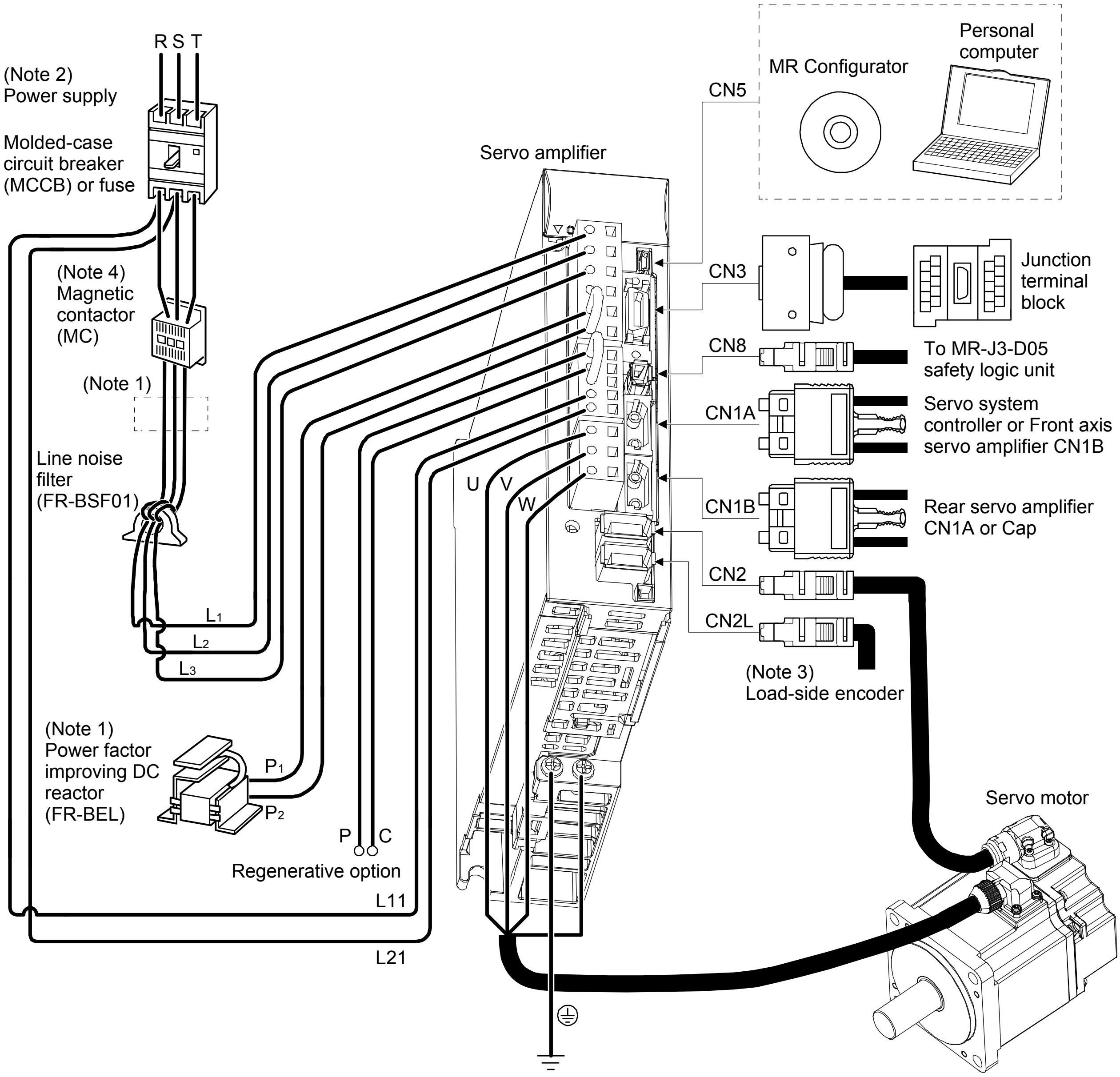
2. By drilling approximately ϕ4 of a hole on the front cover, the front cover can be locked on the body with an enclosed screw (M4 × 14).

1.8 Configuration including auxiliary equipment

POINT
・Equipment other than the servo amplifier and servo motor are optional or recommended products.

(1) MR-J3-100□S or less

(a) For 3-phase or 1-phase 200V to 230VAC



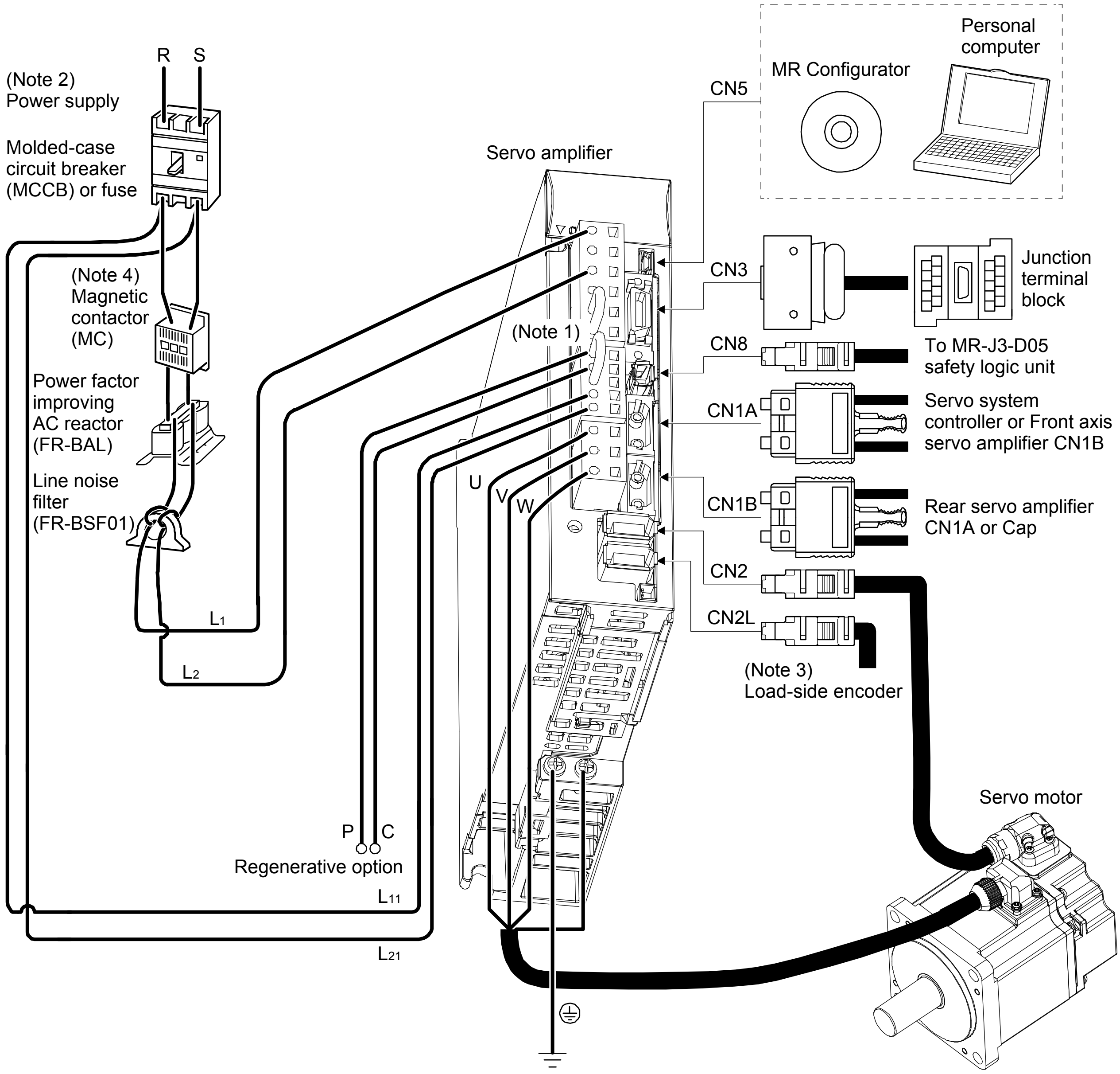
Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.

2. A 1-phase 200V to 230VAC power supply may be used with the servo amplifier of MR-J3-70□S or less. For 1-phase 200V to 230VAC, connect the power supply to L_1 ・ L_2 and leave L_3 open. Refer to section 1.3 for the power supply specification.

3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.

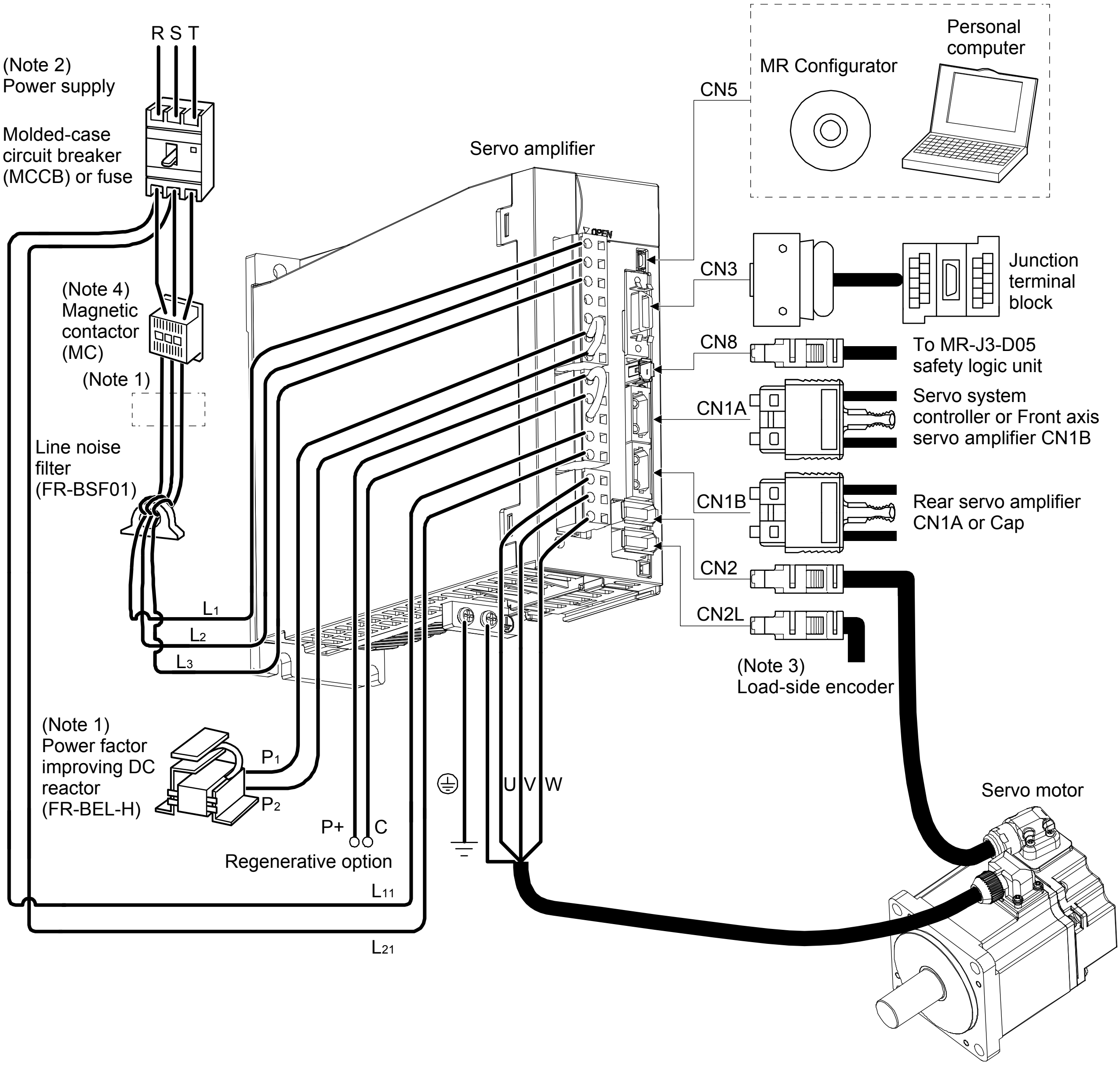
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(b) For 1-phase 100V to 120VAC



Note 1. The power factor improving DC reactor cannot be used.
2. Refer to section 1.3 for the power supply specification.
3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(2) MR-J3-60□S4・MR-J3-100□S4



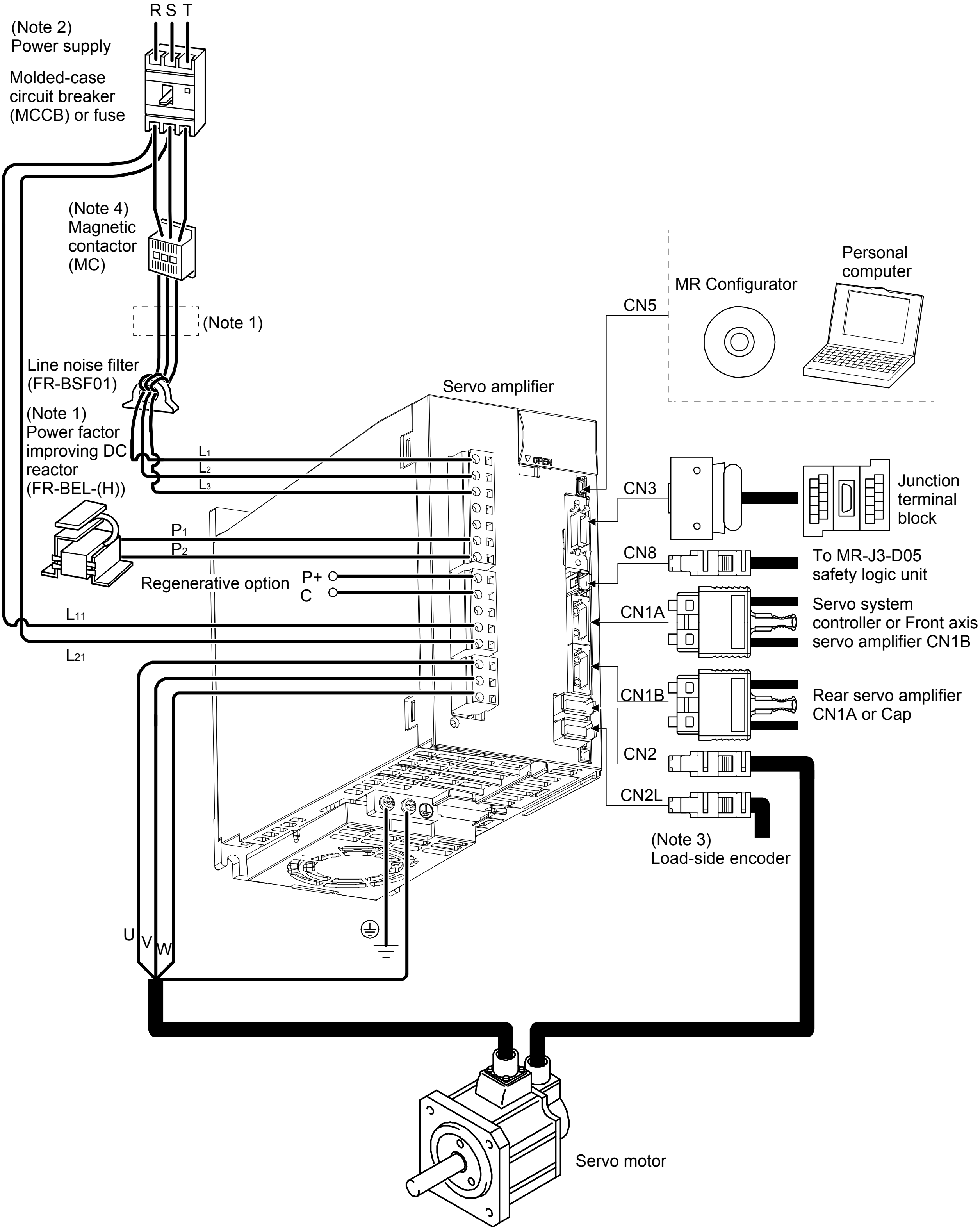
Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.

2. Refer to section 1.3 for the power supply specification.

3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.

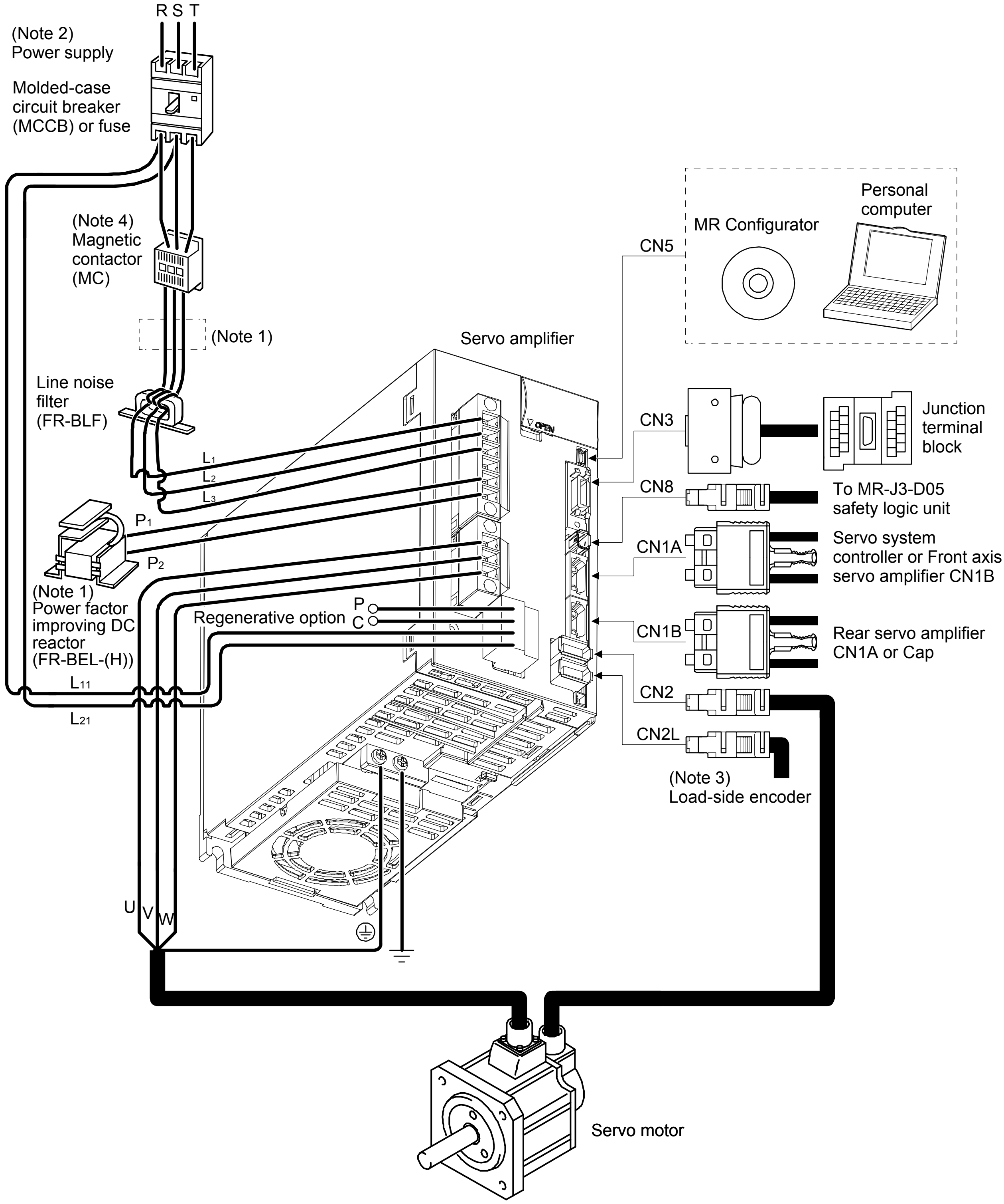
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(3) MR-J3-200□S(4)



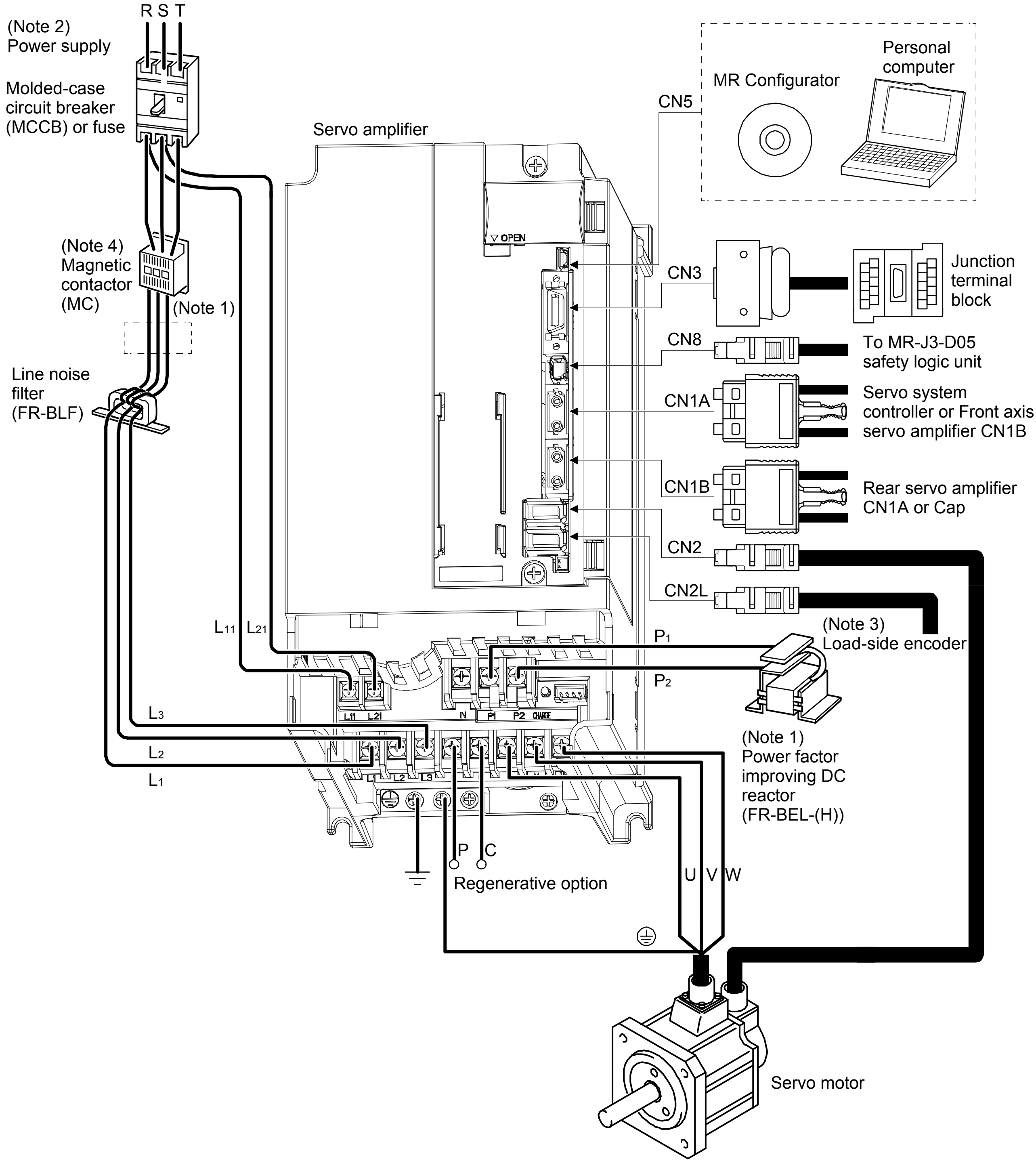
Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.
2. Refer to section 1.3 for the power supply specification.
3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(4) MR-J3-350□S



Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.
2. Refer to section 1.3 for the power supply specification.
3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

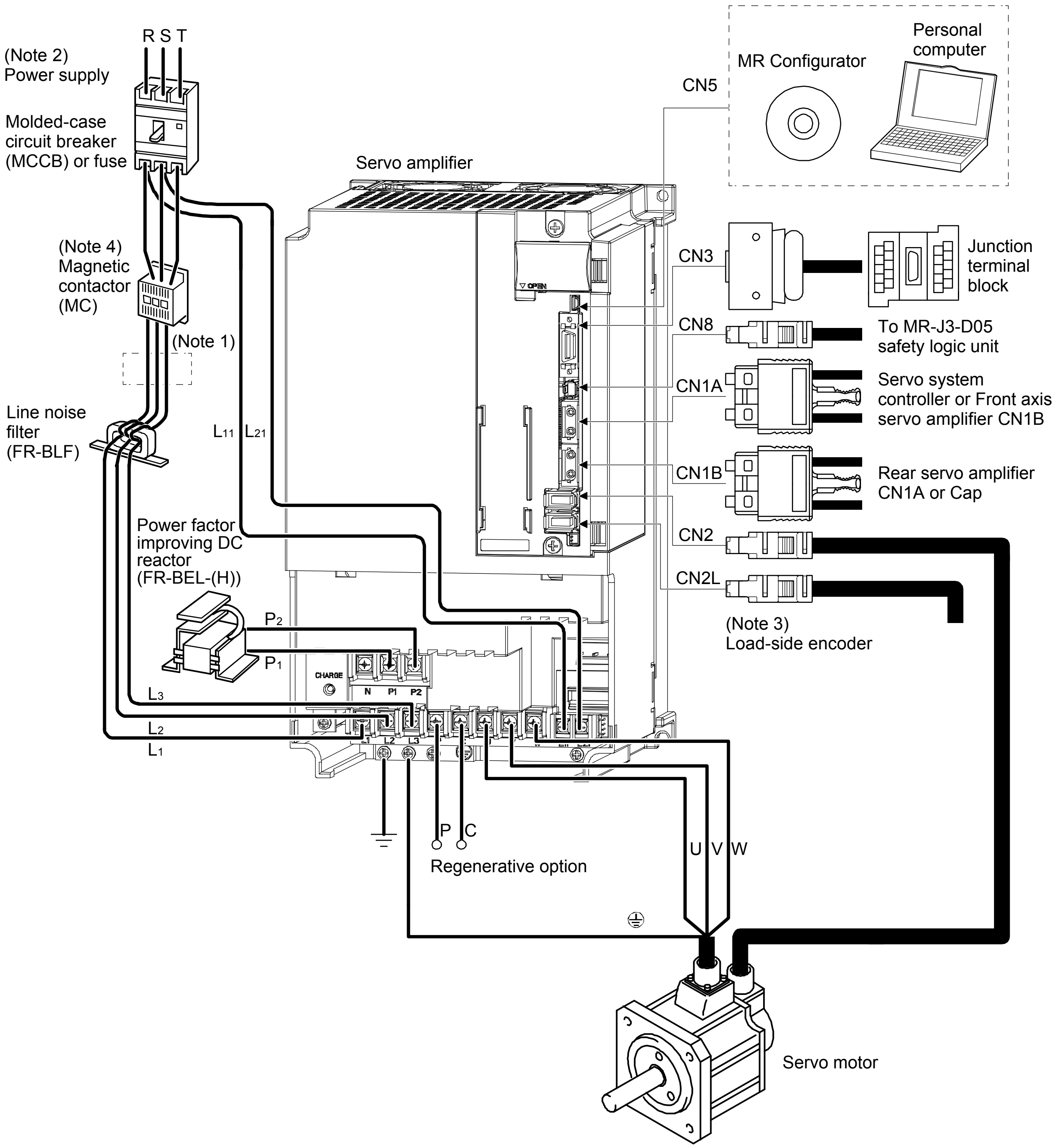
(5) MR-J3-350□S4・MR-J3-500□S(4)



Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.

2. Refer to section 1.3 for the power supply specification.
3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(6) MR-J3-700□S(4)



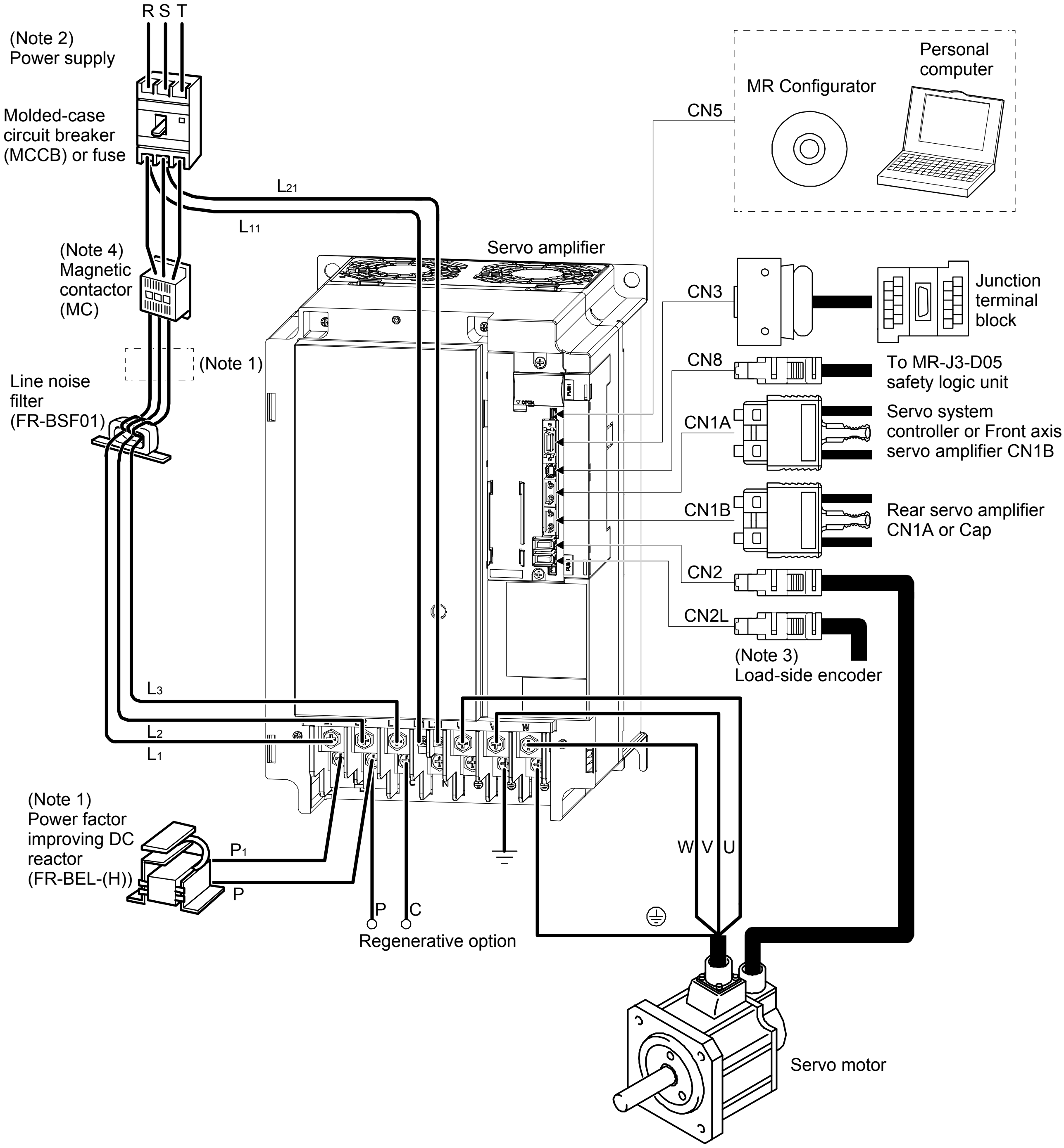
Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P_2.

2. Refer to section 1.3 for the power supply specification.

3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.

4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

(7) MR-J3-11K□S(4) to MR-J3-22K□S(4)



Note 1. The power factor improving AC reactor can also be used. In this case, the power factor improving DC reactor cannot be used. When not using the power factor improving DC reactor, short P_1 and P.

2. Refer to section 1.3 for the power supply specification.
3. When fully closed control is used. For the configuration of the A/B/Z-phase pulse train interface or serial communication specification linear encoder/rotary encoder, refer to section 14.2.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

MEMO

2. INSTALLATION

WARNING	・To prevent electric shock, ground each equipment securely.

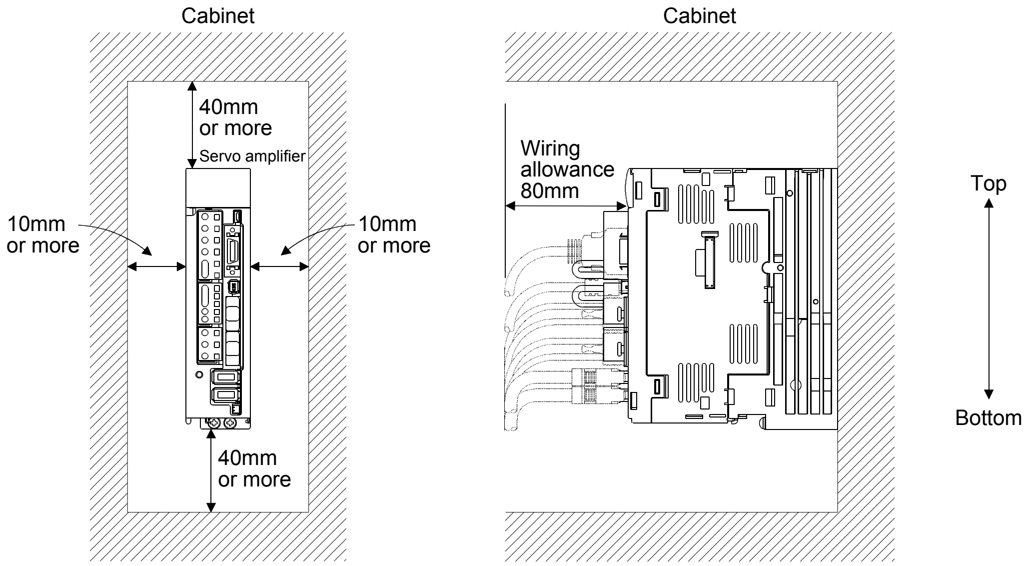
CAUTION	・Stacking in excess of the limited number of product packages is not allowed. ・Install the equipment on incombustible material. Installing them directly or close to combustibles will lead to a fire. ・Install the equipment in a load-bearing place in accordance with this Instruction Manual. ・Do not get on or put heavy load on the equipment to prevent injury. ・Use the equipment within the specified environmental condition range. (For the environmental conditions, refer to section 1.3.) ・Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the converter unit and servo amplifier (drive unit). ・Do not block intake and exhaust areas of the converter unit, the servo amplifier (drive unit) and the servo motor with a cooling fan. Otherwise, it may cause a malfunction. ・Do not drop or strike the converter unit and servo amplifier (drive unit). Isolate from all impact loads. ・Do not install or operate the converter unit and servo amplifier (drive unit) which has been damaged or has any parts missing. ・Do not install or operate a faulty servo amplifier. ・When the product has been stored for an extended period of time, contact your local sales office. ・When treating the converter unit and servo amplifier (drive unit), be careful about the edged parts such as the corners of the servo amplifier. ・The converter unit and servo amplifier (drive unit) must be installed in the metal cabinet.

2.1 Installation direction and clearances

CAUTION	・The equipment must be installed in the specified direction. Otherwise, it may cause a malfunction. ・Leave specified clearances between the servo amplifier and cabinet inside walls or other equipment. Otherwise, it may cause a malfunction.

(1) 7kW or less

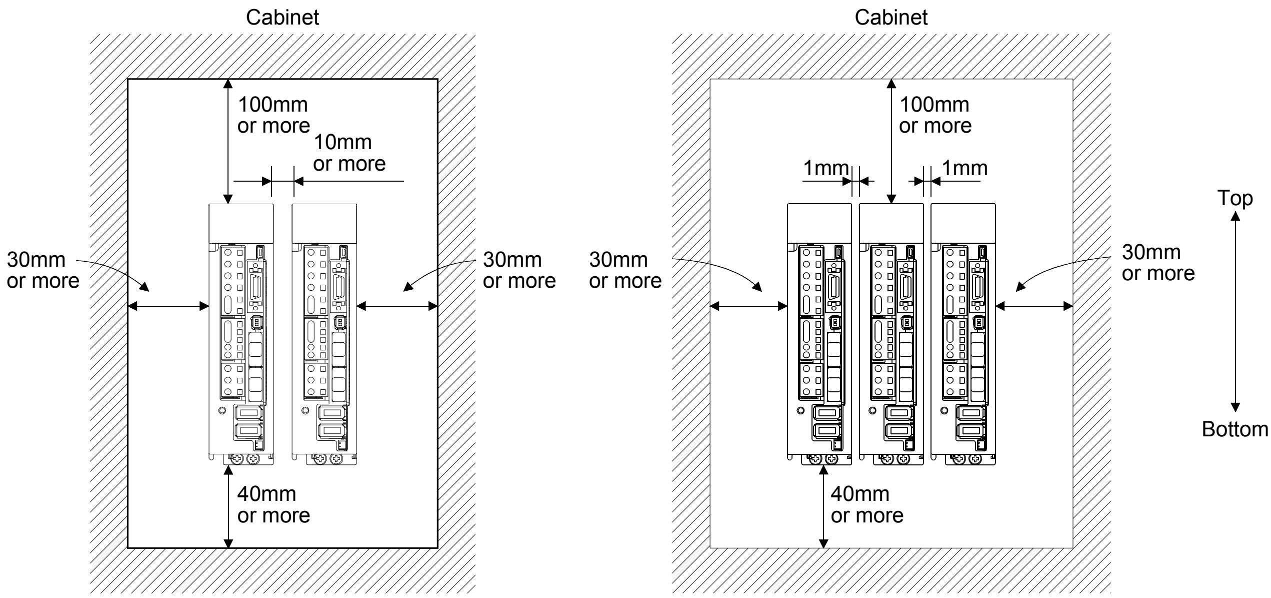
(a) Installation of one servo amplifier



(b) Installation of two or more servo amplifiers

POINT
・Close mounting is available for the servo amplifier of under 3.5kW for 200V class and 400W for 100V class.

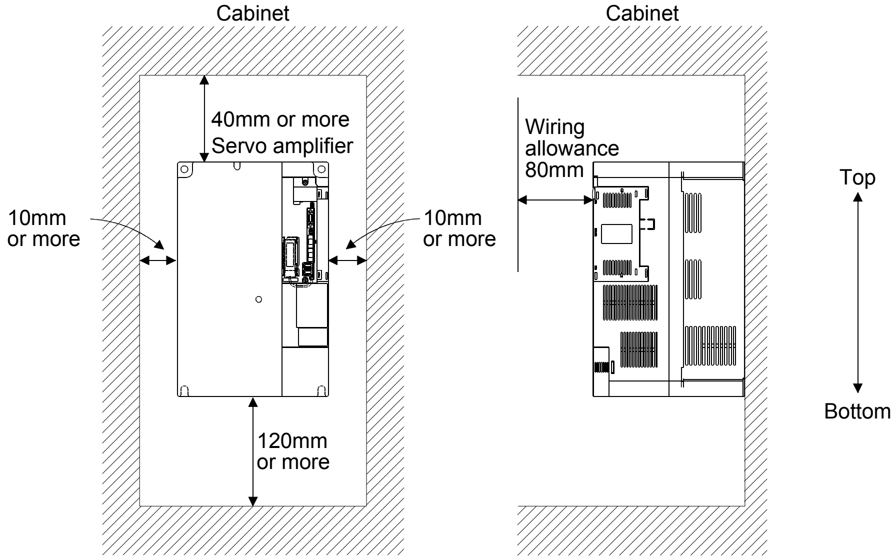
Leave a large clearance between the top of the servo amplifier and the internal surface of the cabinet, and install a cooling fan to prevent the internal temperature of the cabinet from exceeding the environmental conditions.
When installing the servo amplifiers closely, leave a clearance of 1mm between the adjacent servo amplifiers in consideration of mounting tolerances.
In this case, operate the servo amplifiers at the ambient temperature of 0 to 45°C or at 75% or less of the effective load ratio.



Leaving clearance　　Mounting closely

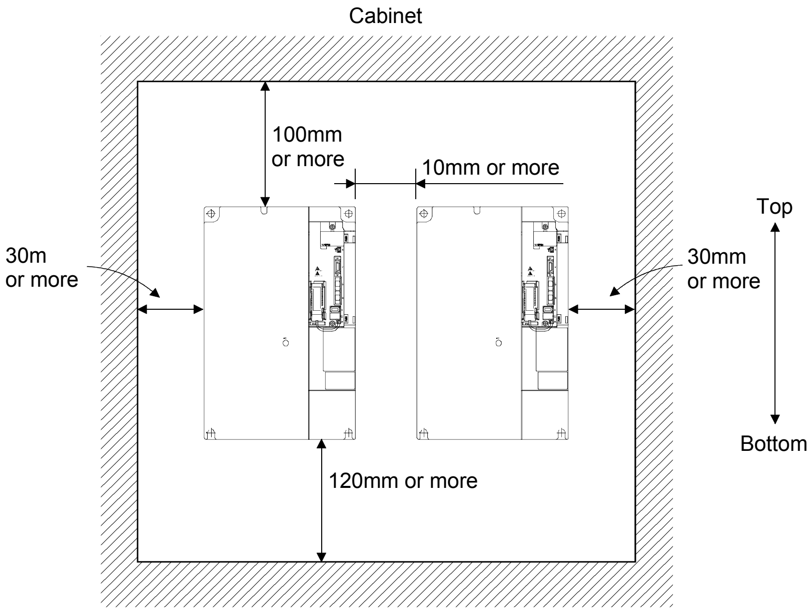
(2) 11k to 22kW

(a) Installation of one servo amplifier



(b) Installation of two or more servo amplifiers

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



(3) Others

When using heat generating equipment such as the regenerative 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.

2.2 Keep out foreign materials

(1) When installing the unit in a cabinet, 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 cabinet or a cooling fan installed on the ceiling.

(3) When installing the cabinet in a place where toxic gas, dirt and dust exist, conduct an air purge (force clean air into the cabinet from outside to make the internal pressure higher than the external pressure) to prevent such materials from entering the cabinet.

2.3 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) For use in any application where the servo motor moves, fix the cables (encoder, power supply, brake) with having some slack from the connector connection part of the servo motor to avoid putting stress on the connector connection part. Use the optional encoder cable within the flexing life range. Use the power supply and brake wiring cables within the flexing life of the cables.

(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.

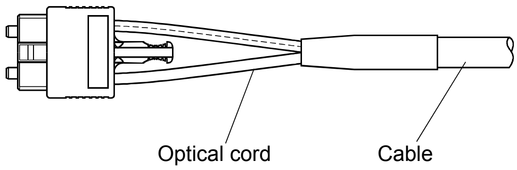
(4) For installation on a machine where the servo motor moves, the flexing radius should be made as large as possible. Refer to section 10.4 for the flexing life.

2.4 SSCNETⅢ cable laying

SSCNETⅢ cable is made from optical fiber. If optical fiber is added a power such as a major shock, lateral pressure, haul, sudden bending or twist, its inside distorts or breaks, and optical transmission will not be available. Especially, as optical fiber for MR-J3BUS□M・MR-J3BUS□M-A is made of synthetic resin, it melts down if being left near the fire or high temperature. Therefore, do not make it touched the part, which becomes high temperature, such as radiator or regenerative option of servo amplifier.
Read described item of this section carefully and handle it with caution.

(1) Minimum bend radius
Make sure to lay the cable with greater radius than the minimum bend radius. Do not press the cable to edges of equipment or others. For SSCNETⅢ cable, the appropriate length should be selected with due consideration for the dimensions and arrangement of servo amplifier. When closing the door of cabinet, pay careful attention for avoiding the case that SSCNETⅢ cable is hold down by the door and the cable bend becomes smaller than the minimum bend radius.
For the minimum bend radius, refer to section 11.1.6.

(2) Prohibition of vinyl tape use
Migrating plasticizer is used for vinyl tape. Keep the MR-J3BUS□M, and MR-J3BUS□M-A cables away from vinyl tape because the optical characteristic may be affected.

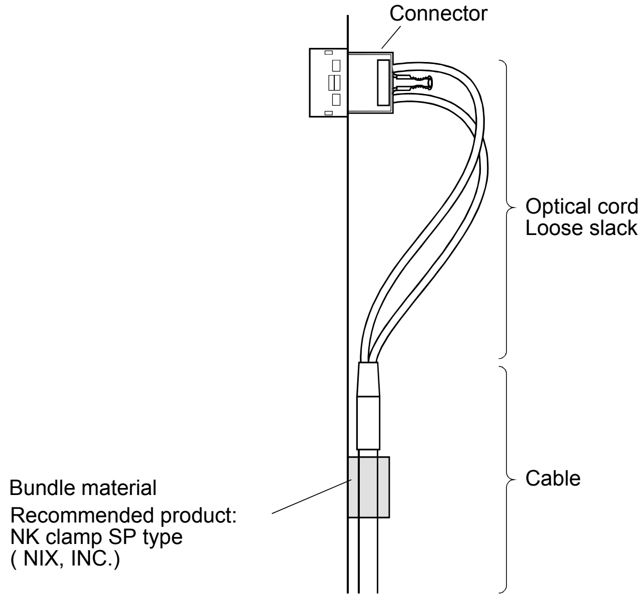


SSCNETⅢ cable	Cord	Cable
MR-J3BUS□M	△	
MR-J3BUS□M-A	△	△
MR-J3BUS□M-B	○	○

△: Phthalate ester plasticizer such as DBP and DOP may affect optical characteristic of cable.
○: Normally, cable is not affected by plasticizer.

(3) Precautions for migrating plasticizer added materials
Generally, soft polyvinyl chloride (PVC), polyethylene resin (PE) and fluorine resin contain non-migrating plasticizer and they do not affect the optical characteristic of SSCNETⅢ cable.
However, some wire sheaths and cable ties, which contain migrating plasticizer (phthalate ester), may affect MR-J3BUS□M and MR-J3BUS□M-A cables (made of plastic).
In addition, MR-J3BUS□M-B cable (made of quartz glass) is not affected by plasticizer.

(4) Bundle fixing
Fix the cable at the closest part to the connector with bundle material in order to prevent SSCNETⅢ cable from putting its own weight on CN1A・CN1B connector of servo amplifier. Optical cord should be given loose slack to avoid from becoming smaller than the minimum bend radius, and it should not be twisted.
When bundling the cable, fix and hold it in position by using cushioning such as sponge or rubber which does not contain migratable plasticizers.
If using adhesive tape for bundling the cable, fire resistant acetate cloth adhesive tape 570F (Teraoka Seisakusho Co., Ltd) is recommended.



(5) Tension
If tension is added on optical cable, the increase of transmission loss occurs because of external force which concentrates on the fixing part of optical fiber or the connecting part of optical connector. At worst, the breakage of optical fiber or damage of optical connector may occur. For cable laying, handle without putting forced tension. For the tension strength, refer to section 11.1.6.

(6) Lateral pressure
If lateral pressure is added on optical cable, the optical cable itself distorts, internal optical fiber gets stressed, and then transmission loss will increase. At worst, the breakage of optical cable may occur. As the same condition also occurs at cable laying, do not tighten up optical cable with a thing such as nylon band (TY-RAP).
Do not trample it down or tuck it down with the door of cabinet or others.

(7) Twisting
If optical fiber is twisted, it will become the same stress added condition as when local lateral pressure or bend is added. Consequently, transmission loss increases, and the breakage of optical fiber may occur at worst.

(8) Disposal
When incinerating optical cable (cord) used for SSCNETⅢ, hydrogen fluoride gas or hydrogen chloride gas which is corrosive and harmful may be generated. For disposal of optical fiber, request for specialized industrial waste disposal services who has incineration facility for disposing hydrogen fluoride gas or hydrogen chloride gas.

2.5 Inspection items

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

CAUTION	· Do not perform insulation resistance test on the servo amplifier as damage may result. · Do not disassemble and/or repair the equipment on customer side.

It is recommended to make the following checks periodically.

(1) Check for loose terminal block screws. Retighten any loose screws.

(2) Check the cables and the wires for scratches and cracks. Perform periodic inspection according to operating conditions.

(3) Check that the connector is securely connected to the servo amplifier.

(4) Check that the wires are not coming out from the connector.

(5) Check for dust accumulation on the servo amplifier.

(6) Check for unusual noise generated from the servo amplifier.

2.6 Parts having service lives

Service lives of the following parts are listed below. However, the service lives vary depending on operating methods and environmental conditions. If any fault is found in the parts, they must be replaced immediately regardless of their service lives. For parts replacement, please contact your local sales office.

Part name		Life guideline
Servo amplifier	Smoothing capacitor	10 years
	Relay	Number of power-on and controller forced stop times: 100,000 times Number of on and off for STO: 1,000,000 times
	Cooling fan	10,000 to 30,000 hours (2 to 3 years)
	Absolute position battery	Refer to section 12.2

(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 (40℃ (104℉) surrounding air temperature or less).

(2) Relays
Contact faults will occur due to contact wear arisen from switching currents. Relays reach the end of their lives when the power has been turned on, and controller forced stop has occurred 100,000 times in total, or when the STO has been turned on and off 1,000,000 times while the servo motor is stopped under servo-off state. However, the lives of relays may 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 cooling 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.

MEMO

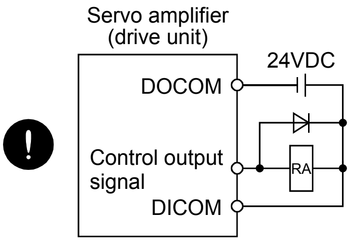
3. SIGNALS AND WIRING

WARNING

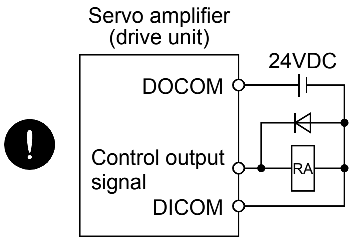
- Any person who is involved in wiring should be fully competent to do the work.
- Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) is safe with a voltage tester and others. Otherwise, an electric shock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

CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly, resulting in injury.
- Connect cables to correct terminals to prevent a burst, fault, etc.
- Ensure that polarity (＋, －) is correct. Otherwise, a burst, damage, etc. may occur.
- The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.

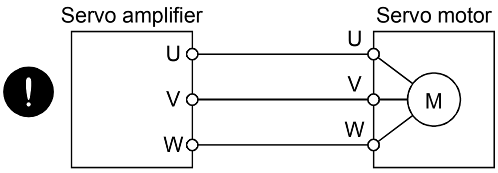


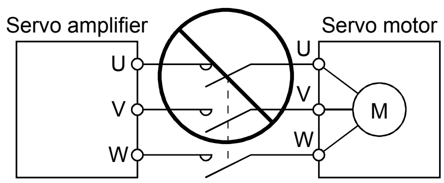
For sink output interface



For source output interface

- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge killer or radio noise filter (FR-BIF(-H) option) with the power line of the servo motor.
- When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative resistor, causing a fire.
- Do not modify the equipment.
- Connect the servo amplifier power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





3.1 Input power supply circuit

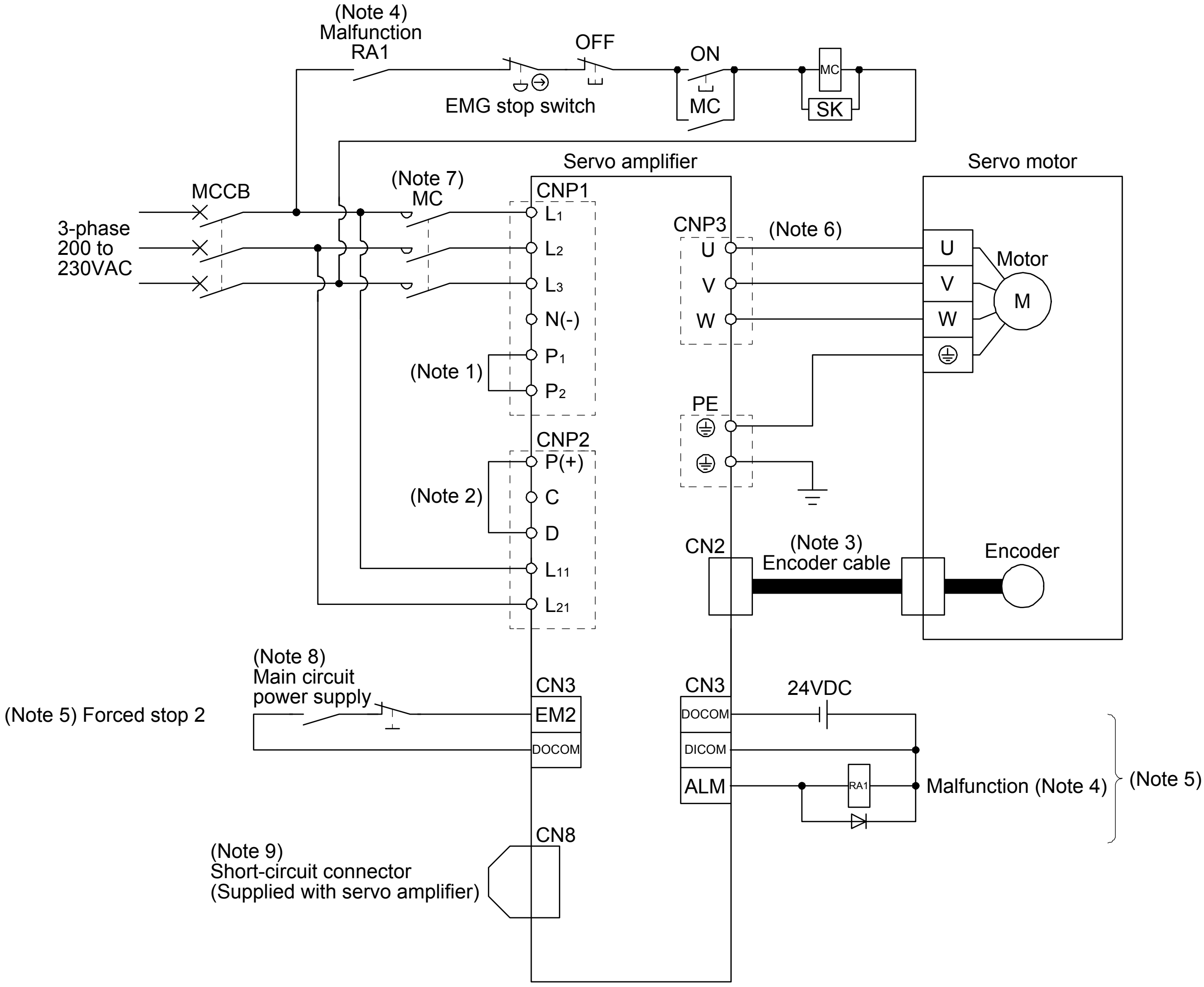
⚠ CAUTION	・Always connect a magnetic contactor between the main circuit power supply and L_1, L_2, and L_3 of the servo amplifier, to configure a circuit that shuts down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions. ・Use the malfunction signal to switch main circuit power supply off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire. ・Check the servo amplifier model, and then input proper voltage to the servo amplifier power supply.

POINT

- Even if alarm has occurred, do not switch off the control circuit power supply. When the control circuit power supply has been switched off, optical module does not operate, and optical transmission of SSCNETⅢ communication is interrupted. Therefore, the servo amplifier on the rear axis displays "AA" at the indicator and turns into base circuit shut-off. The servo amplifier stops with starting dynamic brake.
- The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.

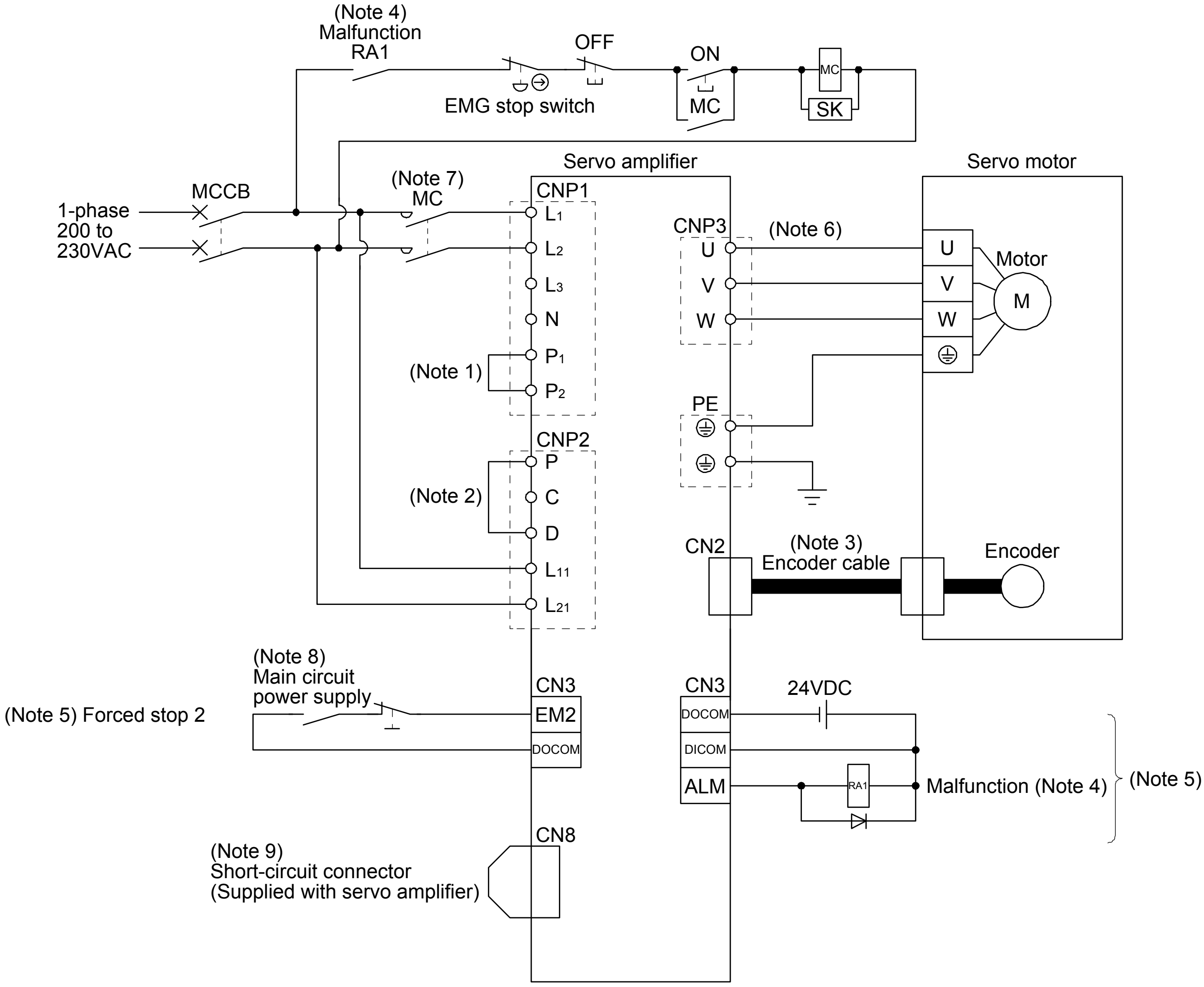
Wire the power supply/main circuit so that power is shut off and the servo-on command turned off as soon as an alarm occurs. A molded-case circuit breaker (MCCB) must be used with the input cables of the main circuit power supply.

(1) For 3-phase 200V to 230VAC power supply to MR-J3-10□S to MR-J3-350□S



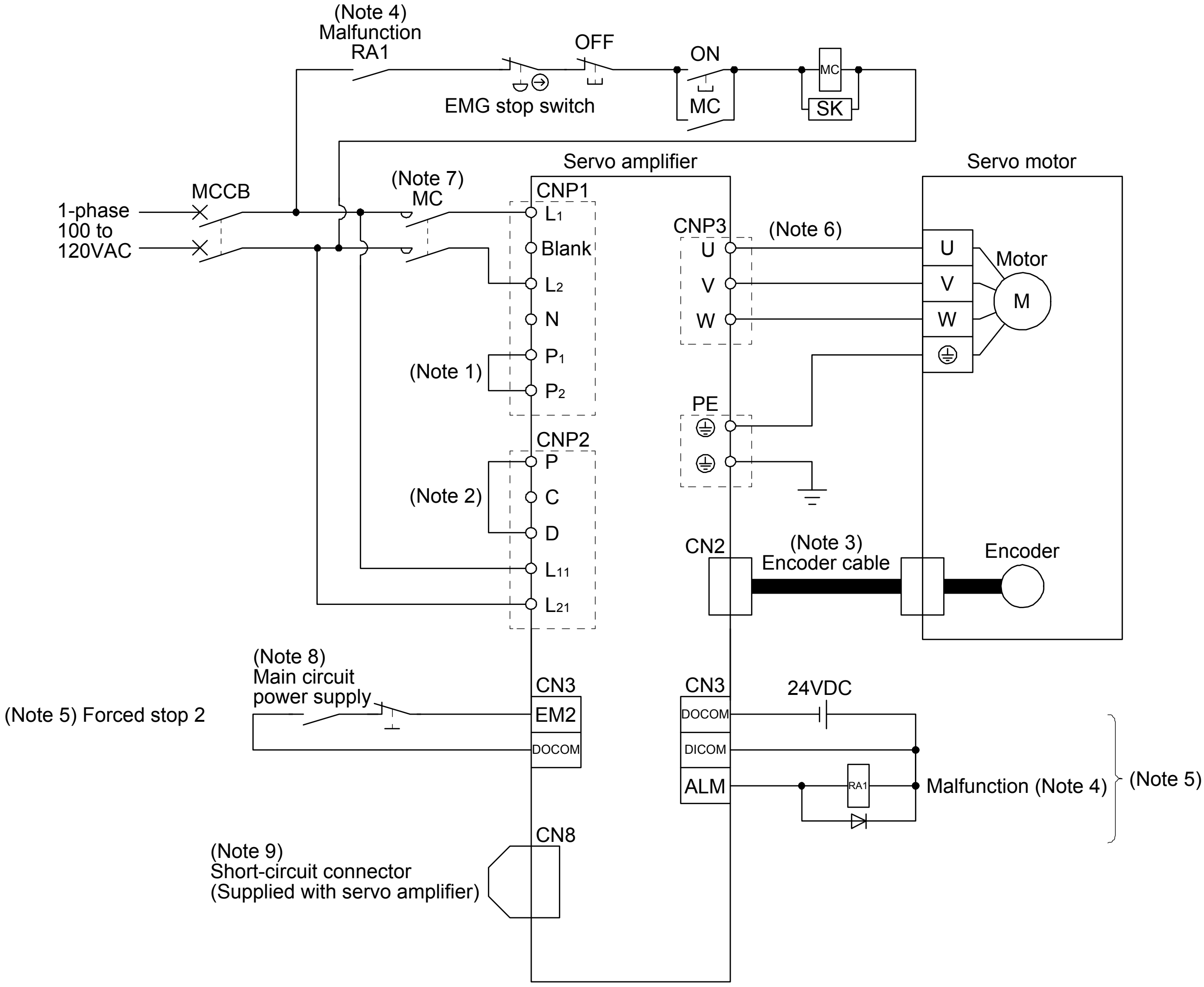
Note 1. Always connect P_1 and P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.
2. Always connect P(+) and D. (Factory-wired.) When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
8. Turn off EM2 when the main power circuit power supply is off.
9. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

(2) For 1-phase 200V to 230VAC power supply to MR-J3-10□S to MR-J3-70□S



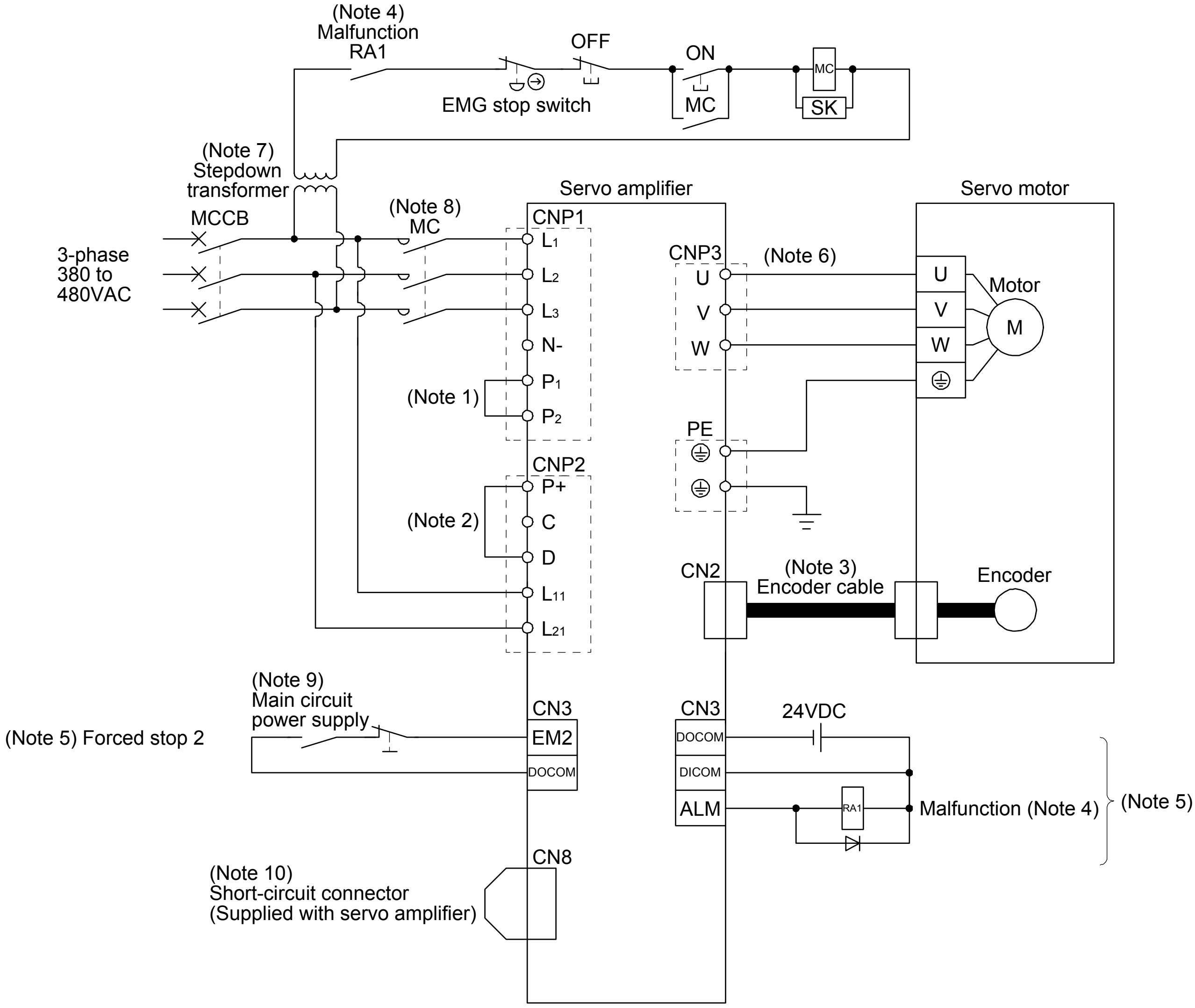
Note 1. Always connect P_1 and P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.
2. Always connect P and D. (Factory-wired.) When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
8. Turn off EM2 when the main power circuit power supply is off.
9. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

(3) For MR-J3-10□S1 to MR-J3-40□S1



Note 1. Always connect P_1 and P_2. (Factory-wired.) The power factor improving DC reactor cannot be used.
2. Always connect P and D. (Factory-wired.) When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
8. Turn off EM2 when the main power circuit power supply is off.
9. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

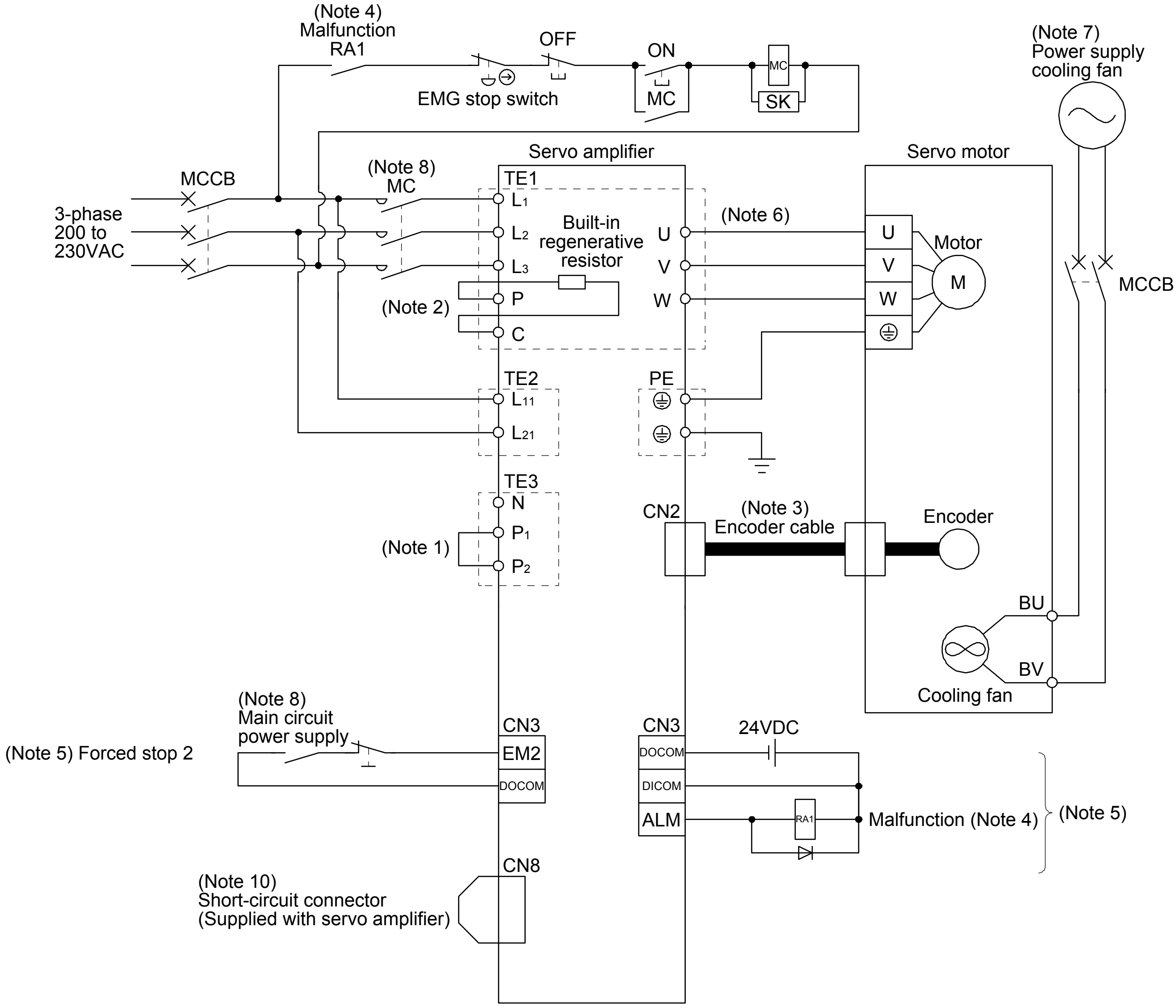
(4) MR-J3-60□S4 to MR-J3-200□S4



Note 1. Always connect P_1 and P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.

2. Always connect P and D. (Factory-wired.) When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.
8. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
9. Turn off EM2 when the main power circuit power supply is off.
10. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

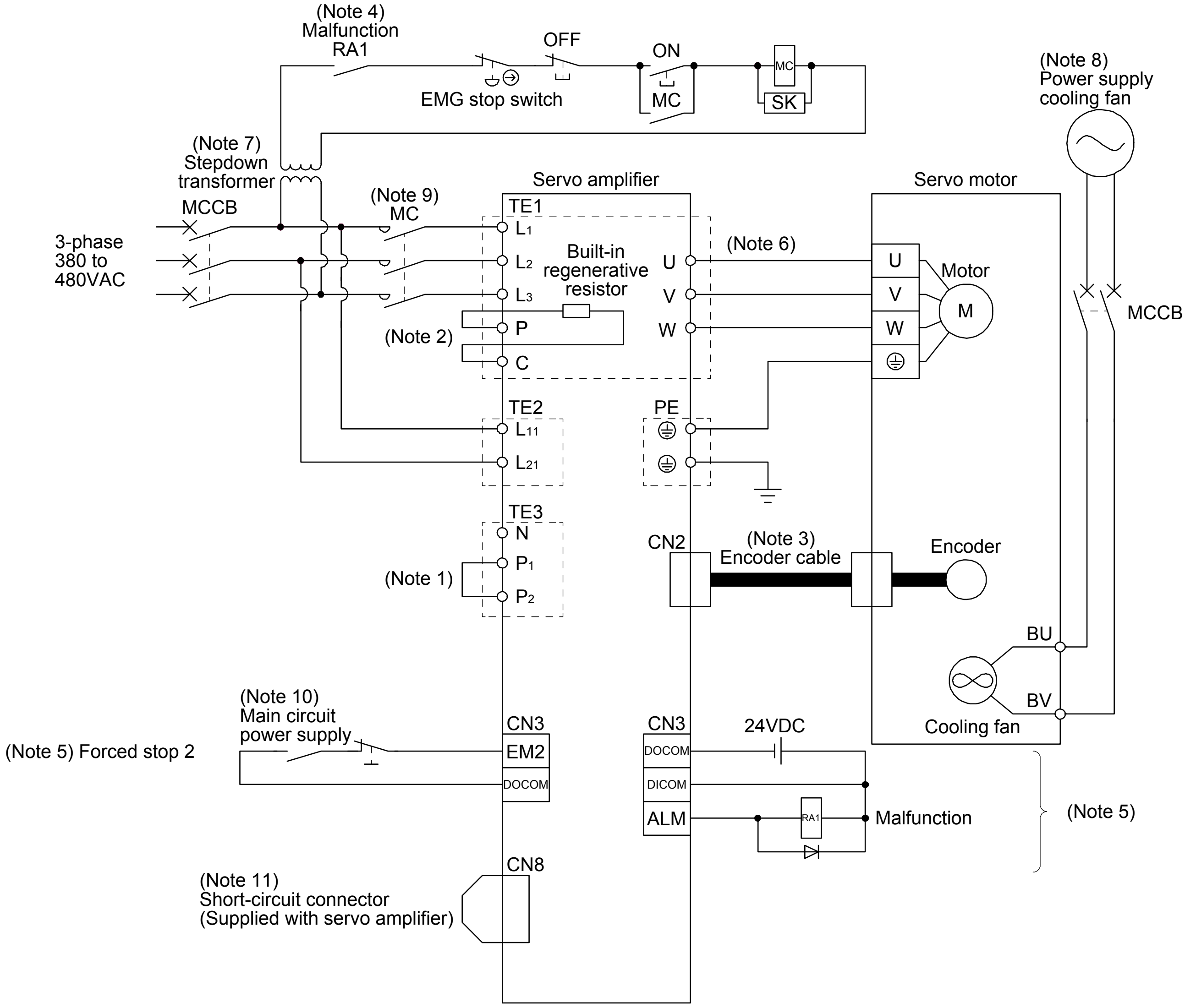
(5) MR-J3-500□S・MR-J3-700□S



Note 1. Always connect P_1 and P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.

2. When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. A cooling fan is attached to the HA-LP601 and the HA-LP701M servo motors. For power supply specification of the cooling fan, refer to section 3.11.2 (3) (b).
8. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
9. Turn off EM2 when the main power circuit power supply is off.
10. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

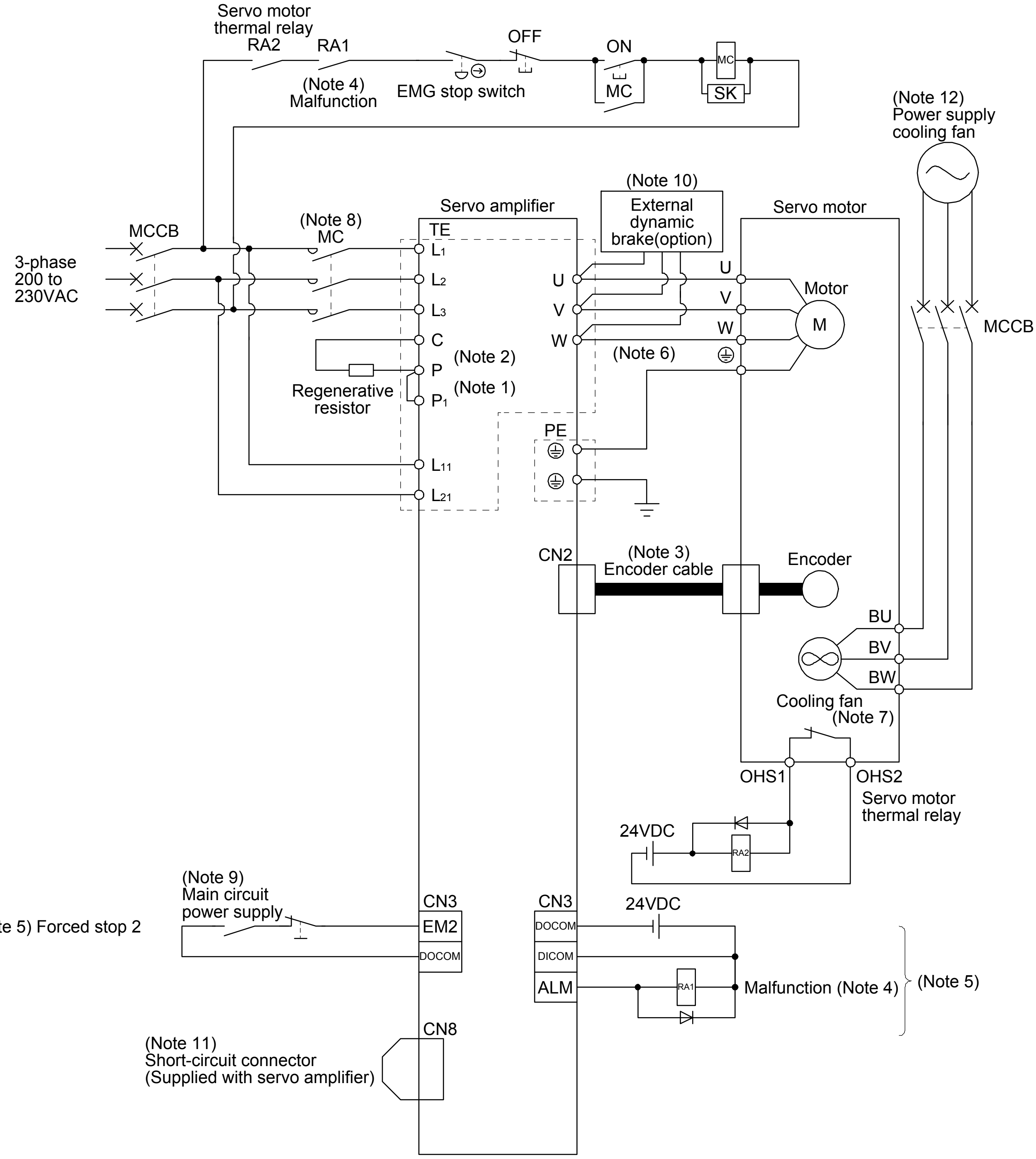
(6) MR-J3-350□S4 to MR-J3-700□S4



Note 1. Always connect P_1 and P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.

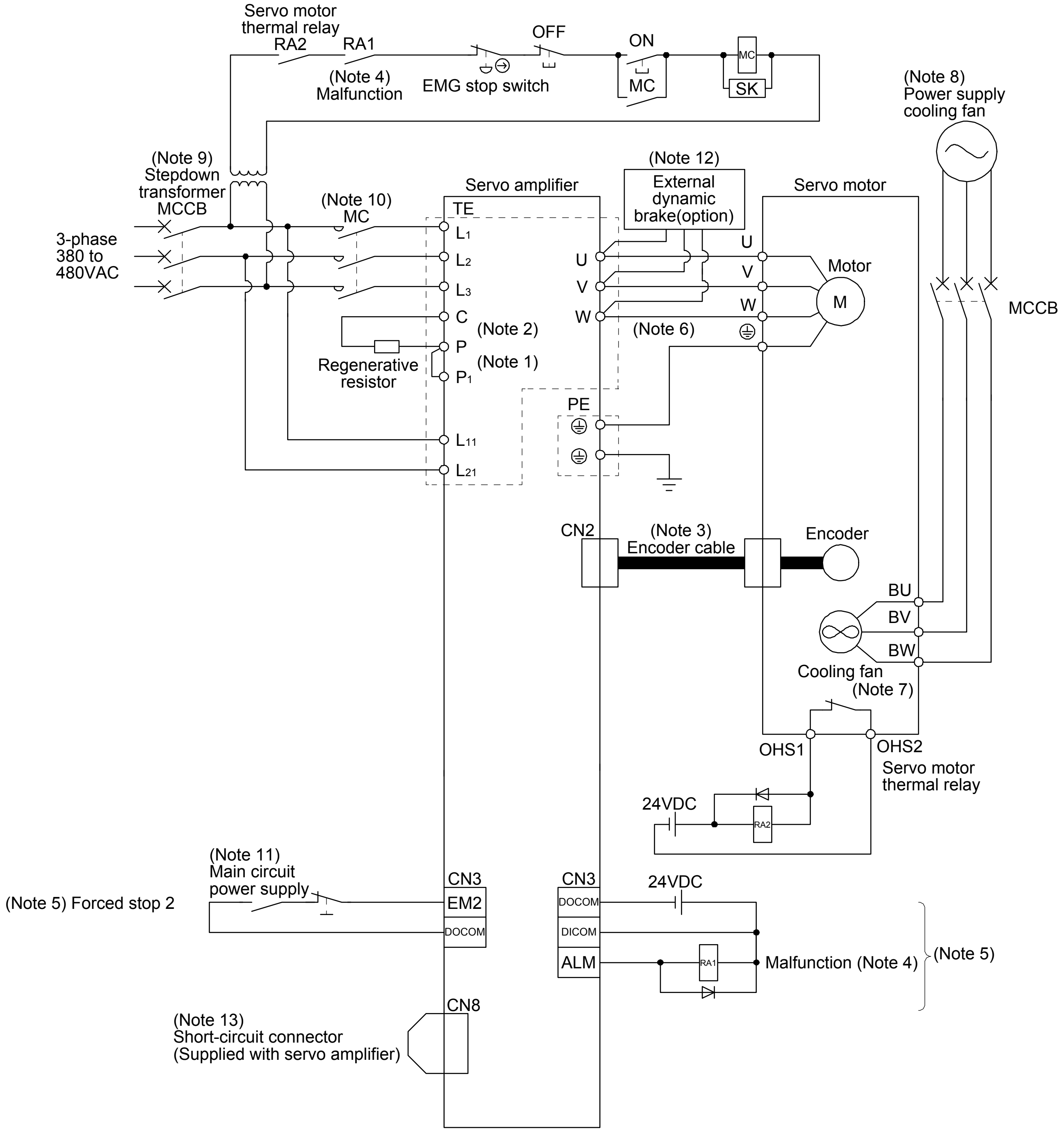
2. When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.
8. A cooling fan is attached to the HA-LP6014 and the HA-LP701M4 servo motors. For power supply specification of the cooling fan, refer to section 3.11.2 (3) (b).
9. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
10. Turn off EM2 when the main power circuit power supply is off.
11. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

(7) MR-J3-11K□S to MR-J3-22K□S



Note 1. Always connect P_1 and P. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.
2. Connect the regenerative resistor. When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Cooling fan power supply of the HA-LP11K2 servo motor is 1-phase. Power supply specification of the cooling fan is different from that of the servo amplifier. Therefore, separate power supply is required.
8. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
9. Turn off EM2 when the main power circuit power supply is off.
10. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.
11. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.
12. For the cooling fan power supply, refer to section 3.11.2 (3) (b).

(8) MR-J3-11K□S4 to MR-J3-22K□S4

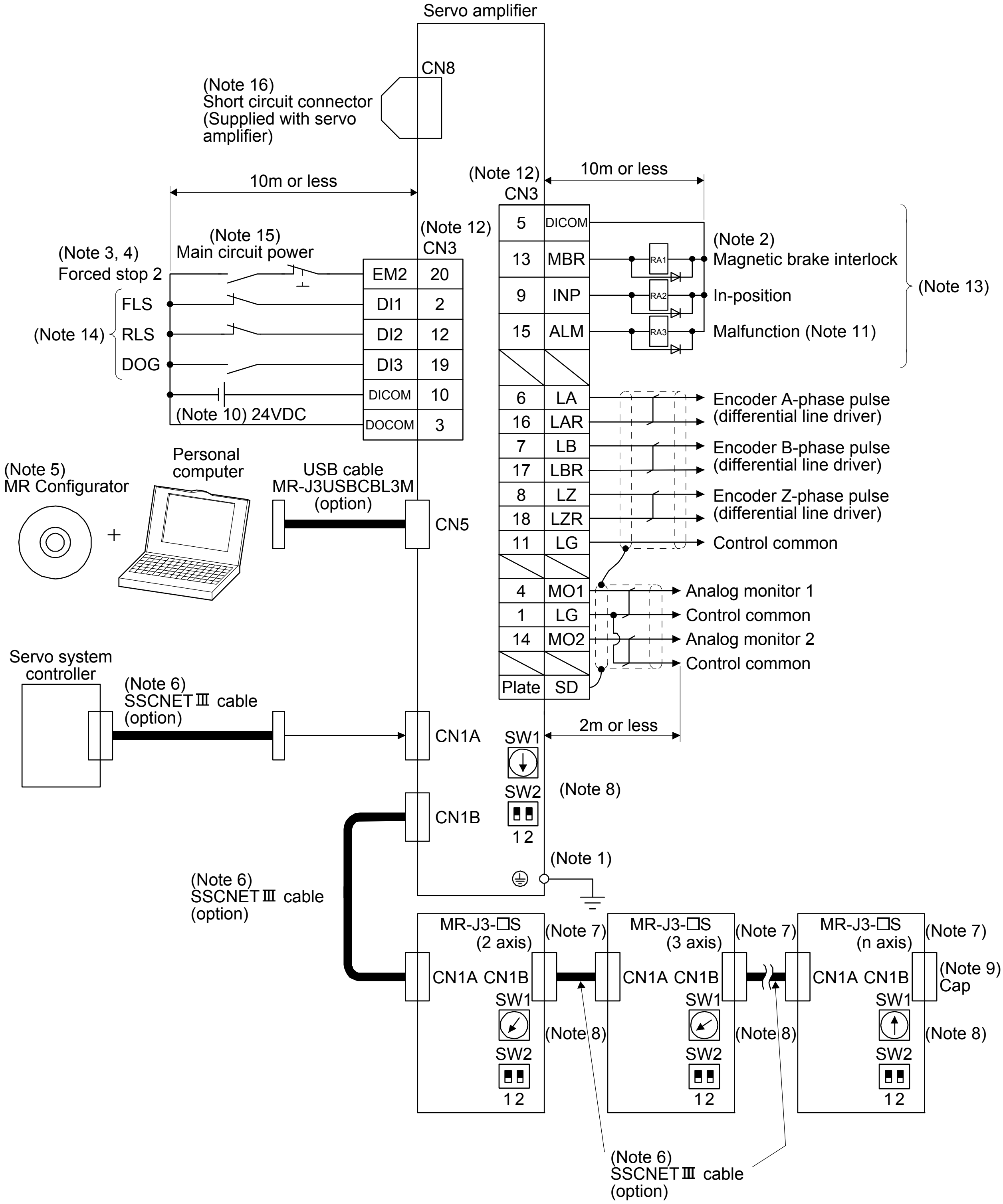


Note 1. Always connect P_1 and P. (Factory-wired.) When using the power factor improving DC reactor, refer to section 11.13. Use either the power factor improving DC reactor or the power factor improving AC reactor.
2. Connect the regenerative resistor. When using the regenerative option, refer to section 11.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
4. If deactivating output of malfunction (ALM) with parameter change, configure up the power supply circuit which switches off the magnetic contactor after detection of alarm occurrence on the controller side.
5. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
6. Refer to section 3.11.
7. Servo amplifiers does not have BW when the cooling fan power supply is 1-phase.
8. For the cooling fan power supply, refer to section 3.11.2 (3) (b).
9. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.
10. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
11. Turn off EM2 when the main power circuit power supply is off.
12. Use an external dynamic brake for this servo amplifier. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.
13. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

3.2 I/O signal connection example

POINT
· The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.

3.2.1 Sink I/O interface



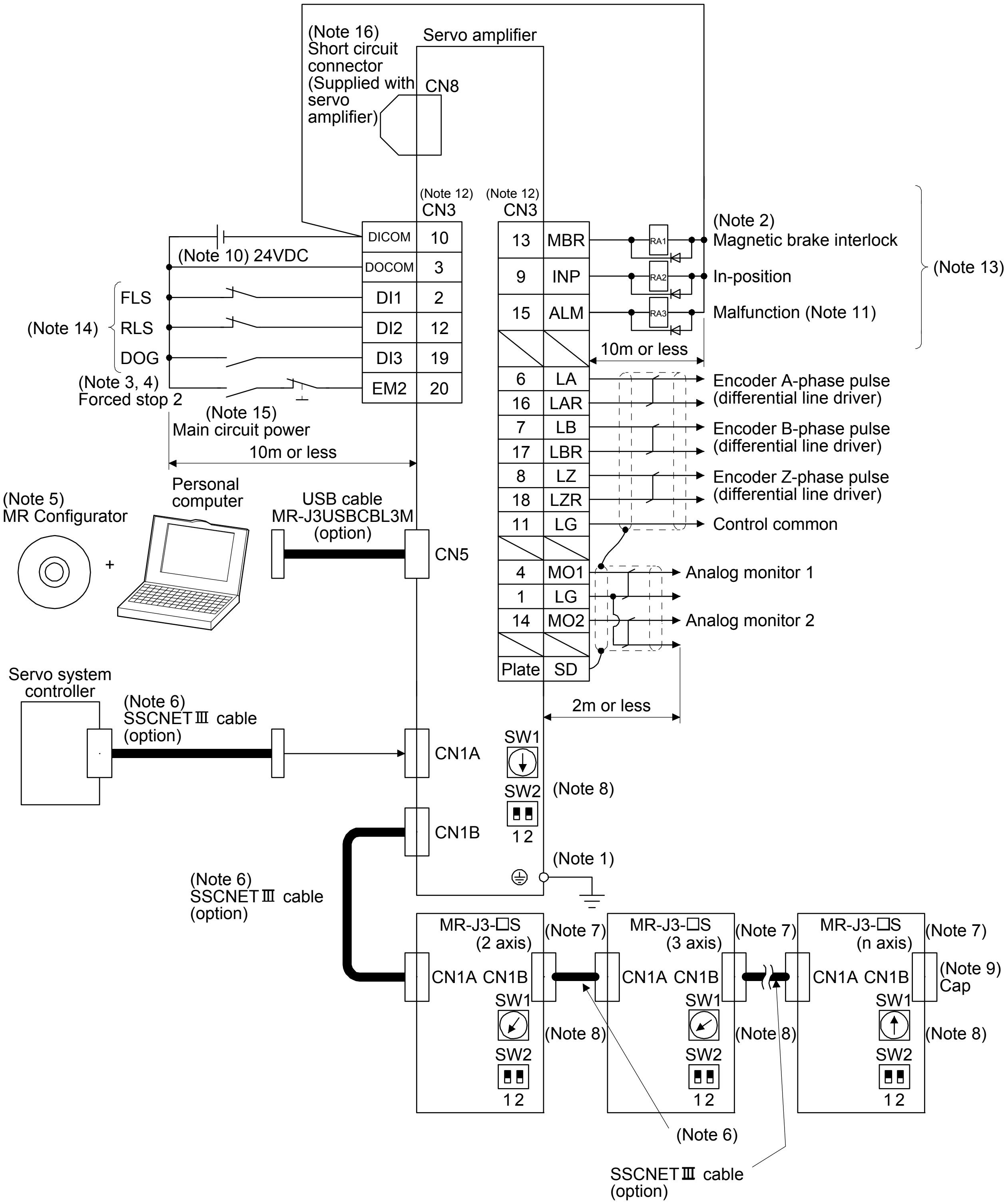
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the cabinet.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. If the controller does not have forced stop function, always install the forced stop 2 switch (Normally closed contact).
4. When starting operation, always turn on the forced stop 2 (EM2). (Normally closed contact)
5. Use MRZJW3-SETUP 221E. (Refer to section 11.8)
6. Use SSCNETⅢ cables listed in the following table.

Cable	Cable model name	Cable length
Standard cord inside panel	MR-J3BUS□M	0.15m to 3m
Standard cable outside panel	MR-J3BUS□M-A	5m to 20m
Long-distance cable	MR-J3BUS□M-B	30m to 50m

7. The wiring of the second and subsequent axes is omitted.
8. Up to sixteen axes may be connected. Refer to section 3.14 for setting of axis selection.
9. Make sure to put a cap on the unused CN1A・CN1B.
10. Supply 24VDC±10% 200mA current for interfaces from the outside. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
11. Malfunction (ALM) turns on in normal alarm-free condition. (Normally closed contact)
12. The pins with the same signal name are connected in the servo amplifier.
13. The signal can be changed by parameter No.PD07, PD08, PD09.
14. Devices can be assigned for DI1・DI2・DI3 with controller setting. For devices that can be assigned, refer to the controller instruction manual. The assigned devices are for the Q173DCPU・Q172DCPU・Q173HCPU・Q172HCPU, Q170MCPU, QD74MH□ and QD75MH□.
FLS: Upper stroke limit
RLS: Lower stroke limit
DOG: Proximity dog
15. Turn off EM2 when the main power circuit power supply is off.
16. When not using the STO function, attach a short-circuit connector supplied with a servo amplifier.

3.2.2 Source I/O interface

POINT
・For Note, refer to section 3.2.1.



3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT

- For the layout of connector and terminal block, refer to chapter 9 OUTLINE DRAWINGS.

<table>
<tr><th>Abbreviation</th><th>Connection target
(Application)</th><th>Description</th></tr>
<tr><td>L_1
L_2
L_3</td><td>Main circuit power supply</td><td>Supply the following power to L_1, L_2, L_3. For the 1-phase 200V to 230VAC power supply, connect the power supply to L_1, L_2, and keep L_3 open.
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J3-10□S to 70□S</th><th>MR-J3-100□S to 22K□S</th><th>MR-J3-10□S1 to 40□S1</th></tr>
<tr><td>3-phase 200V to 230VAC, 50/60Hz</td><td colspan="2">L_1 · L_2 · L_3</td><td></td></tr>
<tr><td>1-phase 200V to 230VAC, 50/60Hz</td><td>L_1 · L_2</td><td></td><td></td></tr>
<tr><td>1-phase 100V to 120VAC, 50/60Hz</td><td></td><td></td><td>L_1 · L_2</td></tr>
</table>
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J3-60□S4 to 22K□S4</th></tr>
<tr><td>3-phase 380V to 480VAC, 50/60Hz</td><td>L_1 · L_2 · L_3</td></tr>
</table>
</td></tr>
<tr><td>P_1
P_2</td><td>Power factor improving DC reactor</td><td>1) MR-J3-700□S or less
When not using the power factor improving DC reactor, connect P_1 and P_2. (Factory-wired.)
When using the power factor improving DC reactor, disconnect P_1 and P_2, and connect the power factor improving DC reactor to P_1 and P_2.
2) MR-J3-11K□S(4) to 22K□S(4)
MR-J3-11K□S(4) to 22K□S(4) do not have P_2.
When not using the power factor improving reactor, connect P_1 and P. (Factory-wired)
When using the power factor improving reactor, connect it to P and P_1.
Refer to section 11.13.</td></tr>
<tr><td>P
C
D</td><td>Regenerative option</td><td>1) MR-J3-350□S or less · MR-J3-200□S4 or less
When using servo amplifier built-in regenerative resistor, connect P(＋) and D. (Factory-wired)
When using regenerative option, disconnect P(＋) and D, and connect regenerative option to P and C.
2) MR-J3-350□S4 · 500□S(4) · 700□S(4)
MR-J3-350□S4 · 500□S(4) · 700□S(4) do not have D.
When using servo amplifier built-in regenerative resistor, connect P and C. (Factory-wired)
When using regenerative option, disconnect P and C, and connect regenerative option to P and C.
3) MR-J3-11K□S(4) to 22K□S(4)
MR-J3-11K□S(4) to 22K□S(4) do not have D.
When not using the power regenerative converter and the brake unit, make sure to connect the regenerative option to P and C.
Refer to section 11.2 to 11.5.</td></tr>
<tr><td>L_{11}
L_{21}</td><td>Control circuit power supply</td><td>Supply the following power to L_{11} · L_{21}.
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J3-10□S to 22K□S</th><th>MR-J3-10□S1 to 40□S1</th><th>MR-J3-60□S4 to 22K□S4</th></tr>
<tr><td>1-phase 200V to 230VAC</td><td>L_{11} · L_{21}</td><td></td><td></td></tr>
<tr><td>1-phase 100V to 120VAC</td><td></td><td>L_{11} · L_{21}</td><td></td></tr>
<tr><td>1-phase 380V to 480VAC</td><td></td><td></td><td>L_{11} · L_{21}</td></tr>
</table>
</td></tr>
<tr><td>U
V
W</td><td>Servo motor power</td><td>Connect to the servo motor power supply terminals (U, V, W). Connect the servo amplifier power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>N</td><td>Regenerative converter
Brake unit</td><td>When using the power regenerative converter/brake unit, connect it to P and N.
Do not connect to servo amplifier MR-J3-350□S(4) or less.
For details, refer to section 11.3 to 11.5.</td></tr>
<tr><td>⏚</td><td>Protective earth (PE)</td><td>Connect to the earth terminal of the servo motor and to the protective earth (PE) of the cabinet to perform grounding.</td></tr>
</table>

3.3.2 Power-on sequence

POINT
・A voltage, output signal, etc. of analog monitor output may be irregular at power-on.

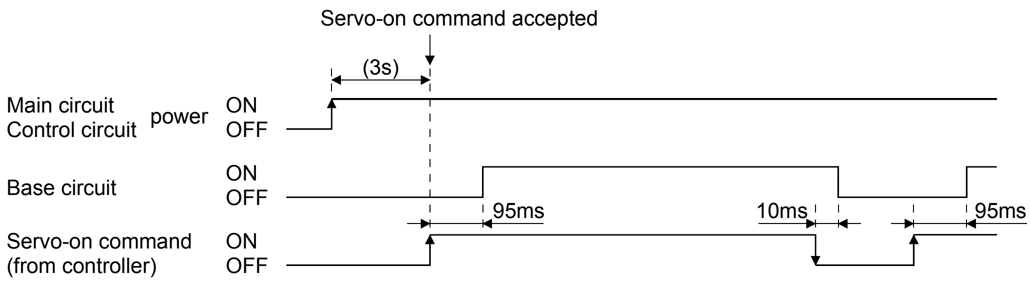
(1) Power-on procedure

1) Always wire the power supply as shown in above section 3.1 using the magnetic contactor with the main circuit power supply (3-phase: L_1, L_2, L_3, 1-phase: L_1, L_2). Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

2) Switch on the control circuit power supply L_{11}, L_{21} 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 command within 3s the main circuit power supply is switched on. (Refer to paragraph (2) of this section.)

(2) Timing chart



3.3.3 CNP1, CNP2, CNP3 wiring method

POINT

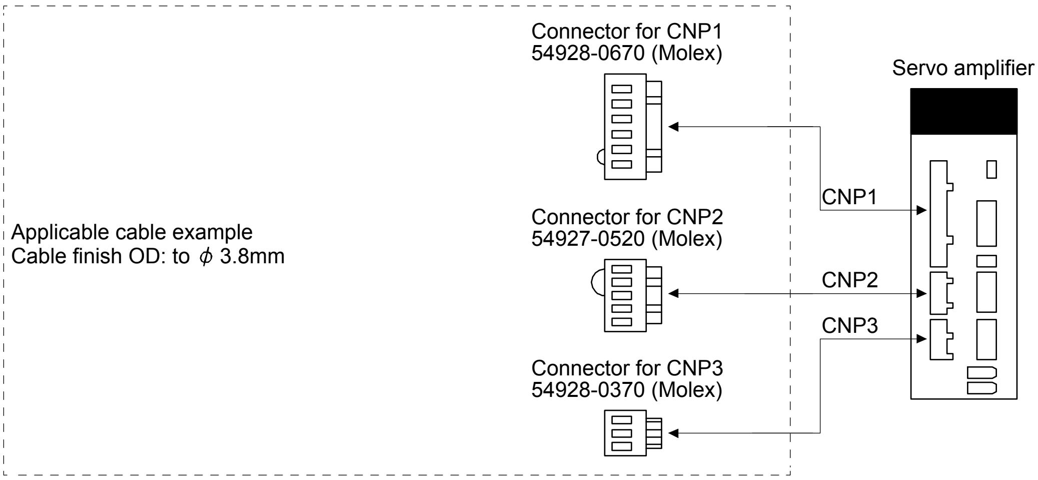
- Refer to section 11.11 for the wire sizes used for wiring.
- MR-J3-500□S or more・MR-J3-350□S4 or more does not have these connectors.

Use the supplied servo amplifier power supply connectors for wiring of CNP1, CNP2 and CNP3.

(1) MR-J3-10□S to MR-J3-100□S

(a) Servo amplifier power supply connectors

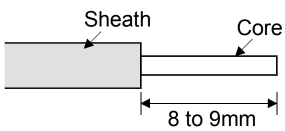
(Note) Servo amplifier power supply connectors



Note. These connectors are of insert type. As the crimping type, the following connectors (Molex) are recommended.
For CNP1: 51241-0600 (connector), 56125-0128 (terminal)
For CNP2: 51240-0500 (connector), 56125-0128 (terminal)
For CNP3: 51241-0300 (connector), 56125-0128 (terminal)
Crimping tool: CNP57349-5300
Connector applicable cable example
Cable finish OD: to ϕ3.8mm

(b) Termination of the cables

Solid wire: After the sheath has been stripped, the cable can be used as it is.

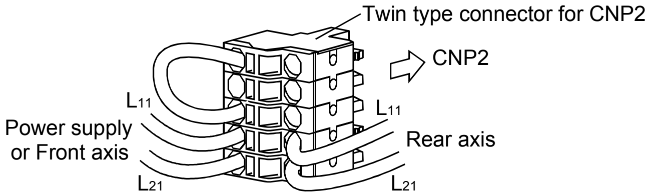


Twisted wire: Use the cable after stripping the sheath without twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a ferrule may be used to put the wires together.

Cable size		Ferrule type (Note 1)		Crimping tool (Note 2)
[mm²]	AWG	For 1 cable	For 2 cable	
1.25/1.5	16	AI1.5-10BK	AI-TWIN2 × 1.5-10BK	Variocrimp 4 206-204
2/2.5	14	AI2.5-10BU		

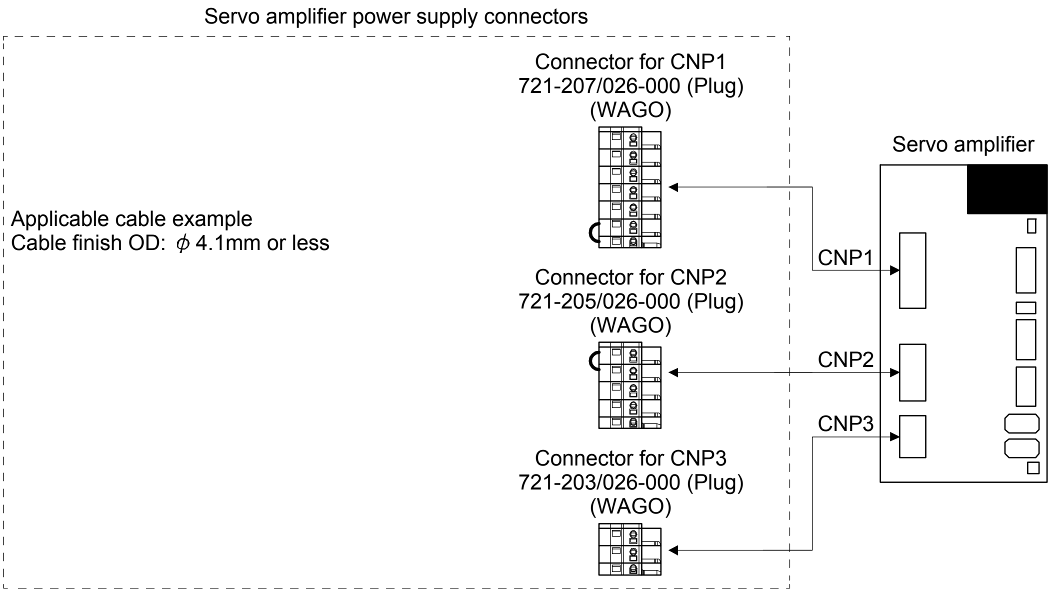
Note 1. Manufacturer: Phoenix Contact
2. Manufacturer: WAGO

(c) The twin type connector for CNP2 (L_{11} · L_{21}): 721-2105/026-000 (WAGO)
Using this connector enables passing a wire of control circuit power supply.
Refer to App. 3 for details of connector.

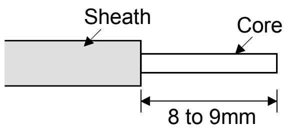


(2) MR-J3-200□S · MR-J3-60□S4 to MR-J3-200□S4

(a) Servo amplifier power supply connectors



(b) Termination of the cables
Solid wire: After the sheath has been stripped, the cable can be used as it is.

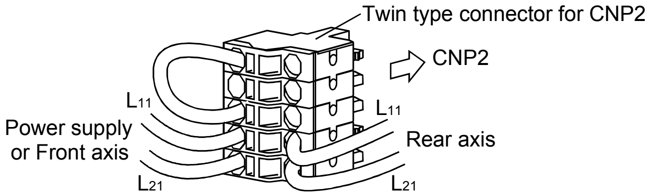


Twisted wire: Use the cable after stripping the sheath without twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a ferrule may be used to put the wires together.

Cable size		Ferrule type		Crimping tool (Note 2)
[mm²]	AWG	For 1 cable	For 2 cable	
1.25/1.5	16	AI1.5-10BK (Note 1)	AI-TWIN2 × 1.5-10BK (Note 1)	Variocrimp 4 206-204
2	14	216-205 (Note 2)		

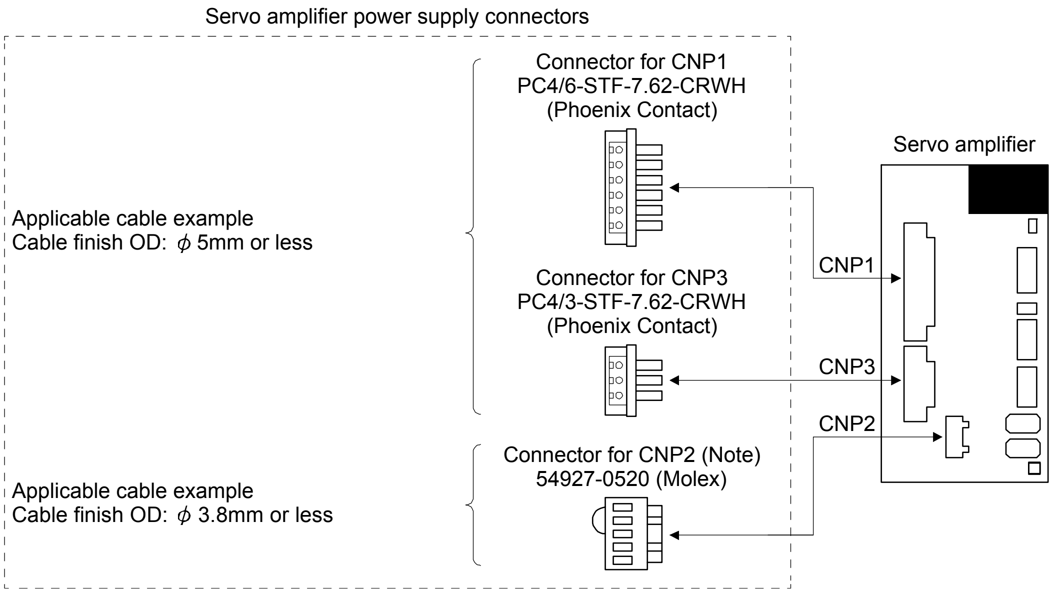
Note 1. Manufacturer: Phoenix Contact
2. Manufacturer: WAGO

(c) The twin type connector for CNP2 (L_{11} ・ L_{21}): 721-2205/026-000 (WAGO)
Using this connector enables passing a wire of control circuit power supply.
Refer to App. 3 for details of connector.



(3) MR-J3-350□S

(a) Servo amplifier power supply connectors

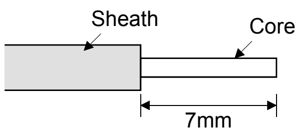


Note. As twin type connector for CNP2 (L_{11}, L_{21}) is the same as MR-J3-100□S or smaller. Refer to (1) (c) of this section.

(b) Termination of the cables

1) CNP1 ・ CNP3

Solid wire: After the sheath has been stripped, the cable can be used as it is.



Twisted wire: Use the cable after stripping the sheath without 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. Alternatively, a ferrule may be used to put the wires together.

Cable size		Ferrule type		Crimping tool	Manufacturer
[mm²]	AWG	For 1 cable	For 2 cables		
1.25/1.5	16	AI1.5-8BK	AI-TWIN2×1.5-8BK	CRIMPFOX-ZA3	Phoenix Contact
2.0/2.5	14	AI2.5-8BU	AI-TWIN2×2.5-10BU		
3.5	12	AI4-10GY			

2) CNP2
CNP2 is the same as MR-J3-100□S or smaller capacities. Refer to (1) (b) of this section.

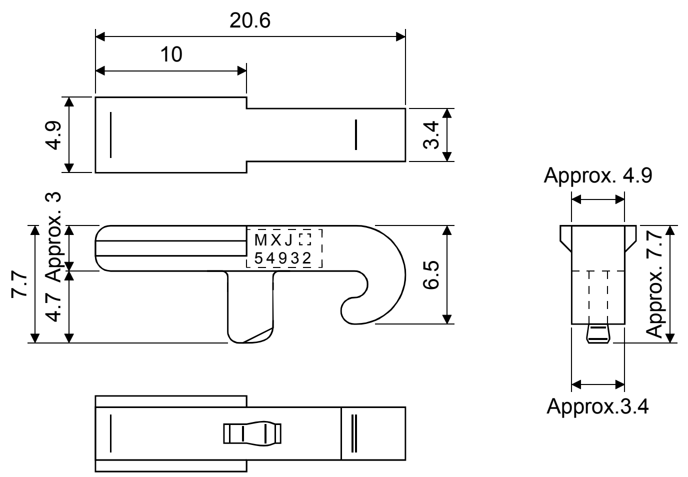
(4) Insertion of cable into Molex and WAGO connectors
Insertion of cable into 54928-0610, 54927-0520, 54928 (Molex) connectors and 721-207/026-000, 721-205/
026-000 and 721-203/026-000 (WAGO) connectors are as follows.
The following explains for Molex, however use the same procedures for inserting WAGO connectors as well.

POINT
・It may be difficult for a cable to be inserted to the connector depending on wire size or ferrule configuration. In this case, change the wire type or correct it in order to prevent the end of ferrule from widening, and then insert it.

How to connect a cable to the servo amplifier power supply connector is shown below.

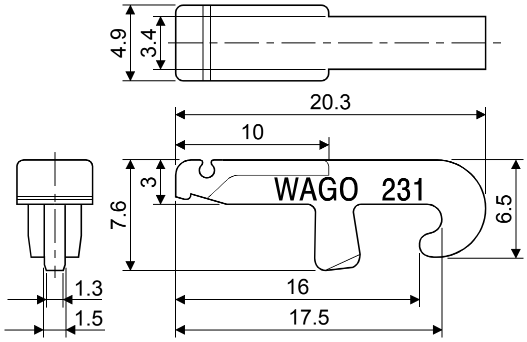
(a) When using the supplied cable connection lever
1) The servo amplifier is packed with the cable connection lever.
a) 54932-0000 (Molex)

[Unit: mm]

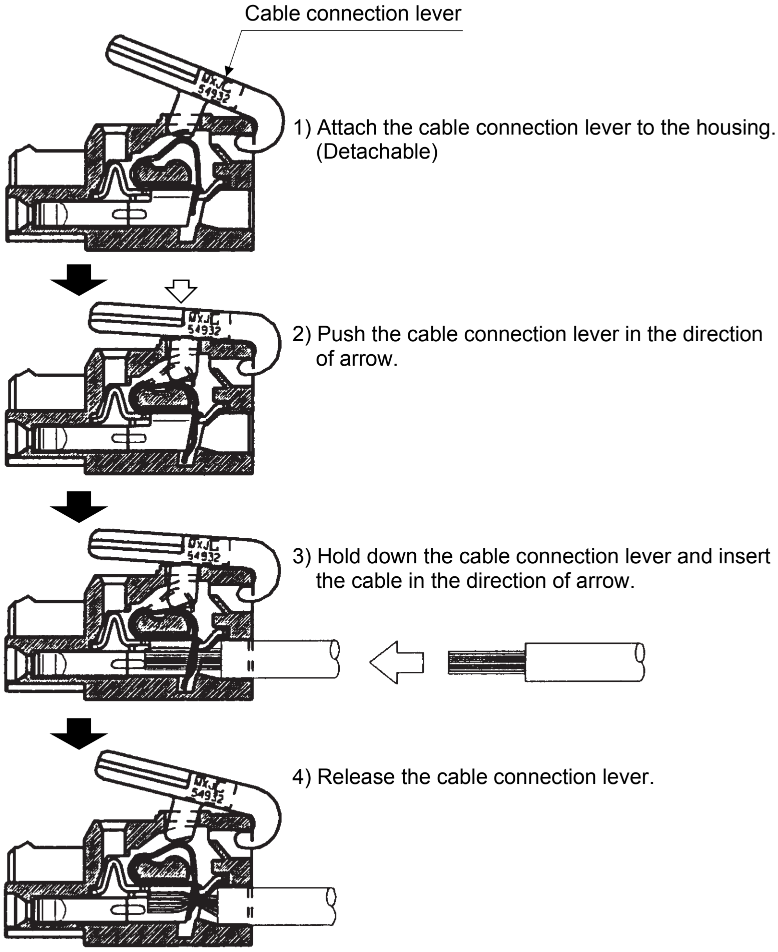


b) 231-131 (WAGO)

[Unit: mm]



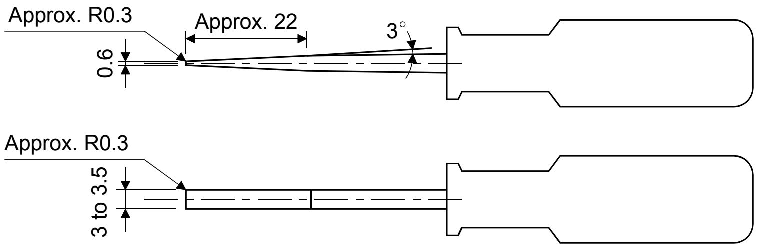
2) Cable connection procedure



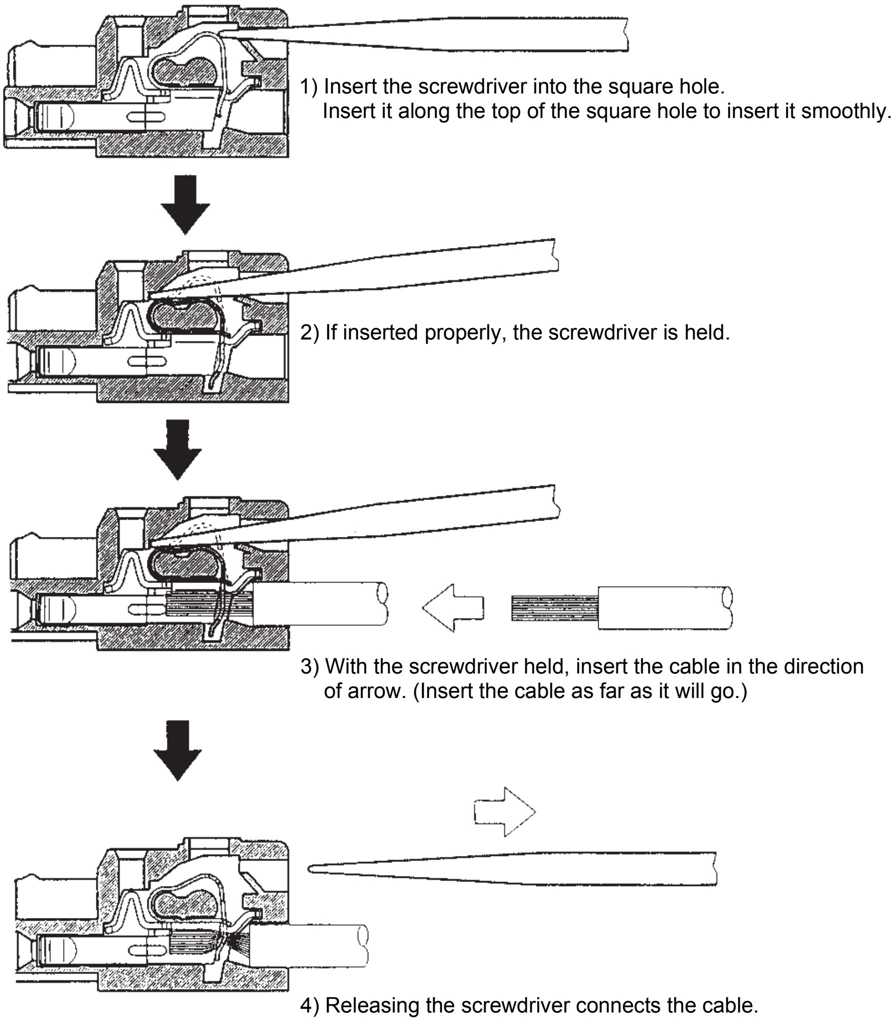
(b) Inserting the cable into the connector

1) Applicable flat-blade screwdriver dimensions
Always use the screwdriver shown here to do the work.

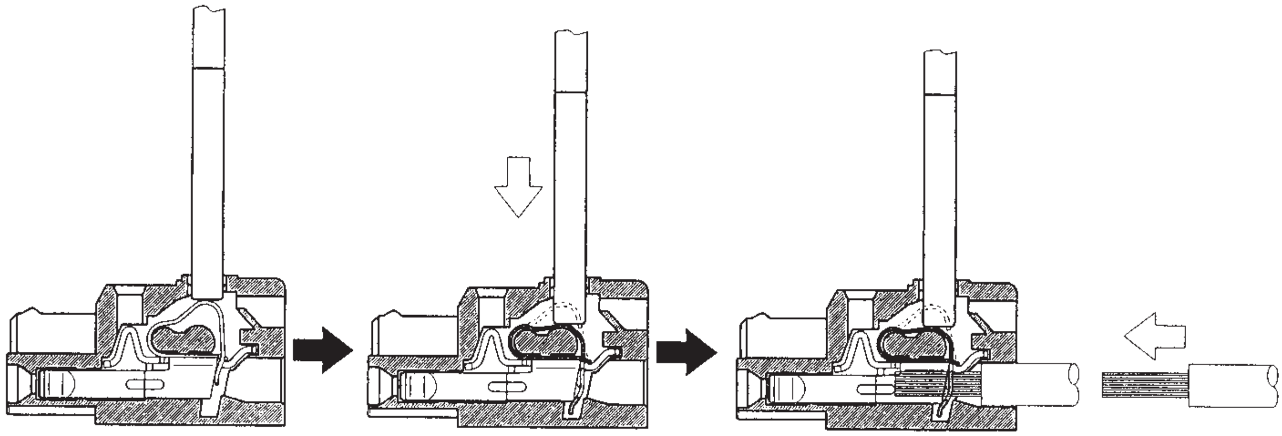
[Unit: mm]



2) When using the flat-blade screwdriver - part 1



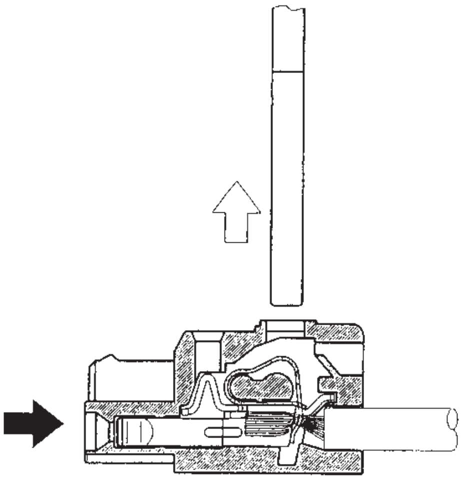
3) When using the flat-blade screwdriver - part 2



1) Insert the screwdriver into the square window at top of the connector.

2) Push the screwdriver in the direction of arrow.

3) With the screwdriver pushed, insert the cable in the direction of arrow. (Insert the cable as far as it will go.)

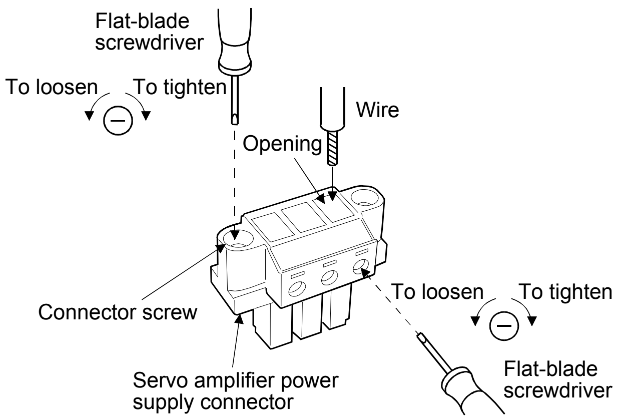


4) Releasing the screwdriver connects the cable.

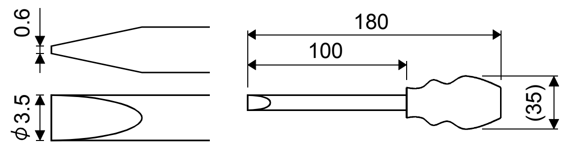
(5) How to insert the cable into Phoenix Contact connector

POINT
・Do not use a precision driver because the cable cannot be tightened with enough torque.

Insertion of cables into Phoenix Contact connector PC4/6-STF-7.62-CRWH or PC4/3-STF-7.62-CRWH is shown as follows.
Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose. Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver. When the cable is not tightened enough to the connector, the cable or connector may generate heat because of the poor contact. (When using a cable of 1.5mm2 or less, two cables may be inserted into one opening.)
Secure the connector to the servo amplifier by tightening the connector screw.
For securing the cable and the connector, use a flat-blade driver with 0.6mm blade edge thickness and 3.5mm diameter (Recommended flat-blade screwdriver: Phoenix Contact SZS 0.6×3.5). Apply 0.5 to 0.6 N・m torque to screw.



[Unit: mm]

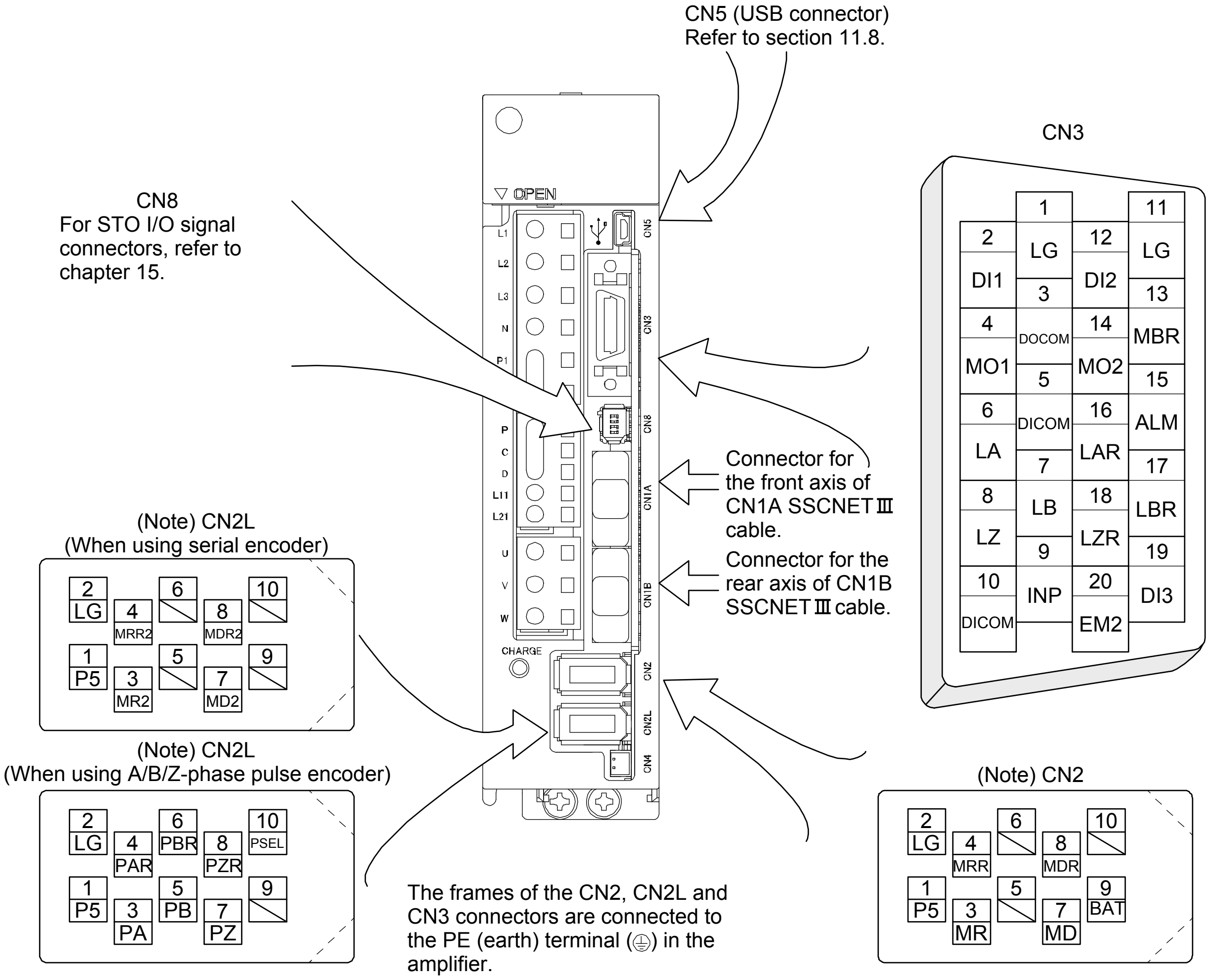


Recommended flat-blade screwdriver dimensions

3.4 Connectors and signal arrangements

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section. ・For STO I/O signal connectors (CN8), refer to chapter 15.

The servo amplifier front view shown is that of the MR-J3-20□S or less. Refer to chapter 9 Outline Drawings for the appearances and connector layouts of the other servo amplifiers.



Note. The 3M make connector is shown. When using any other connector, refer to section 11.1.2.

3.5 Signal (device) explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
The pin No.s in the connector pin No. column are those in the initial status.

(1) 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 cap.
CN2	Servo motor encoder connector	Used for connection with the servo motor encoder.
CN2L	Load-side encoder connector	Used for connection with the load-side encoder.
CN4	Battery connection connector	When using as absolute position detection system, connect to battery (MR-J3BAT). Before installing a battery, turn off the main circuit power while keeping the control circuit power on. Wait for 15 minutes or more (20 minutes or for drive unit 30kW or more) until the charge lamp turns off. Then, confirm that the voltage between P(＋) and N(－) (L＋ and L－ for drive unit 30kW or more) is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not. Replace the battery with main circuit power OFF and with control circuit power ON. Replacing the battery with the control circuit power OFF results in loosing absolute position data.
CN5	Communication connector (USB)	The personal computer is connected.
CN8	STO I/O signal connector	For STO I/O signal connectors (CN8), refer to chapter 15.

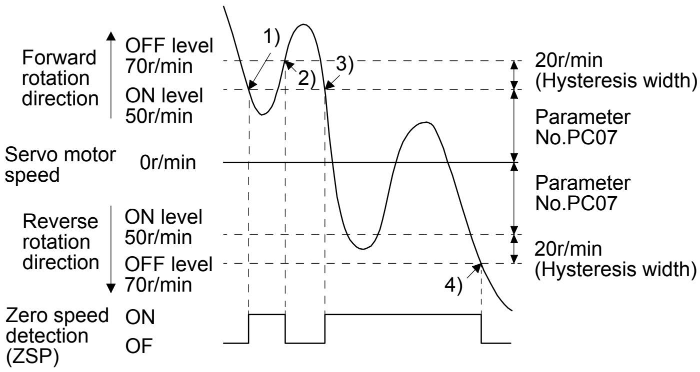
(2) I/O device

(a) Input device

Device	Symbol	Connector pin No.	Function/Application	I/O division
Forced stop 2	EM2	CN3-20	When the forced stop 2 (EM2) turns off or when alarm for forced stop occurs, the servo motor decelerates to a stop. EM2 and EM1 are mutually exclusive. The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.	DI-1
Forced stop	EM1	(CN3-20)	Set parameter No.PA04 to "30□□", and make the forced stop 1 (EM1) usable. Turn EM1 off (open between commons) to bring the motor to an forced stop state, in which the base circuit is shut off and the dynamic brake is operated. Turn EM1 on (short between commons) in the forced stop state to reset that state.	DI-1
	DI1	CN3-2	Devices can be assigned for DI1 DI2 DI3 with controller setting. For devices that can be assigned, refer to the controller instruction manual. The following devices can be assigned for Q173DCPU, Q172DCPU, Q173HCPU, Q172HCPU, Q170MCPU, QD74MH□ and QD75MH□.	DI-1
	DI2	CN3-12		DI-1
	DI3	CN3-19		DI-1

(b) Output device

Device	Symbol	Connector pin No.	Function/Application	I/O division
Malfunction	ALM	CN3-15	ALM turns off when power is switched off or the protective circuit is activated to shut off the base circuit. Without alarm occurring, ALM turns on within about 1s after power-on.	DO-1
Electromagnetic brake interlock	MBR	CN3-13	When using this signal, set operation delay time of the electromagnetic brake in parameter No.PC02. In the servo-off or alarm status, MBR turns off.	DO-1
In-position (Positioning completed)	INP	CN3-9	INP turns on when the number of droop pulse is in the preset in-position range. The in-position range can be changed using parameter No.PA10. When the in-position range is increased, INP may be on conductive status during low-speed rotation. INP turns on when servo-on turns on. This signal cannot be used in the speed control mode and torque control mode.	DO-1
Ready	RD		When using the signal, make it usable by the setting of parameter No.PD07 to PD09. RD turns on when the servo is switched on and the servo amplifier is ready to operate.	DO-1
Dynamic brake interlock	DB		When using the signal, make it usable by the setting of parameter No.PD07 to PD09. DB turns off when the dynamic brake needs to operate. When using the external dynamic brake on the servo amplifier of 11kW or more, this device is required. (Refer to section 11.6.) For the servo amplifier of 7kW or less, it is not necessary to use this device.	DO-1
Speed reached	SA		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. When the servo is off, SA will be turned OFF. When servo motor rotation speed becomes approximately setting speed, SA will be turned ON. When the preset speed is 20r/min or less, SA always turns on. This signal cannot be used in position control mode and torque control mode.	DO-1
Limiting speed	VLC		When using the signal, make it usable by the setting of parameter No.PD07 to parameter No.PD09. When speed reaches the value set with controller in torque control mode, VLC will be turned on. When the servo-on command will be turned off, VLC will be turned off. This signal cannot be used in the position control mode and speed control mode.	DO-1
Limiting torque	TLC		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. When torque is produced level of torque set with controller, TLC will be turned ON. When the servo-on command will be turned off, TLC will be turned OFF. This signal cannot be used in the torque control mode.	DO-1

Device	Symbol	Connector pin No.	Function/Application	I/O division
Zero speed detection	ZSP		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No.PC07. Example Zero speed is 50r/min  ZSP turns on 1) when the servo motor is decelerated to 50r/min, and ZSP turns off 2) when the servo motor is accelerated to 70r/min again. ZSP turns on 3) when the servo motor is decelerated again to 50r/min, and turns off 4) when the servo motor speed has reached -70r/min. The range from the point when the servo motor speed has reached ON level, and ZSP turns on, to the point when it is accelerated again and has reached OFF level is called hysteresis width. Hysteresis width is 20r/min for the MR-J3-□S servo amplifier.	DO-1
Warning	WNG		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. When warning has occurred, WNG turns on. When there is no warning, WNG turns off within about 1.5s after power-on.	DO-1
Battery warning	BWNG		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. BWNG turns on when battery cable disconnection warning (92) or battery warning (9F) has occurred. When there is no battery warning, BWNG turns off within about 1.5s after power-on.	DO-1
Variable gain selection	CDPS		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. CDPS is on during variable gain.	DO-1
Absolute position erasing	ABSV		When using this signal, make it usable by the setting of parameter No.PD07 to PD09. ABSV turns on when the absolute position erased. This signal cannot be used in the speed control mode and torque control mode.	DO-1

(c) Output signals

Signal name	Symbol	Connector pin No.	Function/Application
Encoder A-phase pulse (Differential line driver)	LA LAR	CN3-6 CN3-16	Outputs pulses per servo motor revolution set in parameter No.PA15 in the differential line driver type. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of $\pi/2$. The relationships between rotation direction and phase difference of the A-phase and B-phase pulses can be changed using parameter No.PC03. Output pulse specification and dividing ratio setting can be set. (Refer to section 5.1.9.)
Encoder B-phase pulse (Differential line driver)	LB LBR	CN3-7 CN3-17	
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN3-8 CN3-18	Outputs the zero-point signal in the differential line driver type of the encoder. One pulse is output per servo motor revolution. Turns on when the zero-point position is reached. (negative logic) The minimum pulse width is about 400μs. For home position return using this pulse, set the creep speed to 100r/min. or less.
Analog monitor 1	MO1	CN3-4	Used to output the data set in parameter No.PC09 to across MO1-LG in terms of voltage. Resolution 10 bits or equivalent
Analog monitor 2	MO2	CN3-14	Used to output the data set in parameter No.PC10 to across MO2-LG in terms of voltage. Resolution 10 bits or equivalent

(d) Power supply

Signal name	Symbol	Connector pin No.	Function/Application
Digital I/F power supply input	DICOM	CN3-5 CN3-10	Used to input 24VDC (24VDC 10% 200mA) for I/O interface of the servo amplifier. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect ⊕ of 24VDC external power supply. For source interface, connect ⊖ of 24VDC external power supply.
Digital I/F common	DOCOM	CN3-3	Common terminal for input device such as EM2 of the servo amplifier. DOCOM is separated from LG. For sink interface, connect ⊖ of 24VDC external power supply. For source interface, connect ⊕ of 24VDC external power supply.
Monitor common	LG	CN3-1 CN3-11	Common terminal of MO1 and MO2. Pins are connected internally.
Shield	SD	Plate	Connect the external conductor of the shield cable.

3.6 Function explanation

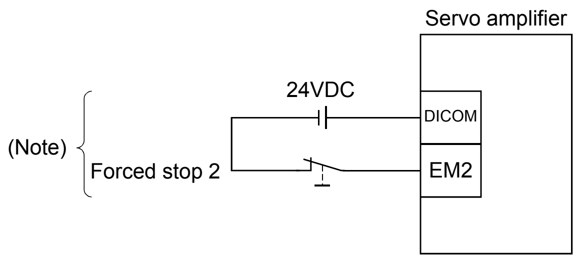
POINT

- When alarms not related to the forced stop function occur, control of motor deceleration can not be guaranteed. (Refer to section 8.1 for alarm list.)
- When SSCNETⅢ communication brake occurs, forced stop deceleration will operate. (Refer to section 3.7.3.)
- The torque control mode does not support the forced stop deceleration function.

3.6.1 Forced stop deceleration function (SS1)

When EM2 is turned off (activated), forced stop deceleration is enabled and, once completed, dynamic brake is used to stop the servo motor. During this sequence, the display shows the servo forced stop warning (E6). During normal operation, do not use forced stop 2 (EM2) to alternate stop and run. The service life of the servo amplifier may be shortened.

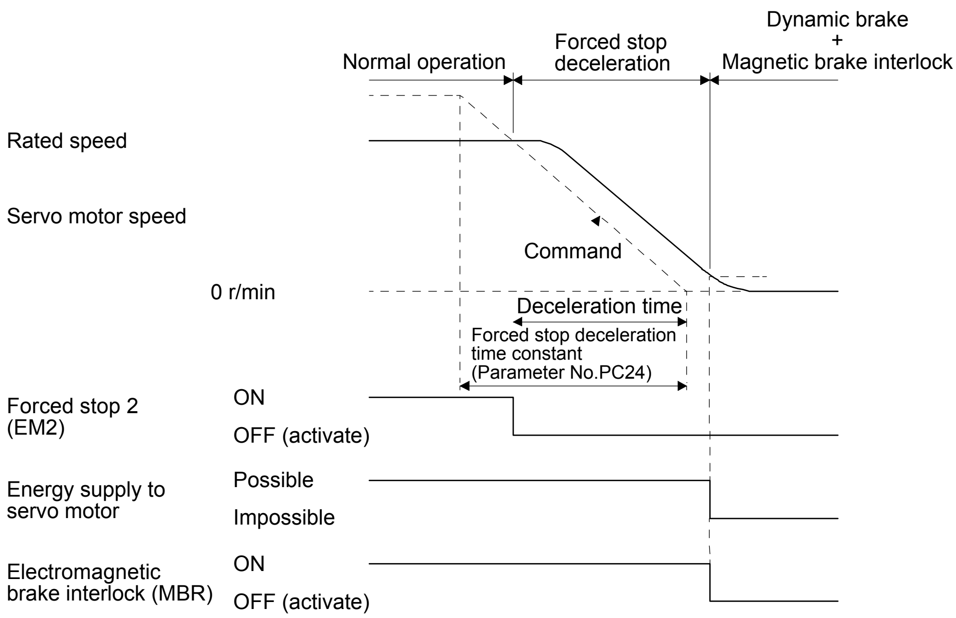
(1) Connection diagram



Note. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.

(2) Timing chart

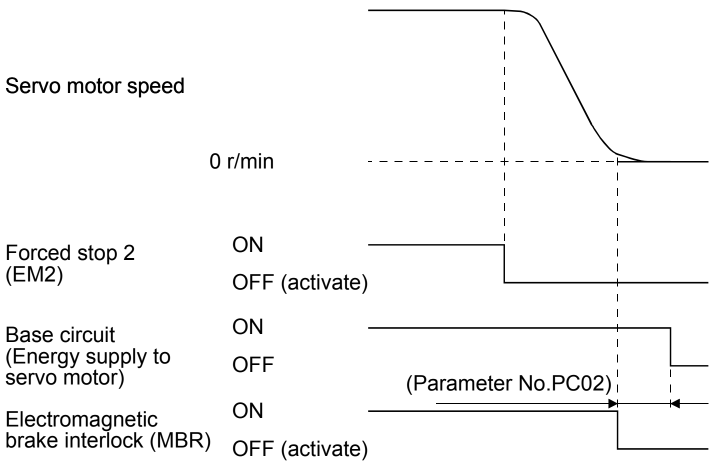
If forced stop 2 (EM2) turns OFF (activates), the motor decelerates according to the forced stop deceleration time constant (Parameter No.PC24). Once the motor speed is below the set zero speed (Parameter No.PC07), base power is cut and the dynamic brake activates.



3.6.2 Base cut delay time function

The base circuit shut-off delay time function is used to prevent vertical axis from dropping at a forced stop (EM2 goes off), alarm occurrence, or SSCNETⅢ communication brake due to delay time. Set the time from electromagnetic brake interlock (MBR) off to base circuit shut-off with parameter No. PC02. This delay allows time for the electromagnetic brake to engage in order to prevent, for example, a vertical axis from free-falling during an alarm occurrence. The time between completion of forced stop 2 (EM2) or activation of electromagnetic brake interlock (MBR) due to an alarm occurrence, and the time at which the base is cut, is the base cut delay time and is set by parameter No.PC02.

(1) Timing chart



When the servo motor is moving and forced stop 2 (EM2) turns OFF (activates), or during the occurrence of an alarm, the servo motor decelerates per the deceleration time constant, next the electromagnetic brake interlock (MBR) turns off (activates), and then after the delay time set in parameter No.PC02, the base signals in the servo amplifier are cut (i.e. torque is removed from the motor).

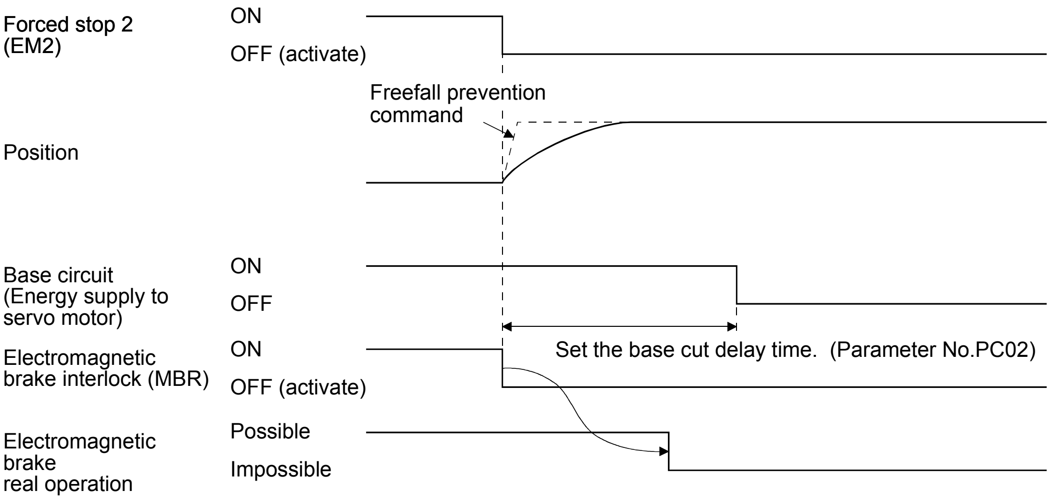
(2) Adjustment method

While the servo motor is stopped, activate (turn OFF) forced stop 2 (EM2), adjust parameter No.PC02 (base cut delay time), setting the value to approximately 1.5 times the smallest delay time in which the servo motor does not freefall.

3.6.3 Vertical axis freefall prevention function

The vertical axis freefall prevention function avoids machine damage by pulling up the shaft slightly in the following case.
When the servo motor is used for operating vertical axis, the servo motor electromagnetic brake and the base cut delay time function avoid dropping axis at forced stop. However, the functions may not avoid dropping axis a few μm due to the backlash of the servo motor electromagnetic brake.
When the vertical axis freefall prevention compensation amount (Parameter No. PC31) is set to a value other than "0", and when Forced stop 2 (EM2) turns off, an alarm occurs, or SSCNETⅢ communication breaks on condition that the servo motor speed decelerates lower than a value set in zero speed, the freefall prevention function begins to work.

(1) Timing chart



(2) Adjustment method
- Set the freefall prevention compensation amount using parameter No.PC31.
- With the servo motor stopped and forced stop 2 (EM2) activated (turned OFF), try to adjust parameter No.PC02 (Base cut delay time) to about 200ms while checking the servo motor rotational velocity, torque ripple, and so on all while keeping an eye on the compensation movement.

3.6.4 Residual risks of the forced stop function (EM2)

The forced stop function, EM2, can be used in conjunction with the MR-J3-D05 safety logic unit for implementation of SS1 (time delayed) according to IEC/EN 61800-5-2. The MR-J3-□S servo amplifier is certified for STO only, while the MR-J3-D05 is certified separately for both STO and SS1.
SS1 selection is realized through two channels on the MR-J3-D05 safety logic unit, however deceleration via EM2 on the MR-J3-□S servo amplifier, only through one channel. If either the STO1 or STO2 input on the servo amplifier is activated (turns OFF), the torque to the motor will be cut immediately. Be sure to perform all risk assessments and safety level certification to the machine/system as a whole.

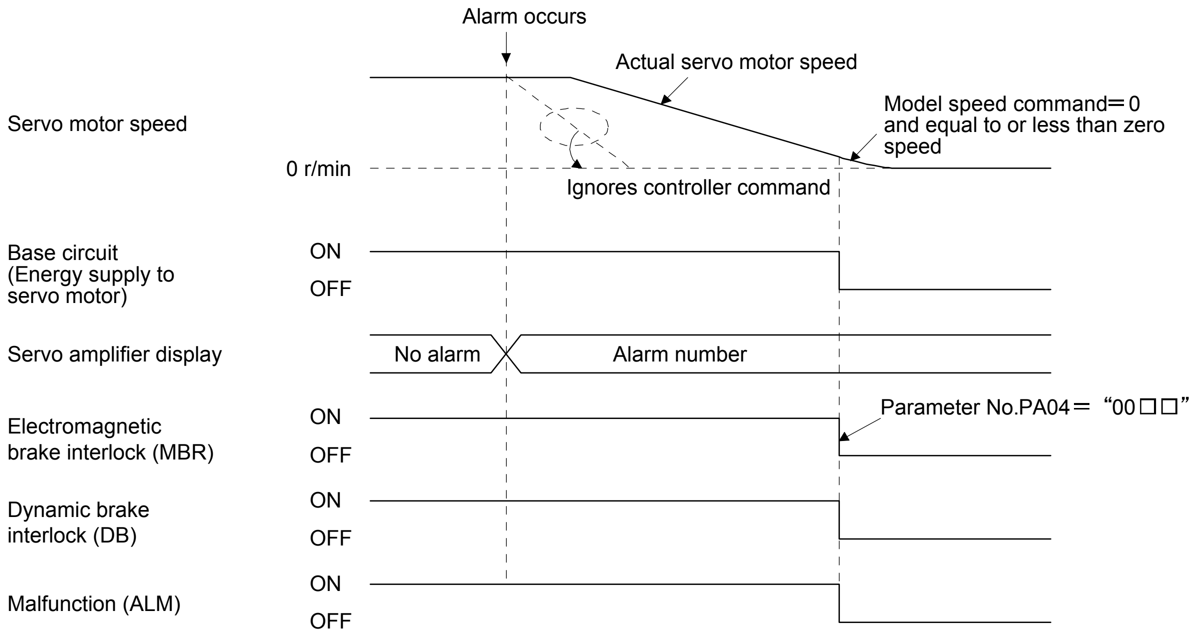
3.7 Alarm occurrence timing chart

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.

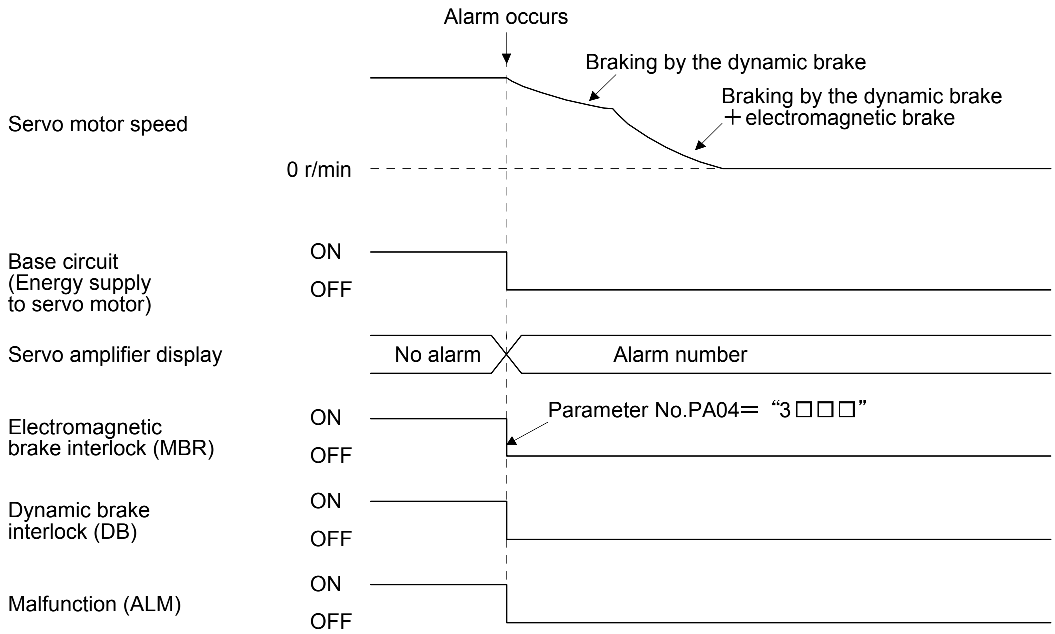
POINT
· The torque control mode does not support the forced stop deceleration function.

To deactivate the alarm, power the control circuit off, then on or give the error reset or CPU reset command from the servo system controller. However, the alarm cannot be deactivated unless its cause is removed.

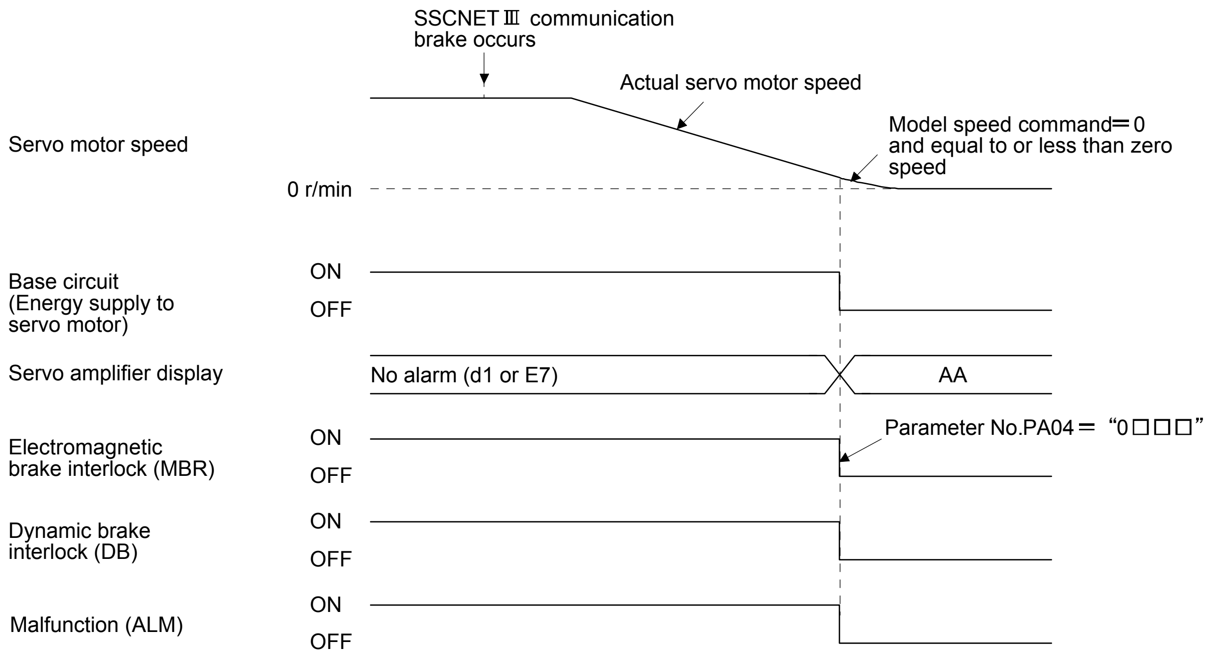
3.7.1 When the forced stop deceleration function is valid



3.7.2 When the forced stop deceleration function is invalid

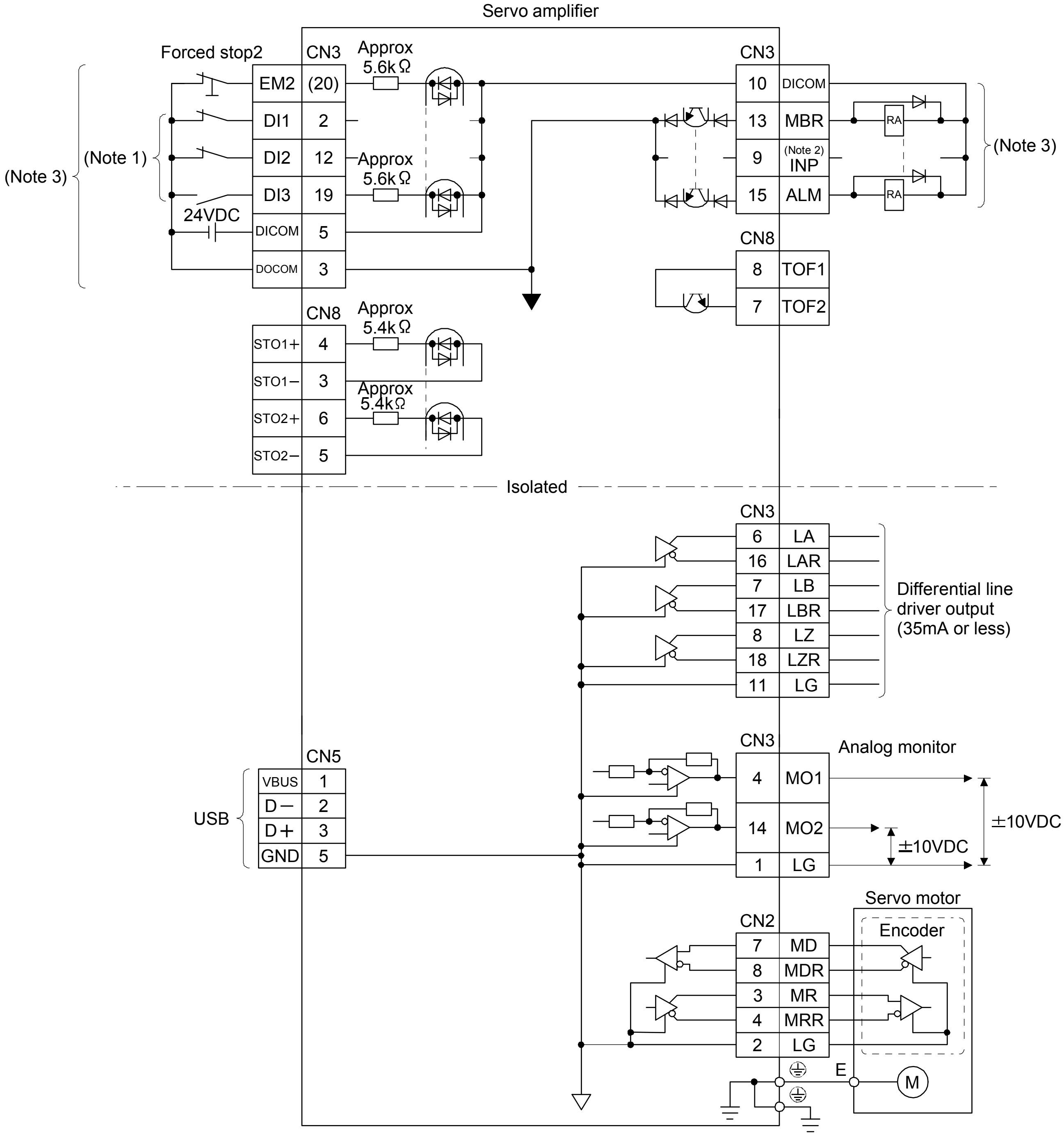


3.7.3 When SSCNETⅢ communication brake occurs



3.8 Interfaces

3.8.1 Internal connection diagram



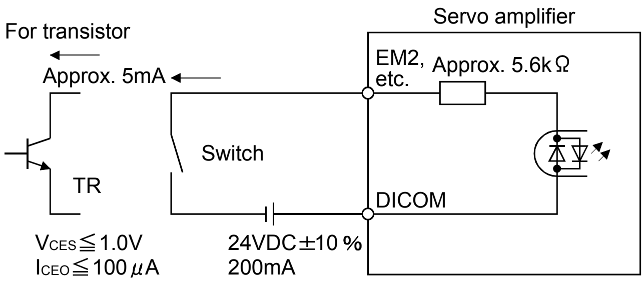
Note 1. Signal can be assigned for these pins with host controller setting.
For contents of signals, refer to the instruction manual of host controller.
2. This signal cannot be used with speed control mode and torque control mode.
3. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.

3.8.2 Detailed description of interfaces

This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 3.5. Refer to this section and make connection with the external equipment.

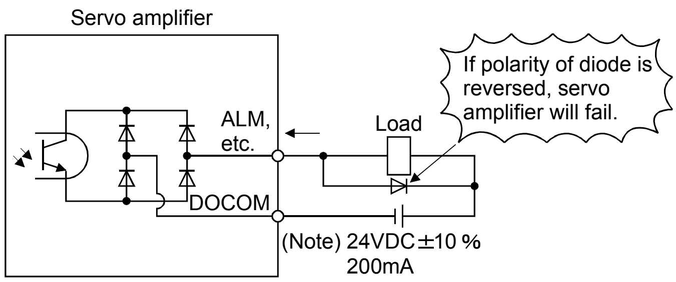
(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor.
The following is a connection diagram for sink input. Refer to section 3.8.3 for source input.



(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the servo amplifier.
The following is a connection diagram for sink output. Refer to section 3.8.3 for source output.

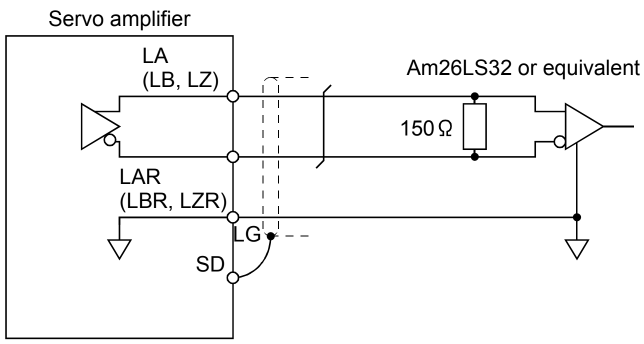


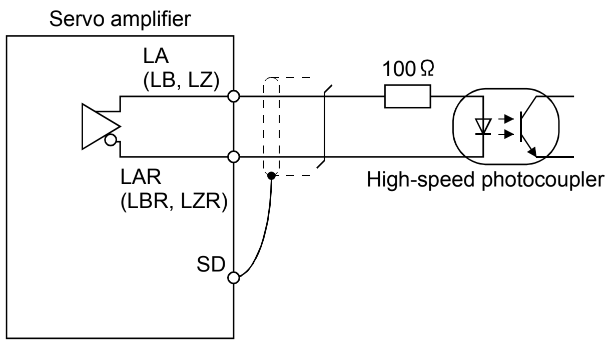
Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

(3) Encoder output pulse DO-2 (Differential line driver type)

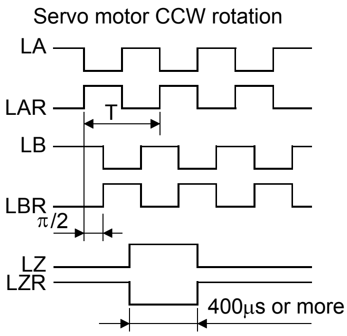
(a) Interface

Max. output current: 35mA



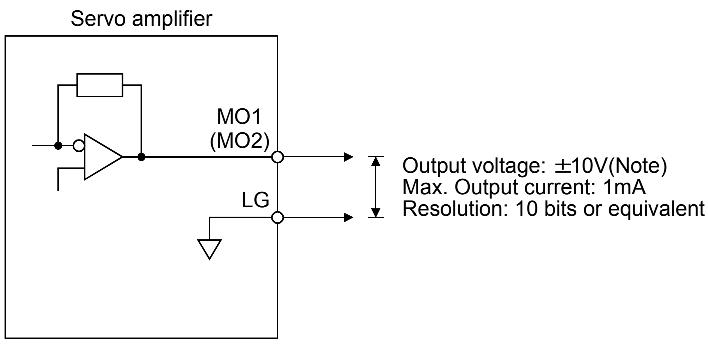


(b) Output pulse



Time cycle (T) is determined by the settings of parameter No.PA15 and PC03.

(4) Analog output

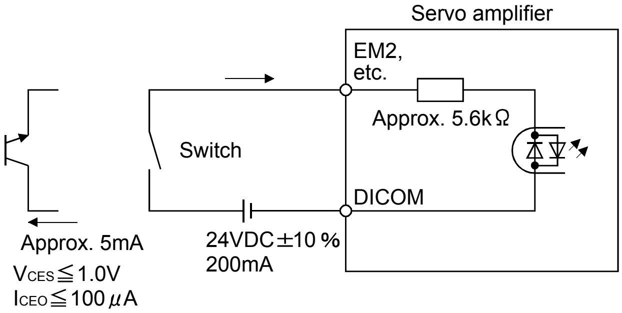


Note. Output voltage range varies depending on the monitored signal. (Refer to section 5.3.3.)

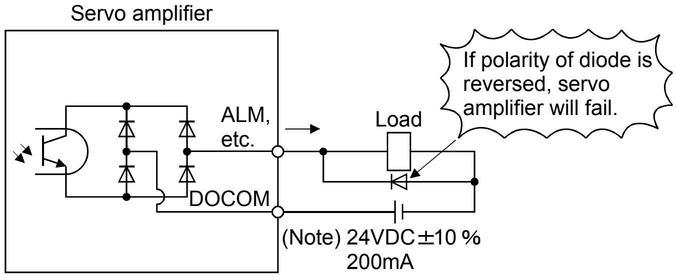
3.8.3 Source I/O interfaces

In this servo amplifier, source type I/O interfaces can be used. In this case, all DI-1 input signals and DO-1 output signals are of source type. Perform wiring according to the following interfaces.

(1) Digital input interface DI-1



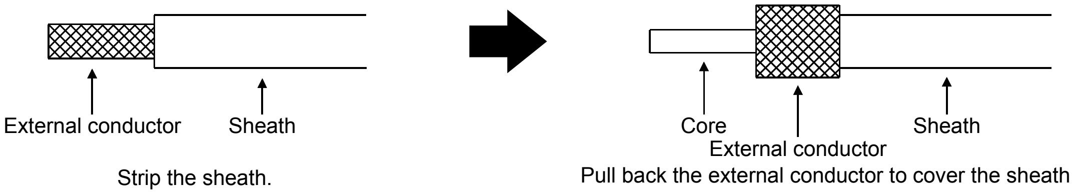
(2) Digital output interface DO-1
A maximum of 2.6V voltage drop occurs in the servo amplifier.



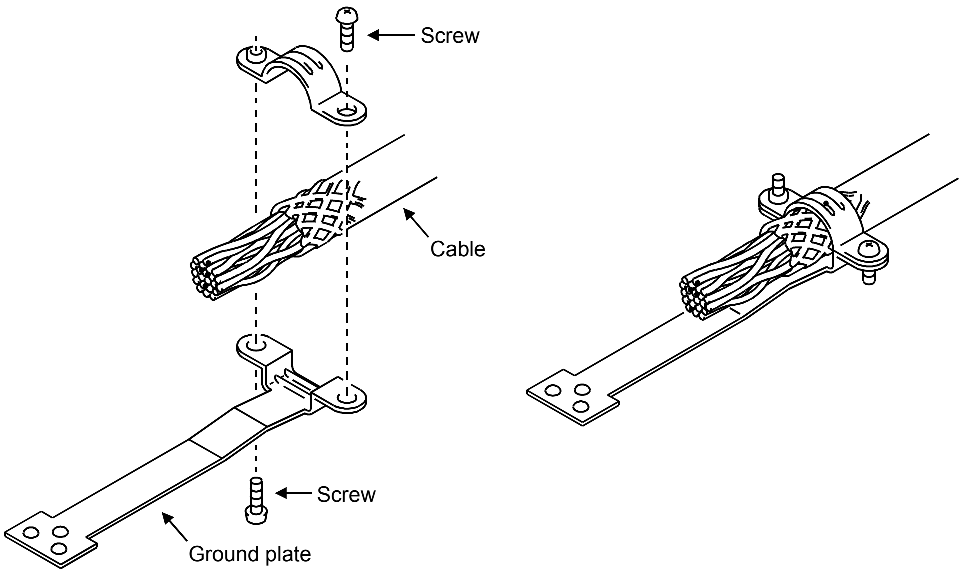
Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

3.9 Treatment of cable shield external conductor

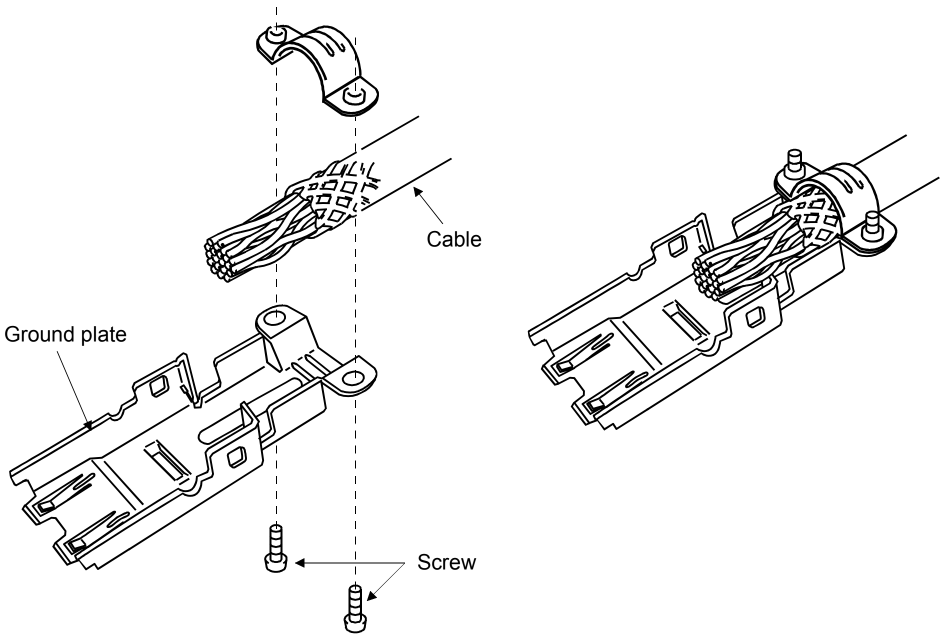
In the case of the CN2, CN2L and CN3 connectors, securely connect the shielded external conductor of the cable to the ground plate as shown in this section and fix it to the connector shell.



(1) For CN3 connector (3M connector)



(2) For CN2/CN2L connector (3M or Molex connector)

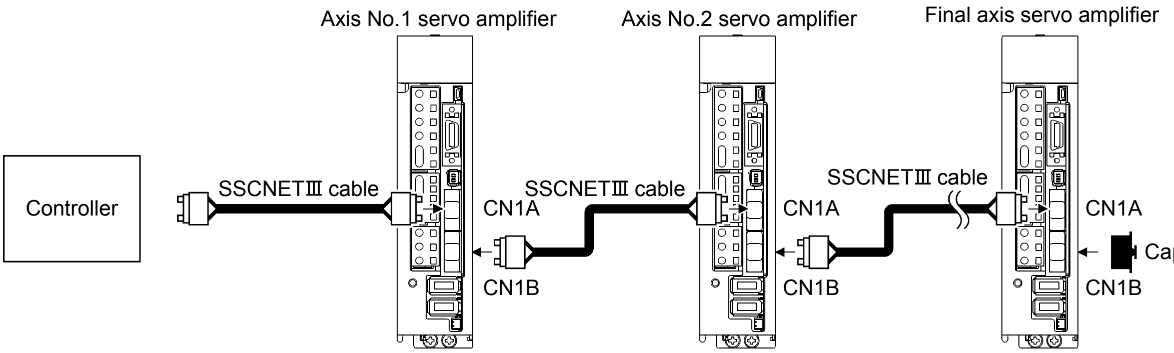


3.10 SSCNETⅢ cable connection

POINT

- Do not see directly the light generated from CN1A・CN1B connector of servo amplifier or the end of SSCNETⅢ cable.
  When the light gets into eye, may feel something is wrong for eye.
  (The light source of SSCNETⅢ complies with class1 defined in JIS C6802 or IEC/EN 60825-1.)

(1) SSCNETⅢ cable connection
For CN1A connector, connect SSCNETⅢ cable connected to controller in host side or servo amplifier.
For CN1B connector, connect SSCNETⅢ cable connected to servo amplifier in lower side.
For CN1B connector of the final axis, put a cap came with servo amplifier.



(2) How to connect/disconnect cable.

POINT

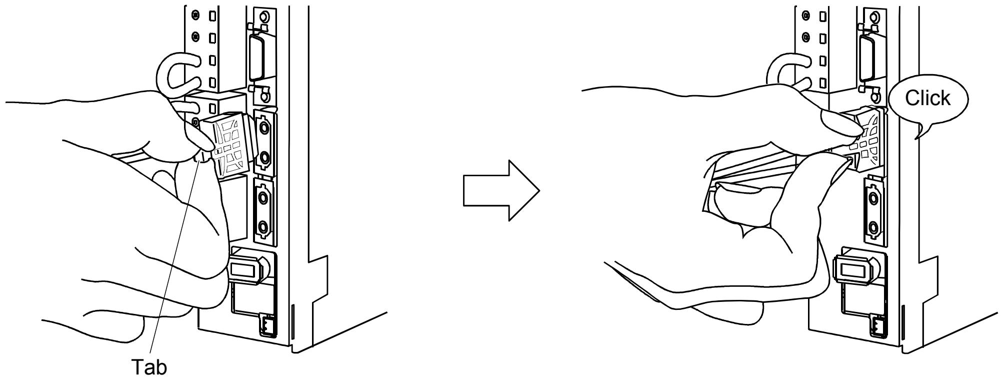
- CN1A・CN1B connector is put a cap to protect light device inside connector from dust.
  For this reason, do not remove a cap until just before mounting SSCNETⅢ cable.
  Then, when removing SSCNETⅢ cable, make sure to put a cap.
- Keep the cap for CN1A・CN1B connector and the tube for protecting optical cord end of SSCNETⅢ cable in a plastic bag with a zipper of SSCNETⅢ cable to prevent them from becoming dirty.
- When asking repair of servo amplifier for some malfunctions, make sure to put a cap on CN1A・CN1B connector.
  When the connector is not put a cap, the light device may be damaged at the transit.
  In this case, exchange and repair of light device is required.

(a) Mounting

1) For SSCNETⅢ cable in the shipping status, the tube for protect optical cord end is put on the end of connector. Remove this tube.

2) Remove the CN1A・CN1B connector cap of servo amplifier.

3) With holding a tab of SSCNETⅢ cable connector, make sure to insert it into CN1A・CN1B connector of servo amplifier until you hear the click.
If the end face of optical cord tip is dirty, optical transmission is interrupted and it may cause malfunctions.
If it becomes dirty, wipe with a bonded textile, etc.
Do not use solvent such as alcohol.

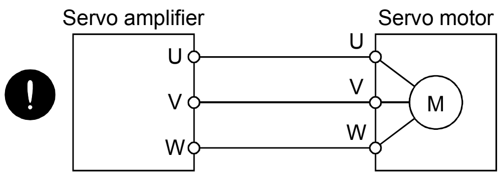


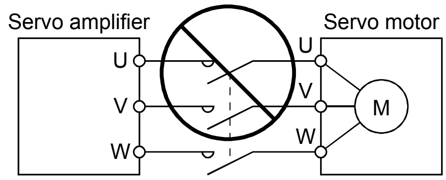
(b) Removal

With holding a tab of SSCNETⅢ cable connector, pull out the connector.
When pulling out the SSCNETⅢ cable from servo amplifier, be sure to put the cap on the connector parts of servo amplifier to prevent it from becoming dirty.
For SSCNETⅢ cable, attach the tube for protection optical cord's end face on the end of connector.

3.11 Connection of servo amplifier and servo motor

CAUTION	・Connect the servo amplifier power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





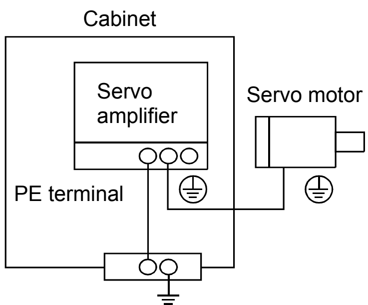
3.11.1 Connection instructions

WARNING	・To avoid an electric shock, insulate the connections of the power supply terminals.

CAUTION	・Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and servo motor. Not doing so may cause unexpected operation. ・Do not connect AC power supply directly to the servo motor. Otherwise, it may cause a malfunction. ・Do not use the 24VDC interface power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake. Otherwise, it may cause a malfunction.

POINT
・Refer to section 11.1 for the selection of the encoder cable. ・Refer to the Servo Motor Instruction Manual (Vol.2) or section 11.19 for the selection of a surge absorber for the electromagnetic brake.

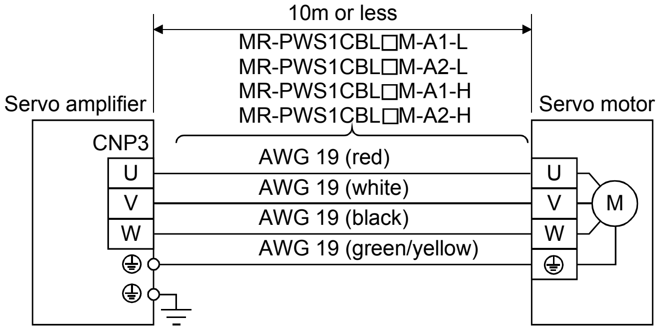
This section indicates the connection of the servo motor power (U, V, W). Use of the optional cable or the connector set is recommended for connection between the servo amplifier and servo motor. Refer to section 11.1 for details of the options.
For grounding, connect the earth cable of the servo motor 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 cabinet. Do not connect them directly to the protective earth of the cabinet.



3.11.2 Power supply cable wiring diagrams

(1) HF-MP service・HF-KP series・HF-KP series servo motor

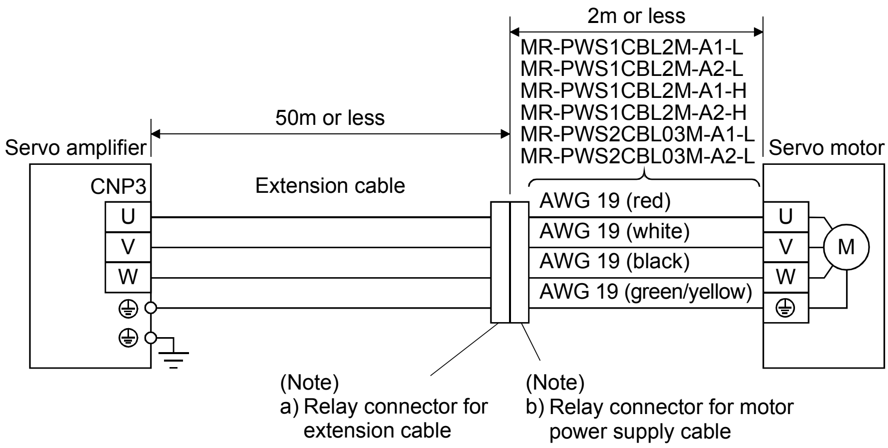
(a) When cable length is 10m or less



(b) When cable length exceeds 10m

When the cable length exceeds 10m, fabricate an extension cable as shown below. In this case, the motor power supply cable should be within 2m long.

Refer to section 11.11 for the wire used for the extension cable.



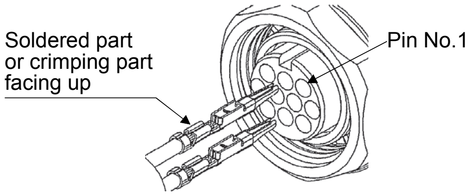
Note. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

Relay connector	Description	IP rating
a) Relay connector for extension cable	Connector: RM15WTPZ-4P(71) Cord clamp: JR13WCC-5(72) (Hirose Electric) Numeral changes depending on the cable OD.	IP65
b) Relay connector for motor power supply cable	Connector: RM15WTJZ-4S(71) Cord clamp: JR13WCC-8(72) (Hirose Electric) Numeral changes depending on the cable OD.	IP65

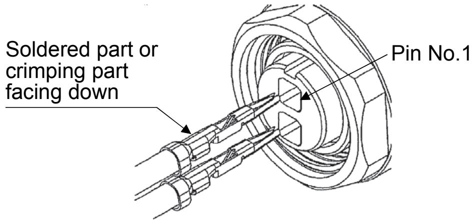
(2) HF-SP series・HC-RP series・HC-UP series・HC-LP series・HA-LP502・LA-LP702・HF-JP series servo motor

POINT

・Insert a contact in the direction shown in the figure. If inserted in the wrong direction, the contact is damaged and falls off.



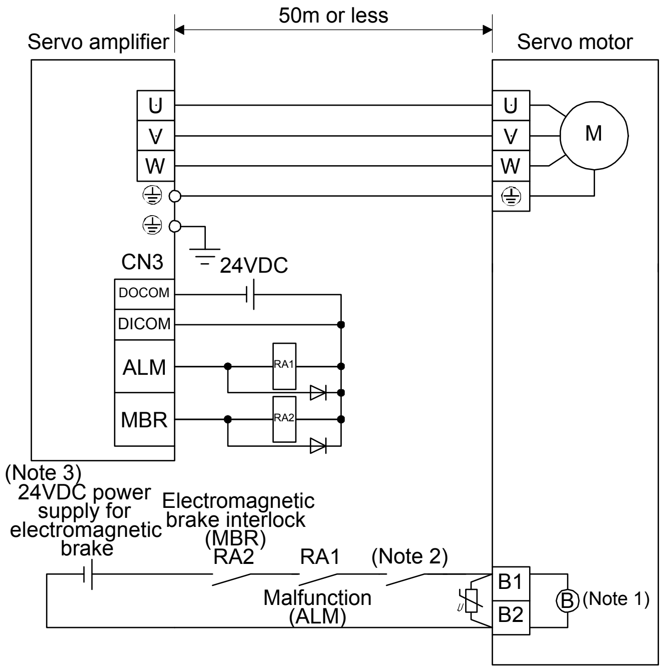
Model: CM10-SP10S-VP-M
CM10-AP10S-VP-M



Model: CM10-SP2S-VP-☐
CM10-AP2S-VP-☐

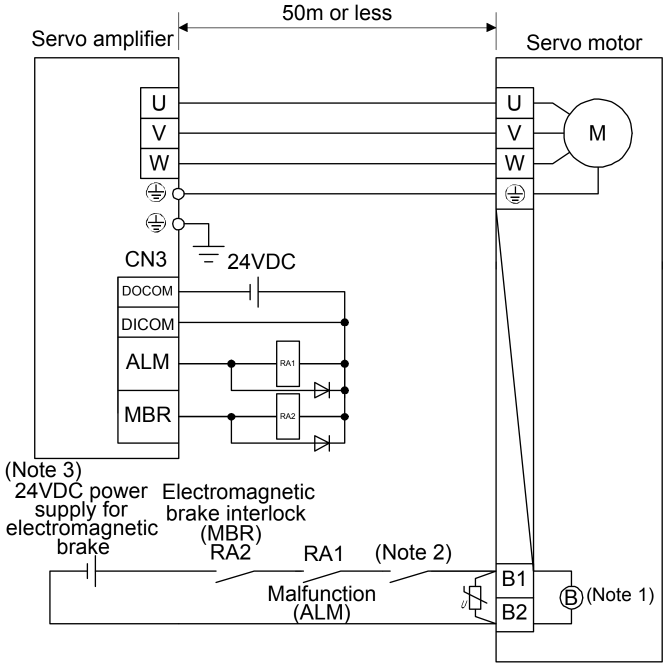
(a) Wiring diagrams
Refer to section 11.11 for the cables used for wiring.

1) When the power supply connector and the electromagnetic brake connector are separately supplied.



Note 1. There is no polarity in electromagnetic brake terminals B1 and B2.
2. Shut off the circuit by interlocking with the emergency stop switch.
3. Do not use the 24VDC interface power supply for the electromagnetic brake.

2) When the power supply connector and the electromagnetic brake connector are shared.



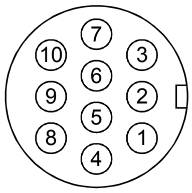
Note 1. There is no polarity in electromagnetic brake terminals B1 and B2.
2. Shut off the circuit by interlocking with the emergency stop switch.
3. Do not use the 24VDC interface power supply for the electromagnetic brake.

(b) Connector and signal allotment

The connector fitting the servo motor is prepared as optional equipment. Refer to section 11.1. For types other than those prepared as optional equipment, refer to chapter 3 in Servo Motor Instruction Manual, (Vol. 2) to select.

Servo motor	Servo motor-side connectors		
	Encoder	Power supply	Electromagnetic brake
HF-SP52(4) to 152(4)	CM10-R10P (DDK)	MS3102A18-10P	CM10-R2P (DDK)
HF-SP51, 81			
HF-SP202(4) to 502(4)		MS3102A22-22P	
HF-SP121 to 301			
HF-SP421, 702(4)		MS3102A32-17P	
HC-RP103 to 203		CE05-2A22-23PD-B	The connector for power is shared
HC-RP353, 503		CE05-2A24-10PD-B	
HC-UP72, 152		CE05-2A22-23PD-B	
HC-UP202 to 502		CE05-2A24-10PD-B	MS3102A10SL-4P
HC-LP52 to 152		CE05-2A22-23PD-B	The connector for power is shared
HC-LP202, 302		CE05-2A24-10PD-B	MS3102A10SL-4P
HA-LP502		CE05-2A24-10PD-B	
HA-LP702		CE05-2A32-17PD-B	
HF-JP53(4) to 203(4), 3534, 5034		MS3102A18-10P	CM10-R2P (DDK)
HF-JP353, 503		MS3102A22-22P	
HF-JP703(4), 903(4)		MS3102A32-17P	
HF-JP11K1M(4), 15K1M(4)	MS3102A20-29P		MS3102A10SL-4P

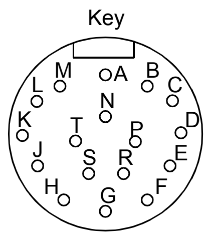
Encoder connector signal allotment
CM10-R10P



View a

Terminal No.	Signal
1	MR
2	MRR
3	
4	BAT
5	LG
6	
7	
8	P5
9	
10	SHD

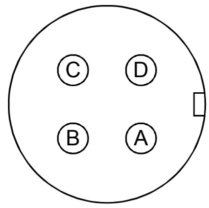
Encoder connector signal allotment
MS3102A20-29P



View a

Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	
F	BAT
G	
H	
J	
K	
L	
M	CONT
N	SHD
P	
R	LG
S	P5
T	

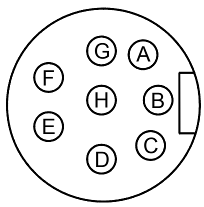
Power supply connector signal allotment
MS3102A18-10P
MS3102A22-22P
MS3102A32-17P
CE05-2A32-17PD-B



View b

Terminal No.	Signal
A	U
B	V
C	W
D	⏚ (earth)

Power supply connector signal allotment
CE05-2A22-23PD-B

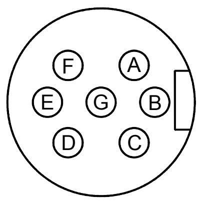


View b

Terminal No.	Signal
A	U
B	V
C	W
D	⏚ (earth)
E	
F	
G	B1 (Note)
H	B2 (Note)

Note. For the motor with an electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

Power supply connector signal allotment
CE05-2A24-10PD-B

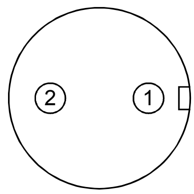


View b

Terminal No.	Signal
A	U
B	V
C	W
D	⏚ (earth)
E	B1 (Note)
F	B2 (Note)
G	

Note. For the motor with an electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

Brake connector signal allotment
CM10-R2P

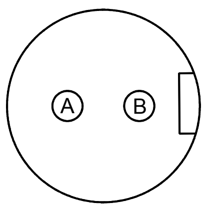


View c

Terminal No.	Signal
1	B1 (Note)
2	B2 (Note)

Note. For the motor with an electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

Brake connector signal allotment
MS3102A10SL-4P



View c

Terminal No.	Signal
A	B1 (Note)
B	B2 (Note)

Note. For the motor with an electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

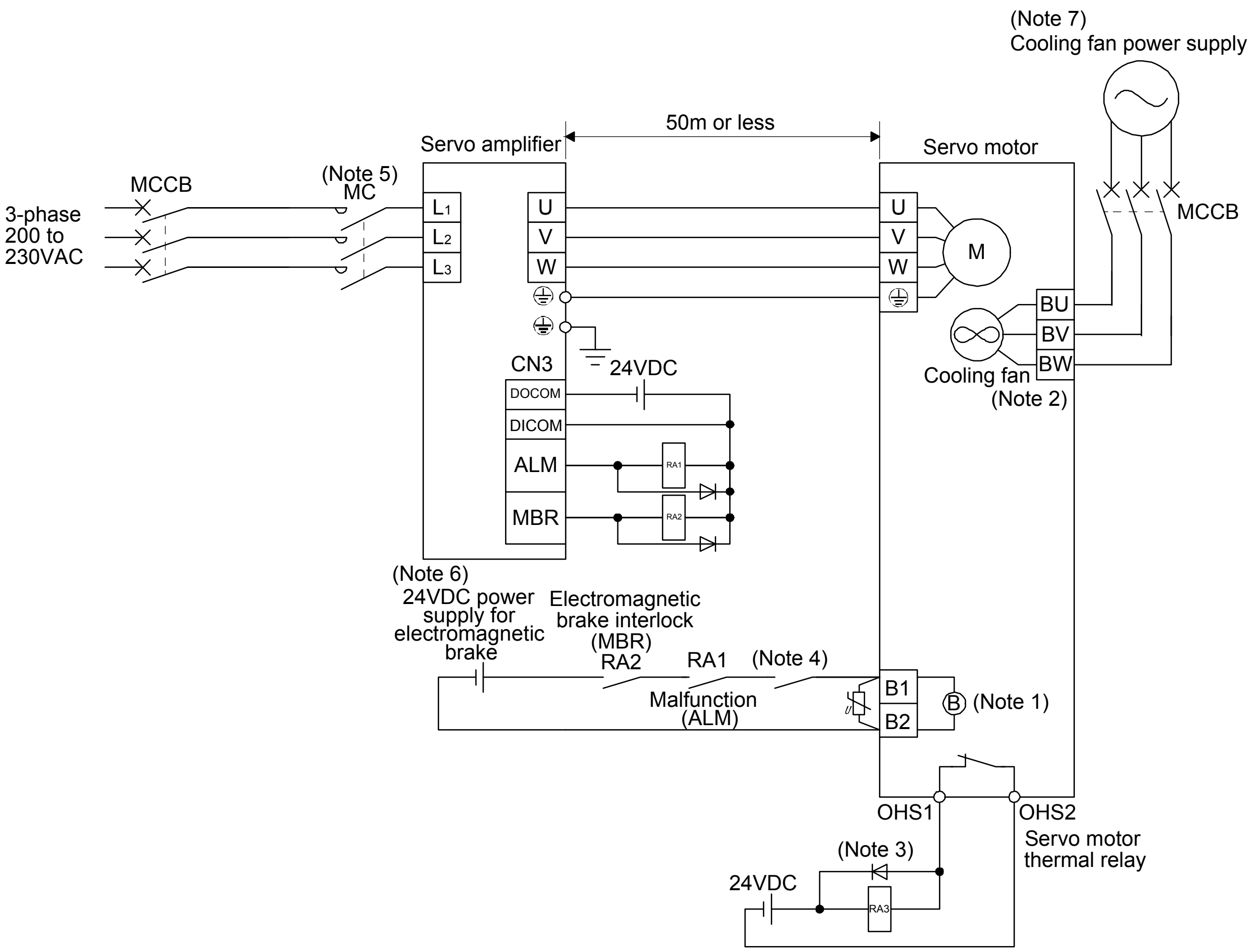
(3) HA-LP series servo motor

POINT
・Refer to (2) in this section for HA-LP502, 702.

(a) Wiring diagrams

Refer to section 11.11 for the cables used for wiring.

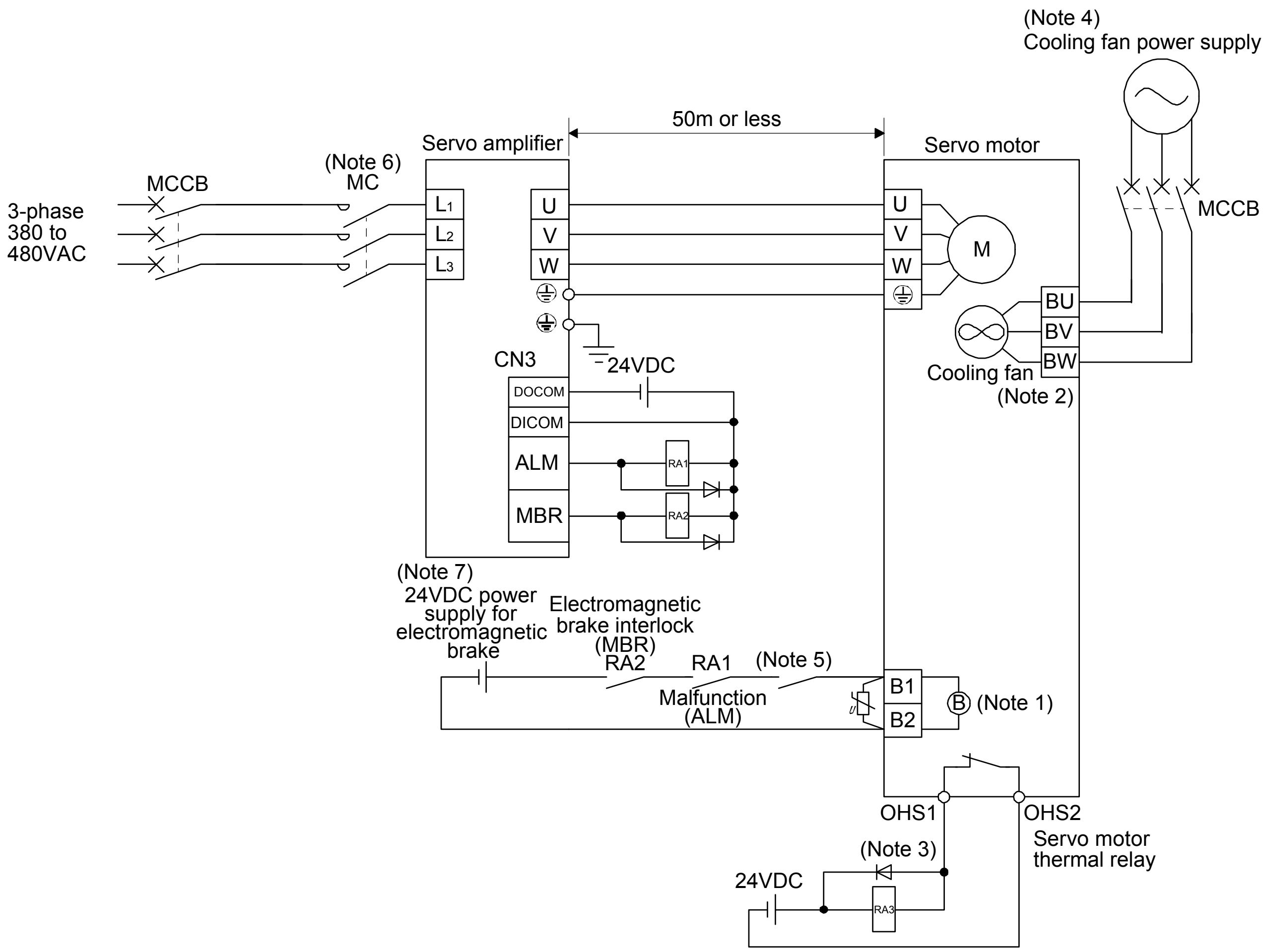
1) 200V class



Note 1. There is no polarity in electromagnetic brake terminals B1 and B2.

2. There is no BW when the power supply of the cooling fan is a 1-phase.
3. Configure the power supply circuit which turns off the magnetic contactor after detection of servo motor thermal.
4. Shut off the circuit by interlocking with the emergency stop switch.
5. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Do not use the 24VDC interface power supply for the electromagnetic brake.
7. For the cooling fan power supply, refer to (3) (b) of this section.

2) 400V class



Note 1. There is no polarity in electromagnetic brake terminals B1 and B2.

2. There is no BW when the power supply of the cooling fan is a 1-phase.

3. Configure the power supply circuit which turns off the magnetic contactor after detection of servo motor thermal.

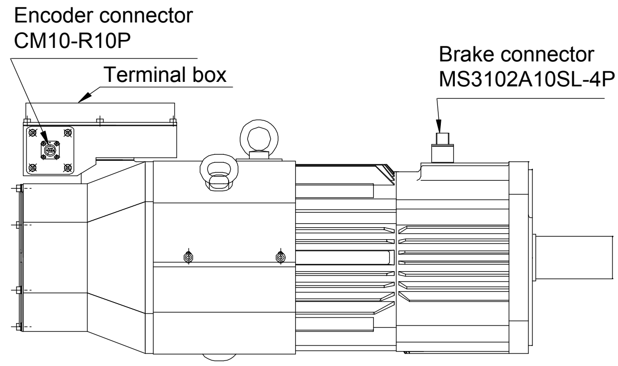
4. For the cooling fan power supply, refer to (3) (b) of this section.

5. Shut off the circuit by interlocking with the emergency stop switch.

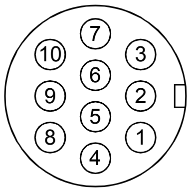
6. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

7. Do not use the 24VDC interface power supply for the electromagnetic brake.

(b) Servo motor terminals

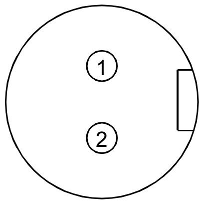


Encoder connector signal allotment CM10-R10P



Terminal No.	Signal
1	MR
2	MRR
3	
4	BAT
5	LG
6	
7	
8	P5
9	
10	SHD

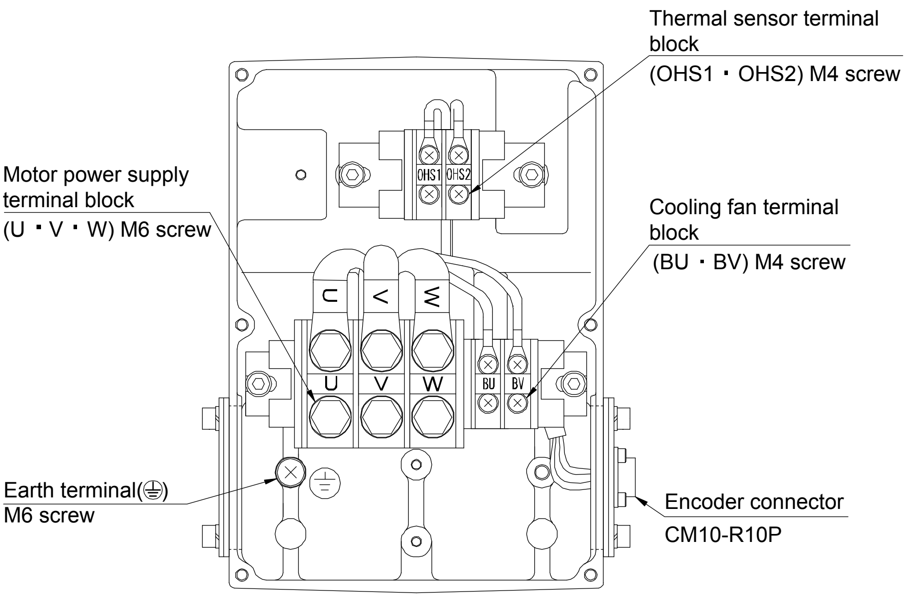
Brake connector signal allotment MS3102A10SL-4P



Terminal No.	Signal
1	B1 (Note)
2	B2 (Note)

Note. For the motor with an electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

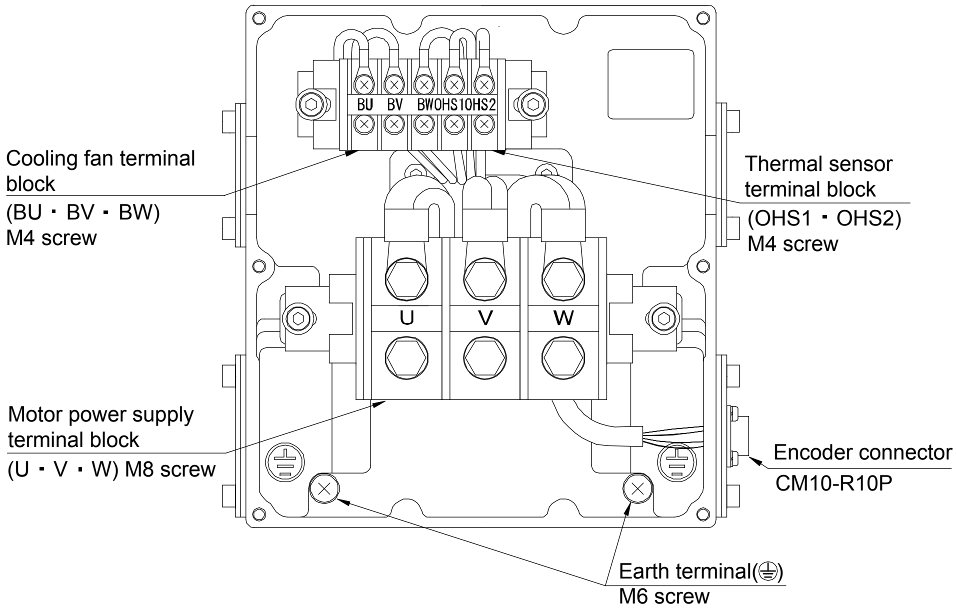
Terminal box inside (HA-LP601(4) ・ 701M(4) ・ 11K2(4))



Terminal block signal arrangement

OHS1	OHS2			
U	V	W	BU	BV

Terminal box inside (HA-LP801(4) ・ 12K1(4) ・ 11K1M(4) ・ 15K1M(4) ・ 15K2(4) ・ 22K2(4))

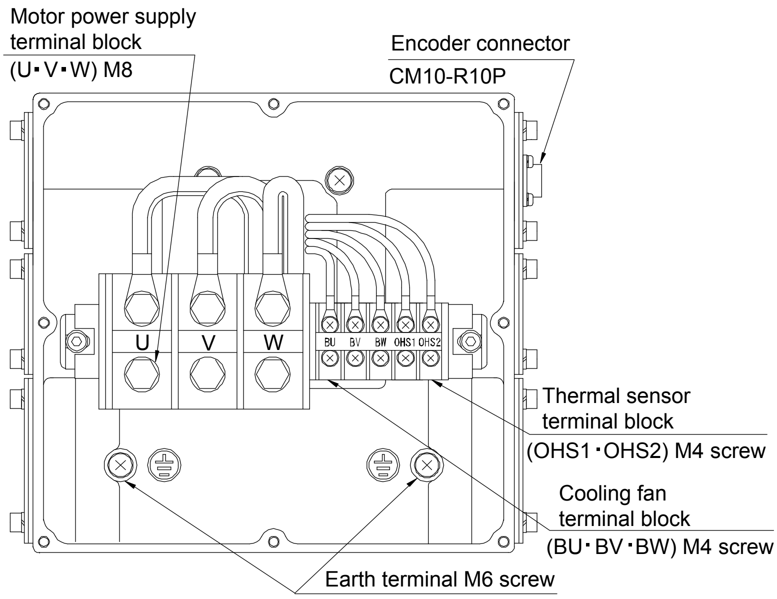


Terminal block signal arrangement

BU	BV	BW	OHS1	OHS2

U	V	W

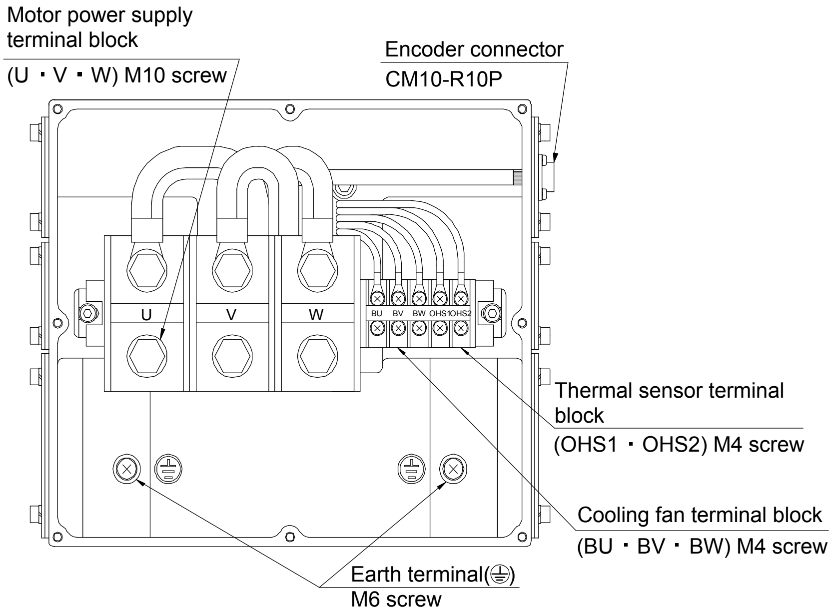
Terminal box inside (HA-LP15K1(4) ・ 20K1(4) ・ 22K1M(4))



Terminal block signal arrangement

U	V	W	BU	BV	BW	OHS1	OHS2

Terminal box inside (HA-LP25K1)



Terminal block signal arrangement

U	V	W	BU	BV	BW	OHS1	OHS2

<table>
<tr><th>Signal name</th><th>Abbreviation</th><th>Description</th></tr>
<tr><td>Power supply</td><td>U・V・W</td><td>Connect to the servo motor output terminals (U, V, W) of the servo amplifier. Connect the servo amplifier power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>Cooling fan</td><td>(Note)
BU・BV・BW</td><td>Supply power which satisfies the following specifications.
<table>
<tr><th>Servo motor</th><th>Voltage division</th><th>Voltage/frequency</th><th>Power consumption [W]</th><th>Rated current [A]</th></tr>
<tr><td>HA-LP601, 701M, 11K2</td><td rowspan="4">200V class</td><td>3-phase 200 to 220VAC 50Hz
3-phase 200 to 230VAC 60Hz</td><td>42 (50Hz)
54 (60Hz)</td><td>0.21 (50Hz)
0.25 (60Hz)</td></tr>
<tr><td>HA-LP801, 12K1, 11K1M, 15K1M, 15K2, 22K2</td><td rowspan="3">3-phase 200 to 230VAC 50Hz/60Hz</td><td>62 (50Hz)
76 (60Hz)</td><td>0.18 (50Hz)
0.17 (60Hz)</td></tr>
<tr><td>HA-LP15K1, 20K1, 22K1M</td><td>65 (50Hz)
85 (60Hz)</td><td>0.20 (50Hz)
0.22 (60Hz)</td></tr>
<tr><td>HA-LP25K1</td><td>120 (50Hz)
175 (60Hz)</td><td>0.65 (50Hz)
0.80 (60Hz)</td></tr>
<tr><td>HA-LP6014, 701M4, 11K24</td><td rowspan="4">400V class</td><td>1-phase 200 to 220VAC 50Hz
3-phase 200 to 230VAC 60Hz</td><td>42 (50Hz)
54 (60Hz)</td><td>0.21 (50Hz)
0.25 (60Hz)</td></tr>
<tr><td>HA-LP8014, 12K14, 11K1M4, 15K1M4, 15K24, 22K24</td><td>3-phase 380 to 440VAC 50Hz
3-phase 380 to 480VAC 60Hz</td><td>62 (50Hz)
76 (60Hz)</td><td>0.14 (50Hz)
0.11 (60Hz)</td></tr>
<tr><td>HA-LP15K14, 20K14, 22K1M4</td><td rowspan="2">3-phase 380 to 460VAC 50Hz
3-phase 380 to 480VAC 60Hz</td><td>65 (50Hz)
85 (60Hz)</td><td>0.12 (50Hz)
0.14 (60Hz)</td></tr>
<tr><td>HA-LP25K14</td><td>110 (50Hz)
150 (60Hz)</td><td>0.20 (50Hz)
0.22 (60Hz)</td></tr>
</table>
</td></tr>
<tr><td>Motor thermal relay</td><td>OHS1・OHS2</td><td>OHS1－OHS2 are opened when heat is generated to an abnormal temperature.
Maximum rating: 125V AC/DC, 3A or 250V AC/DC, 2A
Minimum rating: 6V AC/DC, 0.15A</td></tr>
<tr><td>Earth terminal</td><td>⏚</td><td>For grounding, connect to the earth of the cabinet via the earth terminal of the servo amplifier.</td></tr>
</table>

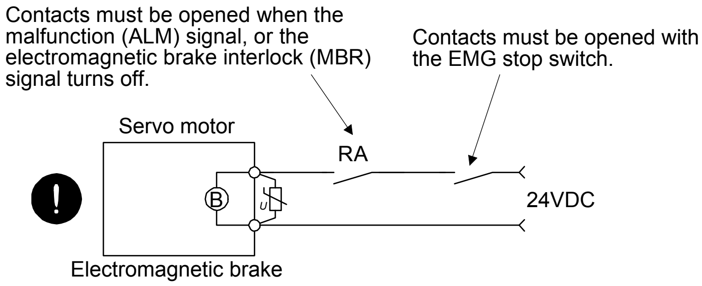
Note. There is no BW when the power supply of the cooling fan is a 1-phase.

3.12 Servo motor with an electromagnetic brake

3.12.1 Safety precautions

⚠ CAUTION

- Configure an electromagnetic brake circuit so that it is activated also by an external EMG stop switch.



- The electromagnetic brake is provided for holding purpose and must not be used for ordinary braking.
- Before performing the operation, be sure to confirm that the electromagnetic brake operates properly.
- Do not use the 24VDC interface power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake. Otherwise, it may cause a malfunction.

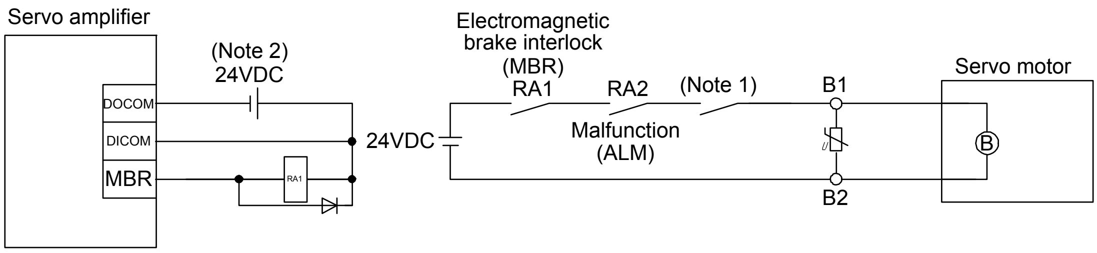
POINT

- Refer to the Servo Motor Instruction Manual (Vol.2) for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Refer to the Servo Motor Instruction Manual (Vol.2) or section 11.19 for the selection of a surge absorber for the electromagnetic brake.

Note the following when the servo motor with an electromagnetic brake is used.

1) The brake will operate when the power (24VDC) switches off.
2) Switch off the servo-on command after the servo motor has stopped.

(1) Connection diagram



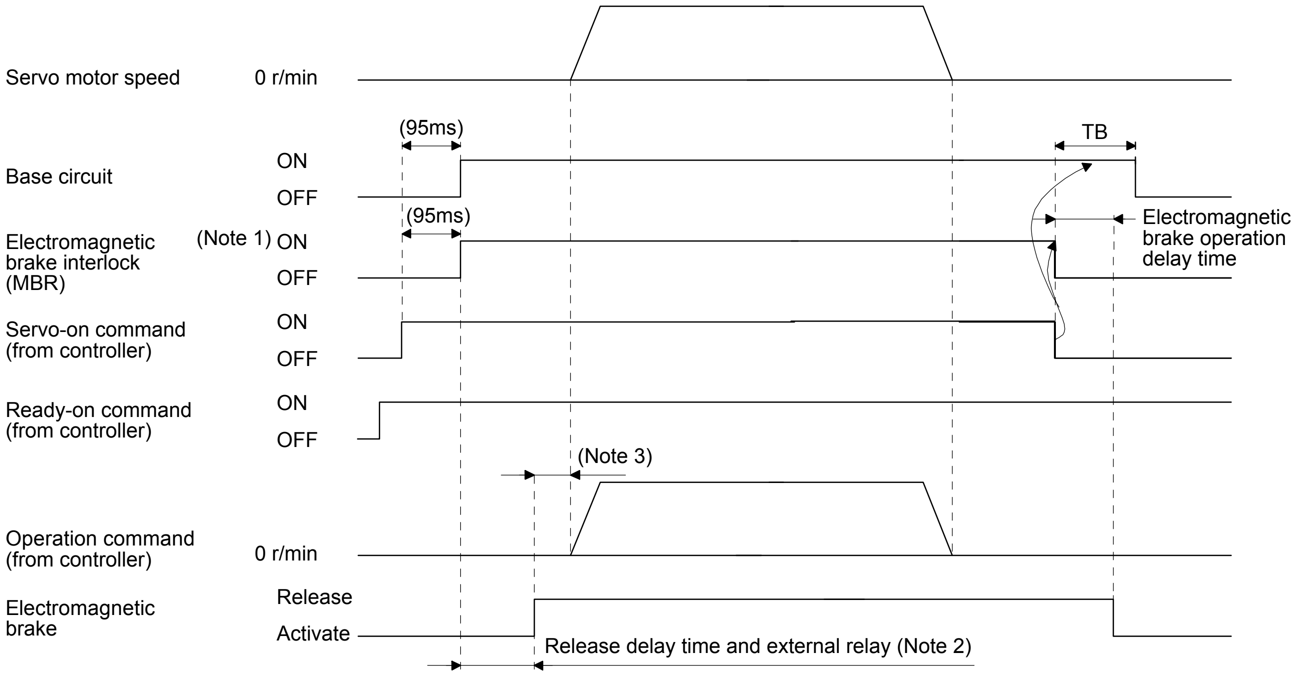
Note 1. Shut off the circuit by interlocking with the emergency stop switch.
2. Do not use the 24VDC interface power supply for the electromagnetic brake.

(2) Setting
In parameter No.PC02 (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 section 3.12.2.

3.12.2 Timing charts

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

Tb [ms] after the servo-on is switched off, the servo lock is released and the servo motor coasts. When using the electromagnetic brake in a vertical lift application or the like, set delay time (Tb) to about the same as the electromagnetic brake operation delay time to prevent a drop.

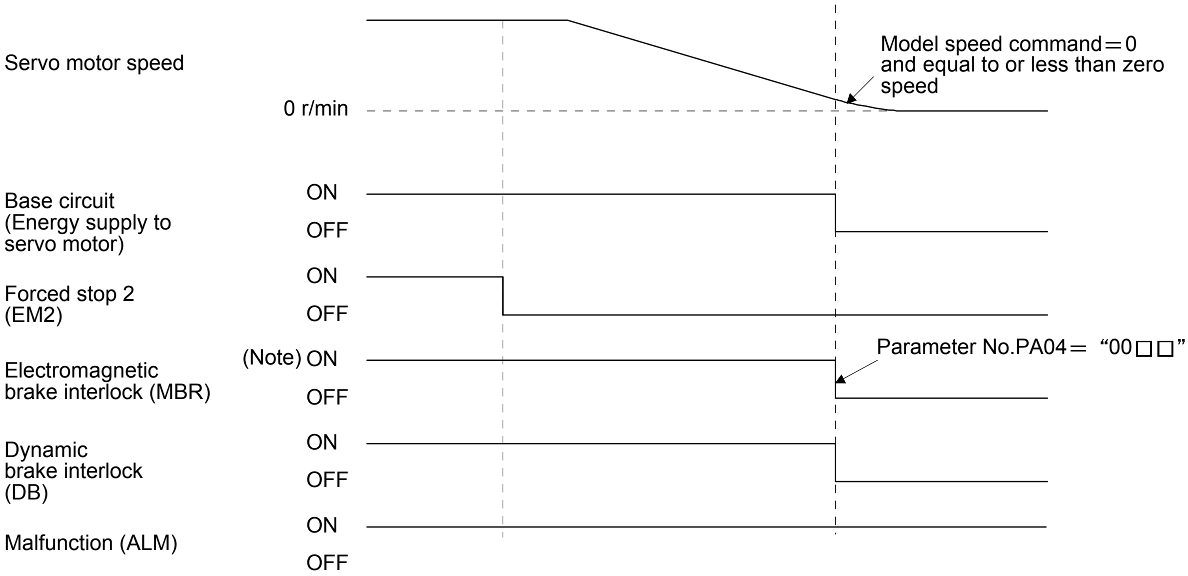


Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

2. Electromagnetic brake is released after delaying for the release delay time of electromagnetic brake and operation time of external circuit relay. For the release delay time of electromagnetic brake, refer to the Servo Motor Instruction Manual (Vol.2).
3. Give the operation command from the controller after the electromagnetic brake is released.

(2) Forced stop 2 (EM2) ON/OFF

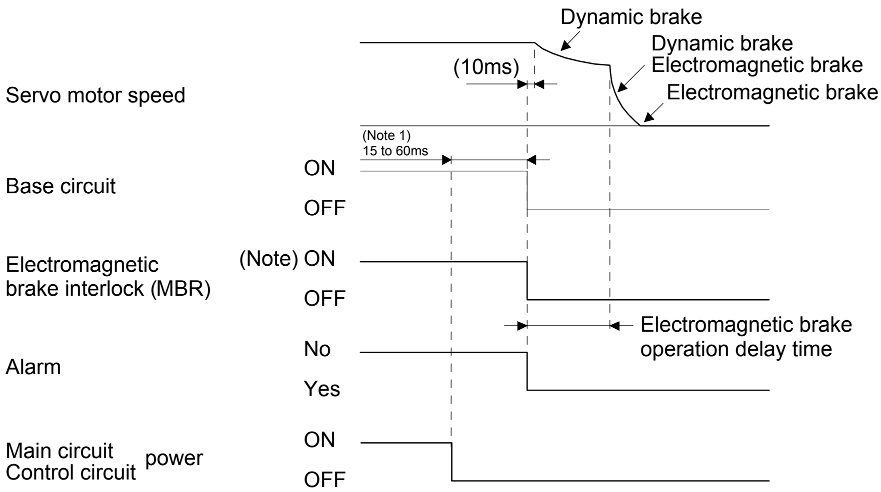
POINT
・The torque control mode does not support the forced stop deceleration function.



Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

(3) Alarm occurrence
Refer to section 3.7.

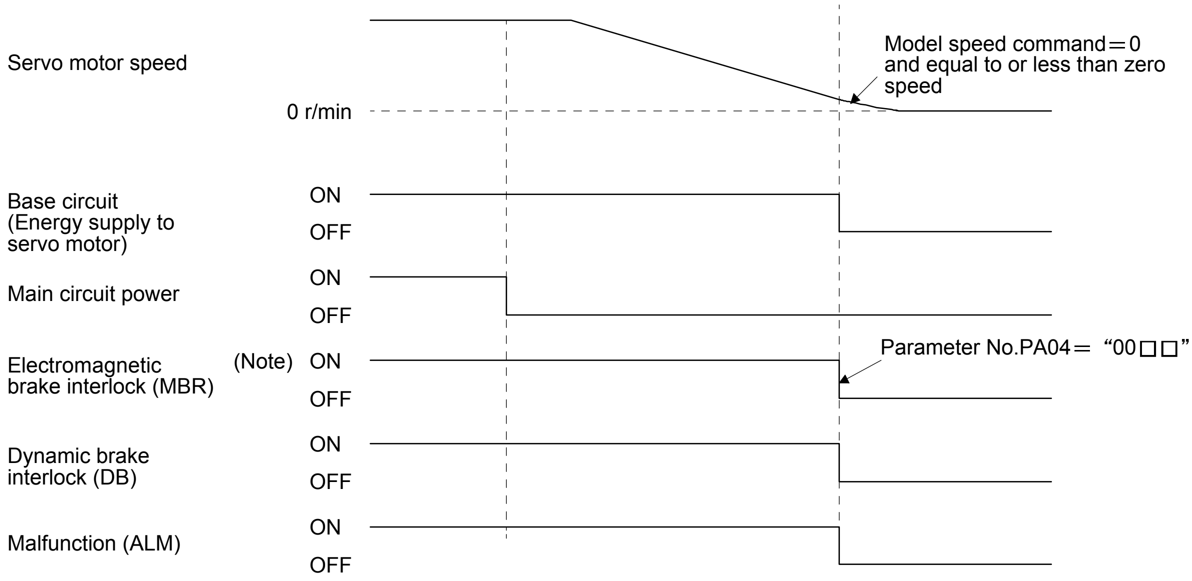
(4) Both main and control circuit power supplies off



Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

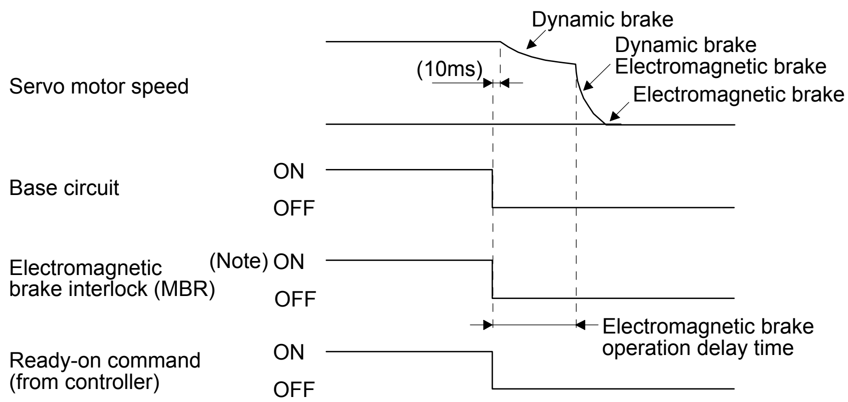
(5) Only main circuit power supply off (control circuit power supply remains on)

POINT
・The torque control mode does not support the forced stop deceleration function.



Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

(6) Ready-off command (from controller)

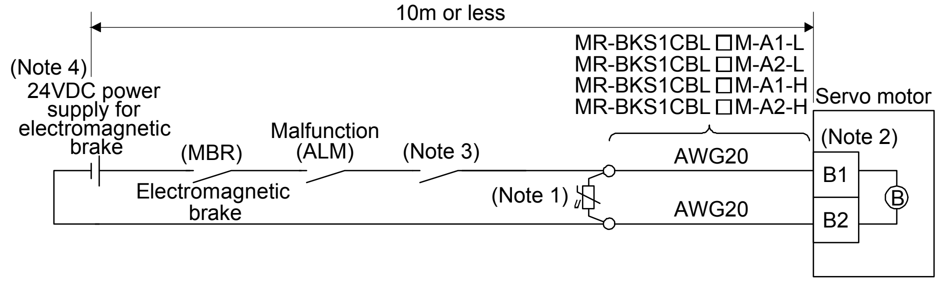


Note. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated

3.12.3 Wiring diagrams (HF-MP series・HF-KP series servo motor)

POINT
・For HF-SP series・HC-RP series・HC-UP series・HC-LP series servo motors, refer to section 3.11.2 (2). ・When the test operation mode is set with the test operation select switch (SW2-1), the SSCNETⅢ communication of the servo amplifiers following the servo amplifier with the test operation mode is disconnected.

(1) When cable length is 10m or less



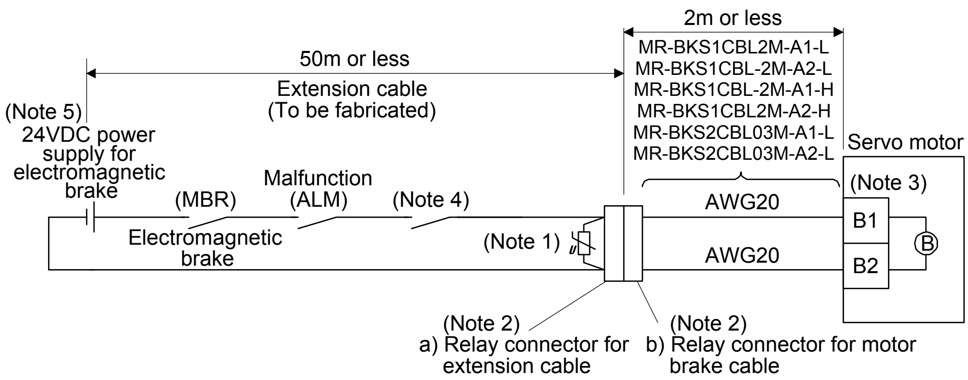
Note 1. Connect a surge absorber as close to the servo motor as possible.
2. There is no polarity in electromagnetic brake terminals (B1 and B2).
3. Shut off the circuit by interlocking with the emergency stop switch.
4. Do not use the 24VDC interface power supply for the electromagnetic brake.

When fabricating the motor brake cable MR-BKS1CBL-□M-H, refer to section 11.1.4.

(2) When cable length exceeds 10m

When the cable length exceeds 10m, fabricate an extension cable as shown below on the customer side. In this case, the motor brake cable should be within 2m long.

Refer to section 11.11 for the wire used for the extension cable.



Note 1. Connect a surge absorber as close to the servo motor as possible.

2. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

Relay connector	Description	IP rating
a) Relay connector for extension cable	CM10-CR2P-∗ (DDK) Wire size: S, M, L	IP65
b) Relay connector for motor brake cable	CM10-SP2S-∗ (D6) (DDK) Wire size: S, M, L	IP65

3. There is no polarity in electromagnetic brake terminals (B1 and B2).

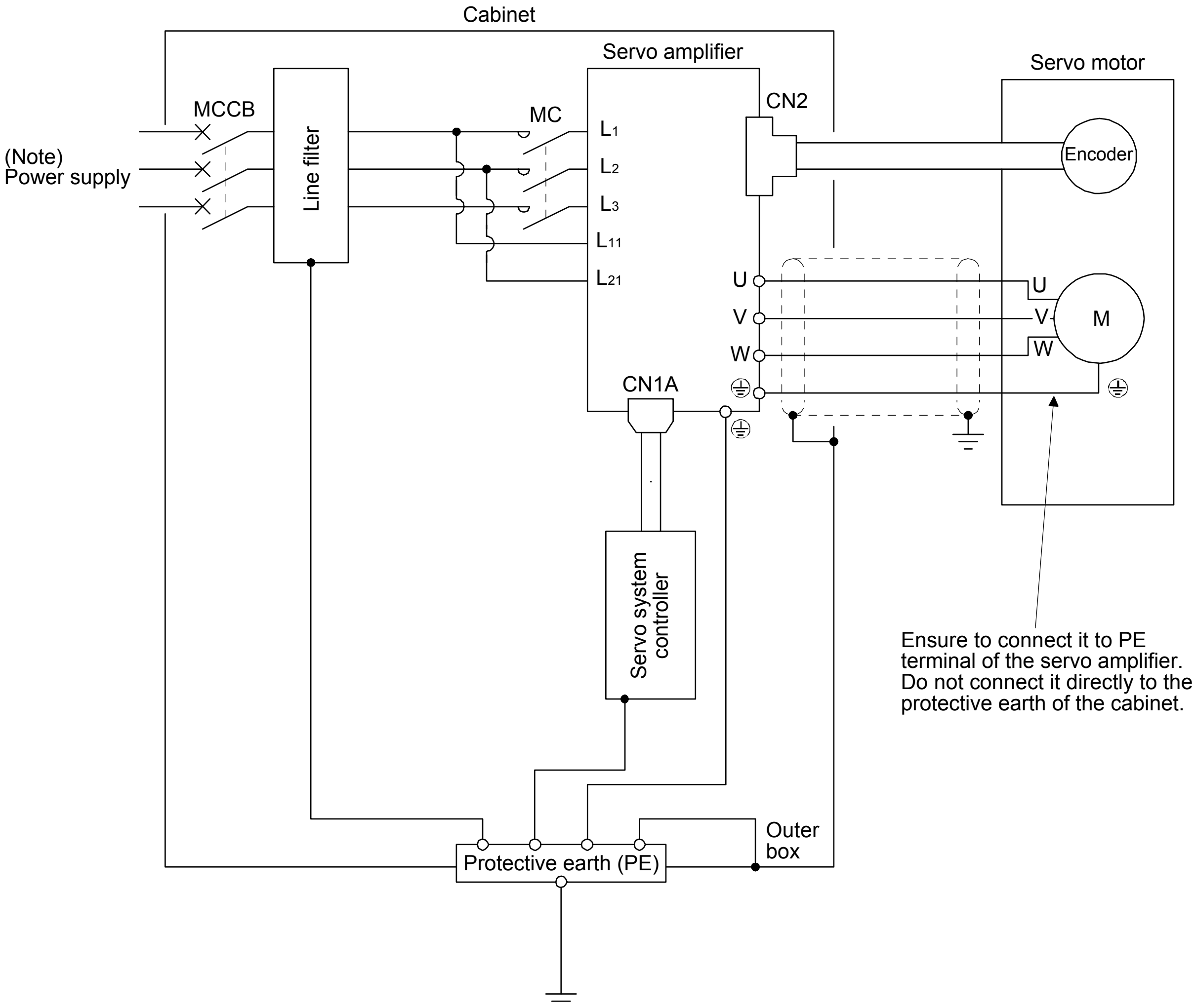
4. Shut off the circuit by interlocking with the emergency stop switch.

5. Do not use the 24VDC interface power supply for the electromagnetic brake.

3.13 Grounding

WARNING	・Ground the servo amplifier and servo motor securely. ・To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier with the protective earth (PE) of the cabinet.

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cable routing, 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).



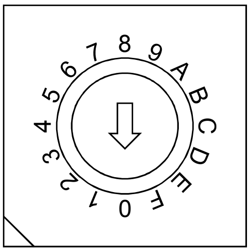
Note. For 1-phase 200V to 230VAC, connect the power supply to L_1・L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. Refer to section 1.3 for the power supply specification.

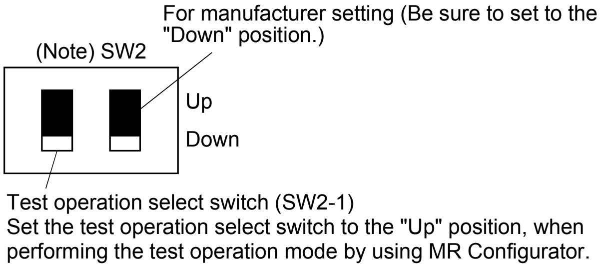
3.14 Control axis selection

POINT
・The control axis number set to rotary axis setting switch (SW1) should be the same as the one set to the servo system controller. ・When the test operation mode is set with the test operation select switch (SW2-1), the SSCNETⅢ communication of the servo amplifiers following the servo amplifier with the test operation mode is disconnected.

Use the rotary axis setting switch (SW1) to set the control axis number for the servo. 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 SSCNETⅢ cable connection sequence.

Rotary axis setting switch(SW1)





Note. This table indicates the status when the switch is set to "Down". (Default)

Switch for manufacturer setting	Rotary axis setting switch (SW1)	Description	Display
Down (Be sure to set to the "Down" position.)	0	Axis No.1	01
	1	Axis No.2	02
	2	Axis No.3	03
	3	Axis No.4	04
	4	Axis No.5	05
	5	Axis No.6	06
	6	Axis No.7	07
	7	Axis No.8	08
	8	Axis No.9	09
	9	Axis No.10	10
	A	Axis No.11	11
	B	Axis No.12	12
	C	Axis No.13	13
	D	Axis No.14	14
	E	Axis No.15	15
	F	Axis No.16	16

MEMO

4. STARTUP

WARNING	- Do not operate the switches with wet hands. Otherwise, it may cause an electric shock.

CAUTION	- Before starting operation, check the parameters. Some machines may perform unexpected operation. - Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the servo amplifier heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a part may damaged. - During operation, never touch the rotating parts of the servo motor. Otherwise, it may cause injury.

4.1 Switching power on for the first time

When switching power on for the first time, follow this section to make a startup.

4.1.1 Startup procedure

Wiring check	Check whether the servo amplifier and servo motor are wired correctly using visual inspection, DO forced output function (section 4.5.1), etc. (Refer to section 4.1.2.)
↓	
Surrounding environment check	Check the surrounding environment of the servo amplifier and servo motor. (Refer to section 4.1.3.)
↓	
Axis No. settings	Confirm that the axis No. settings for rotary axis setting switch (SW1) and servo system controller are consistent. (Refer to section 3.14.)
↓	
Parameter setting	Set the parameters as necessary, such as the regenerative option selection. (Refer to chapter 5.)
↓	
Test operation of servo motor alone in test operation mode	For the test operation, with the servo motor disconnected from the machine and operated at the speed as low as possible, check whether the servo motor rotates correctly. (Refer to sections 4.5.)
↓	
Test operation of servo motor alone by commands	For the test operation with the servo motor disconnected from the machine and operated at the speed as low as possible, give commands to the servo amplifier and check whether the servo motor rotates correctly.
↓	
Test operation with servo motor and machine connected	Connect the servo motor with the machine, give operation commands from the host command device, and check machine motions.
↓	
Gain adjustment	Make gain adjustment to optimize the machine motions. (Refer to chapter 6.)
↓	
Actual operation	
↓	
Stop	Stop giving commands and stop operation.

4.1.2 Wiring check

(1) Power supply system wiring

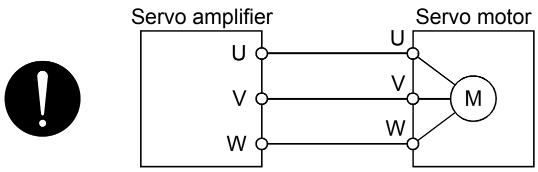
Before switching on the main circuit and control circuit power supplies, check the following items.

(a) Power supply system wiring

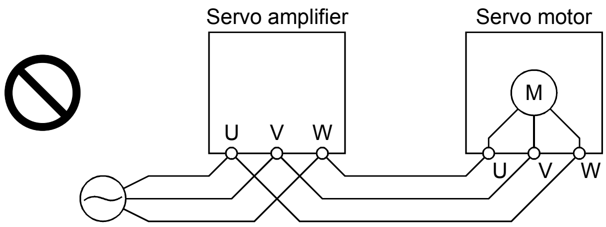
The power supplied to the power input terminals (L_1, L_2, L_3, L_{11}, L_{21}) of the servo amplifier should satisfy the defined specifications. (Refer to section 1.3.)

(b) Connection of servo amplifier and servo motor

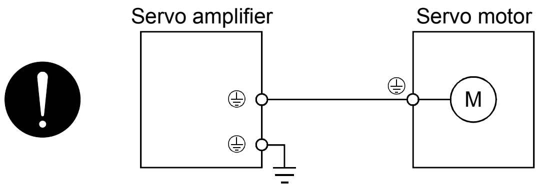
1) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W) of the servo motor.



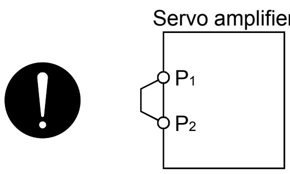
2) The power supplied to the servo amplifier should not be connected to the servo motor power supply terminals (U, V, W). To do so will fail the connected servo amplifier and servo motor.



3) The earth terminal of the servo motor is connected to the PE terminal of the servo amplifier.



4) P_1-P_2 (For 11k to 22kW, P_1-P) should be connected.



(c) When option and auxiliary equipment are used

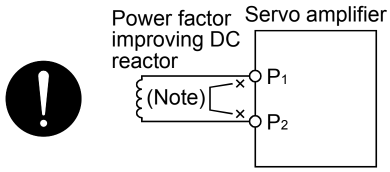
1) When regenerative option is used under 3.5kW for 200V class and 2kW for 400V class

- The lead between P terminal and D terminal of CNP2 connector should not be connected.
- The generative brake option should be connected to P terminal and C terminal.
- A twisted cable should be used. (Refer to section 11.2.)

2) When regenerative option is used over 5kW for 200V class and 3.5kW for 400V class
- The lead of built-in regenerative resistor connected to P terminal and C terminal of TE1 terminal block should not be connected.
- The generative brake option should be connected to P terminal and C terminal.
- A twisted cable should be used when wiring is over 5m and under 10m. (Refer to section 11.2.)

3) When brake unit and power regenerative converter are used over 5kW
- The lead of built-in regenerative resistor connected to P terminal and C terminal of TE1 terminal block should not be connected.
- Brake unit, power regenerative converter or power regenerative converter should be connected to P terminal and N terminal. (Refer to section 11.3 to 11.5.)

4) The power factor improving DC reactor should be connected P_1 and P_2 (For 11k to 22kW, P_1 and P). (Refer to section 11.13.)



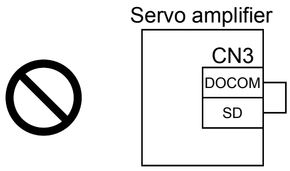
Note. Always disconnect P_1 and P_2. (For 11k to 22kW P_1 and P)

(2) I/O signal wiring

(a) The I/O signals should be connected correctly.
Use DO forced output to forcibly turn on/off the pins of the CN3 connector. This function can be used to perform a wiring check. In this case, switch on the control circuit power supply only.

(b) 24VDC or higher voltage is not applied to the pins of connectors CN3.

(c) SD and DOCOM of connector CN3 is not shorted.



4.1.3 Surrounding environment

(1) Cable routing

(a) The wiring cables are free from excessive force.

(b) The encoder cable should not be used in excess of its flex life. (Refer to section 10.4.)

(c) The connector part of the servo motor should not be strained.

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

4.2 Startup

Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

(1) Power on
When the main and control circuit power supplies are switched on, "b01" (for the first axis) appears on the servo amplifier display.
In the absolute position detection system, first power-on results in the absolute position lost (25) alarm and the servo system cannot be switched on.
The alarm can be deactivated by then switching power off once and on again.
Also in the absolute position detection system, if power is switched on at the servo motor speed of 3000r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(2) Parameter setting
Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for the parameter definitions.

Parameter No.	Name	Setting	Description
PA04	Function selection A-1	00□□ (Initial value)	Uses the forced stop 2 (EM2). If EM2 turns off, the electromagnetic brake interlock (MBR) turns off after the forced stop deceleration. The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.
PC24	Deceleration command time constant at forced stop	—	Set the time to stop the servo motor when the forced stop 2 (EM2) becomes valid or an alarm occurs.

After setting the above parameters, switch power off once. Then switch power on again to make the set parameter values valid.

(3) Servo-on
Switch the servo-on in the following procedure.

1) Switch on main circuit/control circuit power supply.

2) The controller transmits the servo-on command.

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(4) Home position return
Always perform home position return before starting positioning operation.

(5) Stop

If any of the following situations occurs, the servo amplifier suspends the running of the servo motor and brings it to a stop.

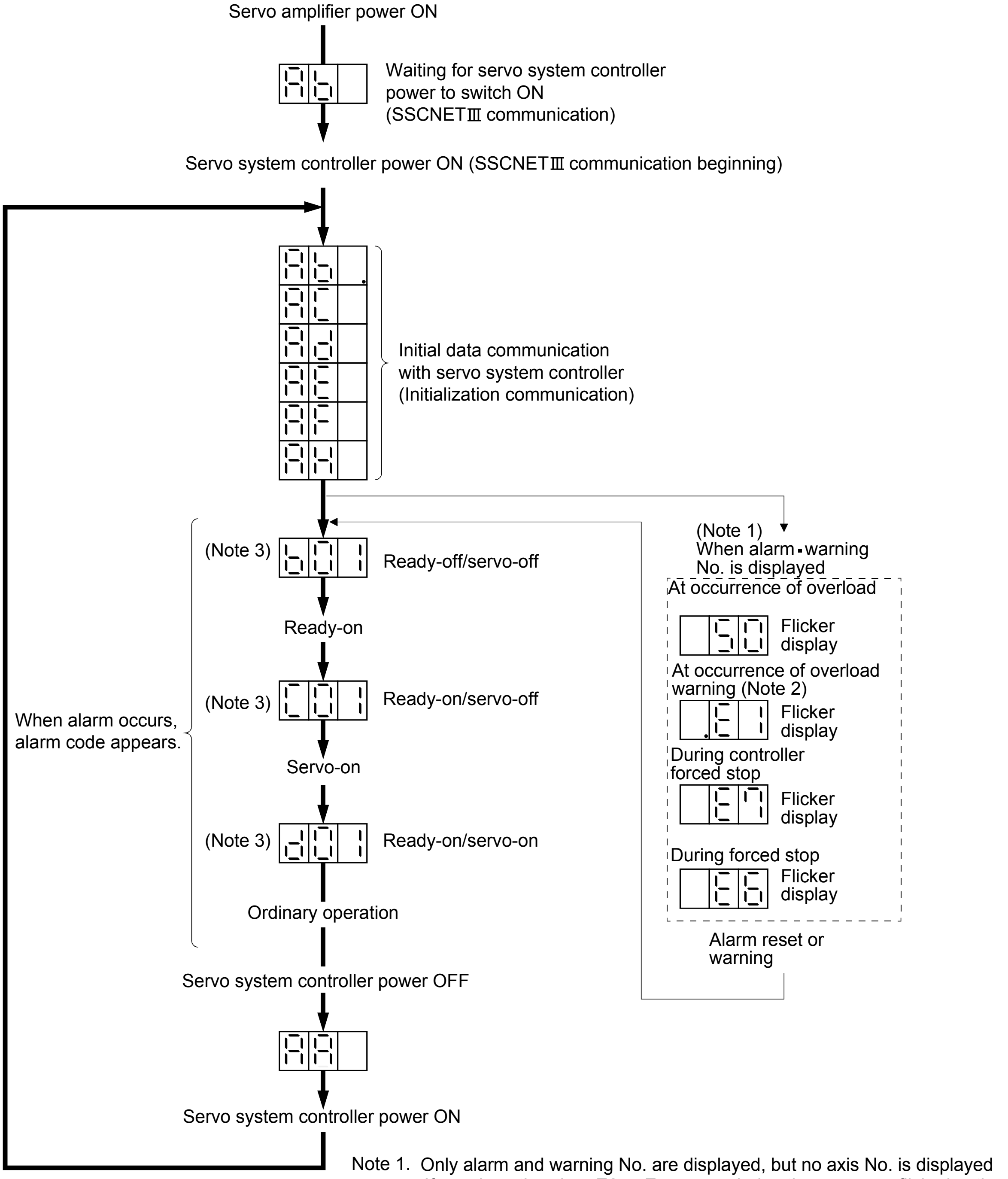
When the servo motor is with an electromagnetic brake, refer to section 3.12.

	Operation/command	Stopping condition
Servo system controller	Servo-off command	The base circuit is shut off and the servo motor coasts.
	Ready-off command	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.
	Forced stop command	The servo motor decelerates to a stop with the command. The controller forced stop warning (E7) occurs.
Servo amplifier	Alarm occurrence	The servo motor decelerates to a stop with the command. With some alarms, however, the dynamic brake operates to bring the servo motor to a stop. (Refer to section 8.1.)
	Forced stop 2 (EM2) OFF	The servo motor decelerates to a stop with the command. The servo forced stop warning (E6) occurs. The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.
	STO (STO1, STO2) OFF	The base circuit is shut off and the dynamic brake operates to bring the servo motor to a stop.

4.3 Servo amplifier display

On the servo amplifier display (3-digit, 7-segment display), check the status of communication with the servo system controller at power-on, check the axis number, and diagnose a fault at occurrence of an alarm.

(1) Display sequence



Note 1. Only alarm and warning No. are displayed, but no axis No. is displayed
2. If warning other than E6 or E7 occurs during the servo-on, flickering the second place of decimal point indicates that it is during the servo-on.
3. The right-hand segments of b01, c02 and d16 indicate the axis number. (Below example indicates Axis1)

(2) Indication list

Indication	Status	Description
Ab␣	Initializing	▪ Power of the servo amplifier was switched on at the condition that the power of servo system controller is OFF. ▪ The axis No. set to the servo system controller does not match the axis No. set with the rotary axis setting switch (SW1) of the servo amplifier. ▪ A servo amplifier fault, or communication error with the servo system controller or the prior servo amplifier axis occured. In this case, the indication changes as follows: "Ab" → "AC" → "Ad" → "Ab" ▪ The servo system controller is faulty.
Ab␣.	Initializing	During initial setting for communication specifications
AC␣	Initializing	Initial setting for communication specifications completed, and then it synchronized with servo system controller.
Ad␣	Initializing	During initial parameter setting communication with servo system controller
AE␣	Initializing	During motor ▪ encoder information and telecommunication with servo system controller
AF␣	Initializing	During initial signal data communication with servo system controller
AH␣	Initializing completion	During the completion process for initial data communication with servo system controller
AA␣	Initializing standby	The power supply of servo system controller is turned off during the power supply of servo amplifier is on.
(Note 1) b##	Ready-off	The ready-off command from the servo system controller was received.
(Note 1) d##	Servo-on	The servo-on command from the servo system controller was received.
(Note 1) C##	Servo-off	The servo-off command from the servo system controller was received.
(Note 2) ␣**	Alarm ・ Warning	The alarm No./warning No. that occurred is displayed. (Refer to section 8.1.)
888	CPU Error	CPU watchdog error has occurred.
(Note 3) b00.	(Note 3) Test operation mode	JOG operation, positioning operation, program operation, DO forced output.
(Note 1) b##. d##. C##.		Motor-less operation

Note 1. ## denotes any of numerals 00 to 16 and what it means is listed below.

#	Description
0	Set to the test operation mode.
1	First axis
2	Second axis
3	Third axis
4	Fourth axis
5	Fifth axis
6	Sixth axis
7	Seventh axis
8	Eighth axis
9	Ninth axis
10	Tenth axis
11	Eleventh axis
12	Twelfth axis
13	Thirteenth axis
14	Fourteenth axis
15	Fifteenth axis
16	Sixteenth axis

2. ** indicates the warning/alarm No.

3. Requires MR Configurator.

4.4 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.2 for the power on and off methods of the servo amplifier.

POINT
・If necessary, verify controller program by using motor-less operation. Refer to section 4.5.2 for the motor-less operation.

Test operation of servo motor alone in JOG operation of test operation mode

In this step, confirm that the servo amplifier and servo motor operate normally. With the servo motor disconnected from the machine, use the test operation mode and check whether the servo motor rotates correctly. Refer to section 4.5 for the test operation mode.

↓

Test operation of servo motor alone by commands

In this step, confirm that the servo motor rotates correctly under the commands from the controller.
Make sure that the servo motor rotates in the following procedure.
Give a low speed command at first and check the rotation direction, etc. of the servo motor.
If the servo motor does not operate in the intended direction, check the input signal.

↓

Test operation with servo motor and machine connected

In this step, connect the servo motor with the machine and confirm that the machine operates normally under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.
Give a low speed command at first and check the operation direction, etc. of the machine. If the machine does not operate in the intended direction, check the input signal. Check any problems with the servo motor speed, load ratio, and others by using MR Configurator.
Then, check automatic operation with the program of the command device.

4.5 Test operation mode

CAUTION	
⚠ CAUTION	・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 the servo motor alone. ・If an operation fault occurred, use the forced stop 2 (EM2) to make a stop.

POINT

・The content described in this section indicates the environment that servo amplifier and personal computer are directly connected.

By using a personal computer and MR Configurator, you can execute jog operation, positioning operation, DO forced output program operation without connecting the servo system controller.

4.5.1 Test operation mode in MR Configurator

POINT

・When the test operation mode is set with the test operation select switch (SW2-1), the SSCNETⅢ communication of the servo amplifiers following the servo amplifier with the test operation mode is disconnected.

(1) Test operation mode

(a) Jog operation

Jog operation can be performed without using the servo system controller. Use this operation with the forced 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 MR Configurator.

1) Operation pattern

Item	Initial value	Setting range
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

2) Operation method

・When the check box of "Rotation only while the button is being pushed" is checked.

Operation	Screen control
Forward rotation start	Keep pressing the "Forward" button.
Reverse rotation start	Keep pressing the "Reverse" button.
Stop	Release "Forward" or "Reverse" button.

・When the check box of "Rotation only while the button is being pushed" is not checked.

Operation	Screen control
Forward rotation start	Click the "Forward" button.
Reverse rotation start	Click the "Reverse" button.
Stop	Click the "Stop" button.

(b) Positioning operation

Positioning operation can be performed without using the servo system controller. Use this operation with the forced 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 MR Configurator.

1) Operation pattern

Item	Initial value	Setting range
Travel distance [pulse]	4000	0 to 99999999
Speed [r/min]	200	0 to max. speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000
Repeat pattern	Fwd. rot. (CCW) → Rev. rot. (CW)	Fwd. rot. (CCW) → Rev. rot. (CW) Fwd. rot. (CCW) → Fwd. rot. (CCW) Rev. rot. (CW) → Fwd. rot. (CCW) Rev. rot. (CW) → Rev. rot. (CW)
Dwell Time [s]	2.0	0.5 to 50.0
Number of repeats [time]	1	1 to 9999

2) Operation method

Operation	Screen control
Forward rotation start	Click the "Forward" button.
Reverse rotation start	Click the "Reverse" button.
Pause	Click the "Pause" button.

(c) Program operation

Positioning operation can be performed in two or more operation patterns combined, without using the servo system controller. Use this operation with the forced 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 program operation screen of MR Configurator. For full information, refer to the MR Configurator Installation Guide.

Operation	Screen control
Start	Click the "Start" button.
Stop	Click the "Reset" button.

(d) Output signal (DO) forced output

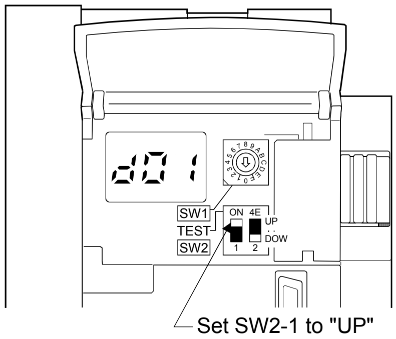
Output signals can be switched on/off forcibly independently of the servo status. Use this function for output signal wiring check, etc.

Exercise control on the DO forced output screen of MR Configurator.

(2) Operation procedure

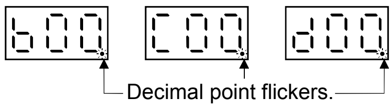
(a) Switch power off.

(b) Set SW2-1 to "UP".



Changing SW2-1 to "UP" while power is on will not start the test operation mode.

(c) Switch servo amplifier power on.
When initialization is over, the display shows the following screen.



(d) Perform operation with the personal computer.

4.5.2 Motor-less operation in controller

POINT
・Use motor-less operation which is available by making the servo system controller parameter setting. ・Motor-less operation is done while connected with the servo system controller. ・When the test operation mode is set with the test operation select switch (SW2-1), the SSCNETⅢ communication of the servo amplifiers following the servo amplifier with the test operation mode is disconnected.

(1) Motor-less operation

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 forced stop reset. Use this operation with the servo amplifier connected to the servo system controller.

For stopping the motor-less operation, set the selection of motor-less operation to [Invalid] in servo parameter setting of servo system controller. Motor-less operation will be invalid condition after switching on power supply next time.

(a) Load conditions

Load item	Condition
Load torque	0
Load inertia moment ratio	Same as servo motor inertia moment

(b) 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 (at power on) (16)
・Encoder error 2 (during runtime) (20)
・Absolute position erasure (during runtime) (25)
・Battery cable disconnection warning (92)
・Battery warning (9F)
・Converter error (1B) (Note 1)
・Converter warning (9C) (Note 1)
・Main circuit off warning (E9) (Note 2)

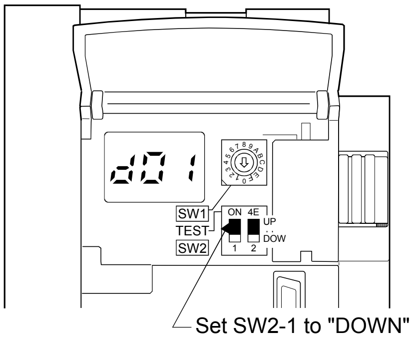
Note 1. Alarm and warning for the drive units of 30kW or more. For details, refer to section 13.6.2.

2. Main circuit off warning (E9) does not occur only when the forced stop of the converter unit is enabled as the cause of occurrence with the drive unit of 30kW or more. Main circuit of warning, otherwise, occurs when the cause of occurrence with the drive unit of 30kW or more is other than above, or with the servo amplifier of 22 kW or less.

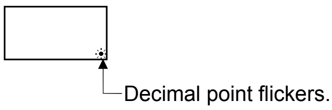
(2) Operating procedure

1) Switch off servo amplifier

2) Set parameter No.PC05 to "1", change test operation mode switch (SW2-1) to normal condition side "Down", and then turn on the power supply.



3) Perform motor-less operation with the personal computer.
The display shows the following screen.



5. PARAMETERS

CAUTION	・Never adjust or change the parameter values extremely as it will make operation instable. ・If fixed values are written in the digits of a parameter, do not change these values.

POINT

- When the servo amplifier is connected with the servo system controller, the parameters are set to the values of the servo system controller. Cycling the power disables the values set in MR Configurator and enables the values set in servo system controller.
- Setting may not be made to some parameters and ranges depending on the model or software version of the servo system controller. For details, refer to the servo system controller user's manual.

In this servo amplifier, the parameters are classified into the following groups on a function basis.

Parameter group	Main description
Basic setting parameters (No.PA□□)	Make basic setting with these parameters. Generally, the operation is possible only with these parameter settings.
Gain/filter parameters (No.PB□□)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No.PC□□)	When changing settings such as analog monitor output signal or encoder electromagnetic brake sequence output, use these parameters.
I/O setting parameters (No.PD□□)	Use these parameters when changing the I/O signals of the servo amplifier.
Extension control parameters (No.PE□□)	Use these parameters when selecting a function in the fully closed loop system.

Mainly setting the basic setting parameters (No.PA□□) allows the setting of the basic parameters at the time of introduction.

5.1 Basic setting parameters (No.PA□□)

POINT

- The parameter whose symbol preceded by * can be validated with the following conditions:
  - * : Turn off the power and then on again, or reset the controller after setting the parameter.
  - **: Turn off the power and then on again after setting the parameter.
- Never change parameters for manufacturer setting.

5.1.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode (Note)	
					Semi	Fully
PA01	**STY	Control mode	0000h		○	○
PA02	**REG	Regenerative option	0000h		○	○
PA03	*ABS	Absolute position detection system	0000h		○	○
PA04	*AOP1	Function selection A-1	0000h		○	○
PA05		For manufacturer setting	0			
PA06			1			
PA07			1			
PA08	ATU	Auto tuning mode	0001h		○	○
PA09	RSP	Auto tuning response	12		○	○
PA10	INP	In-position range	100	pulse	○	○
PA11		For manufacturer setting	1000.0	%		
PA12			1000.0	%		
PA13			0000h			
PA14	*POL	Rotation direction selection	0		○	○
PA15	*ENR	Encoder output pulses	4000	pulse/rev	○	○
PA16	*ENR2	Encoder output pulses 2	0			○
PA17		For manufacturer setting	0000h			
PA18			0000h			
PA19	*BLK	Parameter write inhibit	000Bh		○	○

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system Fully: Fully closed loop system

5.1.2 Parameter write inhibit

Parameter No.	Symbol	Name	Initial value	Unit	Setting range
PA19	*BLK	Parameter write inhibit	000Bh		Refer to the text.

POINT
- When setting the parameter values with the servo system controller, the parameter No.PA19 setting need not be changed.
- Turn off the power and then on again, or reset the controller after setting the parameter to validate the parameter value.

In the factory setting, this servo amplifier allows changes to the basic setting parameter, gain/filter parameter and extension setting parameter settings. With the setting of parameter No.PA19, write can be disabled to prevent accidental changes.
The following table indicates the parameters which are enabled for reference and write by the setting of parameter No.PA19. Operation can be performed for the parameters marked ○ .

Parameter No. PA19 setting	Setting operation	Basic setting parameters No.PA□□	Gain/Filter parameters No.PB□□	Extension setting parameters No.PC□□	I/O setting parameters No.PD□□	Extension control parameters No.PE□□
0000h	Reference	○				
	Write	○				
000Bh (initial value)	Reference	○	○	○		
	Write	○	○	○		
000Ch	Reference	○	○	○	○	
	Write	○	○	○	○	
000Fh	Reference	○	○	○	○	○
	Write	○	○	○	○	○
100Bh	Reference	○				
	Write	Parameter No. PA19 only				
100Ch	Reference	○	○	○	○	○
	Write	Parameter No. PA19 only				

5.1.3 Selection of regenerative option

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA02	**REG	Regenerative option	0000h		Refer to the text.

POINT
- Turn off the power and then on again after setting the parameter to validate the parameter value.
- Wrong setting may cause the regenerative option to burn.
- If the regenerative option selected is not for use with the servo amplifier, parameter error (37) occurs.
- For a drive unit of 30kW or more, always set the parameter to "□□00" since selecting regenerative option is carried out by the converter unit.

Set this parameter when using the regenerative option, brake unit, power regenerative converter, or power regeneration common converter.

Parameter No.PA02

0	0		

Selection of regenerative option
00: Regenerative option is not used
- For servo amplifier of 100W, regenerative resistor is not used.
- For servo amplifier of 0.2k to 7kW, built-in regenerative resistor is used.
- Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11k to 22kW.
- Use a drive unit of 30kW or more in combination with an MR-J3-CR55K(4) converter unit.
  (When using the drive unit of 30kW or more in combination with the MR-J3-CR55K(4) converter unit, set this value whether the regenerative option and brake unit are used or not.)

(Note)
01: FR-BU2-(H)･FR-RC-(H)･FR-CV-(H)
02: MR-RB032
03: MR-RB12
04: MR-RB32
05: MR-RB30
06: MR-RB50(Cooling fan is required)
08: MR-RB31
09: MR-RB51(Cooling fan is required)
80: MR-RB1H-4
81: MR-RB3M-4(Cooling fan is required)
82: MR-RB3G-4(Cooling fan is required)
83: MR-RB5G-4(Cooling fanis required)
84: MR-RB34-4(Cooling fanis required)
85: MR-RB54-4(Cooling fanis required)
FA: When the supplied regenerative resistor is cooled by the cooling fan to increase the ability with the servo amplifier of 11k to 22kW.

Note. The setting is for the servo amplifier of 22kW or less.

5.1.4 Using absolute position detection system

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA03	*ABS	Absolute position detection system	0000h		Refer to the text.

POINT

- Turn off the power and then on again, or reset the controller after setting the parameter to validate the parameter value.
- This parameter cannot be used in the speed control mode and torque control mode.

Set this parameter when using the absolute position detection system in the position control mode.

Parameter No.PA03

0	0	0	

Selection of absolute position detection system (refer to chapter 12)
0: Used in incremental system
1: Used in absolute position detection system
In the following cases, the parameter error (37) occurs, and absolute position detecting system cannot be used.
- Linear encoder of incremental type is used.
- Switching between semi closed/fully closed loop system is set valid.

5.1.5 Forced stop 1 (EM1) and forced stop 2 (EM2) selection

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA04	*AOP1	Function selection A-1	0000h		Refer to the text.

> **POINT**
> - Turn off the power and then on again, or reset the controller after setting the parameter to validate the parameter value.
> - The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.

Devices assigned to CN3-pin 20 can be changed with this parameter. Select forced stop 1 (EM1) and forced stop 2 (EM2). These devices can be invalidated.

(1) Parameter setting

Parameter No.PA04

| | | 0 | 0 |

Servo forced stop selection

Setting value	EM1/EM2 selection	Deceleration method when EM1 or EM2 becomes valid	Deceleration method when an alarm occurs
00	Forced stop 2 (EM2)	The electromagnetic brake interlock (MBR) turns off after the forced stop deceleration.	The electromagnetic brake interlock (MBR) turns off after the forced stop deceleration.
10	Forced stop 2 (EM2)	The electromagnetic brake interlock (MBR) turns off simultaneously with the start of the forced stop deceleration.	The electromagnetic brake interlock (MBR) turns off simultaneously with the start of the forced stop deceleration.
30	Forced stop 1 (EM1)	The electromagnetic brake interlock (MBR) turns off without the forced stop deceleration.	The electromagnetic brake interlock (MBR) turns off without the forced stop deceleration.
01	Not using EM1 or EM2		The electromagnetic brake interlock (MBR) turns off after the forced stop deceleration.
11			The electromagnetic brake interlock (MBR) turns off simultaneously with the start of the forced stop deceleration.
31			The electromagnetic brake interlock (MBR) turns off without the forced stop deceleration.

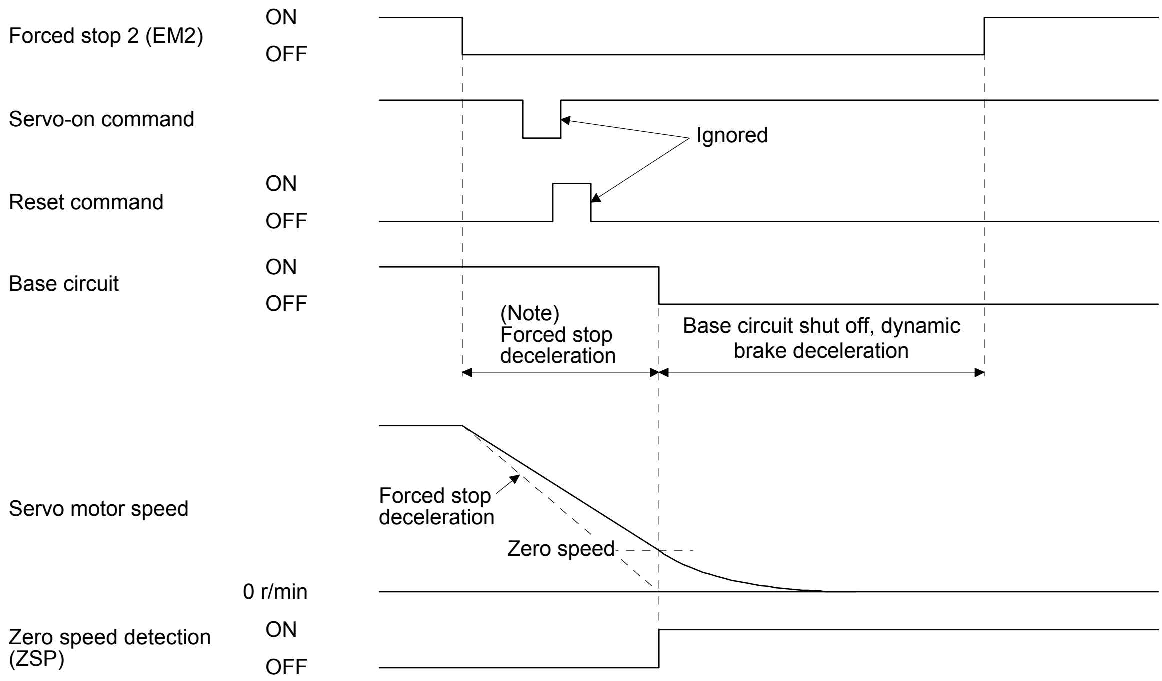
(2) Deceleration to a stop function

- This function can rapidly stop the servo motor at a forced stop or at certain servo alarm occurrence during position control. Set this function valid/invalid by parameter No.PA04.
- Deceleration time constant during a forced stop is determined by the value set in parameter No.PC24 (deceleration command time constant at a forced stop).
- After completion of the forced stop deceleration command, and when the zero speed detection (ZSP) is turned on, the base circuit is shut off and the servo motor stops by normal operation of the dynamic brake. When shifting from the forced stop deceleration to the dynamic brake deceleration, the servo motor coasts for about 10ms due to operation delay of the relay in the servo amplifier.

The sequence at a forced stop is described in this section.

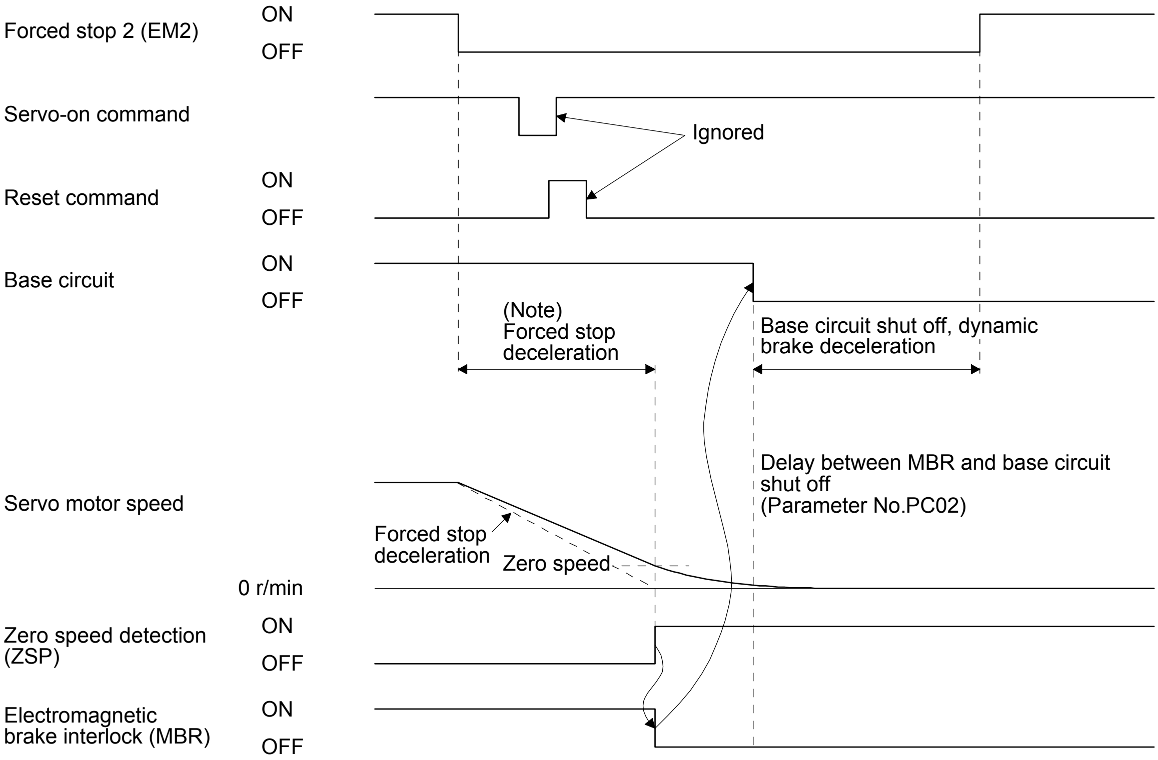
(a) When the forced stop 2 (EM2) is input

The forced stop deceleration is performed. Servo-off command and reset command during a forced stop are ignored and does not shut off the base circuit.



Note. During the forced stop deceleration, commands from the controller are not accepted.

(b) When the forced stop 2 (EM2) is input Vertical axis (Timing of the servo motor electromagnetic brake)
To parameter No.PC02 (electromagnetic brake sequence output), set the time between MBR output and base circuit shut off.



Note. During the forced stop deceleration, commands from the controller are not accepted.

5.1.6 Auto tuning

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA08	ATU	Auto tuning mode	0001h		Refer to the text.
PA09	RSP	Auto tuning response	12		1 to 32

POINT
・This parameter cannot be used in the torque control mode.

Make gain adjustment using auto tuning. Refer to section 6.2 for details.

(1) Auto tuning mode (parameter No.PA08)
Select the gain adjustment mode.

Parameter No.PA08

0	0	0	

Gain adjustment mode setting

Setting	Gain adjustment mode	Automatically set parameter No. (Note)
0	Interpolation mode	PB06・PB08・PB09・PB10
1	Auto tuning mode 1	PB06・PB07・PB08・PB09・PB10
2	Auto tuning mode 2	PB07・PB08・PB09・PB10
3	Manual mode	

Note. The parameters have the following names.

Parameter No.	Name
PB06	Load to motor inertia moment ratio
PB07	Model loop gain
PB08	Position loop gain
PB09	Speed loop gain
PB10	Speed integral compensation

(2) Auto tuning response (parameter No.PA09)
If the machine hunts or generates large gear sound, decrease the set value. To improve performance, e.g. shorten the settling time, increase the set value.

Setting	Response	Guideline for machine resonance frequency [Hz]	Setting	Response	Guideline for machine resonance frequency [Hz]
1	Low response	10.0	17	Middle response	67.1
2	↑	11.3	18	↑	75.6
3		12.7	19		85.2
4		14.3	20		95.9
5		16.1	21		108.0
6		18.1	22		121.7
7		20.4	23		137.1
8		23.0	24		154.4
9		25.9	25		173.9
10		29.2	26		195.9
11		32.9	27		220.6
12		37.0	28		248.5
13		41.7	29		279.9
14		47.0	30		315.3
15	↓	52.9	31	↓	355.1
16	Middle response	59.6	32	High response	400.0

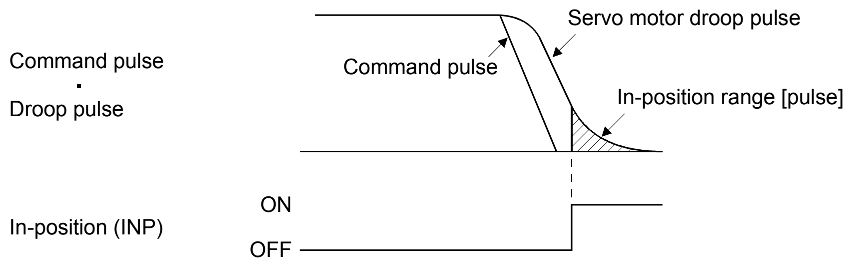
5.1.7 In-position range

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA10	INP	In-position range	100	pulse	0 to 65535

POINT

- This parameter cannot be used in the speed control mode and torque control mode.

Set the range, where in-position (INP) is output, in the command pulse unit.



5.1.8 Selection of servo motor rotation direction

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA14	*POL	Rotation direction selection	0		0 ・ 1

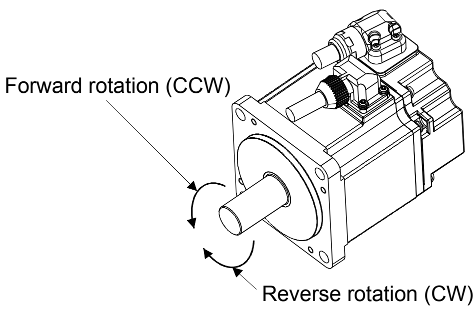
POINT

- Turn off the power and then on again, or reset the controller after setting the parameter to validate the parameter value.

Select servo motor rotation direction relative.

Parameter No.PA14 setting	(Note 1) Servo motor rotation direction	
	When positioning address increases (position control) Command speed in positive direction (speed control) Command torque in positive direction (torque control (Note 2))	When positioning address decreases (position control) Command speed in negative direction (speed control) Command torque in negative direction (torque control (Note 2))
0	CCW	CW
1	CW	CCW

Note 1. Torque generation direction for the torque control.
2. For the master-slave operation function, this parameter is also used to set the torque generation direction of the slave axis.

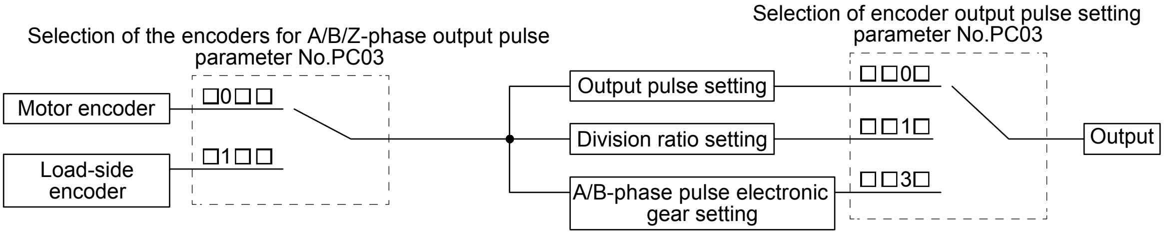


5.1.9 Encoder output pulse

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA15	*ENR	Encoder output pulse	4000	pulse/rev	1 to 65535
PA16	*ENR2	Encoder output pulse 2	0		0 to 65535

POINT
- Use parameter No.PA16 only in the fully closed system.
- Turn off the power and then on again, or reset the controller after setting the parameter to validate the parameter value.

Used to set the encoder pulses (A-phase and B-phase) output by the servo amplifier.
Set the value 4 times greater than the A-phase and B-phase pulses.
You can use parameter No.PC03 to choose the output pulse setting or output division ratio setting.
The number of A-phase and B-phase pulses actually output is 1/4 times greater than the preset number of pulses.
The maximum output frequency is 4.6Mpps (after multiplication by 4). Use this parameter within this range.



(1) For output pulse designation
Set "□□0□" (initial value) in parameter No.PC03. When parameter No.PC03 has been set to "□1□□", the parameter error (37) occurs.
Set the number of pulses per servo motor revolution.
Output pulse＝set value [pulses/rev]
For instance, set "5600" to Parameter No.PA15, the actually A/B-phase output pulses are as indicated below.

$$\text{A/B-phase output pulses} = \frac{5600}{4} = 1400 \text{ [pulse]}$$

(2) For output division ratio setting
Set "□□1□" in parameter No.PC03.
The number of pulses per servo motor revolution is divided by the set value.

$$\text{Output pulse} = \frac{\text{Resolution per servo motor revolution}}{\text{Set value}} \text{ [pulses/rev]}$$

For instance, set "8" to Parameter No.PA15, the actually output A/B-phase pulses are as indicated below.

$$\text{A/B-phase output pulses} = \frac{262144}{8} \cdot \frac{1}{4} = 8192 \text{ [pulse]}$$

(3) For output electronic gear ratio setting
Set "□□3□" in parameter No.PC03.
The resolution per servo motor revolution is set by parameter No.PA15, PA16.

$$\text{Output pulse} = \text{Resolution per servo motor revolution} \times \frac{\text{Set value of parameter No.PA15}}{\text{Set value of parameter No.PA16}} \text{ [pulses/rev]}$$

For instance, set "3" to Parameter No.PA15 and "32" to Parameter No.PA16, the actually A/B-phase output pulses are as indicated below.

$$\text{A/B-phase output pulses} = 262144 \times \frac{3}{32} \times \frac{1}{4} = 6144 \text{ [pulse]}$$

5.1.10 Selecting a control mode

Parameter			Initial value	Unit	Setting range
No.	Symbol	Name			
PA01	**STY	Control mode	0000h		Refer to the text.

POINT
- Use this parameter only in the fully closed system.
- Turn off the power and then on again after setting the parameter to validate the parameter value.

(1) Selecting a semi closed loop system or fully closed loop system

POINT
- Use this parameter only in the fully closed system.

Select a control mode.
The initial value of this parameter is set to "□□0□" (semi closed loop system).
When using the fully closed loop system, make sure to set the value to "□□1□". In this case, the value can be set to the fully closed loop system by the parameter No.PE01 setting and the semi closed loop system/fully closed loop system switching bit of the controller command.

Parameter No.PA01

0	0		0

Control mode selection
0: Semi closed loop system
1: Fully closed loop system

(2) Selecting a control loop composition

POINT
・This parameter is supported by a combination of a servo amplifier, whose software version is C4 or later (manufactured in August 2009 or later), and a HF-KP servo motor (manufactured in June 2009 or later). Check the software version using MR Configurator. ・When the 350% maximum torque setting of the HF-KP servo motor is valid, set the torque limit value in the controller at 1000%. ・A HF-KP servo motor with a decelerator and servo motors except the HF-KP series do not support the 350% maximum torque setting. Making the 350% maximum torque setting valid when using these servo motors causes the parameter error (37).

Set the control loop composition and the maximum torque of the HF-KP series servo motor.
By making the high-response control valid in the control loop composition, response of the servo can be increased compared to the response under the standard control (factory setting). Moreover, the track ability for a command and the settling time in machines with high rigidity can be decreased.
To further shorten the settling time using the auto tuning results of the high-response control, increase the setting of model loop gain (parameter No.PB07) in the manual mode.(Refer to section 6.3.)
By making the 350% maximum torque setting valid, the maximum torque of the HF-KP servo motor can be increased from 300% to 350%.
To operate at the maximum torque of 350%, operate within the range of overload protection characteristic.
If operated beyond the overload protection characteristic range, servo motor overheat (46), overload 1 (50), and overload 2 (51) may occur.

Parameter No. PA01

0		0	0

Control type selection

Setting value	Control loop composition	350% maximum torque setting of HF-KP servo motor
0	Standard control	Invalid
3	Standard control	Valid
4	High-response control	Invalid
5	High-response control	Valid

5.2 Gain/filter parameters (No.PB□□)

POINT

- The parameter whose symbol preceded by * can be validated with the following conditions:
  * : Turn off the power and then on again, or reset the controller after setting the parameter.
- Gain/filter parameters (No.PB□□) cannot be used in the torque control mode.

5.2.1 Parameter list

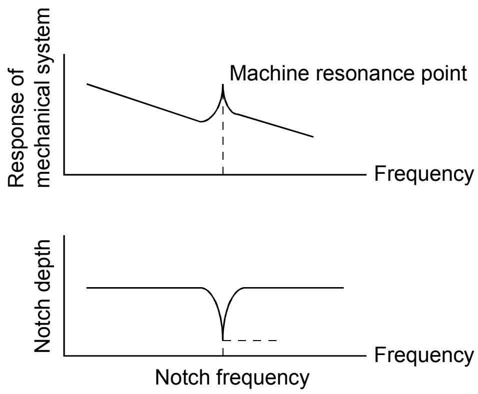
No.	Symbol	Name	Initial value	Unit	Control mode (Note)	
					Semi	Fully
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	0000h		○	○
PB02	VRFT	Vibration suppression control tuning mode (advanced vibration suppression control)	0000h		○	○
PB03		For manufacturer setting	0		○	○
PB04	FFC	Feed forward gain	0	%	○	○
PB05		For manufacturer setting	500		○	○
PB06	GD2	Load to motor inertia moment ratio	7.0	Multiplier (×1)	○	○
PB07	PG1	Model loop gain	24	rad/s	○	○
PB08	PG2	Position loop gain	37	rad/s	○	○
PB09	VG2	Speed loop gain	823	rad/s	○	○
PB10	VIC	Speed integral compensation	33.7	ms	○	○
PB11	VDC	Speed differential compensation	980		○	○
PB12	OVA	Overshoot amount compensation	0	%	○	○
PB13	NH1	Machine resonance suppression filter 1	4500	Hz	○	○
PB14	NHQ1	Notch shape selection 1	0000h		○	○
PB15	NH2	Machine resonance suppression filter 2	4500	Hz	○	○
PB16	NHQ2	Notch shape selection 2	0000h		○	○
PB17		Automatic setting parameter				
PB18	LPF	Low-pass filter setting	3141	rad/s	○	○
PB19	VRF1	Vibration suppression control vibration frequency setting	100.0	Hz	○	○
PB20	VRF2	Vibration suppression control resonance frequency setting	100.0	Hz	○	○
PB21		For manufacturer setting	0.00			
PB22			0.00			
PB23	VFBF	Low-pass filter selection	0000h		○	○
PB24	*MVS	Slight vibration suppression control selection	0000h		○	○
PB25		For manufacturer setting	0000h			
PB26	*CDP	Gain changing selection	0000h		○	○
PB27	CDL	Gain changing condition	10		○	○
PB28	CDT	Gain changing time constant	1	ms	○	○
PB29	GD2B	Gain changing load to motor inertia moment ratio	7.0	Multiplier (×1)	○	○
PB30	PG2B	Gain changing position loop gain	37	rad/s	○	○
PB31	VG2B	Gain changing speed loop gain	823	rad/s	○	○
PB32	VICB	Gain changing speed integral compensation	33.7	ms	○	○
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	100.0	Hz	○	○
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	100.0	Hz	○	○
PB35		For manufacturer setting	0.00			
PB36			0.00			

No.	Symbol	Name	Initial value	Unit	Control mode (Note)	
					Semi	Fully
PB37		For manufacturer setting	100			
PB38			0.0			
PB39			0.0			
PB40			0.0			
PB41			1125			
PB42			1125			
PB43			0004h			
PB44			0.0			
PB45	CNHF	Vibration suppression control filter 2	0000h		○	○

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system Fully: Fully closed loop system

5.2.2 Detail list

No.	Symbol	Name and function	Initial value	Unit	Setting range
PB01	FILT	Adaptive tuning mode (adaptive filter Ⅱ) Select the setting method for filter tuning. Setting this parameter to "□□□1" (filter tuning mode 1) automatically changes the machine resonance suppression filter 1 (parameter No.PB13) and notch shape selection (parameter No.PB14).	0000h		Refer to Name and function column.



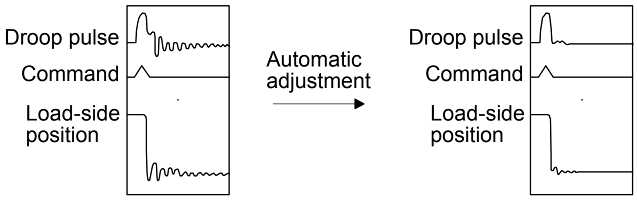
0	0	0	

Filter tuning mode selection

Setting	Filter adjustment mode	Automatically set parameter
0	Filter OFF	(Note)
1	Filter tuning mode	Parameter No.PB13 Parameter No.PB14
2	Manual mode	

Note. Parameter No.PB13 and PB14 are fixed to the initial values.

When this parameter is set to "□□□1", the tuning is completed after positioning is done the predetermined number or times for the predetermined period of time, and the setting changes to "□□□2". When the filter tuning is not necessary, the setting changes to "□□□0". When this parameter is set to "□□□0", the initial values are set to the machine resonance suppression filter 1 and notch shape selection. However, this does not occur when the servo-off.

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PB02</td><td>VRFT</td><td>Vibration suppression control tuning mode (advanced vibration suppression control)
This parameter cannot be used in the speed control mode.
The vibration suppression is valid when the parameter No.PA08 (auto tuning) setting is "□□□2" or "□□□3". When PA08 is "□□□1", vibration suppression is always invalid.
Select the setting method for vibration suppression control tuning. Setting this parameter to "□□□1" (vibration suppression control tuning mode) automatically changes the vibration suppression control vibration frequency (parameter No.PB19) and vibration suppression control resonance frequency (parameter No.PB20) after positioning is done the predetermined number of times.


0 0 0 □
Vibration suppression control tuning mode
<table>
<tr><th>Setting</th><th>Vibration suppression control tuning mode</th><th>Automatically set parameter</th></tr>
<tr><td>0</td><td>Vibration suppression control OFF</td><td>(Note)</td></tr>
<tr><td>1</td><td>Vibration suppression control tuning mode (Advanced vibration suppression control)</td><td>Parameter No.PB19
Parameter No.PB20</td></tr>
<tr><td>2</td><td>Manual mode</td><td></td></tr>
</table>
Note. Parameter No.PB19 and PB20 are fixed to the initial values.

When this parameter is set to "□□□1", the tuning is completed after positioning is done the predetermined number or times for the predetermined period of time, and the setting changes to "□□□2". When the vibration suppression control tuning is not necessary, the setting changes to "□□□0". When this parameter is set to "□□□0", the initial values are set to the vibration suppression control vibration frequency and vibration suppression control resonance frequency. However, this does not occur when the servo-off.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PB03</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0</td><td></td><td></td></tr>
<tr><td>PB04</td><td>FFC</td><td>Feed forward gain
This parameter cannot be used in the speed control mode.
Set the feed forward gain. When the setting is 100%, the droop pulse during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1s or more as the acceleration time constant up to the rated speed.</td><td>0</td><td>%</td><td>0
to
100</td></tr>
<tr><td>PB05</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>500</td><td></td><td></td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range
PB06	GD2	Load to motor inertia moment ratio Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used. (Refer to section 6.1.1.) In this case, it varies between 0 and 100.0. When parameter No.PA08 is set to "□□□2" or "□□□3", this parameter can be set manually.	7.0	Multiplier (×1)	0 to 300.0
PB07	PG1	Model loop gain Set the response gain up to the target position. Increase the gain to improve track ability in response to the command. When auto turning mode 1,2 is selected, the result of auto turning is automatically used. When parameter No.PA08 is set to "□□□0" or "□□□3", this parameter can be set manually.	24	rad/s	1 to 2000
PB08	PG2	Position loop gain This parameter cannot be used in the speed control mode. Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1,2 and interpolation mode is selected, the result of auto tuning is automatically used. When parameter No.PA08 is set to "□□□3", this parameter can be set manually.	37	rad/s	1 to 1000
PB09	VG2	Speed loop gain 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. When auto tuning mode 1・2, manual mode and interpolation mode is selected, the result of auto tuning is automatically used. When parameter No.PA08 is set to "□□□3", this parameter can be set manually.	823	rad/s	20 to 50000
PB10	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. Lower setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1・2 and interpolation mode is selected, the result of auto tuning is automatically used. When parameter No.PA08 is set to "□□□3", this parameter can be set manually.	33.7	ms	0.1 to 1000.0
PB11	VDC	Speed differential compensation Used to set the differential compensation. When parameter No.PB24 is set to "□□3□", this parameter is made valid. When parameter No. PB24 is set to "□□0□", this parameter is made valid by instructions of controller.	980		0 to 1000
PB12	OVA	Overshoot amount compensation This parameter is supported by the servo amplifiers whose software versions are C4 or later. Check the software version using MR Configurator. Used to suppress overshoot during position control. Overshoot can be suppressed in machines with high friction. Set a control ratio against the friction torque in percentage unit. When parameter No.PA01 is set to"□4□□" or "□5□□" and parameter No.PB12 is set to "0", the control ratio to the friction torque is fixed to 5% in the servo amplifier.	0	%	0 to 100
PB13	NH1	Machine resonance suppression filter 1 Set the notch frequency of the machine resonance suppression filter 1. Setting parameter No.PB01 (filter tuning mode 1) to "□□□1" automatically changes this parameter. When the parameter No.PB01 setting is "□□□0", the setting of this parameter is ignored.	4500	Hz	100 to 4500

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PB14</td><td>NHQ1</td><td>Notch shape selection 1
Used to selection the machine resonance suppression filter 1.

0 □ □ 0

Notch depth selection
<table>
<tr><th>Setting value</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width
<table>
<tr><th>Setting value</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table>
Setting parameter No.PB01 (filter tuning mode 1) to "□□□1" automatically changes this parameter.
When the parameter No.PB01 setting is "□□□0", the setting of this parameter is ignored.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PB15</td><td>NH2</td><td>Machine resonance suppression filter 2
Set the notch frequency of the machine resonance suppression filter 2.
Set parameter No.PB16 (notch shape selection 2) to "□□□1" to make this parameter valid.</td><td>4500</td><td>Hz</td><td>100 to 4500</td></tr>
<tr><td>PB16</td><td>NHQ2</td><td>Notch shape selection 2
Select the shape of the machine resonance suppression filter 2.

0 □ □ □

Machine resonance suppression filter 2 selection
0: Invalid
1: Valid

Notch depth selection
<table>
<tr><th>Setting value</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width
<table>
<tr><th>Setting value</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table></td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PB17</td><td></td><td>Automatic setting parameter
The value of this parameter is set according to a set value of parameter No.PB06 (Load to motor inertia moment ratio).</td><td></td><td></td><td></td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range
PB18	LPF	Low-pass filter setting Set the low-pass filter. Setting parameter No.PB23 (low-pass filter selection) to "□□0□" automatically changes this parameter. When parameter No.PB23 is set to "□□1□", this parameter can be set manually.	3141	rad/s	100 to 18000
PB19	VRF1	Vibration suppression control vibration frequency setting This parameter cannot be used in the speed control mode. Set the vibration frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. (Refer to section 7.4.(4)) Setting parameter No.PB02 (vibration suppression control tuning mode) to "□□□1" automatically changes this parameter. When parameter No.PB02 is set to "□□□2", this parameter can be set manually.	100.0	Hz	0.1 to 100.0
PB20	VRF2	Vibration suppression control resonance frequency setting This parameter cannot be used in the speed control mode. Set the resonance frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. (Refer to section 7.4.(4)) Setting parameter No.PB02 (vibration suppression control tuning mode) to "□□□1" automatically changes this parameter. When parameter No.PB02 is set to "□□□2", this parameter can be set manually.	100.0	Hz	0.1 to 100.0
PB21		For manufacturer setting	0.00		
PB22		Do not change this value by any means.	0.00		
PB23	VFBF	Low-pass filter selection Select the low-pass filter. 0 0 □ 0 Low-pass filter selection 0: Automatic setting 1: Manual setting (parameter No.PB18 setting) When automatic setting has been selected, select the filter that has the band width close to the one calculated with $\frac{VG2 \cdot 10}{1 + GD2}$ [rad/s]	0000h		Refer to Name and function column.
PB24	*MVS	Slight vibration suppression control selection Select the slight vibration suppression control and PI-PID change. When parameter No.PA08 (auto tuning mode) is set to "□□□3", this parameter is made valid. (Slight vibration suppression control cannot be used in the speed control mode.) 0 0 □ □ Slight vibration suppression control selection 0: Invalid 1: Valid PI-PID control switch over selection 0: PI control is valid. (Switching to PID control is possible with instructions of controller.) 3: PID control is always valid.	0000h		Refer to Name and function column.
PB25		For manufacturer setting Do not change this value by any means.	0000h		

No.	Symbol	Name and function	Initial value	Unit	Setting range
PB26	*CDP	Gain changing selection Select the gain changing condition. (Refer to section 7.6.) 0 0 □ □ Gain changing selection Under any of the following conditions, the gains change on the basis of the parameter No.PB29 to PB34 settings. 0: Invalid 1: Control instructions from a controller. 2: Command frequency (Parameter No.PB27 setting) 3: Droop pulse value (Parameter No.PB27 setting) 4: Servo motor speed (Parameter No.PB27 setting) Gain changing condition 0: Valid when the control instruction from a controller is ON Valid at equal to or more than the value set in parameter No.PB27 1: Valid when the control instruction from a controller is OFF Valid at equal to or less than the value set in parameter No.PB27	0000h		Refer to Name and function column.
PB27	CDL	Gain changing condition Used to set the value of gain changing condition (command frequency, droop pulse, servo motor speed) selected in parameter No.PB26.The set value unit changes with the changing condition item. (Refer to section 7.6.)	10	kpps pulse r/min	0 to 9999
PB28	CDT	Gain changing time constant Used to set the time constant at which the gains will change in response to the conditions set in parameters No.PB26 and PB27. (Refer to section 7.6.)	1	ms	0 to 100
PB29	GD2B	Gain changing load to motor inertia moment ratio Used to set the load to motor inertia moment ratio when gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	7.0	Multiplier (×1)	0 to 300.0
PB30	PG2B	Gain changing position loop gain This parameter cannot be used in the speed control mode. Set the position loop gain when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	37	rad/s	1 to 2000
PB31	VG2B	Gain changing speed loop gain Set the speed loop gain when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	823	rad/s	20 to 50000
PB32	VICB	Gain changing speed integral compensation Set the speed integral compensation when the gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No.PA08: □□□3).	33.7	ms	0.1 to 5000.0
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting This parameter cannot be used in the speed control mode. Set the vibration frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when the parameter No.PB02 setting is "□□□2" and the parameter No.PB26 setting is "□□□1". When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.	100.0	Hz	0.1 to 100.0
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting This parameter cannot be used in the speed control mode. Set the resonance frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when the parameter No.PB02 setting is "□□□2" and the parameter No.PB26 setting is "□□□1". When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.	100.0	Hz	0.1 to 100.0

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PB35</td><td rowspan="10"></td><td rowspan="10">For manufacturer setting
Do not change this value by any means.</td><td>0.00</td><td rowspan="10"></td><td rowspan="10"></td></tr>
<tr><td>PB36</td><td>0.00</td></tr>
<tr><td>PB37</td><td>100</td></tr>
<tr><td>PB38</td><td>0.0</td></tr>
<tr><td>PB39</td><td>0.0</td></tr>
<tr><td>PB40</td><td>0.0</td></tr>
<tr><td>PB41</td><td>1125</td></tr>
<tr><td>PB42</td><td>1125</td></tr>
<tr><td>PB43</td><td>0004h</td></tr>
<tr><td>PB44</td><td>0.0</td></tr>
<tr><td>PB45</td><td>CNHF
(Note 1)</td><td>Vibration suppression control filter 2
Used to set the vibration suppression control filter 2.
By setting this parameter, machine end vibration, such as workpiece end vibration and base shake, can be suppressed.

0 □ □ □

Vibration suppression control filter 2 setting frequency selection (Note 2)
<table>
<tr><th>Setting value</th><th>Frequency [Hz]</th></tr>
<tr><td>0</td><td>Invalid</td></tr>
<tr><td>1
to
5F</td><td>2250
to
4.5</td></tr>
</table>

Notch depth selection (Note 2)
<table>
<tr><th>Setting value</th><th>Depth</th></tr>
<tr><td>0
to
F</td><td>−40.0dB
to
−0.6dB</td></tr>
</table>

Note 1. This parameter is supported by the servo amplifiers whose software versions are C4 or later.
Check the software version using MR Configurator.
2. Refer to section 7.7 for the setting details.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
</table>

5.3 Extension setting parameters (No.PC□□)

POINT

- The parameter whose symbol preceded by * can be validated with the following conditions:
  * : Turn off the power and then on again, or reset the controller after setting the parameter.
  **: Turn off the power and then on again after setting the parameter.

5.3.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode (Note) Semi	Control mode (Note) Fully
PC01	ERZ	Error excessive alarm level	3	rev	○	○
PC02	MBR	Electromagnetic brake sequence output	0	ms	○	○
PC03	*ENRS	Encoder output pulses selection	0000h		○	○
PC04	**COP1	Function selection C-1	0000h		○	○
PC05	**COP2	Function selection C-2	0000h		○	○
PC06	*COP3	Function selection C-3	0000h		○	○
PC07	ZSP	Zero speed	50	r/min	○	○
PC08		For manufacturer setting	0			
PC09	MOD1	Analog monitor 1 output	0000h		○	○
PC10	MOD2	Analog monitor 2 output	0001h		○	○
PC11	MO1	Analog monitor 1 offset	0	mV	○	○
PC12	MO2	Analog monitor 2 offset	0	mV	○	○
PC13	MOSDL	Analog monitor feedback position output standard data Low	0	pulse	○	○
PC14	MOSDH	Analog monitor feedback position output standard data High	0	10000 pulse	○	○
PC15		For manufacturer setting	0			
PC16			0000h			
PC17	**COP4	Function selection C-4	0000h		○	○
PC18		For manufacturer setting	0000h			
PC19			0000h			
PC20	**COP7	Function selection C-7	0000h		○	○
PC21	*BPS	Alarm history clear	0000h		○	○
PC22		For manufacturer setting	0000h			
PC23			0000h			
PC24	RSBR	Forced stop deceleration time constant	0000h		○	○
PC25		For manufacturer setting	0000h			
PC26	**COP8	Function selection C-8	0100h			○
PC27	**COP9	Function selection C-9	0000h			○
PC28		For manufacturer setting	0000h			
PC29			0000h			
PC30			0000h			
PC31	RSUP	Vertical axis freefall prevention compensation amount	0000h	0.0001 rev	○	○
PC32		For manufacturer setting	0000h			

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system   Fully: Fully closed loop system

5.3.2 List of details

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PC01</td><td>ERZ</td><td>Error excessive alarm level
This parameter cannot be used in the speed control mode and torque control mode.
Set error excessive alarm level with rotation amount of servo motor.
Note. Setting can be changed in parameter No.PC06.</td><td>3</td><td>rev
(Note)</td><td>1
to
200</td></tr>
<tr><td>PC02</td><td>MBR</td><td>Electromagnetic brake sequence output
Used to set the delay time (Tb) between electronic brake interlock (MBR) and the base drive circuit is shut-off.</td><td>0</td><td>ms</td><td>0
to
1000</td></tr>
<tr><td>PC03</td><td>*ENRS</td><td>Encoder output pulse selection
Use to select the, encoder output pulse direction and encoder output pulse setting.

0 □ □ □

Encoder output pulse phase changing
Changes the phases of A/B-phase encoder output pulses.
<table>
<tr><th rowspan="2">Set value</th><th colspan="2">Servo motor rotation direction</th></tr>
<tr><th>CCW</th><th>CW</th></tr>
<tr><td>0</td><td>A-phase
B-phase</td><td>A-phase
B-phase</td></tr>
<tr><td>1</td><td>A-phase
B-phase</td><td>A-phase
B-phase</td></tr>
</table>
Encoder output pulse setting selection (Note)
0: Output pulse designation (When parameter No.PC03 is set to "□1□□", the parameter error (37) occurs.)
1: Division ratio setting
3: A/B-phase pulse electronic gear setting
(The electronic gear is set in parameter No.PA15, PA16.)

Selection of the encoders for A/B/Z-phase output pulse (Note)
The encoder used for A/B/Z-phase pulse output from the servo amplifier is set.
<table>
<tr><th rowspan="2">Set value</th><th colspan="2">Control mode</th></tr>
<tr><th>Semi closed loop system
(□□0□in parameter No.PA01)</th><th>Fully closed loop system
(□□1□in parameter No.PA01)</th></tr>
<tr><td>0
(Motor encoder)</td><td colspan="2">Motor encoder
(in the motor encoder unit)</td></tr>
<tr><td>1
(Load-side encoder)</td><td>Parameter error (37)</td><td>Load-side encoder
(in the load-side encoder unit)</td></tr>
</table>
Note. For details, refer to section 5.1.9.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PC04</td><td>**COP1</td><td>Function selection C-1
Select the encoder cable communication system selection.

□ 0 0 0

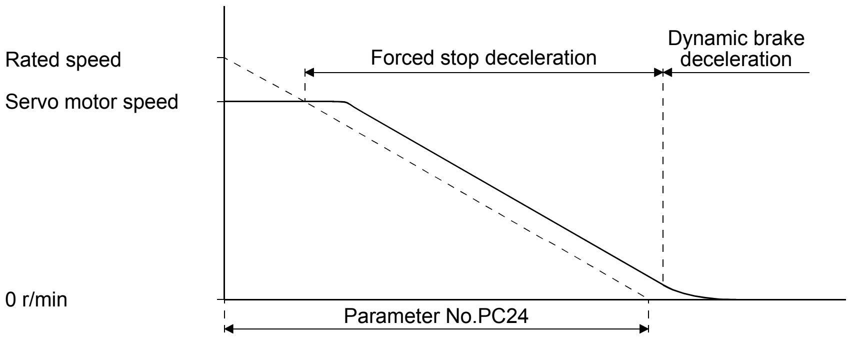
Encoder cable communication system selection
0: Two-wire type
1: Four-wire type
Incorrect setting will result in an encoder alarm 1 (16).
Refer to section 11.1.2 for the communication method of the encoder cable.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range
PC05	**COP2	Function selection C-2 Motor-less operation select. 0 0 0 □ Motor-less operation select. 0: Valid 1: Invalid	0000h		Refer to Name and function column.
PC06	*COP3	Function selection C-3 This parameter cannot be used in the speed control mode and torque control mode. Select the error excessive alarm level setting for parameter No.PC01. □ 0 0 0 Error excessive alarm level setting selection 0: 1 [rev]unit 1: 0.1 [rev]unit 2: 0.01 [rev]unit 3: 0.001[rev]unit This parameter is available to software version B1 or later.	0000h		Refer to Name and function column.
PC07	ZSP	Zero speed Used to set the output range of the zero speed detection (ZSP). Zero speed detection (ZSP) has hysteresis width of 20r/min. (Refer to section 3.5 (2) (b))	50	r/min	0 to 10000
PC08		For manufacturer setting Do not change this value by any means.	0		
PC09	MOD1	Analog monitor 1 output Used to selection the signal provided to the analog monitor 1 (MO1) output. (Refer to section 5.3.3.) 0 0 □ □ Analog monitor 1 (MO1) output selection	0000h		Refer to Name and function column.

Setting	Item	Control mode (Note)	
		Fully	Semi
00	Servo motor speed (±8V/max. speed)	○	○
01	Torque (±8V/max. torque)	○	○
02	Servo motor speed (+8V/max. speed)	○	○
03	Torque (+8V/max. torque)	○	○
04	Current command (±8V/max. current command)	○	○
05	Speed command (±8V/max. speed)	○	○
06	Droop pulse (±10V/100 pulses)	○	○
07	Droop pulse (±10V/1000 pulses)	○	○
08	Droop pulse (±10V/10000 pulses)	○	○
09	Droop pulse (±10V/100000 pulses)	○	○
0A	Feedback position (±10V/1 Mpulses)		○
0B	Feedback position (±10V/10 Mpulses)		○
0C	Feedback position (±10V/100 Mpulses)		○
0D	Bus voltage (±8V/400V)	○	○
0E	Speed command 2 (±8V/max. speed)	○	○
10	Load-side droop pulse (±10V/100 pulses)	○	
11	Load-side droop pulse (±10V/1000 pulses)	○	
12	Load-side droop pulse (±10V/10000 pulses)	○	
13	Load-side droop pulse (±10V/100000 pulses)	○	
14	Load-side droop pulse (±10V/1000000 pulses)	○	
15	Motor-side/load-side position deviation (±10V/100000 pulses)	○	
16	Motor-side/load-side speed deviation (±8V/max. speed)	○	

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system Fully: Fully closed loop system

No.	Symbol	Name and function	Initial value	Unit	Setting range
PC10	MOD2	Analog monitor 2 output Used to selection the signal provided to the analog monitor 2 (MO2) output. (Refer to section 5.3.3.) 0 0 □ □ Select the analog monitor 2 (MO2) output The settings are the same as those of parameter No.PC09.	0001h		Refer to Name and function column.
PC11	MO1	Analog monitor 1 offset Used to set the offset voltage of the analog monitor 1 (MO1) output.	0	mV	−999 to 999
PC12	MO2	Analog monitor 2 offset Used to set the offset voltage of the analog monitor 2 (MO2) output.	0	mV	−999 to 999
PC13	MOSDL	Analog monitor feedback position output standard data Low Used to set the standard position of feedback output with analog monitor 1 (MO1) or 2 (MO2). For this parameter, the lower-order four digits of standard position in decimal numbers are set.	0	pulse	−9999 to 9999
PC14	MOSDH	Analog monitor feedback position output standard data High Used to set the standard position of feedback output with analog monitor 1 (MO1) or 2 (MO2). For this parameter, the higher-order four digits of standard position in decimal numbers are set.	0	10000 pulse	−9999 to 9999
PC15		For manufacturer setting	0		
PC16		Do not change this value by any means.	0000h		
PC17	**COP4	Function Selection C-4 This parameter cannot be used in the speed control mode and torque control mode. Home position setting condition can be selected. 0 0 0 □ Selection of home position setting condition 0: Need to pass motor Z-phase after the power supply is switched on. 1: Not need to pass motor Z-phase after the power supply is switched on.	0000h		Refer to Name and function column.
PC18		For manufacturer setting	0000h		
PC19		Do not change this value by any means.	0000h		
PC20	**COP7	Function Selection C-7 Set this function if undervoltage alarm occurs because of distorted power supply voltage waveform when using power regenerative converter or power regeneration common converter. 0 0 0 □ Setting when undervoltage alarm occurs 0: Initial value (Waveform of power supply voltage is not distorted) 1: Set "1" if undervoltage alarm occurs because of distorted power supply voltage waveform when using power regenerative converter or power regeneration common converter.	0000h		Refer to Name and function column.

No.	Symbol	Name and function	Initial value	Unit	Setting range
PC21	*BPS	Alarm history clear Used to clear the alarm history. 0 0 0 □ Alarm history clear 0: Invalid 1: Valid When alarm history clear is made valid, the alarm history is cleared at next power-on. After the alarm history is cleared, the setting is automatically made invalid (reset to 0).	0000h		Refer to Name and function column.
PC22		For manufacturer setting	0000h		
PC23		Do not change this value by any means.	0000h		
PC24	RSBR	Forced stop deceleration time constant Set deceleration time constant for forced stop deceleration. Convert the time (unit: ms) for servo motor to decelerate from the rated speed to 0 [r/min] into hexadecimal number, and set the converted value to this parameter. Only when the value is set to “0000h”, the deceleration time constant is 100 ms. For example, if the time constant is 5000ms, the set value will be "1388".  [Precautions] ・If the servo motor torque is saturated at the maximum torque because the set time is too short, the time to stop takes longer than the set time constant. ・Overload alarm (50, 51) may occur during forced stop deceleration, depending on the set value. ・Regardless of the deceleration time constant setting, dynamic braking will start if control circuit power is cut or if a second alarm occurs after a forced stop initiating alarm has already occurred.	0000h		0000h to 1FFFh
PC25		For manufacturer setting Do not change this value by any means.	0000h		
PC26	**COP8	Function selection C-8 Used to select the communication system of the serial interface encoder cable to be connected to the CN2L connector. □ 1 0 0 Load-side encoder cable communication system selection 0: 2-wire type 1: 4-wire type If the setting is incorrect, the load-side encoder error1 (70) or load-side encoder error2 (71) occurs.	0100h		Refer to Name and function column

No.	Symbol	Name and function	Initial value	Unit	Setting range
PC27	**COP9	Function Selection C-9 Polarity of the encoder connected to the CN2L connector and the Z-phase connection judgement of the Z-phase input interface encoder are selected. 0 □ 0 □ Selection of encoder pulse count polarity 0: Encoder pulse increasing direction on the servo motor CCW 1: Encoder pulse decreasing direction on the servo motor CCW Selection of A/B/Z-phase input interface encoder Z-phase connection judgement function Alarm judgement function without the Z-phase connection is selected when the A/B/Z-phase input interface encoder is connected. 0: Alarm valid If not connected, the encoder error 2 (71) occurs. 1: Alarm invalid Even if not connected, the encoder error 2 (71) does not occur.	0000h		Refer to Name and function column
PC28		For manufacturer setting Do not change this value by any means.	0000h		
PC29			0000h		
PC30			0000h		
PC31	RSUP	Vertical axis freefall prevention compensation amount Set the compensation amount of the vertical axis freefall prevention function. When a positive value is set to the rotation amount unit of the servo motor, compensation is performed for the address increasing direction. When a negative value is set, compensation is performed for the address decreasing direction. For example, if a positive compensation amount is set when parameter No.PA14 setting is "1" under semi closed loop control, compensation is performed for the CW direction. The vertical axis freefall prevention function is performed when all of the following conditions are met. 1) In the position control mode. 2) The value set to this parameter is other than "0000h". 3) The forced stop deceleration function is valid. 4) Alarm occurs or EM2 turns off when the servo motor speed is equal to or less than zero speed. Setting value is in hexadecimal. Convert the compensation amount (0.0001rev unit) to a hexadecimal value, and set the value. The setting range is −0.2500 (09C4h) rev to +0.2500 (F63Ch) rev. If a value exceeding the range is set, the value is limited at −0.2500rev on the negative value side and +0.2500rev on the positive value side.	0000h	0.0001 rev	Refer to Name and function column
PC32		For manufacturer setting Do not change this value by any means.	0000h		

5.3.3 Analog monitor

The servo status can be output to two channels in terms of voltage.

(1) Setting

Change the following digits of parameter No.PC09, PC10.

Parameter No.PC09

0	0		

Analog monitor (MO1) output selection
(Signal output to across MO1-LG)

Parameter No.PC10

0	0		

Analog monitor (MO2) output selection
(Signal output to across MO2-LG)

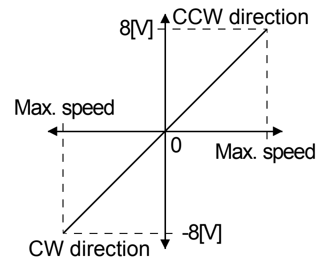
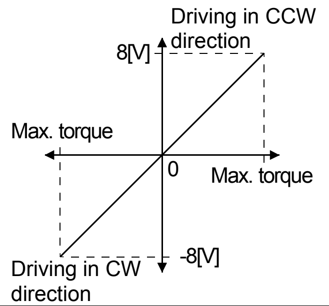
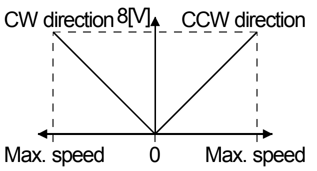
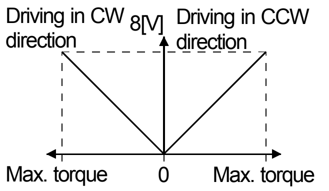
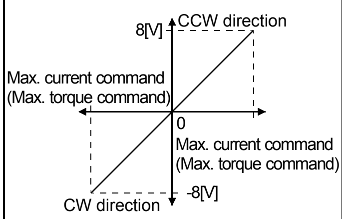
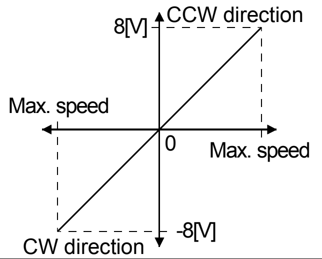
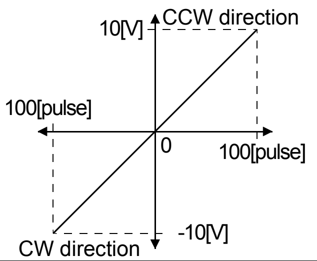
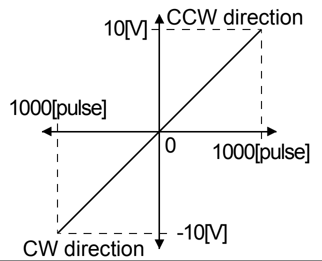
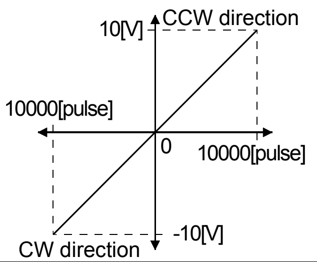
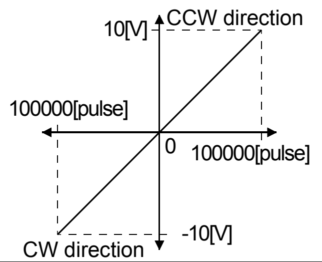
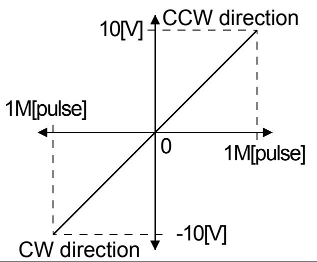
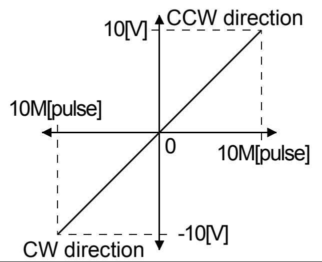
Parameters No.PC11 and PC12 can be used to set the offset voltages to the analog output voltages. The setting range is between −999 and 999mV.

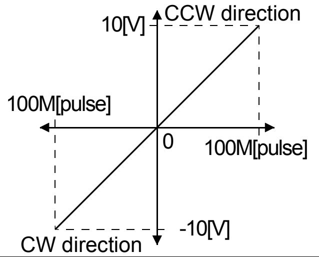
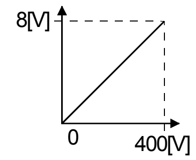
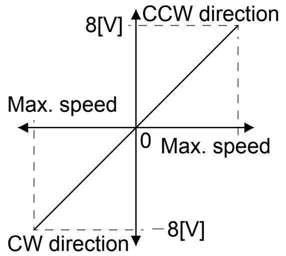
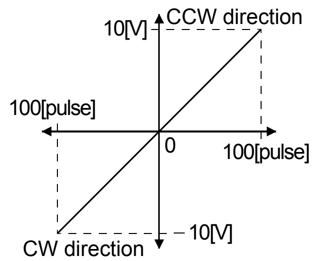
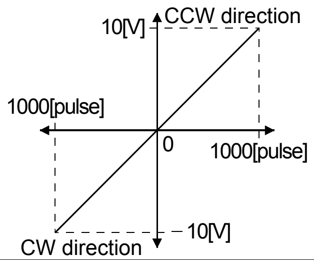
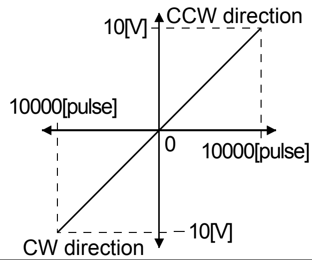
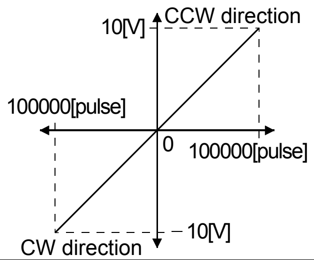
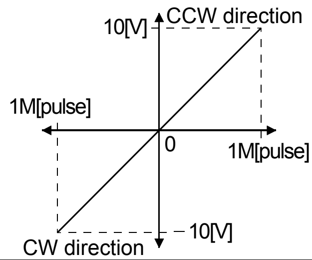
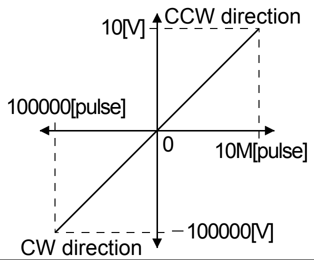
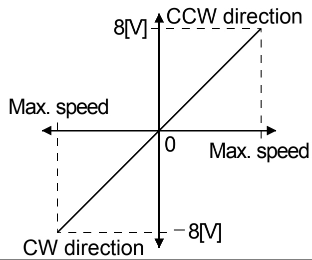
Parameter No.	Description	Setting range [mV]
PC11	Used to set the offset voltage for the analog monitor 1 (MO1).	−999 to 999
PC12	Used to set the offset voltage for the analog monitor 2 (MO2).	

(2) Set content

The servo amplifier is factory-set to output the servo motor speed to analog monitor 1 (MO1) and the torque to analog monitor (MO2). The setting can be changed as listed below by changing the parameter No.PC09 and PC10 value.

Refer to (3) for the measurement point.

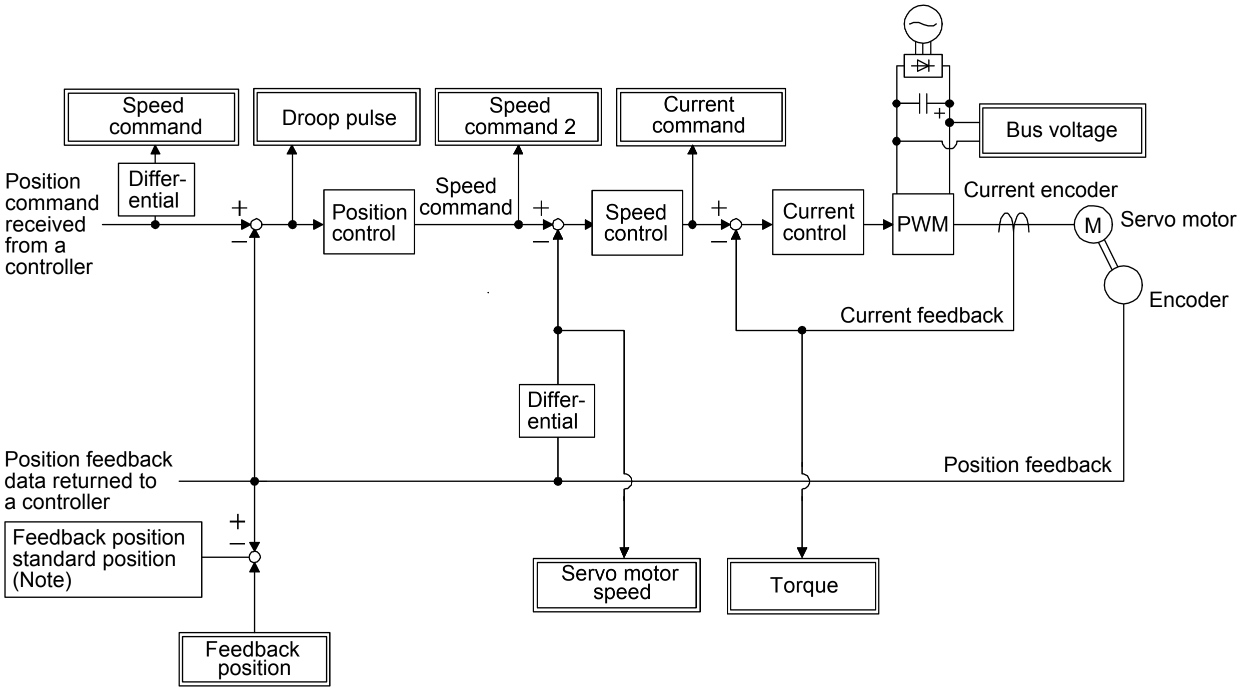
Setting	Output item	Description	Setting	Output item	Description
00	Servo motor speed		01	Torque	
02	Servo motor speed		03	Torque	
04	Current command		05	Speed command	
06	Droop pulse (Note 1,4,6,7) (±10V/100 pulses)		07	Droop pulse (Note 1,4,6,7) (±10V/1000 pulses)	
08	Droop pulse (Note 1,4,6,7) (±10V/10000 pulses)		09	Droop pulse (Note 1,4,6,7) (±10V/100000 pulses)	
0A	Feedback position (Note 1,2,4) (±10V/1 Mpulses)		0B	Feedback position (Note 1,2,4) (±10V/10 Mpulses)	

Setting	Output item	Description	Setting	Output item	Description
0C	Feedback position (Note 1,2,4) (±10V/100 Mpulses)		0D	Bus voltage (Note 3)	
0E	Speed command 2 (Note 4,5)		10	Load-side droop pulse (Note 4,6,7) (±10V/100 pulses)	
11	Load-side droop pulse (Note 4,6,7) (±10V/1000 pulses)		12	Load-side droop pulse (Note 4,6,7) (±10V/10000 pulses)	
13	Load-side droop pulse (Note 4,6,7) (±10V/100000 pulses)		14	Load-side droop pulse (Note 4,6,7) (±10V/1M pulses)	
15	Motor-side/load-side position deviation (Note 4,6,7) (±10V/100000 pulses)		16	Motor-side/load-side speed deviation	

Note 1. Encoder pulse unit.
2. Available in position control mode
3. For 400V class servo amplifier, the bus voltage becomes ＋8V/800V.
4. It cannot be used with torque control mode.
5. This setting is available for the servo amplifier with software version C5 or later and MR Configurator with software version C5 or later.
6. It cannot be used with speed control mode.
7. Output in the load-side encoder unit for the fully closed loop control and in the motor encoder unit for the semi closed loop control.

(3) Analog monitor block diagram

(a) Semi closed loop

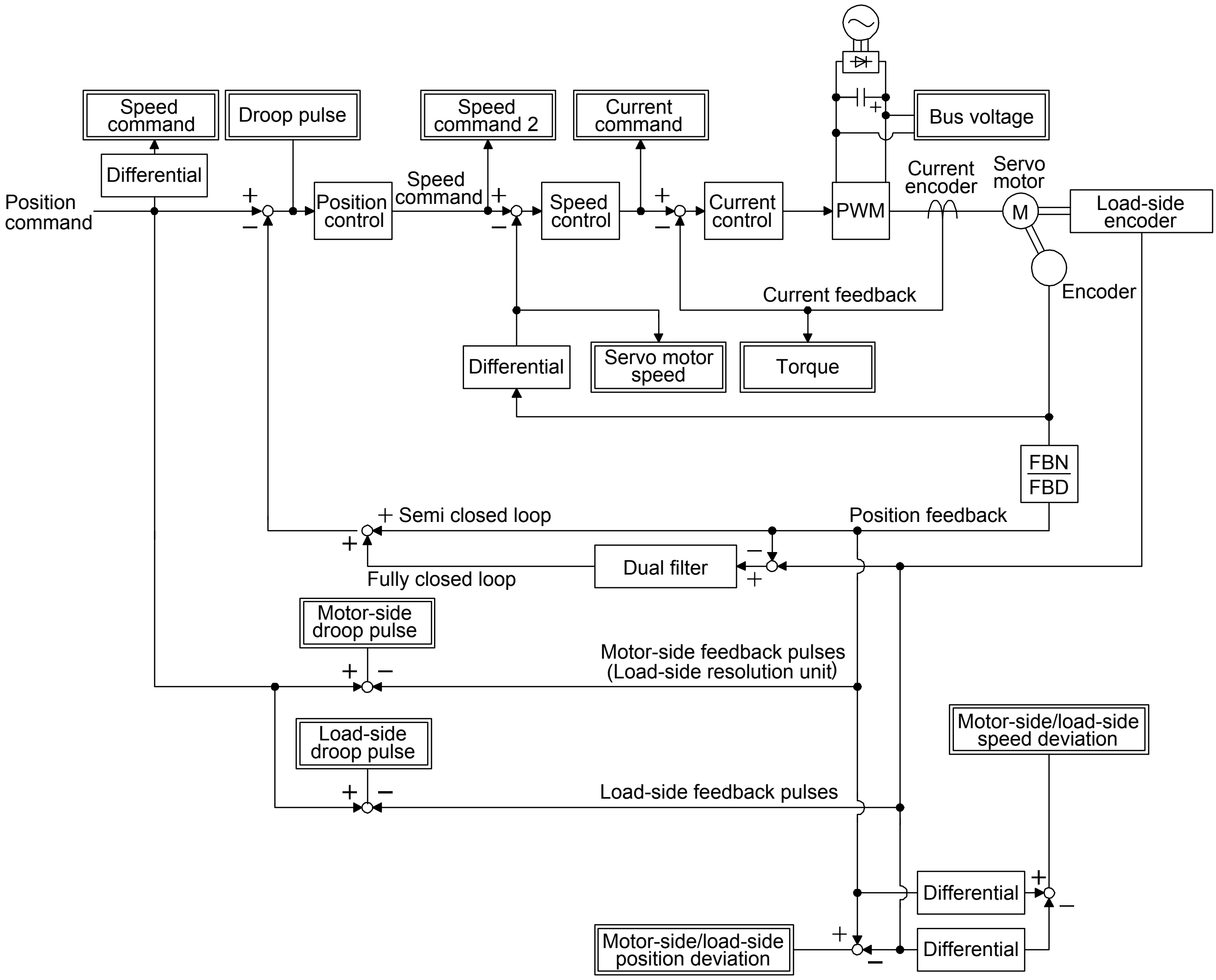


Note. The feedback position is output based on the position data passed between servo system controller and servo amplifier. The parameter number No.PC13/PC14 can set up the standard position of feedback position that is output to analog monitor in order to adjust the output range of feedback position. The setting range is between −99999999 and 99999999 pulses.

Standard position of feedback position = Parameter No.PC14 setting value × 10000 + Parameter No.PC13 setting value

Parameter No.	Description	Setting range
PC13	Sets the lower-order four digits of the standard position of feedback position	−9999 to 9999 [pulse]
PC14	Sets the higher-order four digits of the standard position of feedback position	−9999 to 9999 [10000pulses]

(b) Fully closed loop



5.3.4 Alarm history clear

The servo amplifier stores one current alarm and five past alarms from when its power is switched on first. To control alarms which will occur during operation, clear the alarm history using parameter No.PC21 before starting operation.
Clearing the alarm history automatically returns to "□□□0".
After setting, this parameter is made valid by switch power from OFF to ON.

Parameter No.PC21

0	0	0	

Alarm history clear
0: Invalid (not cleared)
1: Valid (cleared)

5.4 I/O setting parameters (No.PD□□)

POINT

- The parameter whose symbol preceded by * can be validated with the following conditions:
  * : Turn off the power and then on again, or reset the controller after setting the parameter.

5.4.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode (Note)	
					Semi	Fully
PD01		For manufacturer setting	0000h			
PD02			0000h			
PD03			0000h			
PD04			0000h			
PD05			0000h			
PD06			0000h			
PD07	*DO1	Output signal device selection 1 (CN3-13)	0005h		○	○
PD08	*DO2	Output signal device selection 2 (CN3-9)	0004h		○	○
PD09	*DO3	Output signal device selection 3 (CN3-15)	0003h		○	○
PD10		For manufacturer setting	0000h			
PD11			0004h			
PD12			0000h			
PD13			0000h			
PD14	*DOP3	Function selection D-3	0000h		○	○
PD15		For manufacturer setting	0000h			
PD16			0000h			
PD17			0000h			
PD18			0000h			
PD19			0000h			
PD20			0000h			
PD21			0000h			
PD22			0000h			
PD23			0000h			
PD24			0000h			
PD25			0000h			
PD26			0000h			
PD27			0000h			
PD28			0000h			
PD29			0000h			
PD30			0000h			
PD31			0000h			
PD32			0000h			

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system Fully: Fully closed loop system

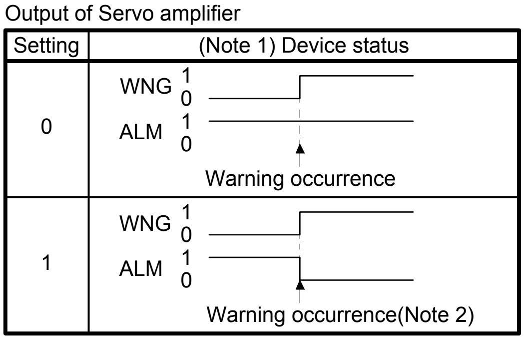
5.4.2 List of details

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PD01</td><td rowspan="6"></td><td rowspan="6">For manufacturer setting
Do not change this value by any means.</td><td>0000h</td><td rowspan="6"></td><td rowspan="6"></td></tr>
<tr><td>PD02</td><td>0000h</td></tr>
<tr><td>PD03</td><td>0000h</td></tr>
<tr><td>PD04</td><td>0000h</td></tr>
<tr><td>PD05</td><td>0000h</td></tr>
<tr><td>PD06</td><td>0000h</td></tr>
<tr><td>PD07</td><td>*DO1</td><td>Output signal device selection 1 (CN3-13)
Any input signal can be assigned to the CN3-13 pin. In the initial setting, MBR is assigned to the pin.

0 0
Select the output device of the CN3-13 pin.

The devices that can be assigned in each control mode are those that have the symbols indicated in the following table.
<table>
<tr><th>Setting</th><th>Device</th><th>Setting</th><th>Device</th></tr>
<tr><td>00</td><td>Always OFF</td><td>0A</td><td>SA (Note 2)</td></tr>
<tr><td>01</td><td>For manufacturer setting (Note 3)</td><td>0B</td><td>VLC (Note 5)</td></tr>
<tr><td>02</td><td>RD</td><td>0C</td><td>ZSP</td></tr>
<tr><td>03</td><td>ALM</td><td>0D</td><td>For manufacturer setting (Note 3)</td></tr>
<tr><td>04</td><td>INP (Note 1,4)</td><td>0E</td><td>For manufacturer setting (Note 3)</td></tr>
<tr><td>05</td><td>MBR</td><td>0F</td><td>CDPS</td></tr>
<tr><td>06</td><td>DB</td><td>10</td><td>For manufacturer setting (Note 3)</td></tr>
<tr><td>07</td><td>TLC (Note 4)</td><td>11</td><td>ABSV (Note 1)</td></tr>
<tr><td>08</td><td>WNG</td><td>12 to 1F</td><td>For manufacturer setting (Note 3)</td></tr>
<tr><td>09</td><td>BWNG</td><td>20 to 3F</td><td>For manufacturer setting (Note 3)</td></tr>
</table>
Note 1. It becomes always OFF in speed control mode.
2. It becomes always OFF in position control mode and torque control mode.
3. For manufacturer setting. Never change this setting.
4. It becomes always OFF in torque control mode.
5. It becomes always OFF in position control mode and speed control mode.</td><td>0005h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PD08</td><td>*DO2</td><td>Output signal device selection 2 (CN3-9)
Any input signal can be assigned to the CN3-9 pin. In the initial setting, INP is assigned to the pin.
The devices that can be assigned and the setting method are the same as in parameter No.PD07.

0 0
Select the output device of the CN3-9 pin.</td><td>0004h</td><td></td><td>Refer to Name and function column.</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range
PD09	*DO3	Output signal device selection 3 (CN3-15) Any input signal can be assigned to the CN3-15 pin. In the initial setting, ALM is assigned to the pin. The devices that can be assigned and the setting method are the same as in parameter No.PD07. | 0 | 0 | | | Select the output device of the CN3-15 pin.	0003h		Refer to Name and function column.
PD10		For manufacturer setting Do not change this value by any means.	0000h		
PD11			0004h		
PD12			0000h		
PD13			0000h		
PD14	*DOP3	Function selection D-3 Set the ALM output signal at warning occurrence. | 0 | 0 | | 0 | Selection of output device at warning occurrence Select the warning (WNG) and malfunction (ALM) output status at warning occurrence. Output of Servo amplifier  Note 1. 0: off 1: on 2. Although ALM is turned off upon occurrence of the warning, the forced stop deceleration is performed.	0000h		Refer to Name and function column.

No.	Symbol	Name and function	Initial value	Unit	Setting range
PD15		For manufacturer setting Do not change this value by any means.	0000h		
PD16			0000h		
PD17			0000h		
PD18			0000h		
PD19			0000h		
PD20			0000h		
PD21			0000h		
PD22			0000h		
PD23			0000h		
PD24			0000h		
PD25			0000h		
PD26			0000h		
PD27			0000h		
PD28			0000h		
PD29			0000h		
PD30			0000h		
PD31			0000h		
PD32			0000h		

5.5 Extension control parameters (No.PE□□)

POINT

- The parameter whose symbol preceded by * can be validated with the following conditions:
  * : Turn off the power and then on again, or reset the controller after setting the parameter.
  **: Turn off the power and then on again after setting the parameter.

5.5.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode (Note)	
					Semi	Fully
PE01	**FCT1	Fully closed loop function selection 1	0000h			○
PE02		For manufacturer setting	0102h			
PE03	*FCT2	Fully closed loop function selection 2	0003h			○
PE04	**FBN	Fully closed loop control feedback pulse electronic gear 1 numerator	1			○
PE05	**FBD	Fully closed loop control feedback pulse electronic gear 1 denominator	1			○
PE06	BC1	Fully closed loop control speed deviation error detection level	400	r/min		○
PE07	BC2	Fully closed loop control position deviation error detection level	100	kpulse		○
PE08	DUF	Fully closed loop dual feedback filter	10	rad/s		○
PE09		For manufacturer setting	0000h			○
PE10	FCT3	Fully closed loop function selection 3	0000h			○
PE11		For manufacturer setting	0			
PE12			40			
PE13			FFFEh			
PE14			0111h			
PE15			20			
PE16			0000h			
PE17			0000h			
PE18			0000h			
PE19			0000h			
PE20			0000h			
PE21			0000h			
PE22			0000h			
PE23			0000h			
PE24			0000h			
PE25			0000h			
PE26			0000h			
PE27			0000h			
PE28			0000h			
PE29			0000h			
PE30			0000h			
PE31			0000h			
PE32			0000h			
PE33			0000h			
PE34	**FBN2	Fully closed loop control feedback pulse electronic gear 2 numerator	1			○
PE35	**FBD2	Fully closed loop control feedback pulse electronic gear 2 denominator	1			○
PE36		For manufacturer setting	0.0			
PE37			0.00			
PE38			0.00			
PE39			0000h			
PE40			0000h			

Note. Parameters with ○ are available for each control mode.
Semi: Semi closed loop system Fully: Fully closed loop system

5.5.2 List of details

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th></tr>
<tr><td>PE01</td><td>**FCT1</td><td>Fully closed loop function selection 1
Select the semi closed loop control/fully closed loop control.

Parameter No.PE01
0 0 0 □

Fully closed loop control selection
0: Always fully closed loop control
1: Selection using the control command of controller
<table>
<tr><th>Selection using the control command of controller</th><th>Control method</th></tr>
<tr><td>OFF</td><td>Semi closed loop control</td></tr>
<tr><td>ON</td><td>Fully closed loop control</td></tr>
</table>
When parameter No.PA01 control configuration is set to "□□1□" (fully closed loop system), this setting is enabled.</td><td>0000h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PE02</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0102h</td><td></td><td></td></tr>
<tr><td>PE03</td><td>*FCT2</td><td>Fully closed loop function selection 2
Set the fully closed loop control error detection function, position deviation error detection system and fully closed loop control error reset.

□ 0 □ □

Fully closed loop control error detection function selection
0: Invalid
1: Speed deviation error detection
2: Position deviation error detection
3: Speed deviation error/position deviation error detection

Position deviation error detection system selection
Selects a detection condition regarding the fully closed loop control error and the position deviation error of the detection function.
0: Standard position deviation detection system (constant detection)
1: Position deviation detection system at stop (detected with command set to 0)

Fully closed loop control error reset selection
Selects an alarm reset condition from the controller when the fully closed loop control error detection (42) occurs.
0: Reset disabled (reset by powering OFF enabled)
1: Reset enabled</td><td>0003h</td><td></td><td>Refer to Name and function column.</td></tr>
<tr><td>PE04</td><td>**FBN</td><td>Fully closed loop control feedback pulse electronic gear 1 numerator
Used to set the numerator of the electronic gear to the motor encoder pulse.
Set the electronic gear so that the number of pulses for one servo motor revolution is converted to the resolution of the load-side encoder.</td><td>1</td><td></td><td>1
to
65535</td></tr>
<tr><td>PE05</td><td>**FBD</td><td>Fully closed loop control feedback pulse electronic gear 1 denominator
Used to set the denominator of the electronic gear to the motor encoder pulse.
Set the electronic gear so that the number of pulses for one servo motor revolution is converted to the resolution of the load-side encoder.</td><td>1</td><td></td><td>1
to
65535</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Unit	Setting range
PE06	BC1	Fully closed loop control speed deviation error detection level Used to set the speed deviation error detection level of the fully closed loop error detection. Valid/invalid of this function can be selected in parameter No.PE03 (FCT2).	400	r/min	1 to 50000
PE07	BC2	Fully closed loop control position deviation error detection level Used to set the position deviation error detection level of the fully closed loop error detection. Valid/invalid of this function can be selected in parameter No.PE03 (FCT2).	100	kpulse	1 to 20000
PE08	DUF	Fully closed loop dual feedback filter Used to set the band of the dual feedback filter. For the dual feedback filter, refer to section 14.3.1 (7).	10	rad/s	0 to 4500
PE09		For manufacturer setting Do not change this value by any means.	0000h		
PE10	FCT3	Fully closed loop function selection 3 Used to set the monitor information of the controller. □ □ 0 0 Droop pulse monitor setting for controller display Sets the encoder to be used for the droop pulse monitor for controller display. 0: Motor encoder 1: Load-side encoder 2: Difference between the motor-side and load-side For the semi closed loop control, the motor encoder is used regardless of the settings. Cumulative feedback pulses monitor setting for controller display Sets the encoder to be used for the cumulative feedback pulses monitor for controller display. 0: Motor encoder 1: Load-side encoder For the semi closed loop control, the motor encoder is used regardless of the settings.	0000h		Refer to Name and function column.
PE11		For manufacturer setting Do not change this value by any means.	0		
PE12			40		
PE13			FFFEh		
PE14			0111h		
PE15			20		
PE16			0000h		
PE17			0000h		
PE18			0000h		
PE19			0000h		
PE20			0000h		
PE21			0000h		
PE22			0000h		
PE23			0000h		
PE24			0000h		
PE25			0000h		
PE26			0000h		
PE27			0000h		

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range
PE28		For manufacturer setting Do not change this value by any means.	0000h		
PE29			0000h		
PE30			0000h		
PE31			0000h		
PE32			0000h		
PE33			0000h		
PE34	**FBN2	Fully closed loop control feedback pulse electronic gear 2 numerator Used to set the numerator of the electronic gear to the motor encoder pulse. Set the electronic gear so that the number of pulses for one servo motor revolution is converted to the resolution of the load-side encoder. When the set value is "0", it is identified as "1" inside.	1		0 to 32767
PE35	**FBD2	Fully closed loop control feedback pulse electronic gear 2 denominator Used to set the denominator of the electronic gear to the motor encoder pulse. Set the electronic gear so that the number of pulses for one servo motor revolution is converted to the resolution of the load-side encoder. When the set value is "0", it is identified as "1" inside.	1		0 to 32767
PE36		For manufacturer setting Do not change this value by any means.	0.0		
PE37			0.00		
PE38			0.00		
PE39			0000h		
PE40			0000h		

MEMO

6. GENERAL GAIN ADJUSTMENT

> **POINT**
> - Consider individual machine differences, and do not adjust gain too strictly. It is recommended to keep the servo motor torque to 90% or less of the maximum torque of the servo motor during the operation.
> - For use in the torque control mode, you need not make gain adjustment.

6.1 Different adjustment methods

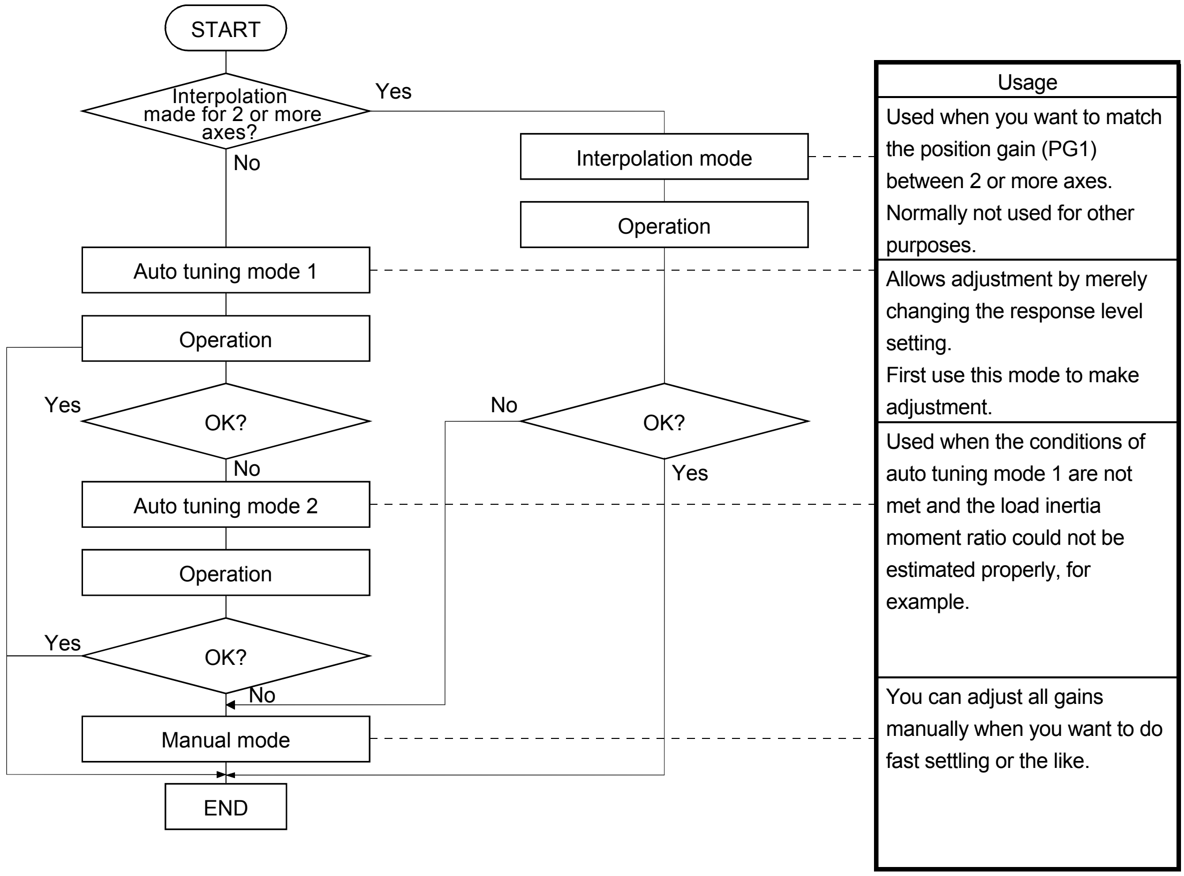
6.1.1 Adjustment on a single servo amplifier

The gain adjustment in this section can be made on a single servo amplifier. For gain adjustment, first execute auto tuning mode 1. If you are not satisfied with the results, execute auto tuning mode 2 and manual mode in this order.

(1) Gain adjustment mode explanation

Gain adjustment mode	Parameter No.PA08 setting	Estimation of load inertia moment ratio	Automatically set parameters	Manually set parameters
Auto tuning mode 1 (initial value)	0001	Always estimated	GD2 (parameter No.PB06) PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	RSP (parameter No.PA09)
Auto tuning mode 2	0002	Fixed to parameter No. PB06 value	PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	RSP (parameter No.PA09) GD2 (parameter No.PB06)
Manual mode	0003			GD2 (parameter No.PB06) PG1 (parameter No.PB07) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)
Interpolation mode	0000	Always estimated	GD2 (parameter No.PB06) PG2 (parameter No.PB08) VG2 (parameter No.PB09) VIC (parameter No.PB10)	RSP (parameter No.PA09) PG1 (parameter No.PB07)

(2) Adjustment sequence and mode usage



6.1.2 Adjustment using MR Configurator

This section gives the functions and adjustment that may be performed by using the servo amplifier with MR Configurator which operates on a personal computer.

Function	Description	Adjustment
Machine analyzer	With the machine and servo motor coupled, the characteristic of the mechanical system can be measured by giving a random vibration command from the personal computer to the servo and measuring the machine response.	・You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter. ・You can automatically set the optimum gains in response to the machine characteristic. This simple adjustment is suitable for a machine which has large machine resonance and does not require much settling time.
Gain search	Executing gain search under to-and-fro positioning command measures settling characteristic while simultaneously changing gains, and automatically searches for gains which make settling time shortest.	・You can automatically set gains which make positioning settling time shortest.
Machine simulation	Response at positioning settling of a machine can be simulated from machine analyzer results on personal computer.	・You can optimize gain adjustment and command pattern on personal computer.

6.2 Auto tuning

6.2.1 Auto tuning mode

The servo amplifier has a real-time auto tuning function which estimates the machine characteristic (load inertia moment ratio) in real time and automatically sets the optimum gains according to that value. This function permits ease of gain adjustment of the servo amplifier.

(1) Auto tuning mode 1
The servo amplifier is factory-set to the auto tuning mode 1.
In this mode, the load inertia moment ratio of a machine is always estimated to set the optimum gains automatically.
The following parameters are automatically adjusted in the auto tuning mode 1.

Parameter No.	Abbreviation	Name
PB06	GD2	Load to motor inertia moment ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

POINT

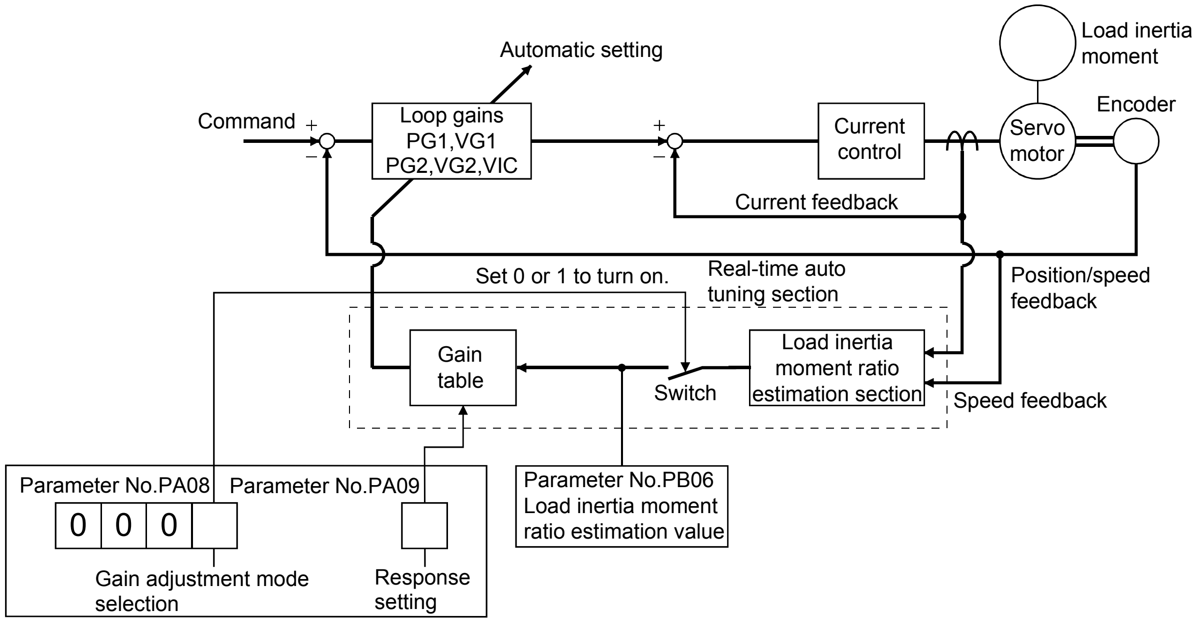
- The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.
- Time to reach 2000r/min is the acceleration/deceleration time constant of 5s or less.
- Speed is 150r/min or higher.
- The load to motor inertia moment ratio is 100 times or less.
- The acceleration/deceleration torque is 10% or more of the rated torque.
- Under operating conditions which will impose sudden disturbance torque during acceleration/deceleration or on a machine which is extremely loose, auto tuning may not function properly, either. In such cases, use the auto tuning mode 2 or manual mode to make gain adjustment.

(2) Auto tuning mode 2
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load inertia moment ratio is not estimated in this mode, set the value of a correct load inertia moment ratio (parameter No.PB06).
The following parameters are automatically adjusted in the auto tuning mode 2.

Parameter No.	Abbreviation	Name
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

6.2.2 Auto tuning mode basis

The block diagram of real-time auto tuning is shown below.

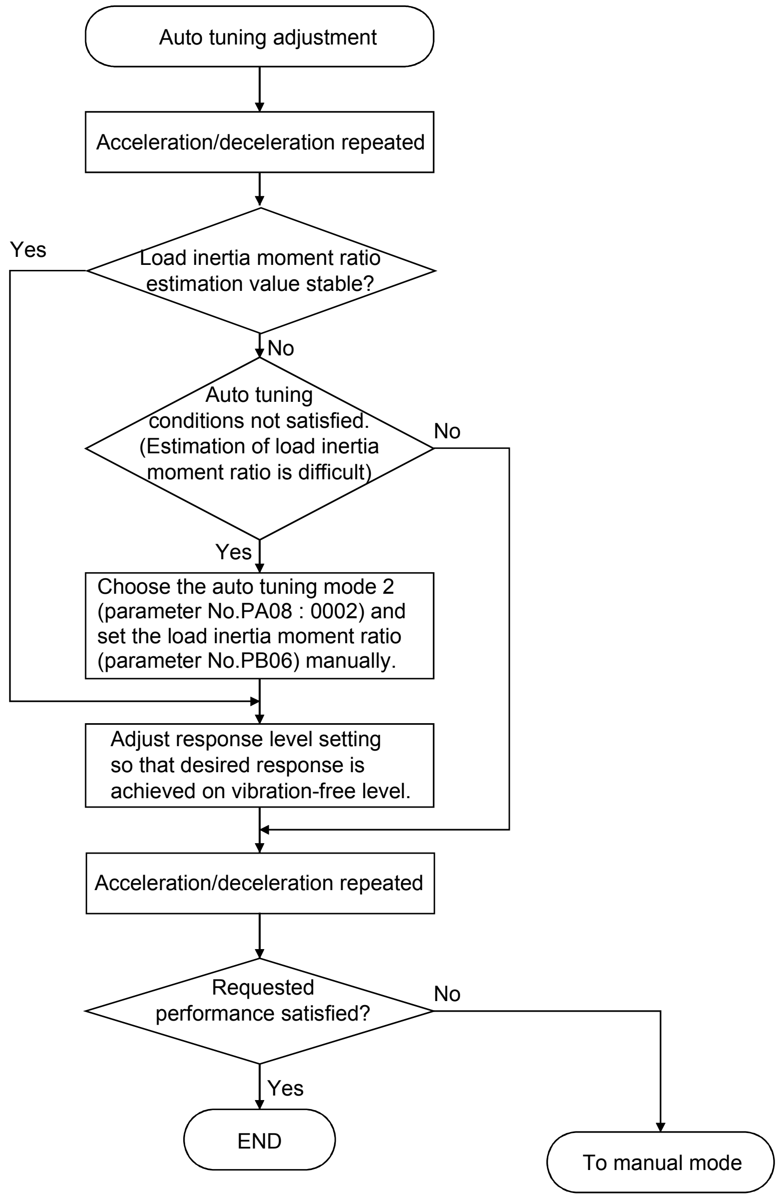


When a servo motor is accelerated/decelerated, the load inertia moment ratio estimation section always estimates the load inertia moment ratio from the current and speed of the servo motor. The results of estimation are written to parameter No.PB06 (the ratio of load inertia moment to servo motor). These results can be confirmed on the status display screen of MR Configurator.
If the value of the load inertia moment ratio is already known or if estimation cannot be made properly, choose the "auto tuning mode 2" (parameter No.PA08: 0002) to stop the estimation of the load inertia moment ratio (Switch in above diagram turned off), and set the load inertia moment ratio (parameter No.PB06) manually.
From the preset load inertia moment ratio (parameter No.PB06) value and response level (parameter No.PA09), the optimum loop gains are automatically set on the basis of the internal gain tale.
The auto tuning results are saved in the EEP-ROM of the servo amplifier every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

POINT
・If sudden disturbance torque is imposed during operation, the estimation of the inertia moment ratio may malfunction temporarily. In such a case, choose the "auto tuning mode 2" (parameter No.PA08: 0002) and set the correct load inertia moment ratio in parameter No.PB06. ・When any of the auto tuning mode 1 and auto tuning mode settings is changed to the manual mode 2 setting, the current loop gains and load inertia moment ratio estimation value are saved in the EEP-ROM.

6.2.3 Adjustment procedure by auto tuning

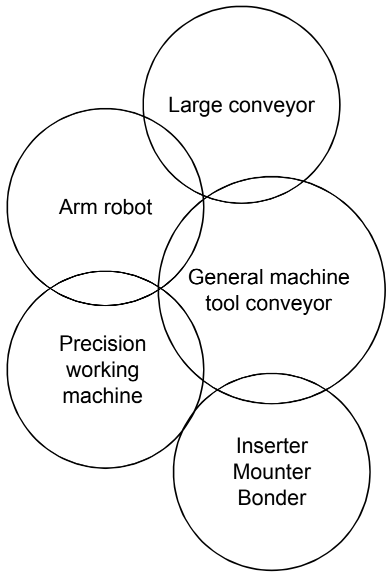
Since auto tuning is made valid before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.



6.2.4 Response level setting in auto tuning mode

Set the response (The first digit of parameter No.PA09) of the whole servo system. As the response level setting is increased, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range. If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100Hz, filter tuning mode (parameter No.PB01) or machine resonance suppression filter (parameter No.PB13 to PB16) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to section 7.3 for filter tuning mode and machine resonance suppression filter.

Setting of parameter No.PA09

Response level setting	Machine characteristic		
	Machine rigidity	Machine resonance frequency guideline	Guideline of corresponding machine
1	Low	10.0	
2		11.3	
3		12.7	
4		14.3	
5		16.1	
6		18.1	
7		20.4	
8		23.0	
9		25.9	
10		29.2	
11		32.9	
12		37.0	
13		41.7	
14		47.0	
15		52.9	
16	Middle	59.6	
17		67.1	
18		75.6	
19		85.2	
20		95.9	
21		108.0	
22		121.7	
23		137.1	
24		154.4	
25		173.9	
26		195.9	
27		220.6	
28		248.5	
29		279.9	
30		315.3	
31		355.1	
32	High	400.0	

6.3 Manual mode

If you are not satisfied with the adjustment of auto tuning, you can make simple manual adjustment with three parameters.

> **POINT**
>
> - If machine resonance occurs, filter tuning mode (parameter No.PB01) or machine resonance suppression filter (parameter No.PB13 to PB16) may be used to suppress machine resonance. (Refer to section 7.3.)

(1) For speed control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name
PB06	GD2	Load to motor inertia moment ratio
PB07	PG1	Model loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the load to motor inertia moment ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the model loop gain.
8	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with filter tuning mode or machine resonance suppression filter and then executing steps 2 and 3.	Suppression of machine resonance. Refer to section 7.2, 7.3.
9	While checking the rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Speed loop gain (parameter No.PB09)

This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency(Hz)} = \frac{\text{Speed loop gain setting}}{(1+\text{load to motor inertia moment ratio})\times 2\pi}$$

2) Speed integral compensation (VIC: parameter No.PB10)

To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting(ms)} \geq \frac{2000\text{ to }3000}{\text{Speed loop gain setting/ }(1+\text{load to motor inertia moment ratio setting})}$$

3) Model loop gain (PG1: Parameter No.PB07)

This parameter determines the response level to a position command. Increasing the model loop gain improves track ability to a position command, but a too high value will make overshooting liable to occur at the time of setting.

$$\text{Model loop gain guideline} \leq \frac{\text{Speed loop gain setting}}{(1+\text{load to motor inertia moment ratio})} \times \left(\frac{1}{4}\text{ to }\frac{1}{8}\right)$$

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name
PB06	GD2	Load to motor inertia moment ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the load to motor inertia moment ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain and the position loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the position loop gain, and return slightly if vibration takes place.	Increase the position loop gain.
8	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the position loop gain.
9	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with filter tuning mode or machine resonance suppression filter and then executing steps 3 to 5.	Suppression of machine resonance. Refer to section 7.2・7.3.
10	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Speed loop gain (VG2: parameter No.PB09)
This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

$$\text{Speed loop response frequency(Hz)} = \frac{\text{Speed loop gain setting}}{(1+\text{ load to motor inertia moment ratio})\times 2\pi}$$

2) Speed integral compensation (VIC: parameter No.PB10)
To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

$$\text{Speed integral compensation setting(ms)} \geq \frac{\text{2000 to 3000}}{\text{Speed loop gain setting/ }(1+\text{load to motor inertia moment ratio setting})}$$

3) Position loop gain (PG2: Parameter No.PB08)
This parameter determines the response level to a disturbance to the position control loop. Increasing the value increases the response level to the disturbance, but a too high value will increase vibration of the mechanical system.

$$\text{Position loop gain guideline} \leq \frac{\text{Speed loop gain setting}}{(1+\text{load to motor inertia moment ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

4) Model loop gain (PG1: parameter No.PB07)
This parameter determines the response level to a position command. Increasing the value improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling.

$$\text{Model loop gain guideline} \leq \frac{\text{Speed loop gain setting}}{(1+\text{load to motor inertia moment ratio})} \times \left(\frac{1}{4} \text{ to } \frac{1}{8}\right)$$

6.4 Interpolation mode

The interpolation mode is used to match the position loop gains of the axes when performing the interpolation operation of servo motors of two or more axes for an X-Y table or the like. In this mode, manually set the model loop gain that determines command track ability. Other parameters for gain adjustment are set automatically.

(1) Parameter

(a) Automatically adjusted parameters

The following parameters are automatically adjusted by auto tuning.

Parameter No.	Abbreviation	Name
PB06	GD2	Load to motor inertia moment ratio
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

(b) Manually adjusted parameters

The following parameters are adjustable manually.

Parameter No.	Abbreviation	Name
PB07	PG1	Model loop gain

(2) Adjustment procedure

Step	Operation	Description
1	Set to the auto tuning mode.	Select the auto tuning mode 1.
2	During operation, increase the response level setting (parameter No.PA09), and return the setting if vibration occurs.	Adjustment in auto tuning mode 1.
3	Check the values of model loop gain.	Check the upper setting limits.
4	Set the interpolation mode (parameter No.PA08: 0000).	Select the interpolation mode.
5	Set the model loop gain of all the axes to be interpolated to the same value. At that time, adjust to the setting value of the axis, which has the smallest model loop gain.	Set position loop gain.
6	Looking at the interpolation characteristic and rotation status, fine-adjust the gains and response level setting.	Fine adjustment.

(3) Adjustment description

(a) Model loop gain (parameter No.PB07)

This parameter determines the response level to a position command. Increasing model loop gain improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling. The droop pulse value is determined by the following expression.

$$\text{Droop pulse value (pulse)} = \frac{\dfrac{\text{Rotation speed (r/min)}}{60} \times 262144 \text{ (pulse)}}{\text{Model loop gain setting}}$$

6.5 Differences between MELSERVO-J2-Super and MELSERVO-J3 in auto tuning

To meet higher response demands, the MELSERVO-J3 series has been changed in response level setting range from the MELSERVO-J2-Super series. The following table lists comparison of the response level setting.

MELSERVO-J2-Super		MELSERVO-J3	
Parameter No.9 setting	Guideline for machine resonance frequency [Hz]	Parameter No.PA09 setting	Guideline for machine resonance frequency [Hz]
		1	10.0
		2	11.3
		3	12.7
1	15	4	14.3
		5	16.1
		6	18.1
2	20	7	20.4
		8	23.0
3	25	9	25.9
4	30	10	29.2
		11	32.9
5	35	12	37.0
		13	41.7
6	45	14	47.0
7	55	15	52.9
		16	59.6
8	70	17	67.1
		18	75.6
9	85	19	85.2
		20	95.9
A	105	21	108.0
		22	121.7
B	130	23	137.1
C	160	24	154.4
		25	173.9
D	200	26	195.9
		27	220.6
E	240	28	248.5
		29	279.9
F	300	30	315.3
		31	355.1
		32	400.0

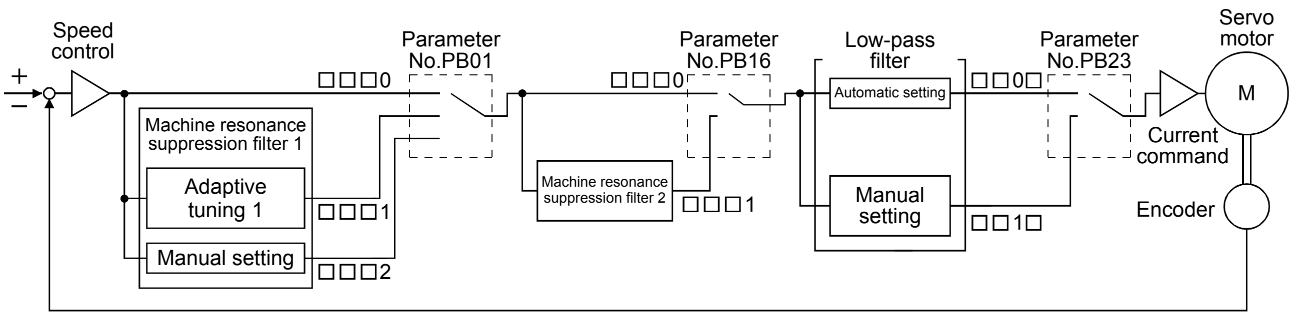
Note that because of a slight difference in gain adjustment pattern, response may not be the same if the resonance frequency is set to the same value.

7. SPECIAL ADJUSTMENT FUNCTIONS

POINT
・The functions given in this chapter need not be used generally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 6.

If a mechanical system has a natural resonance point, increasing the servo system response level may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency.
Using the machine resonance suppression filter and adaptive tuning can suppress the resonance of the mechanical system.

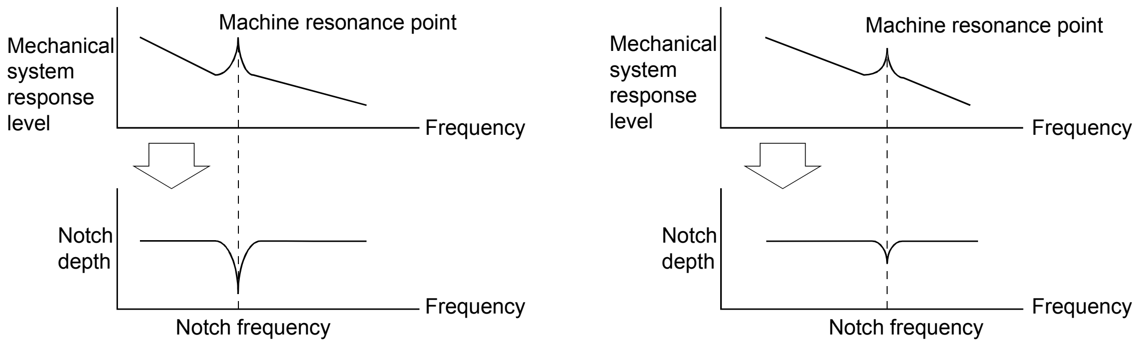
7.1 Function block diagram



7.2 Adaptive filter Ⅱ

(1) Function

Adaptive filter Ⅱ (adaptive tuning) is a function in which the servo amplifier detects machine vibration for a predetermined period of time and sets the filter characteristics automatically to suppress mechanical system vibration. Since the filter characteristics (frequency, depth) are set automatically, you need not be conscious of the resonance frequency of a mechanical system.



When machine resonance is large and frequency is low

When machine resonance is small and frequency is high

POINT

- The machine resonance frequency which adaptive tuning mode can respond to is about 100 to 2.25kHz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range.
- Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics.

(2) Parameters

The adjustment mode of adaptive tuning mode (parameter No.PB01).

Parameter No.PB01

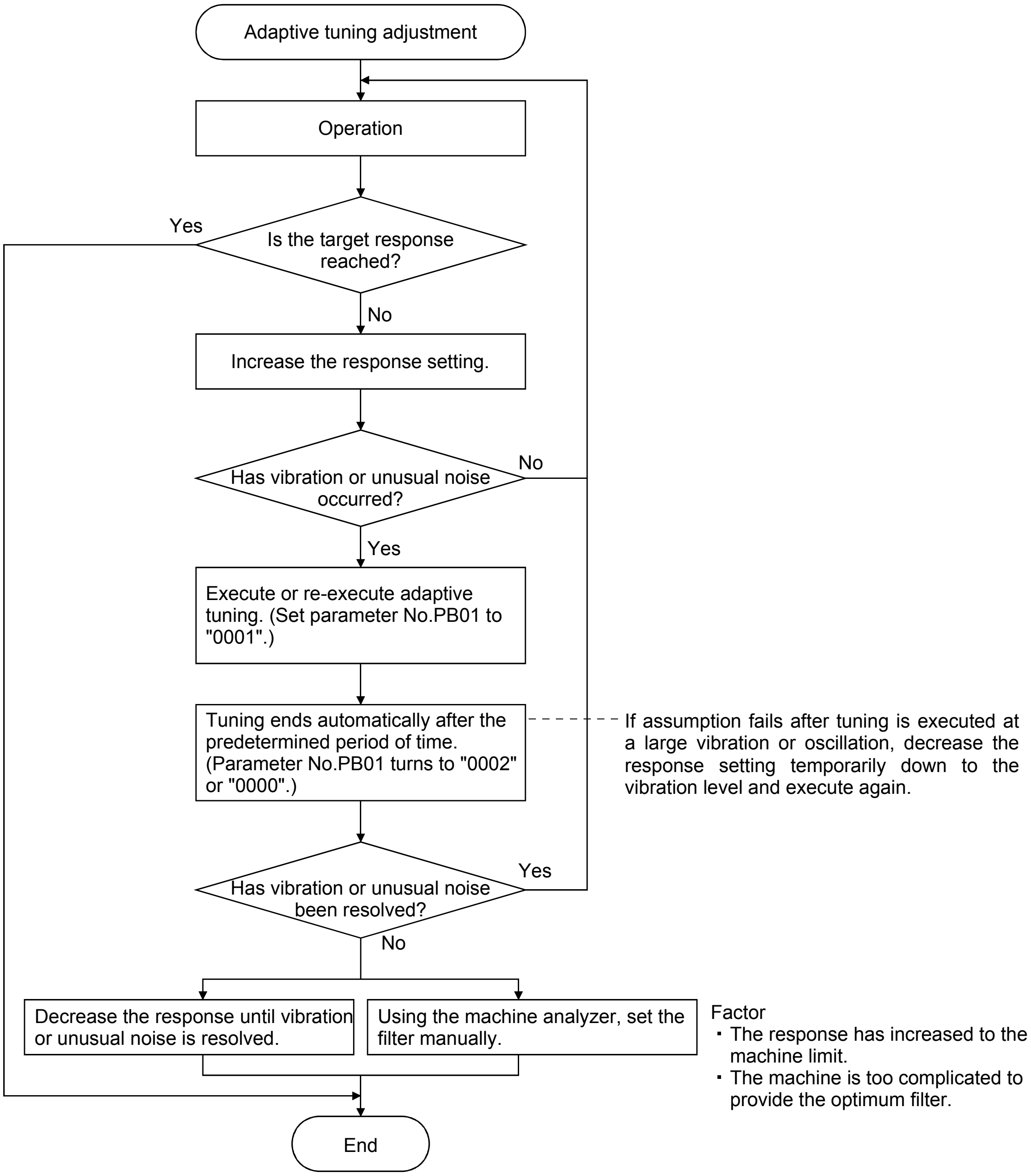
0	0	0	

Filter tuning mode selection

Setting	Filter adjustment mode	Automatically set parameter
0	Filter OFF	(Note)
1	Filter tuning mode	Parameter No.PB13 Parameter No.PB14
2	Manual mode	

Note. Parameter No.PB19 and PB20 are fixed to the initial values.

(3) Adaptive tuning mode procedure

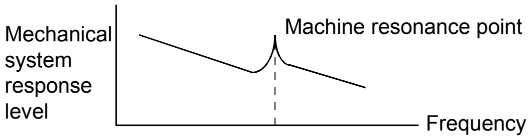


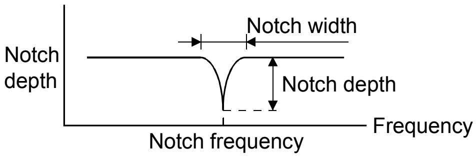
> POINT
> - "Filter OFF" enables a return to the factory-set initial value.
> - When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds.
> - When adaptive tuning is executed, machine resonance is detected for a maximum of 10 seconds and a filter is generated. After filter generation, the adaptive tuning mode automatically shifts to the manual mode.
> - Adaptive tuning generates the optimum filter with the currently set control gains. If vibration occurs when the response setting is increased, execute adaptive tuning again.
> - During adaptive tuning, a filter having the best notch depth at the set control gain is generated. To allow a filter margin against machine resonance, increase the notch depth in the manual mode.

7.3 Machine resonance suppression filter

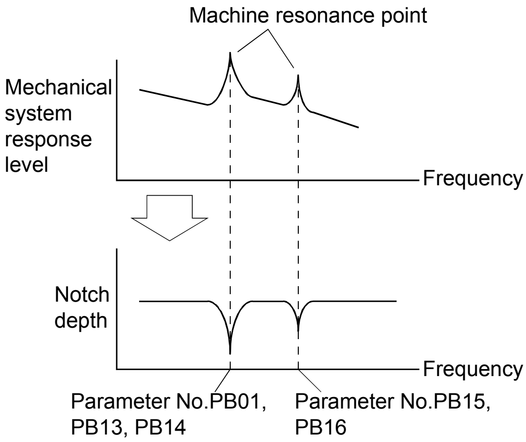
(1) Function

The machine resonance suppression filter is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system. You can set the gain decreasing frequency (notch frequency), gain decreasing depth and width.





You can use the machine resonance suppression filter 1 (parameter No.PB13, PB14) and machine resonance suppression filter 2 (parameter No.PB15, PB16) to suppress the vibration of two resonance frequencies. Execution of adaptive tuning in the filter tuning mode automatically adjusts the machine resonance suppression filter. When adaptive tuning is ON, the adaptive tuning mode shifts to the manual mode after the predetermined period of time. The manual mode enables manual setting using the machine resonance suppression filter 1.



(2) Parameters

(a) Machine resonance suppression filter 1 (parameter No.PB13, PB14)
Set the notch frequency, notch depth and notch width of the machine resonance suppression filter 1 (parameter No.PB13, PB14)
When you have made adaptive filter tuning mode (parameter No.PB01) "manual mode", set up the machine resonance suppression filter 1 becomes effective.

(b) Machine resonance suppression filter 2 (parameter No.PB15, PB16)
Setting method for the machine resonance suppression filter 2 (parameter No.PB15, PB16) is same as for the machine resonance suppression filter 1 (parameter No.PB13, PB14). However, the machine resonance suppression filter 2 can be set whether the filter tuning mode is valid or not.

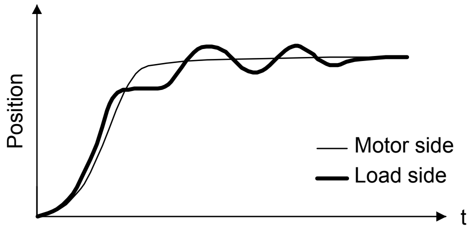
POINT

- The machine resonance suppression filter is a delay factor for the servo system. Hence, vibration may increase if you set a wrong resonance frequency or a too deep notch.
- If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- The machine characteristic can be grasped beforehand by the machine analyzer on MR Configurator. This allows the required notch frequency and depth to be determined.

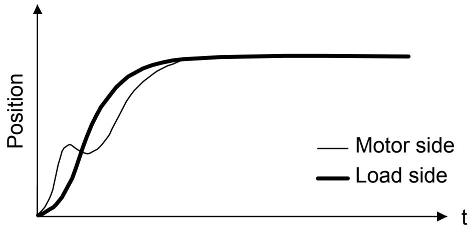
7.4 Advanced vibration suppression control

(1) Operation

Vibration suppression control is used to further suppress load-side vibration, such as workpiece end vibration and base shake. The motor-side operation is adjusted for positioning so that the machine does not shake.



Vibration suppression control OFF
(Nomal control)



Vibration suppression control ON

When the advanced vibration suppression control (vibration suppression control tuning mode parameter No.PB02) is executed, the vibration frequency at machine side can automatically be estimated to suppress load-side vibration.

In the vibration suppression control tuning mode, this mode shifts to the manual mode after operation is performed the predetermined number of times. The manual mode enables manual setting using the vibration suppression control vibration frequency setting (parameter No.PB19) and vibration suppression control resonance frequency setting (parameter No.PB20).

(2) Parameter

Select the adjustment mode of the vibration suppression control tuning mode (parameter No.PB02).

Parameter No.PB02

0	0	0	

Vibration suppression control tuning mode

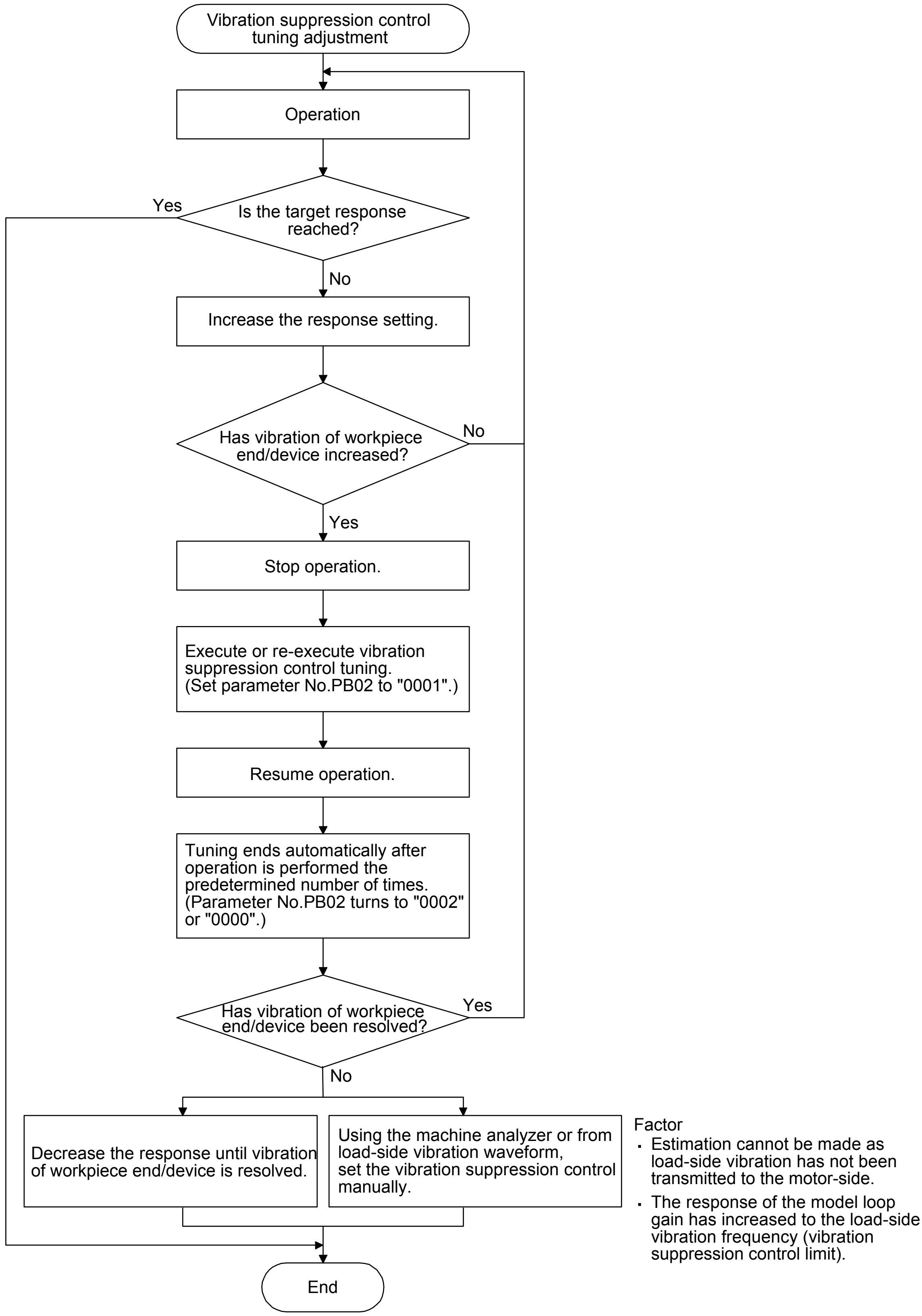
Setting	Vibration suppression control tuning mode	Automatically set parameter
0	Vibration suppression control OFF	(Note)
1	Vibration suppression control tuning mode (Advanced vibration suppression control)	Parameter No.PB19 Parameter No.PB20
2	Manual mode	

Note. Parameter No.PB19 and PB20 are fixed to the initial values.

POINT

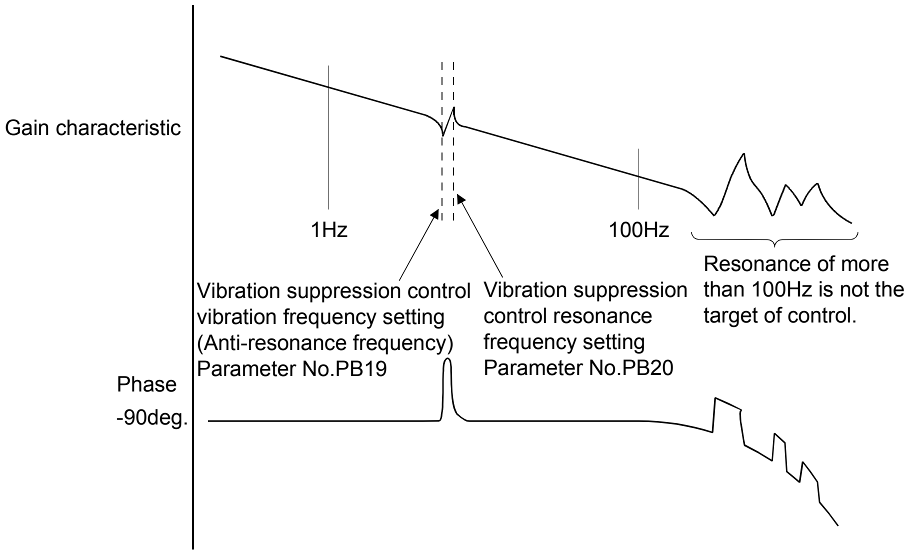
- The function is made valid when the auto tuning mode (parameter No.PA08) is the auto tuning mode 2 ("0002") or manual mode ("0003").
- The machine resonance frequency supported in the vibration suppression control tuning mode is 1.0Hz to 100.0Hz. The function is not effective for vibration outside this range.
- Stop the motor before changing the vibration suppression control-related parameters (parameter No.PB02, PB19, PB20, PB33, PB34). A failure to do so will cause a shock.
- For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after full vibration damping.
- Vibration suppression control tuning may not make normal estimation if the residual vibration at the motor-side is small.
- Vibration suppression control tuning sets the optimum parameter with the currently set control gains. When the response setting is increased, set vibration suppression control tuning again.

(3) Vibration suppression control tuning mode procedure

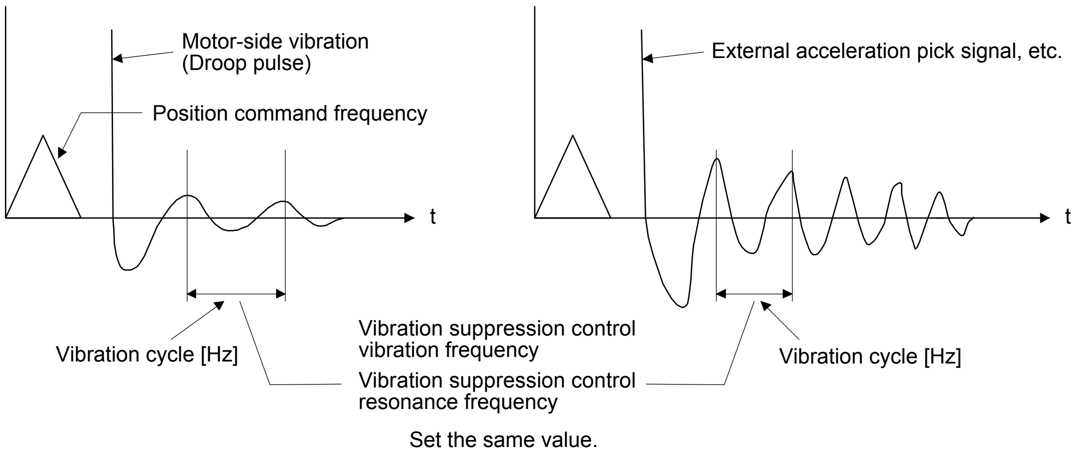


(4) Vibration suppression control manual mode
Measure work side vibration and device shake with the machine analyzer or external measuring instrument, and set the vibration suppression control vibration frequency (parameter No.PB19) and vibration suppression control resonance frequency (parameter No.PB20) to set vibration suppression control manually.

(a) When a vibration peak can be confirmed using MR Configurator, machine analyzer or external equipment



(b) When vibration can be confirmed using monitor signal or external sensor



POINT

- When load-side vibration does not show up in motor-side vibration, the setting of the motor-side vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external equipment do not set the same value but set different values to improve the vibration suppression performance.
- A vibration suppression control effect is not produced if the relationship between the model loop gain (parameter No.PB07) value and vibration frequency is as indicated below. Make setting after decreasing PG1, e.g. reduce the response setting.

  $\frac{1}{2\pi}(1.5 \times PG1) >$ vibration frequency

7.5 Low-pass filter

(1) Function

When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is factory-set to be valid for a torque command. The filter frequency of this low-pass filter is automatically adjusted to the value in the following expression.

$$\text{Filter frequency(rad/s)} = \frac{VG2}{1 + GD2} \times 10$$

When parameter No.PB23 is set to "□□1□", manual setting can be made with parameter No.PB18.

(2) Parameter

Set the low-pass filter selection (parameter No.PB23.)

Parameter No.PB23

Low-pass filter selection
0: Automatic setting (initial value)
1: Manual setting (parameter No.PB18 setting)

7.6 Gain changing function

This function can change the gains. You can change between gains during rotation and gains during stop or can use an input device to change gains during operation.

7.6.1 Applications

This function is used when.

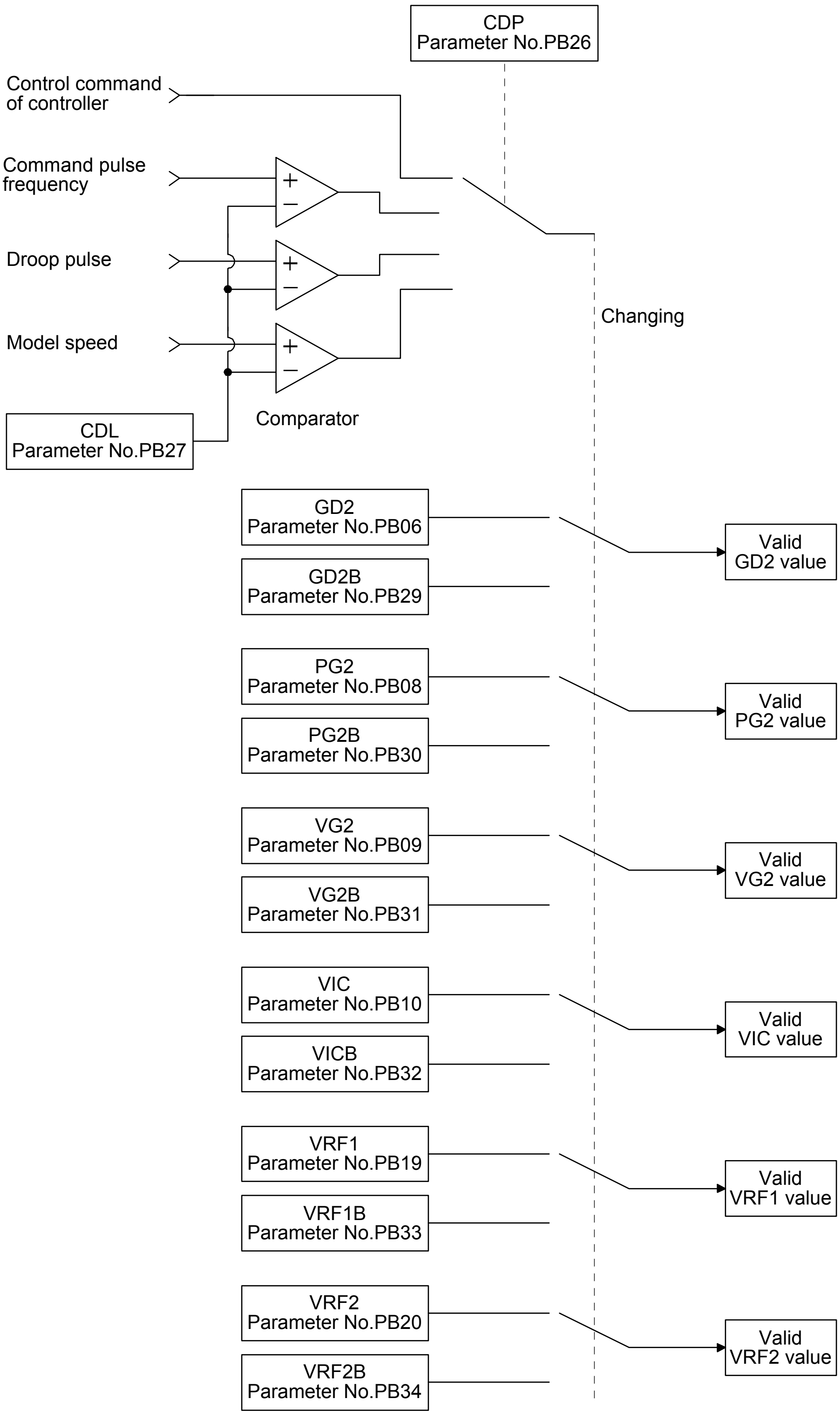
(1) You want to increase the gains during servo lock but decrease the gains to reduce noise during rotation.

(2) You want to increase the gains during settling to shorten the stop settling time.

(3) You want to change the gains using an input device to ensure stability of the servo system since the load to motor inertia ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

7.6.2 Function block diagram

The valid loop gains PG2, VG2, VIC and GD2 of the actual loop are changed according to the conditions selected by gain changing selection CDP (parameter No.PB26) and gain changing condition CDL (parameter No.PB27).



7.6.3 Parameters

When using the gain changing function, always set "□□□3" in parameter No.PA08 (auto tuning) to choose the manual mode of the gain adjustment modes. The gain changing function cannot be used in the auto tuning mode.

Parameter No.	Abbreviation	Name	Unit	Description
PB06	GD2	Load to motor inertia moment ratio	Multi-plier (×1)	Control parameters before changing
PB07	PG1	Model loop gain	rad/s	Position and speed gains of a model used to set the response level to a command. Always valid.
PB08	PG2	Position loop gain	rad/s	
PB09	VG2	Speed loop gain	rad/s	
PB10	VIC	Speed integral compensation	ms	
PB29	GD2B	Gain changing load to motor inertia moment ratio	Multi-plier (×1)	Used to set the load to motor inertia moment ratio after changing.
PB30	PG2B	Gain changing position loop gain	rad/s	Used to set the value of the after-changing position loop gain.
PB31	VG2B	Gain changing speed loop gain	rad/s	Used to set the value of the after-changing speed loop gain.
PB32	VICB	Gain changing speed integral compensation	ms	Used to set the value of the after-changing speed integral compensation.
PB26	CDP	Gain changing selection		Used to select the changing condition.
PB27	CDL	Gain changing condition	kpps pulse r/min	Used to set the changing condition values.
PB28	CDT	Gain changing time constant	ms	You can set the filter time constant for a gain change at changing.
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	Hz	Used to set the value of the after-changing vibration suppression control vibration frequency setting.
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	Hz	Used to set the value of the after-changing vibration suppression control resonance frequency setting.

(1) Parameters No.PB06 to PB10
These parameters are the same as in ordinary manual adjustment. Gain changing allows the values of load to motor inertia moment ratio, position loop gain, speed loop gain and speed integral compensation to be changed.

(2) Gain changing load to motor inertia moment ratio (GD2B: parameter No.PB29)
Set the load to motor inertia moment ratio after changing. If the load inertia moment ratio does not change, set it to the same value as load to motor inertia moment ratio (parameter No.PB06).

(3) Gain changing position loop gain (parameter No.PB30), Gain changing speed loop gain (parameter No.PB31), Gain changing speed integral compensation (parameter No.PB32)
Set the values of after-changing position loop gain, speed loop gain and speed integral compensation.

(4) Gain changing selection (parameter No.PB26)
Used to set the gain changing condition. Choose the changing condition in the first digit and second digit. If you set "1" in the first digit here, you can use the control command from controller is valid for gain changing.

0	0		

Gain changing selection
Under any of the following conditions, the gains change on the basis of the parameter No.PB29 to PB34 settings.
0: Invalid
1: Control command from controller is valid
2: Command frequency (Parameter No.PB27 setting)
3: Droop pulse value (Parameter No.PB27 setting)
4: Servo motor speed (Parameter No.PB27 setting)

Gain changing condition
0: Valid when the control instruction from a controller is ON
Valid at equal to or more than the value set in parameter No.PB27
1: Valid when the control instruction from a controller is OFF
Valid at equal to or less than the value set in parameter No.PB27

(5) Gain changing condition (parameter No.PB27)
When you selected "command frequency", "droop pulse" or "servo motor speed" in gain changing selection (parameter No.PB26), set the gain changing level.
The setting unit is as follows.

Gain changing condition	Unit
Command frequency	kpps
Droop pulse	pulse
Servo motor speed	r/min

(6) Gain changing time constant (parameter No.PB28)
You can set the primary delay filter to each gain at gain changing. This parameter is used to suppress shock given to the machine if the gain difference is large at gain changing, for example.

(7) Gain changing vibration suppression control
Control command from the controller is the only command for the gain changing vibration suppression control.

7.6.4 Gain changing procedure

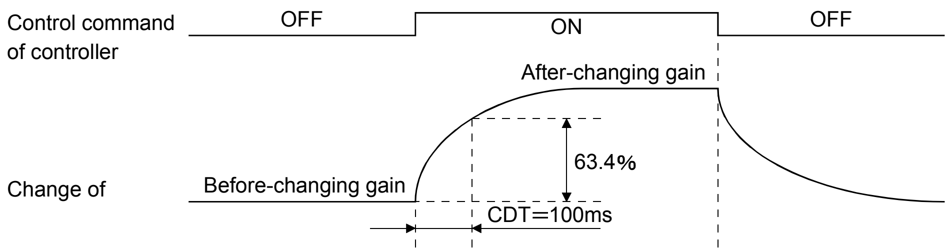
This operation will be described by way of setting examples.

(1) When you choose changing by input device

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB07	PG1	Model loop gain	100	rad/s
PB06	GD2	Load to motor inertia moment ratio	4.0	Multiplier (×1)
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain	3000	rad/s
PB10	VIC	Speed integral compensation	20	Ms
PB19	VRF1	Vibration suppression control vibration frequency setting	50	Hz
PB20	VRF2	Vibration suppression control resonance frequency setting	50	Hz
PB29	GD2B	Gain changing load to motor inertia moment ratio	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	0001 (Changed by ON/OFF of input device)	
PB28	CDT	Gain changing time constant	100	ms
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	Used to set the value of the after-changing vibration suppression control vibration frequency setting.	Hz
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	Used to set the value of the after-changing vibration suppression control resonance frequency setting.	Hz

(b) Changing timing chart



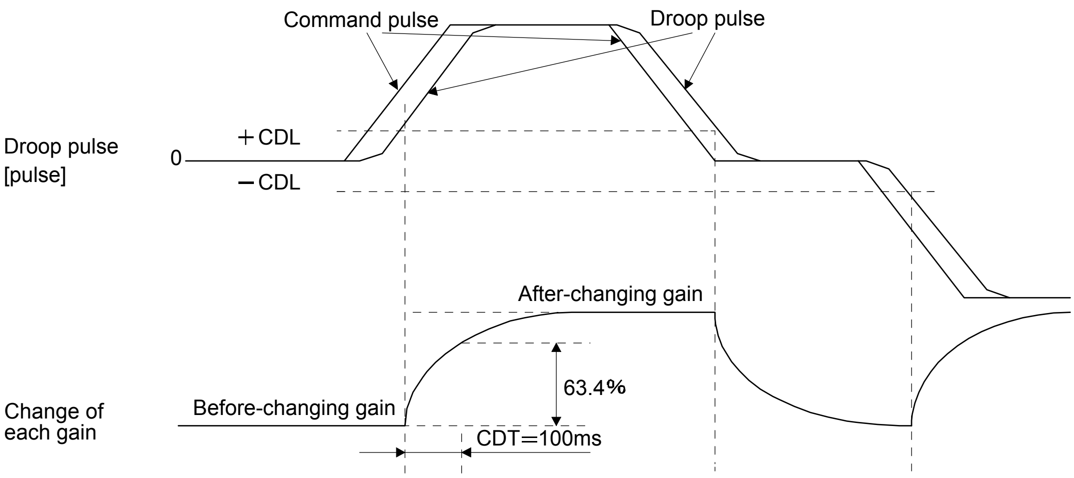
Model loop gain	100				
Load to motor inertia moment ratio	4.0	→	10.0	→	4.0
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control vibration frequency setting	50	→	60	→	50
Vibration suppression control resonance frequency setting	50	→	60	→	50

(2) When you choose changing by droop pulse
In this case, gain changing vibration suppression control cannot be used.

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB07	PG1	Model loop gain	100	rad/s
PB06	GD2	Load to motor inertia moment ratio	4.0	Multiplier (×1)
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB29	GD2B	Gain changing load to motor inertia moment ratio	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	0003 (Changed by droop pulse)	
PB27	CDL	Gain changing condition	50	pulse
PB28	CDT	Gain changing time constant	100	ms

(b) Changing timing chart



Model loop gain	100						
Load to motor inertia moment ratio	4.0	→	10.0	→	4.0	→	10.0
Position loop gain	120	→	84	→	120	→	84
Speed loop gain	3000	→	4000	→	3000	→	4000
Speed integral compensation	20	→	50	→	20	→	50

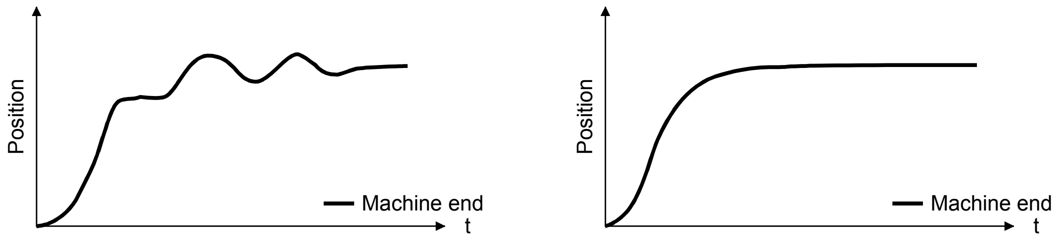
7.7 Vibration suppression control filter 2

POINT
・By using the advanced vibration suppression control and the vibration suppression control filter 2, the machine end vibration of two frequencies can be suppressed. ・The frequency range of machine vibration, which can be supported by the vibration suppression control filter 2, is between 4.5Hz and 2250Hz. Set a frequency close to the machine vibration frequency and within the range. ・When the parameter of the vibration suppression control filter 2 (parameter No.PB45) is changed during the positioning operation, the changed setting is not reflected. The setting is reflected approximately 150ms after the servo motor stops (after servo lock).

(1) Operation

Vibration suppression control filter 2 has a filter function (notch filter) that lowers the gain of the specified frequency contained in a positioning command. By lowering the gain, machine end vibration, such as workpiece end vibration and base shake, can be suppressed.

Which frequency to lower the gain and how deep to lower the gain can be set.



Vibration suppression control filter 2 invalid

Vibration suppression control filter 2 valid

(2) Parameter

Set parameter No.PB45 (vibration suppression control filter 2) as shown below.

For the vibration suppression control filter 2, set a frequency close to the vibration frequency [Hz] at the machine end.

Parameter No.PB45

0			

Notch depth

Setting value	Depth
0	−40.0dB
1	−24.1dB
2	−18.1dB
3	−14.5dB
4	−12.0dB
5	−10.1dB
6	−8.5dB
7	−7.2dB
8	−6.0dB
9	−5.0dB
A	−4.1dB
B	−3.3dB
C	−2.5dB
D	−1.8dB
E	−1.2dB
F	−0.6dB

Vibration suppression filter 2 setting frequency selection

Setting value	Frequency [Hz]	Setting value	Frequency [Hz]	Setting value	Frequency [Hz]
00	Invalid	20	70	40	17.6
01	2250	21	66	41	16.5
02	1125	22	62	42	15.6
03	750	23	59	43	14.8
04	562	24	56	44	14.1
05	450	25	53	45	13.4
06	375	26	51	46	12.8
07	321	27	48	47	12.2
08	281	28	46	48	11.7
09	250	29	45	49	11.3
0A	225	2A	43	4A	10.8
0B	204	2B	41	4B	10.4
0C	187	2C	40	4C	10.0
0D	173	2D	38	4D	9.7
0E	160	2E	37	4E	9.4
0F	150	2F	36	4F	9.1
10	140	30	35.2	50	8.8
11	132	31	33.1	51	8.3
12	125	32	31.3	52	7.8
13	118	33	29.6	53	7.4
14	112	34	28.1	54	7.0
15	107	35	26.8	55	6.7
16	102	36	25.6	56	6.4
17	97	37	24.5	57	6.1
18	93	38	23.4	58	5.9
19	90	39	22.5	59	5.6
1A	86	3A	21.6	5A	5.4
1B	83	3B	20.8	5B	5.2
1C	80	3C	20.1	5C	5.0
1D	77	3D	19.4	5D	4.9
1E	75	3E	18.8	5E	4.7
1F	72	3F	18.2	5F	4.5

8. TROUBLESHOOTING

POINT
・Refer to section 13.6 for the servo amplifiers of 30k to 55kW.

If an alarm/warning has occurred, refer to this chapter and remove its cause.

8.1 Alarms and warning list

When an error 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. When an alarm occurs, the ALM turns OFF.
After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column. The alarm is automatically canceled after removing the cause of occurrence.
For the alarms and warnings with ○ in the Deceleration to a stop column, the forced stop deceleration operates at the alarm or warning occurrence, then the dynamic brake operates to bring the servo motor to a stop.

	Display	Name	Alarm deactivation: Power OFF→ON	Alarm deactivation: Error reset	Alarm deactivation: CPU reset	(Note 5) Deceleration to a stop
Alarms	10	Undervoltage	○	○	○	(Note 3) ○
	12	Memory error 1 (RAM)	○			
	13	Clock error	○			
	15	Memory error 2 (EEP-ROM)	○			
	16	Encoder error 1 (At power on)	○			
	17	Board error	○			
	19	Memory error 3 (Flash-ROM)	○			
	1A	Motor combination error	○			
	20	Encoder error 2 (during runtime)	○			
	21	Encoder error 3 (during runtime)	○			
	24	Main circuit error	○	○	○	
	25	Absolute position erase	○			
	28	Linear encoder error 2	○			
	2A	Linear encoder error 1	○			
	30	Regenerative error	(Note 1) ○	(Note 1) ○	(Note 1) ○	
	31	Overspeed	○	○	○	○
	32	Overcurrent	○			
	33	Overvoltage	○	○	○	
	34	Receive error 1	○	(Note 2) ○	○	○
	35	Command frequency error	○	○	○	○
	36	Receive error 2	○	○	○	○
	37	Parameter error	○			
	42	Fully closed loop control error detection	○	(Note 3) ○	(Note 3) ○	
	45	Main circuit device overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○	(Note 4) ○
	46	Servo motor overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○	○
	47	Cooling fan error	○			○
	50	Overload 1	(Note 1) ○	(Note 1) ○	(Note 1) ○	○
	51	Overload 2	(Note 1) ○	(Note 1) ○	(Note 1) ○	
	52	Error excessive	○	○	○	○
	56	Forced stop error	○	○	○	
	63	STO timing error	○	○	○	
	70	Load-side encoder error 1	○			
	71	Load-side encoder error 2	○			
	8A	USB communication time-out error	○	○	○	○
	8E	USB communication error	○	○	○	○
	888	Watchdog	○			

	Display	Name	Deceleration to a stop
Warnings	92	Battery cable disconnection warning	
	95	STO warning	
	96	Home position setting warning	
	9F	Battery warning	
	E0	Excessive regeneration warning	
	E1	Overload warning 1	
	E3	Absolute position counter warning	
	E4	Parameter warning	
	E6	Servo forced stop warning	○
	E7	Controller forced stop warning	○
	E8	Cooling fan speed reduction warning	
	E9	Main circuit off warning	
	EC	Overload warning 2	
	ED	Output watt excess warning	

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.
2. In some controller communication status, the alarm factor may not be removed.
3. When an instantaneous power failure is detected, the dynamic brake deceleration operates. When a drop of the bus voltage is detected, the forced stop deceleration operates.
4. Deceleration to a stop may not occur.
5. When an alarm without ○ occurs, the dynamic brake operates.

8.2 Remedies for alarms

CAUTION	・When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur. ・If an absolute position erase (25) occurred, always make home position setting again. Not doing so may cause unexpected operation. ・As soon as an alarm occurs, mark servo-off and power off the main circuit and control circuit.

POINT

- When any of the following alarms has occurred, do not deactivate the alarm and resume operation repeatedly. To do so will cause the servo amplifier/servo motor to fail. Remove the cause of occurrence, and leave a cooling time of more than 30 minutes before resuming operation. To protect the main circuit elements, any of these servo alarms cannot be deactivated from the servo system controller until the specified time elapses after its occurrence. Judging the load changing condition until the alarm occurs, the servo amplifier calculates this specified time automatically.
  - Regenerative error (30)
  - Main circuit device overheat (45)
  - Servo motor overheat (46)
  - Overload 1 (50)
  - Overload 2 (51)
- The alarm can be deactivated by switching power off, then on or by the error reset command・CPU reset from the servo system controller. For details, refer to section 8.1.

When an alarm occurs, the malfunction (ALM) switches off and the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No.
The servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. Use MR Configurator to refer to a factor of alarm occurrence.

Display	Name	Definition	Cause	Action
10	Undervoltage	Power supply voltage dropped. 200V class: 160VAC or less 100V class: 83VAC or less 400V class: 280VAC or less	1. Power supply voltage is low.	Check the power supply.
			2. There was an instantaneous control circuit power failure of 60ms or longer.	
			3. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
			4. The bus voltage dropped to the following value or less. 200V class: 200VDC 100V class: 158VDC 400V class: 380VDC	
			5. Faulty parts in the servo amplifier Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
			6. Waveform of power supply voltage is distorted. When power supply impedance is high, waveform of power voltage is distorted, and it may recognized as undervoltage.	Set the parameter No.PC20 to "0001".
12	Memory error 1 (RAM)	RAM, memory fault	Faulty parts in the servo amplifier Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
13	Clock error	Printed board fault		
		Clock error transmitted from the controller	Faulty controller Checking method The alarm occurs, if servo controller is used in multiple CPU system.	Change the servo system controller.
15	Memory error 2 (EEP-ROM)	EEP-ROM fault	1. Faulty parts in the servo amplifier Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
			2. The number of write times to EEP-ROM exceeded 100,000.	
16	Encoder error 1 (At power on)	Communication error occurred between encoder and servo amplifier.	1. Encoder connector (CN2) disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. Encoder cable fault (Wire breakage or shorted)	Repair or change the cable.
			4. Encoder cable type (2-wire, 4-wire) selection was wrong in parameter setting.	Correct the setting in the fourth digit of parameter No.PC04.

Display	Name	Definition	Cause	Action
17	Board error	CPU/parts fault	Faulty parts in the servo amplifier Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change the servo amplifier.
19	Memory error 3 (Flash ROM)	ROM memory fault		
1A	Motor combination error	Wrong combination of servo amplifier and servo motor	Wrong combination of servo amplifier and servo motor connected.	Use correct combination.
20	Encoder error 2 (during runtime)	Communication error occurred between encoder and servo amplifier.	1. Encoder connector (CN2) disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. The encoder detected high acceleration rate due to oscillation and other causes. <Checking method> Check that the servo motor does not vibrate or does not make unusual noise.	1. Decrease the position loop gain. 2. Reduce the response setting of the auto tuning.
21	Encoder error 3 (during runtime)	Error occurred in encoder.	1. The encoder detected high acceleration rate due to oscillation and other causes. <Checking method> Check that the servo motor does not vibrate or does not make unusual noise.	1. Decrease the position loop gain. 2. Reduce the response setting of the auto tuning.
			2. Detection circuit error in encoder.	Change the servo motor.
24	Main circuit error	Ground fault occurred at the servo motor power (U, V and W phases) of the servo amplifier.	1. Power input wires and servo motor power wires are in contact.	Connect correctly.
			2. Sheathes of servo motor power cables deteriorated, resulting in ground fault.	Change the cable.
			3. Main circuit of servo amplifier failed. Checking method The alarm occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	Change the servo amplifier.
25	Absolute position erase	Absolute position data in error	1. Voltage drop in encoder (Battery disconnected.)	After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position setting again.
			2. Battery voltage low	Change the battery. Always make home position setting again.
			3. Battery cable or battery is faulty.	
		Power was switched on for the first time in the absolute position detection system.	4. Home position not set.	After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position setting again.
28	Linear encoder error 2	Working environment of linear encoder is not normal.	1. The temperature of linear encoder is high.	Check the temperature of linear encoder and contact with the linear encoder manufacturer.
			2. The signal level of linear encoder has dropped.	Check the installation of the linear encoder.

Display	Name	Definition	Cause	Action
2A	Linear encoder error 1	An alarm is output from the linear encoder.	1. The speed of linear encoder has exceeded the range of use.	Change the speed of linear encoder within the range of use.
			2. Noise entered.	Take the noise reduction measures.
			3. Alarm of the linear encoder	Contact with the linear encoder manufacturer.
			4. Defective installation positions of the scale and head	Adjust the positions of the scale and head.
30	Regenerative error	Permissible regenerative power of the built-in regenerative resistor or regenerative option is exceeded.	1. Wrong setting of parameter No. PA02	Set correctly.
			2. Built-in regenerative resistor or regenerative option is not connected.	Connect correctly.
			3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative option to be exceeded. Checking method Check the regenerative load ratio using MR Configurator.	1. Reduce the frequency of positioning. 2. Use the regenerative option of larger capacity. 3. Reduce the load.
			4. Power supply voltage is abnormal. 200V class: 260VAC or more 100V class: More than 135VAC 400V class: 535VAC or more	Check the power supply.
			5. Built-in regenerative resistor or regenerative option is faulty.	Change the servo amplifier or regenerative option.
		Regenerative transistor fault	6. Regenerative transistor fault Checking method 1) The regenerative option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative resistor or regenerative option.	Change the servo amplifier.
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. The electronic gear ratio is large. (Servo system controller setting)	Set correctly.
			4. Encoder fault	Change the servo motor.

Display	Name	Definition	Cause	Action
32	Overcurrent	An applied current is higher than the permissible current of the servo amplifier. (If the alarm occurs again when turning ON the servo after resetting the alarm by turning OFF/ON the power when the alarm first occurred, the transistor (IPM・IGBT) of the servo amplifier may be at fault. In the case, do not repeat to turn OFF/ON the power. Check the transistor with the checking method of "Cause 2".)	1. Short occurred in servo motor power (U, V, W).	Correct the wiring.
			2. Transistor (IPM・IGBT) of the servo amplifier is faulty. Checking method This alarm occurs if power is switched on after U,V and W are disconnected.	Change the servo amplifier.
			3. Ground fault occurred in servo motor power (U, V, W).	Correct the wiring.
			4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
33	Overvoltage	Converter bus voltage exceeded to following voltage. 200V class: 400VDC 100V class: 400VDC 400V class: 800VDC	1. Regenerative option is not used.	Use the regenerative option.
			2. Though the regenerative option is used, the parameter No.PA02 setting is "□□00 (not used)".	Set correctly.
			3. Lead of built-in regenerative resistor or regenerative option is open or disconnected.	1. Change the lead. 2. Connect correctly.
			4. Regenerative transistor fault	Change the servo amplifier.
			5. Wire breakage of built-in regenerative resistor or regenerative option	1. For wire breakage of built-in regenerative resistor, change the servo amplifier. 2. For wire breakage of regenerative option, change the regenerative option.
			6. Capacity of built-in regenerative resistor or regenerative option is insufficient.	Add regenerative option or increase capacity.
			7. Power supply voltage high.	Check the power supply.
			8. Ground fault occurred in servo motor power (U, V, W).	Correct the wiring.
			9. The jumper across between BUE and SD of the FR-BU2 brake unit is removed.	Fit the jumper across between BUE and SD.
			10.Impedance at main circuit power supply cable (L_1, L_2, L_3) is high, and leak current from servo motor power supply cable (U, V, W) is large.	Use the regenerative option.

Display	Name	Definition	Cause	Action
34	Receive error 1	SSCNETⅢ communication error (Continuously communication error with about 3.5ms interval.)	1. The SSCNETⅢ cable is disconnected.	Connect it after turning off the control circuit power supply for servo amplifier.
			2. The surface at the end of SSCNETⅢ cable got dirty.	Wipe dirt at the surface away. (Refer to section 3.10.)
			3. The SSCNETⅢ cable is broken or severed.	Change the cable.
			4. Noise entered the servo amplifier.	Take noise suppression measures.
			5. Optical characteristic of SSCNETⅢ cable deteriorated because vinyl tape and/or wire sheath, which contains migrating plasticizer, adhered to the cable.	Remove the vinyl tape and/or wire sheath, which contains migrating plasticizer, and exchange the cable.
			6. SSCNETⅢ communication circuit of the preceding servo amplifier, which is connected closer to the controller than the alarm occurring axis, is faulty.	Change the preceding servo amplifier, which is connected closer the controller than the alarm occurring servo amplifier.
35	Command frequency error	Input pulse frequency of command pulse is too high.	1. Command given is greater than the maximum speed of the servo motor.	Check operation program.
			2. Servo system controller failure.	Change the servo system controller.
			3. Noise entered the servo amplifier.	Take noise of I/O signal suppression measures.
			4. Noise entered the controller.	Take noise from the controller suppression measures.
36	Receive error 2	SSCNETⅢ communication error (Intermittently communication error with about 70ms interval.)	1. The SSCNETⅢ cable is disconnected.	Connect it after turning off the control circuit power supply for servo amplifier.
			2. The surface at the end of SSCNETⅢ cable got dirty.	Wipe dirt away from the surface. (Refer to section 3.10.)
			3. The SSCNETⅢ cable is broken or severed.	Change the cable.
			4. Noise entered the servo amplifier.	Take noise suppression measures.
			5. Optical characteristic of SSCNETⅢ cable deteriorated because vinyl tape and/or wire sheath, which contains migrating plasticizer, adhered to the cable.	Remove the vinyl tape and/or wire sheath, which contains migrating plasticizer, and exchange the cable.
37	Parameter error	Parameter setting is wrong.	1. Servo amplifier fault caused the parameter setting to be rewritten.	Change the servo amplifier.
			2. There is a parameter whose value was set to outside the setting range by the controller.	Change the parameter value to within the setting range.
			3. The number of write times to EEP-ROM exceeded 100,000 due to parameter write, etc.	Change the servo amplifier.

Display	Name	Definition	Cause	Action
42	Fully closed loop control error detection	A fully closed loop control error has occurred.	1. The resolution of the load-side encoder differs from the setting value.	Review the settings of parameter No.PE04, PE05 (fully closed loop control feedback pulse electronic gear). Check the installation of the load-side encoder.
			2. Mismatch of the load-side encoder installation direction.	Check the installation direction of the load-side encoder. Review the encoder pulse count polarity selection in parameter No. PC27.
			3. The position deviation exceeded the detection level.	Review the operation conditions. Review the setting of parameter No.PE07 (fully closed loop control position deviation error detection level) as required.
			4. The speed deviation exceeded the detection level.	Review the operation conditions. Review the setting of parameter No.PE06 (fully closed loop control speed deviation error detection level) as required.
45	Main circuit device overheat	Main circuit device overheat	1. Servo amplifier fault	Change the servo amplifier.
			2. The power supply was turned on and off continuously by overloaded status.	The drive method is reviewed.
			3. Ambient temperature of servo motor is over 55℃.	Check environment so that ambient temperature is 0 to 55℃.
			4. Used beyond the specifications of close mounting.	Use within the range of specifications.
46	Servo motor overheat	Servo motor temperature rise actuated the thermal sensor.	1. Ambient temperature of servo motor is over 40℃.	Check environment so that ambient temperature is 0 to 40℃.
			2. Servo motor is overloaded.	1. Reduce load. 2. Check operation pattern. 3. Use servo motor that provides larger output.
			3. Thermal sensor in encoder is faulty.	Change the servo motor.
47	Cooling fan error	The cooling fan of the servo amplifier stopped, or its speed decreased to or below the alarm level.	1. Cooling fan life expiration. (Refer to section 2.6.)	Change the cooling fan of the servo amplifier.
			2. Foreign matter caught in the cooling fan stopped rotation.	Remove the foreign matter.
			3. The power supply of the cooling fan failed.	Change the servo amplifier.

Display	Name	Definition	Cause	Action
50	Overload 1	Load exceeded overload protection characteristic of servo amplifier.	1. Servo amplifier is used in excess of its continuous output current.	1. Reduce load. 2. Check 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 the auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			3. Machine struck something.	1. Check 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 fault Checking method When the servo motor shaft is rotated with the servo-off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.
			6. After Overload 2 (51) occurred, turn OFF/ON the power supply to clear the alarm. Then the overload operation is repeated.	1. Reduce load. 2. Check operation pattern. 3. Use servo motor that provides larger output.
51	Overload 2	Machine collision or the like caused max. For the time of the alarm occurrence, refer to section 10.1.	1. Machine struck something.	1. Check 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 the auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder fault Checking method When the servo motor shaft is rotated with the servo-off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.

Display	Name	Definition	Cause	Action
52	Error excessive	The deviation between the model position and the actual servo motor position exceeds the parameter No.PC01 setting value (initial value: 3 revolutions).	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/deceleration time constant.
			2. Torque limit value set with controller is too small.	Increase the torque limit value.
			3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Check the power supply capacity. 2. Use servo motor which provides larger output.
			4. Position loop gain 1 (parameter No.PB08) value is small.	Increase set value and adjust to ensure proper operation.
			5. 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.
			6. Machine struck something.	1. Check operation pattern. 2. Install limit switches.
			7. Encoder fault	Change the servo motor.
			8. 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.
			9. SSCNETⅢ cable fault	Change the SSCNETⅢ cable.
			10. Optical characteristic of SSCNETⅢ cable deteriorated because vinyl tape and/or wire sheath, which contains migrating plasticizer, adhered to the cable.	Remove the vinyl tape and/or wire sheath, which contains migrating plasticizer, and exchange the cable.
56	Forced stop error	The servo motor does not decelerate normally during forced stop deceleration.	1. Forced stop deceleration command time constant (parameter No. PC24) value is small.	Increase set value and adjust to ensure proper operation.
			2. 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.
			3. Servo system is instable, causing overshoot.	Re-set servo gain to proper value.
			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 fault	Change the servo motor.

Display	Name	Definition	Cause	Action
63	STO timing error	STO signal turns off while the servo motor is rotating (50r/min or more).	1. Timing of turning off the STO signal is not appropriate.	1. Check the external sequence if the condition, which turns off STO signal of is appropriate. 2. Check STO delay time setting (rotary switch) of MR-J3-D05. Be sure to consult with a machine builder when changing the delay time setting.
			2. STO cable is cut.	Change the STO cable.
			3. MR-J3-D05 is faulty.	Change MR-J3-D05.
			4. The external device connected to CN8 is faulty, or its setting is wrong.	Change the external device, or review the setting.
70	Load-side encoder error 1	An error occurs in the communication between the load-side encoder and the servo amplifier.	1. CN2L connector is disconnected.	Connect correctly.
			2. Faulty of the load-side encoder cable	Repair or change the cable.
			3. Wrong wiring of the load-side encoder cable	Review the wiring connection.
			4. For the serial interface encoder, the load-side encoder cable type (2-wire, 4-wire) selection was wrong in the parameter setting.	Correct the setting in the fourth digit of parameter No.PC26 (encoder cable communication system selection).
			5. The startup timing is slow. (For the load-side encoder with the external power supply input)	Turn on the external power supply, and then turn on the control circuit power supply of servo amplifier.
			6. The power supply voltage dropped. (For the load-side encoder with the external power supply input)	Check the power supply capacity and voltage.
71	Load-side encoder error 2	An error occurs in the communication between the load-side encoder and the servo amplifier.	1. Faulty of the load-side encoder cable	Repair or change the cable.
			2. Wrong wiring of the load-side encoder cable	Review the wiring connection.
			3. The power supply voltage dropped. (For the load-side encoder with the external power supply input)	Check the power supply capacity and voltage.
			4. For the serial interface encoder, the load-side encoder cable type (2-wire, 4-wire) selection was wrong in the parameter setting.	Correct the setting in the fourth digit of parameter No.PC26 (encoder cable communication system selection).
			5. For A/B/Z-phase input interface encoder, the alarm judgement without the Z-phase disconnection was not set to "invalid" in the parameter when using the load-side encoder without Z-phase.	For the load-side encoder without Z-phase, set parameter No.PC27 to "□1□□".
8A	USB communication time-out error	Communication with MR Configurator in test operation mode stopped for longer than the specified time.	USB cable breakage	Change the USB cable.

Display	Name	Definition	Cause	Action
8E	USB communication error	Serial communication error occurred between servo amplifier and communication device (e.g. personal computer).	1. USB cable fault (Open cable or short circuit)	Change the USB cable.
			2. Communication device (e.g. personal computer) fault	Change the communication device (e.g. personal computer).
(Note) 888	Watchdog	CPU, parts fault	Fault of parts in servo amplifier Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change the servo amplifier.

Note. At power-on, "888" appears instantaneously, but it is not an error.

8.3 Remedies for warnings

⚠CAUTION
- If an absolute position counter warning (E3) occurred, always make home position setting again. Not doing so may cause unexpected operation.

POINT
- When any of the following alarms has occurred, do not resume operation by switching power of the servo amplifier OFF/ON repeatedly. The servo amplifier and servo motor may become faulty. If the power of the servo amplifier is switched OFF/ON during the alarms, allow more than 30 minutes for cooling before resuming operation.
  - Excessive regenerative warning (E0)
  - Overload warning 1 (E1)

If E6, E7 or E9 occurs, the servo-off status is established. If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed.
Remove the cause of warning according to this section. Use MR Configurator to refer to a factor of warning occurrence.

Display	Name	Definition	Cause	Action
92	Battery cable disconnection warning	Absolute position detection system battery voltage is low.	1. Battery cable is open.	Repair cable or changed.
			2. Battery voltage supplied from the servo amplifier to the encoder fell to about 3V or less. (Detected with the encoder)	Change the battery.
95	STO warning	STO I/O signal turns off.	1. STO I/O signal connector (CN8) is disconnected.	Connect correctly.
			2. STO cable is cut.	Change the STO cable.
			3. MR-J3-D05 is faulty.	Change MR-J3-D05.
			4. The external device connected to CN8 is faulty, or its setting is wrong.	Change the external device, or review the setting.
96	Home position setting warning	Home position setting could not be made.	1. Droop pulse remaining are greater than the in-position range setting.	Remove the cause of droop pulse occurrence.
			2. Command pulse entered after clearing of droop pulse.	Do not enter command pulse after clearing of droop pulse.
			3. Creep speed high.	Reduce creep speed.

Display	Name	Definition	Cause	Action
9F	Battery warning	Voltage of battery for absolute position detection system reduced.	Battery voltage fell to 3.2V or less. (Detected with the servo amplifier)	Change the battery.
E0	Excessive regeneration warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative resistor or regenerative option.	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative resistor or regenerative option. Checking method Check the regenerative load ratio using MR Configurator.	1. Reduce frequency of positioning. 2. Change the regenerative option for the one with larger capacity. 3. Reduce load.
E1	Overload warning 1	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 is faulty.	1. Noise entered the encoder.	Take noise suppression measures.
			2. Encoder fault	Change the servo motor.
		The multi-revolution counter value of the absolute position encoder exceeded the maximum revolution range.	3. The travel distance from the home position exceeded a 32767 rotation or -32768 rotation in succession.	Make home position setting again.
E4	Parameter warning	Parameter outside setting range	Parameter value set from servo system controller is outside setting range.	Set it correctly.
E6	Servo forced stop warning	EM1 or EM2 is off.	External forced stop was made valid. (EM1 or EM2 was turned off.)	Ensure safety and deactivate forced stop.
E7	Controller forced stop warning		Forced stop signal was entered into the servo system controller.	Ensure safety and deactivate forced stop.
E8	Cooling fan speed reduction warning	The speed of the servo amplifier decreased to or below the warning level. This warning is not displayed with MR-J3-70□S/100□S among servo amplifiers equipped with a cooling fan.	1. Cooling fan life expiration (Refer to section 2.6.)	Change the cooling fan of the servo amplifier.
			2. The power supply of the cooling fan is broken.	Change the servo amplifier.
E9	Main circuit off warning	Servo-on command was issued with main circuit power off.		Switch on main circuit power.

Display	Name	Definition	Cause	Action
EC	Overload warning 2	Operation, in which a current exceeding the rating flew intensively in any of the U, V and W phases of the servo motor, was repeated.	During a stop, the status in which a current flew intensively in any of the U, V and W phases of the servo motor occurred repeatedly, exceeding the warning level.	1. Reduce the positioning frequency at the specific positioning address. 2. Reduce the load. 3. Replace the servo amplifier/ servo motor with the one of larger capacity.
ED	Output watt excess warning	The status, in which the output wattage (speed × torque) of the servo motor exceeded the rated output, continued steadily.	Continuous operation was performed with the output wattage (speed × torque) of the servo motor exceeding 150% of the rated output.	1. Reduce the servo motor speed. 2. Reduce the load.

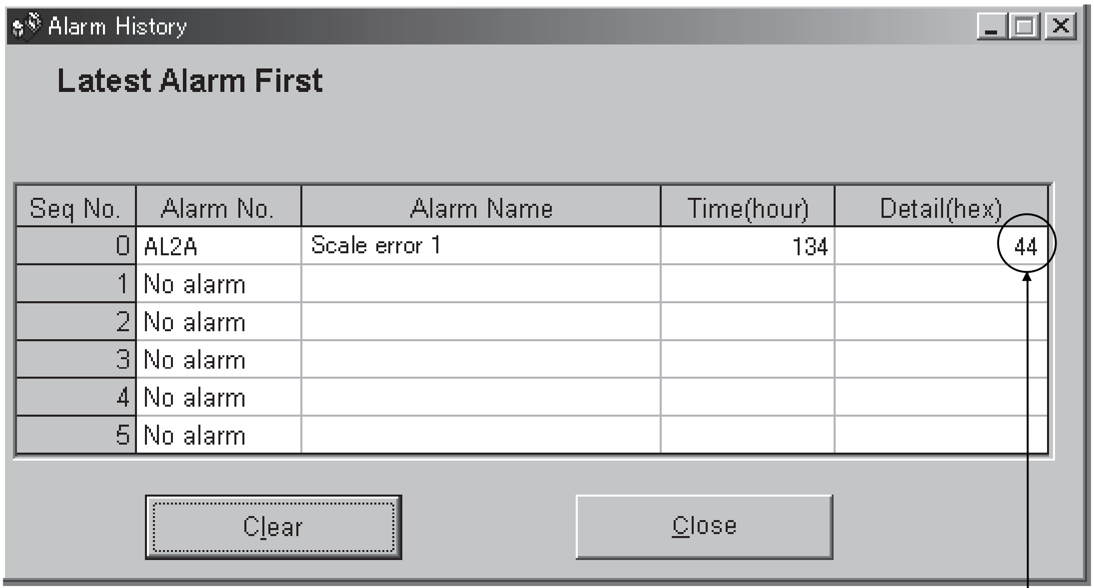
8.4 Detailed explanation of linear encoder error 1 (2A)

If the cause of Linear encoder error 1 (2A) occurrence is not identified, confirm the details shown on the following table according to the alarm detailed information for the alarm history display of MR Configurator, and then contact with the linear encoder manufacturer.

Table 8.1 Detailed explanation of linear encoder error 1 (2A) for each manufacturer

Detail information bit	Linear encoder error 1 (2A) details				
	Mitutoyo Corporation		Magnescale	Heidenhain Corporation	Renishaw Inc.
	AT343A/AT543A	ST741/ST743			
7	Optical overspeed	Servo alarm	—	Overspeed error	—
6	ROM・RAM error	Signal strength alarm	—	—	Overspeed
5	EEPROM error	Signal strength error	Encoder alarm	EEPROM error	—
4	CPU error	Transducer error	—	CPU error	—
3	Capacitive error	ABS detection error	—	ABS data error	—
2	Photoelectric error	Hardware error	—	INC data error	—
1	Photoelectric・capacitive data mismatch	Initialization error	Encoder warning	Scale level error INC/ABS data mismatch error	Level error
0	Initialization error	Overspeed error	—	Initialization error	—

As an example, the following describes the detailed information when Linear encoder error 1 (2A) occurs in the linear encoder AT343A manufactured by Mitutoyo Corporation.



Alarm details : 44h

In this case, the alarm detailed information of Linear encoder error 1 (2A) is "44". This numeral is indicated in hexadecimal number. Convert "44" of hexadecimal number to a binary-coded form as shown below.

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
44h＝	0	1	0	0	0	1	0	0

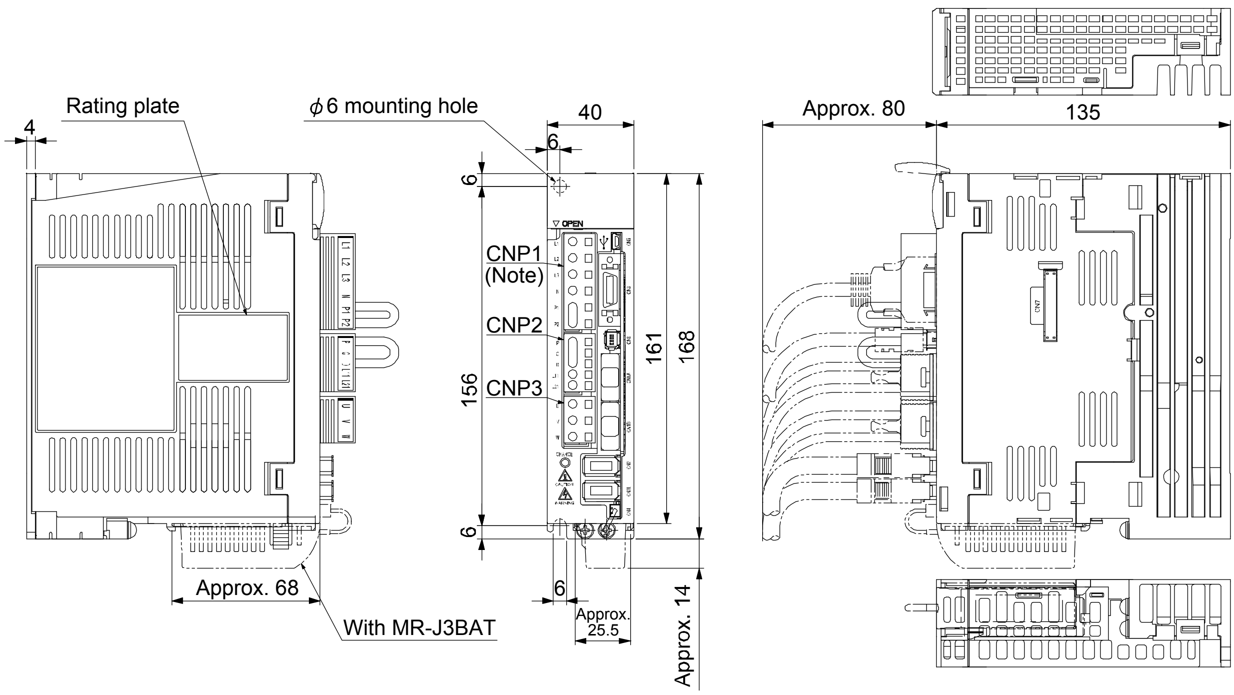
The digits for bit6 and bit2 are "1". Check the details of the bit being "1" in Table 8.1. In this case, the occurrences of ROM・RAM error (bit6) and Photoelectric error (bit2) are identified.

9. OUTLINE DRAWINGS

9.1 Servo amplifier

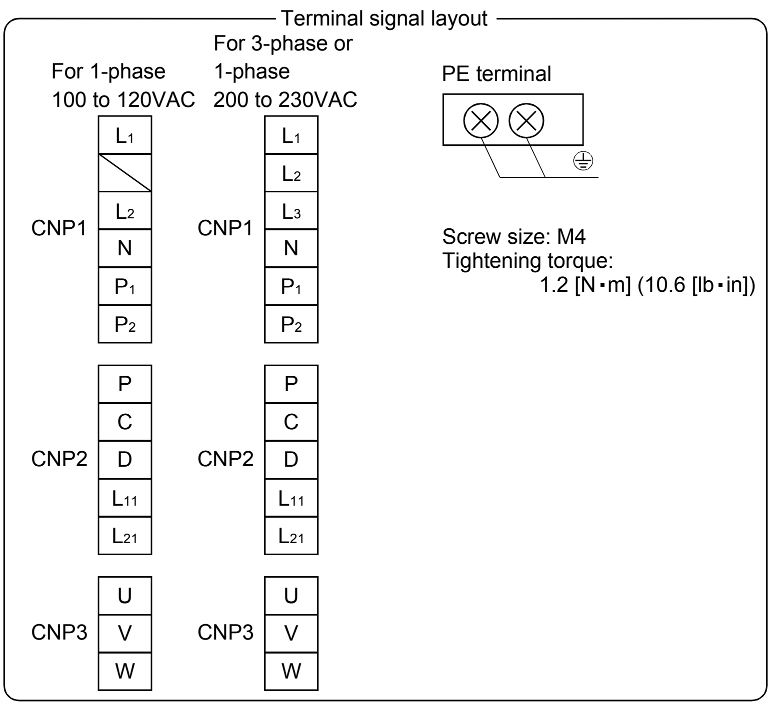
(1) MR-J3-10□S・MR-J3-20□S
MR-J3-10□S1・MR-J3-20□S1

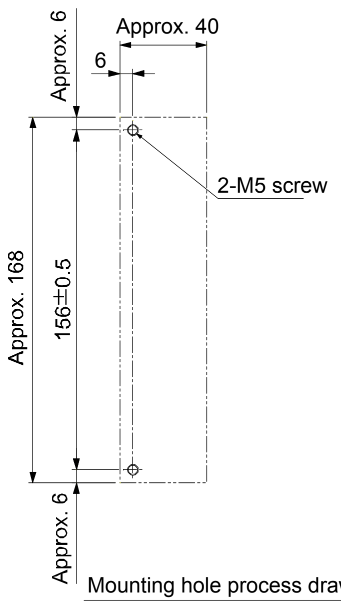
[Unit: mm]



Note. This data applies to the 3-phase or 1-phase 200 to 230VAC power supply models.
For a single-phase, 100 to 120VAC power supply, refer to the terminal signal layout.

Mass: 0.8 [kg] (1.76 [lb])



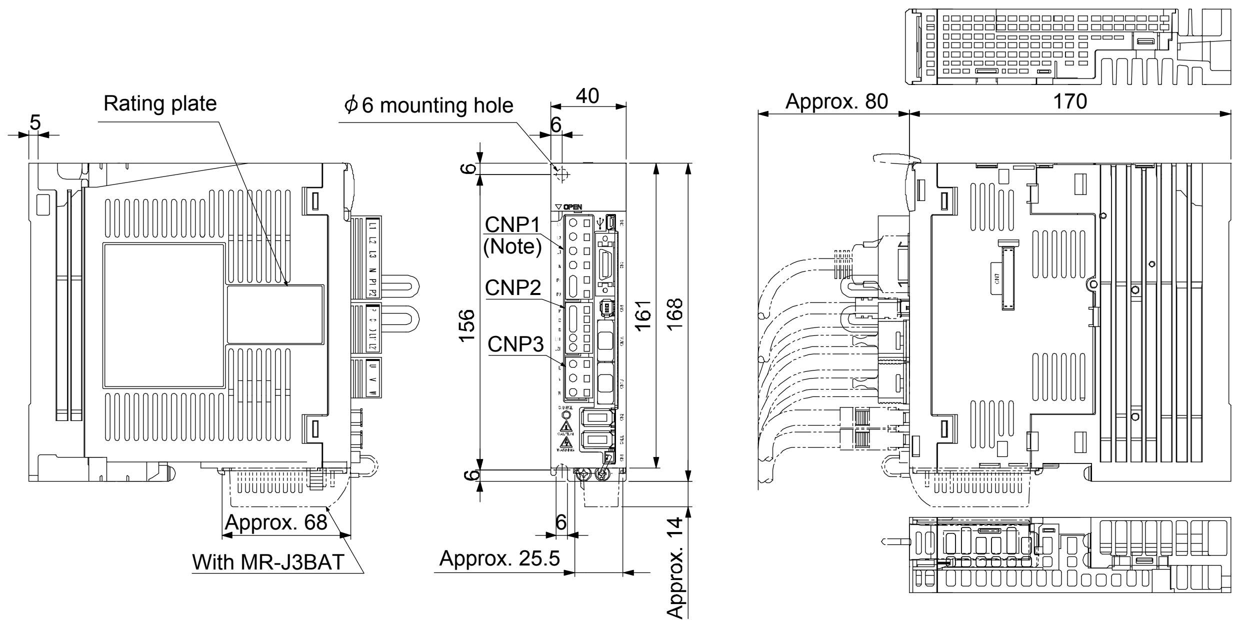


Mounting hole process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

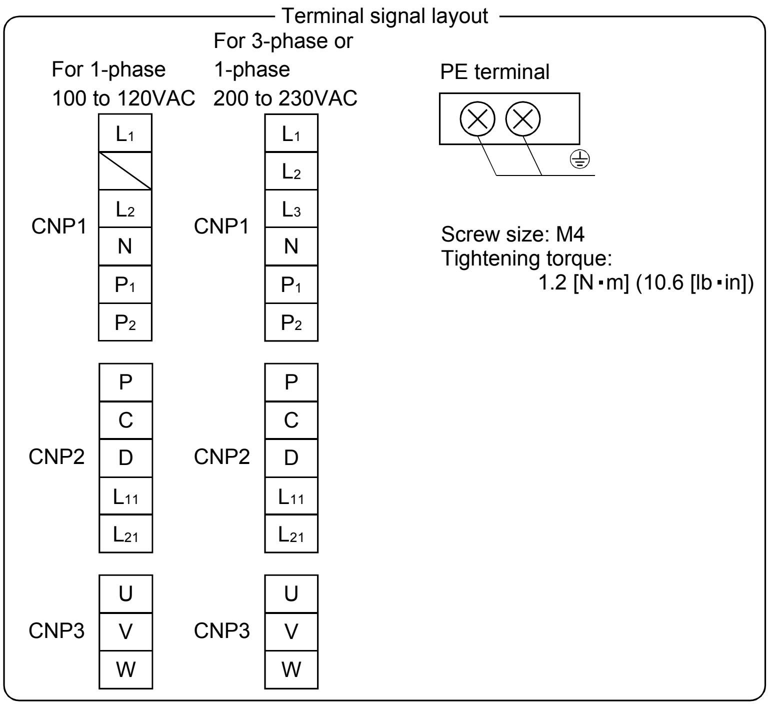
(2) MR-J3-40□S・MR-J3-60□S
MR-J3-40□S1

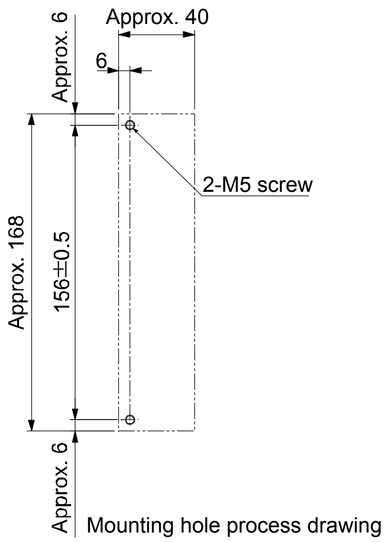
[Unit: mm]



Note. This data applies to the 3-phase or 1-phase 200 to 230VAC power supply models.
For a single-phase, 100 to 120VAC power supply, refer to the terminal signal layout.

Mass: 1.0 [kg] (2.21 [lb])

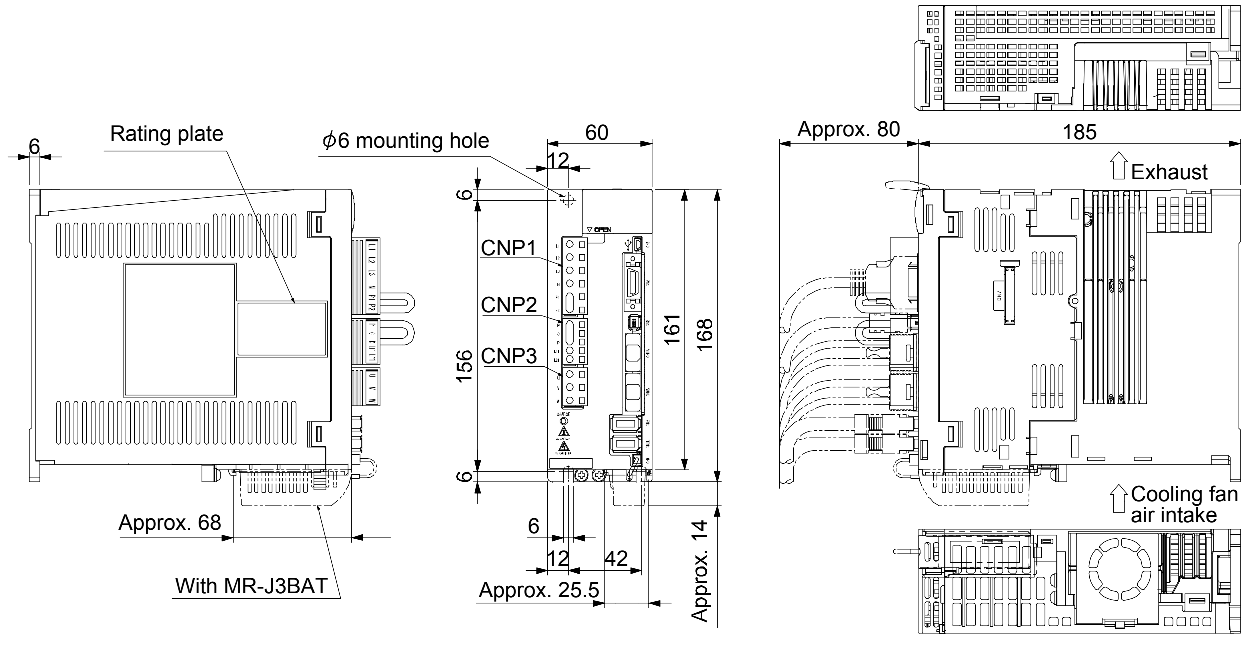




Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

(3) MR-J3-70□S・MR-J3-100□S

[Unit: mm]

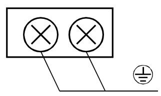


Mass: 1.4 [kg] (3.09 [lb])

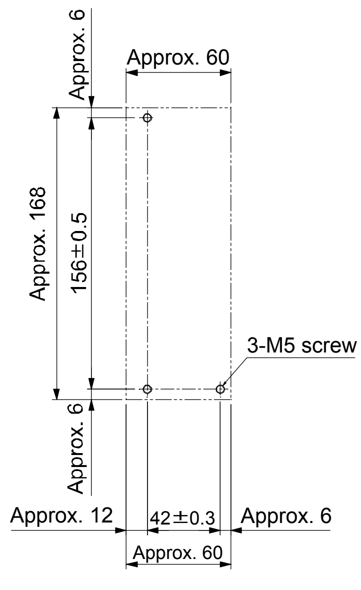
Terminal signal layout

CNP1	L1
	L2
	L3
	N
	P1
	P2
CNP2	P
	C
	D
	L11
	L21
CNP3	U
	V
	W

PE terminal



Screw size: M4
Tightening torque:
1.2 [N・m] (10.6 [lb・in])

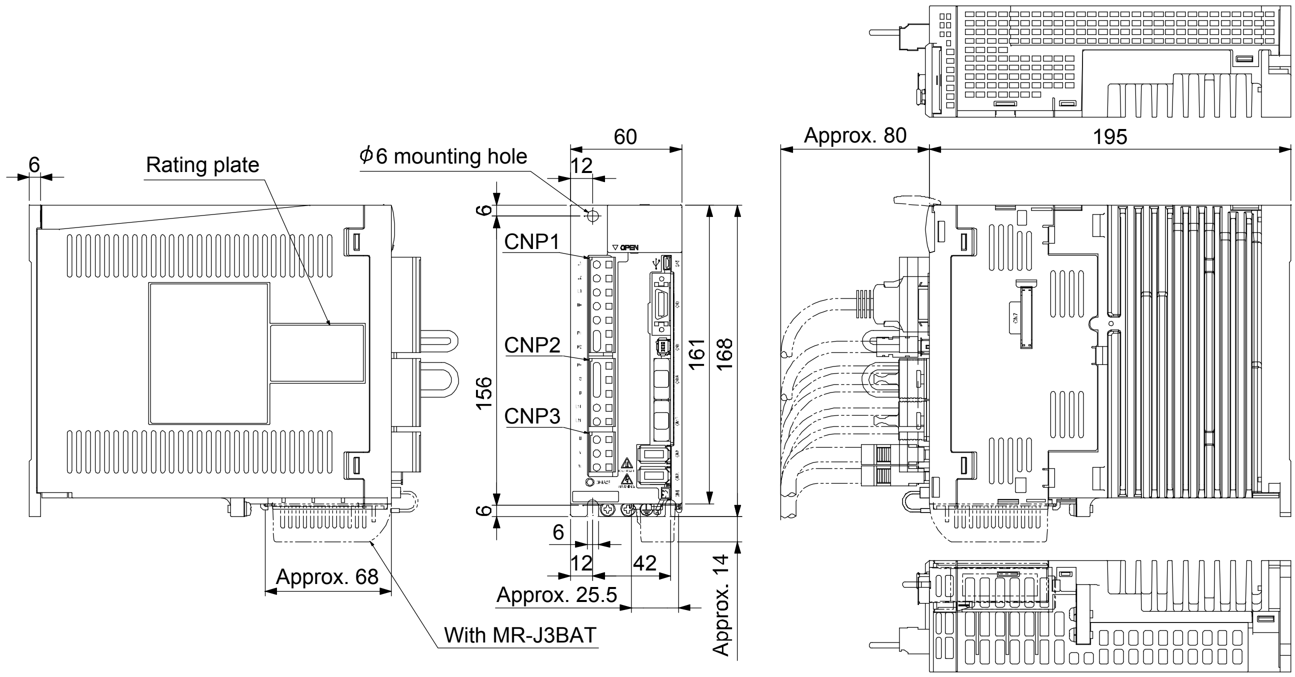


Mounting hole process drawing

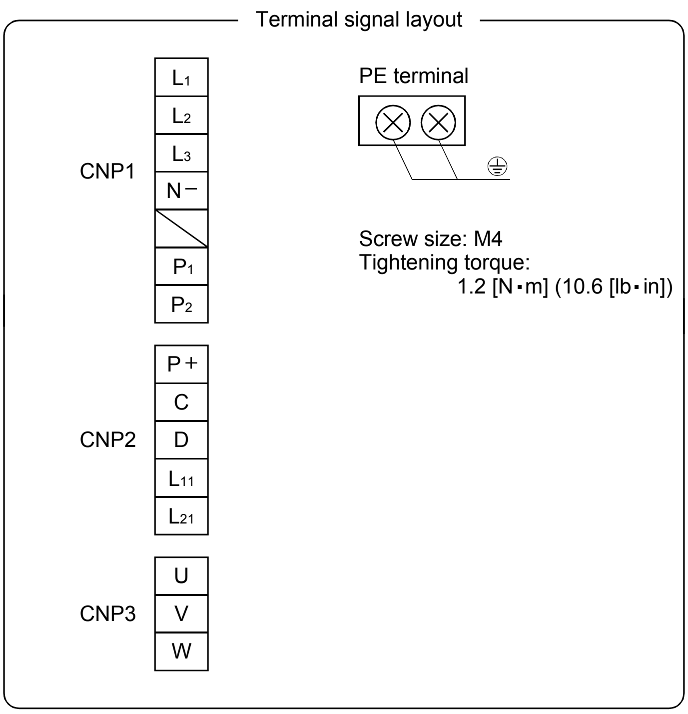
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

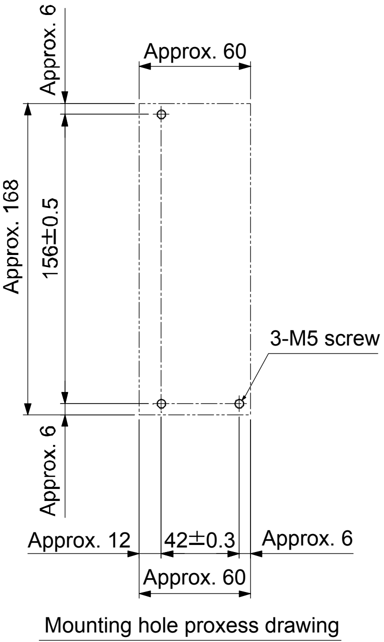
(4) MR-J3-60□S4・MR-J3-100□S4

[Unit: mm]



Mass: 1.4 [kg] (3.09 [lb])

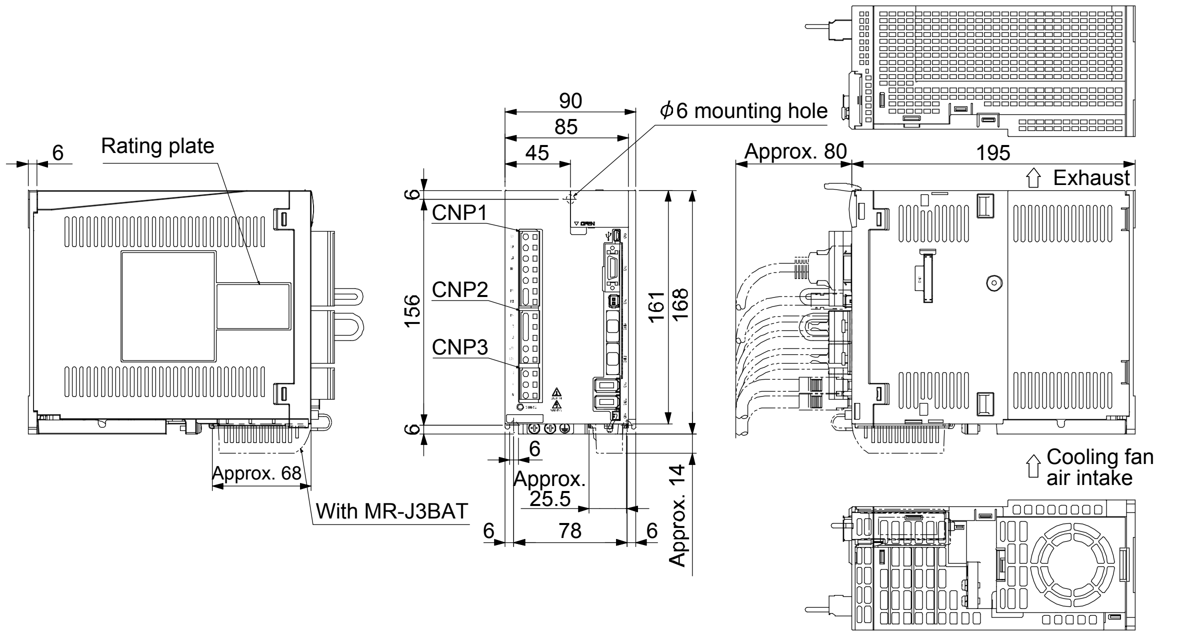




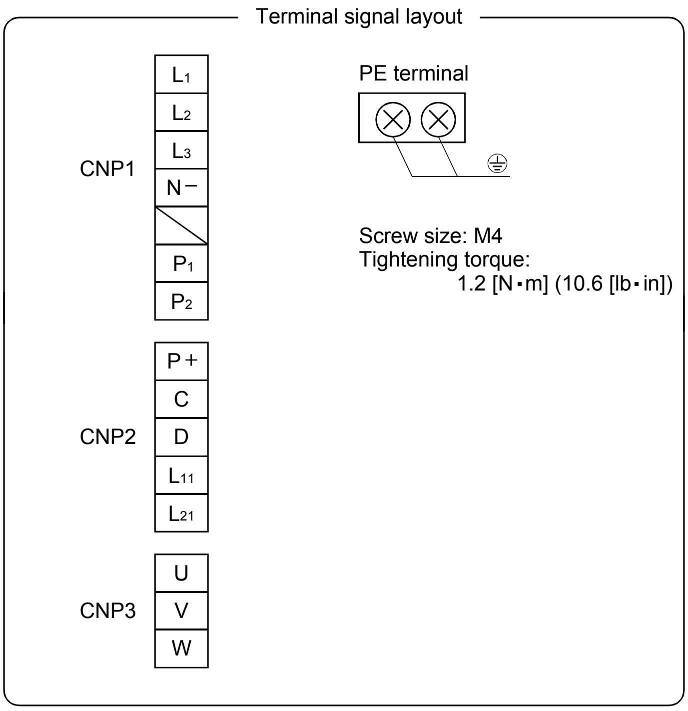
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

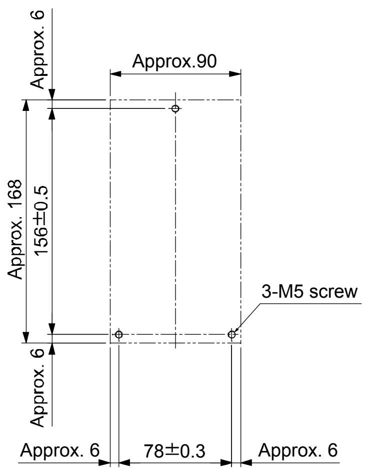
(5) MR-J3-200□S(4)

[Unit: mm]



Mass: 2.4 [kg] (5.30 [lb])



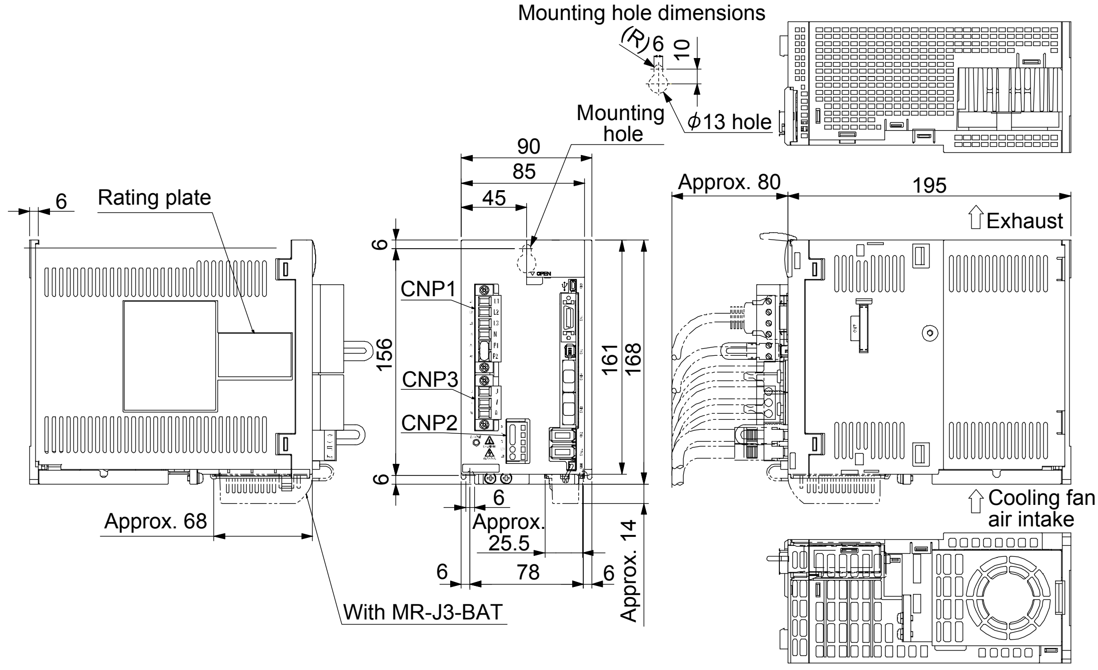


Mounting hole process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

(6) MR-J3-350□S

[Unit: mm]



Mass: 2.4 [kg] (5.30 [lb])

Terminal signal layout

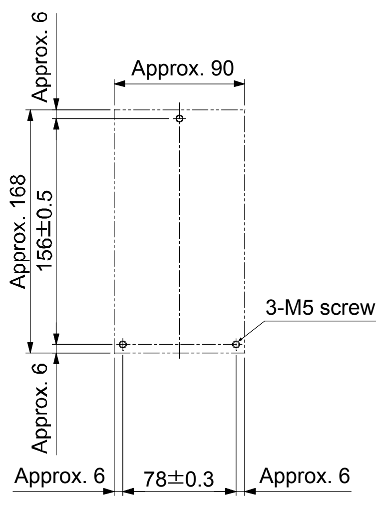
CNP1	L_1
	L_2
	L_3
	N
	P_1
	P_2
CNP3	U
	V
	W
CNP2	P
	C
	D
	L_{11}
	L_{21}

CNP1: Tightening torque of connector mounting screw and wire : 0.6 [N・m] (5.3 [lb・in])

CNP3: Tightening torque of connector mounting screw and wire : 0.6 [N・m] (5.3 [lb・in])

PE terminal

Screw size: M4
Tightening torque:
1.2 [N・m] (10.6 [lb・in])

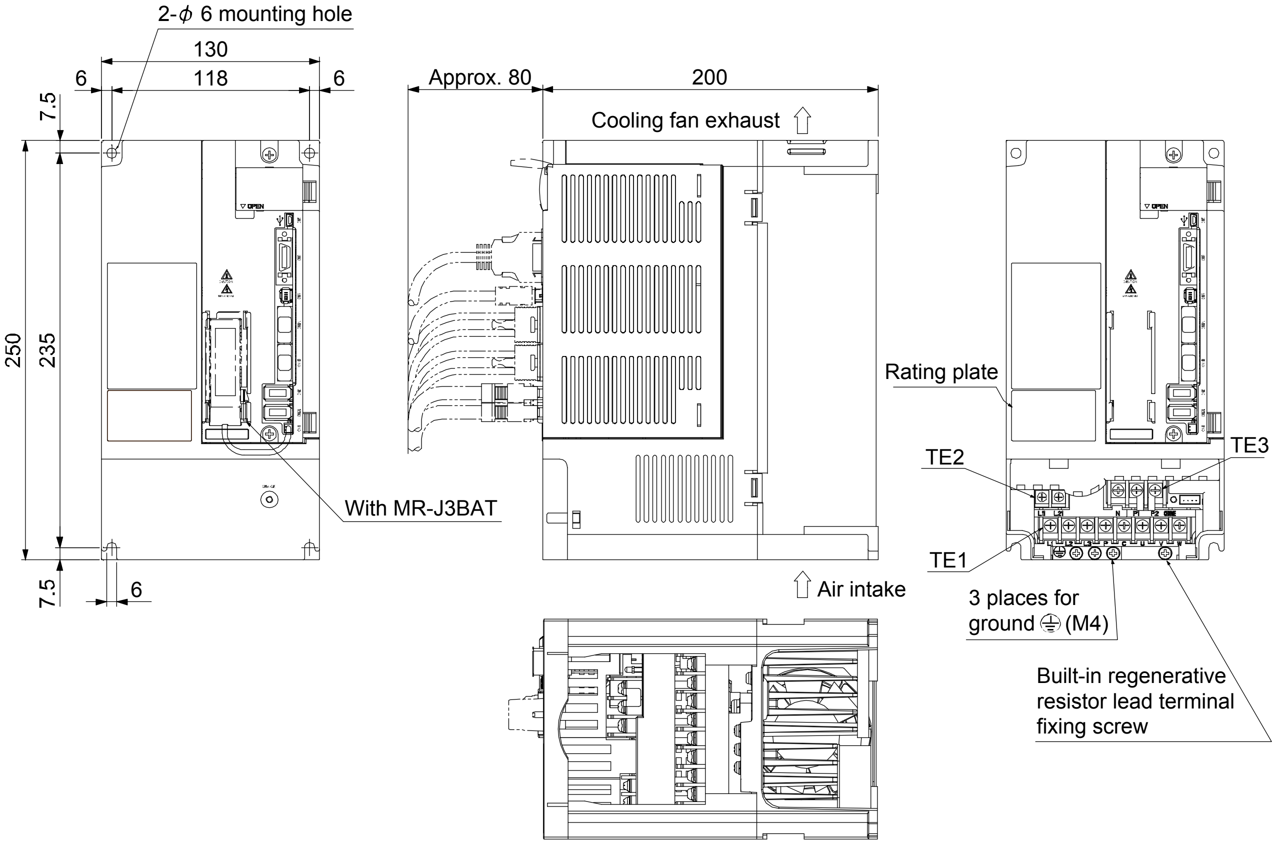


Mounting hole process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

(7) MR-J3-350□S4 ・ MR-J3-500□S(4)

[Unit: mm]



Mass: 4.6 [kg] (10.1 [lb])

Terminal signal layout

TE1

L_1	L_2	L_3	P	C	U	V	W

Terminal screw: M4
Tightening torque: 1.2[N・m] (10.6 [lb・in])

TE2

L_{11}	L_{21}

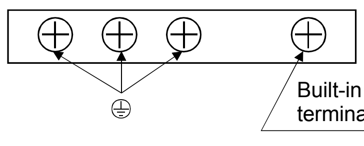
Terminal screw: M3.5
Tightening torque: 0.8[N・m] (7.08 [lb・in])

TE3

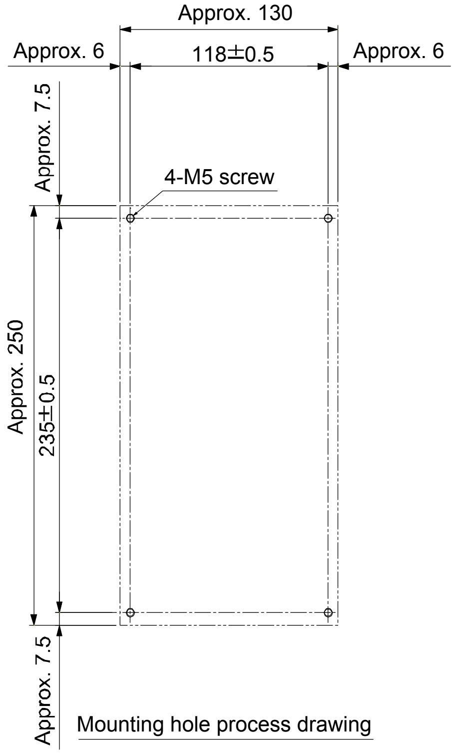
N	P_1	P_2

Terminal screw: M4
Tightening torque: 1.2[N・m] (10.6 [lb・in])

PE terminal



Terminal screw: M4
Tightening torque: 1.2[N・m] (10.6 [lb・in])

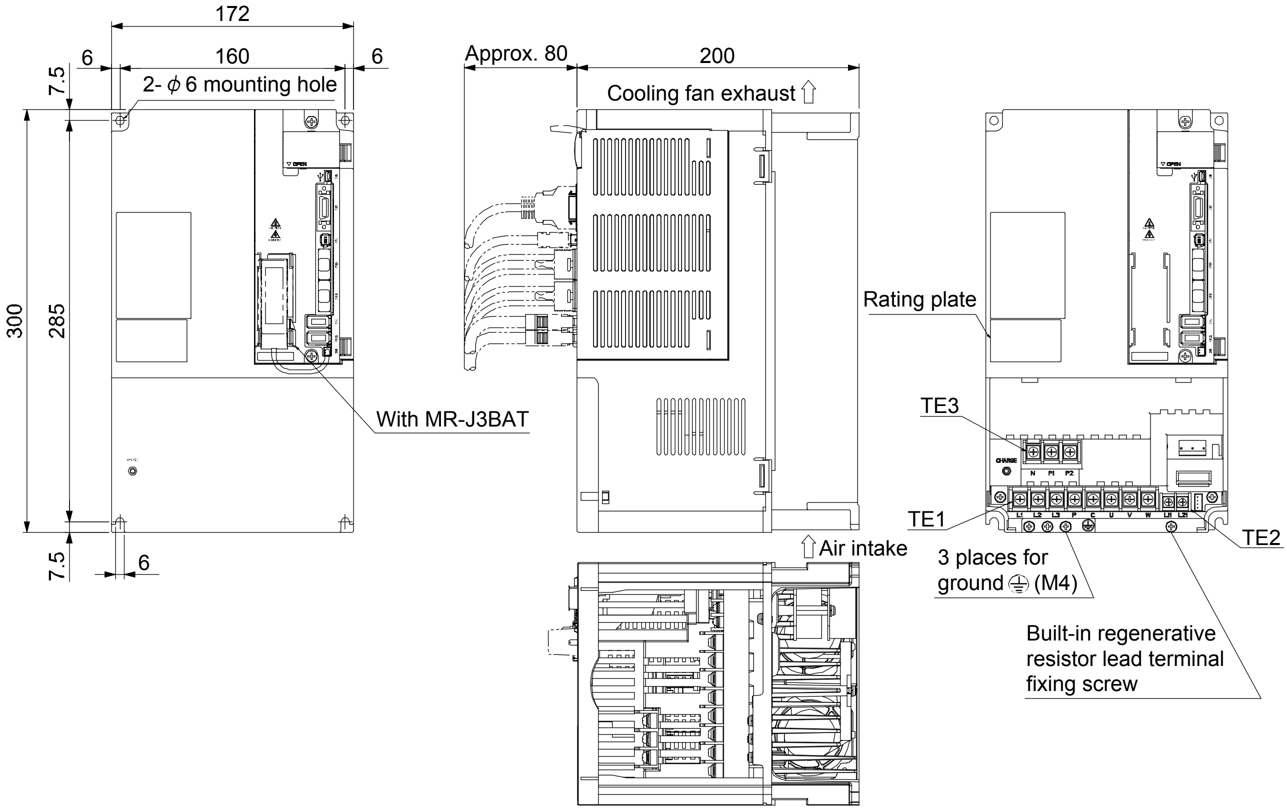


Mounting hole process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.24 [N・m] (28.7 [lb・in])

(8) MR-J3-700□S(4)

[Unit: mm]



Mass: 6.2 [kg] (13.7[lb])

Terminal signal layout

TE1

L_1	L_2	L_3	P	C	U	V	W

Terminal screw: M4
Tightening torque: 1.2 [N•m] (10.6 [lb•in])

TE2

L_{11}	L_{21}

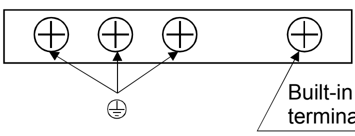
Terminal screw: M3.5
Tightening torque: 0.8 [N•m] (7.08 [lb•in])

TE3

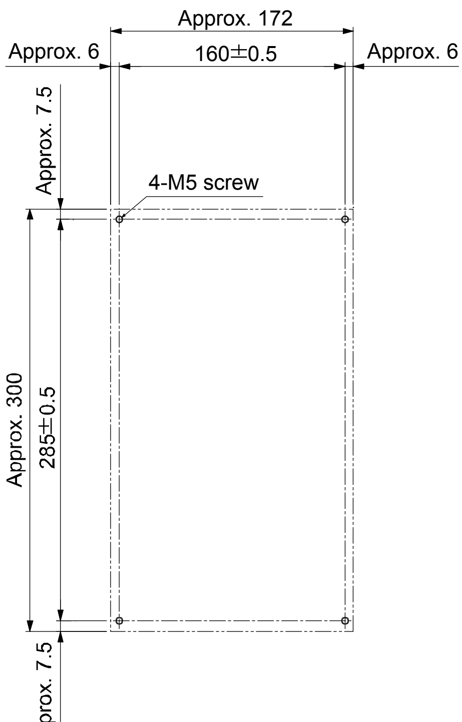
N	P_1	P_2

Terminal screw: M4
Tightening torque: 1.2 [N•m] (10.6 [lb•in])

PE terminal



Terminal screw: M4
Tightening torque: 1.2 [N•m] (10.6 [lb•in])

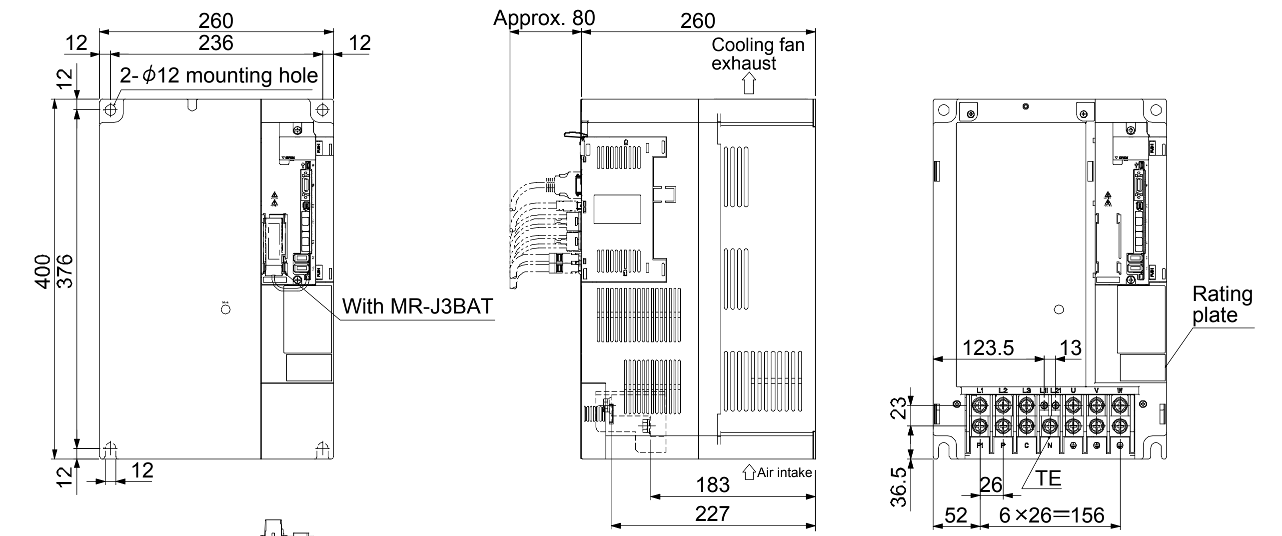


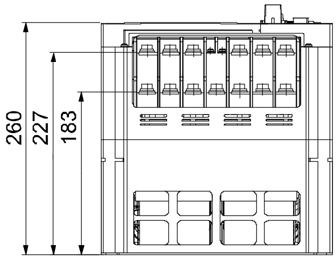
Mounting hole process drawing

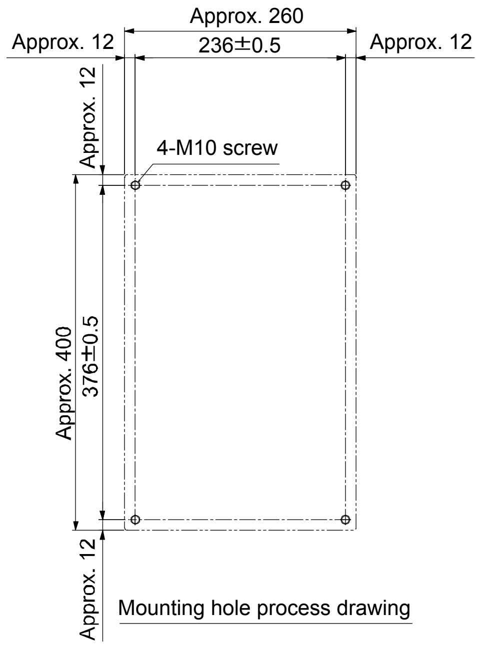
Mounting screw
Screw size: M5
Tightening torque: 3.24 [N • m] (28.7 [lb • in])

(9) MR-J3-11K□S(4) to 22K□S(4)

[Unit: mm]







Mounting hole process drawing

Servo amplifier	Mass [kg]([lb])
MR-J3-11K□S(4)	18.0 (40)
MR-J3-15K□S(4)	18.0 (40)
MR-J3-22K□S(4)	19.0 (42)

Terminal signal layout

TE

L_1	L_2	L_3	L_{11} L_{21}	U	V	W
P_1	P	C	N	⏚	⏚	⏚

		L_1・L_2・L_3・U・V・W P_1・P・C・N・⏚	L_{11}・L_{21}
MR-J3-11K□S(4) MR-J3-15K□S(4)	Screw size	M6	M4
	Tightening torque [N・m]	3.0	1.2
MR-J3-22K□S(4)	Screw size	M8	M4
	Tightening torque [N・m]	6.0	1.2

Mounting screw

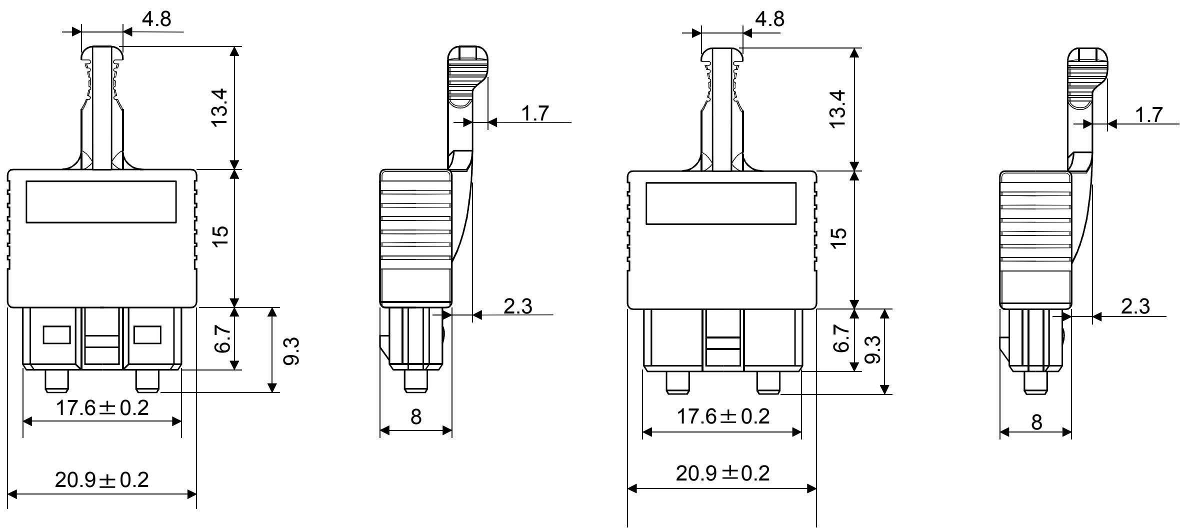
Servo amplifier	Screw size	Tightening torque [N・m][(lb:in)]
MR-J3-11K□S(4) MR-J3-15K□S(4) MR-J3-22K□S(4)	M10	26.5 (234)

9.2 Connector

(1) CN1A・CN1B connector

[Unit: mm]

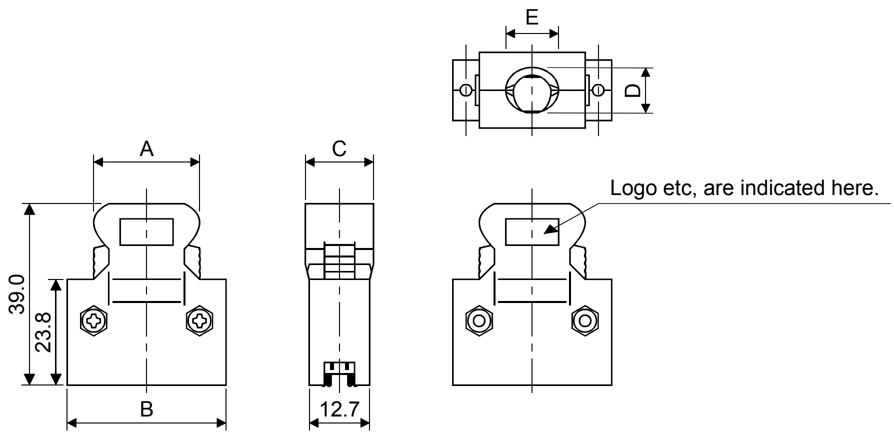
F0-PF2D103 F0-PF2D103-S



(2) Miniature delta ribbon (MDR) system (3M)

(a) One-touch lock type

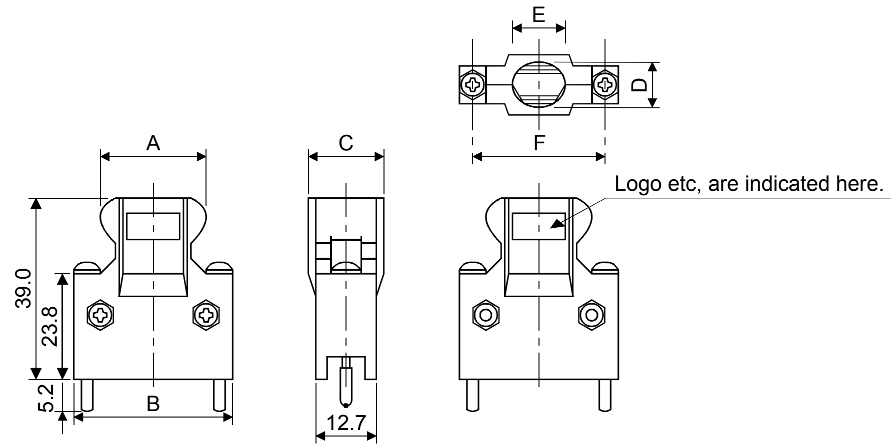
[Unit: mm]



Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10120-3000PE	10320-52F0-008	22.0	33.3	14.0	10.0	12.0

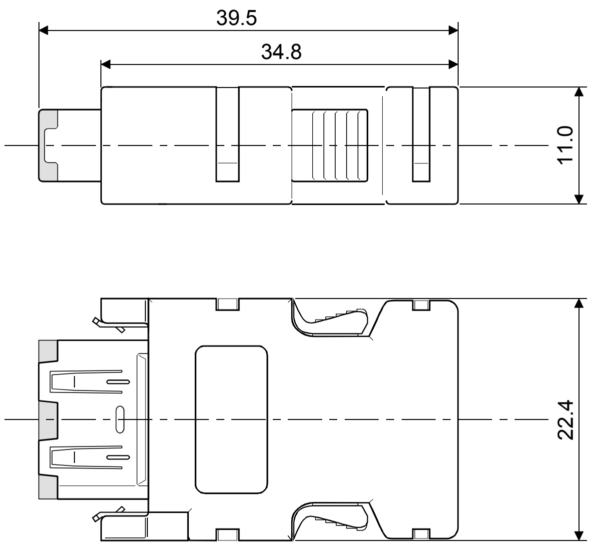
(b) Jack screw M2.6 type
This is not available as option.

[Unit: mm]



Connector	Shell kit	Each type of dimension					
		A	B	C	D	E	F
10120-3000PE	10320-52F0-008	22.0	33.3	14.0	10.0	12.0	27.4

(3) SCR connector system (3M)
Receptacle : 36210-0100PL
Shell kit : 36310-3200-008

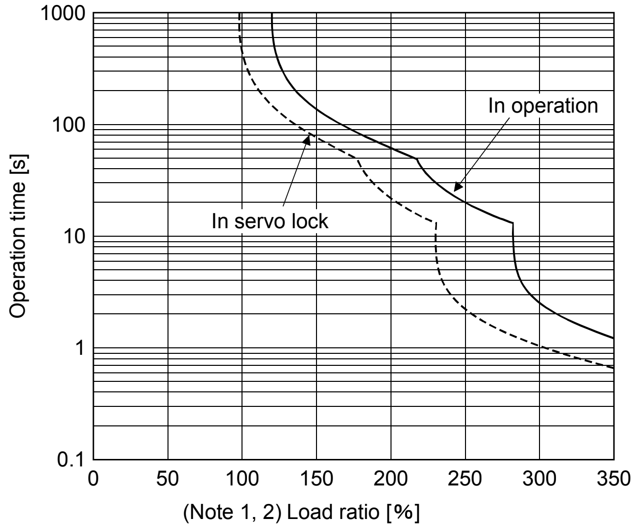


MEMO

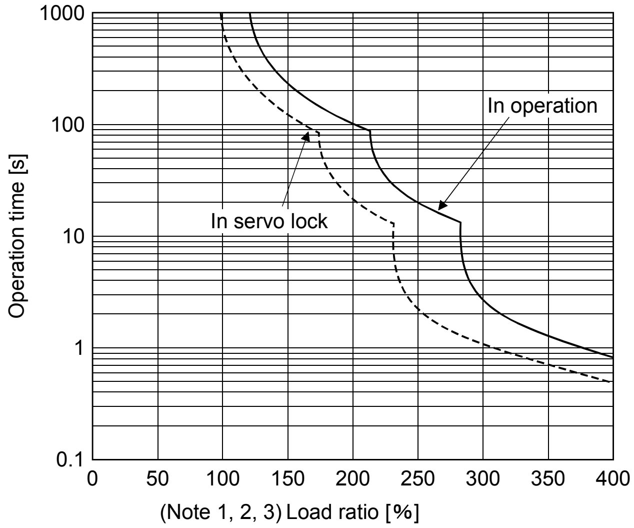
10. CHARACTERISTICS

10.1 Overload protection characteristics

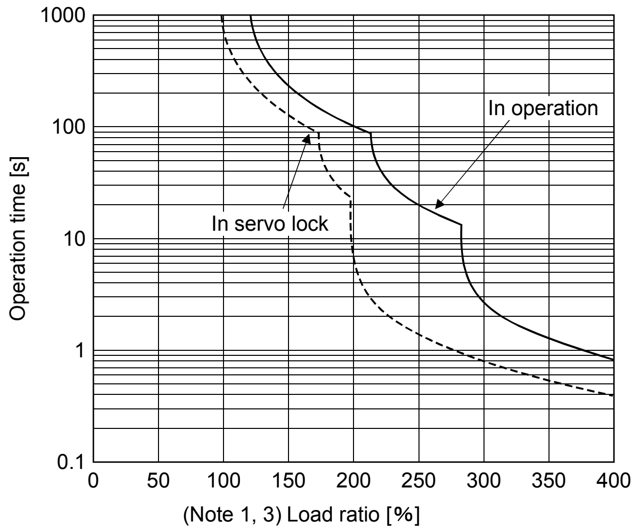
An electronic thermal relay is built in the servo amplifier to protect the servo motor, servo amplifier and servo motor power line from overloads. Overload 1 alarm (50) occurs if overload operation performed is above the electronic thermal relay protection curve shown in any of Figs 10.1. Overload 2 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 a 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.
When you carry out adhesion mounting of the servo amplifier, make circumference temperature into 0 to 45℃, or use it at 75% or smaller effective load ratio.
Servo amplifier MR-J3 series has solid-state servo motor overload protection. (The motor full load current is 115% rated current.)



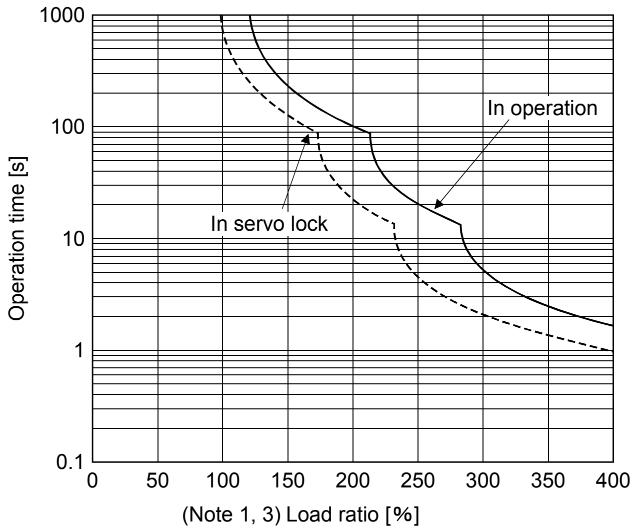
MR-J3-10□S(1)



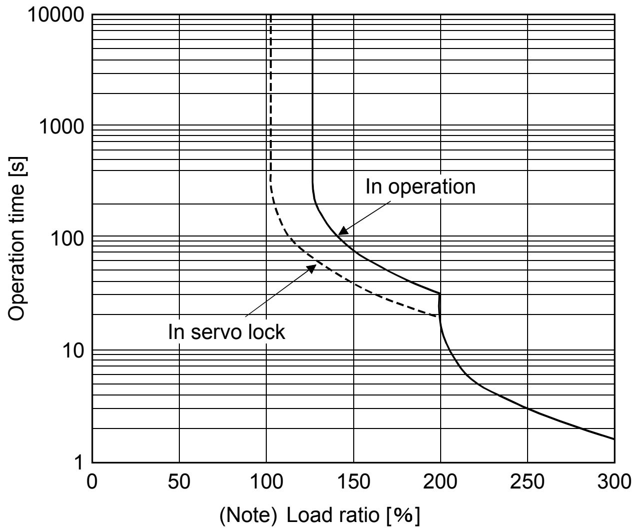
MR-J3-20□S(1) · MR-J3-40□S(1)
MR-J3-60□S(4) to MR-J3-100□S(4)



MR-J3-200□S(4) to MR-J3-350□S(4)



MR-J3-500□S(4) · MR-J3-700□S(4)



MR-J3-11K□S(4) to MR-J3-22K□S(4)

Note 1. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo lock status) or in a 30r/min or less low-speed operation status, the servo amplifier may fail even when the electronic thermal relay protection is not activated.

2. The operation time at the load ratio of 300 to 350% applies when the maximum torque of HF-KP series servo motor is increased to 350%.

3. The operation time at the load ratio of 300 to 400% applies when the maximum torque of HF-JP series servo motor is increased to 400%.

Fig. 10.1 Electronic thermal relay protection characteristics

10.2 Power supply equipment capacity and generated loss

(1) Amount of heat generated by the servo amplifier

Table 10.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 10.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and servo-off 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.

Locating the heat sink outside of the cabinet reduces the amount of generated heat and enables you to design a compact enclosed cabinet.

The values of the HF-JP53 (4) to the HF-JP503 (4) in the following table show the values when the servo motor operates at the maximum torque of 300%.

The values are the same when the servo motor operates at the maximum torque of 400%.

Table 10.1 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 [m²]
			At rated torque	At rated torque [Amount of heat inside the cabinet when the part of the servo amplifier outside the cabinet is cooled]	With servo-off	
MR-J3-10□S(1)	HF-MP053	0.3	25		15	0.5
	HF-MP13	0.3	25		15	0.5
	HF-KP053・13	0.3	25		15	0.5
MR-J3-20□S(1)	HF-MP23	0.5	25		15	0.5
	HF-KP23	0.5	25		15	0.5
MR-J3-40□S(1)	HF-MP43	0.9	35		15	0.7
	HF-KP43	0.9	35		15	0.7
MR-J3-60□S(4)	HF-SP52(4)	1.0	40		15	0.8
	HF-SP51	1.0	40		15	0.8
	HC-LP52	1.0	40		15	0.8
	HF-JP53(4)	1.0	40		15	0.8
MR-J3-70□S	HF-MP73	1.3	50		15	1.0
	HF-KP73	1.3	50		15	1.0
	HC-UP72	1.3	50		15	1.0
	HF-JP73	1.3	50		15	1.0
MR-J3-100□S(4)	HF-SP102(4)	1.7	50		15	1.0
	HF-SP81	1.5	50		15	1.0
	HC-LP102	1.7	50		15	1.0
	HF-JP734	1.3	50		15	1.0
	HF-JP103(4)	1.7	50		15	1.0

Servo amplifier	Servo motor	(Note 1) Power supply capacity [kVA]	(Note 2) Servo amplifier-generated heat [W]			Area required for heat dissipation [m^2]
			At rated torque	At rated torque [Amount of heat inside the cabinet when the part of the servo amplifier outside the cabinet is cooled]	With servo-off	
MR-J3-200□S・200□S4	HF-SP152(4)	2.5	90		20	1.8
	HF-SP202(4)	3.5	90		20	1.8
	HF-SP121	2.1	90		20	1.8
	HF-SP201	3.5	90		20	1.8
	HC-RP103	1.7	50		15	1.0
	HC-RP153	2.5	90		20	1.8
	HC-UP152	2.5	90		20	1.8
	HC-LP152	2.5	90		20	1.8
	HF-JP153(4)	2.5	90		20	1.8
	HF-JP203(4)	3.5	90		20	1.8
MR-J3-350□S(4)	HF-SP352(4)	5.5	130		20 (25) (Note 3)	2.7
	HC-RP203	3.5	90		20	1.8
	HC-UP202	3.5	90		20	1.8
	HC-LP202	3.5	90		20	1.8
	HF-SP301	4.8	120		20	2.4
	HF-JP353(4)	5.5	160		25	2.7
MR-J3-500□S(4)	HF-SP502(4)	7.5	195		25	3.9
	HC-RP353	5.5	135		25	2.7
	HC-RP503	7.5	195		25	3.9
	HC-UP352	5.5	195		25	3.9
	HC-UP502	7.5	195		25	3.9
	HC-LP302	4.8	120		25	2.4
	HA-LP502	7.5	195		25	3.9
	HF-SP421	6.3	160		25	3.2
	HF-JP503(4)	7.5	195		25	3.9
MR-J3-700□S(4)	HF-SP702(4)	10	300		25	6.0
	HA-LP702	10	300		25	6.0
	HA-LP601(4)	8.6	260		25	5.2
	HA-LP701M(4)	10	300		25	6.0
	HF-JP703(4)	10	300		25	6.0
MR-J3-11K□S(4)	HA-LP11K2(4)	16	530	160	45	11.0
	HA-LP801(4)	12	390	120	45	7.8
	HA-LP12K1(4)	18	580	175	45	11.6
	HA-LP11K1M(4)	16	530	160	45	11.0
	HF-JP903(4)	13	435	130	45	8.7
	HF-JP11K1M(4) (Note 4)	16	530	160	45	11.0
MR-J3-15K□S(4)	HA-LP15K2(4)	22	640	195	45	13.0
	HA-LP15K1(4)	22	640	195	45	13.0
	HA-LP15K1M(4)	22	640	195	45	13.0
	HF-JP15K1M(4) (Note 4)	22	640	195	45	13.0

Servo amplifier	Servo motor	(Note 1) Power supply capacity [kVA]	(Note 2) Servo amplifier-generated heat [W]			Area required for heat dissipation [m^2]
			At rated torque	At rated torque [Amount of heat inside the cabinet when the part of the servo amplifier outside the cabinet is cooled]	With servo-off	
MR-J3-22K☐S(4)	HA-LP22K2(4)	33	850	260	55	17.0
	HA-LP20K1(4)	30	775	235	55	15.5
	HA-LP25K1	38	970	295	55	19.4
	HA-LP22K1M(4)	33	850	260	55	17.0

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value is applicable when the power factor improving AC reactor or power factor improving DC reactor are not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 11.2.

3. For 400V class, the value is within the ( ).

4. The servo amplifiers, which support these servo motors, have "-LR" at the end of their model names.

(2) Heat dissipation area for enclosed servo amplifier
The enclosed cabinet (hereafter called the cabinet) which will contain the servo amplifier should be designed to ensure that its temperature rise is within +10℃ at the ambient temperature of 40℃. (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 10.1.

$$A = \frac{P}{K \cdot \Delta T} \qquad (10.1)$$

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

When calculating the heat dissipation area with Equation 10.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 10.1 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.
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 cooling fan should be considered.
Table 10.1 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.

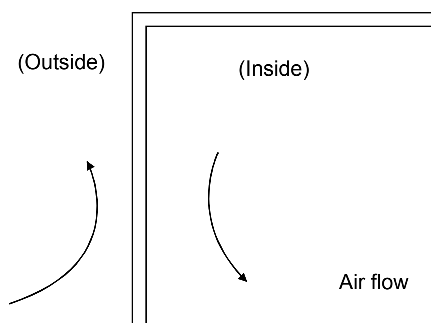


Fig. 10.2 Temperature distribution in enclosure

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.

10.3 Dynamic brake characteristics

POINT
・Dynamic brake operates at occurrence of alarm, servo forced stop warning (E6), and controller forced stop warning (E7), and when power is turned off. Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency. ・Maximum usage time of dynamic brake for a machine operating under recommended load inertia moment ratio is 1000 time while decelerating from rated speed to a stop with frequency of once in 10 minutes. ・Be sure to make forced stop 1 (EM1) valid after servo motor stops when using forced stop 1 (EM1) frequently in other than emergency.

10.3.1 Dynamic brake operation

(1) Calculation of coasting distance

Fig. 10.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 10.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (2)(a), (b) of this section.)

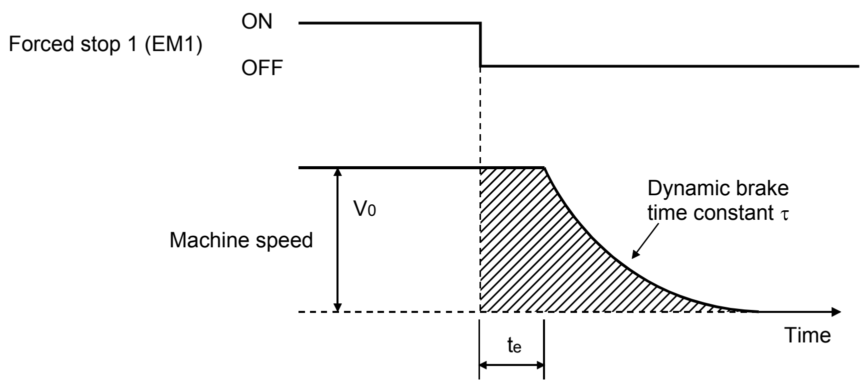


Fig. 10.3 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \quad \cdots\cdots (10.2)$$

L_{max} : Maximum coasting distance ··· [mm][in]

V_o : Machine rapid feed rate ··· [mm/min][in/min]

J_M : Servo motor inertial moment ··· [$\times 10^{-4}$kg・m^2][oz・in^2]

J_L : Load inertia moment converted into equivalent value on servo motor shaft ··· [$\times 10^{-4}$kg・m^2][oz・in^2]

τ : Dynamic brake time constant ··· [s]

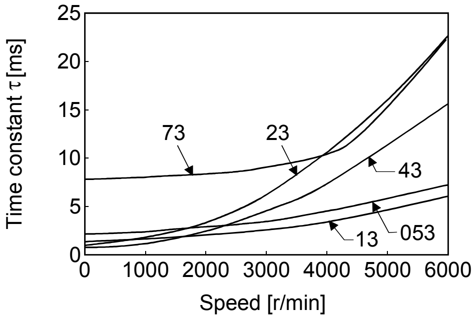
t_e : Delay time of control section ··· [s]

For 7kW or lower servo, there is internal relay delay time of about 10ms. For 11k to 22kW servo, there is delay caused by magnetic contactor built into the external dynamic brake (about 50ms) and delay caused by the external relay.

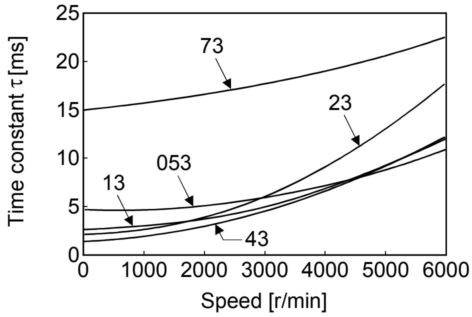
(2) Dynamic brake time constant

The following shows necessary dynamic brake time constant τ for the equations (10.2).

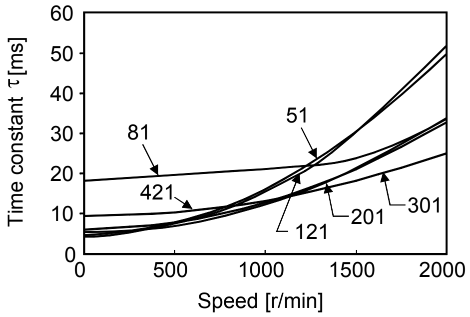
(a) 200V class servo motor



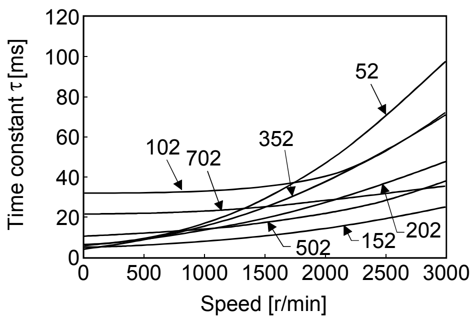
HF-MP series



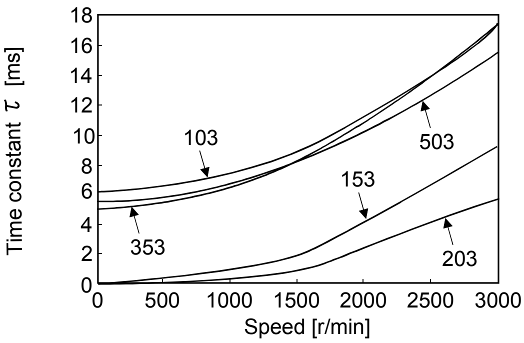
HF-KP series



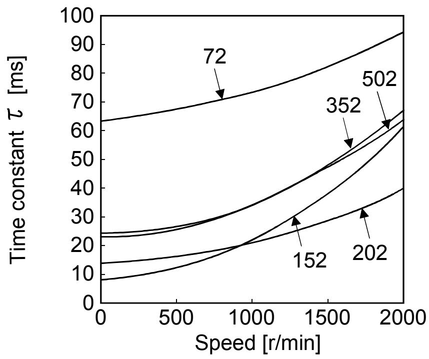
HF-SP1000r/min series



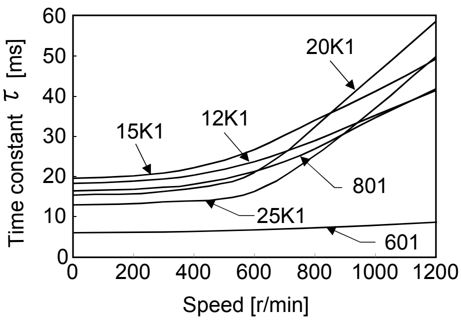
HF-SP2000r/min series



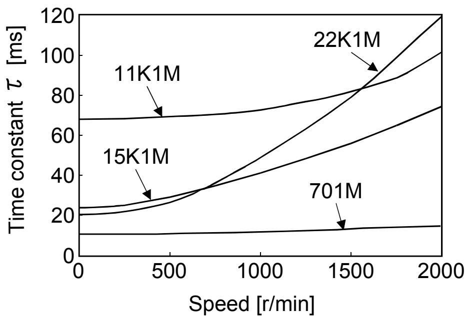
HC-RP series



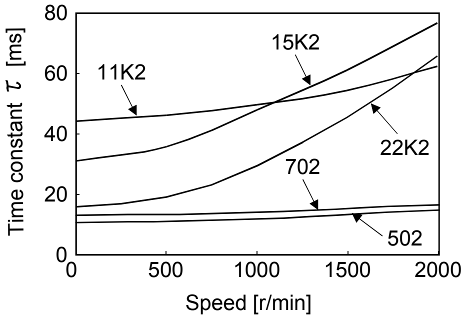
HC-UP series



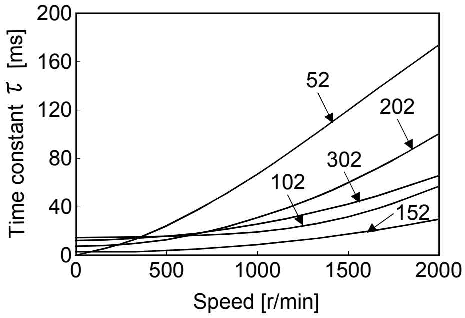
HA-LP1000r/min series



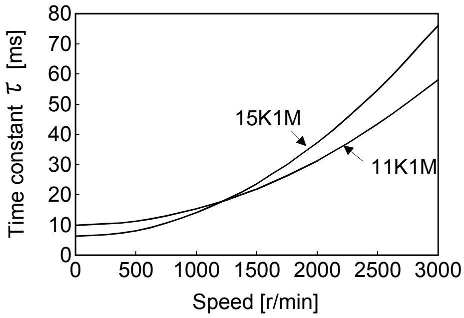
HA-LP1500r/min series



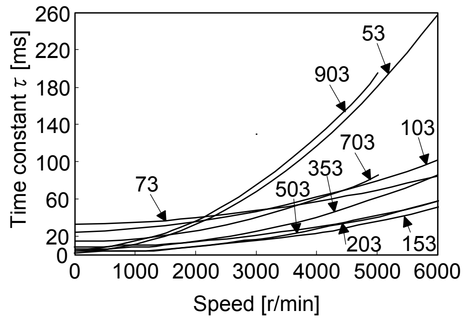
HA-LP2000r/min series



HC-LP series

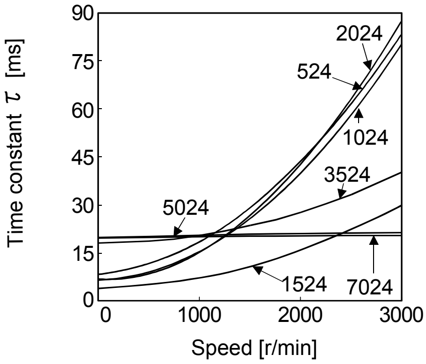


HA-JP1500r/min series

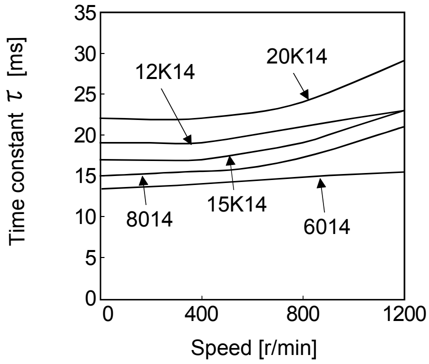


HF-JP3000r/min series

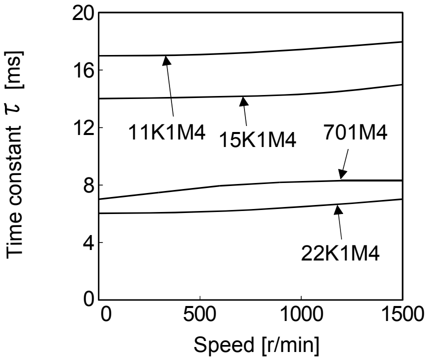
(b) 400V class servo motor



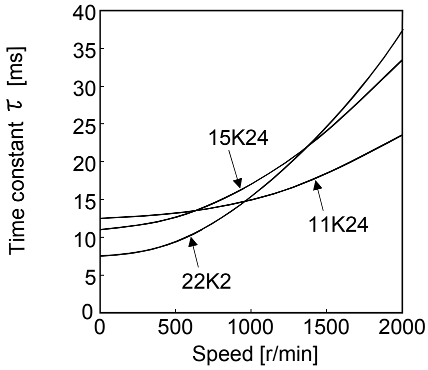
HA-SP2000r/min series



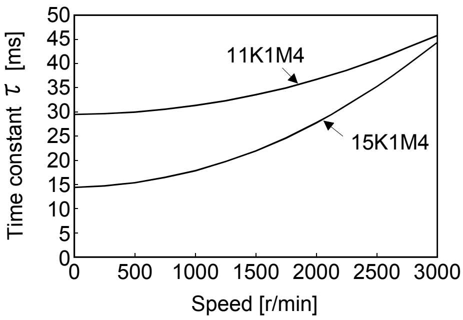
HA-LP1000r/min series



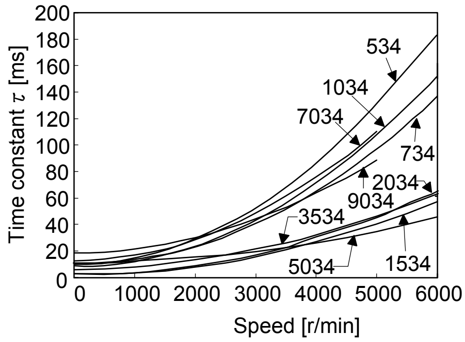
HA-LP1500r/min series



HA-LP2000r/min series



HF-JP1500r/min series



HF-JP3000r/min series

10.3.2 The dynamic brake at the load inertia moment

Use the dynamic brake under the load inertia moment ratio indicated in the following table. If the load inertia moment is higher than this value, the dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact your local sales office.
The values of the load inertia moment ratio in the table are the values at the maximum rotation speed of the servo motor.

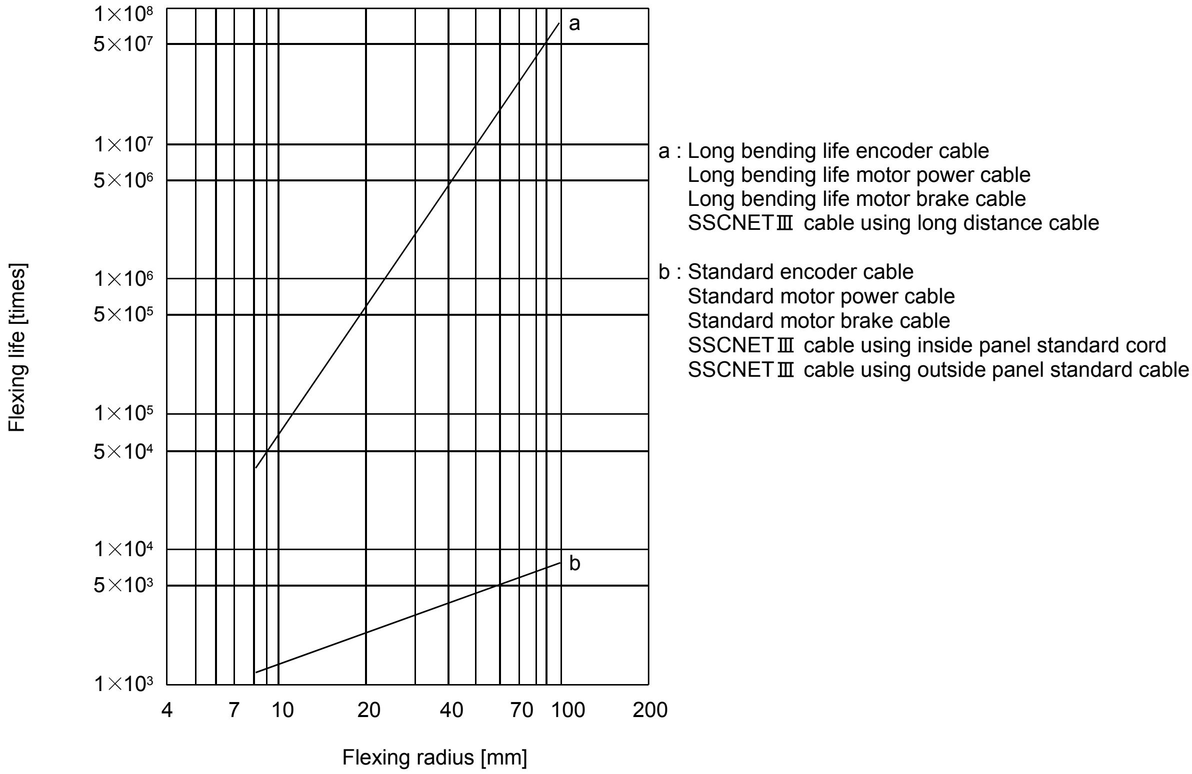
Servo amplifier	Servo motor											
	HF-KP□	HF-MP□	HF-SP□1	HF-SP□2	HC-RP□	HC-UP□	HC-LP□	HA-LP□1	HA-LP□1M	HA-LP□2	HF-JP□	HF-JP□1M
MR-J3-10□S(1)	30	30										
MR-J3-20□S(1)	30	30										
MR-J3-40□S(1)	30	30										
MR-J3-60□S			30	30			30				30	
MR-J3-70□S	30	30				30						
MR-J3-100□S			30	30			30				30	
MR-J3-200□S			30	30	30	30	30				30	
MR-J3-350□S			16	16	16	16	16				16 (Note 3)	
MR-J3-500□S			15	15	15	15	15			15	15 (Note 3)	
MR-J3-700□S				5 (Note 1)				5 (Note 1)	5 (Note 1)	5 (Note 1)		
MR-J3-11K□S (Note 2)								30	30	30		10 (Note 3)
MR-J3-15K□S (Note 2)								30	30	30		10 (Note 3)
MR-J3-22K□S (Note 2)								30	30	30		

Servo amplifier	Servo motor					
	HF-SP□4	HA-LP□14	HA-LP□1M4	HA-LP□24	HF-JP□4	HF-JP□1M4
MR-J3-60□S4	5 (Note 1)				30	
MR-J3-100□S4	5 (Note 1)				30	
MR-J3-200□S4	5 (Note 1)				30	
MR-J3-350□S4	5 (Note 1)				30	
MR-J3-500□S4	5 (Note 1)				15 (Note 3)	
MR-J3-700□S4	5 (Note 1)	10	10		11 (Note 3)	
MR-J3-11K□S4 (Note 2)		30	30	30	18 (Note 3)	10 (Note 3)
MR-J3-15K□S4 (Note 2)		30	30	30		10 (Note 3)
MR-J3-22K□S4 (Note 2)		30	30	30		

Note 1. The load inertia moment ratio is 15 at the rated rotation speed.
2. When the external dynamic brake is used.
3. The load inertia moment ratio is 30 at the rated rotation speed.

10.4 Cable flexing life

The flexing life of the cables is shown below. This graph calculated values. Since they are not guaranteed values, provide a little allowance for these values.



10.5 Inrush currents at power-on of main circuit and control circuit

The following table indicates the inrush currents (reference data) that will flow when the maximum permissible voltage (200V class: 253VAC, 400V class: 528VAC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

Servo amplifier	Inrush currents (A_{0-p})	
	Main circuit power supply (L_1, L_2, L_3)	Control circuit power supply (L_{11}, L_{21})
MR-J3-10□S1 to 40□S1	38A (Attenuated to approx. 14A in 10ms)	20 to 30A (Attenuated to approx. 0A in 1 to 2ms)
MR-J3-10□S to 60□S	30A (Attenuated to approx. 5A in 10ms)	
MR-J3-70□S・100□S	54A (Attenuated to approx. 12A in 10ms)	
MR-J3-200□S・350□S	120A (Attenuated to approx. 12A in 20ms)	
MR-J3-500□S	44A (Attenuated to approx. 20A in 20ms)	30A (Attenuated to approx. 0A in 3ms)
MR-J3-700□S	88A (Attenuated to approx. 20A in 20ms)	
MR-J3-11K□S	235A (Attenuated to approx. 20A in 20ms)	
MR-J3-15K□S		
MR-J3-22K□S		
MR-J3-60□S4・100□S4	100A (Attenuated to approx. 5A in 10ms)	40 to 50A (Attenuated to approx. 0A in 2ms)
MR-J3-200□S4	120A (Attenuated to approx. 12A in 20ms)	
MR-J3-350□S4・500□S4	66A (Attenuated to approx. 10A in 20ms)	41A (Attenuated to approx. 0A in 3ms)
MR-J3-700□S4	67A (Attenuated to approx. 34A in 20ms)	
MR-J3-11K□S4	325A (Attenuated to approx. 20A in 20ms)	45A (Attenuated to approx. 0A in 3ms)
MR-J3-15K□S4		
MR-J3-22K□S4		

Since large inrush currents flow in the power supplies, always use molded-case circuit breakers and magnetic contactors. (Refer to section 11.12.)
When circuit protectors are used, it is recommended to use the inertia delay type that will not be tripped by an inrush current.

11. OPTIONS AND AUXILIARY EQUIPMENT

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

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

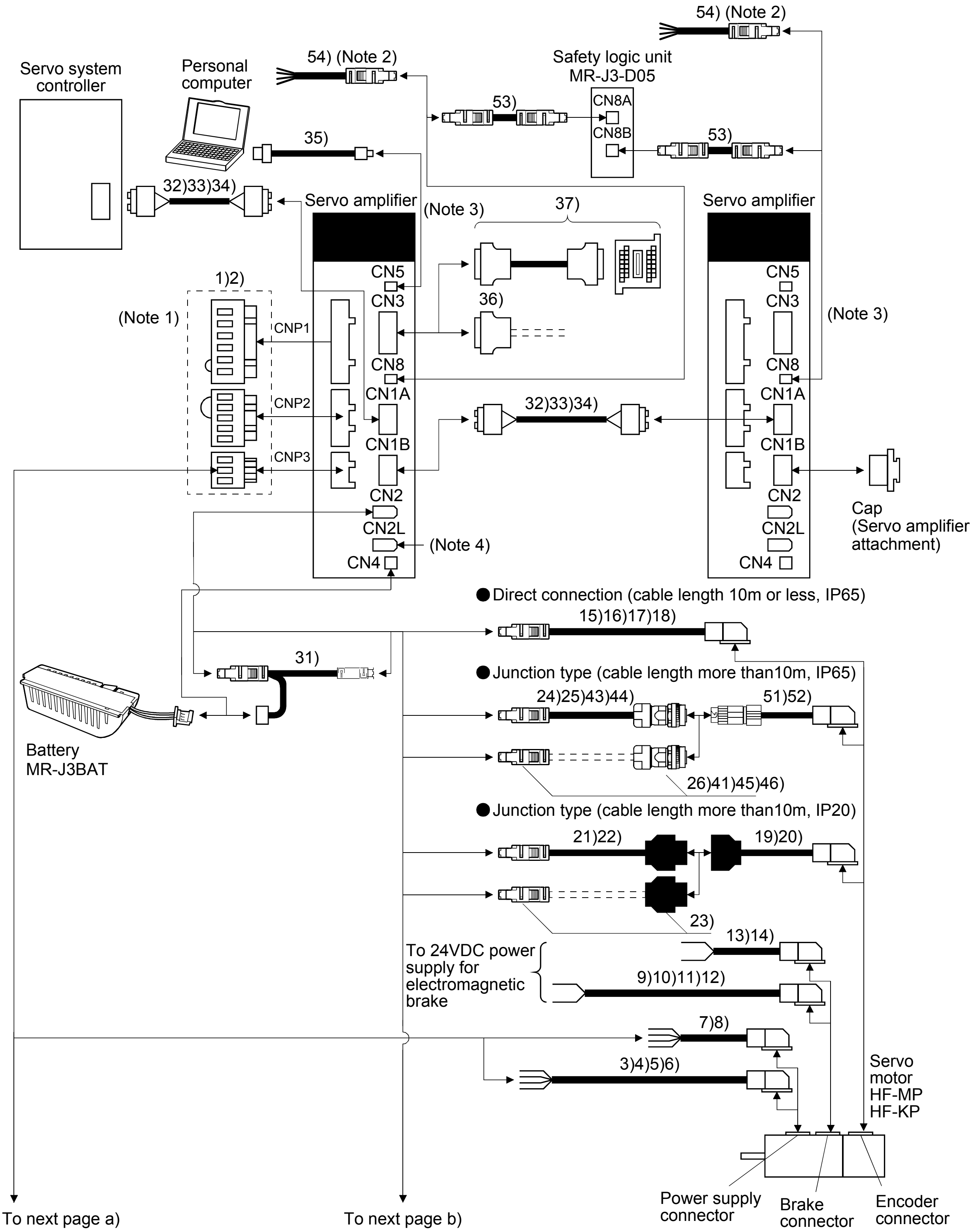
11.1 Cable/connector sets

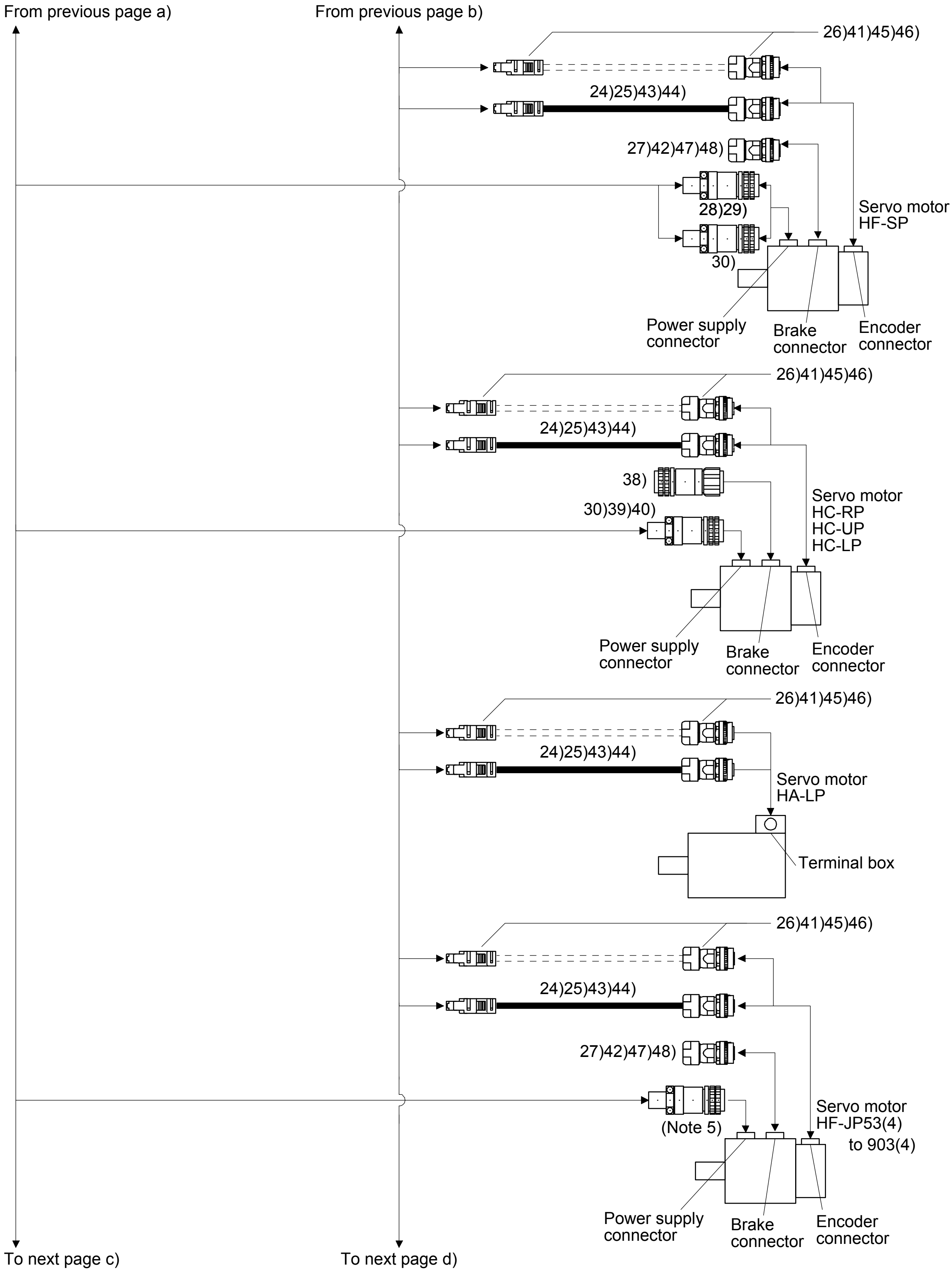
POINT

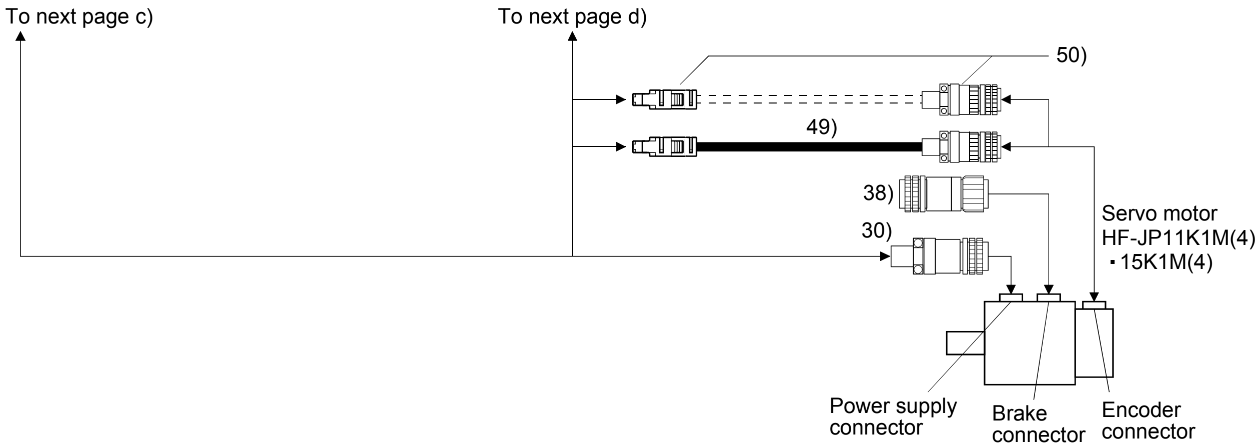
・The IP rating indicated is the cable's or connector's protection against ingress of dust and water when the cable or connector is connected to a servo amplifier or servo motor. If the IP rating of the cable, connector, servo amplifier and servo motor vary, the overall IP rating depends on the lowest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

As the cables and connectors used with this servo, purchase the options indicated in this section.

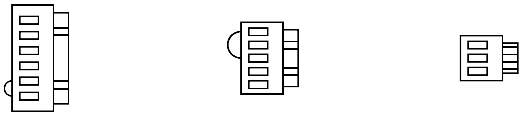
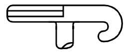
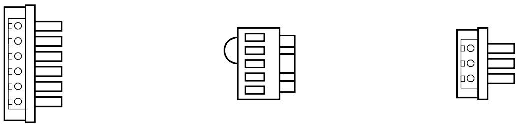
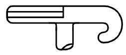
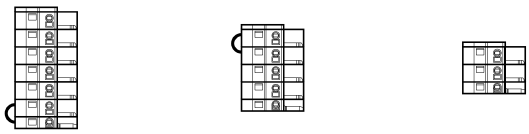
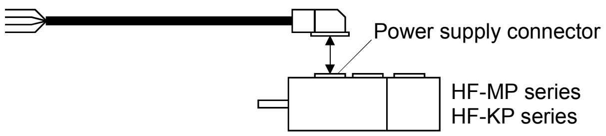
11.1.1 Combinations of cable/connector sets

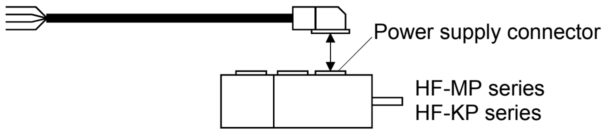
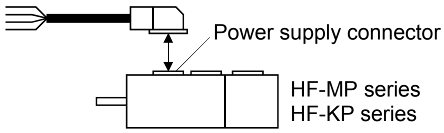
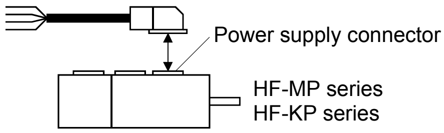
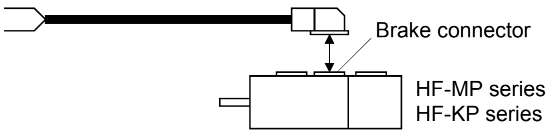
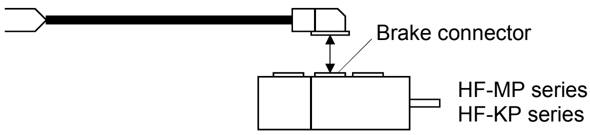
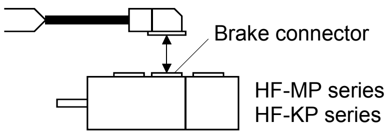
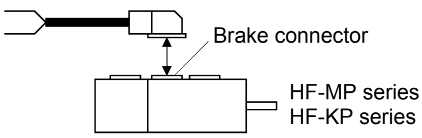


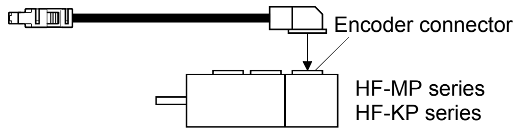
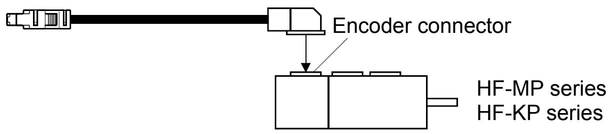
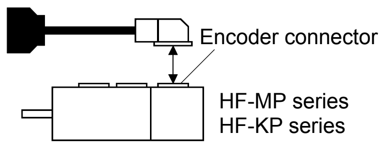
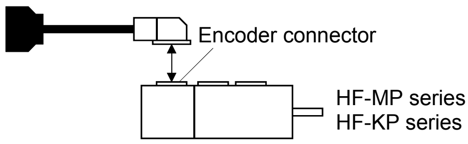

From previous page a)
From previous page b)
26)41)45)46)
24)25)43)44)
27)42)47)48)
28)29)
30)
Servo motor
HF-SP
Power supply connector
Brake connector
Encoder connector
26)41)45)46)
24)25)43)44)
38)
30)39)40)
Servo motor
HC-RP
HC-UP
HC-LP
Power supply connector
Brake connector
Encoder connector
26)41)45)46)
24)25)43)44)
Servo motor
HA-LP
Terminal box
26)41)45)46)
24)25)43)44)
27)42)47)48)
(Note 5)
Servo motor
HF-JP53(4)
to 903(4)
Power supply connector
Brake connector
Encoder connector
To next page c)
To next page d)

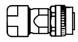
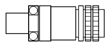
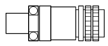
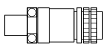
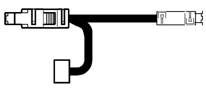
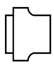


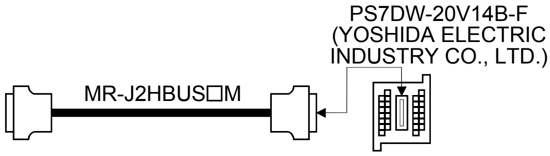
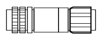
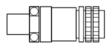
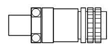
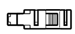
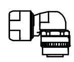
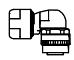
Note 1. Connectors for 3.5kW or less. For 5kW or more, terminal blocks.
2. When connecting with a safety relay.
3. When not using the STO function, attach a short-circuit connecter (55)) supplied with a servo amplifier.
4. Load-side encoder connector.
Use this to connect the load-side encoder. Refer to section 14.2.
5. Use 28) for HF-JP53 to 203, and 534 to 5034. Use 29) for HF-JP353 and 503. Use 30) for HF-JP703(4) and 903(4).

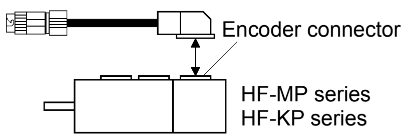
No.	Product	Model	Description	Application
1)	Servo amplifier power supply connector		 CNP1 connector: 54928-0610 (Molex) CNP2 connector: 54927-0520 (Molex) CNP3 connector: 54928-0310 (Molex) Example of applicable cable Wire size: 0.14mm²(AWG26) to 2.5mm² (AWG14) Cable finish OD: to ϕ3.8mm  REC. Lever: 54932-0000 (Molex)	Supplied with servo amplifiers of 1kW or less in 100V class and 200V class
2)	Servo amplifier power supply connector		 CNP1 connector: PC4/6-STF-7.62-CRWH (Phoenix Contact) CNP2 connector: 54927-0520 (Molex) CNP3 connector: PC4/3-STF-7.62-CRWH (Phoenix Contact) Example of applicable cable Wire size: 0.2mm² (AWG24) to 5.5mm² (AWG10) Cable finish OD: to ϕ5mm  REC. Lever: 54932-0000 (Molex)	Supplied with servo amplifiers of 3.5kW in 200V class
			 CNP1 connector: 721-207/026-000 (Plug) (WAGO) CNP2 connector: 721-205/026-000 (Plug) (WAGO) CNP3 connector: 721-203/026-000 (Plug) (WAGO) Example of applicable cable Wire size: 0.08mm² (AWG28) to 2.5mm² (AWG12) Cable finish OD: to ϕ4.1mm  REC. Lever: 231-131 (WAGO)	Supplied with servo amplifiers of 2kW in 200V class and 2kW in 400V class
3)	Motor power supply cable	MR-PWS1CBL☐M-A1-L Cable length: 2・5・10m		IP65 Load-side lead IEC/EN standard compliant
4)	Motor power supply cable	MR-PWS1CBL☐M-A1-H Cable length: 2・5・10m	Refer to section 11.1.3 for details.	IP65 Load-side lead Long bending life IEC/EN standard compliant

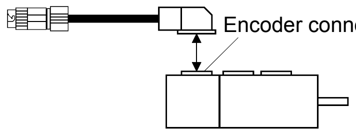
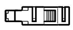
No.	Product	Model	Description	Application
5)	Motor power supply cable	MR-PWS1CBL☐M-A2-L Cable length: 2・5・10m	 Refer to section 11.1.3 for details.	IP65 Opposite to load-side lead IEC/EN standard compliant
6)	Motor power supply cable	MR-PWS1CBL☐M-A2-H Cable length: 2・5・10m		IP65 Opposite to load-side lead Long bending life IEC/EN standard compliant
7)	Motor power supply cable	MR-PWS2CBL03M-A1-L Cable length: 0.3m	 Refer to section 11.1.3 for details.	IP55 Load-side lead IEC/EN standard compliant
8)	Motor power supply cable	MR-PWS2CBL03M-A2-L Cable length: 0.3m	 Refer to section 11.1.3 for details.	IP55 Opposite to load-side lead IEC/EN standard compliant
9)	Motor brake cable	MR-BKS1CBL☐M-A1-L Cable length: 2・5・10m	 Refer to section 11.1.4 for details.	IP65 Load-side lead
10)	Motor brake cable	MR-BKS1CBL☐M-A1-H Cable length: 2・5・10m		IP65 Load-side lead Long bending life
11)	Motor brake cable	MR-BKS1CBL☐M-A2-L Cable length: 2・5・10m	 Refer to section 11.1.4 for details.	IP65 Opposite to load-side lead
12)	Motor brake cable	MR-BKS1CBL☐M-A2-H Cable length: 2・5・10m		IP65 Opposite to load-side lead Long bending life
13)	Motor brake cable	MR-BKS2CBL03M-A1-L Cable length: 0.3m	 Refer to section 11.1.4 for details.	IP55 Load-side lead
14)	Motor brake cable	MR-BKS2CBL03M-A2-L Cable length: 0.3m	 Refer to section 11.1.4 for details.	IP55 Opposite to load-side lead

No.	Product	Model	Description	Application
15)	Encoder cable	MR-J3ENCBL☐M-A1-L Cable length: 2・5・10m	 Refer to section 11.1.2 (1) for details.	IP65 Load-side lead
16)	Encoder cable	MR-J3ENCBL☐M-A1-H Cable length: 2・5・10m		IP65 Load-side lead Long bending life
17)	Encoder cable	MR-J3ENCBL☐M-A2-L Cable length: 2・5・10m	 Refer to section 11.1.2 (1) for details.	IP65 Opposite to load-side lead
18)	Encoder cable	MR-J3ENCBL☐M-A2-H Cable length: 2・5・10m		IP65 Opposite to load-side lead Long bending life
19)	Encoder cable	MR-J3JCBL03M-A1-L Cable length: 0.3m	 Refer to section 11.1.2 (3) for details.	IP20 Load-side lead
20)	Encoder cable	MR-J3JCBL03M-A2-L Cable length: 0.3m	 Refer to section 11.1.2 (3) for details.	IP20 Opposite to load-side lead
21)	Encoder cable	MR-EKCBL☐M-L Cable length: 20・30m	 For HF-MP・HF-KP series Refer to section 11.1.2 (2) for details.	IP20
22)	Encoder cable	MR-EKCBL☐M-H Cable length: 20・30・40・50m		IP20 Long bending life
23)	Encoder connector set	MR-ECNM	 For HF-MP・HF-KP series Refer to section 11.1.2 (2) for details.	IP20
24)	Encoder cable	MR-J3ENSCBL☐M-L Cable length: 2・5・10・20・30m	 For HF-KP・HF-MP・HF-SP・HC-UP・HC-LP・HC-RP・HA-LP series HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67 Standard flex life
25)	Encoder cable	MR-J3ENSCBL☐M-H Cable length: 2・5・10・20・30・40・50m		IP67 Long bending life
26)	Encoder connector set	MR-J3SCNS	 For HF-KP・HF-MP・HF-SP・HC-UP・HC-LP・HC-RP・HA-LP series HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67

No.	Product	Model	Description	Application
27)	Brake connector set	MR-BKCNS1	Straight plug: CM10-SP2S-L (D6) Socket contact: CM10-#22SC(S2)(D8)-100 (DDK)  For HF-SP series For HF-JP53(4) to 903(4)	IP67
28)	Power supply connector set	MR-PWCNS4	Plug: CE05-6A18-10SD-D-BSS Cable clamp: CE3057-10A-1-D (DDK) Example of applicable cable Applicable wire size: 2mm² (AWG14) to 3.5mm² (AWG12) Cable finish ϕD: ϕ10.5 to 14.1mm  For HF-SP51・81 For HF-SP52・152 For HF-JP53 to 203 For HF-JP534 to 5034	IP67 EN standard compliant
29)	Power supply connector set	MR-PWCNS5	Plug: CE05-6A22-22SD-D-BSS Cable clamp: CE3057-12A-1-D (DDK) Example of applicable cable Applicable wire size: 5.5mm² (AWG10) to 8mm² (AWG8) Cable finish ϕD: ϕ12.5 to 16mm  For HF-SP121 to 301 For HF-SP202 to 502 For HF-JP353 to 503	IP67 EN standard compliant
30)	Power supply connector set	MR-PWCNS3	Plug: CE05-6A32-17SD-D-BSS Cable clamp: CE3057-20A-1-D (DDK) Example of applicable cable Applicable wire size: 14mm² (AWG6) to 22mm² (AWG4) Cable finish ϕD: ϕ22 to 23.8mm  For HF-SP421 For HF-SP702 For HA-LP702 For HF-JP703(4)・903(4)・11K1M(4)・15K1M(4)	IP67 EN standard compliant
31)	Cable for connecting battery	MR-J3BTCBL03M	 Refer to section 11.1.2 (7) for details.	For connection of battery
32)	SSCNETⅢ cable	MR-J3BUS□M Cable length: 0.15 to 3m (Refer to section 11.1.6.)	Connector: PF-2D103 (Japan Aviation Electronics Industry, Ltd.) Connector: PF-2D103 (Japan Aviation Electronics Industry, Ltd.) 	Inside panel standard cord
33)	SSCNETⅢ cable	MR-J3BUS□M-A Cable length: 5 to 20m (Refer to section 11.1.6.)		Outside panel standard cable
34)	SSCNETⅢ cable	MR-J3BUS□M-B Cable length: 30 to 50m (Refer to section 11.1.6.)	Connector: CF-2D103-S (Japan Aviation Electronics Industry, Ltd.) Connector: CF-2D103-S (Japan Aviation Electronics Industry, Ltd.) 	Long distance cable
35)	USB cable	MR-J3USBCBL3M Cable length: 3m	For CN5 connector mini-B connector (5 pins) For personal computer connector A connector 	For connection with PC-AT compatible personal computer
36)	Connector set	MR-CCN1	 Connector: 10120-3000PE Shell kit: 10320-52F0-008 (3M or similar product)	

No.	Product	Model	Description	Application
37)	Junction terminal block (Recommended)		 Junction terminal block PS7DW-20V14B-F is not option. For using the junction terminal block, option MR-J2HBUS□M is necessary. Refer to section 11.7 for details.	
38)	Break connector set	MR-BKCN	Plug: D/MS3106A10SL-4S(D190) (DDK) Cable clamp: YS010-5-8(Daiwa Dengyo) Example of applicable cable Applicable wire size: 0.3mm² (AWG22) to 1.25mm² (AWG16) Cable finish: ϕ5 to 8.3mm  For HA-LP For HC-UP For HC-LP For HF-JP11K1M(4)・15K1M(4)	IP65
39)	Power supply connector set	MR-PWCNS1	Plug: CE05-6A22-23SD-D-BSS Cable clamp: CE3057-12A-2-D (DDK) Example of applicable cable Applicable wire size: 2mm² (AWG14) to 3.5mm² (AWG12) Cable finish: ϕ9.5 to 13mm  For HC-UP For HC-LP For HC-RP	IP65 EN standard compliant
40)	Power supply connector set	MR-PWCNS2	Plug: CE05-6A24-10SD-D-BSS Cable clamp: CE3057-16A-2-D (DDK) Example of applicable cable Applicable wire size: 5.5mm² (AWG10) to 8mm² (AWG8) Cable finish: ϕ13 to 15.5mm  For HA-LP For HC-UP For HC-LP For HC-RP	
41)	Encoder connector set	MR-J3SCNSA	  For HF-SP・HA-LP・HC-UP・HC-LP・HC-RP series・HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67
42)	Brake connector set	MR-BKCNS1A	Angle plug: CM10-AP2S-L(D6) Socket contact: CM10-# 22SC(S2)(D8)-100 (DDK)  For HF-SP series・HF-JP53(4) to 903(4)	IP67
43)	Encoder cable	MR-J3ENSCBL□M-L-S06 Cable length: 2・5・10・20・30m	 For HF-SP・HA-LP・HC-UP・HC-LP・HC-RP series・HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67 Standard flex life (Note)
44)	Encoder cable	MR-J3ENSCBL□M-H-S06 Cable length: 2・5・10・20・30・40・50m		IP67 Long bending life (Note)

No.	Product	Model	Description	Application
45)	Encoder connector set	MR-J3SCNS-S06	 For HF-SP・HA-LP・HC-UP・HC-LP・HC-RP series・HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67 (Note)
46)	Encoder connector set	MR-J3SCNSA-S06	 For HF-SP・HA-LP・HC-UP・HC-LP・HC-RP series・HF-JP53(4) to 903(4) Refer to section 11.1.2 (5) for details.	IP67 (Note)
47)	Brake connector set	MR-BKCNS1-S06	Straight plug: CM10-SP2S-VP-L Socket contact: CM10-#22SC (S2) (D8)-100 (DDK)  For HF-SP series・ HF-JP53(4) to 903(4)	IP67 (Note)
48)	Brake connector set	MR-BKCNS1A-S06	Angle plug: CM10-AP2S-VP-L Socket contact: CM10-#22SC (S2) (D8)-100 (DDK)  For HF-SP series・ HF-JP53(4) to 903(4)	IP67 (Note)
49)	Encoder cable for IP67	MR-ENECBL☐M-H Refer to section 11.1.2 (6).	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex) Plug: D/MS3106A20-29S(D190) Cable clamp: CE3057-12A-3-D Back shell: CE02-20BS-S-D (DDK)  For HF-JP11K1M(4) to 15K1M(4) Refer to section 11.1.2 (6) for details.	Long bending life IP67 It is not a resistance to oil.
50)	Encoder connector set	MR-ENECNS	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex) Plug: D/MS3106A20-29S(D190) Cable clamp: CE3057-12A-3-D Back shell: CE02-20BS-S-D (DDK)  For HF-JP11K1M(4) to 15K1M(4) Refer to section 11.1.2 (6) for details.	IP67
51)	Encoder cable	MR-J3JCBL03M-A1-L Cable length: 0.3m	 Refer to section 11.1.2 (4) for details.	IP65 Load-side lead

No.	Product	Model	Description	Application
52)	Encoder cable	MR-J3JCBL03M-A2-L Cable length: 0.3m	 Refer to section 11.1.2 (4) for details.	IP65 Opposite to load-side lead
53)	STO cable	MR-D05UDL□M Cable length: 0.3・1・3m	Connector set: 2069250-1 (TE Connectivity) Connector set: 2069250-1 (TE Connectivity) 	
54)	STO cable	MR-D05UDL3M-B	Connector set: 2069250-1 (TE Connectivity) 	
55)	Short-circuit connector			Supplied with servo amplifier

Note. Use this option when the connector is expected to receive large vibration and shock.

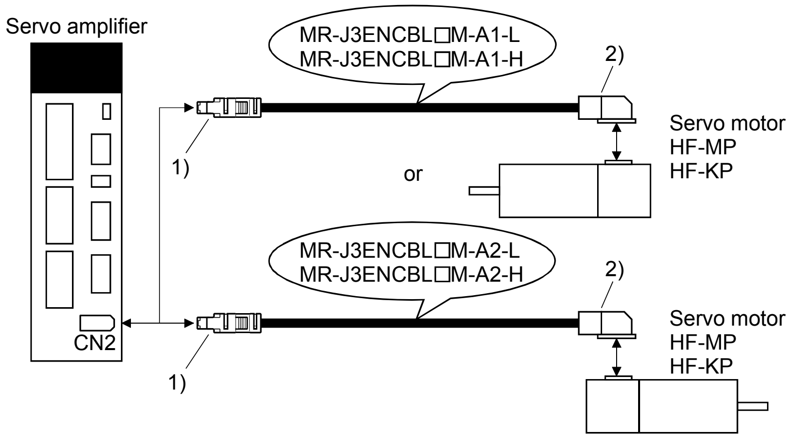
11.1.2 Encoder cable/connector sets

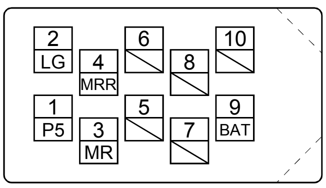
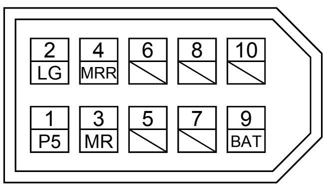
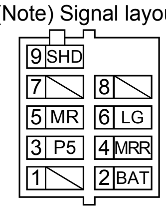
(1) MR-J3ENCBL☐M-A1-L/H・MR-J3ENCBL☐M-A2-L/H

These cables are encoder cables for the HF-MP・HF-KP series servo motors. The numerals in the Cable Length field of the table are the symbols entered in the ☐ part of the cable model. The cables of the lengths with the symbols are available.

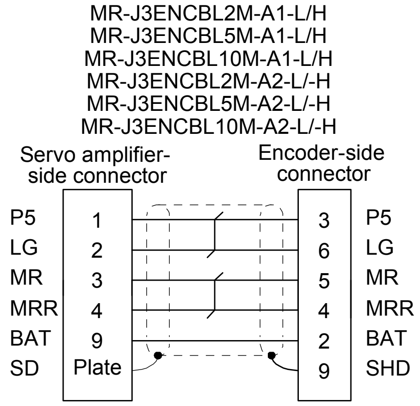
Cable model	Cable length			IP rating	Flex life	Application
	2m	5m	10m			
MR-J3ENCBL☐M-A1-L	2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Load-side lead
MR-J3ENCBL☐M-A1-H	2	5	10	IP65	Long bending life	
MR-J3ENCBL☐M-A2-L	2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Opposite to load-side lead
MR-J3ENCBL☐M-A2-H	2	5	10	IP65	Long bending life	

(a) Connection of servo amplifier and servo motor



Cable model	1) For CN2 connector	2) For encoder connector
MR-J3ENCBL☐M-A1-L MR-J3ENCBL☐M-A1-H MR-J3ENCBL☐M-A2-L MR-J3ENCBL☐M-A2-H	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) Connector set: 54599-1019(Molex) (Note) Signal layout  View seen from wiring side. or (Note) Signal layout  View seen from wiring side. Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (TE Connectivity) (Note) Signal layout  View seen from wiring side. Note. Keep open the pin shown with an ⧅.

(b) Cable internal wiring diagram



(2) MR-EKCBL☐M-L/H

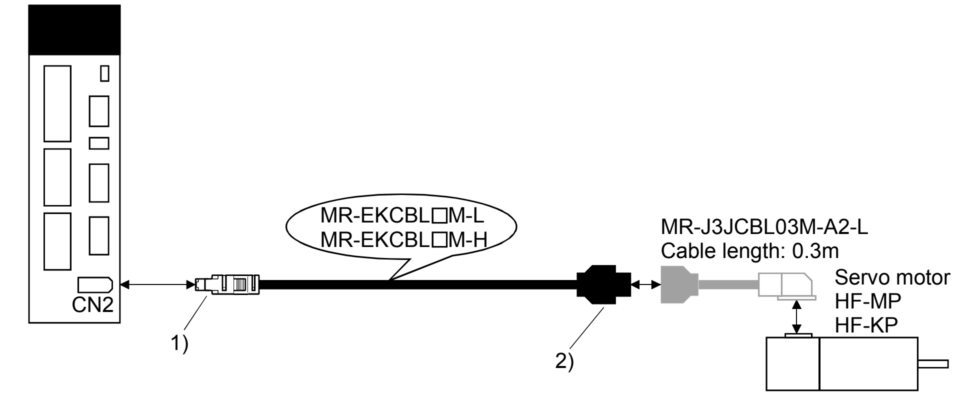
POINT
・The following encoder cables are of four-wire type. When using any of these encoder cables, set parameter No.PC04 to "1☐☐☐" to select the four-wire type. MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H

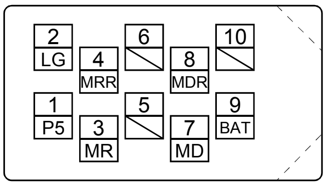
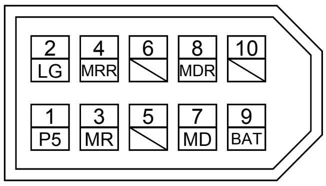
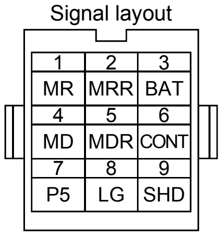
The servo amplifier and servo motor cannot be connected with these cables only. The servo motor-side encoder cable (MR-J3JCBL03M-A1-L or MR-J3JCBL03M-A2-L) is required.
The numerals in the Cable Length field of the table are the symbols entered in the ☐ part of the cable model. The cables of the lengths with the symbols are available.

<table>
<tr><th rowspan="2">Cable model</th><th colspan="4">Cable length</th><th rowspan="2">IP rating</th><th rowspan="2">Flex life</th><th rowspan="2">Application</th></tr>
<tr><th>20m</th><th>30m</th><th>40m</th><th>50m</th></tr>
<tr><td>MR-EKCBL☐M-L</td><td>20</td><td>(Note)
30</td><td></td><td></td><td>IP20</td><td>Standard</td><td rowspan="2">For HF-MP・HF-KP servo motor
Use in combination with MR-J3JCBL03M-A1-L or MR-J3JCBL03M-A2-L.</td></tr>
<tr><td>MR-EKCBL☐M-H</td><td>20</td><td>(Note)
30</td><td>(Note)
40</td><td>(Note)
50</td><td>IP20</td><td>Long bending life</td></tr>
</table>

Note. Four-wire type cable.

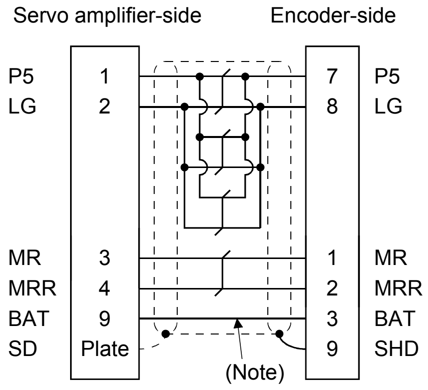
(a) Connection of servo amplifier and servo motor



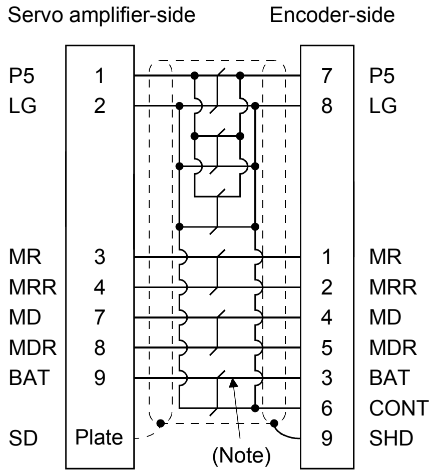
Cable model	1) For CN2 connector	2) For encoder connector
MR-EKCBL□M-L MR-EKCBL□M-H	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) Connector set: 54599-1019(Molex) (Note) Signal layout  View seen from wiring side. or (Note) Signal layout  View seen from wiring side. Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.	Housing: 1-172161-9 Crimping pin: 170359-1 (TE Connectivity or equivalent) Cable clamp: MTI-0002 (Toa Electric Industry) Signal layout  View seen from wiring side. Note. Keep open the pin shown with an ⧅.

(b) Internal wiring diagram

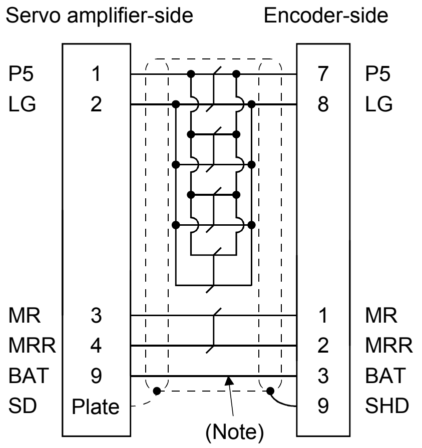
MR-EKCBL20M-L



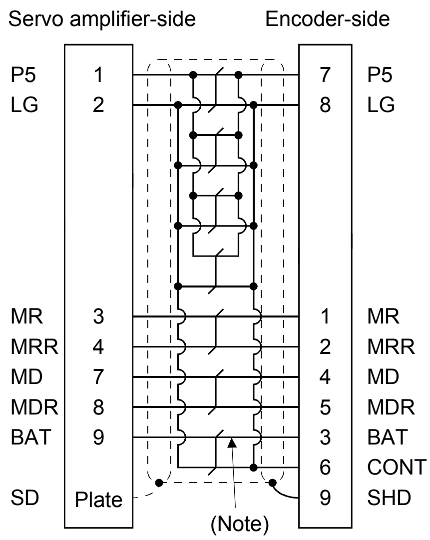
MR-EKCBL30M-L



MR-EKCBL20M-H



MR-EKCBL30M-H
MR-EKCBL40M-H
MR-EKCBL50M-H



Note. Always make connection for use in an absolute position detection system. Wiring is not necessary for use in an incremental system.

When fabricating the cable, use the wiring diagram corresponding to the length indicated below.

Cable flex life	Applicable wiring diagram	
	Less than 30m	30m to 50m
Standard	MR-EKCBL20M-L	MR-EKCBL30M-L
Long bending life	MR-EKCBL20M-H	MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H

(c) When fabricating the encoder cable

When fabricating the cable, prepare the following parts and tool, and fabricate it according to the wiring diagram in (b). Refer to section 11.11 for the specifications of the used cable.

<table>
<tr><th>Parts/tool</th><th colspan="2">Description</th></tr>
<tr><td>Connector set</td><td>MR-ECNM

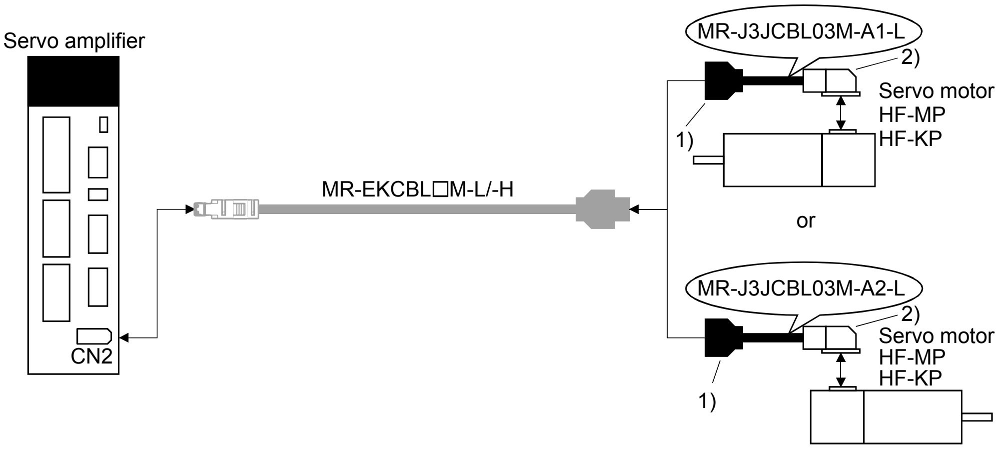
Servo amplifier-side connector
Receptacle: 36210-0100PL
Shell kit: 536310-3200-008
(3M)
or
Connector set: 54599-1019(Molex)</td><td>
Encoder-side connector
Housing: 1-172161-9
Connector pin: 170359-1
(TE Connectivity or equivalent)
Cable clamp: MTI-0002
(Toa Electric Industry)</td></tr>
</table>

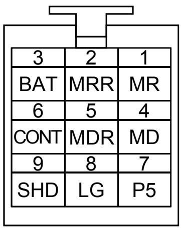
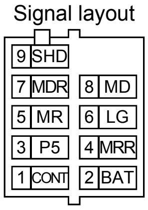
(3) MR-J3JCBL03M-A1-L・MR-J3JCBL03M-A2-L

The servo amplifier and servo motor cannot be connected with these cables only. The servo motor-side encoder cable (MR-EKCBL□M-L/H) is required.

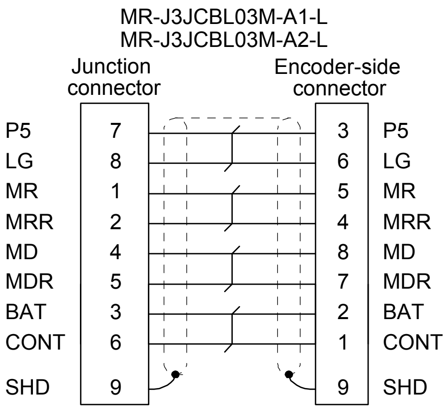
Cable model	Cable length	IP rating	Flex life	Application
MR-J3JCBL03M-A1-L	0.3m	IP20	Standard	For HF-MP・HF-KP servo motor Load-side lead Use in combination with MR-EKCBL□M-L/H.
MR-J3JCBL03M-A2-L				For HF-MP・HF-KP servo motor Opposite to load-side lead Use in combination with MR-EKCBL□M-L/H.

(a) Connection of servo amplifier and servo motor



Cable model	1) Junction connector	2) For encoder connector
MR-J3JCBL03M-A1-L MR-J3JCBL03M-A2-L	Housing: 1-172169-9 Contact: 1473226-1 Cable clamp: 316454-1 Crimping tool: 91529-1 (TE Connectivity) Signal layout  View seen from wiring side.	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (TE Connectivity) Signal layout  View seen from wiring side.

(b) Internal wiring diagram

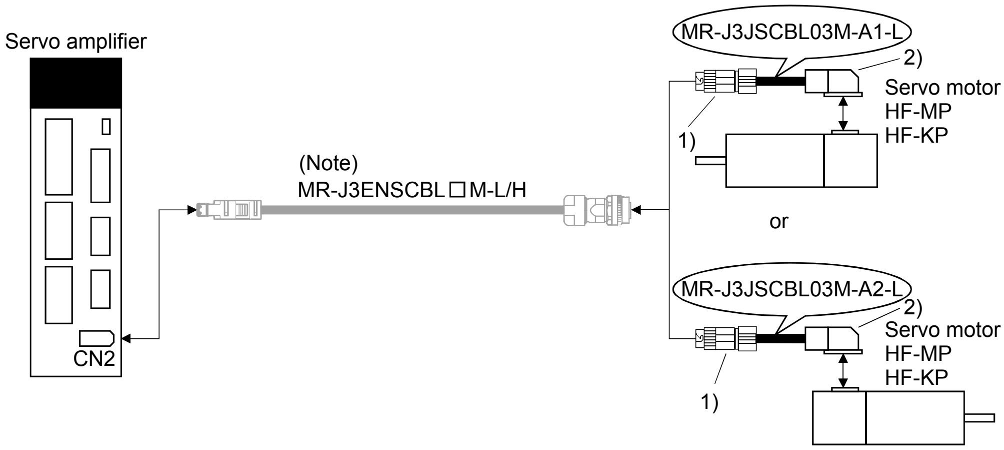


(4) MR-J3JSCBL03M-A1-L・MR-J3JSCBL03M-A2-L

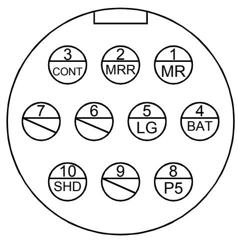
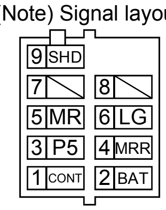
A servo amplifier and a servo motor cannot be connected by these cables alone. The servo motor-side encoder cable (MR-J3ENSCBL□M-L/H) is required.

Cable model	Cable length	IP rating	Flex life	Application
MR-J3JSCBL03M-A1-L	0.3m	IP65	Standard	For HF-KP・HF-MP servo motor Load-side lead Use in combination with MR-J3ENSCBL□M-L/H.
MR-J3JSCBL03M-A2-L				For HF-KP・HF-MP servo motor Opposite to load-side lead Use in combination with MR-J3ENSCBL□M-L/H.

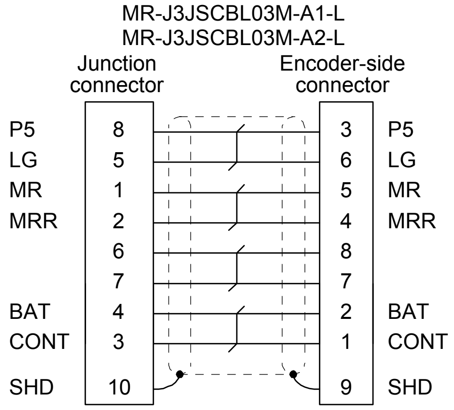
(a) Connection of Servo amplifier and Servo motor



Note. For details of this cable, refer to (5) in this section.
MR-J3ENSCBL□M-L-S06 and MR-J3ENSCBL□M-H-S06 cannot be used.

Cable model	1) Junction connector	2) For encoder connector
MR-J3JCBL03M-A1-L	Receptacle: CM10-CR10P-M (DDK) Applicable wire size: AWG20 or less (Note) Signal layout  View seen from wiring side. Note. Keep open the pin shown with an .	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (TE Connectivity) (Note) Signal layout  View seen from wiring side. Note. Keep open the pin shown with an .
MR-J3JCBL03M-A2-L		

(b) Internal wiring diagram



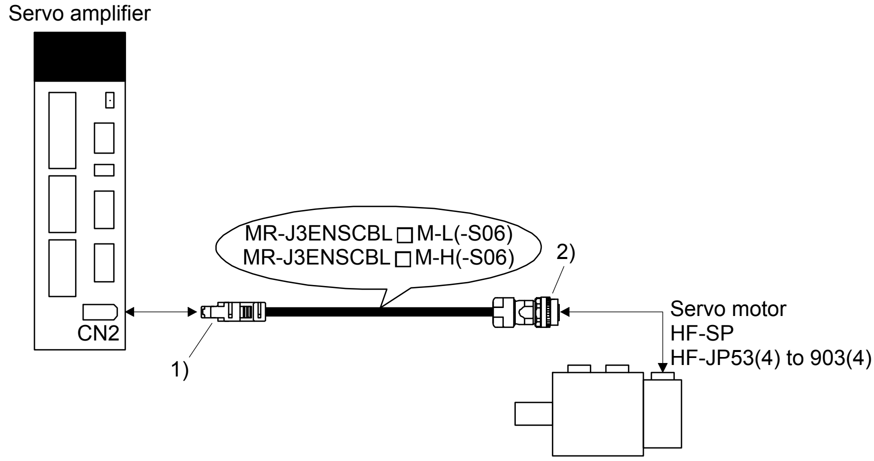
(5) MR-J3ENSCBL□M-L(-S06) ・ MR-J3ENSCBL□M-H(-S06)

These cables are detector cables for HF-MP ・ HF-KP ・ HF-SP ・ HA-LP ・ HC-RP ・ HC-UP ・ HC-LP series ・ HF-JP53(4) to 903(4) servo motors. The number in the cable length column of the table indicates the symbol filling the square □ in the cable model. Cable lengths corresponding to the specified symbols are prepared.

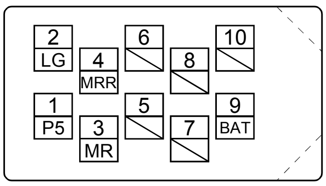
Cable model	Cable length							IP rating	Flex life	Application
	2m	5m	10m	20m	30m	40m	50m			
MR-J3ENSCBL□M-L	2	5	10	20	30			IP67	Standard	For HF-MP ・ HF-KP ・ HF-SP ・ HA-LP ・ HC-RP ・ HC-UP ・ HC-LP series ・ HF-JP53(4) to 903(4) servo motor
MR-J3ENSCBL□M-H	2	5	10	20	30	40	50	IP67	Long bending life	
MR-J3ENSCBL□M-L-S06	2	5	10	20	30			IP67	Standard	For HF-SP ・ HA-LP ・ HC-RP ・ HC-UP ・ HC-LP series ・ HF-JP53(4) to 903(4) servo motor (Note)
MR-J3ENSCBL□M-H-S06	2	5	10	20	30	40	50	IP67	Long bending life	

Note. Use this option when the connector is expected to receive large vibration and shock. The connector at the servo motor-side can be removed up to 5 times. Use the dedicated tool 357J-52780T (DDK) or a spanner with jaw size of 21mm.

(a) Connection of servo amplifier and servo motor

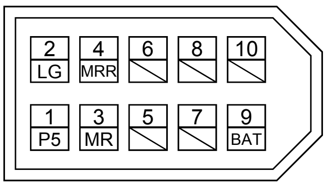


<table>
<tr><th>Cable model</th><th colspan="2">1) For CN2 connector</th><th>2) For encoder connector</th></tr>
<tr><td>MR-J3ENSCBL□M-L
(-S06)</td><td rowspan="2">Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(3M)

(Note) Signal layout


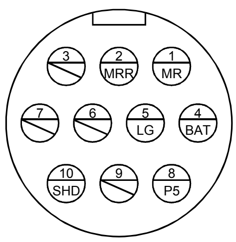
View seen from wiring side.</td><td rowspan="2">Connector set: 54599-1019(Molex)

or

(Note) Signal layout


View seen from wiring side.</td><td rowspan="2">In case of 10m or shorter cables
Straight plug:
CM10-SP10S-M(D6) or CM10-SP10S-VP-M
Socket contact:
CM10-#22SC(C1)(D8)-100
Crimping tool: 357J-50446
(DDK)
Applicable cable AWG20 to 22

In case of 20m or longer cables
Straight plug:
CM10-SP10S-M(D6) or CM10-SP10S-VP-M
Socket contact:
CM10-#22SC(C2)(D8)-100
Crimping tool: 357J-50447
(DDK)
Applicable cable AWG23 to 28

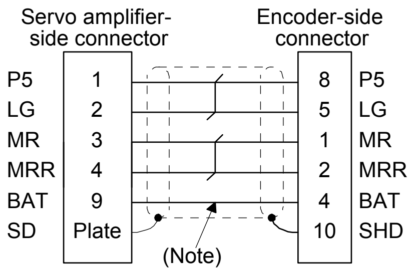
(Note) Signal layout


View seen from wiring side

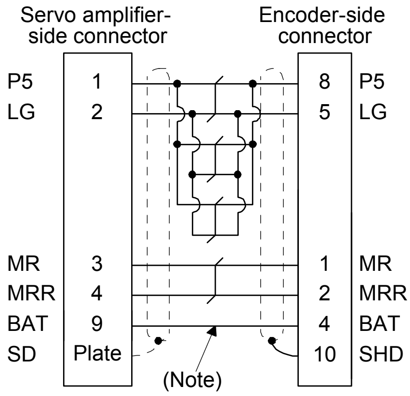
Note. Keep open the pin shown with an ⦰.</td></tr>
<tr><td>MR-J3ENSCBL□M-H
(-S06)</td></tr>
<tr><td></td><td colspan="2">Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.</td><td></td></tr>
</table>

(b) Internal wiring diagram

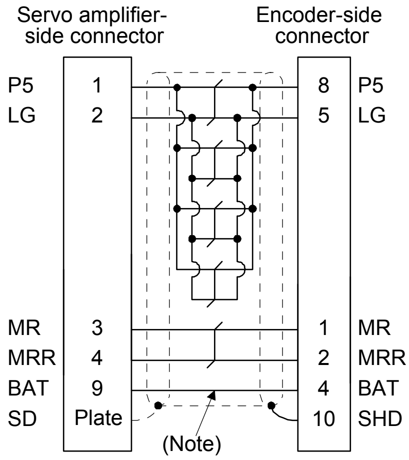
MR-J3ENSCBL2M-L (-S06) /H (-S06)
MR-J3ENSCBL5M-L (-S06) /H (-S06)
MR-J3ENSCBL10M-L (-S06) /H (-S06)



MR-J3ENSCBL20M-L (-S06)
MR-J3ENSCBL30M-L (-S06)



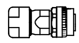
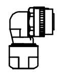
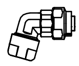
MR-J3ENSCBL20M-H (-S06)
MR-J3ENSCBL30M-H (-S06)
MR-J3ENSCBL40M-H (-S06)
MR-J3ENSCBL50M-H (-S06)



Note. Always make connection for use in an absolute position detection system. Wiring is not necessary for use in an incremental system.

(c) When fabricating the encoder cable

When fabricating the cable, prepare the following parts, and fabricate it according to the wiring diagram in (b). Refer to section 11.11 for the specifications of the used cable.

Parts/Tool (Connector set)	Description	
MR-J3SCNS	 Servo amplifier-side connector Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) Or Connector set: 54599-1019 (Molex)	 Encoder-side connector Straight plug: CM10-SP10S-M (D6) Socket contact: CM10-#22SC (S1) (D8)-100 Applicable wire size: AWG20 or less (DDK)
MR-J3SCNS-S06 (Note)		 Encoder-side connector Straight plug: CM10-SP10S-VP-M Socket contact: CM10-#22SC (S1) (D8)-100 Applicable wire size: AWG20 or less (DDK)
MR-J3SCNSA		 Encoder-side connector Straight plug: CM10-AP10S-M (D6) Socket contact: CM10-#22SC (S1) (D8)-100 Applicable wire size: AWG20 or less (DDK)
MR-J3SCNSA-S06 (Note)		 Encoder-side connector Straight plug: CM10-AP10S-VP-M Socket contact: CM10-#22SC (S1) (D8)-100 Applicable wire size: AWG20 or less (DDK)

Note. Use this option when the connector is expected to receive large vibration and shock. The connector at the servo motor-side can be removed up to 5 times. Use the dedicated tool 357J-52780T (DDK) or a spanner with jaw size of 21mm.

(6) MR-ENECBL□M-H

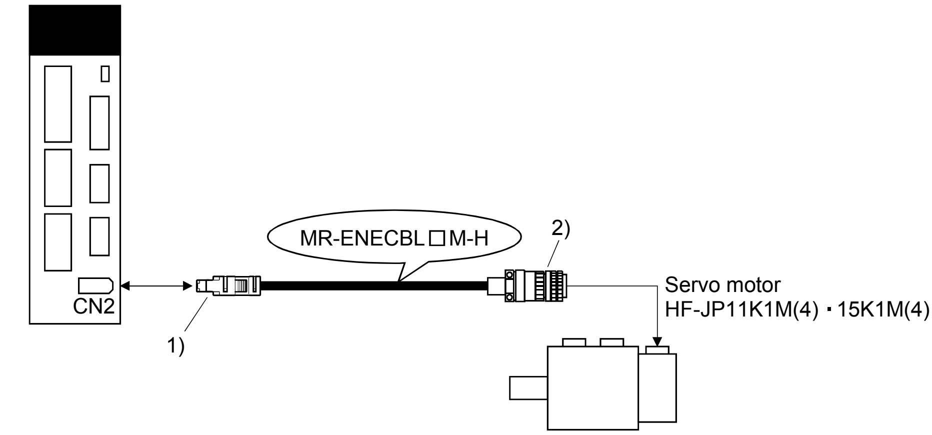
POINT
・The following encoder cables are of four-wire type. When using any of these encoder cables, set parameter No. PC22 to "1□□□" to select the four-wire type. MR-ENECBL30M-H MR-ENECBL40M-H MR-ENECBL50M-H

These cables are encoder cables for HF-JP11K1M(4)・15K1M(4) servo motors.
The number in the cable length column of the table indicates the symbol filling the square □ in the cable model. Cable lengths corresponding to the specified symbols are prepared.

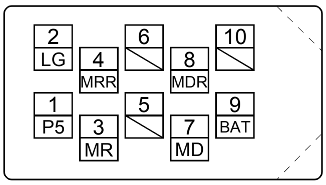
Cable model	Cable length							IP rating	Flex life	Application
	2m	5m	10m	20m	30m	40m	50m			
MR-ENECBL□M-H	2	5	10	20	(Note) 30	(Note) 40	(Note) 50	IP67	Long bending life	For HF-JP11K1M(4)・15K1M(4) servo motor

Note. Four-wire type cable.

(a) Connection of servo amplifier and servo motor

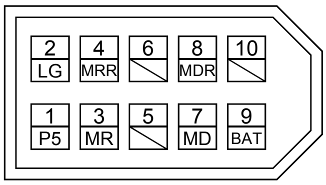


<table>
<tr><th>Cable model</th><th>1) For CN2 connector</th><th>2) For encoder connector</th></tr>
<tr>
<td>MR-ENESCBL□M-H</td>
<td>Receptacle: 36210-0100PL
Shell kit: 36310-3200-008
(3M)
Connector set: 54599-1019(Molex)

(Note) Signal layout


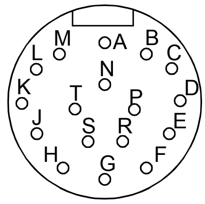
View seen from wiring side.

or

(Note) Signal layout


View seen from wiring side.

Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the servo amplifier cannot operate normally.</td>
<td>Plug: D/MS3106A20-29S (D190)
Cable clamp:
CE3057-12A-3-D
Back shell: CE02-20BS-S-D

(Note) Signal layout


View seen from wiring side.

<table>
<tr><th>Pin</th><th>Signal</th></tr>
<tr><td>A</td><td>MD</td></tr>
<tr><td>B</td><td>MDR</td></tr>
<tr><td>C</td><td>MR</td></tr>
<tr><td>D</td><td>MRR</td></tr>
<tr><td>E</td><td></td></tr>
<tr><td>F</td><td>BAT</td></tr>
<tr><td>G</td><td></td></tr>
<tr><td>H</td><td></td></tr>
<tr><td>J</td><td></td></tr>
</table>
<table>
<tr><th>Pin</th><th>Signal</th></tr>
<tr><td>K</td><td></td></tr>
<tr><td>L</td><td></td></tr>
<tr><td>M</td><td>CONT</td></tr>
<tr><td>N</td><td>SHD</td></tr>
<tr><td>P</td><td></td></tr>
<tr><td>R</td><td>LG</td></tr>
<tr><td>S</td><td>P5</td></tr>
<tr><td>T</td><td></td></tr>
</table>
Note. Keep open the pin shown with an ⧅.</td>
</tr>
</table>

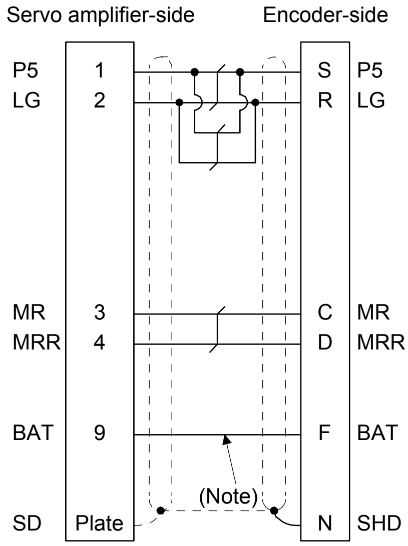
(b) Cable internal wiring diagram

1) Less than 30m

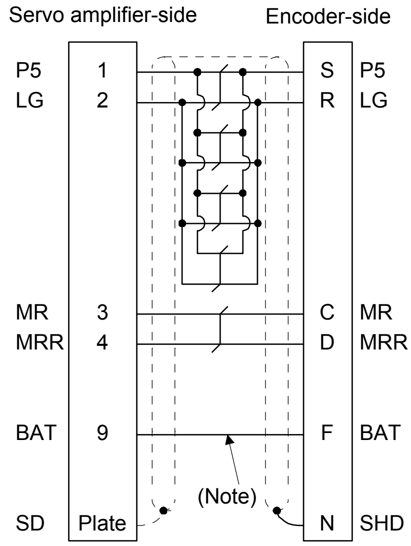
To fabricate, use the connector set MR-ECNS(IP20 compatible)or MR-ENECNS(IP67 compatible).

Use the following wiring diagram to fabricate a cable shorter than 30m.

MR-ENECBL2M-H
MR-ENECBL5M-H
MR-ENECBL10M-H



MR-ENECBL20M-H



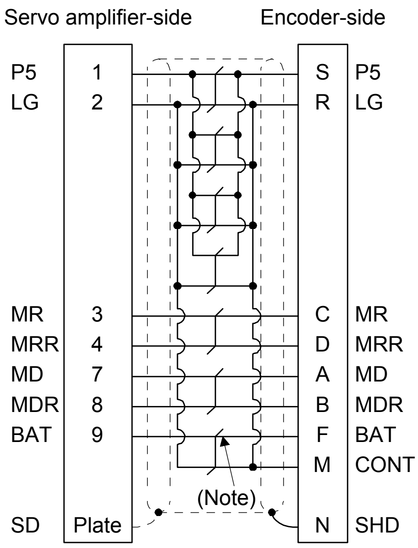
Note. Always make connection for use in an absolute position detection system.
Wiring is not necessary for use in an incremental system.

2) For 30m or more

To fabricate, use the connector set MR-ECNS(IP20 compatible)or MR-ENECNS(IP67 compatible).

Use the following wiring diagram to fabricate a cable up to 50m.

MR-ENECBL30M-H
MR-ENECBL40M-H
MR-ENECBL50M-H



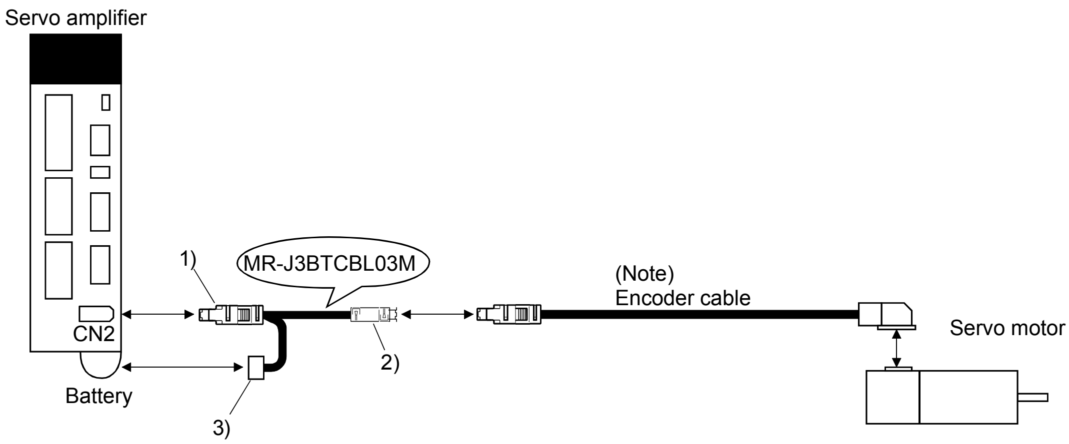
Note. Always make connection for use in an absolute position detection system.
Wiring is not necessary for use in an incremental system.

(7) MR-J3BTCBL03M

This cable is a battery connection cable. Use this cable to retain the current position even if the detector cable is disconnected from the servo amplifier.

Cable model	Cable length	Application
MR-J3BTCBL03M	0.3m	For HF-MP・HF-KP・HF-SP・HA-LP・HC-RP・HC-UP・HC-LP series servo motor

(a) Connection of servo amplifier and servo motor



Note. For the detector cable, refer to (1), (2), (3) and (4) of this section.

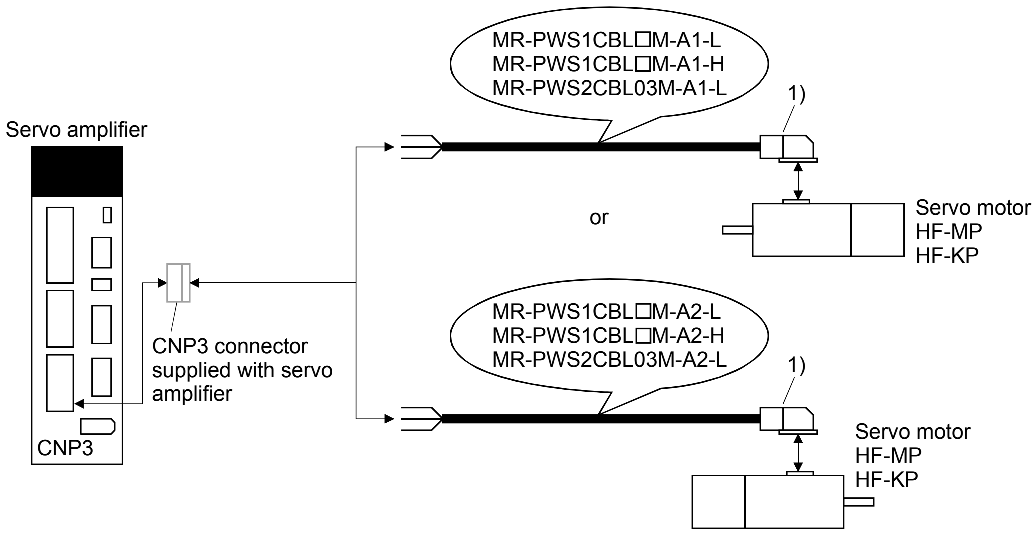
Cable model	1) For CN2 connector	2) Junction connector	3) For battery connector
MR-J3BTCBL03M	Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M) Or Connector set: 54599-1019 (Molex)	Plug: 36110-3000FD Shell kit: 36310-F200-008 (3M)	Connector: DF3-2EP-2C Contact: DF3-EP2428PCA (Hirose Denki)

11.1.3 Motor power supply cables

These cables are motor power supply cables for the HF-MP・HF-KP series servo motors. The numerals in the Cable length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available. Refer to section 3.11 when wiring.

Cable model	Cable length				IP rating	Flex life	Application
	0.3m	2m	5m	10m			
MR-PWS1CBL□M-A1-L		2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS1CBL□M-A2-L		2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Opposite to load-side lead
MR-PWS1CBL□M-A1-H		2	5	10	IP65	Long bending life	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS1CBL□M-A2-H		2	5	10	IP65	Long bending life	For HF-MP・HF-KP servo motor Opposite to load-side lead
MR-PWS2CBL03M-A1-L	03				IP55	Standard	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS2CBL03M-A2-L	03				IP55	Standard	For HF-MP・HF-KP servo motor Opposite to load-side lead

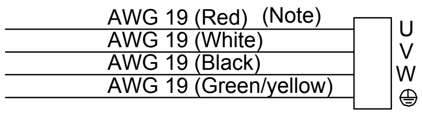
(1) Connection of servo amplifier and servo motor



<table>
<tr><th>Cable model</th><th colspan="2">1) For motor power supply connector</th></tr>
<tr><td>MR-PWS1CBL□M-A1-L</td><td rowspan="4">Connector: JN4FT04SJ1-R
Hood, socket insulator
Bushing, ground nut
Contact: ST-TMH-S-C1B-100-(A534G)
Crimping tool: CT160-3-TMH5B
(Japan Aviation Electronics Industry)</td><td rowspan="6">Signal layout
1 ⏚
2 U
3 V
4 W
View seen from wiring side.</td></tr>
<tr><td>MR-PWS1CBL□M-A2-L</td></tr>
<tr><td>MR-PWS1CBL□M-A1-H</td></tr>
<tr><td>MR-PWS1CBL□M-A2-H</td></tr>
<tr><td>MR-PWS2CBL03M-A1-L</td><td rowspan="2">Connector: JN4FT04SJ2-R
Hood, socket insulator
Bushing, ground nut
Contact: ST-TMH-S-C1B-100-(A534G)
Crimping tool: CT160-3-TMH5B
(Japan Aviation Electronics Industry)</td></tr>
<tr><td>MR-PWS2CBL03M-A2-L</td></tr>
</table>

(2) Internal wiring diagram

MR-PWS1CBL□M-A1-L MR-PWS1CBL□M-A2-L
MR-PWS1CBL□M-A1-H MR-PWS1CBL□M-A2-H
MR-PWS2CBL03M-A1-L MR-PWS2CBL03M-A2-L



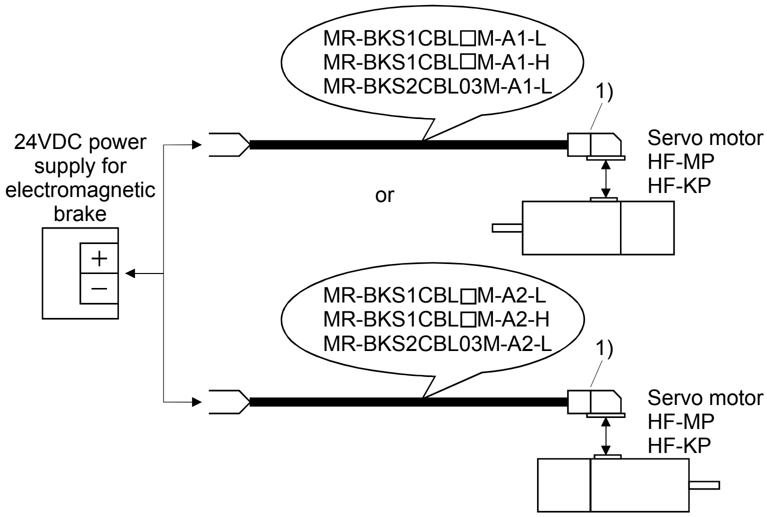
Note. These are not shielded cables.

11.1.4 Motor brake cables

These cables are motor brake cables for the HF-MP・HF-KP series servo motors. The numerals in the Cable length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available. Refer to section 3.12 when wiring.

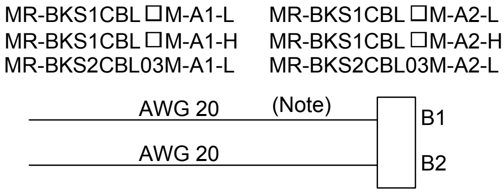
Cable model	Cable length				IP rating	Flex life	Application
	0.3m	2m	5m	10m			
MR-PWS1CBL□M-A1-L		2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS1CBL□M-A2-L		2	5	10	IP65	Standard	For HF-MP・HF-KP servo motor Opposite to load-side lead
MR-PWS1CBL□M-A1-H		2	5	10	IP65	Long bending life	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS1CBL□M-A2-H		2	5	10	IP65	Long bending life	For HF-MP・HF-KP servo motor Opposite to load-side lead
MR-PWS2CBL03M-A1-L	03				IP55	Standard	For HF-MP・HF-KP servo motor Load-side lead
MR-PWS2CBL03M-A2-L	03				IP55	Standard	For HF-MP・HF-KP servo motor Opposite to load-side lead

(1) Connection of power supply for electromagnetic brake and servo motor



Cable model	1) For motor brake connector	
MR-BKS1CBL□M-A1-L MR-BKS1CBL□M-A2-L MR-BKS1CBL□M-A1-H MR-BKS1CBL□M-A2-H	Connector: JN4FT02SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout 1 B1 2 B2 View seen from wiring side.
MR-BKS2CBL03M-A1-L MR-BKS2CBL03M-A2-L	Connector: JN4FT02SJ2-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	

(2) Internal wiring diagram



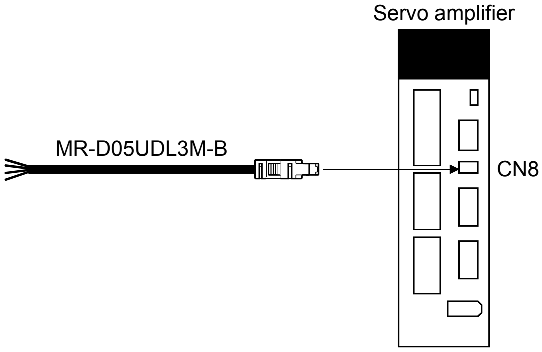
Note. These are not shielded cables.

11.1.5 MR-D05UDL3M-B STO cable

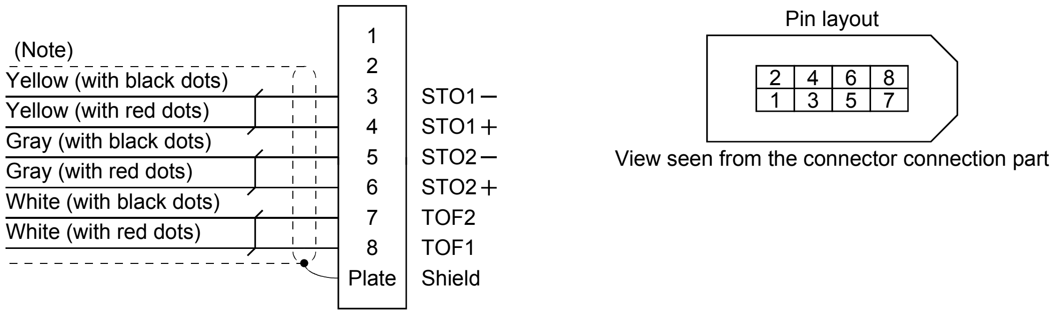
This cable is for connecting an external device to the CN8 connector.

Cable model	Cable length	Application/Remark
MR-D05UDL3M-B	3m	Connection cable for the CN8 connector

(1) Configuration diagram



(2) Internal wiring diagram



Note. Do not use the two core wires with orange sheath (with red or black dots).

11.1.6 SSCNETⅢ cable

POINT

- Do not see directly the light generated from CN1A・CN1B connector of servo amplifier or the end of SSCNETⅢ cable. When the light gets into eye, you may feel something is wrong for eye. (The light source of SSCNETⅢ complies with class1 defined in JIS C6802 or IEC/EN 60825-1.)

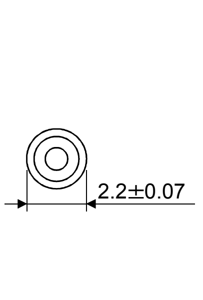
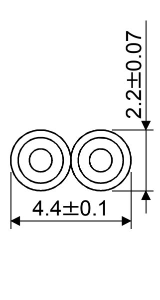
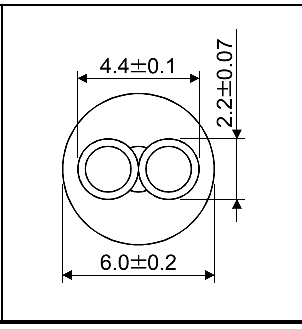
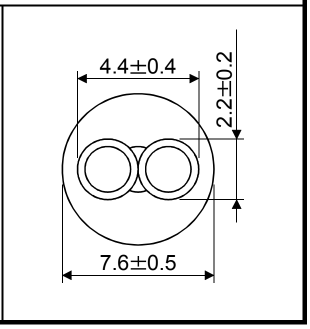
(1) Model explanations

Numeral in the column of cable length on the table is a symbol put in the □ part of cable model. Cables of which symbol exists are available.

Cable model	Cable length											Flex life	Application・remark
	0.15m	0.3m	0.5m	1m	3m	5m	10m	20m	30m	40m	50m		
MR-J3BUS□M	015	03	05	1	3							Standard	Using inside panel standard cord
MR-J3BUS□M-A						5	10	20				Standard	Using outside panel standard cable
(Note) MR-J3BUS□M-B									30	40	50	Long bending life	Using long distance cable

Note. For cable of 30m or less, contact your local sales office.

(2) Specifications

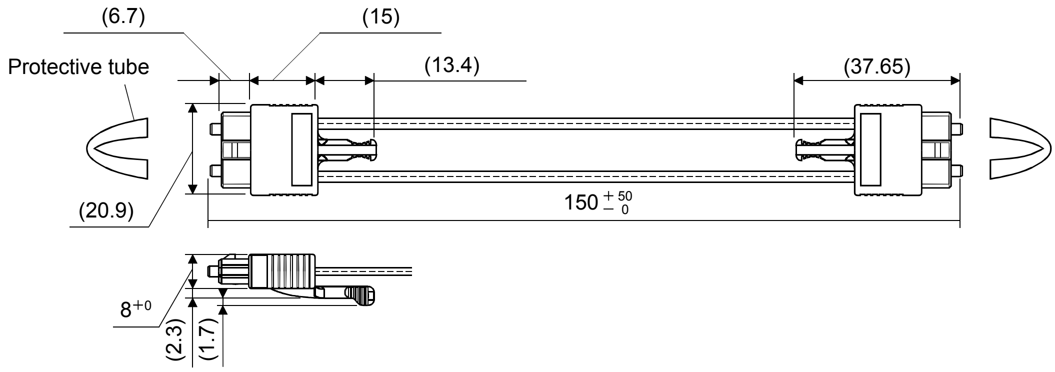
		Description			
SSCNETⅢ cable model		MR-J3BUS□M		MR-J3BUS□M-A	MR-J3BUS□M-B
SSCNETⅢ cable length		0.15m	0.3 to 3m	5 to 20m	30 to 50m
Optical cable (cord)	Minimum bend radius	25mm		Enforced covering cable: 50mm Cord: 25mm	Enforced covering cable: 50mm Cord: 30mm
	Tension strength	70N	140N	420N (Enforced covering cable)	980N (Enforced covering cable)
	Temperature range for use (Note)	−40 to 85℃			−20 to 70℃
	Ambient	Indoors (no direct sunlight) No solvent or oil			
	External appearance [mm]	 2.2±0.07	 2.2±0.07, 4.4±0.1	 4.4±0.1, 2.2±0.07, 6.0±0.2	 4.4±0.4, 2.2±0.2, 7.6±0.5

Note. This temperature range for use is the value for optical cable (cord) only. Temperature condition for the connector is the same as that for servo amplifier.

(3) Outline drawings

(a) MR-J3BUS015M

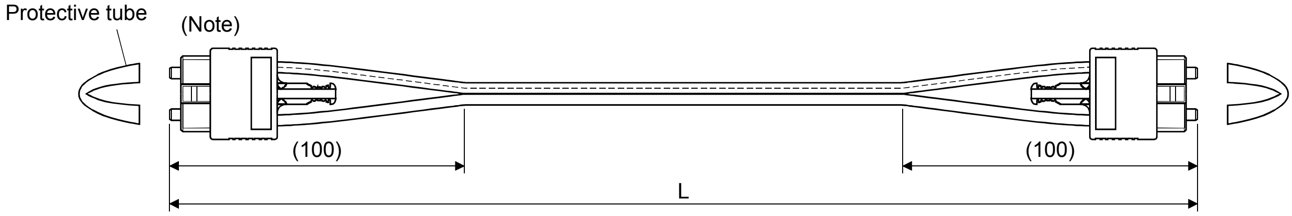
[Unit: mm]



(b) MR-J3BUS03M to MR-J3BUS3M

Refer to the table shown in (1) of this section for cable length (L).

[Unit: mm]



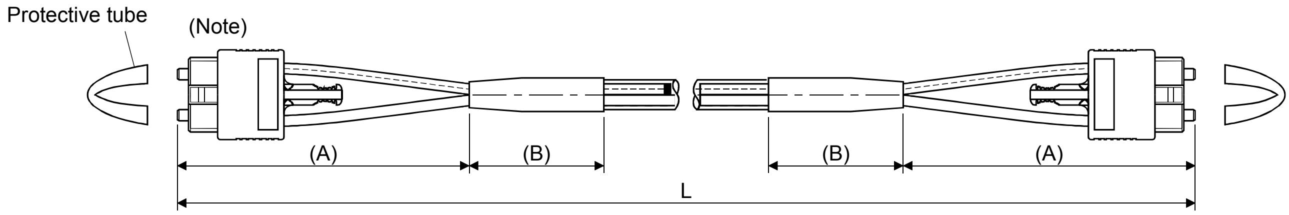
Note. Dimension of connector part is the same as that of MR-J3BUS015M.

(c) MR-J3BUS5M-A to MR-J3BUS20M-A・MR-J3BUS30M-B to MR-J3BUS50M-B

Refer to the table shown in (1) of this section for cable length (L).

SSCNETⅢ cable	Distortion dimension [mm]	
	A	B
MR-J3BUS5M-A to MR-J3BUS20M-A	100	30
MR-J3BUS30M-B to MR-J3BUS50M-B	150	50

[Unit: mm]



Note. Dimension of connector part is the same as that of MR-J3BUS015M.

11.2 Regenerative options

CAUTION	· The specified combinations of regenerative options and servo amplifiers may only be used. Otherwise, it may cause a fire.

(1) Combination and regenerative power
The power values in the table are resistor-generated powers and not rated powers.

Servo amplifier	Regenerative power [W]							
	Built-in regenerative resistor	MR-RB032 [40Ω]	MR-RB12 [40Ω]	MR-RB30 [13Ω]	MR-RB31 [6.7Ω]	MR-RB32 [40Ω]	(Note 1) MR-RB50 [13Ω]	(Note 1) MR-MB51 [6.7Ω]
MR-J3-10□S(1)		30						
MR-J3-20□S(1)	10	30	100					
MR-J3-40□S(1)	10	30	100					
MR-J3-60□S	10	30	100					
MR-J3-70□S	20	30	100			300		
MR-J3-100□S	20	30	100			300		
MR-J3-200□S	100			300			500	
MR-J3-350□S	100			300			500	
MR-J3-500□S	130				300			500
MR-J3-700□S	170				300			500

Servo amplifier	Regenerative power [W]						
	Built-in regenerative resistor	MR-RB1H-4 [82Ω]	(Note 1) MR-RB3M-4 [120Ω]	(Note 1) MR-RB3G-4 [47Ω]	(Note 1) MR-RB5G-4 [47Ω]	(Note 1) MR-RB34-4 [26Ω]	(Note 1) MR-RB54-4 [26Ω]
MR-J3-60□S4	15	100	300				
MR-J3-100□S4	15	100	300				
MR-J3-200□S4	100			300	500		
MR-J3-350□S4	100			300	500		
MR-J3-500□S4	130					300	500
MR-J3-700□S4	170					300	500

Servo amplifier	(Note 2) Regenerative power [W]						
	External regenerative resistor (Accessory)	MR-RB5E [6Ω]	MR-RB9P [4.5Ω]	MR-RB9F [3Ω]	MR-RB6B-4 [20Ω]	MR-RB60-4 [12.5Ω]	MR-RB6K-4 [10Ω]
MR-J3-11K□S	500 (800)	500 (800)					
MR-J3-15K□S	850 (1300)		850 (1300)				
MR-J3-22K□S	850 (1300)			850 (1300)			
MR-J3-11K□S4	500 (800)				500 (800)		
MR-J3-15K□S4	850 (1300)					850 (1300)	
MR-J3-22K□S4	850 (1300)						850 (1300)

Servo amplifier	(Note 2) Regenerative power [W]				
	External regenerative resistor (Accessory)	MR-RB5R [3.2Ω]	MR-RB9F [3Ω]	MR-RB5K-4 [10Ω]	MR-RB6K-4 [10Ω]
MR-J3-11K☐S-LR	500 (800)	500 (800)			
MR-J3-11K☐S-LW		500 (800)			
MR-J3-15K☐S-LR	850 (1300)		850 (1300)		
MR-J3-15K☐S-LW			850 (1300)		
MR-J3-11K☐S4-LR	500 (800)			500 (800)	
MR-J3-11K☐S4-LW				500 (800)	
MR-J3-15K☐S4-LR	850 (1300)				850 (1300)
MR-J3-15K☐S4-LW					850 (1300)

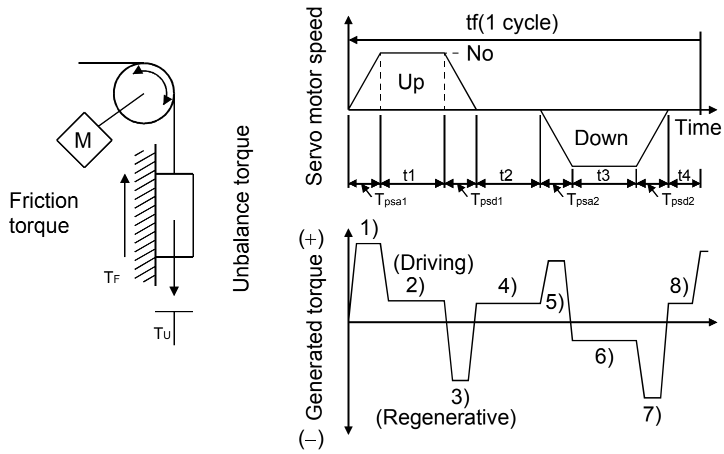
Note 1. Always install a cooling fan.

2. Values in parentheses assume the installation of a cooling fan.

(2) Selection of the regenerative option

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 option.

(a) Regenerative energy calculation



Formulas for calculating torque and energy in operation

Regenerative power	Torque applied to servo motor [N・m]	Energy E [J]
1)	$T_1 = \frac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psa1}} + T_U + T_F$	$E_1 = \frac{0.1047}{2} \cdot N_0 \cdot T_1 \cdot T_{psa1}$
2)	$T_2 = T_U + T_F$	$E_2 = 0.1047 \cdot N_0 \cdot T_2 \cdot t_1$
3)	$T_3 = \frac{-(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psd1}} + T_U + T_F$	$E_3 = \frac{0.1047}{2} \cdot N_0 \cdot T_3 \cdot T_{psd1}$
4), 8)	$T_4 = T_U$	$E_4 \geq 0$ (No regeneration)
5)	$T_5 = \frac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psa2}} - T_U + T_F$	$E_5 = \frac{0.1047}{2} \cdot N_0 \cdot T_5 \cdot T_{psa2}$
6)	$T_6 = -T_U + T_F$	$E_6 = 0.1047 \cdot N_0 \cdot T_6 \cdot t_3$
7)	$T_7 = \frac{-(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psd2}} - T_U + T_F$	$E_7 = \frac{0.1047}{2} \cdot N_0 \cdot T_7 \cdot T_{psd2}$

From the calculation results in 1) to 8), find the absolute value (Es) of the sum total of negative energies.

(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-J3-10□S	55	9
MR-J3-10□S1	55	4
MR-J3-20□S	70	9
MR-J3-20□S1	70	4
MR-J3-40□S	85	11
MR-J3-40□S1	85	10
MR-J3-60□S(4)	85	11
MR-J3-70□S	80	18
MR-J3-100□S	80	18
MR-J3-100□S4	80	12

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-J3-200□S	85	40
MR-J3-200□S4	85	25
MR-J3-350□S	85	40
MR-J3-350□S4	85	36
MR-J3-500□S(4)	90	45
MR-J3-700□S(4)	90	70
MR-J3-11K□S(4)	90	120
MR-J3-15K□S(4)	90	170
MR-J3-22K□S(4)	90	250

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 option.

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

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

$$PR\ [W] = ER/tf$$

(3) Parameter setting
Set parameter No.PA02 according to the option to be used.

Parameter No.PA02

0	0		

Selection of regenerative option
00: Regenerative option is not used
- For servo amplifier of 100W, regenerative resistor is not used.
- For servo amplifier of 0.2k to 7kW, built-in regenerative resistor is used.
- Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11k to 22kW.
- Use a drive unit of 30kW or more in combination with an MR-J3-CR55K(4) converter unit.
  (When using the drive unit of 30kW or more in combination with the MR-J3-CR55K(4) converter unit, set this value whether the regenerative option and brake unit are used or not.)

(Note)
01: FR-BU2-(H)･FR-RC-(H)･FR-CV-(H)
02: MR-RB032
03: MR-RB12
04: MR-RB32
05: MR-RB30
06: MR-RB50(Cooling fan is required)
08: MR-RB31
09: MR-RB51(Cooling fan is required)
80: MR-RB1H-4
81: MR-RB3M-4(Cooling fan is required)
82: MR-RB3G-4(Cooling fan is required)
83: MR-RB5G-4(Cooling fanis required)
84: MR-RB34-4(Cooling fanis required)
85: MR-RB54-4(Cooling fanis required)
FA: When the supplied regenerative resistor is cooled by the cooling fan to increase the ability with the servo amplifier of 11k to 22kW.

Note. The setting is for the servo amplifier of 22kW or less.

The following are setting values for regenerative resistor and regenerative option which are used with a servo amplifier of 11k to 22kW.

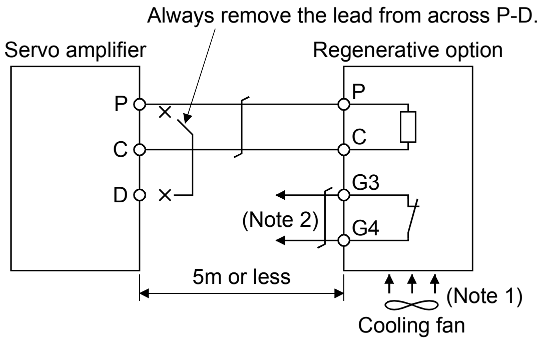
Regenerative resistor, regenerative option	Setting value
Standard supplied regenerative resistor	00
Standard supplied regenerative resistor (with a cooling fan to cool it)	FA
MR-RB5E	00
MR-RB5E (with a cooling fan to cool it)	FA
MR-RB5R	00
MR-RB5R (with a cooling fan to cool it)	FA
MR-RB9P	00
MR-RB9P (with a cooling fan to cool it)	FA
MR-RB9F	00
MR-RB9F (with a cooling fan to cool it)	FA
MR-RB5K-4	00
MR-RB5K-4 (with a cooling fan to cool it)	FA
MR-RB6B-4	00
MR-RB6B-4 (with a cooling fan to cool it)	FA
MR-RB60-4	00
MR-RB60-4 (with a cooling fan to cool it)	FA
MR-RB6K-4	00
MR-RB6K-4 (with a cooling fan to cool it)	FA

(4) Connection of the regenerative option

POINT
・When the MR-RB50・MR-RB51・MR-RB3M-4・MR-RB3G-4・MR-RB5G-4・MR-RB34-4・MR-RB54-4 is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer. ・For the sizes of wires used for wiring, refer to section 11.11.

The regenerative option will cause a temperature rise of 100℃ relative to the ambient temperature. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant wires and keep them clear of the regenerative option body. Always use twisted cables of max. 5m length for connection with the servo amplifier.

(a) MR-J3-350□S or less・MR-J3-200□S4 or less
Always remove the wiring from across P-D and fit the regenerative option across P-C.
The G3 and G4 terminals act as a thermal sensor. G3-G4 is disconnected when the regenerative option overheats abnormally.

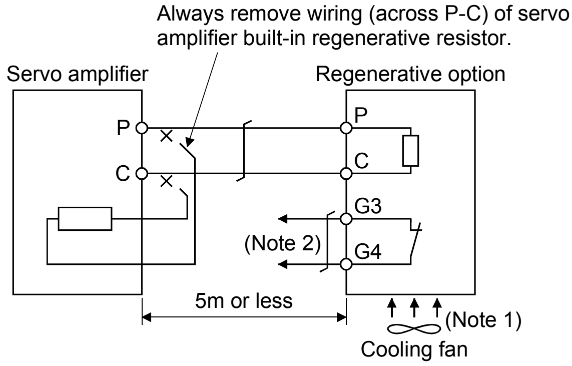


Note 1. When using the MR-RB50・MR-RB3M-4・MR-RB3G-4・MR-RB5G-4, forcibly cool it with a cooling fan (92×92, minimum air flow: 1.0m^3).
2. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

(b) MR-J3-350□S4・MR-J3-500□S(4)・MR-J3-700□S(4)

Always remove the wiring (across P-C) of the servo amplifier built-in regenerative resistor and fit the regenerative option across P-C.

The G3 and G4 terminals act as a thermal sensor. G3-G4 is opened when the regenerative option overheats abnormally.

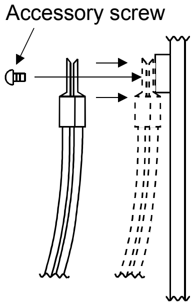


Note 1. When using the MR-RB51・MR-RB3G-4・MR-RB5G-4・MR-RB34-4・MR-RB54-4, forcibly cool it with a cooling fan (92×92, minimum air flow: 1.0m³).

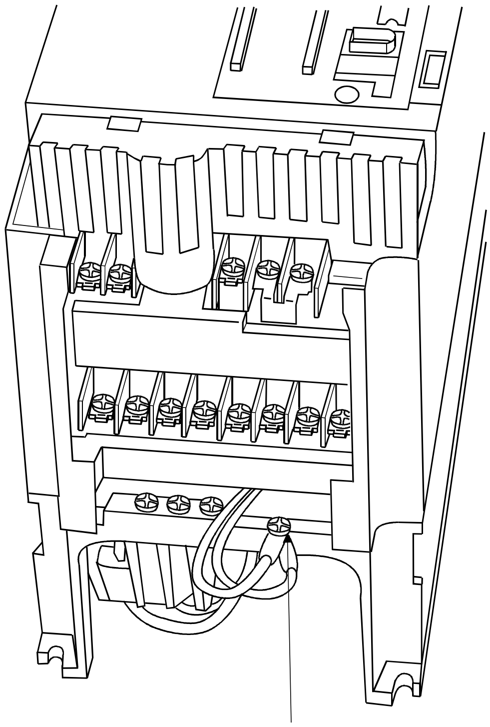
2. Make up a sequence which will switch off the magnetic contactor when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

When using the regenerative option, remove the servo amplifier's built-in regenerative resistor wires (across P-C), fit them back to back, and secure them to the frame with the accessory screw as shown below.

Mounting method



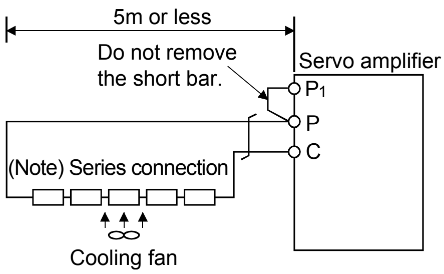
The drawing below shows the MR-J3-350□S4・MR-J3-500□S(4). Refer to section 9.1 (8) outline drawings for the position of the fixing screw for MR-J3-700□S(4).



(c) MR-J3-11K□S(4)(-LR) · MR-J3-15K□S(4)(-LR) · MR-J3-22K□S(4) (when using the supplied regenerative resistor)

CAUTION	· The regenerative resistor supplied with 11 kW to 22 kW servo amplifiers does not have a protect cover. Touching the resistor (including wiring/screw hole area) may cause a burn injury and electric shock. Even if the power was shut-off, be careful until the bus voltage discharged and the temperature decreased because of the following reasons. · It may cause a burn injury due to very high temperature without cooling. · It may cause an electric shock due to charged capacitor of the servo amplifier.

When using the regenerative resistors supplied to the servo amplifier, the specified number of resistors (4 or 5 resistors) must be connected in series. If they are connected in parallel or in less than the specified number, the servo amplifier may become faulty and/or the regenerative resistors burn. Install the resistors at intervals of about 70mm. Cooling the resistors with two cooling fans (92 × 92, minimum air flow : 1.0m^3) improves the regeneration capability. In this case, set "□□FA" in parameter No.PA02.



Note. The number of resistors connected in series depends on the resistor type. The thermal sensor is not mounted on the attached regenerative resistor. An abnormal heating of resistor may be generated at a regenerative circuit failure. Install a thermal sensor near the resistor and establish a protective circuit to shut off the main circuit power supply when abnormal heating occurs. The detection level of the thermal sensor varies according to the settings of the resistor. Set the thermal sensor in the most appropriate position on your design basis or use the thermal sensor built-in regenerative option. (MR-RB5E, 5R, 9P, 9F, 5K-4, 6B-4, 60-4, 6K-4)

Servo amplifier	Regenerative resistor	Regenerative power [W]		Resistance [Ω]	Number of resistors
		Normal	Cooling		
MR-J3-11K□S	GRZG400-1.5Ω	500	800	6	4
MR-J3-11K□S-LR	GRZG400-0.8Ω	500	800	3.2	4
MR-J3-15K□S	GRZG400-0.9Ω	850	1300	4.5	5
MR-J3-15K□S-LR MR-J3-22K□S	GRZG400-0.6Ω	850	1300	3	5
MR-J3-11K□S4	GRZG400-5.0Ω	500	800	20	4
MR-J3-11K□S4-LR	GRZG400-2.5Ω	500	800	10	4
MR-J3-15K□S4	GRZG400-2.5Ω	850	1300	12.5	5
MR-J3-15K□S4-LR MR-J3-22K□S4	GRZG400-2.0Ω	850	1300	10	5

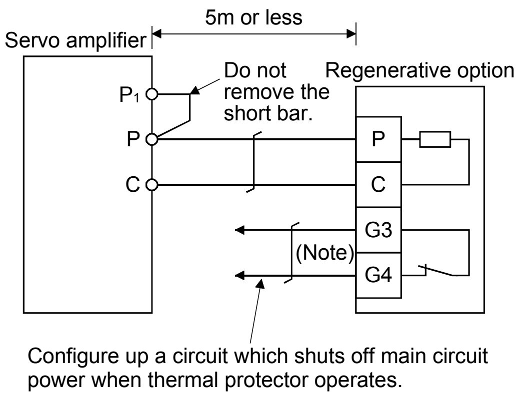
(d) MR-J3-11K□S(4)-PX/LW・MR-J3-15K□S(4)-PX/LW・MR-J3-22K□S(4)-PX (when using the regenerative option)

The MR-J3-11K□S(4)-PX/LW・MR-J3-15K□S(4)-PX/LW・MR-J3-22K□S(4)-PX servo amplifiers are not supplied with regenerative resistors. When using any of these servo amplifiers, always use the MR-RB5E, 5R, 9P, 9F, 5K-4, 6B-4, 60-4 and 6K-4 regenerative option.

The MR-RB5E, 5R, 9P, 9F, 5K-4, 6B-4, 60-4 and 6K-4 are regenerative options that have encased the GRZG400-1.5Ω, GRZG400-0.9Ω, GRZG400-0.8Ω, GRZG400-0.6Ω, GRZG400-5.0Ω, GRZG400-2.5Ω, GRZG400-2.0Ω respectively. When using any of these regenerative options, make the same parameter setting as when using the GRZG400-1.5Ω, GRZG400-0.9Ω, GRZG400-0.8Ω, GRZG400-0.6Ω, GRZG400-5.0Ω, GRZG400-2.5Ω, GRZG400-2.0Ω (supplied regenerative resistors or regenerative option is used with 11k to 22kW servo amplifier).

Cooling the regenerative option with cooling fans improves regenerative capability.

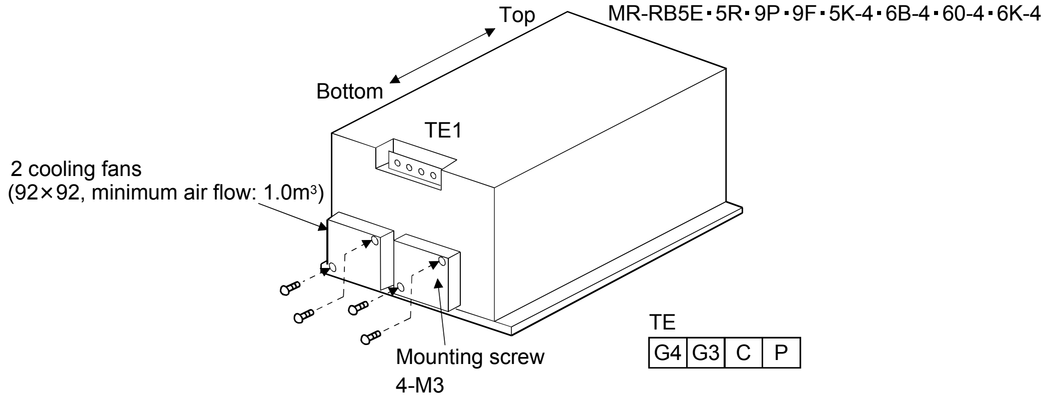
The G3 and G4 terminals are for the thermal protector. G3-G4 is opened when the regenerative option overheats abnormally.



Note. Specifications of contact across G3-G4
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

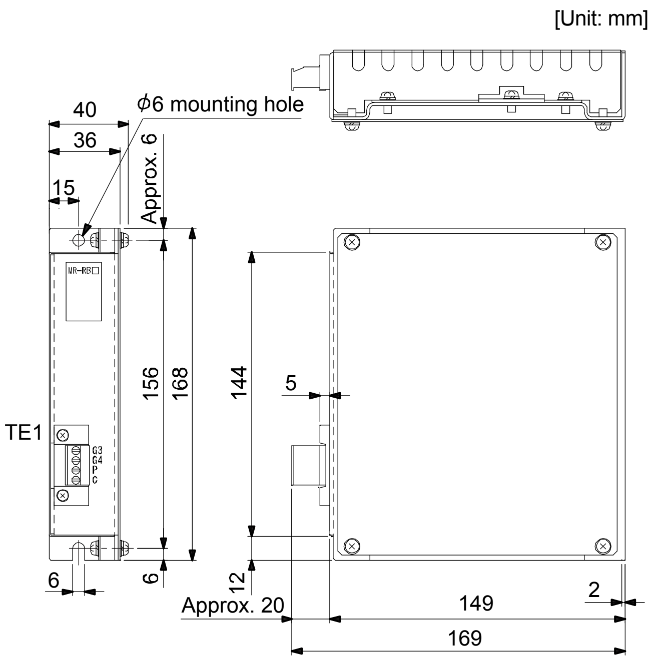
Servo amplifier	Regenerative option model	Resistance [Ω]	Regenerative power [W]	
			Without cooling fans	With cooling fans
MR-J3-11K□S-PX	MR-RB5E	6	500	800
MR-J3-11K□S-LW	MR-RB5R	3.2	500	800
MR-J3-15K□S-PX	MR-RB9P	4.5	850	1300
MR-J3-15K□S-LW MR-J3-22K□S-PX	MR-RB9F	3	850	1300
MR-J3-11K□S4-PX	MR-RB6B-4	20	500	800
MR-J3-11K□S4-LW	MR-RB5K-4	10	500	800
MR-J3-15K□S4-PX	MR-RB60-4	12.5	850	1300
MR-J3-15K□S4-LW MR-J3-22K□S4-PX	MR-RB6K-4	10	850	1300

When using cooling fans, install them using the mounting holes provided in the bottom of the regenerative option. In this case, set "□□FA" in parameter No.PA02.



(5) Outline drawing

(a) MR-RB12



・TE1

Terminal block

G3
G4
P
C

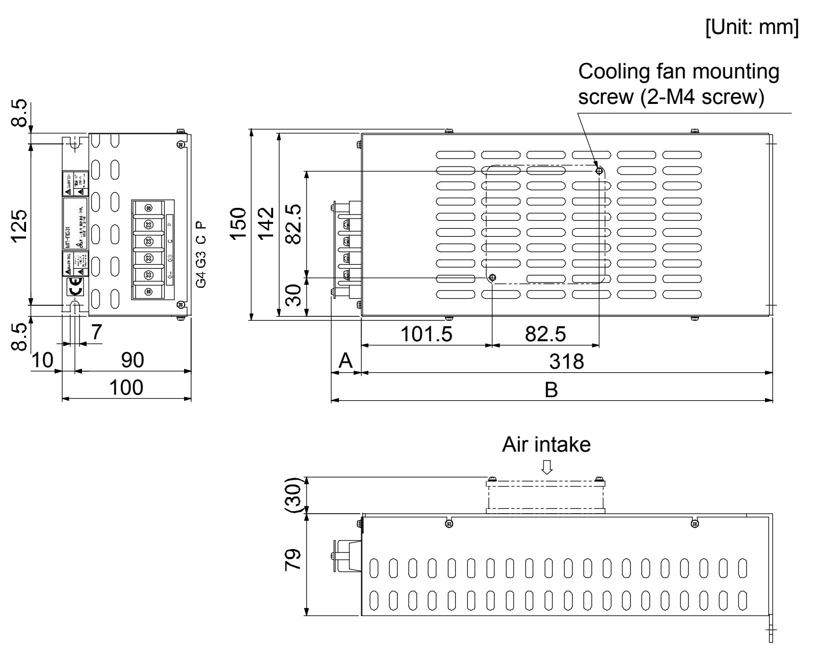
Applicable wire size: 0.2mm^2 to 2.5mm^2 (AWG24 to AWG12)
Tightening torque: 0.5 to 0.6 [N・m]
(4 to 5 [lb・in])

・Mounting screw

Screw size: M5
Tightening torque: 3.24 [N・m]
(28.7 [lb・in])

Mass: 1.1 [kg] (2.4 [lb])

(b) MR-RB30 · MR-RB31 · MR-RB32 · MR-RB34-4 · MR-RB3M-4 · MR-RB3G-4



· TE1
Terminal block

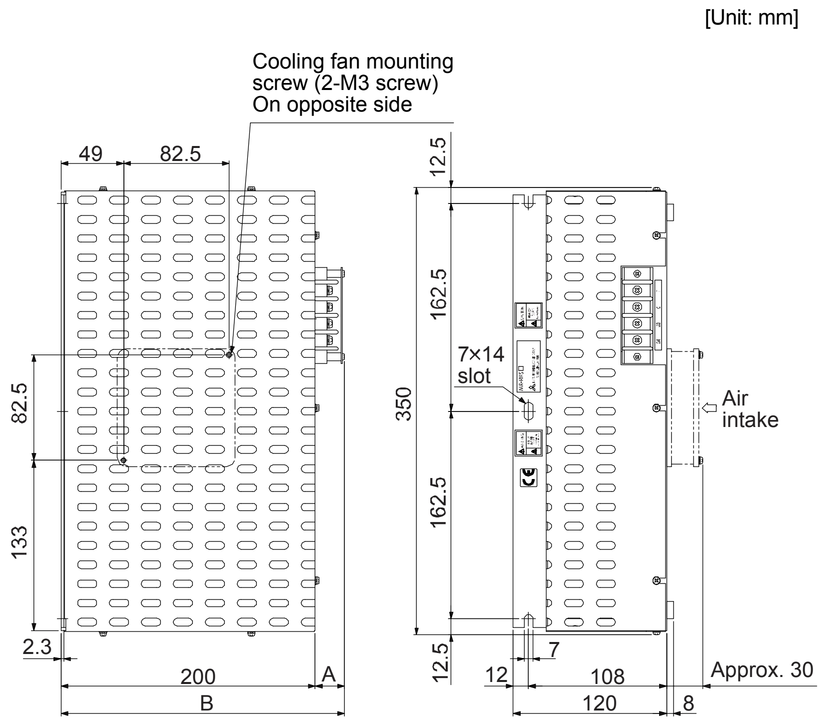
P
C
G3
G4

Terminal screw: M4
Tightening torque: 1.2 [N · m] (10.62 [lb · in])

· Mounting screw
Screw size: M6
Tightening torque: 5.4 [N · m] (47.79 [lb · in])

Regenerative option	Variable dimensions		Mass [kg] (lb)
	A	B	
MR-RB30	17	335	2.9 (6.4)
MR-RB31			
MR-RB32			
MR-RB34-4	23	341	
MR-RB3M-4			
MR-RB3G-4			

(c) MR-RB50 · MR-RB51 · MR-RB54-4 · MR-RB5G-4



· Terminal block

P
C
G3
G4

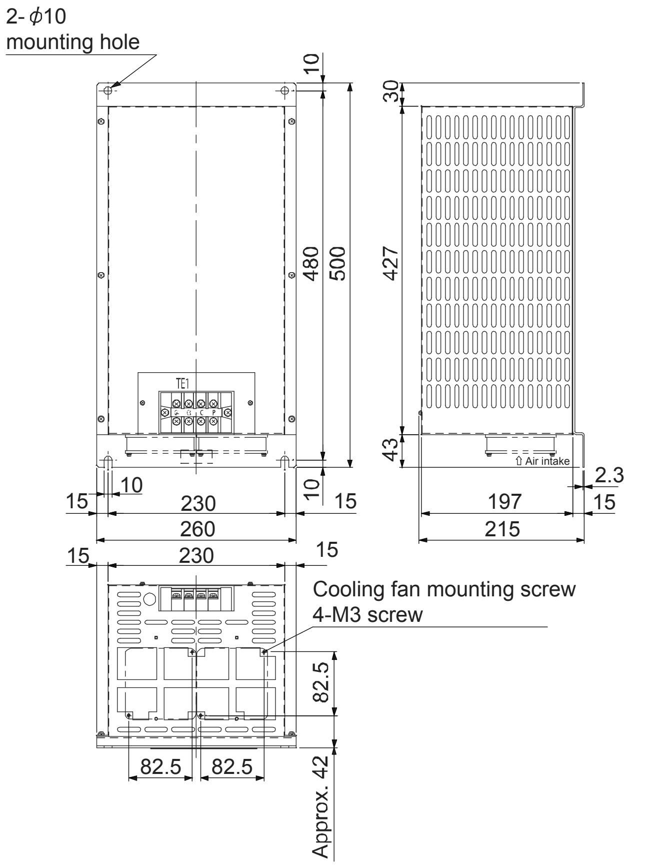
Terminal screw: M4
Tightening torque: 1.2 [N · m] (10.62 [lb · in])

· Mounting screw
Screw size: M6
Tightening torque: 5.4 [N · m] (47.79 [lb · in])

Regenerative option	Variable dimensions		Mass [kg] (lb)
	A	B	
MR-RB50	17	217	5.6 (12.3)
MR-RB51			
MR-RB54-4	23	233	
MR-RB5G-4			

(d) MR-RB5E・MR-RB5R・MR-RB9P・MR-RB9F・MR-RB5K-4・MR-RB6B-4・MR-RB60-4・MR-RB6K-4

[Unit: mm]



・Terminal block

G4	G3	C	P

Terminal screw: M5

Tightening torque: 2.0 [N・m] (17.70 [lb・in])

・Mounting screw

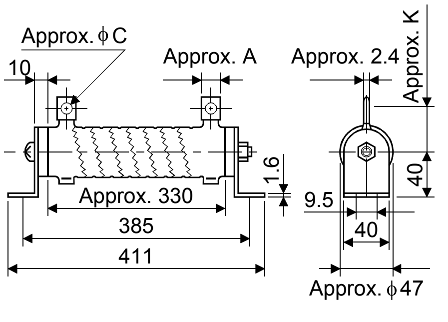
Screw size: M8

Tightening torque: 13.2 [N・m] (116.83 [lb・in])

Regenerative option	Mass	
	[kg]	[lb]
MR-RB5E	10	22.0
MR-RB5R	11	24.3
MR-RB9P		
MR-RB9F		
MR-RB5K-4	10	22.0
MR-RB6B-4		
MR-RB60-4	11	24.3
MR-RB6K-4		

(e) GRZG400-1.5Ω・GRZG400-0.9Ω・GRZG400-0.8Ω・GRZG400-0.6Ω・GRZG400-5.0Ω・GRZG400-2.5Ω・GRZG400-2.0Ω (standard accessories)

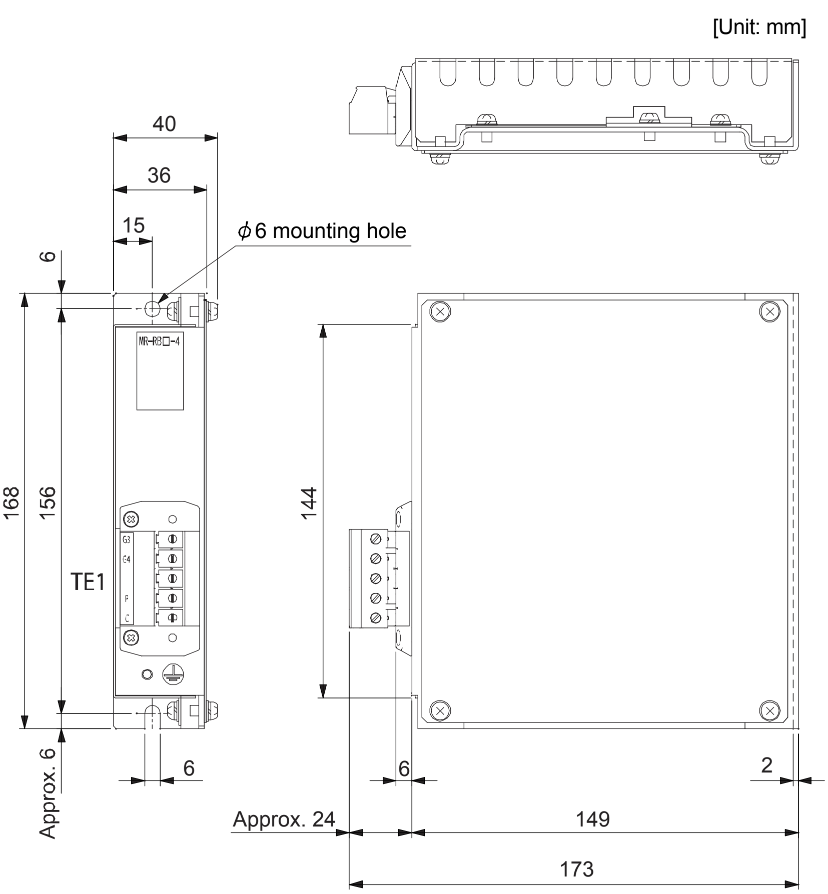
[Unit: mm]



Regenerative brake	Variable dimensions			Mounting screw size	Tightening torque [N・m] ([lb・in])	Mass [kg] ([lb])
	A	C	K			
GRZG400-1.5Ω	10	5.5	39	M8	13.2 (116.83)	0.8 (1.76)
GRZG400-0.9Ω						
GRZG400-0.8Ω						
GRZG400-0.6Ω	16	8.2	46			
GRZG400-5.0Ω	10	5.5	39			
GRZG400-2.5Ω						
GRZG400-2.0Ω						

(f) MR-RB1H-4

[Unit: mm]



G3
G4
╲
P
C

Applicable wire size: 0.2mm^2 to 4.0mm^2 (AWG24 to AWG10)

Tightening torque: 0.5 to 0.6 [N・m] (4.43 to 5.31 [lb・in])

・Mounting screw

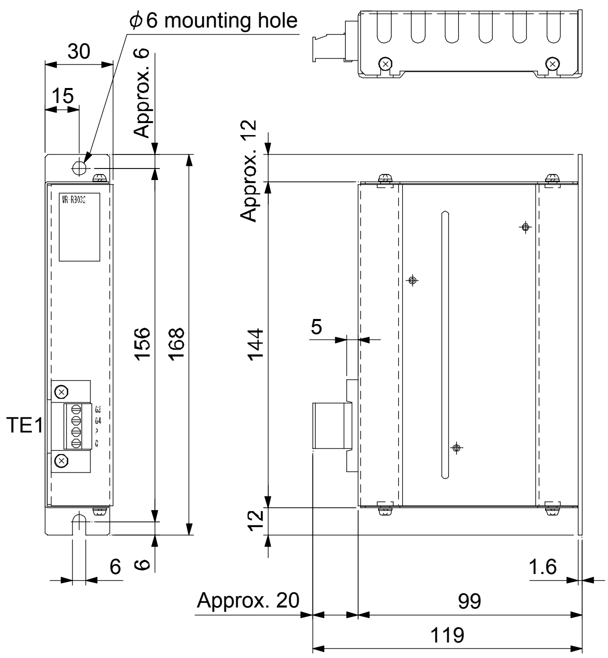
Screw size: M5

Tightening torque: 3.24 [N・m] (28.32 [lb・in])

Mass: 1.1[kg] (2.4 [lb])

(g) MR-RB032

[Unit: mm]



・TE1

Terminal block

G3
G4
P
C

Applicable wire size: 0.2mm^2 to 2.5mm^2 (AWG24 to AWG12)

Tightening torque: 0.5 to 0.6 [N・m] (4 to 5 [lb・in])

・Mounting screw

Screw size: M5

Tightening torque: 3.24 [N・m] (28.7 [lb・in])

Mass: 0.5 [kg] (1.1 [lb])

11.3 FR-BU2-(H) Brake unit

POINT

- Use a 200V class brake unit and a resistor unit with a 200V class servo amplifier, and a 400V class brake unit and a resistor unit with a 400V class servo amplifier. Combination of different voltage class units and servo amplifier cannot be used.
- Install a brake unit and a resistor unit on a flat surface vertically. When the unit is installed horizontally or diagonally, the heat dissipation effect diminishes.
- Temperature of the resistor unit case rises to higher than 100℃. Keep cables and flammable materials away from the case.
- Ambient temperature condition of the brake unit is between −10℃ (14℉) and 50℃ (122℉). Note that the condition is different from the ambient temperature condition of the servo amplifier (between 0℃ (32℉) and 55℃ (131℉)).
- Configure the circuit to shut down the power-supply with the alarm output of the brake unit and resistor unit under abnormal condition.
- Use the brake unit with a combination indicated in section 11.3.1.
- For executing a continuous regenerative operation, use FR-RC-(H) power regenerative converter or FR-CV-(H) power regeneration common converter.
- Brake unit and regenerative options (Regenerative resistor) cannot be used simultaneously.

Connect the brake unit to the bus of the servo amplifier. As compared to the MR-RB regenerative option, the brake unit can return larger power. Use the brake unit when the regenerative option cannot provide sufficient regenerative capability.
When using the brake unit, set the parameter No.PA02 of the servo amplifier to "□□01".
When using the brake unit, always refer to the FR-BU2-(H) Brake Unit Instruction Manual.

11.3.1 Selection

Use a combination of servo amplifier, brake unit and resistor unit listed below.

Brake unit		Resistor unit	Number of connected units	Permissible continuous power [kW]	Resultant resistance [Ω]	(Note 2) Servo amplifier
200V class	FR-BU2-15K	FR-BR-15K	1	0.99	8	MR-J3-500□S (Note 1)
			2 (parallel)	1.98	4	MR-J3-500□S MR-J3-700□S MR-J3-11K□S MR-J3-15K□S
	FR-BU2-30K	FR-BR-30K	1	1.99	4	MR-J3-500□S MR-J3-700□S MR-J3-11K□S MR-J3-15K□S
	FR-BU2-55K	FR-BR-55K	1	3.91	2	MR-J3-11K□S MR-J3-15K□S MR-J3-22K□S
		MT-BR5-55K	1	5.5	2	MR-J3-22K□S
400V class	FR-BU2-H30K	FR-BR-H30K	1	1.99	16	MR-J3-500□S4 MR-J3-700□S4 MR-J3-11K□S4
	FR-BU2-H55K	FR-BR-H55K	1	3.91	8	MR-J3-11K□S4 MR-J3-15K□S4 MR-J3-22K□S4
	FR-BU2-H75K	MT-BR5-H75K	1	7.5	6.5	MR-J3-22K□S4

Note 1. Only for using with HC-LP302, HC-RP353, HA-LP502 or HC-UP352.

2. When the brake unit is selected by using Capacity Selection Software, a combination of a unit and a servo amplifier other than the combinations shown in the above table may be selected.
For details, refer to combinations displayed by using Capacity Selection Software.

11.3.2 Brake unit parameter setting

Normally, when the FR-BU2-(H) is used for the MR-J3-□S servo amplifier, changing parameters is not necessary. Whether a parameter can be changed or not is listed below.

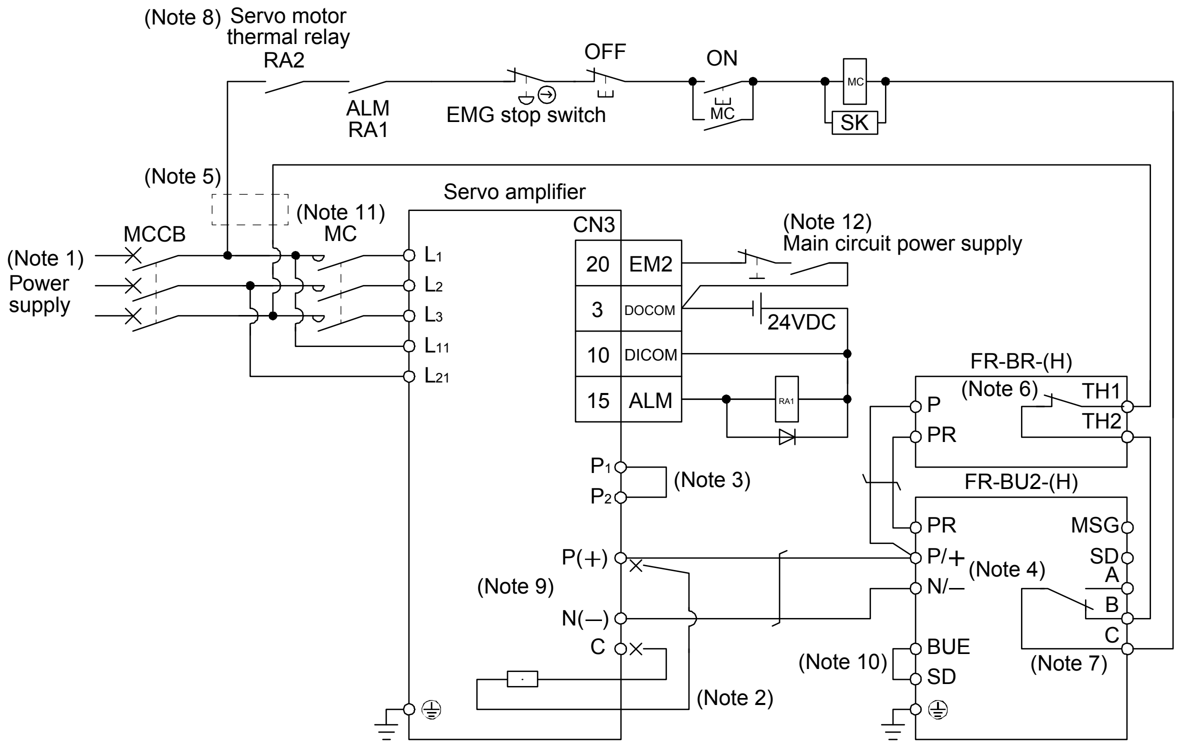
Parameter		Change possible/ impossible	Remarks
No.	Name		
0	Brake mode switchover	Impossible	Do not change the parameter.
1	Monitor display data selection	Possible	Refer to the FR-BU2-(H) Brake Unit Instruction Manual.
2	Input terminal function selection 1	Impossible	Do not change the parameter.
3	Input terminal function selection 2		
77	Parameter write selection		
78	Cumulative energization time carrying-over times		
CLr	Parameter clear		
ECL	Alarm history clear		
C1	For manufacturer setting		

11.3.3 Connection example

POINT
・The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode. ・Connecting PR terminal of the brake unit to P terminal of the servo amplifier results in brake unit malfunction. Always connect the PR terminal of the brake unit to the PR terminal of the resistor unit.

(1) Combination with FR-BR-(H) resistor unit

(a) When connecting a brake unit to a servo amplifier

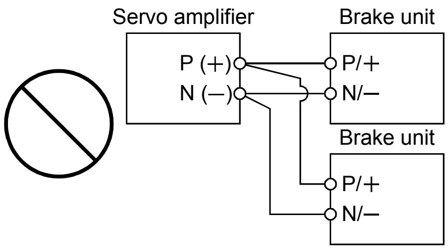


Note 1. For power supply specifications, refer to section 1.3.
2. For the servo amplifier of 5k and 7kW, always disconnect the lead of built-in regenerative resistor, which is connected to the P and C terminals. For the servo amplifier of 11k to 22kW, do not connect a supplied regenerative resistor to the P and C terminals.
3. Always connect P_1 and P_2 terminals (P_1 and P for the servo amplifier of 11k to 22kW) (Factory-wired). When using the power factor improving DC reactor, refer to section 11.13. Use only one of power factor improving DC reactor or power factor improving AC reactor.
4. Connect the P/＋ and N/－ terminals of the brake unit to a correct destination. Wrong connection results in servo amplifier and brake unit malfunction.
5. For 400VAC class, a step-down transformer is required.
6. Contact rating: 1b contact, 110VAC_5A/220VAC_3A
Normal condition: TH1-TH2 is conducting. Abnormal condition: TH1-TH2 is not conducting.
7. Contact rating: 230VAC_0.3A/30VDC_0.3A
Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
8. For the servo amplifier of 11kW or more, connect the thermal sensor of the servo motor.
9. Do not connect more than one cable to each P(＋) to N(－) terminals of the servo amplifier.
10. Always connect BUE and SD terminals (Factory-wired).
11. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
12. Turn off EM2 when the main power circuit power supply is off.

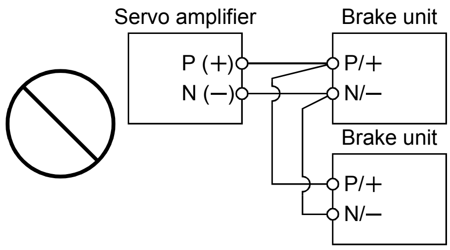
(b) When connecting two brake units to a servo amplifier

POINT

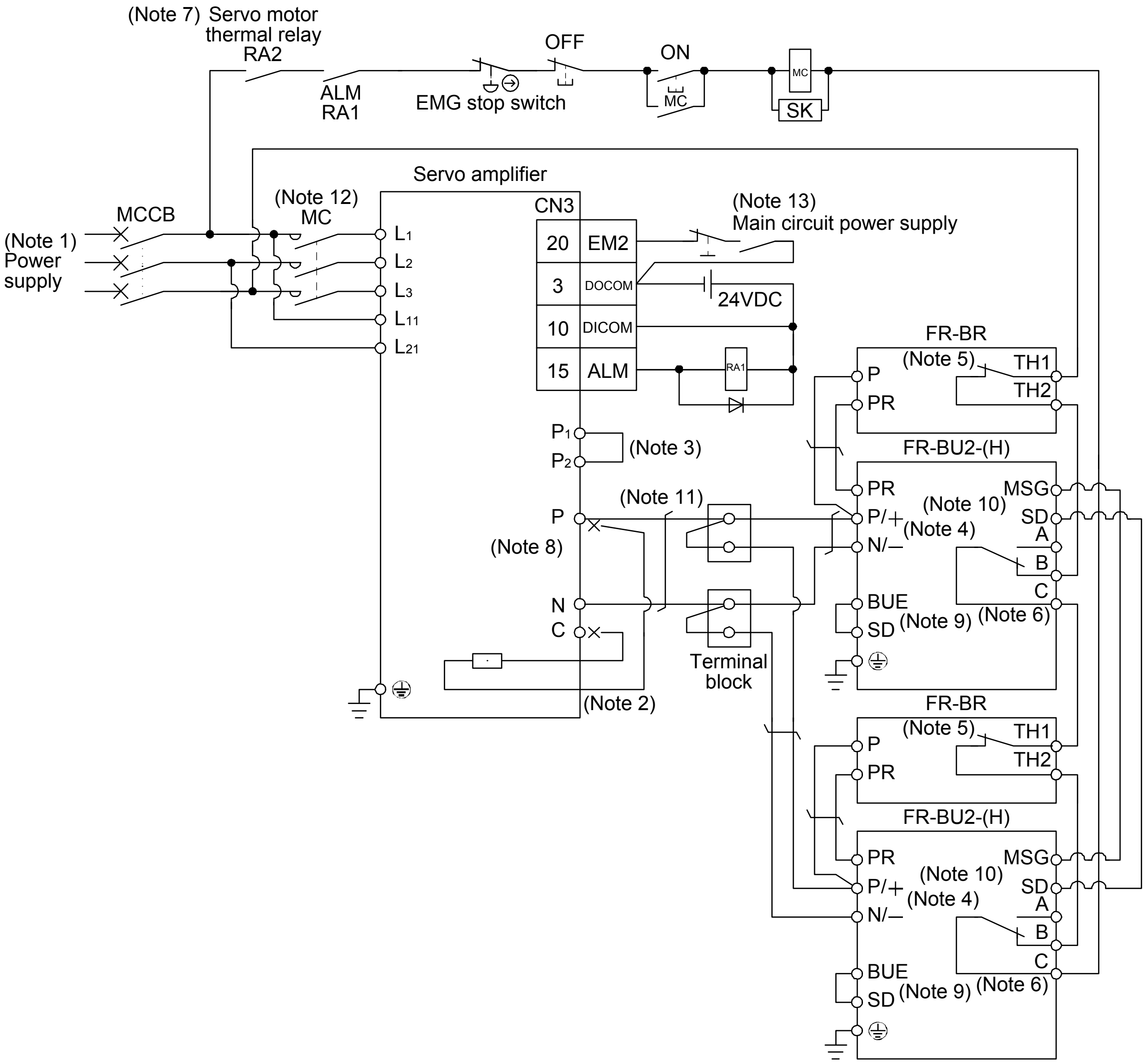
- To use brake units with a parallel connection, use two sets of FR-BU2 brake unit. Combination with other brake unit results in alarm occurrence or malfunction.
- Always connect the master and slave terminals (MSG and SD) of the two brake units.
- Do not connect the servo amplifier and brake units as below. Connect the cables with a terminal block to distribute as indicated in this section.



Connecting two cables to P and N terminals

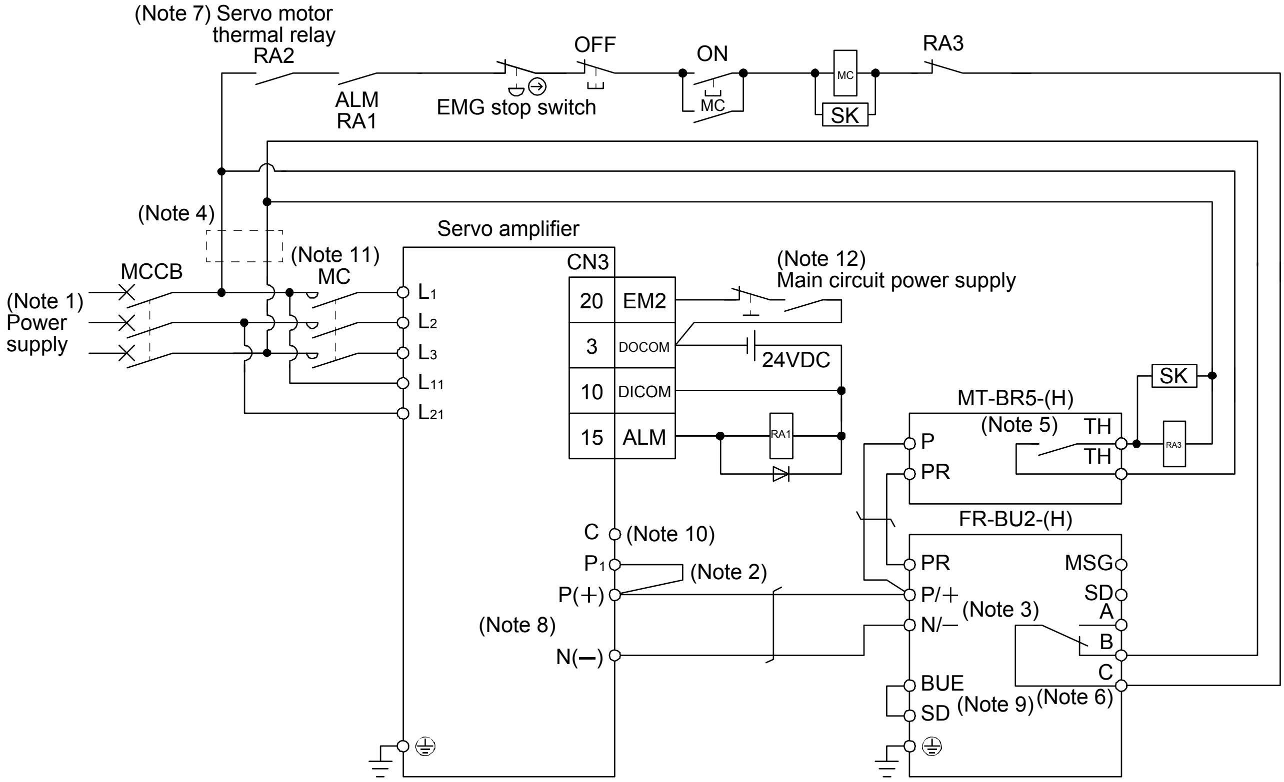


Passing wiring



Note 1. For power supply specifications, refer to section 1.3.
2. For the servo amplifier of 5k and 7kW, always disconnect the lead of built-in regenerative resistor, which is connected to the P and C terminals. For the servo amplifier of 11k and 15kW, do not connect a supplied regenerative resistor to the P and C terminals.
3. Always connect P_1 and P_2 terminals (P_1 and P for the servo amplifier of 11k and 15kW) (Factory-wired). When using the power factor improving DC reactor, refer to section 11.13. Use only one of power factor improving DC reactor or power factor improving AC reactor.
4. Connect the P/＋ and N/－ terminals of the brake unit to a correct destination. Wrong connection results in servo amplifier and brake unit malfunction.
5. Contact rating: 1b contact, 110VAC_5A/220VAC_3A
Normal condition: TH1-TH2 is conducting. Abnormal condition: TH1-TH2 is not conducting.
6. Contact rating: 230VAC_0.3A/30VDC_0.3A
Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
7. For the servo amplifier of 11kW or more, connect the thermal sensor of the servo motor.
8. Do not connect more than one cable to each P and N terminals of the servo amplifier.
9. Always connect BUE and SD terminals (Factory-wired).
10. Connect the MSG and SD terminals of the brake unit to a correct destination. Wrong connection results in servo amplifier and brake unit malfunction.
11. For the cable to connect the terminal block and the P and N terminals of the servo amplifier, use the cable indicated in (4) (b) of this section.
12. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
13. Turn off EM2 when the main power circuit power supply is off.

(2) Combination with MT-BR5-(H) resistor unit

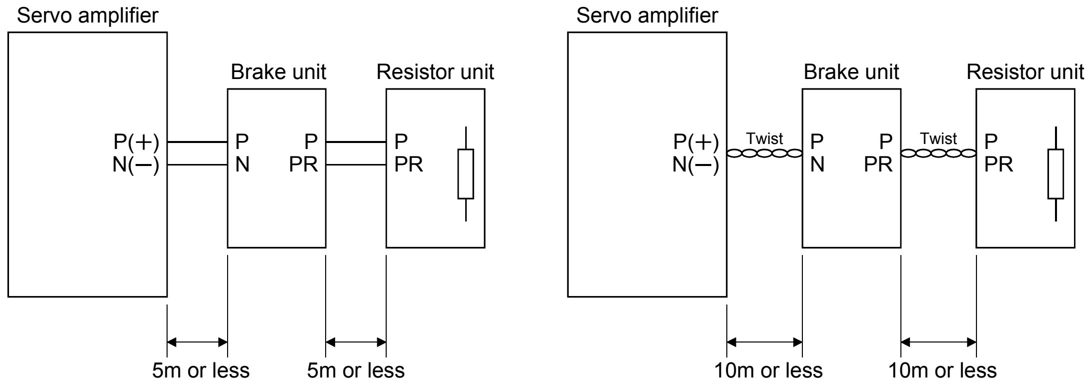


Note 1. For power supply specifications, refer to section 1.3.

2. Always connect P_1 - P(+) terminals (Factory-wired). When using the power factor improving DC reactor, refer to section 11.13. Use only one of power factor improving DC reactor or power factor improving AC reactor.
3. Connect the P/＋ and N/－ terminals of the brake unit to a correct destination. Wrong connection results in servo amplifier and brake unit malfunction.
4. For the servo amplifier of 400V class, a step-down transformer is required.
5. Contact rating: 1a contact, 110VAC_5A/220VAC_3A
   Normal condition: TH1-TH2 is not conducting. Abnormal condition: TH1-TH2 is conducting.
6. Contact rating: 230VAC_0.3A/30VDC_0.3A
   Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
7. For the servo amplifier of 11kW or more, connect the thermal sensor of the servo motor.
8. Do not connect more than one cable to each P and N terminals of the servo amplifier.
9. Always connect BUE and SD terminals (Factory-wired).
10. For the servo amplifier of 22kW, do not connect a supplied regenerative resistor to the P and C terminals.
11. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
12. Turn off EM2 when the main power circuit power supply is off.

(3) Precautions for wiring

The cables between the servo amplifier and the brake unit, and between the resistor unit and the brake unit should be as short as possible. Always twist the cable longer than 5m (twist five times or more per one meter). Even when the cable is twisted, the cable should be less than 10m. Using cables longer than 5m without twisting or twisted cables longer than 10m, may result in the brake unit malfunction.

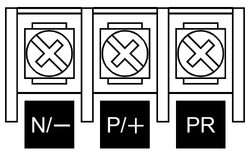


(4) Cables

(a) Cables for the brake unit

For the brake unit, HIV wire (600V Grade heat-resistant polyvinyl chloride insulated wire) is recommended.

1) Main circuit terminal

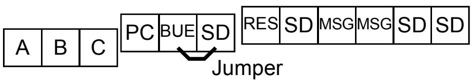


Terminal block

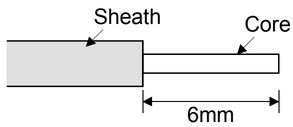
Brake unit		Main circuit terminal screw size	Crimping terminal N/−, P/+, PR, ⏚	Tightening torque	Wire size N/−, P/+, PR, ⏚ HIV wire [mm²]	Wire size N/−, P/+, PR, ⏚ AWG
200V class	FR-BU2-15K	M4	5.5-4	1.5	3.5	12
	FR-BU2-30K	M5	5.5-5	2.5	5.5	10
	FR-BU2-55K	M6	14-6	4.4	14	6
400V class	FR-BU2-H30K	M4	5.5-4	1.5	3.5	12
	FR-BU2-H55K	M5	5.5-5	2.5	5.5	10
	FR-BU2-H75K	M6	14-6	4.4	14	6

2) Control circuit terminal

POINT
・Undertightening can cause a cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or the brake unit.



Terminal block



Wire the stripped cable after twisting to prevent the cable from becoming loose. In addition, do not solder it.
Screw size: M3
Tightening torque: 0.5 to 0.6N・m
Wire size: 0.3 to 0.75 mm^2
Screw driver: Small flat-blade screwdriver
(Tip thickness: 0.4mm/Tip width 2.5mm)

(b) Cables for connecting the servo amplifier and a distribution terminal block when connecting two sets of the brake unit

Brake unit	Wire size	
	HIV wire [mm^2]	AWG
FR-BU2-15K	8	8

(5) Crimping terminals for P and N terminals of servo amplifier

(a) Recommended crimping terminals

POINT
・Always use recommended crimping terminals or equivalent since some crimping terminals cannot be installed depending on the size.

	Servo amplifier	Brake unit	Number of connected units	Crimping terminal (Manufacturer)	(Note 1) Applicable tool
200V class	MR-J3-500□S	FR-BU2-15K	1	FVD5.5-S4 (JST)	c
			2	8-4NS (JST) (Note 2)	d
		FR-BU2-30K	1	FVD5.5-S4 (JST)	c
	MR-J3-700□S	FR-BU2-15K	2	8-4NS (JST) (Note 2)	d
		FR-BU2-30K	1	FVD5.5-S4 (JST)	c
	MR-J3-11K□S	FR-BU2-15K	2	FVD8-6 (JST)	a
		FR-BU2-30K	1	FVD5.5-6 (JST)	c
		FR-BU2-55K	1	FVD14-6 (JST)	b
	MR-J3-15K□S	FR-BU2-15K	2	FVD8-6 (JST)	a
		FR-BU2-30K	1	FVD5.5-6 (JST)	c
		FR-BU2-55K	1	FVD14-6 (JST)	b
	MR-J3-22K□S	FR-BU2-55K	1	FVD14-8 (JST)	b
400V class	MR-J3-500□S4	FR-BU2-H30K	1	FVD5.5-S4 (JST)	c
	MR-J3-700□S4	FR-BU2-H30K	1	FVD5.5-S4 (JST)	c
	MR-J3-11K□S4	FR-BU2-H30K	1	FVD5.5-6 (JST)	c
		FR-BU2-H55K	1	FVD5.5-6 (JST)	c
	MR-J3-15K□S4	FR-BU2-H55K	1	FVD5.5-6 (JST)	c
	MR-J3-22K□S4	FR-BU2-H55K	1	FVD5.5-8 (JST)	c
		FR-BU2-H75K	1	FVD14-8 (JST)	b

Note 1. Symbols in the applicable tool field indicate applicable tools in (5)(b) of this section.

2. Coat the crimping part with an insulation tube.

(b) Applicable tool

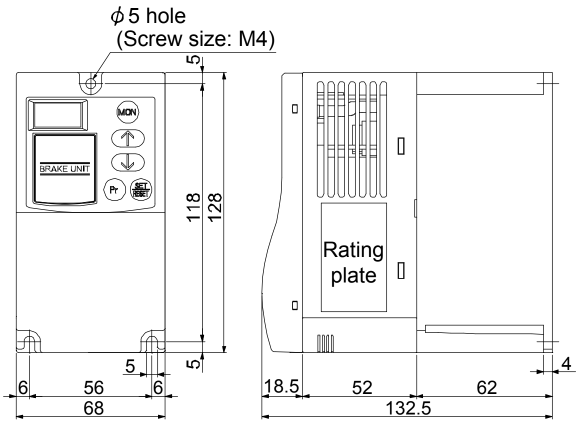
Symbol	Servo amplifier-side crimping terminals				
	Crimping terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FVD8-6	YF-1・E-4	YNE-38	DH-111・DH121	JST
b	FVD14-6 FVD14-8	YF-1・E-4	YNE-38	DH-112・DH122	
c	FDV5.5-S4 FDV5.5-6	YNT-1210S			
d	8-4NS	YHT-8S			

11.3.4 Outline dimension drawings

(1) FR-BU2- (H) brake unit

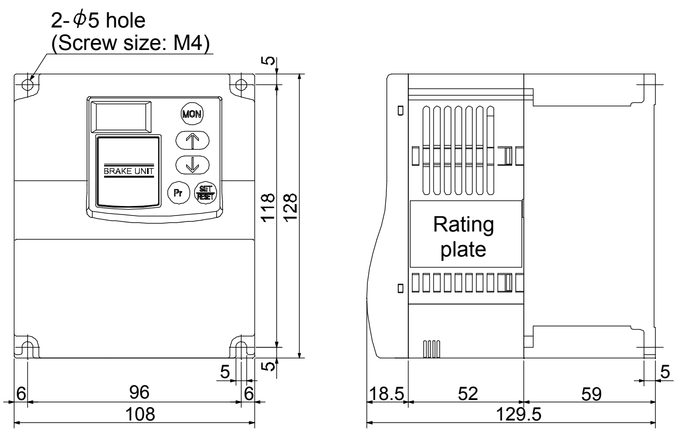
[Unit: mm]

FR-BU2-15K



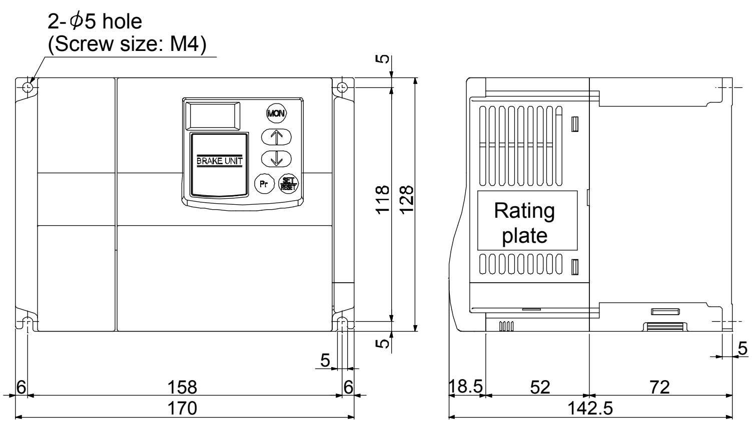
FR-BU2-30K

FR-BU2-H30K



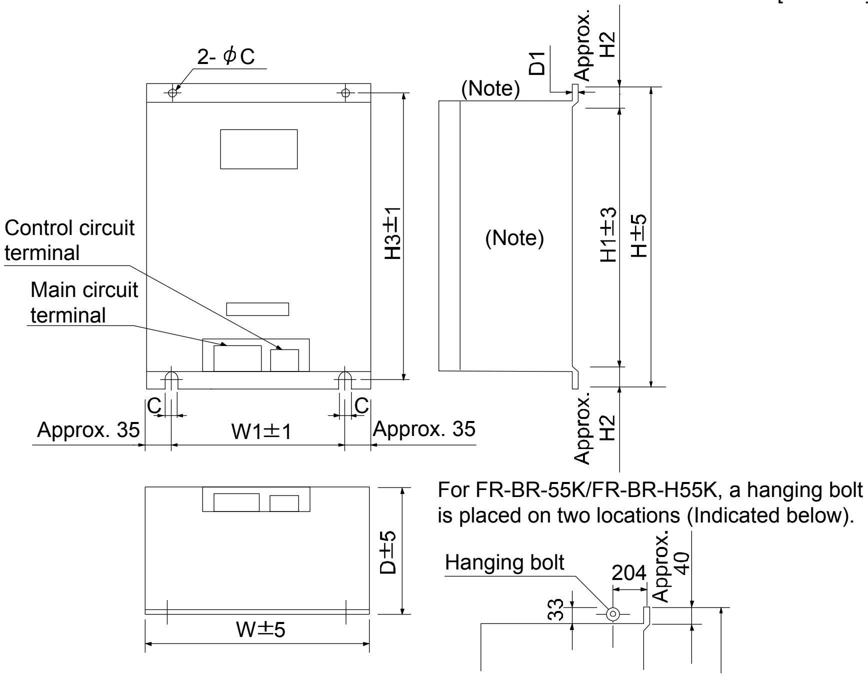
FR-BU2-55K

FR-BU2-H55K, H75K



(2) FR-BR- (H) resistor unit

[Unit: mm]

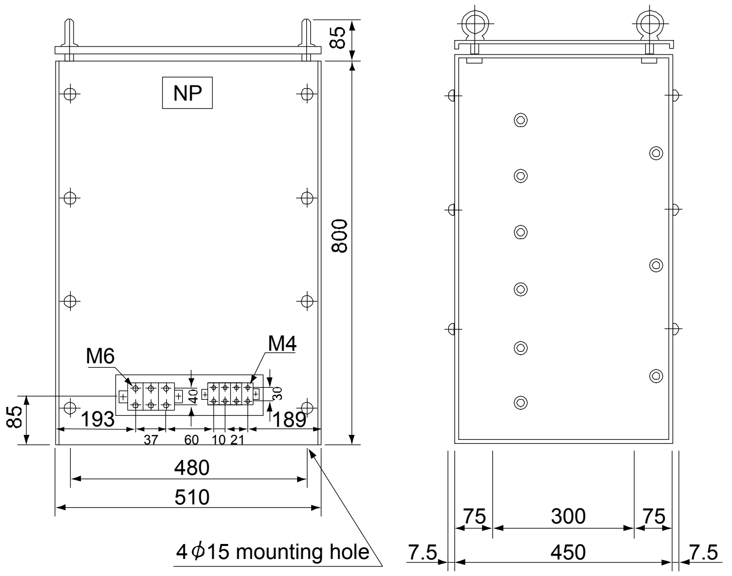


Note. Ventilation ports are provided on both sides and the top. The bottom is open.

Resistor unit		W	W1	H	H1	H2	H3	D	D1	C	Approximate mass [kg]
200V class	FR-BR-15K	170	100	450	410	20	432	220	3.2	6	15
	FR-BR-30K	340	270	600	560	20	582	220	4	10	30
	FR-BR-55K	480	410	700	620	40	670	450	3.2	12	70
400V class	FR-BR-H30K	340	270	600	560	20	582	220	4	10	30
	FR-BR-H55K	480	410	700	620	40	670	450	3.2	12	70

(3) MT-BR5- (H) resistor unit

[Unit: mm]



Resistor unit		Resistance value	Approximate mass [kg]
200V class	MT-BR5-55K	2.0Ω	50
400V class	MT-BR5-H75K	6.5Ω	70

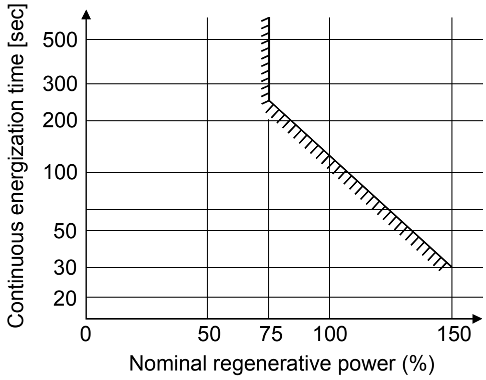
11.4 Power regenerative converter

POINT
・When using FR-RC-(H), set parameter No.PA04 to "30□□", and make the forced stop 1 (EM1) usable. ・When using the FR-RC-(H) power regenerative converter, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

When using the power regenerative converter, set "□□01" in parameter No.PA02.

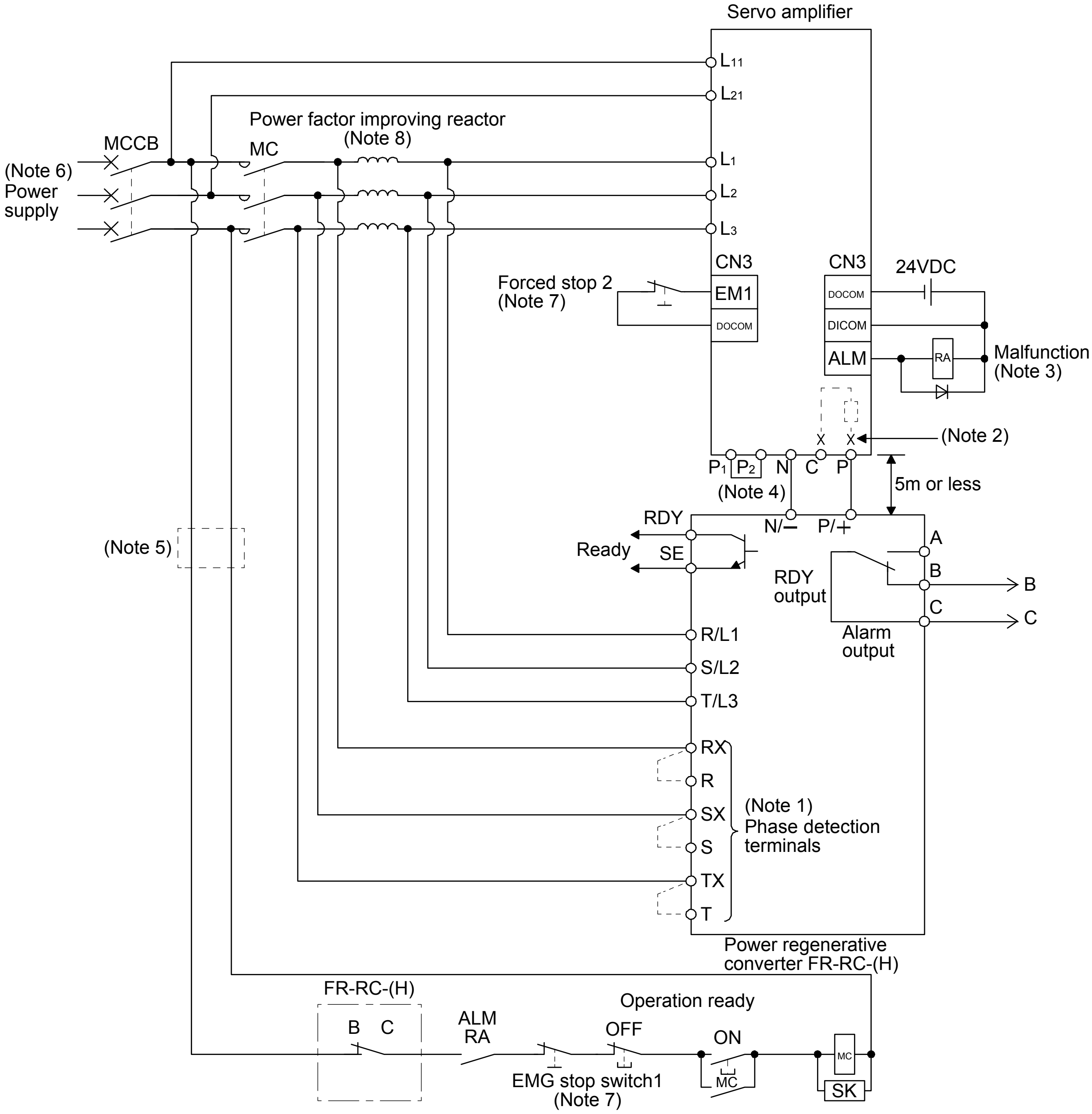
(1) Selection
The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the 5k to 22kW.

Power regenerative converter	Nominal regenerative power [kW]	Servo amplifier
FR-RC-15K	15	MR-J3-500□S MR-J3-700□S
FR-RC-30K	30	MR-J3-11K□S MR-J3-15K□S
FR-RC-55K	55	MR-J3-22K□S
FR-RC-H15K	15	MR-J3-500□S4 MR-J3-700□S4
FR-RC-H30K	30	MR-J3-11K□S4 MR-J3-15K□S4
FR-RC-H55K	55	MR-J3-22K□S4



(2) Connection example

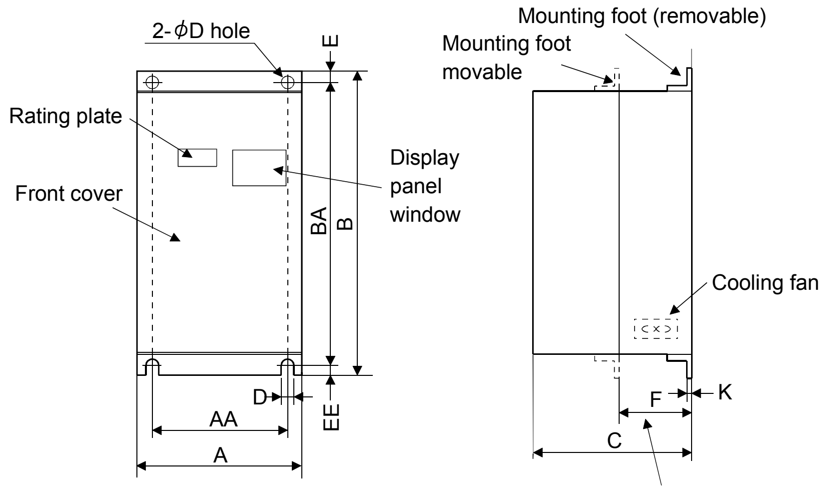
POINT
・In this configuration, only the STO function is supported. The forced stop deceleration function is not available.



Note 1. When not using the phase detection terminals, fit the jumpers across RX-R, SX-S and TX-T. If the jumpers remain removed, the FR-RC-(H) will not operate.
2. When using servo amplifiers of 5kW and 7kW, always remove the lead of built-in regenerative resistor connected to P terminal and C terminal.
3. When setting not to output malfunction (ALM) with parameter change, configure power supply circuit for turning magnetic contactor off after detecting an occurrence of alarm on the controller side.
4. Between P_1 and P_2 (P_1 and P for 11kW to 22kW) is connected by default.
5. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class in 400V class servo amplifiers.
6. Refer to section 1.3 for the power supply specification.
7. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
8. For selection of power factor improving AC reactors, refer to "Power Regeneration Converter FR-RC Instruction Manual (IB(NA)66330)".

(3) Outside dimensions of the power regeneration converters

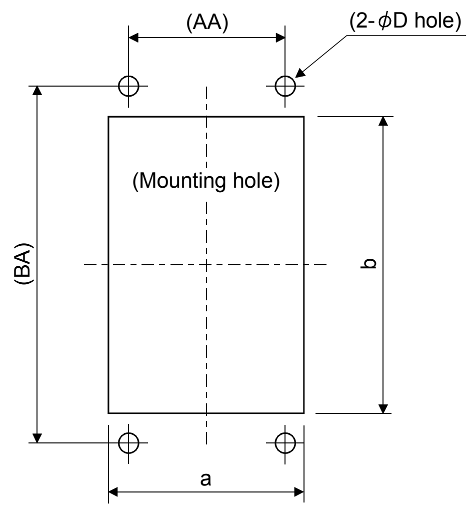
[Unit: mm]



Power regenerative converter	A	AA	B	BA	C	D	E	EE	K	F	Approx. mass [kg(lb)]
FR-RC-15K	270	200	450	432	195	10	10	8	3.2	87	19 (41.888)
FR-RC-H15K FR-RC-30K FR-RC-H30K	340	270	600	582	195	10	10	8	3.2	90	31 (68.343)
FR-RC-55K FR-RC-H55K	480	410	700	670	250	12	15	15	3.2	135	55 (121.3)

(4) Mounting hole machining dimensions
When the power regenerative converter is fitted to a totally enclosed type box, mount the heat generating area of the converter outside the box to provide heat generation measures. At this time, the mounting hole having the following dimensions is machined in the box.

[Unit: mm]



Power regenerative converter	a	b	D	AA	BA
FR-RC-15K	260	412	10	200	432
FR-RC-H15K FR-RC-30K FR-RC-H30K	330	562	10	270	582
FR-RC-55K FR-RC-H55K	470	642	12	410	670

11.5 Power regeneration common converter

POINT

- Use the FR-CV for the servo amplifier of 200V class and the FR-CV-H for that of 400V class.
- For details of the power regeneration common converter FR-CV-(H), refer to the FR-CV-(H) Installation Guide (IB(NA)0600075).
- Do not supply power to the main circuit power supply terminals (L_1, L_2, L_3) of the servo amplifier. Doing so will fail the servo amplifier and FR-CV-(H).
- Connect the DC power supply between the FR-CV-(H) and servo amplifier with correct polarity. Connection with incorrect polarity will fail the FR-CV-(H) and servo amplifier.
- Two or more FR-CV-(H)'s cannot be installed to improve regeneration capability. Two or more FR-CV-(H)'s cannot be connected to the same DC power supply line.
- When using FR-CV-(H), set parameter No.PA04 to "30□□", and make the forced stop 1 (EM1) usable.

When using the power regeneration common converter, set parameter No.PA02 to "□□01".

(1) Model

FR－CV－□□

Capacity

Symbol	Capacity [kW]
7.5K	7.5
11K	11
15K	15
22K	22
30K	30
37K	37
55K	55

Symbol	Voltage class
None	200V class
H	400V class

(2) Selection

The power regenerative common converter FR-CV can be used for the servo amplifier of 200V class with 750 to 22kW and that of 400V class with 11k to 22kW. The following shows the restrictions on using the FR-CV-(H).

(a) Up to six servo amplifiers can be connected to one FR-CV-(H).

(b) FR-CV-(H) capacity [W] $\geq$ Total of rated capacities [W] $\times$ 2 of servo amplifiers connected to FR-CV-(H).

(c) The total of used servo motor rated currents should be equal to or less than the applicable current [A] of the FR-CV-(H).

(d) Among the servo amplifiers connected to the FR-CV-(H), the servo amplifier of the maximum capacity should be equal to or less than the maximum connectable capacity [W].

The following table lists the restrictions.

Item	FR-CV						
	7.5K	11K	15K	22K	30K	37K	55K
Maximum number of connected servo amplifiers	6						
Total of connectable servo amplifier capacities [kW]	3.75	5.5	7.5	11	15	18.5	27.5
Total of connectable servo motor rated currents [A]	33	46	61	90	115	145	215
Maximum servo amplifier capacity [kW]	3.5	5	7	11	15	15	22

Item	FR-CV-H			
	22K	30K	37K	55K
Maximum number of connected servo amplifiers	6			
Total of connectable servo amplifier capacities [kW]	11	15	18.5	27.5
Total of connectable servo motor rated currents [A]	90	115	145	215
Maximum servo amplifier capacity [kW]	11	15	15	22

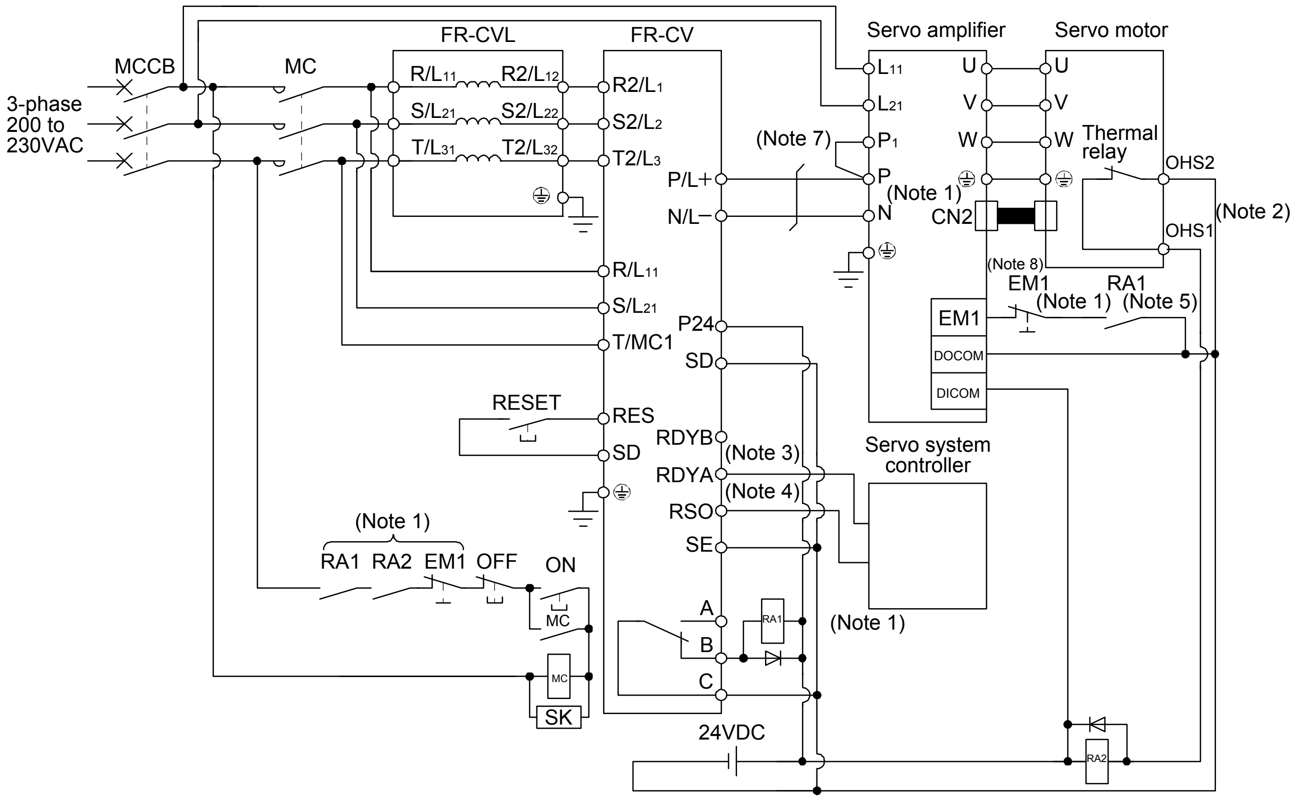
When using the FR-CV-(H), always install the dedicated stand-alone reactor (FR-CVL-(H)).

Power regeneration common converter	Dedicated stand-alone reactor
FR-CV-7.5K(-AT)	FR-CVL-7.5K
FR-CV-11 K(-AT)	FR-CVL-11 K
FR-CV-15K(-AT)	FR-CVL-15K
FR-CV-22K(-AT)	FR-CVL-22K
FR-CV-30K(-AT)	FR-CVL-30K
FR-CV-37K	FR-CVL-37K
FR-CV-55K	FR-CVL-55K
FR-CV-H22K(-AT)	FR-CVL-H22K
FR-CV-H30K(-AT)	FR-CVL-H30K
FR-CV-H37K	FR-CVL-H37K
FR-CV-H55K	FR-CVL-H55K

(3) Connection diagram

POINT
· In this configuration, only the STO function is supported. The forced stop deceleration function is not available.

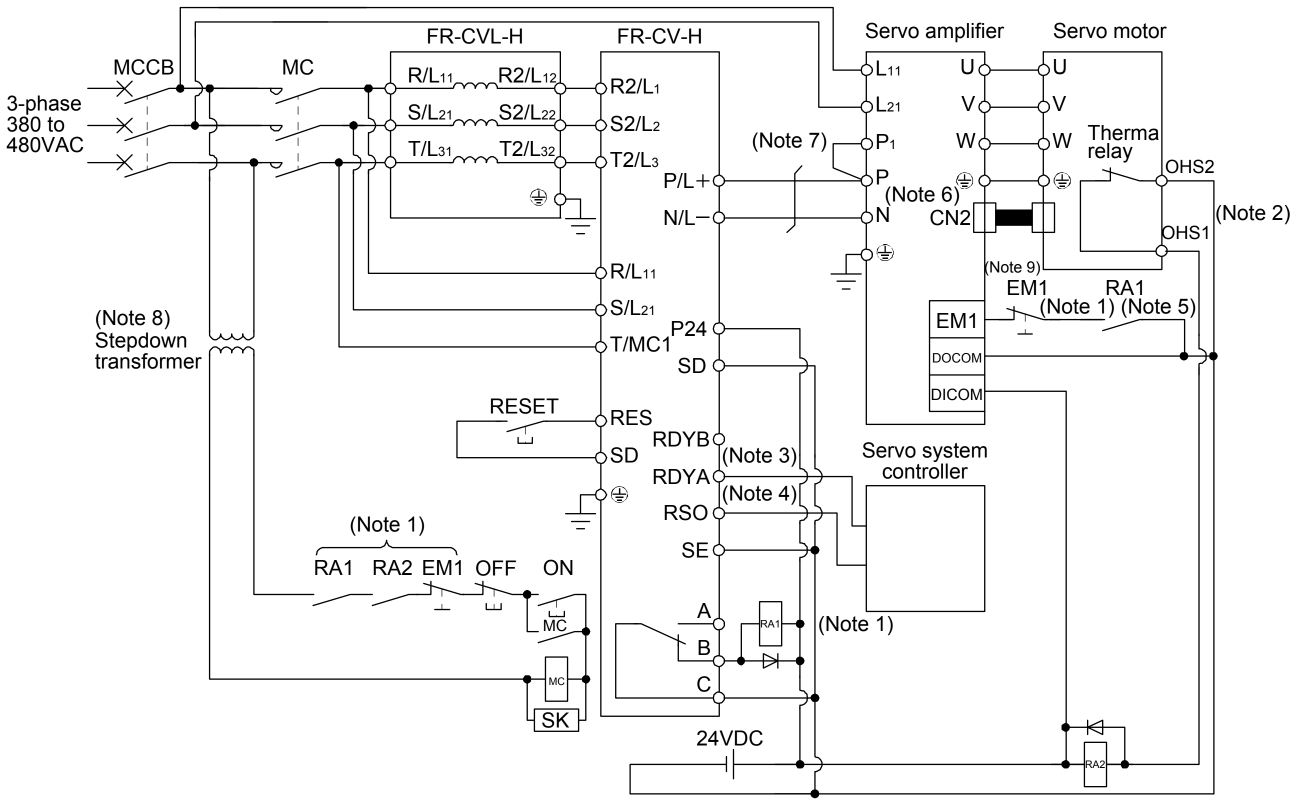
(a) 200V class



Note 1. Configure a sequence that will shut off main circuit power at an forced stop 1 (EM1) or at FR-CV or servo amplifier alarm occurrence.

2. For the servo motor with thermal relay, configure a sequence that will shut off main circuit power when the thermal relay operates.
3. For the servo amplifier, configure a sequence that will switch the servo-on after the FR-CV is ready.
4. For the FR-CV, the RSO signal turns off when it is put in a ready-to-operate status where the reset signal is input. Configure a sequence that will make the servo inoperative when the RSO signal is on.
5. Configure a sequence that will make a stop with the emergency stop input of the servo system controller if an alarm occurs in the FR-CV. When the servo system controller does not have an emergency stop input, use the forced stop input of the servo amplifier to make a stop as shown in the diagram.
6. When using the servo amplifier of 7kW or less, make sure to disconnect the wiring of built-in regenerative resistor (3.5kW or less: P and D, 5k/7kW: P and C).
7. When using the servo amplifier of 11k to 22kW, make sure to connect P_1 and P. (Factory-wired.)
8. Set parameter No.PA04 to "30□□", and make the forced stop 1 (EM1) usable.

(b) 400V class



Note 1. Configure a sequence that will shut off main circuit power at an forced stop 1 (EM1) or at FR-CV-H or servo amplifier alarm occurrence.

2. For the servo motor with thermal relay, configure a sequence that will shut off main circuit power when the thermal relay operates.
3. For the servo amplifier, configure a sequence that will switch the servo-on after the FR-CV-H is ready.
4. For the FR-CV-H, the RSO signal turns off when it is put in a ready-to-operate status where the reset signal is input. Configure a sequence that will make the servo inoperative when the RSO signal is on.
5. Configure a sequence that will make a stop with the emergency stop input of the servo system controller if an alarm occurs in the FR-CV-H. When the servo system controller does not have an emergency stop input, use the forced stop input of the servo amplifier to make a stop as shown in the diagram.
6. When using the servo amplifier of 7kW or less, make sure to disconnect the wiring of built-in regenerative resistor (2kW or less: P＋ and D, 3.5k to 7kW: P＋ and C).
7. When using the servo amplifier of 11k to 22kW, make sure to connect P_1 and P(＋). (Factory-wired.)
8. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class servo amplifiers.
9. Set parameter No.PA04 to "30□□", and make the forced stop 1 (EM1) usable.

(4) Selection example of wires used for wiring

POINT
・Selection condition of wire size is as follows. Wire type: 600V Polyvinyl chloride insulated wire (IV wire) Construction condition: One wire is constructed in the air

(a) Wire sizes

1) Across P-P(＋), N-N(－)

The following table indicates the connection wire sizes of the DC power supply (P, N terminals) between the FR-CV and servo amplifier.

Total of servo amplifier capacities [kW]	Wires [mm^2]
1 or less	2
2	3.5
5	5.5
7	8
11	14
15	22
22	50

The following table indicates the connection wire sizes of the DC power supply (P(＋), N(－) terminals) between the FR-CV-H and servo amplifier.

Total of servo amplifier capacities [kW]	Wires [mm^2]
1 or less	2
2	3.5
5	5.5
7	8
11	8
15	22
22	22

2) Grounding

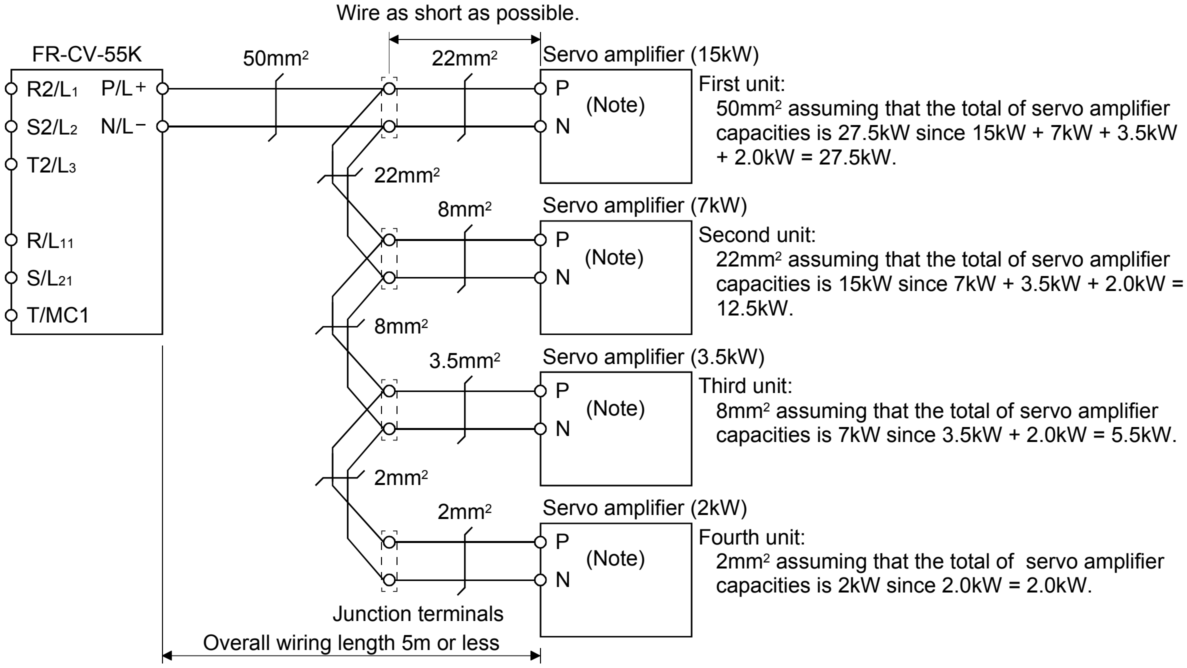
For grounding, use the wire of the size equal to or greater than that indicated in the following table, and make it as short as possible.

Power regeneration common converter	Grounding wire size [mm^2]
FR-CV-7.5K to FR-CV-15K	14
FR-CV-22K・FR-CV-30K	22
FR-CV-37K・FR-CV-55K	38
FR-CV-H22K・FR-CV-H30K	8
FR-CV-H37K・FR-CV-H55K	22

(b) Example of selecting the wire sizes

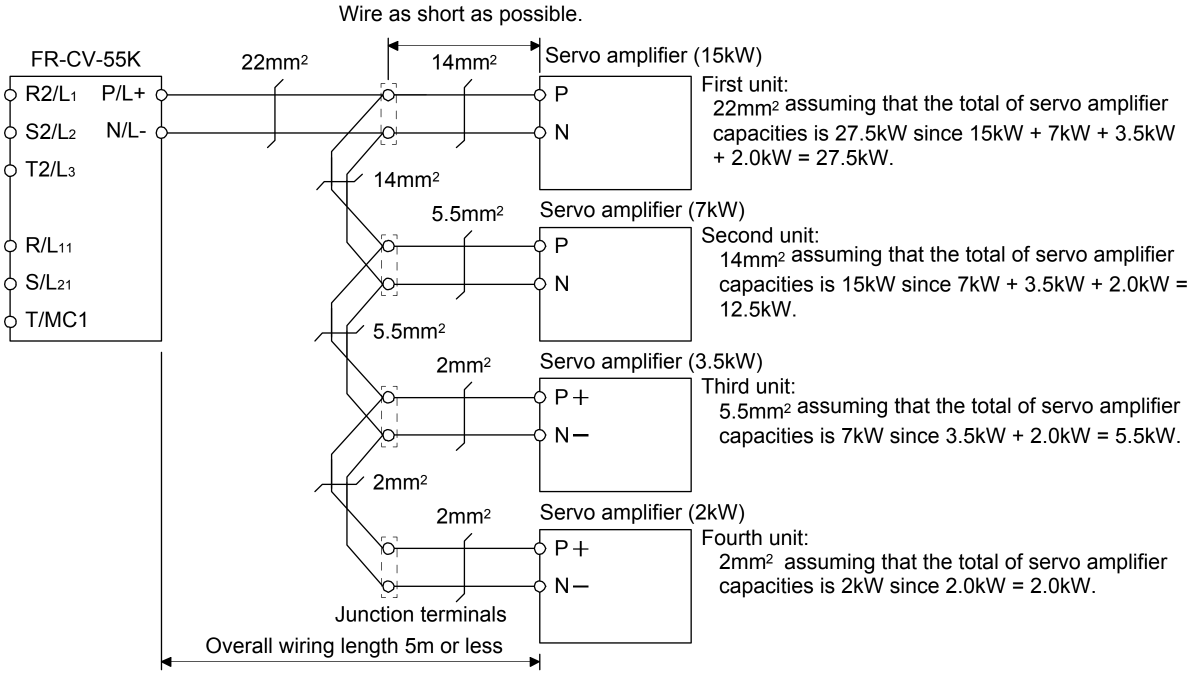
When connecting multiple servo amplifiers, always use junction terminals for wiring the servo amplifier terminals P, N. Also, connect the servo amplifiers in the order of larger to smaller capacities.

1) 200V class



Note. When using the servo amplifier of 7kW or less, make sure to disconnect the wiring of built-in regenerative resistor (3.5kW or less: P-D, 5k/7kW: P-C).

2) 400V class



(5) Other precautions

(a) Always use the dedicated stand-alone reactor (FR-CVL-(H)) as the power factor improving reactor. Do not use the power factor improving AC reactor (FR-BAL) or Power factor improving DC reactor (FR-BEL).

(b) The inputs/outputs (main circuits) of the FR-CV-(H) and servo amplifiers include high-frequency components and may provide electromagnetic wave interference to communication equipment (such as AM radios) used near them. In this case, interference can be reduced by installing the radio noise filter (FR-BIF-(H)) or line noise filter (FR-BSF01, FR-BLF).

(c) The overall wiring length for connection of the DC power supply between the FR-CV-(H) and servo amplifiers should be 5m or less, and the wiring must be twisted.

(6) Specifications

Item \ Power regeneration common converter FR-CV-			7.5K	11K	15K	22K	30K	37K	55K
Total of connectable servo amplifier capacities [kW]			3.75	5.5	7.5	11	15	18.5	27.5
Maximum servo amplifier capacity [kW]			3.5	5	7	11	15	15	22
Output	Total of connectable servo motor rated currents [A]		33	46	61	90	115	145	215
	Regenerative braking torque	Short-time rating	Total capacity of applicable servo motors, 300% torque, 60s (Note 1)						
		Continuous rating	100% torque						
Power supply	Rated input AC voltage/frequency		3-phase 200 to 220V 50Hz, 200 to 230V 60Hz						
	Permissible AC voltage fluctuation		3-phase 170 to 242V 50Hz, 170 to 253V 60Hz						
	Permissible frequency fluctuation		±5%						
	Power supply capacity (Note 2) [kVA]		17	20	28	41	52	66	100
IP rating (JEM 1030), cooling system			Open type (IP00), forced cooling						
Environmental conditions	Ambient temperature		−10℃ to 50℃ (non-freezing)						
	Ambient humidity		90%RH or less (non-condensing)						
	Ambience		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt)						
Altitude, vibration			1000m or less above sea level, $5.9m/s^2$ 2 or less						
Molded-case circuit breaker or earth-leakage current breaker			30AF 30A	50AF 50A	100AF 75A	100AF 100A	225AF 125A	225AF 125A	225AF 175A
Magnetic contactor			S-N20	S-N35	S-N50	S-N65	S-N95	S-N95	S-N125

Item \ Power regeneration common converter FR-CV-H			22K	30K	37K	55K
Total of connectable servo amplifier capacities [kW]			11	15	18.5	27.5
Maximum servo amplifier capacity [kW]			11	15	15	22
Output	Total of connectable servo motor rated currents [A]		43	57	71	110
	Regenerative braking torque	Short-time rating	Total capacity of applicable servo motors, 300% torque, 60s (Note 1)			
		Continuous rating	100% torque			
Power supply	Rated input AC voltage/frequency		3-phase 380 to 480V, 50Hz/60Hz			
	Permissible AC voltage fluctuation		3-phase 323 to 528V, 50Hz/60Hz			
	Permissible frequency fluctuation		±5%			
	Power supply capacity [kVA]		41	52	66	100
IP rating (JEM 1030), cooling system			Open type (IP00), forced cooling			
Environmental conditions	Ambient temperature		−10℃ to 50℃ (non-freezing)			
	Ambient humidity		90%RH or less (non-condensing)			
	Ambience		Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt)			
Altitude, vibration			1000m or less above sea level, $5.9m/s^2$ 2 or less			
Molded-case circuit breaker or earth-leakage current breaker			60AF 60A	100AF 75A	100AF 75A	225AF 125A
Magnetic contactor			S-N25	S-N35	S-N35	S-N65

Note 1. This is the time when the protective function of the FR-CV-(H) is activated. The protective function of the servo amplifier is activated in the time indicated in section 10.1.

2. When connecting the capacity of connectable servo amplifier, specify the value of servo amplifier.

11.6 External dynamic brake

CAUTION	
⚠CAUTION	・Use an external dynamic brake for a servo amplifier of MR-J3-11K□S(4) to MR-J3-22K□S(4). Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

POINT

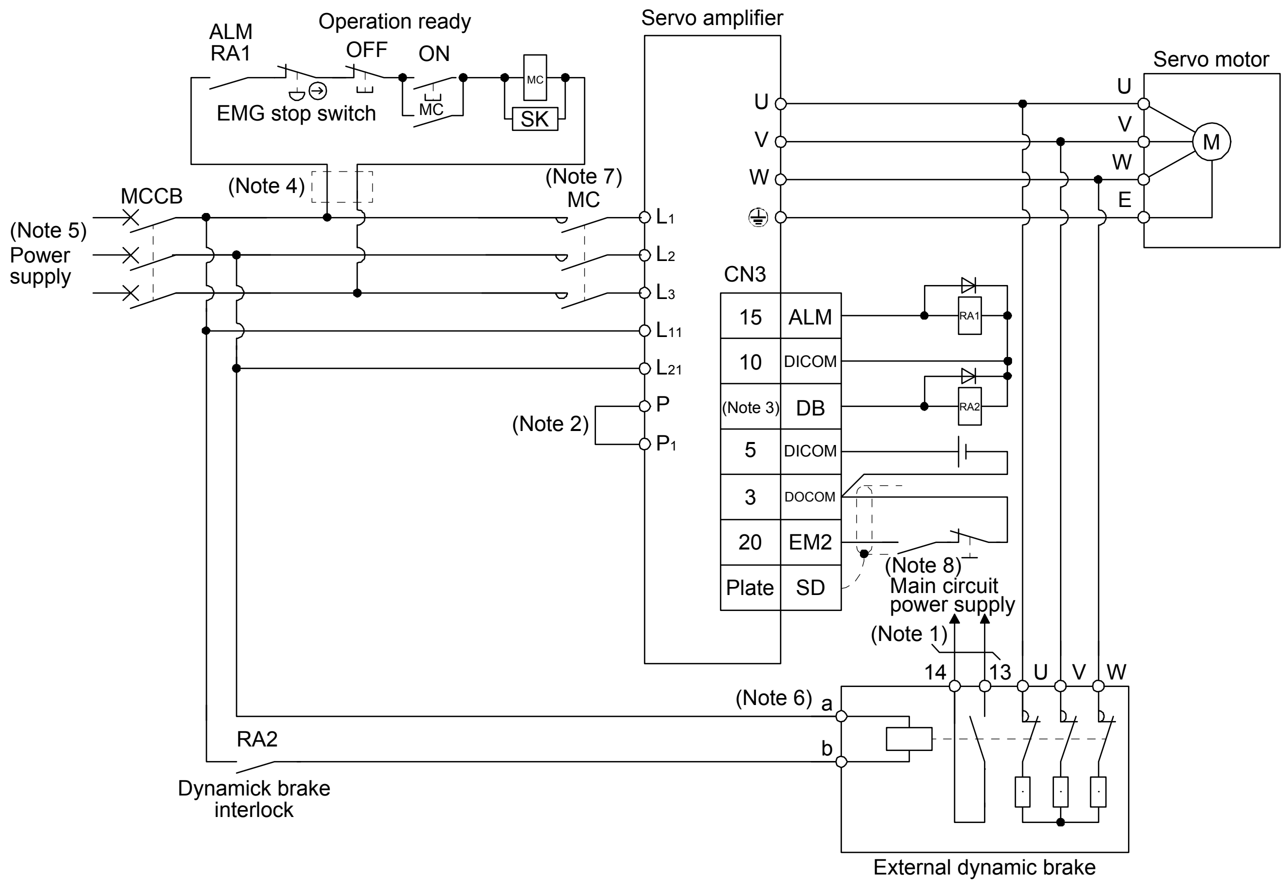
- The signal EM2 of the servo amplifier is the same as EM1 of the servo amplifier in torque control mode.
- Configure up a sequence which switches off the magnetic contactor of the brake unit after (or as soon as) the servo-on command has been turned off at a power failure or failure.
- For the braking time taken when the dynamic brake is operated, refer to section 10.3.
- The brake unit is rated for a short duration. Do not use it for high duty.
- When using the 400V class dynamic brake, the power supply voltage is restricted to 1-phase 380VAC to 463VAC (50Hz/60Hz).
- Dynamic brake operates at occurrence of alarm, servo forced stop warning (E6), and controller forced stop warning (E7), and when power is turned off. Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- Maximum usage time of dynamic brake for a machine operating under recommended load inertia moment ratio is 1000 time while decelerating from rated speed to a stop with frequency of once in 10 minutes.
- Be sure to make forced stop 1 (EM1) valid after servo motor stops when using forced stop 1 (EM1) frequently in other than emergency.

(1) Selection of dynamic brake

The dynamic brake is designed to bring the servo motor to a sudden stop when a power failure occurs or the protective circuit is activated, and is built in the 7kW or less servo amplifier. Since it is not built in the 11kW or more servo amplifier, purchase it separately. Assign the dynamic brake interlock (DB) to any of CN3-9, CN3-13, and CN3-15 pins in parameter No.PD07 to PD09.

Servo amplifier	Dynamic brake
MR-J3-11K□S	DBU-11K
MR-J3-15K□S	DBU-15K
MR-J3-22K□S	DBU-22K
MR-J3-11K□S4	DBU-11K-4
MR-J3-15K□S4	DBU-22K-4
MR-J3-22K□S4	

(2) Connection example

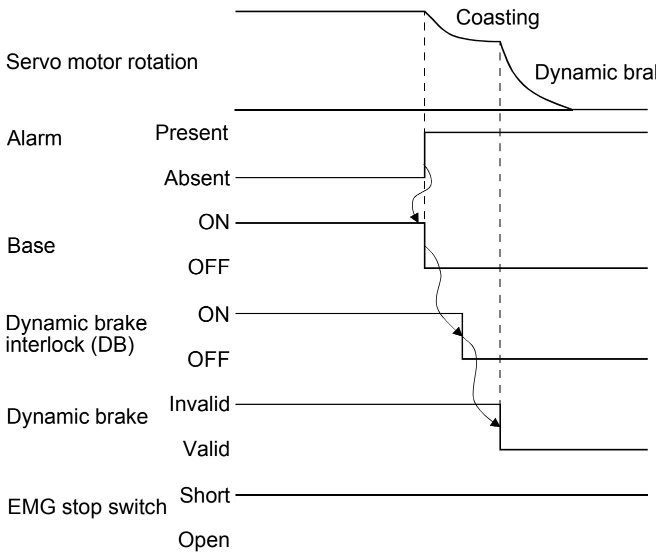


Note 1. Terminals 13, 14 are normally open contact outputs. If the dynamic brake is seized, terminals 13, 14 will open. Therefore, configure up an external sequence to prevent servo-on.

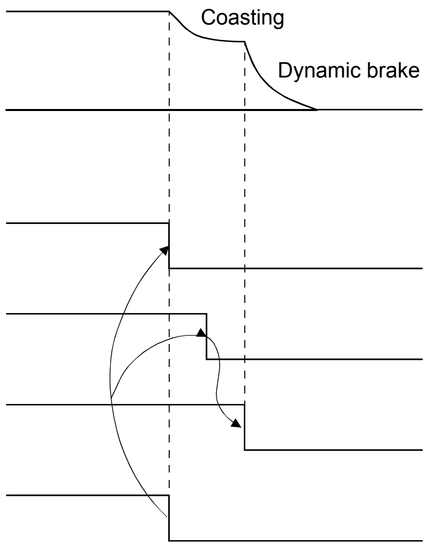
2. For the servo amplifiers from 11k to 22kW, be sure to connect P_1 and P. (Factory-wired) When using the power factor DC reactor, refer to section 11.13. Use only one of power factor improving DC reactor or power factor improving AC reactor.
3. Assign the dynamic brake interlock (DB) in the parameters No.PD07 to PD09.
4. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class in 400V class servo amplifiers.
5. Refer to section 1.3 for the power supply specification.
6. The power supply voltage of the inside magnet contactor for 400V class dynamic brake DBU-11K-4 and DBU-22K-4 is restricted as follows. When using these dynamic brakes, use them within the range of the power supply.

Dynamic brake	Power supply voltage
DBU-11K-4 DBU-22K-4	1-phase 380 to 463VAC 50Hz/60Hz

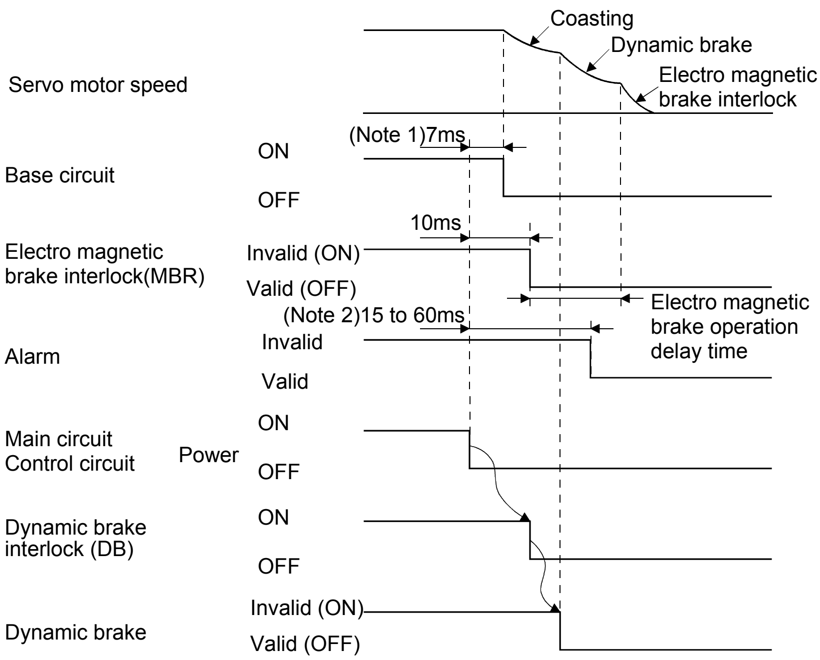
7. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
8. Turn off EM2 when the main power circuit power supply is off.



a. Timing chart at alarm occurrence



b. Timing chart at EMG stop switch validity



Note 1. When powering OFF, the dynamic brake interlock (DB) will be turned OFF, and the base circuit is turned OFF earlier than usual before an output shortage occurs. (Only when assigning the DB as the output signal in the parameter No.PD07, PD08 or PD09)

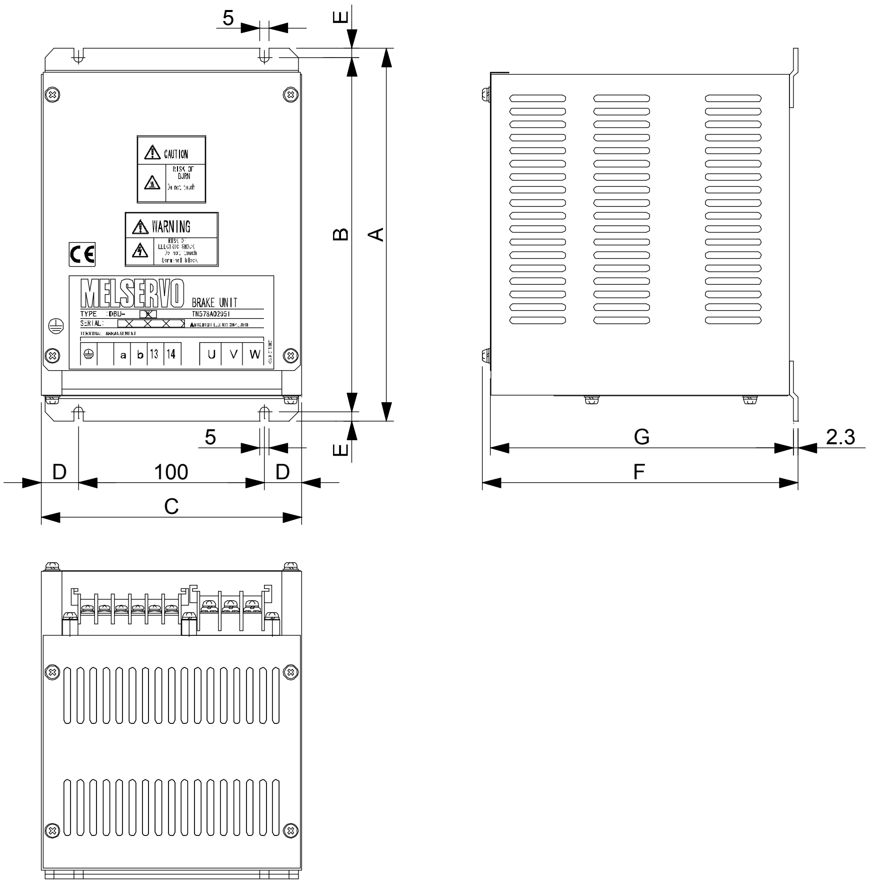
2. Variable according to the operation status.

c. Timing chart when both of the main and control circuit power are OFF

(3) Outline dimension drawing

(a) DBU-11K・DBU-15K・DBU-22K

[Unit: mm]



Terminal block

E (GND)		a	b	13	14

Screw: M3.5
Tightening torque: 0.8 [N・m](7 [lb・in]

U	V	W

Screw: M4
Tightening torque: 1.2 [N・m](10.6 [lb・in])

Dynamic brake	A	B	C	D	E	F	G	Mass [kg] ([lb])	Connection wire [mm^2] (Note)
DBU-11K	200	190	140	20	5	170	163.5	2 (4.41)	5.5
DBU-15K, 22K	250	238	150	25	6	235	228	6 (13.23)	5.5

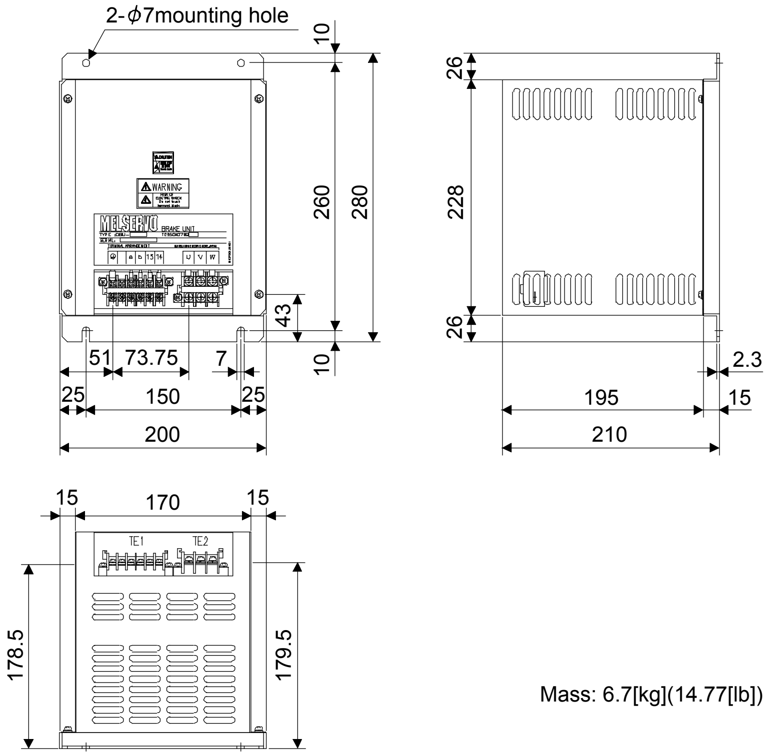
Note. Selection condition of wire size is as follows.

Wire type: 600V Polyvinyl chloride insulated wire (IV wire)

Construction condition: One wire is constructed in the air

(b) DBU-11K-4・DBU-22K-4

[Unit: mm]



Mass: 6.7[kg](14.77[lb])

Terminal block
TE1

⏚		a	b	13	14

Screw: M3.5
Tightening torque: 0.8[N•m](7[lb•in])

TE2

U	V	W

Screw: M4
Tightening torque: 1.2[N•m](10.6[lb•in])

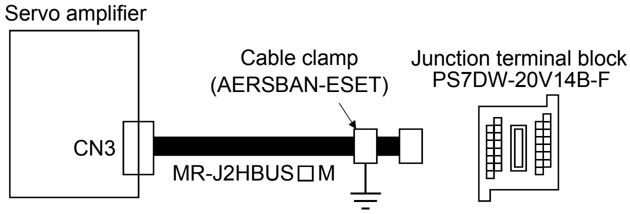
Dynamic brake	Wire [mm²] (Note)	
	a・b	U・V・W
DBU-11K-4	2	5.5
DBU-22K-4	2	5.5

Note. Selection condition of wire size is as follows.
Wire type: 600V Polyvinyl chloride insulated wire (IV wire)
Construction condition: One wire is constructed in the air

11.7 Junction terminal block PS7DW-20V14B-F (recommended)

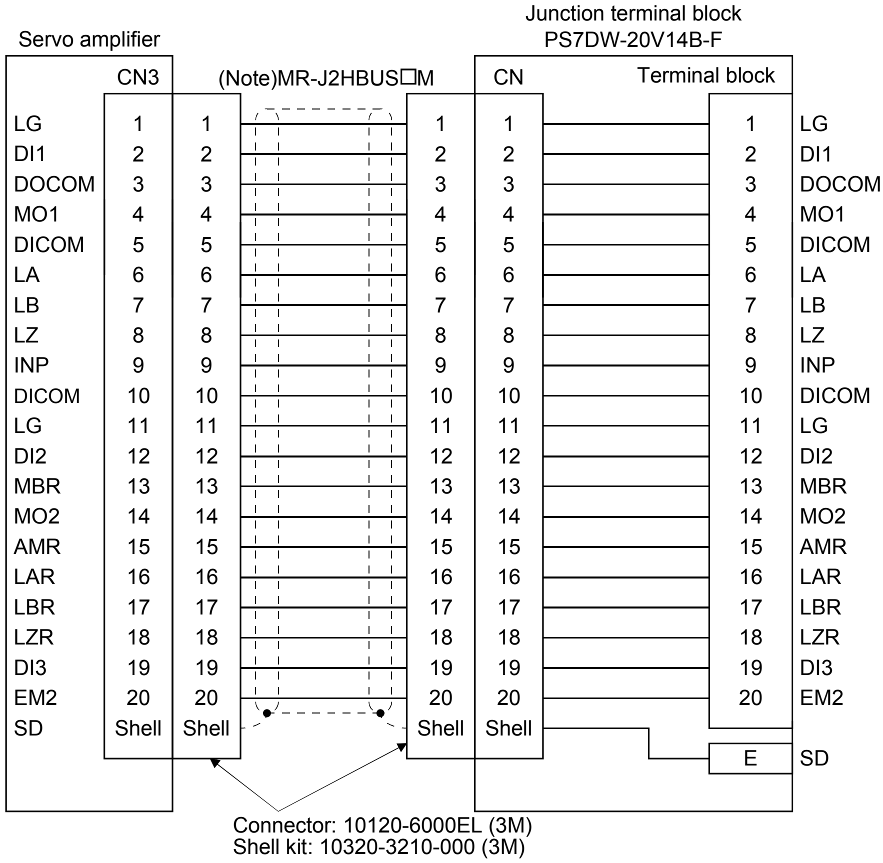
(1) How to use the junction terminal block

Always use the junction terminal block (PS7W-20V14B-F(YOSHIDA ELECTRIC INDUSTRY)) with the option cable (MR-J2HBUS□M) as a set. A connection example is shown below.



Ground the option cable on the junction terminal block side with the cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to section 11.16, (2)(c).

(2) Connection of MR-J2HBUS□M cable and junction terminal block



Note. Symbol indicating cable length is put in □.

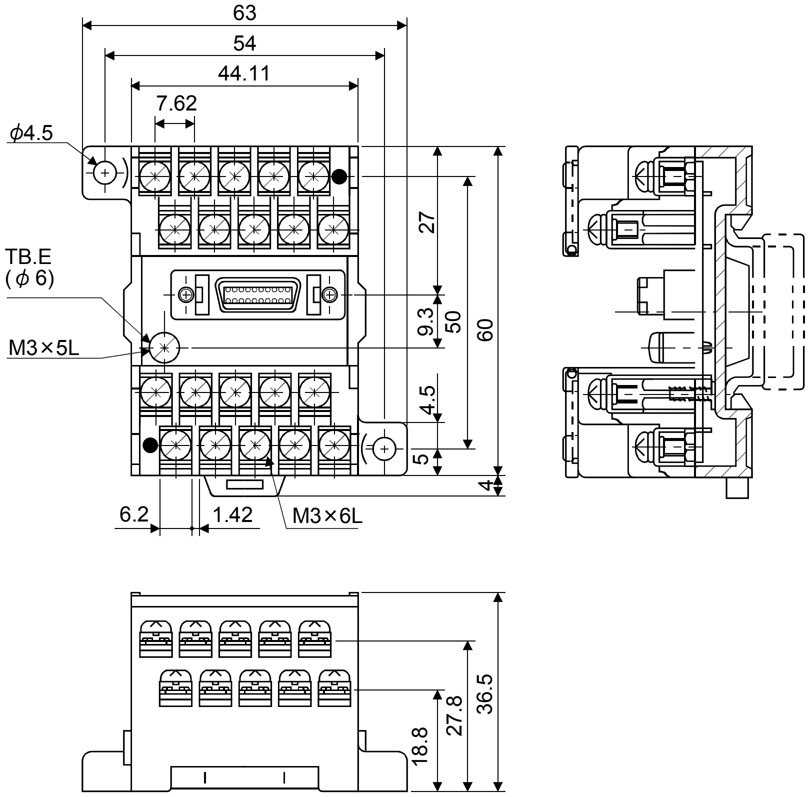
05: 0.5m

1: 1m

5: 5m

(3) Outline drawings of junction terminal block

[Unit: mm]



11.8 MR Configurator

MR Configurator (MRZJW3-SETUP221E) 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	Description
Compatibility with a servo amplifier	Software version C3 or later is compatible.
Monitor	Display, high speed monitor, trend graph (Minimum resolution changes with the processing speed of the personal computer.)
Alarm	Display, history, amplifier data
Diagnostic	DI/DO display, no motor rotation, total power-on time, amplifier software version info, motor information, tuning data, absolute encoder data, Axis name setting
Parameters	Parameter list, turning, change list, detailed information
Test operation	Jog operation, positioning operation, Do forced output, program operation
Advanced function (Note)	Machine analyzer, gain search, machine simulation, robust disturbance compensation, Advanced gain search
File operation	Data read, save, delete, print
Others	Automatic demo, help display

Note. The advanced gain search is supported by MR Configurator with software version C2 or later.

(2) System configuration

(a) Components

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

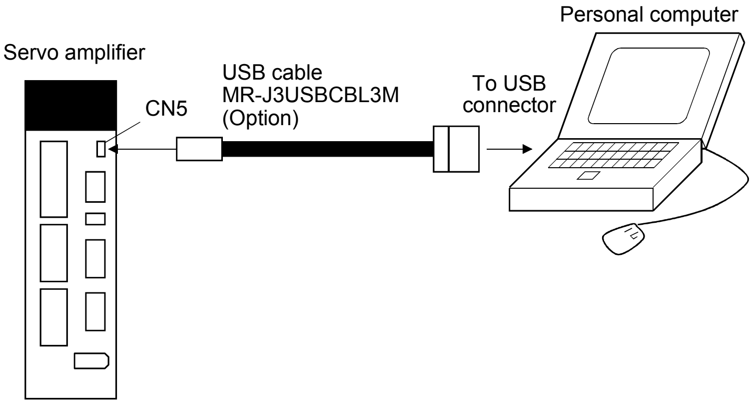
Equipment		(Note 1) Description
(Note 2, 3) Personal computer	OS	IBM PC/AT compatible where the English version of Windows® 98, Windows® Me, Windows® 2000 Professional, Windows® XP Professional, Windows® XP Home Edition, Windows Vista® Home Basic, Windows Vista® Home Premium, Windows Vista® Business, Windows Vista® Ultimate, Windows Vista® Enterprise operates
	Processor	Pentium® 133MHz or more (Windows® 98, Windows® 2000 Professional) Pentium® 150MHz or more (Windows® Me) Pentium® 300MHz or more (Windows® XP Professional, Windows® XP Home Edition) 32-bit (x86) processor of 1GHz or higher (Windows Vista® Home Basic, Windows Vista® Home Premium, Windows Vista® Business, Windows Vista® Ultimate, Windows Vista® Enterprise)
	Memory	24MB or more (Windows® 98) 32MB or more (Windows® Me, Windows® 2000 Professional) 128MB or more (Windows® XP Professional, Windows® XP Home Edition) 512MB or more (Windows Vista® Home Basic) 1GB or more (Windows Vista® Home Premium, Windows Vista® Business, Windows Vista® Ultimate, Windows Vista® Enterprise)
	Hard Disk	130MB or more of free space
Browser		Internet Explorer 4.0 or more
Display		One whose resolution is 1024×768 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.
Keyboard		Connectable with the above personal computer.
Mouse		Connectable with the above personal computer.
Printer		Connectable with the above personal computer.
USB cable		MR-J3USBCBL3M

Note 1. Windows and Windows Vista is the registered trademarks of Microsoft Corporation in the United States and other countries. Pentium is the registered trademarks of Intel Corporation.

2. On some personal computers, MR Configurator may not run properly.

3. 64-bit Windows XP and 64-bit Windows Vista are not supported.

(b) Connection with servo amplifier

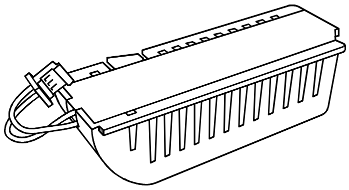


11.9 Battery MR-J3BAT

POINT
・Refer to App. 5 and 6 for battery transportation and the new EU Battery Directive.

(1) Purpose of use for MR-J3BAT

This battery is used to construct an absolute position detection system. Refer to section 12.3 for the fitting method, etc.

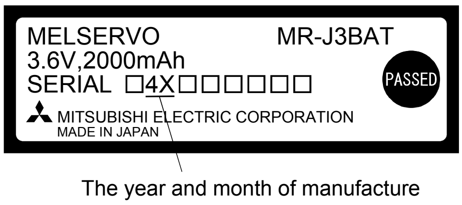


(2) Year and month when MR-J3BAT is manufactured

Production year and month of the MR-J3BAT are indicated in a serial number on the rating plate of the battery back face.

The year and month of manufacture are indicated by the last one digit of the year and 1 to 9, X(10), Y(11), Z(12).

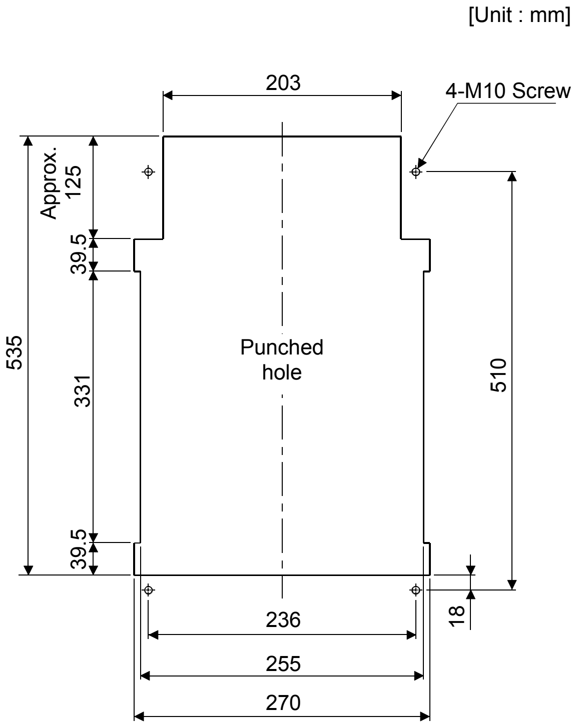
For October 2004, the Serial No. is like, "SERIAL□4X□□□□□□".



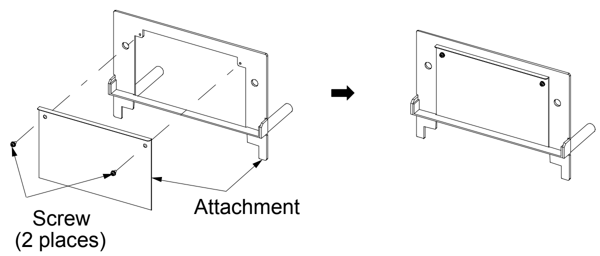
11.10 Heat sink outside mounting attachment (MR-J3ACN)

Use the heat sink outside mounting attachment to mount the heat generation area of the servo amplifier in the outside of the cabinet to dissipate servo amplifier-generated heat to the outside of the box and reduce the amount of heat generated in the box, thereby allowing a compact cabinet to be designed.
In the cabinet, machine a hole having the panel cut dimensions, fit the heat sink outside mounting attachment to the servo amplifier with the fitting screws (4 screws supplied), and install the servo amplifier to the cabinet.
The environment outside the cabinet when using the heat sink outside mounting attachment should be within the range of the servo amplifier operating environmental conditions.
The heat sink outside mounting attachment of MR-J3ACN can be used for MR-J3-11K□S(4) to MR-J3-22K□S (4).

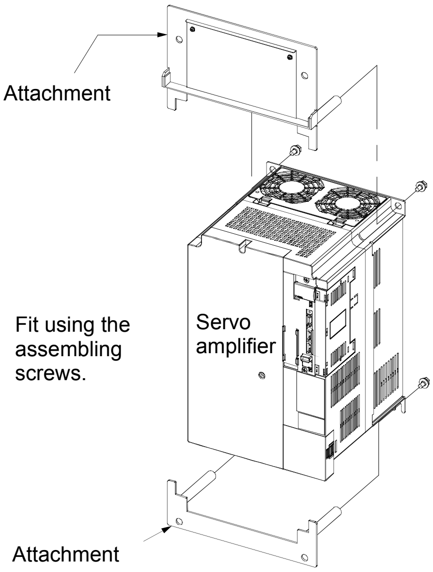
(1) Panel cut dimensions



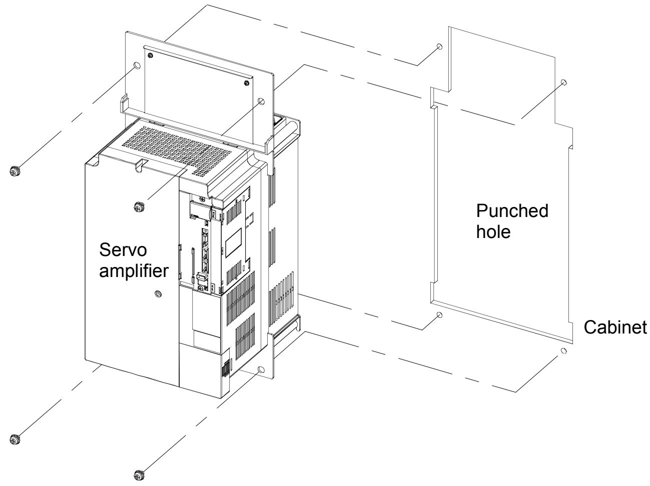
(2) How to assemble the attachment for a heat sink outside mounting attachment



(3) Fitting method



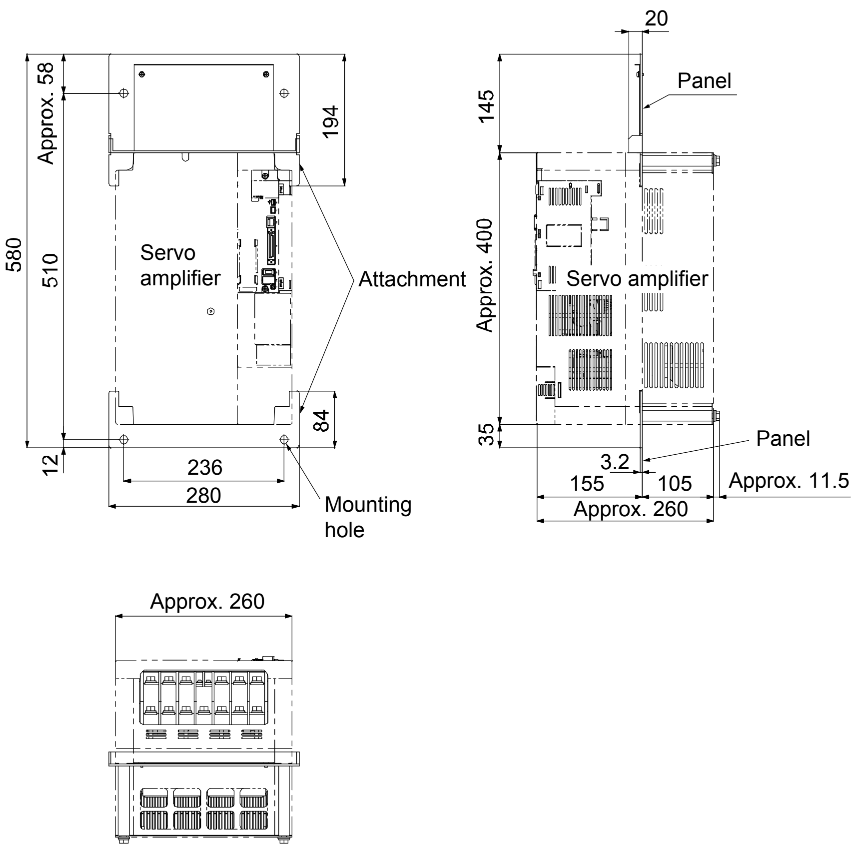
a. Assembling the heat sink outside mounting attachment



b. Installation to the cabinet

(4) Outline dimension drawing

[Unit: mm]



11.11 Selection example of wires

POINT

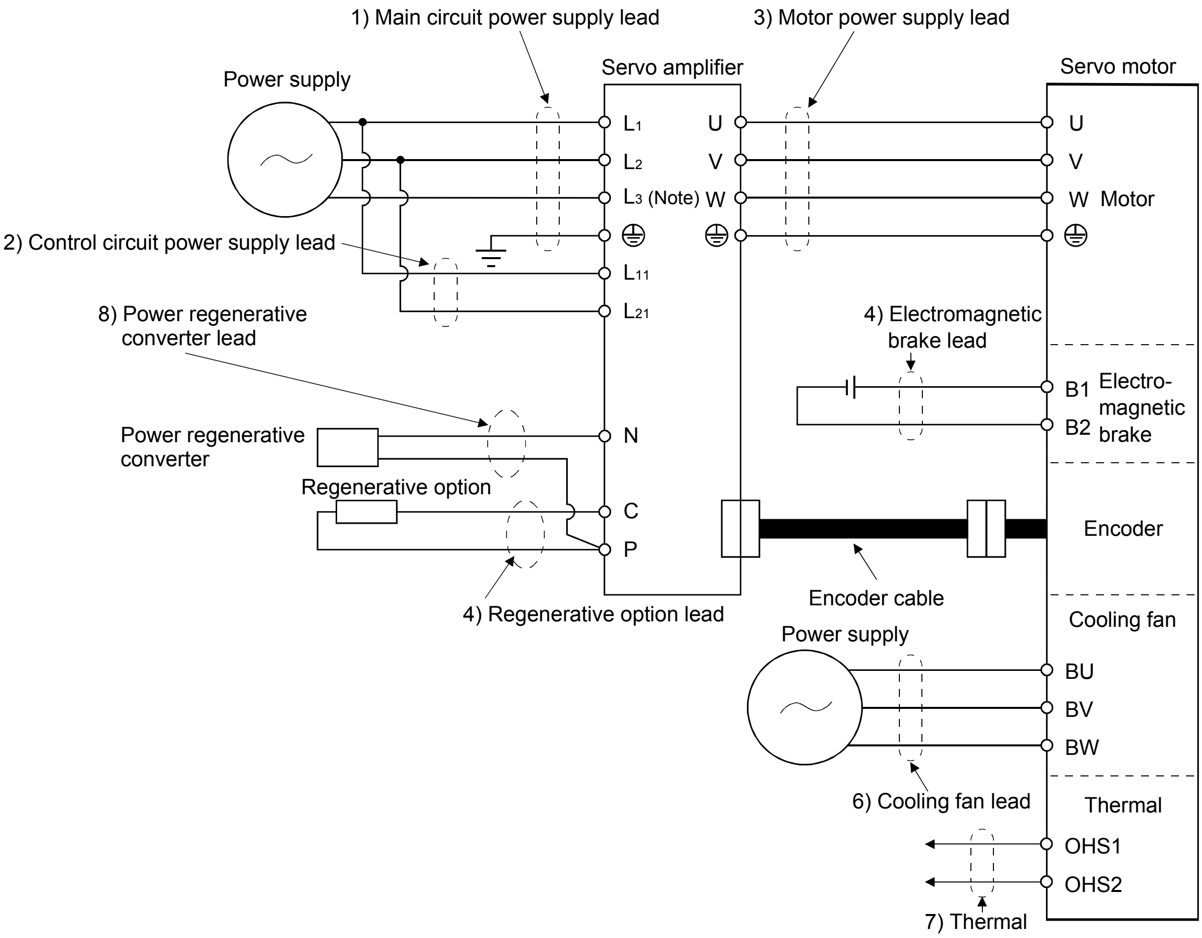
- Refer to section 11.1.6 for SSCNETⅢ cable.
- Wires indicated in this section are separated wires. When using a cable for power line (U, V, and W) between the servo amplifier and servo motor, use a 600V grade EP rubber insulated chloroprene sheath cab-tire cable (2PNCT). For selection of cables, refer to App. 6.
- To comply with the UL/CSA Standard, use the wires shown in App. 9 for wiring. To comply with other standards, use a wire that is complied with each standard.
- Selection condition of wire size is as follows.
  Construction condition: One wire is constructed in the air
  Wire length: 30m or less

(1) Wires for power supply wiring

POINT

- Use 600V Grade heat-resistant polyvinyl chloride insulated wires (HIV wires) for HF-JP series servo motor.

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



Note. There is no L_3 for 1-phase 100 to 120VAC power supply.

(a) When using the 600V Polyvinyl chloride insulated wire (IV wire)
Selection example of wire size when using IV wires is indicated below.

Table 11.1 Wire size selection example 1 (IV wire)

<table>
<tr><th rowspan="2">Servo amplifier</th><th colspan="7">Wires [mm²] (Note 1, 4)</th></tr>
<tr><th>1) L1・L2・L3・⏚</th><th>2) L11・L21</th><th>3) U・V・W・⏚</th><th>4) P・C</th><th>5) B1・B2</th><th>6) BU・BV・BW</th><th>7) OHS1・OHS2</th></tr>
<tr><td>MR-J3-10□S(1)</td><td rowspan="7">2(AWG14)</td><td rowspan="8">1.25(AWG16)</td><td rowspan="5">1.25(AWG16)</td><td rowspan="8">2(AWG14)</td><td rowspan="22">1.25(AWG16)</td><td rowspan="9"></td><td rowspan="9"></td></tr>
<tr><td>MR-J3-20□S(1)</td></tr>
<tr><td>MR-J3-40□S(1)</td></tr>
<tr><td>MR-J3-60□S</td></tr>
<tr><td>MR-J3-70□S</td></tr>
<tr><td>MR-J3-100□S</td><td rowspan="2">2(AWG14)</td></tr>
<tr><td>MR-J3-200□S</td></tr>
<tr><td>MR-J3-350□S</td><td>3.5(AWG12)</td><td>3.5(AWG12)</td></tr>
<tr><td>MR-J3-500□S (Note 2)</td><td>5.5(AWG10): a</td><td rowspan="2">1.25(AWG16): h</td><td>5.5(AWG10): a</td><td>2(AWG14): g</td></tr>
<tr><td>MR-J3-700□S (Note 2)</td><td>8(AWG8): b</td><td>8(AWG8): b</td><td>3.5(AWG12): a</td><td>2(AWG14) (Note 3)</td><td>1.25(AWG16) (Note 3)</td></tr>
<tr><td>MR-J3-11K□S (Note 2)</td><td>14(AWG6): c</td><td rowspan="3">1.25(AWG16): g</td><td>22(AWG4): d</td><td rowspan="2">5.5(AWG10): j</td><td rowspan="3">2(AWG14)</td><td rowspan="3">1.25(AWG16)</td></tr>
<tr><td>MR-J3-15K□S (Note 2)</td><td>22(AWG4): d</td><td>30(AWG2): e</td></tr>
<tr><td>MR-J3-22K□S (Note 2)</td><td>50(AWG1/0): f</td><td>60(AWG2/0): f</td><td>5.5(AWG10): k</td></tr>
<tr><td>MR-J3-60□S4</td><td rowspan="3">2(AWG14)</td><td rowspan="3">1.25(AWG16)</td><td rowspan="2">1.25(AWG16)</td><td rowspan="3">2(AWG14)</td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>MR-J3-100□S4</td></tr>
<tr><td>MR-J3-200□S4</td><td>2(AWG14)</td></tr>
<tr><td>MR-J3-350□S4</td><td>2(AWG14): g</td><td rowspan="3">1.25(AWG16): h</td><td>2(AWG14): g</td><td rowspan="3">2(AWG14): g</td></tr>
<tr><td>MR-J3-500□S4 (Note 2)</td><td rowspan="2">5.5(AWG10): a</td><td rowspan="2">5.5(AWG10): a</td></tr>
<tr><td>MR-J3-700□S4 (Note 2)</td><td>2(AWG14) (Note 3)</td><td>1.25(AWG16) (Note 3)</td></tr>
<tr><td>MR-J3-11K□S4 (Note 2)</td><td>8(AWG8): l</td><td rowspan="3">1.25(AWG16): g</td><td>8(AWG8): l</td><td>3.5(AWG12): j</td><td rowspan="3">2(AWG14)</td><td rowspan="3">1.25(AWG16)</td></tr>
<tr><td>MR-J3-15K□S4 (Note 2)</td><td>14(AWG6): c</td><td>22(AWG4): d</td><td>5.5(AWG10): j</td></tr>
<tr><td>MR-J3-22K□S4 (Note 2)</td><td>14(AWG6): m</td><td>22(AWG4): n</td><td>5.5(AWG10): k</td></tr>
</table>

Note 1. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to (1) (c) in this section.
2. When connecting to the terminal block, be sure to use the screws which are provided with the terminal block.
3. For the servo motor with a cooling fan.
4. Wires are selected based on the highest rated current among combining servo motors.

Use wires 8) of the following sizes with the power regenerative converter (FR-RC-(H)).

Model	Wires[mm²]
FR-RC-15K	14(AWG6)
FR-RC-30K	14(AWG6)
FR-RC-55K	22(AWG4)
FR-RC-H15K	14(AWG6)
FR-RC-H30K	14(AWG6)
FR-RC-H55K	14(AWG6)

(b) When using the 600V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire)

POINT
・Refer to the table 11.3 when using the HF-JP series servo motor of 0.5k to 5kW with the 400% maximum torque setting.

Selection example of wire size when using HIV wires is indicated below. For the wire (8)) for power regenerative converter (FR-RC-(H)), use the IV wire indicated in (1) (a) in this section.

Table 11.2 Wire size selection example 2 (HIV wire)

Servo amplifier	Wires [mm²] (Note 1, 4)						
	1) L_1・L_2・L_3・⏚	2) L_{11}・L_{21}	3) U・V・W・⏚	4) P・C	5) B1・B2	6) BU・BV・BW	7) OHS1・OHS2
MR-J3-10□S(1)	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)	1.25(AWG16)		
MR-J3-20□S(1)							
MR-J3-40□S(1)							
MR-J3-60□S							
MR-J3-70□S							
MR-J3-100□S			1.25(AWG16)				
MR-J3-200□S			2(AWG14)				
MR-J3-350□S	3.5(AWG12)		3.5(AWG12)				
MR-J3-500□S (Note 2)	5.5(AWG10): a	1.25(AWG16): h	5.5(AWG10): a	2(AWG14): g			
MR-J3-700□S (Note 2)	8(AWG8): b		8(AWG8): b	2(AWG14): g		1.25(AWG16) (Note 3)	1.25(AWG16) (Note 3)
MR-J3-11K□S (Note 2)	14(AWG6): c	1.25(AWG16): g	14(AWG6): c	3.5(AWG12): j		1.25(AWG16)	1.25(AWG16)
MR-J3-15K□S (Note 2)	22(AWG4): d		22(AWG4): d				
MR-J3-22K□S (Note 2)	38(AWG1): p		38(AWG1): p	5.5(AWG10): k			
MR-J3-60□S4	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)			
MR-J3-100□S4							
MR-J3-200□S4			2(AWG14)				
MR-J3-350□S4	2(AWG14): g	1.25(AWG16): h	2(AWG14): g	2(AWG14): g			
MR-J3-500□S4 (Note 2)	3.5(AWG12): a		3.5(AWG12): a				
MR-J3-700□S4 (Note 2)			5.5(AWG10): a			1.25(AWG16) (Note 3)	1.25(AWG16) (Note 3)
MR-J3-11K□S4 (Note 2)	5.5(AWG10): j	1.25(AWG16): g	8(AWG8): l	2(AWG14): q		1.25(AWG16)	1.25(AWG16)
MR-J3-15K□S4 (Note 2)	8(AWG8): l		14(AWG6): c	3.5(AWG12): j			
MR-J3-22K□S4 (Note 2)	14(AWG6): m		14(AWG6): m	3.5(AWG12): k			

Note 1. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to (1) (c) in this section.
2. When connecting to the terminal block, be sure to use the screws which are provided with the terminal block.
3. For the servo motor with a cooling fan.
4. Wires are selected based on the highest rated current among combining servo motors.

Table 11.3 Wire size selection example (HIV wire) for the HF-JP series with the 400% maximum torque setting

<table>
<tr><th rowspan="2">HF-JP□
Servo motor</th><th rowspan="2">Servo amplifier</th><th colspan="5">Wires [mm^2] (Note 1)</th></tr>
<tr><th>1)
L_1 ・ L_2 ・ L_3 ・ ⏚</th><th>2) L_{11} ・ L_{21}</th><th>3)
U ・ V ・ W ・ ⏚</th><th>4) P ・ C</th><th>5) B1 ・ B2</th></tr>
<tr><td>53</td><td>MR-J3-100□S-U100</td><td rowspan="3">2(AWG14)</td><td rowspan="5">1.25(AWG16)</td><td rowspan="3">1.25(AWG16)</td><td rowspan="5">2(AWG14)</td><td rowspan="14">1.25(AWG16)</td></tr>
<tr><td>73</td><td>MR-J3-200□S-U101</td></tr>
<tr><td>103</td><td>MR-J3-200□S-U102</td></tr>
<tr><td>153</td><td>MR-J3-350□S-U103</td><td rowspan="2">3.5(AWG12)</td><td rowspan="2">2(AWG14)</td></tr>
<tr><td>203</td><td>MR-J3-350□S-U104</td></tr>
<tr><td>353</td><td>MR-J3-500□S-U105
(Note 2)</td><td>5.5(AWG10): a</td><td rowspan="2">1.25(AWG16): h</td><td>3.5(AWG12): a</td><td rowspan="2">2(AWG14): g</td></tr>
<tr><td>503</td><td>MR-J3-700□S-U106
(Note 2)</td><td>8(AWG8): b</td><td>5.5(AWG10): a</td></tr>
<tr><td>534</td><td>MR-J3-100□S4-U110</td><td rowspan="3">2(AWG14)</td><td rowspan="5">1.25(AWG16)</td><td rowspan="3">1.25(AWG16)</td><td rowspan="3">2(AWG14)</td></tr>
<tr><td>734</td><td>MR-J3-200□S4-U111</td></tr>
<tr><td>1034</td><td>MR-J3-200□S4-U112</td></tr>
<tr><td>1534</td><td>MR-J3-350□S4-U113</td><td rowspan="2">2(AWG14): g</td><td rowspan="3">2(AWG14): g</td><td rowspan="4">2(AWG14): g</td></tr>
<tr><td>2034</td><td>MR-J3-350□S4-U114</td></tr>
<tr><td>3534</td><td>MR-J3-500□S4-U115
(Note 2)</td><td rowspan="2">3.5(AWG12): a</td><td rowspan="2">1.25(AWG16): h</td></tr>
<tr><td>5034</td><td>MR-J3-700□S4-U116
(Note 2)</td><td>3.5(AWG12): a</td></tr>
</table>

Note 1. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to (1) (c) in this section.

2. When connecting to the terminal block, be sure to use the screws which are provided with the terminal block.

(c) Selection example of crimping terminals

Selection example of crimping terminals for the servo amplifier terminal box when using the wires mentioned in (1) (a) and (b) in this section is indicated below.

Symbol	Servo amplifier-side crimping terminals				
	(Note 2) Crimping terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S			JST
(Note 1)b	8-4NS	YHT-8S			
c	FVD14-6	YF-1・E-4	YNE-38	DH-122・DH112	
d	FVD22-6			DH-123・DH113	
(Note 1)e	38-6	YPT-60-21		TD-124・TD-112	
		YF-1・E-4	YET-60-1		
(Note 1)f	R60-8	YPT-60-21		TD-125・TD-113	
		YF-1・E-4	YET-60-1		
g	FVD2-4	YNT-1614			
h	FVD2-M3				
j	FVD5.5-6	YNT-1210S			
k	FVD5.5-8				
l	FVD8-6	YF-1・E-4	YNE-38	DH-121・DH111	
m	FVD14-8			DH-122・DH112	
n	FVD22-8			DH-123・DH113	
(Note 1)p	R38-8	YPT-60-21		TD-124・TD-112	
		YF-1・E-4	YET-60-1		
q	FVD2-6	YNT-1614			

Note 1. Coat the part of crimping with the insulation tube.

2. Some crimping terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

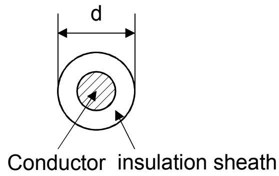
(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent.

Table 11.4 Wires for option cables

Type	Model	Length [m]	Core size [mm²]	Number of Cores	Characteristics of one core			(Note 2) Finishing OD [mm]	Wire model
					Structure [Wires/mm]	Conductor resistance [Ω/mm]	Insulation coating OD d [mm] (Note 1)		
Encoder cable	MR-J3ENCBL□M-A1-L	2 to 10	AWG22	6 (3 pairs)	7/0.26	53 or less	1.2	7.1±0.3	(Note 3) VSVP 7/0.26 (AWG#22 or equivalent)-3P Ban-gi-shi-16823
	MR-J3ENCBL□M-A2-L								
	MR-J3ENCBL□M-A1-H	2 to 10	AWG22	6 (3 pairs)	70/0.08	56 or less	1.2	7.1±0.3	(Note 3) ETFE・SVP 70/0.08 (AWG#22 or equivalent)-3P Ban-gi-shi-16824
	MR-J3ENCBL□M-A2-H								
	MR-J3JCBL03M-A1-L	0.3	AWG26	8 (4 pairs)	30/0.08	233 or less	1.2	7.1±0.3	(Note 5) T/2464-1061/II A-SB 4P×26AWG
	MR-J3JCBL03M-A2-L								
	MR-EKCBL□M-L	2 to 10	0.3mm²	4 (2 pairs)	12/0.18	65.7 or less	1.3	7.3	(Note 3) 20276 composite 4-pair shielded cable (A-TYPE)
			0.08mm²	4 (2 pairs)	7/0.127	234 or less	0.67		
		20・30	0.3mm²	12 (6 pairs)	12/0.18	63.6 or less	1.2	8.2	UL 20276 AWG#23 6pair(BLACK)
	MR-EKCBL□M-H	20	0.2mm²	12 (6 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) A14B2343 6P
		30 to 50	0.2mm²	14 (7 pairs)	40/0.08	105 or less	0.88	8.0	(Note 3) J14B0238(0.2*7P)
	MR-J3JSCBL03M-A1-L	0.3	AWG26	8 (4 pairs)	7/0.16	146 or less	1.0	7.1±0.3	(Note 3) VSVP 7/0.16 (Equivalent to AWG#26)-4P Ban-gi-shi-16822
	MR-J3JSCBL03M-A2-L								
	MR-J3ENSCBL□M-L(-S06)	2 to 10	AWG22	6 (3 pairs)	7/0.26	53 or less	1.2	7.1±0.3	(Note 3) VSVP 7/0.26 (Equivalent to AWG#22)-3P Ban-gi-shi-16823
		20・30	AWG23	12 (6 pairs)	12/0.18	63.3 or less	1.2	8.2±0.3	(Note 3) 20276 VSVCAWG#23×6P Ban-gi-shi-15038
	MR-J3ENSCBL□M-H(-S06)	2 to 10	AWG22	6 (3 pairs)	70/0.08	56 or less	1.2	7.1±0.3	(Note 3) ETEF SVP 70/0.08 (Equivalent to AWG#22)-3P Ban-gi-shi-16824
		20 to 50	AWG24	12 (6 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) ETFE・SVP 40/0.08mm×6P Ban-gi-shi-15266
	MR-ENECBL□M-H	2 to 10	0.2	8 (4 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) A14B2339 4P
		20	0.2	12 (6 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) A14B2343 6P
		30 to 50	0.2	14 (7 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) J14B0238(0.2*7P)
Motor power supply cable	MR-PWS1CBL□M-A1-L	2 to 10	AWG18	4	34/0.18	21.8 or less	1.71	62±0.3	HRZFEV-A(CL3) AWG18 4-cores
	MR-PWS1CBL□M-A2-L	2 to 10							
	MR-PWS1CBL□M-A1-H	2 to 10	(Note 6) AWG19 (0.75mm²)	4	150/0.08	29.1 or less	1.63	5.7±0.5	(Note 4) RMFES-A(CL3X) AWG19 4-cores
	MR-PWS1CBL□M-A2-H	2 to 10							
	MR-PWS2CBL03M-A1-L	0.3	AWG19	4	30/0.18	25.8 or less	1.64	—	(Note 3, 7) J11B2330 UL 10125
	MR-PWS2CBL03M-A2-L	0.3							
Motor brake cable	MR-BKS1CBL□M-A1-L	2 to 10	AWG20	2	21/0.18	34.6 or less	1.35	4.7±0.1	(Note 4) HRZFEV-A(CL3) AWG20 2-cores
	MR-BKS1CBL□M-A2-L	2 to 10							
	MR-BKS1CBL□M-A1-H	2 to 10	(Note 6) AWG20 (0.75mm²)	2	110/0.08	39.0 or less	1.37	4.5±0.3	RMFES-A(CL3X) AWG20 2-cores
	MR-BKS1CBL□M-A2-H	2 to 10							
	MR-BKS2CBL03M-A1-L	0.3	AWG20	2	19/0.203	32.0 or less	1.42	—	(Note 3, 7) J11B331 UL 10125
	MR-BKS2CBL03M-A2-L	0.3							

Note 1. d is as shown below.



2. Standard OD. Max. OD is about 10% greater.
3. Purchased from Toa Electric Industry
4. KURABE Industrial Co.,Ltd.
5. Taiyo Cabletec
6. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.
7. These models consist with solid wires. Specify the color, separately.

11.12 Molded-case circuit breakers, fuses, magnetic contactors

Always use one molded-case circuit breaker and one magnetic contactor with one servo amplifier. When using a fuse instead of the molded-case circuit breaker, use the one having the specifications given in this section.

Servo amplifier	Molded-case circuit breaker			Fuse			(Note 2) Magnetic contactor
	Current		Voltage AC	(Note 1) Class	Current [A]	Voltage AC [V]	
	Not using power factor improving reactor	Using power factor improving reactor					
MR-J3-10□S(1)	30A frame 5A	30A frame 5A	240V	T	10	300	S-N10
MR-J3-20□S	30A frame 5A	30A frame 5A			10		
MR-J3-20□S1	30A frame 10A	30A frame 10A			15		
MR-J3-40□S	30A frame 10A	30A frame 5A			15		
MR-J3-60□S MR-J3-70□S MR-J3-100□S MR-J3-40□S1	30A frame 15A	30A frame 10A			20		
MR-J3-200□S	30A frame 20A	30A frame 15A			40		S-N18
MR-J3-350□S	30A frame 30A	30A frame 30A			70		S-N20
MR-J3-500□S	50A frame 50A	50A frame 40A			125		S-N35
MR-J3-700□S	100A frame 75A	50A frame 50A			150		S-N50
MR-J3-11K□S	100A frame 100A	100A frame 75A			200		S-N65
MR-J3-15K□S	225A frame 125A	100A frame 100A			250		S-N95
MR-J3-22K□S	225A frame 175A	225A frame 150A			350		S-N125
MR-J3-60□S4	30A frame 5A	30A frame 5A	600Y/347V		10	600	S-N10
MR-J3-100□S4	30A frame 10A	30A frame 10A			15		
MR-J3-200□S4	30A frame 15A	30A frame 15A			25		
MR-J3-350□S4	30A frame 20A	30A frame 20A			35		S-N18
MR-J3-500□S4	30A frame 30A	30A frame 30A			50		
MR-J3-700□S4	50A frame 40A	50A frame 30A			65		S-N20
MR-J3-11K□S4	60A frame 60A	50A frame 50A			100		S-N25
MR-J3-15K□S4	100A frame 75A	60A frame 60A			150		S-N35
MR-J3-22K□S4	225A frame 125A	100A frame 100A			175		S-N65

Note 1. When not using the servo amplifier as a UL/CSA Standard compliant product, K5 class fuse can be used.
2. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

11.13 Power factor improving DC reactors

POINT
・For the 100V power supply type (MR-J3-□S1), the power factor improving DC reactor cannot be used.

The power factor improving DC reactor increases the form factor of the servo amplifier's input current to improve the power factor. It can decrease the power supply capacity. As compared to the power factor improving AC reactor (FR-BAL), it can decrease the loss. The input power factor is improved to about 95%.
When connecting the power factor improving DC reactor to the servo amplifier, always disconnect P_1 and P_2 (For 11k to 22kW, disconnect P_1 and P). If it remains connected, the effect of the power factor improving DC reactor is not produced.
When used, the power factor improving DC reactor generates heat. To release heat, therefore, leave a 10cm or more clearance at each of the top and bottom, and a 5cm or more clearance on each side.

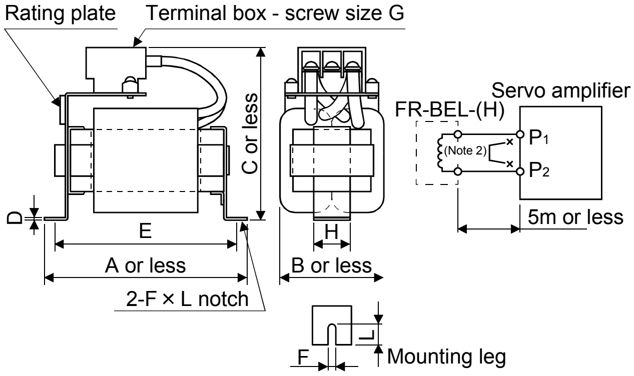


Fig. 11.1

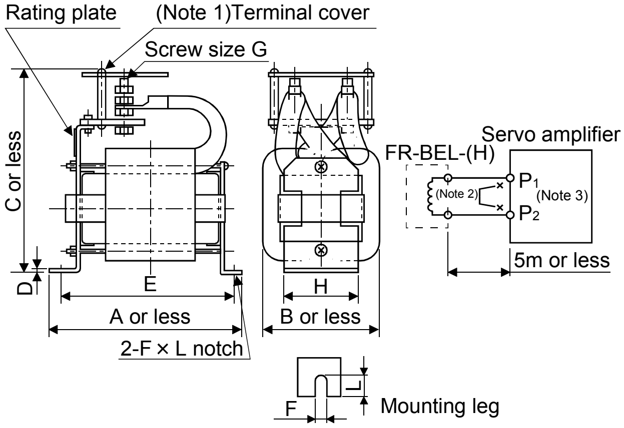


Fig. 11.2

Note 1. Since the terminal cover is supplied, attach it after connecting a wire.
2. When using power factor improving DC reactor, disconnect P_1 and P_2.
3. When 11k to 22kW, "P_2" becomes "P", respectively.

Servo amplifier	Power factor improving DC reactor	Outline drawing	Dimensions [mm]									Mounting screw size	Mass [kg(lb)]	Wire [mm^2] (Note)
			A	B	C	D	E	F	L	G	H			
MR-J3-10□S・20□S	FR-BEL-0.4K	Fig. 11.1	110	50	94	1.6	95	6	12	M3.5	25	M5	0.5(1.10)	2(AWG14)
MR-J3-40□S	FR-BEL-0.75K		120	53	102	1.6	105	6	12	M4	25	M5	0.7(1.54)	
MR-J3-60□S・70□S	FR-BEL-1.5K		130	65	110	1.6	115	6	12	M4	30	M5	1.1(2.43)	
MR-J3-100□S	FR-BEL-2.2K		130	65	110	1.6	115	6	12	M4	30	M5	1.2(2.65)	
MR-J3-200□S	FR-BEL-3.7K		150	75	102	2.0	135	6	12	M4	40	M5	1.7(3.75)	
MR-J3-350□S	FR-BEL-7.5K		150	75	126	2.0	135	6	12	M5	40	M5	2.3(5.07)	3.5(AWG12)
MR-J3-500□S	FR-BEL-11K		170	93	132	2.3	155	6	14	M5	50	M5	3.1(6.83)	5.5(AWG10)
MR-J3-700□S	FR-BEL-15K	Fig. 11.2	170	93	170	2.3	155	6	14	M8	56	M5	3.8(8.38)	8(AWG8)
MR-J3-11K□S														22(AWG4)
MR-J3-15K□S	FR-BEL-22K		185	119	182	2.6	165	7	15	M8	70	M6	5.4(11.91)	30(AWG2)
MR-J3-22K□S	FR-BEL-30K		185	119	201	2.6	165	7	15	M8	70	M6	6.7(14.77)	60(AWG2/0)
MR-J3-60□S4	FR-BEL-H1.5K	Fig. 11.1	130	63	89	1.6	115	6	12	M3.5	32	M5	0.9(1.98)	2(AWG14)
MR-J3-100□S4	FR-BEL-H2.2K		130	63	101	1.6	115	6	12	M3.5	32	M5	1.1(2.43)	
MR-J3-200□S4	FR-BEL-H3.7K		150	75	102	2	135	6	12	M4	40	M5	1.7(3.75)	
MR-J3-350□S4	FR-BEL-H7.5K		150	75	124	2	135	6	12	M4	40	M5	2.3(5.07)	
MR-J3-500□S4	FR-BEL-H11K		170	93	132	2.3	155	6	14	M5	50	M5	3.1(6.83)	5.5(AWG10)
MR-J3-700□S4	FR-BEL-H15K	Fig. 11.2	170	93	160	2.3	155	6	14	M6	56	M5	3.7(8.16)	8(AWG8)
MR-J3-11K□S4														
MR-J3-15K□S4	FR-BEL-H22K		185	119	171	2.6	165	7	15	M6	70	M6	5.0(11.02)	22(AWG4)
MR-J3-22K□S4	FR-BEL-H30K		185	119	189	2.6	165	7	15	M6	70	M6	6.7(14.77)	

Note. Selection condition of wire size is as follows.

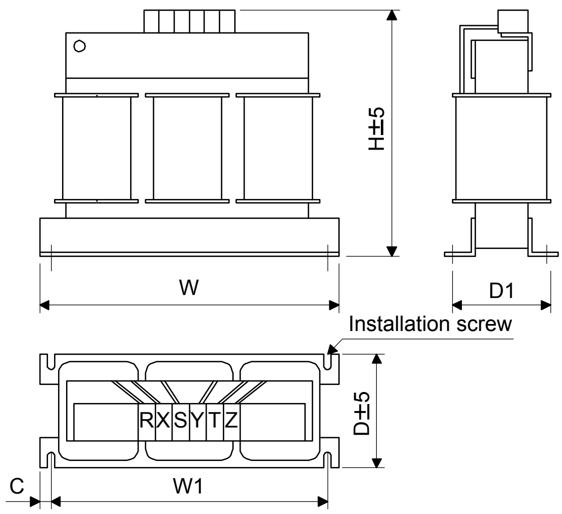
Wire type: 600V Polyvinyl chloride insulated wire (IV wire)

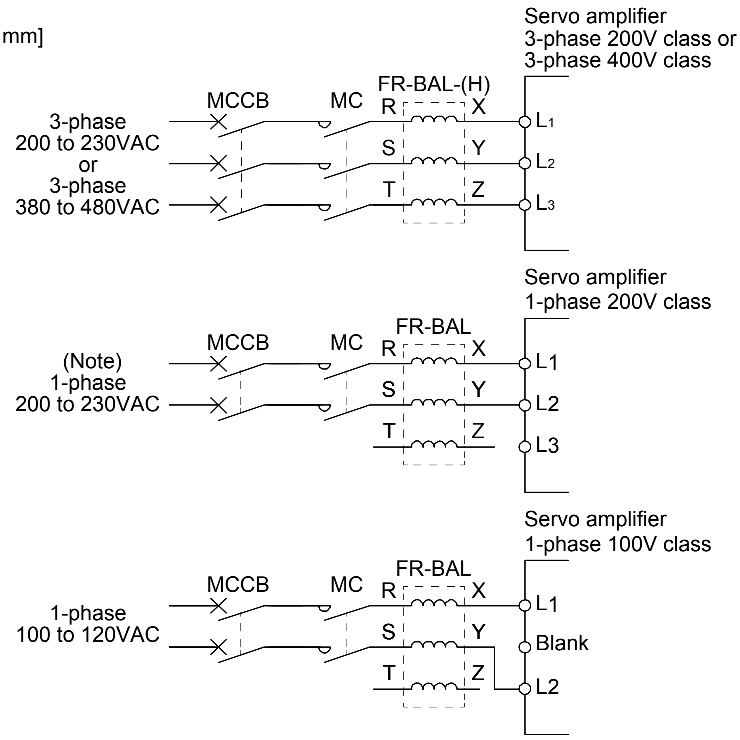
Construction condition: One wire is constructed in the air

11.14 Power factor improving AC reactors

The power factor improving AC reactors improve the phase factor by increasing the form factor of servo amplifier's input current.
It can reduce the power capacity.
The input power factor is improved to be about 90%. For use with a 1-phase power supply, it may be slightly lower than 90%.
When using power factor improving reactors for two servo amplifiers or more, be sure to connect a power factor improving reactor to each servo amplifier.
If using only one power factor improving reactor, enough improvement effect of phase factor cannot be obtained unless all servo amplifiers are operated.

[Unit : mm]





Note. For the 1-phase 200 to 230VAC power supply, Connect the power supply to L_1, L_2 and leave L_3 open.

Servo amplifier	Model	Dimensions [mm]						Mounting screw size	Terminal screw size	Mass [kg (lb)]
		W	W1	H	D	D1	C			
MR-J3-10□S・20□S・10□S1	FR-BAL-0.4K	135	120	115	59	$45^{\ 0}_{-2.5}$	7.5	M4	M3.5	2.0 (4.41)
MR-J3-40□S・20□S1	FR-BAL-0.75K	135	120	115	69	$57^{\ 0}_{-2.5}$	7.5	M4	M3.5	2.8 (6.17)
MR-J3-60□S・70□S・40□S1	FR-BAL-1.5K	160	145	140	71	$55^{\ 0}_{-2.5}$	7.5	M4	M3.5	3.7 (8.16)
MR-J3-100□S	FR-BAL-2.2K	160	145	140	91	$75^{\ 0}_{-2.5}$	7.5	M4	M3.5	5.6 (12.35)
MR-J3-200□S	FR-BAL-3.7K	220	200	192	90	$70^{\ 0}_{-2.5}$	10	M5	M4	8.5 (18.74)
MR-J3-350□S	FR-BAL-7.5K	220	200	194	120	$100^{\ 0}_{-2.5}$	10	M5	M5	14.5 (31.97)
MR-J3-500□S	FR-BAL-11K	280	255	220	135	$100^{\ 0}_{-2.5}$	12.5	M6	M6	19 (41.89)
MR-J3-700□S MR-J3-11K□S	FR-BAL-15K	295	270	275	133	$110^{\ 0}_{-2.5}$	12.5	M6	M6	27 (59.53)
MR-J3-15K□S	FR-BAL-22K	290	240	301	199	170±5	25	M8	M8	35 (77.16)
MR-J3-22K□S	FR-BAL-30K	290	240	301	219	190±5	25	M8	M8	43 (94.80)
MR-J3-60□S4	FR-BAL-H1.5K	160	145	140	87	$70^{\ 0}_{-2.5}$	7.5	M4	M3.5	5.3 (11.68)
MR-J3-100□S4	FR-BAL-H2.2K	160	145	140	91	$75^{\ 0}_{-2.5}$	7.5	M4	M3.5	5.9 (13.01)
MR-J3-200□S4	FR-BAL-H3.7K	220	200	190	90	$70^{\ 0}_{-2.5}$	10	M5	M3.5	8.5 (18.74)
MR-J3-350□S4	FR-BAL-H7.5K	220	200	192	120	100±5	10	M5	M4	14 (30.87)
MR-J3-500□S4	FR-BAL-H11K	280	255	226	130	100±5	12.5	M6	M5	18.5 (40.79)
MR-J3-700□S4 MR-J3-11K□S4	FR-BAL-H15K	295	270	244	130	110±5	12.5	M6	M5	27 (59.53)
MR-J3-15K□S4	FR-BAL-H22K	290	240	269	199	170±5	25	M8	M8	Approx.35 (Approx.77.16)
MR-J3-22K□S4	FR-BAL-H30K	290	240	290	219	190±5	25	M8	M8	Approx.43 (Approx.94.80)

11.15 Relays (recommended)

The following relays should be used with the interfaces

Interface	Selection example
Relay used for digital input command signals (interface DI-1)	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 rated current 40mA or less (Ex.) Omron : type MY

11.16 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) Noise reduction techniques

(a) General reduction techniques

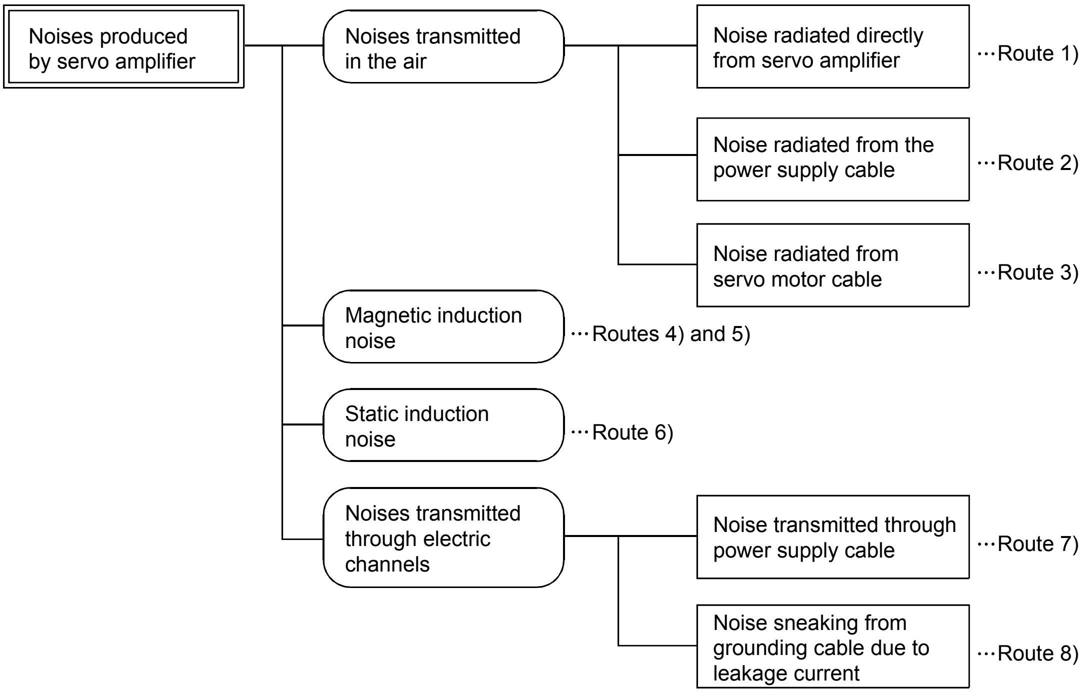
- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the servo amplifier, servo motor, etc. together at one point (refer to section 3.13).

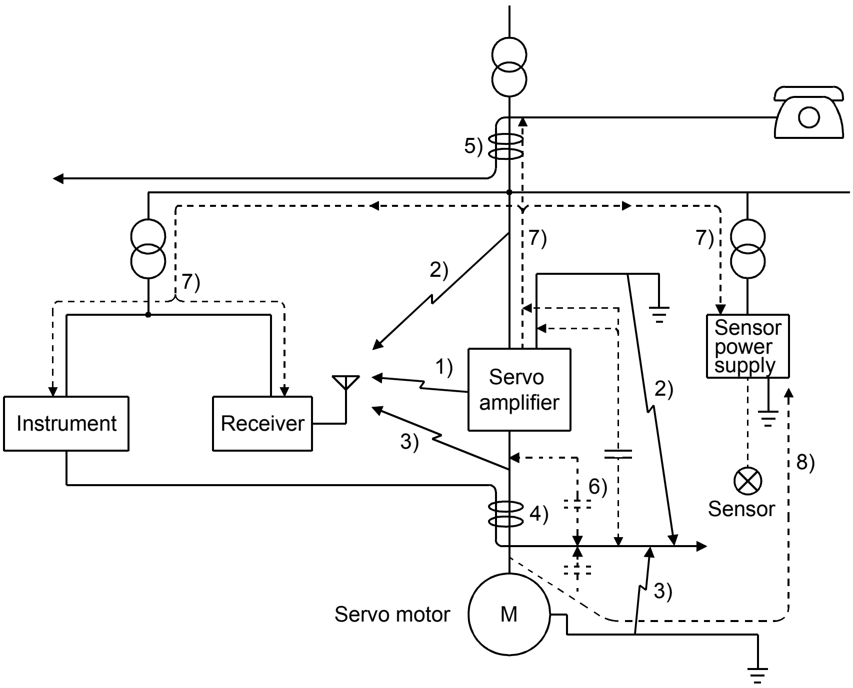
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

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.
- Although a surge absorber is built into the servo amplifier, to protect the servo amplifier and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

(c) 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 cabinet 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 (Input 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-(H)) on the power cables (Input cables) of the servo amplifier. 2. Insert the line noise filter (FR-BSF01・FR-BLF) 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.

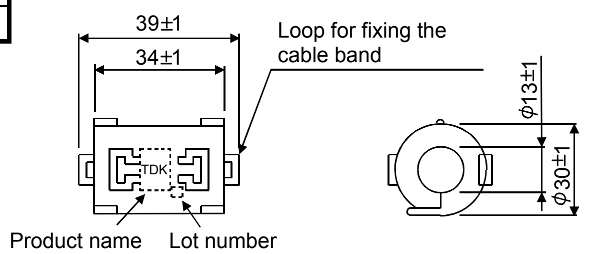
(2) Noise reduction products

(a) Data line filter (Recommended)

Noise can be prevented by installing a data line filter onto the encoder cable, etc. For example, the ZCAT3035-1330 of TDK and the ESD-SR-250 of NEC TOKIN make are available as data line filters. As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below. This impedances are reference values and not guaranteed values.

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

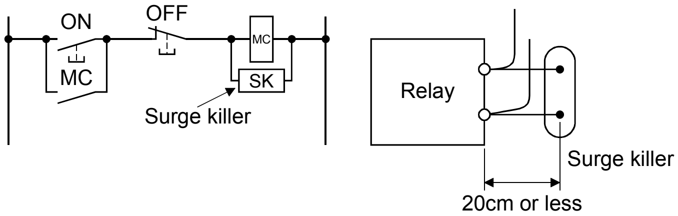
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge killer

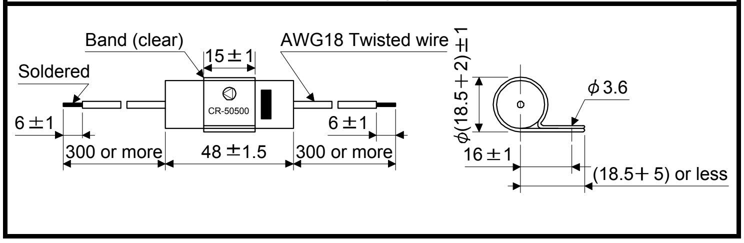
The recommended surge killer for installation to an AC relay, AC valve or the like near the servo amplifier is shown below. Use this product or equivalent.



(Ex.) CR-50500
(OKAYA Electric Industries Co., Ltd.)

Rated voltage AC [V]	C [μF±20%]	R [Ω±30%]	Test voltage AC [V]
250	0.5	50 (1/2W)	Between terminals: 625VAC 50/60Hz 60s Between terminal and case: 2,000VAC 50/60Hz 60s

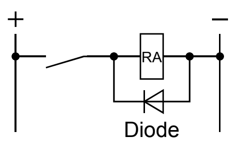
Outline drawing [Unit: mm]



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

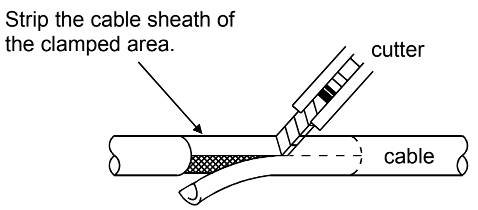
Maximum voltage: Not less than 4 times the drive voltage of the relay or the like

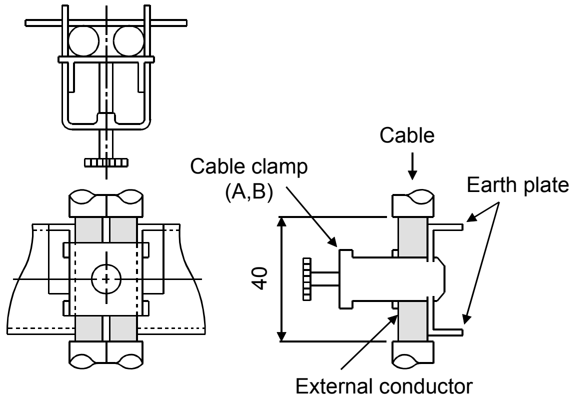
Maximum current: Not less than twice the drive current of the relay or the like



(c) 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.

[Unit: mm]



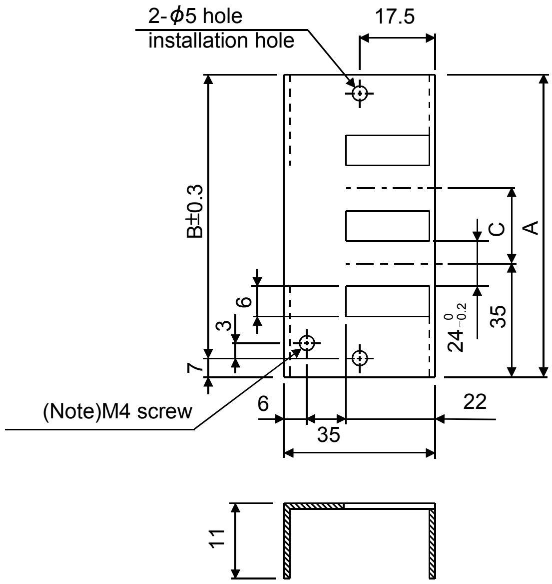


Clamp section diagram

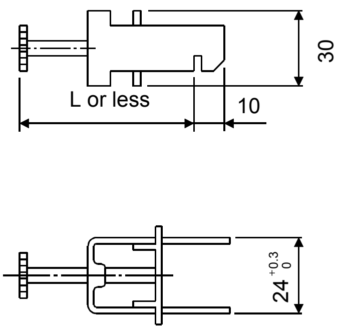
・Outline drawing

[Unit: mm]

Earth plate



Clamp section diagram



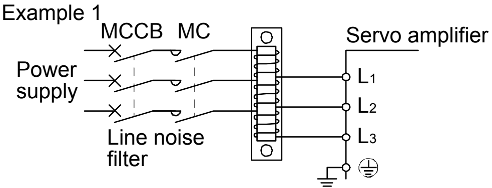
Note. Screw hole for grounding. Connect it to the earth plate of the cabinet.

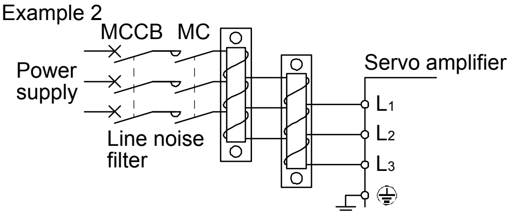
Type	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	clamp A: 2pcs.
AERSBAN-ESET	70	56		clamp B: 1pc.

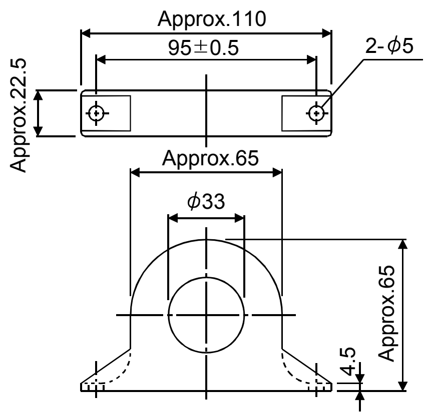
Clamp fitting	L
A	70
B	45

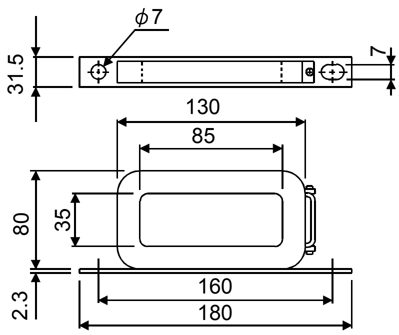
(d) Line noise filter (FR-BSF01, FR-BLF)

This filter is effective in suppressing noises radiated from the power supply side or output side of the servo amplifier and also in suppressing high-frequency leakage current (0-phase current). It especially affects the noises between 0.5MHz and 5MHz band.

<table>
<tr><th>Connection diagram</th><th>Outline drawing [Unit: mm]</th></tr>
<tr><td rowspan="2">
Use the line noise filters for wires of the main power supply (L_1 ・ L_2 ・ L_3) and of the motor power supply (U ・ V ・ W). Pass each of the wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the motor power supply, passes must be four times or less. Do not pass the grounding (earth) wire through the filter, or the effect of the filter will drop. Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2. Place the line noise filters as close to the servo amplifier as possible for their best performance.
Example 1


(Number of turns: 4)
Example 2


Two filters are used
(Total number of turns: 4)
</td><td>
FR-BSF01 (for wire size 3.5mm² (AWG12) or less))


</td></tr>
<tr><td>
FR-BLF(for wire size 5.5mm² (AWG10) or more))


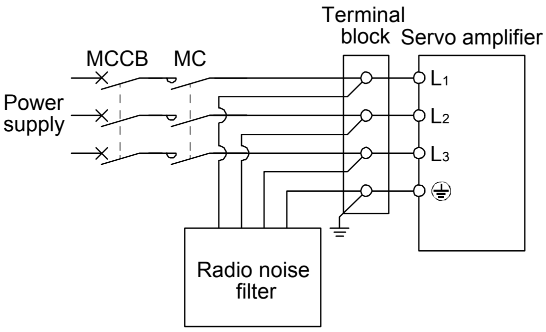
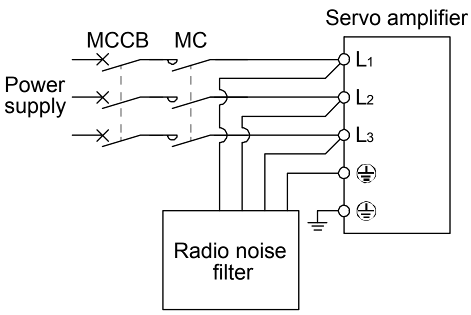
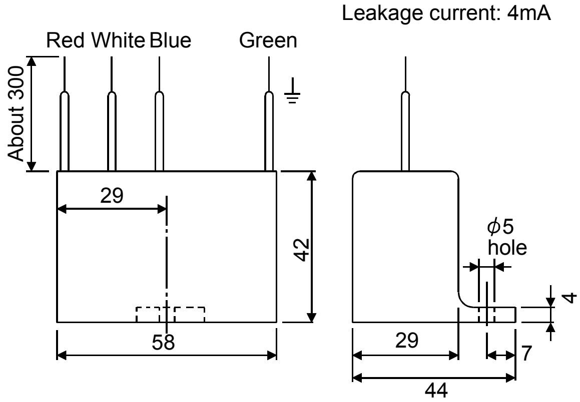
</td></tr>
</table>

(e) Radio noise filter (FR-BIF-(H))

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 (-H) is designed for the input only.

200V class: FR-BIF

400V class: FR-BIF-H

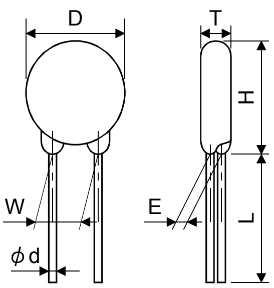
Connection diagram	Outline drawing (Unit: mm)
Make the connection cables as short as possible. Grounding is always required. When using the FR-BIF with a single-phase power supply, always insulate the wires that are not used for wiring. ・MR-J3-350□S or less, MR-J3-200□S4 or less  ・MR-J3-500□S or more, MR-J3-350□S4 or more 	Leakage current: 4mA 

(f) Varistors for input power supply (Recommended)

Varistors are effective to prevent exogenous noise and lightning surge from entering the servo amplifier. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K, TND20V-471K and TND20V-102K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power				
		AC [V_{rms}]	DC [V]	8/20μs [A]	2ms [J]	[W]	[A]	[V]	[pF]	[V]
100V class	TND20V-431K	275	350	10000/1 time	195	1.0	100	710	1300	430(387 to 473)
200V class	TND20V-471K	300	385	7000/2 time	215			775	1200	470(423 to 517)
400V class	TND20V-102K	625	825	7500/1 time 6500/2 time	400			1650	500	1000(900 to 1100)

[Unit: mm]



Model	D Max.	H Max.	T Max.	E ±1.0	(Note)L min.	ϕd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			
TND20V-102K	22.5	25.5	9.5	6.4			

Note. For special purpose items for lead length (L), contact the manufacturer.

11.17 Earth-leakage current breaker

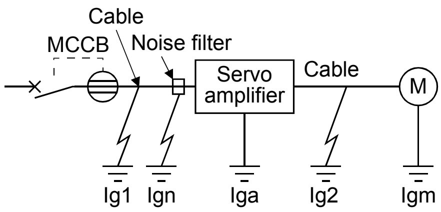
(1) Selection method

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 an earth-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) to minimize leakage currents.

Rated sensitivity current $\geq 10 \cdot \{Ig1 + Ign + Iga + K \cdot (Ig2 + Igm)\}$ [mA] (11.1)



Earth-leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-L	1
General models	BV-C1 NFB NV-L	3

Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 11.3.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 11.3.)

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

Iga: Leakage current of the servo amplifier (Found from Table 11.6.)

Igm: Leakage current of the servo motor (Found from Table 11.5.)

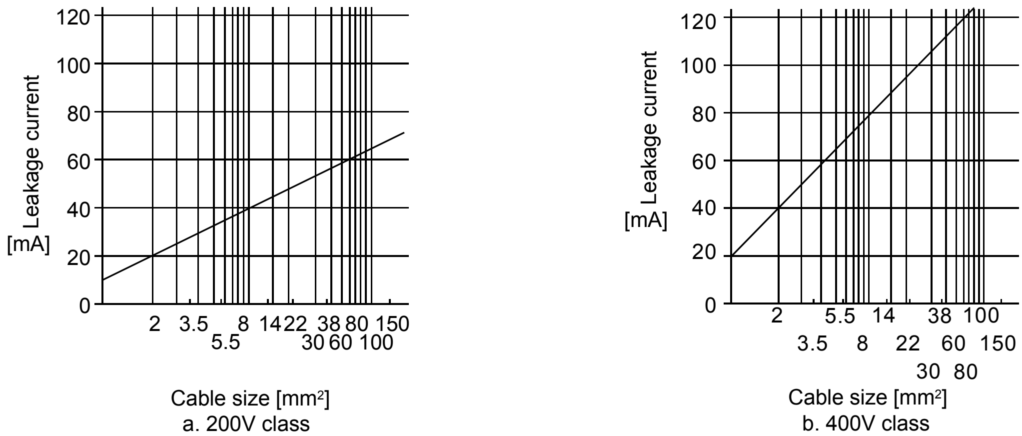


Fig. 11.3 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

Table 11.5 Servo motor's leakage current example (Igm)

Servo motor power [kW]	Leakage current [mA]
0.05 to 1	0.1
2	0.2
3.5	0.3
5	0.5
7	0.7
11	1.0
15	1.3
22	2.3

Table 11.6 Servo amplifier's leakage current example (Iga)

Servo amplifier capacity [kW]	Leakage current [mA]
0.1 to 0.6	0.1
0.75 to 3.5 (Note)	0.15
5 • 7	2
11 • 15	5.5
22	7

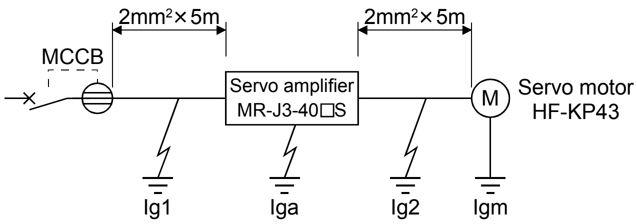
Note. For the 3.5kW of 400V class, leakage current is 2mA, which is the same as for 5kW and 7kW.

Table 11.7 Leakage circuit breaker selection example

Servo amplifier	Rated sensitivity current of leakage circuit breaker [mA]
MR-J3-10□S to MR-J3-350□S MR-J3-10□S1 to MR-J3-40□S1 MR-J3-60□S4 to MR-J3-350□S4	15
MR-J3-500□S(4)	30
MR-J3-700□S(4)	50
MR-J3-11K□S(4) to MR-J3-22K□S(4)	100

(2) Selection example

Indicated below is an example of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker generally available.

Find the terms of Equation (11.1) 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 (11.1).

$$Ig \geq 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\}$$

$$\geq 4.0 \ [mA]$$

According to the result of calculation, use an earth-leakage current breaker having the rated sensitivity current (Ig) of 4.0 [mA] or more. An earth-leakage current breaker having Ig of 15 [mA] is used with the NV-SP/SW/CP/CW/HW series.

11.18 EMC filter (recommended)

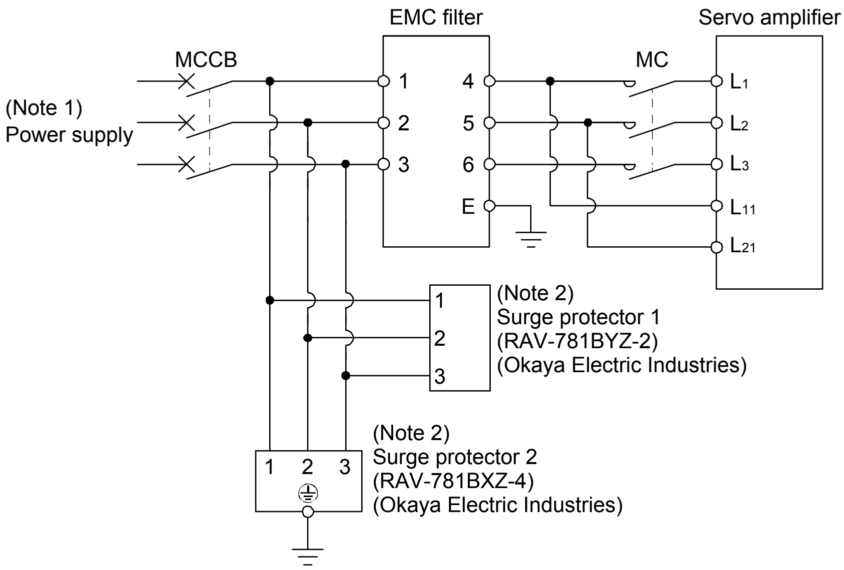
For compliance with the EMC directive of the EN Standard, it is recommended to use the following filter. Some EMC filters are large in leakage current.

(1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)				Mass [kg]([lb])
	Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]	
MR-J3-10□S to MR-J3-100□S MR-J3-10□S1 to MR-J3-40□S1	(Note) HF3010A-UN	10	250	5	3.5 (7.72)
MR-J3-200□S・MR-J3-350□S	(Note) HF3030A-UN	30			5.5 (12.13)
MR-J3-500□S・MR-J3-700□S	(Note) HF3040A-UN	40		6.5	6 (13.23)
MR-J3-11K□S to MR-J3-22K□S	(Note) HF3100A-UN	100			12 (26.46)
MR-J3-60□S4・MR-J3-100□S4	TF3005C-TX	5	500	5.5	6 (13.23)
MR-J3-200□S4 to MR-J3-700□S4	TF3020C-TX	20			
MR-J3-11K□S4	TF3030C-TX	30			7.5 (16.54)
MR-J3-15K□S4	TF3040C-TX	40			12.5 (27.56)
MR-J3-22K□S4	TF3060C-TX	60			

Note. A surge protector is separately required to use any of these EMC filters.

(2) Connection example



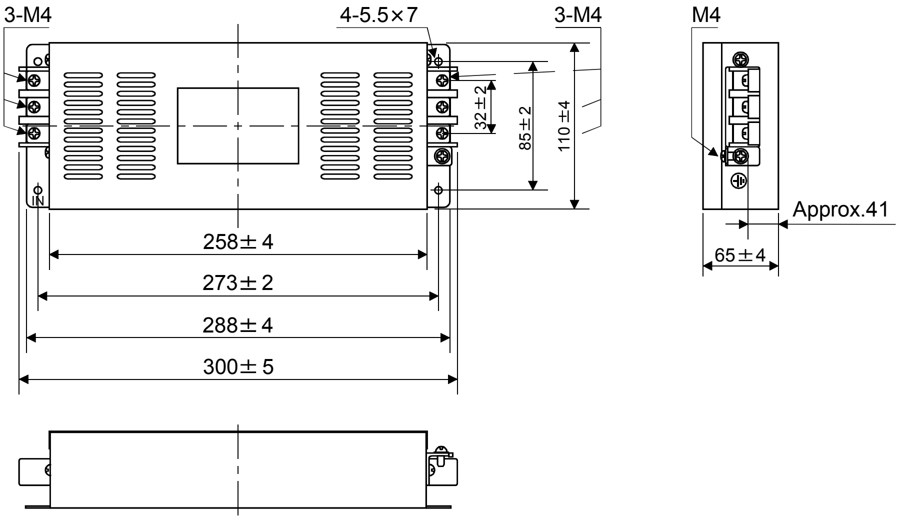
Note 1. For 1-phase 200V to 230VAC power supply, connect the power supply to L_1, L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. Refer to section 1.3 for the power supply specification.
2. The example is when a surge protector is connected.

(3) Outline drawing

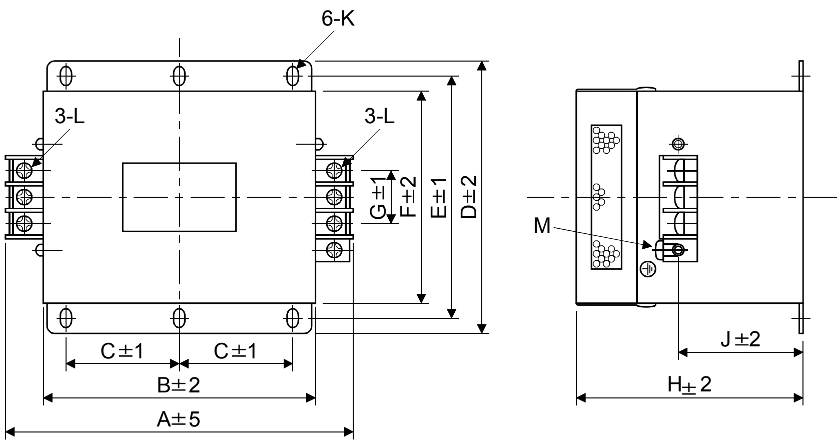
(a) EMC filter

HF3010A-UN

[Unit: mm]



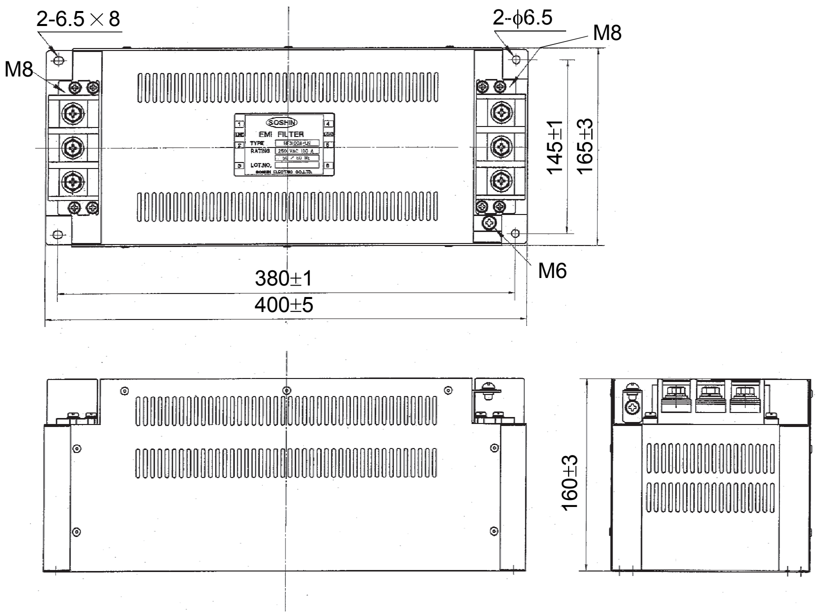
HF3030A-UN・HF-3040A-UN



Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN HF3040A-UN	260	210	85	155	140	125	44	140	70	R3.25, length 8	M5	M4

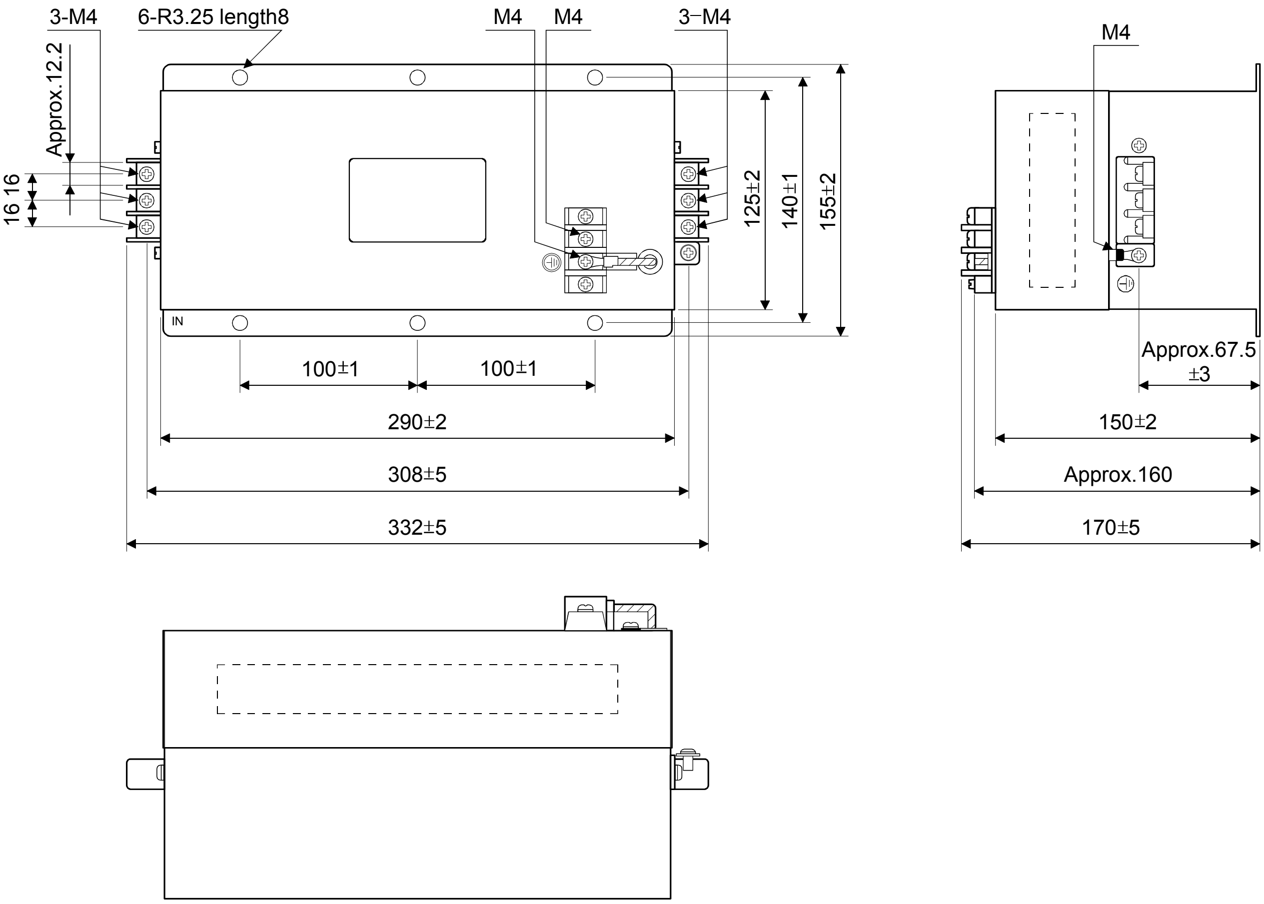
HF3100A-UN

[Unit: mm]



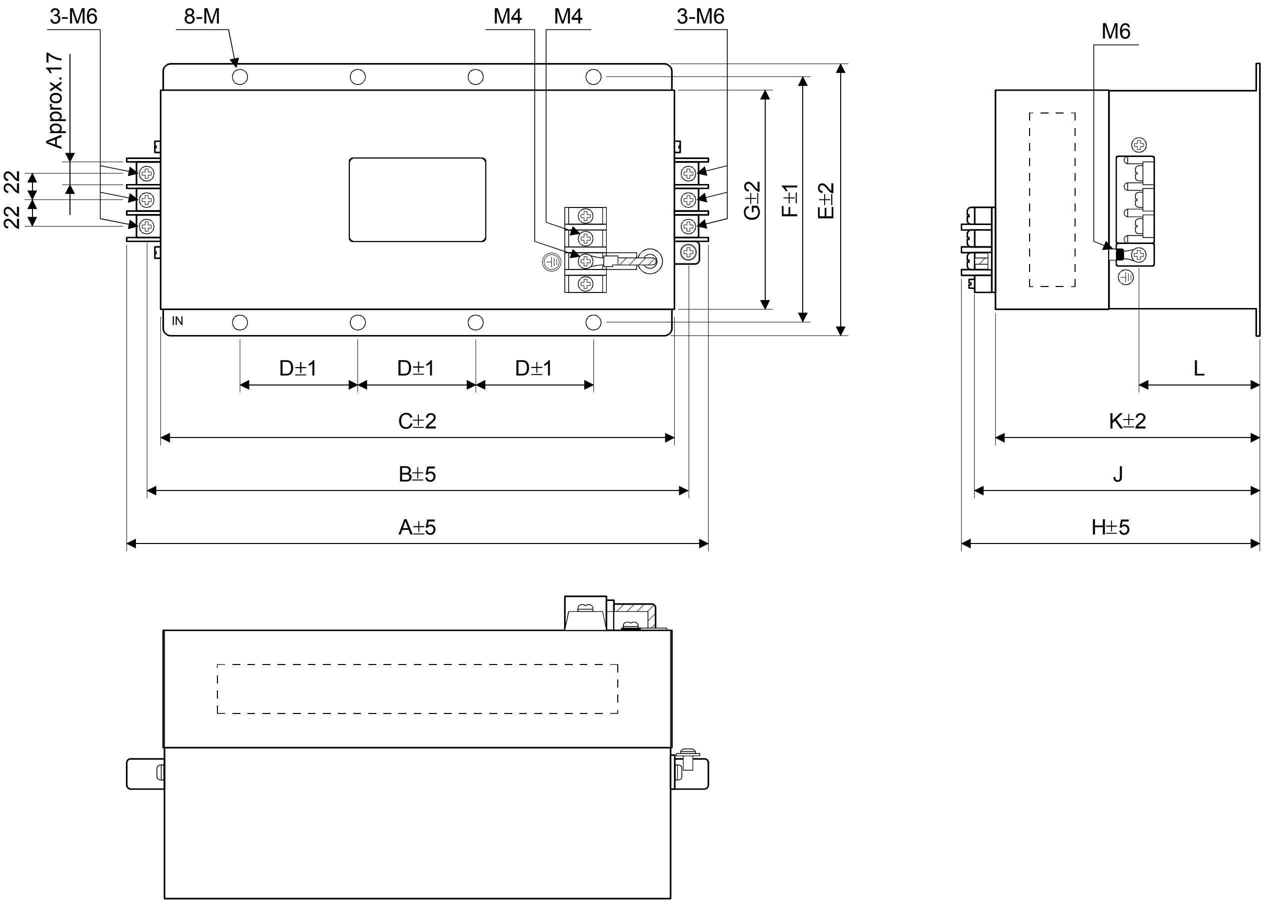
TF3005C-TX・TX3020C-TX・TF3030C-TX

[Unit: mm]



TF3040C-TX・TF3060C-TX

[Unit: mm]

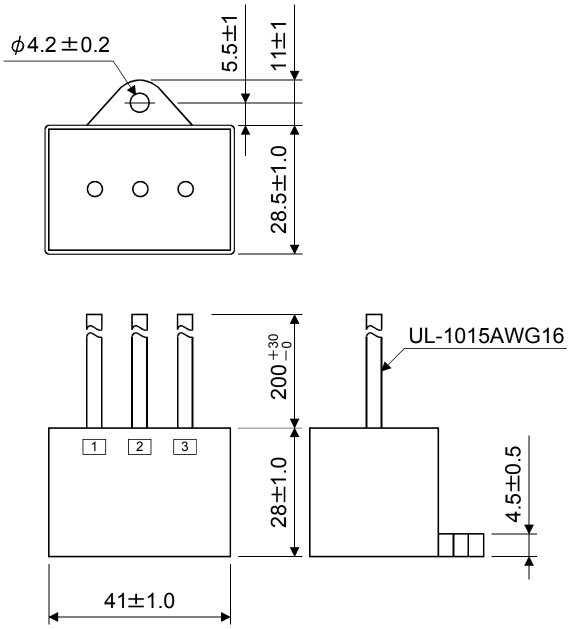


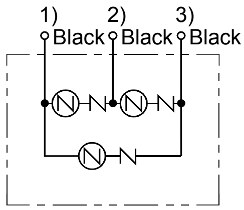
Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
TF3040C-TX TF3060C-TX	438	412	390	100	175	160	145	200	Approx. 190	180	Approx. 91.5	R3.25 length 8 (M6)

(b) Surge protector

RAV-781BYZ-2

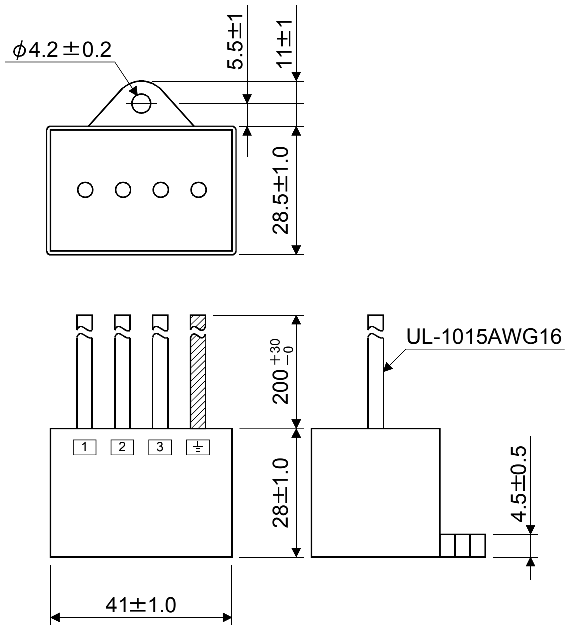
[Unit: mm]

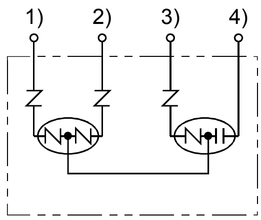




RAV-781BXZ-4

[Unit: mm]





MEMO

12. ABSOLUTE POSITION DETECTION SYSTEM

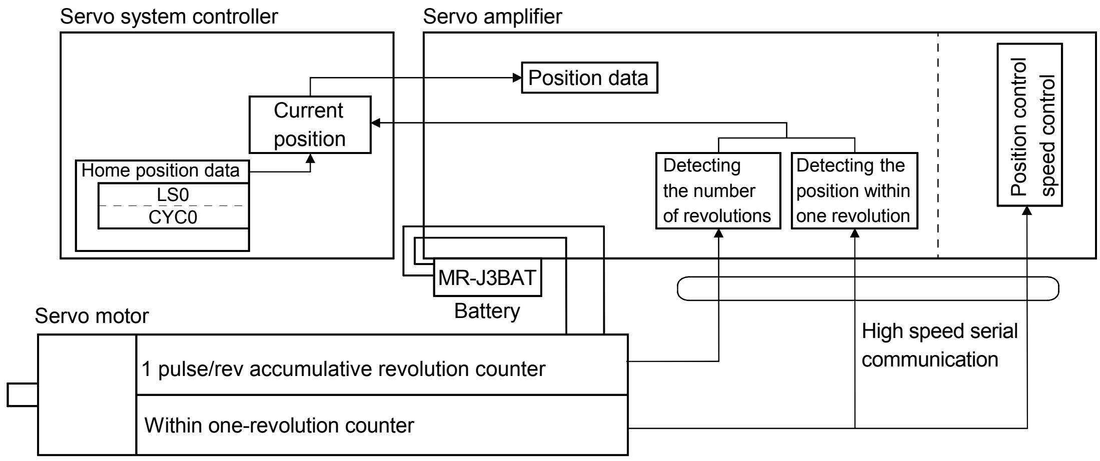
CAUTION	・If an absolute position erase alarm (25) or absolute position counter warning (E3) has occurred, always perform home position setting again. Not doing so can cause runaway. Not doing so may cause unexpected operation.

POINT

・If the encoder cable is disconnected, absolute position data will be lost in the following servo motor. HF-MP, HF-KP, HF-SP, HC-RP, HC-UP, HC-LP, and HA-LP series. After disconnecting the encoder cable, always execute home position setting and then positioning operation.

12.1 Features

For normal operation, as shown below, the encoder consists of a detector designed to detect a position within one revolution and a cumulative revolution counter designed to detect the number of revolutions.
The absolute position detection system always detects the absolute position of the machine and keeps it battery-backed, independently of whether the servo system controller power is on or off.
Therefore, once home position return is made at the time of machine installation, home position return is not needed when power is switched on thereafter.
If a power failure or a fault occurs, restoration is easy.



12.2 Specifications

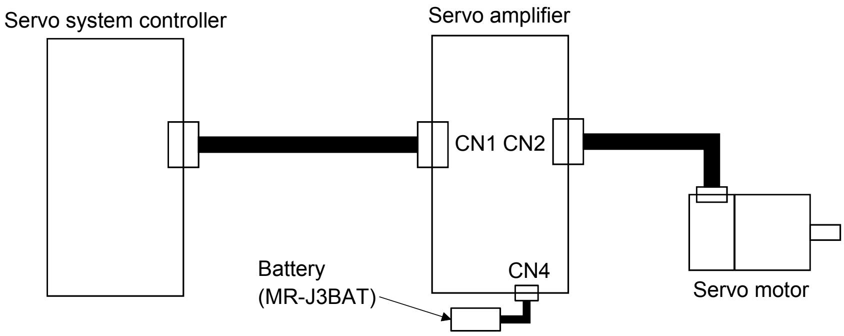
POINT
・Replace the battery with only the control circuit power ON. Removal of the battery with the control circuit power OFF will erase the absolute position data.

(1) Specification list

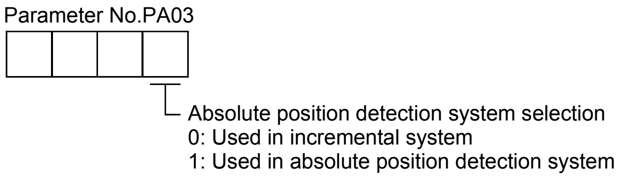
Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal＋3.6V) Type: MR-J3BAT
Maximum revolution range	Home position±32767 rev.
(Note 1) Maximum speed at power failure	3000r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
(Note 3) Battery life	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. Replace battery within three years since the operation start whether power is kept on/off. If the battery is used out of specification, the absolute position lost (25) may occur.
3. Quality of battery degrades by the storage condition. It is recommended to connect and use battery in the servo amplifier within two years from the production date. The life of battery is five years from the production date regardless of the connection.

(2) Configuration



(3) Parameter setting
Set "□□□1" in parameter No.PA03 to make the absolute position detection system valid.



12.3 Battery installation procedure

WARNING	・Before installing a battery, turn off the main circuit power and wait for 15 minutes or longer (20 minutes for 30kW or higher) until the charge lamp turns off. Then, check the voltage between P(＋) and N(－) with a voltage tester or others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not.

POINT

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

12.3.1 When replacing battery with the control circuit power ON

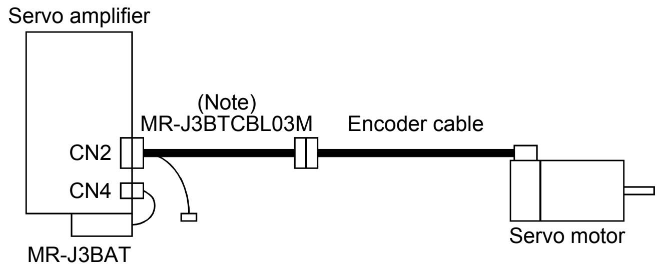
POINT

- Replacing battery with the control circuit power OFF will erase the absolute position data.

Replacing battery with the control circuit power ON will not erase the absolute position data. Refer to section 12.4 for installation procedure of battery to the servo amplifier. To replace battery with the control circuit power OFF, refer to section 12.3.2.

12.3.2 When replacing battery with the control circuit power OFF

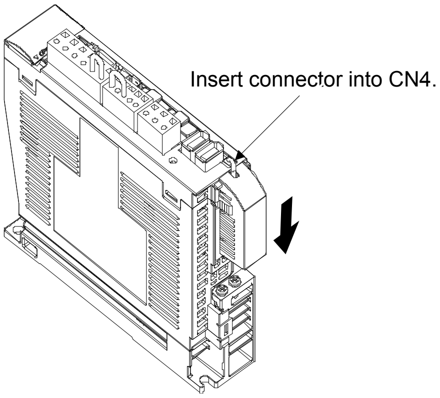
Replacing battery with the control circuit power OFF will erase the absolute position data, but battery can be replaced without erasing the absolute position data in the following procedure. In this procedure, MR-J3BTCBL03M battery connection cable is required. MR-J3BTCBL03M cannot be added after home position is set. Make sure to connect MR-J3BTCBL03M between the servo amplifier and the encoder cable when setting up the encoder cable. Refer to section 12.5 for the replacement procedure of the battery.



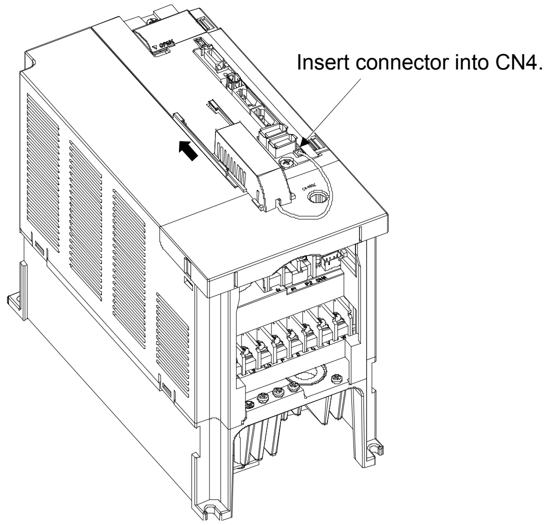
Note. Make sure to install MR-J3BTCBL03M when setting up the encoder cable.

12.4 Battery installation procedure

POINT
・For the servo amplifier with a battery holder on the bottom, it is not possible to wire for the earth with the battery installed. Insert the battery after executing the earth wiring of the servo amplifier.



For MR-J3-350□S or less・MR-J3-200□S4 or less



For MR-J3-500□S or more・MR-J3-350□S4 or more

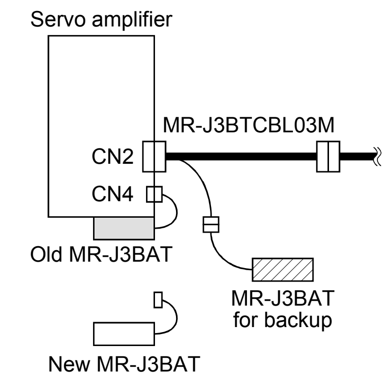
12.5 Procedure to replace battery with the control circuit power OFF

12.5.1 Preparation for battery replacement

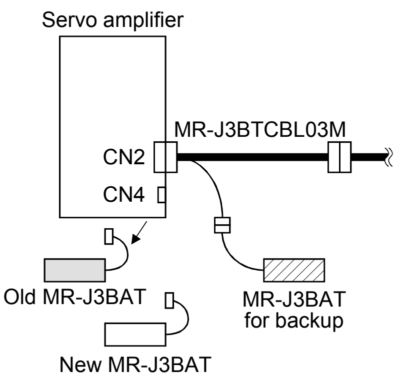
For the battery replacement, battery for backup is required separately from the battery to be replaced. Prepare the following batteries.

Product	Number and Use	Remarks
MR-J3BAT	1 for backup	Battery within two years from the production date.
	1 for replacement	

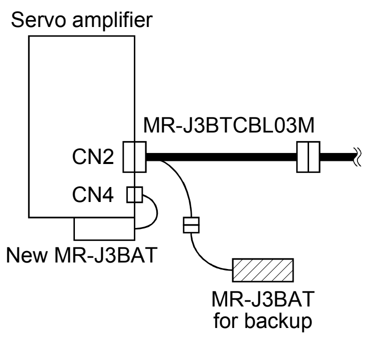
12.5.2 Replacement procedure



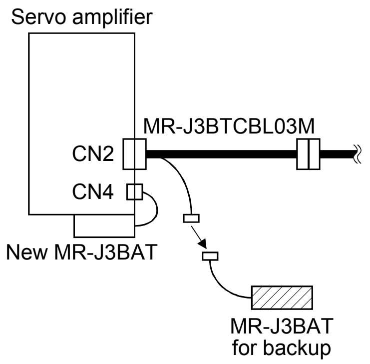
Step 1
Connect MR-J3BAT for backup to the battery connector of MR-J3BTCBL03M.



Step 2
Remove old MR-J3BAT from the servo amplifier.



Step 3
Install new MR-J3BAT to the servo amplifier. Then, connect the lead wire plug of new MR-J3BAT to the C4 connector of the servo amplifier.

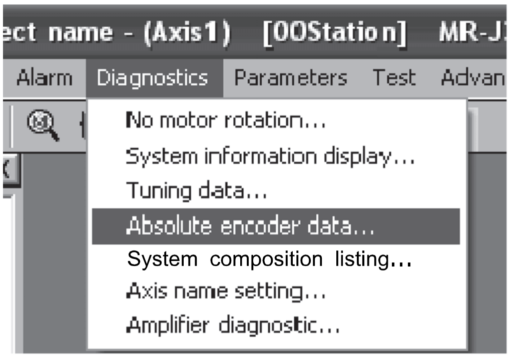


Step 4
Remove the MR-J3BAT for backup from the battery connector of MR-J3BTCBL03M, and the procedure is completed.

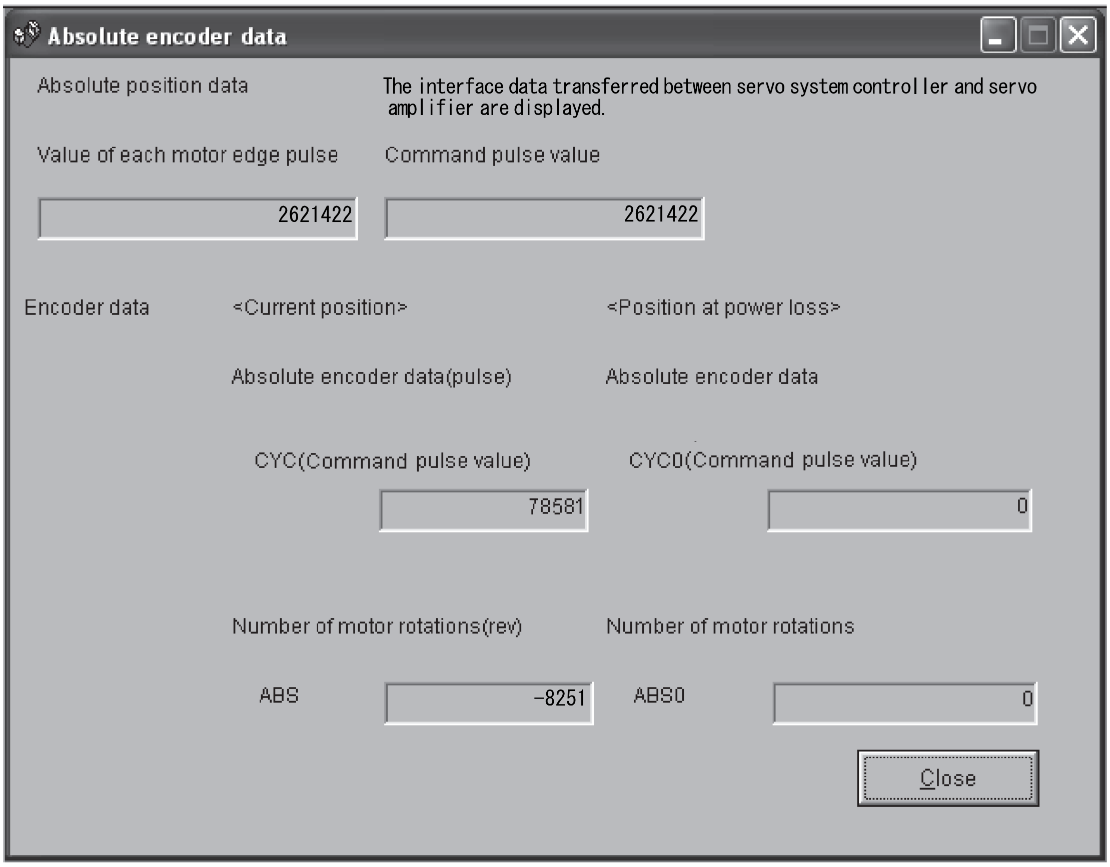
12.6 Confirmation of absolute position detection data

You can confirm the absolute position data with MR Configurator.
Choose "Diagnostics" and "Absolute Encoder Data" to open the absolute position data display screen.

(1) Choosing "Diagnostics" in the menu opens the sub-menu as shown below.



(2) By choosing "Absolute Encoder Data" in the sub-menu, the absolute encoder data display window appears.



(3) Press the "Close" button to close the absolute encoder data display window.

13. SERVO AMPLIFIERS WITH A LARGE CAPACITY (30k TO 55kW)

This chapter explains a large capacity of 200V (30k to 37kW)/400V (30k to 55kW).
Explanation made in this chapter is exclusively for the MR-J3-CR converter units and the MR-J3-DU□S drive units. Explanations on the following items are the same as those for servo amplifiers with 22kW or less. For such explanations, refer to the section indicated in the table.

Item	Reference
Startup	Chapter 4
General gain adjustment	Chapter 6
Special adjustment functions	Chapter 7
Absolute position detection system	Chapter 12

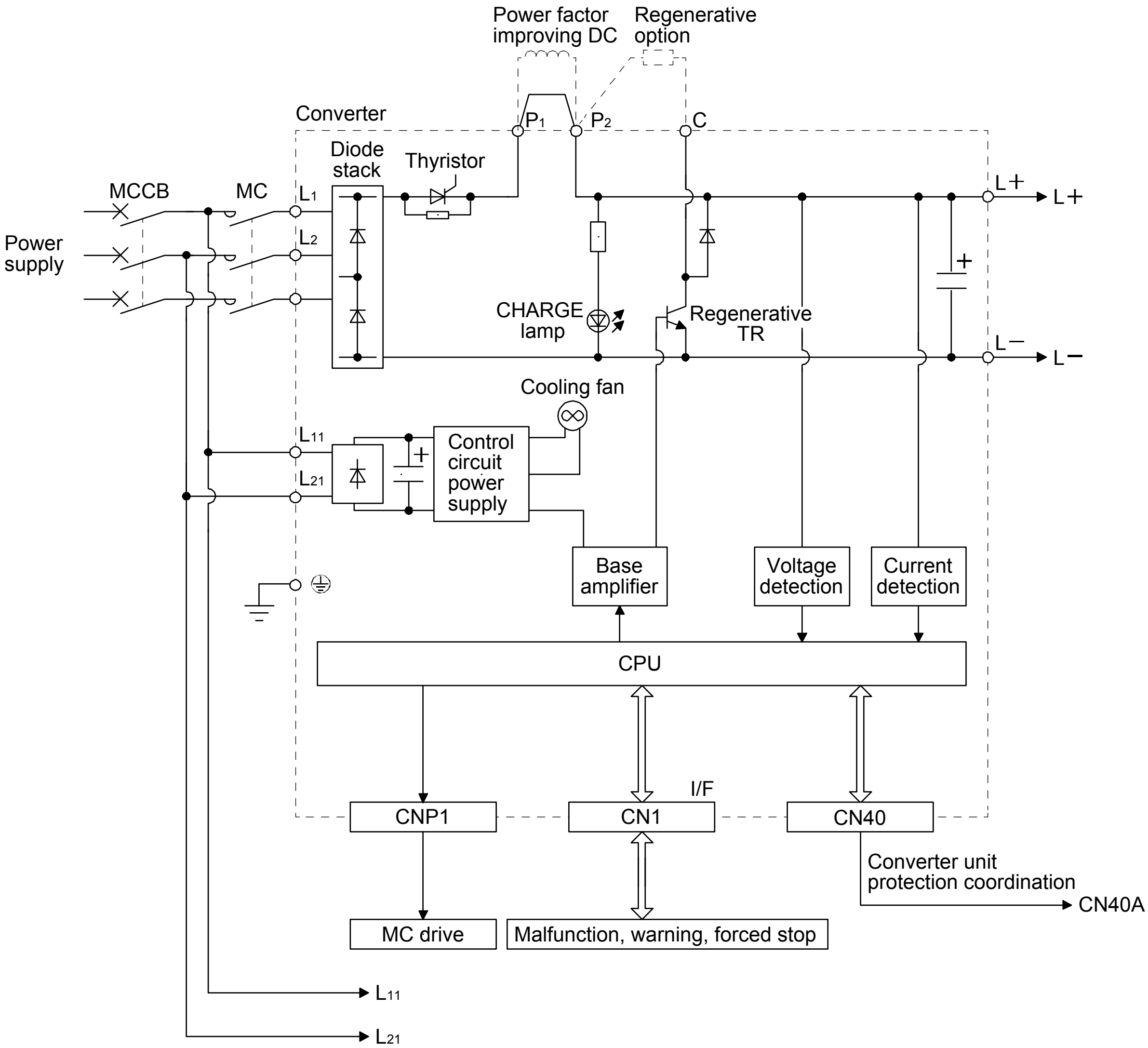
13.1 Functions and menus

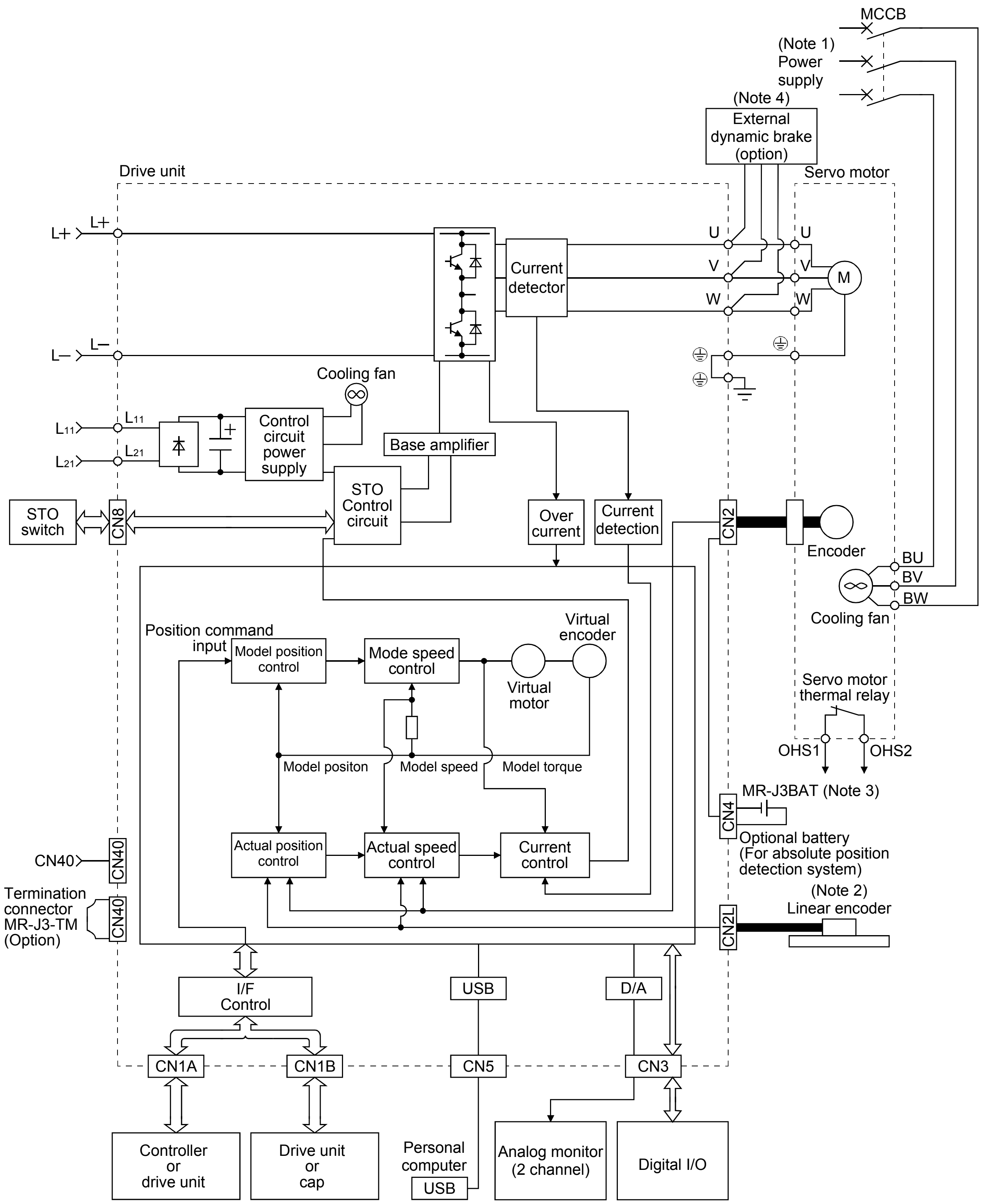
POINT

・Explanations on the following item are the same as those for servo amplifiers with 22kW or less. Refer to the section below for details.
 ・Function list section 1.4

13.1.1 Function block diagram

The function block diagram of this servo is shown below.





Note 1. Refer to section 13.3.8 for the power supply specification of the servo motor cooling fan.
2. When fully closed control is used.
3. When configuring absolute position detection system in fully closed control, battery is not required.
4. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

13.1.2 Packing list

Unpack the product and check the rating plate to see if the converter unit, drive unit and servo motor are as you ordered.

(1) Converter unit

POINT
・Regenerative resistor and power factor improving DC reactors are option. Purchase them separately if required. (Section 13.9.2, 13.9.6)

Model	Converter unit	Eyebolt	Magnetic contactor wiring connector (Note)	Digital I/O connector	To use the AC servo safely
MR-J3-CR55K MR-J3-CR55K4	1	2	1	1	1

Note. Magnetic contactor control connector is mounted to CNP1 of the converter unit before shipping.

(2) Drive unit

Model	Drive unit	Bus bar	Eyebolt	To use the AC servo safely
MR-J3-DU30K□S・MR-J3-DU37K□S MR-J3-DU30K□S4 to MR-J3-DU55K□S4	1	2	2	1

(3) Servo motor

Model	Servo motor	To use the AC servo safely
HA-LP30K1・HA-LP37K1 HA-LP30K1M・HA-LP37K1M HA-LP30K2・HA-LP37K2 HA-LP25K14 to HA-LP37K14 HA-LP30K1M4 to HA-LP50K1M4 HA-LP30K24 to HA-LP55K24	1	1

13.1.3 Standard specifications

(1) Converter unit

Item				Converter unit: MR-J3-CR□ 55K	55K4
Output	Rated voltage			283 to 326VDC	538 to 678VDC
	Rated current [A]			215.9	113.8
Main circuit power supply	Voltage/frequency			3-phase 200 to 230VAC, 50/60Hz	3-phase 380 to 480VAC, 50/60Hz
	Rated current [A]			251.1	132.2
	Permissible voltage fluctuation			3-phase 170 to 253VAC	3-phase 323 to 528VAC
	Permissible frequency fluctuation			Within±5%	
Control circuit power supply	Voltage/frequency			1-phase 200 to 230VAC, 50/60Hz	1-phase 380 to 480VAC, 50/60Hz
	Rated current [A]			0.3	0.2
	Permissible voltage fluctuation			1-phase 170 to 253VAC	1-phase 323 to 528VAC
	Permissible frequency fluctuation			Within±5%	
	Power consumption [W]			45	
Interface power supply	Voltage			24VDC±10%	
	Power supply capacity [A]			(Note) 0.13	
Rated output [kW]				55	
Regenerative power (Using regenerative option)				One MR-RB139: 1300W Three MR-RB137: 3900W	One MR-RB136-4: 1300W Three MR-RB138-4: 3900W
Protective function				Regenerative overvoltage shutoff, overload shutoff (electronic thermal protector) Regenerative alarm protection, undervoltage, instantaneous power failure protection	
Compliance to standards				CE (LVD: EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)	
Structure				Force-cooling, open (IP rating: IP00)	
Environmental conditions	Ambient temperature	In operation	[°C]	0 to 55 (non-freezing)	
			[°F]	32 to 131 (non-freezing)	
		In storage	[°C]	−20 to 65 (non-freezing)	
			[°F]	−4 to 149 (non-freezing)	
	Ambient humidity	In operation		90%RH or less (non-condensing)	
		In storage			
	Ambient			Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt	
	Altitude			Max. 1000m above sea level	
	Vibration			5.9 [m/s^2] or less at 10 to 55Hz (directions of X, Y and Z axes)	
Mass	[kg]			25	
	[lb]			55.1	

Note. 0.13A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

(2) Drive unit

(a) 200V class

<table>
<tr><td colspan="4" rowspan="2">Item \ Drive unit</td><td colspan="2">MR-J3-DU□S</td></tr>
<tr><td>30KB</td><td>37KB</td></tr>
<tr><td rowspan="2" colspan="2">Output</td><td colspan="2">Rated voltage</td><td colspan="2">3-phase 170VAC</td></tr>
<tr><td colspan="2">Rated current [A]</td><td>174</td><td>204</td></tr>
<tr><td rowspan="5" colspan="2">Control circuit power supply</td><td colspan="2">Voltage/frequency</td><td colspan="2">1-phase 200 to 230VAC, 50/60Hz</td></tr>
<tr><td colspan="2">Rated current [A]</td><td colspan="2">0.3</td></tr>
<tr><td colspan="2">Permissible voltage fluctuation</td><td colspan="2">1-phase 170 to 253VAC</td></tr>
<tr><td colspan="2">Permissible frequency fluctuation</td><td colspan="2">Within±5%</td></tr>
<tr><td colspan="2">Power consumption [W]</td><td colspan="2">45</td></tr>
<tr><td colspan="4">Main circuit power supply</td><td colspan="2">The main circuit power of the drive unit is supplied by the converter unit.</td></tr>
<tr><td rowspan="2" colspan="2">Interface power supply</td><td colspan="2">Voltage</td><td colspan="2">24VDC±10%</td></tr>
<tr><td colspan="2">Power supply capacity</td><td colspan="2">(Note 1) 0.2A (including CN8 connector signals)</td></tr>
<tr><td colspan="4">Control system</td><td colspan="2">Sine-wave PWM control, current control system</td></tr>
<tr><td colspan="4">Dynamic brake</td><td colspan="2">External option (Note 2)</td></tr>
<tr><td colspan="4">Protective function</td><td colspan="2">Overcurrent shut-off, overload shutoff (electronic thermal protector)
Servo motor overheat protection, encoder error protection, undervoltage
Instantaneous power failure protection, overspeed protection
Excessive error protection</td></tr>
<tr><td colspan="4">Response performance</td><td colspan="2">8ms or less (STO input OFF → energy shut off)</td></tr>
<tr><td colspan="4">(Note 3)
Test pulse input (STO)</td><td colspan="2">Test pulse interval: 1 to 25Hz
Test pulse off time: Up to 1ms</td></tr>
<tr><td colspan="4">Safety function</td><td colspan="2">STO (IEC/EN 61800-5-2)</td></tr>
<tr><td colspan="4">Safety performance</td><td colspan="2">ISO/EN ISO 13849-1 PL d (category 3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2</td></tr>
<tr><td colspan="4">Compliance to standards</td><td colspan="2">CE (LVD: EN 50178, EMC: IEC/EN 61800-3)
UL (UL 508C)</td></tr>
<tr><td colspan="4">Structure</td><td colspan="2">Force-cooling, open (IP rating: IP00)</td></tr>
<tr><td rowspan="9">Environmental conditions</td><td rowspan="4">Ambient temperature</td><td rowspan="2">In operation</td><td>[°C]</td><td colspan="2">0 to 55 (non-freezing)</td></tr>
<tr><td>[°F]</td><td colspan="2">32 to 131 (non-freezing)</td></tr>
<tr><td rowspan="2">In storage</td><td>[°C]</td><td colspan="2">−20 to 65 (non-freezing)</td></tr>
<tr><td>[°F]</td><td colspan="2">−4 to 149 (non-freezing)</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td colspan="2">In operation</td><td rowspan="2" colspan="2">90%RH or less (non-condensing)</td></tr>
<tr><td colspan="2">In storage</td></tr>
<tr><td colspan="3">Ambient</td><td colspan="2">Indoors (no direct sunlight)
Free from corrosive gas, flammable gas, oil mist, dust and dirt</td></tr>
<tr><td colspan="3">Altitude</td><td colspan="2">Max. 1000m above sea level</td></tr>
<tr><td colspan="3">Vibration</td><td colspan="2">5.9 [m/s²] or less at 10 to 55Hz (directions of X, Y and Z axes)</td></tr>
<tr><td rowspan="2" colspan="2">Mass</td><td colspan="2">[kg]</td><td colspan="2">26</td></tr>
<tr><td colspan="2">[lb]</td><td colspan="2">57.3</td></tr>
</table>

Note 1. 0.2A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

3. This function diagnoses malfunction of contacts including an external circuit by shortly turning OFF signals from a controller to the servo amplifier at a constant period while input signals of the servo amplifier are ON.

(b) 400V class

Item				Drive unit MR-J3-DU□S4 30KB	37KB	45KB	55KB
Output	Rated voltage			3-phase 323VAC			
	Rated current [A]			87	102	131	143
Control circuit power supply	Voltage/frequency			1-phase 380 to 480VAC, 50/60Hz			
	Rated current [A]			0.2			
	Permissible voltage fluctuation			1-phase 323 to 528VAC			
	Permissible frequency fluctuation			Within±5%			
	Power consumption [W]			45			
Main circuit power supply				The main circuit power of the drive unit is supplied by the converter unit.			
Interface power supply	Voltage			24VDC±10%			
	Power supply capacity			(Note 1) 0.2A (including CN8 connector signals)			
Control system				Sine-wave PWM control, current control system			
Dynamic brake				External option (Note 2)			
Protective function				Overcurrent shut-off, overload shutoff (electronic thermal protector) Servo motor overheat protection, encoder error protection, undervoltage Instantaneous power failure protection, overspeed protection Excessive error protection			
Response performance				8ms or less (STO input OFF → energy shut off)			
(Note 3) Test pulse input (STO)				Test pulse interval: 1 to 25Hz Test pulse off time: Up to 1ms			
Safety function				STO (IEC/EN 61800-5-2)			
Safety performance				ISO/EN ISO 13849-1 PL d (category 3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2			
Compliance to standards				CE (LVD: EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)			
Structure				Force-cooling, open(IP rating: IP00)			
Environmental conditions	Ambient temperature	In operation	[°C]	0 to 55 (non-freezing)			
			[°F]	32 to 131 (non-freezing)			
		In storage	[°C]	−20 to 65 (non-freezing)			
			[°F]	−4 to 149 (non-freezing)			
	Ambient humidity	In operation		90%RH or less (non-condensing)			
		In storage					
	Ambient			Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt			
	Altitude			Max. 1000m above sea level			
	Vibration			5.9 [m/s^2] or less at 10 to 55Hz (directions of X, Y and Z axes)			
Mass	[kg]			18.5		26	
	[lb]			40.8		57.3	

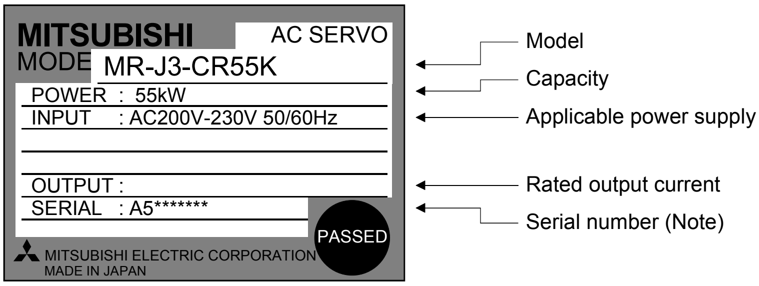
Note 1. 0.2A is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

2. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

3. This function diagnoses malfunction of contacts including an external circuit by shortly turning OFF signals from a controller to the servo amplifier at a constant period while input signals of the servo amplifier are ON.

13.1.4 Model definition

(1) Rating plate



Note. For the year and month of manufacture, refer to section 1.5 (1).

(2) Model

(a) Converter unit

MR－J3－CR55K□

- MR－J3: Series
- CR: Indicates converter unit
- 55K: Rated output: 55kW
- □: Power supply

Symbol	Power supply
None	3-phase 200 to 230VAC
4	3-phase 380 to 480VAC

(b) Drive unit

MR－J3－DU□BS□

- MR－J3: Series
- DU: Indicates drive unit
- □: Rated output
- B: SSCNETⅢ interface
- S: Drive safety compatible
- □: Power supply

Symbol	Power supply
None	3-phase 200 to 230VAC
4	3-phase 380 to 480VAC

Symbol	Rated output [kW]	
	200V class	400V class
30K	30	30
37K	37	37
45K		45
55K		55

13.1.5 Combinations of converter units, drive units and servo motors

The following tables indicate the combinations of the converter units, drive units and servo motors.

(1) 200V class

Converter unit	Drive unit	Servo motor HA-LP□		
		1000r/min	1500r/min	2000r/min
MR-J3-CR55K	MR-J3-DU30K□S	30K1	30K1M	30K2
	MR-J3-DU37K□S	37K1	37K1M	37K2

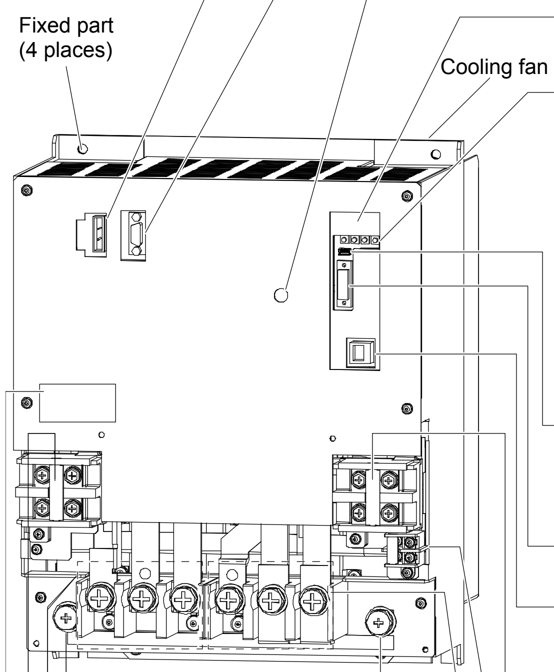
(2) 400V class

Converter unit	Drive unit	Servo motor HA-LP□		
		1000r/min	1500r/min	2000r/min
MR-J3-CR55K4	MR-J3-DU30K□S4	25K14 30K14	30K1M4	30K24
	MR-J3-DU37K□S4	37K14	37K1M4	37K24
	MR-J3-DU45K□S4		45K1M4	45K24
	MR-J3-DU55K□S4		50K1M4	55K24

13.1.6 Parts identification

(1) Converter unit (MR-J3-CR55K(4))

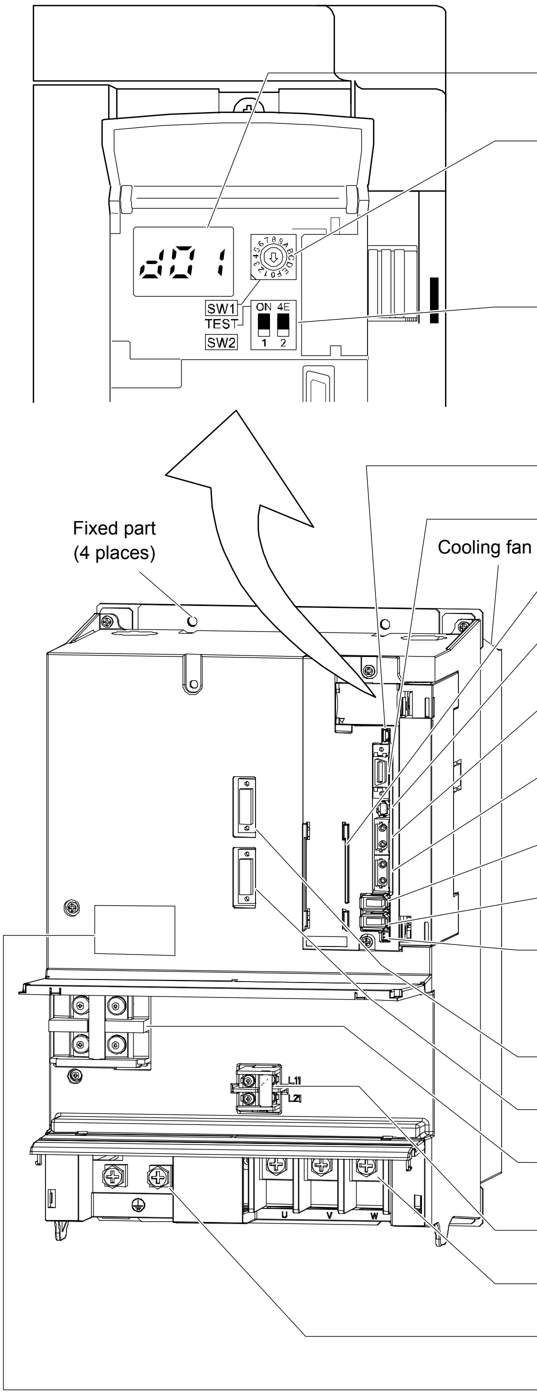
POINT
・This servo amplifier is shown without the terminal cover. For removal of the terminal cover, refer to section 13.1.7.

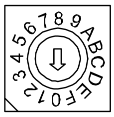
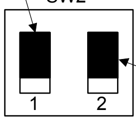


Name/Application	Detailed explanation
Magnetic contactor control connector (CNP1) Connect to the operation coil of the magnetic contactor.	Section 13.3.5
I/O signal connector (CN1) Used to connect digital I/O signals.	
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 13.4
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE UP DOWN SET SET: Used to set data. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode.	
For manufacturer setting connector (CN6) The connector is for manufacturer setting. Although the shape is similar to analog monitor connector (CN6) of the drive unit, do not connect anything including an analog monitor.	
Protection coordination connector (CN40) Connect to CN40A of the drive unit.	
For manufacturer setting connector (CN3) For manufacturer adjustment. Though the shape is similar to RS-422 communication connector (CN3), do not connect anything, including a personal computer and MR-PRU03 parameter unit.	
L＋L−terminal (TE2-2) Used to connect to a drive unit using a bus bar supplied with drive unit.	Section 13.3.2 Section 13.3.3 Section 13.3.4
Control circuit terminal L_{11}・L_{21}(TE3) Supply control circuit power.	
Regenerative option・Power factor improving DC reactor (TE1-2) Used to connect regenerative options and a power factor improving DC reactor.	
Used to connect regenerative options and a power factor improving DC reactor.	
Protective earth (PE) terminal (⏚) Ground terminal.	
Main circuit terminal block (TE1-1) Supply main circuit power.	
L＋L−terminal (TE2-1) When using brake unit, connect it to this terminal. Do not connect anything other than the brake unit.	Section 13.9.10
Rating plate	Section 13.1.4

(2) Drive unit (MR-J3-DU30K□S4・MR-J3-DU37K□S4)

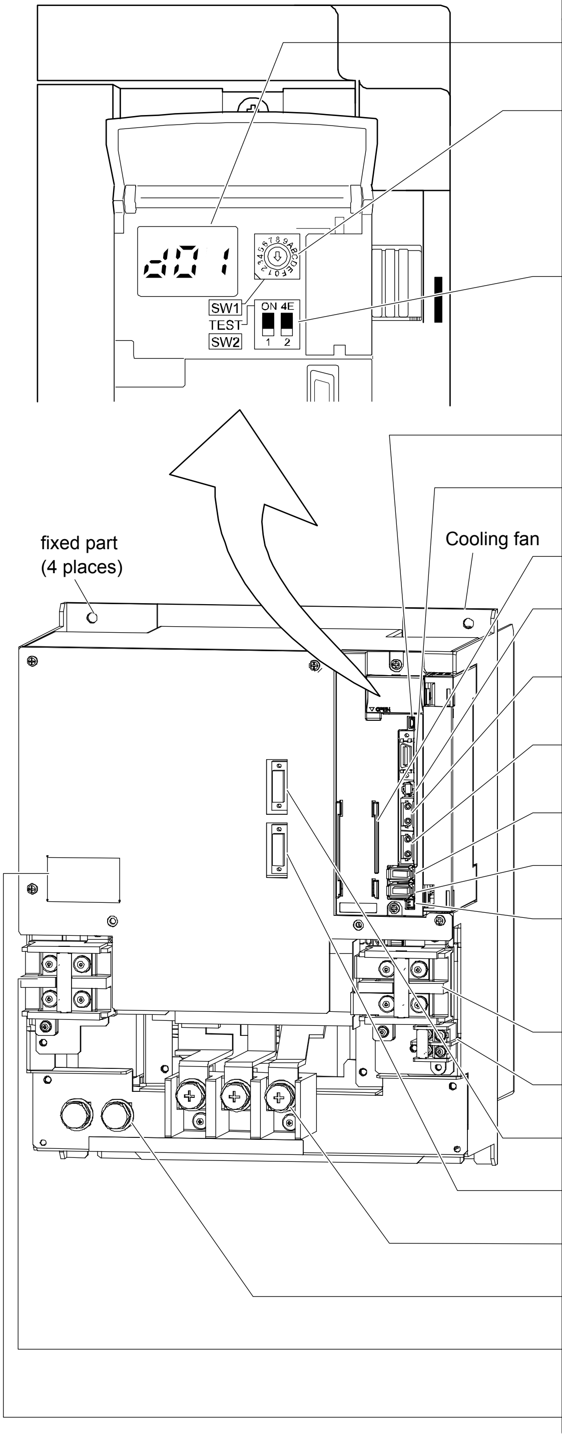
POINT
・The cover of the terminal section is open in the illustration below. For opening or closing of the terminal cover, refer to section 13.1.7.

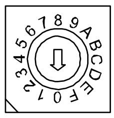
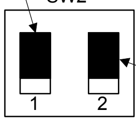


Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of drive unit.	Section 3.14
Test operation select switch (SW2-1) SW2  Used to perform the test operation mode by using MR Configurator· For manufacturer setting (Be sure to set to the "Down" position).	
USB communication connector (CN5) Connect with the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Battery holder Install the MR-J3BAT battery.	Section 12.4
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis drive unit.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis drive unit. For the final axis, puts a cap.	
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
Converter unit connectors (CN40A) Connect to CN40 of the converter unit.	Section 13.3.2
Converter unit connectors (CN40B) Connect the termination connector (MR-J3-TM).	
L＋L− terminals (TE2) Connect to the L＋ L− terminals of the converter unit using the bus bar supplied.	Section 13.3.2 Section 13.3.3 Section 13.3.4
Control circuit terminal L_{11}・L_{21}(TE3) Supply control circuit power.	
Motor power supply terminals (TE1) Connect to U, V, W of the servo motor.	
Protective earth (PE) terminal (⏚) Ground terminal.	
Rating plate	Section 13.1.4

(3) Drive unit (MR-J3-DU30K□S・MR-J3-DU37K□S・MR-J3-DU45K□S4・MR-J3-DU55K□S4)

POINT
・This servo amplifier is shown without the terminal cover. For removal of the terminal cover, refer to section 13.1.7.



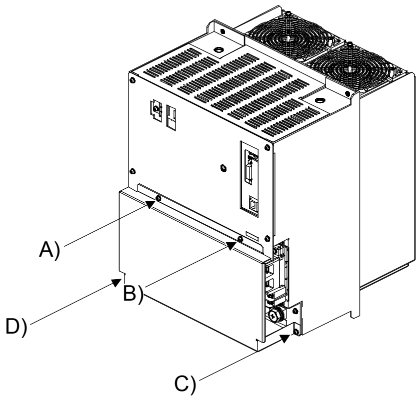
Name/Application	Detailed explanation
Display The 3-digit, seven-segment LED shows the servo status and alarm number.	Section 4.3
Rotary axis setting switch (SW1) SW1  Used to set the axis No. of drive unit.	Section 3.14
SW2  Test operation select switch (SW2-1) Used to perform the test operation mode by using MR Configurator. For manufacturer setting (Be sure to set to the "Down" position).	
USB communication connector (CN5) Connect with the personal computer.	Section 11.8
I/O signal connector (CN3) Used to connect digital I/O signals. More over an analog monitor is output.	Section 3.2 Section 3.4
Battery holder Install the MR-J3BAT battery.	Section 12.4
STO I/O signal connector (CN8) Used to connect MR-J3-D05 safety logic unit and external safety relay.	Chapter 15 App. 10
SSCNETⅢ cable connector (CN1A) Used to connect the servo system controller or the front axis drive unit.	Section 3.10
SSCNETⅢ cable connector (CN1B) Used to connect the rear axis drive unit. For the final axis, puts a cap.	
Servo motor encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1
Load-side encoder connector (CN2L) Connect the load-side encoder.	Section 14.2
Battery connector (CN4) Used to connect the battery for absolute position data backup. To use this servo amplifier for the absolute position detection system in the semi closed loop system, the MR-J3BAT battery is required.	Section 11.9 Chapter 12
TE2-2 For manufacturer adjustment. Leave this open.	
Control circuit terminal L_{11}・L_{21} (TE3) Supply control circuit power.	Section 13.3.2 Section 13.3.3 Section 13.3.4
Converter unit connectors (CN40A) Connect to CN40 of the converter unit.	
Converter unit connectors (CN40B) Connect the termination connector (MR-J3-TM).	
Motor power supply terminals (TE1) Connect to U, V, W of the servo motor.	
Protective earth (PE) terminal (⏚) Ground terminal.	
L+L− terminals (TE2) Connect to the L+ L− terminals of the converter unit using the bus bar supplied.	
Rating plate	Section 13.1.4

13.1.7 Removal and reinstallation of the terminal block cover

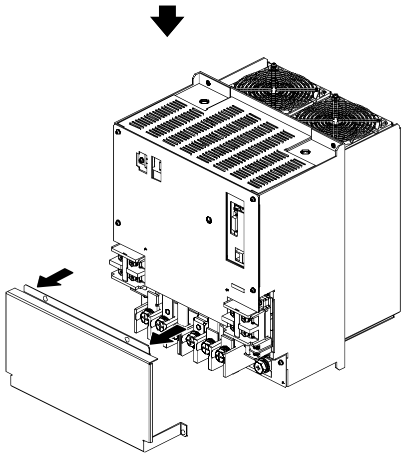
⚠CAUTION	・Before removing or installing the front cover, turn off the power and wait for 20 minutes or more until the charge lamp turns off. Then, confirm that the voltage between L＋ and L－ is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not.

(1) MR-J3-CR55K(4), MR-J3-DU30K□S, MR-J3-DU37K□S, MR-J3-DU45K□S4 or MR-J3-DU55K□S4
Here, the method for removing and reinstalling the terminal block cover using the figure of converter unit as an example. For a drive unit, the shape of the main unit is different. However, the removal and reinstallation of the terminal block can be performed in the same procedure.

(a) How to remove the terminal block cover

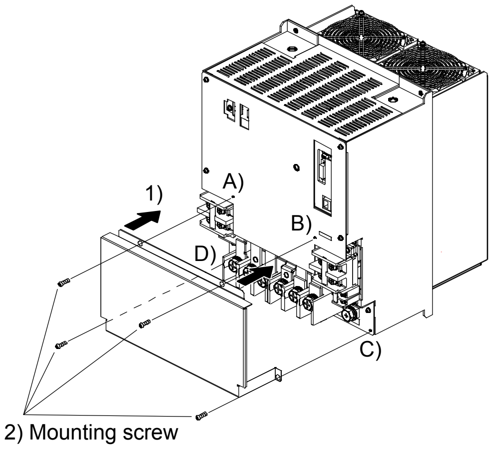


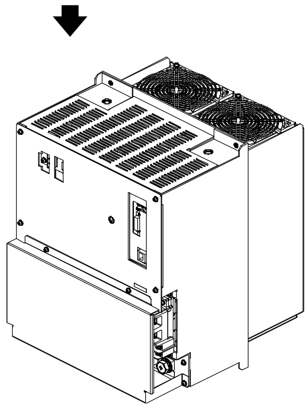
Remove the installation screws (A), B), C), D)) on the four corners of the terminal block cover.



Pull the terminal block cover toward you and remove it.

(b) How to reinstall the terminal block cover



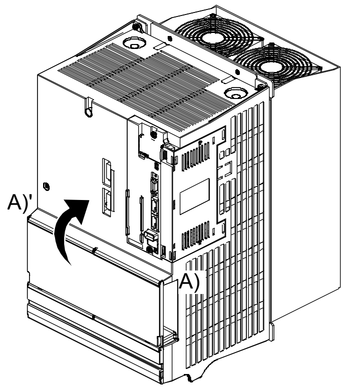


1) Put the terminal block cover on and match the screw holes of the cover fit with those of the main unit.
2) Install the installing screws into the screw holes (A), B), C), D)).

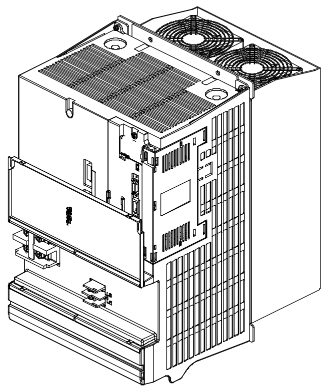
(2) MR-J3-DU30K□S4 or MR-J3-DU37K□S4

(a) Upper terminal block cover

1) How to open

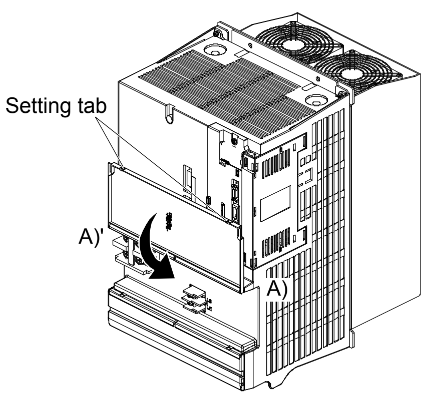


Pull up the cover using the axis A), A)' as a support.

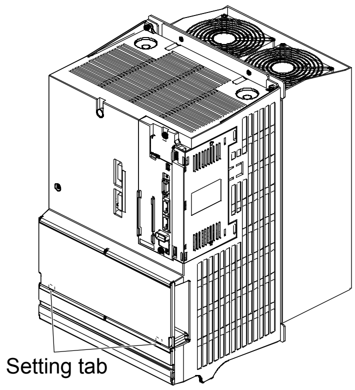


When pulled up to the top, the cover is fixed.

2) How to close



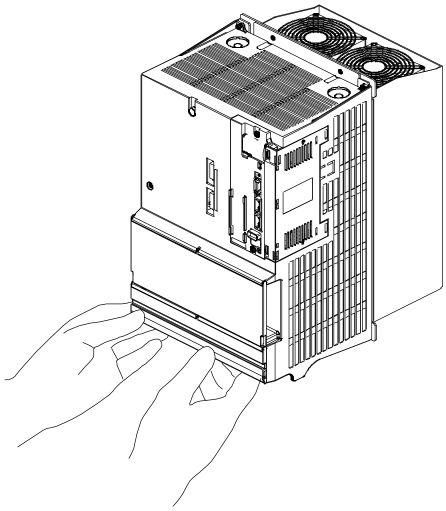
Close the cover using the axis A), A)' as a support.



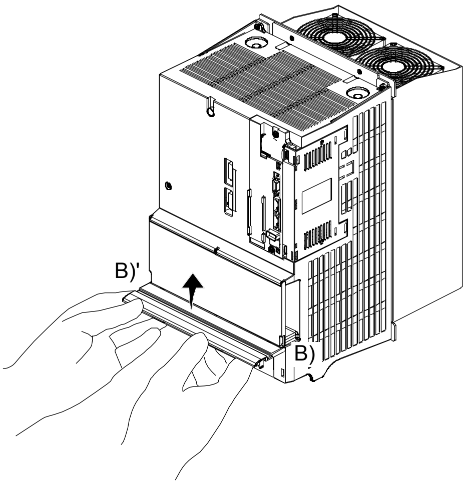
Press the cover against the terminal box until the installing knobs click.

(b) Lower terminal block cover

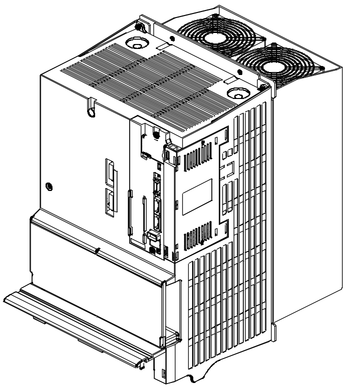
1) How to open



Hold the bottom of the terminal block cover with both hands.

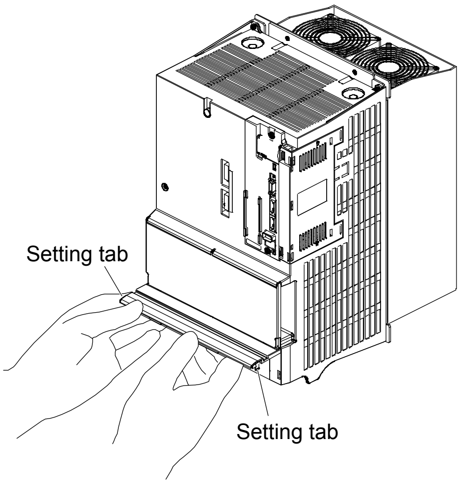


Pull up the cover using the axis B), B)' as a support.

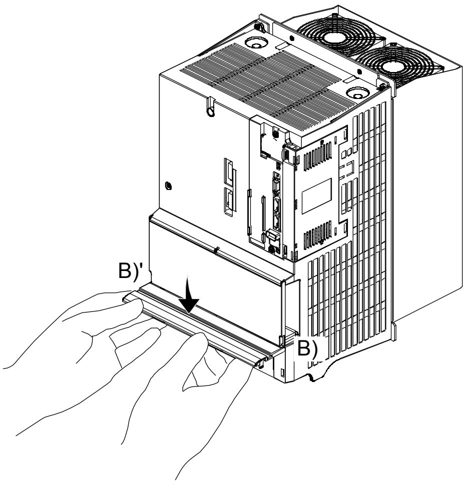


When pulled up to the top, the cover is fixed.

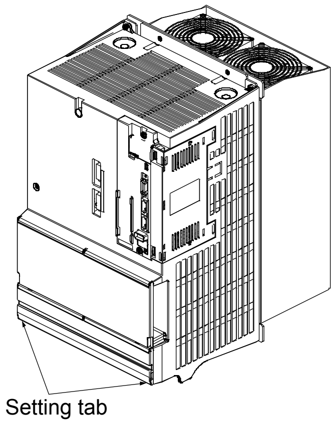
2) How to close



Hold the bottom of the terminal block cover with both hands.

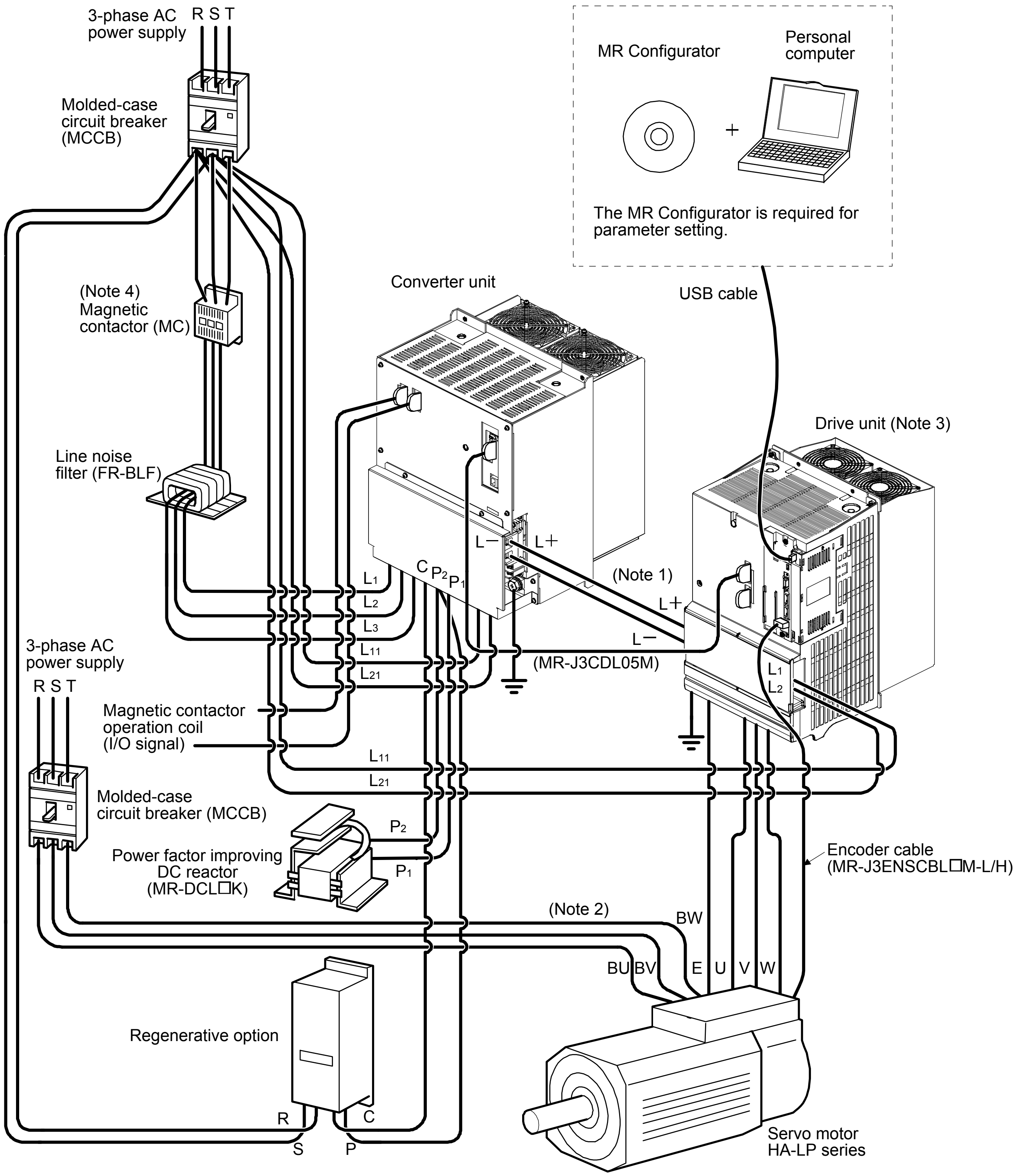


Close the cover using the axis B), B)' as a support.



Press the cover against the terminal box until the installing knobs click.

13.1.8 Servo system with auxiliary equipment



Note 1. The L＋ and L－ bus bar used to connect a converter unit to a drive unit are standard accessories. The converter unit is attached to the drive unit actually. (Refer to section 13.2.1.)

2. The power supply of the servo motor cooling fan differs depending on the capacity of a servo motor. Refer to section 13.3.8.
3. For MR-J3-DU30KB4 or MR-J3-DU37KB4.
4. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

13.2 Installation

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

⚠ CAUTION	・Stacking in excess of the limited number of product packages is not allowed. ・Install the equipment on incombustible material. Installing them directly or close to combustibles will lead to a fire. ・Install the equipment in a load-bearing place in accordance with this Instruction Manual. ・Do not get on or put heavy load on the equipment to prevent injury. ・Use the equipment within the specified environmental condition range. (For the environmental conditions, refer to section 13.1.3.) ・Provide an adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the converter unit and servo amplifier (drive unit). ・Do not block intake and exhaust areas of the converter unit, the drive unit and the servo motor with a cooling fan. Otherwise, it may cause a malfunction. ・Do not drop or strike the converter unit and servo amplifier (drive unit). Isolate from all impact loads. ・Do not install or operate the converter unit and servo amplifier (drive unit) which has been damaged or has any parts missing. ・When the product has been stored for an extended period of time, contact your local sales office. ・When treating the converter unit and servo amplifier (drive unit), be careful about the edged parts such as the corners of the servo amplifier. ・The converter unit and drive unit must be installed in the metal cabinet.

POINT

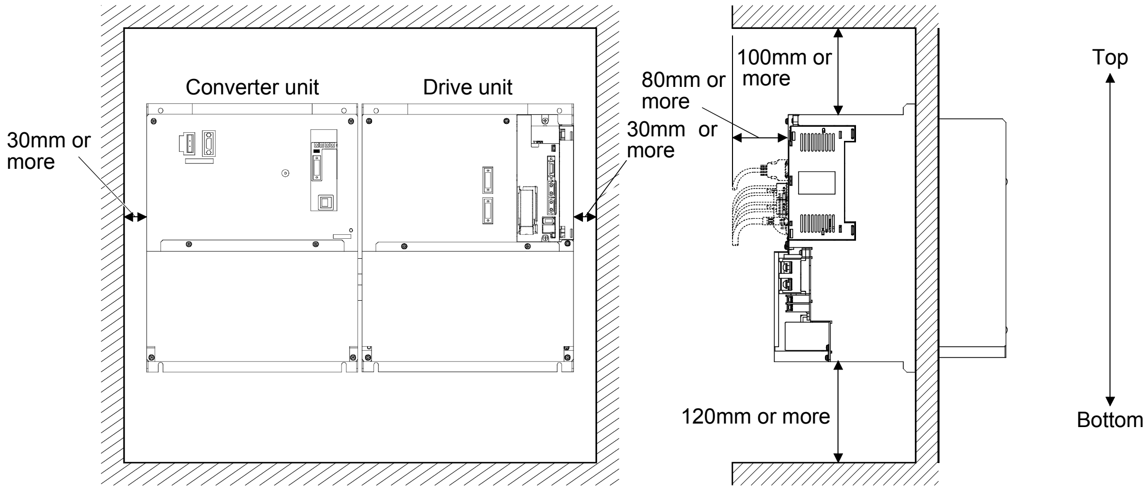
・Explanations on the following item are the same as those for servo amplifiers with 22kW or less. Refer to the section below for details.
- ・Keep out foreign materials　Refer to section 2.2.
- ・Cable stress　Refer to section 2.3.
- ・SSCNETⅢ cable laying　Refer to section 2.4.
- ・Parts Having Service Lives　Refer to section 2.6.

13.2.1 Installation direction and clearances

CAUTION	
⚠ CAUTION	・Install the equipment in the specified direction. Not doing so can cause a failure. ・Leave the specified clearances between the converter unit/drive unit and the cabinet inside walls or other equipment. Not doing so can cause a failure.

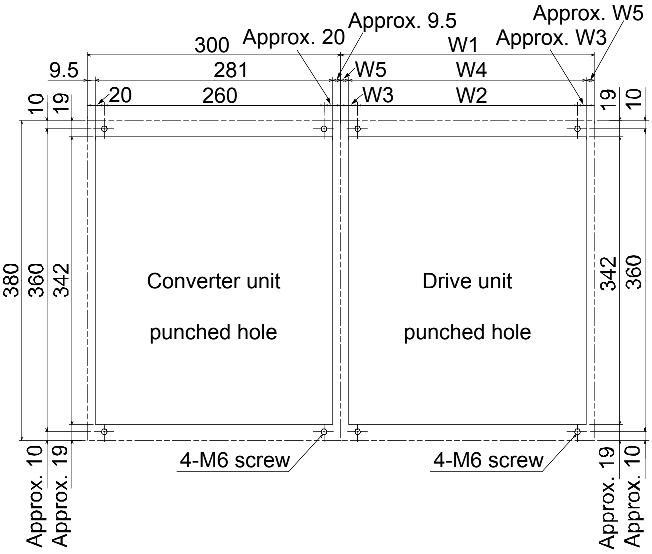
(1) Installation

POINT
・Make sure to connect a drive unit to the right side of a converter unit as shown in the diagram.



Front view Side view

(2) Mounting dimensional diagram



[Unit: mm]

Drive unit model	Dimensions					
	W1	W2	W3	W4	W5	A
MR-J3-DU30K□S, 37K□S, 45K□S4, 55K□S4	300	260	20	281	9.5	M6
MR-J3-DU30K□S4, 37K□S4	240	120	60	222	9	M5

(3) Others

When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the converter unit and drive unit is not affected.

Install the converter unit and drive unit on a perpendicular wall in the correct vertical direction.

13.2.2 Inspection

WARNING	・Before starting maintenance and/or inspection, turn off the power and wait for 20 minutes or more until the charge lamp turns off. Then, confirm that the voltage between L＋ and L－ is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the converter unit whether the charge lamp is off or not.

CAUTION	・To avoid the risk of electric shock, only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

POINT
・Do not perform insulation resistance test on the drive unit as damage may result.

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 that the cables and the wires are not damaged or cracked. When the cables and wires are movable, check them periodically according to the usage conditions.

(4) Check that the connector is securely connected to the servo amplifier.

(5) Check that the wires are not coming out from the connector.

(6) Check for dust accumulation on the servo amplifier.

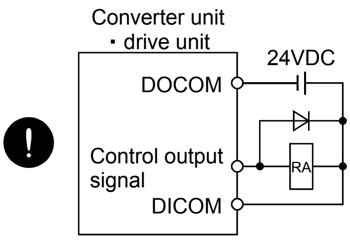
(7) Check for unusual noise generated from the servo amplifier.

13.3 Signals and wiring

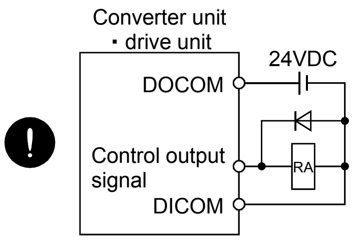
WARNING	
⚠WARNING	・Any person who is involved in wiring should be fully competent to do the work. ・Before wiring, turn off the power and wait for 20 minutes or more until the charge lamp turns off. Then, confirm that the voltage between L＋ and L－ is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the converter unit whether the charge lamp is off or not. ・Ground the converter unit・drive unit and the servo motor securely. ・Do not attempt to wire the converter unit・drive unit and servo motor until they have been installed. Otherwise, it may cause an electric shock. ・The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, it may cause an electric shock.

⚠CAUTION

・Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpectedly, resulting in injury.
・Connect cables to correct terminals to prevent a burst, fault, etc.
・Ensure that polarity (＋, －) is correct. Otherwise, a burst, damage, etc. may occur.
・The surge absorbing diode installed to the DC relay for control output should be fitted in the specified direction. Otherwise, the emergency stop and other protective circuits may not operate.

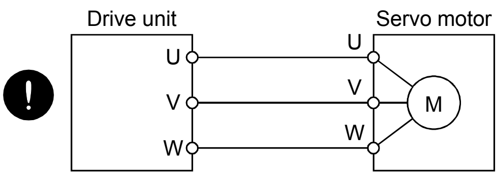


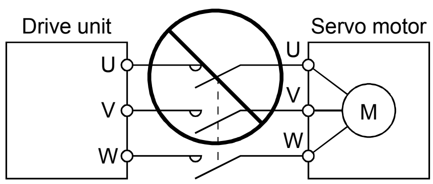
For sink output interface



For source output interface

・Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the converter unit・drive unit.
・Do not install a power capacitor, surge killer or radio noise filter (FR-BIF-(H) option) with the power line of the servo motor.
・When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative resistor, causing a fire.
・Do not modify the equipment.
・Connect the drive unit power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.





POINT

- Explanations on the following item are the same as those for servo amplifiers with 22kW or less. Refer to the section below for details.
  - I/O signal connection example Refer to section 3.2.
  - Signal (device) explanations Refer to section 3.5.
  - Interfaces Refer to section 3.8.
  - Treatment of cable shield external conductor Refer to section 3.9.
  - SSCNETⅢ cable connection Refer to section 3.10.
  - Grounding Refer to section 3.13.
  - Control axis selection Refer to section 3.14.
- The pins with the same signal name are connected in the drive unit.

13.3.1 Magnetic contactor control connector (CNP1)

WARNING	• Always connect the magnetic contactor wiring connector to the converter unit. If the connector is not connected, an electric shock may occur since CNP1-1 and L_{11} are always conducting.

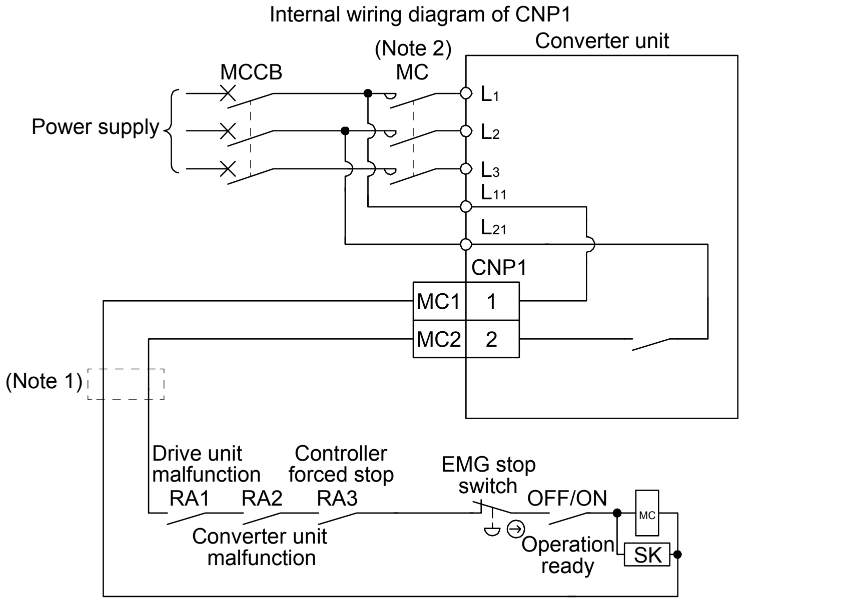
By enabling the control function of the magnetic contactor (parameter No.PA02＝□□□1 (initial value)), main circuit power supply can be shut off automatically when an alarm occurs on the converter unit or the drive unit.

Parameter No.PA02

			1

Used to select the output of the external magnet contactor drive signal.
0: No used
1: Used (initial value)

(1) Enabling control function of magnetic contactor (parameter No.PA02＝□□□1 (initial value))
Connecting the magnetic contactor control connector (CNP1) to the operating coil of the magnetic contactor enables to control the magnetic contactor.



Note 1. Stepdown transformer is required when coil voltage of the magnetic contactor is 200V class, and the converter unit and the drive unit are 400V class.
2. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

When the converter unit receives a start command from the drive unit while the magnetic contactor control connector (CNP1) is connected to the magnetic contactor (refer to section 13.3.2 (1)), CNP1-2 and L_{21} conduct in the converter unit. Then the control circuit power is supplied to turn ON the magnetic contactor and the main circuit power is supplied to the converter unit.
Either when an alarm occurs on the converter unit or the drive unit while the control function of the magnetic contactor is enabled, or when the forced stop 2 (EM2) of the converter unit or the drive unit is turned OFF, the switch between CNP1-2 and L_{21} in the converter unit is disconnected and the main circuit power supply is automatically shut off.
To automatically shut off the main circuit power supply by alarm, enable the control function of the magnetic contactor.

(2) Disabling control function of magnetic contactor (parameter No.PA02＝□□□0)
When not connecting the magnetic contactor control connector (CNP1) to the operating coil of the magnetic contactor, configure the circuit to shut off the main circuit power supply when detecting an alarm since the main circuit power supply is not automatically shut off even when an alarm occurs on the converter unit or the drive unit.

13.3.2 Input power supply circuit

WARNING	
⚠ WARNING	・Insulate the connections of the power supply terminals. Not doing so can cause an electric shock. ・Magnetic contactor wiring connector on the converter unit CNP1. Unattached state may cause an electric shock.

CAUTION	
⚠ CAUTION	・Always, connect the magnetic contactor between the main circuit power supply and L_1, L_2, and L_3 of the converter unit, to configure a circuit that shuts down the power supply on the side of the converter unit power supply. If the magnetic contactor is not connected, a large current keeps flowing and may cause a fire when the converter unit or the drive unit malfunctions. ・Use the malfunction signal to switch power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire. ・Connect the power supply phases (U, V, W) of the servo amplifier and servo motor correctly. Not doing so can cause the servo motor to run abnormally. ・Do not connect a 3-phase 200V power supply or a 3-phase 400V power supply directly to the servo motor. Otherwise, it may cause a malfunction. ・Check the converter unit model, and then input proper voltage to the converter unit power supply. When a value exceeding the upper limit value of the input voltage specification for the converter unit is input, the converter unit and the drive unit will fail.

POINT

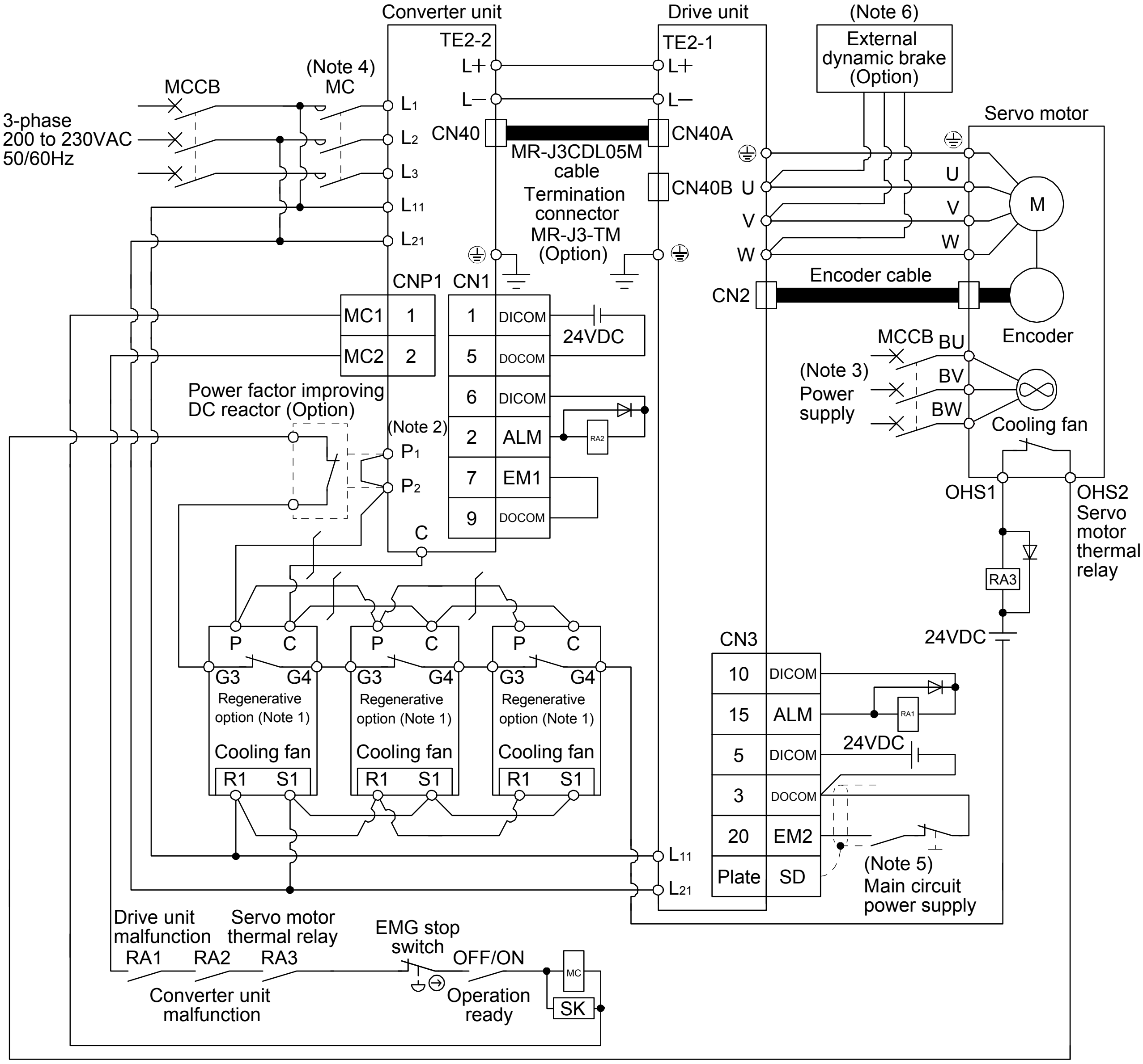
- The signal EM2 of the drive unit is the same as EM1 of the drive unit in torque control mode.
- Magnetic contactor control connector (CNP1) of the converter unit can be made valid or invalid with parameter No.PA02 of the converter unit. Refer to section 13.3.1 and 13.3.6 for details of CNP1 and section 13.5 for the parameter settings.
- When using the external dynamic brake, refer to section 11.6 and 13.9.3.

(1) When magnetic contactor control connector (CNP1) is made valid (factory-set)

POINT

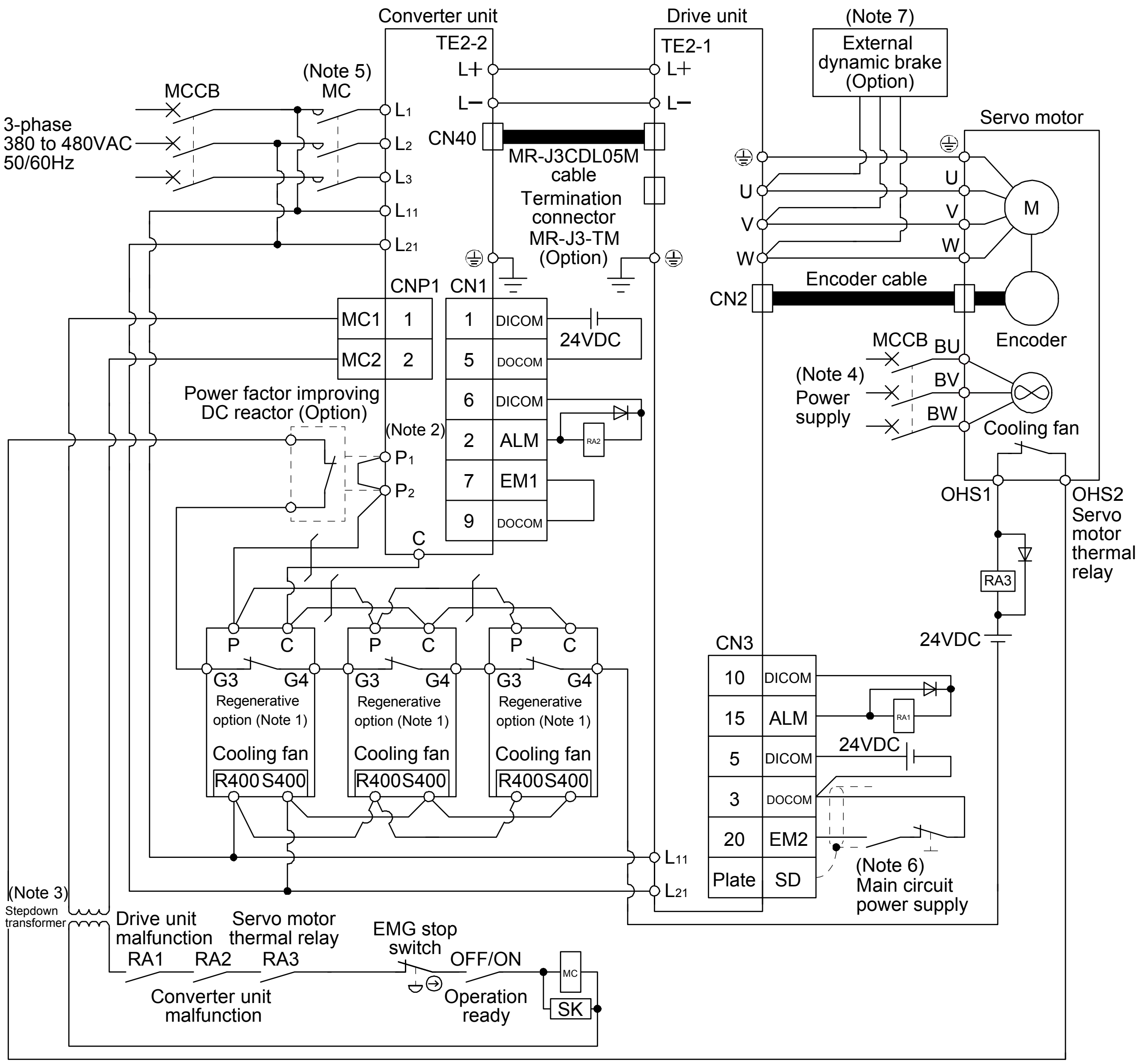
- The converter unit controls the main circuit magnetic contactor.
- Refer to section 13.3.7 (1) for the power circuit timing chart, section 13.3.7 (2) for the alarm occurrence timing chart, section 13.3.7 (3) for the forced stop 2 (EM2) timing chart.
- Always connect a protection coordination cable (MR-J3CDL05M) and a termination connector (MR-J3-TM). When they are not connected properly, the servo-on may not be turned ON.
- For the control circuit power supplies of the converter unit and the drive unit, always turn ON or OFF at the same time.

(a) 200V class (MR-J3-DU30K□S・MR-J3-DU37K□S)



Note 1. For the MR-RB137. For the MR-RB137, three units are used as one set (permissible wattage: 3900W).
2. When using the Power factor improving DC reactor, disconnect the short bar across P_1-P_2.
3. For specifications of cooling fan power supply, refer to section 13.3.8.
4. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
5. Turn off EM2 when the main power circuit power supply is off.
6. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

(b) 400V class (MR-J3-DU30K□S4 to MR-J3-DU55K□S4)



Note 1. For the MR-RB138-4. For the MR-RB138-4, three units are used as one set (permissible wattage: 3900W).

2. When using the Power factor improving DC reactor, disconnect the short bar across P_1-P_2.

3. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.

4. For specifications of cooling fan power supply, refer to section 13.3.8.

5. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

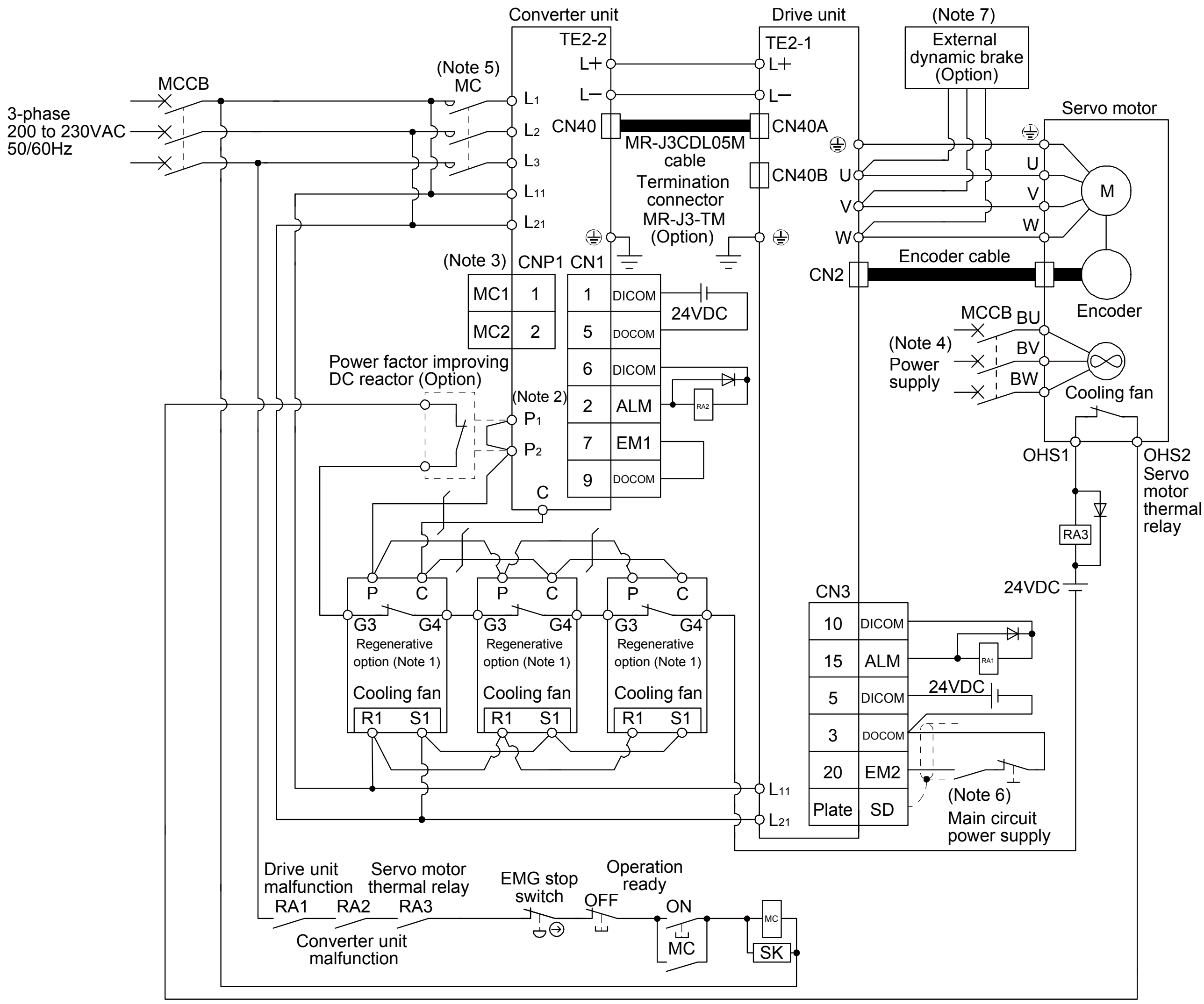
6. Turn off EM2 when the main power circuit power supply is off.

7. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

(2) When magnetic contactor control connector (CNP1) is made invalid

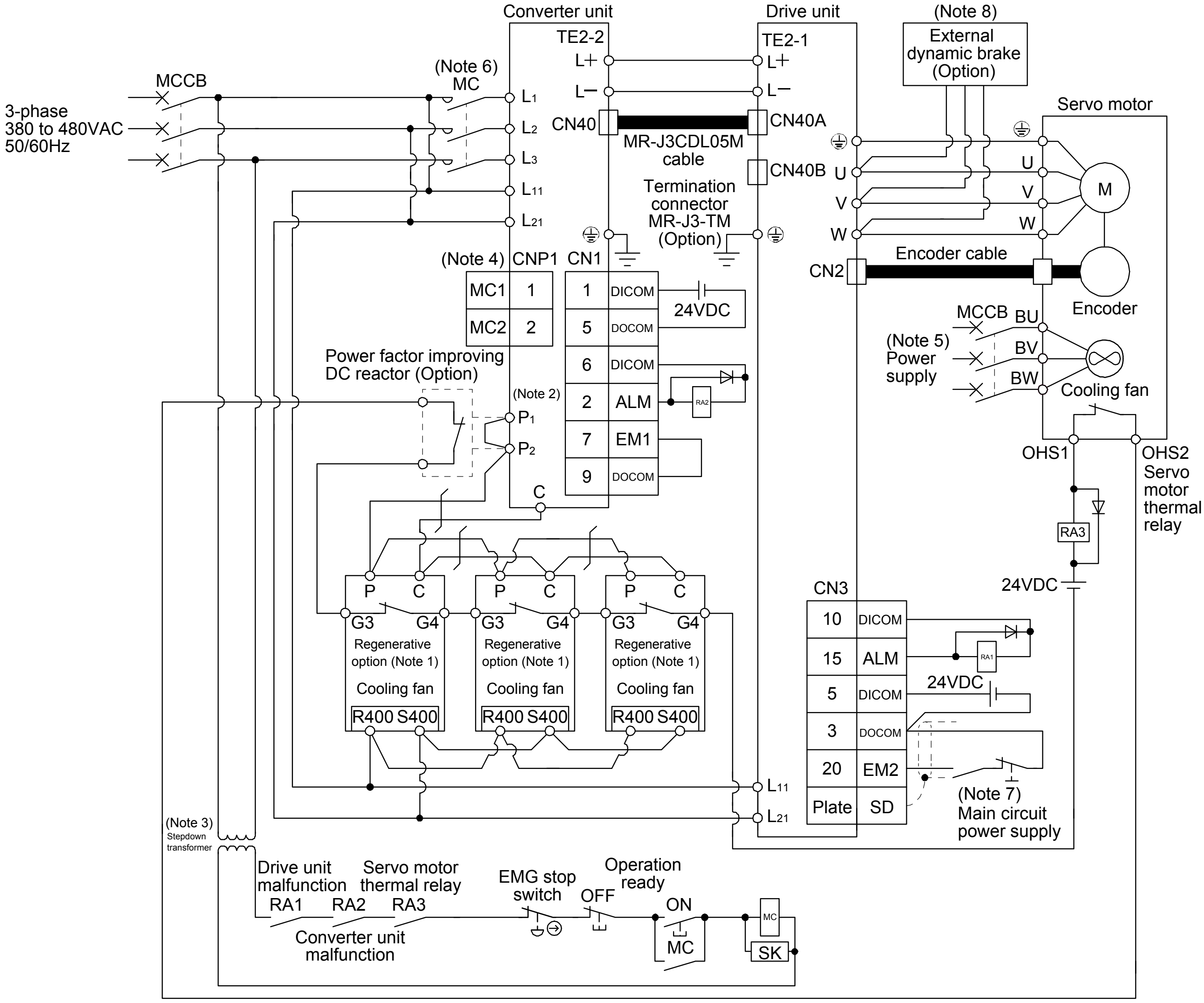
POINT
・When making CNP1 invalid, set "□□00" in parameter No.PA02. (Refer to section 13.5.) ・Always connect a protection coordination cable (MR-J3CDL05M) and a termination connector (MR-J3-TM). When they are not connected properly, the servo-on may not be turned ON. ・For the control circuit power supplies of the converter unit and the drive unit, always turn ON or OFF at the same time.

(a) 200V class (MR-J3-DU30K□S・MR-J3-DU37K□S)



Note 1. For the MR-RB137. For the MR-RB137, three units are used as one set (permissible wattage: 3900W).
2. When using the Power factor improving DC reactor, disconnect the short bar across P_1-P_2.
3. Attach connector for magnetic contactor control (CNP1) on the converter unit. Unattached state may cause an electric shock.
4. For specifications of cooling fan power supply, refer to section 13.3.8.
5. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Turn off EM2 when the main power circuit power supply is off.
7. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

(b) 400V class (MR-J3-DU30K□S4 to MR-J3-DU55K□S4)



Note 1. For the MR-RB138-4. For the MR-RB138-4, three units are used as one set (permissible wattage: 3900W).

2. When using the Power factor improving DC reactor, disconnect the short bar across P_1-P_2.
3. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.
4. Attach connector for magnetic contactor wiring on the converter unit. Unattached state may cause an electric shock.
5. For specifications of cooling fan power supply, refer to section 13.3.8.
6. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
7. Turn off EM2 when the main power circuit power supply is off.
8. Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

13.3.3 Terminal

Refer to section 13.7 for the terminal block arrangement and signal layout.

(1) Converter unit

Connection target (Application)	Abbreviation	(Note) Terminal block	Description	
			MR-J3-CR55K	MR-J3-CR55K4
Main circuit power supply	L_1 ・ L_2 ・ L_3	TE1-1	Connect 3-phase 200 to 230VAC, 50/60Hz to L_1, L_2, L_3.	Connect 3-phase 380 to 480VAC, 50/60Hz to L_1, L_2, L_3.
Control circuit power supply	L_{11} ・ L_{21}	TE3	Connect 1-phase 200 to 230VAC, 50/60Hz.	Connect 1-phase 380 to 480VAC, 50/60Hz.
Power factor improving DC reactor	P_1 ・ P_2	TE1-2	When using the power factor improving DC reactor, connect it after removing the connection plate across P_1-P_2.	
Regenerative brake	P_2 ・ C	TE1-2	Connect to the P_2 and C terminals of the regenerative option.	
DC link	L＋ ・ L−	TE2-2	Connect to the L＋, L− terminals of the drive unit. Use the connection bar, which is supplied with the drive unit, to connect.	
Grounding	⏚	PE	Connect this terminal to the protective earth (PE) terminals of the servo motor and cabinet for grounding.	

Note. The permissible tension applied to any of the terminal blocks TE1-1, TE1-2, TE2-2 is 350 [N].

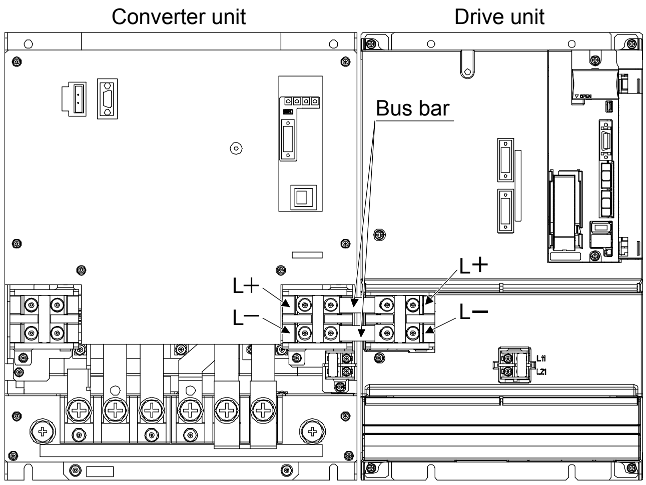
(2) Drive unit

Connection target (Application)	Abbreviation	(Note) Terminal block	Description	
			MR-J3-DU30K□S ・ MR-J3-DU37K□S	MR-J3-DU30K□S4 to MR-J3-DU55K□S4
Control circuit power supply	L_{11} ・ L_{21}	TE3	Connect 1-phase 200 to 230VAC, 50/60Hz.	Connect 1-phase 380 to 480VAC, 50/60Hz.
L＋L− power supply input	L＋ ・ L−	TE2-1	Connect to the L＋ and L− terminals of the converter unit. Use the connection bar, which is supplied with the drive unit, to connect.	
Servo motor power	U ・ V ・ W	TE1	Connect to the servo motor power terminals (U, V, W). Connect the drive unit power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.	
Grounding	⏚	PE	Connect this terminal to the protective earth (PE) terminals of the servo motor and cabinet for grounding.	

Note. The permissible tension applied to any of the terminal blocks TE1, TE2-1 is 350 [N].

13.3.4 How to use the connection bars

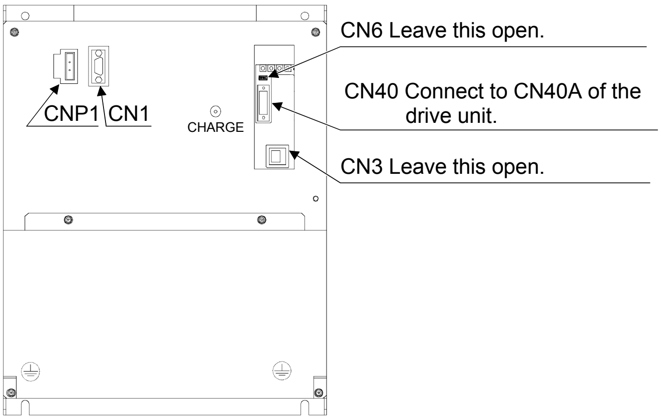
Make sure to use the supplied bus bar and connect the L+ and L− of the drive unit to those of the converter unit as shown below. Never use bus bar other than the ones supplied with the drive unit. Both units are shown without the front covers.



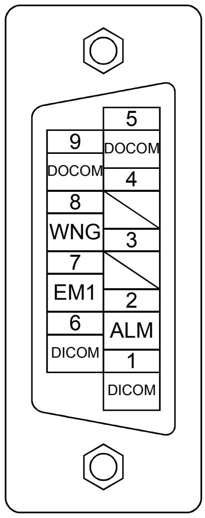
13.3.5 Connectors and signal arrangements

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section.

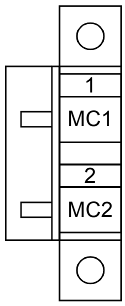
(1) Converter unit



CN1 (Digital I/O connector)
Model: 17JE-23090-02 (D8A) K11-CG (D-sub 9 pin or equivalent)
(DDK)

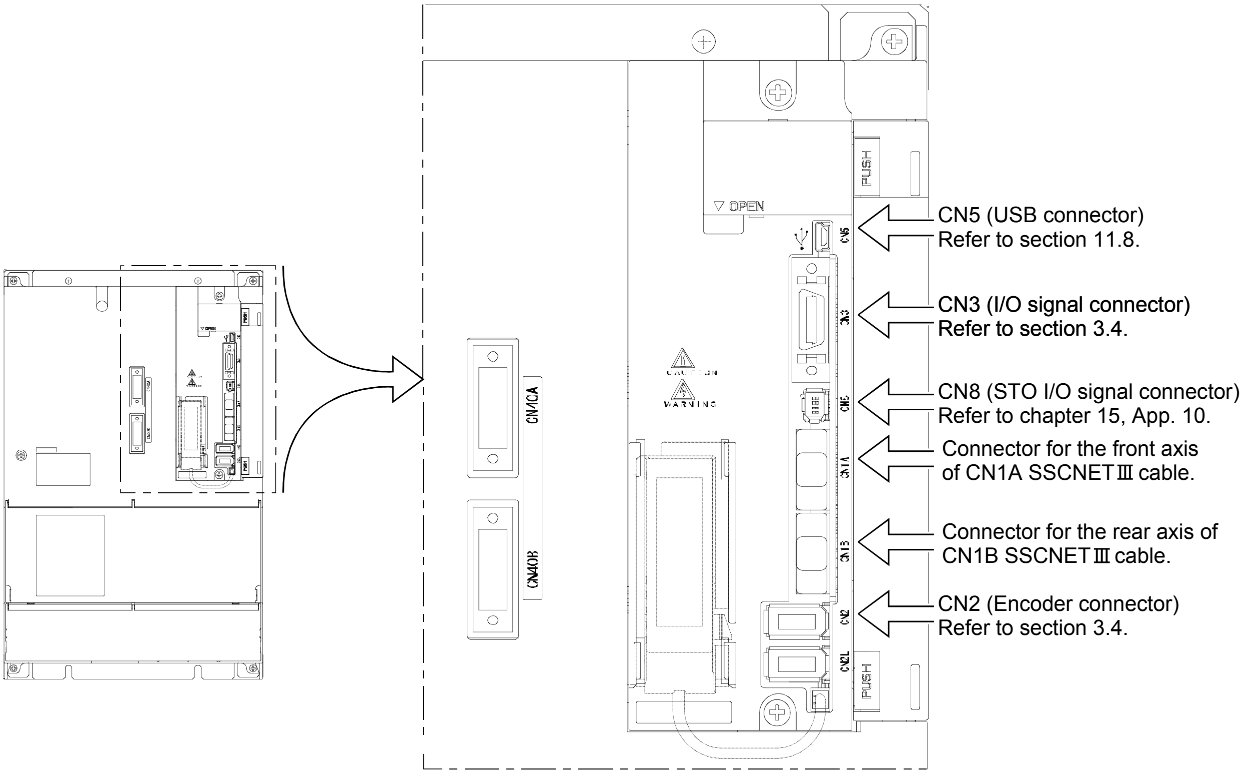


CNP1 (Magnetic contactor wiring connector)
Model: GFKC 2.5/2-STF-7.62
(Phoenix Contact)



(2) Drive unit

The drive unit front view shown is that of the MR-J3-DU30K□S4, MR-J3-DU37K□S4 or less. Refer to section 13.7 Outline Drawings for the appearances and connector layouts of the MR-J3-DU30K□S, MR-J3-DU37K□S, MR-J3-DU45K□S4, MR-J3-DU55K□S4.



The frames of the CN2 and CN3 connectors are connected to the PE (earth) terminal in the amplifier.

13.3.6 Converter unit signal (device) explanations

POINT

- Explanations on the drive unit signals are the same as those for servo amplifiers with 22kW or less. Refer to section 3.5.

(1) Signals

For the I/O interfaces (symbols in I/O column in the table), refer to (b) of this section.

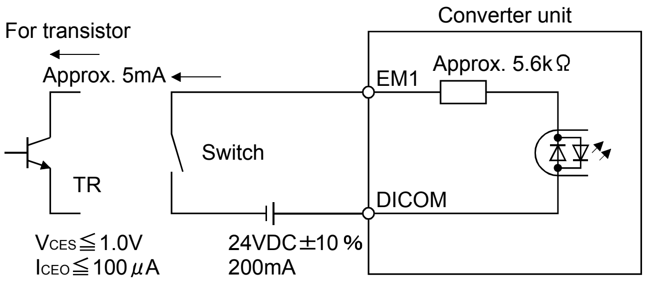
Signal name	Pin code	Pin No.	Function/Application	I/O division
Digital I/F power supply input	DICOM	CN1-1 CN1-6	Used to input 24VDC (24VDC±10% 200mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For sink interface, connect ⊕ of 24VDC external power supply. For source interface, connect ⊖ of 24VDC external power supply.	
Forced stop	EM1	CN1-7	When using MR-J3-CR55K(4) in combination with MR-J3-DU□S(4), EM1 is not used. Connect between EM1 and DOCOM externally. Turn EM1 off to bring the motor to a forced stop state, in which the magnetic connector is turned off and the servo-off signal is output to the drive unit. Turn EM1 on in the forced stop state to reset that state.	DI
Malfunction	ALM	CN1-2	ALM turns off when power is switched off or the protective circuit is activated. Without alarm occurring, ALM turns on within about 1.5s after power-on.	DO
Warning	WNG	CN1-8	When warning has occurred, WNG turns on.	DO
Digital I/F common	DOCOM	CN1-5 CN1-9	Common terminal for the ALM and WNG output signals of the converter unit. Separated from LG. Pins are connected internally. For sink interface, connect ⊖ of 24VDC external power supply. For source interface, connect ⊕ of 24VDC external power supply.	
Magnetic contactor drive output	MC1	CNP1-1	Connect to the operation coil of the magnetic contactor. Always supplies the control circuit power since it is conducted with L_{11} in the converter unit. ⚠WARNING · Magnetic contactor wiring connector on the converter unit. Disconnected state may cause an electric shock.	
	MC2	CNP1-2 (Note)	Connect to the operation coil of the magnetic contactor. When the converter unit receives a start command from the drive unit, it is conducted with L_{21} inside, the control circuit power is supplied, and then the magnetic contactor is turned ON. Change parameter No.PA02 setting to "□□□0" when controlling without magnetic contactor control connector (CNP1). (Refer to section 13.3.1.)	

(2) I/O interfaces

(a) Digital input interface (DI)

Give a signal with a relay or open collector transistor.

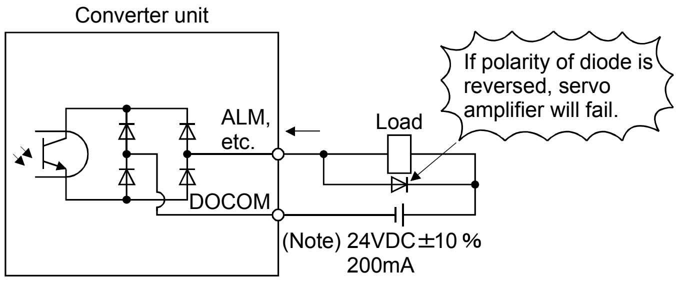
The following is a connection diagram for sink input. Refer to section 3.8.3 for source input.



(b) Digital output interface (DO)

A lamp, relay or photocoupler can be driven. Install a diode for an inductive load, or install an inrush current suppressing resistor for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the servo amplifier.

The following is a connection diagram for sink output. Refer to section 3.8.3 for source output.



Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

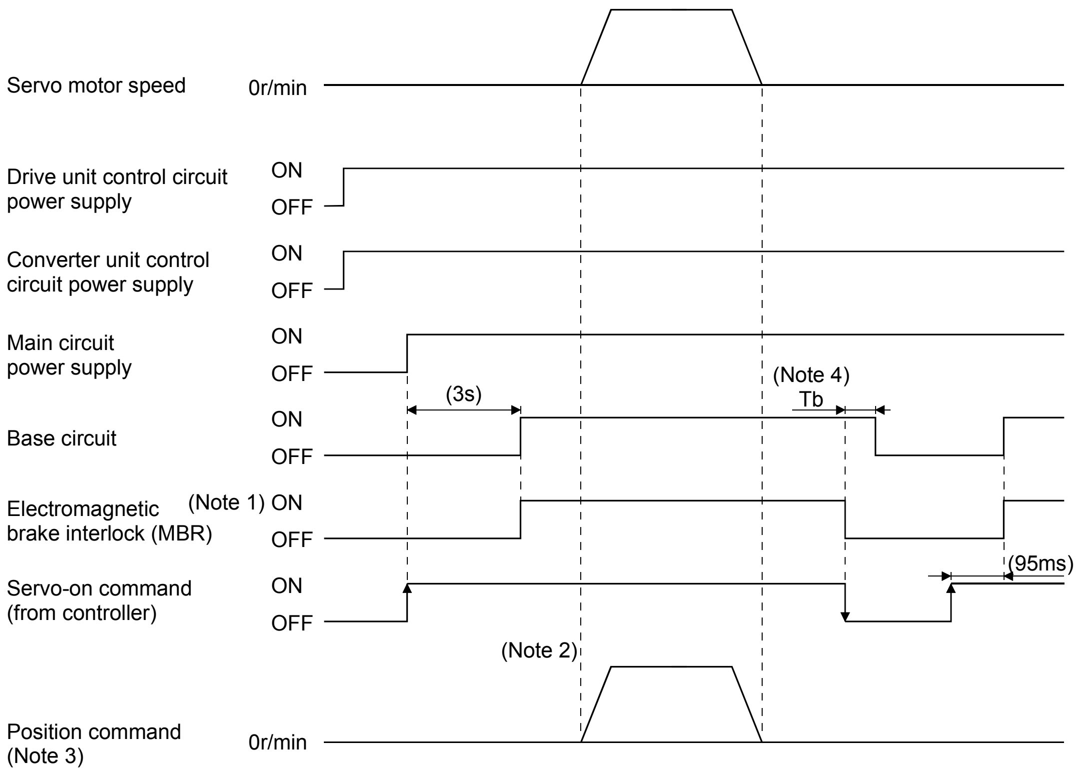
13.3.7 Timing chart

(1) Power circuit timing chart
Power-on procedure

(a) Always wire the power supply as shown in above section 13.3.2 using the magnetic contactor with the main circuit power supply (3-phase: L_1, L_2, L_3). Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.

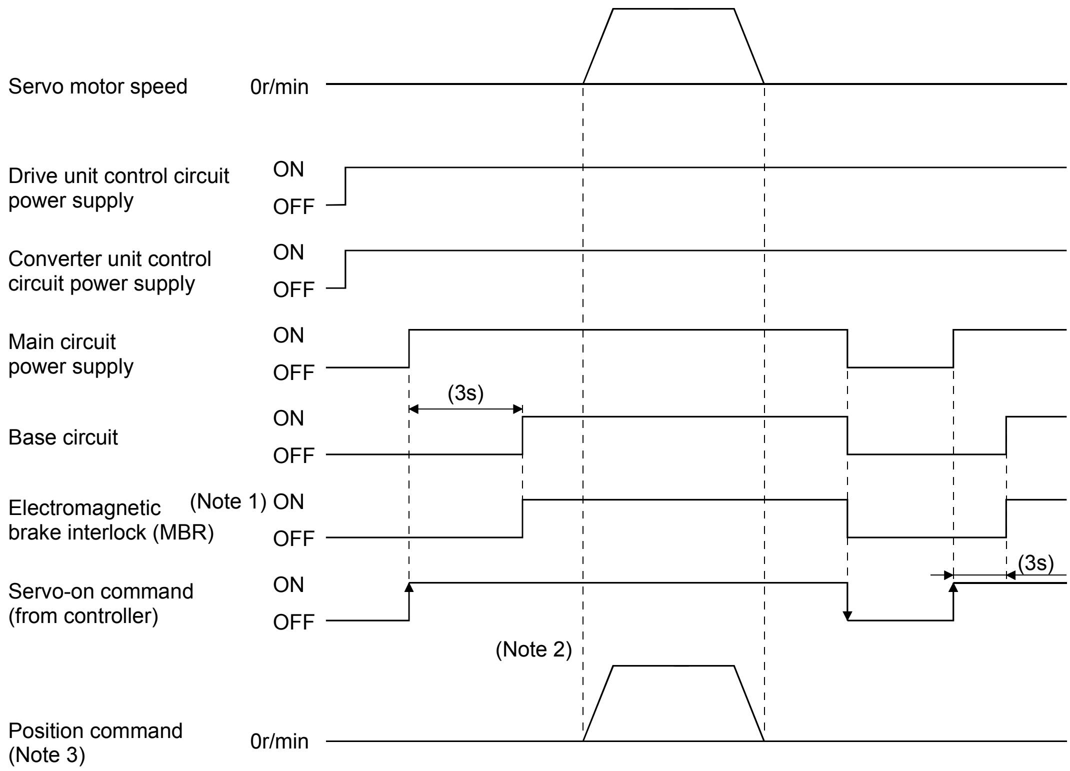
(b) Switch on the control circuit power supply L_{11}, L_{21} simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the drive unit will operate properly.

1) When control function of magnetic contactor is enabled and the status remains at ready-on
The main circuit power is not shut off with servo-off.



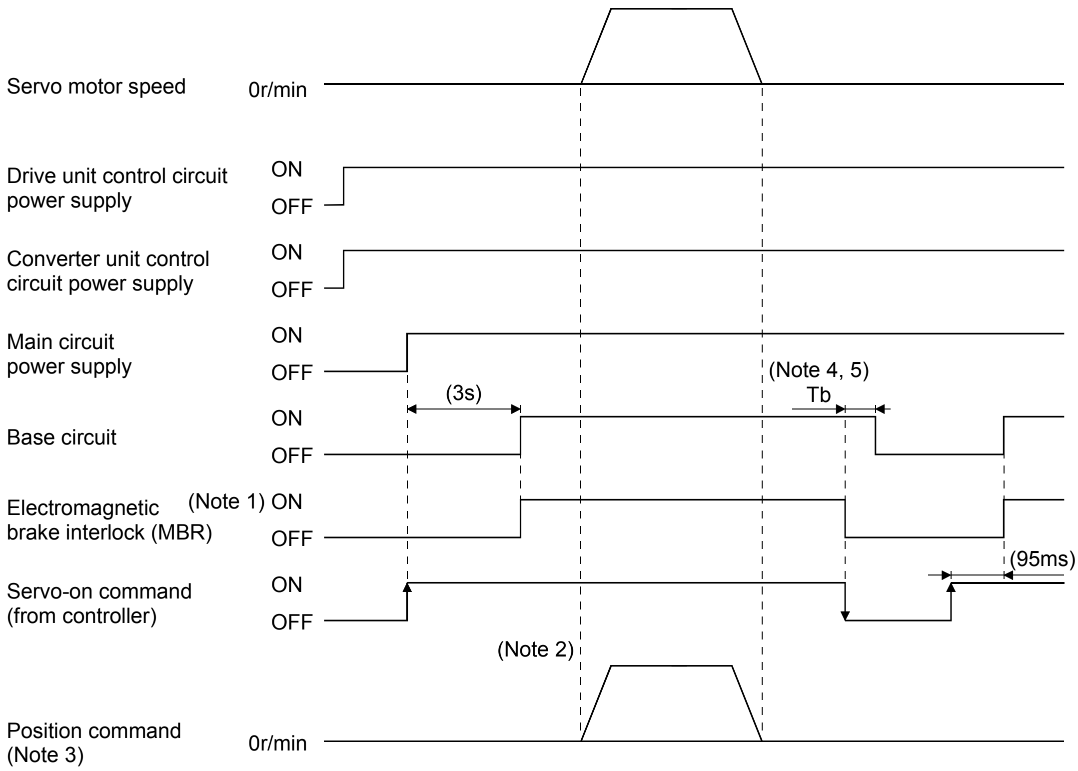
Note 1. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).
ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated
2. Give a position command after the external electromagnetic brake is released.
3. In position control mode
4. “Tb” refers to a delay time when the electromagnetic brake interlock (MBR) is turned off until when the base circuit is shut off at servo-off. Set Tb using parameter No.PC02.

2) When control function of magnetic contactor is enabled and the status returns to ready-off
The magnetic contactor of the converter unit is turned off with servo-off, and the main circuit magnetic contactor is shut off.



Note 1. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).
ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated
2. Give a position command after the external electromagnetic brake is released.
3. In position control mode

3) When controlling magnetic contactor by external sequence
When an alarm occurs, turn OFF the magnetic contactor by the external sequence and shut off the main circuit power supply.



Note 1. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).
ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated
2. Give a position command after the external electromagnetic brake is released.
3. In position control mode
4. “Tb” refers to a delay time when the electromagnetic brake interlock (MBR) is turned off until when the base circuit is shut off at servo-off. Set Tb using parameter No.PC02.
5. When turning OFF servo amplifiers, the base circuit remains ready-on state. When the status is ready-off, the base circuit and the servo-on command turns OFF at the same time. (Tb＝0)

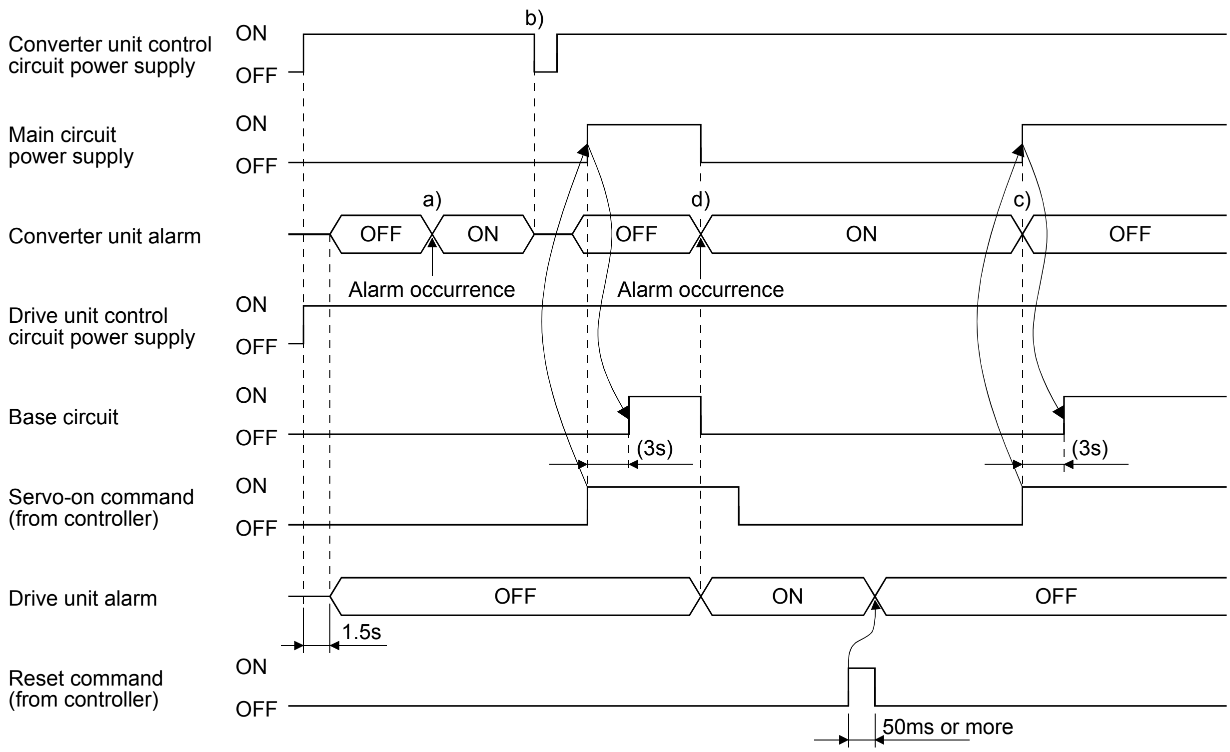
(2) Alarm occurrence timing chart

⚠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. ・As soon as an alarm occurs, make the servo-off status and interrupt the main circuit power.

(a) When control function of magnetic contactor is enabled

1) Converter unit

When an alarm occurs in the converter unit, the magnetic contactor is turned off and the main circuit magnetic contactor is shut off. The drive unit in operation stops. To deactivate the alarm, turn the control circuit power off, then on or request the operation from the driver unit. However, the alarm cannot be deactivated unless its cause is removed.

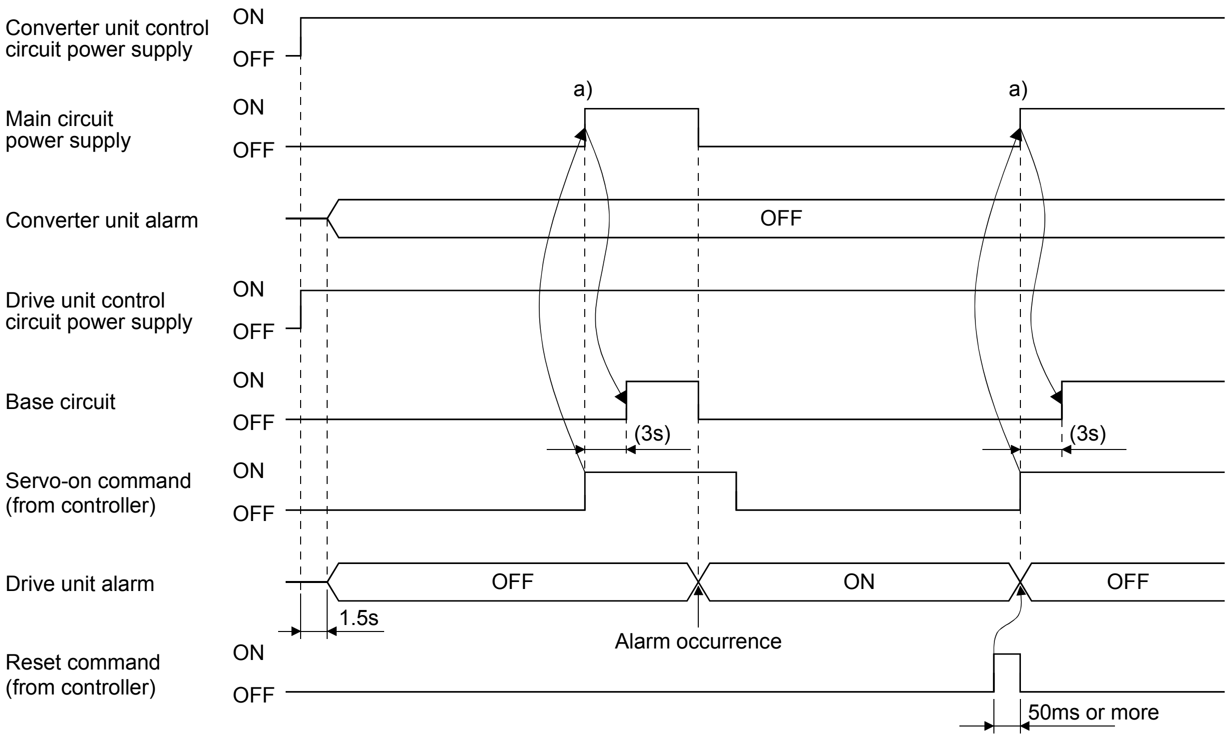


a) in Figure Even if an alarm occurs in the converter when the drive unit is at servo-off, the drive unit does not detect the alarm.

b) c) in Figure To deactivate the alarm of the converter unit, turn the power of the converter unit off, and then on (b)) or make the drive unit servo-on (c)). (Refer to section 13.6.1.)

d) in Figure If an alarm occurs in the converter when the drive unit is at servo-on, the alarm also occurs in the drive unit and the drive unit becomes servo-off.

2) Drive unit
When an alarm occurs on the drive unit, the base circuit is shut off and the servo motor coasts. When using an external dynamic brake (option), the external dynamic brake is activated to stop the servo motor. To deactivate the alarm, power the control circuit off, then on, turn the reset (RES) on or CPU reset command. However, the alarm cannot be deactivated unless its cause is removed.

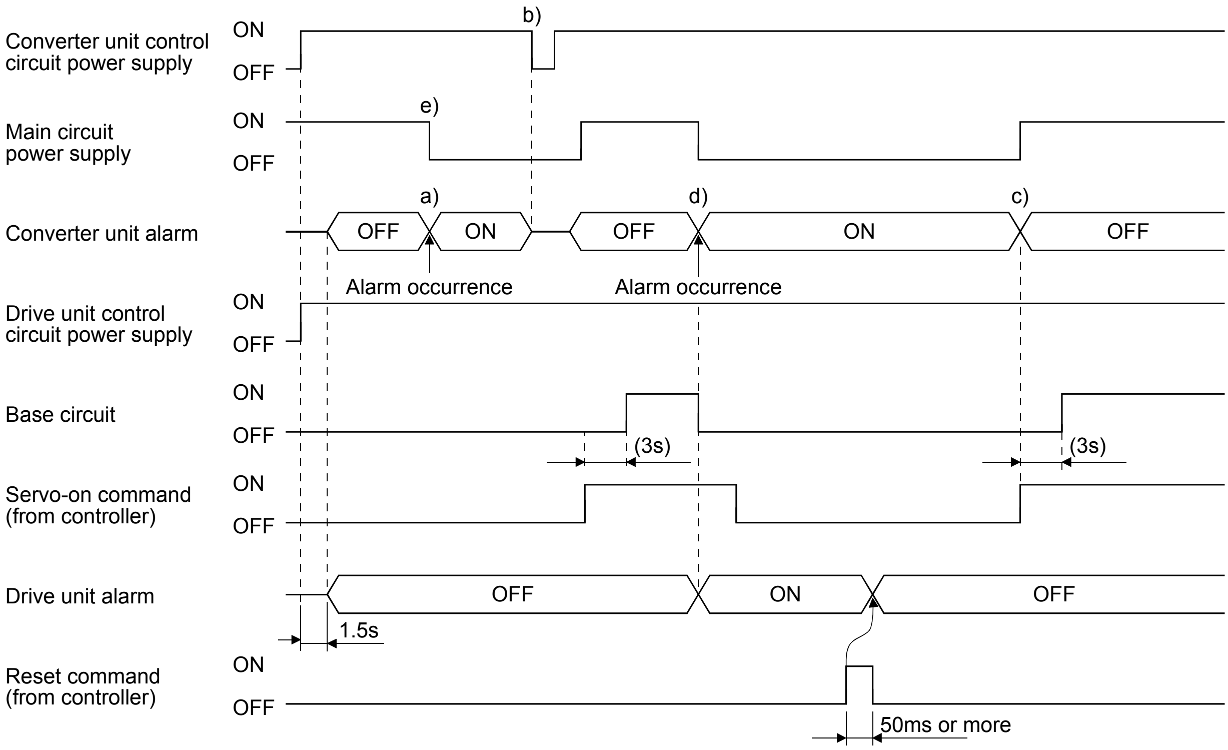


a) in Figure After completing to start the drive unit, the main circuit power is supplied while the drive unit and the converter unit have no alarms.

(b) When controlling magnetic contactor by external sequence

1) Converter unit

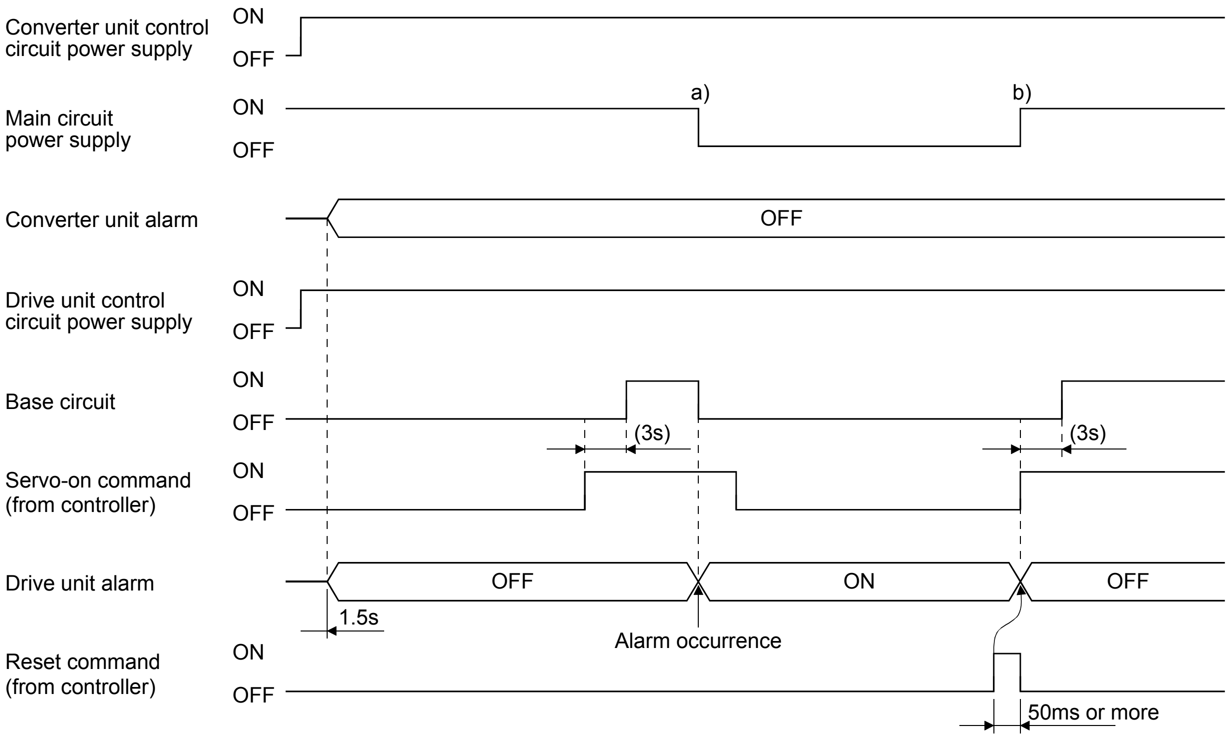
When an alarm occurs on the converter unit, the servo-on turns OFF; however, the main circuit power supply is not shut off. Therefore, shut off the main circuit power supply by the external sequence. After cancelling the alarm on the converter unit (when an alarm is also occurring on the drive unit after cancelling the alarm on the drive unit as well), turning ON the reset command enables to operate again.



a) in Figure	Even if an alarm occurs in the converter when the drive unit is at servo-off, the drive unit does not detect the alarm.
b) c) in Figure	To deactivate the alarm of the converter unit, turn the power of the converter unit off, and then on (b)) or make the drive unit servo-on (c)). (Refer to section 13.6.1.)
d) in Figure	If an alarm occurs in the converter unit when the drive unit is at servo-on, the alarm also occurs in the drive unit and the drive unit becomes servo-off.
e) in Figure	Shut off the main circuit power supply by the external sequence as soon as an alarm occurs.

2) Drive unit

When an alarm occurs in the drive unit, the drive unit turns into the servo-off but the main circuit power supply is not shut off. Therefore, shut off the main circuit power supply using the external sequence. Operation can be resumed by turning the reset (RES) ON after the alarm is deactivated in the drive unit.



a) in Figure — When an alarm occurs on the drive unit, shut off the main circuit power supply by the external sequence.

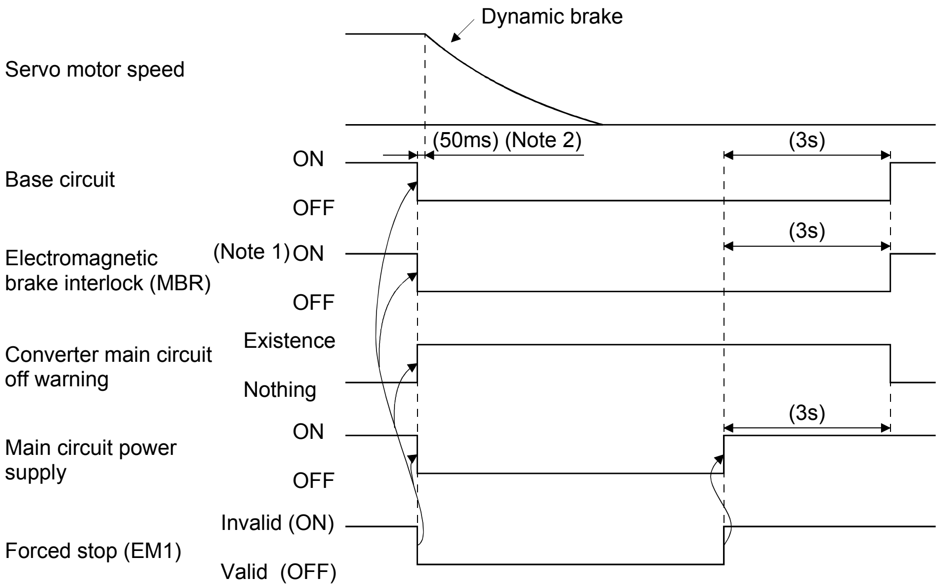
b) in Figure — Turn ON the main circuit power supply while an alarm of the drive unit is cancelled.

(3) Forced stop (EM1) ON/OFF timing chart

(a) Forced stop in the converter unit

1) When magnetic contactor control connector (CNP1) is valid

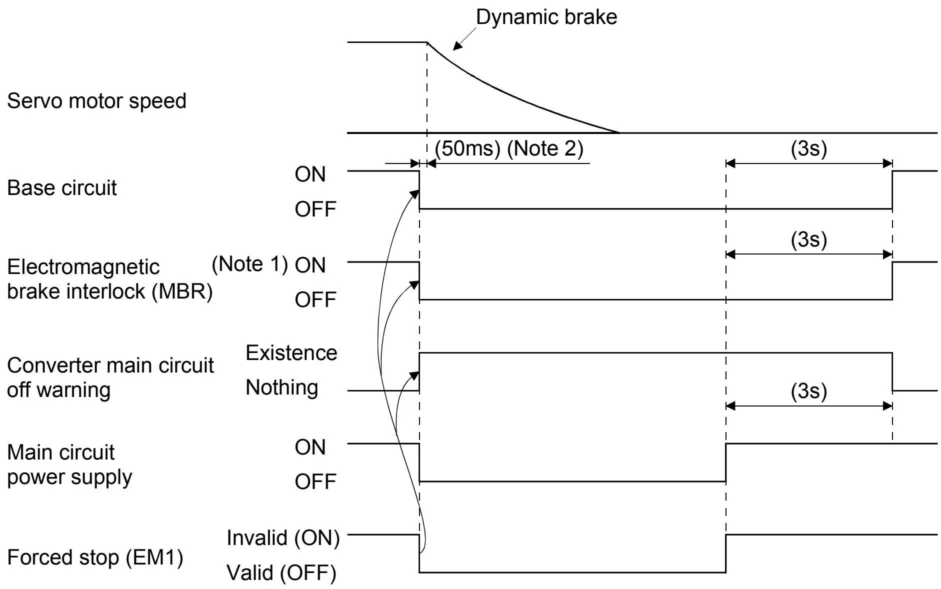
When the forced stop (EM1) is made valid in the converter unit, the magnetic contactor is turned off and the main circuit power supply is shut off. The drive unit in operation stops, and Main circuit off warning (E9) appears. When the forced stop (EM1) is deactivated in the converter unit, the magnetic contactor is turned on, the main circuit power is supplied, and then the drive unit automatically resumes the operation.



Note 1. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).
ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated

2. There is delay caused by magnetic contactor built into the external dynamic brake (about 50ms) and delay caused by the external relay.

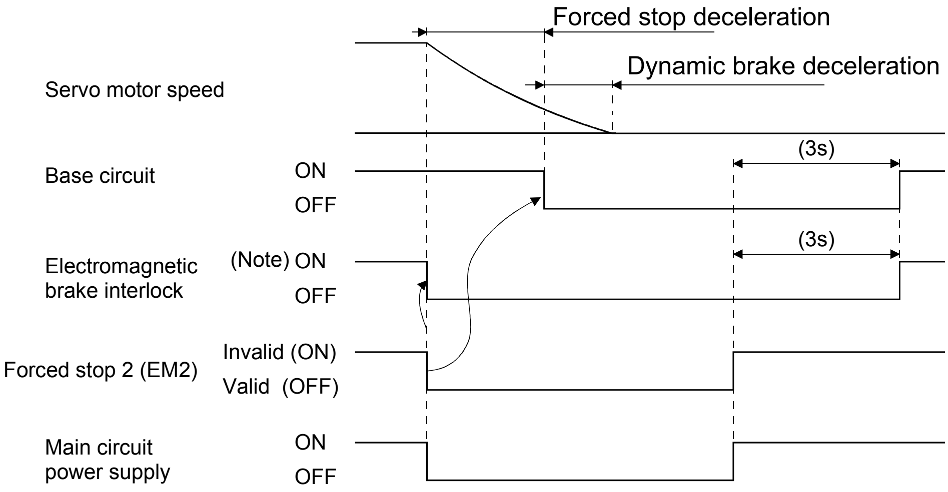
2) When magnetic contactor control connector (CNP1) is invalid (when turning off magnetic contactor by the external sequence)
When the converter unit forced stop (EM1) is valid, the base circuit of the drive unit that is in operation shuts off, and the main circuit off warning (E9) is displayed to the drive unit.
When the forced stop (EM1) of the converter unit is deactivated, the drive unit automatically restarts operation.



Note 1. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).
ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated
2. There is delay caused by magnetic contactor built into the external dynamic brake (about 50ms) and delay caused by the external relay.

(b) Forced stop in the drive unit

When the forced stop 2 (EM2) is made valid in the drive unit, the drive unit in operation stops, and then forced stop occurs.

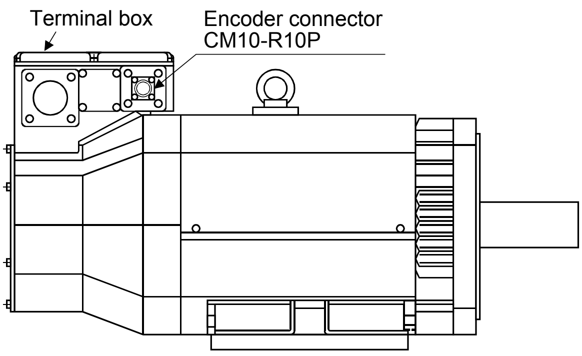


Note. When setting up an electromagnetic brake at customer's side, make up a sequence which will operate the electromagnetic brake as follow using the electromagnetic brake interlock (MBR).

ON: Electromagnetic brake is not activated.

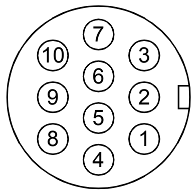
OFF: Electromagnetic brake is activated

13.3.8 Servo motor-side details



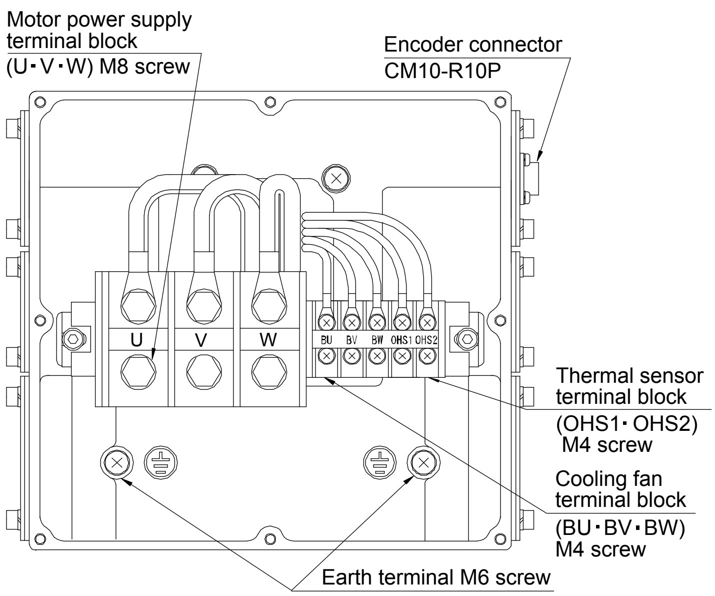
Encoder connector signal arrangement

CM10-R10P



Terminal No.	Signal
1	MR
2	MRR
3	
4	BAT
5	LG
6	
7	
8	P5
9	
10	SHD

	HA-LP30K1M4 HA-LP30K24 HA-LP37K24	HA-LP30K1 HA-LP37K1 HA-LP30K1M HA-LP37K1M HA-LP30K2 HA-LP37K2 HA-LP25K14 HA-LP30K14 HA-LP37K14 HA-LP37K1M4 HA-LP45K1M4 HA-LP50K1M4 HA-LP45K24 HA-LP55K24
Motor power supply terminal block screw size	M8	M10
Earth screw size	M6	M6



Terminal block signal arrangement

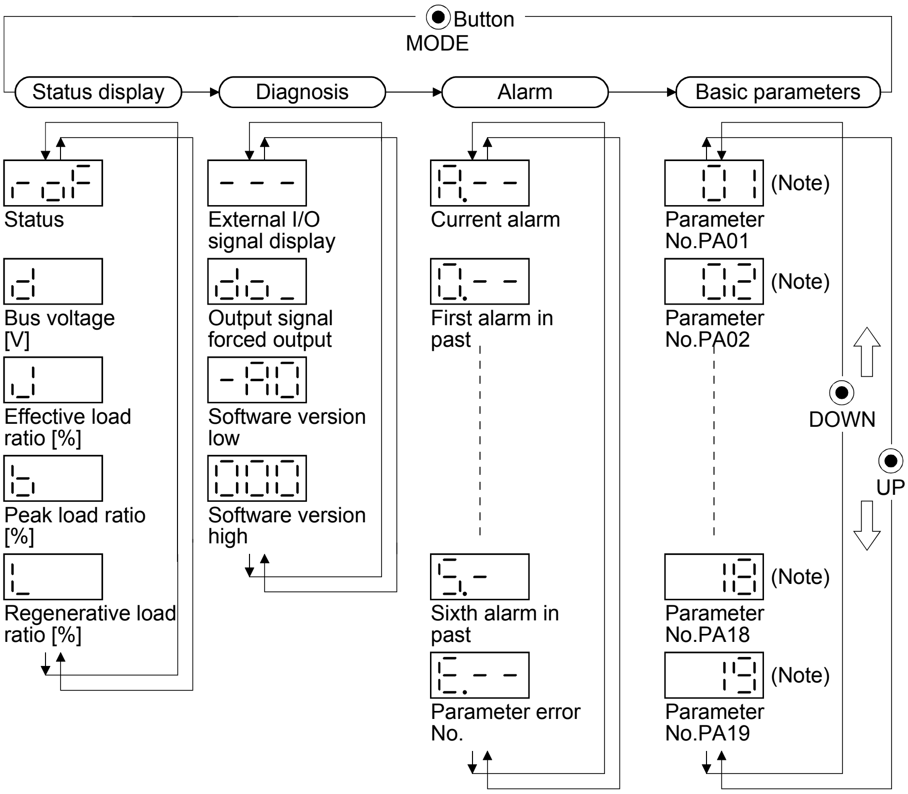
U	V	W	BU	BV	BW	OHS1	OHS2

<table>
<tr><th>Signal name</th><th>Abbreviation</th><th>Description</th></tr>
<tr><td>Servo motor power supply</td><td>U・V・W</td><td>Connect to the motor power terminals (U, V, W) of the drive unit. Connect the drive unit power supply output (U, V, and W) to the servo motor power supply input (U, V, and W) directly. Do not let a magnetic contactor, etc. intervene. Otherwise, it may cause a malfunction.</td></tr>
<tr><td>Cooling fan</td><td>BU・BV・BW</td><td>Supply power which satisfies the following specifications.
<table>
<tr><th>Servo motor</th><th>Voltage division</th><th>Voltage/ frequency</th><th>Power consumption [W]</th><th>Rated current [A]</th></tr>
<tr><td>HA-LP30K1M, 30K2, 37K2</td><td rowspan="2">200V class</td><td rowspan="2">3-phase 200 to 230VAC 50Hz/60Hz</td><td>65 (50Hz)
85 (60Hz)</td><td>0.20 (50Hz)
0.22 (60Hz)</td></tr>
<tr><td>HA-LP30K1, 37K1, 37K1M</td><td>120 (50Hz)
175 (60Hz)</td><td>0.65 (50Hz)
0.80 (60Hz)</td></tr>
<tr><td>HA-LP30K1M4, 30K24, 37K24</td><td rowspan="2">400V class</td><td rowspan="2">3-phase 380 to 460VAC 50Hz
3-phase 380 to 480VAC 60Hz</td><td>65 (50Hz)
85 (60Hz)</td><td>0.12 (50Hz)
0.14 (60Hz)</td></tr>
<tr><td>HA-LP30K14, 37K14, 37K1M4, 45K1M4, 50K1M4, 45K24, 55K24</td><td>110 (50Hz)
150 (60Hz)</td><td>0.20 (50Hz)
0.22 (60Hz)</td></tr>
</table>
</td></tr>
<tr><td>Motor thermal relay</td><td>OHS1・OHS2</td><td>OHS1-OHS2 are opened when heat is generated to an abnormal temperature.
Maximum rating: 125V AC/DC 3A or 250V AC/DC 2A
Minimum rating: 6V AC/DC 0.15A</td></tr>
<tr><td>Earth terminal</td><td>⏚</td><td>For grounding, connect to the earth of the cabinet via the earth terminal of the drive unit.</td></tr>
</table>

13.4 Display section and operation section of the converter unit

13.4.1 Display flowchart

Use the display (3-dight, 7-segment LED) on the front panel of the converter unit for status display, parameter setting, etc. Set the parameters before operation, diagnose an alarm, confirm external sequences, and/or confirm the operation status.
Press the MODE, UP or DOWN button once to move the next screen.



Note. When parameter is selected, parameter group and parameter No. are displayed alternately.
Refer to section 13.4.5 for details.

13.4.2 Status display mode

The servo status during operation is shown on the 3-digit, 7-segment LED display. Press the "UP" or "DOWN" button to change display data as desired.
When the required data is selected, the corresponding symbol is displayed. Press the "SET" button to display that data.
The converter unit display section shows four items of data such as the effective load ratio.

(1) Display examples
The following table shows the display examples.

Item	Status	Display
Status	Ready-off	roF
	Ready-on	ron
Bus voltage	300 [V]	300
Effective load ratio	67 [%]	67
Peak load ratio	95 [%]	95
Regenerative load ratio	90 [%]	90

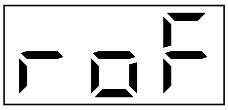
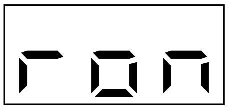
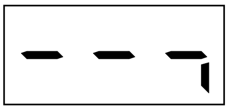
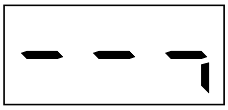
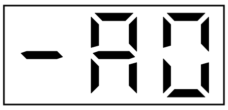
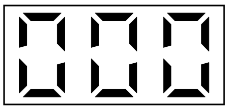
(2) Status display list
The following table lists the converter unit statuses that may be displayed.

Status display		Symbol	Unit	Description	Indication range
Status	Ready-off			The ready-off is displayed during initialization or alarm occurrence, in the forced stop status, or when the bus voltage is not established.	roF
	Ready-on			The ready-on is displayed when the servo was switched on after completion of initialization and the servo amplifier is ready to operate.	ron
Bus voltage		d	V	The converter unit voltage is displayed.	0 to 999
Effective load ratio		J	%	Continuous effective load torque is displayed. (Note) The effective value in the past 15 seconds is displayed relative to the rated current of 100%.	0 to 300
Peak load ratio		b	%	The peak output is displayed. (Note) The peak value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Regenerative load ratio		L	%	The percentage of regenerative power to the permissible regenerative value is displayed.	0 to 300

Note. Output = converter unit bus voltage × output current

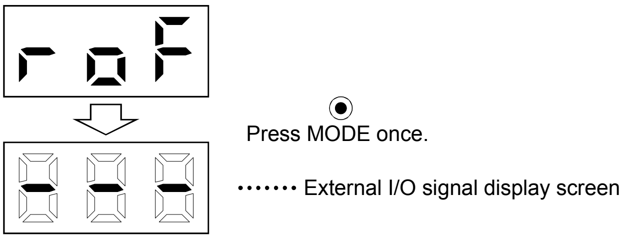
13.4.3 Diagnostic mode

(1) Diagnostic list

Name	Display	Unit
Sequence		Not ready. ・Initializing. ・An alarm occurred. ・External forced stop status. ・Bus voltage is not established.
		Ready Indicates that the servo was switched on after completion of initialization and the drive unit is ready to operate.
External I/O signal display		Indicates the ON/OFF status of external I/O signal. Lit : ON Extinguished: OFF For details, refer to (2) of this section.
Output signal forced output		Allows external I/O signal to be switched on/off forcibly. For details, refer to (3) of this section.
Software version low		Indicates the version of the software.
Software version high		Indicates the system number of the software.

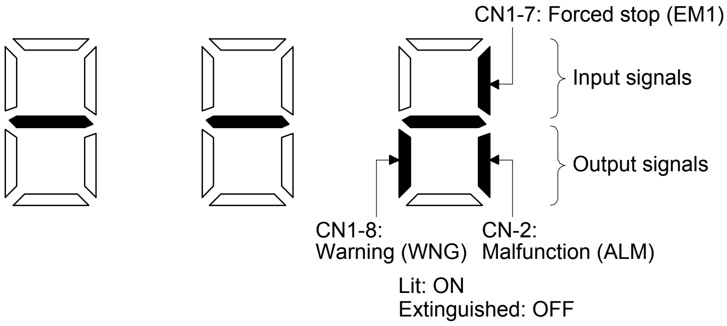
(2) External I/O signal display
The ON/OFF states of the digital I/O signals connected to the converter unit can be confirmed.

(a) Operation
Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



(b) Display definition

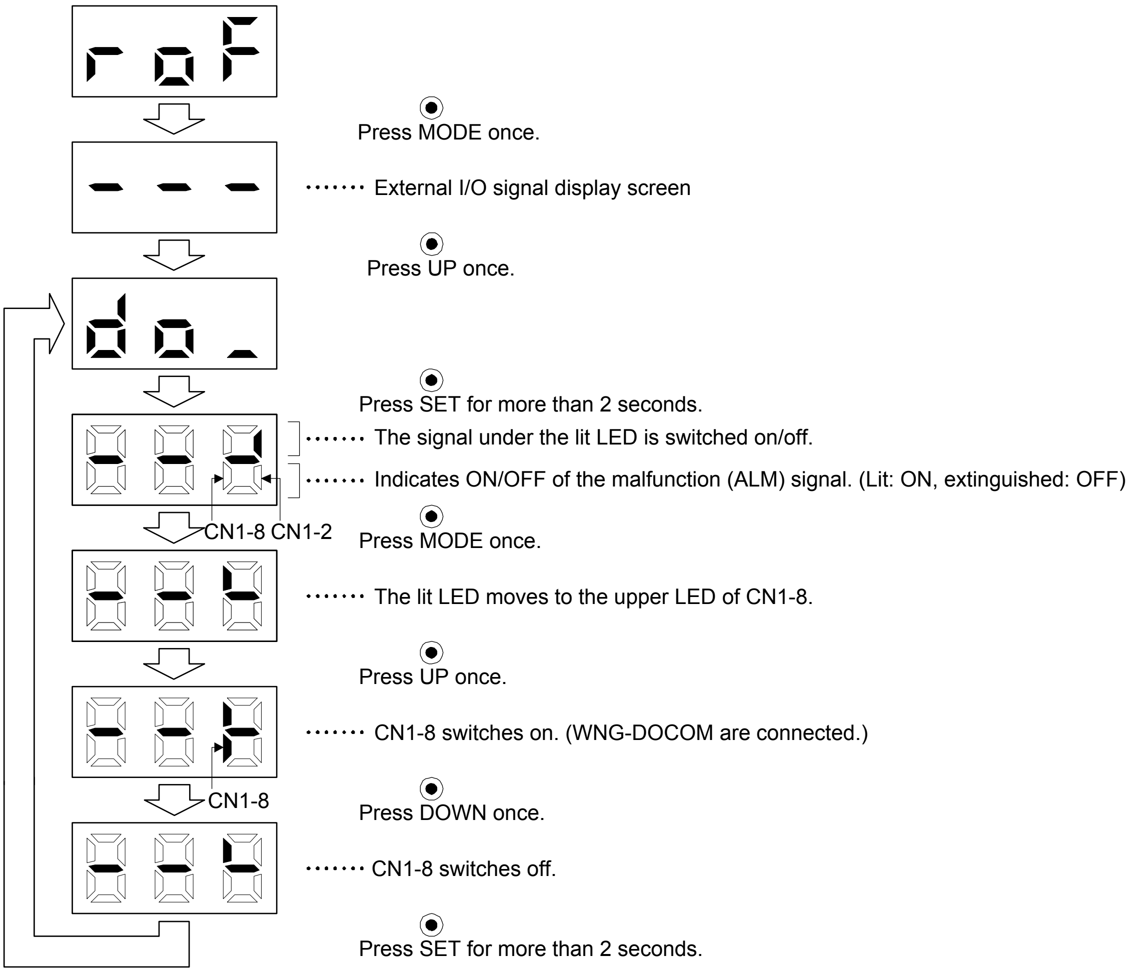
The LED segment corresponding to the pin is lit to indicate ON, and is extinguished to indicate OFF. The 7-segment LED segments and CN1 connector pins correspond as shown below.



(3) Output signal forced output

You can force the output signal to be switched on/off, independently of the converter status. This function is used for wiring check of output signal. Call the display screen shown after power-on.

When turning CN1-8 on and off



13.4.4 Alarm mode

The current alarm, parameter error and point table error are displayed.
The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error.
Display example are shown below.

Name	Display	Description
Current alarm	A. - -	Indicates on occurrence of an alarm.
	A.33	Indicates that overvoltage (A.33) occurred. Flickers at alarm occurrence.
Alarm history	0.50	Indicates that the last alarm is overload (A.50).
	1.33	Indicates that the second alarm in the past is overvoltage (A.33).
	2. 10	Indicates that the third alarm in the past is undervoltage (A.10).
	3. 10	Indicates that the fourth alarm in the past is undervoltage (A.10).
	4. 10	Indicates that the fifth alarm in the past is undervoltage (A.10).
	5.50	Indicates that the sixth alarm in the past is overload (A.50).
Parameter error No.	E. - -	Indicates no occurrence of parameter error (A.37).
	E.PA Displayed alternately E.0 1	Indicates that the data of parameter No.PA01 is faulty.

Functions at occurrence of an alarm
(1) Any mode screen displays the current alarm.

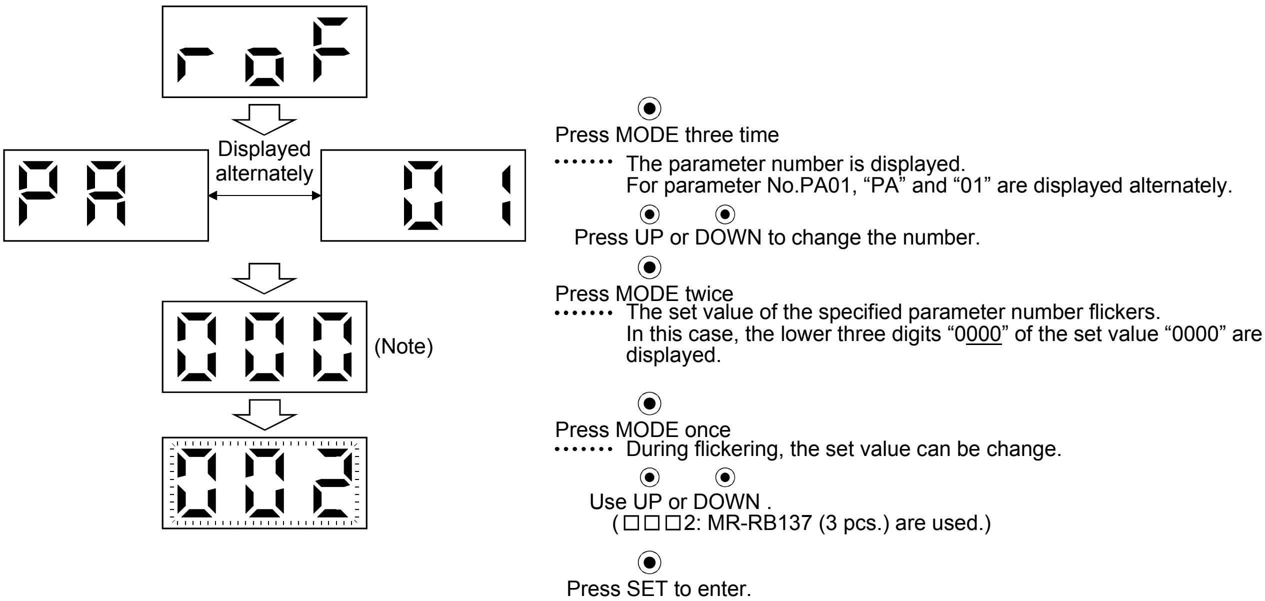
(2) The other screen is visible during occurrence of an alarm. At this time, the decimal point in the third digit flickers.

(3) To clear any alarm, switch power off, then on or press the "SET" button on the current alarm screen. Note that this should be done after removing the case of the alarm.

13.4.5 Parameter mode

POINT
・The display section of the converter unit has three digits. When a parameter No. is displayed, parameter group and parameter No. are displayed alternately. When, for example, "PA01" is displayed, [PA] and [01] are displayed alternately.

The following example gives the operation procedure after power-on for use of the regenerative options (MR-RB137).



Note. If the "MODE" button is pressed when the lower three digits of the four digits "0000" are displayed, the fourth digit "0000" is displayed as [- 0] . However, do not change the setting of the fourth digit. Press the "MODE" button again to reset the display to the lower three digits [000] .

To shift to the next parameter, press the "UP"/"DOWN" button.
When changing the parameter No.PA01 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

13.5 Parameters for converter unit

CAUTION	
⚠ CAUTION	・Never adjust or change the parameter values extremely as it will make operation instable. ・If fixed values are written in the digits of a parameter, do not change these values.

POINT

・Refer to chapter 5 for parameters for drive unit.

・Parameter whose symbol is preceded by * is made valid with the following conditions:

  * : Set the parameter value, switch power off once after setting, and then switch it on again, or perform the controller reset.

・Never change parameters for manufacturer setting.

13.5.1 Parameter list

No.	Symbol	Name	Initial value	Unit
PA01	*REG	Regenerative option	0000h	
PA02	*MCC	Magnetic contactor drive output selection	0001h	
PA03		For manufacturer setting	0001h	
PA04			0	
PA05			100	
PA06			0	
PA07			100	
PA08	*DMD	Status display selection	0000h	
PA09	*BPS	Alarm history clear	0000h	
PA10		For manufacturer setting	0	
PA11			0000h	
PA12	*DIF	Input filter setting	0002h	
PA13		For manufacturer setting	0000h	
PA14			0000h	
PA15			0000h	
PA16			0000h	
PA17			0000h	
PA18			0000h	
PA19			0000h	

13.5.2 List of details

No.	Symbol	Name and function	Initial value	Unit	Setting range
PA01	*REG	Regenerative option Used to select the regenerative option. 0 0 □ □ Select the regenerative option. 00: No used 01: MR-RB139 } Only for MR-J3-CR55K 02: MR-RB137(3 pcs.) } Only for MR-J3-CR55K 11: MR-RB136-4 } Only for MR-J3-CR55K4 12: MR-RB138-4(3 pcs.) } Only for MR-J3-CR55K4 "01" and "02" are the set values for the MR-J3-CR55K only, and "11" and "12" are those for the MR-J3-CR55K4 only. Wrong setting will result in parameter alarm (A.37).	0000h		Refer to Name and function column.
PA02	*MCC	Magnetic contactor drive output selection Used to select the output of the magnetic contactor drive power supply. 0 0 0 □ Used to select the output of the magnetic contactor drive power supply. 0: No used 1: Used	0001h		Refer to Name and function column.
PA03		For manufacturer setting Do not change this value by any means.	0001h		
PA04			0		
PA05			100		
PA06			0		
PA07			100		
PA08	*DMD	Status display selection Used to select the status display shown at power-on. 0 0 0 □ Status display of converter unit display section at power-on. 0: Status 1: Bus voltage 2: Effective load ratio 3: Peak load ratio 4: Regenerative load ratio	0000h		Refer to Name and function column.
PA09	*BPS	Alarm history clear Used to clear the alarm history. 0 0 0 □ Alarm history clear 0: Invalid 1: Valid When alarm history clear is made valid, the alarm history is cleared at next power-on. After the alarm history is cleared, the setting is automatically made invalid (reset to 0).	0000h		Refer to Name and function column.
PA10		For manufacturer setting Do not change this value by any means.	0		
PA11			0000h		

No.	Symbol	Name and function	Initial value	Unit	Setting range
PA12	*DIF	Input filter setting Select the input filter. 0 0 0 □ Input signal filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 1.777[ms] 2: 3.555[ms] 3: 5.333[ms]	0002h		Refer to Name and function column.
PA13		For manufacturer setting Do not change this value by any means.	0000h		
PA14			0000h		
PA15			0000h		
PA16			0000h		
PA17			0000h		
PA18			0000h		
PA19			0000h		

13.6 Troubleshooting

13.6.1 Converter unit

(1) Alarms and warning list

When an error occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to (2) or (3) of this section and take the appropriate action.

Switch power off, then on to deactivate the alarm. The alarms marked "○" in the error reset column of the table can also be deactivated by error reset of the converter unit.

	Display	Name	Alarm deactivation	
			Power OFF→ON	Error reset
Alarm	A.10	Undervoltage	○	○
	A.12	Memory error1 (RAM)	○	
	A.15	Memory error2 (EEP-ROM)	○	
	A.17	Board error	○	
	A.19	Memory error3 (Flash-ROM)	○	
	A.30	Regenerative error	(Note) ○	(Note) ○
	A.33	Over voltage	○	○
	A.37	Parameter error	○	
	A.38	MC drive circuit error	○	
	A.39	Open phase	○	
	A.3A	Inrush current suppressor circuit error	○	
	A.45	Main circuit device overheat	(Note) ○	(Note) ○
	A.47	Cooling fan error	○	
	A.50	Overload 1	(Note) ○	(Note) ○
	A.51	Overload 2	(Note) ○	(Note) ○
	888	Watchdog	○	

	Display	Name
Warning	A.91	Overheat warning
	A.E0	Excessive regenerative load warning
	A.E1	Overload warning
	A.E6	Converter forced stop warning
	A.E8	Cooling fan speed reduction warning

Note. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.

(2) Remedies for alarms

CAUTION	・When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.

POINT

- 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 resumed by switching control circuit power off, then on to reset the alarm, the converter unit and regenerative option may become faulty.
    - Regenerative error (A.30)
    - Overload 1 (A.50)
    - Overload 2 (A.51)
    - Main circuit device overheat (A.45)
- The alarm can be deactivated by switching the power off, then on or by the error reset command from the host controller. Refer to (1) in this section for details.

When an alarm occurs, the malfunction (ALM) signal switches off and the display section shows the alarm number.
Remove the cause of the alarm in accordance with this section.

Display	Name	Definition	Cause	Action
A.10	Undervoltage	Power supply voltage dropped.	1. Instantaneous control circuit power failure occurred for more than 60ms.	Review the power supply.
			2. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
			3. Failure of the part in the converter unit. Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the Converter unit.
A.12	Memory error 1 (RAM)	RAM memory fault	Failure of the part in the converter unit. Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the converter unit.
A.15	Memory error 2 (EEP-ROM)	EEP-ROM fault	1. Failure of the part in the converter unit. Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the converter unit.
			2. The number of write times to EEP-ROM exceeded 100,000.	
A.17	Board error	CPU/parts fault	Failure of the part in the converter unit. Checking method The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the converter unit.
A.19	Memory error 3 (Flash-ROM)	ROM memory fault		

Display	Name	Definition	Cause	Action
A.30	Regenerative error	Permissible regenerative power of regenerative option is exceeded.	1. Wrong setting of parameter No.PA01	Set correctly.
			2. Regenerative option is not connected.	Connect correctly.
			3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative option to be exceeded. Checking method Check the regenerative load ratio using the status display.	1. Reduce the frequency of positioning. 2. Use the regenerative option of larger capacity. 3. Reduce the load.
			4. Power supply voltage is abnormal. MR-J3-CR55K: 260VAC or more MR-J3-CR55K4: 520VAC or more	Review the power supply.
			5. Regenerative option faulty.	Change regenerative option.
			6. Ground fault occurred in servo motor power (U, V, W).	Correct the wiring.
		Regenerative transistor fault	7. Regenerative transistor faulty. Checking method 1) The regenerative option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative resistor or regenerative option.	Change the converter unit.
A.33	Over voltage	Converter bus voltage exceeded to following voltage. MR-J3-CR55K: 400VDC MR-J3-CR55K4: 800VDC	1. Regenerative option is not used.	Use the regenerative option.
			2. Though the regenerative option is used, the parameter No.PA01 setting is "□□00 (not used)".	Set correctly.
			3. Lead of regenerative option is open or disconnected.	1. Change lead. 2. Connect correctly.
			4. Regenerative transistor faulty.	Change the converter unit.
			5. Wire breakage of regenerative option.	Change the regenerative option.
			6. Capacity of regenerative option is insufficient.	Add regenerative option or increase capacity.
			7. Power supply voltage high.	Review the power supply.
			8. Ground fault occurred in servo motor power (U, V, W).	Correct the wiring.
			9. Impedance at main circuit power supply cable (L_1, L_2, L_3) is high, and leak current from servo motor power supply cable (U, V, W) is large.	Use the regenerative option.
A.37	Parameter error	Parameter setting is wrong.	1. Converter unit fault caused the parameter setting to be rewritten.	Change the converter unit.
			2. Regenerative option not used with converter unit was selected in parameter No.PA02.	Set parameter No.PA01 correctly.
			3. The number of write times to EEP-ROM exceeded 100,000 due to parameter write, etc.	Change the converter unit.

Display	Name	Definition	Cause	Action
A.38	MC drive circuit error	Magnetic contactor drive circuit error (When the magnetic contactor is turned on: the main circuit power supply is not turned on within two seconds after the servo-on of the drive unit. When the magnetic contactor is opened: the main circuit power supply is turned on although the magnetic contactor is opened.)	1. Wrong connection of the magnetic contactor.	Review the wiring.
			2. Parameters specifying whether to use/not use the magnetic contactor do not match the configuration.	Set parameter No.PA02 correctly.
			3. Magnetic contactor failed.	Change the magnetic contactor.
			4. Magnetic contactor drive circuit faulty. Checking method: Check the output of magnetic contactor control connector (CNP1) . Power supply voltage is applied to this connector. Take care to avoid an electric shock at connecting.	Change the converter unit.
			5. Mismatch of an external sequence.	Review the power-on sequence. (Refer to section 3.3.2.)
A.39	Open phase	Power supply error	1. Any of L_1, L_2 and L_3 is disconnected. Or, open.	Review the wiring.
			2. Failure of the part in the converter unit.	Change the converter unit.
A.3A	Inrush current suppressor circuit error	Inrush current suppressor circuit error	1. Power-on/off was repeated with high frequency.	Review operation pattern.
			2. Inrush current suppressor resistance overheated.	Change the converter unit.
			3. Inrush current suppressor circuit faulty.	
A.45	Main circuit device overheat	Main circuit device overheat.	1. The power supply was turned on and off continuously by overloaded status.	Review operation pattern.
			2. Ambient temperature of converter unit is over 55℃.	Review environment so that ambient temperature is 0 to 55℃.
			3. Converter unit faulty.	Change the converter unit.
A.47	Cooling fan alarm	The cooling fan of the converter unit stopped, or its speed decreased to or below the alarm level.	1. Cooling fan life expiration. (Refer to section 2.6.)	Change the cooling fan of the converter unit.
			2. Foreign matter caught in the cooling fan stopped rotation.	Remove the foreign matter.
			3. The power supply of the cooling fan failed.	Change the converter unit.
A.50	Overload 1	Load exceeded overload protection characteristic of converter unit.	Converter unit is used in excess of its continuous output current.	1. Reduce load. 2. Review operation pattern.
A.51	Overload 2	Load exceeded overload protection characteristic of converter unit.	Converter unit is used in excess of its output current for a short time.	Review operation pattern of a drive unit.
(Note) 888	Watchdog	CPU/parts fault	Failure of the part in the converter unit. Checking method: The alarm occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the converter unit.

Note. At power-on, "888" appears instantaneously, but it is not an error.

(3) Remedies for warnings

Continuing operation in an alarm occurrence status may result in an alarm or disable proper operation. Eliminate the cause of the warning according to this section. The warning displayed will disappear when the cause of its occurrence is resolved.

Display	Name	Definition	Cause	Action
A.91	Overheat warning	The temperature of the heat sink exceeded the warning level.	1. Operated in the overloaded status.	Review operation pattern.
			2. Ambient temperature of converter unit is over 55℃.	Review environment so that ambient temperature is 0 to 55℃.
			3. Converter unit faulty.	Change the converter unit.
A.E0	Excessive regenerative load warning	There is a possibility that regenerative power may exceed permissible regenerative power of regenerative option.	Regenerative power increased to 85% or more of permissible regenerative power of regenerative option. Checking method Check the regenerative load ratio using the status display.	1. Reduce frequency of positioning. 2. Change regenerative option for the one with larger capacity. 3. Reduce load.
A.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 A.50, 51.	Refer to A.50, A.51.
A.E6	Converter forced stop warning	EM1 is off.	External forced stop was made valid. (EM1 was turned off.)	Ensure safety and deactivate forced stop.
A.E8	Cooling fan speed reduction warning	The speed of the converter unit cooling fan decreased to or below the warning level.	1. Cooling fan life expiration. (Refer to section 2.6.)	Change the cooling fan of the converter unit.
			2. The power supply of the cooling fan failed.	Change the converter unit.

(4) Clearing the alarm history

You can clear the alarm numbers stored in the alarm history of the alarm mode. To ensure that you can control the alarms that will occur after regular operation, make this setting before starting regular operation to clear the alarm history.

After setting "0001" in parameter No.PA09, switch power off once. Switching it on again clears the alarm history. At this time, the parameter No.PA09 setting returns to "0000".

13.6.2 Drive unit

POINT

- Explanation made in this section is exclusively for the driver unit. Other troubleshooting is the same as that for servo amplifiers with 22kW or less. Refer to chapter 8.
- As soon as an alarm occurs, make the servo-off status and interrupt the main circuit power.

(1) Alarms and warning list

When an error occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to (2) or (3) of this section and take the appropriate action. When an alarm occurs, the ALM turns OFF.

After its cause has been removed, the alarm can be deactivated in any of the methods marked in the alarm deactivation column. The alarm is automatically canceled after removing the cause of occurrence.

	Display	Name	Alarm deactivation		
			Power OFF → ON	Error reset	CPU reset
Alarms	1B	Converter alarm	○	○	○

	Display	Name
Warnings	9C	Converter warning
	E9	Main circuit off warning

(2) Remedies for alarms

⚠CAUTION

- When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur.
- As soon as an alarm occurs, mark servo-off and power off the main circuit and control circuit.

POINT

- The alarm can be deactivated by switching power off, then on or by the error reset command CPU reset from the servo system controller. For details, refer to (1) of this section.

When an alarm occurs, the malfunction (ALM) switches off and the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No.

The servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. MR Configurator may be used to refer to the cause.

Display	Name	Definition	Cause	Action
1B	Converter alarm	An alarm occurred in the converter unit during servo-on.	1. An alarm occurred in the converter unit during servo-on.	Check the alarm of the converter unit, and take the action following the remedies for alarms of the converter unit. (Refer to section 13.6.1 (2).)
			2. The protection coordination cable or terminal connector is not correctly connected.	Connect correctly.

(3) Remedies for warnings

Continuing operation in an alarm occurrence status may result in an alarm or disable proper operation. Eliminate the cause of the warning according to this section. The warning displayed will disappear when the cause of its occurrence is resolved.

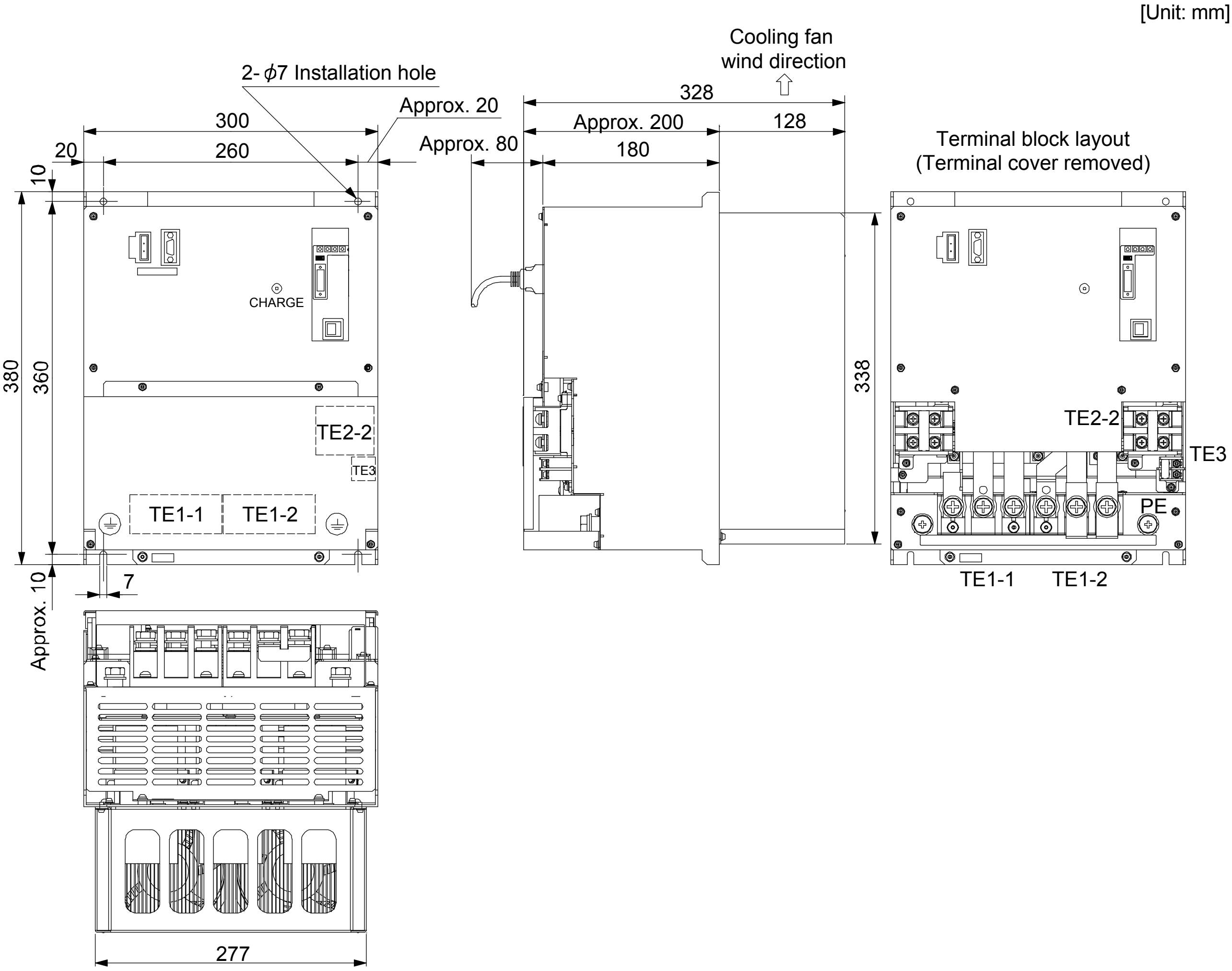
Indication	Name	Definition	Cause	Action
9C	Converter warning	A warning occurred in the converter unit during the servo-on.		Check the warning of the converter unit, and take the action following the remedies for warnings of the converter unit. (Refer to section 13.6.1 (3).)
E9	Main circuit off warning	The forced stop of the converter unit is made valid during the servo-on.	1. The forced stop of the converter unit is made valid.	Deactivate the forced stop of the converter unit.
			2. The protection coordination cable or terminal connector is not correctly connected.	Connect correctly.

13.7 Outline drawings

POINT
・Refer to section 13.2.1 for outline dimension drawing.

13.7.1 Converter unit (MR-J3-CR55K(4))

[Unit: mm]



Mass: 25[kg] (55.2[lb])

Terminal block signal layout

TE2-2

L+
L−

Terminal block screw: M6
Tightening torque: 3.0 [N・m] (26.6 [lb・in])

TE3

L_{11}
L_{21}

Terminal block screw: M4
Tightening torque: 1.2 [N・m] (10.6 [lb・in])

TE1-1

L_1	L_2	L_3

Terminal block screw: M10
Tightening torque: 12.0 [N・m] (106 [lb・in])

TE1-2

C	P2	P1

Terminal block screw: M10
Tightening torque: 12.0 [N・m] (106 [lb・in])

PE

⏚	⏚

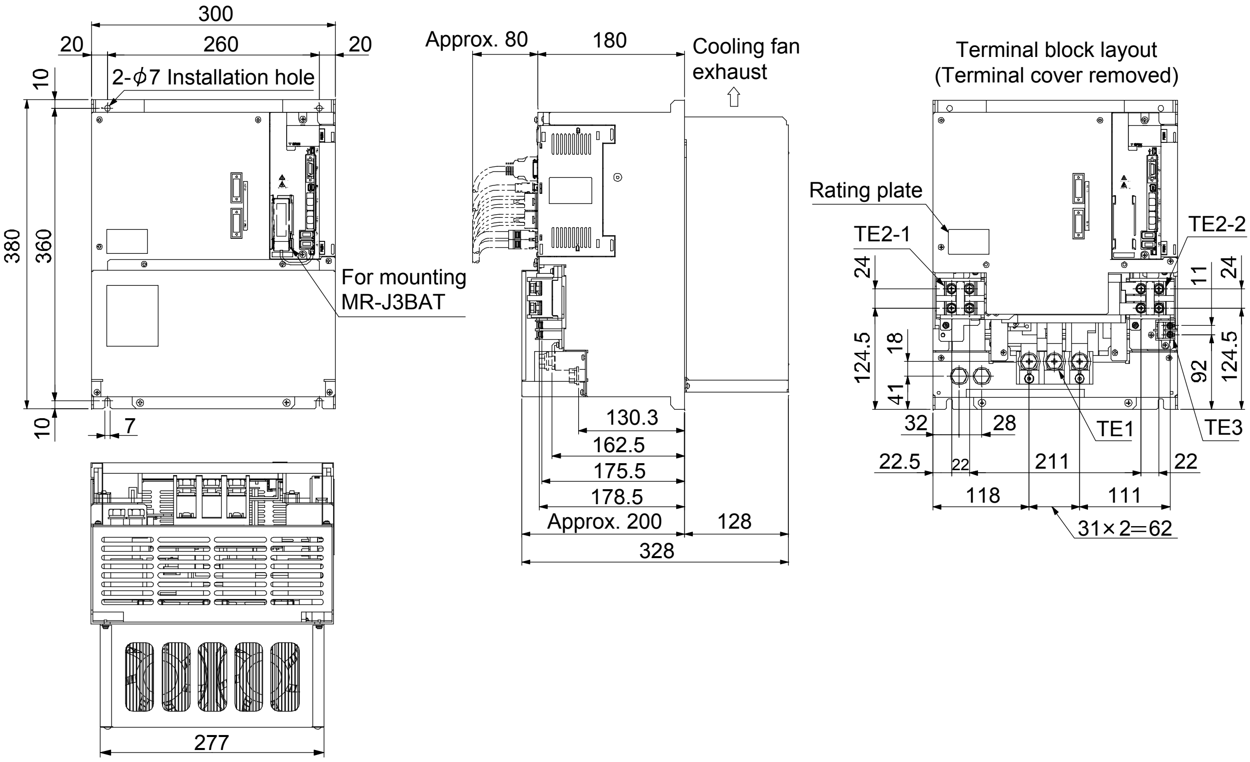
Terminal block screw: M10
Tightening torque: 12.0 [N・m] (106 [lb・in])

Mounting screw
Screw size: M6
Tightening torque: 5.4 [N・m] (47.8 [lb・in])

13.7.2 Drive unit

(1) MR-J3-DU30K□S・MR-J3-DU37K□S
MR-J3-DU45K□S4・MR-J3-DU55K□S4

[Unit: mm]



Mass: 26[kg] (57.3[lb])

Terminal block signal layout

TE2-1

L+
L−

Terminal block screw: M6
Tightening torque: 3.0 [N・m] (26.6 [lb・in])

TE3

L11
L21

Terminal block screw: M4
Tightening torque: 1.2 [N・m] (10.6 [lb・in])

TE1

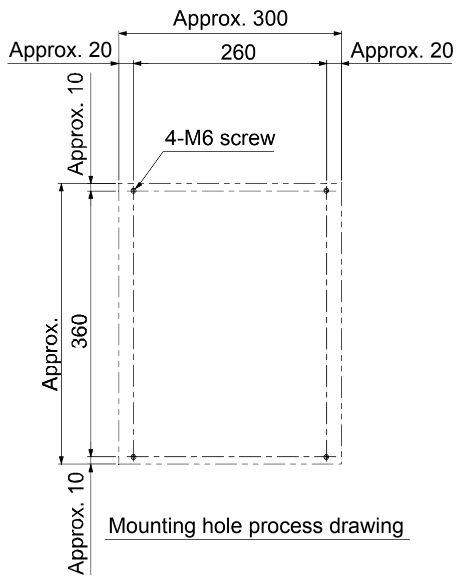
U	V	W

Terminal block screw: M10
Tightening torque: 12.0 [N・m] (106 [lb・in])

PE

⏚	⏚

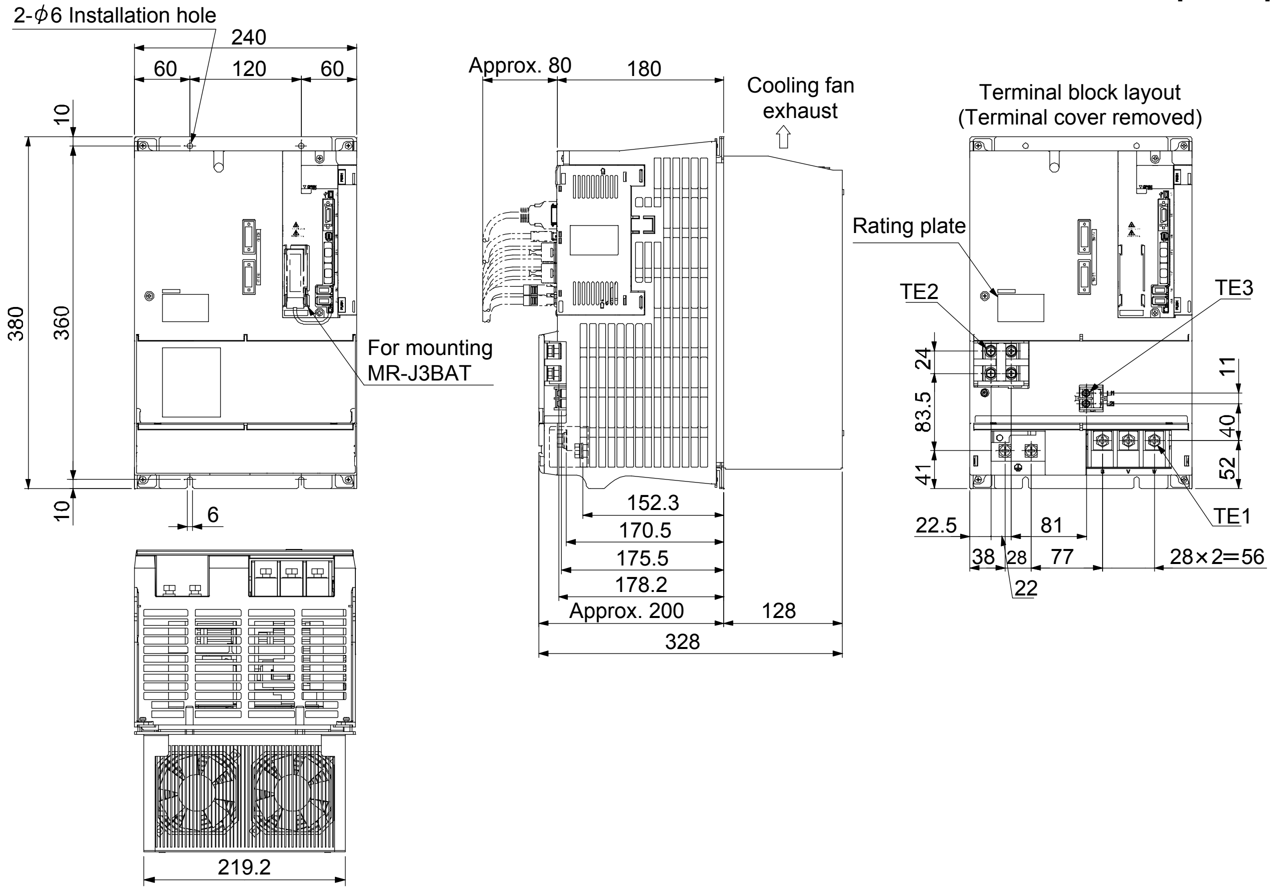
Terminal block screw: M10
Tightening torque: 12.0 [N・m] (106 [lb・in])



Mounting screw
Screw size: M6
Tightening torque: 5.4 [N・m] (47.8 [lb・in])

(2) MR-J3-DU30K□S4・MR-J3-DU37K□S4

[Unit: mm]



Mass: 18[kg] (39.7[lb])

Terminal block signal layout

TE2

L+
L−

Terminal block screw: M6
Tightening torque: 3.0 [N・m] (26.6 [lb・in])

TE3

L_{11}
L_{21}

Terminal block screw: M4
Tightening torque: 1.2 [N・m] (10.6 [lb・in])

TE1

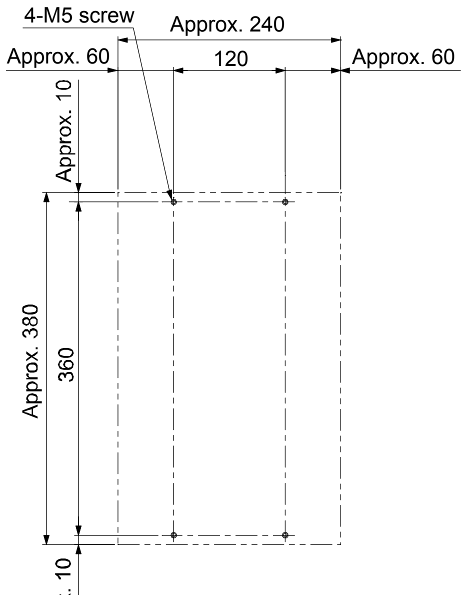
U	V	W

Terminal block screw: M8
Tightening torque: 6.0 [N・m] (53.1 [lb・in])

PE

⏚	⏚

Terminal block screw: M8
Tightening torque: 6.0 [N・m] (53.1 [lb・in])



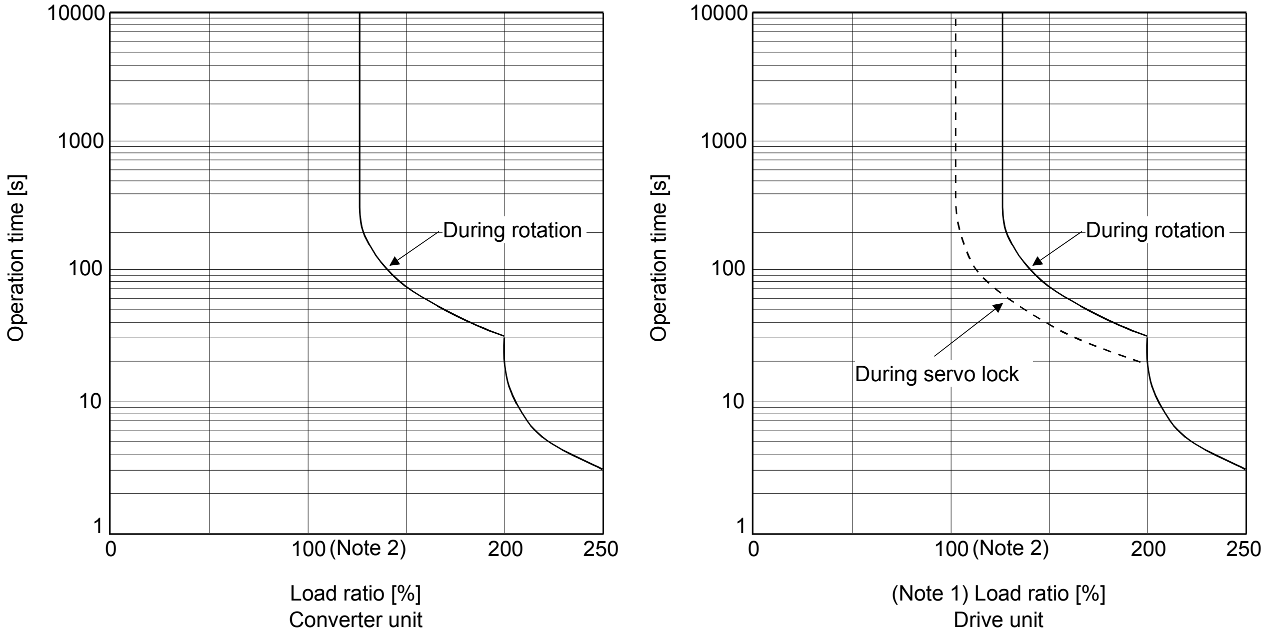
Mounting process drawing

Mounting screw
Screw size: M5
Tightening torque: 3.2 [N・m] (28.3 [lb・in])

13.8 Characteristics

13.8.1 Overload protection characteristics

An electronic thermal relay is built in the converter unit and drive unit to protect the servo motor, converter unit, drive unit and servo motor power line from overloads.
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.
It is recommended to use the machine which generates unbalanced torque, e.g. a vertical lift application, so that the unbalanced torque is not more than 70% of the rated torque.
Servo amplifier MR-J3 series has solid-state servo motor overload protection. (The motor full load current is 115% rated current.)



Note 1. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo lock status) or in a 30r/min or less low-speed operation status, the drive unit may fail even when the electronic thermal relay protection is not activated.

2. Load ratio 100% indicates the rated output of each converter unit and drive unit. Refer to section 13.1.3 for rated output.

Fig. 13.1 Overload protection characteristics

13.8.2 Power supply equipment capacity and generated loss

POINT
・The calculation method of heat dissipation area for enclosed cabinet is the same as that for servo amplifiers with 22kW or less. Refer to section 10.2 (2).

Table 13.1 indicates the generated loss and power supply capacity under rated load per combination of the converter unit and drive unit. When the servo motors is run at less than the maximum speed, the power supply equipment capacity is lower than the value in the table but the heat generated does not change.
Since the servo motor requires 2 to 2.5 times greater instantaneous power for acceleration, use the power supply which ensures that the voltage lies within the permissible voltage fluctuation at the main circuit power supply terminals (L_1, L_2, L_3) of the converter unit. The power supply equipment capacity changes with the power supply impedance.
The actually generated heat falls within the ranges at rated torque and at zero torque according to the frequencies of use during operation. When designing an enclosed cabinet, use the values in the table, considering the worst operating conditions. The generated heat in Table 13.1 does not include heat produced during regeneration.

Table 13.1 Power supply capacity and generated heat per servo amplifier at rated output

Converter unit	Drive unit	Servo motor	Power supply capacity [kVA]		(Note) Drive unit-generated heart [W]			Area required for heat dissipation [m²]
			Power factor improving DC reactor is not used	Power factor improving DC reactor is used	At rated torque	At rated torque [Amount of heat inside the cabinet when the part of the drive unit outside the cabinet is cooled]	At zero torque	
MR-J3-CR55K	MR-J3-DU30K□S	HA-LP30K1 HA-LP30K1M HA-LP30K2	48	40	1550(1100＋450)	470	60(30＋30)	31.0
	MR-J3-DU37K□S	HA-LP37K1 HA-LP37K1M HA-LP37K2	59	49	1830(1280＋550)	550		36.6
MR-J3-CR55K4	MR-J3-DU30K□S4	HA-LP25K14	40	35	1080(850＋230)	330		21.6
		HA-LP30K14 HA-LP30K1M4 HA-LP30K24	48	40	1290(1010＋280)	390		25.8
	MR-J3-DU37K□S4	HA-LP37K14 HA-LP37K1M4 HA-LP37K24	59	49	1542(1200＋342)	470		30.8
	MR-J3-DU45K□S4	HA-LP45K1M4 HA-LP45K24	71	59	1810(1370＋440)	550		36.2
	MR-J3-DU55K□S4	HA-LP50K1M4	80	67	2120(1650＋470)	640		42.4
		HA-LP55K24	87	72	2150(1650＋500)	650		43.0

Note. The heat generated by the drive unit is indicated in the left term within the parentheses, and the heat generated by the converter unit in the right term.

13.8.3 Dynamic brake characteristics

POINT
・Dynamic brake operates at occurrence of alarm, servo forced stop warning (E6), and controller forced stop warning (E7), and when power is turned off. Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency. ・Maximum usage time of dynamic brake for a machine operating under recommended load inertia moment ratio is 1000 time while decelerating from rated speed to a stop with frequency of once in 10 minutes. ・Be sure to make forced stop 1 (EM1) valid after servo motor stops when using forced stop 1 (EM1) frequently in other than emergency.

(1) Dynamic brake operation

(a) Calculation of coasting distance

Fig. 13.2 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 13.1 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to (1) (b) in this section. Please contact your local sales office for the servo motor not indicated.)

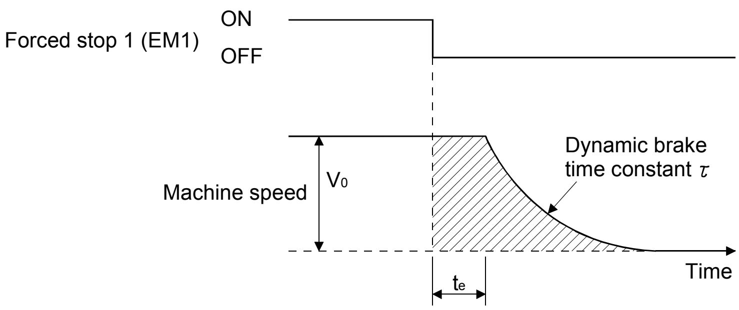


Fig. 13.2 Dynamic Brake Operation Diagram

$$L_{max} = \frac{V_o}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \quad \cdots\cdots (13.1)$$

L_{max} : Maximum coasting distance ········ [mm]

V_o : Machine rapid feed rate ········ [mm/min][in/min]

J_M : Servo motor inertial moment ········ [$\times 10^{-4}$kg・m^2][oz・in^2]

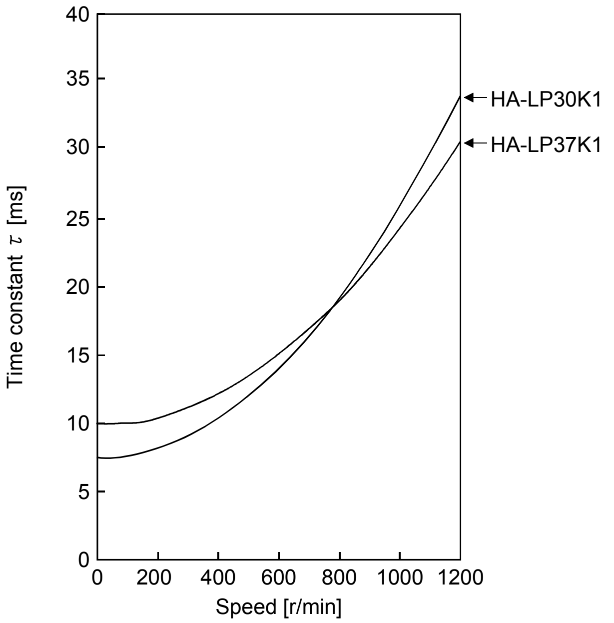
J_L : Load inertia moment converted into equivalent value on servo motor shaft ········ [$\times 10^{-4}$kg・m^2][oz・in^2]

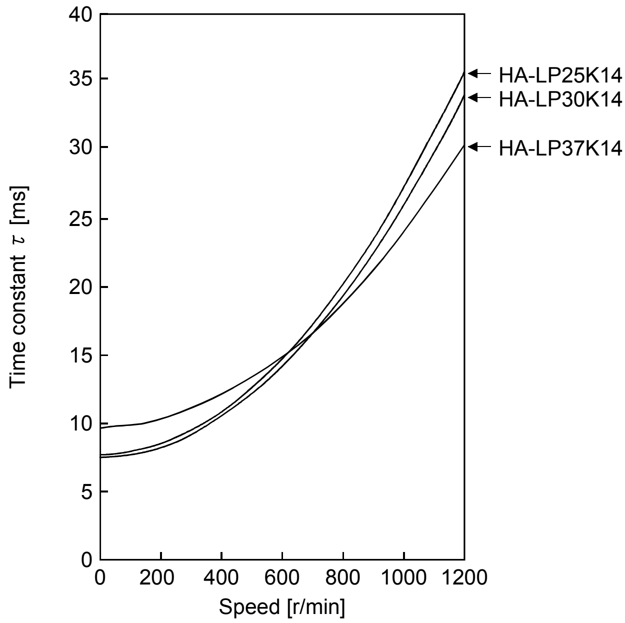
τ : Dynamic brake time constant ········ [s]

t_e : Delay time of control section ········ [s]

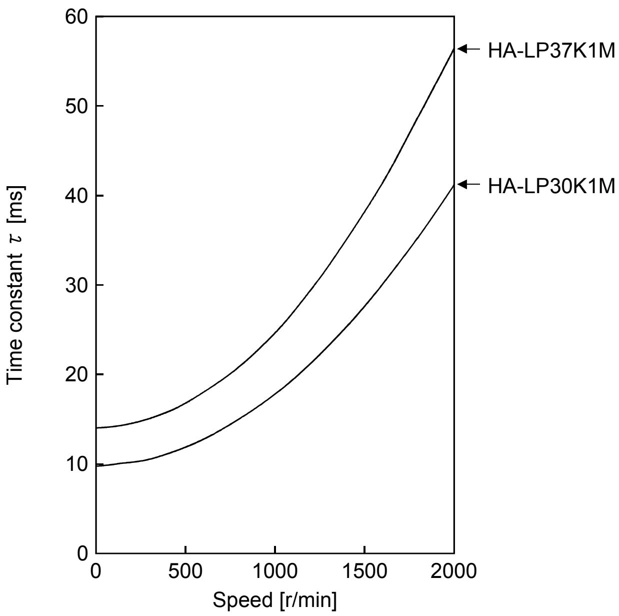
There is delay caused by magnetic contactor built into the external dynamic brake (about 50ms)
and delay caused by the external relay.

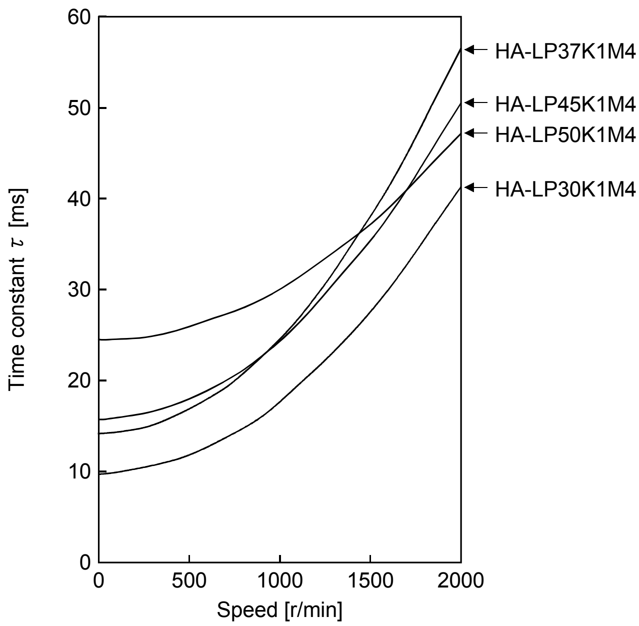
(b) Dynamic brake time constant
The following shows necessary dynamic brake time constant τ for the equations (13.1).



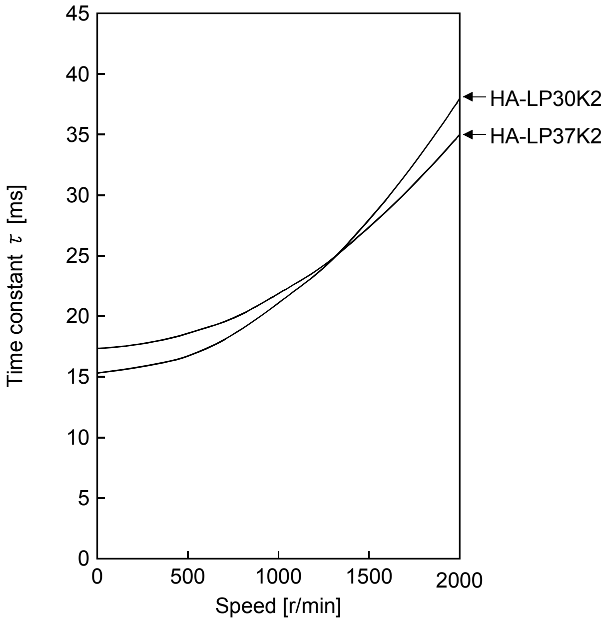


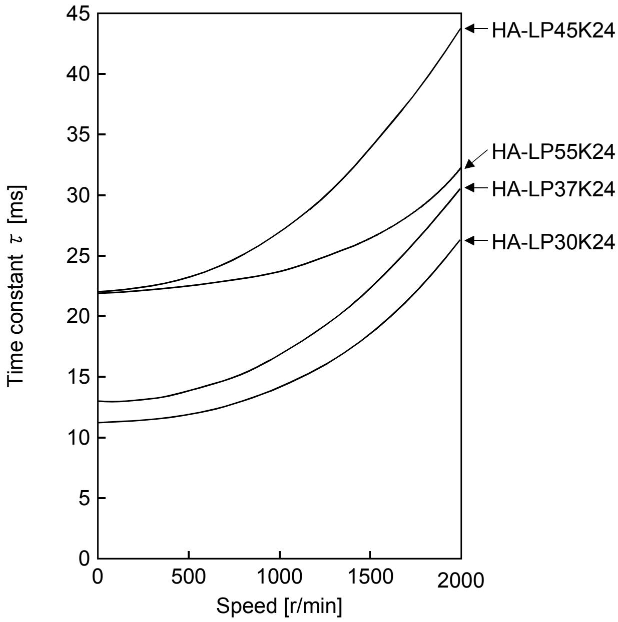
HA-LP1000r/min series





HA-LP1500r/min series





HA-LP2000r/min series

(2) The dynamic brake at the load inertia moment

Use the dynamic brake under the load inertia moment ratio indicated in the following table. If the load inertia moment is higher than this value, the dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact your local sales office.

The values of the load inertia moment ratio in the table are the values at the maximum rotation speed of the servo motor.

Drive unit	Load inertia moment ratio [Multiplier (×1)]
MR-J3-DU30K□S(4)	10
MR-J3-DU37K□S(4)	
MR-J3-DU45K□S4	
MR-J3-DU55K□S4	

13.8.4 Inrush currents at power-on of main circuit and control circuit

The following table indicates the inrush currents (reference data) that will flow when the maximum permissible voltage (200V class: 253VAC, 400V class: 528VAC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

Converter unit	Drive unit	Inrush currents (A_0-p)	
		Main circuit power supply (L_1, L_2, L_3)	Control circuit power supply (L_{11}, L_{21})
MR-J3-CR55K	MR-J3-DU30K□S	163A (Attenuated to approx. 20A in 180ms)	18A (Attenuated to approx. 0A in 100ms)
	MR-J3-DU37K□S		
MR-J3-CR55K4	MR-J3-DU30K□S4	339A (Attenuated to approx. 20A in 70ms)	19A (Attenuated to approx. 0A in 60ms)
	MR-J3-DU37K□S4		
	MR-J3-DU45K□S4		
	MR-J3-DU55K□S4		

Since large inrush currents flow in the power supplies, always use molded-case circuit breakers and magnetic contactors. (Refer to section 13.9.5.)
When circuit protectors are used, it is recommended to use the inertia delay type that will not be tripped by an inrush current.

13.9 Options

WARNING	・Before connecting any option or peripheral equipment, turn off the power and wait for 20 minutes or more until the charge lamp turns off. Then, confirm that the voltage between L＋ and L－ is safe with a voltage tester and others. Otherwise, an electric shock may occur. In addition, always confirm from the front of the converter unit whether the charge lamp is off or not.

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

POINT

・Explanations on the following item are the same as those for servo amplifiers with 22kW or less. Refer to the section below for details.
  ・Cable/connector sets Refer to section 11.1.
  ・Junction terminal block Refer to section 11.7.
  ・MR Configurator Refer to section 11.8.
  ・Battery Refer to section 11.9.
  ・Relays Refer to section 11.15.
  ・Radio noise filter (FR-BIF(-H)) Refer to section 11.16 (2) (e).

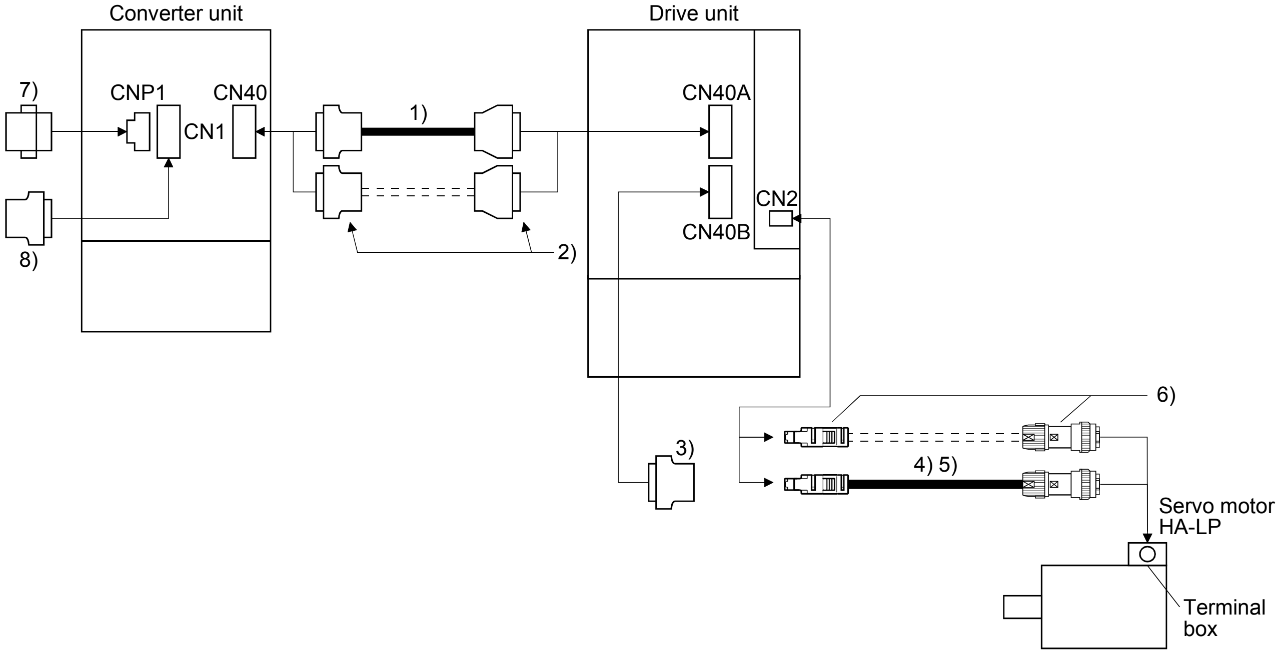
13.9.1 Cables and connectors

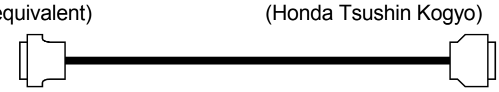
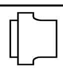
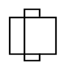
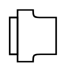
POINT

・Other connectors are the same as those for servo amplifiers with 22kW or less. Refer to section 11.1.

(1) Configuration of cables and connectors

The following shows the cable makeup for connection with the servo motor and other model.



No.	Product	Model	Description	Application
1)	Protection coordination cable	MR-J3CDL05M Refer to (2) of this section.	Connector: 10120-3000PE Shell kit: 10320-52F0-008 (3M or equivalent) Connector: PCR-S20FS+ Case: PCR-LS20LA1 (Honda Tsushin Kogyo) 	
2)	Connector set	MR-J2CN1-A Refer to (2) of this section.	Connector: 10120-3000PE Shell kit: 10320-52F0-008 (3M or equivalent) Connector: PCR-S20FS+ Shell kit: PCR-LS20LA1 (Honda Tsushin Kogyo) 	
3)	Termination connector	MR-J3-TM		
4)	Encoder cable	MR-J3ENSCBL□M-L Cable length: 2・5・10・20・30m		IP67 Standard life
5)	Encoder cable	MR-J3ENSCBL□M-H Cable length: 2・5・10・20・30・40・50m	For HA-LP series Refer to section 11.1.2 (4) for details.	IP67 Long bending life
6)	Encoder connector set	MR-J3SCNS	 For HA-LP series Refer to section 11.1.2 (4) for details.	IP67
7)	Magnetic contactor wiring connector		Converter unit-side connector (Phoenix Contact) Socket: GFKC 2.5/2-STF-7.62 	Supplied with converter unit
8)	Digital I/O connector		Converter unit-side connector (DDK) Connector: 17JE23090-02(D8A)K11-CG 	

(2) MR-J3CDL05M(0.5m) Protection coordination cable

CAUTION	• Connect protection coordination cables correctly if they are fabricated. Otherwise, it may cause an unexpected operation.

When fabricating a protection coordination cable, use the recommended wires given in section 13.9.4, and fabricate a protection coordination cable as shown in the wiring diagram in this section.

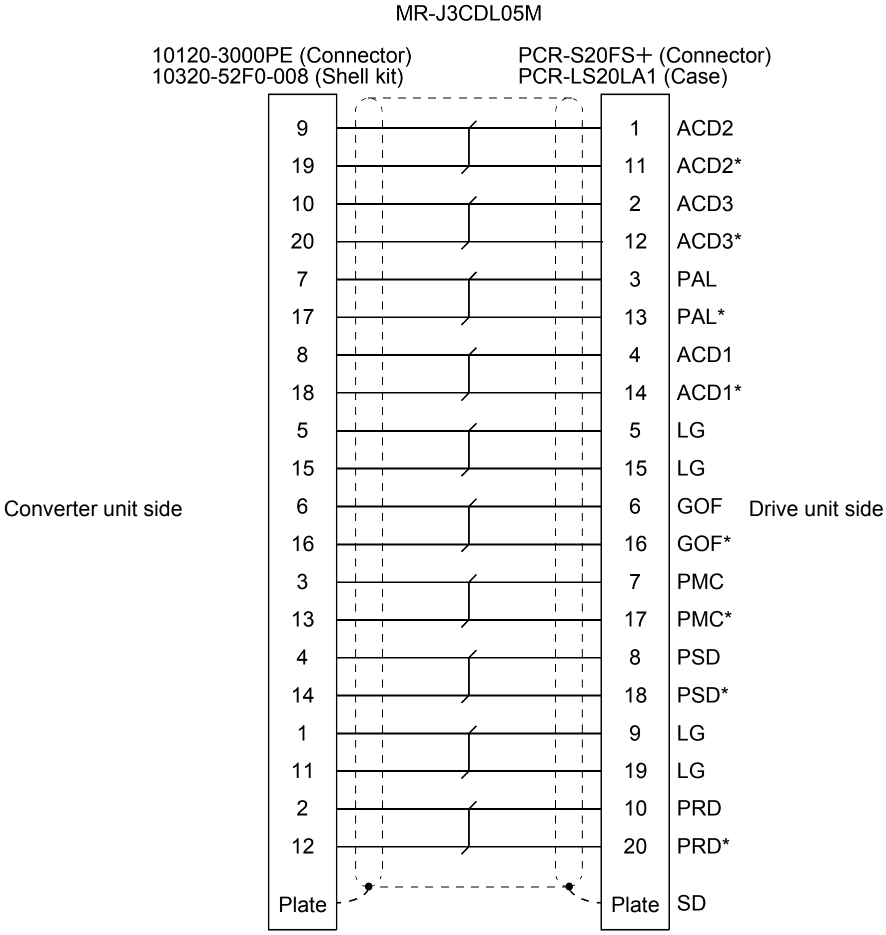
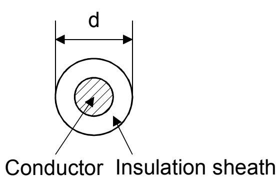


Table 13.2 Recommended wire

Model	Length [m(ft)]	Core size [mm²]	Number of cores	Characteristics of one core: Structure [Wires/mm]	Characteristics of one core: Conductor resistance [Ω/mm]	Characteristics of one core: Insulation coating OD d[mm] (Note 1)	(Note 2) Finishing OD [mm]	Wire model
MR-J3CDL05M	0.5 to 5 (1.64 to 16.4)	0.08	20 (10 pairs)	7/0.127	222	0.38	6.1	UL 20276 AWG#28 10pair (CREAM)

Note 1. d is as shown below.



2. Standard OD. Max. OD is about 10% greater.

13.9.2 Regenerative option

CAUTION	
	・The specified combinations of regenerative options, converter units and drive units may only be used. Otherwise, it may cause a fire.

POINT
・The calculation method of regenerative energy is the same as that for servo amplifiers with 22kW or less. Refer to section 11.2 (2).

(1) Combination and regenerative power

The regenerative power values in the table are the regenerative power of the resistor and are not the rated power.

<table>
<tr><th rowspan="2">Converter unit</th><th rowspan="2">Drive unit</th><th colspan="4">Regenerative Power [W]</th></tr>
<tr><th>MR-RB139
(1.3Ω)</th><th>(Note 1) Three
MR-RB137
(1.3Ω) in parallel</th><th>MR-RB136-4
(5Ω)</th><th>(Note 2) Three
MR-RB138-4
(5Ω) in parallel</th></tr>
<tr><td rowspan="2">MR-J3-CR55K</td><td>MR-J3-DU30K□S</td><td rowspan="2">1300</td><td rowspan="2">3900</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>MR-J3-DU37K□S</td></tr>
<tr><td rowspan="4">MR-J3-CR55K4</td><td>MR-J3-DU30K□S4</td><td rowspan="4"></td><td rowspan="4"></td><td rowspan="4">1300</td><td rowspan="4">3900</td></tr>
<tr><td>MR-J3-DU37K□S4</td></tr>
<tr><td>MR-J3-DU45K□S4</td></tr>
<tr><td>MR-J3-DU55K□S4</td></tr>
</table>

Note 1. The composite resistor value of three options is 1.3Ω. The resistor value of one option is 4Ω.
2. The composite resistor value of three options is 5Ω. The resistor value of one option is 15Ω.

(2) Parameter setting

POINT
・Always set parameter No.PA02 of the drive unit to "□□00" (Not used) since the regenerative option cannot be connected to the drive unit.

When using the regenerative option, set the parameter of the converter unit. Match parameter No.PA01 to the regenerative option used.

Parameter No.PA01

0	0		

Regenerative option selection
00: Not used
01: MR-RB139
02: MR-RB137 (3 pcs.)
11: MR-RB136-4
12: MR-RB138-4 (3 pcs.)

(3) Regenerative loss of drive unit and servo motor

Drive unit	Inverse efficiency [%]	C charge [J]
MR-J3-DU30K□S	90	450
MR-J3-DU37K□S		
MR-J3-DU30K□S4		
MR-J3-DU37K□S4		
MR-J3-DU45K□S4		
MR-J3-DU55K□S4		

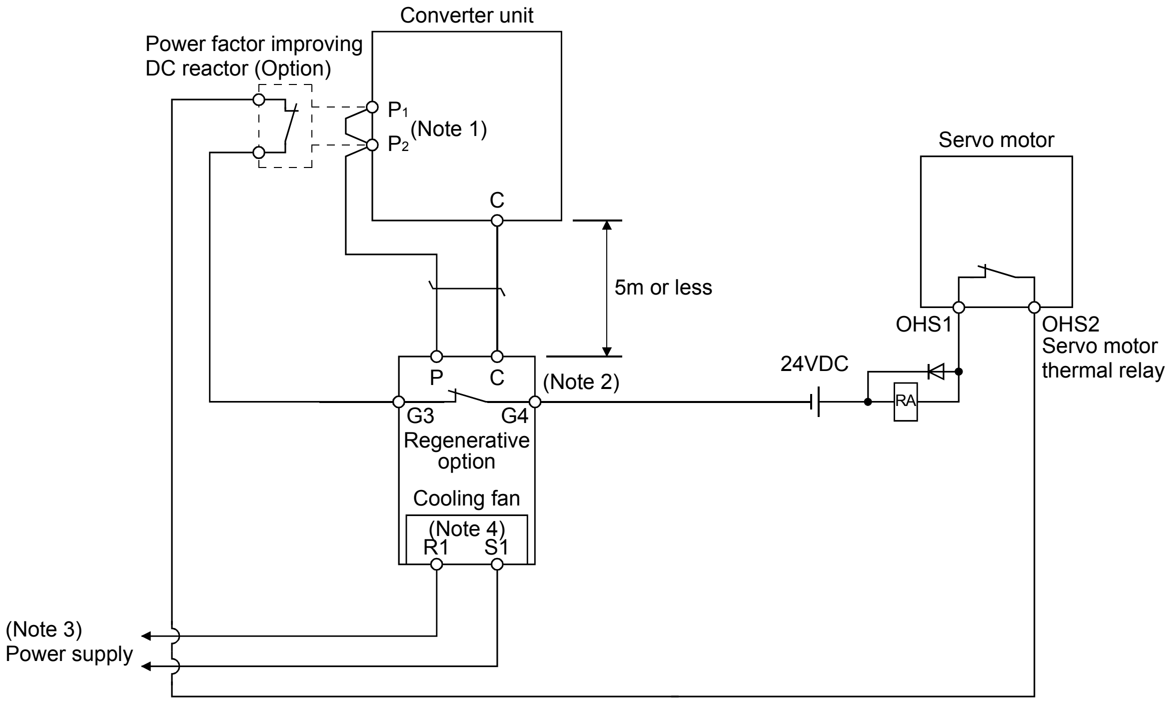
(4) Connection of the regenerative option
Always supply 1-phase 200V and 400V respectively to the cooling fan. The cooling fan specifications are as follows.

Table 13.3 Cooling fan

Item	200V class	400V class
Model	MR-RB137・MR-RB139	MR-RB136-4・MR-RB138-4
Voltage・Frequency	1-phase 198 to 242VAC, 50/60Hz	1-phase 380 to 480VAC, 50/60Hz
Power consumption [W]	20 (50Hz)/18 (60Hz)	20 (50Hz)/18 (60Hz)

The regenerative option generates heat of 100°C higher than the ambient temperature. Fully consider heat dissipation, installation position, used wires, etc. to place the option. For wiring, use flame-resistant wires or make the wires flame-resistant and keep them away from the regenerative option. The G3 and G4 terminals act as a thermal sensor. G3-G4 is opened when the regenerative option overheats abnormally. Always twist the wires for connection with the converter unit and connect the wires within the overall distance of 5m.

(a) MR-RB139 · MR-RB136-4



Note 1. When using the Power factor improving DC reactor, remove the short bar across P_1-P_2.

2. G3-G4 contact specifications

   Maximum voltage: 120V AC/DC

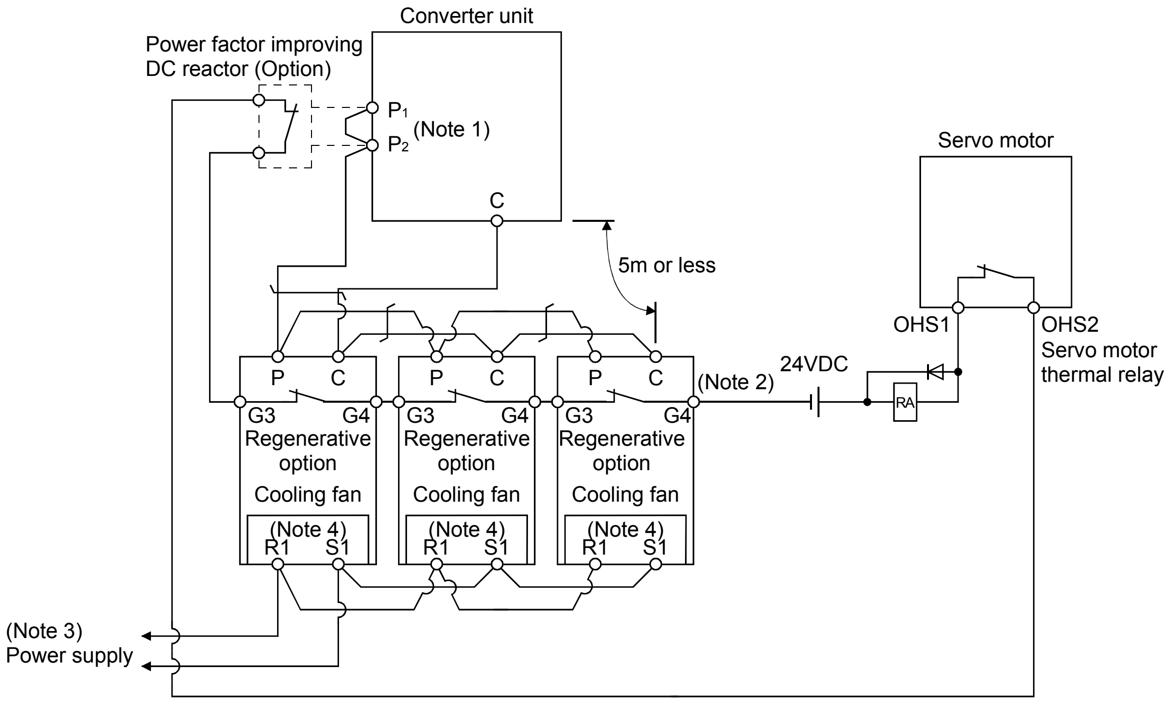
   Maximum current: 0.5V/4.8VDC

   Maximum capacity: 2.4VA

3. For specifications of cooling fan power supply, refer to Table 13.3.
4. For MR-RB136-4, “R1” is “R400” and “S1” is “S400”.

(b) MR-RB137 · MR-RB138-4

POINT
· Three of MR-RB137 or MR-RB138-4 are required per converter unit. Please purchase three of MR-RB137 or MR-RB138-4.

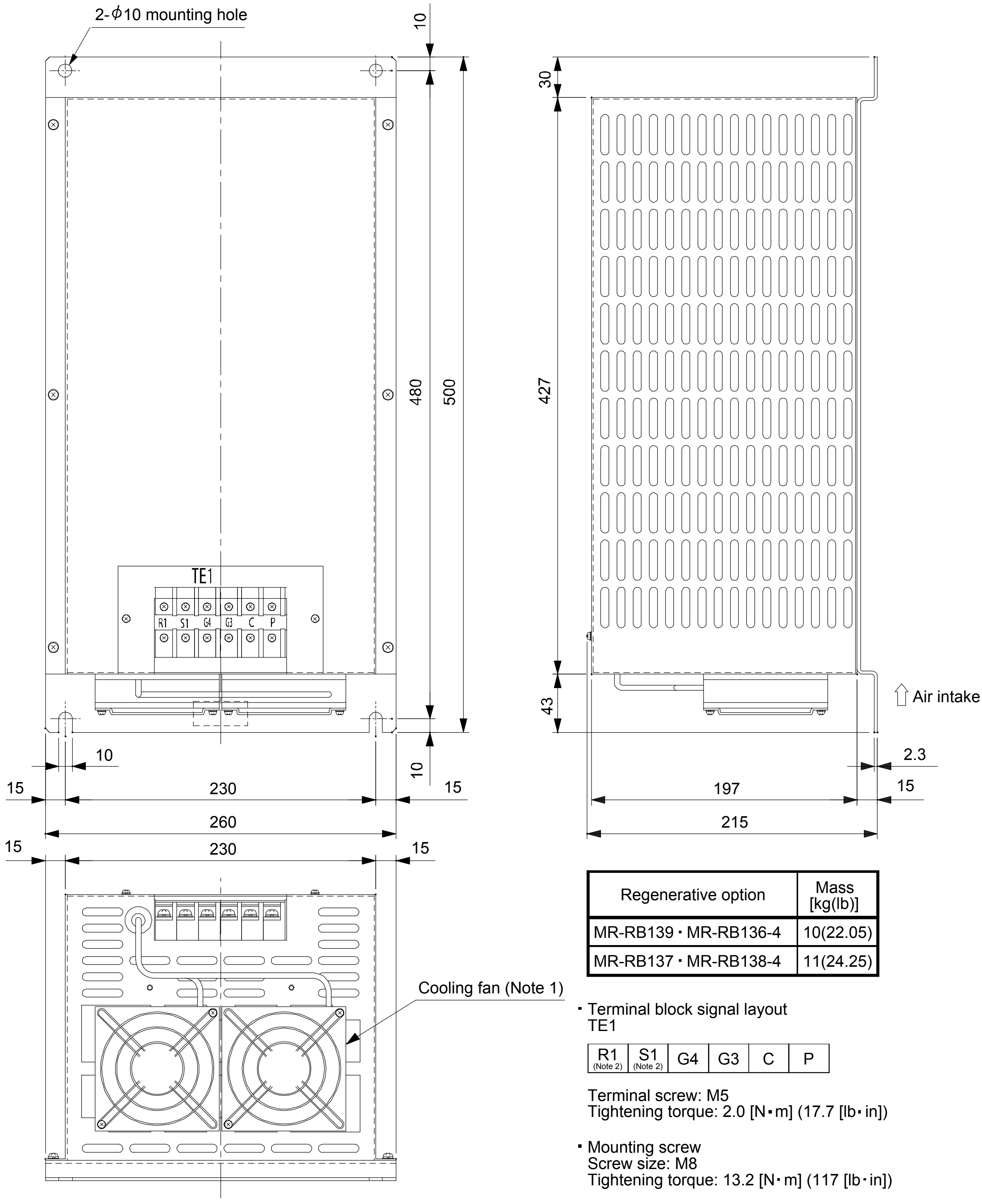


Note 1. When using the Power factor improving DC reactor, remove the short bar across P_1-P_2.

2. G3-G4 contact specifications
   Maximum voltage: 120V AC/DC
   Maximum current: 0.5V/4.8VDC
   Maximum capacity: 2.4VA
3. For specifications of cooling fan power supply, refer to Table 13.3.
4. For MR-RB138-4, “R1” is “R400” and “S1” is “S400”.

(5) Outline dimension drawings

[Unit: mm]



Regenerative option	Mass [kg(lb)]
MR-RB139 · MR-RB136-4	10(22.05)
MR-RB137 · MR-RB138-4	11(24.25)

- Terminal block signal layout
  TE1

R1 (Note 2)	S1 (Note 2)	G4	G3	C	P

Terminal screw: M5
Tightening torque: 2.0 [N·m] (17.7 [lb·in])

- Mounting screw
  Screw size: M8
  Tightening torque: 13.2 [N·m] (117 [lb·in])

Note 1. One cooling fan for MR-RB136-4, MR-RB138-4.
2. For MR-RB138-4, “R1” is “R400” and “S1” is “S400”.

13.9.3 External dynamic brake

⚠ CAUTION

- Use an external dynamic brake for the drive unit. Failure to do so will cause an accident because the servo motor dose not stop immediately but coasts at an alarm occurrence for which the servo motor does not decelerate to stop. Ensure the safety in the entire system. For alarms for which the servo motor does not decelerate to stop, refer to section 8.1.

POINT

- The signal EM2 of the drive unit is the same as EM1 of the drive unit in torque control mode.
- Configure up a sequence which switches off the magnetic contactor of the brake unit after (or as soon as) the servo-on command has been turned off at a power failure or failure.
- For the braking time taken when the dynamic brake is operated, refer to section 13.8.3.
- The brake unit is rated for a short duration. Do not use it for high duty.
- The specifications of the input power supply for external dynamic brake are the same as those of the converter unit control circuit power supply.
- Operation timing is the same as that for servo amplifiers with 22kW or less. Refer to section 11.6.
- Dynamic brake operates at occurrence of alarm, servo forced stop warning (E6), and controller forced stop warning (E7), and when power is turned off. Do not use dynamic brake to stop in a normal operation as it is the function to stop in emergency.
- Maximum usage time of dynamic brake for a machine operating under recommended load inertia moment ratio is 1000 time while decelerating from rated speed to a stop with frequency of once in 10 minutes.
- Be sure to make forced stop 1 (EM1) valid after servo motor stops when using forced stop 1 (EM1) frequently in other than emergency.

(1) Selection of dynamic brake
The dynamic brake is designed to bring the servo motor to a sudden stop when a power failure occurs or the protective circuit is activated. When using the external dynamic brake, assign the dynamic brake interlock (DB) to any of CN3-9, CN3-13, and CN3-15 pins in parameter No.PD07 to PD09.

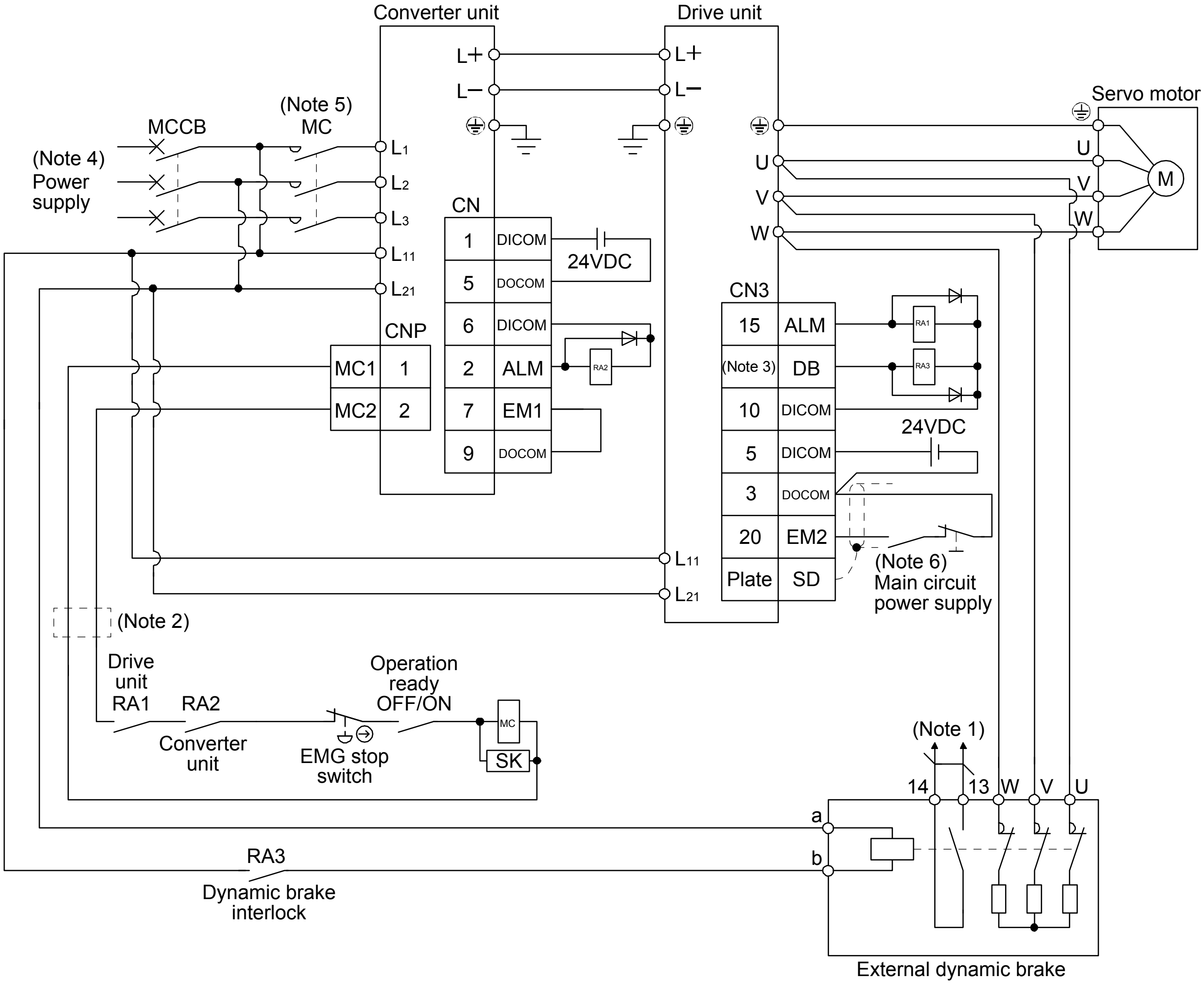
<table>
<tr><th>Converter unit</th><th>Drive unit</th><th>Dynamic brake</th></tr>
<tr><td rowspan="2">MR-J3-CR55K</td><td>MR-J3-DU30K□S</td><td rowspan="2">DBU-37K</td></tr>
<tr><td>MR-J3-DU37K□S</td></tr>
<tr><td rowspan="4">MR-J3-CR55K4</td><td>MR-J3-DU30K□S4</td><td rowspan="4">DBU-55K-4</td></tr>
<tr><td>MR-J3-DU37K□S4</td></tr>
<tr><td>MR-J3-DU45K□S4</td></tr>
<tr><td>MR-J3-DU55K□S4</td></tr>
</table>

(2) Connection example

Use the following wires to connect the dynamic brake.

Dynamic brake	Wire [mm²] (Note)	
	a・b	U・V・W
DBU-37K	2	14
DBU-55K-4		

Note. Selection condition of wire size is as follows.
Wire type: 600V Polyvinyl chloride insulated wire (IV wire)
Construction condition: One wire is constructed in the air

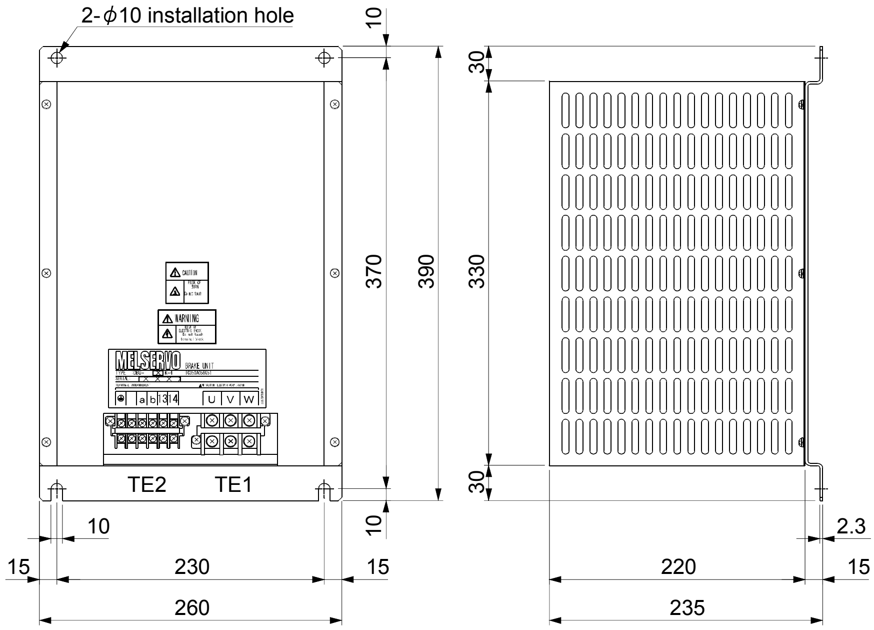


Note 1 Terminals 13, 14 are N/O contact outputs. When the dynamic brake has stuck, terminals 13, 14 are opened. Therefore, configure up the circuit to prevent servo-on in the external sequence.

2. For converter unit and servo amplifier 400 V class, stepdown transformer is required for coil voltage of magnetic contactor more than 200 V class.
3. Assign the dynamic brake interlock (DB) in parameter No.PD07 to PD09.
4. Refer to section 13.1.3 for the power supply specifications.
5. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
6. Turn off EM2 when the main power circuit power supply is off.

(3) Outline dimension drawing

[Unit: mm]



- Terminal block
  TE1

U	V	W

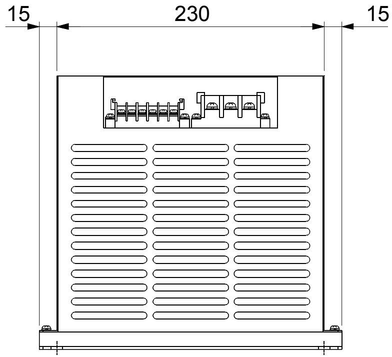
Terminal screw: M5
Tightening torque: 2.0 [N・m] (17.7 [lb・in])

TE2

⏚		a	b	13	14

Terminal screw: M5
Tightening torque: 0.8 [N・m] (7.1 [lb・in])

- Mounting screw
  Screw size: M8
  Tightening torque: 13.2 [N・m] (117 [lb・in])

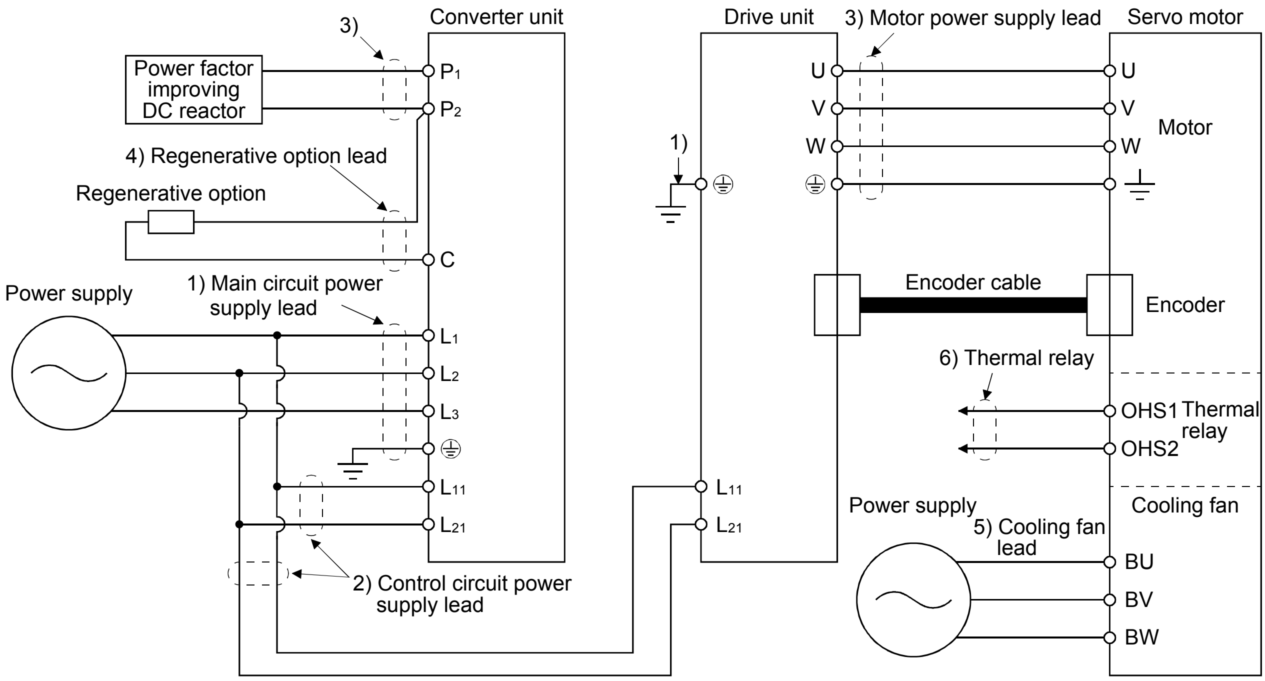


External dynamic brake	Mass [kg(lb)]
DBU-37K	8(17.64)
DBU-55K-4	11(24.25)

13.9.4 Selection example of wires

POINT
・Wires indicated in this section are separated wires. When using a cable for power line (U, V, and W) between the drive unit and servo motor, use a 600V grade EP rubber insulated chloroprene sheath cab-tire cable (2PNCT). For selection of cables, refer to App. 4. ・To comply with the UL/CSA Standard, use the wires shown in App. 9 for wiring. To comply with other standards, use a wire that is complied with each standard ・Selection condition of wire size is as follows. Construction condition: One wire is constructed in the air Wire length: 30m or less

The following diagram shows the wires used for wiring. Use the wires given in this paragraph or equivalent.



(1) When using the 600V Polyvinyl chloride insulated wire (IV wire)
Selection example of wire size when using IV wires is indicated below.

Table 13.4 Wire size selection example 1 (IV wire)

Converter unit	(Note 2) Drive unit	Wires [mm²] (Note 1, 3)					
		1) L_1 · L_2 · L_3 · ⏚	2) L_{11} · L_{21}	3) U · V · W P1 · P2 · ⏚	4) P2 · C	5) BU · BV · BW	6) OHS1 · OHS2
MR-J3-CR55K	MR-J3-DU30K☐S	50(AWG1/0): d	2(AWG14)	60(AWG2/0): d	5.5(AWG10): a	2(AWG14)	1.25(AWG16)
	MR-J3-DU37K☐S	60(AWG2/0): d		(Note 4)			
MR-J3-CR55K4	MR-J3-DU30K☐S4	22(AWG4): b		30(AWG2): f		1.25(AWG16)	
	MR-J3-DU37K☐S4	30(AWG2): c		38(AWG2): f			
	MR-J3-DU45K☐S4	38(AWG2): c		50(AWG1/0): d			
	MR-J3-DU55K☐S4	50(AWG1/0): d		60(AWG2/0): d			

Note 1. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to (3) in this section.
2. When connecting to the terminal block, be sure to use the screws which are provided with the terminal block.
3. Wires are selected based on the highest rated current among combining servo motors.
4. IV wires cannot be used. Use HIV wires indicated in (2) of this section.

(2) When using the 600V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Selection example of wire size when using HIV wires is indicated below.

Table 13.5 Wire size selection example 2 (HIV wire)

Converter unit	(Note 2) Drive unit	Wires [mm²] (Note 1, 3)					
		1) L_1 · L_2 · L_3 · ⏚	2) L_{11} · L_{21}	3) U · V · W P1 · P2 · ⏚	4) P2 · C	5) BU · BV · BW	6) OHS1 · OHS2
MR-J3-CR55K	MR-J3-DU30K☐S	38(AWG2): c	2(AWG14)	60(AWG2/0): d	5.5(AWG10): a	2(AWG14)	1.25(AWG16)
	MR-J3-DU37K☐S	60(AWG2/0): d		60(AWG2/0): d			
MR-J3-CR55K4	MR-J3-DU30K☐S4	22(AWG4): b		22(AWG4): e		1.25(AWG16)	
	MR-J3-DU37K☐S4	22(AWG4): b		22(AWG4): e			
	MR-J3-DU45K☐S4	38(AWG2): c		38(AWG2): c			
	MR-J3-DU55K☐S4	38(AWG2): c		38(AWG2): c			

Note 1. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to (3) in this section.
2. When connecting to the terminal block, be sure to use the screws which are provided with the terminal block.
3. Wires are selected based on the highest rated current among combining servo motors.

(3) Selection example of crimping terminals
The table below shows a selection example of crimping terminals for the servo amplifier terminal block when using the wires mentioned in (1) and (2) in this section.

Symbol	Servo amplifier-side crimping terminals				
	(Note 2) Crimping terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FVD5.5-10	YNT-1210S			JST
b	FVD22-10	YF-1・E-4	YNE-38	DH-123・DH113	
(Note 1) c	R38-10	YPT-60-21		TD-124・TD112	
		YF-1・E-4	YET-60-1		
(Note 1) d	R60-10	YPT-60-21		TD-125・TD113	
		YF-1・E-4	YET-60-1		
e	FVD22-8	YF-1・E-4	YNE-38	DH-123・DH-113	
(Note 1) f	R38-8	YPT-60-21		TD-124・TD-112	
		YF-1・E-4	YET-60-1		

Note 1. Coat the part of crimping with the insulation tube.
2. Make sure to use recommended crimping terminals or equivalent since some crimping terminals cannot be installed depending on the size.

13.9.5 Molded-case circuit breakers, fuses, magnetic contactors

Always use one molded-case circuit breakers and one magnetic contactor with one drive unit.

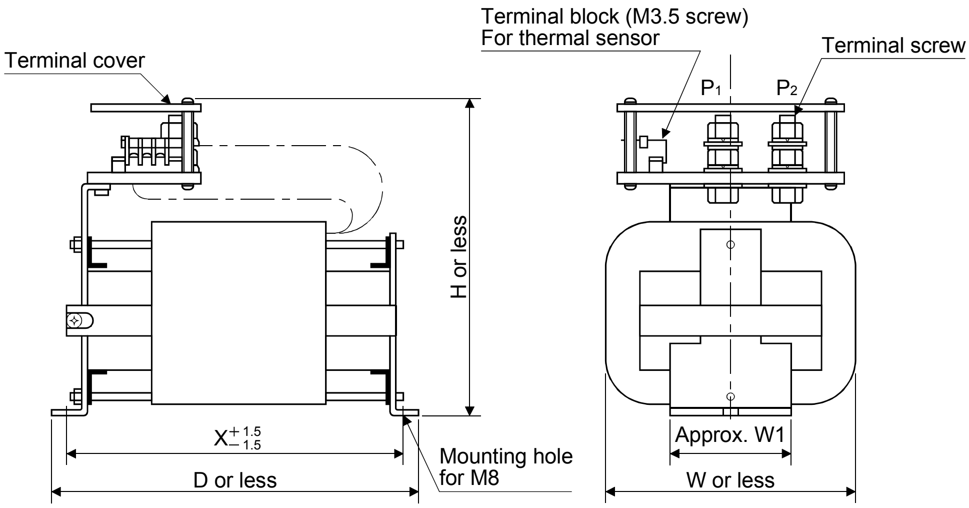
Converter unit	Drive unit	Molded-case circuit breaker			Fuse			(Note) Magnetic contactor
		Current		Voltage AC	Class	Current [A]	Voltage AC [V]	
		Power factor improving DC reactor is not used	Power factor improving DC reactor is used					
MR-J3-CR55K	MR-J3-DU30K□S	400A frame 250A	225A frame 225A	240V	T	500	300	S-N150
	MR-J3-DU37K□S	400A frame 300A	400A frame 300A			600		S-N180
MR-J3-CR55K4	MR-J3-DU30K□S4	225A frame 125A	225A frame 125A	600Y/347V		250	600	S-N95
	MR-J3-DU37K□S4	225A frame 150A	225A frame 150A			300		S-N125
	MR-J3-DU45K□S4	225A frame 175A	225A frame 175A			400		S-N150
	MR-J3-DU55K□S4	400A frame 225A	225A frame 225A			450		S-N180

Note. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

13.9.6 Power factor improving DC reactor

The input power factor is improved to about 95%.

<table>
<tr><th rowspan="2">Converter unit</th><th rowspan="2">Drive unit</th><th rowspan="2">Power factor improving DC reactor</th><th colspan="5">Dimension [mm]</th><th rowspan="2">Terminal screw</th><th rowspan="2">Mass [kg (lb)]</th></tr>
<tr><th>W</th><th>D</th><th>H</th><th>W1</th><th>X</th></tr>
<tr><td rowspan="2">MR-J3-CR55K</td><td>MR-J3-DU30K□S</td><td>MR-DCL30K</td><td rowspan="6">135</td><td rowspan="2">255</td><td rowspan="2">215</td><td rowspan="2">80</td><td rowspan="2">232</td><td rowspan="2">M12</td><td rowspan="2">9.5
(20.94)</td></tr>
<tr><td>MR-J3-DU37K□S</td><td>MR-DCL37K</td></tr>
<tr><td rowspan="4">MR-J3-CR55K4</td><td>MR-J3-DU30K□S4</td><td>MR-DCL30K-4</td><td>205</td><td rowspan="3">200</td><td>75</td><td>175</td><td rowspan="4">M8</td><td>6.5
(14.33)</td></tr>
<tr><td>MR-J3-DU37K□S4</td><td>MR-DCL37K-4</td><td>225</td><td rowspan="3">80</td><td>197</td><td>7
(15.43)</td></tr>
<tr><td>MR-J3-DU45K□S4</td><td>MR-DCL45K-4</td><td>240</td><td>212</td><td>7.5
(16.54)</td></tr>
<tr><td>MR-J3-DU55K□S4</td><td>MR-DCL55K-4</td><td>260</td><td>215</td><td>232</td><td>9.5
(20.94)</td></tr>
</table>



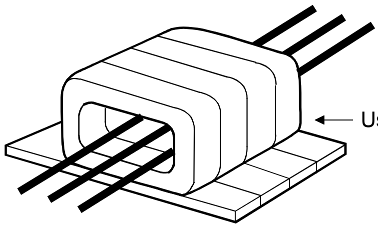
13.9.7 Line noise filter (FR-BLF)

POINT
・This section explains how to use the line noise filter unique to servo amplifiers with a large capacity. Other noise reduction products are the same as those for servo amplifiers with 22kW or less. Refer to section 11.16.

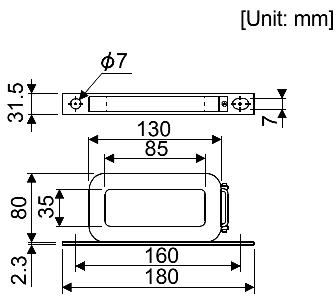
This filter is effective in suppressing noises radiated from the power supply side or output side of the converter unit, drive unit and also in suppressing high-frequency leakage current (0-phase current) especially within 0.5MHz to 5MHz band. The filters are used with the converter power supply wires (L_1・L_2・L_3) and drive unit power wires (U・V・W).

(1) Usage

Pass the 3-phase wires through four line noise filters. When using the line noise filters with the power wires, passing the power wires together with the ground wire will reduce the filter effect. Run the ground wire separately from the power wires.



(2) Outline drawing



13.9.8 Earth-leakage current breaker

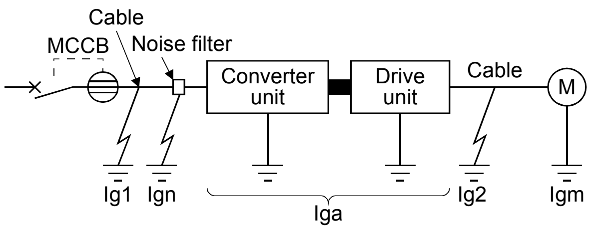
(1) Selection method

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 an earth-leakage current breaker according to the following formula, and ground the drive unit, 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) to minimize leakage currents.

Rated sensitivity current $\geq 10 \cdot \{Ig1 + Ign + Iga + K \cdot (Ig2 + Igm)\} +$ [mA] ·· (13.2)



Earth-leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-HW	1
General models	BV-C1 NFB NV-L	3

Ig1: Leakage current on the electric channel from the earth-leakage current breaker to the input terminals of the drive unit (Found from Fig. 13.3.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 13.3.)

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

Iga: Leakage current of the drive unit (Found from Table 13.7.)

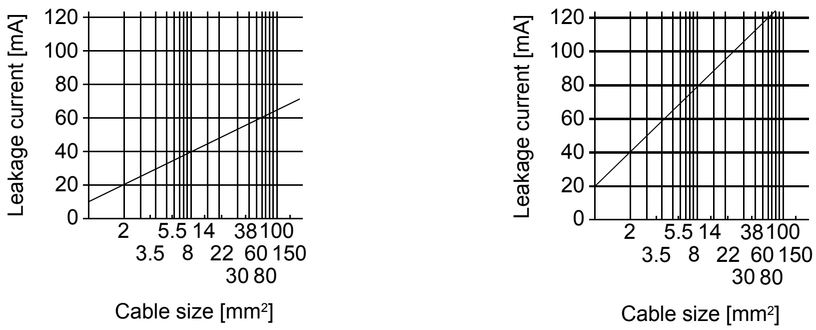
Igm: Leakage current of the servo motor (Found from Table 13.6.)

Table 13.6 Servo motor's leakage current example (Igm)

Servo motor power [kW]	Leakage current [mA]
30 to 55	2.5

Table 13.7 Converter unit・drive unit's leakage current Example (Iga)

Converter unit Drive unit	Leakage current [mA]
All series	5



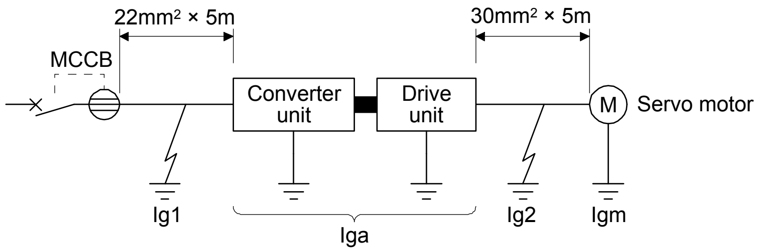
a) 200V class

b) 400V class

Fig.13.3 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

(2) Selection example

Indicated below is an example of selecting an earth-leakage current breaker under the following conditions.



Use an earth-leakage current breaker designed for suppressing harmonics/surges.
Find the terms of Equation (13.2) from the diagram.

$$Ig1 = 95 \times \frac{5}{1000} = 0.475 \text{ [mA]}$$

$$Ig2 = 105 \times \frac{5}{1000} = 0.525 \text{ [mA]}$$

Ign = 0(not used)

Iga = 5 [mA]

Igm = 2.5 [mA]

Insert these values in Equation (13.2).

$$\begin{aligned} Ig &\geq 10 \cdot \{0.475 + 0 + 5 + 1 \cdot (0.525 + 2.5)\} \\ &\geq 85 \text{ [mA]} \end{aligned}$$

According to the result of calculation, use an earth-leakage current breaker having the rated sensitivity current (Ig) of 85 [mA] or more. An earth-leakage current breaker having Ig of 200 [mA] is used with the NV-SP/SW/CP/CW/HW series.

13.9.9 EMC filter (recommended)

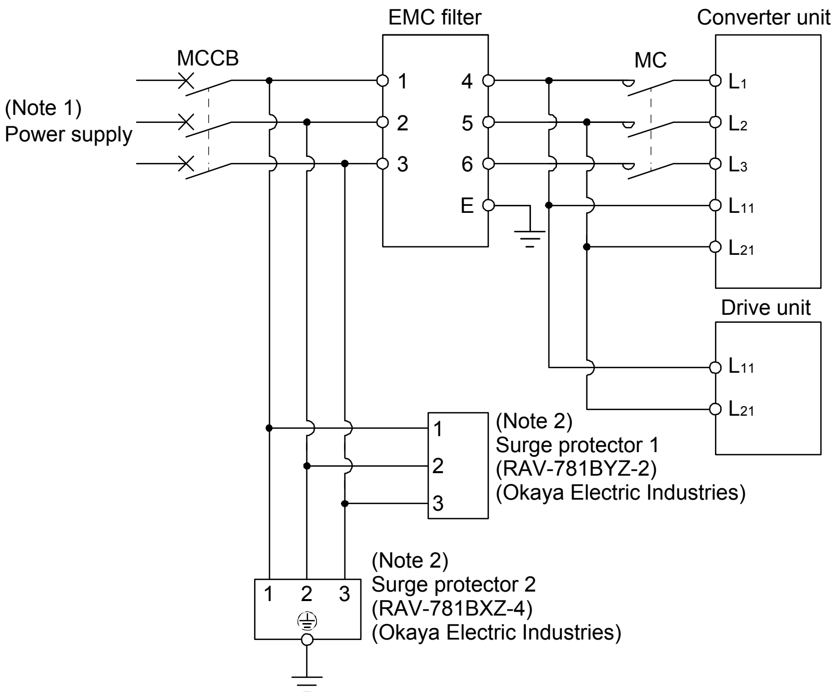
For compliance with the EMC directive of the EN Standard, it is recommended to use the following filter. Some EMC filters are large in leakage current.

(1) Combinations of converter units and drive units

Converter unit	Drive unit	Recommended filter (Soshin Electric)					Mass [kg]
		Model	Rated current [A]	Rated voltage [VAC]	Leakage current [mA]		
MR-J3-CR55K	MR-J3-DU30K□S・MR-J3-DU37K□S	(Note) HF3200A-UN	200	250	9		18
MR-J3-CR55K4	MR-J3-DU30K□S4 to MR-J3-DU55K□S4	TF3150C-TX	150	500	5.5		31

Note. A surge protector is separately required to use any of these EMC filters.

(2) Connection example

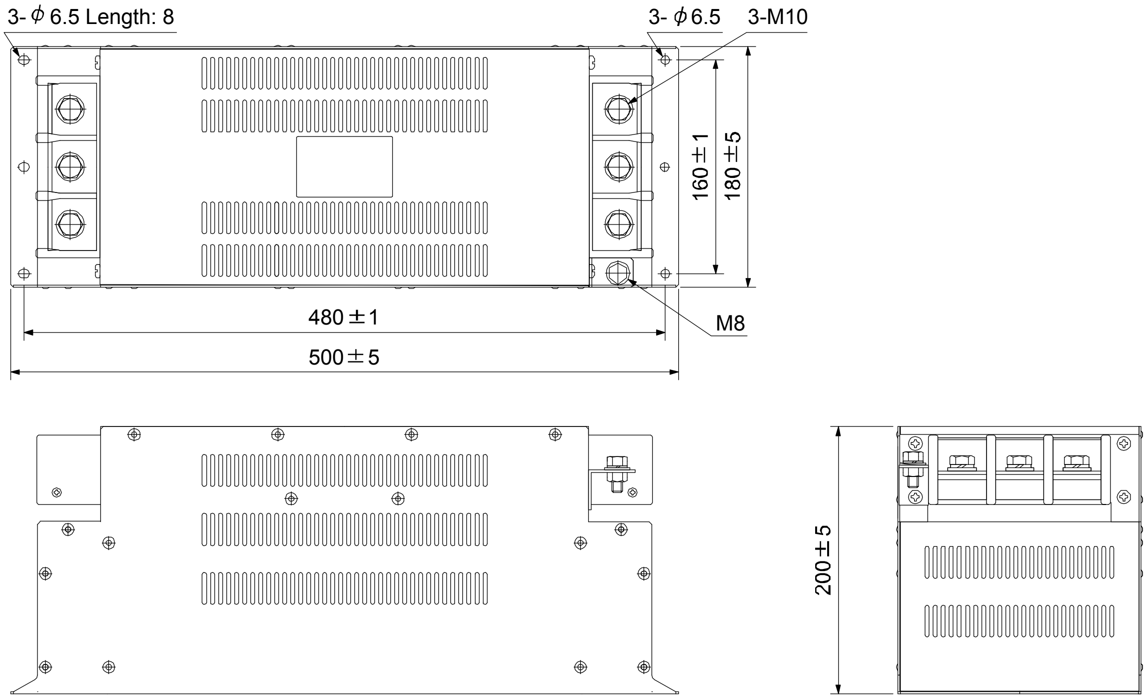


Note 1. For power supply specifications, refer to section 13.1.3.
2. The example is when a surge protector is connected.
For dimension of surge protector, refer to section 11.18 (3) (b).

(3) Outline drawing

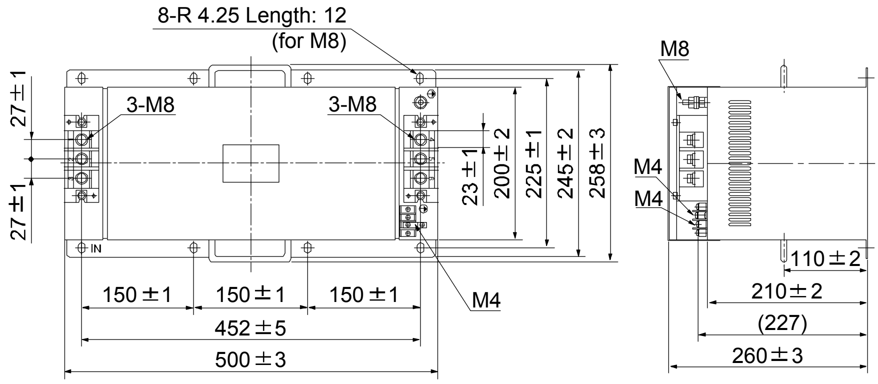
HF3200A-UN

[Unit: mm]



TF3150C-TX

[Unit: mm]



13.9.10 FR-BU2-(H) Brake Unit

POINT

- The signal EM2 of the drive unit is the same as EM1 of the drive unit in torque control mode.
- Use a 200V class brake unit and a resistor unit with a 200V class converter unit, and a 400V class brake unit and a resistor unit with a 400V class converter unit. Combination of different voltage class units cannot be used.
- Install a brake unit and a resistor unit on a flat surface vertically. When the unit is installed horizontally or diagonally, the heat dissipation effect diminishes.
- Temperature of the resistor unit case rises to higher than ＋100℃. Keep cables and flammable materials away from the case.
- Ambient temperature condition of the brake unit is between －10℃ to 50℃. Note that the condition is different from the ambient temperature condition of the converter unit (between 0℃ to 55℃).
- Configure the circuit to shut down the power-supply with the alarm output of the brake unit and the resistor unit under abnormal condition.
- Use the brake unit with a combination indicated in (1) of this section.
- When using the brake unit, set the parameters as shown below.

	Setting value
Parameter No.PA01 of the MR-J3-CR55K(4) converter unit	□□00 (Initial value)
Parameter No.PA02 of the drive unit	□□00 (Initial value)

Connect the brake unit to the bus of the converter unit (L＋ and L－ of TE2-1) for use. As compared to the MR-RB regenerative option, the brake unit can return larger power. Use the brake unit when the regenerative option cannot provide sufficient regenerative capability.
When using the brake unit, always refer to the FR-BU2-(H) Brake Unit Instruction Manual.

(1) Selection
Use a combination of converter unit, brake unit and resistor unit listed below.

Brake unit		Resistor unit	Number of connected units	Permissible continuous power [kW]	Resultant resistance [Ω]	Applicable converter unit
200V class	FR-BU2-55K	FR-BR-55K	2 (parallel)	7.82	1	MR-J3-CR55K
		MT-BR5-55K	2 (parallel)	11.0	1	MR-J3-CR55K
400V class	FR-BU2-H55K	FR-BR-H55K	2 (parallel)	7.82	4	MR-J3-CR55K4
	FR-BU2-H75K	MT-BR5-H75K	2 (parallel)	15.0	3.25	MR-J3-CR55K4

(2) Brake unit parameter setting

Normally, changing parameters of the FR-BU2-(H) is not necessary. Whether a parameter can be changed or not is listed below.

Parameter		Change possible/ impossible	Remarks
No.	Name		
0	Brake mode switchover	Impossible	Do not change the parameter.
1	Monitor display data selection	Possible	Refer to FR-BU2-(H) Brake Unit Instruction Manual.
2	Input terminal function selection 1	Impossible	Do not change the parameter
3	Input terminal function selection 2		
77	Parameter write selection		
78	Cumulative energization time carrying-over times		
CLr	Parameter clear		
ECL	Alarm history clear		
C1	For manufacturer setting		

(3) Connection example

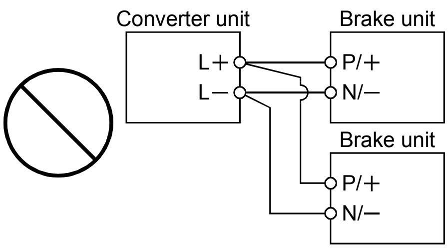
POINT

- Connecting PR terminal of the brake unit to L+ terminal of the converter unit results in a brake unit malfunction. Always connect the PR terminal of the brake unit to the PR terminal of the resistor unit.

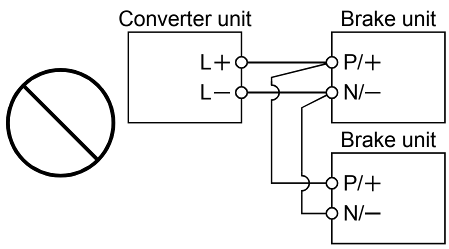
(a) Combination with FR-BR-(H) resistor unit

POINT

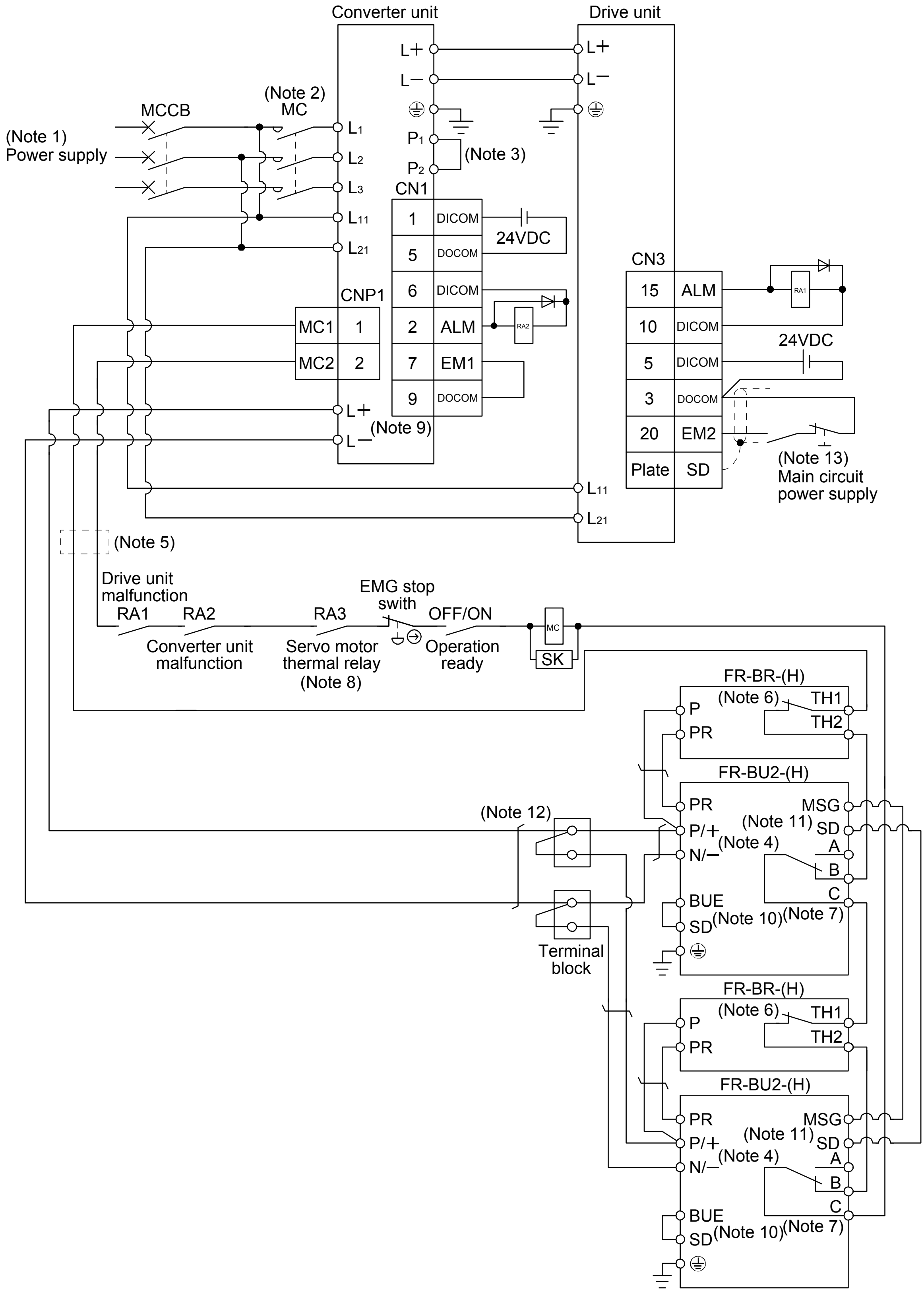
- To use brake units with a parallel connection, use two sets of FR-BU2-(H) brake unit. Combination with other brake unit results in alarm occurrence or malfunction.
- Always connect the master and slave terminals (MSG and SD) of the two brake units.
- Do not connect as shown below.



Connecting two cables to P and N terminals



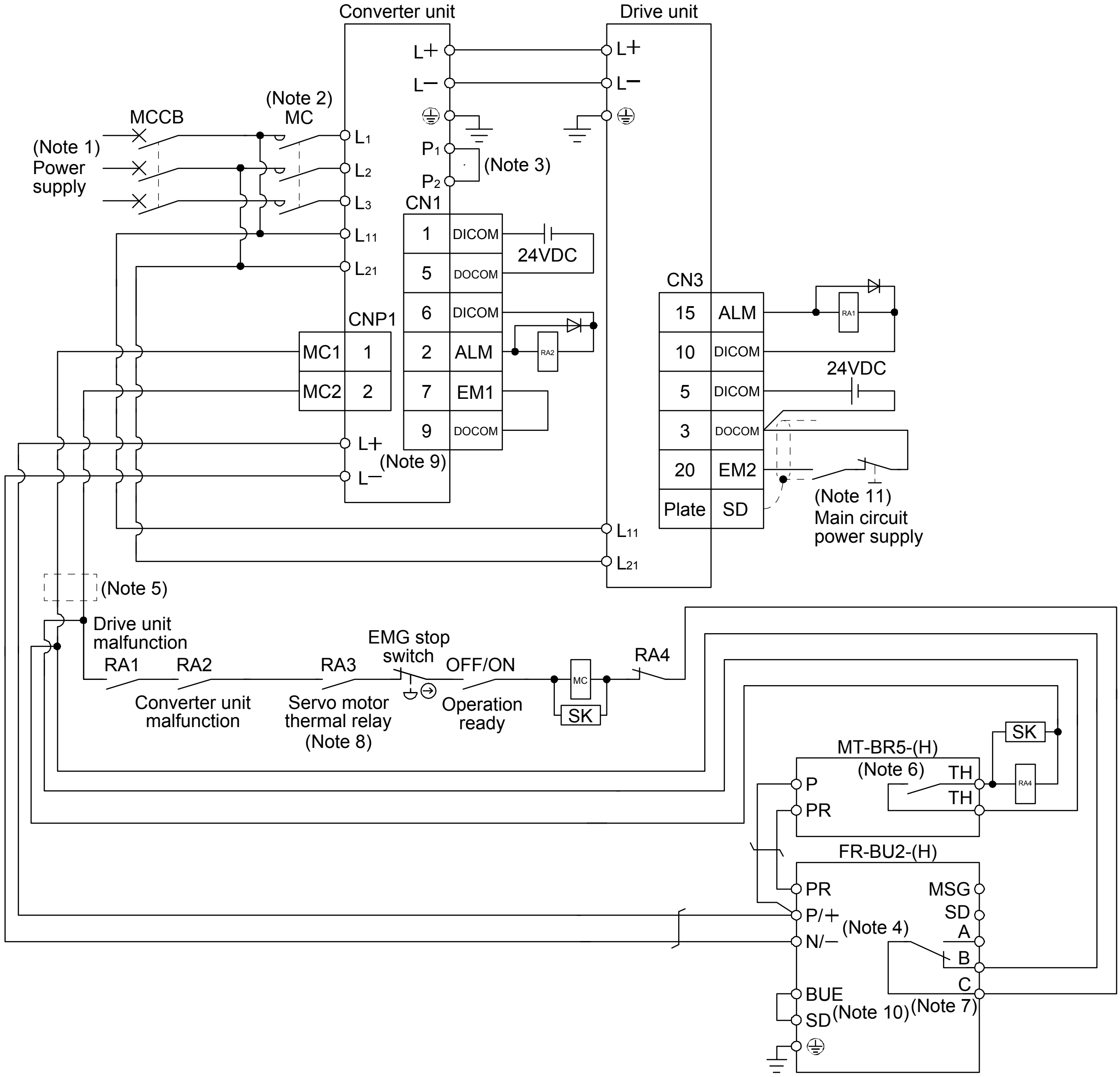
Passing wiring


Converter unit
Drive unit
L+
L−
(Note 2)
MC
MCCB
(Note 1)
Power supply
L1
L2
L3
L11
L21
P1
P2
(Note 3)
CN1
DICOM
DOCOM
24VDC
RA2
CNP1
MC1
MC2
ALM
EM1
(Note 9)
CN3
15
10
5
3
20
Plate
SD
EM2
RA1
(Note 13)
Main circuit
power supply
(Note 5)
Drive unit
malfunction
RA1
RA2
Converter unit
malfunction
RA3
Servo motor
thermal relay
(Note 8)
EMG stop
swith
OFF/ON
Operation
ready
MC
SK
FR-BR-(H)
(Note 6)
P
PR
TH1
TH2
FR-BU2-(H)
MSG
(Note 11)
P/+
N/−
(Note 4)
A
B
C
BUE
(Note 10)
(Note 7)
(Note 12)
Terminal
block

Note 1. For power supply specifications, refer to section 13.1.3.
2. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
3. Always connect P_1 and P_2 terminals (Factory-wired). When using the power factor improving DC reactor, refer to section 13.9.6.
4. Connect P/＋ and N/－ terminals of the brake unit to a correct destination. Wrong connection results in the converter unit and brake unit malfunction.
5. For the converter unit and the drive unit of 400V class, a stepdown transformer is required.
6. Contact rating: 1b contact, 110VAC_5A/220VAC_3A
Normal condition: TH1-TH2 is conducting. Abnormal condition: TH1-TH2 is not conducting.
7. Contact rating: 230VAC_0.3A/30VDC_0.3A
Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
8. Connect the thermal sensor of the servo motor.
9. Do not connect more than one cable to each L＋ and L－ terminals of TE2-1 of the converter unit.
10. Always connect BUE and SD terminals (Factory-wired).
11. Connect MSG and SD terminals of the brake unit to a correct destination. Wrong connection results in the converter unit and brake unit malfunction.
12. For connecting L＋ and L－- terminals of TE2-1 of the converter unit to the terminal block, use the cable indicated in (3) (d) of this section.
13. Turn off EM2 when the main power circuit power supply is off.

(b) Combination with MT-BR5-(H) resistor unit

1) When connecting a brake unit to a converter unit



Note 1. For power supply specifications, refer to section 13.1.3.

2. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.

3. Always connect P_1 and P_2 terminals (Factory-wired). When using the power factor improving DC reactor, refer to section 13.9.6.

4. Connect P/+ and N/− terminals of the brake unit to a correct destination. Wrong connection results in the converter unit and brake unit malfunction.

5. For the converter unit and the drive unit of 400V class, a stepdown transformer is required.

6. Contact rating: 1a contact, 110VAC_5A/220VAC_3A
Normal condition: TH1-TH2 is not conducting. Abnormal condition: TH1-TH2 is conducting.

7. Contact rating: 230VAC_0.3A/30VDC_0.3A
Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.

8. Connect the thermal sensor of the servo motor.

9. Do not connect more than one cable to each L+ and L− terminals of TE2-1 of the converter unit.

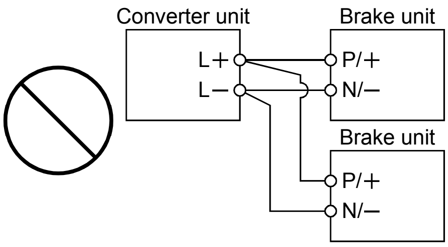
10. Always connect BUE and SD terminals (Factory-wired).

11. Turn off EM2 when the main power circuit power supply is off.

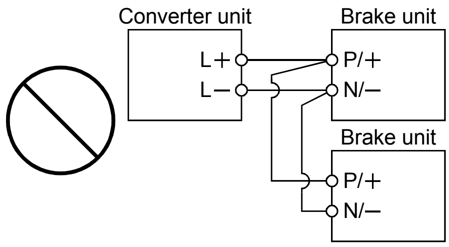
2) When connecting two brake units to a converter unit

POINT

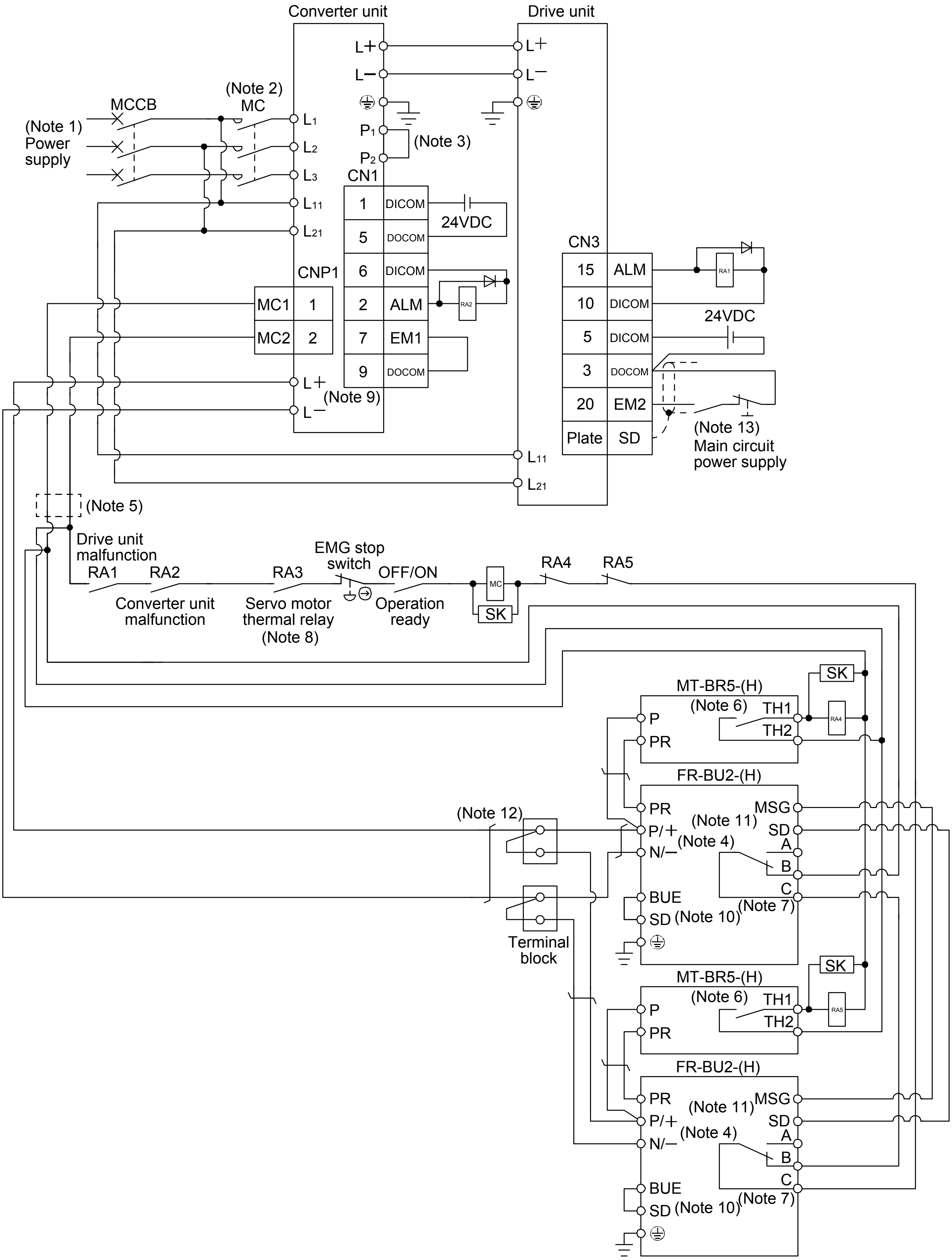
- To use brake units with a parallel connection, use two sets of FR-BU2-(H) brake unit. Combination with other brake unit results in alarm occurrence or malfunction.
- Always connect the master and slave terminals (MSG and SD) of the two brake units.
- Do not connect the converter unit and brake units as below. Connect the cables with a terminal block to distribute as indicated in this section.



Connecting two cables to P and N terminals



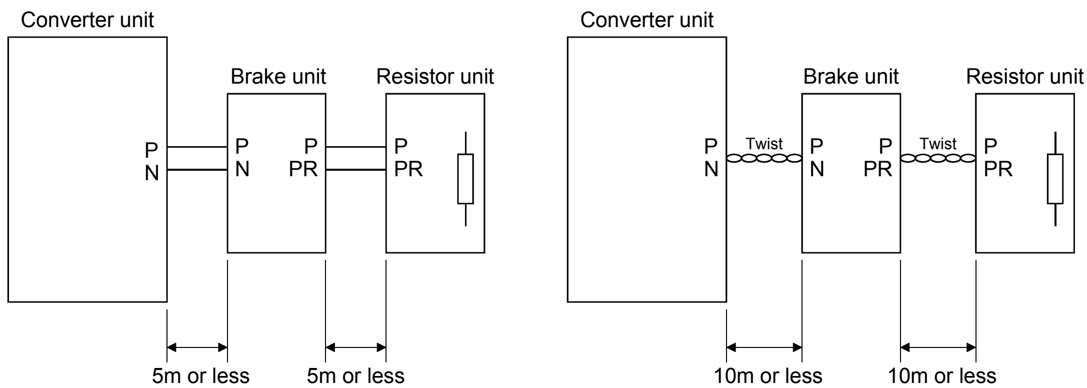
Passing wiring


Converter unit
Drive unit
L+
L−
MCCB
(Note 2) MC
(Note 1) Power supply
L1
L2
L3
L11
L21
P1
P2
(Note 3)
CN1
1 DICOM
5 DOCOM
6 DICOM
2 ALM
7 EM1
9 DOCOM
24VDC
RA2
CNP1
MC1 1
MC2 2
(Note 9)
CN3
15 ALM
10 DICOM
5 DICOM
3 DOCOM
20 EM2
Plate SD
RA1
24VDC
(Note 13)
Main circuit power supply
(Note 5)
Drive unit malfunction
RA1
RA2
Converter unit malfunction
RA3
Servo motor thermal relay (Note 8)
EMG stop switch
OFF/ON
Operation ready
MC
SK
RA4
RA5
MT-BR5-(H)
(Note 6)
P
PR
TH1
TH2
RA4
SK
FR-BU2-(H)
PR
P/+
N/−
MSG
SD
A
B
C
(Note 11)
(Note 4)
BUE
SD
(Note 10)
(Note 7)
(Note 12)
Terminal block
MT-BR5-(H)
(Note 6)
RA5
FR-BU2-(H)

Note 1. For power supply specifications, refer to section 13.1.3.
2. Be sure to use a magnetic contactor with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts. Depending on the main circuit voltage and operation pattern, bus voltage decreases, and that may cause the forced stop deceleration to shift to the dynamic brake deceleration. When dynamic brake deceleration is not required, slow the time to turn off the magnetic contactor.
3. Always connect P_1 and P_2 terminals (Factory-wired). When using the power factor improving DC reactor, refer to section 13.9.6.
4. Connect P/＋ and N/－ terminals of the brake unit to a correct destination. Wrong connection results in the converter unit and brake unit malfunction.
5. For the converter unit and the drive unit of 400V class, a stepdown transformer is required.
6. Contact rating: 1a contact, 110VAC_5A/220VAC_3A
Normal condition: TH1-TH2 is conducting. Abnormal condition: TH1-TH2 is not conducting.
7. Contact rating: 230VAC_0.3A/30VDC_0.3A
Normal condition: B-C is conducting/A-C is not conducting. Abnormal condition: B-C is not conducting/A-C is conducting.
8. Connect the thermal sensor of the servo motor.
9. Do not connect more than one cable to each L＋ and L－ terminals of TE2-1 of the converter unit.
10. Always connect BUE and SD terminals (Factory-wired).
11. Connect MSG and SD terminals of the brake unit to a correct destination. Wrong connection results in the converter unit and brake unit malfunction.
12. For connecting L＋ and L－- terminals of TE2-1 of the converter unit to the terminal block, use the cable indicated in (3) (d) of this section.
13. Turn off EM2 when the main power circuit power supply is off.

(c) Precautions for wiring

The cables between the converter unit and the brake unit, and between the resistor unit and the brake unit should be as short as possible. Always twist the cable longer than 5m (twist five times or more per one meter). Even when the cable is twisted, the cable should be less than 10m. Using cables longer than 5m without twisting or twisted cables longer than 10m, may result in the brake unit malfunction.

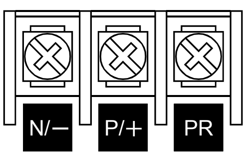


(d) Cables

1) Cables for the brake unit

For the brake unit, HIV cable (600V grade heat-resistant PVC insulated wire) is recommended.

a) Main circuit terminal

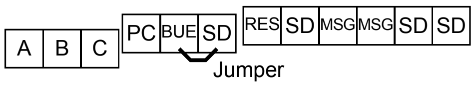


Terminal block

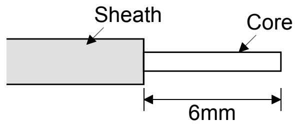
Brake unit		Main circuit terminal screw size	Crimping terminal N/－, P/＋, PR, ⏚	Tightening torque [N・m]	Wire size N/－, P/＋, PR, ⏚ HIV wire [mm²]	Wire size N/－, P/＋, PR, ⏚ AWG
200V class	FR-BU2-55K	M6	14-6	4.4	14	6
400V class	FR-BU2-H55K	M5	5.5-5	2.5	5.5	10
	FR-BU2-H75K	M6	14-6	4.4	14	6

b) Control circuit terminal

POINT
• Under tightening can cause a cable disconnection or malfunction. Over tightening can cause a short circuit or malfunction due to damage to the screw or the brake unit.



Terminal block



Wire the stripped cable after twisting to prevent the cable from becoming loose. In addition, do not solder it.
Screw size: M3
Tightening torque: 0.5 to 0.6N • m
Wire size: 0.3 to 0.75 mm^2
Screw driver: Small flat-blade screwdriver
(Tip thickness: 0.4mm/Tip width 2.5mm)

2) Cables for connecting the servo amplifier and a distribution terminal block when connecting two sets of the brake unit

Brake unit		Wire size	
		HIV wire [mm^2]	AWG
200V class	FR-BU2-55K	38	2
400V class	FR-BU2-H55K	14	6
	FR-BU2-H75K	38	2

(e) Crimping terminals for L＋ and L－ terminals of TE2-1 of servo amplifier

1) Recommended crimping terminals

POINT
・Always use recommended crimping terminals or equivalent since some crimping terminals cannot be installed depending on the size.

	Converter unit	Brake unit	Number of connected units	Crimping terminal (Manufacturer)	(Note 1) Applicable tool
200V class	MR-J3-CR55K	FR-BU2-55K	2	38-S6 (JST) (Note 2) R38-6S (NICHIFU) (Note 2)	a
400V class	MR-J3-CR55K4	FR-BU2-H55K	2	FVD14-6 (JST)	b
		FR-BU2-H75K	2	38-S6 (JST) (Note 2) R38-6S (NICHIFU) (Note 2)	a

Note 1. Symbols in the applicable tool field indicate the following applicable tools.

Symbol	Servo amplifier-side crimping terminals				
	Crimping terminal	Crimping terminal			Manufacturer
		Body	Head	Dice	
a	38-S6	YPT-60-21		TD-124・TD-112	JST
		YF-1・E-4	YET-60-1		
	R38-6S	NOP60 NOM60			NICHIFU
b	FDV14-6	YF-1・E-4	YNE-38	DH-112・DH-122	JST

2. Coat the crimping part with an insulation tube.

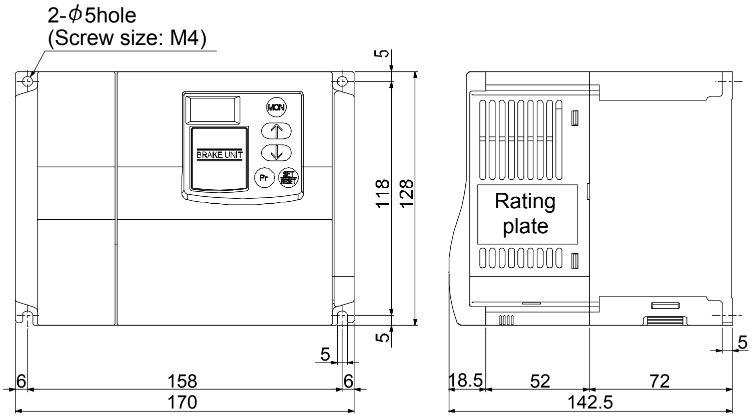
(4) Outline dimension drawings

(a) FR-BU2- (H) brake unit

[Unit: mm]

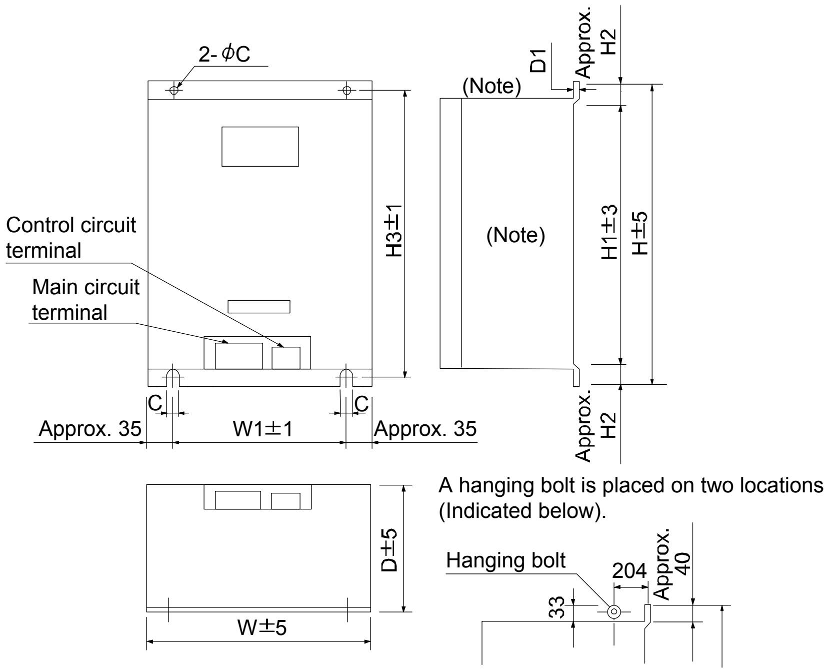
FR-BU2-55K

FR-BU2-H55K, H75K



(b) FR-BR- (H) resistor unit

[Unit: mm]

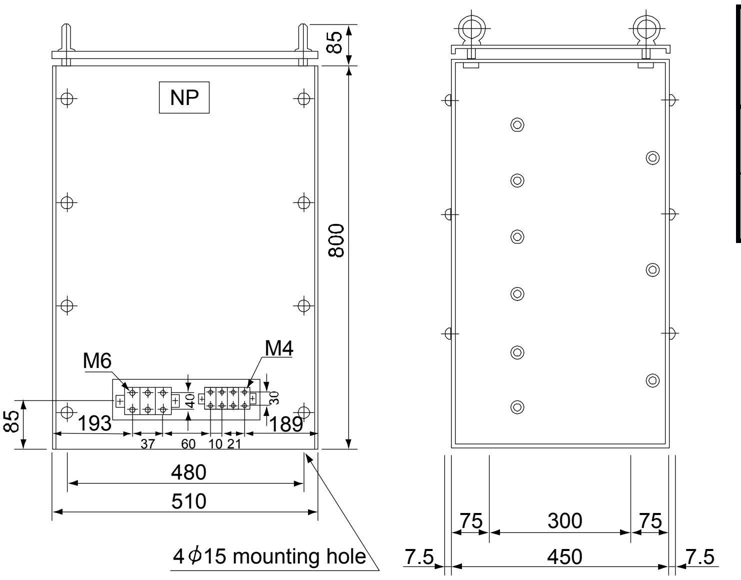


Note. Ventilation ports are provided on both sides and the top. The bottom is open.

Resistor unit		W	W1	H	H1	H2	H3	D	D1	C	Approximate mass [kg]
200V class	FR-BR-55K	480	410	700	620	40	670	450	3.2	12	70
400V class	FR-BR-H55K	480	410	700	620	20	670	450	3.2	12	70

(c) MT-BR5- (H) resistor unit

[Unit: mm]



Resistor unit		Resistance value	Approximate mass [kg]
200V class	MT-BR5-55K	2.0Ω	50
400V class	MT-BR5-H75K	6.5Ω	70

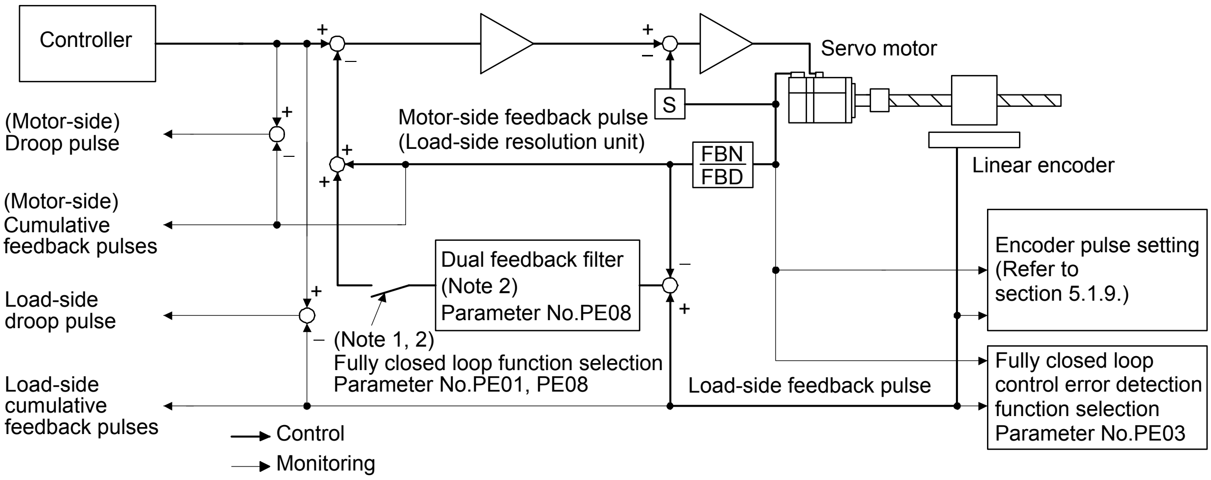
14. FULLY CLOSED LOOP SYSTEM

POINT
· The fully closed loop system can be used in the position control mode only.

14.1 Functions and configuration

14.1.1 Control block diagram

A fully closed loop control block diagram is shown below. The fully closed loop system is controlled in the load - side encoder unit.



Note 1. Switching between semi closed loop control and fully closed loop control can be performed by changing the setting of parameter No.PE01.
When semi closed loop control is selected, a control is always performed on the bases of the position data of the motor encoder independently of whether the motor is at a stop or running.

2. When parameter No.PE01 "fully closed loop system" is valid, dual feedback control in which the motor feedback signal and load-side encoder feedback signal are combined by the dual feedback filter in parameter No.PE08 is performed.
In this case, fully closed loop control is performed when the motor is at a stop, and semi closed loop control is performed when the motor is operating to improve control performance. When "4500" is set as the filter value of parameter No.PE08, fully closed loop control is always performed.

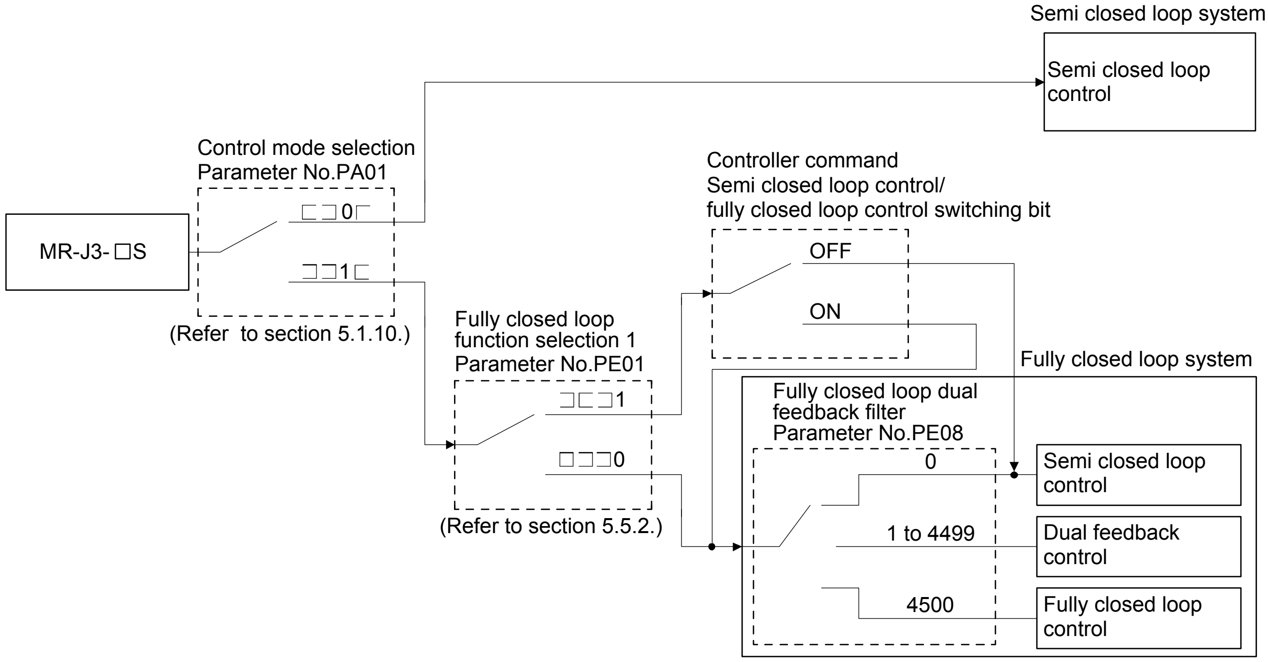
The following table shows the functions of each control mode.

Control mode	Description	
Semi closed loop control	Feature	Position is controlled according to the motor-side data.
	Advantage	Since this control is insusceptible to machine influence (such as machine resonance), the gains of the servo amplifier can be raised and the settling time shortened.
	Disadvantage	If the motor-side is at a stop, the side may be vibrating or the load-side accuracy not obtained.
Dual feedback control	Feature	Position is controlled according to the motor-side data and load-side data.
	Advantage	Control is performed according to the motor-side data during operation, and according to the load-side data at a stop in sequence to raise the gains during operation and shorten the settling time. A stop is made with the load-side accuracy.

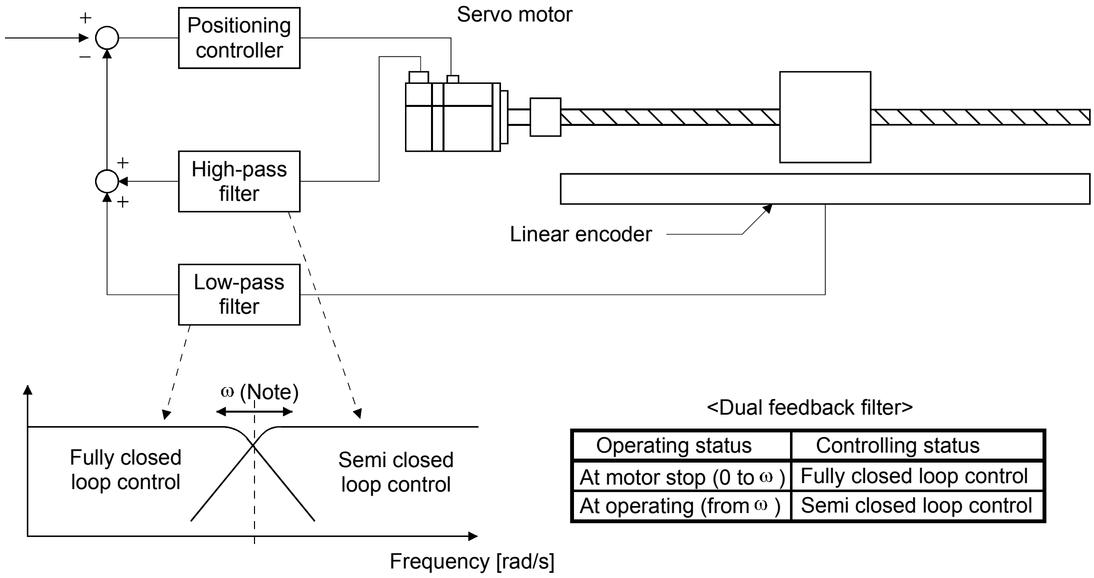
Control mode	Description	
Fully closed loop control	Feature	Position is controlled according to the load-side data.
	Advantage	The load-side accuracy is obtained not only at a stop but also during operation.
	Disadvantage	Since this control is susceptible to machine resonance or other influences, the gains of the servo amplifier do not rise and the settling time increases.

14.1.2 Selecting procedure of control mode

(1) Control mode configuration
In this servo, a semi closed loop system or fully closed loop system can be selected as a control system. Also, on the fully closed loop system, the semi closed loop control, fully closed loop control and dual feedback control can be switched by the parameter No.PE08 settings.



(2) Dual feedback filter equivalent block diagram
A dual feedback filter equivalent block diagram on the dual feedback control is shown below.



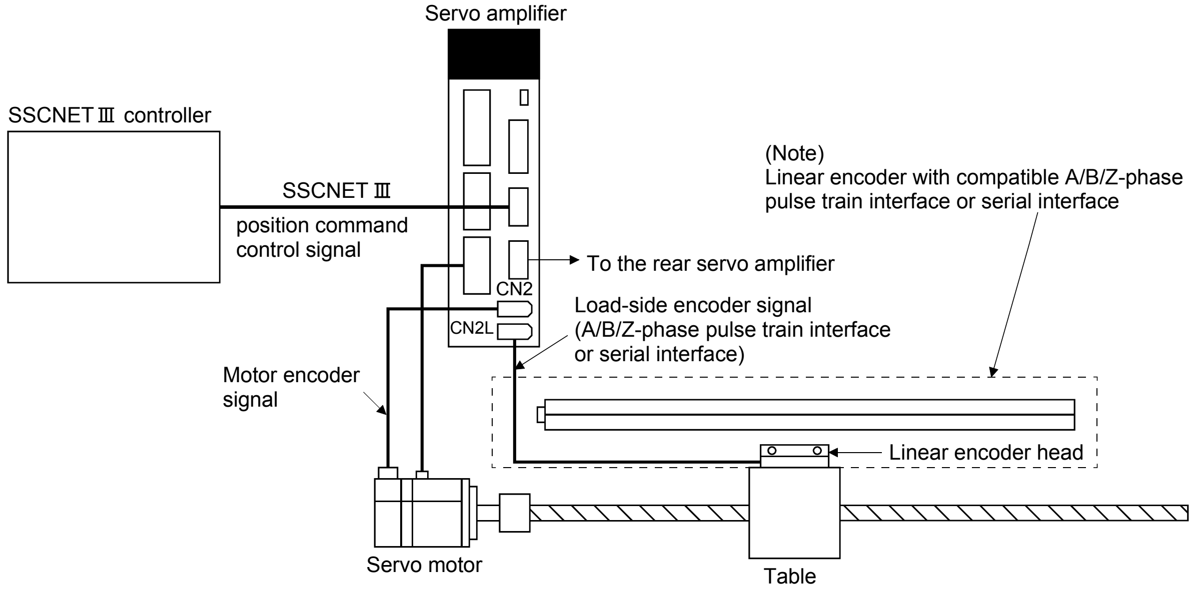
<Dual feedback filter>

Operating status	Controlling status
At motor stop (0 to ω)	Fully closed loop control
At operating (from ω)	Semi closed loop control

Note. ω (a dual feedback filter band) is set by parameter No.PE08.

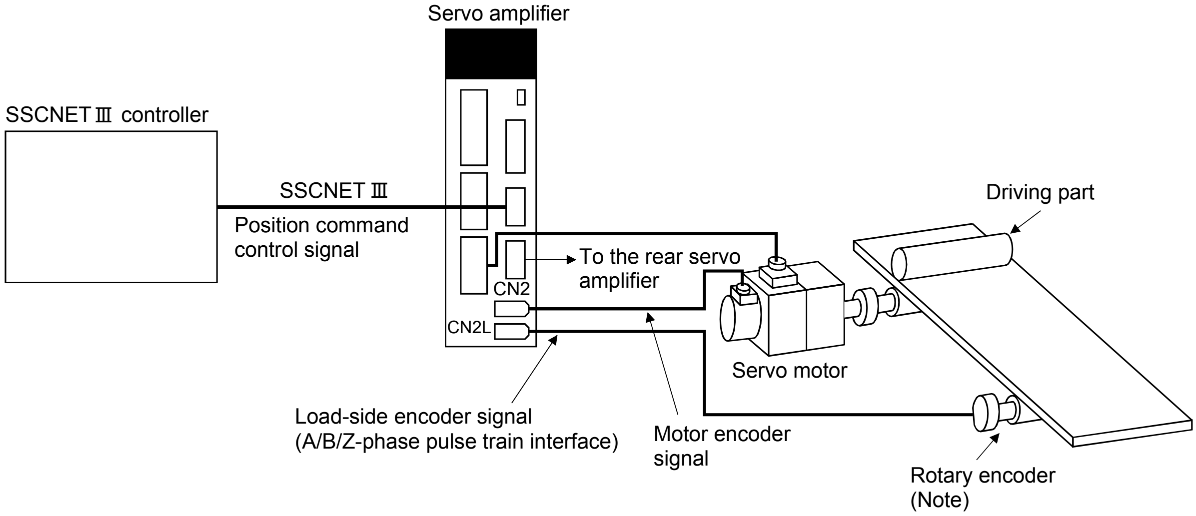
14.1.3 System configuration

(1) For a linear encoder



Note. Applicable for the absolute position detection system when an absolute position linear encoder is used.
In that case, a battery (MR-J3BAT) is not required.

(2) For a rotary encoder



Note. Not applicable for the absolute position detection system.
For the A/B/Z-phase differential output rotary encoder, refer to section 14.2.3.

14.2 Load-side encoder

> **POINT**
> - Always use the load-side encoder cable introduced in this section. If the other products are used, a faulty may occur.
> - For details of the load-side encoder specifications, performance and assurance, contact each encoder manufacturer.

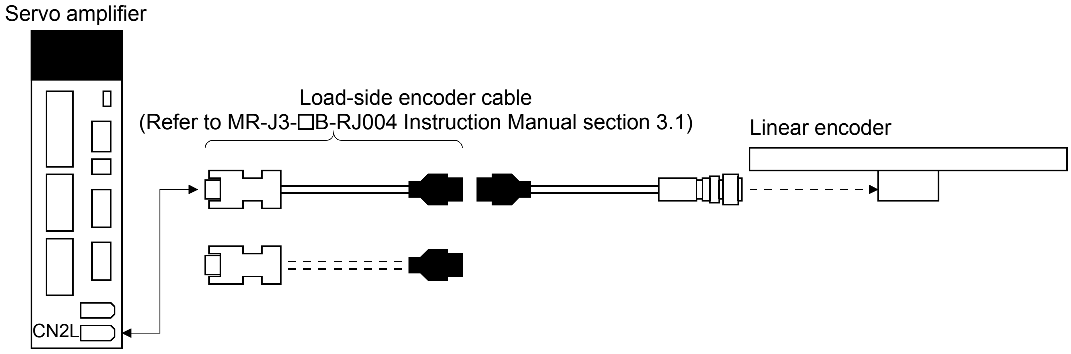
14.2.1 Compatible linear encoder list

<table>
<tr><th colspan="2">Linear encoder type</th><th>Manufacturer</th><th>Model</th><th>Resolution</th><th>Rated speed</th><th>Effective measurement length (Maximum)</th><th>Communication system</th><th>Absolute position detection system</th></tr>
<tr><td rowspan="23">Mitsubishi serial interface compatibility</td><td rowspan="13">Absolute type</td><td rowspan="2">Magnescale (Note 5)</td><td>SR77</td><td rowspan="2">0.05μm/ 0.01μm</td><td rowspan="2">3.3m/s</td><td>2040mm</td><td rowspan="2">2 wire type</td><td rowspan="13">○</td></tr>
<tr><td>SR87</td><td>3040mm</td></tr>
<tr><td rowspan="7">Mitutoyo Corporation</td><td>AT343A</td><td rowspan="2">0.05μm</td><td>2.0m/s</td><td>3000mm</td><td rowspan="7">2 wire type</td></tr>
<tr><td>AT543A-SC</td><td>2.5m/s</td><td>2200mm</td></tr>
<tr><td>AT545A-SC</td><td>20μm/4096 pulses (about 0.005μm)</td><td>2.5m/s</td><td>2200mm</td></tr>
<tr><td>ST741A</td><td rowspan="2">0.5μm</td><td rowspan="4">4.0m/s</td><td rowspan="4">6000mm</td></tr>
<tr><td>ST742A</td></tr>
<tr><td>ST743A</td><td rowspan="2">0.1μm</td></tr>
<tr><td>ST744A</td></tr>
<tr><td rowspan="4">Heidenhain</td><td rowspan="2">LC 493M (Note 3)</td><td>0.05μm</td><td rowspan="4">3.0m/s</td><td rowspan="2">2040mm</td><td rowspan="4">4 wire type</td></tr>
<tr><td>0.01μm</td></tr>
<tr><td rowspan="2">LC 193M (Note 3)</td><td>0.05μm</td><td rowspan="2">4240mm</td></tr>
<tr><td>0.01μm</td></tr>
<tr><td rowspan="10">Incremental type</td><td rowspan="5">Magnescale (Note 5)</td><td rowspan="2">SR75</td><td>0.05μm</td><td rowspan="4">3.3m/s</td><td rowspan="2">2040mm</td><td rowspan="5">2 wire type</td><td rowspan="11">×</td></tr>
<tr><td>0.01μm</td></tr>
<tr><td rowspan="2">SR85</td><td>0.05μm</td><td rowspan="2">3040mm</td></tr>
<tr><td>0.01μm</td></tr>
<tr><td>SL710 ＋PL101-R/RH ＋MJ830 or MJ831 (Note 2)</td><td>0.2μm (Note 1)</td><td>6.4m/s</td><td>100000mm</td></tr>
<tr><td rowspan="3">Renishaw Inc.</td><td>RGH26P</td><td>5μm</td><td>4.0m/s</td><td rowspan="3">70000mm</td><td rowspan="3">2 wire type</td></tr>
<tr><td>RGH26Q</td><td>1μm</td><td>3.2m/s</td></tr>
<tr><td>RGH26R</td><td>0.5μm</td><td>1.6m/s</td></tr>
<tr><td rowspan="2">Heidenhain</td><td>LIDA 485 ＋EIB 392M (Note 4)</td><td rowspan="2">20μm/16384 pulses (about 1.22nm)</td><td rowspan="2">4.0m/s</td><td>30040mm</td><td rowspan="2">4 wire type</td></tr>
<tr><td>LIDA 487 ＋EIB 392M (Note 4)</td><td>6040mm</td></tr>
<tr><td>A/B/Z-phase differential output</td><td>Incremental type</td><td>Not specified</td><td></td><td>Permissible resolution range</td><td>Linear encoder dependent</td><td>Linear encoder dependent</td><td>Differential 3 pair type</td></tr>
</table>

Note 1. Varies depending on the setting of the interpolator (MJ830/MJ831: Magnescale)
2. Production of the SH13 has been discontinued. For details, please contact Magnescale.
3. The models are changed from LC 491M and LC 192M. For details, please contact Heidenhain.
4. The model is changed from APE391M. For details, please contact Heidenhain.
5. Former company name: Sony Manufacturing Systems (The company name was changed in the end of March 2010.)

14.2.2 Configuration diagram

The following figure shows the cable connection between the servo amplifier and the linear encoder. The applicable encoder cable configuration differs according to the linear encoders used. For the encoder cable, refer to section 3.1 in the MR-J3-□B-RJ004 Instruction Manual.

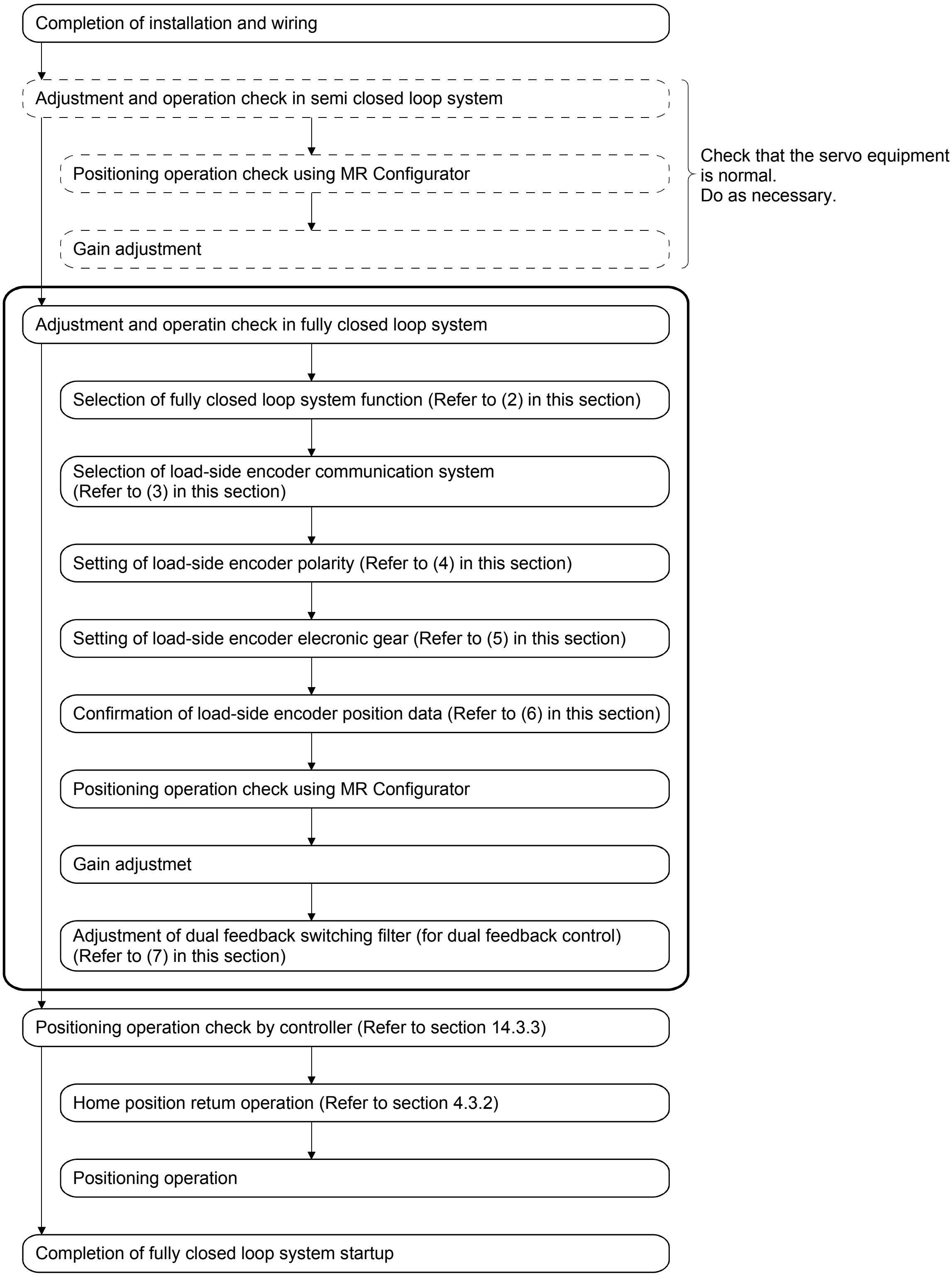


14.3 Operation and functions

14.3.1 Startup

(1) Startup procedure

Start up the fully closed loop system in the following procedure.



(2) Selection of fully closed loop system

By setting parameter No.PA01, PE01 and the control command of controller, the control method can be selected as shown in the following table.

Parameter No. PA01	Parameter No. PE01	Semi closed loop control/fully closed loop control change command	Command unit	Control method	Absolute position detection system
□□0□ semi closed loop system			Motor encoder unit	Semi closed loop control	○
□□1□ fully closed loop system	□□□0		Load-side encoder unit	Dual feedback control (fully closed loop control)	○ (Note)
	□□□1	OFF		Semi closed loop control	×
		ON		Dual feedback control (fully closed loop control)	×

Note. Applicable when the load-side encoder is set as the absolute position encoder.

(a) Control mode selection

Select a control mode.

Parameter No.PA01

0	0		0

Control mode selection
0: Semi closed loop system
1: Fully closed loop system

Set value	Control mode	Control unit
□□0□	Semi closed loop system	Motor-side resolution unit
□□1□	Fully closed loop system	Load-side resolution unit

(b) Semi closed loop control/fully closed loop control selection

Select the semi closed loop control/fully closed loop control.

Parameter No.PE01

0	0	0	

Fully closed loop control selection
0: Always fully closed loop control
1: Selection using the control command of controller

Selection using the control command of controller	Control method
OFF	Semi closed loop control
ON	Fully closed loop control

When parameter No.PA01 control configuration is set to "□□1□" (fully closed loop system), this setting is enabled.

(3) Selection of load-side encoder communication system
The communication system changes depending on the load-side encoder type.
Refer to section 14.2.1 for the communication system of the load-side encoder.
Select the cable to be connected to CN2L connector in parameter No.PC26.

Parameter No.PC26

	1	0	0

Load-side encoder cable communication system selection
0: 2-wire type
1: 4-wire type
If the setting is incorrect, the load-side encoder error1 (70) or load-side encoder error2 (71) occurs.

(4) Setting of load-side encoder polarity

CAUTION	・Do not set a wrong value in the encoder direction of parameter No.PC27 (encoder pulse count polarity selection). An abnormal operation and a machine collision may occur if a wrong value is set, which cause a fault and parts damaged.

POINT

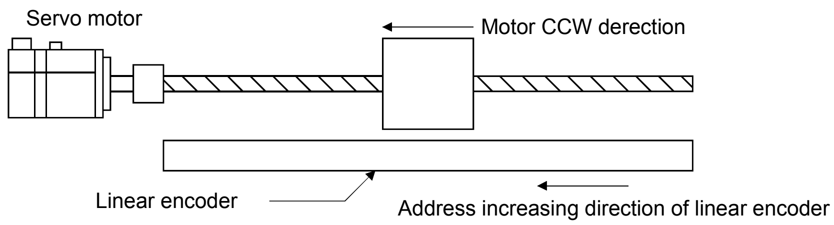
- Parameter No.PC27 (encoder pulse count polarity selection) is not related to parameter No.PA14 (rotation direction selection). Make sure to set the parameter according to the relationships between servo motor and linear encoder ・ rotary encoder.
- Do not set a wrong value in the encoder direction of parameter No.PC27 (encoder pulse count polarity selection). During the positioning operation, a fully closed loop control error (42) may occur.

(a) Parameter setting method
Set the load-side encoder polarity to be connected to CN2L connector in order to match the CCW direction of servo motor and the increasing direction of load-side encoder feedback.

Parameter No.PC27

0	0	0	

Load-side encoder pulse count polarity selection
0: Load-side encoder pulse increasing direction in the servo motor CCW
1: Load-side encoder pulse decreasing direction in the servo motor CCW



(b) How to confirm the load-side encoder feedback direction
For the may to confirm the load-side encoder feedback direction, refer to (6) in this section.

(5) Setting of feedback pulse electronic gear

POINT
・If setting a wrong value in the feedback pulse electronic gear (parameter No.PE04, PE05, PE34, PE35), a parameter error (37) and an abnormal operation may occur. Also, a fully closed loop control error (42) may occur during the positioning operation.

The numerator (parameter No.PE04, PE34) and denominator (parameter No.PE05, PE35) of the electronic gear are set to the motor encoder pulse. Set the electronic gear so that the number of motor encoder pulses per motor revolution is converted to the number of load-side encoder pulses. The relational expression is shown below.

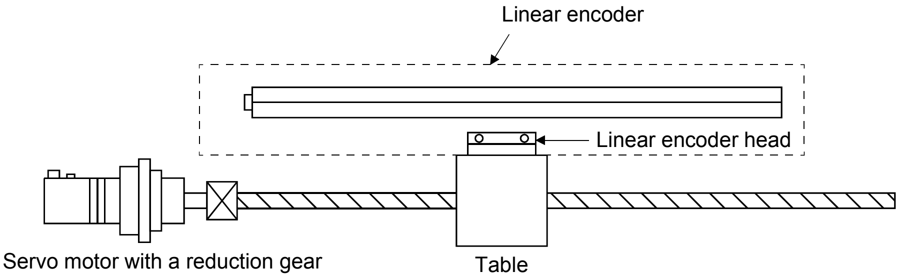
$$\frac{\text{Parameter No.PE04}\times\text{Parameter No.PE34}}{\text{Parameter No.PE05}\times\text{Parameter No.PE35}}=\frac{\text{Number of load-side encoder pulses per servo motor revolution}}{\text{Number of motor encoder pulses per servo motor revolution}}$$

Select the load-side encoder so that the number of load-side encoder pulses per servo motor revolution is within the following range.

4096 (2^{12}) ≤ Number of load-side encoder pulses per servo motor revolution ≤ 67108864 (2^{26})

(a) When the servo motor is directly coupled with a ball screw and the linear encoder resolution is 0.05 μm

Condition
Servo motor resolution: 262144pulse/rev
Servo motor reduction ratio: 1/11
Ball screw lead: 20mm
Linear encoder resolution: 0.05 μm



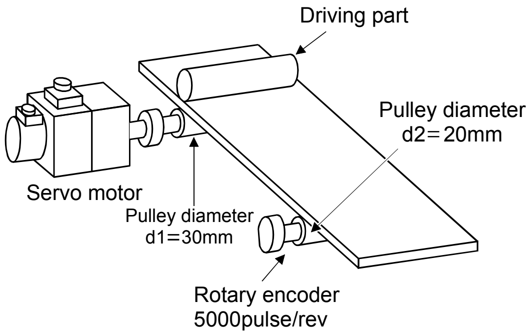
Number of linear encoder pulses per ball screw revolution is calculated.

Number of linear encoder pulses per ball screw revolution
＝Ball screw lead/Linear encoder resolution
＝20mm/0.05 μm＝400000pluse

$$\frac{\text{1) Parameter No.PE04}\times\text{2) Parameter No.PE34}}{\text{3) Parameter No.PE05}\times\text{4) Parameter No.PE35}}=\frac{400000}{262144}\times\frac{1}{11}=\frac{\text{1) }3125}{\text{3) }22528}\times\frac{\text{2) }1}{\text{4) }1}$$

(b) Setting example when using the rotary encoder for the load-side encoder of roll feeder

Condition
Servo motor resolution: 262144pulse/rev
Pulley diameter on the servo motor-side: 30mm
Pulley diameter on the rotary encoder-side: 20mm
Rotary encoder resolution: 5000pulse/rev
(20000 pulse/rev after multiplication by 4)



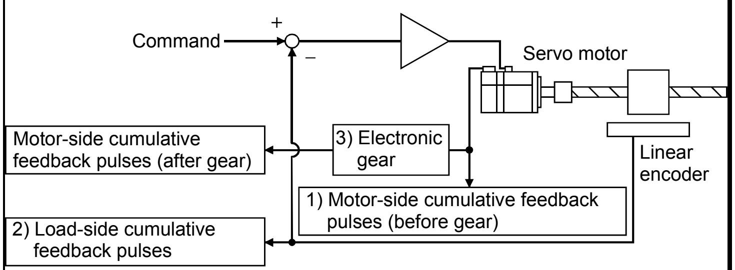
When the pulley diameters or reduction ratios differ, consider that in calculation.
For the rotary encoder, make calculation using the number of pulses multiplied by 4.

$$\frac{\text{1) Parameter No.PE04} \times \text{2) Parameter No.PE34}}{\text{3) Parameter No.PE05} \times \text{4) Parameter No.PE35}} = \frac{20000 \times 30}{262144 \times 20} = \frac{\text{1) } 1875}{\text{3) } 16384} \times \frac{\text{2) } 1}{\text{4) } 1}$$

(6) Confirmation of load-side encoder position data
Check the load-side encoder mounting and parameter settings for any problems.

POINT
・Depending on the check items, MR Configurator may be used. Refer to section 14.3.6 for the data displayed on MR Configurator.

When checking the following items, the fully closed loop control mode must be set. For the setting of control mode, refer to (2) in this section.

No.	Check item	Checking method/Description
1	Read of load-side encoder position data	With the load-side encoder in a normal state (mounting, connection, etc.), the load-side cumulative feedback pulses value is counted normally when the load-side encoder is moved.
2	Read of load-side encoder scale home position (reference mark, Z-phase)	With the linear encoder home position (reference mark, Z-phase) of the load-side encoder in a normal condition (mounting, connection, etc.), the value of load-side encoder information 1 is cleared to 0 when the linear encoder home position (reference mark, Z-phase) is passed through by moving the load-side encoder.
3	Confirmation of load-side encoder feedback direction (Setting of load-side encoder polarity)	Confirm that the directions of the cumulative feedback pulses of motor encoder (after gear) and the load-side cumulative feedback pulses are matched by moving the device (load-side encoder) manually in the servo-off status. If mismatched, reverse the polarity.
4	Setting of load-side encoder electronic gear	When the servo motor and load-side encoder operate synchronously, the motor-side cumulative feedback pulses (after gear) and load-side cumulative feedback pulses are matched and increased. If mismatched, review the setting of fully closed loop control feedback electronic gear (parameter No.PE04, PE05, PE34, PE35) with the following method. 1) Check the motor-side cumulative feedback pulses (before gear). 2) Check the load-side cumulative feedback pulses. 3) Check that the ratio of above 1) and 2) has been that of the feedback electronic gear. 

(7) Setting of fully closed loop dual feedback filter

With the initial value (setting＝10) set in parameter No.PE08, make gain adjustment by auto tuning, etc. as in semi closed loop control.

While observing the servo operation waveform with the graph function, etc. of MR Configurator, adjust the dual feedback filter.

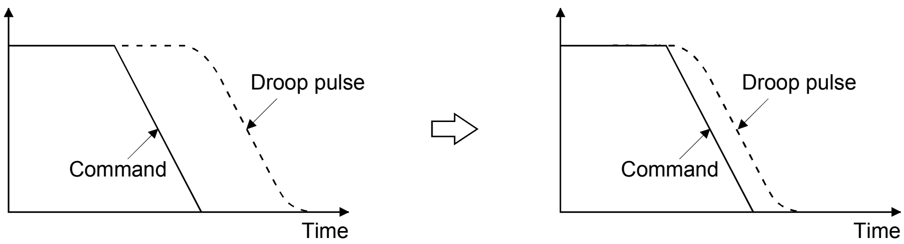
The dual feedback filter operates as described below depending on the setting.

Parameter No.PE08 setting value	Control mode	Vibration	Settling time
0	Semi closed loop		
1 to 4499	Dual feedback	Hard-to-occur to Easy-to-occur	Longer to Shorter
4500	Fully closed loop		

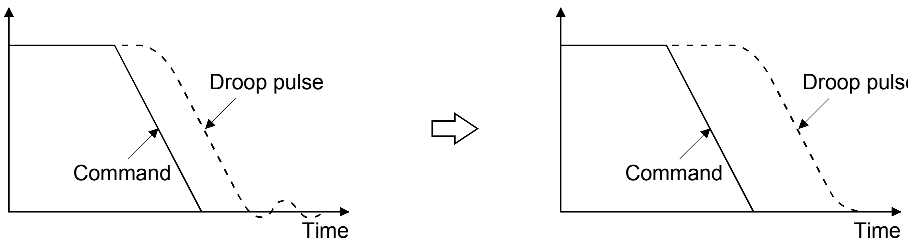
Increasing the dual feedback filter setting shortens the settling time, but increases motor vibration since the motor is more likely to be influenced by the load-side encoder vibration.

The maximum setting of the dual feedback filter should be less than half of the PG2 setting.

Reduction of settling time: Increase the dual feedback filter setting.



Suppression of vibration: Decrease the dual feedback filter setting.



14.3.2 Home position return

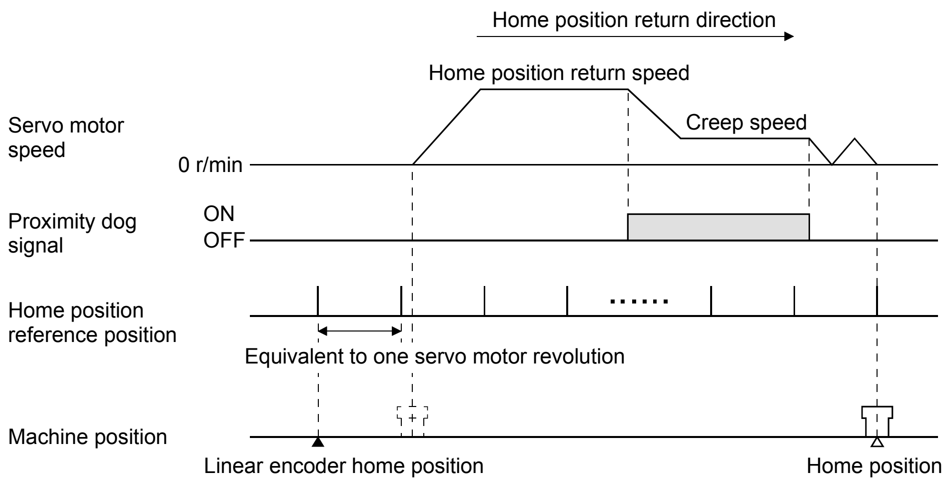
(1) General precautions

Home position return is all performed according to the load-side encoder feedback data, independently of the load-side encoder type. It is irrelevant to the Z-phase position of the motor encoder.
In the case of a home position return using a dog signal, the scale home position (reference mark) must be passed through when an incremental type linear encoder is used, or the Z-phase be passed through when a rotary encoder is used, during a period from a home position return start until the dog signal turns off.

(2) Load-side encoder types and home position return methods

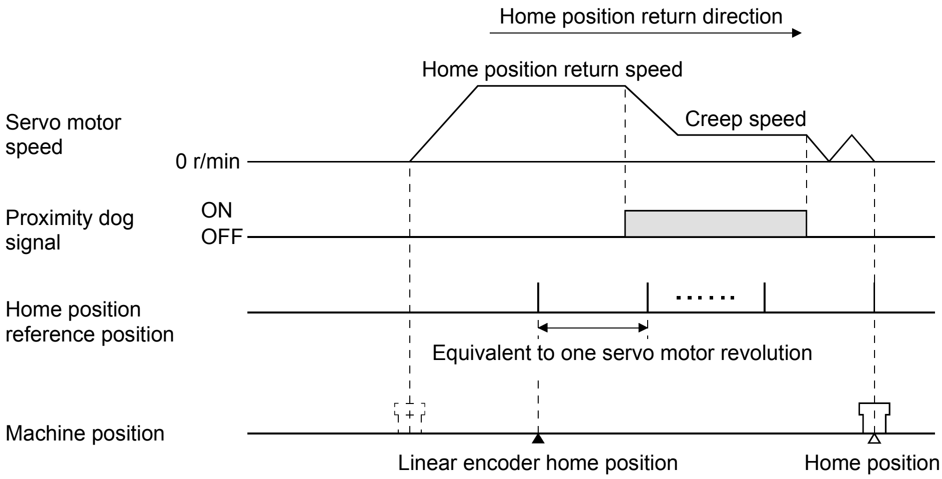
(a) About proximity dog type home position return using absolute type linear encoder

When an absolute type linear encoder is used, the home position reference position is the position per servo motor revolution to the linear encoder home position (absolute position data＝0).
In the case of a proximity dog type home position return, the nearest position after proximity dog OFF is the home position.
The linear encoder home position may be set in any position.

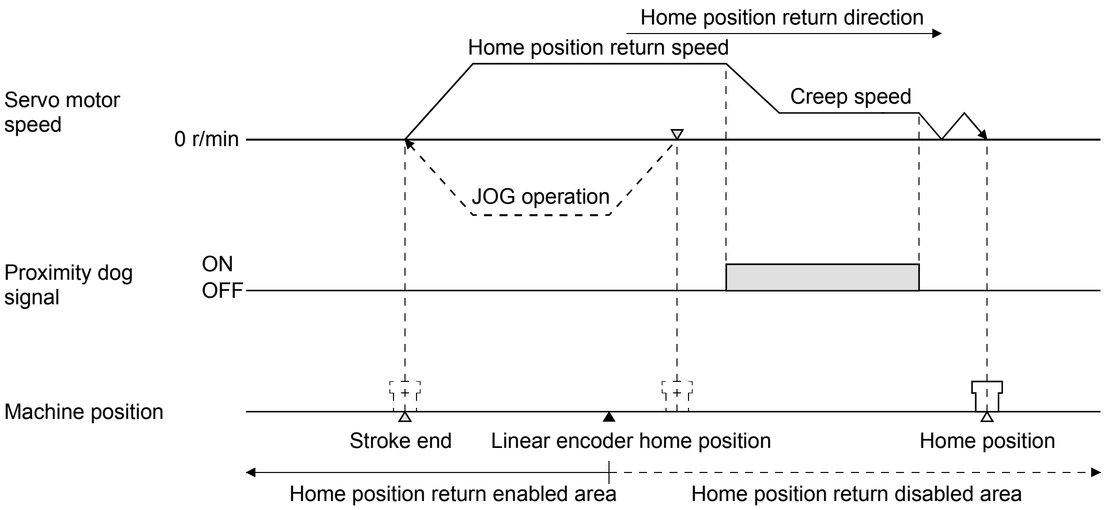


(b) About proximity dog type home position return using incremental linear encoder

1) When the linear encoder home position (reference mark) exists in the home position return direction
When an incremental linear encoder is used, the home position is the position per servo motor revolution to the Linear encoder home position (reference mark) passed through first after a home position return start.
In the case of a proximity dog type home position return, the nearest position after proximity dog OFF is the home position.
Set one linear encoder home position in the full stroke, and set it in the position that can always be passed through after a home position return start.



2) When the linear encoder home position does not exist in the home position return direction
If a home position return is started at the position where the linear encoder home position (reference mark) does not exist in the home position return direction, a home position return error occurs in the controller, the error definition changes depending on the controller type. When starting a home position return at the position where the linear encoder home position (reference mark) does not exist in the home position return direction, move the axis up to the stroke end on the side opposite to the home position return direction by jog operation, etc. of the controller once, then make a home position return.

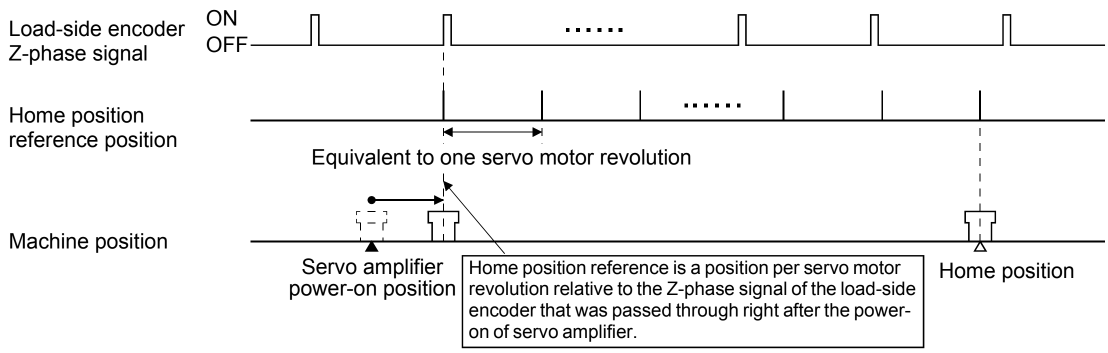


POINT

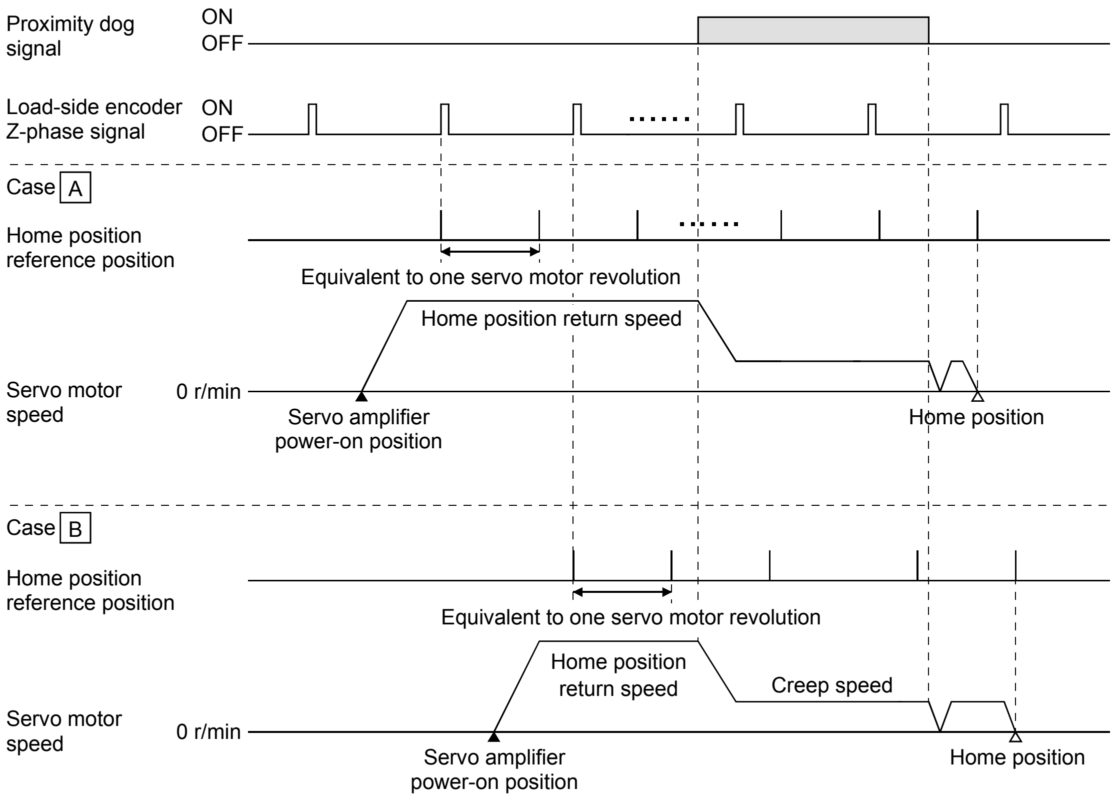
- To execute a home position return securely, start a home position return after moving the axis to the opposite stroke end by jog operation, etc. of the controller.
- To execute a home position return securely, start a home position ret A home position return cannot be made if the incremental linear encoder does not have a linear encoder home position (reference mark). Always provide a linear encoder home position (reference mark). (One place in the fully stroke)

(c) About dog type home position return when using the A/B/Z-phase pulse train specification rotary encoder

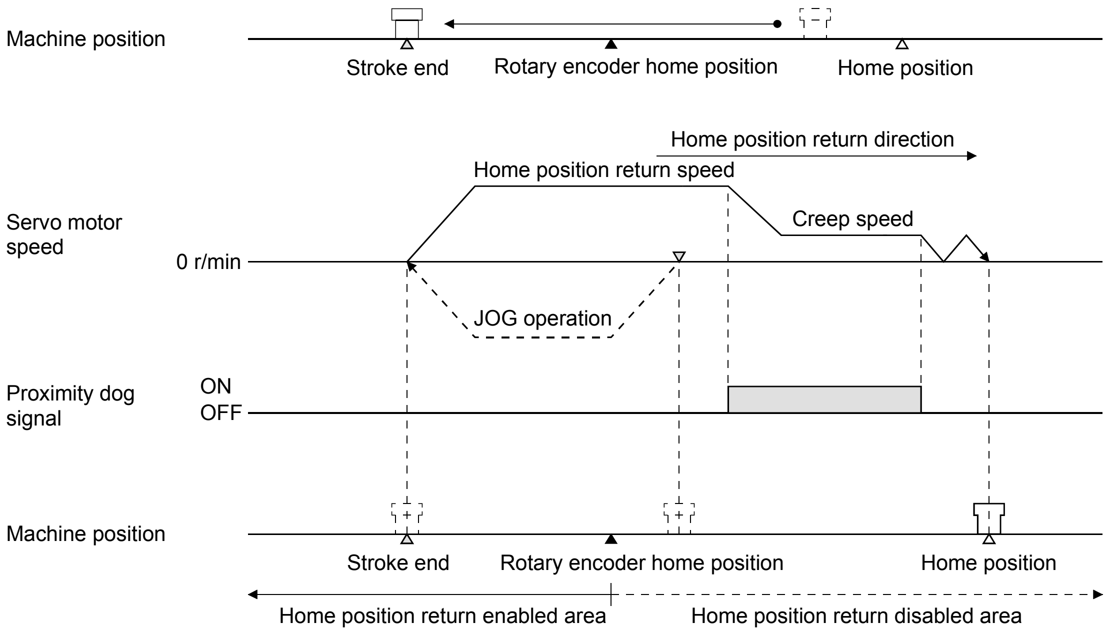
The home position using a A/B/Z-phase pulse train specification rotary encoder as a load-side encoder is as described below. It is the position per servo motor revolution, starting at the position where the Z-phase of the load-side encoder is passed through first after power-on of the servo amplifier.



The home position reference position is set relative to the Z-phase position of the load-side encoder that is passed through first after power-on of the servo amplifier.
In Case A and Case B where the power-on position differs as shown below, the power-on position must be noted since the axis cannot stop at the same home position return position.

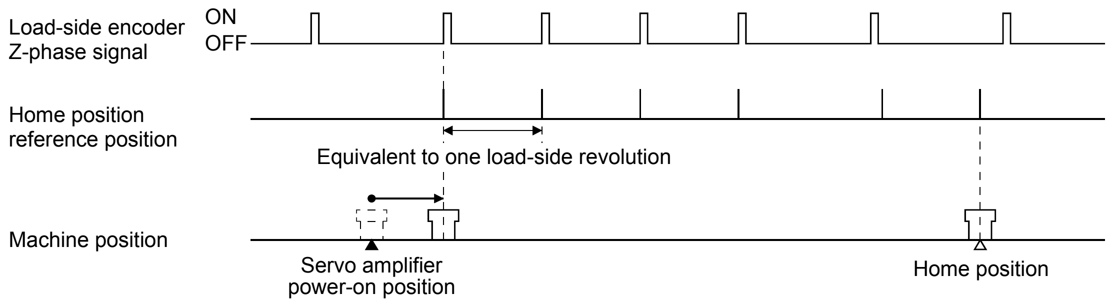


To always make a home position return to the same position, perform the following operation.
Once move the rotary encoder to the stroke end opposite to the home position return direction with the JOG operation of controller, etc. and then perform a home position return.



(d) About dog type home position return when using the rotary encoder of a serial communication servo motor

The home position for when using the rotary encoder of a serial communication servo motor for the load-side encoder is at the load-side Z-phase position.



(e) About data setting type (Common to all load-side encoders)

In the data setting type home position return method, pass through a scale home position (reference mark) and the Z-phase signal of the rotary encoder, and then make a home position return.

When the machine has no distance of one motor encoder revolution until the Z-phase of the rotary encoder is passed through, a home position return can be made by changing the parameter No.PC17 (home position setting condition selection) setting if the home position is not yet passed through.

14.3.3 Operation from controller

The fully closed loop control compatible servo amplifier can be used with any of the following controllers.

Servo system controller	Model	Remarks
Motion controller	Q17□DCPU/ Q17□HCPU	Speed control (II) instructions (VVF and VVR) cannot be used.
Positioning module	QD75MH□	

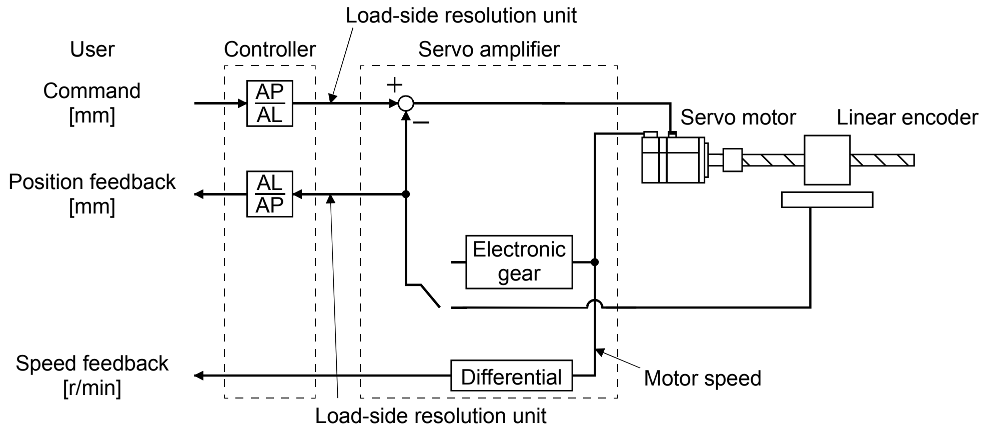
An absolute type linear scale is required to configure an absolute position detection system.
The battery (MR-J3BAT) need not be fitted to the servo amplifier.

(1) Operation from controller
Positioning operation from the controller is basically performed like the MR-J3-□S servo amplifier.

(2) Servo system controller setting
When using fully closed loop system, make the following setting.
Parameter No.PA01, PC17, PC26, PC27, PE01, PE03 to PE05, PE34 and PE35 are written to the servo amplifier and then are enabled using any of the methods indicated by ○ in Parameter valid conditions.
Parameter No.PE06 to PE08 are enabled at setting regardless of the valid conditions.

Setting item		Parameter valid conditions: Controller reset	Parameter valid conditions: Power OFF→ON	Settings: Motion controller Q17□DCPU/ Q17□HCPU	Settings: Positioning module QD75MH□
Command resolution				Load-side encoder resolution unit	
Servo parameters	MR-J3-B Fully closed loop servo amplifier setting			MR-J3-B fully closed loop	
	Motor setting			Automatic setting	
	Serial encoder cable selection (parameter No.PC26, PC27)	×	○	Set the items as required.	
	Home position setting condition selection (parameter No.PC17)	○	○		
	Fully closed loop function selection (parameter No.PA01, PE01)	×	○		
	Fully closed loop function selection 2 (parameter No.PE03)	○	○		
	Fully closed loop control error detection speed deviation error detection level (parameter No.PE06)	Valid at setting regardless of the valid conditions			
	Fully closed loop control error detection position deviation error detection level (parameter No.PE07)				
	Fully closed loop electronic gear numerator (parameter No.PE04, PE34)	×	○		
	Fully closed loop electronic gear denominator (parameter No.PE05, PE35)	×	○		
	Fully closed loop dual feedback filter (parameter No.PE08)	Valid at setting regardless of the valid conditions			
Positioning control parameters	Unit setting	mm/inch/degree/pulse			
	Number of pulses per revolution (AP) Travel distance per revolution (AL)	For the setting methods, refer to (2) (a), (b) in this section.			

(a) When using a linear encoder (unit setting: mm)



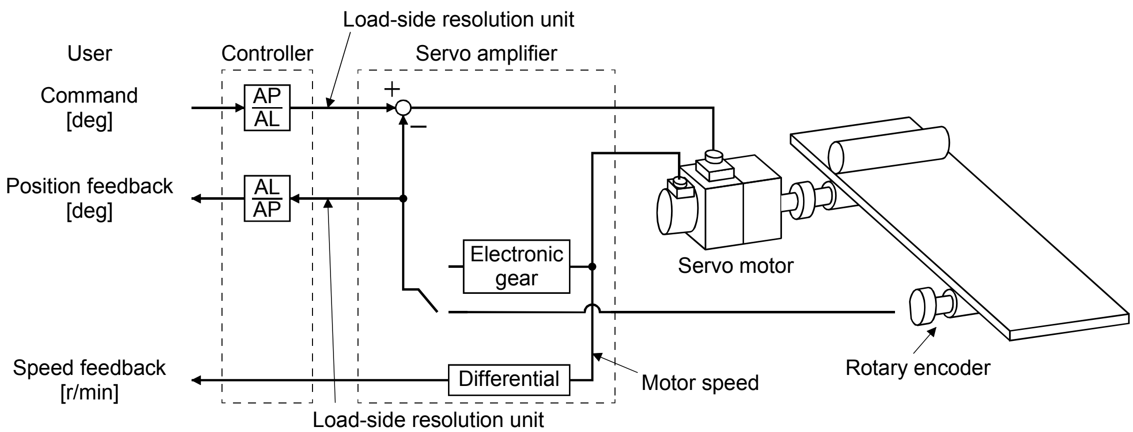
Calculate the number of pulses (AP) and travel distance (AL) of the linear encoder per ball screw revolution in the following conditions.

Ball screw lead: 20mm
Linear encoder resolution: 0.05μm

Number of linear encoder pulses (AP) per ball screw revolution
＝Ball screw lead/linear encoder resolution＝20mm/0.05 μ m＝400000pulse

$$\frac{\text{Number of pulses per revolution [pulse] (AP)}}{\text{Travel distance per revolution [}\mu\text{m] (AL)}} = \frac{400000\text{pulse}}{20\text{mm}} = \frac{400000}{20000}$$

(b) When using a rotary encoder (unit setting: deg)



Calculate the number of pulses (AP) and travel distance (AL) of the rotary encoder per servo motor revolution in the following conditions.

Resolution of rotary encoder＝Load-side resolution: 20000pulse/rev

$$\frac{\text{Number of pulses per revolution [pulse] (AP)}}{\text{Travel distance per revolution [deg] (AL)}} = \frac{20000\text{pulse}}{360\text{deg}} = \frac{20000}{360}$$

14.3.4 Fully closed loop control error detection functions

If fully closed loop control becomes instable for some reason, the speed at servo motor-side may increase abnormally.
The fully closed loop control error detection function is a protective function designed to pre-detect it and stop operation.
The fully closed loop control error detection function has two different detection methods, speed deviation and position deviation, and errors are detected only when the corresponding functions are made valid by setting Fully closed loop function selection (parameter No.PE03).
The detection level setting can be changed using the parameters (No.PE06, PE07).

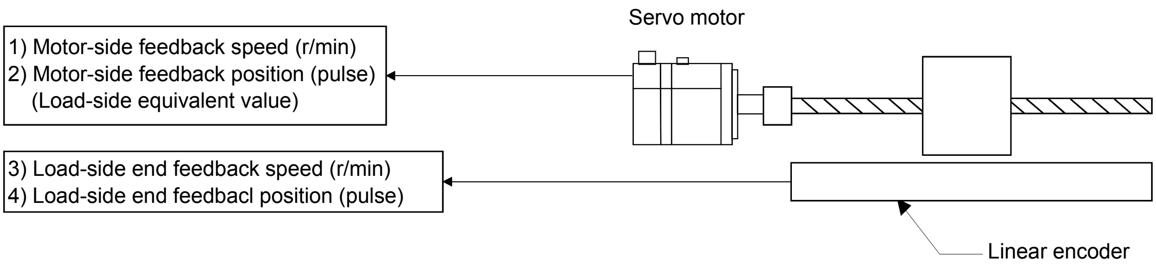
(1) Parameters
The fully closed loop control error detection function is selected.

Parameter No.PE03

0	0	0	

Fully closed loop control error detection function selection
0: Invalid
1: Speed deviation error detection
2: Position deviation error detection
3: Speed deviation error/position deviation error detection

(2) Fully closed loop control error detection function



(a) Speed deviation error detection
Set "□□□1" in parameter No.PE03 to make the speed deviation error detection valid.

Parameter No.PE03

			1

Speed deviation error detection

Comparing the motor-side feedback speed (1)) and load-side feedback speed (3)), if the deviation is not less than the set value (1 to the permissible speed r/min) of parameter No.PE06 (fully closed loop control speed deviation error detection level), the function generates an alarm (fully closed loop control error detection (42)) and stops. The initial value of parameter No.PE06 is 400r/min. Change the set value as required.

(b) Position deviation error detection

Set "□□□2" in parameter No.PA03 to make the position deviation error detection valid.

Parameter No.PE03

□□□2

Position deviation error detection

Comparing the motor-side feedback position (2)) and load-side feedback position (4)), if the deviation is not less than the set value (1 to 20000kpulse) of parameter No.PE07 (fully closed loop control position deviation error detection level), the function generates an alarm (fully closed loop control error detection (42)) and stops. The initial value of parameter No.PE07 is 100kpulse. Change the set value as required.

(c) Detecting multiple deviation errors

When setting parameter No.PE03 as shown below, multiple deviation errors can be detected. For the error detection method, refer to (2) (a), (b) in this section.

Parameter No.PE03

□□□□

Set value	Speed deviation error detection	Position deviation error detection
1	○	
2		○
3	○	○

(3) Test operation mode

Test operation mode can be performed by combining MR Configurator software that runs on the personal computer and the servo amplifier.

The fully closed loop system cannot use motor-less operation.

For details on the test operation, refer to section 4.4.

Function	Item	Usability	Remarks
Test operation mode	Jog operation	Usable	Performed by the feedback of the motor encoder. It is irrelevant to the load-side encoder.
	Positioning operation	Usable	In the setting of parameter No.PA01, the operations can be set in the motor encoder resolution unit or the load-side encoder resolution unit. In the setting of parameter No.PE01, semi closed loop control/fully closed loop control can be set. However, the semi closed loop control is always set only if parameter No.PE01 is set to "□□□1". For details, refer to section 14.3.1 (2).
	Program operation	Usable	
	Output signal (DO) forced output	Usable	Refer to section 4.5.1 (1).
	Motor-less operation	Unusable	Not compatible.

14.3.5 Absolute position detection system under fully closed loop system

POINT
・When using a rotary encoder, the absolute position detection system cannot be configured.

An absolute type linear encoder is necessary to configure an absolute position detection system under fully closed loop control using a linear encoder.
In this case, the encoder battery (MR-J3BAT) need not be installed to the servo amplifier.

Make setting to make Absolute position detection valid in the servo parameter (Parameter No.PA03). The system can be used in the following limited conditions.

(1) Using conditions

(a) Use an absolute type linear encoder with the load-side encoder.

(b) Select Always fully closed loop (Parameter No.PA01＝□□1□, Parameter No.PE01＝□□□0).

(2) Absolute position detection range using encoder

Encoder type	Absolute position detection enabled range
Linear encoder (Serial Interface)	Movable distance range of scale (within 32-bit absolute position data)

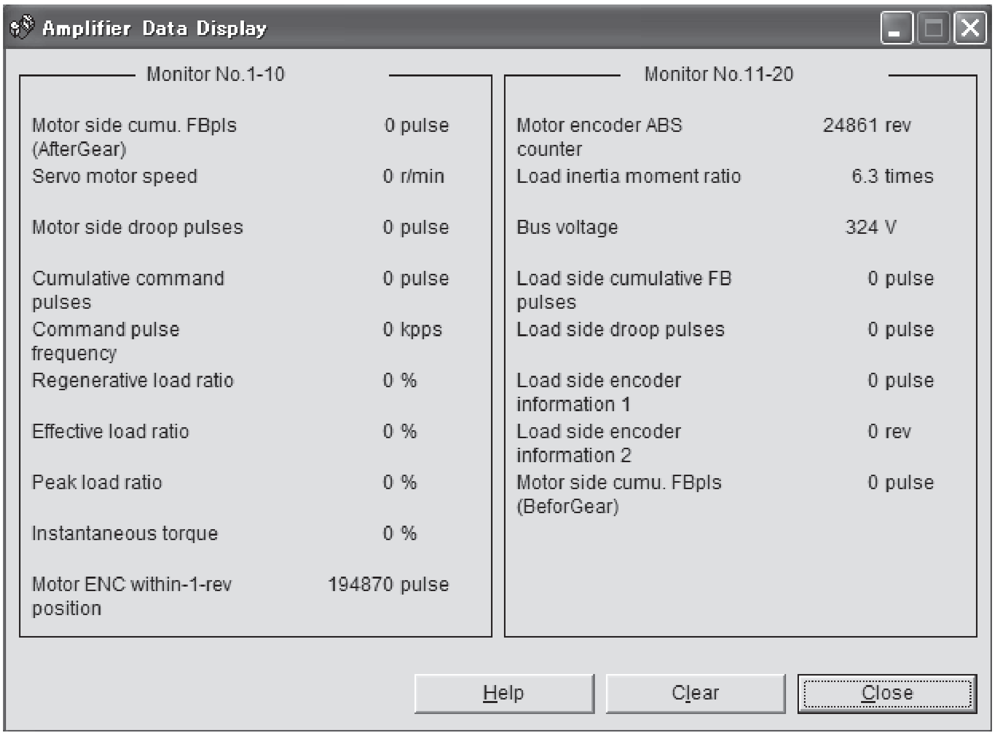
(3) Alarm detection

The absolute position-related alarm (25) and warnings (92, 9F) are not detected.

14.3.6 About MR Configurator

Using MR Configurator can confirm if the parameter setting is normal or if the servo motor and the load-side encoder operate properly.

(1) Batch monitor display
Select "MR-J3-B fully closed loop" in the system setting of the set-up menu.

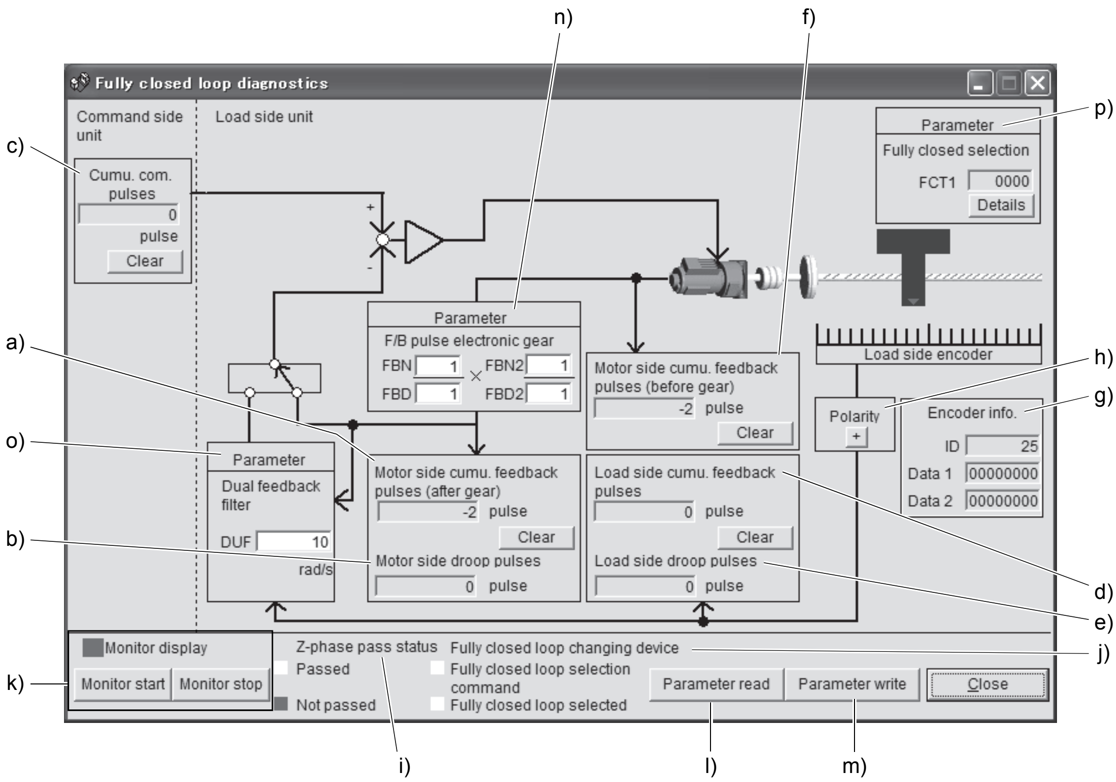


Name	Explanation	Unit
Motor-side cumu. FBpls (After Gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Load-side encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "－" symbol is indicated for reverse.	pulse
Servo motor speed	The servo motor speed is displayed. It is displayed rounding off 0.1r/min unit. The "－" symbol is indicated for reverse.	r/min
Motor-side droop pulse	Droop pulse of the deviation counter between a motor-side position and a command are displayed. The "－" symbol is indicated for reverse.	pulse
Cumulative command pulses	Position command input pulses are counted and displayed. Click "Clear" to reset the value to 0. The "－" symbol is indicated for reverse command.	pulse
Command pulse frequency	The frequency of position command input pulses is counted and displayed. The "－" symbol is indicated for reverse command.	kpps
Regenerative load ratio	The proportion of regenerative powers to permissive regenerative powers is indicated in percentage. Permissive regenerative powers differ according to the absence or presence of a regenerative option. Set parameter No.PA02 correctly according to the regenerative option.	%
Effective load ratio	The continuous effective load torque is displayed. The effective value is displayed considering a rated torque as 100%.	%

Name	Explanation	Unit
Peak load ratio	The maximum occurrence torque is displayed. The maximum value for the past 15 seconds is displayed considering a rated torque as 100%.	%
Instantaneous torque	The instantaneous occurrence torque is displayed. The value of torque being occurred is displayed in real time considering a rated torque as 100%.	%
Motor ENC within-1-rev position	The position in servo motor-side 1-revolution is displayed in the encoder pulse unit. When the value exceeds the maximum number of pulses, it resets to 0. When the servo motor rotates in the CCW direction, the value is added.	pulse
Motor encoder ABS counter	The travel distance from the home position (0) is displayed as multi-revolution counter value of the absolution position encoder in the absolution position detection system.	rev
Load inertia moment ratio	The estimated value of the servo motor shaft conversion load inertia moment ratio to the servo motor inertia moment is displayed.	Multi-plier (×1)
Bus voltage	The voltage (across P(＋)-N(－)) of main circuit converter is displayed.	V
Load-side cumulative FB pulses	Feedback pulses from the load-side encoder are counted and displayed. When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "－" symbol is indicated for reverse.	pulse
Load-side droop pulse	Droop pulse of the deviation counter between a load-side position and a command are displayed. The "－" symbol is indicated for reverse.	pulse
Load-side encoder information 1	The position in load-side encoder 1-revolution is displayed. For an incremental linear scale, the Z-phase counter is displayed. The value is counted up from 0 based on the home position (reference mark). It is displayed in load-side encoder pulse unit. For an absolute position linear scale, the encoder absolute position is displayed.	pulse
Load-side encoder information 2	Multi-revolution counter of the load-side encoder is displayed. (for using a rotary encoder)	rev
Motor-side cumu. FBpls (Before Gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Motor encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "－" symbol is indicated for reverse.	pulse

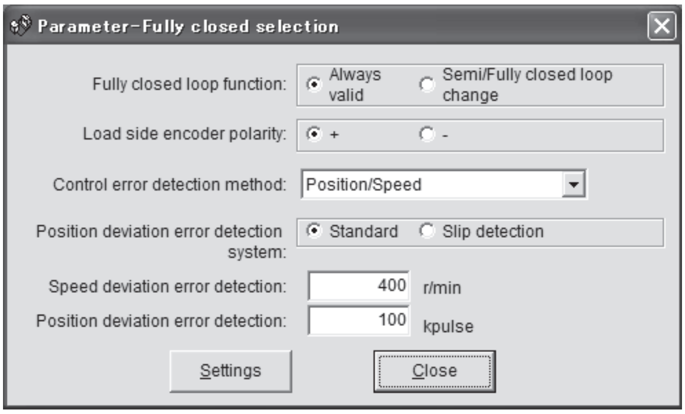
(2) Fully closed loop diagnostic screen

Select the fully closed loop diagnostics of the diagnostics menu.
Click "Monitor start" to constantly read the monitor display items from the servo amplifier.
Then, click "Monitor stop" to stop reading.
Click "Parameter read" to read the parameter items from the servo amplifier, and then click "Parameter write" to write them.



Symbol	Name	Explanation	Unit
a)	Motor-side cumu. feedback pulses (after gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Load-side encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "−" symbol is indicated for reverse.	pulse
b)	Motor-side droop pulse	Droop pulse of the deviation counter between a motor-side position and a command are displayed. The "−" symbol is indicated for reverse.	pulse
c)	Cumu. Com. pulses	Position command input pulses are counted and displayed. Click "Clear" to reset the value to 0. The "−" symbol is indicated for reverse command.	pulse
d)	Load-side cumu. feedback pulses	Feedback pulses from the load-side encoder are counted and displayed. When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "−" symbol is indicated for reverse.	pulse
e)	Load-side droop pulse	Droop pulse of the deviation counter between a load-side position and a command are displayed. The "−" symbol is indicated for reverse.	pulse
f)	Motor-side cumu. feedback pulses (before gear)	Feedback pulses from the servo motor encoder are counted and displayed. (Motor encoder unit) When the set value exceeds 999999999, it starts with 0. Click "Clear" to reset the value to 0. The "−" symbol is indicated for reverse.	pulse

Symbol	Name	Explanation	Unit
g)	Encoder information	The load-side encoder information is displayed. The display contents differ depending on the load-side encoder type. ・ID: The ID No. of the load-side encoder is displayed. ・Data 1: For the incremental type linear encoder, the counter from powering ON is displayed. For the absolute position type linear encoder, the absolute position data is displayed. ・Data 2: For the incremental type linear encoder, the distance (number of pulses) from the reference mark (Z-phase) is displayed. For the absolute position type linear encoder, "00000000" is displayed.	
h)	Polarity	A polarity is indicated as "＋" or "－" according to the load-side encoder polarity specified in parameter No.PC27. For address increasing direction in the motor CCW, it is indicated as "＋" and for address decreasing direction in the motor CCW, as "－".	
i)	Z-phase pass status	If the fully closed loop system is "Invalid", the Z-phase pass status of the motor encoder is displayed. If the fully closed loop system is "Valid" or "Semi closed loop control/fully closed loop control switching", the Z-phase pass status of the load-side encoder is displayed.	
j)	Fully closed loop changing device	Only if the fully closed loop system is "Semi closed loop control/fully closed loop control switching", the device is displayed. The state of the semi closed loop control/fully closed loop control switching bit and the inside state during selection are displayed.	
k)	Monitor display	Click the "Monitor start" button to start monitoring. Click the "Monitor stop" button to stop monitoring.	
l)	Parameter read	Click the "Parameter read" button to read all the parameter settings that can be set and displayed on this window from the servo amplifier and display them.	
m)	Parameter write	Click the "Parameter write" button to write the all parameter settings set and displayed on this window to the servo amplifier.	
n)	Parameter (Feedback pulse electronic gear)	The feedback pulse electronic gears (parameter No.PE04, PE05, PE34, PE35) are displayed/set for motor encoder pulses in this parameter. (Refer to section 14.3.1 (5).) For details of each parameter, refer to section 5.5.2.	
o)	Parameter (Dual feedback filter)	The band of dual feedback filter (parameter No.PE08) is displayed/set in this parameter. For details of parameter, refer to section 5.5.2.	

Symbol	Name	Explanation	Unit
p)	Parameter (fully closed loop selection)	The parameter for the fully closed loop control is displayed/set. Click "Details" button to display the "Parameter – Fully closed selection" window.  1) Fully closed loop function (Parameter No.PE01) Select "Always valid" or "Semi/Fully closed loop change" for the fully closed loop control function. 2) Load-side encoder polarity (Parameter No.PC27) Select "＋ (encoder pulse increasing direction in the servo motor CCW)" or "－ (encoder pulse decreasing direction in the servo motor CCW) for the encoder pulse count polarity. 3) Control error detection method (Parameter No.PE03) Select "Invalid", "Speed (speed deviation error detection)", "Position (position deviation error detection)" or "Position/Speed (speed deviation error/position deviation error) for the fully closed loop control error detection function. 4) Position deviation error detection system (Parameter No.PE03) Select "Standard (always position deviation detection system)" or "Slip detection (stopping position deviation detection system)" for a detection condition regarding the fully closed loop control error and the position deviation error of the detection function. 5) Speed deviation error detection (Parameter No.PE06) Set the speed deviation error detection level to be used in the fully closed loop control error detection function. 6) Position deviation error detection (Parameter No.PE07) Set the position deviation error detection level to be used in the fully closed loop control error detection function. For details of each parameter, refer to section 5.3 and 5.5. Click "Settings" to set the functions. Click "Close" to close the window.	

15. USING STO FUNCTION OF MR-J3-☐B SAFETY

POINT
・The torque control mode does not support the forced stop deceleration function.

15.1 Introduction

The following is cautions regarding STO, EMG STOP and EMG OFF functions, of the MR-J3-☐S.

15.1.1 Summary

MR-J3-☐S servo amplifier complies with the following safety standards is backwards compatible with MR-J3 series and can be used with either the MR-J3-D05 safety logic unit, with cerified safety relays, or safety PLCs.
・ISO/EN ISO 13849-1 Category 3 PL d
・IEC/EN 61508 SIL 2
・IEC/EN 61800-5-2 SIL 2
・IEC/EN 60204-1 Stop Category 0

15.1.2 Terms related to safety

(1) Stop function for IEC/EN 61800-5-2
・STO function (Refer to IEC/EN 61800-5-2: 2007 4.2.2.2 STO.)
STO function is integrated into the MR-J3-☐S.
The STO function shuts down energy to servo motors, thus removing torque. The MR-J3-☐S electronically cuts off power the servo motor within the servo amplifier.
The purpose for this safety function is as follows.

1) Uncontrolled stop according to stop category 0 of IEC/EN 60204-1

2) Designed to prevent unexpected start-up

(2) Emergency operation for IEC/EN 60204-1
(a) Emergency stop (Refer to IEC/EN 60204-1: 2005 9.2.5.4.2 Emergency Stop.)
Emergency stop must override all other functions and actuation in all operation modes. Power to the machine driving part which may cause a hazardous state must be either removed immediately (stop category 0) or must be controlled to stop such hazardous state as soon as possible (stop category 1). Unexpected start must not be allowed even after the cause of the emergency state has been removed.

(b) Emergency switching off (Refer to IEC/EN 60204-1: 2005 9.2.5.4.3 Emergency Switching OFF.)
Removal of input power to the drive for prevention of electric shock risk and to meet the above mentioned safety standards.

15.1.3 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property. Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed. They must be familiar with all applicable local safety regulations and laws in which machines with these components are installed, particularly the standards and guidelines mentioned in this manual and the requirements mentioned in ISO/EN ISO 13849-1, IEC/EN 61508, IEC/EN 61800-5-2, and IEC/EN 60204-1. The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.

⚠DANGER	・Improper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.

Protective Measures

・The STO function (Safe Torque Off), as described in IEC/EN 61800-5-2, only prevents the servo amplifier from supplying energy to the servo motor. It does not guarantee that the drive part of the servo motor will not rotate due to external or unforeseen forces. If an external force acts upon the drive axis, additional safety measures, such as brakes or counter-weights must be used.

15.1.4 Residual risk

(1) Residual risks of the STO function
Machine builders are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO function. Mitsubishi is not liable for any damages or injuries caused by these risks.

(a) The STO function removes energy to the servo motor using electric circuitry. It does not remove source power to the amplifier nor does it mechanically isolate electricity from the motor. Therefore, it cannot prevent exposure to electric shock. Be sure to use the EMG Shutting Off function if electric shock prevention is desired.

(b) The STO function disables energy supply to the servo motor by electrical shutdown. It does not guarantee stoppage of the servo motor nor control of deceleration.

(c) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.

(d) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards. The Mitsubishi Electric safety related components mentioned in this manual are certified by TÜV Rheinland as meeting the requirements of ISO/EN ISO 13849-1 Category 3, PL d, and IEC/EN 61508 SIL 2.

(e) Due to delays inherent in electric devices, power may remain at the servo motor for a brief time after the STO function is activated by the STO switch.

(f) Safety is not assured until safety-related components of the system are completely installed or adjusted.

(g) When replacing an MR-J3-□S servo amplifier confirm that the new parts are exactly the same as those being replaced. Once installed, be sure to verify the performance of the safety functions before commissioning the system.

(h) Perform all risk assessments and safety level certification to the machine/system as a whole. It is recommended that a Certification Body, such as TÜV Rheinland, final safety certification of the system be used.

(i) To prevent accumulation of multiple failures, perform a failure check at regular intervals as deemed necessary by the applicable safety standard. Regardless of the system safety level, failure checks should be performed at least once per year.

(j) If the upper and lower power transistor in the inverter bridge have failure simultaneously, the servo motor may move maximum of 0.5 rotation.

(k) STO input signals (STO1 and STO2) must be supplied from one power source. Otherwise, the STO function may not function properly due to a sneak current, failing to bring the STO shut-off state.

(2) Residual risks of the EMG function
Machine builders are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the EMG function.

(a) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.

(b) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards. The Mitsubishi Electric safety related components mentioned in this manual are certified by TÜV Rheinland as meeting the requirements of ISO/EN ISO 13849-1 Category 3, PL d, and IEC/EN 61508 SIL 2.

(c) Due to delays inherent in electric devices, power may remain at the servo amplifier or servo motor for a brief time after the STO function is activated by the STO switch.

(d) Safety is not assured until safety-related components of the system are completely installed or adjusted.

(e) When replacing an MR-J3-□S servo amplifier confirm that the new parts are exactly the same as those being replaced. Once installed, be sure to verify the performance of the safety functions before commissioning the system.

(f) Perform all risk assessments and safety level certification to the machine/system as a whole. It is recommended that an external governing body, such as TÜV Rheinland, oversea final safety certification of the system.

(g) To prevent accumulation of multiple failures, perform a failure check at regular intervals as deemed necessary by the applicable safety standard. Regardless of the system safety level, failure checks should be performed at least once per year.

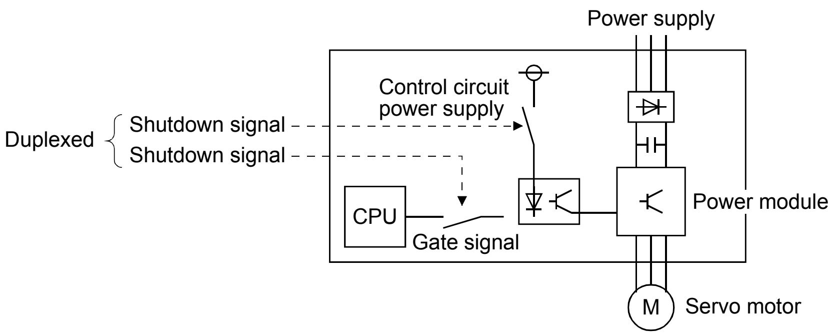
(h) If the upper and lower power transistor in the inverter bridge have failure simultaneously, the servo motor may move maximum of 0.5 rotation.

15.1.5 Specifications

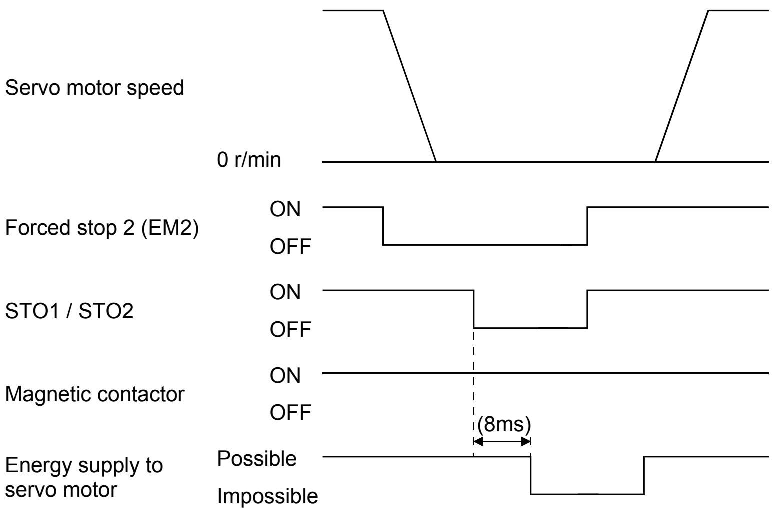
(1) Specifications

Items	Specifications
Safety function MR-J3-□S	STO (IEC/EN 61800-5-2)
Safety performance	ISO/EN ISO 13849-1 PL d (category 3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2
Compliance to standards	CE (LVD: EN 50178, EMC: IEC/EN 61800-3) UL (UL 508C)
Mean time to dangerous failure (MTTFd)	100 years
Diagnostic converge (DC)	90%
Average probability of dangerous failures per hour (PFH)	1.01×10^{-7} [1/h]

(2) Function block diagram (STO function)



(3) Operation sequence (STO function)



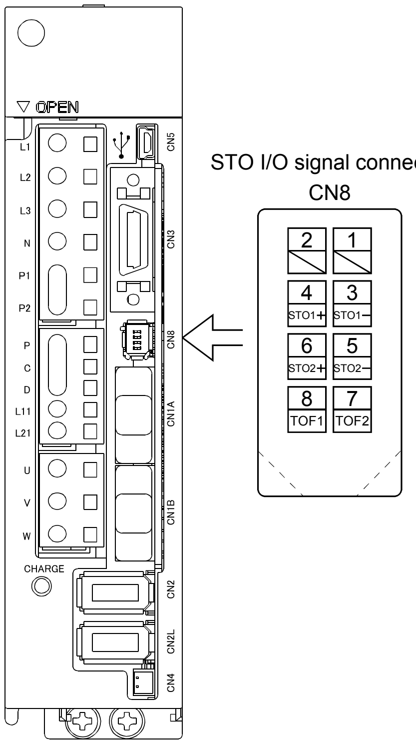
15.1.6 Maintenance

Alarms and warnings for maintenance compatible with Mitsubishi drive safety function have been added MR-J3-□S servo amplifier. (Refer to chapter 8.)

15.2 STO I/O signal connectors (CN8)

15.2.1 Signal layouts

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section.



15.2.2 Signal (device) explanations

(1) I/O device

Signal name	Connector pin No.	Definition	I/O
STO1－	CN8-3	Inputs STO state 1. STO state (base shutdown): Open between STO1＋ and STO1－. STO release state (in driving): Close between STO1＋ and STO1－. Be sure to turn off STO1 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off the forced stop 2 (EM2).	DI-1
STO1＋	CN8-4		DI-1
STO2－	CN8-5	Inputs STO state 2. STO state (base shutdown): Open between STO2＋ and STO2－. STO release state (in driving): Close between STO2＋ and STO2－. Be sure to turn off STO2 after the servo motor stops by the servo-off state or with forced stop deceleration by turning off the forced stop 2 (EM2).	DI-1
STO2＋	CN8-6		DI-1
TOF2	CN8-7	Outputs TOF to MR-J3-D05 etc. STO state (base shutdown): Between TOF1 and TOF2 is closed. STO release state (in driving): Between TOF1 and TOF2 is opened.	DO-1
TOF1	CN8-8		DO-1

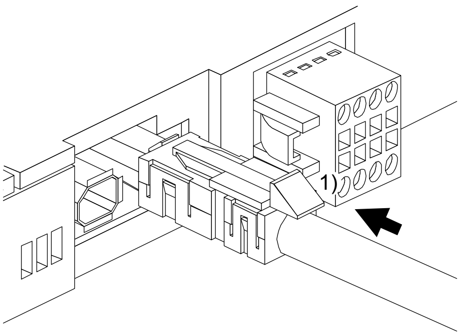
(2) Signals and their STO status
The following shows the TOF and STO status when STO1 or STO2 is on (closed) or off (opened) if the power is normally turned on.

Input signal		Status
STO1	STO2	
OFF	OFF	TOF: ON STO status (base circuit shut off)
OFF	ON	TOF: OFF STO status (base circuit shut off)
ON	OFF	TOF: OFF STO status (base circuit shut off)
ON	ON	TOF: OFF STO release status

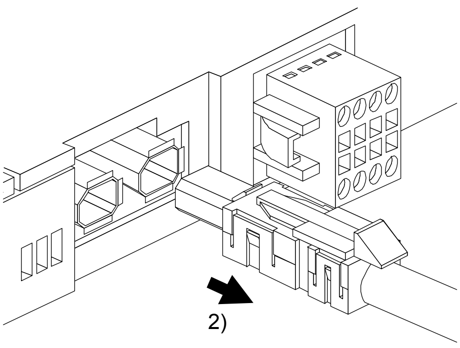
(3) Test pulse of STO input signal
The test pulse off time is 1ms or less.

15.2.3 How to pull out the STO cable

The following shows how to pull out the STO cable from the CN8B connector of the servo amplifier and the CN8A/CN8B connector of the MR-J3-D05.



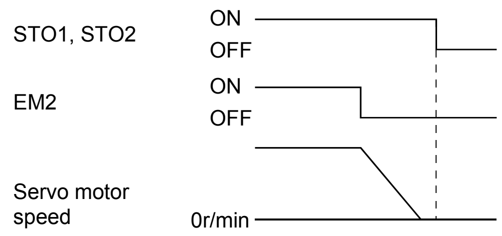
Press the knob 1) of the STO cable plug toward the direction of the arrow 1), and pull out the plug toward the direction of the arrow 2).
(The following figure shows the example of pulling out the STO cable from the CN8B connector of the MR-J3-D05.)



15.3 Connection example

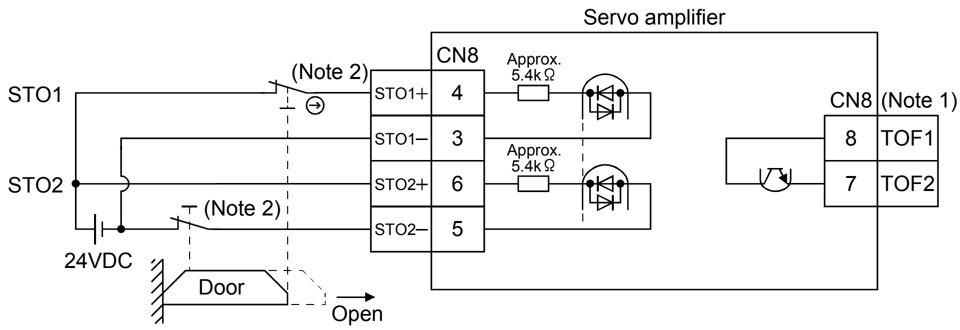
POINT

- Be sure to turn off STO (STO1 and STO2) after the servo motor stops by the servo-off state or with forced stop deceleration by turning off the forced stop 2 (EM2). Configure an external sequence that has the timings shown as below using an external device such as the MR-J3-D05 safety logic unit.



15.3.1 Connection example for CN8 connector

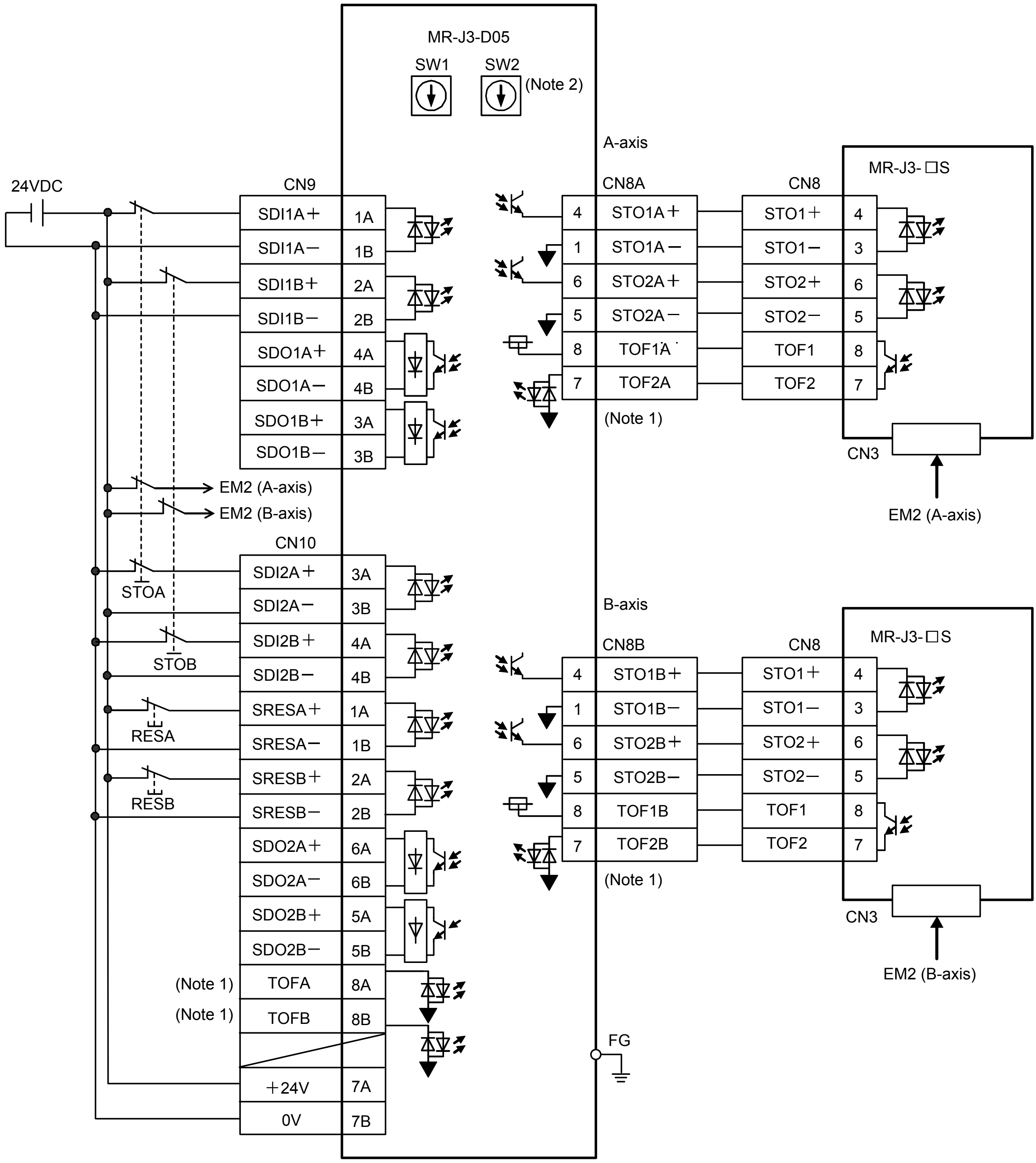
The MR-J3-□S servo amplifier is equipped with connector (CN8) in accordance with the STO function. When this connector is used with a certified external safety relay, power to the motor can be safely removed and prevention of unexpected re-start can be realized. The safety relay used should meet the applicable safety standards and have forcibly guided or mirror contacts for the purpose of fault detection.
In addition, Mitsubishi Electric's MR-J3-D05 Safety Logic Unit can be used instead of a safety relay for implementation of various safety standards. Please refer to App. 10 of this manual for more details.
For MR-D05UDL3M-B STO cables for CN8 connecters, refer to section 11.1.5.



Note 1. By using TOF, whether the servo is in the STO state can be confirmed. For connection examples, refer to section 15.3.2 to 15.3.4.
2. When using the STO function, turn off STO1 and STO2 at the same time. Be sure to turn off STO1 and STO2 after the servo motor stops in servo-off state or with forced stop deceleration by turning off the forced stop 2 (EM2).

15.3.2 External I/O signal connection example using an MR-J3-D05 safety logic unit

POINT
・The following connection is for source interface. Refer to section 3.2.2 for other I/O signals.



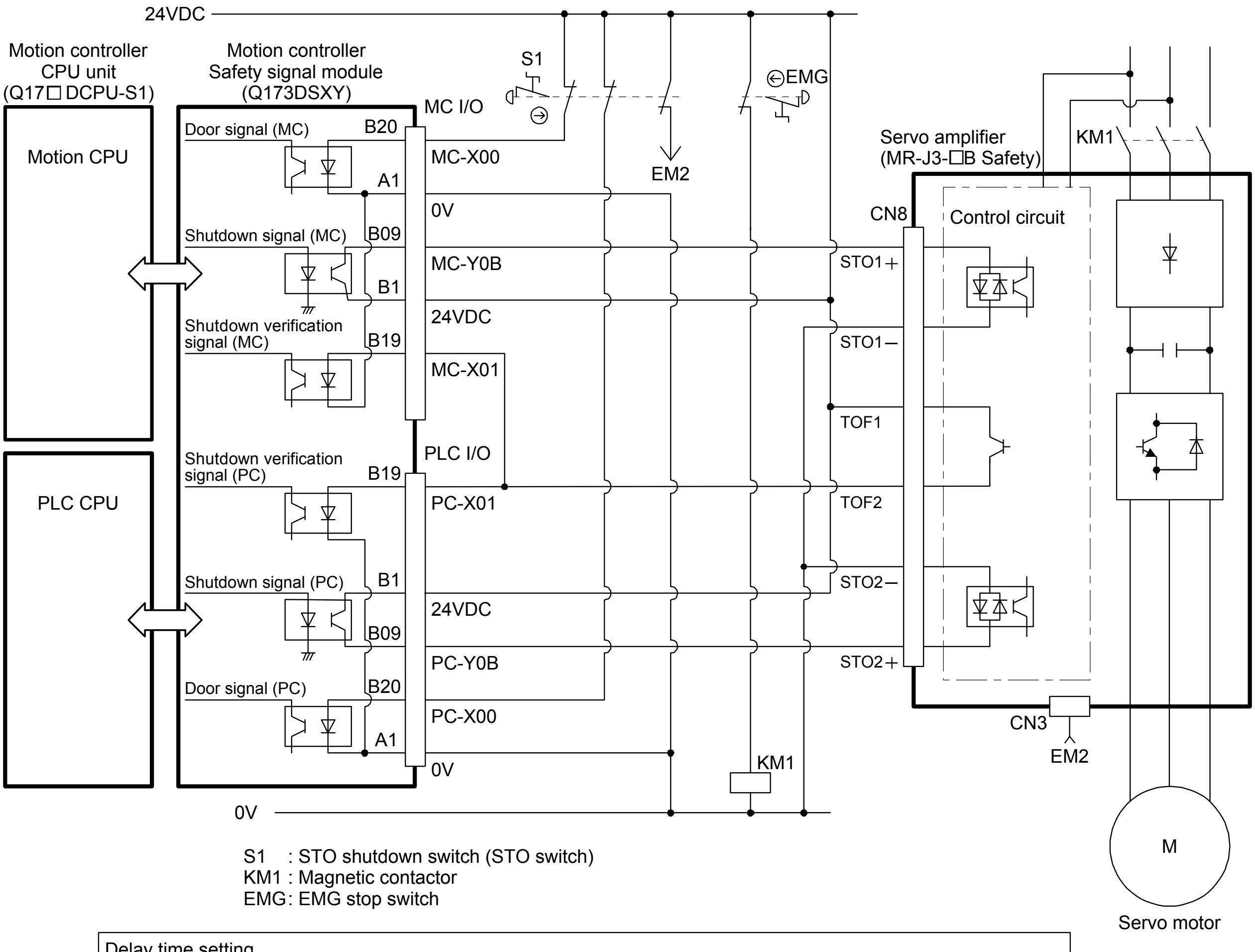
Note. 1. CN8A-7 pin (TOF2A) and CN10-8A pin (TOFA) are same input signals. CN8B-7 pin (TOF2B) and CN10-8B pin (TOFB) are same input signals as well.

2. Set the delay time of STO output with SW1 and SW2. These switches are located where dented from the front panel.

15.3.3 External I/O signal connection example using a motion controller

POINT
· The following connection is for source interface. Refer to section 3.2.2 for other I/O signals.

This connection diagram is an example of STO circuit configured with a servo amplifier and motion controller.
Use the switch that complies with the requirement of ISO/EN ISO 13849-1 PL d (category 3) as an emergency stop switch.
This connection example complies with the requirement of ISO/EN ISO 13849-1 PL d (category 3).
For details, refer to the motion controller user's manual.



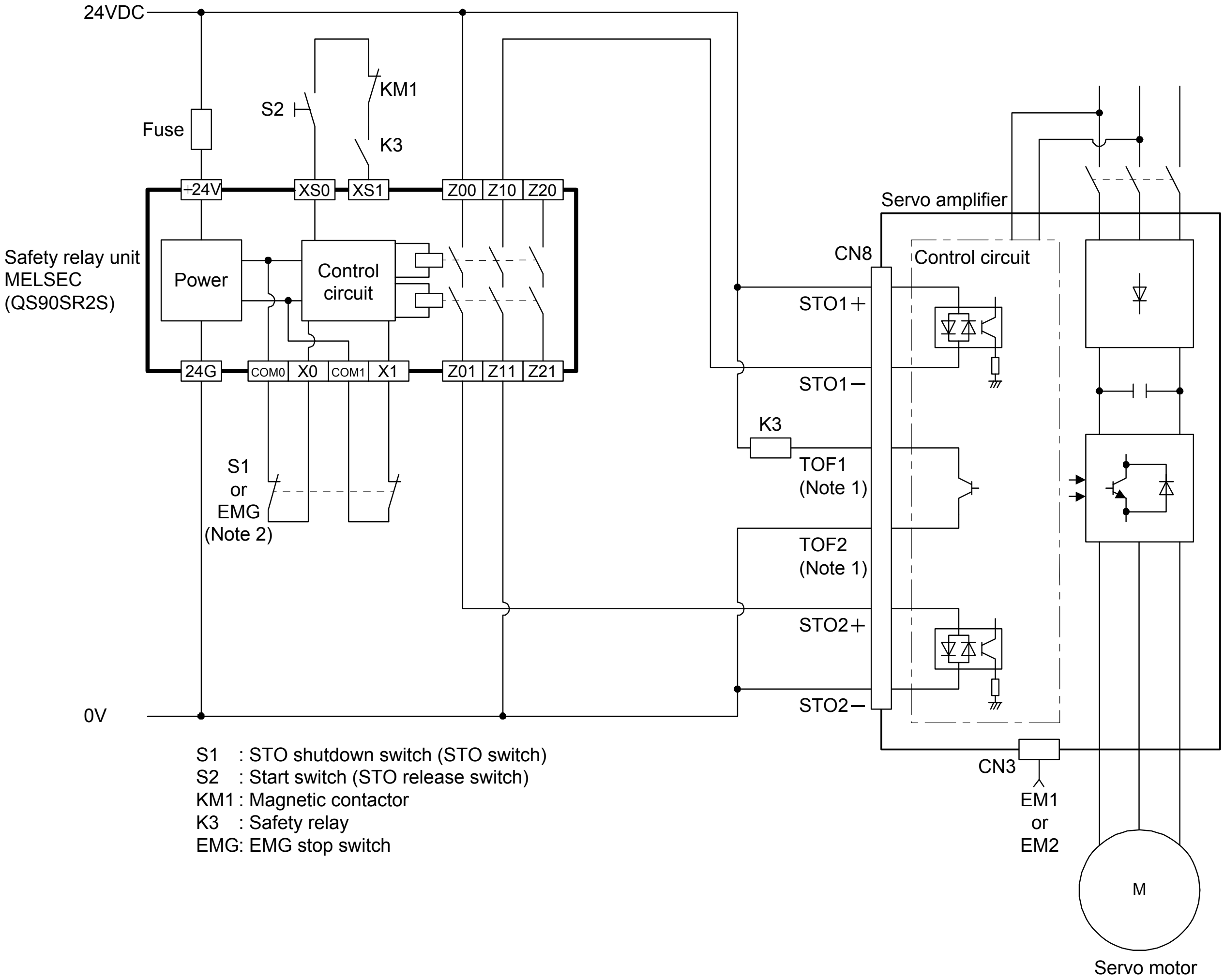
S1 : STO shutdown switch (STO switch)
KM1 : Magnetic contactor
EMG: EMG stop switch

Delay time setting
For MC-Y0B and PC-Y0B, design a ladder program to output MC-Y0B and PC-Y0B after the servo motor stops.

15.3.4 I/O signal connection example using an external safety relay unit

POINT
・The following connection is for source interface. Refer to section 3.2.2 for other I/O signals.

This connection example has suited ISO/EN ISO 13849-1 Category 3 PL d.
For details, refer to the safety relay module user's manual.



S1 : STO shutdown switch (STO switch)
S2 : Start switch (STO release switch)
KM1 : Magnetic contactor
K3 : Safety relay
EMG: EMG stop switch

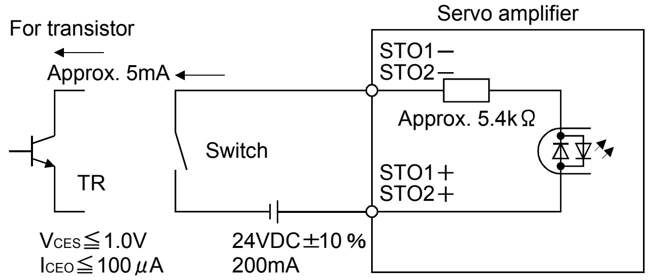
Note 1. TOF1 and TOF2 have polarities. Connect TOF1 to the 24VDC side terminal of the power supply and TOF2 to the 0V side terminal of the power supply.
2. To enable "emergency switching off" of the STO function for the servo amplifier, change S1 to EMG.

15.4 Detailed description of interfaces

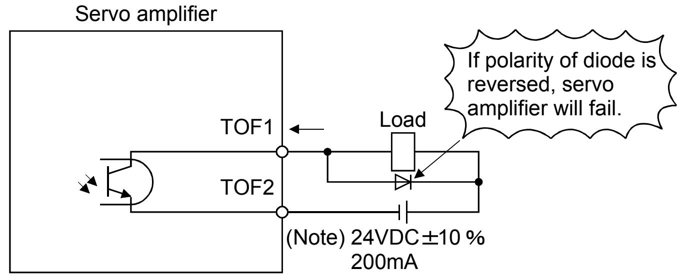
This section provides the details of the I/O signal interfaces (refer to the I/O division in the table) given in section 15.2. Refer to this section and make connection with the external equipment.

15.4.1 Sink I/O interface

(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. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the servo amplifier.

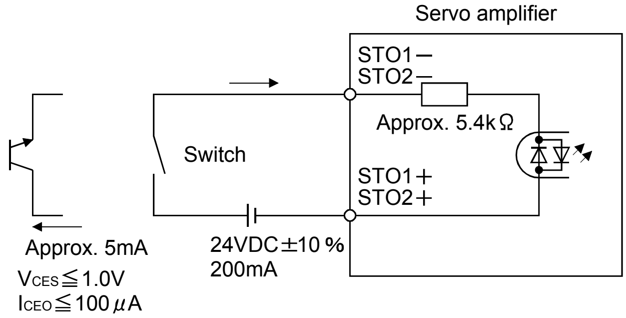


Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

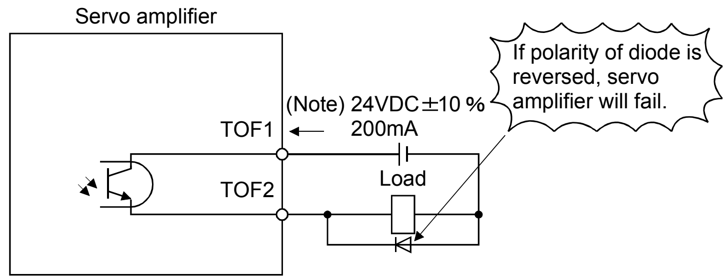
15.4.2 Source I/O interfaces

In this servo amplifier, source type I/O interfaces can be used. In this case, all DI-1 input signals and DO-1 output signals are of source type. Perform wiring according to the following interfaces.

(1) Digital input interface DI-1



(2) Digital output interface DO-1
A maximum of 2.6V voltage drop occurs in the servo amplifier.



Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

App. 1 Parameter list

POINT

- Parameter whose symbol is preceded by * is made valid with the following conditions.
  * : Set the parameter value, switch power off once after setting, and then switch it on again, or perform the controller reset.
  **: Set the parameter value, switch power off once, and then switch it on again.

App. 1.1 Servo amplifier (drive unit)

Basic setting parameters (PA□□)		
No.	Symbol	Name
PA01	**STY	Control mode
PA02	**REG	Regenerative option
PA03	*ABS	Absolute position detection system
PA04	*AOP1	Function selection A-1
PA05 to PA07		
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PA10	INP	In-position range
PA11 to PA13		
PA14	*POL	Rotation direction selection
PA15	*ENR	Encoder output pulses
PA16	*ENR2	Encoder output pulses 2
PA17		
PA18		
PA19	*BLK	Parameter write inhibit

Gain/filter parameters (PB□□)		
No.	Symbol	Name
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)
PB02	VRFT	Vibration suppression control filter tuning mode (advanced vibration suppression control)
PB03		
PB04	FFC	Feed forward gain
PB05		
PB06	GD2	For manufacturer setting load to motor inertia moment ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation
PB11	VDC	Speed differential compensation
PB12	OVA	Overshoot compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch form selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch form selection 2
PB17		Automatic setting parameter
PB18	LPF	Low-pass filter
PB19	VRF1	Vibration suppression control vibration frequency setting
PB20	VRF2	Vibration suppression control resonance frequency setting
PB21		
PB22		
PB23	VFBF	Low-pass filter selection
PB24	*MVS	Slight vibration suppression control selection
PB25		
PB26	*CDP	Gain changing selection
PB27	CDL	Gain changing condition
PB28	CDT	Gain changing time constant
PB29	GD2B	Gain changing load to motor inertia moment ratio
PB30	PG2B	Gain changing position loop gain
PB31	VG2B	Gain changing speed loop gain
PB32	VICB	Gain changing speed integral compensation
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting
PB35 to PB44		
PB45	CNHF	Vibration suppression control filter 2

Extension setting parameters (PC□□)		
No.	Symbol	Name
PC01	*ERZ	Error excessive alarm level
PC02	MBR	Electromagnetic brake sequence output
PC03	*ENRS	Encoder output pulses selection
PC04	**COP1	Function selection C-1
PC05	**COP2	Function selection C-2
PC06	*COP3	Function selection C-3
PC07	ZSP	Zero speed
PC08		
PC09	MOD1	Analog monitor 1 output
PC10	MOD2	Analog monitor 2 output
PC11	MO1	Analog monitor 1 offset
PC12	MO2	Analog monitor 2 offset
PC13	MOSDL	Analog monitor feedback position output standard data Low 0 pulse
PC14	MOSDH	Analog monitor feedback position output standard data High
PC15		
PC16		
PC17	**COP4	Function selection C-4
PC18		
PC19		
PC20	**COP7	Function selection C-7
PC21	*BPS	Alarm history clear
PC22		
PC23		
PC24	RSBR	Forced stop deceleration command time constant
PC25		
PC26	**COP8	Function selection C-8
PC27	**COP9	Function selection C-9
PC28 to PC32		

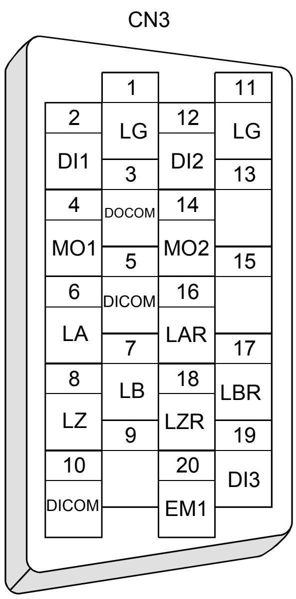
I/O setting parameters (PD□□)		
No.	Symbol	Name
PD01 to PD06		
PD07	*DO1	Output signal device selection 1 (CN3-13)
PD08	*DO2	Output signal device selection 2 (CN3-9)
PD09	*DO3	Output signal device selection 3 (CN3-15)
PD10 to PD13		
PD14	*DOP3	Function selection D-3
PD15		
PD16		
PD17		
PD18		
PD19		
PD20		
PD21 to PD29		
PD30		
PD31		
PD32		

Extension control parameters (PE□□)		
No.	Symbol	Name
PE01	**FCT	Fully closed loop function selection 1
PE02		
PE03	*FCT2	Fully closed loop function selection 2
PE04	**FBN	Fully closed loop control feedback pulse electronic gear 1 numerator
PE05	**FBD	Fully closed loop control feedback pulse electronic gear 1 denominator
PE06	BC1	Fully closed loop control speed deviation error detection level
PE07	BC2	Fully closed loop control position deviation error detection level
PE08	DUF	Fully closed loop dual feedback filter
PE09		
PE10	FCT3	Fully closed loop function selection 3
PE11 to PE33		
PE34	**FBN2	Fully closed loop control feedback pulse electronic gear 2 numerator
PE35	**FBD2	Fully closed loop control feedback pulse electronic gear 2 denominator
PE36 to PE40		

App. 1.2 Converter unit

No.	Symbol	Name
PA01	*REG	Regenerative selection
PA02	*MCC	Magnetic contactor drive output selection
PA03 to PA07		
PA08	*DMD	Status display selection
PA09	*BPS	Alarm history clear
PA10		
PA11		
PA12	*DIF	Input filter setting
PA13 to PA15		

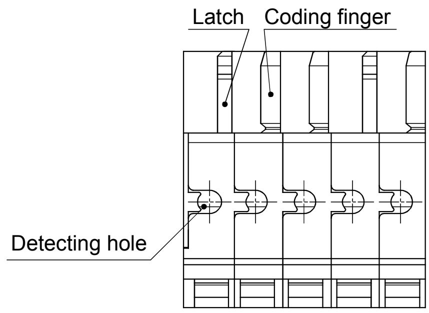
App. 2 Signal layout recording paper

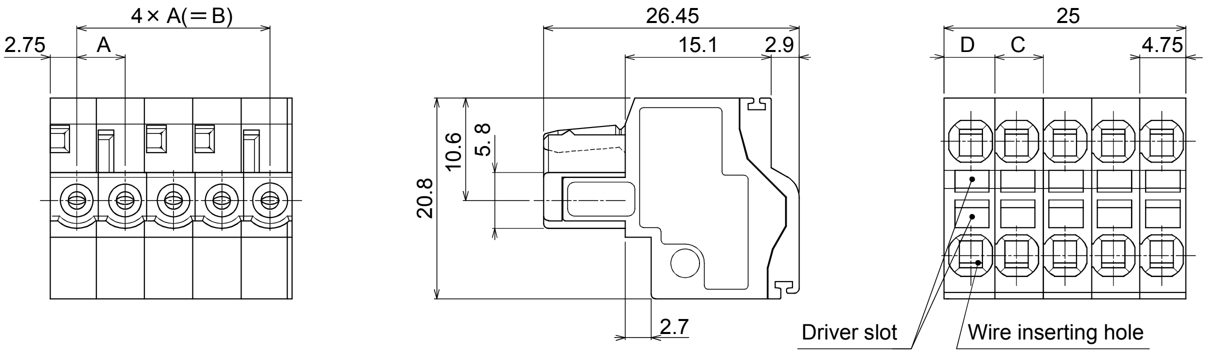


App. 3 Twin type connector: Outline drawing for 721-2105/026-000(WAGO)

[Unit: mm]

Model	Size [mm]			
	A	B	C	D
721-2105/026-000	5	20	5	5.25
721-2205/026-000	7.5	30	7.5	7.75





App. 4 Selection example of servo motor power cable

POINT

- Selection condition of wire size is as follows.
  Wire length: 30m or less
- Depending on the cable selected, there may be cases that the cable does not fit into the option or recommended cable clamp. Select a cable clamp according to the cable diameter.

Selection example when using the 600V grade EP rubber insulated chloroprene sheath cab-tire cable (2PNCT) for servo motor power (U, V, and W) is indicated below.

Servo motor	Wire size [mm^2]
HF-SP52	1.25
HF-SP102	1.25
HF-SP152	2
HF-SP202	2
HF-SP352	3.5
HF-SP502	5.5
HF-SP702	8
HF-SP51	1.25
HF-SP81	1.25
HF-SP121	2
HF-SP201	2
HF-SP301	3.5
HF-SP421	5.5
HF-SP524	1.25
HF-SP1024	1.25
HF-SP1524	2
HF-SP2024	2
HF-SP3524	2
HF-SP5024	3.5
HF-SP7024	5.5
HC-RP103	2
HC-RP153	2
HC-RP203 (Note)	3.5
HC-RP353 (Note)	5.5
HC-RP503 (Note)	5.5
HC-LP52	1.25
HC-LP102	1.25
HC-LP152	2
HC-LP202	3.5
HC-LP302	5.5
HC-UP72	1.25
HC-UP152	2
HC-UP202	3.5
HC-UP352	5.5

Servo motor	Wire size [mm^2]
HC-UP502	5.5
HA-LP601	8
HA-LP801	14
HA-LP12K1	14
HA-LP15K1	22
HA-LP20K1	38
HA-LP25K1	38
HA-LP30K1	38
HA-LP37K1	60
HA-LP701M	8
HA-LP11K1M	14
HA-LP15K1M	22
HA-LP22K1M	38
HA-LP30K1M	60
HA-LP37K1M	60
HA-LP502	5.5
HA-LP702	8
HA-LP11K2	14
HA-LP15K2	22
HA-LP22K2	22
HA-LP30K2	60
HA-LP37K2	60
HA-LP6014	5.5
HA-LP8014	5.5
HA-LP12K14	8
HA-LP15K14	14
HA-LP20K14	14
HA-LP25K14	22
HA-LP30K14	22
HA-LP37K14	22
HA-LP701M4	5.5
HA-LP11K1M4	8
HA-LP15K1M4	14
HA-LP22K1M4	14

Servo motor	Wire size [mm^2]
HA-LP30K1M4	22
HA-LP37K1M4	22
HA-LP45K1M4	38
HA-LP50K1M4	38
HA-LP11K24	8
HA-LP15K24	14
HA-LP22K24	14
HA-LP30K24	22
HA-LP37K24	22
HA-LP45K24	38
HA-LP55K24	38
HF-JP53	1.25
HF-JP73	1.25
HF-JP103	2
HF-JP153	2
HF-JP203	2
HF-JP353	3.5
HF-JP503	5.5
HF-JP703	8
HF-JP903	14
HF-JP11K1M	22
HF-JP15K1M	30
HF-JP534	1.25
HF-JP734	2
HF-JP1034	2
HF-JP1534	2
HF-JP2034	2
HF-JP3534	5.5
HF-JP5034	5.5
HF-JP7034	8
HF-JP9034	8
HF-JP11K1M4	8
HF-JP15K1M4	22

Note. Use a composite cable and others when combining with wiring of the electromagnetic brake power in the same cable.

App. 5 Handling of AC servo amplifier batteries for the United Nations Recommendations on the Transport of Dangerous Goods

United Nations Recommendations on the Transport of Dangerous Goods Rev. 15 (hereinafter Recommendations of the United Nations) has been issued. To reflect this, transport regulations for lithium metal batteries are partially revised in the Technical Instruction (ICAO-TI) by the International Civil Aviation Organization (ICAO) and the International Maritime Dangerous Goods Code (IMDG Code) by the International Maritime Organization (IMO).
To comply the instruction and code, we have modified the indication on the package for general-purpose AC servo batteries.

(1) Target model
Battery (Cell): MR-J3BAT, MR-BAT, A6BAT
Battery unit (Battery): MR-J2M-BT

(2) Purpose
Safer transportation of lithium metal batteries.

(3) Change in regulations
The following points are changed for lithium metal batteries transportation by sea or air due to Recommendations of the United Nations Rev. 15 and ICAO-TI 2009-2010 edition. For lithium metal batteries, cells are classified as UN3090, and batteries contained in or packed with equipment are classified as UN3091.

(a) A package containing 24 cells or 12 batteries or less that are not contained in equipment are no longer exempt from the following: attachment of a handling label, submission of the Shipper's Declaration for Dangerous Goods, and a 1.2m drop test.

(b) A battery handling label (size: 120 × 110mm) is required. Emergency telephone number must be filled out in the additional handling information of the Shipper's Declaration for Dangerous Goods.

(c) New handling label design containing battery illustration (Figure) must be used.

Figure. Example of Mitsubishi Label with Battery Illustration (size: 120 × 110mm)

(4) Action taken by Mitsubishi
The following caution will be added to the packages of the target batteries.
"Containing lithium metal battery. Regulations apply for transportation."

(5) Transportation precaution for customers
For sea or air transportation, the handling label (Figure) is required for the package of a Mitsubishi cell or battery and the outer package containing several packages of Mitsubishi cells or batteries. Documentations like the handling label in the specified design and the Shipper's Declaration for Dangerous Goods are required. Please attach the documentations to the packages. The above change will not affect the function and performance of the product.

App. 6 Symbol for the new EU Battery Directive

Symbol for the new EU Battery Directive (2006/66/EC) that is plastered to general-purpose AC servo battery is explained here.

Note. This symbol mark is for EU countries only.

This symbol mark is according to the directive 2006/66/EC Article 20 Information for end-users and Annex II.

Your MITSUBISHI ELECTRIC product is designed and manufactured with high quality materials and components which can be recycled and/or reused.

This symbol means that batteries and accumulators, at their end-of-life, should be disposed of separately from your household waste.

If a chemical symbol is printed beneath the symbol shown above, this chemical symbol means that the battery or accumulator contains a heavy metal at a certain concentration. This will be indicated as follows.
Hg: mercury (0.0005%), Cd: cadmium (0.002%), Pb: lead (0.004%)

In the European Union there are separate collection systems for used batteries and accumulators.

Please, dispose of batteries and accumulators correctly at your local community waste collection/recycling centre.

Please, help us to conserve the environment we live in!

App. 7 Differences among MR-J3-☐B, MR-J3-☐B-RJ006 and MR-J3-☐S

App. 7.1 Comparison table

Item	MR-J3-☐B	MR-J3-☐B-RJ006 (supports fully closed loop)	MR-J3-☐S
Connector (for main circuit)		←Same as MR-J3-☐B	←Same as MR-J3-☐B-RJ
DIO connector	CN3	←Same as MR-J3-☐B	←Same as MR-J3-☐B-RJ
Encoder connector	CN2	←Same as MR-J3-☐B	←Same as MR-J3-☐B-RJ
External encoder connector	Not available	CN2L	←Same as MR-J3-☐B-RJ
Optional connector	Not available	CN7	←Same as MR-J3-☐B-RJ
STO I/O signal connector	Not available	Not available	CN8
Forced stop signal in initial status	Forced stop (EM1) (Dynamic brake deceleration)	Forced stop (EM1) (Dynamic brake deceleration)	Forced stop2 (EM2) (Forced stop deceleration)
Alarm/Warning			Forced stop error (56), STO timing error (63), STO warning (95)
Additional parameter			Parameter No.PA04 Parameter No.PC24 Parameter No.PC31
Controller setting	Select MR-J3-B.	Select MR-J3-B fully closed loop system.	Select MR-J3-B fully closed loop system.

App. 7.2 Precautions during the forced stop deceleration

(1) The servo amplifier ignores commands including servo-off, ready-off and error reset, which are commanded from the controller.

(2) From the controller, servo amplifier appears to be in an error state (during an alarm or servo-off).

(3) When the main circuit power supply turns off, the forced stop deceleration may shift to the dynamic brake deceleration.

(4) Emergency stop of the positioning operation by FLS/RLS cannot be performed as the servo amplifier is ignoring the commands from the controller.

(5) When a forced stop or an alarm occurs during low speed operation, the braking by electromagnetic brake and dynamic brake is immediately applied in MR-J3-☐B. In MR-J3-☐S, the forced stop deceleration is performed first, then it shifts to these brake decelerations. For this reason, it may take longer time to stop, or machine may overrun in some conditions.

App. 8 Compliance with the European EC directives

App. 8.1 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 also to machines and equipment into which servos have been installed.

(1) EMC directive
The EMC directive applies to the servo units alone. This servo is designed to comply with the EMC directive. The EMC directive also applies the servo-incorporated machines and equipment. This requires the EMC filters to be used with the servo-incorporated machines and equipment to comply with the EMC directive. For specific EMC directive conforming methods, refer to the EMC Installation Guidelines (IB(NA)67310).

(2) Low voltage directive
The low voltage directive applies also to servo units alone. This servo is designed to comply with the low voltage directive.

(3) Machinery directive
The converter units and servo amplifiers (drive units) complies with the safety components laid down in the machinery directive.
Do not allow using the machine until the machine in which the converter unit and the servo amplifier (drive unit) are mounted is declared to comply with the machinery directive.

App. 8.2 For compliance

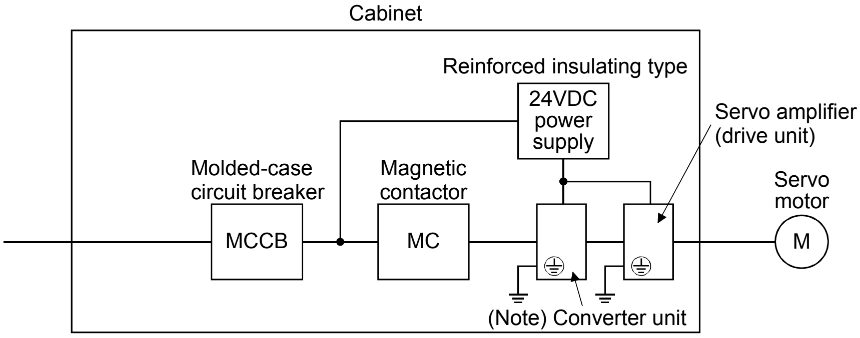
Be sure to perform an appearance inspection of every unit before installation. In addition, have a final performance inspection on the entire machine/system, and keep the inspection record.

(1) Converter units, servo amplifiers (drive units) and servo motors used
Use the converter units, servo amplifiers (drive units) and servo motors which standard product.

Converter unit	: MR-J3-CR55K・MR-J3-CR55K4
Servo amplifier	: MR-J3-10□S to MR-J3-22K□S・MR-J3-10□S1 to MR-J3-40□S1・MR-J3-60□S4 to MR-J3-22K□S4
Drive unit	: MR-J3-DU30K□S・MR-J3-DU37K□S・MR-J3-DU30K□S4 to MR-J3-DU55K□S4
Servo motor	: HF-MP□・HF-KP□・HF-SP□・HF-SP□4・HC-RP□・HC-UP□・HC-LP□ HA-LP□・HA-LP□4・HF-JP□・HF-JP□4

(2) Structure

The control circuit provides safe separation to the main circuit in the servo amplifier.



Note. Servo amplifiers of 22kW or less do not have a converter unit.

(3) Environment

(a) Operate the converter unit and servo amplifier (drive unit) at pollution degree 2 or 1 set forth in IEC/EN 60664-1. For this purpose, install the servo amplifier in a cabinet which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(b) Environment

Environment			Conditions
(Note 1) Ambient temperature	In operation	[°C]	(Note 2) 0 to 55
		[°F]	32 to 131
	In storage, in transportation	[°C]	−20 to 65
		[°F]	−4 to 149
Ambient humidity	In operation, in storage, in transportation		90% RH or less
Maximum altitude	In operation, in storage		1000m or less
	In transportation		10000m or less

Note 1. Ambient temperature is the internal temperature of the cabinet.
2. The servo amplifier 200V 3.5kW or less and 100V 400W or less can be mounted closely. In this case, keep the ambient temperature within 0 to 45°C (32 to 113°F) or use the servo amplifier with 75% or less of the effective load ratio.

(4) Power supply

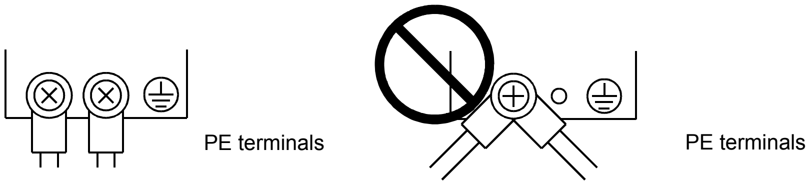
(a) This converter unit and servo amplifier (drive unit) can be supplied from star-connected supply with earthed neutral point of overvoltage category Ⅲ set forth in IEC/EN 60664-1. However, when using the neutral point of 400V system for single phase supply, a reinforced insulating transformer is required in the power input section.

(b) For the interface power supply, use a 24VDC power supply with reinforced insulation on I/O terminals.

(5) Grounding

(a) To prevent an electric shock, the protective earth (PE) terminal (marked ⏚) of the converter unit, servo amplifier (drive unit) must be connected to the protective earth (PE) of the cabinet.

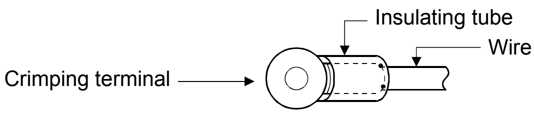
(b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect cables to the terminals one-to-one.



(c) If an earth leakage circuit breaker is used, always earth the protective earth (PE) terminal of the servo amplifier to prevent an electric shock.

(6) Wiring

(a) The wires to be connected to the terminal block of the converter unit, servo amplifier (drive unit) must have crimping terminals provided with insulating tubes to prevent contact with adjacent terminals.



(b) Use the servo motor-side power connector which complies with the IEC/EN Standard.
The IEC/EN Standard-compliant power connector sets are available from us as options.

(c) The converter unit and servo amplifier (drive unit) must be installed in the metal cabinet.

(7) Peripheral devices, options

(a) Use the circuit breaker and magnetic contactor models which are IEC/EN Standard-compliant products given in this Instruction Manual.
Use a residual current device (RCD) of type B. When it is not used, provide insulation between the servo amplifier and other device by double insulation or reinforced insulation, or install a transformer between the main power supply and servo amplifier (drive unit).

(b) The sizes of the wires given in this Instruction Manual meet the following conditions. For use in any other conditions, follow Table 5 and Annex C of IEC/EN 60204-1.
・Ambient temperature: 40℃ (104℉)
・Sheath : PVC (polyvinyl chloride)
・Installation on wall surface or open cable tray

(c) Use the EMC filter for noise reduction.

(8) Performing EMC tests

When EMC tests are run on a machine/device into which the converter unit and servo amplifier (drive unit) 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 converter unit and servo amplifier (drive unit), refer to the EMC Installation Guidelines (IB(NA)67310).

App. 9 Conformance with UL/CSA standard

This servo amplifier is designed to comply with UL 508C and CSA C22.2 No.14 standard.

(1) Converter units, servo amplifiers (drive units) and servo motors used
Use the converter units, servo amplifiers (drive units) and servo motors which standard product.

Servo amplifier	Servo motor							
	HF-KP	HF-MP	HF-SP	HC-RP	HC-UP	HC-LP	HA-LP	HF-JP
MR-J3-10□S(1)	053・13	053・13						
MR-J3-20□S(1)	23	23						
MR-J3-40□S(1)	43	43						
MR-J3-60□S			51・52			52		53
MR-J3-70□S	73	73			72			
MR-J3-100□S			81・102			102		73・103
MR-J3-200□S			121・201・152・202	103・153	152	152		153・203
MR-J3-350□S			301・352	203	202	202		353
MR-J3-500□S			421・502	353・503	352・502	302	502	503
MR-J3-700□S			702				601・701M・702	703
MR-J3-11K□S							801・12K1・11K1M・11K2	903・11K1M
MR-J3-15K□S							15K1・15K1M・15K2	15K1M
MR-J3-22K□S							20K1・25K1・22K1M・22K2	

Servo amplifier	Servo motor		
	HF-SP	HA-LP	HF-JP
MR-J3-60□S4	524		534
MR-J3-100□S4	1024		734・1034
MR-J3-200□S4	1524・2024		1534・2034
MR-J3-350□S4	3524		3534
MR-J3-500□S4	5024		5034
MR-J3-700□S4	7024	6014・701M4	7034
MR-J3-11K□S4		8014・12K14・11K1M4・11K24	9034・11K1M4
MR-J3-15K□S4		15K14・15K1M4・15K24	15K1M4
MR-J3-22K□S4		20K14・22K1M4・22K24	

Converter unit	Drive unit	Servo motor HA-LP
MR-J3-CR55K	MR-J3-DU30K□S	30K1・30K1M・30K2
	MR-J3-DU37K□S	37K1・37K1M・37K2
MR-J3-CR55K4	MR-J3-DU30K□S4	25K14・30K14・30K1M4・30K24
	MR-J3-DU37K□S4	37K14・37K1M4・37K24
	MR-J3-DU45K□S4	45K1M4・45K24
	MR-J3-DU55K□S4	50K1M4・55K24

(2) Installation

The MR-J3 series have been approved as the products which have been installed in the electrical enclosure.

The minimum enclosure size is based on 150% of each MR-J3 combination.

And also, design the enclosure so that the ambient temperature in the enclosure is 55℃ (131°F) or less.

The servo amplifier must be installed in the metal cabinet.

(3) Short circuit rating (SCCR: Short Circuit Current Rating)

Suitable For Use In A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 Volts Maximum.

(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						
	HF-MP HF-KP	HF-SP	HC-RP	HC-UP	HC-LP	HA-LP	HF-JP
250 × 250 × 6	053・13・23						
250 × 250 × 12	43	51・81 52(4) to 152(4)	103 to 203		52 to 152		53(4) to 203(4)
300 × 300 × 12	73						
300 × 300 × 20		121・201 202(4)・352(4)			202・302		
550 × 550 × 30			353・503	72・152			353(4)・503(4)
650 × 650 × 35		301・421 502(4)・702(4)		202 to 502		601(4) to 12K1(4) 701M(4) to 15K1M(4) 502 to 22K2 11K24 to 22K24	703(4)・903(4) ・11K1M(4)・ 15K1M4(4)
950 × 950 × 35						15K1(4) to 37K1(4) 22K1M to 37K1M 22K1M4 to 50K1M4 30K2・37K2 30K24 to 55K24	

(5) About wiring protection

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

(6) Options, peripheral devices
Use the UL/CSA Standard-compliant products.
Use the molded-case circuit breaker (UL489 Listed MCCB) or a Class T fuse indicated in the table below.

Servo amplifier		Molded-case circuit breaker (Note)		Fuse	
		Current	Voltage AC [V]	Current [A]	Voltage AC [V]
MR-J3-10□S(1) ・ 20□S		50A frame 5A	240	10	300
MR-J3-40□S ・ 20□S1		50A frame 10A		15	
MR-J3-60□S to 100□S ・ 40□S1		50A frame 15A		20	
MR-J3-200□S		50A frame 20A		40	
MR-J3-350□S		50A frame 30A		70	
MR-J3-500□S		50A frame 50A		125	
MR-J3-700□S		100A frame 75A		150	
MR-J3-11K□S		100A frame 100A		200	
MR-J3-15K□S		225A frame 125A		250	
MR-J3-22K□S		225A frame 175A		350	
MR-J3-CR55K	MR-J3-DU30K□S	400A frame 250A		500	
	MR-J3-DU37K□S	400A frame 300A		600	
MR-J3-60□S4		50A frame 5A	600Y/347	10	600
MR-J3-100□S4		50A frame 10A		15	
MR-J3-200□S4		50A frame 15A		25	
MR-J3-350□S4		50A frame 20A		35	
MR-J3-500□S4		50A frame 30A		50	
MR-J3-700□S4		50A frame 40A		65	
MR-J3-11K□S4		60A frame 60A		100	
MR-J3-15K□S4		100A frame 75A		150	
MR-J3-22K□S4		225A frame 125A		175	
MR-J3-CR55K4	MR-J3-DU30K□S4	225A frame 125A		250	
	MR-J3-DU37K□S4	225A frame 150A		300	
	MR-J3-DU45K□S4	225A frame 175A		400	
	MR-J3-DU55K□S4	400A frame 225A		450	

Note. Listed molded-case circuit breakers are for when the power factor improving reactor is not used.

(7) Capacitor discharge time
The capacitor discharge time is as follows. To ensure safety, do not touch the charging section for 15 minutes (20 minutes in case drive unit is 30kW or more) after power-off.

Servo amplifier	Discharge time [min]
MR-J3-10□S ・ 20□S	1
MR-J3-40□S ・ 60□S(4) ・ 10□S1 ・ 20□S1	2
MR-J3-70□S	3
MR-J3-40□S1	4
MR-J3-100□S(4)	5
MR-J3-200□S(4) ・ 350□S	9

Servo amplifier	Discharge time [min]
MR-J3-350□S4 ・ 500□S(4) ・ 700□S(4)	10
MR-J3-11K□S(4)	4
MR-J3-15K□S(4)	6
MR-J3-22K□S(4)	8
MR-J3-DU30K□S ・ DU37SK□S ・ DU30K□S4 ・ DU37K□S4 ・ DU45K□S4 ・ DU55K□S4	20

(8) Selection example of wires

To comply with the UL/CSA Standard, use UL-approved copper wires rated at 60/75℃ (140/167℉) for wiring.

The following table shows the wire sizes [AWG] and the crimping terminal symbols rated at 60℃ (140℉). The sizes and the symbols rated at 75℃ (167℉) are shown in the brackets.

Servo amplifier	Converter unit	(Note 3) Wires [AWG]			
		L_1・L_2・L_3・⏚	L_{11}・L_{21}	U・V・W・P_1・P_2・⏚	P・P_2・C
MR-J3-10□S(1) to 40□S(1)・60□S・70□S		14(14)	16(16)	(Note 4) 14(14)	14(14)
MR-J3-100□S・200□S					
MR-J3-350□S		12(12)		12(12)	
(Note 1) MR-J3-500□S		10(10): a(a)	16(16): h(h)	10(10): a(a)	14(14): g(g)
(Note 1) MR-J3-700□S		8(8): b(b)		8(8): b(b)	12(12): a(a)
(Note 1) MR-J3-11K□S		6(6): c(c)	16(16): g(g)	4(4): d(d)	10(10): j(j)
(Note 1) MR-J3-15K□S		4(4): d(d)		2(3): e(d)	
(Note 1) MR-J3-22K□S		1/0(1): f(p)		—(1): —(p)	10(10): k(k)
(Note 1) MR-J3-DU30K□S	MR-J3-CR55K	—(1): —(t)	14(14)	—(2/0): —(u)	10(10): r(r)
(Note 1) MR-J3-DU37K□S		—(2/0): —(u)			
MR-J3-60□S4		14(14)	16(16)	14(14)	14(14)
MR-J3-100□S4					
MR-J3-200□S4					
MR-J3-350□S4		14(14): g(g)	16(16): h(h)	14(14): g(g)	14(14): g(g)
(Note 1) MR-J3-500□S4		10(12): a(a)		10(12): a(a)	
(Note 1) MR-J3-700□S4				10(10): a(a)	
(Note 1) MR-J3-11K□S4		8(10): l(j)	16(16): g(g)	8(8): l(l)	12(12): j(j)
(Note 1) MR-J3-15K□S4		6(8): c(l)		4(6): d(c)	10(10): j(j)
(Note 1) MR-J3-22K□S4		6(6): m(m)		4(6): n(m)	10(10): k(k)
(Note 1) MR-J3-DU30K□S4	MR-J3-CR55K4	3(4): s(s)	14(14)	2(3): p(n)	10(10): r(r)
(Note 1) MR-J3-DU37K□S4		2(2): t(s)		1(2): p(n)	
(Note 1) MR-J3-DU45K□S4		—(2): (t)		—(1/0): —(t)	
(Note 1) MR-J3-DU55K□S4					

<table>
<tr><th rowspan="2">Servo amplifier</th><th rowspan="2">Converter unit</th><th colspan="3">(Note 3) Wires [AWG]</th></tr>
<tr><th>B1 ・ B2</th><th>BU ・ BV ・ BW</th><th>OHS1 ・ OHS2</th></tr>
<tr><td>MR-J3-10□S(1) to 40□S(1) ・ 60□S ・ 70□S</td><td rowspan="8"></td><td rowspan="8">16(16)</td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>MR-J3-100□S ・ 200□S</td></tr>
<tr><td>MR-J3-350□S</td></tr>
<tr><td>(Note 1) MR-J3-500□S</td></tr>
<tr><td>(Note 1) MR-J3-700□S</td><td>(Note 2) 14(14)</td><td>(Note 2) 16(16)</td></tr>
<tr><td>(Note 1) MR-J3-11K□S</td><td rowspan="5">14(14)</td><td rowspan="5">16(16)</td></tr>
<tr><td>(Note 1) MR-J3-15K□S</td></tr>
<tr><td>(Note 1) MR-J3-22K□S</td></tr>
<tr><td>(Note 1) MR-J3-DU30K□S</td><td rowspan="2">MR-J3-CR55K</td><td rowspan="2"></td></tr>
<tr><td>(Note 1) MR-J3-DU37K□S</td></tr>
<tr><td>MR-J3-60□S4</td><td rowspan="9"></td><td rowspan="9">16(16)</td><td rowspan="5"></td><td rowspan="5"></td></tr>
<tr><td>MR-J3-100□S4</td></tr>
<tr><td>MR-J3-200□S4</td></tr>
<tr><td>MR-J3-350□S4</td></tr>
<tr><td>(Note 1) MR-J3-500□S4</td></tr>
<tr><td>(Note 1) MR-J3-700□S4</td><td>(Note 2) 14(14)</td><td>(Note 2) 16(16)</td></tr>
<tr><td>(Note 1) MR-J3-11K□S4</td><td rowspan="3">14(14)</td><td rowspan="7">16(16)</td></tr>
<tr><td>(Note 1) MR-J3-15K□S4</td></tr>
<tr><td>(Note 1) MR-J3-22K□S4</td></tr>
<tr><td>(Note 1) MR-J3-DU30K□S4</td><td rowspan="4">MR-J3-CR55K4</td><td rowspan="4"></td><td rowspan="4">16(16)</td></tr>
<tr><td>(Note 1) MR-J3-DU37K□S4</td></tr>
<tr><td>(Note 1) MR-J3-DU45K□S4</td></tr>
<tr><td>(Note 1) MR-J3-DU55K□S4</td></tr>
</table>

Note 1. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.

2. For the servo motor with a cooling fan.

3. Alphabets in the table indicate crimping tools. Refer to the following table for the crimping terminals and crimping tools.

4. To wire the servo amplifier and a HF-MP・KP servo motor, use the MR-PWS1CBL (option). To extend the wiring, use the AWG14 wire size.

Table: Recommended crimping terminals

Symbol	Servo amplifier-side crimping terminals				
	(Note 2) Crimping terminal	Applicable tool: Body	Applicable tool: Head	Applicable tool: Dice	Manufacturer
a	FVD5.5-4	YNT-1210S			JST
(Note 1) b	8-4NS	YHT-8S			
C	FVD14-6	YF-1 · E-4	YNE-38	DH-122 · DH-112	
D	FVD22-6			DH-123 · DH-113	
(Note 1) e	38-6	YPT-60-21		TD-124 · TD-112	
		YF-1 · E-4	YET-60-1		
(Note 1) f	R60-8	YPT-60-21		TD-125 · TD-113	
		YF-1 · E-4	YET-60-1		
G	FVD2-4	YNT-1614			
H	FVD2-M3				
J	FVD5.5-6	YNT-1210S			
K	FVD5.5-8				
L	FVD8-6	YF-1 · E-4	YNE-38	DH-121 · DH-111	
M	FVD14-8			DH-122 · DH-112	
N	FVD22-8			DH-123 · DH-113	
(Note 1) p	R38-8	YPT-60-21		TD-124 · TD-112	
		YF-1 · E-4	YET-60-1		
Q	FVD2-6	YNT-1614			
R	R38-10	YPT-60-21		TD-124 · TD-112	
S		YF-1 · E-4	YET-60-1		
(Note 1) t	R60-10	YPT-60-21		TD-125 · TD-113	
(Note 1) u		YF-1 · E-4	YET-60-1		

Note 1. Coat the part of crimping with the insulation tube.

2. Some crimping terminals may not be mounted depending on the size. Make sure to use the recommended ones or equivalent ones.

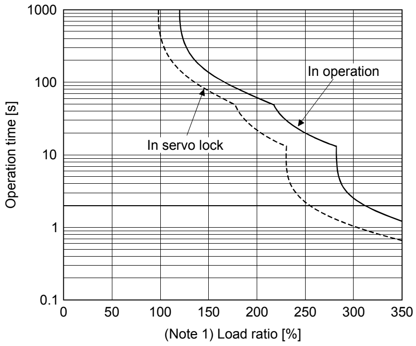
(9) Terminal block tightening torque

Servo amplifier	Tightening torque [N · m]								
	TE1	TE2	TE3	PE	L_1/L_2/L_3/U/V/W/P_1/P/C/N	L_{11}/L_{12}	TE1-1 TE1-2	TE2-1	TE2-2
MR-J3-10□S(1) to 40□S(1) · 60□S to 100□S · 60□S4 · 100□S4 · 200□S(4)				1.2					
MR-J3-350□S					0.6				
MR-J3-350□S4 · 500□S(4) · 700□S(4)	1.2	0.8	1.2		1.2	0.8			
MR-J3-11K□S(4) · 15K□S(4)				3.0	3.0	1.2			
MR-J3-22K□S(4)				6.0	6.0				
MR-J3-DU30K□S · DU37K□S · DU45K□S4 · DU55K□S4	10.0		1.2	10.0				3.0	
MR-J3-DU30K□S · DU37K□S4	6.0	3.0		6.0					
MR-J3-CR55K□S(4)				10.0			10.0		3.0

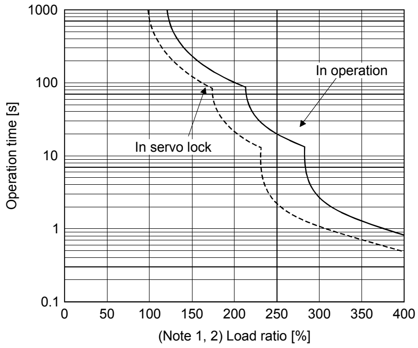
(10)Overload protection characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor, converter unit, servo amplifier (drive unit) and servo motor power line from overloads. The operation characteristics of the electronic thermal relay are shown below. It is recommended to use an unbalanced torque-generated machine, such as a vertical motion shaft, so that unbalanced torque is not more than 70% of the rated torque. When you carry out adhesion mounting of the servo amplifier, make circumference temperature into 0 to 45℃ (32 to 113℉) or use it with 75% or less of effective load torque.

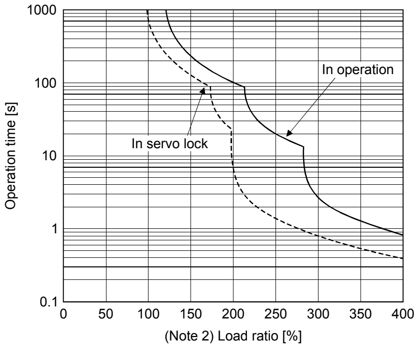
Servo amplifier MR-J3 series has solid-state servo motor overload protection. (The motor full load current is 115% rated current.)



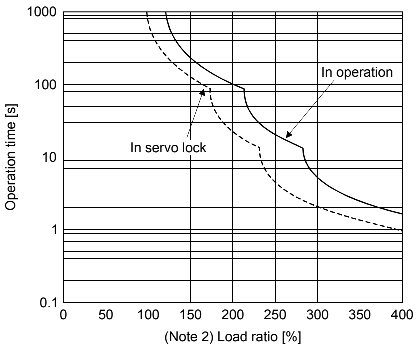
MR-J3-10□S(1)



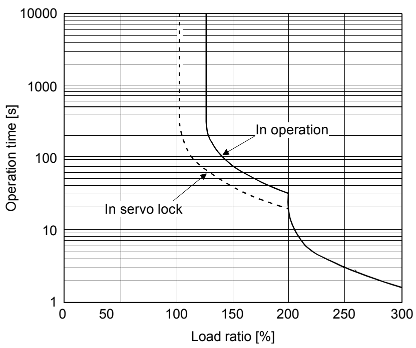
MR-J3-20□S(1) ・ MR-J3-40□S(1)
MR-J3-60□S(4) to
MR-J3-100□S(4)



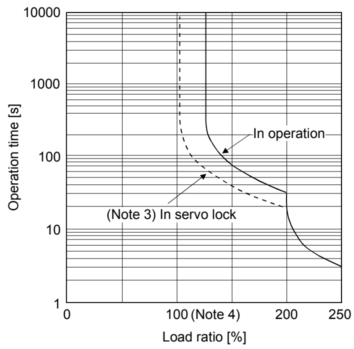
MR-J3-200□S(4) ・
MR-J3-350□S(4)



MR-J3-500□S(4) ・
MR-J3-700□S(4)



MR-J3-11K□S(4) to
MR-J3-22K□S(4)



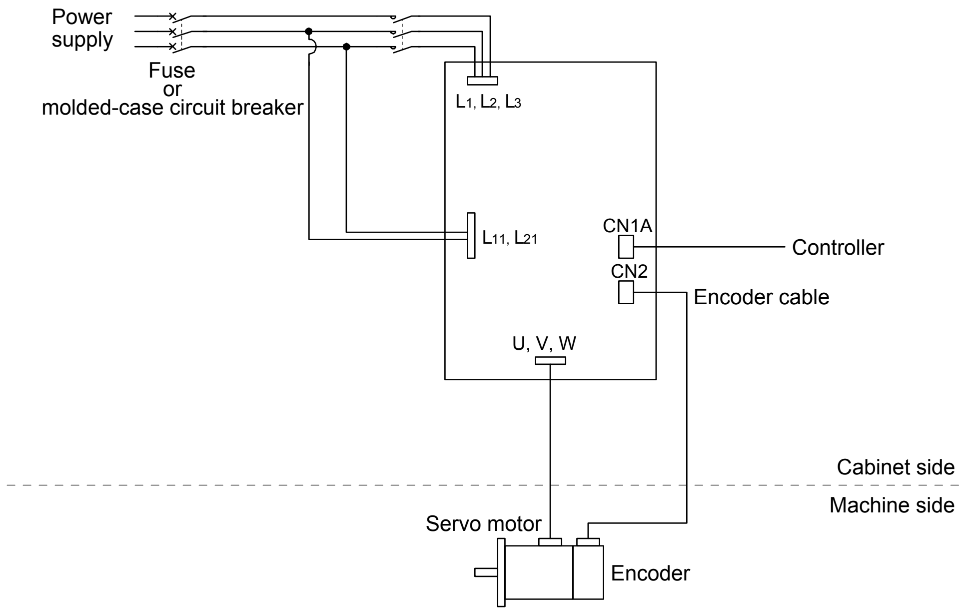
MR-J3-DU30K□S(4) ・
MR-J3-DU37K□S(4)
MR-J3-DU45K□S ・
MR-J3-DU55K□S4
Converter unit
MR-J3-CR55K(4)

Note 1. The operation time at the load ratio of 300 to 350% applies when the maximum torque of HF-KP series servo motor is increased to 350%.
2. The operation time at the load ratio of 300 to 400% applies when the maximum torque of HF-JP series servo motor is increased to 400%.
3. The thermal relay protection characteristics for servo lock are not applied to MR-J3-CR55K(4).
4. Load ratio 100% indicates the rated output of each converter unit and drive unit.

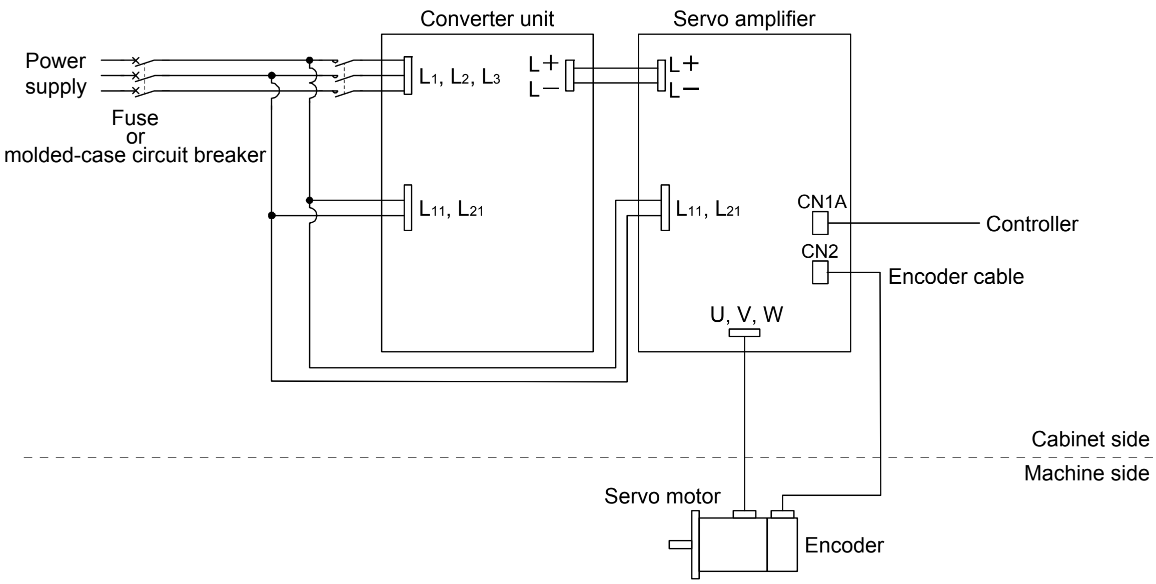
(11)Figure configuration

Representative configuration example to conform to the UL/CSA standard is shown below. The earth wiring is excluded from the figure configuration.

(a) MR-J3-22K□S(4) or less



(b) MR-J3-DU30K□S or more



App. 10 MR-J3-D05 Safety logic unit

This section is equivalent to Safety logic unit MR-J3-D05 Installation Guide (IB(NA)0300155-B).

App. 10.1 Contents of the packing

Open packing, and confirm the content of packing.

Contents	Quantity
MR-J3-D05 Safety logic unit	1
Connector for CN9 1-1871940-4 (TE Connectivity)	1
Connector for CN10 1-1871940-8 (TE Connectivity)	1
MR-J3-D05 Installation Guide	1

App. 10.2 Terms related to safety

App. 10.2.1 Stop function for IEC/EN 61800-5-2

(1) STO function (Refer to IEC/EN 61800-5-2:2007 4.2.2.2 STO)
STO function is integrated into the MR-J3-□B Safety.
STO is a stop function used to shut down energy to servo motors which exert torque. The MR-J3-□B Safety electronically cuts off power supply in the servo amplifier.
The purpose for this safety function is as follows.

a) Uncontrolled stop according to stop category 0 of IEC/EN 60204-1

b) Designed to prevent unexpected start-up

(2) SS1 function (Refer to 4.2.2.3 Safe stop 1 temporal delay.)
SS1 is a function which initiates the STO function when the previously set delay time has passed after the servo motor starts decelerating. The delay time can be set with MR-J3-D05 safety logic unit.
The purpose of this safety function is as follows. SS1 function can be realized by combining MR-J3-□B Safety with MR-J3-D05.

・Controlled stop according to stop category 1 of IEC/EN 60204-1

App. 10.2.2 Emergency operation for IEC/EN 60204-1

(1) Emergency stop (Refer to IEC/EN 60204-1:2005 9.2.5.4.2 Emergency Stop)
Emergency stop must override all other functions and actuation in all operation modes. Power to the machine driving part which may cause a hazardous state must be either removed immediately (stop category 0) or must be controlled to stop such hazardous state as soon as possible (stop category 1). Restart must not allowed even after the cause of the emergency state has been removed.

(2) Emergency switching off (Refer to IEC/EN 60204-1:2005 9.2.5.4.3 Emergency Switching OFF)
Removal of input power to driving device to remove electrical risk and to meet above mentioned safety standards.

App. 10.3 Cautions

The following basic safety notes must be read carefully and fully in order to prevent injury to persons or damage to property. Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed. They must be familiar with all applicable local safety regulations and laws in which machines with these components are installed, particularly the standards and guidelines mentioned in this manual and the requirements mentioned in ISO/EN ISO 13849-1, IEC/EN 61508, IEC/EN 61800-5-2, and IEC/EN 60204-1. The staff responsible for this work must be given express permission from the company to perform start-up, programming, configuration, and maintenance of the machine in accordance with the safety standards.

⚠ DENGER	・Improper installation of the safety related components or systems may cause improper operation in which safety is not assured, and may result in severe injuries or even death.

Protective Measures:
・The STO function (Safe Torque Off), as described in IEC/EN 61800-5-2, only prevents the servo amplifier from supplying energy to the servo motor. It does not guarantee that the drive part of the servo motor will not rotate due to external or unforeseen forces. If an external force acts upon the drive axis, additional safety measures, such as brakes or counter-weights must be used.

App. 10.4 Residual risk

Machine builders are responsible for all risk evaluations and all associated residual risks. Below are residual risks associated with the STO/EMG function. Mitsubishi is not liable for any damages or injuries caused by the residual risks.

(1) The SS1 function only guarantees the delay time before STO/EMG is engaged. Proper setting of this delay time is the full responsibility of the company and/or individuals responsible for installation and commissioning of the safety related system. The system, as a whole, must pass safety standards certification.

(2) When the SS1 delay time is shorter than the required servo motor deceleration time, if there is a failure in the forced stop function, or if STO/EMG is engaged while the servo motor is still rotating; the servo motor will stop with the dynamic brake or freewheeling.

(3) For proper installation, wiring, and adjustment, thoroughly read the manual of each individual safety related component.

(4) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards. The Mitsubishi Electric safety related components mentioned in this manual are certified by TUV Rheinland as meeting the requirements of ISO/EN ISO 13849-1 Category 3, PL d, and IEC/EN 61508 SIL 2.

(5) Safety is not assured until safety-related components of the system are completely installed or adjusted.

(6) When replacing a servo amplifier etc. or MR-J3-D05 safety logic unit, confirm that the new parts are exactly the same as those being replaced. Once installed, be sure to verify the performance of the safety functions before commissioning the system.

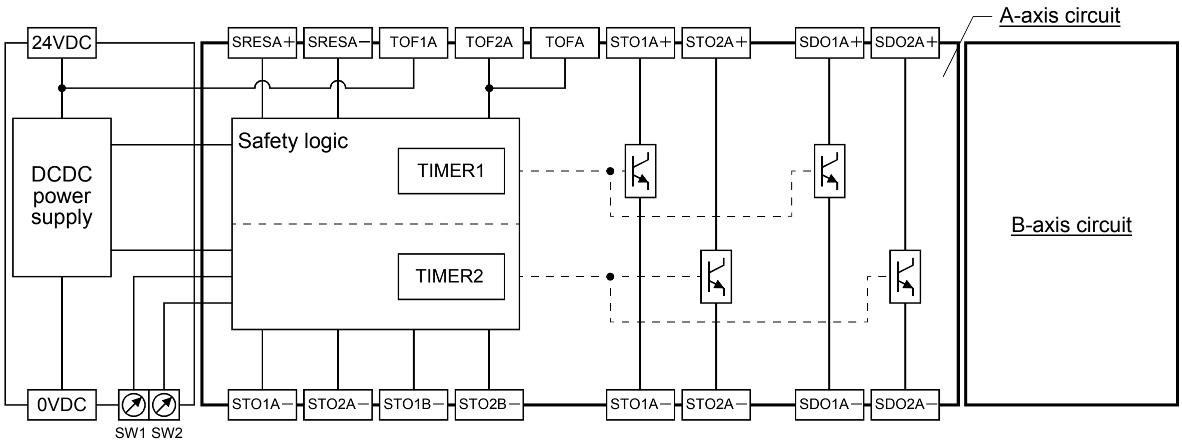
(7) Perform all risk assessments and safety level certification to the machine/system as a whole. It is recommended that an external governing body, such as TUV Rheinland, oversea final safety certification of the system.

(8) To prevent accumulation of multiple failures, perform a failure check at regular intervals as deemed necessary by the applicable safety standard. Regardless of the system safety level, failure checks should be performed at least once per year.

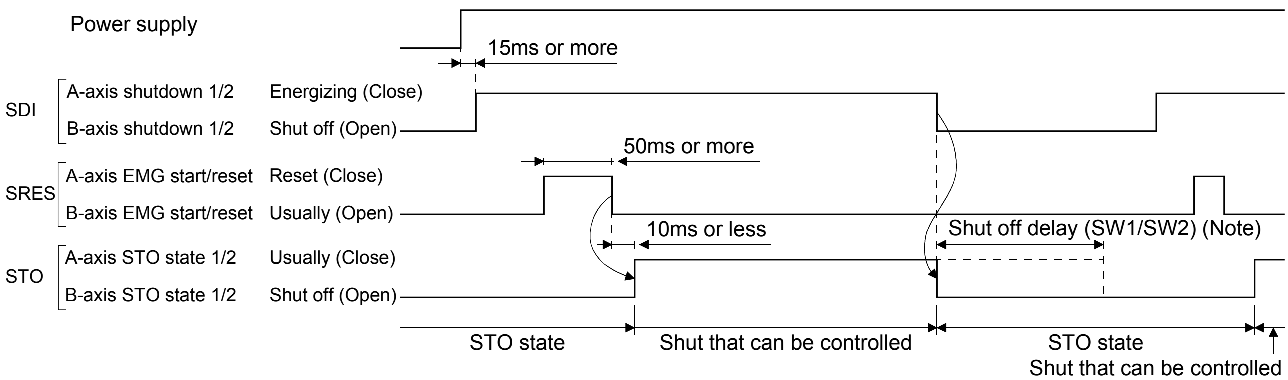
(9) If the upper and lower power transistor in the inverter bridge have failure simultaneously, the servo motor may move maximum of 0.5 rotation.

App. 10.5 Block diagram and timing chart

(1) Function block diagram



(2) Operation sequence



Note: Refer to App. 10.10.

App. 10.6 Maintenance and disposal

MR-J3-D05 safety logic unit is equipped with LED displays to check errors for maintenance.
Please dispose this unit according to your local laws and regulations.

App. 10.7 Functions and configuration

App. 10.7.1 Introduction

The safety logic unit MR-J3-D05 has two systems in which the each system has SS1 function (delay time) and output of STO function.

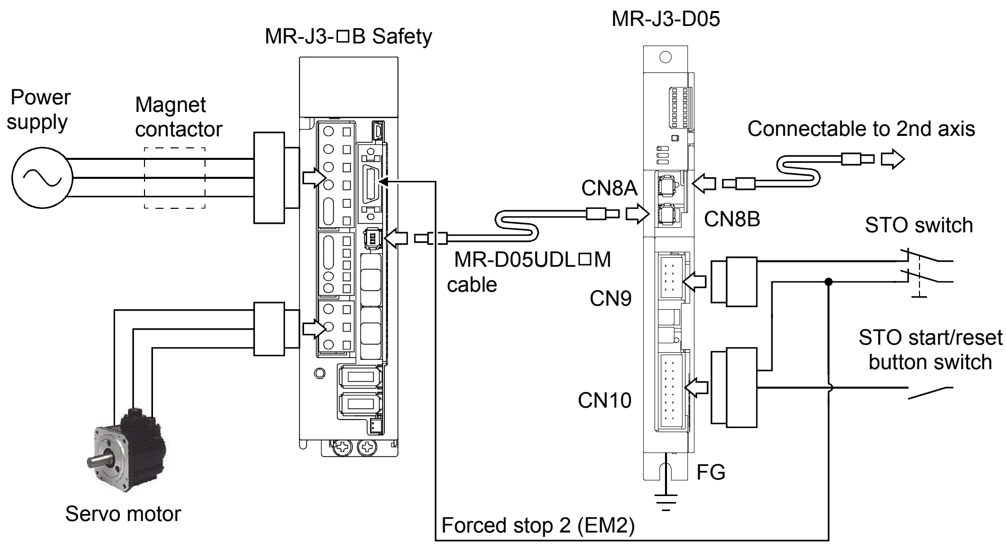
App. 10.7.2 Specifications

Name				Safety logic unit
Model				MR-J3-D05
Control circuit power supply	Voltage			24VDC
	Permissible voltage fluctuation			24VDC±10%
	Power supply capacity			500mA(1, 2)
Compatible system				2 systems (A axis, B axis independent)
Shut-off input				4 points (2 points × 2 systems) SDI□: (source/sink compatible) (Note 3)
Shut-off release input				2 points (1 points × 2 systems) SRES□: (source/sink compatible) (Note 3)
Feedback input				2 points (1 points × 2 systems) TOF□: (source compatible) (Note 3)
Input method				Photo coupler insulation, 24VDC (External supply), internal limited resistance 5.4kΩ
Shut-off output				8 points (4 points × 2 systems) STO□: (source compatible) (Note 3) SDO□: (source/sink compatible) (Note 3)
Output method				Photo coupler insulation, Open collector method Permissible current: 40mA/1 output, Inrush current: 100mA/1 output
Response performance (when delay time is set to 0s)				10ms or less (STO input OFF→shut-off output OFF)
Delay time setting				A-axis: select from 0s, 1.4s, 2.8s, 5.6s, 9.8s, 30.8s B-axis: select from 0s, 1.4s, 2.8s, 9.8s, 30.8s Accuracy: ±2
(Note 4) Test pulse input (STO)				Test pulse interval: 1 to 25Hz Test pulse off time: Up to 1ms
Safety function				STO, SS1(IEC/EN 61800-5-2) EMG STOP, EMG OFF(IEC/EN 60204-1)
Safety performance				ISO/EN ISO 13849-1 PL d(3), IEC/EN 61508 SIL 2, IEC/EN 62061 SIL CL2
Mean time to dangerous failure (MTTFd)				100 years
Diagnostic converge (DC)				90%
Average probability of dangerous failures per hour (PFH)				1.01×10^{-7} [1/h]
Structure				Natural-cooling, open (IP rating: IP 00)
Environmental conditions	Ambient temperature	In operation	[°C]	0 to 55 (non-freezing)
			[°F]	32 to 131 (non-freezing)
		In storage	[°C]	−20 to 65 (non-freezing)
			[°F]	4 to 149 (non-freezing)
	Ambient humidity	In operation		90%RH or less (non-condensing)
		In storage		
	Ambient			Indoors (no direct sunlight), Free from corrosive gas, flammable gas, oil mist, dust and dirt
	Altitude			Max. 1000m above sea level
	Vibration			5.9 m/s² or less at 10 to 55Hz (X, Y and Z axes)
Mass			[kg] ([lb])	0.2 (0.44) (including CN9 and CN10 connectors)

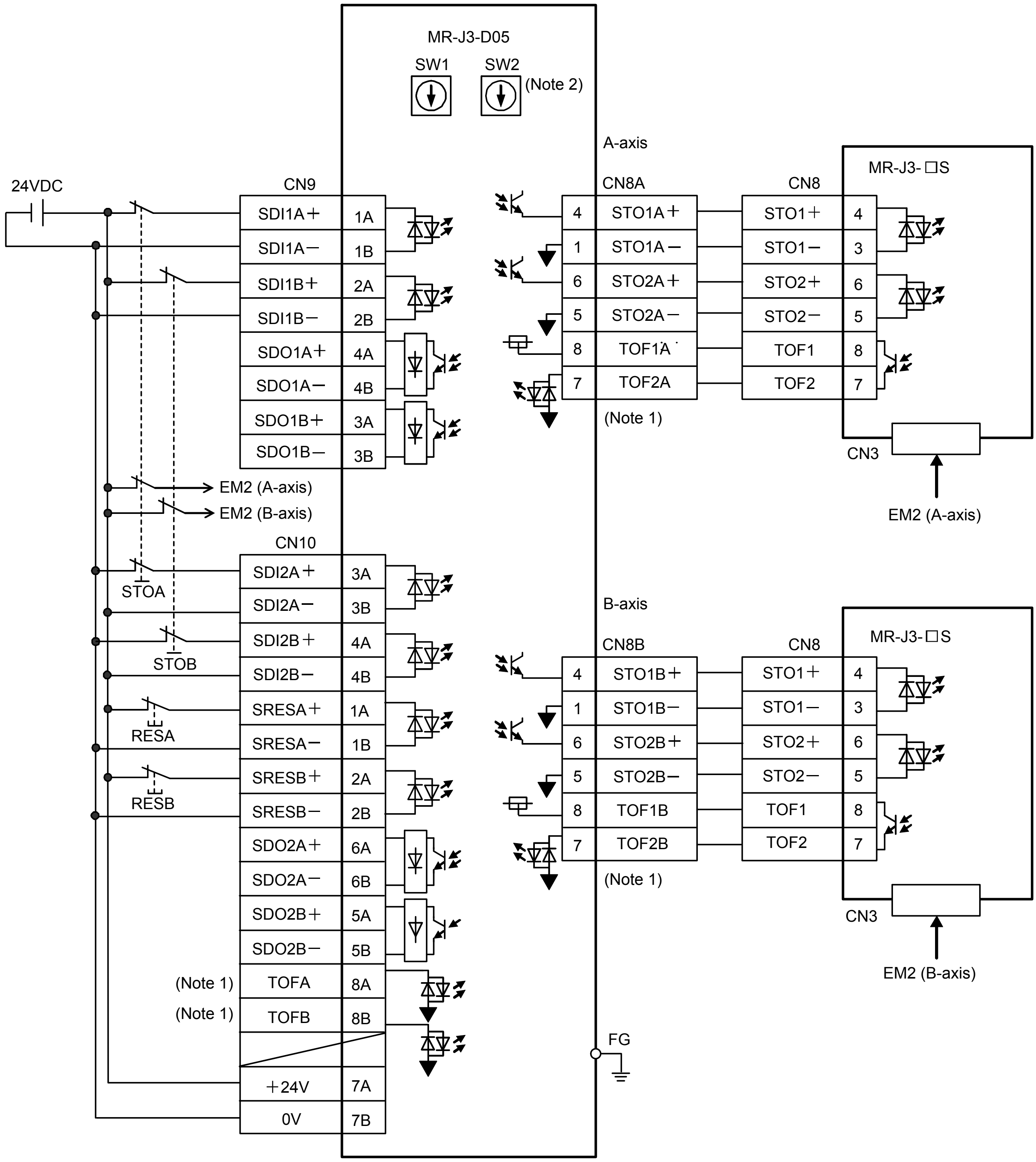
Note 1. Inrush current of approximately 1.5A flows instantaneously when turning the control circuit power supply on. Select an appropriate capacity of power supply considering the inrush current.
2. Power-ON duration of the safety logic unit is 100,000 times.
3. □: in signal name indicates a number or axis name.
4. This function diagnoses malfunction of contacts including an external circuit by shortly turning OFF signals from a controller to the servo amplifier at a constant period while input signals of the servo amplifier are ON.

App. 10.7.3 When using MR-J3-D05 with the MR-J3-□B Safety servo amplifier

(1) System configuration diagram



(2) I/O signal connection example



Note 1. CN8A-7 pin (TOF2A) and CN10-8A pin (TOFA) are same input signals. CN8B-7 pin (TOF2B) and CN10-8B pin (TOFB) are same input signals as well.

2. Set the delay time of STO output with SW1 and SW2. These switches are located where dented from the front panel.

(3) Description of signal and function

The following table lists which operation, the forced stop deceleration or the dynamic brake, will function for each signal input or power-off.

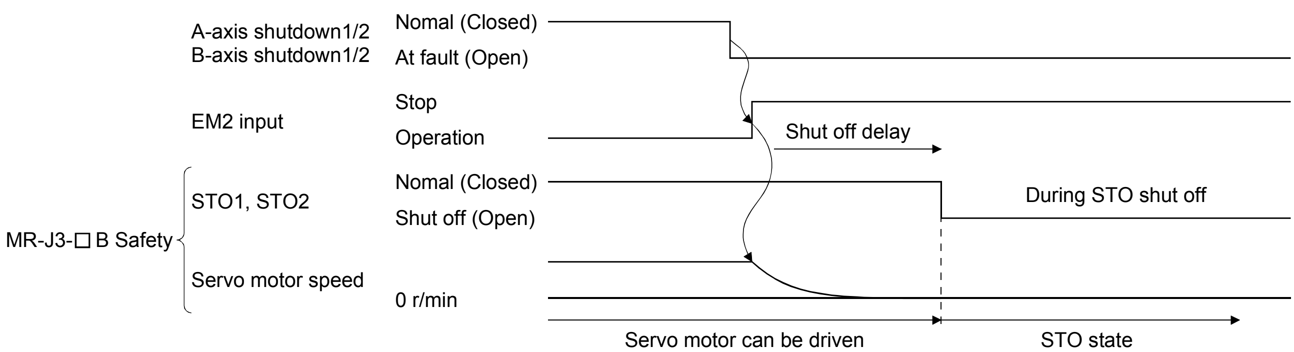
Input signal to MR-J3-□B Safety	Signal logic	Definition	Forced stop deceleration ○: operates ×: does not operate	Remarks
EM2	Normally closed contact opens	Decelerating to stop signal	○	
STO1	Normally closed contact opens	STO1 shut-off signal	—	
STO2	Normally closed contact opens	STO2 shut-off signal	—	
LSP	Normally closed contact opens	Stroke end ＋	○	Sudden stop function of the standard servo amplifier. Unlike the decelerating to stop signal, RES and SON are prioritized.
LSN	Normally closed contact opens	Stroke end －	○	
Reset command	Normally open contact closes	Alarm reset	—	
Servo-on command	Normally open contact opens	Servo-off	—	
Servo amplifier control circuit power supply shut-off			×	Decelerating to stop starts with dynamic brake after control circuit power supply shut-off is detected.
Servo amplifier main circuit power supply shut-off			○	Decelerating to stop starts with undervoltage alarm level (AL10).Dynamic brake starts with 80 of undervoltage alarm level.

(4) Basic operation example

The following basic operation applies when combined with the MR-J3-□B Safety.

The switching of STOA is output to CN8A and usually is input to the MR-J3-□B Safety servo amplifier.

The switching of STOB is output to CN8B and usually is input to the MR-J3-□B Safety servo amplifier.



App. 10.8 Signal

App. 10.8.1 Connector pin assignment

(1) CN8A

Device	Symbol	Pin No.	Function/Application	(Note) I/O
A-axis STO1	STO1A－ STO1A＋	4 1	Outputs STO1 to A-axis driving device. Outputs same signal as A-axis STO2. STO state (base shutdown): Between STO1A＋ and STO1A－ is opened. STO release state (in driving): Between STO1A＋ and STO1A－ is closed.	O
A-axis STO2	STO2A－ STO2A＋	5 6	Outputs STO2 to A-axis driving device. Outputs same signal as A-axis STO1. STO state (base shutdown): Between STO2A＋ and STO2A－ is opened. STO release state (in driving): Between STO2A＋ and STO2A－ is closed.	O
A-axis STO state	TOF2A TOF1A	7 8	Inputs STO state of A-axis driving device. STO state (base shutdown): Open between TOF2A and TOF1A. STO release state (in driving): Close between TOF2A and TOF1A.	I

Note. Exclusive interface for MR-J3-□B Safety.

(2) CN8B

Device	Symbol	Pin No.	Function/Application	(Note) I/O
B-axis STO1	STO1B－ STO1B＋	1 4	Outputs STO1 to B-axis driving device. Outputs same signal as B-axis STO2. STO state (base shutdown): Between STO1B＋ and STO1B－ is opened. STO release state (in driving): Between STO1B＋ and STO1B－ is closed.	O
B-axis STO2	STO2B－ STO2B＋	5 6	Outputs STO2 to B-axis driving device. Outputs same signal as B-axis STO1. STO state (base shutdown): Between STO2B＋ and STO2B－ is opened. STO release state (in driving): Between STO2B＋ and STO2B－ is closed.	O
B-axis STO state	TOF2B TOF1B	7 8	Inputs STO state of B-axis driving device. STO state (base shutdown): Open between TOF2B and TOF1B. STO release state (in driving): Close between TOF2B and TOF1B.	I

Note. Exclusive interface for MR-J3-□B Safety.

(3) CN9

Device	Symbol	Pin No.	Function/Application	I/O
A-axis shutdown 1	SDI1A＋ SDI1A－	1A 1B	Connect this device to a safety switch for A-axis driving device. Input a same signal as A-axis shutdown 2. STO state (base shutdown): Open between SDI1A＋ and SDI1A－. STO release state (in driving): Close between SDI1A＋ and SDI1A－.	DI-1
B-axis shutdown 1	SDI1B＋ SDI1B－	2A 2B	Connect this device to a safety switch for B-axis driving device. Input a same signal as B-axis shutdown 2. STO state (base shutdown): Open between SDI1B＋ and SDI1B－. STO release state (in driving): Close between SDI1B＋ and SDI1B－.	DI-1
A-axis SDO1	SDO1A＋ SDO1A－	4A 4B	Outputs STO1 to A-axis driving device. Output a same signal as A-axis SDO2. STO state (base shutdown): Between SDO1A＋ and SDO1A－ is opened. STO release state (in driving): Between SDO1A＋ and SDO1A－ is closed.	DO-1
B-axis SDO1	SDO1B＋ SDO1B－	3A 3B	Outputs STO1 to B-axis driving device. Output a same signal as B-axis SDO 2. STO state (base shutdown): Between SDO1B＋ and SDO1B－ is opened. STO release state (in driving): Between SDO1B＋ and SDO1B－ is closed.	DO-1

(4) CN10

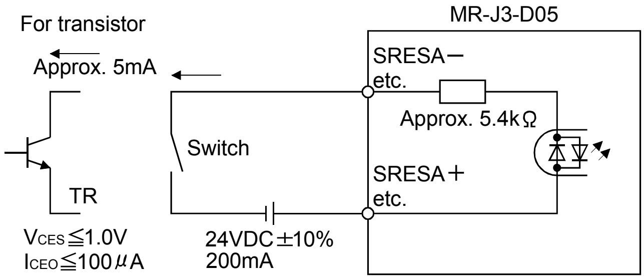
Device	Symbol	Pin No.	Function/Application	I/O
A-axis shutdown 2	SDI2A＋ SDI2A－	3A 3B	Connect this device to a safety switch for A-axis driving device. Input a same signal as A-axis shutdown 1. STO state (base shutdown): Open between SDI2A＋ and SDI2A－. STO release state (in driving): Close between SDI2A＋ and SDI2A－.	DI-1
B-axis shutdown 2	SDI2B＋ SDI2B－	4A 4B	Connect this device to a safety switch for B-axis driving device. Input a same signal as B-axis shutdown 1. STO state (base shutdown): Open between SDI2B＋ and SDI2B－. STO release state (in driving): Close between SDI2B＋ and SDI2B－.	DI-1
A-axis EMG start/reset	SRESA＋ SRESA－	1A 1B	Signal for releasing STO state (base shutdown) on A-axis driving device. Releases STO state (base shutdown) on A-axis driving device by switching between SRESA+ and SRESA− from ON (connected) to OFF (opened).	DI-1
B-axis EMG start/reset	SRESB＋ SRESB－	2A 2B	Signal for releasing STO state (base shutdown) on B-axis driving device. Releases STO state (base shutdown) on B-axis driving device by switching between SRESB+ and SRESB− from ON (connected) to OFF (opened).	DI-1
A-axis SDO2	SDO2A＋ SDO2A－	6A 6B	Outputs STO2 to A-axis driving device. Outputs a same signal as A-axis SDO1. STO state (base shutdown): Between SDO2A＋ and SDO2A－ is opened. STO release state (in driving): Between SDO2A＋ and SDO2A－ is closed.	DO-1
B-axis SDO2	SDO2B＋ SDO2B－	5A 5B	Outputs STO2 to B-axis driving device. Outputs a same signal as B-axis SDO1. STO state (base shutdown): Between SDO2B＋ and SDO2B－ is opened. STO release state (in driving): Between SDO2B＋ and SDO2B－ is closed.	DO-1
Control circuit power	＋24V	7A	Connect ＋side of 24VDC.	
Control circuit power GND	0V	7B	Connect －side of 24VDC.	
A-axis STO state	TOFA	8A	TOFA is internally connected with TOF2A.	
B-axis STO state	TOFB	8B	TOFB is internally connected with TOF2B.	

App. 10.8.2 Interfaces

(1) Detailed description of interfaces

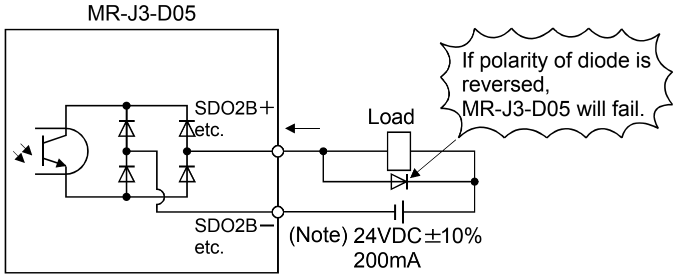
(a) Digital input interface

Give a signal with a relay or open collector transistor.



(b) Digital output interface

A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the MR-J3-D05.

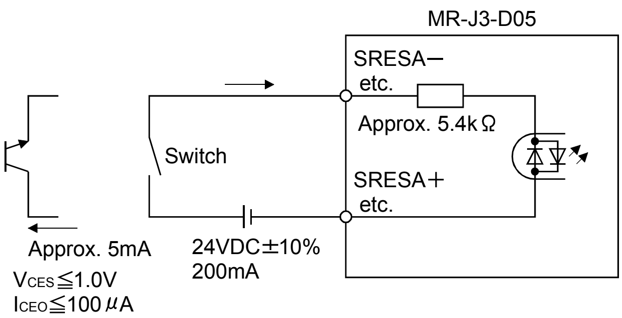


Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

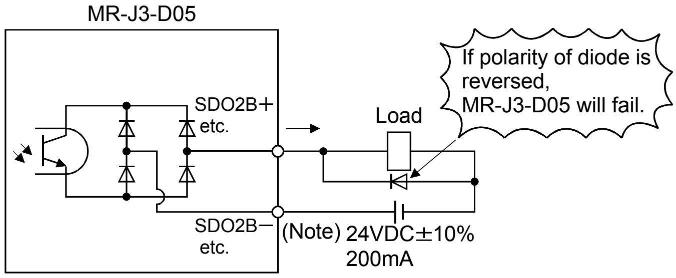
(2) Source I/O interfaces (CN9, CN10 connector)

In this servo amplifier, source type I/O interfaces can be used. In this case, all DI-1 input signals and DO-1 output signals are of source type. Perform wiring according to the following interfaces.

(a) Digital input interface



(b) Digital output interface
A maximum of 2.6V voltage drop occurs in the servo amplifier.



Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (maximum of 26.4V) from external source.

App. 10.8.3 Wiring CN9 and CN10 connectors

Handle with the tool with care when connecting wires.

(1) Wire strip
(a) Use wires with size of AWG#20 to #24 (0.22 to 0.5mm^2) (recommended electric wire: UL1007) and strip the wires to make the strip length 7.0±0.3mm. Confirm the strip length with gauge, etc. before using the wires.

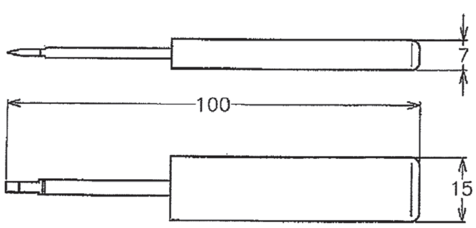
(b) If the stripped wires are bent, feazed or too thick due to twisting too much, fix the wires by twisting lightly, etc. Then, confirm the strip length before using the wires. Do not use excessively deformed wires.

(c) Smooth out the wire surface and stripped insulator surface.

(2) Connecting wires
It works when wires is connected with the Receptacle assembly pulled out from the header connector with out fail. There is danger of damaging the connector and the printed board when working with the connector mated.

(a) Using extraction tool (1891348-1 or 2040798-1)
1) External dimensions and mass

[Unit: mm]

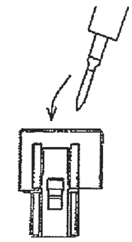


Mass : Approx. 20g

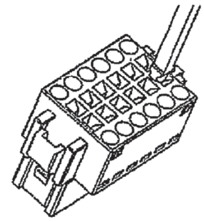
2) Connecting wires

a) Confirm the model number of the housing, contact and tool to be used.

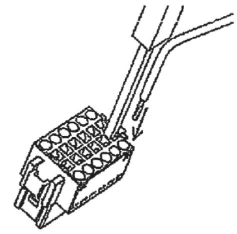
b) Insert the tool diagonally into the receptacle assembly.



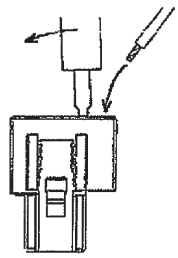
c) Insert the tool until it hits the surface of the receptacle assembly. At this stage, the tool is vertical to the receptacle assembly.



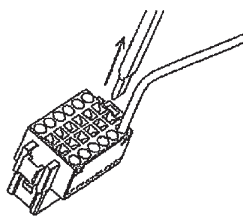
d) Insert wires in the wiring hole till the end. The wires should be slightly twisted in advance to prevent it from being feazed.



It is easy to insert the wire if the wire is inserted diagonally while twisting the tool.



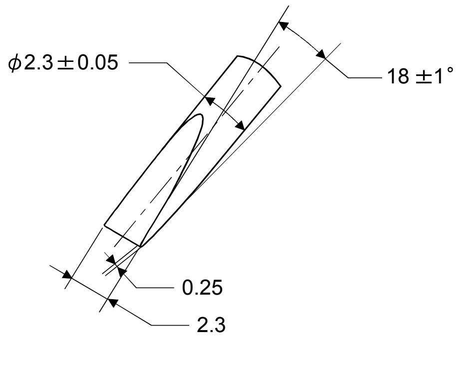
e) Remove the tool.



(b) Using a screwdriver
Do not put excessive force, and be cautious when working.

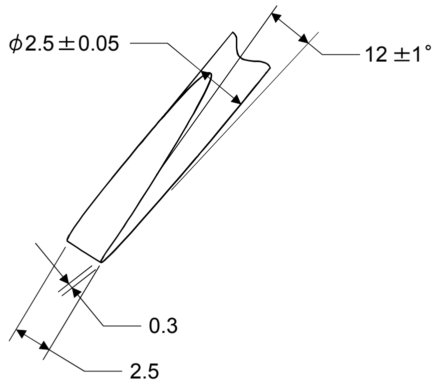
1) Adjusting driver

Diameter: 2.3±0.05mm
Length: 120mm MAX
Width: 2.3mm, Blade thickness: 0.25mm
Angle in tip of the blade: 18±1 degrees



Screwdriver diameter φ2.3mm

Diameter: 2.3±0.05mm
Length: 120mm MAX
Width: 2.5mm, Blade thickness: 0.3mm
Angle in tip of the blade: 12±1 degrees



Screwdriver diameter φ2.5mm

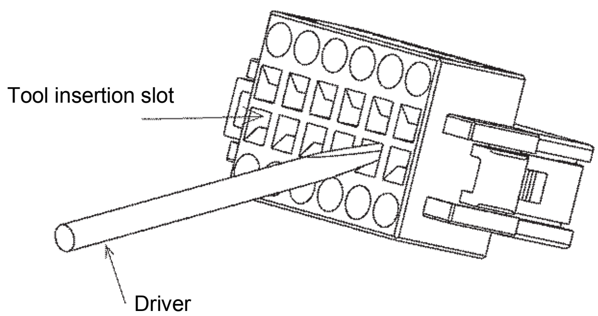
2) Connecting wires

a) Insert a screwdriver in the front slot a little diagonally, and depress the spring. While depressing the spring, insert the wires until they hit the end. Note that the housing and spring may be damaged if the screwdriver is inserted strongly. Never insert the screwdriver in the wire hole. Otherwise, the connector will be damaged.

b) Pull the screwdriver out while pressing the wires. Connecting wires is completed.

c) Pull the wires lightly, and confirm that the wires are surely connected.

d) To remove the wires, depress the spring by the screwdriver in the same way as connecting wires, and then pull the wires out.



(3) Connector insertion
Insert the connector all the way straight until you hear or feel clicking.
When removing the connector, depress the lock part completely before pulling out. If the connector is pulled out without depressing the lock part completely, the housing, contact and/or wires may be damaged.

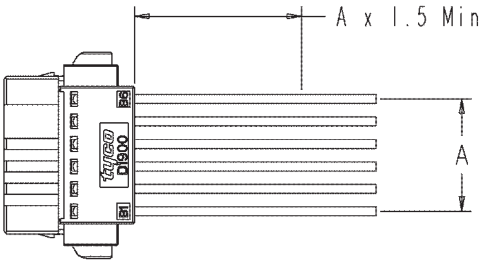
(4) Compatible wire

Compatible wire size is listed below.

Wire size mm^2	(AWG)
0.22	#24
0.34	#22
0.50	#20

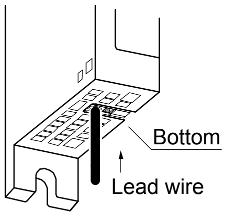
(5) Others

(a) Fix a wire tie at least distance of “A” ×1.5 away from the end of the connector.



(b) Be sure that wires are not pulled excessively when the connector is inserted.

App. 10.8.4 Wiring FG



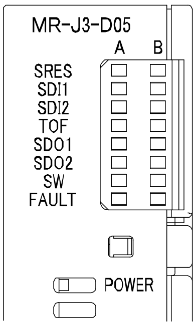
・Wire range

Single wire : ϕ0.4 mm to ϕ1.2 mm (AWG 26 to AWG 16)

Stranded wire : 0.2 mm^2 to 1.25 mm^2 (AWG 24 to AWG 16), wire ϕ0.18 mm or more

App. 10.9 LED display

I/O status, fault and power ON/OFF are displayed with LED for each A-axis and B-axis.



<table>
<tr><th rowspan="2">LED</th><th rowspan="2">Definition</th><th colspan="2">LED</th></tr>
<tr><th>Column A</th><th>Column B</th></tr>
<tr><td>SRES</td><td>Monitor LED for start/reset
OFF: The start/reset is off. (The switch contact is opened.)
ON: The start/reset is on. (The switch contact is closed.)</td><td rowspan="8">A-axis</td><td rowspan="8">B-axis</td></tr>
<tr><td>SDI1</td><td>Monitor LED for shutdown 1
OFF: The shutdown 1 is off. (The switch contact is opened.)
ON: The shutdown 1 is on. (The switch contact is closed.)</td></tr>
<tr><td>SDI2</td><td>Monitor LED for shutdown 2
OFF: The shutdown 2 is off. (The switch contact is opened.)
ON: The shutdown 2 is on. (The switch contact is closed.)</td></tr>
<tr><td>TOF</td><td>Monitor LED for STO state
OFF: Not in STO state
ON: In STO state</td></tr>
<tr><td>SDO1</td><td>Monitor LED for SDO1
OFF: Not in STO state
ON: In STO state</td></tr>
<tr><td>SDO2</td><td>Monitor LED for SDO2
OFF: Not in STO state
ON: In STO state</td></tr>
<tr><td>SW</td><td>Monitor LED for confirming shutdown delay setting
OFF: The settings of SW1 and SW2 do not match.
ON: The settings of SW1 and SW2 match.</td></tr>
<tr><td>FAULT</td><td>FAULT LED
OFF: Normal operation (STO monitoring state)
ON: Fault has occurred.</td></tr>
<tr><td>POWER</td><td>Power
OFF: Power is not supplied to MR-J3-D05.
ON: Power is being supplied to MR-J3-D05.</td><td colspan="2"></td></tr>
</table>

App. 10.10 Rotary switch setting

Rotary switch is used to shut off the power after control stop by SS1 function.
Set the delay time for STO output after STO shut off switch is pressed.
Set same setting for SW1 and SW2, and set the rotary switch setting according to the delay time in the table below.
Setting cannot be changed while power is ON. Notify users that setting cannot be changed by putting a seal or by another method so that end users will not change the setting after the shipment.
0 to F in the following table is the set value of the rotary switches (SW1 and SW2).

Rotary switch setting and delay time at A/B-axis [s]

		B axis					
		0s	1.4s	2.8s	5.6s	9.8s	30.8s
A axis	0s	0	1	2	−	3	4
	1.4s		−	5	−	6	7
	2.8s			8	−	9	A
	5.6s				−	B	C
	9.8s					D	E
	30.8s						F

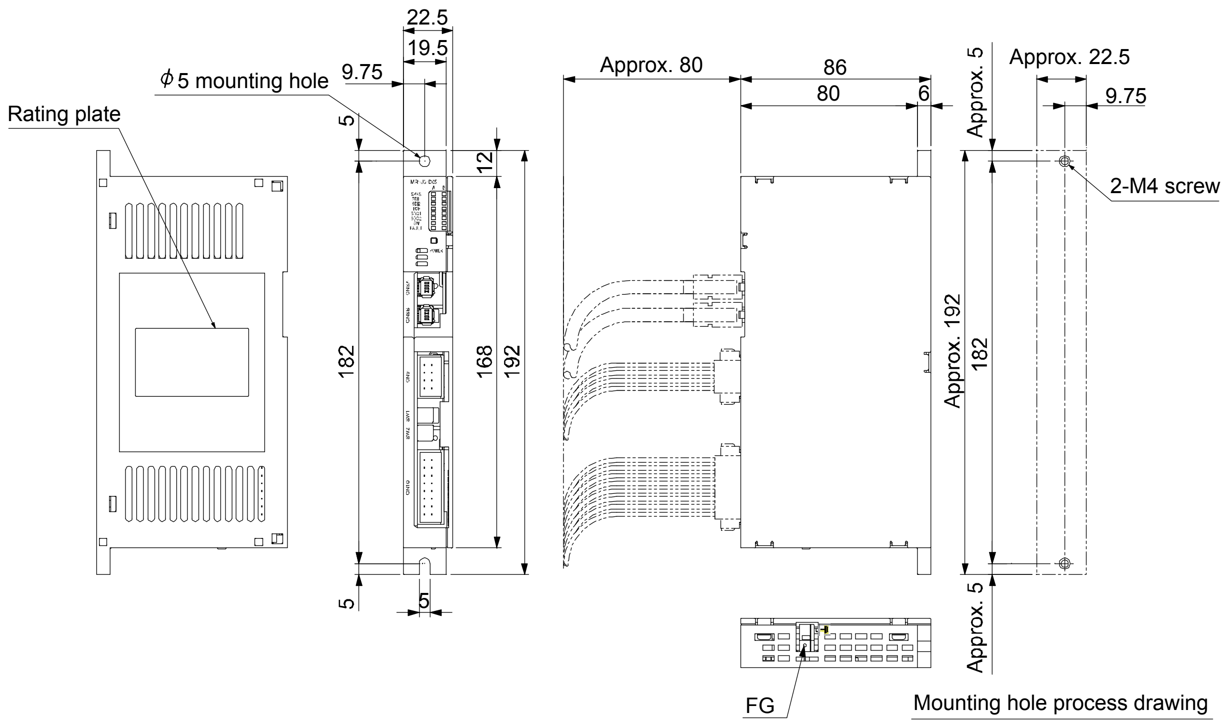
App. 10.11 Troubleshooting

When power is not supplied or FAULT LED turns on, refer the following table and take the appropriate action.

Event	Definition	Cause	Action
Power is not supplied.	Power LED does not turn on although power is supplied.	1. 24VDC power supply is faulty.	Change the 24VDC power supply.
		2. Wires between MR-J3-D05 and 24VDC power supply are disconnected or are in contact with other wires.	Check the wiring.
		3. MR-J3-D05 is faulty.	Change the MR-J3-D05.
FAULT LED is on.	FAULT LED of A-axis or B-axis is on, and will not turn off.	1. Mismatch of delay time setting.	Check the settings of the rotary switch.
		2. Switch input error	Check the wiring or sequence of the input signals.
		3. TOF signal error	Check the connection with the servo amplifier.
		4. MR-J3-D05 is faulty.	Change the MR-J3-D05.

App. 10.12 Outline drawings

[Unit: mm]



Mounting screw

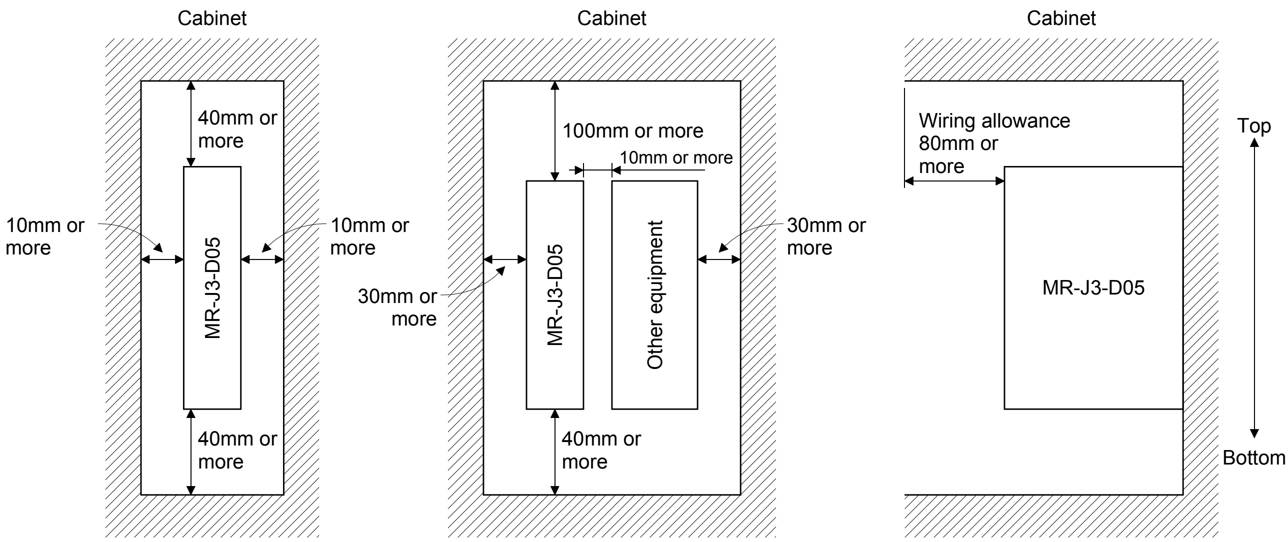
Screw size: M4

Tightening torque: 1.2 [N・m]

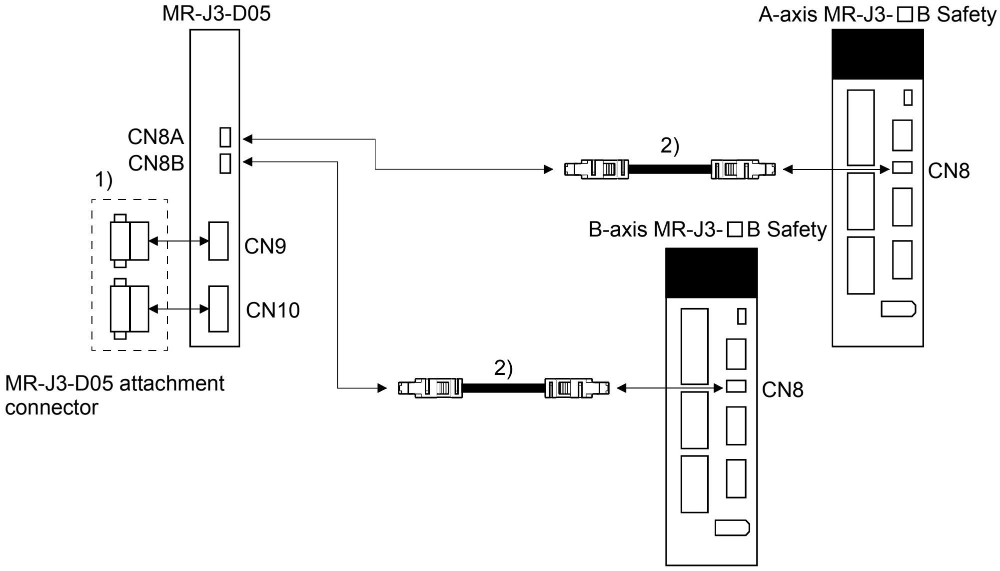
Mass: 0.2 [kg]

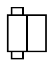
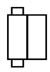
App. 10.13 Installation

Follow the instructions in this chapter and install MR-J3-D05 in the specified direction. Leave clearances between MR-J3-D05 and other equipment including the cabinet.



App. 10.14 Combinations of cable/connector



No.	Product	Model	Description	
1)	Connector	MR-J3-D05 attachment connector	 For CN9 Connector: 1-1871940-4 (TE Connectivity)	 For CN10 Connector: 1-1871940-8 (TE Connectivity)
2)	STO cable	MR-D05UDL□M Cable length: 0.3・1・3m	Connector set: 2069250-1 (TE Connectivity) 	Connector set: 2069250-1 (TE Connectivity)

COMPLIANCE WITH THE MACHINERY DIRECTIVES

The MR-J3-D05 complies with the safety components laid down in the directive 2006/42/EC (Machinery).

App. 11 EC declaration of conformity

The MR-J3-□S servo amplifier and MR-J3-D05 safety logic unit comply with the safety component laid down in the Machinery directive.

TÜVRheinland®

ZERTIFIKAT
CERTIFICATE

Nr./No. 968/EL 612.01/09

Prüfgegenstand **Product tested**	Drive control board within MR-J3-□S	**Inhaber** **Holder**	Mitsubishi Electric Corporation Nagoya Works 1-14 Yada-Minami 5-chome Higashi-ku Nagoya 461-8670 Japan
Typbezeichnung **Type designation**	MR-J3-□S Servo Drives	**Verwendungs-zweck** **Intended application**	Drive applications STO acc. to EN 61800-5-2, Safe Stop Stop Category 0 acc. to EN 60204-1
Prüfgrundlagen **Codes and standards forming the basis of testing**		EN ISO 13849-1:2008 EN 62061:2005 EN 61800-5-2:2007 EN 61800-5-1:2007	EN 61800-3:2004 EN 60204-1:2006 EN 50178:1997 EN 61508-1 to -7:2000-2002
Prüfungsergebnis **Test results**		The MR-J3-□S series servo drives is suitable for the basic safety functions "STO" according to EN 61800-5-2 as well as "Safe Stop" (Stop category 0) according to EN 60204-1. It can be used within safety related applications up to Safety Category 3 / PL d and SIL 2 / SIL CL 2 according to EN ISO 13849-1 and EN 62061.	
Besondere Bedingungen **Specific requirements**		For a safe usage of the product the instructions in the user documentation must be observed.	

Der Prüfbericht-Nr.: 968/EL 612.01/09 vom 31.07.2009 ist Bestandteil dieses Zertifikates.
Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen. Es wird ungültig bei jeglicher Änderung der Prüfgrundlagen für den angegebenen Verwendungszweck.

The test report-no.: 968/EL 612.01/09 dated 2009-07-31 is an integral part of this certificate.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

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Am Grauen Stein, 51105 Köln
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2009-07-31
Datum/Date

Firmenstempel/Company stamp

Dipl.-Ing. Stephan Häb

TÜVRheinland®

ZERTIFIKAT
CERTIFICATE

Nr./No. 968/EL 612.00/09

Prüfgegenstand **Product tested**	Safety Logic Module for usage in combination with MR-J3-□S Servo Drives	**Inhaber** **Holder**	Mitsubishi Electric Corporation Nagoya Works 1-14 Yada-Minami 5-chome, Higashi-ku Nagoya 461-8670 Japan
Typbezeichnung **Type designation**	MR-J3-D05	**Verwendungs-zweck** **Intended application**	Drive Applications STO / SS1 acc. to EN 61800-5-2 Safe Stop / Safe Off Stop Category 0 / Stop Category 1 acc. to EN 60204-1
Prüfgrundlagen **Codes and standards forming the basis of testing**		EN ISO 13849-1:2008 EN 62061:2005 EN 61800-5-2:2007 EN 61800-5-1:2007	EN 61800-3:2004 EN 60204-1:2006 EN 50178:1997 EN 61508-1 to -7:2000-2002
Prüfungsergebnis **Test results**		The MR-J3-D05 Safety Logic Module in combination with the MR-J3 series servo drives is suitable for the basic safety functions “STO” and “SS1” (Type C) according to EN 61800-5-2 as well as “Safe Stop” (Stop category 0 and Stop category 1) and “Safe Off” according to EN 60204-1. It can be used within safety related applications up to Safety Category 3 / PL d and SIL 2 / SIL CL 2 according to EN ISO 13849-1 and EN 62061.	
Besondere Bedingungen **Specific requirements**		For a safe usage of the product the instructions in the user documentation must be observed. For “Safe Off” two suitable additional magnetic contactors must be used additionally.	

Der Prüfbericht-Nr.: 968/EL 612.00/09 vom 21.04.2009 ist Bestandteil dieses Zertifikates.
Dieses Zertifikat ist nur gültig für Erzeugnisse, die mit dem Prüfgegenstand übereinstimmen. Es wird ungültig bei jeglicher Änderung der Prüfgrundlagen für den angegebenen Verwendungszweck.

The test report-no.: 968/EL 612.00/09 dated 2009-04-21 is an integral part of this certificate.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

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H. Gall

2009-04-21		
Datum/Date	Firmenstempel/Company stamp	Dipl.-Ing. Heinz Gall

REVISIONS

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

Print Data	*Manual Number	Revision
Oct. 2009	SH(NA)030084-A	First edition
Apr. 2010	SH(NA)030084-B	Front cover — MR-J3-D05 is deleted. HF-KP series servo motor 350% is supported. HF-JP series servo motor is added. Precautions for safety use — Changed to STO function of MR-J3-□B Safety servo amplifier. Section 1.2 (2) — External dynamic brake is added. Note 4 is added. Section 1.3 (1) — Rated current of the control circuit power supply for MR-J3-10BS1/MR-J3-20BS1/MR-J3-40BS1 is changed from 0.2A to 0.4A. Response performance is added. Test pulse input is added. Note 4 and 5 are added. Section 1.3 (2) — Response performance is added. Note 2 and 3 are added. Test pulse input is added. Section 1.5 (1) — Detailed description for the serial number is added. Section 1.5 (2) — Special specification is added. Section 1.6 — HF-JP is added. Chapter 2 — The description in CAUTION is changed. Chapter 3 — The description in CAUTION is changed. Section 3.1 — The description in POINT is changed. Section 3.1 (1) — Short circuit connector is connected to CN8. Note 7 to Note 9 are changed. Section 3.1 (2) — Short circuit connector is connected to CN8. Note 7 to Note 9 are changed. Section 3.1 (3) — Short circuit connector is connected to CN8. Note 7 to Note 9 are changed. Section 3.1 (4) — Short circuit connector is connected to CN8. Note 8 to Note 10 are changed. Section 3.1 (5) — Short circuit connector is connected to CN8. Note 8 to Note 10 are changed. Section 3.1 (6) — Short circuit connector is connected to CN8. Note 9 to Note 11 are changed. Section 3.1 (7) — Short circuit connector is connected to CN8. Note 8 to Note 11 are changed. Section 3.1 (8) — Short circuit connector is connected to CN8. Note 10 to Note 13 are changed. Section 3.2 — Short circuit connector is connected to CN8. The circuit diagram of the analog monitor 1 and 2 are changed. Note 10 and Note 13 are changed. Section 3.2.2 — Deleted. Section 3.3.2 (2) — STO is deleted. Section 3.4 — The description is added to POINT. Signal arrangement for CN8 in the diagram is deleted (moved to Chapter 15). Section 3.5 (1) — The description in CN8 is changed. Section 3.5 (2)(e) — Deleted.

Print Data	*Manual Number	Revision	
Apr. 2010	SH(NA)030084-B	Section 3.6.1 (2)	STO is deleted.
		Section 3.7	Timing chart is entirely changed.
		Section 3.8.1	The circuit diagram of CN8 is deleted. Note 4 is deleted.
		Section 3.8.2 (1)	The interface of CN8 is deleted.
		Section 3.8.2 (4)	Note is added for the output voltage.
		Section 3.8.3 (1), (2)	The interface of CN8 is deleted.
		Section 3.11.1	The description is added to CAUTION. The description is added to POINT.
		Section 3.11.2 (2)	HF-JP is added. Connectors are added to POINT.
		Section 3.11.2 (2)(a) 1), 2)	Note 3 is added.
		Section 3.11.2 (2)(b)	HF-JP is added. MS3102A20-29P and MS3102A32-17P are added.
		Section 3.11.2 (3)(a)	Note 6 is added.
		Section 3.11.2 (4)(b)	Note 7 is added.
		Section 3.12.1	The description is added to CAUTION. The description is added to POINT.
		Section 3.12.1 (1)	Note 2 is added.
		Section 3.12.2 (2)	The timing chart is changed.
		Section 3.12.2 (5)	The timing chart is changed.
		Section 3.12.3 (1)	Note 4 is added.
		Section 3.12.3 (2)	Note 5 is added.
		Section 3.14	The shape of SW1 is changed.
		Section 4.5.1 (1)(b) 1)	Addition
		Section 5.1.3	The description is changed.
		Section 5.1.5 (2)	The timing chart is changed.
		Section 5.2.1	Parameter No.PB12 and PB45 are added.
		Section 5.2.2	Parameter No.PB12 and PB45 are added.
		Section 5.3.2	Change of parameter No.PC04 definition. The timing chart of parameter No.PC24 is changed.
		Chapter 6	POINT is added.
		Section 7.7	Addition
		Section 10.1	The description is partially changed. The graphs are entirely changed. Note 2 and Note 3 are added.
		Section 10.2	HF-JP is added. Note 4 is added.
		Section 10.3.1 (2)	HF-JP is added.
		Section 10.3.2	HF-JP is added. Note 3 is added.
		Section 11.1.1	Note 3 is changed. 41) to 52) is added.
		Section 11.1.2 (4)	Addition
		Section 11.1.2 (5)	MR-J3ENSCBL□M-L-S06, MR-J3ENSCBL□M-H-S06, MR-J3SCNS-S06, MR-J3SCNSA, and MR-J3SCNSA-S06 are added.
		Section 11.1.2 (6)	Addition
		Section 11.2 (1)	The combination of MR-J3-15K□S-LW and the regenerative option is changed.
		Section 11.2 (3)	The setting of parameter No.PA02 is changed.
		Section 11.2 (4)	POINT is added. The combination of MR-J3-15K□S4-LW and the regenerative option is changed.

Print Data	*Manual Number	Revision	
Apr. 2010	SH(NA)030084-B	Section 11.2 (4)(c)	The combination of "-LR" and the regenerative option is added.
		Section 11.2 (4)(d)	The combination of "-LW" and the regenerative option is added.
		Section 11.2 (5)(b)	MR-RB5R and MR-RB5K-4 are added.
		Section 11.2 (5)(e)	GRZG400-0.8Ω is added.
		Section 11.6	CAUTION is added.
		Section 11.6 (1)	The description is changed.
		Section 11.11 (1)	POINT is added.
		Section 11.11 (1)(b)	POINT is added. Table 11.3 is added.
		Section 11.11 (2)	The motor power supply cable and the motor brake cable are changed. MR-J3JSCBL03M-A1-L・MR-J3JSCBL03M-A2-L, MR-J3ENSCBL□M-L-S06, MR-J3ENSCBL□M-H-S06, MR-ENECBL□M-H are added.
		Section 11.16	Moved to section 11.19.
		Section 12.3	The description is deleted in POINT.
		Section 13.1.1	External dynamic brake is added. Note 4 is added.
		Section 13.1.3 (2)(a), (b)	Response performance is added. Note 2 is added. External dynamic brake is added. Note 4 is added. Test pulse input is added.
		Section 13.1.4 (1)	Note is added.
		Section 13.2	The description in CAUTION is changed.
		Section 13.3	The description in CAUTION is changed.
		Section 13.3.2 (1)(a)	Note 4 is changed. Note 6 is added.
		Section 13.3.2 (1)(b)	Note 5 is changed. Note 7 is added.
		Section 13.3.2 (2)(a)	Note 5 is changed. Note 7 is added.
		Section 13.3.2 (2)(b)	Note 6 is changed. Note 8 is added.
		Section 13.3.6 (2)(b)	The diagram is changed.
		Section 13.7.1	The tightening toques for TE1-1, TE1-2 and PE are changed.
		Section 13.7.2 (1)	The tightening torques for TE1 and PE are changed.
		Section 13.9.3	CAUTION is added.
		Section 13.9.4	The description in POINT is changed.
		Section 13.9.5	The molded-case circuit breaker for MR-J3-CR55K4 is changed.
		Section 13.9.10	The description in POINT is changed. The description is changed.
		Chapter 14	Sony Manufacturing Systems Corporation is changed to Magnescale. The linear encoder model names of Heidenhain Corporation are changed.
		Chapter 15	The title is changed to "USING STO FUNCTION OF MR-J3-B SAFETY."
		App.8.1 (3)	The description is changed.
		App.8.2	The description is added.
		App.11	Addition
Dec. 2011	SH(NA)030084-C	Section 2.4(2)(3)	The description is changed.
Aug. 2012	SH(NA)030084-D	HF-JP703 and HF-JP903 are added. Torque control motor is added.	

Print Data	*Manual Number	Revision	
Aug. 2012	SH(NA)030084-D	The abbreviation of the molded-case circuit breaker is changed to MCCB.	
		Environmental conditions of the servo motor in the precautions for safety use	HF-JP703 and HF-JP903 are added.
		Section 1.4	Position control mode, speed control mode and torque control mode are added.
		Section 1.7.1	The description is changed to CN4.
		Section 3.1	The description is added to CAUTION. The description is added to POINT.
		Section 3.2.2	Addition
		Section 3.3.3 (2)(b)	The description in the table is changed.
		Section 3.5 (2)(a)	EM2: The description is added.
		Section 3.5 (2)(b)	INP: The description is changed. SA: The description is changed. VLC: The description is added. ABSV: The description is changed.
		Section 3.6	The description is added to POINT.
		Section 3.7	POINT is added.
		Section 3.8.1	The diagram is partially changed.
		Section 3.11.2 (1)(b)	The description of the note in the table is changed.
		Section 3.11.2 (3)(a)	The diagram is partially changed. Note 2 is changed. Note 7 is added.
		Section 3.12.2 (1)	The diagram is partially changed.
		Section 3.12.2 (2)	POINT is added.
		Section 3.12.2 (5)	POINT is added.
		Section 3.12.2 (6)	Addition
		Section 3.14	The description is added to POINT.
		Section 4.2 (2)	The description in the table is changed.
		Section 4.2 (5)	The description in the table is changed.
		Section 4.5.1	POINT is added.
		Section 4.5.2	POINT is added.
		Chapter 5	The description is added to POINT.
		Section 5.1.2	The description is added to POINT.
		Section 5.1.4	The description is added to POINT.
		Section 5.1.5	The description is added to POINT.
		Section 5.1.6	POINT is added.
		Section 5.1.7	The description is changed to POINT.
		Section 5.1.8	The description in the table is changed.
		Section 5.2	The description is added to POINT.
		Section 5.2.2	The description is added to PB12.
		Section 5.3.2	The description is changed to PC01. The description is added to PC06. The speed command 2 is added to PC09. The description is added to PC17. The description is added to PC24.
		Section 5.3.3 (2)	Speed command 2 is added.
		Section 5.3.3 (3)	Speed command 2 is added to the block diagram.
		Chapter 6	The description is changed to POINT.
		Section 8.2	The cause is added to alarm 31.
		Section 9.1 (6)	The tightening torque is added.

Print Data	*Manual Number	Revision	
Aug. 2012	SH(NA)030084-D	Section 10.2 (1)	The description is added. The amount of heat inside the cabinet when the part of the servo amplifier outside the cabinet is cooled is added to the table.
		Section 10.3.2	The values of HF-JP7034 and HF-JP9034 are added to the table.
		Section 11.1.1	HF-JP703(4) and HF-JP903(4) are added.
		Section 11.1.2 (2)(b)	The table in the note is changed.
		Section 11.1.2 (5)	HF-JP703(4) and HF-JP903(4) are added.
		Section 11.2 (4)(c)	The values in the table are partially changed.
		Section 11.3.1	Note 2 is added.
		Section 11.3.3	The description is added to POINT.
		Section 11.6	The description is added to POINT.
		Section 11.8 (1)	The description in the table is changed.
		Section 11.13	The description is partially deleted.
		Section 11.14	The description is partially deleted.
		Section 11.16 (2)(b)	The recommended product is changed.
		Section 11.18 (1)	The description in the table is changed.
		Section 13.1.6 (1)	The description is changed to TE1-2.
		Section 13.1.6 (2)	The description is changed to CN4.
		Section 13.1.6 (3)	The description is changed to CN4.
		Section 13.1.8	The diagram is partially changed.
		Section 13.2.2	The description is changed to CAUTION.
		Section 13.3.2	The description is added to CAUTION. The description is added to POINT.
		Section 13.6.1 (1)	The description is changed.
		Section 13.8.2	The amount of heat inside the cabinet when the part of the servo amplifier outside the cabinet is cooled is added to the table.
		Section 13.9.3	The description is added to POINT.
		Section 13.9.9	The description in the table is changed.
		Section 13.9.10	The description is added to POINT.
		Chapter 14	POINT is added.
		Section 14.2.1	The description in the table is changed.
		Section 14.2.2	The description is entirely changed.
		Chapter 15	The description is added to POINT.
		Section 15.2.2 (2)	Addition
		Section 15.3.2	The description is added to POINT.
		Section 15.3.3	The description is added to POINT. The diagram is partially changed.
		Section 15.3.4	The description is added to POINT. The diagram is partially changed.
		Section 15.4.2 (2)	The diagram is partially changed.
		App. 4	The HF-JP series servo motor is added to the table.
		App. 8.2 (1)	HF-JP series servo motor is added.
		App. 9 (1)	The HF-JP series servo motor is added to the table.
		App. 9 (4)	The HF-JP series servo motor is added to the table.
		App. 10.5 (2)	The diagram is partially changed.

Print Data	*Manual Number	Revision	
Aug. 2013	SH(NA)030084-E	Section 11.4	POINT is added.
		Section 11.4(2)	Note is added.
Jun. 2014	SH(NA)030084-F	Section 11.2 (4) (c)	CAUTION is added.
		Section 11.3.3 (3)	The diagram is partially changed.

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Thailand	MITSUBISHI ELECTRIC FACTORY AUTOMATION (THAILAND) CO., LTD. 12th Floor, SV.City Building, Office Tower 1, No. 896/19 and 20 Rama 3 Road, Kwaeng Bangpongpang, Khet Yannawa, Bangkok 10120,Thailand	Tel : +66-2682-6522 to 6531 Fax : +66-2682-6020
Indonesia	PT. MITSUBISHI ELECTRIC INDONESIA Gedung Jaya 11th Floor, JL. MH. Thamrin No.12, Jakarta Pusat 10340, Indonesia	Tel : +62-21-3192-6461 Fax : +62-21-3192-3942
Vietnam	MITSUBISHI ELECTRIC VIETNAM COMPANY LIMITED Unit 01 - 04, 10th Floor, Vincom Center, 72 Le Thanh Ton Street, District 1, Ho Chi Minh City, Vietnam	Tel : +84-8-3910-5945 Fax : +84-8-3910-5947
India	MITSUBISHI ELECTRIC INDIA PVT. LTD. Pune Branch Emerald House, EL-3, J Block, M.I.D.C., Bhosari, Pune, 411026, Maharashtra State, India	Tel : +91-20-2710-2000 Fax : +91-20-2710-2100
Australia	MITSUBISHI ELECTRIC AUSTRALIA PTY. LTD. 348 Victoria Road, P.O. Box 11, Rydalmere, N.S.W 2116, Australia	Tel : +61-2-9684-7777 Fax : +61-2-9684-7245

Warranty

1. Warranty period and coverage

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

[Term]

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

[Limitations]

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

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

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

2. Term of warranty after the stop of production

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

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

3. Service in overseas countries

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

4. Exclusion of responsibility for compensation against loss of opportunity, secondary loss, etc.

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

5. Change of Product specifications

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

6. Application and use of the Product

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

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

MODEL	
MODEL CODE	

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE : TOKYO BLDG MARUNOUCHI TOKYO 100-8310

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Specifications are subject to change without notice.