MITSUBISHI ELECTRIC

MELSERVO

Servo Amplifier

Instruction Manual
(General-Purpose Interface)

MR-J3-□A

01072007
SH(NA)030038
Version ES

MITSUBISHI ELECTRIC INDUSTRIAL AUTOMATION

● Safety Instructions ●

(Always read these instructions before using the equipment.)

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this Instruction Manual, Installation guide, Servo motor Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.
In this 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, switch power off and wait for more than 15 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.
- Connect the servo amplifier and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, you may get an electric shock.
- During power-on or operation, do not open the front cover of the servo amplifier. You may get an electric shock.
- Do not operate the servo amplifier 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 of the servo amplifier if the power is off. The servo amplifier is charged and you may get an electric shock.

2. To prevent fire, note the following:

⚠ CAUTION

- Do not install the servo amplifier, servo motor and regenerative resistor on or near combustibles. Otherwise a fire may cause.
- When the servo amplifier has become faulty, switch off the main servo amplifier power side. Continuous flow of a large current may cause a fire.
- When a regenerative 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.

3. To prevent injury, note the follow

⚠ 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 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 parts may damaged.
- During operation, never touch the rotating parts of the servo motor. Doing so can 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 weights.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the servo motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the servo amplifier. The servo amplifier may drop.
- Install the servo amplifier in a load-bearing place in accordance with the Instruction Manual.
- Do not climb or stand on servo equipment. Do not put heavy objects on equipment.
- The servo amplifier and servo motor must be installed in the specified direction.
- Leave specified clearances between the servo amplifier and control enclosure walls or other equipment.
- Do not install or operate the servo amplifier and servo motor which has been damaged or has any parts missing.
- Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier and servo motor.
- Do not drop or strike servo amplifier or servo motor. Isolate from all impact loads.
- When you keep or use it, please fulfill the following environmental conditions.

<table>
<tr><th colspan="3" rowspan="2">Environment</th><th colspan="3">Conditions</th></tr>
<tr><th>Servo amplifier</th><th colspan="2">Servo motor</th></tr>
<tr><td rowspan="4">Ambient temperature</td><td rowspan="2">During 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 (3280 ft) above sea level</td></tr>
<tr><td rowspan="6">(Note)
Vibration</td><td colspan="2" rowspan="6">[m/s²]</td><td rowspan="6">5.9 or less</td><td>HF-MP Series
HF-KP Series</td><td>X・Y : 49</td></tr>
<tr><td>HF-SP 52 to 152
HF-SP 51・81
HC-RP Series
HC-UP 72・152</td><td>X・Y : 24.5</td></tr>
<tr><td>HF-SP 202・352
HF-SP 121・201
HC-UP 202 to 502</td><td>X : 24.5
Y : 49</td></tr>
<tr><td>HF-SP 301・421
HF- SP 502・702</td><td>X : 24.5
Y : 29.5</td></tr>
<tr><td>HA-LP601 to12K1
HA-LP701M to 15K1M
HA-LP502 to 22K2
HA-LP8014・12K14
HA-LP11K1M4・15K1M14
HA-LP11K24 to 22K24</td><td>X : 11.7
Y : 29.4</td></tr>
<tr><td>HA-LP15K1 to 25K1 HA-LP22K1M
HA-LP15K14・20K14 HA-LP22K1M4</td><td>X・Y : 9.8</td></tr>
</table>

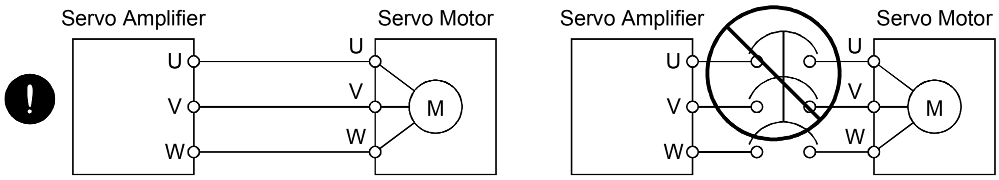
Note. Except the servo motor with reduction gear.

- 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. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.
- When the equipment has been stored for an extended period of time, consult Mitsubishi.

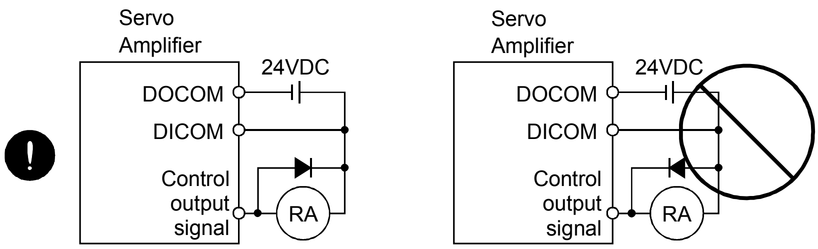
(2) Wiring

⚠ CAUTION

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



(3) Test run adjustment

⚠ CAUTION

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

(4) Usage

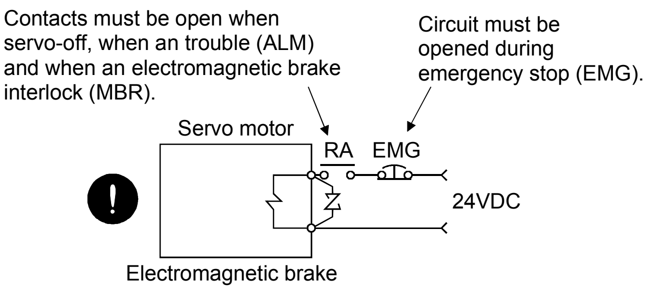
⚠ CAUTION

- 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 is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.
- Do not modify the equipment.
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo amplifier.
- Burning or breaking a servo amplifier may cause a toxic gas. Do not burn or break a servo amplifier.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ballscrew and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

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



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

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

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

(7) 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.

● About processing of waste ●

When you discard servo amplifier, a battery (primary battery), and other option articles, please follow the law of each country (area).

⚠ FOR MAXIMUM SAFETY

- These products have been manufactured as a general-purpose part for general industries, and have not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the products for special purposes such as nuclear power, electric power, aerospace, medicine, passenger movement vehicles or under water relays, contact Mitsubishi.
- These products have been manufactured under strict quality control. However, when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.

⚠ 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 servo amplifier 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
- Home position setting in the absolute position detection system
- 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.

COMPLIANCE WITH EC DIRECTIVES

1. WHAT ARE EC DIRECTIVES?

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

(1) EMC directive

The EMC directive applies not to the servo units alone but to 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. Hence, they are designed to comply with the low voltage directive.

This servo is certified by TUV, third-party assessment organization, to comply with the low voltage directive.

(3) Machine directive

Not being machines, the servo amplifiers need not comply with this directive.

2. PRECAUTIONS FOR COMPLIANCE

(1) Servo amplifiers and servo motors used

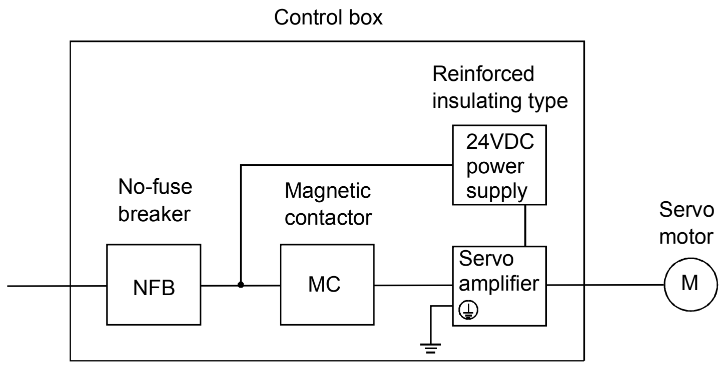
Use the servo amplifiers and servo motors which comply with the standard model.

Servo amplifier :MR-J3-10A to MR-J3-22KA
MR-J3-10A1 to MR-J3-40A1
MR-J3-11KA4 to MR-J3-22KA4

Servo motor :HF-MP □
HF-KP □
HF-SP □
HC-RP □
HC-UP □
HC-LP □
HA-LP □
HA-LP □ 4

(2) Configuration

The control circuit provide safe separation to the main circuit in the servo amplifier.



(3) Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC60664-1. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(4) Power supply

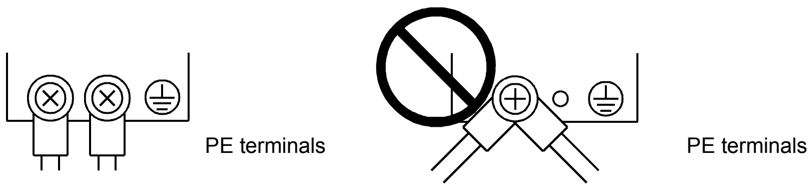
(a) This servo amplifier can be supplied from star-connected supply with earthed neutral point of overvoltage category III set forth in IEC60664-1. However, when using the neutral point of 400V system for single phase supply, a reinforced insulating transformer is required in the power input section.

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

(5) Grounding

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

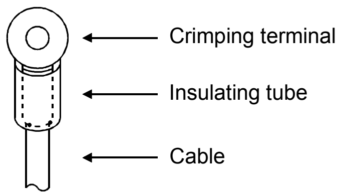
(b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect the cables to the terminals one-to-one.



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

(6) Wiring

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



(b) Use the servo motor side power connector which complies with the EN Standard. The EN Standard compliant power connector sets are available from us as options. (Refer to section 12.1)

(7) Auxiliary equipment and options

(a) The no-fuse breaker and magnetic contactor used should be the EN or IEC standard-compliant products of the models described in section 12.12.

Use a type B (Note) breaker. 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.

Note. Type A: AC and pulse detectable

Type B: Both AC and DC detectable

(b) The sizes of the cables described in section 12.11 meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in EN60204-1.

- Ambient temperature: 40 (104) [°C (°F)]
- Sheath: PVC (polyvinyl chloride)
- Installed on wall surface or open table 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 servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

For the other EMC directive guidelines on the servo amplifier, refer to the EMC Installation Guidelines (IB(NA)67310).

CONFORMANCE WITH UL/C-UL STANDARD

(1) Servo amplifiers and servo motors used
Use the servo amplifiers and servo motors which comply with the standard model.

Servo amplifier :MR-J3-10A to MR-J3-22KA
MR-J3-10A1 to MR-J3-40A1
MR-J3-11KA4 to MR-J3-22KA4
Servo motor :HF-MP □
HF-KP □
HF-SP □
HC-RP □
HC-UP □
HC-LP □
HA-LP □
HA-LP □ 4

(2) Installation
Install a fan of 100CFM (2.8m^3/min) air flow 4 in (10.16 cm) above the servo amplifier or provide cooling of at least equivalent capability.

(3) Short circuit rating
This servo amplifier conforms to the circuit whose peak current is limited to 5000A or less. Having been subjected to the short-circuit tests of the UL in the alternating-current circuit, the servo amplifier conforms to the above circuit.

(4) Capacitor discharge time
The capacitor discharge time is as listed below. To ensure safety, do not touch the charging section for 15 minutes after power-off.

Servo amplifier	Discharge time [min]
MR-J3-10A・20A	1
MR-J3-40A・60A(4)・10A1・20A1	2
MR-J3-70A	3
MR-J3-40A1	4
MR-J3-100A(4)	5
MR-J3-200A(4)・350A	9
MR-J3-350A4・500A(4)・700A(4)	10
MR-J3-11KA(4)	4
MR-J3-15KA(4)	6
MR-J3-22KA(4)	8

(5) Options and auxiliary equipment

Use UL/C-UL standard-compliant products.

This servo amplifier is UL/C-UL-listed when using the fuses indicated in the following table. When the servo amplifier must comply with the UL/C-UL Standard, be sure to use these fuses.

Servo amplifier	Fuse		
	Class	Current [A]	Voltage [V]
MR-J3-10A (1) · 20A	T	10	AC250
MR-J3-40A · 20A1		15	
MR-J3-60A to 100A · 40A1		20	
MR-J3-200A		40	
MR-J3-350A		70	
MR-J3-500A		125	
MR-J3-700A		150	
MR-J3-11KA		200	
MR-J3-15KA		250	
MR-J3-22KA		350	

Servo amplifier	Fuse		
	Class	Current [A]	Voltage [V]
MR-J3-60A4	T	10	AC600
MR-J3-100A4		15	
MR-J3-200A4		25	
MR-J3-350A4		35	
MR-J3-500A4		50	
MR-J3-700A4		65	
MR-J3-11KA4		100	
MR-J3-15KA4		150	
MR-J3-22KA4		175	

(6) Attachment of a servo motor

For the flange size of the machine side where the servo motor is installed, refer to "CONFORMANCE WITH UL/C-UL STANDARD" in the Servo Motor Instruction Manual.

(7) 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.

<<About the manuals>>

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

Relevant manuals

Manual name	Manual No.
MELSERVO-J3 Series To Use the AC Servo Safely	IB(NA)0300077
MELSERVO Servo Motor Instruction Manual Vol.2	SH(NA)030041
EMC Installation Guidelines	IB(NA)67310

MEMO

CONTENTS

1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The Mitsubishi MELSERVO-J3 series general-purpose AC servo is based on the MELSERVO-J2-Super series and has further higher performance and higher functions.
It has position control, speed control and torque control modes. Further, it can perform operation with the control modes changed, e.g. position/speed control, speed/torque control and torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
As this new series has the USB or RS-422 serial communication function, a servo configuration software-installed personal computer or the like can be used to perform parameter setting, test operation, status display monitoring, gain adjustment, etc.
With real-time auto tuning, you can automatically adjust the servo gains according to the machine.
The MELSERVO-J3 series servo motor is equipped with an absolute position encoder which has the resolution of 262144 pulses/rev to ensure more accurate control as compared to the MELSERVO-J2-Super series. Simply adding a battery to the servo amplifier makes up an absolute position detection system. This makes home position return unnecessary at power-on or alarm occurrence by setting a home position once.

(1) Position control mode
An up to 1Mpps high-speed pulse train is used to control the speed and direction of a motor and execute precision positioning of 262144 pulses/rev resolution.
The position smoothing function provides a choice of two different modes appropriate for a machine, so a smoother start/stop can be made in response to a sudden position command.
A torque limit is imposed on the servo amplifier by the clamp circuit to protect the power transistor in the main circuit from overcurrent due to sudden acceleration/deceleration or overload. This torque limit value can be changed to any value with an external analog input or the parameter.

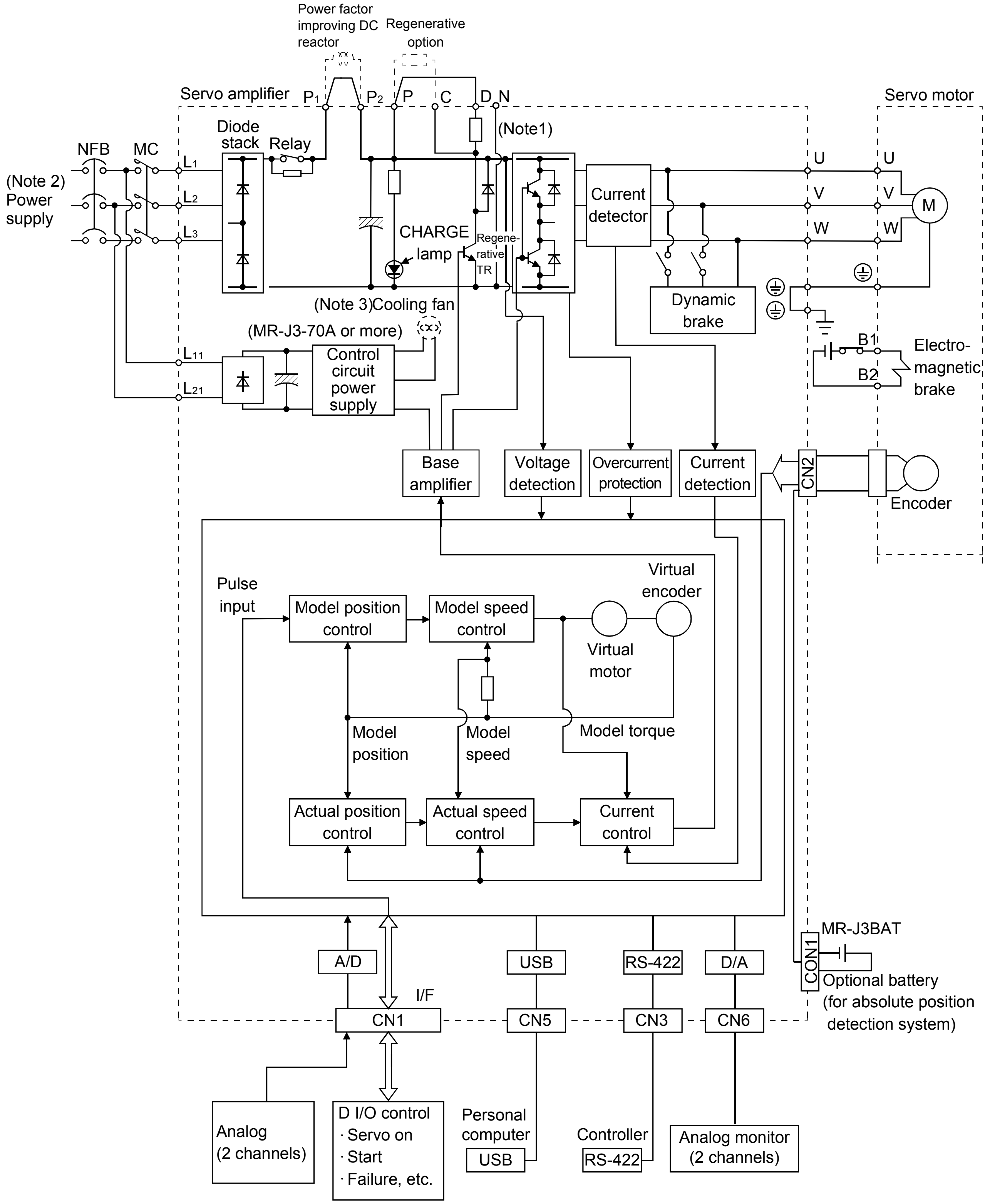
(2) Speed control mode
An external analog speed command (0 to $\pm$10VDC) or parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.
There are also the acceleration/deceleration time constant setting in response to speed command, the servo lock function at a stop time, and automatic offset adjustment function in response to external analog speed command.

(3) Torque control mode
An external analog torque command (0 to $\pm$8VDC) or parameter-driven internal torque command is used to control the torque output by the servo motor.
To protect misoperation under no load, the speed limit function (external or internal setting) is also available for application to tension control, etc.

1.2 Function block diagram

The function block diagram of this servo is shown below.

(1) MR-J3-350A or less



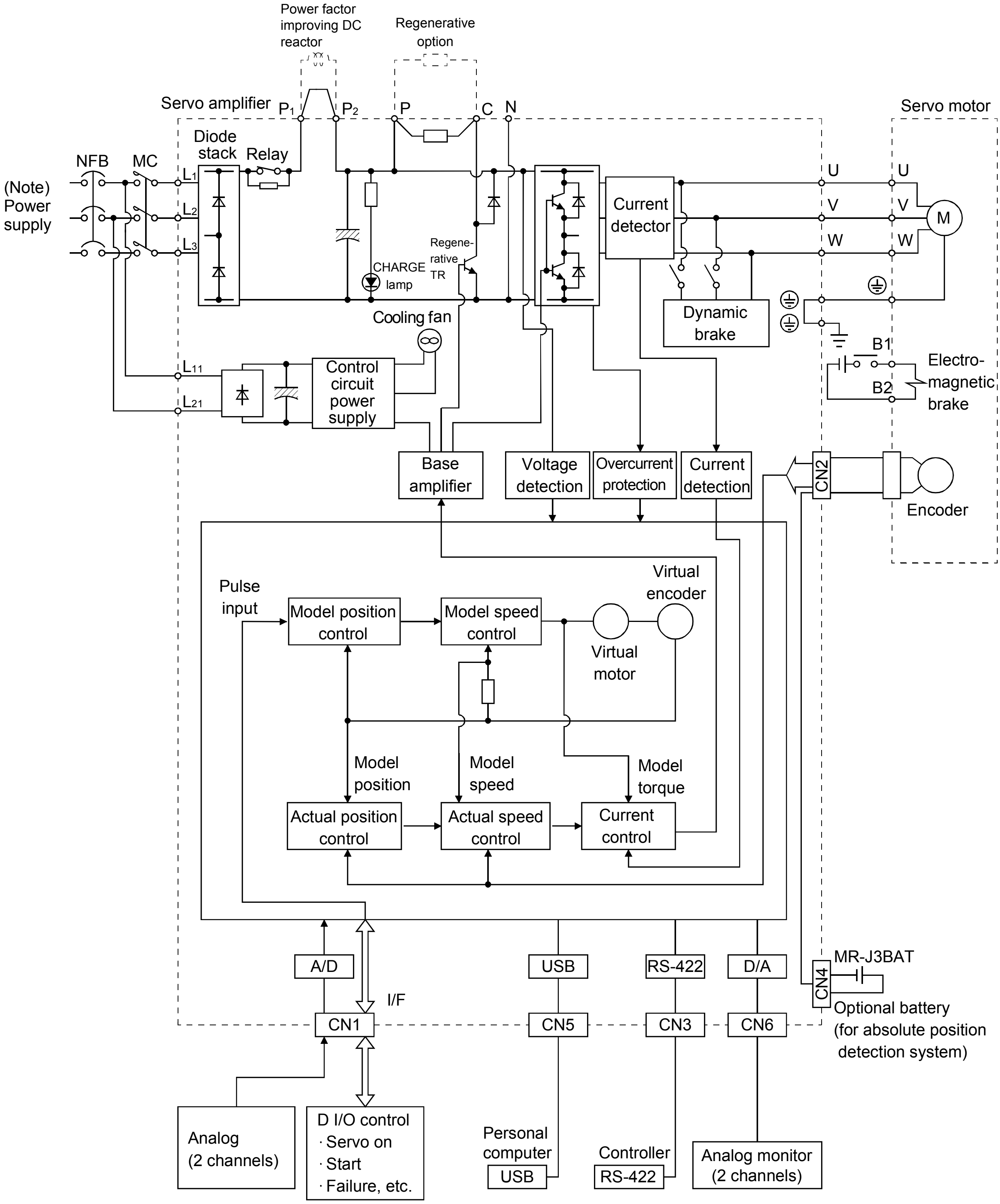
Note 1. The built-in regenerative resistor is not provided for the MR-J3-10A (1).

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. For the specification of power supply, refer to section 1.3.

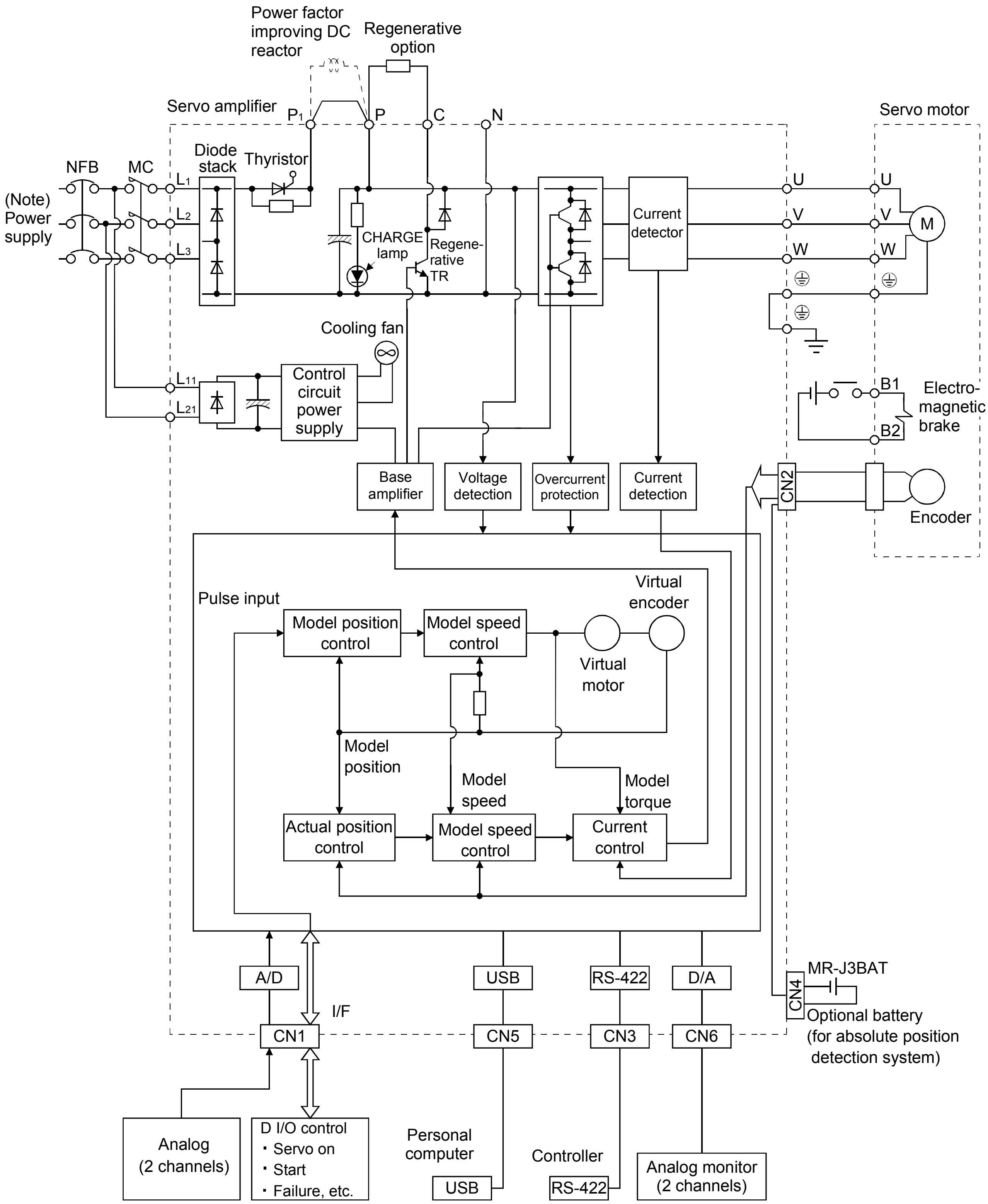
3. Servo amplifiers MR-J3-70A or greater have a cooling fan.

(2) MR-J3-350A4 · MR-J3-500A(4) · MR-J3-700A(4)



Note. For the specification of power supply, refer to section 1.3.

(3) MR-J3-11KA(4) to 22KA(4)



Note. For the specification of power supply, refer to section 1.3.

1.3 Servo amplifier standard specifications

(1) 200VAC class, 100VAC class

Item \ Servo Amplifier MR-J3-□	10A	20A	40A	70A	100A	200A	350A	500 A	700 A	11KA	15KA	22KA	10A1	20A1	40A1
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		
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		
Power supply: Permissible frequency fluctuation	Within ±5%														
Power supply: Power supply capacity	Refer to section 11.2														
Power supply: Inrush current	Refer to section 11.5														
Control circuit power supply: Voltage, frequency	1-phase 200 to 230VAC, 50/60Hz												1-phase 100 to 120VAC, 50/60Hz		
Control circuit power supply: 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: Input	30W							45W					30W		
Control circuit power supply: Inrush current	Refer to section 11.5														
Interface power supply: Voltage, frequency	24VDC±10%														
Interface power supply: Power supply capacity	(Note 1) 300mA or more														
Control System	Sine-wave PWM control, current control system														
Dynamic brake	Built-in									External option			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														
Position control mode: Max. input pulse frequency	1Mpps (for differential receiver), 200kpps (for open collector)														
Position control mode: Command pulse multiplying factor	Electronic gear A:1 to 1048576, B:1 to 1048576, 1/10 < A/B < 2000														
Position control mode: In-position range setting	0 to ±10000 pulse (command pulse unit)														
Position control mode: Error excessive	±3 revolutions														
Position control mode: Torque limit	Set by parameter setting or external analog input (0 to +10VDC/maximum torque)														
Speed control mode: Speed control range	Analog speed command 1: 2000, internal speed command 1: 5000														
Speed control mode: Analog speed command input	0 to ±10VDC / Rated speed														
Speed control mode: Speed fluctuation ratio	±0.01% or less (load fluctuation 0 to 100%) 0% or less (power fluctuation ±10%) ±0.2% max.(ambient temperature 25±10°C) for external speed setting only														
Speed control mode: Torque limit	Set by parameter setting or external analog input (0 to +10VDC/maximum torque)														
Torque control mode: Analog torque command input	0 to ±8VDC / Maximum torque (input impedance 10 to 12kΩ)														
Torque control mode: Speed limit	Set by parameter setting or external analog input (0 to ±10VDC/Rated speed)														
Structure	Self-cooled, open (IP00)				Force-cooling, open (IP00)								Self-cooled, open (IP00)		
Environment: Ambient temperature: During operation [°C]	(Note 2) 0 to +55 (non-freezing)														
Environment: Ambient temperature: During operation [°F]	32 to +131 (non-freezing)														
Environment: Ambient temperature: In storage [°C]	−20 to +65 (non-freezing)														
Environment: Ambient temperature: In storage [°F]	−4 to +149 (non-freezing)														
Environment: Ambient humidity: In operation / In storage	90%RH or less (non-condensing)														
Environment: Ambient	Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt														
Environment: Altitude	Max. 1000m above sea level														
Environment: Vibration	5.9 [m/s^2] or less														
Mass [kg]	0.8	0.8	1.0	1.4	1.4	2.3	2.3	4.6	6.2	18	18	19	0.8	0.8	1.0
Mass [lb]	1.8	1.8	2.2	3.1	3.1	5.071	5.071	10.1	13.7	39.68	39.68	41.88	1.8	1.8	2.2

Note 1. 300mA 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°C or at 75% or smaller effective load ratio.

(2) 400VAC class

Item			Servo Amplifier MR-J3-□	60A4	100A4	200A4	350A4	500A4	700A4	11KA4	15KA4	22KA4
Power supply	Voltage/frequency			3-phase 380 to 480VAC, 50/60Hz								
Power supply	Permissible voltage fluctuation			3-phase 323 to 528VAC								
Power supply	Permissible frequency fluctuation			Within ±5%								
Power supply	Power supply capacity			Refer to section 11.2								
Power supply	Inrush current			Refer to section 11.5								
Control circuit power supply	Voltage/frequency			1-phase 380 to 480VAC, 50/60Hz								
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	Input			30W			45W					
Control circuit power supply	Inrush current			Refer to section 11.5								
Interface power supply	Voltage, frequency			24VDC±10%								
Interface power supply	Power supply capacity			(Note) 300mA or more								
Control System				Sine-wave PWM control, current control system								
Dynamic brake				Built-in						External option		
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								
Position control mode	Max. input pulse frequency			1Mpps (for differential receiver), 200kpps (for open collector)								
Position control mode	Command pulse multiplying factor			Electronic gear A:1 to 1048576, B:1 to 1048576, 1/10 < A/B < 2000								
Position control mode	In-position range setting			0 to ±10000 pulse (command pulse unit)								
Position control mode	Error excessive			±3 revolutions								
Position control mode	Torque limit			Set by parameter setting or external analog input (0 to +10VDC/maximum torque)								
Speed control mode	Speed control range			Analog speed command 1: 2000, internal speed command 1: 5000								
Speed control mode	Analog speed command input			0 to ±10VDC / Rated speed								
Speed control mode	Speed fluctuation ratio			±0.01% or less (load fluctuation 0 to 100%) 0% or less (power fluctuation ±10%) ±0.2% max.(ambient temperature 25±10°C) for external speed setting only								
Speed control mode	Torque limit			Set by parameter setting or external analog input (0 to +10VDC/maximum torque)								
Torque control mode	Analog torque command input			0 to ±8VDC / Maximum torque (input impedance 10 to 12kΩ)								
Torque control mode	Speed limit			Set by parameter setting or external analog input (0 to ±10VDC/Rated speed)								
Structure				Self-cooled, open (IP00)		Force-cooling, open (IP00)						
Environment	Ambient temperature	During operation	[°C]	(Note 2) 0 to +55 (non-freezing)								
Environment	Ambient temperature	During operation	[°F]	32 to +131 (non-freezing)								
Environment	Ambient temperature	In storage	[°C]	−20 to +65 (non-freezing)								
Environment	Ambient temperature	In storage	[°F]	−4 to +149 (non-freezing)								
Environment	Ambient humidity	In operation		90%RH or less (non-condensing)								
Environment	Ambient humidity	In storage										
Environment	Ambient			Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt								
Environment	Altitude			Max. 1000m above sea level								
Environment	Vibration			5.9 [m/s^2] or less								
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. 300mA 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.

1.4 Function list

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

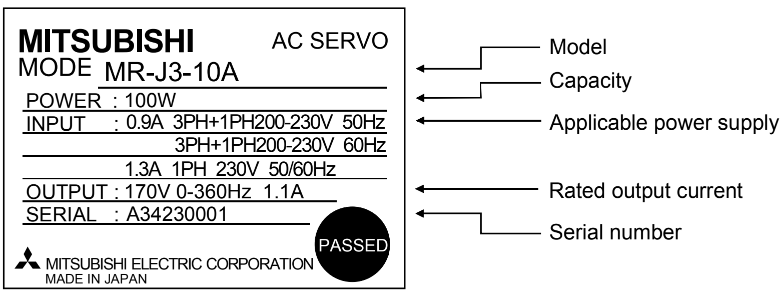
Function	Description	(Note) Control mode	Reference
Position control mode	This servo is used as position control servo.	P	Section 3.2.1 Section 3.6.1 Section 4.2
Speed control mode	This servo is used as speed control servo.	S	Section 3.2.2 Section 3.6.2 Section 4.3
Torque control mode	This servo is used as torque control servo.	T	Section 3.2.3 Section 3.6.3 Section 4.4
Position/speed control change mode	Using external input signal, control can be switched between position control and speed control.	P/S	Section 3.6.4
Speed/torque control change mode	Using external input signal, control can be switched between speed control and torque control.	S/T	Section 3.6.5
Torque/position control change mode	Using external input signal, control can be switched between torque control and position control.	T/P	Section 3.6.6
High-resolution encoder	High-resolution encoder of 262144 pulses/rev is used as a servo motor encoder.	P, S, T	
Absolute position detection system	Merely setting a home position once makes home position return unnecessary at every power-on.	P	Chapter 14
Gain changing function	You can switch between gains during rotation and gains during stop or use an external signal to change gains during operation.	P, S	Section 8.6
Advanced vibration suppression control	This function suppresses vibration at the arm end or residual vibration.	P	Section 8.4
Adaptive filter Ⅱ	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	P, S, T	Section 8.2
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	P, S, T	Section 8.5
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting a servo configuration software-installed personal computer and servo amplifier. MR Configurator MRZJW3-SETUP221E is necessary for this function.	P	
Machine simulation	Can simulate machine motions on a personal computer screen on the basis of the machine analyzer results. MR Configurator MRZJW3-SETUP221E is necessary for this function.	P	
Gain search function	Personal computer changes gains automatically and searches for overshoot-free gains in a short time. MR Configurator MRZJW3-SETUP221E is necessary for this function.	P	
Slight vibration suppression control	Suppresses vibration of ±1 pulse produced at a servo motor stop.	P	Parameters No. PB24
Electronic gear	Input pulses can be multiplied by 1/50 to 50.	P	Parameters No. PA06, PA07
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.	P, S	Chapter 7
Position smoothing	Speed can be increased smoothly in response to input pulse.	P	Parameter No. PB03
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	S, T	Parameter No. PC03
Regenerative option	Used when the built-in regenerative resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated.	P, S, T	Section 12.2

Function	Description	(Note) Control mode	Reference
Brake until	Used when the regenerative option cannot provide enough regenerative power. Can be used with the MR-J3-500A・MR-J3-700A.	P, S, T	Section 12.3
Return converter	Used when the regenerative option cannot provide enough regenerative power. Can be used with the MR-J3-500A・MR-J3-700A.	P, S, T	Section 12.4
Alarm history clear	Alarm history is cleared.	P, S, T	Parameter No. PC18
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal.	S	Parameter No. PC22
Command pulse selection	Command pulse train form can be selected from among four different types.	P	Section 5.1.12
Input signal selection	Forward rotation start, reverse rotation start, servo-on (SON) and other input signals can be assigned to any pins.	P, S, T	Parameters No. PD03 to PD08, PD10 to PD12
Torque limit	Servo motor torque can be limited to any value.	P, S	Section 3.6.1 (5) Section 5.1.11
Speed limit	Servo motor speed can be limited to any value.	T	Section 3.6.3 (3) Parameter No. PC05 to PC11
Status display	Servo status is shown on the 5-digit, 7-segment LED display	P, S, T	Section 6.3
External I/O signal display	ON/OFF statuses of external I/O signals are shown on the display.	P, S, T	Section 6.7
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.	P, S, T	Section 6.8
Automatic VC offset	Voltage is automatically offset to stop the servo motor if it does not come to a stop at the analog speed command (VC) or analog speed limit (VLA) of 0V.	S, T	Section 6.4
Test operation mode	JOG operation・positioning operation・motor-less operation・DO forced output. However, MR Configurator MRZJW3-SETUP221E is necessary for positioning operation.	P, S, T	Section 6.9
Analog monitor output	Servo status is output in terms of voltage in real time.	P, S, T	Parameter No. PC14
MR Configurator	Using a personal computer, parameter setting, test operation, status display, etc. can be performed.	P, S, T	Section 12.8
Alarm code output	If an alarm has occurred, the corresponding alarm number is output in 3-bit code.	P, S, T	Section 9.1
Amplifier diagnosis function	The DI/DO signals, analog monitor input I/F, analog monitor output, command pulse I/F and encoder pulse output are checked. The diagnosis cable (MR-J3ACHECK) and MR Configurator MRZJW3-SETUP211E are necessary for this function.	P, S, T	Section 12.8 (2)(C)

Note. P: Position control mode, S: Speed control mode, T: Torque control mode
P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

1.5 Model code definition

(1) Rating plate



(2) Model

MR－J3－□A□□

- Series
- With no regenerative resistor

Symbol	Description
-PX	Indicates a servo amplifier of 11 to 22kW that does not use a regenerative resistor as standard accessory.

- Power supply

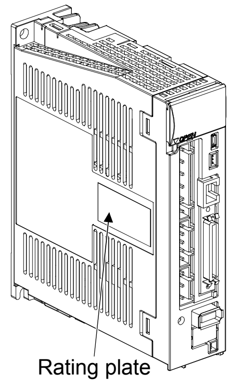
Symbol	Power supply
None (Note 1)	3-phase or 1-phase 200 to 230VAC
(Note 2) 1	1-phase 100 to 120VAC
4	3-phase 380 to 480VAC

Note 1. 1-phase 200V to 230V is supported by 750W or less.
2. 1-phase 100V to 120V is supported by 400W or less.

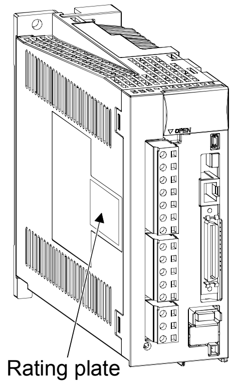
- General purpose interface
- Rated output

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

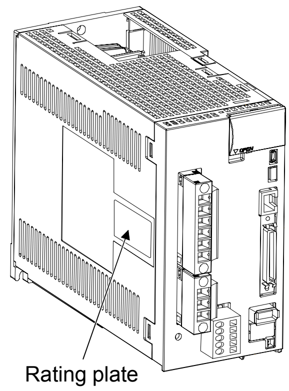
MR-J3-100A or less



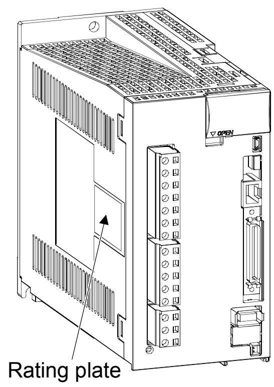
MR-J3-60A4・100A4



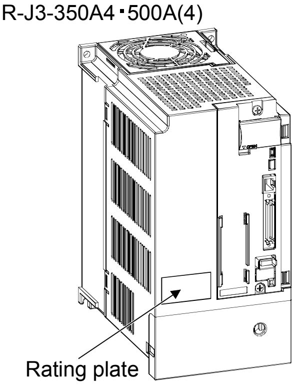
MR-J3-200A・350A



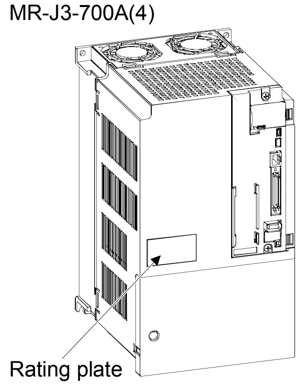
MR-J3-200A4



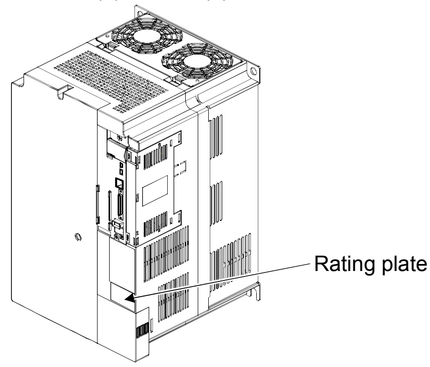
MR-J3-350A4・500A(4)



MR-J3-700A(4)



MR-J3-11KA(4) to 22KA(4)



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 electromagnetic brakes.

Servo amplifier	Servo motors						
	HF-MP□	HF-KP□	HF-SP□		HC-RP□	HC-UP□	HC-LP□
			1000r/min	2000r/min			
MR-J3-10A (1)	053・13	053・13					
MR-J3-20A (1)	23	23					
MR-J3-40A (1)	43	43					
MR-J3-60A			51	52			52
MR-J3-70A	73	73				72	
MR-J3-100A			81	102			102
MR-J3-200A			121・201	152・202	103・153	152	152
MR-J3-350A			301	352	203	202	202
MR-J3-500A			421	502	353・503	352・502	302
MR-J3-700A				702			
MR-J3-11KA							
MR-J3-15KA							
MR-J3-22KA							

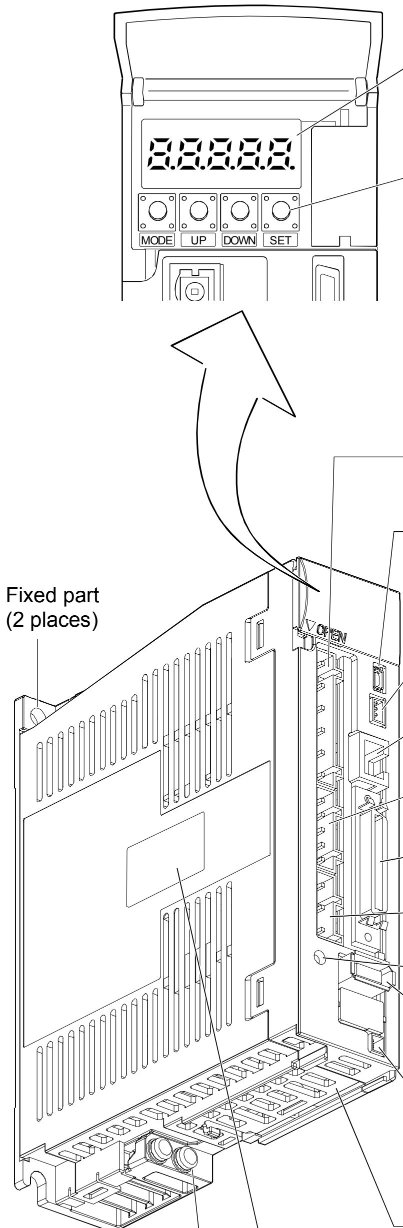
Servo amplifier	Servo motors		
	HA-LP□		
	1000r/min	1500r/min	2000r/min
MR-J3-500A			502
MR-J3-700A	601	701M	702
MR-J3-11KA	801・12K1	11K1M	11K2
MR-J3-15KA	15K1	15K1M	15K2
MR-J3-22KA	20K1・25K1	22K1M	22K2

Servo amplifier	Servo motors			
	HF-SP	HA-LP□		
		1000r/min	1500r/min	2000r/min
MR-J3-60A4	524			
MR-J3-100A4	1024			
MR-J3-200A4	1524・2024			
MR-J3-350A4	3524			
MR-J3-500A4	5024			
MR-J3-700A4	7024	6014	701M4	
MR-J3-11KA4		8014・12K14	11K1M4	11K24
MR-J3-15KA4		15K14	15K1M4	15K24
MR-J3-22KA4		20K14	22K1M4	22K24

1.7 Structure

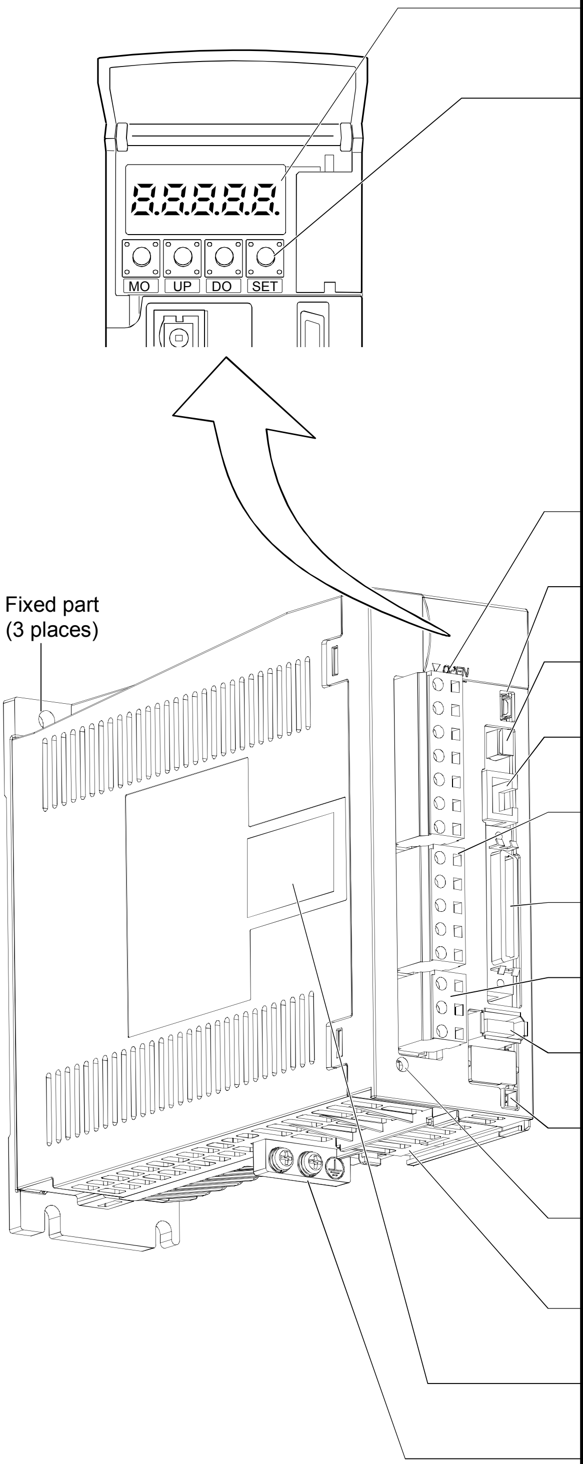
1.7.1 Parts identification

(1) MR-J3-100A or less



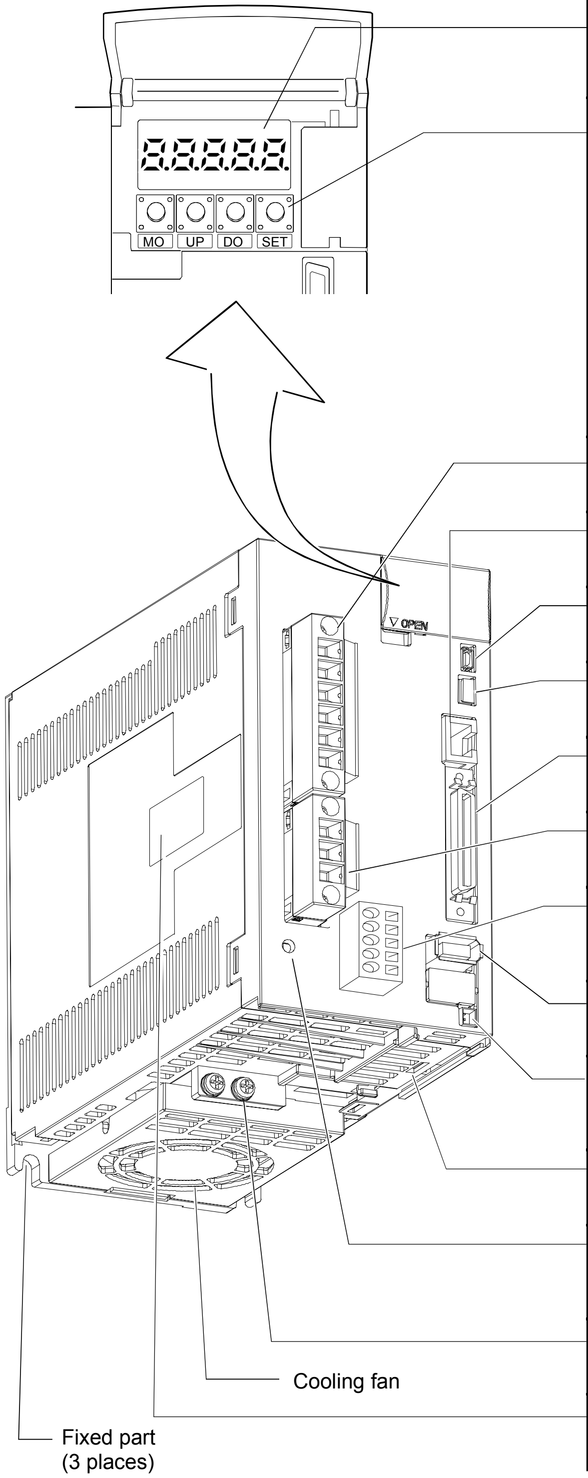
Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE UP DOWN SET SET: Used to set data. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode.	Chapter 6
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Servo motor power connector (CNP3) Connect the servo motor.	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.	
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Battery holder Contains the battery for absolute position data backup.	Section 14.3
Rating plate	Section 1.5
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3

(2) MR-J3-60A4・MR-J3-100A4



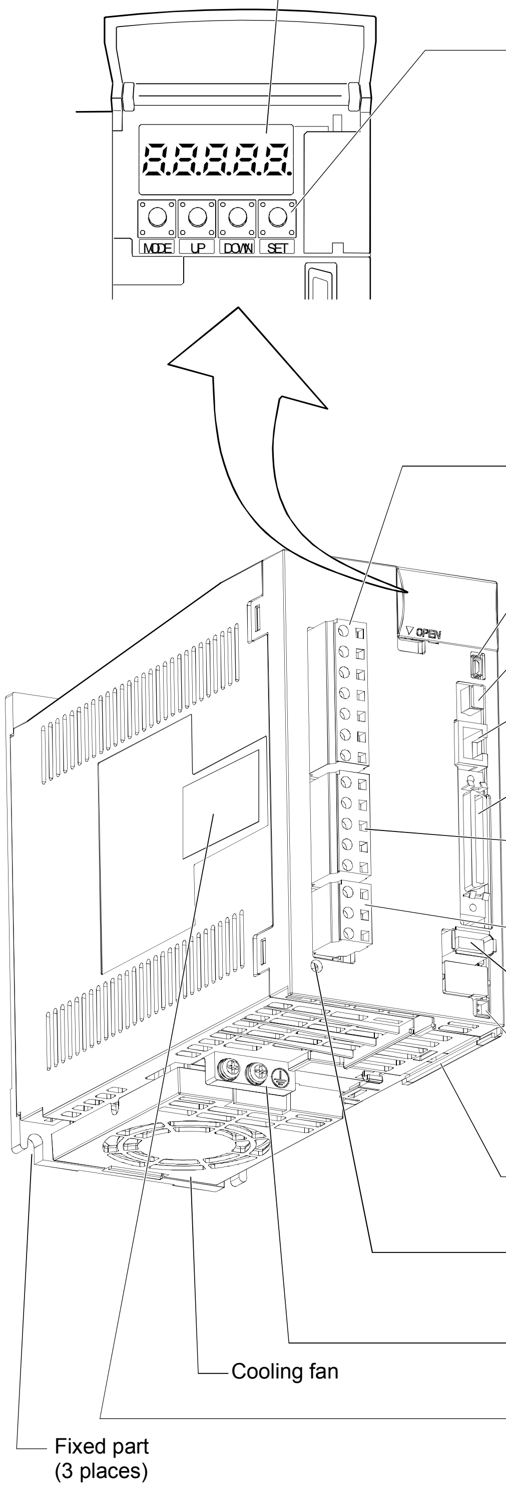
Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE UP DOWN SET SET: Used to set data. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode.	Chapter 6
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Battery holder Contains the battery for absolute position data backup.	Section 14.3
Rating plate	Section 1.5
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3

(3) MR-J3-200A・MR-J3-350A



Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
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.	Chapter 6
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Battery holder Contains the battery for absolute position data backup.	Section 14.3
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

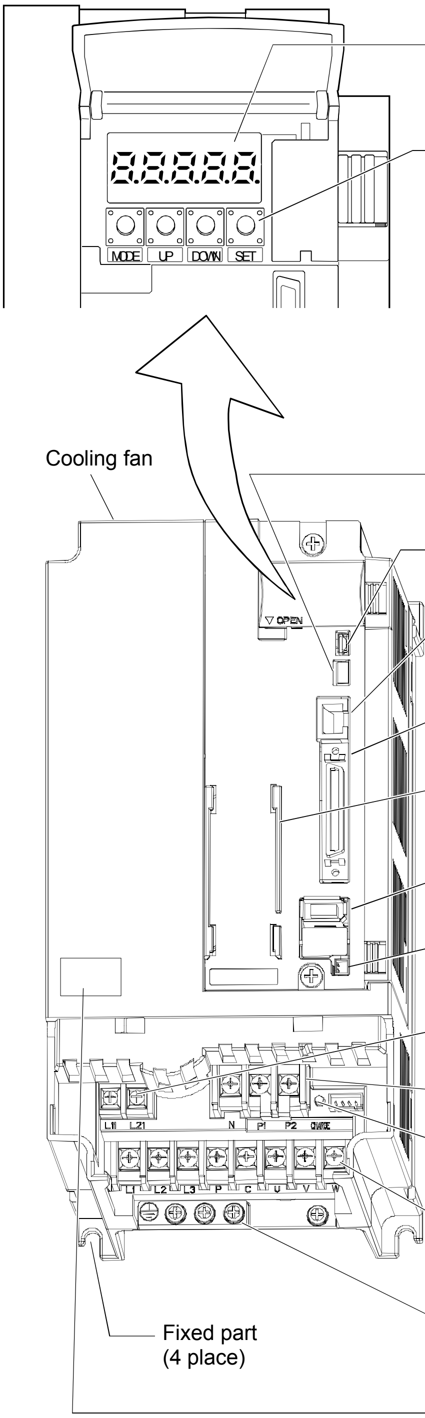
(4) MR-J3-200A4



Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
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.	Chapter 6
Main circuit power supply connector (CNP1) Connect the input power supply.	Section 3.1 Section 3.3
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Control circuit connector (CNP2) Connect the control circuit power supply/regenerative option.	Section 3.1 Section 3.3
Servo motor power connector (CNP3) Connect the servo motor.	Section 3.1 Section 3.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Battery holder Contains the battery for absolute position data backup.	Section 14.3
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-J3-350A4 · MR-J3-500A(4)

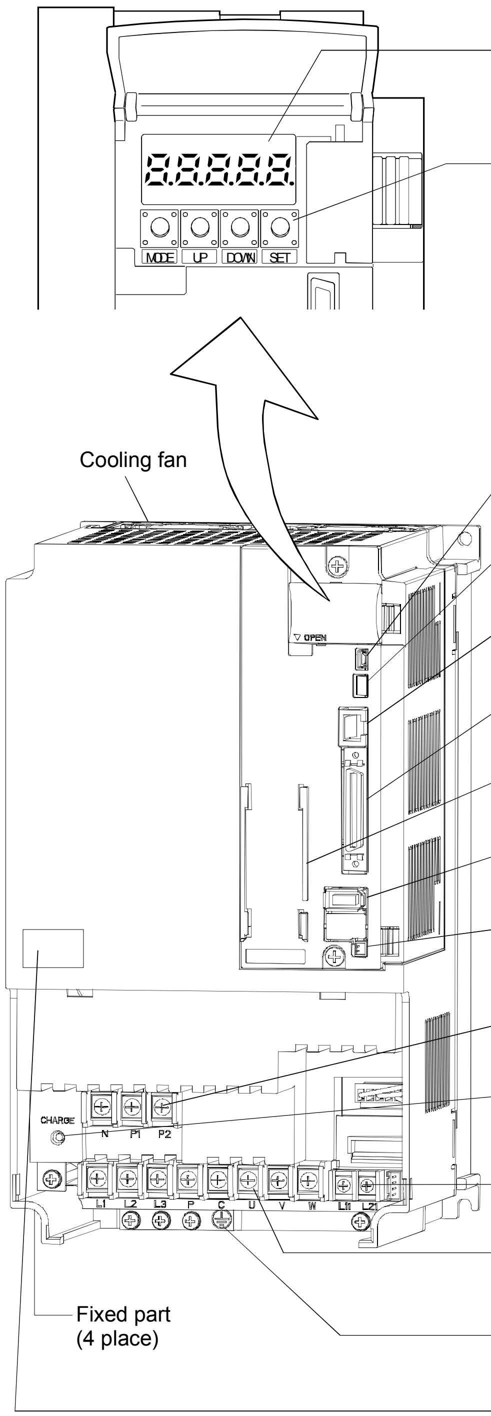
POINT
· The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.



Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE: Used to change the mode. UP, DOWN: Used to change the display or data in each mode. SET: Used to set data.	Chapter 6
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Battery unit holder Contains the battery for absolute position data backup.	Section 14.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Control circuit terminal block (TE2) Used to connect the control circuit power supply.	Section 3.1 Section 3.3
DC reactor terminal block (TE3) Used to connect the DC reactor.	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.	
Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section 3.1 Section 3.3
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

(6) MR-J3-700A(4)

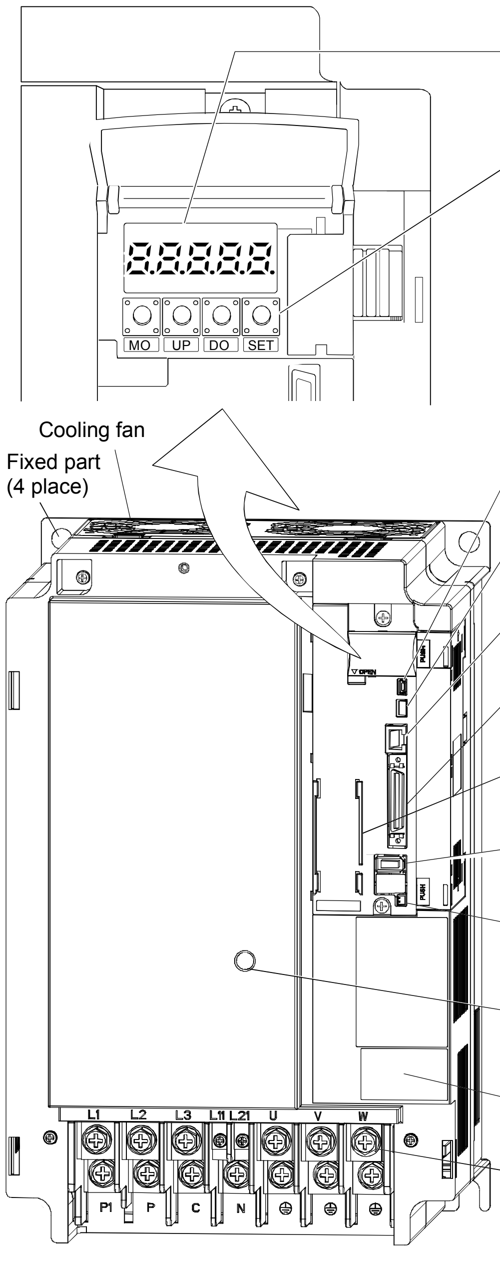
POINT
・The servo amplifier is shown without the front cover. For removal of the front cover, refer to section 1.7.2.



Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
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.	Chapter 6
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Battery unit holder Contains the battery for absolute position data backup.	Section 14.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
DC reactor terminal block (TE3) Used to connect the DC reactor.	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.	
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.	Section 3.1 Section 3.3
Protective earth (PE) terminal (⏚) Ground terminal.	Section 3.1 Section 3.3
Rating plate	Section 1.5

(7) MR-J3-11KA(4) to MR-J3-22KA(4)

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



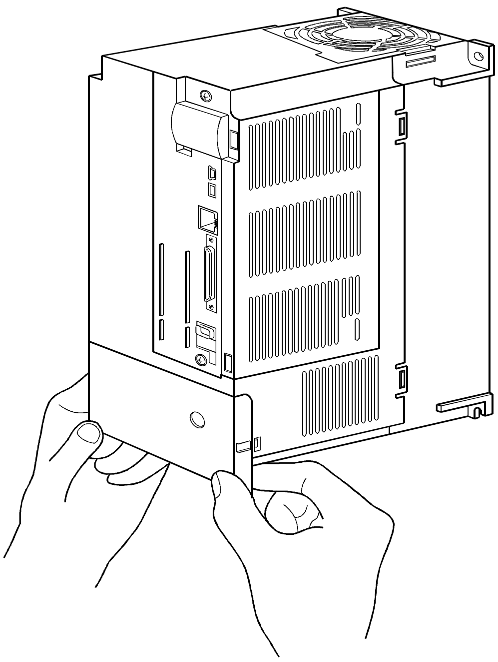
Name/Application	Detailed Explanation
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter 6
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE UP DOWN SET SET: Used to set data. UP, DOWN: Used to change the display or data in each mode. MODE: Used to change the mode.	Chapter 6
USB communication connector (CN5) Connect with the personal computer.	Section 12.8
Analog monitor connector (CN6) Outputs the analog monitor.	Section 3.2 Section 3.4
RS-422 communication connector (CN3) Connect with the personal computer.	Section 12.8 Chapter 13
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
Battery unit holder Contains the battery for absolute position data backup.	Section 14.3
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 12.1
Battery connector (CN4) Used to connect the battery for absolute position data backup.	Section 12.9 Chapter 14
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
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 Section 12.2

1.7.2 Removal and reinstallation of the front cover

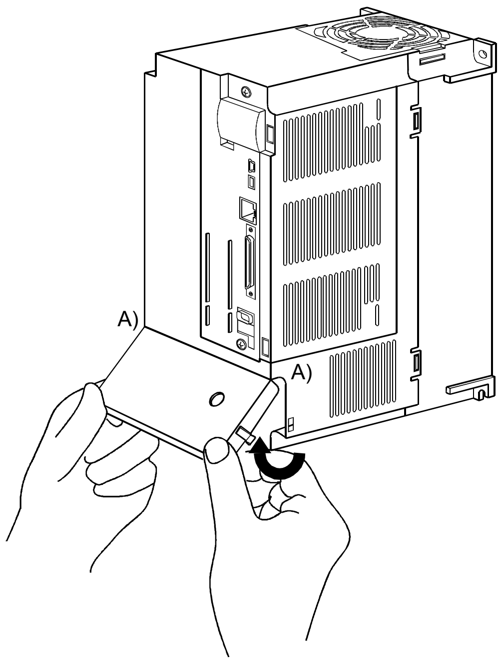
WARNING	・Before removing or reinstalling the front cover, make sure that the charge lamp is off more than 15 minutes after power off. Otherwise, you may get an electric shock.

(1) For MR-J3-350A4・MR-J3-500A(4)・MR-J3-700A(4)

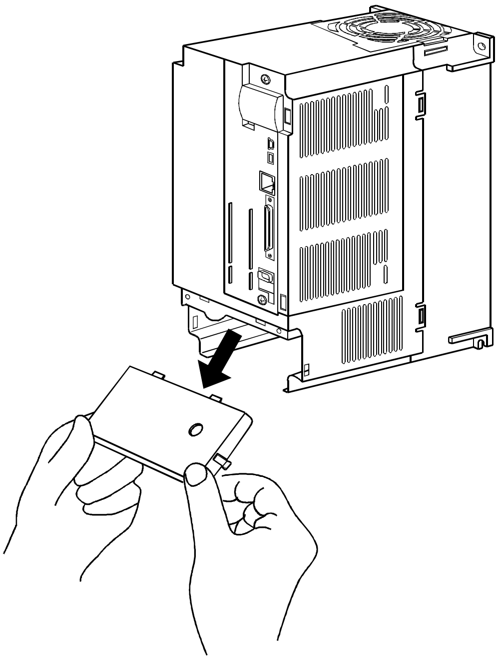
Removal of the front cover



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

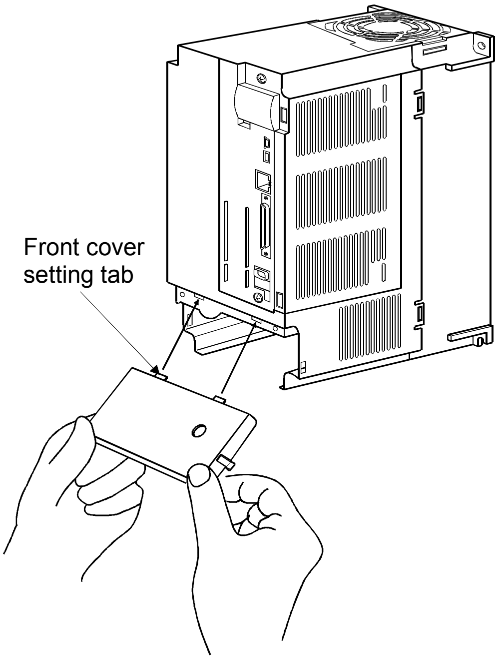


Pull up the cover, supporting at point A).

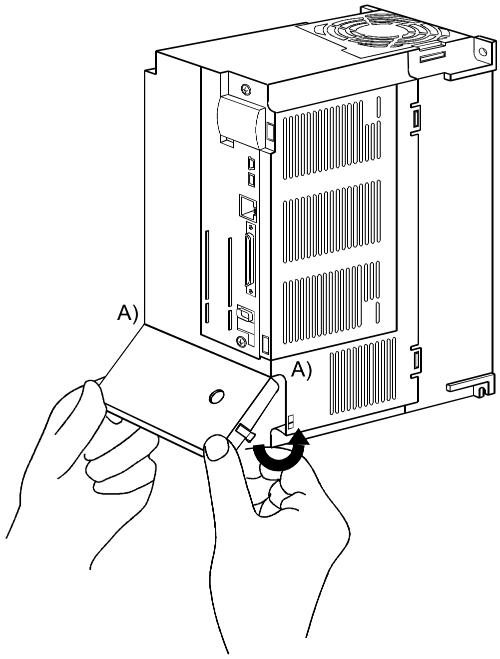


Pull out the front cover to remove.

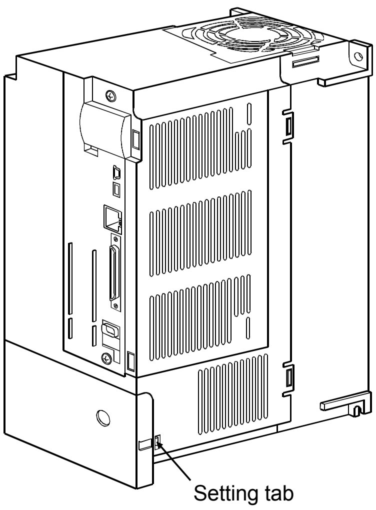
Reinstallation of the front cover



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



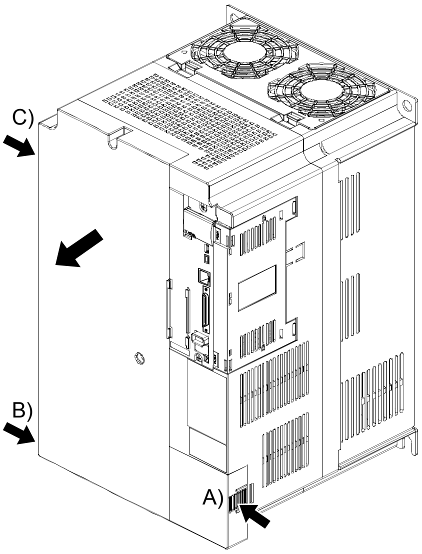
Pull up the cover, supporting at point A).

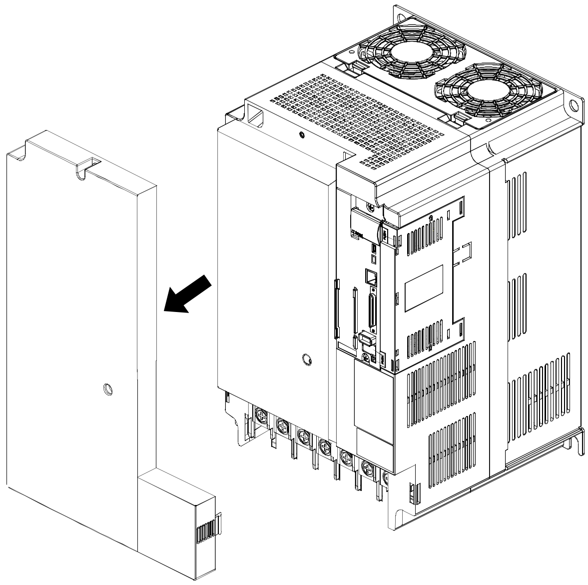


Push the setting tabs until they click.

(2) For MR-J3-11KA(4) to MR-J3-22KA(4)

Removal of the front cover

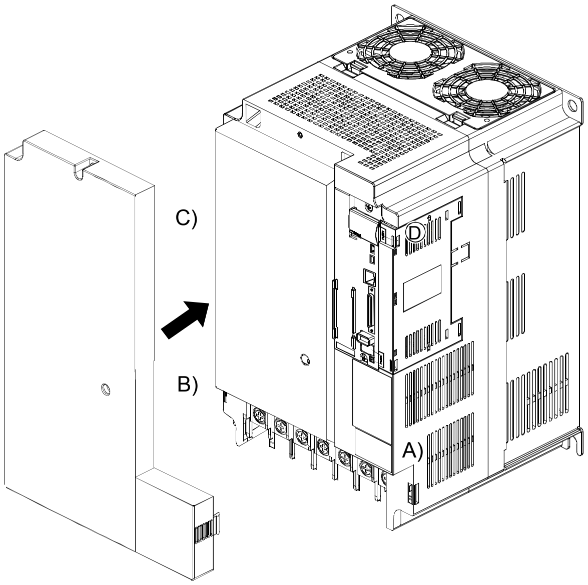


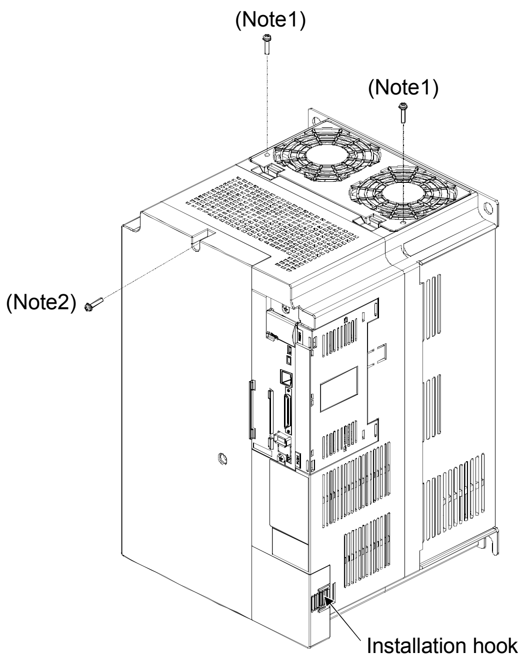


1) Press the removing knob on the lower side of the front cover (A) and B)) and release the installation hook.
2) Press the removing knob of C) and release the external hook.

3) Pull it to remove the front cover.

Reinstallation of the front cover





1) Fit the front cover installation hooks on the sockets of body cover (A) to B)) to reinstall it.

2) Push the front cover until your hear the clicking noise of the installation hook.

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

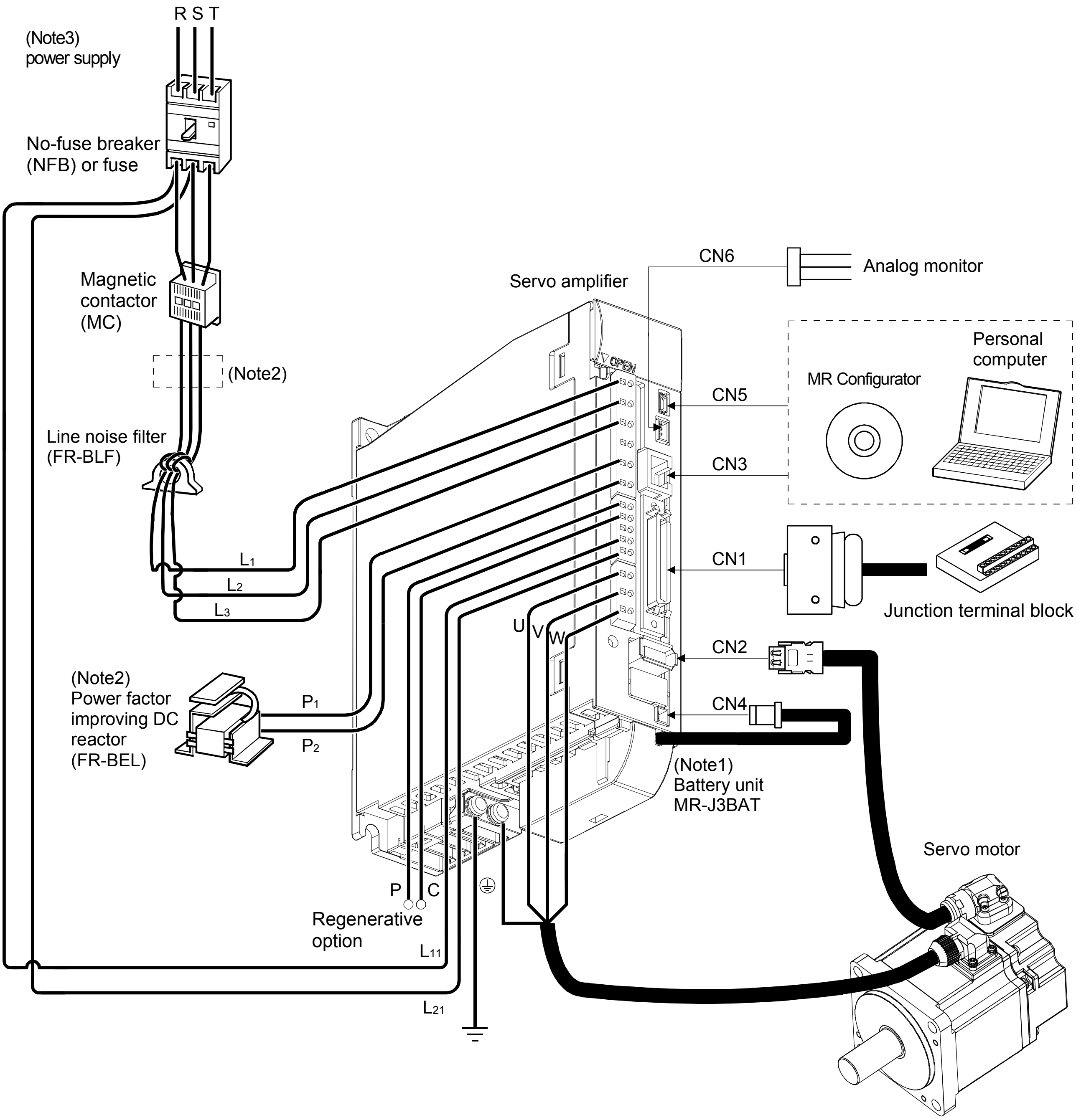
2. By drilling approximately φ4 of a hole on the front cover, the front cover can be locked on the body with an enclosed screw (M4 × 14).

1.8 Configuration including auxiliary equipment

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

(1) MR-J3-100A or less

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

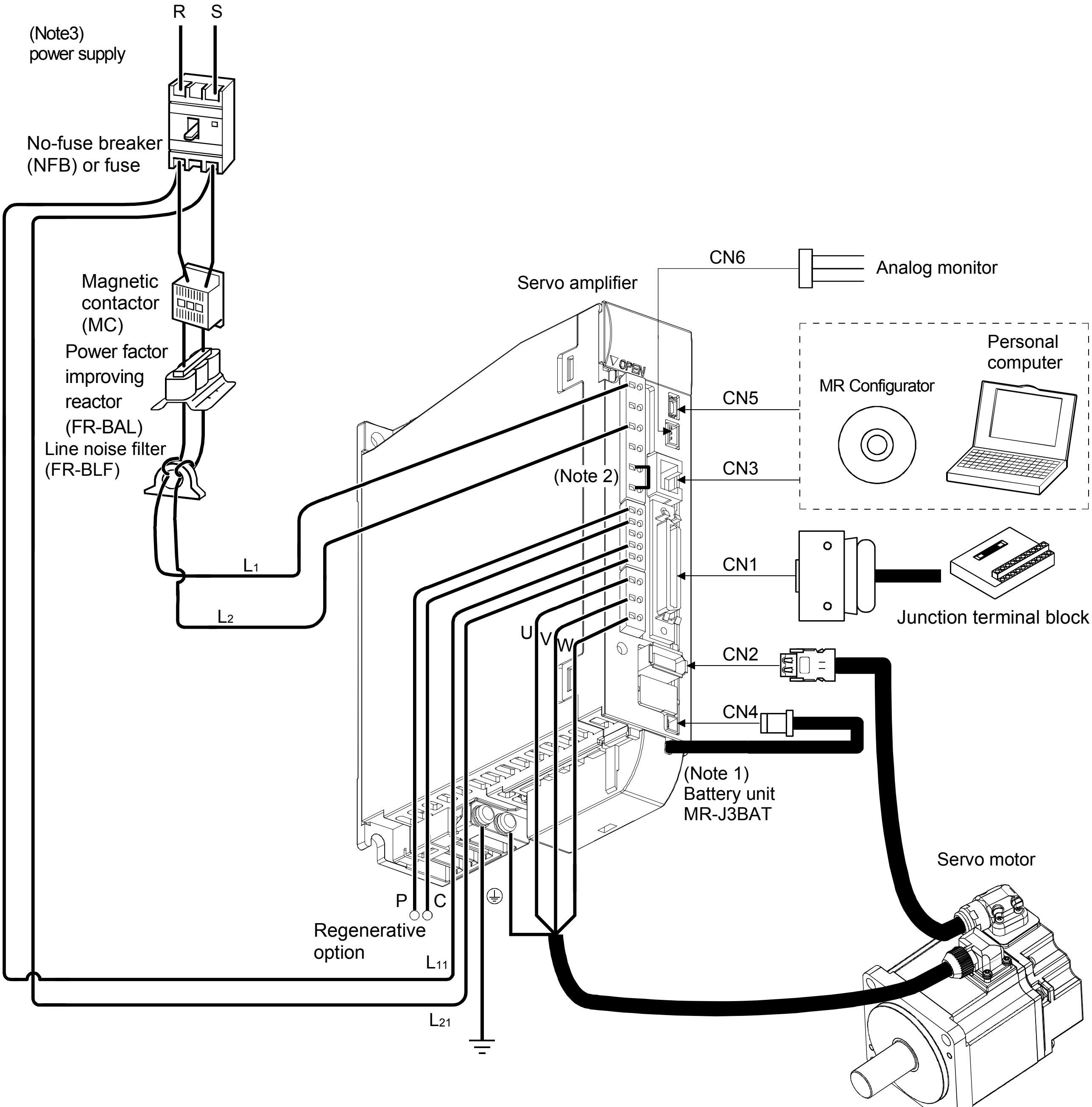


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used.

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

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

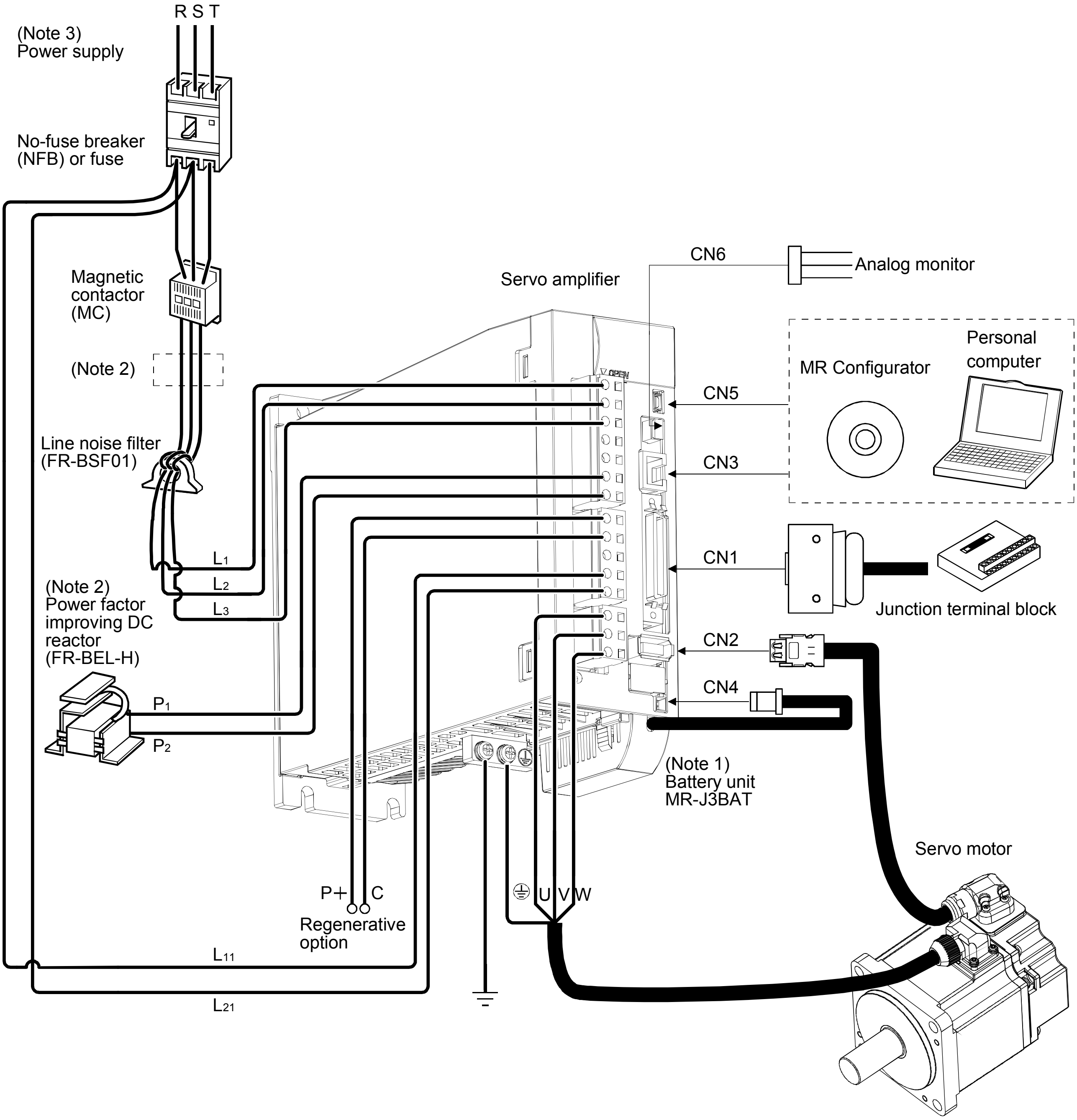


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The power factor improving DC reactor cannot be used.

3. For the specification of power supply, refer to section 1.3.

(2) MR-J3-60A4・MR-J3-100A4

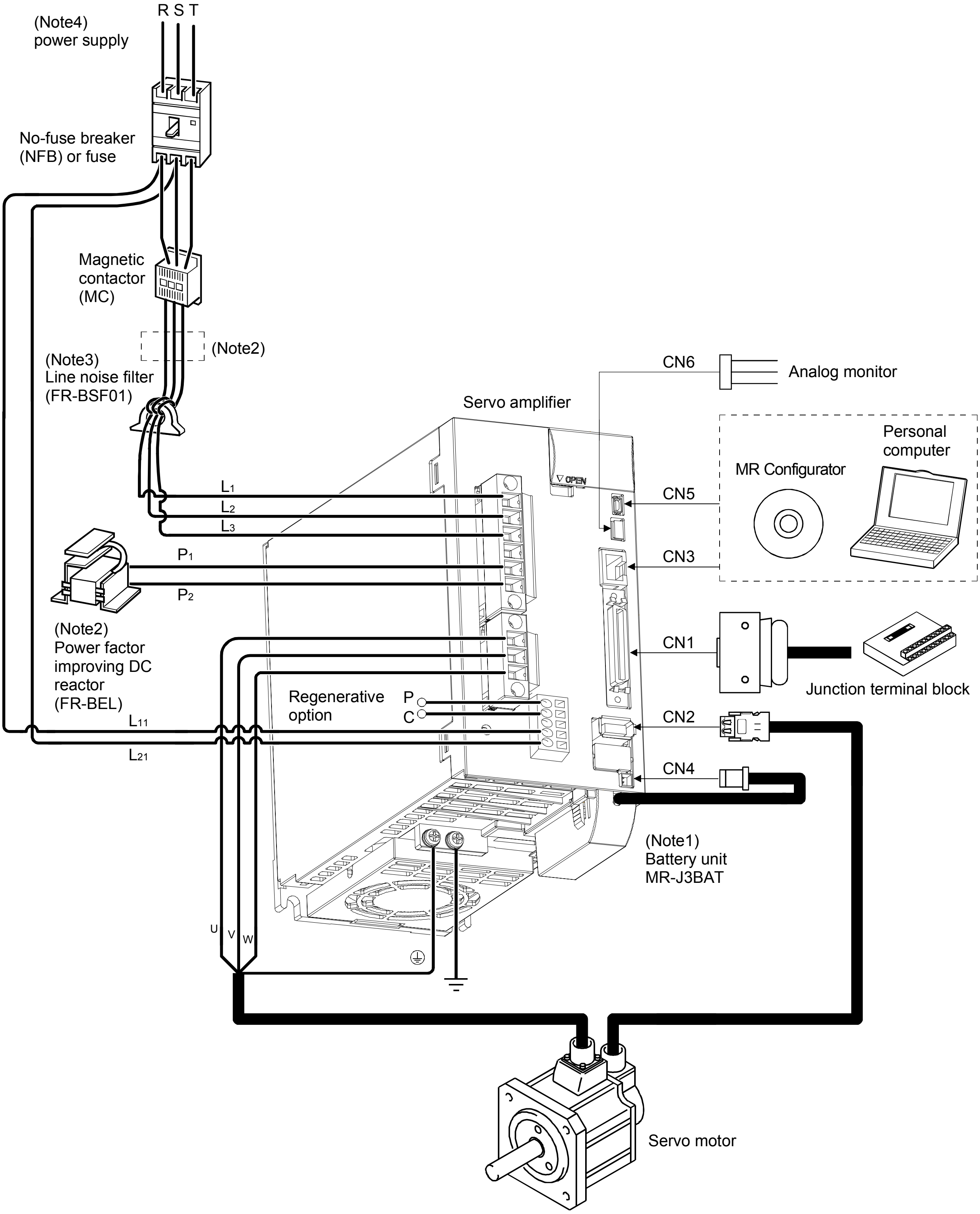


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For the specification of power supply, refer to section 1.3.

(3) MR-J3-200A · MR-J3-350A



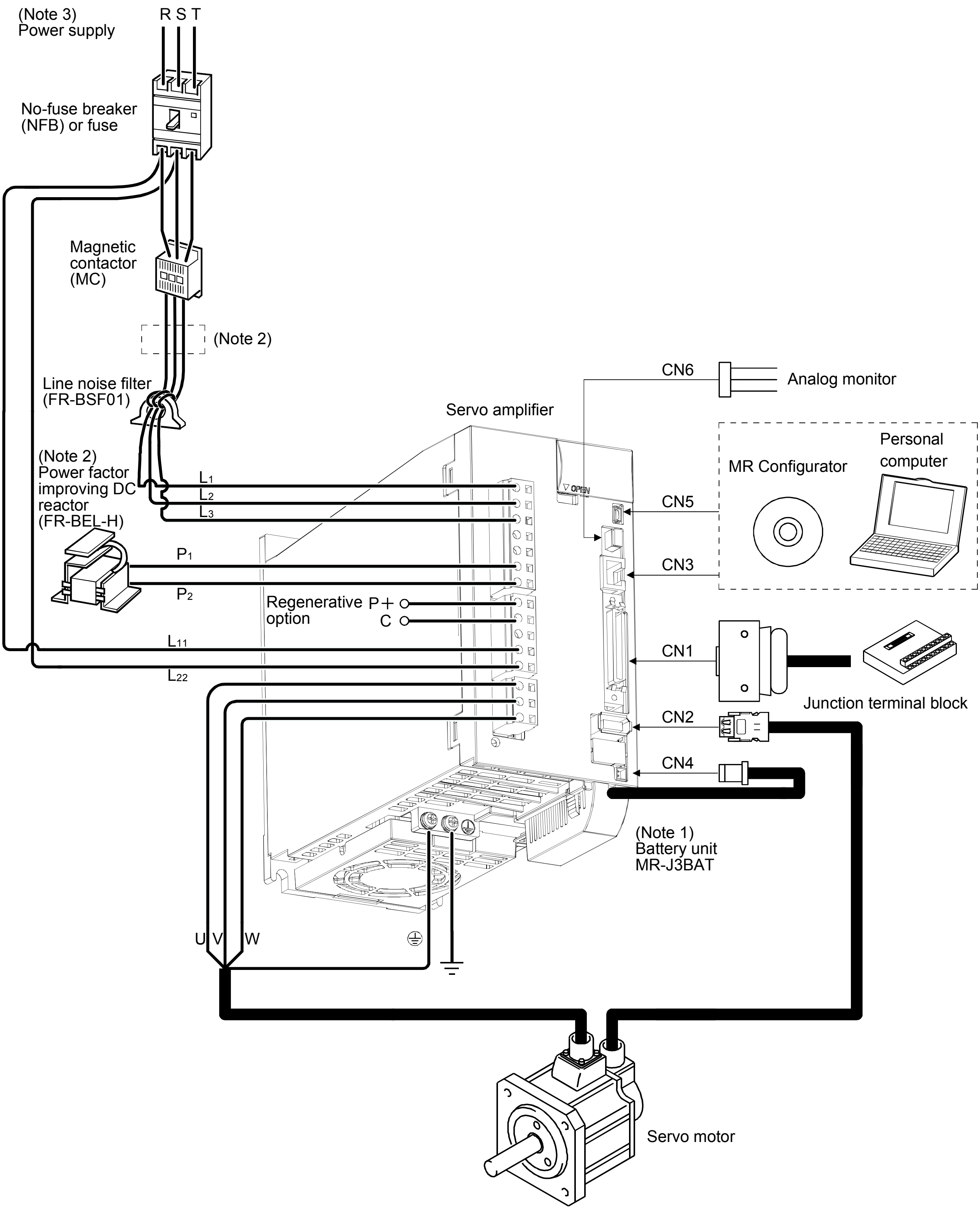
Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For MR-J3-350A, use FR-BLF.

4. For the specification of power supply, refer to section 1.3.

(4) MR-J3-200A4

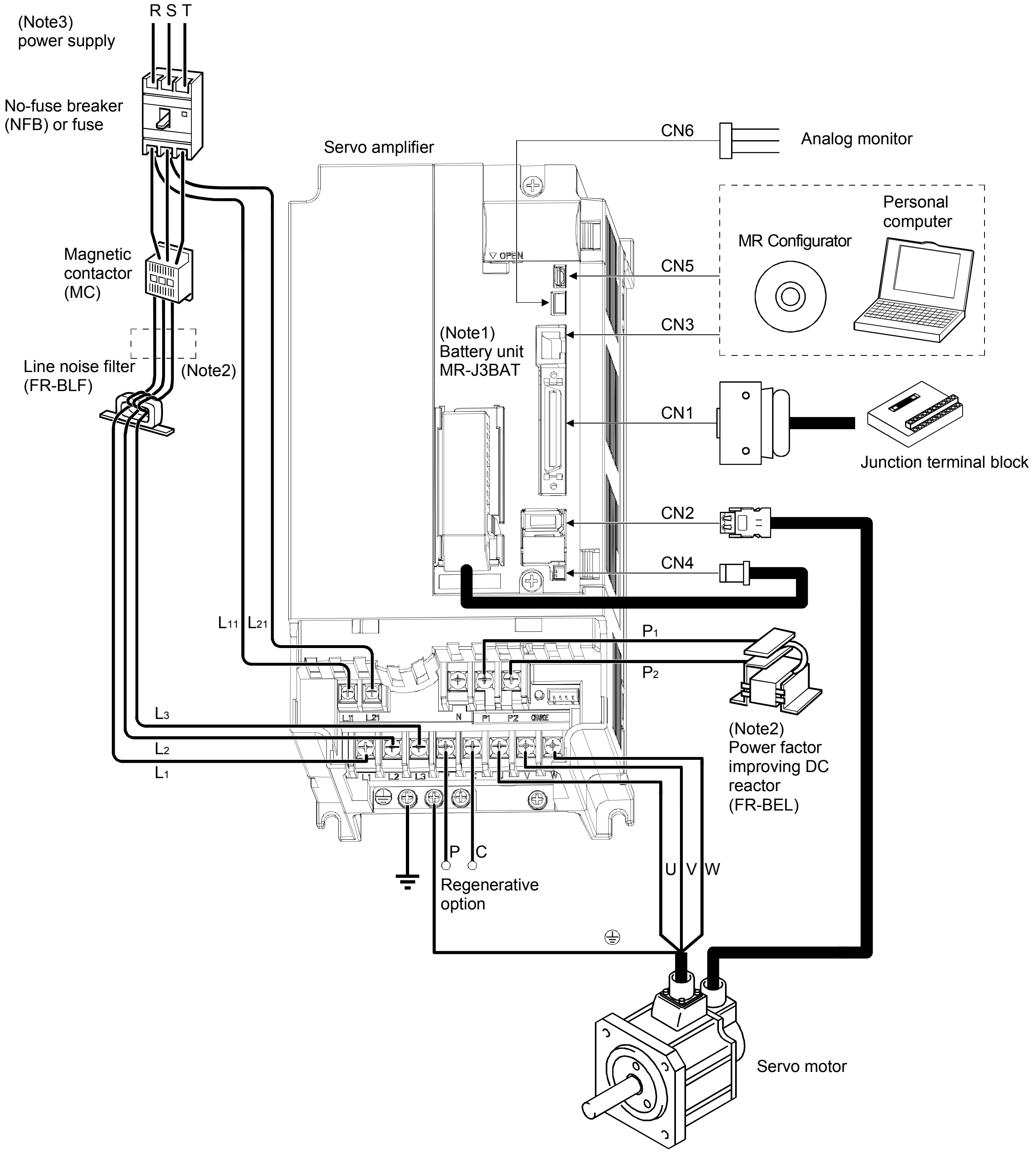


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For the specification of power supply, refer to section 1.3.

(5) MR-J3-350A4・MR-J3-500A(4)

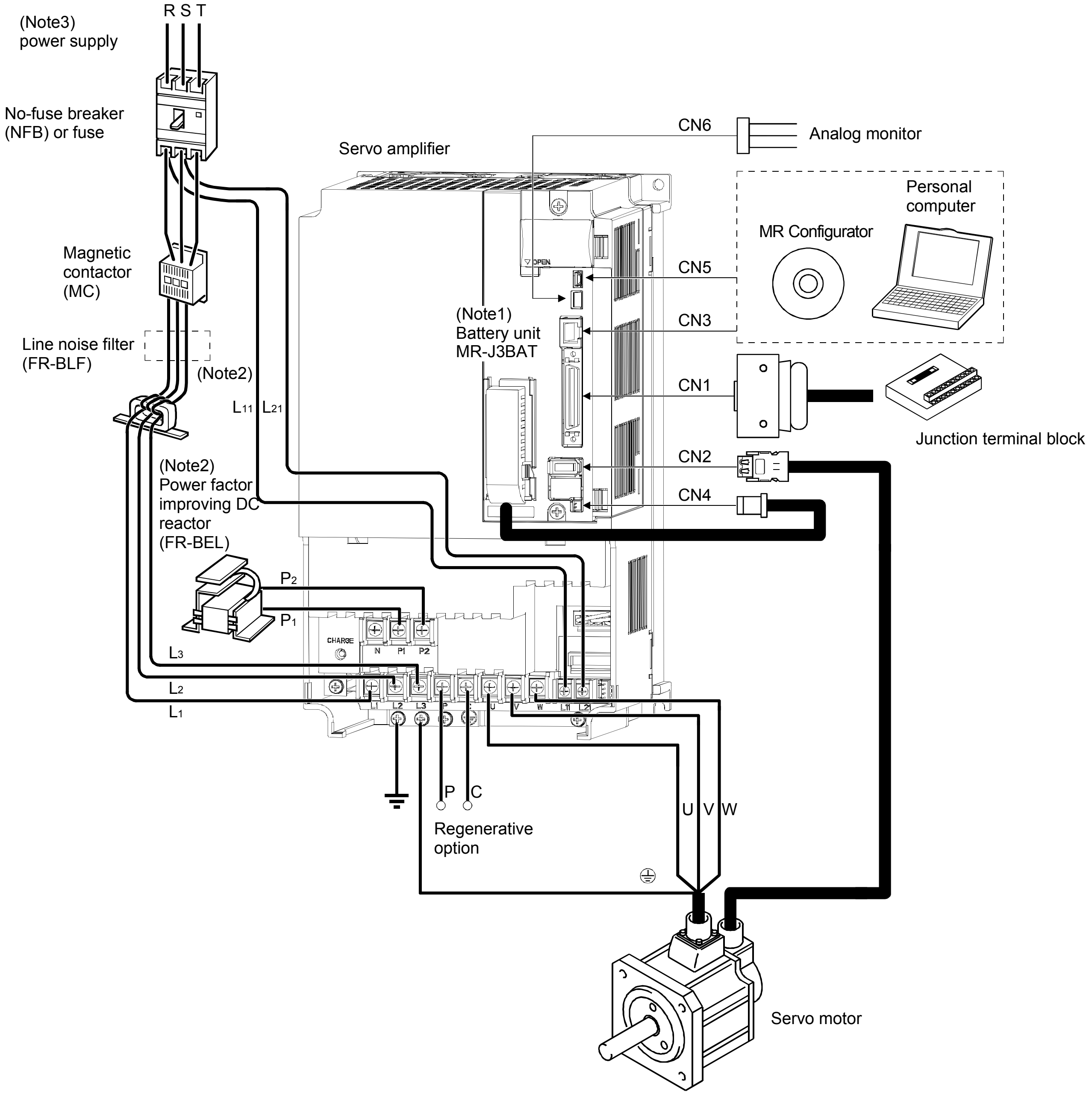


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For the specification of power supply, refer to section 1.3.

(6) MR-J3-700A(4)

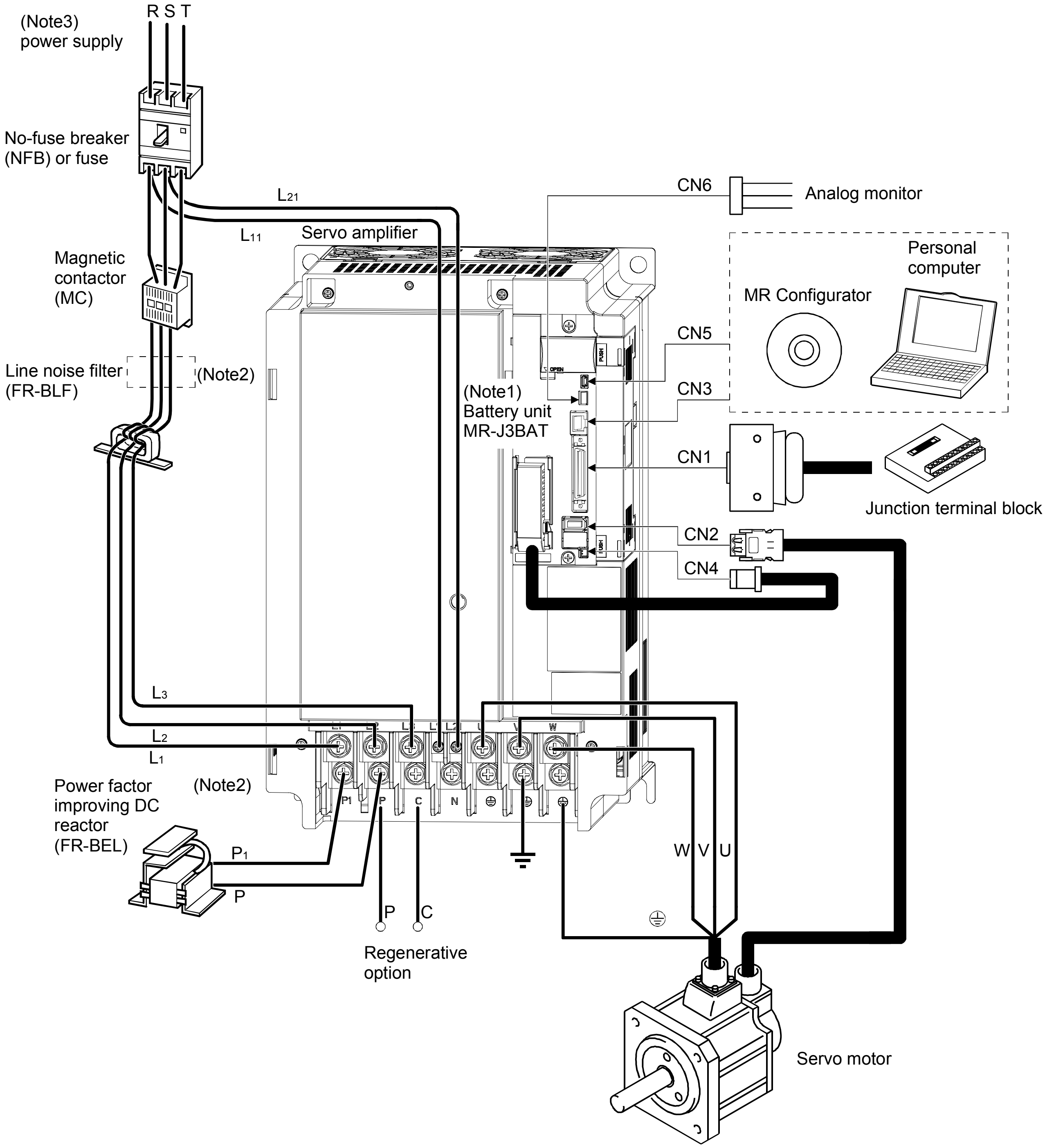


Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For the specification of power supply, refer to section 1.3.

(7) MR-J3-11KA(4) to MR-J3-22KA(4)



Note 1. The battery unit(option) is used for the absolute position detection system in the position control mode.

2. The AC reactor can also be used. In this case, the DC reactor cannot be used. When not using DC reactor, short P_1-P_2.

3. For the specification of power supply, refer to section 1.3.

2. INSTALLATION

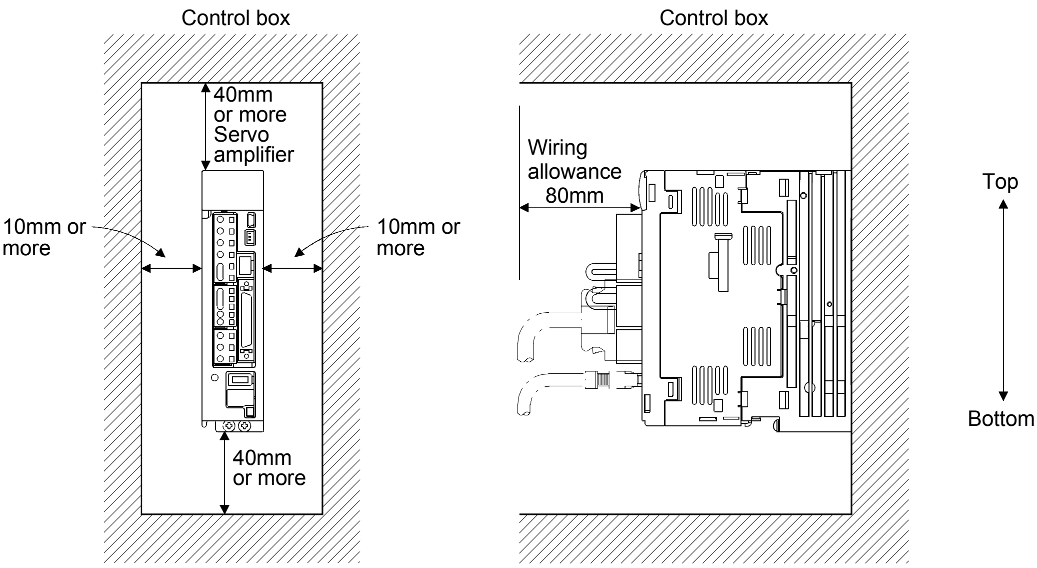
⚠CAUTION	· Stacking in excess of the limited number of products is not allowed. · Install the equipment to incombustibles. Installing them directly or close to combustibles will led to a fire. · Install the equipment in a load-bearing place in accordance with this Instruction Manual. · Do not get on or put heavy load on the equipment to prevent injury. · Use the equipment within the specified environmental condition range. (For details of the environmental condition, refer to section 1.3.) · Provide an adequate protection to prevent screws, metallic detritus and other conductive matter or oil and other combustible matter from entering the servo amplifier. · Do not block the intake/exhaust ports of the servo amplifier. Otherwise, a fault may occur. · Do not subject the servo amplifier to drop impact or shock loads as they are precision equipment. · Do not install or operate a faulty servo amplifier. · When the product has been stored for an extended period of time, consult Mitsubishi. · When treating the servo amplifier, be careful about the edged parts such as the corners of the servo amplifier.

2.1 Installation direction and clearances

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

(1) 7kW or less

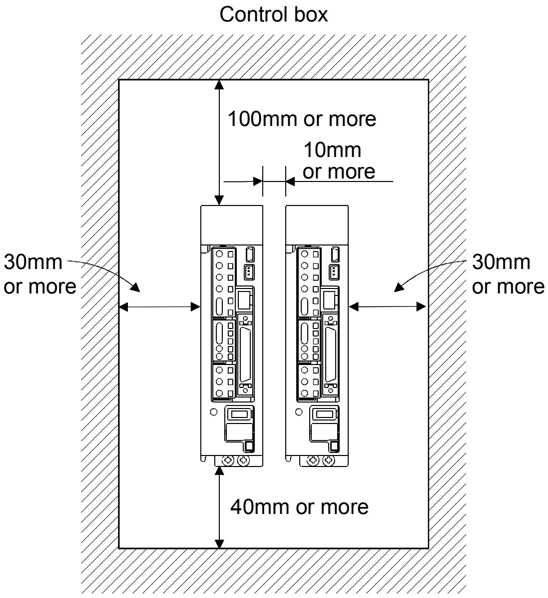
(a) Installation of one servo amplifier



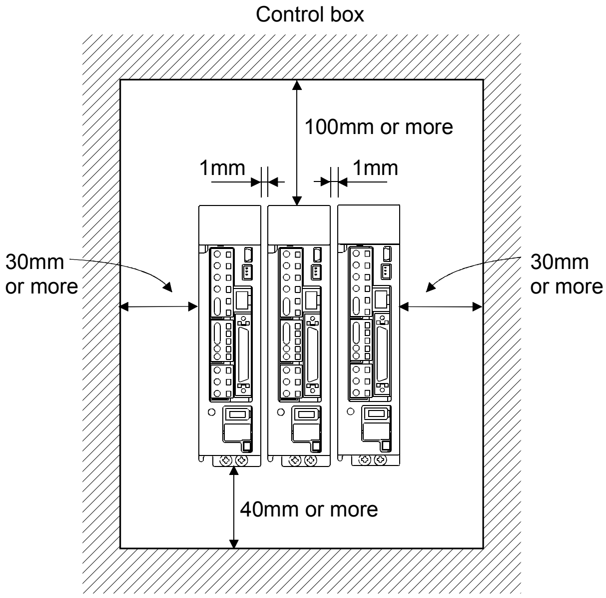
(b) Installation of two or more servo amplifiers

POINT
・Mounting closely is available for a combination of servo amplifiers of 3.5kW or less in 200V or 100V class.

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box, and install a fan to prevent the internal temperature of the control box from exceeding the environmental conditions.
When installing the servo amplifiers closely, leave a clearance of 1mm between the adjacent servo amplifiers in consideration of mounting tolerances.
In this case, make circumference temperature into 0 to 45°C, or use it at 75% or a smaller effective load ratio.



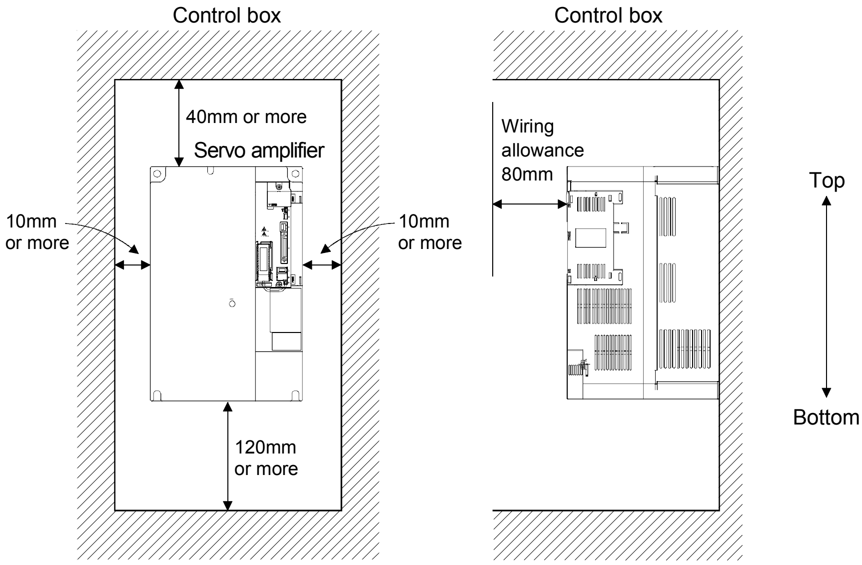
Leaving clearance



Mounting closely

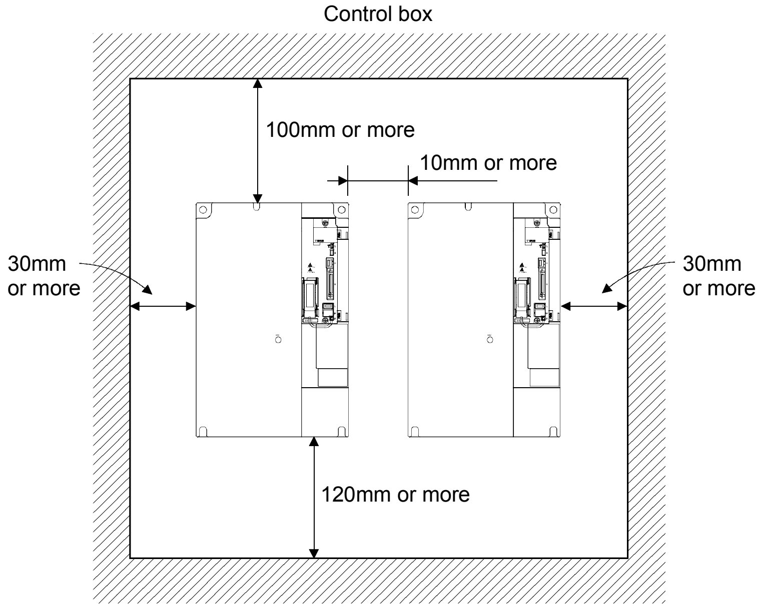
(2) 11kW or more

(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 control box, and install a fan to prevent the internal temperature of the control box from exceeding the environmental conditions.



(3) Others

When using heat generating equipment such as the regenerative 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 control box, prevent drill chips and wire fragments from entering the servo amplifier.

(2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box or a fan installed on the ceiling.

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

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) supplied with the servo motor, and flex the optional encoder cable or the power supply and brake wiring cables. 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 will move, the flexing radius should be made as large as possible. Refer to section 11.4 for the flexing life.

2.4 Inspection items

⚠WARNING	・Before starting maintenance and/or inspection, make sure that the charge lamp is off more than 15 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock. ・Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.

POINT

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

It is recommended to make the following checks periodically:

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

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

2.5 Parts having service lives

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. For parts replacement, please contact your sales representative.

Part name		Life guideline
Servo amplifier	Smoothing capacitor	10 years
	Relay	Number of power-on and number of emergency stop times : 100,000 times
	Cooling fan	10,000 to 30,000hours (2 to 3 years)
	Absolute position battery	Refer to section 14.2

(a) 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.

(b) Relays

Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life when the cumulative number of power-on and emergency stop times is 100,000, which depends on the power supply capacity.

(c) Servo amplifier cooling fan

The cooling fan bearings reach the end of their life in 10,000 to 30,000 hours. Normally, therefore, the fan must be changed in a few years of continuous operation as a guideline.

It must also be changed if unusual noise or vibration is found during inspection.

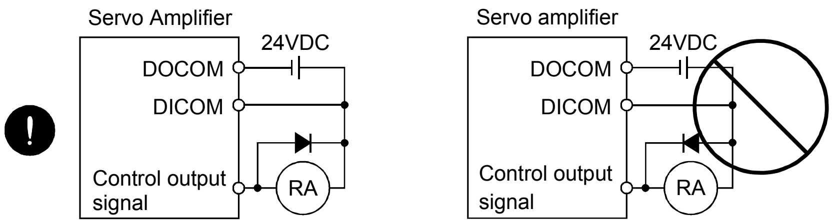
3. SIGNALS AND WIRING

⚠ WARNING

- Any person who is involved in wiring should be fully competent to do the work.
- Before starting wiring, switch power off, then wait for more than 15 minutes, and after the charge lamp has gone off, make sure that the voltage is safe in the tester or like. Otherwise, you may get an electric shock.
- 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, you may get an electric shock.
- The cables should not be damaged, stressed excessively, loaded heavily, or pinched. Otherwise, you may get an electric shock.

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate, 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 designed for control output should be fitted in the specified direction. Otherwise, the signal is not output due to a fault, disabling the emergency stop (EMG) and other protective circuits.



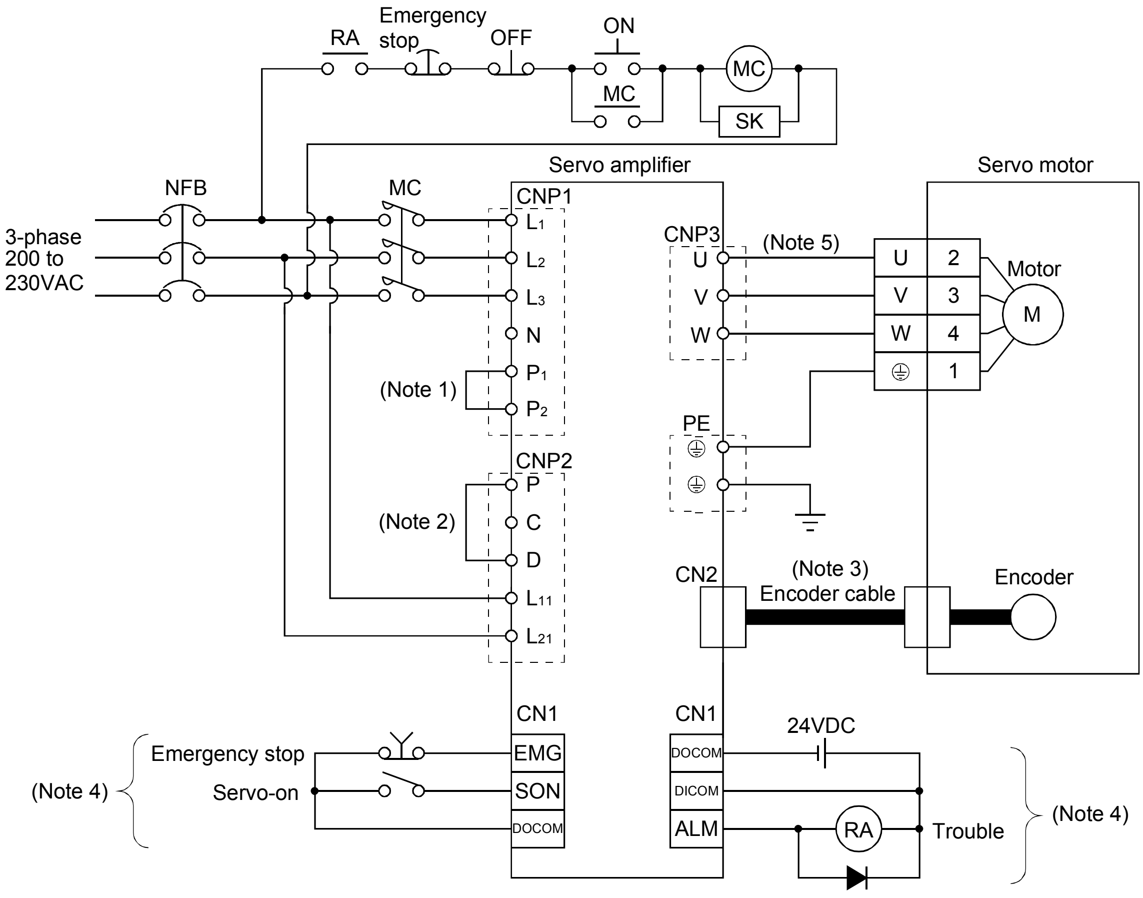
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) with the power line of the servo motor.
- When using 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.
- During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

3.1 Input power supply circuit

⚠ CAUTION	・When the servo amplifier has become faulty, switch power off on the servo amplifier power side. Continuous flow of a large current may cause a fire. ・Use the trouble signal to switch power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire. ・During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

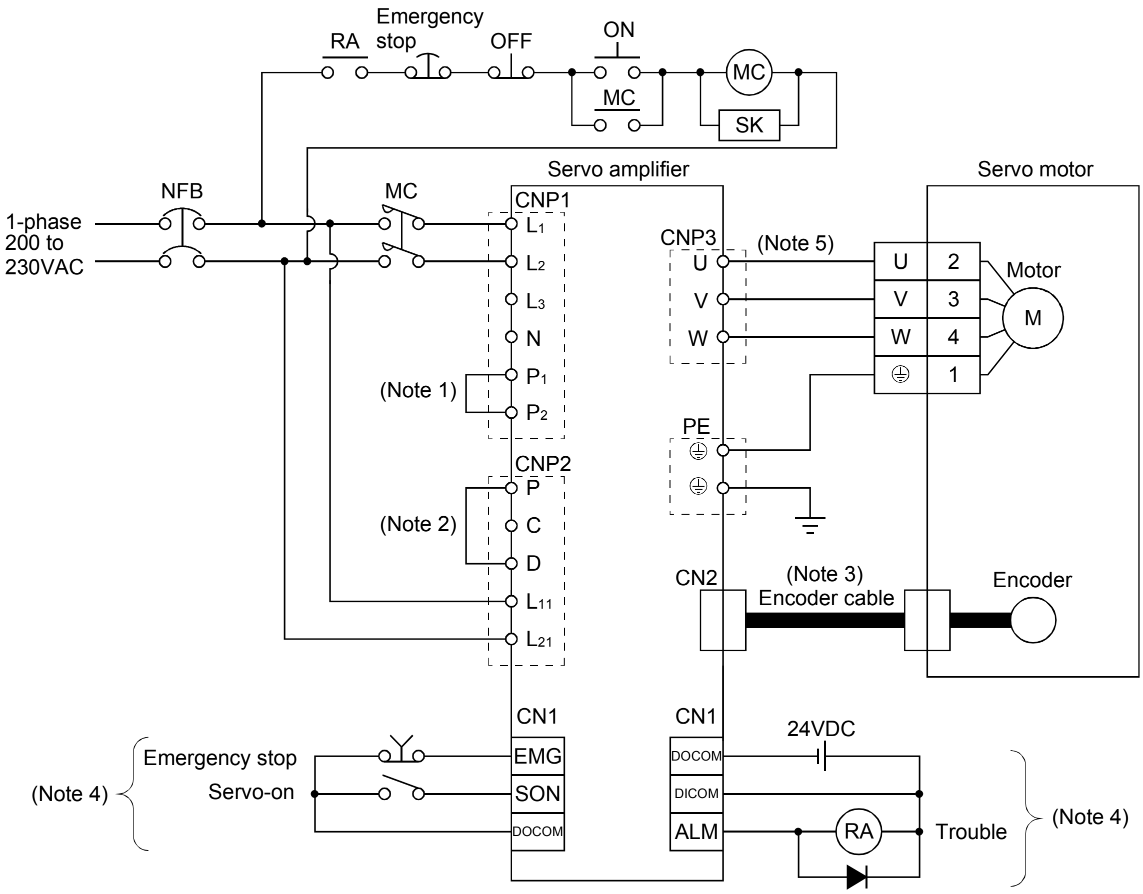
Wire the power supply and main circuit as shown below so that the servo-on (SON) turns off as soon as alarm occurrence is detected and power is shut off.
A no-fuse breaker (NFB) must be used with the input cables of the power supply.

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



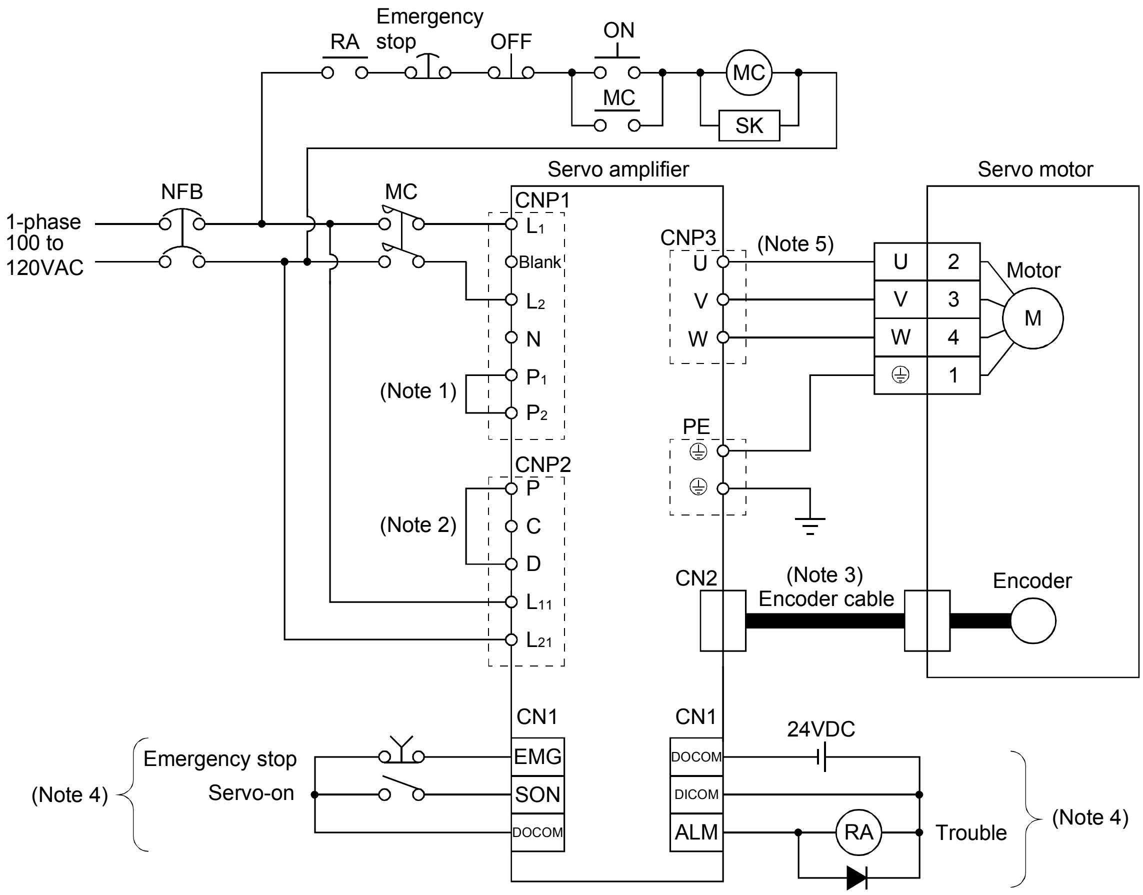
Note 1. Always connect P1-P2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.
2. Always connect P-D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface.
For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.

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



Note 1. Always connect P1-P2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.
2. Always connect P-D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.

(3) For 1-phase 100 to 120VAC power supply to MR-J3-10A1 to MR-J3-40A1



Note 1. Always connect P1-P2. (Factory-wired.) The power factor improving DC reactor cannot be used.

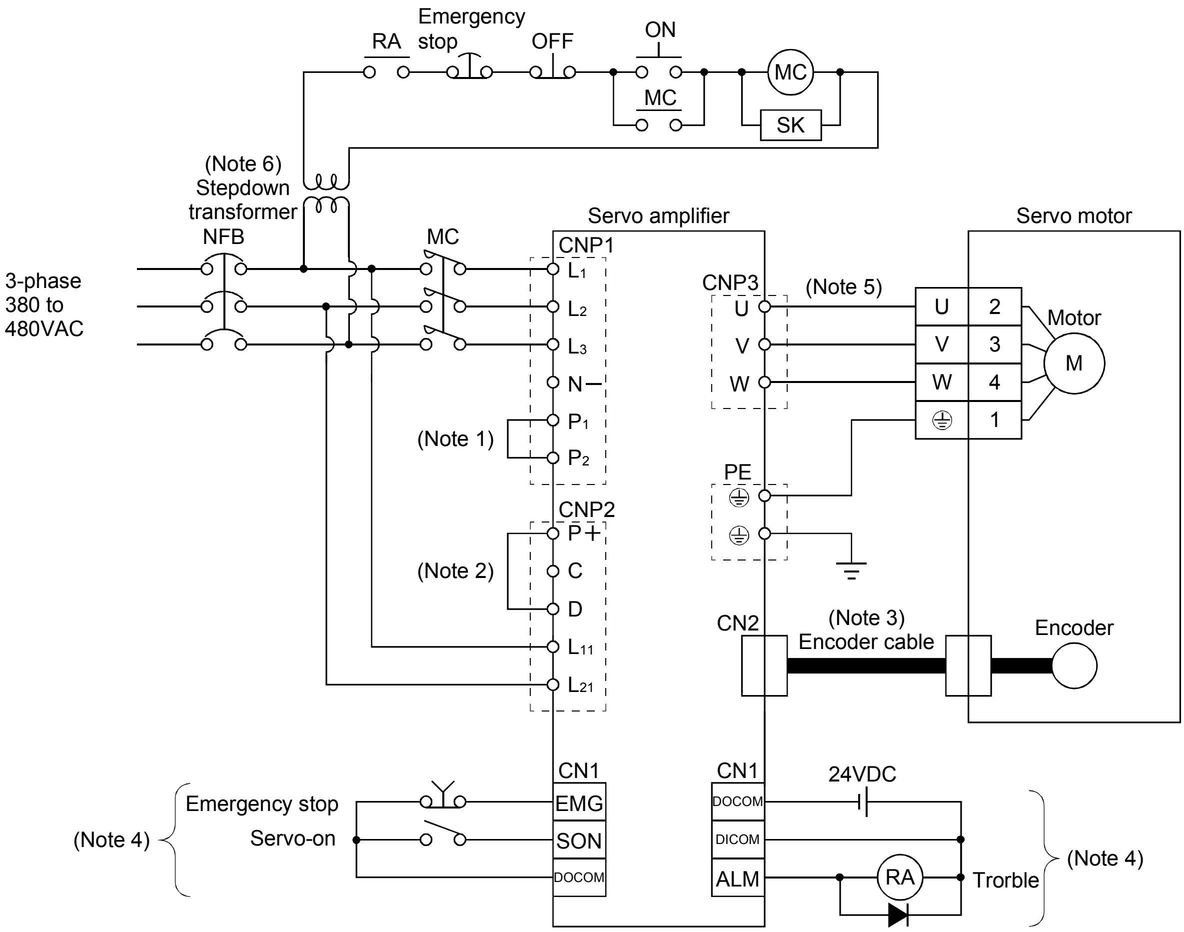
2. Always connect P-D. (Factory-wired.) When using the regenerative option, refer to section 12.2.

3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.

4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

5. Refer to section 3.10.

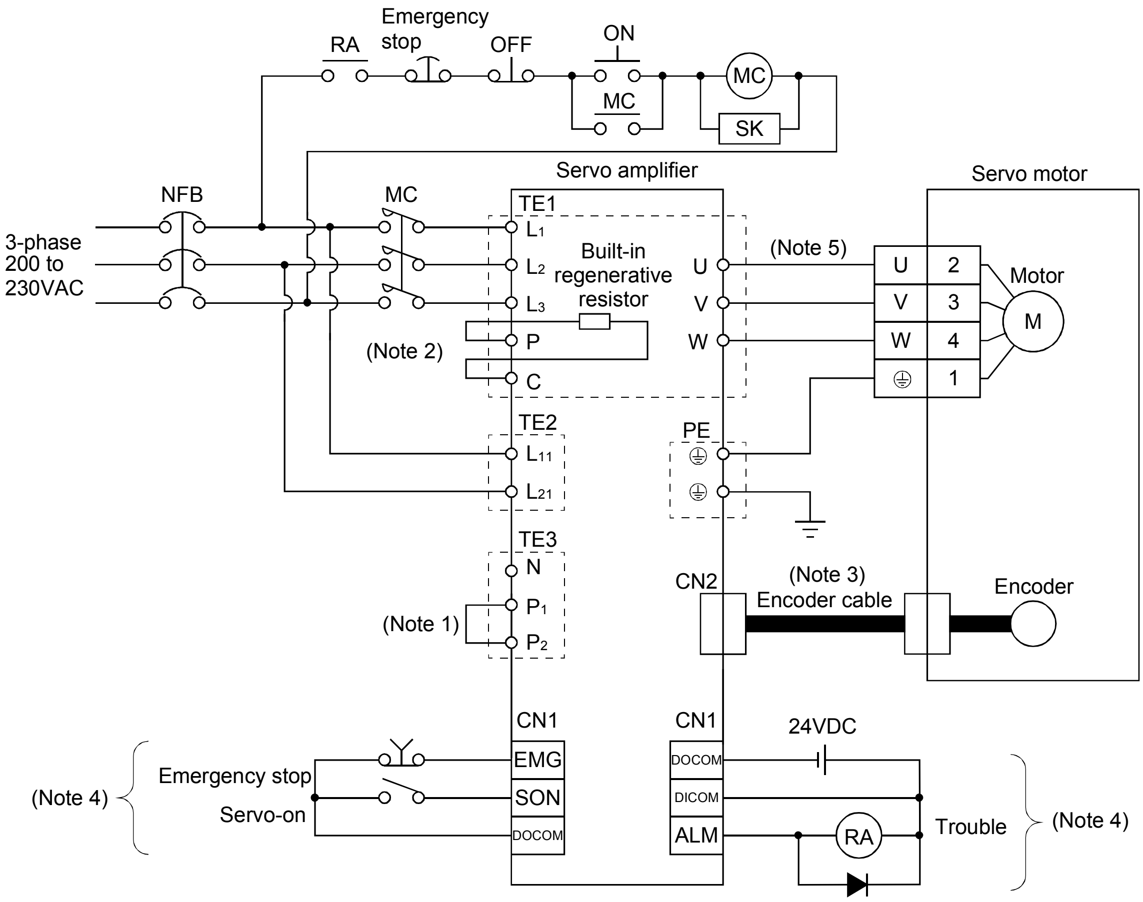
(4) MR-J3-60A4 to MR-J3-200A4



Note 1. Always connect P1-P2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.

2. Always connect P-D. (Factory-wired.) When using the regenerative option, refer to section 12.2.
3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.
6. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.

(5) MR-J3-500A · MR-J3-700A



Note 1. Always connect P1-P2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.

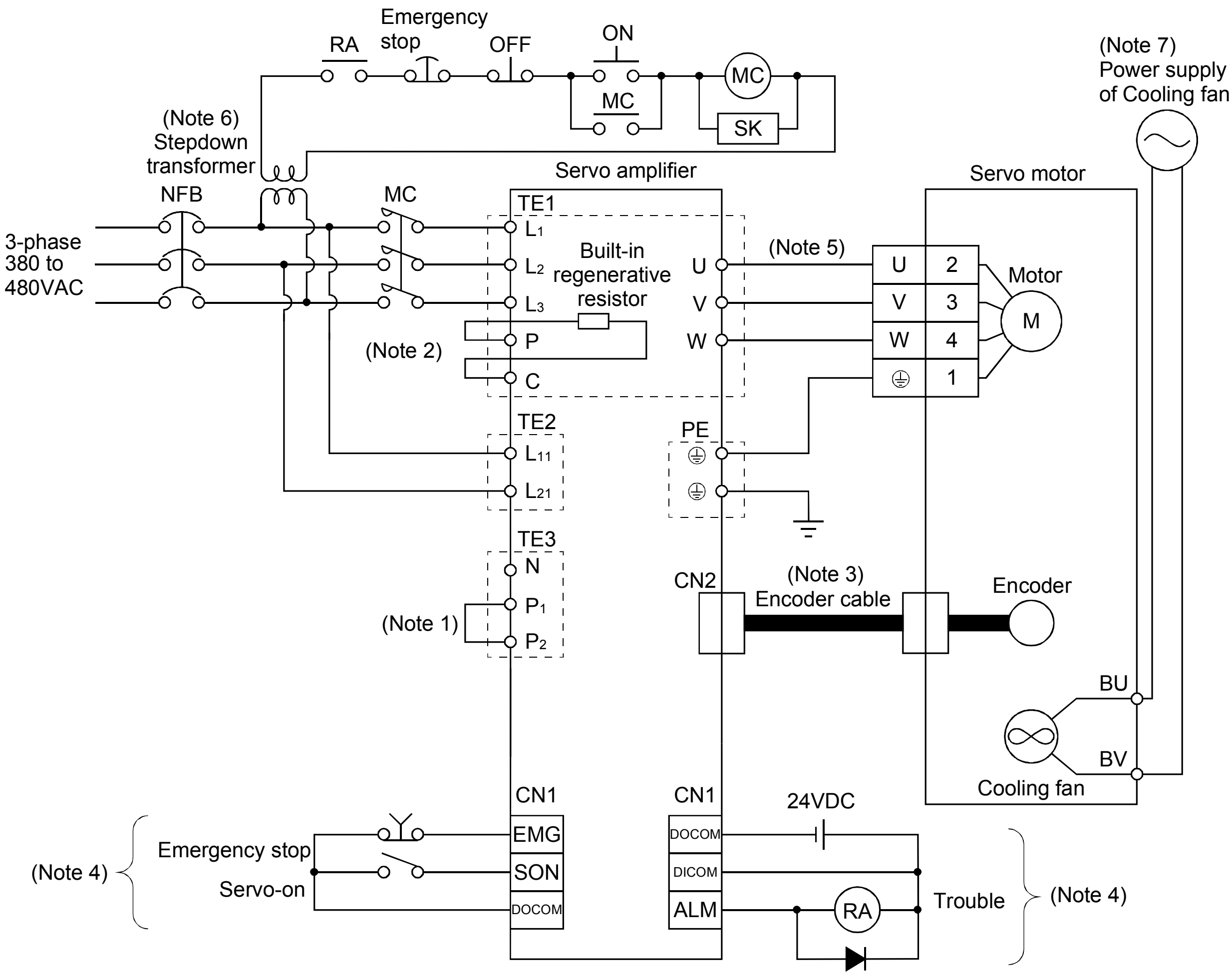
2. When using the regenerative option, refer to section 12.2.

3. For encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.

4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

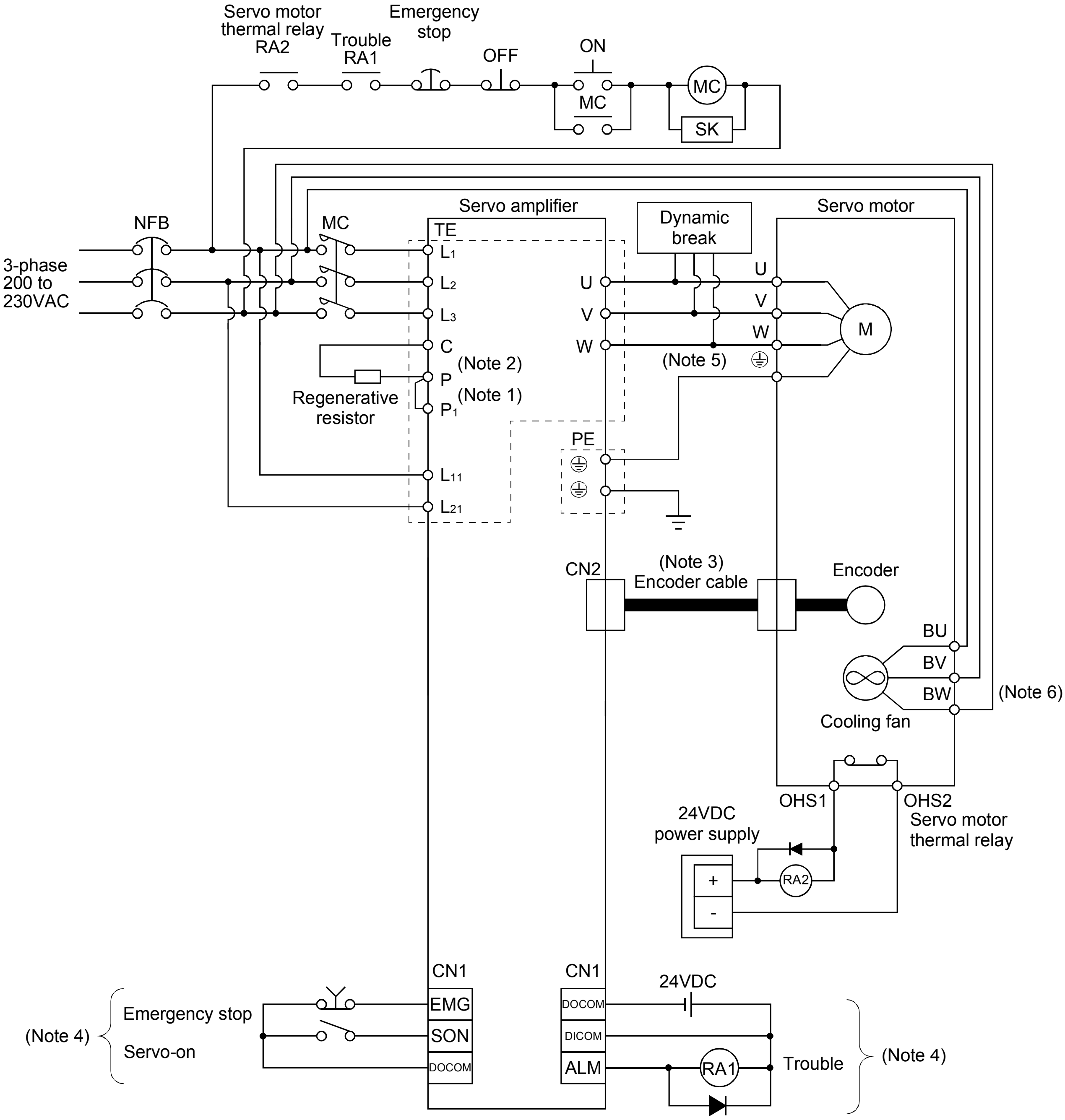
5. Refer to section 3.10.

(6) MR-J3-350A4 to MR-J3-700A4



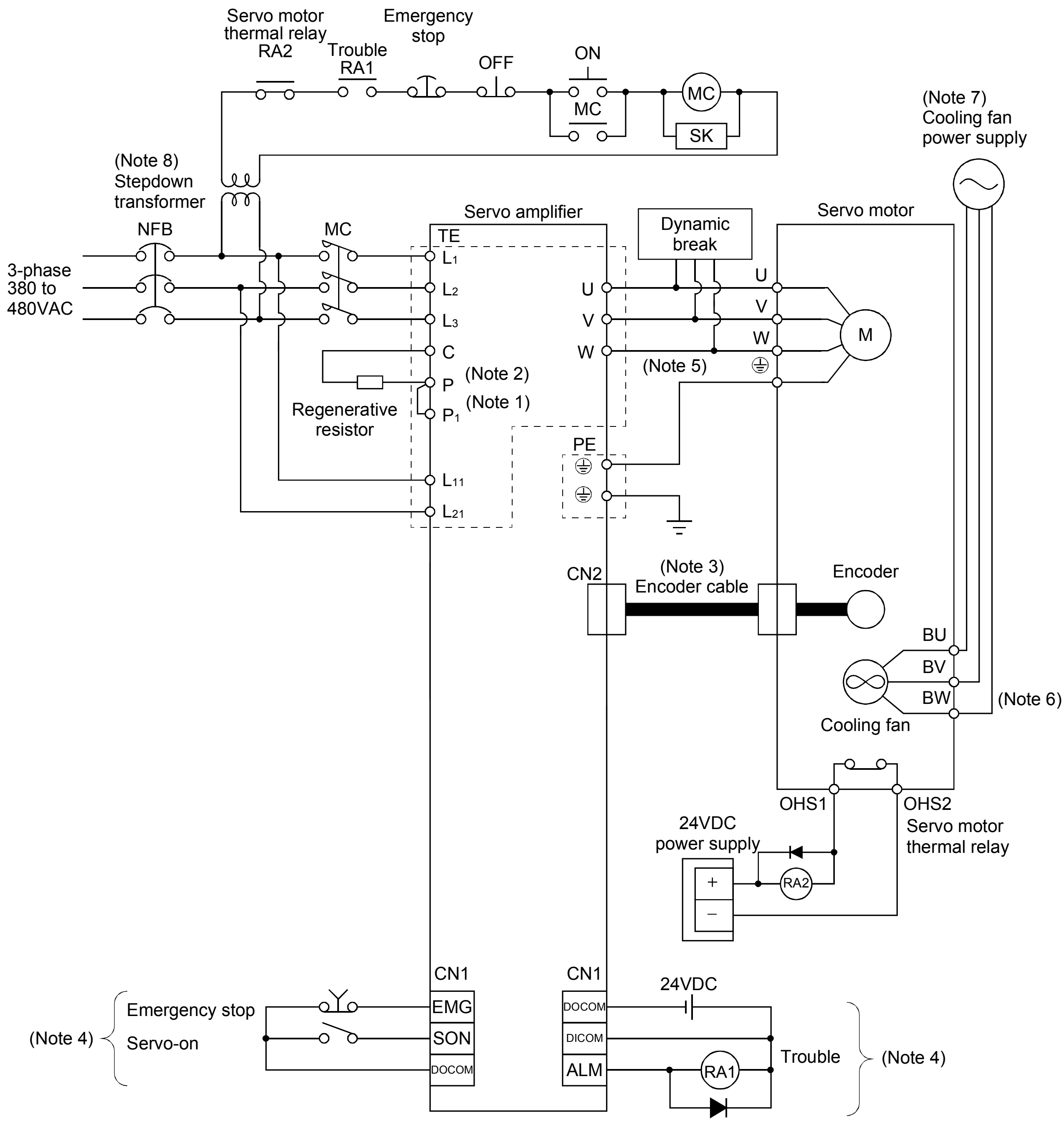
Note 1. Always connect P_1-P_2. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.
2. When using the regenerative option, refer to section 12.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
5. Refer to section 3.10.
6. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.
7. A cooling fan is attached to the HA-LP6014 and the HA-LP701N4 servo motors. For power supply specification of the cooling fan, refer to section 3.10.2 (3) (b).

(7) MR-J3-11KA to MR-J3-22KA



Note 1. Always connect P-P1. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.
2. When using the regenerative option, refer to section 12.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.7.3.
5. Refer to section 3.10.
6. 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.

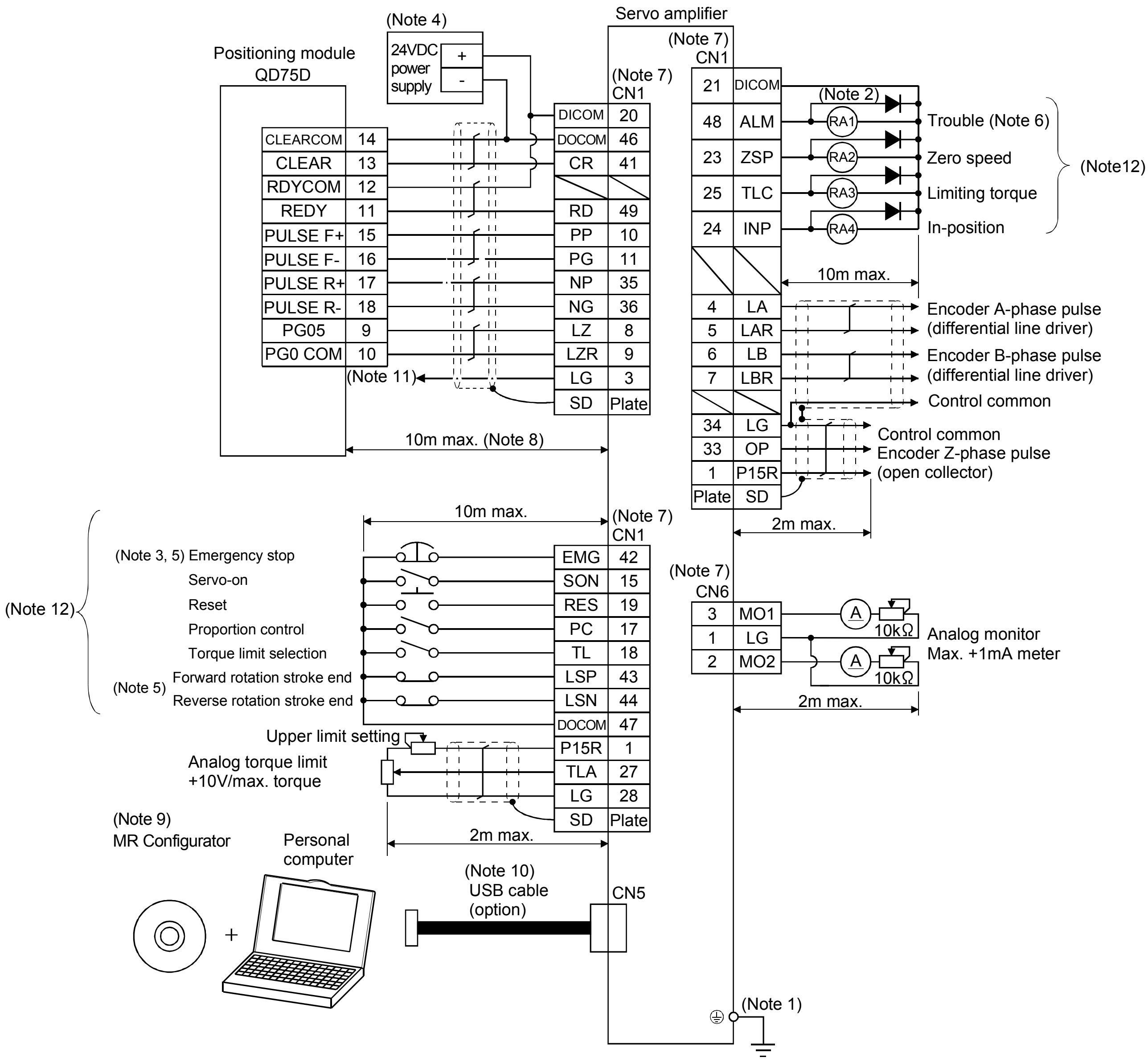
(8) MR-J3-11KA4 to MR-J3-22KA4



Note 1. Always connect P-P1. (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.
2. When using the regenerative option, refer to section 12.2.
3. For the encoder cable, use of the option cable is recommended. Refer to section 12.1 for selection of the cable.
4. For the sink I/O interface. For the source I/O interface, refer to section 3.7.3.
5. Refer to section 3.10.
6. There is no BW if HA-LP11K24 is used.
7. For the cooling fan power supply, refer to section 3.10.2 (3) (b).
8. Stepdown transformer is required for coil voltage of magnetic contactor more than 200V class.

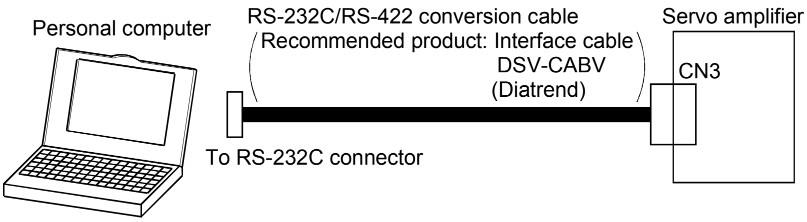
3.2 I/O Signal connection example

3.2.1 Position control mode



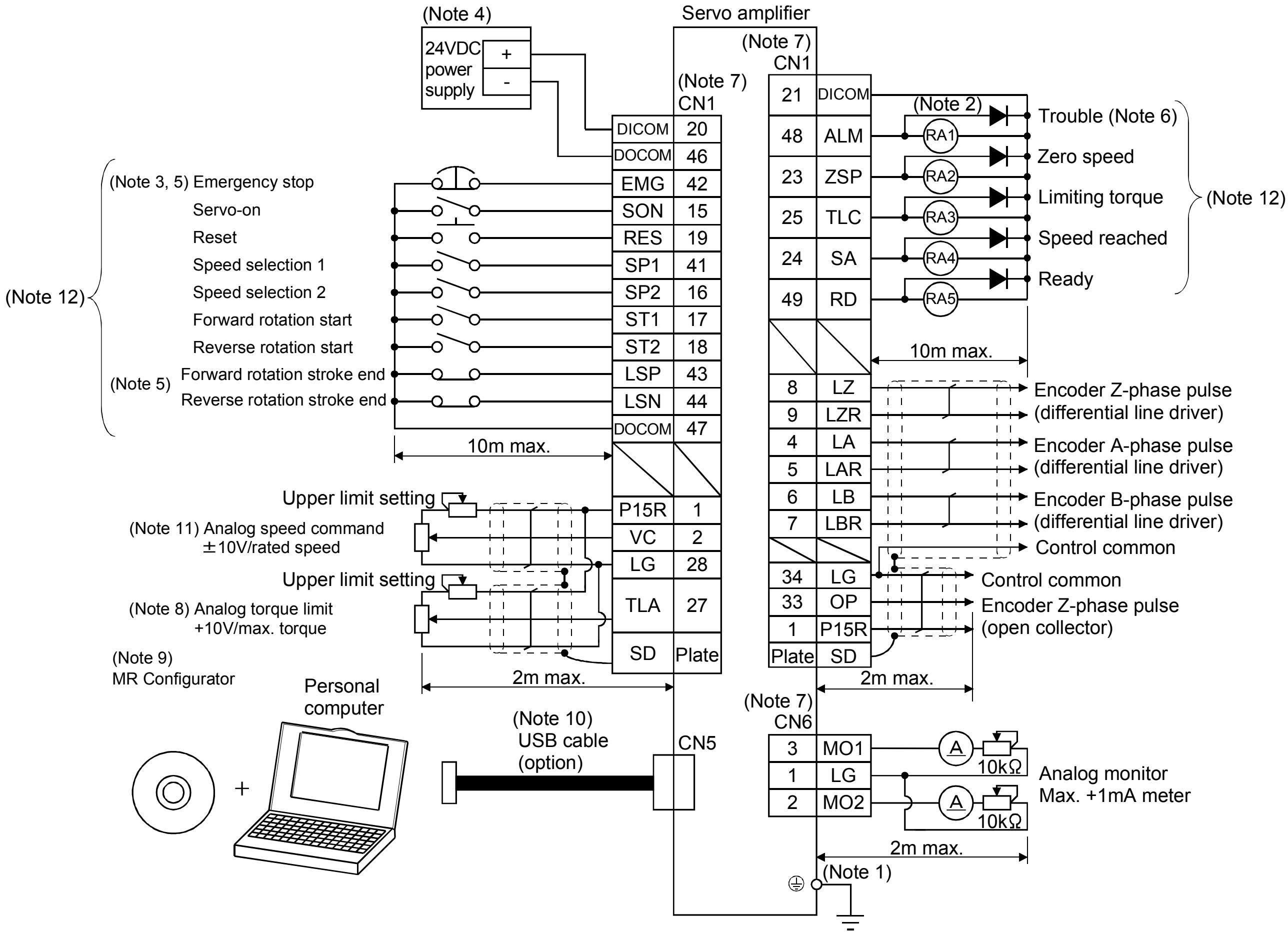
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.

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 (EMG) and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA 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.
5. When starting operation, always turn on emergency stop (EMG) and Forward/Reverse rotation stroke end (LSP/LSN). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the programmable controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the servo amplifier.
8. This length applies to the command pulse train input in the opencollector system. It is 10m or less in the differential line driver system.
9. Use MRZJW3-SETUP 211E.
10. RS-422 can also be used to connect the servo amplifier and personal computer.

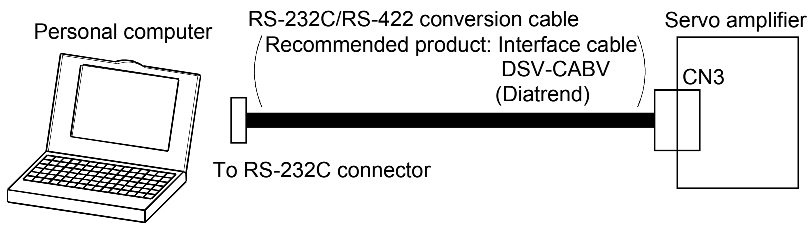


11. This connection is not required for the QD75D. Depending on the used positioning module, however, it is recommended to connect the LG and control common terminals of the servo amplifier to enhance noise immunity.
12. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

3.2.2 Speed control mode

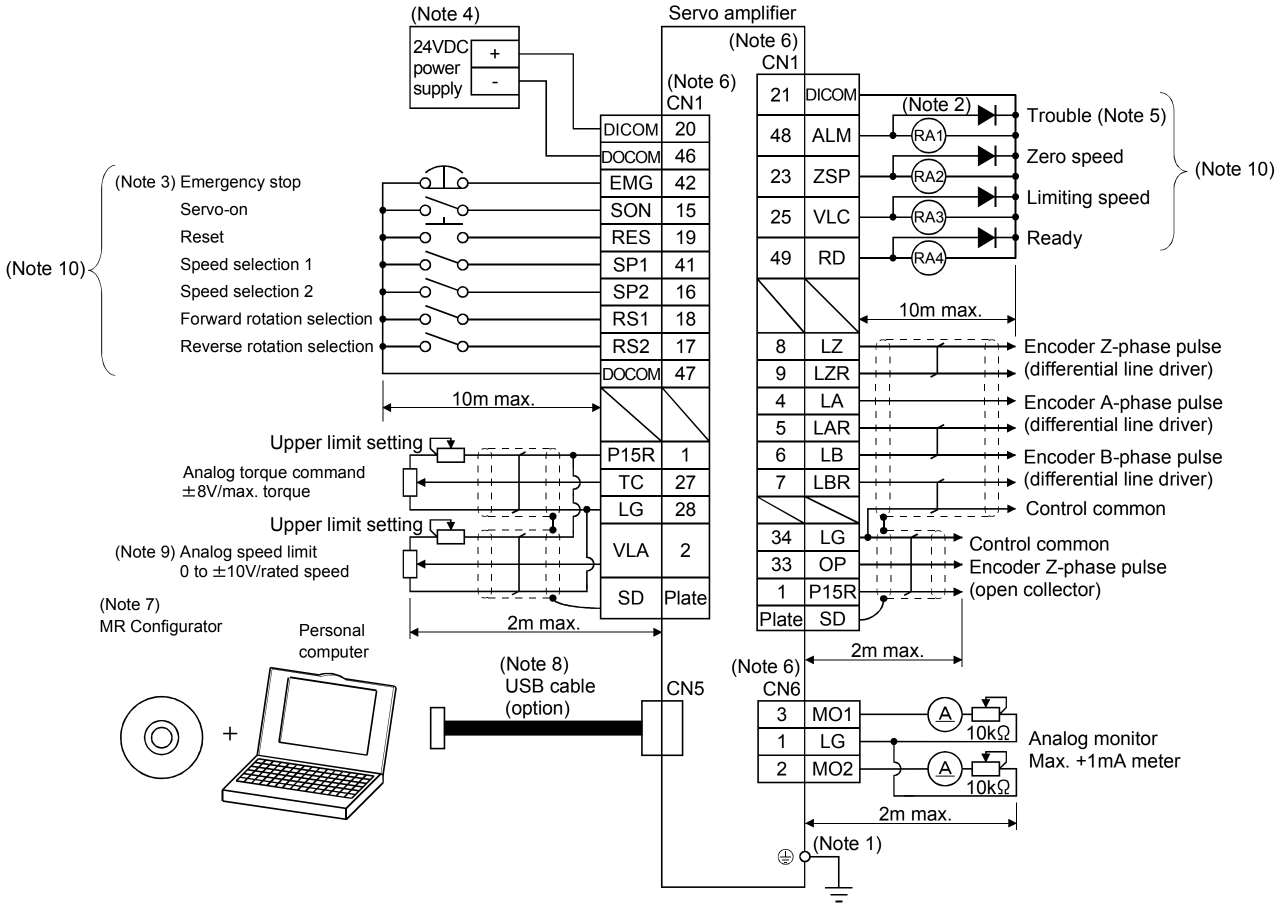


Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop (EMG) and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA 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.
5. When starting operation, always turn on emergency stop (EMG) and forward/reverse rotation stroke end (LSP/LSN). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition.
7. The pins with the same signal name are connected in the servo amplifier.
8. By setting parameters No.PD03 to PD08, PD09 to PD12 to make TL available, TLA can be used.
9. Use MRZJW3-SETUP 211E.
10. RS-422 can also be used to connect the servo amplifier and personal computer.



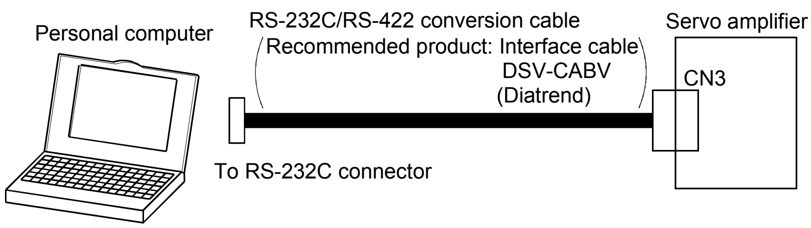
11. Use an external power supply when inputting a negative voltage.
12. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

3.2.3 Torque control mode



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

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 (EMG) and other protective circuits.
3. The emergency stop switch(normally closed contact) must be installed.
4. Supply 24VDC±10% 300mA current for interfaces from the outside. 300mA 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.
5. Trouble (ALM) turns on in normal alarm-free condition.
6. The pins with the same signal name are connected in the servo amplifier.
7. Use MRZJW3-SETUP 211E.
8. RS-422 can also be used to connect the servo amplifier and personal computer.



9. Use an external power supply when inputting a negative voltage.
10. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

3.3 Explanation of power supply system

3.3.1 Signal explanations

> **POINT**
>
> - For the layout of connector and terminal block, refer to outline drawings in chapter 10.

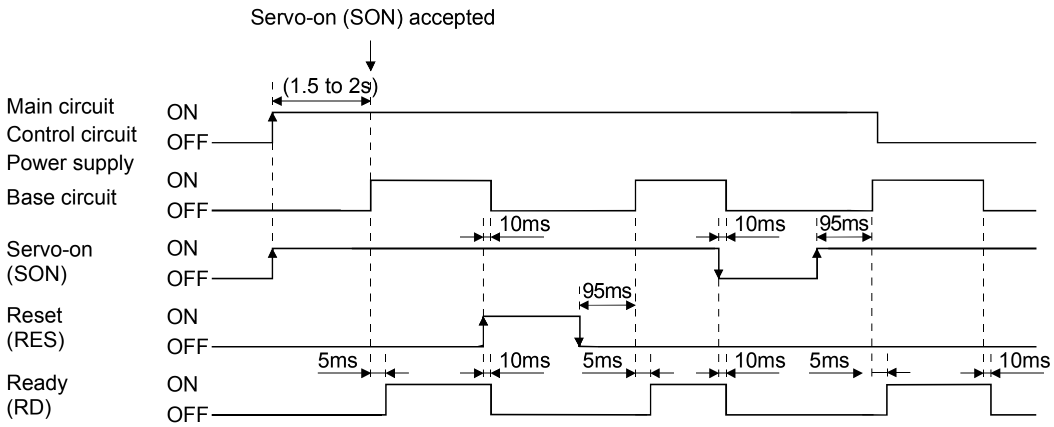
<table>
<tr><th>Abbreviation</th><th>Connection Target (Application)</th><th>Description</th></tr>
<tr><td>L_1
L_2
L_3</td><td>Main circuit power supply</td><td>Supply the following power to L_1, L_2, L_3. For the 1-phase 200V to 230VAC power supply, connect the power supply to L_1, L_2, and keep L_3 open.
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J3-10A to 70A</th><th>MR-J3-100A to 22KA</th><th>MR-J3-10A1 to 40A1</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-J3-60A4 to 22KA4</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-J3-700A or less
When not using the power factor improving DC reactor, connect P_1-P_2. (Factory-wired.)
When using the power factor improving DC reactor, disconnect the wiring across P_1-P_2 and connect the power factor improving DC reactor across P_1-P_2.
2) MR-J3-11KA(4) to 22KA(4)
MR-J3-11KA(4) to 22KA(4) do not have P_2 terminal.
When not using the power factor improving reactor, connect P_1-P. (Factory-wired)
When using the power factor improving reactor, connect it across P-P_1.
Refer to section 12.13.</td></tr>
<tr><td>P
C
D</td><td>Regenerative option</td><td>1) MR-J3-350A or less ・ MR-J3-200A4 or less
When using servo amplifier built-in regenerative resistor, connect between P-D terminals. (Wired by default)
When using regenerative option, disconnect between P-D terminals and connect regenerative option to P terminal and C terminal.
2) MR-J3-350A4 ・ 500A(4) ・ 700A(4)
MR-J3-350A4 ・ 500A(4) ・ 700A(4) do not have D terminal.
When using servo amplifier built-in regenerative resistor, connect P terminal and C terminal. (Wired by default)
When using regenerative option, disconnect P terminal and C terminal and connect regenerative option to P terminal and C terminal.
3) MR-J3-11KA(4) to 22KA(4)
MR-J3-11KA(4) to 22KA(4) do not have D terminal.
When not using the power supply return converter and the brake unit, make sure to connect the regenerative option to P terminal and C terminal.
Refer to section 12.2 to 12.5.</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-J3-10A to 22KA</th><th>MR-J3-10A1 to 40A1</th><th>MR-J3-60A4 to 22KA4</th></tr>
<tr><td>1-phase 200V to 230VAC, 50/60Hz</td><td>L_{11} ・ L_{21}</td><td></td><td></td></tr>
<tr><td>1-phase 100V to 120VAC, 50/60Hz</td><td></td><td>L_{11} ・ L_{21}</td><td></td></tr>
<tr><td>1-phase 380V to 480VAC, 50/60Hz</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). During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.</td></tr>
<tr><td>N</td><td>Return converter
Brake unit</td><td>When using return converter/brake unit, connect to P terminal and N terminal.
Do not connect to servo amplifier MR-J3-350A or less.
For details, refer to section 12.3 to 12.5.</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 control box to perform grounding.</td></tr>
</table>

3.3.2 Power-on sequence

(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 (three-phase: L_1, L_2, L_3, single-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 (SON) about 1 to 2s after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the main circuit power supply, the base circuit will switch on in about 1 to 2s, and the ready (RD) will switch on in further about 5ms, making the servo amplifier ready to operate. (Refer to paragraph (2) of this section.)
4) When the reset (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart

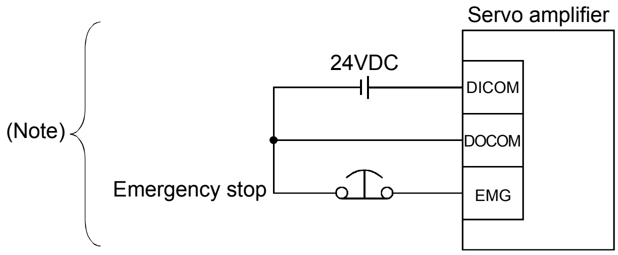


Power-on timing chart

(3) Emergency stop

CAUTION	• Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.

Make up a circuit that shuts off main circuit power as soon as EMG is turned off at an emergency stop. When EMG is turned off, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (AL.E6).
During ordinary operation, do not use the external emergency stop (EMG) to alternate stop and run.
The servo amplifier life may be shortened.
Also, if the forward rotation start (ST1) and reverse rotation start (ST2) are on or a pulse train is input during an emergency stop, the servo motor will rotate as soon as the warning is reset. During an emergency stop, always shut off the run command.



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

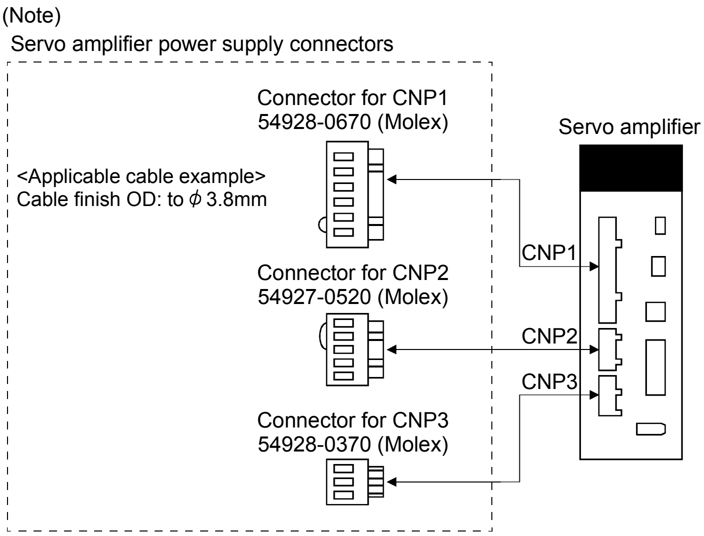
3.3.3 CNP1, CNP2, CNP3 wiring method

POINT
· Refer to Table 12.1 in section 12.11 for the wire sizes used for wiring. · MR-J3-500A or more does not have these connectors.

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

(1) MR-J3-100A or less

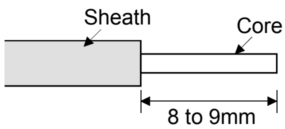
(a) Servo amplifier power supply connectors



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.



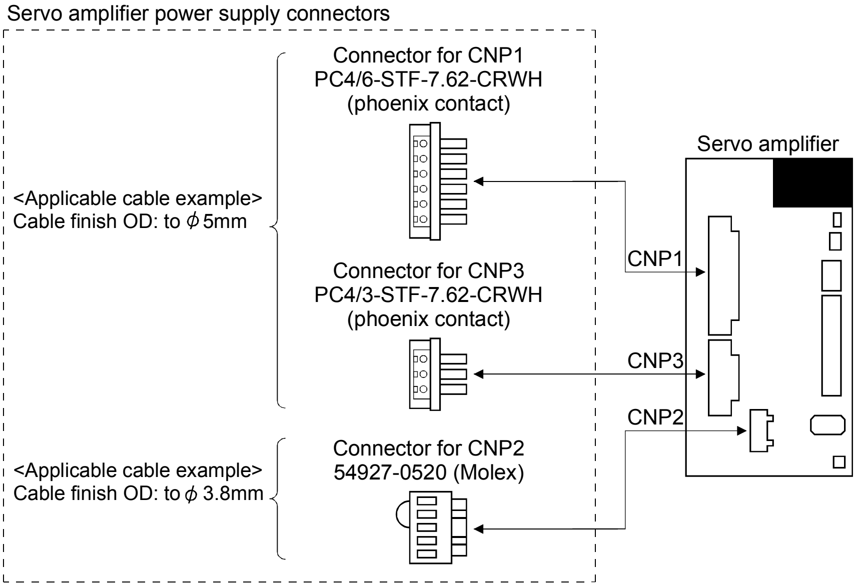
Twisted wire: Use the cable after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a bar terminal may be used to put the wires together.

Cable size		Bar terminal type		Crimping tool (Note 2)
[mm^2]	AWG	For 1 cable (Note 1)	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. Maker: Phoenix Contact
2. Maker: WAGO Japan

(2) MR-J3-200A・MR-J3-350A

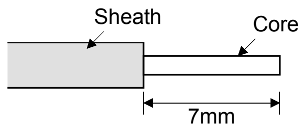
(a) Servo amplifier power supply connectors



(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 and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a bar terminal may be used to put the wires together.

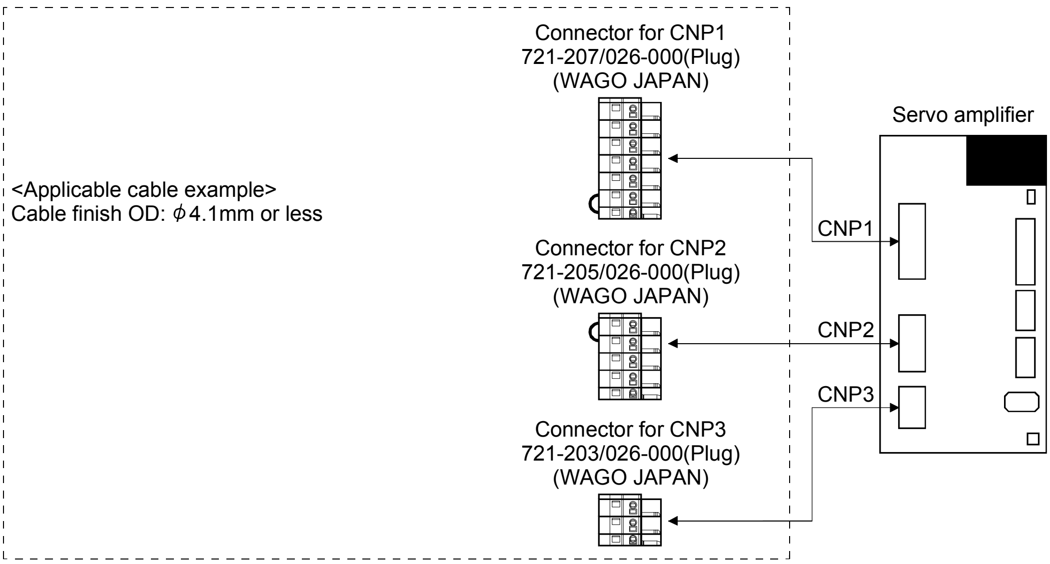
Cable size		Bar terminal type		Crimping tool	Maker
[mm^2]	AWG	For 1 cable	For 2 cables		
1.25/1.5	16	AI1.5-8BK	AI-TWIN2 × 1.5-8BK	CRIMPFOX-ZA3	Phoenix Contact
2.0/2.5	14	AI2.5-8BU	AI-TWIN2 × 2.5-10BU		
3.5	12	AI4-10GY			

2) CNP2

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

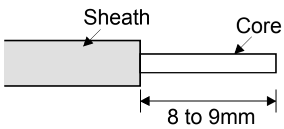
(3) MR-J3-200A4・MR-J3-350A4

(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 and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a bar terminal may be used to put the wires together.

Cable size		Bar terminal type		Crimping tool (Note 2)
[mm^2]	AWG	For 1 cable (Note 1)	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 JAPAN

(4) Insertion of cable into Molex and WAGO JAPAN connectors

Insertion of cable into 54928-0610, 54927-0510, 54928 (Molex) connectors and 721-207/026-000, 721-205/026-000 and 721-203/026-000 (WAGO JAPAN) connectors are as follows.

The following explains for Molex, however use the same procedures for inserting WAGO JAPAN connectors as well.

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

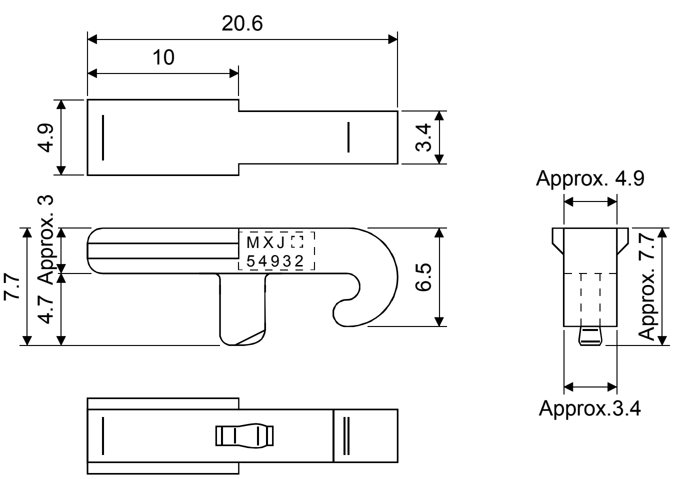
How to connect a cable to the servo amplifier power supply connector is shown below.

(a) When using the supplied cable connection lever

1) The servo amplifier is packed with the cable connection lever.

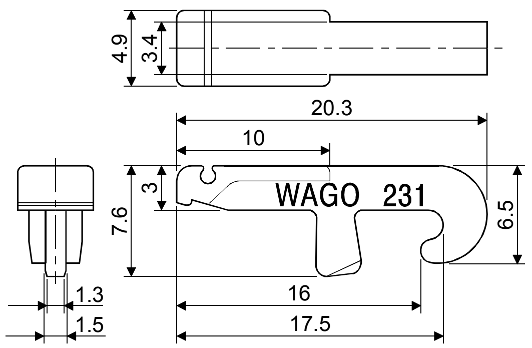
a) 54932-0000 (Molex)

[Unit: mm]

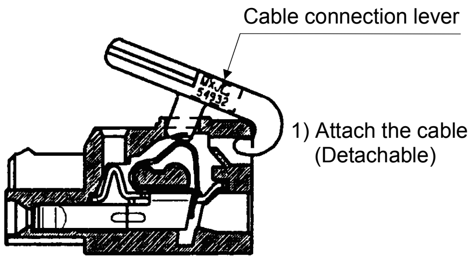


b) 231-131 (WAGO JAPAN)

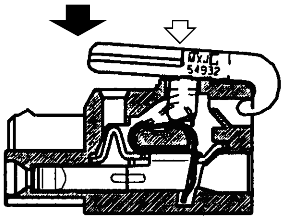
[Unit: mm]



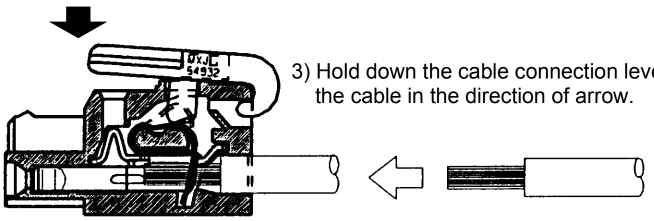
2) Cable connection procedure



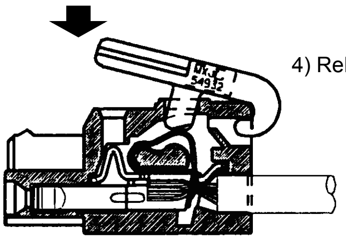
1) Attach the cable connection lever to the housing.
(Detachable)



2) Push the cable connection lever in the direction of arrow.



3) Hold down the cable connection lever and insert the cable in the direction of arrow.



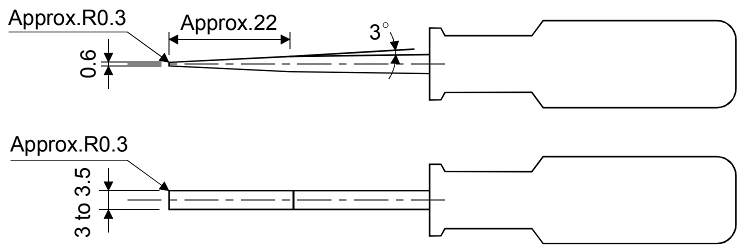
4) Release the cable connection lever.

(b) Inserting the cable into the connector

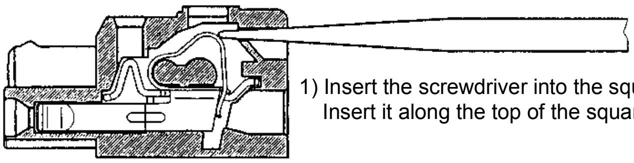
1) Applicable flat-blade screwdriver dimensions

Always use the screwdriver shown here to do the work.

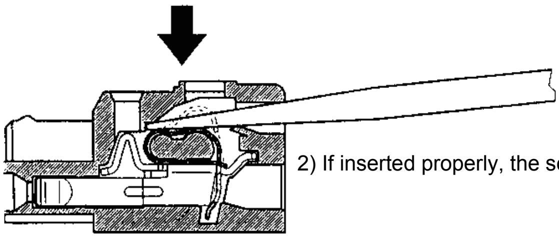
[Unit: mm]



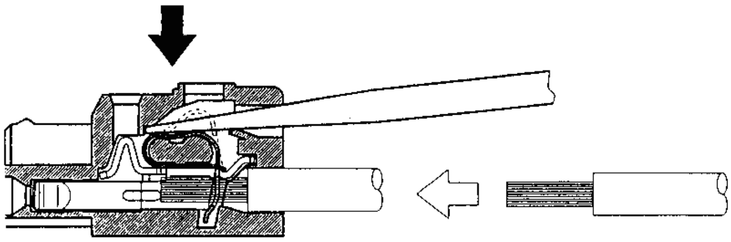
2) When using the flat-blade screwdriver - part 1



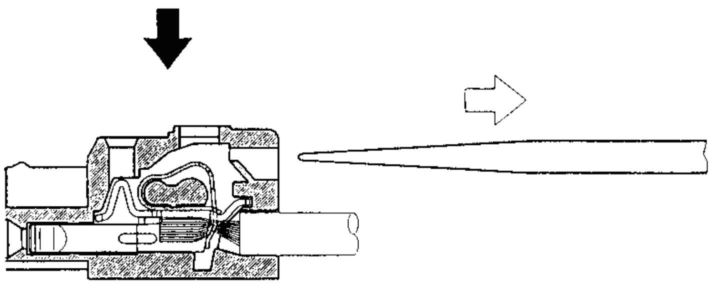
1) Insert the screwdriver into the square hole.
Insert it along the top of the square hole to insert it smoothly.



2) If inserted properly, the screwdriver is held.

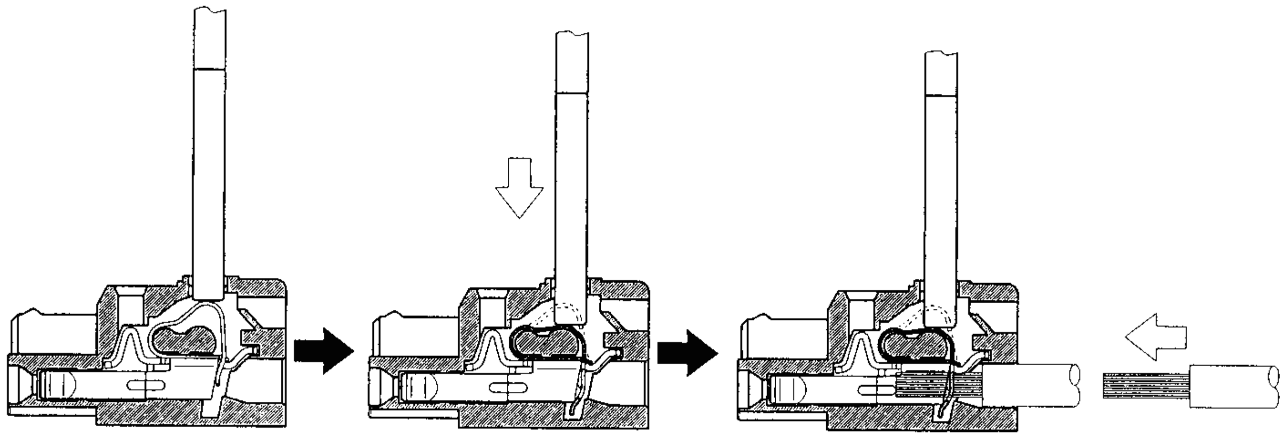


3) With the screwdriver held, insert the cable in the direction of arrow. (Insert the cable as far as it will go.)



4) Releasing the screwdriver connects the cable.

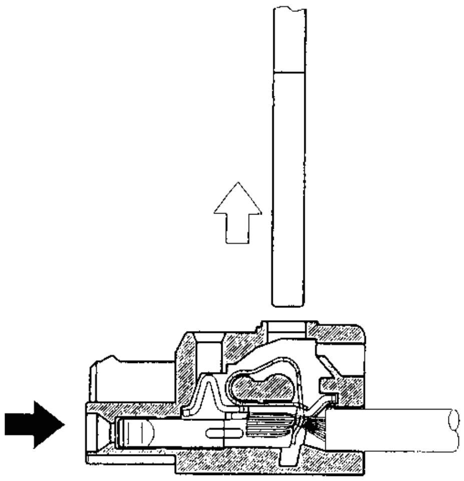
3) When using the flat-blade screwdriver - part 2



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.)

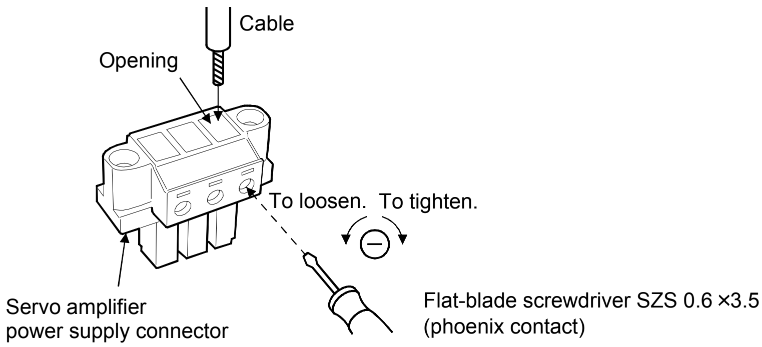


4) Releasing the screwdriver connects the cable.

(5) How to insert the cable into PC4/6-STF-7.62-CRWH or PC4/3-STF-7.62-CRWH connector

Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver so that the cable does not come off. (Tightening torque: 0.5 to 0.6N m(4.425 to 5.31 lb in)) Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose.

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

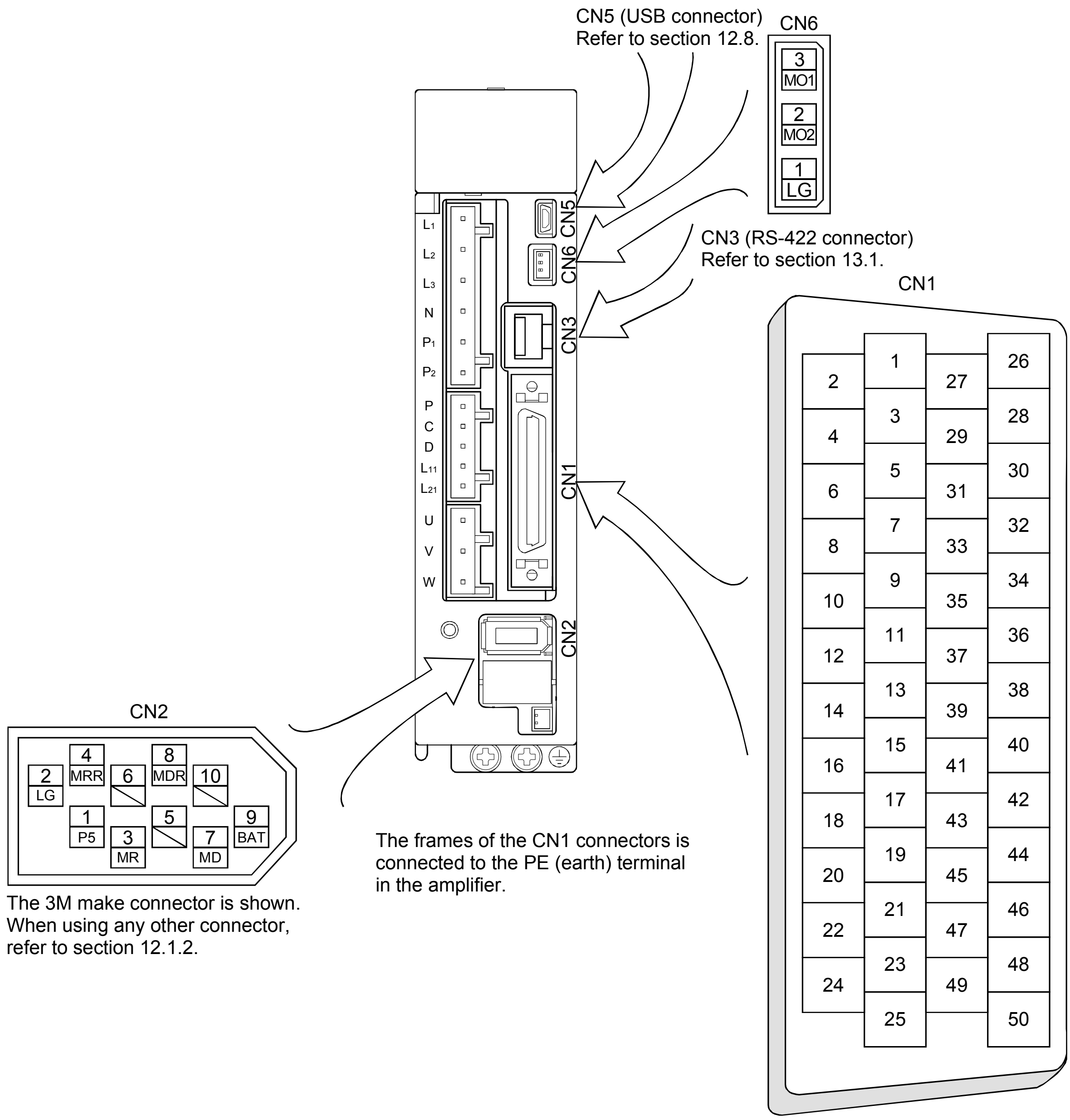


3.4 Connectors and signal arrangements

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section. ・Refer to (2) of this section for CN1 signal assignment.

(1) Signal arrangement

The servo amplifier front view shown is that of the MR-J3-20A or less. Refer to chapter 10 Outline Drawings for the appearances and connector layouts of the other servo amplifiers.



(2) CN1 signal assignment

The signal assignment of connector changes with the control mode as indicated below;

For the pins which are given parameter No.s in the related parameter column, their signals can be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O Signals in Control Modes						Related Parameter No.
		P	P/S	S	S/T	T	T/P	
1		P15R	P15R	P15R	P15R	P15R	P15R	
2	I		−/VC	VC	VC/VLA	VLA	VLA/−	
3		LG	LG	LG	LG	LG	LG	
4	O	LA	LA	LA	LA	LA	LA	
5	O	LAR	LAR	LAR	LAR	LAR	LAR	
6	O	LB	LB	LB	LB	LB	LB	
7	O	LBR	LBR	LBR	LBR	LBR	LBR	
8	O	LZ	LZ	LZ	LZ	LZ	LZ	
9	O	LZR	LZR	LZR	LZR	LZR	LZR	
10	I	PP	PP/−				−/PP	
11	I	PG	PG/−				−/PG	
12		OPC	OPC/−				−/OPC	
13								
14								
15	I	SON	SON	SON	SON	SON	SON	PD03
16	I		−/SP2	SP2	SP2/SP2	SP2	SP2/−	PD04
17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	PD05
18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	PD06
19	I	RES	RES	RES	RES	RES	RES	PD07
20		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
21		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
22	O	INP	INP/SA	SA	SA/−		−/INP	PD13
23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	PD14
24	O	INP	INP/SA	SA	SA/−		−/INP	PD15
25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	PD16
26								
27	I	TLA	(Note 3) TLA	(Note 3) TLA	(Note 3) TLA/TC	TC	TC/TLA	
28		LG	LG	LG	LG	LG	LG	
29								
30		LG	LG	LG	LG	LG	LG	
31								
32								
33	O	OP	OP	OP	OP	OP	OP	
34		LG	LG	LG	LG	LG	LG	
35	I	NP	NP/−				−/NP	
36	I	NG	NG/−				−/NG	
37								
38								
39								
40								
41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD08
42	I	EMG	EMG	EMG	EMG	EMG	EMG	
43	I	LSP	LSP	LSP	LSP/−		−/LSP	PD10
44	I	LSN	LSN	LSN	LSN/−		−/LSN	PD11
45	I	LOP	LOP	LOP	LOP	LOP	LOP	PD12

Pin No.	(Note 1) I/O	(Note 2) I/O Signals in Control Modes						Related Parameter No.
		P	P/S	S	S/T	T	T/P	
46		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
47		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
48	O	ALM	ALM	ALM	ALM	ALM	ALM	
49	O	RD	RD	RD	RD	RD	RD	PD18
50								

Note 1. I: Input signal, O: Output signal

2. P: Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control changeover mode, S/T: Speed/torque control changeover mode, T/P: Torque/position control changeover mode

3. TLA can be used when TL is made usable by setting the parameter No. PD03 to PD08/PD10 to PD12.

(3) Explanation of abbreviations

Abbreviation	Signal Name	Abbreviation	Signal Name
SON	Servo-on	TLC	Limiting torque
LSP	Forward rotation stroke end	VLC	Limiting speed
LSN	Reverse rotation stroke end	RD	Ready
CR	Clear	ZSP	Zero speed
SP1	Speed selection 1	INP	In-position
SP2	Speed selection 2	SA	Speed reached
PC	Proportion control	ALM	Trouble
ST1	Forward rotation start	WNG	Warning
ST2	Reverse rotation start	BWNG	Battery warning
TL	Torque limit selection	OP	Encoder Z-phase pulse (open collector)
RES	Reset	MBR	Electromagnetic brake interlock
EMG	Emergency stop	LZ	Encoder Z-phase pulse (differential line driver)
LOP	Control selection	LZR	
VC	Analog speed command	LA	Encoder A-phase pulse (differential line driver)
VLA	Analog speed limit	LAR	
TLA	Analog torque limit	LB	Encoder B-phase pulse (differential line driver)
TC	Analog torque command	LBR	
RS1	Forward rotation selection	DICOM	Digital I/F power supply input
RS2	Reverse rotation selection	OPC	Open collector power input
PP	Forward/reverse rotation pulse train	DOCOM	Digital I/F common
NP		P15R	15VDC power supply
PG		LG	Control common
NG		SD	Shield

3.5 Signal explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
In the control mode field of the table
P : Position control mode, S: Speed control mode, T: Torque control mode
○ : Denotes that the signal may be used in the initial setting status.
△ : Denotes that the signal may be used by setting the corresponding parameter No. PD03 to PD08, PD10 to PD12, PD13 to PD16, PD18.
The pin No.s in the connector pin No. column are those in the initial status.

(1) I/O devices

(a) Input devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-15</td><td>Turn SON on to power on the base circuit and make the servo amplifier ready to operate (servo-on).
Turn it off to shut off the base circuit and coast the servo motor.
Set " □□□4 " in parameter No. PD01 to switch this signal on (keep terminals connected) automatically in the servo amplifier.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1-19</td><td>Turn RES on for more than 50ms to reset the alarm.
Some alarms cannot be deactivated by the reset (RES). Refer to section 9.1.
Turning RES on in an alarm-free status shuts off the base circuit.
The base circuit is not shut off when " □□1□ " is set in parameter No. PD20.
This signal is not designed to make a stop. Do not turn it ON during operation.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1-43</td><td rowspan="2">To start operation, turn LSP/LSN on. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Set " □□□1 " in parameter No. PD20 to make a slow stop.
(Refer to section 5.4.3.)
<table>
<tr><th colspan="2">(Note) Input signals</th><th colspan="2">Operation</th></tr>
<tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr>
<tr><td>1</td><td>1</td><td>○</td><td>○</td></tr>
<tr><td>0</td><td>1</td><td></td><td>○</td></tr>
<tr><td>1</td><td>0</td><td>○</td><td></td></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
</table>
Note. 0: off
1: on
Set parameter No. PD01 as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier:
<table>
<tr><th rowspan="2">Parameter No. PD01</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>□4□□</td><td>Automatic ON</td><td></td></tr>
<tr><td>□8□□</td><td></td><td>Automatic ON</td></tr>
<tr><td>□C□□</td><td>Automatic ON</td><td>Automatic ON</td></tr>
</table>
When LPS or LSN turns OFF, an external stroke limit warning (AL. 99) occurs, and Warning (WNG) turns OFF. However, when using WNG, set the parameter No. PD13 to PD16/PD18 to make it usable.</td><td rowspan="2">DI-1</td><td rowspan="2">○</td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1-44</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>External torque limit selection</td><td>TL</td><td>CN1-18</td><td>Turn TL off to make Forward torque limit (parameter No. PA11) and Reverse torque limit (parameter No. PA12) valid, or turn it on to make Analog torque limit (TLA) valid.
For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>When using this signal, make it usable by making the setting of parameter No. PD03 to PD08, PD10 to PD12.
For details, refer to section 3.6.1 (5).</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td>CN1-17</td><td rowspan="2">Used to start the servo motor in any of the following directions:
<table>
<tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Servo motor starting direction</th></tr>
<tr><th>ST2</th><th>ST1</th></tr>
<tr><td>0</td><td>0</td><td>Stop (servo lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop (servo lock)</td></tr>
</table>
Note. 0: off
1: on
If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the parameter No. PC02 setting and servo-locked.
When "□□□1" is set in parameter No. PC23, the servo motor is not servo-locked after deceleration to a stop.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td>CN1-18</td></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td>CN1-18</td><td rowspan="2">Used to select any of the following servo motor torque generation directions:
<table>
<tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Torque generation direction</th></tr>
<tr><th>RS2</th><th>RS1</th></tr>
<tr><td>0</td><td>0</td><td>Torque is not generated.</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation in driving mode / reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in driving mode / forward rotation in regenerative mode</td></tr>
<tr><td>1</td><td>1</td><td>Torque is not generated.</td></tr>
</table>
Note. 0: off
1: on</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">○</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td>CN1-17</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-
tor pin
No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O
division</th><th colspan="3">Control
mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td>CN1-41</td><td rowspan="3"><Speed control mode>
Used to select the command speed for operation.
When using SP3, make it usable by making the setting of parameter No. PD03 to PD08, PD10 to PD12.
<table>
<tr><th colspan="3">(Note) Input signals</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed command 1 (parameter No. PC05)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. PC06)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No. PC07)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed command 4 (parameter No. PC08)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed command 5 (parameter No. PC09)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed command 6 (parameter No. PC10)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed command 7 (parameter No. PC11)</td></tr>
</table>
Note. 0: off
1: on

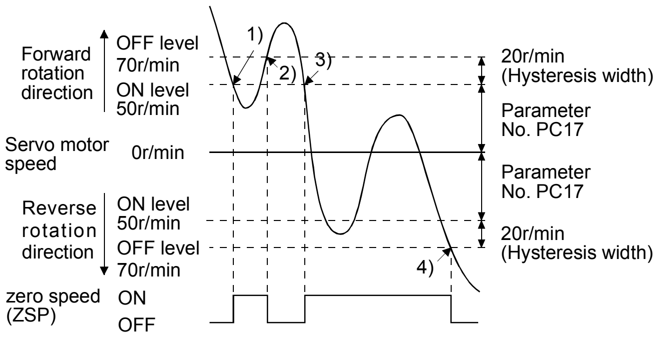
<Torque control mode>
Used to select the limit speed for operation.
When using SP3, make it usable by making the setting of parameter No. PD03 to PD08, PD10 to PD12.
<table>
<tr><th colspan="3">(Note) Input signals</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed limit 1 (parameter No. PC05)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed limit 2 (parameter No. PC06)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed limit 3 (parameter No. PC07)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed limit 4 (parameter No. PC08)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed limit 5 (parameter No. PC09)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed limit 6 (parameter No. PC10)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed limit 7 (parameter No. PC11)</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td>CN1-16</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 3</td><td>SP3</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-
tor pin
No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O
division</th><th colspan="3">Control
mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Proportion control</td><td>PC</td><td>CN1-17</td><td>Turn PC on to switch the speed amplifier from the proportional integral type to the proportional type.
If the servo motor at a stop is rotated even one pulse due to any external factor, it generates torque to compensate for a position shift. When the servo motor shaft is to be locked mechanically after positioning completion (stop), switching on the proportion control (PC) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.
When the shaft is to be locked for a long time, switch on the proportion control (PC) and torque control (TL) at the same time to make the torque less than the rated by the analog torque limit.</td><td>DI-1</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Emergency stop</td><td>EMG</td><td>CN1-42</td><td>Turn EMG off (open between commons) to bring the motor to an emergency stop state, in which the base circuit is shut off and the dynamic brake is operated.□Turn EMG on (short between commons) in the emergency stop state to reset that state.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1-41</td><td>Turn CR on to clear the position control counter droop pulses on its leading edge. The pulse width should be 10ms or more.
The delay amount set in parameter No. PB03 (position command acceleration/deceleration time constant) is also cleared.□When the parameter No. PD22 setting is "□□□1", the pulses are always cleared while CR is on.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 1</td><td>CM1</td><td></td><td rowspan="2">When using CM1 and CM2, make them usable by the setting of parameters No. PD03 to PD08, PD10 to PD12.
The combination of CM1 and CM2 gives you a choice of four different electronic gear numerators set in the parameters.
CM1 and CM2 cannot be used in the absolute position detection system.
<table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Electronic gear molecule</th></tr><tr><th>CM2</th><th>CM1</th></tr><tr><td>0</td><td>0</td><td>Parameter No. PA06</td></tr><tr><td>0</td><td>1</td><td>Parameter No. PC32</td></tr><tr><td>1</td><td>0</td><td>Parameter No. PC33</td></tr><tr><td>1</td><td>1</td><td>Parameter No. PC34</td></tr></table>Note. 0: off
1: on</td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Electronic gear selection 2</td><td>CM2</td><td></td><td>DI-1</td><td>△</td><td></td><td></td></tr>
<tr><td>Gain changing</td><td>CDP</td><td></td><td>When using this signal, make it usable by the setting of parameter No. PD03 to PD08, PD10 to PD12.
Turn CDP on to change the load inertia moment ratio and gain values into the parameter No. PB29 to PB32 values.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Control change</td><td>LOP</td><td>CN1-45</td><td><Position/speed control change mode>
Used to select the control mode in the position/speed control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Position</td></tr><tr><td>1</td><td>Speed</td></tr></table>Note. 0: off
1: on
<Speed/torque control change mode>
Used to select the control mode in the speed/torque control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Speed</td></tr><tr><td>1</td><td>Torque</td></tr></table>Note. 0: off
1: on
<Torque/position control mode>
Used to select the control mode in the torque/position control change mode.
<table><tr><th>(Note) LOP</th><th>Control mode</th></tr><tr><td>0</td><td>Torque</td></tr><tr><td>1</td><td>Position</td></tr></table>Note. 0: off
1: on</td><td>DI-1</td><td colspan="3">Refer to Functions/ Appli-cations.</td></tr>
<tr><td>Second acceleration/deceleration selection</td><td>STAB2</td><td></td><td>When using this signal, set the parameter No. PD03 to PD08/PD10 to PD12 to make it usable.
This signal allows selection of the acceleration/deceleration time constant at servo motor rotation in the speed control mode or torque control mode. The S-pattern acceleration/deceleration time constant is always uniform.
<table><tr><th>(Note) STAB2</th><th>Acceleration/deceleration time constant</th></tr><tr><td>0</td><td>Acceleration time constant
(parameter No. PC10)
Deceleration time constant
(parameter No. PC11)</td></tr><tr><td>1</td><td>Acceleration time constant 2
(parameter No. PC30)
Deceleration time constant 2
(parameter No. PC31)</td></tr></table>Note. 0: off
1: on</td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>ABS transfer mode</td><td>ABSM</td><td>CN1-17</td><td>ABS transfer mode request device.
The CN1-17 pin acts as ABSM only during absolute position data transfer. (Refer to chapter 14.)</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS request</td><td>ABSR</td><td>CN1-18</td><td>ABS request device.
The CN1-18 pin acts as ABSR only during absolute position data transfer. (Refer to chapter 14.)</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
</table>

(b) Output devices

Device	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Trouble	ALM	CN1-48	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 1.5s after power-on.	DO-1	○	○	○
Dynamic brake interlock	DB		When using the signal, make it usable by the setting of parameter No.PD13 to PD18. DB turns off simultaneously when the dynamic brake is operated. When using the external dynamic brake on the servo amplifier of 11 kW or more, this device is required. (Refer to section 12.6) For the servo amplifier of 7kw or less, it is not necessary to use this device.	DO-1	○	○	○
Ready	RD	CN1-49	RD turns on when the servo is switched on and the servo amplifier is ready to operate.	DO-1	○	○	○
In position	INP	CN1-24	INP turns on when the number of droop pulses 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, may be kept connected during low-speed rotation. INP turns on when servo on turns on.	DO-1	○		
Speed reached	SA		SA turns off when servo on (SON) turns off or the servomotor speed has not reached the preset speed with both forward rotation start (ST1) and reverse rotation start (ST2) turned off. SA turns on when the servomotor speed has nearly reached the preset speed. When the preset speed is 20r/min or less, SA always turns on.	DO-1		○	
Limiting speed	VLC	CN1-25	VLC turns on when speed reaches the value limited using any of the internal speed limits 1 to 7 (parameter No. PC05 to PC11) or the analog speed limit (VLA) in the torque control mode. VLC turns off when servo on (SON) turns off.	DO-1			○
Limiting torque	TLC		TLC turns on when the torque generated reaches the value set to the Forward torque limit (parameter No. PA11), Reverse torque limit (parameter No. PA12) or analog torque limit (TLA).	DO-1	○	○	

Device	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Zero speed	ZSP	CN1-23	ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No. PC17. 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-A servo amplifier.	DO-1	○	○	○
Electromagnetic brake interlock	MBR		Set the parameter No. PD13 to PD16/PD18 or parameter No. PA04 to make this signal usable. Note that ZSP will be unusable. MBR turns off when the servo is switched off or an alarm occurs.	DO-1	△	△	△
Warning	WNG		To use this signal, assign the connector pin for output using parameter No. PD13 to PD16, PD18. The old signal before assignment will be unusable. 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		To use this signal, assign the connector pin for output using parameter No. PD13 to PD16, PD18. The old signal before assignment will be unusable. BWNG turns on when battery cable breakage warning (AL. 92) or battery warning (AL. 9F) has occurred. When there is no battery warning, BWNG turns off within about 1.5s after power-on.	DO-1	△	△	△

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td rowspan="3">Alarm code</td><td>ACD 0</td><td>CN1-24</td><td rowspan="3">To use this signal, set "□□□1 " in parameter No. PD24.
This signal is output when an alarm occurs. When there is no alarm, respective ordinary signals (RD, INP, SA, ZSP) are output.
Alarm codes and alarm names are listed below:
<table>
<tr><th colspan="3">(Note) Alarm code</th><th rowspan="2">Alarm display</th><th rowspan="2">Name</th></tr>
<tr><th>CN1-22</th><th>CN1-23</th><th>CN1-24</th></tr>
<tr><td rowspan="9">0</td><td rowspan="9">0</td><td rowspan="9">0</td><td>88888</td><td>Watchdog</td></tr>
<tr><td>AL.12</td><td>Memory error 1</td></tr>
<tr><td>AL.13</td><td>Clock error</td></tr>
<tr><td>AL.15</td><td>Memory error 2</td></tr>
<tr><td>AL.17</td><td>Board error</td></tr>
<tr><td>AL.19</td><td>Memory error 3</td></tr>
<tr><td>AL.37</td><td>Parameter error</td></tr>
<tr><td>AL.8A</td><td>Serial communication timeout</td></tr>
<tr><td>AL.8E</td><td>Serial communication error</td></tr>
<tr><td rowspan="2">0</td><td rowspan="2">0</td><td rowspan="2">1</td><td>AL.30</td><td>Regenerative error</td></tr>
<tr><td>AL.33</td><td>Overvoltage</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>AL.10</td><td>Undervoltage</td></tr>
<tr><td rowspan="5">0</td><td rowspan="5">1</td><td rowspan="5">1</td><td>AL.45</td><td>Main circuit device overheat</td></tr>
<tr><td>AL.46</td><td>Servo motor overheat</td></tr>
<tr><td>AL.47</td><td>Cooling fan alarm</td></tr>
<tr><td>AL.50</td><td>Overload 1</td></tr>
<tr><td>AL.51</td><td>Overload 2</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">0</td><td rowspan="2">0</td><td>AL.24</td><td>Main circuit error</td></tr>
<tr><td>AL.32</td><td>Overcurrent</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">0</td><td rowspan="3">1</td><td>AL.31</td><td>Overspeed</td></tr>
<tr><td>AL.35</td><td>Command pulse frequency alarm</td></tr>
<tr><td>AL.52</td><td>Error excessive</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">1</td><td rowspan="4">0</td><td>AL.16</td><td>Encoder error 1</td></tr>
<tr><td>AL.1A</td><td>Monitor combination error</td></tr>
<tr><td>AL.20</td><td>Encoder error 2</td></tr>
<tr><td>AL.25</td><td>Absolute position erase</td></tr>
</table>
Note. 0: off
1: on</td><td rowspan="3">DO-1</td><td rowspan="3">△</td><td rowspan="3">△</td><td rowspan="3">△</td></tr>
<tr><td>ACD 1</td><td>CN1-23</td></tr>
<tr><td>ACD 2</td><td>CN1-22</td></tr>
<tr><td>Variable gain selection</td><td>CDPS</td><td></td><td>CDPS is on during gain changing.</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Absolute position erasing</td><td>ABSV</td><td></td><td>ABSV turns on when the absolute position is erased.</td><td>DO-1</td><td>△</td><td></td><td></td></tr>
<tr><td>ABS transmission data bit 0</td><td>ABSB0</td><td>CN1-22</td><td>Outputs ABS transmission data bit 0. CN1-22 acts as ABSB0 only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS transmission data bit 1</td><td>ABSB1</td><td>CN1-23</td><td>Outputs ABS transmission data bit 1. CN1-23 acts as ABSB1 only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
<tr><td>ABS transmission data ready</td><td>ABST</td><td>CN1-25</td><td>Outputs ABS transmission data ready. CN1-25 acts as ABST only during ABS transmission data transmission. (Refer to chapter 14.)</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
</table>

(2) Input signals

Signal	Symbol	Connec-tor pin No.	Functions/Applications	I/O division	Control mode		
					P	S	T
Analog torque limit	TLA	CN1-27	To use this signal in the speed control mode, set any of parameters No. PD13 to PD16, PD18 to make TL available. When the analog torque limit (TLA) is valid, torque is limited in the full servo motor output torque range. Apply 0 to +10VDC across TLA-LG. Connect the positive terminal of the power supply to TLA. Maximum torque is generated at +10V. (Refer to section 3.6.1 (5).) Resolution:10bit	Analog input	○	△	
Analog torque command	TC		Used to control torque in the full servo motor output torque range. Apply 0 to ±8VDC across TC-LG. Maximum torque is generated at ±8V. (Refer to section 3.6.3 (1).) The torque at ±8V input can be changed using parameter No. PC13.	Analog input			○
Analog speed command	VC	CN1-2	Apply 0 to ±10VDC across VC-LG. Speed set in parameter No. PC12 is provided at ±10V. (Refer to section 3.6.2 (1).) Resolution:14bit or equivalent	Analog input		○	
Analog speed limit	VLA		Apply 0 to +10VDC across VLA-LG. Speed set in parameter No. PC12 is provided at +10V (Refer to section 3.6.3 (3).).	Analog input			○
Forward rotation pulse train Reverse rotation pulse train	PP NP PG NG	CN1-10 CN1-35 CN1-11 CN1-36	Used to enter a command pulse train. ・In the open collector system (max. input frequency 200kpps): Forward rotation pulse train across PP-DOCOM Reverse rotation pulse train across NP-DOCOM ・In the differential receiver system (max. input frequency 1Mpps): Forward rotation pulse train across PG-PP Reverse rotation pulse train across NG-NP The command pulse train form can be changed using parameter No. PA13.	DI-2	○		

(3) Output signals

Signal	Symbol	Connect or pin No.	Functions/Applications	I/O division	Control mode		
					P	S	T
Encoder Z-phase pulse (Open collector)	OP	CN1-33	Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP 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.	DO-2	○	○	○
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1-4 CN1-5	Outputs pulses per servo motor revolution set in parameter No. PA15 in the differential line driver system. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of π/2. The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. PC19.	DO-2	○	○	○
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1-6 CN1-7					
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1-8 CN1-9	The same signal as OP is output in the differential line driver system.	DO-2	○	○	○
Analog monitor 1	MO1	CN6-3	Used to output the data set in parameter No. PC14 to across MO1-LG in terms of voltage. Resolution 10 bits	Analog output	○	○	○
Analog monitor 2	MO2	CN6-2	Used to output the data set in parameter No. PC15 to across MO2-LG in terms of voltage. Resolution 10 bits	Analog output	○	○	○

(4) Communication

POINT

・Refer to chapter 13 for the communication function.

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
RS-422 I/F	SDP SDN RDP RDN	CN3-5 CN3-4 CN3-3 CN3-6	Terminals for RS-422 communication. (Refer to chapter 13.)		○	○	○

(5) Power supply

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Digital I/F power supply input	DICOM	CN1-20 CN1-21	Used to input 24VDC (300mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. Connect the positive terminal of the 24VDC external power supply. 24VDC±10%		○	○	○
Open collector power input	OPC	CN1-12	When inputting a pulse train in the open collector system, supply this terminal with the positive (+) power of 24VDC.		○	○	○
Digital I/F common	DOCOM	CN1-46 CN1-47	Common terminal for input signals such as SON and EMG. Pins are connected internally. Separated from LG.		○	○	○
15VDC power supply	P15R	CN1-1	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA		○	○	○
Control common	LG	CN1-3 CN1-28 CN1-30 CN1-34 CN3-1 CN3-7 CN6-1	Common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2 and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shield cable.		○	○	○

3.6 Detailed description of the signals

3.6.1 Position control mode

(1) Pulse train input

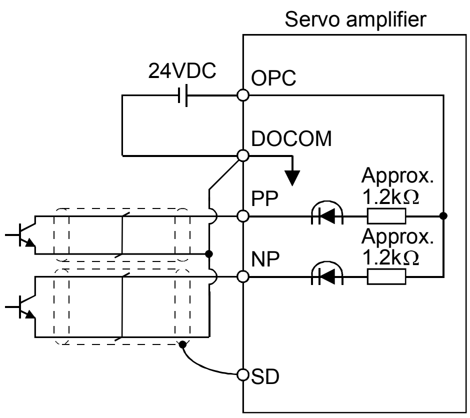
(a) Input pulse waveform selection

Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command pulse train form in parameter No. PA13. Refer to section 5.1.10 for details.

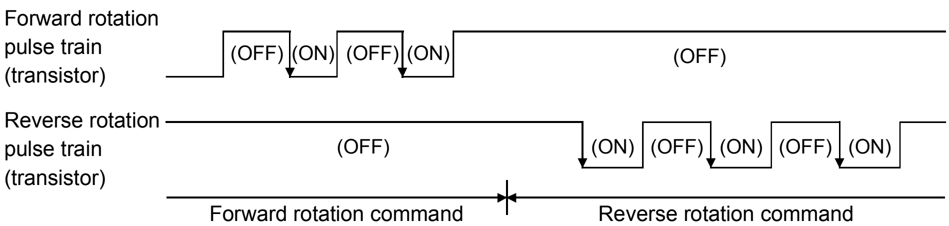
(b) Connections and waveforms

1) Open collector system

Connect as shown below:

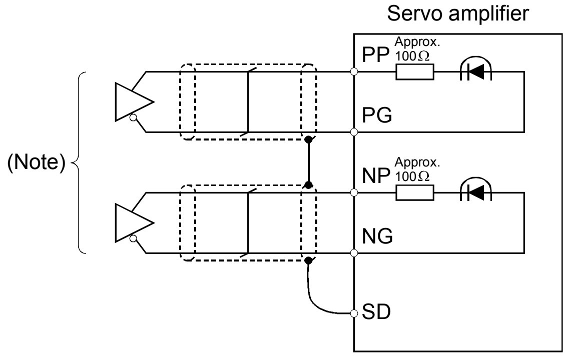


The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No. PA13 has been set to 0010). Their relationships with transistor ON/OFF are as follows:



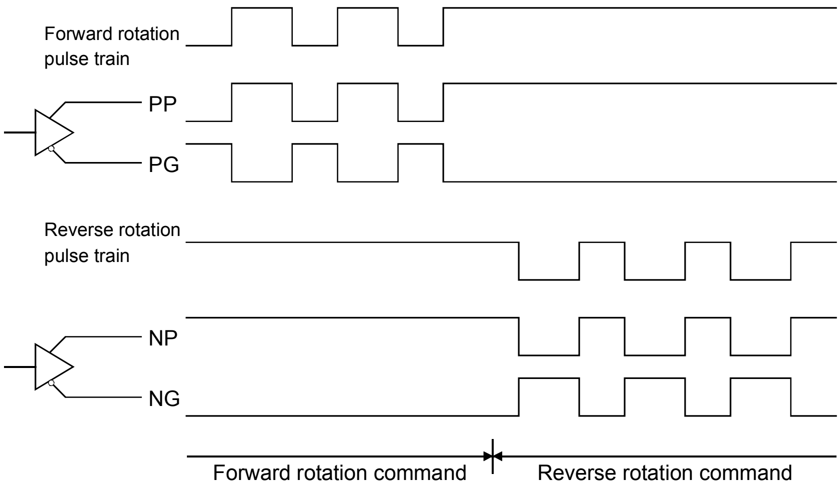
2) Differential line driver system

Connect as shown below:



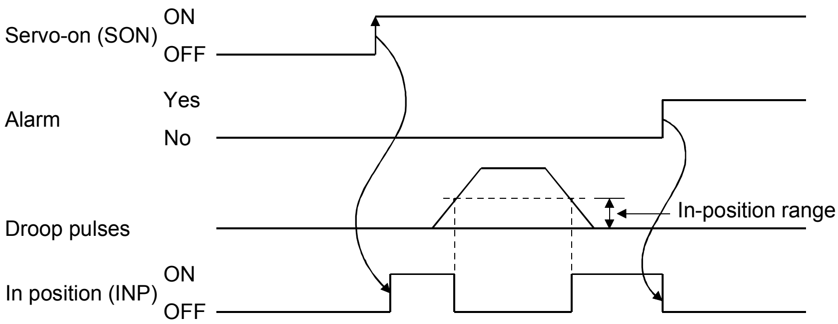
Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No. PA13 has been set to 0010).
The waveforms of PP, PG, NP and NG are based on that of the ground of the differential line driver.

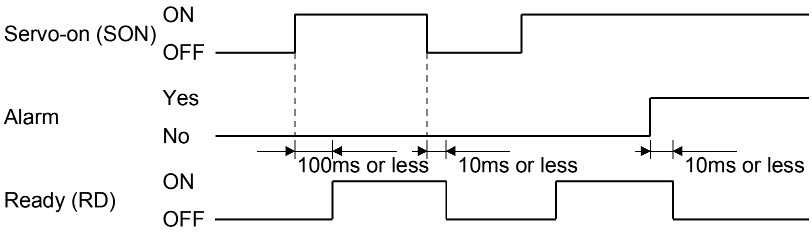


(2) In-position (INP)

INP turns on when the number of droop pulses in the deviation counter falls within the preset in-position range (parameter No. PA10). INP turns on when low-speed operation is performed with a large value set as the in-position range.



(3) Ready (RD)



(4) Electronic gear switching
The combination of CM1 and CM2 gives you a choice of four different electronic gear numerators set in the parameters.
As soon as CM1/CM2 is turned ON or OFF, the molecule of the electronic gear changes. Therefore, if any shock occurs at this change, use position smoothing (parameter No. PB03) to relieve shock.

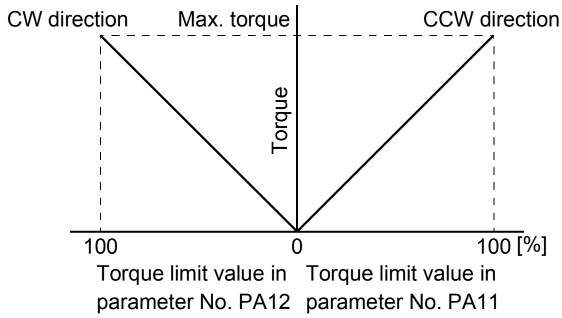
(Note) External input signal		Electronic gear molecule
CM2	CM1	
0	0	Parameter No. PA06
0	1	Parameter No. PC32
1	0	Parameter No. PC33
1	1	Parameter No. PC34

Note. 0: off
1: on

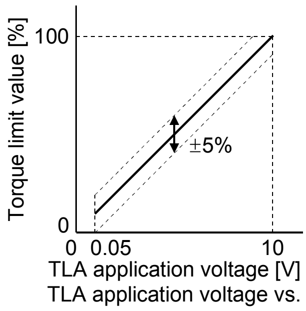
(5) Torque limit

CAUTION	· If the torque limit is canceled during servo lock, the servomotor may suddenly rotate according to position deviation in respect to the command position.

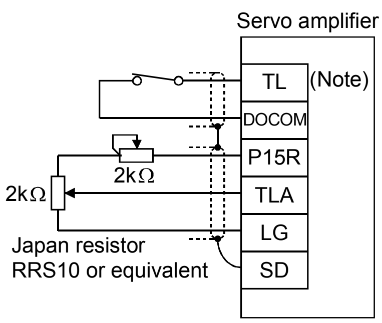
(a) Torque limit and torque
By setting parameter No. PA11 (forward torque limit) or parameter No. PA12 (reverse torque limit), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor torque is shown below.



A relationship between the applied voltage of the analog torque limit (TLA) and the torque limit value of the servo motor is shown below. Torque limit values will vary about 5% relative to the voltage depending on products.
At the voltage of less than 0.05V, torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



TLA application voltage vs. torque limit value



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Torque limit value selection

As shown below, the forward torque limit (parameter No. PA11), or reverse torque limit (parameter No. PA12) and the analog torque limit (TLA) can be chosen using the external torque limit selection (TL).

When internal torque limit selection (TL1) is made usable by parameter No. PD03 to PD08, PD10 to PD12, internal torque limit 2 (parameter No. PC35) can be selected. However, if the parameter No. PA11 and parameter No. PA12 value is less than the limit value selected by TL/TL1, the parameter No. PA11 and parameter No. PA12 value is made valid.

(Note) External Input Signals		Limit Value Status	Validated Torque Limit Values	
TL1	TL		CCW driving/CW regeneration	CW driving/CCW regeneration
0	0		Parameter No. PA11	Parameter No. PA12
0	1	TLA > Parameter No. PA11 Parameter No. PA12	Parameter No. PA11	Parameter No. PA12
		TLA < Parameter No. PA11 Parameter No. PA12	TLA	TLA
1	0	Parameter No. PC35 > Parameter No. PA11 Parameter No. PA12	Parameter No. PA11	Parameter No. PA12
		Parameter No. PC35 < Parameter No. PA11 Parameter No. PA12	Parameter No. PC35	Parameter No. PC35
1	1	TLA > Parameter No. PC35	Parameter No. PC35	Parameter No. PC35
		TLA < Parameter No. PC35	TLA	TLA

Note. 0: off
1: on

(c) Limiting torque (TLC)

TLC turns on when the servo motor torque reaches the torque limited using the forward torque limit, reverse torque limit or analog torque limit.

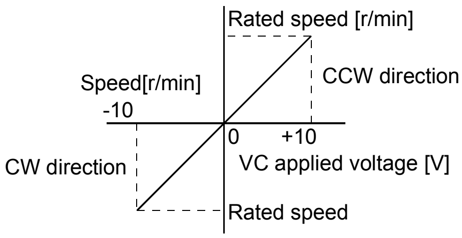
3.6.2 Speed control mode

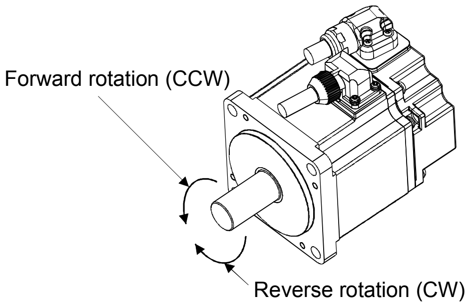
(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of the analog speed command (VC). A relationship between the analog speed command (VC) applied voltage and the servo motor speed is shown below:

The maximum speed is achieved at ±10V. The speed at ±10V can be changed using parameter No. PC12.





The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination:

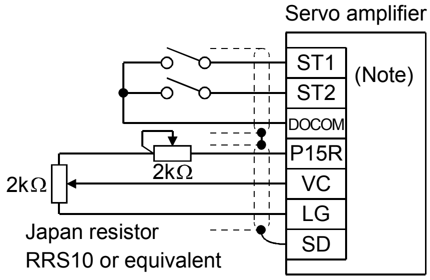
(Note 1) External input signals		(Note 2) Rotation direction			
ST2	ST1	Analog speed command (VC)			Internal speed commands
		+ Polarity	0V	− Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)

Note 1. 0: off

1: on

2. If the torque limit is canceled during servo lock, the servomotor may suddenly rotate according to position deviation in respect to the command position.

Generally, make connection as shown below:



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1), speed selection 2 (SP2) and speed command value

Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the analog speed command (VC).

(Note) External input signals		Speed command value
SP2	SP1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No. PC05)
1	0	Internal speed command 2 (parameter No. PC06)
1	1	Internal speed command 3 (parameter No. PC07)

Note. 0: off
1: on

By making speed selection 3 (SP3) usable by setting of parameter No.PD03 to PD08/PD10 to PD12, you can choose the speed command values of analog speed command (VC) and internal speed commands 1 to 7.

(Note) External input signals			Speed command value
SP3	SP2	SP1	
0	0	0	Analog speed command (VC)
0	0	1	Internal speed command 1 (parameter No. PC05)
0	1	0	Internal speed command 2 (parameter No. PC06)
0	1	1	Internal speed command 3 (parameter No. PC07)
1	0	0	Internal speed command 4 (parameter No. PC08)
1	0	1	Internal speed command 5 (parameter No. PC09)
1	1	0	Internal speed command 6 (parameter No. PC10)
1	1	1	Internal speed command 7 (parameter No. PC11)

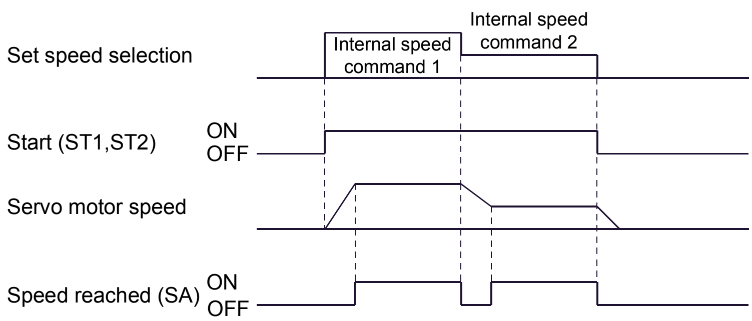
Note. 0: off
1: on

The speed may be changed during rotation. In this case, the values set in parameters No. PC10, PC11 and 12 are used for acceleration/deceleration.

When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(2) Speed reached (SA)

SA turns on when the servo motor speed has nearly reached the speed set to the internal speed command or analog speed command.



(3) Torque limit

As in section 3.6.1 (5).

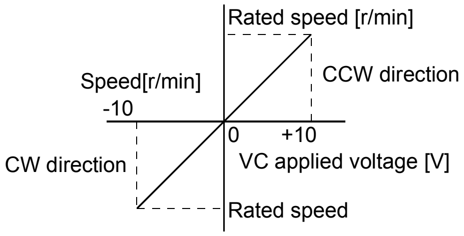
3.6.3 Torque control mode

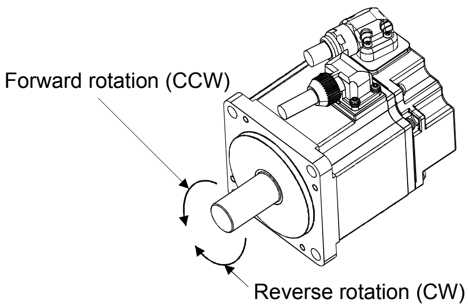
(1) Torque control

(a) Torque command and torque

A relationship between the applied voltage of the analog torque command (TC) and the torque by the servo motor is shown below.

The maximum torque is generated at ±8V. Note that the torque at ±8V input can be changed with parameter No. PC13.



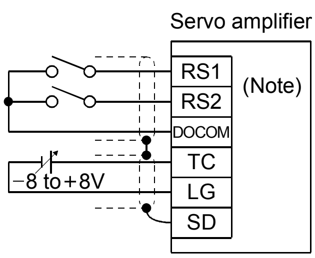


Generated torque limit values will vary about 5% relative to the voltage depending on products.
Also the torque may vary if the voltage is low (−0.05 to +0.05V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.
The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and reverse rotation selection (RS2) when the analog torque command (TC) is used.

(Note) External input signals		Rotation direction		
RS2	RS1	Torque control command (TC)		
		+ Polarity	0V	− Polarity
0	0	Torque is not generated.	Torque is not generated.	Torque is not generated.
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)		CW (forward rotation in driving mode/reverse rotation in regenerative mode)
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)		CCW (reverse rotation in driving mode/forward rotation in regenerative mode)
1	1	Torque is not generated.		Torque is not generated.

Note. 0: off
1: on

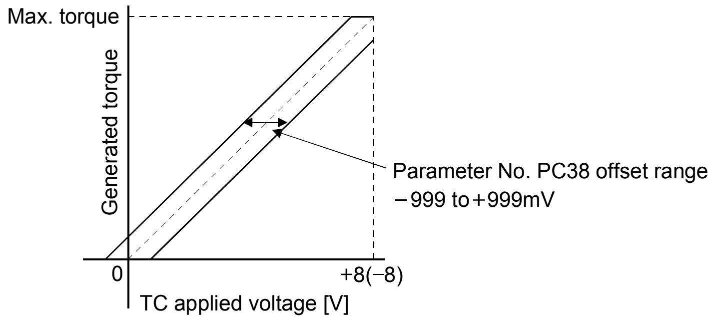
Generally, make connection as shown below:



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Analog torque command offset

Using parameter No. PC38, the offset voltage of −999 to +999mV can be added to the TC applied voltage as shown below.



(2) Torque limit

By setting parameter No. PA11 (forward torque limit) or parameter No. PA12 (reverse torque limit), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor torque is as in section 3.6.1 (5). Note that the analog torque limit (TLA) is unavailable.

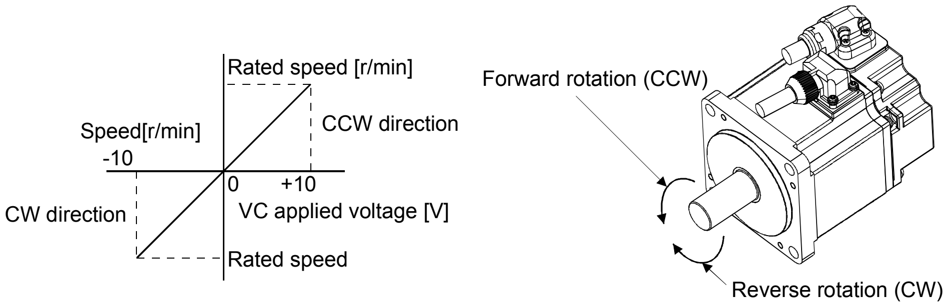
(3) Speed limit

(a) Speed limit value and speed

The speed is limited to the values set in parameters No. PC05 to PC11 (internal speed limits 1 to 7) or the value set in the applied voltage of the analog speed limit (VLA).

A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is shown below.

When the servo motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/min greater than the desired speed limit value.

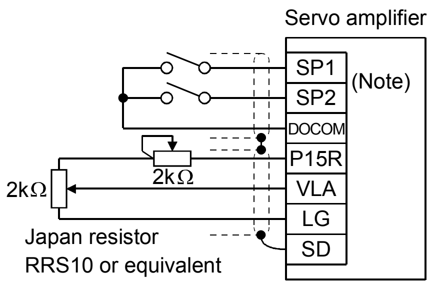


The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination:

(Note) External input signals		Speed limit direction		
RS1	RS2	Analog speed limit (VLA)		Internal speed commands
		+ Polarity	− Polarity	
1	0	CCW	CW	CCW
0	1	CW	CCW	CW

Note. 0: off
1: on

Generally, make connection as shown below:



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1(SP1)/speed selection 2(SP2)/speed selection 3(SP3) and speed limit values

Choose any of the speed settings made by the internal speed limits 1 to 7 using speed selection 1(SP1), speed selection 2(SP2) and speed selection 3(SP3) or the speed setting made by the speed limit command (VLA), as indicated below.

(Note) Input signals			Speed limit value
SP3	SP2	SP1	
0	0	0	Analog speed limit (VLA)
0	0	1	Internal speed limit 1 (parameter No. PC05)
0	1	0	Internal speed limit 2 (parameter No. PC06)
0	1	1	Internal speed limit 3 (parameter No. PC07)
1	0	0	Internal speed limit 4 (parameter No. PC08)
1	0	1	Internal speed limit 5 (parameter No. PC09)
1	1	0	Internal speed limit 6 (parameter No. PC10)
1	1	1	Internal speed limit 7 (parameter No. PC11)

Note. 0: off
1: on

When the internal speed limits 1 to 7 are used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

VLC turns on when the servo motor speed reaches the speed limited using any of the internal speed limits 1 to 7 or the analog speed limit (VLA).

3.6.4 Position/speed control change mode

Set "□□□1" in parameter No. PA01 to switch to the position/speed control change mode. This function is not available in the absolute position detection system.

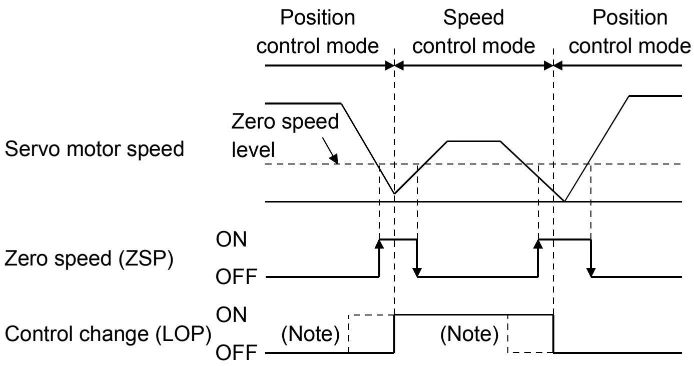
(1) Control change (LOP)

Use control change (LOP) to switch between the position control mode and the speed control mode from an external contact. Relationships between LOP and control modes are indicated below:

(Note) LOP	Servo control mode
0	Position control mode
1	Speed control mode

Note. 0: off
1: on

The control mode may be changed in the zero-speed status. To ensure safety, change control after the servo motor has stopped. When position control mode is changed to speed control mode, droop pulses are reset. If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



Note. When ZSP is not on, control cannot be changed if LOP is switched on-off.
If ZSP switches on after that, control cannot be changed.

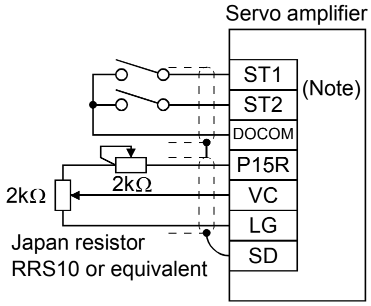
(2) Torque limit in position control mode

As in section 3.6.1 (5).

(3) Speed setting in speed control mode

(a) Speed command and speed

The servo motor is run at the speed set in parameter No. 8 (internal speed command 1) or at the speed set in the applied voltage of the analog speed command (VC). A relationship between analog speed command (VC) applied voltage and servo motor speed and the rotation directions determined by the forward rotation start (ST1) and reverse rotation start (ST2) are as in (a), (1) in section 3.6.2.
Generally, make connection as shown below:



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1), speed selection 2 (SP2) and speed command value

Choose any of the speed settings made by the internal speed commands 1 to 3 using speed selection 1 (SP1) and speed selection 2 (SP2) or the speed setting made by the analog speed command (VC).

(Note) External input signals		Speed command value
SP2	SP1	
0	0	Analog speed command (VC)
0	1	Internal speed command 1 (parameter No. PC05)
1	0	Internal speed command 2 (parameter No. PC06)
1	1	Internal speed command 3 (parameter No. PC07)

Note. 0: off
1: on

By making speed selection 3 (SP3) usable by setting of parameter No.PD03 to PD08/PD10 to PD12, you can choose the speed command values of analog speed command (VC) and internal speed commands 1 to 7.

(Note) External input signals			Speed command value
SP3	SP2	SP1	
0	0	0	Analog speed command (VC)
0	0	1	Internal speed command 1 (parameter No. PC05)
0	1	0	Internal speed command 2 (parameter No. PC06)
0	1	1	Internal speed command 3 (parameter No. PC07)
1	0	0	Internal speed command 4 (parameter No. PC08)
1	0	1	Internal speed command 5 (parameter No. PC09)
1	1	0	Internal speed command 6 (parameter No. PC10)
1	1	1	Internal speed command 7 (parameter No. PC11)

Note. 0: off
1: on

The speed may be changed during rotation. In this case, the values set in parameters No. PC01 and PC02 are used for acceleration/deceleration.
When the internal speed command 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Speed reached (SA)

As in section 3.6.2 (2).

3.6.5 Speed/torque control change mode

Set "□□□3" in parameter No. PA01 to switch to the speed/torque control change mode.

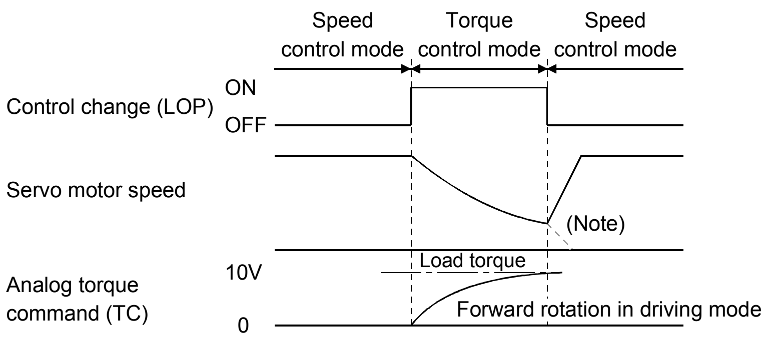
(1) Control change (LOP)

Use control change (LOP) to switch between the speed control mode and the torque control mode from an external contact. Relationships between LOP and control modes are indicated below:

(Note) LOP	Servo control mode
0	Speed control mode
1	Torque control mode

Note. 0: off
1: on

The control mode may be changed at any time. A change timing chart is shown below:



Note. When the start (ST1 ・ ST2) is switched off as soon as the mode is changed to speed control, the servo motor comes to a stop according to the deceleration time constant.

(2) Speed setting in speed control mode

As in section 3.6.2 (1).

(3) Torque limit in speed control mode

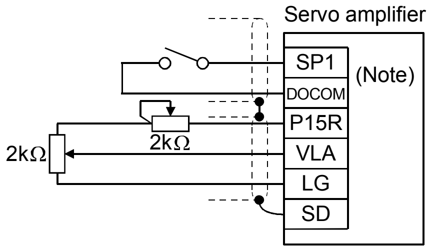
As in section 3.6.1 (5).

(4) Speed limit in torque control mode

(a) Speed limit value and speed

The speed is limited to the limit value set in parameter No. 8 (internal speed limit 1) or the value set in the applied voltage of the analog speed limit (VLA). A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is as in section 3.6.3 (3) (a).

Generally, make connection as shown below:



Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

(b) Speed selection 1 (SP1) and speed limit value

Use speed selection 1 (SP1) to select between the speed set by the internal speed command 1 and the speed set by the analog speed limit (VLA) as indicated in the following table:

(Note) External input signals	Speed command value
SP1	
0	Analog speed limit (VLA)
1	Internal speed limit 1 (parameter No. PC05)

Note. 0: off

1: on

When the internal speed limit 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

As in section 3.6.3 (3) (c)

(5) Torque control in torque control mode

As in section 3.6.3 (1).

(6) Torque limit in torque control mode

As in section 3.6.3 (2).

3.6.6 Torque/position control change mode

Set "□□□5" in parameter No. PA01 to switch to the torque/position control change mode.

(1) Control change (LOP)

Use control change (LOP) to switch between the torque control mode and the position control mode from an external contact. Relationships between LOP and control modes are indicated below:

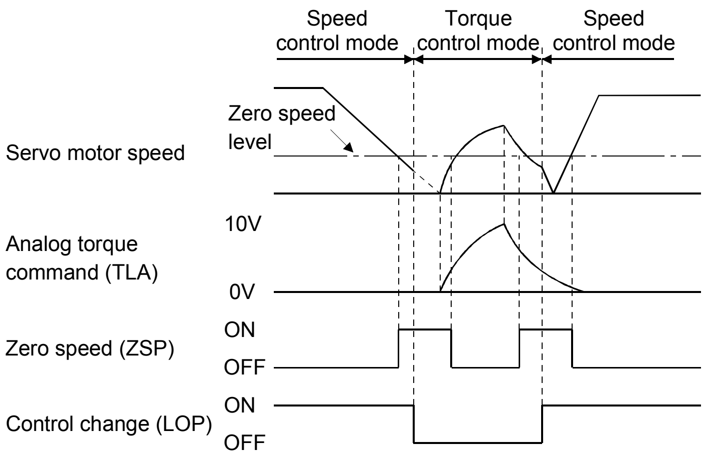
(Note) LOP	Servo control mode
0	Torque control mode
1	Position control mode

Note. 0: off
1: on

The control mode may be changed in the zero-speed status.

To ensure safety, change control after the servo motor has stopped. When position control mode is changed to torque control mode, droop pulses are reset.

If the signal has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below:



(2) Speed limit in torque control mode

As in section 3.6.3 (3).

(3) Torque control in torque control mode

As in section 3.6.3 (1).

(4) Torque limit in torque control mode

As in section 3.6.3 (2).

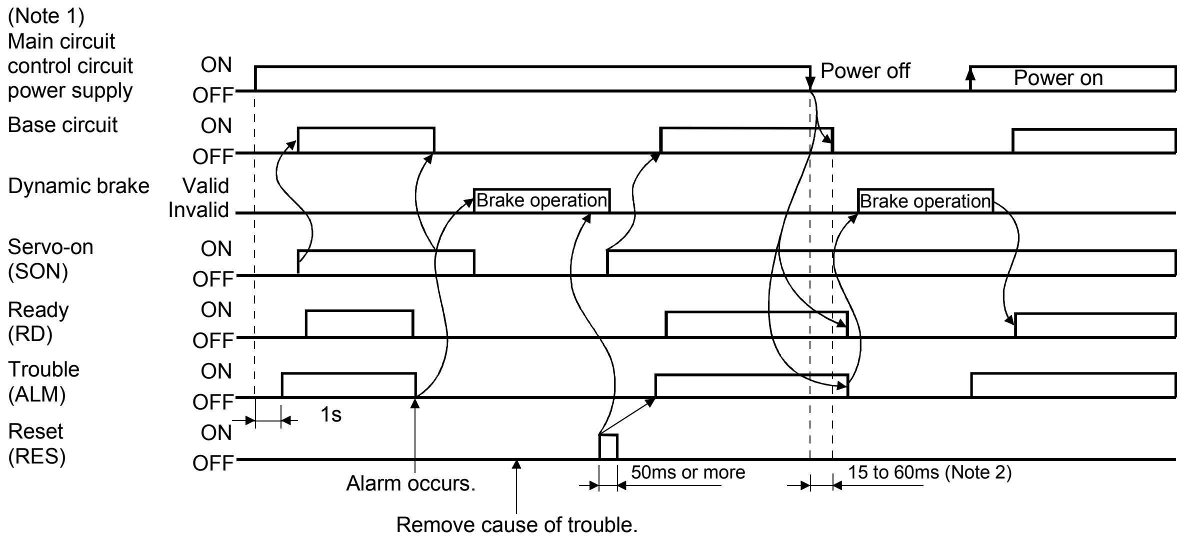
(5) Torque limit in position control mode

As in section 3.6.1 (5).

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. ・As soon as an alarm occurs, turn off Servo-on (SON) and power off.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. Switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply from off to on, press the " SET " button on the current alarm screen, or turn the reset (RES) from off to on. However, the alarm cannot be reset unless its cause is removed.



Note 1. Shut off the main circuit power as soon as an alarm occurs.
2. Changes depending on the operating status.

(1) Overcurrent, overload 1 or overload 2

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

(2) Regenerative alarm

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

(3) Instantaneous power failure

Undervoltage (AL.10) occurs when the input power is in either of the following statuses.

・A power failure of the control circuit power supply continues for 60ms or longer and the control circuit is not completely off.

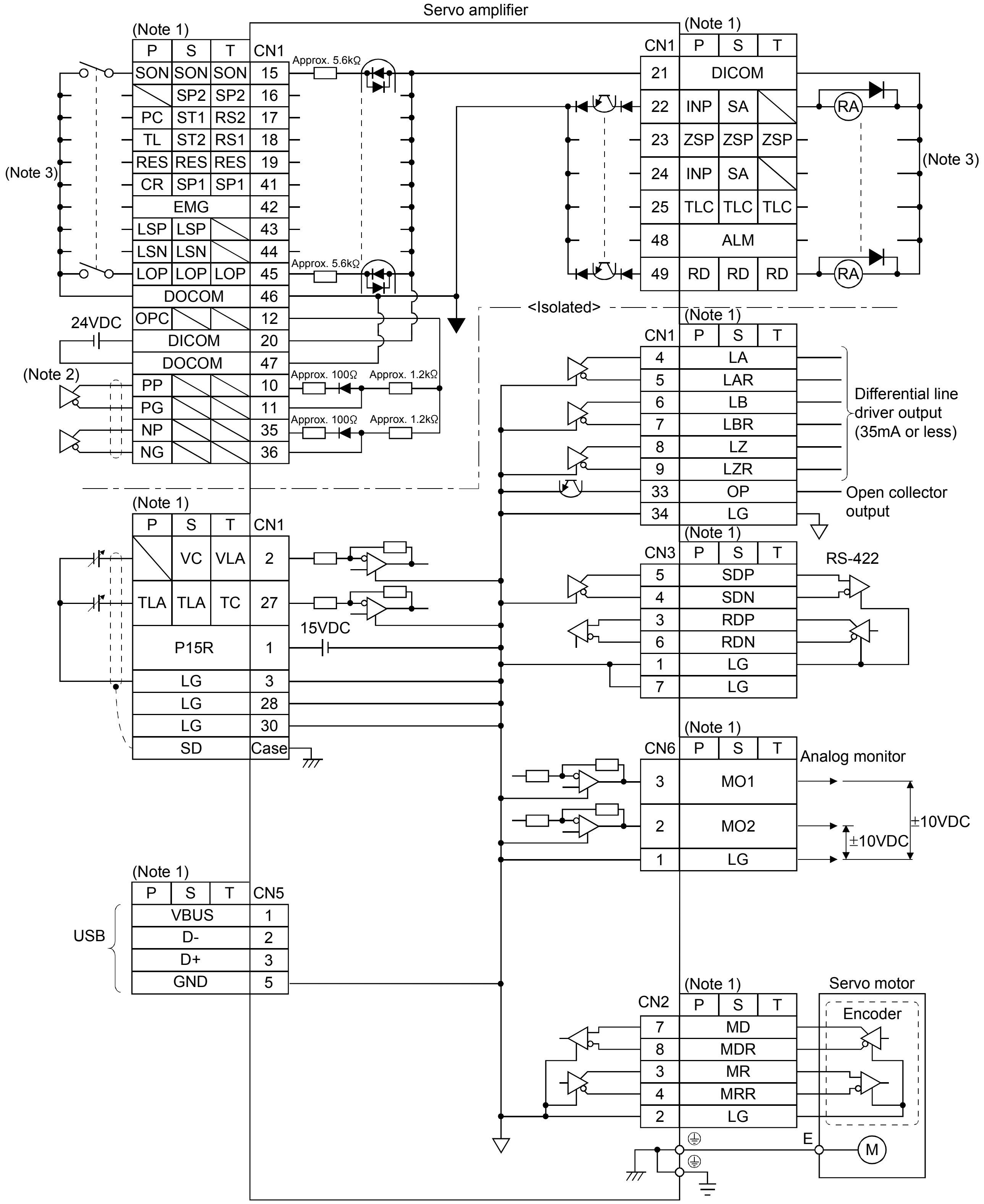
・The bus voltage dropped to 200VDC or less for the MR-J3-□A, or to 158VDC or less for the MR-J3-□A1, or to 380VDC or less for the MR-J3-□A4.

(4) In position control mode (incremental)

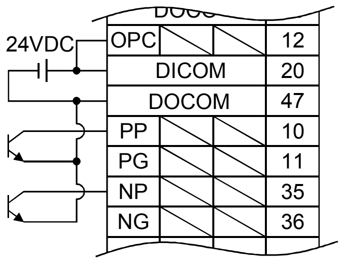
When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a home position return.

3.8 Interfaces

3.8.1 Internal connection diagram



Note 1. P: Position control mode S: Speed control mode T: Torque control mode
2. For the differential line driver pulse train input. For the open collector pulse train input, make the following connection.



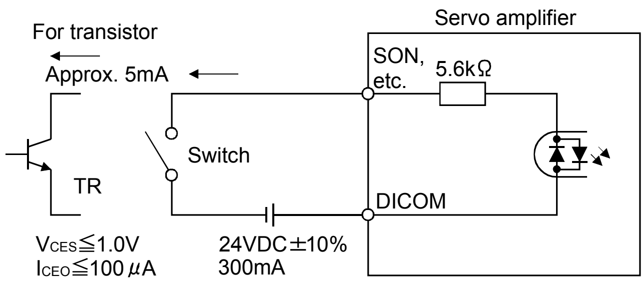
3. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

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

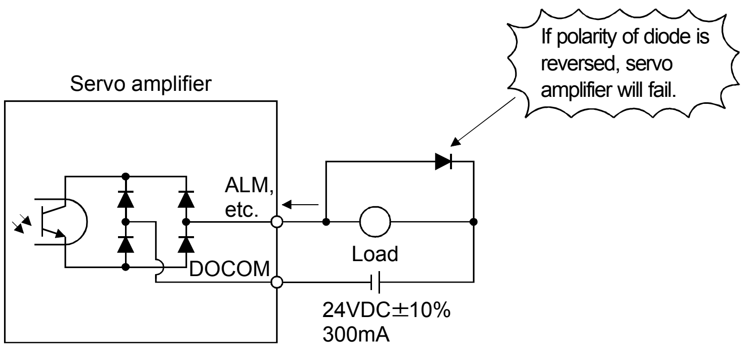
Give a signal with a relay or open collector transistor. Refer to section 3.8.3 for the source input.



(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. (Permissible current: 40mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the servo amplifier.

Refer to section 3.8.3 for the source output.

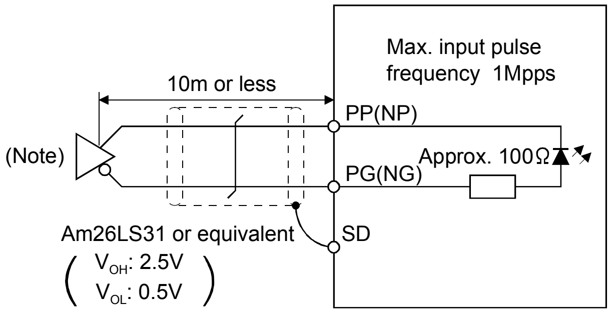


(3) Pulse train input interface DI-2

Give a pulse train signal in the differential line driver system or open collector system.

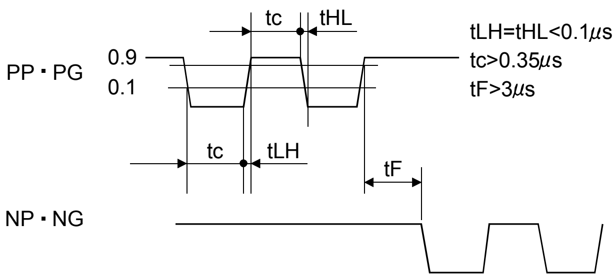
(a) Differential line driver system

1) Interface



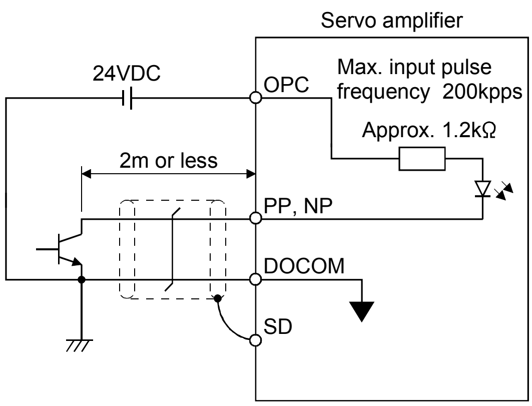
Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

2) Input pulse condition

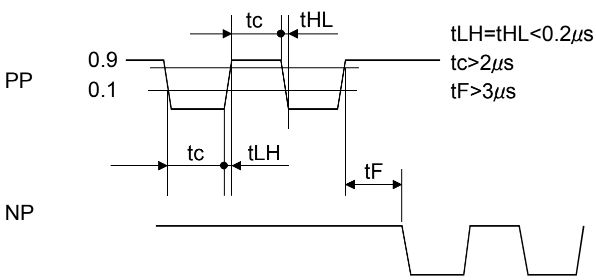


(b) Open collector system

1) Interface



2) Input pulse condition

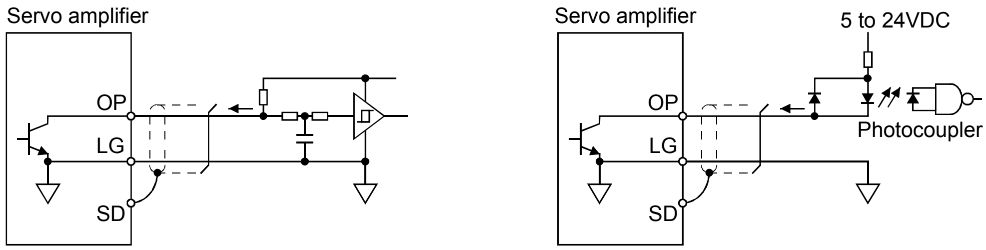


(4) Encoder pulse output DO-2

(a) Open collector system

Interface

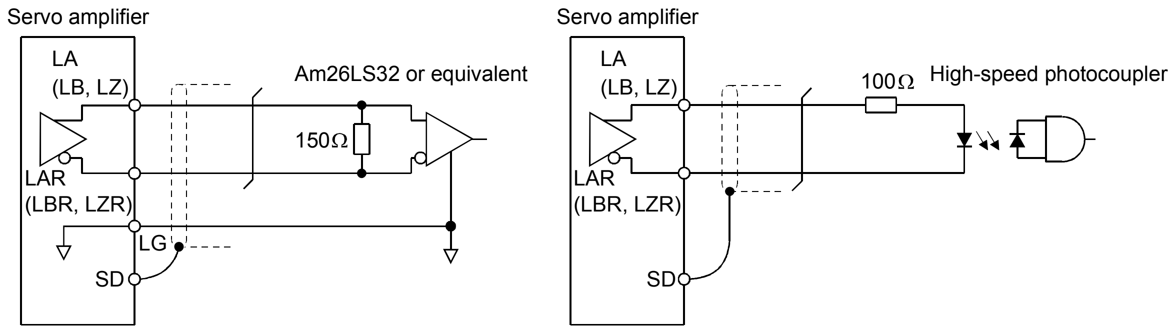
Max. output current : 35mA



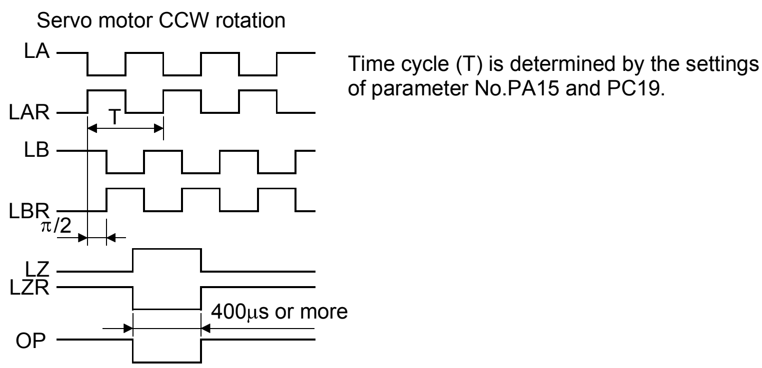
(b) Differential line driver system

1) Interface

Max. output current: 35mA

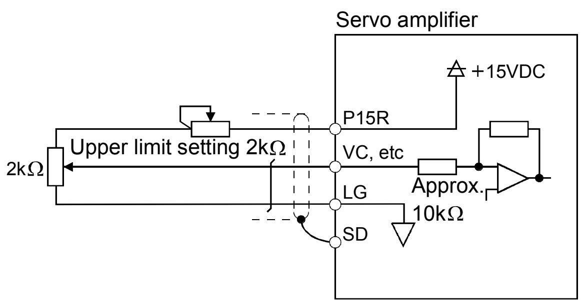


2) Output pulse

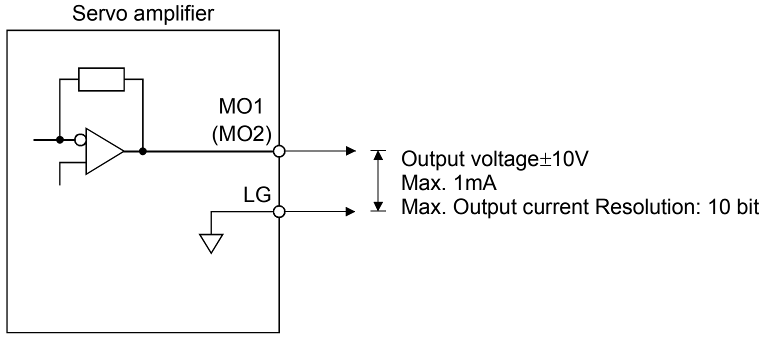


(5) Analog input

Input impedance 10 to 12kΩ



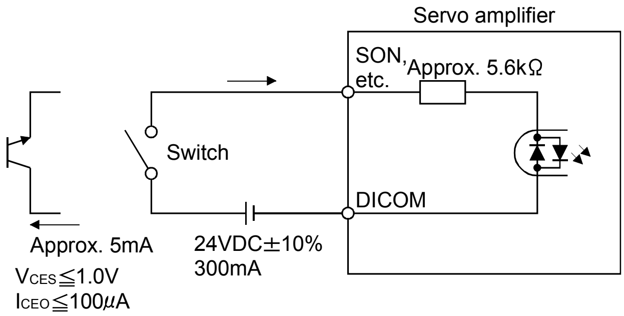
(6) Analog output



3.8.3 Source I/O interfaces

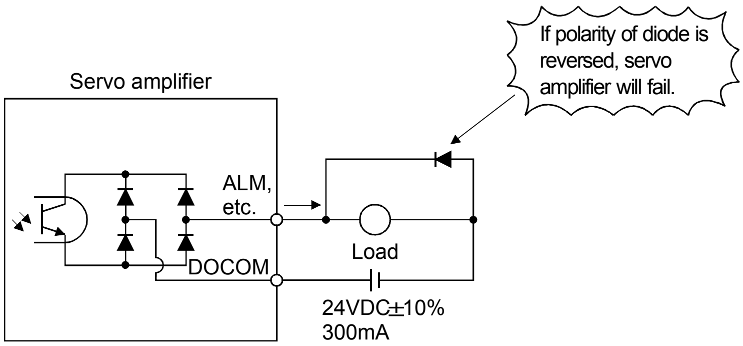
In this servo amplifier, source type I/O interfaces can be used. In this case, all DI-1 input signals and DO-1 output signals are of source type. Perform wiring according to the following interfaces.

(1) Digital input interface DI-1



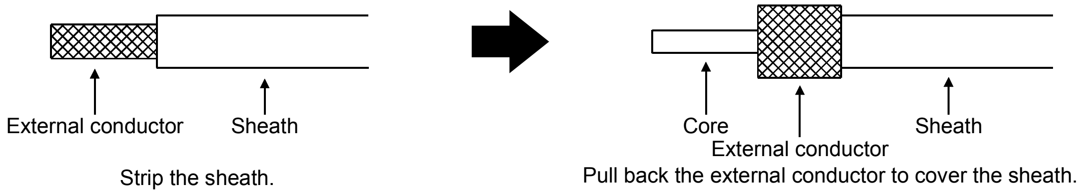
(2) Digital output interface DO-1

A maximum of 2.6V voltage drop occurs in the servo amplifier.

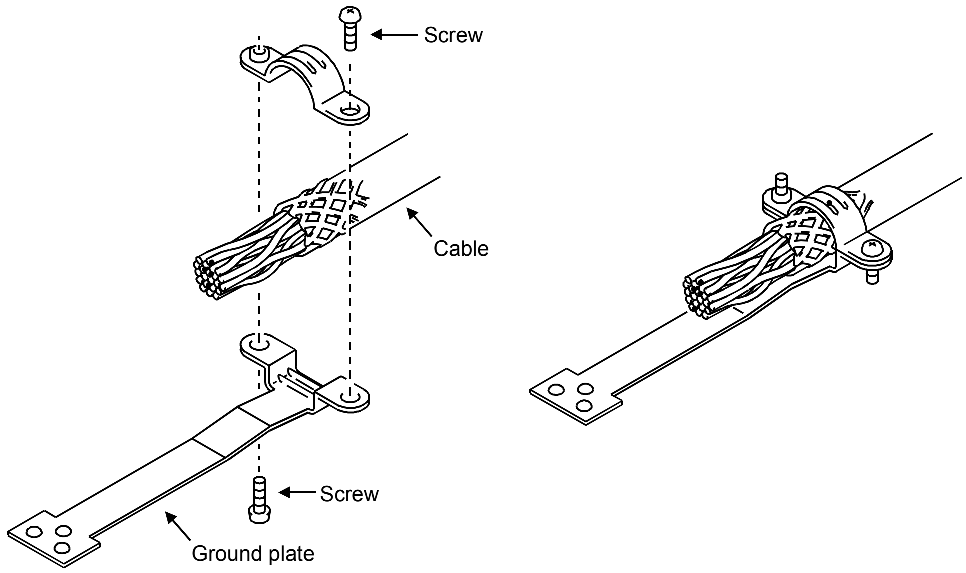


3.9 Treatment of cable shield external conductor

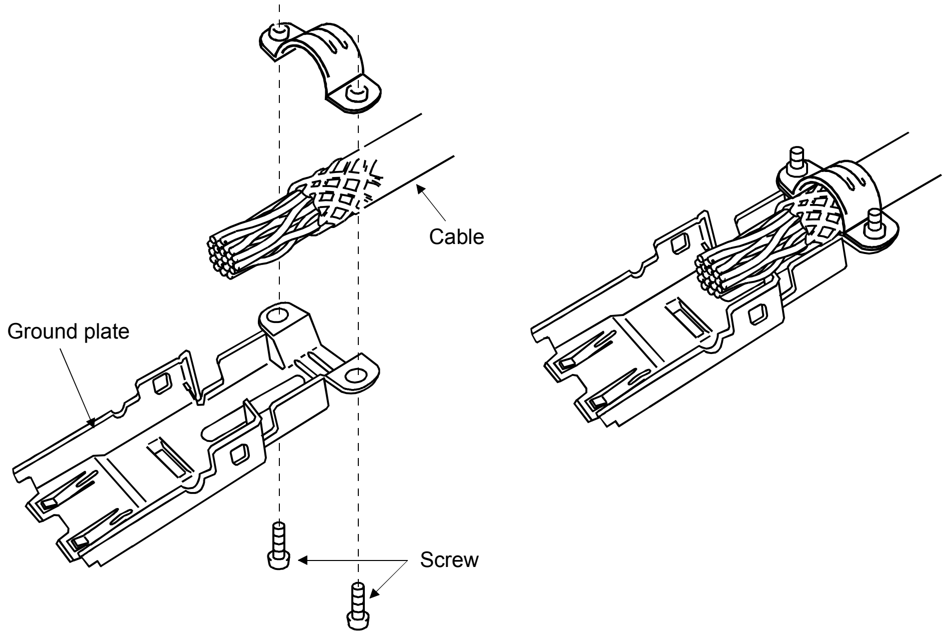
In the case of the CN1 and CN2 connectors, securely connect the shielded external conductor of the cable to the ground plate as shown in this section and fix it to the connector shell.



(1) For CN1 connector (3M connector)



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



3.10 Connection of servo amplifier and servo motor

WARNING	
	・During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

3.10.1 Connection instructions

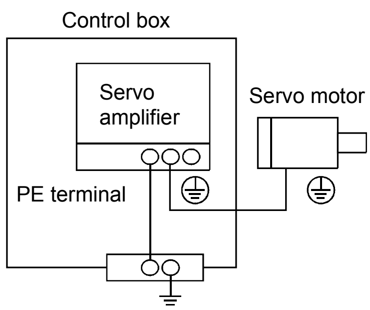
WARNING	
	・Insulate the connections of the power supply terminals to prevent an electric shock.

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

POINT
・Refer to section 12.1 for the selection of the encoder cable.

This section indicates the connection of the motor power supply (U, V, W). Use of the optional cable and connector set is recommended for connection between the servo amplifier and servo motor. When the options are not available, use the recommended products. Refer to section 12.1 for details of the options.

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

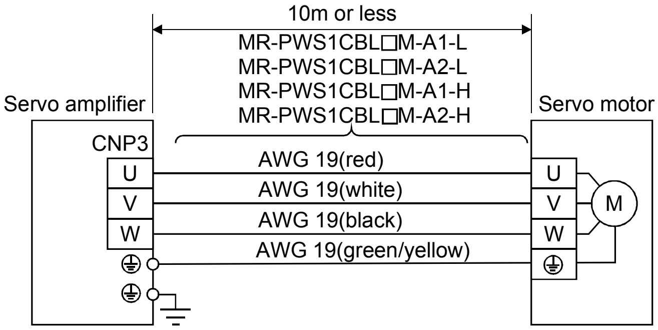


(2) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.

3.10.2 Power supply cable wiring diagrams

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

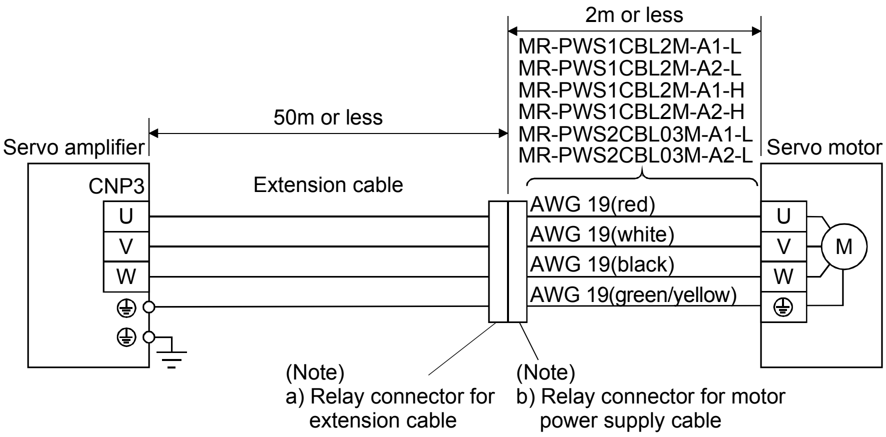
(a) When cable length is 10m or less



(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 pulled from the servo motor should be within 2m long.

Refer to section 12.11 for the wire used for the extension cable.



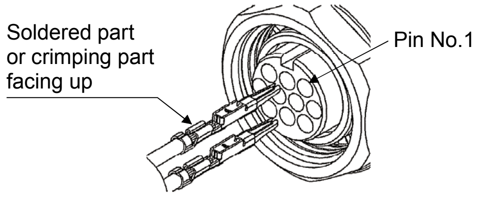
Note. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

Relay Connector	Description	Protective Structure
a) Relay connector for extension cable	Connector: RM15WTPZ-4P(71) Cord clamp: RM15WTP-CP(5)(71) (Hirose Electric) └ Numeral changes depending on the cable OD.	IP65
b) Relay connector for motor power supply cable	Connector: RM15WTJA-4S(71) Cord clamp: RM15WTP-CP(8)(71) (Hirose Electric) └ Numeral changes depending on the cable OD.	IP65

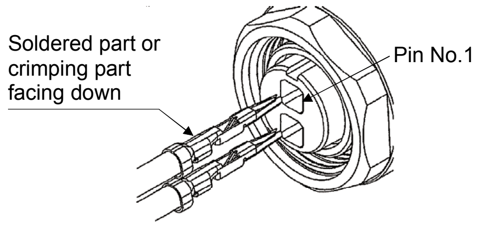
(2) HF-SP series · HC-RP series · HC-UP series · HC-LP series servo motor

POINT

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

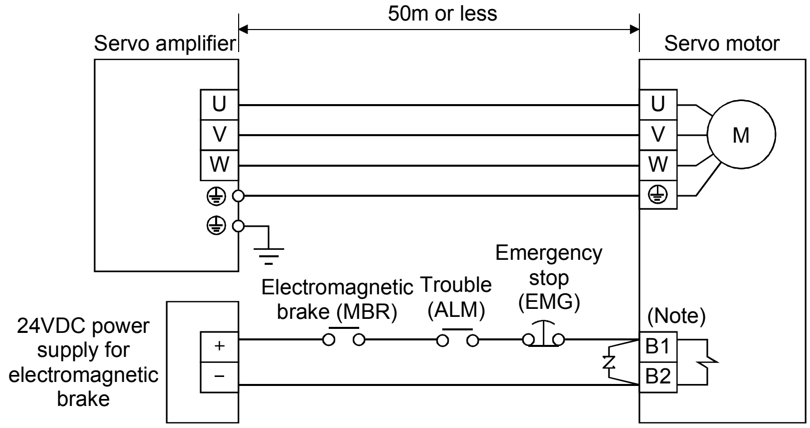


For CM10-SP10S-☐

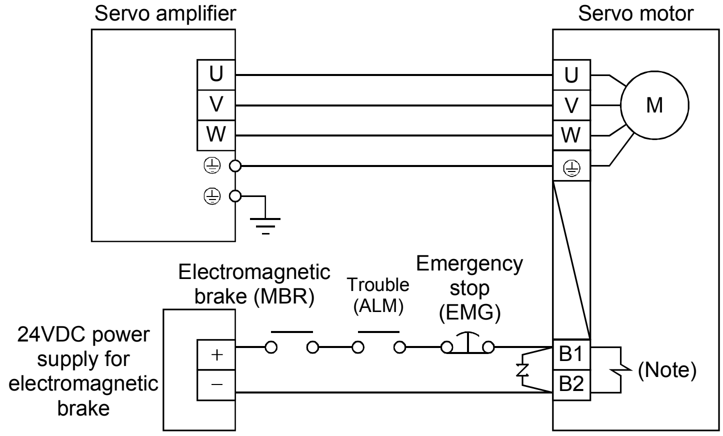


For CM10-SP2S-☐

(a) Wiring diagrams
Refer to section 12.11 for the cables used for wiring.



When the power supply connector and the electromagnetic brake connector are separately supplied

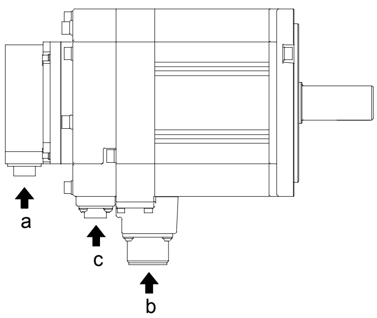


When the power supply connector and the electromagnetic brake connector are shared

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

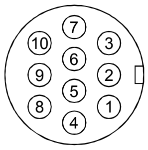
(b) Connector and signal allotment

The connector fitting the servomotor is prepared as optional equipment. Refer to section 12.1. For types other than those prepared as optional equipment, refer to chapter 3 in Servomotor 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 ・ 352 ・ 502(4)		MS3102A22-22P	
HF-SP121 to 301			
HF-SP421 ・ 702(4)		CE05-2A32-17RD-B	
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

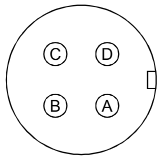
Encoder connector signal allotment
CM10-R10P



View a

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

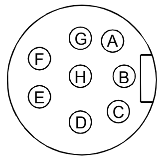
Power supply connector signal allotment
MS3102A18-10P
MS3102A22-22P
CE05-2A32-17PD-B



View b

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

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

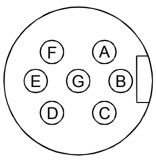


View b

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

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

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

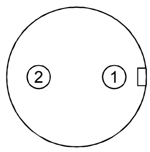


View b

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

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

Brake connector signal allotment
CM10-R2P

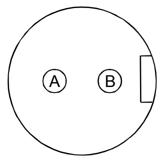


View c

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

Note. For the motor with 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)

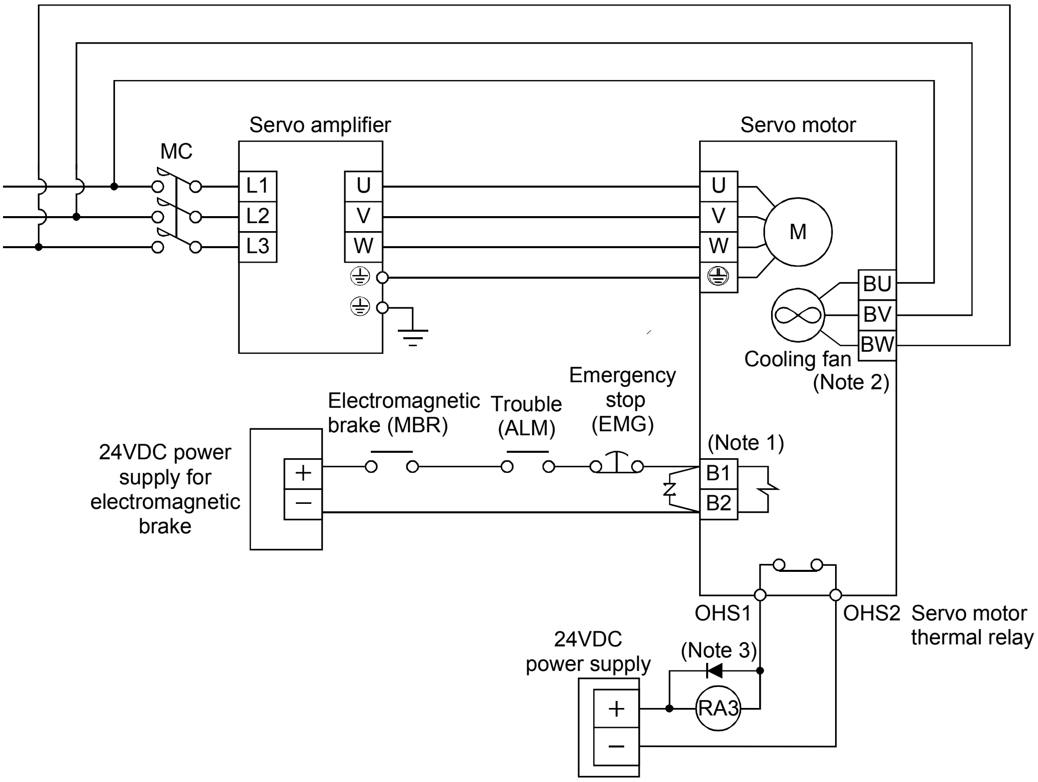
Note. For the motor with electromagnetic brake, supply electromagnetic brake power (24VDC). There is no polarity.

(3) HA-LP series servo motor

(a) Wiring diagrams

Refer to section 12.11 for the cables used for wiring.

1) 200VAC class

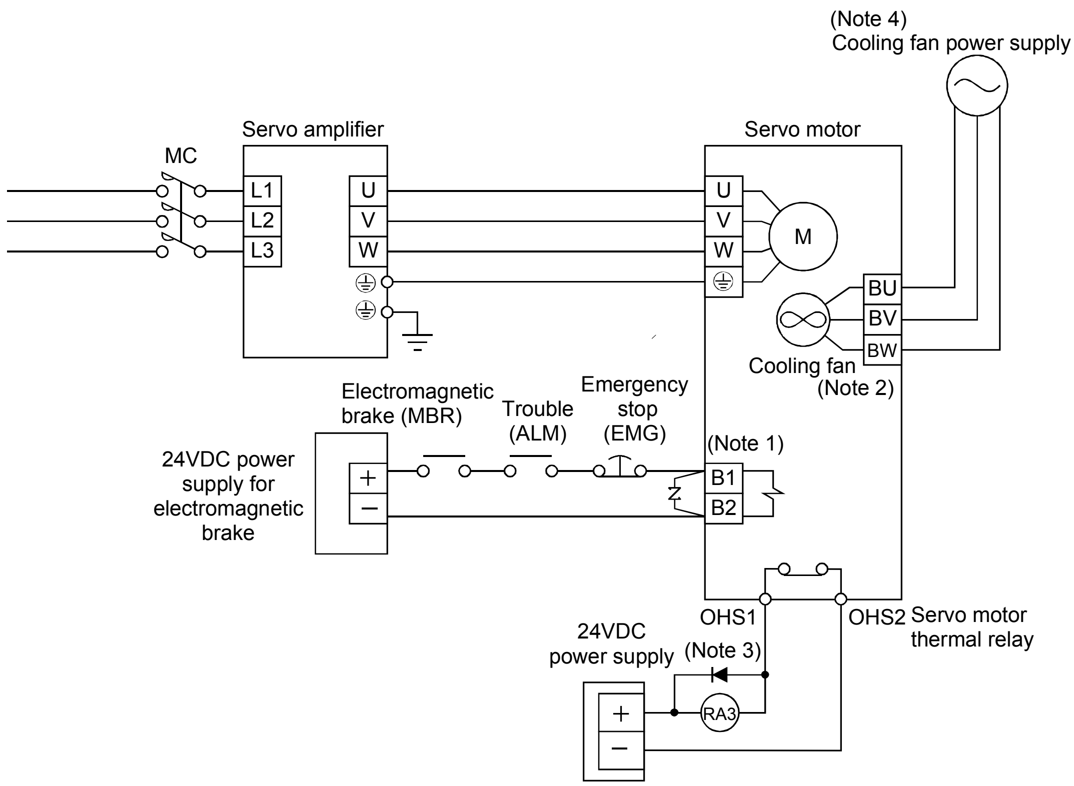


Note 1. When using the external dynamic brake, refer to section 12.6.

2. The servo motor with cooling fan for single-phase has no BW terminal.

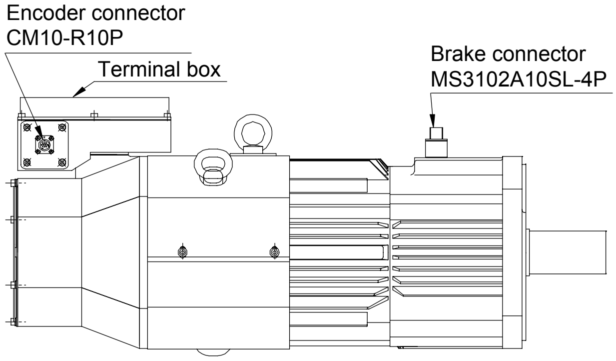
3. Configure the power supply circuit which turns off the magnetic contactor after detection of servo motor thermal.

2) 400VAC class

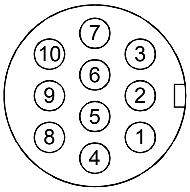


Note 1. When using the external dynamic brake, refer to section 12.6.
2. The servo motor with cooling fan for single-phase has no BW terminal.
3. Configure the power supply circuit which turns off the magnetic contactor after detection of servo motor thermal.
4. For the cooling fan power supply, refer to (3) (b) of this section.

(b) Servo motor terminals

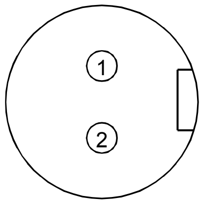


Encoder connector signal allotment
CM10-R10P



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

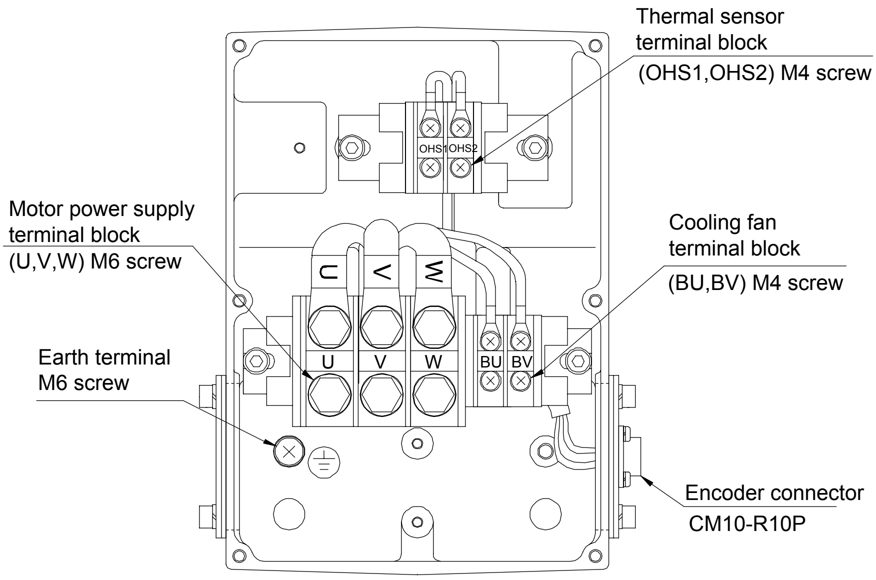
Brake connector signal allotment
MS3102A10SL-4P



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

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

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

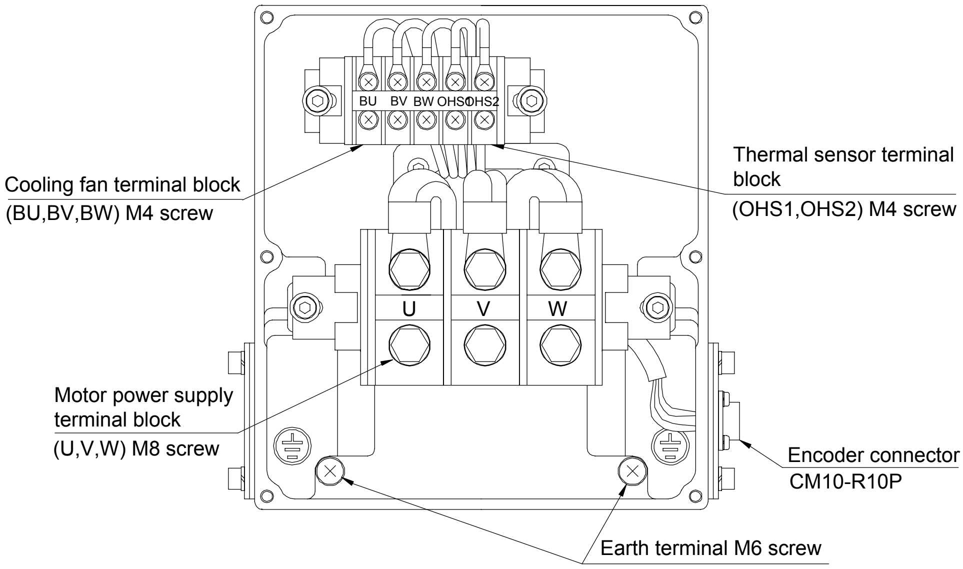


Terminal block signal arrangement

OHS1	OHS2

U	V	W	BU	BV

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

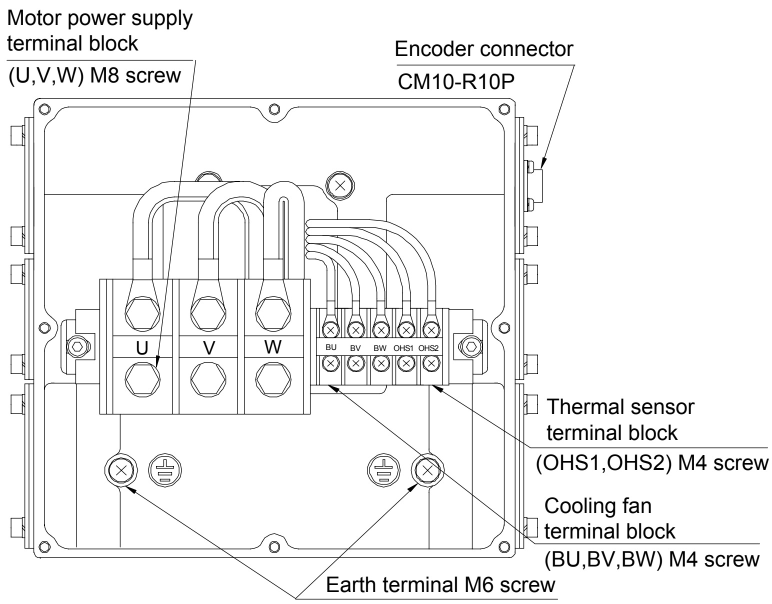


Terminal block signal arrangement

BU	BV	BW	OHS1	OHS2

U	V	W

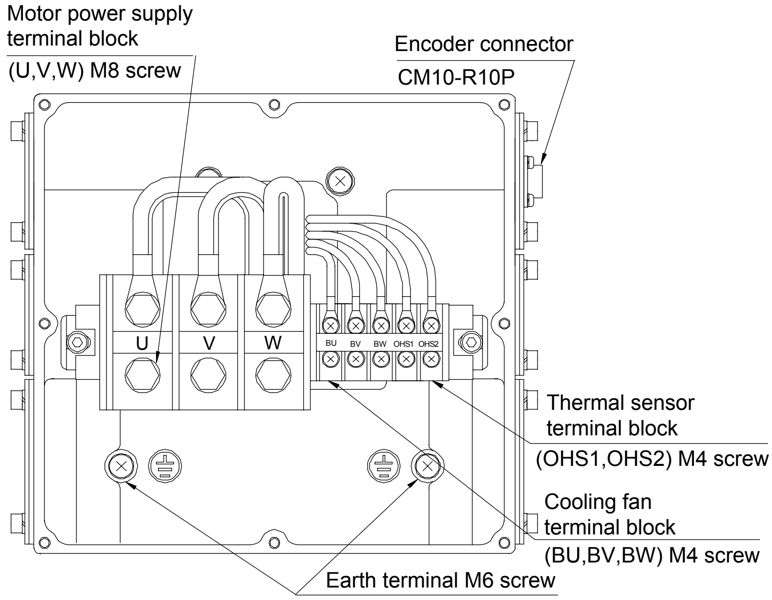
Terminal box inside (HA-LP15K1(4), 20K1(4), 22K1M(4))



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 motor output terminals (U, V, W) of the servo amplifier. During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.</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>1-phase 200 to 220VAC 50Hz
1-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
1-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: AC/DC 125V, or 250V, 2A
Minimum rating: AC/DC 6V, 0.15A</td></tr>
<tr><td>Earth terminal</td><td>⏚</td><td>For grounding, connect to the earth of the control box via the earth terminal of the servo amplifier.</td></tr>
</table>

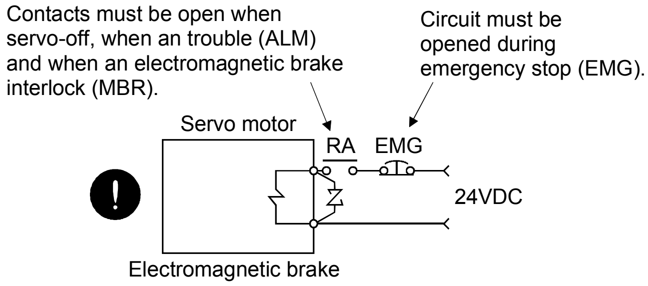
Note. The servo motor with cooling fan for single-phase has no BW terminal.

3.11 Servo motor with electromagnetic brake

3.11.1 Safety precautions

⚠ CAUTION

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



- 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.

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.

Note the following when the servo motor equipped with electromagnetic brake is used:

1) Set "□□□1"in parameter No. PA04 to make the electromagnetic brake interlock (MBR) valid.
2) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.
3) The brake will operate when the power (24VDC) switches off.
4) While the reset (RES) is on, the base circuit is shut off. When using the servo motor with a vertical shaft, use the electromagnetic brake interlock (MBR).
5) Switch off the servo-on (SON) after the servo motor has stopped.

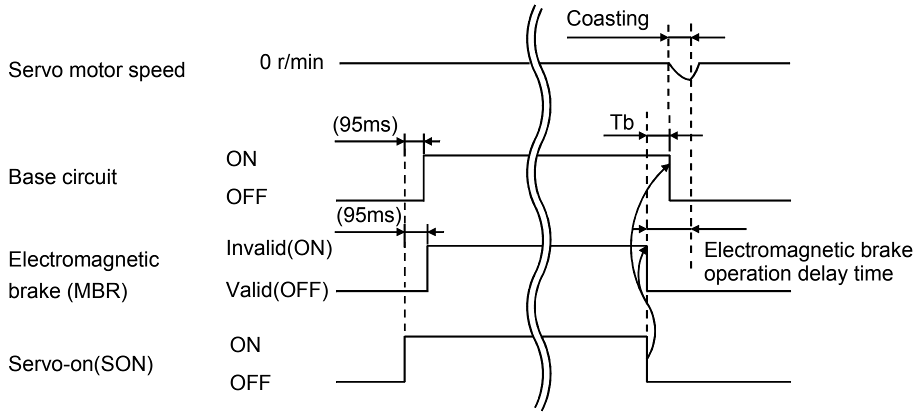
3.11.2 Setting

1) Set"□□□1"in parameter No. PA04 to make the electromagnetic brake interlock (MBR) valid.
2) Using parameter No. PC16 (electromagnetic brake sequence output), set a time delay (Tb) at servo-off from electromagnetic brake operation to base circuit shut-off as in the timing chart shown in section 3.11.3(1).

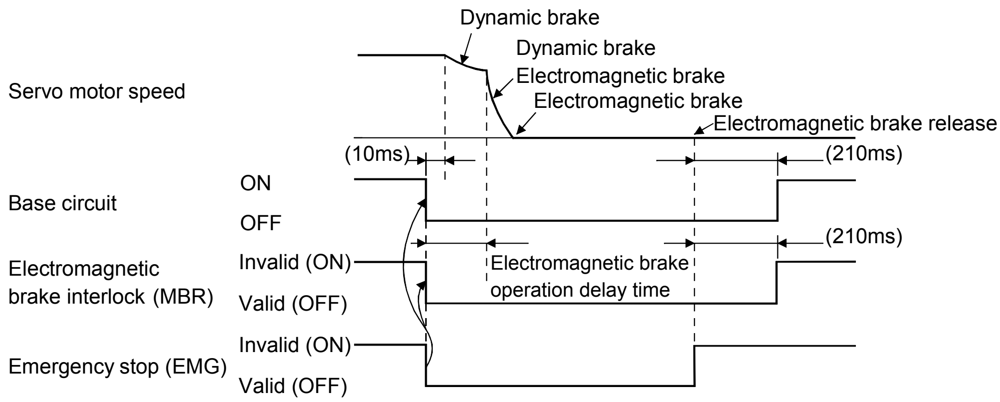
3.11.3 Timing charts

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

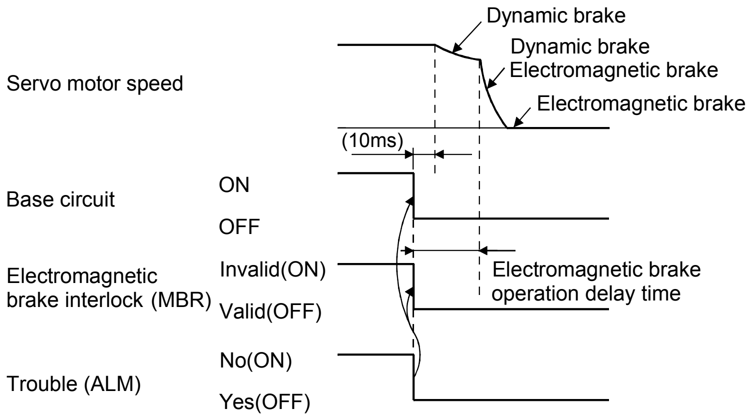
Tb [ms] after the servo-on (SON) signal is switched off, the servo lock is released and the servo motor coasts. If the electromagnetic brake is made valid in the servo lock status, the brake life may be shorter. Therefore, when using the electromagnetic brake in a vertical lift application or the like,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



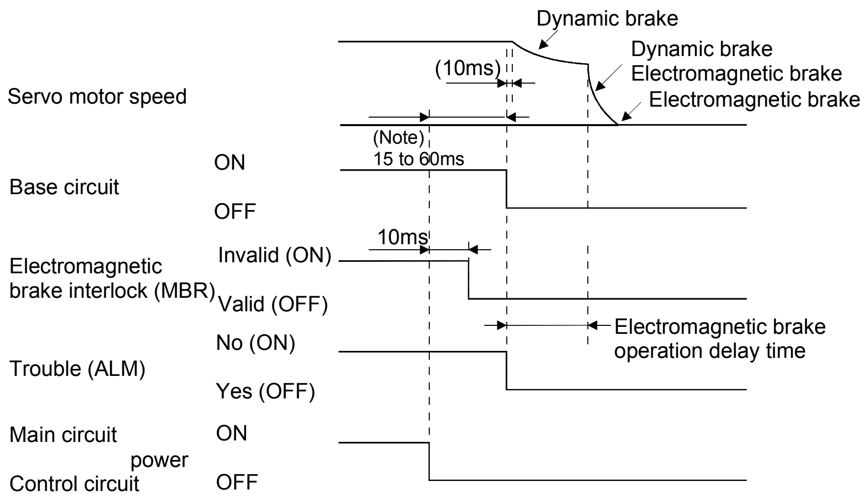
(2) Emergency stop (EMG) ON/OFF



(3) Alarm occurrence

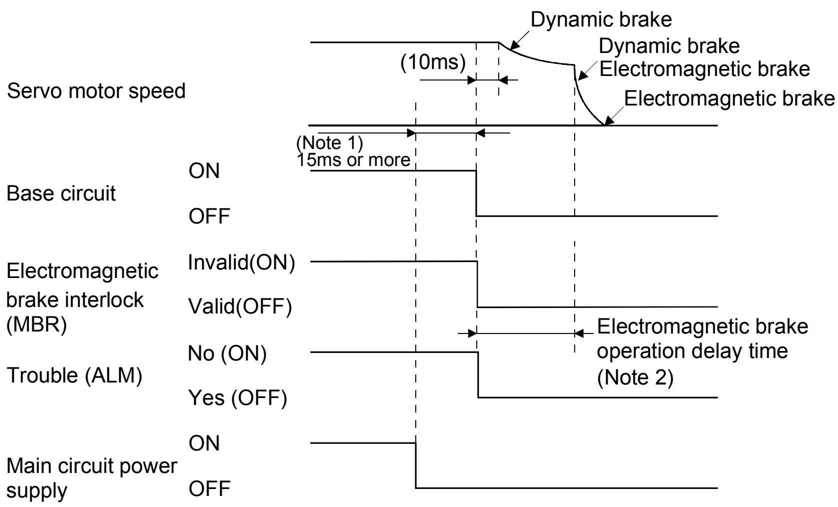


(4) Both main and control circuit power supplies off



Note. Changes with the operating status.

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



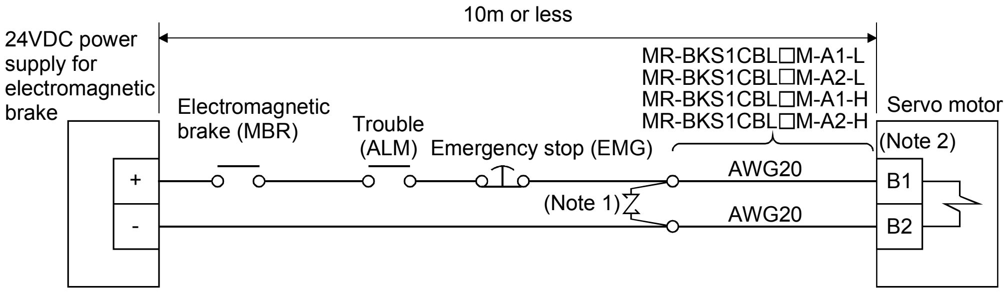
Note 1. Changes with the operating status.

2. When the main circuit power supply is off in a motor stop status, the main circuit off warning (AL.E9) occurs and the alarm (ALM) does not turn off.

3.11.4 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 3.10.2 (2).

(1) When cable length is 10m or less



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

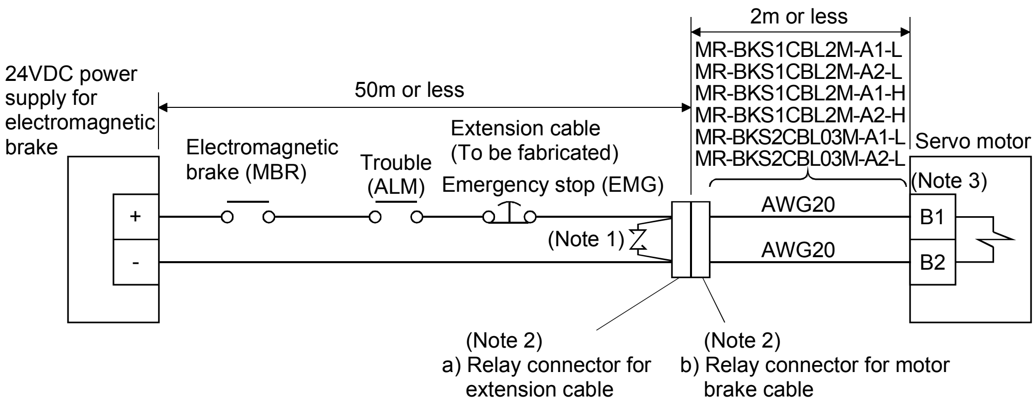
2. There is no polarity in electromagnetic brake terminals (B1 and B2).

When fabricating the motor brake cable MR-BKS1CBL-□M-H, refer to section 12.1.4.

(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 power supply cable pulled from the servo motor should be within 2m long.

Refer to section 12.11 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	Protective Structure
a) Relay connector for extension cable	CM10-CR2P-∗ (DDK) Wire size: S, M, L	IP65
b) Relay connector for motor brake cable	CM10-SP2S-∗ (DDK) Wire size: S, M, L	IP65

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

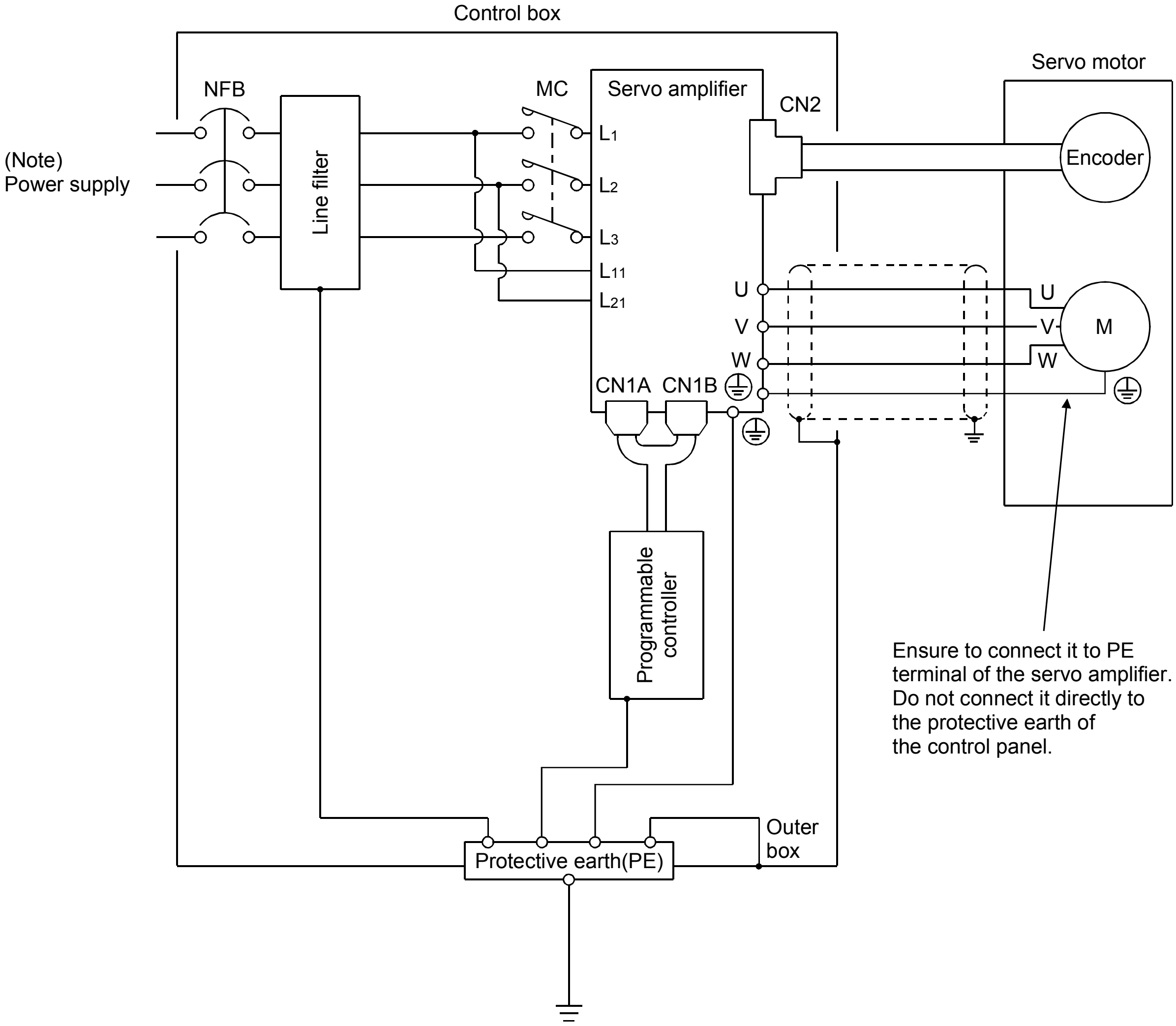
4. When using a servo motor with electromagnetic brake, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No. PA04, PD13 to PD16, and PD18.

3.12 Grounding

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

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground 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 or 1-phase 100 to 120VAC, 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. For the specification of power supply, refer to section 1.3.

4. STARTUP

⚠ WARNING	・Do not operate the switches with wet hands. You may get 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 parts may damaged. ・During operation, never touch the rotating parts of the servo motor. Doing so can 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 6.8), 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.)
↓	
Parameter setting	Set the parameters as necessary, such as the used control mode and regenerative option selection. (Refer to chapter 5 and sections 4.2.4, 4.3.4 and 4.4.4.)
↓	
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 6.9, 4.2.3, 4.3.3 and 4.4.3.)
↓	
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 7.)
↓	
Actual operation	
↓	
Stop	Stop giving commands and stop operation. The other conditions where the servo motor will come to a stop are indicated in sections 4.2.2, 4.3.2 and 4.4.2.

4.1.2 Wiring check

(1) Power supply system wiring

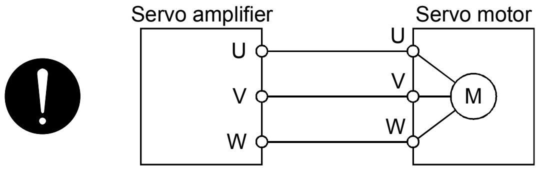
Before switching on the main circuit and control circuit power supplies, check the following items.

(a) Power supply system wiring

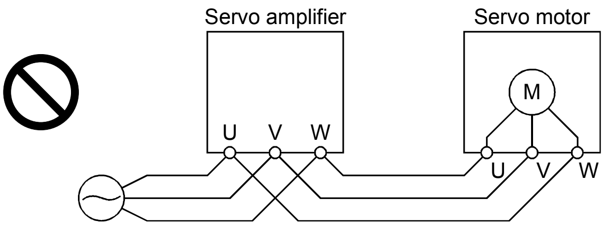
The power supplied to the power input terminals (L_1, L_2, L_3, L_{11}, L_{21}) of the servo amplifier should satisfy the defined specifications. (Refer to section 1.3.)

(b) Connection of servo amplifier and servo motor

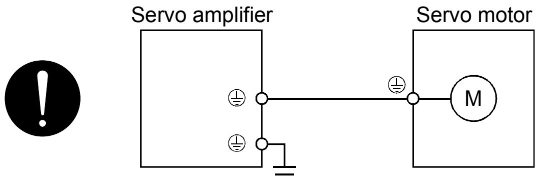
1) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W) of the servo motor.



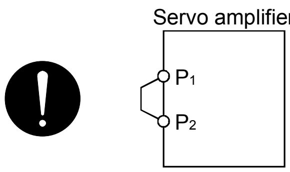
2) The power supplied to the servo amplifier should not be connected to the servo motor power supply terminals (U, V, W). To do so will fail the connected servo amplifier and servo motor.



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



4) P_1-P_2 (For 11kW or more, P-P1) should be connected.



(c) When option and auxiliary equipment are used

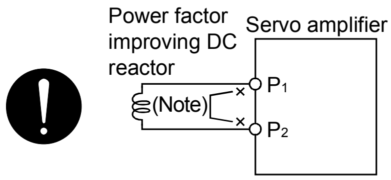
1) When regenerative option is used under 3.5kW

- 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 12.2)

2) When regenerative option is used over 5kW
- The lead of built-in regenerative resistor connected to P terminal and D 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 12.2)

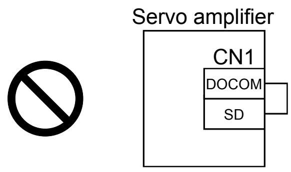
3) When brake unit and power supply return converter are used over 5kW
- The lead of built-in regenerative resistor connected to P terminal and D terminal of TE1 terminal block should not be connected.
- Brake unit, power supply return converter or power regeneration common converter should be connected to P terminal and N terminal. (Refer to section 12.3 to 12.5)

4) The power factor improving DC reactor should be connected across P_1-P_2 (For 11kW or more, P-P_1). (Refer to section 12.13.)



Note. Always disconnect the wiring across P_1-P_2 (For 11kW or more, P-P1).

(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 CN1 connector. This function can be used to perform a wiring check. (Refer to section 6.8.) In this case, switch on the control circuit power supply only.
(b) 24VDC or higher voltage is not applied to the pins of connectors CN1.
(c) SD and DOCOM of connector CN1 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 11.4.)
(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 in position control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the position control mode.

4.2.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off the servo-on (SON).
2) Make sure that a command pulse train is not input.
3) Switch on the main circuit power supply and control circuit power supply.
   At power-on, "88888" appears instantaneously, but it is not an error.
   When main circuit power/control circuit power is switched on, the display shows "C (Cumulative feedback pulses)", and in two second later, shows data.

In the absolute position detection system, first power-on results in the absolute position lost (AL.25) alarm and the servo system cannot be switched on.
The alarm can be deactivated 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) Power-off

1) Make sure that a command pulse train is not input.
2) Switch off the Servo-on (SON).
3) Switch off the main circuit power supply and control circuit power supply.

4.2.2 Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:
Refer to section 3.11.3 for the servo motor equipped with electromagnetic brake.

(a) Servo-on (SON) OFF
   The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
   When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
   The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF
   The droop pulse value is erased and the servo motor is stopped and servo-locked. It can be run in the opposite direction.

4.2.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.2.1 for the power on and off methods of the servo amplifier.

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 correctly rotates at the slowest speed. Refer to section 6.9 for the test operation mode.

Test operation of servo motor alone by commands

↓

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When a pulse train is input from the command device, the servo motor starts rotating. 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.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When a pulse train is input from the command device, the servo motor starts rotating. 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. In the status display, check for any problems of the servo motor speed, command pulse frequency, load ratio, etc.
4) Then, check automatic operation with the program of the command device.

4.2.4 Parameter setting

POINT

- The encoder cable MR-EKCBL□M-L/H for the HF-MP series・HF-KP series servo motor requires the parameter No. PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (AL. 16) will occur at power-on.

Encoder Cable	Parameter No. PC22 Setting
MR-EKCBL20M-L/H	0 □□□ (initial value)
MR-EKCBL30M-H	1 □□□
MR-EKCBL40M-H	
MR-EKCBL50M-H	

In the position control mode, the servo amplifier can be used by merely changing the basic setting parameters (No. PA □□) mainly.
As necessary, set the gain filter parameters (No. PB □□), extension setting parameters (No. PC □□) and I/O setting parameters (No. PD □□).

Parameter Group	Main Description
Basic setting parameter (No. PA □□)	Set the basic setting parameters first. Generally, operation can be performed by merely setting this parameter group. In this parameter group, set the following items. Control mode selection (select the position control mode) Regenerative option selection Absolute position detection system selection Setting of command input pulses per revolution Electronic gear setting Auto tuning selection and adjustment In-position range setting Torque limit setting Command pulse input form selection Servo motor rotation direction selection Encoder output pulse setting
Gain filter parameter (No. PB □□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain switching function is used.
Extension setting parameter (No. PC □□)	This parameter group must be set when multiple electronic gears, analog monitor outputs or analog inputs are used.
(Note) I/O setting parameter (No. PD □□)	Used when changing the I/O devices of the servo amplifier.

Note. The parameter No. PA19 setting must be changed when this parameter group is used.

4.2.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings. Perform a home position return as necessary.

4.2.6 Trouble at start-up

CAUTION	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT

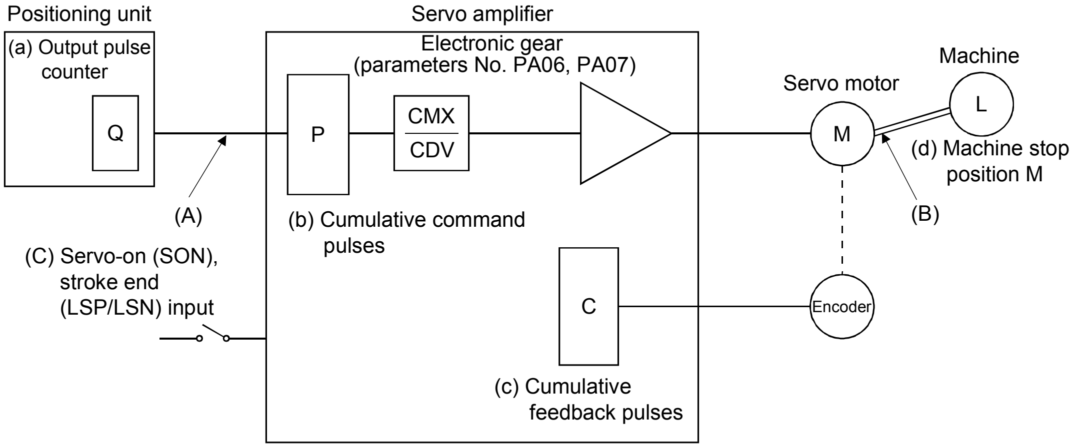
・Using the optional MR Configurator, you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

(1) Troubleshooting

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
2	Switch on servo-on (SON).	Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
		Servo motor shaft is not servo-locked (is free).	1. Check the display to see if the servo amplifier is ready to operate. 2. Check the external I/O signal indication (section 6.7) to see if the servo-on (SON) is ON.	1. Servo-on (SON) is not input. (Wiring mistake) 2. External 24VDC power is not supplied to DICOM.	Section 6.7
3	Enter input command. (Test operation)	Servo motor does not rotate.	Check cumulative command pulses for the status display (section 6.3).	1. Wiring mistake (a) For open collector pulse train input, 24VDC power is not supplied to OPC. (b) LSP and LSN are not on. 2. No pulses is input.	Section 6.3
		Servo motor run in reverse direction.		1. Mistake in wiring to controller. 2. Mistake in setting of parameter No. PA14.	Chapter 5
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
5	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	(2) in this section

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter, (b) cumulative command pulse display, (c) cumulative feedback pulse display, and (d) machine stop position in the above diagram.
(A), (B) and (C) indicate position shift causes. For example, (A) indicates that noise entered the wiring between positioning unit and servo amplifier, causing pulses to be mis-counted.

In a normal status without position shift, there are the following relationships:

1) Q = P (positioning unit's output counter = servo amplifier's cumulative command pulses)
2) When using the electronic gear

$$P \cdot \frac{\text{CMX (parameter No. PA06)}}{\text{CDV (parameter No. PA07)}}$$

= C (cumulative command pulses × electronic gear = cumulative feedback pulses)

3) When using parameter No. PA05 to set the number of pulses per servo motor one rotation.

$$P \cdot \frac{262144}{\text{FBP (parameter No. PA05)}} = C$$

4) $C \cdot \Delta \ell = M$ (cumulative feedback pulses × travel per pulse = machine position)

Check for a position shift in the following sequence:

1) When $Q \neq P$

Noise entered the pulse train signal wiring between positioning unit and servo amplifier, causing pulses to be miss-counted. (Cause A)
Make the following check or take the following measures:
- Check how the shielding is done.
- Change the open collector system to the differential line driver system.
- Run wiring away from the power circuit.
- Install a data line filter. (Refer to section 12.17 (2)(a).)

2) When $P \cdot \frac{\text{CMX}}{\text{CDV}} \neq C$

During operation, the servo-on (SON) or forward/reverse rotation stroke end was switched off or the clear (CR) and the reset (RES) switched on. (Cause C)
If a malfunction may occur due to much noise, increase the input filter setting (parameter No. PD19).

3) When $C \cdot \Delta \ell \neq M$

Mechanical slip occurred between the servo motor and machine. (Cause B)

4.3 Startup in speed control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the speed control mode.

4.3.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off the servo-on (SON).
2) Make sure that the Forward rotation start (ST1) and Reverse rotation start (ST2) are off.
3) Switch on the main circuit power supply and control circuit power supply.
   At power-on, "88888" appears instantaneously, but it is not an error.
   When main circuit power/control circuit power is switched on, the display shows "r (servo motor speed)", and in two second later, shows data.

(2) Power-off

1) Switch off the Forward rotation start (ST1) or Reverse rotation start (ST2).
2) Switch off the Servo-on (SON).
3) Switch off the main circuit power supply and control circuit power supply.

4.3.2 Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:
Refer to section 13.11.13 for the servo motor equipped with electromagnetic brake.

(a) Servo-on (SON) OFF
The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Stroke end (LSP/LSN) OFF
The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2)
The servo motor is decelerated to a stop.

> **POINT**
>
> ・A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

4.3.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.3.1 for the power on and off methods of the servo amplifier.

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 correctly rotates at the slowest speed. Refer to section 6.9 for the test operation mode.

↓

Test operation of servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When the analog speed command (VC) is input from the command device and the Forward rotation start (ST1) or Reverse rotation start (ST2) is switched on, the servo motor starts rotating. 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.

1) Switch on the Emergency stop (EMG) and Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) Switch on the Forward rotation stroke end (LSP) or Reverse rotation stroke end (LSN).
3) When the analog speed command (VC) is input from the command device and the Forward rotation start (ST1) or Reverse rotation start (ST2) is switched on, the servo motor starts rotating. 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. In the status display, check for any problems of the servo motor speed, load ratio, etc.
4) Then, check automatic operation with the program of the command device.

4.3.4 Parameter setting

POINT

- The encoder cable MR-EKCBL□M-L/H for the HF-MP series · HF-KP series servo motor requires the parameter No. PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (AL. 16) will occur at power-on.

Encoder Cable	Parameter No. PC22 Setting
MR-EKCBL20M-L/H	0 □□□ (initial value)
MR-EKCBL30M-H	1 □□□
MR-EKCBL40M-H	
MR-EKCBL50M-H	

When using this servo in the speed control mode, change the parameter No. PA01 setting to select the speed control mode. In the speed control mode, the servo can be used by merely changing the basic setting parameters (No. PA □□) and extension setting parameters (No. PC □□) mainly.
As necessary, set the gain filter parameters (No. PB □□) and I/O setting parameters (No. PD □□).

Parameter Group	Main Description
Basic setting parameter (No. PA □□)	Set the basic setting parameters first. In this parameter group, set the following items. Control mode selection (select the speed control mode) Regenerative option selection Auto tuning selection and adjustment Torque limit setting Encoder output pulse setting
Gain filter parameter (No. PB □□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain switching function is used.
Extension setting parameter (No. PC □□)	In this parameter group, set the following items. Acceleration/deceleration time constant S-pattern acceleration/deceleration time constant Internal speed command Analog speed command maximum speed Analog speed command offset In addition, this parameter group must be set when analog monitor output, torque limit, etc. are used.
(Note) I/O setting parameter (No. PD □□)	Used when changing the I/O devices of the servo amplifier.

Note. The parameter No. PA19 setting must be changed when this parameter group is used.

4.3.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.3.6 Trouble at start-up

CAUTION	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT
・Using the optional servo configuration software, you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
2	Switch on servo-on (SON).	Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
		Servo motor shaft is not servo-locked (is free).	1. Check the display to see if the servo amplifier is ready to operate. 2. Check the external I/O signal indication (section 6.7) to see if the servo-on (SON) is ON.	1. Servo-on (SON) is not input. (Wiring mistake) 2. External 24VDC power is not supplied to DICOM.	Section 6.7
3	Switch on forward rotation start (ST1) or reverse rotation start (ST2).	Servo motor does not rotate.	Call the status display and check the input voltage of the analog speed command (VC).	Analog speed command is 0V.	Section 6.3
			Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	LSP, LSN, ST1 or ST2 is off.	Section 6.7
			Check the internal speed commands 1 to 7 (parameters No. PC05 to PC11).	Set value is 0.	Section 5.1.9
			Check the forward torque limit (Parameter no. PA11) or reverse torque limit (Parameter No. PA12)	Torque limit level is too low as compared to the load torque.	
			When the analog torque limit (TLA) is usable, check the input voltage on the status display.	Torque limit level is too low as compared to the load torque.	
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	Make gain adjustment in the following procedure: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7

4.4 Startup in torque control mode

Make a startup in accordance with section 4.1. This section provides the methods specific to the torque control mode.

4.4.1 Power on and off procedures

(1) Power-on

Switch power on in the following procedure. Always follow this procedure at power-on.

1) Switch off the servo-on (SON).
2) Make sure that the Forward rotation selection (RS1) and Reverse rotation selection (RS2) are off.
3) Switch on the main circuit power supply and control circuit power supply.
   At power-on, "88888" appears instantaneously, but it is not an error.
   When main circuit power/control circuit power is switched on, the display shows "U (torque command voltage)", and in two second later, shows data.

(2) Power-off

1) Switch off the Forward rotation selection (RS1) or Reverse rotation selection (RS2).
2) Switch off the Servo-on (SON).
3) Switch off the main circuit power supply and control circuit power supply.

4.4.2 Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor: Refer to section 3.11.3 for the servo motor equipped with electromagnetic brake.

(a) Servo-on (SON) OFF
The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence
When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF
The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 occurs.

(d) Simultaneous ON or simultaneous OFF of forward rotation selection (RS1) and reverse rotation selection (RS2)
The servo motor coasts.

POINT
・A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

4.4.3 Test operation

Before starting actual operation, perform test operation to make sure that the machine operates normally.
Refer to section 4.4.1 for the power on and off methods of the servo amplifier.

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 correctly rotates at the slowest speed. Refer to section 6.9 for the test operation.

↓

Test operation of servo motor alone by commands

In this step, confirm that the servo motor correctly rotates at the slowest speed under the commands from the command device.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) When the analog speed command (TC) is input from the command device and the Forward rotation start (RS1) or Reverse rotation start (RS2) is switched on, the servo motor starts rotating. 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.

1) Switch on the Servo-on (SON). When the servo amplifier is put in a servo-on status, the Ready (RD) switches on.
2) When the analog speed command (TC) is input from the command device and the Forward rotation start (RS1) or Reverse rotation start (RS2) is switched on, the servo motor starts rotating. 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. In the status display, check for any problems of the servo motor speed, load ratio, etc.
3) Then, check automatic operation with the program of the command device.

4.4.4 Parameter setting

POINT
・The encoder cable MR-EKCBL□M-L/H for the HF-MP series・HF-KP series servo motor requires the parameter No. PC22 setting to be changed depending on its length. Check whether the parameter is set correctly. If it is not set correctly, the encoder error 1 (AL. 16) will occur at power-on.

Encoder Cable	Parameter No. PC22 Setting
MR-EKCBL20M-L/H	0 □□□ (initial value)
MR-EKCBL30M-H	1 □□□
MR-EKCBL40M-H	
MR-EKCBL50M-H	

When using this servo in the torque control mode, change the parameter No. PA01 setting to select the torque control mode. In the torque control mode, the servo can be used by merely changing the basic setting parameters (No. PA □□) and extension setting parameters (No. PC □□) mainly.
As necessary, set the I/O setting parameters (No. PD □□).

Parameter Group	Main Description
Basic setting parameter (No. PA □□)	Set the basic setting parameters first. In this parameter group, set the following items. Control mode selection (select the torque control mode) Regenerative option selection Torque limit setting Encoder output pulse setting
Gain filter parameter (No. PB □□)	If satisfactory operation cannot be achieved by the gain adjustment made by auto tuning, execute in-depth gain adjustment using this parameter group. This parameter group must also be set when the gain switching function is used.
Extension setting parameter (No. PC □□)	In this parameter group, set the following items. Acceleration/deceleration time constant S-pattern acceleration/deceleration time constant Internal torque command Analog torque command maximum speed Analog torque command offset In addition, this parameter group must be set when analog monitor output, speed limit, etc. are used.
(Note) I/O setting parameter (No. PD □□)	Used when changing the I/O devices of the servo amplifier.

Note. The parameter No. PA19 setting must be changed when this parameter group is used.

4.4.5 Actual operation

Start actual operation after confirmation of normal operation by test operation and completion of the corresponding parameter settings.

4.4.6 Trouble at start-up

CAUTION	・Excessive adjustment or change of parameter setting must not be made as it will make operation instable.

POINT
・Using the optional servo configuration software, you can refer to unrotated servo motor reasons, etc.

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on	・LED is not lit. ・LED flickers.	Not improved if connectors CN1, CN2 and CN3 are disconnected.	1. Power supply voltage fault 2. Servo amplifier is faulty.	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
2	Switch on servo-on (SON).	Alarm occurs.	Refer to chapter 9 and remove cause.		Chapter 9
		Servo motor shaft is free.	Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	1. Servo-on (SON) is not input. (Wiring mistake) 2. External 24VDC power is not supplied to DICOM.	Section 6.7
3	Switch on forward rotation start (RS1) or reverse rotation start (RS2).	Servo motor does not rotate.	Call the status display (section 6.3) and check the analog torque command (TC).	Analog torque command is 0V.	Section 6.3
			Call the external I/O signal display (section 6.7) and check the ON/OFF status of the input signal.	RS1 or RS2 is off.	Section 6.7
			Check the internal speed limits 1 to 7 (parameters No. PC05 to PC11).	Set value is 0.	Section 5.3
			Check the analog torque command maximum output (parameter No. 26) value.	Torque command level is too low as compared to the load torque.	
			Check the internal torque limit 1 (parameter No. PC13).	Set value is 0.	Section 5.1.11

5. PARAMETERS

⚠CAUTION	・Never adjust or change the parameter values extremely as it will make operation instable.

In the MR-J3-A servo amplifier, the parameters are classified into the following groups on a function basis.

Parameter Group	Main Description
Basic setting parameters (No. PA□□)	When using this servo amplifier in the position control mode, make basic setting with these parameters.
Gain/filter parameters (No. PB□□)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No. PC□□)	When using this servo amplifier in the speed control mode or torque control mode, mainly use these parameters.
I/O setting parameters (No. PD□□)	Use these parameters when changing the I/O signals of the servo amplifier.

When using this servo in the position control mode, 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
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

5.1.1 Parameter list

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
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	*FBP	Number of command input pulses per revolution	0		○		
PA06	CMX	Electronic gear numerator (Command pulse multiplying factor numerator)	1		○		
PA07	CDV	Electronic gear denominator (Command pulse multiplying factor denominator)	1		○		
PA08	ATU	Auto tuning	0001h		○	○	
PA09	RSP	Auto tuning response	12		○	○	
PA10	INP	In-position range	100	pulse	○		
PA11	TLP	Forward torque limit	100.0	%	○	○	○
PA12	TLN	Reverse torque limit	100.0	%	○	○	○
PA13	*PLSS	Command pulse input from	0000h		○		
PA14	*POL	Rotation direction selection	0		○		
PA15	*ENR	Encoder output pulses	4000	pulse/rev	○	○	○
PA16		For manufacturer setting	0				
PA17			0000h				
PA18			0000h				
PA19	*BLK	Parameter write inhibit	000Bh		○	○	○

5.1.2 Parameter write inhibit

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA19	*BLK	Parameter write inhibit	000Bh		Refer to the text.	○	○	○

POINT
- This parameter is made valid when power is switched off, then on after setting.

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□□
0000h	Reference	○			
	Write	○			
000Bh (initial value)	Reference	○	○	○	
	Write	○	○	○	
000Ch	Reference	○	○	○	○
	Write	○	○	○	○
100Bh	Reference	○			
	Write	Parameter No. PA19 only			
100Ch	Reference	○	○	○	○
	Write	Parameter No. PA19 only			

5.1.3 Selection of control mode

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA01	*STY	Control mode	0000h		Refer to the text.	○	○	○

POINT
- This parameter is made valid when power is switched off, then on after setting.

Select the control mode of the servo amplifier.

Parameter No. PA01

0	0	0	

Selection of control mode
0: Position control mode
1: Position control mode and speed control mode
2: Speed control mode
3: Speed control mode and torque control mode
4: Torque control mode
5: Torque control mode and position control mode

5.1.4 Selection of regenerative option

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA02	*REG	Regenerative option	0000h		Refer to the text.	○	○	○

POINT

- This parameter is made valid when power is switched off, then on after setting.
- Wrong setting may cause the regenerative option to burn.
- If the regenerative option selected is not for use with the servo amplifier, parameter error (AL. 37) occurs.

Set this parameter when using the regenerative option.

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 200 to 7kW, built-in regenerative resistor is used.
- Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11k to 22kW.
- For a drive unit of 30kW or more, select regenerative option by the converter unit.

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.

5.1.5 Using absolute position detection system

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA03	*ABS	Absolute position detection system	0000h		Refer to the text.	○		

> **POINT**
> - This parameter is made valid when power is switched off, then on after setting.

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 14)
0: Used in incremental system
1: Used in absolute position detection system
ABS transfer by DI0
2: Used in absolute position detection system
ABS transfer by communication

5.1.6 Using electromagnetic brake interlock (MBR)

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA04	*AOP1	Function selection A-1	0000h		Refer to the text.	○	○	○

> **POINT**
> - This parameter is made valid when power is switched off, then on after setting.

Set this parameter when assigning the electromagnetic brake to the CN1-23 pin.

Parameter No. PA04

0	0	0	

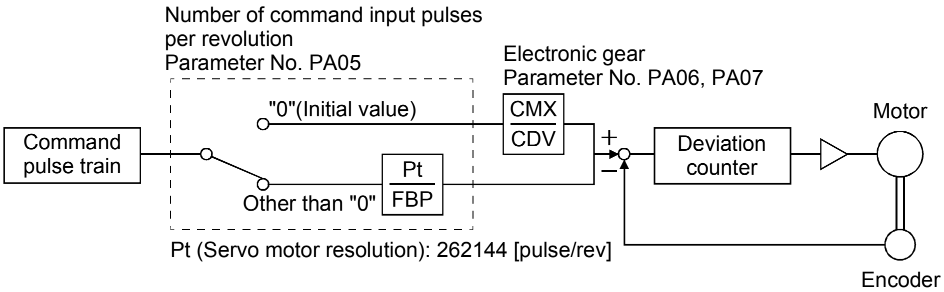
CN1-23 pin function selection
0: Output device assigned with parameter No. PD14
1: Electromagnetic brake interlock (MBR)

5.1.7 Number of command input pulses per servo motor revolution

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA05	*FBP	Number of command input pulses per revolution	0		0 · 1000 to 50000	○		

POINT
- This parameter is made valid when power is switched off, then on after setting.

When "0" (initial value) is set in parameter No. PA05, the electronic gear (parameter No. PA06, No. PA07) is made valid. When the setting is other than "0", that value is used as the command input pulses necessary to rotate the servo motor one turn. At this time, the electronic gear is made invalid.



Parameter No. PA05 Setting	Description
0	Electronic gear (parameter No. PA06, No. PA07) is made valid.
1000 to 50000	Number of command input pulses necessary to rotate the servo motor one turn [pulse]

5.1.8 Electronic gear

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA06	CMX	Electronic gear numerator (command pulse multiplying factor numerator)	1		1 to 1048576	○		
PA07	CDV	Electronic gear denominator (command pulse multiplying factor denominator)	1		1 to 1048576	○		

CAUTION ・Wrong setting can lead to unexpected fast rotation, causing injury.

POINT

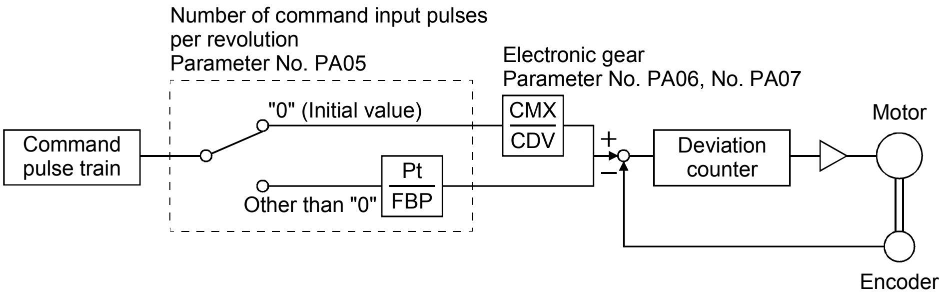
・The electronic gear setting range is $\frac{1}{10} < \frac{CMX}{CDV} < 2000$.

If the set value is outside this range, noise may be generated during acceleration/ deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.

・The following specification symbols are required to calculate the electronic gear.

(1) Concept of electronic gear

The machine can be moved at any multiplication factor to input pulses.



$$\frac{CMX}{CDV} = \frac{\text{Parameter No. PA06}}{\text{Parameter No. PA07}}$$

The following setting examples are used to explain how to calculate the electronic gear:

POINT

・The following specification symbols are required to calculate the electronic gear

Pb : Ballscrew lead [mm]

n : Reduction ratio

Pt : Servo motor resolution [pulses/rev]

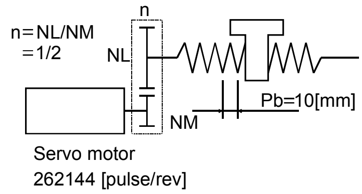
$\Delta \ell_0$: Travel per command pulse [mm/pulse]

ΔS : Travel per servo motor revolution [mm/rev]

$\Delta \theta^\circ$: Angle per pulse [° /pulse]

$\Delta \theta$: Angle per revolution [° /rev]

(a) For motion in increments of 10μm per pulse



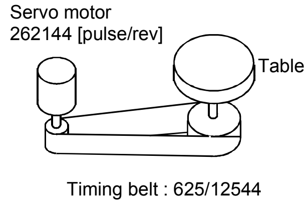
Machine specifications

Ballscrew lead Pb =10 [mm]
Reduction ratio: n = 1/2
Servo motor resolution: Pt = 262144 [pulse/rev]

$$\frac{CMX}{CDV} = \Delta \ell_0 \cdot \frac{Pt}{\Delta S} = \Delta \ell_0 \cdot \frac{Pt}{n \cdot Pb} = 10 \times 10^{-3} \cdot \frac{262144}{1/2 \cdot 10} = \frac{524288}{1000} = \frac{65536}{125}$$

Hence, set 65538 to CMX and 125 to CDV.

(b) Conveyor setting example
For rotation in increments of 0.01° per pulse



Machine specifications

Table : 360° /rev
Reduction ratio: n = 625/12544
Servo motor resolution: Pt = 262144 [pulse/rev]

$$\frac{CMX}{CDV} = \Delta\theta^\circ \cdot \frac{Pt}{\Delta\theta} = 0.01 \cdot \frac{262144}{625/12544 \cdot 360} = \frac{102760448}{703125} \quad \text{.......} (5.1)$$

Since CMX is not within the setting range in this status, it must be reduced to the lowest term. When CMX has been reduced to a value within the setting range, round off the value to the nearest unit.

$$\frac{CMX}{CDV} = \frac{102760448}{703125} = \frac{822083.6}{5625} \cong \frac{822084}{5625}$$

Hence, set 822084 to CMX and 5625 to CDV.

POINT
・For unlimited one-way rotation, e.g. an index table, indexing positions will be missed due to cumulative error produced by rounding off. ・For example, entering a command of 36000 pulses in the above example causes the table to rotate only: $36000 \cdot \frac{822084}{5625} \cdot \frac{1}{262144} \cdot \frac{625}{12544} \cdot 360^\circ = 360.00018^\circ$ ・Therefore, indexing cannot be done in the same position on the table.

(2) Instructions for reduction

The calculated value before reduction must be as near as possible to the calculated value after reduction. In the case of (1), (b) in this section, an error will be smaller if reduction is made to provide no fraction for CDV. The fraction of Expression (5.1) before reduction is calculated as follows.

$$\frac{CMX}{CDV} = \frac{102760488}{7023125} = 146.1481927 \quad \cdots\cdots (5.2)$$

The result of reduction to provide no fraction for CMX is as follows.

$$\frac{CMX}{CDV} = \frac{102760488}{7023125} = \frac{917504}{6277.9} \fallingdotseq \frac{917504}{62778} = 146.1459063 \quad \cdots\cdots (5.3)$$

The result of reduction to provide no fraction for CDV is as follows.

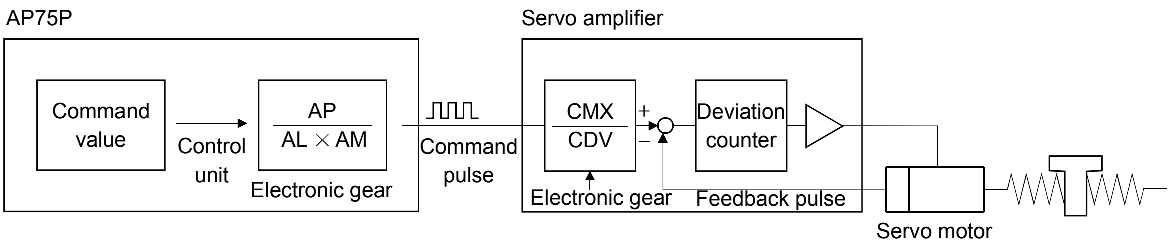
$$\frac{CMX}{CDV} = \frac{102760488}{7023125} = \frac{822083.6}{5625} \fallingdotseq \frac{822084}{5625} = 146.1482667 \quad \cdots\cdots (5.4)$$

As a result, it is understood that the value nearer to the calculation result of Expression (5.2) is the result of Expression (5.4). Accordingly, the set values of (1), (b) in this section are CMX=822084, CDV=5625.

(3) Setting for use of QD75

The QD75 also has the following electronic gear parameters. Normally, the servo amplifier side electronic gear must also be set due to the restriction on the command pulse frequency (differential 1Mpulse/s, open collector 200kpulse/s).

AP: Number of pulses per motor revolution
AL: Moving distance per motor revolution
AM: Unit scale factor



The resolution of the servo motor is 262144 pulses/rev. For example, the pulse command needed to rotate the servo motor is as follows

Servo motor speed [r/min]	Required pulse command
2000	262144 × 2000/60=8738133 pulse/s
3000	262144 × 3000/60=13107200 pulse/s

Use the electronic gear of the servo amplifier to run the servo motor under the maximum output pulse command of the QD75.

To rotate the servo motor at 3000r/min in the open collector system (200kpulse/s), set the electronic gear as follows

$$f \cdot \frac{CMX}{CDV} = \frac{N_0}{60} \cdot Pt$$

f : Input pulses [pulse/s]
N_0 : Servo motor speed [r/min]
Pt : Servo motor resolution [pulse/rev]

$$200 \cdot 10^3 \cdot \frac{CMX}{CDV} = \frac{3000}{60} \cdot 262144$$

$$\frac{CMX}{CDV} = \frac{3000}{60} \cdot \frac{262144}{200 \cdot 10^3} = \frac{3000 \cdot 262144}{60 \cdot 200000} = \frac{8192}{125}$$

The following table indicates the electronic gear setting example (ballscrew lead = 10mm) when the QD75 is used in this way.

Rated servo motor speed				3000r/min		2000r/min	
Servo amplifier	Input system			Open collector	Differential line driver	Open collector	Differential line driver
	Max. input pulse frequency [pulse/s]			200k	1M	200k	1M
	Feedback pulse/revolution [pulse/rev]			262144		262144	
	Electronic gear (CMX/CDV)			8192/125	8192/625	16384/375	16384/1875
AD75P	Command pulse frequency [kpulse/s] (Note)			200k	1M	200k	1M
	Number of pulses per servo motor revolution as viewed from QD75[pulse/rev]			4000	20000	6000	30000
	Electronic gear	Minimum command unit 1pulse	AP	1	1	1	1
			AL	1	1	1	1
			AM	1	1	1	1
		Minimum command unit 0.1μm	AP	4000	20000	6000	30000
			AL	100.0[μm]	100.0[μm]	100.0[μm]	100.0[μm]
			AM	10	10	10	10

Note. Command pulse frequency at rated speed

POINT

- In addition to the setting method using the electronic gear given here, the number of pulses per servo motor revolution can also be set directly using parameter No. PA05. In this case, parameter No. PA05 is the "Number of pulses per servo motor revolution as viewed from QD75".

5.1.9 Auto tuning

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA08	ATU	Auto tuning mode	0001h		Refer to the text.	○	○	
PA09	RSP	Auto tuning response	12		1 to 32	○	○	

Make gain adjustment using auto tuning. Refer to section 7.2 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	Ratio of load inertia moment to servo motor inertia moment
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.

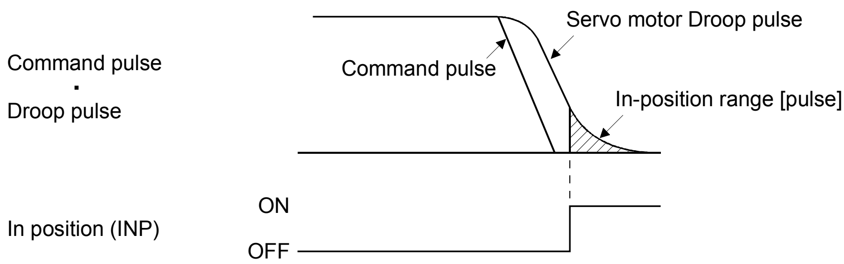
Setting	Response	Guideline for Machine Resonance Frequency [Hz]
1	Low response	10.0
2		11.3
3		12.7
4		14.3
5		16.1
6		18.1
7		20.4
8		23.0
9		25.9
10		29.2
11		32.9
12		37.0
13		41.7
14		47.0
15		52.9
16	Middle response	59.6

Setting	Response	Guideline for Machine Resonance Frequency [Hz]
17	Low response	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	Middle response	400.0

5.1.10 In-position range

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA10	INP	In-position range	100	pulse	0 to 65535	○		

Set the range, where In position (INP) is output, in the command pulse unit before calculation of the electronic gear. With the setting of parameter No. PC24, the range can be changed to the encoder output pulse unit.



5.1.11 Torque limit

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA11	TLP	Forward rotation torque limit	100.0	%	0 to 100.0	○	○	○
PA12	TLN	Reverse rotation torque limit	100.0	%	0 to 100.0	○	○	○

The torque generated by the servo motor can be limited. Refer to section 3.6.1 (5) and use these parameters.
When torque is output with the analog monitor output, the larger torque of the values in this parameter and parameter No. PA12 (reverse rotation torque limit) is the maximum output voltage (＋8V).

(1) Forward rotation torque limit (parameter No. PA11)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CCW driving mode or CW regeneration mode. Set this parameter to "0.0" to generate no torque.

(2) Reverse rotation torque limit (parameter No. PA12)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CW driving mode or CCW regeneration mode. Set this parameter to "0.0" to generate no torque.

5.1.12 Selection of command pulse input form

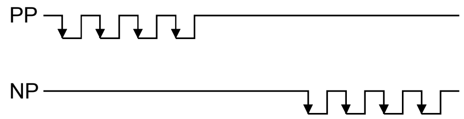
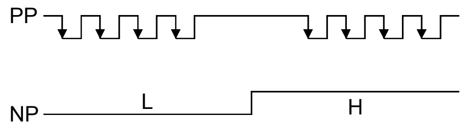
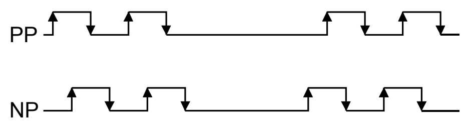
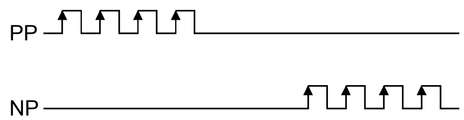
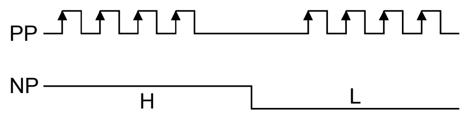
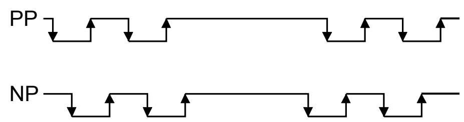
Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA13	*PLSS	Command pulse input form	0000h		Refer to the text.	○		

POINT

- This parameter is made valid when power is switched off, then on after setting.

Select the input form of the pulse train input signal. Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen.
Arrow or in the table indicates the timing of importing a pulse train.
A- and B-phase pulse trains are imported after they have been multiplied by 4.

Selection of command pulse input form

Setting	Pulse train form		Forward rotation command	Reverse rotation command
0010h	Negative logic	Forward rotation pulse train Reverse rotation pulse train		
0011h		Pulse train + sign		
0012h		A-phase pulse train B-phase pulse train		
0000h	Positive logic	Forward rotation pulse train Reverse rotation pulse train		
0001h		Pulse train + sign		
0002h		A-phase pulse train B-phase pulse train		

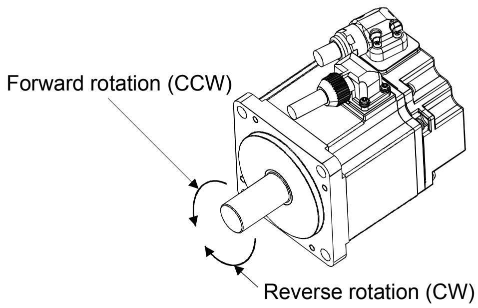
5.1.13 Selection of servo motor rotation direction

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA14	*POL	Rotation direction selection	0		0・1	○		

> **POINT**
> ・This parameter is made valid when power is switched off, then on after setting.

Select servo motor rotation direction relative to the input pulse train.

Parameter No. PA14 Setting	Servo Motor Rotation Direction	
	When forward rotation pulse is input (Note)	When reverse rotation pulse is input (Note)
0	CCW	CW
1	CW	CCW



5.1.14 Encoder output pulse

Parameter			Initial Value	Unit	Setting Range	Control Mode		
No.	Symbol	Name				Position	Speed	Torque
PA15	*ENR	Encoder output pulse	4000	pulse/rev	1 to 100000	○	○	○

> **POINT**
> ・This parameter is made valid when power is switched off, then on after setting.

Used to set the encoder pulses (A-phase, B-phase) output by the servo amplifier.
Set the value 4 times greater than the A-phase or B-phase pulses.
You can use parameter No. PC19 to choose the output pulse setting or output division ratio setting.
The number of A/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. PC19.

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 output A/B-phase pulses are as indicated below:

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

(2) For output division ratio setting

Set " □□1□ " in parameter No. PC19.

The number of pulses per servo motor revolution is divided by the set value.

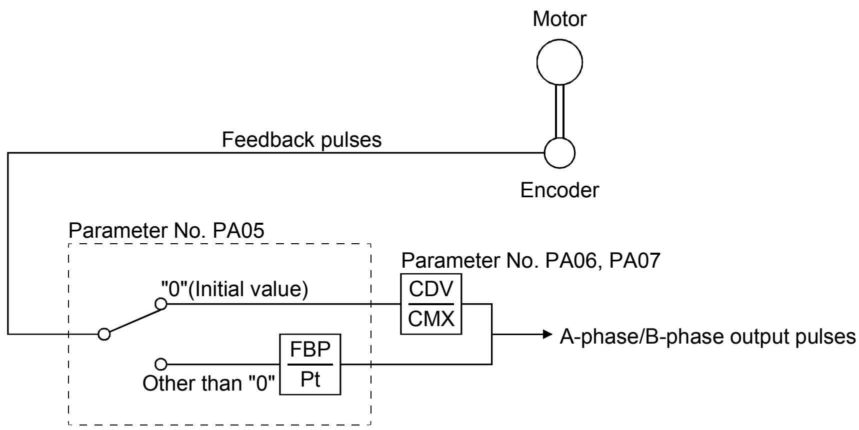
Output pulse $= \frac{\text{Resolution per servo motor revolution}}{\text{Set value}}$ [pulses/rev]

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

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

(3) When outputting pulse train similar to command pulses

Set parameter No. PC19 to " □□2□ ". The feedback pulses from the servo motor encoder are processed and output as shown below. The feedback pulses can be output in the same pulse unit as the command pulses.



5.2 Gain/filter parameters (No. PB□□)

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

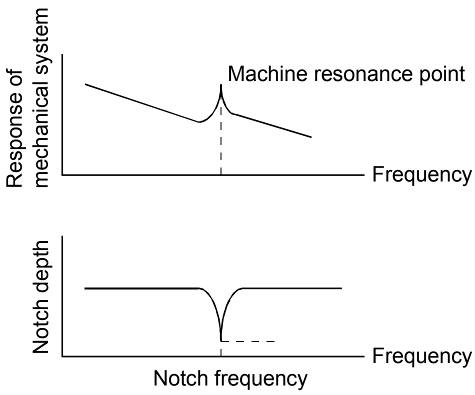
5.2.1 Parameter list

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	0000h		○	○	
PB02	VRFT	Vibration suppression control filter tuning mode (Advanced vibration suppression control)	0000h		○		
PB03	PST	Position command acceleration/deceleration time constant (Position smoothing)	0	ms	○		
PB04	FFC	Feed forward gain	0	%	○		
PB05		For manufacturer setting	500				
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	7.0	times	○	○	
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		For manufacturer setting	0				
PB13	NH1	Machine resonance suppression filter 1	4500	Hz	○	○	
PB14	NHQ1	Notch form selection 1	0000h		○	○	
PB15	NH2	Machine resonance suppression filter 2	4500	Hz	○	○	
PB16	NHQ2	Notch form selection 2	0000h		○	○	
PB17		Automatic setting parameter					
PB18	LPF	Low-pass filter	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	*BOP1	Function selection B-1	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 ratio of load inertia moment to servo motor inertia moment	7.0	times	○	○	
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				
PB37			100				
PB38			0.0				
PB39			0.0				
PB40			0.0				
PB41			1125				

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
PB42		For manufacturer setting	1125				
PB43			0004h				
PB44			0.0				
PB45			0000h				

5.2.2 Detail list

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
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			○	○	



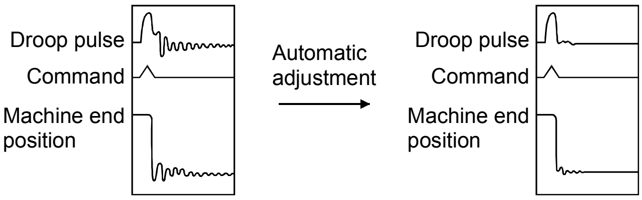
0 0 0 □

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	

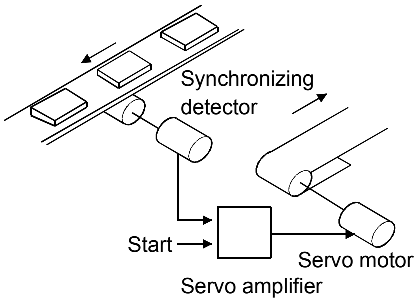
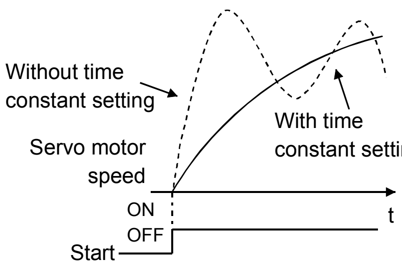
Note. Parameter No. PB13 and PB14 are fixed to the initial values.

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 rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PB02</td><td>VRFT</td><td>Vibration suppression control tuning mode (advanced vibration suppression control)
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></td><td>○</td><td></td><td></td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode: Position	Control Mode: Speed	Control Mode: Torque
PB03	PST	Position command acceleration/deceleration time constant (position smoothing) Used to set the time constant of a low-pass filter in response to the position command. You can use parameter No. PB25 to choose the primary delay or linear acceleration/deceleration control system. When you choose linear acceleration/deceleration, the setting range is 0 to 10ms. Setting of longer than 10ms is recognized as 10ms. **POINT** ・When you have chosen linear acceleration/deceleration, do not select control selection (parameter No. PA01) and restart after instantaneous power failure (parameter No. PC22). Doing so will cause the servo motor to make a sudden stop at the time of position control switching or restart. Example: When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation.   	0	ms	0 to 20000	○		
PB04	FFC	Feed forward gain Set the feed forward gain. When the setting is 100%, the droop pulses 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/deceleration time constant up to the rated speed.	0	%	0 to 100	○		
PB05		For manufacturer setting Do not change this value by any means.	500					
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment 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 7.1.1) In this case, it varies between 0 and 100.0.	7.0	times	0 to 300.0	○	○	

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
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.	24	rad/s	1 to 2000	○	○	
PB08	PG2	Position loop gain 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.	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. Note. The setting range of 50000 applies to the servo amplifier whose software version is A3 or later. The setting range of the servo amplifier whose software version is older than A3 is 20 to 20000. When the software version of MR Configurator is A3 or earlier, 20001 or more cannot be set. Use the display/operation section of the servo amplifier to set 20001 or more.	823	rad/s	20 to 50000 (Note)	○	○	
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.	33.7	ms	0.1 to 1000.0	○	○	
PB11	VDC	Speed differential compensation Used to set the differential compensation. Made valid when the proportion control (PC) is switched on.	980		0 to 1000	○	○	
PB12		For manufacturer setting Do not change this value by any means.	0					
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 rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</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><td>○</td><td>○</td><td></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><td>○</td><td>○</td><td></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><td>○</td><td>○</td><td></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 (Ratio of load inertia moment to servo motor inertia moment).</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
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 Set the vibration frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. 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 Set the resonance frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. 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. When parameter No. PA08 (auto tuning mode) is set to "□□□3", this parameter is made valid. 0 0 0 □ Slight vibration suppression control selection 0: Invalid 1: Valid	0000h		Refer to Name and function column.	○		

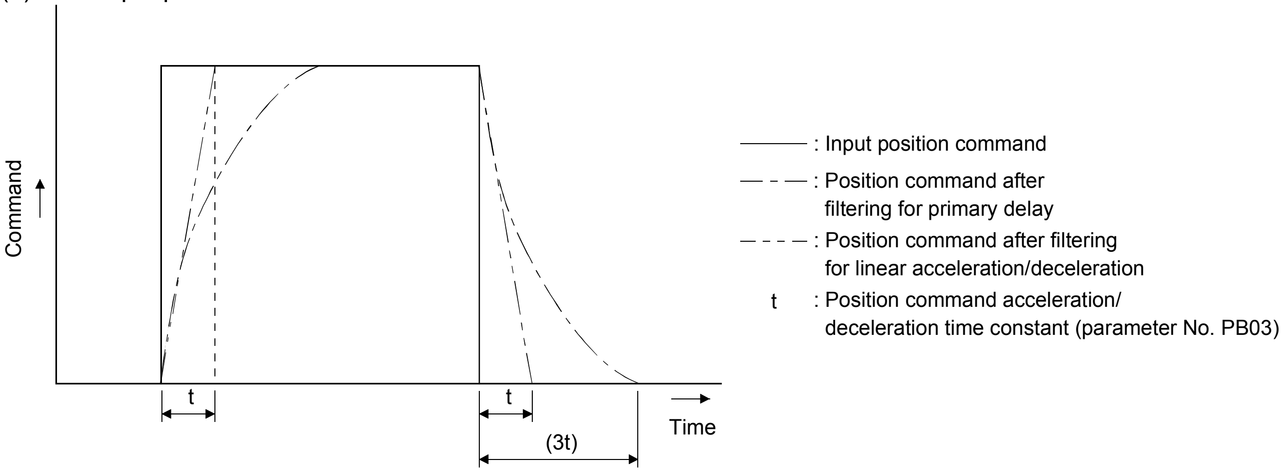
No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
PB25	*BOP1	Function selection B-1 Select the control systems for position command acceleration/deceleration time constant (parameter No. PB03). 0 0 □ 0 Control of position command acceleration/ deceleration time constant 0: Primary delay 1: Linear acceleration/deceleration When linear acceleration/deceleration has been selected, do not execute control switching after instantaneous power failure. The servo motor will make a hard stop at control switching or automatic restart.	0000h		Refer to Name and function column.	○		
PB26	*CDP	Gain changing selection Select the gain changing condition. (Refer to section 8.6.) 0 0 □ □ Gain changing selection Under any of the following conditions, the gains change on the basis of the parameter No. PB29 to PB32 settings. 0: Invalid 1: Gain changing (CDP) is ON 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 at more than condition (Valid when gain changing (CDP) is ON) 1: Valid at less than condition (Valid when gain changing (CDP) is OFF))	0000h		Refer to Name and function column.	○	○	
PB27	CDL	Gain changing condition Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No. PB26.The set value unit changes with the changing condition item. (Refer to section 8.6.)	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 8.6.)	1	ms	0 to 100	○	○	
PB29	GD2B	Gain changing - ratio of load inertia moment to servo motor inertia moment Used to set the ratio of load inertia moment to servo motor inertia moment when gain changing is valid. This parameter is made valid when the auto tuning is invalid (parameter No. PA08: □□□ 3).	7.0	times	0 to 300.0	○	○	
PB30	PG2B	Gain changing - position loop gain 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	○		

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
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). Note. The setting range of 50000 applies to the servo amplifier whose software version is A3 or later. The setting range of the servo amplifier whose software version is older than A3 is 20 to 20000. When the software version of MR Configurator is A3 or earlier, 20001 or more cannot be set. Use the display/operation section of the servo amplifier to set 20001 or more.	823	rad/s	20 to 20000	○	○	
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 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 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	○		
PB35		For manufacturer setting Do not change this value by any means.	0.00					
PB36			0.00					
PB37			100					
PB38			0.0					
PB39			0.0					
PB40			0.0					
PB41			1125					
PB42			1125					
PB43			0004h					
PB44			0.0					
PB45			0000h					

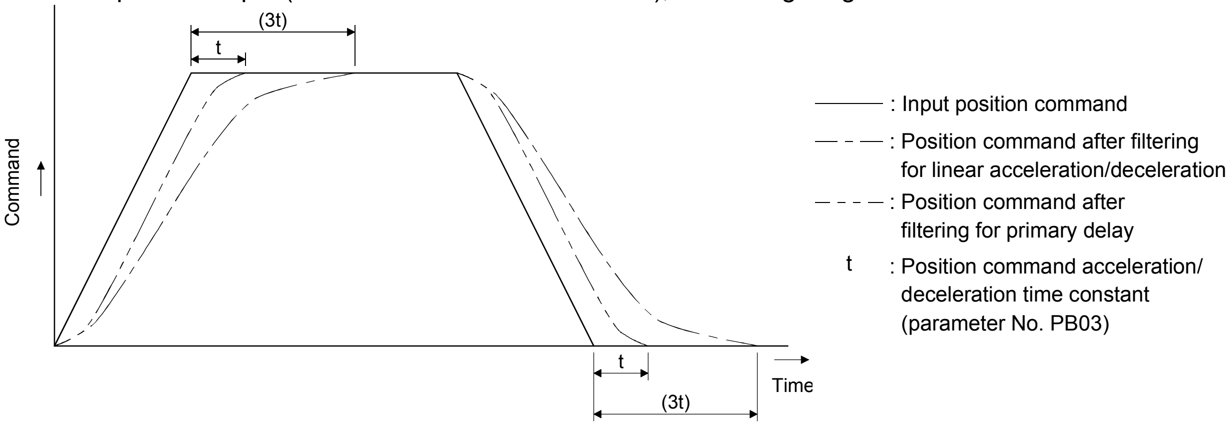
5.2.3 Position smoothing

By setting the position command acceleration/deceleration time constant (parameter No. PB03), you can run the servo motor smoothly in response to a sudden position command.
The following diagrams show the operation patterns of the servo motor in response to a position command when you have set the position command acceleration/deceleration time constant.
Choose the primary delay or linear acceleration/deceleration in parameter No. PB25 according to the machine used.

(1) For step input



(2) For trapezoidal input
For trapezoidal input (linear acceleration/deceleration), the setting range is 0 to 10ms.



5.3 Extension setting parameters (No. PC□□)

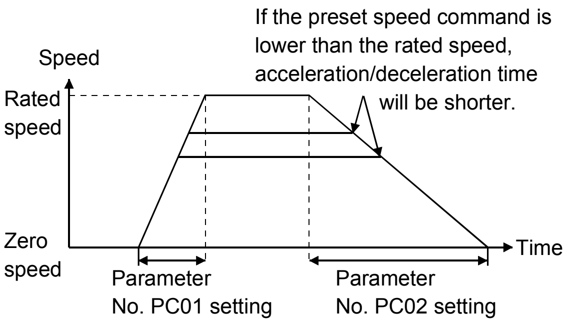
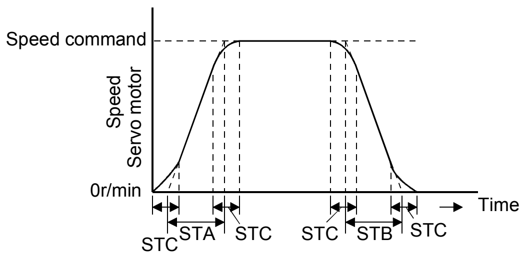
POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

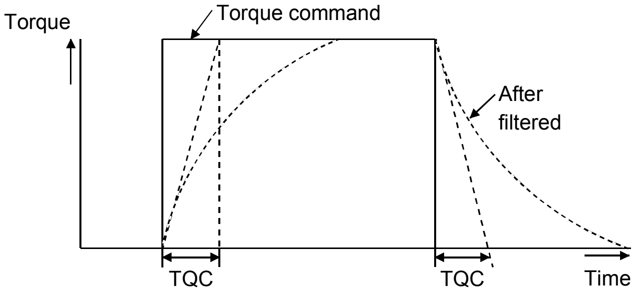
5.3.1 Parameter list

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
PC01	STA	Acceleration time constant	0	ms		○	○
PC02	STB	Deceleration time constant	0	ms		○	○
PC03	STC	S-pattern acceleration/deceleration time constant	0	ms		○	○
PC04	TQC	Torque command time constant	0	ms			○
PC05	SC1	Internal speed command 1	100	r/min		○	
		Internal speed limit 1					○
PC06	SC2	Internal speed command 2	500	r/min		○	
		Internal speed limit 2					○
PC07	SC3	Internal speed command 3	1000	r/min		○	
		Internal speed limit 3					○
PC08	SC4	Internal speed command 4	200	r/min		○	
		Internal speed limit 4					○
PC09	SC5	Internal speed command 5	300	r/min		○	
		Internal speed limit 5					○
PC10	SC6	Internal speed command 6	500	r/min		○	
		Internal speed limit 6					○
PC11	SC7	Internal speed command 7	800	r/min		○	
		Internal speed limit 7					○
PC12	VCM	Analog speed command maximum speed	0	r/min		○	
		Analog speed limit maximum speed					○
PC13	TLC	Analog torque command maximum output	100.0	%			○
PC14	MOD1	Analog monitor output 1	0000h		○	○	○
PC15	MOD2	Analog monitor output 2	0001h		○	○	○
PC16	MBR	Electromagnetic brake sequence output	100	ms	○	○	○
PC17	ZSP	Zero speed	50	r/min	○	○	○
PC18	*BPS	Alarm history clear	0000h		○	○	○
PC19	*ENRS	Encoder output pulses selection	0000h		○	○	○
PC20	*SNO	Station number setting	0	station	○	○	○
PC21	*SOP	Communication function selection	0000h		○	○	○
PC22	*COP1	Function selection C-1	0000h		○	○	○
PC23	*COP2	Function selection C-2	0000h			○	○
PC24	*COP3	Function selection C-3	0000h		○		
PC25		For manufacturer setting	0000h				
PC26	*COP5	Function selection C-5	0000h		○	○	
PC27		For manufacturer setting	0000h				
PC28			0000h				
PC29			0000h				
PC30	STA2	Acceleration time constant 2	0	ms		○	○
PC31	STB2	Deceleration time constant 2	0	ms		○	○
PC32	CMX2	Command pulse multiplying factor numerator 2	1		○		
PC33	CMX3	Command pulse multiplying factor numerator 3	1		○		

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
PC34	CMX4	Command pulse multiplying factor numerator 4	1		○		
PC35	TL2	Internal torque limit 2	100.0	%	○	○	○
PC36	*DMD	Status display selection	0000h		○	○	○
PC37	VCO	Analog speed command offset	0	mV		○	
		Analog speed limit offset					○
PC38	TPO	Analog torque command offset	0	mV			○
		Analog torque limit offset				○	
PC39	MO1	Analog monitor 1 offset	0	mV	○	○	○
PC40	MO2	Analog monitor 2 offset	0	mV	○	○	○
PC41		For manufacturer setting	0				
PC42			0				
PC43			0				
PC44			0				
PC45			0				
PC46			0				
PC47			0				
PC48			0				
PC49			0				
PC50			0				

5.3.2 List of details

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
PC01	STA	Acceleration time constant Used to set the acceleration time required to reach the rated speed from 0r/min in response to the analog speed command and internal speed commands 1 to 7.  For example for the servo motor of 3000r/min rated speed, set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second.	0	ms	0 to 50000		○	○
PC02	STB	Deceleration time constant Used to set the deceleration time required to reach 0r/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○
PC03	STC	S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration.  STA: Acceleration time constant (parameter No. PC01) STB: Deceleration time constant (parameter No. PC02) STC: S-pattern acceleration/deceleration time constant (parameter No. PC03) Long setting of STA (acceleration time constant) or STB (deceleration time constant) may produce an error in the time of the arc part for the setting of the S-pattern acceleration/deceleration time constant. The upper limit value of the actual arc part time is limited by $\frac{2000000}{STA}$ for acceleration or by $\frac{2000000}{STB}$ for deceleration. (Example) At the setting of STA=20000, STB=5000 and STC=200, the actual arc part times are as follows: During acceleration: 100[ms] $\left(\text{Limited to 100[ms] since } \frac{2000000}{20000} = 100\text{[ms]} < 200\text{[ms]}. \right)$ During deceleration: 200[ms] $\left(\text{200[ms] as set since } \frac{2000000}{5000} = 400\text{[ms]} > 200\text{[ms]}. \right)$	0	ms	0 to 1000		○	○

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
PC04	TQC	Torque command time constant Used to set the constant of a low-pass filter in response to the torque command.  TQC: Torque command time constant	0	ms	0 to 20000			○
PC05	SC1	Internal speed command 1 Used to set speed 1 of internal speed commands.	100	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 1 Used to set speed 1 of internal speed limits.						○
PC06	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 2 Used to set speed 2 of internal speed limits.						○
PC07	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 3 Used to set speed 3 of internal speed limits.						○
PC08	SC4	Internal speed command 4 Used to set speed 4 of internal speed commands.	200	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 4 Used to set speed 4 of internal speed limits.						○
PC09	SC5	Internal speed command 5 Used to set speed 5 of internal speed commands.	300	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 5 Used to set speed 5 of internal speed limits.						○
PC10	SC6	Internal speed command 6 Used to set speed 6 of internal speed commands.	500	r/min	0 to instantaneous permissible speed		○	
		Internal speed limit 6 Used to set speed 6 of internal speed limits.						○

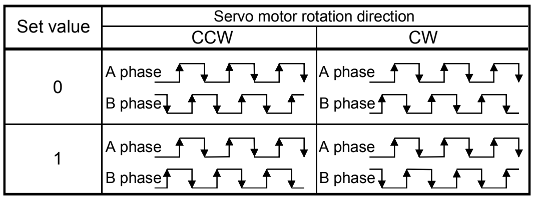
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td rowspan="2">PC11</td><td rowspan="2">SC7</td><td>Internal speed command 7
Used to set speed 7 of internal speed commands.</td><td rowspan="2">800</td><td rowspan="2">r/min</td><td rowspan="2">0 to instan-taneous permi-ssible speed</td><td></td><td>○</td><td></td></tr>
<tr><td>Internal speed limit 7
Used to set speed 7 of internal speed limits.</td><td></td><td></td><td>○</td></tr>
<tr><td rowspan="2">PC12</td><td rowspan="2">VCM</td><td>Analog speed command maximum speed
Used to set the speed at the maximum input voltage (10V) of the analog speed command (VC).
Set "0" to select the rated speed of the servo motor connected.
The speed is as indicated below for motorless operation of test operation.
<table>
<tr><th colspan="2">Servo amplifier capacity [W]</th><th>Servo motor speed [r/min]</th></tr>
<tr><td>100V class</td><td>100 to 400</td><td rowspan="2">3000</td></tr>
<tr><td rowspan="2">200V class</td><td>100 to 750</td></tr>
<tr><td>1k to 37k</td><td rowspan="2">2000</td></tr>
<tr><td>400V class</td><td>600 to 55k</td></tr>
</table></td><td>0</td><td>
r/min</td><td>0
1
to
50000</td><td></td><td>○</td><td></td></tr>
<tr><td>Analog speed limit maximum speed
Used to set the speed at the maximum input voltage (10V) of the analog speed limit (VLA).
Set "0" to select the rated speed of the servo motor connected.</td><td>0</td><td>
r/min</td><td>0
1
to
50000</td><td></td><td></td><td>○</td></tr>
<tr><td>PC13</td><td>TLC</td><td>Analog torque command maximum output
Used to set the output torque at the analog torque command voltage (TC = ±8V) of +8V on the assumption that the maximum torque is 100[%]. For example, set 50 to output (maximum torque × 50/100) at the TC of +8V.</td><td>100.0</td><td>%</td><td>0
to
1000.0</td><td></td><td></td><td>○</td></tr>
</table>

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and Function</th><th>Initial Value</th><th>Unit</th><th>Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><td>PC14</td><td>MOD1</td><td>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 0
Analog monitor 1 (MO1) output selection
<table>
<tr><th>Setting</th><th>Item</th></tr>
<tr><td>0</td><td>Servo motor speed (±8V/max. speed)</td></tr>
<tr><td>1</td><td>Torque (±8V/max. torque) (Note 2)</td></tr>
<tr><td>2</td><td>Servo motor speed (+8V/max. speed)</td></tr>
<tr><td>3</td><td>Torque (+8V/max. torque) (Note 2)</td></tr>
<tr><td>4</td><td>Current command (±8V/max. current command)</td></tr>
<tr><td>5</td><td>Command pulse frequency (±10V/1Mpps)</td></tr>
<tr><td>6</td><td>Droop pulses (±10V/100 pulses) (Note 1)</td></tr>
<tr><td>7</td><td>Droop pulses (±10V/1000 pulses) (Note 1)</td></tr>
<tr><td>8</td><td>Droop pulses (±10V/10000 pulses) (Note 1)</td></tr>
<tr><td>9</td><td>Droop pulses (±10V/100000 pulses) (Note 1)</td></tr>
<tr><td>A</td><td>Feedback position (±10V/1 Mpulses) (Note 1)</td></tr>
<tr><td>B</td><td>Feedback position (±10V/10 Mpulses) (Note 1)</td></tr>
<tr><td>C</td><td>Feedback position (±10V/100 Mpulses) (Note 1)</td></tr>
<tr><td>D</td><td>Bus voltage (±8V/400V) (Note 3)</td></tr>
</table>
Note1. Encoder pulse unit.
2. 8V is outputted at the maximum torque. However, when parameter No. PA11・PA12 are set to limit torque, 8V is outputted at the torque highly limited.
3. For 400V class servo amplifier, the bus voltage becomes +8V/800V.</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC15</td><td>MOD2</td><td>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 0
Select the analog monitor 2 (MO2) output
The settings are the same as those of parameter No. PC14.</td><td>0001h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC16</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>100</td><td>ms</td><td>0
to
1000</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC17</td><td>ZSP</td><td>Zero speed
Used to set the output range of the zero speed (ZSP).
Zero speed signal detection has hysteresis width of 20r/min (refer to section 3.5 (1) (b))</td><td>50</td><td>r/min</td><td>0
to
10000</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC18</td><td>*BPS</td><td>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).</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PC19</td><td>*ENRS</td><td>Encoder output pulse selection
Use to select the, encoder output pulse direction and encoder pulse output setting.
0 0 □ □
Encoder pulse output phase changing
Changes the phases of A, B-phase encoder pulses output .


Encoder output pulse setting selection (refer to parameter No. PA15
0: Output pulse designation
1: Division ratio setting
2: Ratio is automatically set to command pulse unit
Setting "2" makes the parameter No. PA15 (encoder output pulse) setting invalid.</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC20</td><td>*SNO</td><td>Station number setting
Used to specify the station number for serial communication.
Always set one station to one axis of servo amplifier. If one station number is set to two or more stations, normal communication cannot be made.</td><td>0</td><td>station</td><td>0
to
31</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PC21</td><td>*SOP</td><td>Communication function selection
Select the communication I/F and select the RS-422 communication conditions.
0 □ □ 0
RS-422 communication baud rate selection
0: 9600 [bps]
1: 19200 [bps]
2: 38400 [bps]
3: 57600 [bps]
4: 115200[bps]
RS-422 communication response delay time
0: Invalid
1: Valid, reply sent after delay time of 800 μs or more</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PC22	*COP1	Function selection C-1 Select the execution of automatic restart after instantaneous power failure selection, and encoder cable communication system selection. _ 0 0 _ Restart after instantaneous power failure selection If the power supply voltage has returned to normal after an undervoltage status caused by the reduction of the input power supply voltage in the speed control mode, the servo motor can be restarted by merely turning on the start signal without resetting the alarm. 0: Invalid (Undervoltage alarm (AL.10) occurs.) 1: Valid	0000h		Refer to the Name and Function field.		○	
		Encoder cable communication system selection 0: Two-wire type 1: Four-wire type The following encoder cables are of 4-wire type. MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H The other encoder cables are all of 2-wire type. Incorrect setting will result in an encoder alarm 1 (AL. 16) or encoder alarm 2 (AL. 20).				○	○	○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td rowspan="3">PC23</td><td rowspan="3">*COP2</td><td>Function selection C-2
Select the servo lock at speed control mode stop, the VC-VLA voltage averaging, and the speed limit in torque control mode.
□ □ 0 □
Selection of servo lock at stop
In the speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by the external force.
0: Valid (Servo-locked)
The operation to maintain the stop position is performed.
1: Invalid (Not servo-locked)
The stop position is not maintained.
The control to make the speed 0r/min is performed.</td><td rowspan="3">0000h</td><td rowspan="3"></td><td rowspan="3">Refer to the Name and Function field.</td><td></td><td>○</td><td></td></tr>
<tr><td>VC/VLA voltage averaging
Used to set the filtering time when the analog speed command (VC) voltage or analog speed limit (VLA) is imported.
Set 0 to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.
<table><tr><th>Set value</th><th>Filtering time [ms]</th></tr><tr><td>0</td><td>0</td></tr><tr><td>1</td><td>0.444</td></tr><tr><td>2</td><td>0.888</td></tr><tr><td>3</td><td>1.777</td></tr><tr><td>4</td><td>3.555</td></tr><tr><td>5</td><td>7.111</td></tr></table></td><td></td><td>○</td><td>○</td></tr>
<tr><td>Selection of speed limit for torque control
0: Valid
1: Invalid
Do not use this function except when configuring a speed loop externally.
If the speed limit is invalid, the following parameters can be used.
Parameter No. PB01 (filter tuning mode)
Parameter No. PB13 (machine resonance suppression filter 1)
Parameter No. PB14 (notch shape selection 1)
Parameter No. PB15 (machine resonance suppression filter 2)
Parameter No. PB01 (notch shape selection 2)</td><td></td><td></td><td>○</td></tr>
<tr><td>PC24</td><td>*COP3</td><td>Function selection C-3
Select the unit of the in-position range.
0 0 0 □
In-position range unit selection
0: Command input pulse unit
1: Servo motor encoder pulse unit</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td></td><td></td></tr>
<tr><td>PC25</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0000h</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
PC26	*COP5	Function selection C-5 Select the stroke limit warning (AL. 99). 0 0 0 □ Stroke limit warning (AL. 99) selection 0: Valid 1: Invalid When this parameter is set to "1", AL. 99 will not occur if the forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) turns OFF.	0000h		Refer to the Name and Function field.	○	○	
PC27		For manufacturer setting Do not change this value by any means.	0000h					
PC28			0000h					
PC29			0000h					
PC30	STA2	Acceleration time constant 2 This parameter is made valid when the acceleration/deceleration selection (STAB2) is turned ON. Used to set the acceleration time required to reach the rated speed from Or/min in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○
PC31	STB2	Deceleration time constant 2 This parameter is made valid when the acceleration/deceleration selection (STAB2) is turned ON. Used to set the deceleration time required to reach Or/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 50000		○	○
PC32	CMX2	Command pulse multiplying factor numerator 2 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1		1 to 65535	○		
PC33	CMX3	Command pulse multiplying factor numerator 3 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1		1 to 65535	○		
PC34	CMX4	Command pulse multiplying factor numerator 4 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1		1 to 65535	○		
PC35	TL2	Internal torque limit 2 Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced. When torque is output in analog monitor output, this set value is the maximum output voltage (8V). (Refer to section 3.6.1 (5))	100.0	%	0 to 100.0	○	○	○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PC36</td><td>*DMD</td><td>Status display selection
Select the status display to be provided at power-on.

0 □ □ □

Selection of status display at power-on
0: Cumulative feedback pulse
1: Servo motor speed
2: Droop pulse
3: Cumulative command pulses
4: Command pulse frequency
5: Analog speed command voltage (Note 1)
6: Analog torque command voltage (Note 2)
7: Regenerative load ratio
8: Effective load ratio
9: Peak load ratio
A: Instantaneous torque
B: Within one-revolution position
(1 pulse unit)
C: Within one-revolution position
(100 pulse unit)
D: ABS counter
E: Load inertia moment ratio
F: Bus voltage

Note 1. In speed control mode. Analog speed limit voltage in torque control mode.
2. In torque control mode. Analog torque limit voltage in speed or position control mode.

Status display at power-on in corresponding control mode
0: Depends on the control mode.
<table>
<tr><th>Control Mode</th><th>Status display at power-on</th></tr>
<tr><td>Position</td><td>Cumulative feedback pulses</td></tr>
<tr><td>Position/speed</td><td>Cumulative feedback pulses/servo motor speed</td></tr>
<tr><td>Speed</td><td>Servo motor speed</td></tr>
<tr><td>Speed/torque</td><td>Servo motor speed/analog torque command voltage</td></tr>
<tr><td>Torque</td><td>Analog torque command voltage</td></tr>
<tr><td>Torque/position</td><td>Analog torque command voltage/cumulative feedback pulses</td></tr>
</table>
1: Depends on the first digit setting of this parameter.</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">PC37</td><td rowspan="2">VCO</td><td>Analog speed command offset
Used to set the offset voltage of the analog speed command (VC).
For example, if CCW rotation is provided by switching on forward rotation start (ST1) with 0V applied to VC, set a negative value.
When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section6.4.)
The initial value is the value provided by the automatic VC offset function before shipment at the VC-LG voltage of 0V.</td><td rowspan="2">Depending on servo amplifier</td><td rowspan="2">mV</td><td rowspan="2">−999 to 999</td><td></td><td>○</td><td></td></tr>
<tr><td>Analog speed limit offset
Used to set the offset voltage of the analog speed limit (VLA).
For example, if CCW rotation is provided by switching on forward rotation selection (RS1) with 0V applied to VLA, set a negative value.
When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section6.4.)
The initial value is the value provided by the automatic VC offset function before shipment at the VLA-LG voltage of 0V.</td><td></td><td></td><td>○</td></tr>
</table>

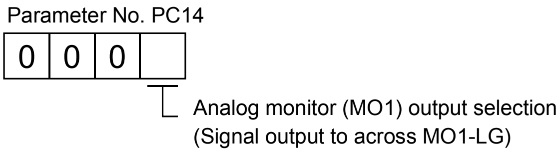
No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PC38	TPO	Analog torque command offset Used to set the offset voltage of the analog torque command (TC).	0	mV	−999 to 999			○
		Analog torque limit offset Used to set the offset voltage of the analog torque limit (TLA).					○	
PC39	MO1	Analog monitor 1 offset Used to set the offset voltage of the analog monitor (MO1).	0	mV	−999 to 999	○	○	○
PC40	MO2	Analog monitor 2 offset Used to set the offset voltage of the analog monitor (MO2).	0	mV	−999 to 999	○	○	○
PC41		For manufacturer setting Do not change this value by any means.	0					
PC42			0					
PC43			0					
PC44			0					
PC45			0					
PC46			0					
PC47			0					
PC48			0					
PC49			0					
PC50			0					

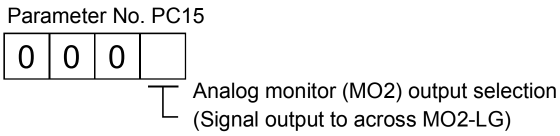
5.3.3 Analog monitor

The servo status can be output to two channels in terms of voltage. The servo status can be monitored using un ammeter.

(1) Setting

Change the following digits of parameter No. PC14, PC15:





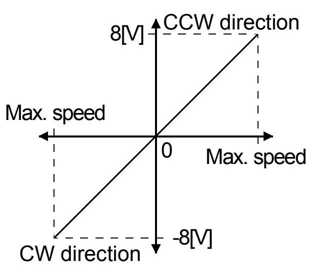
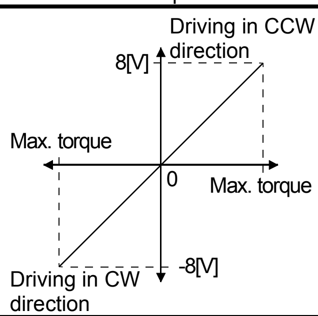
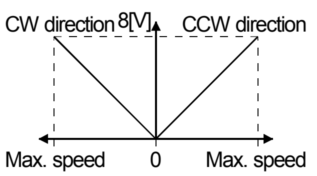
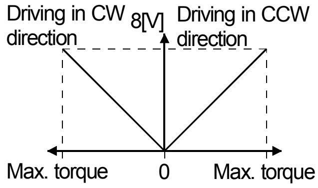
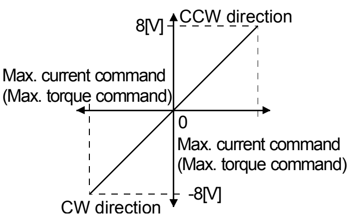
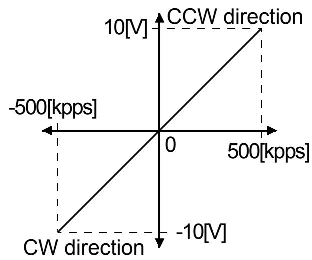
Parameters No. PC39 and PC40 can be used to set the offset voltages to the analog output voltages. The setting range is between −999 and 999mV.

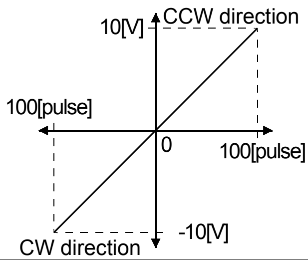
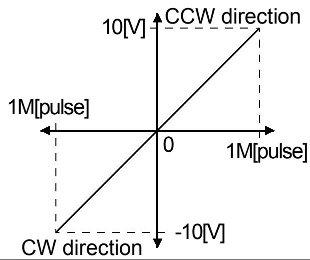
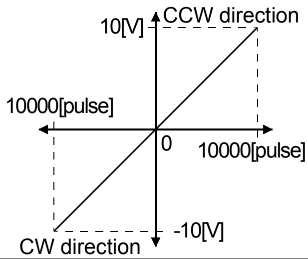
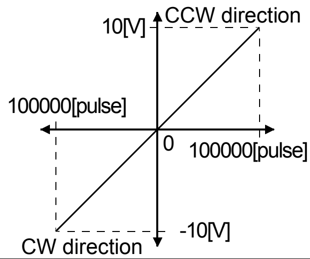
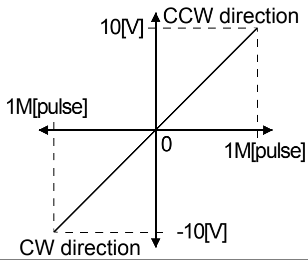
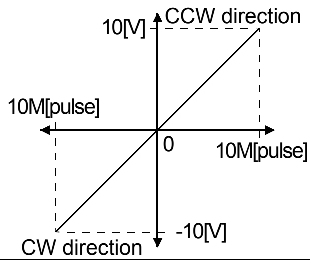
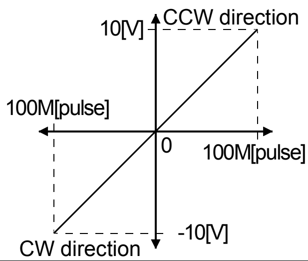
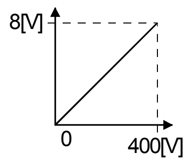
Parameter No.	Description	Setting range [mV]
PC39	Used to set the offset voltage for the analog monitor 1 (MO1).	−999 to 999
PC40	Used to set the offset voltage for the analog monitor 2 (MO2).	

(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. PC14 and PC15 value:

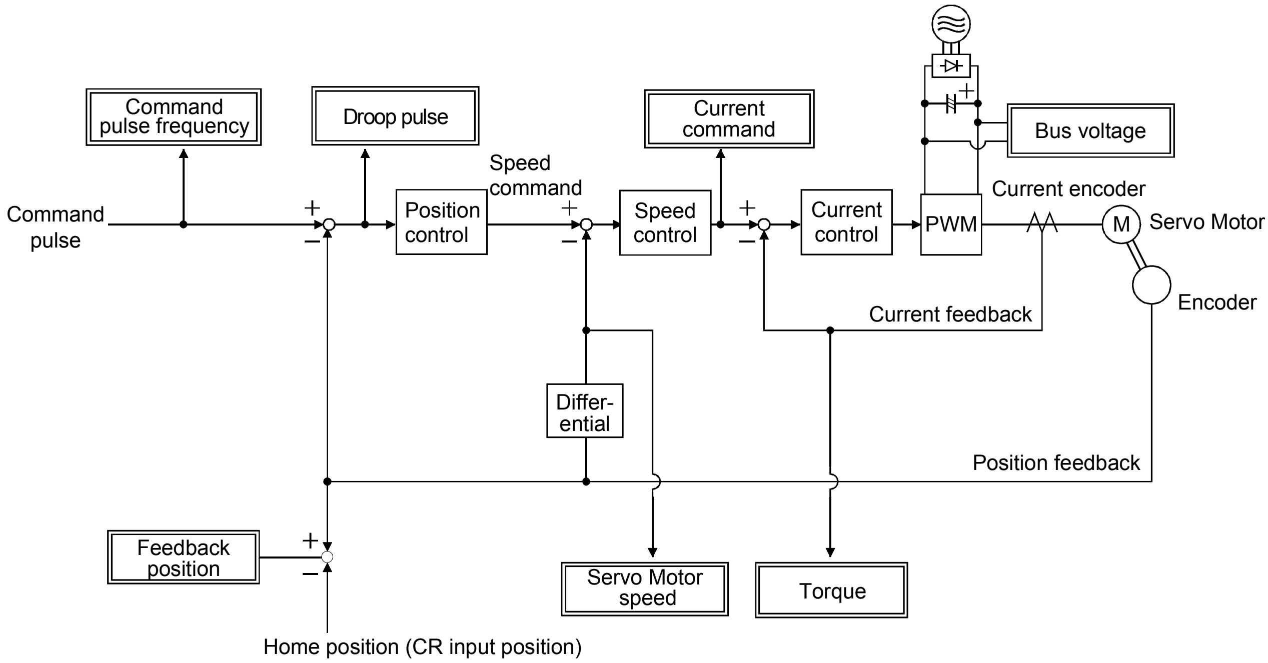
Refer to (3) for the measurement point.

Setting	Output item	Description	Setting	Output item	Description
0	Servo motor speed		1	Torque (Note 3)	
2	Servo motor speed		3	Torque (Note 3)	
4	Current command		5	Command pulse frequency	

Setting	Output item	Description	Setting	Output item	Description
6	Droop pulses (Note) (±10V/100 pulses)		7	Droop pulses (Note) (±10V/1000 pulses)	
8	Droop pulses (Note 1) (±10V/10000 pulses)		9	Droop pulses (Note 1) (±10V/100000 pulses)	
A	Feedback position (Note 1,2) (±10V/1 Mpulses)		B	Feedback position (Note 1,2) (±10V/10 Mpulses)	
C	Feedback position (Note 1,2) (±10V/100 Mpulses)		D	Bus voltage (Note 4)	

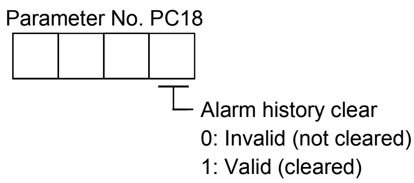
Note 1. Encoder pulse unit.
2. Available in position control mode
3. 8V is outputted at the maximum torque.
However, when parameter No. PA11 ・ PA12 are set to limit torque, 8V is outputted at the torque highly limited.
4. For 400V class servo amplifier, the busvoltage becomes +8V/800V.

(3) Analog monitor block diagram



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. PC18 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.



5.4 I/O Setting parameters (No. PD□□)

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

5.4.1 Parameter list

No.	Symbol	Name	Initial Value	Unit	Control Mode		
					Position	Speed	Torque
PD01	*DIA1	Input signal automatic ON selection 1	0000h		○	○	○
PD02		For manufacturer setting	0000h				
PD03	*DI1	Input signal device selection 1 (CN1-15)	00020202h		○	○	○
PD04	*DI2	Input signal device selection 2 (CN1-16)	00212100h		○	○	○
PD05	*DI3	Input signal device selection 3 (CN1-17)	00070704h		○	○	○
PD06	*DI4	Input signal device selection 4 (CN1-18)	00080805h		○	○	○
PD07	*DI5	Input signal device selection 5 (CN1-19)	00030303h		○	○	○
PD08	*DI6	Input signal device selection 6 (CN1-41)	00202006h		○	○	○
PD09		For manufacturer setting	00000000h				
PD10	*DI8	Input signal device selection 8 (CN1-43)	00000A0Ah		○	○	○
PD11	*DI9	Input signal device selection 9 (CN1-44)	00000B0Bh		○	○	○
PD12	*DI10	Input signal device selection 10 (CN1-45)	00232323h		○	○	○
PD13	*DO1	Output signal device selection 1 (CN1-22)	0004h		○	○	○
PD14	*DO2	Output signal device selection 2 (CN1-23)	000Ch		○	○	○
PD15	*DO3	Output signal device selection 3 (CN1-24)	0004h		○	○	○
PD16	*DO4	Output signal device selection 4 (CN1-25)	0007h		○	○	○
PD17		For manufacturer setting	0003h				
PD18	*DO6	Output signal device selection 6 (CN1-49)	0002h		○	○	○
PD19	*DIF	Response level setting	0002h		○	○	○
PD20	*DOP1	Function selection D-1	0000h		○	○	○
PD21		For manufacturer setting	0000h				
PD22	*DOP3	Function selection D-3	0000h		○		
PD23		For manufacturer setting	0000h				
PD24	*DOP5	Function selection D-5	0000h		○	○	○
PD25		For manufacturer setting	0				
PD26			0				
PD27			0				
PD28			0				
PD29			0				
PD30			0				

5.4.2 List of details

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PD01</td><td>*DIA1</td><td>Input signal automatic ON selection 1
Select the input devices to be automatically turned ON.

0 □ □ □
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td></td><td>0</td><td rowspan="4">0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td>Servo-on (SON)</td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
</table>
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td>Proportion control (PC)</td><td>0</td><td rowspan="4">0</td></tr>
<tr><td>External torque limit (TL)</td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
</table>
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td></td><td>0</td><td rowspan="4">0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td>Forward rotation stroke end (LSP)</td><td>0</td></tr>
<tr><td>Reverse rotation stroke end (LSN)</td><td>0</td></tr>
</table>
BIN 0: Used as external input signal
BIN 1: Automatic ON

For example, to turn ON SON, the setting is "□□□4".</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PD02</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0000h</td><td></td><td>Refer to the Name and Function field.</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PD03</td><td>*DI1</td><td>Input signal device selection 1 (CN1-15)
Any input signal can be assigned to the CN1-15 pin.
Note that the setting digits and the signal that can be assigned change depending on the control mode.

0 0 □□ □□ □□
Position control
Speed control mode
Torque control mode
Select the input device of the CN1-15 pin.

The devices that can be assigned in each control mode are those that have the symbols indicated in the following table. If any other device is set, it is invalid.
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Control Modes (Note 1)</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>00</td><td></td><td></td><td></td></tr>
<tr><td>01</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>02</td><td>SON</td><td>SON</td><td>SON</td></tr>
<tr><td>03</td><td>RES</td><td>RES</td><td>RES</td></tr>
<tr><td>04</td><td>PC</td><td>PC</td><td></td></tr>
<tr><td>05</td><td>TL</td><td>TL</td><td></td></tr>
<tr><td>06</td><td>CR</td><td>CR</td><td>CR</td></tr>
<tr><td>07</td><td></td><td>ST1</td><td>RS2</td></tr>
<tr><td>08</td><td></td><td>ST2</td><td>RS1</td></tr>
<tr><td>09</td><td>TL1</td><td>TL1</td><td></td></tr>
<tr><td>0A</td><td>LSP</td><td>LSP</td><td></td></tr>
<tr><td>0B</td><td>LSN</td><td>LSN</td><td></td></tr>
<tr><td>0C</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0D</td><td>CDP</td><td>CDP</td><td></td></tr>
<tr><td>0E to 1F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>20</td><td></td><td>SP1</td><td>SP1</td></tr>
<tr><td>21</td><td></td><td>SP2</td><td>SP2</td></tr>
<tr><td>22</td><td></td><td>SP3</td><td>SP3</td></tr>
<tr><td>23</td><td>LOP</td><td>LOP</td><td>LOP</td></tr>
<tr><td>24</td><td>CM1</td><td></td><td></td></tr>
<tr><td>25</td><td>CM2</td><td></td><td></td></tr>
<tr><td>26</td><td></td><td>STAB2</td><td>STAB2</td></tr>
<tr><td>27 to 3F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
</table>
Note 1. P: Position control mode
S: Speed control mode
T: Torque control mode
2. For manufacturer setting. Never set this value.</td><td>0002
0202h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PD04</td><td>*DI2</td><td>Input signal device selection 2 (CN1-16)
Any input signal can be assigned to the CN1-16 pin.
The devices that can be assigned and the setting method are the same as in parameter No. PD03.

0 0 □□ □□ □□
Position control mode
Speed control mode
Torque control mode
Select the input device of the CN1-16 pin.</td><td>0021
2100h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PD05	*DI3	Input signal device selection 3 (CN1-17) Any input signal can be assigned to the CN1-17 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-17 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No. PA03, the CN1-17 pin is set to the ABS transfer mode (ABSM). (Refer to section 14.5.)	0007 0704h		Refer to the Name and Function field.	○	○	○
PD06	*DI4	Input signal device selection 4 (CN1-18) Any input signal can be assigned to the CN1-18 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 Position control Speed control mode Torque control mode Select the input device of the CN1-18 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No. PA03, the CN1-18 pin is set to the ABS transfer request (ABSR). (Refer to section 14.5.)	0008 0805h		Refer to the Name and Function field.	○	○	○
PD07	*DI5	Input signal device selection 5 (CN1-19) Any input signal can be assigned to the CN1-19 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-19 pin.	0003 0303h		Refer to the Name and Function field.	○	○	○
PD08	*DI6	Input signal device selection 6 (CN1-41) Any input signal can be assigned to the CN1-41 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 Position control mode Speed control mode Torque control mode Select the input device of the CN1-41 pin.	0020 2006h		Refer to the Name and Function field.	○	○	○
PD09		For manufacturer setting Do not change this value by any means.	0000 0000h					

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PD10	*DI8	Input signal device selection 8 (CN1-43) Any input signal can be assigned to the CN1-43 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 □□ □□ □□ Position control mode Speed control mode Torque control mode Select the input device of the CN1-43 pin.	0000 0A0Ah		Refer to the Name and Function field.	○	○	○
PD11	*DI9	Input signal device selection 9 (CN1-44) Any input signal can be assigned to the CN1-44 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 □□ □□ □□ Position control mode Speed control mode Torque control mode Select the input device of the CN1-44 pin.	0000 0B0Bh		Refer to the Name and Function field.	○	○	○
PD12	*DI10	Input signal device selection 10 (CN1-45) Any input signal can be assigned to the CN1-45 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 0 □□ □□ □□ Position control mode Speed control mode Torque control mode Select the input device of the CN1-45 pin.	0023 2323h		Refer to the Name and Function field.	○	○	○

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and Function</th><th rowspan="2">Initial Value</th><th rowspan="2">Unit</th><th rowspan="2">Setting Range</th><th colspan="3">Control Mode</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>PD13</td><td>*DO1</td><td>Output signal device selection 1 (CN1-22)
Any output signal can be assigned to the CN1-22 pin.
Note that the device that can be assigned changes depending on the control mode.

0 0 0 □
Select the output device of the CN1-22 pin.

The devices that can be assigned in each control mode are those that have the symbols indicated in the following table. If any other device is set, it is invalid.
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Control Modes (Note 1)</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>00</td><td>Always OFF</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>01</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>02</td><td>RD</td><td>RD</td><td>RD</td></tr>
<tr><td>03</td><td>ALM</td><td>ALM</td><td>ALM</td></tr>
<tr><td>04</td><td>INP</td><td>SA</td><td>Always OFF</td></tr>
<tr><td>05</td><td>MBR</td><td>MBR</td><td>MBR</td></tr>
<tr><td>06</td><td>DB</td><td>DB</td><td>DB</td></tr>
<tr><td>07</td><td>TLC</td><td>TLC</td><td>VLC</td></tr>
<tr><td>08</td><td>WNG</td><td>WNG</td><td>WNG</td></tr>
<tr><td>09</td><td>BWNG</td><td>BWNG</td><td>BWNG</td></tr>
<tr><td>0A</td><td>Always OFF</td><td>SA</td><td>SA</td></tr>
<tr><td>0B</td><td>Always OFF</td><td>Always OFF</td><td>VLC</td></tr>
<tr><td>0C</td><td>ZSP</td><td>ZSP</td><td>ZSP</td></tr>
<tr><td>0D</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0E</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0F</td><td>CDPS</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>10</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>11</td><td>ABSV</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>12 to 3F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
</table>
Note 1. P: Position control mode
S: Speed control mode
T: Torque control mode
2. For manufacturer setting. Never set this value.

When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No. PA03, the CN1-22 pin is set to the ABS transmission data bit 0 (ABSB0) in the ABS transfer mode only. (Refer to section 14.5.)</td><td>0004h</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PD14</td><td>*DO2</td><td>Output signal device selection 2 (CN1-23)
Any output signal can be assigned to the CN1-23 pin.
The devices that can be assigned and the setting method are the same as in parameter No. PD13.

0 0 0 □
Select the output device of the CN1-23 pin.

When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No. PA03, the CN1-23 pin is set to the ABS transmission data bit 1 (ABSB1) in the ABS transfer mode only. (Refer to section 14.5.)</td><td>000Ch</td><td></td><td>Refer to the Name and Function field.</td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PD15	*DO3	Output signal device selection 3 (CN1-24) Any output signal can be assigned to the CN1-24 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD13. 0 0 0 □ Select the output device of the CN1-24 pin.	0004h		Refer to the Name and Function field.	○	○	○
PD16	*DO4	Output signal device selection 4 (CN1-25) Any output signal can be assigned to the CN1-25 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD13. 0 0 0 □ Select the output device of the CN1-25 pin. When "Valid (ABS transfer by DI0)" has been selected for the absolute position detection system in parameter No. PA03, the CN1-25 pin is set to the ABS transmission data ready (ABST) in the ABS transfer mode only. (Refer to section 14.5.)	0007h		Refer to the Name and Function field.	○	○	○
PD17		For manufacturer setting Do not change this value by any means.	0003h					
PD18	*DO6	Output signal device selection 6 (CN1-49) Any output signal can be assigned to the CN1-49 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD13. 0 0 0 □ Select the output device of the CN1-49 pin.	0002h		Refer to the Name and Function field.	○	○	○
PD19	*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 the Name and Function field.	○	○	○

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode Position	Control Mode Speed	Control Mode Torque
PD20	*DOP1	Function selection D-1 Select the stop processing at forward rotation stroke end (LSP)/reverse rotation stroke end (LSN) OFF and the base circuit status at reset (RES) ON. 0 0 □ □ How to make a stop when forward rotation stroke end (LSP) · reverse rotation stroke end (LSN) is valid. (Refer to Section 5.4.3.) 0: Sudden stop 1: Slow stop Selection of base circuit status at reset (RES) ON 0: Base circuit switched off 1: Base circuit not switched off	0000h		Refer to the Name and Function field.	○ ○	○ ○	○
PD21		For manufacturer setting Do not change this value by any means.	0000h					
PD22	*DOP3	Function selection D-3 Set the clear (CR). 0 0 0 □ Clear (CR) selection 0: Droop pulses are cleared on the leading edge. 1: While on, droop pulses are always cleared.	0000h		Refer to the Name and Function field.	○		
PD23		For manufacturer setting Do not change this value by any means.	0000h					

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PD24	*DOP5	Function selection D-5 Select the alarm code and warning (WNG) outputs.	0000h			○	○	○

0 0 □ □

Setting of alarm code output

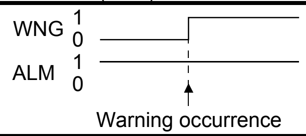
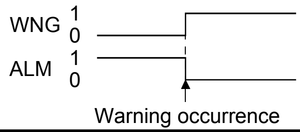
Set value	Connector pins of CN1		
	22	23	24
0	Alarm code is not output.		
1	Alarm code is output at alarm occurrence.		

(Note) Alarm code			Alarm display	Name
CN1 pin 22	CN1 pin 23	CN1 pin 24		
0	0	0	88888	Watchdog
			AL.12	Memory error 1
			AL.13	Clock error
			AL.15	Memory error 2
			AL.17	Board error 2
			AL.19	Memory error 3
			AL.37	Parameter error
			AL.8A	Serial communication time-out error
			AL.8E	Serial communication error
0	0	1	AL.30	Regenerative error
			AL.33	Overvoltage
0	1	0	AL.10	Undervoltage
0	1	1	AL.45	Main circuit device overheat
			AL.46	Servo motor overheat
			AL.47	Cooling fan alarm
			AL.50	Overload 1
			AL.51	Overload 2
1	0	0	AL.24	Main circuit
			AL.32	Overcurrent
1	0	1	AL.31	Overspeed
			AL.35	Command pulse frequency error
			AL.52	Error excessive
1	1	0	AL.16	Encoder error 1
			AL.1A	Motor combination error
			AL.20	Encoder error 2
			AL.25	Absolute position erase

Note. 0: off
1: on

A parameter alarm (AL. 37) occurs if the alarm code output is selected with parameter No. PA03 set to "□□□1" and the DI0-based absolute value detection system selected.

Selection of output device at warning occurrence
Select the warning (WNG) and trouble (ALM) output status at warning occurrence.

Setting	(Note) Device status
0	
1	

Note. 0: off
1: on

No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Control Mode		
						Position	Speed	Torque
PD25		For manufacturer setting Do not change this value by any means.	0					
PD26			0					
PD27			0					
PD28			0					
PD29			0					
PD30			0					

5.4.3 Using forward/reverse rotation stroke end to change the stopping pattern

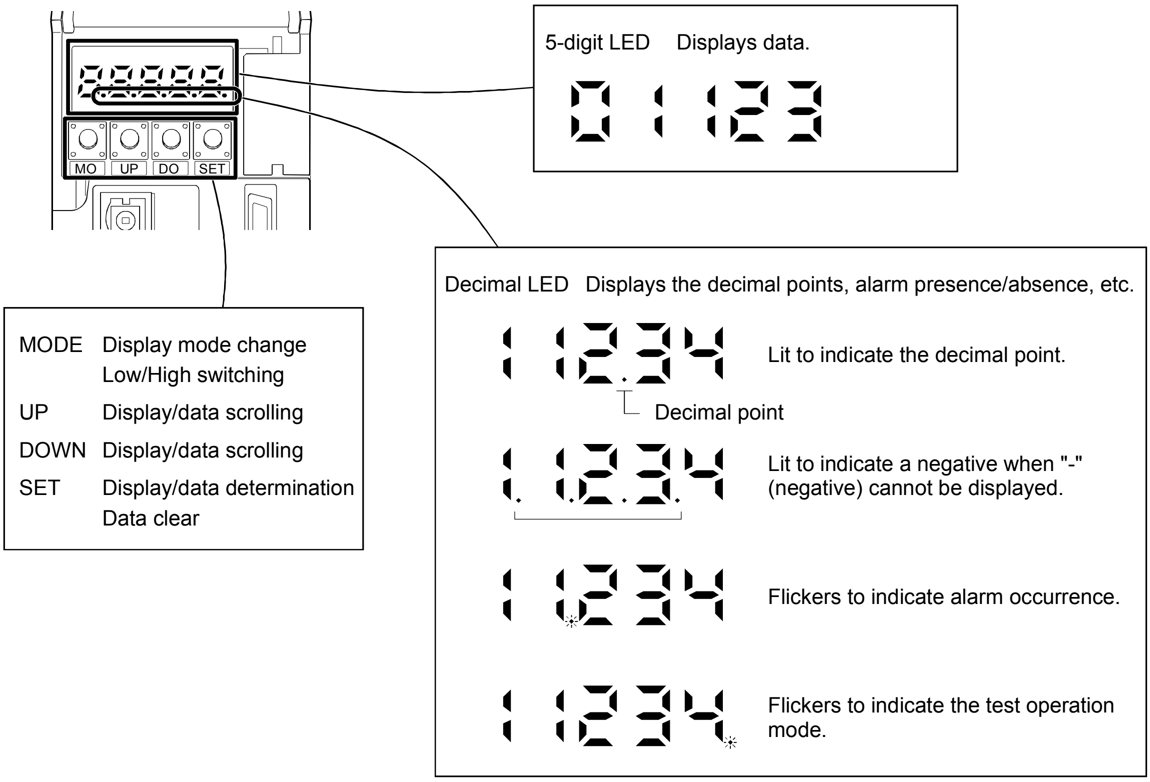
The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing the parameter No. PD20 value.

Parameter No. PD20 Setting	Stopping method
□□□0 (initial value)	Sudden stop Position control mode : Motor stops with droop pulses cleared. Speed control mode : Motor stops at deceleration time constant of zero.
□□□1	Slow stop Position control mode : The motor is decelerated to a stop in accordance with the parameter No. PB03 value. Speed control mode : The motor is decelerated to a stop in accordance with the parameter No. PC02 value.

6. DISPLAY AND OPERATION SECTIONS

6.1 Overview

The MR-J3-A servo amplifier has the display section (5-digit, 7-segment LED) and operation section (4 pushbuttons) for servo amplifier status display, alarm display, parameter setting, etc.
The operation section and display data are described below.



6.2 Display sequence

Press the "MODE" button once to shift to the next display mode. Refer to section 6.3 and later for the description of the corresponding display mode.
To refer to or set the gain filter parameters, extension setting parameters and I/O setting parameters, make them valid with parameter No. PA19 (parameter write disable).

Display mode transition	Initial screen	Function	Reference
Status display	C	Servo status display. C appears at power-on. (Note)	Section 6.3
Diagnosis	rd-oF	Sequence display, external signal display, output signal (DO), forced output, test operation, software version display, VC automatic offset, motor series ID display, motor type ID display, motor encoder ID display, external encoder ID display, parameter write inhibit, next deactivation display.	Section 6.4
Alarm	AL --	Current alarm display, alarm history display, parameter error No. display, point table error No. display.	Section 6.5
MODE button Basic setting parameters	P A01	Display and setting of basic setting parameters.	Section 6.6
Gain/filter parameters	P b01	Display and setting of gain filter parameters.	
Extension setting parameters	P C01	Display and setting of extension setting parameters.	
I/O setting parameters	P d01	Display and setting of I/O setting parameters.	

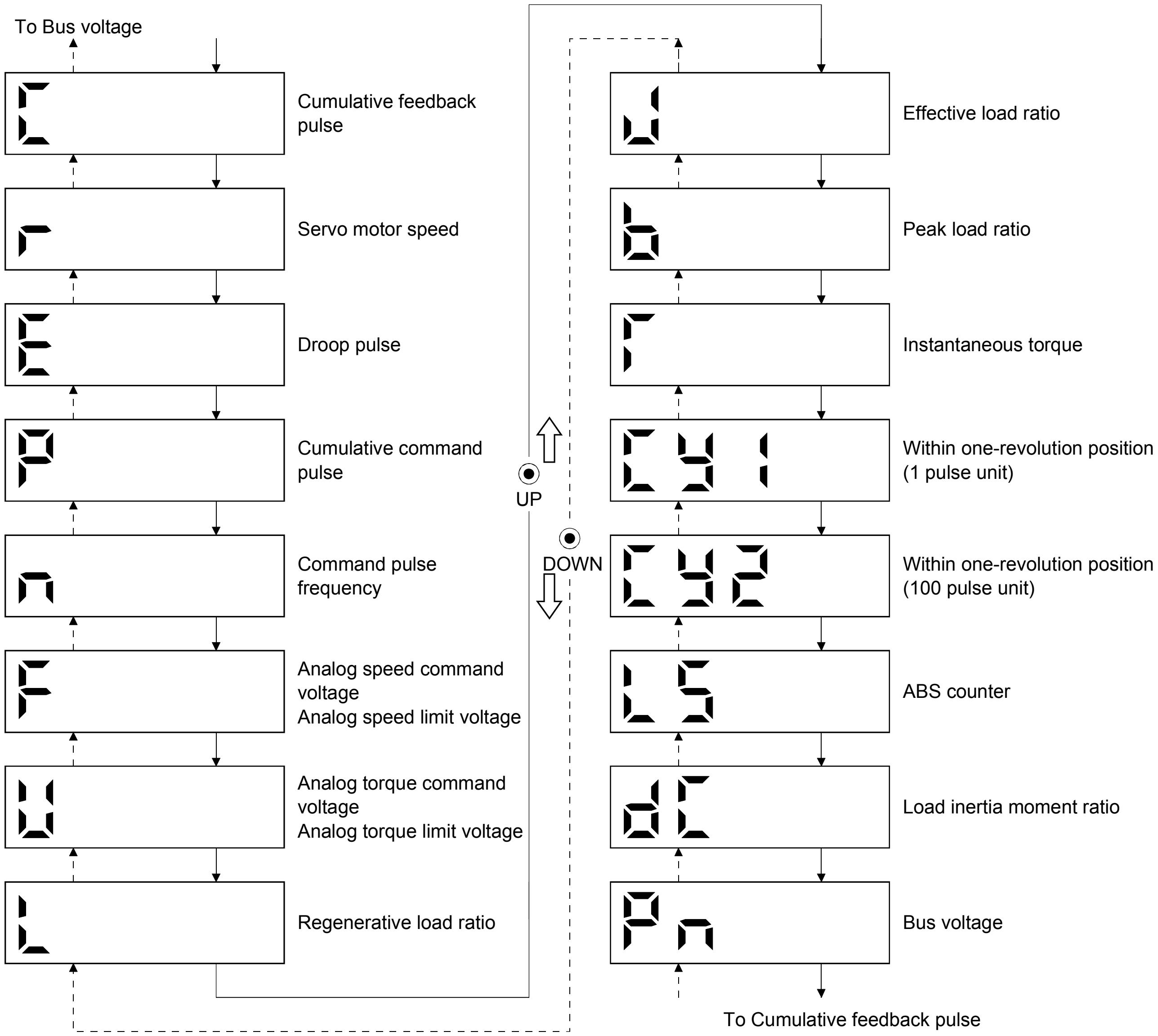
Note. When the axis name is set to the servo amplifier using MR Configurator, the axis name is displayed and the servo status is then displayed.

6.3 Status display

The servo status during operation is shown on the 5-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 appears. Press the "SET" button to display its data. At only power-on, however, data appears after the symbol of the status display selected in parameter No. PC36 has been shown for 2[s].
The servo amplifier display shows the lower five digits of 16 data items such as the motor speed.

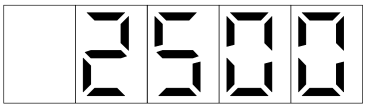
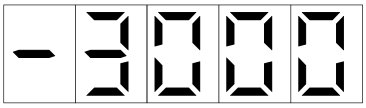
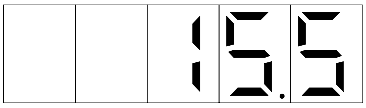
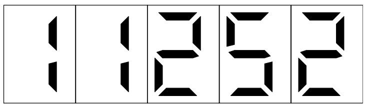
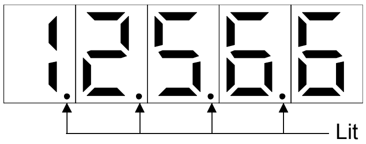
6.3.1 Display transition

After choosing the status display mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



6.3.2 Display examples

The following table lists display examples:

Item	Status	Displayed data Servo amplifier display
Servo motor speed	Forward rotation at 2500r/min	
	Reverse rotation at 3000r/min	 Reverse rotation is indicated by "−".
Load inertia moment	15.5 times	
ABS counter	11252rev	
	−12566rev	 Negative value is indicated by the lit decimal points in the upper four digits.

6.3.3 Status display list

The following table lists the servo statuses that may be shown:
Refer to Appendix 2 for the measurement point.

Name	Symbol	Unit	Description	Display range
Cumulative feedback pulses	C	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The value in excess of ±99999 is counted, bus since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. The value of minus is indicated by the lit decimal points in the upper four digits.	−99999 to 99999
Servo motor speed	r	r/min	The servo motor speed is displayed. The value rounded off is displayed in ×0.1r/min.	−7200 to 7200
Droop pulses	E	pulse	The number of droop pulses in the deviation counter is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit. The value in excess of ±99999 is counted. Since the servo amplifier display is five digits, it shows the lower five digits of the actual value. The number of pulses displayed is in the encoder pulse unit.	−99999 to 99999
Cumulative command pulses	P	pulse	The position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. The value in excess of ±99999 is counted, but since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit.	−99999 to 99999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).	−1500 to 1500
Analog speed command voltage Analog speed limit voltage	F	V	(1) Torque control mode Analog speed limit (VLA) voltage is displayed. (2) Speed control mode Analog speed command (VC) voltage is displayed.	−10.00 to 10.00
Analog torque command voltage Analog torque limit voltage	U	V	(1) Position control mode, speed control mode Analog torque limit (TLA) voltage is displayed.	0 to 10.00
			(2) Torque control mode Analog torque command (TLA) voltage is displayed.	−8.00 to +8.00
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100
Effective load ratio	J	%	The continuous effective load current is displayed. 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 maximum torque generated during acceleration/deceleration, etc. The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Instantaneous torque	T	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rate torque of 100%.	0 to 400
Within one-revolution position low	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 99999

Name	Symbol	Unit	Description	Display range
Within one-revolution position high	Cy2	100 pulse	The within one-revolution position is displayed in 100 pulse increments of the encoder. The value returns to 0 when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 2621
ABS counter	LS	rev	Travel value from the home position in the absolute position detection systems is displayed in terms of the absolute position detectors counter value.	−32768 to 32767
Load inertia moment ratio	dC	0.1 Times	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	0.0 to 300.0
Bus voltage	Pn	V	The voltage (across P-N) of the main circuit converter is displayed.	0 to 900

6.3.4 Changing the status display screen

The status display item of the servo amplifier display shown at power-on can be changed by changing the parameter No. PC36 settings.
The item displayed in the initial status changes with the control mode as follows:

Control mode	Status display at power-on
Position	Cumulative feedback pulses
Position/speed	Cumulative feedback pulses/servo motor speed
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage
Torque/position	Analog torque command voltage/cumulative feedback pulses

6.4 Diagnostic mode

Name		Display	Description
Sequence		rd-oF	Not ready. Indicates that the servo amplifier is being initialized or an alarm has occurred.
		rd-on	Ready. Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
External I/O signal display		Refer to section 6.7.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF
Output signal (DO) forced output		do-on	The digital output signal can be forced on/off. For more information, refer to section 6.8.
Test operation mode	Jog feed	TEST1	Jog operation can be performed when there is no command from the external command device. For details, refer to section 6.9.2.
	Positioning operation	TEST2	The MR Configurator MRZJW3-SETUP211E is required for positioning operation. This operation cannot be performed from the operation section of the servo amplifier. Positioning operation can be performed once when there is no command from the external command device. For details, refer to section 6.9.3.
	Motorless operation	TEST3	Without connection of the servo motor, the servo amplifier provides output signals and displays the status as if the servo motor is running actually in response to the external input signal. For details, refer to section 6.9.4.
	Machine analyzer operation	TEST4	Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured. The MR Configurator MRZJW3-SETUP211E is required for machine analyzer operation. For details, refer to section 12.8.
	Amplifier diagnosis	TEST5	Simple diagnosis as to correct function of the input/output interface of the servo amplifier can be made. To diagnose the amplifier, the diagnosis cable (MR-J3ACHECK) and MR Configurator MRZJW3-SETUP211 are necessary. For details, refer to section 12.8.
Software version low		-A0	Indicates the version of the software.
Software version high		=000	Indicates the system number of the software.
Automatic VC offset		H1 0	If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at the analog speed command (VC) or analog speed limit (VLA) of 0V, this function automatically makes zero-adjustment of offset voltages. When using this function, make it valid in the following procedure. Making it valid causes the parameter No. PC37 value to be the automatically adjusted offset voltage. 1) Press "SET" once. 2) Set the number in the first digit to 1 with "UP"/"DOWN". 3) Press "SET". You cannot use this function if the input voltage of VC or VLA is ±0.4V or more.

Name	Display	Description
Motor series	H2 0	Press the "SET" button to show the motor series ID of the servo motor currently connected. For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual.
Motor type	H3 0	Press the "SET" button to show the motor type ID of the servo motor currently connected. For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual.
Encoder	H4 0	Press the "SET" button to show the encoder ID of the servo motor currently connected. For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual.
For manufacturer setting	H5 0	For manufacturer setting
For manufacturer setting	H6 0	For manufacturer setting

6.5 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error. Display examples are shown below.

Name	Display	Description
Current alarm	AL --	Indicates no occurrence of an alarm.
	AL.33	Indicates the occurrence of overvoltage (AL.33). Flickers at occurrence of the alarm.
Alarm history	A0 50	Indicates that the last alarm is overload 1 (AL.50).
	A1 33	Indicates that the second alarm in the past is overvoltage (AL.33).
	A2 10	Indicates that the third alarm in the past is undervoltage (AL.10).
	A3 31	Indicates that the fourth alarm in the past is overspeed (AL.31).
	A4 --	Indicates that there is no fifth alarm in the past.
	A5 --	Indicates that there is no sixth alarm in the past.
Parameter error No.	E. --	Indicates no occurrence of parameter error (AL.37).
	E. 01	Indicates that the data of parameter No. PA12 is faulty.

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

(2) Even during alarm occurrence, the other screen can be viewed by pressing the button in the operation area. At this time, the decimal point in the fourth digit remains flickering.

(3) For any alarm, remove its cause and clear it in any of the following methods (for clearable alarms, refer to section 9.1):

(a) Switch power OFF, then ON.

(b) Press the "SET" button on the current alarm screen.

(c) Turn on the alarm reset (RES).

(4) Use parameter No. PC18 to clear the alarm history.

(5) Pressing "SET" on the alarm history display screen for 2s or longer shows the following detailed information display screen. Note that this is provided for maintenance by the manufacturer.

A0C02

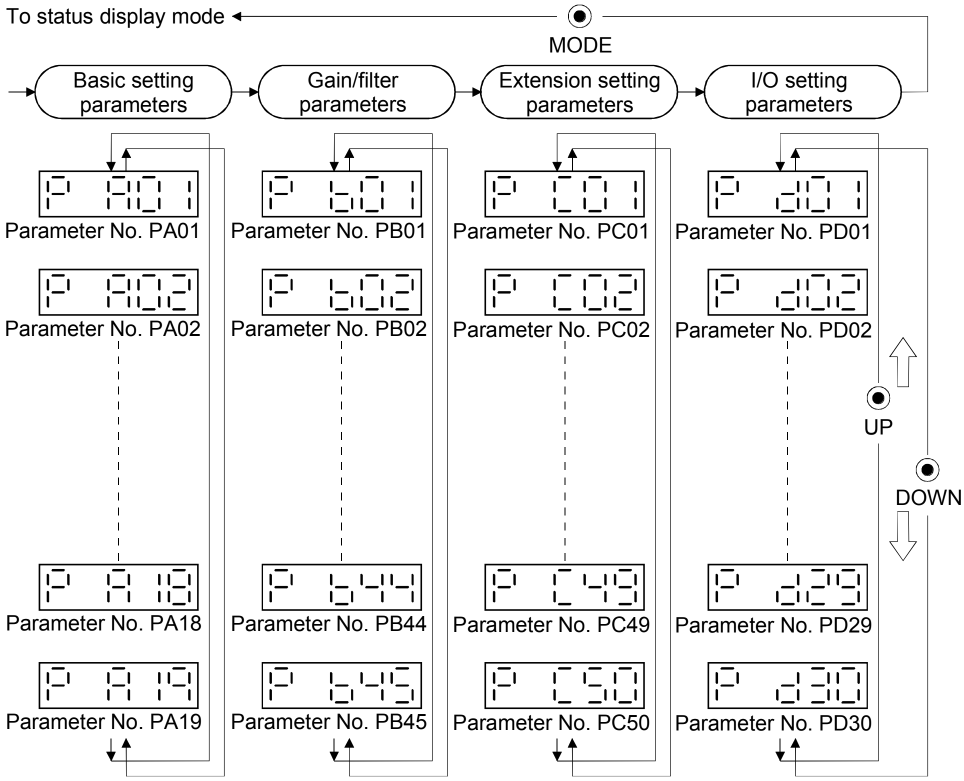
(6) Press "UP" or "DOWN" to move to the next history.

6.6 Parameter mode

POINT
· To use the I/O setting parameters, change the parameter No. PA19 (parameter write inhibit value. (Refer to section 5.1.1) · The I/O signal settings can be changed using the I/O setting parameter No. PD03 to PD08, PD10 to PD18.

6.6.1 Parameter mode transition

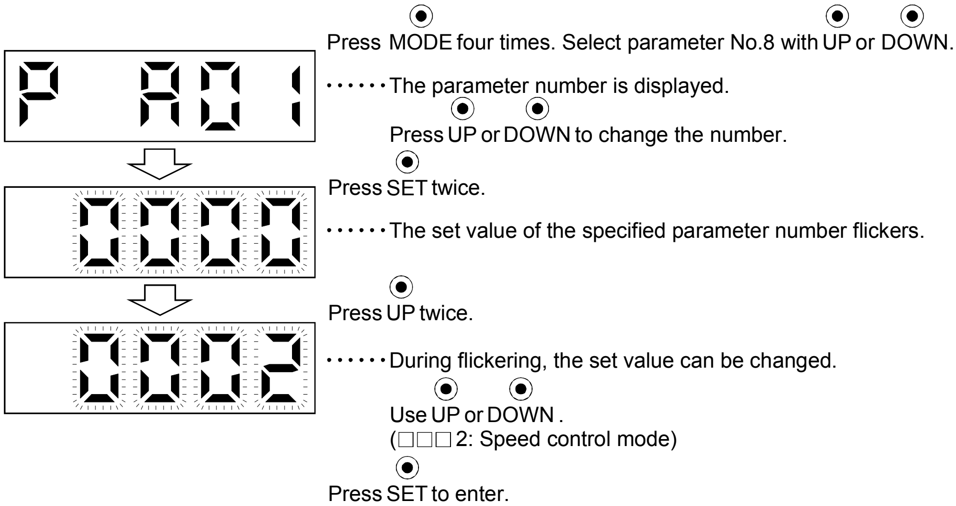
After choosing the corresponding parameter mode with the "MODE" button, pressing the "UP" or "DOWN" button changes the display as shown below.



6.6.2 Operation example

(1) Parameter of 5 or less digits

The following example shows the operation procedure performed after power-on to change the control mode (Parameter No. PA01) into the speed control mode. Press "MODE" to switch to the basic setting parameter screen.

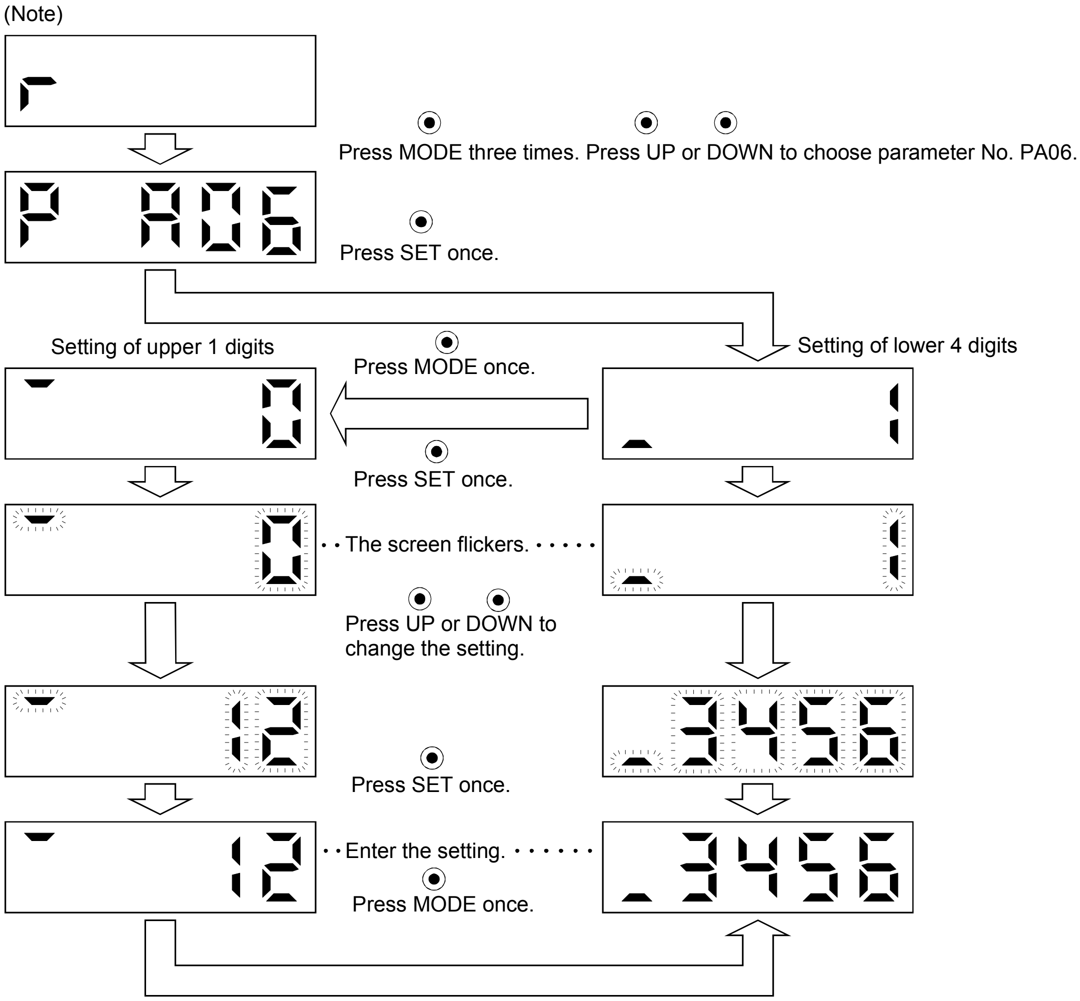


To shift to the next parameter, press the "UP" or "DOWN" button.

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.

(2) Signed 6-digit or more parameter

The following example gives the operation procedure to change the electronic gear numerator (parameter No. PA06) to "123456".



Note. The example assumes that the status display screen that appears at power-on has been set to the servo motor speed in parameter No. PC36.

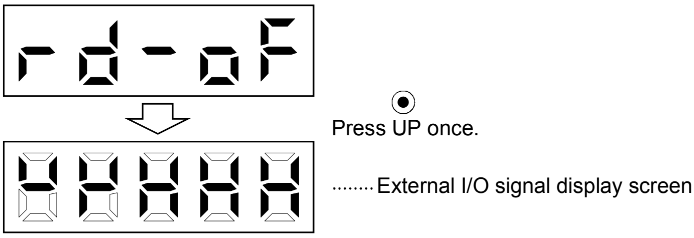
6.7 External I/O signal display

The ON/OFF states of the digital I/O signals connected to the servo amplifier can be confirmed.

(1) Operation

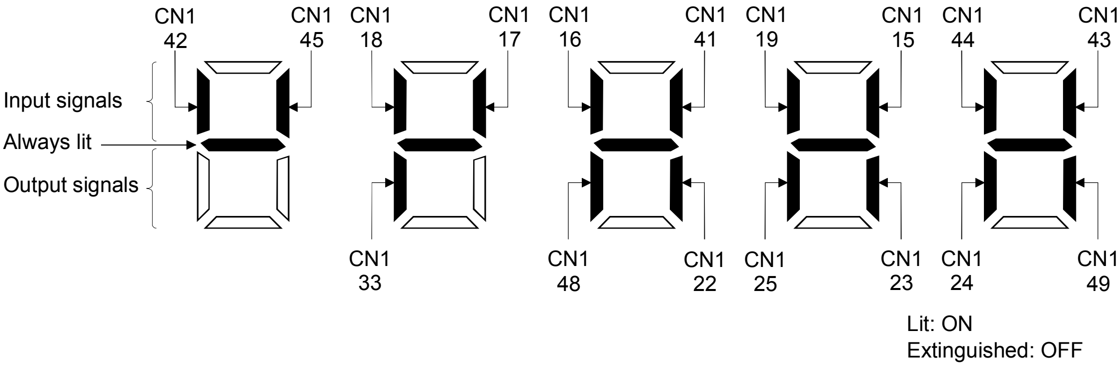
Call the display screen shown after power-on.

Using the "MODE" button, show the diagnostic screen.



(2) Display definition

The 7-segment LED segments and CN1 connector pins correspond as shown below.



The LED segment corresponding to the pin is lit to indicate ON, and is extinguished to indicate OFF.

The signals corresponding to the pins in the respective control modes are indicated below:

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	15	I	SON	SON	SON	SON	SON	SON	No. PD03
	16	I		−/SP2	SP2	SP2/SP2	SP2	SP2/−	No. PD04
	17	I	PC	PC/ST1	ST1	ST1/RS2	RS2	RS2/PC	No. PD05
	18	I	TL	TL/ST2	ST2	ST2/RS1	RS1	RS1/TL	No. PD06
	19	I	RES	RES	RES	RES	RES	RES	No. PD07
	22	O	INP	INP/SA	SA	SA/−		−/INP	No. PD13
	23	O	ZSP	ZSP	ZSP	ZSP	ZSP	ZSP	No. PD14
	24	O	INP	INP/SA	SA	SA/−		−/INP	No. PD15
	25	O	TLC	TLC	TLC	TLC/VLC	VLC	VLC/TLC	No. PD16
	33	O	OP	OP	OP	OP	OP	OP	
	41	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	No. PD08
	42	I	EMG	EMG	EMG	EMG	EMG	EMG	
	43	I	LSP	LSP	LSP	LSP/−		−/LSP	No. PD10
	44	I	LSN	LSN	LSN	LSN/−		−/LSN	No. PD11
	45	I	LOP	LOP	LOP	LOP	LOP	LOP	No. PD12
	48	O	ALM	ALM	ALM	ALM	ALM	ALM	
	49	O	RD	RD	RD	RD	RD	RD	No. PD18

Note 1. I: Input signal, O: Output signal

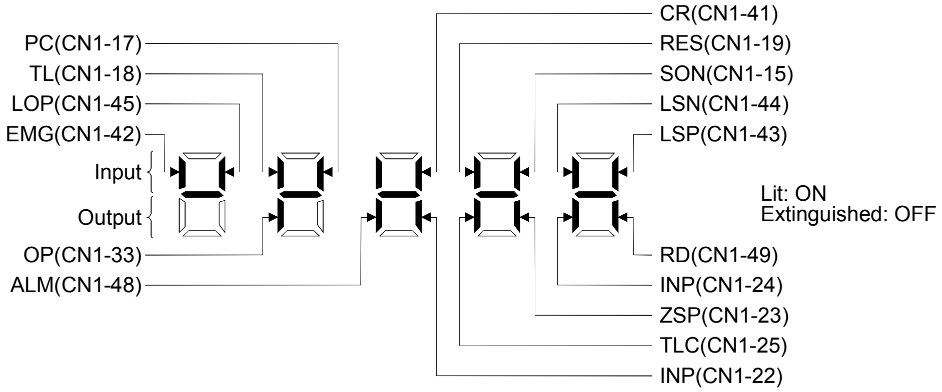
2. P: Position control mode, S: Speed control mode, T: Torque control mode, P/S: Position/speed control change mode, S/T: Speed/torque control change mode, T/P: Torque/position control change mode

(b) Symbol and signal names

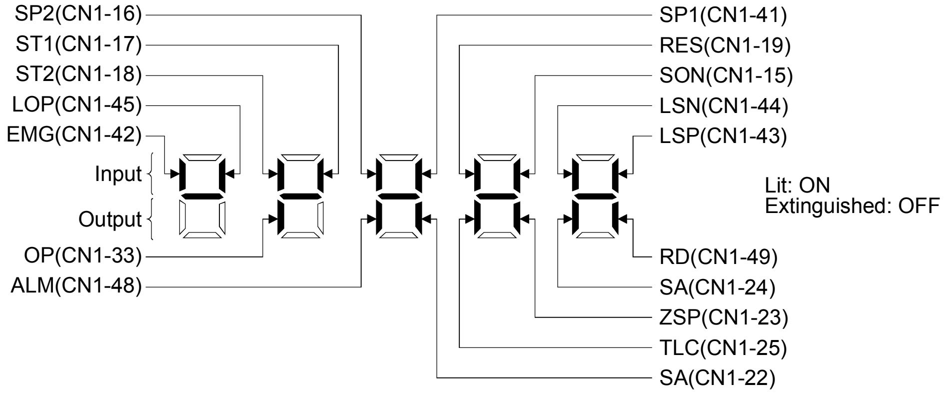
Symbol	Signal name	Symbol	Signal name
SON	Servo-on	RES	Reset
LSP	Forward rotation stroke end	EMG	Emergency stop
LSN	Reverse rotation stroke end	LOP	Control change
CR	Clear	TLC	Limiting torque
SP1	Speed selection 1	VLC	Limiting speed
SP2	Speed selection 2	RD	Ready
PC	Proportion control	ZSP	Zero speed
ST1	Forward rotation start	INP	In position
ST2	Reverse rotation start	SA	Speed reached
RS1	Forward rotation selection	ALM	Trouble
RS2	Reverse rotation selection	OP	Encoder Z-phase pulse (open collector)
TL	External torque limit selection		

(3) Display data at initial values

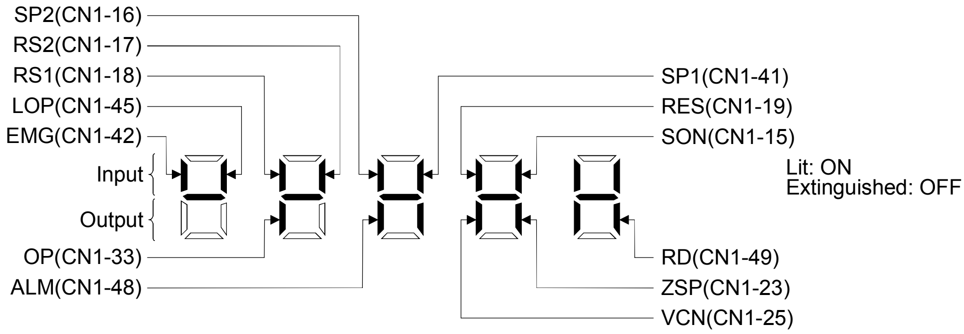
(a) Position control mode



(b) Speed control mode



(c) Torque control mode

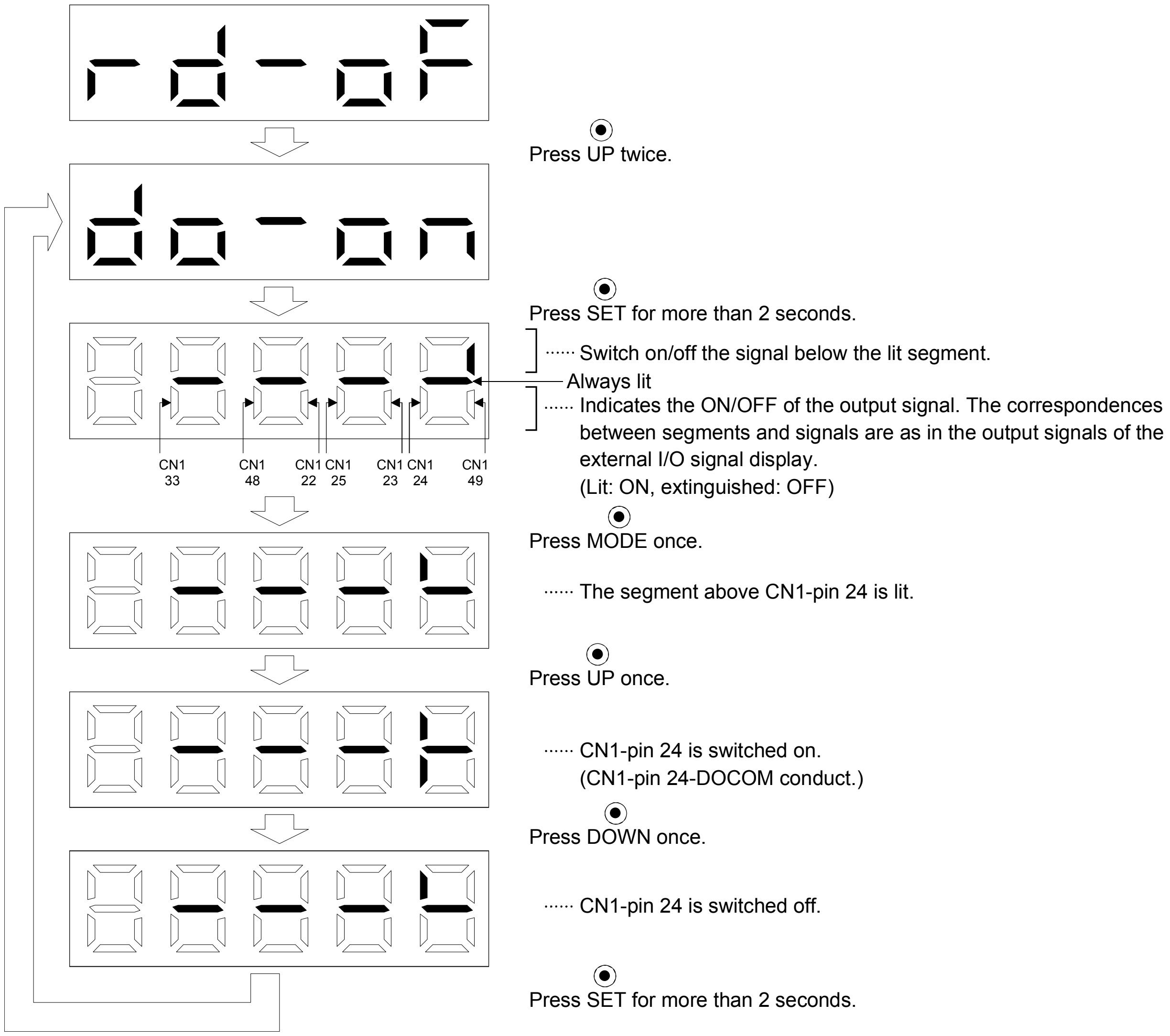


6.8 Output signal (DO) forced output

POINT
· When the servo system is used in a vertical lift application, turning on the electromagnetic brake interlock (MBR) after assigning it to connector CN1 will release the electromagnetic brake, causing a drop. Take drop preventive measures on the machine side.

The output signal can be forced on/off independently of the servo status. This function is used for output signal wiring check, etc. This operation must be performed in the servo off state servo-on (SON).

Operation
Call the display screen shown after power-on.
Using the "MODE" button, show the diagnostic screen.



6.9 Test operation mode

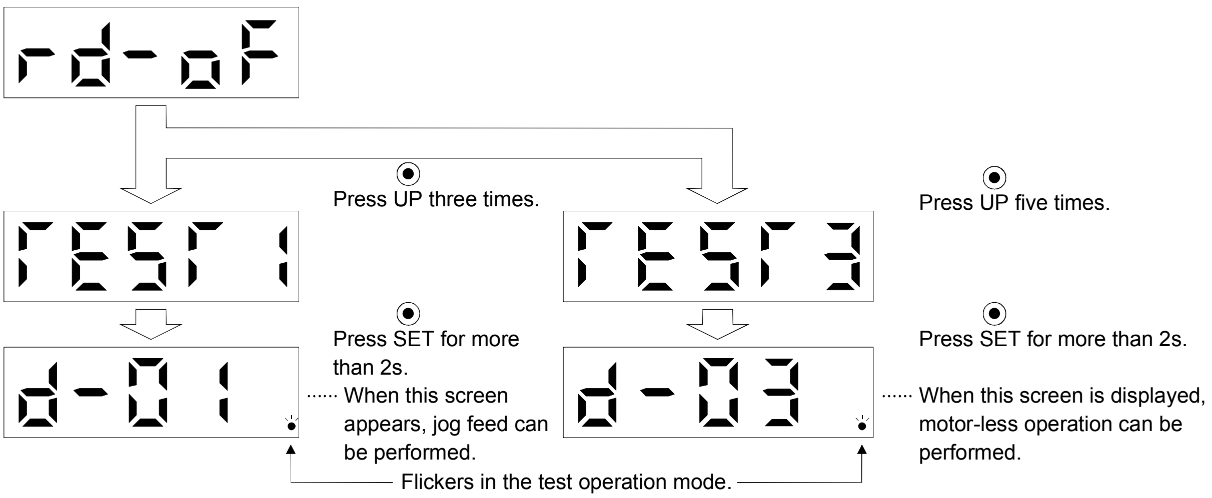
⚠ CAUTION	· The test operation mode is designed to confirm servo operation. Do not use it for actual operation. · If any operational fault has occurred, stop operation using the emergency stop (EMG) signal.

POINT

- The test operation mode cannot be used in the absolute position detection system. Use it after choosing "Incremental system" in parameter No. PA03.
- The servo configuration software is required to perform positioning operation.
- Test operation cannot be performed if the servo-on (SON) is not turned OFF.

6.9.1 Mode change

Call the display screen shown after power-on. Choose jog operation/motor-less operation in the following procedure. Using the "MODE" button, show the diagnostic screen.



6.9.2 Jog operation

POINT
- When performing jog operation, turn ON EMG, LSP and LSN. LSP and LSN can be set to automatic ON by setting parameter No. PD01 to "□ C □ □".

Jog operation can be performed when there is no command from the external command device.

(1) Operation

Hold down the "UP" or "DOWN" button to run the servo motor. Release it to stop. When using the servo configuration software, you can change the operation conditions. The initial conditions and setting ranges for operation are listed below:

Item	Initial setting	Setting range
Speed [r/min]	200	0 to instantaneous permissible speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the buttons is explained below:

Button	Description
"UP"	Press to start CCW rotation. Release to stop.
"DOWN"	Press to start CW rotation. Release to stop.

If the communication cable is disconnected during jog operation performed by using the servo configuration software, the servo motor will be decelerated to a stop.

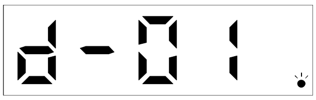
(2) Status display

You can confirm the servo status during jog operation.

Pressing the "MODE" button in the jog operation-ready status calls the status display screen. With this screen being shown, perform jog operation with the "UP" or "DOWN" button. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the jog operation-ready status screen. For full information of the status display, refer to section 6.3. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of jog operation

To end the jog operation, switch power off once or press the "MODE" button to switch to the next screen and then hold down the "SET" button for 2 or more seconds.

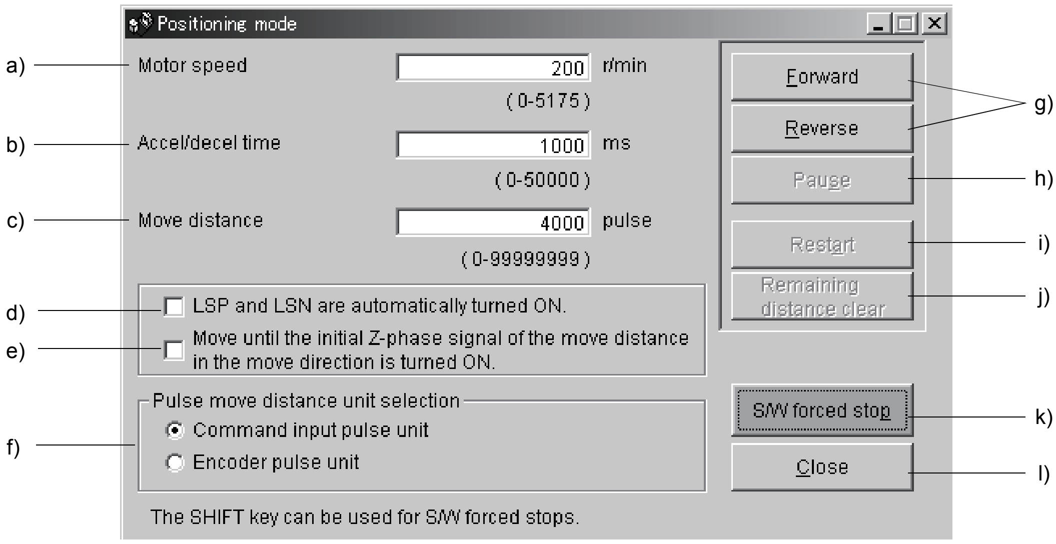


6.9.3 Positioning operation

POINT
・MR Configurator is required to perform positioning operation.
・Turn ON EMG when performing positioning operation.

With no command given from the external command device, positioning operation can be executed once.

(1) Operation



a) Motor speed [r/min]
   Enter the servo motor speed into the "Motor speed" input field.

b) Accel/decel time [ms]
   Enter the acceleration/deceleration time constant into the "Accel/decel time" input field.

c) Move distance [pulse]
   Enter the moving distance into the "Move distance" input field.

d) LSP/LSN automatically turned ON
   When setting the external stroke signal to automatic ON, click the check box to make it valid. When it is not checked, turn ON LSN/LSP externally.

e) Move till a first Z-phase signal turned ON in the moving direction
   Movement is made until the moving distance is reached and the first Z-phase signal in the moving direction turns ON.

f) Pulse move distance unit selection/Command input pulse unit/Encoder pulse unit
   Select with the option buttons whether the moving distance set in c) is in the command pulse unit or in the encoder pulse unit.
   When the encoder pulse unit is selected, the moving distance is regarded as the value before multiplication of the electronic gear ($\frac{CMX}{CDV}$). When the command pulse unit is selected, the moving distance is regarded as the value after multiplication of the electronic gear.

g) Forward/Reverse
Click the "Forward" button to rotate the servo motor in the forward rotation direction.
Click the "Reverse" button to rotate the servo motor in the reverse rotation direction.

h) Pause
Click the "Pause" button during servo motor rotation to temporarily stop the servo motor.
This button is valid during servo motor rotation.

i) Restart
Click the "Restart" button during a temporary stop to restart the servo motor rotation.
This button is valid during a temporary stop of the servo motor.

j) Remaining move distance clear
Click the "Remaining distance clear" button during a temporary stop to erase the remaining distance.
This button is valid during a temporary stop of the servo motor.

k) Forced stop
Click the "S/W forced stop" button during servo motor rotation to make a hard stop.
This button is valid during servo motor rotation.

l) Close
Click the "Close" button to cancel the positioning operation mode and close the window.

(2) Status display
The status display can be monitored during positioning operation.

6.9.4 Motor-less operation

Without connecting the servo motor, you can provide output signals or monitor the status display as if the servo motor is running in response to external input signals. This operation can be used to check the sequence of a host programmable controller or the like.

(1) Operation
Turn SON off, choose motor-less operation. After that, perform external operation as in ordinary operation.

(2) Status display
You can confirm the servo status during motor-less operation.
Pressing the "MODE" button in the motor-less operation-ready status calls the status display screen. With this screen being shown, perform motor-less operation. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the motor-less operation-ready status screen. For full information of the status display, refer to section 6.3. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of motor-less operation
To terminate the motor-less operation, switch power off.

7. GENERAL GAIN ADJUSTMENT

POINT
・For use in the torque control mode, you need not make gain adjustment.

7.1 Different adjustment methods

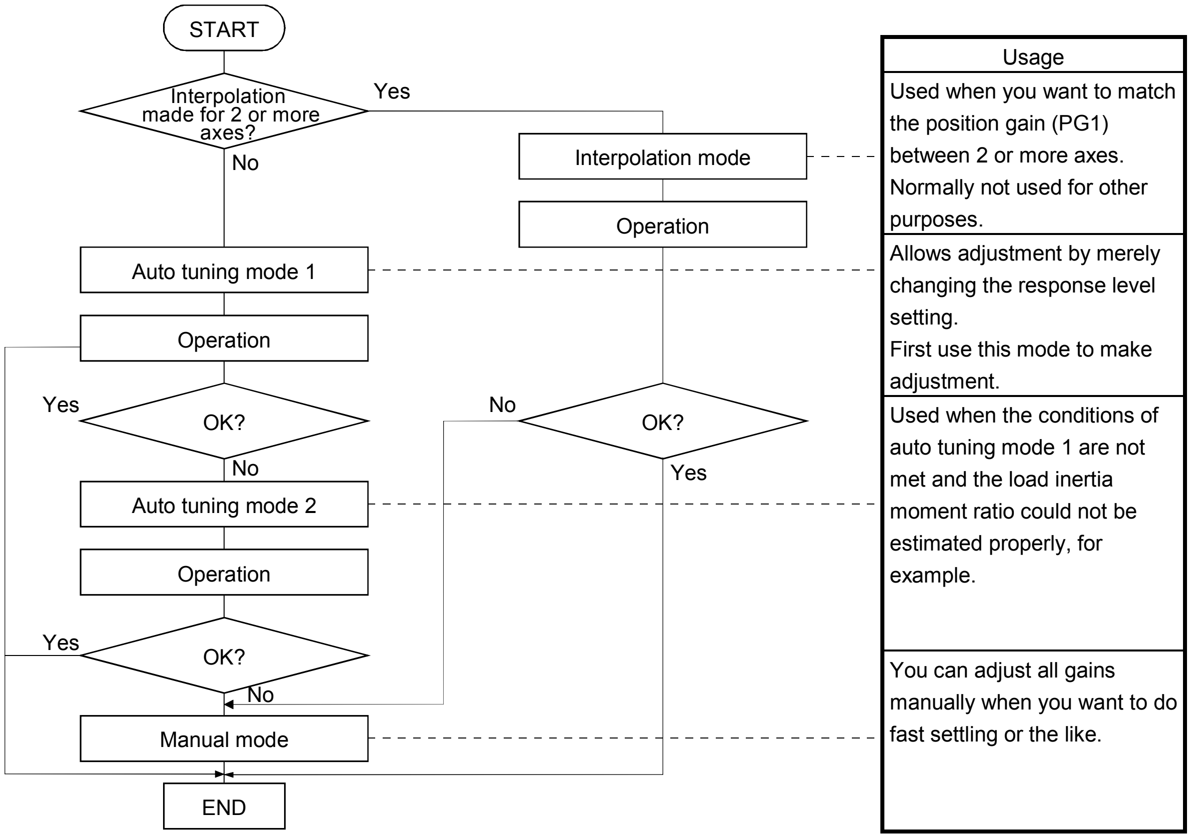
7.1.1 Adjustment on a single servo amplifier

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)	Response level setting of 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)	GD2 (parameter No. PB06) Response level setting of parameter No. PA09
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)	PG1 (parameter No. PB07)

(2) Adjustment sequence and mode usage



7.1.2 Adjustment using MR Configurator

This section gives the functions and adjustment that may be performed by using the servo amplifier with the 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.

7.2 Auto tuning

7.2.1 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	Ratio of load inertia moment to servo motor inertia moment
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 ratio of load inertia moment to servo motor inertia moment 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.

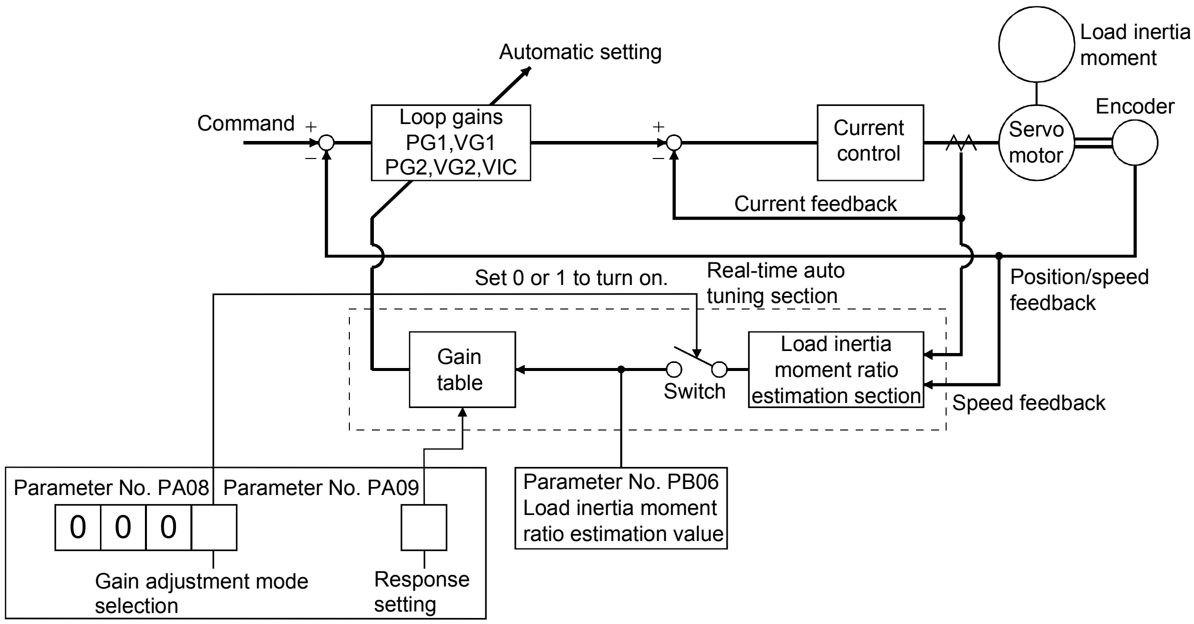
(2) Auto tuning mode 2

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

7.2.2 Auto tuning mode operation

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

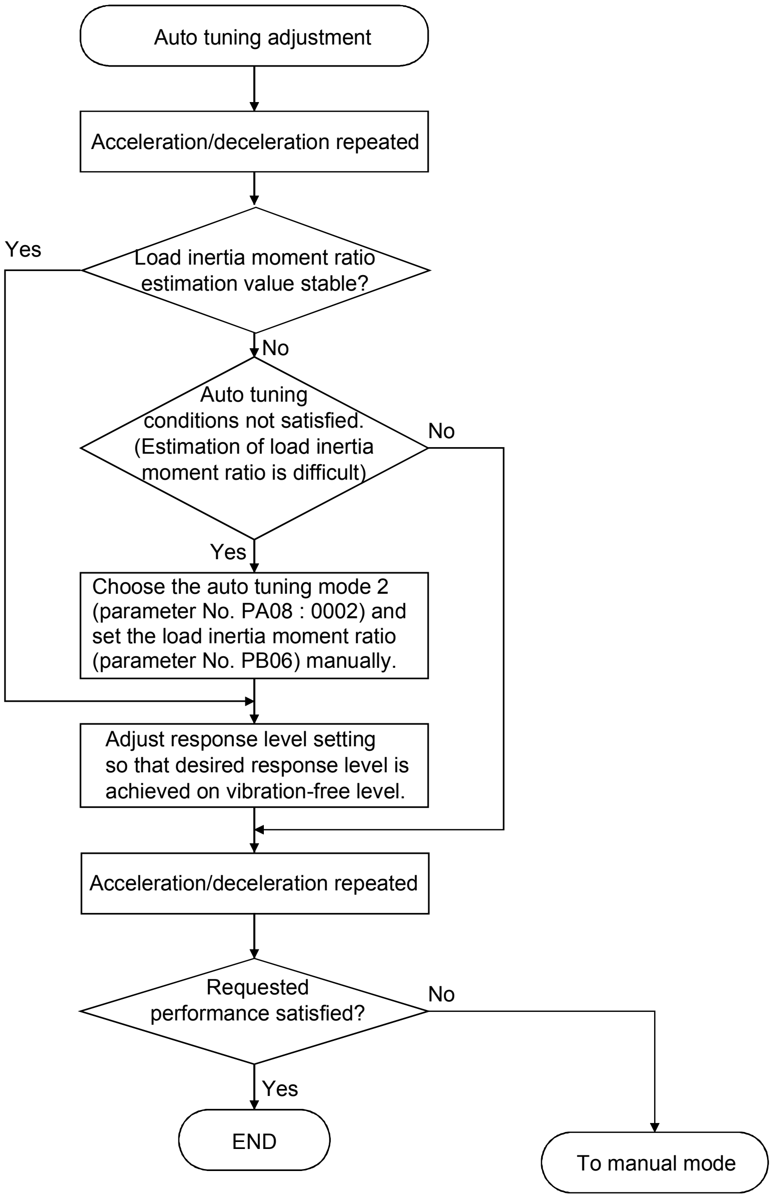


When a servo motor is accelerated/decelerated, the load inertia moment ratio estimation section always estimates the load inertia moment ratio from the current and speed of the servo motor. The results of estimation are written to parameter No. PB06 (the ratio of load inertia moment to servo motor). These results can be confirmed on the status display screen of the servo configuration software section.
If the value of the load inertia moment ratio is already known or if estimation cannot be made properly, chose 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. 34) 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.

7.2.3 Adjustment procedure by auto tuning

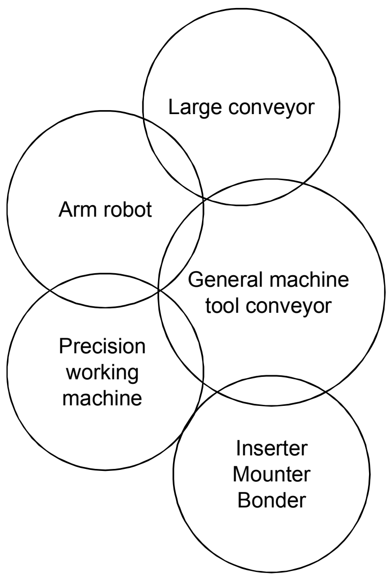
Since auto tuning is made valid before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.



7.2.4 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 8.3 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	

7.3 Manual mode 1 (simple manual adjustment)

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 8.3.)

(1) For speed control

(a) Parameters

The following parameters are used for gain adjustment:

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
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 7.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment. (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 8.2, 8.3.
9	While checking the settling characteristic and 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:

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

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:

$$\text{Speed integral compensation setting(ms)} \geq \frac{2000 \text{ to } 3000}{\text{Speed loop gain setting/ }(1+\text{ratio of load inertia moment to servo motor inertia moment setting}\times 0.1)}$$

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment:

Parameter No.	Abbreviation	Name
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment
PB07	PG1	Model loop gain
PB08	VG2	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 7.2.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 0003).	
3	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment. (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 8.2・8.3.
10	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Model loop gain (parameter No. PB07)

This parameter determines the response level of the model loop. Increasing position loop gain 1 improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling.

$$\text{Model loop gain guideline} \leq \frac{\text{Speed loop gain 2 setting}}{(1+\text{ratio of load inertia moment to servo motor inertia moment})} \times \left(\frac{1}{4}\text{ to }\frac{1}{8}\right)$$

2) 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:

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

3) Speed integral compensation (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:

$$\text{Speed integral compensation setting(ms)} \geq \frac{2000\text{ to }3000}{\text{Speed loop gain 2 setting}/(1+\text{ratio of load inertia moment to servo motor inertia moment 2 setting})}$$

7.4 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, the model loop gain and speed loop gain which determine command track ability are set manually and the other parameter 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	Ratio of load inertia moment to servo motor inertia moment
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 model 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 of the position control loop. 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.

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

7.5 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-J2S-Super series. The following table lists comparison of the response level setting.

MELSERVO-J2-Super		MELSERVO-J3	
Parameter No. 2 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.

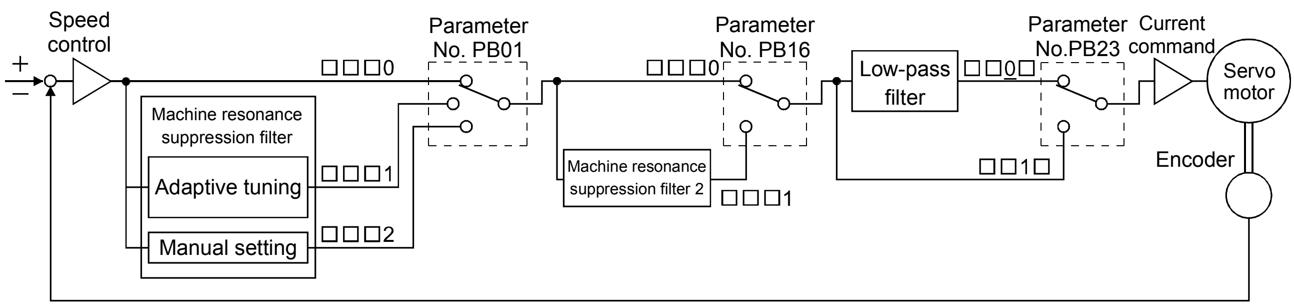
MEMO

8. 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 7.

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.

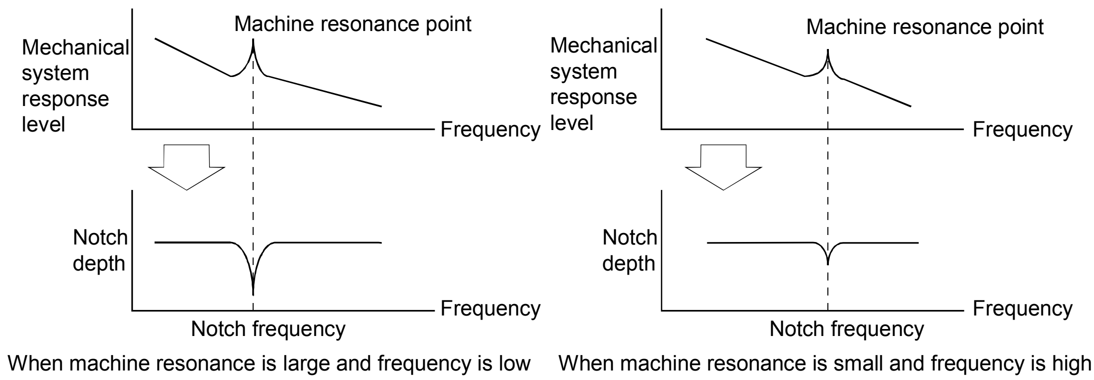
8.1 Function block diagram



8.2 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.



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 operation of adaptive tuning mode (parameter No. PB01).

Parameter No. PB01

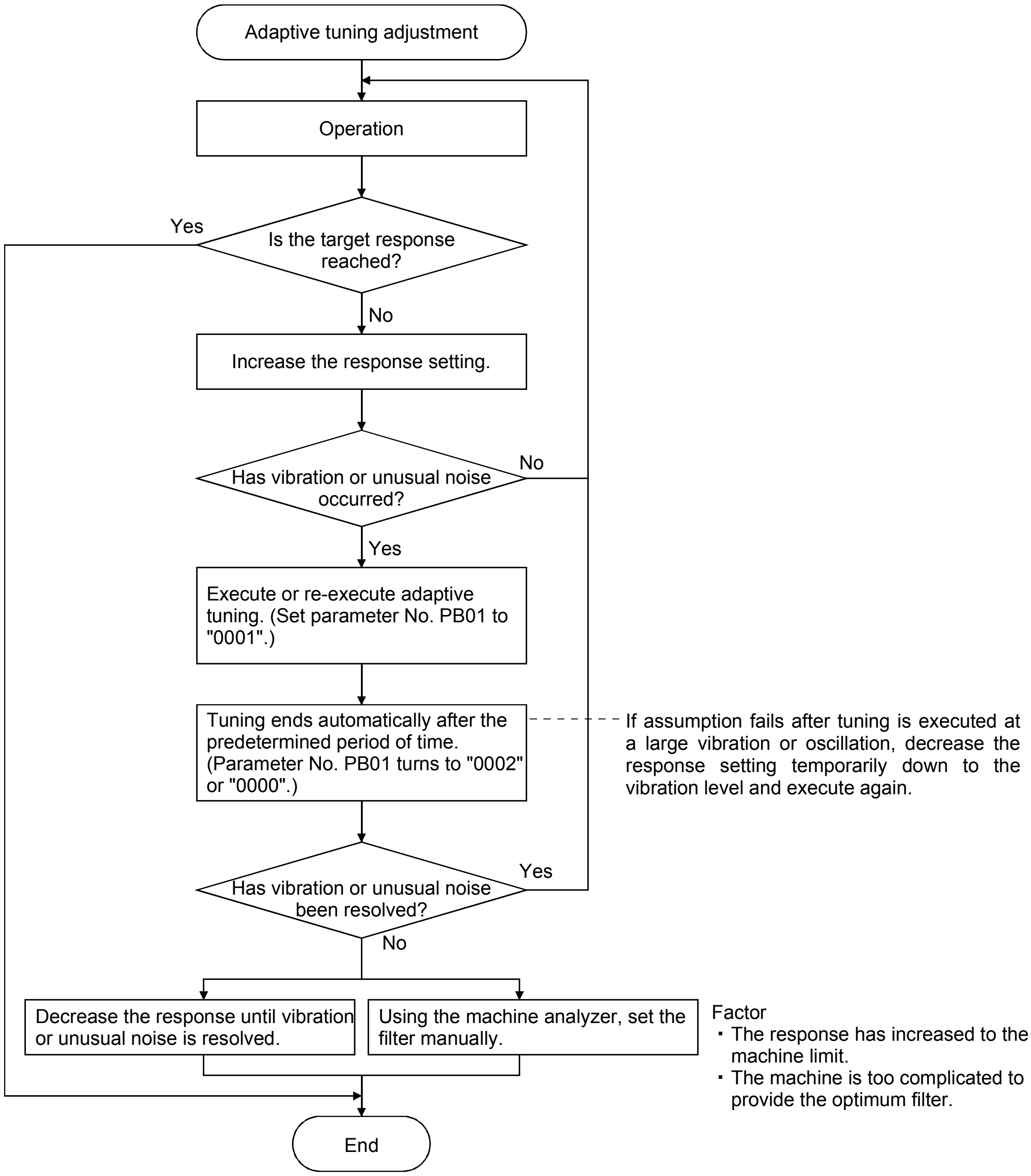
0	0	0	

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. PB13 and PB14 are fixed to the initial values.

(3) Adaptive tuning mode procedure

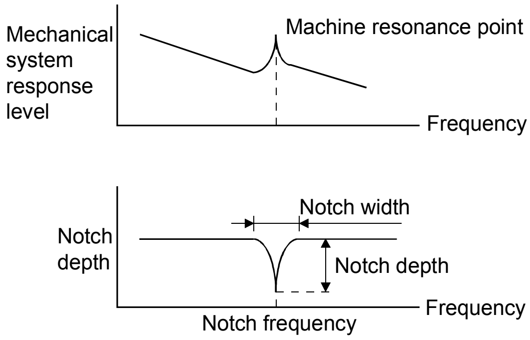


POINT
· "Filter OFF" enables a return to the factory-set initial value. · When adaptive tuning is executed, vibration sound increases as an excitation signal is forcibly applied for several seconds. · When adaptive tuning is executed, machine resonance is detected for a maximum of 10 seconds and a filter 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.

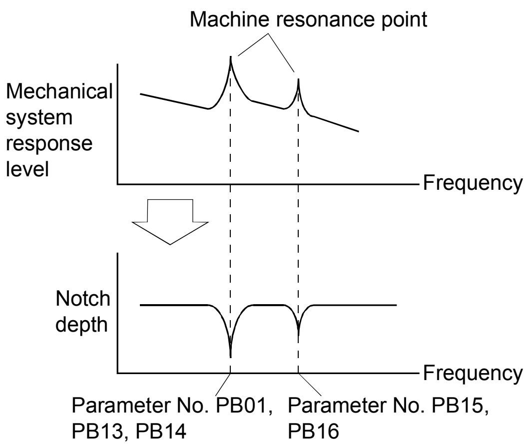
8.3 Machine resonance suppression filter

(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.

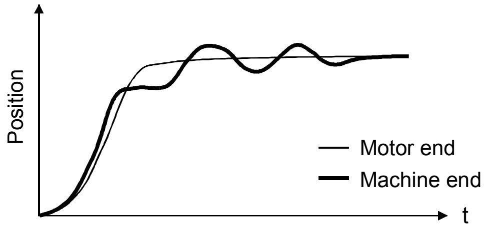
POINT

- 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 the MR Configurator (Servo configuration software). This allows the required notch frequency and depth to be determined.

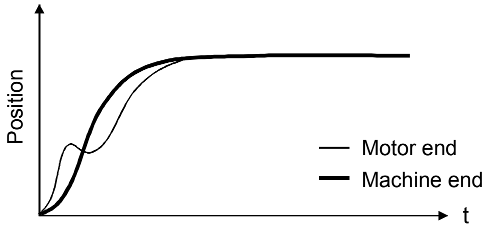
8.4 Advanced vibration suppression control

(1) Operation

Vibration suppression control is used to further suppress machine end 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
(Normal control)



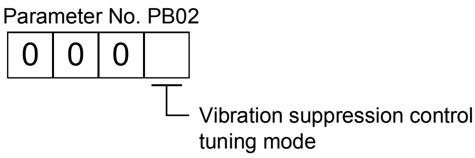
Vibration suppression control ON

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



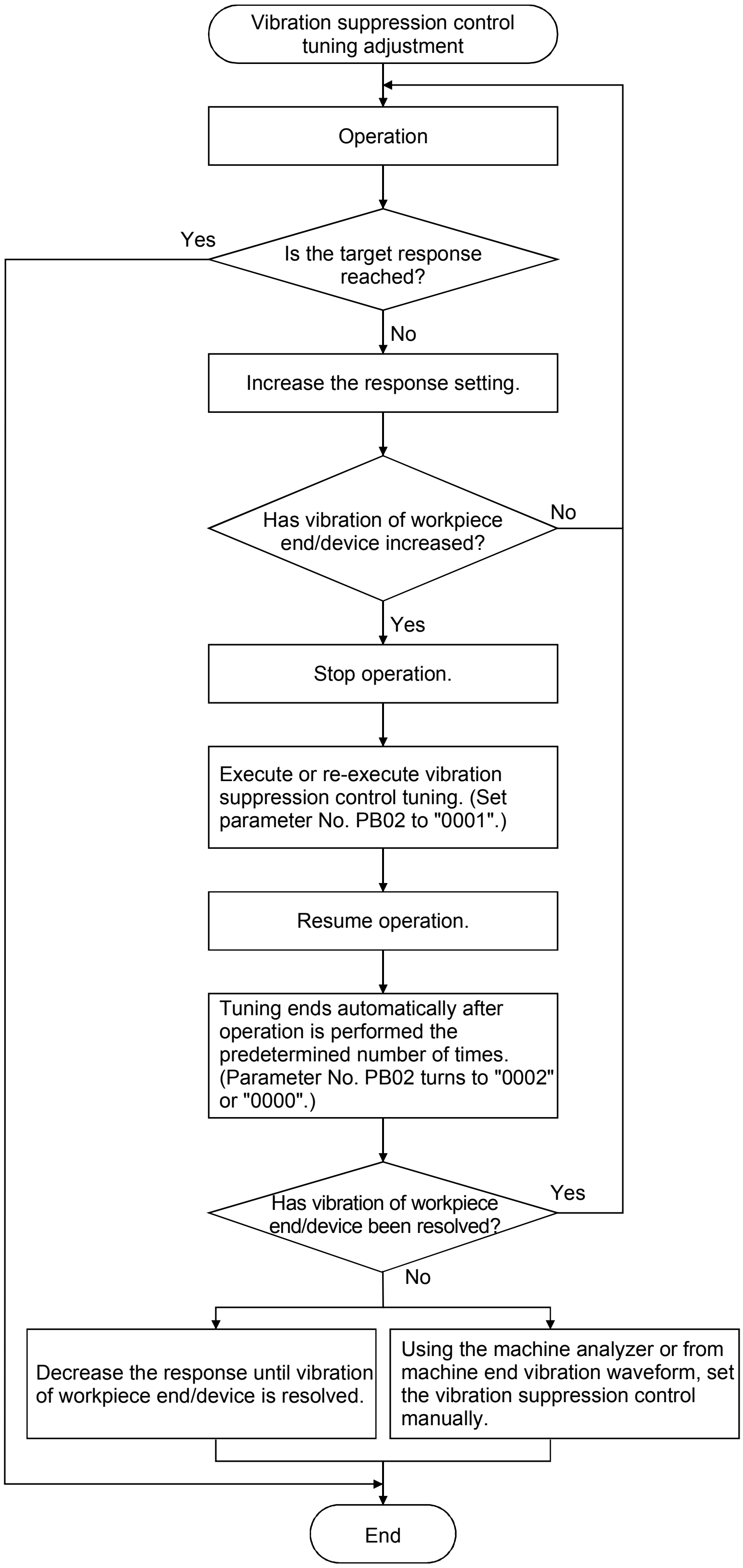
Setting	Vibration Suppression Control Tuning Mode	Automatically Set Parameter
0	Vibration suppression control OFF	(Note)
1	Vibration suppression control tuning mode (Advanced vibration suppression control)	Parameter No. PB19 Parameter No. PB20
2	Manual mode	

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 end 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

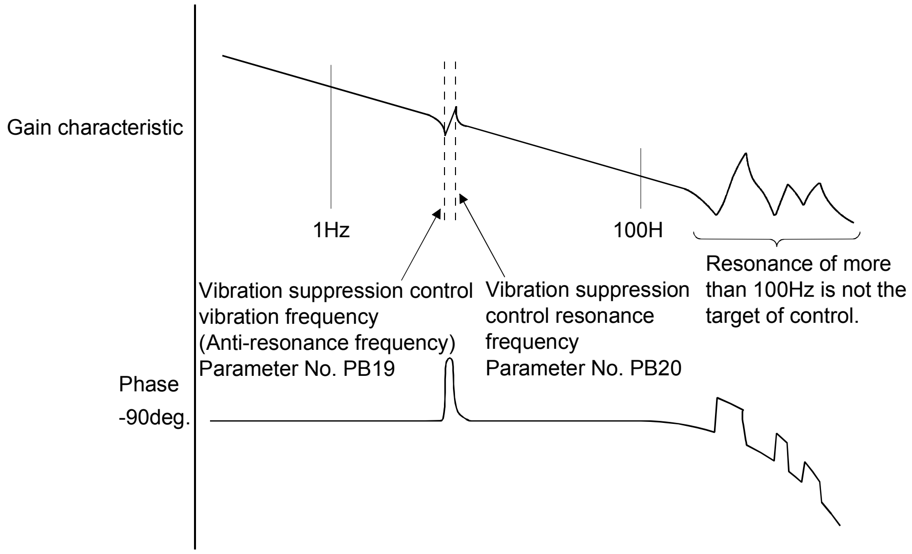


Factor
- Estimation cannot be made as machine end vibration has not been transmitted to the motor end.
- The response of the model loop gain has increased to the machine end vibration frequency (vibration suppression control limit).

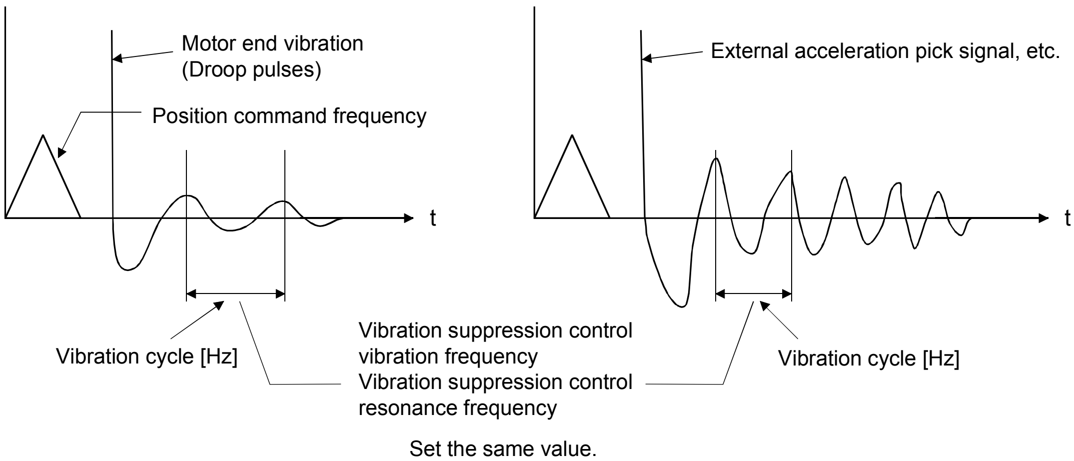
(4) Vibration suppression control manual mode

Measure work end 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 FFT equipment



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



POINT

- When machine end vibration does not show up in motor end vibration, the setting of the motor end vibration frequency does not produce an effect.
- When the anti-resonance frequency and resonance frequency can be confirmed using the machine analyzer or external FFT device, 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.

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

8.5 Low-pass filter

(1) Function

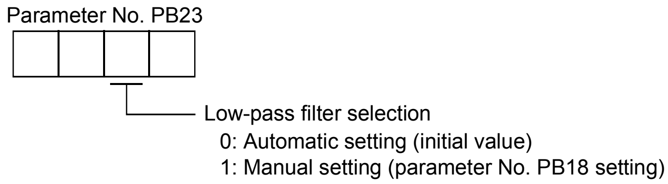
When a ballscrew or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is factory-set to be valid for a torque command. The filter frequency of this low-pass filter is automatically adjusted to the value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

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

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

(2) Parameter

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



8.6 Gain changing function

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

8.6.1 Applications

This function is used when:

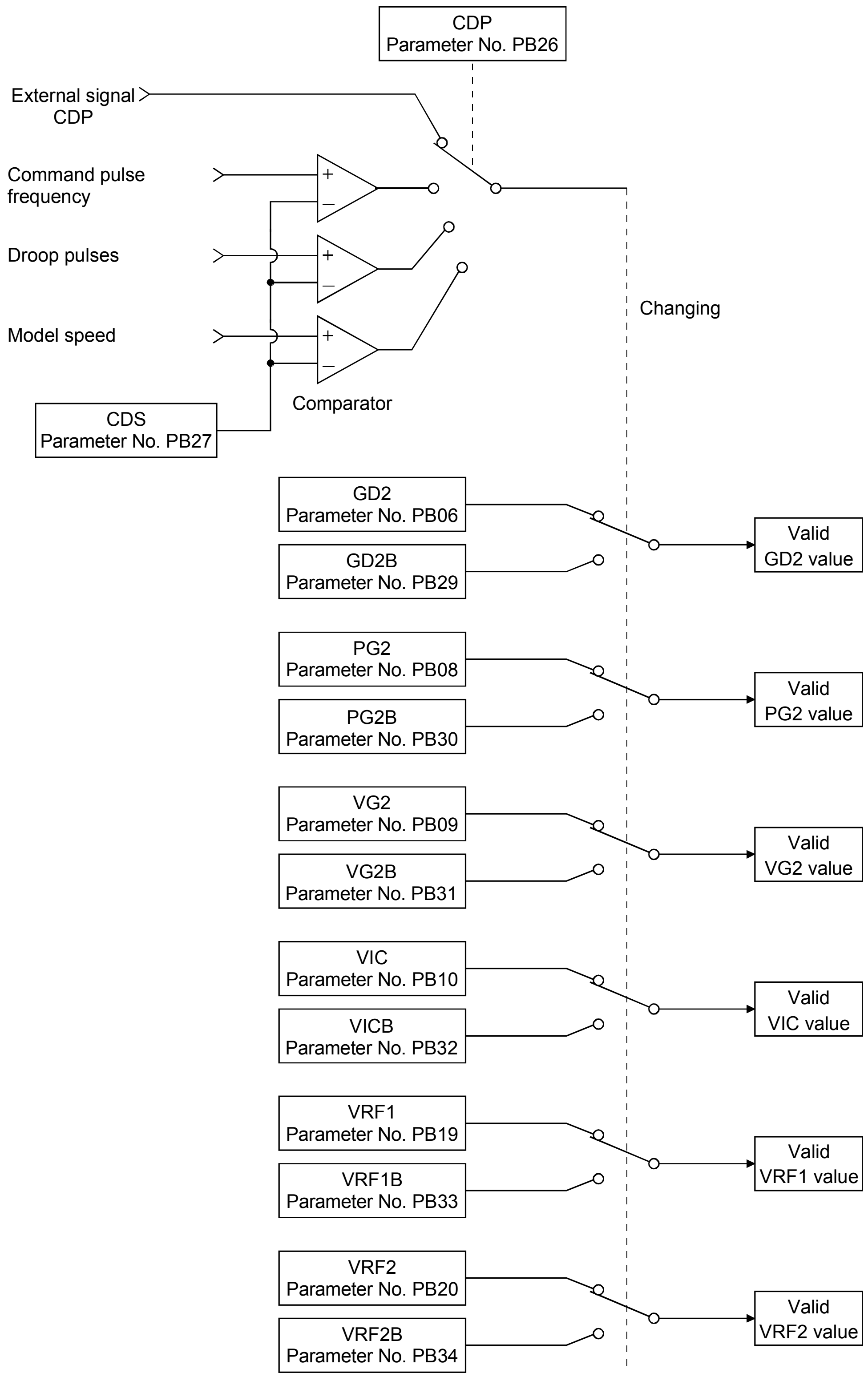
(1) You want to increase the gains during servo lock but decrease the gains to reduce noise during rotation.

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

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

8.6.2 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 CDS (parameter No. PB27).



8.6.3 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	Ratio of load inertia moment to servo motor inertia moment	times	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 ratio of load inertia moment to servo motor inertia moment	times	Used to set the ratio of load inertia moment to servo motor inertia moment after changing.
PB30	PG2B	Gain changing position loop gain 2	rad/s	Used to set the value of the after-changing position loop gain 2.
PB31	VG2B	Gain changing speed loop gain 2	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	CDS	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 ratio of load inertia moment to servo motor inertia moment, position loop gain, speed loop gain and speed integral compensation to be changed.

(2) Gain changing ratio of load inertia moment to servo motor inertia moment (GD2B: parameter No. PB29)

Set the ratio of load inertia moment to servo motor inertia moment after changing. If the load inertia moment ratio does not change, set it to the same value as ratio of load inertia moment to servo motor inertia moment (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 gain changing (CDP) external input signal for gain changing. The gain changing (CDP) can be assigned to the pins using parameters No. PB13 to PB16, PB18.

Parameter No. PB26

0	0		

Gain changing selection
Under any of the following conditions, the gains change on the basis of the parameter No. PB29 to PB32 settings.
0: Invalid
1: Gain changing (CDP) is ON
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 at more than condition (Valid when gain changing (CDP) is ON)
1: Valid at less than condition (Valid when gain changing (CDP) is OFF)

(5) Gain changing condition (parameter No. PB27)

When you selected "command frequency", "droop pulses" 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 pulses	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.

8.6.4 Gain changing operation

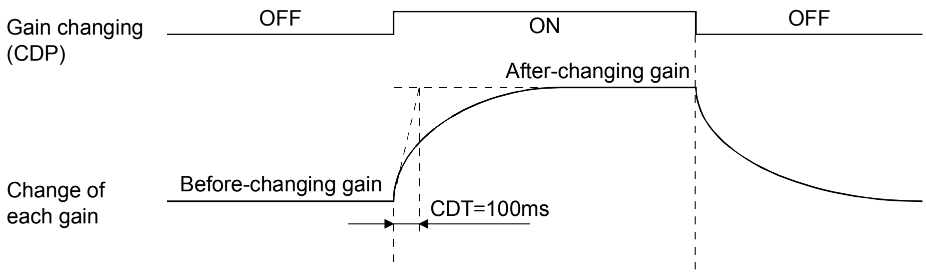
This operation will be described by way of setting examples.

(1) When you choose changing by external input

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	4.0	times
PB07	PG1	Model loop gain	100	rad/s
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 ratio of load inertia moment to servo motor inertia moment	10.0	times
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 signal)	
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 operation



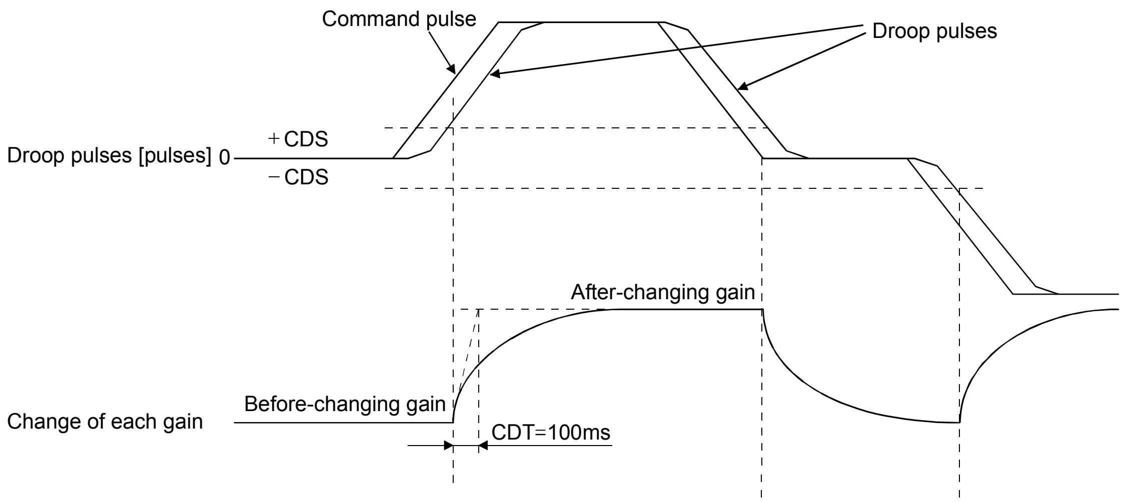
Model loop gain 1			100		
Ratio of load inertia moment to servo motor inertia moment	4.0	→	10.0	→	4.0
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20

(2) When you choose changing by droop pulses

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	4.0	times
PB07	PG1	Model loop gain	100	rad/s
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain 2	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	10.0	times
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 pulses)	
PB27	CDS	Gain changing condition	50	pulse
PB28	CDT	Gain changing time constant	100	ms

(b) Changing operation



Model loop gain	100						
Ratio of load inertia moment to servo motor inertia moment	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

MEMO

9. TROUBLESHOOTING

POINT
・ As soon as an alarm occurs, turn off Servo-on (SON) and power off.

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

9.1 Alarms and warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 9.2 or 9.3 and take the appropriate action. When an alarm occurs, ALM turns off. Set "□□□ 1" in parameter No.PD24 to output the alarm code is outputted by ON/OFF of bit0 to bit2. Warnings (AL.92 to AL.EA) have no alarm codes. Any alarm code is output at occurrence of the corresponding alarm. In the normal status, the alarm code is not output.
After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column.

	Display	(Note 2) Alarm code			Name	Alarm deactivation		
		CN1 22 (bit2)	CN1 23 (bit1)	CN1 24 (bit0)		Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES)
Alarms	AL.10	0	1	0	Undervoltage	○	○	○
	AL.12	0	0	0	Memory error1 (RAM)	○		
	AL.13	0	0	0	Clock error	○		
	AL.15	0	0	0	Memory error2 (EEP-ROM)	○		
	AL.16	1	1	0	Encoder error1 (At power on)	○		
	AL.17	0	0	0	Board error	○		
	AL.19	0	0	0	Memory error3 (Flash-ROM)	○		
	AL.1A	1	1	0	Motor combination error	○		
	AL.20	1	1	0	Encoder error2	○		
	AL.24	1	0	0	Main circuit error	○	○	○
	AL.25	1	1	0	Absolute position erase	○		
	AL.30	0	0	1	Regenerative error	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.31	1	0	1	Overspeed	○	○	○
	AL.32	1	0	0	Overcurrent	○		
	AL.33	0	0	1	Overvoltage	○	○	○
	AL.35	1	0	1	Command pulse frequency alarm	○	○	○
	AL.37	0	0	0	Parameter error	○		
	AL.45	0	1	1	Main circuit device overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.46	0	1	1	Servo motor overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.47	0	1	1	Cooling fan alarm	○		
	AL.50	0	1	1	Overload1	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.51	0	1	1	Overload2	(Note 1) ○	(Note 1) ○	(Note 1) ○
	AL.52	1	0	1	Error excessive	○	○	○
	AL.8A	0	0	0	Serial communication time-out	○	○	○
	AL.8E	0	0	0	Serial communication error	○	○	○
	88888				Watchdog	○		

	Display	Name
Warnings	AL.92	Open battery cable warning
	AL.96	Home position setting error
	AL.99	Stoke limit warning
	AL.9F	Battery warning
	AL.E0	Excessive regeneration warning
	AL.E1	Overload warning 1
	AL.E3	Absolute position counter warning
	AL.E5	ABS time-out warning
	AL.E6	Servo emergency stop warning
	AL.E8	Cooling fan speed reduction warning
	AL.E9	Main circuit off warning
	AL.EA	ABS servo on warning
	AL.EC	Overload warning 2
	AL.ED	Output watt excess warning

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.
2. 0: off
1: on

9.2 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 (AL.25) occurred, always make home position setting again. Otherwise, misoperation may occur. ・As soon as an alarm occurs, turn off Servo-on (SON) and power off.

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.
  - Regenerative error (AL.30)
  - Overload 1 (AL.50)
  - Overload 2 (AL.51)
- The alarm can be deactivated by switching power off, then on press the "SET" button on the current alarm screen or by turning on the reset (RES). For details, refer to section 9.1.

When an alarm occurs, the trouble (ALM) switches off and the dynamic brake is operated to stop the servomotor. 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. The optional MR Configurator may be used to refer to the cause.

Display	Name	Definition	Cause	Action
AL.10	Undervoltage	Power supply voltage dropped. MR-J3-□A: 160VAC or less MR-J3-□A1: 83VAC or less MR-J3-□A4: 280VAC or less	1. Power supply voltage is low.	Review the power supply.
			2. There was an instantaneous control 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. MR-J3-□A: 200VDC MR-J3-□A1: 158VDC MR-J3-□A4: 380VDC	
			5. Faulty parts in the servo amplifier Checking method Alarm (AL.10) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
AL.12	Memory error 1 (RAM)	RAM, memory fault	Faulty parts in the servo amplifier Checking method Alarm (any of AL.12 and AL.13) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
AL.13	Clock error	Printed board fault		

Display	Name	Definition	Cause	Action
AL.15	Memory error 2 (EEP-ROM)	EEP-ROM fault	1. Faulty parts in the servo amplifier Checking method Alarm (AL.15) 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.	
AL.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 faulty (Wire breakage or shorted)	Repair or change 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. PC22.
AL.17	Board error	CPU/parts fault	Faulty parts in the servo amplifier Checking method Alarm (AL.17 or AL.19) occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change the servo amplifier.
AL.19	Memory error 3 (Flash ROM)	ROM memory fault		
AL.1A	Motor combination error	Wrong combination of servo amplifier and servo motor.	Wrong combination of servo amplifier and servo motor connected.	Use correct combination.
AL.20	Encoder error 2	Communication error occurred between encoder and servo amplifier.	1. Encoder connector (CN2) disconnected.	Connect correctly.
			2. Encoder cable faulty (Wire breakage or shorted)	Repair or change the cable.
			3. Encoder fault	Change the servo motor.
AL.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 AL.24 occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	Change the servo amplifier.
AL.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 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.

Display	Name	Definition	Cause	Action
AL.30	Regenerative alarm	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 Call the status display and check the regenerative load ratio.	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-□A:260VAC or more MR-J3-□A1:More than 135VAC MR-J3-□A4:535VAC or more	Review power supply
			5. Built-in regenerative resistor or regenerative option faulty.	Change servo amplifier or regenerative option.
		Regenerative transistor fault	6. 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 servo amplifier.
AL.31	Overspeed	Speed has exceeded the instantaneous permissible speed.	1. Input command pulse frequency exceeded the permissible instantaneous speed frequency.	Set command pulses correctly.
			2. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/deceleration time constant.
			3. 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.
			4. Electronic gear ratio is large (parameters No. PA06, PA07)	Set correctly.
			5. Encoder faulty.	Change the servo motor.

<table>
<tr><th>Display</th><th>Name</th><th>Definition</th><th>Cause</th><th>Action</th></tr>
<tr><td rowspan="4">AL.32</td><td rowspan="4">Overcurrent</td><td rowspan="4">Current that flew is higher than the permissible current of the servo amplifier. (When the alarm (AL.32) occurs, switch the power OFF and then ON to reset the alarm. Then, turn on the servo-on. When the alarm (AL.32) still occurs at the time, the transistor (IPM・IGBT) of the servo amplifier may be at fault. Do not switch the power OFF/ON repeatedly; check the transistor according to the cause 2 checking method.)</td><td>1. Short occurred in servo motor power (U, V, W).</td><td>Correct the wiring.</td></tr>
<tr><td>2. Transistor (IPM・IGBT) of the servo amplifier faulty.
Checking method
Alarm (AL.32) occurs if power is switched on after U,V and W are disconnected.</td><td>Change the servo amplifier.</td></tr>
<tr><td>3. Ground fault occurred in servo motor power (U, V, W).</td><td>Correct the wiring.</td></tr>
<tr><td>4. External noise caused the overcurrent detection circuit to misoperate.</td><td>Take noise suppression measures.</td></tr>
<tr><td rowspan="8">AL.33</td><td rowspan="8">Overvoltage</td><td rowspan="8">Converter bus voltage input value has become the following.
MR-J3-□A(1): 400VDC or more
MR-J3-□A4: 800VDC or more</td><td>1. Regenerative option is not used.</td><td>Use the regenerative option.</td></tr>
<tr><td>2. Though the regenerative option is used, the parameter No.PA02 setting is "□□00 (not used)".</td><td>Set correctly.</td></tr>
<tr><td>3. Lead of built-in regenerative resistor or regenerative option is open or disconnected.</td><td>1. Change lead.
2. Connect correctly.</td></tr>
<tr><td>4. Regenerative transistor faulty.</td><td>Change servo amplifier</td></tr>
<tr><td>5. Wire breakage of built-in regenerative resistor or regenerative option</td><td>1. For wire breakage of built-in regenerative resistor, change servo amplifier.
2. For wire breakage of regenerative option, change regenerative option.</td></tr>
<tr><td>6. Capacity of built-in regenerative resistor or regenerative option is insufficient.</td><td>Add regenerative option or increase capacity.</td></tr>
<tr><td>7. Power supply voltage high.</td><td>Review the power supply.</td></tr>
<tr><td>8. Ground fault occurred in servo motor power (U, V, W).</td><td>Correct the wiring.</td></tr>
<tr><td rowspan="3">AL.35</td><td rowspan="3">Command pulse frequency error</td><td rowspan="3">Input pulse frequency of the command pulse is too high.</td><td>1. Pulse frequency of the command pulse is too high.</td><td>Change the command pulse frequency to a proper value.</td></tr>
<tr><td>2. Noise entered command pulses.</td><td>Take action against noise.</td></tr>
<tr><td>3. Command device failure</td><td>Change the command device.</td></tr>
<tr><td rowspan="3">AL.37</td><td rowspan="3">Parameter error</td><td rowspan="3">Parameter setting is wrong.</td><td>1. Servo amplifier fault caused the parameter setting to be rewritten.</td><td>Change the servo amplifier.</td></tr>
<tr><td>2. Regenerative option not used with servo amplifier was selected in parameter No.PA02.</td><td>Set parameter No.PA02 correctly.</td></tr>
<tr><td>3. The number of write times to EEP-ROM exceeded 100,000 due to parameter write, etc.</td><td>Change the servo amplifier.</td></tr>
</table>

Display	Name	Definition	Cause	Action
AL.45	Main circuit device overheat	Main circuit device overheat	1. Servo amplifier faulty.	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℃.	Review environment so that ambient temperature is 0 to 55℃.
			4. Used beyond the specifications of close mounting.	Use within the range of specifications.
AL.46	Servo motor overheat	Servo motor temperature rise actuated the thermal sensor.	1. Ambient temperature of servo motor is over 40℃.	Review environment so that ambient temperature is 0 to 40℃.
			2. Servo motor is overloaded.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			3. Thermal sensor in encoder is faulty.	Change servo motor.
AL.47	Cooling fan alarm	The cooling fan of the servo amplifier stopped, or its speed decreased to or below the alarm level.	Cooling fan life expiration (Refer to section 2.5.)	Change the cooling fan of the servo amplifier.
			Foreign matter caught in the fan stopped rotation.	Remove the foreign matter.
			The power supply of the cooling fan failed.	Change servo amplifier.
AL.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. Review operation pattern. 3. Use servo motor that provides larger output.
			2. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			3. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			5. Encoder faulty. 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 (AL.51) occurred, turn OFF/ON the power supply to clear the alarm. Then the overload operation is repeated.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.

Display	Name	Definition	Cause	Action
AL.51	Overload 2	Machine collision or the like caused max. output current to flow successively for several seconds. Servo motor locked: 1s or more During rotation: 2.5s or more	1. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			2. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			3. Servo system is instable and hunting.	1. Repeat acceleration/deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. Checking method When the servo motor shaft is rotated 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.
AL.52	Error excessive	The difference between the model position and the actual servomotor position exceeds three rotations. (Refer to the function block diagram in section 1.2.)	1. Acceleration/deceleration time constant is too small.	Increase the acceleration/deceleration time constant.
			2. Forward torque limit (parameter No.PA11) or reverse torque limit (parameter No.PA12) are too small.	Increase the torque limit value.
			3. Motor cannot be started due to torque shortage caused by power supply voltage drop.	1. Review the power supply capacity. 2. Use servo motor which provides larger output.
			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. Review operation pattern. 2. Install limit switches.
			7. Encoder faulty	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.
AL.8A	Serial communication time-out error	Communication stopped for longer than the specified time.	1. Communication cable breakage.	Repair or change communication cable
			2. Communication cycle longer than regulated time.	Shorten the communication cycle.
			3. Wrong protocol.	Correct protocol.
AL.8E	Serial communication error	Serial communication error occurred between servo amplifier and communication device (e.g. personal computer).	1. Communication cable fault (Open cable or short circuit)	Repair or change the cable.
			2. Communication device (e.g. personal computer) faulty	Change the communication device (e.g. personal computer).

Display	Name	Definition	Cause	Action
(Note) 88888	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier Checking method Alarm (88888) occurs if power is switched on after disconnection of all cables but the control circuit power supply cable.	Change servo amplifier.

Note. At power-on, "88888" appears instantaneously, but it is not an error.

9.3 Remedies for warnings

CAUTION	・If an absolute position counter warning (AL.E3) occurred, always make home position setting again. Otherwise, misoperation may occur.

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 (AL.E0)
  - Overload warning 1 (AL.E1)

If AL.E6 or AL.EA 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. Use the optional servo configuration software to refer to the cause of warning.

Remove the cause of warning according to this section. Use the optional MR Configurator to refer to a factor of warning occurrence.

Display	Name	Definition	Cause	Action
AL.92	Open battery cable 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 battery.
AL.96	Home position setting warning	Home position setting could not be made.	1. Droop pulses remaining are greater than the in-position range setting.	Remove the cause of droop pulse occurrence
			2. Command pulse entered after clearing of droop pulses.	Do not enter command pulse after clearing of droop pulses.
			3. Creep speed high.	Reduce creep speed.
AL.99	Stroke limit warning	The stroke end (LSP or LSN) of the direction which gave instructions was turned off.	The limit switch became valid.	Reexamine the operation pattern to turn LSP/LSN ON.
AL.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.
AL.E0	Excessive regenerative 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 Call the status display and check regenerative load ratio.	1. Reduce frequency of positioning. 2. Change regenerative option for the one with larger capacity. 3. Reduce load.
AL.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 AL.50,51.	Refer to AL.50, AL.51.

Display	Name	Definition	Cause	Action
AL.E3	Absolute position counter warning	Absolute position encoder pulses faulty.	1. Noise entered the encoder.	Take noise suppression measures.
			2. Encoder faulty.	Change servo motor.
		The multi-revolution counter value of the absolute position encoder exceeded the maximum revolution range.	3. The movement amount from the home position exceeded a 32767 rotation or -37268 rotation in succession.	Make home position setting again.
AL.E5	ABS time-out warning		1. PC ladder program wrong.	Contact the program.
			2. Reverse rotation start (ST2) ・ Limiting torque (TLC) improper wiring	Connect properly.
AL.E6	Servo emergency stop warning	EMG is off.	External emergency stop was made valid. (EMG was turned off.)	Ensure safety and deactivate emergency stop.
AL.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-J3-70A/100A among servo amplifiers equipped with a cooling fan.	Cooling fan life expiration (Refer to section 2.5.)	Change the cooling fan of the servo amplifier.
			The power supply of the cooling fan is broken.	Change servo amplifier.
AL.E9	Main circuit off warning	Servo-on (SON) was switched on with main circuit power off.		Switch on main circuit power.
AL.EA	ABS servo-on warning	Servo-on (SON) turned on more than 1s after servo amplifier had entered absolute position data transfer mode.	1. PC ladder program wrong.	1. Correct the program.
			2. Servo-on (SON) improper wiring.	2. Connect properly.
AL.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.
AL.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.

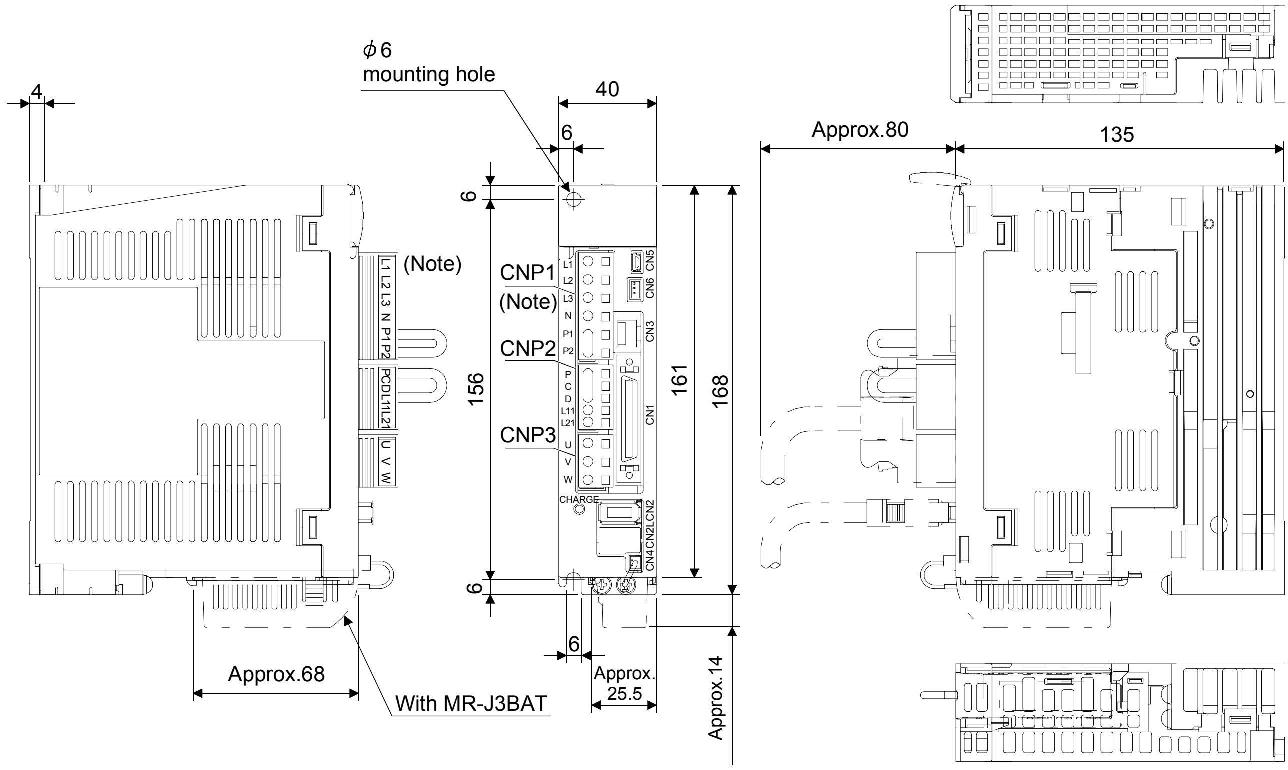
MEMO

10. OUTLINE DRAWINGS

10.1 Servo amplifier

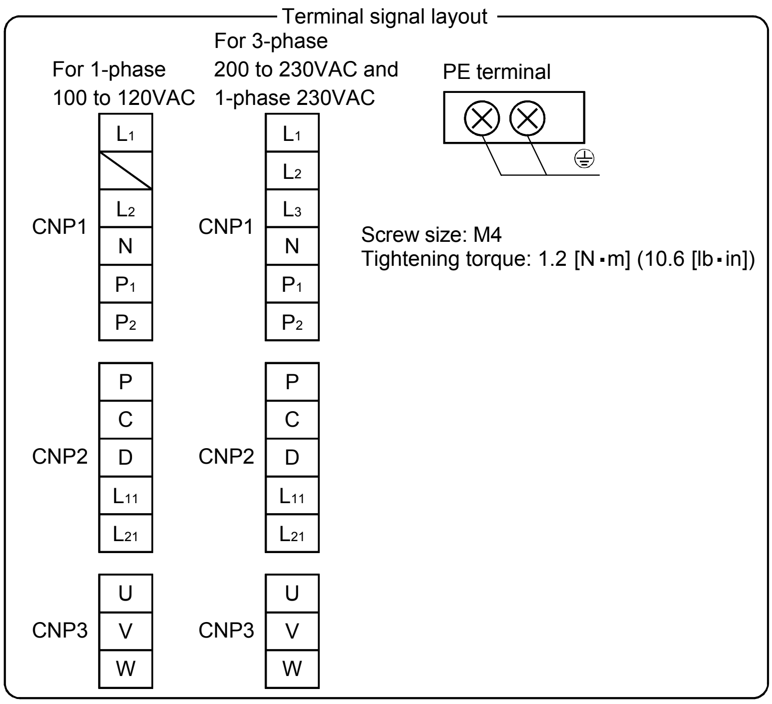
(1) MR-J3-10A・MR-J3-20A
MR-J3-10A1・MR-J3-20A1

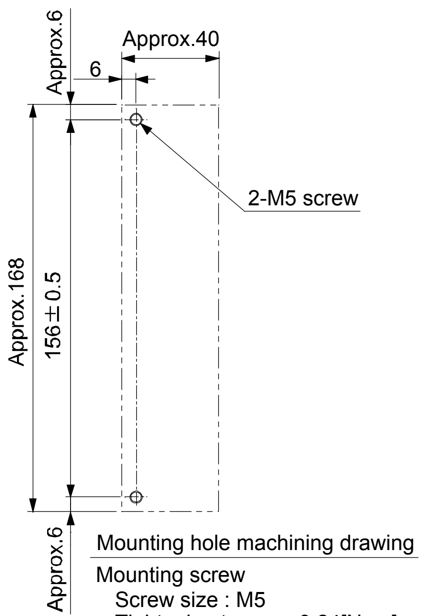
[Unit: mm]



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] (1.764 [lb])





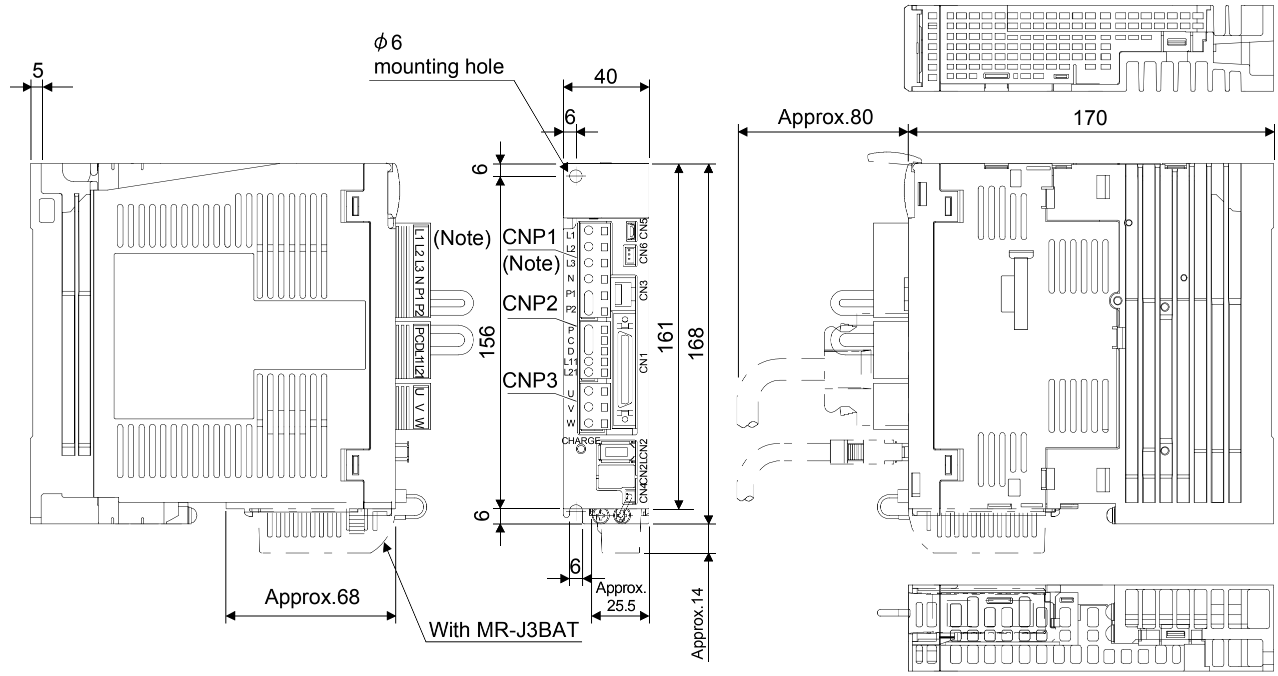
Mounting hole machining drawing

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

(2) MR-J3-40A・MR-J3-60A

MR-J3-40A1

[Unit: mm]



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

Mass: 1.0 [kg] (2.205 [lb])

Terminal signal layout

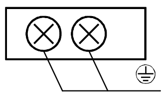
For 1-phase 100 to 120VAC

CNP1	L_1
	(none)
	L_2
	N
	P_1
	P_2
CNP2	P
	C
	D
	L_{11}
	L_{21}
CNP3	U
	V
	W

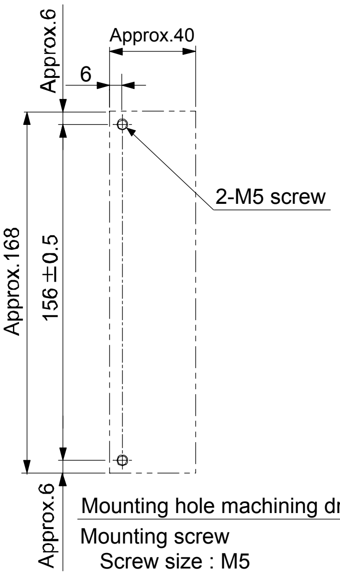
For 3-phase 200 to 230VAC and 1-phase 230VAC

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

PE terminal



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

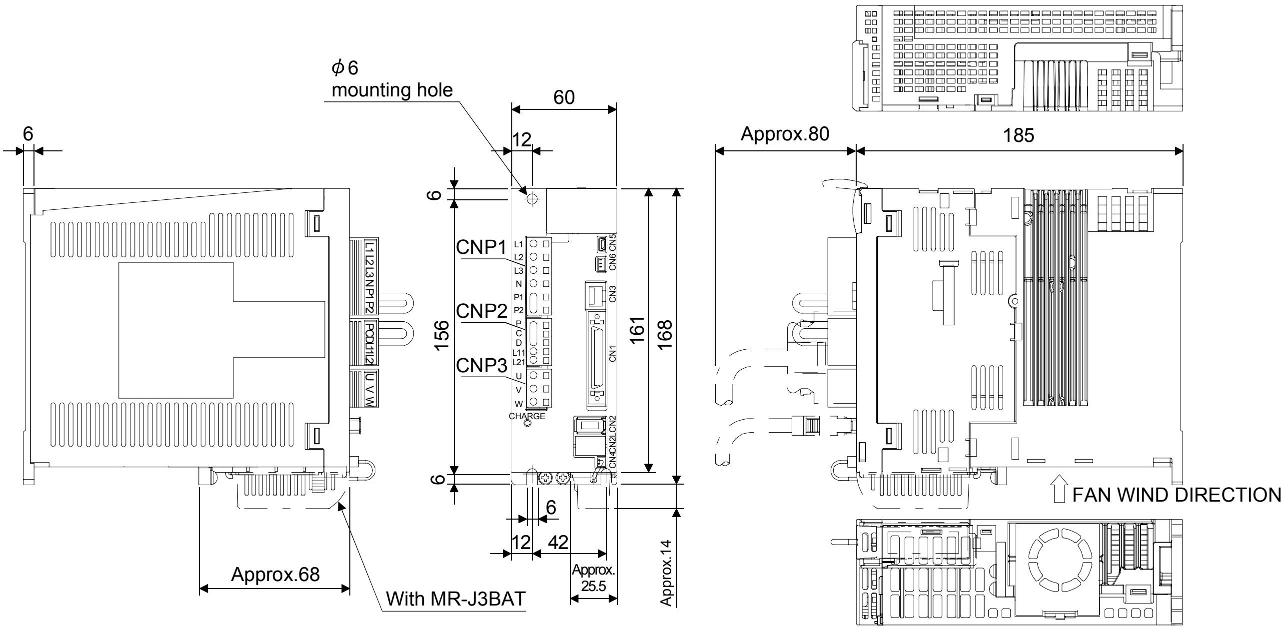


Mounting hole machining drawing

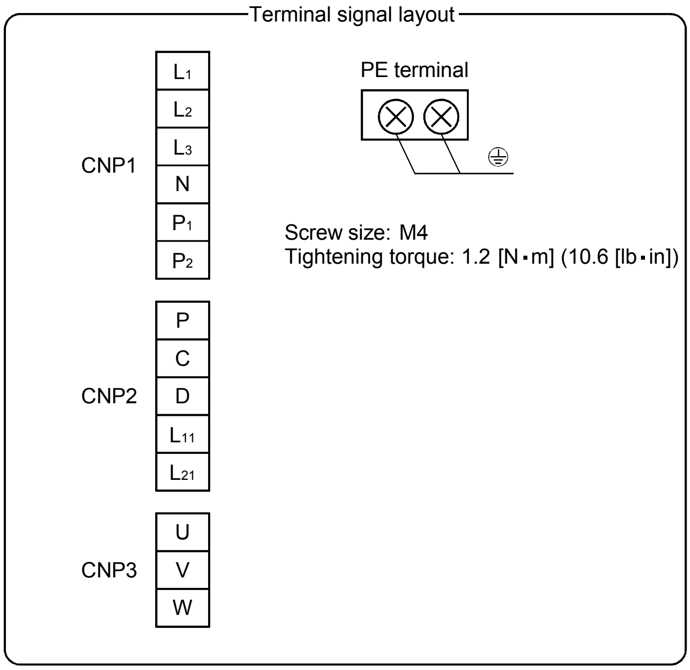
Mounting screw
Screw size : M5
Tightening torque : 3.24[N・m] (28.676[lb・in])

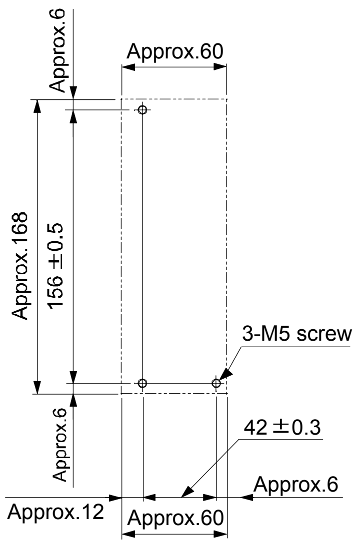
(3) MR-J3-70A・MR-J3-100A

[Unit: mm]



Mass: 1.4 [kg] (3.086 [lb])



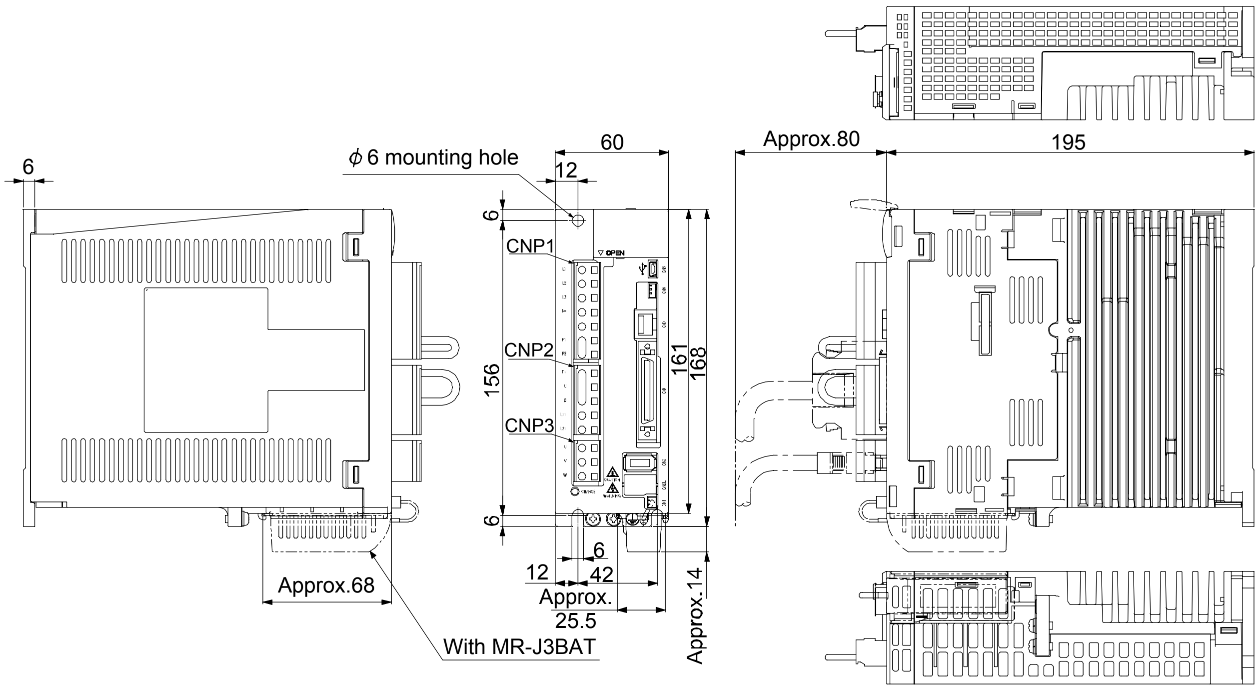


Mounting hole machining drawing

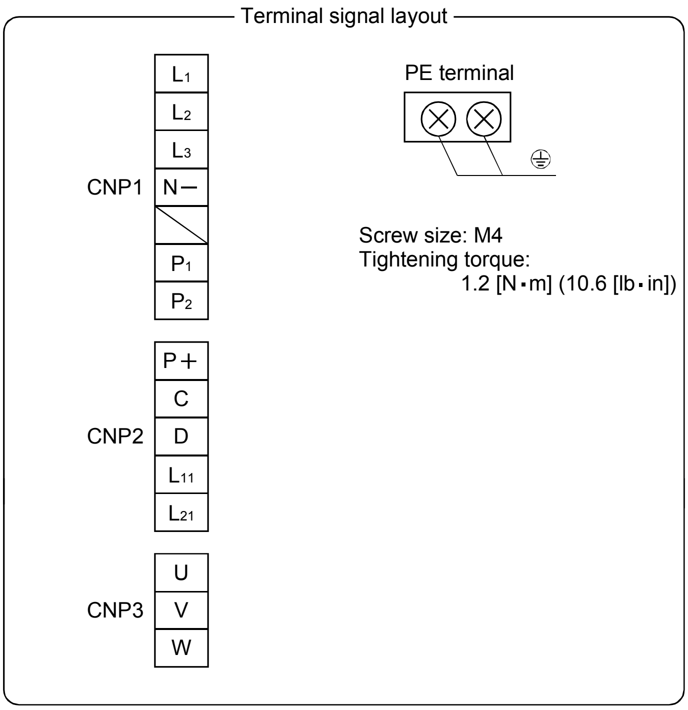
Mounting screw
Screw size : M5
Tightening torque : 3.24[N・m](28.676[lb・in])

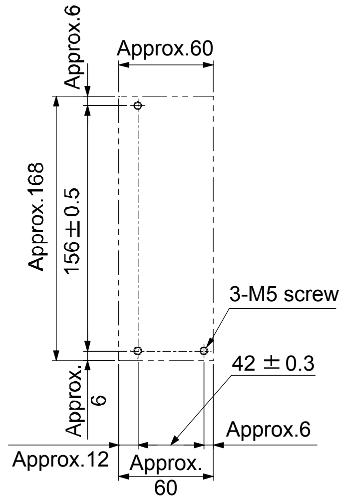
(4) MR-J3-60A4 · MR-J3-100A4

[Unit: mm]



Mass: 1.7 [kg] (3.75 [lb])



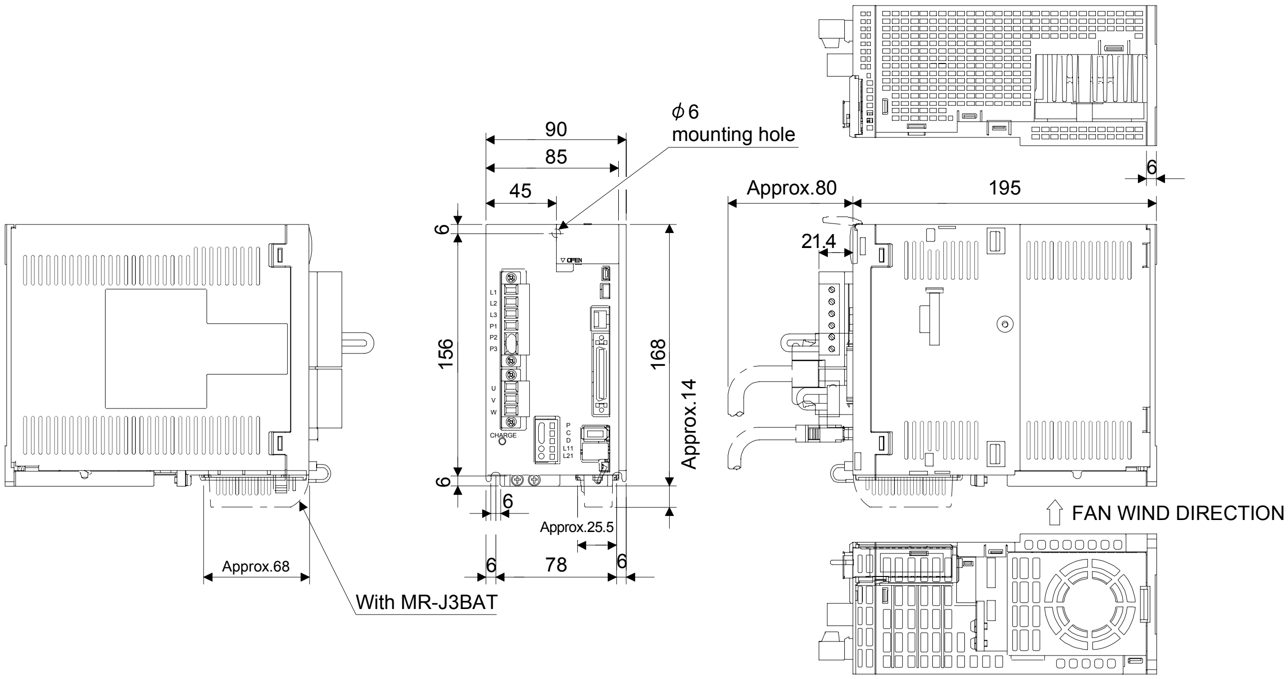


Mounting hole process drawing

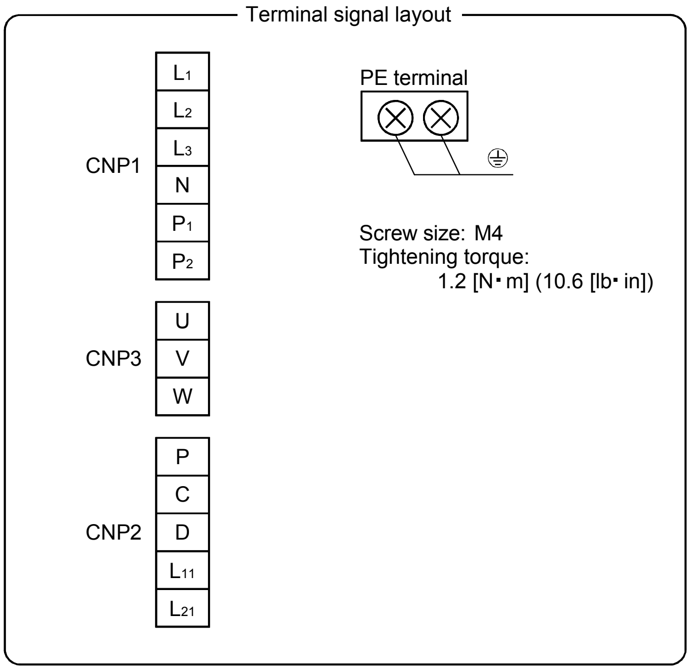
Mounting screw
Screw size: M5
Tightening torque: 3.24[N·m] (28.7[lb·in])

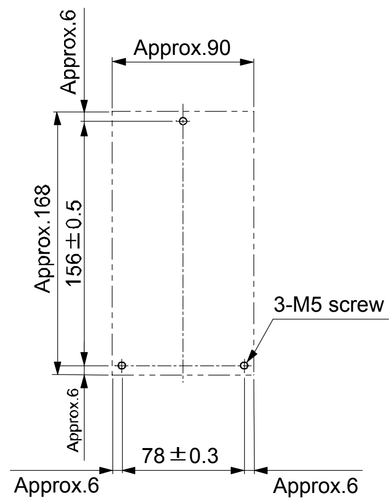
(5) MR-J3-200A・MR-J3-350A

[Unit: mm]



Mass: 2.3 [kg] (5.071 [lb])



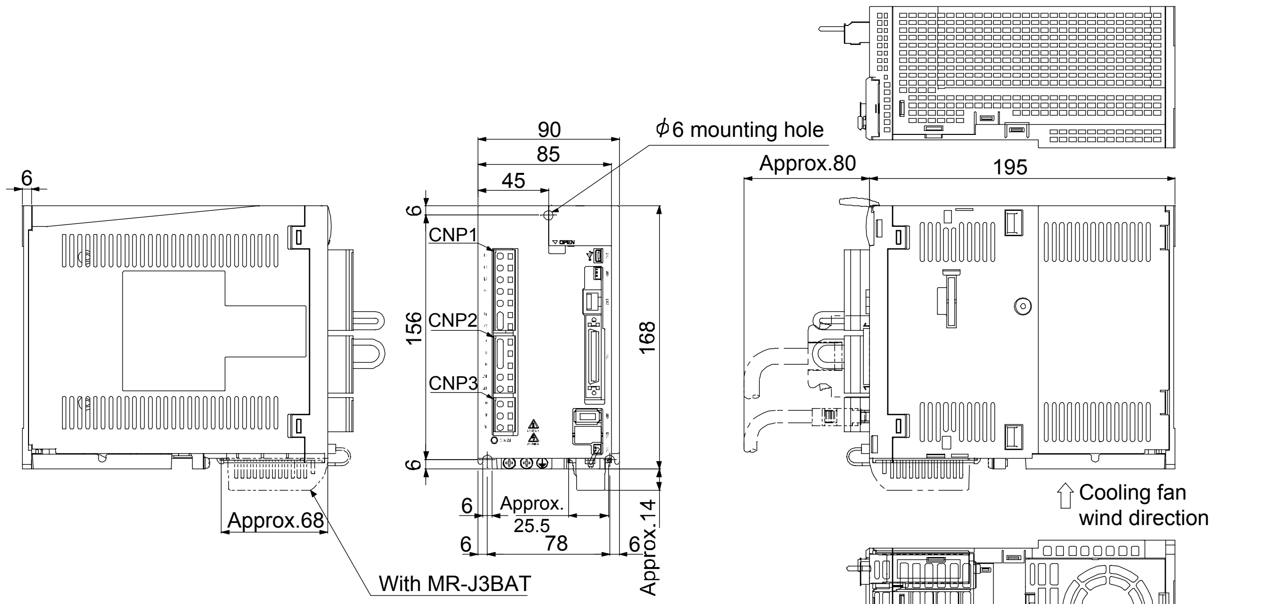


Mounting hole machining drawing

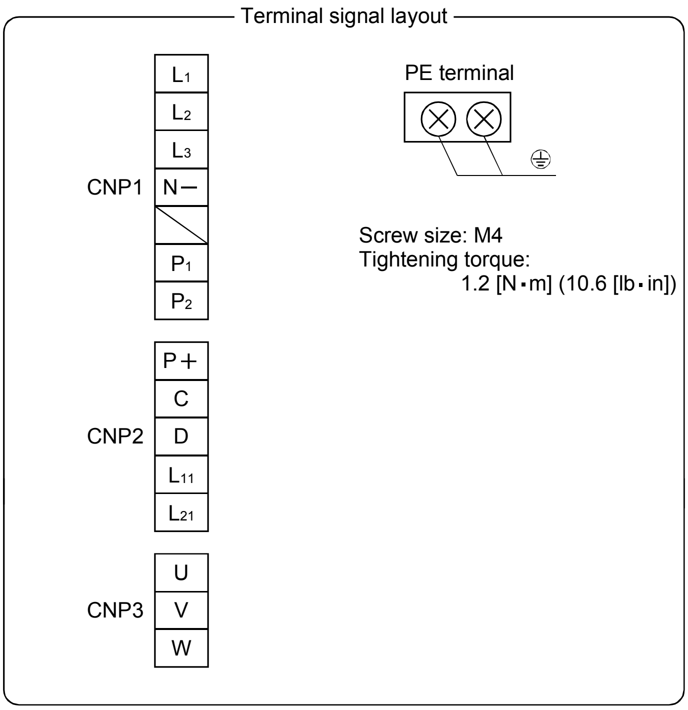
Mounting screw
Screw size : M5
Tightening torque : 3.24[N・m](28.676[lb・in])

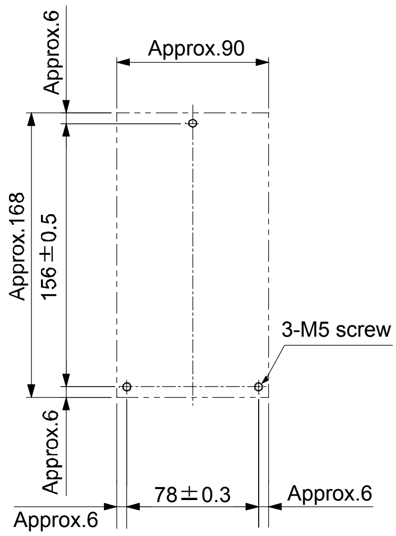
(6) MR-J3-200A4

[Unit: mm]



Mass: 2.1 [kg] (4.63 [lb])



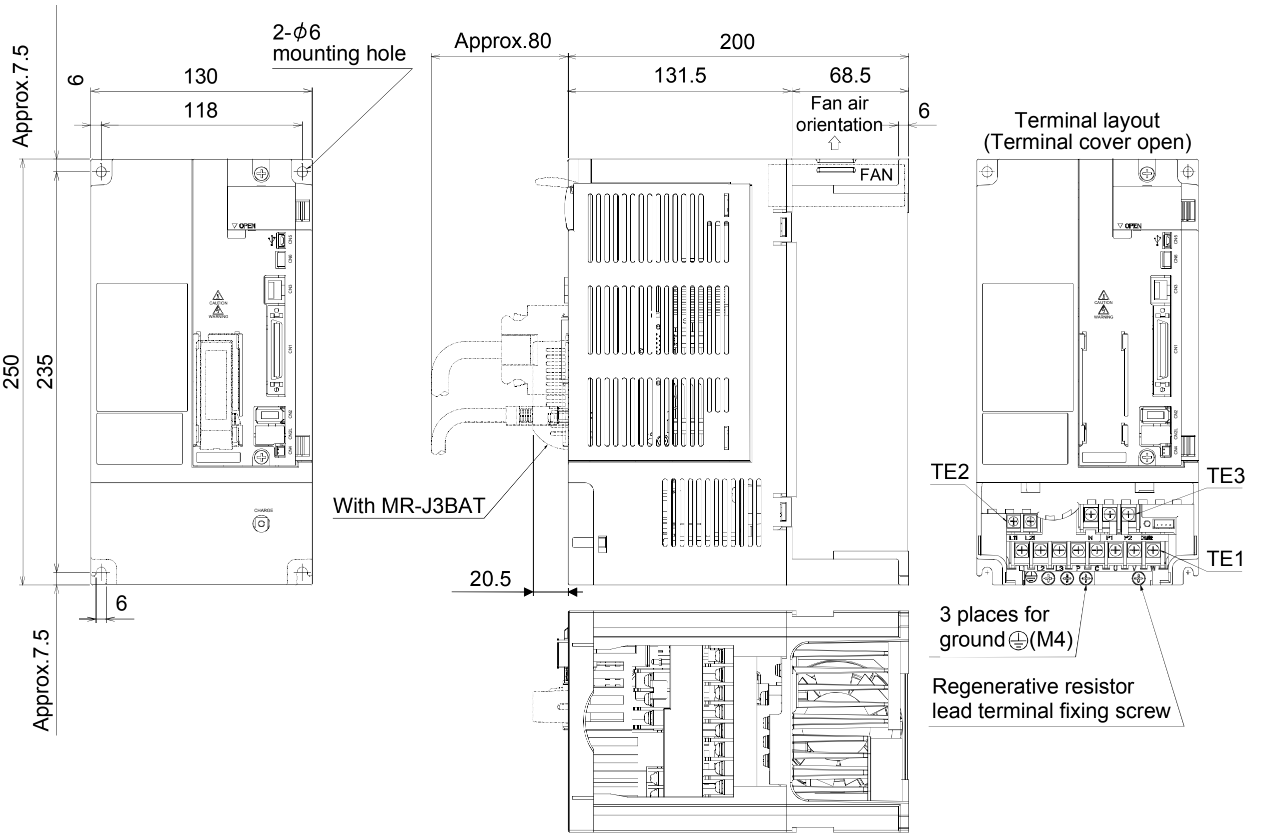


Mounting hole process drawing

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

(7) MR-J3-350A4 ・ MR-J3-500A (4)

[Unit: mm]



Mass: 4.6 [kg] (10.141 [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}

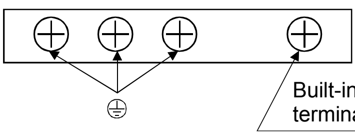
Terminal screw: M3.5(Note)
Tightening torque: 0.8[N・m]
(7.08 [lb・in])

TE3

N	P_1	P_2

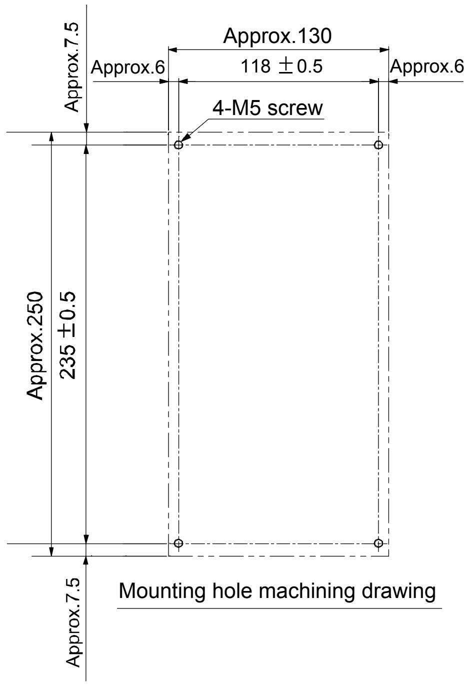
Terminal screw: M4
Tightening torque: 1.2[N・m]
(10.6 [lb・in])

PE terminal



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

Built-in regenerative resistor lead terminal fixing screw



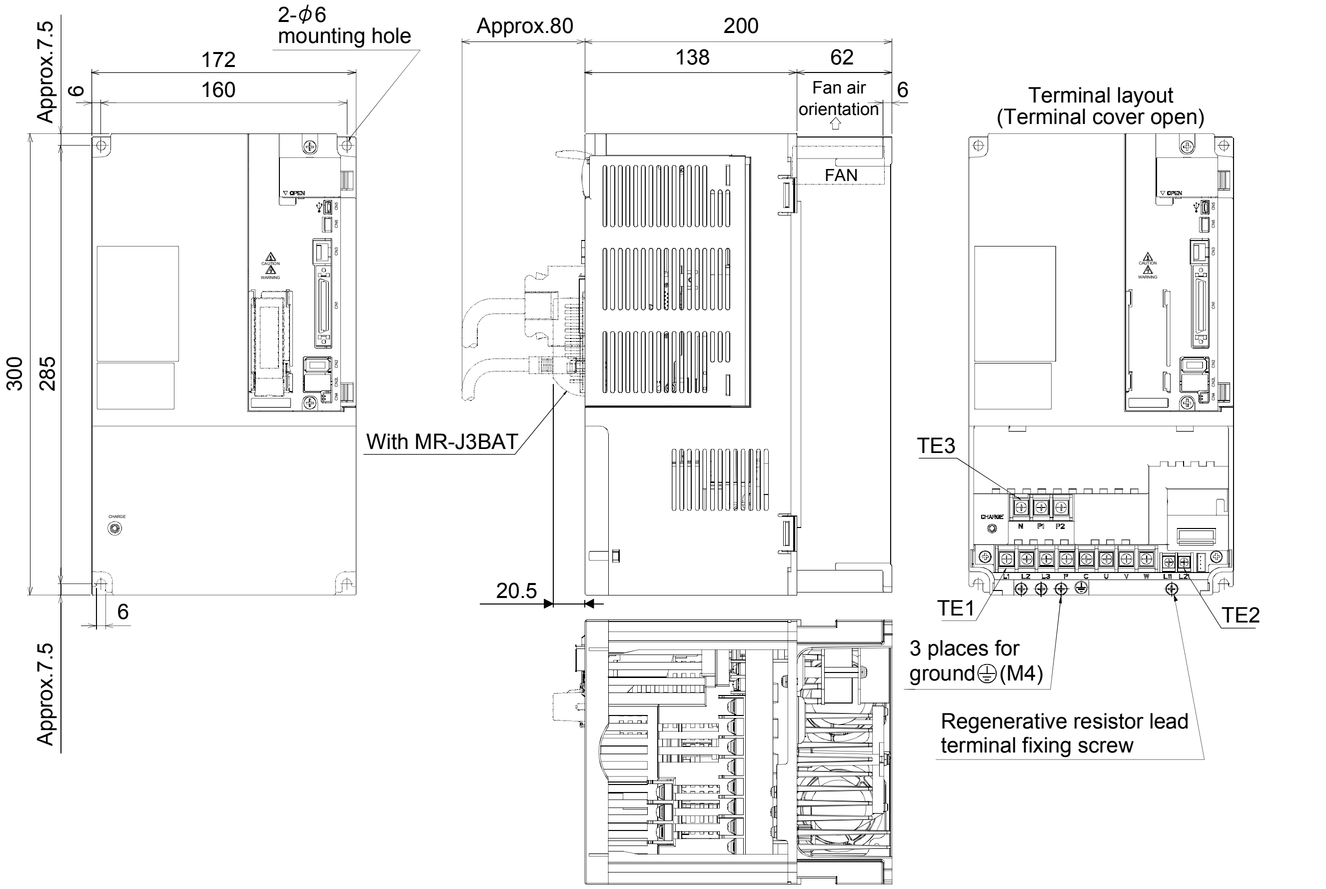
Mounting hole machining drawing

Note. Screw size is M3.5 for the control circuit terminal block (TE2) of the servo amplifier manufactured in April 2007 or later. Screw size is M3 for the control terminal block (TE2) of the servo amplifier manufactured in March 2007 or earlier.

Mounting screw
Screw size : M5
Tightening torque : 3.24[N・m](28.676[lb・in])

(8) MR-J3-700A (4)

[Unit: mm]



Mass: 6.2 [kg] (13.669[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(Note)
Tightening torque: 0.8[N•m]
(7.08 [lb•in])

TE3

N	P_1	P_2

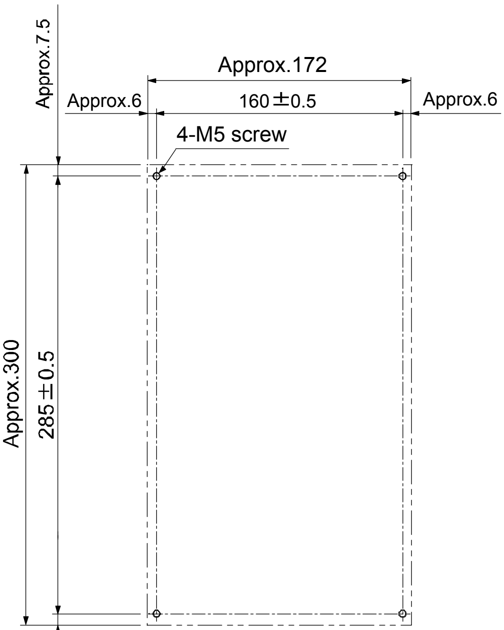
Terminal screw: M4
Tightening torque: 1.2[N•m]
(10.6 [lb•in])

PE terminal

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

⏚

Built-in regenerative resistor lead
terminal fixing screw



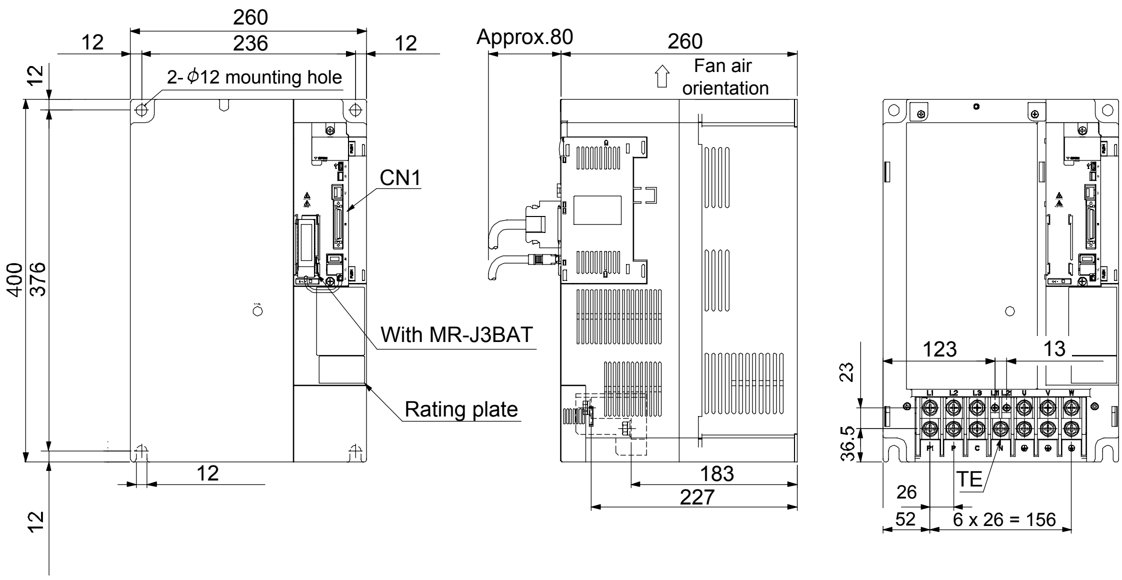
Mounting hole machining drawing

Mounting screw
Screw size : M5
Tightening torque : 3.24[N•m](28.676[lb•in])

Note. Screw size is M3.5 for the control circuit terminal block (TE2) of the servo amplifier manufactured in April 2007 or later. Screw size is M3 for the control terminal block (TE2) of the servo amplifier manufactured in March 2007 or earlier.

(9) MR-J3-11KA(4) to MR-J3-22KA(4)

[Unit: mm]



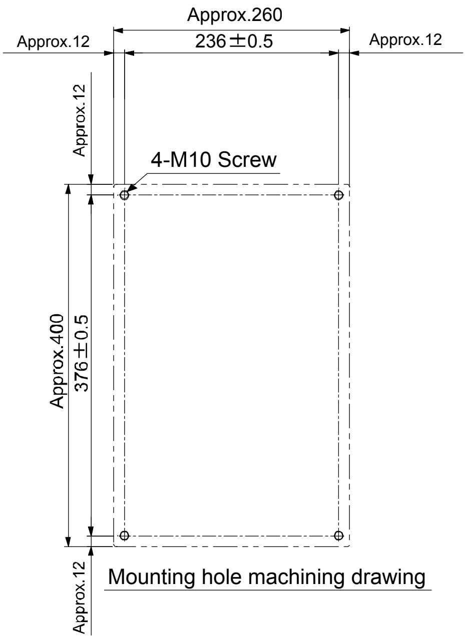
Servo amplifier	Mass[kg] ([lb])
MR-J3-11KA(4)	18.0 (39.7)
MR-J3-15KA(4)	18.0 (39.7)
MR-J3-22KA(4)	19.0 (41.9)

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-J3-11KA(4) MR-J3-15KA(4)	Screw size	M6	M4
	Tightening torque [N · m]	3.0	1.2
MR-J3-22KA(4)	Screw size	M8	M4
	Tightening torque [N · m]	6.0	1.2



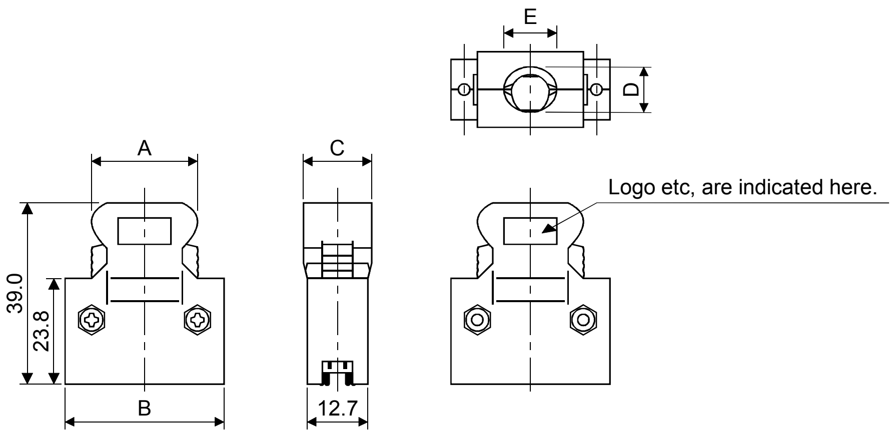
Mounting screw
Screw size : M5
Tightening torque : 26.5[N · m](234.545[lb · in])

10.2 Connector for CN1

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

(a) One-touch lock type

[Unit: mm]

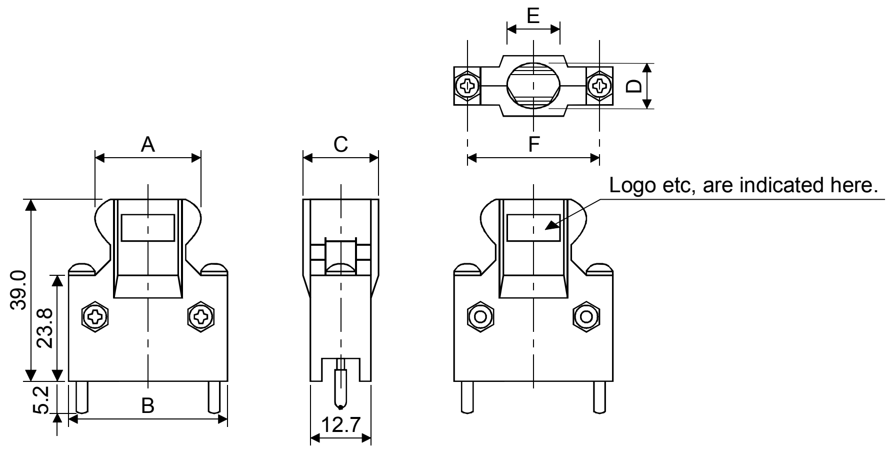


Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10150-3000PE	10350-52F0-008	41.1	52.4	18.0	14.0	17.0

(b) Jack screw M2.6 type

This is not available as option.

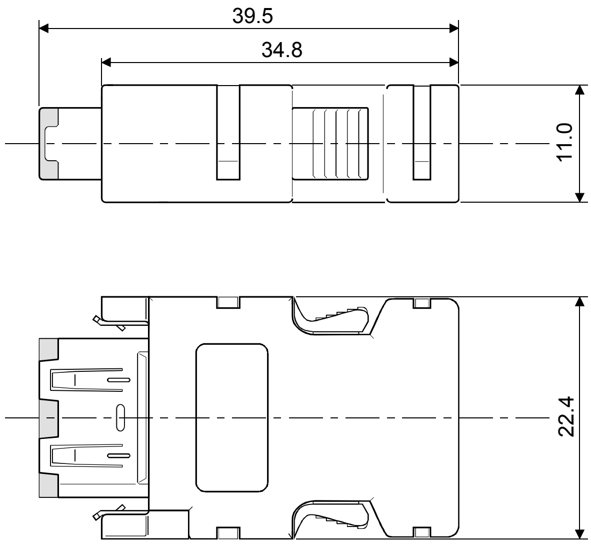
[Unit: mm]



Connector	Shell kit	Each type of dimension					
		A	B	C	D	E	F
10150-3000PE	10350-52A0-008	41.1	52.4	18.0	14.0	17.0	46.5

(2) SCR connector system (3M)

Receptacle: 36210-0100PL
Shell kit : 36310-3200-008

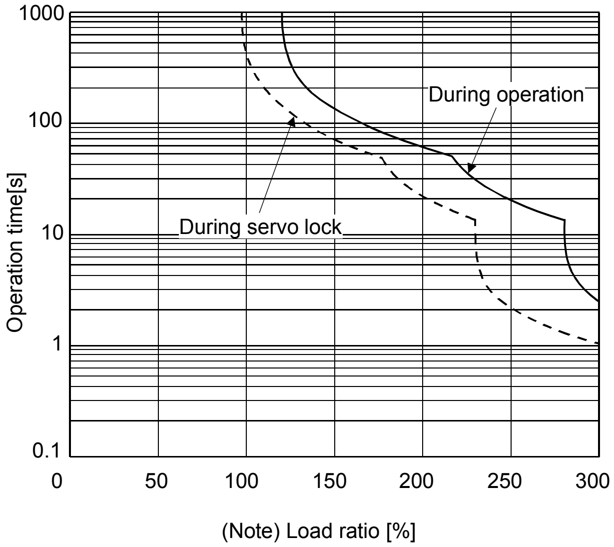


MEMO

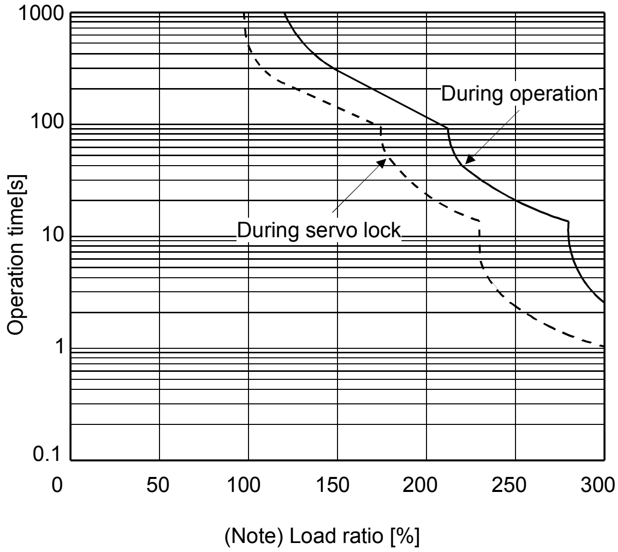
11. CHARACTERISTICS

11.1 Overload protection characteristics

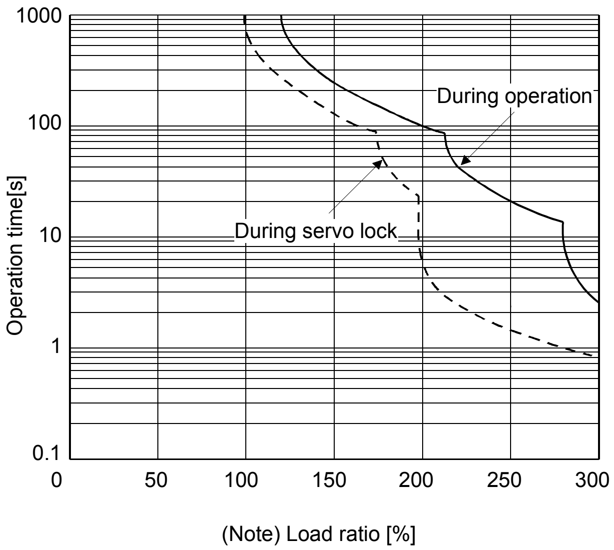
An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. Overload 1 alarm (AL.50) occurs if overload operation performed is above the electronic thermal relay protection curve shown in any of Figs 11.1. Overload 2 alarm (AL.51) occurs 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 a smaller effective load ratio.



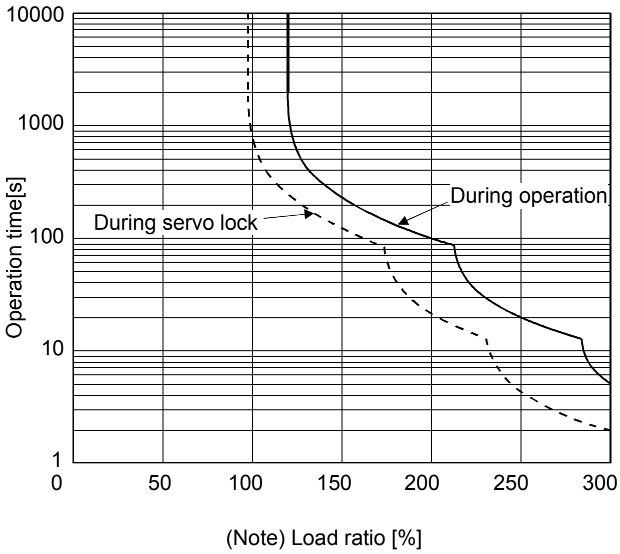
MR-J3-10A (1)



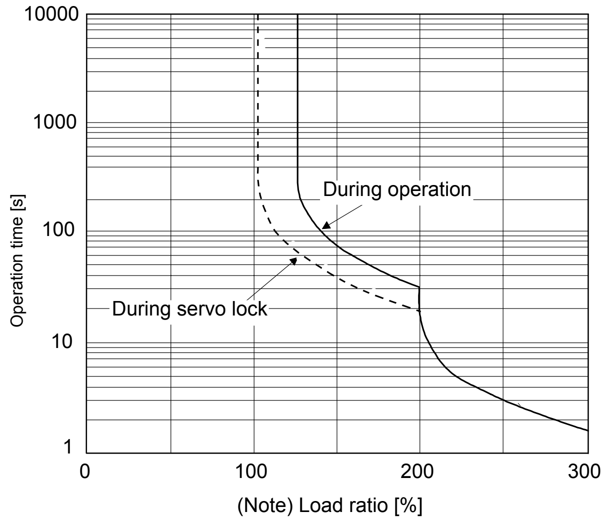
MR-J3-20A (1) · MR-J3-40A (1)
MR-J3-60A to MR-J3-100A (4)



MR-J3-200A (4) · MR-J3-350A (4)



MR-J3-500A (4) · MR-J3-700A (4)



MR-J3-11KA(4) to MR-J3-22KA (4)

Note. 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.

Fig 11.1 Electronic thermal relay protection characteristics

11.2 Power supply equipment capacity and generated loss

(1) Amount of heat generated by the servo amplifier

Table 11.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 11.1 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.

Table 11.1 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	With servo off	
MR-J3-10A (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-J3-20A (1)	HF-MP23	0.5	25	15	0.5
	HF-KP23	0.5	25	15	0.5
MR-J3-40A (1)	HF-MP43	0.9	35	15	0.7
	HF-KP43	0.9	35	15	0.7
MR-J3-60A (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
MR-J3-70A	HF-MP73	1.3	50	15	1.0
	HF-KP73	1.3	50	15	1.0
	HC-UP72	1.3	50	15	1.0
MR-J3-100A (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
MR-J3-200A (4)	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	1.8	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
MR-J3-350A (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
MR-J3-500A (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	4.5	120	25	2.4
	HA-LP502	7.5	195	25	3.9
	HF-SP421	6.7	160	25	3.2

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	With servo off	
MR-J3-700A (4)	HF-SP702 (4)	10.0	300	25	6.0
	HA-LP702	10.6	300	25	6.0
	HA-LP601 (4)	10.0	260	25	5.2
	HA-LP701M (4)	11.0	300	25	6.0
MR-J3-11KA (4)	HC-LP11K2 (4)	16.0	530	45	11.0
	HC-LP801 (4)	12.0	390	45	7.8
	HC-LP12K1 (4)	18.0	580	45	11.6
	HC-LP11K1M (4)	16.0	530	45	11.0
MR-J3-15KA (4)	HC-LP15K2 (4)	22.0	640	45	13.0
	HC-LP15K1 (4)	22.0	640	45	13.0
	HC-LP15K1M (4)	22.0	640	45	13.0
MR-J3-22KA (4)	HC-LP22K2 (4)	33.0	850	55	17.0
	HC-LP20K1 (4)	30.1	775	55	15.5
	HC-LP25K1	37.6	970	55	19.4
	HC-LP22K1M (4)	33.0	850	55	17.0

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value assumes that the power factor improving reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, in section 12.2.

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

(2) Heat dissipation area for enclosed servo amplifier

The enclosed control box (hereafter called the control box) 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°F) safety margin, the system should operate within a maximum 55℃ (131°F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 11.1:

$$A = \frac{P}{K \cdot \Delta T} \qquad (11.1)$$

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

When calculating the heat dissipation area with Equation 11.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 11.1 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 fan should be considered.

Table 11.1 lists the enclosure dissipation area for each servo amplifier when the servo amplifier is operated at the ambient temperature of 40℃ (104°F) under rated load.

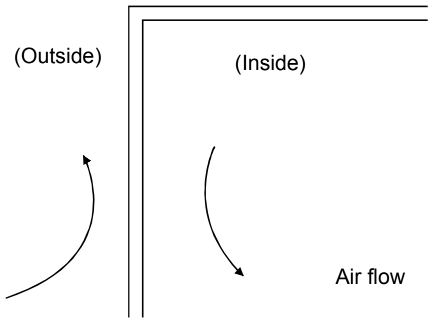


Fig. 11.2 Temperature distribution in enclosure

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.

11.3 Dynamic brake characteristics

11.3.1 Dynamic brake operation

Fig. 11.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 11.2 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.)

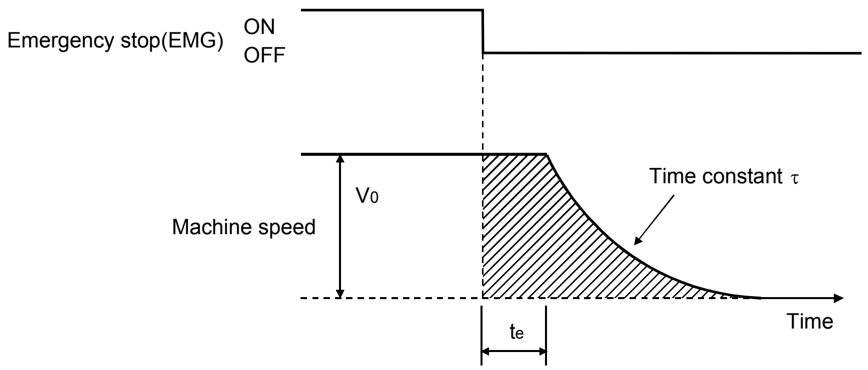


Fig. 11.3 Dynamic brake operation diagram

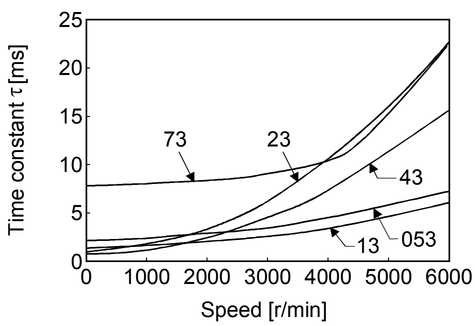
$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left(1 + \frac{J_L}{J_M} \right) \right\} \quad \text{(11.2)}$$

L_{max} : Maximum coasting distance ..... [mm][in]
Vo : Machine rapid feed rate ..... [mm/min][in/min]
J_M : Servo motor inertial moment ..... [kg・cm^2][oz・in^2]
J_L : Load inertia moment converted into equivalent value on servo motor shaft ..... [kg・cm^2][oz・in^2]
τ : Brake time constant ..... [s]
t_e : Delay time of control section ..... [s]
For 7kW or less servo, there is internal relay delay time of about 30ms. For 11kW to 22kW servo, there is delay time of about 100ms caused by a delay of the external relay and a delay of the magnetic contactor built in the external dynamic brake.

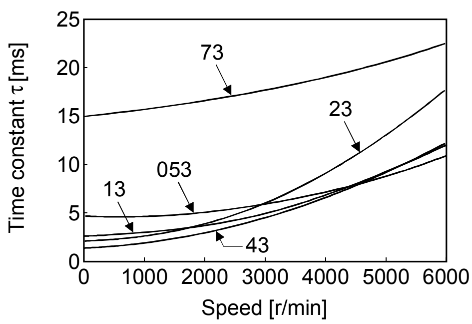
(2) Dynamic brake time constant

The following shows necessary dynamic brake time constant τ for the equations (11.2):

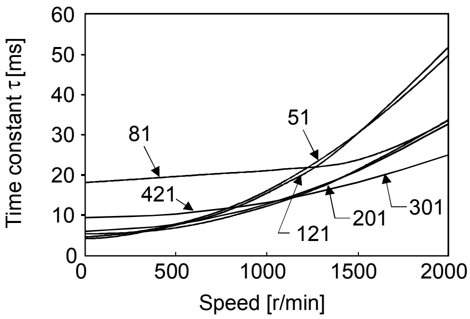
(a) 200V class servo motor



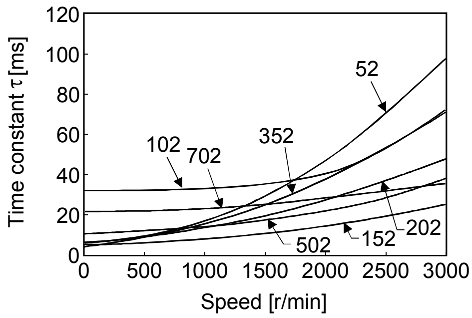
HF-MP series



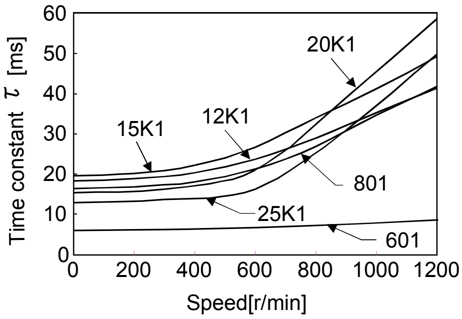
HF-KP series



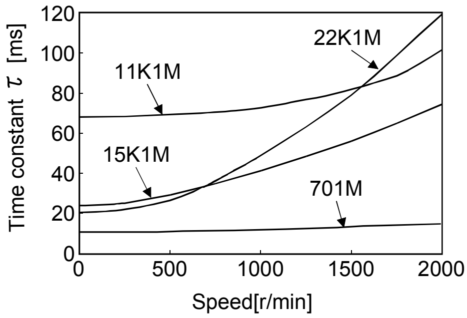
HF-SP1000r/min series



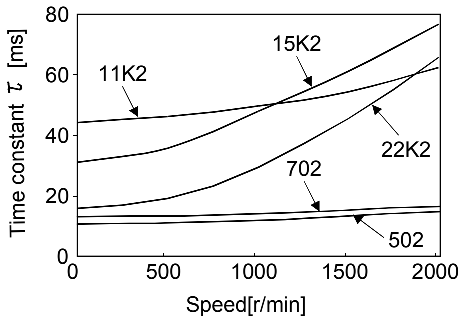
HF-SP2000r/min series



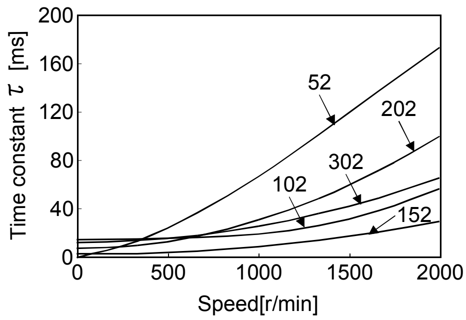
HA-LP1000r/min series



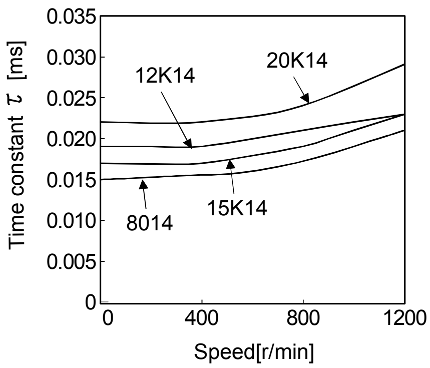
HA-LP1500r/min series



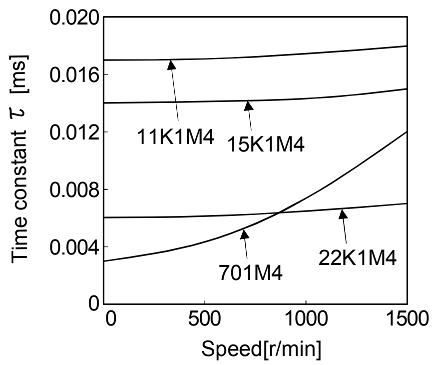
HA-LP2000r/min series



HC-LP series

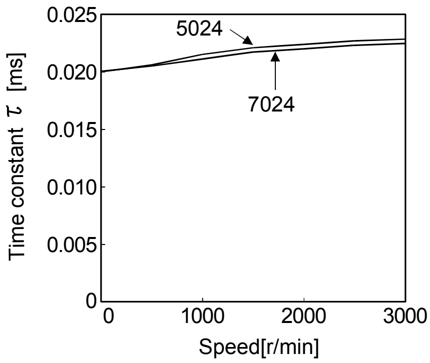


HA-LP1000r/min series

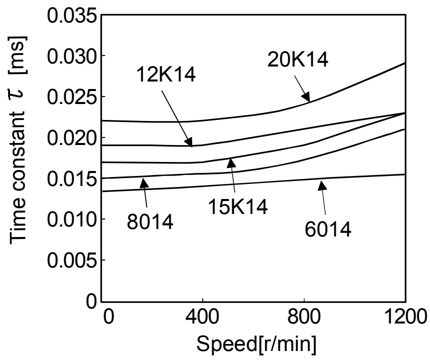


HA-LP1500r/min series

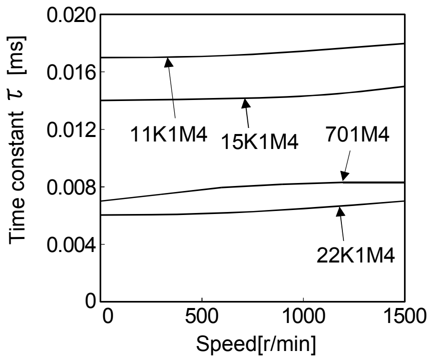
(b) 400V class servo motor



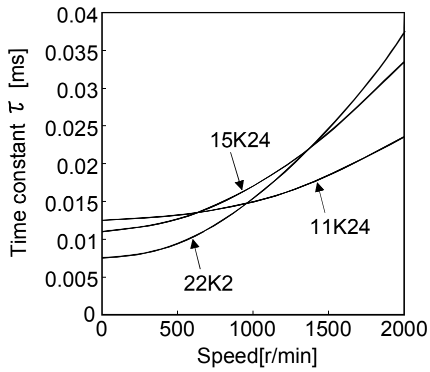
HA-SP2000r/min series



HA-LP1000r/min series



HA-LP1500r/min series



HA-LP2000r/min series

11.3.2 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 built-in dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact Mitsubishi.
The values of the load inertia moment ratio in the table are the values at the maximum rotation speed of the servo motor.

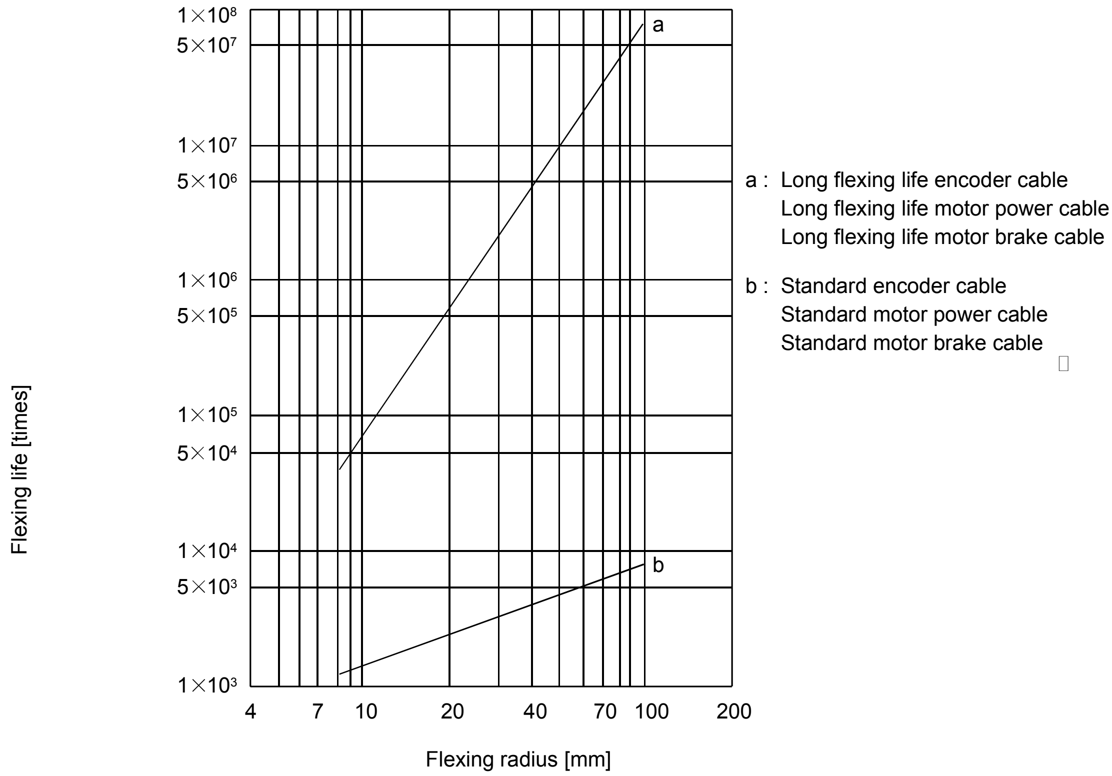
Servo amplifier	Servo motor									
	HF-KP□	HF-MP□	HF-SP□1	HF-SP□2	HC-RP□	HC-UP□	HC-LP□	HA-LP□1	HA-LP□1M	HA-LP□2
MR-J3-10A(1)	30	30								
MR-J3-20A(1)	30	30								
MR-J3-40A(1)	30	30								
MR-J3-60A			30	30			30			
MR-J3-70A	30	30				30				
MR-J3-100A			30	30			30			
MR-J3-200A			30	30	30	30	30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

Servo amplifier	Servo motor			
	HF-SP□4	HA-LP□14	HA-LP□1M4	HA-LP□24
MR-J3-60A4	5 (Note 1)			
MR-J3-100A4	5 (Note 1)			
MR-J3-200A4	5			
MR-J3-350A4	5 (Note 1)			
MR-J3-500A4	5 (Note 1)			
MR-J3-700A4	5 (Note 1)	10	10	
MR-J3-11KA4 (Note 2)		30	30	30
MR-J3-15KA4 (Note 2)		30	30	30
MR-J3-22KA4 (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.

11.4 Encoder 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.



11.5 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 (200VAC class: 253VAC, 400VAC class: 528VAC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

<table>
<tr><th rowspan="2">Servo Amplifier</th><th colspan="2">Inrush Currents ($A_{0\text{-}p}$)</th></tr>
<tr><th>Main circuit power supply (L_1, L_2, L_3)</th><th>Control circuit power supply (L_{11}, L_{21})</th></tr>
<tr><td>MR-J3-10A1 to 40A1</td><td>38A (Attenuated to approx. 14A in 10ms)</td><td rowspan="4">20 to 30A
(Attenuated to approx. 0A in 1 to 2ms)</td></tr>
<tr><td>MR-J3-10A to 60A</td><td>30A (Attenuated to approx. 5A in 10ms)</td></tr>
<tr><td>MR-J3-70A・100A</td><td>54A (Attenuated to approx. 12A in 10ms)</td></tr>
<tr><td>MR-J3-200A・350A</td><td>120A (Attenuated to approx. 12A in 20ms)</td></tr>
<tr><td>MR-J3-500A</td><td>44A (Attenuated to approx. 20A in 20ms)</td><td rowspan="5">30A (Attenuated to approx. 0A in 3ms)</td></tr>
<tr><td>MR-J3-700A</td><td>88A (Attenuated to approx. 20A in 20ms)</td></tr>
<tr><td>MR-J3-11KA</td><td rowspan="3">235A (Attenuated to approx. 20A in 20ms)</td></tr>
<tr><td>MR-J3-15KA</td></tr>
<tr><td>MR-J3-22KA</td></tr>
<tr><td>MR-J3-60A4・100A4</td><td>100A (Attenuated to approx. 5A in 10ms)</td><td rowspan="2">40 to 50A
(Attenuated to approx. 0A in 2ms)</td></tr>
<tr><td>MR-J3-200A4</td><td>120A (Attenuated to approx. 12A in 20ms)</td></tr>
<tr><td>MR-J3-350A4・500A4</td><td>66A (Attenuated to approx. 10A in 20ms)</td><td rowspan="2">41A (Attenuated to approx. 0A in 3ms)</td></tr>
<tr><td>MR-J3-700A4</td><td>67A (Attenuated to approx. 34A in 20ms)</td></tr>
<tr><td>MR-J3-11KA4</td><td rowspan="3">325A (Attenuated to approx. 20A in 20ms)</td><td rowspan="3">45A (Attenuated to approx. 0A in 3ms)</td></tr>
<tr><td>MR-J3-15KA4</td></tr>
<tr><td>MR-J3-22KA4</td></tr>
</table>

Since large inrush currents flow in the power supplies, always use no-fuse breakers and magnetic contactors. (Refer to section 12.12.)
When circuit protectors are used, it is recommended to use the inertia delay type that will not be tripped by an inrush current.

12. OPTIONS AND AUXILIARY EQUIPMENT

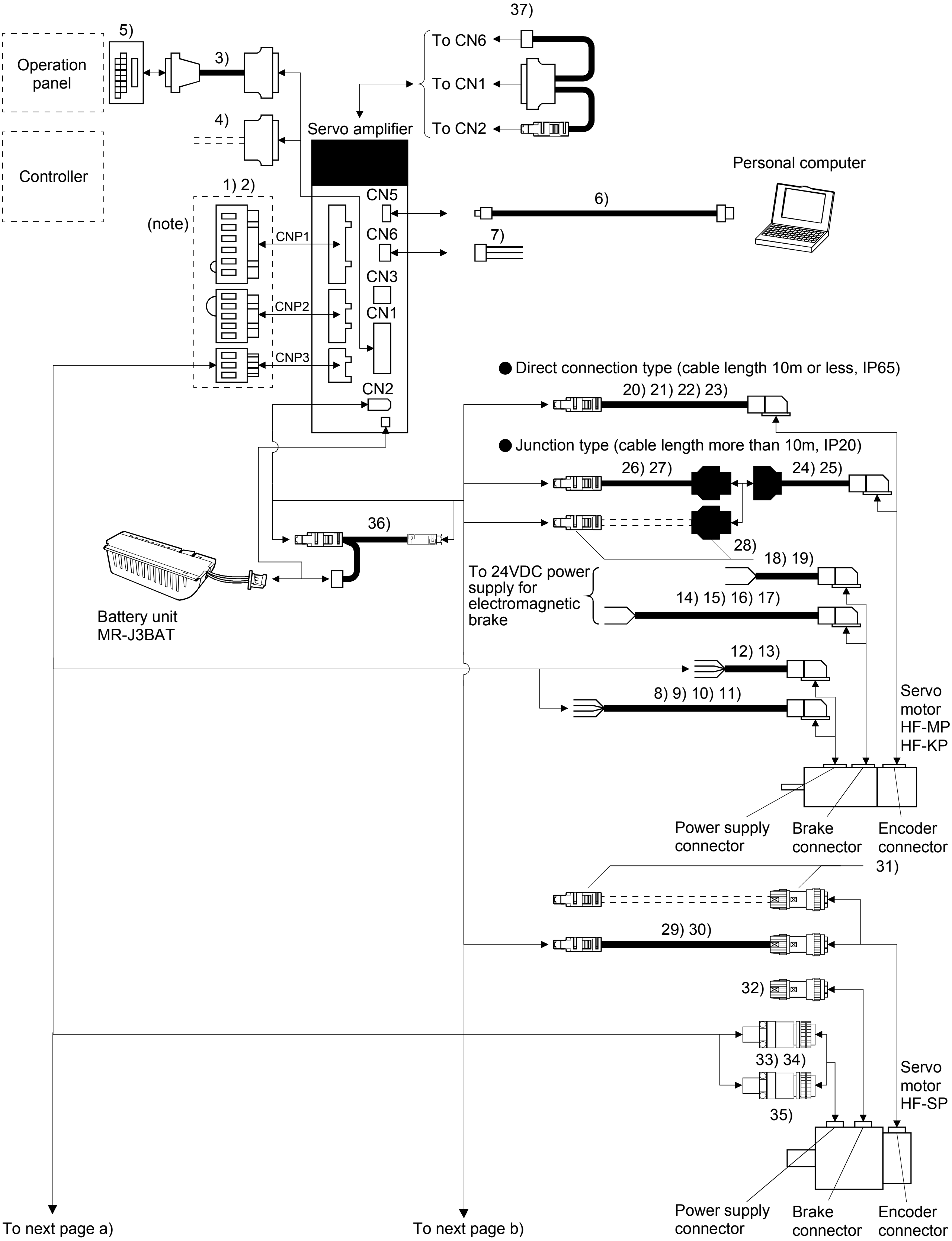
⚠WARNING	· Before connecting any option or auxiliary equipment, make sure that the charge lamp is off more than 15 minutes after power-off, then confirm the voltage with a tester or the like. Otherwise, you may get an electric shock.

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

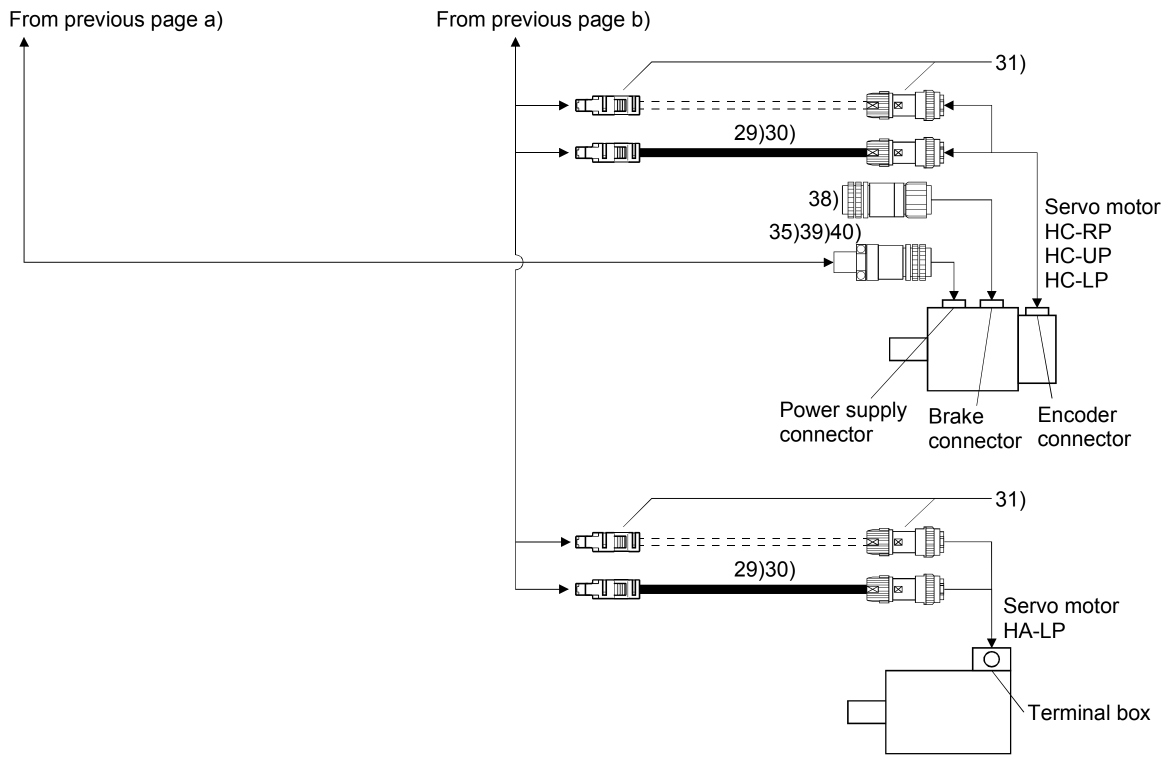
12.1 Cable/connector sets

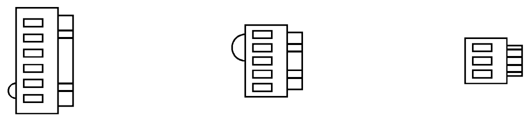
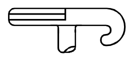
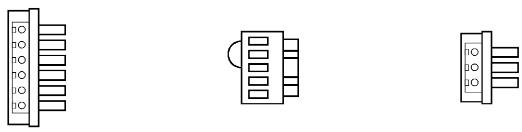
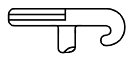
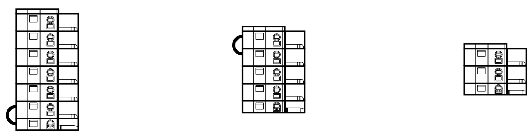
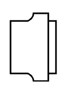
As the cables and connectors used with this servo, purchase the options indicated in this section.

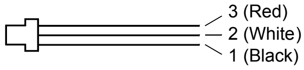
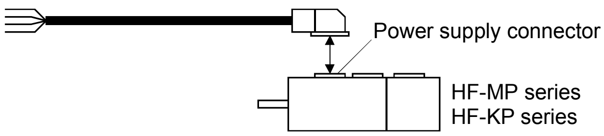
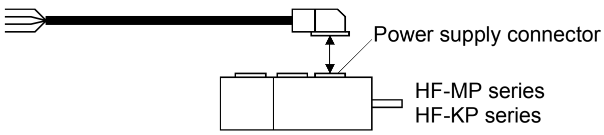
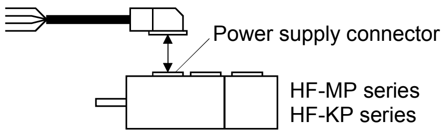
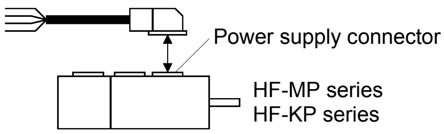
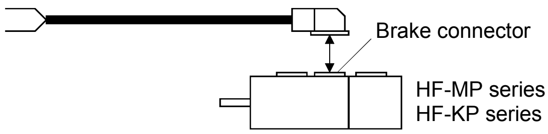
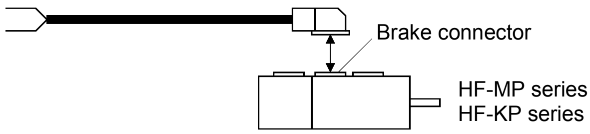
12.1.1 Combinations of cable/connector sets

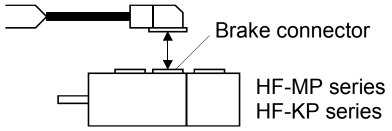
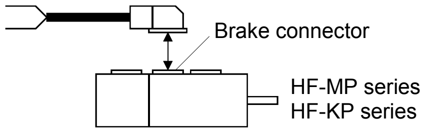
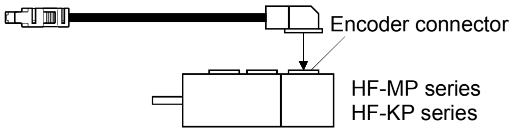
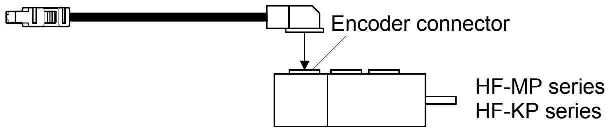
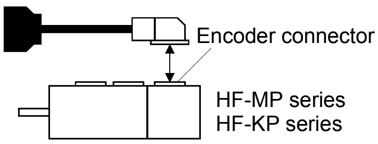
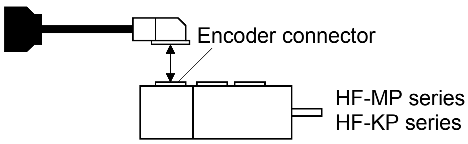


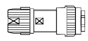
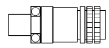
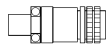
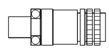
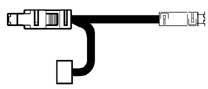
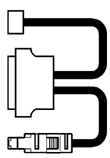
Note. Connectors for 3.5kW or less. For 5kW or more, terminal blocks.

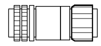
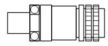
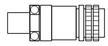

From previous page a)
From previous page b)
31)
29)30)
38)
35)39)40)
Servo motor
HC-RP
HC-UP
HC-LP
Power supply connector
Brake connector
Encoder connector
31)
29)30)
Servo motor
HA-LP
Terminal box

No.	Product	Model	Description	Application
1)	Servo amplifier power supply connector		 CNP1 connector: 54928-0670 (Molex) CNP2 connector: 54927-0520 (Molex) CNP3 connector: 54928-0370 (Molex) <Applicable cable example> Wire size: 0.14mm^2(AWG26) to 2.5mm^2 (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) <Applicable cable example> Wire size: 0.2mm^2 (AWG24) to 5.5mm^2 (AWG10) Cable finish OD: to ϕ5mm  REC. Lever: 54932-0000 (Molex)	Supplied with servo amplifiers of 2kW and 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) <Applicable cable example> Wire size: 0.08mm^2 (AWG28) to 2mm^2 (AWG14) Cable finish OD: to ϕ4.1mm  REC. Lever: 231-131 (WAGO)	Supplied with servo amplifiers of 2kW or less in 400V class
3)	Junction terminal block cable	MR-J2M-CN1TBL □ M Cable length: 0.5・1m (Refer to section 12.7)	For junction terminal block connector Connector: D7950-B500FL (3M) CN1 connector Connector: 10150-6000EL Shell kit: 10350-3210-000 (3M or equivalent) 	For junction terminal block connection
4)	CN1 connector set	MR-J3CN1	Connector: 10150-3000PE Shell kit: 10350-52F0-008 (3M or equivalent) 	
5)	Junction terminal block cable	MR-TB50	Refer to section 12.7.	

No.	Product	Model	Description	Application
6)	USB cable	MR-J3USBCBL3M Cable length: 3m	For CN5 connector minB connector (5 pins) For personal computer connector A connector 	For connection with PC-AT compatible personal computer
7)	Monitoring cable	MR-J3CN6CBL1M Cable length: 1m	 CN6 connector Housing: 51004-0300 Terminal: 50011-8100 (Molex)	
8)	Motor power supply cable	MR-PWS1CBL□M-A1-L Cable length: 2・5・10m		IP65 Load side lead
9)	Motor power supply cable	MR-PWS1CBL□M-A1-H Cable length: 2・5・10m	Refer to section 12.1.3 for details.	IP65 Load side lead Long flex life
10)	Motor power supply cable	MR-PWS1CBL□M-A2-L Cable length: 2・5・10m		IP65 Opposite-to-load side lead
11)	Motor power supply cable	MR-PWS1CBL□M-A2-H Cable length: 2・5・10m	Refer to section 12.1.3 for details.	IP65 Opposite-to-load side lead Long flex life
12)	Motor power supply cable	MR-PWS2CBL03M-A1-L Cable length: 0.3m	 Refer to section 12.1.3 for details.	IP55 Load side lead
13)	Motor power supply cable	MR-PWS2CBL03M-A2-L Cable length: 0.3m	 Refer to section 12.1.3 for details.	IP55 Opposite-to-load side lead
14)	Motor brake cable	MR-BKS1CBL□M-A1-L Cable length: 2・5・10m		IP65 Load side lead
15)	Motor brake cable	MR-BKS1CBL□M-A1-H Cable length: 2・5・10m	Refer to section 12.1.4 for details.	IP65 Load side lead Long flex life
16)	Motor brake cable	MR-BKS1CBL□M-A2-L Cable length: 2・5・10m		IP65 Opposite-to-load side lead
17)	Motor brake cable	MR-BKS1CBL□M-A2-H Cable length: 2・5・10m	Refer to section 12.1.4 for details.	IP65 Opposite-to-load side lead Long flex life

No.	Product	Model	Description	Application
18)	Motor brake cable	MR-BKS2CBL03M-A1-L Cable length: 0.3m	 Refer to section 12.1.4 for details.	IP55 Load side lead
19)	Motor brake cable	MR-BKS2CBL03M-A2-L Cable length: 0.3m	 Refer to section 12.1.4 for details.	IP55 Opposite-to-load side lead
20)	Encoder cable	MR-J3ENCBL □ M-A1-L Cable length: 2・5・10m	 Refer to section 12.1.2 (1) for details.	IP65 Load side lead
21)	Encoder cable	MR-J3ENCBL □ M-A1-H Cable length: 2・5・10m		IP65 Opposite-to-load side lead Long flex life
22)	Encoder cable	MR-J3ENCBL □ M-A2-L Cable length: 2・5・10m	 Refer to section 12.1.2 (1) for details.	IP65 Opposite-to-load side lead
23)	Encoder cable	MR-J3ENCBL □ M-A2-H Cable length: 2・5・10m		IP65 Opposite-to-load side lead Long flex life
24)	Encoder cable	MR-J3JCBL03M-A1-L Cable length: 0.3m	 Refer to section 12.1.2 (3) for details.	IP20 Load side lead
25)	Encoder cable	MR-J3JCBL03M-A2-L Cable length: 0.3m	 Refer to section 12.1.2 (3) for details.	IP20 Opposite-to-load side lead
26)	Encoder cable	MR-EKCBL □ M-L Cable length: 20・30m	 For HF-MP・HF-KP series Refer to section 12.1.2 (2) for details.	IP20
27)	Encoder cable	MR-EKCBL □ M-H Cable length: 20・30・40・50m		IP20 Long flex life
28)	Encoder connector set	MR-ECNM	 For HF-MP・HF-KP series Refer to section 12.1.2 (2) for details.	IP20

No.	Product	Model	Description	Application
29)	Encoder cable	MR-J3ENSCBL☐M-L Cable length: 2・5・10・20・30m	 For HF-SP・HA-LP・HC-UP・HC-LP・HC-RP series Refer to section 12.1.2 (4) for details.	IP67 Standard flex life
30)	Encoder cable	MR-J3ENSCBL☐M-H Cable length: 2・5・10・20・30・40・50m		IP67 Long flex life
31)	Encoder connector set	MR-J3SCNS	 For HF-SP・ HA-LP・HC-UP・HC-LP・HC-RP series Refer to section 12.1.2 (4) for details.	IP67
32)	Brake connector set	MR-BKCNS1	Straight plug: CM10-SP2S-L Socket contact: CM10-#22SC(S2)-100 (DDK)  For HF-SP series	IP67
33)	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: 2mm^2 (AWG14) to 3.5mm^2 (AWG12) Cable finish ϕD: ϕ10.5 to 14.1mm  For HF-SP51・81 For HF-SP52 to 152	IP67
34)	Power supply connector set	MR-PWCNS5	Plug: CE05-6A22-22D-D-BSS Cable clamp: CE3057-12A-1-D (DDK) Example of applicable cable Applicable wire size: 5.5mm^2 (AWG10) to 8mm^2 (AWG8) Cable finish ϕD: ϕ12.5 to 16mm  For HF-SP121・201 For HF-SP202 to 502	IP67
35)	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: 14mm^2 (AWG6) to 22mm^2 (AWG4) Cable finish ϕD: ϕ22 to 23.8mm  For HF-SP702 For HC-UP For HC-LP For HC-RP	IP65 IP67 Be sure to use this when corresponding to EN Standard.
36)	Cable for connecting battery	MR-J3BTCBL03M	 Refer to section 12.1.2 (5) for details.	For connection of battery
37)	Diagnosis cable	MR-J3ACHECK	 Necessary for amplifier diagnosis function of MR-Configurator (Servo configuration software). Refer to section 12.8 (2) (c) for details.	For diagnosis of servo amplifier

No.	Product	Model	Description		Application
38)	Break connector set	MR-BKCN	Plug: D/MS3106A10SL-4S(D190) (DDK) For cable connector : YS010-5-8(Daiwa Dengyo) Example of applicable cable Applicable wire size: 0.3mm^2 (AWG22) to 1.25mm^2 (AWG16) Cable finish: ϕ5 to 8.3mm	 For HC-UP For HC-LP For HC-RP	EN standard compliant IP65 IP67
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: 2mm^2 (AWG14) to 3.5mm^2 (AWG12) Cable finish: ϕ9.5 to 13mm	 For HC-UP For HC-LP For HC-RP	Be sure to use this when corresponding to EN standard IP65 IP67
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: 5.5mm^2 (AWG10) to 8mm^2 (AWG8) Cable finish: ϕ13 to 15.5mm	 For HC-UP For HC-LP For HC-RP	

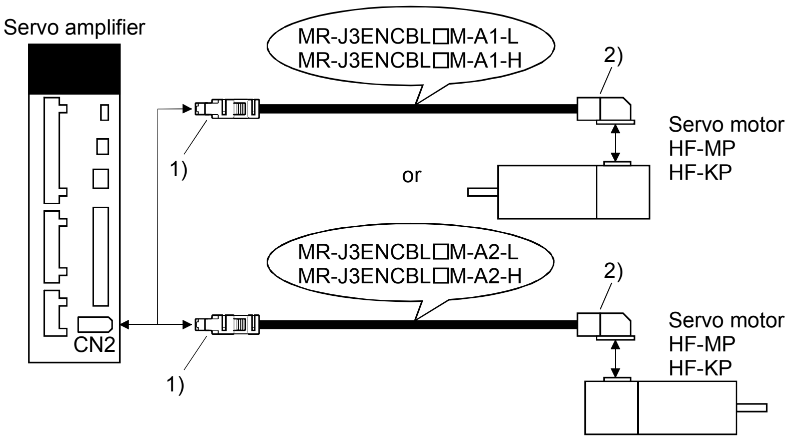
12.1.2 Encoder cable/connector sets

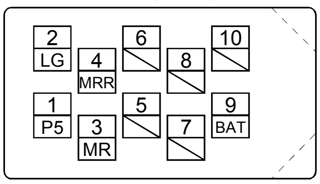
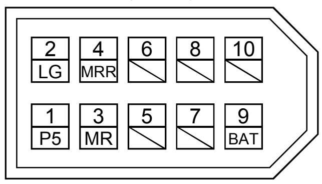
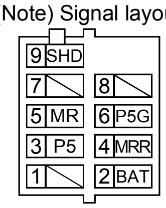
(1) MR-J3ENCBL □ M-A1-L/H ・ MR-J3ENCBL □ M-A2-L/H

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.

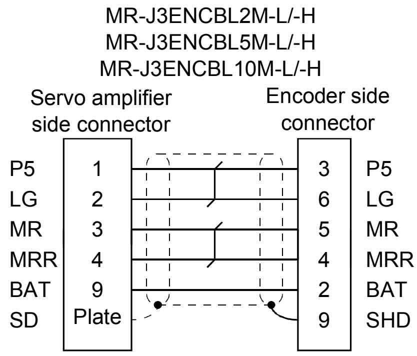
Cable Model	Cable Length								Protective Structure	Flex Life	Application
	0.3m	2m	5m	10m	20m	30m	40m	50m			
MR-J3ENCBL □ M-A1-L		2	5	10					IP65	Standard	For HF-MP ・ HF-KP servo motor Load side lead
MR-J3ENCBL □ M-A1-H		2	5	10					IP65	Long flex	
MR-J3ENCBL □ M-A2-L		2	5	10					IP65	Standard	For HF-MP ・ HF-KP servo motor Opposite-to-load side lead
MR-J3ENCBL □ M-A2-H		2	5	10					IP65	Long flex	

(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: 536310-3200-008 (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 (Tyco Electronics) (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

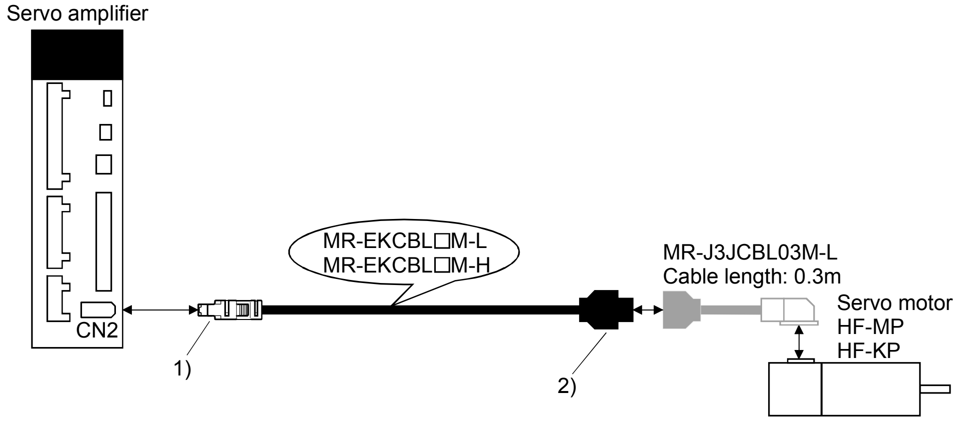
- The following encoder cables are of four-wire type. When using any of these encoder cables, set parameter No. PC22 to "1 □ □ □" to select the four-wire type.
  MR-EKCBL30M-L
  MR-EKCBL30M-H
  MR-EKCBL40M-H
  MR-EKCBL50M-H

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.

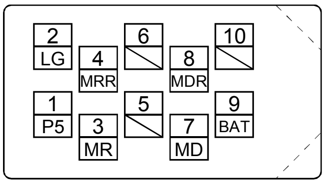
Cable Model	Cable Length								Protective Structure	Flex Life	Application
	0.3m	2m	5m	10m	20m	30m	40m	50m			
MR-EKCBL □ M-L					20	(Note) 30			IP20	Standard	For HF-MP・HF-KP servo motor Use in combination with MR-J3JCBL03M-A1-L or MR-J3JCBL03M-A2-L.
MR-EKCBL □ M-H					20	(Note) 30	(Note) 40	(Note) 50	IP20	Long flex	

Note. Four-wire type cable.

(a) Connection of servo amplifier and servo motor

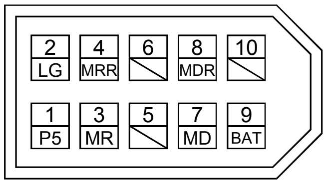


<table>
<tr><th>Cable Model</th><th>1) CN2 Connector</th><th>2) Junction Connector</th></tr>
<tr><td>MR-EKCBL □ M-L

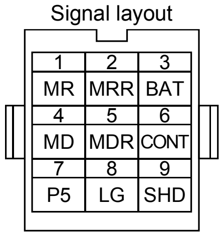
MR-EKCBL □ M-H</td><td>Receptacle: 36210-0100PL
Shell kit: 536310-3200-008
(3M)
(Note) Signal layout


View seen from wiring side.

or

Connector set: 54599-1019
(Molex)
(Note) Signal layout


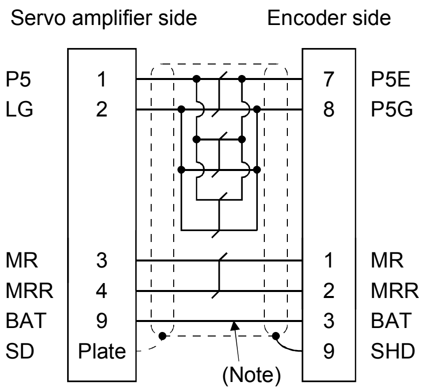
View seen from wiring side.

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>Housing: 1-172161-9
Connector pin: 170359-1
(Tyco Electronics or equivalent)
Cable clamp: MTI-0002
(Toa Electric Industries)
Signal layout


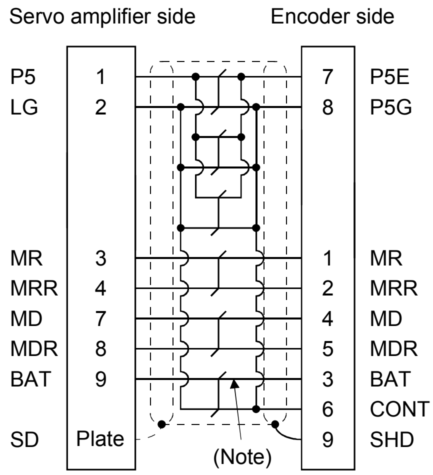
View seen from wiring side.</td></tr>
</table>

(b) Internal wiring diagram

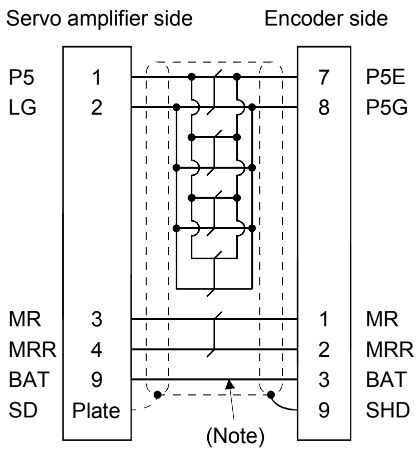
MR-EKCBL20M-L



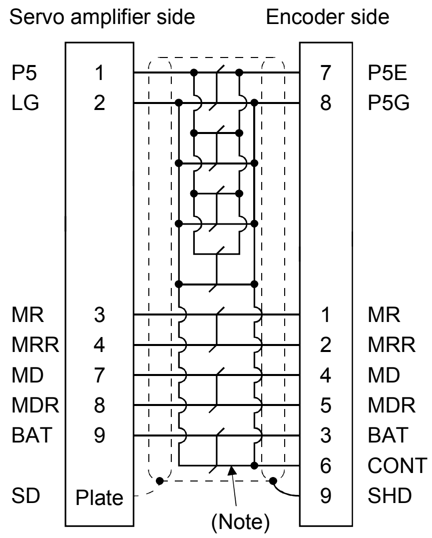
MR-EKCBL30M-L



MR-EKCBL20M-H



MR-EKCBL30M-H
MR-EKCBL40M-H
MR-EKCBL50M-H



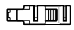
Note. Always make connection for use in an absolute position detection system. Wiring is not necessary for use in an incremental system.

When fabricating the cable, use the wiring diagram corresponding to the length indicated below.

Cable Flex Life	Applicable Wiring Diagram	
	Less than 10m	30m to 50m
Standard	MR-EKCBL20M-L	
Long flex	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 12.11 for the specifications of the used cable.

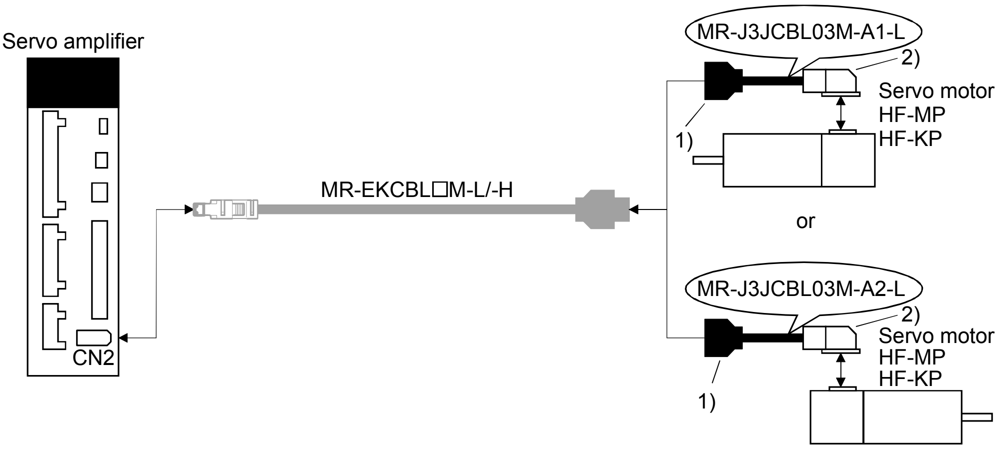
Parts/Tool	Description	
Connector set	MR-ECNM  For CN2 connector Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M) Or Connector set: 54599-1019 (Molex)	 Junction connector Housing: 1-172161-9 Connector pin: 170359-1 (Tyco Electronics or equivalent) Cable clamp: MTI-0002 (Toa Electric Industries)

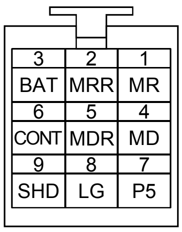
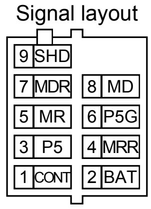
(3) MR-J3JCBL03M-A1-L・MR-J3JCLB03M-A2-L

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	Protective Structure	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.

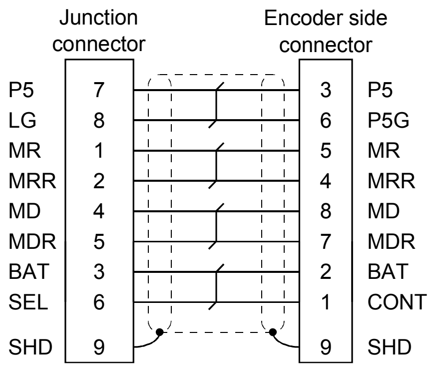
(a) Connection of servo amplifier and servo motor



Cable Model	1) Junction Connector	2) For Encoder Connector
MR-J3JCBL03M-A1-L	Housing: 1-172169-9 Contact: 1473226-1 Cable clamp: 316454-1 (Tyco Electronics) Signal layout  View seen from wiring side.	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847 (Tyco Electronics) Signal layout  View seen from wiring
MR-J3JCBL03M-A2-L		

(b) Internal wiring diagram

MR-J3JCBL03M-A1-L

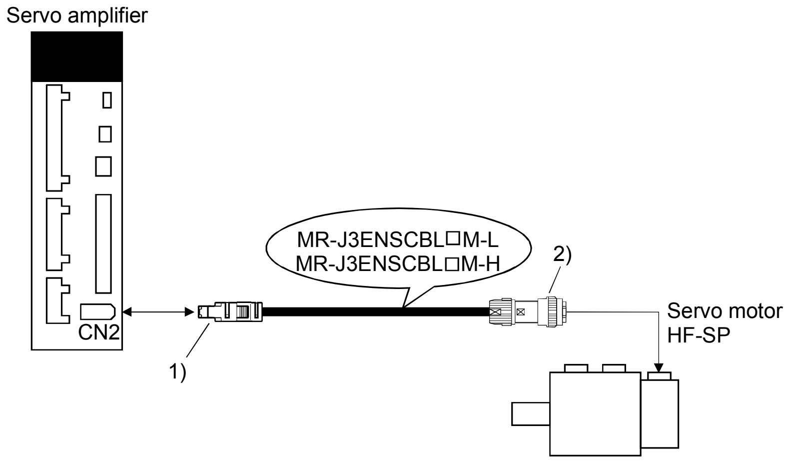


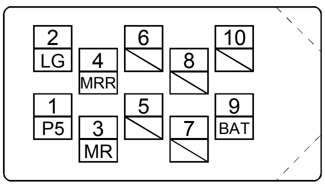
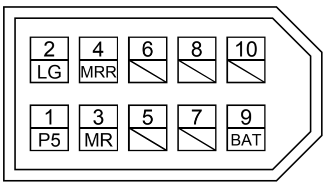
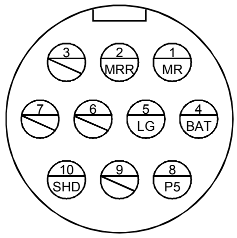
(4) MR-J3ENSCBL □ M-L ・ MR-J3ENSCBL □ M-H

These cables are detector cables for HF-SP Series servomotors. 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.

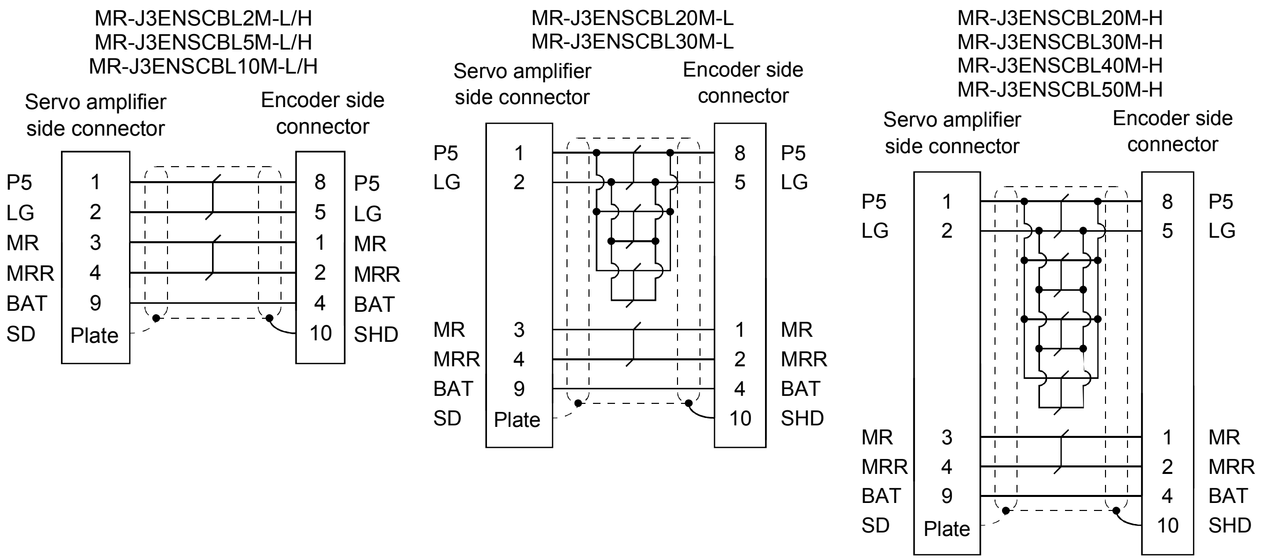
Cable Model	Cable Length							Protective Structure	Flex Life	Application
	2m	5m	10m	20m	30m	40m	50m			
MR-J3ENSCBL □ M-L	2	5	10	20	30			IP67	Standard	For HF-SP servo motor
MR- J3ENSCBL □ M-H	2	5	10	20	30	40	50	IP67	Long flex	

(a) Connection of servo amplifier and servo motor



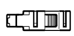
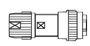
Cable Model	1) For CN2 Connector	2) For Encoder Connector
MR-J3ENSCBL □ M-L MR-J3ENSCBL □ M-H	Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M) (Note) Signal layout  View seen from wiring side. or Connector set: 54599-1019 (Molex) (Note) Signal layout  View seen from wiring side. Note. Keep open 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.	In case of 10m or shorter cables Straight plug: CM10-SP10S-M Socket contact: CM10-#22SC(C1)-100 Crimping tool: 357J-50446 (DDK) Applicable cable AWG20 to 22 In case of 20m or longer cables Straight plug: CM10-SP10S-M Socket contact: CM10-#22SC(C2)-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 ⊘.

(b) Internal wiring diagram



(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 12.11 for the specifications of the used cable.

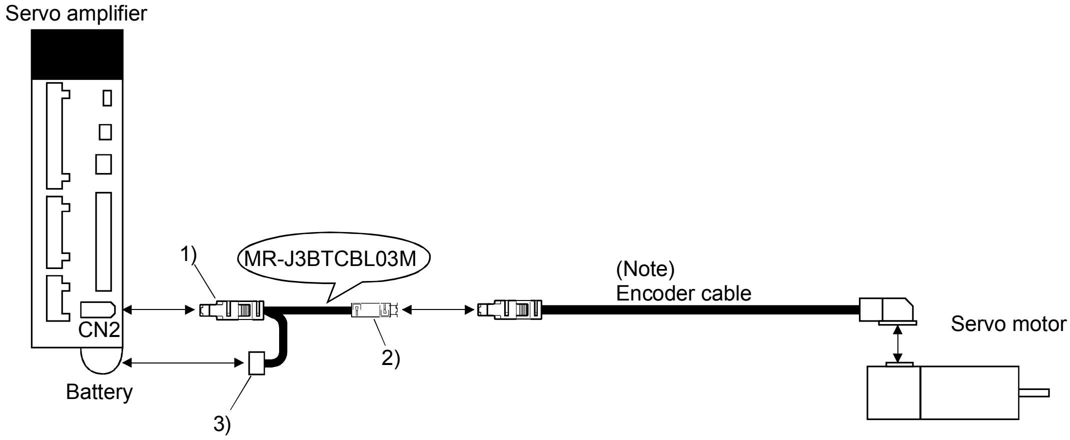
Parts/Tool	Description	
Connector set	MR- J3SCNS (Option)  Servo amplifier side connector Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M) Or Connector set: 54599-1019 (Molex)	 Encoder side connector Straight plug: CM10-SP10S-M Socket contact: CM10-#22SC(S1)-100 Applicable wire size: AWG20 or less Recommended tightening jig: 357J-51456T (DDK)

(5) 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 servo motor

(a) Connection of servo amplifier and servo motor



Note. For the detector cable, refer to (1), (2), (3) and (4) in this section.

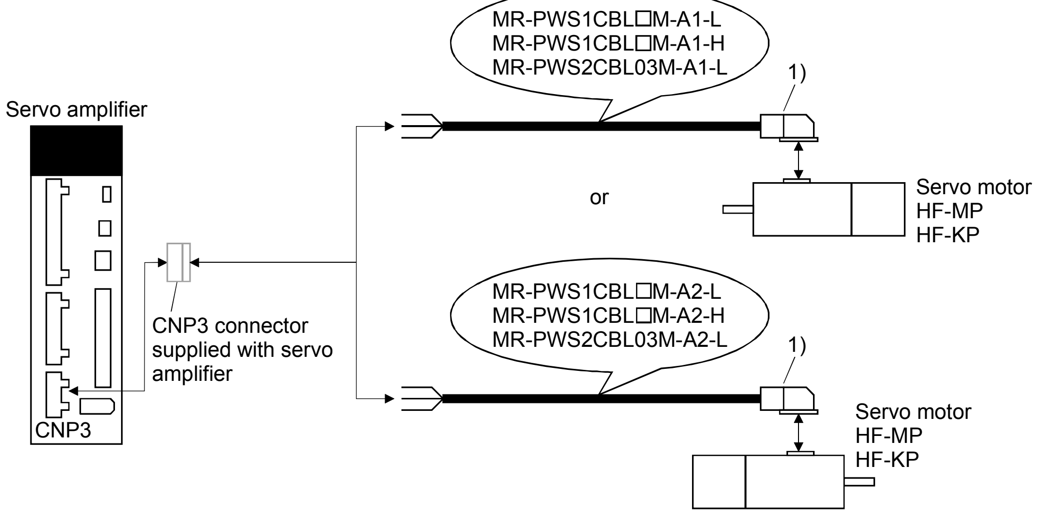
Cable Model	1) For CN2 Connector	1) Junction Connector	2) For Battery Connector
MR-J3BTCBL03M	Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M) Or Connector set: 54599-1019 (Molex)	Plug: 36110-3000PL Shell kit: 36310-F200-008 (3M)	Connector: DF3-2EP-2C Contact: DF3-EP2428PCFA (Hirose Denki)

12.1.3 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 3.10 when wiring.

Cable Model	Cable Length 0.3m	2m	5m	10m	20m	30m	40m	50m	Protective Structure	Flex Life	Application
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 flex	For HF-MP ・ HF-KP servo motor Load side lead
MR-PWS1CBL □ M-A2-H		2	5	10					IP65	Long flex	For HF-MP ・ HF-KP servo motor Opposite-to-load side lead
MR-PWS2CBL □ M-A1-L	03								IP55	Standard	For HF-MP ・ HF-KP servo motor Load side lead
MR-PWS2CBL □ M-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



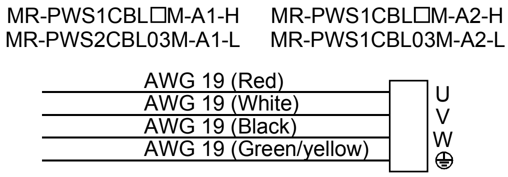
Cable Model	1) For Motor Power Supply Connector
MR-PWS1CBL □ M-A1-L MR-PWS1CBL □ M-A2-L MR-PWS1CBL □ M-A1-H MR-PWS1CBL □ M-A2-H	Connector: JN4FT04SJ1-R Hod, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)
MR-PWS2CBL03M-A1-L MR-PWS2CBL03M-A2-L	Connector: JN4FT04SJ2-R Hod, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)

Signal layout

1	⏚
2	U
3	V
4	W

View seen from wiring side.

(2) Internal wiring diagram

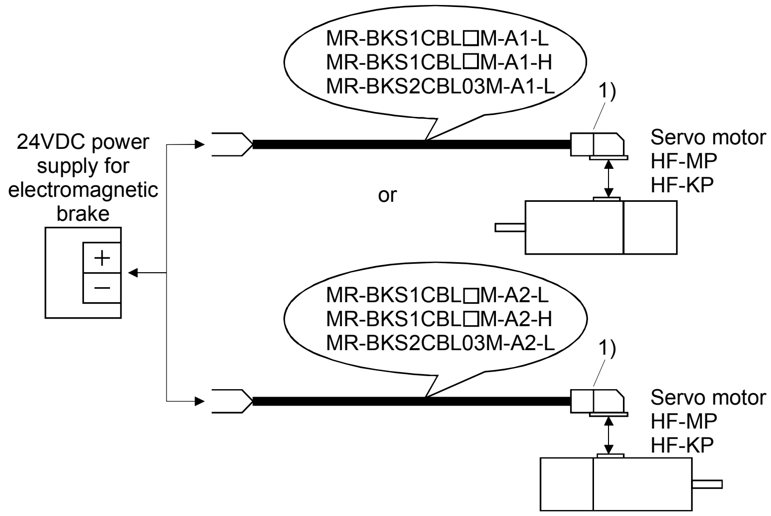


12.1.4 Motor brake cables

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 3.11 when wiring.

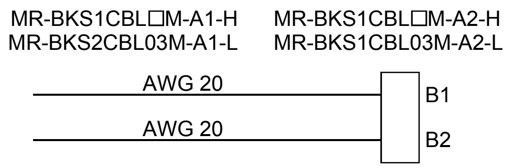
Cable Model	Cable Length								Protective Structure	Flex Life	Application
	0.3m	2m	5m	10m	20m	30m	40m	50m			
MR-BKS1CBL □ M-A1-L		2	5	10					IP65	Standard	For HF-MP・HF-KP servo motor Load side lead
MR-BKS1CBL □ M-A2-L		2	5	10					IP65	Standard	For HF-MP・HF-KP servo motor Opposite-to-load side lead
MR-BKS1CBL □ M-A1-H		2	5	10					IP65	Long flex	For HF-MP・HF-KP servo motor Load side lead
MR-BKS1CBL □ M-A2-H		2	5	10					IP65	Long flex	For HF-MP・HF-KP servo motor Opposite-to-load side lead
MR-BKS2CBL □ M-A1-L	03								IP55	Standard	For HF-MP・HF-KP servo motor Load side lead
MR-BKS2CBL □ M-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



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 Hod, 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 Hod, 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



12.2 Regenerative options

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

(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-J3-10A (1)		30						
MR-J3-20A (1)	10	30	100					
MR-J3-40A (1)	10	30	100					
MR-J3-60A	10	30	100					
MR-J3-70A	20	30	100			300		
MR-J3-100A	20	30	100			300		
MR-J3-200A	100			300			500	
MR-J3-350A	100			300			500	
MR-J3-500A	130				300			500
MR-J3-700A	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-J3-60A4	20	100	300				
MR-J3-100A4	20	100	300				
MR-J3-200A4	100			300	500		
MR-J3-350A4	100			300	500		
MR-J3-500A4	130					300	500
MR-J3-700A4	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-J3-11KA	500 (800)	500 (800)					
MR-J3-15KA	850 (1300)		850 (1300)				
MR-J3-22KA	850 (1300)			850 (1300)			
MR-J3-11KA4	500 (800)				500 (800)		
MR-J3-15KA4	850 (1300)					850 (1300)	
MR-J3-22KA4	850 (1300)						850 (1300)

Note 1. Always install a cooling fan.

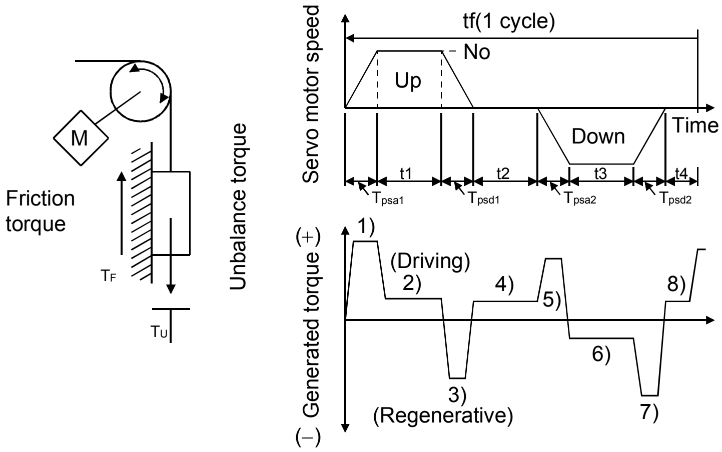
2. Values in parentheses assume the installation of a cooling fan.

(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

Use the following table to calculate the regenerative energy.



Formulas for calculating torque and energy in operation

Regenerative power	Torque applied to servo motor [N・m]	Energy [J]
1)	$T_1 = \frac{(J_L+J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psa1}} + T_U + T_F$	$E_1 = \frac{0.1047}{2} \cdot N_0 \cdot T_1 \cdot T_{psa1}$
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-J3-10A	55	9
MR-J3-10A1	55	4
MR-J3-20A	70	9
MR-J3-20A1	70	4
MR-J3-40A	85	11
MR-J3-40A1	85	10
MR-J3-60A(4)	85	11
MR-J3-70A	80	18
MR-J3-100A	80	18
MR-J3-100A4	80	12

Servo amplifier	Inverse efficiency[%]	Capacitor charging[J]
MR-J3-200A	85	40
MR-J3-200A4	85	25
MR-J3-350A	85	40
MR-J3-350A4	85	36
MR-J3-500A(4)	90	45
MR-J3-700A(4)	90	70
MR-J3-11KA(4)	90	120
MR-J3-15KA(4)	90	170
MR-J3-22KA(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.

$$PR\ [W] = ER/tf \quad \text{(12.1)}$$

(3) Parameter setting

Set parameter No. PA02 according to the open 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 200 to 7kW, built-in regenerative resistor is used.
- Supplied regenerative resistors or regenerative option is used with the servo amplifier of 11k to 22kW.

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 necessary)
08: MR-RB31
09: MR-RB51(Cooling fan necessary)
80: MR-RB1H-4
81: MR-RB3M-4(Cooling fan necessary)
82: MR-RB3G-4(Cooling fan necessary)
83: MR-RB5G-4(Cooling fan necessary)
84: MR-RB34-4(Cooling fan necessary)
85: MR-RB54-4(Cooling fan necessary)
FA: When the supplied regenerative resistor is cooled by the cooling

(4) Connection of the regenerative option

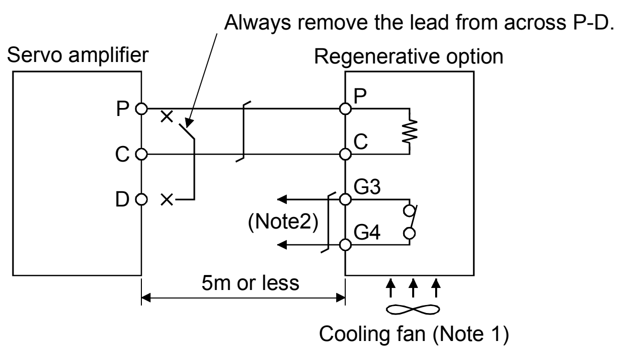
POINT
・When the MR-RB50・MR-RB51・MR-RB3M-4・MR-RB3G-4・MR-RB5G-4・MR-RB34-4・MR-RB54-4 is used, a cooling fan is required to cool it. The cooling fan should be prepared by the customer. ・For the sizes of wires used for wiring, refer to section 12.11.

The regenerative option will generate heat of about 100℃. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant cables 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-J3-350A or less・MR-J3-200A4 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.

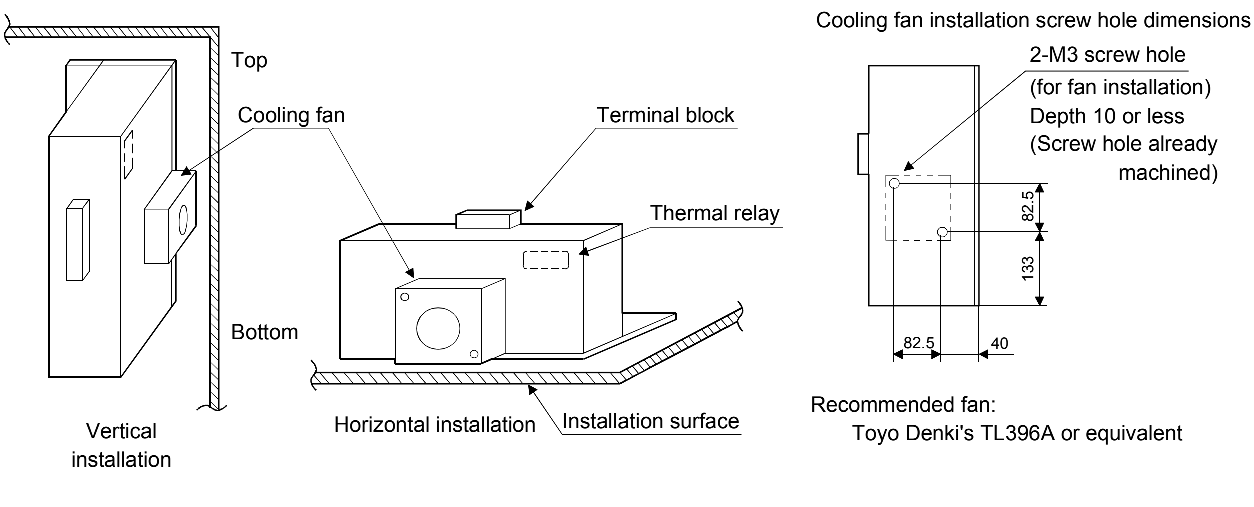


Note 1. When using the MR-RB50, MR-RB3M-4, MR-RB3G-4 or MR-RB5G-4, forcibly cool it with a cooling fan (1.0m³/min, □92 or so).

2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

For the MR-RB50, MR-RB3M-4, MR-RB3G-4 or MR-RB5G-4 install the cooling fan as shown.

[Unit : mm]

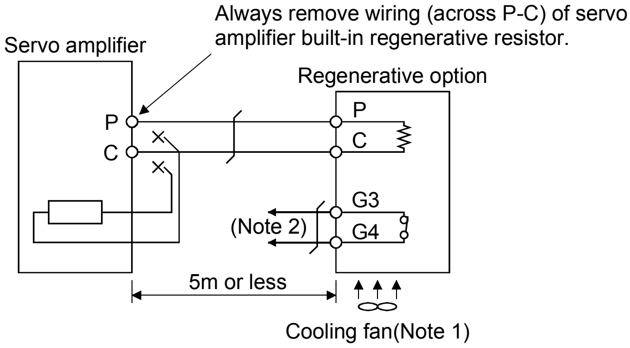


Recommended fan:
Toyo Denki's TL396A or equivalent

(b) MR-J3-350A4 · MR-J3-500A(4) · MR-J3-700A(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.

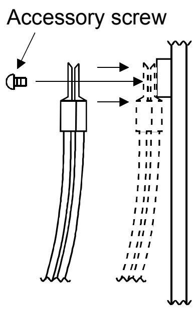


Note 1. When using the MR-RB51 · MR-RB3G-4, MR-RB5G-4, MR-RB34-4 or MR-RB54-4, forcibly cool it with a cooling fan (1.0m^3/min, □92 or so).

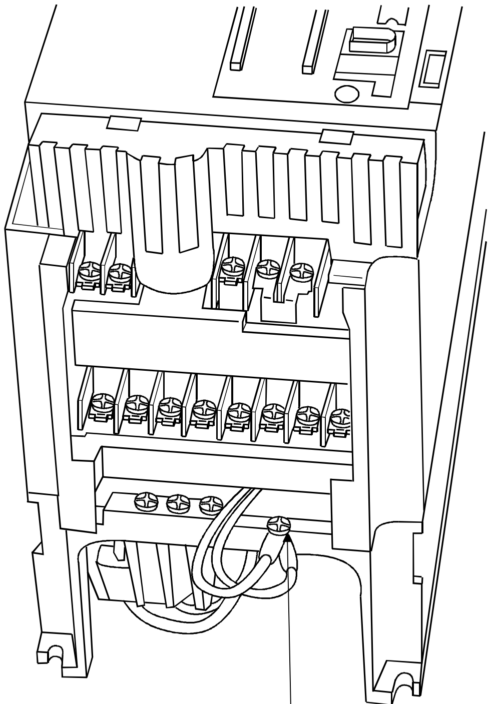
2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

When using the regenerative resistor option, remove the servo amplifier's built-in regenerative resistor terminals (across P-C), fit them back to back, and secure them to the frame with the accessory screw as shown below.

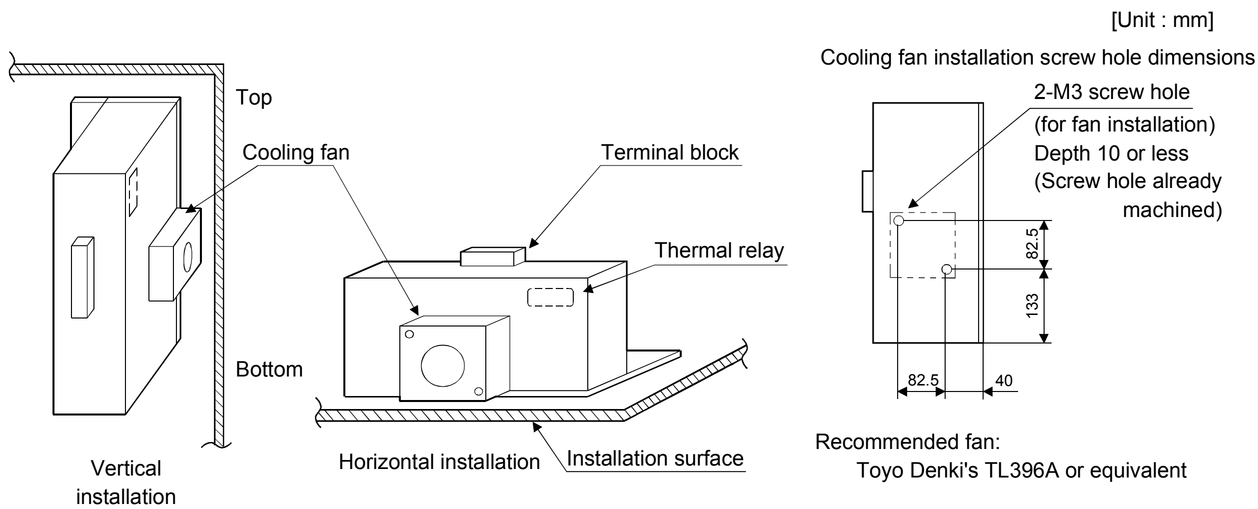
Mounting method



The drawing below shows the MR-J3-350A4 and MR-J3-500A. Refer to section 10.1 (6) Outline Drawings for the position of the fixing screw for MR-J3-700A.

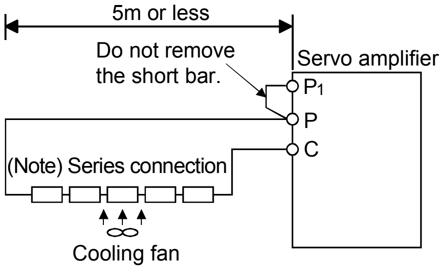


For the MR-RB51, MR-RB3G-4, MR-RB5G-4, MR-RB34-4 or MR-RB54-4 install the cooling fan as shown.



(c) MR-J3-11KA(4) to MR-J3-22KA(4) (when using the supplied regenerative resistor)

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 fans ($1.0m^3$/min, □ 92 (about two fans) 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, 9P, 9F, 6B-4, 60-4 and 6K-4) provided by Mitsubishi Electric Corporation.

Servo Amplifier	Regenerative Resistor	Regenerative Power [W]		Resistance [Ω]	Number of Resistors
		Normal	Cooling		
MR-J3-11KA	GRZG400-1.5Ω	500	800	6	4
MR-J3-15KA	GRZG400-0.9Ω	850	1300	4.5	5
MR-J3-22KA	GRZG400-0.6Ω	850	1300	3	5
MR-J3-11KA4	GRZG400-5.0Ω	500	800	20	4
MR-J3-15KA4	GRZG400-2.5Ω	850	1300	12.5	5
MR-J3-22KA4	GRZG400-2.0Ω	850	1300	10	5

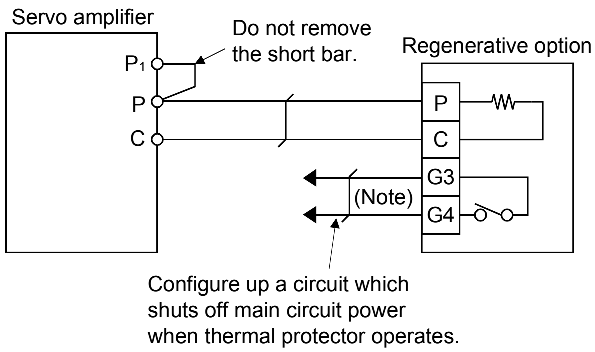
(d) MR-J3-11KA(4)-PX to MR-J3-22KA(4)-PX (when using the regenerative option)

The MR-J3-11KA(4)-PX to MR-J3-22KA(4)-PX servo amplifiers are not supplied with regenerative resistors. When using any of these servo amplifiers, always use the MR-RB5E, 9P, 9F, 6B-4, 60-4 and 6K-4 regenerative option.

The MR-RB5E, 9P, 9F, 6B-4, 60-4 and 6K-4 are regenerative options that have encased the GRZG400-1.5Ω, GRZG400-0.9Ω, 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, GRZG400-0.6Ω, GRZG400-5.0Ω, GRZG400-2.5Ω, GRZG400-2.0Ω (supplied regenerative resistors or regenerative option is used with 11kW or more servo amplifier).

Cooling the regenerative option with fans improves regenerative capability.

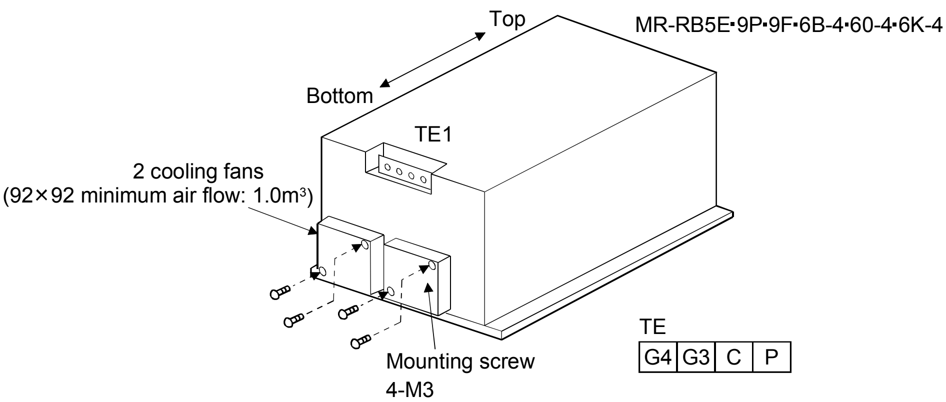
The G3 and G4 terminals are for the thermal protector. G3-G4 is opened when the regenerative option overheats abnormally.



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 Fans	With Fans
MR-J3-11KA-PX	MR-RB5E	6	500	800
MR-J3-15KA-PX	MR-RB9P	4.5	850	1300
MR-J3-22KA-PX	MR-RB9F	3	850	1300
MR-J3-11KA4-PX	MR-RB6B-4	20	500	800
MR-J3-15KA4-PX	MR-RB60-4	12.5	850	1300
MR-J3-22KA4-PX	MR-RB6K-4	10	850	1300

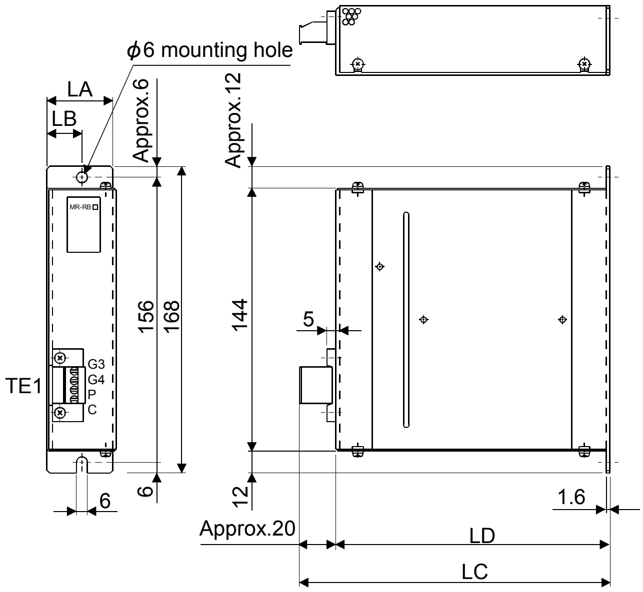
When using fans, install them using the mounting holes provided in the bottom of the regenerative option. In this case, set "□□FA" in parameter No. PA02.



(5) Outline dimension drawings

(a) MR-RB032・MR-RB12

[Unit: mm]



・TE1 terminal block

G3
G4
P
C

Terminal screw: M3

Tightening torque: 0.5 to 0.6 [N・m] (4 to 5 [lb・in])

・Mounting screw

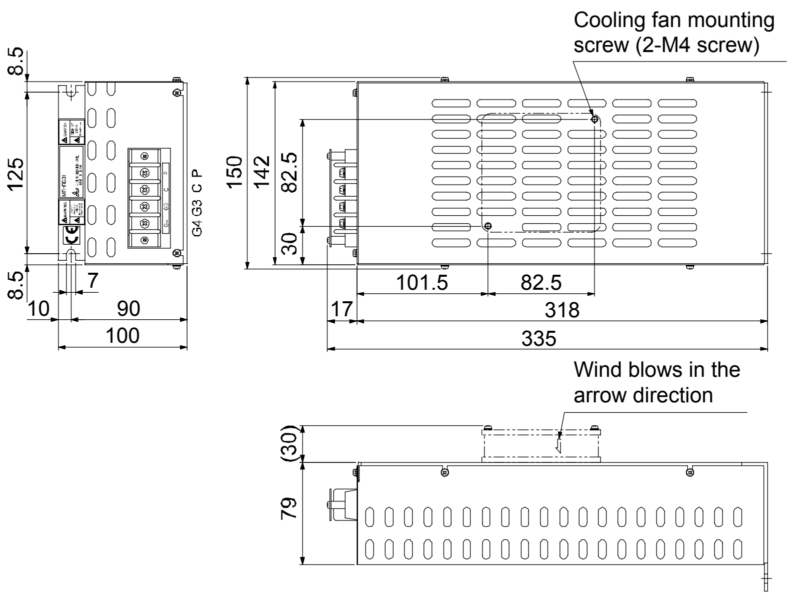
Screw: M5

Tightening torque: 3.2 [N・m] (28.3 [lb・in])

Regenerative option	Variable dimensions				Mass	
	LA	LB	LC	LD	[kg]	[lb]
MR-RB032	30	15	119	99	0.5	1.1
MR-RB12	40	15	169	149	1.1	2.4

(b) MR-RB30・MR-RB31・MR-RB32・MR-RB34-4・MR-RB3M-4・MR-RB3G-4

[Unit: mm]



・Terminal block

P
C
G3
G4

Terminal screw: M4

Tightening torque: 1.2 [N・m]

(10.62 [lb・in])

・Mounting screw

Screw: M6

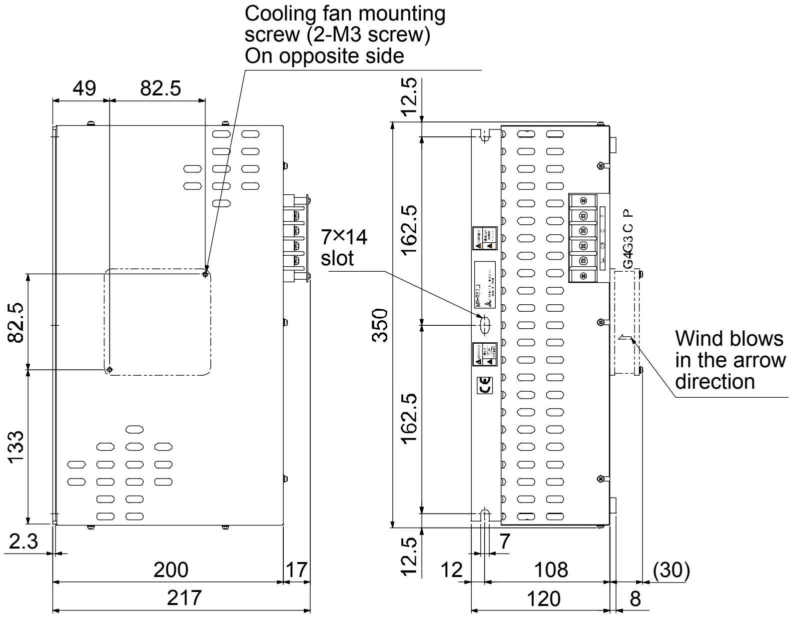
Tightening torque: 5.4 [N・m]

(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

[Unit: mm]



· Terminal block

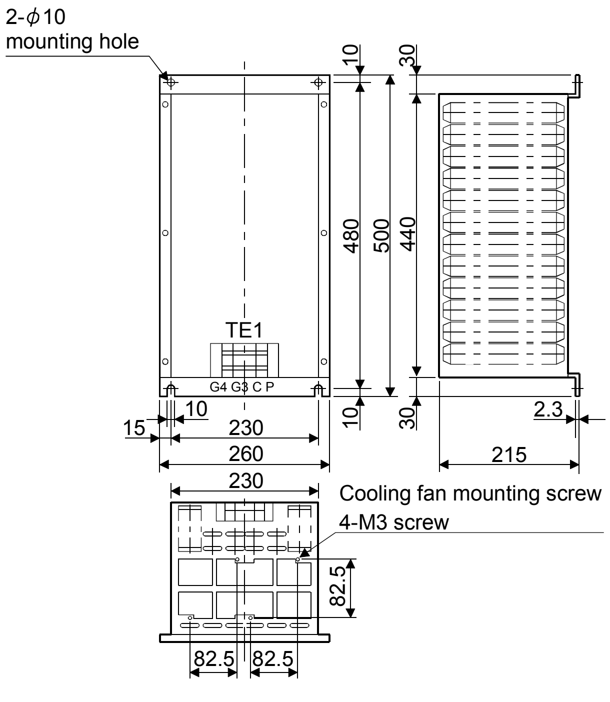
P
C
G3
G4

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-RB9P · MR-RB9F · MR-RB6B-4 · MR-RB60-4 · MR-RB6K-4

[Unit: mm]



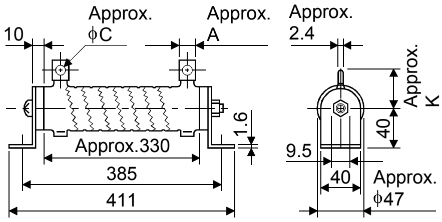
· Terminal block

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-RB9P	11	24.3
MR-RB9F	11	24.3
MR-RB6B-4	10	22.0
MR-RB60-4	11	24.3
MR-RB6K-4	11	24.3

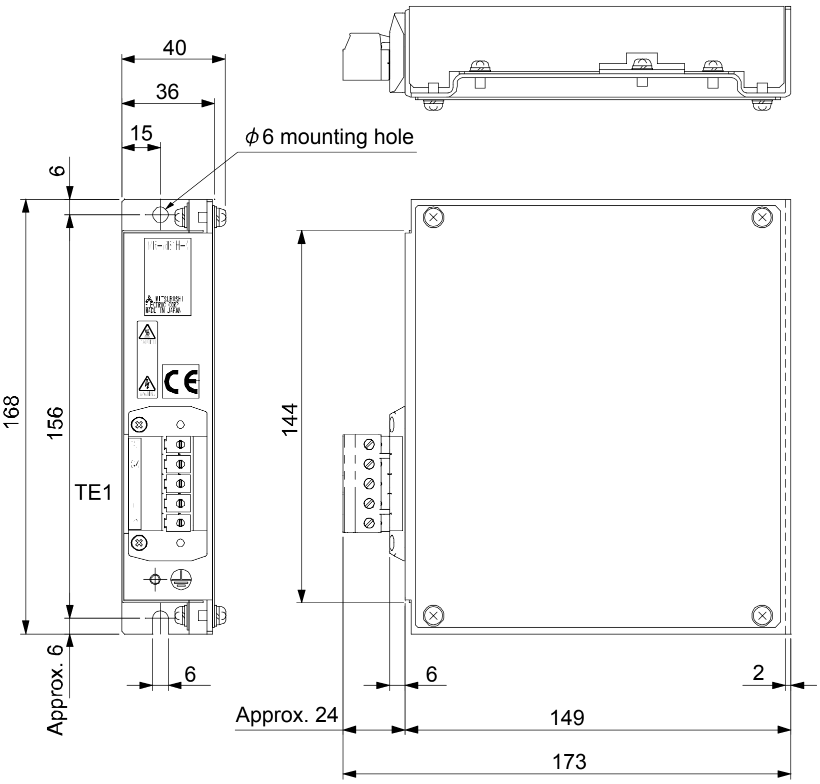
(e) GRZG400-1.5Ω・GRZG400-0.9Ω・GRZG400-0.6Ω・GRZG400-5.0Ω・GRZG400-2.5Ω・GRZG400-2.0Ω (standard accessories)



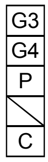
Regenerative resistor	Variable dimensions A	Variable dimensions C	Variable dimensions K	Mounting screw size	Tightening torque [N・m] ([lb・in])	Mass [kg] ([lb])
GRZG400-1.5Ω	10	5.5	39	M8	13.2 (116.83)	0.8 (1.76)
GRZG400-0.9Ω						
GRZG400-0.6Ω	16	8.2	46			
GRZG400-5.0Ω	10	5.5	39			
GRZG400-2.5Ω						
GRZG400-2.0Ω						

(f) MR-RB1H-4

[Unit: mm]



Terminal screw: M3
Tightening torque: 0.5 to 0.6 [N・m]
(4.43 to 5.31 [lb・in])



・Mounting screw
Screw size: M5
Tightening torque: 3.2 [N・m]
(28.32 [lb・in])

Regenerative option	Mass [kg] ([lb])
MR-RB1H-4	1.1 (2.4)

12.3 Brake unit

POINT

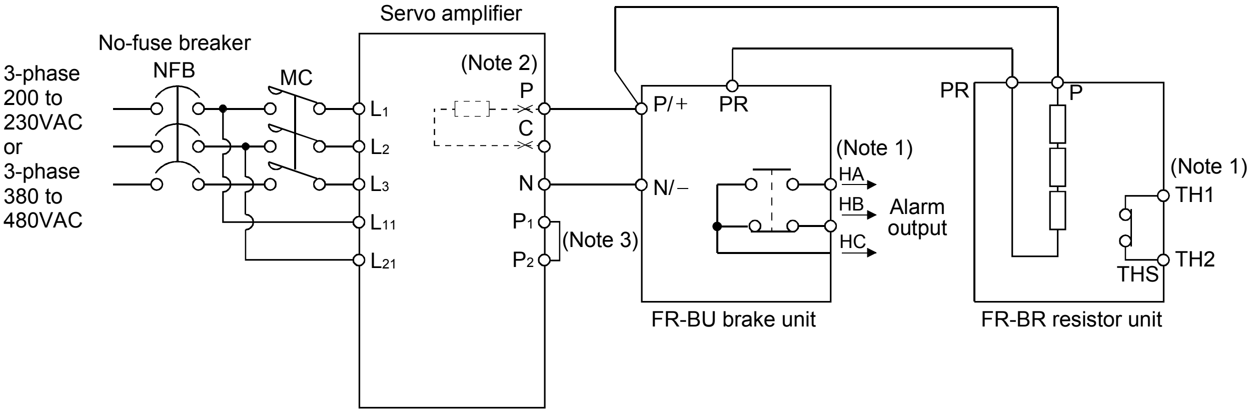
- The brake unit and resistor unit of other than 200V class are not applicable to the servo amplifier.
- The brake unit and resistor unit of other than 400V class are not applicable to the servo amplifier.
- The brake unit and resistor unit of the same capacity must be combined. The units of different capacities may result in damage.
- The brake unit and resistor unit must be installed on a vertical surface in the vertical direction. If they are installed in the horizontal direction or on a horizontal surface, a heat dissipation effect reduces.
- The temperature of the resistor unit casing rises to higher than 100℃. Do not cause cables and combustibles to make contact with the casing.

The brake unit is the integration of the regenerative control and resistor and is connected to the bus (across P-N) of the servo amplifier. As compared to the MR-RB regenerative option, the brake unit can return larger power. Hence, use this brake unit when the MR-RB cannot provide sufficient regenerative capability.
When using the brake unit, set "□□01" in parameter No.PA02.

(1) Selection

Brake unit	Resistor unit	Permissible continuous power [kW]	Max. instantaneous power [kW]	Applicable servo amplifier
FR-BU-15K	FR-BR-15K	0.99	16.5	MR-J3-500A MR-J3-700A MR-J3-11KA MR-J3-15KA MR-J3-22KA
FR-BU-30K	FR-BR-30K	1.99	33.4	
FR-BU-55K	FR-BR-55K	3.91	66.8	
FR-BU-H15K	FR-BR-H15K	0.99	16.5	MR-J3-11KA4 MR-J3-15KA4 MR-J3-22KA4
FR-BU-H30K	FR-BR-H30K	1.99	33.4	
FR-BU-H55K	FR-BR-H55K	3.91	66.8	

(2) Connection example

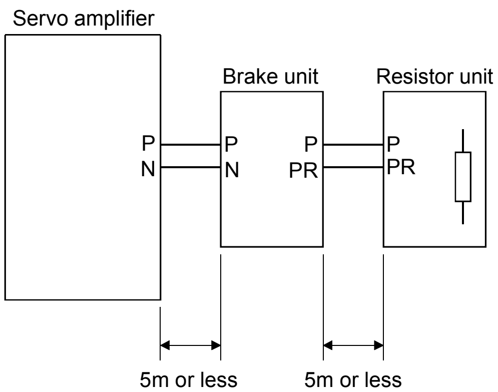


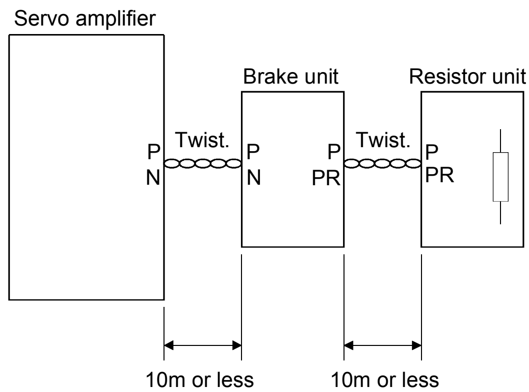
Note 1. Make up the external sequence to switch the power off when an alarm occurs or when the thermal relay is actuated.

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. Always connect P_1-P_2 (For 11k to 22kW, connect P-P_1). (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.

The cables between the servo amplifier and brake unit and between the resistor unit and brake unit should be as short as possible. The cables longer than 5m should be twisted. If twisted, the cables must not be longer than 10m.
The cable size should be equal to or larger than the recommended size. See the brake unit instruction manual. You cannot connect one set of brake unit to two servo amplifiers or two sets of brake units to one servo amplifier.

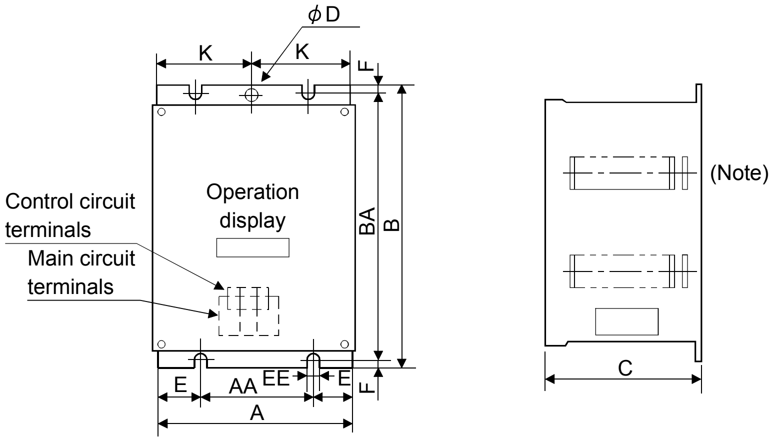




(3) Outside dimensions

(a) Brake unit (FR-BU)

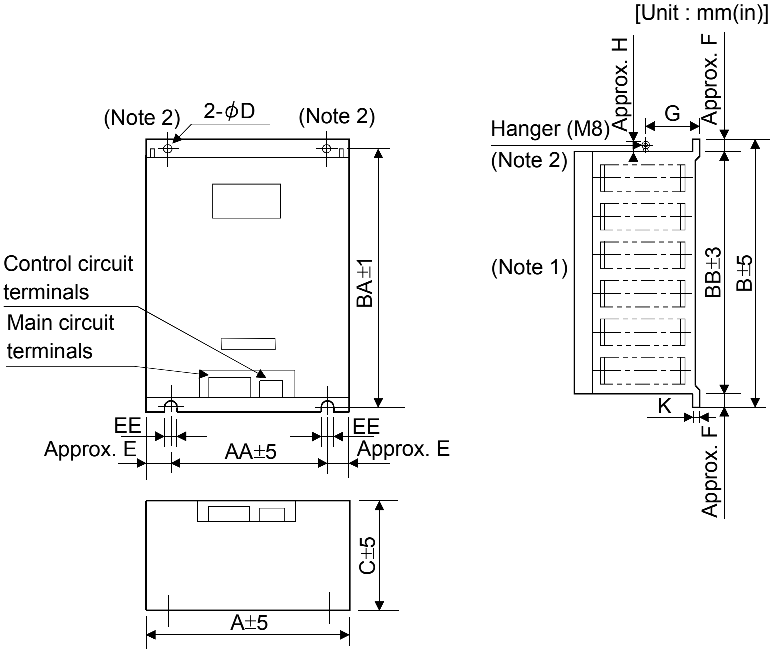
[Unit : mm(in)]



Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

Brake Unit	A	AA	B	BA	C	D	E	EE	K	F	Approx. Mass [kg(lb)]
FR-BU-15K	100	60	240	225	128	6	18.5	6	48.5	7.5	2.4 (5.291)
FR-BU-30K	160	90	240	225	128	6	33.5	6	78.5	7.5	3.2 (7.055)
FR-BU-55K	265	145	240	225	128		58.6	6		7.5	5.8 (12.79)
FR-BU-H15K FR-BU-H30K	160	90	240	225	128	6	33.5	6	78.5	7.5	3.2 (7.055)
FR-BU-H55K	265	145	240	225	128		58.6	6		7.5	5.8 (12.79)

(b) Resistor unit (FR-BR)



Note 1. Ventilation ports are provided in both side faces and top face. The bottom face is open.
2. For FR-BR-55K and FR-BR-H55K, two eye bolts (M8) are provided.

Resistor Unit Model	A	AA	B	BA	BB	C	D	E	EE	K	F	G	H	Approx. Mass [kg(lb)]
FR-BR-15K	170	100	450	432	410	220	6	35	6	1.6	20			15 (66.139)
FR-BR-30K	340	270	600	582	560	220	10	35	10	2	20			30 (33.069)
FR-BR-55K	480	410	700	670	620	450	12	35	12	3.2	40	204	33	70 (154.3)
FR-BR-H15K	170	100	450	432	410	220	6	35	6	1.6	20			15 (66.139)
FR-BR-H30K	340	270	600	582	560	220	10	35	10	2	20			30 (33.069)
FR-BR-H55K	480	410	700	670	620	450	12	35	12	3.2	40	204	33	70 (154.3)

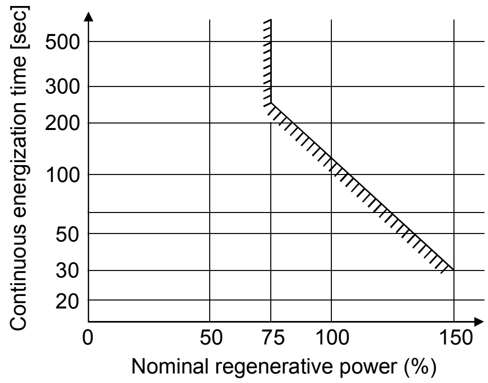
12.4 Power regeneration converter

When using the power regeneration converter, set "□ □ 01" in parameter No.PA02.

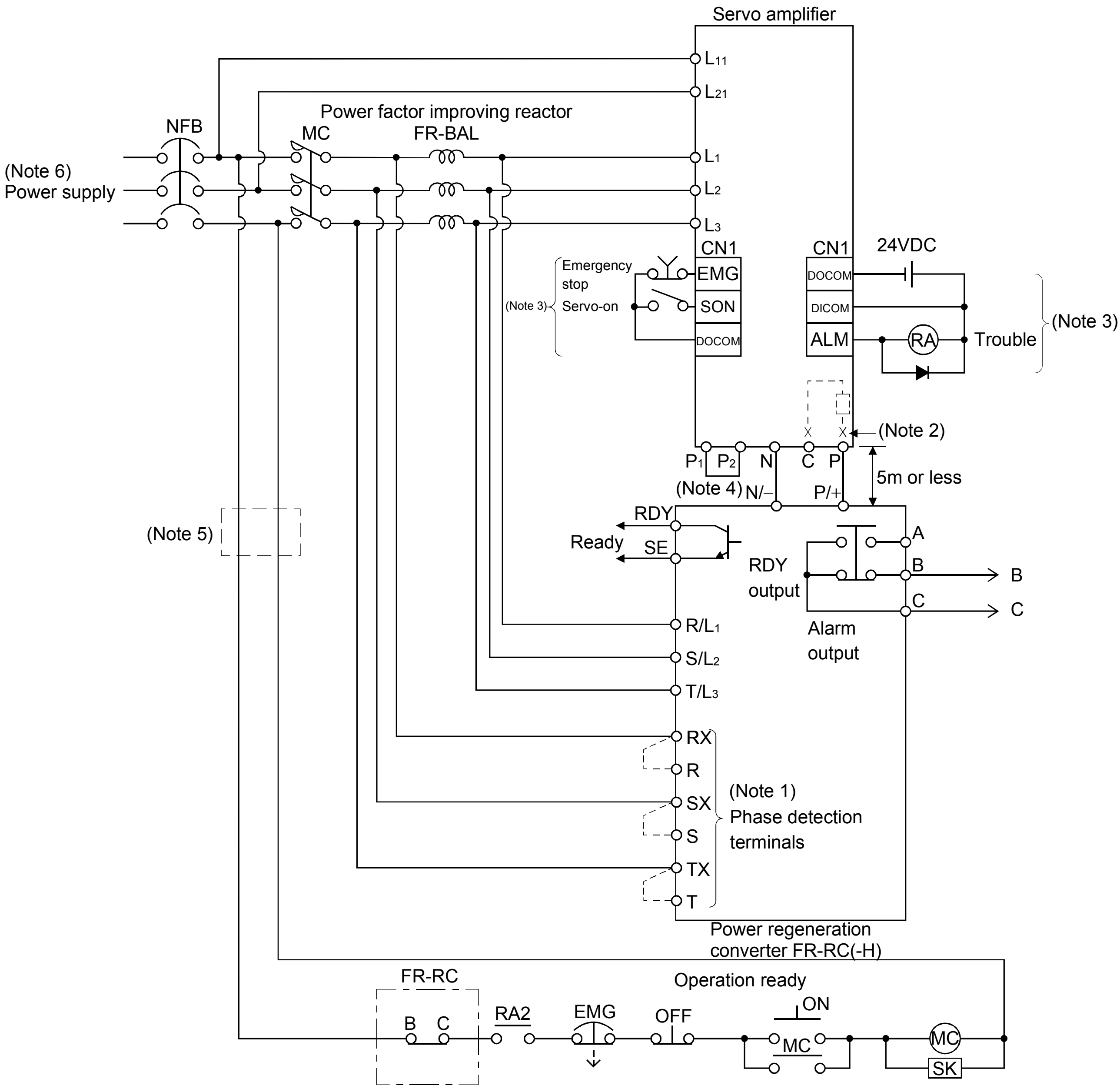
(1) Selection

The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the 5kW to 22kW.

Power regeneration converter	Nominal regenerative power (kW)	Servo amplifier
FR-RC-15K	15	MR-J3-500A MR-J3-700A
FR-RC-30K	30	MR-J3-11KA MR-J3-15KA
FR-RC-55K	55	MR-J3-22KA
FR-RC-H15K	15	MR-J3-500A4 MR-J3-700A4
FR-RC-H30K	30	MR-J3-11KA4 MR-J3-15KA4
FR-RC-H55K	55	MR-J3-22KA4



(2) Connection example



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 amplifier of 5kW and 7kW, always remove the lead of built-in regenerative resistor connected to P terminal and C terminal.

3. For sink input-output interface. Refer to section 3.8.3 for source input-output interface.

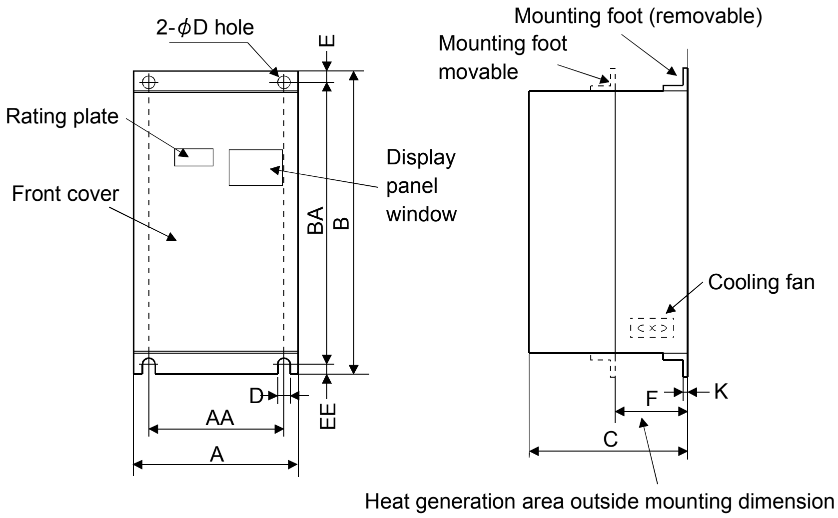
4. Always connect P_1-P_2 (For 11k to 22kW, connect P-P_1). (Factory-wired.) When using the power factor improving DC reactor, refer to section 12.13.

5. For 400VAC class, the stepdown transformer is required.

6. For the specification of power supply, refer to section 1.3.

(3) Outside dimensions of the power regeneration converters

[Unit : mm(in)]

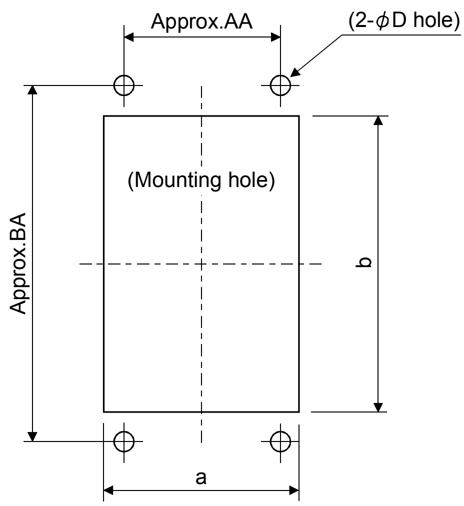


Power regeneration converter	A	AA	B	BA	C	D	E	EE	K	F	Approx. Mass [kg(lb)]
FR-RC-15K	270	200	450	432	195	10	10	8	3.2	87	19 (41.888)
FR-RC-H15K FR-RC-30K FR-RC-H30K	340	270	600	582	195	10	10	8	3.2	90	31 (68.343)
FR-RC-55K FR-RC-H55K	480	410	700	670	250	12	15	15	3.2	135	55 (121.3)

(4) Mounting hole machining dimensions

When the power regeneration 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(in)]



Model	a	b	D	AA	BA
FR-RC-15K	260	412	10	200	432
FR-RC-30K FR-RC-H30K	330	562	10	270	582
FR-RC-55K FR-RC-H55K	470	642	12	410	670

12.5 Power regeneration common converter

POINT

- Use the FR-CV for the servo amplifier of 200VAC class and the FR-CV-H for that of 400 VAC 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 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	200VAC class
H	400VAC class

(2) Selection

The power regenerative common converter FR-CV can be used for the servo amplifier of 200VAC class with 750W to 22kW and that of 400VAC class with 11kW 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] Total of rated capacities [W] 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

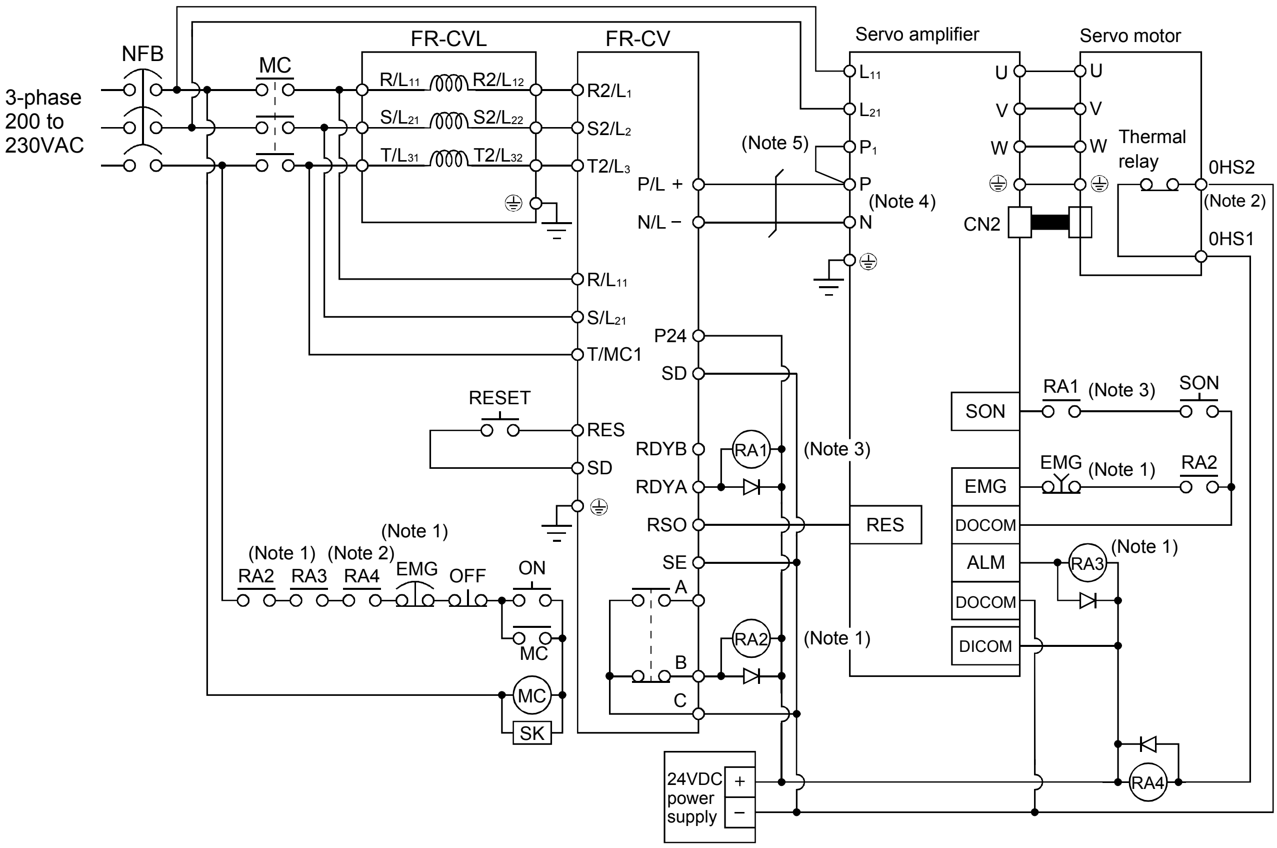
Item	FR-CV-H□			
	22K	30K	37K	55K
Maximum number of connected servo amplifiers	6			
Total of connectable servo amplifier capacities [kW]	11	15	18.5	27.5
Total of connectable servo motor rated currents [A]	90	115	145	215
Maximum servo amplifier capacity [kW]	11	15	15	22

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

(a) 200VAC class



Note 1. Configure a sequence that will shut off main circuit power at an emergency stop or at FR-CV or servo amplifier alarm occurrence.

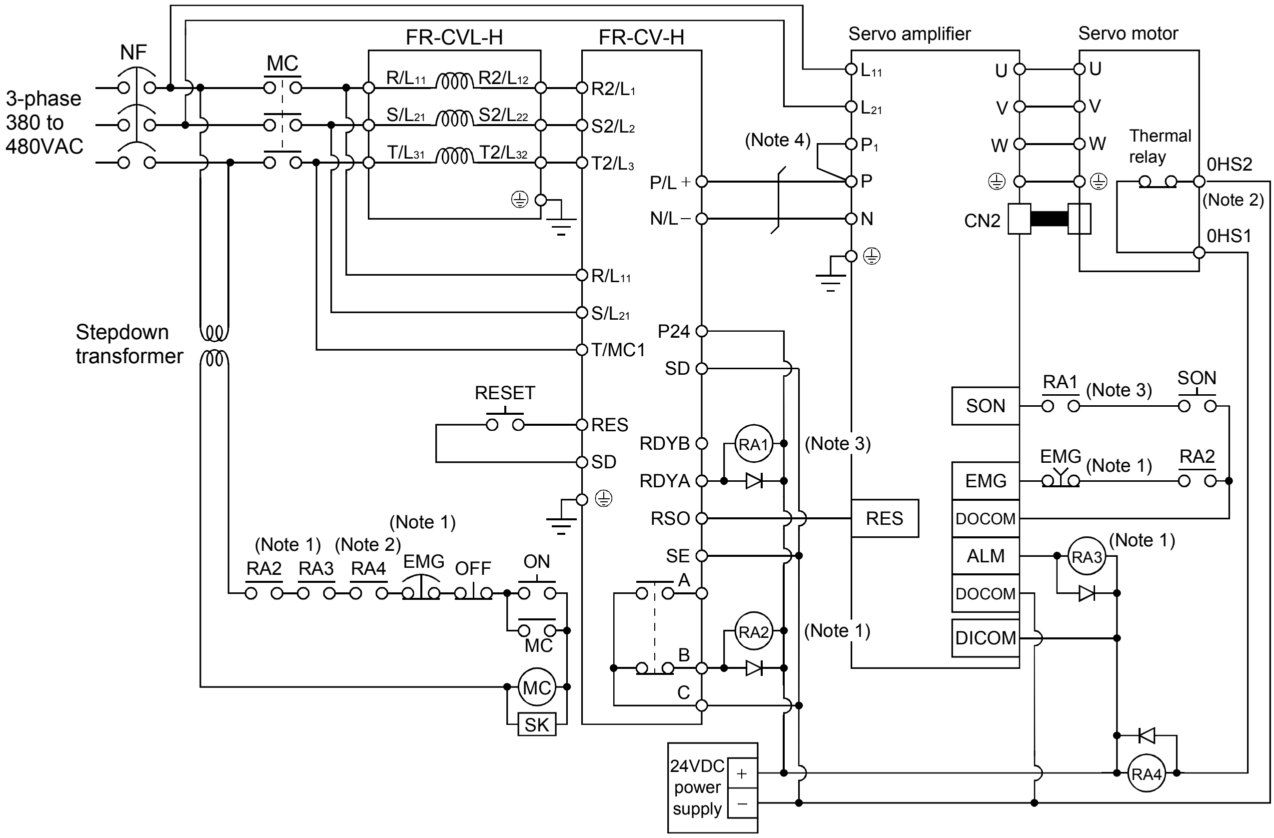
2. For the servo motor with thermal relay, configure a sequence that will shut off main circuit power when the thermal relay operates.

3. For the servo amplifier, configure a sequence that will switch the servo on after the FR-CV is ready.

4. When using the servo amplifier of 7kW or less, make sure to disconnect the wiring of built-in regeneration resistor (3.5kW or less: P-D, 5k/7kW: P-C).

5. When using the servo amplifier of 11k to 22kW, make sure to connect P-P_1. (Factory-wired.)

(b) 400VAC class



Note 1. Configure a sequence that will shut off main circuit power at an emergency stop 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. When using the servo amplifier of 11k to 22kW, make sure to connect P-P_1. (Factory-wired.)

(4) Wires used for wiring

(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. The used wires are based on the 600V vinyl wires.

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. The used wires are based on the 600V vinyl wires.

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

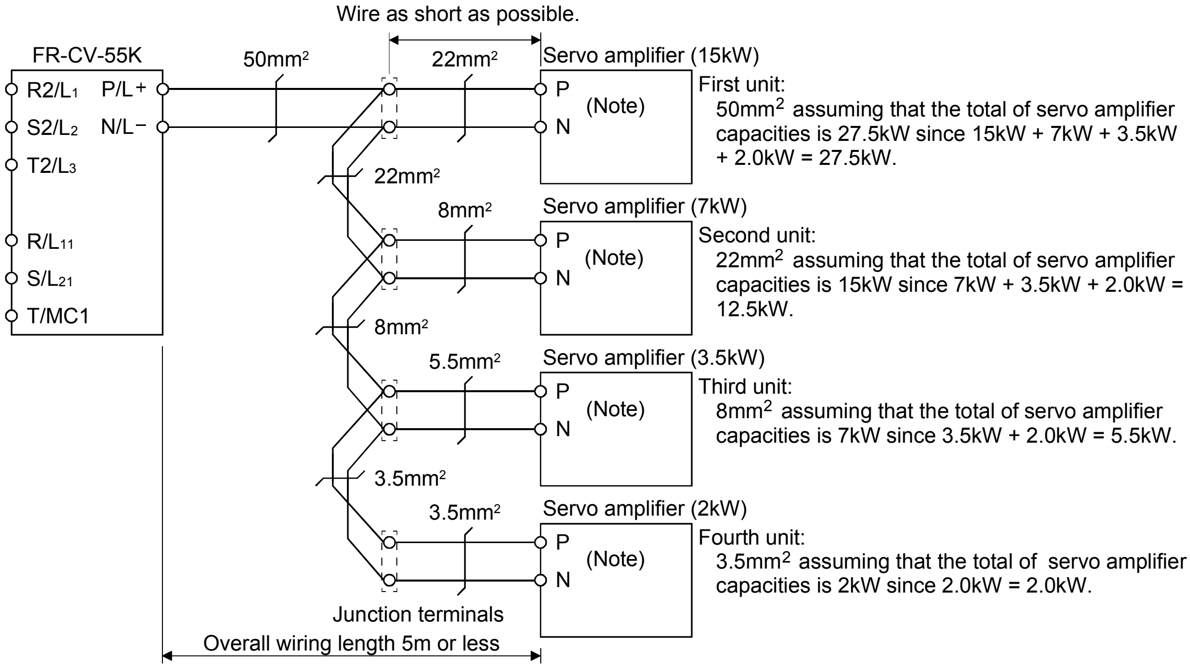
For grounding, use the wire of the size equal to or greater than that indicated in the following table, and make it as short as possible.

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

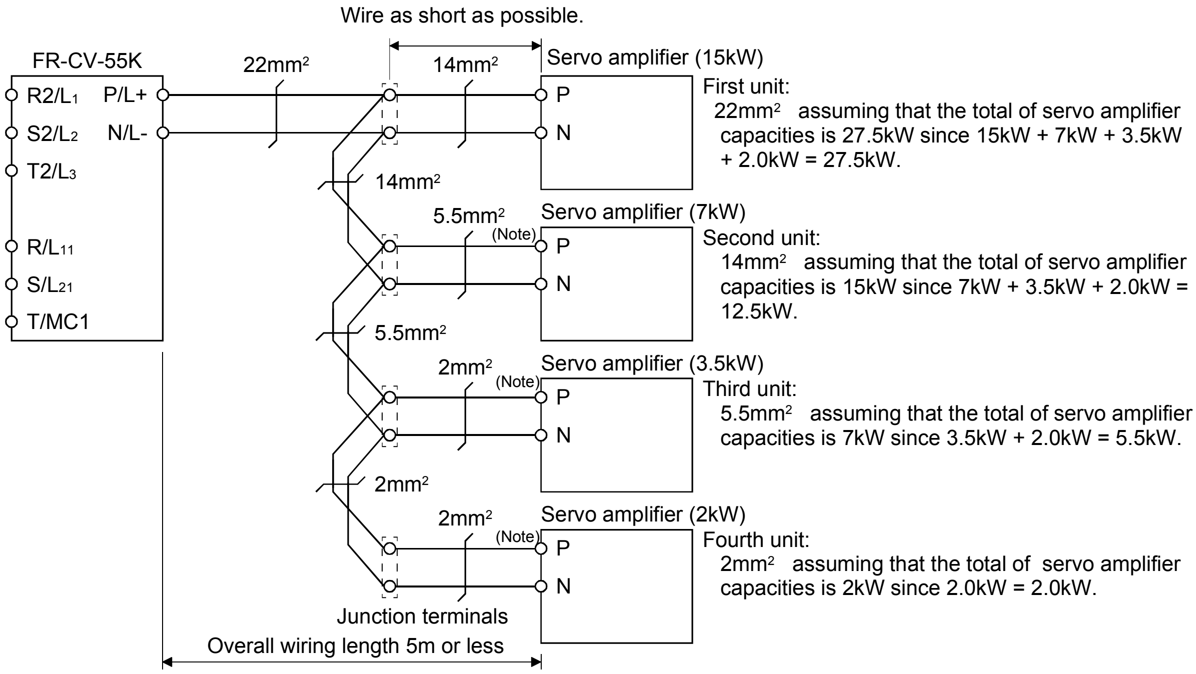
When connecting multiple servo amplifiers, always use junction terminals for wiring the servo amplifier terminals P, N. Also, connect the servo amplifiers in the order of larger to smaller capacities.

1) 200VAC class



Note. When using the servo amplifier of 7kW or less, make sure to disconnect the wiring of built-in regeneration resistor (3.5kW or less: P-D, 5k/7kW: P-C).

2) 400VAC class



Note. These servo amplifiers are development forecasted.

(5) Other precautions

(a) Always use the FR-CVL(-H) as the power factor improving reactor. Do not use the FR-BAL or 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 (Note1)						
		Continuous rating	100% torque						
Power supply	Rated input AC voltage/frequency		Three-phase 200 to 220V 50Hz, 200 to 230V 60Hz						
	Permissible AC voltage fluctuation		Three-phase 170 to 242V 50Hz, 170 to 253V 60Hz						
	Permissible frequency fluctuation		±5%						
	Power supply capacity (Note2) [kVA]		17	20	28	41	52	66	100
Protective structure (JEM 1030), cooling system			Open type (IP00), forced cooling						
Environment	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						
No-fuse breaker or 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 (Note1)			
		Continuous rating	100% torque			
Power supply	Rated input AC voltage/frequency		Three-phase 380 to 480V, 50Hz/60Hz			
	Permissible AC voltage fluctuation		Three-phase 323 to 528V, 50Hz/60Hz			
	Permissible frequency fluctuation		±5%			
	Power supply capacity [kVA]		41	52	66	100
Protective structure (JEM 1030), cooling system			Open type (IP00), forced cooling			
Environment	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			
No-fuse breaker or leakage current breaker			60AF 60A	100AF 175A	100AF 175A	225AF 125A
Magnetic contactor			S-N25	S-N35	S-N35	S-N65

Note1. This is the time when the protective function of the FR-CV is activated. The protective function of the servo amplifier is activated in the time indicated in section 11.1.

2. When connecting the capacity of connectable servo amplifier, specify the value of servo amplifier.

12.6 External dynamic brake

POINT

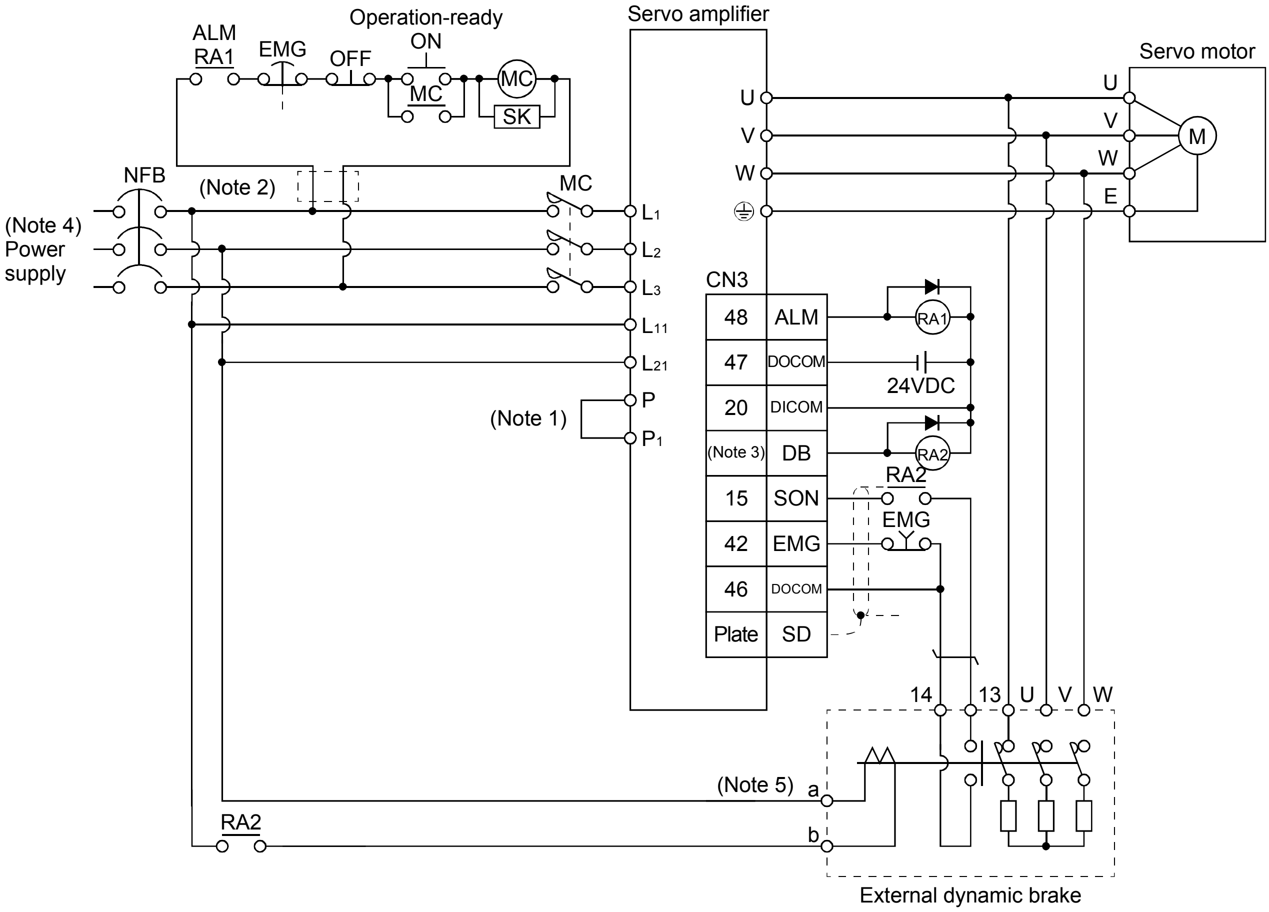
- Configure up a sequence which switches off the contact of the brake unit after (or as soon as) it has turned off the servo on signal at a power failure or failure.
- For the braking time taken when the dynamic brake is operated, refer to section 11.3.
- The brake unit is rated for a short duration. 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).

(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 if required. Assign the dynamic brake interlock (DB) to any of CN1-22 to CN1-25, and CN1-49 pins in parameter No.PD13 to PD16 and PD18.

Servo amplifier	Dynamic brake
MR-J3-11KA	DBU-11K
MR-J3-15KA	DBU-15K
MR-J3-22KA	DBU-22K
MR-J3-11KA4	DBU-11K-4
MR-J3-15KA4	DBU-22K-4
MR-J3-22KA4	

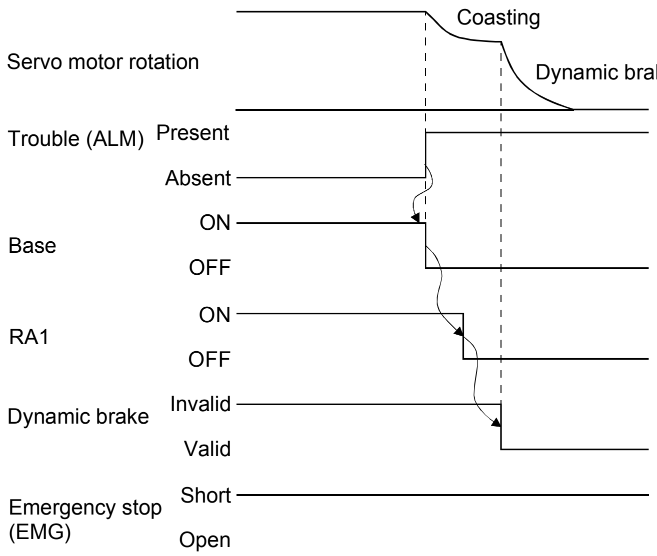
(2) Connection example



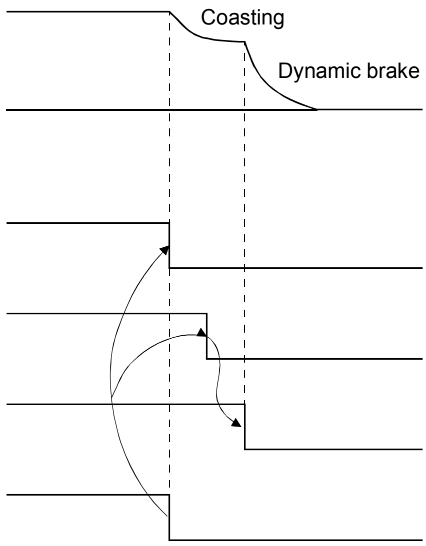
Note 1. For the servo amplifiers from 11k to 22kW, be sure to connect P - P_1. (Factory-wired) When using the power factor DC reactor, refer to section 12.10.

2. For 400VAC class, a step-down transformer is required.
3. Assign the dynamic brake interlock (DB) in the parameters No.PD13 to PD18.
4. For the specification of power supply, refer to section 1.3.
5. 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.

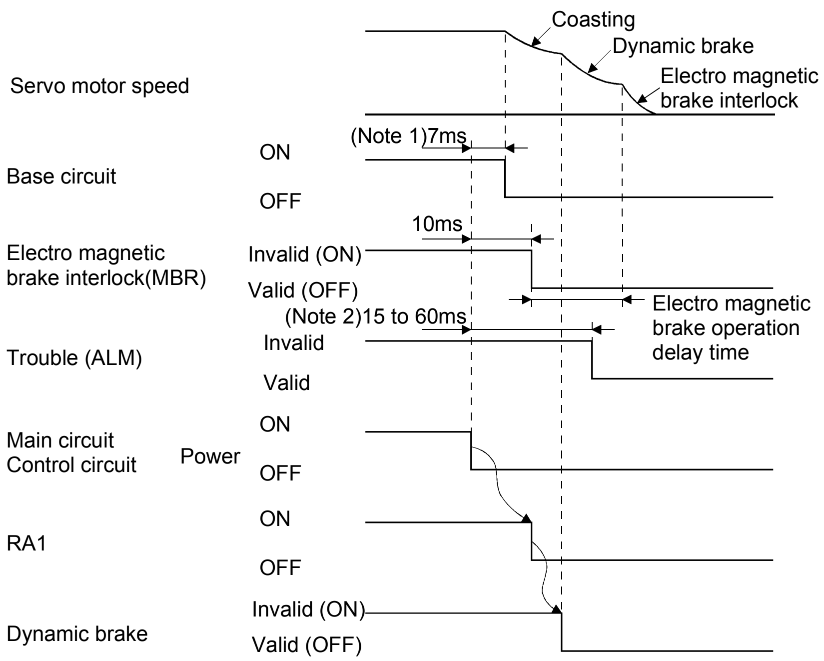
Dynamic brake	Power supply voltage
DBU-11K-4 DBU-22K-4	1-phase 380 to 463VAC 50Hz/60Hz



a. Timing chart at alarm occurrence



b. Timing chart at Emergency stop (EMG) validity



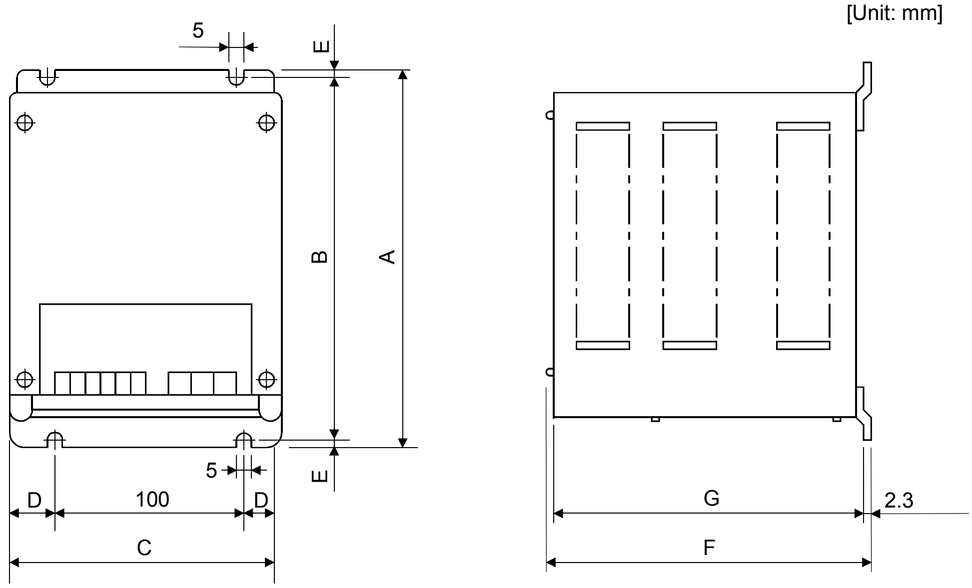
Note 1. When powering OFF,the RA1 of external dynamic brake circuit will be turned OFF, and the base circuit is turned OFF earlier than usual before an output shortage occurs.
(Only when assigning the DB as the output signal in the parameter No. PD13 to PD18.)
2. Variable according to the operation status.

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])

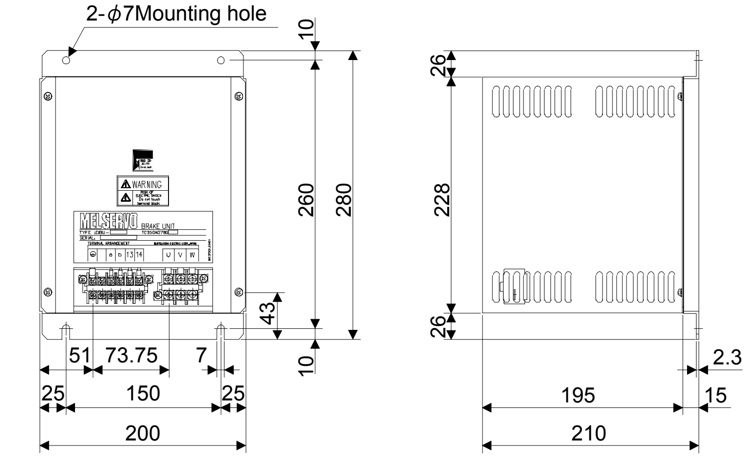
U	V	W

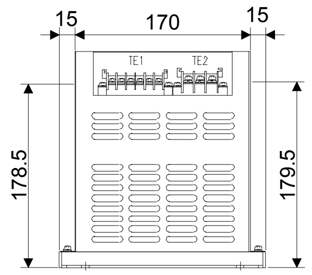
Screw : M4

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}]
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

(b) DBU-11K-4・DBU-22K-4





Mass: 6.7[kg]

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

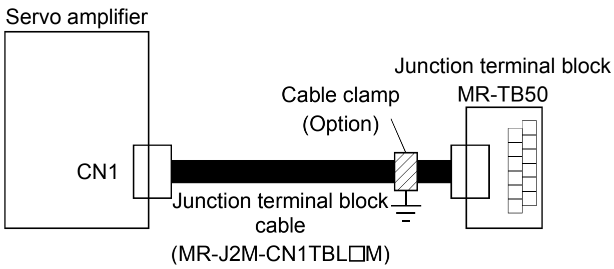
Tightening torque: 1.2[N•m](10.6[lb•in])

Dynamic brake	Wire [mm^2]	
	a・b	U・V・W
DBU-11K	2	5.5
DBU-15K, 22K	2	5.5

12.7 Junction terminal block MR-TB50

(1) How to use the junction terminal block

Always use the junction terminal block (MR-TB50) with the junction terminal block cable (MR-J2M-CN1TBL □ M) as a set. A connection example is shown below:



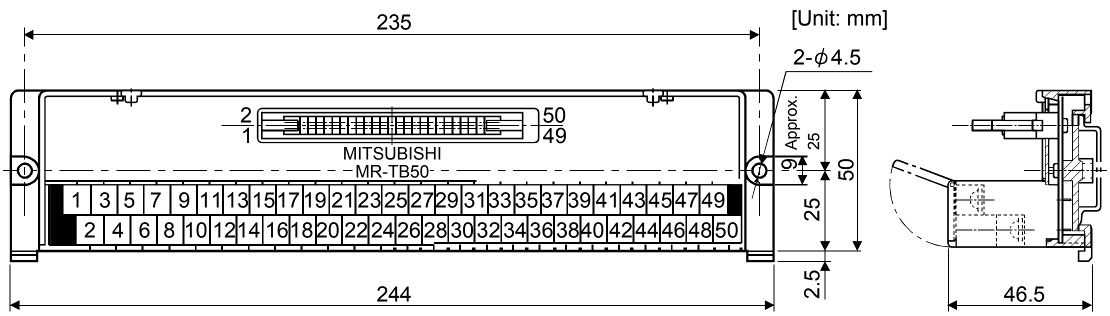
Ground the junction terminal block cable on the junction terminal block side with the standard accessory cable clamp fitting (AERSBAN-ESET). For the use of the cable clamp fitting, refer to section 12.17, (2)(c).

(2) Terminal labels

Use the following junction terminal block labels. This label is supplied with the junction terminal block cable MR-J2M-CN1TBL.

P15R	LG	LAR	LBR	LZR	PG		SON	PC	RES	DI_COM	ZSP	TLC	TLA			OP	NP			CR	LSP	LOP	DO_COM	RD
VC	LA	LB	LZ	PP	OPC		LOP	TL	DI_COM	INP	INP		LG	LG		LG	NG			EMG	LSN	DO_COM	ALM	SD

(3) Outline drawing



Terminal screw: M3.5
Applicable cable: $2mm^2$
Crimping terminal width: 7.2mm or less.

(4) Junction terminal block cable MR-J2M-CN1TBL□M

(a) Model explanation

Model: MR-J2M-CN1TBL□M

Symbol	Cable length[m]
05	0.5
1	1

(b) Connection diagram

PCR-S50FS(Servo amplifier side) JE1S-501(Junction terminal side)

Signal Symbols Position	Speed	Torque	Pin No.	Pin No.
P15R	P15R	P15R	1	1
	VC	VLA	2	2
LG	LG	LG	3	3
LA	LA	LA	4	4
LAR	LAR	LAR	5	5
LB	LB	LB	6	6
LBR	LBR	LBR	7	7
LZ	LZ	LZ	8	8
LZR	LZR	LZR	9	9
PP			10	10
PG			11	11
OPC			12	12
			13	13
			14	14
SON	SON	SON	15	15
LOP	SP2	SP2	16	16
PC	ST1	RS2	17	17
TL	ST2	RS1	18	18
RES	RES	RES	19	19
DICOM	DICOM	DICOM	20	20
DICOM	DICOM	DICOM	21	21
INP	SA		22	22
ZSP	ZSP	ZSP	23	23
INP	SA		24	24
TLC	TLC	TLC	25	25
			26	26
TLA	TLA	TC	27	27
LG	LG	LG	28	28
			29	29
LG	LG	LG	30	30
			31	31
			32	32
OP	OP	OP	33	33
LG	LG	LG	34	34
NP			35	35
NG			36	36
			37	37
			38	38
			39	39
			40	40
CR	SP1	SP1	41	41
EMG	EMG	EMG	42	42
LSP	LSP		43	43
LSN	LSN		44	44
LOP	LOP	LOP	45	45
DOCOM	DOCOM	DOCOM	46	46
DOCOM	DOCOM	DOCOM	47	47
ALM	ALM	ALM	48	48
RD	RD	RD	49	49
			50	50
SD	SD	SD	Plate	

12.8 MR Configurator

The MR Configurator (MRZJW3-SETUP211E) 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
Baud rate [bps]	115200, 57600, 38400, 19200, 9600
Monitor	Display, high speed monitor, trend graph Minimum resolution changes with the processing speed of the personal computer.
Alarm	Display, history, amplifier data
Diagnostic	Digital I/O, no motor rotation, total power-on time, amplifier version info, motor information, tuning data, absolute encoder data, automatic voltage control, Axis name setting.
Parameters	Parameter list, turning, change list, detailed information
Test operation	Jog operation, positioning operation, motor-less operation, Do forced output, program operation.
Advanced function	Machine analyzer, gain search, machine simulation.
File operation	Data read, save, print
Others	Automatic demo, help display

(2) System configuration

(a) Components

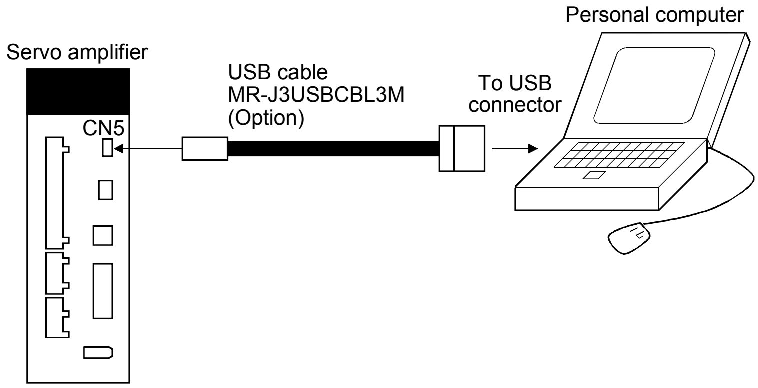
To use this software, the following components are required in addition to the servo amplifier and servo motor:

Model	Description
(Note 2) Personal computer	IBM PC-AT compatible where the English version of Windows® 98, Windows® Me, Windows® 2000 Professional, Windows® XP Professional and Windows® XP Home Edition 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) Memory: 24MB or more (Windows® 98) 32MB or more (Windows® Me, Windows® 2000 Professional) 128MB or more (Windows® XP Professional, Windows® XP Home Edition) Free hard disk space: 130MB or more
OS	Windows® 98, Windows® Me, Windows® 2000 Professional, Windows® XP Professional, Windows® XP Home Edition (English version)
Display	One whose resolution is 800×600 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
RS-422/232C conversion cable	DSV-CABV (Diatrend) is recommended.
RS-422/232C converter	FA-T-RS40VS (Mitsubishi Electric Engineering) is recommended. Required for use of the multidrop communication function.

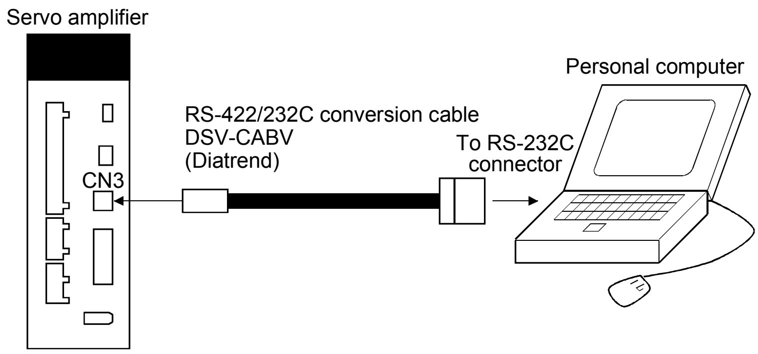
Note 1. Windows is the registered trademarks of Microsoft Corporation in the United State and other countries.
Pentium is the registered trademarks of Intel Corporation.
2. On some personal computers, this software may not run properly.

(b) Connection with servo amplifier

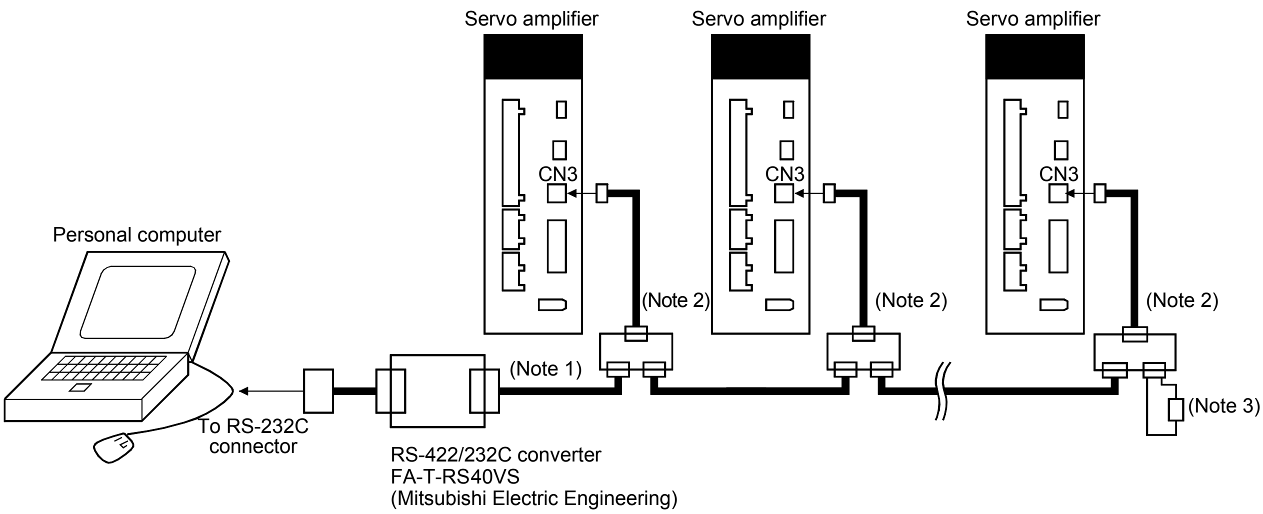
1) For use of USB



2) For use of RS-422



3) For use of RS-422 to make multidrop connection



Note 1. Refer to section 13.1 for cable wiring.

2. The BMJ-8 (Hakko Electric Machine Works) is recommended as the branch connector.

3. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No.6) on the receiving side (servo amplifier) with a 150Ω resistor.

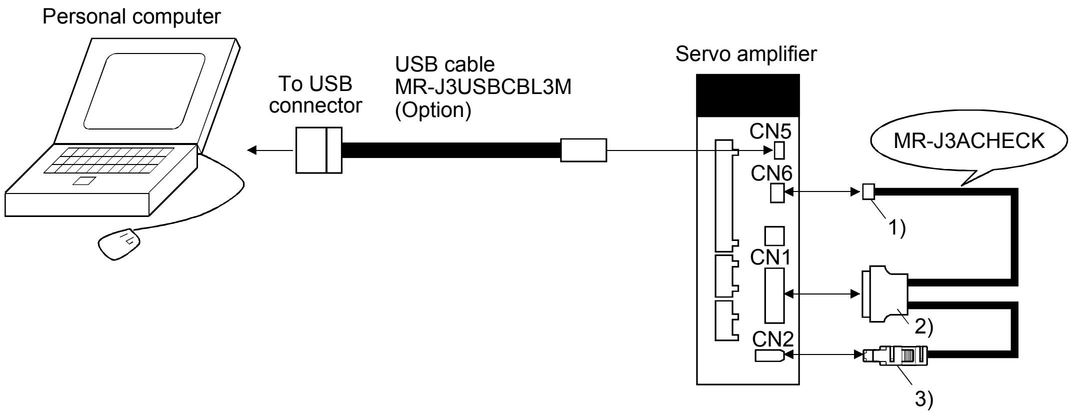
(c) To diagnose the trouble using diagnosis cable (MR-J3ACHECK)

POINT
· The amplifier diagnosis function can be used with the following software versions of the servo amplifier. Servo amplifier: A1 or later · Do not turn the power on with all connectors connected. Do not connect or disconnect connectors after the power is turned on. Otherwise failure will be caused.

This cable is a diagnosis cable of the servo amplifier. The amplifier diagnosis function of MR Configurator can be used when this cable is used.

Cable Model	Application
MR-J3ACHECK	Amplifier diagnosis cable for MR Configurator.

Connection between the servo amplifier and servo motor is shown in the figure below.



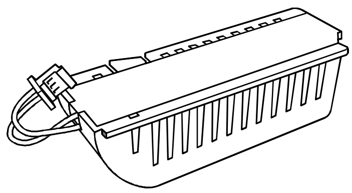
Cable Model	1) For CN6 Connector	2) For CN1 Connector	3) For CN2 Connector
MR-J3ACHECK	Housing: 51004-0300 Contact: 50011-8000 (Molex)	Plug: 10150-3000VE Shell kit: 10350-52F0-008 (3M)	Receptacle: 36210-0100JE Shell kit: 36310-3200-008 (3M or equivalent)

12.9 Battery unit MR-J3BAT

POINT
· The revision (Edition 44) of the Dangerous Goods Rule of the International Air Transport Association (IATA) went into effect on January 1, 2003 and was enforced immediately. In this rule, "provisions of the lithium and lithium ion batteries" were revised to tighten the restrictions on the air transportation of batteries. However, since this battery is non-dangerous goods (non-Class 9), air transportation of 24 or less batteries is outside the range of the restrictions. Air transportation of more than 24 batteries requires packing compliant with the Packing Standard 903. When a self-certificate is necessary for battery safety tests, contact our branch or representative. For more information, consult our branch or representative. (As of Jul, 2007).

(1) Purpose of use for MR-J3BAT

This battery is used to construct an absolute position detection system. Refer to section 14.3 for the fitting method, etc.

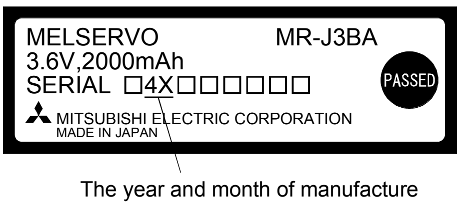


(2) Year and month when MR-J3BAT is manufactured

The year and month when MR-J3BAT is manufactured are written down in Serial No. on the name 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 □□□□□□".

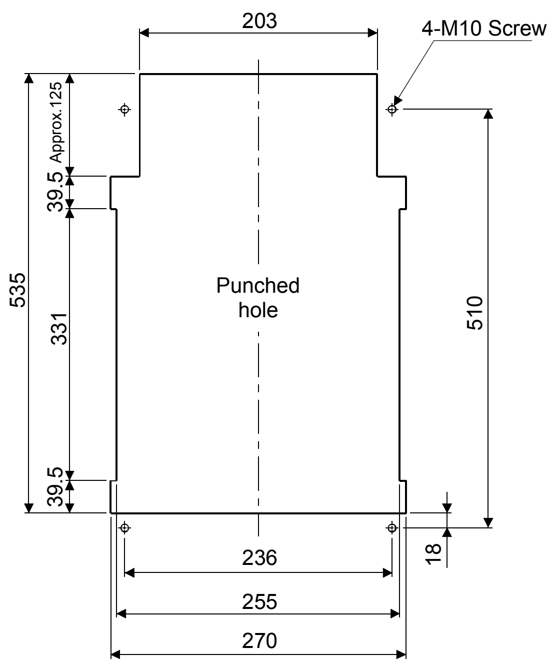


12.10 Heat sink outside mounting attachment (MR-J3ACN)

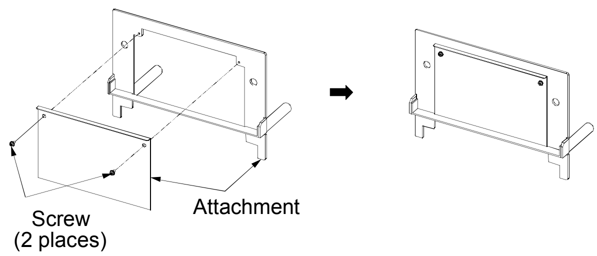
Use the heat sink outside mounting attachment to mount the heat generation area of the servo amplifier in the outside of the control box to dissipate servo amplifier-generated heat to the outside of the box and reduce the amount of heat generated in the box, thereby allowing a compact control box to be designed.
In the control box, 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 control box.
The environment outside the control box when using the heat sink outside mounting attachment should be within the range of the servo amplifier operating environment conditions.
The heat sink outside mounting attachment of MR-J3ACN can be used for MR-J3-11KA(4) to MR-J3-22KA(4).

(1) Panel cut dimensions

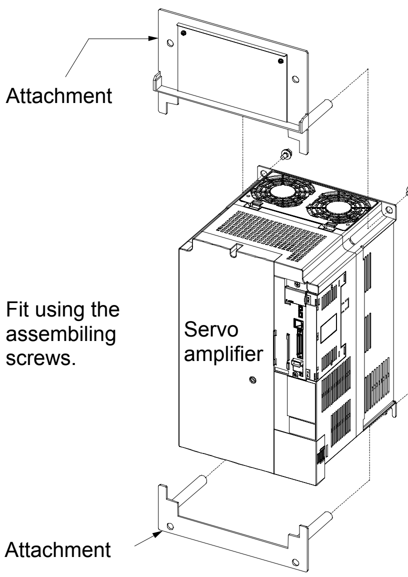
[Unit : mm]

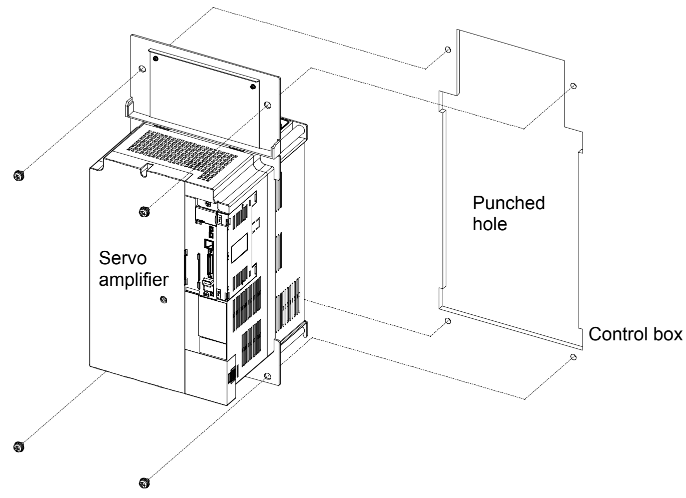


(2) How to assemble the attachment for a heat sink outside mounting attachment



(3) Fitting method

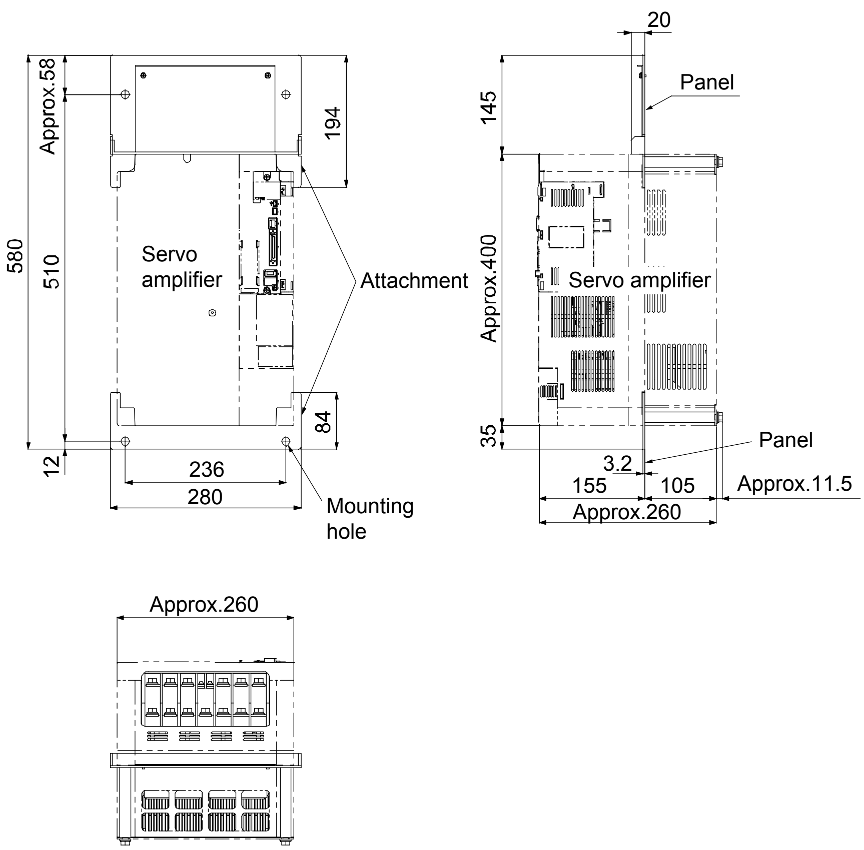




a. Assembling the heat sink outside mounting attachment

b. Installation to the control box

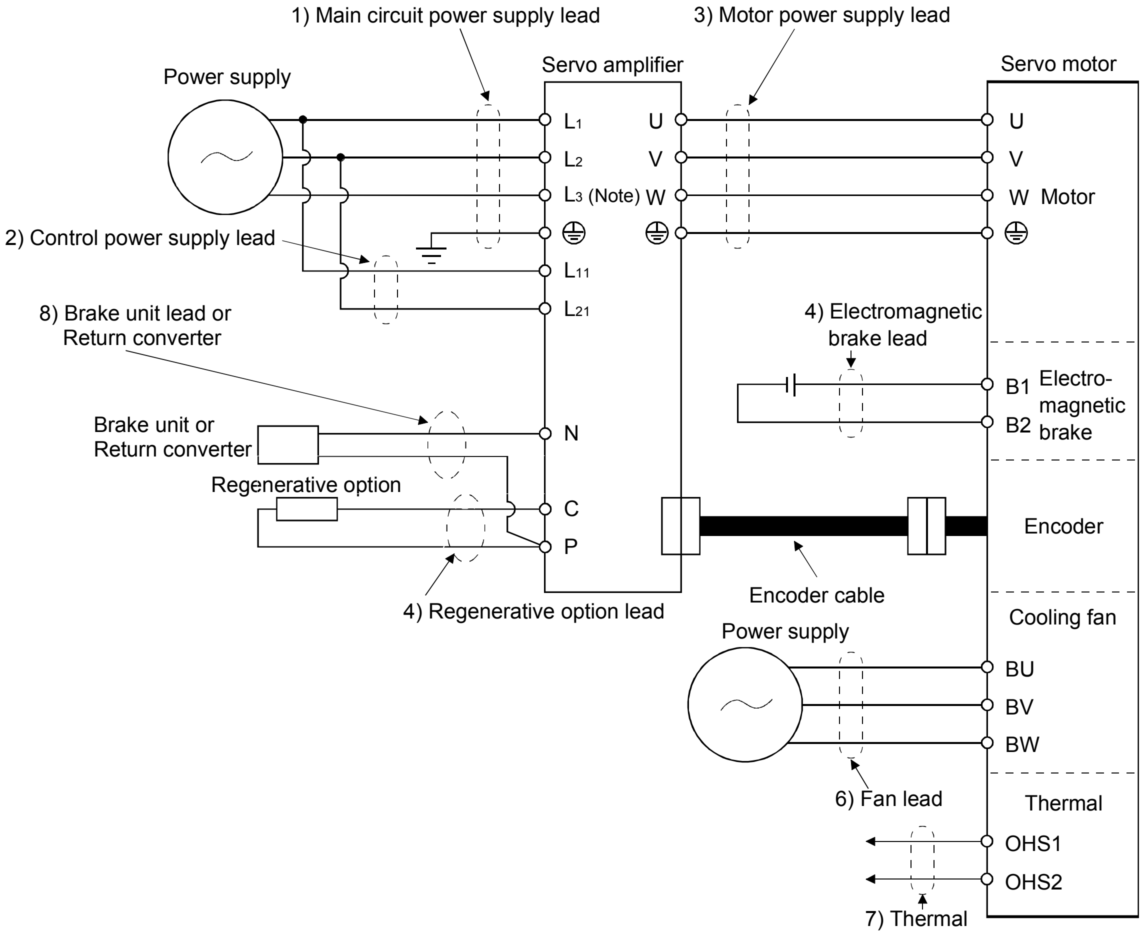
(4) Outline dimension drawing



12.11 Recommended wires

(1) Wires for power supply wiring

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.

The following table lists wire sizes. The wires used assume that they are 600V vinyl wires and the wiring distance is 30m or less. If the wiring distance is over 30m, choose the wire size in consideration of voltage drop.

To comply with the UL/C-UL (CSA) Standard, use UL-recognized copper wires rated at 60℃ (140°F) or more for wiring.

Table 12.1 Recommended wires

Servo amplifer	Wires [mm^2]						
	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-J3-10A(1)	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)	1.25(AWG16)		
MR-J3-20A(1)							
MR-J3-40A(1)							
MR-J3-60A							
MR-J3-70A							
MR-J3-100A			2(AWG14)				
MR-J3-200A							
MR-J3-350A	3.5(AWG12)		3.5(AWG12)				
MR-J3-500A (Note 2)	5.5(AWG10): a (Note 1)	1.25(AWG16): h	5.5(AWG10): a (Note 1)	2(AWG14): g			
MR-J3-700A (Note 2)	8(AWG8): b (Note 1)		8(AWG8): b (Note 1)	3.5(AWG12): a		2(AWG14) (Note 3)	1.25(AWG16) (Note 3)
MR-J3-11KA (Note 2)	14(AWG6): c	1.25(AWG16): g	22(AWG4): d	5.5(AWG10): j		2(AWG14)	1.25(AWG16)
MR-J3-15KA (Note 2)	22(AWG4): d		30(AWG2): e				
MR-J3-22KA (Note 2)	50(AWG1/0): f		60(AWG2/0): f	5.5(AWG10): k			
MR-J3-60A4	2(AWG14)	1.25(AWG16)	1.25(AWG16)	2(AWG14)			
MR-J3-100A4							
MR-J3-200A4			2(AWG14)				
MR-J3-350A4	2(AWG14): g	1.25(AWG16): h	2(AWG14): g	2(AWG14): g			
MR-J3-500A4 (Note 2)	5.5(AWG10): a		5.5(AWG10): a				
MR-J3-700A4 (Note 2)						2(AWG14) (Note 3)	1.25(AWG16) (Note 3)
MR-J3-11KA4 (Note 2)	8(AWG8): l	1.25(AWG16): g	8(AWG8): l	3.5(AWG12): j		2(AWG14)	1.25(AWG16)
MR-J3-15KA4 (Note 2)	14(AWG6): c		22(AWG4): d	5.5(AWG10): j			
MR-J3-22KA4 (Note 2)	14(AWG6): m		22(AWG4): n	5.5(AWG10): k			

Note 1. For crimping terminals and applicable tools, refer to Table 12.2.

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.

Use wires 8) of the following sizes with the brake unit (FR-BU) and power regeneration converter (FR-RC).

Model	Wires[mm^2]
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)

Table 12.2 Recommended crimping terminals

Symbol	Servo amplifier side crimping terminals				
	(Note 2) Crimping terminal	Applicable tool			Manufacturer
		Body	Head	Dice	
a	FVD5.5-4	YNT-1210S			Japan Solderless Terminal
(Note 1)b	8-4NS	YHT-8S			
c	FVD14-6	YF-1・E-4	YNE-38	DH-112・DH122	
d	FVD22-6			DH-113・DH123	
(Note 1)e	38-6	YPT-60-21		TD-112・TD-124	
		YF-1・E-4	YET-60-1		
(Note 1)f	R60-8	YPT-60-21		TD-113・TD-125	
		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-111・DH121	
m	FVD14-8			DH-112・DH122	
n	FVD22-8			DH-113・DH123	

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.

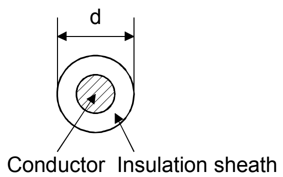
(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent:

Table 12.3 Wires for option cables

Type	Model	Length [m]	Core size [mm^2]	Number of Cores	Characteristics of one core			(Note 3) 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 MR-J3ENCBL□M-A2-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-A1-H MR-J3ENCBL□M-A2-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-J3JCBL03M-A1-L MR-J3JCBL03M-A2-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-EKCBL□M-L	2 to 10	0.3mm^2	4 (2 pairs)	12/0.18	65.7 or less	1.3	7.3	(Note 3) 20276 composite 4-pair shielded cable (A-TYPE)
			0.08mm^2	4 (2 pairs)	7/0.127	234 or less	0.67		
		20・30	0.3mm^2	12 (6 pairs)	12/0.18	63.6 or less	1.2	8.2	UL20276 AWG#23 6pair(BLACK)
	MR-EKCBL□M-H	20	0.2mm^2	12 (6 pairs)	40/0.08	105 or less	0.88	7.2	(Note 3) A14B2343 6P
		30 to 50	0.2mm^2	14 (7 pairs)	40/0.08	105 or less	0.88	8.0	(Note 3) J14B0238(0.2*7P)
	MR-J3ENSCBL□M-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 (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	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 (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
Motor power supply cable	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	2 to 10 2 to 10 2 to 10 2 to 10 0.3 0.3	(Note 6) AWG19	4	50/0.08	25.40 or less	1.8	5.7±0.3	(Note 4) UL Style 2103 AWG19 4 cores
Motor brake cable	MR-BKS1CBL□M-A1-L MR-BKS1CBL□M-A2-L MR-BKS1CBL□M-A1-H MR-BKS1CBL□M-A2-H MR-BKS2CBL03M-A1-L MR-BKS2CBL03M-A2-L	2 to 10 2 to 10 2 to 10 2 to 10 0.3 0.3	(Note 6) AWG20	2	100/0.08	38.14 or less	1.3	4.0±0.3	(Note 4) UL Style 2103 AWG20 2 cores

Note 1. d is as shown below:



2. Purchased from Toa Electric Industry
3. Standard OD. Max. OD is about 10% greater.
4. Kurabe
5. Taiyo Electric Wire and Cable
6. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.

12.12 No-fuse breakers, fuses, magnetic contactors

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

Servo amplifier	No-fuse breaker		Fuse			Magnetic contactor
	Not using power factor improving reactor	Using power factor improving reactor	(Note) Class	Current [A]	Voltage AC [V]	
MR-J3-10A (1)	30A frame 5A	30A frame 5A	K5	10	250	S-N10
MR-J3-20A	30A frame 5A	30A frame 5A	K5	10		
MR-J3-20A1	30A frame 10A	30A frame 10A	K5	15		
MR-J3-40A	30A frame 10A	30A frame 5A	K5	15		
MR-J3-60A・70A・100A・40A1	30A frame 15A	30A frame 10A	K5	20		
MR-J3-200A	30A frame 20A	30A frame 15A	K5	40		S-N18
MR-J3-350A	30A frame 30A	30A frame 30A	K5	70		S-N20
MR-J3-500A	50A frame 50A	50A frame 40A	K5	125		S-N35
MR-J3-700A	100A frame 75A	50A frame 50A	K5	150		S-N50
MR-J3-11KA	100A frame 100A	100A frame 75A	K5	200		S-N65
MR-J3-15KA	225A frame 125A	100A frame 100A	K5	250		S-N95
MR-J3-22KA	225A frame 175A	225A frame 150A	K5	350		S-N125
MR-J3-60A4	30A frame 5A	30A frame 5A	K5	10	600	S-N10
MR-J3-100A4	30A frame 10A	30A frame 10A	K5	15		
MR-J3-200A4	30A frame 15A	30A frame 15A	K5	25		
MR-J3-350A4	30A frame 20A	30A frame 20A	K5	35		
MR-J3-500A4	30A frame 30A	30A frame 30A	K5	50		S-N18
MR-J3-700A4	50A frame 40A	50A frame 30A	K5	65		S-N20
MR-J3-11KA4	60A frame 60A	50A frame 50A	K5	100		S-N25
MR-J3-15KA4	100A frame 75A	60A frame 60A	K5	150		S-N35
MR-J3-22KA4	225A frame 125A	100A frame 100A	K5	175		S-N65

Note. This servo amplifier is UL/C-UL-listed when using a Class T fuse. Therefore, when using the servo amplifier as a UL/C-UL Standard compliant product, be sure to use the Class T fuse.

12.13 Power factor improving DC reactor

POINT
・For the 100VAC power supply type (MR-J3-□A1), 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%.
It is also effective to reduce the input side harmonics.
When connecting the power factor improving DC reactor to the servo amplifier, always disconnect the wiring across P_1-P_2 (For 11kW or more, disconnect the wiring across P-P_1). 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.

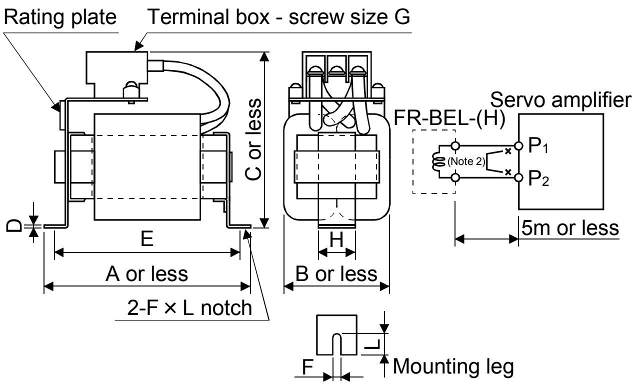


Fig. 12.1

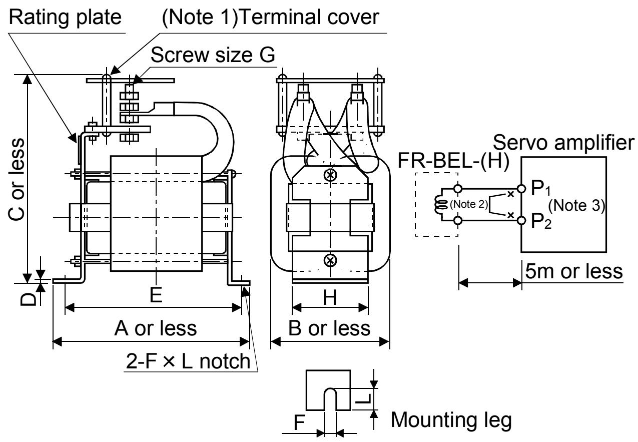


Fig. 12.2

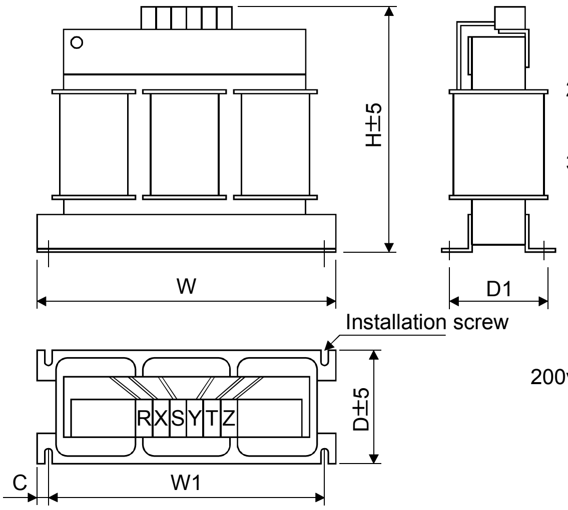
Note 1. Since the terminal cover is supplied, attach it after connecting a wire.
2. When using DC reactor, disconnect the wiring across P_1-P_2.
3. When over 11kW, "P_2" becomes "P", respectively.

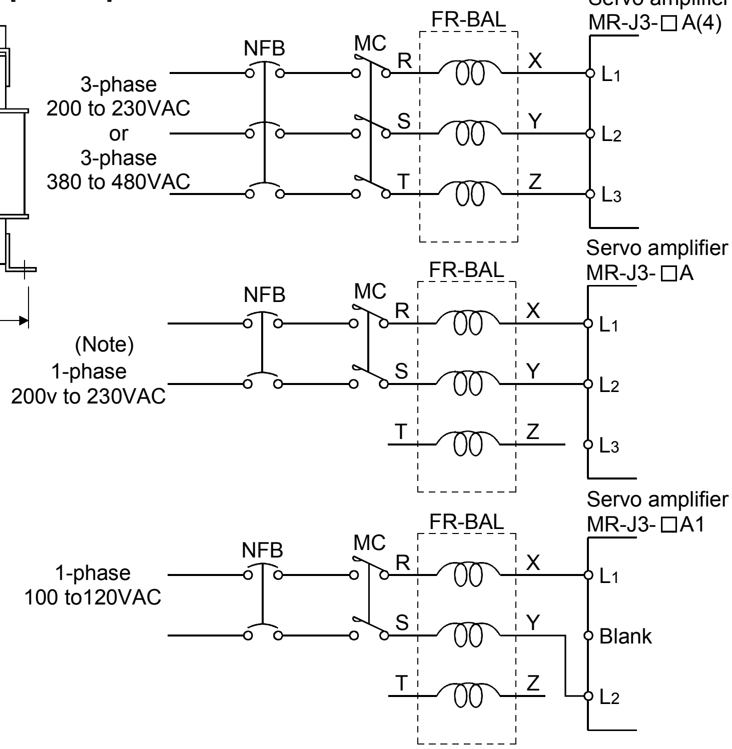
Servo Amplifier	Power Factor Improving DC Reactor	Outline drawing	Dimensions [mm] A	B	C	D	E	F	L	G	H	Mounting Screw Size	Mass [kg(lb)]	Used Power Supply [mm²]
MR-J3-10A・20A	FR-BEL-0.4K		110	50	94	1.6	95	6	12	M3.5	25	M5	0.5(1.10)	
MR-J3-40A	FR-BEL-0.75K		120	53	102	1.6	105	6	12	M4	25	M5	0.7(1.54)	
MR-J3-60A・70A	FR-BEL-1.5K		130	65	110	1.6	115	6	12	M4	30	M5	1.1(2.43)	2(AWG14)
MR-J3-100A	FR-BEL-2.2K	Fug. 12.1	130	65	110	1.6	115	6	12	M4	30	M5	1.2(2.65)	
MR-J3-200A	FR-BEL-3.7K		150	75	102	2.0	135	6	12	M4	40	M5	1.7(3.75)	
MR-J3-350A	FR-BEL-7.5K		150	75	126	2.0	135	6	12	M5	40	M5	2.3(5.07)	3.5(AWG12)
MR-J3-500A	FR-BEL-11K		170	93	132	2.3	155	6	14	M5	50	M5	3.1(6.83)	5.5(AWG10)
MR-J3-700A	FR-BEL-15K		170	93	170	2.3	155	6	14	M8	56	M5	3.8(8.38)	8(AWG8)
MR-J3-11KA		Fig. 12.2												22(AWG4)
MR-J3-15KA	FR-BEL-22K		185	119	182	2.6	165	7	15	M8	70	M6	5.4(11.91)	30(AWG2)
MR-J3-22KA	FR-BEL-30K		185	119	201	2.6	165	7	15	M8	70	M6	6.7(14.77)	60(AWG2/0)
MR-J3-60A4	FR-BEL-H1.5K		130	63	89	1.6	115	6	12	M3.5	32	M5	0.9(1.98)	
MR-J3-100A4	FR-BEL-H2.2K		130	63	101	1.6	115	6	12	M3.5	32	M5	1.1(2.43)	
MR-J3-200A4	FR-BEL-H3.7K	Fig. 12.1	150	75	102	2	135	6	12	M4	40	M5	1.7(3.75)	2(AWG14)
MR-J3-350A4	FR-BEL-H7.5K		150	75	124	2	135	6	12	M4	40	M5	2.3(5.07)	
MR-J3-500A4	FR-BEL-H11K		170	93	132	2.3	155	6	14	M5	50	M5	3.1(6.83)	5.5(AWG10)
MR-J3-700A4	FR-BEL-H15K		170	93	160	2.3	155	6	14	M6	56	M5	3.7(8.16)	8(AWG8)
MR-J3-11KA4														
MR-J3-15KA4	FR-BEL-H22K	Fig. 12.2	185	119	171	2.6	165	7	15	M6	70	M6	5.0(11.02)	22(AWG4)
MR-J3-22KA4	FR-BEL-H30K		185	119	189	2.6	165	7	15	M6	70	M6	6.7(14.77)	

12.14 Power factor improving reactors

The power factor improving 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%.
In addition, it reduces the higher harmonic of input side.
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 200V to 230V 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-J3-10A・20A・10A1	FR-BAL-0.4K	135	120	115	59	$45^{0}_{-2.5}$	7.5	M4	M3.5	2.0 (4.41)
MR-J3-40A・20A1	FR-BAL-0.75K	135	120	115	69	$57^{0}_{-2.5}$	7.5	M4	M3.5	2.8 (6.17)
MR-J3-60A・70A・40A1	FR-BAL-1.5K	160	145	140	71	$55^{0}_{-2.5}$	7.5	M4	M3.5	3.7 (8.16)
MR-J3-100A	FR-BAL-2.2K	160	145	140	91	$75^{0}_{-2.5}$	7.5	M4	M3.5	5.6 (12.35)
MR-J3-200A	FR-BAL-3.7K	220	200	192	90	$70^{0}_{-2.5}$	10	M5	M4	8.5 (18.74)
MR-J3-350A	FR-BAL-7.5K	220	200	194	120	$100^{0}_{-2.5}$	10	M5	M5	14.5 (31.97)
MR-J3-500A	FR-BAL-11K	280	255	220	135	$100^{0}_{-2.5}$	12.5	M6	M6	19 (41.89)
MR-J3-700A MR-J3-11KA	FR-BAL-15K	295	270	275	133	$110^{0}_{-2.5}$	12.5	M6	M6	27 (59.53)
MR-J3-15KA	FR-BAL-22K	290	240	301	199	170 ± 5	25	M8	M8	35 (77.16)
MR-J3-22KA	FR-BAL-30K	290	240	301	219	190 ± 5	25	M8	M8	43 (94.80)
MR-J3-60A4	FR-BAL-H1.5K	160	145	140	87	$70^{0}_{-2.5}$	7.5	M4	M3.5	5.3 (11.68)
MR-J3-100A4	FR-BAL-H2.2K	160	145	140	91	$75^{0}_{-2.5}$	7.5	M4	M3.5	5.9 (13.01)
MR-J3-200A4	FR-BAL-H3.7K	220	200	190	90	$70^{0}_{-2.5}$	10	M5	M3.5	8.5 (18.74)
MR-J3-350A4	FR-BAL-H7.5K	220	200	192	120	100 ± 5	10	M5	M4	14 (30.87)
MR-J3-500A4	FR-BAL-H11K	280	255	226	130	100 ± 5	12.5	M6	M5	18.5 (40.79)
MR-J3-700A4 MR-J3-11KA4	FR-BAL-H15K	295	270	244	130	110 ± 5	12.5	M6	M5	27 (59.53)
MR-J3-15KA4	FR-BAL-H22K	290	240	269	199	170 ± 5	25	M8	M8	Approx.35 (Approx.77.16)
MR-J3-22KA4	FR-BAL-H30K	290	240	290	219	190 ± 5	25	M8	M8	Approx.43 (Approx.94.80)

12.15 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 40mA or less (Ex.) Omron : type MY

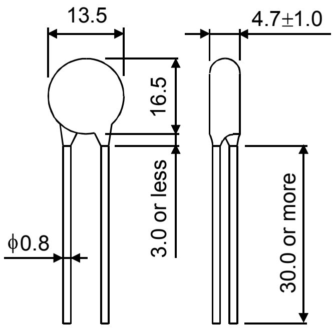
12.16 Surge absorbers (recommended)

A surge absorber is required for the electromagnetic brake. Use the following surge absorber or equivalent. When using the surge absorber, perform insulation beforehand to prevent short-circuit.

Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1mA
Permissible circuit voltage		Surge immunity	Energy immunity	Rated power				
AC [Vma]	DC [V]	[A]	[J]	[W]	[A]	[V]	[pF]	[V]
140	180	(Note) 500/time	5	0.4	25	360	300	220 (198 to 242)

Note. 1 time = 8 × 20μs

(Example) ERZV10D221 (Matsushita Electric Industry)
TNR-10V221K (Nippon chemi-con)
Outline drawing [mm] ([in]) (ERZ-C10DK221)



12.17 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

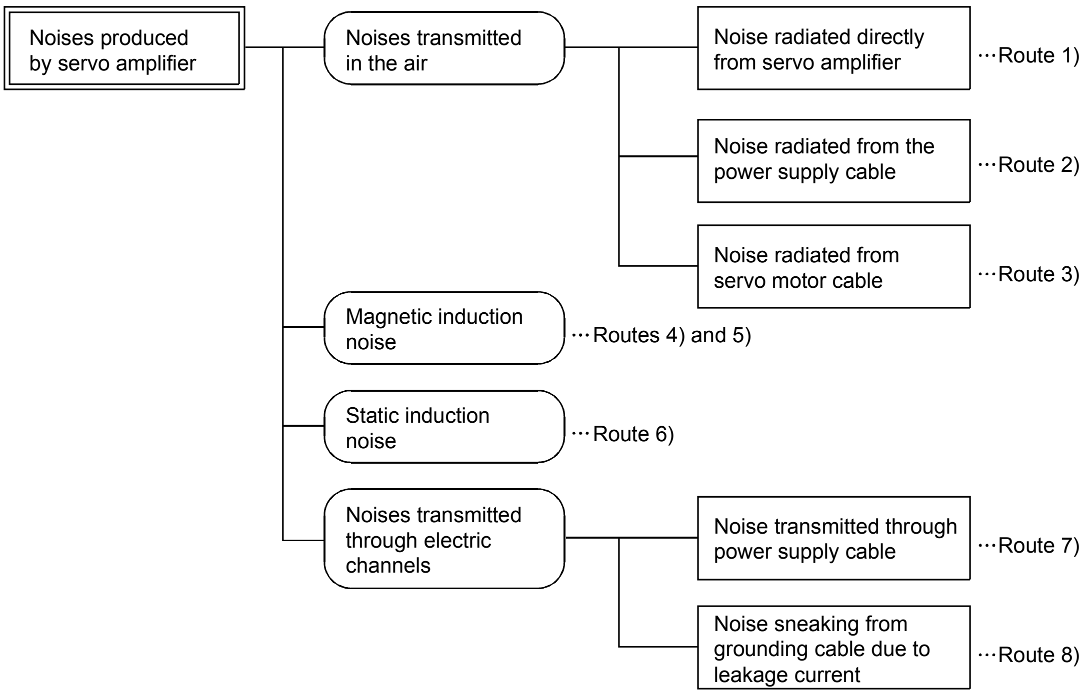
- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the servo amplifier, servo motor, etc. together at one point (refer to section 3.12).

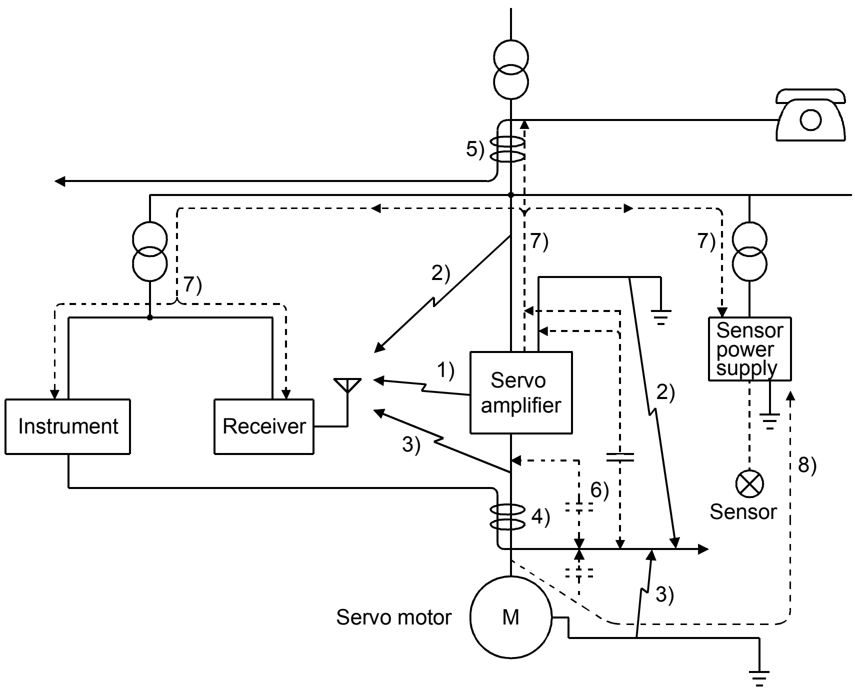
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

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.

(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 control box together with the servo amplifier or run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The following techniques are required. 1. Provide maximum clearance between easily affected devices and the servo amplifier. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier. 3. Avoid laying the power lines (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・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.

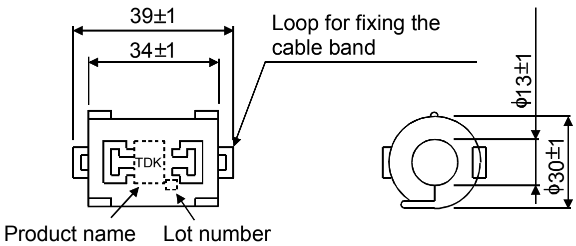
For example, the ZCAT3035-1330 of TDK and the ESD-SR-25 of NEC TOKIN make are available as data line filters.

As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below.

This impedances is reference values and not guaranteed values.

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

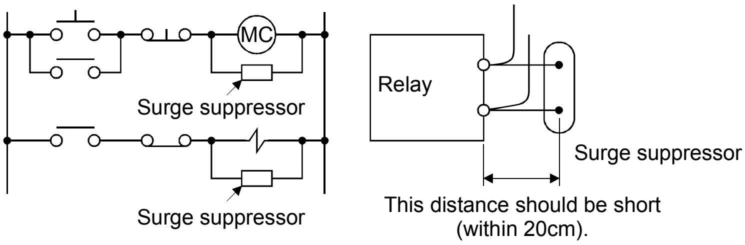
[Unit: mm]



Outline drawing (ZCAT3035-1330)

(b) Surge suppressor

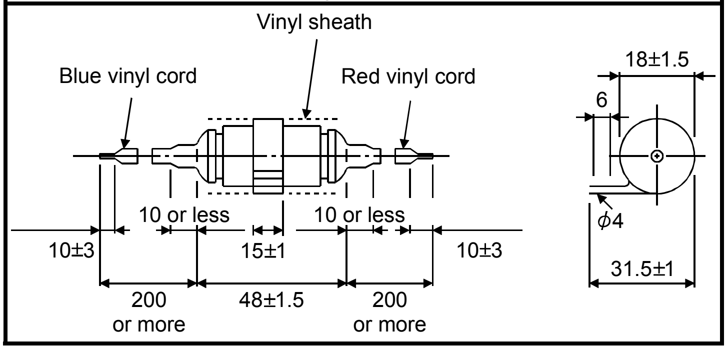
The recommended surge suppressor for installation to an AC relay, AC valve, AC electromagnetic brake or the like near the servo amplifier is shown below. Use this product or equivalent.



(Ex.) 972A.2003 50411
(Matsuo Electric Co.,Ltd.—200VAC rating)

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

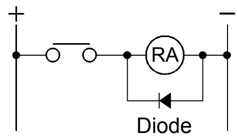
Outline drawing [Unit: mm] ([Unit: in.])



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

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

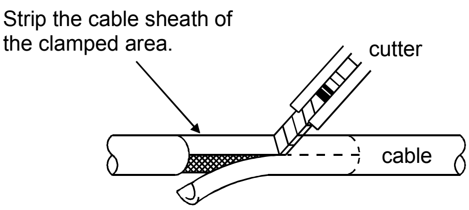
Maximum current: Not less than twice the drive current of the relay or the like

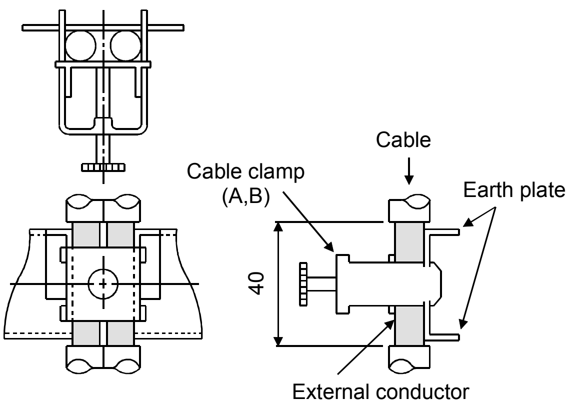


(c) Cable clamp fitting (AERSBAN-☐SET)

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.



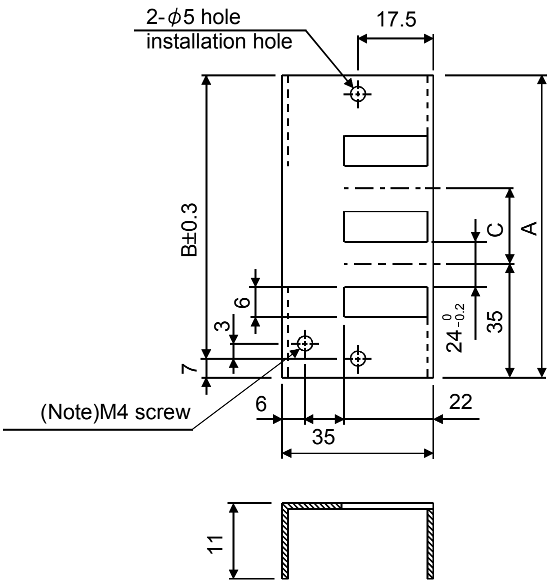


Clamp section diagram

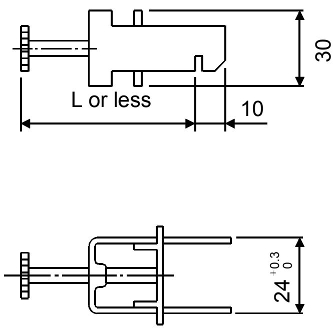
・Outline drawing

[Unit: mm]

Earth plate



Clamp section diagram



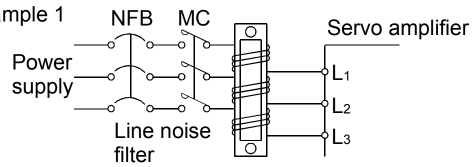
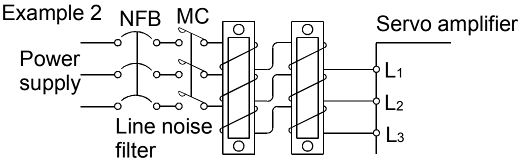
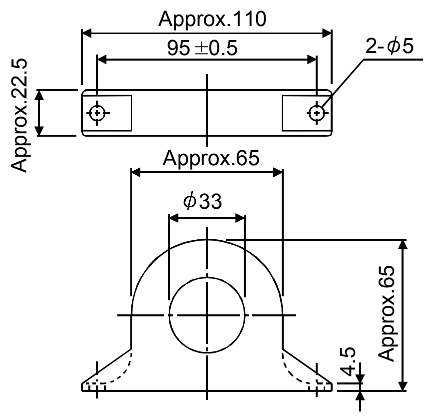
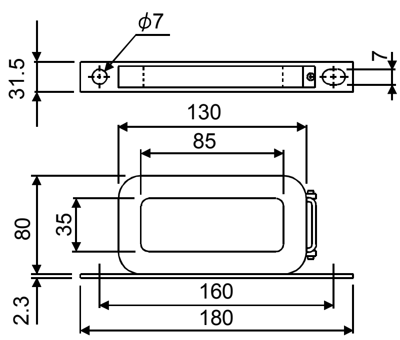
Note. Screw hole for grounding. Connect it to the earth plate of the control box.

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

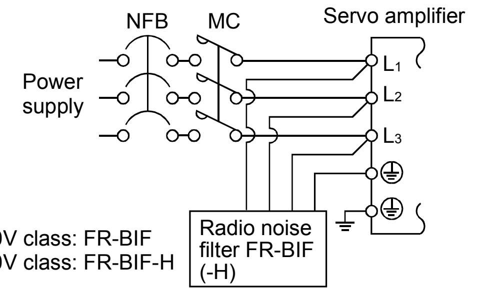
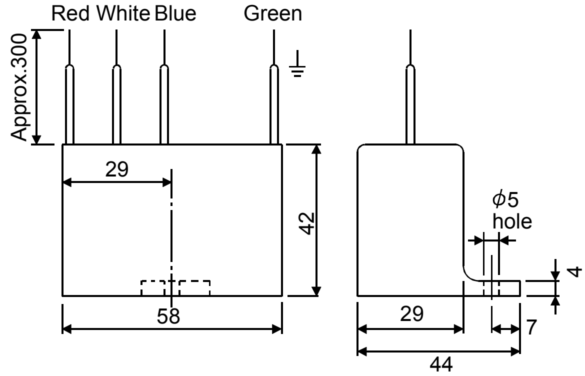
(d) Line noise filter (FR-BSF01, FR-BLF)

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

Connection diagram	Outline drawing [Unit: mm]
Wind the 3-phase wires by the equal number of times in the same direction, and connect the filter to the power supply side and output side of the servo amplifier. The effect of the filter on the power supply side is higher as the number of winds is larger. The number of turns is generally four. If the wires are too thick to be wound, use two or more filters and make the total number of turns as mentioned above. On the output side, the number of turns must be four or less. Do not wind the grounding wire together with the 3-phase wires. The filter effect will decrease. Use a separate wire for grounding. Example 1  (Number of turns: 4) Example 2  Two filters are used (Total number of turns: 4)	FR-BSF01 (for MR-J3-200A or less)  FR-BLF(MR-J3-350A or more) 

(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 is designed for the input only.

Connection diagram	Outline drawing (Unit: mm)
Make the connection cables as short as possible. Grounding is always required. When using the FR-BIF(-H) with a single-phase wire, always insulate the wires that are not used for wiring.  200V class: FR-BIF 400V class: FR-BIF-H	Leakage current: 4mA 

12.18 Leakage current breaker

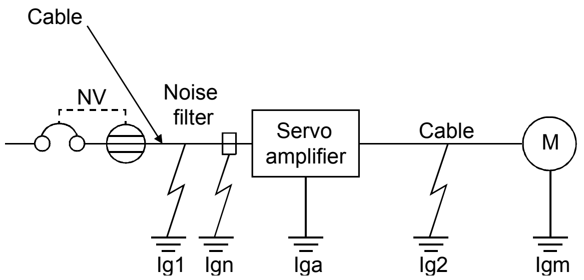
(1) Selection method

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

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

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

Rated sensitivity current $\geq$ 10 · {Ig1+Ign+Iga+K · (Ig2+Igm)} [mA]..................(12.2)



K: Constant considering the harmonic contents

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 leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 12.1.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 12.1.)

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

Iga: Leakage current of the servo amplifier (Found from Table 12.5.)

Igm: Leakage current of the servo motor (Found from Table 12.4.)

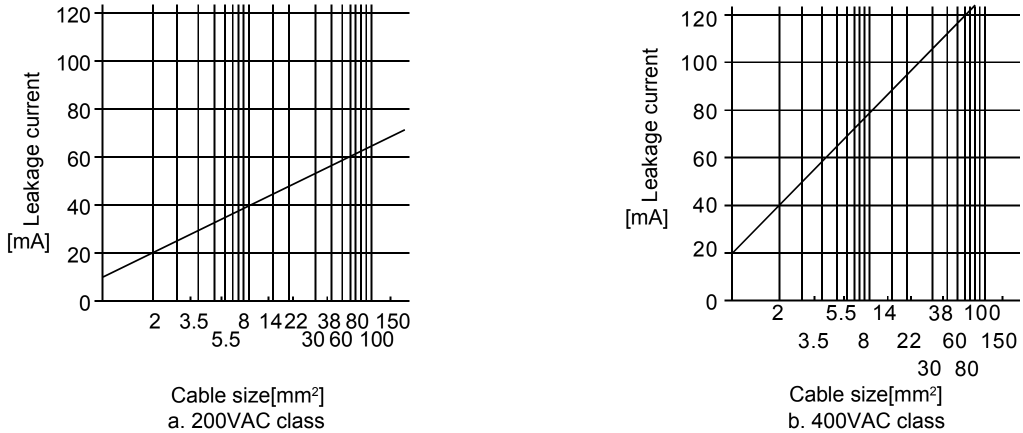


Fig. 12.1 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

Table 12.4 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 12.5 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

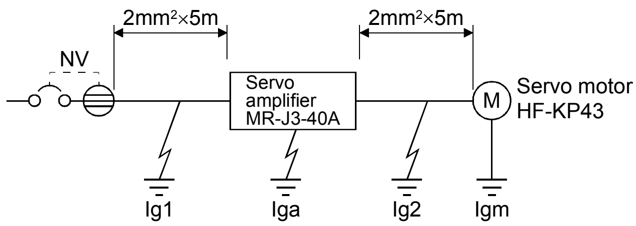
Note. For the 3.5kW of 400V class, leakage current is 2mA, which is the same as for 5kW and 7kW.

Table 12.6 Leakage circuit breaker selection example

Servo amplifier	Rated sensitivity current of leakage circuit breaker [mA]
MR-J3-10A to MR-J3-350A MR-J3-10A1 to MR-J3-40A1	15
MR-J3-500A(4)	30
MR-J3-700A(4)	50
MR-J3-11KA(4) to MR-J3-22KA(4)	100

(2) Selection example

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



Use a leakage current breaker generally available.

Find the terms of Equation (12.2) from the diagram:

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

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

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (12.2):

$$Ig \geq 10 \cdot \{0.1+0+0.1+1 \cdot (0.1+0.1)\}$$

$$\geq 4.0 \text{ [mA]}$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 4.0[mA] or more. A leakage current breaker having Ig of 15[mA] is used with the NV-SP/SW/CP/CW/HW series.

12.19 EMC filter (recommended)

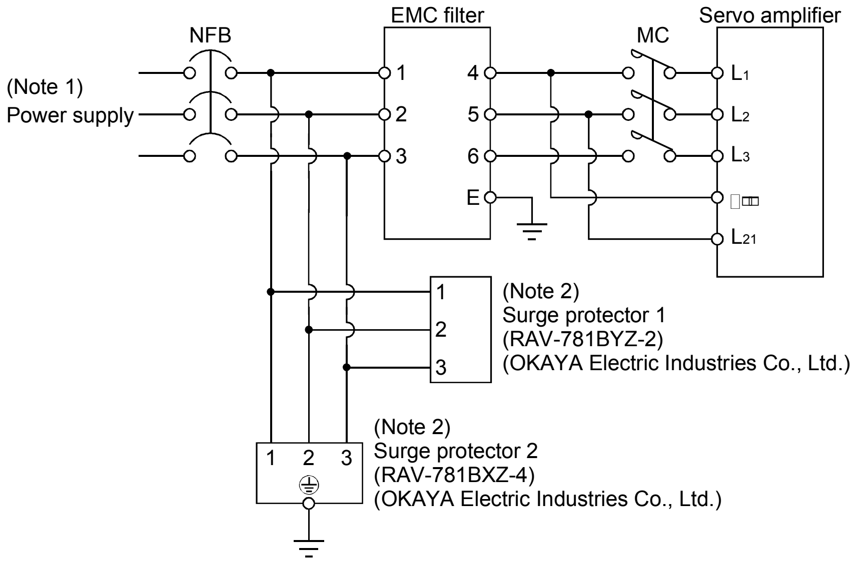
For compliance with the EMC directive of the EN Standard, it is recommended to use the following filter: Some EMC filters are large in leakage current.

(1) Combination with the servo amplifier

Servo amplifier	Recommended filter (Soshin Electric)		Mass [kg]([lb])
	Model	Leakage current [mA]	
MR-J3-10A to MR-J3-100A MR-J3-10A1 to MR-J3-40A1	(Note) HF3010A-UN	5	3 (6.61)
MR-J3-250A・MR-J3-350A	(Note) HF3030A-UN		5.5 (12.13)
MR-J3-500A・MR-J3-700A	(Note) HF3040A-UN	1.5	6.0 (13.23)
MR-J3-11KA to MR-J3-22KA	(Note) HF3100A-UN	6.5	15 (33.07)
MR-J3-60A4 to MR-J3-100A4	TF3005C-TX	5.5	6(13.23)
MR-J3-200A4・MR-J3-700A4	TF3020C-TX		
MR-J3-11KA4	TF3030C-TX		7.5(16.54)
MR-J3-15KA4	TF3040C-TX		12.5(27.56)
MR-J3-22KA4	TF3060C-TX		

Note. A surge protector is separately required to use any of these EMC filters.

(2) Connection example



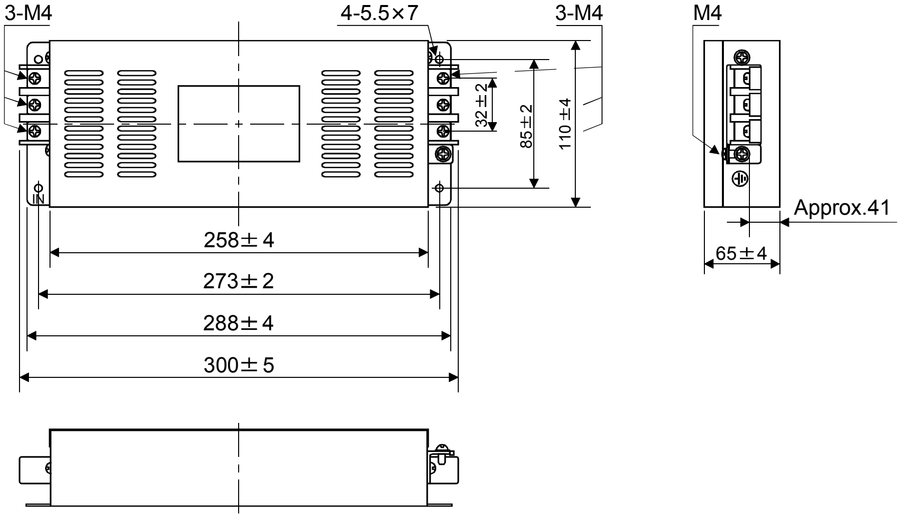
Note 1. For 1-phase 200V to 230VAC power supply, connect the power supply to L_1,L_2 and leave L_3 open.
There is no L_3 for 1-phase 100 to 120VAC power supply. Refer to section 1.2 for the power supply specification.
2. The example is when a surge protector is connected.

(3) Outline drawing

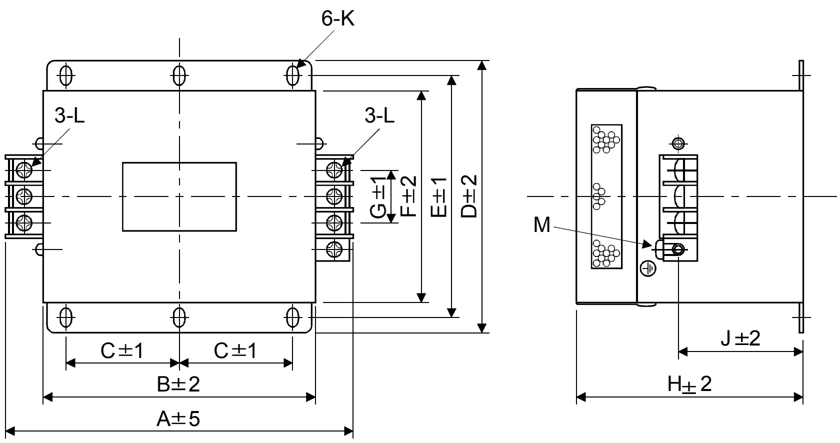
(a) EMC filter

HF3010A-UN

[Unit: mm]

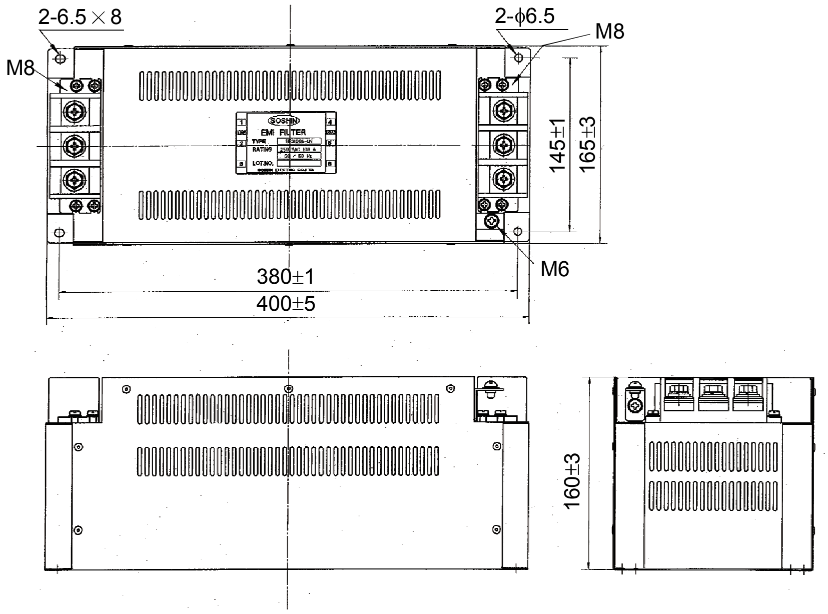


HF3030A-UN・HF-3040A-UN



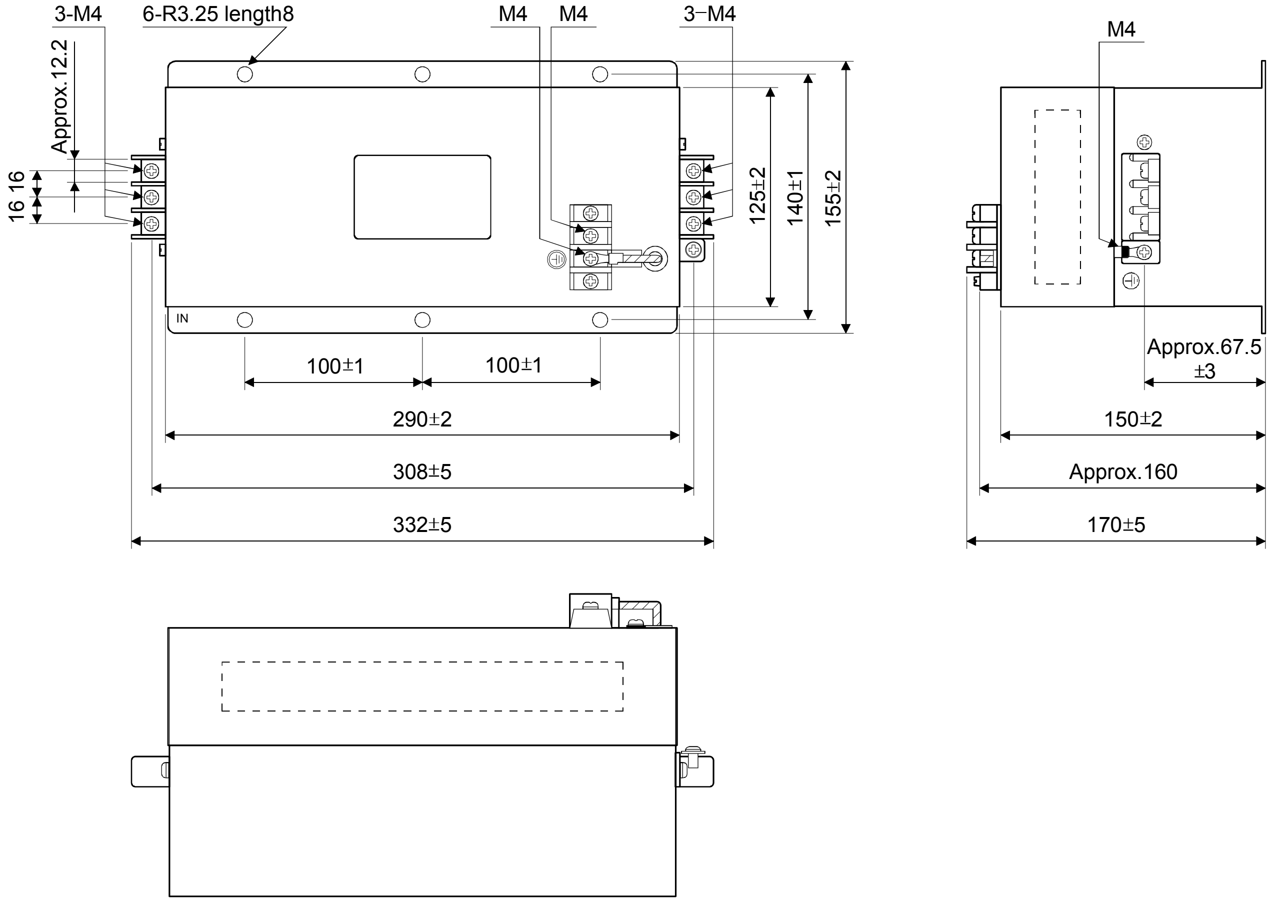
Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
HF3030A-UN	260	210	85	155	140	125	44	140	70	R3.25, length 8	M5	M4
HF3040A-UN	260	210	85	155	140	125	44	140	70		M5	M4

HF3100A-UN



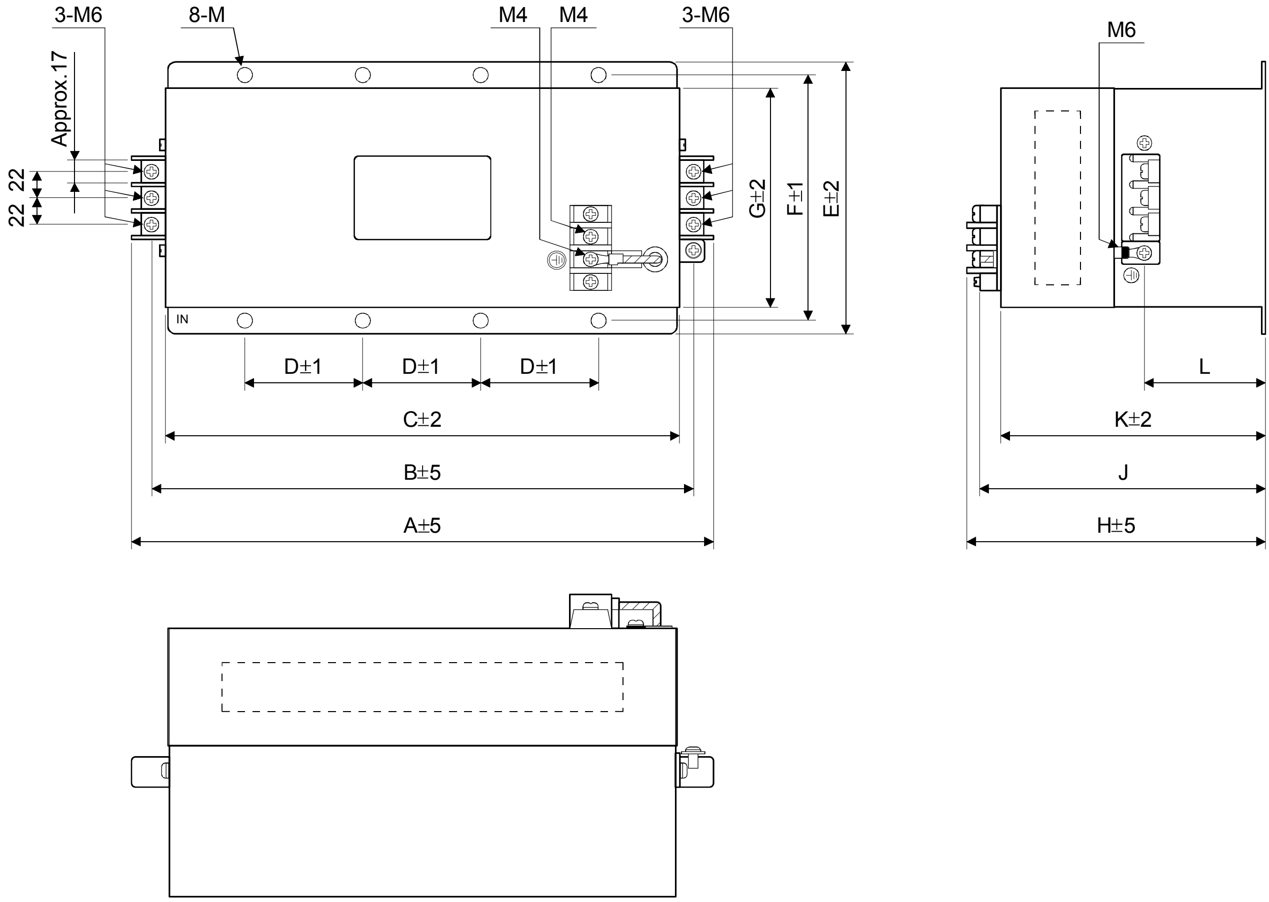
TF3005C-TX・TX3020C-TX・TF3030C-TX

[Unit: mm]



TF3040C-TX・TF3060C-TX

[Unit: mm]

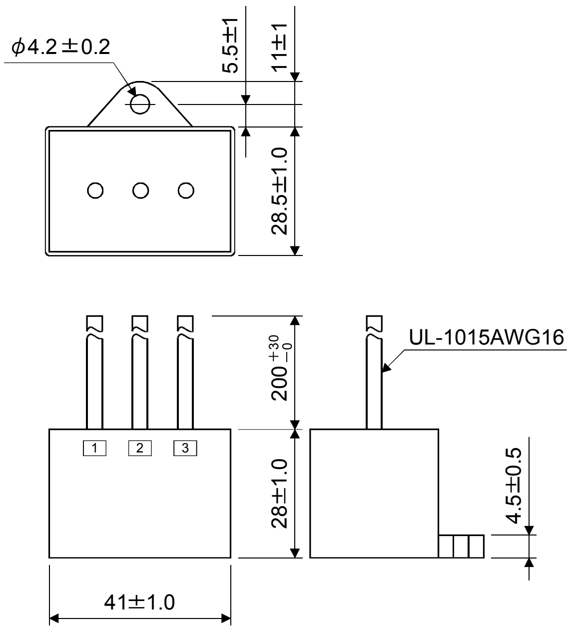


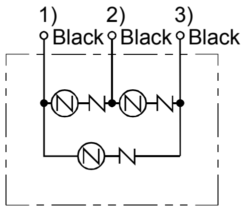
Model	Dimensions [mm]											
	A	B	C	D	E	F	G	H	J	K	L	M
TF3040C-TX TF3060C-TX	438	412	390	100	175	160	145	200	Approx.190	180	Approx.91.5	R3.25 length 8 (M6)

(b) Surge protector

RAV-781BYZ-2

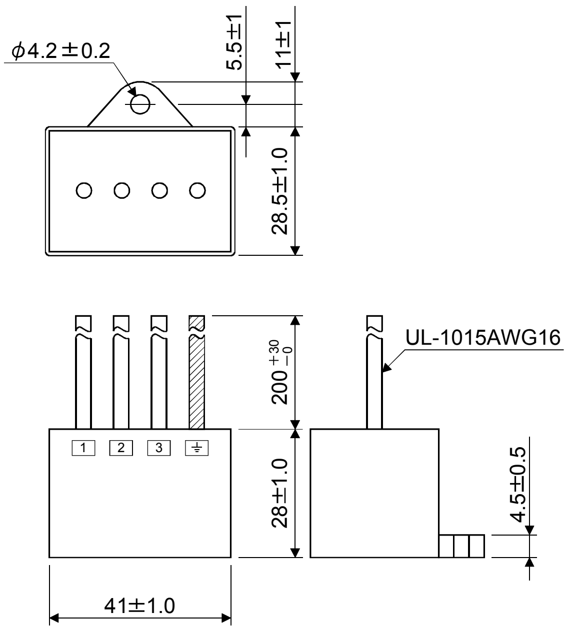
[Unit: mm]

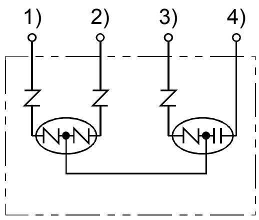




RAV-781BXZ-4

[Unit: mm]





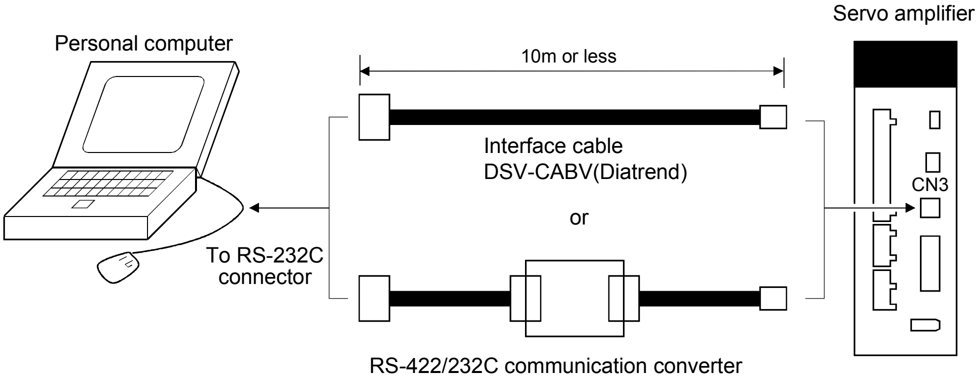
13. COMMUNICATION FUNCTION

Using the serial communication function of RS-422, this servo amplifier enables servo operation, parameter change, monitor function, etc.

13.1 Configuration

(1) Single axis

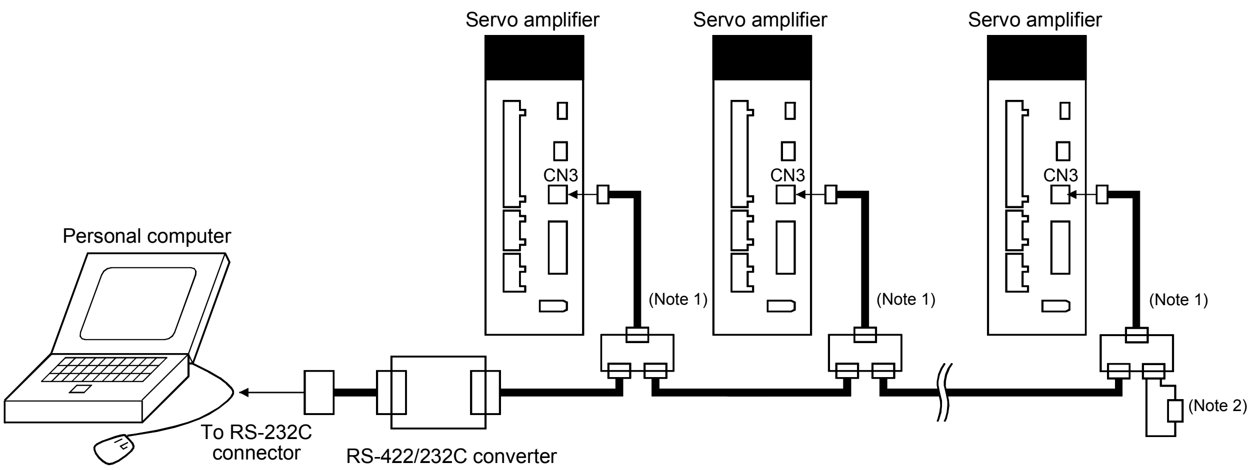
Operate the single-axis servo amplifier. It is recommended to use the following cable or RS-422/232C communication converter.



(2) Multidrop connection

(a) Diagrammatic sketch

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.

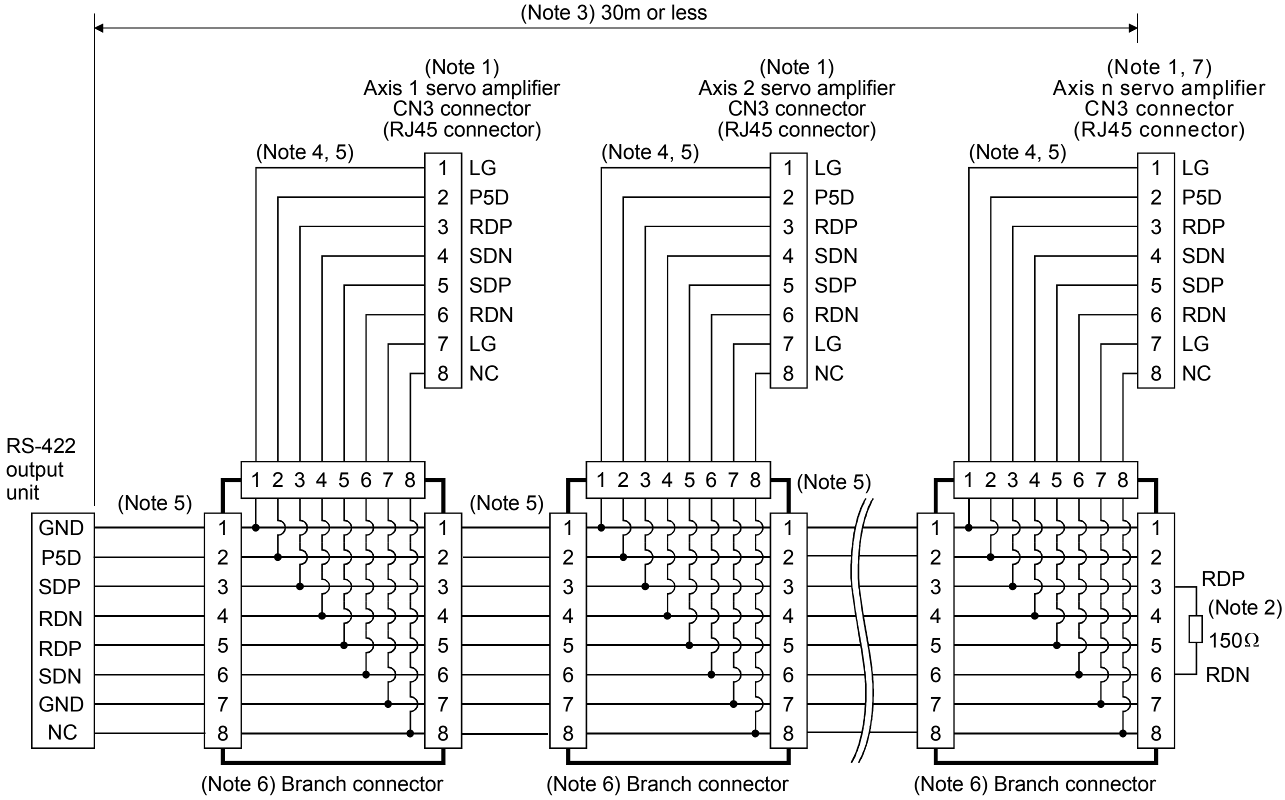


Note 1. The BMJ-8 (Hakko Electric Machine Works) is recommended as the branch connector.

2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No.6) on the receiving side (servo amplifier) with a 150Ω resistor.

(b) Cable connection diagram

Wire the cables as shown below.



Note 1. Recommended connector (Hirose Electric)

Plug: TM10P-88P

Connection tool: CL250-0228-1

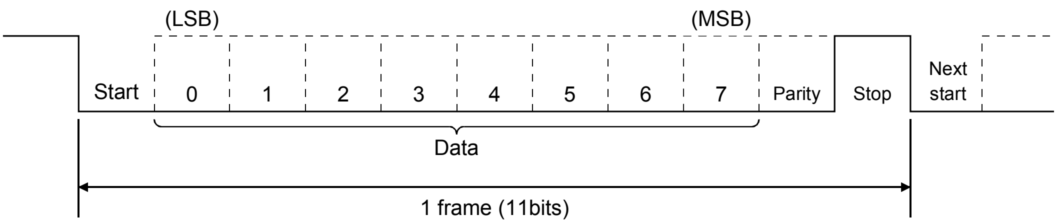
2. The final axis must be terminated between RDP (pin No. 3) and RDN (pin No.6) on the receiving side (servo amplifier) with a 150Ω resistor.
3. The overall length is 30m or less in low-noise environment.
4. The wiring between the branch connector and servo amplifier should be as short as possible.
5. Use the EIA568-compliant cable (10BASE-T cable, etc.).
6. Recommended branch connector: BMJ-8 (Hakko Electric Machine Works)
7. n ≤ 32 (Up to 32 axes can be connected.)

13.2 Communication specifications

13.2.1 Communication overview

This servo amplifier is designed to send a reply on receipt of an instruction. The device which gives this instruction (e.g. personal computer) is called a master station and the device which sends a reply in response to the instruction (servo amplifier) is called a slave station. When fetching data successively, the master station repeatedly commands the slave station to send data.

Item	Description
Baud rate	9600/19200/38400/57600/115200 asynchronous system
Transfer code	Start bit : 1 bit Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system

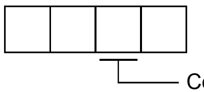


13.2.2 Parameter setting

When the USB/RS-422 communication function is used to operate the servo, set the communication specifications of the servo amplifier in the corresponding parameters.
After setting the values of these parameters, they are made valid by switching power off once, then on again.

(1) Serial communication baud rate
Choose the communication speed. Match this value to the communication speed of the sending end (master station).

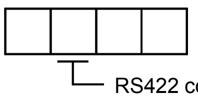
Parameter No. PC21



Communication baud rate
0: 9600[bps]
1: 19200[bps]
2: 38400[bps]
3: 57600[bps]
4: 115200[bps]

(2) RS-422 communication response delay time
Set the time from when the servo amplifier (slave station) receives communication data to when it sends back data. Set "0" to send back data in less than 800μs or "1" to send back data in 800μs or more.

Parameter No. PC21



RS422 communication response delay time
0: Invalid
1: Valid, reply sent in 800μs or more

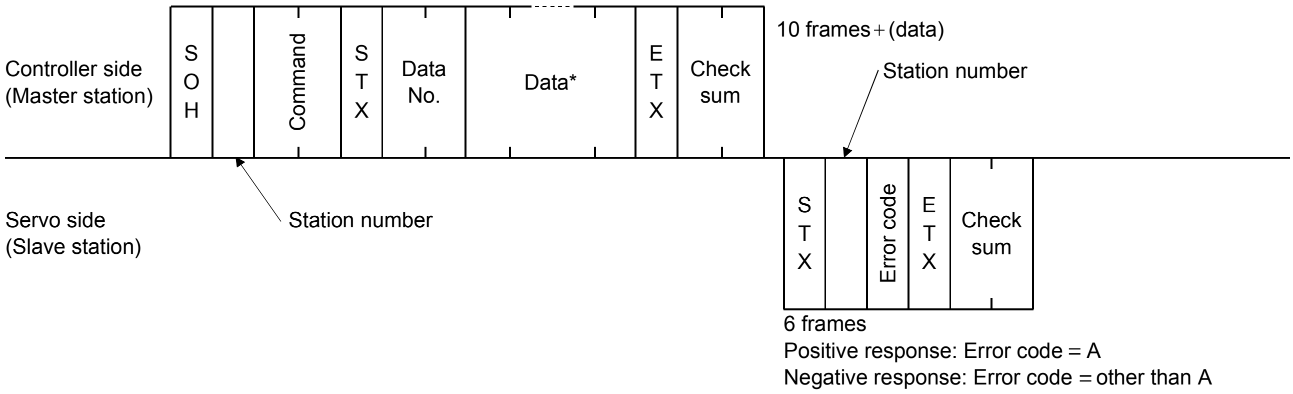
(3) Station number setting
Set the station number of the servo amplifier in parameter No. PC20. The setting range is station 0 to 31.

13.3 Protocol

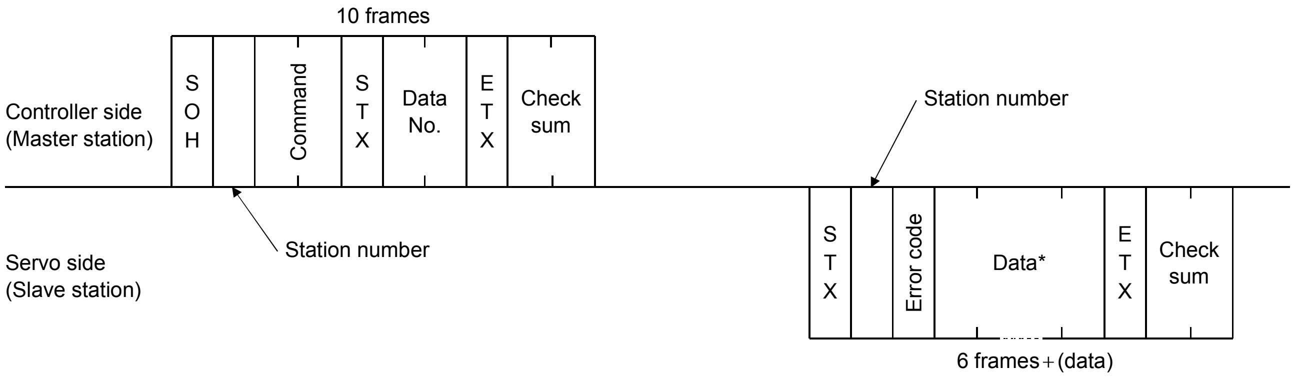
13.3.1 Transmission data configuration

Since up to 32 axes may be connected to the bus, add a station number to the command, data No., etc. to determine the destination servo amplifier of data communication. Set the station number to each servo amplifier using the parameter. Transmission data is valid for the servo amplifier of the specified station number. When "*" is set as the station number added to the transmission data, the transmission data is made valid for all servo amplifiers connected. However, when return data is required from the servo amplifier in response to the transmission data, set "0" to the station number of the servo amplifier which must provide the return data.

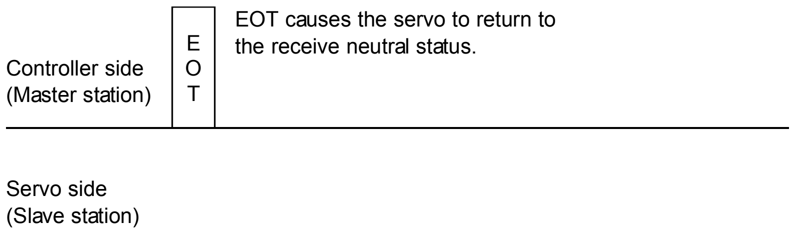
(1) Transmission of data from the controller to the servo



(2) Transmission of data request from the controller to the servo

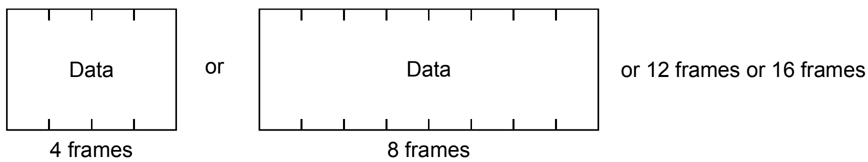


(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



13.3.2 Character codes

(1) Control codes

Code name	Hexadecimal (ASCII code)	Description	Personal computer terminal key operation (General)
SOH	01H	start of head	ctrl + A
STX	02H	start of text	ctrl + B
ETX	03H	end of text	ctrl + C
EOT	04H	end of transmission	ctrl + D

(2) Codes for data

ASCII unit codes are used.

b_8	0	0	0	0	0	0	0	0
b_7	0	0	0	0	1	1	1	1
b_6	0	0	1	1	0	0	1	1
b_5	0	1	0	1	0	1	0	1

b_8 to b_5	b_4	b_3	b_2	b_1	C / R	0	1	2	3	4	5	6	7
	0	0	0	0	0	NUL	DLE	Space	0	@	P	`	p
	0	0	0	1	1	SOH	DC_1	!	1	A	Q	a	q
	0	0	1	0	2	STX	DC_2	“	2	B	R	b	r
	0	0	1	1	3	ETX	DC_3	#	3	C	S	c	s
	0	1	0	0	4			$	4	D	T	d	t
	0	1	0	1	5			%	5	E	U	e	u
	0	1	1	0	6			&	6	F	V	f	v
	0	1	1	1	7			‘	7	G	W	g	w
	1	0	0	0	8			(	8	H	X	h	x
	1	0	0	1	9			)	9	I	Y	i	y
	1	0	1	0	10			*	:	J	Z	j	z
	1	0	1	1	11			+	;	K	[	k	{
	1	1	0	0	12			,	<	L	¥	l	|
	1	1	0	1	13			−	=	M	]	m	}
	1	1	1	0	14			.	>	N	^	n	‾
	1	1	1	1	15			/	?	O	–	o	DEL

(3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the ASCII unit codes are used to specify the stations.

Station number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal for the station number of "0" (axis 1).

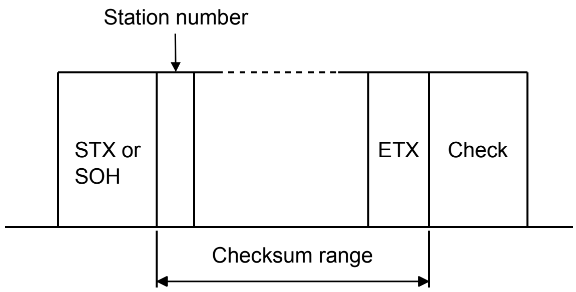
13.3.3 Error codes

Error codes are used in the following cases and an error code of single-code length is transmitted.
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station.
The error code sent in upper case indicates that the servo is normal and the one in lower case indicates that an alarm occurred.

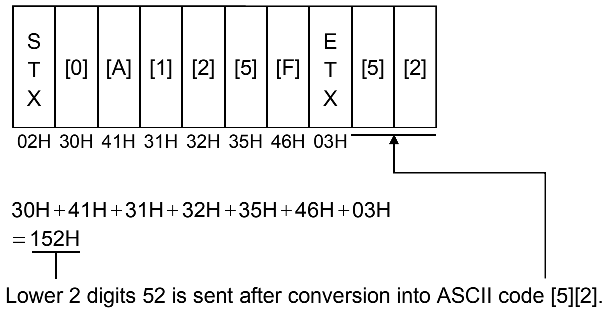
Error code		Error name	Description	Remarks
Servo normal	Servo alarm			
[A]	[a]	Normal operation	Data transmitted was processed properly.	Positive response
[B]	[b]	Parity error	Parity error occurred in the transmitted data.	Negative response
[C]	[c]	Checksum error	Checksum error occurred in the transmitted data.	
[D]	[d]	Character error	Character not existing in the specifications was transmitted.	
[E]	[e]	Command error	Command not existing in the specifications was transmitted.	
[F]	[f]	Data No. error	Data No. not existing in the specifications was transmitted.	

13.3.4 Checksum

The check sum is a ASCII-coded hexadecimal representing the lower two digits of the sum of ASCII-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or SOH).

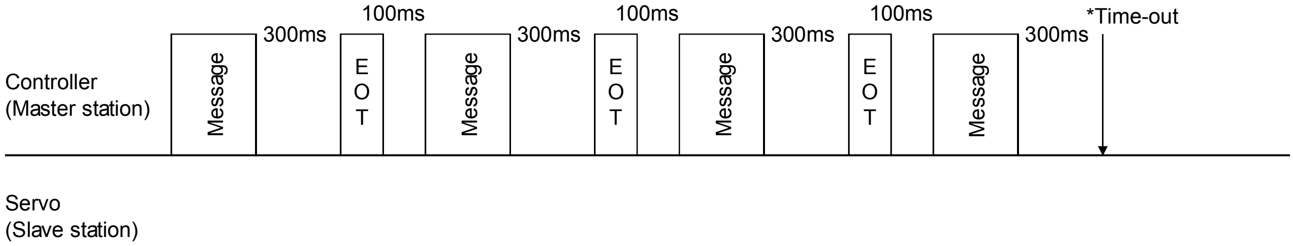


(Example)



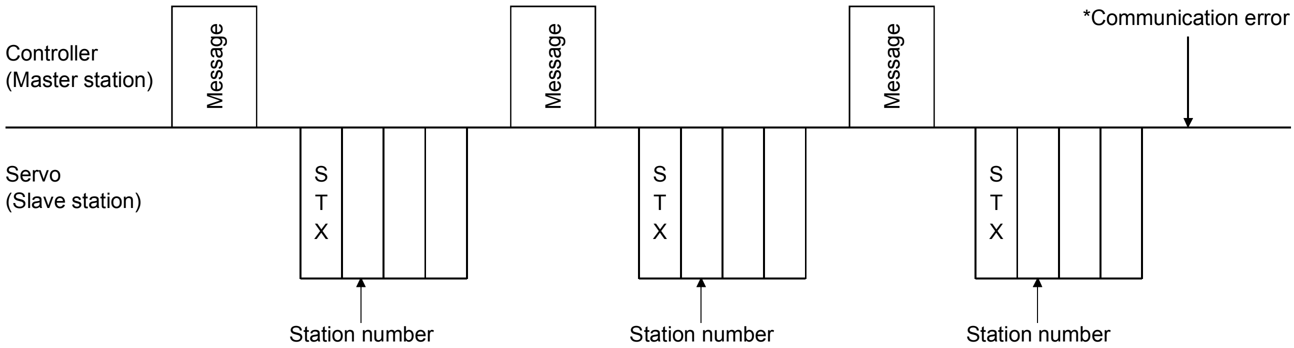
13.3.5 Time-out operation

The master station transmits EOT when the slave station does not start reply operation (STX is not received) 300[ms] after the master station has ended communication operation. 100[ms] after that, the master station retransmits the message. Time-out occurs if the slave station does not answer after the master station has performed the above operation three times. (Communication error)



13.3.6 Retry operation

When a fault occurs in communication between the master and slave stations, the error code in the response data from the slave station is a negative response code ([B] to [F], [b] to [f]). In this case, the master station retransmits the message which was sent at the occurrence of the fault (Retry operation). A communication error occurs if the above operation is repeated and results in the error three or more consecutive times.



Similarly, when the master station detects a fault (e.g. checksum, parity) in the response data from the slave station, the master station retransmits the message which was sent at the occurrence of the fault. A communication error occurs if the retry operation is performed three times.

13.3.7 Initialization

After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after:

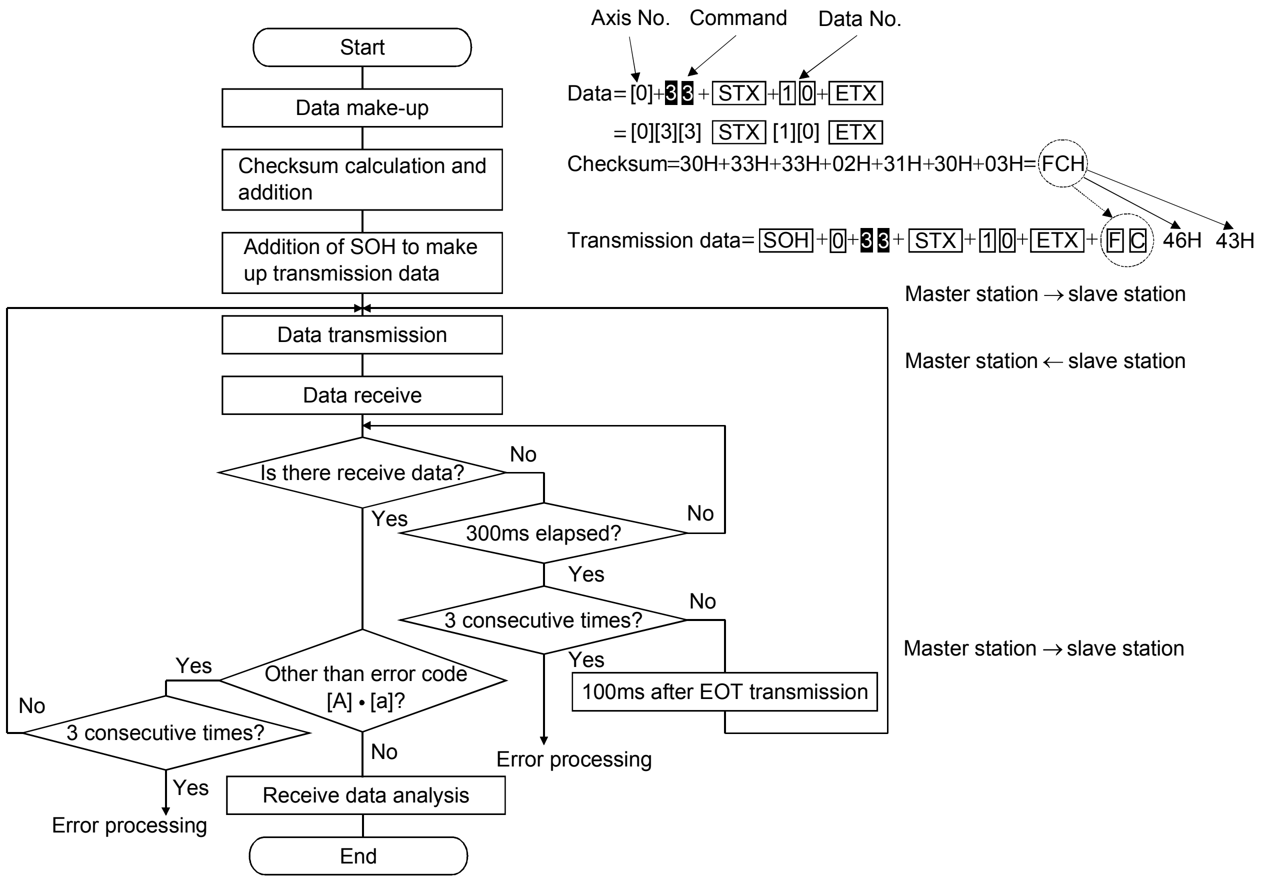
(1) 1s or more time has elapsed after the slave station is switched on; and

(2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

13.3.8 Communication procedure example

The following example reads the set value of alarm history (last alarm) from the servo amplifier of station 0:

Data item	Value	Description
Station number	0	Servo amplifier station 0
Command	33	Read command
Data No.	10	Alarm history (last alarm)



13.4 Command and data No. list

> **POINT**
>
> - If the command and data No. are the same, the description may be different from that of the servo amplifier.

13.4.1 Read commands

(1) Status display (Command [0][1])

Command	Data No.	Description	Display Item	Frame Length
[0][1]	[0][0]	Status display name and unit	Cumulative feedback pulse	16
	[0][1]		Servo motor speed	
	[0][2]		Droop pulse	
	[0][3]		Cumulative command pulse	
	[0][4]		Command pulse frequency	
	[0][5]		Analog speed command voltage Analog speed limit voltage	
	[0][6]		Analog torque command voltage Analog torque limit voltage	
	[0][7]		Regenerative load ratio	
	[0][8]		Effective load ratio	
	[0][9]		Peak load ratio	
	[0][A]		Instantaneous torque	
	[0][B]		Within one-revolution position	
	[0][C]		ABS counter	
	[0][D]		Load inertia moment ratio	
	[0][E]		Bus voltage	
	[8][0]	Status display data value and processing information	Cumulative feedback pulse	12
	[8][1]		Servo motor speed	
	[8][2]		Droop pulse	
	[8][3]		Cumulative command pulse	
	[8][4]		Command pulse frequency	
	[8][5]		Analog speed command voltage Analog speed limit voltage	
	[8][6]		Analog torque command voltage Analog torque limit voltage	
	[8][7]		Regenerative load ratio	
	[8][8]		Effective load ratio	
	[8][9]		Peak load ratio	
	[8][A]		Instantaneous torque	
	[8][B]		Within one-revolution position	
	[8][C]		ABS counter	
	[8][D]		Load inertia moment ratio	
	[8][E]		Bus voltage	

(2) Parameters (Command [0][4] ・ [0][5] ・ [0][6] ・ [0][7] ・ [0][8] ・ [0][9])

Command	Data No.	Description	Frame Length
[0] [4]	[0] [1]	Parameter group read 0000: Basic setting parameter (No.PA□□) 0001: Gain filter parameter (No.PB□□) 0002: Extension setting parameter (No.PC□□) 0003: I/O setting parameter (No.PD□□)	4
[0] [5]	[0] [1] to [F] [F]	Current values of parameters Reads the current values of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before reading the current values, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0] [6]	[0] [1] to [F] [F]	Upper limit values of parameter setting ranges Reads the permissible upper limit values of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before reading the upper limit values, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0] [7]	[0] [1] to [F] [F]	Lower limit values of parameter setting ranges Reads the permissible lower limit values of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before reading the lower limit values, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	8
[0] [8]	[0] [1] to [F] [F]	Abbreviations of parameters Reads the abbreviations of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before reading the abbreviations, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	12
[0] [9]	[0] [1] to [F] [F]	Write enable/disable of parameters Reads write enable/disable of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before reading write enable/disable, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. 0000: Write enabled 0001: Write disabled	4

(3) External I/O signals (Command [1][2])

Command	Data No.	Description	Frame Length
[1] [2]	[0] [0]	Input device status	8
	[4] [0]	External input pin status	
	[6] [0]	Status of input device turned ON by communication	
	[8] [0]	Output device status	
	[C] [0]	External output pin status	

(4) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm Occurrence Sequence	Frame Length
[3] [3]	[1] [0]	Alarm number in alarm history	most recent alarm	4
	[1] [1]		first alarm in past	
	[1] [2]		second alarm in past	
	[1] [3]		third alarm in past	
	[1] [4]		fourth alarm in past	
	[1] [5]		fifth alarm in past	
	[2] [0]	Alarm occurrence time in alarm history	most recent alarm	8
	[2] [1]		first alarm in past	
	[2] [2]		second alarm in past	
	[2] [3]		third alarm in past	
	[2] [4]		fourth alarm in past	
	[2] [5]		fifth alarm in past	

(5) Current alarm (Command [0][2])

Command	Data No.	Description	Frame Length
[0] [2]	[0] [0]	Current alarm number	4

Command	Data No.	Description	Display Item	Frame Length
[3][5]	[0][0]	Status display name and unit at alarm occurrence	Cumulative feedback pulse	16
	[0][1]		Servo motor speed	
	[0][2]		Droop pulse	
	[0][3]		Cumulative command pulse	
	[0][4]		Command pulse frequency	
	[0][5]		Analog speed command voltage Analog speed limit voltage	
	[0][6]		Analog torque command voltage Analog torque limit voltage	
	[0][7]		Regenerative load ratio	
	[0][8]		Effective load ratio	
	[0][9]		Peak load ratio	
	[0][A]		Instantaneous torque	
	[0][B]		Within one-revolution position	
	[0][C]		ABS counter	
	[0][D]		Load inertia moment ratio	
	[0][E]		Bus voltage	
	[8][0]	Status display data value and processing information at alarm occurrence	Cumulative feedback pulse	12
	[8][1]		Servo motor speed	
	[8][2]		Droop pulse	
	[8][3]		Cumulative command pulse	
	[8][4]		Command pulse frequency	
	[8][5]		Analog speed command voltage Analog speed limit voltage	
	[8][6]		Analog torque command voltage Analog torque limit voltage	
	[8][7]		Regenerative load ratio	
	[8][8]		Effective load ratio	
	[8][9]		Peak load ratio	
	[8][A]		Instantaneous torque	
	[8][B]		Within one-revolution position	
	[8][C]		ABS counter	
	[8][D]		Load inertia moment ratio	
	[8][E]		Bus voltage	

(6) Test operation mode (Command [0][0])

Command	Data No.	Description	Frame Length
[0] [0]	[1] [2]	Test operation mode read 0000: Normal mode (not test operation mode) 0001: JOG operation 0002: Positioning operation 0003: Motorless operation 0004: Output signal (DO) forced output	4

(7) Others

Command	Data No.	Description	Frame Length
[0] [2]	[9] [0]	Servo motor end pulse unit absolute position	8
	[9] [1]	Command unit absolute position	8
	[7] [0]	Software version	16

13.4.2 Write commands

(1) Status display (Command [8][1])

Command	Data No.	Description	Setting Range	Frame Length
[8] [1]	[0] [0]	Status display data erasure	1EA5	4

(2) Parameters (Command [8][4] ・ [8][5])

Command	Data No.	Description	Setting Range	Frame Length
[8] [4]	[0] [1] to [F] [F]	Write of parameters Writes the values of the parameters in the parameter group specified with the command [8][5] + data No. [0][0]. Before writing the values, therefore, always specify the parameter group with the command [8][5] + data No. [0][0]. The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number.	Depending on the parameter	8
[8] [5]	[0] [0]	Parameter group write 0000: Basic setting parameter (No. PA□□) 0001: Gain filter parameter (No. PB□□) 0002: Extension setting parameter (No. PC□□) 0003: I/O setting parameter (No. PD□□)	0000 to 0003	4

(3) External I/O signal (Command [9][2])

Command	Data No.	Description	Setting Range	Frame Length
[9] [2]	[6] [0]	Communication input device signal	Refer to section 13.5.5	8

(4) Alarm history (Command [8][2])

Command	Data No.	Description	Setting Range	Frame Length
[8] [2]	[2] [0]	Alarm history erasure	1EA5	4

(5) Current alarm (Command [8][2])

Command	Data No.	Description	Setting Range	Frame Length
[8] [2]	[0] [0]	Alarm erasure	1EA5	4

(6) I/O device prohibition (Command [9][0])

Command	Data No.	Description	Setting Range	Frame Length
[9] [0]	[0] [0]	Turns OFF the input device, external analog input signal or pulse train input, except EMG, LSP and LSN, independently of the external ON/OFF status.	1EA5	4
	[0] [3]	Changes the output device into the value of command [8][B] or command [A][0] + data No. [0][1].	1EA5	4
	[1] [0]	Cancels the prohibition of the input device, external analog input signal or pulse train input, except EMG, LSP and LSN.	1EA5	4
	[1] [3]	Cancels the prohibition of the output device.	1EA5	4

(7) Operation mode selection (Command [8][B])

Command	Data No.	Description	Setting Range	Frame Length
[8] [B]	[0] [0]	Operation mode switching 0000: Test operation mode cancel 0001: JOG operation 0002: Positioning operation 0003: Motorless operation 0004: Output signal (DO) forced output	0000 to 0004	4

(8) Test operation mode data (Command [9][2] · [A][0])

Command	Data No.	Description	Setting Range	Frame Length
[9] [2]	[0] [0]	Input signal for test operation	Refer to section 13.5.7.	8
	[A] [0]	Forced output of signal pin	Refer to section 13.5.9.	8
[A] [0]	[1] [0]	Writes the speed in the test operation mode (JOG operation, positioning operation).	0000 to 7FFF	4
	[1] [1]	Writes the acceleration/deceleration time constant in the test operation mode (JOG operation, positioning operation).	00000000 to 7FFFFFFF	8
	[2] [0]	Sets the moving distance in the test operation mode (JOG operation, positioning operation).	00000000 to 7FFFFFFF	8
	[2] [1]	Selects the positioning direction of test operation (positioning operation). 0 □ 0 □ 0: Forward rotation direction 1: Reverse rotation direction 0: Command pulse unit 1: Encoder pulse unit	0000 to 0001	4
	[4] [0]	Test operation (positioning operation) start command.	1EA5	4
	[4] [1]	Used to make a temporary stop during test operation (positioning operation). □in the data indicates a blank. STOP: Temporary stop G0□□: Restart for remaining distance CLR□: Remaining distance clear.	STOP G0□□ CLR□	4

13.5 Detailed explanations of commands

13.5.1 Data processing

When the master station transmits a command + data No. or a command + data No. + data to a slave station, the servo amplifier returns a reply or data according to the purpose.
When numerical values are represented in these send data and receive data, they are represented in decimal, hexadecimal, etc.
Therefore, data must be processed according to the application.
Since whether data must be processed or not and how to process data depend on the monitoring, parameters, etc., follow the detailed explanation of the corresponding command.
The following methods are how to process send and receive data when reading and writing data.

(1) Processing the read data

When the display type is 0, the eight-character data is converted from hexadecimal to decimal and a decimal point is placed according to the decimal point position information.
When the display type is 1, the eight-character data is used unchanged.

The following example indicates how to process the receive data "003000000929" given to show.
The receive data is as follows.

0	0	3	0	0	0	0	0	0	9	2	9

Data 32-bit length (hexadecimal representation)
(Data conversion is required as indicated in the display type)

Display type
0: Data must be converted into decimal.
1: Data is used unchanged in hexadecimal.

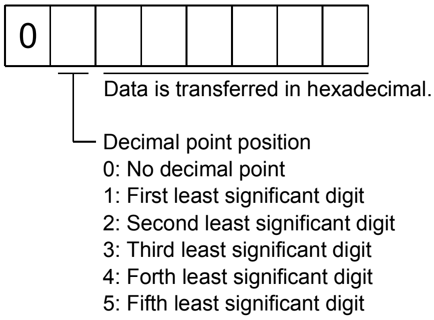
Decimal point position
0: No decimal point
1: First least significant digit (normally not used)
2: Second least significant digit
3: Third least significant digit
4: Forth least significant digit
5: Fifth least significant digit
6: Sixth least significant digit

Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(2) Writing the processed data

When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, the data cannot be written. When the data is handled as hexadecimal, specify "0" as the decimal point position.

The data to be sent is the following value.



By way of example, here is described how to process the set data when a value of "15.5" is sent.

Since the decimal point position is the second digit, the decimal point position data is "2".

As the data to be sent is hexadecimal, the decimal data is converted into hexadecimal.

155→9B

Hence, "0200009B" is transmitted.

13.5.2 Status display

(1) Reading the status display name and unit

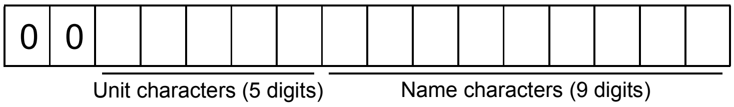
Read the status display name and unit.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read, [0][0] to [0][E]. (Refer to section 13.4.1.)

(b) Reply

The slave station sends back the status display name and unit requested.



(2) Status display data read

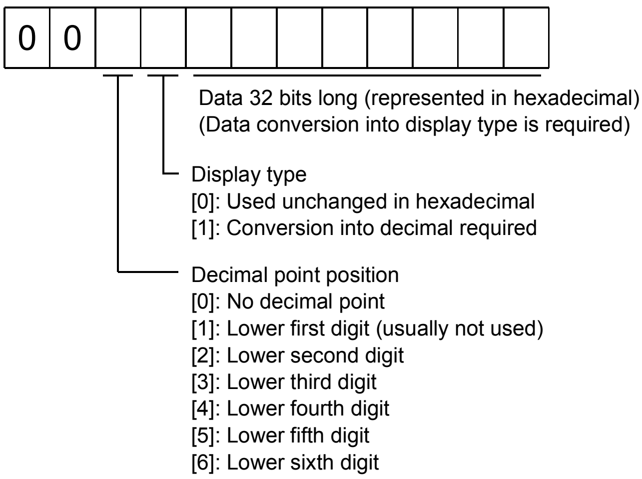
Read the status display data and processing information.

(a) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read. Refer to section 13.4.1.

(b) Reply

The slave station sends back the status display data requested.



(3) Status display data clear

The cumulative feedback pulse data of the status display is cleared. Send this command immediately after reading the status display item. The data of the status display item transmitted is cleared to zero.

Command	Data No.	Data
[8][1]	[0][0]	[1][E][A][5]

For example, after sending command [0][1] and data No. [8][0] and receiving the status display data, send command [8][1], data No. [0][0] and data [1EA5] to clear the cumulative feedback pulse value to zero.

13.5.3 Parameters

(1) Specify the parameter group

The group of the parameters to be operated must be specified in advance to read or write the parameter settings, etc. Write data to the servo amplifier as described below to specify the parameter group to be operated.

Command	Data No.	Transmission Data	Parameter Group
[8] [5]	[0] [0]	0000	Basic setting parameter (No.PA□□)
		0001	Gain filter parameter (No.PB□□)
		0002	Extension setting parameter (No.PC□□)
		0003	I/O setting parameter (No.PD□□)

(2) Reading the parameter group

Read the parameter group.

(a) Transmission

Send command [0][4] and data No.[0][1].

Command	Data No.
[0] [4]	[0] [1]

(b) Reply

The slave station sends back the preset parameter group.

0	0	0	

Parameter group
0: Basic setting parameter (No.PA□□)
1: Gain filter parameter (No.PB□□)
2: Extension setting parameter (No.PC□□)
3: I/O setting parameter (No.PD□□)

(3) Reading the symbol

Read the parameter name. Specify the parameter group in advance (refer to (1) of this section).

(a) Transmission

Transmit command [0][8] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the name of the parameter No. requested.

0	0	0									

Name characters (9 digits)

(4) Reading the setting

Read the parameter setting. Specify the parameter group in advance (refer to (1) of this section).

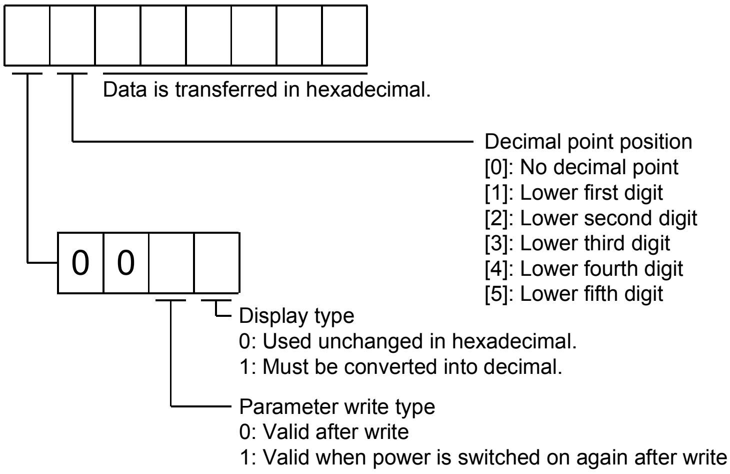
(a) Transmission

Transmit command [0][5] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "1200270F" means 999.9 (decimal display format) and data "0003ABC" means 3ABC (hexadecimal display format).
When the display type is "0" (hexadecimal) and the decimal point position is other than 0, the display type is a special hexadecimal display format and "F" of the data value is handled as a blank. Data "01FFF053" means 053 (special hexadecimal display format).

"000000" is transferred when the parameter that was read is the one inaccessible for write/reference in the parameter write disable setting of parameter No. 19.

(5) Reading the setting range

Read the parameter setting range. Specify the parameter group in advance (refer to (1) of this section).

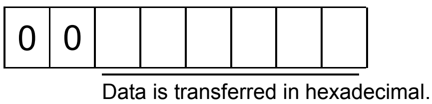
(a) Transmission

When reading the upper limit value, transmit command [0][6] and the data No. corresponding to the parameter No., [0][0] to [F][F]. When reading the lower limit value, transmit command [0][7] and the data No. corresponding to the parameter No., [0][0] to [F][F]. (Refer to section 13.4.1.)

The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.

(b) Reply

The slave station sends back the data and processing information of the parameter No. requested.



For example, data "10FFFFEC" means -20.

(6) Parameter write

> POINT
>
> - If setting values need to be changed with a high frequency (i.e. one time or more per one hour), write the setting values to the RAM, not the EEP-ROM. The EEP-ROM has a limitation in the number of write times and exceeding this limitation causes the servo amplifier to malfunction. Note that the number of write times to the EEP-ROM is limited to approximately 100, 000.

Write the parameter setting into EEP-ROM of the servo amplifier. Specify the parameter group in advance (refer to (1) of this section).
Write the value within the setting enabled range. For the setting enabled range, refer to chapter 5 or read the setting range by performing operation in (3) of this section.
Transmit command [8][4], the data No. , and the set data.
The data No. is expressed in hexadecimal. The decimal equivalent of the data No. value corresponds to the parameter number.
When the data to be written is handled as decimal, the decimal point position must be specified. If it is not specified, data cannot be written. When the data is handled as hexadecimal, specify 0 as the decimal point position.
Write the data after making sure that it is within the upper/lower limit value range.
Read the parameter data to be written, confirm the decimal point position, and create transmission data to prevent error occurrence. On completion of write, read the same parameter data to verify that data has been written correctly.

Command	Data No.	Set data
[8][4]	[0][0] to [F][F]	See below.

Data is transferred in hexadecimal.

Decimal point position
0: No decimal point
1: Lower first digit
2: Lower second digit
3: Lower third digit
4: Lower forth digit
5: Lower fifth digit

Write mode
0: Write to EEP-ROM
3: Write to RAM
When the parameter data is changed frequently through communication,
set "3" to the write mode to change only the RAM data in the servo amplifier.
When changing data frequently (once or more within one hour),
do not write it to the EEP-ROM.

13.5.4 External I/O signal statuses (DI0 diagnosis)

(1) Reading of input device statuses

Read the statuses of the input devices.

(a) Transmission

Transmit command [1][2] and data No. [0][0].

Command	Data No.
[1][2]	[0][0]

(b) Reply

The slave station sends back the statuses of the input pins.

b31 - - - - - - - - - - b1 b0

1:ON
0:OFF

Command of each bit is transmitted to the master station as hexadecimal data.

bit	Abbreviation
0	SON
1	LSP
2	LSN
3	TL
4	TL1
5	PC
6	RES
7	CR

bit	Abbreviation
8	SP1
9	SP2
10	SP3
11	ST1
12	ST2
13	CM1
14	CM2
15	LOP

bit	Abbreviation
16	
17	
18	
19	
20	STAB2
21	
22	
23	

bit	Abbreviation
24	
25	
26	
27	CDP
28	
29	
30	
31	

(2) External input pin status read

Read the ON/OFF statuses of the external output pins.

(a) Transmission

Transmit command [1][2] and data No. [4][0].

Command	Data No.
[1][2]	[4][0]

(b) Reply

The ON/OFF statuses of the input pins are sent back.

b31 - - - - - - - - - - b1 b0

1:ON
0:OFF

Command of each bit is transmitted to the master station as hexadecimal data.

bit	CN1 connector pin
0	43
1	44
2	42
3	15
4	19
5	41
6	16
7	17

bit	CN1 connector pin
8	18
9	45
10	
11	
12	
13	
14	
15	

bit	CN1 connector pin
16	
17	
18	
19	
20	
21	
22	
23	

bit	CN1 connector pin
24	
25	
26	
27	
28	
29	
30	
31	

(3) Read of the statuses of input devices switched on through communication

Read the ON/OFF statuses of the input devices switched on through communication.

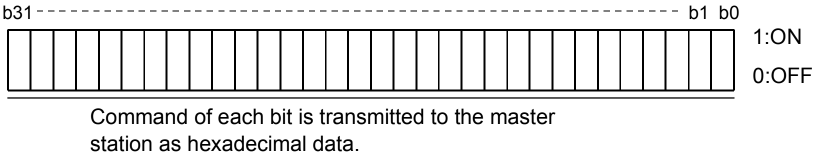
(a) Transmission

Transmit command [1][2] and data No. [6][0].

Command	Data No.
[1][2]	[6][0]

(b) Reply

The slave station sends back the statuses of the input pins.



bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

(4) External output pin status read

Read the ON/OFF statuses of the external output pins.

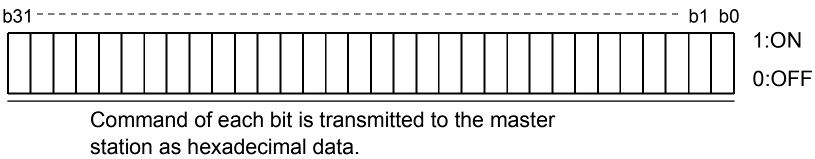
(a) Transmission

Transmit command [1][2] and data No. [C][0].

Command	Data No.
[1][2]	[C][0]

(b) Reply

The slave station sends back the ON/OFF statuses of the output pins.



bit	CN1 connector pin	bit	CN1 connector pin	bit	CN1 connector pin	bit	CN1 connector pin
0	49	8		16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7		15		23		31	

(5) Read of the statuses of output devices

Read the ON/OFF statuses of the output devices.

(a) Transmission

Transmit command [1][2] and data No. [8][0].

Command	Data No.
[1][2]	[8][0]

(b) Reply

The slave station sends back the statuses of the output devices.

b31 ---------- b1 b0

1:ON
0:OFF

Command of each bit is transmitted to the master station as hexadecimal data.

bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	RD	8	ALM	16		24	
1	SA	9	OP	17		25	CDPS
2	ZSP	10	MBR	18		26	
3	TLC	11		19		27	ABSV
4	VLC	12	ACD0	20		28	
5	INP	13	ACD1	21		29	
6		14	ACD2	22		30	
7	WNG	15	BWNG	23		31	

13.5.5 Input device ON/OFF

POINT

- The ON/OFF states of all devices in the servo amplifier are the states of the data received last. Hence, when there is a device which must be kept ON, send data which turns that device ON every time.

Each input device can be switched on/off. However, when the device to be switched off exists in the external input signal, also switch off that input signal.

Send command [9][2], data No. [6][0] and data.

Command	Data No.	Set data
[9][2]	[6][0]	See below.

b31 ---------- b1 b0

1:ON
0:OFF

Command of each bit is transmitted to the slave station as hexadecimal data.

bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

13.5.6 Disable/enable of I/O devices (DIO)

Inputs can be disabled independently of the I/O devices ON/OFF. When inputs are disabled, the input signals (devices) are recognized as follows. Among the input devices, EMG, LSP and LSN cannot be disabled.

Signal	Status
Input devices (DI)	OFF
External analog input signals	0V
Pulse train inputs	None

(1) Disabling/enabling the input devices (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN.
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][0]	1EA5

(b) Enable

Command	Data No.	Data
[9][0]	[1][0]	1EA5

(2) Disabling/enabling the output devices (DO)
Transmit the following communication commands:
(a) Disable

Command	Data No.	Data
[9][0]	[0][3]	1EA5

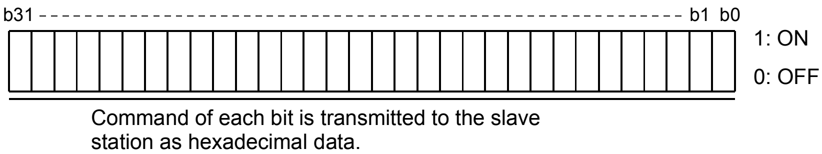
(b) Enable

Command	Data No.	Data
[9][0]	[1][3]	1EA5

13.5.7 Input devices ON/OFF (test operation)

Each input devices can be turned on/off for test operation. when the device to be switched off exists in the external input signal, also switch off that input signal.
Send command [9] [2], data No. [0] [0] and data.

Command	Data No.	Set data
[9][2]	[0][0]	See below



bit	Abbreviation	bit	Abbreviation	bit	Abbreviation	bit	Abbreviation
0	SON	8	SP1	16		24	
1	LSP	9	SP2	17		25	
2	LSN	10	SP3	18		26	
3	TL	11	ST1	19		27	CDP
4	TL1	12	ST2	20	STAB2	28	
5	PC	13	CM1	21		29	
6	RES	14	CM2	22		30	
7	CR	15	LOP	23		31	

13.5.8 Test operation mode

POINT
· The test operation mode is used to confirm operation. Do not use it for actual operation. · If communication stops for longer than 0.5s during test operation, the servo amplifier decelerates to a stop, resulting in servo lock. To prevent this, continue communication all the time, e.g. monitor the status display. · Even during operation, the servo amplifier can be put in the test operation mode. In this case, as soon as the test operation mode is selected, the base circuit is shut off, coasting the servo amplifier.

(1) Preparation and cancel of test operation mode

(a) Preparation of test operation mode

Set the test operation mode type in the following procedure.

1) Selection of test operation mode

Send the command [8][B] + data No. [0][0] to select the test operation mode.

Command	Data No.	Transmission Data	Test Operation Mode Selection
[8][B]	[0][0]	0001	JOG operation
		0002	Positioning operation
		0003	Motorless operation
		0004	DO forced output (Note)

Note. Refer to section 13.5.9 for DO forced output.

2) Confirmation of test operation mode

Read the test operation mode set for the slave station, and confirm that it is set correctly.

a. Transmission

Send the command [0][0] + data No. [1][2].

Command	Data No.
[0][0]	[1][2]

b. Return

The slave station returns the set test operation mode.

0	0	0	

Test operation mode read
0: Normal mode (not test operation mode)
1: JOG operation
2: Positioning operation
3: Motorless operation
4: DO forced output

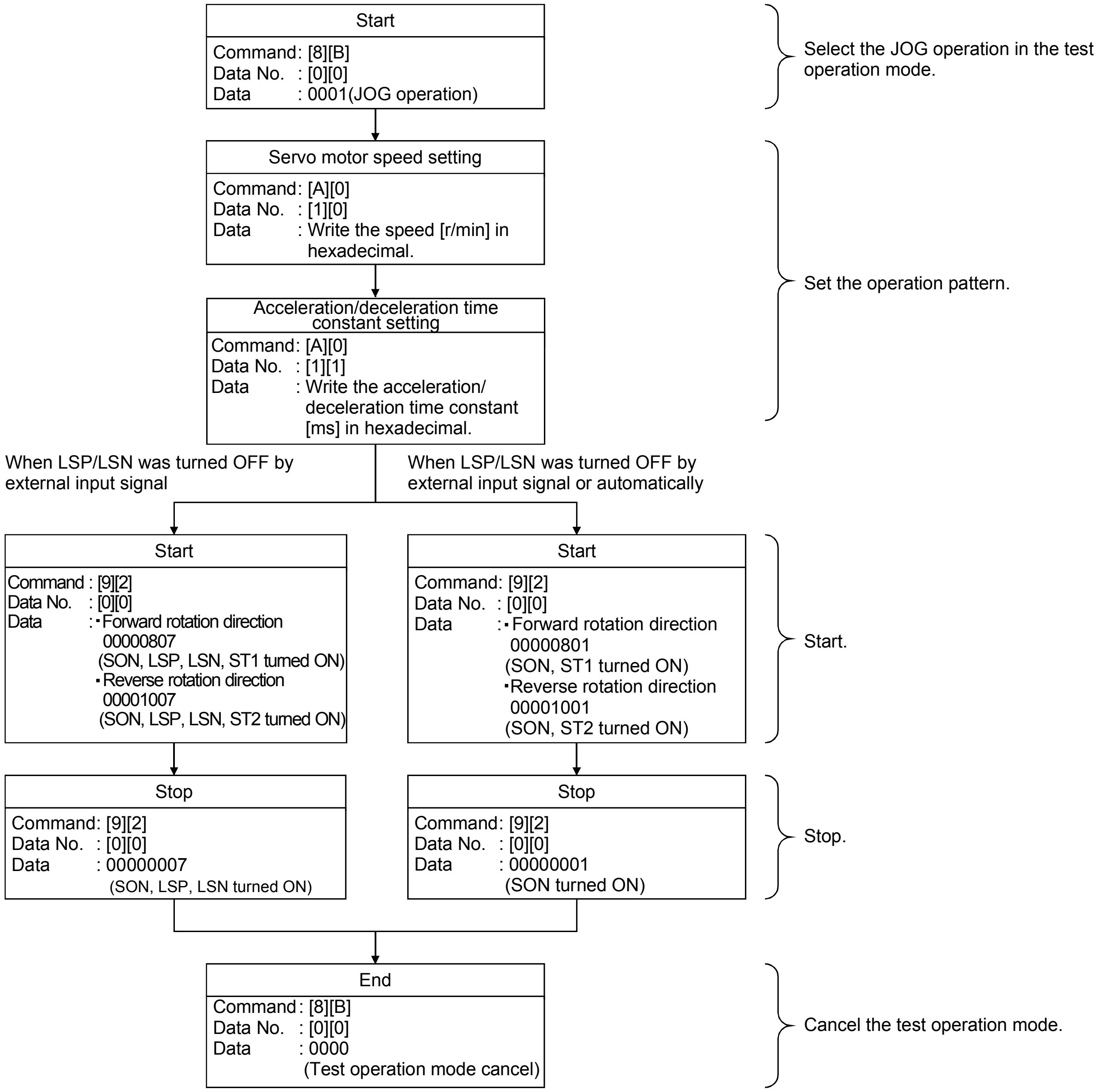
(b) Cancel of test operation mode

To terminate the test operation mode, send the command [8][B] + data No. [0][0] + data.

Command	Data No.	Transmission Data	Test Operation Mode Selection
[8][B]	[0][0]	0000	Test operation mode cancel

(2) JOG operation

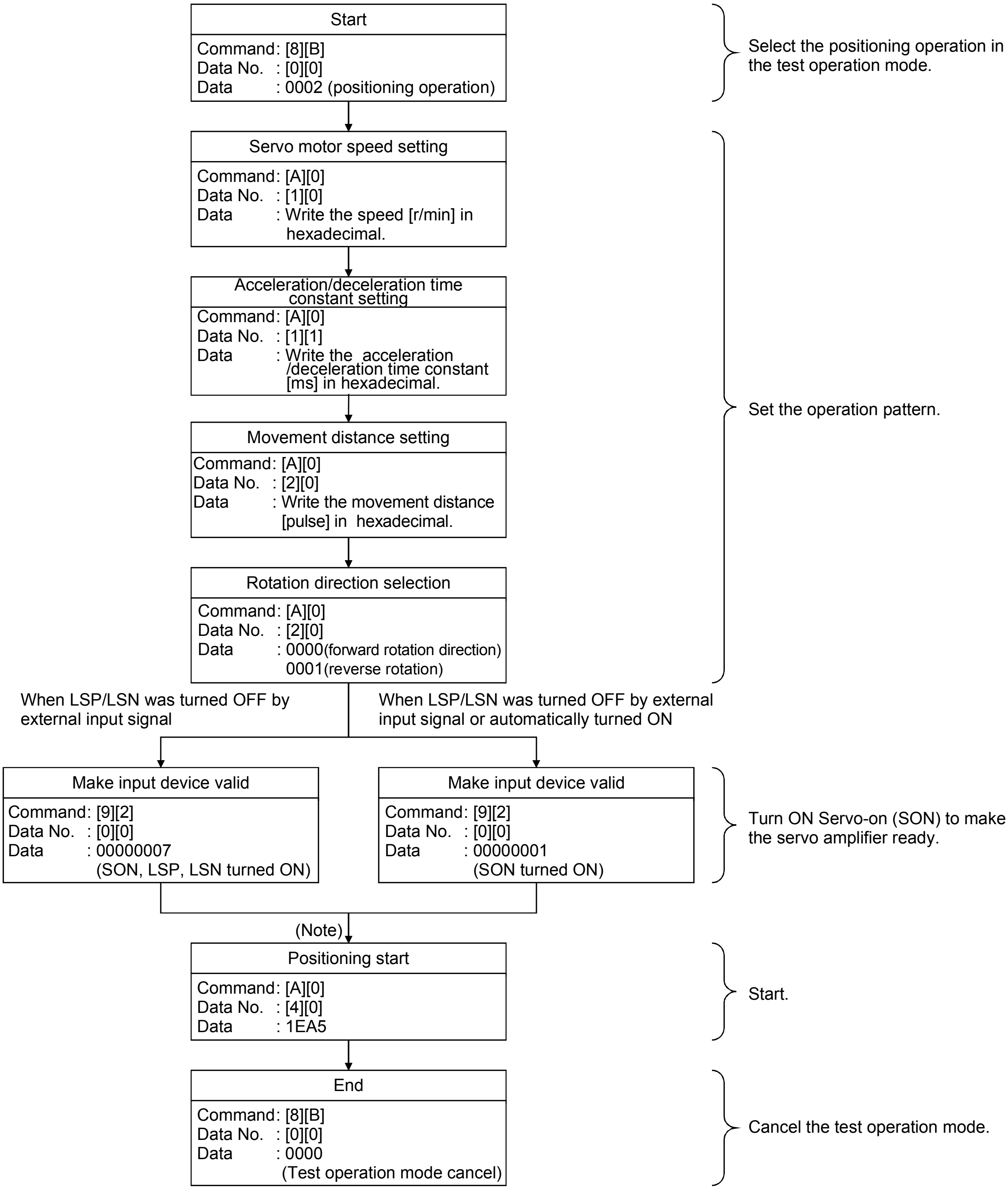
Send the command, data No. and data as indicated below to execute JOG operation.



(3) Positioning operation

(a) Operation procedure

Send the command, data No. and data as indicated below to execute positioning operation.



Note. There is a 100ms delay.

(b) Temporary stop/restart/remaining distance clear

Send the following command, data No. and data during positioning operation to make deceleration to a stop.

Command	Data No.	Data
[A][0]	[4][1]	STOP

Send the following command, data No. and data during a temporary stop to make a restart.

Command	Data No.	(Note) Data
[A][0]	[4][1]	GO□□

Note. □ indicates a blank.

Send the following command, data No. and data during a temporary stop to stop positioning operation and erase the remaining movement distance.

Command	Data No.	(Note) Data
[A][0]	[4][1]	CLR□

Note. □ indicates a blank.

13.5.9 Output signal pin ON/OFF output signal (DO) forced output

In the test operation mode, the output signal pins can be turned on/off independently of the servo status.
Using command [9][0], disable the output signals in advance.

(1) Choosing DO forced output in test operation mode

Transmit command [8][B] + data No. [0][0] + data "0004" to choose DO forced output.

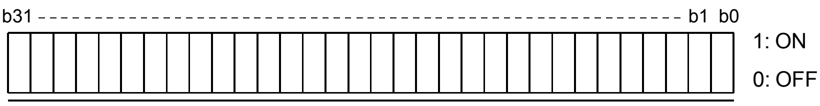
0	0	0	4

Selection of test operation mode
4: DO forced output (output signal forced output)

(2) External output signal ON/OFF

Transmit the following communication commands:

Command	Data No.	Setting data
[9][2]	[A][0]	See below.



Command of each bit is sent to the slave station in hexadecimal.

bit	CN1 connector pin	bit	CN1 connector pin	bit	CN1 connector pin	bit	CN1 connector pin
0	49	8		16		24	
1	24	9		17		25	
2	23	10		18		26	
3	25	11		19		27	
4	22	12		20		28	
5	48	13		21		29	
6	33	14		22		30	
7		15		23		31	

(3) DO forced output

Transmit command [8][B] + data No. [0][0] + data to choose DO forced output.

Command	Data No.	Test Operation Mode Selection
[8][B]	[0][0]	Test operation mode cancel

13.5.10 Alarm history

(1) Alarm No. read

Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No. 0 (last alarm) to No. 5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][5]. Refer to section 13.4.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.

0	0		

Alarm No. is transferred in decimal.

For example, "0032" means AL.32 and "00FF" means AL._ (no alarm).

(2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No. [2][0] to [2][5].

Refer to section 13.4.1.

(b) Reply

The alarm occurrence time is transferred in decimal.
Hexadecimal must be converted into decimal.

For example, data "01F5" means that the alarm occurred in 501 hours after start of operation.

(3) Alarm history clear

Erase the alarm history.

Send command [8][2] and data No. [2][0].

Command	Data No.	Data
[8][2]	[2][0]	1EA5

13.5.11 Current alarm

(1) Current alarm read

Read the alarm No. which is occurring currently.

(a) Transmission

Send command [0][2] and data No. [0][0].

Command	Data No.
[0][2]	[0][0]

(b) Reply

The slave station sends back the alarm currently occurring.

0	0		

Alarm No. is transferred in decimal.

For example, "0032" means AL.32 and "00FF" means AL._ (no alarm).

(2) Read of the status display at alarm occurrence

Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(a) Transmission

Send command [3][5] and any of data No. [8][0] to [8][E] corresponding to the status display item to be read. Refer to section 13.4.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.

0	0										

Data 32 bits long (represented in hexadecimal)
(Data conversion into display type is required)

Display type
0: Conversion into decimal required
1: Used unchanged in hexadecimal

Decimal point position
0: No decimal point
1: Lower first digit (usually not used)
2: Lower second digit
3: Lower third digit
4: Lower fourth digit
5: Lower fifth digit
6: Lower sixth digit

(3) Current alarm clear

As by the reset (RES) on, reset the servo amplifier alarm to make the servo amplifier ready to operate. After removing the cause of the alarm, reset the alarm with no command entered.

Command	Data No.	Data
[8][2]	[0][0]	1EA5

13.5.12 Other commands

(1) Servo motor end pulse unit absolute position

Read the absolute position in the servo motor end pulse unit.

Note that overflow will occur in the position of 8192 or more revolutions from the home position.

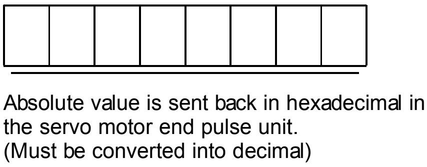
(a) Transmission

Send command [0][2] and data No. [9][0].

Command	Data No.
[0][2]	[9][0]

(b) Reply

The slave station sends back the requested servo motor end pulses.



For example, data "000186A0" is 100000 [pulse] in the motor end pulse unit.

(2) Command unit absolute position

Read the absolute position in the command unit.

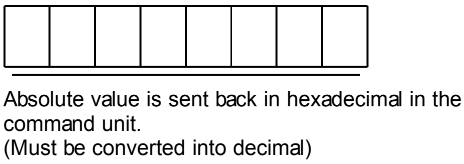
(a) Transmission

Send command [0][2] and data No. [9][1].

Command	Data No.
[0][2]	[9][1]

(b) Reply

The slave station sends back the requested command pulses.



For example, data "000186A0" is 100000 [pulse] in the command unit.

(3) Software version

Reads the software version of the servo amplifier.

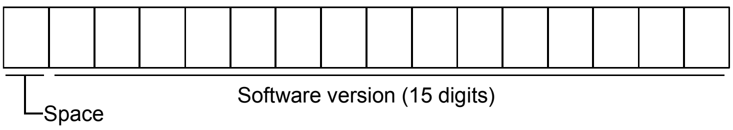
(a) Transmission

Send command [0][2] and data No.[7][0].

Command	Data No.
[0][2]	[7][0]

(b) Reply

The slave station returns the software version requested.



14. ABSOLUTE POSITION DETECTION SYSTEM

CAUTION	• If an absolute position erase alarm (AL.25) or absolute position counter warning (AL.E3) has occurred, always perform home position setting again. Not doing so can cause runaway.

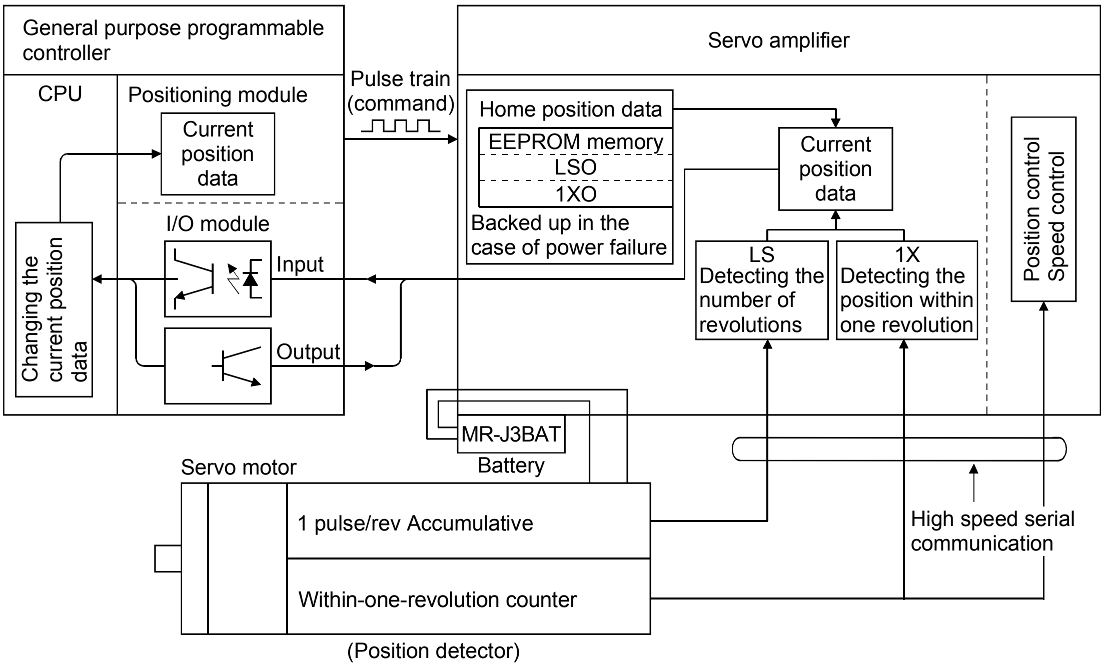
POINT

- When configuring an absolute position detection system using the QD75P/D PLC, refer to the Type QD75P/QD75D Positioning Module User's Manual QD75P1/QD75P2/QD75P4, QD75D1/QD75D2/QD75D4 (SH (NA) 080058).

14.1 Outline

14.1.1 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 general-purpose programming controller power is on or off. Therefore, once the home position is defined 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.



14.1.2 Restrictions

The absolute position detection system cannot be configured under the following conditions. Test operation cannot be performed in the absolute position detection system, either. To perform test operation, choose incremental in parameter No.PA03.

(1) Speed control mode, torque control mode.
(2) Control switch-over mode (position/speed, speed/torque, torque/position).
(3) Stroke-less coordinate system, e.g. rotary shaft, infinitely long positioning.
(4) Changing of electronic gear after home position setting.
(5) Use of alarm code output.

14.2 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

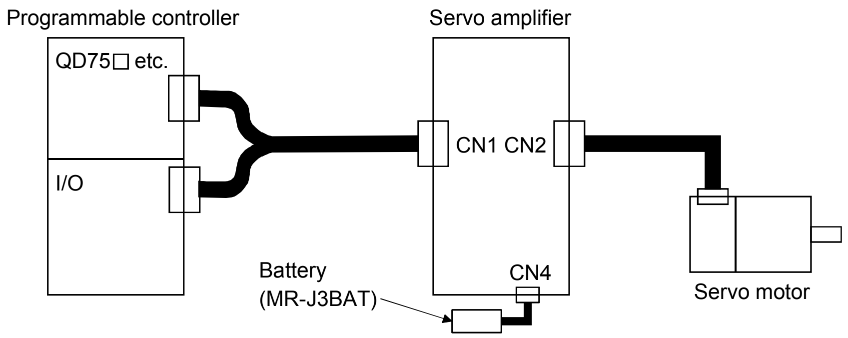
Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery (primary battery, nominal + 3.6V) Type: MR-J3BAT
Maximum revolution range	Home position ± 32767 rev.
(Note 1) Maximum speed at power failure	3000r/min
(Note 2) Battery backup time	Approx. 10,000 hours (battery life with power off)
Battery storage period	5 years from date of manufacture

Note 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.

2. Time to hold data by a battery with power off. It is recommended to replace the battery in three years independently of whether power is kept on or off.

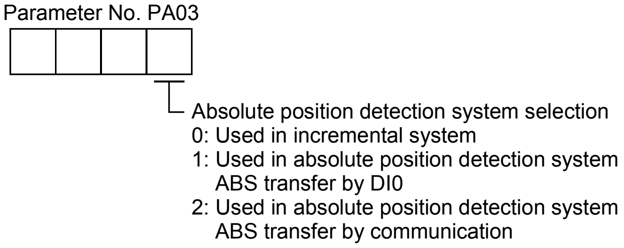
(2) Configuration

Positioning module	I/O module
QD75□	QX40・41・42 QY40・41・42・50
A1SD75□	AX40・41・42 AY40・41・42
FX-1PG・FX-1GM・FX10GM	FX_2-32MT



(3) Parameter setting

Set "□□□1" in parameter No.PA03 to make the absolute position detection system valid. Set "□□□2" when using the communication-based ABS transfer system. Refer to section 14.10 for the communication-based ABS transfer system.



14.3 Battery installation procedure

⚠ WARNING	・Before starting battery installation procedure, make sure that the charge lamp is off more than 15 minutes after main circuit power is switched OFF. Then, confirm that the voltage between P-N terminals is safe in the tester or the like with control circuit power ON. Otherwise, you may get an electrical shock.

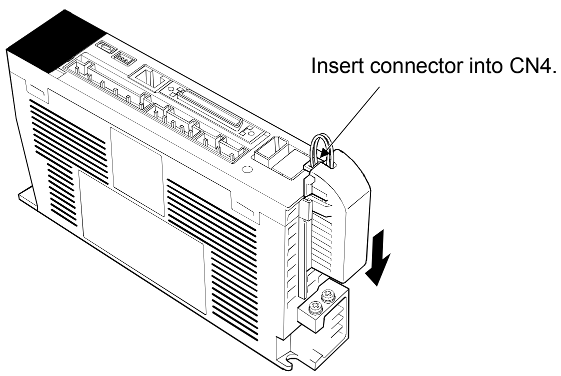
POINT

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.
- Before starting battery changing procedure, make sure that the main circuit power is switched OFF with the control circuit power ON. When battery is changed with the control power OFF, the absolute position data is lost.

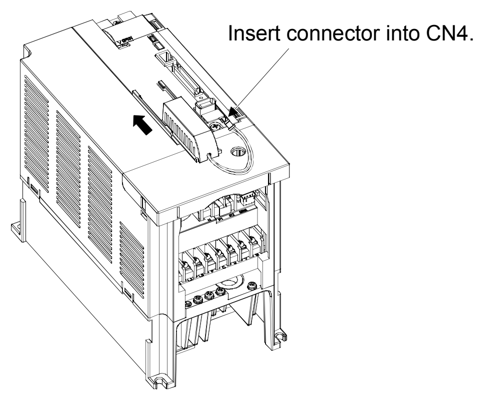
(1) For MR-J3-350A or less

POINT

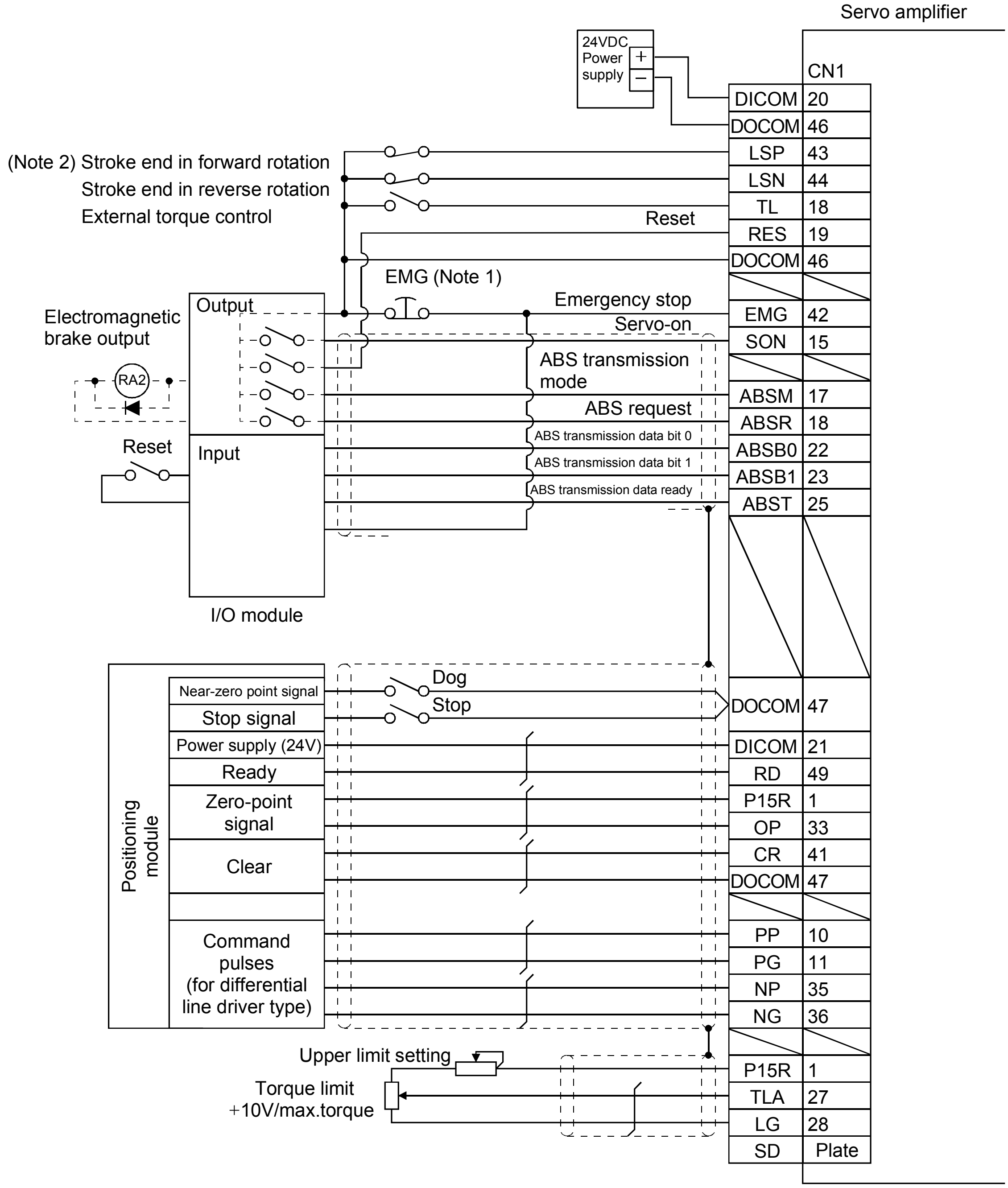
- For the servo amplifier of 3.5kW or less, the structure is not designed for the installation with a battery set. Be sure to set the battery after installing the servo amplifier.



(2) For MR-J3-500A or more



14.4 Standard connection diagram



Note 1. Always install the emergency stop switch.

2. For operation, always turn on forward rotation stroke end (LSP)/reverse rotation stroke end (LSN).

14.5 Signal explanation

When the absolute position data is transferred, the signals of connector CN1 change as described in this section. They return to the previous status on completion of data transfer. The other signals are as described in section 3.5.
For the I/O interfaces (symbols in the I/O Category column in the table), refer to section 3.8.2.

Signal name	Code	CN1 Pin No.	Function/Application	I/O category	Control mode
ABS transfer mode	ABSM	(Note) 17	While ABSM is on, the servo amplifier is in the ABS transfer mode, and the functions of ZSP, TLC, and D01 are as indicated in this table.	DI-1	P (Position control)
ABS request	ABSR	(Note) 18	Turn on ABSR to request the ABS data in the ABS transfer mode.	DI-1	
ABS transmission data bit 0	ABSB0	22	Indicates the lower bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, D01 turns on.	DO-1	
ABS transmission data bit 1	ABSB1	23	Indicates the upper bit of the ABS data (2 bits) which is sent from the servo to the programmable controller in the ABS transfer mode. If there is a signal, ZSP turns on.	DO-1	
ABS transmission data ready	ABST	25	Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion of the ready state, TLC turns on.	DO-1	
Home position setting	CR	41	When CR is turned on, the position control counter is cleared and the home position data is stored into the non-volatile memory (backup memory).	DI-1	

Note. When "Used in absolute position detection system" is selected in parameter No.PA03, pin 17 acts as the ABS transfer mode (ABSM) and pin 18 as the ABS request (ABSR). They do not return to the original signals if data transfer ends.

14.6 Startup procedure

(1) Battery installation.
Refer to section 14.3 installation of absolute position backup battery.

(2) Parameter setting
Set "□□□ 1"in parameter No.PA03 of the servo amplifier and switch power off, then on.

(3) Resetting of absolute position erase (AL.25)
After connecting the encoder cable, the absolute position erase (AL.25) occurs at first power-on. Leave the alarm as it is for a few minutes, then switch power off, then on to reset the alarm.

(4) Confirmation of absolute position data transfer
When the servo-on (SON) is turned on, the absolute position data is transferred to the programmable controller. When the ABS data is transferred properly:
(a) The ready output (RD) turns on.

(b) The programmable controller/ABS data ready contact turns on.

(c) The servo configuration software ABS data display window (refer to section 14.11) and programmable controller side ABS data registers show the same value (at the home position address of 0).
If any warning such as ABS time-out warning (AL.E5) or programmable controller side transfer error occurs, refer to section 14.9 or chapter 9 and take corrective action.

(5) Home position setting
The home position must be set if:
(a) System setup is performed;

(b) The servo amplifier has been changed;

(c) The servo motor has been changed; or

(d) The absolute position erase (AL.25) occurred.

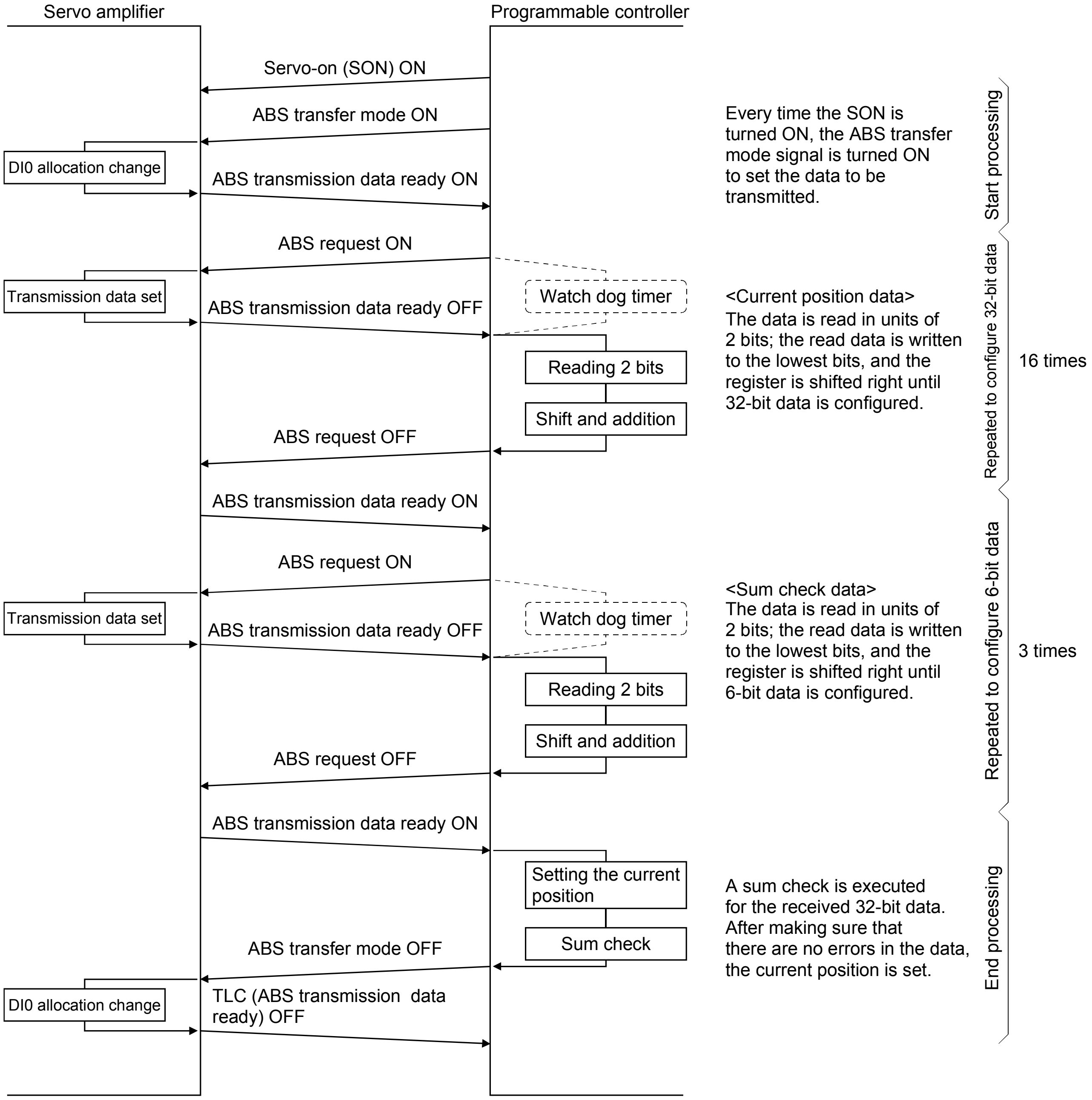
In the absolute position system, the absolute position coordinates are made up by making home position setting at the time of system setup.
The motor shaft may misoperate if positioning operation is performed without home position setting. Always make home position setting before starting operation.
For the home position setting method and types, refer to section 14.7.3.

14.7 Absolute position data transfer protocol

POINT
・After switching on the ABS transfer mode (ABSM), turn on the servo-on signal (SON). When the ABS transfer mode is off, turning on the servo-on signal (SON) does not switch on the base circuit.

14.7.1 Data transfer procedure

Each time the servo-on (SON) is turned ON (when the power is switched ON for example), the programmable controller reads the position data (present position) of the servo amplifier.
Time-out monitoring is performed by the programmable controller.

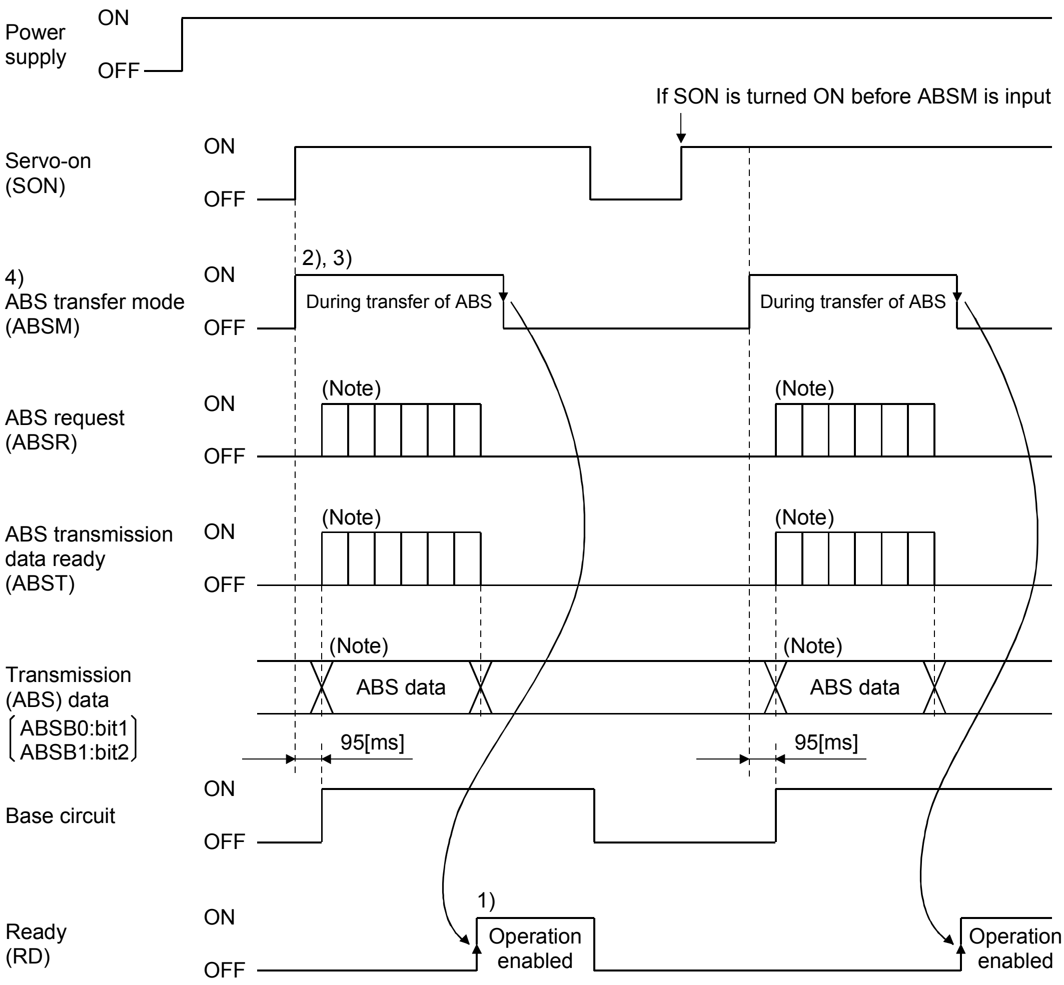


14.7.2 Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on (SON) going OFF, an emergency stop (EMG), or alarm (ALM), is explained below. In the absolute position detection system, every time the servo-on (SON) is turned on, the ABS transfer mode (ABSM) should always be turned on to read the current position in the servo amplifier to the controller. The servo amplifier transmits to the controller the current position latched when the ABS transfer mode (ABSM) switches from OFF to ON. At the same time, this data is set as a position command value inside the servo amplifier. Unless the ABS transfer mode (ABSM) is turned ON, the base circuit cannot be turned ON.

(1) At power-on

(a) Timing chart

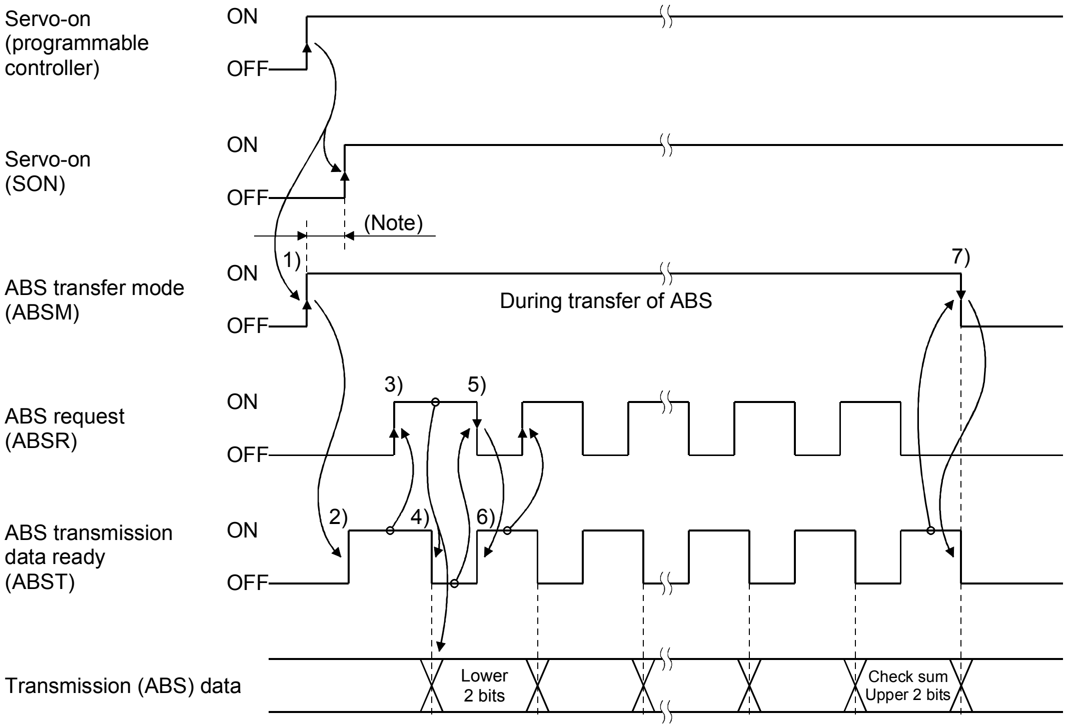


Note. For details, refer to (1) (b) of this section.

1) The ready (RD) is turned ON when the ABS transfer mode (ABSM) is turned OFF after transmission of the ABS data.
   While the ready (RD) is ON, the ABS transfer mode (ABSM) input is not accepted.
2) Even if the servo-on (SON) is turned ON before the ABS transfer mode (ABSM) is turned ON, the base circuit is not turned ON until the ABS transfer mode (ABSM) is turned ON.
   If a servo alarm has occurred, the ABS transfer mode (ABSM) is not received.
   The ABS transfer mode (ABSM) allows data transmission even while a servo warning is occurring.
3) If the ABS transfer mode (ABSM) is turned OFF during the ABS transfer mode, the ABS transfer mode is interrupted and the time-out error (AL.E5) occurs.
4) The functions of output signals such as ABST, ABSB0, and ABSB1 change depending on the ON/OFF state of the ABS transfer mode (ABSM).
   Note that if the ABS transfer mode (ABSM) is turned ON for a purpose other than ABS data transmission, the output signals will be assigned the functions of ABS data transmission.

CN1 Pin No.	Output signal	
	ABS transfer mode (ABSM): OFF	ABS transfer mode (ABSM): ON
22	Positioning completion	ABS transmission data bit 0
23	Zero speed	ABS transmission data bit 1
25	During torque limit control	ABS transmission data ready

(b) Detailed description of absolute position data transfer



Note. If the servo-on (SON) is not turned ON within 1 second after the ABS transfer mode (ABSM) is turned ON, an SON time-out warning (AL.EA) occurs. This warning, however, does not interrupt data transmission. It is automatically cleared when the servo-on (SON) is turned ON.

1) The programmable controller turns ON the ABS transfer mode (ABSM) and servo-on (SON) at the leading edge of the internal servo-on (SON).
2) In response to the ABS transfer mode (ABSM), the servo detects and calculates the absolute position and turns ON the ABS transmission data ready (ABST) to notify the programmable controller that the servo is ready for data transmission.
3) After acknowledging that the ready to send (ABST) has been turned ON, the programmable controller turns ABS request (ABSR) ON.
4) In response to ABS request (ABSR), the servo outputs the lower 2 bits of the ABS data and the ABS transmission data ready (ABST) in the OFF state.
5) After acknowledging that the ABS transmission data ready (ABST) has been turned OFF, which implies that 2 bits of the ABS data have been transmitted, the programmable controller reads the lower 2 bits of the ABS data and then turns OFF the ABS request (ABSR).
6) The servo turns ON the ABS transmission data ready (ABST) so that it can respond to the next request.
   Steps 3) to 6) are repeated until 32-bit data and the 6-bit check sum have been transmitted.
7) After receiving of the check sum, the programmable controller turns the ABS transfer mode (ABSM) OFF.
   If the ABS transfer mode (ABSM) is turned OFF during data transmission, the ABS transfer mode (ABSM) is interrupted.

(c) Checksum

The check sum is the code which is used by the programmable controller to check for errors in the received ABS data. The 6-bit check sum is transmitted following the 32-bit ABS data.
At the programmable controller, calculate the sum of the received ABS data using the ladder program and compare it with the check sum code sent from the servo.
The method of calculating the check sum is shown. Every time the programmable controller receives 2 bits of ABS data, it adds the data to obtain the sum of the received data. The check sum is 6-bit data.

Example: ABS data: −10 (FFFFFFF6H)

$$
\begin{array}{rr}
 & 10^{b} \\
 & 01^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
 & 11^{b} \\
+) & 11^{b} \\
\hline
 & 101101^{b}
\end{array}
$$

<Appendix>

Decimal	−10
Hexadecimal	FFFF FFF6
Binary	1111 1111 1111··········0110

When the binary data of each 2bits of the ABS data is added up, "10 1101^{b} " is obtained.

Therefore, the check sum of "−10" (ABS data) is "$2D^{b}$"

(2) Transmission error

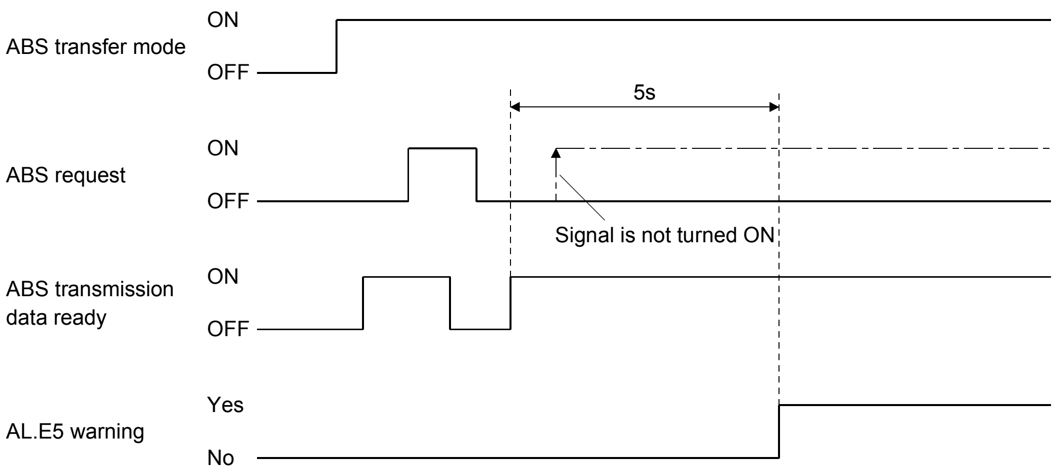
(a) Time-out warning(AL.E5)

In the ABS transfer mode, the time-out processing shown below is executed at the servo. If a time-out error occurs, an ABS time-out warning (AL.E5) is output.

The ABS time-out warning (AL.E5) is cleared when the ABS transfer mode (ABSM) changes from OFF to ON.

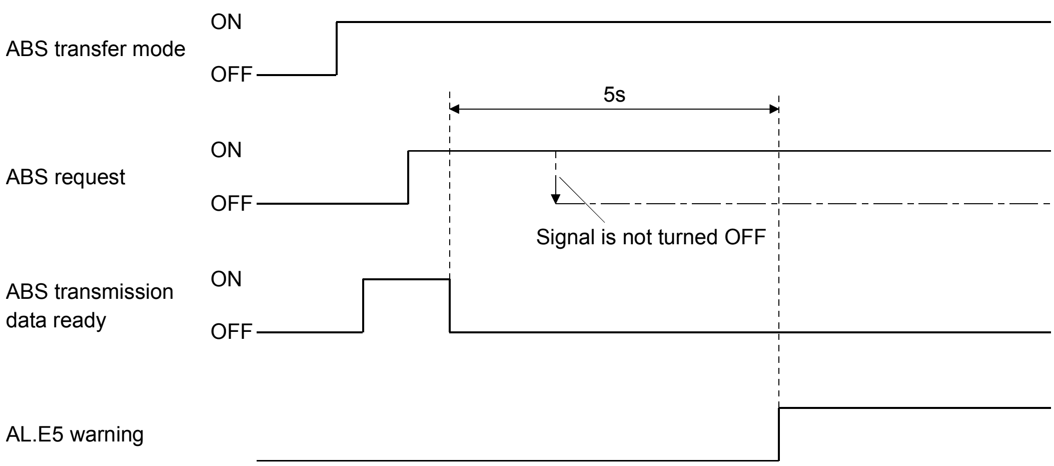
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned ON by the programmable controller within 5s after the ABS transmission data ready (ABST) is turned ON, this is regarded as a transmission error and the ABS time-out warning (AL.E5) is output.



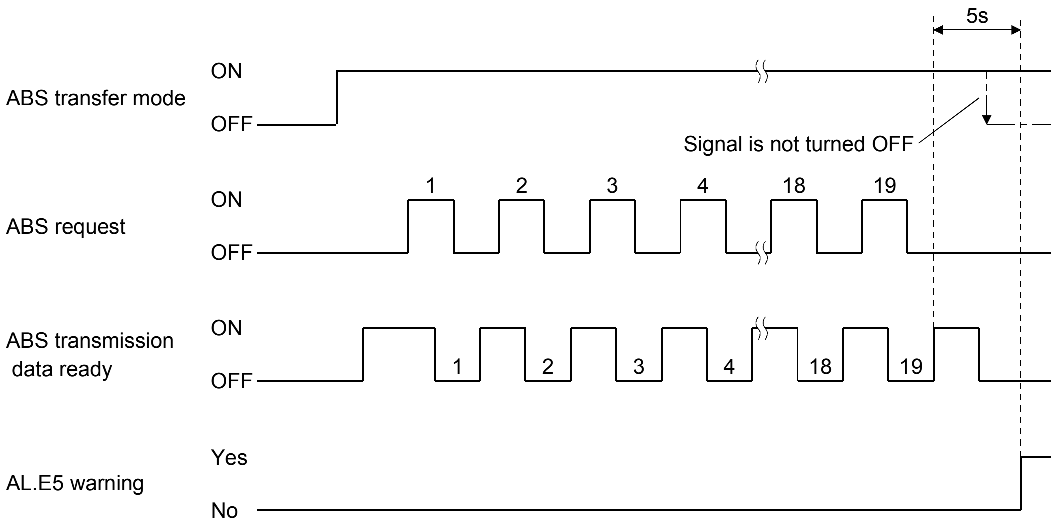
2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned OFF by the programmable controller within 5s after the ABS transmission data ready (ABST) is turned OFF, this is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.



3) ABS transfer mode finish-time time-out check

If the ABS transfer mode (ABSR) is not turned OFF within 5s after the last ready to send signal (19th signal for ABS data transmission) is turned ON, it is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.

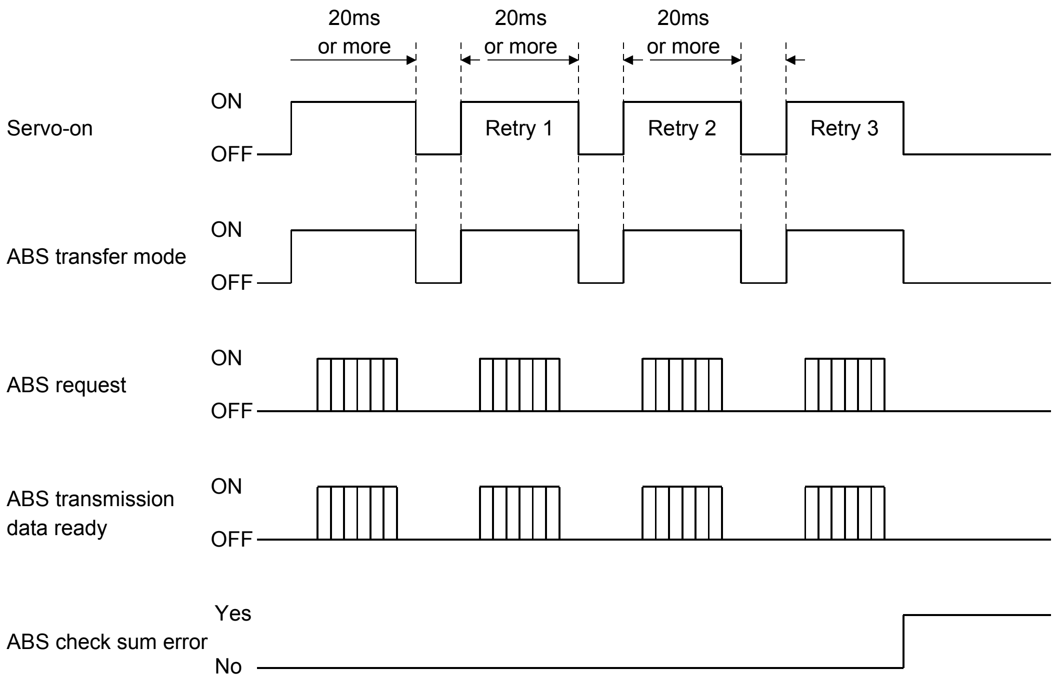


(b) Check sum error

If the check sum error occurs, the programmable controller should retry transmission of the ABS data. Using the ladder check program, turn OFF the ABS transfer mode (ABSM) and servo-on (SON) once. Turn them ON again after an OFF time of longer than 20 ms.

If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

The start command should be interlocked with the ABS data ready signal to disable positioning operation when an check sum error occurs.

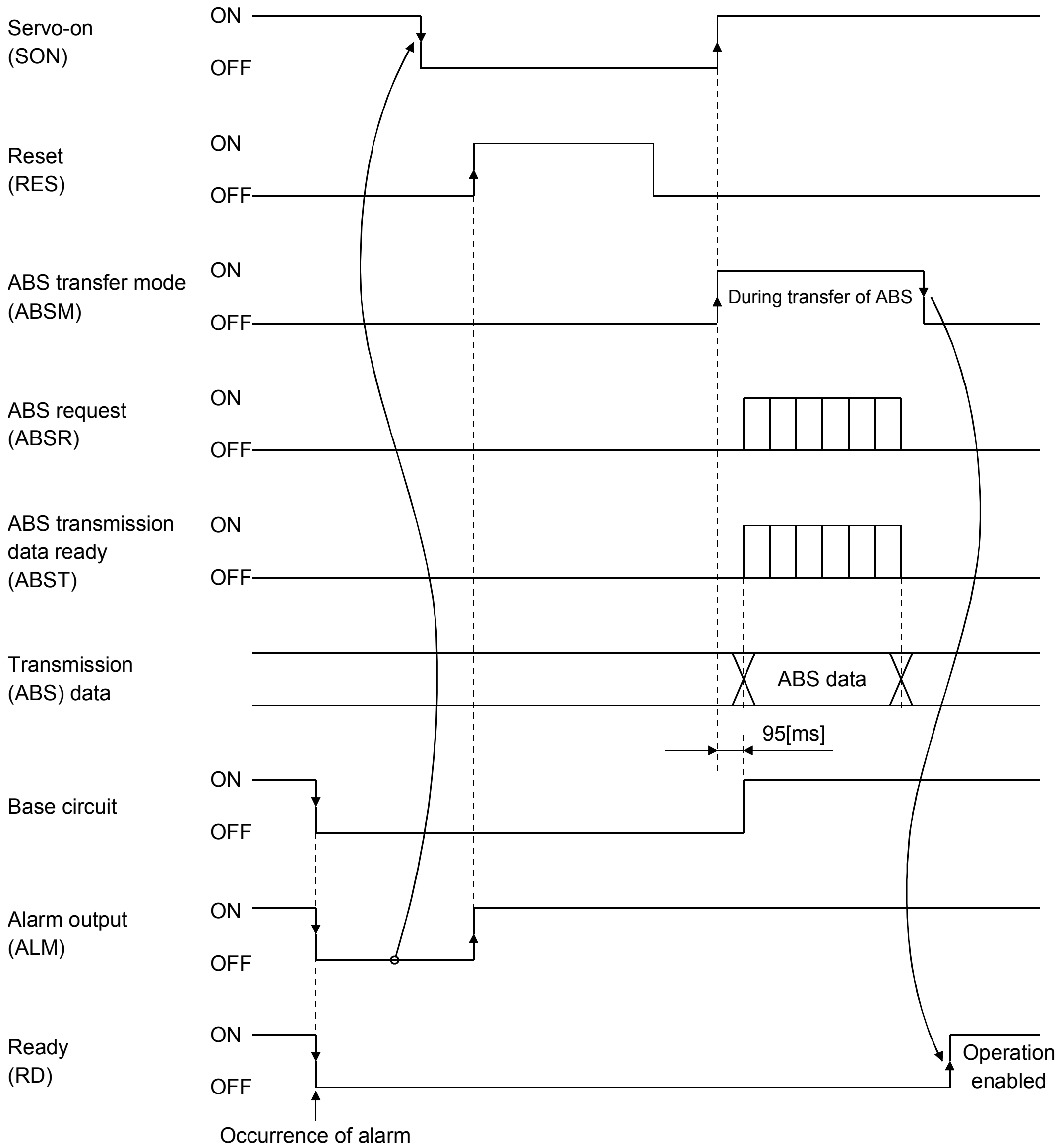


(3) At the time of alarm reset

If an alarm occurs, turn OFF the servo-on (SON) by detecting the alarm output (ALM).

If an alarm has occurred, the ABS transfer mode (ABSM) cannot be accepted.

In the reset state, the ABS transfer mode (ABSM) can be input.



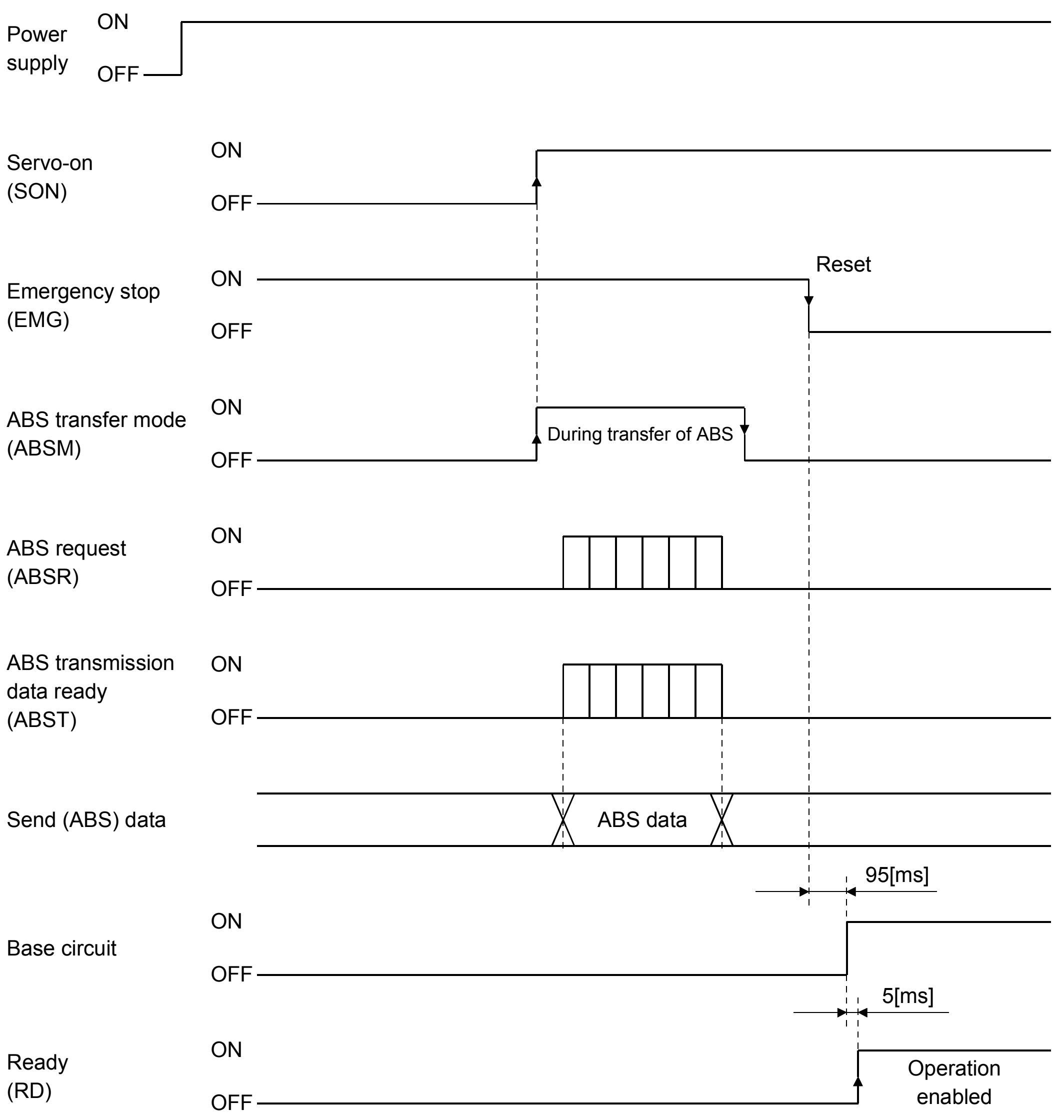
(4) At the time of emergency stop reset

(a) If the power is switched ON in the emergency stop state

The emergency stop state can be reset while the ABS data is being transferred.

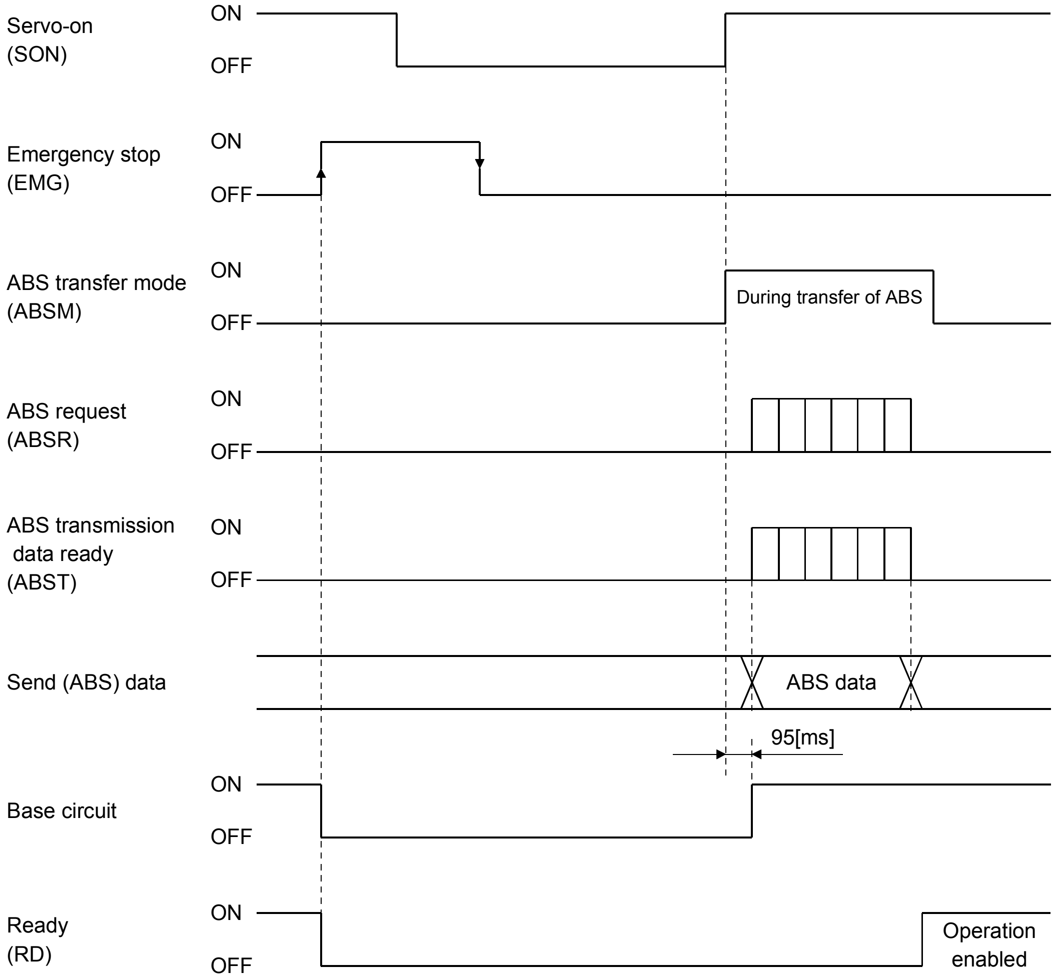
If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 95[ms] after resetting. If the ABS transfer mode (ABSM) is OFF when the base circuit is turned ON, the ready (RD) is turned ON 5[ms] after the turning ON of the base circuit. If the ABS transfer mode (ABSM) is ON when the base circuit is turned ON, it is turned OFF and then the ready (RD) is turned ON. The ABS data can be transmitted after the emergency stop state is reset.

The current position in the servo amplifier is updated even during an emergency stop. When servo-on (SON) and ABS transfer mode (ABSM) are turned ON during an emergency stop as shown below, the servo amplifier transmits to the controller the current position latched when the ABS transfer mode (ABSM) switches from OFF to ON, and at the same time, the servo amplifier sets this data as a position command value. However, since the base circuit is OFF during an emergency stop, the servo-lock status is not encountered. Therefore, if the servo motor is rotated by external force or the like after the ABS transfer mode (ABSM) is turned ON, this travel is accumulated in the servo amplifier as droop pulses. If the emergency stop is cleared in this status, the base circuit turns ON and the motor returns to the original position rapidly to compensate for the droop pulses. To avoid this status, reread the ABS data before clearing the emergency stop.



(b) If emergency stop is activated during servo-on

The ABS transfer mode (ABSM) is permissible while in the emergency stop state. In this case, the base circuit and the ready (RD) are turned ON after the emergency stop state is reset.



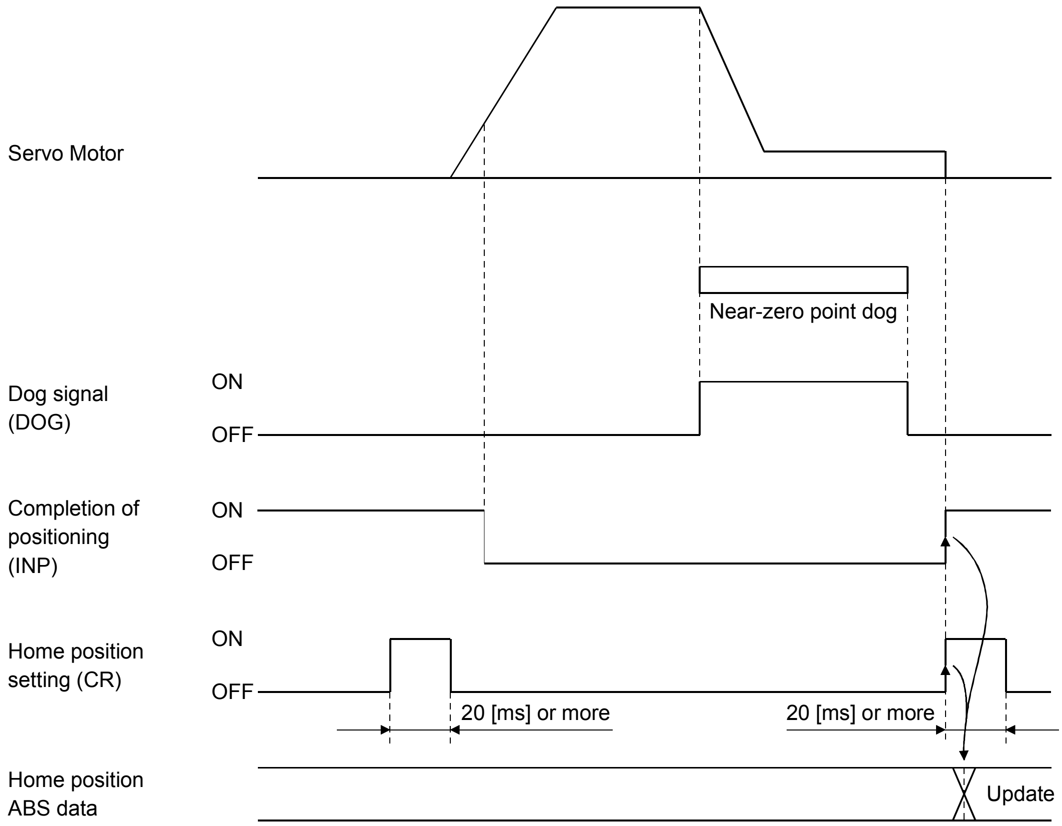
14.7.3 Home position setting

(1) Dog type home position return

Preset a home position return creep speed at which the machine will not be given impact. On detection of a zero pulse, the home position setting (CR) is turned from off to on. At the same time, the servo amplifier clears the droop pulses, comes to a sudden stop, and stores the stop position into the non-volatile memory as the home position ABS data.

The home position setting (CR) should be turned on after it has been confirmed that the in-position (INP) is on. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.

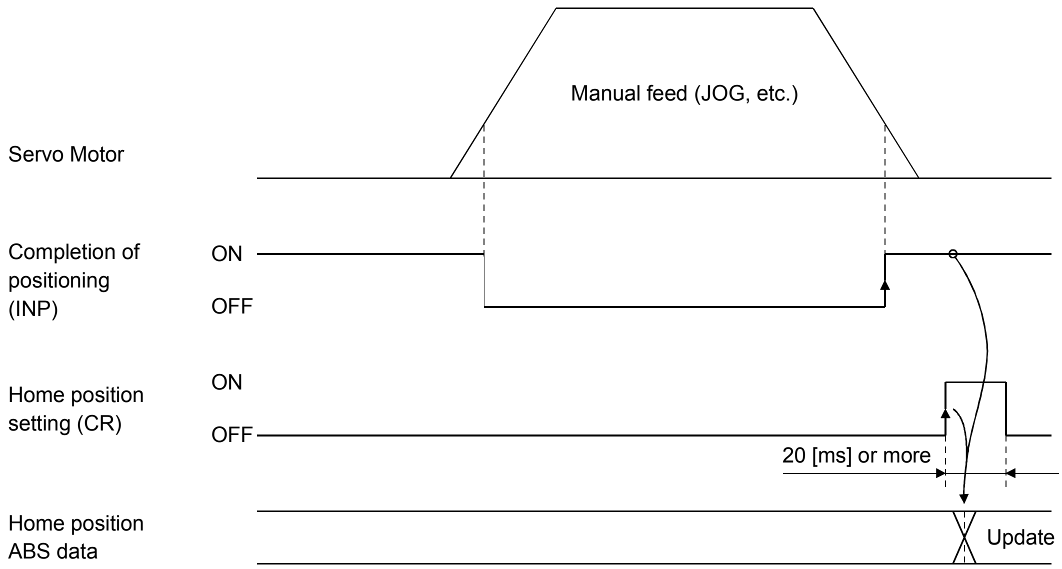
The number of home position setting times is limited to 1,000,000 times.



(2) Data set type home position return

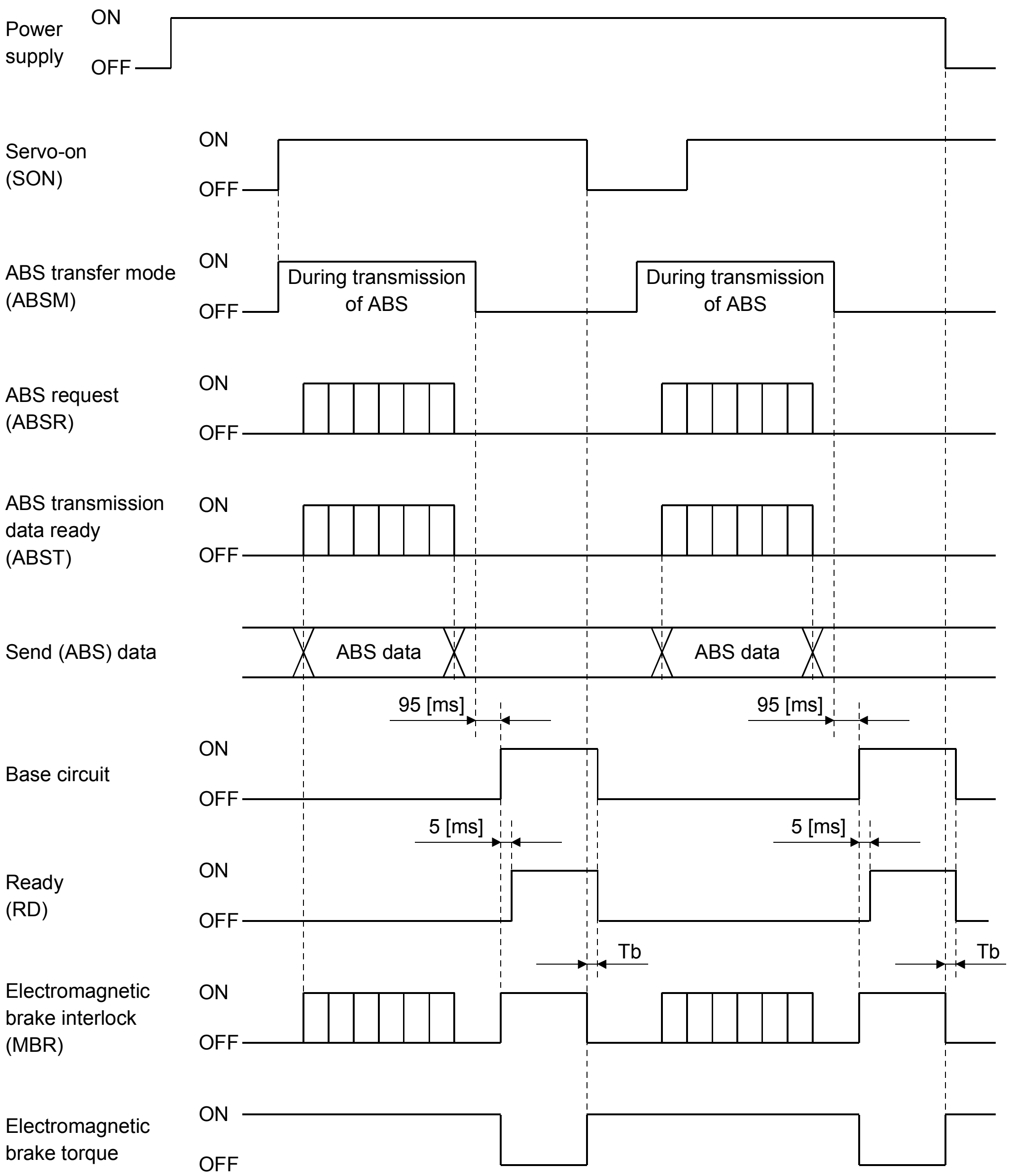
POINT
· Never make home position setting during command operation or servo motor rotation. It may cause home position sift. · It is possible to execute data set type home position return when the servo off.

Move the machine to the position where the home position is to be set by performing manual operation such as jog operation. When the home position setting (CR) is on for longer than 20ms, the stop position is stored into the non-volatile memory as the home position ABS data.
When the servo on, set home position setting (CR) to ON after confirming that the in-position (INP) is ON. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.
The number of home position setting times is limited to 1,000,000 times.



14.7.4 Use of servo motor with electromagnetic brake

The timing charts at power on/off and servo-on (SON) on/off are given below.
Preset parameter No. PA04/PD13 to PD16/PD18 of the servo amplifier to make the electromagnetic brake interlock (MBR) valid. When the ABS transfer mode is ON, the electromagnetic brake interlock (MBR) set in parameter No. PA04 is used as the ABS data bit 1.
Hence, make up an external sequence which will cause the electromagnetic brake torque to be generated by the ABS mode (ABSM) and electromagnetic brake interlock (MBR).



14.7.5 How to process the absolute position data at detection of stroke end

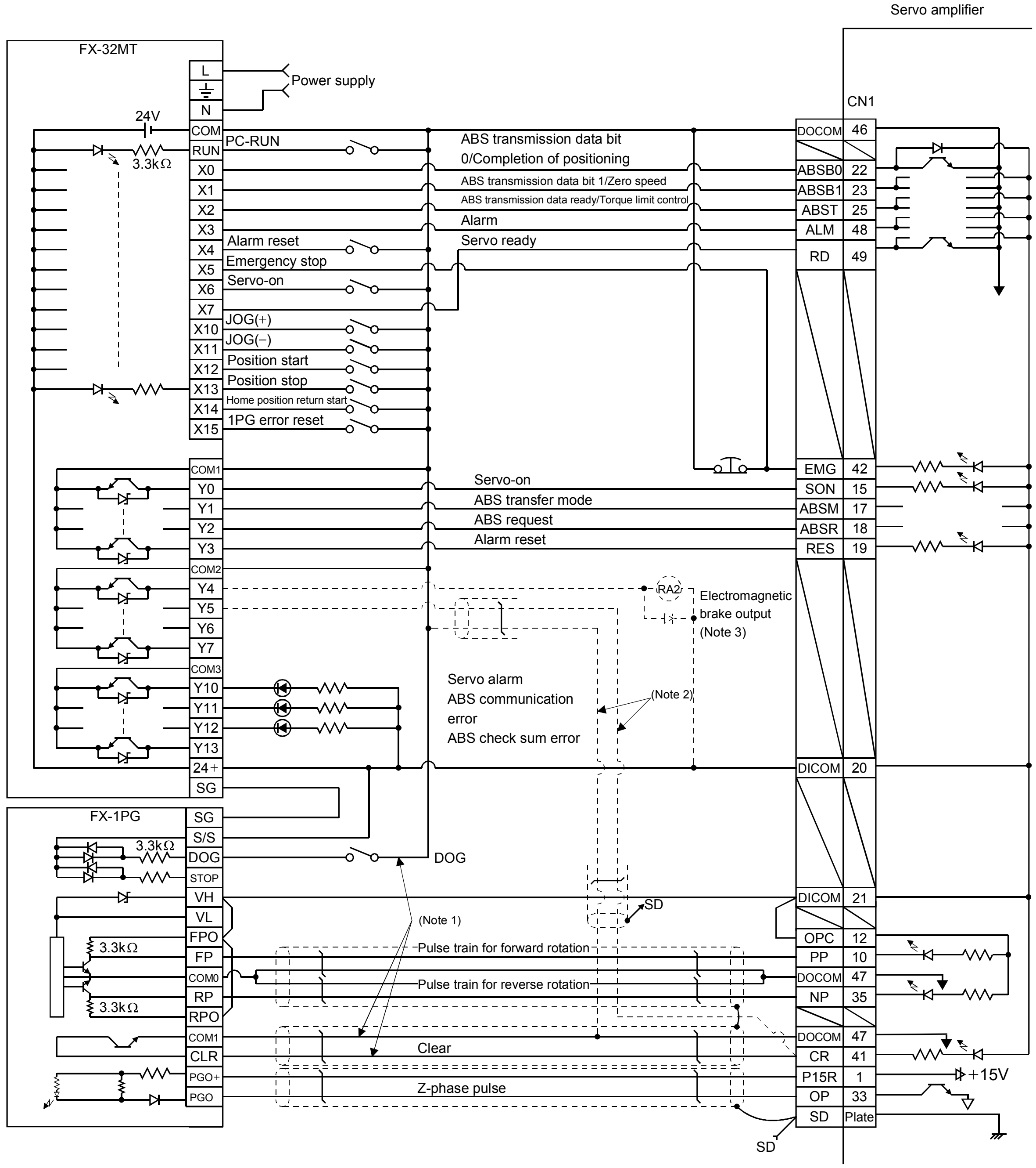
The servo amplifier stops the acceptance of the command pulse when stroke end (LSP・LSN) is detected, clears the droop pulses to 0 at the same time, and stops the servo motor rapidly.
At this time, the programmable controller keeps outputting the command pulse. Since this causes a discrepancy between the absolute position data of the servo amplifier and the programmable controller, a difference will occur between the position data of the servo amplifier and that of the programmable controller.
To prevent this difference in position data from occurring, do as described below. When the servo amplifier has detected the stroke end, perform jog operation or the like to clear the stroke end. After that, switch the servo-on (SON) off once, then on again, or switch the power off once, then on again. This causes the absolute position data of the servo amplifier to be transferred to the programmable controller, restoring the normal data.

14.8 Examples of use

14.8.1 MELSEC FX(2N)-32MT (FX(2N)-1PG)

(1) Connection diagram

(a) FX-32MT (FX-1PG)

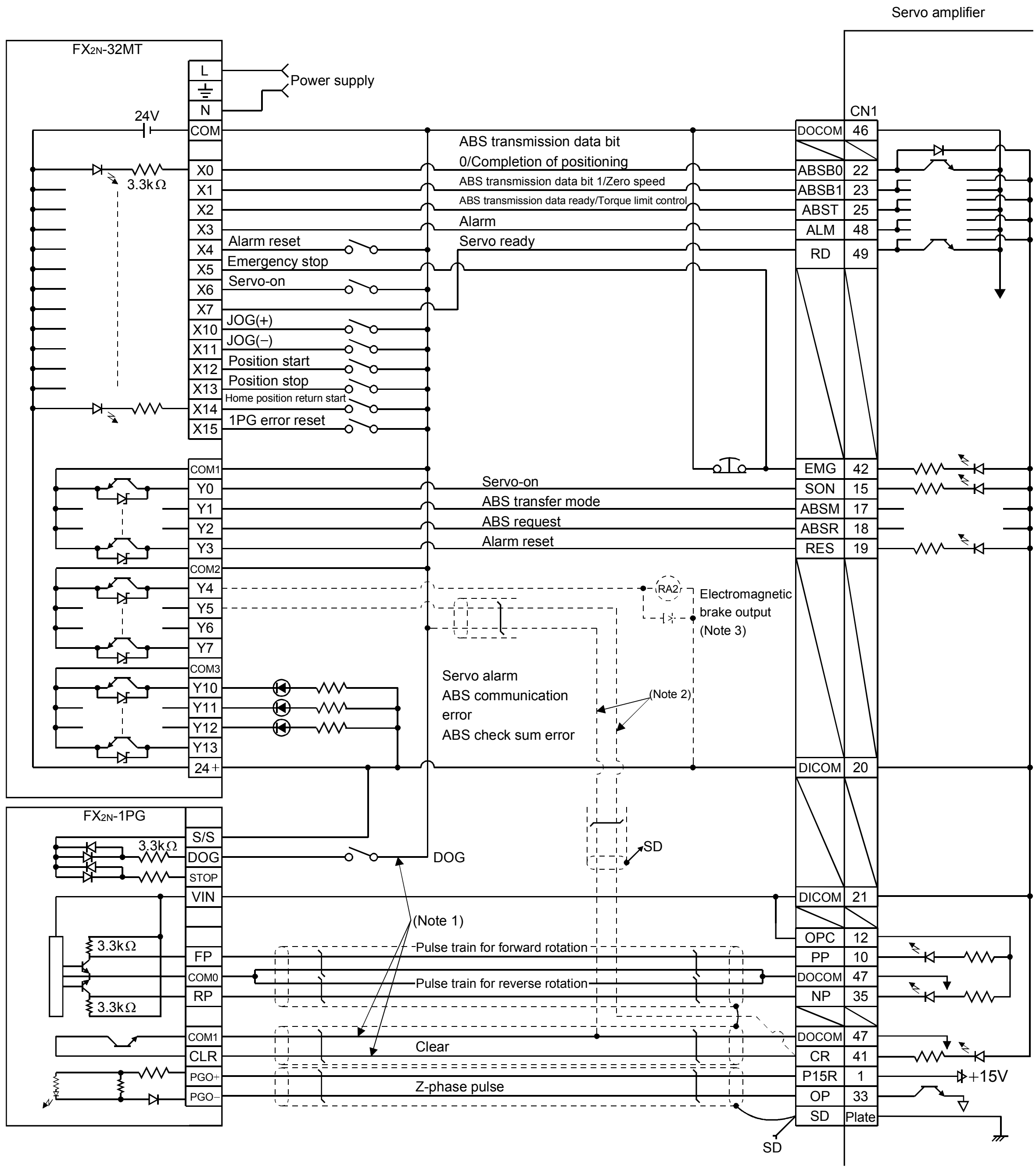


Note 1. To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2. To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

3. The electromagnetic brake interlock (MBR) should be controlled by connecting the programmable controller output to a relay.

(b) FX2N-32MT (FX2N-1PG)



Note 1. To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).

2. To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).

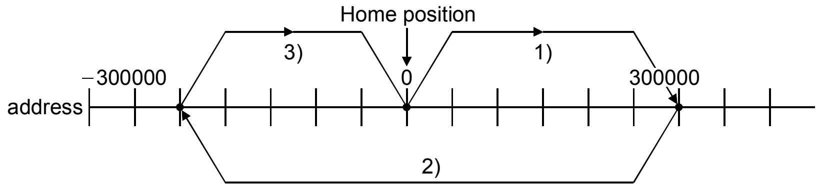
3. The electromagnetic brake interlock (MBR) should be controlled by connecting the programmable controller output to a relay.

(2) Sequence program example

(a) Conditions

1) Operation pattern

ABS data transfer is made as soon as the servo-on pushbutton is turned on. After that, positioning operation is performed as shown below:



After the completion of ABS data transmission, JOG operation is possible using the JOG+ or JOG− pushbutton switch.

After the completion of ABS data transmission, dog type home position return is possible using the home position return pushbutton switch.

2) Buffer memory assignment

For BFM#26 and later, refer to the FX2(N)-1PG User's Manual.

BMF No.		Name and symbol		Set value	Remark
Upper 16 bits	Lower 16 bits				
-	#0	Pulse rate	A	2000	
#2	#1	Feed rate	B	1000	
-	#3	Parameter		H0000	Command unit: Pulses
#5	#4	Max. speed	Vmax	100000PPS	
-	#6	Bias speed	Vbia	0PPS	
#8	#7	JOG operation	Vjog	10000PPS	
#10	#9	Home position return speed (high speed)	V_{RT}	50000PPS	
-	#11	Home position return speed (creep)	V_{CL}	1000PPS	
-	#12	Home position return zero-point signal count	N	2 pulses	Initial value: 10
#14	#13	Home position address	HP	0	
-	#15	Acceleration/deceleration time	Ta	200ms	Initial value: 100
-	#16	Not usable			
#18	#17	Target address (I)	P(I)	0	
#20	#19	Operation speed (I)	V(I)	100000	Initial value: 10
#22	#21	Target address (II)	P(II)	0	
#24	#23	Operation speed (II)	V(II)	10	
-	#25	Operation command		H0000	

3) Instructions

When the servo-on pushbutton switch and the GND of the power supply are shorted, the ABS data is transmitted when the servo amplifier power is turned ON, or at the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset, or when the emergency stop state is reset.

If check sum discrepancy is detected in the transmitted data, the ABS data transmission is retried up to three times. If the check sum discrepancy is still detected after retrying, the ABS check sum error is generated (Y12 ON).

The following time periods are measured and if the ON/OFF state does not change within the specified time, the ABS communication error is generated (Y11 ON).

ON period of ABS transfer mode (Y1)

ON period of ABS request (Y2)

OFF period of ready to send the ABS data (X2).

(b) Device list

X input contact		Y output contact	
X0	Transmission data bit 0 / completion of positioning	Y0	Servo-on
X1	Transmission data bit 1 / zero speed	Y1	ABS transfer mode
X2	Send ABS transmission data ready/ torque limit control	Y2	ABS request
X3	Servo alarm	Y3	Alarm reset
X4	Alarm reset PB	Y4 (Note 2)	Electromagnetic brake output
X5	Servo emergency stop	Y5 (Note 1)	Clear
X6	Servo-on PB	Y10	Servo alarm
X7	Servo ready	Y11	ABS communication error
X10	JOG (+) PB	Y12	ABS check sum error
X11	JOG (−) PB		
X12	Position start PB		
X13	Position stop PB		
X14	Home position return start PB		
X15	1PG error reset		

D register	
D0	ABS data: Lower 16 bits
D1	ABS data: Upper 16 bits
D2	Check sum addition counter
D3	Check data in case of check sum error
D4	Transmission retry count in check sum discrepancy
D24	Home position address: Lower 16 bits
D25	Home position address: Upper 16 bits
D106	1PG present position address: Lower 16 bits
D107	1PG present position address: Upper 16 bits

M contact	
M0	Error flag
M1	ABS data transmission start
M2	Retry command
M3	ABS data read
M4	Spare
M5	Servo-on request
M6	Retry flag
M10	ABS data 2 bit receiving buffer
M11	
M12	
M13	
M20	ABS data 32 bit buffer
↓	
M51	
M52	Check sum 6 bit buffer
↓	
M57	
M58	For checksum comparison
M59	
M62	Sum check discrepancy (greater) >
M63	Sum check discrepancy =
M64	Sum check discrepancy (less) >
M70 (Note 1)	Clear (CR) ON timer request
M71 (Note 1)	Data set type home position return request
M99	ABS data ready

T timer	
T200	Retry wait timer
T201	ABS transfer mode timer
T202	ABS request response timer
T203	Ready to send response timer
T204	ABS data waiting timer
T210 (Note 1)	Clear (CR) ON timer

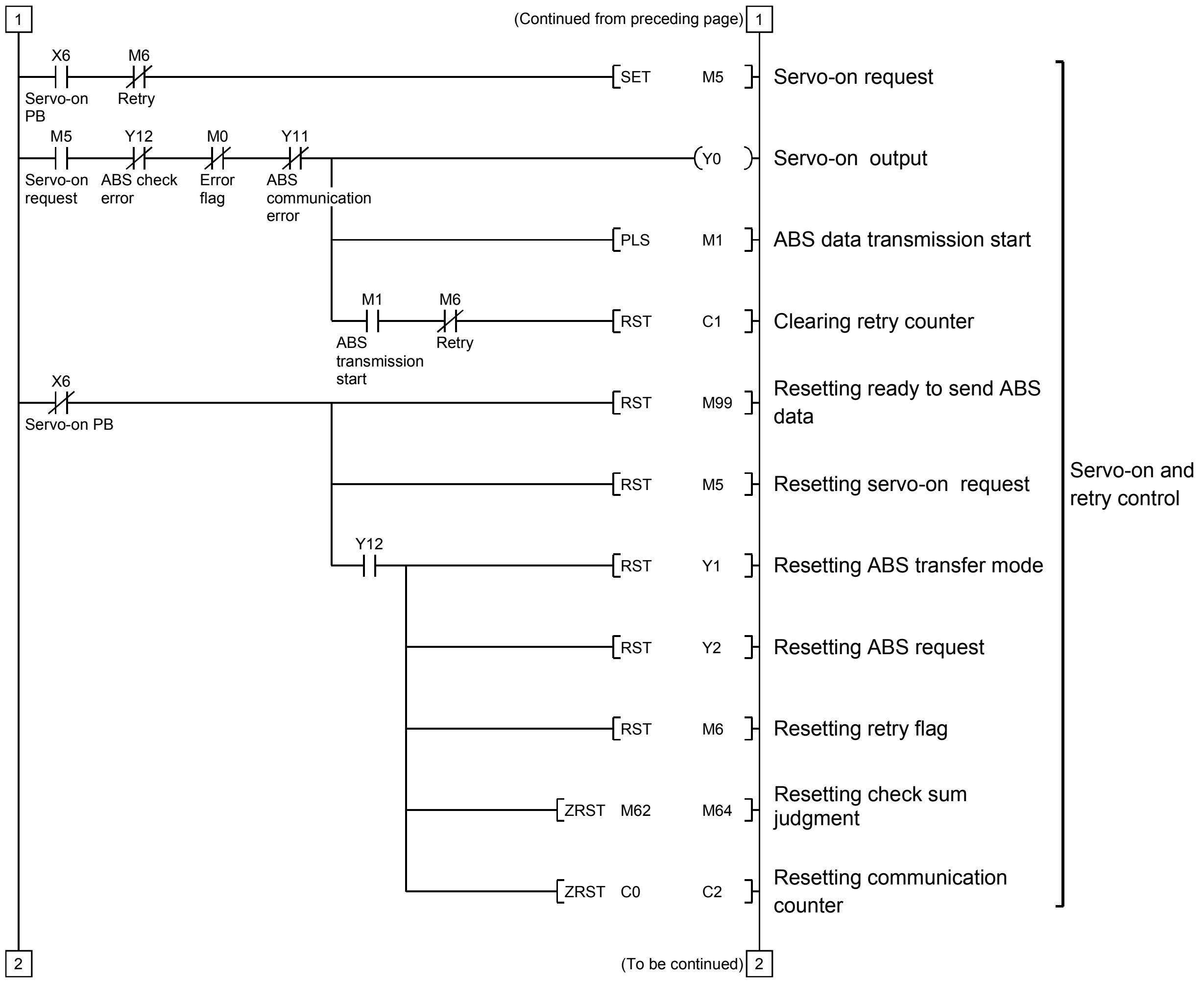
C counter	
C0	All data reception frequency counter (19 times)
C1	Check sum reception frequency counter
C2	ABS data reception frequency counter (16 times)

Note 1. Necessary when data set type home position return is executed.
2. Necessary in the event of electromagnetic brake output.

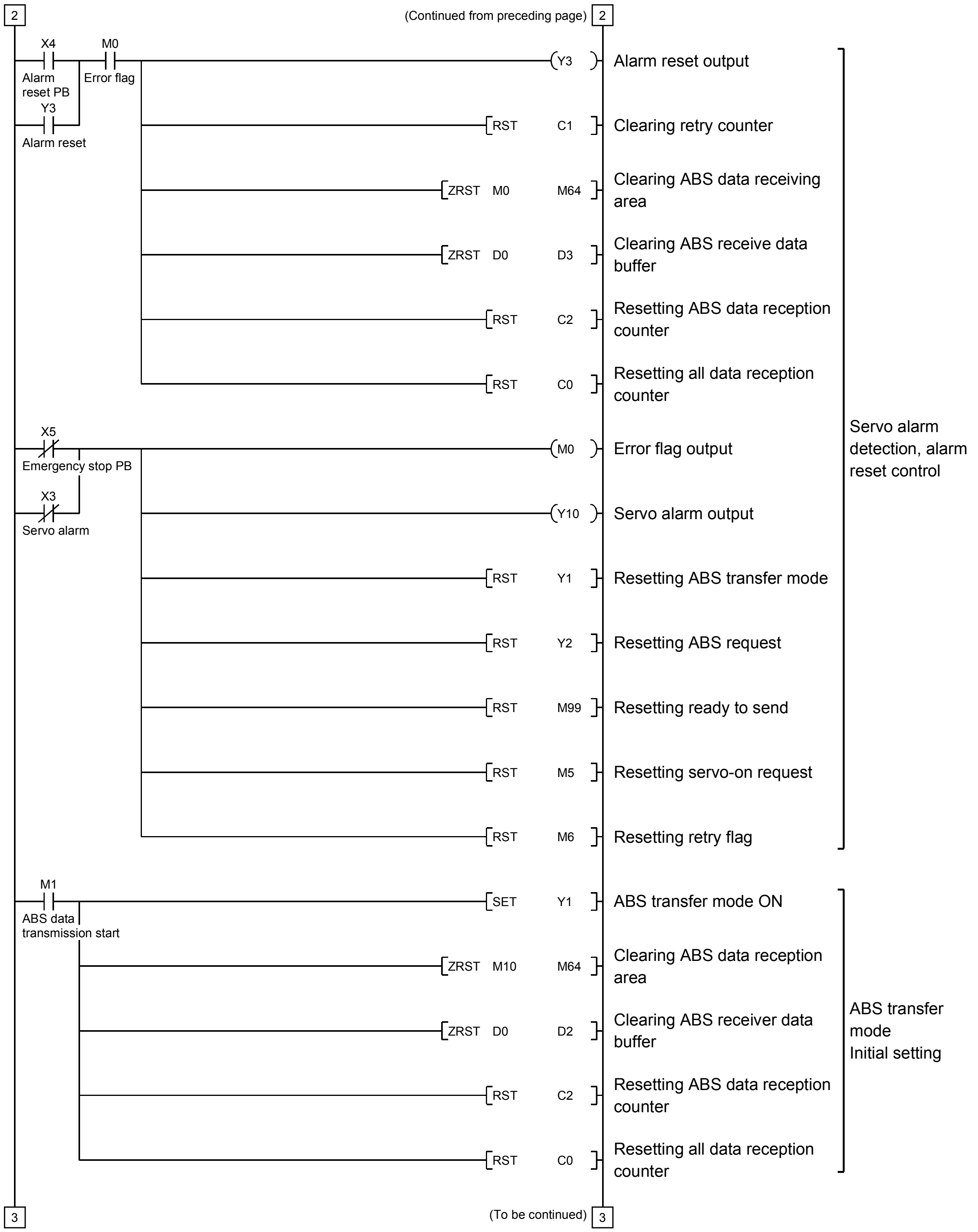
(c) ABS data transfer program for X-axis

M8002 Initial pulse	[DMOV K0 D24]	Setting home position address to 0	Initial setting
	[TO K0 K3 K0 K1]	Setting 1PG pulse command unit	
	[DTO K0 K4 K100000 K1]	1PG max. speed: 100 kpps	
	[DTO K0 K7 K10000 K1]	1PG Jog speed: 10 kpps	
	[DTO K0 K9 K50000 K1]	1PG home position return speed: 50 kpps	
	[TO K0 K11 K1000 K1]	1PG creep speed: 1 kpps	
	[TO K0 K12 K2 K1]	1PG home position return zero-point count: twice	
	[DTO K0 K13 D24 K1]	1PG home position address setting	
	[TO K0 K15 K200 K1]	1PG acceleration/deceleration time: 200ms	
	[DTO K0 K19 K100000 K1]	1PG operation speed: 100kpps	
	[DMOV K300000 D100]	Position move account 1: 300000 pulses	
	[DMOV K−250000 D102]	Position move account 2: −250000 pulses	
	[DMOV K0 D104]	Position move account 3: 0 pulses	
	[DMOV K0 Z]	Clearing index registers V, Z	
	[DMOV K4 D4]	Setting "4 times" for check sum error transmission frequency	

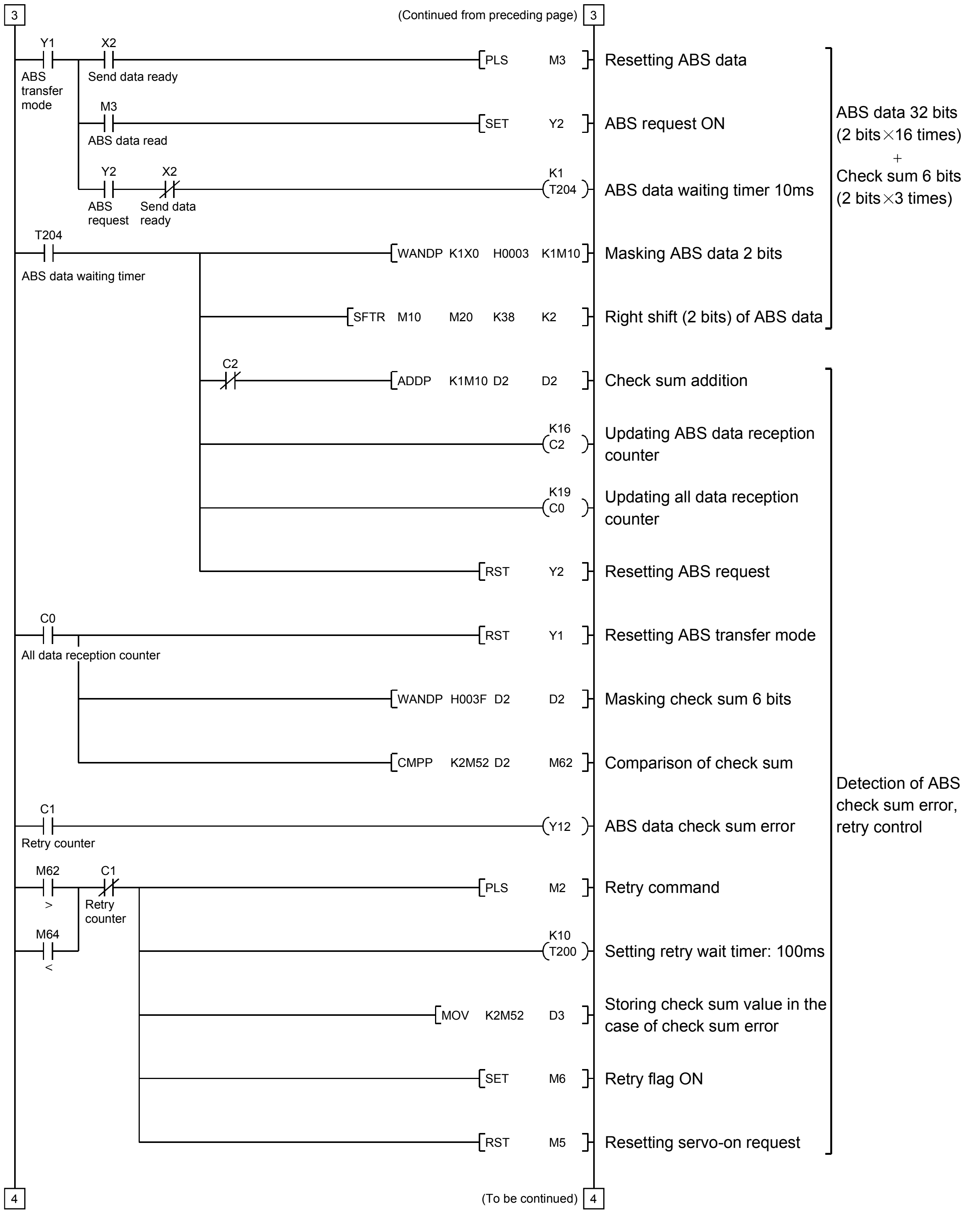
1 (To be continued) 1

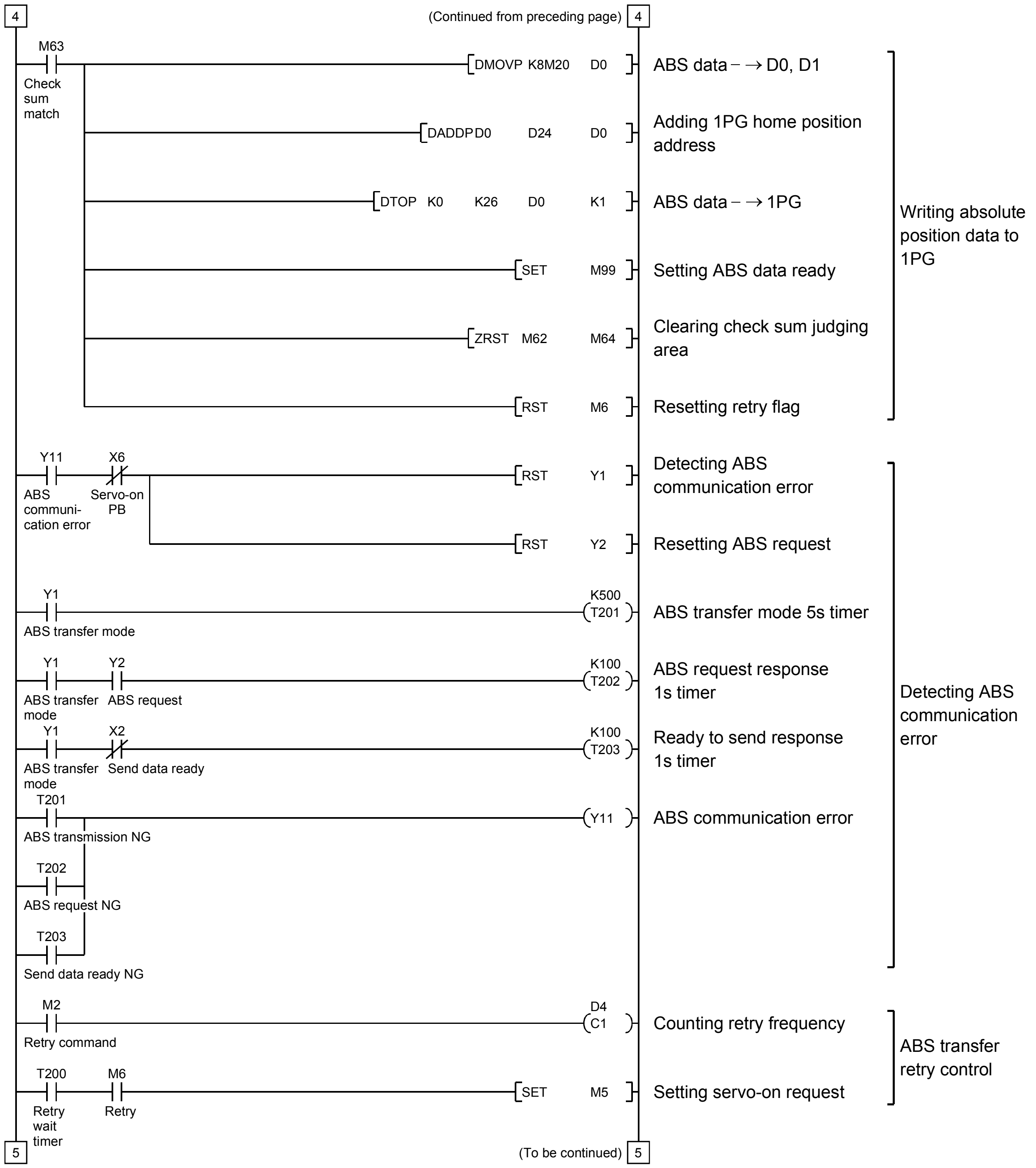


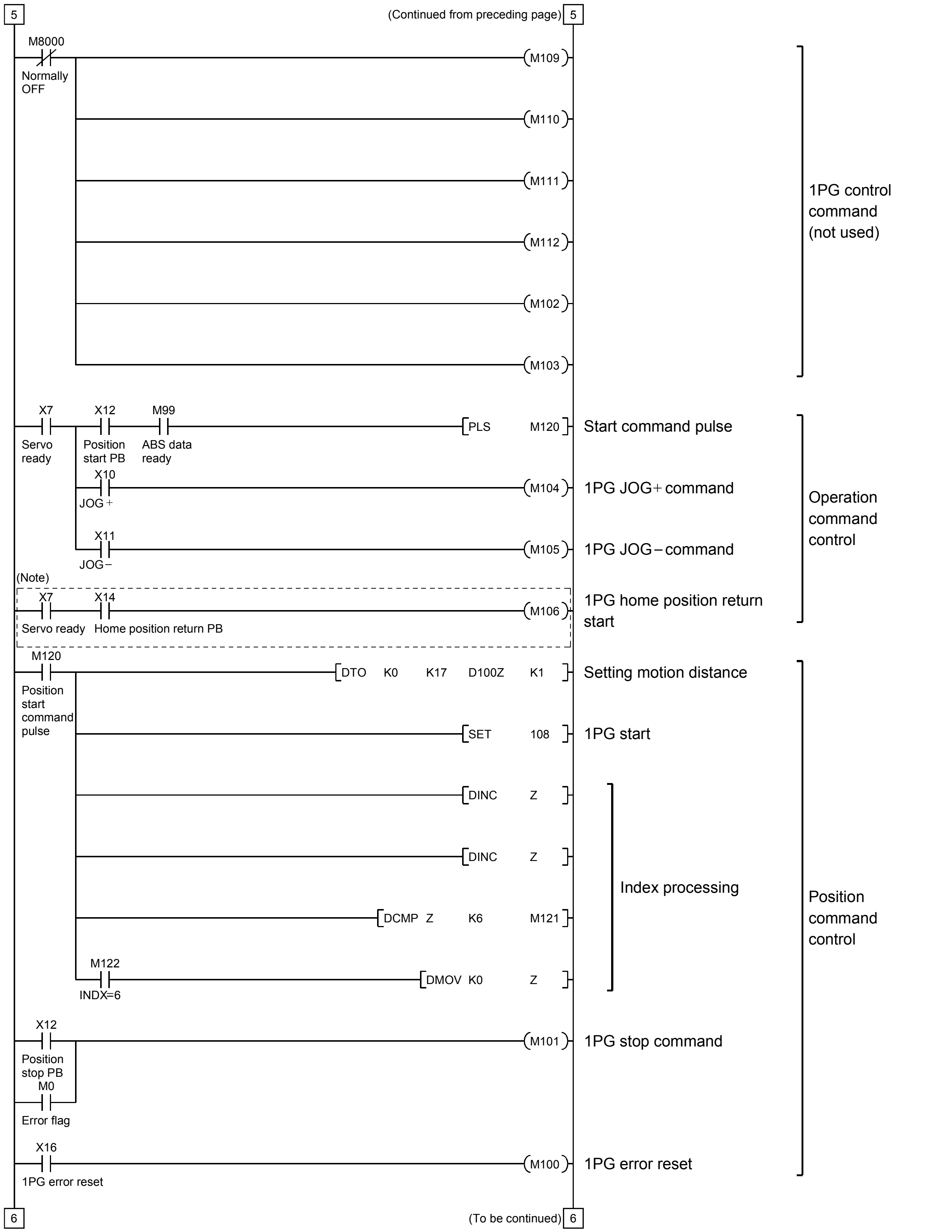
1
(Continued from preceding page) 1
X6
M6
Servo-on PB
Retry
SET M5
Servo-on request
M5
Y12
M0
Y11
Servo-on request
ABS check error
Error flag
ABS communication error
Y0
Servo-on output
PLS M1
ABS data transmission start
M1
M6
ABS transmission start
Retry
RST C1
Clearing retry counter
X6
Servo-on PB
RST M99
Resetting ready to send ABS data
RST M5
Resetting servo-on request
Y12
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M6
Resetting retry flag
ZRST M62 M64
Resetting check sum judgment
ZRST C0 C2
Resetting communication counter
Servo-on and retry control
2
(To be continued) 2



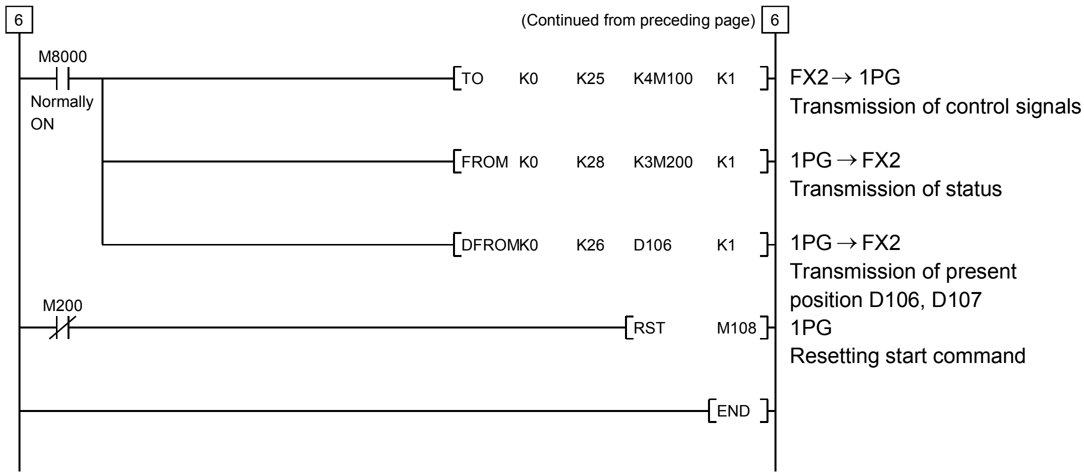
2
(Continued from preceding page) 2
X4
M0
Alarm reset PB
Error flag
Y3
Alarm reset
Y3
Alarm reset output
RST C1
Clearing retry counter
ZRST M0 M64
Clearing ABS data receiving area
ZRST D0 D3
Clearing ABS receive data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
X5
Emergency stop PB
X3
Servo alarm
M0
Error flag output
Y10
Servo alarm output
RST Y1
Resetting ABS transfer mode
RST Y2
Resetting ABS request
RST M99
Resetting ready to send
RST M5
Resetting servo-on request
RST M6
Resetting retry flag
Servo alarm detection, alarm reset control
M1
ABS data transmission start
SET Y1
ABS transfer mode ON
ZRST M10 M64
Clearing ABS data reception area
ZRST D0 D2
Clearing ABS receiver data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
ABS transfer mode Initial setting
3
(To be continued) 3


3
(Continued from preceding page) 3
Y1
X2
ABS transfer mode
Send data ready
PLS M3
Resetting ABS data
M3
ABS data read
SET Y2
ABS request ON
Y2
X2
ABS request
Send data ready
K1
T204
ABS data waiting timer 10ms
ABS data 32 bits (2 bits×16 times)
+
Check sum 6 bits (2 bits×3 times)
T204
ABS data waiting timer
WANDP K1X0 H0003 K1M10
Masking ABS data 2 bits
SFTR M10 M20 K38 K2
Right shift (2 bits) of ABS data
C2
ADDP K1M10 D2 D2
Check sum addition
K16
C2
Updating ABS data reception counter
K19
C0
Updating all data reception counter
RST Y2
Resetting ABS request
C0
All data reception counter
RST Y1
Resetting ABS transfer mode
WANDP H003F D2 D2
Masking check sum 6 bits
CMPP K2M52 D2 M62
Comparison of check sum
C1
Retry counter
Y12
ABS data check sum error
Detection of ABS check sum error, retry control
M62
>
C1
Retry counter
PLS M2
Retry command
M64
<
K10
T200
Setting retry wait timer: 100ms
MOV K2M52 D3
Storing check sum value in the case of check sum error
SET M6
Retry flag ON
RST M5
Resetting servo-on request
4
(To be continued) 4


4
(Continued from preceding page) 4
M63
Check sum match
DMOVP K8M20 D0
ABS data → D0, D1
DADDP D0 D24 D0
Adding 1PG home position address
DTOP K0 K26 D0 K1
ABS data → 1PG
SET M99
Setting ABS data ready
ZRST M62 M64
Clearing check sum judging area
RST M6
Resetting retry flag
Writing absolute position data to 1PG
Y11
ABS communi-cation error
X6
Servo-on PB
RST Y1
Detecting ABS communication error
RST Y2
Resetting ABS request
Y1
ABS transfer mode
K500
T201
ABS transfer mode 5s timer
Y1
ABS transfer mode
Y2
ABS request
K100
T202
ABS request response 1s timer
Y1
ABS transfer mode
X2
Send data ready
K100
T203
Ready to send response 1s timer
T201
ABS transmission NG
T202
ABS request NG
T203
Send data ready NG
Y11
ABS communication error
Detecting ABS communication error
M2
Retry command
D4
C1
Counting retry frequency
T200
Retry wait timer
M6
Retry
SET M5
Setting servo-on request
ABS transfer retry control
5
(To be continued) 5

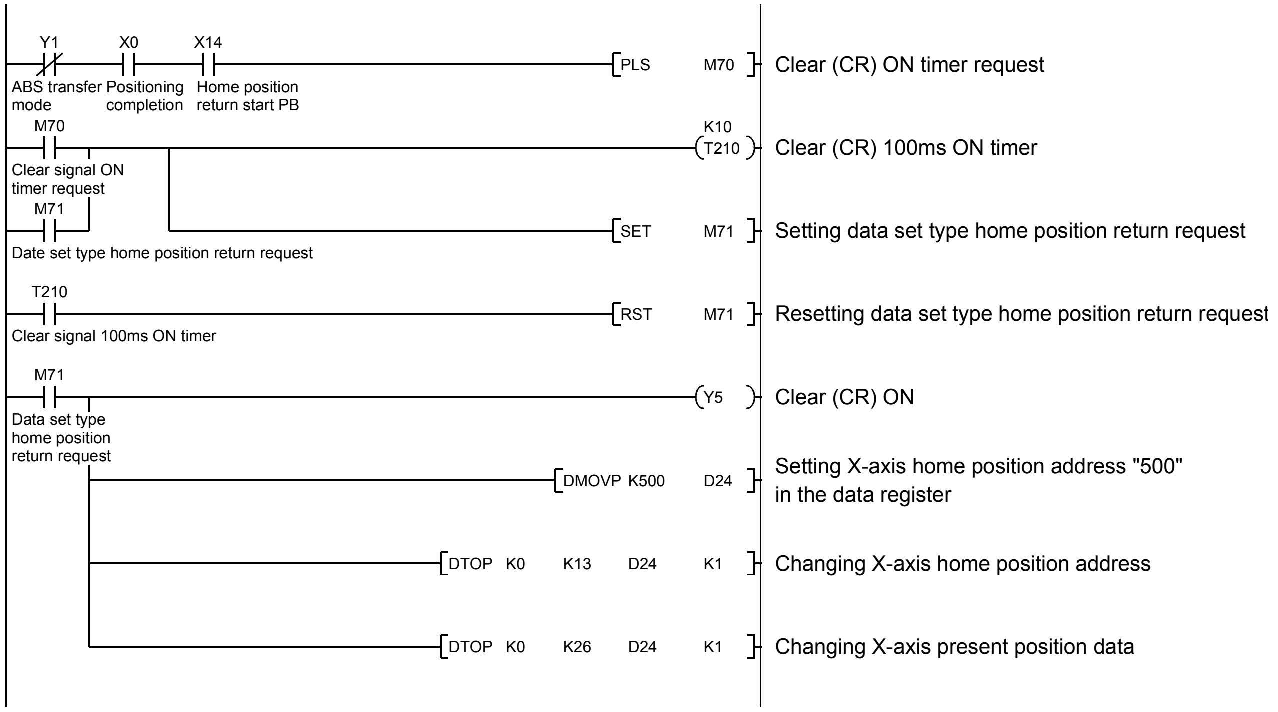


Note. Program example for the dog type home position return. For the data set type home position return, refer to the program example in (2), (d) of this section.



(d) Data set type home position return

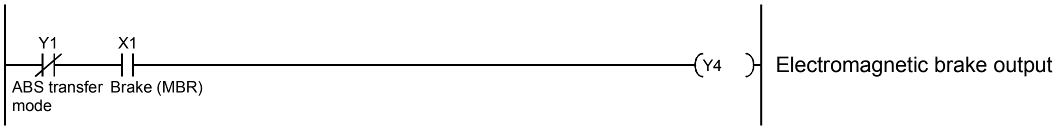
After jogging the machine to the position where the home position (e.g.500) is to be set, choose the home position return mode set the home position with the home position return start (PBON). After switching power on, rotate the servo motor more than 1 revolution before starting home position return. Do not turn ON the clear (CR) (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(e) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

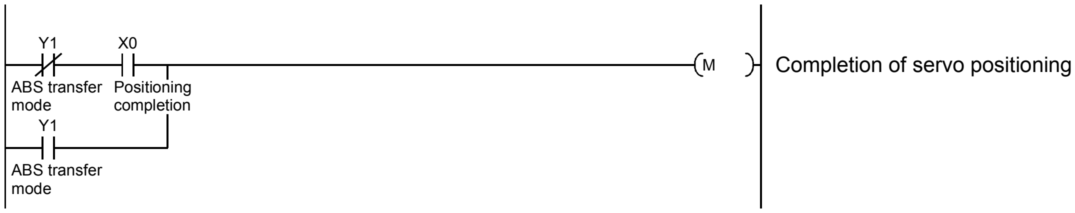
Set " □ □ □ 1" in parameter No. PA04 of the servo amplifier to make the electromagnetic brake interlock (MBR) valid.



(f) Positioning completion

To create the status information for servo positioning completion.

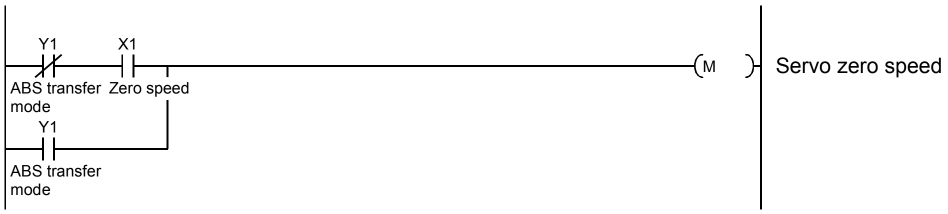
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(g) Zero speed

To create the status information for servo zero speed.

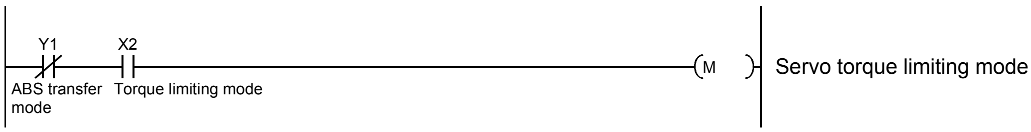
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(h) Torque limiting

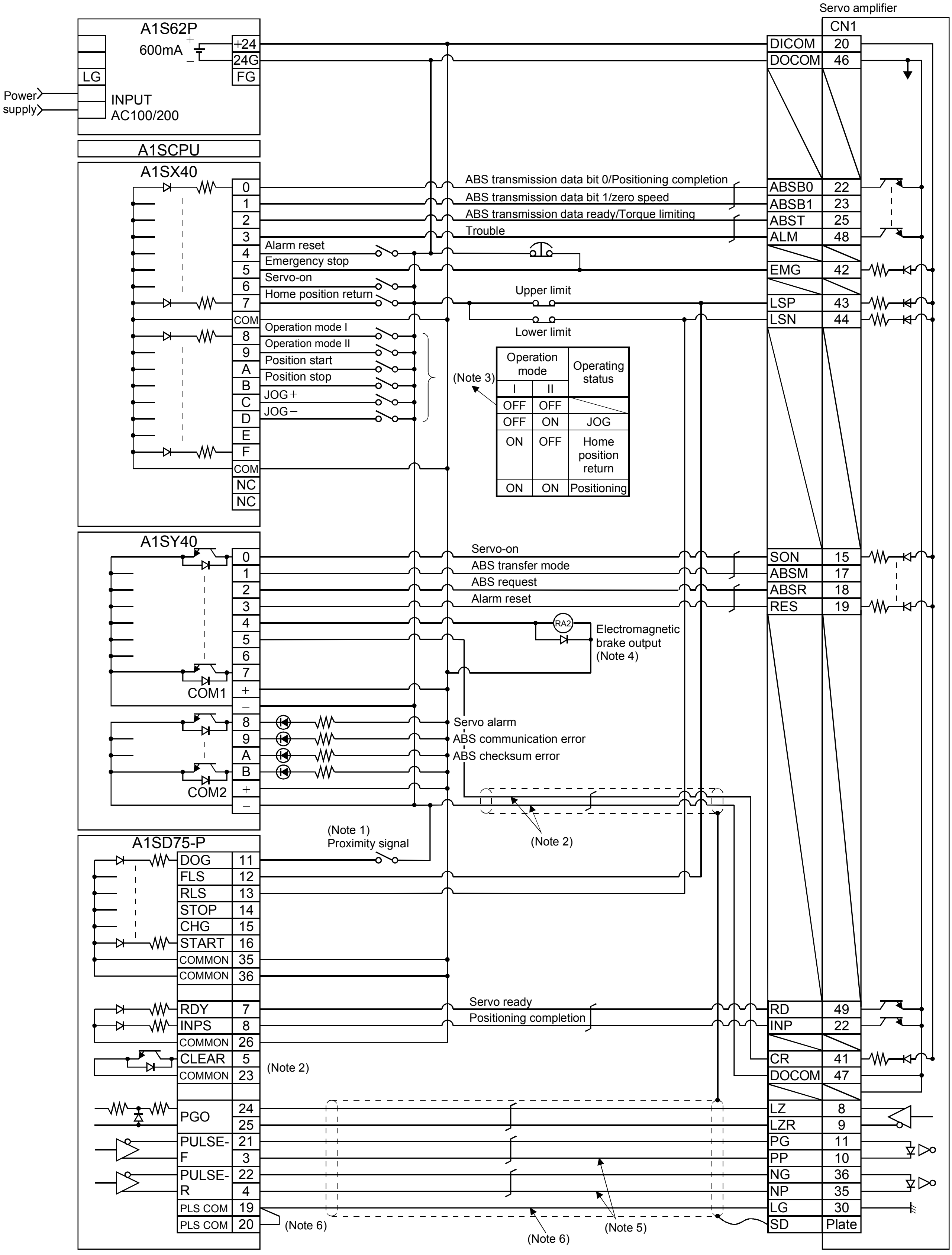
To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



14.8.2 MELSEC A1SD75

(1) Connection diagram



Note 1. For the dog type home position return. Need not be connected for the data set type home position return.
2. If the servo motor provided with the zero point signal is started, the A1SD75 will output the deviation counter clear (CR). Therefore, do not connect the clear (CR) of the MR-J3-A to the A1SD75 but connect it to the output module of the programmable controller.
3. This circuit is provided for your reference.
4. The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.
5. Use the differential line driver system for pulse input. Do not use the open collector system.
6. To reinforce noise suppression, connect LG and pulse output COM.

(2) Sequence program example

(a) Conditions

1) When the servo-on signal and power supply GND are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.

2) If a checksum mismatch is detected in the transmitted data, data transmission is retried up to three times. If the checksum mismatch still persists after the retries, the ABS checksum error occurs (Y3A ON).

3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON):
ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of reading to send ABS data (X22)

(b) Device list

X input contact		Y output contact	
X20	ABS Transmission data bit 0 / positioning completion	Y30	Servo-on
X21	ABS Transmission data bit 1 / zero speed	Y31	ABS transfer mode
X22	Reading to send ABS data / limiting torque	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset	X34 (Note 2)	Electromagnetic brake output
X25	Servo emergency stop	Y35 (Note 1)	Clear
X26	Servo-on	Y38	Servo alarm
X27	Home position return start	Y39	ABS communication error
X28	Operation mode I	Y3A	ABS checksum error
X29	Operation mode II		
D register		**M contact**	
D0	ABS data transmission counter	M5	ABS data transmission start
D1	Checksum transmission counter	M6	Sum check completion
D2	Checksum addition register	M7	Sum check mismatch
D3	ABS data: Lower 16 bits	M8	ABS data ready
D4	ABS data: Upper 16 bits	M9	Transmission data read enabled
D5	ABS data 2-bit receiving buffer	M10	Checksum 2 bits read completion
D6	Check data in case of checksum error	M11	ABS 2 bits read completion
D7	Number of retries	M12	ABS 2 bits request
D8	Forward rotation direction	M13	Servo-on request
D9	Home position address: Lower 16 bits	M14	Servo alarm
D10	Home position address: Upper 16 bits	M15	ABS data transmission retry start pulse
D11	Drive unit ready data	M16	Retry flag set
D12	Home position return completion data	M17	Retry flag reset
D110	Received shift data: Lower 16 bits	M18	PLS processing command
D111	Received shift data: Upper 16 bits	M20 (Note 1)	Clear (CR) ON timer request
T timer		M21 (Note 1)	Data set type home position return request
T0	ABS transmission mode timer	M22	Home position return processing instruction
T1	ABS request response timer		
T2	Retry wait timer	M23	Current position change processing instruction
T3	ABS data send reading response timer		
T10 (Note 1)	Clear (CR) ON timer	M24	Current position change flag
T200	Transmitted data read 10ms delay timer	**C counter**	
		C0	ABS data receive times counter
		C1	Checksum receive times counter
		C2	Retry counter

Note 1. Required for data set type home position return.

2. Required for electromagnetic brake output.

(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

・Parameters of the A1SD75-P1 positioning module

1) Unit setting :3 = pulse (PLS)

2) Travel per pulse :1 = 1 pulse

To select the unit other than the pulse, conversion into the unit of the feed value per pulse is required.
Hence, add the following program to the area marked (Note) in the sequence program:

<Additional program>

[D * P K □□ D3 D3]

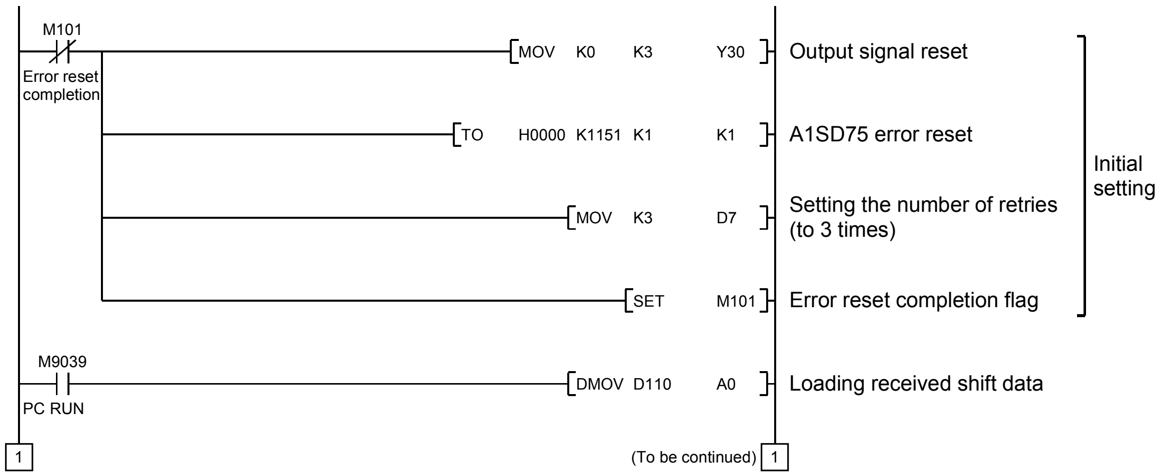
Item	mm				inch				degree				pulse
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.0000 1 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	μm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	None

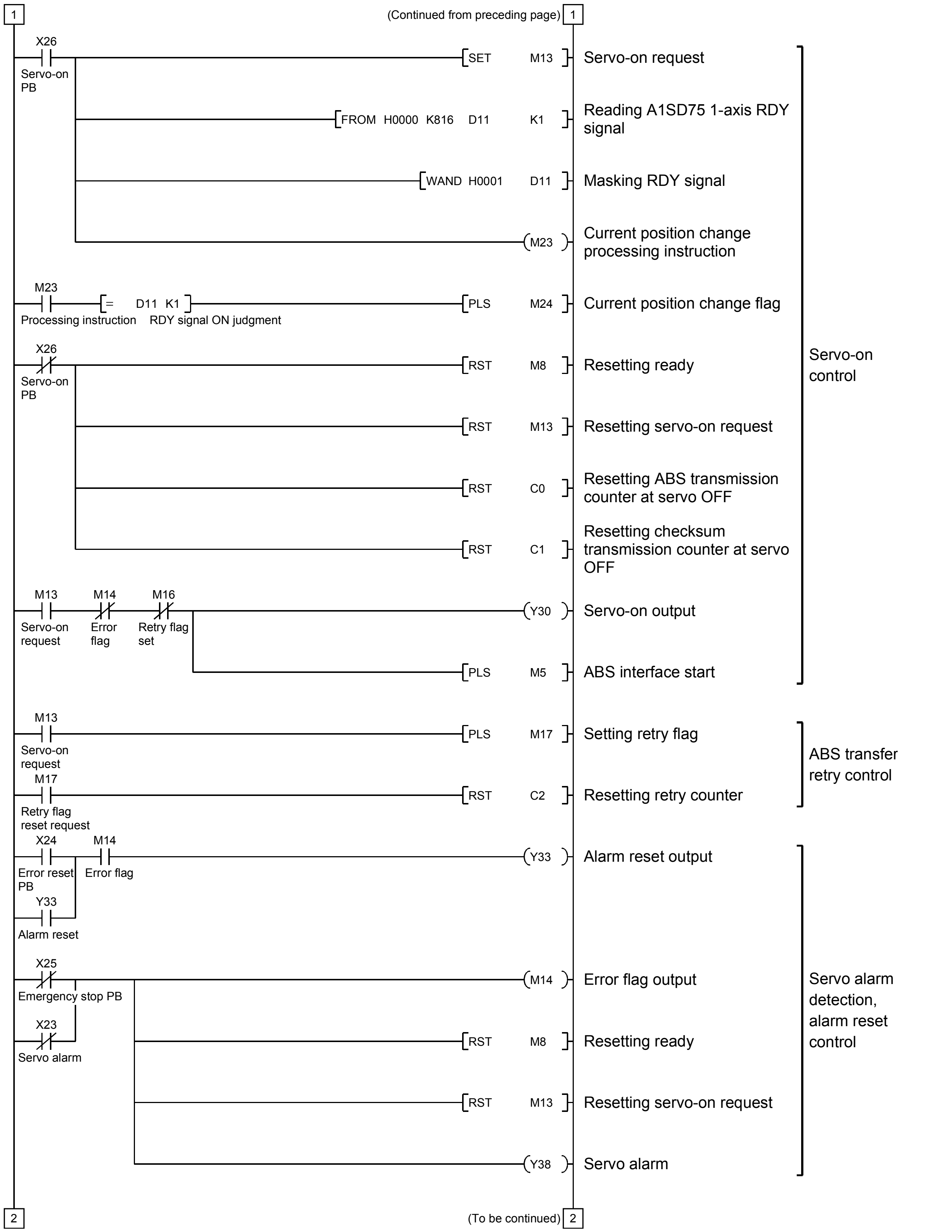
Reference

・For 1μm/PLS, set constant K to 10

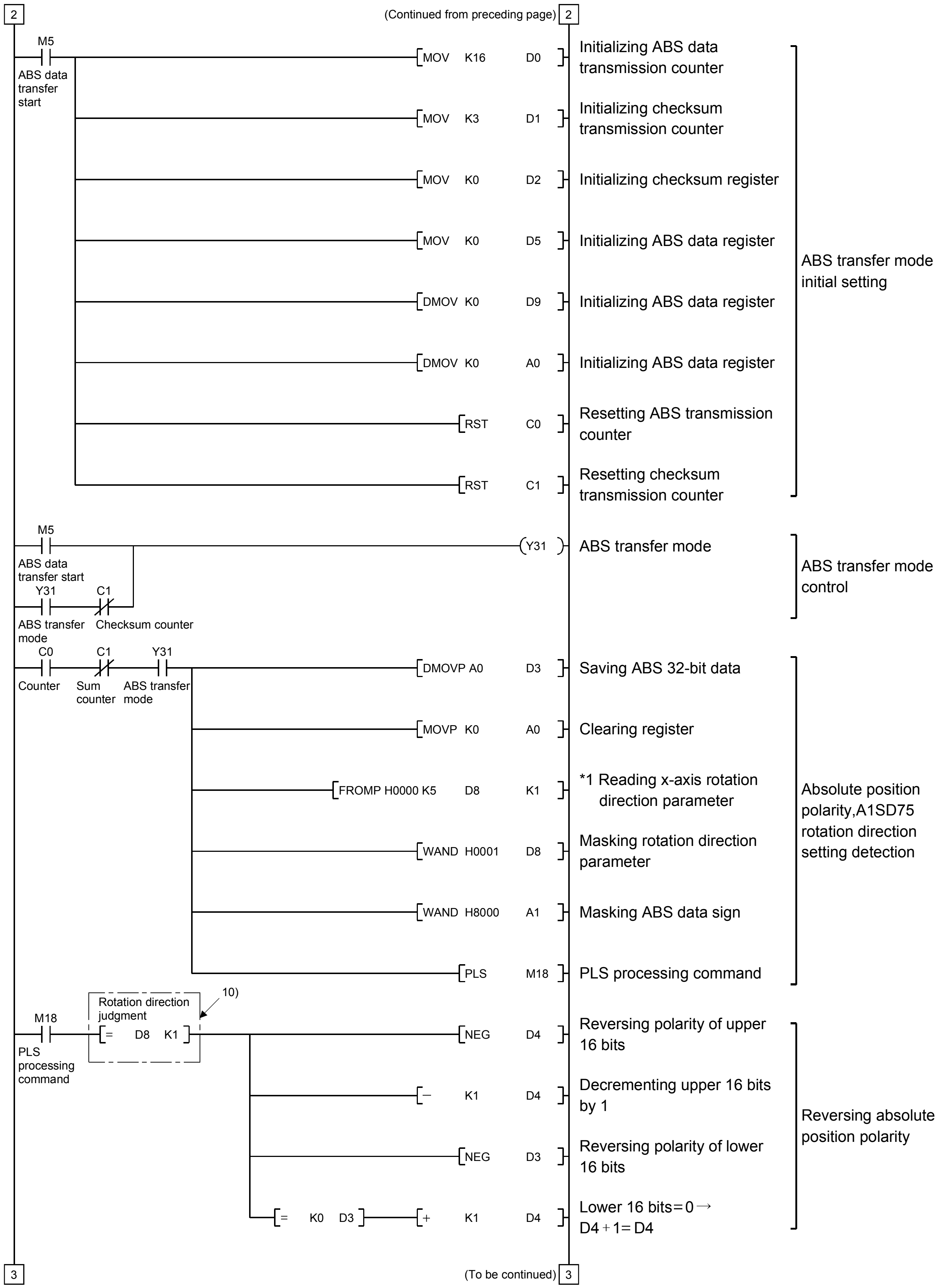
・For 5μm/PLS, set constant K to 50

・The additional program is not required for the unit setting is PLS.

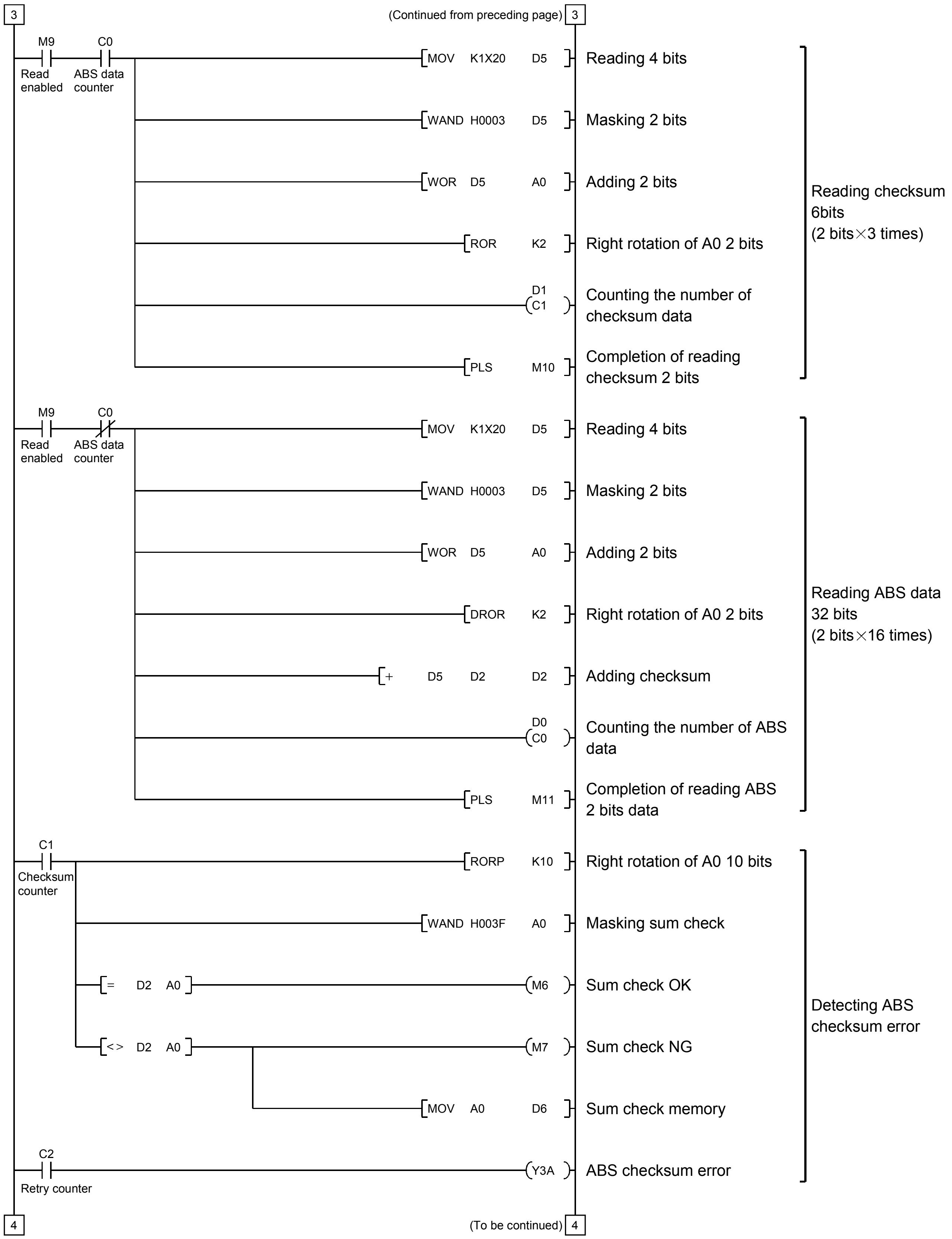


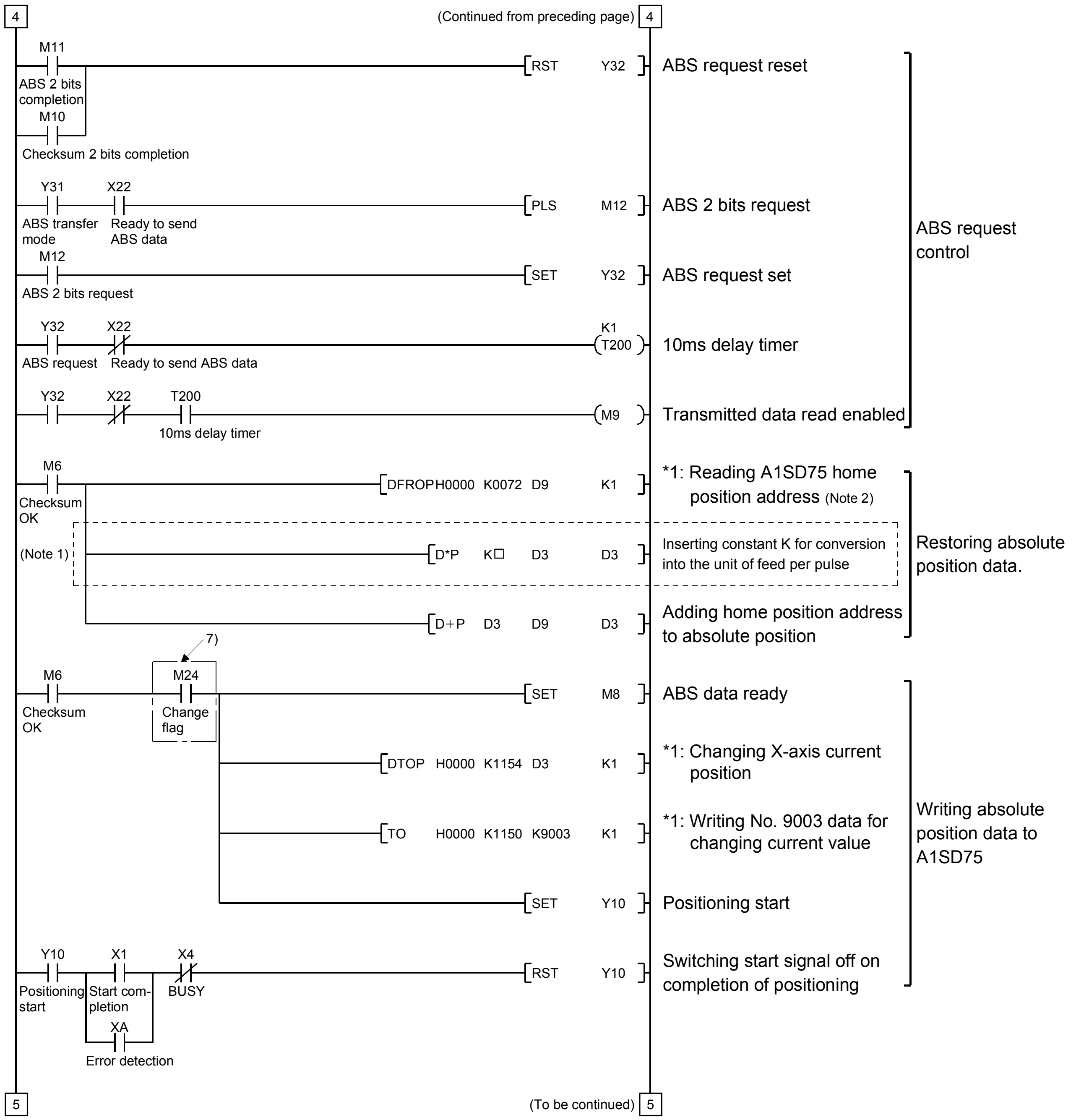


1
(Continued from preceding page) 1
X26
Servo-on PB
SET M13
Servo-on request
FROM H0000 K816 D11 K1
Reading A1SD75 1-axis RDY signal
WAND H0001 D11
Masking RDY signal
M23
Current position change processing instruction
M23
Processing instruction
= D11 K1
RDY signal ON judgment
PLS M24
Current position change flag
X26
Servo-on PB
RST M8
Resetting ready
RST M13
Resetting servo-on request
RST C0
Resetting ABS transmission counter at servo OFF
RST C1
Resetting checksum transmission counter at servo OFF
Servo-on control
M13
Servo-on request
M14
Error flag
M16
Retry flag set
Y30
Servo-on output
PLS M5
ABS interface start
M13
Servo-on request
PLS M17
Setting retry flag
M17
Retry flag reset request
RST C2
Resetting retry counter
ABS transfer retry control
X24
Error reset PB
M14
Error flag
Y33
Alarm reset output
Y33
Alarm reset
X25
Emergency stop PB
X23
Servo alarm
M14
Error flag output
RST M8
Resetting ready
RST M13
Resetting servo-on request
Y38
Servo alarm
Servo alarm detection, alarm reset control
2
(To be continued) 2



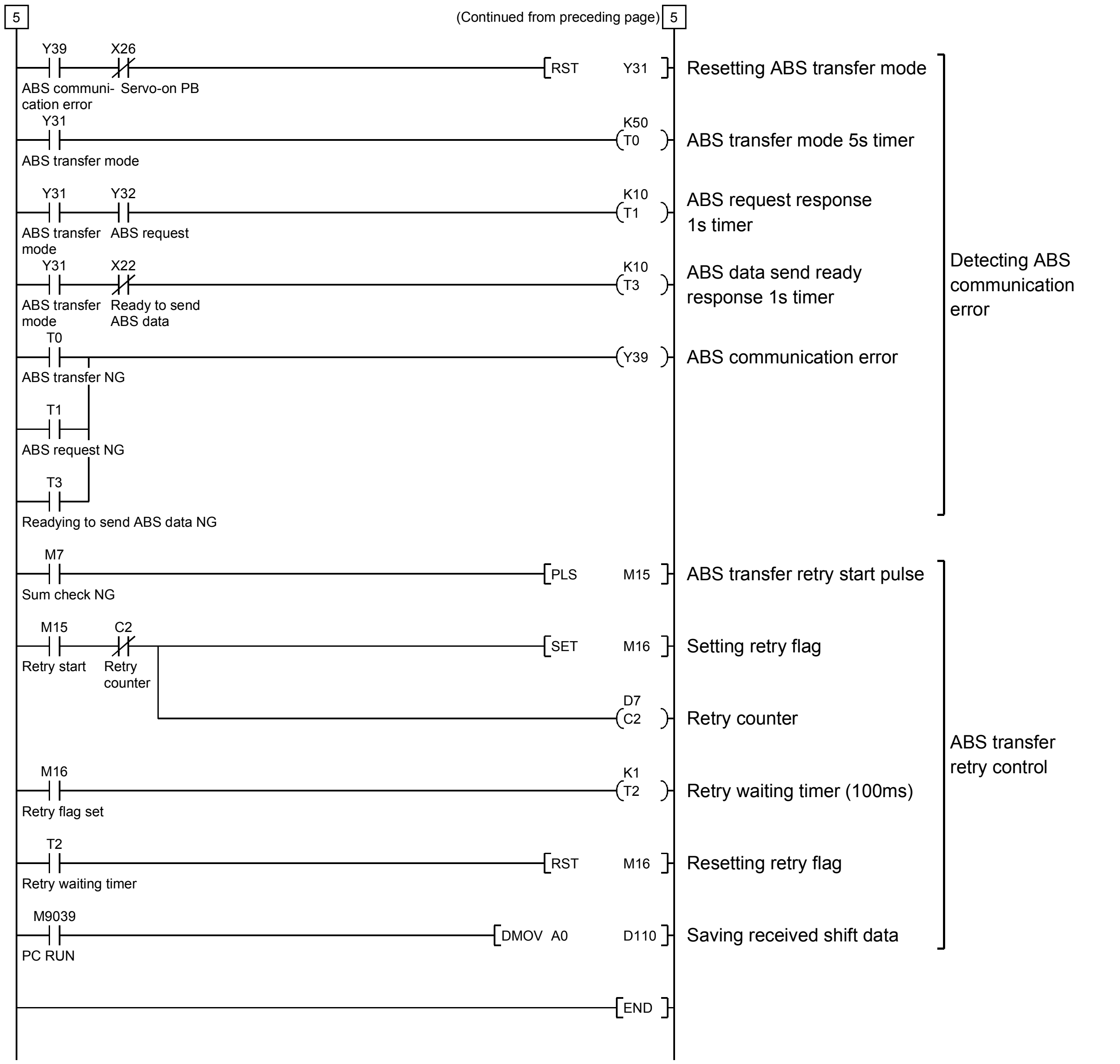
(Continued from preceding page)
M5
ABS data transfer start
[MOV K16 D0] Initializing ABS data transmission counter
[MOV K3 D1] Initializing checksum transmission counter
[MOV K0 D2] Initializing checksum register
[MOV K0 D5] Initializing ABS data register
[DMOV K0 D9] Initializing ABS data register
[DMOV K0 A0] Initializing ABS data register
[RST C0] Resetting ABS transmission counter
[RST C1] Resetting checksum transmission counter
ABS transfer mode initial setting
M5
ABS data transfer start
Y31
ABS transfer mode
C1
Checksum counter
(Y31) ABS transfer mode
ABS transfer mode control
C0
Counter
C1
Sum counter
Y31
ABS transfer mode
[DMOVP A0 D3] Saving ABS 32-bit data
[MOVP K0 A0] Clearing register
[FROMP H0000 K5 D8 K1] *1 Reading x-axis rotation direction parameter
[WAND H0001 D8] Masking rotation direction parameter
[WAND H8000 A1] Masking ABS data sign
[PLS M18] PLS processing command
Absolute position polarity,A1SD75 rotation direction setting detection
M18
PLS processing command
Rotation direction judgment
10)
[= D8 K1]
[NEG D4] Reversing polarity of upper 16 bits
[− K1 D4] Decrementing upper 16 bits by 1
[NEG D3] Reversing polarity of lower 16 bits
[= K0 D3] [+ K1 D4] Lower 16 bits=0→ D4+1=D4
Reversing absolute position polarity
(To be continued)


3
(Continued from preceding page) 3
M9
Read enabled
C0
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
ROR K2
Right rotation of A0 2 bits
D1
C1
Counting the number of checksum data
PLS M10
Completion of reading checksum 2 bits
Reading checksum 6bits (2 bits×3 times)
M9
Read enabled
C0
ABS data counter
MOV K1X20 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
DROR K2
Right rotation of A0 2 bits
+ D5 D2 D2
Adding checksum
D0
C0
Counting the number of ABS data
PLS M11
Completion of reading ABS 2 bits data
Reading ABS data 32 bits (2 bits×16 times)
C1
Checksum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking sum check
= D2 A0
M6
Sum check OK
<> D2 A0
M7
Sum check NG
MOV A0 D6
Sum check memory
C2
Retry counter
Y3A
ABS checksum error
Detecting ABS checksum error
4
(To be continued) 4



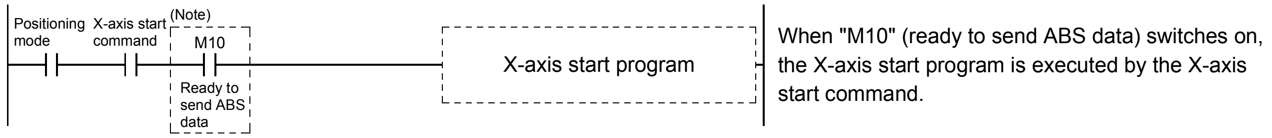
Note 1. When the unit setting parameter value of the A1SD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is × 0.1μm for the input value. To set the unit to × 1μm, add this program to multiple the feed value by 10.

2. The home position address loaded from flash ROM of normal positioning module can be obtained. For updating the home position address by the home position setting, refer to (2) (f) Data set type home position return in this Section.


5
(Continued from preceding page)
5
Y39
X26
ABS communi- cation error
Servo-on PB
RST
Y31
Resetting ABS transfer mode
Y31
ABS transfer mode
K50
T0
ABS transfer mode 5s timer
Y31
Y32
ABS transfer mode
ABS request
K10
T1
ABS request response 1s timer
Y31
X22
ABS transfer mode
Ready to send ABS data
K10
T3
ABS data send ready response 1s timer
T0
ABS transfer NG
Y39
ABS communication error
T1
ABS request NG
T3
Readying to send ABS data NG
Detecting ABS communication error
M7
Sum check NG
PLS
M15
ABS transfer retry start pulse
M15
C2
Retry start
Retry counter
SET
M16
Setting retry flag
D7
C2
Retry counter
M16
Retry flag set
K1
T2
Retry waiting timer (100ms)
T2
Retry waiting timer
RST
M16
Resetting retry flag
M9039
PC RUN
DMOV A0
D110
Saving received shift data
ABS transfer retry control
END

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.

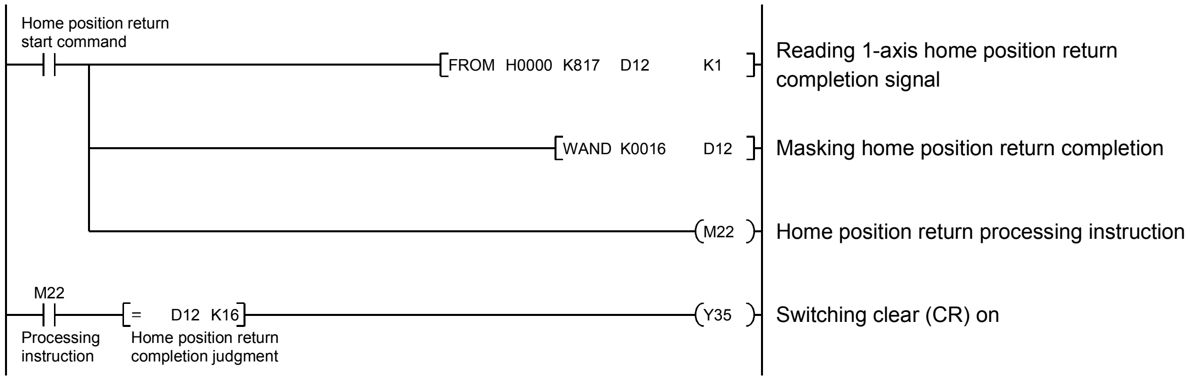


(e) Dog type home position return

Refer to the home position return program in the A1SD75 User's Manual.

Note that this program requires a program which outputs the clear (CR) (Y35) after completion of home position return.

Add the following program:

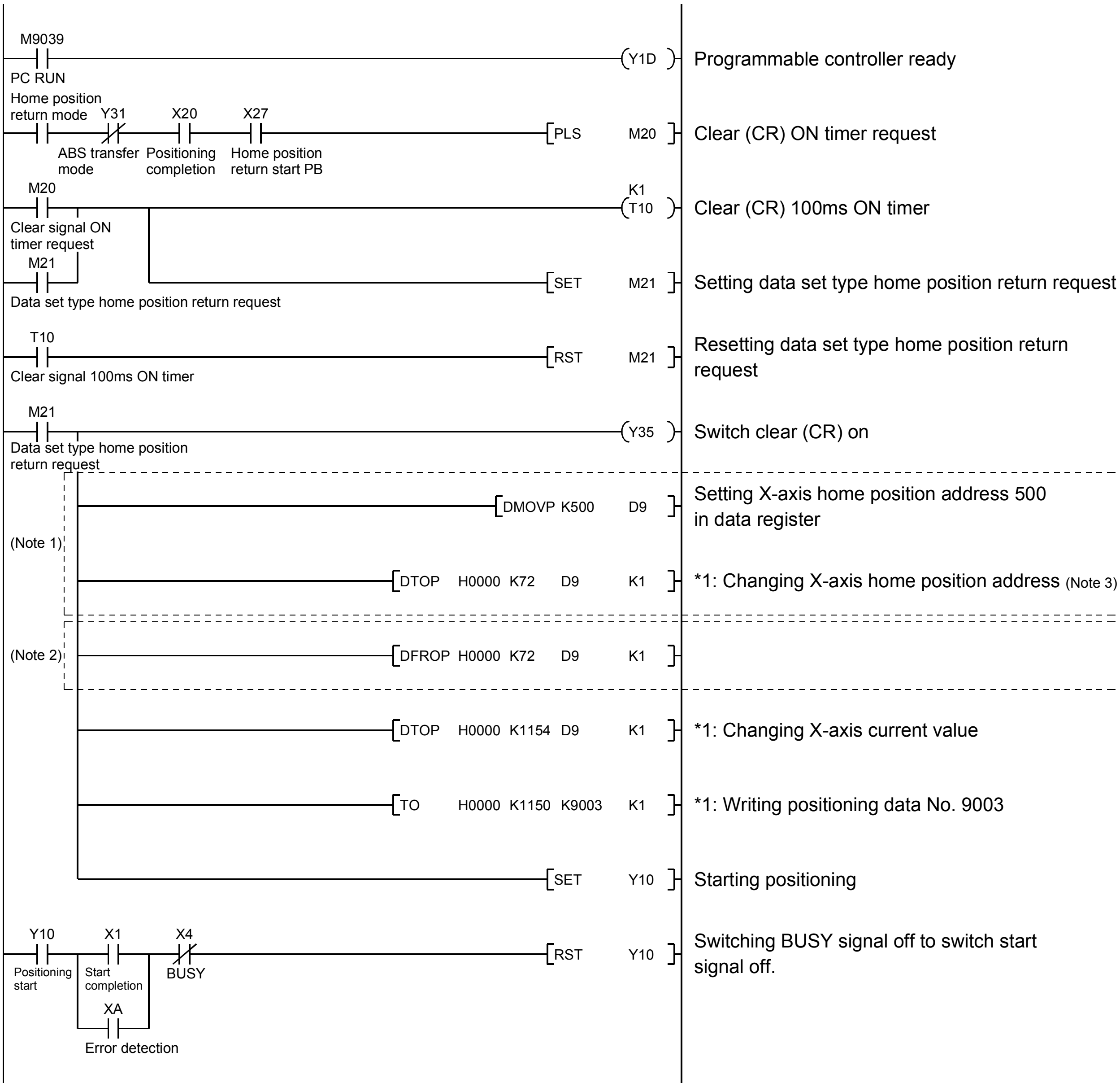


(f) Data set type home position return

After jogging the machine to the position where the home position (e.g. 500) is to be set, choose the home position return mode and set the home position with the home position return start (PBON).

After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear (CR) (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



Note 1. If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

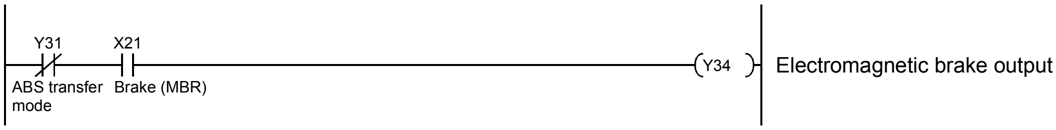
2. Contrary to above 2, if the home position address is written in the home position address parameter, the sequence circuit (Note1) is not required but this sequence circuit (Note 1) is required.

3. Changes are stored temporarily to buffer memory at this time. An additional processing is required when changes should be reflected to memory for OS or flash ROM. For details, refer to the positioning module user's manual.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

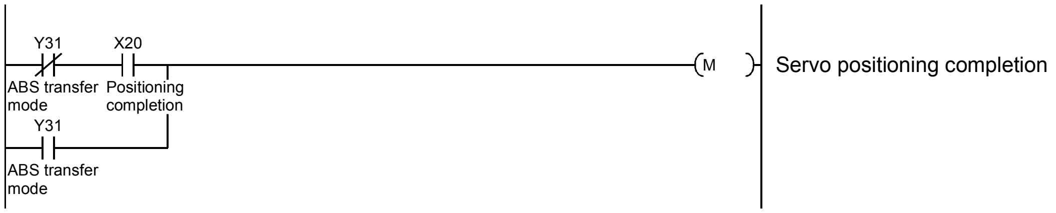
Set " □ □ □ 1" in parameter No. PA04 of the servo amplifier to make the electromagnetic brake interlock (MBR) valid.



(h) Positioning completion

To create the status information for servo positioning completion.

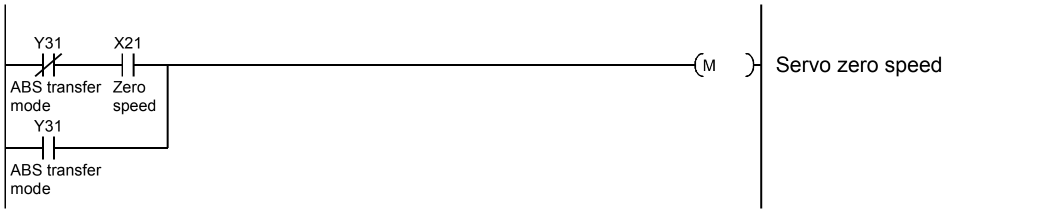
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for servo zero speed.

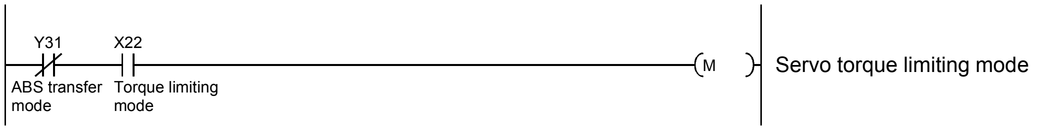
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single A1SD75 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

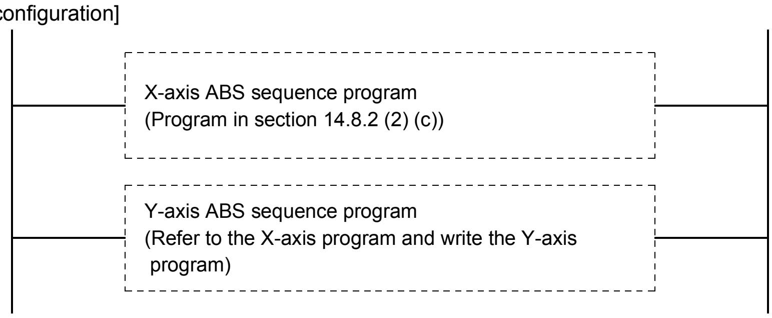
Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.8.2 (2) (c) should be changed as indicated below for use with the Y axis:

```
[FROMP  H0000  K5     D8     K1]  →  [FROMP  H0000  K155   D8     K1]
[DFROP  H0000  K0072  D9     K1]  →  [DFROP  H0000  K222   D9     K1]
[DTOP   H0000  K1154  D3     K1]  →  [DTOP   H0000  K1204  D3     K1]
[TO     H0000  K1150  K9003  K1]  →  [TO     H0000  K1200  K9003  K1]
```

[Program configuration]



(b) Data set type home position return

Arrange the data set type home position return programs given in section 14.8.2 (2) (f) in series to control two axes.

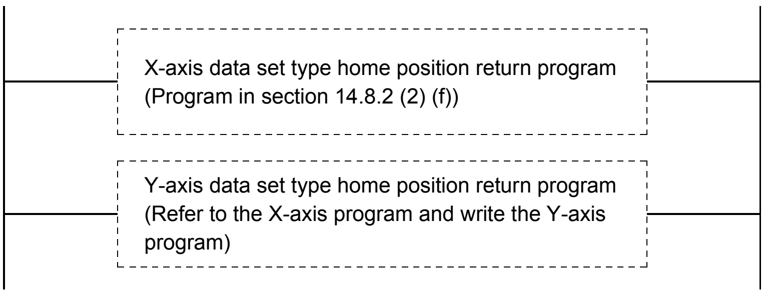
Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.8.2 (2) (f) should be changed as indicated below for use with the Y axis:

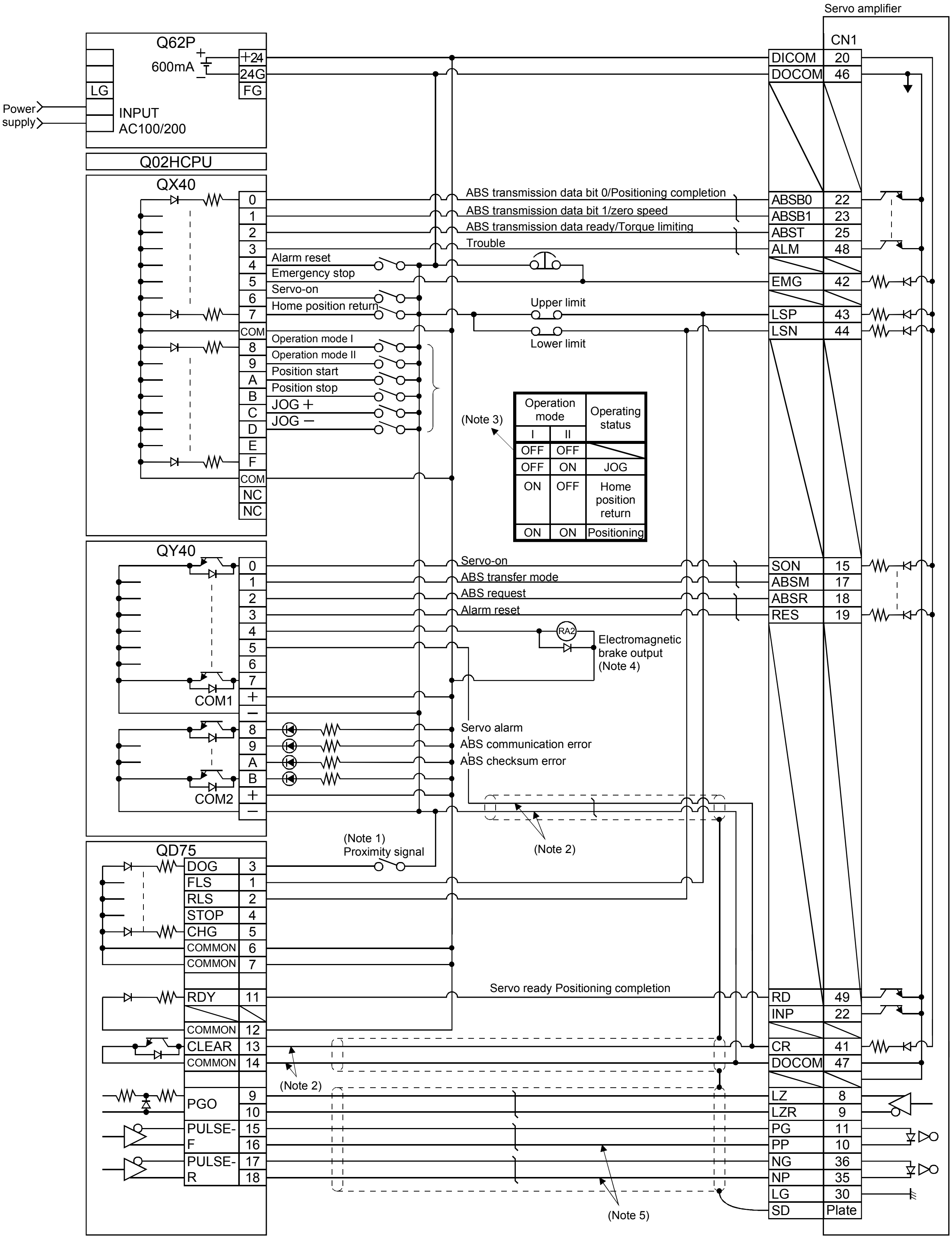
```
[DTOP  H0000  K72    D9     K1]  →  [DTOP  H0000  K222   D9     K1]
[DTOP  H0000  K1154  D9     K1]  →  [DTOP  H0000  K1204  D3     K1]
[TO    H0000  K1150  K9003  K1]  →  [TO    H0000  K1200  K9003  K1]
```

[Program configuration]



14.8.3 MELSEC QD75

(1) Connection diagram



Note 1. For the dog type home position return. Need not be connected for the data set type home position return.
2. For the dog type home position return, connect a QD75 deviation counter clearing signal cable. For the data set type home position return, connect a cable to the output module of the programmable logic controller.
3. This circuit is provided for your reference.
4. The electromagnetic brake output should be controlled via a relay connected to the programmable controller output.
5. Use the differential line driver system for pulse input. Do not use the open collector system.

(2) Sequence program example

(a) Conditions

1) When the servo-on signal and power supply GND are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.

2) An ABS checksum error is caused (Y3AON) if checksum inconsistency is found in transferred data.

3) The following time periods are measured. If the ON/OFF state does not change within the specified time, the ABS communication error occurs change within the specified time, the ABS communication error occurs (Y3A ON):
ON period of ABS transfer mode (Y31)
ON period of ABS request (Y32)
OFF period of reading to send ABS data (X22)

(b) Device list

X input contact		Y output contact	
X20	ABS transmission data bit 0/Positioning completion	Y30	Servo-on
X21	ABS transmission data bit 1/zero speed	Y31	ABS transfer mode
X22	ABS transmission data ready/Torque limiting	Y32	ABS request
X23	Servo alarm	Y33	Alarm reset
X24	Alarm reset	X34 (Note 2)	Electromagnetic brake output
X25	Servo emergency stop	Y35 (Note 1)	Clear
X26	Servo-on	Y38	Servo alarm
X27	Home position return start	Y39	ABS communication error
X28	Operation mode I	Y3A	ABS checksum error
X29	Operation mode II		

D register	
D0	Number of retries
D9	Home position address: Lower 16 bits
D10	Home position address: Upper 16 bits
D100 to D104	For special absolute value restoration instruction

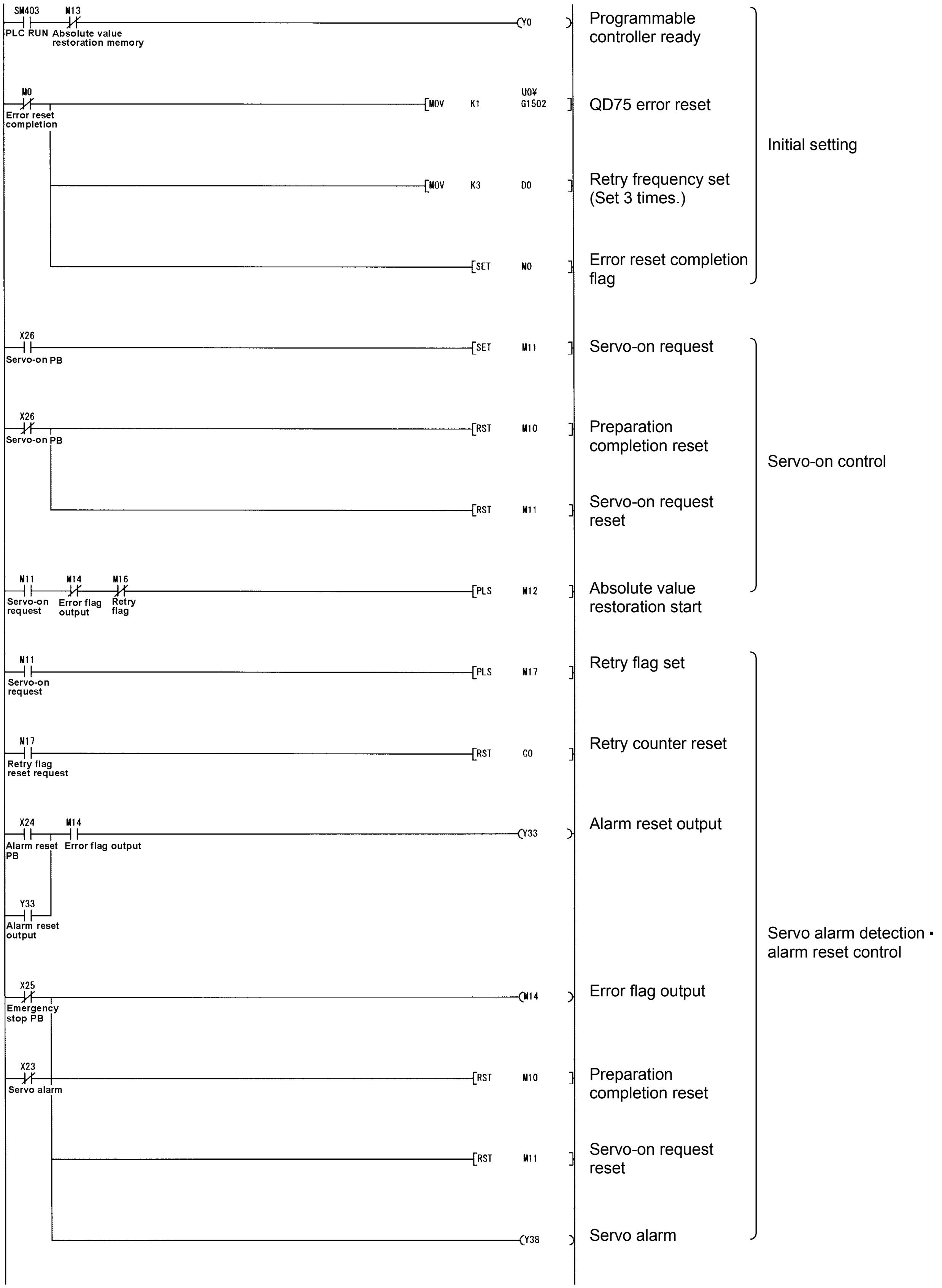
T timer	
T0	Retry wait timer
T10 (Note 1)	Clear (CR) ON timer

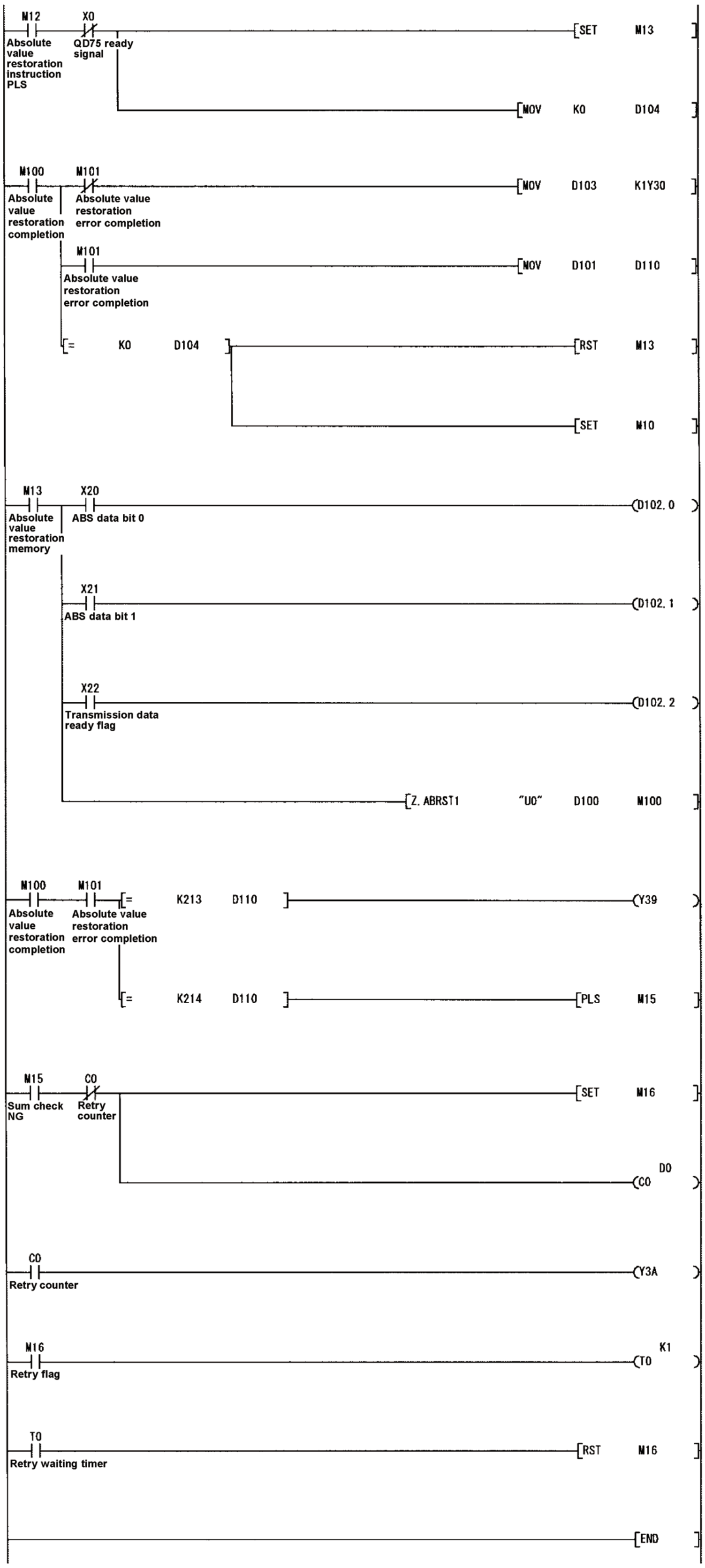
M contact	
M0	End of error reset
M10	Preparation completion
M11	Servo-on request
M12	Absolute position restoration command
M13	Absolute value restoration memory
M14	Error flag output
M15	Sum check NG
M16	Retry flag
M17	Retry flag reset request
M20 (Note 1)	Clear (CR) ON timer request
M21 (Note 1)	Data set type home position return request
M100 to M101	For special absolute value restoration instruction

C counter	
C0	Retry counter

Note 1. Required for data set type home position return.
2. Required for electromagnetic brake output.

(c) ABS data transfer program for X axis





Absolute value restoration start flag

Absolute value restoration status reset

Absolute value restoration output

Error code storage

Absolute value restoration start flag

Preparation completion

Absolute value restoration data reception

Absolute value restoration data reception

Absolute value restoration data reception

Special absolute value restoration instruction execution

Absolute value restoration

ABS communication error

Sum check error detection

Retry flag set

Retry counter

ABS checksum error

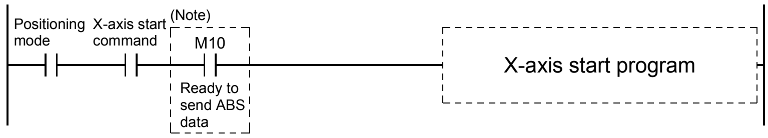
Retry wait timer

Retry flag reset

Error detection・retry control

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M10) is off.



When "M10" (ready to send ABS data) switches on, the X-axis start program is executed by the X-axis start command.

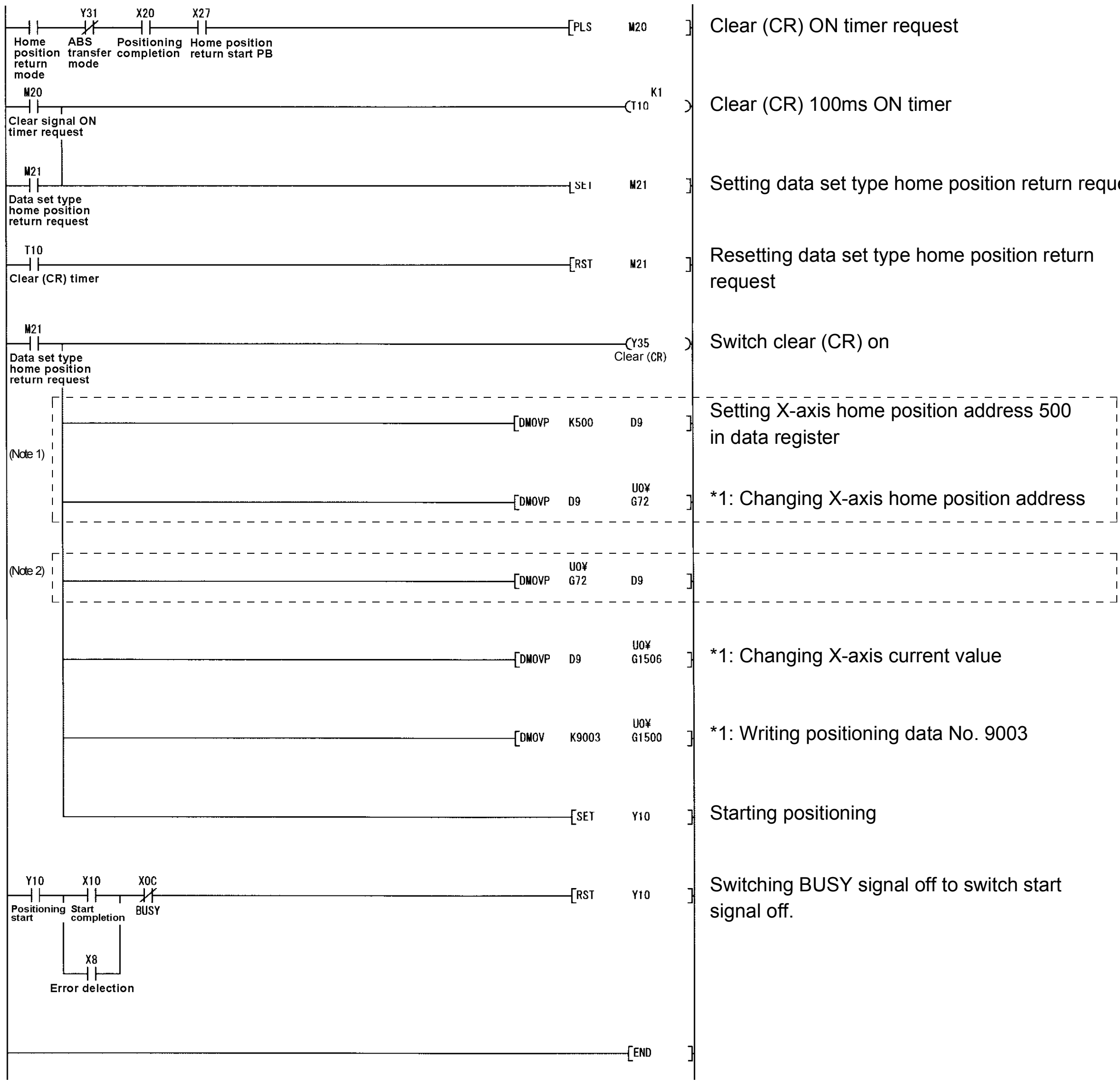
(e) Dog type home position return

Refer to the home position return program in the QD75 User's Manual.

(f) Data set type home position return

After jogging the machine to the position where the home position (e.g. 500) is to be set, choose the home position return mode and set the home position with the home position return start (PBON). After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear (CR) (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



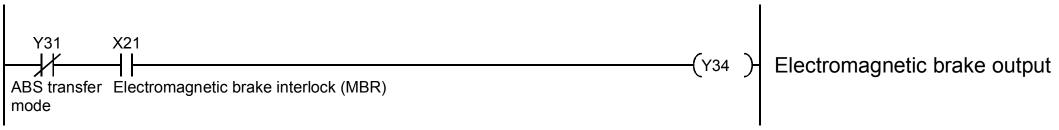
Note 1. If the data of the home position address parameter is not written from the programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

2. Contrary to above 2, if the home position address is written in the home position address parameter, the sequence circuit (Note1) is not required but this sequence circuit (Note 1) is required.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.

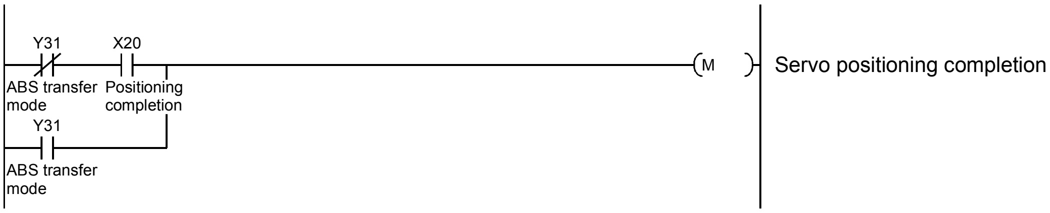
Set "□ □ □ 1" in parameter No. PA04 of the servo amplifier to make the electromagnetic brake interlock (MBR) valid.



(h) Positioning completion

To create the status information for servo positioning completion.

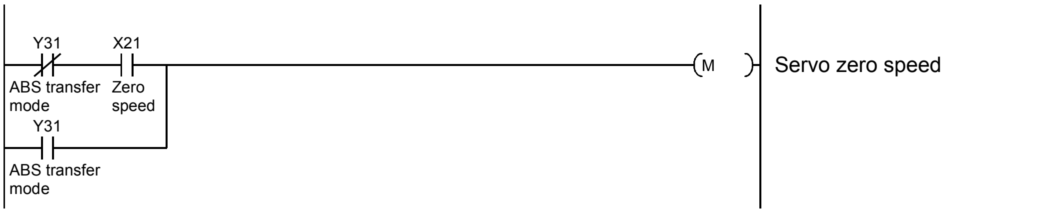
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(i) Zero speed

To create the status information for servo zero speed.

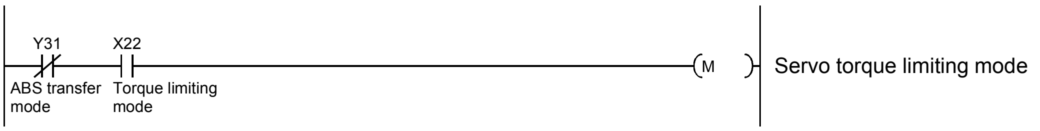
During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the servo motor must be at a stop.



(j) Torque limiting

To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on (SON) is turned on), the torque limiting must be off.



(3) Sequence program - 2-axis control

The following program is a reference example for creation of an ABS sequence program for the second axis (Y axis) using a single QD75 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

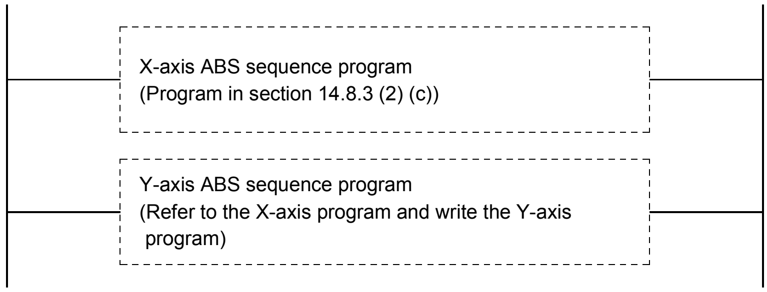
Refer to the X-axis ABS sequence program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts, T timers and C counters of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the QD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.8.3 (2) (c) should be changed as indicated below for use with the Y axis:

[Z. ABRST1 "U0" D100 M100] → [Z. ABRST2 "U0" D100 M100]

[Program configuration]



(b) Data set type home position return

Arrange the data set type home position return programs given in section 14.8.3 (2) (f) in series to control two axes.

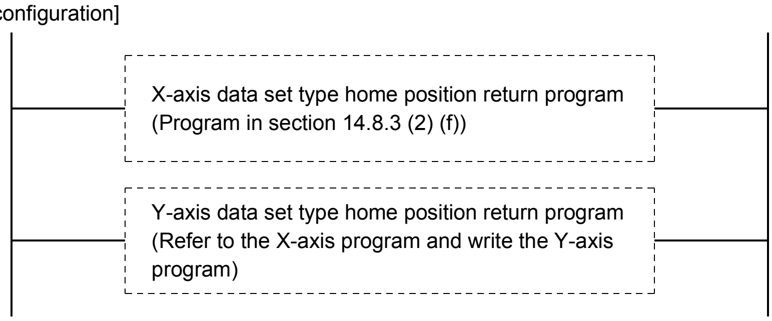
Refer to the X-axis data set type home position return program and create the Y-axis program.

Assign the X inputs, Y outputs, D registers, M contacts and T timers of the Y axis so that they do not overlap those of the X axis.

The buffer memory addresses of the QD75 differ between the X and Y axes. The instructions marked *1 in the program of section 14.8.2 (2) (f) should be changed as indicated below for use with the Y axis:

[DMOVP D9 U0¥G72] → [DMOVP D9 U0¥G222]
[DMOVP U0¥G72 D9] → [DMOVP U0¥G222 D9]
[DMOVP D9 U0¥1506] → [DMOVP D9 U0¥1606]
[DMOVP K9003 U0¥1500] → [DMOVP D9 U0¥1600]

[Program configuration]



14.9 Absolute position data transfer errors

14.9.1 Corrective actions

(1) Error list

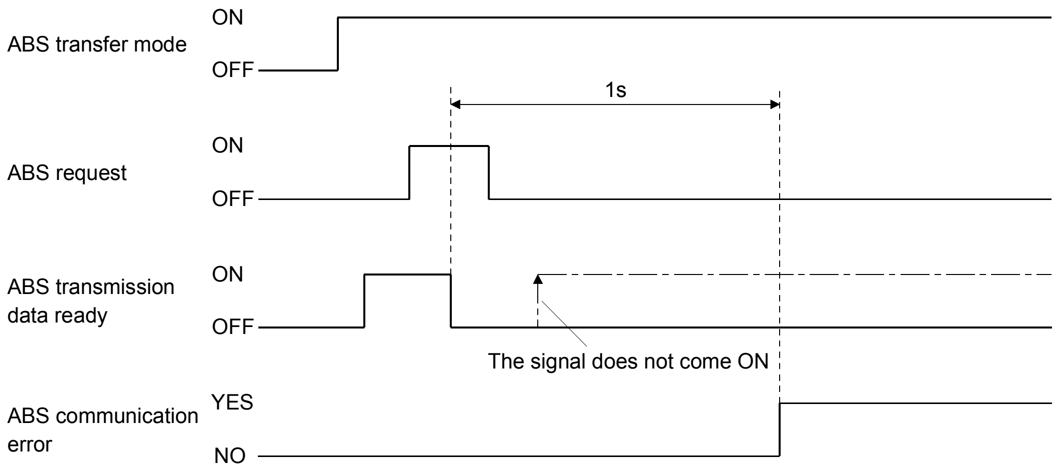
The number within parentheses in the table indicates the output coil or input contact number of the A1SD75.

Name	Output coil		Description	Cause	Action
	AD75	1PG			
(Note) ABS communication error	Y39	Y11	1. The ABS data transfer mode signal (Y41) is not completed within 5s. 2. The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON. 3. The ready to send signal (X32) remains OFF for longer than 1s.	1. Wiring for ABS transfer mode signal, ABS data request signal, or ready to send signal is disconnected or connected to the DOCOM terminal.	Correct the wiring.
				2. PC ladder program wrong.	Correct the ladder.
				3. Faulty PLC output or input module.	Change the input or output module.
				4. Faulty printed board in the servo amplifier.	Change the amplifier
				5. Power supply to the servo amplifier is OFF.	Turn on the power to the servo amplifier.
ABS data check sum error	Y3A	Y12	・ABS data sumcheck resulted in mismatch four times consecutively.	1. Wiring for the ABS data signal (ABS bit 0 (PF), bit 1 (ZSP)) is disconnected or connected to the SG terminal.	Correct the wiring.
				2. PC ladder program wrong.	Correct the ladder.
				3. Faulty PLC input module.	Change the input module.
				4. Faulty printed board in the servo amplifier.	Change the amplifier.
Servo alarm	Y38	Y10	・Alarm occurred in the servo amplifier.	1. Emergency stop (EMG) of the servo amplifier was turned off.	After ensuring safety, turn EMG on.
				2. Trouble (ALM) of the servo amplifier was turned on.	Refer to chapter 9 and take action.

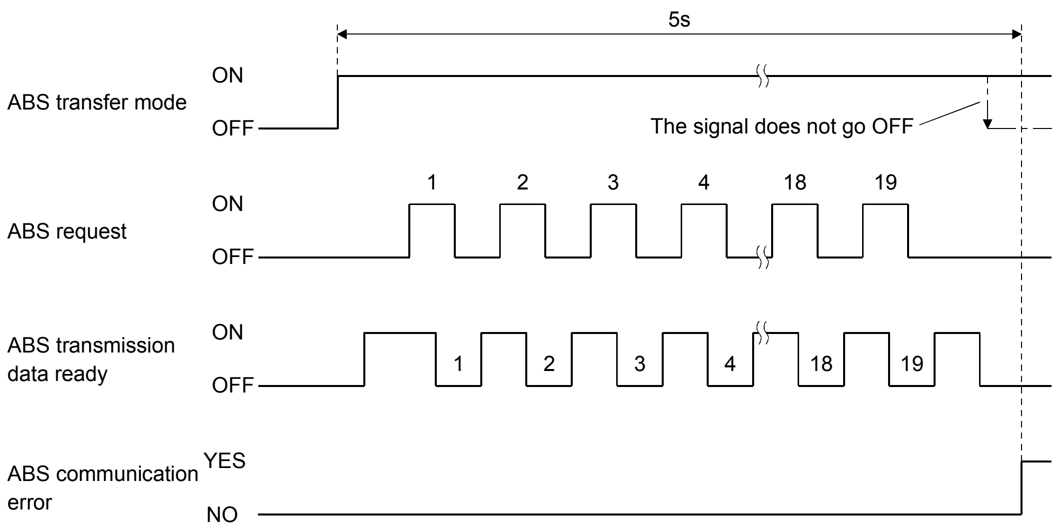
Note. Refer to (2) of this section for details of error occurrence definitions.

(2) ABS communication error

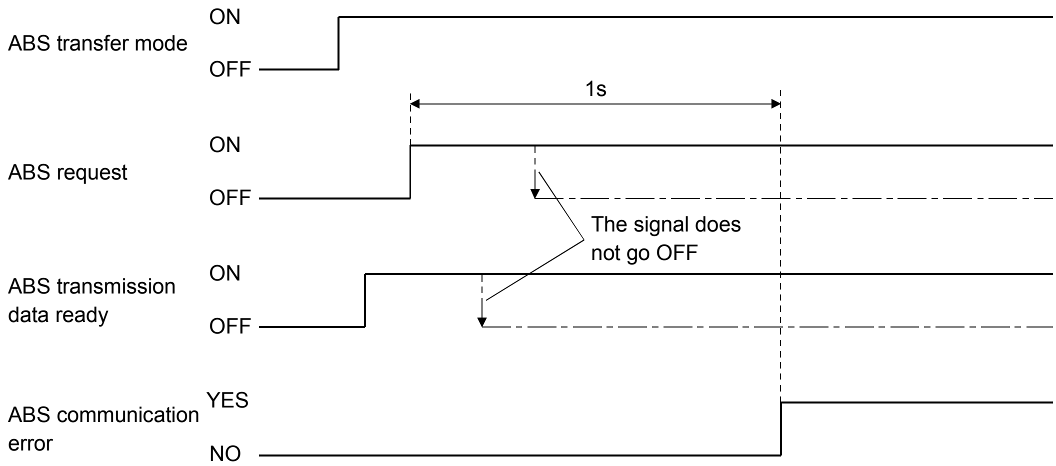
(a) The OFF period of the ABS transmission data ready signal output from the servo amplifier is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS request ON time time-out.



(b) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked.
If the ABS transfer time is longer than 5s, this is communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS transfer mode completion time time-out.



(c) To detect the ABS time-out warning (AL.E5) at the servo amplifier, the time required for the ABS request signal to go OFF after it has been turned ON (ABS request time) is checked. If the ABS request remains ON for longer than 1s, it is regarded that an fault relating to the ABS request signal or the ABS transmission data ready (ABST) has occurred, and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the servo amplifier due to an ABS request OFF time time-out.



14.9.2 Error resetting conditions

Always remove the cause of the error before resetting the error.

Name	Output coil		Servo status	Resetting condition
	A1SD75	1PG		
ABS communication error	Y39	Y11	Ready (RD) off	Reset when servo-on (SON) PB (X26) signal turns off.
ABS checksum error	Y3A	Y12	Ready (RD) on	For A1SD75 Reset when servo-on (SON) PB (X26) signal turns from off to on.
				For FX-1PG Reset when servo-on (SON) PB (X26) signal turns off.
Servo alarm	Y38	Y10	Ready (RD) on	Reset when alarm reset PB turns on or power switches from off to on.

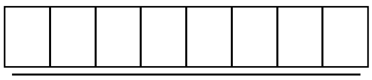
14.10 Communication-based ABS transfer system

14.10.1 Serial communication command

The following commands are available for reading absolute position data using the serial communication function. When reading data, take care to specify the correct station number of the drive unit from where the data will be read.
When the master station sends the data No. to the slave station (servo amplifier), the slave station returns the data value to the master station.

(1) Transmission
Transmit command [0][2] and data No. [9][1].

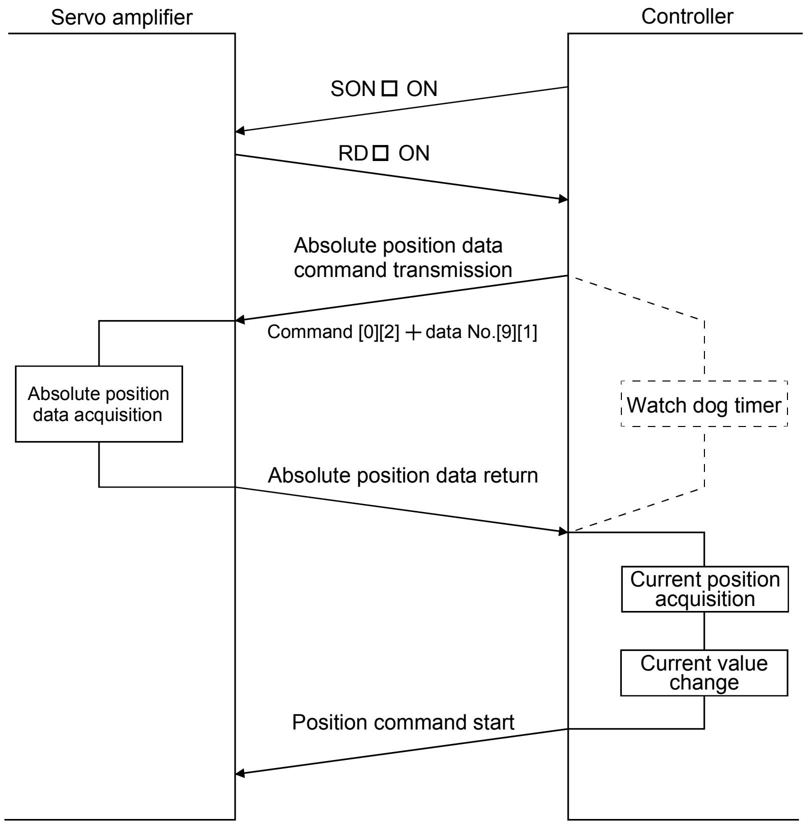
(2) Reply
The absolute position data in the command pulse unit is returned in hexadecimal.



Data 32-bit length (hexadecimal representation)

14.10.2 Absolute position data transfer protocol

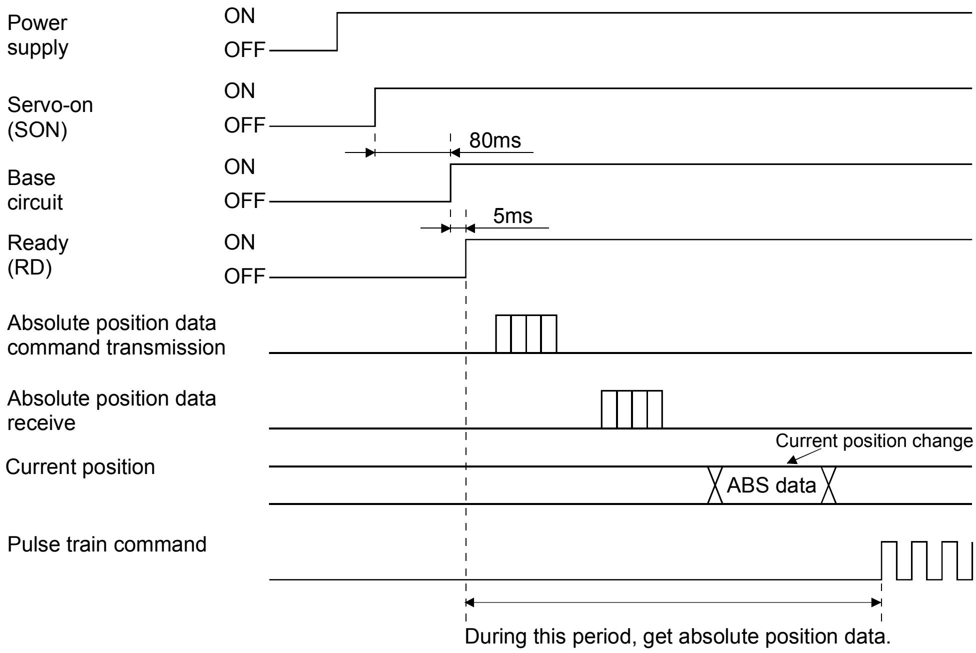
(1) Data transfer procedure
Every time the servo-on (SON) turns on at power-on or like, the controller must read the current position data in the servo amplifier. Not performing this operation will cause a position shift.
Time-out monitoring is performed by the controller.



(2) Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on (SON) going OFF, an emergency stop, or alarm, is explained below. In the absolute position detection system, always give the serial communication command to read the current position in the servo amplifier to the controller every time the ready (RD) turns on. The servo amplifier sends the current position to the controller on receipt of the command. At the same time, this data is set as a position command value in the servo amplifier.

(a) Sequence processing at power-on



1) 95ms after the servo-on (SON) has turned on, the base circuit turns on.
2) After the base circuit has turned on, the ready (RD) turns on.
3) After the ready (RD) turned on and the controller acquired the absolute position data, give command pulses to the drive unit. Providing command pulses before the acquisition of the absolute position data can cause a position shift.

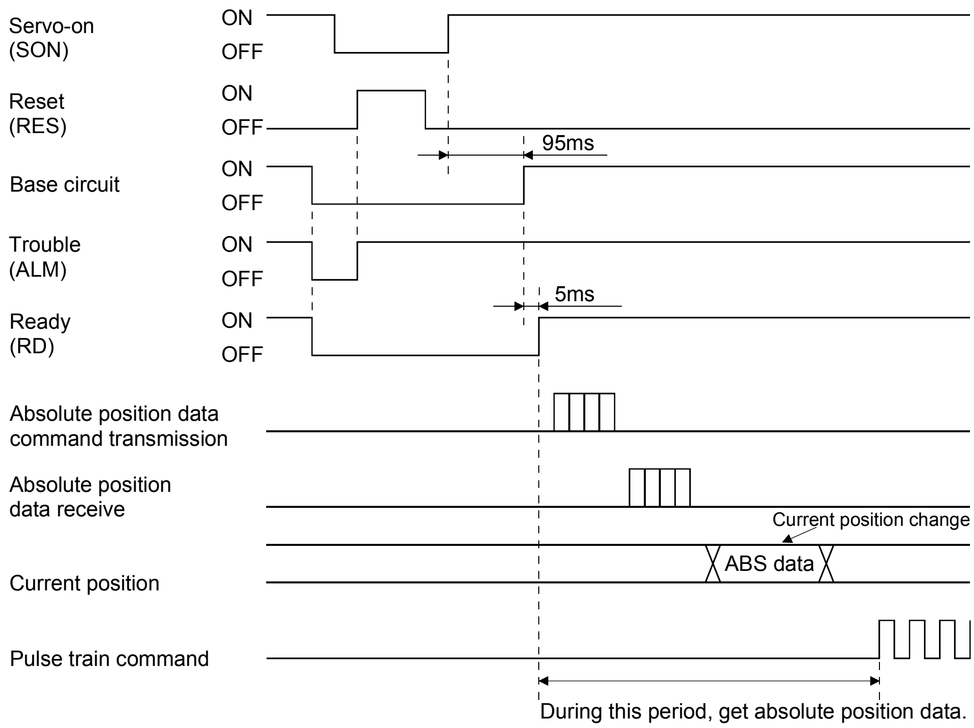
(b) Communication error

If a communication error occurs between the controller and servo amplifier, the servo amplifier sends the error code. The definition of the error code is the same as that of the communication function. Refer to section 13.3.3 for details.

If a communication error has occurred, perform retry operation. If several retries do not result in a normal termination, perform error processing.

(c) At the time of alarm reset

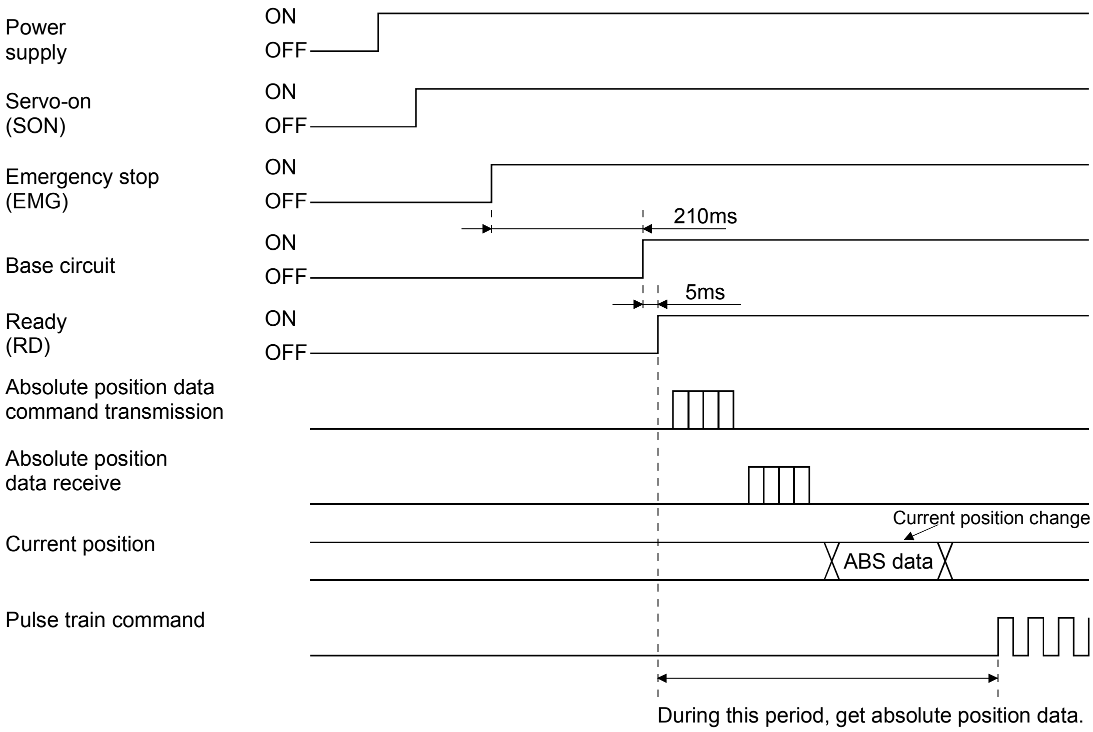
If an alarm has occurred, detect the trouble (ALM) and turn off the servo-on (SON). After removing the alarm occurrence factor and deactivating the alarm, get the absolute position data again from the servo amplifier in accordance with the procedure in (a) of this section.



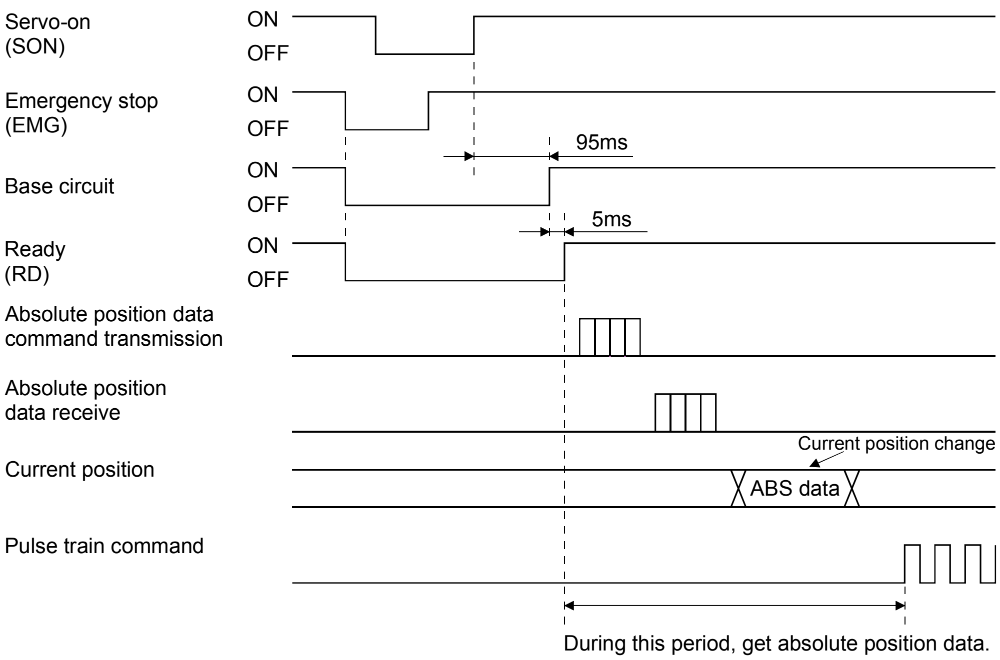
(d) At the time of forced stop reset

210ms after the forced stop is deactivated, the base circuit turns on, and further 5ms after that, the ready (RD) turns on. Always get the current position data from when the ready (RD) is triggered until before the position command is issued.

1) When power is switched on in a forced stop status



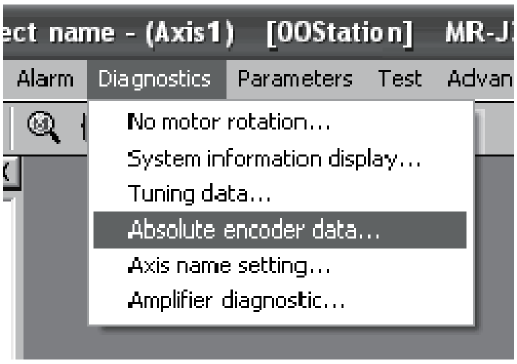
2) When a emergency stop is activated during servo on



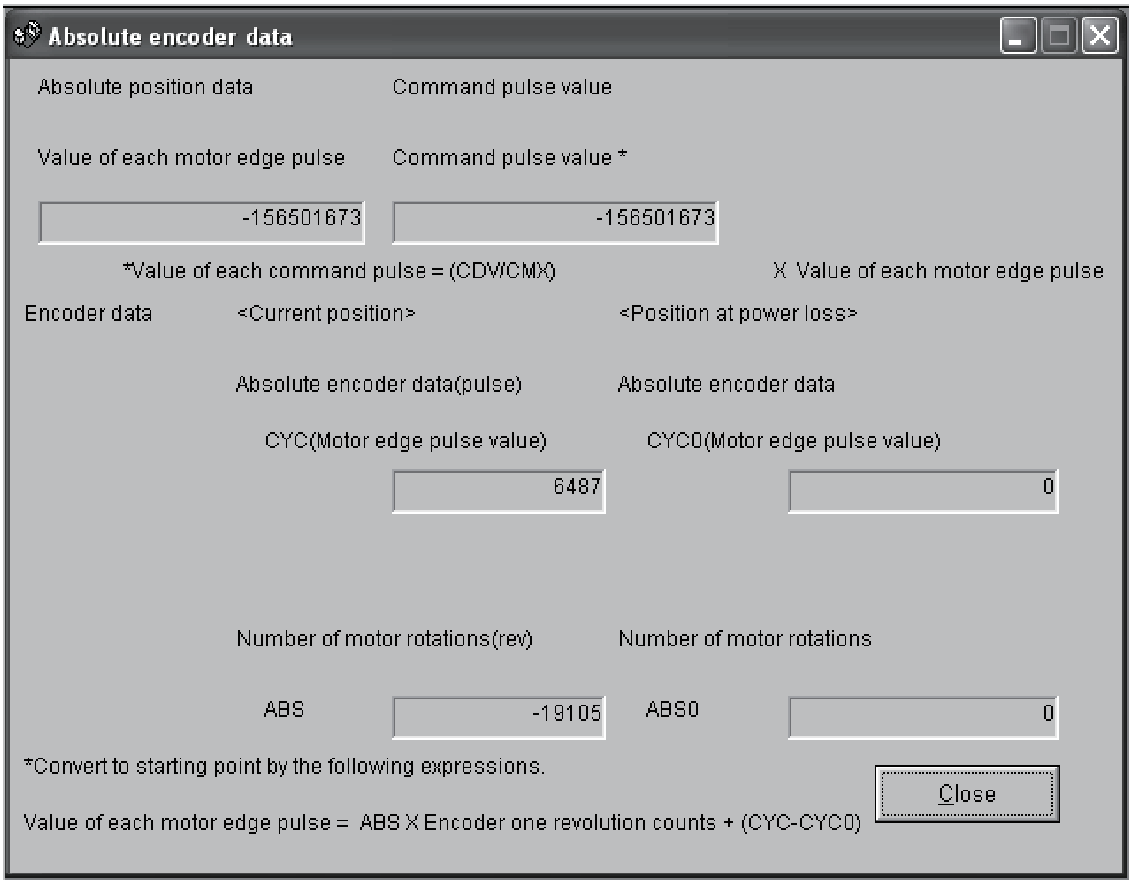
14.11 Confirmation of absolute position detection data

You can confirm the absolute position data with MR Configurator (servo configuration software).
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.

App 1. Parameter list

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

Basic setting parameters (PA □□)			
No.	Symbol	Name	Control mode
PA01	*STY	Control mode	P・S・T
PA02	*REG	Regenerative option	P・S・T
PA03	*ABS	Absolute position detection system	P
PA04	*AOP1	Function selection A-1	P・S・T
PA05	*FBP	Number of command input pulses per revolution	P
PA06	CMX	Electronic gear numerator (Command pulse multiplying factor numerator)	P
PA07	CDV	Electronic gear denominator (Command pulse multiplying factor denominator)	P
PA08	ATU	Auto tuning	P・S
PA09	RSP	Auto tuning response	P・S
PA10	INP	Control mode, regenerative option selection	P
PA11	TLP	Forward torque limit	P・S・T
PA12	TLN	Reverse torque limit	P・S・T
PA13	*PLSS	Selection of servo motor stop pattern at LSP/LSN signal off	P
PA14	*POL	Rotation direction selection	P
PA15	*ENR	Encoder output pulses	P・S・T
PA16 to PA18		For manufacturer setting	
PA19	*BLK	Parameter write inhibit	P・S・T

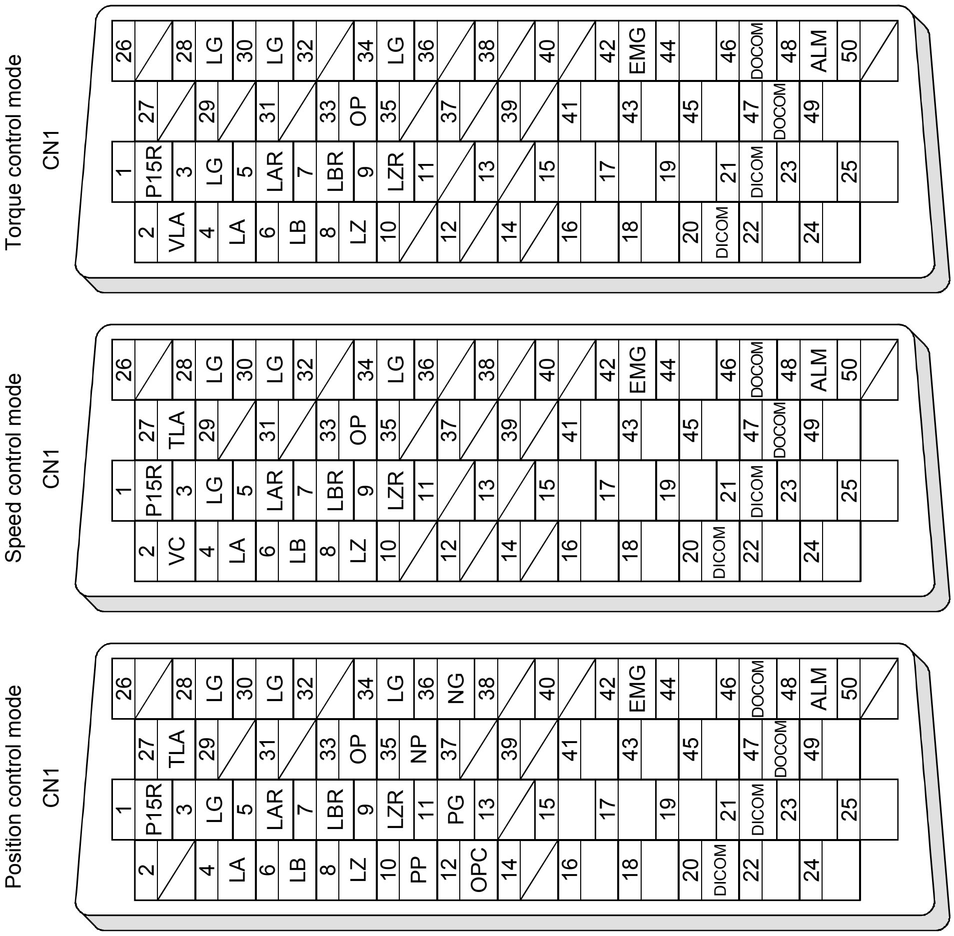
Gain/filter parameters (PB □□)			
No.	Symbol	Name	Control mode
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	P・S
PB02	VRFT	Vibration suppression control filter tuning mode (Advanced vibration suppression control)	P
PB03	PST	Position command acceleration/ deceleration time constant (Position smoothing)	P
PB04	FFC	Feed forward gain	P
PB05		For manufacturer setting	
PB06	GD2	Ratio of load inertia moment to servo motor inertia moment	P・S
PB07	PG1	Model loop gain	P
PB08	PG2	Position loop gain	P
PB09	VG2	Speed loop gain	P・S
PB10	VIC	Speed integral compensation	P・S
PB11	VDC	Speed differential compensation	P・S
PB12		For manufacturer setting	
PB13	NH1	Machine resonance suppression filter 1	P・S
PB14	NHQ1	Notch form selection 1	P
PB15	NH2	Machine resonance suppression filter 2	P
PB16	NHQ2	Notch form selection 2	P
PB17		Automatic setting parameter	
PB18	LPF	Low-pass filter	P
PB19	VRF1	Vibration suppression control vibration frequency setting	P
PB20	VRF2	Vibration suppression control resonance frequency setting	P
PB21		For manufacturer setting	
PB22		For manufacturer setting	
PB23	VFBF	Low-pass filter selection	P
PB24	*MVS	Slight vibration suppression control selection	P・S
PB25	*BOP1	Function selection B-1	P
PB26	*CDP	Gain changing selection	P・S
PB27	CDL	Gain changing condition	P・S
PB28	CDT	Gain changing time constant	P・S
PB29	GD2B	Gain changing ratio of load inertia moment to servo motor inertia moment	P・S
PB30	PG2B	Gain changing position loop gain	P
PB31	VG2B	Gain changing speed loop gain	P・S
PB32	VICB	Gain changing speed integral compensation	P・S
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	P
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	P
PB35 to PB45		For manufacturer setting	

Extension setting parameters (PC□□)			
No.	Symbol	Name	Control mode
PC01	STA	Acceleration time constant	S・T
PC02	STB	Deceleration time constant	S・T
PC03	STC	S-pattern acceleration/ deceleration time constant	S・T
PC04	TQC	Torque command time constant	T
PC05	SC1	Internal speed command 1	S
		Internal speed limit 1	T
PC06	SC2	Internal speed command 2	S
		Internal speed limit 2	T
PC07	SC3	Internal speed command 3	S
		Internal speed limit 3	T
PC08	SC4	Internal speed command 4	S
		Internal speed limit 4	T
PC09	SC5	Internal speed command 5	S
		Internal speed limit 5	T
PC10	SC6	Internal speed command 6	S
		Internal speed limit 6	T
PC11	SC7	Internal speed command 7	S
		Internal speed limit 7	T
PC12	VCM	Analog speed command maximum speed	S
		Analog speed limit maximum speed	T
PC13	TLC	Analog torque command maximum output	T
PC14	MOD1	Analog monitor output 1	P・S・T
PC15	MOD2	Analog monitor output 2	P・S・T
PC16	MBR	Electromagnetic brake sequence output	P・S・T
PC17	ZSP	Zero speed	P・S・T
PC18	*BPS	Alarm history clear	P・S・T
PC19	*ENRS	Encoder output pulses selection	P・S・T
PC20	*SNO	Parameter block	P・S・T
PC21	*SOP	communication function selection	P・S・T
PC22	*COP1	Function selection C-1	S
PC23	*COP2	Function selection C-2	P・S・T
PC24	*COP3	Function selection C-3	P・S・T
PC25		For manufacturer setting	
PC26	*COP5	Function selection C-4	P・S
PC27 to PC29		For manufacturer setting	
PC30	STA2	Acceleration time constant 2	S・T
PC31	STB2	Deceleration time constant 2	S・T
PC32	CMX2	Command pulse multiplying factor numerator 2	P
PC33	CMX3	Command pulse multiplying factor numerator 3	P
PC34	CMX4	Command pulse multiplying factor numerator 4	P
PC35	TL2	For manufacturer setting	P・S・T
PC36	*DMD	Status display selection	P・S・T
PC37	VCO	Analog speed command offset	S
		Analog speed limit offset	T
PC38	TPO	Analog torque command offset	T
		Analog torque limit offset	S

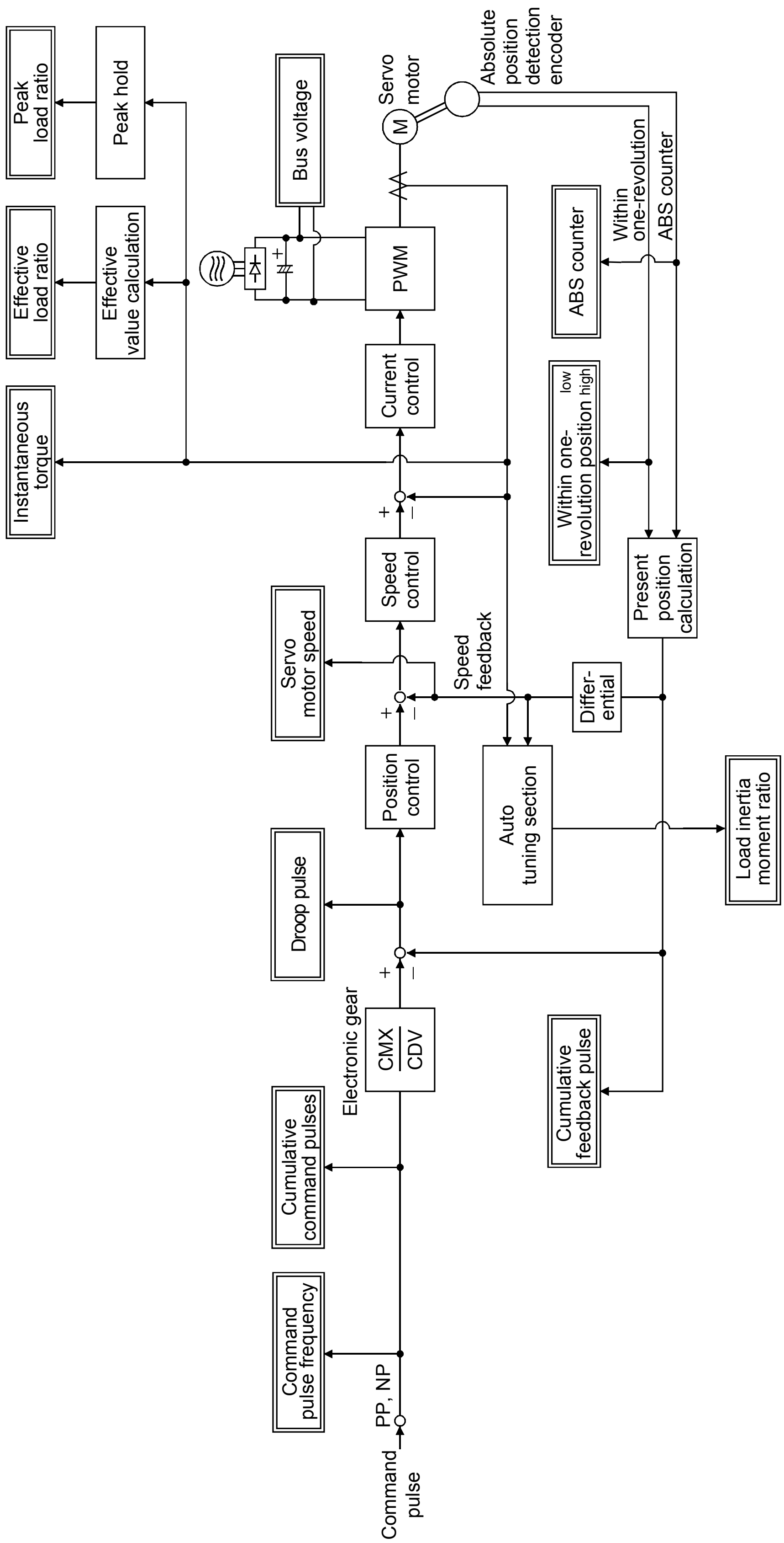
Extension setting parameters (PC□□)			
No.	Symbol	Name	Control mode
PC39	MO1	Analog monitor 1 offset	P・S・T
PC40	MO2	Analog monitor 2 offset	P・S・T
PC41 to PC50		For manufacturer setting	

I/O setting parameters (PD□□)			
No.	Symbol	Name	Control mode
PD01	*DIA1	Input signal automatic ON selection 1	P・S・T
PD02		For manufacturer setting	
PD03	*DI1	Input signal device selection 1 (CN1-pin 15)	P・S・T
PD04	*DI2	Input signal device selection 2 (CN1-pin 16)	P・S・T
PD05	*DI3	Input signal device selection 3 (CN1-pin 17)	P・S・T
PD06	*DI4	Input signal device selection 4 (CN1-pin 18)	P・S・T
PD07	*DI5	Input signal device selection 5 (CN1-pin 19)	P・S・T
PD08	*DI6	Input signal device selection 6 (CN1-pin 41)	P・S・T
PD09		For manufacturer setting	
PD10	*DI8	Input signal device selection 8 (CN1-pin 43)	P・S・T
PD11	*DI9	Input signal device selection 9 (CN1-pin 44)	P・S・T
PD12	*DI10	Input signal device selection 10 (CN1-pin 45)	P・S・T
PD13	*DO1	Output signal device selection 1 (CN1-pin 22)	P・S・T
PD14	*DO2	Output signal device selection 2 (CN1-pin 23)	P・S・T
PD15	*DO3	Output signal device selection 3 (CN1-pin 24)	P・S・T
PD16	*DO4	Output signal device selection 4 (CN1-pin 25)	P・S・T
PD17		For manufacturer setting	
PD18	*DO6	Output signal device selection 6 (CN1-pin 49)	P・S・T
PD19	*DIF	Response level setting	P・S・T
PD20	*DOP1	Function selection D-1	P・S・T
PD21		For manufacturer setting	
PD22	*DOP3	Function selection D-2	P
PD23		For manufacturer setting	
PD24	*DOP5	Function selection D-4	P・S・T
PD25 to PD30		For manufacturer setting	

App 2. Signal layout recording paper



App 3. Status display block diagram



App 4. Change of connector sets to the RoHS compatible products

Connector sets (options) in the following table are changed to the RoHS compatible products after September, 2006 shipment.
Please accept that the current products might be mixed with RoHS compatible products based on availability.

Model	Current Product	RoHS Compatible Product
MR-J3SCNS MR-ECNM	Amplifier connector (3M or equivalent of 3M) 36210-0100TL (Receptacle) (Note) 36310-3200-008 (Shell kit)	Amplifier connector (3M or equivalent of 3M) 36210-0100PL (Receptacle) 36310-3200-008 (Shell kit)
MR-PWCNS4	Power supply connector (DDK) CE05-6A18-10SD-B-BSS (Connector and Back shell) CE3057-10A-1 (D265) (Cable clump)	Power supply connector (DDK) CE05-6A18-10SD-D-BSS (Connector and Back shell) CE3057-10A-1-D (Cable clump)
MR-PWCNS5	Power supply connector (DDK) CE05-6A22-22SD-B-BSS (Connector and Back shell) CE3057-12A-1 (D265) (Cable clump)	Power supply connector (DDK) CE05-6A22-22SD-D-BSS (Connector and Back shell) CE3057-12A-1-D (Cable clump)
MR-PWCNS3	Power supply connector (DDK) CE05-6A32-17SD-B-BSS (Connector and Back shell) CE3057-20A-1 (D265) (Cable clump)	Power supply connector (DDK) CE05-6A32-17SD-D-BSS (Connector and Back shell) CE3057-20A-1-D (Cable clump)
MR-PWCNS1	Power supply connector (DDK) CE05-6A22-23SD-B-BSS (Connector and Back shell) CE3057-12A-2 (D265) (Cable clump)	Power supply connector (DDK) CE05-6A22-23SD-D-BSS (Connector and Back shell) CE3057-12A-2-D (Cable clump)
MR-PWCNS2	Power supply connector (DDK) CE05-6A24-10SD-B-BSS (Connector and Back shell) CE3057-16A-2 (D265) (Cable clump)	Power supply connector (DDK) CE05-6A24-10SD-D-BSS (Connector and Back shell) CE3057-16A-2-D (Cable clump)
MR-BKCN	Electromagnetic brake connector MS3106A10SL-4S(D190) (Plug, DDK)	Electromagnetic brake connector D/MS3106A10SL-4S(D190) (Plug, DDK)
MR-J3CN1	Amplifier connector (3M or equivalent of 3M) 10150-3000VE (connector)	Amplifier connector (3M or equivalent of 3M) 10150-3000PE (connector)

Note. RoHS compatible 36210-0100FD is partly packed.

REVISIONS

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

Print Data	*Manual Number	Revision
Oct., 2003	SH(NA)030038-A	First edition
May, 2003	SH(NA)030038-B	Safety Instructions: 4. (1) HF-SP Series servomotor is added to the environment conditions. Compliance with EC directives in EU: 2.(1) Servo amplifiers MR-J3-60A/100A/200A/350A are added. HF-SP Series servomotor is added. Compliance with UL/C-UL standard: (1) Servo amplifiers MR-J3-60A/100A/200A/350A are added. HF-SP Series servomotor is added. (4) Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 1.3: Servo amplifiers MR-J3-60A/100A/200A/350A are added. Note 2. The torque limit is changed to the effective load ratio. Section 1.4: The amplifier diagnosis function is added. Section 1.5 (2): Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 1.6: Servo amplifiers MR-J3-60A/100A/200A/350A are added. HF-SP Series servomotor is added. Section 1.7 (2): Added. Section 1.8 (2): Added. Section 2.1 (2): Part of the paragraph is changed. Section 3.2.2: Analog torque limit $\pm$10V is changed to 8V. Section 3.3.1: Paragraph is added. Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 3.3.3 (2) (4) : Added. Section 3.4 (1): Error in the CN2 connector signal allotment is corrected. Section 3.5 (1) (b): Description of speed reached is examined. Alarm code AL. 47 is added. Section 3.5 (5): Caution is added. Section 3.6.2 (1) (a): Note is added. Section 3.8.2 (3) (a) 2): 0.7μs is changed to 0.35μs. Section 3.10.2 (1): HF-KP Series is added. Section 3.10.2 (2): HF-SP Series is added. Section 3.11.4: "POINT" is added. Section 5.1.4: Parameter No. PA02 MR-RB30 and MR-RB50 is added. Section 5.1.8 (3): The per-revolution pulse count of the servomotor viewed from QD75 is examined. Section 5.2.2: PB01 Paragraph is added. PB02 Paragraph is added. PB23 Paragraph is examined. Section 5.3.1: PC22 Control mode is examined. PC13 Setting is changed to "1000.0." PC23 Part of the paragraph is examined. PC24 The in-position range unit selection setting is changed to the fourth digit. Section 5.4.1: PD08 Initial value is changed to 00202006h.

Print Data	*Manual Number	Revision
May, 2003	SH(NA)030038-B	Section 5.4.2: List of details is added. PD24 AL. 47 is added. Section 6.4: Amplifier diagnosis is added. Section 6.7 (3) (a) (b): SP2 (CN1-16) is added. Section 8.2 (3): Paragraph is added. Part of the paragraph in "POINT" is examined. Section 9.1: AL. 47 is added. AL. E8 is added. Section 9.2: Description of AL. 52 is changed. Section 9.3: Paragraph is added. AL. E8 is added. Section 10: Outline drawing is examined. Section 10.1 (4): Added. Section 11.1: c. HF-SP152 to 352 is added. Section 11.2 (1): Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 11.3: HF-SP Series is added. Section 11.5: Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.1.1: The cable and connector set drawing is added and changed. Section 12.1.2 (1) (a): The CN2 connector signal allotment drawing is changed. Section 12.1.2 (4) (5): Added. Section 12.2 (1) (b): Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.2 (1) (c): MR-RB30 and MR-RB50 are added. Section 12.2 (5): MR-RB30 and MR-0RB50 are added. Section 12.4 (2): The free space of the hard disk is changed to 30MB. Section 12.4 (2) (c): Added. Section 12.6 (1): Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.6 (2): Cable is added. Section 12.7: Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.8: Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.9: Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.12 (2) (d): FR-BLF is added. Section 12.13 (1): Servo amplifiers MR-J3-60A/100A/200A/350A are added. Section 12.14: HF-3030-UN is added. Section 14.8.3: Added. App 4.: Added.
Apr., 2005	SH(NA)030038-C	Servo amplifiers MR-J3-500A/700A are added. Servo motors HF-MP Series・HF-SP1000/min Series・HF-SP502/702 Series are added. Section 1.2 (2): Added. Section 1.3: Power supply capacity column is deleted. PInput and inrush current columns are added. Section 1.4: Modified to MRZJW3-SETUP211E. Brake unit and return converter are added. Section 1.7: Format is examined. Section 1.7.1 (3) (4): Added. Section 1.7.2: Added. Section 1.8 (3) (4): Added. Section 2.1 (2): "POINT" is added.

Print Data	*Manual Number	Revision
Apr., 2005	SH(NA)030038-C	Section 3.1 (1) (2) (3) Titles are examined. Note 4. is added. Section 3.1 (4): Added. Section 3.2.1: Note 12. is added. Section 3.2.2: Note 12. is added. Section 3.2.3: Note 10. is added. Section 3.3.1: "POINT" is added. Servo amplifier conceptual diagram is deleted. Regenerative option is separated into each case. Section 3.3.2 (3): Note is added into the drawing. Section 3.3.3: Sentence is added into "POINT". Section 3.5 (1) (a): Servo on and servo off condition is deleted. Part of columns of emergency stop and functions/applications is examined. Section 3.5 (1) (b): Zero speed Example is added. Section 3.5 (3): The minimum pulse width of Encoder Z-phase pulse is changed to 400μs. Section 3.6.2 (1) (a): Note is added. Section 3.6.3 (1) (a): Note is added. Section 3.6.3 (3) (a): Note is added. Section 3.6.4 (3) (a): Note is added. Section 3.6.4 (3) (b): Content is examined. Section 3.6.5 (4) (a): Note is added. Section 3.7 (3): Sentence is examined. Section 3.8.1: Part of connection diagram is modified. Section 3.8.2 (4) (b) 2): Part of drawing is modified. Section 3.8.2 (6): Drawing is examined. Section 3.10.2 (2) (b): Connector signal allotment CE05-2A32-17PD-B is added. Section 3.11.1: Sentence is examined. Section 4.1.2 (1) (c): Examined. Section 5.1.1: PA16 Initial value is modified to 0. PA17・PA18 Initial value is modified to 0000h. PA19 Name is examined. Section 5.1.4: Parameter No.PA02 setting 01・08・09 are added. Section 5.1.10: Feedback pulses are changed to droop pulses. Section 5.2.1: PB14・PB15・PB16・PB18・PB23 are modified to correspond to speed control mode. PB44 Initial value is modified to 0.0 Section 5.2.2: PB02 Sentence is added. PB07 Setting range is modified to 1~2000. PB17 Sentence is examined. PB26 Expression is examined. Section 5.3.1: PC20 Errors in writing are modified. Section 5.3.2: PC12 The case of MR-J3-100A to 700A is added. PC14 Note 2. is added. PC15 Note 2. is added. PC17 Sentence is added. PC22 Sentence is added.

Print Data	*Manual Number	Revision
Apr., 2005	SH(NA)030038-C	Section 5.3.3 (1): Parameters are separated into each case. Section 5.3.3 (2): Note 2. is added. Setting A Horizontal axis is changed to 1Mpulse. Setting B Horizontal axis is changed to 10Mpulse. Setting C Horizontal axis is changed to 100Mpulse. Section 6.6.2 (1) (2): Error in Parameter screen is corrected. Section 8.1: Setting of machine resonance suppression filter 2 is modified to □□□1. Section 8.6.3 (4): Expression for setting parameter is examined. Chapter 9: Sentence in "POINT" is changed. Section 9.1: AL.45・AL.47 Note 1. is added. Section 9.2: AL.33 Causes 1・2 are added. AL.46 Modified to thermal sensor. Section 9.3: Caution is added. AL.E3 Content is added. Section 10.1 (5) (6): Added. Section 11.1: d.HF-SP502・702 is added. Section 11.2 (1): Table is examined. Section 11.3: Dynamic brake time constant is added. Chapter 12: "WARNING" 10 minutes are modified to 15 minutes. Section 12.1.1: Combinations of cable and connector sets diagram is examined. 2) Servo amplifier power supply connector is added. 3) Power supply connector set is added. Section 12.1.2 (1) (a): Encoder connector Crimping tool are added. Section 12.1.2 (2) (a): Note is added. Section 12.2 (1): MR-RB31 and MR-RB51 are added. Section 12.2 (3): Parameter No.PA02 setting 01・08・09 are added. Section 12.2 (4): "POINT" is added. Content is examined. Section 12.2 (5): MR-RB31 and MR-RB51 are added. Section 12.5 (5) (b): Outline drawing is partially modified. Section 12.3: Added. Section 12.4: Added. Section 12.6 (2) (a): The free space of the hard disk is changed to 130MB. Section 12.7 (2): Added. Section 12.8: Part of wiring diagram is added. Table of crimping terminals and applicable tools is added. Section 12.16: HF3040A-UN is added. Section 13.4.1 (5): Current alarm data [0][1]・[0][8]・[0][9] are deleted. Section 13.4.2 (3): Error in reference page No. is corrected. Section 13.4.2 (8): Data No. [2] [0] Content is changed. Data No. [2] [1] The expression of test operation setting is changed. Chapter 14: Caution Sentence is added. Description of AD75□ is deleted. Section 14.2 (2): QD75□ is added. Section 14.3 (2): Added. Section 14.7.3 (2): Part of sentence is examined.

Print Data	*Manual Number	Revision
Apr., 2005	SH(NA)030038-C	Section 17.8.2 (2) (c): Note 2. is added. Section 17.8.2 (2) (f): Note 3. is added. App 6.: Table is examined.
Oct., 2006	SH(NA)030038-D	Servo amplifiers MR-J3-11KA to 22KA・11KA4 to 22KA4 are added. Servo motors HC-RU・HC-UP・HC-LP・HA-LP・HA-LP4 are added. Safety Instructions: 4. (1) Environmental conditions table: Vibration is examined. Safety Instructions: 4. (2) Caution is added. Safety Instructions: 4. (4) Caution is added. Section 1.2: Connection diagram is modified. Addition of Note Section 1.3: 400VAC class supporting table is added. Section 1.5 (2): Drawings are modified. Section 1.7: Mounting hole is changed into fixing part. Section 1.7.1 (5): Added. Section 1.8 (5): Added. Chapter 2: Caution is added. Section 2.1 (2): Added. Section 3.1 (1) to (4): Modified. Section 3.1 (5): Added. Section 3.2.1: SD (Plate) is added to CN1. Section 3.3.3 (2) (b) 1): 2.5mm size bar terminal model name (for 2 cables) is modified. Section 3.3.3 (3): "POINT" is added. Table for parameter No. PD01 in the functions/applications column of the forward rotation stroke end and reverse rotation stroke end is examined. Section 3.5 (1) (a): Functions/Applications column of devices is modified. Section 3.5 (1) (b): Dynamic interlock is added. Zero speed detection graph is modified. Variable gain selection is modified. Section 3.6 (5) (b): Table is modified. Section 3.8.1: Differential line driver is modified to 35mA. Section 3.8.1 (4) (b) 2): Explanation is added. Section 3.9: Content is examined. Section 3.10.2 (2): Content is examined. Section 3.11.1: Caution is added. Section 3.11.3 (4): 10ms is added to electromagnetic brake interlock invalid. Section 3.11.4 (1) (2): Electromagnetic brake interlock (MBR) is added. Section 4.1.1: Part of sentence is examined. Section 4.2.3: Part of sentence is examined. Section 4.3.3: Part of sentence is examined. Section 4.4.3: Added. Section 4.4.6: Ex-Section 4.4.3 is moved. Section 5.1.1: PA13 Name is modified. Section 5.1.3: Setting of parameter No. PA02 is added and modified. Section 5.1.11: Setting value is modified. Section 5.2.1: Parameter No.PB07 is modified. Parameter No.PB17 is modified. Section 5.2.2: Sentence of parameter No.PB07 is modified. Sentence of parameter No.PB09 is modified. Sentence of parameter No.PB10 is modified. Sentence of parameter No.PB24 is modified. Section 5.3.2: Addition of Note for parameter No. PC14. Modified description for parameter No. PC15.

Print Data	*Manual Number	Revision
Oct., 2006	SH(NA)030038-D	Section 5.3.3: (Note 3) is added to setting value 1 and 3. (Note 4) is added to setting value D. Section 5.4.2: PD01 Explanation is modified. PD13 Setting value 06 is modified. PD13 Setting value 09 is modified. Section 6.3.3: Change of bus voltage display range. Section 7.3 (1) (a): Part of table is added. Section 7.3 (1) (b): Table is modified. Section 7.3 (2) (b): Table is modified. Section 7.4 (2): Sentence in the table is modified. Section 9.2: AL.10 Description of 400V class is added. AL.30 Description of 400V class is added. AL.32 Cause 2. IGBT is added to transistor. AL.33 Description of 400V class is added. Section 9.3: "POINT" is added. Section 10.1: Mounting hole machining drawing is added. Section 10.1 (5) (6): Outline drawings are modified. Section 10.1 (7): Added. Section 10.2: Examined. Section 11.1: Table is added. Graph is added. Section 11.3: Graph is added. Section 12.1.1: Motor drawing is added. Connector set is added. Change of connector set model. Section 12.1.2 (1) (a): For CN2 connector: Model name is changed. For CN2 connector: Added Section 12.1.2 (2) (a) (c): For CN2 connector: Model name is changed. For CN2 connector: Added Section 12.1.2 (4) (a) (c): For CN2 connector: Model name is changed. For CN2 connector: Added Section12.1.2 (5) (a): For CN2 connector: Model name is changed. For CN2 connector: Added Section 12.2 (3): Parameter No. PA02 Selection description of regenerative option is examined. Section 12.2 (4) (b): Sentence is modified. Section 12.2 (4) (c) (d): Added. Section 12.2 (5) (d) (e): Added. Section 12.3: Part of "POINT" is added. Section 12.3: FR-BU-55K・FR-BU-H 1 5K・FR-BU-H30K・FR-BU-H55K are added. Section 12.3 (2): Sentence of Note is modified. Section 12.4: FR-BU-55K・FR-BU-H 1 5K・FR-BU-H30K・FR-BU-H55K are added. Section 12.4 (2): Note 5. is added. Section 12.5: Power regeneration common converter is added. Section 12.6: External dynamic brake is added. Section 12.10: Heat sink outside mounting attachment (MR-J3ACN) is added.

Print Data	*Manual Number	Revision
Oct., 2006	SH(NA)030038-D	Section 12.11 (1): Cooling fan・thermal are added. Section 12.13 (2): 400V class is added. Section 12.14 (2) (e): Radio noise filter FR-BIF-H is added. Section 12.15 (1): 400V class graph is added. Section 12.16: Sentence is modified. Part of drawing is deleted. Section 12.19: Outline drawings are added. Section 12.19 (1): Part of table is added. Section 13.1 (2) (a): Note 2. is added. Section 13.1 (2) (b): (Note 7) is added to cable connection diagram. Section 13.4: Part of POINT is modified. Section 13.4.1 (2): Data No. [0] [1] is modified. Section 13.4.1 (6): Part of table is deleted. Section 13.4.2 (2): Data No. [0] [1] is modified. Section 13.5.3 (5): "POINT" is added. Section 13.5.9 (3): Added. Section 14.3 (1): "POINT" is added. APPENDIX: App5 is added.
Jul., 2007	SH(NA)030038-E	Servo amplifier MR-J3-60A4 to MR-J3-700A4 added

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