# MELSERVO

## Servo Amplifiers and Motors

## Instruction Manual

# MR-J2S-□A

Art. no.: 138918
2001 02 15
Version C

# ● 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 10 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.
- Connect the servo amplifier and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, you may get an electric shock.

2. To prevent fire, note the following:

## ⚠ CAUTION

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

3. To prevent injury, note the follow

## ⚠ CAUTION

- Only the voltage specified in the 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.
- During power-on or for some time after power-off, do not touch or close a parts (cable etc.) to the servo amplifier heat sink, regenerative brake resistor, servo motor, etc. Their temperatures may be high and you may get burnt or a parts may damaged.

## 4. Additional instructions

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

### (1) Transportation and installation

**⚠ CAUTION**

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

| Environment | | Conditions | | |
|---|---|---|---|---|
| | | Servo amplifier | Servo motor | |
| Ambient temperature | [℃] | 0 to +55 (non-freezing) | 0 to +40 (non-freezing) | |
| | [°F] | 32 to 131 (non-freezing) | 32 to 104 (non-freezing) | |
| Ambient humidity | | 90%RH or less (non-condensing) | 80%RH or less (non-condensing) | |
| Storage temperature | [℃] | −20 to +65 (non-freezing) | −15 to +70 (non-freezing) | |
| | [°F] | −4 to 149 (non-freezing) | 5 to 158 (non-freezing) | |
| Storage humidity | | 90%RH or less (non-condensing) | | |
| Ambience | | Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt | | |
| Altitude | | Max. 1000m (3280 ft) above sea level | | |
| Vibration | [$m/s^2$] | 5.9 or less | HC-KFS Series<br>HC-MFS Series<br>HC-UFS13 to 73 | X・Y : 49 |
| | | | HC-SFS81<br>HC-SFS52 to 152<br>HC-SFS53 to 153<br>HC-RFS Series<br>HC-UFS 72・152 | X・Y : 24.5 |
| | | | HC-SFS121・201<br>HC-SFS202・352<br>HC-SFS203・353<br>HC-UFS202 to 502 | X : 24.5<br>Y : 49 |
| | | | HC-SFS301<br>HC-SFS502・702 | X : 24.5<br>Y : 29.4 |
| | [$ft/s^2$] | 19.4 or less | HC-KFS Series<br>HC-MFS Series<br>HC-UFS 13 to 73 | X・Y : 161 |
| | | | HC-SFS81<br>HC-SFS52 to 152<br>HC-SFS53 to 153<br>HC-RFS Series<br>HC-UFS 72・152 | X・Y : 80 |
| | | | HC-SFS121・201<br>HC-SFS202・352<br>HC-SFS203・353<br>HC-UFS202 to 502 | X : 80<br>Y : 161 |
| | | | HC-SFS301<br>HC-SFS502・702 | X : 80<br>Y : 96 |

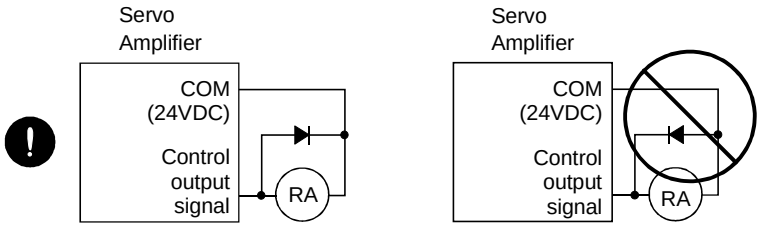
## ⚠ CAUTION

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

(2) Wiring

## ⚠ CAUTION

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




(3) Test run adjustment

## ⚠ CAUTION

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

(4) Usage

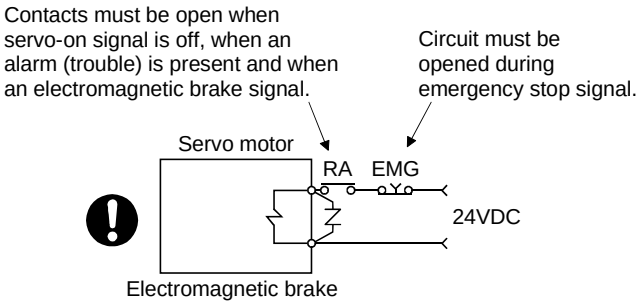
## ⚠ CAUTION

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

(5) Corrective actions

## ⚠ CAUTION

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




- When any alarm has occurred, eliminate its cause, ensure safety, 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 will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment. Please consult our sales representative. |

(7) Disposal

| ⚠ CAUTION |
| --- |
| ・Dispose of the product as general industrial waste. |

(8) General instruction

| |
| --- |
| ・To illustrate details, the equipment in the diagrams of this 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 Instruction Manual. |

# 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).

This servo is certified by TUV, third-party assessment organization, to comply with the EMC directive in the conforming methods of the EMC Installation Guidelines.

### (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

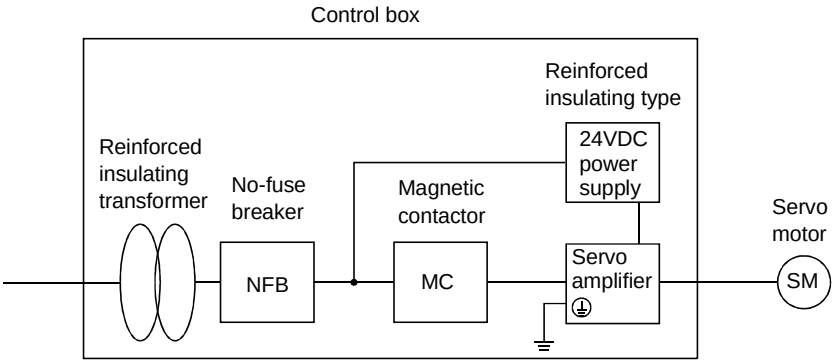
### (1) Servo amplifiers and servo motors used

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

Servo amplifier :MR-J2S-10A to MR-J2S-700A
MR-J2S-10A1 to MR-J2S-40A1

Servo motor :HC-KFS□
HC-MFS□
HC-SFS□
HC-RFS□
HC-UFS□

### (2) Configuration




### (3) Environment

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

(4) Power supply

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

(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.

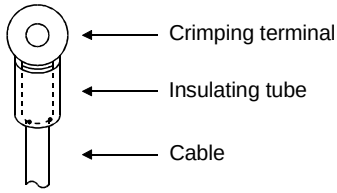
(b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect the cables to the terminals one-to-one.



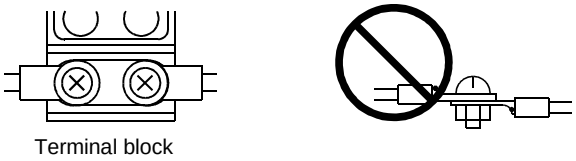

(c) If a leakage current breaker is used to prevent an electric shock, the protective earth (PE) terminals of the servo amplifier must be connected to the corresponding earth terminals.

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



(7) Auxiliary equipment and options

(a) The no-fuse breaker and magnetic contactor used should be the EN or IEC standard-compliant products of the models described in Section 13.2.2.

(b) The sizes of the cables described in Section 13.2.1 meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in EN60204-1.

- Ambient temperature: 40 (104) [℃ (℉)]
- Sheath: PVC (polyvinyl chloride)
- Installed on wall surface or open table tray

(c) Use the EMC filter for noise reduction. The radio noise filter (FR-BIF) is not required.

(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-J2S-10A to MR-J2S-700A
MR-J2S-10A1 to MR-J2S-40A1
Servo motor :HC-KFS□
HC-MFS□
HC-SFS□
HC-RFS□
HC-UFS□

(2) Installation

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

(3) Short circuit rating

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 10 minutes after power-off.

| Servo amplifier | Discharge time [min] |
|---|---|
| MR-J2S-10A(1)・20A(1) | 1 |
| MR-J2S-40A(1)・60A | 2 |
| MR-J2S-70A to 350A | 3 |
| MR-J2S-500A・700A | 5 |

(5) Options and auxiliary equipment

Use UL/C-UL standard-compliant products.

<<About the manuals>>

This Instruction Manual and the MELSERVO Servo Motor Instruction Manual are required if you use the General-Purpose AC servo MR-J2S-A for the first time. Always purchase them and use the MR-J2S-A safely.

Relevant manuals

| Manual name | Manual No. |
|---|---|
| MELSERVO-J2-Super Series To Use the AC Servo Safely | IB(NA)0300010 |
| MELSERVO Servo Motor Instruction Manual | SH(NA)3181 |
| EMC Installation Guidelines | IB(NA)67310 |

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# Optional Servo Motor Instruction Manual CONTENTS

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1. INTRODUCTION

2. INSTALLATION

3. CONNECTORS USED FOR SERVO MOTOR WIRING

4. INSPECTION

5. SPECIFICATIONS

6. CHARACTERISTICS

7. OUTLINE DIMENSION DRAWINGS

8. CALCULATION METHODS FOR DESIGNING

# 1. FUNCTIONS AND CONFIGURATION

## 1.1 Introduction

The Mitsubishi MELSERVO-J2-Super series general-purpose AC servo is based on the MELSERVO-J2 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 RS-232C 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-J2-Super series servo motor is equipped with an absolute position encoder which has the resolution of 131072 pulses/rev to ensure more accurate control as compared to the MELSERVO-J2 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 500kpps high-speed pulse train is used to control the speed and direction of a motor and execute precision positioning of 131072 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 ±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.

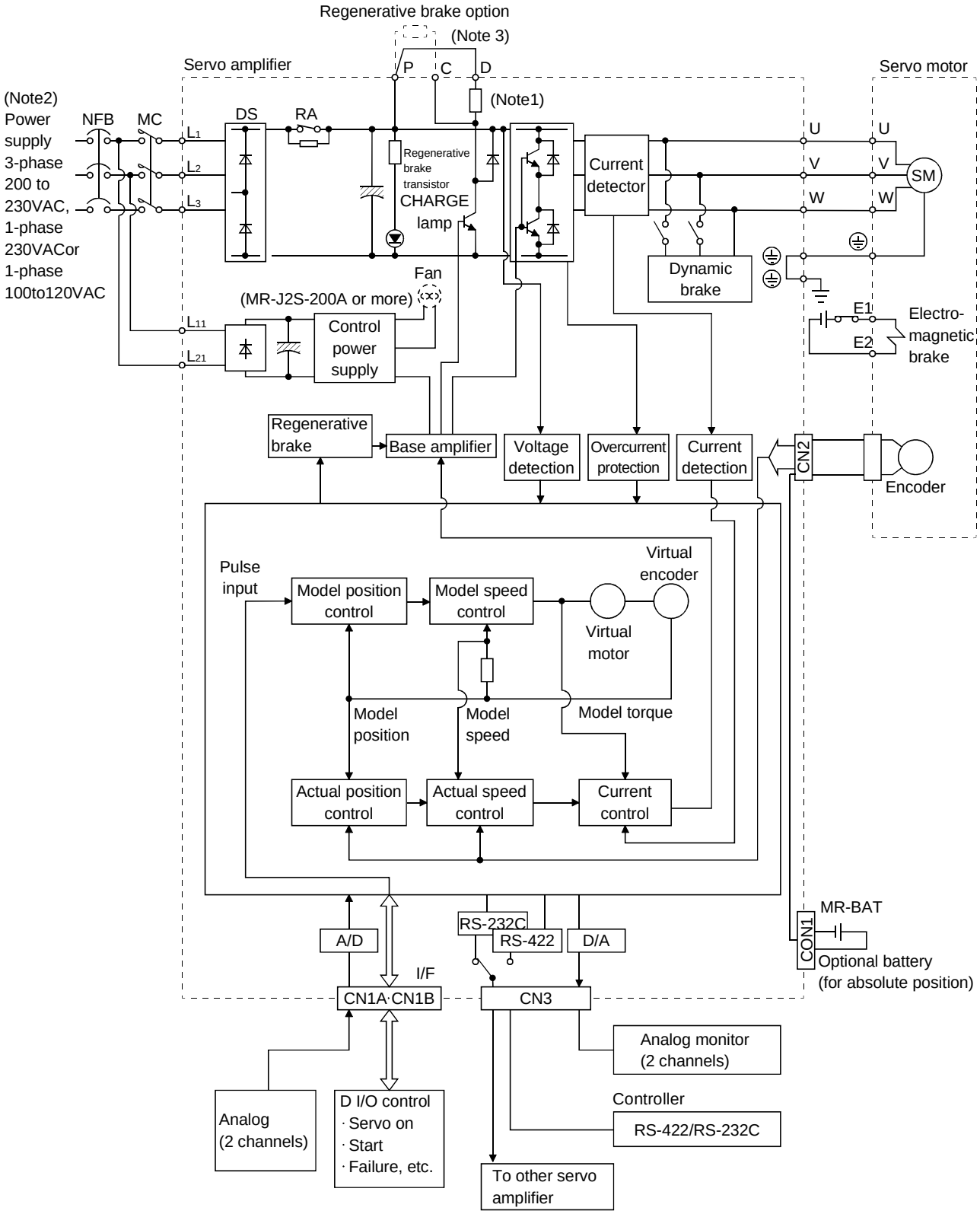
### (3) Torque control mode

An external analog torque command (0 to ±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.




Note:1. The built-in regenerative brake resistor is not provided for the MR-J2S-10A(1).
2. For 1-phase 230VAC, connect the power supply to $L_1$,$L_2$ and leave $L_3$ open.
$L_3$ is not provided for a 1-phase 100 to120VAC power supply.
3. For MR-J2S-350 or less.

## 1.3 Servo amplifier standard specifications

| Item \ Servo Amplifier MR-J2S-□ | | | | 10A | 20A | 40A | 60A | 70A | 100A | 200A | 350A | 500A | 700A | 10A1 | 20A1 | 40A1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Power supply | Voltage/frequency | | | 3-phase 200 to 230VAC, 50/60Hz or 1-phase 230VAC, 50/60Hz | | | | | 3-phase 200 to 230VAC, 50/60Hz | | | | | 1-phase 100 to 120VAC 50/60Hz | | |
| | Permissible voltage fluctuation | | | 3-phase 200 to 230VAC: 170 to 253VAC<br>1-phase 230VAC: 207 to 253VAC | | | | | 3-phase 170 to 253VAC | | | | | 1-phase 85 to 127VAC | | |
| | Permissible frequency fluctuation | | | Within ±5% | | | | | | | | | | | | |
| | Power supply capacity | | | Refer to Section12.2 | | | | | | | | | | | | |
| System | | | | Sine-wave PWM control, current control system | | | | | | | | | | | | |
| Dynamic brake | | | | Built-in | | | | | | | | | | | | |
| Protective functions | | | | Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder error protection, regenerative brake error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection | | | | | | | | | | | | |
| Position control mode | Max. input pulse frequency | | | 500kpps (for differential receiver), 200kpps (for open collector) | | | | | | | | | | | | |
| | Command pulse multiplying factor | | | Electronic gear A:1 to 65535 · 131072 B:1 to 65535, 1/50 < A/B < 500 | | | | | | | | | | | | |
| | In-position range setting | | | 0 to ±10000 pulse (command pulse unit) | | | | | | | | | | | | |
| | Error excessive | | | ±10 revolutions | | | | | | | | | | | | |
| | 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 | | | | | | | | | | | | |
| | Analog speed command input | | | 0 to ±10VDC / Rated speed | | | | | | | | | | | | |
| | Speed fluctuation ratio | | | ±0.01% or less (load fluctuation 0 to 100%)<br>0% or less (power fluctuation ±10%)<br>±0.2% max.(ambient temperature 25±10℃) for external speed setting only | | | | | | | | | | | | |
| | 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) | | | | | | | | | | | | |
| | 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 | Operation | [℃] | 0 to +55 (non-freezing) | | | | | | | | | | | | |
| | | | [°F] | 32 to +131 (non-freezing) | | | | | | | | | | | | |
| | | Storage | [℃] | −20 to +65 (non-freezing) | | | | | | | | | | | | |
| | | | [°F] | −4 to +149 (non-freezing) | | | | | | | | | | | | |
| | Ambient humidity | Operation | | 90%RH or less (non-condensing) | | | | | | | | | | | | |
| | | Storage | | | | | | | | | | | | | | |
| | Ambient | | | Indoors (no direct sunlight)<br>Free from corrosive gas, flammable gas, oil mist, dust and dirt | | | | | | | | | | | | |
| | Altitude | | | Max. 1000m (3280ft) above sea level | | | | | | | | | | | | |
| | Vibration | | | 5.9 [m/s$^2$] or less | | | | | | | | | | | | |
| | | | | 19.4 [ft/s$^2$] or less | | | | | | | | | | | | |
| Weight | | | [kg] | 0.7 | 0.7 | 1.1 | 1.1 | 1.7 | 1.7 | 2.0 | 2.0 | 4.9 | 7.2 | 0.7 | 0.7 | 1.1 |
| | | | [lb] | 1.5 | 1.5 | 2.4 | 2.4 | 3.75 | 3.75 | 4.4 | 4.4 | 10.8 | 15.87 | 1.5 | 1.5 | 2.4 |

## 1.4 Function list

The following table lists the functions of this servo. For details of the functions, refer to the corresponding chapters and sections.

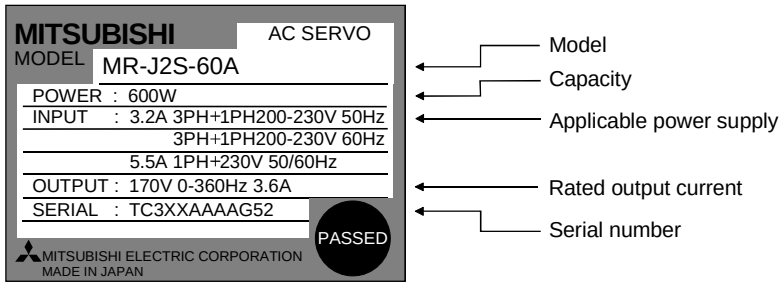
| Function | Description | (Note) Control mode | Refer to |
|---|---|---|---|
| Position control mode | This servo is used as position control servo. | P | Section 3.1.1<br>Section 3.4.1<br>Section 4.2.2 |
| Speed control mode | This servo is used as speed control servo. | S | Section 3.1.2<br>Section 3.4.2<br>Section 4.2.3 |
| Torque control mode | This servo is used as torque control servo. | T | Section 3.1.3<br>Section 3.4.3<br>Section 4.2.4 |
| Position/speed control change mode | Using external input signal, control can be switched between position control and speed control. | P/S | Section 3.4.4 |
| Speed/torque control change mode | Using external input signal, control can be switched between speed control and torque control. | S/T | Section 3.4.5 |
| Torque/position control change mode | Using external input signal, control can be switched between torque control and position control. | T/P | Section 3.4.6 |
| High-resolution encoder | High-resolution encoder of 131072 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 15 |
| 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 8.5 |
| Adaptive vibration suppression control | Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration. | P, S, T | Section 8.3 |
| Low-pass filter | Suppresses high-frequency resonance which occurs as servo system response is increased. | P, S, T | Section 8.4 |
| Machine analyzer function | Analyzes the frequency characteristic of the mechanical system by simply connecting a servo configuration software-installed personal computer and servo amplifier. | P | |
| Machine simulation | Can simulate machine motions on a personal computer screen on the basis of the machine analyzer results. | P | |
| Gain search function | Personal computer changes gains automatically and searches for overshoot-free gains in a short time. | P | |
| Slight vibration suppression control | Suppresses vibration of ±1 pulse produced at a servo motor stop. | P | Section 7.5 |
| Electronic gear | Input pulses can be multiplied by 1/50 to 50. | P | Parameters No. 3, 4 |
| Auto tuning | Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies. Higher in performance than MR-J2 series servo amplifier. | P, S | Chapter 7 |
| Position smoothing | Speed can be increased smoothly in response to input pulse. | P | Parameter No. 7 |
| S-pattern acceleration/ deceleration time constant | Speed can be increased and decreased smoothly. | S, T | Parameter No. 13 |
| Regenerative brake option | Used when the built-in regenerative brake resistor of the servo amplifier does not have sufficient regenerative capability for the regenerative power generated. | P, S, T | Section 13.1.1 |
| Brake unit | Used when the regenerative brake option cannot provide enough regenerative power.<br>Can be used with the MR-J2S-500A・MR-J2S-700A. | P, S, T | Section 13.1.2 |

| Function | Description | (Note) Control mode | Refer to |
|---|---|---|---|
| Return converter | Used when the regenerative brake option cannot provide enough regenerative power.<br>Can be used with the MR-J2S-500A・MR-J2S-700A. | P, S, T | Section 13.1.3 |
| Alarm history clear | Alarm history is cleared. | P, S, T | Parameter No. 16 |
| 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. 20 |
| Command pulse selection | Command pulse train form can be selected from among four different types. | P | Parameter No. 21 |
| Input signal selection | Forward rotation start, reverse rotation start, servo-on and other input signals can be assigned to any pins. | P, S, T | Parameters No. 43 to 48 |
| Torque limit | Servo motor-generated torque can be limited to any value. | P, S | Section 3.4.1 (5)<br>Parameter No. 28 |
| Speed limit | Servo motor speed can be limited to any value. | T | Section 3.4.3 (3)<br>Parameter No. 8 to 10,72 to 75 |
| Status display | Servo status is shown on the 5-digit, 7-segment LED display | P, S, T | Section 6.2 |
| External I/O signal display | ON/OFF statuses of external I/O signals are shown on the display. | P, S, T | Section 6.6 |
| Output signal (DO) forced output | Output signal can be forced on/off independently of the servo status.<br>Use this function for output signal wiring check, etc. | P, S, T | Section 6.7 |
| 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 6.3 |
| Test operation mode | Servo motor can be run from the operation section of the servo amplifier without the start signal entered. | P, S, T | Section 6.8 |
| Analog monitor output | Servo status is output in terms of voltage in real time. | P, S, T | Parameter No. 17 |
| Servo configuration software | Using a personal computer, parameter setting, test operation, status display, etc. can be performed. | P, S, T | Section 13.1.8 |
| Alarm code output | If an alarm has occurred, the corresponding alarm number is output in 3-bit code. | P, S, T | Section 10.2.1 |

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–J2S– □ A □

Series

Power Supply

| Symbol | Power supply |
|---|---|
| None | 3-phase 200 to 230VAC<br>(Note2) 1-phase 230VAC |
| (Note1) 1 | 1-phase 100V to 120VAC |

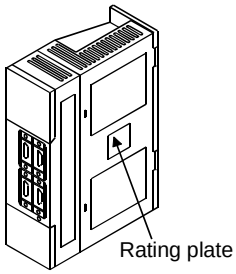
Note:1. Not supplied to the servo amplifier of MR-J2S-60A or more.
2. Not supplied to the servo amplifier of MR-J2S-100A or more.

General-purpose interface

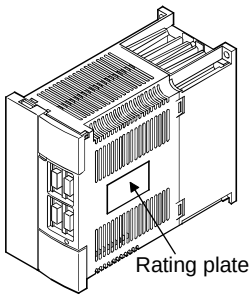
Rated output

| Symbol | Rated output [W] | Symbol | Rated output [W] |
|---|---|---|---|
| 10 | 100 | 100 | 1000 |
| 20 | 200 | 200 | 2000 |
| 40 | 400 | 350 | 3500 |
| 60 | 600 | 500 | 5000 |
| 70 | 700 | 700 | 7000 |

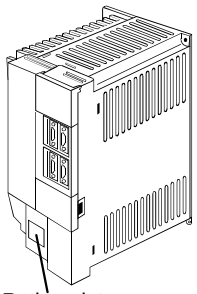
MR–J2S–100A or less



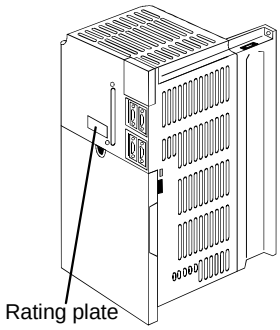

MR–J2S–200A•350A




MR-J2S-500A




MR-J2S-700A




## 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 and the models with reduction gears.

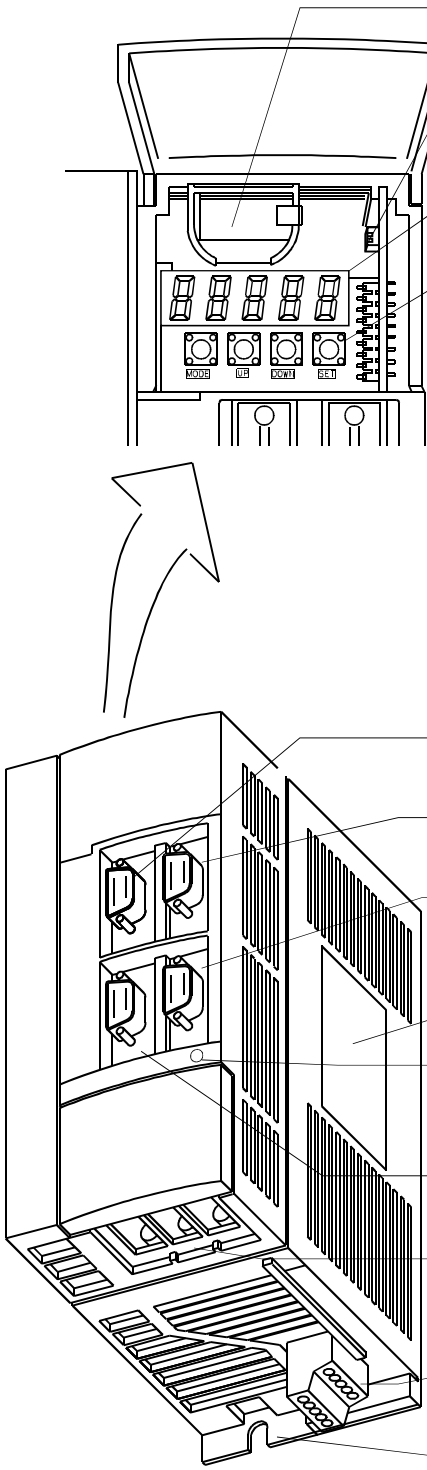
| Servo amplifier | Servo motors | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | HC-KFS□ | HC-MFS□ | HC-SFS□ | | | HC-RFS□ | HC-UFS□ | |
| | | | 1000r/min | 2000r/min | 3000r/min | | 2000r/min | 3000r/min |
| MR-J2S-10A(1) | 053・13 | 053・13 | | | | | | 13 |
| MR-J2S-20A(1) | 23 | 23 | | | | | | 23 |
| MR-J2S-40A(1) | 43 | 43 | | | | | | 43 |
| MR-J2S-60A | | | | 52 | 53 | | | |
| MR-J2S-70A | (Note) 73 | 73 | | | | | 72 | 73 |
| MR-J2S-100A | | | 81 | 102 | 103 | | | |
| MR-J2S-200A | | | 121・201 | 152・202 | 153・203 | 103・153 | 152 | |
| MR-J2S-350A | | | 301 | 352 | 353 | 203 | 202 | |
| MR-J2S-500A | | | | 502 | | 353・503 | 352・502 | |
| MR-J2S-700A | | | | 702 | | | | |

Note: The HC-KFS73 may not be connected depending on the production time of the servo amplifier. Please consult us.

## 1.7 Structure

### 1.7.1 Parts identification

(1) MR-J2S-100A or less

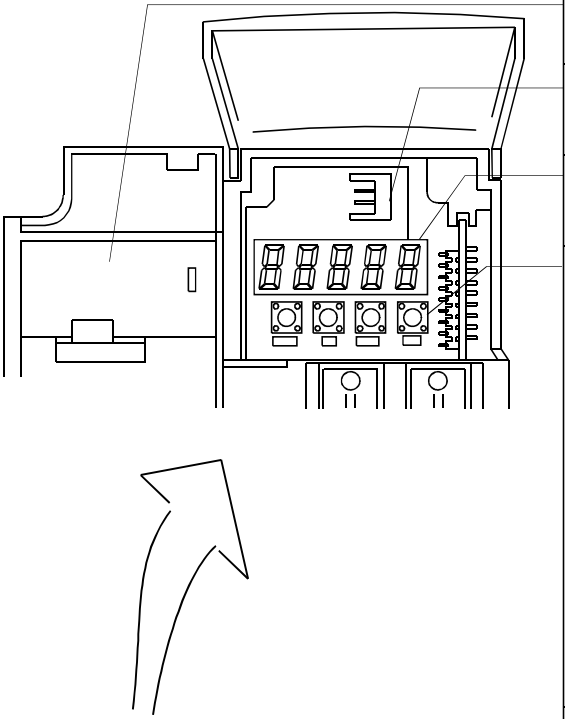


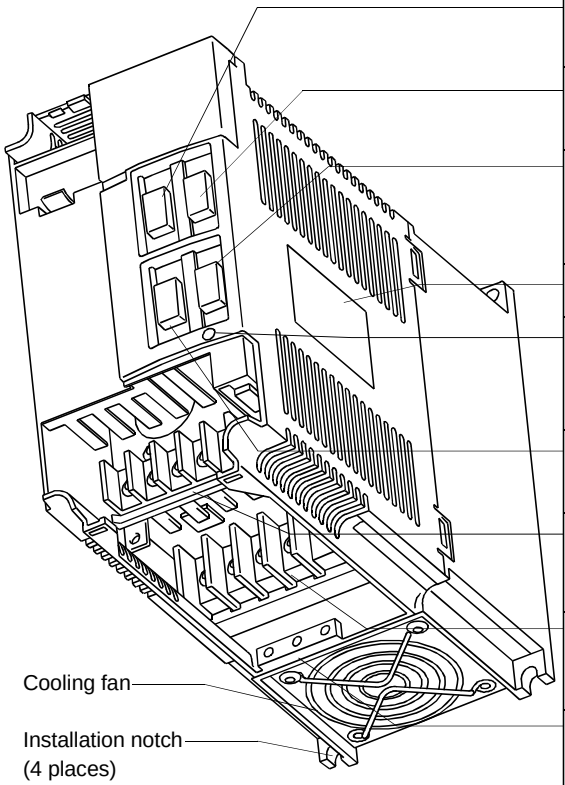

| Name/Application | Refer to |
|---|---|
| Battery holder<br>Contains the battery for absolute position data backup. | Section15.3 |
| Battery connector (CON1)<br>Used to connect the battery for absolute position data backup. | Section15.3 |
| Display<br>The 5-digit, seven-segment LED shows the servo status and alarm number. | Chapter6 |
| Operation section<br>Used to perform status display, diagnostic, alarm and parameter setting operations.<br>MODE UP DOWN SET<br>Used to set data.<br>Used to change the display or data in each mode.<br>Used to change the mode. | Chapter6 |
| I/O signal connector (CN1A)<br>Used to connect digital I/O signals. | Section3.3 |
| I/O signal connector (CN1B)<br>Used to connect digital I/O signals. | Section3.3 |
| Communication connector (CN3)<br>Used to connect a command device (RS-422/RS-232C) and output analog monitor data. | Chapter14<br>Section13.1.2 |
| Name plate | Section1.5 |
| Charge lamp<br>Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables. | |
| Encoder connector (CN2)<br>Connector for connection of the servo motor encoder. | Section3.3<br>Section13.1.4 |
| Main circuit terminal block (TE1)<br>Used to connect the input power supply and servo motor. | Section3.7<br>Section11.1 |
| Control circuit terminal block (TE2)<br>Used to connect the control circuit power supply and regenerative brake option. | Section3.7<br>Section11.1<br>Section13.1.1 |
| Protective earth (PE) terminal (⏚)<br>Ground terminal. | Section3.10<br>Section11.1 |

(2) MR-J2S-200A · MR-J2S-350A

POINT

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



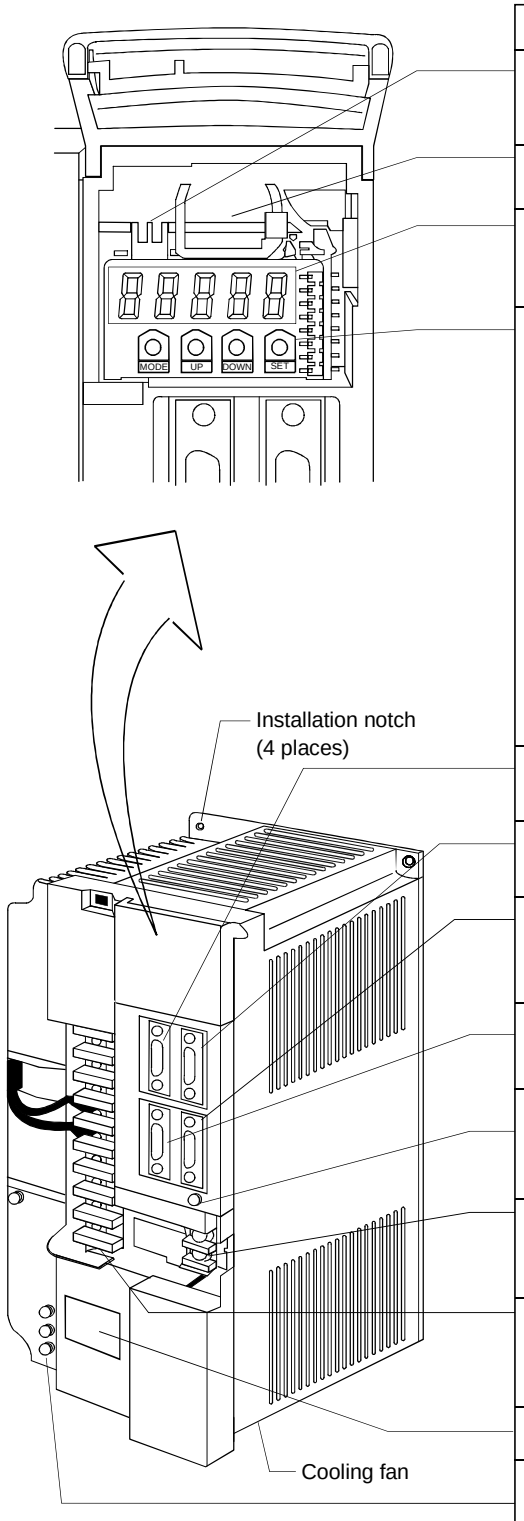




| Name/Application | Refer to |
|---|---|
| Battery holder<br>Contains the battery for absolute position data backup. | Section15.3 |
| Battery connector (CON1)<br>Used to connect the battery for absolute position data backup. | Section15.3 |
| Display<br>The 5-digit, seven-segment LED shows the servo status and alarm number. | Chapter6 |
| Operation section<br>Used to perform status display, diagnostic, alarm and parameter setting operations. | Chapter6 |
| I/O signal connector (CN1A)<br>Used to connect digital I/O signals. | Section3.3 |
| I/O signal connector (CN1B)<br>Used to connect digital I/O signals. | Section3.3 |
| Communication connector (CN3)<br>Used to connect a command device (RS-422/RS232C) and output analog monitor data. | Section3.3<br>Section13.1.2<br>Chapter14 |
| Name plate | Section1.5 |
| Charge lamp<br>Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables. | |
| Encoder connector (CN2)<br>Connector for connection of the servo motor encoder. | Section3.3<br>Section13.1.4 |
| Main circuit terminal block (TE1)<br>Used to connect the input power supply and servo motor. | Section3.7<br>Section11.1 |
| Control circuit terminal block (TE2)<br>Used to connect the control circuit power supply and regenerative brake option. | Section3.7<br>Section11.1<br>Section13.1.1 |
| Protective earth (PE) terminal (⏚)<br>Ground terminal. | Section3.10<br>Section11.1 |

(3) MR-J2S-500A

POINT

- The servo amplifier is shown without the front cover. For removal of the front cover, refer to Section 1.7.2.

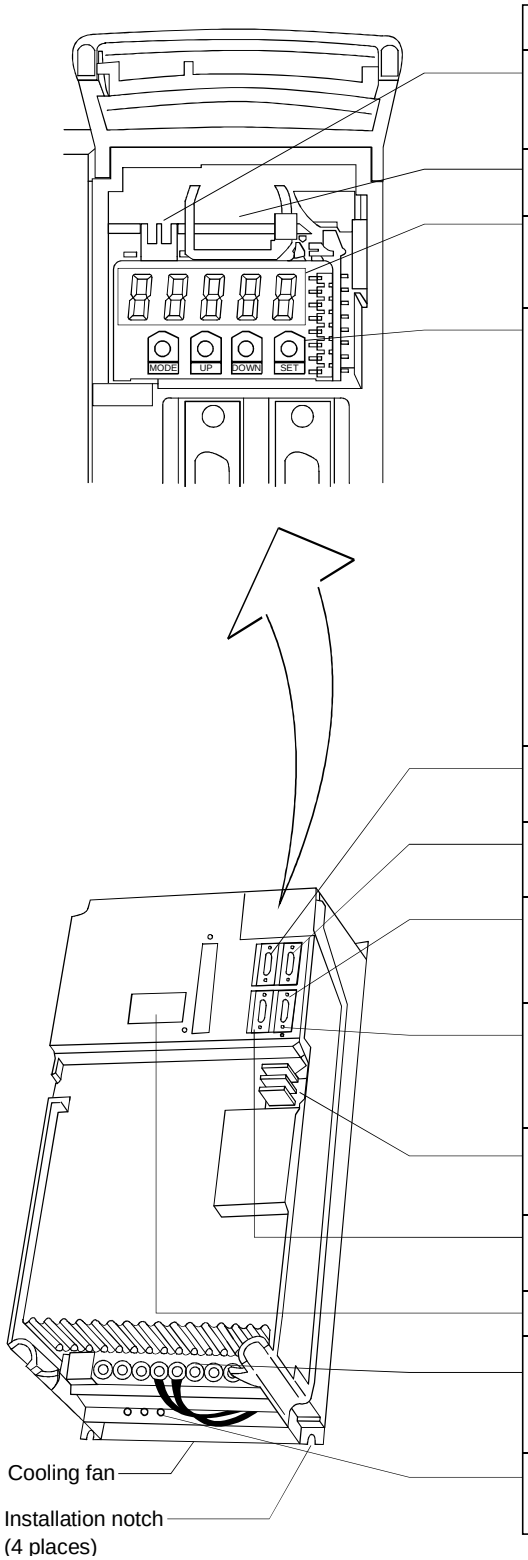



| Name/Application | Refer to |
|---|---|
| Battery connector (CON1)<br>Used to connect the battery for absolute position data backup. | Section15.3 |
| Battery holder<br>Contains the battery for absolute position data backup. | Section15.3 |
| Display<br>The 5-digit, seven-segment LED shows the servo status and alarm number. | Chapter6 |
| Operation section<br>Used to perform status display, diagnostic, alarm and parameter setting operations.<br>MODE UP DOWN SET<br>Used to set data.<br>Used to change the display or data in each mode.<br>Used to change the mode. | Chapter6 |
| I/O signal connector (CN1A)<br>Used to connect digital I/O signals. | Section3.3 |
| I/O signal connector (CN1B)<br>Used to connect digital I/O signals. | Section3.3 |
| Communication connector (CN3)<br>Used to connect a command device (RS-422/RS232C) and output analog monitor data. | Section3.3<br>Section13.1.2<br>Chapter14 |
| Encoder connector (CN2)<br>Connector for connection of the servo motor encoder. | Section3.3<br>Section13.1.4 |
| Charge lamp<br>Lit to indicate that the main circuit is charged.<br>While this lamp is lit, do not reconnect the cables. | |
| Control circuit terminal block (TE2)<br>Used to connect the control circuit power supply and regenerative brake option. | Section3.7<br>Section11.1.1 |
| Main circuit terminal block (TE1)<br>Used to connect the input power supply and servo motor. | Section3.7<br>Section11.1<br>Section13.1.1 |
| Name plate | Section1.5 |
| Protective earth (PE) terminal (⏚)<br>Ground terminal. | Section3.10<br>Section11.1 |

(4) MR-J2S-700A

POINT

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



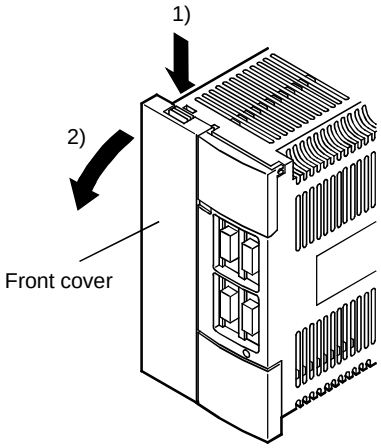

| Name/Application | Refer to |
|---|---|
| Battery connector (CON1)<br>Used to connect the battery for absolute position data backup. | Section15.3 |
| Battery holder<br>Contains the battery for absolute position data backup. | Section15.3 |
| Display<br>The 5-digit, seven-segment LED shows the servo status and alarm number. | Chapter6 |
| Operation section<br>Used to perform status display, diagnostic, alarm and parameter setting operations.<br>MODE UP DOWN SET<br>Used to set data.<br>Used to change the display or data in each mode.<br>Used to change the mode. | Chapter6 |
| I/O signal connector (CN1A)<br>Used to connect digital I/O signals. | Section3.3 |
| I/O signal connector (CN1B)<br>Used to connect digital I/O signals. | Section3.3 |
| Communication connector (CN3)<br>Used to connect a command device (RS-422/RS232C) and output analog monitor data. | Section3.3<br>Section13.1.4<br>Chapter14 |
| Charge lamp<br>Lit to indicate that the main circuit is charged.<br>While this lamp is lit, do not reconnect the cables. | |
| Control circuit terminal block (TE2)<br>Used to connect the control circuit power supply. | Section3.7<br>Section11.1.1 |
| Encoder connector (CN2)<br>Connector for connection of the servo motor encoder. | Section3.3<br>Section13.1.4 |
| Name plate | Section1.5 |
| Main circuit terminal block (TE1)<br>Used to connect the input power supply, regenerative brake option and servo motor. | Section3.7<br>Section11.1<br>Section13.1.1 |
| Protective earth (PE) terminal (⏚)<br>Ground terminal. | Section3.10<br>Section11.1 |

### 1.7.2 Removal and reinstallation of the front cover

| | |
|---|---|
| ⚠ CAUTION | ▪ To avoid the risk of an electric shock, do not open the front cover while power is on. |

(1) For MR-J2S-200A or more

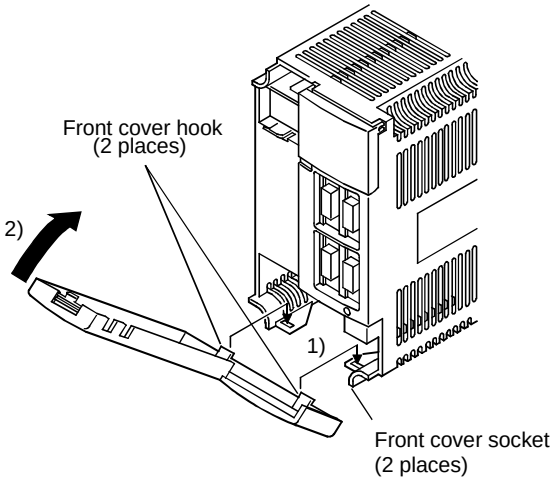
Removal of the front cover




1) Hold down the removing knob.

2) Pull the front cover toward you.

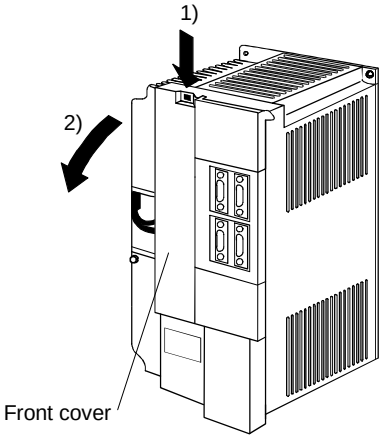
Reinstallation of the front cover




1) Insert the front cover hooks into the front cover sockets of the servo amplifier.
2) Press the front cover against the servo amplifier until the removing knob clicks.

(2) For MR-J2S-500A

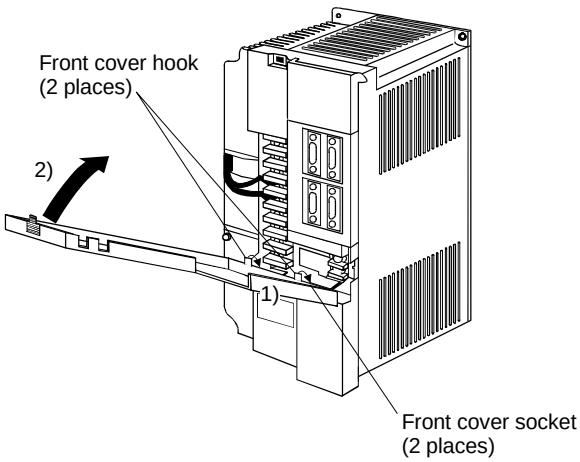
Removal of the front cover




1) Hold down the removing knob.

2) Pull the front cover toward you.

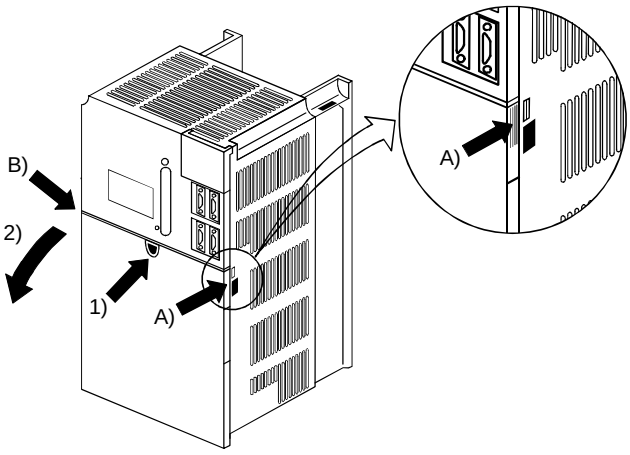
Reinstallation of the front cover




1) Insert the front cover hooks into the front cover sockets of the servo amplifier.
2) Press the front cover against the servo amplifier until the removing knob clicks.

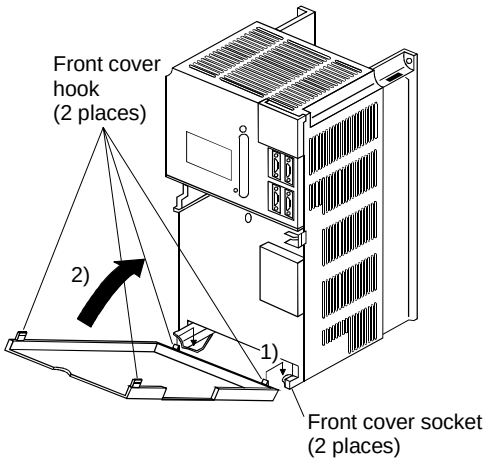
(3) For MR-J2S-700A

Removal of the front cover




1) Push the removing knob A) or B), and put you finger into the front hole of the front cover.
2) Pull the front cover toward you.

Reinstallation of the front cover




1) Insert the two front cover hooks at the bottom into the sockets of the servo amplifier.
2) Press the front cover against the servo amplifier until the removing knob clicks.

## 1.8 Servo system with auxiliary equipment

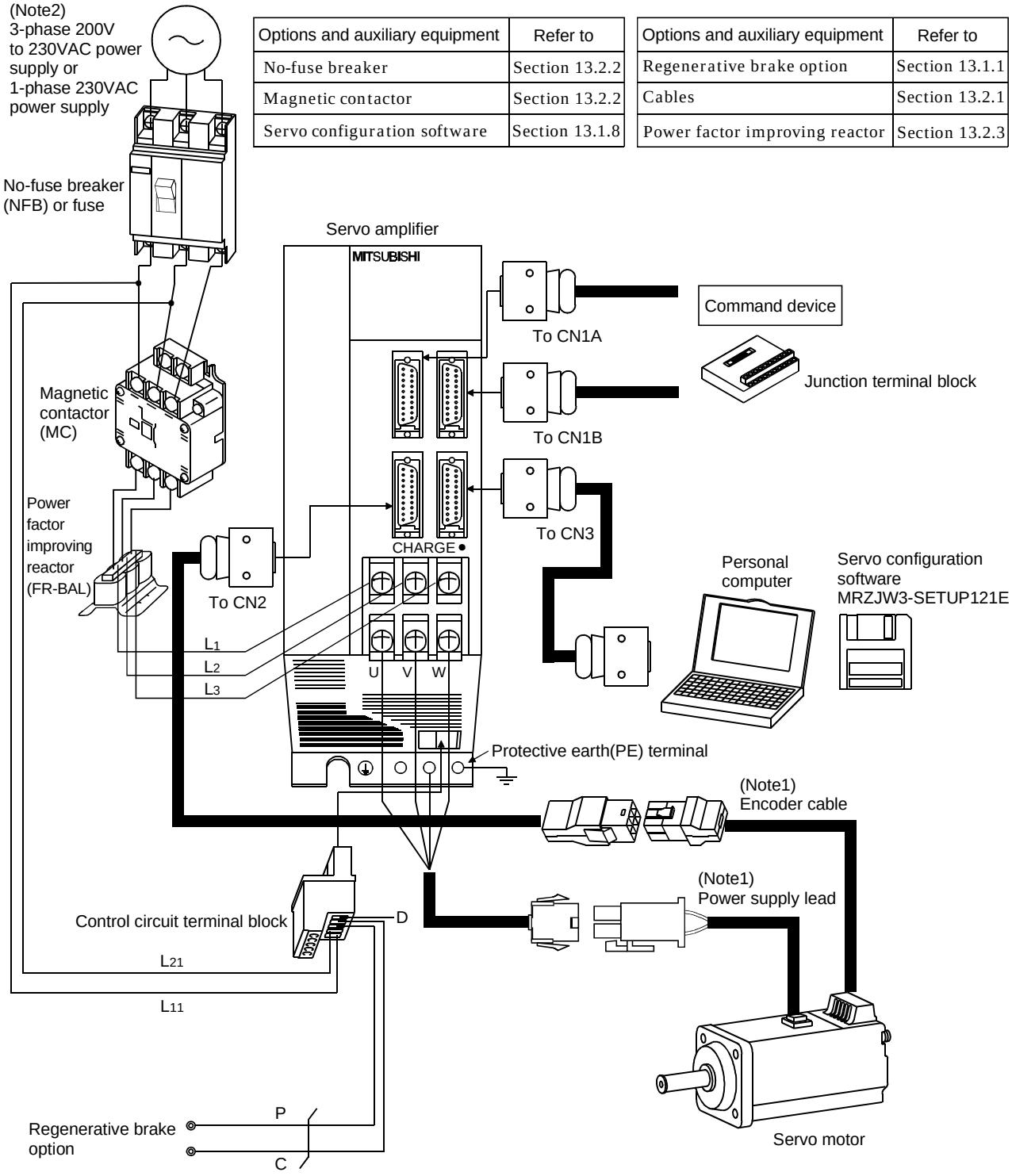
> **WARNING** To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.

(1) MR-J2S-100A or less

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

| Options and auxiliary equipment | Refer to |
|---|---|
| No-fuse breaker | Section 13.2.2 |
| Magnetic contactor | Section 13.2.2 |
| Servo configuration software | Section 13.1.8 |

| Options and auxiliary equipment | Refer to |
|---|---|
| Regenerative brake option | Section 13.1.1 |
| Cables | Section 13.2.1 |
| Power factor improving reactor | Section 13.2.3 |

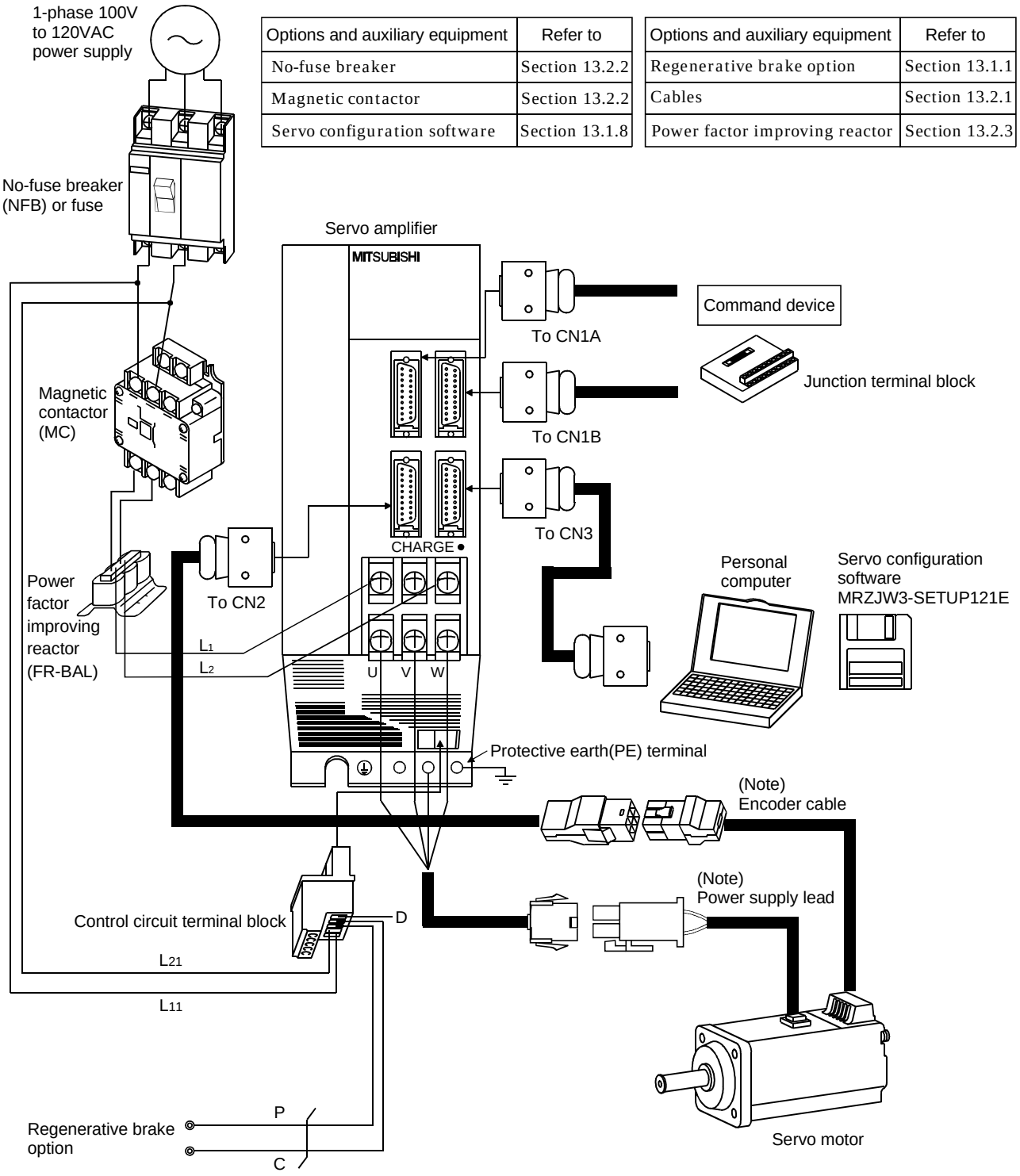



Note: 1. The HC-SFS, HC-RFS series have cannon connectors.
2. A 1-phase 230VAC power supply may be used with the servo amplifier of MR-J2S-70A or less. Connect the power supply to $L_1$ and $L_2$ terminals and leave $L_3$ open.

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

| Options and auxiliary equipment | Refer to |
|---|---|
| No-fuse breaker | Section 13.2.2 |
| Magnetic contactor | Section 13.2.2 |
| Servo configuration software | Section 13.1.8 |

| Options and auxiliary equipment | Refer to |
|---|---|
| Regenerative brake option | Section 13.1.1 |
| Cables | Section 13.2.1 |
| Power factor improving reactor | Section 13.2.3 |

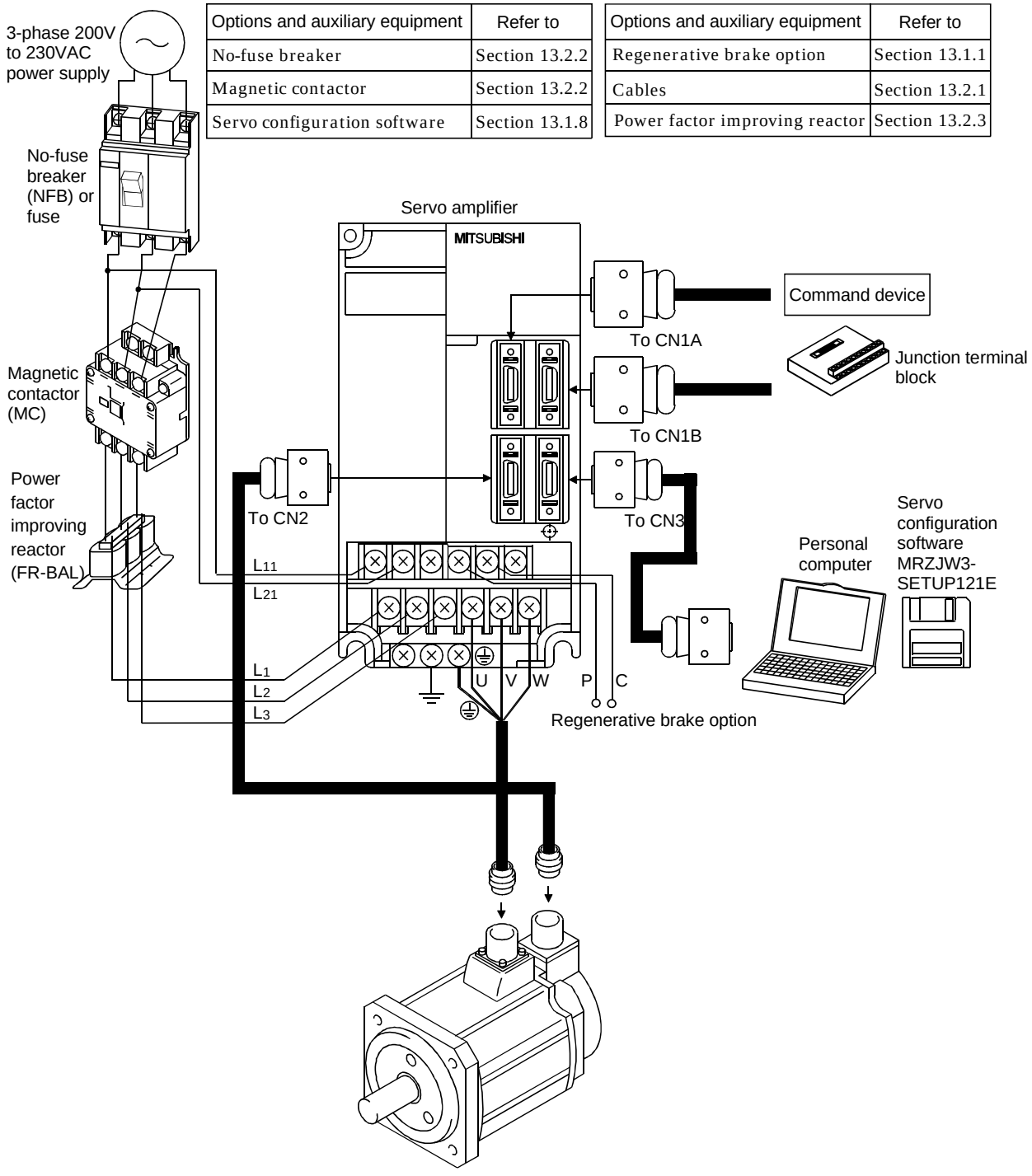



Note: The HC-SFS, HC-RFS series have cannon connectors.

(2) MR-J2S-200A・MR-J2S-350A or more

| Options and auxiliary equipment | Refer to |
|---|---|
| No-fuse breaker | Section 13.2.2 |
| Magnetic contactor | Section 13.2.2 |
| Servo configuration software | Section 13.1.8 |

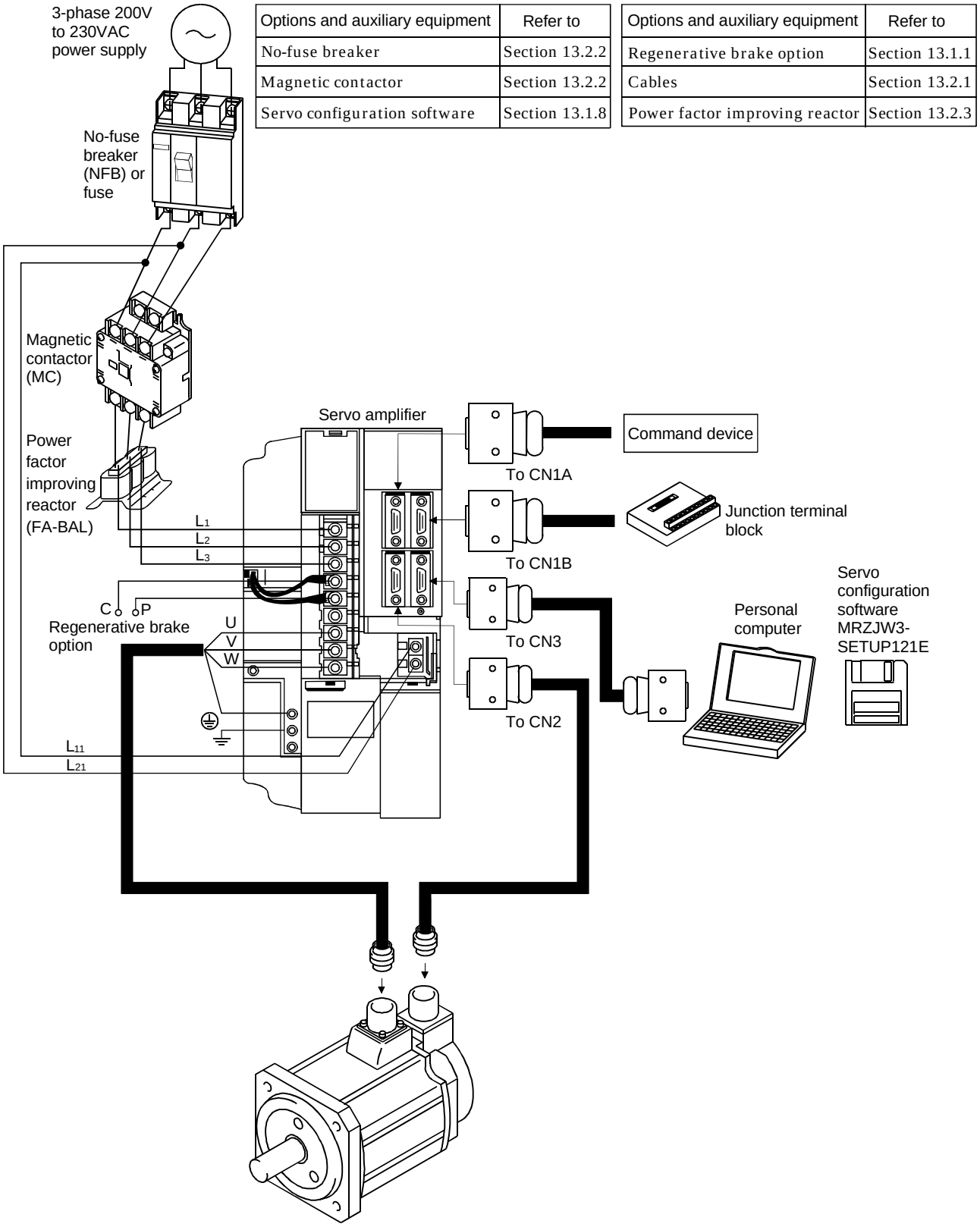
| Options and auxiliary equipment | Refer to |
|---|---|
| Regenerative brake option | Section 13.1.1 |
| Cables | Section 13.2.1 |
| Power factor improving reactor | Section 13.2.3 |



(3) MR-J2S-500A

| Options and auxiliary equipment | Refer to |
|---|---|
| No-fuse breaker | Section 13.2.2 |
| Magnetic contactor | Section 13.2.2 |
| Servo configuration software | Section 13.1.8 |

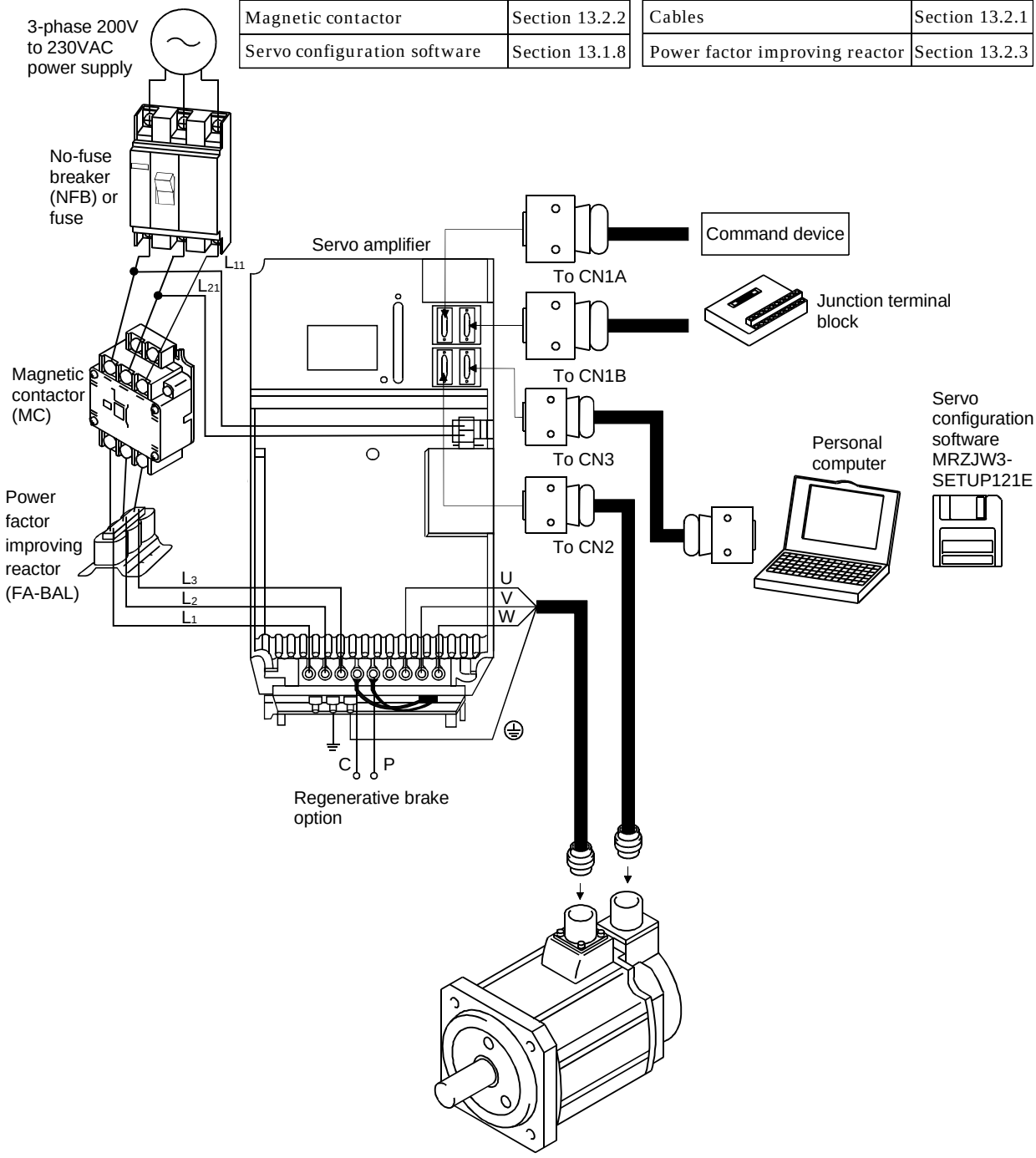
| Options and auxiliary equipment | Refer to |
|---|---|
| Regenerative brake option | Section 13.1.1 |
| Cables | Section 13.2.1 |
| Power factor improving reactor | Section 13.2.3 |



(4) MR-J2S-700A

| Options and auxiliary equipment | Refer to |
|---|---|
| No-fuse breaker | Section 13.2.2 |
| Magnetic contactor | Section 13.2.2 |
| Servo configuration software | Section 13.1.8 |

| Options and auxiliary equipment | Refer to |
|---|---|
| Regenerative brake option | Section 13.1.1 |
| Cables | Section 13.2.1 |
| Power factor improving reactor | Section 13.2.3 |



# MEMO

## 2. INSTALLATION

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

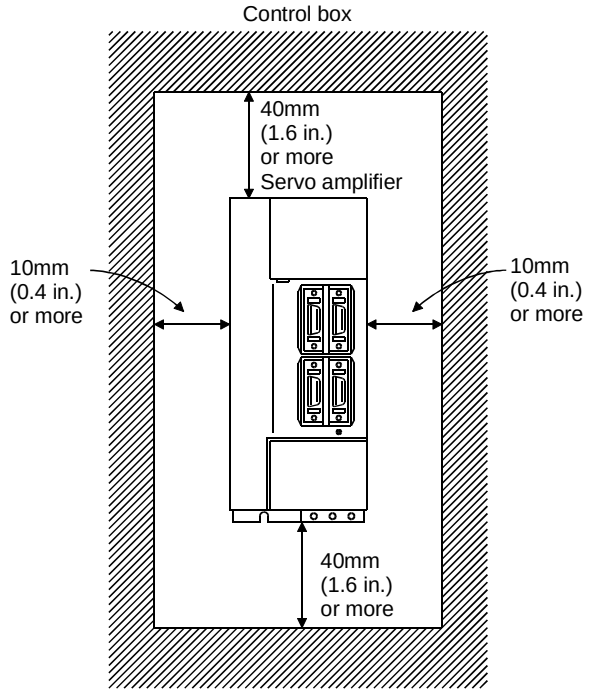
### 2.1 Environmental conditions

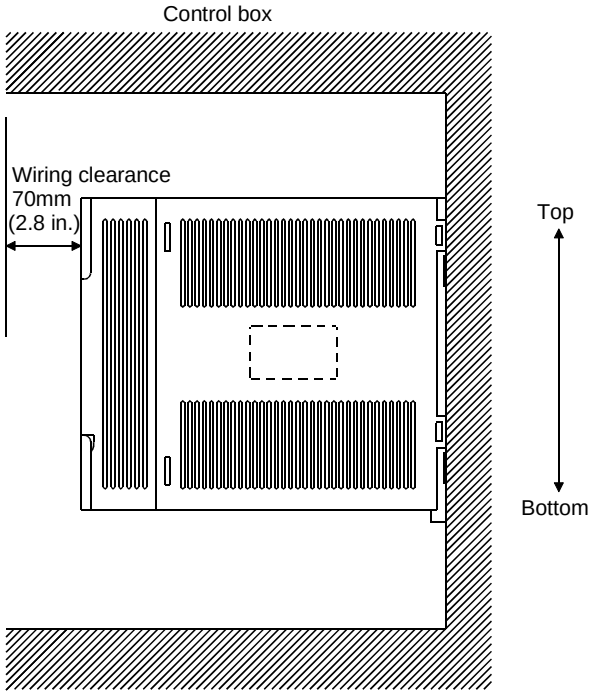
| Environment | | | Conditions |
|---|---|---|---|
| Ambient temperature | Operation | [℃] | 0 to +55 (non-freezing) |
| | | [℉] | 32 to +131 (non-freezing) |
| | Storage | [℃] | −20 to +65 (non-freezing) |
| | | [℉] | −4 to +149 (non-freezing) |
| Ambient humidity | Operation | | 90%RH or less (non-condensing)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

## 2.2 Installation direction and clearances

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

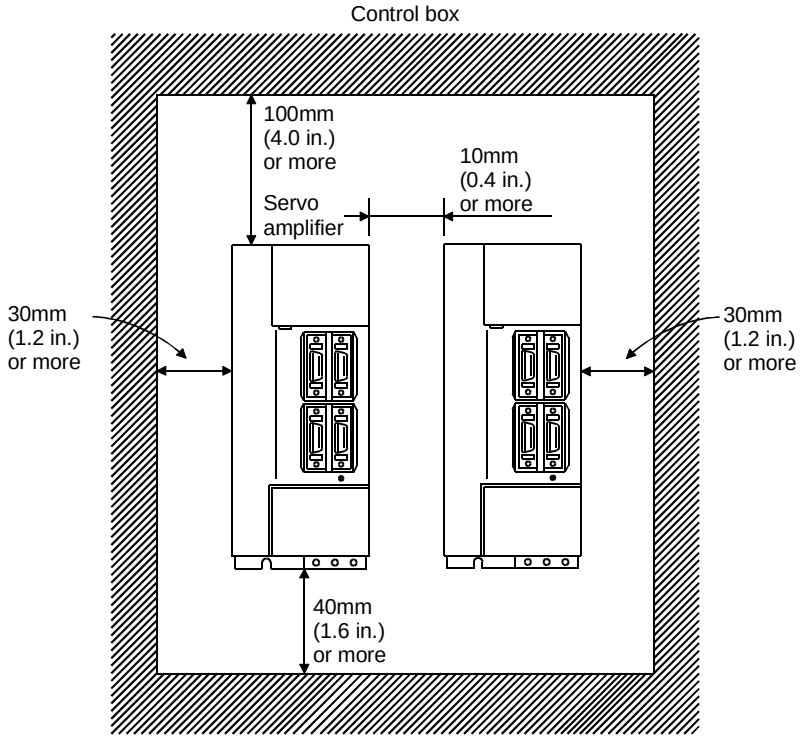
(1) Installation of one servo amplifier



(2) Installation of two or more servo amplifiers

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




(3) Others

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

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

## 2.3 Keep out foreign materials

(1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.

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

(3) When installing the control box in a place where there are toxic gas, dirt and dust, provide positive pressure in the control box by forcing in clean air to prevent such materials from entering the control box.

### 2.4 Cable stress

(1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.
(2) In any application where the servo motor moves, the cables should be free from excessive stress. For use in any application where the servo motor moves run the cables so that their flexing portions fall within the optional encoder cable range. Fix the encoder cable and power cable of the servo motor.
(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.
(4) For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to section 12.4 for the flexing life.

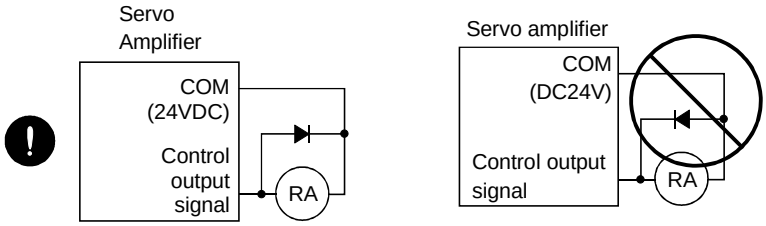
## 3. SIGNALS AND WIRING

**⚠ 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 10 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 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 brake resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative brake resistor, causing a fire.
- Do not modify the equipment.

**POINT**

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

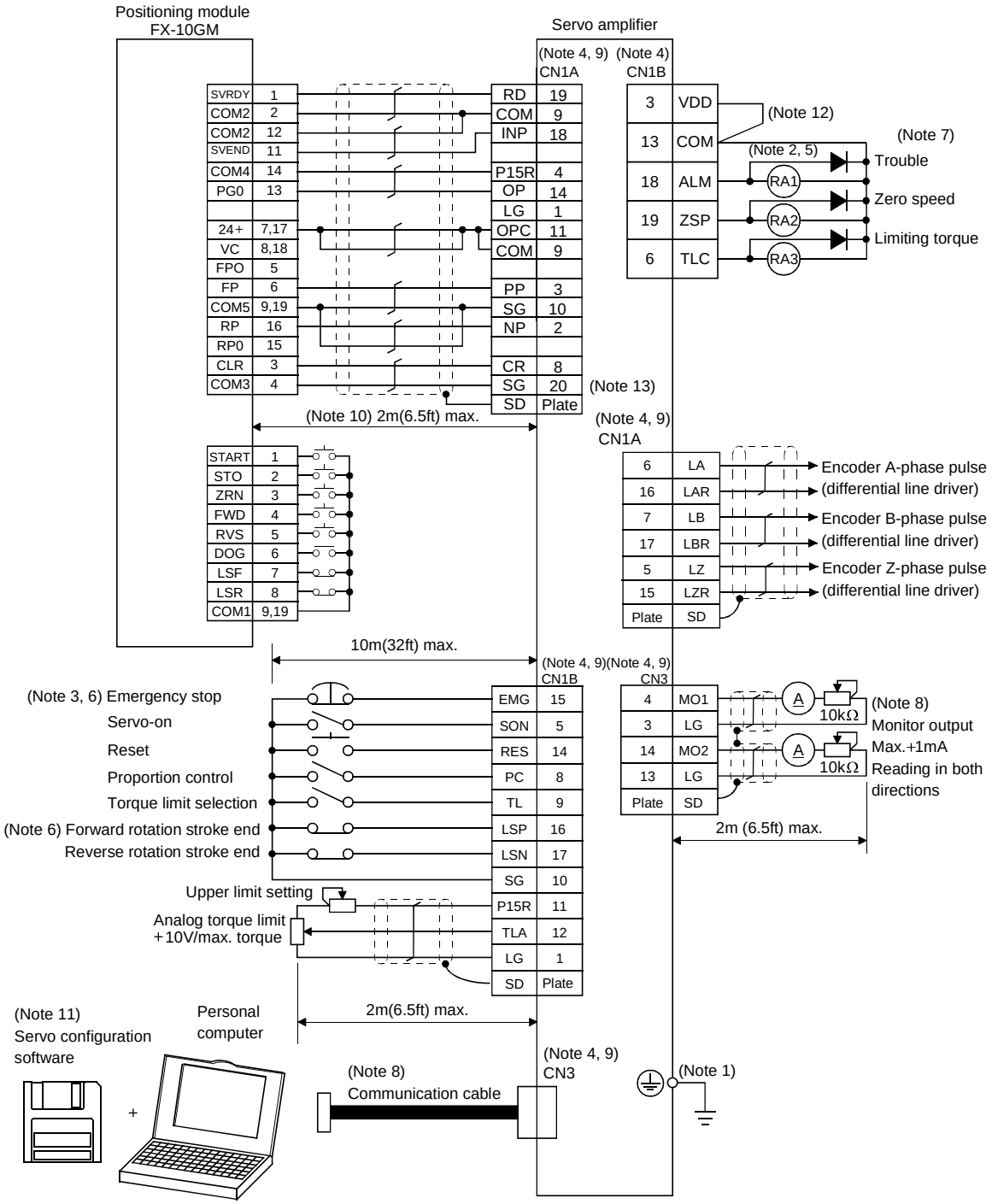
## 3.1 Standard connection example

**POINT**

- Refer to Section 3.7.1 for the connection of the power supply system and to Section 3.8 for connection with the servo motor.

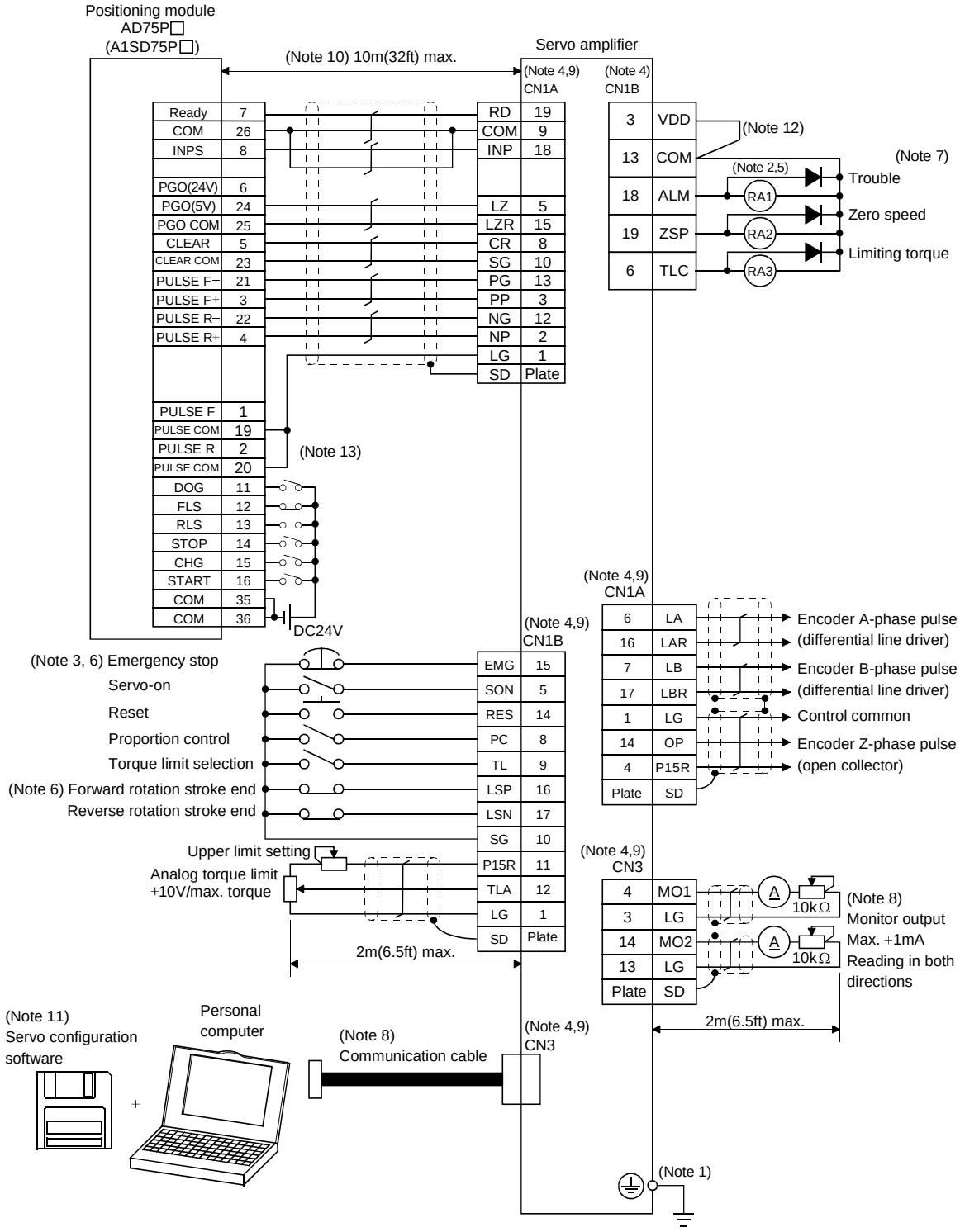
### 3.1.1 Position control mode

(1) FX-10GM



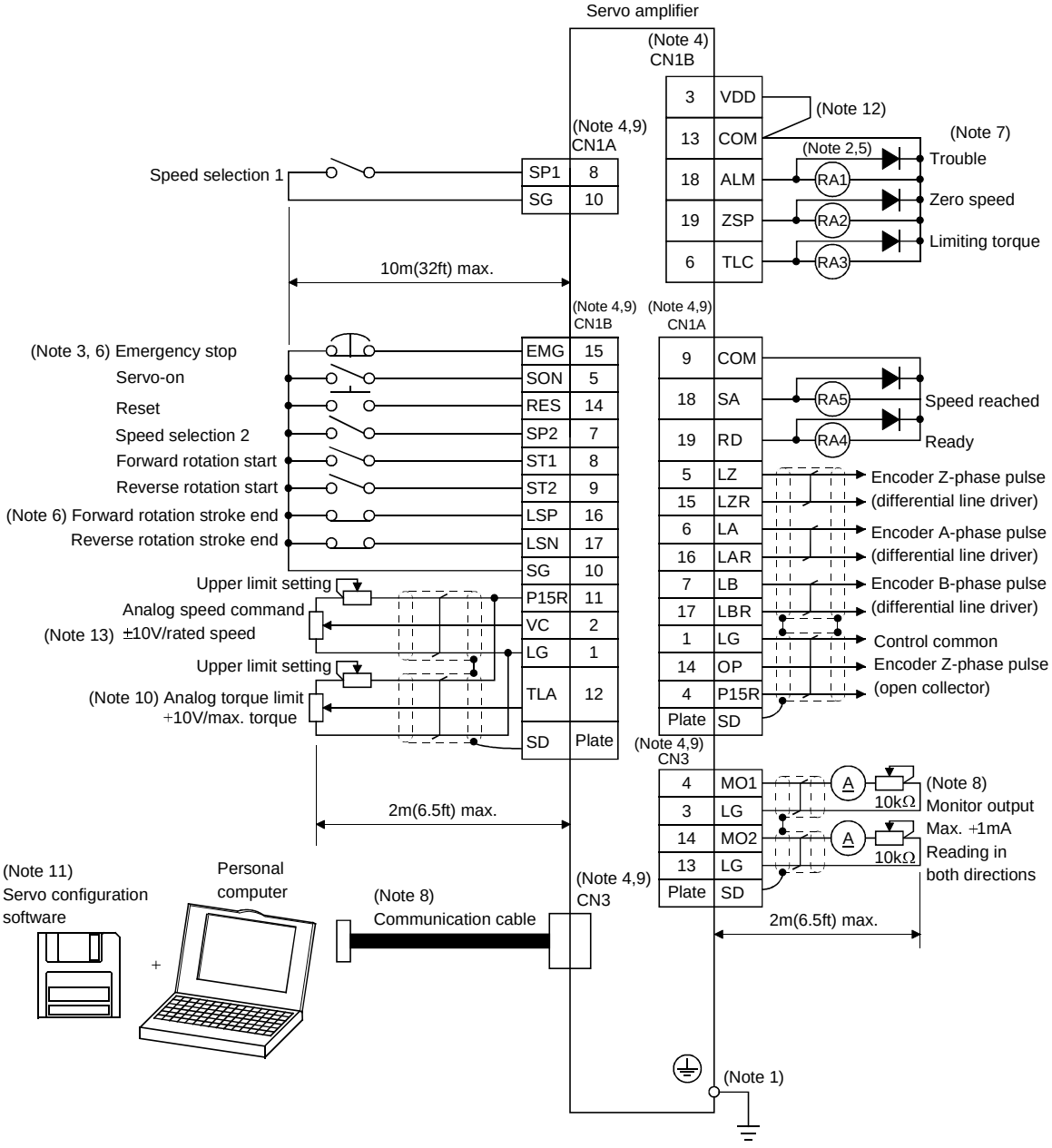
Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault.
5. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external. (Refer to Section 3.6.2)
6. When starting operation, always connect the emergency stop signal (EMG) and forward/ reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
7. Trouble (ALM) is connected with COM in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the controller should be stopped by the sequence program.
8. When connecting the personal computer together with monitor outputs 1, 2, use the maintenance junction card (MR-J2CN3TM). (Refer to Section 13.1.4)
9. The pins with the same signal name are connected in the servo amplifier.
10. This length applies to the command pulse train input in the opencollector system. It is 10m (32ft) or less in the differential line driver system.
11. Use MRZJW3-SETUP 121E.
12. When using the internal power supply (VDD), always connect VDD-COM. Do not connect them when supplying external power. Refer to Section 3.6.2.
13. Connect to CN1A-10 when using the junction terminal block (MR-TB20).

(2) AD75P☐(A1SD75P☐)



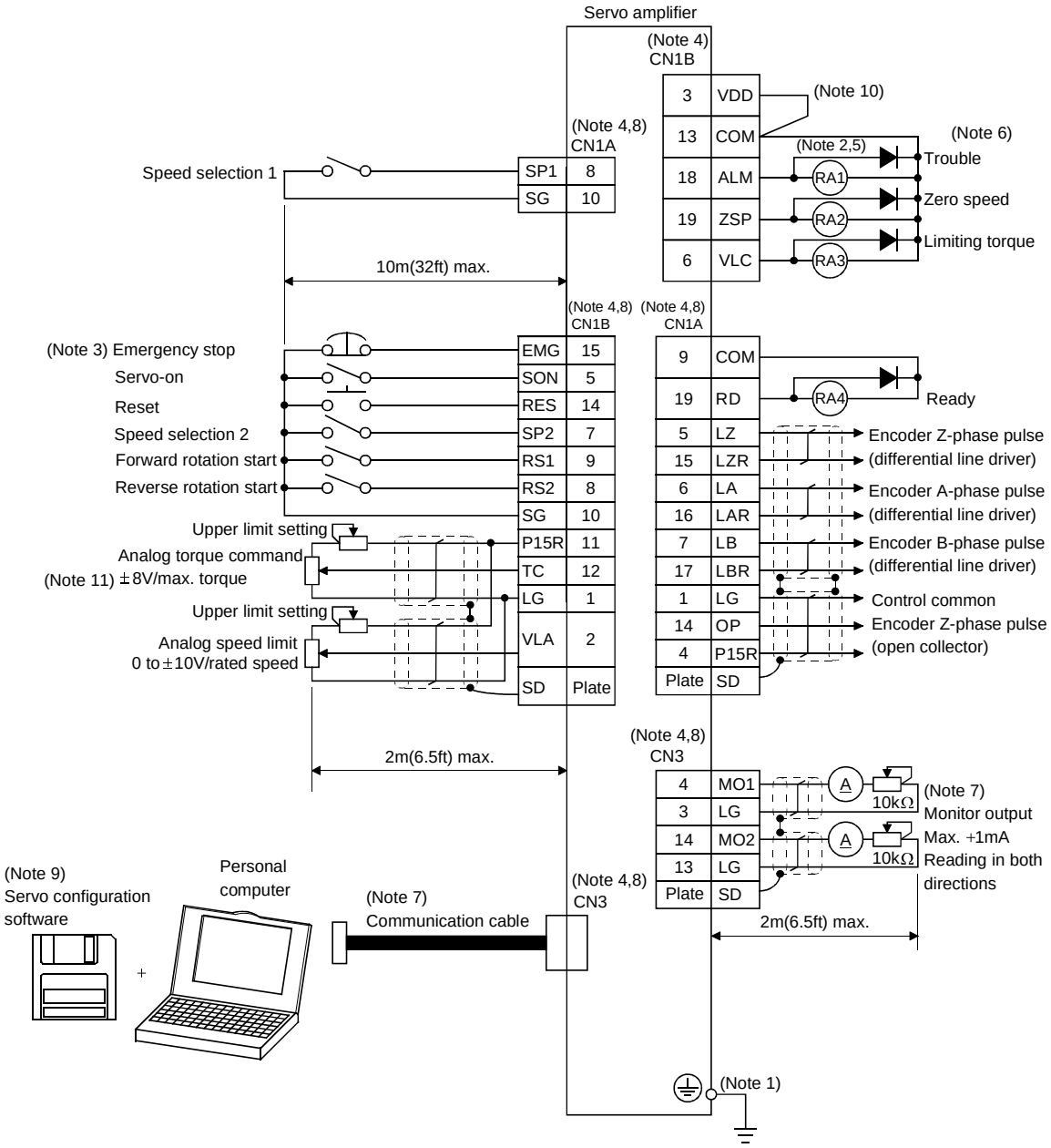
Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the servo amplifier to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault.
5. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external.(Refer to Section 3.6.2)
6. When starting operation, always connect the emergency stop signal (EMG) and forward/ reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
7. Trouble (ALM) is connected with COM in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the controller should be stopped by the sequence program.
8. When connecting the personal computer together with monitor outputs 1, 2, use the maintenance junction card (MR-J2CN3TM). (Refer to Section 13.1.4)
9. The pins with the same signal name are connected in the servo amplifier.
10. This length applies to the command pulse train input in the differential line driver system. It is 2m (6.5ft) or less in the opencollector system.
11. Use MRZJW3-SETUP 121E.
12. When using the internal power supply (VDD), always connect VDD-COM. Do not connect them when supplying external power. Refer to Section 3.6.2.
13. Connect LG and pulse output COM to increase noise immunity.

### 3.1.2 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 and other protective circuits.
3. The emergency stop switch (normally closed contact) must be installed.
4. CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault.
5. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external.(Refer to Section 3.6.2)
6. When starting operation, always connect the emergency stop signal (EMG) and forward/ reverse rotation stroke end signal (LSN/LSP) with SG. (Normally closed contacts)
7. Trouble (ALM) is connected with COM in normal alarm-free condition.
8. When connecting the personal computer together with monitor outputs 1, 2, use the maintenance junction card (MR-J2CN3TM). (Refer to Section 13.1.4)
9. The pins with the same signal name are connected in the servo amplifier.
10. By setting parameters No.43 to 48 to make TL available, TLA can be used.
11. Use MRZJW3-SETUP 121E.
12. When using the internal power supply (VDD), always connect VDD-COM. Do not connect them when supplying external power. Refer to Section 3.6.2.
13. Use an external power supply when inputting a negative voltage.

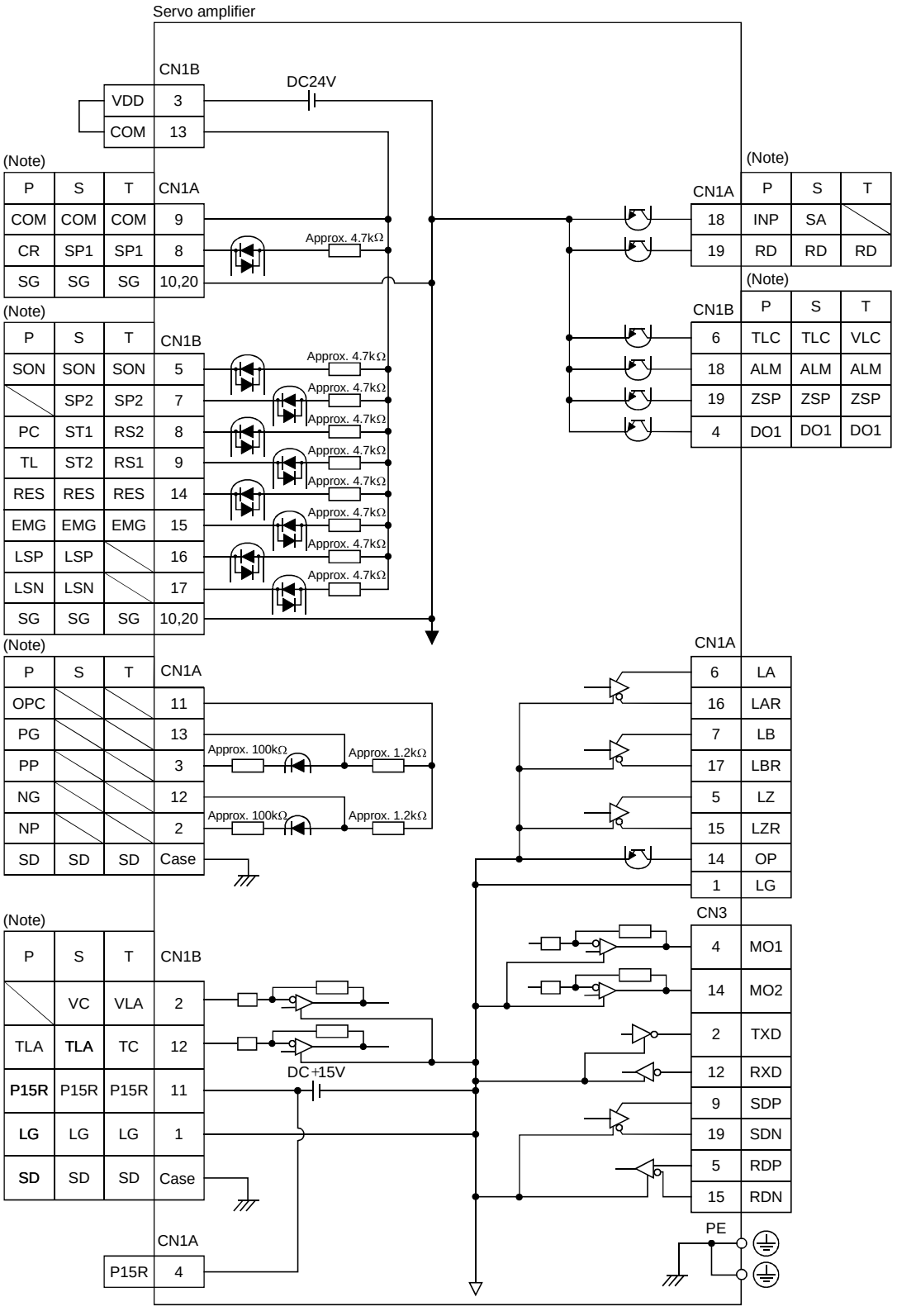
### 3.1.3 Torque control mode



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 and other protective circuits.
3. The emergency stop switch(normally closed contact) must be installed.
4. CN1A, CN1B, CN2 and CN3 have the same shape. Wrong connection of the connectors will lead to a fault.
5. The sum of currents that flow in the external relays should be 80mA max. If it exceeds 80mA, supply interface power from external. (Refer to Section 3.6.2)
6. Trouble (ALM) is connected with COM in normal alarm-free condition.
7. When connecting the personal computer together with monitor outputs 1, 2, use the maintenance junction card (MR-J2CN3TM). (Refer to Section 13.1.4)
8. The pins with the same signal name are connected in the servo amplifier.
9. Use MRZJW3-SETUP 121E.
10. When using the internal power supply (VDD), always connect VDD-COM. Do not connect them when supplying external power. Refer to Section 3.6.2.
11. Use an external power supply when inputting a negative voltage.

## 3.2 Internal connection diagram of servo amplifier

The following is the internal connection diagram where the signal assignment has been made in the initial status in each control mode.




Note. P: Position control mode, S: Speed control mode, T: Torque control mode

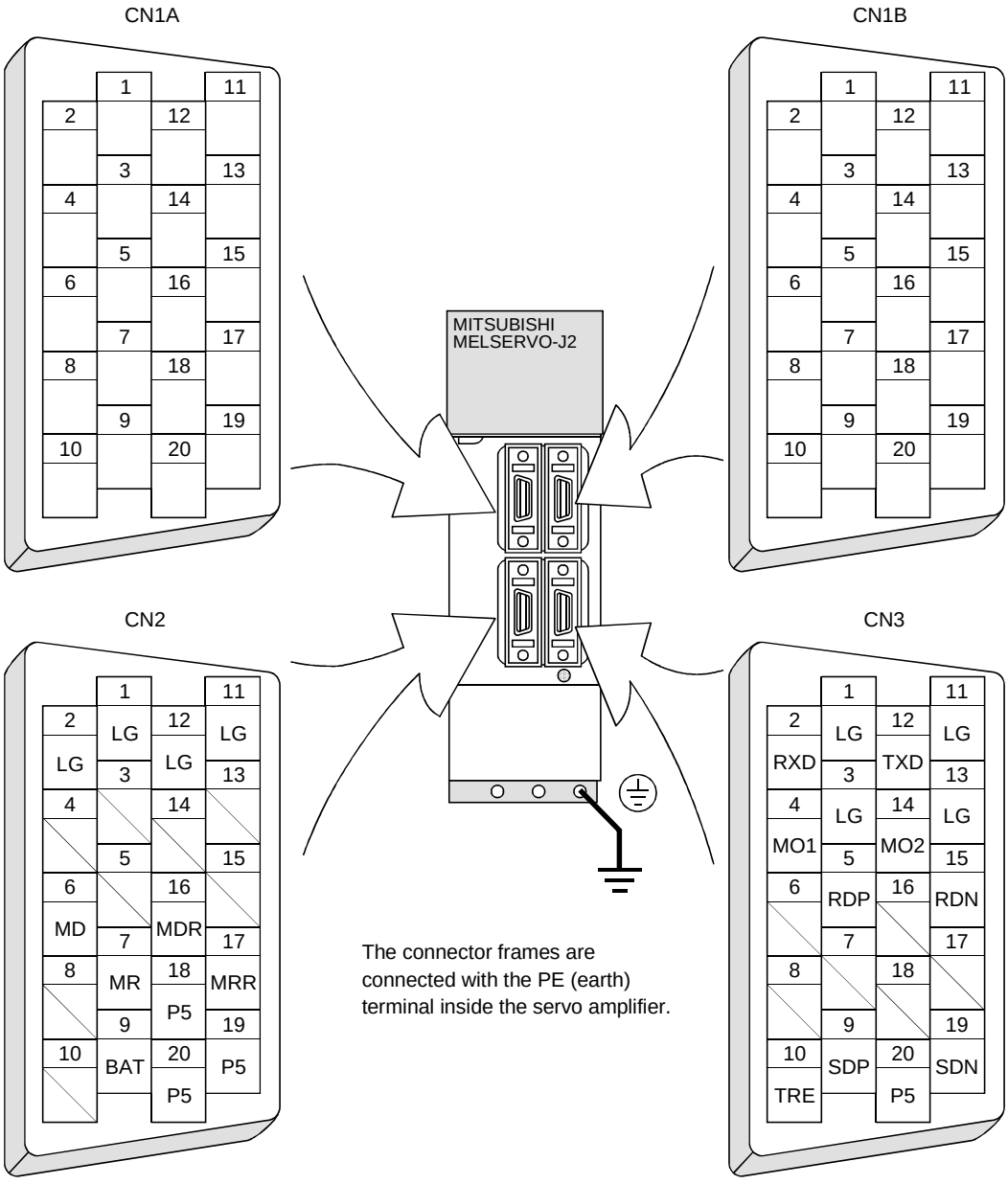
## 3.3 I/O signals

### 3.3.1 Connectors and signal arrangements

**POINT**

- The connector pin-outs shown above are viewed from the cable connector wiring section side.
- Refer to the next page for CN1A and CN1B signal assignment.

(1) Signal arrangement



(2) CN1A and CN1B 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.

| Connector | Pin No. | (Note1) I/O | (Note2) I/O Signals in control modes | | | | | | Related parameter |
|---|---|---|---|---|---|---|---|---|---|
| | | | P | P/S | S | S/T | T | T/P | |
| CN1A | 1 | | LG | LG | LG | LG | LG | LG | |
| | 2 | I | NP | NP/— | | | | —/NP | |
| | 3 | I | PP | PP/— | | | | —/PP | |
| | 4 | | P15R | P15R/P15R | P15R | P15R | P15R | P15R | |
| | 5 | O | LZ | LZ | LZ | LZ | LZ | LZ | |
| | 6 | O | LA | LA | LA | LA | LA | LA | |
| | 7 | O | LB | LB | LB | LB | LB | LB | |
| | 8 | I | CR | CR/SP1 | SP1 | SP1/SP1 | SP1 | SP1/CR | No.43 to 48 |
| | 9 | | COM | COM | COM | COM | COM | COM | |
| | 10 | | SG | SG | SG | SG | SG | SG | |
| | 11 | | OPC | OPC/— | | | | —/OPC | |
| | 12 | I | NG | NG/— | | | | —/NG | |
| | 13 | I | PG | PG/— | | | | —/PG | |
| | 14 | O | OP | OP | OP | OP | OP | OP | |
| | 15 | O | LZR | LZR | LZR | LZR | LZR | LZR | |
| | 16 | O | LAR | LAR | LAR | LAR | LAR | LAR | |
| | 17 | O | LBR | LBR | LBR | LBR | LBR | LBR | |
| | 18 | O | INP | INP/SA | SA | SA/— | | —/INP | No.49 |
| | 19 | O | RD | RD | RD | RD | RD | RD | No.49 |
| | 20 | | SG | SG | SG | SG | SG | SG | |
| CN1B | 1 | | LG | LG | LG | LG | LG | LG | |
| | 2 | I | | —/VC | VC | VC/VLA | VLA | VLA/— | |
| | 3 | | VDD | VDD | VDD | VDD | VDD | VDD | |
| | (Note 4) 4 | O | DO1 | DO1 | DO1 | DO1 | DO1 | DO1 | |
| | 5 | I | SON | SON | SON | SON | SON | SON | No.43 to 48 |
| | 6 | O | TLC | TLC | TLC | TLC/VLC | VLC | VLC/TLC | No.49 |
| | 7 | I | | LOP | SP2 | LOP | SP2 | LOP | No.43 to 48 |
| | 8 | I | PC | PC/ST1 | ST1 | ST1/RS2 | RS2 | RS2/PC | No.43 to 48 |
| | 9 | I | TL | TL/ST2 | ST2 | ST2/RS1 | RS1 | RS1/TL | No.43 to 48 |
| | 10 | | SG | SG | SG | SG | SG | SG | |
| | 11 | | P15R | P15R | P15R | P15R | P15R | P15R | |
| | 12 | I | TLA | (Note3) TLA/TLA | (Note3) TLA | (Note3) TLA/TC | TC | TC/TLA | |
| | 13 | | COM | COM | COM | COM | COM | COM | |
| | 14 | I | RES | RES | RES | RES | RES | RES | No.43 to 48 |
| | 15 | I | EMG | EMG | EMG | EMG | EMG | EMG | |
| | 16 | I | LSP | LSP | LSP | LSP/— | | —/LSP | |
| | 17 | I | LSN | LSN | LSN | LSN/— | | —/LSN | |
| | 18 | O | ALM | ALM | ALM | ALM | ALM | ALM | No.49 |
| | 19 | O | ZSP | ZSP | ZSP | ZSP | ZSP | ZSP | No.1, 49 |
| | 20 | | SG | SG | SG | SG | SG | SG | |

For note, refer to the next page.

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
3. By setting parameters No. 43 to 48 to make TL available, TLA can be used.
4. The signal of CN1A-18 is always output.

(3) Symbols and signal names

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

### 3.3.2 Signal explanations

For the I/O interfaces (symbols in I/O column in the table), refer to Section 3.6.2.
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 among parameters 43 to 49.
The pin No.s in the connector pin No. column are those in the initial status.

#### (1) Input signals

<table>
<tr><th rowspan="2">Signal</th><th rowspan="2">Symbol</th><th rowspan="2">Connector 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>CN1B 5</td><td>Connect SON-SG to switch on the base circuit and make the servo amplifier ready to operate (servo-on).<br>Disconnect SON-SG to shut off the base circuit and coast the servo motor (servo off) .<br>Set "□□□1" in parameter No. 41 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>CN1B 14</td><td>Disconnect RES-SG for more than 50ms to reset the alarm.<br>Some alarms cannot be deactivated by the reset signal. Refer to Section 10.2.<br>Shorting RES-SG in an alarm-free status shuts off the base circuit. The base circuit is not shut off when "□1□□" is set in parameter No. 51.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1B 16</td><td rowspan="2">To start operation, short LSP-SG and/or LSN-SG. Open them to bring the motor to a sudden stop and make it servo-locked.<br>Set "□□□1" in parameter No. 22 to make a slow stop.<br>(Refer to Section 5.2.3.)
<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: LSP/LSN-SG off (open)<br>1: SP/LSN-SG on (short)<br>Set parameter No. 41 as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier:
<table>
<tr><th>Parameter No.41</th><th>Automatic ON</th></tr>
<tr><td>□□1□</td><td>LSP</td></tr>
<tr><td>□1□□</td><td>LSN</td></tr>
</table></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>CN1B 17</td></tr>
</table>

<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>Outside torque limit selection</td><td>TL</td><td>CN1B 9</td><td>Torque limit selection disconnecting TL-SG makes internal torque limit 1 (parameter No. 28) valid and connecting them makes analog torque limit (TLA) valid.<br>For details, refer to (5), Section 3.4.1.</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. 43 to 48.<br>For details, refer to (5), Section 3.4.1.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td>CN1B 8</td><td rowspan="2">Used to start the servo motor in any of the following directions:<br><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: ST1/ST2-SG off (open)<br>1: ST1/ST2-SG on (short)<br>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. 12 setting and servo-locked.</td><td rowspan="2">DI-1</td><td></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td>CN1B 9</td><td></td></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td>CN1B 9</td><td rowspan="2">Used to select any of the following servo motor torque generation directions:<br><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: RS1/RS2-SG off (open)<br>1: RS1/RS2-SG on (short)</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>CN1B 8</td></tr>
</table>

<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>Speed selection 1</td><td>SP1</td><td>CN1A 8</td><td rowspan="3">
<Speed control mode><br>
Used to select the command speed for operation.<br>
When using SP3, make it usable by making the setting of parameter No. 43 to 48.
<table>
<tr><th rowspan="2">Setting of parameter No. 43 to 48</th><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 rowspan="4">When speed selection (SP3) is not used (initial status)</td><td></td><td>0</td><td>0</td><td>Analog speed command (VC)</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Internal speed command 1 (parameter No. 8)</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. 9)</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No. 10)</td></tr>
<tr><td rowspan="8">When speed selection (SP3) is made valid</td><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. 8)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. 9)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No.10)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed command 4 (parameter No. 72)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed command 5 (parameter No. 73)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed command 6 (parameter No. 74)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed command 7 (parameter No. 75)</td></tr>
</table>
Note 0: SP1/SP2/SP3-SG off (open)<br>
1: SP1/SP2/SP3-SG on (short)<br>
<Torque control mode><br>
Used to select the limit speed for operation.<br>
When using SP3, make it usable by making the setting of parameter No. 43 to 48.
<table>
<tr><th rowspan="2">Setting of parameter No. 43 to 48</th><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 rowspan="4">When speed selection (SP3) is not used (initial status)</td><td></td><td>0</td><td>0</td><td>Analog speed limit (VLA)</td></tr>
<tr><td></td><td>0</td><td>1</td><td>Internal speed command 1 (parameter No. 8)</td></tr>
<tr><td></td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. 9)</td></tr>
<tr><td></td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No. 10)</td></tr>
<tr><td rowspan="8">When speed selection (SP3) is made valid</td><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 command 1 (parameter No. 8)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. 9)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No.10)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed command 4 (parameter No. 72)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed command 5 (parameter No. 73)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed command 6 (parameter No. 74)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed command 7 (parameter No. 75)</td></tr>
</table>
Note. 0: SP1/SP2/SP3-SG off (open)<br>
1: SP1/SP2/SP3-SG on (short)
</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td>CN1B 7</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">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>Proportion control</td><td>PC</td><td>CN1B 8</td><td>Connect PC-SG to switch the speed amplifier from the proportional integral type to the proportional type.<br>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 signal (PC) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift.<br>When the shaft is to be locked for a long time, switch on the proportion control signal and torque control signal (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>CN1B 15</td><td>Disconnect EMG-SG to bring the servo motor to emergency stop state, in which the servo is switched off and the dynamic brake is operated.<br>Connect EMG-SG 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>CN1A 8</td><td>Connect CR-SG to clear the position control counter droop pulses on its leading edge. The pulse width should be 10ms or more.<br>When the parameter No.42 setting is "□□1□", the pulses are always cleared while CR-SG are connected.</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. 43 to 48.<br>The combination of CM1-SG and CM2-SG 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.<br><table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Electronic gear denominator</th></tr><tr><th>CM2</th><th>CM1</th></tr><tr><td>0</td><td>0</td><td>Parameter No. 3 (CMX)</td></tr><tr><td>0</td><td>1</td><td>Parameter No. 69 (CM2)</td></tr><tr><td>1</td><td>0</td><td>Parameter No. 70 (CM3)</td></tr><tr><td>1</td><td>1</td><td>Parameter No. 71 (CM4)</td></tr></table>Note. 0: CM1/CM2-SG off (open)<br>1: CM1/CM2-SG on (short)</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. 43 to 48.<br>Connect CDP-SG to change the load inertia moment ratio into the parameter No. 61 setting and the gain values into the values multiplied by the parameter No. 62 to 64 settings.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

<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>Control change</td><td>LOP</td><td>CN1B 7</td><td><Position/speed control change mode><br>Used to select the control mode in the position/speed control change mode.<br><br>(Note) LOP: 0 — Control mode: Position<br>(Note) LOP: 1 — Control mode: Speed<br>Note.0: LOP-SG off (open)<br>1: LOP-SG on (short)<br><Speed/torque control change mode><br>Used to select the control mode in the speed/torque control change mode.<br><br>(Note) LOP: 0 — Control mode: Speed<br>(Note) LOP: 1 — Control mode: Torque<br>Note.0: LOP-SG off (open)<br>1: LOP-SG on (short)<br><Torque/position control mode><br>Used to select the control mode in the torque/position control change mode.<br><br>(Note) LOP: 0 — Control mode: Torque<br>(Note) LOP: 1 — Control mode: Position<br>Note.0: LOP-SG off (open)<br>1: LOP-SG on (short)</td><td>DI-1</td><td colspan="3">Refer to Functions/ Appli-cations.</td></tr>
<tr><td>Analog torque limit</td><td>TLA</td><td>CN1B 12</td><td>To use this signal in the speed control mode, set any of parameters No. 43 to 48 to make TL available.<br>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 (5) in Section 3.4.1.) Resolution:10bit</td><td>Analog input</td><td>○</td><td>△</td><td></td></tr>
<tr><td>Analog torque command</td><td>TC</td><td></td><td>Used to control torque in the full servo motor output torque range.<br>Apply 0 to ±8VDC across TC-LG. Maximum torque is generated at ±8V. (Refer to (1) in Section 3.4.3.)<br>The torque generated at ±8V input can be changed using parameter No. 26.</td><td>Analog input</td><td></td><td></td><td>○</td></tr>
<tr><td>Analog speed command</td><td>VC</td><td>CN1B 2</td><td>Apply 0 to ±10VDC across VC-LG. Speed set in parameter No. 25 is provided at ±10V. (Refer to (1) in Section 3.4.2.)<br>Resolution:14bit or equivalent</td><td>Analog input</td><td></td><td>○</td><td></td></tr>
<tr><td>Analog speed limit</td><td>VLA</td><td></td><td>Apply 0 to +10VDC across VLA-LG. Speed set in parameter No. 25 is provided at +10V (Refer to (3) in Section 3.4.3.).</td><td>Analog input</td><td></td><td></td><td>○</td></tr>
<tr><td>Forward rotation pulse train<br>Reverse rotation pulse train</td><td>PP<br>NP<br>PG<br>NG</td><td>CN1A 3<br>CN1A 2<br>CN1A 13<br>CN1A 12</td><td>Used to enter a command pulse train.<br>・In the open collector system (max. input frequency 200kpps):<br>Forward rotation pulse train across PP-SG<br>Reverse rotation pulse train across NP-SG<br>・In the differential receiver system (max. input frequency 500kpps):<br>Forward rotation pulse train across PG-PP<br>Reverse rotation pulse train across NG-NP<br>The command pulse train form can be changed using parameter No. 21.</td><td>DI-2</td><td>○</td><td></td><td></td></tr>
</table>

(2) Output signals

| Signal | Symbol | Connector pin No. | Functions/Applications | I/O division | Control mode | | |
|---|---|---|---|---|---|---|---|
| | | | | | P | S | T |
| Trouble | ALM | CN1B 18 | ALM-SG are disconnected when power is switched off or the protective circuit is activated to shut off the base circuit. Without alarm, ALM-SG are connected within 1 after power on. | DO-1 | ○ | ○ | ○ |
| Ready | RD | CN1A 19 | RD-SG are connected when the servo is switched on and the servo amplifier is ready to operate. | DO-1 | ○ | ○ | ○ |
| In position | INP | CN1A 18 | INP-SG are connected when the number of droop pulses is in the preset in-position range. The in-position range can be changed using parameter No. 5.<br>When the in-position range is increased, INP-SG may be kept connected during low-speed rotation. | DO-1 | ○ | | |
| Speed reached | SA | | SA-SG are connected when the servo motor speed has nearly reached the preset speed. When the preset speed is 50r/min or less, SA-SG are kept connected. | DO-1 | | ○ | |
| Limiting speed | VLC | CN1B 6 | VLC-SG are connected when speed reaches the value set to any of the internal speed limits 1 to 7 (parameters No. 8 to 10, 72 to 75) or the analog speed limit (VLA) in the torque control mode. They are disconnected when the servo-on signal (SON) switches off. | DO-1 | | | ○ |
| Limiting torque | TLC | | TLC-SG are connected when the torque generated reaches the value set to the internal torque limit 1 (parameter No. 28) or analog torque limit (TLA). They are disconnected when the servo-on signal (SON) switches off. | DO-1 | ○ | ○ | |
| Zero speed | ZSP | CN1B 19 | ZSP-SG are connected when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No. 24. | DO-1 | ○ | ○ | ○ |
| Electromagnetic brake interlock | MBR | (CN1B 19) | Set "□□1□" in parameter No. 1 to use this parameter. Note that ZSP will be unusable.<br>In the servo-off or alarm status, MBR-SG are disconnected.<br>When an alarm occurs, they are disconnected independently of the base circuit status. | DO-1 | △ | △ | △ |
| Warning | WNG | | To use this signal, assign the connector pin for output using parameter No.49. The old signal before assignment will be unusable.<br>When warning has occurred, WNG-SG are connected.<br>When there is no warning, WNG-SG are disconnected within 1 second after power-on. | DO-1 | △ | △ | △ |
| Battery warning | BWNG | | To use this signal, assign the connector pin for output using parameter No.49. The old signal before assignment will be unusable.<br>BWNG-SG are connected when battery cable breakage warning (AL.92) or battery warning (AL.9F) has occurred.<br>When there is no battery warning, BWNG-SG are disconnected within 1 second after power-on. | DO-1 | △ | △ | △ |

<table>
<tr><th>Signal</th><th>Symbol</th><th>Connec-tor pin No.</th><th>Functions/Applications</th><th>I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th></th><th></th><th></th><th></th><th></th><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Alarm code</td><td>ACD 0<br><br>ACD 1<br><br>ACD 2</td><td>CN1A 19<br>CN1A 18<br>CN1B 19</td><td>To use this signal, set "□□□1" in parameter No.49.<br>This signal is output when an alarm occurs. When there is no alarm, respective ordinary signals (RD, INP, SA, ZSP) are output.<br>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>CN1B 19 Pin</th><th>CN1A 18 Pin</th><th>CN1A 19 Pin</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="4">0</td><td rowspan="4">1</td><td rowspan="4">1</td><td>AL.45</td><td>Main circuit device</td></tr>
<tr><td>AL.46</td><td>Servo motor overheat</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: Pin-SG off (open)<br>1: Pin-SG on (short)</td><td>DO-1</td><td>△</td><td>△</td><td>△</td></tr>
</table>

| Signal | Symbol | Connector pin No. | Functions/Applications | I/O division | Control mode | | |
|---|---|---|---|---|---|---|---|
| | | | | | P | S | T |
| Encoder Z-phase pulse (Open collector) | OP | CN1A 14 | Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP and LG are connected 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<br>LAR | CN1A 6<br>CN1A 16 | Outputs pulses per servo motor revolution set in parameter No. 27 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. | DO-2 | ○ | ○ | ○ |
| Encoder B-phase pulse (Differential line driver) | LB<br>LBR | CN1A 7<br>CN1A 17 | The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. 54. | | | | |
| Encoder Z-phase pulse (Differential line driver) | LZ<br>LZR | CN1A 5<br>CN1A 15 | The same signal as OP is output in the differential line driver system. | DO-2 | ○ | ○ | ○ |
| Analog monitor 1 | MO1 | CN3 4 | Used to output the data set in parameter No.17 to across MO1-LG in terms of voltage. Resolution 10 bits | Analog output | ○ | ○ | ○ |
| Analog monitor 2 | MO2 | CN3 14 | Used to output the data set in parameter No.17 to across MO2-LG in terms of voltage. Resolution 10 bits | Analog output | ○ | ○ | ○ |

(3) Communication

POINT

・Refer to Chapter 14 for the communication function.

| Signal | Symbol | Connector pin No. | Functions/Applications | I/O division | Control mode | | |
|---|---|---|---|---|---|---|---|
| | | | | | P | S | T |
| RS-422 I/F | SDP<br>SDN<br>RDP<br>RDN | CN3 9<br>CN3 19<br>CN3 5<br>CN3 15 | RS-485 and RS-232C functions cannot be used together. Choose either one in parameter No. 16. | | ○ | ○ | ○ |
| RS-422 termination | TRE | CN3 10 | Termination resistor connection terminal of RS-422 interface. When the servo amplifier is the termination axis, connect this terminal to RDN (CN3-15). | | ○ | ○ | ○ |
| RS-232C I/F | RXD<br>TXD | CN3 2<br>CN3 12 | RS-485 and RS-232C functions cannot be used together. Choose either one in parameter No. 16. | | ○ | ○ | ○ |

(4) Power supply

| Signal | Symbol | Connector pin No. | Functions/Applications | I/O division | Control mode | | |
|---|---|---|---|---|---|---|---|
| | | | | | P | S | T |
| I/F internal power supply | VDD | CN1B 3 | Used to output +24V±10% to across VDD-SG.<br>When using this power supply for digital interface, connect it with COM.<br>Permissible current : 80mA | | ○ | ○ | ○ |
| Digital I/F power supply input | COM | CN1A 9<br>CN1B 13 | Used to input 24VDC for input interface.<br>Connect the positive terminal of the 24VDC external power supply.<br>24VDC±10% | | ○ | ○ | ○ |
| Open collector power input | OPC | CN1A 11 | When inputting a pulse train in the open collector system, supply this terminal with the positive (+) power of 24VDC. | | ○ | ○ | ○ |
| Digital I/F common | SG | CN1A 10<br>20<br>CN1B 10<br>20 | Common terminal for input signals such as SON and EMG. Pins are connected internally.<br>Separated from LG. | | ○ | ○ | ○ |
| 15VDC power supply | P15R | CN1A 4<br>CN1B 11 | Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA.<br>Permissible current: 30mA | | ○ | ○ | ○ |
| Control common | LG | CN1A 1<br>CN1B 1<br>CN3 1<br>3<br>5<br>11<br>13<br>15 | Common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2 and P15R.<br>Pins are connected internally. | | ○ | ○ | ○ |
| Shield | SD | Plate | Connect the external conductor of the shield cable. | | ○ | ○ | ○ |

## 3.4 Detailed description of the signals

### 3.4.1 Position control mode

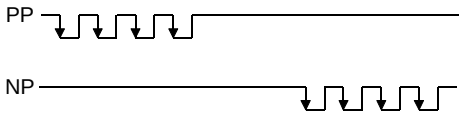
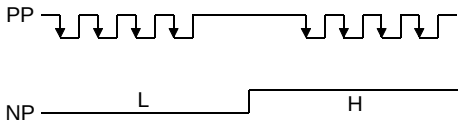
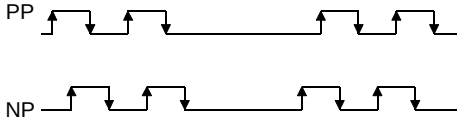
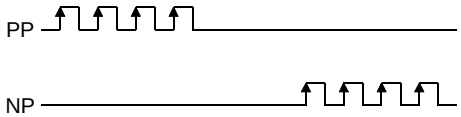
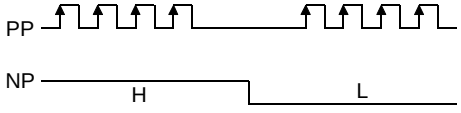
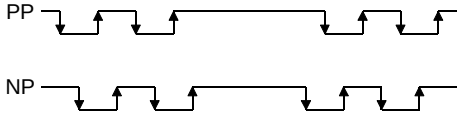
(1) Pulse train input

(a) Input pulse waveform selection

Encoder 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. 21.

Arrow ↑ or ↓ in the table indicates the timing of importing a pulse train.

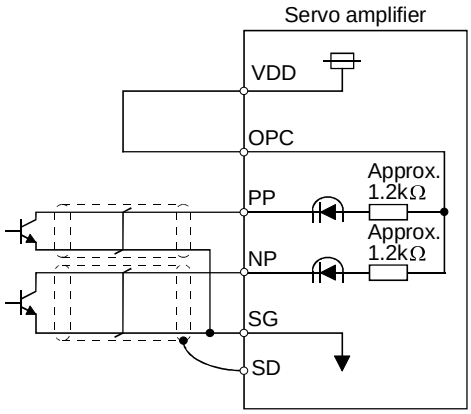
A- and B-phase pulse trains are imported after they have been multiplied by 4.

| Pulse train form | | Forward rotation command / Reverse rotation command | Parameter No. 21 (Command pulse train) |
|---|---|---|---|
| Negative logic | Forward rotation pulse train<br>Reverse rotation pulse train |  | 0010 |
| | Pulse train + sign |  | 0011 |
| | A-phase pulse train<br>B-phase pulse train |  | 0012 |
| Positive logic | Forward rotation pulse train<br>Reverse rotation pulse train |  | 0000 |
| | Pulse train + sign |  | 0001 |
| | A-phase pulse train<br>B-phase pulse train |  | 0002 |

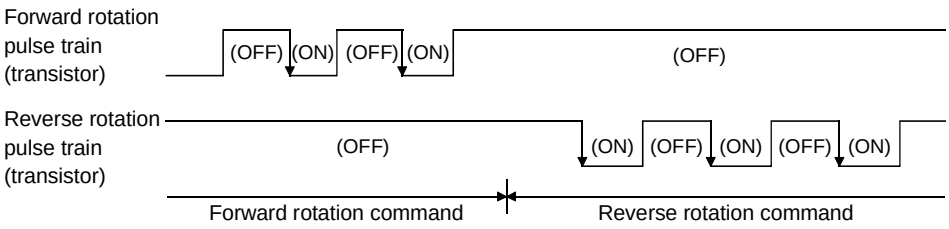
(b) Connections and waveforms

1) Open collector system

Connect as shown below:

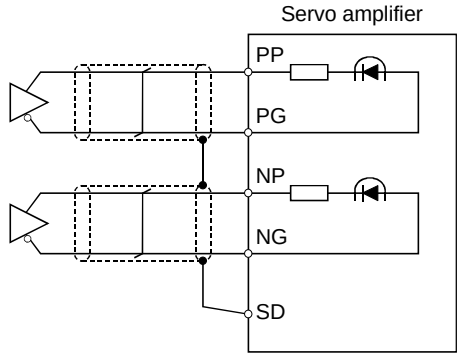



The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010). The waveforms in the table in (a), (1) of this section are voltage waveforms of PP and NP based on SG. Their relationships with transistor ON/OFF are as follows:



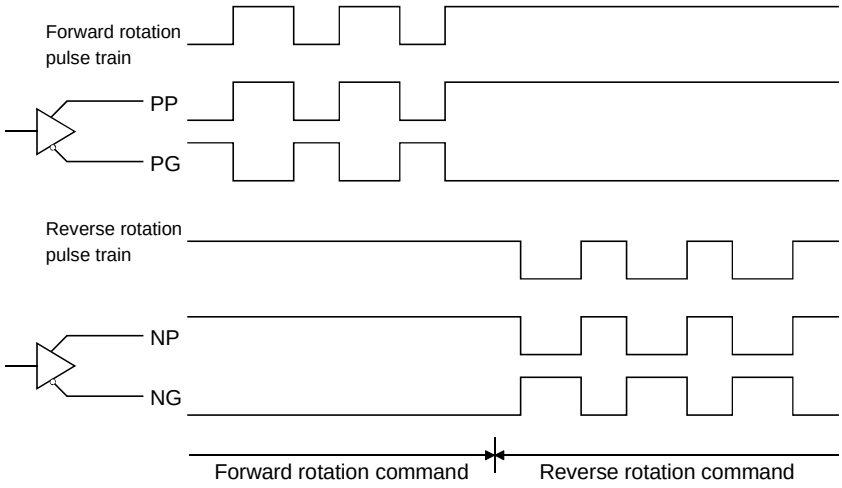
2) Differential line driver system

Connect as shown below:



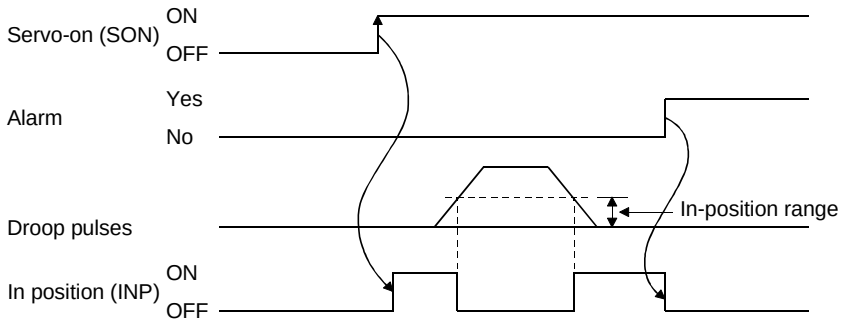

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010).

For the differential line driver, the waveforms in the table in (a), (1) of this section are as follows. The waveforms of PP, PG, NP and NG are based on that of the ground of the differential line driver.

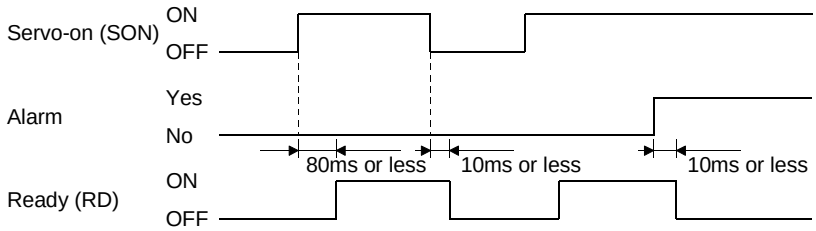


(2) In-position (INP)

PF-SG are connected when the number of droop pulses in the deviation counter falls within the preset in-position range (parameter No. 5). INP-SG may remain connected 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-SG and CM2-SG 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 denominator of the electronic gear changes. Therefore, if any shock occurs at this change, use position smoothing (parameter No. 7) to relieve shock.

| (Note) External input signal | | Electronic gear denomination |
|---|---|---|
| CM2 | CM1 | |
| 0 | 0 | Parameter No. 3 (CMX) |
| 0 | 1 | Parameter No. 69 (CM2) |
| 1 | 0 | Parameter No. 70 (CM3) |
| 1 | 1 | Parameter No. 71 (CM4) |

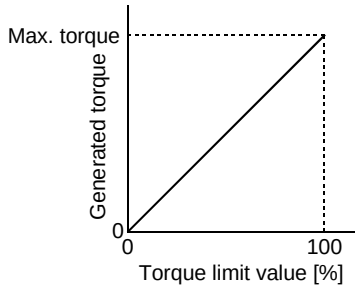
Note.0: CM1/CM2-SG off(open)

1: CM1/CM2-SG on(short)

(5) Torque limit

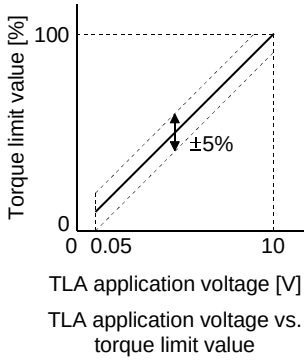
(a) Torque limit and generated torque

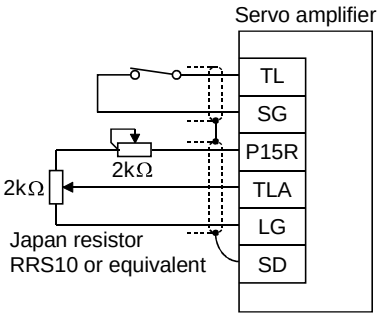
By setting parameter No. 28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor-generated torque is shown below.




A relationship between the applied voltage of the analog torque limit (TLA) and the torque limit value of the servo motor is shown below. Generated torque limit values will vary about 5% relative to the voltage depending on products.

At the voltage of less than 0.05V, generated torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.




(b) Torque limit value selection

Choose the torque limit made valid by the internal torque limit value 1 (parameter No. 28) using the external torque limit selection (TL) or the torque limit made valid by the analog torque limit (TLA) as indicated below.

When internal torque limit selection (TL1) is made usable by parameter No. 43 to 48, internal torque limit 2 (parameter No. 76) can be selected. However, if the parameter No. 28 value is less than the limit value selected by TL/TL1, the parameter No. 28 value is made valid.

| (Note) External input signals | | Torque limit value made valid |
|---|---|---|
| TL1 | TL | |
| 0 | 0 | Internal torque limit value 1 (parameter No. 28) |
| 0 | 1 | TLA > Parameter No. 28: Parameter No. 28<br>TLA < Parameter No. 28: TLA |
| 1 | 0 | Parameter No. 76 > Parameter No. 28: Parameter No. 28<br>Parameter No. 76 < Parameter No. 28: Parameter No. 76 |
| 1 | 1 | TLA > Parameter No. 76: Parameter No. 76<br>TLA < Parameter No. 76: TLA |

Note.0: TL/TL1-SG off (open)
1: TL/TL1-SG on (short)

(c) Limiting torque (TLC)

TLC-SG are connected when the torque generated by the servo motor reaches the torque set to internal torque limit value 1 or analog torque limit.

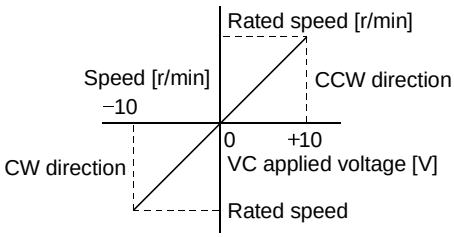
### 3.4.2 Speed control mode

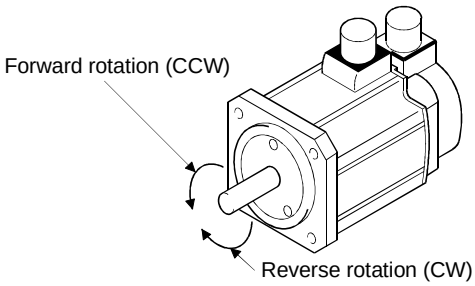
#### (1) Speed setting

(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. 25.



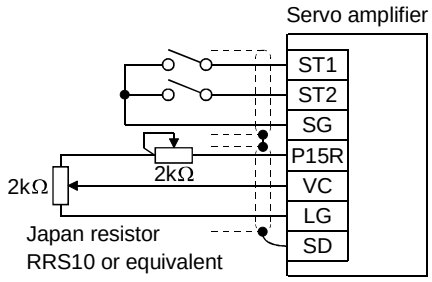




The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination:

| (Note) External input signals | | 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.0: ST1/ST2-SG off (open)
1: ST1/ST2-SG on (short)

The forward rotation start signal (ST1) and reverse rotation start signal (ST2) can be assigned to any pins of the connector CN1A, CN1B using parameters No. 43 to 48.
Generally, make connection as shown below:



(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. 8) |
| 1 | 0 | Internal speed command 2 (parameter No. 9) |
| 1 | 1 | Internal speed command 3 (parameter No. 10) |

Note.0: SP1/SP2-SG off (open)
1: SP1/SP2-SG on (short)

By making speed selection 3 (SP3) usable by setting of parameter No. 43 to 48, 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. 8) |
| 0 | 1 | 0 | Internal speed command 2 (parameter No. 9) |
| 0 | 1 | 1 | Internal speed command 3 (parameter No. 10) |
| 1 | 0 | 0 | Internal speed command 4 (parameter No. 72) |
| 1 | 0 | 1 | Internal speed command 5 (parameter No. 73) |
| 1 | 1 | 0 | Internal speed command 6 (parameter No. 74) |
| 1 | 1 | 1 | Internal speed command 7 (parameter No. 75) |

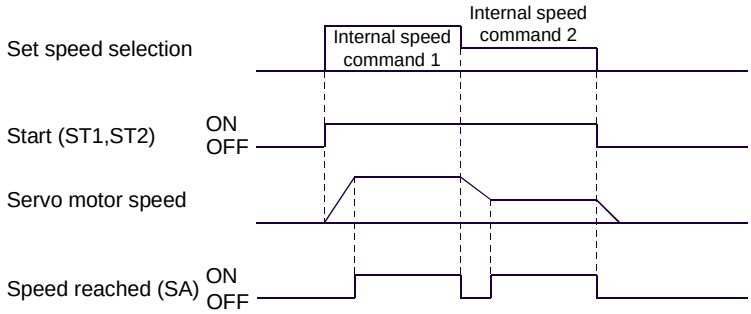
Note.0 : SP1/SP2/SP3-SG off (open)
1 : SP1/SP2/SP3-SG on (short)

The speed may be changed during rotation. In this case, the values set in parameters No. 11 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-SG are connected when the servo motor speed nearly reaches the speed set to the internal speed command or analog speed command.




(3) Torque limit

As in Section 3.4.1 (5).

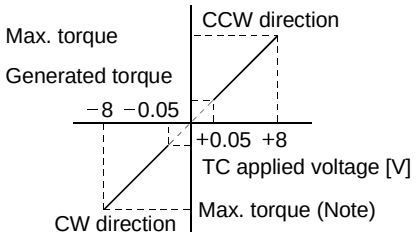
### 3.4.3 Torque control mode

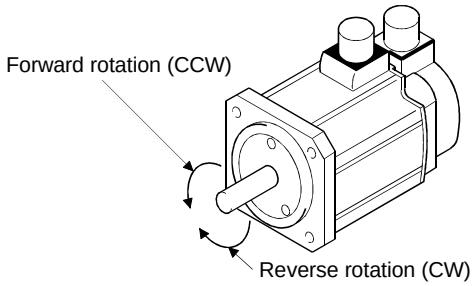
(1) Torque control

(a) Torque command and generated torque

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

The maximum torque is generated at ±8V. Note that the torque generated at ±8V input can be changed with parameter No. 26.



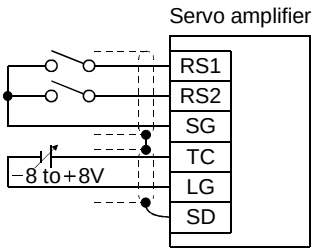

Generated torque limit values will vary about 5% relative to the voltage depending on products. Also the generated torque may vary if the voltage is low (−0.05 to +0.05V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

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. |

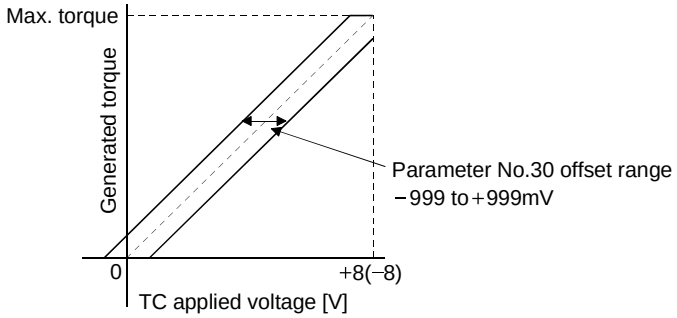
Note. 0: RS1/RS2-SG off (open)
1: RS1/RS2-SG on (short)

Generally, make connection as shown below:



(b) Analog torque command offset

Using parameter No. 30, 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. 28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor-generated torque is as in (5) in section 3.4.1. Note that the analog torque limit (TLA) is unavailable.

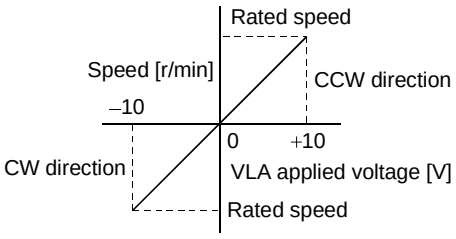
(3) Speed limit

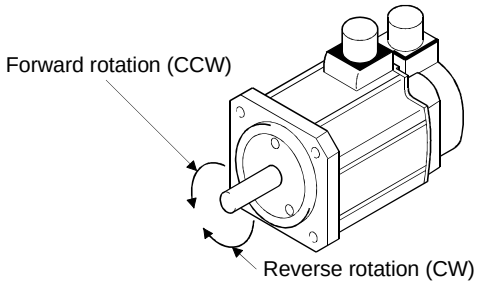
(a) Speed limit value and speed

The speed is limited to the values set in parameters No. 8 to 10, 72 to 75 (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 motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/m greater than the desired speed limit value.



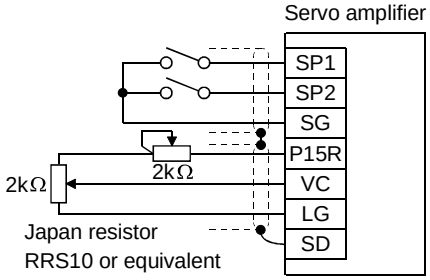




The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination:

| (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: RS1/RS2-SG off (open)
1: RS1/RS2-SG on (short)

Generally, make connection as shown below:



(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.

| Setting of parameter No. 43 to 48 | (Note) Input signals | | | Speed limit value |
|---|---|---|---|---|
| | SP3 | SP2 | SP1 | |
| When speed selection (SP3) is not used (initial status) | | 0 | 0 | Analog speed command (VLA) |
| | | 0 | 1 | Internal speed command 1 (parameter No. 8) |
| | | 1 | 0 | Internal speed command 2 (parameter No. 9) |
| | | 1 | 1 | Internal speed command 3 (parameter No. 10) |
| When speed selection (SP3) is made valid | 0 | 0 | 0 | Analog speed command (VLA) |
| | 0 | 0 | 1 | Internal speed command 1 (parameter No. 8) |
| | 0 | 1 | 0 | Internal speed command 2 (parameter No. 9) |
| | 0 | 1 | 1 | Internal speed command 3 (parameter No. 10) |
| | 1 | 0 | 0 | Internal speed command 4 (parameter No. 72) |
| | 1 | 0 | 1 | Internal speed command 5 (parameter No. 73) |
| | 1 | 1 | 0 | Internal speed command 6 (parameter No. 74) |
| | 1 | 1 | 1 | Internal speed command 7 (parameter No. 75) |

Note.0: SP1/SP2/SP3-SG off (open)
1: SP1/SP2/SP3-SG on (short)

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-SG are connected when the servo motor speed reaches the limit speed set to any of the internal speed limits 1 to 3 or analog speed limit.

### 3.4.4 Position/speed control change mode

Set "0001" in parameter No. 0 to switch to the position/speed control change mode. This function is not available in the absolute position detection system.

(1) Control change (LOP)

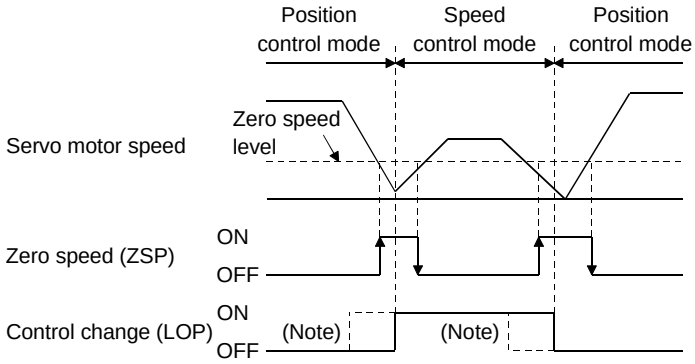
Use control change (LOP) to switch between the position control mode and the speed control mode from an external contact. Relationships between LOP-SG status and control modes are indicated below:

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

Note.0: LOP-SG off (open)
1: LOP-SG on (short)

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 not be changed.

(2) Torque limit in position control mode

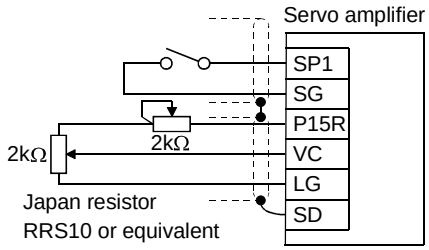
As in Section 3.4.1 (5).

(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 signal (ST1) and reverse rotation start signal (ST2) are as in (a), (1) in section 3.4.2.

Generally, make connection as shown below:




(b) Speed selection 1 (SP1) and speed command 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 command (VC) as indicated in the following table:

| (Note) External input signals | Speed command value |
|---|---|
| SP1 | |
| 0 | Analog speed command (VC) |
| 1 | Internal speed command 1 (parameter No. 8) |

Note.0: SP1-SG off (open)
1: SP1-SG on (short)

The speed may also be changed during rotation. In this case, it is increased or decreased according to the value set in parameter No. 11 or 12.

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 3.4.2 (2).

### 3.4.5 Speed/torque control change mode

Set "0003" in parameter No. 0 to switch to the speed/torque control change mode.

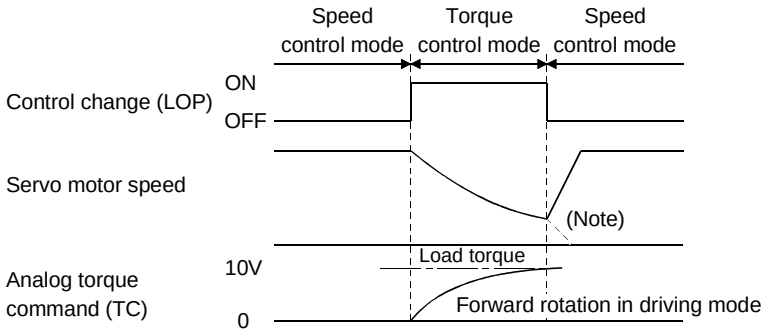
(1) Control change (LOP)

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

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

Note.0: LOP-SG off (open)
1: LOP-SG on (short)

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




Note: When the start signal (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 3.4.2 (1).

(3) Torque limit in speed control mode

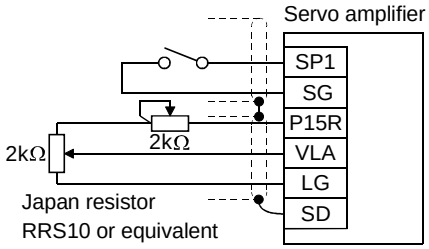
As in Section 3.4.1 (5).

(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 (a), (3) in section 3.4.3.

Generally, make connection as shown below:




(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. 8) |

Note.0: SP1-SG off (open)
1: SP1-SG on (short)

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 (c), (3) in section 3.4.3.

(5) Torque control in torque control mode

As in Section 3.4.3 (1).

(6) Torque limit in torque control mode

As in Section 3.4.3 (2).

### 3.4.6 Torque/position control change mode

Set "0005" in parameter No. 0 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-SG status and control modes are indicated below:

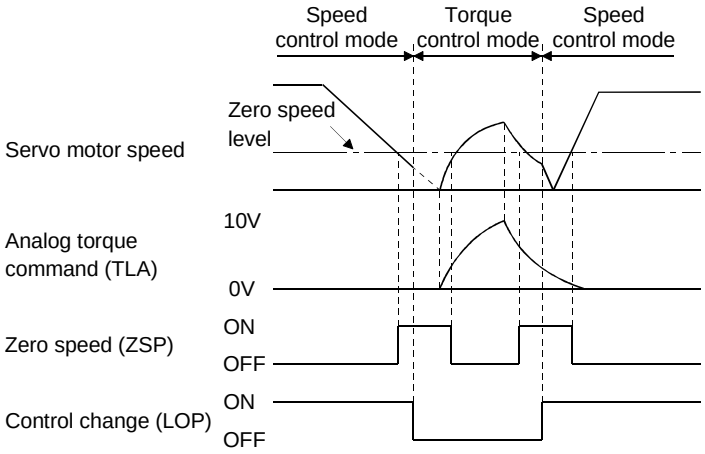
| (Note) LOP | Servo control mode |
|---|---|
| 0 | Torque control mode |
| 1 | Position control mode |

Note.0: LOP-SG off (open)
1: LOP-SG on (short)

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 3.4.3 (3).

(3) Torque control in torque control mode

As in Section 3.4.3 (1).

(4) Torque limit in torque control mode

As in Section 3.4.3 (2).

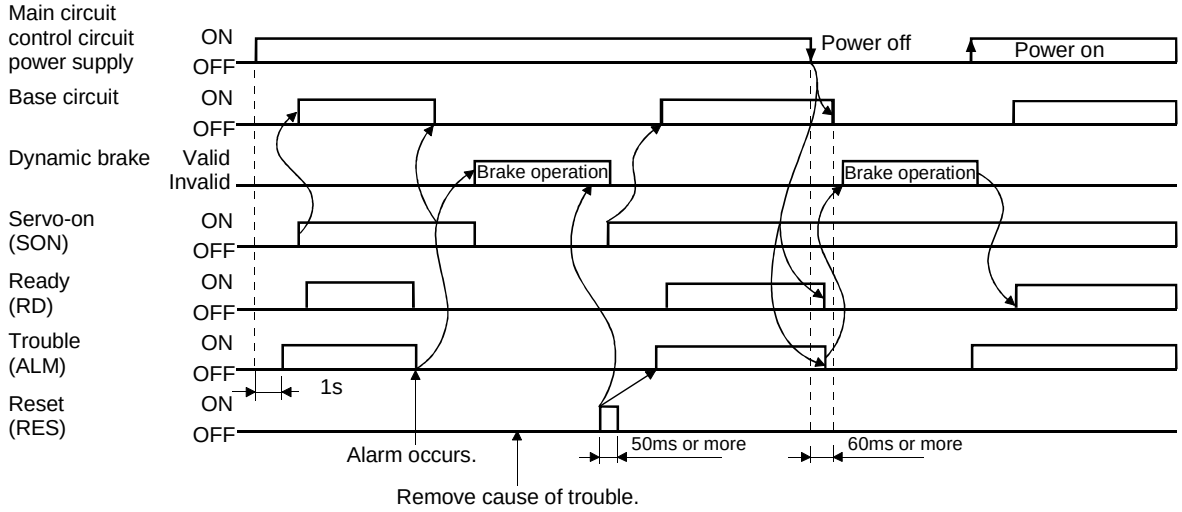
(5) Torque limit in position control mode

As in Section 3.4.1 (5).

## 3.5 Alarm occurrence timing chart

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

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. 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 signal (RES) from off to on. However, the alarm cannot be reset unless its cause is removed.




(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 brake resistor will generate heat, resulting in an accident.

(3) Instantaneous power failure

Undervoltage (AL.10) occurs if power is restored after a 60ms or longer power failure of the control power supply or after a drop of the bus voltage to or below 200VDC. If the power failure persists further, the control power switches off. When the power failure is reset in this state, the alarm is reset and the servo motor will start suddenly if the servo-on signal (SON) is on. To prevent hazard, make up a sequence which will switch off the servo-on signal (SON) if an alarm occurs.

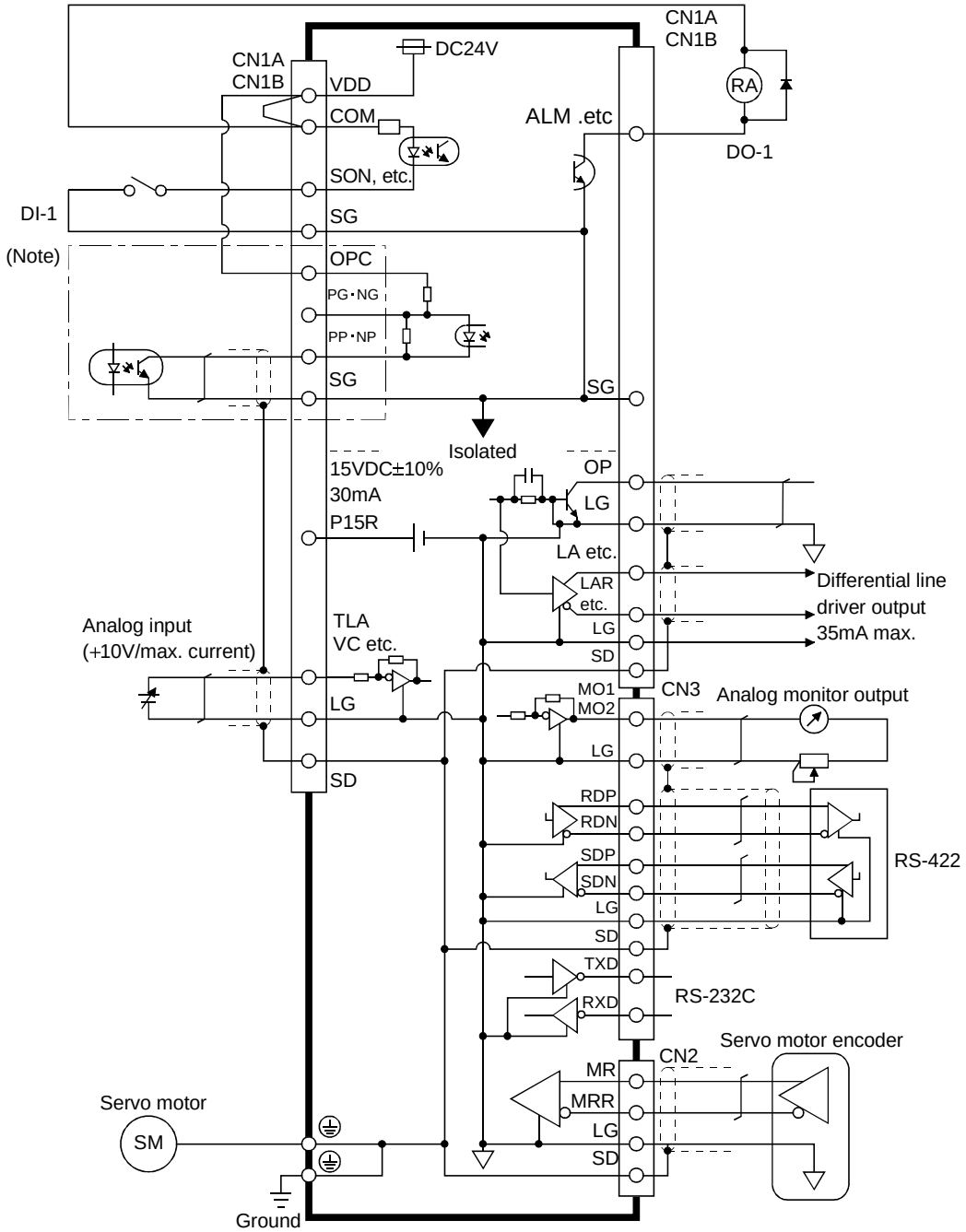
(4) In position control mode (incremental)

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

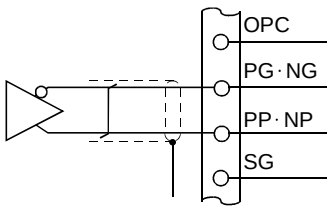
## 3.6 Interfaces

### 3.6.1 Common line

The following diagram shows the power supply and its common line.




Note: For the open collection pulse train input. Make the following connection for the different line driver pulse train input.



### 3.6.2 Detailed description of the interfaces

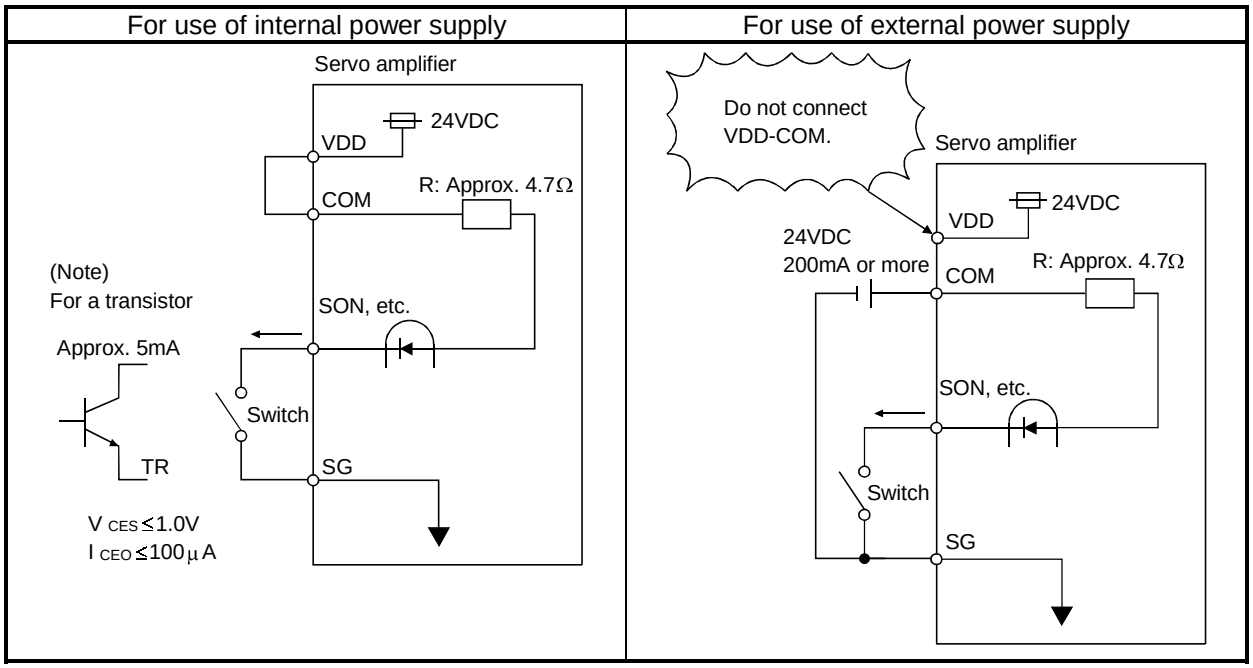
This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in Sections 3.3.2.

Refer to this section and connect the interfaces with the external equipment.

(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor.

Source input is also possible. Refer to (7) in this section.

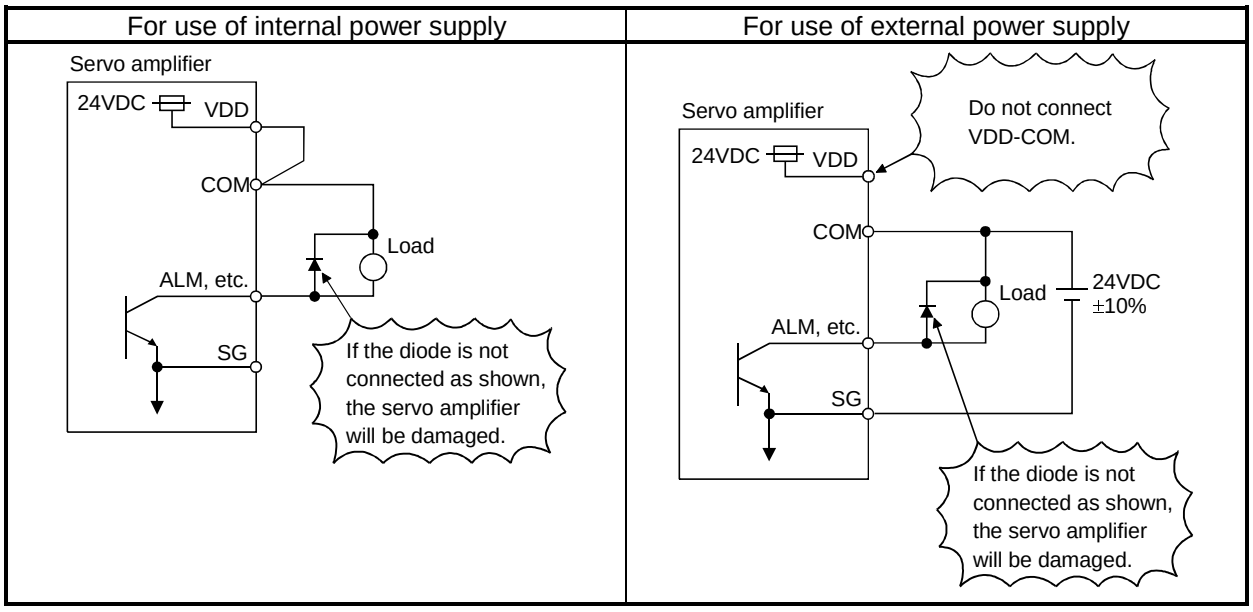



Note: This also applies to the use of the external power supply.

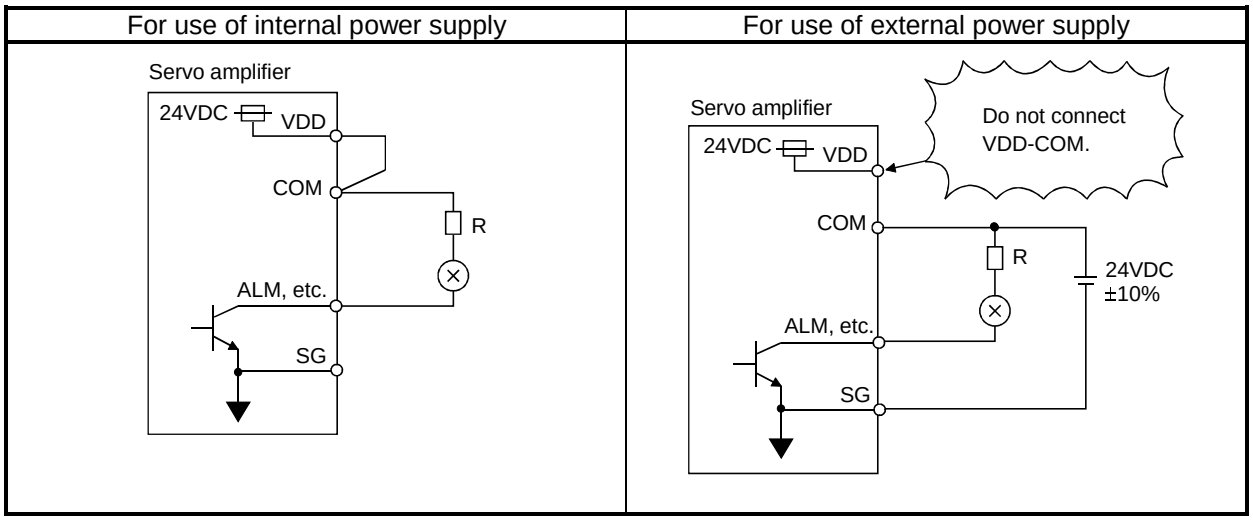
(2) Digital output interface DO-1

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

(a) Inductive load



(b) Lamp load

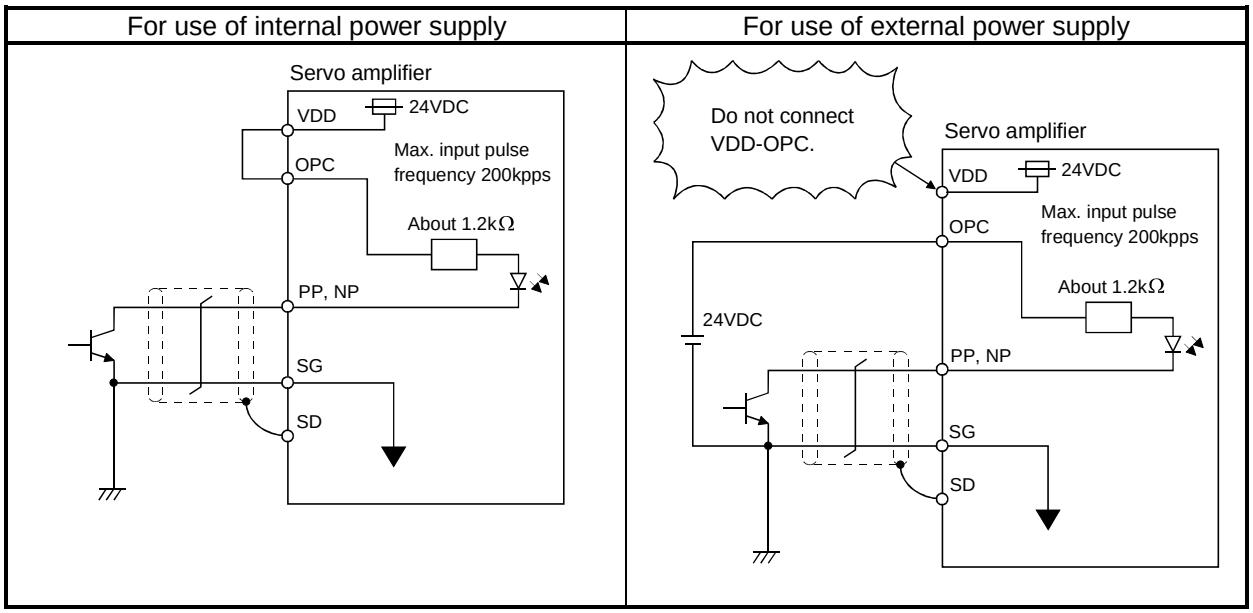



(3) Pulse train input interface DI-2

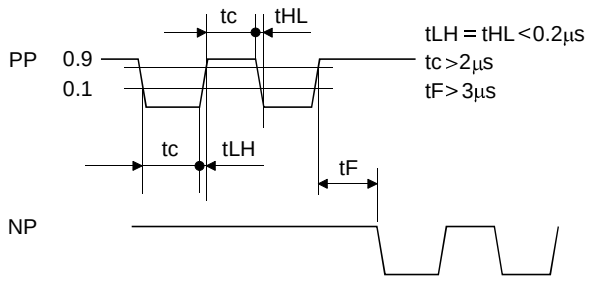
Provide a pulse train signal in the open collector or differential line driver system.

(a) Open collector system

1) Interface

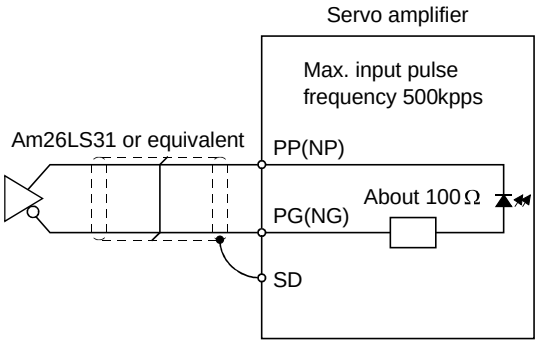



2) Conditions of the input pulse

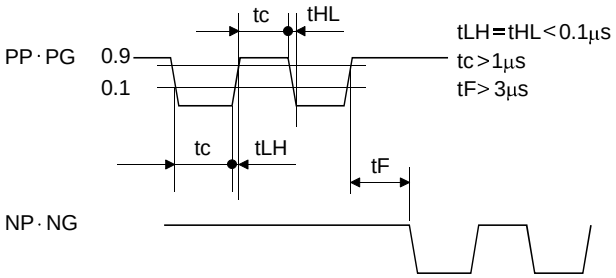


(b) Differential line driver system

1) Interface



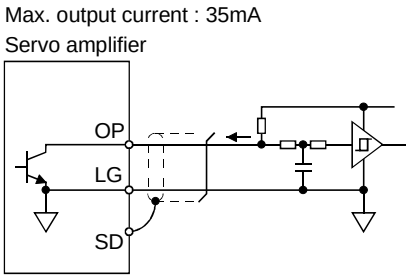

2) Conditions of the input pulse

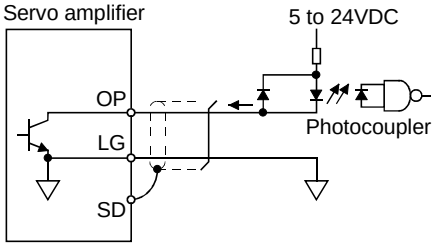



(4) Encoder pulse output DO-2

(a) Open collector system

Interface

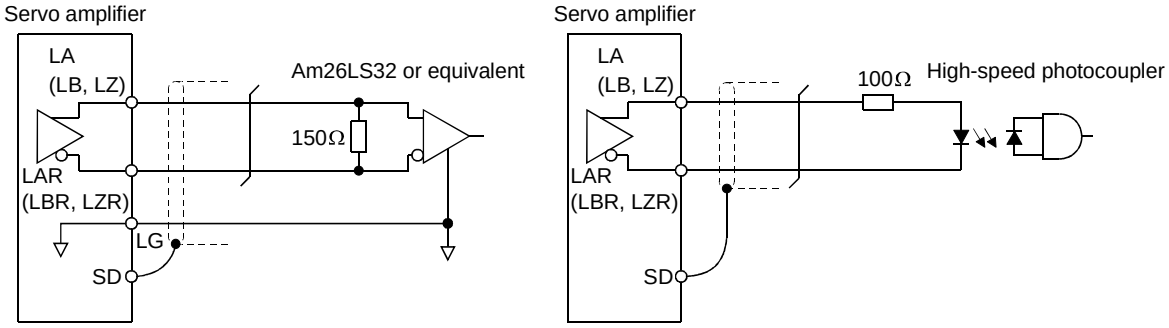


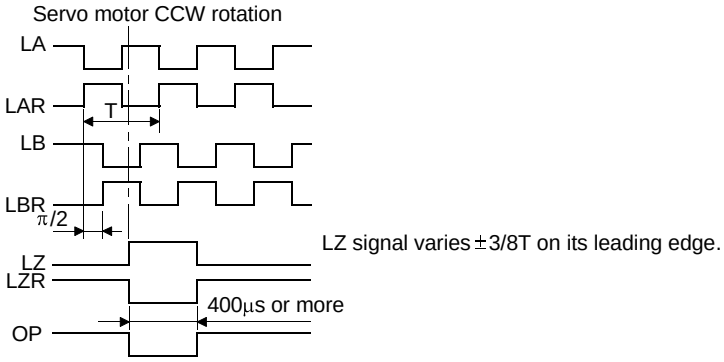
(b) Differential line driver system

1) Interface

Max. output current: 35mA

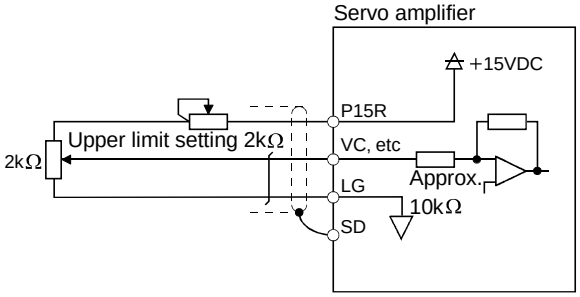



2) Output pulse




(5) Analog input

Input impedance 10 to 12kΩ



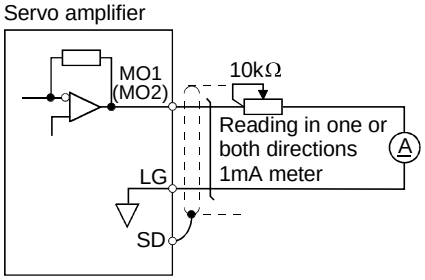

(6) Analog output

Output voltage ±10V

Max.1mA

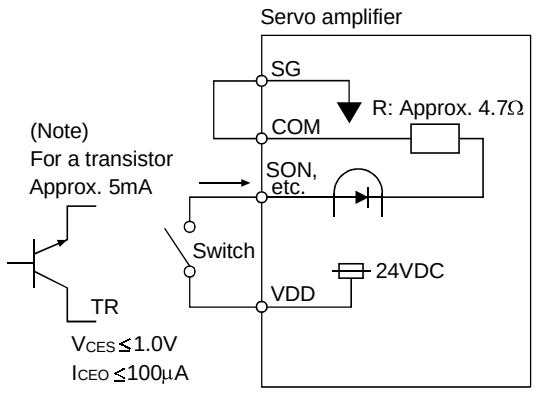
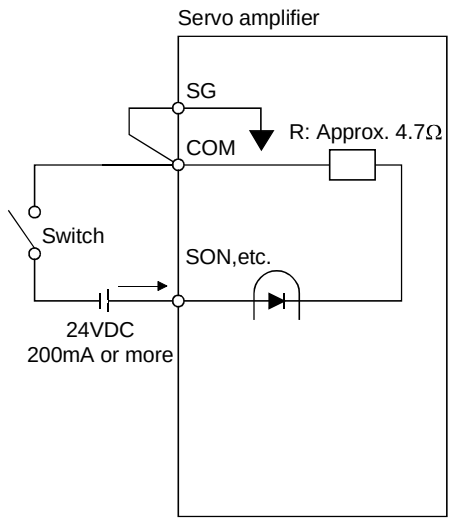
Max. output current

Resolution : 10bit



(7) Source input interface

When using the input interface of source type, all Dl-1 input signals are of source type.
Source output cannot be provided.

| For use of internal power supply | For use of external power supply |
|---|---|
|  |  |



Note: This also applies to the use of the external power supply.

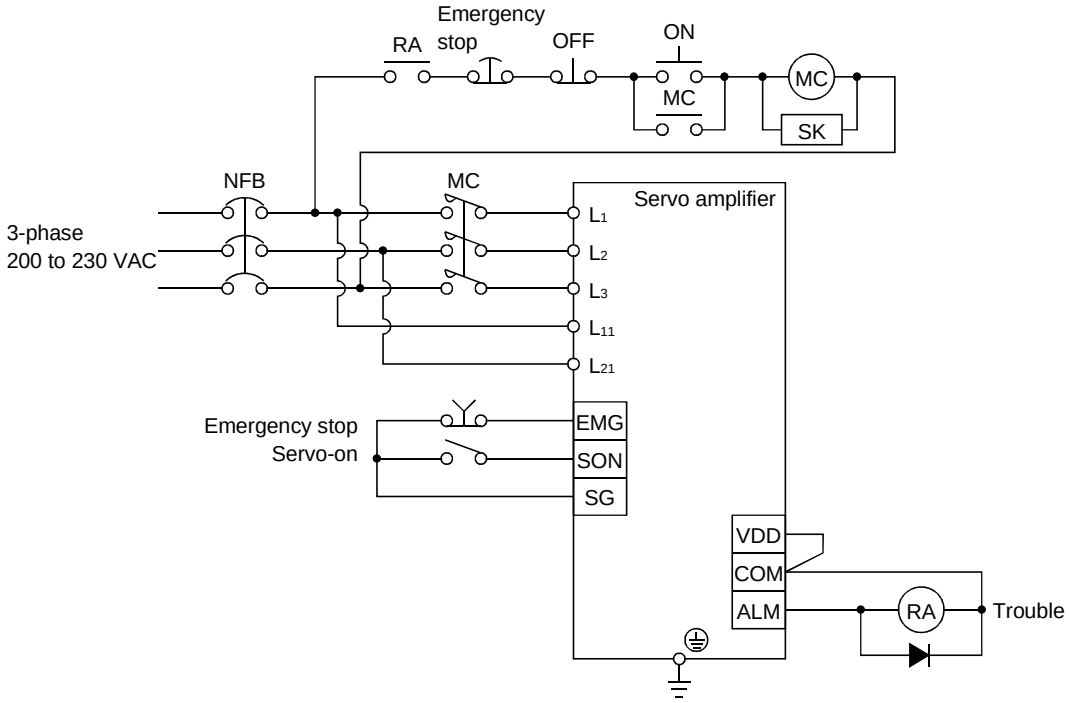
## 3.7 Input power supply circuit

| | |
|---|---|
| ⚠ 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.<br>▪ Use the trouble signal to switch power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor, causing a fire. |

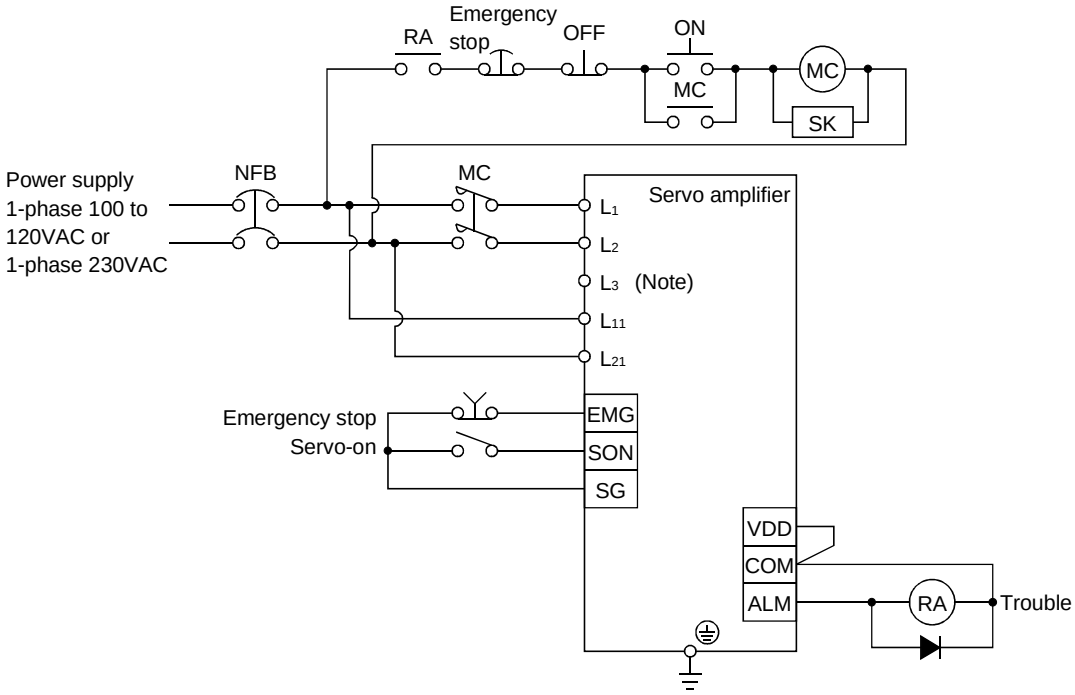
### 3.7.1 Connection example

Wire the power supply and main circuit as shown below so that the servo-on signal 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



(2) For 1-phase 100 to 120VAC or 1-phase 100 to 120VAC power supply




Note : Not provided for 1-phase 100 to 120VAC.

### 3.7.2 Terminals

The positions and signal arrangements of the terminal blocks change with the capacity of the servo amplifier. Refer to Section 11.1.

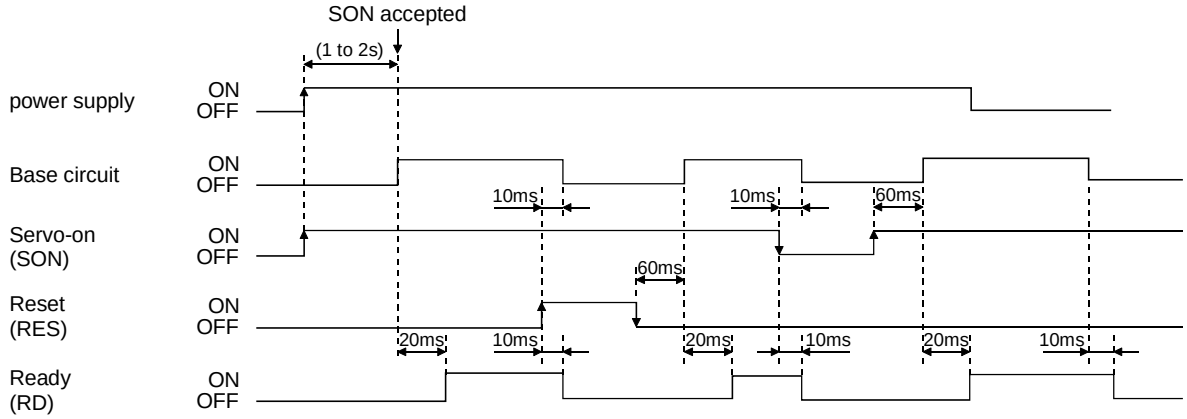
<table>
<tr><th>Symbol</th><th>Signal</th><th>Description</th></tr>
<tr><td>$L_1$, $L_2$, $L_3$</td><td>Main circuit power supply</td><td>Supply $L_1$, $L_2$ and $L_3$ with the following power:<br>For 1-phase 230VAC, connect the power supply to $L_1$/$L_2$ and leave $L_3$ open.
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J2S-10A to 70A</th><th>MR-J2S-100A to 700A</th><th>MR-J2S-10A1 to 40A1</th></tr>
<tr><td>3-phase 200 to 230VAC, 50/60Hz</td><td colspan="2">$L_1$ · $L_2$ · $L_3$</td><td></td></tr>
<tr><td>1-phase 230VAC, 50/60Hz</td><td>$L_1$ · $L_2$</td><td></td><td></td></tr>
<tr><td>1-phase 100 to 120VAC, 50/60Hz</td><td></td><td></td><td>$L_1$ · $L_2$</td></tr>
</table></td></tr>
<tr><td>U, V, W</td><td>Servo motor output</td><td>Connect to the servo motor power supply terminals (U, V, W).</td></tr>
<tr><td>$L_{11}$, $L_{21}$</td><td>Control circuit power supply</td><td>
<table>
<tr><th>Servo amplifier / Power supply</th><th>MR-J2S-10A to 700A</th><th>MR-J2S-10A1 to 40A1</th></tr>
<tr><td>1-phase 200 to 230VAC, 50/60Hz</td><td>$L_{11}$ · $L_{21}$</td><td></td></tr>
<tr><td>1-phase 100 to 120VAC, 50/60Hz</td><td></td><td>$L_{11}$ · $L_{21}$</td></tr>
</table></td></tr>
<tr><td>P, C, D</td><td>Regenerative brake option</td><td>1) MR-J2S-350A or less<br>Wiring is factory-connected across P-D (servo amplifier built-in regenerative brake resistor).<br>When using the regenerative brake option, always remove the wiring from across P-D and connect the regenerative brake option across P-C.<br>2) MR-J2S-500A or more<br>Wiring is factory-connected across P-C (servo amplifier built-in regenerative brake resistor).<br>When using the regenerative brake option, always remove the wiring from across P-C and connect the regenerative brake option across P-C.<br>Refer to Section 13.1.1 for details.</td></tr>
<tr><td>N</td><td>Return converter<br>Brake unit</td><td>When using the return converter or brake unit, connect it across P-N.<br>Do not connect it to the servo amplifier of MR-J2S-350A or less.<br>Refer to Sections 13.1.2 and 13.1.3 for details.</td></tr>
<tr><td>  </td><td>Protective earth (PE)</td><td>Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.</td></tr>
</table>

### 3.7.3 Power-on sequence

(1) Power-on procedure

1) Always wire the power supply as shown in above Section 3.7.1 using the magnetic contactor with the main circuit power supply (three-phase 200V: $L_1$, $L_2$, $L_3$, single-phase 230V: $L_1$, $L_2$). 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 signal (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 signal (RD) will switch on in further about 20ms, making the servo amplifier ready to operate. (Refer to paragraph (2) in this section.)
4) When the reset signal (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart

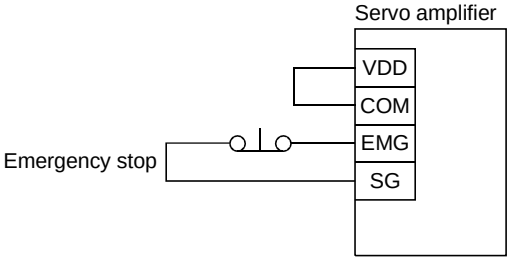



(3) Emergency stop

Make up a circuit which shuts off main circuit power as soon as EMG-SG are opened at an emergency stop. To ensure safety, always install an external emergency stop switch across EMG-SG. By disconnecting EMG-SG, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (AL.E6).

During ordinary operation, do not use the external emergency stop signal to alternate stop and run. The servo amplifier life may be shortened.

Also, if the start signal is 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.



## 3.8 Connection of servo amplifier and servo motor

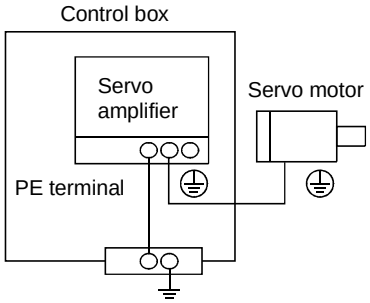
### 3.8.1 Connection instructions

| | |
|---|---|
| ⚠ 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.<br>・Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur. |

The connection method differs according to the series and capacity of the servo motor and whether or not the servo motor has the electromagnetic brake. Perform wiring in accordance with this section.

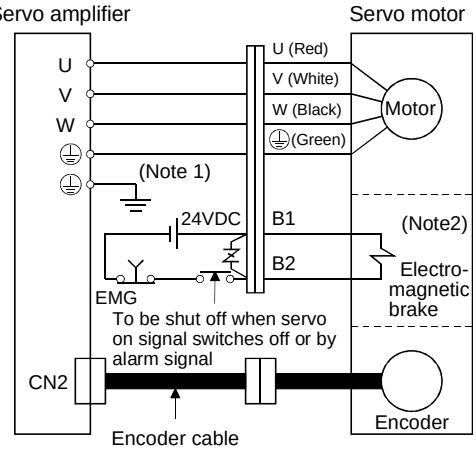
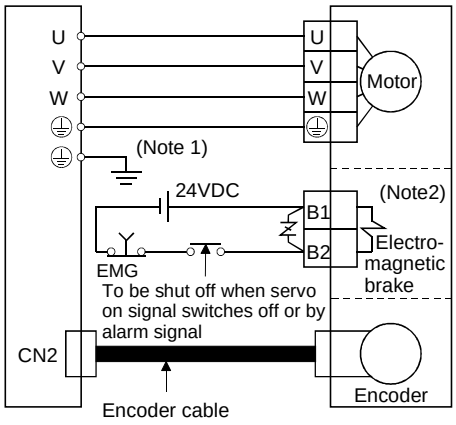
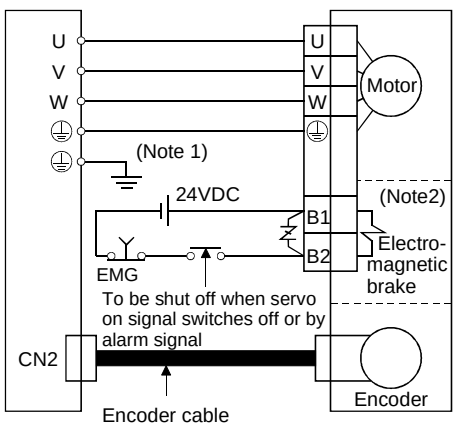
(1) For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal of the servo amplifier and connect the ground cable of the servo amplifier to the earth via the protective earth of the control box. Do not connect them directly to the protective earth of the control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

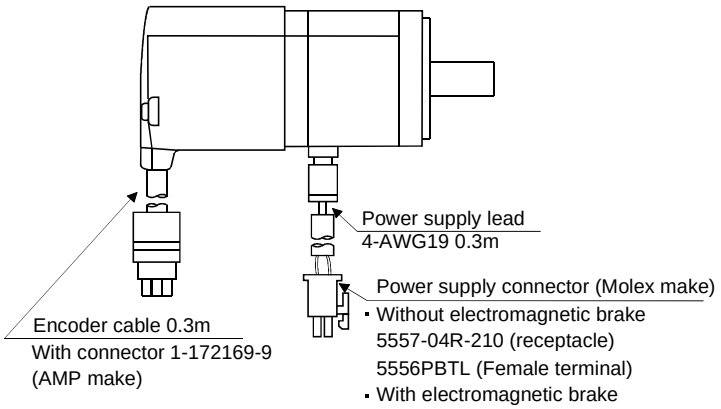
### 3.8.2 Connection diagram

The following table lists wiring methods according to the servo motor types. Use the connection diagram which conforms to the servo motor used. For cables required for wiring, refer to Section 13.2.1. For encoder cable connection, refer to Section 13.1.4. For the signal layouts of the connectors, refer to Section 3.8.3.
For the servo motor connector, refer to Chapter 3 of the Servo Motor Instruction Manual.

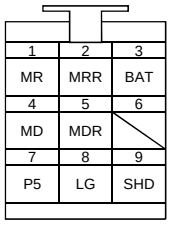
| Servo motor | Connection diagram |
|---|---|
| HC-KFS053 (B) to 73 (B)<br>HC-MFS053 (B) to 73 (B)<br>HC-UFS13 (B) to 73 (B) |  <br>Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.<br>2. This circuit applies to the servo motor with electromagnetic brake. |
| HC-SFS121 (B) to 301 (B)<br>HC-SFS202 (B)・702 (B)<br>HC-SFS203 (B)・353 (B)<br>HC-UFS202 (B) to 502 (B)<br>HC-RFS353 (B) to 503 (B) |  <br>Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.<br>2. This circuit applies to the servo motor with electromagnetic brake. |
| HC-SFS81 (B)<br>HC-SFS52 (B) to 152 (B)<br>HC-SFS53 (B) to 153 (B)<br>HC-RFS103 (B) to 203 (B)<br>HC-UFS72 (B)・152 (B) |  <br>Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box.<br>2. This circuit applies to the servo motor with electromagnetic brake. |

### 3.8.3 I/O terminals

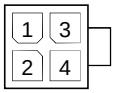
(1) HC-KFS · HC-MFS · HC-UFS3000r/min series




Encoder connector signal arrangement

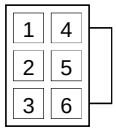



Power supply connector 5557-04R-210



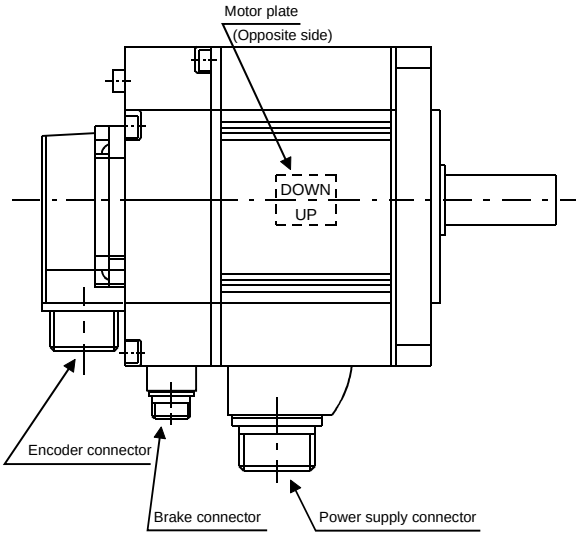

| Pin | Signal | Lead wire color |
|---|---|---|
| 1 | U | Red |
| 2 | V | White |
| 3 | W | Black |
| 4 | Earth | Green/yellow |

Power supply connector 5557-06R-210




| Pin | Signal | Lead wire color |
|---|---|---|
| 1 | U | Red |
| 2 | V | White |
| 3 | W | Black |
| 4 | Earth | Green/yellow |
| 5 | B1 | |
| 6 | B2 | |

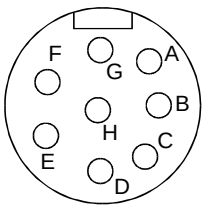
(2) HC-SFS・HC-RFS・HC-UFS2000 r/min series




| Servo motor | Servo motor side connectors | | |
|---|---|---|---|
| | For power supply | For encoder | Electromagnetic brake connector |
| HC-SFS81(B)<br>HC-SFS52(B) to 152(B)<br>HC-SFS53(B) to 153(B) | CE05-2A22-23PD-B | MS3102A20-29P | The connector for power is shared. |
| HC-SFS121(B) to 301(B)<br>HC-SFS202(B) to 502 (B)<br>HC-SFS203(B)・353(B) | CE05-2A24-17PD-B | | MS3102A10SL-4P |
| HC-SFS702(B) | CE05-2A32-17PD-B | | |
| HC-RFS103(B) to 203 (B) | CE05-2A22-23PD-B | | The connector for power is shared. |
| HC-RFS353(B)・503(B) | CE05-2A24-10PD-B | | |
| HC-UFS72(B)・152(B) | CE05-2A22-23PD-B | | |
| HC-UFS202(B) to 502(B) | CE05-2A24-10PD-B | | MS3102A10SL-4P |

Power supply connector signal arrangement

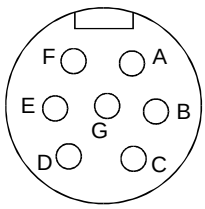
CE05-2A22-23PD-B




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

Note:24VDC,without polarity

CE05-2A24-10PD-B

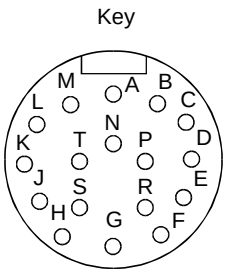



| Pin | Signal |
|---|---|
| A | U |
| B | V |
| C | W |
| D | ⏚ (Earth) |
| E | (Note) B1 |
| F | (Note) B2 |
| G | |

Note:24VDC,without polarity

Encoder connector signal arrangement

MS3102A20-29P

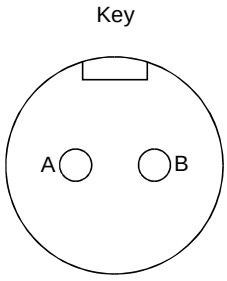



| Pin | Signal |
|---|---|
| A | MD |
| B | MDR |
| C | MR |
| D | MRR |
| E | |
| F | BAT |
| G | LG |
| H | |
| J | |

| Pin | Signal |
|---|---|
| K | |
| L | |
| M | |
| N | SD |
| P | |
| R | LG |
| S | P5 |
| T | |

Electromagnetic brake connector signal arrangement

MS3102A10SL-4P



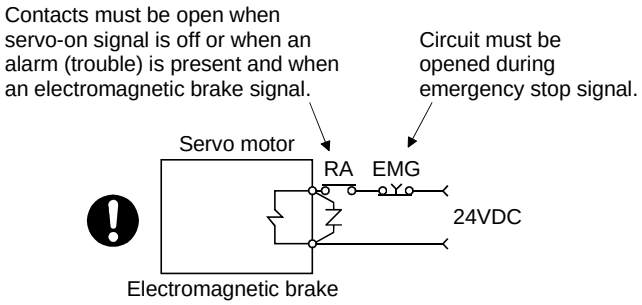

| Pin | Signal |
|---|---|
| A | (Note)B1 |
| B | (Note)B2 |

Note:24VDC without polarity

3.9 Servo motor with electromagnetic brake

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.

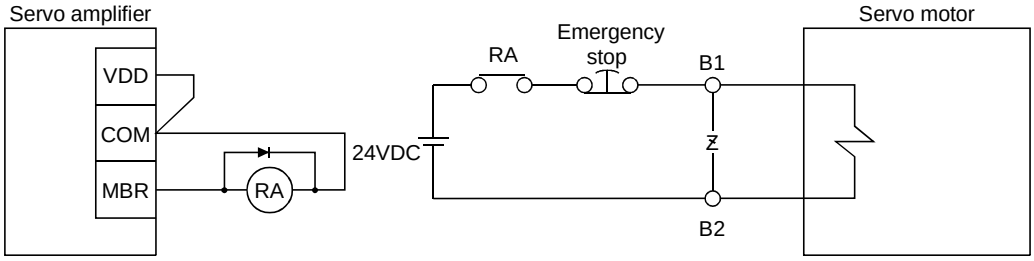
POINT

- Refer to the Servo Motor Instruction Manual 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 for applications requiring a brake to hold the motor shaft (vertical lift applications):

1) Set "□□1□"in parameter No.1 to make the electromagnetic brake interlock signal (MBR) valid. Note that this will make the zero speed signal (ZSP) unavailable.
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 signal is on, the base circuit is shut off. When using the servo motor with a vertical shaft, use the electromagnetic brake interlock signal (MBR).
5) Switch off the servo-on signal after the servo motor has stopped.

(1) Connection diagram



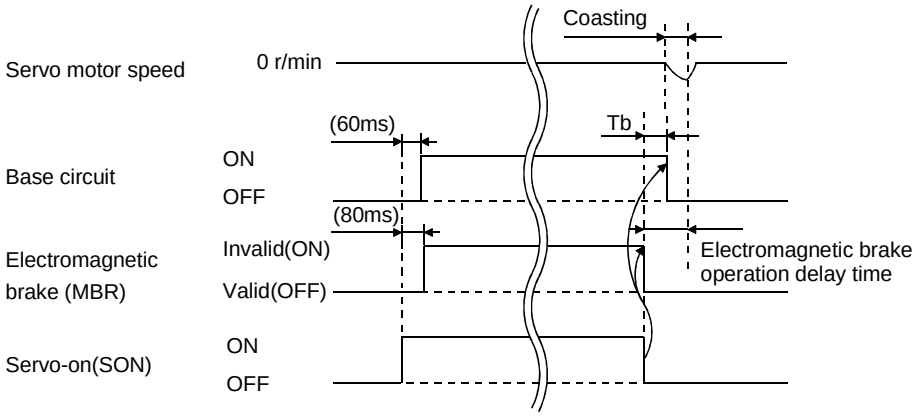

(2) Setting

1) Set "□□1□"in parameter No.1 to make the electromagnetic brake interlock signal (MBR) valid.
2) Using parameter No. 33 (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 (3) in this section.

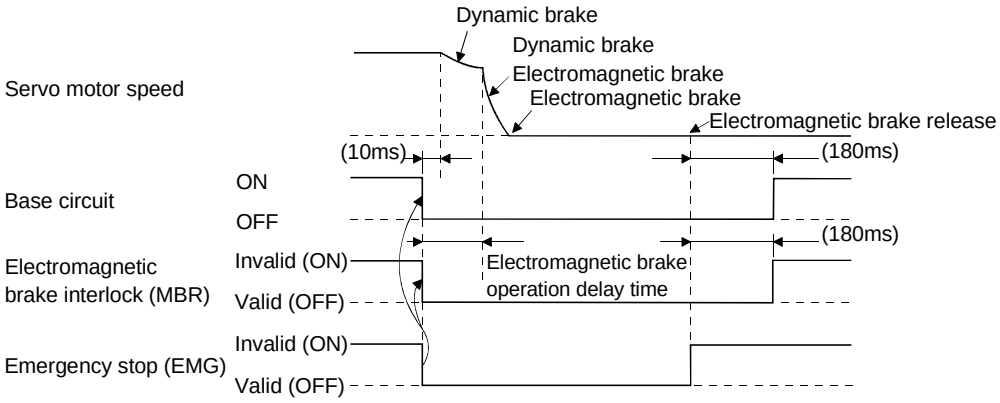
(3) Timing charts

(a) Servo-on signal command (from controller) ON/OFF

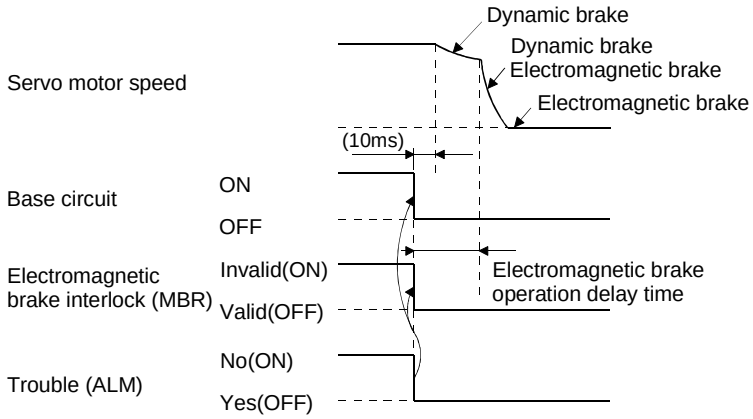
Tb [ms] after the servo-on (SON) signal is switched off, the servo lock is released and the servo motor coasts. If the electromagnetic brake is made valid in the servo lock status, the brake life may be shorter. Therefore, when using the electromagnetic brake in a vertical lift application or the like,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



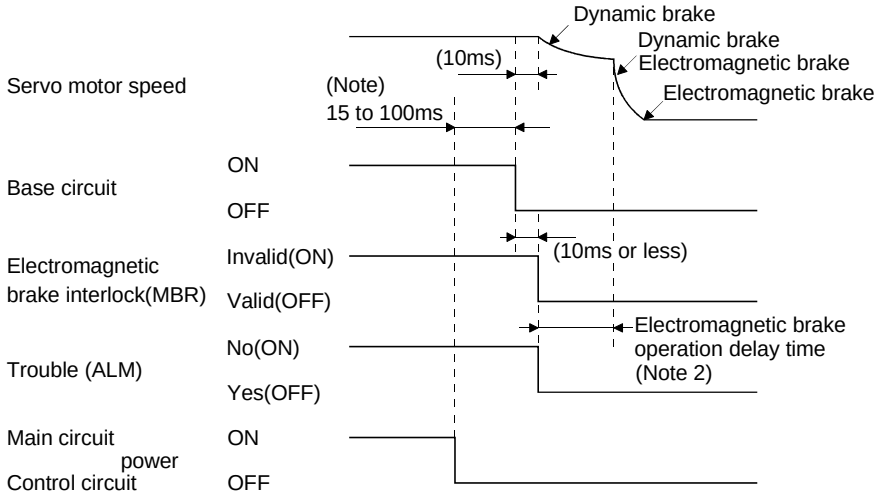

(b) Emergency stop signal (EMG) ON/OFF



(c) Alarm occurrence

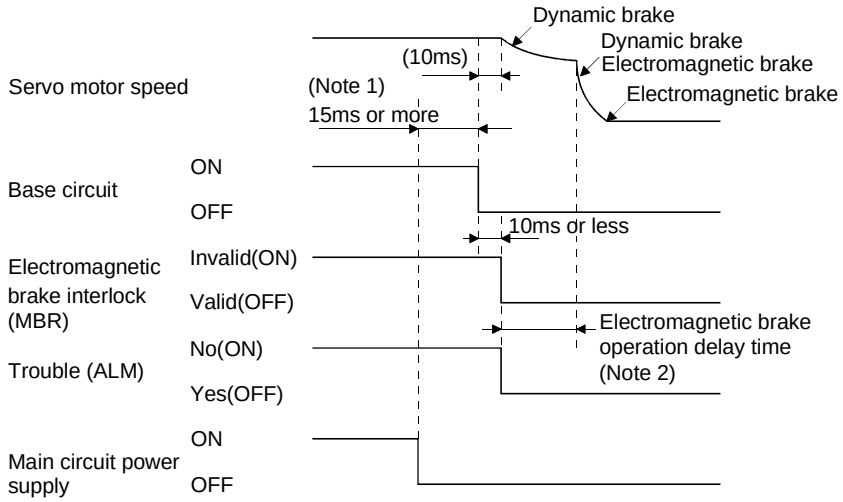



(d) Both main and control circuit power supplies off




Note: Changes with the operating status.

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



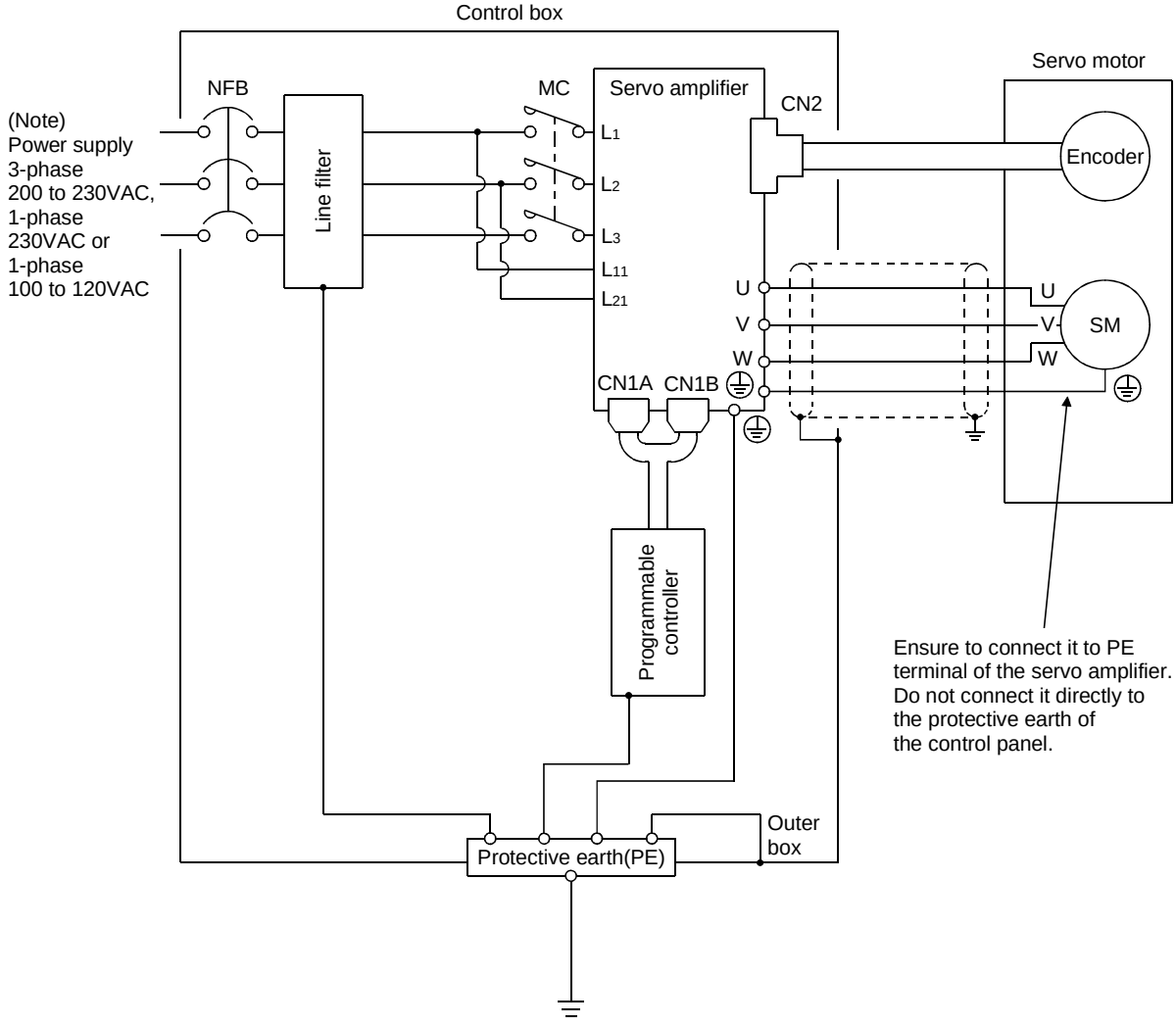

Note: 1. Changes with the operating status.
2. When the main circuit power supply is off in a motor stop status, the main circuit off warning (A.E9) occurs and the ALM signal does not turn off.

## 3.10 Grounding

| | |
|---|---|
| ⚠ WARNING | ▪ Ground the servo amplifier and servo motor securely.<br>▪ 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 cablerouting, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground.

To conform to the EMC Directive, refer to the EMC Installation Guidelines (IB(NA)67310).

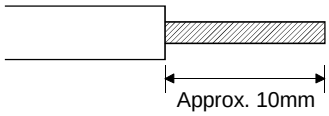



Note: For 1-phase 230VAC, connect the power supply to $L_1 \cdot L_2$ and leave $L_3$ open.
There is no $L_3$ for 1-phase 100 to 120VAC power supply.

## 3.11 Servo amplifier terminal block (TE2) wiring method

### (1) Termination of the cables

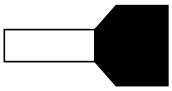
Solid wire: After the sheath has been stripped, the cable can be used as it is. (Cable size: 0.2 to 2.5mm$^2$)




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



Bar terminal for 1 cable
(Bar terminal ferrule with insulation sleeve)



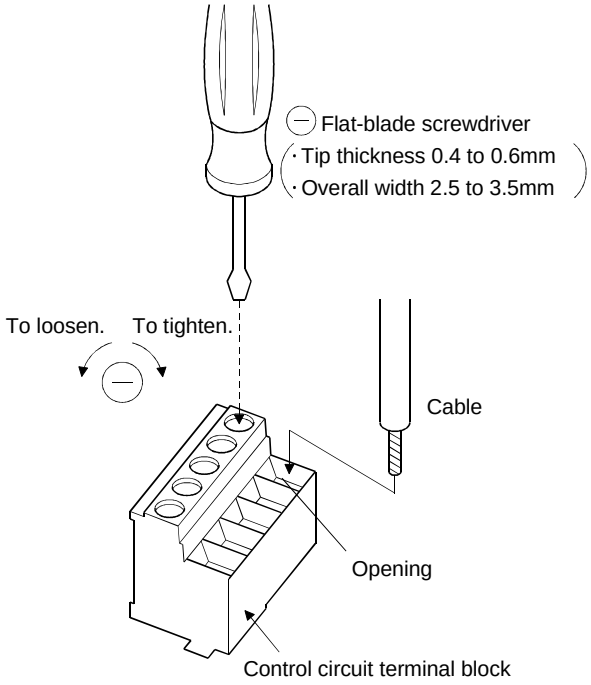
Bar terminal for 2 cable
(Twin ferrule with insulation sleeve)

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

(2) Connection

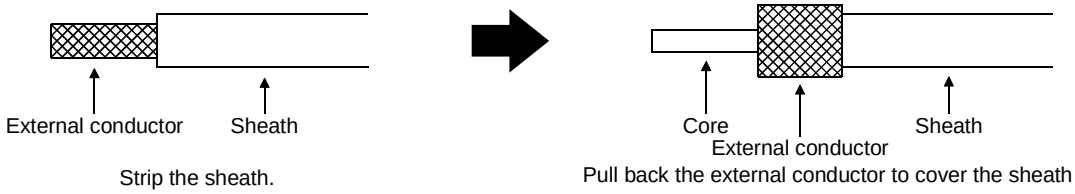
Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver so that the cable does not come off. (Tightening torque: 0.5 to 0.6N · m) Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose.

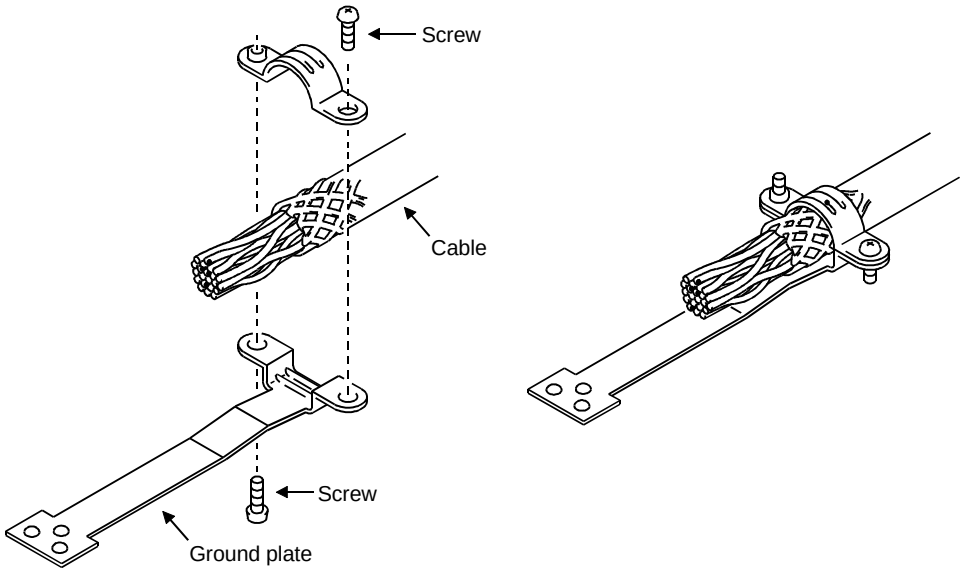
When using a cable of 1.5mm$^2$ or less, two cables may be inserted into one opening.




## 3.12 Instructions for the 3M connector

When fabricating an encoder cable or the like, 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.



# 4. OPERATION

## 4.1 When switching power on for the first time

Before starting operation, check the following:

(1) Wiring

(a) A correct power supply is connected to the power input terminals ($L_1$, $L_2$, $L_3$, $L_{11}$, $L_{21}$) of the servo amplifier.

(b) 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.

(c) The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals ($L_1$, $L_2$, $L_3$) of the servo motor.

(d) The servo amplifier and servo motor are grounded securely.

(e) Note the following when using the regenerative brake option, brake unit or power return converter:

1) For the MR-J2S-350A or less, the lead has been removed from across D-P of the control circuit terminal block, and twisted cables are used for its wiring.

2) For the MR-J2S-500A or more, the lead has been removed from across P-C of the servo amplifier built-in regenerative brake resistor, and twisted cables are used for its wiring.

(f) When stroke end limit switches are used, the signals across LSP-SG and LSN-SG are on during operation.

(g) 24VDC or higher voltages are not applied to the pins of connectors CN1A and CN1B.

(h) SD and SG of connectors CN1A and CN1B are not shorted.

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

(2) Environment

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

(3) Machine

(a) The screws in the servo motor installation part and shaft-to-machine connection are tight.

(b) The servo motor and the machine connected with the servo motor can be operated.

## 4.2 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.<br>・During power-on for some after power-off, do not touch or close a parts (cable etc.) to the servo amplifier heat sink, regenerative brake resistor, the servo motor, etc. Their temperatures may be high and you may get burnt or a parts may damaged. |

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

### 4.2.1 Selection of control mode

Use parameter No. 0 to choose the control mode used. After setting, this parameter is made valid by switching power off, then on.

### 4.2.2 Position control mode

(1) Power on

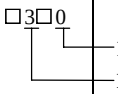
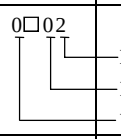
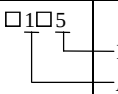
1) Switch off the servo-on (SON) signal.
2) When main circuit power/control circuit power is switched on, the display shows "C (Cumulative feedback pulses)", and in two second later, shows data.
   In the absolute position detection system, first power-on results in the absolute position lost (AL.25) alarm and the servo system cannot be switched on. This is not a failure and takes place due to the uncharged capacitor in the encoder.
   The alarm can be deactivated by keeping power on for a few minutes in the alarm status and 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 500r/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) Test operation 1

Using jog operation in the test operation mode, make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 6.5 for the setting method.

| Parameter No. | Name | Setting | Description |
|---|---|---|---|
| 0 | Control mode, regenerative brake option selection |  | Position control mode<br>MR-RB12 regenerative brake option is used. |
| 1 | Function selection 1 |  | Input filter 3.555ms (initial value)<br>Electromagnetic brake interlock signal is not used.<br>Used in incremental positioning system. |
| 2 | Auto tuning |  | Middle response (initial value) is selected.<br>Auto tuning mode 1 is selected. |
| 3 | Electronic gear numerator (CMX) | 2 | Electronic gear numerator |
| 4 | Electronic gear denominator (CDV) | 1 | Electronic gear denominator |

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

(4) Servo-on

Switch the servo-on in the following procedure:

1) Switch on main circuit/control power supply.

2) Switch on the servo-on signal (SON).

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

(5) Command pulse input

Entry of a pulse train from the positioning device rotates the servo motor. At first, run it at low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, command pulse frequency, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the program of the positioning device.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 2. (Refer to chapter 7)

(6) Home position return

Make home position return as required.

(7) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.9, (2) for the servo motor equipped with electromagnetic brake. Note that the stop pattern of stroke end (LSP/LSN) OFF is as described below.

(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.

| POINT |
| --- |
| ▪ A sudden stop indicates that a stop is made with the droop pulses erased. |

### 4.2.3 Speed control mode

(1) Power on

1) Switch off the servo-on (SON) signal.

2) 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) Test operation

Using jog operation in the test operation mode, make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 6.5 for the setting method.

| Parameter No. | Name | Setting | Description |
|---|---|---|---|
| 0 | Control mode, regenerative brake option selection | □0□2 | Speed control mode<br>Regenerative brake option is not used. |
| 1 | Function selection 1 | □□12 | Input filter 3.555ms (initial value)<br>Electromagnetic brake interlock signal is used. |
| 2 | Auto tuning | □1□5 | Middle response (initial value) is selected.<br>Auto tuning mode 1 is selected. |
| 8 | Internal speed command 1 | 1000 | Set 1000r/min. |
| 9 | Internal speed command 2 | 1500 | Set 1500r/min. |
| 10 | Internal speed command 3 | 2000 | Set 2000r/min. |
| 11 | Acceleration time constant | 1000 | Set 1000ms. |
| 12 | Deceleration time constant | 500 | Set 500ms. |
| 13 | S-pattern acceleration/deceleration time constant | 0 | Not used |

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

(4) Servo-on

Switch the servo-on in the following procedure:

1) Switch on main circuit/control power supply.

2) Switch on the servo-on signal (SON) (short SON-SG).
When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation start (ST1) to run the motor in the forward rotation (CCW) direction or reverse rotation start (ST2) to run it in the reverse rotation (CW) direction. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.
On the status display, check the speed, load factor, etc. of the servo motor.
When machine operation check is over, check automatic operation with the host controller or the like.
This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No. 2. (Refer to chapter 7)

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.9, (2) for the servo motor equipped with electromagnetic brake. Note that simultaneous ON or simultaneous OFF of stroke end (LSP, LSN) OFF and forward rotation start (ST1) or reverse rotation start (ST2) signal has the same stop pattern as described below.

(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) signals

The servo motor is decelerated to a stop.

| POINT |
|---|
| ▪ A sudden stop indicates that a stop is made at the deceleration time constant of zero. |

4.2.4 Torque control mode

(1) Power on

1) Switch off the servo-on (SON) signal.

2) 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) Test operation

Using jog operation in the test operation mode, make sure that the servo motor operates. (Refer to Section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to Chapter 5 for the parameter definitions and to Sections 6.5 for the setting method.

| Parameter No. | Name | Setting | Description |
|---|---|---|---|
| 0 | Control mode, regenerative brake option selection | □0□4 | Torque control mode<br>Regenerative brake option is not used. |
| 1 | Function selection 1 | □□02 | Input filter 3.555ms (initial value)<br>Electromagnetic brake interlock signal is not used. |
| 8 | Internal speed limit 1 | 1000 | Set 1000r/min. |
| 9 | Internal speed limit 2 | 1500 | Set 1500r/min. |
| 10 | Internal speed limit 3 | 2000 | Set 2000r/min. |
| 11 | Acceleration time constant | 1000 | Set 1000ms. |
| 12 | Deceleration time constant | 500 | Set 500ms. |
| 13 | S-pattern acceleration/deceleration time constant | 0 | Not used |
| 14 | Torque command time constant | 2000 | Set 2000ms |
| 28 | Internal torque limit 1 | 50 | Controlled to 50% output |

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

(4) Servo-on

Switch the servo-on in the following procedure:

1) Switch on main circuit/control power supply.

2) Switch on the servo-on signal (SON) (short SON-SG).

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

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation select (DI4) to run the motor in the forward rotation (CCW) direction or reverse rotation select (DI3) to run it in the reverse rotation (CW) direction, generating torque. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor:

Refer to Section 3.9, (2) 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) signals

The servo motor coasts.

| POINT |
| --- |
| ▪ A sudden stop indicates that a stop is made at the deceleration time constant of zero. |

## 4.3 Multidrop communication

You can use the RS-422 communication function (parameter No.16) to operate two or more servo amplifiers on the same bus. In this case, set station numbers to the servo amplifiers to recognize the servo amplifier to which the current data is being sent. Use parameter No. 15 to set the station numbers.

Always set one station number to one servo amplifier. Normal communication cannot be made if the same station number is set to two or more servo amplifiers.

For details, refer to Chapter 14.

# 5. PARAMETERS

> **CAUTION**
> - Never adjust or change the parameter values extremely as it will make operation instable.

## 5.1 Parameter list

### 5.1.1 Parameter write inhibit

> **POINT**
> - After setting the parameter No. 19 value, switch power off, then on to make that setting valid.

In the MR-J2S-A servo amplifier, its parameters are classified into the basic parameters (No. 0 to 19), expansion parameters 1 (No. 20 to 49) and expansion parameters 2 (No.50 to 84) according to their safety aspects and frequencies of use. In the factory setting condition, the customer can change the basic parameter values but cannot change the expansion parameter values. When fine adjustment, e.g. gain adjustment, is required, change the parameter No. 19 setting to make the expansion parameters write-enabled.
The following table indicates the parameters which are enabled for reference and write by the setting of parameter No. 19. Operation can be performed for the parameters marked ○.

| Parameter No. 19 setting | Operation | Basic parameters No. 0 to No. 19 | Expansion parameters 1 No. 20 to No. 49 | Expansion parameters 2 No. 50 to No. 84 |
|---|---|---|---|---|
| 0000 (initial value) | Reference | ○ | | |
| | Write | ○ | | |
| 000A | Reference | No. 19 only | | |
| | Write | No. 19 only | | |
| 000B | Reference | ○ | ○ | |
| | Write | ○ | | |
| 000C | Reference | ○ | ○ | |
| | Write | ○ | ○ | |
| 000E | Reference | ○ | ○ | ○ |
| | Write | ○ | ○ | ○ |
| 100B | Reference | ○ | | |
| | Write | No. 19 only | | |
| 100C | Reference | ○ | ○ | |
| | Write | No. 19 only | | |
| 100E | Reference | ○ | ○ | ○ |
| | Write | No. 19 only | | |

### 5.1.2 Lists

**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.

The symbols in the control mode column of the table indicate the following modes:
P : Position control mode
S : Speed control mode
T : Torque control mode

(1) Item list

| | No. | Symbol | Name | Control mode | Initial value | Unit | Customer setting |
|---|---|---|---|---|---|---|---|
| Basic parameters | 0 | *STY | Control mode ,regenerative brake option selection | P･S･T | 0000 | | |
| | 1 | *OP1 | Function selection 1 | P･S･T | 0002 | | |
| | 2 | ATU | Auto tuning | P･S | 0105 | | |
| | 3 | CMX | Electronic gear numerator | P | 1 | | |
| | 4 | CDV | Electronic gear denominator | P | 1 | | |
| | 5 | INP | In-position range | P | 100 | pulse | |
| | 6 | PG1 | Position loop gain 1 | P | 35 | rad/s | |
| | 7 | PST | Position command acceleration/deceleration time constant (Smoothing) | P | 3 | ms | |
| | 8 | SC1 | Internal speed command 1 | S | 100 | r/min | |
| | | | Internal speed limit 1 | T | 100 | r/min | |
| | 9 | SC2 | Internal speed command 2 | S | 500 | r/min | |
| | | | Internal speed limit 2 | T | 500 | r/min | |
| | 10 | SC3 | Internal speed command 3 | S | 1000 | r/min | |
| | | | Internal speed limit 3 | T | 1000 | r/min | |
| | 11 | STA | Acceleration time constant | S･T | 0 | ms | |
| | 12 | STB | Deceleration time constant | S･T | 0 | ms | |
| | 13 | STC | S-pattern acceleration/deceleration time constant | S･T | 0 | ms | |
| | 14 | TQC | Torque command time constant | T | 0 | ms | |
| | 15 | *SNO | Station number setting | P･S･T | 0 | station | |
| | 16 | *BPS | Serial communication function selection, alarm history clear | P･S･T | 0000 | | |
| | 17 | MOD | Analog monitor output | P･S･T | 0100 | | |
| | 18 | *DMD | Status display selection | P･S･T | 0000 | | |
| | 19 | *BLK | Parameter block | P･S･T | 0000 | | |

| | No. | Symbol | Name | Control mode | Initial value | Unit | Customer setting |
|---|---|---|---|---|---|---|---|
| Expansion parameters 1 | 20 | *OP2 | Function selection 2 | P･S | 0000 | | |
| | 21 | *OP3 | Function selection 3 (Command pulse selection) | P | 0000 | | |
| | 22 | *OP4 | Function selection 4 | P･S･T | 0000 | | |
| | 23 | FFC | Feed forward gain | P | 0 | % | |
| | 24 | ZSP | Zero speed | P･S･T | 50 | r/min | |
| | 25 | VCM | Analog speed command maximum speed | S | (Note1)0 | (r/min) | |
| | | | Analog speed limit maximum speed | T | (Note1)0 | (r/min) | |
| | 26 | TLC | Analog torque command maximum output | T | 100 | % | |
| | 27 | *ENR | Encoder output pulses | P･S･T | 4000 | pulse /rev | |
| | 28 | TL1 | Internal torque limit 1 | P･S･T | 100 | % | |
| | 29 | VCO | Analog speed command offset | S | (Note2) | mV | |
| | | | Analog speed limit offset | T | (Note2) | mV | |
| | 30 | TLO | Analog torque command offset | T | 0 | mV | |
| | | | Analog torque limit offset | S | 0 | mV | |
| | 31 | MO1 | Analog monitor 1 offset | P･S･T | 0 | mV | |
| | 32 | MO2 | Analog monitor 2 offset | P･S･T | 0 | mV | |
| | 33 | MBR | Electromagnetic brake sequence output | P･S･T | 100 | ms | |
| | 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment | P･S | 70 | 0.1 times | |
| | 35 | PG2 | Position loop gain 2 | P | 35 | rad/s | |
| | 36 | VG1 | Speed loop gain 1 | P･S | 177 | rad/s | |
| | 37 | VG2 | Speed loop gain 2 | P･S | 817 | rad/s | |
| | 38 | VIC | Speed integral compensation | P･S | 48 | ms | |
| | 39 | VDC | Speed differential compensation | P･S | 980 | | |
| | 40 | | For manufacturer setting | | 0 | | |
| | 41 | *DIA | Input signal automatic ON selection | P･S･T | 0000 | | |
| | 42 | *DI1 | Input signal selection 1 | P･S･T | 0003 | | |
| | 43 | *DI2 | Input signal selection 2 (CN1B-5) | P･S･T | 0111 | | |
| | 44 | *DI3 | Input signal selection 3 (CN1B-14) | P･S･T | 0222 | | |
| | 45 | *DI4 | Input signal selection 4 (CN1A-8) | P･S･T | 0665 | | |
| | 46 | *DI5 | Input signal selection 5 (CN1B-7) | P･S･T | 0770 | | |
| | 47 | *DI6 | Input signal selection 6 (CN1B-8) | P･S･T | 0883 | | |
| | 48 | *DI7 | Input signal selection 7 (CN1B-9) | P･S･T | 0994 | | |
| | 49 | *DO1 | Output signal selection 1 | P･S･T | 0000 | | |

For notes, refer to next page.

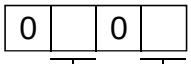
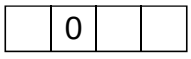
| | No. | Symbol | Name | Control mode | Initial value | Unit | Customer setting |
|---|---|---|---|---|---|---|---|
| Expansion parameters 2 | 50 | | For manufacturer setting | | 0000 | | |
| | 51 | *OP6 | Function selection 6 | P･S･T | 0000 | | |
| | 52 | | For manufacturer setting | | 0000 | | |
| | 53 | *OP8 | Function selection 8 | P･S･T | 0000 | | |
| | 54 | *OP9 | Function selection 9 | P･S･T | 0000 | | |
| | 55 | *OPA | Function selection A | P | 0000 | | |
| | 56 | SIC | Serial communication time-out selection | P･S･T | 0 | s | |
| | 57 | | For manufacturer setting | | 10 | | |
| | 58 | NH1 | Machine resonance suppression filter 1 | P･S･T | 0000 | | |
| | 59 | NH2 | Machine resonance suppression filter 2 | P･S･T | 0000 | | |
| | 60 | LPF | Low-pass filter, adaptive vibration suppression control | P･S･T | 0000 | | |
| | 61 | GD2B | Ratio of load inertia moment to Servo motor inertia moment 2 | P･S | 70 | 0.1 times | |
| | 62 | PG2B | Position control gain 2 changing ratio | P | 100 | % | |
| | 63 | VG2B | Speed control gain 2 changing ratio | P･S | 100 | % | |
| | 64 | VICB | Speed integral compensation changing ratio | P･S | 100 | % | |
| | 65 | *CDP | Gain changing selection | P･S | 0000 | | |
| | 66 | CDS | Gain changing condition | P･S | 10 | (Note3) | |
| | 67 | CDT | Gain changing time constant | P･S | 1 | ms | |
| | 68 | | For manufacturer setting | | 0 | | |
| | 69 | CMX2 | Command pulse multiplying factor numerator 2 | P | 1 | | |
| | 70 | CMX3 | Command pulse multiplying factor numerator 3 | P | 1 | | |
| | 71 | CMX4 | Command pulse multiplying factor numerator 4 | P | 1 | | |
| | 72 | SC4 | Internal speed command 4 | S | 200 | r/min | |
| | | | Internal speed limit 4 | T | | | |
| | 73 | SC5 | Internal speed command 5 | S | 300 | r/min | |
| | | | Internal speed limit 5 | T | | | |
| | 74 | SC6 | Internal speed command 6 | S | 500 | r/min | |
| | | | Internal speed limit 6 | T | | | |
| | 75 | SC7 | Internal speed command 7 | S | 800 | r/min | |
| | | | Internal speed limit 7 | T | | | |
| | 76 | TL2 | Internal torque limit 2 | P･S･T | 100 | % | |
| | 77 | | For manufacturer setting | | 100 | | |
| | 78 | | | | 10000 | | |
| | 79 | | | | 10 | | |
| | 80 | | | | 10 | | |
| | 81 | | | | 100 | | |
| | 82 | | | | 100 | | |
| | 83 | | | | 100 | | |
| | 84 | | | | 0 | | |

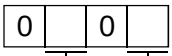
Note 1. The setting of "0" provides the rated servo motor speed.

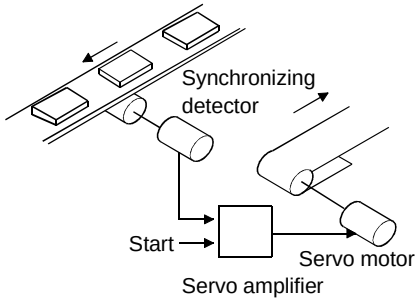
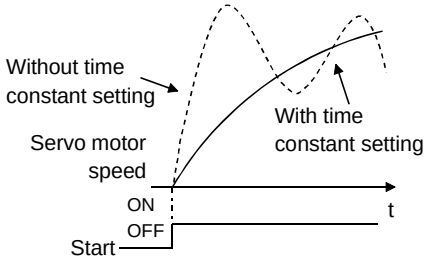
2. Depends on the servo amplifier.

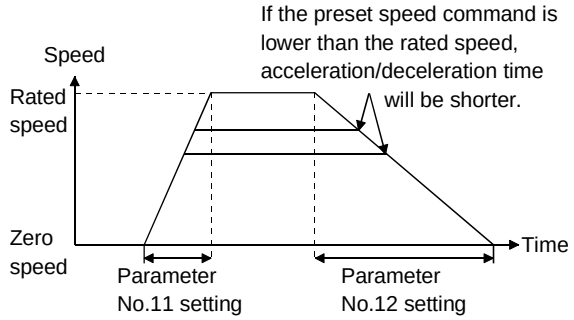
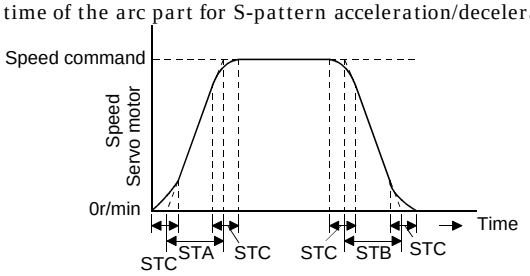
3. Depends on the parameter No. 65 setting.

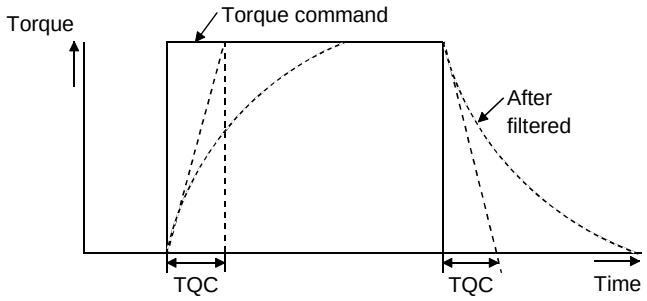
(2) Details list

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="2">Basic parameters</td><td>0</td><td>*STY</td><td>Control mode, regenerative brake option selection<br>Used to select the control mode and regenerative brake option.<br>  <br>Select the control mode.<br>0:Position<br>1:Position and speed<br>2:Speed<br>3:Speed and torque<br>4:Torque<br>5:Torque and position<br><br>Selection of regenerative brake option<br>0:Not used<br>1:FR-RC, FR-BU<br>2:MR-RB032<br>3:MR-RB12<br>4:MR-RB32<br>5:MR-RB30<br>6:MR-RB50<br>8:MR-RB31<br>9:MR-RB51<br><br>POINT<br>· Wrong setting may cause the regenerative brake option to burn.<br>· If the regenerative brake option selected is not for use with the servo amplifier, parameter error (AL.37) occurs.</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P·S·T</td></tr>
<tr><td>1</td><td>*OP1</td><td>Function selection 1<br>Used to select the input signal filter, pin CN1B-19 function and absolute position detection system.<br>  <br>Input signal filter<br>If external input signal causes chattering due to noise, etc., input filter is used to suppress it.<br>0:None<br>1:1.777[ms]<br>2:3.555[ms]<br>3:5.333[ms]<br>CN1B-pin 19's function selection<br>0:Zero Speed detection signal<br>1:Electromagnetic brake interlock signal<br>Selection of absolute position detection system<br>(Refer to Chapter 15)<br>0: Used in incremental system<br>1: Used in absolute position detection system</td><td>0002</td><td></td><td>Refer to Name and function column.</td><td>P·S·T</td></tr>
</table>

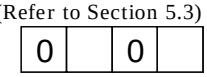
<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="4">Basic parameters</td><td>2</td><td>ATU</td><td>Auto tuning<br>Used to selection the response level, etc. for execution of auto tuning.<br>Refer to Chapter 7.<br>  <br><br>Auto tuning response level setting<br><table><tr><th>Set value</th><th>Response level</th><th>Machine resonance frequency guideline</th></tr><tr><td>1</td><td rowspan="16">Low response<br>↕<br>Middle response<br>↕<br>High response</td><td>15Hz</td></tr><tr><td>2</td><td>20Hz</td></tr><tr><td>3</td><td>25Hz</td></tr><tr><td>4</td><td>30Hz</td></tr><tr><td>5</td><td>35Hz</td></tr><tr><td>6</td><td>45Hz</td></tr><tr><td>7</td><td>55Hz</td></tr><tr><td>8</td><td>70Hz</td></tr><tr><td>9</td><td>85Hz</td></tr><tr><td>A</td><td>105Hz</td></tr><tr><td>B</td><td>130Hz</td></tr><tr><td>C</td><td>160Hz</td></tr><tr><td>D</td><td>200Hz</td></tr><tr><td>E</td><td>240Hz</td></tr><tr><td>F</td><td>300Hz</td></tr></table>· If the machine hunts or generates large gear sound, decrease the set value.<br>· To improve performance, e.g. shorten the settling time, increase the set value.<br>Gain adjustment mode selection<br>(For more information, refer to Section 7.1.1.)<br><table><tr><th>Set value</th><th>Gain adjustment mode</th><th>Description</th></tr><tr><td>0</td><td>Interpolation mode</td><td>Fixes position control gain 1 (parameter No. 6).</td></tr><tr><td>1</td><td>Auto tuning mode 1</td><td>Ordinary auto tuning.</td></tr><tr><td>2</td><td>Auto tuning mode 2</td><td>Fixes the load inertia moment ratio set in parameter No. 34. Response level setting can be changed.</td></tr><tr><td>3</td><td>Manual mode 1</td><td>Simple manual adjustment.</td></tr><tr><td>4</td><td>Manual mode 2</td><td>Manual adjustment of all gains.</td></tr></table></td><td>0105</td><td></td><td>Refer to Name and function column.</td><td>P·S</td></tr>
<tr><td>3</td><td>CMX</td><td>Electronic gear numerator<br>Used to set the electronic gear numerator value.<br>For the setting, refer to Section 5.2.1.<br>Setting "0" automatically sets the resolution of the servo motor connected.<br>For the HC-MFS series, 131072 pulses are set for example.</td><td>1</td><td></td><td>0<br>1<br>to<br>65535</td><td>P</td></tr>
<tr><td>4</td><td>CDV</td><td>Electronic gear denominator<br>Used to set the electronic gear denominator value.<br>For the setting, refer to Section 5.2.1.</td><td>1</td><td></td><td>1<br>to<br>65535</td><td>P</td></tr>
</table>

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Basic parameters | 5 | INP | In-position range<br>Used to set the in-position signal (INP) output range in the command pulse increments prior to electronic gear calculation.<br>For example, when you want to set ±10μm in the conditions that the ballscrew is direct coupled, the lead is 10mm, and the feedback pulses are 8192 pulses/rev (parameter No. 6 : 1), set "8" as indicated by the following expression:<br>$\frac{10 \times 10^{-6}}{10 \times 10^{-3}} \cdot 8192 = 8.192 \fallingdotseq 8$ | 100 | pulse | 0 to 10000 | P |
| | 6 | PG1 | Position loop gain 1<br>Used to set the gain of position loop.<br>Increase the gain to improve trackability in response to the position command.<br>When auto turning mode 1,2 is selected, the result of auto turning is automatically used. | 35 | red/s | 4 to 2000 | P |
| | 7 | PST | Position command acceleration/deceleration time constant (position smoothing)<br>Used to set the time constant of a low pass filter in response to the position command.<br>You can use parameter No. 55 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.<br>**POINT**<br>· When you have chosen linear acceleration/deceleration, do not select control selection (parameter No. 0) and restart after instantaneous power failure (parameter No. 20). Doing so will cause the servo motor to make a sudden stop at the time of position control switching or restart.<br>Example: When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation.<br>  <br>  | 3 | ms | 0 to 20000 | P |
| | 8 | SC1 | Internal speed command 1<br>Used to set speed 1 of internal speed commands. | 100 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 1<br>Used to set speed 1 of internal speed limits. | | | | T |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Basic parameters | 9 | SC2 | Internal speed command 2<br>Used to set speed 2 of internal speed commands. | 500 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 2<br>Used to set speed 2 of internal speed limits. | | | | T |
| | 10 | SC3 | Internal speed command 3<br>Used to set speed 3 of internal speed commands. | 1000 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 3<br>Used to set speed 3 of internal speed limits. | | | | T |
| | 11 | STA | Acceleration time constant<br>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.<br>  <br>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 20000 | S·T |
| | 12 | STB | Deceleration time constant<br>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 | | | |
| | 13 | STC | S-pattern acceleration/deceleration time constant<br>Used to smooth start/stop of the servo motor.<br>Set the time of the arc part for S-pattern acceleration/deceleration.<br>  <br>STA: Acceleration time constant (parameter No.11)<br>STB: Deceleration time constant (parameter No.12)<br>STC: S-pattern acceleration/deceleration time constant (parameter No.13)<br>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.<br>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.<br>(Example) At the setting of STA=20000, STB=5000 and STC=200, the actual arc part times are as follows:<br>During acceleration: 100[ms] $\left(\frac{2000000}{20000} = 100[ms] < 200[ms].\right.$ Limited to 100[ms] since<br>During deceleration: 200[ms] $\left(\frac{2000000}{5000} = 400[ms] > 200[ms].\right.$ 200[ms] as set since | 0 | ms | 0 to 1000 | S·T |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Basic parameters | 14 | TQC | Torque command time constant<br>Used to set the constant of a low pass filter in response to the torque command.<br>  <br><br>TQC: Torque command time constant | 0 | ms | 0 to 20000 | T |
| | 15 | *SNO | Station number setting<br>Used to specify the station number for serial communication.<br>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. | 0 | sta-tion | 0 to 31 | P･S･T |
| | 16 | *BPS | Serial communication function selection, alarm history clear<br>Used to select the serial communication baudrate, select various communication conditions, and clear the alarm history.<br>  <br>Serial baudrate selection<br>0: 9600 [bps]<br>1: 19200[bps]<br>2: 38400[bps]<br>3: 57600[bps]<br>Alarm history clear<br>0: Invalid<br>1: Valid<br>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).<br>Serial communication standard selection<br>0: RS-232C used<br>1: RS-485 used<br>Serial communication response delay time<br>0: Invalid<br>1: Valid, reply sent after delay time of 800μs or more | 0000 | | Refer to Name and function column. | P･S･T |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Basic parameters | 17 | MOD | Analog monitor output<br>Used to selection the signal provided to the analog monitor output.<br>(Refer to Section 5.3) | 0100 | | Refer to Name and function column. | P・S・T |



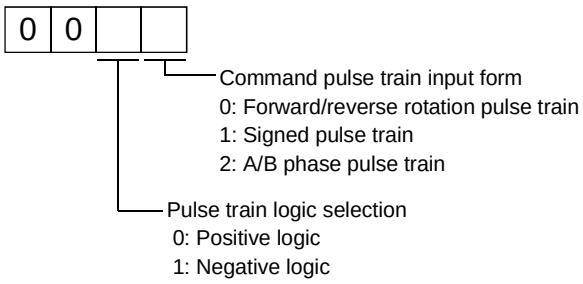
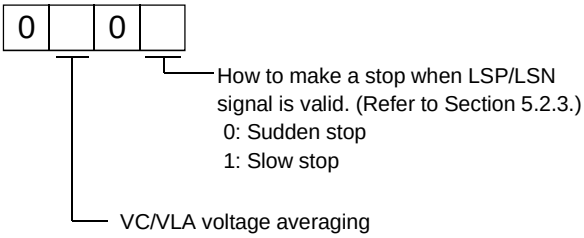

| Setting | Analog monitor output selection | |
|---|---|---|
| | ch2 | ch1 |
| 0 | Servo motor speed (±8V/max. speed) | |
| 1 | Torque (±8V/max. torque) | |
| 2 | Motor speed (+8V/max. speed) | |
| 3 | Torque (+8V/max. torque) | |
| 4 | Current command (±8V/max. current command) | |
| 5 | Command pulse frequency (±10V/500kpulse/s) | |
| 6 | Droop pulses (±10V/128 pulses) | |
| 7 | Droop pulses (±10V/2048 pulses) | |
| 8 | Droop pulses (±10V/8192 pulses) | |
| 9 | Droop pulses (±10V/32768 pulses) | |
| A | Droop pulses (±10V/131072 pulses) | |
| B | Bus voltage (+8V/400V) | |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Basic parameters | 18 | *DMD | Status display selection<br>Used to select the status display shown at power-on.<br>0 0 ☐ ☐<br>Selection of status display at power-on<br>0: Cumulative feedback pulses<br>1: Servo motor speed<br>2: Droop pulses<br>3: Cumulative command pulses<br>4: Command pulse frequency<br>5: Analog speed command voltage (Note 1)<br>6: Analog torque command voltage (Note 2)<br>7: Regenerative load ratio<br>8: Effective load ratio<br>9: Peak load ratio<br>A: Instantaneous torque<br>B: Within one-revolution position low<br>C: Within one-revolution position high<br>D: ABS counter<br>E: Load inertia moment ratio<br>F: Bus voltage<br>Note: 1. In speed control mode. Analog speed limit voltage in torque control mode.<br>2. In torque control mode. Analog torque limit voltage in speed or position control mode.<br>Status display at power-on in corresponding control mode<br>0: Depends on the control mode. | 0000 | | Refer to Name and function column. | P·S·T |

| 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 |

1: Depends on the first digit setting of this parameter.

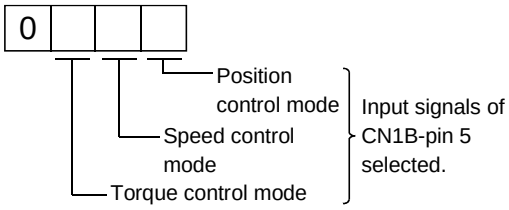
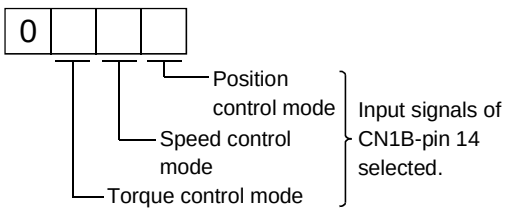
<table>
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<tr><td>Basic parameters</td><td>19</td><td>*BLK</td><td>Parameter block<br>Used to select the reference and write ranges of the parameters.<br>Operation can be performed for the parameters marked ○.
<table>
<tr><th>Set value</th><th>Operation</th><th>Basic parameters No. 0 to No. 19</th><th>Expansion parameters 1 No. 20 to No. 49</th><th>Expansion parameters 2 No. 50 to No. 84</th></tr>
<tr><td rowspan="2">0000 (Initial value)</td><td>Reference</td><td>○</td><td></td><td></td></tr>
<tr><td>Write</td><td>○</td><td></td><td></td></tr>
<tr><td rowspan="2">000A</td><td>Reference</td><td>No. 19 only</td><td></td><td></td></tr>
<tr><td>Write</td><td>No. 19 only</td><td></td><td></td></tr>
<tr><td rowspan="2">000B</td><td>Reference</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Write</td><td>○</td><td></td><td></td></tr>
<tr><td rowspan="2">000C</td><td>Reference</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Write</td><td>○</td><td>○</td><td></td></tr>
<tr><td rowspan="2">000E</td><td>Reference</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Write</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td rowspan="2">100B</td><td>Reference</td><td>○</td><td></td><td></td></tr>
<tr><td>Write</td><td>No. 19 only</td><td></td><td></td></tr>
<tr><td rowspan="2">100C</td><td>Reference</td><td>○</td><td>○</td><td></td></tr>
<tr><td>Write</td><td>No. 19 only</td><td></td><td></td></tr>
<tr><td rowspan="2">100E</td><td>Reference</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Write</td><td>No. 19 only</td><td></td><td></td></tr>
</table></td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
<tr><td>Expansion parameters 1</td><td>20</td><td>*OP2</td><td>Function selection 2<br>Used to select restart after instantaneous power failure, servo lock at a stop in speed control mode, and slight vibration suppression control.<br>0 | | | |<br>Restart after instantaneous power failure<br>If the input power supply voltage had reduced in the speed control mode to stop the servo motor due to the undervoltage alarm (AL.10) but the supply voltage has returned to normal, the servo motor can be restarted by merely switching on the start signal without resetting the alarm.<br>0: Invalid<br>1: Valid<br>Stop-time servo lock selection<br>The shaft can be servo-locked to remain still at a stop in the speed control mode.<br>0: Valid<br>1: Invalid<br>Slight vibration suppression control<br>Made valid when auto tuning selection is set to "0400" in parameter No. 2.<br>Used to suppress vibration at a stop.<br>0: Invalid<br>1: Valid</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>S<br>P</td></tr>
</table>

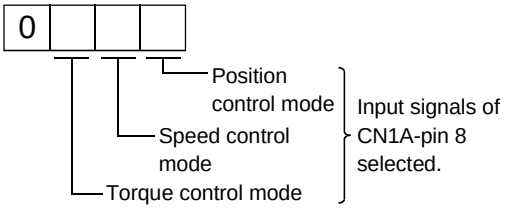
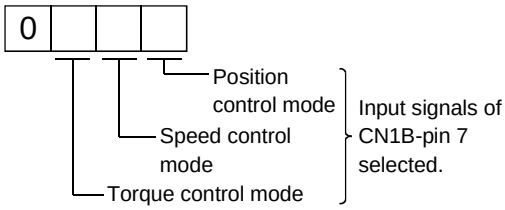
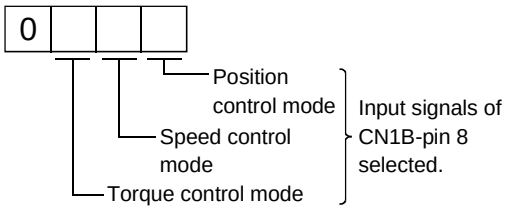
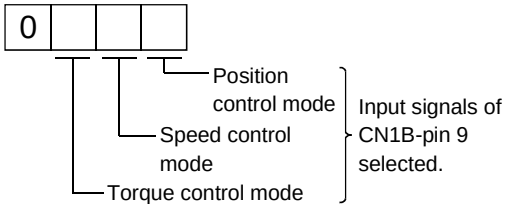
<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="2">Expansion parameters 1</td><td>21</td><td>*OP3</td><td>Function selection 3 (Command pulse selection)<br>Used to select the input form of the pulse train input signal. (Refer to Section 3.4.1.)<br>  <br></td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P</td></tr>
<tr><td>22</td><td>*OP4</td><td>Function selection 4<br>Used to select stop processing at LSP/LSN signal off and choose VC/VLA voltage averaging.<br>  <br><br><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></table></td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P·S<br>P·S·T</td></tr>
</table>

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 1 | 23 | FFC | Feed forward gain<br>Used to set the feed forward gain.<br>At the setting of 100%, droop pulses during constant-speed operation will be almost “zero”.<br>Note that sudden acceleration/deceleration will increase overshoot.<br>As a guideline, set 1s or more as the acceleration/deceleration time constant to the rated speed when the feed forward gain is set to 100%. | 0 | % | 0 to 100 | P |
| | 24 | ZSP | Zero speed<br>Used to set the output range of the zero speed signal (ZSP). | 50 | r/min | 0 to 10000 | P･S･T |
| | 25 | VCM | Analog speed command maximum speed<br>Used to set the speed at the maximum input voltage (10V) of the analog speed command (VC).<br>Set "0" to select the rated speed of the servo motor connected. | 0 | r/min | 0<br>1 to 50000 | S |
| | | | Analog speed limit maximum speed<br>Used to set the speed at the maximum input voltage (10V) of the analog speed limit (VLA).<br>Set "0" to select the rated speed of the servo motor connected. | 0 | r/min | 0<br>1 to 50000 | T |
| | 26 | TLC | Analog torque command maximum output<br>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. | 100 | % | 0 to 1000 | T |
| | 27 | *ENR | Encoder output pulses<br>Used to set the encoder pulses (A-phase, B-phase) output by the servo amplifier.<br>Set the value 4 times greater than the A-phase or B-phase pulses.<br>You can use parameter No. 54 to choose the output pulse setting or output division ratio setting.<br>The number of A/B-phase pulses actually output is 1/4 times greater than the preset number of pulses.<br>The maximum output frequency is 1.3Mpps (after multiplication by 4). Use this parameter within this range.<br>･ For output pulse designation<br>Set "0□□□" (initial value) in parameter No. 54.<br>Set the number of pulses per servo motor revolution.<br>Output pulse = set value [pulses/rev]<br>At the setting of 5600, for example, the actually output A/B-phase pulses are as indicated below:<br>A･B-phase output pulses = $\frac{5600}{4}$ = 1400[pulse]<br>･ For output division ratio setting<br>Set "1□□□" in parameter No. 54.<br>The number of pulses per servo motor revolution is divided by the set value.<br>Output pulse = $\frac{\text{Resolution per servo motor revolution}}{\text{Set value}}$ [pulses/rev]<br>At the setting of 8, for example, the actually output A/B-phase pulses are as indicated below:<br>A･B-phase output pulses = $\frac{131072}{8} \cdot \frac{1}{4}$ = 4096[pulse] | 4000 | pulse/rev | 1 to 65535 | P･S･T |
| | 28 | TL1 | Internal torque limit 1<br>Set this parameter to limit servo motor-generated torque on the assumption that the maximum torque is 100[%].<br>When 0 is set, torque is not produced.<br>(Note) TL: 0 — Internal torque limit 1 (Parameter No. 28)<br>(Note) TL: 1 — Analog torque limit < internal torque limit 1 : Analog torque limit<br>Analog torque limit > internal torque limit 1 : Internal torque limit 1<br>Note.0 :TL-SG off (open)<br>1 :TL-SG on(short)<br>When torque is output in analog monitor output, this set value is the maximum output voltage (+8V). (Refer to Section 3.4.1, (5)) | 100 | % | 0 to 100 | P･S･T |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 1 | 29 | VCO | Analog speed command offset<br>Used to set the offset voltage of the analog speed command (VC).<br>For example, if CCW rotation is provided by switching on forward rotation start (ST1) with 0V applied to VC, set a negative value.<br>When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to Section6.3.)<br>The initial value is the value provided by the automatic VC offset function before shipment at the VC-LG voltage of 0V. | Depends on servo amplifier | mV | −999 to 999 | S |
| | | | Analog speed limit offset<br>Used to set the offset voltage of the analog speed limit (VLA).<br>For example, if CCW rotation is provided by switching on forward rotation selection (RS1) with 0V applied to VLA, set a negative value.<br>When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to Section6.3.)<br>The initial value is the value provided by the automatic VC offset function before shipment at the VLA-LG voltage of 0V. | | | | T |
| | 30 | TLO | Analog torque command offset<br>Used to set the offset voltage of the analog torque command (TC). | 0 | mV | −999 to 999 | T |
| | | | Analog torque limit offset<br>Used to set the offset voltage of the analog torque limit (TLA). | | | | S |
| | 31 | MO1 | Analog monitor 1 offset<br>Used to set the offset voltage of the analog monitor ch1 output (MO1). | 0 | mV | −999 to 999 | P·S·T |
| | 32 | MO2 | Analog monitor 2 offset<br>Used to set the offset voltage of the analog monitor ch2 output (MO2). | 0 | mV | −999 to 999 | P·S·T |
| | 33 | MBR | Electromagnetic brake sequence output<br>Used to set the delay time (Tb) between electronic brake interlock signal (MBR) and the base drive circuit is shut-off. | 100 | ms | 0 to 1000 | P·S·T |
| | 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment<br>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.<br>(Refer to section 7.1.1)<br>In this case, it varies between 0 and 1000. | 70 | 0.1 times | 0 to 3000 | P·S |
| | 35 | PG2 | Position loop gain 2<br>Used to set the gain of the position loop.<br>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.<br>When auto tuning mode 1,2 and interpolation mode is selected, the result of auto tuning is automatically used. | 35 | rad/s | 1 to 1000 | P |
| | 36 | VG1 | Speed loop gain 1<br>Normally this parameter setting need not be changed.<br>Higher setting increases the response level but is liable to generate vibration and/or noise.<br>When auto tuning mode 1 · 2, manual mode and interpolation mode is selected, the result of auto tuning is automatically used. | 177 | rad/s | 20 to 8000 | P·S |
| | 37 | VG2 | Speed loop gain 2<br>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.<br>When auto tuning mode 1 · 2 and interpolation mode is selected, the result of auto tuning is automatically used. | 817 | rad/s | 20 to 20000 | P·S |
| | 38 | VIC | Speed integral compensation<br>Used to set the integral time constant of the speed loop.<br>Higher setting increases the response level but is liable to generate vibration and/or noise.<br>When auto tuning mode 1 · 2 and interpolation mode is selected, the result of auto tuning is automatically used. | 48 | ms | 1 to 1000 | P·S |

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="3">Expansion parameters 1</td><td>39</td><td>VDC</td><td>Speed differential compensation<br>Used to set the differential compensation.<br>Made valid when the proportion control signal is switched on.</td><td>980</td><td></td><td>0<br>to<br>1000</td><td>P·S</td></tr>
<tr><td>40</td><td></td><td>For manufacturer setting<br>Must not be changed.</td><td>0</td><td></td><td></td><td></td></tr>
<tr><td>41</td><td>*DIA</td><td>Input signal automatic ON selection<br>Used to set automatic ON of SON, LSP and LSN.<br>0 | | | |<br>Servo-on signal (SON) input selection<br>0: Switched on/off by external input.<br>1: Switched on automatically in servo amplifier.<br>(No need of external wiring)<br>Forward rotation stroke end signal (LSP) input selection<br>0: Switched on/off by external input.<br>1: Switched on automatically in servo amplifier.<br>(No need of external wiring)<br>Reverse rotation stroke end signal (LSN) input selection<br>0: Switched on/off by external input.<br>1: Switched on automatically in servo amplifier.<br>(No need of external wiring)</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P·S·T<br>P·S</td></tr>
<tr><td>42</td><td>*DI1</td><td>Input signal selection 1<br>Used to assign the control mode changing signal input pins and to set the clear signal.<br>0 | 0 | | |<br>Control change signal (LOP) input pin assignment<br>Used to set the control mode change signal input connector pins. Note that this parameter is made valid when parameter No. 0 is set to select the position/speed, speed/torque or torque/position change mode.<br><table><tr><th>Set value</th><th>Connector pin No.</th></tr><tr><td>0</td><td>CN1B-5</td></tr><tr><td>1</td><td>CN1B-14</td></tr><tr><td>2</td><td>CN1A-8</td></tr><tr><td>3</td><td>CN1B-7</td></tr><tr><td>4</td><td>CN1B-8</td></tr><tr><td>5</td><td>CN1B-9</td></tr></table><br>Clear signal (CR) selection<br>0: Droop pulses are cleared on the leading edge.<br>1: While on, droop pulses are always cleared.</td><td>0003</td><td></td><td>Refer to Name and function column.</td><td><br>P/S<br>S/T<br>T/P<br>P·S·T</td></tr>
</table>

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="2">Expansion parameters 1</td><td>43</td><td>*DI2</td><td>Input signal selection 2 (CN1B-5)<br>This parameter is unavailable when parameter No.42 is set to assign the control change signal (LOP) to CN1B-pin 5.<br>Allows any input signal to be assigned to CN1B-pin 5.<br>Note that the setting digit and assigned signal differ according to the control mode.<br>  <br><br>Signals that may be assigned in each control mode are indicated below by their symbols.<br>Setting of any other signal will be invalid.<br><table><tr><th rowspan="2">Set value</th><th colspan="3">(Note) Control mode</th></tr><tr><th>P</th><th>S</th><th>T</th></tr><tr><td>0</td><td></td><td></td><td></td></tr><tr><td>1</td><td>SON</td><td>SON</td><td>SON</td></tr><tr><td>2</td><td>RES</td><td>RES</td><td>RES</td></tr><tr><td>3</td><td>PC</td><td>PC</td><td></td></tr><tr><td>4</td><td>TL</td><td>TL</td><td></td></tr><tr><td>5</td><td>CR</td><td>CR</td><td>CR</td></tr><tr><td>6</td><td></td><td>SP1</td><td>SP1</td></tr><tr><td>7</td><td></td><td>SP2</td><td>SP2</td></tr><tr><td>8</td><td></td><td>ST1</td><td>RS2</td></tr><tr><td>9</td><td></td><td>ST2</td><td>RS1</td></tr><tr><td>A</td><td></td><td>SP3</td><td>SP3</td></tr><tr><td>B</td><td>CM1</td><td></td><td></td></tr><tr><td>C</td><td>CM2</td><td></td><td></td></tr><tr><td>D</td><td>TL1</td><td>TL1</td><td>TL1</td></tr><tr><td>E</td><td>CDP</td><td>CDP</td><td>CDP</td></tr></table>Note: P: Position control mode<br>S: Speed control mode<br>T: Torque control mode</td><td>0111</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
<tr><td>44</td><td>*DI3</td><td>Input signal selection 3 (CN1B-14)<br>Allows any input signal to be assigned to CN1B-pin 14.<br>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).<br>  <br><br>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 14.</td><td>0222</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
</table>

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 1 | 45 | *DI4 | Input signal selection 4 (CN1A-8)<br>Allows any input signal to be assigned to CN1A-pin 8.<br>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).<br>  <br>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1 A-pin 8. | 0665 | | Refer to Name and function column. | P•S•T |
| | 46 | *DI5 | Input signal selection 5 (CN1B-7)<br>Allows any input signal to be assigned to CN1B-pin 7.<br>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).<br>  <br>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1 B-pin 7. | 0770 | | Refer to Name and function column. | P•S•T |
| | 47 | *DI6 | Input signal selection 6 (CN1B-8)<br>Allows any input signal to be assigned to CN1B-pin 8.<br>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).<br>  <br>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 8.<br>When "Used in absolute position detection system" is selected in parameter No. 1, CN1B-pin 8 is in the ABS transfer mode (ABSM). (Refer to Section 15.5.) | 0883 | | Refer to Name and function column. | P•S•T |
| | 48 | *DI7 | Input signal selection 7 (CN1B-9)<br>Allows any input signal to be assigned to CN1B-pin 9.<br>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).<br>  <br>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 9.<br>When "Used in absolute position detection system" is selected in parameter No. 1, CN1B-pin 9 is in the ABS request mode (ABSR). (Refer to Section 15.5.) | 0994 | | Refer to Name and function column. | P•S•T |

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td>Expansion parameters 1</td><td>49</td><td>*DO1</td><td>
Output signal selection 1<br>
Used to select the connector pins to output the alarm code, warning (WNG) and battery warning (BWNG).<br>
0 | | | |<br>
Setting of alarm code output
<table>
<tr><th rowspan="2">Set value</th><th colspan="3">Connector pins</th></tr>
<tr><th>CN1B-19</th><th>CN1A-18</th><th>CN1A-19</th></tr>
<tr><td>0</td><td>ZSP</td><td>INP or SA</td><td>RD</td></tr>
<tr><td>1</td><td colspan="3">Alarm code is output at alarm occurrence.</td></tr>
</table>
<table>
<tr><th colspan="3">(Note) Alarm code</th><th rowspan="2">Alarm display</th><th rowspan="2">Name</th></tr>
<tr><th>CN1B pin 19</th><th>CN1A pin 18</th><th>CN1A pin 19</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 2</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 time-out error</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="4">0</td><td rowspan="4">1</td><td rowspan="4">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.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</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 error</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>Motor 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:Pin-SG off (open)<br>
1:Pin-SG on (short)<br>
Setting of warning (WNG) output<br>
Select the connector pin to output warning.<br>
The old signal before selection will be unavailable.
<table>
<tr><th>Set value</th><th>Connector pin No.</th></tr>
<tr><td>0</td><td>Not output.</td></tr>
<tr><td>1</td><td>CN1A-19</td></tr>
<tr><td>2</td><td>CN1B-18</td></tr>
<tr><td>3</td><td>CN1A-18</td></tr>
<tr><td>4</td><td>CN1B-19</td></tr>
<tr><td>5</td><td>CN1B-6</td></tr>
</table>
Setting of battery warning (BWNG) output<br>
Select the connector pin to output battery warning.<br>
The old signal before selection will be unavailable.<br>
Set this function as in the second digit of this parameter.<br>
Parameter No. 1 setting has priority.
</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
</table>

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="6">Expansion parameters 2</td><td>50</td><td></td><td>For manufacturer setting<br>Must not be changed.</td><td>0000</td><td></td><td></td><td></td></tr>
<tr><td>51</td><td>*OP6</td><td>Function selection 6<br>Used to select the operation to be performed when the alarm reset signal switches on.<br>0 _ 0 0<br>Operation to be performed when the alarm reset signal switches on<br>0: Base circuit not switched off<br>1: Base circuit switched off</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
<tr><td>52</td><td></td><td>For manufacturer setting<br>Must not be changed.</td><td>0000</td><td></td><td></td><td></td></tr>
<tr><td>53</td><td>*OP8</td><td>Function selection 8<br>Used to select the protocol of serial communication.<br>0 _ _ 0<br>Protocol checksum selection<br>0: Yes (checksum added)<br>1: No (checksum not added)<br>Protocol checksum selection<br>0: With station numbers<br>1: No station numbers</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
<tr><td>54</td><td>*OP9</td><td>Function selection 9<br>Use to select the command pulse rotation direction, encoder output pulse direction and encoder pulse output setting.<br>_ _ 0 _<br>Servo motor rotation direction changing<br>Changes the servo motor rotation direction for the input pulse train.<br><table><tr><th rowspan="2">Set value</th><th colspan="2">Servo motor rotation direction</th></tr><tr><th>At forward rotation pulse input (Note)</th><th>At reverse rotation pulse input (Note)</th></tr><tr><td>0</td><td>CCW</td><td>CW</td></tr><tr><td>1</td><td>CW</td><td>CCW</td></tr></table>Note. Refer to Section 3.4.1, (1), (a).<br>Encoder pulse output phase changing<br>Changes the phases of A, B-phase encoder pulses output .<br><table><tr><th rowspan="2">Set value</th><th colspan="2">Servo motor rotation direction</th></tr><tr><th>CCW</th><th>CW</th></tr><tr><td>0</td><td>A phase<br>B phase</td><td>A phase<br>B phase</td></tr><tr><td>1</td><td>A phase<br>B phase</td><td>A phase<br>B phase</td></tr></table>Encoder output pulse setting selection (refer to parameter No. 27)<br>0: Output pulse setting<br>1: Division ratio setting</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P･S･T</td></tr>
</table>

<table>
<tr><th>Class</th><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Unit</th><th>Setting range</th><th>Control mode</th></tr>
<tr><td rowspan="5">Expansion parameters 2</td><td>55</td><td>*OPA</td><td>Function selection A<br>Used to select the position command acceleration/deceleration time constant (parameter No. 7) control system.<br>0 0 _ 0<br>Position command acceleration/deceleration time constant control<br>0: Primary delay<br>1: Linear acceleration/deceleration</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P</td></tr>
<tr><td>56</td><td>SIC</td><td>Serial communication time-out selection<br>Used to set the communication protocol time-out period in [s].<br>When you set "0", time-out check is not made.</td><td>0</td><td>s</td><td>0<br>1 to 60</td><td>P·S·T</td></tr>
<tr><td>57</td><td></td><td>For manufacturer setting<br>Must not be changed.</td><td>10</td><td></td><td></td><td></td></tr>
<tr><td>58</td><td>NH1</td><td>Machine resonance suppression filter 1<br>Used to selection the machine resonance suppression filter.<br>(Refer to Section 8.1.)<br>0 _ _ _<br>Notch frequency selection<br>Set "00" when you have set adaptive vibration suppression control to be "valid" or "held" (parameter No. 60: □1□□ or □2□□).
<table>
<tr><th>Setting value</th><th>Frequency</th><th>Setting value</th><th>Frequency</th><th>Setting value</th><th>Frequency</th><th>Setting value</th><th>Frequency</th></tr>
<tr><td>00</td><td>Invalid</td><td>08</td><td>562.5</td><td>10</td><td>281.3</td><td>18</td><td>187.5</td></tr>
<tr><td>01</td><td>4500</td><td>09</td><td>500</td><td>11</td><td>264.7</td><td>19</td><td>180</td></tr>
<tr><td>02</td><td>2250</td><td>0A</td><td>450</td><td>12</td><td>250</td><td>1A</td><td>173.1</td></tr>
<tr><td>03</td><td>1500</td><td>0B</td><td>409.1</td><td>13</td><td>236.8</td><td>1B</td><td>166.7</td></tr>
<tr><td>04</td><td>1125</td><td>0C</td><td>375</td><td>14</td><td>225</td><td>1C</td><td>160.1</td></tr>
<tr><td>05</td><td>900</td><td>0D</td><td>346.2</td><td>15</td><td>214.3</td><td>1D</td><td>155.2</td></tr>
<tr><td>06</td><td>750</td><td>0E</td><td>321.4</td><td>16</td><td>204.5</td><td>1E</td><td>150</td></tr>
<tr><td>07</td><td>642.9</td><td>0F</td><td>300</td><td>17</td><td>195.7</td><td>1F</td><td>145.2</td></tr>
</table>
Notch depth selection
<table>
<tr><th>Setting value</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td rowspan="4">Deep<br>to<br>Shallow</td><td>−40dB</td></tr>
<tr><td>1</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>−4dB</td></tr>
</table></td><td></td><td>Refer to Name and function column.</td><td>P·S·T</td></tr>
<tr><td>59</td><td>NH2</td><td>Machine resonance suppression filter 2<br>Used to set the machine resonance suppression filter.<br>0 _ _ _<br>Notch frequency<br>Same setting as in parameter No. 58<br>However, you need not set "00" if you have set adaptive vibration suppression control to be "valid" or "held".<br>Notch depth<br>Same setting as in parameter No. 58</td><td>0000</td><td></td><td>Refer to Name and function column.</td><td>P·S·T</td></tr>
</table>

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 2 | 60 | LPF | Low-pass filter/adaptive vibration suppression control<br>Used to selection the low-pass filter and adaptive vibration suppression control. (Refer to Chapter 8.)<br>  <br>Low-pass filter selection<br>0: Valid (Automatic adjustment)<br>1: Invalid<br>When you choose "valid", $\frac{\text{VG2 setting}\times 10}{2\pi(1+\text{GD2 setting}\times 0.1)}$ [Hz] bandwidth filter is set automatically.<br>Adaptive vibration suppression control selection<br>Choosing "valid" or "held" in adaptive vibration suppression control selection makes the machine resonance control filter 1 (parameter No. 58) invalid.<br>0: Invalid<br>1: Valid<br>Machine resonance frequency is always detected and the filter is generated in response to resonance to suppress machine vibration.<br>2: Held<br>The characteristics of the filter generated so far are held, and detection of machine resonance is stopped.<br>Adaptive vibration suppression control sensitivity selection<br>Used to set the sensitivity of machine resonance detection.<br>0: Normal<br>1: Large sensitivity | 0000 | | Refer to Name and function column. | P･S･T |
| | 61 | GD2B | Ratio of load inertia moment to servo motor inertia moment 2<br>Used to set the ratio of load inertia moment to servo motor inertia moment when gain changing is valid. | 70 | ×0.1 times | 0 to 3000 | P･S |
| | 62 | PG2B | Position control gain 2 changing ratio<br>Used to set the ratio of changing the position control gain 2 when gain changing is valid.<br>Made valid when auto tuning is invalid. | 100 | % | 10 to 200 | P |
| | 63 | VG2B | Speed control gain 2 changing ratio<br>Used to set the ratio of changing the speed control gain 2 when gain changing is valid.<br>Made valid when auto tuning is invalid. | 100 | % | 10 to 200 | P･S |
| | 64 | VICB | Speed integral compensation changing ratio<br>Used to set the ratio of changing the speed integral compensation when gain changing is valid. Made valid when auto tuning is invalid. | 100 | % | 50 to 1000 | P･S |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 2 | 65 | *CDP | Gain changing selection<br>Used to select the gain changing condition. (Refer to Section 8.3.)<br>0 0 0 [ ]<br>Gain changing selection<br>Gains are changed in accordance with the settings of parameters No. 61 to 64 under any of the following conditions:<br>0: Invalid<br>1: Gain changing (CDP) signal is ON<br>2: Command frequency is equal to higher than parameter No. 66 setting<br>3: Droop pulse value is equal to higher than parameter No. 66 setting<br>4: Servo motor speed is equal to higher than parameter No. 66 setting | 0000 | | Refer to Name and function column. | P•S |
| | 66 | CDS | Gain changing condition<br>Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No. 65.The set value unit changes with the changing condition item. (Refer to Section 8.3.) | 10 | kpps<br>pulse<br>r/min | 10<br>to<br>9999 | P•S |
| | 67 | CDT | Gain changing time constant<br>Used to set the time constant at which the gains will change in response to the conditions set in parameters No. 65 and 66.<br>(Refer to Section 8.3.) | 1 | ms | 0<br>to<br>100 | P•S |
| | 68 | | For manufacturer setting<br>Must not be changed. | 0 | | | |
| | 69 | CMX2 | Command pulse multiplying factor numerator 2<br>Used to set the multiplier for the command pulse.<br>Setting "0" automatically sets the connected motor resolution. | 1 | | 0•1<br>to<br>65535 | P |
| | 70 | CMX3 | Command pulse multiplying factor numerator 3<br>Used to set the multiplier for the command pulse.<br>Setting "0" automatically sets the connected motor resolution. | 1 | | 0•1<br>to<br>65535 | P |
| | 71 | CMX4 | Command pulse multiplying factor numerator 4<br>Used to set the multiplier for the command pulse.<br>Setting "0" automatically sets the connected motor resolution. | 1 | | 0•1<br>to<br>65535 | P |
| | 72 | SC4 | Internal speed command 4<br>Used to set speed 4 of internal speed commands. | 200 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 4<br>Used to set speed 4 of internal speed limits. | | | | T |

| Class | No. | Symbol | Name and function | Initial value | Unit | Setting range | Control mode |
|---|---|---|---|---|---|---|---|
| Expansion parameters 2 | 73 | SC5 | Internal speed command 5<br>Used to set speed 5 of internal speed commands. | 300 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 5<br>Used to set speed 5 of internal speed limits. | | | | T |
| | 74 | SC6 | Internal speed command 6<br>Used to set speed 6 of internal speed commands. | 500 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 6<br>Used to set speed 6 of internal speed limits. | | | | T |
| | 75 | SC7 | Internal speed command 7<br>Used to set speed 7 of internal speed commands. | 800 | r/min | 0 to instantaneous permissible speed | S |
| | | | Internal speed limit 7<br>Used to set speed 7 of internal speed limits. | | | | T |
| | 76 | TL2 | Internal torque limit 2<br>Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%].<br>When 0 is set, torque is not produced.<br>When torque is output in analog monitor output, this set value is the maximum output voltage (+8V). (Refer to Section 3.4.1, (5)) | 100 | % | 0 to 100 | P·S·T |
| | 77 | | For manufacturer setting<br>Must not be changed. | 00 | | | |
| | 78 | | | 10000 | | | |
| | 79 | | | 10 | | | |
| | 80 | | | 10 | | | |
| | 81 | | | 100 | | | |
| | 82 | | | 100 | | | |
| | 83 | | | 100 | | | |
| | 84 | | | 0 | | | |

## 5.2 Detailed description

### 5.2.1 Electronic gear

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

**POINT**

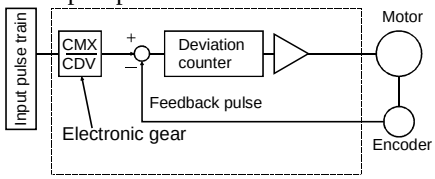
▪ The guideline of the electronic gear setting range is $\frac{1}{50} < \frac{CMX}{CDV} < 500$.
If the set value is outside this range, noise may be generated during acceleration/ deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.

▪ 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.

$$\frac{CMX}{CDV} = \frac{\text{Parameter No.3}}{\text{Parameter No.4}}$$




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

**POINT**

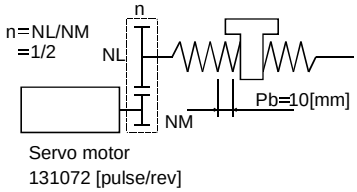
▪ The following specification symbols are required to calculate the electronic gear

Pb : Ballscrew lead [mm]
n : Reduction ratio
Pt : Servo motor resolution [pulses/rev]
$\Delta\ell_0$: Travel per command pulse [mm/pulse]
$\Delta S$ : Travel per servo motor revolution [mm/rev]
$\Delta\theta°$ : 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 = 131072 [pulses/rev]




$$\frac{CMX}{CDV} = \Delta\ell_0 \cdot \frac{Pt}{\Delta S} = \Delta\ell_0 \cdot \frac{Pt}{n \cdot Pb} = 10 \times 10^{-3} \cdot \frac{131072}{1/2 \cdot 10} = \frac{262144}{1000} = \frac{32768}{125}$$

Hence, set 32768 to CMX and 125 to CDV.

(b) Conveyor setting example

For rotation in increments of 0.01° per pulse

Machine specifications

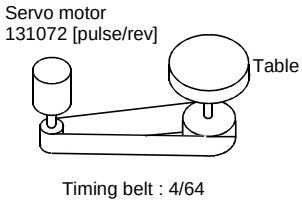



Table : 360°/rev
Reduction ratio: n = 4/64
Servo motor resolution: Pt = 131072 [pulses/rev]

$$\frac{CMX}{CDV} = \Delta\theta^\circ \cdot \frac{Pt}{\Delta\theta} = 0.01 \cdot \frac{131072}{4/64 \cdot 360} = \frac{65536}{1125} \quad \text{.....(5.2)}$$

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.

$$\frac{CMX}{CDV} = \frac{65536}{1125} = \frac{26214.4}{450} \cong \frac{26214}{450}$$

Hence, set 26214 to CMX and 450 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:
>
> $$36000 \cdot \frac{26214}{450} \cdot \frac{1}{131072} \cdot \frac{4}{64} \cdot 360^\circ = 359.995^\circ$$
>
> 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.

$$\frac{CMX}{CDV} = \frac{65536}{1125} = 58.25422 \quad \text{.....(5.2)}$$

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

$$\frac{CMX}{CDV} = \frac{65536}{1125} = \frac{32768}{562.5} \cong \frac{32768}{563} = 58.20249 \quad \text{.....(5.3)}$$

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

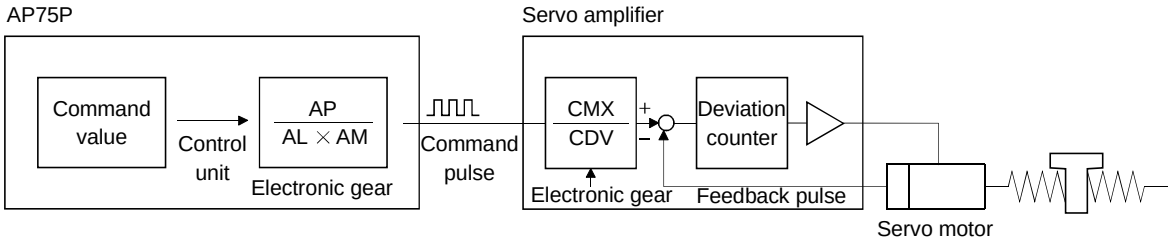
$$\frac{CMX}{CDV} = \frac{65536}{1125} = \frac{26214.4}{450} \cong \frac{26214}{450} = 58.25333 \quad \text{.....(5.4)}$$

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=26214, CDV=450.

(3) Setting for use of AD75P

The AD75P 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 400kpulse/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 131072 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 | 131072×2000/60=4369066 pulse/s |
| 3000 | 131072×3000/60=6553600 pulse/s |

For the AD75P, the maximum value of the pulse command that may be output is 200kpulse/s in the open collector system or 400kpulse/s in the differential line driver system. Hence, either of the servo motor speeds exceeds the maximum output pulse command of the AD75P.
Use the electronic gear of the servo amplifier to run the servo motor under the maximum output pulse command of the AD75P.

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]

$$200 \cdot \frac{CMX}{CDV} = \frac{3000}{60} \cdot 131072$$

$$\frac{CMX}{CDV} = \frac{3000}{60} \cdot \frac{131072}{200} = \frac{3000 \cdot 131072}{60 \cdot 200000} = \frac{4096}{125}$$

The following table indicates the electronic gear setting example (ballscrew lead = 10mm) when the AD75P 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 [kpulse/s] | | | 200 | 500 | 200 | 500 |
| | Feedback pulse/revolution [pulse/rev] | | | 131072 | | 131072 | |
| | Electronic gear (CMX/CDV) | | | 4096/125 | 2048/125 | 8192/375 | 4096/375 |
| AD75P | Command pulse frequency [kpulse/s] (Note) | | | 200 | 400 | 200 | 400 |
| | Number of pulses per servo motor revolution as viewed from AD75P[pulse/rev] | | | 4000 | 10000 | 6000 | 15000 |
| | 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 | 10000 | 6000 | 15000 |
| | | | AL | 1000 | 1000 | 1000 | 1000 |
| | | | AM | 10 | 10 | 10 | 10 |

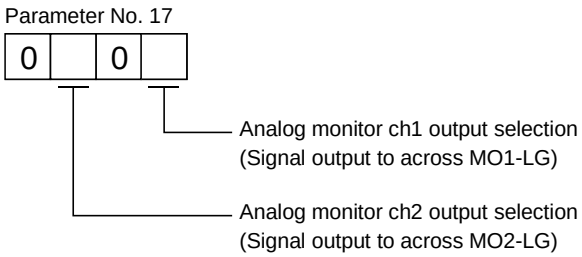
Note: Command pulse frequency at rated speed

### 5.2.2 Analog output

The servo status can be output to two channels in terms of voltage. Use this function when using an ammeter to monitor the servo status or synchronizing the torque/speed with the other servo.

(1) Setting

Change the following digits of parameter No.17:



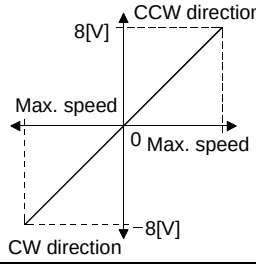
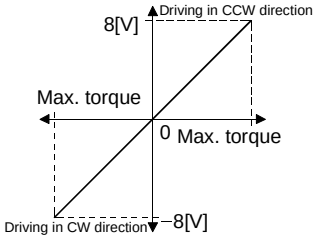
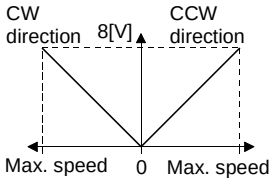
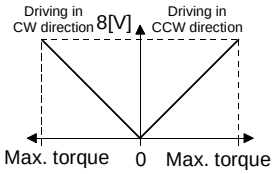
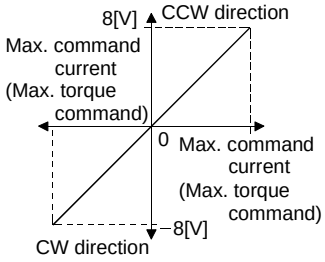
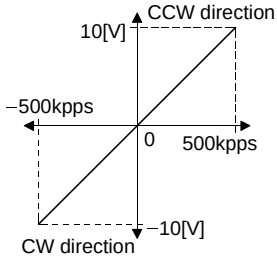

Parameters No.31 and 32 can be used to set the offset voltages to the analog output voltages. The setting range is between −999 and 999mV.

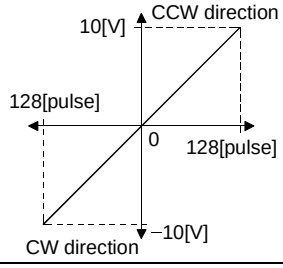
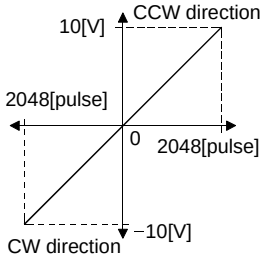
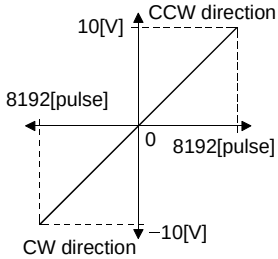
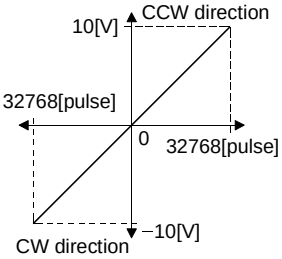
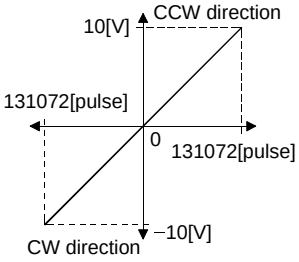
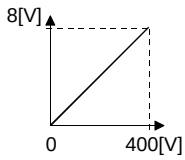
| Parameter No. | Description | Setting range [mV] |
|---|---|---|
| 31 | Used to set the offset voltage for the analog monitor ch1 output. | −999 to 999 |
| 32 | Used to set the offset voltage for the analog monitor ch2 output. | |

(2) Set content

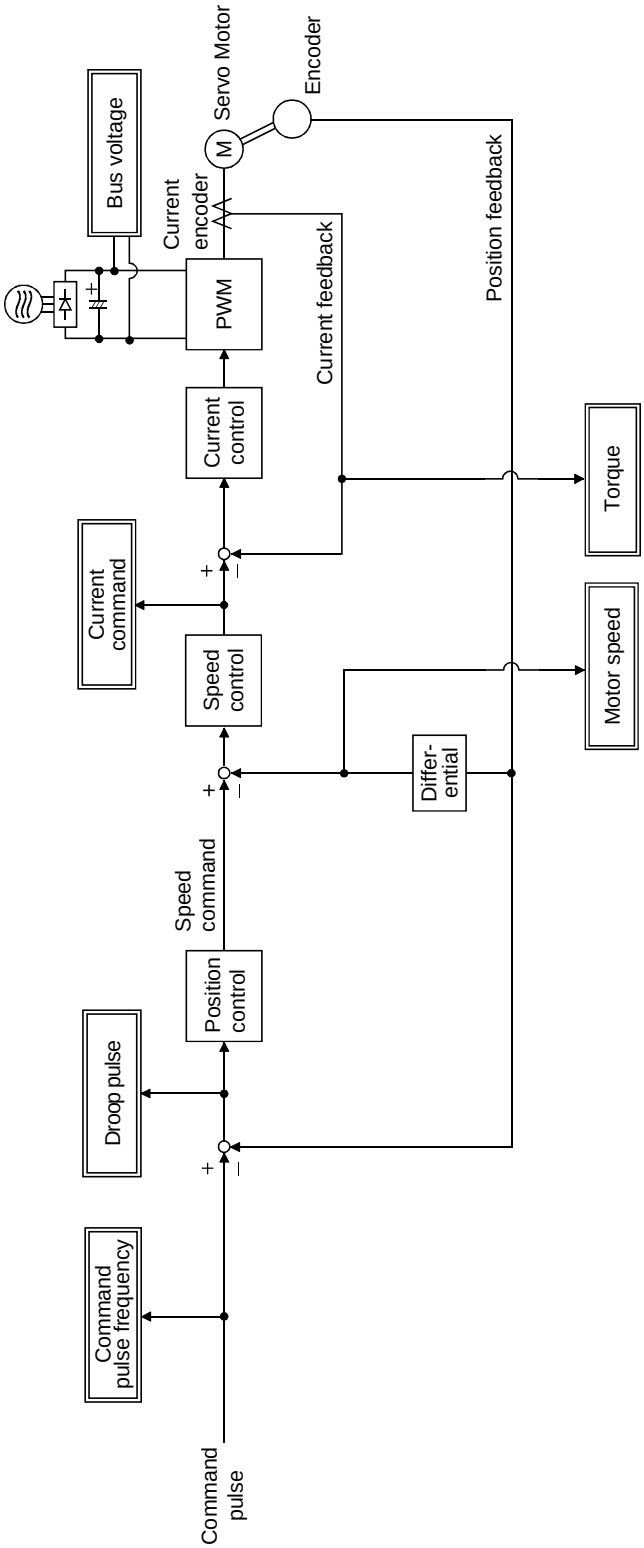
The servo amplifier is factory-set to output the motor speed to ch1 and the torque to ch2. The setting can be changed as listed below by changing the parameter No.17 value:

Refer to Appendix 2 for the measurement point.

| Setting | Output item | Description |
|---|---|---|
| 0 | Motor speed |  |
| 1 | Torque |  |
| 2 | Motor speed |  |
| 3 | Torque |  |
| 4 | Current command (Torque command) |  |
| 5 | Command pulse frequency |  |

| Setting | Output item | Description |
|---|---|---|
| 6 | Droop pulses (±10V/128pulse) |  |
| 7 | Droop pulses (±10V/2048pulse) |  |
| 8 | Droop pulses (±10V/8192pulse) |  |
| 9 | Droop pulses (±10V/32768pulse) |  |
| A | Droop pulses (±10V/131072pulse) |  |
| B | Bus voltage |  |

(3) Analog monitor block diagram



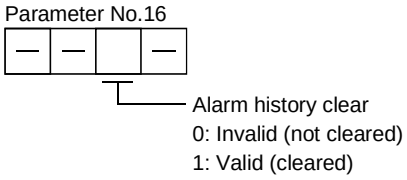
### 5.2.3 Using forward/reverse rotation stroke end to change the stopping pattern

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. 22 value.

| Parameter No.22 Setting | Stopping method |
|---|---|
| □□□0<br>(initial value) | Sudden stop<br>Position control mode : Motor stops with droop pulses cleared.<br>Speed control mode : Motor stops at deceleration time constant of zero. |
| □□□1 | Slow stop<br>Position control mode : The motor is decelerated to a stop in accordance with the parameter No. 7 value.<br>Speed control mode : The motor is decelerated to a stop in accordance with the parameter No. 12 value. |

### 5.2.4 Alarm history clear

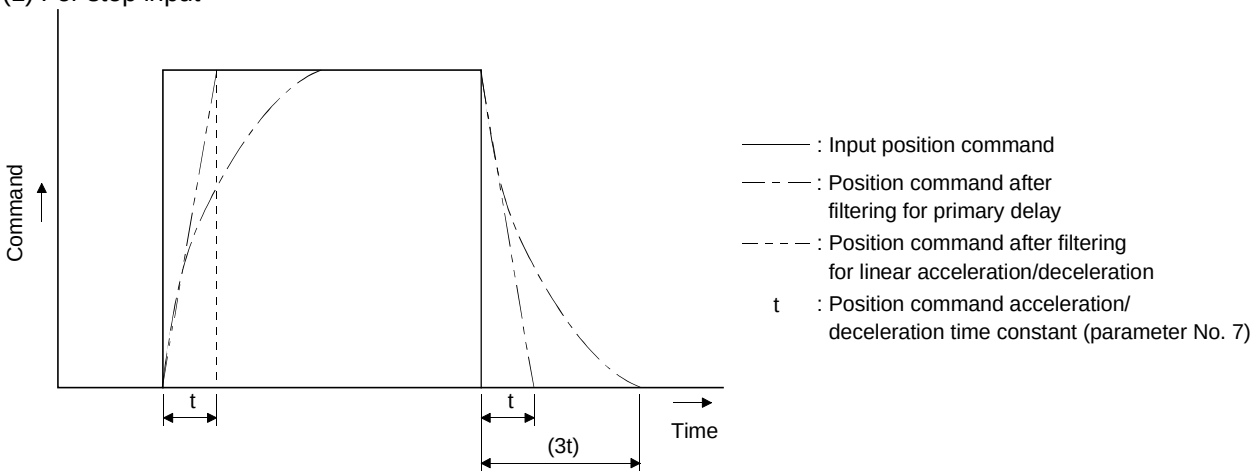
The servo amplifier stores one current alarm and five past alarms from when its power is switched on first. To control alarms which will occur during operation, clear the alarm history using parameter No.16 before starting operation.
Clearing the alarm history automatically returns to "□□0□".
After setting, this parameter is made valid by switch power from OFF to ON.



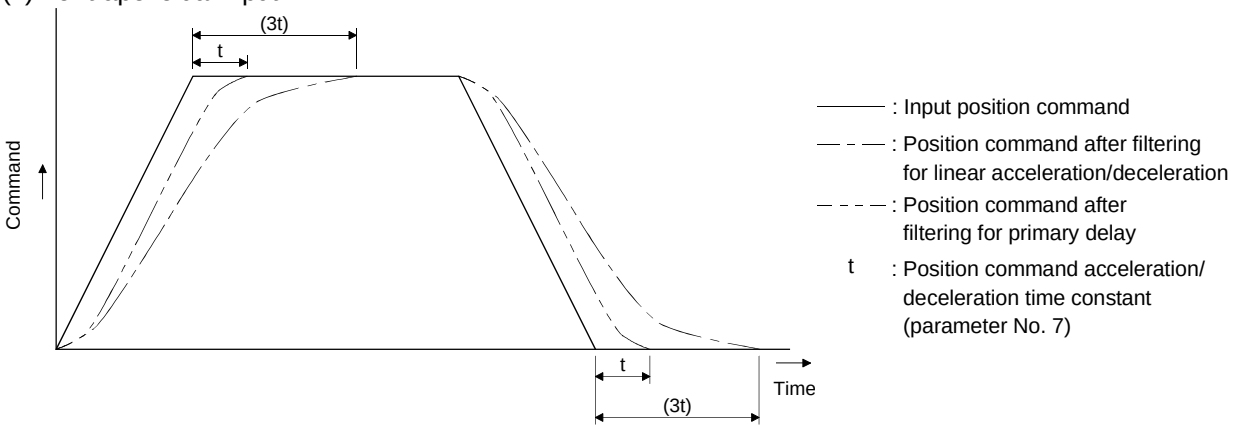
### 5.2.5 Position smoothing

By setting the position command acceleration/deceleration time constant (parameter No.7), 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. 55 according to the machine used.

(1) For step input




(2) For trapezoidal input



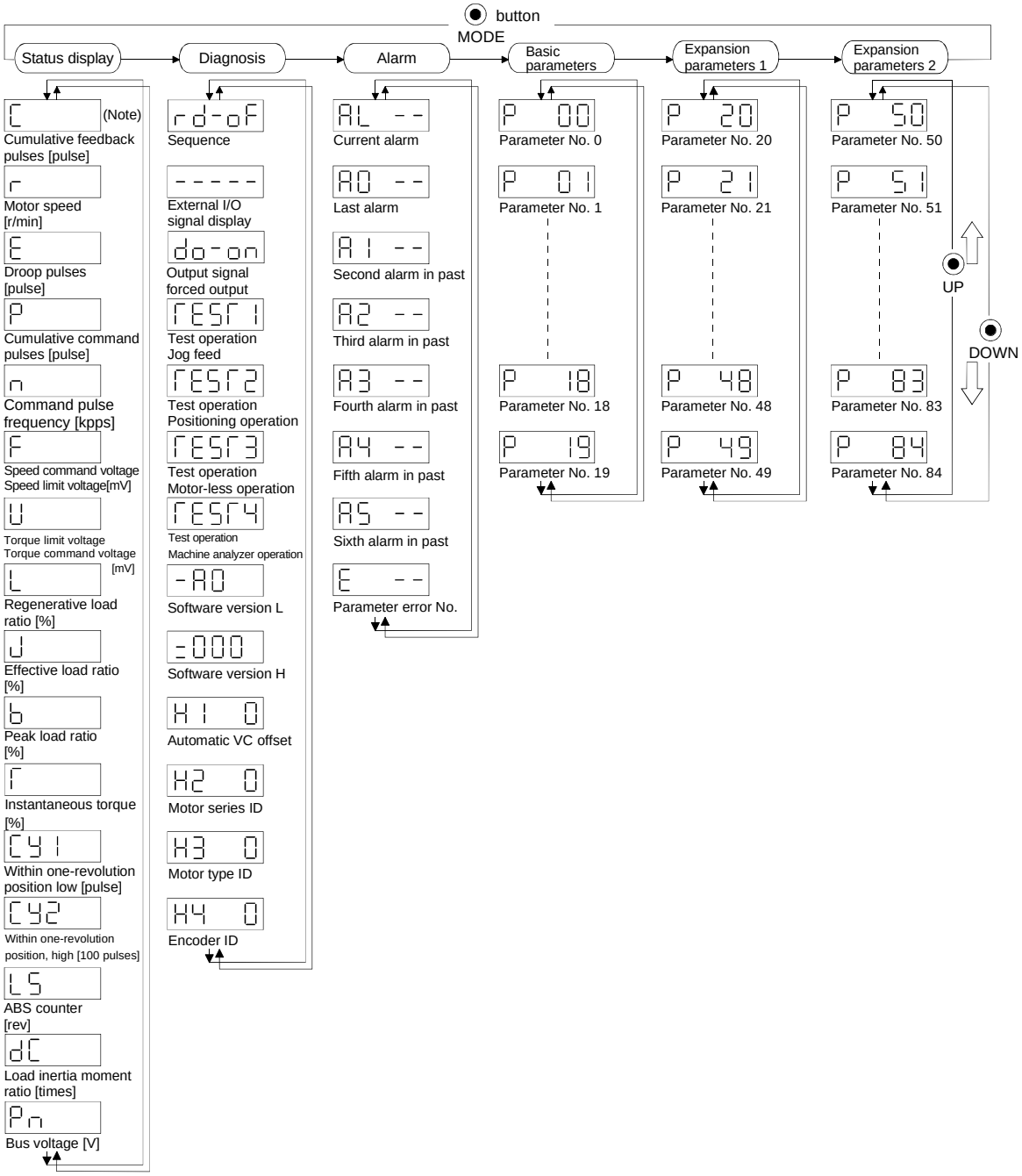
# MEMO

# 6. DISPLAY AND OPERATION

## 6.1 Display flowchart

Use the display (5-digit, 7-segment LED) on the front panel of the servo amplifier for status display, parameter setting, etc. Set the parameters before operation, diagnose an alarm, confirm external sequences, and/or confirm the operation status. Press the "MODE" "UP" or "DOWN" button once to move to the next screen.

To refer to or set the expansion parameters, make them valid with parameter No. 19 (parameter write disable).



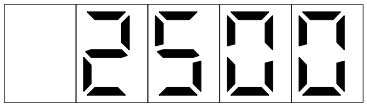
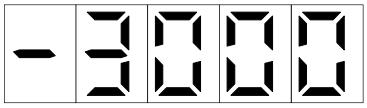
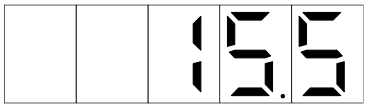
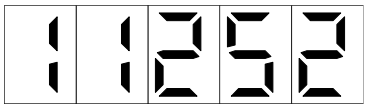
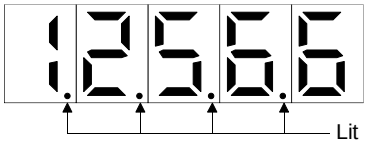

Note: The initial status display at power-on depends on the control mode.
Position control mode: Cumulative feedback pulses(C), Speed control mode: Motor speed(r),
Torque control mode: Torque command voltage(U)
Also, parameter No. 18 can be used to change the initial indication of the status display at power-on.

## 6.2 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. 18 has been shown for 2[s].
The servo amplifier display shows the lower five digits of 16 data items such as the motor speed.

### 6.2.1 Display examples

The following table lists display examples:

| Item | Status | Displayed data<br>Servo amplifier display |
|---|---|---|
| Motor speed | Forward rotation at 3000r/min |  |
| | Reverse rotation at 3000r/min |  <br>Reverse rotation is indicated by "−". |
| Load inertia moment | 15.5 times |  |
| Multi-revolution counter | 11252pulse |  |
| | −12566pulse |  <br>Negative value is indicated by the lit decimal points in the upper four digits. |

### 6.2.2 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.<br>Reverse rotation 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.<br>The value rounded off is displayed in ×0.1r/min. | −5400 to 5400 |
| 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.<br>Since the servo amplifier display is five digits, it shows the lower five digits of the actual value.<br>The number of pulses displayed is not yet multiplied by the electronic gear. | −99999 to 99999 |
| Cumulative command pulses | P | pulse | The position command input pulses are counted and displayed.<br>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.<br>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.<br>The value displayed is not multiplied by the electronic gear (CMX/CDV). | −800 to 800 |
| Analog speed command voltage<br>Analog speed limit voltage | F | V | (1) Torque control mode<br>Analog speed limit (VLA) voltage is displayed.<br>(2) Speed control mode<br>Analog speed command (VC) voltage is displayed. | −10.00 to 10.00 |
| Analog torque command voltage<br>Analog torque limit voltage | U | V | (1) Position control mode, speed control mode<br>Analog torque limit (TLA) voltage is displayed. | 0 to +10V |
| | | | (2) Torque control mode<br>Analog torque command (TLA) voltage is displayed. | −10 to +10V |
| 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 torque is displayed.<br>The effective value is displayed relative to the rated torque of 100%. | 0 to 300 |
| Peak load ratio | b | % | The maximum torque generated during acceleration/deceleration, etc.<br>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.<br>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.<br>The value returns to 0 when it exceeds the maximum number of pulses.<br>The value is incremented in the CCW direction of rotation. | 0 to 99999 |

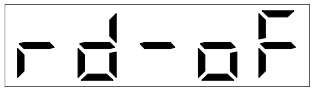
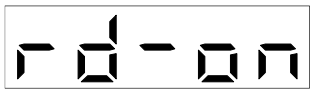
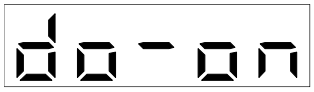
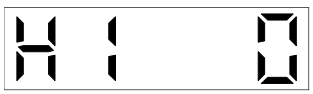
| Name | Symbol | Unit | Description | Display range |
|---|---|---|---|---|
| Within one-revolution position high | Cy2 | 100 pulse | The within one-revolution position is displayed in 100 pulse increments of the encoder.<br>The value returns to 0 when it exceeds the maximum number of pulses.<br>The value is incremented in the CCW direction of rotation. | 0 to 1310 |
| 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 450 |

### 6.2.3 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. 18 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 |

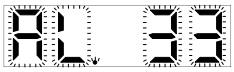
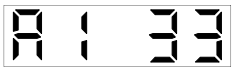
## 6.3 Diagnostic mode

| Name | | Display | Description |
|---|---|---|---|
| Sequence | |  | Not ready.<br>Indicates that the servo amplifier is being initialized or an alarm has occurred. |
| | |  | Ready.<br>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 6.6. | Indicates the ON-OFF states of the external I/O signals.<br>The upper segments correspond to the input signals and the lower segments to the output signals.<br>Lit: ON<br>Extinguished: OFF<br>The I/O signals can be changed using parameters No. 43 to 49. |
| Output signal (DO) forced output | |  | The digital output signal can be forced on/off. For more information, refer to section 6.7. |
| Test operation mode | Jog feed |  | Jog operation can be performed when there is no command from the external command device.<br>For details, refer to section 6.8.2. |
| | Positioning operation |  | The servo configuration software (MRZJW3-SETUP121E) is required for positioning operation. This operation cannot be performed from the operation section of the servo amplifier.<br>Positioning operation can be performed once when there is no command from the external command device. |
| | Motorless operation |  | 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.<br>For details, refer to section 6.8.4. |
| | Machine analyzer operation |  | Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured.<br>The servo configuration software (MRZJW3-SETUP121E or later) is required for machine analyzer operation. |
| Software version Low | |  | Indicates the version of the software. |
| Software version High | |  | Indicates the system number of the software. |
| Automatic VC offset | |  | 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.<br>When using this function, make it valid in the following procedure. Making it valid causes the parameter No. 29 value to be the automatically adjusted offset voltage.<br>1) Press "SET" once.<br>2) Set the number in the first digit to 1 with "UP"/"DOWN".<br>3) Press "SET".<br>You cannot use this function if the input voltage of VC or VLA is ±0.4V or more. |

| Name | Display | Description |
|---|---|---|
| Motor series |  | Press the "SET" button to show the motor series ID of the servo motor currently connected.<br>For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual. |
| Motor type |  | Press the "SET" button to show the motor type ID of the servo motor currently connected.<br>For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual. |
| Encoder |  | Press the "SET" button to show the encoder ID of the servo motor currently connected.<br>For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual. |

## 6.4 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 |  | Indicates no occurrence of an alarm. |
| |  | Indicates the occurrence of overvoltage (AL.33).<br>Flickers at occurrence of the alarm. |
| Alarm history |  | Indicates that the last alarm is overload 1 (AL.50). |
| |  | Indicates that the second alarm in the past is overvoltage (AL.33). |
| |  | Indicates that the third alarm in the past is undervoltage (AL.10). |
| |  | Indicates that the fourth alarm in the past is overspeed (AL.31). |
| |  | Indicates that there is no fifth alarm in the past. |
| |  | Indicates that there is no sixth alarm in the past. |
| Parameter error |  | Indicates no occurrence of parameter error (AL.37). |
| |  | Indicates that the data of parameter No. 1 is faulty. |

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

(2) The other screen is visible during occurrence of an alarm. At this time, the decimal point in the fourth digit flickers.

(3) For any alarm, remove its cause and clear it in any of the following methods (for clearable alarms, refer to Section 10.2.1):
   (a) Switch power OFF, then ON.
   (b) Press the "SET" button on the current alarm screen.
   (c) Turn on the alarm reset (RES) signal.

(4) Use parameter No. 16 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.



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

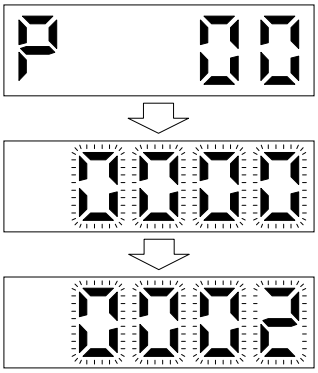
## 6.5 Parameter mode

The parameters whose abbreviations are marked* are made valid by changing the setting and then switching power off once and switching it on again. Refer to Section 5.1.2.

### (1) Operation example

The following example shows the operation procedure performed after power-on to change the control mode (parameter No. 0) to the speed control mode.

Using the "MODE" button, show the basic parameter screen.



····· The parameter number is displayed.

Press ⊙ UP or ⊙ DOWN to change the number.

⊙ Press SET twice.

····· The set value of the specified parameter number flickers.

⊙ Press UP once.

····· During flickering, the set value can be changed.

Use ⊙ UP or ⊙ DOWN .

(□□□2: Speed control mode)

⊙ Press SET to enter.

To shift to the next parameter, press the ⊙ UP / ⊙ DOWN button.

When changing the parameter No. 0 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

### (2) Expansion parameters

To use the expansion parameters, change the setting of parameter No. 19 (parameter write disable). Refer to section 5.1.1.

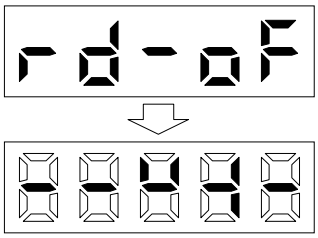
## 6.6 External I/O signal display

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

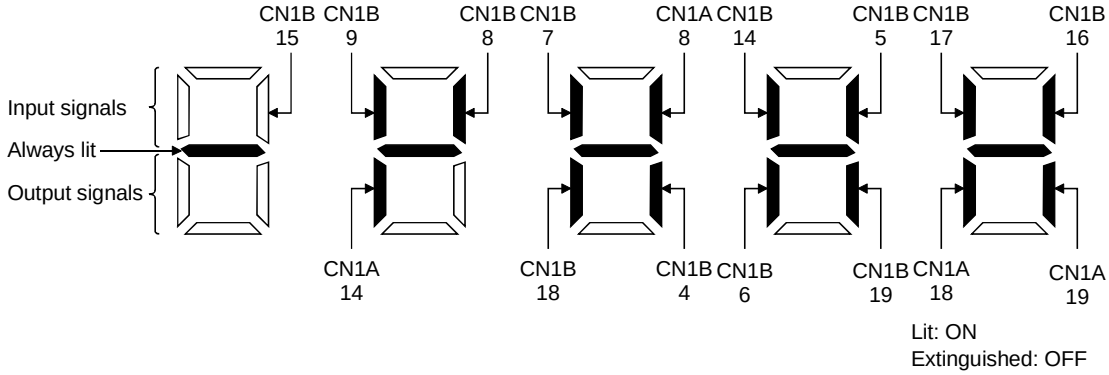
### (1) Operation

Call the display screen shown after power-on.

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




### (2) Display definition




The 7-segment LED shown above indicates ON/OFF.

Each segment at top indicates the input signal and each segment at bottom indicates the output signal.

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 | |
| CN1A | 8 | I | CR | CR/SP1 | SP1 | SP1 | SP1 | SP1/CR | No.43 to 48 |
| | 14 | O | OP | OP | OP | OP | OP | OP | |
| | 18 | O | INP | INP/SA | SA | SA/— | | —/INP | No.49 |
| | 19 | O | RD | RD | RD | RD | RD | RD | No.49 |
| CN1B | (Note 3) 4 | O | DO1 | DO1 | DO1 | DO1 | DO1 | DO1 | |
| | 5 | I | SON | SON | SON | SON | SON | SON | No.43 to 48 |
| | 6 | O | TLC | TLC | TLC | TLC/VLC | VLC | VLC/TLC | No.49 |
| | 7 | I | | LOP | SP2 | LOP | SP2 | LOP | No.43 to 48 |
| | 8 | I | PC | PC/ST1 | ST1 | ST1/RS2 | RS2 | RS2/PC | No.43 to 48 |
| | 9 | I | TL | TL/ST2 | ST2 | ST2/RS1 | RS1 | RS1/TL | No.43 to 48 |
| | 14 | I | RES | RES | RES | RES | RES | RES | No.43 to 48 |
| | 15 | I | EMG | EMG | EMG | EMG | EMG | EMG | |
| | 16 | I | LSP | LSP | LSP | LSP/— | | —/LSP | |
| | 17 | I | LSN | LSN | LSN | LSN/— | | —/LSN | |
| | 18 | O | ALM | ALM | ALM | ALM | ALM | ALM | No.49 |
| | 19 | O | ZSP | ZSP | ZSP | ZSP | ZSP | ZSP | No.1・49 |

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

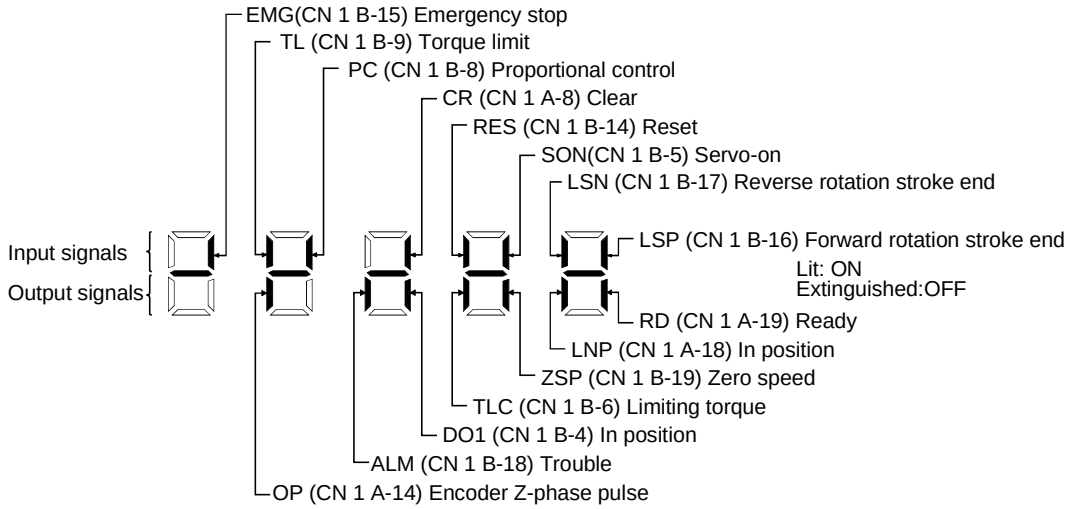
3. The signal of CN1A-18 is always output.

(b) Symbol and signal names

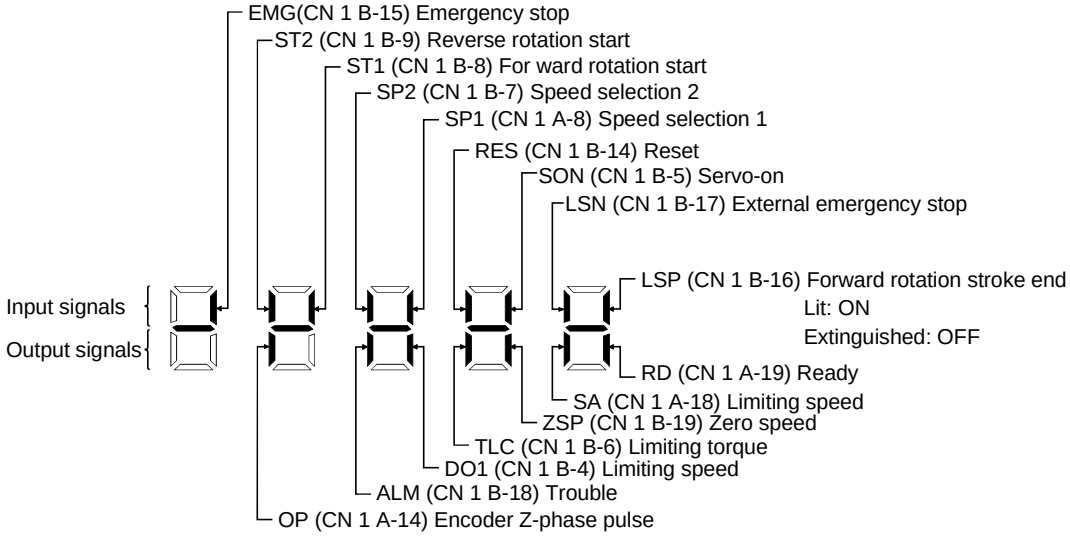
| Symbol | Signal name | Symbol | Signal name |
|---|---|---|---|
| SON | Servo-on | EMG | Emergency stop |
| LSP | Forward rotation stroke end | LOP | Control change |
| LSN | Reverse rotation stroke end | TLC | Limiting torque |
| CR | Clear | VLC | Limiting speed |
| SP1 | Speed selection 1 | RD |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

(3) Default signal indications

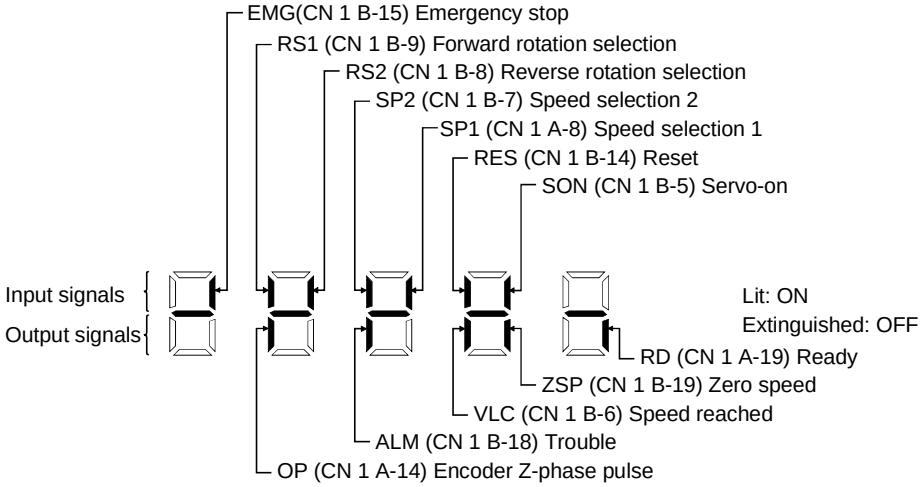
(a) Position control mode




(b) Speed control mode




(c) Torque control mode

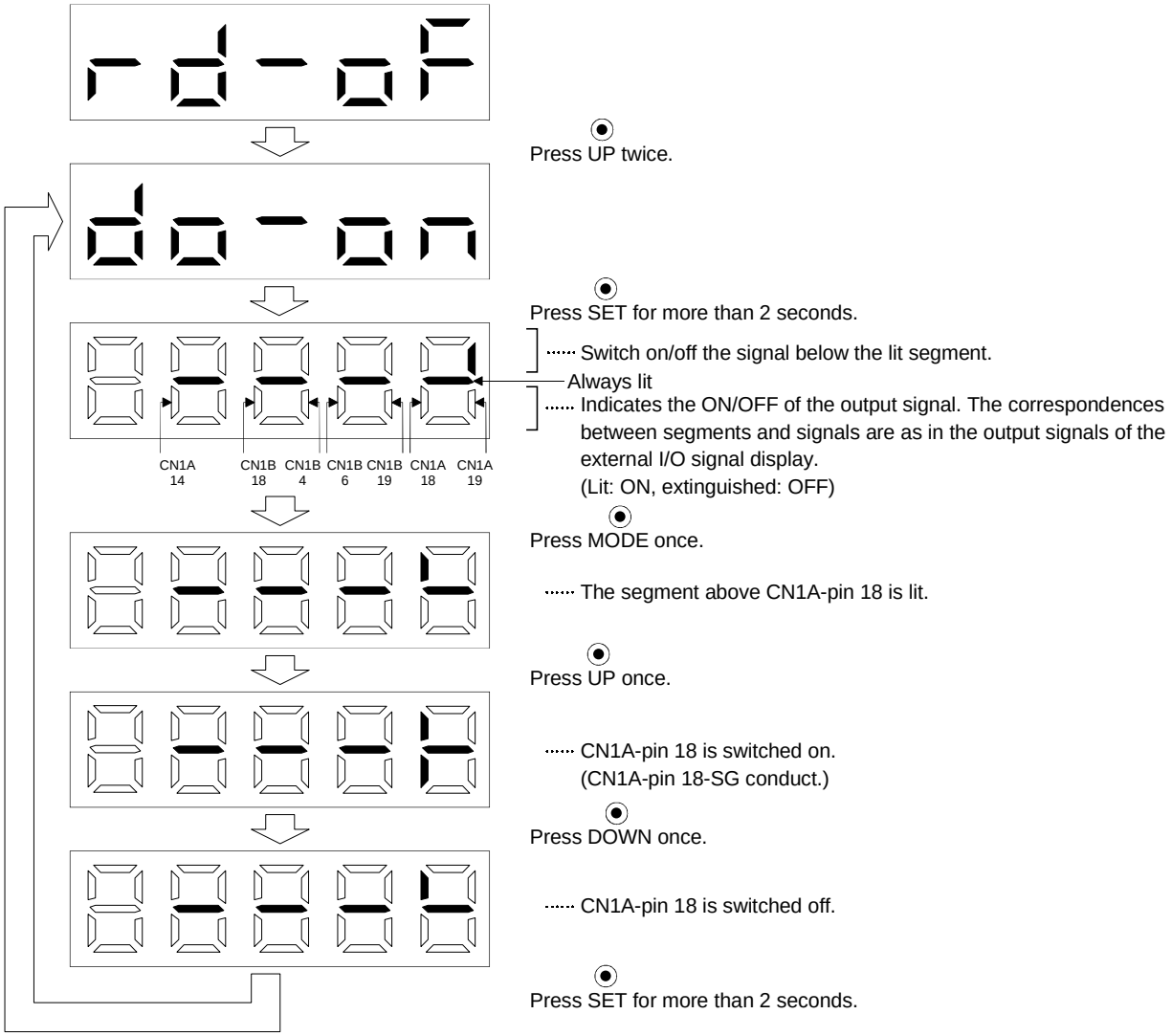


## 6.7 Output signal (DO) forced output

> POINT
>
> ▪ When the servo system is used in a vertical lift application, turning on the electromagnetic brake interlock signal after assigning it to pin CN1B-19 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 (SON signal off).

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



## 6.8 Test operation mode

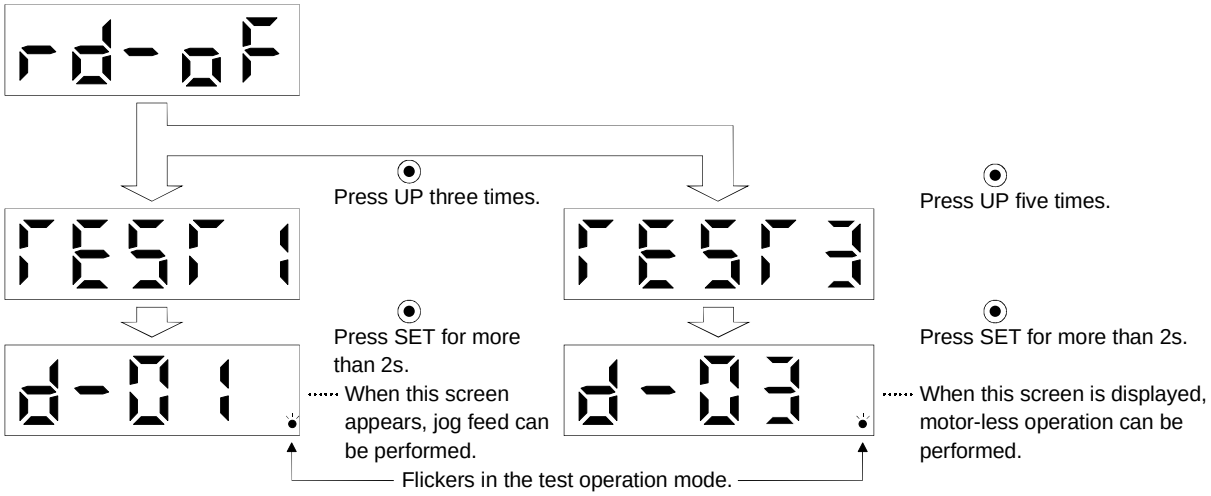
| | |
|---|---|
| ⚠ CAUTION | ・The test operation mode is designed to confirm servo operation and not to confirm machine operation. In this mode, do not use the servo motor with the machine. Always use the servo motor alone.<br>・If any operational fault has occurred, stop operation using the forced stop (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. 1.
- The servo configuration software is required to perform positioning operation.
- Test operation cannot be performed if the servo-on (SON) signal is not turned OFF.

### 6.8.1 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.



### 6.8.2 Jog operation

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

#### (1) Operation

Connect EMG-SG to start jog operation and connect VDD-COM to use the internal power supply.
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.<br>Release to stop. |
| "DOWN" | Press to start CW rotation.<br>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 6.2. 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.



### 6.8.3 Positioning operation

> **POINT**
>
> ▪ The servo configuration software is required to perform positioning operation.

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

#### (1) Operation

Connect EMG-SG to start positioning operation and connect VDD-COM to use the internal power supply.

Pressing the "Forward" or "Reverse" button on the servo configuration software starts the servo motor, which will then stop after moving the preset travel distance. You can change the operation conditions on the servo configuration software. The initial conditions and setting ranges for operation are listed below:

| Item | Initial setting | Setting range |
|---|---|---|
| Travel distance [pulse] | 10000 | 0 to 9999999 |
| Speed [r/min] | 200 | 0 to instantaneous permissible speed |
| Acceleration/deceleration time constant [ms] | 1000 | 0 to 50000 |

How to use the keys is explained below:

| Key | Description |
|---|---|
| "Forward" | Press to start positioning operation CCW. |
| "Reverse" | Press to start positioning operation CW. |
| "Pause" | Press during operation to make a temporary stop. Pressing the "Pause" button again erases the remaining distance.<br>To resume operation, press the button that was pressed to start the operation. |

If the communication cable is disconnected during positioning operation, the servo motor will come to a sudden stop.

#### (2) Status display

You can monitor the status display even during positioning operation.

### 6.8.4 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

After turning off the signal across SON-SG, 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 6.2. 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

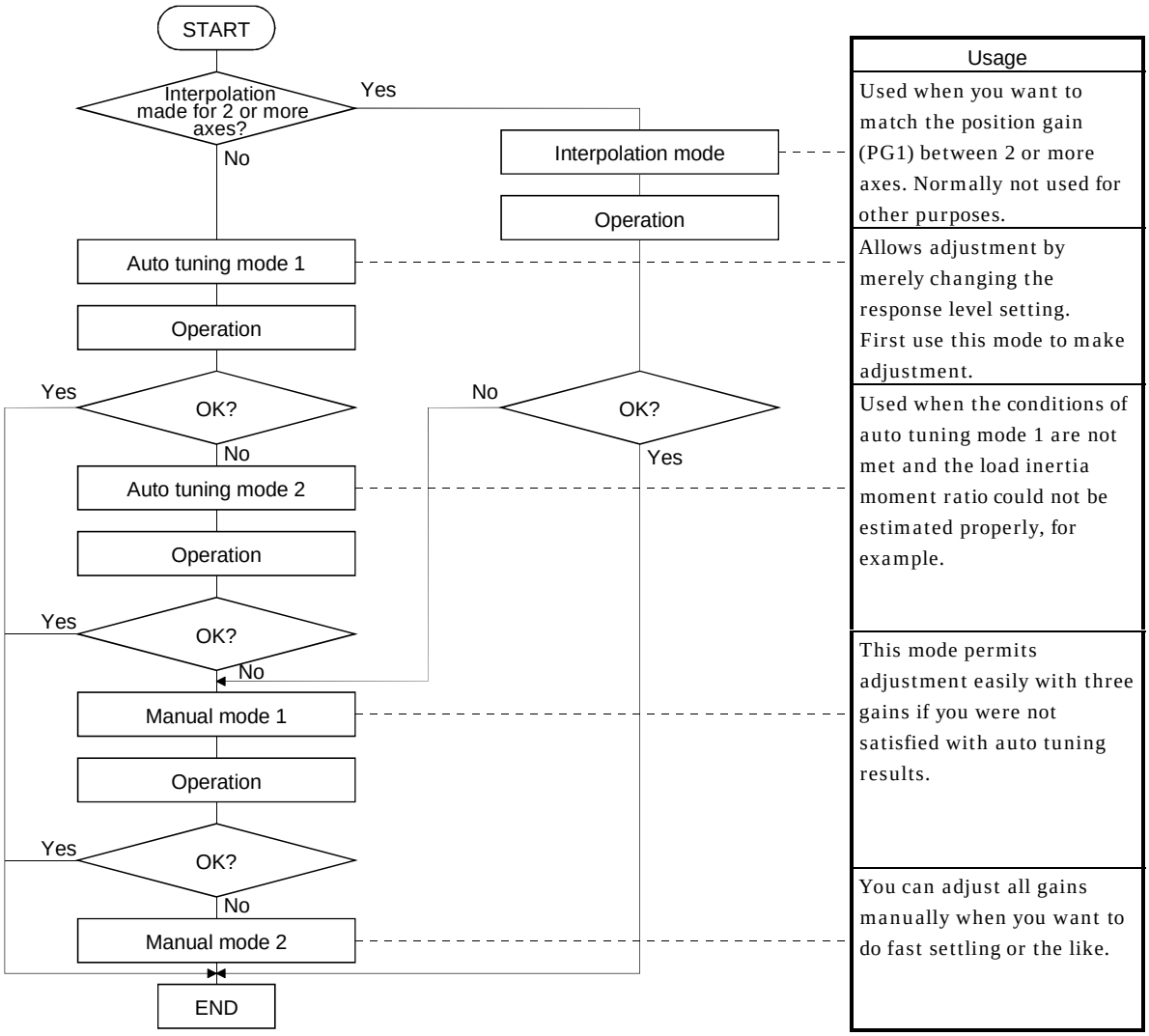
### 7.1.1 Adjustment on a single servo amplifier

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, manual mode 1 and manual mode 2 in this order.

(1) Gain adjustment mode explanation

| Gain adjustment mode | Parameter No. 2 setting | Estimation of load inertia moment ratio | Automatically set parameters | Manually set parameters |
|---|---|---|---|---|
| Auto tuning mode 1 (initial value) | 010□ | Always estimated | PG1 (parameter No. 6)<br>GD2 (parameter No. 34)<br>PG2 (parameter No. 35)<br>VG1 (parameter No. 36)<br>VG2 (parameter No. 37)<br>VIC (parameter No. 38) | Response level setting of parameter No. 2 |
| Auto tuning mode 2 | 020□ | Fixed to parameter No. 34 value | PG1 (parameter No. 6)<br>PG2 (parameter No. 35)<br>VG1 (parameter No. 36)<br>VG2 (parameter No. 37)<br>VIC (parameter No. 38) | GD2 (parameter No. 34)<br>Response level setting of parameter No. 2 |
| Manual mode 1 | 030□ | | PG2 (parameter No. 35)<br>VG1 (parameter No. 36) | PG1 (parameter No. 6)<br>GD2 (parameter No. 34)<br>VG2 (parameter No. 37)<br>VIC (parameter No. 38) |
| Manual mode 2 | 040□ | | | PG1 (parameter No. 6)<br>GD2 (parameter No. 34)<br>PG2 (parameter No. 35)<br>VG1 (parameter No. 36)<br>VG2 (parameter No. 37)<br>VIC (parameter No. 38) |
| Interpolation mode | 000□ | Always estimated | GD2 (parameter No. 34)<br>PG2 (parameter No. 35)<br>VG2 (parameter No. 37)<br>VIC (parameter No. 38) | PG1 (parameter No. 6)<br>VG1 (parameter No. 36) |

(2) Adjustment sequence and mode usage




### 7.1.2 Adjustment using servo configuration software

This section gives the functions and adjustment that may be performed by using the servo amplifier with the servo configuration software 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.<br>・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 |
|---|---|---|
| 6 | PG1 | Position control gain 1 |
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment |
| 35 | PG2 | Position control gain 2 |
| 36 | VG1 | Speed control gain 1 |
| 37 | VG2 | Speed control gain 2 |
| 38 | 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 motor inertia moment is not more than 100 times.
  - 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 1,2 to make gain adjustment.

(2) Auto tuning mode 2

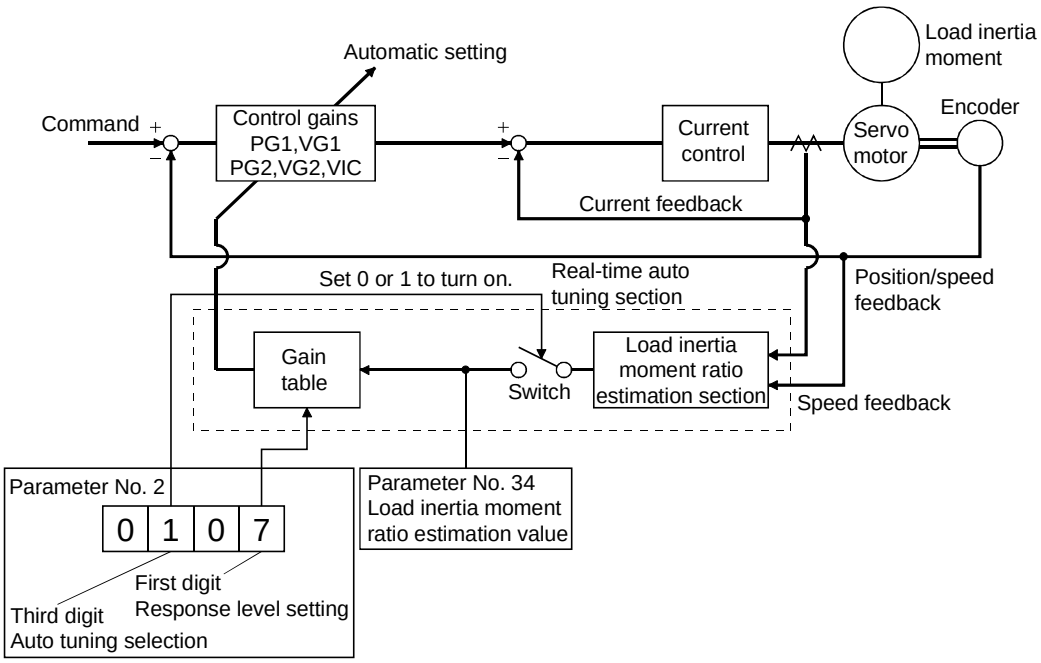
Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load inertia moment ratio is not estimated in this mode, set the value of a correct load inertia moment ratio (parameter No. 34).

The following parameters are automatically adjusted in the auto tuning mode 2.

| Parameter No. | Abbreviation | Name |
|---|---|---|
| 6 | PG1 | Position control gain 1 |
| 35 | PG2 | Position control gain 2 |
| 36 | VG1 | Speed control gain 1 |
| 37 | VG2 | Speed control gain 2 |
| 38 | 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. 34 (load inertia moment ratio). These results can be confirmed on the status display screen of the servo amplifier display 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.2: □ 2 □ □) 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. 34) value and response level (The first digit of parameter No. 2), the optimum control gains are automatically set on the basis of the internal gain tale.

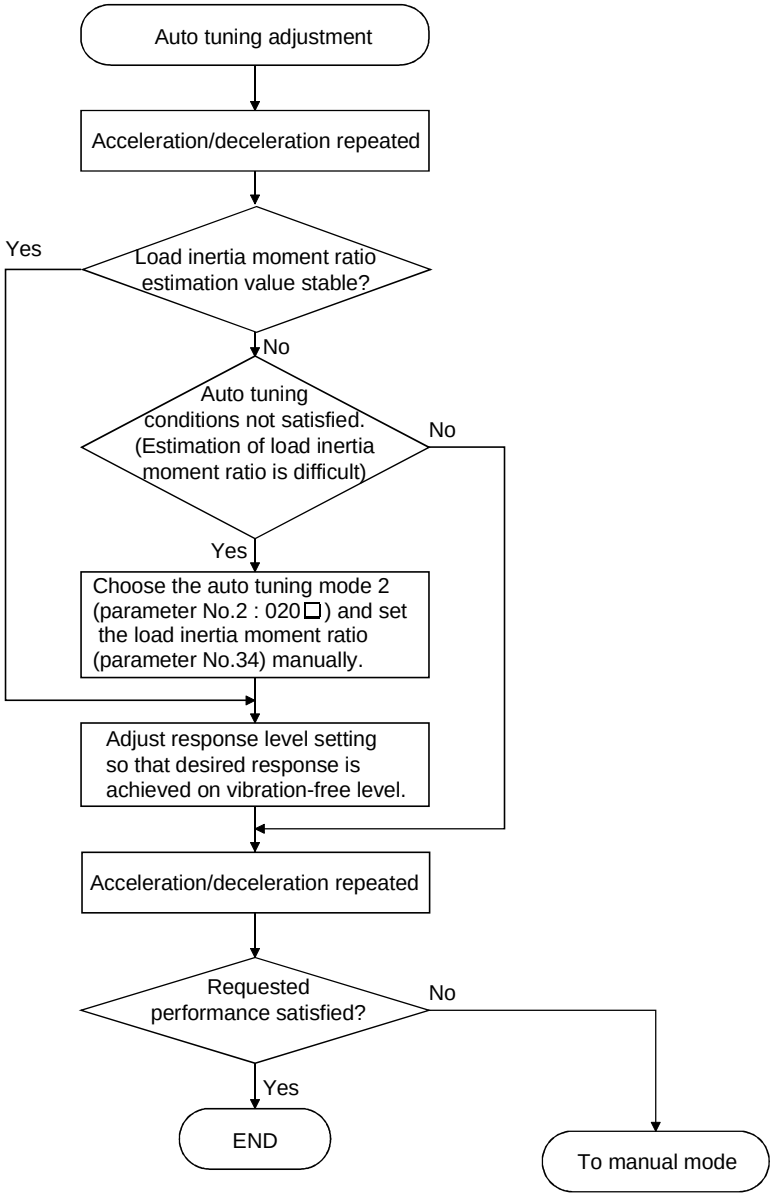
The auto tuning results are saved in the EEP-ROM of the servo amplifier every 6 minutes since power-on. At power-on, auto tuning is performed with the value of each control gain saved in the EEP-ROM being used as an initial value.

| 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. 2: 020□) and set the correct load inertia moment ratio in parameter No. 34. |

### 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.

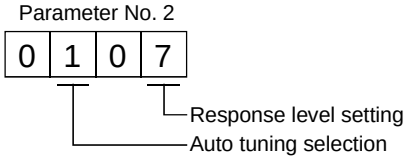
(1) Basic procedure

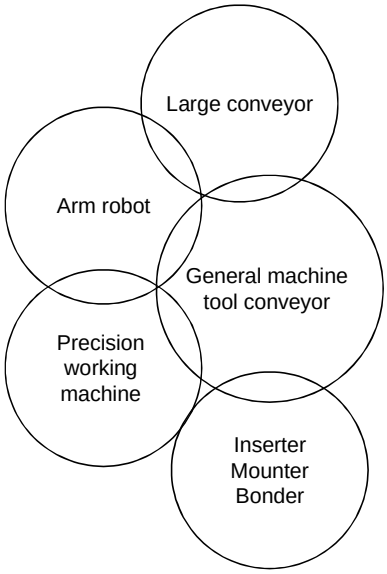


### 7.2.4 Response level setting in auto tuning mode

Set the response (The first digit of parameter No.2) of the whole servo system. As the response level setting is increased, the trackability 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, adaptive vibration suppression control (parameter No. 60) or machine resonance suppression filter (parameter No. 58 · 59) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to Section 8.1 for adaptive vibration suppression control and machine resonance suppression filter.



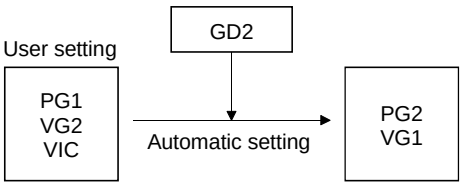

| Response level setting | Machine characteristic | | |
|---|---|---|---|
| | Machine rigidity | Machine resonance frequency guideline | Guideline of corresponding machine |
| 1 | Low | 15Hz |  |
| 2 | | 20Hz | |
| 3 | | 25Hz | |
| 4 | ↑ | 30Hz | |
| 5 | | 35Hz | |
| 6 | | 45Hz | |
| 7 | | 55Hz | |
| 8 | Middle | 70Hz | |
| 9 | | 85Hz | |
| A | | 105Hz | |
| B | | 130Hz | |
| C | ↓ | 160Hz | |
| D | | 200Hz | |
| E | | 240Hz | |
| F | High | 300Hz | |

### 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.

#### 7.3.1 Operation of manual mode 1

In this mode, setting the three gains of position control gain 1 (PG1), speed control gain 2 (VG2) and speed integral compensation (VIC) automatically sets the other gains to the optimum values according to these gains.




Therefore, you can adjust the model adaptive control system in the same image as the general PI control system (position gain, speed gain, speed integral time constant). Here, the position gain corresponds to PG1, the speed gain to VG2 and the speed integral time constant to VIC. When making gain adjustment in this mode, set the load inertia moment ratio (parameter No. 34) correctly.

#### 7.3.2 Adjustment by manual mode 1

> **POINT**
>
> ▪ If machine resonance occurs, adaptive vibration suppression control (parameter No. 60) or machine resonance suppression filter (parameter No. 58 ▪ 59) may be used to suppress machine resonance. (Refer to Section 8.1.)

(1) For speed control

(a) Parameters

The following parameters are used for gain adjustment:

| Parameter No. | Abbreviation | Name |
|---|---|---|
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment |
| 37 | VG2 | Speed control gain 2 |
| 38 | VIC | Speed integral compensation |

(b) Adjustment procedure

| Step | Operation | Description |
|---|---|---|
| 1 | Set an estimated value to the ratio of load inertia moment to servo motor inertia moment (parameter No. 34). | |
| 2 | Increase the speed control gain 2 (parameter No. 37) within the vibration- and unusual noise-free range, and return slightly if vibration takes place. | Increase the speed control gain. |
| 3 | Decrease the speed integral compensation (parameter No. 38) within the vibration-free range, and return slightly if vibration takes place. | Decrease the time constant of the speed integral compensation. |
| 4 | 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 adaptive vibration suppression control or machine resonance suppression filter and then executing steps 2 and 3. | Suppression of machine resonance.<br>Refer to Section 8.2, 8.3. |
| 5 | While checking the settling characteristic and rotational status, fine-adjust each gain. | Fine adjustment |

(c)Adjustment description

1) Speed control gain 2 (parameter No. 37)

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:

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

2) Speed integral compensation (VIC: parameter No. 38)

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:

$$\text{Speed integral compensation setting(ms)} \geq \frac{2000 \text{ to } 3000}{\text{Speed control gain 2 setting}/\ (1+\text{ratio of load inertia moment to servo motor inertia moment setting}\times 0.1)}$$

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment:

| Parameter No. | Abbreviation | Name |
|---|---|---|
| 6 | PG1 | Position control gain 1 |
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment |
| 37 | VG2 | Speed control gain 2 |
| 38 | VIC | Speed integral compensation |

(b) Adjustment procedure

| Step | Operation | Description |
|---|---|---|
| 1 | Set an estimated value to the ratio of load inertia moment to servo motor inertia moment (parameter No. 34). | |
| 2 | Set a slightly smaller value to the position control gain 1 (parameter No. 6). | |
| 3 | Increase the speed control gain 2 (parameter No. 37) within the vibration- and unusual noise-free range, and return slightly if vibration takes place. | Increase the speed control gain. |
| 4 | Decrease the speed integral compensation (parameter No. 38) within the vibration-free range, and return slightly if vibration takes place. | Decrease the time constant of the speed integral compensation. |
| 5 | Increase the position control gain 1 (parameter No. 6). | Increase the position control gain. |
| 6 | 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 adaptive vibration suppression control or machine resonance suppression filter and then executing steps 3 to 5. | Suppression of machine resonance.<br>Refer to Section 8.1. |
| 7 | While checking the settling characteristic and rotational status, fine-adjust each gain. | Fine adjustment |

(c) Adjustment description

1) Position control gain 1 (parameter No. 6)

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

$$\text{Position control gain 1 guideline} \leq \frac{\text{Speed control gain 2 setting}}{(1+\text{ratio of load inertia moment to servo motor inertia moment})} \times \left(\frac{1}{3} \text{ to } \frac{1}{5}\right)$$

2) Speed control gain 2 (VG2: parameter No. 37)

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:

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

3) Speed integral compensation (parameter No. 38)

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

$$\text{Speed integral compensation setting(ms)} \geq \frac{\text{2000 to 3000}}{\text{Speed control gain 2 setting}/\ (1+\text{ratio of load inertia moment to servo motor inertia moment 2 setting} \times 0.1)}$$

## 7.4 Interpolation mode

The interpolation mode is used to match the position control 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 position control gain 2 and speed control gain 2 which determine command trackability 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 |
|---|---|---|
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment |
| 35 | PG2 | Position control gain 2 |
| 37 | VG2 | Speed control gain 2 |
| 38 | VIC | Speed integral compensation |

(b) Manually adjusted parameters

The following parameters are adjustable manually.

| Parameter No. | Abbreviation | Name |
|---|---|---|
| 6 | PG1 | Position control gain 1 |
| 36 | VG1 | Speed control gain 1 |

### (2) Adjustment procedure

| Step | Operation | Description |
|---|---|---|
| 1 | Set 15Hz (parameter No. 2: 010□) as the machine resonance frequency of response in the auto tuning mode 1. | Select the auto tuning mode 1. |
| 2 | During operation, increase the response level setting (parameter No. 2), and return the setting if vibration occurs. | Adjustment in auto tuning mode 1. |
| 3 | Check the values of position control gain 1 (parameter No. 6) and speed control gain 1 (parameter No. 36). | Check the upper setting limits. |
| 4 | Set the interpolation mode (parameter No. 2: 000□). | Select the interpolation mode. |
| 5 | Using the position control gain 1 value checked in step 3 as the guideline of the upper limit, set in PG1 the value identical to the position loop gain of the axis to be interpolated. | Set position control gain 1. |
| 6 | Using the speed control gain 1 value checked in step 3 as the guideline of the upper limit, look at the rotation status and set in speed control gain 1 the value three or more times greater than the position control gain 1 setting. | Set speed control gain 1. |
| 7 | Looking at the interpolation characteristic and rotation status, fine-adjust the gains and response level setting. | Fine adjustment. |

### (3) Adjustment description

(a) Position control gain 1 (parameter No.6)

This parameter determines the response level of the position control loop. Increasing position control gain 1 improves trackability 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.

$$\text{Droop pulse value (pulse)} = \frac{\text{Rotation speed (r/min)} \times 131{,}072\text{(pulse)}}{\text{Position control gain 1 setting}}$$

(b) Speed control gain 1 (parameter No. 36)

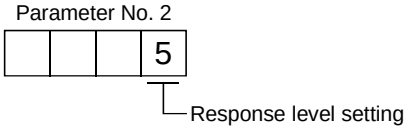
Set the response level of the speed loop of the model. Make setting using the following expression as a guideline.

Speed control gain 1 setting $\geq$ Position control gain 1 setting $\times 3$

## 7.5 Differences in auto tuning between MELSERVO-J2 and MELSERVO-J2-Super

### 7.5.1 Response level setting

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

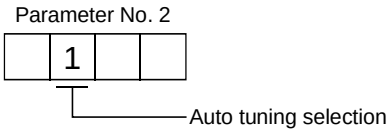



| MELSERVO-J2 series | | MELSERVO-J2-Super series | |
|---|---|---|---|
| Response level setting | Machine resonance frequency | Response level setting | Machine resonance frequency guideline |
| | | 1 | 15Hz |
| 1 | 20Hz | 2 | 20Hz |
| | | 3 | 25Hz |
| | | 4 | 30Hz |
| | | 5 | 35Hz |
| 2 | 40Hz | 6 | 45Hz |
| | | 7 | 55Hz |
| 3 | 60Hz | 8 | 70Hz |
| 4 | 80Hz | 9 | 85Hz |
| 5 | 100Hz | A | 105Hz |
| | | B | 130Hz |
| | | C | 160Hz |
| | | D | 200Hz |
| | | E | 240Hz |
| | | F | 300Hz |

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

### 7.5.2 Auto tuning selection

The MELSERVO-J2-Super series has an addition of the load inertia moment ratio fixing mode. It also has the addition of the manual mode 1 which permits manual adjustment with three parameters.




| Gain adjustment mode | | Auto tuning selection | | Remarks |
|---|---|---|---|---|
| | | MELSERVO-J2 series | MELSERVO-J2-Super series | |
| Interpolation mode | | 0 | 0 | Position control gain 1 is fixed. |
| Auto tuning | Auto tuning mode 1 | 1 | 1 | Ordinary auto tuning |
| | Auto tuning mode 2 | | 2 | Estimation of load inertia moment ratio stopped.<br>Response level setting valid. |
| Auto tuning invalid | Manual mode 1 | | 3 | Simple manual adjustment |
| | Manual mode 2 | 2 | 4 | Manual adjustment of all gains |

# MEMO

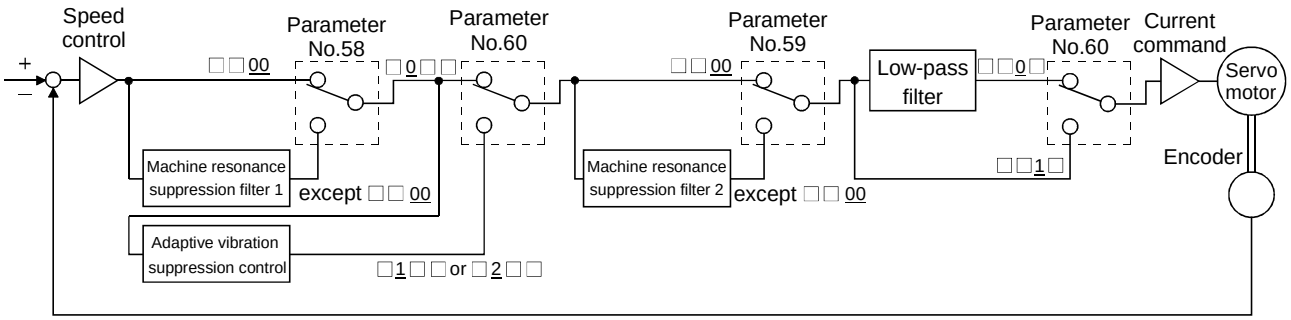
# 8. SPECIAL ADJUSTMENT FUNCTIONS

**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 may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency. Using the machine resonance suppression filter and adaptive vibration suppression control functions can suppress the resonance of the mechanical system.

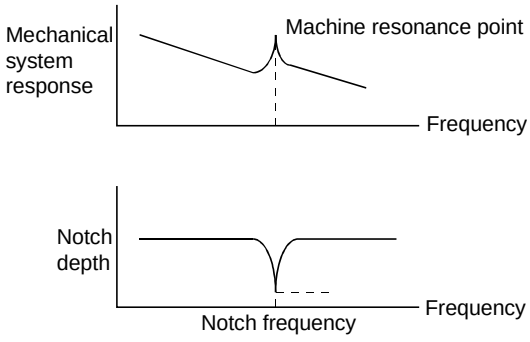
## 8.1 Function block diagram



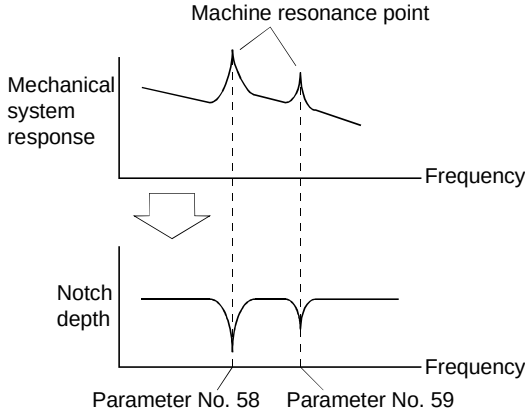

## 8.2 Machine resonance suppression filter

### (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) and gain decreasing depth.



You can use the machine resonance suppression filter 1 (parameter No. 58) and machine resonance suppression filter 2 (parameter No. 59) to suppress the vibration of two resonance frequencies. Note that if adaptive vibration suppression control is made valid, the machine resonance suppression filter 1 (parameter No. 58) is made invalid.




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.

(2) Parameters

(a) Machine resonance suppression filter 1 (parameter No. 58)

Set the notch frequency and notch depth of the machine resonance suppression filter 1 (parameter No. 58)

When you have made adaptive vibration suppression control selection (parameter No. 60) "valid" or "held", make the machine resonance suppression filter 1 invalid (parameter No. 58: 0000).

Parameter No. 58

| 0 | | | |
|---|---|---|---|

Notch frequency

| Setting value | Frequency | Setting value | Frequency | Setting value | Frequency | Setting value | Frequency |
|---|---|---|---|---|---|---|---|
| 00 | Invalid | 08 | 562.5 | 10 | 281.3 | 18 | 187.5 |
| 01 | 4500 | 09 | 500 | 11 | 264.7 | 19 | 180 |
| 02 | 2250 | 0A | 450 | 12 | 250 | 1A | 173.1 |
| 03 | 1500 | 0B | 409.1 | 13 | 236.8 | 1B | 166.7 |
| 04 | 1125 | 0C | 375 | 14 | 225 | 1C | 160.1 |
| 05 | 900 | 0D | 346.2 | 15 | 214.3 | 1D | 155.2 |
| 06 | 750 | 0E | 321.4 | 16 | 204.5 | 1E | 150 |
| 07 | 642.9 | 0F | 300 | 17 | 195.7 | 1F | 145.2 |

Notch depth

| Setting value | Depth (Gain) |
|---|---|
| 0 | Deep (−40dB) |
| 1 | ↑ (−14dB) |
| 2 | ↓ (−8dB) |
| 3 | Shallow(−4dB) |

POINT

- 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.
- The machine characteristic can be grasped beforehand by the machine analyzer on the servo configuration software. This allows the required notch frequency and depth to be determined.
- Resonance may occur if parameter No. 58 • 59 is used to select a close notch frequency and set a deep notch.

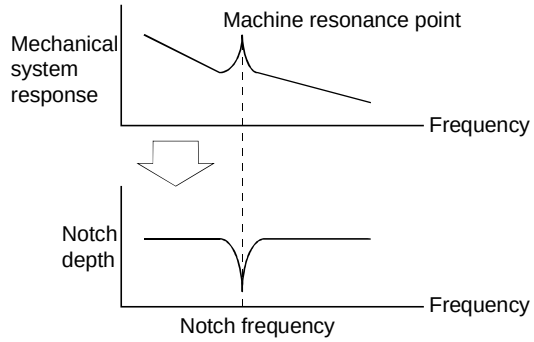
(b) Machine resonance suppression filter 2 (parameter No. 59)

The setting method of machine resonance suppression filter 2 (parameter No. 59) is the same as that of machine resonance suppression filter 1 (parameter No. 58). However, the machine resonance suppression filter 2 can be set independently of whether adaptive vibration suppression control is valid or invalid.

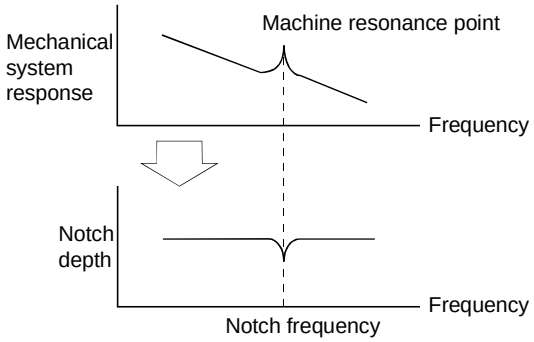
### 8.3 Adaptive vibration suppression control

#### (1) Function

Adaptive vibration suppression control is a function in which the servo amplifier detects machine resonance 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. Also, while adaptive vibration suppression control is valid, the servo amplifier always detects machine resonance, and if the resonance frequency changes, it changes the filter characteristics in response to that frequency.




When machine resonance is large and frequency is low



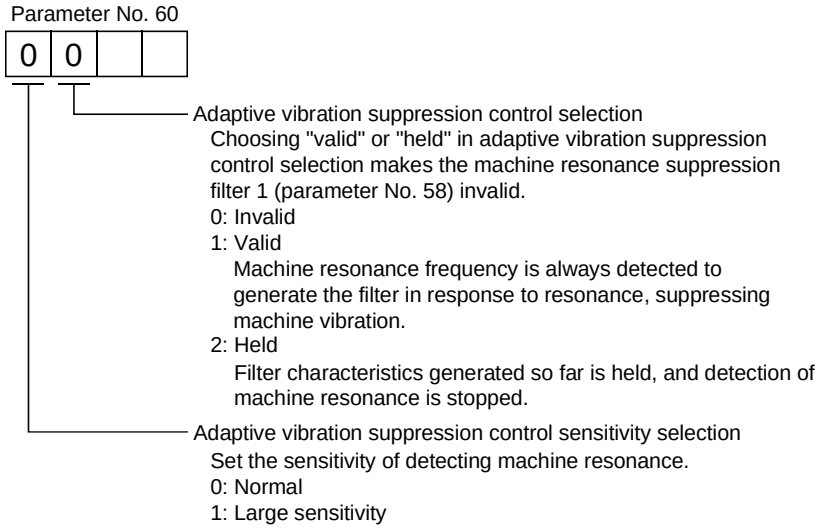

When machine resonance is small and frequency is high

POINT

- The machine resonance frequency which adaptive vibration suppression control can respond to is about 150 to 500Hz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range. Use the machine resonance suppression filter for the machine resonance of such frequency.
- Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics or which has too large resonance.
- Under operating conditions in which sudden disturbance torque is imposed during operation, the detection of the resonance frequency may malfunction temporarily, causing machine vibration. In such a case, set adaptive vibration suppression control to be "held" (parameter No. 60: □2□□) to fix the characteristics of the adaptive vibration suppression control filter.

(2) Parameters

The operation of adaptive vibration suppression control selection (parameter No.60).




POINT

- Adaptive vibration suppression control is factory-set to be invalid (parameter No. 60: 0000).
- The filter characteristics generated are saved in the EEP-ROM every 6 minutes since power-on. At next power-on, vibration suppression control is performed with this data saved in the EEP-ROM being used as an initial value.
- Setting the adaptive vibration suppression control sensitivity can change the sensitivity of detecting machine resonance. Setting of "large sensitivity" detects smaller machine resonance and generates a filter to suppress machine vibration. However, since a phase delay will also increase, the response of the servo system may not increase.

## 8.4 Low-pass filter

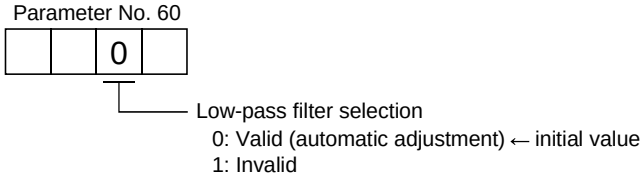
(1) Function

When a ballscrew or the like is used, resonance of high frequency may occur as the response 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:

$$\text{Filter frequency(Hz)} = \frac{\text{Speed control gain 2 setting} \times 10}{2\pi \times (1 + \text{Ratio of load inertia moment to servo motor inertia moment setting} \times 0.1)}$$

(2) Parameter

Set the operation of the low-pass filter (parameter No. 60.)




POINT

- In a mechanical system where rigidity is extremely high and resonance is difficult to occur, setting the low-pass filter to be "invalid" may increase the servo system response to shorten the settling time.

## 8.5 Gain changing function

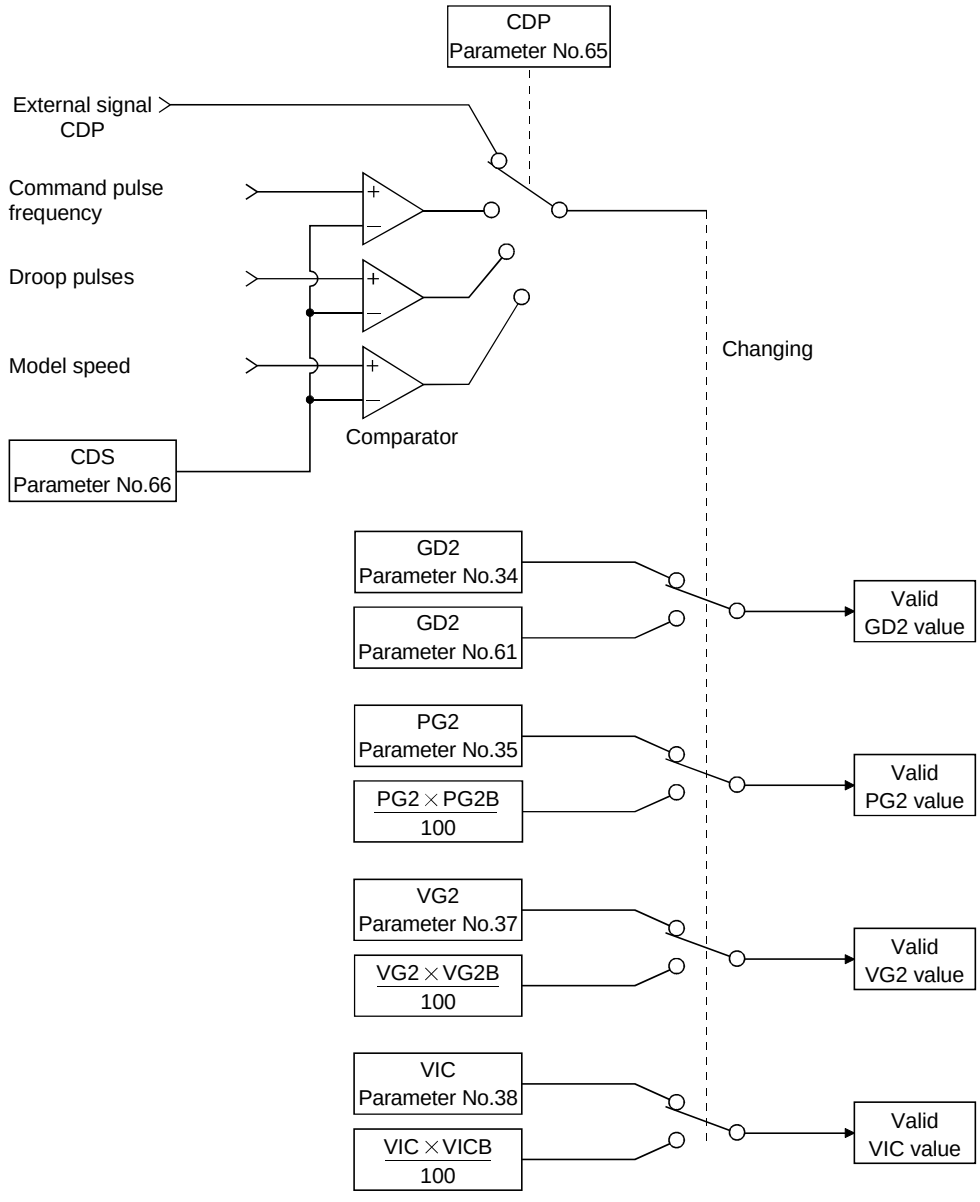
This function can change the gains. You can change between gains during rotation and gains during stop or can use an external signal to change gains during operation.

### 8.5.1 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).

### 8.5.2 Function block diagram

The valid control gains PG2, VG2, VIC and GD2 of the actual loop are changed according to the conditions selected by gain changing selection CDP (parameter No. 65) and gain changing condition CDS (parameter No. 66).



### 8.5.3 Parameters

When using the gain changing function, always set "□□4□" in parameter No.2 (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 |
|---|---|---|---|---|
| 6 | PG1 | Position control gain 1 | rad/s | Position and speed gains of a model used to set the response level to a command. Always valid. |
| 36 | VG1 | Speed control gain 1 | rad/s | |
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment | 0.1 times | Control parameters before changing |
| 35 | PG2 | Position control gain 2 | rad/s | |
| 37 | VG2 | Speed control gain 2 | rad/s | |
| 38 | VIC | Speed integral compensation | ms | |
| 61 | GD2B | Ratio of load inertia moment to servo motor inertia moment 2 | 0.1 times | Used to set the ratio of load inertia moment to servo motor inertia moment after changing. |
| 62 | PG2B | Position control gain 2 changing ratio | % | Used to set the ratio (%) of the after-changing position control gain 2 to position control gain 2. |
| 63 | VG2B | Speed control gain 2 changing ratio | % | Used to set the ratio (%) of the after-changing speed control gain 2 to speed control gain 2. |
| 64 | VICB | Speed integral compensation changing ratio | % | Used to set the ratio (%) of the after-changing speed integral compensation to speed integral compensation. |
| 65 | CDP | Gain changing selection | | Used to select the changing condition. |
| 66 | CDS | Gain changing condition | kpps<br>pulse<br>r/min | Used to set the changing condition values. |
| 67 | CDT | Gain changing time constant | ms | You can set the filter time constant for a gain change at changing. |

(1) Parameters No. 6, 34 to 38

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 control gain 2, speed control gain 2 and speed integral compensation to be changed.

(2) Ratio of load inertia moment to servo motor inertia moment 2 (GD2B: parameter No. 61)

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. 34).

(3) Position control gain 2 changing ratio (parameter No. 62), speed control gain 2 changing ratio (parameter No. 63), speed integral compensation changing ratio (parameter No. 64)

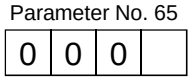
Set the values of after-changing position control gain 2, speed control gain 2 and speed integral compensation in ratio (%). 100% setting means no gain change.

For example, at the setting of position control gain 2 = 100, speed control gain 2 = 2000, speed integral compensation = 20 and position control gain 2 changing ratio = 180%, speed control gain 2 changing ratio = 150% and speed integral compensation changing ratio = 80%, the after-changing values are as follows:

Position control gain 2 = Position control gain 2 × Position control gain 2 changing ratio /100=180rad/s
Speed control gain 2 = Speed control gain 2 × Speed control gain 2 changing ratio /100 = 3000rad/s
Speed integral compensation = Speed integral compensation × Speed integral compensation changing ratio /100 = 16ms

(4) Gain changing selection (parameter No. 65)

Used to set the gain changing condition. Choose the changing condition in the first digit. If you set "1" here, you can use the gain changing (CDP) external input signal for gain changing. The gain changing signal (CDP) can be assigned to the pins using parameters No. 43 to 48.




Gain changing selection
Gains are changed in accordance with the settings of parameters No. 61 to 64 under any of the following conditions:
0: Invalid
1: Gain changing (CDP) input signal is ON
2: Command frequency is equal to higher than parameter No. 66 setting
3: Droop pulse value is equal to higher than parameter No. 66 setting
4: Servo motor speed is equal to higher than parameter No. 66 setting

(5) Gain changing condition (parameter No. 66)

When you selected "command frequency", "droop pulses" or "servo motor speed" in gain changing selection (parameter No.65), 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. 67)

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.

### 8.5.4 Gain changing operation

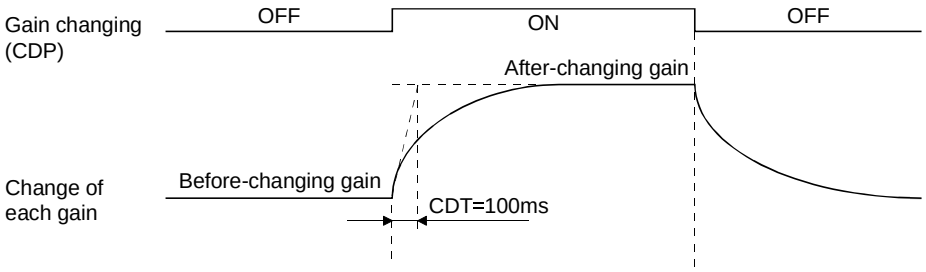
This operation will be described by way of setting examples.

(1) When you choose changing by external input

(a) Setting

| Parameter No. | Abbreviation | Name | Setting | Unit |
|---|---|---|---|---|
| 6 | PG1 | Position control gain 1 | 100 | rad/s |
| 36 | VG1 | Speed control gain 1 | 1000 | rad/s |
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment | 4 | 0.1 times |
| 35 | PG2 | Position control gain 2 | 120 | rad/s |
| 37 | VG2 | Speed control gain 2 | 3000 | rad/s |
| 38 | VIC | Speed integral compensation | 20 | ms |
| 61 | GD2B | Ratio of load inertia moment to servo motor inertia moment 2 | 100 | 0.1 times |
| 62 | PG2B | Position control gain 2 changing ratio | 70 | % |
| 63 | VG2B | Speed control gain 2 changing ratio | 133 | % |
| 64 | VICB | Speed integral compensation changing ratio | 250 | % |
| 65 | CDP | Gain changing selection | 0001 (Changed by ON/OFF of pin CN1A-8) | |
| 67 | CDT | Gain changing time constant | 100 | ms |

(b) Changing operation



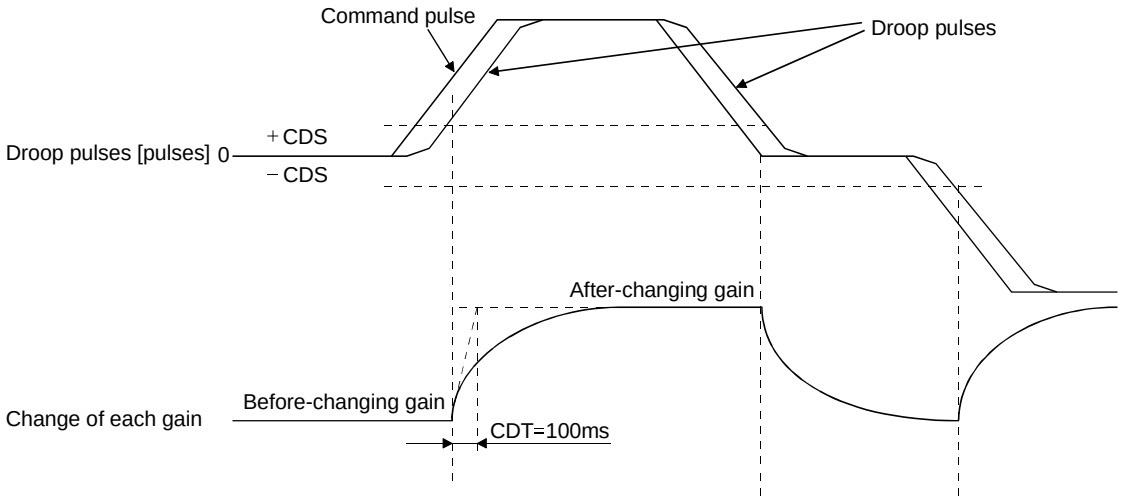

| | | | | |
|---|---|---|---|---|
| Position control gain 1 | 100 | | | |
| Speed control gain 1 | 1000 | | | |
| Ratio of load inertia moment to servo motor inertia moment | 4.0 | → | 10.0 | → 4.0 |
| Position control gain 2 | 120 | → | 84 | → 120 |
| Speed control gain 2 | 3000 | → | 4000 | → 3000 |
| Speed integral compensation | 20 | → | 50 | → 20 |

(2) When you choose changing by droop pulses

(a) Setting

| Parameter No. | Abbreviation | Name | Setting | Unit |
|---|---|---|---|---|
| 6 | PG1 | Position control gain 1 | 100 | rad/s |
| 36 | VG1 | Speed control gain 1 | 1000 | rad/s |
| 34 | GD2 | Ratio of load inertia moment to servo motor inertia moment | 40 | 0.1 times |
| 35 | PG2 | Position control gain 2 | 120 | rad/s |
| 37 | VG2 | Speed control gain 2 | 3000 | rad/s |
| 38 | VIC | Speed integral compensation | 20 | ms |
| 61 | GD2B | Ratio of load inertia moment to servo motor inertia moment 2 | 100 | 0.1 times |
| 62 | PG2B | Position control gain 2 changing ratio | 70 | % |
| 63 | VG2B | Speed control gain 2 changing ratio | 133 | % |
| 64 | VICB | Speed integral compensation changing ratio | 250 | % |
| 65 | CDP | Gain changing selection | 0003 (Changed by droop pulses) | |
| 66 | CDS | Gain changing condition | 50 | pulse |
| 67 | CDT | Gain changing time constant | 100 | ms |

(b) Changing operation




| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Position control gain 1 | 100 | | | | | | |
| Speed control gain 1 | 1000 | | | | | | |
| Ratio of load inertia moment to servo motor inertia moment | 4.0 | → | 10.0 | → | 4.0 | → | 10.0 |
| Position control gain 2 | 120 | → | 84 | → | 120 | → | 84 |
| Speed control gain 2 | 3000 | → | 4000 | → | 3000 | → | 4000 |
| Speed integral compensation | 20 | → | 50 | → | 20 | → | 50 |

# MEMO

## 9. INSPECTION

| | |
|---|---|
| ⚠WARNING | ・Before starting maintenance and/or inspection, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock.<br>・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.

(1) Inspection

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) Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. 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 15.2 |

(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.

# MEMO

# 10. TROUBLESHOOTING

## 10.1 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.

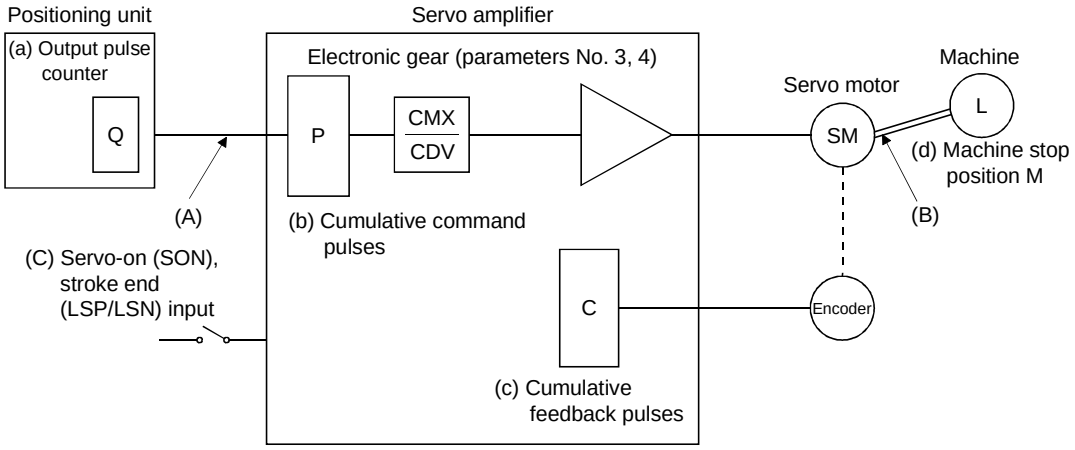
### 10.1.1 Position control mode

(1) Troubleshooting

| No. | Start-up sequence | Fault | Investigation | Possible cause | Refer to |
|---|---|---|---|---|---|
| 1 | Power on | ・LED is not lit.<br>・LED flickers. | Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected. | 1. Power supply voltage fault<br>2. Servo amplifier is faulty. | |
| | | | Improved when connectors CN1A and CN1B are disconnected. | Power supply of CNP1 cabling is shorted. | |
| | | | Improved when connector CN2 is disconnected. | 1. Power supply of encoder cabling is shorted.<br>2. Encoder is faulty. | |
| | | | Improved when connector CN3 is disconnected. | Power supply of CN3 cabling is shorted. | |
| | | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| 2 | Switch on servo-on signal. | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| | | Servo motor shaft is not servo-locked (is free). | 1. Check the display to see if the servo amplifier is ready to operate.<br>2. Check the external I/O signal indication to see if the servo-on (SON) signal is ON. | 1. Servo-on signal is not input. (Wiring mistake)<br>2. 24VDC power is not supplied to COM. | Section 6.6 |
| 3 | Enter input command.<br>(Test operation) | Servo motor does not rotate. | Check cumulative command pulses. | 1. Wiring mistake<br>(a) For open collector pulse train input, 24VDC power is not supplied to OPC.<br>(b) LSP/LSN-SG are not connected.<br>2. No pulses is input. | Section 6.2 |
| | | Servo motor run in reverse direction. | | 1. Mistake in wiring to controller.<br>2. Mistake in setting of parameter No. 54. | Chapter 5 |

| No. | Start-up sequence | Fault | Investigation | Possible cause | Refer to |
|---|---|---|---|---|---|
| 4 | Gain adjustment | Rotation ripples (speed fluctuations) are large at low speed. | Make gain adjustment in the following procedure:<br>1. Increase the auto tuning response level.<br>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) $P \cdot \frac{CMX(\text{parameter No.3})}{CDV(\text{parameter No.4})}$
   = C (cumulative command pulses × electronic gear = cumulative feedback pulses)
3) $C \cdot \Delta\ell = M$ (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 (2)(a) Section 13.2.6.)
2) When $P \cdot \frac{CMX}{CDV} \neq C$
   During operation, the servo-on signal (SON) or forward/reverse rotation stroke end signal was switched off or the clear signal (CR) and the reset signal (RES) switched on. (Cause C)
   If a malfunction may occur due to much noise, increase the input filter setting (parameter No. 1).
3) When $C \cdot \Delta\ell \neq M$
   Mechanical slip occurred between the servo motor and machine. (Cause B)

### 10.1.2 Speed control mode

| No. | Start-up sequence | Fault | Investigation | Possible cause | Refer to |
|---|---|---|---|---|---|
| 1 | Power on | ・LED is not lit.<br>・LED flickers. | Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected. | 1. Power supply voltage fault<br>2. Servo amplifier is faulty. | |
| | | | Improved when connectors CN1A and CN1B are disconnected. | Power supply of CN1 cabling is shorted. | |
| | | | Improved when connector CN2 is disconnected. | 1. Power supply of encoder cabling is shorted.<br>2. Encoder is faulty. | |
| | | | Improved when connector CN3 is disconnected. | Power supply of CN3 cabling is shorted. | |
| | | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| 2 | Switch on servo-on signal. | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| | | Servo motor shaft is not servo-locked (is free). | 1. Check the display to see if the servo amplifier is ready to operate.<br>2. Check the external I/O signal indication to see if the servo-on (SON) signal is ON. | 1. Servo-on signal is not input. (Wiring mistake)<br>2. 24VDC power is not supplied to COM. | Section 6.6 |
| 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 6.2 |
| | | | Call the external I/O signal display and check the ON/OFF status of the input signal. | LSP, LSN, ST1 or ST2 is off. | Section 6.6 |
| | | | Check the internal speed commands 1 to 7 (parameters No. 8 to 10・72 to 75). | Set value is 0. | (1), Section 5.1.2 |
| | | | Check the internal torque limit 1 (parameter No. 28). | 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:<br>1. Increase the auto tuning response level.<br>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 |

### 10.1.3 Torque control mode

| No. | Start-up sequence | Fault | Investigation | Possible cause | Refer to |
|---|---|---|---|---|---|
| 1 | Power on | ・LED is not lit.<br>・LED flickers. | Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected. | 1. Power supply voltage fault<br>2. Servo amplifier is faulty. | |
| | | | Improved when connectors CN1A and CN1B are disconnected. | Power supply of CN1 cabling is shorted. | |
| | | | Improved when connector CN2 is disconnected. | 1. Power supply of encoder cabling is shorted.<br>2. Encoder is faulty. | |
| | | | Improved when connector CN3 is disconnected. | Power supply of CN3 cabling is shorted. | |
| | | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| 2 | Switch on servo-on signal. | Alarm occurs. | Refer to Section 10.2 and remove cause. | | Section 10.2 |
| | | Servo motor shaft is free. | Call the external I/O signal display and check the ON/OFF status of the input signal. | 1. Servo-on signal is not input. (Wiring mistake)<br>2. 24VDC power is not supplied to COM. | Section 6.6 |
| 3 | Switch on forward rotation start (RS1) or reverse rotation start (RS2). | Servo motor does not rotate. | Call the status display and check the analog torque command (TC). | Analog torque command is 0V. | Section 6.2 |
| | | | Call the external I/O signal display and check the ON/OFF status of the input signal. | RS1 or RS2 is off. | Section 6.6 |
| | | | Check the internal speed limits 1 to 7 (parameters No. 8 to 10・72 to 75). | Set value is 0. | (1), Section 5.1.2 |
| | | | 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. 28). | Set value is 0. | |

## 10.2 When alarm or warning has occurred

> **POINT**
>
> ▪ Configure up a circuit which will detect the trouble (ALM) signal and turn off the servo-on (SON) signal at occurrence of an alarm.

### 10.2.1 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 10.2.2 or 10.2.3 and take the appropriate action.
Set "□□□1" in parameter No. 49 to output the alarm code in ON/OFF status across the corresponding pin and SG. 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 signals available before alarm code setting (CN1B-19: ZSP, CN1A-18: INP or SA, CN1A-19: RD) are output.
The alarms marked ○ in the alarm deactivation column can be deactivated by the corresponding operations.

| | Display | (Note 2) Alarm code | | | Name | Alarm deactivation | | |
|---|---|---|---|---|---|---|---|---|
| | | CN1B-19 pin | CN1A-18 pin | CN1A-19 pin | | Power OFF→ON | Press "SET" on current alarm screen. | Alarm reset (RES) signal |
| Alarms | AL.10 | 0 | 1 | 0 | Undervoltage | ○ | ○ | ○ |
| | AL.12 | 0 | 0 | 0 | Memory error 1 | ○ | | |
| | AL.13 | 0 | 0 | 0 | Clock error | ○ | | |
| | AL.15 | 0 | 0 | 0 | Memory error 2 | ○ | | |
| | AL.16 | 1 | 1 | 0 | Encoder error 1 | ○ | | |
| | AL.17 | 0 | 0 | 0 | Board error | ○ | | |
| | AL.19 | 0 | 0 | 0 | Memory error 3 | ○ | | |
| | AL.1A | 1 | 1 | 0 | Motor combination error | ○ | | |
| | AL.20 | 1 | 1 | 0 | Encoder error 2 | ○ | | |
| | AL.24 | 1 | 0 | 0 | Main circuit error | ○ | | |
| | AL.25 | 1 | 1 | 0 | Absolute position erase | ○ | | |
| | AL.30 | 0 | 0 | 1 | Regenerative error | ○ | ○ | ○ |
| | 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 error | ○ | ○ | ○ |
| | AL.37 | 0 | 0 | 0 | Parameter error | ○ | | |
| | AL.45 | 0 | 1 | 1 | Main circuit device overheat | ○ | ○ | ○ |
| | AL.46 | 0 | 1 | 1 | Servo motor overheat | ○ | ○ | ○ |
| | AL.50 | 0 | 1 | 1 | Overload 1 | ○ (Note 1) | ○ (Note 1) | ○ (Note 1) |
| | AL.51 | 0 | 1 | 1 | Overload 2 | ○ (Note 1) | ○ (Note 1) | ○ (Note 1) |
| | AL.52 | 1 | 0 | 1 | Error excessive | ○ | ○ | ○ |
| | AL.8A | 0 | 0 | 0 | Serial communication time-out error | ○ | ○ | ○ |
| | AL.8E | 0 | 0 | 0 | Serial communication error | ○ | ○ | ○ |
| | 88888 | 0 | 0 | 0 | Watchdog | ○ | | |
| Warnings | AL.92 | | | | Open battery cable warning | Removing the cause of occurrence deactivates the alarm automatically. | | |
| | AL.96 | | | | Home position setting warning | | | |
| | AL.9F | | | | Battery warning | | | |
| | AL.E0 | | | | Excessive regenerative warning | | | |
| | AL.E1 | | | | Overload warning | | | |
| | AL.E3 | | | | Absolute position counter warning | | | |
| | AL.E5 | | | | ABS time-out warning | | | |
| | AL.E6 | | | | Servo emergency stop warning | | | |
| | AL.E9 | | | | Main circuit off warning | | | |
| | AL.EA | | | | ABS servo-on warning | | | |

Note: 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.
2. 0: Pin-SG off (open)
1: Pin-SG on (short)

### 10.2.2 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 alarm (AL.25) occurred, always make home position setting again. Otherwise, misoperation may occur.

> **POINT**
> - When any of the following alarms has occurred, always remove its cause and allow about 30 minutes for cooling before resuming operation. If operation is resumed by switching control circuit power off, then on to reset the alarm, the servo amplifier and servo motor may become faulty.
>   - 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 signal (RES). For details, refer to Section 10.2.1.

When an alarm occurs, the trouble signal (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 servo configuration software may be used to refer to the cause.

| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| AL.10 | Undervoltage | Power supply voltage dropped.<br>MR-J2S-□A:160V or less<br>MR-J2S-□A1:83V 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. Power was restored after the bus voltage had dropped to 200VDC. (Main circuit power switched on within 5s after it had switched off.) | |
| | | | 5. Faulty parts in the servo amplifier<br>Checking method<br>Alarm (AL.10) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected. | Change the servo amplifier. |
| AL.12 | Memory error 1 | RAM, memory fault | Faulty parts in the servo amplifier<br>Checking method<br>Alarm (any of AL.12,13 and 15) occurs if power is switched on after CN1A, CN1B and CN3 all connectors are disconnected. | Change the servo amplifier. |
| AL.13 | Clock error | Printed board fault | | |
| AL.15 | Memory error 2 | EEP-ROM fault | | |
| AL.16 | Encoder error 1 | Communication error occurred between encoder and servo amplifier. | 1. CN2 connector disconnected. | Connect correctly. |
| | | | 2. Encoder fault | Change the servo motor. |
| | | | 3. Encoder cable faulty (Wire breakage or shorted) | Repair or change cable. |

| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| AL.17 | Board error 2 | CPU/parts fault | Faulty parts in the servo amplifier<br>Checking method<br>Alarm (AL.17 or AL.19) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected. | Change the servo amplifier. |
| AL.19 | Memory error 3 | ROM memory fault | | |
| AL.1A | Motor combination error | Wrong combination of servo anplifier 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. |
| AL.24 | Main circuit error | Ground fault occurred at the servo motor outputs (U,V and W phases) of the servo amplififer. | 1. Power input wires and servo motor output wires are in contact at main circuit terminal block (TE1). | Connect correctly. |
| | | | 2. Sheathes of servo motor power cables deteriorated, resulting in ground fault. | Change the cable. |
| | | | 3. Main circuit of servo amplifier failed.<br>Checking method<br>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. Reduced voltage of super capacitor in encoder | After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position 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. Super capacitor of the absolute position encoder is not charged | After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position setting again. |
| AL.30 | Regenerative alarm | Permissible regenerative power of the built-in regenerative brake resistor or regenerative brake option is exceeded. | 1. Wrong setting of parameter No. 0 | Set correctly. |
| | | | 2. Built-in regenerative brake resistor or regenerative brake option is not connected. | Connect correctly |
| | | | 3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative brake option to be exceeded.<br>Checking method<br>Call the status display and check the regenerative load ratio. | 1. Reduce the frequency of positioning.<br>2. Use the regenerative brake option of larger capacity.<br>3. Reduce the load. |
| | | | 4. Power supply voltage is abnormal.<br>MR-J2S-□A:260V or more<br>MR-J2S-□A1:135V or more | Review power supply |
| | | | 5. Built-in regenerative brake resistor or regenerative brake option faulty. | Change servo amplifier or regenerative brake option. |
| | | Regenerative transistor fault | 6. Regenerative transistor faulty.<br>Checking method<br>1) The regenerative brake option has overheated abnormally.<br>2) The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option. | Change the servo amplifier. |

| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| 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.<br>2. If servo gain cannot be set to proper value:<br>1) Reduce load inertia moment ratio; or<br>2) Reexamine acceleration/ deceleration time constant. |
| | | | 4. Electronic gear ratio is large (parameters No. 3, 4) | Set correctly. |
| | | | 5. Encoder faulty. | Change the servo motor. |
| AL.32 | Overcurrent | Current that flew is higher than the permissible current of the servo amplifier. | 1. Short occurred in servo amplifier output phases U, V and W. | Correct the wiring. |
| | | | 2. Transistor (IPM) of the servo amplifier faulty.<br>Checking method<br>Alarm (AL.32) occurs if power is switched on after U,V and W are disconnected. | Change the servo amplifier. |
| | | | 3. Ground fault occurred in servo amplifier output phases U, V and W. | Correct the wiring. |
| | | | 4. External noise caused the overcurrent detection circuit to misoperate. | Take noise suppression measures. |
| AL.33 | Overvoltage | Converter bus voltage exceeded 400V. | 1. Lead of built-in regenerative brake resistor or regenerative brake option is open or disconnected. | 1. Change lead.<br>2. Connect correctly. |
| | | | 2. Regenerative transistor faulty. | Change servo amplifier |
| | | | 3. Wire breakage of built-in regenerative brake resistor or regenerative brake option | 1. For wire breakage of built-in regenerative brake resistor, change servo amplifier.<br>2. For wire breakage of regenerative brake option, change regenerative brake option. |
| | | | 4. Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient. | Add regenerative brake option or increase capacity. |
| | | | 5. Power supply voltage high. | Review the power supply. |

| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| AL.35 | Command pulse frequency error | Input pulse frequency of the command pulse is too high. | 1. Pulse frequency of the command pulse is too high. | Change the command pulse frequency to a proper value. |
| | | | 2. Noise entered command pulses. | Take action against noise. |
| | | | 3. Command device failure | Change the command device. |
| AL.37 | Parameter error | Parameter setting is wrong. | 1. Servo amplifier fault caused the parameter setting to be rewritten. | Change the servo amplifier. |
| | | | 2. Regenerative brake option not used with servo amplifier was selected in parameter No.0. | Set parameter No.0 correctly. |
| 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. Air cooling fan of servo amplifier stops. | 1. Exchange the cooling fan or the servo amplifier.<br>2. Reduce ambient temperature. |
| AL.46 | Servo motor overheat | Servo motor temperature rise actuated the thermal protector. | 1. Ambient temperature of servo motor is over 40℃. | Review environment so that ambient temperature is 0 to 40℃. |
| | | | 2. Servo motor is overloaded. | 1. Reduce load.<br>2. Review operation pattern.<br>3. Use servo motor that provides larger output. |
| | | | 3. Thermal protector in encoder is faulty. | Change servo motor. |
| AL.50 | Overload 1 | Load exceeded overload protection characteristic of servo amplifier.<br>Load ratio 300%: 2.5s or more<br>Load ratio 200%: 100s or more | 1. Servo amplifier is used in excess of its continuous output current. | 1. Reduce load.<br>2. Review operation pattern.<br>3. Use servo motor that provides larger output. |
| | | | 2. Servo system is instable and hunting. | 1. Repeat acceleration/ deceleration to execute auto tuning.<br>2. Change auto tuning response setting.<br>3. Set auto tuning to OFF and make gain adjustment manually. |
| | | | 3. Machine struck something. | 1. Review operation pattern.<br>2. Install limit switches. |
| | | | 4. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W. | Connect correctly. |
| | | | 5. Encoder faulty.<br>Checking method<br>When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty. | Change the servo motor. |

| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| 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 | 1. Machine struck something. | 1. Review operation pattern.<br>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.<br>2. Change auto tuning response setting.<br>3. Set auto tuning to OFF and make gain adjustment manually. |
| | | | 4. Encoder faulty.<br>Checking method<br>When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty. | Change the servo motor. |
| AL.52 | Error excessive | The droop pulse value of the deviation counter exceeded the encoder resolution ×10 [pulse]. | 1. Acceleration/deceleration time constant is too small. | Increase the acceleration/deceleration time constant. |
| | | | 2. Torque limit value (parameter No.28) is 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.<br>2. Use servo motor which provides larger output. |
| | | | 4. Position control gain 1 (parameter No.6) 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.<br>2. Reduce load.<br>3. Use servo motor that provides larger output. |
| | | | 6. Machine struck something. | 1. Review operation pattern.<br>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 | RS-232C or RS-422 communication stopped for longer than the time set in parameter No.56. | 1. Communication cable breakage. | Repair or change communication cable |
| | | | 2. Communication cycle longer than parameter No. 56 setting. | Set correct value in parameter. |
| | | | 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 |
|---|---|---|---|---|
| 88888 | Watchdog | CPU, parts faulty | Fault of parts in servo amplifier<br>Checking method<br>Alarm (88888) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected. | Change servo amplifier. |

### 10.2.3 Remedies for warnings

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.

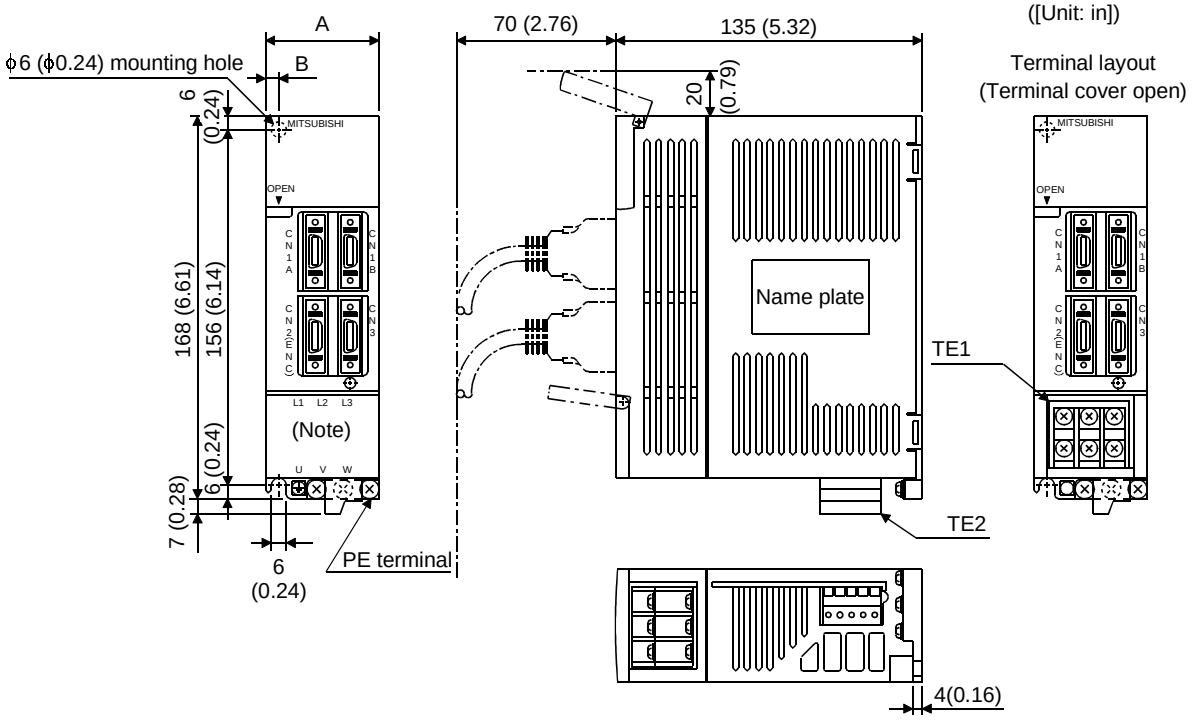
| Display | Name | Definition | Cause | Action |
|---|---|---|---|---|
| AL.92 | Open battery cable warning | Absolute position detection system battery voltage is low. | 1. Battery cable is open. | Repair cable or changed. |
| | | | 2. Battery voltage dropped to 2.8V or less. | Change battery. |
| AL.96 | 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.9F | Battery warning | Voltage of battery for absolute position detection system reduced. | Battery voltage fell to 3.2V or less. | Change the battery. |
| AL.E0 | Excessive regenerative warning | There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative brake resistor or regenerative brake option. | Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative brake resistor or regenerative brake option.<br>Checking method<br>Call the status display and check regenerative load ratio. | 1. Reduce frequency of positioning.<br>2. Change regenerative brake option for the one with larger capacity.<br>3. Reduce load. |
| AL.E1 | Overload warning | There is a possibility that overload alarm 1 or 2 may occur. | Load increased to 85% or more of overload alarm 1 or 2 occurrence level.<br>Cause, checking method<br>Refer to AL.50,51. | Refer to AL.50, AL.51. |
| 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. |
| AL.E5 | ABS time-out warning | | 1. PC lader program wrong. | Contact the program. |
| | | | 2. ST2・TLC signal mis-wiring | Connect properly. |
| AL.E6 | Servo emergency stop warning | EMG-SG are open. | External emergency stop was made valid. (EMG-SG opened.) | Ensure safety and deactivate emergency stop. |
| AL.E9 | Main circuit off warning | Servo was switched on with main circuit power off. | | Switch on main circuit power. |
| AL.EA | ABS servo-on warning | Servo-on signal (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. SON signal mis-wiring. | 2. Connect properly. |

# 11. OUTLINE DIMENSION DRAWINGS

## 11.1 Servo amplifiers

(1) MR-J2S-10A to MR-J2S-60A
MR-J2S-10A1 to MR-J2S-40A1

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




| Servo amplifier | Variable dimensions | | Weight |
|---|---|---|---|
| | A | B | [kg]([lb]) |
| MR-J2S-10A(1) | 50 (1.97) | 6 (0.24) | 0.7 (1.54) |
| MR-J2S-20A(1) | | | |
| MR-J2S-40A(1) | 70 (2.76) | 22 (0.87) | 1.1 (2.43) |
| MR-J2S-60A | | | |

Note: This data applies to the 3-phase 200 to 230VAC and 1-phase 230VAC power supply models.

TE1

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

| $L_1$ | $L_2$ | $L_3$ |
|---|---|---|
| U | V | W |

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

• For 1-phase 100 to 120VAC

| $L_1$ | | $L_2$ |
|---|---|---|
| U | V | W |

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

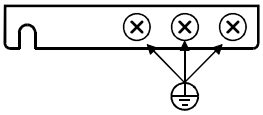
TE2

←Front

| D | C | P | $L_{21}$ | $L_{11}$ |
|---|---|---|---|---|

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

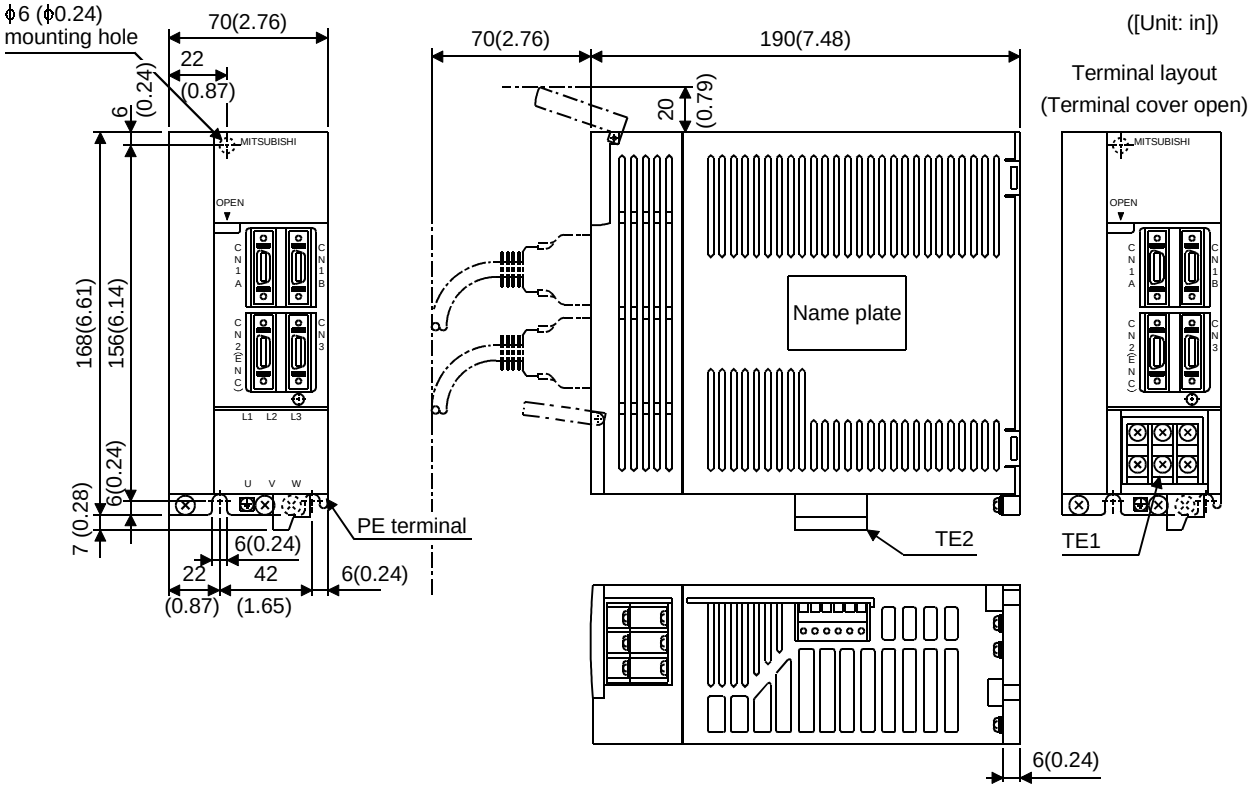
PE terminals



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

(2) MR-J2S-70A・MR-J2S-100A

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




| Servo amplifier | Weight [kg]([lb]) |
|---|---|
| MR-J2S-70A | 1.7 |
| MR-J2S-100A | (3.75) |

TE1

| | | |
|---|---|---|
| L1 | L2 | L3 |
| U | V | W |

Terminal screw: M4

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

TE2

← Front

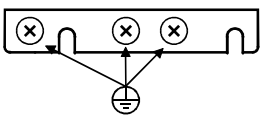
| | | | | | |
|---|---|---|---|---|---|
| D | C | P | L21 | L11 | N |

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

(Phoenix Contact make)

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

PE terminals

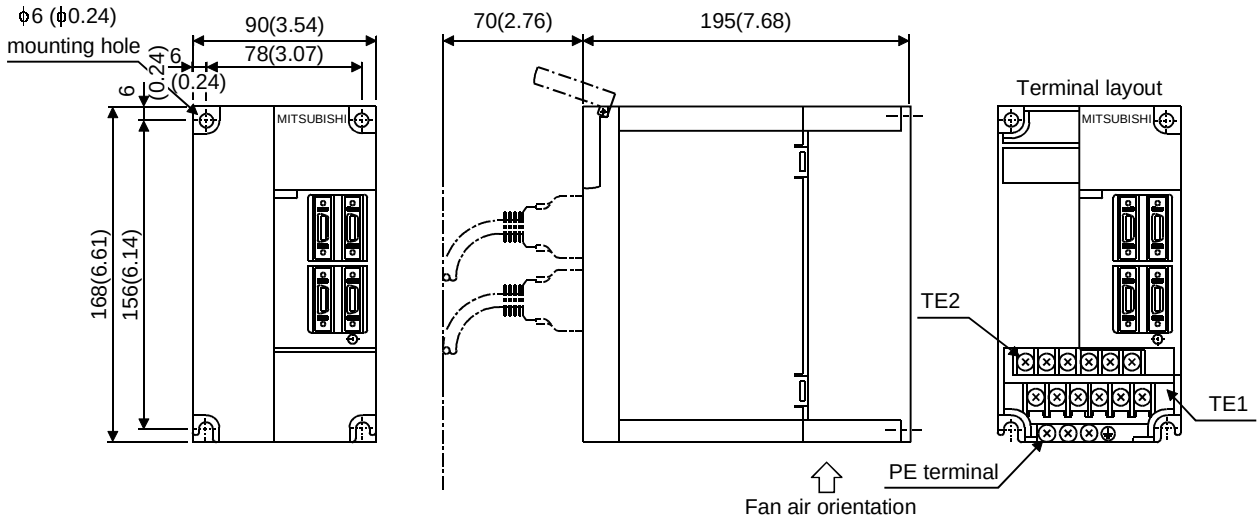


Terminal screw: M4

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

(3) MR-J2S-200A ▪ MR-J2S-350A

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




| Servo amplifier | Weight [kg]([lb]) |
|---|---|
| MR-J2S-200A | 2.0 |
| MR-J2S-350A | (4.41) |

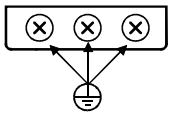
TE1

| $L_1$ | $L_2$ | $L_3$ | U | V | W |
|---|---|---|---|---|---|

Terminal screw: M4

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

PE terminals



Terminal screw: M4

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

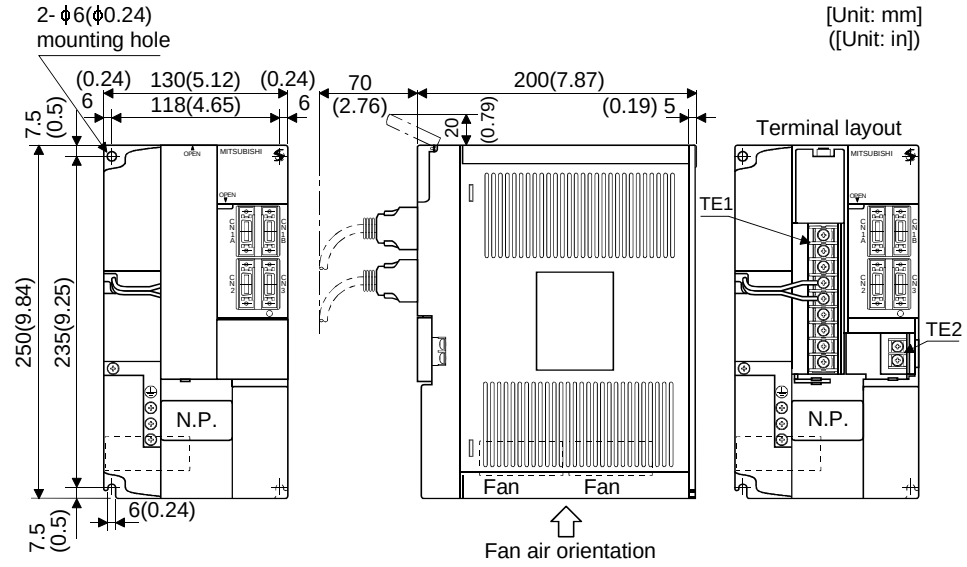
TE2

| $L_{11}$ | $L_{21}$ | D | P | C | N |
|---|---|---|---|---|---|

Terminal screw: M4

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

(4) MR-J2S-500A

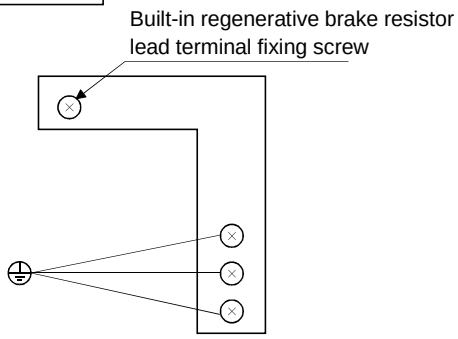



| Servo amplifier | Weight [kg]([lb]) |
|---|---|
| MR-J2S-500A | 4.9(10.8) |

TE1

| | |
|---|---|
| $L_1$ | Terminal screw : M4 |
| $L_2$ | Tightening torque : 1.2 [N・m](169.9[oz・in]) |
| $L_3$ | |
| C | |
| P | |
| N | |
| U | |
| V | |
| W | |

PE terminals

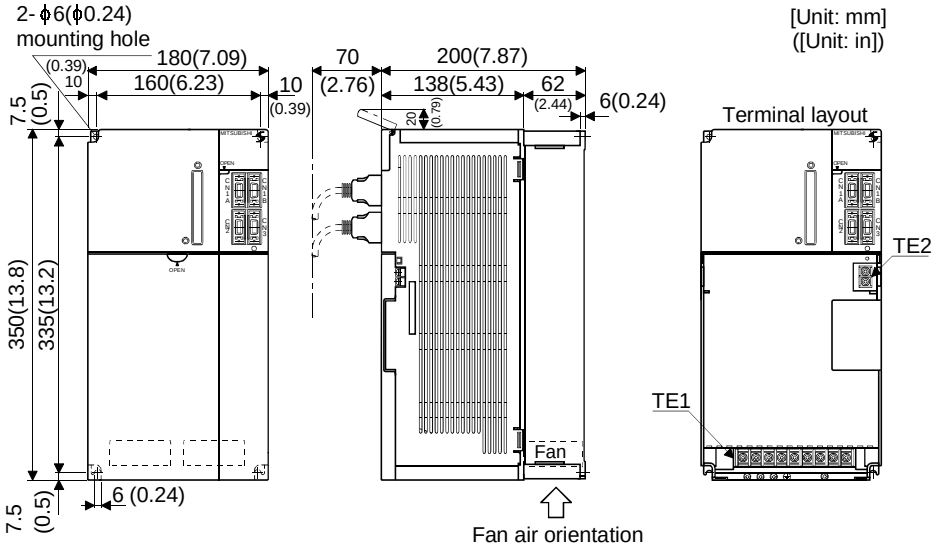



Terminal screw : M4
Tightening torque : 1.2 [N・m](169.9[oz・in])

TE2

| | |
|---|---|
| $L_{11}$ | Terminal screw : M3.5 |
| $L_{21}$ | Tightening torque : 1.0 [N・m](141.6[oz・in]) |

(5) MR-J2S-700A



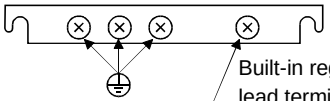

| Servo amplifier | Weight [kg]([lb]) |
|---|---|
| MR-J2S-700A | 7.2(15.9) |

TE1

| $L_1$ | $L_2$ | $L_3$ | C | P | N | U | V | W |
|---|---|---|---|---|---|---|---|---|

Terminal screw : M4
Tightening torque : 1.2 [N・m](169.9[oz・in])

PE terminals



Built-in regenerative brake resistor lead terminal fixing screw

Terminal screw : M4
Tightening torque : 1.2 [N・m](169.9[oz・in])

TE2

| $L_{11}$ |
|---|
| $L_{21}$ |

Terminal screw : M3.5
Tightening torque : 1.0 [N・m](141.6[oz・in])

## 11.2 Connectors

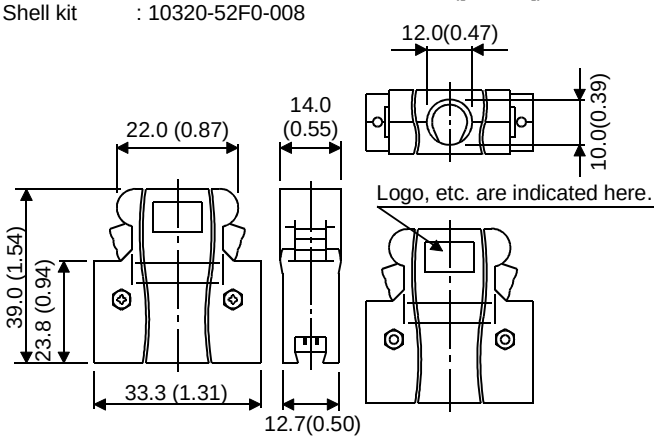
### (1) Servo amplifier side

<3M >

(a) Soldered type

Model
Connector : 10120-3000VE
Shell kit : 10320-52F0-008

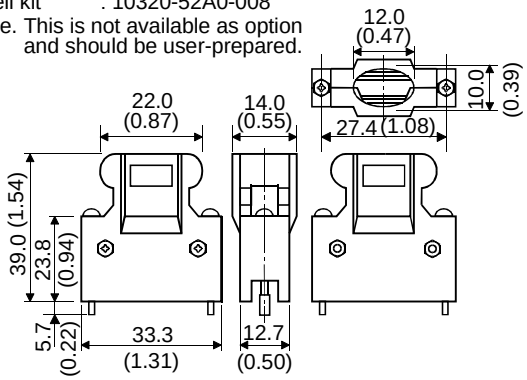
[Unit: mm]
([Unit: in])




(b) Threaded type

Model
Connector : 10120-3000VE
Shell kit : 10320-52A0-008
Note. This is not available as option and should be user-prepared.

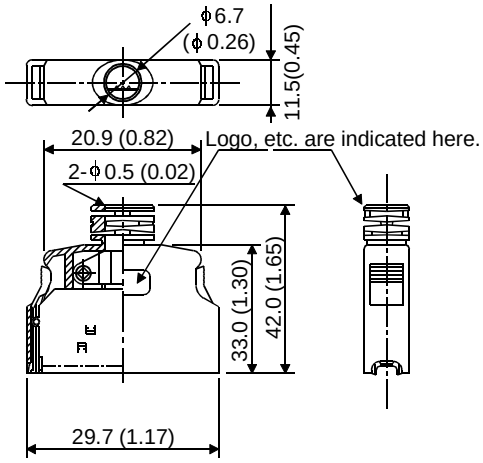
[Unit: mm]
([Unit: in])




(c) Insulation displacement type

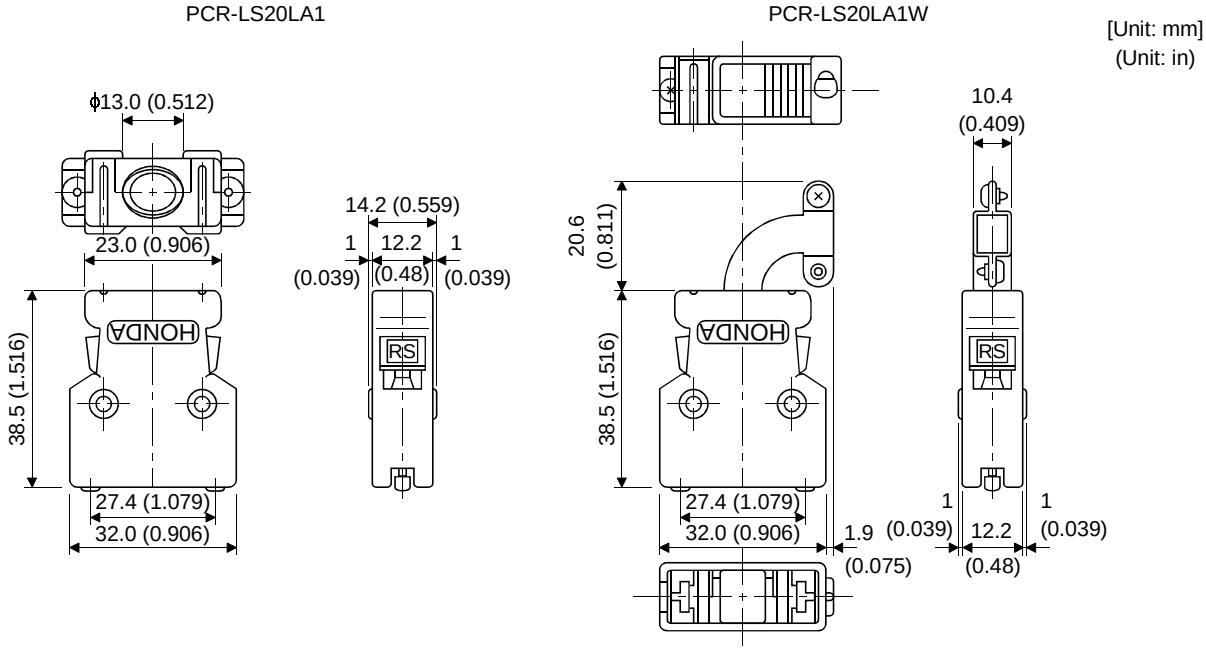
Model
Connector : 10120-6000EL
Shell kit : 10320-3210-000

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



(2) Bus cable connector

<Honda Tsushin>



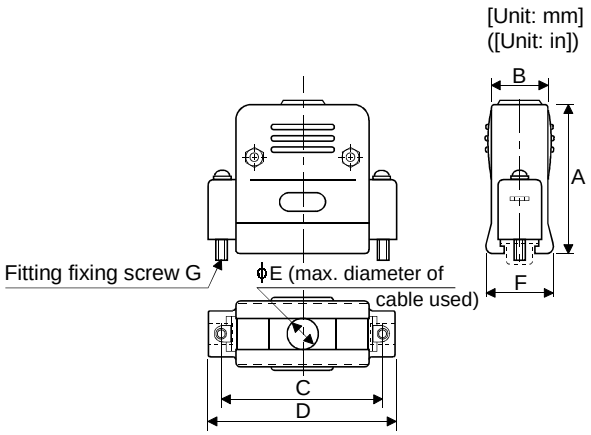

| Number of Pins | Model | |
|---|---|---|
| | Connector | Case |
| 20 | PCR-S20FS (soldering type) | PCR-LS20LA1 |
| | PCR-S20F (insulation displacement type) | PCR-LS20LA1W |

Crimping terminal: FHAT-002A

Note: PCR-S20F and PCR-LS20LA1W are not options and are to be supplied by the customer.

(3) Communication cable connector

<Japan Aviation Electronics Industry >




| Type | A ±1 | B ±1 | C ±0.25 | D ±1 | ϕE | F Reference | G |
|---|---|---|---|---|---|---|---|
| DE-C1-J6-S6 | 34.5(1.36) | 19(0.75) | 24.99(0.98) | 33(1.30) | 6(0.24) | 18(0.71) | #4-40 |

# MEMO

# 12. CHARACTERISTICS

## 12.1 Overload protection characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. Overload 1 alarm (AL.50) occurs if overload operation performed is above the electronic thermal relay protection curve shown below. 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.

(1) MR-J2S-10A to MR-J2S-100A

HC-KFS series
HC-MFS series
HC-SFS series
HC-UFS series

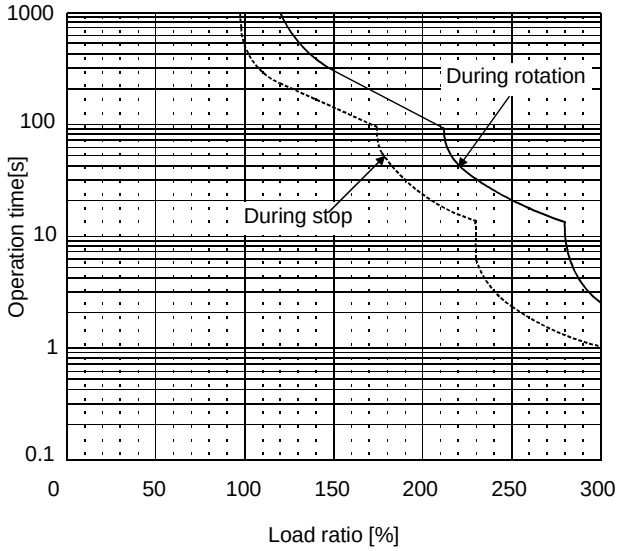



Fig 12.1 Electronic thermal relay protection characteristics 1

(2) MR-J2S-200A to MR-J2S-350A

HC-SFS series
HC-RFS series
HC-UFS series

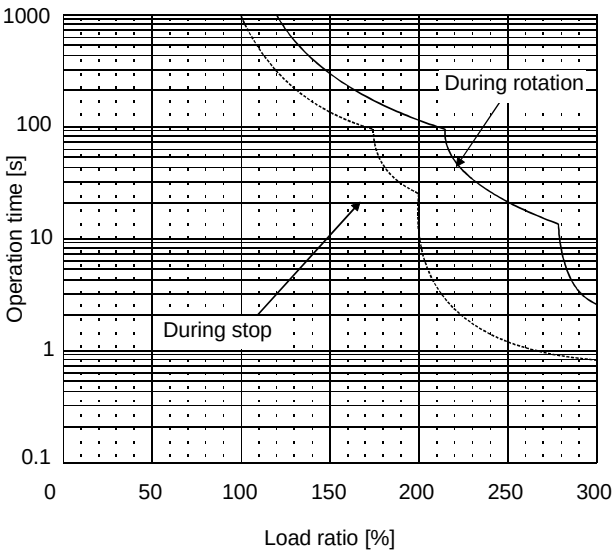



Fig 12.2 Electronic thermal relay protection characteristics 2

(3) MR-J2S-500A・MR-J2S-700A

HC-SFS series
HC-RFS series
HC-UFS series

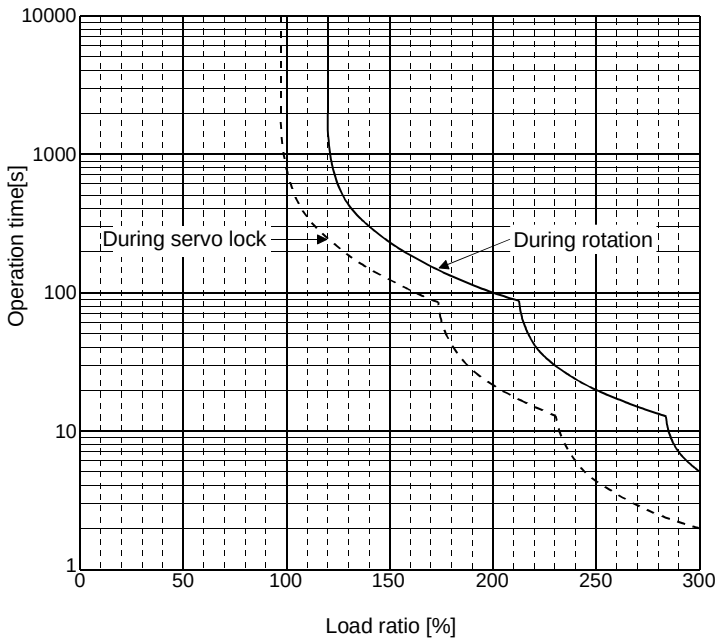



Fig 12.3 Electronic thermal relay protection characteristics 3

## 12.2 Power supply equipment capacity and generated loss

### (1) Amount of heat generated by the servo amplifier

Table 12.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 12.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and zero torque according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Table 12.1 Power supply capacity and generated heat per servo amplifier at rated output

| Servo amplifier | Servo motor | (Note 1) Power supply capacity[kVA] | (Note 2) Servo amplifier-generated heat[W] | | Area required for heat dissipation | |
|---|---|---|---|---|---|---|
| | | | At rated torque | With servo off | [m²] | [ft²] |
| MR-J2S-10A(1) | HC-KFS053・13 | 0.3 | 25 | 15 | 0.5 | 5.4 |
| | HC-MFS053・13 | 0.3 | 25 | 15 | 0.5 | 5.4 |
| | HC-UFS13 | 0.3 | 25 | 15 | 0.5 | 5.4 |
| MR-J2S-20A(1) | HC-KFS23 | 0.5 | 25 | 15 | 0.5 | 5.4 |
| | HC-MFS23 | 0.5 | 25 | 15 | 0.5 | 5.4 |
| | HC-UFS23 | 0.5 | 25 | 15 | 0.5 | 5.4 |
| MR-J2S-40A(1) | HC-KFS43 | 0.9 | 35 | 15 | 0.7 | 7.5 |
| | HC-MFS43 | 0.9 | 35 | 15 | 0.7 | 7.5 |
| | HC-UFS43 | 0.9 | 35 | 15 | 0.7 | 7.5 |
| MR-J2S-60A | HC-SFS52 | 1.0 | 40 | 15 | 0.8 | 8.6 |
| | HC-SFS53 | 1.0 | 40 | 15 | 0.8 | 8.6 |
| MR-J2S-70A | HC-KFS73 | 1.3 | 50 | 15 | 1.0 | 10.8 |
| | HC-MFS73 | 1.3 | 50 | 15 | 1.0 | 10.8 |
| | HC-UFS72・73 | 1.3 | 50 | 15 | 1.0 | 10.8 |
| MR-J2S-100A | HC-SFS81 | 1.5 | 50 | 15 | 1.0 | 10.8 |
| | HC-SFS102・103 | 1.7 | 50 | 15 | 1.0 | 10.8 |
| MR-J2S-200A | HC-SFS121 | 2.1 | 90 | 20 | 1.8 | 19.4 |
| | HC-SFS201 | 3.5 | 90 | 20 | 1.8 | 19.4 |
| | HC-SFS152・153 | 2.5 | 90 | 20 | 1.8 | 19.4 |
| | HC-SFS202・203 | 3.5 | 90 | 20 | 1.8 | 19.4 |
| | HC-RFS103 | 1.7 | 50 | 15 | 1.0 | 10.8 |
| | HC-RFS153 | 2.5 | 90 | 20 | 1.8 | 19.4 |
| | HC-UFS152 | 2.5 | 90 | 20 | 1.8 | 19.4 |
| MR-J2S-350A | HC-SFS301 | 4.8 | 120 | 20 | 2.7 | 29.1 |
| | HC-SFS352・353 | 5.5 | 130 | 20 | 2.7 | 29.1 |
| | HC-RFS203 | 3.5 | 90 | 20 | 1.8 | 19.4 |
| | HC-UFS202 | 3.5 | 90 | 20 | 1.8 | 19.4 |
| MR-J2S-500A | HC-SFS502 | 7.5 | 195 | 25 | 3.9 | 42.0 |
| | HC-RFS353 | 5.5 | 135 | 25 | 2.7 | 29.1 |
| | HC-RFS503 | 7.5 | 195 | 25 | 3.9 | 42.0 |
| | HC-UFS352 | 5.5 | 195 | 25 | 3.9 | 42.0 |
| | HC-UFS502 | 7.5 | 195 | 25 | 3.9 | 42.0 |
| MR-J2S-700A | HC-SFS702 | 10.0 | 300 | 25 | 6.0 | 64.6 |

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

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative brake option, use Equation 13.1 in Section 13.1.1.

(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℉) safety margin, the system should operate within a maximum 55℃ (131℉) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 12.1:

$$A = \frac{P}{K \cdot \Delta T} \quad \text{.....(12.1)}$$

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

When calculating the heat dissipation area with Equation 12.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 12.1 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 12.1 lists the enclosure dissipation area for each servo amplifier when the servo amplifier is operated at the ambient temperature of 40℃ (104℉) under rated load.

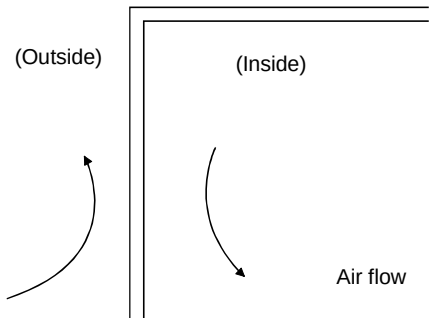



Fig. 12.4 Temperature distribution in enclosure

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.

### 12.3 Dynamic brake characteristics

Fig. 12.4 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 12.2 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 Fig. 12.5)

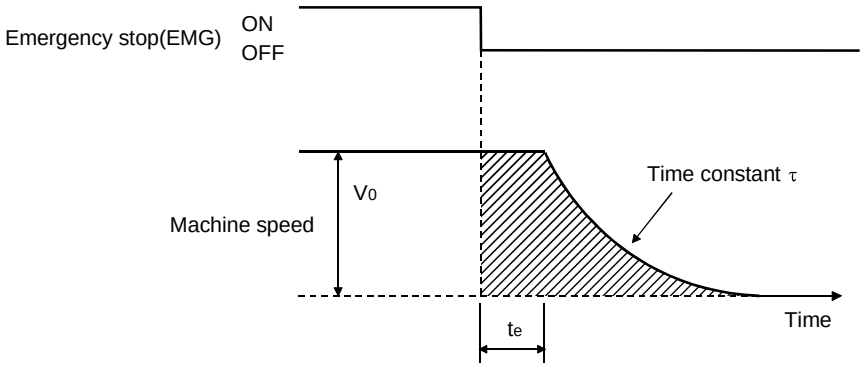
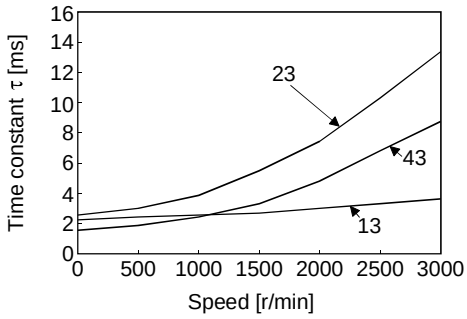


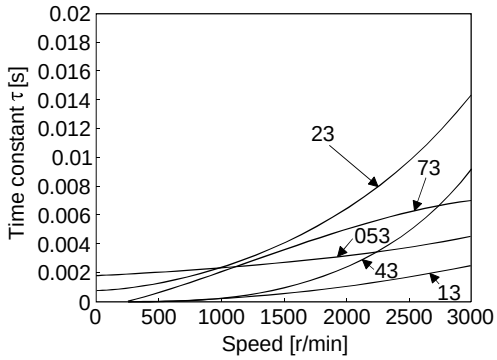

Fig. 12.5 Dynamic brake operation diagram

$$L_{max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left( 1 + \frac{J_L}{J_M} \right) \right\} \quad \text{.....(12.2)}$$

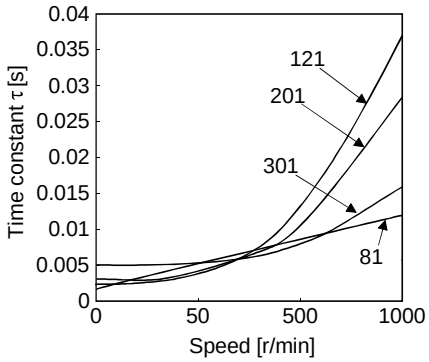
$L_{max}$ : Maximum coasting distance .....[mm][in]
$V_o$ : Machine rapid feedrate ..... [mm/min][in/min]
$J_M$ : Servo motor inertial moment.....[kg · cm²][oz · in²]
$J_L$ : Load inertia moment converted into equivalent value on servo motor shaft.....[kg · cm²][oz · in²]
$\tau$ : Brake time constant (Fig. 12.5).....[s]
$t_e$ : Delay time of control section (Fig. 12.4).....[s]
(There is internal relay delay time of about 30ms.)



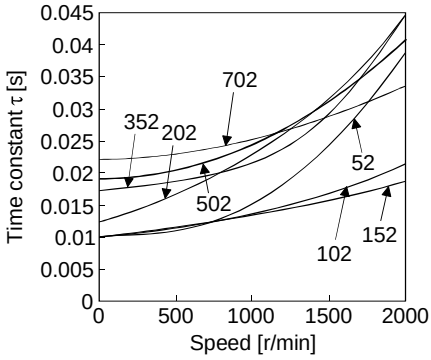

a. HC-KFS series



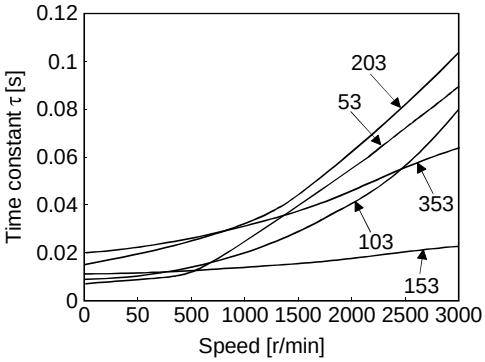

b. HC-MFS series



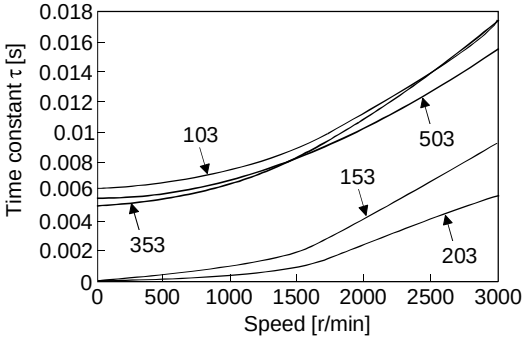

c. HC-SFS1000r/min series



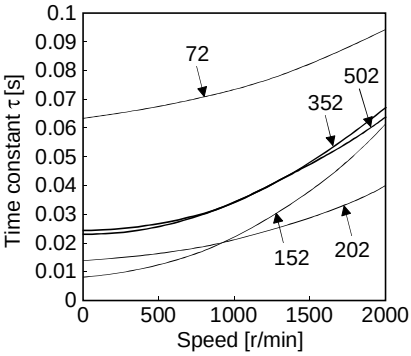

d. HC-SFS2000r/min series



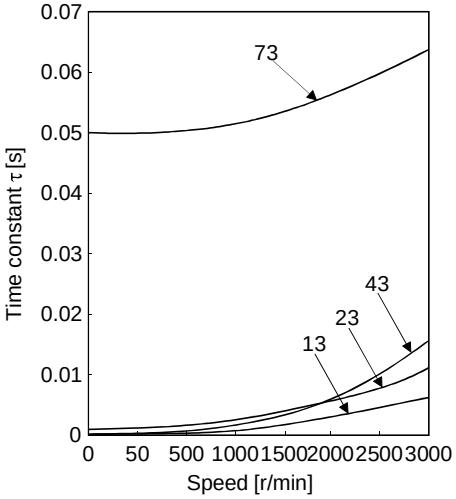

e. HC-SFS3000r/min series




f. HC-RFS series




g. HC-UFS 2000r/min series




h. HC-UFS3000r/min series

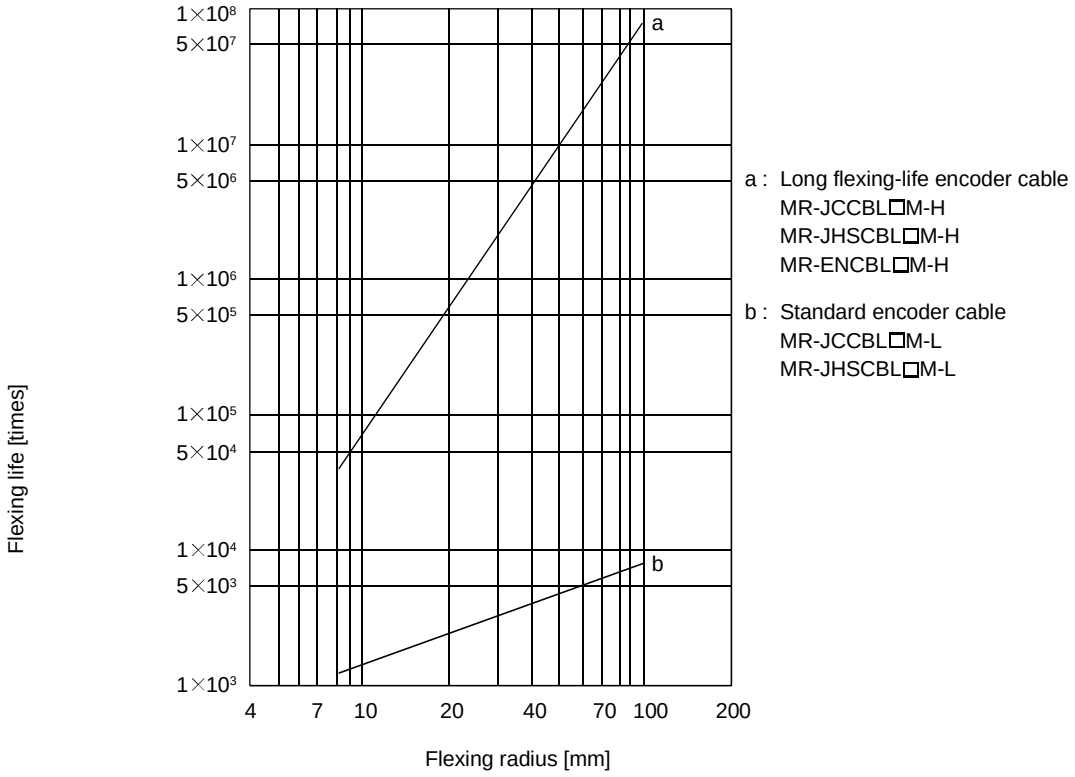
Fig. 12.6 Dynamic brake time constant

Use the dynamic brake at the load inertia moment 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.

| Servo amplifier | Load inertia moment ratio [times] |
|---|---|
| MR-J2S-10A to MR-J2S-200A<br>MR-J2S-10A1 to MR-J2S-40A1 | 30 |
| MR-J2S-350A | 16 |
| MR-J2S-500A・MR-J2S-700A | 15 |

### 12.4 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.



# MEMO

# 13. OPTIONS AND AUXILIARY EQUIPMENT

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

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

## 13.1 Options

### 13.1.1 Regenerative brake options

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

(1) Combination and regenerative power

| Servo amplifier | (Note) Regenerative power[W] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Built-in regenerative brake resistor | MR-RB032 [40Ω] | MR-RB12 [40Ω] | MR-RB32 [40Ω] | MR-RB30 [13Ω] | MR-RB50 [13Ω] | MR-RB31 [6.7Ω] | MR-RB51 [6.7Ω] |
| MR-J2S-10A(1) | | 30 | | | | | | |
| MR-J2S-20A(1) | 10 | 30 | 100 | | | | | |
| MR-J2S-40A(1) | 10 | 30 | 100 | | | | | |
| MR-J2S-60A | 10 | 30 | 100 | | | | | |
| MR-J2S-70A | 20 | 30 | 100 | 300 | | | | |
| MR-J2S-100A | 20 | 30 | 100 | 300 | | | | |
| MR-J2S-200A | 100 | | | | 300 | 500 | | |
| MR-J2S-350A | 100 | | | | 300 | 500 | | |
| MR-J2S-500A | 130 | | | | 300 | 500 | | |
| MR-J2S-700A | 170 | | | | | | 300 | 500 |

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

(2) Selection of the regenerative brake option

(a) Simple selection method

In horizontal motion applications, select the regenerative brake option as described below: When the servo motor is run without load in the regenerative mode from the running speed to a stop, the permissible duty is as indicated in Section 5.1 of the separately available Servo Motor Instruction Manual.

For the servo motor with a load, the permissible duty changes according to the inertia moment of the load and can be calculated by the following formula:

$$\text{Permissible duty} = \frac{\text{Permissible duty for servo motor with no load (value indication Section 5.1 in Servo Motor Instruction Manual)}}{(m+1)} \times \left(\frac{\text{ratedspeed}}{\text{running speed}}\right)^2 [\text{times/min}]$$

where m = load inertia moment/servo motor inertia moment

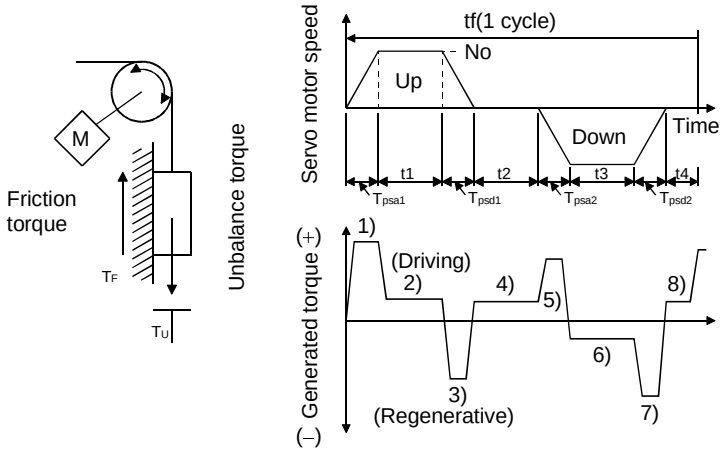
From the permissible duty, find whether the regenerative brake option is required or not.
Permissible duty < number of positioning times [times/min]
Select the regenerative brake option out of the combinations in (1) in this section.

(b) To make selection according to regenerative energy

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

a. Regenerative energy calculation

Use the following table to calculate the regenerative energy.




Formulas for calculating torque and energy in operation

| Regenerative power | Torque applied to servo motor [N・m] | Energy [J] |
|---|---|---|
| 1) | $T_1 = \frac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psa1}} + T_U + T_F$ | $E_1 = \frac{0.1047}{2} \cdot N_0 \cdot T_1 \cdot T_{psa1}$ |
| 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) | $T_7 = \frac{(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psd2}} - T_U + T_F$ | $E_7 = \frac{0.1047}{2} \cdot N_0 \cdot T_7 \cdot T_{psd2}$ |
| Sum total of regenerative energies | | Sum total of negative energies in 1) to 8) |

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

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

| Servo amplifier | Inverse efficiency[%] | Capacitor charging[J] |
|---|---|---|
| MR-J2S-10A(1) | 55 | 9 |
| MR-J2S-20A(1) | 70 | 9 |
| MR-J2S-40A(1) | 85 | 11 |
| MR-J2S-60A | 85 | 11 |
| MR-J2S-70A | 80 | 18 |
| MR-J2S-100A | 80 | 18 |
| MR-J2S-200A | 85 | 40 |
| MR-J2S-350A | 85 | 40 |
| MR-J2S-500A | 90 | 45 |
| MR-J2S-700A | 90 | 70 |

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

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

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

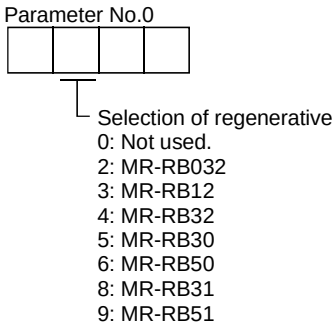
$$ER\ [J] = \eta \cdot Es - Ec$$

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

$$PR\ [W] = ER/tf \quad \text{.....(13.1)}$$

(3) Connection of the regenerative brake option

Set parameter No.2 according to the open to be used.

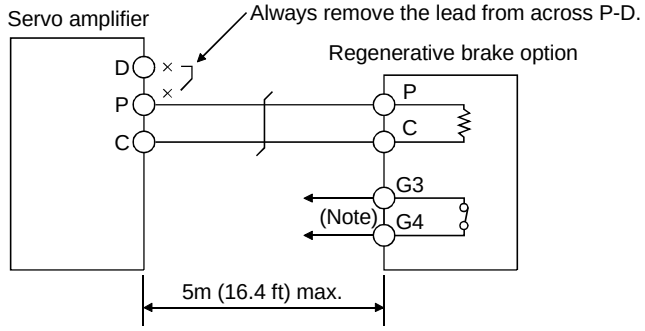


(4) Connection of the regenerative brake option

The regenerative brake option will generate heat of about 100℃. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant cables and keep them clear of the regenerative brake option body. Always use twisted cables of max. 5m(16.4ft) length for connection with the servo amplifier.

(a) MR-J2S-350A or less

Always remove the wiring from across P-D and fit the regenerative brake option across P-C.

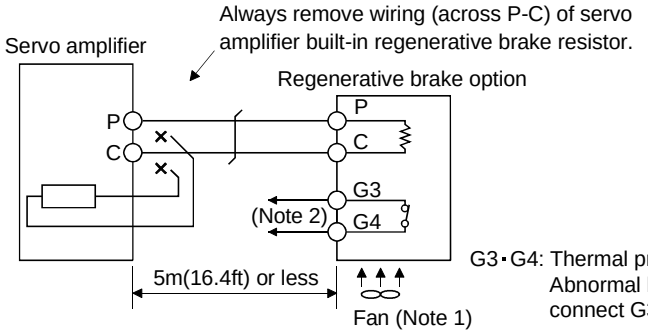



G3・G4: Thermal protector terminals. Abnormal heating will disconnect G3-G4.

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

(b) MR-J2S-500A・MR-J2S-700A

Always remove the wiring (across P-C) of the servo amplifier built-in regenerative brake resistor and fit the regenerative brake option across P-C.

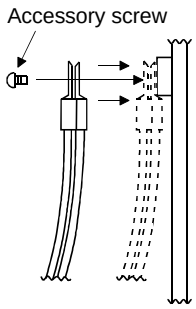



G3・G4: Thermal protector terminals. Abnormal heating will disconnect G3-G4.

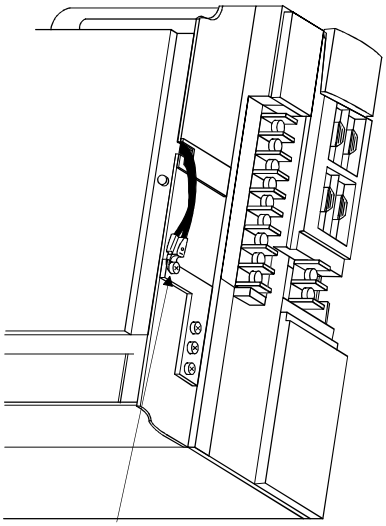
Note 1. When using the MR-RB51, forcibly cool it with a cooling fan (1.0m³/min, □92 or so).
2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.

When using the regenerative brake resistor option, remove the servo amplifier's built-in regenerative brake resistor terminals (across P-C), fit them back to back, and secure them to the frame with the accessory screw as shown below.

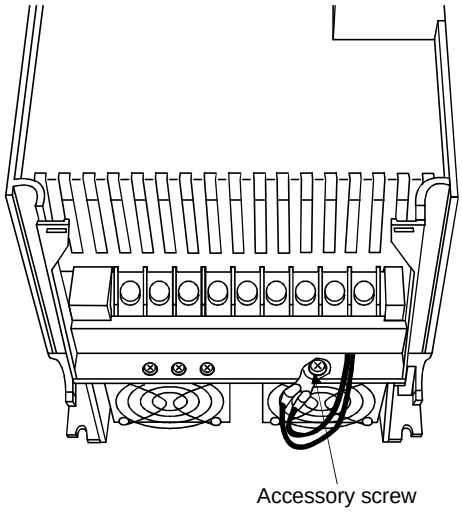
Mounting method




For MR-J2S-500A

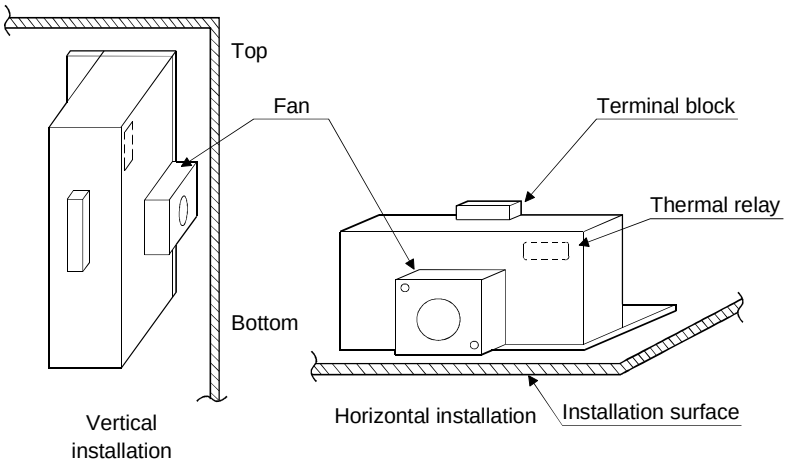



For MR-J2S-700A

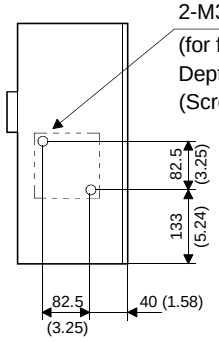



For the MR-RB51 install the cooling fan as shown.

[Unit : mm(in)]




Fan installation screw hole dimensions

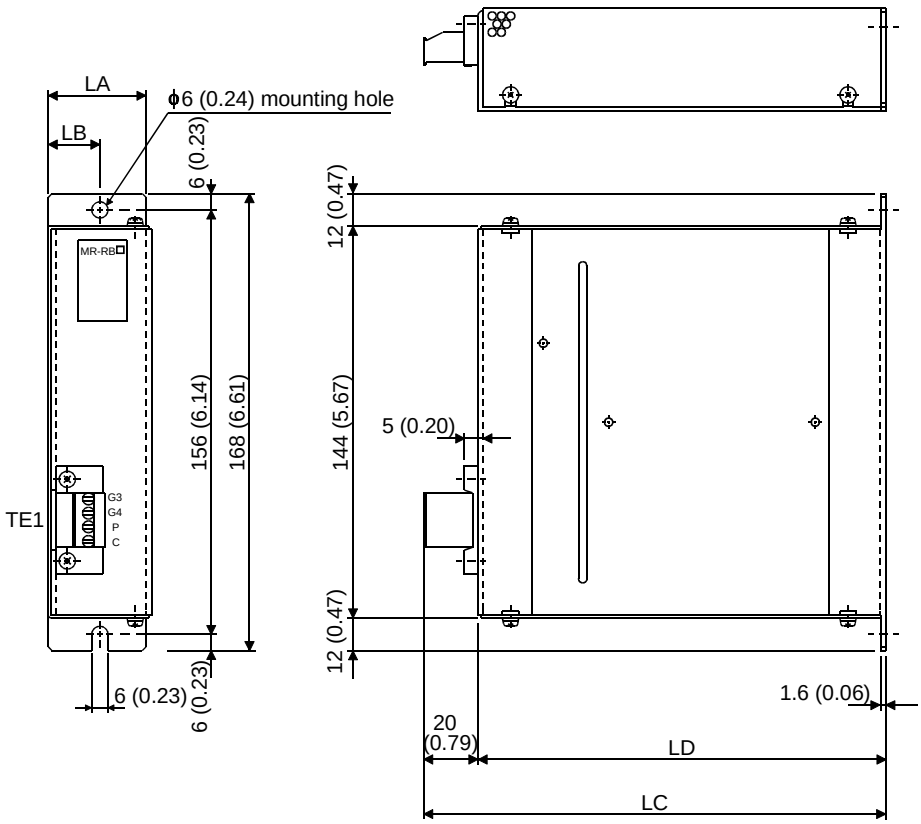



Recommended fan:
Toyo Denki's TL396A or equivalent

(5) Outline drawing

(a) MR-RB032 · MR-RB12

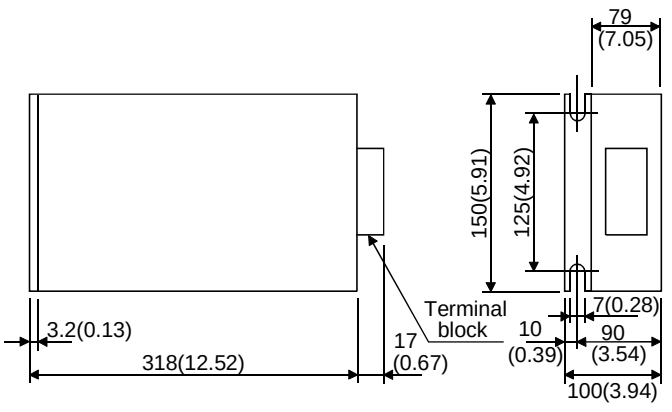
[Unit: mm (in)]




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

(b) MR-RB32 · MR-RB30 · MR-RB31

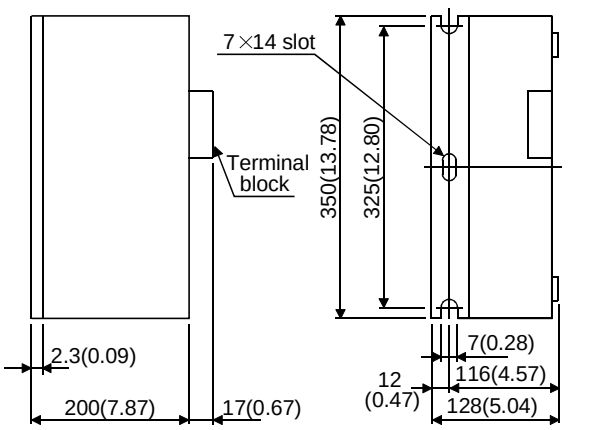
[Unit: mm (in)]




| Regenerative brake option | Regenerative power [W] | Resistance [Ω] | Weight | |
|---|---|---|---|---|
| | | | [kg] | [lb] |
| MR-RB32 | 300 | 40 | 2.9 | 6.4 |
| MR-RB30 | 300 | 13 | 2.9 | 6.4 |

(c) MR-RB50 · MR-RB51

[Unit: mm (in)]




| Regenerative brake option | Regenerative power [W] | Resistance [Ω] | Weight | |
|---|---|---|---|---|
| | | | [kg] | [lb] |
| MR-RB50 | 500 | 13 | 5.6 | 12.3 |

### 13.1.2 Brake unit

**POINT**

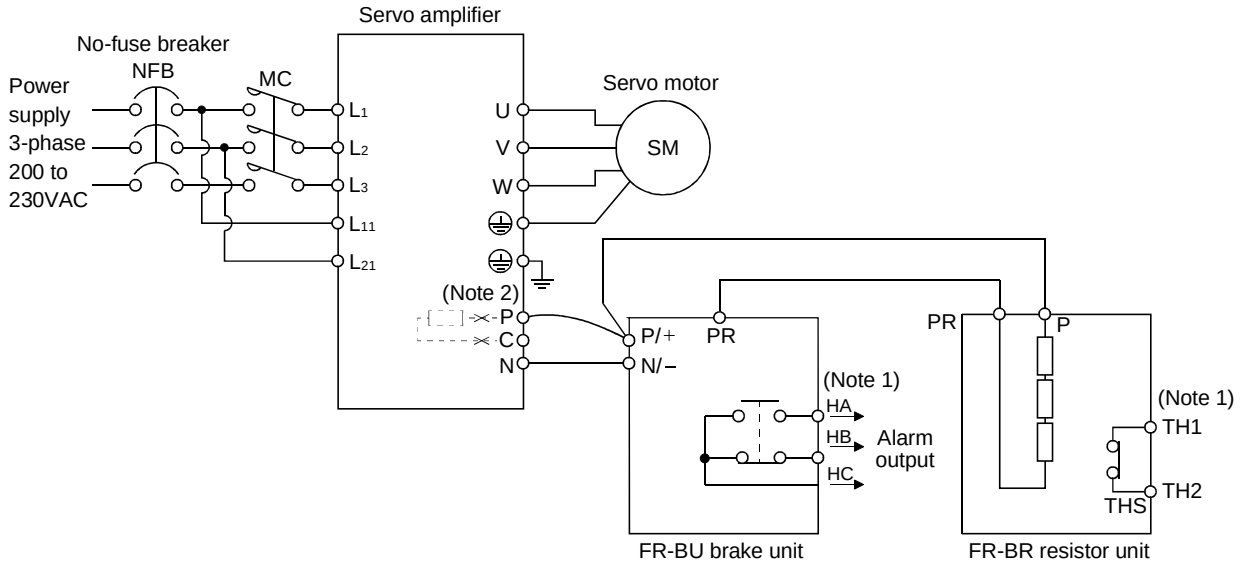
- The brake unit and resistor unit of other than 200V class are not applicable to the servo amplifier.
- The brake unit and resistor unit of the same capacity must be combined. The units of different capacities may result in damage.
- The brake unit and resistor unit must be installed on a vertical surface 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 brake option, the brake unit can return larger power. Hence, use the this brake unit when the MR-RB cannot provide sufficient regenerative brake capability.

(1) Selection

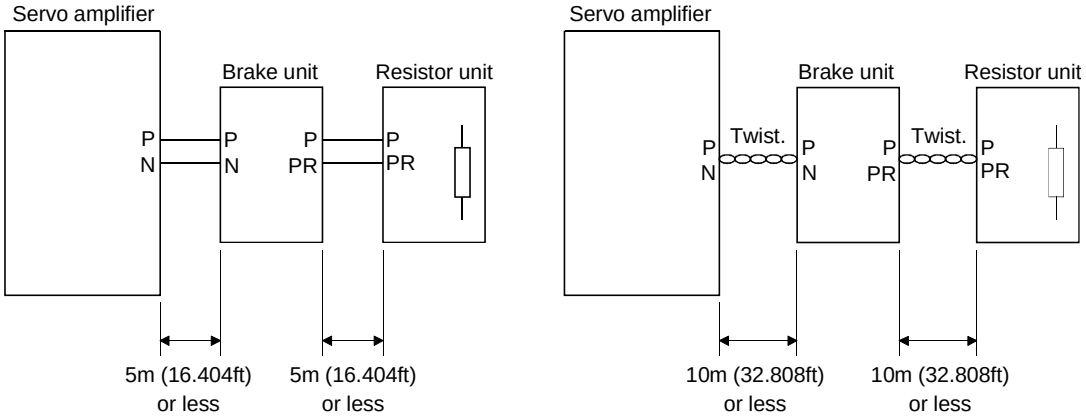
| Brake unit | Resistor unit | Permissible Continuous Power [kw] | Max. Instantaneous Current [kw] | Applicable Servo Amplifier |
|---|---|---|---|---|
| FR-BU-15K | FR-BR-15K | 0.99 | 16.5 | MR-J2S-500A |
| FR-BU-30K | FR-BR-30K | 1.99 | 33.4 | MR-J2S-700A |

(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. Always remove the wiring (across P-C) of the servo amplifier built-in resistor.

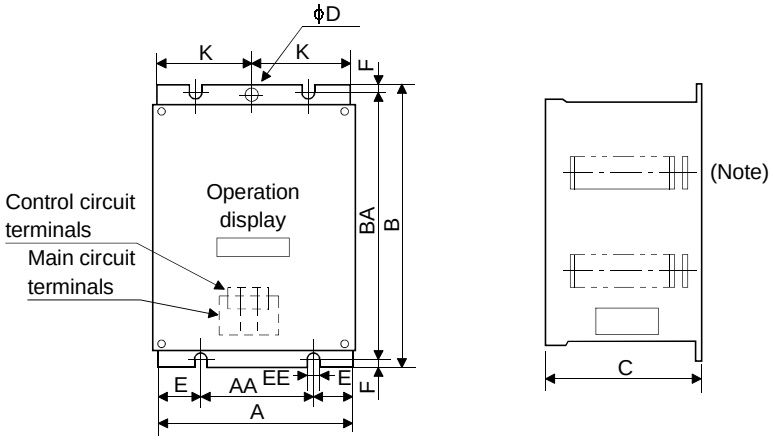
The cables between the servo amplifier and brake unit and between the resistor unit and brake unit should be as short as possible. The cables longer than 5m(16.404ft) should be twisted. If twisted, the cables must not be longer than 10m(32.808ft).
The cable size should be equal to or larger than the 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)]

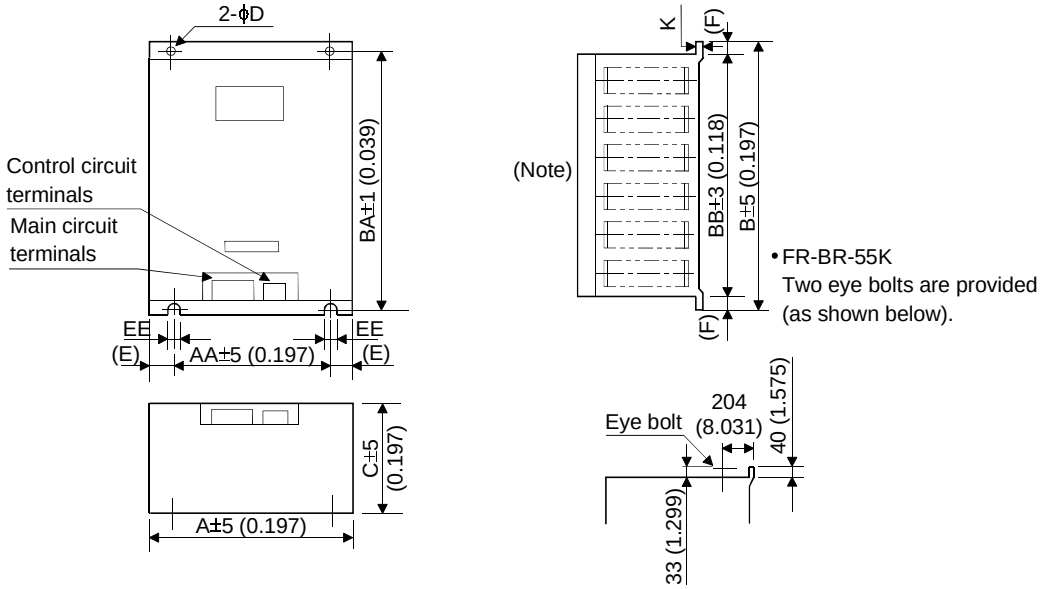



Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

| Brake Unit | A | AA | B | BA | C | D | E | EE | K | F | Approx. Weight [kg(lb)] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FR-BU-15K | 100 (3.937) | 60 (2.362) | 240 (9.446) | 225 (10.039) | 128 (5.039) | 6 (0.236) | 18.5 (0.728) | 6 (0.236) | 48.5 (1.909) | 7.5 (0.295) | 2.4 (5.291) |
| FR-BU-30K | 160 (6.299) | 90 (3.543) | 240 (9.446) | 225 (10.039) | 128 (5.039) | 6 (0.236) | 33.5 (1.319) | 6 (0.236) | 78.5 (3.091) | 7.5 (0.295) | 3.2 (7.055) |

(b) Resistor unit (FR-BR)

[Unit : mm(in)]




Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

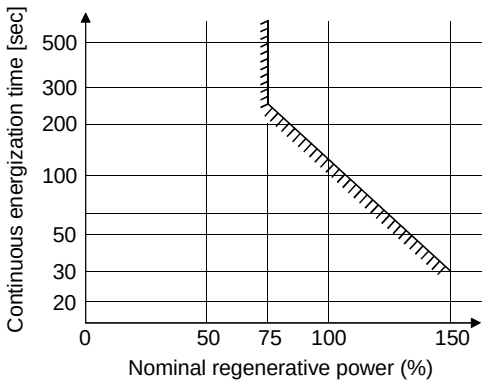
| Resistor Unit Model | A | AA | B | BA | BB | C | D | E | EE | K | F | Approx. Weight [kg(lb)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FR-BR-15K | 170 (6.693) | 100 (3.937) | 450 (17.717) | 432 (17.008) | 410 (16.142) | 220 (8.661) | 6 (0.236) | 35 (1.378) | 6 (0.236) | 1.6 (0.063) | 20 (0.787) | 15 (66.139) |
| FR-BR-30K | 340 (11.389) | 270 (10.63) | 600 (23.622) | 582 (22.913) | 560 (22.047) | 220 (8.661) | 10 (0.394) | 35 (1.378) | 10 (0.394) | 2 (0.079) | 20 (0.787) | 30 (33.069) |

### 13.1.3 Power return converter

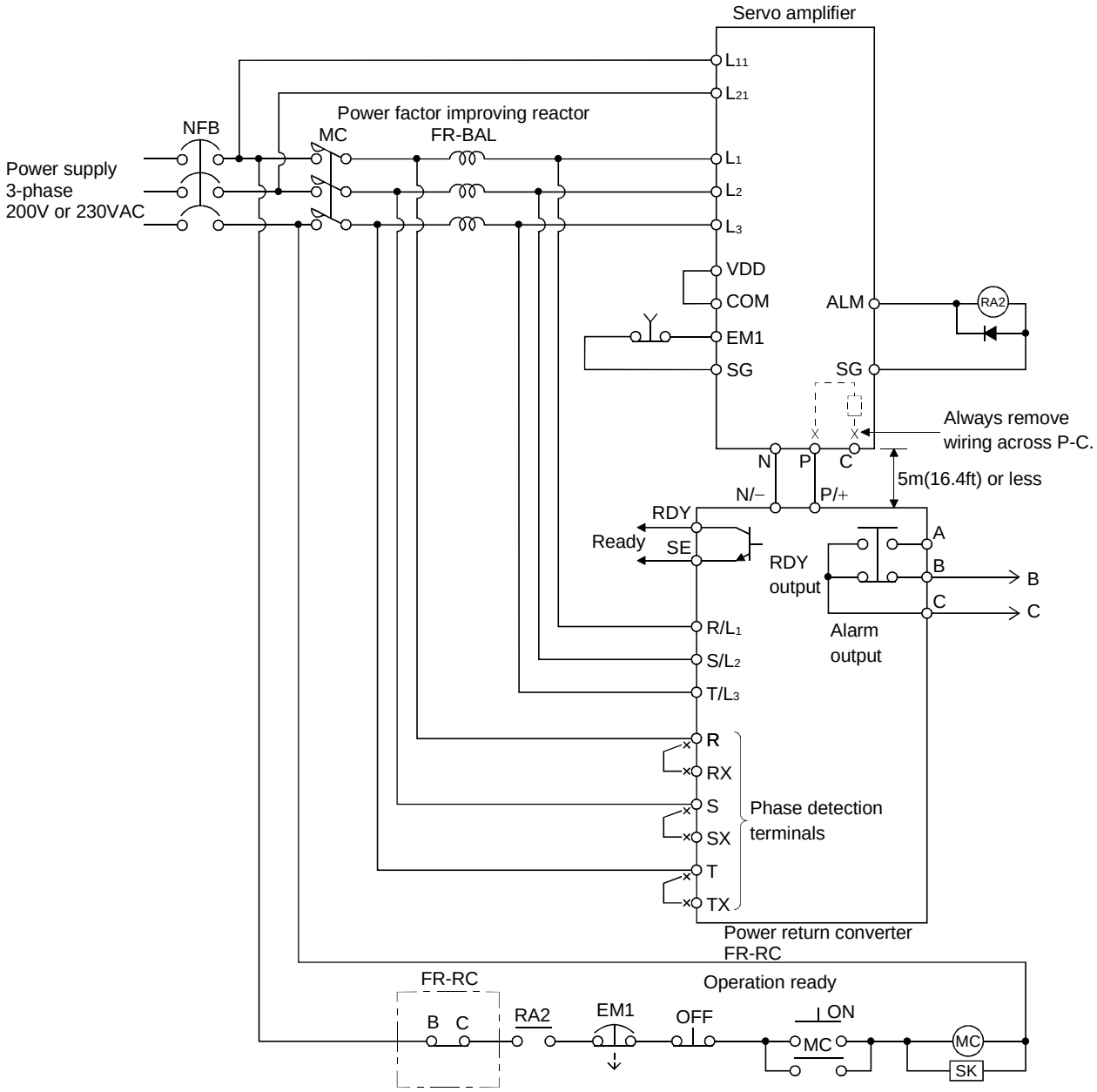
(1) Selection

The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the MR-J2S-500A and MR-J2S-700A.

| Power return converter | Nominal Regenerative Power (kW) | Servo Amplifier |
|---|---|---|
| FR-RC15 | 15 | MR-J2S-500A |
| FR-RC30 | 30 | MR-J2S-700A |

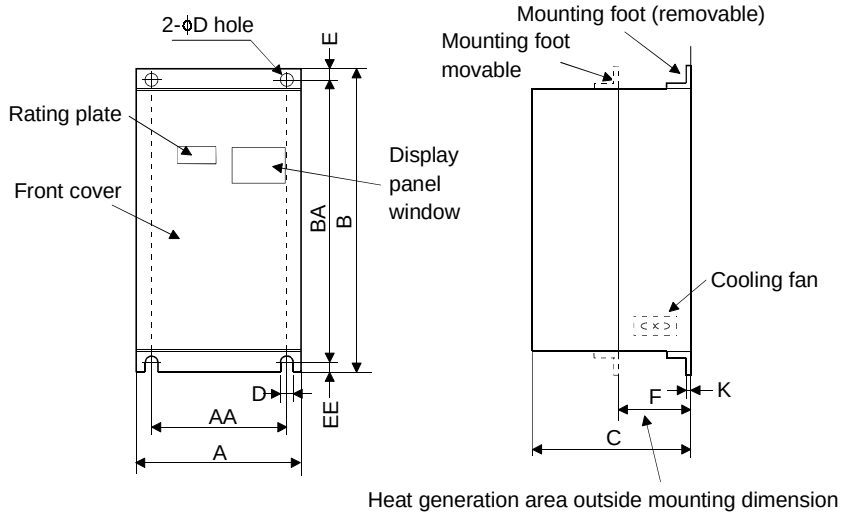


(2) Connection example



(3) Outside dimensions of the power return converters

[Unit : mm(in)]

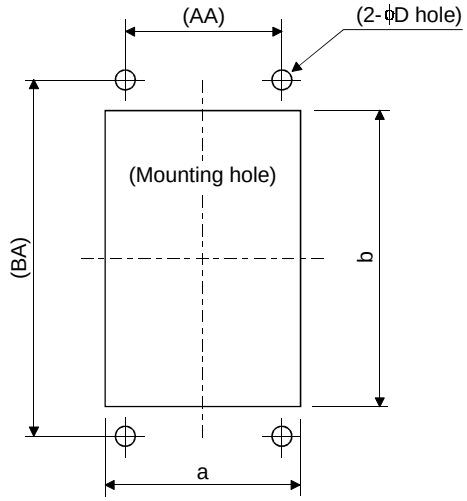



| Power return converter | A | AA | B | BA | C | D | E | EE | K | F | Approx. Weight [kg(lb)] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| FR-RC-15K | 270 (10.630) | 200 (7.874) | 450 (17.717) | 432 (17.008) | 195 (7.677) | 10 (0.394) | 10 (0.394) | 8 (0.315) | 3.2 (0.126) | 87 (3.425) | 19 (41.888) |
| FR-RC-30K | 340 (13.386) | 270 (10.630) | 600 (23.622) | 582 (22.913) | 195 (7.677) | 10 (0.394) | 10 (0.394) | 8 (0.315) | 3.2 (0.126) | 90 (3.543) | 31 (68.343) |

(4) Mounting hole machining dimensions

When the power return 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)]

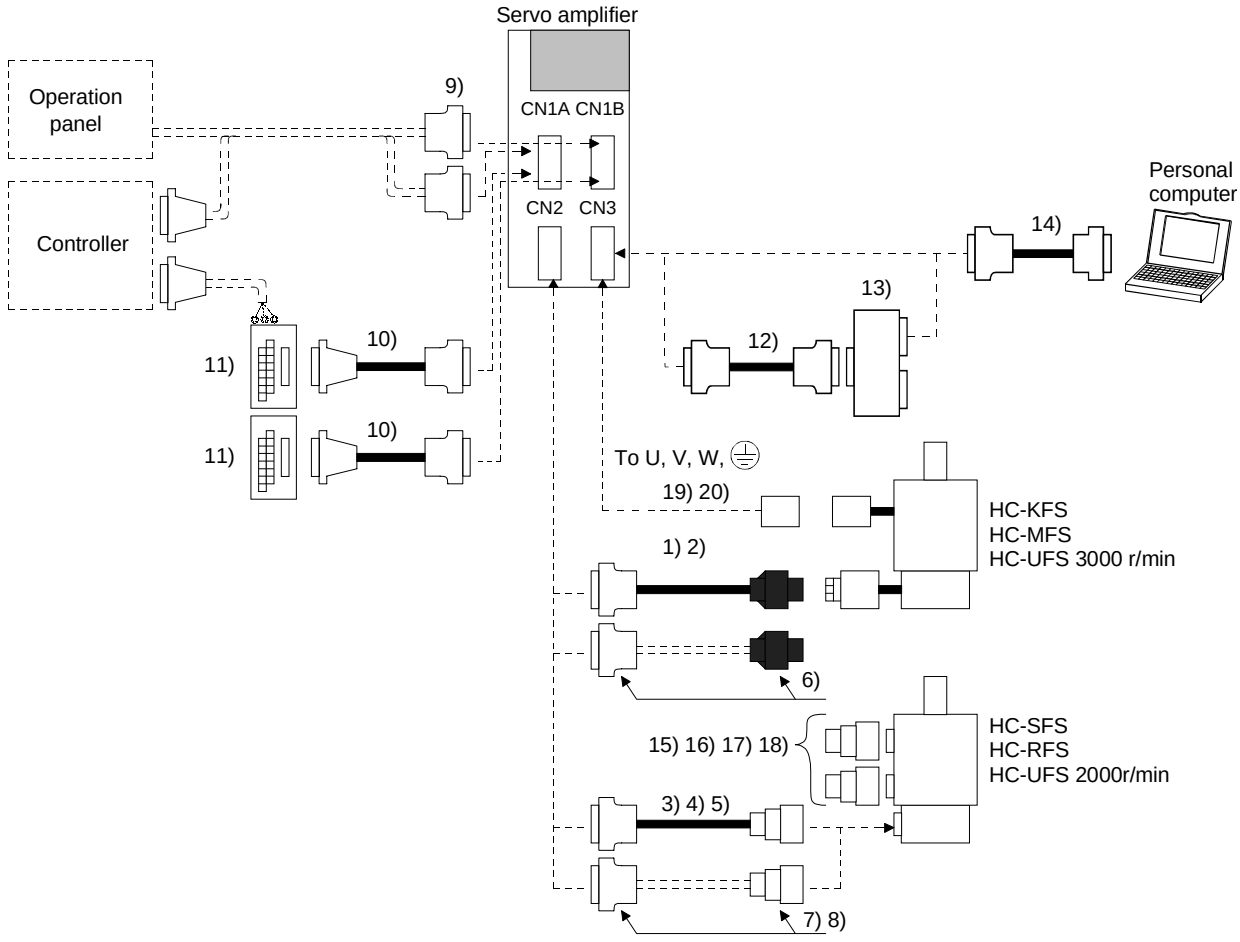



| Model | A | B | D | AA | BA |
|---|---|---|---|---|---|
| FR-RC-15K | 260 (10.236) | 412 (16.220) | 10 (0.394) | 200 (7.874) | 432 (17.009) |
| FR-RC-30K | 330 (12.992) | 562 (22.126) | 10 (0.394) | 270 (10.630) | 582 (22.913) |

### 13.1.4 Cables and connectors

(1) Cable make-up

The following cables are used for connection with the servo motor and other models. Those indicated by broken lines in the figure are not options.



| No. | Product | Model | Description | Application |
|---|---|---|---|---|
| 1) | Standard encoder cable | MR-JCCBL□M-L<br>Refer to (2) in this section. | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Housing : 1-172161-9<br>Connector pin : 170359-1<br>(AMP or equivalent) | Standard flexing life<br>IP20 |
| 2) | Long flexing life encoder cable | MR-JCCBL□M-H<br>Refer to (2) in this section. |  | Long flexing life<br>IP20 |
| 3) | Standard encoder cable | MR-JHSCBL□M-L<br>Refer to (2) in this section. | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Connector: MS3106B20-29S<br>Cable clamp: MS3057-12A<br>(Japan Aviation Electronics) | Standard flexing life<br>IP20 |
| 4) | Long flexing life encoder cable | MR-JHSCBL□M-H<br>Refer to (2) in this section. |  | Long flexing life |
| 5) | IP65-compliant encoder cable | MR-ENCBL□M-H<br>Refer to (2) in this section. | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Connector<br>: MS3106A20-29S (D190)<br>Cable clamp<br>: CE3057-12A-3 (D265)<br>Back shell: CE02-20BS-S<br>(DDK)<br>  | Long flexing life<br>IP65<br>IP67<br>Not oil-resistant. |
| 6) | Encoder connector set | MR-J2CNM | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Housing : 1-172161-9<br>Pin : 170359-1<br>Cable clamp: MTI-0002<br>(AMP or equivalent)<br>  | IP20 |
| 7) | Encoder connector set | MR-J2CNS | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Connector: MS3106B20-29S<br>Cable clamp: MS3057-12A<br>(Japan Aviation Electronics)<br>  | IP20 |
| 8) | Encoder connector set | MR-ENCNS | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>Connector: MS3106A20-29S (D190)<br>Cable clamp: CE3057-12A-3 (D265)<br>Back shell: CE02-20BS-S<br>(DDK)<br>  | IP65<br>IP67 |

| No. | Product | Model | Description | Application |
|---|---|---|---|---|
| 9) | Control signal connector set | MR-J2CN1 | Connector: 10120-3000VE<br>Shell kit: 10320-52F0-008<br>(3M or equivalent)<br>  <br>Qty: 2 each | |
| 10) | Junction terminal block cable | MR-J2TBL□M<br>Refer to Section13.1.5. | Connector: HIF3BA-20D-2.54R<br>(Hirose Electric)<br>Connector: 10120-6000EL<br>Shell kit: 10320-3210-000<br>(3M or equivalent)<br>  | For junction terminal block connection |
| 11) | Junction terminal block | MR-TB20 | Refer to Section 13.1.5. | |
| 12) | Bus cable | MR-J2HBUS□M<br>Refer to section13.1.6. | Connector: 10120-6000EL<br>Shell kit: 10320-3210-000<br>(3M or equivalent)<br>Connector: 10120-6000EL<br>Shell kit: 10320-3210-000<br>(3M or equivalent)<br>  | For maintenance junction card connection |
| 13) | Maintenance junction card | MR-J2CN3TM | Refer to Section 13.1.6. | |
| 14) | Communication cable | MR-CPCATCBL3M<br>Refer to (3) in this section. | Connector: 10120-6000EL<br>Shell kit: 10320-3210-000<br>(3M or equivalent)<br>Connector: DE-9SF-N<br>Case: DE-C1-J6-S6<br>(Japan Aviation Electronics)<br>  | For connection with PC-AT-compatible personal computer |
| 15) | Power supply connector set | MR-PWCNS1<br>Refer to the Servo Motor Instruction Manual. |  <br>Connector: CE05-6A22-23SD-B-BSS<br>Cable clamp:CE3057-12A-2 (D265)<br>(DDK) | EN Standard-compliant IP65 IP67 |
| 16) | Power supply connector set | MR-PWCNS2<br>Refer to the Servo Motor Instruction Manual. |  <br>Connector: CE05-6A24-10SD-B-BSS<br>Cable clamp: CE3057-16A-2 (D265)<br>(DDK) | |
| 17) | Power supply connector set | MR-PWCNS2<br>Refer to the Servo Motor Instruction Manual. |  <br>Plug: CE05-6A24-10SD-B-BSS<br>Cable clamp: CE3057-16A-2 (D265)<br>(DDK) | |
| 18) | Brake connector set | MR-BKCN<br>Refer to the Servo Motor Instruction Manual. |  <br>Plug: MS3106A10SL-4S (D190) (DDK)<br>Cable connector: YS010-5-8 (Daiwa Dengyo) | |
| 19) | Power supply connector set | MR-PWCNK1<br>Refer to the Servo Motor Instruction Manual. |  <br>Plug: 5559-04P-210<br>Terminal: 5558PBT3L (For AWG16)(6 pcs.)<br>(Molex make) | IP20 |
| 20) | Power supply connector set | MR-PWCNK2 |  <br>Plug: 5559-06P-210<br>Terminal: 5558PBT3L (For AWG16)(8 pcs.)<br>(Molex make) | For motor with brake IP20 |

(2) Encoder cable

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

| POINT |
|---|
| ・The encoder cable is not oil resistant. |
| ・Refer to Section 12.4 for the flexing life of the encoder cable. |

Generally use the encoder cable available as our options. If the required length is not found in the options, fabricate the cable on the customer side.

(a) MR-JCCBL□M-L・MR-JCCBL□M-H

These encoder cables are used with the HC-KFS・HC-MFS・HC-UFS3000r/min series servo motors.

1) Model explanation

Model: MR-JCCBL□M-□

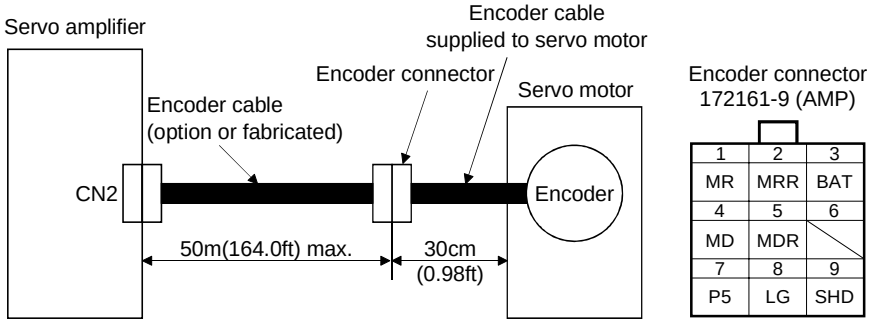
| Symbol | Specifications |
|---|---|
| L | Standard flexing life |
| H | Long flexing life |

| Symbol | (Note) Cable length [m(ft)] |
|---|---|
| 2 | 2 (6.56) |
| 5 | 5 (16.4) |
| 10 | 10 (32.8) |
| 20 | 20 (65.6) |
| 30 | 30 (98.4) |
| 40 | 40 (131.2) |
| 50 | 50 (164.0) |

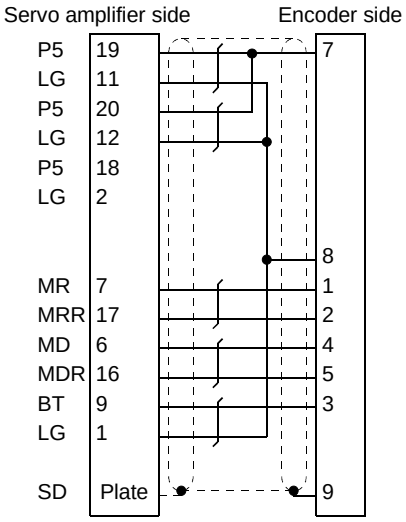
Note: MR-JCCBL□M-H has no 40(131.2) and 50m(164.0ft) sizes.

2) Connection diagram

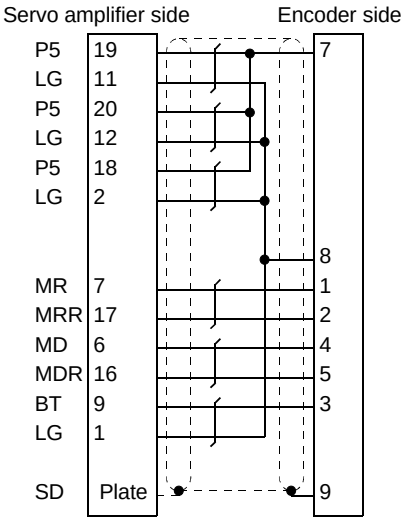
For the pin assignment on the servo amplifier side, refer to Section 3.3.1.



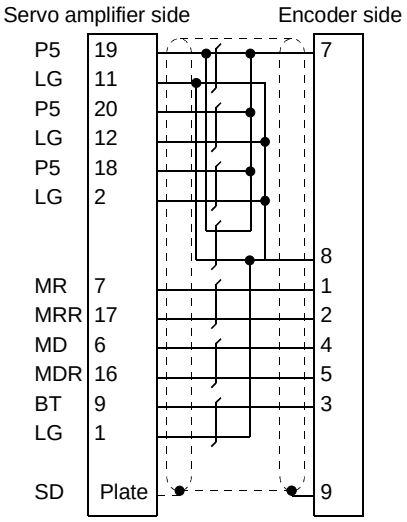
MR-JCCBL2M-L
MR-JCCBL5M-L
MR-JCCBL2M-H
MR-JCCBL5M-H




MR-JCCBL10M-L
to
MR-JCCBL30M-L




MR-JCCBL10M-H
to
MR-JCCBL50M-H

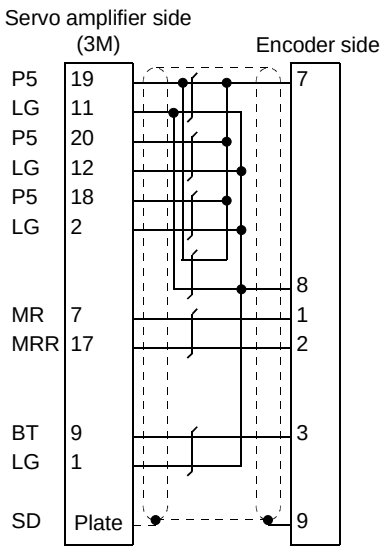



When fabricating an encoder cable, use the recommended wires given in Section 13.2.1 and the MR-J2CNM connector set for encoder cable fabrication, and fabricate an encoder cable as shown in the following wiring diagram. Referring to this wiring diagram, you can fabricate an encoder cable of up to 50m(164.0ft) length including the length of the encoder cable supplied to the servo motor.

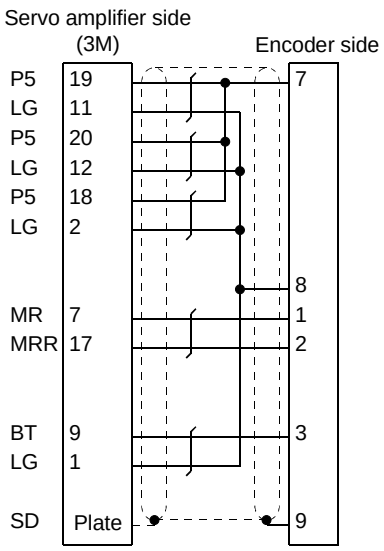
When the encoder cable is to be fabricated by the customer, the wiring of MD and MDR is not required.

Refer to Chapter 3 of the servo motor instruction guide and choose the encode side connector according to the servo motor installation environment.

For use of AWG24




For use of AWG22



(b) MR-JHSCBL□M-L・MR-JHSCBL□M-H・MR-ENCBL□M-H

These encoder cables are used with the HC-SFS・HC-RFS・HC-UFS2000r/min series servo motors.

1) Model explanation

Model: MR-JHSCBL□M-□

| Symbol | Specifications |
|---|---|
| L | Standard flexing life |
| H | Long flexing life |

| Symbol | Cable length [m(ft)] |
|---|---|
| 2 | 2 (6.56) |
| 5 | 5 (16.4) |
| 10 | 10 (32.8) |
| 20 | 20 (65.6) |
| 30 | 30 (98.4) |
| 40 | 40 (131.2) |
| 50 | 50 (164.0) |

Note: MR-JHSCBL□M-L has no 40(131.2) and 50m(164.0ft) sizes.

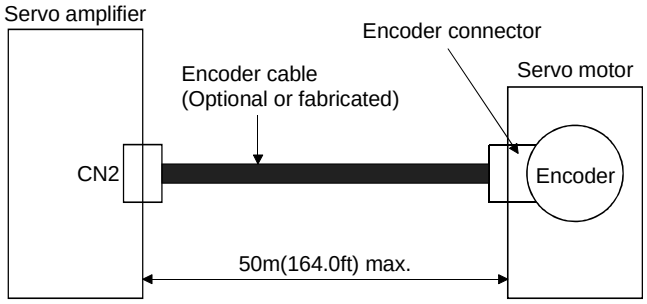
Model: MR-ENCBL□M-H

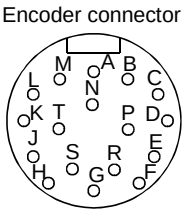
Long flexing life

| Symbol | Cable length [m(ft)] |
|---|---|
| 2 | 2 (6.56) |
| 5 | 5 (16.4) |
| 10 | 10 (32.8) |
| 20 | 20 (65.6) |
| 30 | 30 (98.4) |
| 40 | 40 (131.2) |
| 50 | 50 (164.0) |

2) Connection diagram

For the pin assignment on the servo amplifier side, refer to Section 3.3.1.

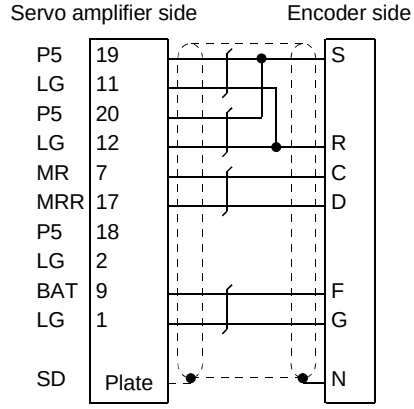



| Pin | Signal |
|---|---|
| A | MD |
| B | MDR |
| C | MR |
| D | MRR |
| E | |
| F | BAT |
| G | LG |
| H | |
| J | |

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

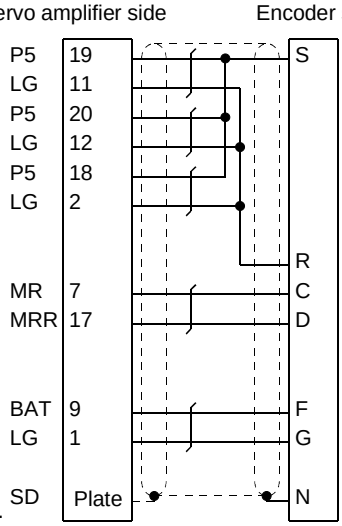
MR-JHSCBL2M-L
MR-JHSCBL5M-L
MR-JHSCBL2M-H
MR-JHSCBL5M-H
MR-ENCBL2M-H
MR-ENCBL5M-H




(Note) Use of AWG24
(Less than 10m(32.8ft))

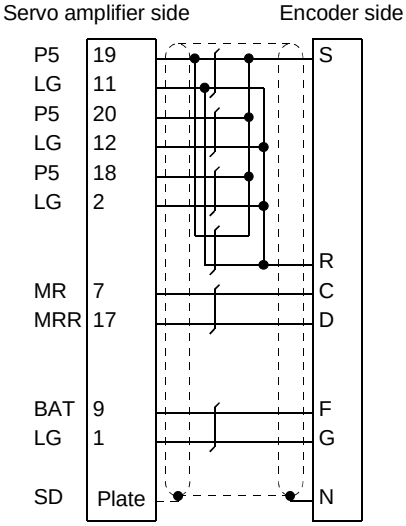
Note: AWG28 can be used for 5m(16.4ft) or less.

MR-JHSCBL10M-L
to
MR-JHSCBL30M-L




Use of AWG22
(10m(32.8ft) to 50m(164.0ft))

MR-JHSCBL10M-H
to
MR-JHSCBL50M-H
MR-ENCBL10M-H
to
MR-ENCBL50M-H




Use of AWG24
(10m(32.8ft) to 50m(164.0ft))

When fabricating an encoder cable, use the recommended wires given in Section 13.2.1 and the MR-J2CNS connector set for encoder cable fabrication, and fabricate an encoder cable in accordance with the optional encoder cable wiring diagram given in this section. You can fabricate an encoder cable of up to 50m(164.0ft) length.

Refer to Chapter 3 of the servo motor instruction guide and choose the encode side connector according to the servo motor installation environment.

(3) Communication cable

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

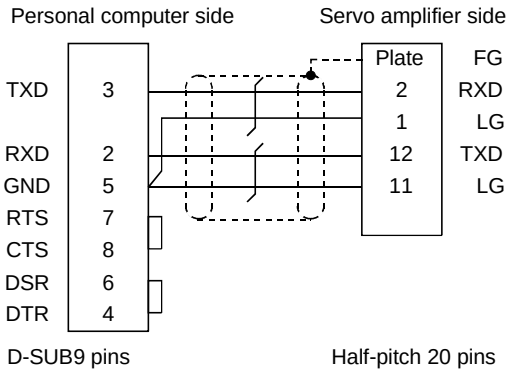
(a) Model definition

Model : MR-CPCATCBL3M

Cable length 3[m](10[ft])

(b) Connection diagram

▪ MR-CPCATCBL3M



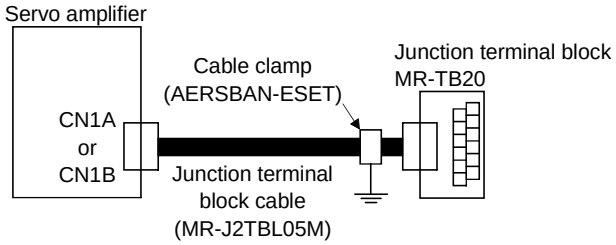

When fabricating the cable, refer to the connection diagram in this section.
The following must be observed in fabrication:
1) Always use a shielded, multi-core cable and connect the shield with FG securely.
2) The optional communication cable is 3m(10ft) long. When the cable is fabricated, its maximum length is 15m(49ft) in offices of good environment with minimal noise.

### 13.1.5 Junction terminal block (MR-TB20)

> **POINT**
>
> ▪ When using the junction terminal block, you cannot use SG of CN1A-20 and CN1B-20. Use SG of CN1A-4 and CN1B-4.

#### (1) How to use the junction terminal block

Always use the junction terminal block (MR-TB20) with the junction terminal block cable (MR-J2TBL □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 13.2.6, (2)(c).

#### (2) Terminal labels

Among the terminal block labels for the junction terminal block, use the two for the MR-J2S-A(MR-J2-A). When changing the input signals in parameters No. 43 to 48, refer to (4) in this section and Section 3.3 and apply the accessory signal seals to the labels.

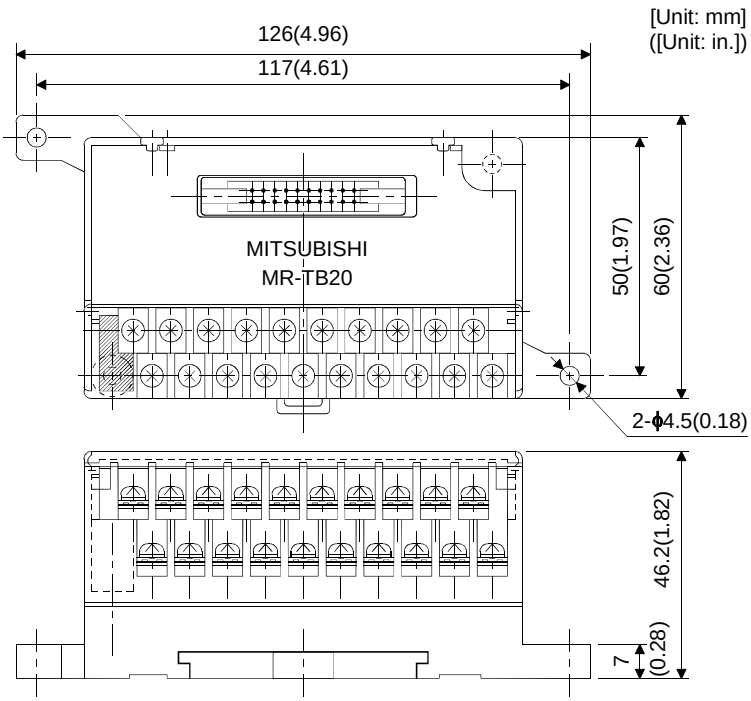
1) For CN1A

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| LG | PP | LZ | LB | COM | OPC | PG | LZR | LBR | RD | |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
| NP | P15R | LA | CR | SG | NG | OP | LAR | INP | SD | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

2) For CN1B

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| LG | VDD | SON | | TL | P15R | COM | EMG | LSN | ZSP | |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | |
| VC | DO1 | TLC | PC | SG | TLA | RES | LSP | ALM | SD | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |

#### (3) Outline drawing




Terminal screw: M3.5
Applicable cable: Max. 2mm$^2$
(Crimping terminal width: 7.2mm (0.283 in) max.)

(4) Junction terminal block cable (MR-J2TBL□M)

Model : MR-J2TBL□M

| Symbol | Cable length[m(ft)] |
|---|---|
| 05 | 0.5 (1.64) |
| 1 | 1 (3.28) |

Junction terminal block side connector (Hirose Electric)
HIF3BA-20D-2.54R (connector)

Servo amplifier side (CN1A•CN1B) connector (3M)
10120-6000EL (connector)
10320-3210-000 (shell kit)

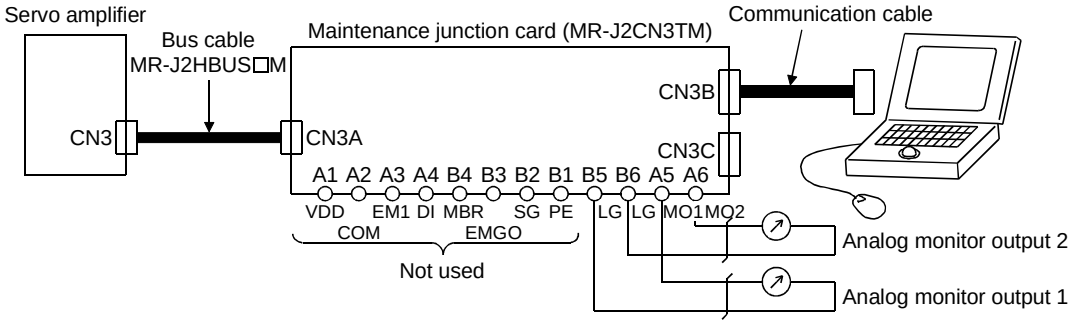
| (Note) Symbol | | | | | | Junction terminal block terminal No. | Pin No. | Pin No. |
|---|---|---|---|---|---|---|---|---|
| Position control mode | | Speed control mode | | Torque control mode | | | | |
| For CN1A | For CN1B | For CN1A | For CN1B | For CN1A | For CN1B | | | |
| LG | LG | LG | LG | LG | LG | 10 | B1 | 1 |
| NP | VC | | VC | | VLA | 0 | A1 | 2 |
| PP | VDD | | VDD | | VDD | 11 | B2 | 3 |
| P15R | DO1 | P15R | DO1 | P15R | DO1 | 1 | A2 | 4 |
| LZ | SON | LZ | SON | LZ | SON | 12 | B3 | 5 |
| LA | TLC | LA | TLC | LA | VLC | 2 | A3 | 6 |
| LB | | LB | SP2 | LB | SP2 | 13 | B4 | 7 |
| CR | PC | SP1 | ST1 | SP1 | RS2 | 3 | A4 | 8 |
| COM | TLC | COM | ST2 | COM | RS1 | 14 | B5 | 9 |
| SG | SG | SG | SG | SG | SG | 4 | A5 | 10 |
| OPC | P15R | | P15R | | P15R | 15 | B6 | 11 |
| NG | TLA | | TLA | | TC | 5 | A6 | 12 |
| PG | COM | | COM | | COM | 16 | B7 | 13 |
| OP | RES | OP | RES | OP | RES | 6 | A7 | 14 |
| LZR | EMG | LZR | EMG | LZR | EMG | 17 | B8 | 15 |
| LAR | LSP | LAR | LSP | LAR | | 7 | A8 | 16 |
| LBR | LSN | LBR | LSN | LBR | | 18 | B9 | 17 |
| INP | ALM | SA | ALM | | ALM | 8 | A9 | 18 |
| RD | ZSP | RD | ZSP | RD | ZSP | 19 | B10 | 19 |
| SD | SD | SD | SD | SD | SD | 9 | A10 | 20 |
| | | | | | | | | Plate |

Note: The labels supplied to the junction terminal block are designed for the position control mode. When using the junction terminal block in the speed or torque control mode, change the signal abbreviations using the accessory signal seals.

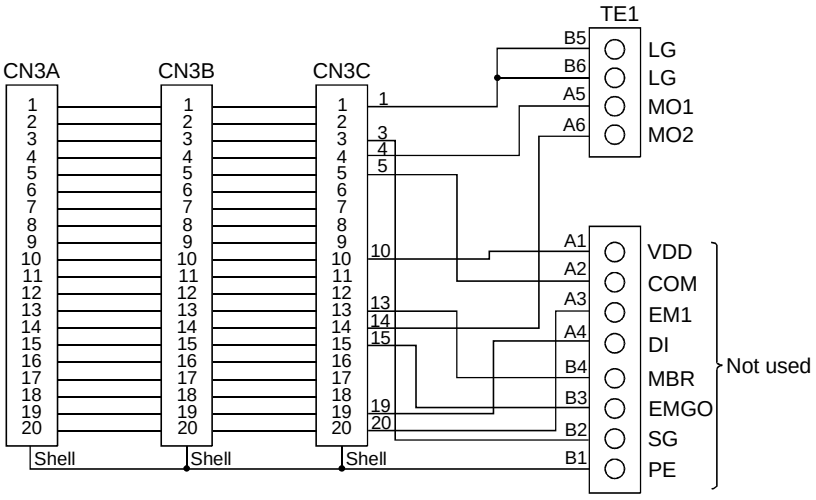
### 13.1.6 Maintenance junction card (MR-J2CN3TM)

(1) Usage

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

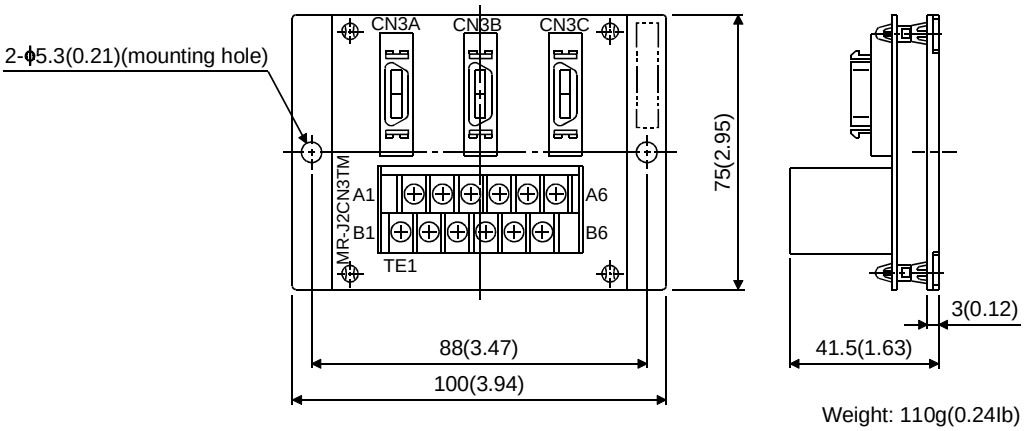



(2) Connection diagram




(3) Outline drawing

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



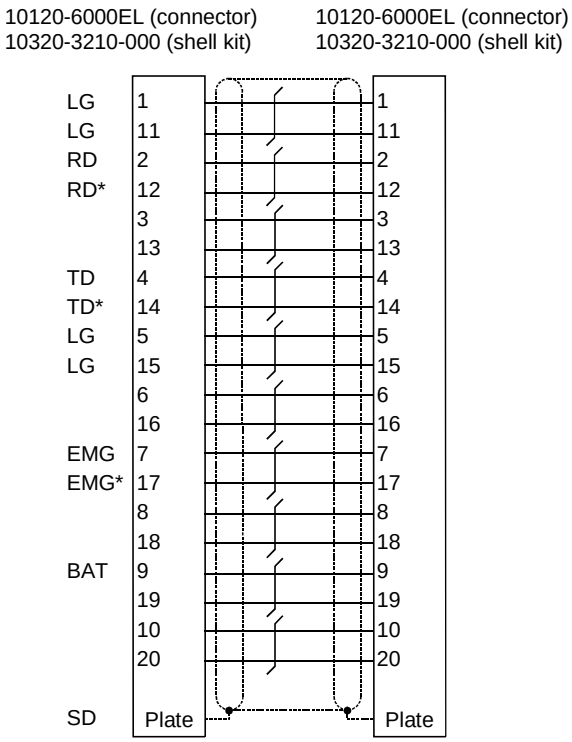

Weight: 110g(0.24lb)

(4) Bus cable (MR-J2HBUS□M)

Model: MR-J2HBUS□M

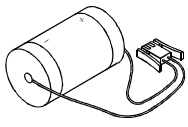
| Symbol | Cable length [m(ft)] |
|---|---|
| 05 | 0.5 (1.64) |
| 1 | 1 (3.28) |
| 5 | 5 (16.4) |

MR-J2HBUS05M
MR-J2HBUS1M
MR-J2HBUS5M




13.1.7 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



### 13.1.8 Servo configurations software

The servo configuration software 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 |
|---|---|
| Communication signal | Conforms to RS-232C. |
| Baudrate [bps] | 57600, 38400, 19200, 9600 |
| Monitor | Batch display, high-speed display, graph display<br>(Minimum resolution changes with the processing speed of the personal computer.) |
| Alarm | Alarm display, alarm history, data display at alarm occurrence |
| Diagnostic | External I/O signal display, no-rotation reason display, cumulative power-on time display, software number display, motor information display, tuning data display, ABS data display, automatic VC offset display, shaft name setting. |
| Parameters | Data setting, list display, change list display, detailed information display, turning |
| Test operation | Jog operation, positioning operation, motor-less operation, output signal forced output, program operation in simple language. |
| Advanced function | Machine analyzer, gain search, machine simulation. |
| File operation | Data read, save, print |
| Others | Automatic operation, station setting, 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:

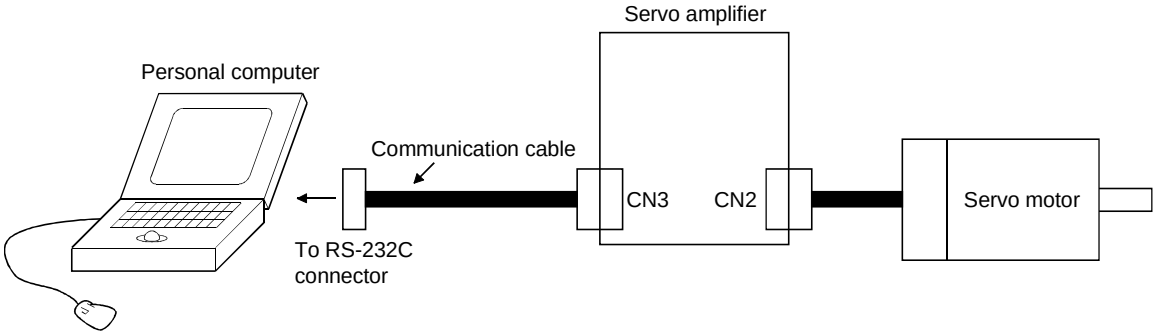
| Model | (Note 1) Description |
|---|---|
| (Note 2)<br>Personal computer | IBM PC-AT compatible on which Windows 95 or 98 (English) runs<br>(Pentium133MHz or higher recommended).Memory: 16MB or more, hard disk free space: 20MB or more, serial port used. |
| OS | Windows 95/98 (English) |
| Display | 800×600 or more, 256-color or more display which can be used with Windows 95/98 (English). |
| Keyboard | Which can be connected to the personal computer. |
| Mouse | Which can be used with Windows 95/98(English). Note that a serial mouse is not used. |
| Printer | Which can be used with Windows 95/98(English). |
| Communication cable | MR-CPCATCBL3M<br>When this cannot be used, refer to (3) Section 13.1.4 and fabricate. |
| RS-232C/RS-422 converter | Needed to use the RS-422 multidrop communication function of the servo amplifier. |

Note: 1. Windows is a trade mark of Microsoft Corporation.

2. On some personal computers, this software may not run properly.

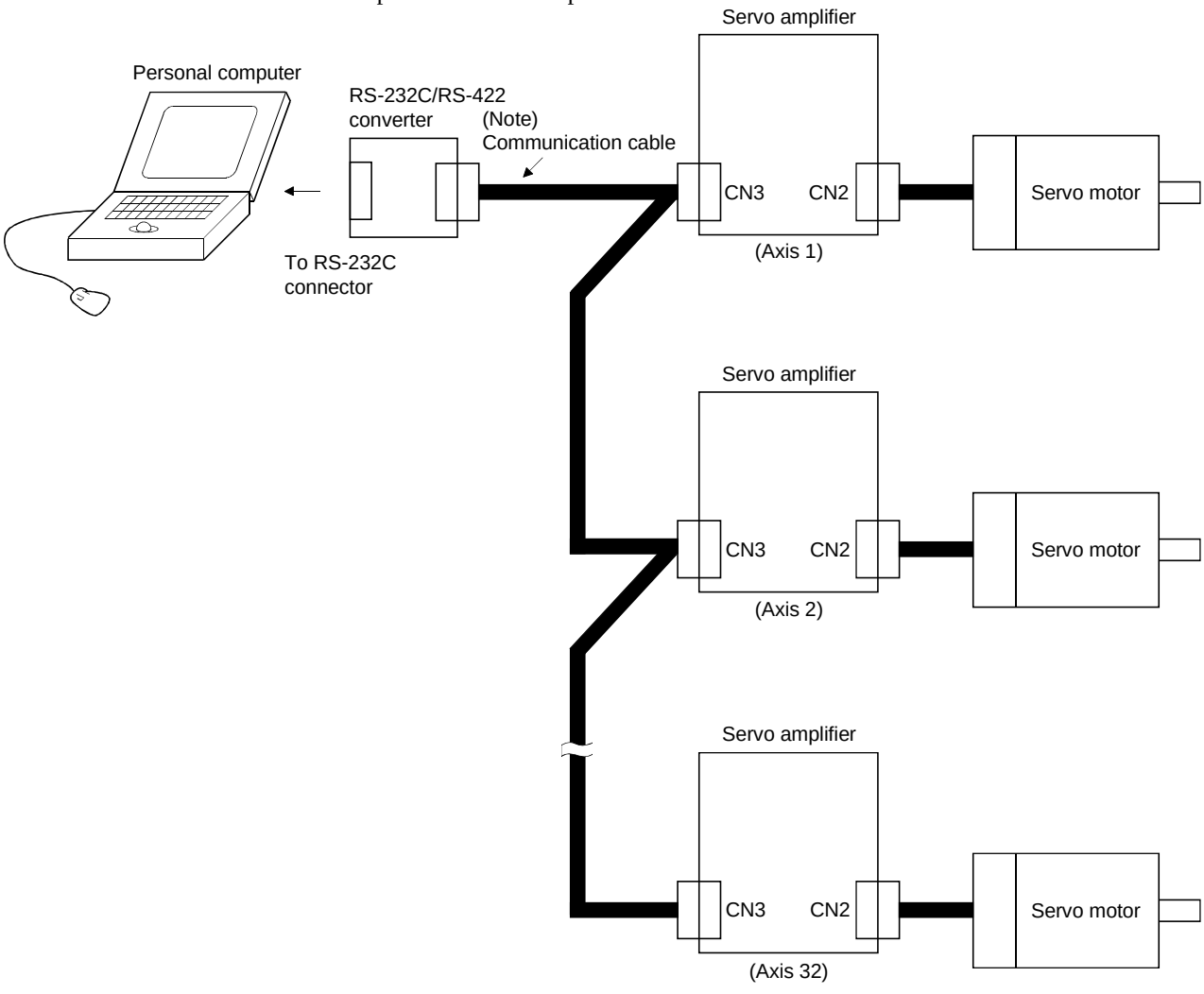
(b) Configuration diagram

1) When using RS-232C




2) When using RS-422

You can make multidrop connection of up to 32 axes.




Note: For cable connection, refer to section 14.1.1.

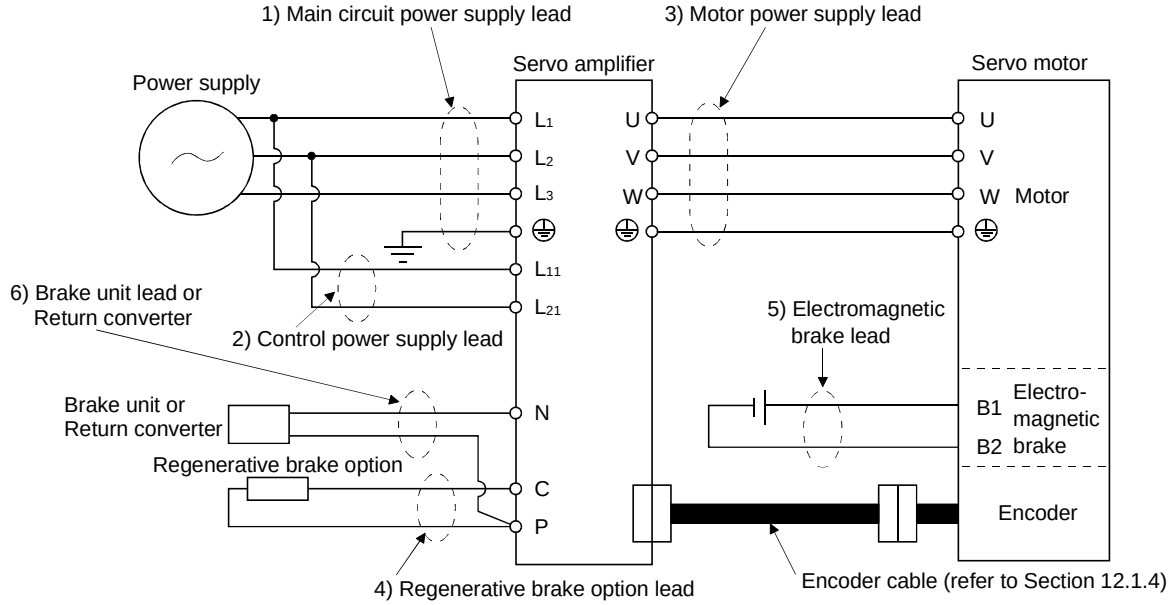
## 13.2 Auxiliary equipment

Always use the devices indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL Standard, use the products which conform to the corresponding standard.

### 13.2.1 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.




The following table lists wire sizes. The wires used assume that they are 600V vinyl wires and the wiring distance is 30m(98.4ft) max. If the wiring distance is over 30m(98.4ft), choose the wire size in consideration of voltage drop.

The alphabets (a, b, c) in the table correspond to the crimping terminals (Table 13.2) used to wire the servo amplifier. For connection with the terminal block TE2 of the MR-J2S-100A or less, refer to Section 3.11.

The servo motor side connection method depends on the type and capacity of the servo motor. Refer to Section 3.8.

Table 13.1 Recommended wires

| Servo amplifier | (Note 1) Wires [$mm^2$] | | | | |
|---|---|---|---|---|---|
| | 1) L1・L2・L3 | 2) L11・L21 | 3) U・V・W・⏚ | 4) P・C | 5) B1・B2 |
| MR-J2S-10A(1) | 2 (AWG14) : a | 1.25 (AWG16) | 1.25 (AWG16) : a | 2 (AWG14) : a | 1.25 (AWG16) |
| MR-J2S-20A(1) | | | | | |
| MR-J2S-40A(1) | | | | | |
| MR-J2S-60A | | | | | |
| MR-J2S-70A | | | | | |
| MR-J2S-100A | | | 2 (AWG14) : a | | |
| MR-J2S-200A | 3.5 (AWG12) : b | | 3.5 (AWG12) : b | | |
| MR-J2S-350A | 5.5 (AWG10) : b | | (Note 2)<br>5.5 (AWG10) : b | | |
| MR-J2S-500A | | | 5.5 (AWG10) : b | | |
| MR-J2S-700A | 8 (AWG8) : c | | 8 (AWG8) : c | 3.5(AW12) : c | |

Note: 1. For the crimping terminals and applicable tools, refer to table 13.2:

2. 3.5$mm^2$ for use of the HC-RFS203 servo motor.

Use wires 6) of the following sizes with the brake unit (FR-BU) and power return converter (FR-RC).

| Model | Wires[mm$^2$] |
|---|---|
| FR-BU-15K | 3.5(AWG12) |
| FR-BU-30K | 5.5(AWG10) |
| FR-BU-55K | 14(AWG6) |
| FR-RC-15K | 14(AWG6) |

Table 13.2 Recommended crimping terminals

| Symbol | Servo amplifier side crimping terminals | | |
|---|---|---|---|
| | Crimping terminal | Applicable tool | Maker name |
| a | 32959 | 47387 | AMP |
| b | 32968 | 59239 | |
| c | FVD8-5 | Body YF-1・E-4<br>Head YNE-38<br>Die DH-111・DH-121 | Japan Solderless Terminal |

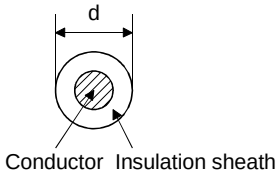
(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent:

Table 13.3 Wires for option cables

| Type | Model | Length [m(ft)] | 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 ODd[mm] (Note 1) | | |
| Encoder cable | MR-JCCBL□M-L | 2 to 10 (6.56 to 32.8) | 0.08 | 12 (6 pairs) | 7/0.127 | 222 | 0.38 | 5.6 | UL20276 AWG#28 6pair (BLAC) |
| | | 20・30 (65.6・98.4) | 0.3 | 12 (6 pairs) | 12/0.18 | 62 | 1.2 | 8.2 | UL20276 AWG#22 6pair (BLAC) |
| | MR-JCCBL□M-H | 2・5 (6.56・16.4) | 0.2 | 12 (6 pairs) | 40/0.08 | 105 | 0.88 | 7.2 | (Note 2) A14B2343 6P |
| | | 10 to 50 (32.8 to 164) | 0.2 | 14 (7 pairs) | 40/0.08 | 105 | 0.88 | 8.0 | (Note 2) A14B0238 7P |
| | MR-JHSCBL□M-L | 2・5 (6.56・16.4) | 0.08 | 8 (4 pairs) | 7/0.127 | 222 | 0.38 | 4.7 | UL20276 AWG#28 4pair (BLAC) |
| | | 10 to 30 (32.8 to 98.4) | 0.3 | 12 (6 pairs) | 12/0.18 | 62 | 1.2 | 8.2 | UL20276 AWG#22 6pair (BLAC) |
| | MR-JHSCBL□M-H | 2・5 (6.56・16.4) | 0.2 | 8 (4 pairs) | 40/0.08 | 105 | 0.88 | 6.5 | (Note 2) A14B2339 4P |
| | | 10 to 50 (32.8 to 164) | 0.2 | 12 (6 pairs) | 40/0.08 | 105 | 0.88 | 7.2 | (Note 2) A14B2343 6P |
| | MR-ENCBL□M-H | 2・5 (6.56・16.4) | 0.2 | 8 (4 pairs) | 40/0.08 | 105 | 0.88 | 6.5 | (Note 2) A14B2339 4P |
| | | 10 to 50 (32.8 to 164) | 0.2 | 12 (6 pairs) | 40/0.08 | 105 | 0.88 | 7.2 | (Note 2) A14B2343 6P |
| Communication cable | MR-CPCATCBL3M | 3 (9.84) | 0.08 | 6 (3 pairs) | 7/0.127 | 222 | 0.38 | 4.6 | UL20276 AWG#28 3pair (BLAC) |
| Bus cable | MR-J2HBUS□M | 0.5 to 5 (1.64 to 16.4) | 0.08 | 20 (10 pairs) | 7/0.127 | 222 | 0.38 | 6.1 | UL20276 AWG#28 10pair (CREAM) |

Note 1: d is as shown below:




2: Purchased from Toa Electric Industry

3: Standard OD. Max. OD is about 10% greater.

### 13.2.2 No-fuse breakers, fuses, magnetic contactors

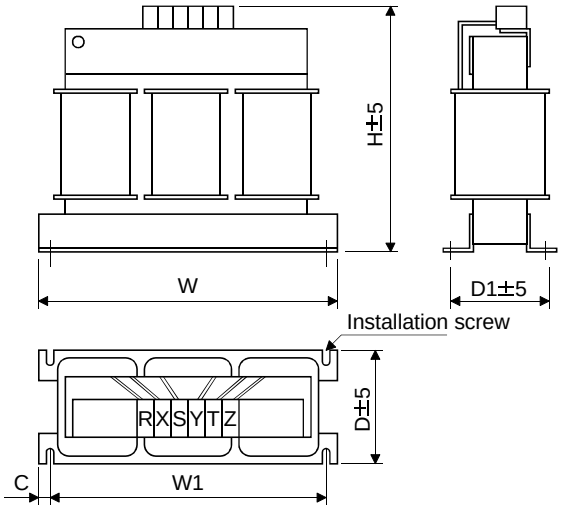
Always use one no-fuse breaker and one magnetic contactor with one servo amplifier. When using a fuse instead of the no-fuse breaker, use the one having the specifications given in this section.

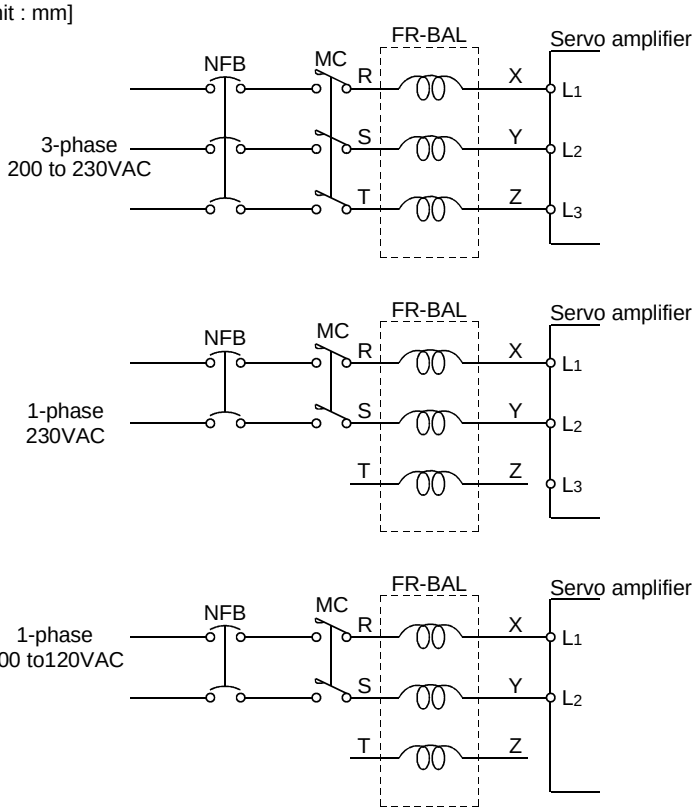
| Servo amplifier | No-fuse breaker | Fuse | | | Magnetic contactor |
|---|---|---|---|---|---|
| | | Class | Current [A] | Voltage [V] | |
| MR-J2S-10A(1) | NF30 type 5A | K5 | 10 | AC250 | S-N10 |
| MR-J2S-20A | NF30 type 5A | K5 | 10 | | |
| MR-J2S-40A・20A1 | NF30 type 10A | K5 | 15 | | |
| MR-J2S-60A・40A1 | NF30 type 15A | K5 | 20 | | |
| MR-J2S-70A | NF30 type 15A | K5 | 20 | | |
| MR-J2S-100A | NF30 type 15A | K5 | 25 | | |
| MR-J2S-200A | NF30 type 20A | K5 | 40 | | S-N18 |
| MR-J2S-350A | NF30 type 30A | K5 | 70 | | S-N20 |
| MR-J2S-500A | NF50 type 50A | K5 | 125 | | S-N35 |
| MR-J2S-700A | NF100 type 75A | K5 | 150 | | S-N50 |

### 13.2.3 Power factor improving reactors

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%.

[Unit : mm]




| Servo amplifier | Model | Dimensions [mm (in) ] | | | | | | Mounting screw size | Terminal screw size | Weight [kg (lb)] |
|---|---|---|---|---|---|---|---|---|---|---|
| | | W | W1 | H | D | D1 | C | | | |
| MR-J2S-10A(1)/20A | FR-BAL-0.4K | 135 (5.31) | 120 (4.72) | 115 (4.53) | 59 (2.32) | 45 (1.77) | 7.5 (0.29) | M4 | M3.5 | 2.0 (4.4) |
| MR-J2S-40A/20A1 | FR-BAL-0.75K | 135 (5.31) | 120 (4.72) | 115 (4.53) | 69 (2.72) | 57 (2.24) | 7.5 (0.29) | M4 | M3.5 | 2.8 (6.17) |
| MR-J2S-60A/70A/40A1 | FR-BAL-1.5K | 160 (6.30) | 145 (5.71) | 140 (5.51) | 71 (2.79) | 55 (2.17) | 7.5 (0.29) | M4 | M3.5 | 3.7 (8.16) |
| MR-J2S-100A | FR-BAL-2.2K | 160 (6.30) | 145 (5.71) | 140 (5.51) | 91 (3.58) | 75 (2.95) | 7.5 (0.29) | M4 | M3.5 | 5.6 (12.35) |
| MR-J2S-200A | FR-BAL-3.7K | 220 (8.66) | 200 (7.87) | 192 (7.56) | 90 (3.54) | 70 (2.76) | 10 (0.39) | M5 | M4 | 8.5 (18.74) |
| MR-J2S-350A | FR-BAL-7.5K | 220 (8.66) | 200 (7.87) | 194 (7.64) | 120 (4.72) | 100 (3.94) | 10 (0.39) | M5 | M5 | 14.5 (32.0) |
| MR-J2S-500A | FR-BAL-11K | 280 (11.02) | 255 (10.04) | 220 (8.66) | 135 (5.31) | 100 (3.94) | 12.5 (0.49) | M6 | M6 | 19 (41.9) |
| MR-J2S-700A | FR-BAL-15K | 295 (11.61) | 270 (10.62) | 275 (10.83) | 133 (5.24) | 110 (4.33) | 12.5 (0.49) | M6 | M6 | 27 (59.5) |

### 13.2.4 Relays

The following relays should be used with the interfaces:

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

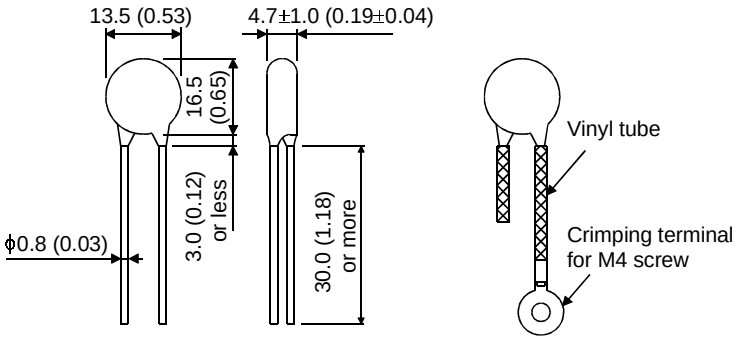
### 13.2.5 Surge absorbers

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

| Maximum rating | | | | | Maximum limit voltage | | Static capacity (reference value) | Varistor voltage rating (range) V1mA |
|---|---|---|---|---|---|---|---|---|
| Permissible circuit voltage | | Surge immunity | Energy immunity | Rated power | | | | |
| AC[Vma] | DC[V] | [A] | [J] | [W] | [A] | [V] | [pF] | [V] |
| 140 | 180 | (Note)<br>500/time | 5 | 0.4 | 25 | 360 | 300 | 220<br>(198 to 242) |

Note: 1 time = 8 × 20μs

(Example) ERZV10D221 (Matsushita Electric Industry)
TNR-10V221K (Nippon chemi-con)
Outline drawing [mm] ( [in] ) (ERZ-C10DK221)




### 13.2.6 Noise reduction techniques

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

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

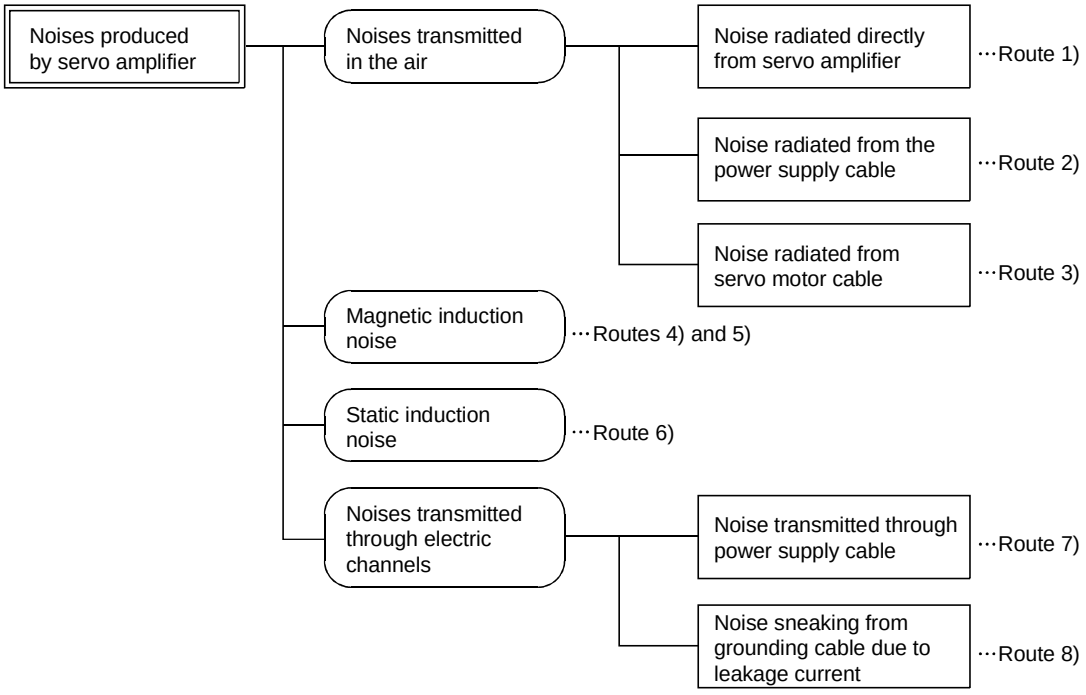
(1) Noise reduction techniques

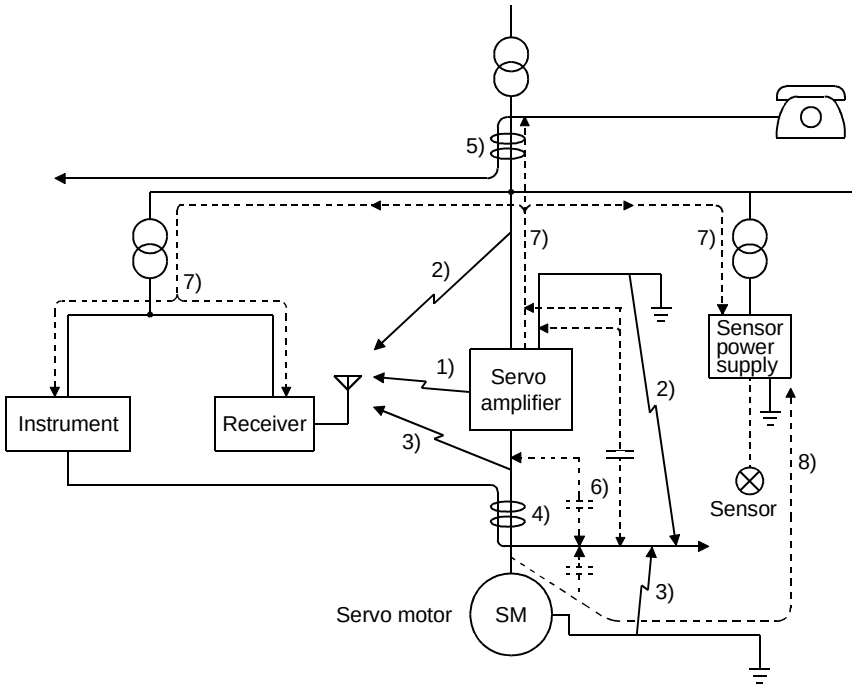
(a) General reduction techniques

- 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 3.10).

(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.<br>(1) Provide maximum clearance between easily affected devices and the servo amplifier.<br>(2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier.<br>(3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or bundling them together.<br>(4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line.<br>(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.<br>(1) Provide maximum clearance between easily affected devices and the servo amplifier.<br>(2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier.<br>(3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or bundling them together.<br>(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.<br>(1) Insert the radio noise filter (FR-BIF) on the power cables (Input cables) of the servo amplifier.<br>(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

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

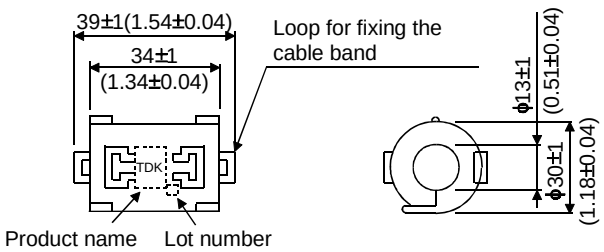
For example, the ZCAT3035-1330 of TDK and the ESD-SR-25 of Tokin make are available as data line filters.

As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below.

This impedances are reference values and not guaranteed values.

| Impedance[Ω] | |
|---|---|
| 10 to 100MHz | 100 to 500MHz |
| 80 | 150 |

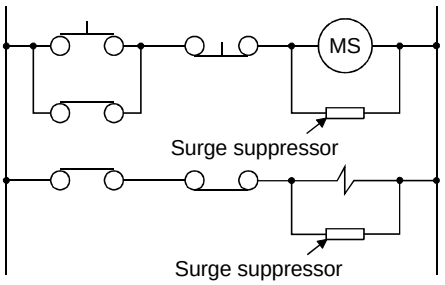
[Unit: mm]([Unit: in.])

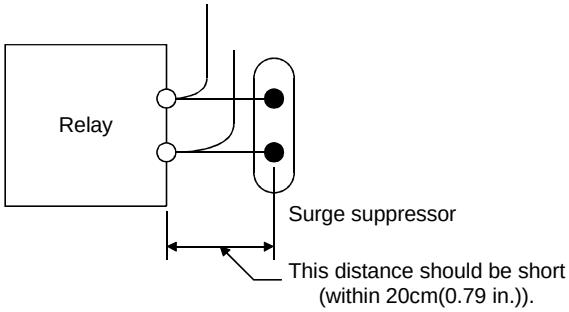



Outline drawing (ZCAT3035-1330)

(b) Surge suppressor

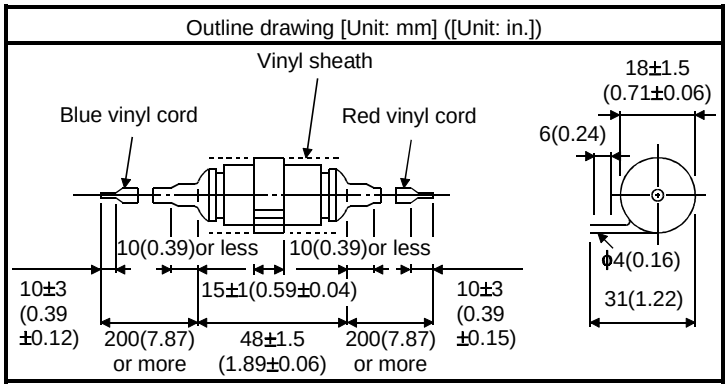
The recommended surge suppressor for installation to an AC relay, AC valve, AC electromagnetic brake or the like near the servo amplifier is shown below. Use this product or equivalent.



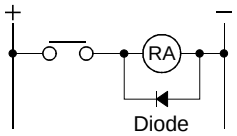




(Ex.) 972A.2003 50411
(Matsuo Electric Co.,Ltd.−200VAC rating)

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




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



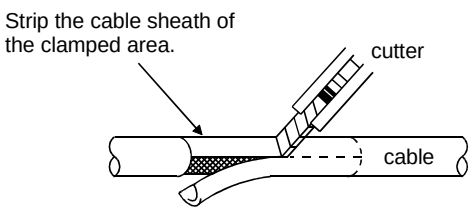

Maximum voltage: Not less than 4 times the drive voltage of the relay or the like
Maximum current: Not less than twice the drive current of the relay or the like

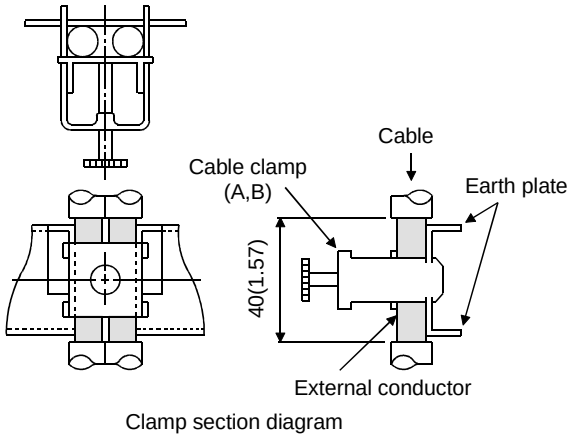
(c) Cable clamp fitting (AERSBAN□-SET)

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.



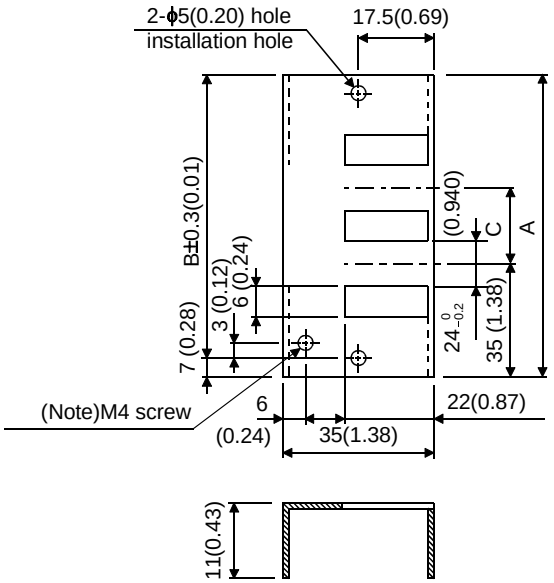




Clamp section diagram

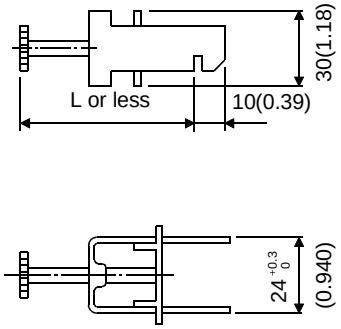
- Outline drawing

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

Earth plate




Clamp section diagram



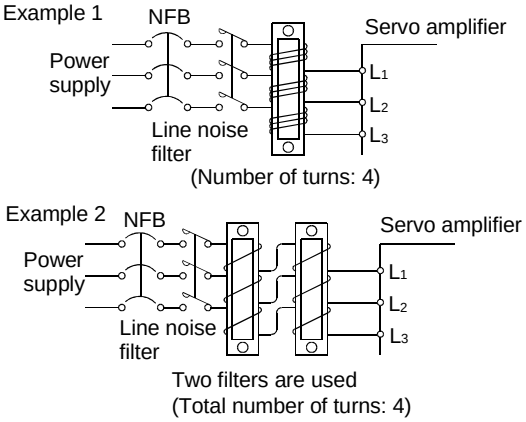
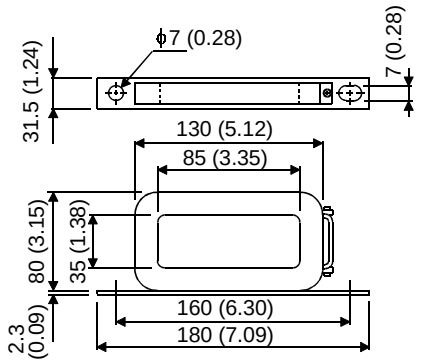
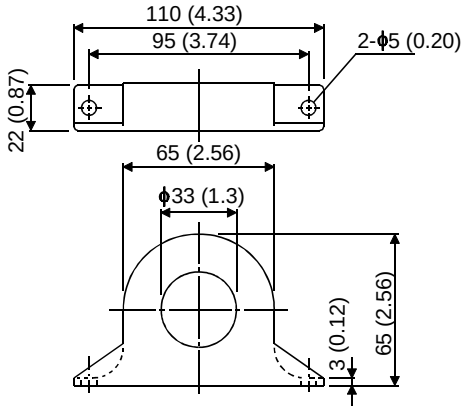

Note: Screw hole for grounding. Connect it to the earth plate of the control box.

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

| Clamp fitting | L |
|---|---|
| A | 70 (2.76) |
| B | 45 (1.77) |

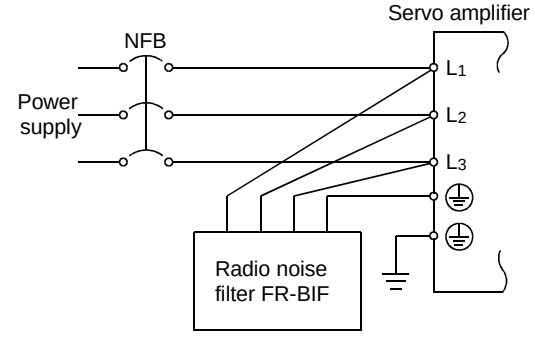
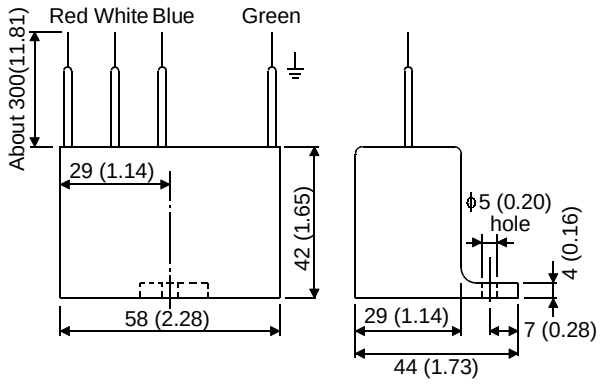
(d) Line noise filter (FR-BLF, FR-BSF01)

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

| Connection diagram | Outline drawing [Unit: mm] ([Unit: in.]) |
|---|---|
| Wind the 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.<br>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.<br>If the wires are too thick to be wound, use two or more filters and make the total number of turns as mentioned above.<br>On the output side, the number of turns must be four or less.<br>Do not wind the grounding wire together with the 3-phase wires. The filter effect will decrease. Use a separate wire for grounding.<br>  | FR-BLF(MR-J2S-350A) or more<br>  <br>FR-BSF01(for MR-J2S-200A or less)<br>  |

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

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

| Connection diagram | Outline drawing (Unit: mm) ([Unit: in.]) |
|---|---|
| Make the connection cables as short as possible.<br>Grounding is always required.<br>  | Leakage current: 4mA<br>  |

### 13.2.7 Leakage current breaker

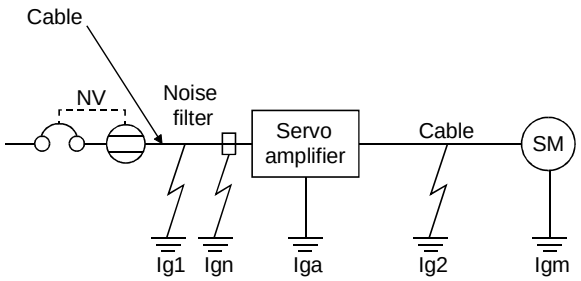
(1) Selection method

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

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

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

$$\text{Rated sensitivity current} \geq 10 \cdot \{Ig1+Ign+Iga+K \cdot (Ig2+Igm)\} \text{ [mA]} \quad \text{.....(13.2)}$$




K: Constant considering the harmonic contents

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

Ig1: Leakage current on the electric channel from the leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 13.1.)

Ig2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 13.1.)

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 13.6.)

Igm: Leakage current of the servo motor (Found from Table 13.5.)

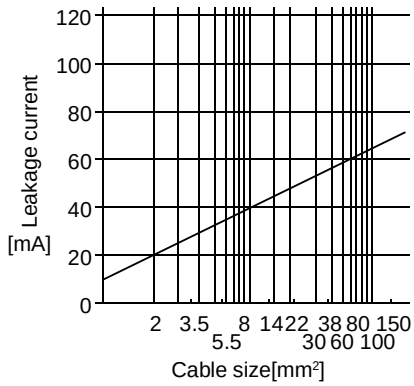



Fig. 13.1 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

Table 13.5 Servo motor's leakage current example (Igm)

| Servo motor output [kW] | Leakage current [mA] |
|---|---|
| 0.05 to 0.5 | 0.1 |
| 0.6 to 1.0 | 0.1 |
| 1.2 to 2.2 | 0.2 |
| 3 to 3.5 | 0.3 |
| 5 | 0.5 |
| 7 | 0.7 |

Table 13.6 Servo amplifier's leakage current example (Iga)

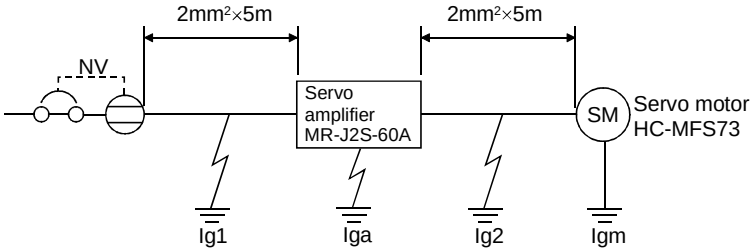
| Servo amplifier capacity [kW] | Leakage current [mA] |
|---|---|
| 0.1 to 0.6 | 0.1 |
| 0.7 to 3.5 | 0.15 |
| 5 • 7 | 2 |

Table 13.7 Leakage circuit breaker selection example

| Servo amplifier | Rated sensitivity current of leakage circuit breaker [mA] |
|---|---|
| MR-J2S-10A to MR-J2S-350A<br>MR-J2S-10A1 to MR-J2S-40A1 | 15 |
| MR-J2S-500A | 30 |
| MR-J2S-700A | 50 |

(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 (13.2) 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 (13.2):

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

$$\geq 8.0 \text{ [mA]}$$

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

### 13.2.8 EMC filter

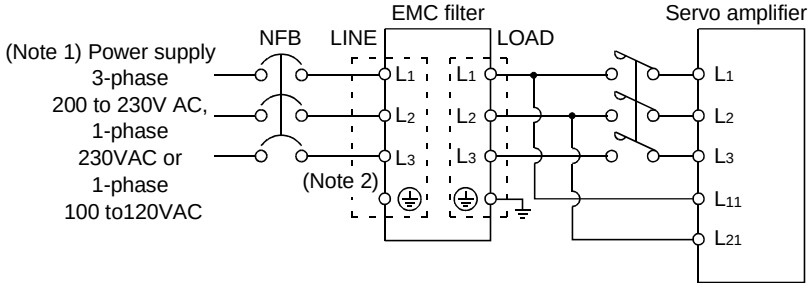
For compliance with the EMC Directive of the EN Standard, it is recommended to use the following filter:

(1) Combination with the servo amplifier

| Servo amplifier | Recommended filter | | Weight [kg]([lb]) |
|---|---|---|---|
| | Model | Leakage current [mA] | |
| MR-J2S-10A to MR-J2S-100A<br>MR-J2S-10A1 to MR-J2S-40A1 | SF1252 | 38 | 0.75 (1.65) |
| MR-J2S-200A・MR-J2S-350A | SF1253 | 57 | 1.37 (1.65) |
| MR-J2S-500A | (Note) HF-3040A-TM | 1.5 | 5.5 (12.13) |
| MR-J2S-700A | (Note) HF-3050A-TM | 1.5 | 6.7 (14.77) |

Note : Soshin Electric

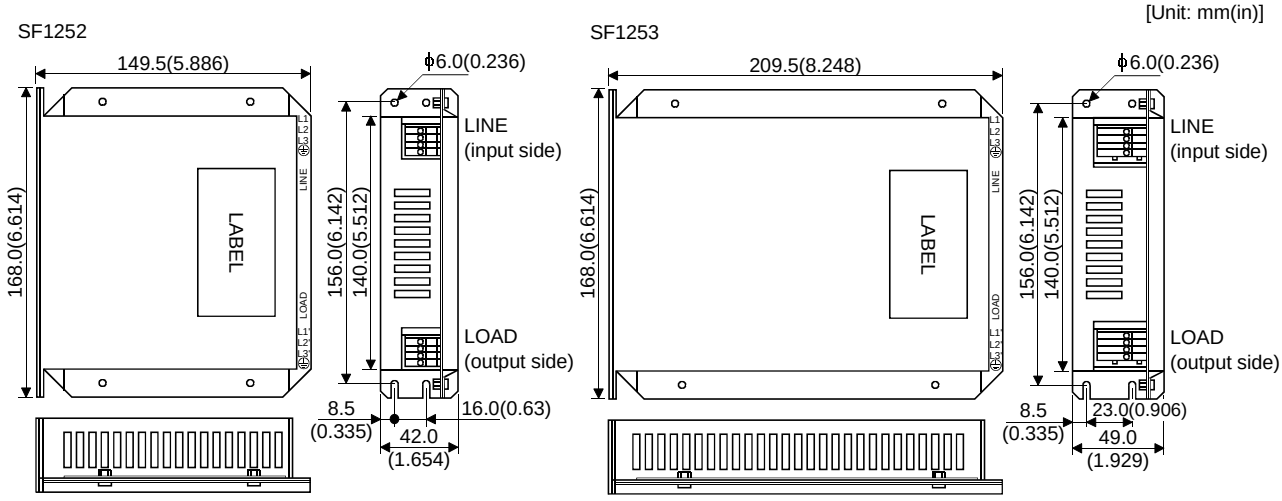
(2) Connection example



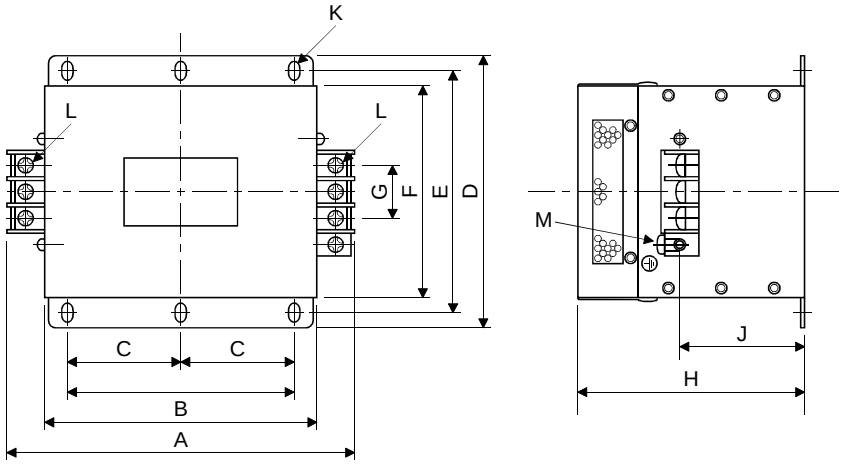

Note: 1. For 1-phase 230VAC power supply, connect the power supply to $L_1$,$L_2$ and leave $L_3$ open.
There is no $L_3$ for 1-phase 100 to 120VAC power supply.
2. Connect when the power supply has earth.

(3) Outline drawing

[Unit: mm(in)]



HF3040-TM・HF-3050A-TM




| Model | Dimensions [mm(in)] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G | H | J | K | L | M |
| HF3040A-TM | 260 (10.23) | 210 (8.27) | 85 (3.35) | 155 (6.10) | 140 (5.51) | 125 (4.92) | 44 (1.73) | 140 (5.51) | 70 (2.76) | R3.25, length 8 | M5 | M4 |
| HF3050A-TM | 290 (11.42) | 240 (9.45) | 100 (3.94) | 190 (7.48) | 175 (6.89) | 160 (6.30) | 44 (1.73) | 170 (5.51) | 100 (3.94) | | M6 | M4 |

# 14. COMMUNICATION FUNCTIONS

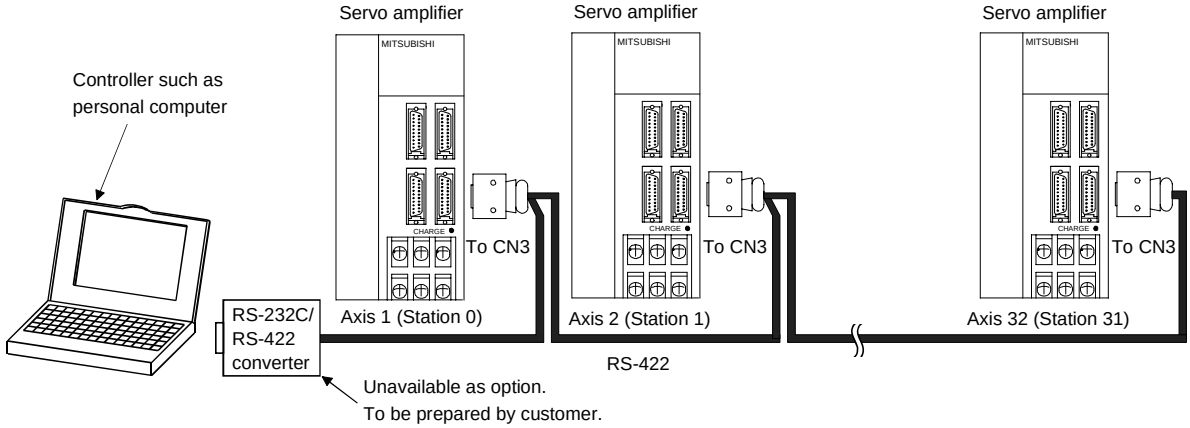
This servo amplifier has the RS-422 and RS-232C serial communication functions. These functions can be used to perform servo operation, parameter changing, monitor function, etc.
However, the RS-422 and RS-232C communication functions cannot be used together. Select between RS-422 and RS-232C with parameter No.16. (Refer to Section 14.2.2.)

## 14.1 Configuration

### 14.1.1 RS-422 configuration

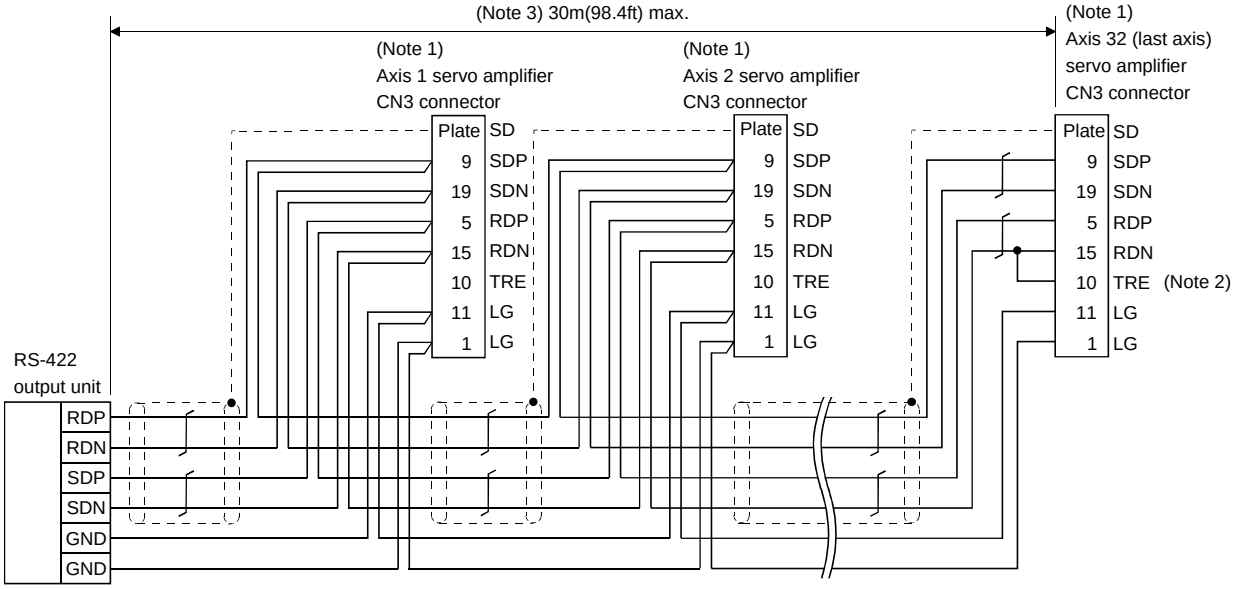
(1) Outline

Up to 32 axes of servo amplifiers from stations 0 to 31 can be operated on the same bus.




(2) Cable connection diagram

Wire as shown below:

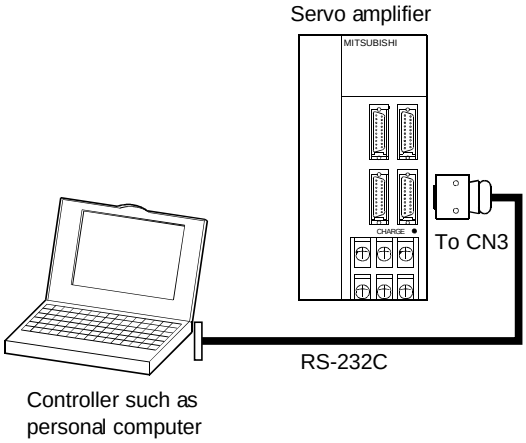



Note: 1. Connector set MR-J2CN1(3M or equivalent)
Connector: 10120-3000VE
Shell kit: 10320-52F0-008
2. In the last axis, connect TRE and RDN.
3. 30m max. in environment of little noise.

### 14.1.2 RS-232C configuration

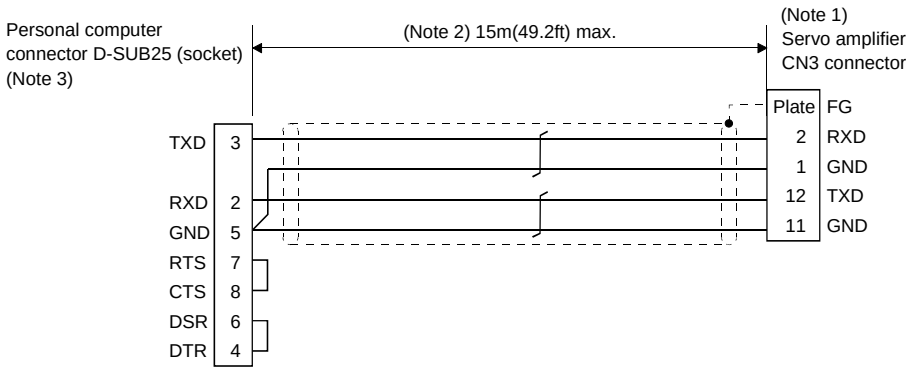
(1) Outline

A single axis of servo amplifier is operated.




(2) Cable connection diagram

Wire as shown below. The communication cable for connection with the personal computer (MR-CPCATCBL3M) is available. (Refer to Section 13.1.4.)




Note: 1. 3M's CN3 connector
Connector: 10120-6000EL
Shell kit: 10320-3210-000

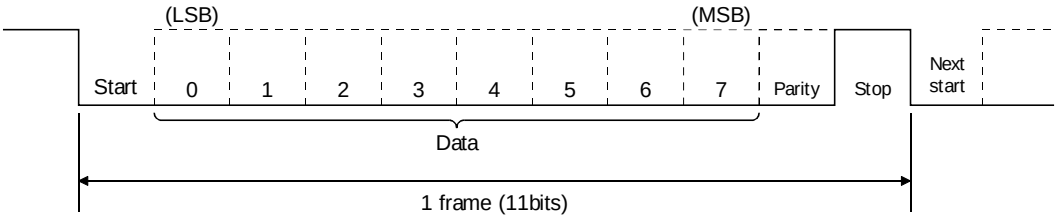
2. 15m(49.2ft) max. in environment of little noise. However, this distance should be 3m(9.84ft) max. for use at 38400bps or more baudrate.
3. For PC-AT compatible controller.

## 14.2 Communication specifications

### 14.2.1 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 |
|---|---|
| Baudrate | 9600/19200/38400/57600 asynchronous system |
| Transfer code | Start bit : 1 bit<br>Data bit : 8 bits<br>Parity bit : 1 bit (even)<br>Stop bit : 1 bit |
| Transfer protocol | Character system, half-duplex communication system |



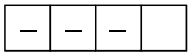
### 14.2.2 Parameter setting

When the RS-422/RS-232C 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 baudrate

Choose the communication speed. Match this value to the communication speed of the sending end (master station).

Parameter No. 16

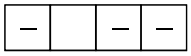


Communication baudrate
0: 9600[bps]
1: 19200[bps]
2: 38400[bps]
3: 57600[bps]

(2) Serial communication selection

Select the RS-422 or RS-232C communication standard. RS-422 and RS-232C cannot be used together.

Parameter No. 16

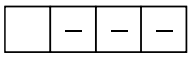


Serial communication standard selection
0: RS-232C used
1: RS-422 used

(3) Serial 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. 16



Serial communication response delay time
0: Invalid
1: Valid, reply sent in 800μs or more

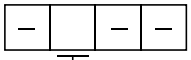
(4) Station number setting

Set the station number of the servo amplifier in parameter No. 15. The setting range is stations 0 to 31.

(5) Protocol station number selection

When communication is made without setting station numbers to servo amplifiers as in the MR-J2-A servo amplifiers, choose "no station numbers" in parameter No. 53. The communication protocol will be free of station numbers.

Parameter No. 53



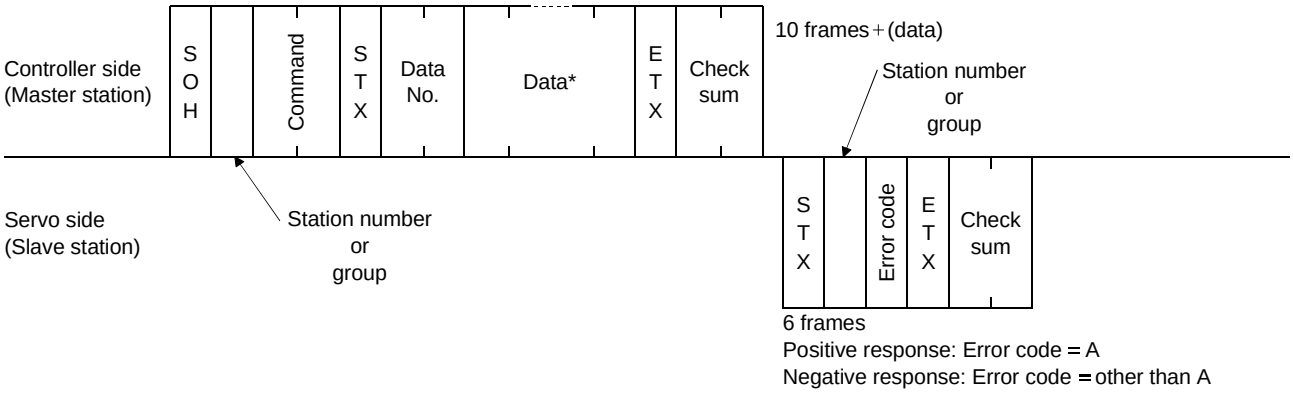
Protocol station number selection
0: With station numbers
1: No station numbers

## 14.3 Protocol

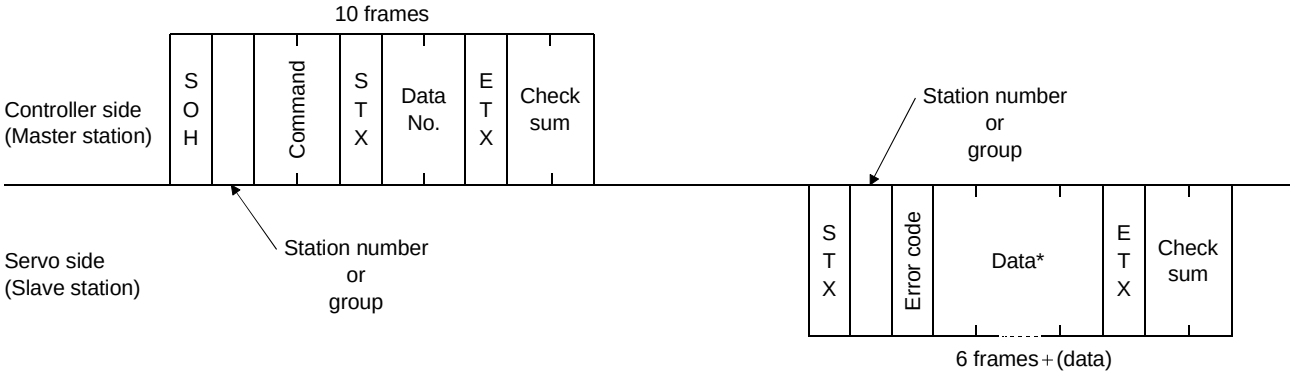
> **POINT**
>
> ▪ Whether station number setting will be made or not must be selected if the RS-232C communication function is used. Note that choosing "no station numbers" in parameter No. 53 will make the communication protocol free of station numbers as in the MR-J2-A servo amplifiers.

Since up to 32 axes may be connected to the bus, add a station number or group 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 and set the group to each station using the communication command. Transmission data is valid for the servo amplifier of the specified station number or group.
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.

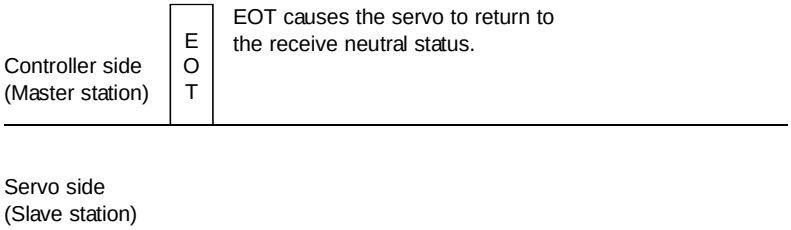
(1) Transmission of data from the controller to the servo



(2) Transmission of data request from the controller to the servo

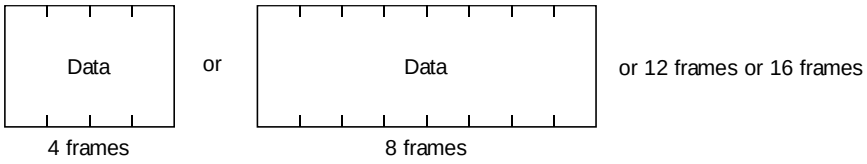



(3) Recovery of communication status by time-out




(4) Data frames

The data length depends on the command.



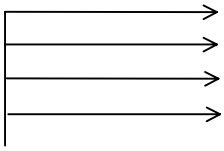
## 14.4 Character codes

### (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

JIS8 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 $b_5$ | $b_4$ | $b_3$ | $b_2$ | $b_1$ |
|---|---|---|---|---|
| | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 1 |
| | 0 | 0 | 1 | 0 |
| | 0 | 0 | 1 | 1 |
| | 0 | 1 | 0 | 0 |
| | 0 | 1 | 0 | 1 |
| | 0 | 1 | 1 | 0 |
| | 0 | 1 | 1 | 1 |
| | 1 | 0 | 0 | 0 |
| | 1 | 0 | 0 | 1 |
| | 1 | 0 | 1 | 0 |
| | 1 | 0 | 1 | 1 |
| | 1 | 1 | 0 | 0 |
| | 1 | 1 | 0 | 1 |
| | 1 | 1 | 1 | 0 |
| | 1 | 1 | 1 | 1 |

| C / R | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 0 | NUL | DLE | Space | 0 | @ | P | ` | p |
| 1 | SOH | $DC_1$ | ! | 1 | A | Q | a | q |
| 2 | STX | $DC_2$ | “ | 2 | B | R | b | r |
| 3 | ETX | $DC_3$ | # | 3 | C | S | c | s |
| 4 | | | $ | 4 | D | T | d | t |
| 5 | | | % | 5 | E | U | e | u |
| 6 | | | & | 6 | F | V | f | v |
| 7 | | | ‘ | 7 | G | W | g | w |
| 8 | | | ( | 8 | H | X | h | x |
| 9 | | | ) | 9 | I | Y | i | y |
| 10 | | | * | : | J | Z | j | z |
| 11 | | | + | ; | K | [ | k | { |
| 12 | | | , | < | L | ¥ | l | \| |
| 13 | | | − | = | M | ] | m | } |
| 14 | | | . | > | N | ^ | n | ¯ |
| 15 | | | / | ? | O | _ | o | DEL |

### (3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the JIS8 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS8 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JIS8 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).

### (4) Group

| Group | a | b | c | d | e | f | All group |
|---|---|---|---|---|---|---|---|
| JIS8 code | a | b | c | d | e | f | * |

For example, "61H" is transmitted in hexadecimal for group a.

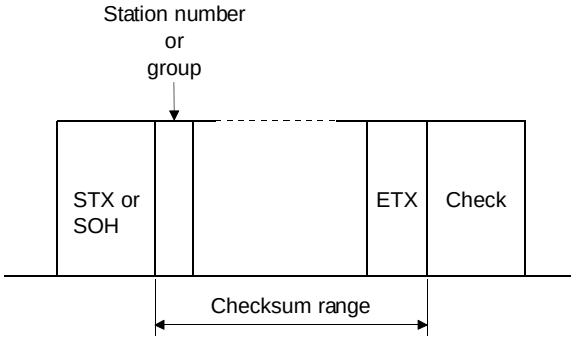
## 14.5 Error codes

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. | |

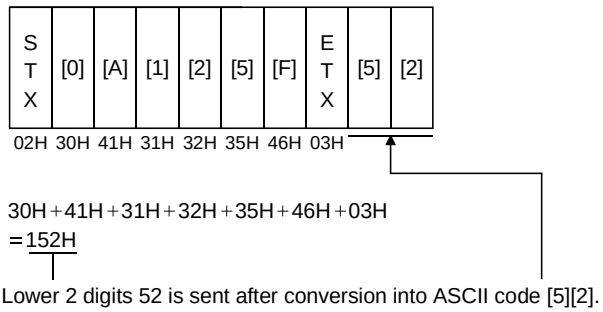
## 14.6 Checksum

Checksum range



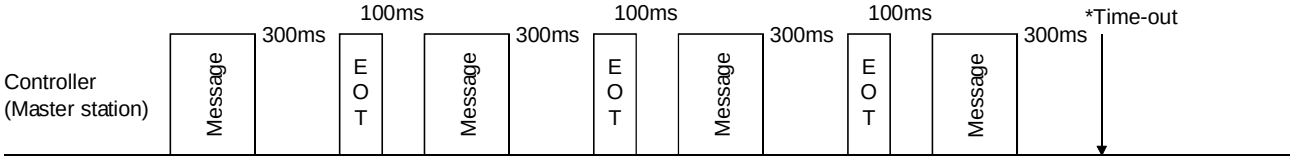

The check sum is a JIS8-coded hexadecimal representing the lower two digits of the sum of JIS8-coded hexadecimal numbers up to ETX, with the exception of the first control code (STX or S0H).

(Example)



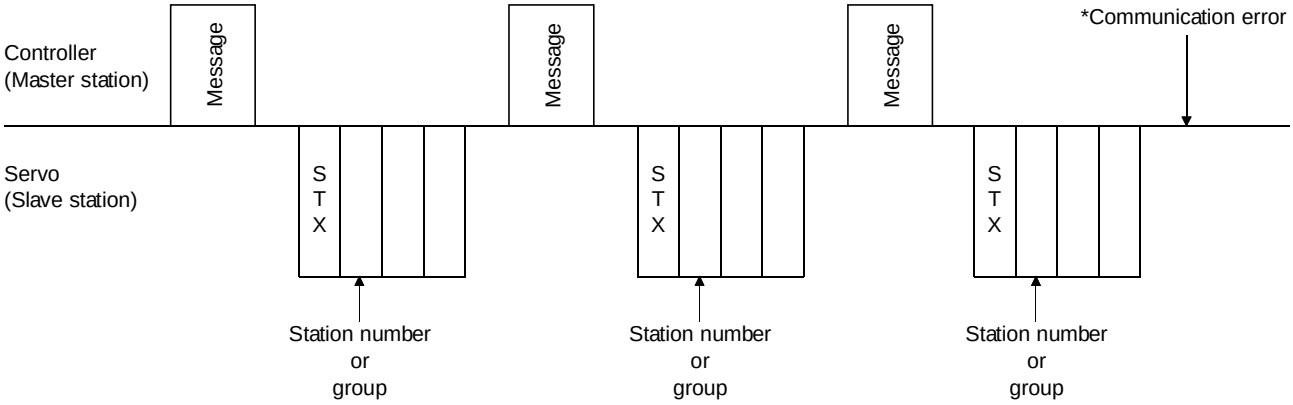
## 14.7 Time-out operation

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)




## 14.8 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.

### 14.9 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:

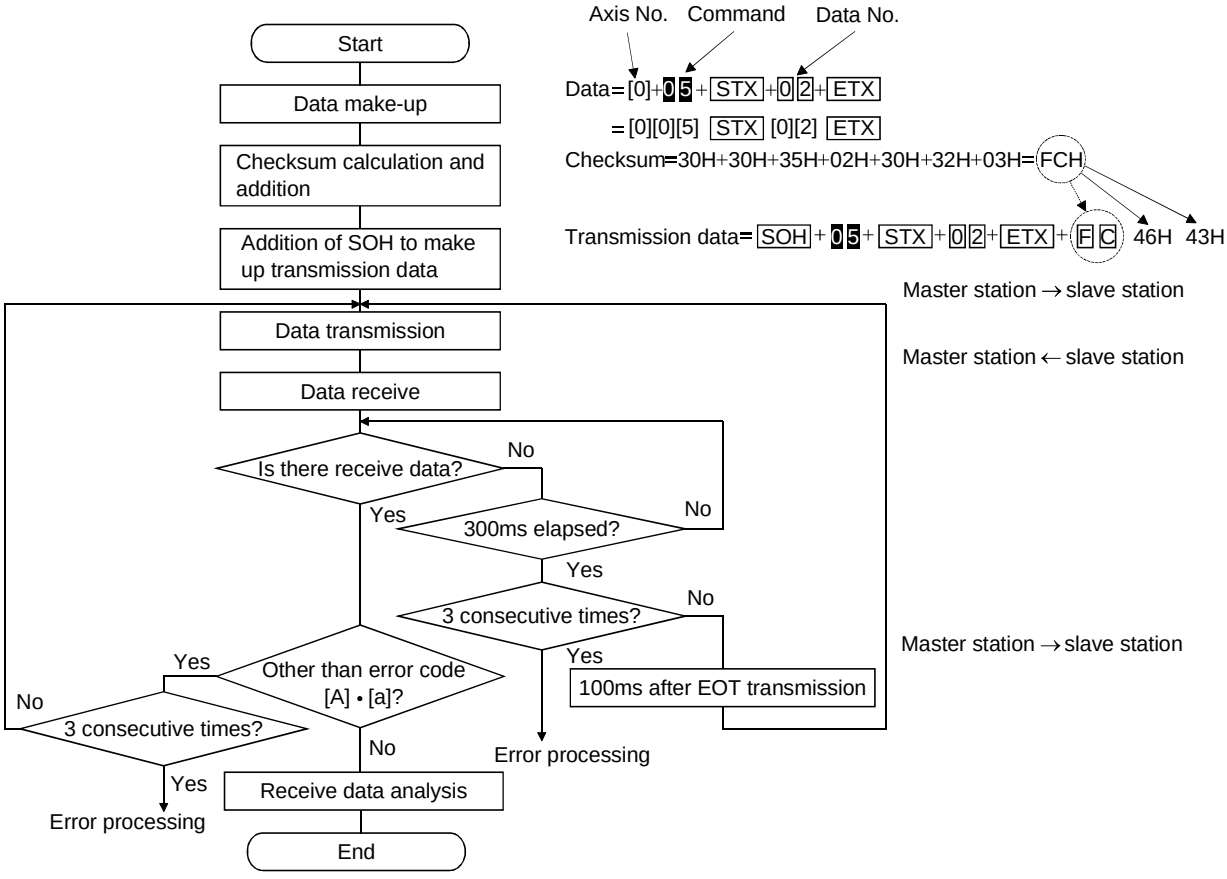
(1) 1s or more time has elapsed after the slave station is switched on; and

(2) Making sure that normal communication can be made by reading the parameter or other data which does not pose any safety problems.

### 14.10 Communication procedure example

The following example reads the set value of parameter No.2 "function selection 1" from the servo amplifier of station 0:

| Data item | Value | Description |
|---|---|---|
| Station number | 0 | Servo amplifier station 0 |
| Command | 05 | Read command |
| Data No. | 02 | Parameter No.2 |



## 14.11 Command and data No. list

### 14.11.1 Read commands

(1) Status display (Command [0][1])

| Command | Data No. | Description | Display item | Frame length |
|---|---|---|---|---|
| [0][1] | [8][0] | Status display data value and processing information | cumulative feedback pulses | 12 |
| [0][1] | [8][1] | | servo motor speed | 12 |
| [0][1] | [8][2] | | droop pulses | 12 |
| [0][1] | [8][3] | | cumulative command pulses | 12 |
| [0][1] | [8][4] | | command pulse frequency | 12 |
| [0][1] | [8][5] | | analog speed command voltage<br>analog speed limit voltage | 12 |
| [0][1] | [8][6] | | analog torque command voltage<br>analog torque limit voltage | 12 |
| [0][1] | [8][7] | | regenerative load ratio | 12 |
| [0][1] | [8][8] | | effective load ratio | 12 |
| [0][1] | [8][9] | | peak load ratio | 12 |
| [0][1] | [8][A] | | Instantaneous torque | 12 |
| [0][1] | [8][B] | | within one-revolution position | 12 |
| [0][1] | [8][C] | | ABS counter | 12 |
| [0][1] | [8][D] | | load inertia moment ratio | 12 |
| [0][1] | [8][E] | | Bus voltage | 12 |

(2) Parameter (Command [0][5])

| Command | Data No. | Description | Frame length |
|---|---|---|---|
| [0][5] | [0][0] to [5][4] | Current value of each parameter<br>The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number. | 8 |

(3) External I/O signals (Command [1][2])

| Command | Data No. | Description | Frame length |
|---|---|---|---|
| [1][2] | [4][0] | External input pin statuses | 8 |
| [1][2] | [C][0] | External output pin statuses | 8 |

(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 |
| [3][3] | [1][1] | | first alarm in past | 4 |
| [3][3] | [1][2] | | second alarm in past | 4 |
| [3][3] | [1][3] | | third alarm in past | 4 |
| [3][3] | [1][4] | | fourth alarm in past | 4 |
| [3][3] | [1][5] | | fifth alarm in past | 4 |
| [3][3] | [2][0] | Alarm occurrence time in alarm history | most recent alarm | 8 |
| [3][3] | [2][1] | | first alarm in past | 8 |
| [3][3] | [2][2] | | second alarm in past | 8 |
| [3][3] | [2][3] | | third alarm in past | 8 |
| [3][3] | [2][4] | | fourth alarm in past | 8 |
| [3][3] | [2][5] | | fifth alarm in past | 8 |

(5) Current alarm (Command [0][2] ▪ [3][5])

| Command | Data No. | Description | Frame length |
|---|---|---|---|
| [0][2] | [0][0] | Current alarm number | 4 |

| Command | Data No. | Description | Display item | Frame length |
|---|---|---|---|---|
| [3][5] | [8][0] | Status display data value and processing information at alarm occurrence | cumulative feedback pulses | 12 |
| [3][5] | [8][1] | | servo motor speed | 12 |
| [3][5] | [8][2] | | droop pulses | 12 |
| [3][5] | [8][3] | | cumulative command pulses | 12 |
| [3][5] | [8][4] | | command pulse frequency | 12 |
| [3][5] | [8][5] | | analog speed command voltage<br>analog speed limit voltage | 12 |
| [3][5] | [8][6] | | analog torque command voltage<br>analog torque limit voltage | 12 |
| [3][5] | [8][7] | | regenerative load ratio | 12 |
| [3][5] | [8][8] | | effective load ratio | 12 |
| [3][5] | [8][9] | | peak load ratio | 12 |
| [3][5] | [8][A] | | Instantaneous torque | 12 |
| [3][5] | [8][B] | | within one-revolution position | 12 |
| [3][5] | [8][C] | | ABS counter | 12 |
| [3][5] | [8][D] | | load inertia moment ratio | 12 |
| [3][5] | [8][E] | | Bus voltage | 12 |

(6) Group setting (Command [1][F])

| Command | Data No. | Description | Frame length |
|---|---|---|---|
| [1][F] | [0][0] | Reading of group setting value | 4 |

(7) Others

| Command | Data No. | Description | Frame length |
|---|---|---|---|
| [0][2] | [9][0] | Servo motor end pulse unit absolute position | 8 |
| [0][2] | [9][1] | Command unit absolute position | 8 |
| [0][2] | [7][0] | Software version | 16 |

14.11.2 Write commands

(1) Status display (Command [8][1])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [8][1] | [0][0] | Status display data clear | 1EA5 | 4 |

(2) Parameter (Command [8][4])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [8][4] | [0][0] to [5][4] | Each parameter write<br>The decimal equivalent of the data No. value (hexadecimal) corresponds to the parameter number. | Depends on the parameter. | 8 |

(3) Alarm history (Command [8][2])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [8][2] | [2][0] | Alarm history clear | 1EA5 | 4 |

(4) Current alarm (Command [8][2])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [8][2] | [0][0] | Alarm reset | 1EA5 | 4 |

(5) Operation mode selection (Command [8][B])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [8][B] | [0][0] | Operation mode changing<br>0000: Exit from test operation mode<br>0001: Jog operation<br>0002: Positioning operation<br>0003: Motor-less operation<br>0004: Output signal (DO) forced output | 0000 to 0004 | 4 |

(6) External input signal disable (Command [9][0])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [9][0] | [0][0] | Turns off the external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN, independently of the external ON/OFF statuses. | 1EA5 | 4 |
| [9][0] | [0][3] | Changes the external output signals (DO) into the value of command [8][B] or command [A][0] + data No. [0][1]. | 1EA5 | 4 |
| [9][0] | [1][0] | Enables the disabled external input signals (DI), external analog input signals and pulse train inputs with the exception of EMG, LSP and LSN. | 1EA5 | 4 |
| [9][0] | [1][3] | Enables the disabled external output signals (DO). | 1EA5 | 4 |

(7) Data for test operation mode (Command [9][2] ▪ [A][0])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [9][2] | [0][0] | Input signal for test operation | | 8 |
| [9][2] | [A][0] | Forced output from signal pin | | 8 |

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [A][0] | [1][0] | Writes the speed of the test operation mode (jog operation, positioning operation). | 0000 to 7FFF | 4 |
| [A][0] | [1][1] | Writes the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation). | 00000000 to 7FFFFFFF | 8 |
| [A][0] | [1][2] | Clears the acceleration/deceleration time constant of the test operation mode (jog operation, positioning operation). | 1EA5 | 4 |
| [A][0] | [1][3] | Writes the moving distance (in pulses) of the test operation mode (jog operation, positioning operation). | 80000000 to 7FFFFFFF | 8 |
| [A][0] | [1][5] | Temporary stop command of the test operation mode (jog operation, positioning operation) | 1EA5 | 4 |

(8) Group setting (Command [9][F])

| Command | Data No. | Description | Setting range | Frame length |
|---|---|---|---|---|
| [9][F] | [0][0] | Setting of group | | 4 |

## 14.12 Detailed explanations of commands

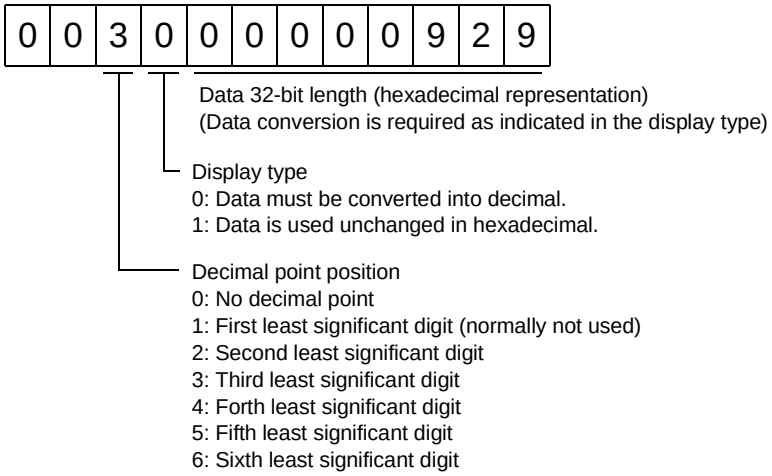
### 14.12.1 Data processing

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.

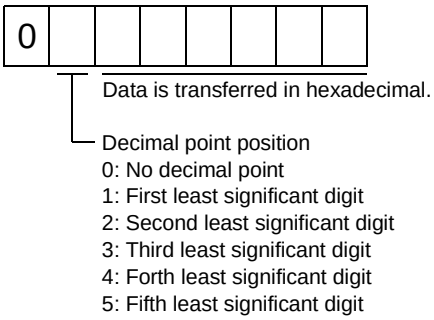



Since the display type is "0" in this case, the hexadecimal data is converted into decimal.
00000929H→2345
As the decimal point position is "3", a decimal point is placed in the third least significant digit.
Hence, "23.45" is displayed.

(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.

### 14.12.2 Status display

(1) Status display data read

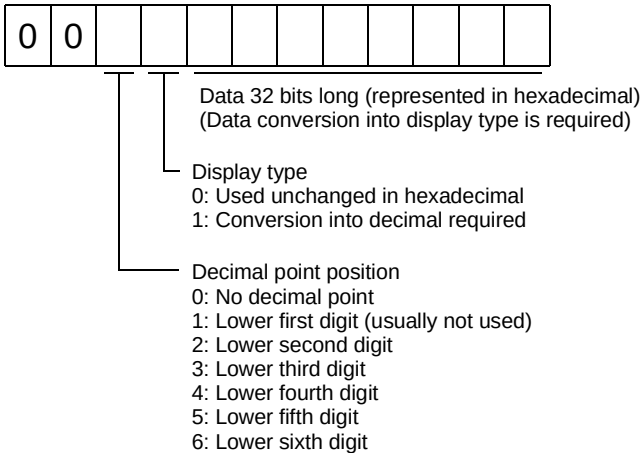
When the master station transmits the data No. (refer to the following table for assignment) to the slave station, the slave station sends back the data value and data processing information.

1) Transmission

Transmit command [0][1] and the data No. corresponding to the status display item to be read. Refer to Section 14.11.1.

2) Reply

The slave station sends back the status display data requested.




(2) 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] | 1EA5 |

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.

### 14.12.3 Parameter

#### (1) Parameter read

Read the parameter setting.

1) Transmission

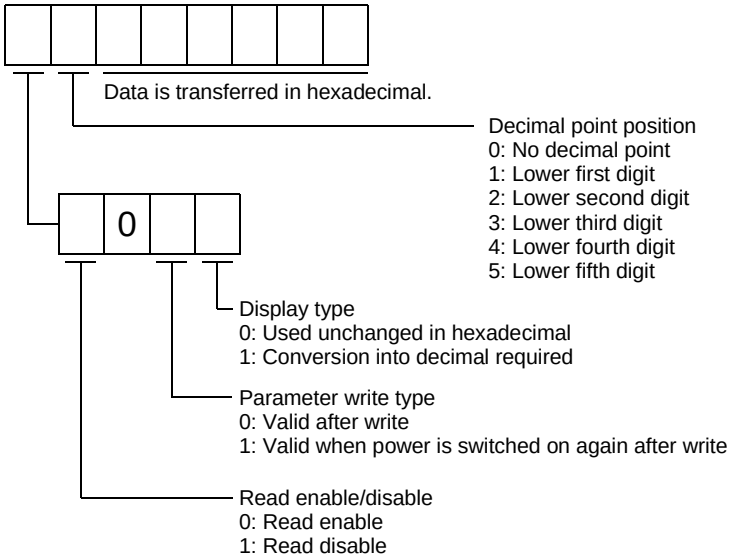
Transmit command [0][5] and the data No. corresponding to the parameter No.

The data No. is expressed in hexadecimal equivalent of the data No. value corresponds to the parameter number.

| Command | Data No. |
|---|---|
| [0][5] | [0][0] to [5][4] |

2) Reply

The slave station sends back the data and processing information of the requested parameter No.



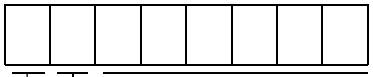

Enable/disable information changes according to the setting of parameter No.19 "parameter write inhibit". When the enable/disable setting is read disable, ignore the parameter data part and process it as unreadable.

(2) Parameter write

| POINT |
| --- |
| ▪ The number of parameter write times is restricted to 1,000,000 times. |

Write the parameter setting.
Write the value within the setting range. Refer to Section 5.1 for the setting range.
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 given in Section 5.1.2. 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 [5][4] | 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 using communication to change parameter values frequently, set "3" here and change data on RAM in the servo amplifier.
Frequent change to EEP-ROM data may cause the permissible write times (1 million times) of EEP-ROM to be exceeded, leading to a failure.

### 14.12.4 External I/O pin statuses (DIO diagnosis)

#### (1) External input pin status read

Read the ON/OFF statuses of the external input pins.

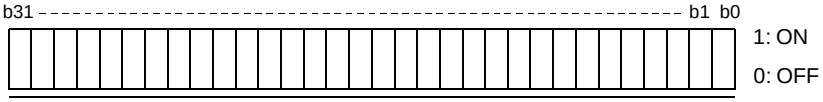
(a) Transmission

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.




Command of each bit is transmitted to the master station as hexadecimal data.

| bit | External input pin |
|---|---|
| 0 | CN1B-16 |
| 1 | CN1B-17 |
| 2 | CN1B-15 |
| 3 | CN1B-5 |
| 4 | CN1B-14 |
| 5 | CN1A-8 |
| 6 | CN1B-7 |
| 7 | CN1B-8 |

| bit | External input pin |
|---|---|
| 8 | CN1B-9 |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |

| bit | External input pin |
|---|---|
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | |

| bit | External input pin |
|---|---|
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |

#### (2) External output pin status read

Read the ON/OFF statuses of the external output pins.

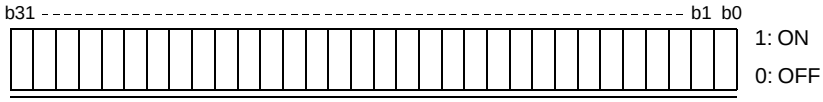
(a) Transmission

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.




Command of each bit is transmitted to the master station as hexadecimal data.

| bit | External output pin |
|---|---|
| 0 | CN1A-19 |
| 1 | CN1A-18 |
| 2 | CN1B-19 |
| 3 | CN1B-6 |
| 4 | CN1B-4 |
| 5 | CN1B-18 |
| 6 | CN1A-14 |
| 7 | |

| bit | External output pin |
|---|---|
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |

| bit | External output pin |
|---|---|
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | |

| bit | External output pin |
|---|---|
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |

### 14.12.5 Disable/enable of external I/O signals (DIO)

Inputs can be disabled independently of the external I/O signal ON/OFF. When inputs are disabled, the input signals are recognized as follows. Among the external input signals, EMG, LSP and LSN cannot be disabled.

| Signal | Status |
|---|---|
| External input signals (DI) | OFF |
| External analog input signals | 0V |
| Pulse train inputs | None |

(1) Disabling/enabling the external input signals (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 external output signals (DO)
Transmit the following communication commands:
(a) Disable

| Command | Data No. | Data |
|---|---|---|
| [9][0] | [0][3] | 1EA5 |

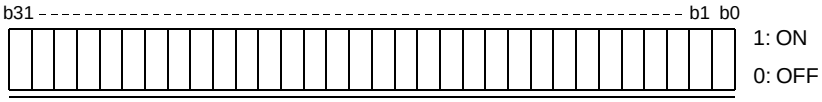
(b) Enable

| Command | Data No. | Data |
|---|---|---|
| [9][0] | [1][3] | 1EA5 |

### 14.12.6 External input signal ON/OFF (test operation)

Each input signal can be turned on/off for test operation. Turn off the external input signals.
Send command [9] [2], data No. [0] [0] and data.

| Command | Data No. | Set data |
|---|---|---|
| [9][2] | [0][0] | See below |




Command of each bit is transmitted to the slave station as hexadecimal data.

| bit | Signal abbreviation |
|---|---|
| 0 | SON |
| 1 | LSP |
| 2 | LSN |
| 3 | TL |
| 4 | |
| 5 | PC |
| 6 | RES |
| 7 | CR |

| bit | Signal abbreviation |
|---|---|
| 8 | |
| 9 | |
| 10 | |
| 11 | ST1 |
| 12 | ST2 |
| 13 | |
| 14 | |
| 15 | |

| bit | Signal abbreviation |
|---|---|
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | |

| bit | Signal abbreviation |
|---|---|
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |

### 14.12.7 Test operation mode

#### (1) Instructions for test operation mode

The test operation mode must be executed in the following procedure. If communication is interrupted for longer than 0.5s during test operation, the servo amplifier causes the motor to be decelerated to a stop and servo-locked. To prevent this, continue communication without a break, e.g. monitor the status display.

(a) Execution of test operation

1) Turn off all external input signals.

2) Disable the external input signals.

| Command | Data No. | Data |
|---|---|---|
| [9][0] | [0][0] | 1EA5 |

3) Choose the test operation mode.

| Command | Data No. | Transmission data | Selection of test operation mode |
|---|---|---|---|
| [8][B] | [0][0] | 0000 | Test operation mode cancel |
| [8][B] | [0][0] | 0001 | Jog operation |
| [8][B] | [0][0] | 0002 | Positioning operation |
| [8][B] | [0][0] | 0003 | Motor-less operation |
| [8][B] | [0][0] | 0004 | DO forced output |

4) Set the data needed for test operation.

5) Start.

6) Continue communication using the status display or other command.

(b) Termination of test operation

To terminate the test operation mode, complete the corresponding operation and:

1) Clear the test operation acceleration/deceleration time constant.

| Command | Data No. | Data |
|---|---|---|
| [A][0] | [1][2] | 1EA5 |

2) Cancel the test operation mode.

| Command | Data No. | Data |
|---|---|---|
| [8][B] | [0][0] | 0000 |

3) Enable the disabled external input signals.

| Command | Data No. | Data |
|---|---|---|
| [9][0] | [1][0] | 1EA5 |

(2) Jog operation

Transmit the following communication commands:

(a) Setting of jog operation data

| Item | Command | Data No. | Data |
|---|---|---|---|
| Speed | [A][0] | [1][0] | Write the speed [r/min] in hexadecimal. |
| Acceleration/deceleration time constant | [A][0] | [1][1] | Write the acceleration/deceleration time constant [ms] in hexadecimal. |

(b) Start

Turn on the external input signals SON and ST1/ST2 by using command [9][2] + data No. [0][0].

| Item | Command | Data No. | Data |
|---|---|---|---|
| Forward rotation start | [9][2] | [0][0] | 00000801: Turns on SON and ST1. |
| Reverse rotation start | [9][2] | [0][0] | 00001001: Turns on SON and ST2. |

(3) Positioning operation

Transmit the following communication commands:

(a) Setting of positioning operation data

| Item | Command | Data No. | Data |
|---|---|---|---|
| Speed | [A][0] | [1][0] | Write the speed [r/min] in hexadecimal. |
| Acceleration/deceleration time constant | [A][0] | [1][1] | Write the acceleration/deceleration time constant [ms] in hexadecimal. |
| Moving distance | [A][0] | [1][3] | Write the moving distance [pulse] in hexadecimal. |

(b) Start

Turn on the external input signals SON and ST1/ST2 by using command [9][2] + data No. [0][0].

| Item | Command | Data No. | Data |
|---|---|---|---|
| Forward rotation start | [9][2] | [0][0] | 00000801: Turns on SON and ST1. |
| Reverse rotation start | [9][2] | [0][0] | 00001001: Turns on SON and ST2. |

(c) Temporary stop

A temporary stop can be made during positioning operation.

| Command | Data No. | Data |
|---|---|---|
| [A][0] | [1][5] | 1EA5 |

Retransmit the same communication commands as at the start time to resume operation.

To stop positioning operation after a temporary stop, retransmit the temporary stop communication command. The remaining moving distance is then cleared.

### 14.12.8 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.

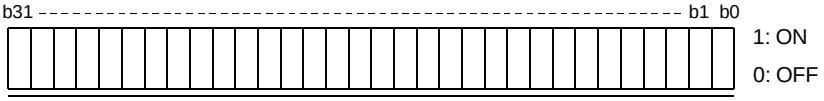
| 0 | 0 | 0 | 4 |
|---|---|---|---|

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 | External output pin |
|---|---|
| 0 | CN1A-19 |
| 1 | CN1A-18 |
| 2 | CN1B-19 |
| 3 | CN1B-6 |
| 4 | CN1B-4 |
| 5 | CN1B-18 |
| 6 | CN1A-14 |
| 7 | |

| bit | External output pin |
|---|---|
| 8 | |
| 9 | |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |

| bit | External output pin |
|---|---|
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |
| 21 | |
| 22 | |
| 23 | |

| bit | External output pin |
|---|---|
| 24 | |
| 25 | |
| 26 | |
| 27 | |
| 28 | |
| 29 | |
| 30 | |
| 31 | |

### 14.12.9 Alarm history

#### (1) Alarm No. read

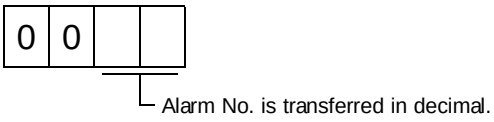
Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No. 0 (last alarm) to No. 5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][5]. Refer to Section 14.11.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.




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.

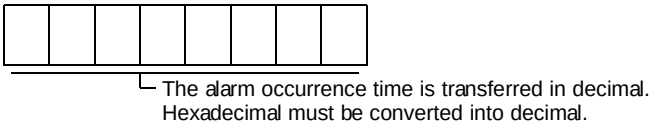
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

Send command [3][3] and data No. [2][0] to [2][5].

Refer to Section 14.11.1.

(b) Reply




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 |

### 14.12.10 Current alarm

#### (1) Current alarm read

Read the alarm No. which is occurring currently.

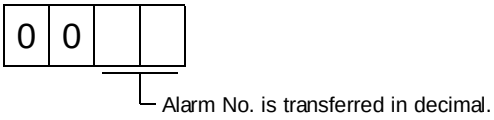
(a) Transmission

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.




For example, “0032” means AL.32 and “00FF” means AL._ (no alarm).

#### (2) Read of the status display at alarm occurrence

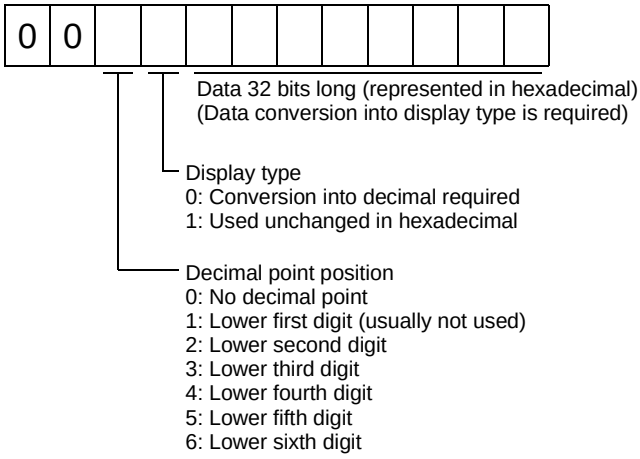
Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

(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 14.11.1.

(b) Reply

The slave station sends back the requested status display data at alarm occurrence.




#### (3) Current alarm clear

As by the entry of the RES signal, 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 |

### 14.12.11 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 16384 or more revolutions from the home position.

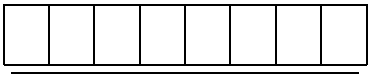
(a) Transmission

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.



Absolute value is sent back in hexadecimal in the servo motor end pulse unit.
(Must be converted into decimal)

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.

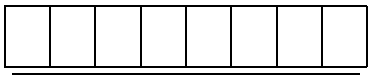
(a) Transmission

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.



Absolute value is sent back in hexadecimal in the command unit.
(Must be converted into decimal)

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.



Space | Software version (15 digits)

# MEMO

# 15. ABSOLUTE POSITION DETECTION SYSTEM

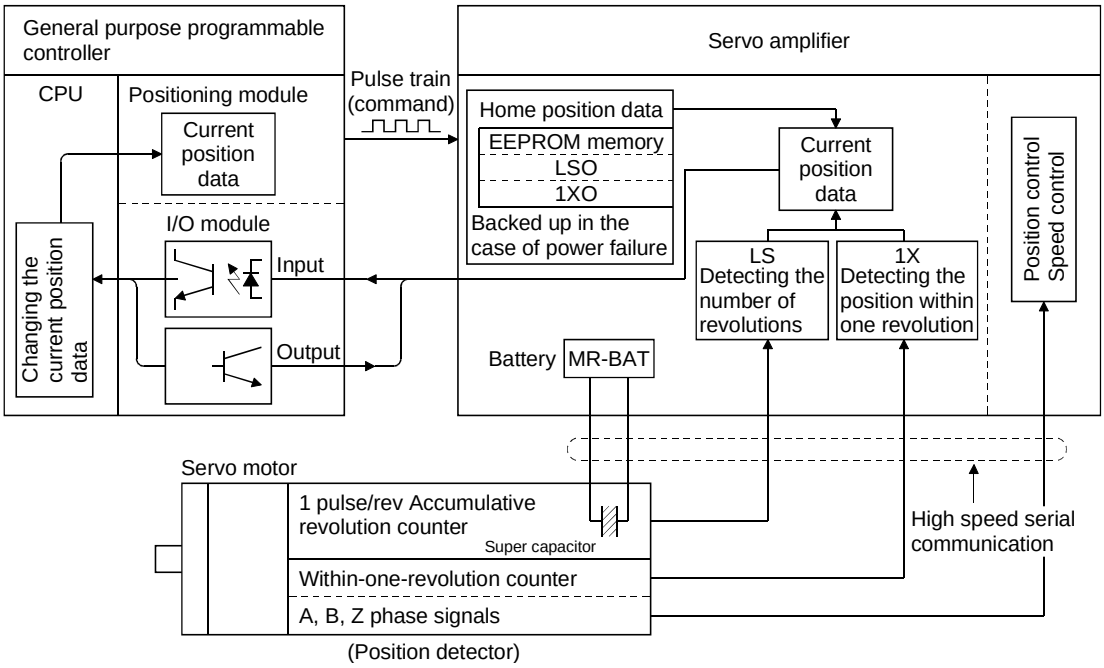
**CAUTION**

- If an absolute position erase alarm (AL.25) has occurred, always perform home position setting again. Not doing so can cause runaway.

## 15.1 Outline

### 15.1.1 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.
Also, the absolute position data, which is battery-backed by the super capacitor in the encoder, can be retained within the specified period (cumulative revolution counter value retaining time) if the cable is unplugged or broken.




### 15.1.2 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.1.
(1) Speed control mode, torque control mode.
(2) Control switch-over mode (position/speed, speed/torque, torque/speed).
(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.

## 15.2 Specifications

### (1) Specification list

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

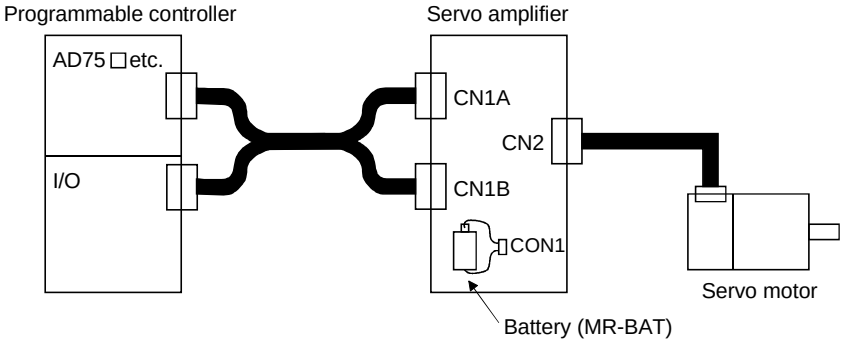
Note: 1. Maximum speed available when the shaft is rotated by external force at the time of power failure or the like.

2. Time to hold data by a battery with power off. It is recommended to replace the battery in three years independently of whether power is kept on or off.

3. Period during which data can be held by the super capacitor in the encoder after power-off, with the battery voltage low or the battery removed, or during which data can be held with the encoder cable disconnected.
   Battery replacement should be finished within this period.

### (2) Configuration

| Positioning module | I/O module |
|---|---|
| AD71・AD71S2・AD71S7<br>A1SD71S2・A1SD71S7<br>AD75□<br>A1SD75□ | AX40・41・42<br>AY40・41・42 |
| FX-1PG・FX-1GM<br>FX(E)-20GM・FX-10GM | FX2-32MT |




### (3) Parameter setting

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

Parameter No. 1

| 1 | – | – | – |
|---|---|---|---|

Selection of absolute position detection system
0: Incremental system
1: Absolute position detection system

## 15.3 Battery installation procedure

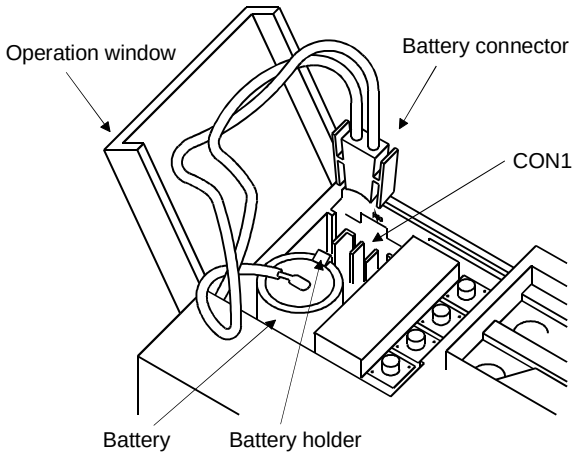
| | |
|---|---|
| ⚠ WARNING | ▪ Before starting battery installation procedure, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock. |

**POINT**

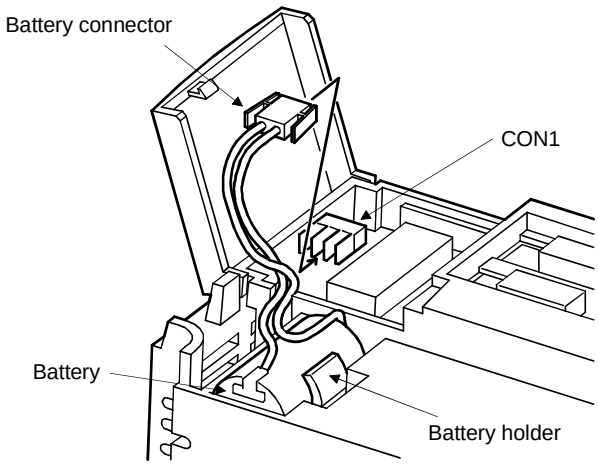
The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:

- Ground human body and work bench.
- Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

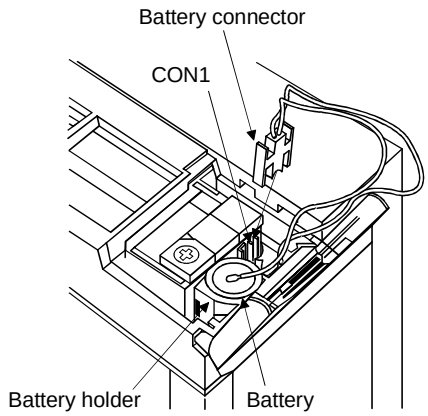
(1) Open the operation window. (When the model used is the MR-J2S-200A ▪ MR-J2S-350A or more, also remove the front cover.)
(2) Install the battery in the battery holder.
(3) Install the battery connector into CON1 until it clicks.




For MR-J2S-100A or less

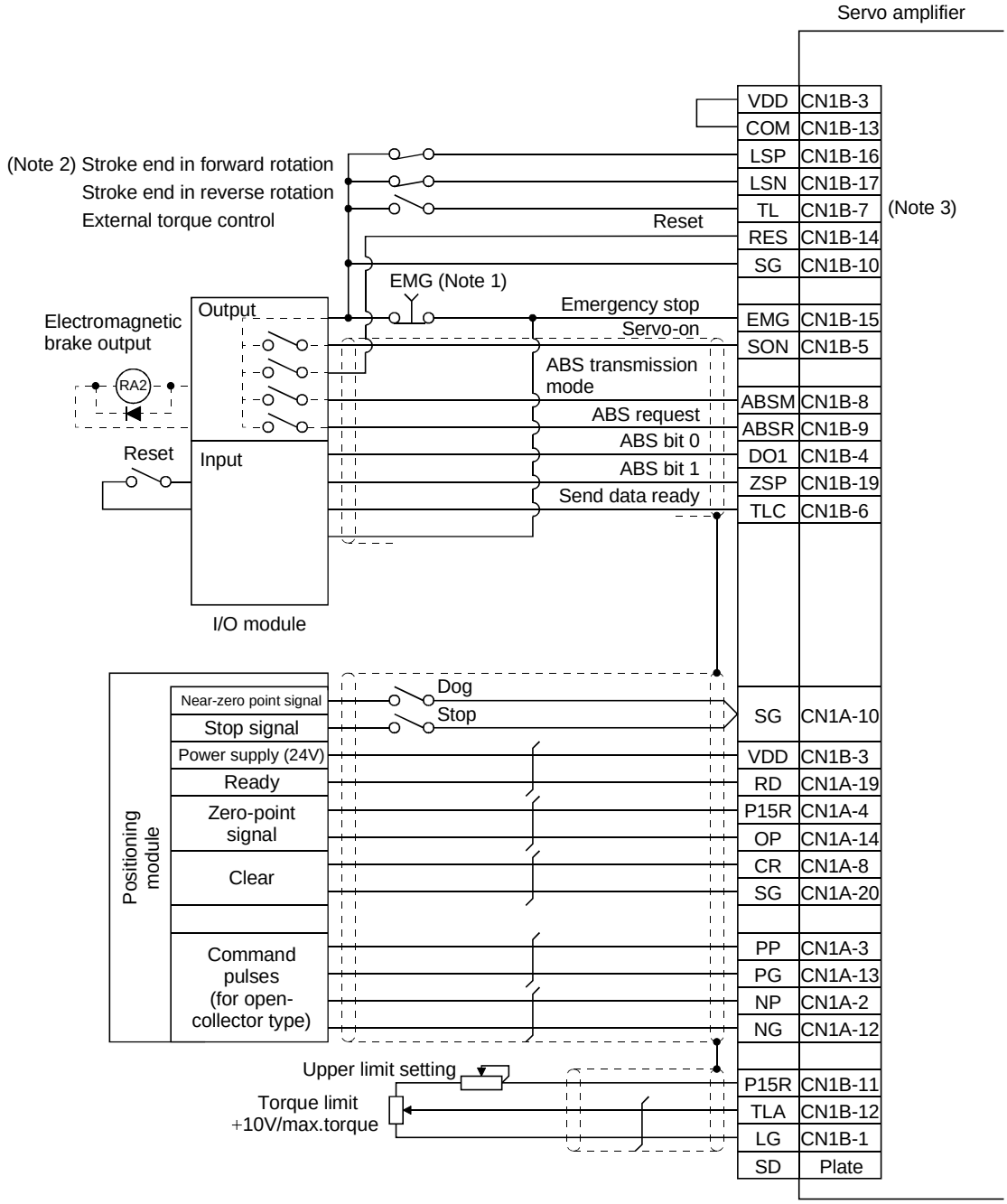



For MR-J2S-200A ▪ MR-J2S-350A




For MR-J2S-500A ▪ MR-J2S-700A

## 15.4 Standard connection diagram




Note: 1. Always install the emergency stop switch.

2. For operation, always short the forward/reverse rotation stroke end (LSN/LSP) with SG.

3. When using the torque limit signal (TL), set "□□□4" in parameter No.46 to assign TL to pin CN1B-7.

## 15.5 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 3.3.2.
For the I/O interfaces (symbols in the I/O Category column in the table), refer to Section 3.6.

| Signal name | Code | Pin No. | Function/Application | I/O category | Control mode |
|---|---|---|---|---|---|
| ABS transfer mode | ABSM | (Note) CN1B-8 | While ABSM is shorted by connection to SG, 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) CN1B-9 | ABSR-SG are shorted to request the ABS data in the ABS transfer mode. | DI-1 | |
| ABS bit 0 | D01 | CN1B-4 | 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.<br>If there is a signal, the circuit between D01 and SG is closed. | DO-1 | |
| ABS bit 1 | ZSP | CN1B-19 | 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.<br>If there is a signal, the circuit between ZSP and SG is closed. | DO-1 | |
| Send data ready | TLC | CN1B-6 | Indicates that the data to be sent is being prepared in the ABS transfer mode. At the completion for the ready state, the circuit between TLC and SG is closed. | DO-1 | |
| Home position setting | CR | CN1A-8 | When CR-SG are shorted, 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. 1, pin CN1B-8 acts as the ABS transfer mode (ABSM) signal and pin CN1B-9 as the ABS request (ABSR) signal. They do not return to the original signals if data transfer ends.

## 15.6 Startup procedure

(1) Battery installation.

Refer to Section 15.3 installation of absolute position backup battery.

(2) Parameter setting

Set "1 □□□"in parameter No. 1 of the servo amplifier and switch power off, then on.

(3) Resetting of absolute position erase alarm (AL.25)

After connecting the encoder cable, the absolute position erase alarm (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 signal 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 (M3 for A1SD71, M99 for 1PG) turns on.

(c) The servo configuration software ABS data display window (refer to Section 15.9) and programmable controller side ABS data registers (D3, D4 for A1SD71, D106, D107 for 1PG) 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 15.10 or Chapter 10 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 alarm (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 15.7.3.

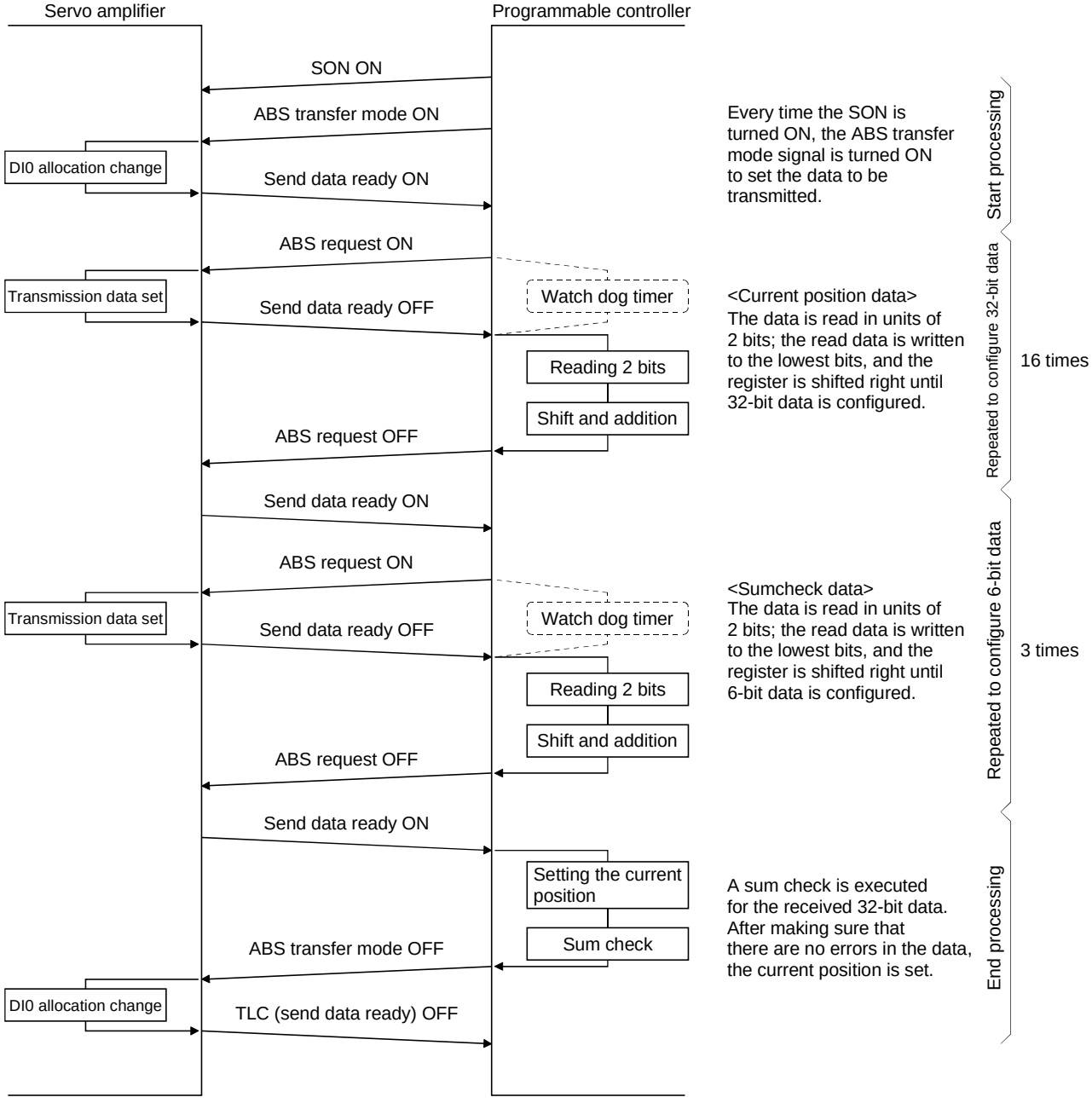
## 15.7 Absolute position data transfer protocol

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.

### 15.7.1 Data transfer procedure

Each time the SON signal 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.

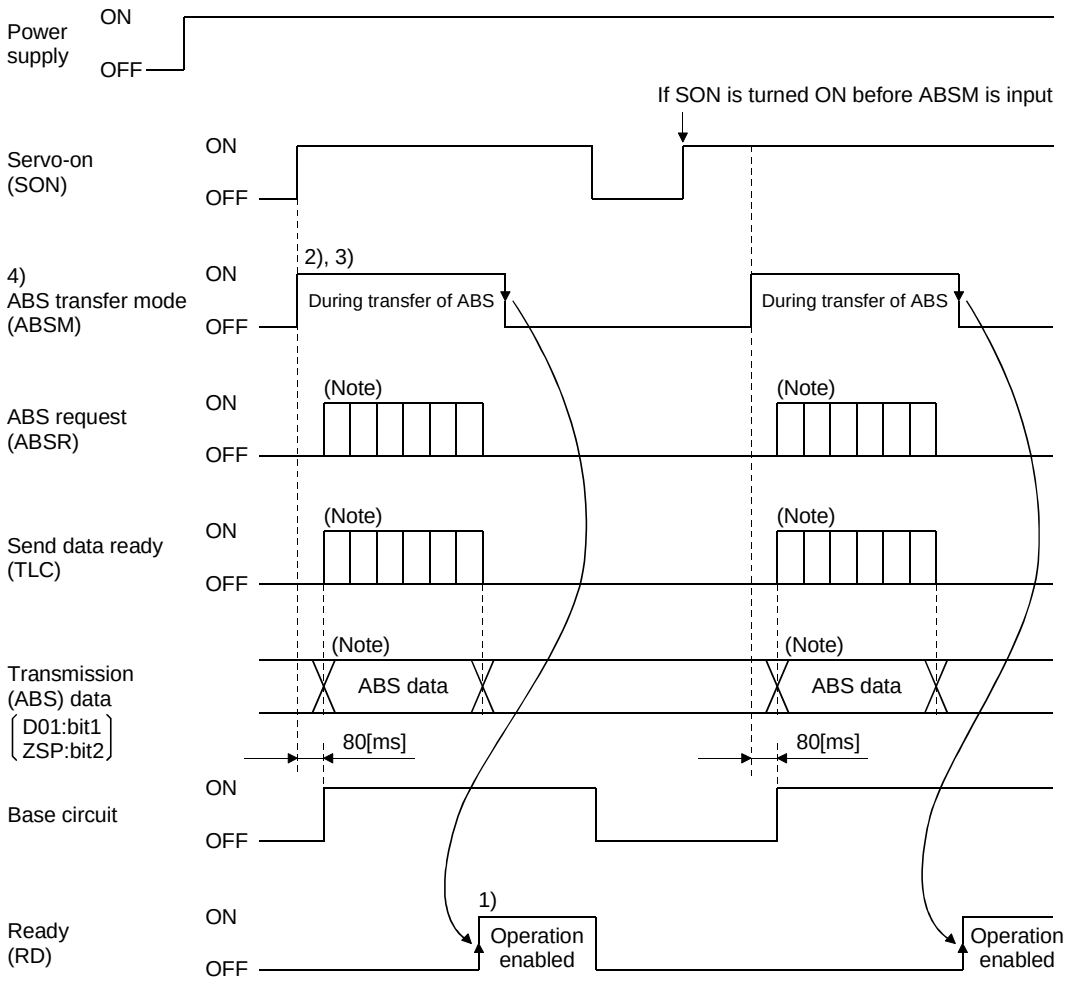


### 15.7.2 Transfer method

The sequence in which the base circuit is turned ON (servo-on) when it is in the OFF state due to the servo-on signal (SON) going OFF, an emergency stop, or alarm, is explained below. In the absolute position detection system, every time the servo-on (SON) signal is turned on, the ABS transfer mode (ABSM) signal 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) signal 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 signal (ABSM) is turned ON, the base circuit cannot be turned ON.

(1) At power-on

(a) Timing chart



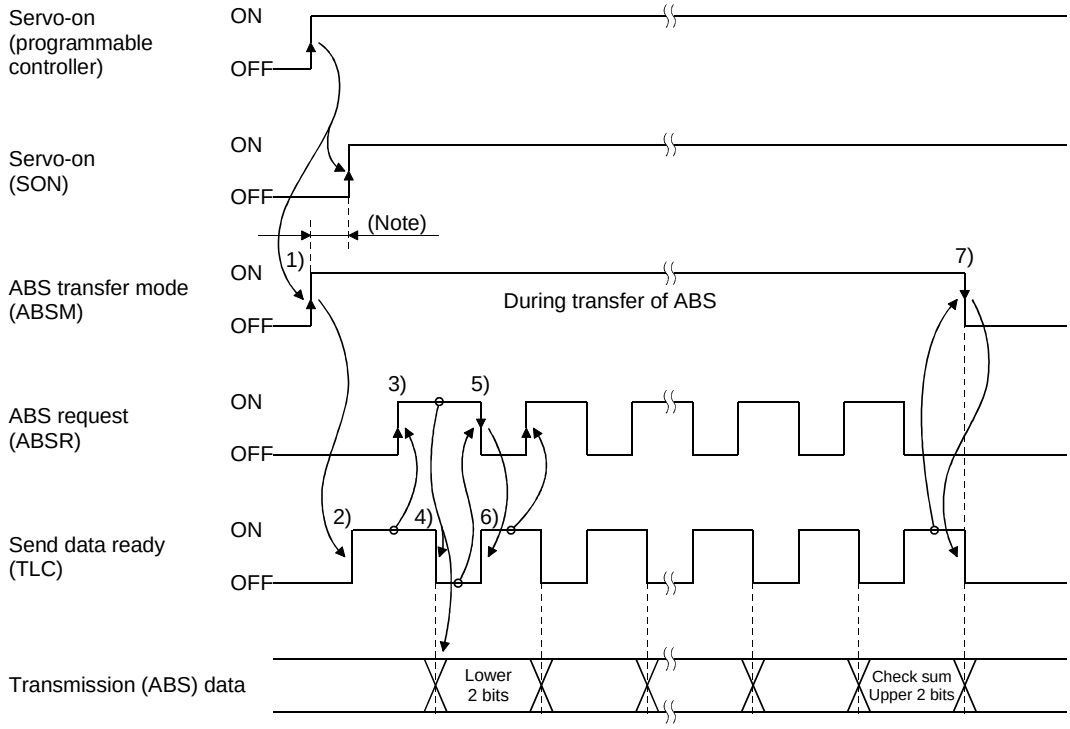

Note: For details, refer to (1) (b) in this section.

1) The ready signal (RD) is turned ON when the ABS transfer mode signal (ABSM) is turned OFF after transmission of the ABS data.
   While the ready signal (RD) is ON, the ABS transfer mode signal (ABSM) input is not accepted.
2) Even if the servo-on (SON) signal is turned ON before the ABS transfer mode signal (ABSM) is turned ON, the base circuit is not turned ON until the ABS transfer mode signal (ABSM) is turned ON.
   If a servo alarm has occurred, the ABS transfer mode signal (ABSM) is not received.
   The ABS transfer mode signal (ABSM) allows data transmission even while a servo warning is occurring.
3) If the ABS transfer mode signal (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 ZSP, TLC, D01, and INP change depending on the ON/OFF state of the ABS transfer mode signal (ABSM).
   Note that if the ABS transfer mode signal (ABSM) is turned ON for a purpose other than ABS data transmission, the output signals will be assigned the functions of ABS data transmission.

| Symbol | Pin No. | Output signal | |
|---|---|---|---|
| | | ABS transfer mode (ABSM): OFF | ABS transfer mode (ABSM): ON |
| (Note) D01 | CN1B-4 | Positioning completion | ABS data bit 0 |
| ZSP | CN1B-19 | Zero speed | ABS data bit 1 |
| TLC | CN1B-6 | During torque limit control | Send data ready |
| (Note) INP | CN1A-18 | Positioning completion | ABS data bit 0 |

Note: CN1B-4 and CN1A-18 output the same signals. (To enter the positioning completion signal into INPS of the AD75, connect CN1A-18.)

(b) Detailed description of absolute position data transfer




Note: If the servo-on signal (SON) is not turned ON within 1 second after the ABS transfer mode signal (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) signal is turned ON.

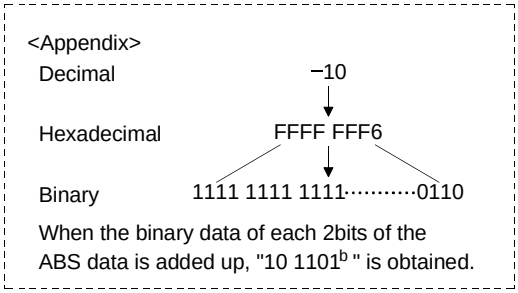
1) The programmable controller turns ON the ABS transfer mode signal (ABSM) and servo-on signals (SON) at the leading edge of the internal servo-on signal.
2) In response to the ABS transfer mode signal, the servo detects and calculates the absolute position and turns ON the send data ready (TLC) signal to notify the programmable controller that the servo is ready for data transmission.
3) After acknowledging that the ready to send (TLC) signal 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 ready to send (TLC) signal in the OFF state.
5) After acknowledging that the ready to send (TLC) signal 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 ready to send (TLC) 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 signal (ABSM) OFF.
   If the ABS transfer mode signal (ABSM) is turned OFF during data transmission, the ABS transfer mode 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.
Negative data is available for the FX-1PG and unavailable for the A1SD71.

Example: ABS data: −10 (FFFFFFF6H)

$10^{b}$
$01^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
$11^{b}$
+) $11^{b}$
$101101^{b}$




Therefore, the check sum of "−10" (ABS data) is "2Dᵇ"

(2) Transmission error

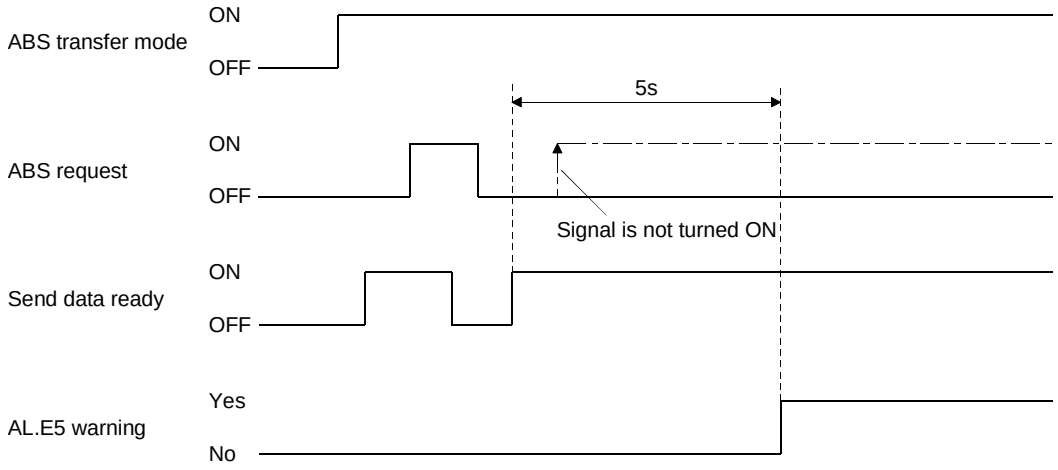
(a) Time-out warning(AL.E5)

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.

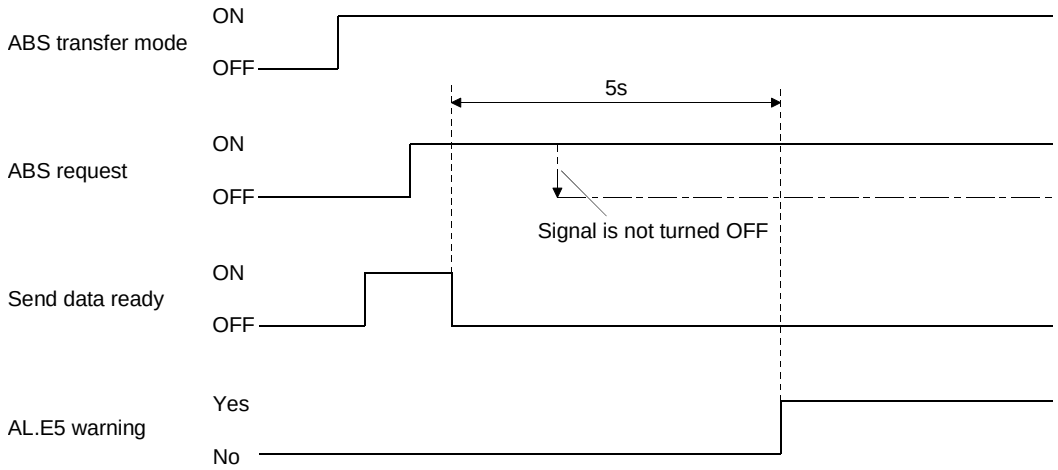
1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned ON by the programmable controller within 5s after the send data ready signal is turned ON, this is regarded as a transmission error and the ABS time-out warning (AL.E5) is output.



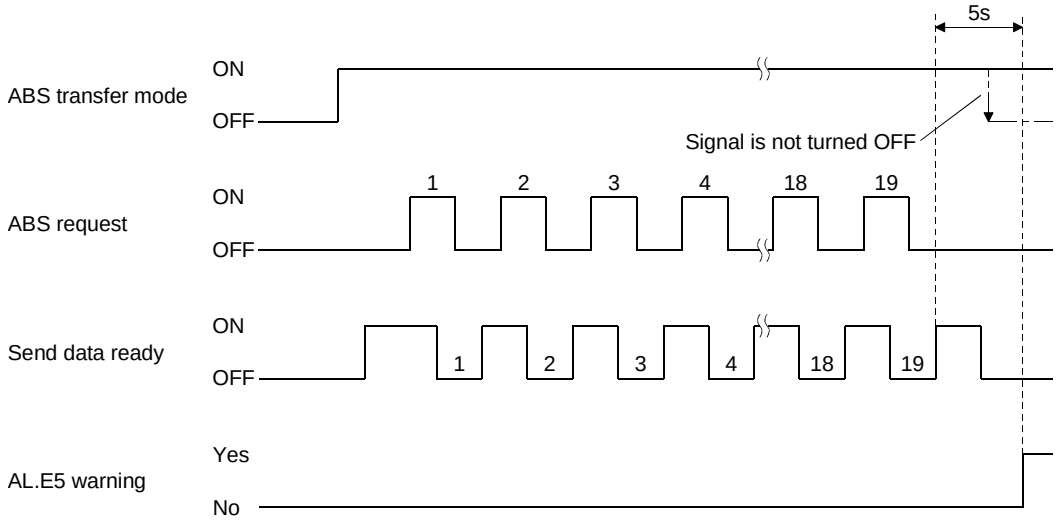

2) ABS request ON-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

If the ABS request signal is not turned OFF by the programmable controller within 5s after the send data ready signal 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 signal 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.



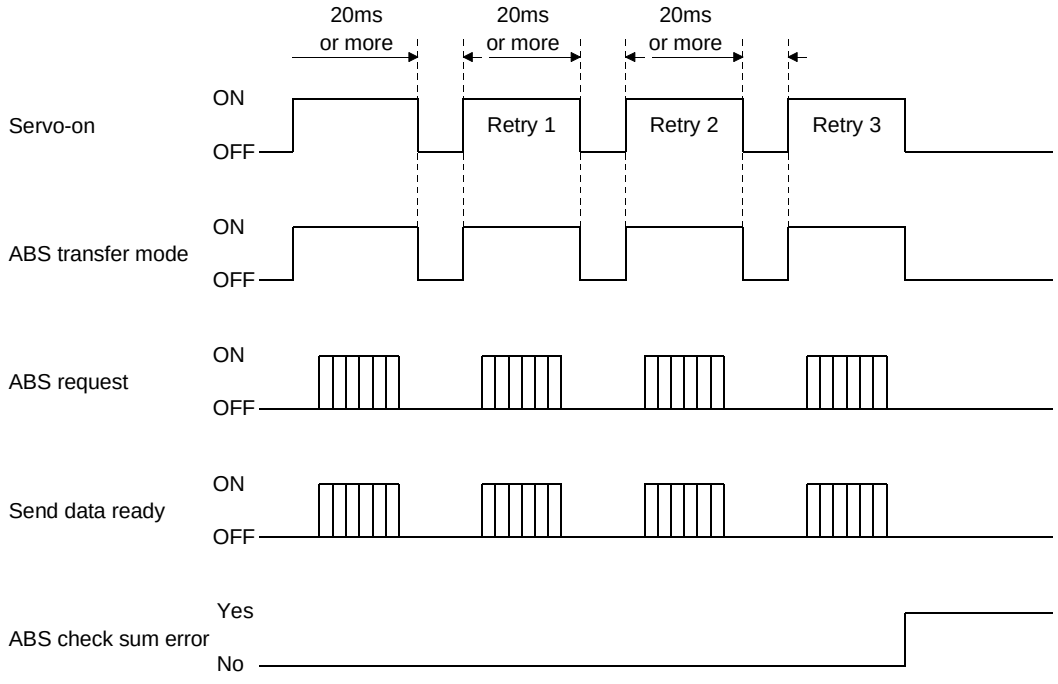

(b) Check sum error

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) signals once. Turn them ON again after an OFF time of longer than 20 ms.

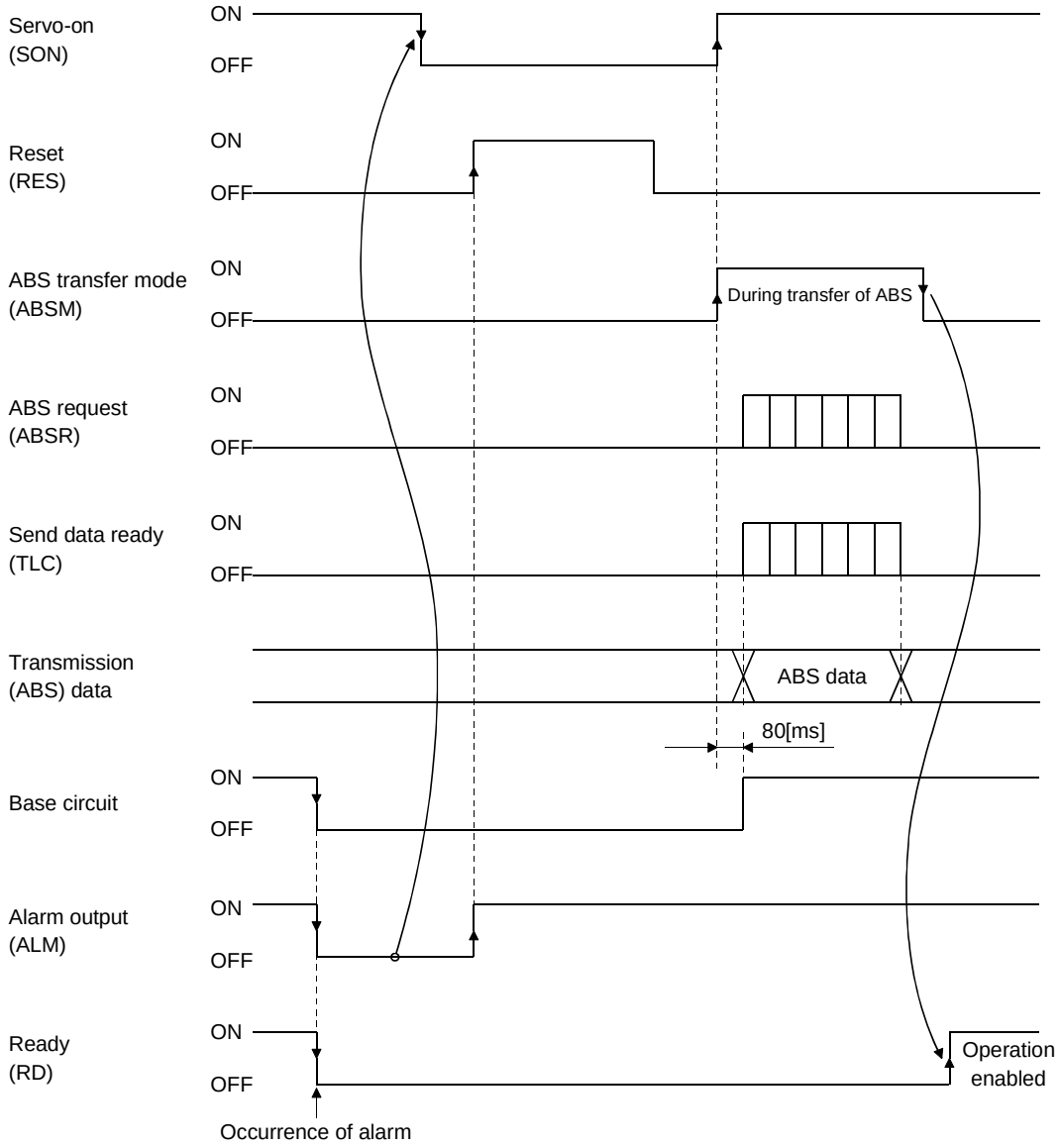
If the ABS data transmission fails to end normally even after retry, regard this situation as an ABS check sum error and execute error processing.

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) signal by detecting the alarm output (ALM).
If an alarm has occurred, the ABS transfer mode signal (ABSM) cannot be accepted.
In the reset state, the ABS transfer mode signal (ABSM) can be input.



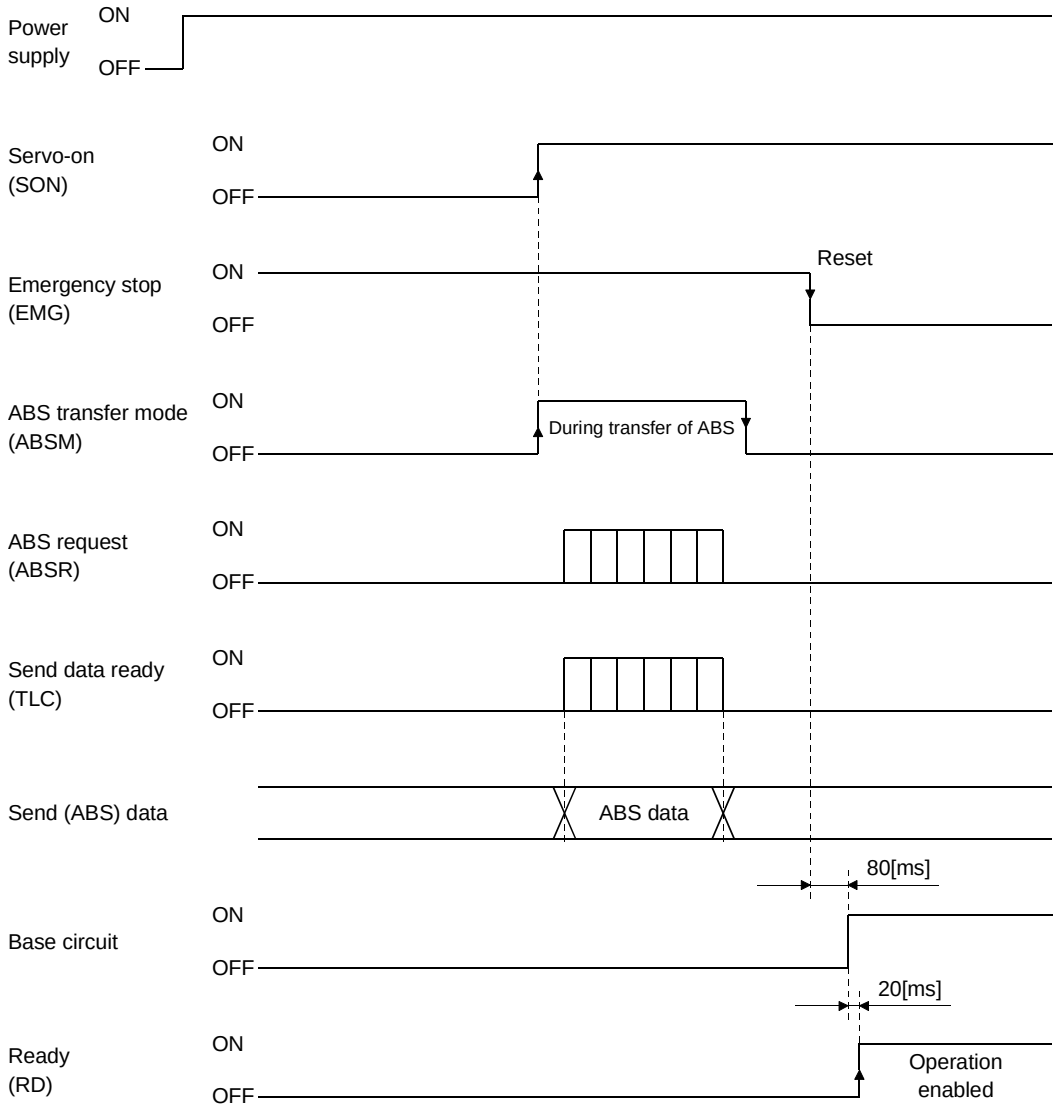
(4) At the time of emergency stop reset

(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.

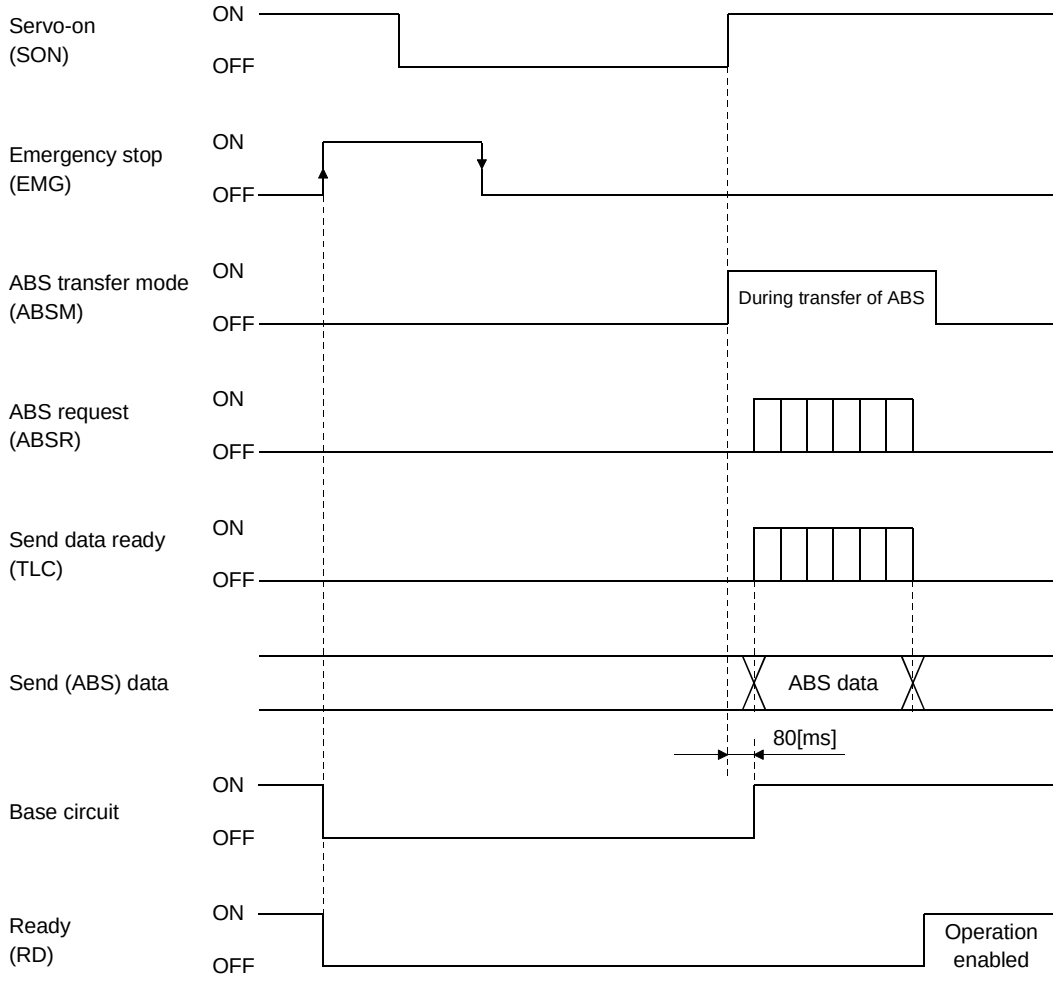
If the emergency stop state is reset while the ABS data is transmitted, the base circuit is turned ON 80[ms] after resetting. If the ABS transfer mode signal (ABSM) is OFF when the base circuit is turned ON, the ready signal (RD) is turned ON 20[ms] after the turning ON of the base circuit. If the ABS transfer mode signal (ABSM) is ON when the base circuit is turned ON, it is turned OFF and then the ready signal (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 signal (ABSM) is permissible while in the emergency stop state. In this case, the base circuit and the ready signal (RD) are turned ON after the emergency stop state is reset.



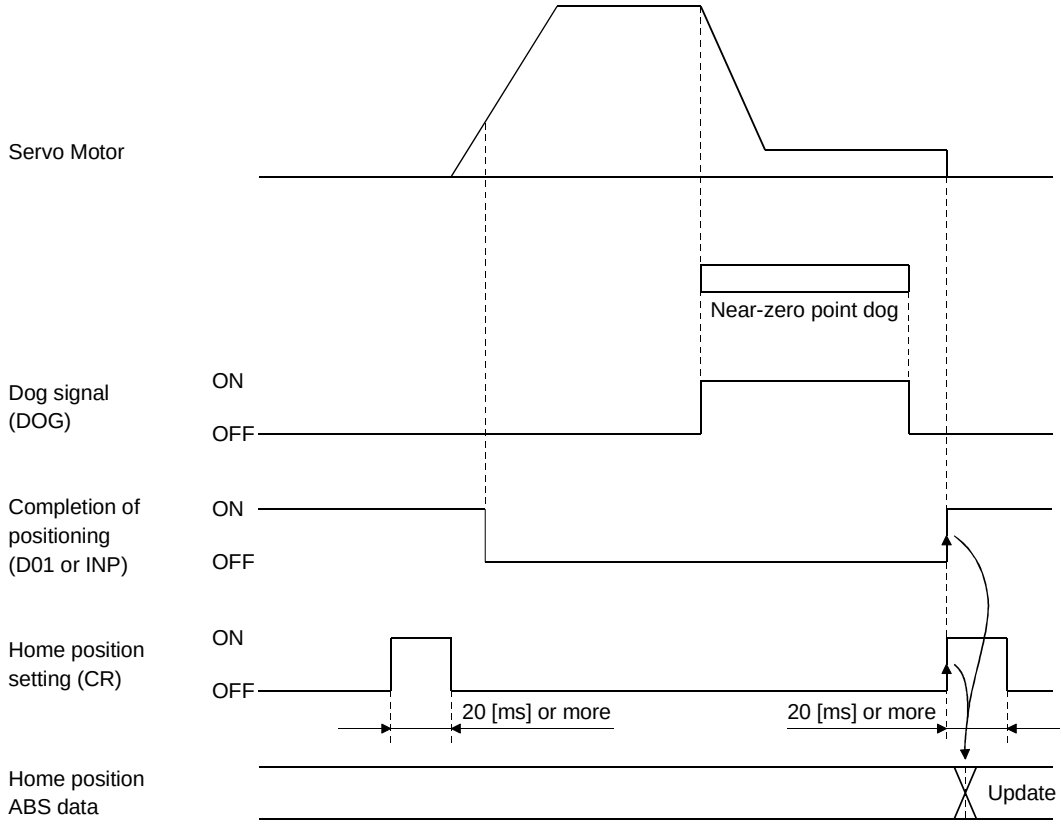
### 15.7.3 Home position setting

#### (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 signal (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 signal should be turned on after it has been confirmed that the in-position (D01 or 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.

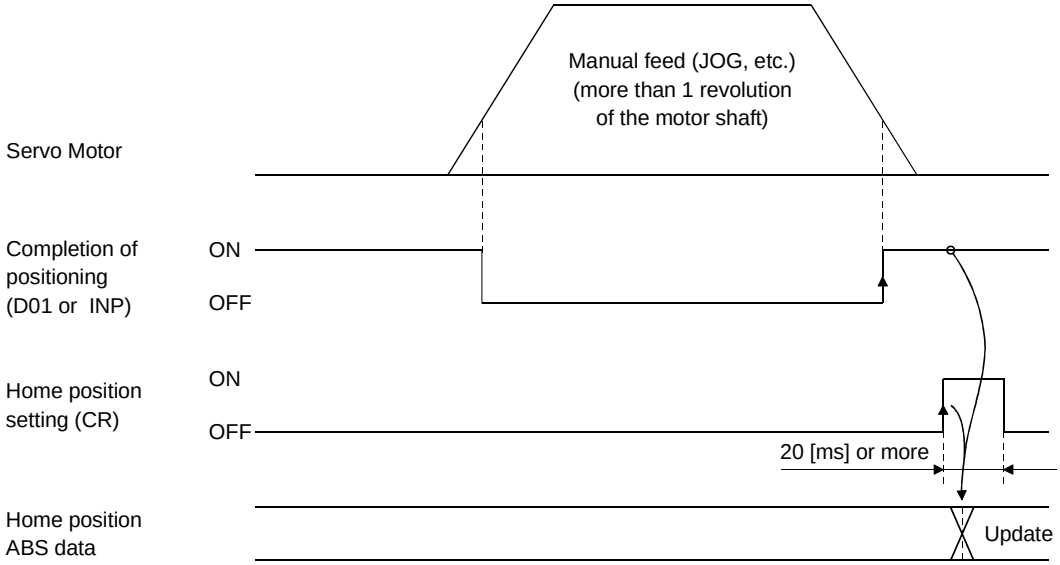


(2) Data set type home position return

Move the machine to the position where the home position is to be set by performing manual operation such as jog operation to turn the motor shaft more than one revolution. When the home position setting signal (CR) is on for longer than 20ms, the stop position is stored into the non-volatile memory as the home position ABS data.

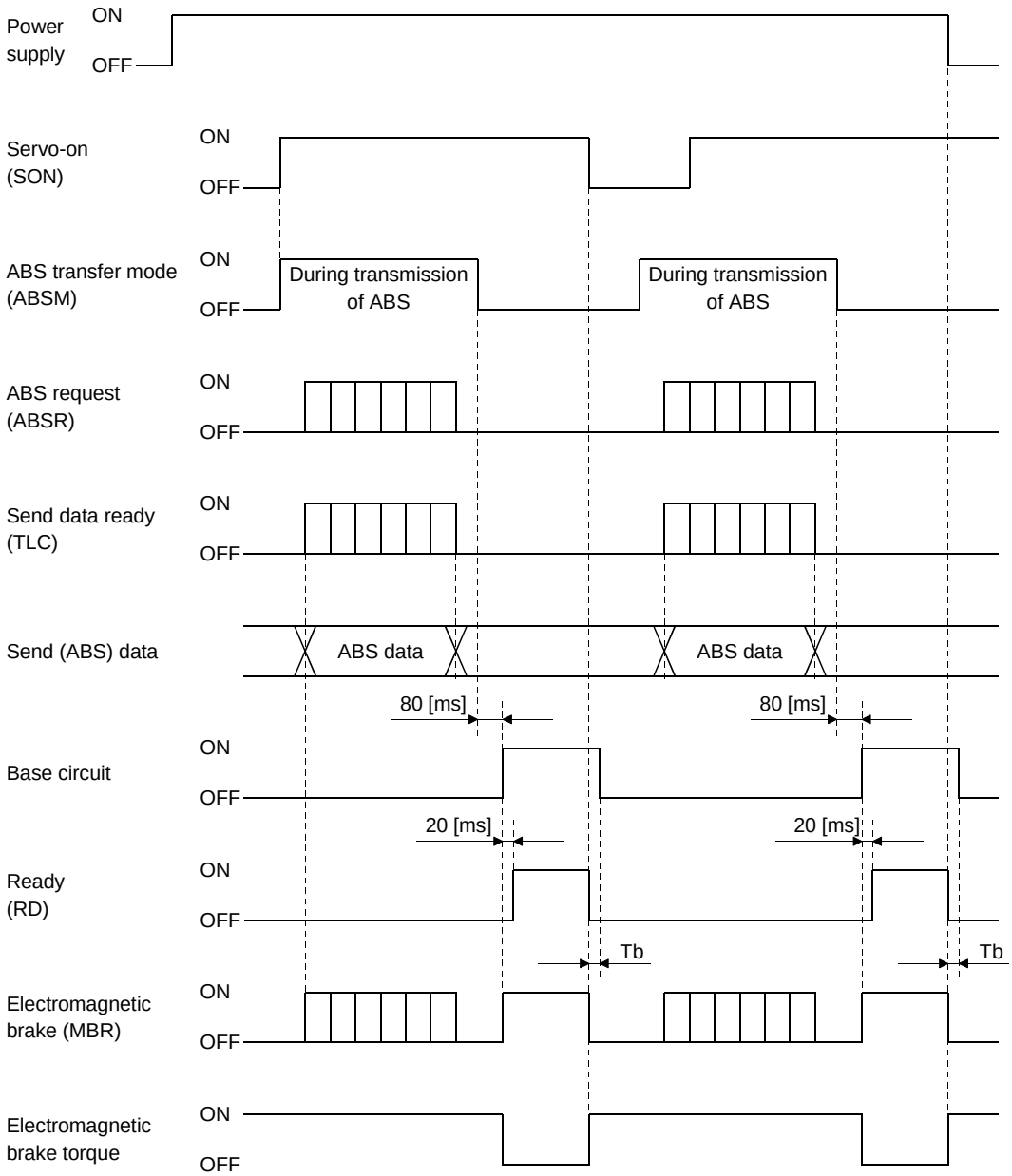
The home position setting signal should be turned on after it has been confirmed that the in-position (D01 or INP) is on. If this condition is not satisfied, the home position setting warning (AL.96) will occur, but that warning will be reset automatically by making home position return correctly.

The number of home position setting times is limited to 1,000,000 times.



### 15.7.4 Use of servo motor with electromagnetic brake

The timing charts at power on/off and servo-on (SON) on/off are given below.
Preset "□□1□" in parameter No. 1 to make the electromagnetic brake interlock signal (MBR) usable.
When the ABS transfer mode is ON, the electromagnetic brake interlock (MBR) 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 signals.



### 15.7.5 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 signal 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.

## 15.8 Examples of use

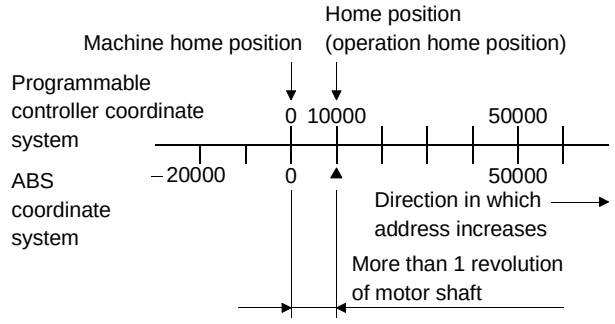
### 15.8.1 MELSEC-A1S (A1SD71)

(1) Instructions

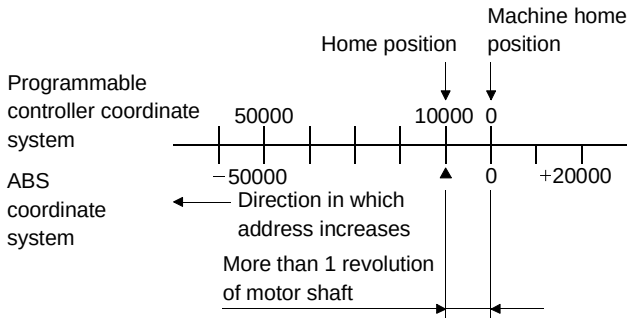
The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the motor enters the range where the coordinate value is negative due to the load torque or a fall on a vertical axis when the power is turned ON/OFF at a point near the machine home position, the system fails to detect the absolute position. To prevent this problem, it is necessary to set the home position (operation home position) for positioning in addition to the machine home position.

(a) The home position should be set in the direction in which the position address of the programmable controller coordinate system increases on moving away from machine home position, as illustrated below. Note that the home position for positioning must be more than one revolution of the servo motor shaft from the machine home position.

If the address of the machine home position is changed to any value other than "0", the home position should be set in the direction in which the position address increases on moving away from the machine home position (machine home position after changing the home position address) and at a point removed from the machine home position by more than one revolution of the motor shaft.

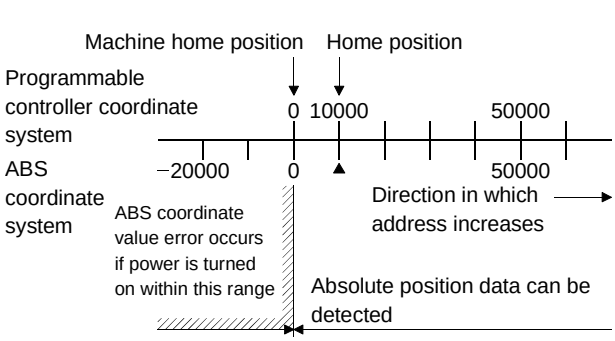



a) If revolution direction parameter (Pr. 14)=0

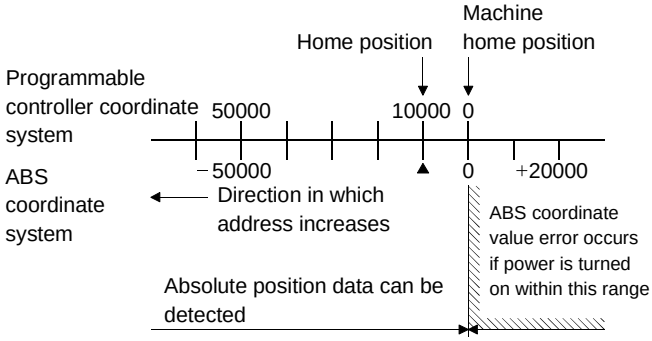



b) If revolution direction parameter (Pr. 14)=1

(b) In the range where the address decreases on moving away from the machine home position, do not turn the power supply to the programmable controller or the servo amplifier, the servo-on pushbutton switch, or the PC-RESET switch, ON/OFF. If any of these operations are attempted, the ABS coordinate error (Y4B) is output since the absolute position cannot be detected.

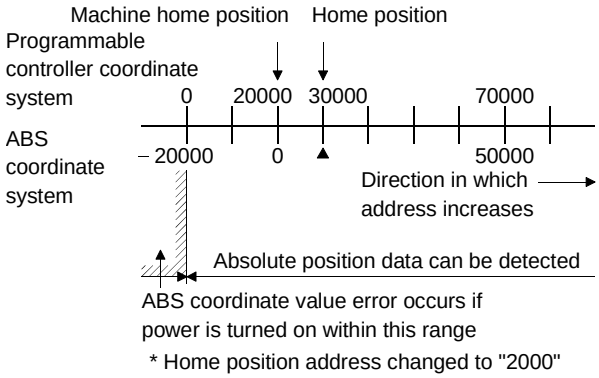



a) If revolution direction parameter (Pr. 14)= 0

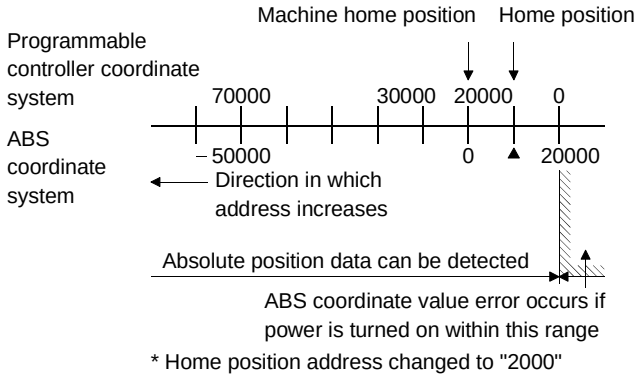



b) If revolution direction parameter (Pr. 14)=1

If the address of the machine home position is changed to any coordinate value other than "0", the programmable controller coordinate system will be as illustrated below.
The power should be turned ON/OFF in the range in which the address increases on moving away from the home position.



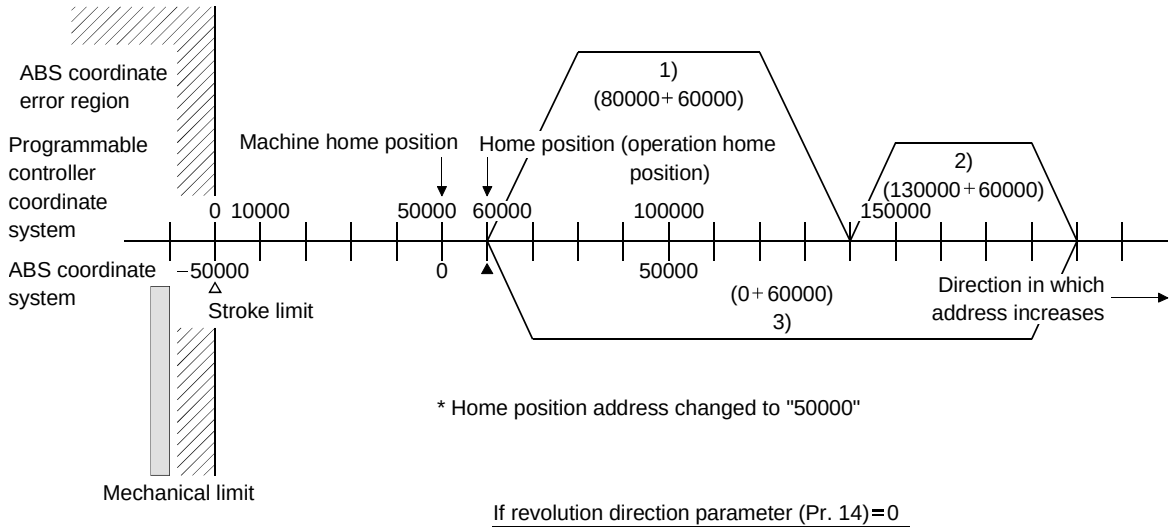

a) If revolution direction parameter (Pr. 14) = 0




b) If revolution direction parameter (Pr. 14) = 1

(c) In a positioning program, the address of the positioning point should be determined by adding the home position address to the target position address.
Example) After home position return, execute positioning at 1) to 3).

1) Positioning at position address 80000
(PC coordinate 140000)
2) Positioning at position address 130000
(PC coordinate 190000)
3) Positioning at position address 0
(PC coordinate 60000)

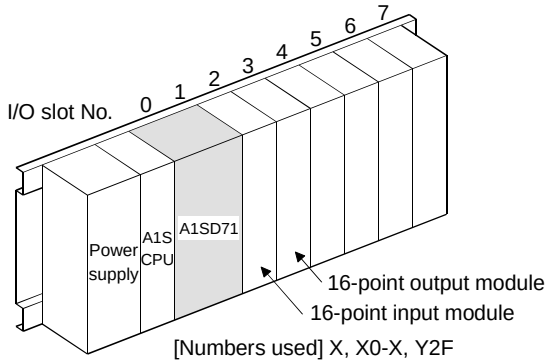



If revolution direction parameter (Pr. 14) = 0

(d) Slot arrangement

The sequence programs presented in this section show I/O numbers (X, Y) assuming the arrangement of modules on the main base unit is as illustrated below. A1SD71 is mounted at I/O slots 0 and 1, a 16-point input module at slot 2, and 16-point output module at slot 3. If the actual arrangement of the modules differs from this arrangement, change the X and Y numbers accordingly.

The numbers of the devices (M, D, T, etc.) used in the program can be changed as required.




Example arrangement of modules

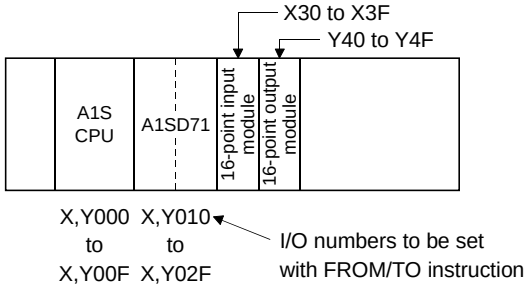
(e) Points

1) The A1SD71 has 48 I/O points and occupies 2 slots. For I/O allocation using the GPP function, follow the instructions given below.

First slot: Vacant slot 16 points

Second slot: Special function module 32 points

2) To execute the FROM/TO instruction for the A1SD71, use the head I/O number of the second slot.

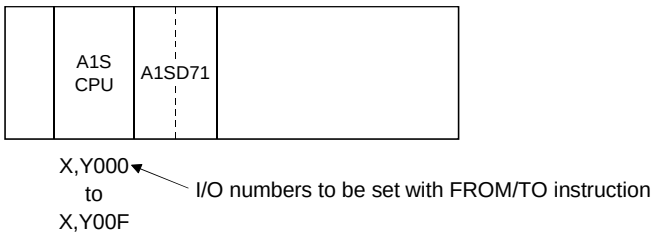



Note: The program example given in (3) in this section is for 1-axis control. Slot allocations are as illustrated to the left. To use the system for 2-axis control, increase the number of I/O points.

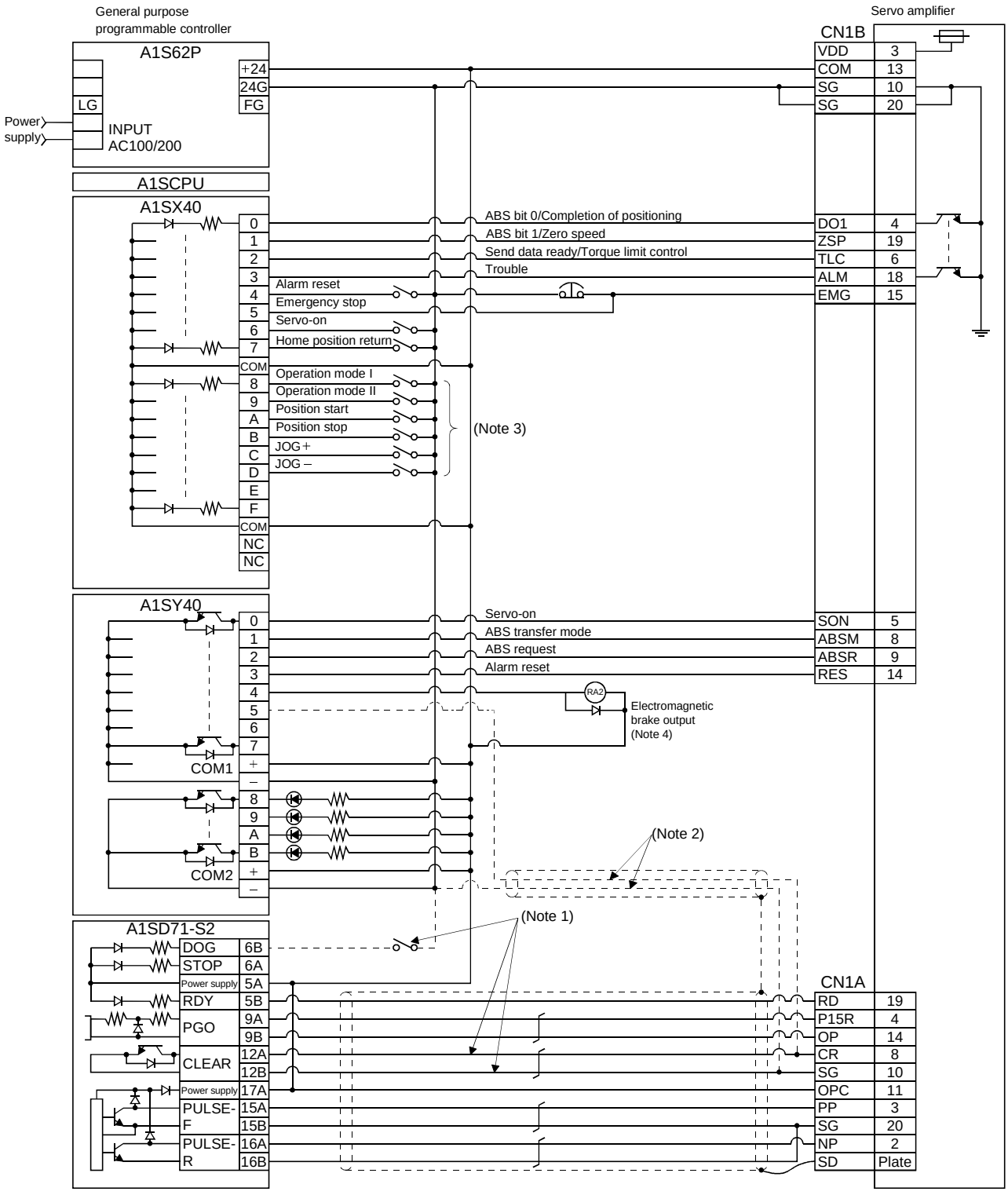
Therefore, the I/O number to be set with the FROM/TO instruction is head I/O number allocated to the A1SD71 + 010H.

3) By setting "0 point of vacant slot" for the first slot of the A1SD71 in the "I/O allocation" of the GPP function, the 16 points in the first slot can be saved.

In this case, the I/O number to be set with the FROM/TO instruction is the same number as the head I/O number allocated to the A1SD71.



(2) Connection diagram




Note: 1. To be connected for dog type home position setting. The connection in Note 2 is not required.
2. To be connected for data set type home position setting. The connection in Note 1 is not required.
3. This circuit is for reference only.
4. The electromagnetic brake output should be controlled by connecting the programmable controller output to a relay.

(3) Sequence program example

(a) Conditions

This sample program is an ABS sequence program example for a single axis (X axis).

To transmit the ABS data using the OFF-to-ON change of the servo-on signal as the trigger.

1) When the servo-ON signal and the GND of the power supply are shorted, the ABS data is transmitted when the power to 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.
2) If a check sum discrepancy is detected in the transmitted data, 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 (Y4A ON).
3) 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 (Y4A ON).
   ON period of ABS transfer mode (Y41)
   ON period of ABS request (Y42)
   OFF period of ready to send ABS data (X32).
4) If the relationship between the polarity (±) of the received ABS data and the setting value for parameter No. 14 (rotating direction) of A1SD71 (AD71) involves negative coordinate values, which cannot be handled by the A1SD71 (AD71), the ABS coordinate error is generated (Y4B ON).

(b) Device list

| X input contact | | Y output contact | |
|---|---|---|---|
| X30 | ABS bit 0 / completion of positioning | Y40 | Servo-on |
| X31 | ABS bit 1 / zero speed | Y41 | ABS transfer mode |
| X32 | Send ABS data ready / torque limit control | Y42 | ABS request |
| X33 | Servo alarm | Y43 | Alarm reset |
| X34 | Error reset | X44 (Note 2) | Electromagnetic brake output |
| X35 | Servo emergency stop | Y45 (Note 1) | Clear |
| X36 | Servo-on | Y48 | Servo alarm |
| X37 | Home position return start | Y49 | ABS communication error |
| X38 | Operation mode I | Y4A | ABS check sum error |
| X39 | Operation mode II | Y4B | ABS coordinate error |
| D register | | M contact | |
| D0 | ABS data transmission counter | M0 | ABS data transmission start |
| D1 | Check sum transmission counter | M1 | Sum check completion |
| D2 | Check sum addition counter | M2 | Sum check discrepancy |
| D3 | ABS data: Lower 16 bits | M3 | ABS data ready |
| D4 | ABS data: Upper 16 bits | M4 | Transmission data read enabled |
| D5 | ABS data 2-bit receiving buffer | M5 | Check sum 2 bits read completion |
| D6 | Check data in case of check sum error | M6 | ABS 2 bits read completion |
| D7 | Retry frequency | M7 | ABS 2 bits request |
| D8 | Forward rotation direction | M8 | Servo-on request |
| D9 | Home position address: Lower 16 bits | M9 | Servo alarm |
| D10 | Home position address: Upper 16 bits | M10 | ABS data transmission retry start pulse |
| D100 | Received shift data: Lower 16 bits | M11 | Retry flag setting |
| D101 | Received shift data: Upper 16 bits | M12 | Retry flag reset |
| T timer | | M13 | PLS processing command |
| T0 | ABS transfer mode timer | M20 (Note 1) | Clear signal ON timer request |
| T1 | ABS request response timer | M21 (Note 2) | Data set type home position return request |
| T2 | Retry wait timer | C counter | |
| T3 | Ready to send response timer | C0 | ABS data receive frequency counter |
| T10 (Note 1) | Clear signal ON timer | C1 | Check sum receive frequency counter |
| T200 | Transmitted data read 10ms delay timer | C2 | Retry counter |

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

This sequence program example assumes the following conditions:

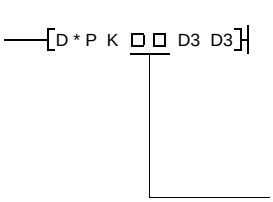
- Parameters of the A1SD71-S2 (AD71) positioning module

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 command value per pulse is required. Hence, add the following program to the area marked Note in the sequence program.

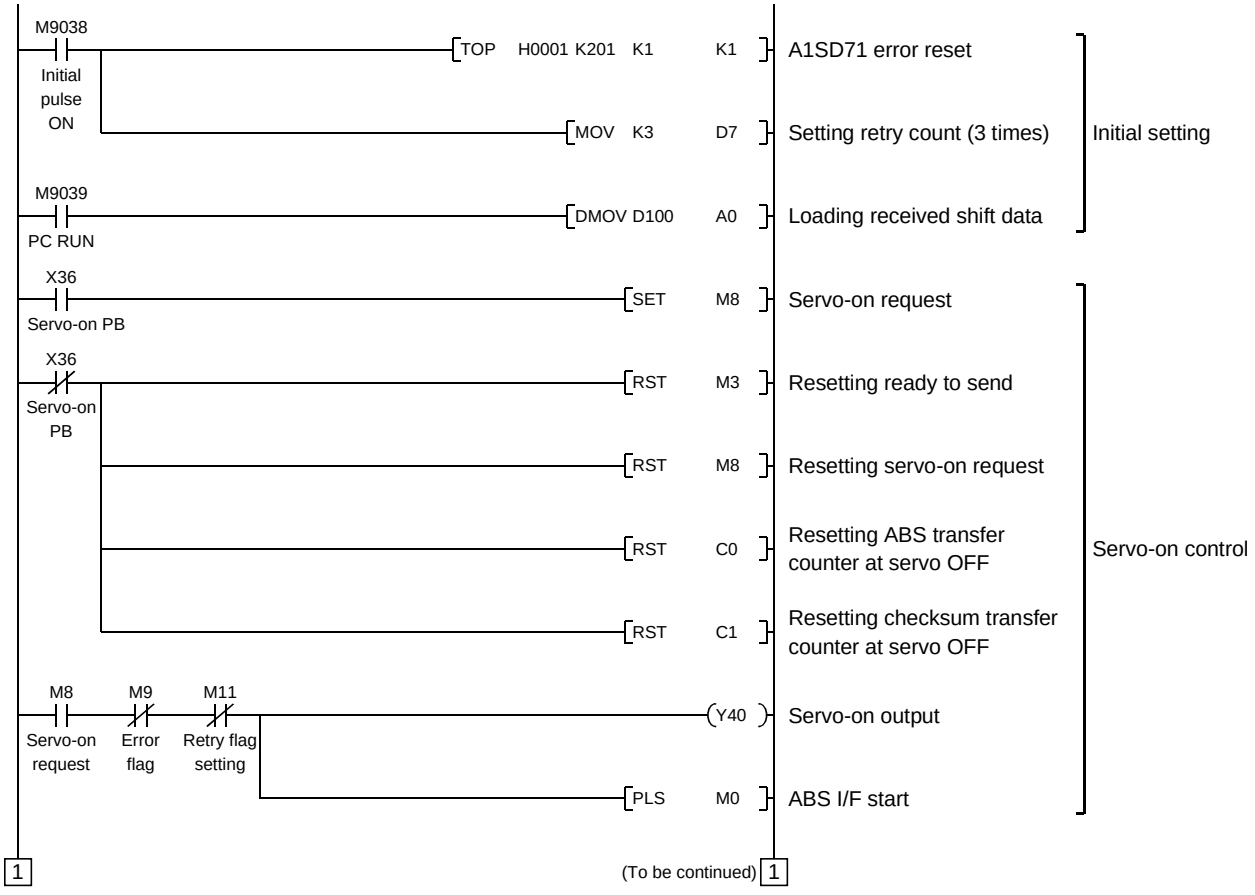
<Additional program>

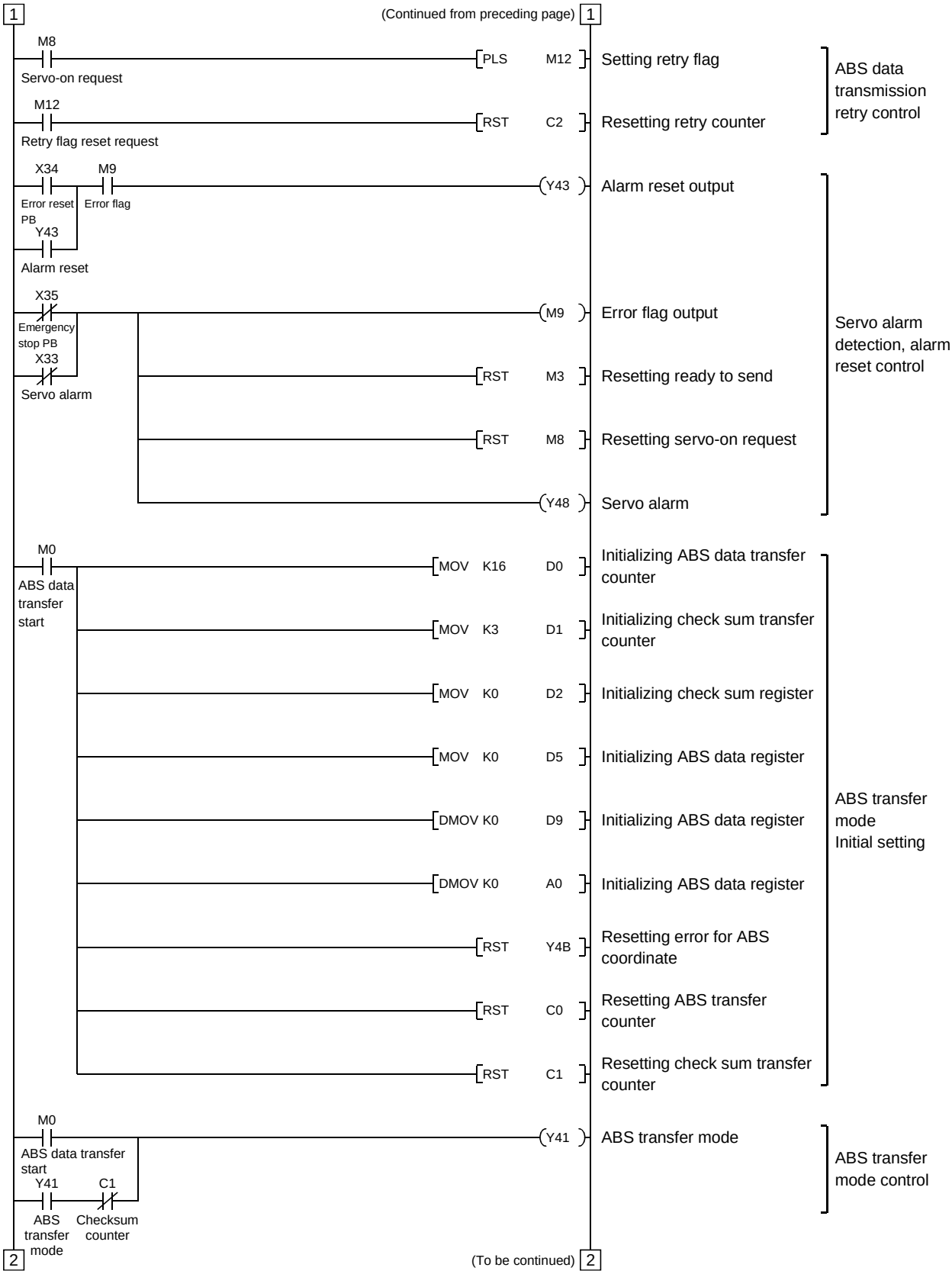


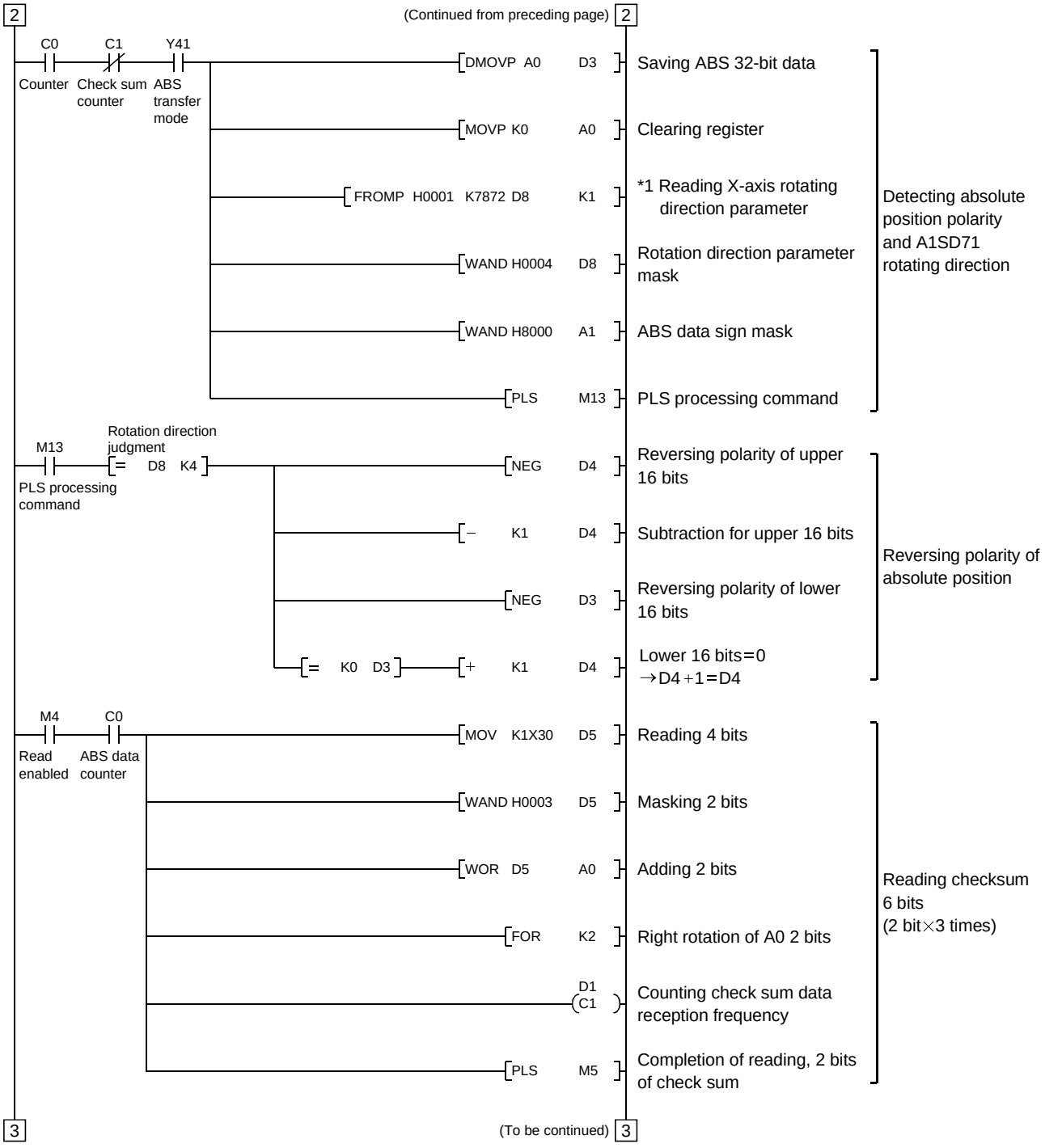

| Item | mm | | | inch | | | degree | | | pulse |
|---|---|---|---|---|---|---|---|---|---|---|
| Unit setting | 0 | | | 1 | | | 2 | | | 3 |
| Travel per pulse | 0.1 to | 1.0 to | 10.0 | 0.00001 to | 0.0001 to | 0.001 to | 0.00001 to | 0.0001 to | 0.001 to | |
| Unit of travel | μm/PLS | | | inch/PLS | | | degree/PLS | | | PLS |
| Constant K for conversion into unit of travel | 1 to | 10 to | 100 | 1 to | 10 to | 100 | 1 to | 10 to | 100 | None |

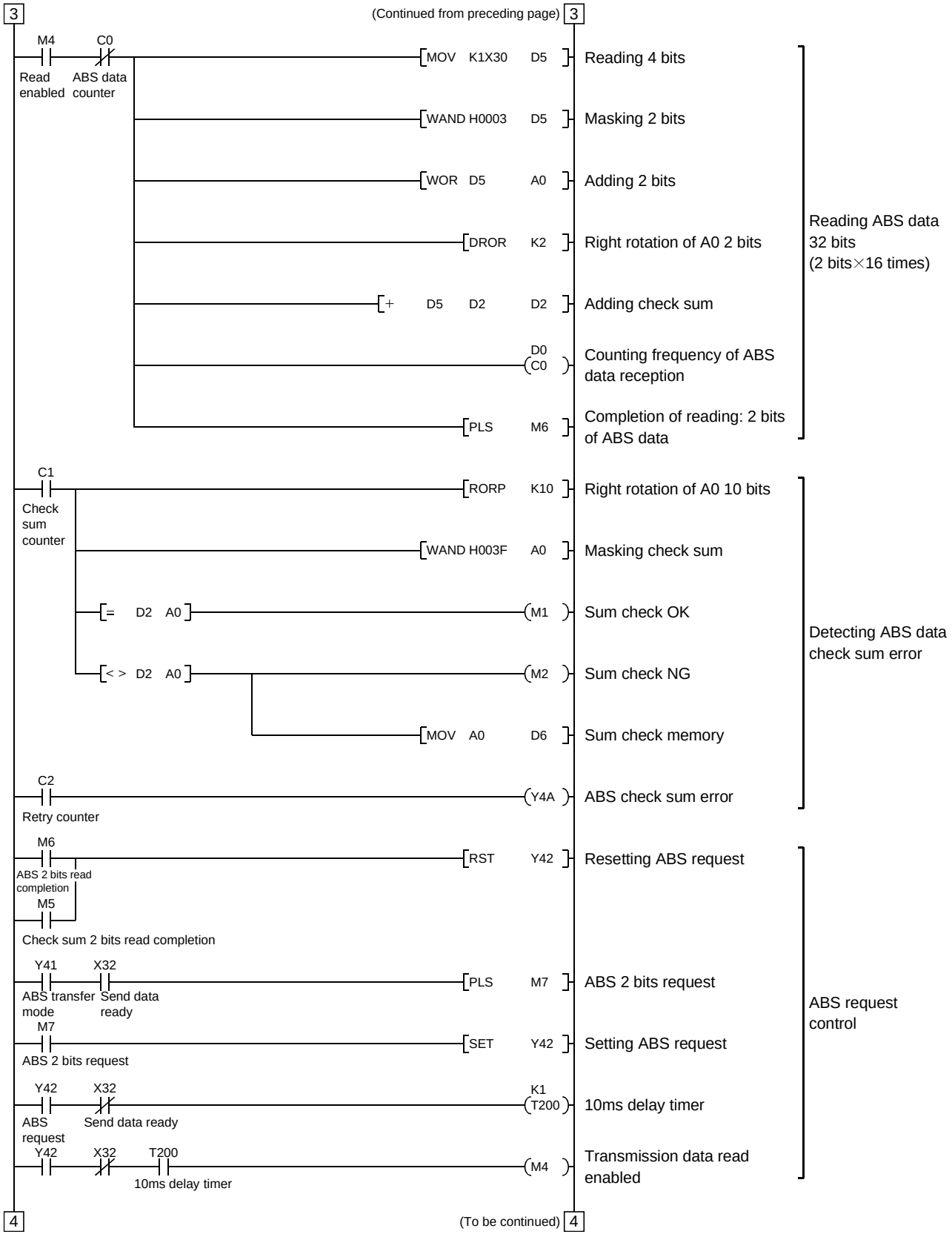
Reference

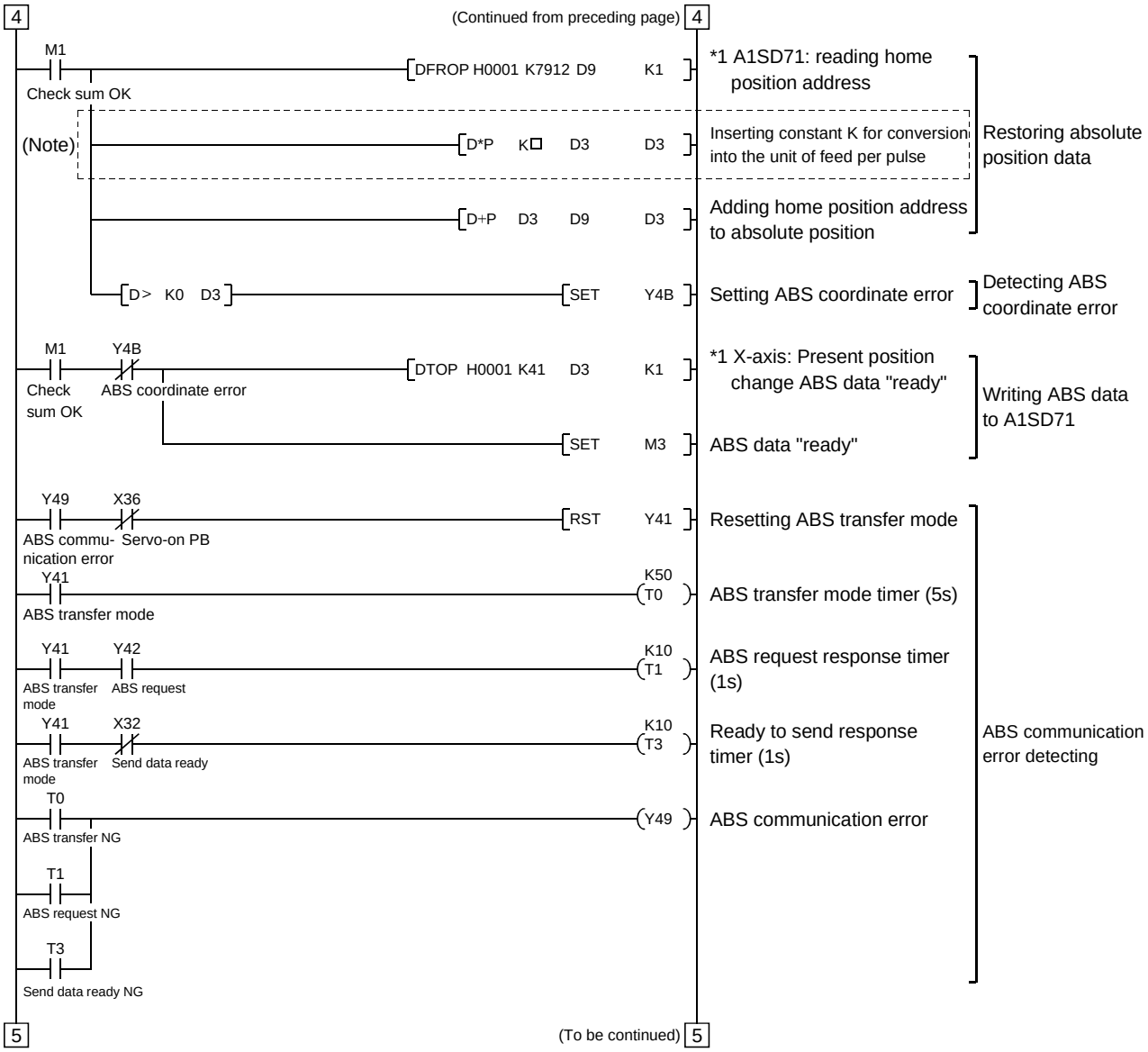
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- When the unit setting is pulse, the additional program is not required.



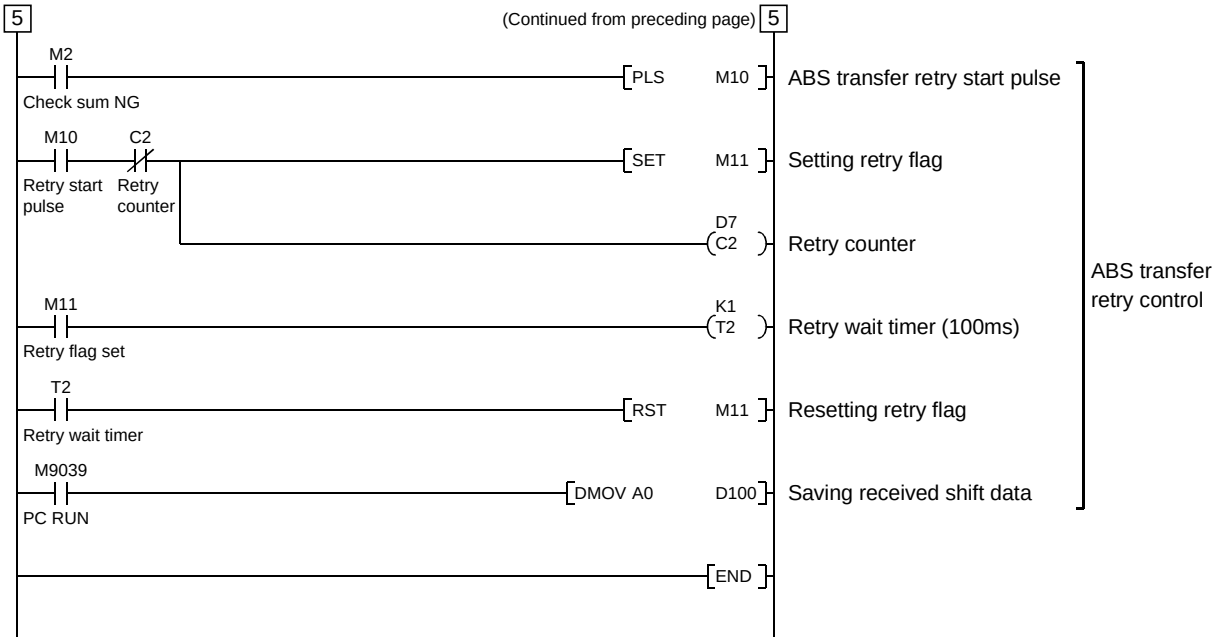

1
(Continued from preceding page)
1
M8
Servo-on request
PLS M12
Setting retry flag
M12
Retry flag reset request
RST C2
Resetting retry counter
ABS data transmission retry control
X34
Error reset PB
M9
Error flag
Y43
Alarm reset
Y43
Alarm reset output
X35
Emergency stop PB
X33
Servo alarm
M9
Error flag output
RST M3
Resetting ready to send
RST M8
Resetting servo-on request
Y48
Servo alarm
Servo alarm detection, alarm reset control
M0
ABS data transfer start
MOV K16 D0
Initializing ABS data transfer counter
MOV K3 D1
Initializing check sum transfer counter
MOV K0 D2
Initializing check sum register
MOV K0 D5
Initializing ABS data register
DMOV K0 D9
Initializing ABS data register
DMOV K0 A0
Initializing ABS data register
RST Y4B
Resetting error for ABS coordinate
RST C0
Resetting ABS transfer counter
RST C1
Resetting check sum transfer counter
ABS transfer mode Initial setting
M0
ABS data transfer start
Y41
ABS transfer mode
C1
Checksum counter
Y41
ABS transfer mode
ABS transfer mode control
2
(To be continued)
2


2
(Continued from preceding page)
2
C0
C1
Y41
Counter
Check sum counter
ABS transfer mode
DMOVP A0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
FROMP H0001 K7872 D8 K1
*1 Reading X-axis rotating direction parameter
WAND H0004 D8
Rotation direction parameter mask
WAND H8000 A1
ABS data sign mask
PLS M13
PLS processing command
Detecting absolute position polarity and A1SD71 rotating direction
M13
Rotation direction judgment
= D8 K4
PLS processing command
NEG D4
Reversing polarity of upper 16 bits
– K1 D4
Subtraction for upper 16 bits
NEG D3
Reversing polarity of lower 16 bits
= K0 D3
+ K1 D4
Lower 16 bits=0 →D4+1=D4
Reversing polarity of absolute position
M4
C0
Read enabled
ABS data counter
MOV K1X30 D5
Reading 4 bits
WAND H0003 D5
Masking 2 bits
WOR D5 A0
Adding 2 bits
FOR K2
Right rotation of A0 2 bits
D1
C1
Counting check sum data reception frequency
PLS M5
Completion of reading, 2 bits of check sum
Reading checksum 6 bits
(2 bit×3 times)
3
(To be continued)
3


3
(Continued from preceding page)
3
M4
C0
Read enabled
ABS data counter
MOV K1X30 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 check sum
D0
C0
Counting frequency of ABS data reception
PLS M6
Completion of reading: 2 bits of ABS data
Reading ABS data 32 bits (2 bits×16 times)
C1
Check sum counter
RORP K10
Right rotation of A0 10 bits
WAND H003F A0
Masking check sum
= D2 A0
M1
Sum check OK
< > D2 A0
M2
Sum check NG
MOV A0 D6
Sum check memory
C2
Retry counter
Y4A
ABS check sum error
Detecting ABS data check sum error
M6
ABS 2 bits read completion
M5
Check sum 2 bits read completion
RST Y42
Resetting ABS request
Y41
ABS transfer mode
X32
Send data ready
PLS M7
ABS 2 bits request
M7
ABS 2 bits request
SET Y42
Setting ABS request
Y42
ABS request
X32
Send data ready
K1
T200
10ms delay timer
Y42
X32
T200
10ms delay timer
M4
Transmission data read enabled
ABS request control
4
(To be continued)
4




Note: When the unit setting parameter value of the AD71 positioning module is changed from "3" (pulse) to "0" (mm), the unit is×0.1μm for the input value. To change the unit to×1μm, and this program to multiple the feed value by 10.

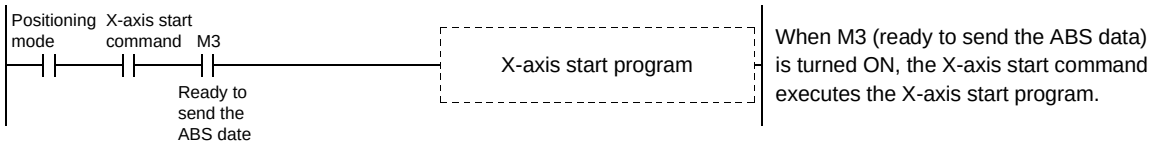



POINT

- When absolute position data is received at power ON, for example, if a negative coordinate position which cannot be handled by the A1SD71 is detected, the ABS coordinate error (Y4B ON) is generated. If this error is generated, move the axis into the positive coordinate zone in JOG operation. Then, turn OFF the servo-on pushbutton switch and turn it ON again.

(d) X-axis control program

This precludes execution of the X-axis start program while M3 (ready to send the ABS data) is OFF.




(e) Dog type home position return

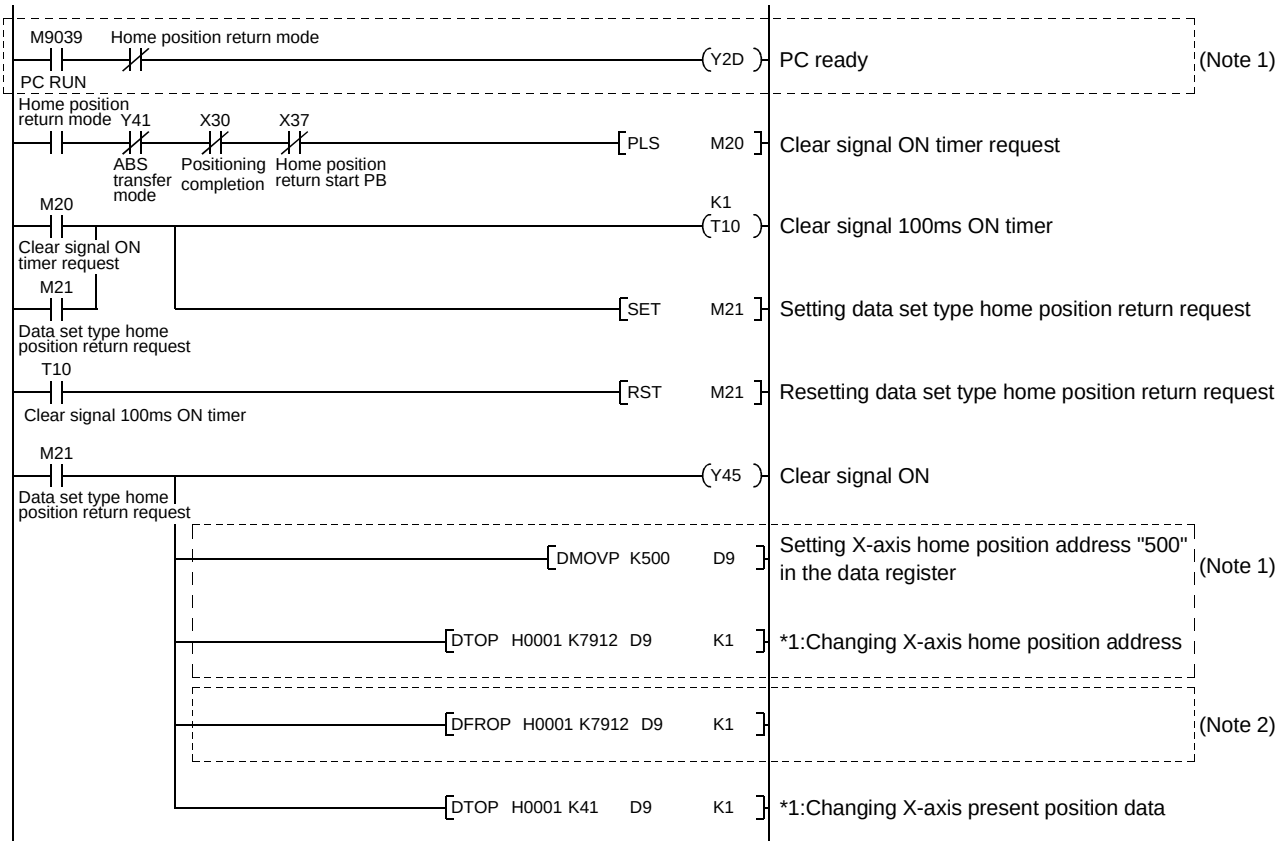
For an example of a program for the dog type home position return operation, refer to the home position return program presented in the User's Manual for A1SD71.

(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 set the home position with the home position return start (PB ON).

After switching power on, rotate the servo motor more than 1 revolution before starting home position return.

Do not turn ON the clear signal (Y45) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



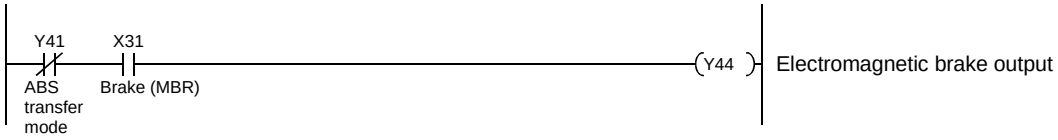

Note 1: If data of the home position address parameter is not written by using an A6GPP programming tol, etc. before starting a program for data set type home position return, the circuits indicated by Note 1 are necessary and the circuit indicated by Note 2 is not necessary.

2: Contrary to Note 1 above, if the home position address is written in the home position address parameter. the circuit indicated by Note 3 is necessary and the circuits indicated by Note 1 are not necerssary.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1□1□"in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.




(h) Positioning completion

To create the status information for servo positioning completion.

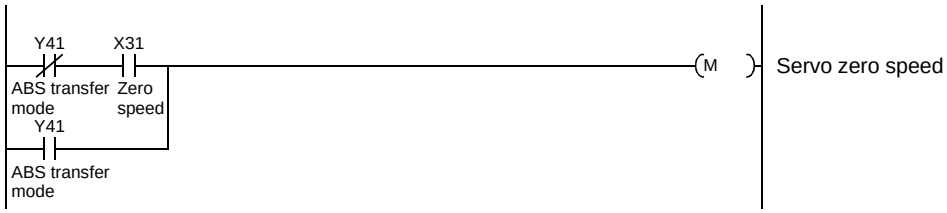
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(i) Zero speed

To create the status information for servo zero speed

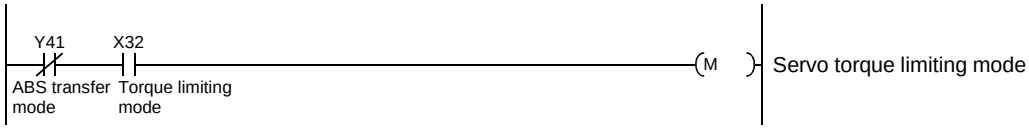
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(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 signal is turned on), the torque limiting must be off.



(4) 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 A1SD71 module. Create a program for the third axis in a similar manner.

(a) Y-axis program

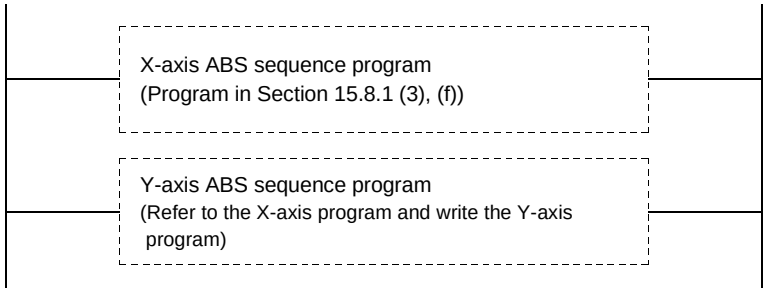
Refer to the X-axis ABS sequence program and create the Y-axis program.

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 A1SD71 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.1 (3), (c) should be changed as indicated below for use with the Y axis:

```
[FROMP  H0001 K7872 D8 K1]  →  [FROMP  H0001 K7892 D8 K1]
[DFROP  H0001 K7912 D9 K1]  →  [DFROP  H0001 K7922 D9 K1]
[DTOP   H0001 K41   D3 K1]  →  [DTOP   H0001 K341  D3 K1]
```

[Program configuration]




(b) Data set type home position return

Arrange the data set type home position return programs given in Section 15.8.1 (3), (f) in series to control two axes.

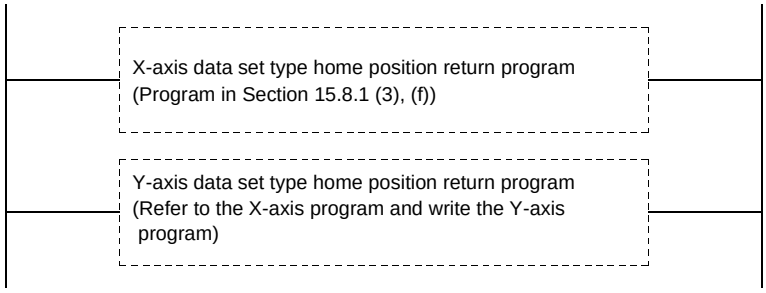
Refer to the X-axis data set type home position return program and create the Y-axis program.

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 15.8.1 (3), (f) should be changed as indicated below for use with the Y axis:

```
[DTOP   H0001 K7912 D9 K1]  →  [DTOP   H0001 K7922 D9 K1]
[DTOP   H0001 K41   D9 K1]  →  [DTOP   H0001 K341  D9 K1]
```

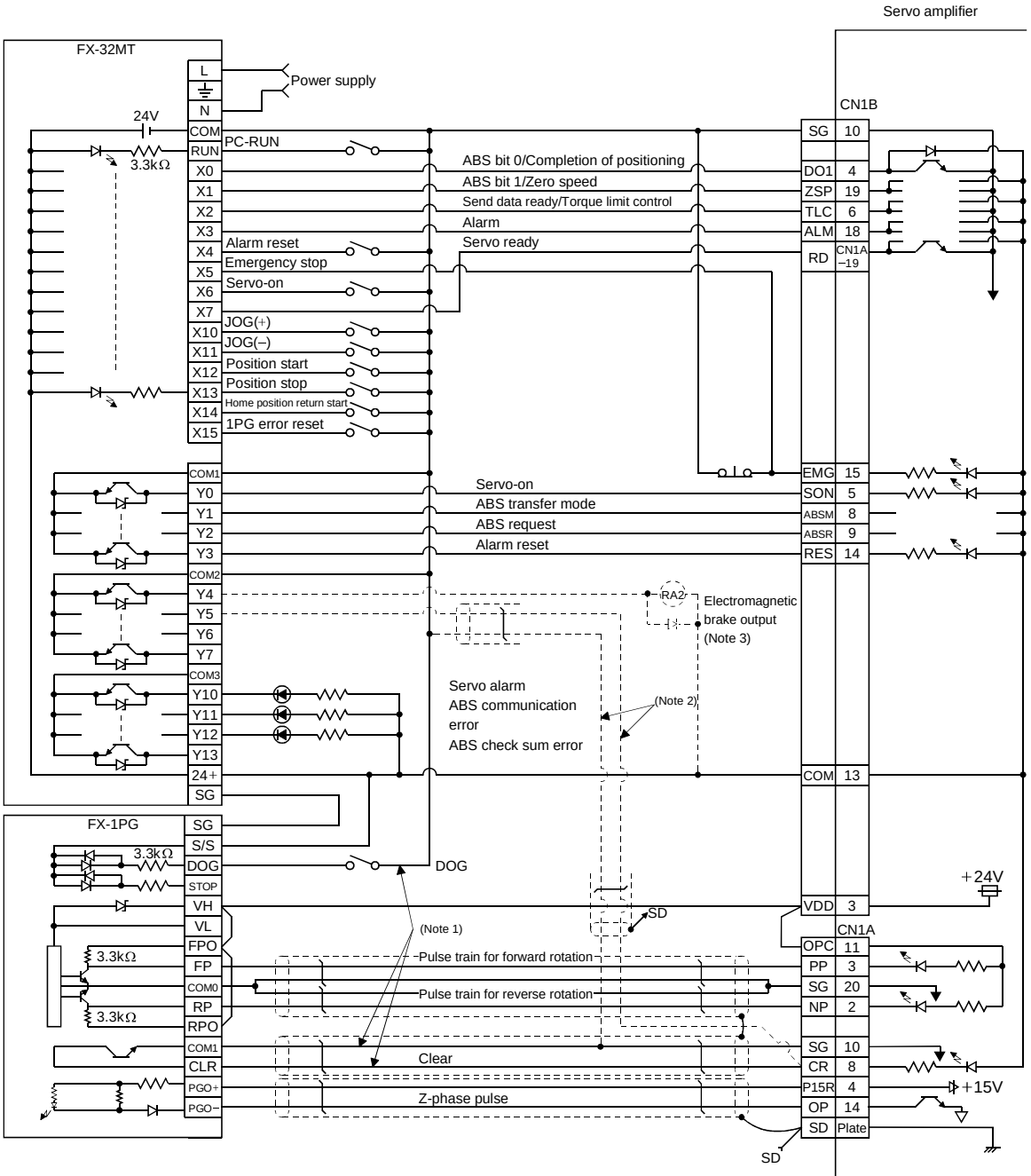
[Program configuration]



## 15.8.2 MELSEC FX(2N)-32MT (FX(2N)-1PG)

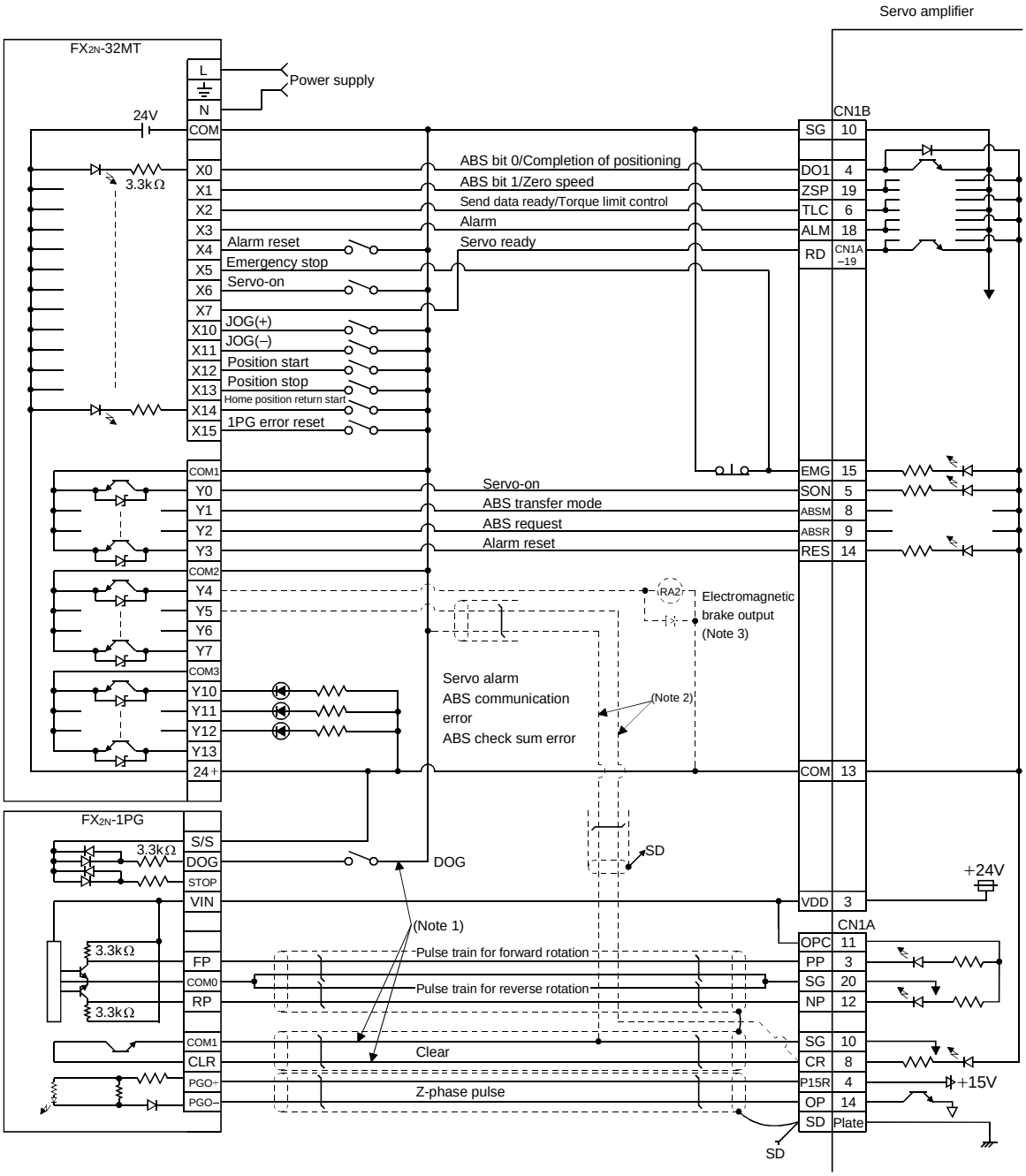
### (1) Connection diagram

(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 signal should be controlled by connecting the programmable controller output to a relay.

(b) FX2N-32MT (FX2N-1PG)



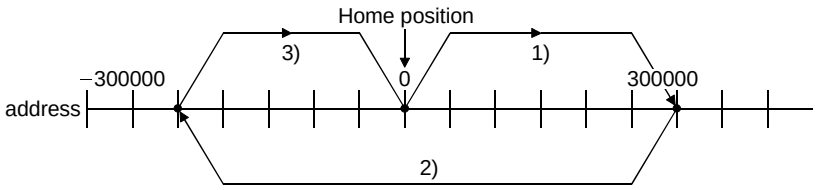

Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).
2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).
3: The electromagnetic brake interlock signal should be 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) | VRT | 50000PPS | |
| - | #11 | Home position return speed (creep) | VCL | 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 | |
|---|---|
| X0 | ABS bit 0 / completion of positioning |
| X1 | ABS bit 1 / zero speed |
| X2 | Send ABS data ready/ torque limit control |
| X3 | Servo alarm |
| X4 | Alarm reset PB |
| X5 | Servo emergency stop |
| X6 | Servo-on PB |
| X7 | Servo ready |
| X10 | JOG (+) PB |
| X11 | JOG (–) PB |
| X12 | Position start PB |
| X13 | Position stop PB |
| X14 | Home position return start PB |
| X15 | 1PG error reset |

| Y output contact | |
|---|---|
| Y0 | Servo-on |
| Y1 | ABS transfer mode |
| Y2 | ABS request |
| Y3 | Alarm reset |
| Y4 (Note 2) | Electromagnetic brake output |
| Y5 (Note 1) | Clear |
| Y10 | Servo alarm |
| Y11 | ABS communication error |
| Y12 | ABS check sum error |

| 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 |

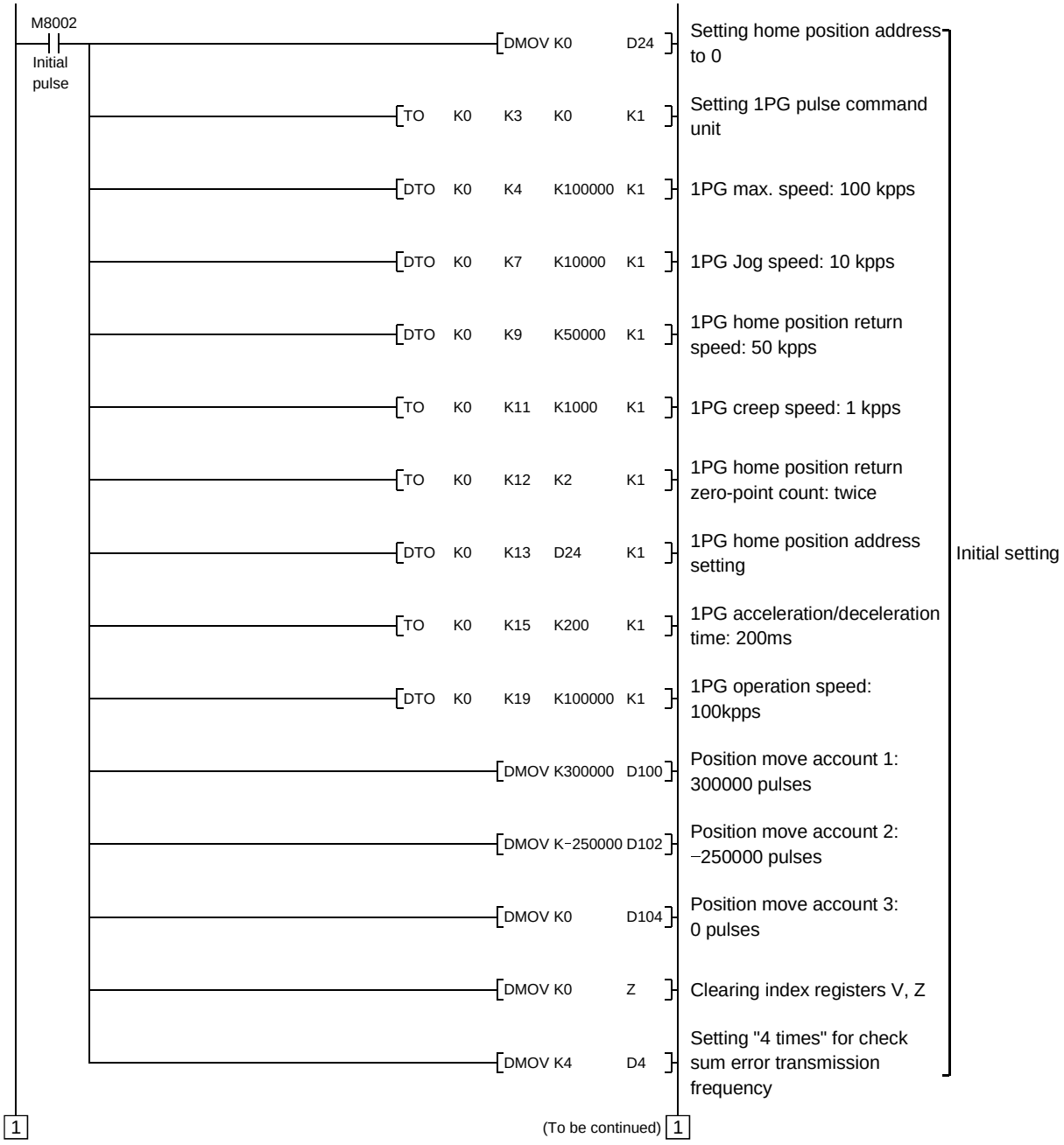
| T timer | |
|---|---|
| T200 | Retry wait timer |
| T201 | ABS transfer mode timer |
| T202 | ABS request response timer |
| T203 | Ready to send response timer |
| T204 | ABS data waiting timer |
| T210 (Note 1) | Clear signal ON timer |

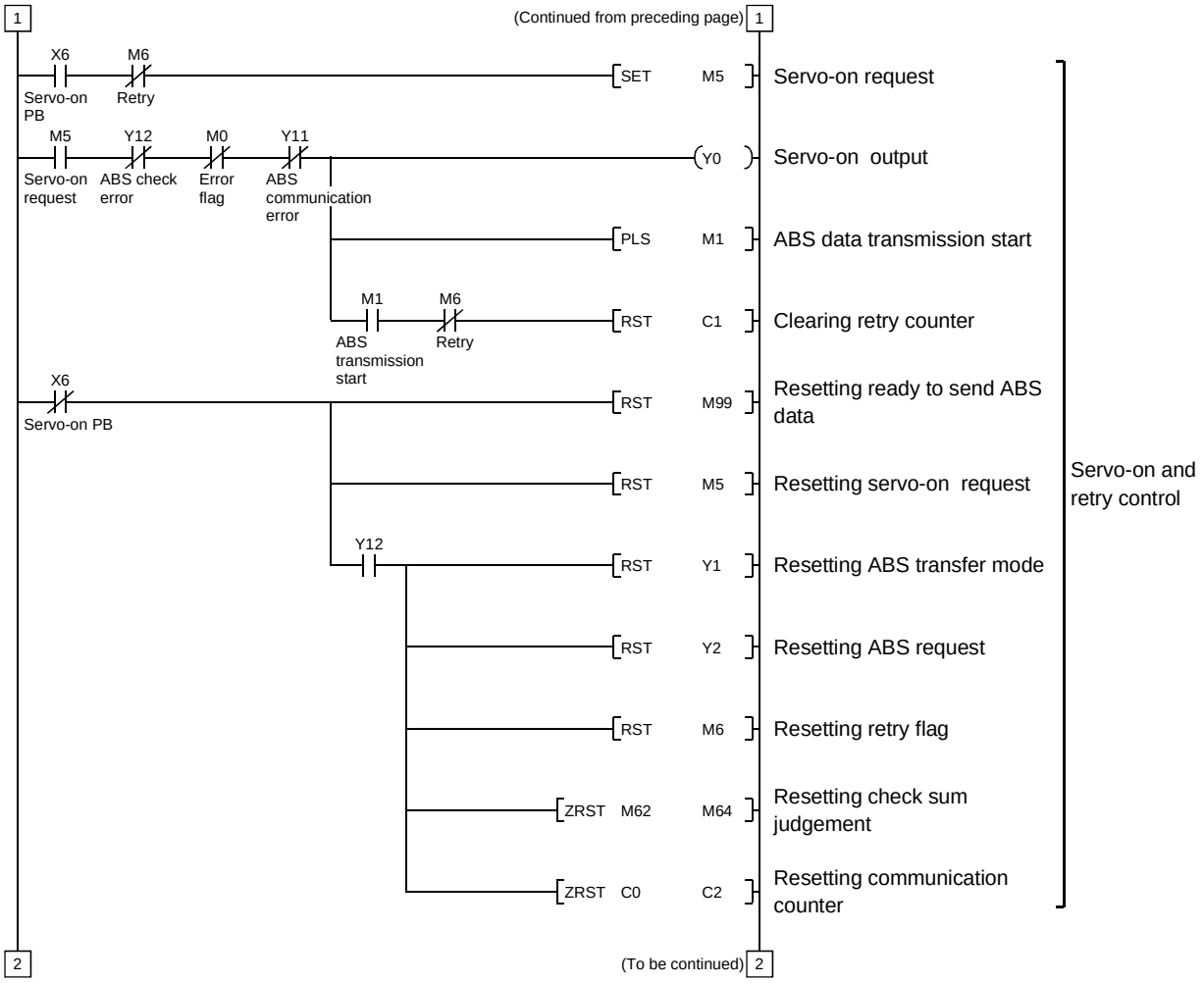
| M contact | |
|---|---|
| M0 | Error flag |
| M1 | ABS data transmission start |
| M2 | Retry command |
| M3 | ABS data read |
| M4 | Spare |
| M5 | Servo-on request |
| M6 | Retry flag |
| M10 | ABS data 2 bit receiving buffer |
| M11 | |
| M12 | |
| M13 | |
| M20 ↓ M51 | ABS data 32 bit buffer |
| M52 ↓ M57 | Check sum 6 bit buffer |
| M58 | For checksum comparison |
| M59 | |
| M62 | Sum check discrepancy (greater) > |
| M63 | Sum check discrepancy = |
| M64 | Sum check discrepancy (less) > |
| M70 (Note 1) | Clear signal ON timer request |
| M71 (Note 1) | Data set type home position return request |
| M99 | ABS data ready |

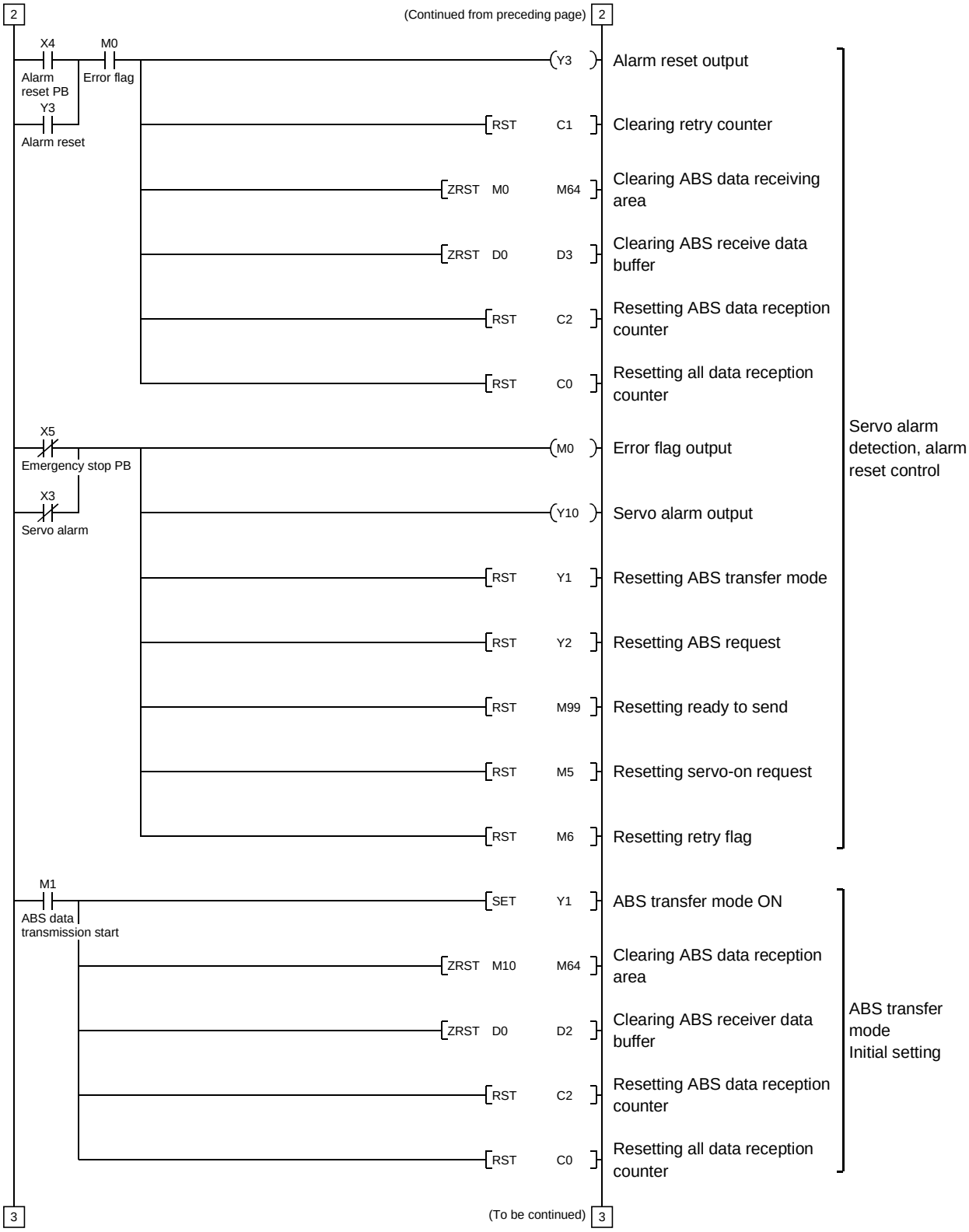
| C counter | |
|---|---|
| C0 | All data reception frequency counter (19 times) |
| C1 | Check sum reception frequency counter |
| C2 | ABS data reception frequency counter (16 times) |

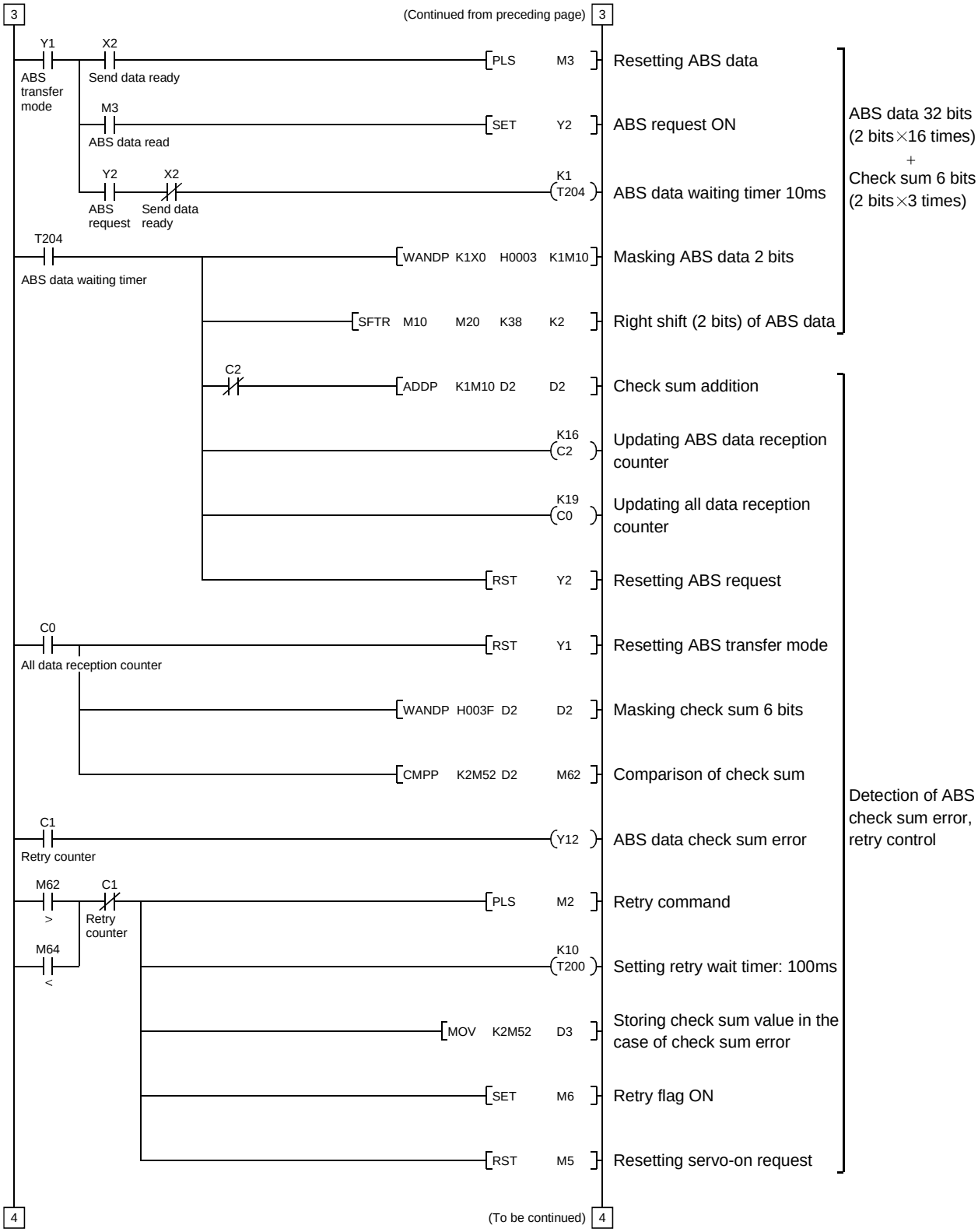
Note 1: Necessary when data set type home position return is executed.
2: Necessary in the event of electromagnetic brake output.

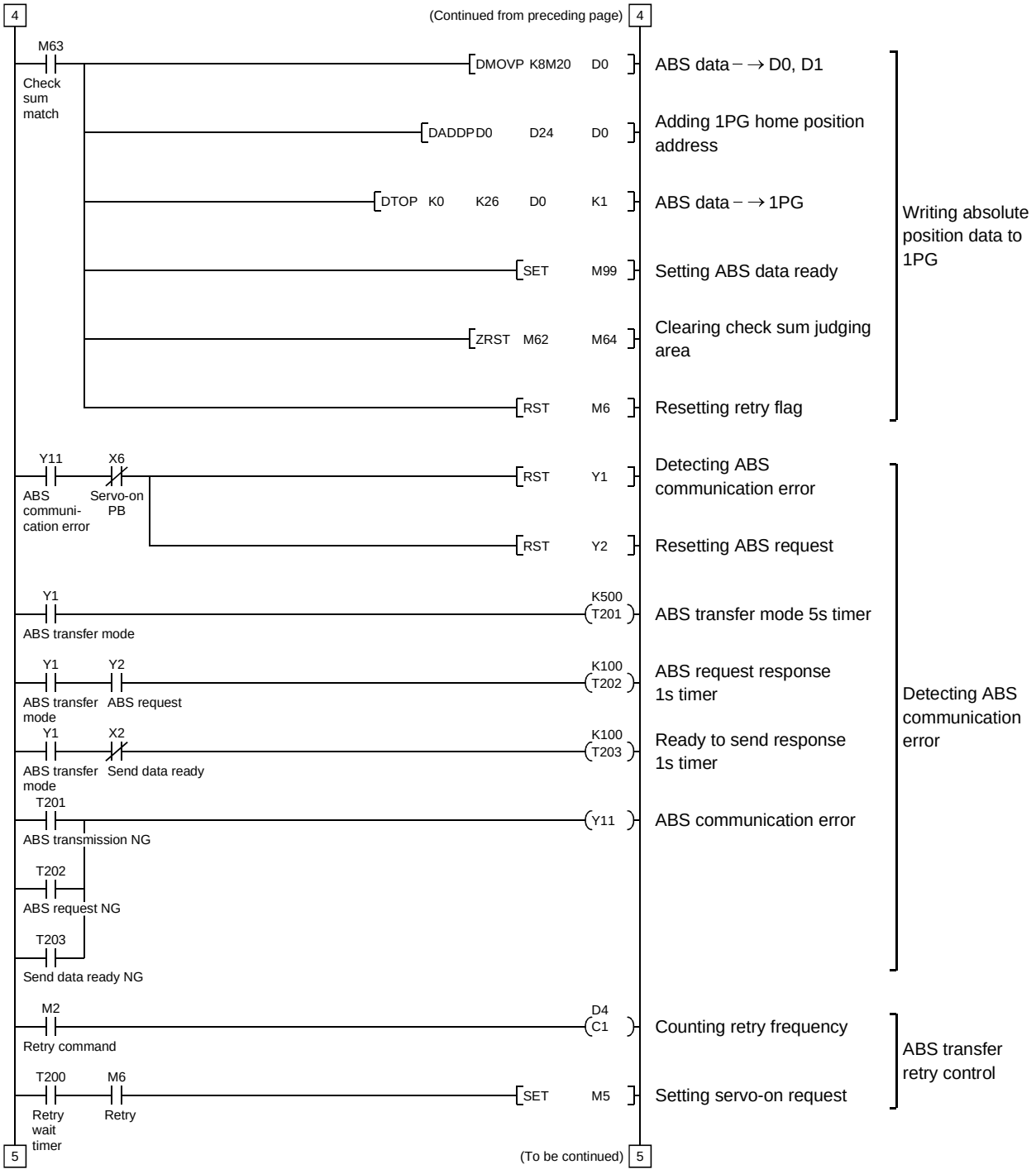
(c) ABS data transfer program for X-axis

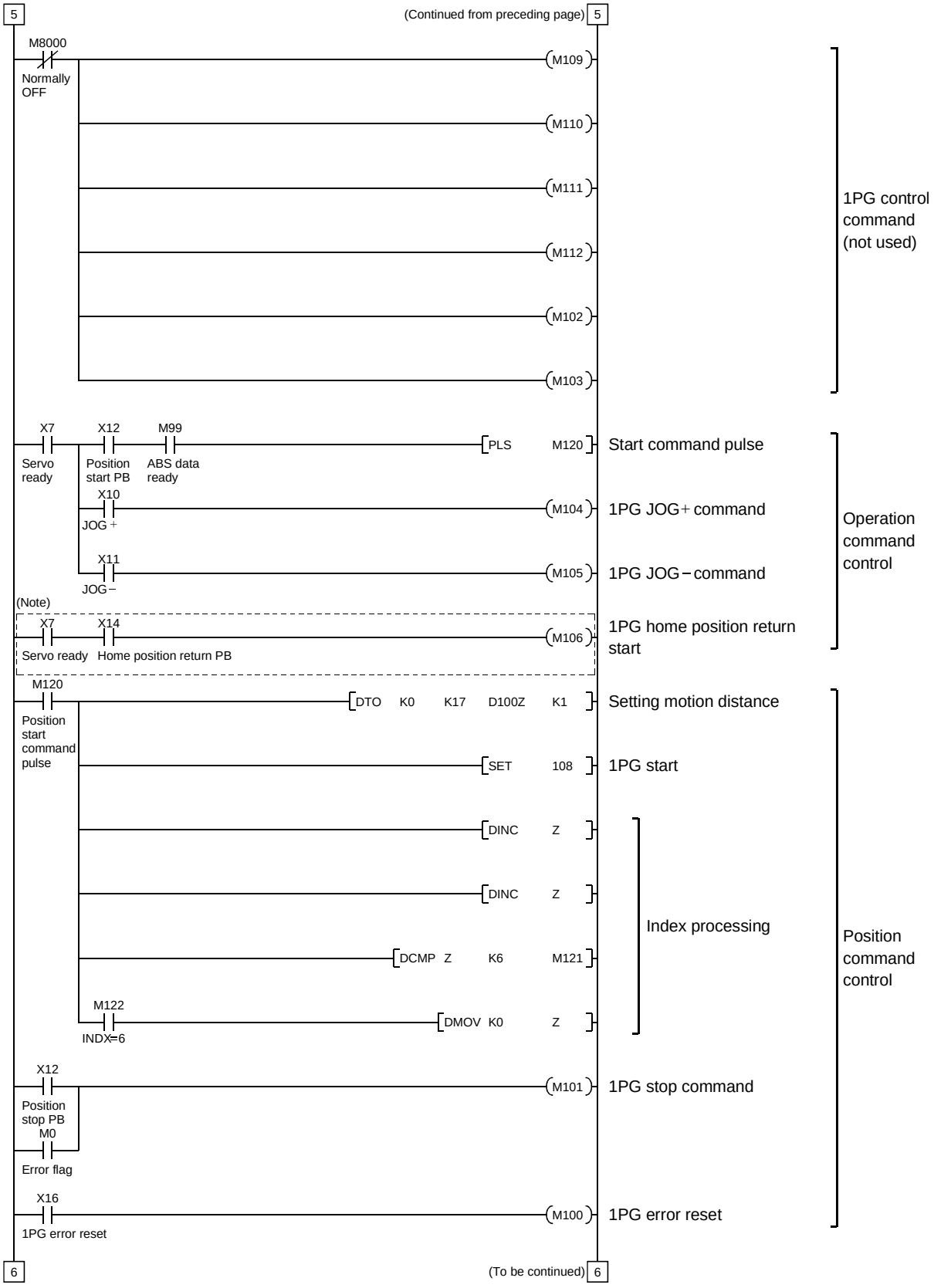



1
(Continued from preceding page)
1
X6
Servo-on PB
M6
Retry
SET M5
Servo-on request
M5
Servo-on request
Y12
ABS check error
M0
Error flag
Y11
ABS communication error
Y0
Servo-on output
PLS M1
ABS data transmission start
M1
ABS transmission start
M6
Retry
RST C1
Clearing retry counter
X6
Servo-on PB
RST 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 judgement
ZRST C0 C2
Resetting communication counter
Servo-on and retry control
2
(To be continued)
2

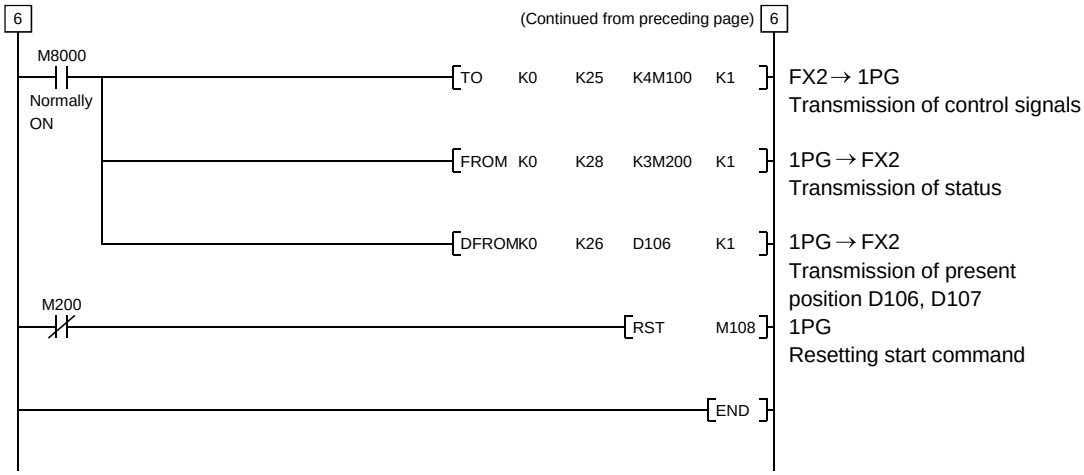

2
(Continued from preceding page)
2
X4
M0
Alarm reset PB
Error flag
Y3
Alarm reset output
Y3
Alarm reset
RST C1
Clearing retry counter
ZRST M0 M64
Clearing ABS data receiving area
ZRST D0 D3
Clearing ABS receive data buffer
RST C2
Resetting ABS data reception counter
RST C0
Resetting all data reception counter
X5
Emergency stop PB
M0
Error flag output
X3
Servo alarm
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
Y11
ABS communication error
T202
ABS request NG
T203
Send data ready NG
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



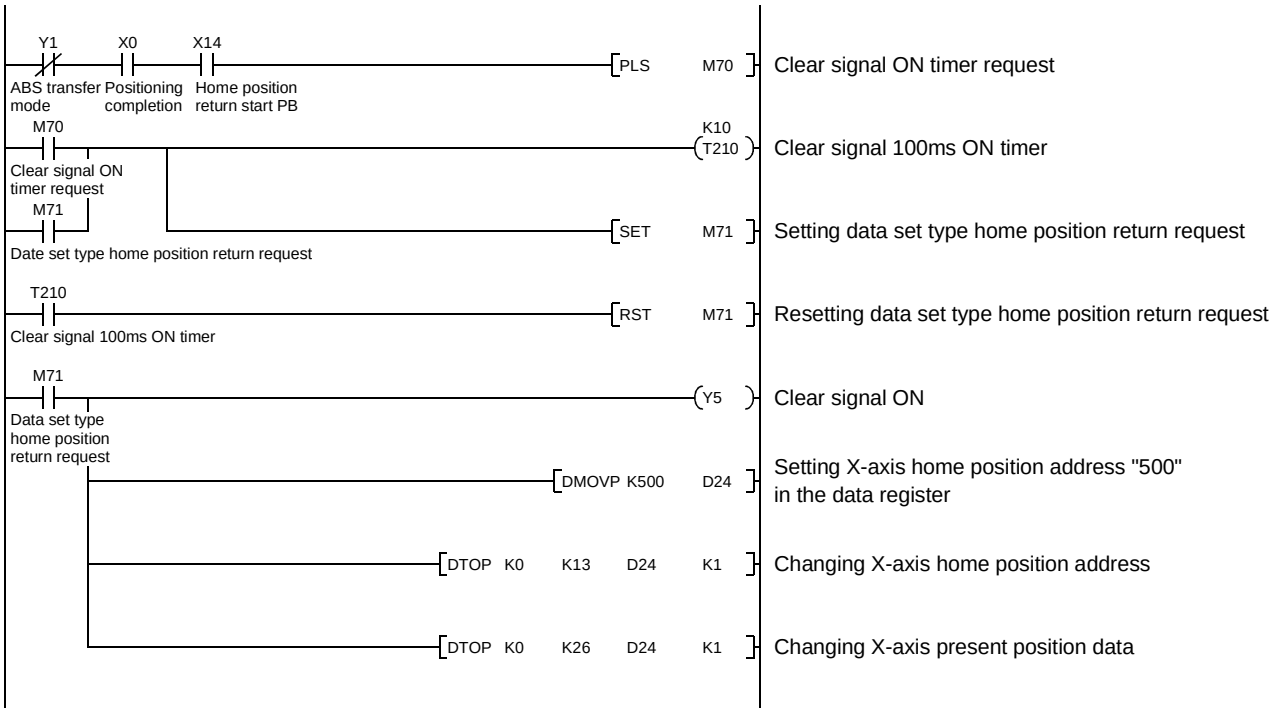

Note: Program example for the dog type home position return. For the data set type home position return, refer to the program example in (2), (d) in this section.




(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.

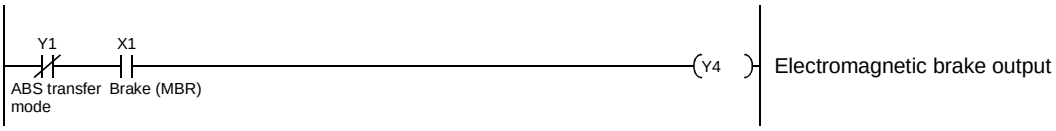
Do not turn ON the clear signal (Y5) for an operation other than home position return. Turning it ON in other circumstances will cause position shift.



(e) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1□1□" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.




(f) Positioning completion

To create the status information for servo positioning completion.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(g) Zero speed

To create the status information for servo zero speed.

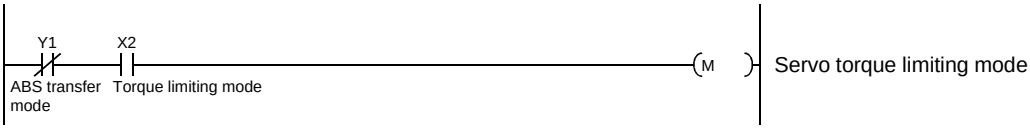
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(h) Torque limiting

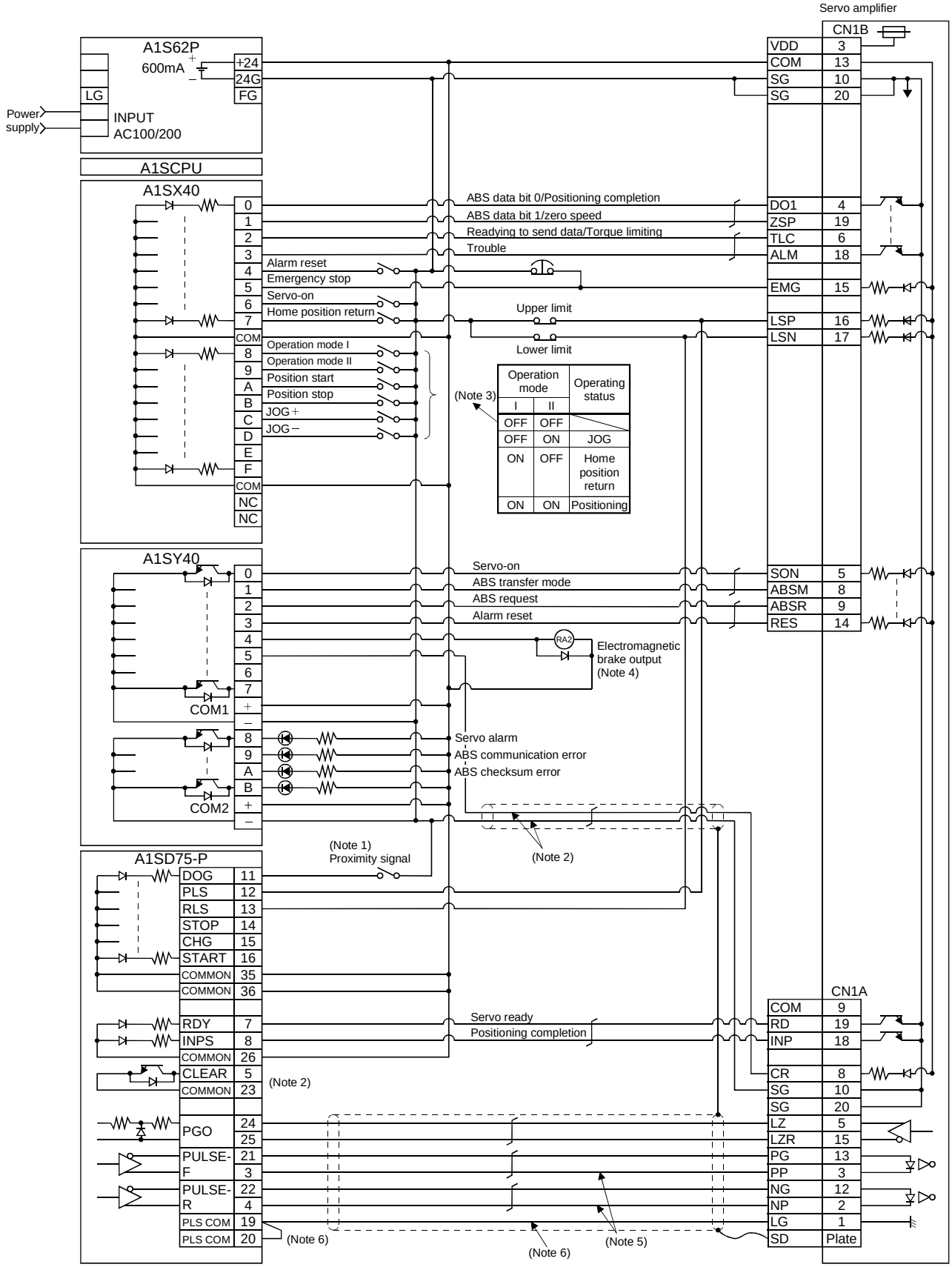
To create the status information for the servo torque limiting mode.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the torque limiting must be off.



### 15.8.3 MELSEC A1SD75(AD75)

(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(AD75) will output the deviation counter clear signal. Therefore, do not connect the clear signal of the MR-J2-A to the A1SD75(AD75) 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 bit 0 / positioning completion | Y30 | Servo-on |
| X21 | ABS 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 2) | Y39 | ABS communication error |
| X28 | Operation mode I | Y3A | ABS checksum error |
| X29 | Operation mode II | | |
| 1) | 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 4) | 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 signal ON timer request |
| 3) | 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 signal 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.

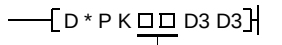
(c) ABS data transfer program for X axis

This sequence program example assumes the following conditions:

- Parameters of the A1SD75-P1 (AD75-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:

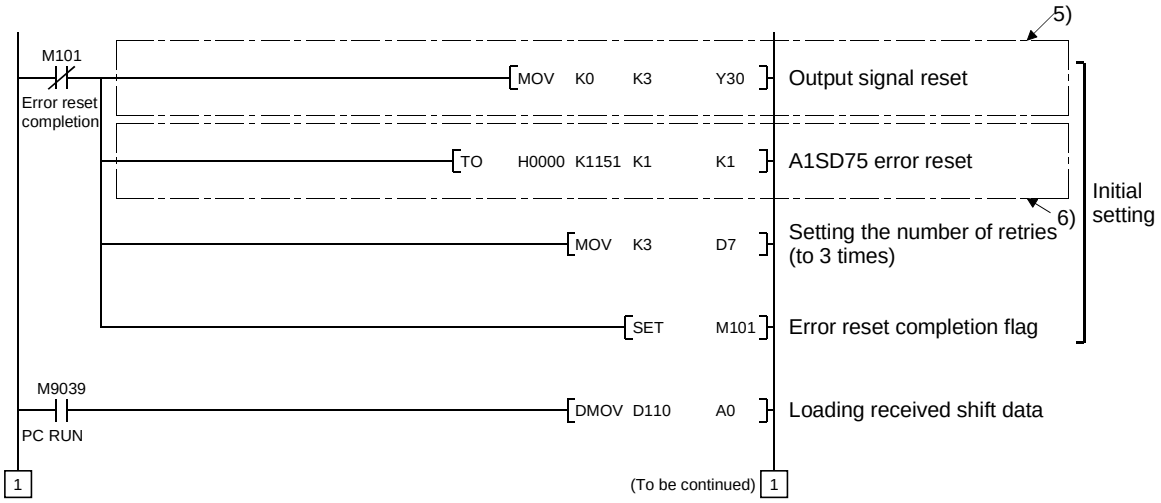
<Additional program>

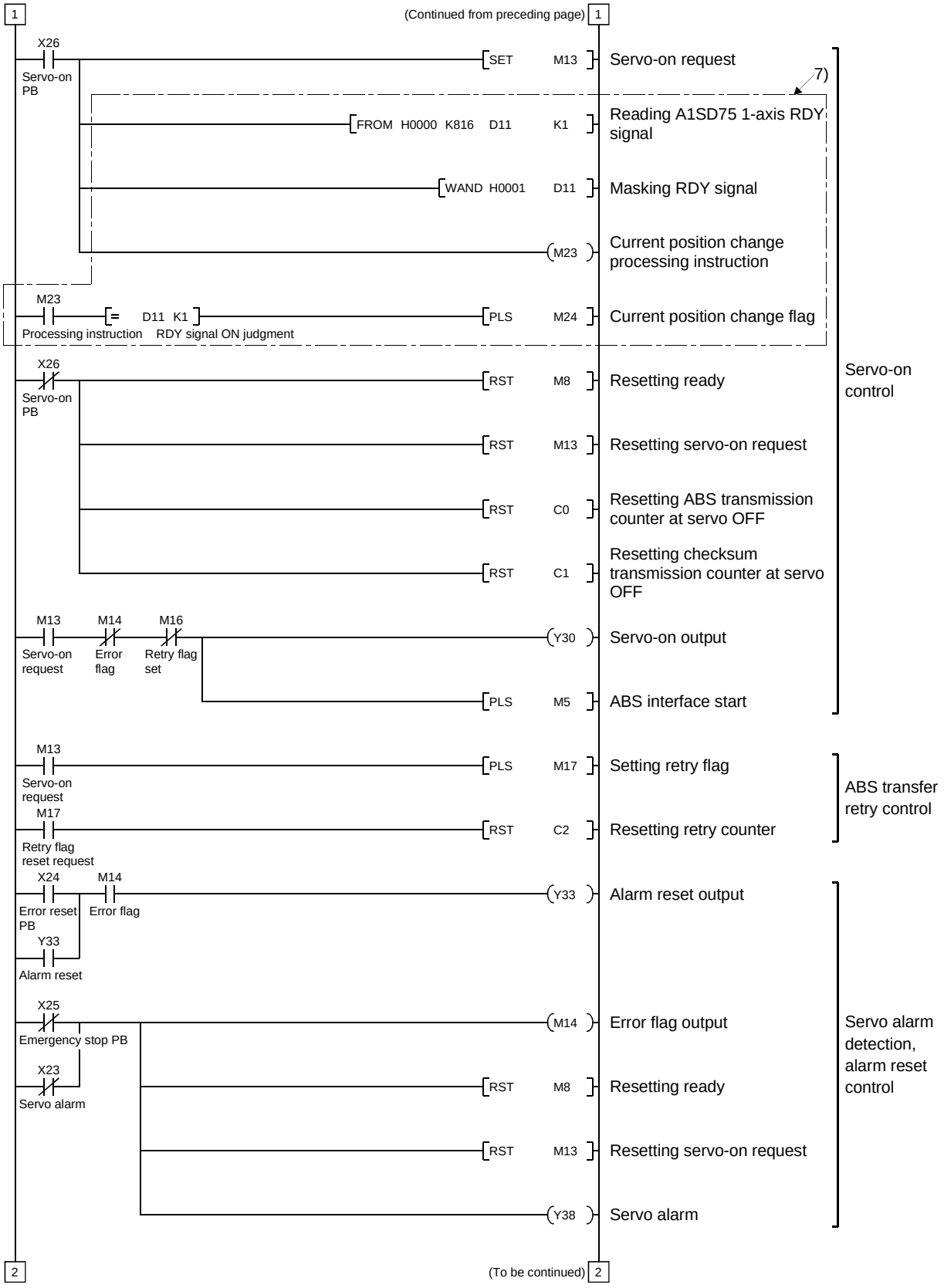


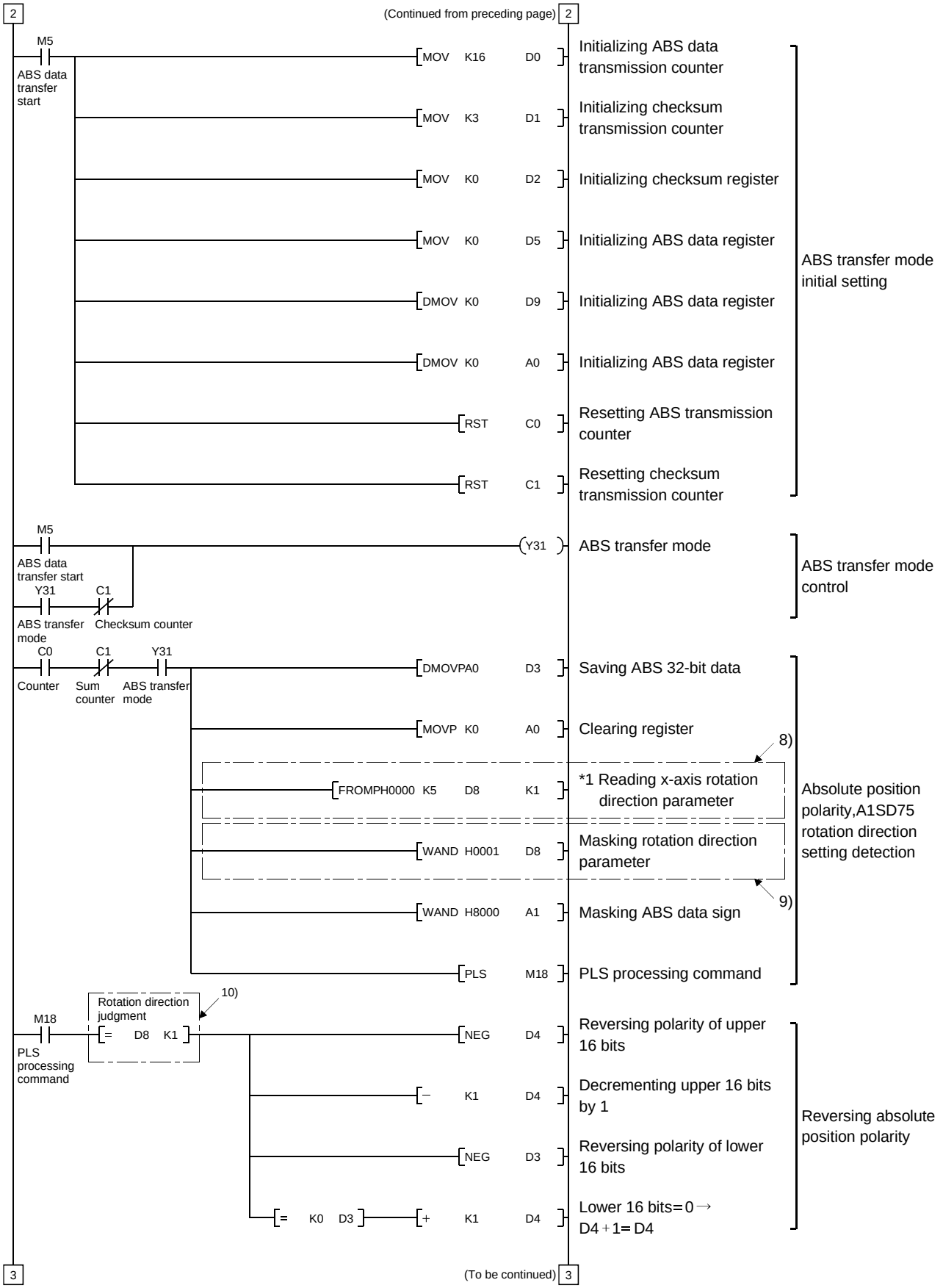

| Item | mm | | | | inch | | | | degree | | | | pulse |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Unit setting | 0 | | | | 1 | | | | 2 | | | | 3 |
| Travel per pulse | 0.1 to | 1 to | 10 to | 100 | 0.00001 to | 0.0001 to | 0.001 to | 0.01 to | 0.00001 to | 0.0001 to | 0.001 to | 0.01 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 |

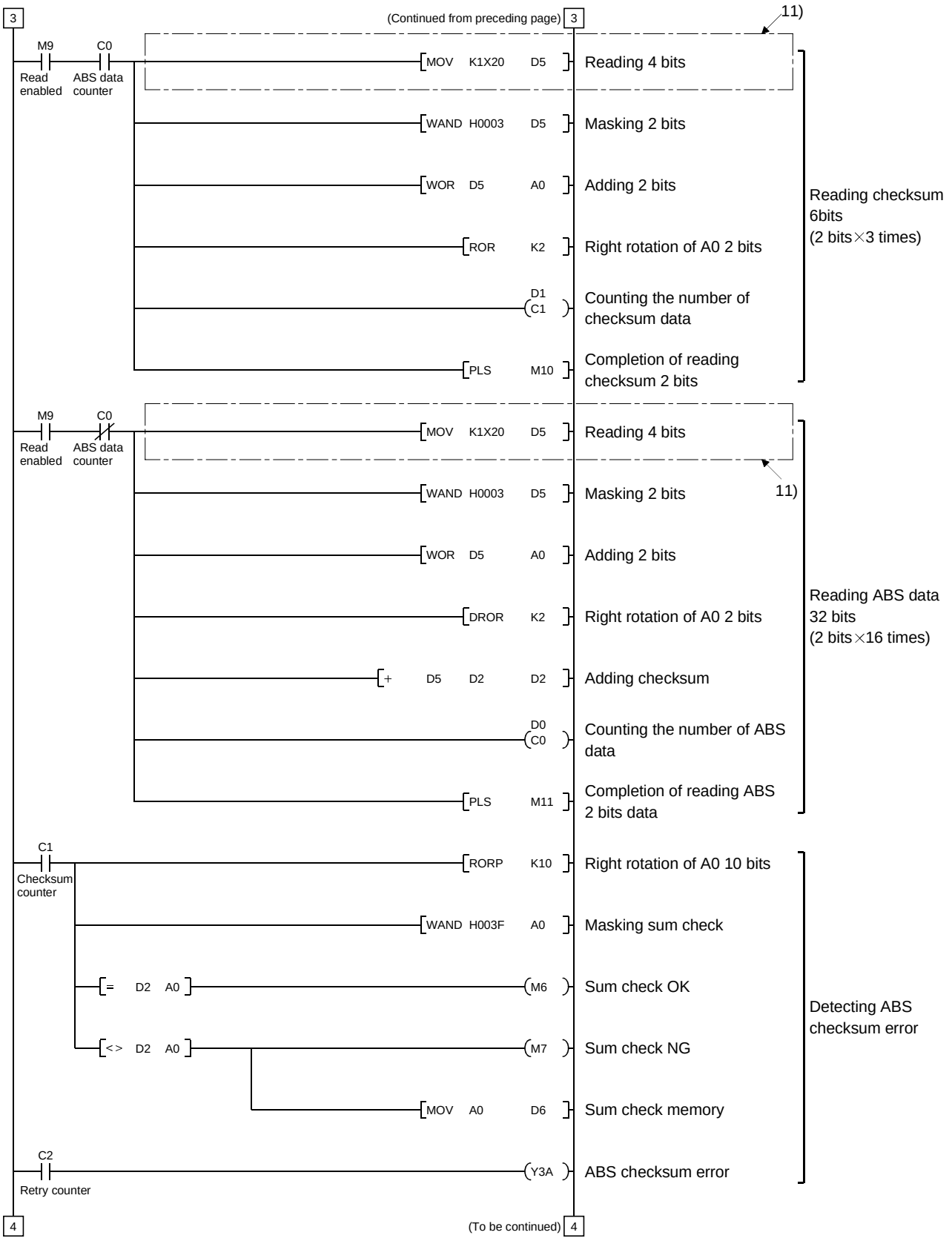
Reference

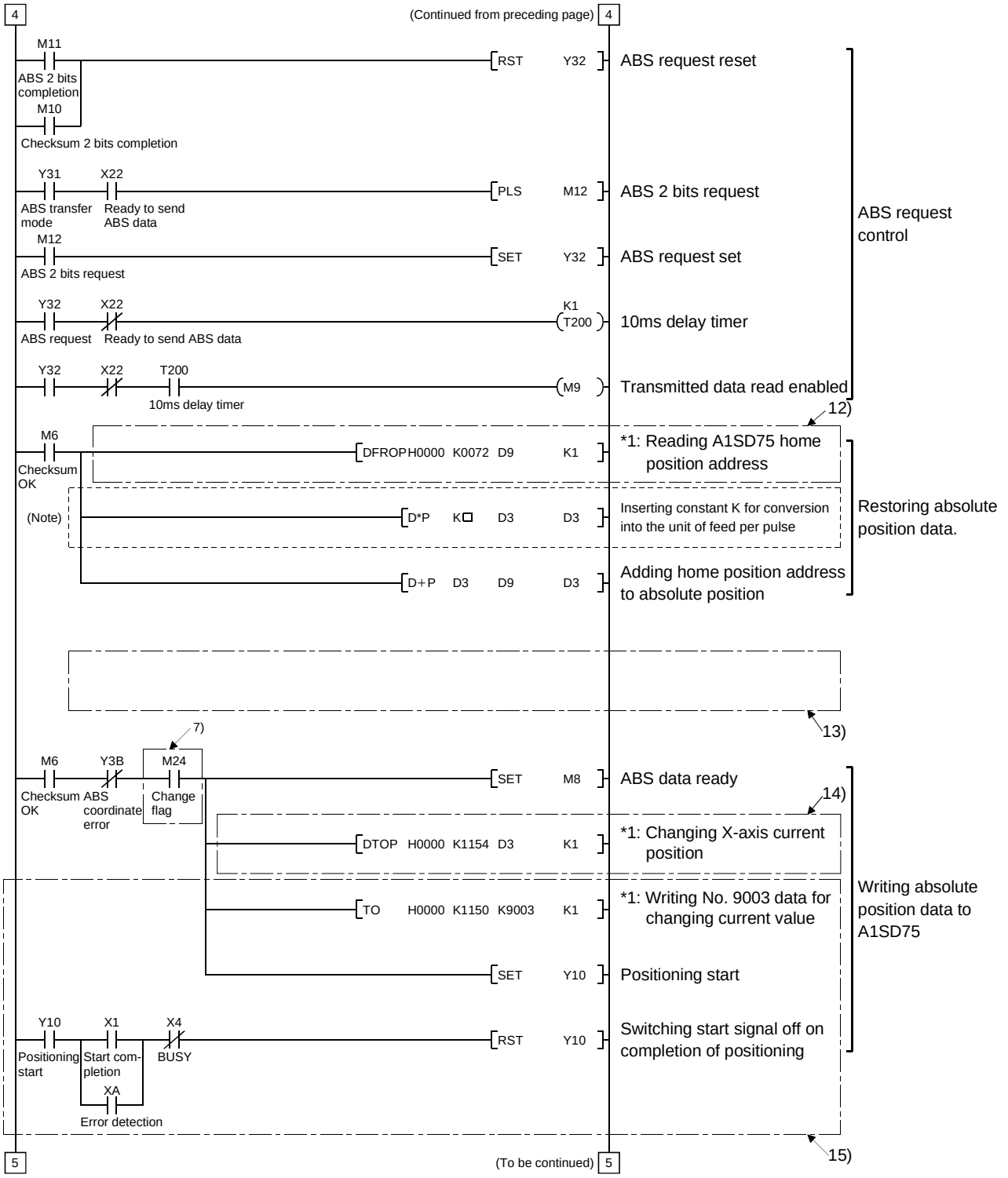
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- The additional program is not required for the unit setting is PLS.



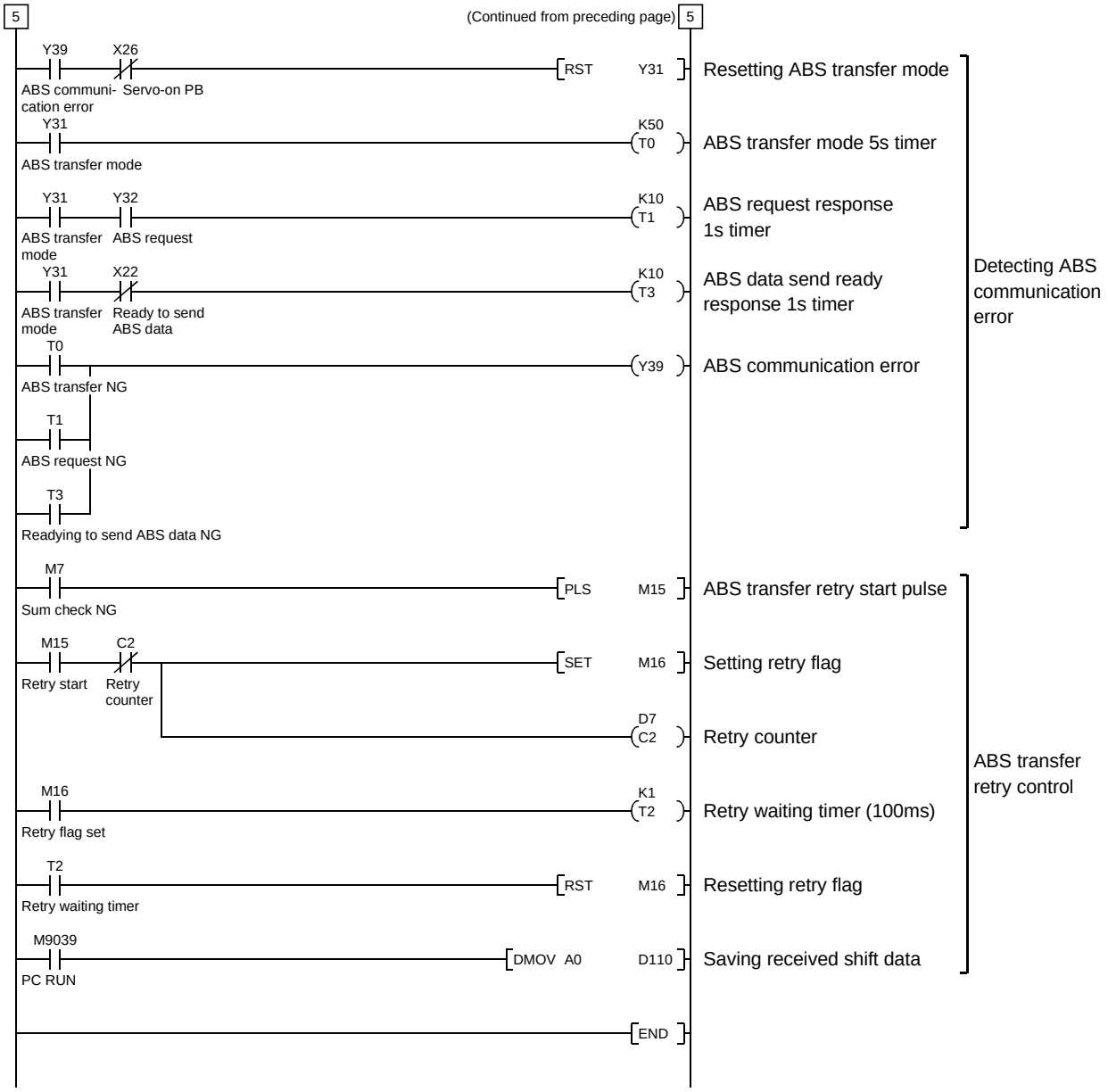

1
(Continued from preceding page)
1
X26
Servo-on PB
SET M13
Servo-on request
7)
FROM H0000 K816 D11 K1
Reading A1SD75 1-axis RDY signal
WAND H0001 D11
Masking RDY signal
M23
Current position change processing instruction
M23
Processing instruction
= D11 K1
RDY signal ON judgment
PLS M24
Current position 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
Y33
Alarm reset output
X25
Emergency stop PB
M14
Error flag output
X23
Servo alarm
RST M8
Resetting ready
RST M13
Resetting servo-on request
Y38
Servo alarm
Servo alarm detection, alarm reset control
2
(To be continued)
2


2
(Continued from preceding page)
2
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
ABS transfer mode control
Y31
ABS transfer mode
C1
Checksum counter
C0
Counter
C1
Sum counter
Y31
ABS transfer mode
DMOVPA0 D3
Saving ABS 32-bit data
MOVP K0 A0
Clearing register
8)
FROMPH0000 K5 D8 K1
*1 Reading x-axis rotation direction parameter
WAND H0001 D8
Masking rotation direction parameter
9)
WAND H8000 A1
Masking ABS data sign
PLS M18
PLS processing command
Absolute position polarity,A1SD75 rotation direction setting detection
10)
Rotation direction judgment
= D8 K1
M18
PLS processing command
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
3
(To be continued)
3


3
(Continued from preceding page)
3
11)
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
11)
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

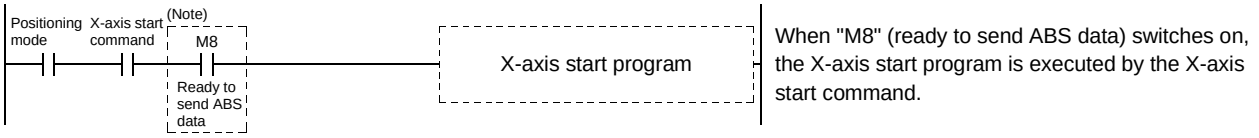



Note: When the unit setting parameter value of the AD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is $\times 0.1\mu$m for the input value. To set the unit to $\times 1\mu$m, add this program to multiple the feed value by 10.


5
(Continued from preceding page)
5
Y39
X26
RST
Y31
Resetting ABS transfer mode
ABS communi-cation error
Servo-on PB
Y31
K50
T0
ABS transfer mode 5s timer
ABS transfer mode
Y31
Y32
K10
T1
ABS request response 1s timer
ABS transfer mode
ABS request
Y31
X22
K10
T3
ABS data send ready response 1s timer
ABS transfer mode
Ready to send ABS data
T0
Y39
ABS communication error
ABS transfer NG
T1
ABS request NG
T3
Readying to send ABS data NG
Detecting ABS communication error
M7
PLS
M15
ABS transfer retry start pulse
Sum check NG
M15
C2
SET
M16
Setting retry flag
Retry start
Retry counter
D7
C2
Retry counter
M16
K1
T2
Retry waiting timer (100ms)
Retry flag set
T2
RST
M16
Resetting retry flag
Retry waiting timer
M9039
DMOV A0
D110
Saving received shift data
PC RUN
ABS transfer retry control
END

(d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.

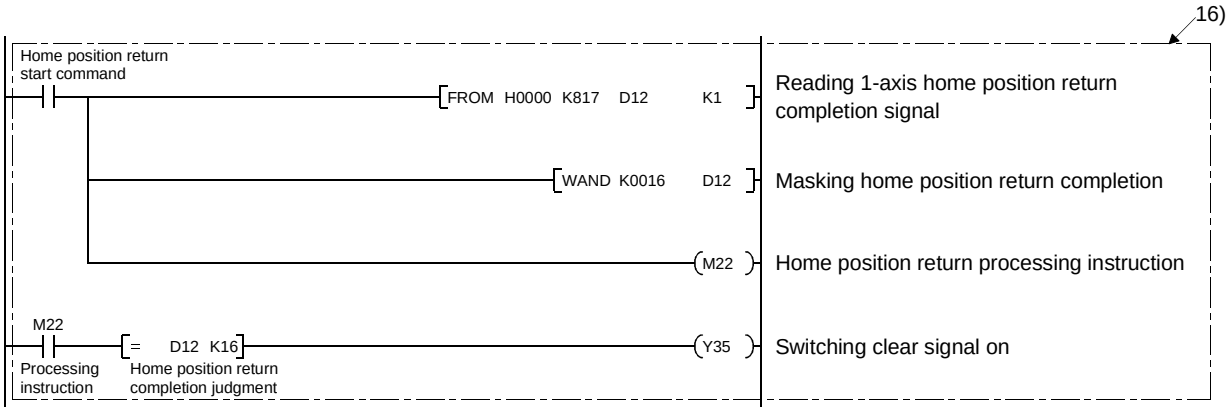



(e) Dog type home position return

Refer to the home position return program in the A1SD75 User's Manual.

Note that this program requires a program which outputs the clear signal (Y35) after completion of home position return.

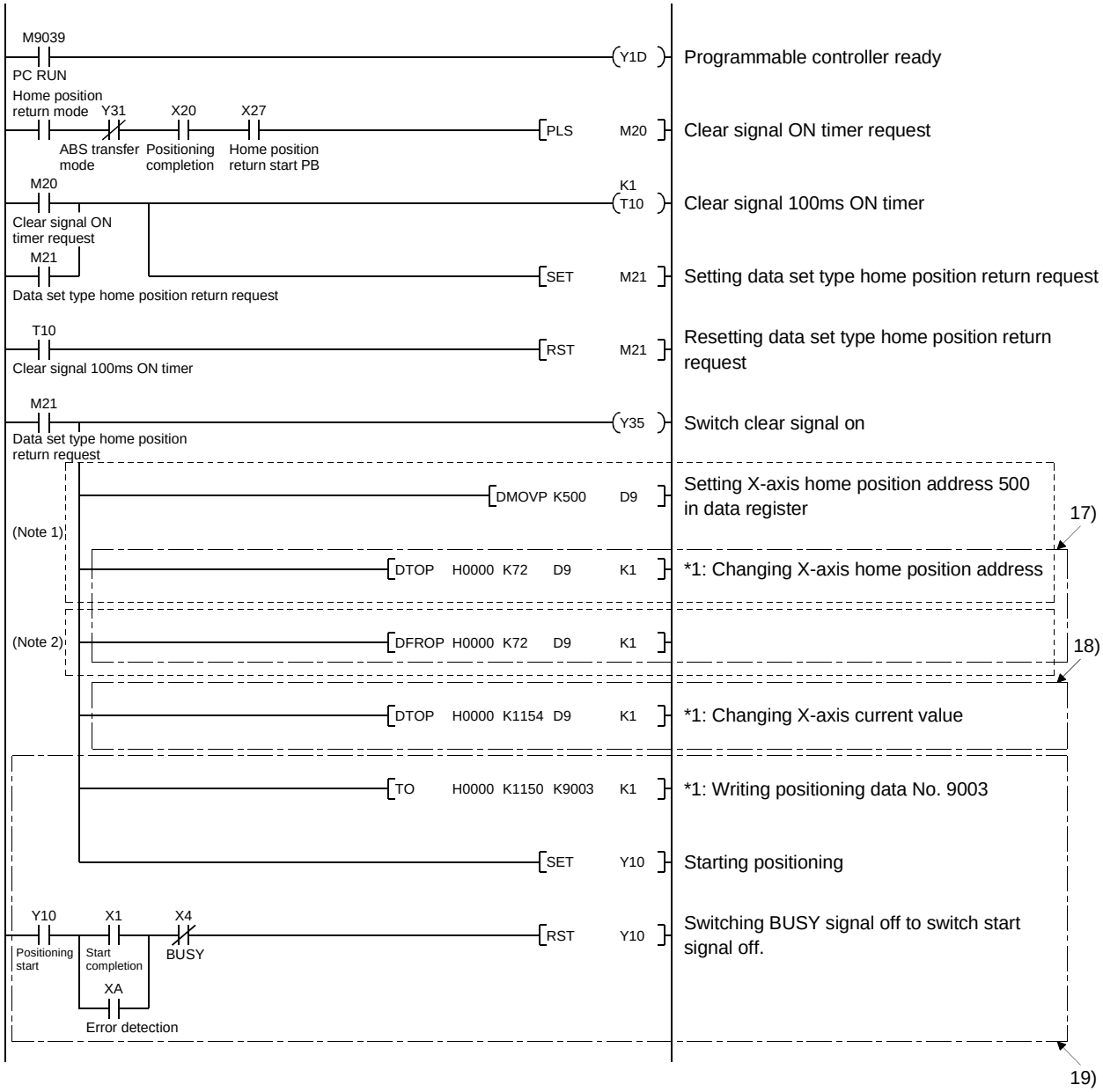
Add the following program:



(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 signal (Y35) for an operation other than home position return. Turning it on in other circumstances will cause position shift.



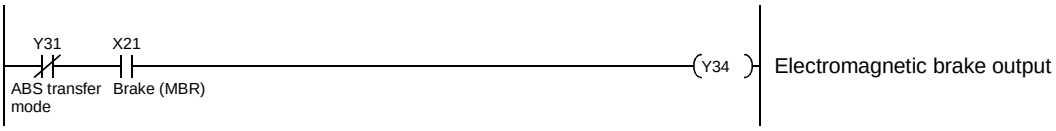

Note 1: If the data of the home position address parameter is not written from the A7PHP programming tool or the like before starting the data set type home position return program, this sequence circuit (Note 1) is required and the sequence circuit (Note 2) is not required.

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.

(g) Electromagnetic brake output

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.

Set "1□1□" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.




(h) Positioning completion

To create the status information for servo positioning completion.

During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(i) Zero speed

To create the status information for servo zero speed.

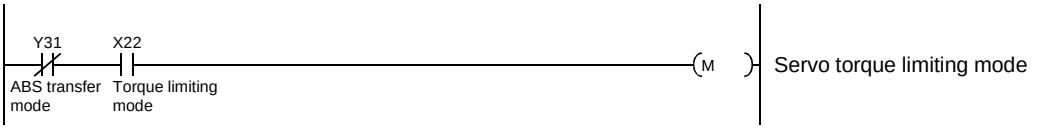
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.




(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 signal 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.

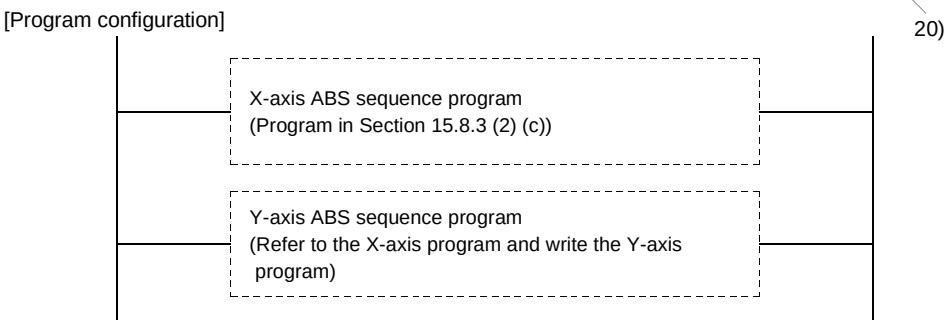
(a) Y-axis program

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 15.8.3 (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]
                                                              20)
```




(b) Data set type home position return

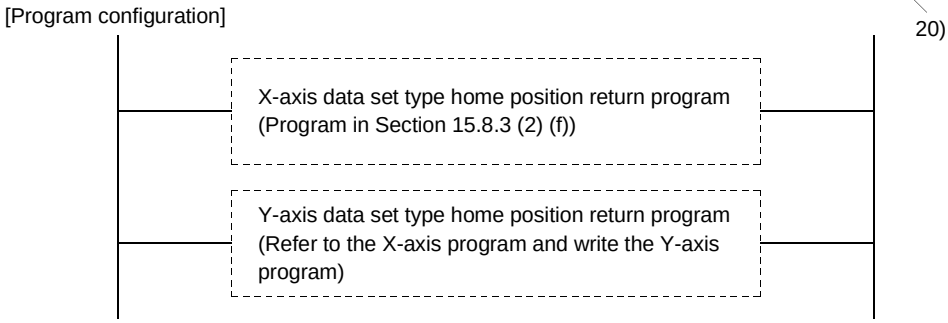
Arrange the data set type home position return programs given in Section 15.8.3 (2), (f) in series to control two axes.

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 A1SD75 differ between the X and Y axes. The instructions marked *1 in the program of Section 15.8.3 (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]
                                                              20)
```



(4) Differences between A1SD75 (AD75) and A1SD71 (AD71)

The sequence programs shown in (2) of this section differ from those for the A1SD71 (AD71) in the following portions. 1) to 20) in the following sentences indicate the numbers in the programs given in (2) of this section.

(a) Devices used

Since the A1SD75 (AD75) is a one-slot module which occupies 32 I/O points, the I/O devices are different, as indicated by 1) and 2), from those of the two-slot A1SD71 which occupies 48 point. The A1SD75 (AD75) uses the devices indicated in the following table, and its D registers and M contacts are different as indicated by 3) and 4).

| Device name | Devices | | | Application | Bit device :Data at ON<br>Data register :Stored data |
|---|---|---|---|---|---|
| | Axis 1 | Axis 2 | Axis 3 | | |
| Input | X0 | | | AD75 ready | Not ready/ WDT error |
| | X4 | X5 | X6 | BUSY | BUSY(running) |
| | XA | XB | XC | Error detection | Error detection |
| Output | Y10 | Y11 | Y12 | Positioning start | Start being requested |
| | Y13 | Y14 | Y1C | Axis stop | Stop being requested |
| | Y16 | Y18 | Y1A | Forward rotation jog start | Forward rotation being started |
| | Y17 | Y19 | Y1B | Reverse rotation jog start | Reverse rotation being started |
| | Y1D | | | Programmable controller ready | Programmable controller CPU normal |
| internal relay | M0 | | | Parameter setting completion flag | Setting complete |
| | M1 | | | Flash ROM registration processing flag | Processing |
| | M2 | M3 | M4 | Axis error reset requesting flag | Requesting |
| | M100 | | | AD75 normal flag | AD75 normal |
| | M101 | | | Initial error reset completion flag | Error reset complete |
| | M102 | | | All BUSY signal OFF flag | All BUSY signal OFF |
| | M103 | | | AD75 operable flag | Operable |
| Data register | D100 | | | Flash ROM registration results | Registration results |
| | D101 | D102 | D103 | Axis error code | Error code |
| | D104 | D105 | D106 | Axis warning code | Warning code |
| | D107 | D108 | D109 | Axis error reset results | Axis error reset results |

(b) ABS sequence program example

1) Initial setting

To reset the error of the A1SD75, the program 5) is added to reset all output signals at start-up. The axis error reset buffer memory address is changed from 201 to 1154 (axis 1) and the slot number from H0001 (slot number 1) to H0000 (slot number 2) 6).

2) Absolute position polarity, A1SD75 rotation direction setting detection

The slot number and buffer memory of the X-axis rotation direction parameter reading area are changed from [FROMP H0001 K7872 D8 K1] to [FROMP H0000 K5 D8 K1] 8).

The rotation direction parameter masking area is changed from [WAND H0004 D8] to [WAND H0001 D8] 9).

3) Reversing absolute position polarity

The rotation direction judging area is changed from [= D8 K4] to [= D8 K1] 10).

4) Reading checksum 6 bits, reading ABS data 32 bits

The 4 bits reading area is changed from [MOV K1 X30D5] to [MOV K1X20 D5] 11).

5) Restoring absolute position data

The slot number and buffer address of the A1SD75 home position address reading area are changed from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 12)

6) Writing absolute position data to A1SD75
The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 14). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003. Therefore, the starting program for positioning data No.9003 15) is added.

7) X-axis data set type home position return program
The slot numbers and buffer addresses of the X-axis home position address changing area are changed from [DTOP H0001 K7912 D9 K1] to [DTOP H0000 K72 D9 K1] and from [DFROP H0001 K7912 D9 K1] to [DFROP H0000 K72 D9 K1] 17).
The slot number and buffer address of the X-axis current value changing area are changed from [DTOP H0001 K41 D3 K1] to [DTOP H0000 K1154 D3 K1] 18). When the current value is changed in the A1SD75, the current feed value is changed at the start of positioning data No.9003. Therefore, the starting program for positioning data No.9003 19) is added.

8) Y-axis sequence program, Y-axis data set type home position return program.
The slot numbers and buffer addresses are changed as indicated by 20).

9) Writing absolute position data to AD75
The A1SD75 (AD75) allows the current position to be changed only when the ready signal of the Servo amplifier is on. Therefore, if the CPU scan is fast, the program for A1SD71 may change the current position before the ready signal switches on. 7) is added because the current position must be changed after it has been confirmed that the drive unit ready signal of the A1SD75 (D75) has switched on/off.

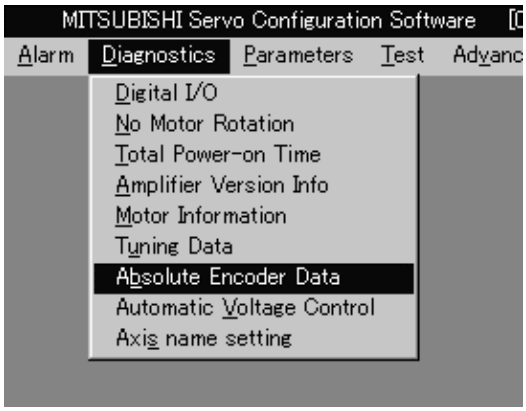
10) ABS coordinate error detection
As the A1SD75 (AD75) can handle the negative-polarity coordinate position that the A1SD71 could not handle, the program for ABS coordinate error detection is deleted. 13)

11) Dog type home position return program
Due to the changes in wiring described in (4), (a), 4) of this section, the program for outputting the clear signal (Y35) after completion of a home position return is required. 16)

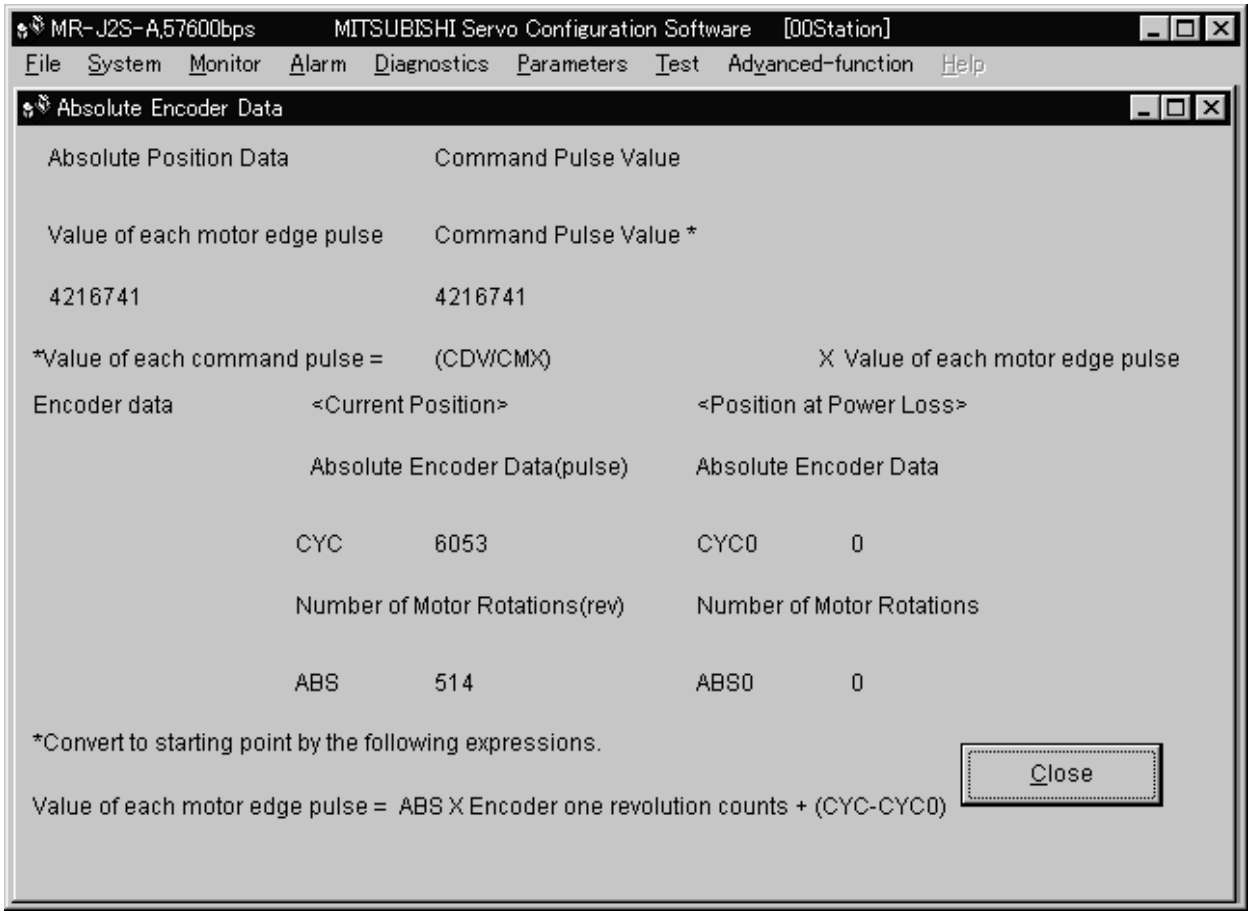
## 15.9 Confirmation of absolute position detection data

You can confirm the absolute position data with servo configuration software (MRZJW3-SETUP121E). 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.

## 15.10 Absolute position data transfer errors

### 15.10.1 Corrective actions

(1) Error list

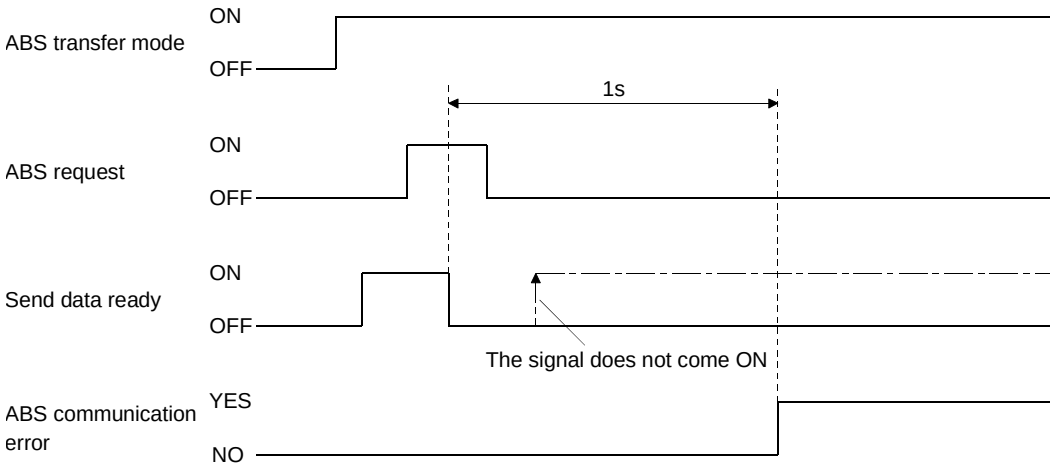
The number within parentheses in the table indicates the output coil or input contact number of the A1SD71 (AD71).

| Name | Output coil | | Description | Cause | Action |
|---|---|---|---|---|---|
| | AD71 | 1PG | | | |
| (Note) ABS communication error | Y49 | Y11 | 1. The ABS data transfer mode signal (Y41) is not completed within 5s.<br>2. The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON.<br>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 SG 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 | Y4A | 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. |
| ABS coordinate error | Y4B | | ・The motor position is in the negative coordinate value range when the servo is turned ON or when power supply is turned ON. | 1. The servo is turned ON or the power supply is turned ON near the machine home position or in the zone in which addresses decrease. | 1. Reconsider the position where the servo is turned ON.<br>2. Set the home position for positioning apart from the machine home position. |
| | | | | 2. The machine falls on a vertical axis when the servo signal is turned ON/OFF. | Change the electromagnetic brake operation sequence. |
| Servo alarm | Y48 | 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 Section 10.2.2 and take action. |

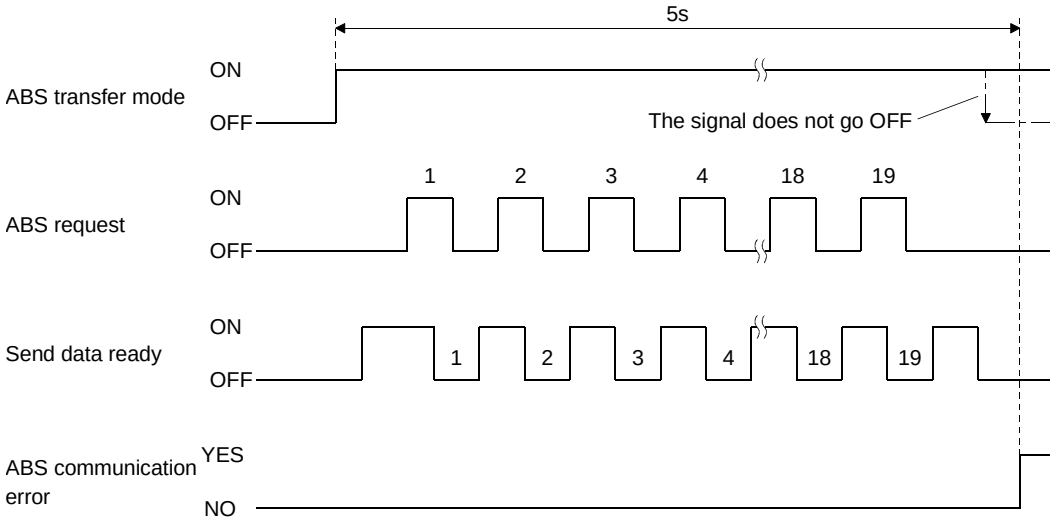
Note: Refer to (2) in this section for details of error occurrence definitions.

(2) ABS communication error

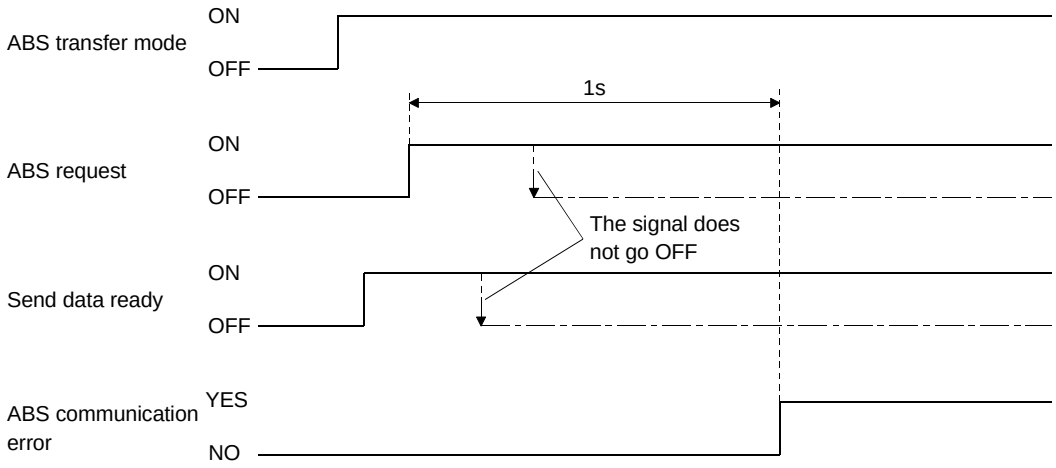
(a) The OFF period of the send data ready signal output from the servo amplifier is checked.
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.
The ABS communication error occurs if the ABS time-out warning (AL.E5) is generated at the 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 send data ready signal 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.




### 15.10.2 Error resetting conditions

Always remove the cause of the error before resetting the error.

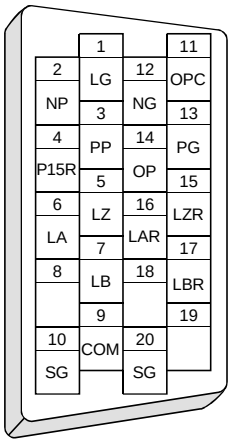
| Name | Output coil | | Servo status | Resetting condition |
|---|---|---|---|---|
| | AD71 | 1PG | | |
| ABS communication error | Y49 | Y11 | Ready (RD) signal off | Reset when servo-on PB (X36) signal turns off. |
| ABS checksum error | Y4A | Y12 | Ready (RD) signal on | For AD71<br>Reset when servo-on PB (X36) signal turns from off to on. |
| | | | | For FX-1PG<br>Reset when servo-on PB (X36) signal turns off. |
| ABS coordinate error | Y4B | | Ready (RD) signal on | Reset when servo-on PB (X36) signal turns from off to on after a motion to (+) coordinate is made by jog operation. |
| Servo alarm | Y48 | Y10 | Ready (RD) signal on | Reset when alarm reset PB turns on or power switches from off to on. |

# MEMO

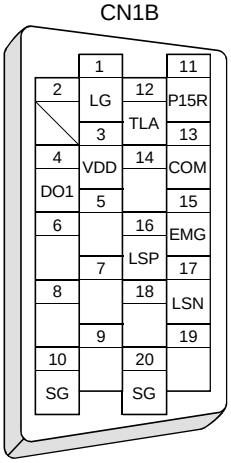
## App 1. Signal arrangement recording sheets

(1) Position control mode

CN1A

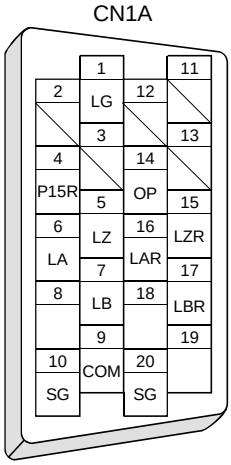



CN1B

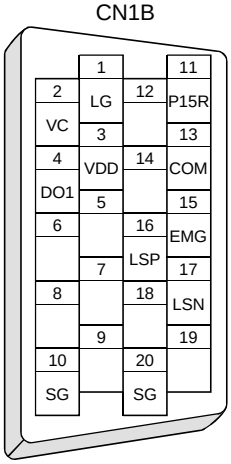



(2) Speed control mode

CN1A

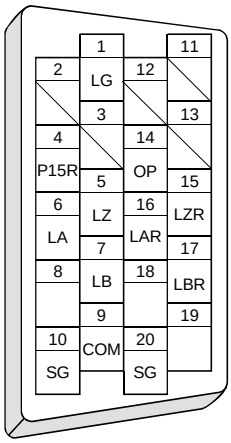



CN1B

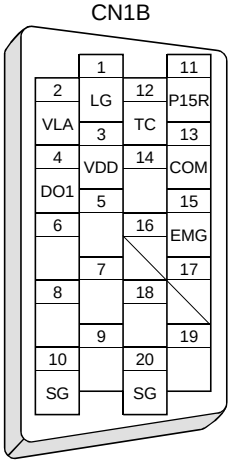



(3) Torque control mode

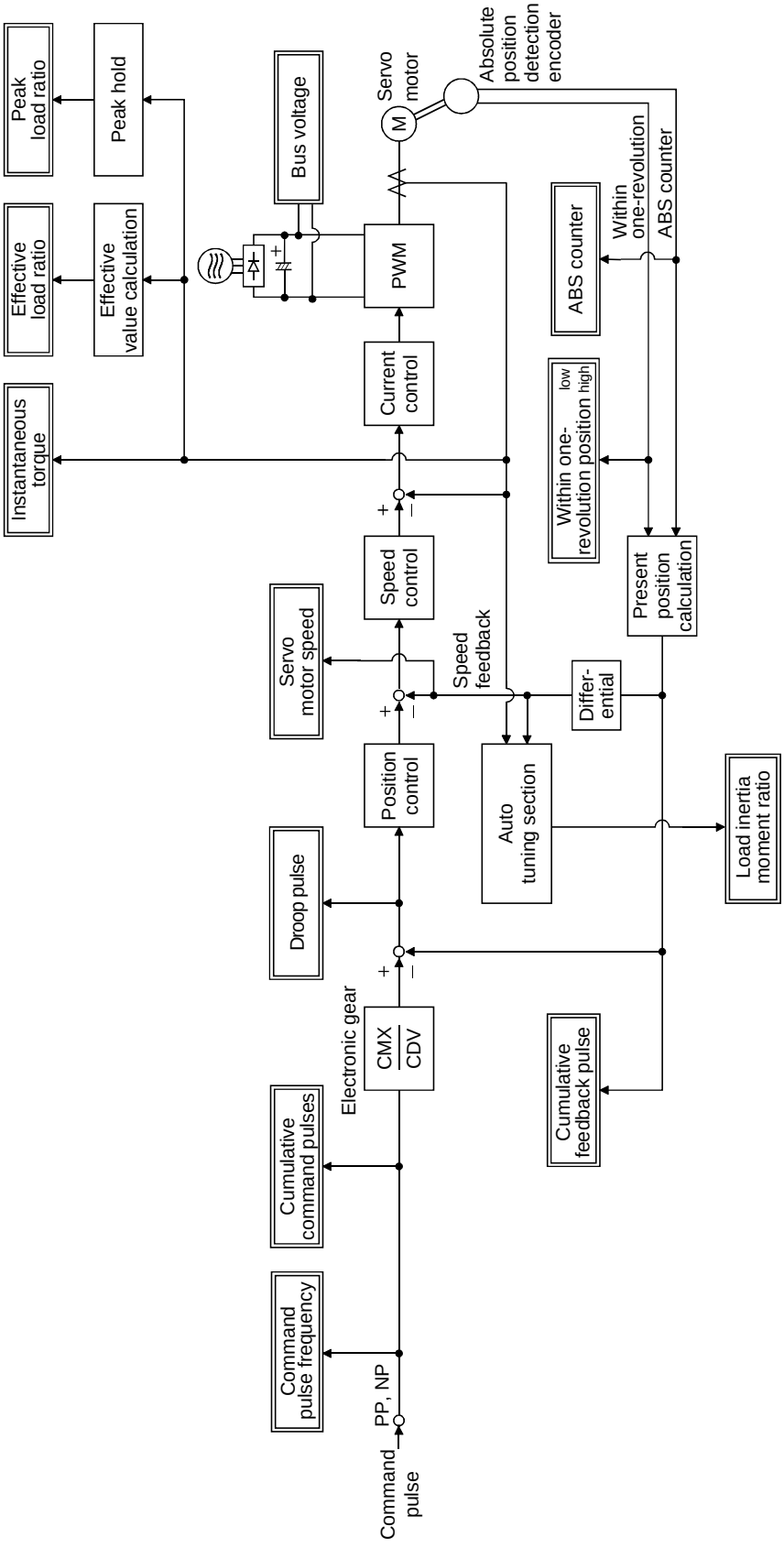
CN1A




CN1B



App 2. Status display block diagram



# REVISIONS

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

| Print data | *Manual number | Revision |
|---|---|---|
| Nov.,1999 | SH(NA)030006-A | First edition |
| Sep.,2000 | SH(NA)030006-B | Addition of single-phase 100VAC specifications<br>Compatible Servo Configuration software model name change<br>Compliance with EC Directives 1: Review of sentence<br>Section 1.2: Review of function block diagram<br>Section 1.3: Moving of servo amplifier standard specifications<br>Review of torque limit description in position control mode<br>Review of torque limit description in speed control mode<br>Deletion of torque linearity in torque limit mode<br>Addition of speed limit in torque control mode<br>Section 3.1.1 (1): Addition of encoder Z-phase pulse connection<br>Addition of Note for use of junction terminal block<br>Section 3.1.1 (2): Addition of Note for increased noise immunity<br>Section 3.1.2: Addition of Note for input of negative voltage<br>Section 3.1.3: Addition of Note for input of negative voltage<br>Section 3.3.1 (2): Review of Note<br>Section 3.4.1 (4): Addition of description about electronic gear switching<br>Section 3.4.3 (1)(a): Review of description for low voltage<br>Section 3.5: Change in timing chart<br>Section 3.5 3): Review of description<br>Section 3.6.2 (7): Review of connection<br>Section 3.9: Review of POINT<br>Section 3.9 (3)(b),(c): Change in timing chart<br>Section 3.9 (3)(d),(e): Addition<br>Section 5.1.2 (2): Deletion of description as to parameter No. 22 TC, TLA<br>Addition of parameter No. 27 setting example<br>Correction of parameter No. 35 setting range<br>Review of parameter No. 47, 48 sentences<br>Section 5.2.5: Correction of operation pattern diagram<br>Section 6.2.2: Review of within one-revolution position sentence<br>Section 6.3: Review of automatic VC offset description<br>Section 6.6 (2)(a): Review of Note<br>Section 6.8: Review of PL sentence<br>Chapter 7: Addition of POINT<br>Section 7.3.2 (1), (2): Review of sentence makeup<br>Section 7.4: Addition<br>Section 8.1.1: Addition<br>Section 8.3.2: Addition<br>Section 10.1.1 (1): Addition of Investigation item at power-on<br>Section 10.1.2: Addition of Investigation item at power-on<br>Addition of Investigation item at on of ST1 or ST2<br>Section 10.1.3: Addition of Investigation item at power-on<br>Addition of Investigation item at on of ST1 or ST2<br>Section 10.2: Addition of POINT<br>Section 10.2.2: Review of Cause of AL.10<br>Deletion of Cause 4 of AL.16<br>Review of Cause and Action of AL.24<br>Addition of description to AL.25 |

| Print data | *Manual number | Revision |
|---|---|---|
| Sep.,2000 | SH(NA)030006-B | Section 10.2.2: Addition of description to AL.30<br>Addition of Cause to AL.33<br>Chapter 11: Changed to only outline dimensional drawing<br>Section 11.2 (2): Addition<br>Section 12.2 (1): Review of Note for Table 12.1<br>Section 12.3: Correction of dynamic brake time constant graph<br>Chapter 13: Deletion of MR-CPC98CBL3M communication cable<br>Section 13.1.1 (4)(c): Review of outline drawing<br>Section 13.1.2 (1): Deletion of MR-PWCNF power supply connector set<br>Section 13.1.2 (1)1), 6): Change of encoder side connector models<br>Section 13.1.2 (1)19), 20): Change of terminal models<br>Section 13.1.2 (2)(a)2): Addition of description for fabrication<br>Section 13.1.3: Addition of POINT<br>Section 13.1.3 (4): Addition of cable length<br>Change in connection diagram<br>Section 13.2.1 (1): Addition of Note for recommended wires<br>Section 13.2.8 (1): Addition of leakage current to recommended filter<br>Section 14.1.2 (2): Deletion of MR-CPC98CBL3M communication cable<br>Section 14.11.1 (6): Addition<br>Section 14.11.2 (8): Addition<br>Section 15.7: Addition of POINT<br>Section 15.8.1 (1)(b): Change in b) Coordinates when zero address is changed to other than 0<br>Section 15.8.2 (1)(b): Review of connection diagram<br>Section 15.9: Change of display screen<br>Section 15.10.1 (1): Deletion of Cause 5 of ABS checksum error |
| Feb.,2001 | SH(NA)030006-C | Addition of MR-J2S-500A, 700A servo amplifiers<br>Addition of HC-KFS73, HC-SFS502, HC-SFS702, HC-RFS353, HC-RFS503, HC-UFS502, HC-UFS353 servo motors<br>Section 1.2: Function block diagram modification<br>Section 1.7: Overall reexamination<br>Section 3.7.1(2): Addition of single-phase 100 to 120VAC<br>Section 3.7.2: Addition of regenerative brake converter and brake unit<br>Section 5.1.2(2): No. 0, Item addition to regenerative brake option selection<br>No. 5, Example addition<br>No. 27, Setting range change<br>No. 49, AL.26 addition<br>Section 5.2.2: Overall reexamination<br>Section 7.4(1): Reexamination<br>Chapter 8: Hierarchy reexamination<br>Section 10.2.2: AL.30, Reexamination<br>AL.8E, Reexamination of Cause and Action<br>Section 11.1(4)(5): Addition<br>Section 11.2(3): Addition<br>Section 12.1(3): Addition<br>Chapter 13: Hierarchy reexamination<br>Section 13.1.4(1): Connection diagram change<br>Cable addition<br>Section 13.1.4(3): Reexamination<br>Section 13.2.1(1): Connection diagram change<br>Wire table addition<br>Chapter 15: Addition of Note on AL.25 |

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