

# **mitsubishi**

**General-Purpose AC Servo**

# **MELSERVO-J2-Super Series**

**General-Purpose Interface**

**MR-J2S-□A**

**Servo Amplifier**

**Instruction Manual**

# ● 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".



Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.




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


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

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



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



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

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".

After reading this 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	[°C]	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	[°C]	−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 <sup>2</sup> ]	5.9 or less	HC-KFS Series HC-MFS Series HC-UFS13 to 73	X · Y : 49
			HC-SFS81 HC-SFS52 to 152 HC-SFS53 to 153 HC-RFS Series HC-UFS 72 · 152	X · Y : 24.5
			HC-SFS121 · 201 HC-SFS202 · 352 HC-SFS203 · 353 HC-UFS202 to 502	X : 24.5 Y : 49
			HC-SFS301 HC-SFS502 · 702	X : 24.5 Y : 29.4
	[ft/s <sup>2</sup> ]	19.4 or less	HC-KFS Series HC-MFS Series HC-UFS 13 to 73	X · Y : 161
			HC-SFS81 HC-SFS52 to 152 HC-SFS53 to 153 HC-RFS Series HC-UFS 72 · 152	X · Y : 80
			HC-SFS121 · 201 HC-SFS202 · 352 HC-SFS203 · 353 HC-UFS202 to 502	X : 80 Y : 161
			HC-SFS301 HC-SFS502 · 702	X : 80 Y : 96

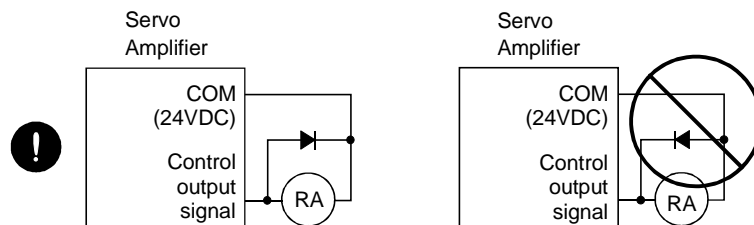
## ⚠ CAUTION

- 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.

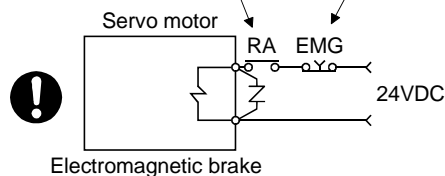
#### (5) Corrective actions

### 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.

Contacts must be open when servo-on signal is off, when an alarm (trouble) is present and when an electromagnetic brake signal.

Circuit must be opened during 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

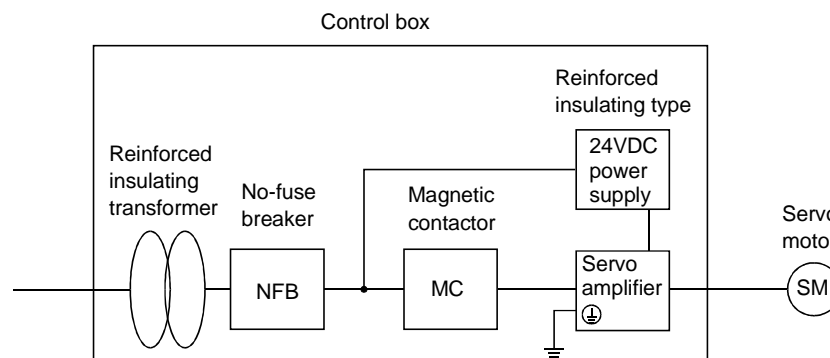
### (1) Servo amplifiers and servo motors used

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

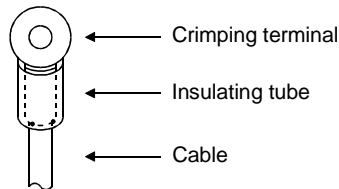
- (a) To prevent an electric shock, always connect the protective earth (PE) terminals (marked ⊕ ) of the servo amplifier to the protective earth (PE) of the control box.
- (b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect the cables to the terminals one-to-one.



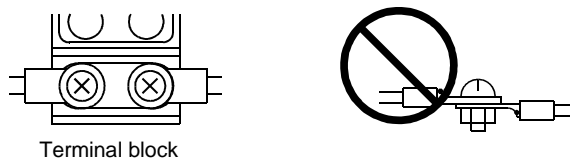
- (c) If a leakage current breaker is used to prevent an electric shock, the protective earth (PE) terminals of the servo amplifier must be connected to the corresponding earth terminals.

(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) [°C (°F)]
  - 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

The rough table of contents of the optional MELSERVO Servo Motor Instruction Manual is introduced here for your reference. Note that the contents of the Servo Motor Instruction Manual are not included in the Servo Amplifier Instruction Manual.

1. INTRODUCTION

2. INSTALLATION

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# 1. FUNCTIONS AND CONFIGURATION

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## 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  $\pm 10$ VDC) or parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.

There are also the acceleration/deceleration time constant setting in response to speed command, the servo lock function at a stop time, and automatic offset adjustment function in response to external analog speed command.

#### (3) Torque control mode

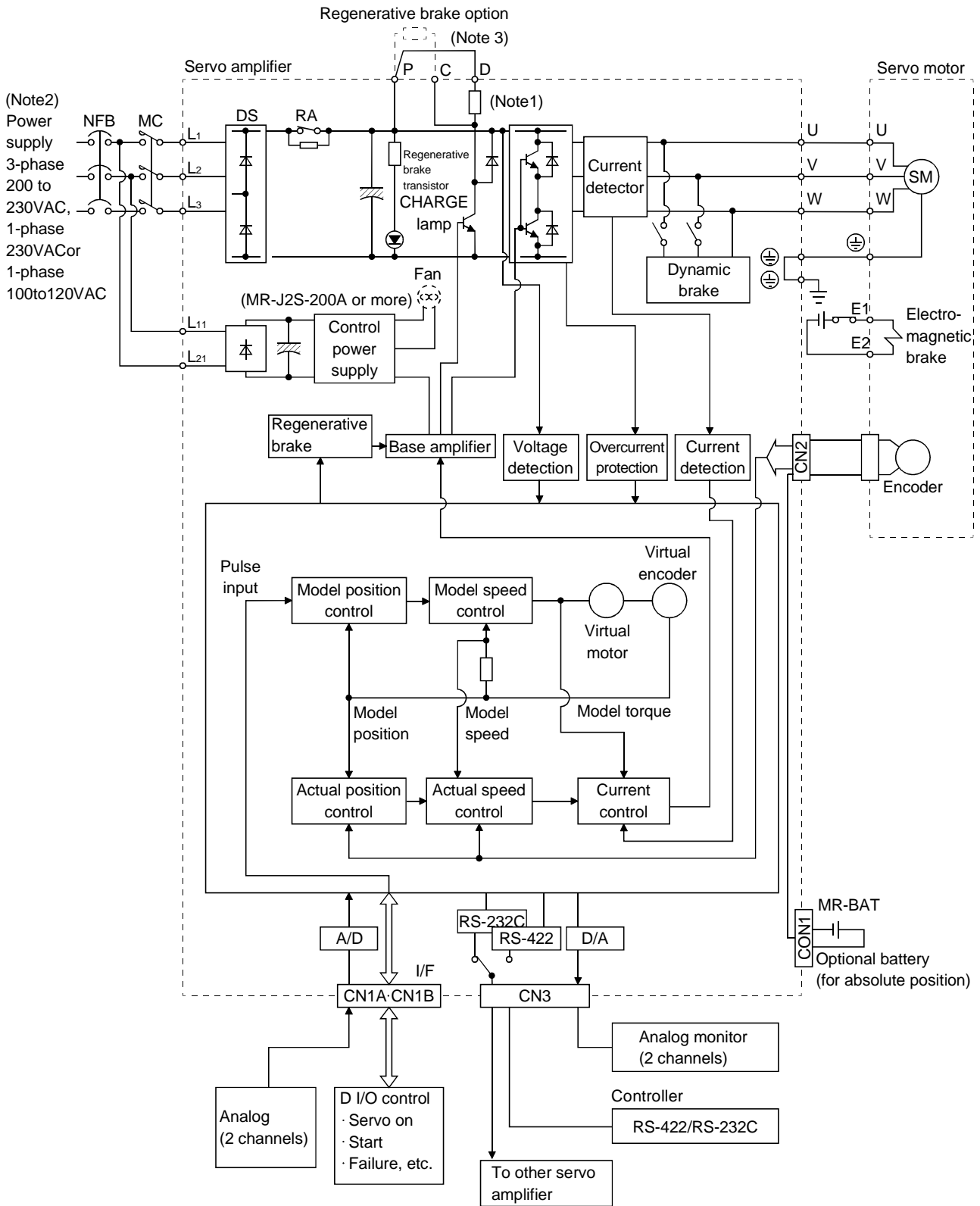
An external analog torque command (0 to  $\pm 8$ VDC) or parameter-driven internal torque command is used to control the torque output by the servo motor.

To protect misoperation under no load, the speed limit function (external or internal setting) is also available for application to tension control, etc.

# 1. FUNCTIONS AND CONFIGURATION

## 1.2 Function block diagram

The function block diagram of this servo is shown below.



# 1. FUNCTIONS AND CONFIGURATION

## 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 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%) 0% or less (power fluctuation ±10%) ±0.2% max.(ambient temperature 25±10°C) 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	[°C]	0 to +55 (non-freezing)													
			[°F]	32 to +131 (non-freezing)													
		Storage	[°C]	-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) Free from corrosive gas, flammable gas, oil mist, dust and dirt														
	Altitude		Max. 1000m (3280ft) above sea level														
Vibration		5.9 [m/s <sup>2</sup> ] or less															
		19.4 [ft/s <sup>2</sup> ] 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. FUNCTIONS AND CONFIGURATION

## 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 Section 3.4.1 Section 4.2.2
Speed control mode	This servo is used as speed control servo.	S	Section 3.1.2 Section 3.4.2 Section 4.2.3
Torque control mode	This servo is used as torque control servo.	T	Section 3.1.3 Section 3.4.3 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 $\pm 1$ 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. Can be used with the MR-J2S-500A • MR-J2S-700A.	P, S, T	Section 13.1.2

# 1. FUNCTIONS AND CONFIGURATION

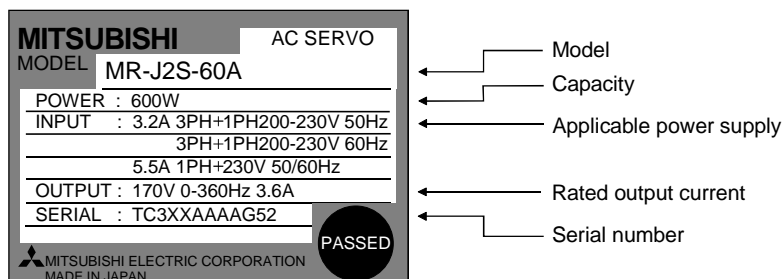
Function	Description	(Note) Control mode	Refer to
Return converter	Used when the regenerative brake option cannot provide enough regenerative power. Can be used with the MR-J2S-500A · MR-J2S-700A.	P, S, T	Section 13.1.3
Alarm history clear	Alarm history is cleared.	P, S, T	Parameter No. 16
Restart after 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) Parameter No. 28
Speed limit	Servo motor speed can be limited to any value.	T	Section 3.4.3 (3) 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. 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



# 1. FUNCTIONS AND CONFIGURATION

## (2) Model



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

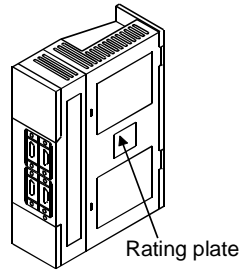
Note:1. Not supplied to the servo amplifier of MR-J2S-60A or more.  
 2. Not supplied to the servo amplifier of MR-J2S-100A or more.

General-purpose interface

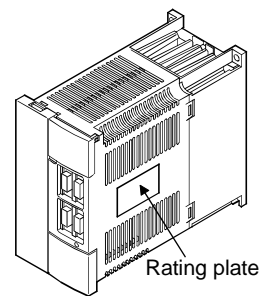
Rated output

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

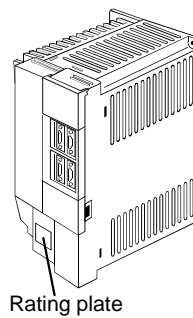
MR-J2S-100A or less



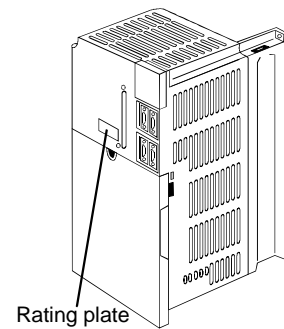
MR-J2S-200A-350A



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				

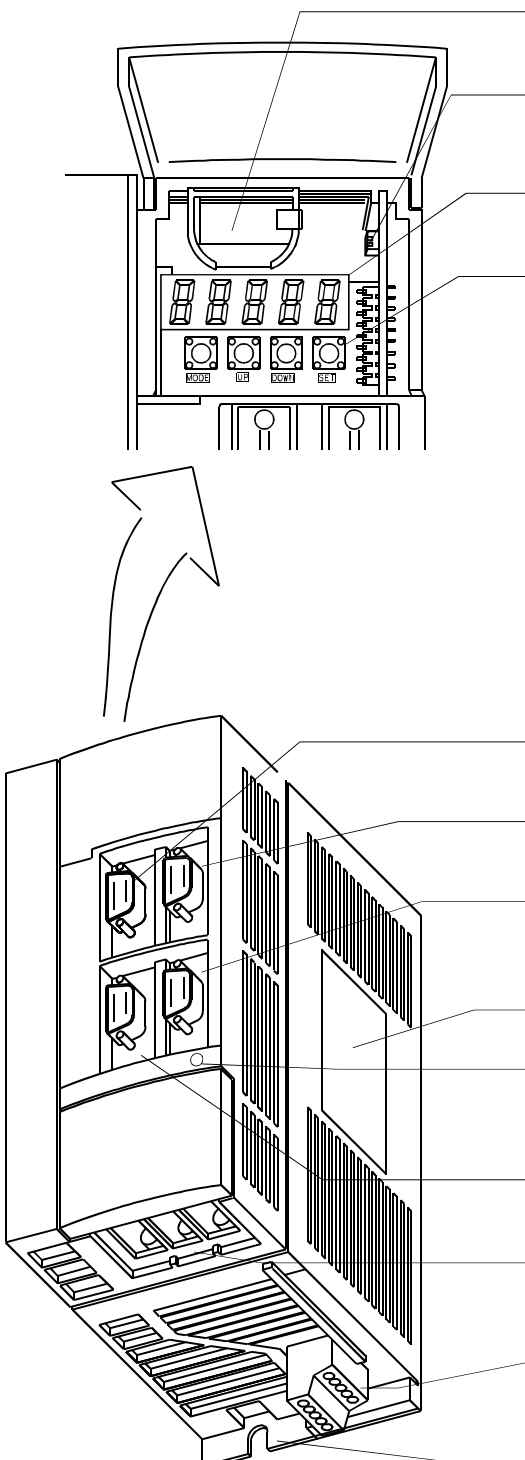
Note: The HC-KFS73 may not be connected depending on the production time of the servo amplifier. Please consult us.

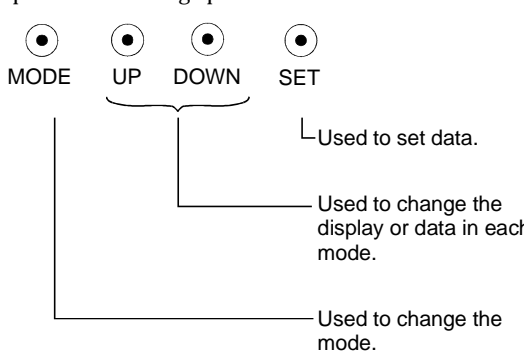
# 1. FUNCTIONS AND CONFIGURATION

## 1.7 Structure

### 1.7.1 Parts identification

(1) MR-J2S-100A or less



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

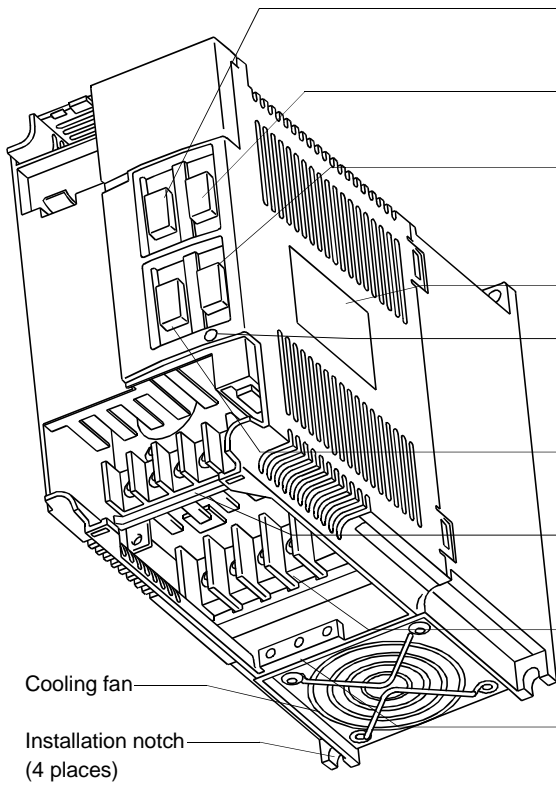
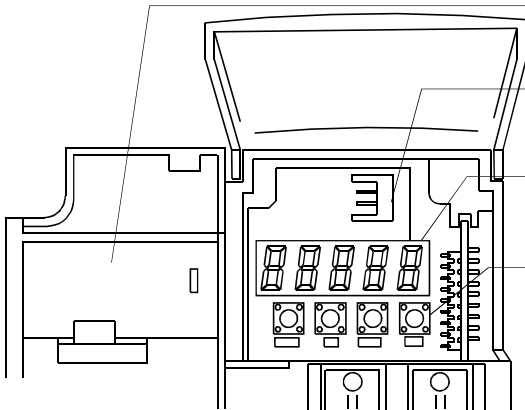


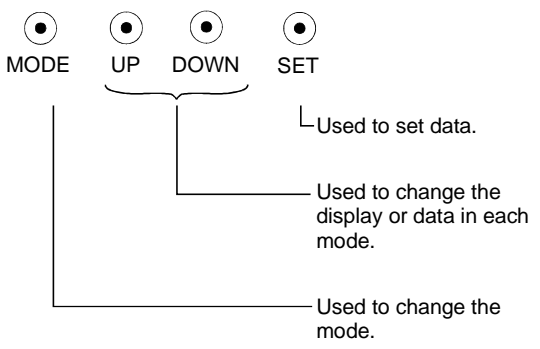
# 1. FUNCTIONS AND CONFIGURATION

(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.



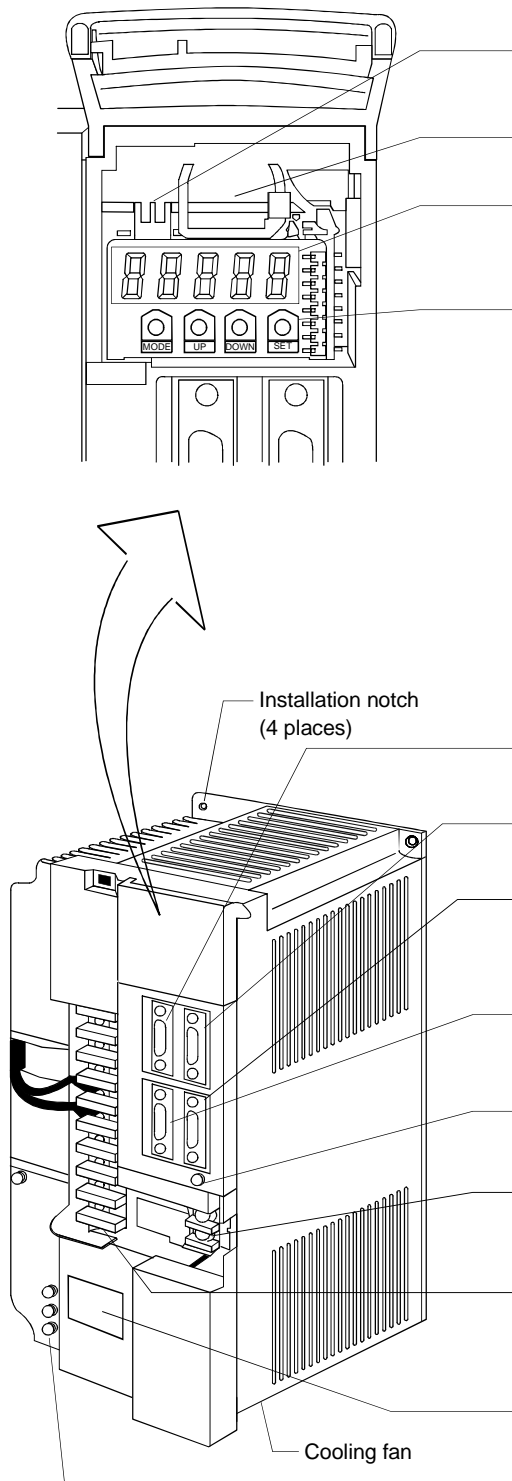
Name/Application	Refer to
Battery holder Contains the battery for absolute position data backup.	Section15.3
Battery connector (CON1) Used to connect the battery for absolute position data backup.	Section15.3
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter6
Operation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

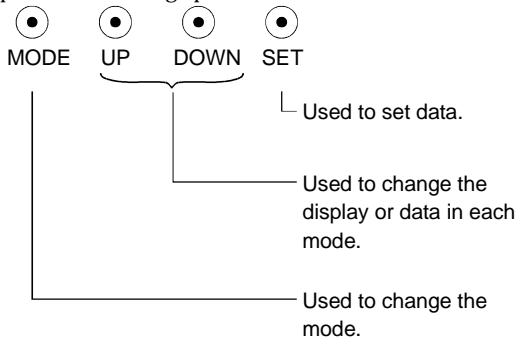
# 1. FUNCTIONS AND CONFIGURATION

(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.



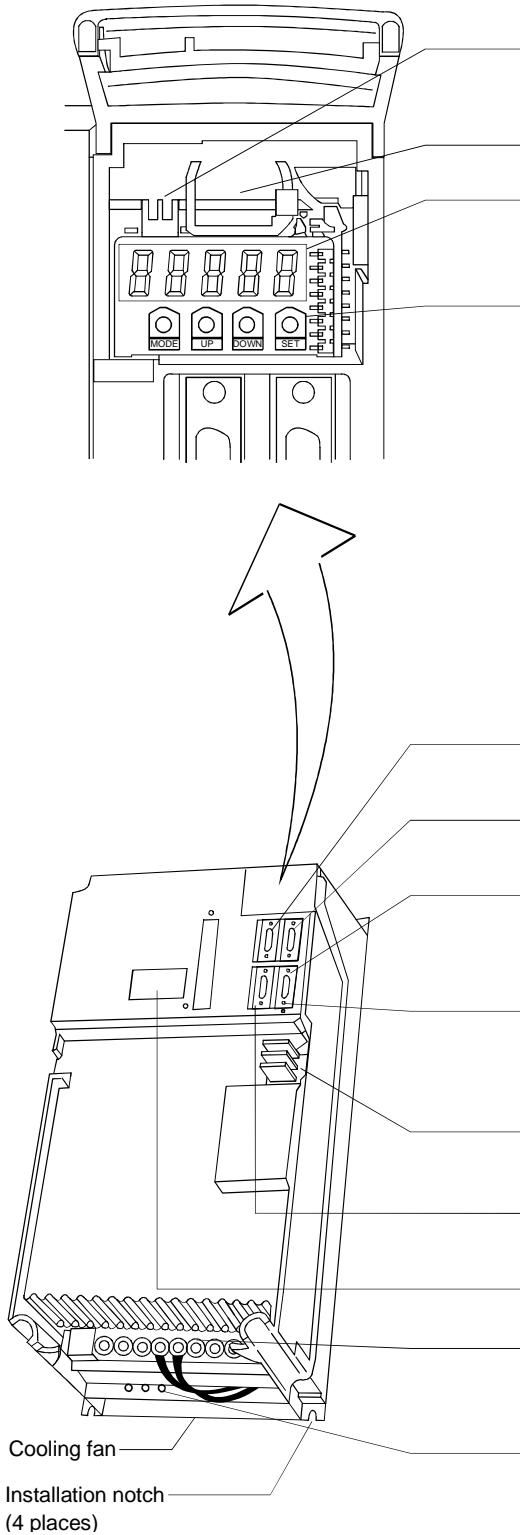
Name/Application	Refer to
Battery connector (CON1) Used to connect the battery for absolute position data backup.	Section15.3
Battery holder Contains the battery for absolute position data backup.	Section15.3
Display The 5-digit, seven-segment LED shows the servo status and alarm number.	Chapter6
Operation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

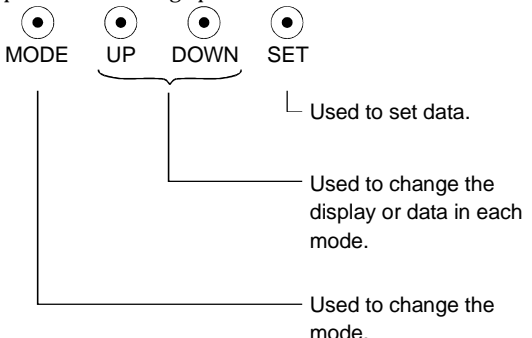
# 1. FUNCTIONS AND CONFIGURATION

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

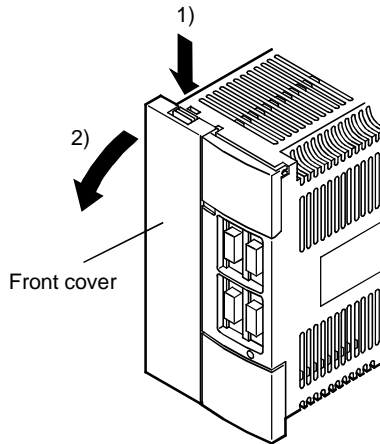
# 1. FUNCTIONS AND CONFIGURATION

## 1.7.2 Removal and reinstallation of the front cover

	<b>CAUTION</b>	To avoid the risk of an electric shock, do not open the front cover while power is on.
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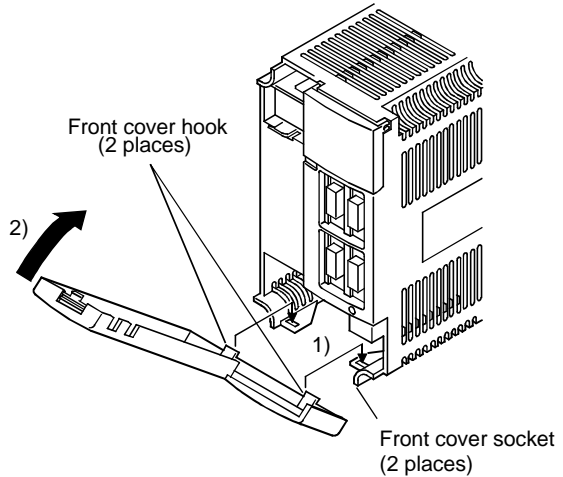
(1) For MR-J2S-200A or more

Removal of the front cover



- 1) Hold down the removing knob.
- 2) Pull the front cover toward you.

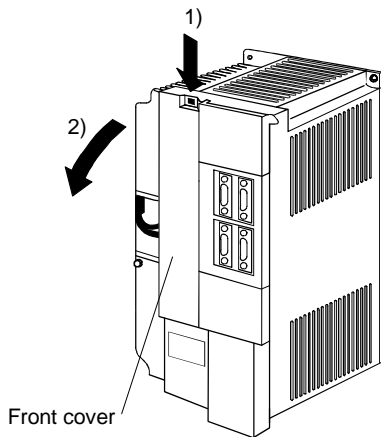
Reinstallation of the front cover



- 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.

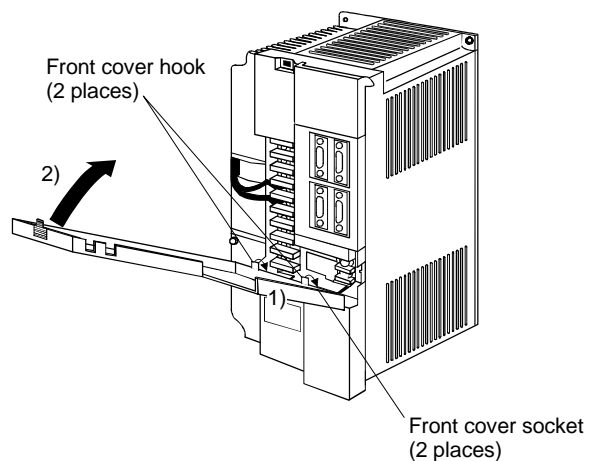
(2) For MR-J2S-500A

Removal of the front cover



- 1) Hold down the removing knob.
- 2) Pull the front cover toward you.

Reinstallation of the front cover

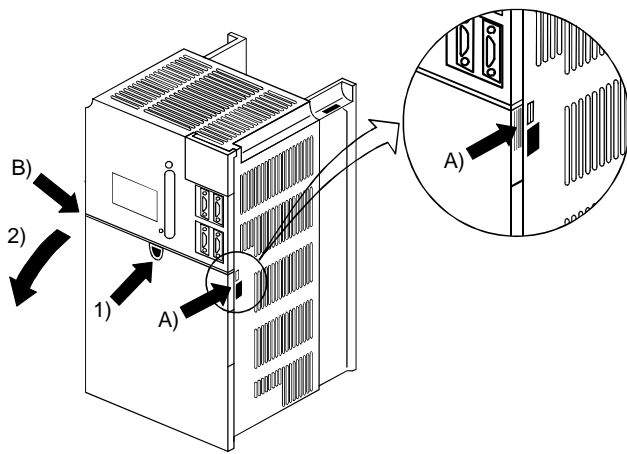


- 1) Insert the front cover hooks into the front cover sockets of the servo amplifier.
- 2) Press the front cover against the servo amplifier until the removing knob clicks.

# 1. FUNCTIONS AND CONFIGURATION

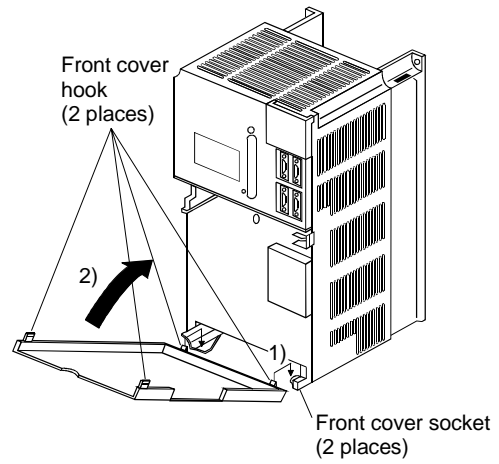
## (3) For MR-J2S-700A

### Removal of the front cover



- 1) Push the removing knob A) or B), and put your 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. FUNCTIONS AND CONFIGURATION

## 1.8 Servo system with auxiliary equipment

	<b>WARNING</b>	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.
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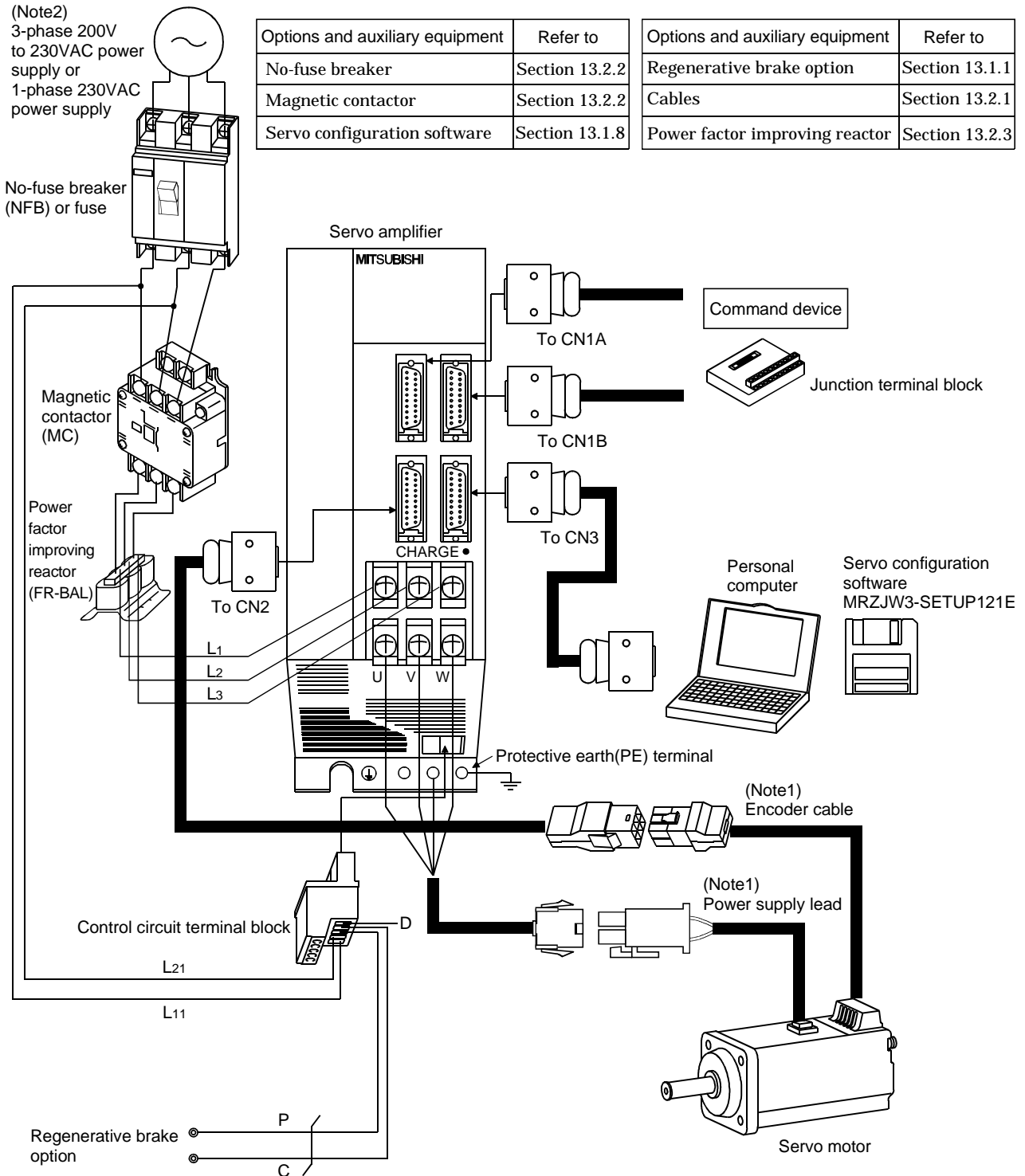
### (1) MR-J2S-100A or less

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

(Note2)  
3-phase 200V to 230VAC power supply or 1-phase 230VAC power supply

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

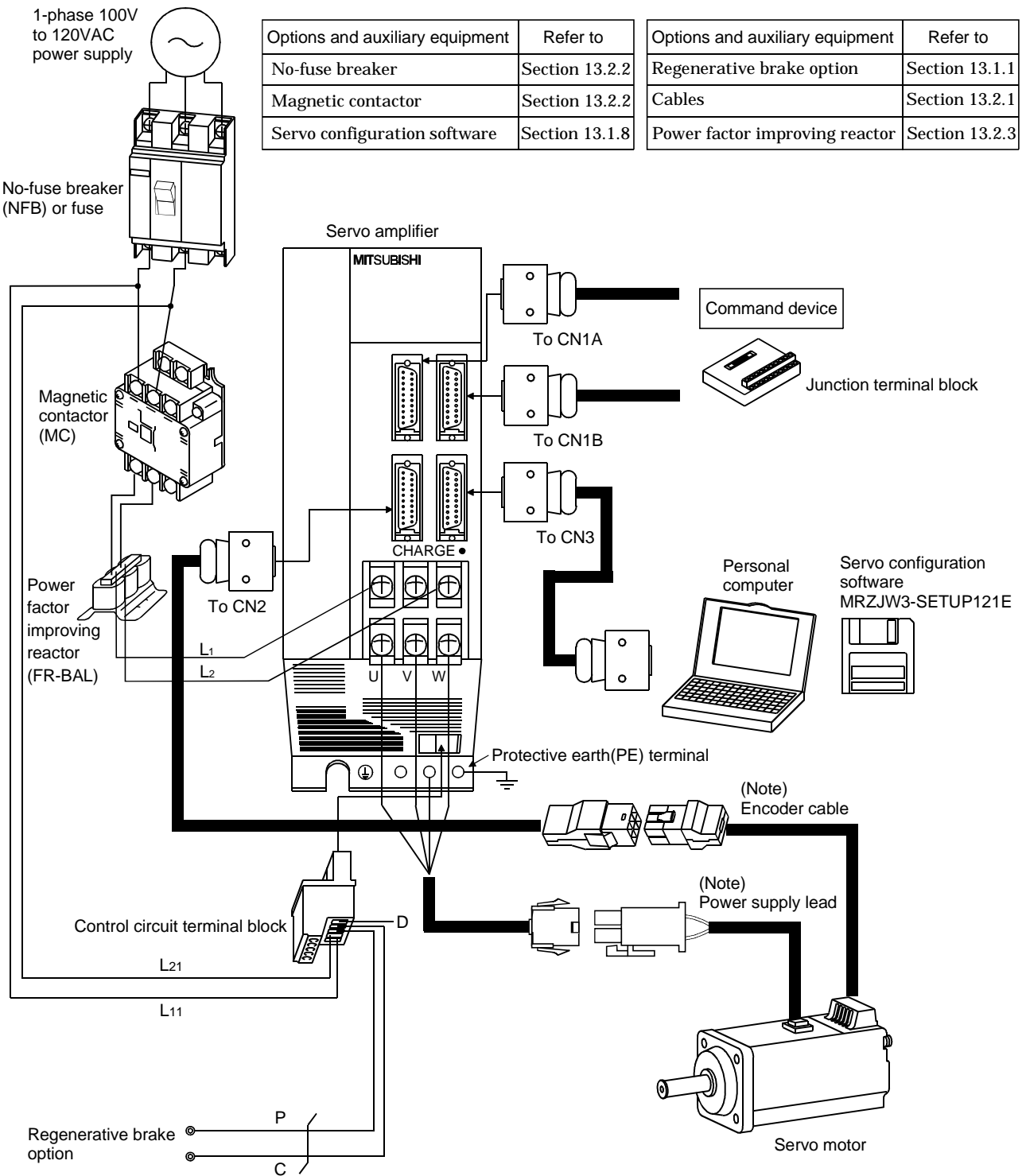


Note: 1. The HC-SFS, HC-RFS series have cannon connectors.

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 L1 and L2 terminals and leave L3 open.

# 1. FUNCTIONS AND CONFIGURATION

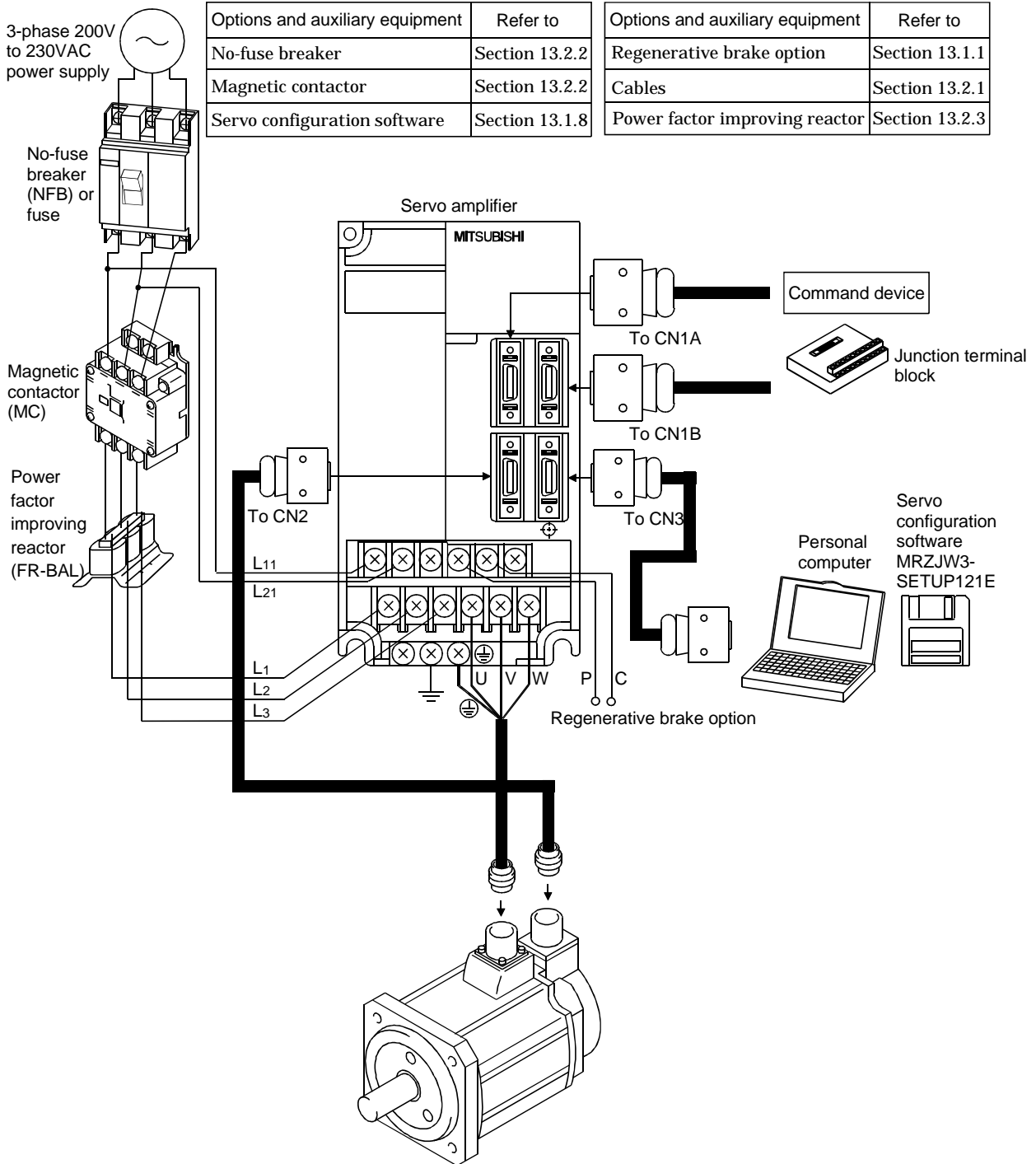
(b) For 1-phase 100V to 120VAC



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

# 1. FUNCTIONS AND CONFIGURATION

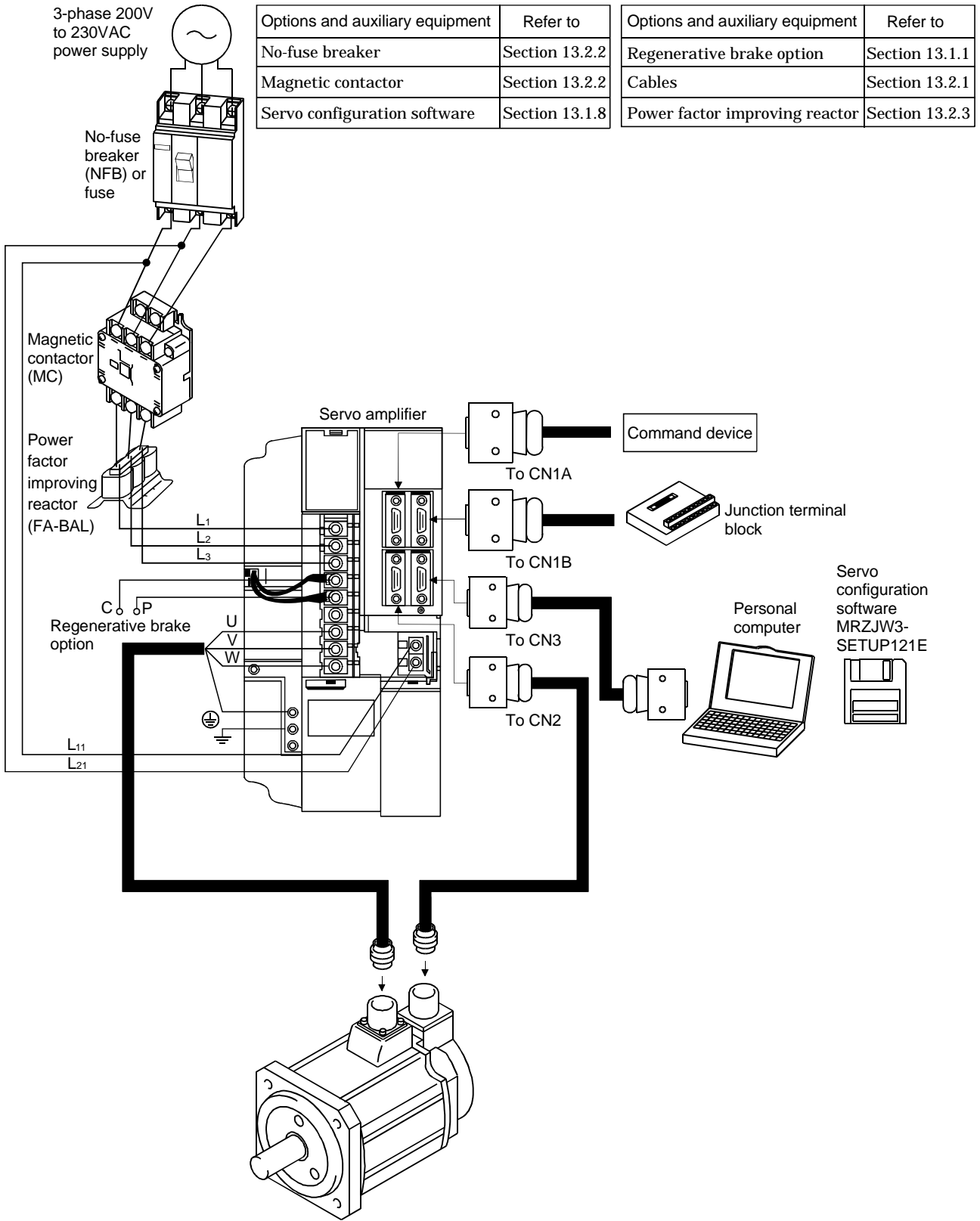
## (2) MR-J2S-200A • MR-J2S-350A or more





# 1. FUNCTIONS AND CONFIGURATION

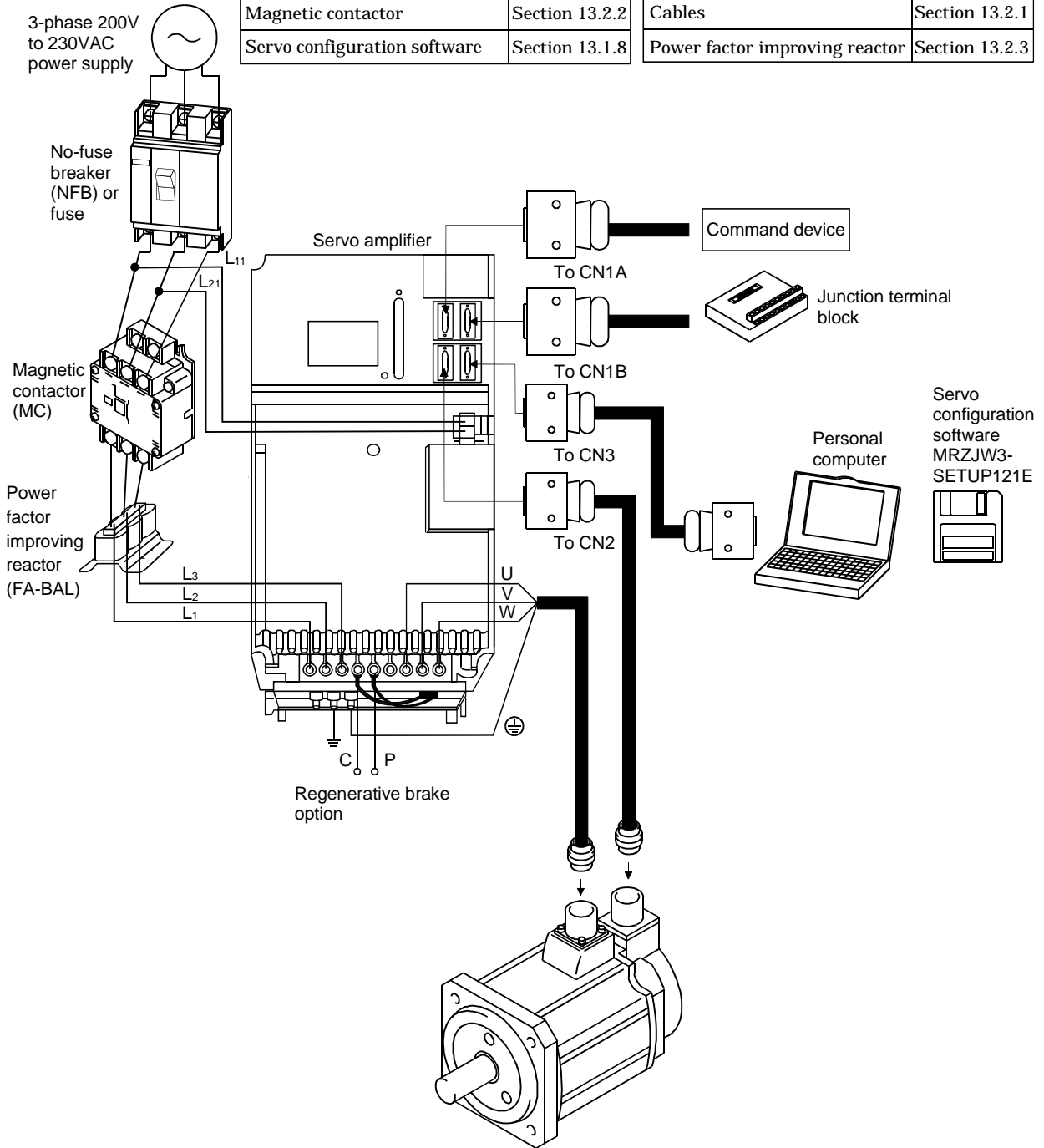
## (3) MR-J2S-500A



# 1. FUNCTIONS AND CONFIGURATION

## (4) MR-J2S-700A

Options and auxiliary equipment	Refer to	Options and auxiliary equipment	Refer to
No-fuse breaker	Section 13.2.2	Regenerative brake option	Section 13.1.1
Magnetic contactor	Section 13.2.2	Cables	Section 13.2.1
Servo configuration software	Section 13.1.8	Power factor improving reactor	Section 13.2.3





## 2. INSTALLATION

### 2. INSTALLATION



#### CAUTION

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

#### 2.1 Environmental conditions

Environment		Conditions	
Ambient temperature	Operation	[°C]	0 to +55 (non-freezing)
		[°F]	32 to +131 (non-freezing)
	Storage	[°C]	−20 to +65 (non-freezing)
		[°F]	−4 to +149 (non-freezing)
Ambient humidity	Operation	90%RH or less (non-condensing)	
	Storage		
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 <sup>2</sup> ]	5.9 [m/s <sup>2</sup> ] or less	
	[ft/s <sup>2</sup> ]	19.4 [ft/s <sup>2</sup> ] or less	

## 2. INSTALLATION

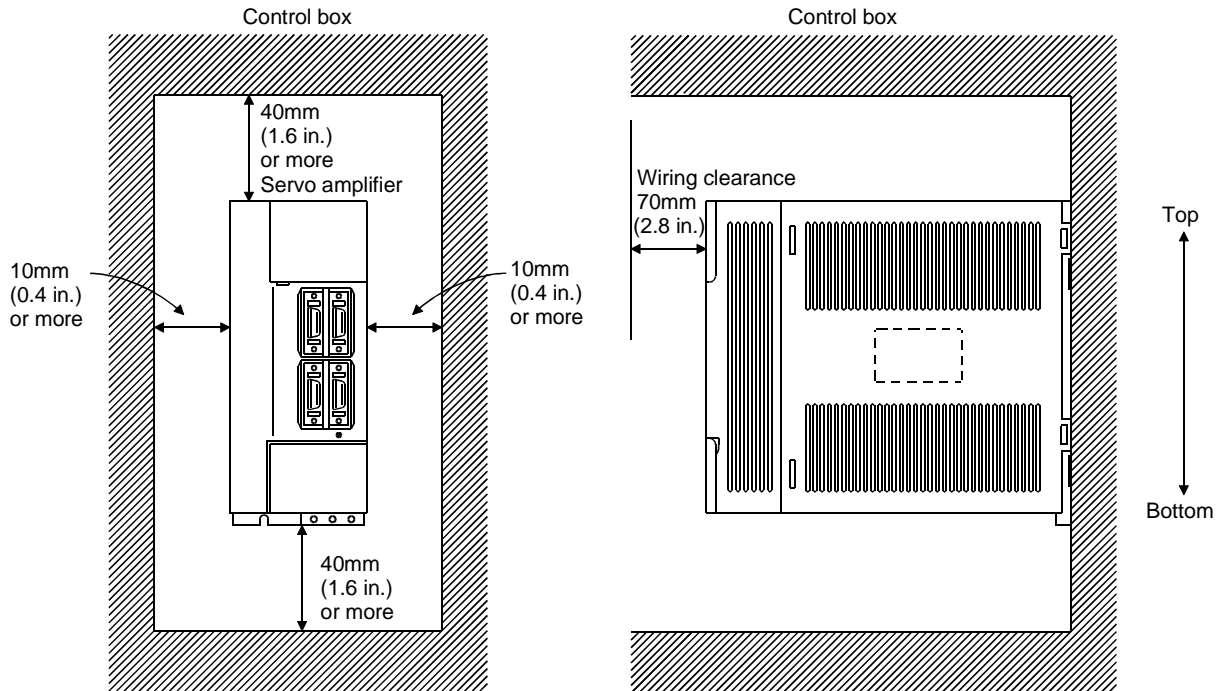
### 2.2 Installation direction and clearances



#### CAUTION

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

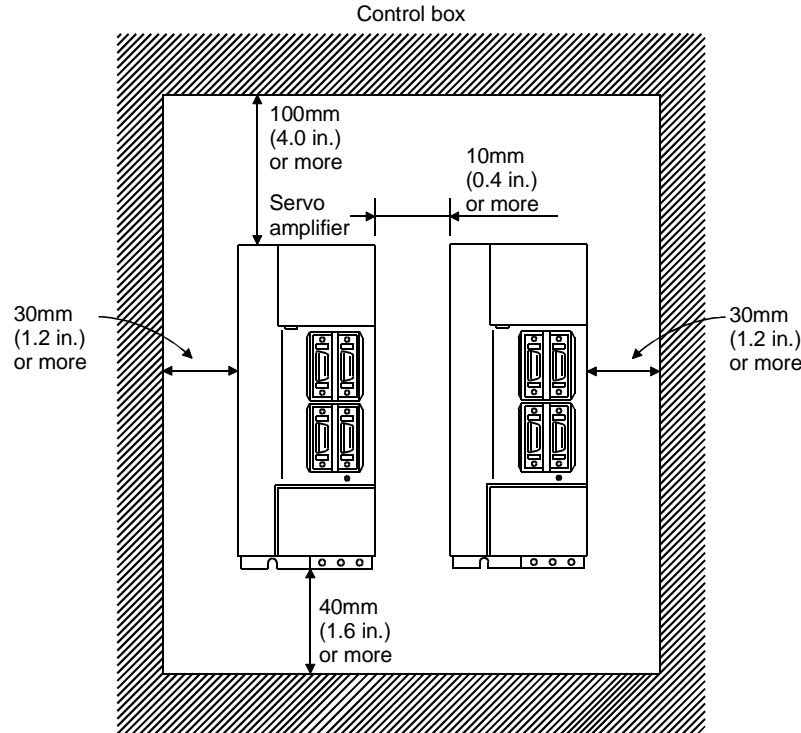
#### (1) Installation of one servo amplifier



## 2. INSTALLATION

### (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. INSTALLATION

---

### 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

#### 3. SIGNALS AND WIRING



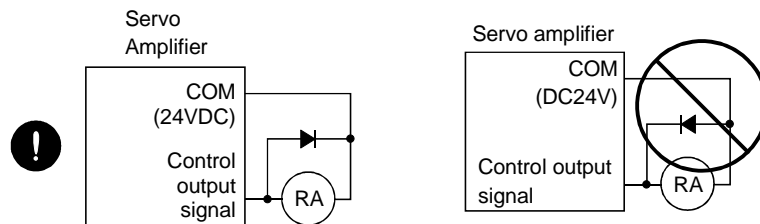
WARNING

- 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. SIGNALS AND WIRING

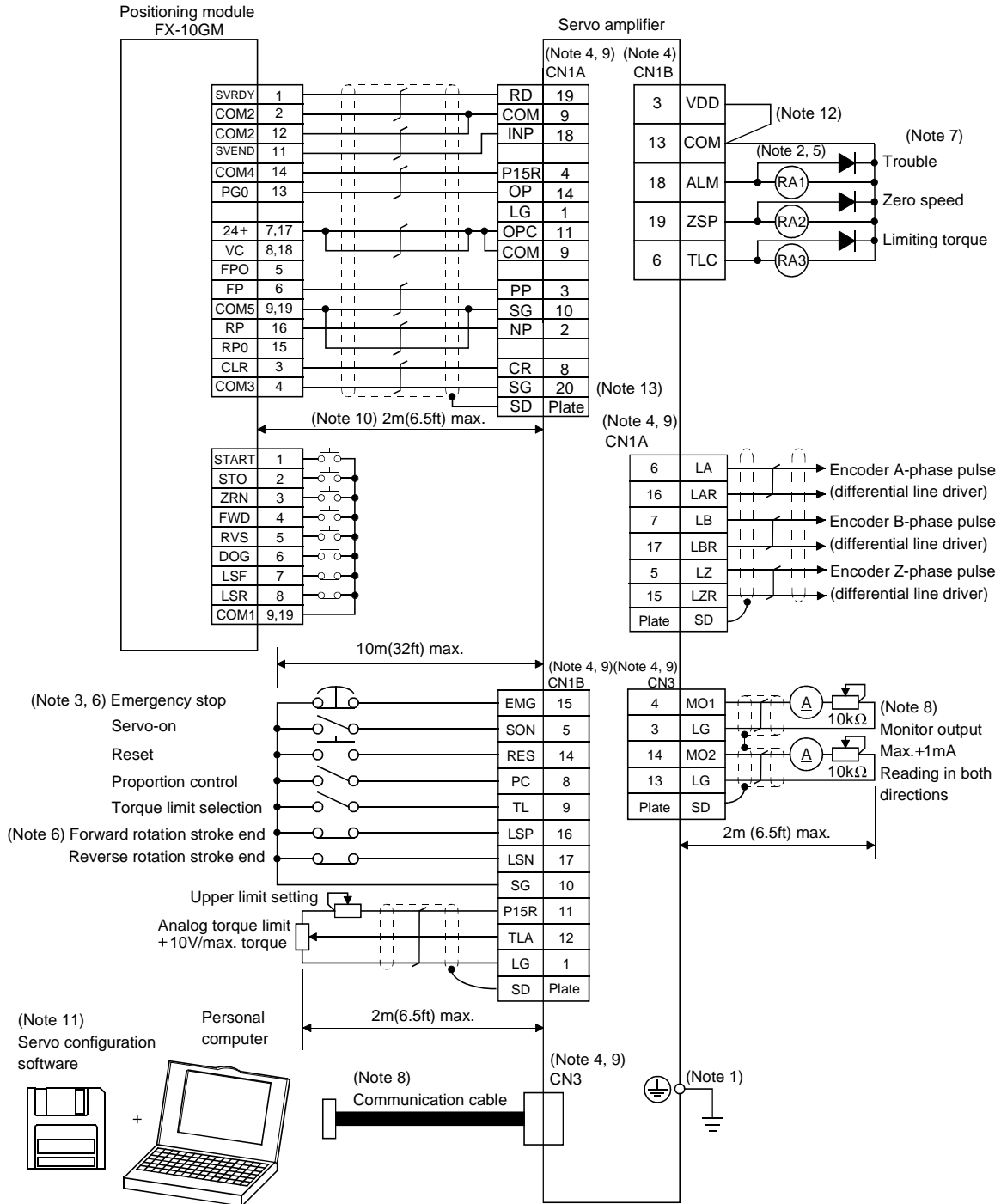
#### 3.1 Standard connection example

**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



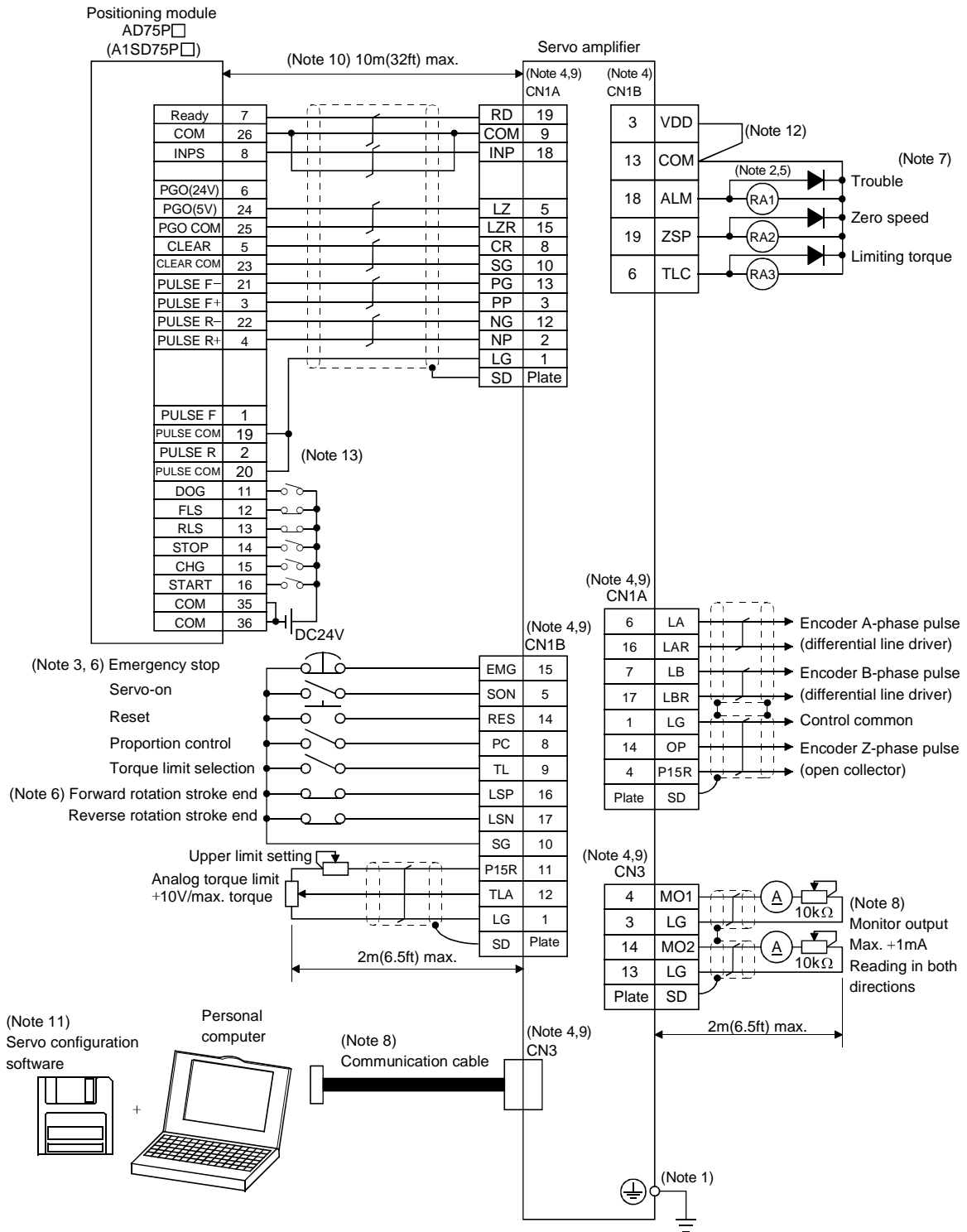
### 3. SIGNALS AND WIRING

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- 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).

### 3. SIGNALS AND WIRING

#### (2) AD75P□(A1SD75P□)



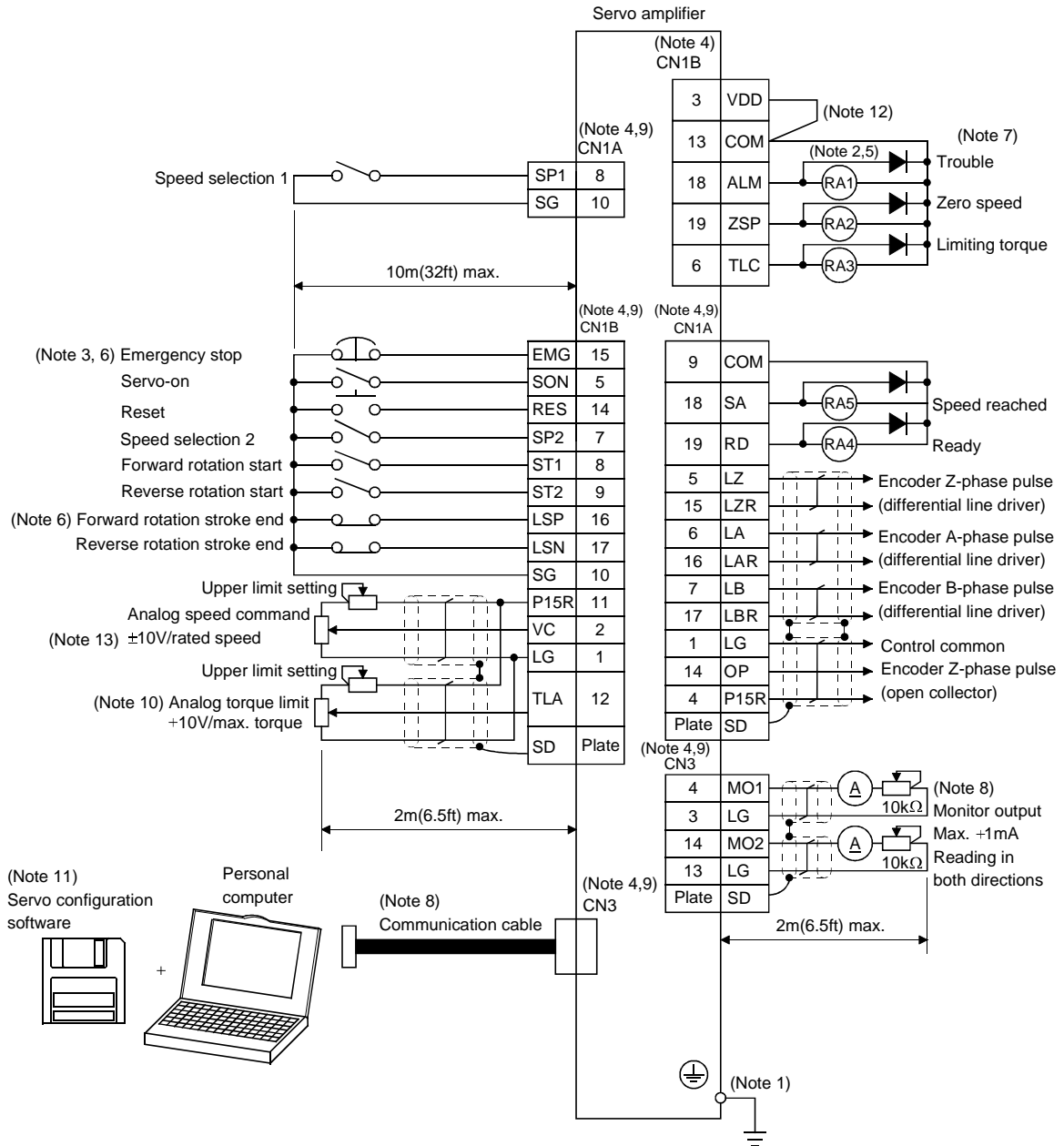
### 3. SIGNALS AND WIRING

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- 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. SIGNALS AND WIRING

#### 3.1.2 Speed control mode



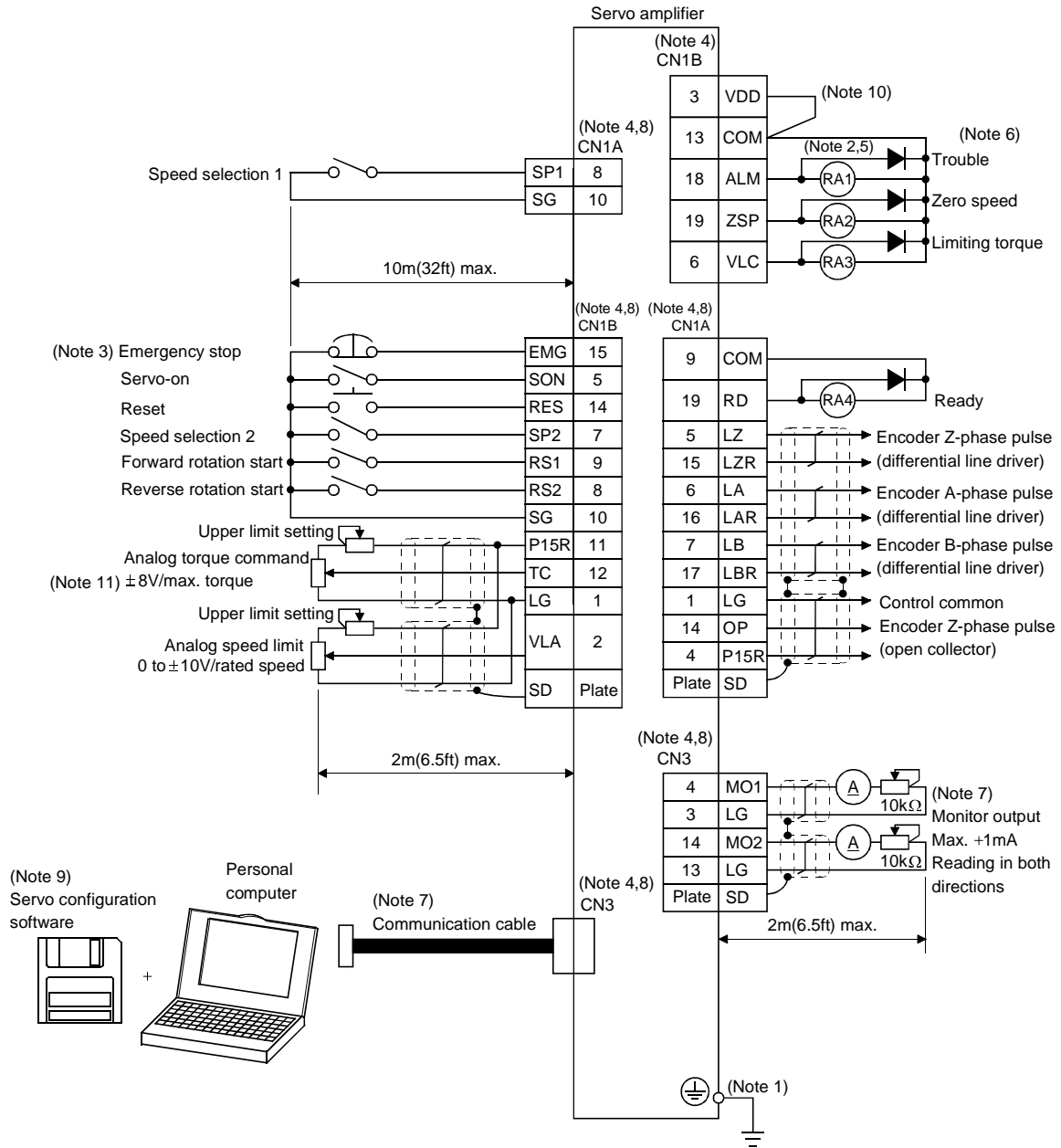
### 3. SIGNALS AND WIRING

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- Note:
1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked  $\oplus$ ) 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. SIGNALS AND WIRING

#### 3.1.3 Torque control mode



### 3. SIGNALS AND WIRING

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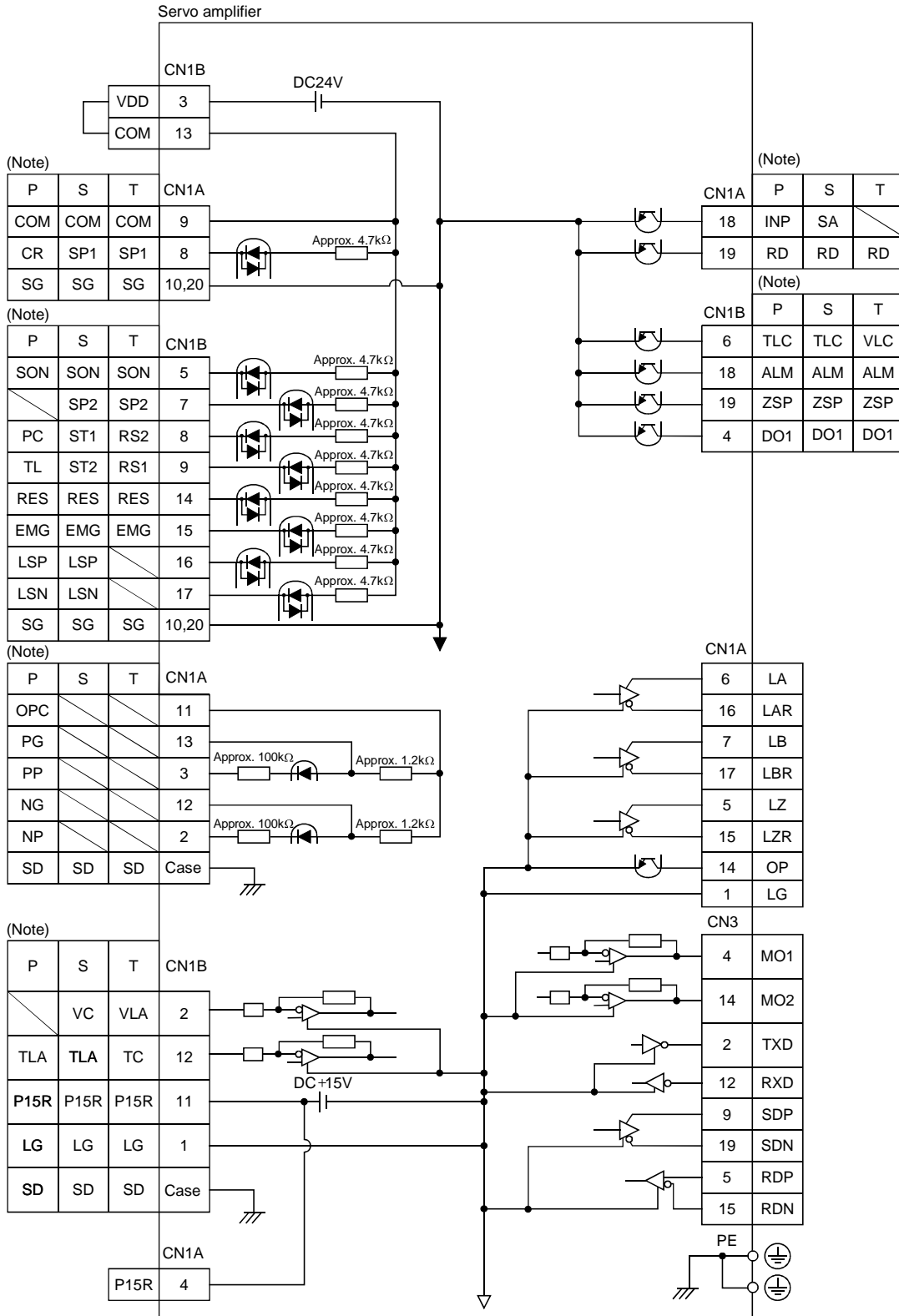
- Note: 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the (terminal marked ⊕) servo amplifier to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will 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. SIGNALS AND WIRING

#### 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. SIGNALS AND WIRING

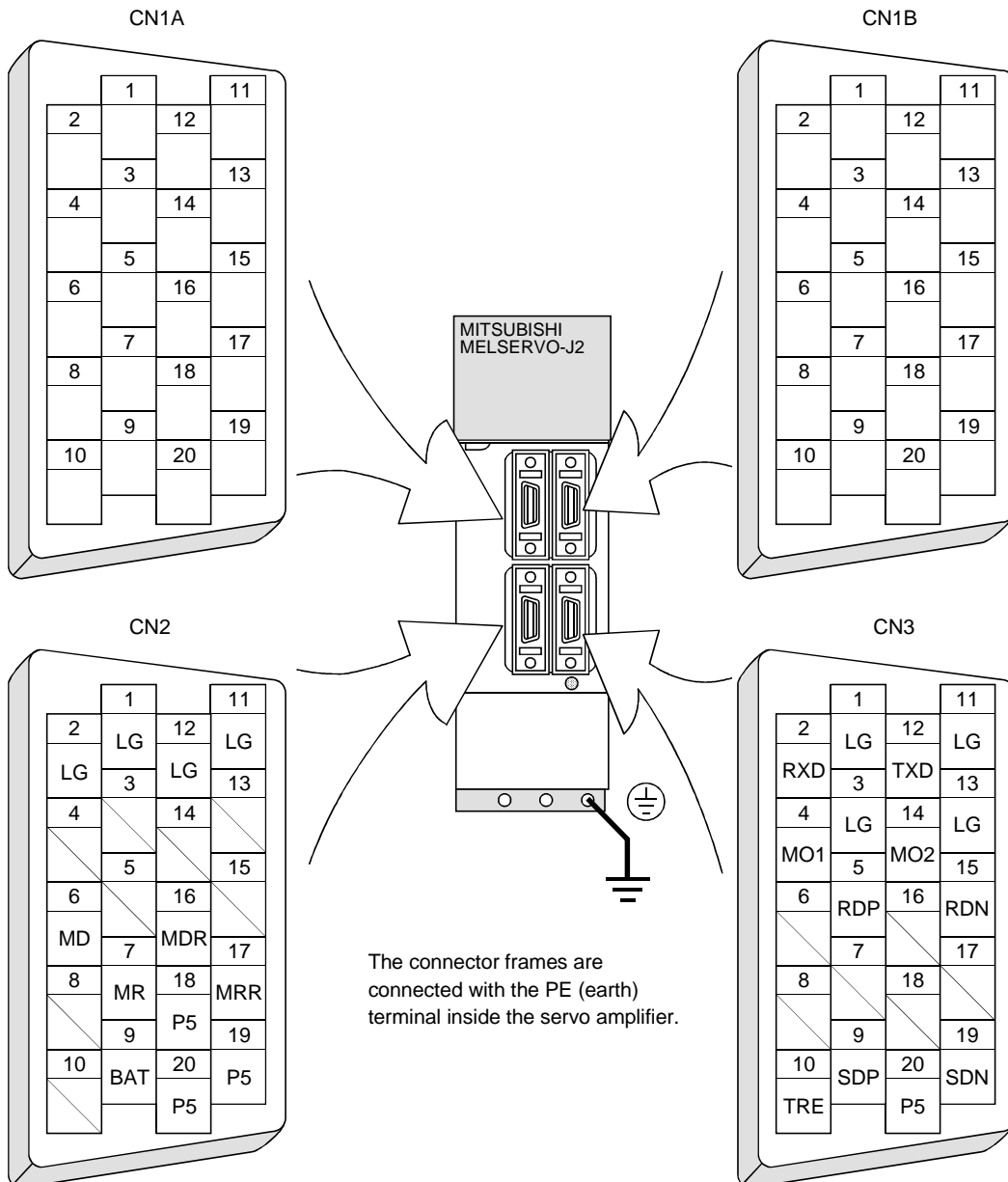
#### 3.3 I/O signals

##### 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



### 3. SIGNALS AND WIRING

#### (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.

### 3. SIGNALS AND WIRING

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. SIGNALS AND WIRING

#### 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

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																																
					P	S	T																														
Servo-on	SON	CN1B 5	Connect SON-SG to switch on the base circuit and make the servo amplifier ready to operate (servo-on). Disconnect SON-SG to shut off the base circuit and coast the servo motor (servo off) . Set "□□□1" in parameter No. 41 to switch this signal on (keep terminals connected) automatically in the servo amplifier.	DI-1	○	○	○																														
Reset	RES	CN1B 14	Disconnect RES-SG for more than 50ms to reset the alarm. Some alarms cannot be deactivated by the reset signal. Refer to Section 10.2. 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.	DI-1	○	○	○																														
Forward rotation stroke end	LSP	CN1B 16	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. Set "□□□1" in parameter No. 22 to make a slow stop. (Refer to Section 5.2.3.)	DI-1	○	○																															
Reverse rotation stroke end	LSN	CN1B 17	<table border="1" style="margin-bottom: 10px;"> <thead> <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> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>○</td> <td>○</td> </tr> <tr> <td>0</td> <td>1</td> <td style="text-align: center;">/</td> <td>○</td> </tr> <tr> <td>1</td> <td>0</td> <td>○</td> <td style="text-align: center;">/</td> </tr> <tr> <td>0</td> <td>0</td> <td style="text-align: center;">/</td> <td style="text-align: center;">/</td> </tr> </tbody> </table> <p>Note: 0: LSP/LSN-SG off (open) 1: SP/LSN-SG on (short)</p> <p>Set parameter No. 41 as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier:</p> <table border="1" style="margin-bottom: 10px;"> <thead> <tr> <th>Parameter No.41</th> <th>Automatic ON</th> </tr> </thead> <tbody> <tr> <td>□□1□</td> <td>LSP</td> </tr> <tr> <td>□1□□</td> <td>LSN</td> </tr> </tbody> </table>	(Note) Input signals		Operation		LSP	LSN	CCW direction	CW direction	1	1	○	○	0	1	/	○	1	0	○	/	0	0	/	/	Parameter No.41	Automatic ON	□□1□	LSP	□1□□	LSN	DI-1	○	○	
(Note) Input signals		Operation																																			
LSP	LSN	CCW direction	CW direction																																		
1	1	○	○																																		
0	1	/	○																																		
1	0	○	/																																		
0	0	/	/																																		
Parameter No.41	Automatic ON																																				
□□1□	LSP																																				
□1□□	LSN																																				

### 3. SIGNALS AND WIRING

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																			
					P	S	T																	
Outside torque limit selection	TL	CN1B 9	Torque limit selection disconnecting TL-SG makes internal torque limit 1 (parameter No. 28) valid and connecting them makes analog torque limit (TLA) valid. For details, refer to (5), Section 3.4.1.	DI-1	○	△																		
Internal torque limit selection	TL1		When using this signal, make it usable by making the setting of parameter No. 43 to 48. For details, refer to (5), Section 3.4.1.	DI-1	△	△	△																	
Forward rotation start	ST1	CN1B 8	Used to start the servo motor in any of the following directions:  <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: ST1/ST2-SG off (open) 1: ST1/ST2-SG on (short)</p> 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.	(Note) Input signals		Servo motor starting direction	ST2	ST1	0	0	Stop (servo lock)	0	1	CCW	1	0	CW	1	1	Stop (servo lock)	DI-1		○	
(Note) Input signals		Servo motor starting direction																						
ST2	ST1																							
0	0	Stop (servo lock)																						
0	1	CCW																						
1	0	CW																						
1	1	Stop (servo lock)																						
Reverse rotation start	ST2	CN1B 9																						
Forward rotation selection	RS1	CN1B 9	Used to select any of the following servo motor torque generation directions:  <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2">(Note) Input signals</th> <th rowspan="2">Torque generation direction</th> </tr> <tr> <th>RS2</th> <th>RS1</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: RS1/RS2-SG off (open) 1: RS1/RS2-SG on (short)</p>	(Note) Input signals		Torque generation direction	RS2	RS1	0	0	Torque is not generated.	0	1	Forward rotation in driving mode / reverse rotation in regenerative mode	1	0	Reverse rotation in driving mode / forward rotation in regenerative mode	1	1	Torque is not generated.	DI-1			○
(Note) Input signals		Torque generation direction																						
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Reverse rotation selection	RS2	CN1B 8																						

### 3. SIGNALS AND WIRING

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																																																												
					P	S	T																																																										
Speed selection 1	SP1	CN1A 8	<Speed control mode> Used to select the command speed for operation. When using SP3, make it usable by making the setting of parameter No. 43 to 48.	DI-1		○	○																																																										
Speed selection 2	SP2	CN1B 7	<table border="1"> <thead> <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> </thead> <tbody> <tr> <td rowspan="3">When speed selection (SP3) is not used (initial status)</td> <td>0</td> <td>0</td> <td>0</td> <td>Analog speed command (VC)</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>Internal speed command 1 (parameter No. 8)</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>Internal speed command 2 (parameter No. 9)</td> </tr> <tr> <td rowspan="7">When speed selection (SP3) is made valid</td> <td>1</td> <td>1</td> <td>1</td> <td>Internal speed command 3 (parameter No. 10)</td> </tr> <tr> <td>0</td> <td>0</td> <td>0</td> <td>Analog speed command (VC)</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>Internal speed command 1 (parameter No. 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> </tbody> </table>	Setting of parameter No. 43 to 48	(Note) Input signals			Speed command	SP3	SP2	SP1	When speed selection (SP3) is not used (initial status)	0	0	0	Analog speed command (VC)	0	1	1	Internal speed command 1 (parameter No. 8)	1	0	0	Internal speed command 2 (parameter No. 9)	When speed selection (SP3) is made valid	1	1	1	Internal speed command 3 (parameter No. 10)	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)	DI-1		○	○
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### 3. SIGNALS AND WIRING

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																			
					P	S	T																	
Proportion control	PC	CN1B 8	Connect PC-SG to switch the speed amplifier from the proportional integral type to the proportional type. If the servo motor at a stop is rotated even one pulse due to any external factor, it generates torque to compensate for a position shift. When the servo motor shaft is to be locked mechanically after positioning completion (stop), switching on the proportion control signal (PC) upon positioning completion will suppress the unnecessary torque generated to compensate for a position shift. When the shaft is to be locked for a long time, switch on the proportion control signal and torque control signal (TL) at the same time to make the torque less than the rated by the analog torque limit.	DI-1	○	△																		
Emergency stop	EMG	CN1B 15	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. Connect EMG-SG in the emergency stop state to reset that state.	DI-1	○	○	○																	
Clear	CR	CN1A 8	Connect CR-SG to clear the position control counter droop pulses on its leading edge. The pulse width should be 10ms or more. When the parameter No.42 setting is "□□1□", the pulses are always cleared while CR-SG are connected.	DI-1	○																			
Electronic gear selection 1	CM1		When using CM1 and CM2, make them usable by the setting of parameters No. 43 to 48. 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.	DI-1	△																			
Electronic gear selection 2	CM2		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">(Note) Input signals</th> <th rowspan="2">Electronic gear denominator</th> </tr> <tr> <th>CM2</th> <th>CM1</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Note. 0: CM1/CM2-SG off (open) 1: CM1/CM2-SG on (short)</p>	(Note) Input signals		Electronic gear denominator	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)	DI-1	△		
(Note) Input signals		Electronic gear denominator																						
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0	1	Parameter No. 69 (CM2)																						
1	0	Parameter No. 70 (CM3)																						
1	1	Parameter No. 71 (CM4)																						
Gain changing	CDP		When using this signal, make it usable by the setting of parameter No. 43 to 48. 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.	DI-1	△	△	△																	



### 3. SIGNALS AND WIRING

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																				
					P	S	T																		
Control change	LOP	CN1B 7	<p>&lt;Position/speed control change mode&gt; Used to select the control mode in the position/speed control change mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Position</td> </tr> <tr> <td>1</td> <td>Speed</td> </tr> </tbody> </table> <p>Note.0: LOP-SG off (open) 1: LOP-SG on (short)</p> <p>&lt;Speed/torque control change mode&gt; Used to select the control mode in the speed/torque control change mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Speed</td> </tr> <tr> <td>1</td> <td>Torque</td> </tr> </tbody> </table> <p>Note.0: LOP-SG off (open) 1: LOP-SG on (short)</p> <p>&lt;Torque/position control mode&gt; Used to select the control mode in the torque/position control change mode.</p> <table border="1"> <thead> <tr> <th>(Note) LOP</th> <th>Control mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Torque</td> </tr> <tr> <td>1</td> <td>Position</td> </tr> </tbody> </table> <p>Note.0: LOP-SG off (open) 1: LOP-SG on (short)</p>	(Note) LOP	Control mode	0	Position	1	Speed	(Note) LOP	Control mode	0	Speed	1	Torque	(Note) LOP	Control mode	0	Torque	1	Position	DI-1	Refer to Functions/Applications.		
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Analog torque limit	TLA	CN1B 12	To use this signal in the speed control mode, set any of parameters No. 43 to 48 to make TL available. When the analog torque limit (TLA) is valid, torque is limited in the full servo motor output torque range. Apply 0 to +10VDC across TLA-LG. Connect the positive terminal of the power supply to TLA. Maximum torque is generated at +10V. (Refer to (5) in Section 3.4.1.) Resolution:10bit	Analog input	○	△																			
Analog torque command	TC		Used to control torque in the full servo motor output torque range. Apply 0 to ±8VDC across TC-LG. Maximum torque is generated at ±8V. (Refer to (1) in Section 3.4.3.) The torque generated at ±8V input can be changed using parameter No. 26.	Analog input			○																		
Analog speed command	VC	CN1B 2	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.) Resolution:14bit or equivalent	Analog input		○																			
Analog speed limit	VLA		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.).	Analog input			○																		
Forward rotation pulse train	PP	CN1A 3	Used to enter a command pulse train. • In the open collector system (max. input frequency 200kpps): Forward rotation pulse train across PP-SG Reverse rotation pulse train across NP-SG • In the differential receiver system (max. input frequency 500kpps): Forward rotation pulse train across PG-PP Reverse rotation pulse train across NG-NP The command pulse train form can be changed using parameter No. 21.	DI-2	○																				
Reverse rotation pulse train	NP	CN1A 2																							
	PG	CN1A 13																							
	NG	CN1A 12																							

### 3. SIGNALS AND WIRING

#### (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. 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. In the servo-off or alarm status, MBR-SG are disconnected. 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. When warning has occurred, WNG-SG are connected. 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. BWNG-SG are connected when battery cable breakage warning (AL.92) or battery warning (AL.9F) has occurred. When there is no battery warning, BWNG-SG are disconnected within 1 second after power-on.	DO-1	△	△	△

### 3. SIGNALS AND WIRING

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode																																																																															
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Alarm code	ACD 0	CN1A 19	<p>To use this signal, set "□□□1" in parameter No.49.</p> <p>This signal is output when an alarm occurs. When there is no alarm, respective ordinary signals (RD, INP, SA, ZSP) are output.</p> <p>Alarm codes and alarm names are listed below:</p> <table border="1"> <thead> <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> </thead> <tbody> <tr> <td rowspan="8">0</td> <td rowspan="8">0</td> <td rowspan="8">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 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 rowspan="4">0</td> <td rowspan="4">1</td> <td rowspan="4">1</td> <td>AL.10</td> <td>Undervoltage</td> </tr> <tr> <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 rowspan="2">1</td> <td rowspan="2">0</td> <td rowspan="2">0</td> <td>AL.51</td> <td>Overload 2</td> </tr> <tr> <td>AL.24</td> <td>Main circuit error</td> </tr> <tr> <td rowspan="3">1</td> <td rowspan="3">0</td> <td rowspan="3">1</td> <td>AL.32</td> <td>Overcurrent</td> </tr> <tr> <td>AL.31</td> <td>Overspeed</td> </tr> <tr> <td>AL.35</td> <td>Command pulse frequency alarm</td> </tr> <tr> <td rowspan="4">1</td> <td rowspan="4">1</td> <td rowspan="4">0</td> <td>AL.52</td> <td>Error excessive</td> </tr> <tr> <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></td> <td></td> <td></td> <td>AL.25</td> <td>Absolute position erase</td> </tr> </tbody> </table> <p>Note:0: Pin-SG off (open) 1: Pin-SG on (short)</p>	(Note) Alarm code			Alarm display	Name	CN1B 19 Pin	CN1A 18 Pin	CN1A 19 Pin	0	0	0	88888	Watchdog	AL.12	Memory error 1	AL.13	Clock error	AL.15	Memory error 2	AL.17	Board error	AL.19	Memory error 3	AL.37	Parameter error	AL.8A	Serial communication timeout	0	0	1	AL.30	Regenerative error	AL.33	Overvoltage	0	1	1	AL.10	Undervoltage	AL.45	Main circuit device	AL.46	Servo motor overheat	AL.50	Overload 1	1	0	0	AL.51	Overload 2	AL.24	Main circuit error	1	0	1	AL.32	Overcurrent	AL.31	Overspeed	AL.35	Command pulse frequency alarm	1	1	0	AL.52	Error excessive	AL.16	Encoder error 1	AL.1A	Monitor combination error	AL.20	Encoder error 2				AL.25	Absolute position erase	DO-1	△	△	△
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1	1	0	AL.52	Error excessive																																																																																
			AL.16	Encoder error 1																																																																																
			AL.1A	Monitor combination error																																																																																
			AL.20	Encoder error 2																																																																																
			AL.25	Absolute position erase																																																																																

### 3. SIGNALS AND WIRING

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 400 $\mu$ s. For home position return using this pulse, set the creep speed to 100r/min. or less.	DO-2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1A 6 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 $\pi/2$ . The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. 54.	DO-2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1A 7 CN1A 17					
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1A 5 CN1A 15	The same signal as OP is output in the differential line driver system.	DO-2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

#### (3) Communication

<b>POINT</b>
• 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 SDN RDP RDN	CN3 9 CN3 19 CN3 5 CN3 15	RS-485 and RS-232C functions cannot be used together. Choose either one in parameter No. 16.	/	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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).		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
RS-232C I/F	RXD TXD	CN3 2 CN3 12	RS-485 and RS-232C functions cannot be used together. Choose either one in parameter No. 16.		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### 3. SIGNALS AND WIRING

#### (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. When using this power supply for digital interface, connect it with COM. Permissible current : 80mA		○	○	○
Digital I/F power supply input	COM	CN1A 9 CN1B 13	Used to input 24VDC for input interface. Connect the positive terminal of the 24VDC external power supply. 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 20 CN1B 10 20	Common terminal for input signals such as SON and EMG. Pins are connected internally. Separated from LG.		○	○	○
15VDC power supply	P15R	CN1A 4 CN1B 11	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA		○	○	○
Control common	LG	CN1A 1 CN1B 1 CN3 1 3 5 11 13 15	Common terminal for TLA, TC, VC, VLA, FPA, FPB, OP ,MO1, MO2 and P15R. Pins are connected internally.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shield cable.		○	○	○

### 3. SIGNALS AND WIRING

#### 3.4 Detailed description of the signals

##### 3.4.1 Position control mode

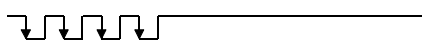
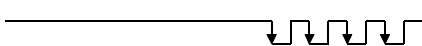
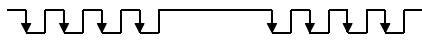
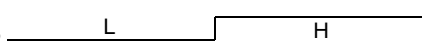
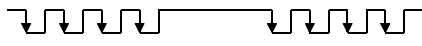

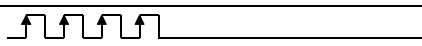

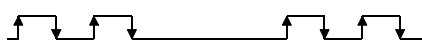

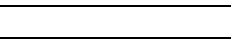
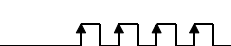
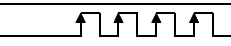
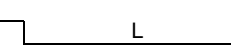
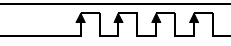
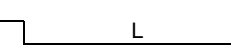
##### (1) Pulse train input

##### (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.

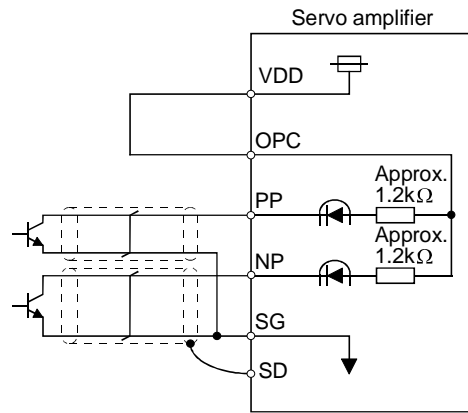
Arrow  or  in the table indicates the timing of importing a pulse train.

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

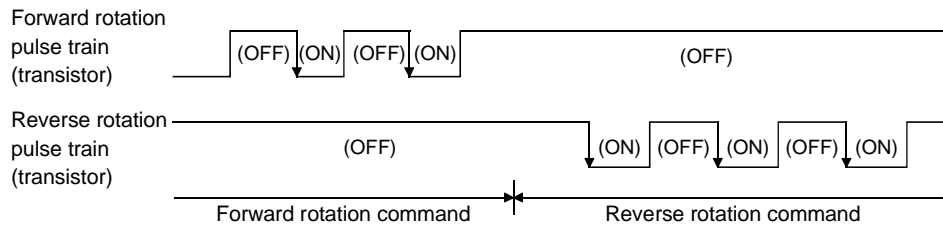
Pulse train form		Forward rotation command	Reverse rotation command	Parameter No. 21 (Command pulse train)
Negative logic	Forward rotation pulse train Reverse rotation pulse train	PP 	NP 	0010
	Pulse train + sign	PP  NP 	NP 	0011
	A-phase pulse train B-phase pulse train	PP  NP 	NP 	0012
Positive logic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

### 3. SIGNALS AND WIRING

- (b) Connections and waveforms
  - 1) Open collector system
    - Connect as shown below:

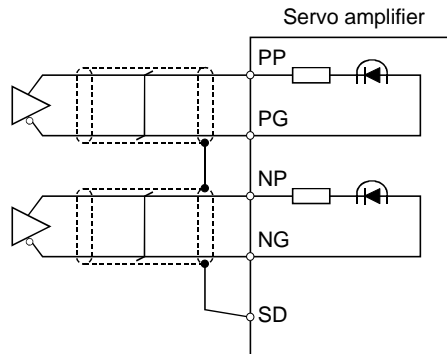


The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010). The waveforms in the table in (a), (1) of this section are voltage waveforms of PP and NP based on SG. Their relationships with transistor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



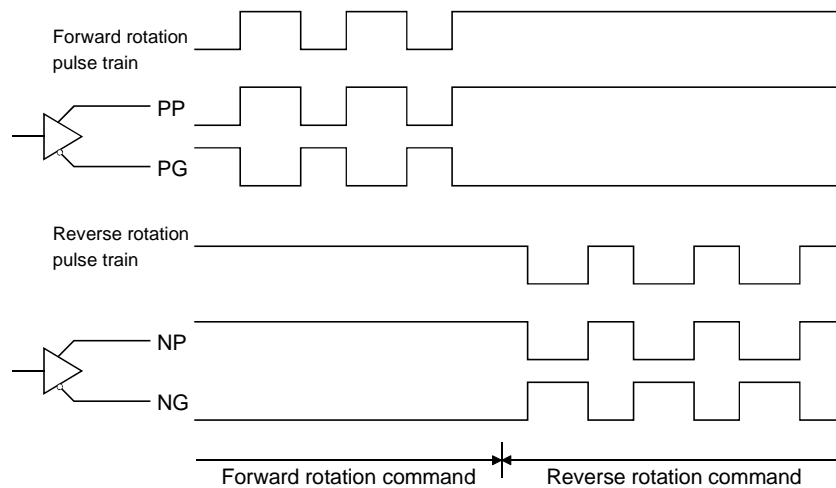
### 3. SIGNALS AND WIRING

- 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.

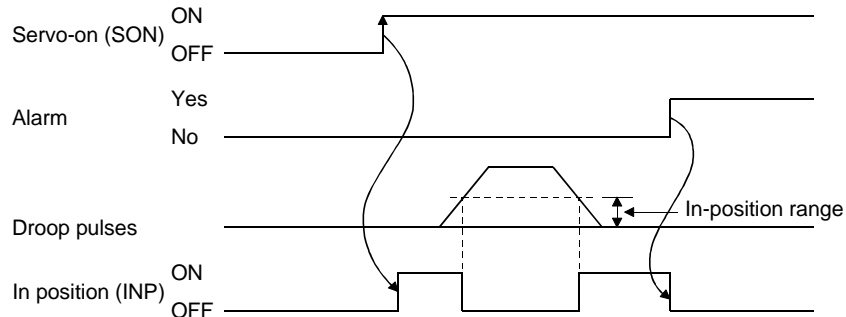




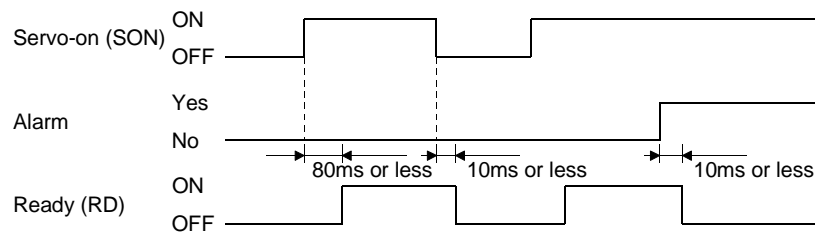
### 3. SIGNALS AND WIRING

#### (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)

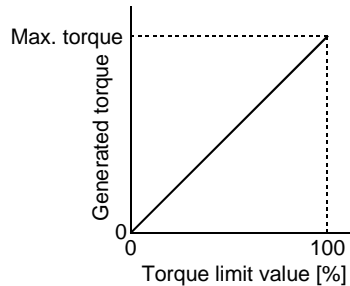
1: CM1/CM2-SG on(short)

### 3. SIGNALS AND WIRING

#### (5) Torque limit

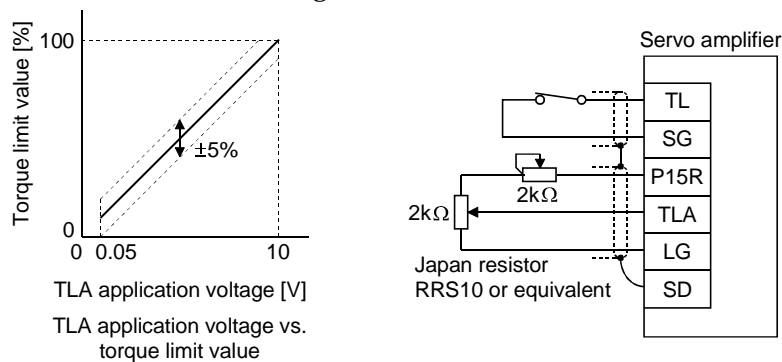
##### (a) Torque limit and generated torque

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 TLA < Parameter No. 28: TLA
1	0	Parameter No. 76 > Parameter No. 28: Parameter No. 28 Parameter No. 76 < Parameter No. 28: Parameter No. 76
1	1	TLA > Parameter No. 76: Parameter No. 76 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. SIGNALS AND WIRING

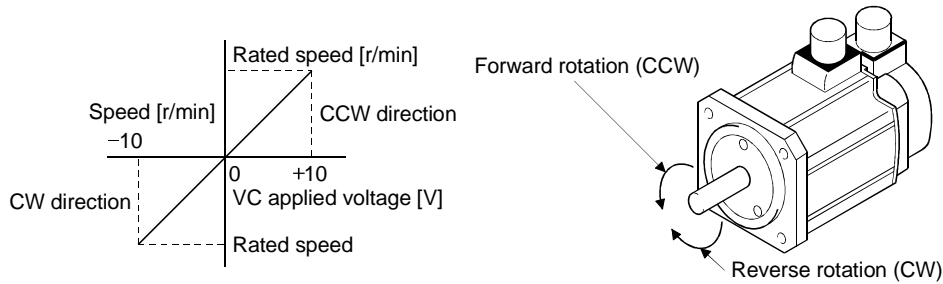
#### 3.4.2 Speed control mode

##### (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  $\pm 10V$ . The speed at  $\pm 10V$  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:

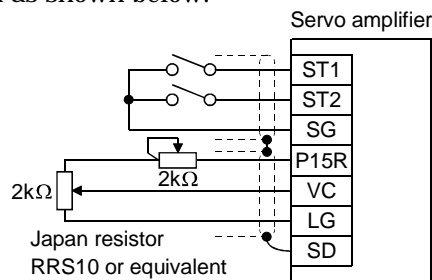
(Note) External input signals		Rotation direction			Internal speed commands
ST2	ST1	Analog speed command (VC)			
		+ Polarity	0V	- Polarity	
0	0	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)	Stop (Servo lock)
0	1	CCW	Stop (No servo lock)	CW	CCW
1	0	CW		CCW	CW
1	1	Stop (Servo lock)	Stop (Servo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



### 3. SIGNALS AND WIRING

(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)

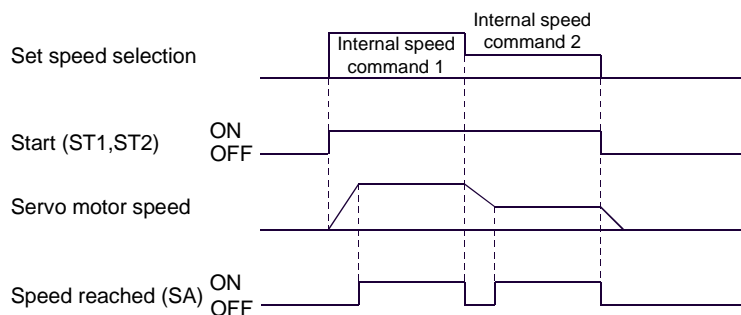
1 : SP1/SP2/SP3-SG on (short)

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. SIGNALS AND WIRING

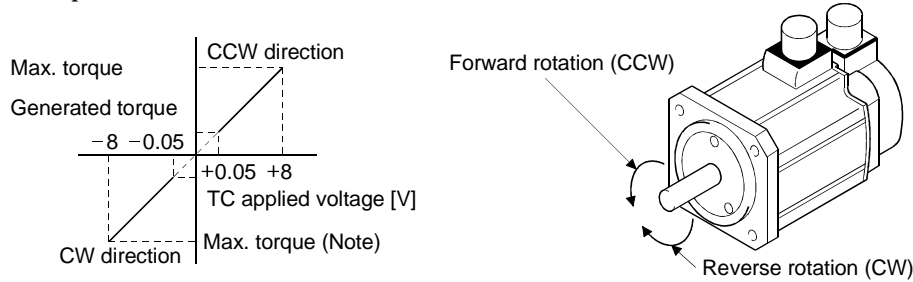
#### 3.4.3 Torque control mode

##### (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  $\pm 8V$ . Note that the torque generated at  $\pm 8V$  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.

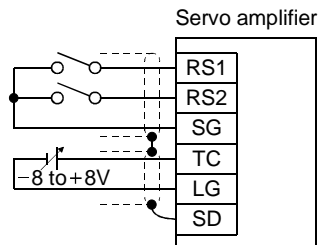
The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and reverse rotation selection (RS2) when the analog torque command (TC) is used.

(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)

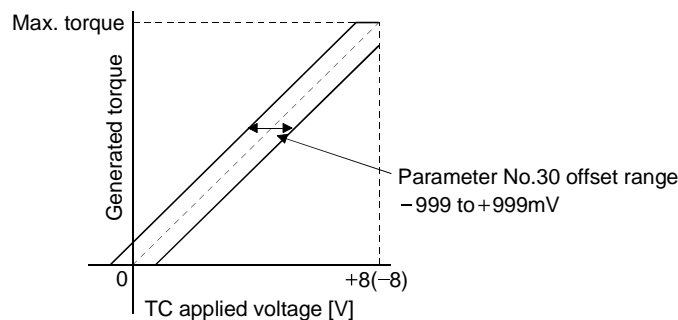
Generally, make connection as shown below:



### 3. SIGNALS AND WIRING

(b) Analog torque command offset

Using parameter No. 30, the offset voltage of  $-999$  to  $+999\text{mV}$  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.

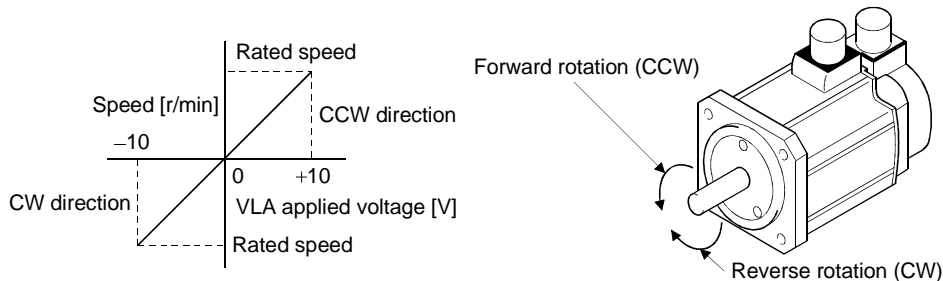
(3) Speed limit

(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  $100\text{r/m}$  greater than the desired speed limit value.

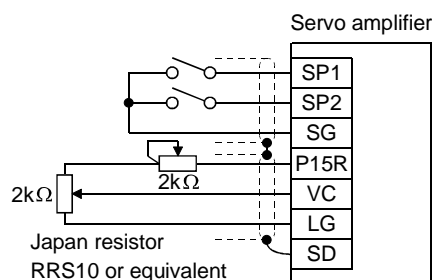


The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination:

(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:



### 3. SIGNALS AND WIRING

- (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. SIGNALS AND WIRING

#### 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:

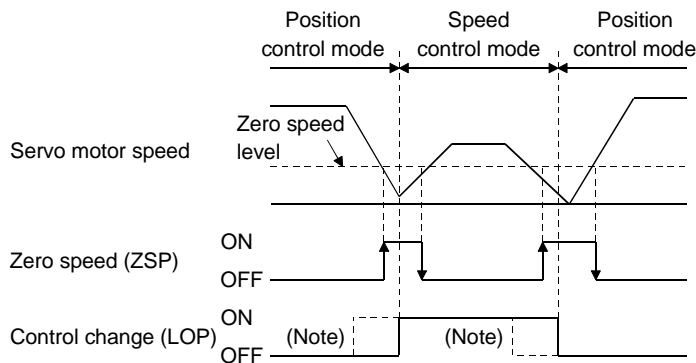
(Note) LOP	Servo control mode
0	Position control mode
1	Speed control mode

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).



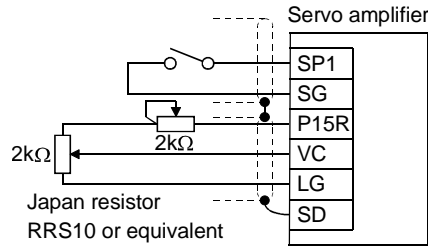
### 3. SIGNALS AND WIRING

#### (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. SIGNALS AND WIRING

#### 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)

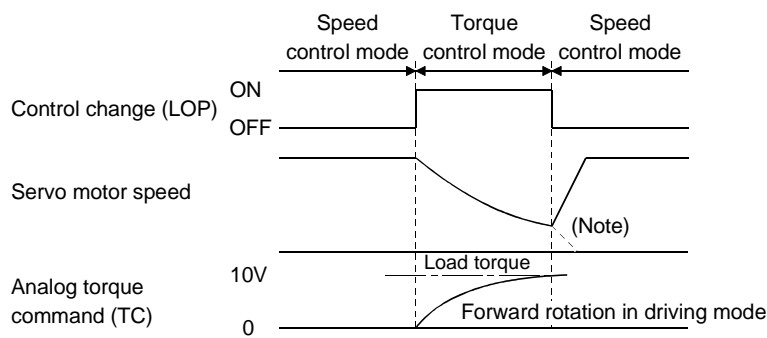
Use control change (LOP) to switch between the speed control mode and the torque control mode from an external contact. Relationships between LOP-SG status and control modes are indicated below:

(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).

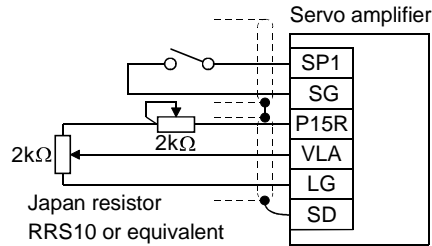
### 3. SIGNALS AND WIRING

#### (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. SIGNALS AND WIRING

#### 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

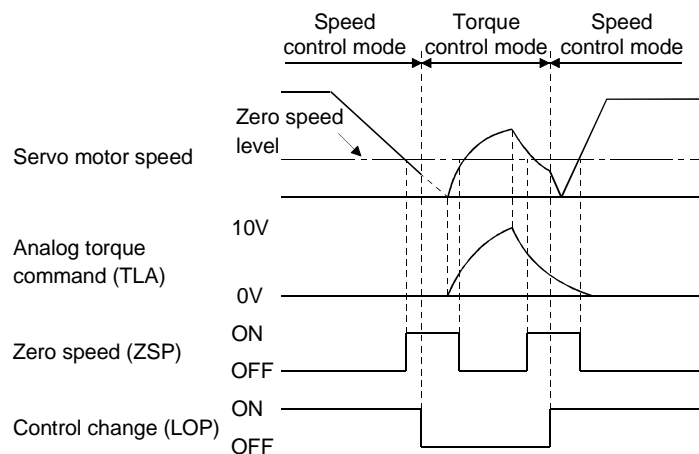
Note.0: LOP-SG off (open)

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

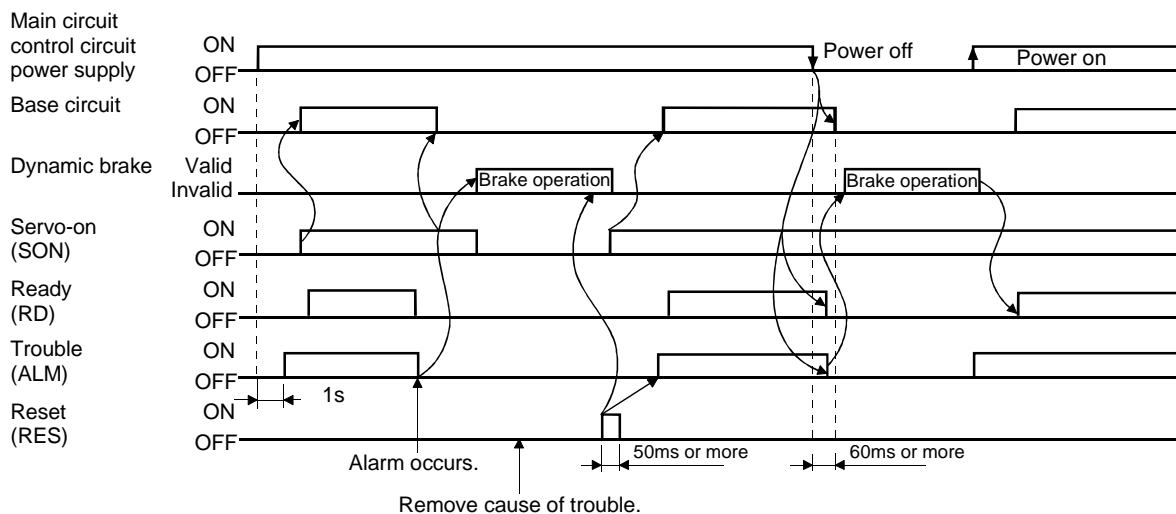
As in Section 3.4.1 (5).

### 3. SIGNALS AND WIRING

#### 3.5 Alarm occurrence timing chart

 <b>CAUTION</b>	<p>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.</p>
--	--

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)

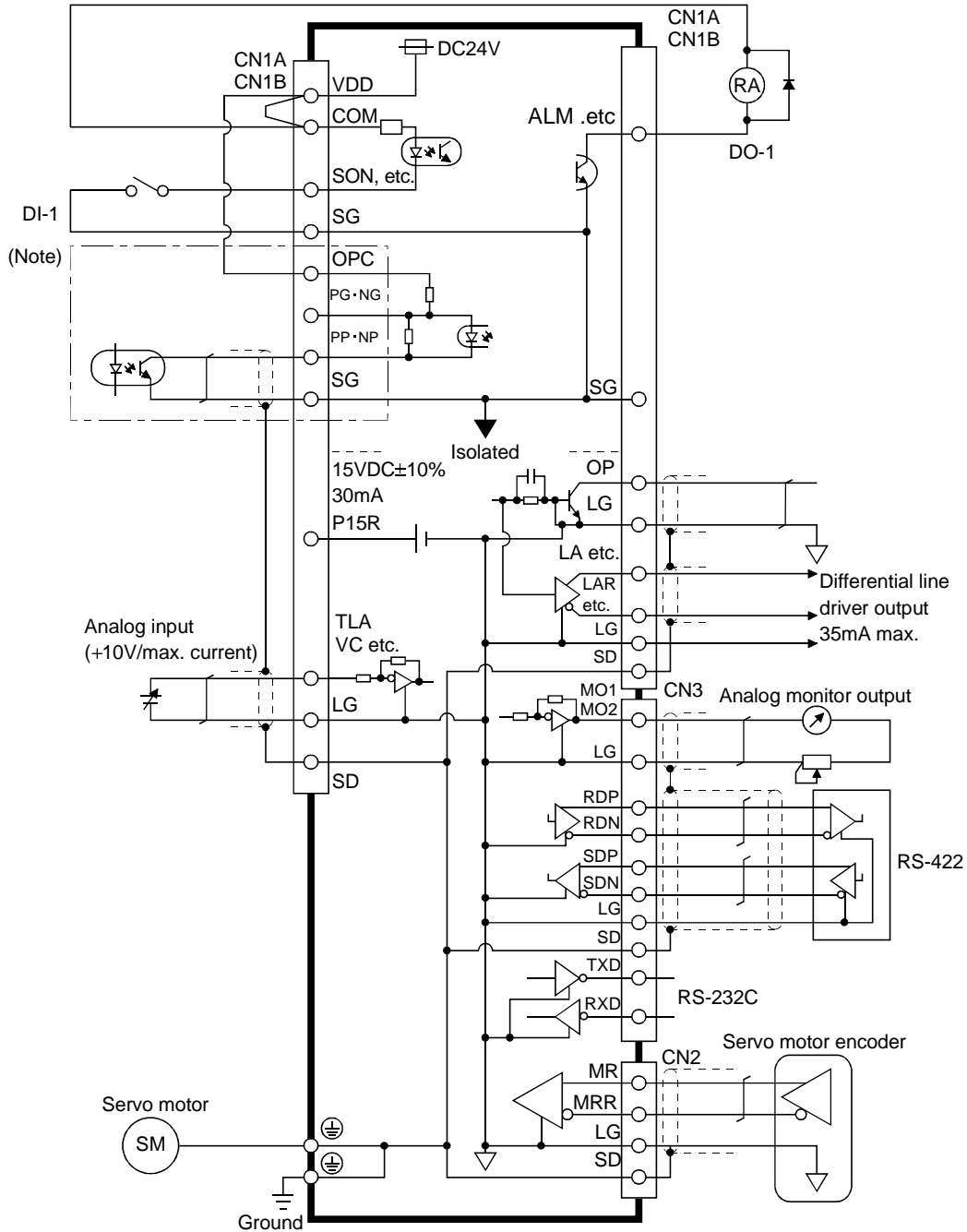
When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a home position return.

### 3. SIGNALS AND WIRING

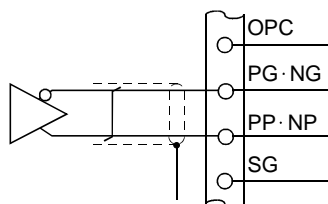
#### 3.6 Interfaces

##### 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. SIGNALS AND WIRING

#### 3.6.2 Detailed description of the interfaces

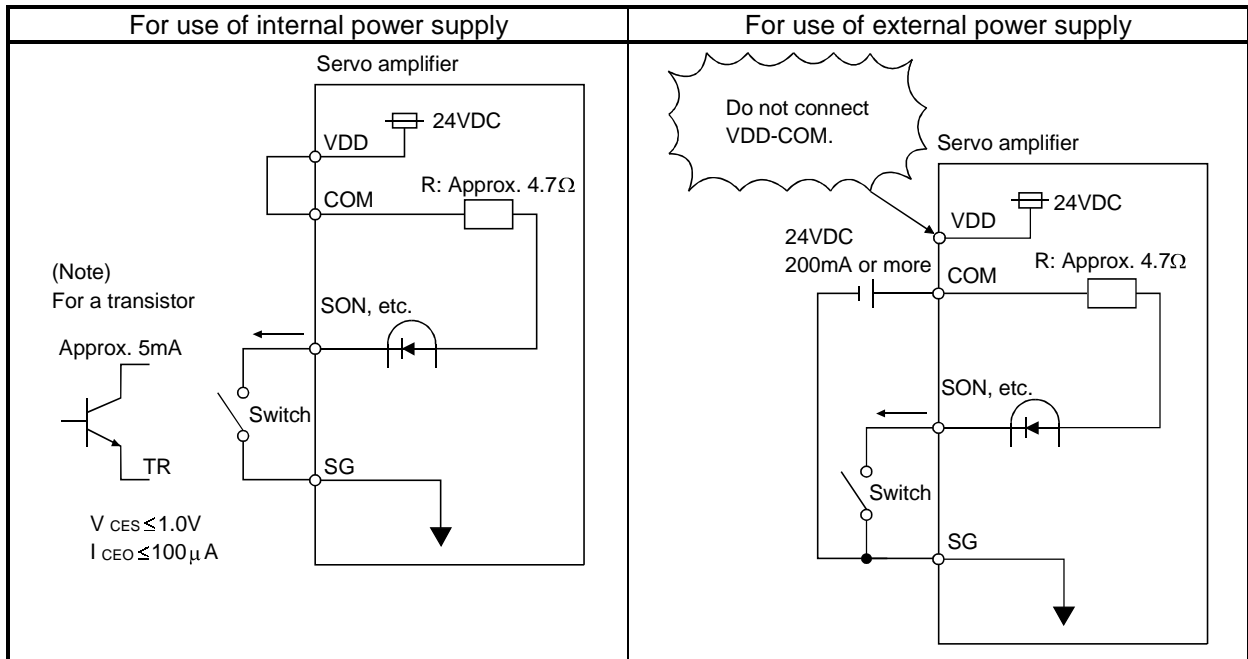
This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in Sections 3.3.2.

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.

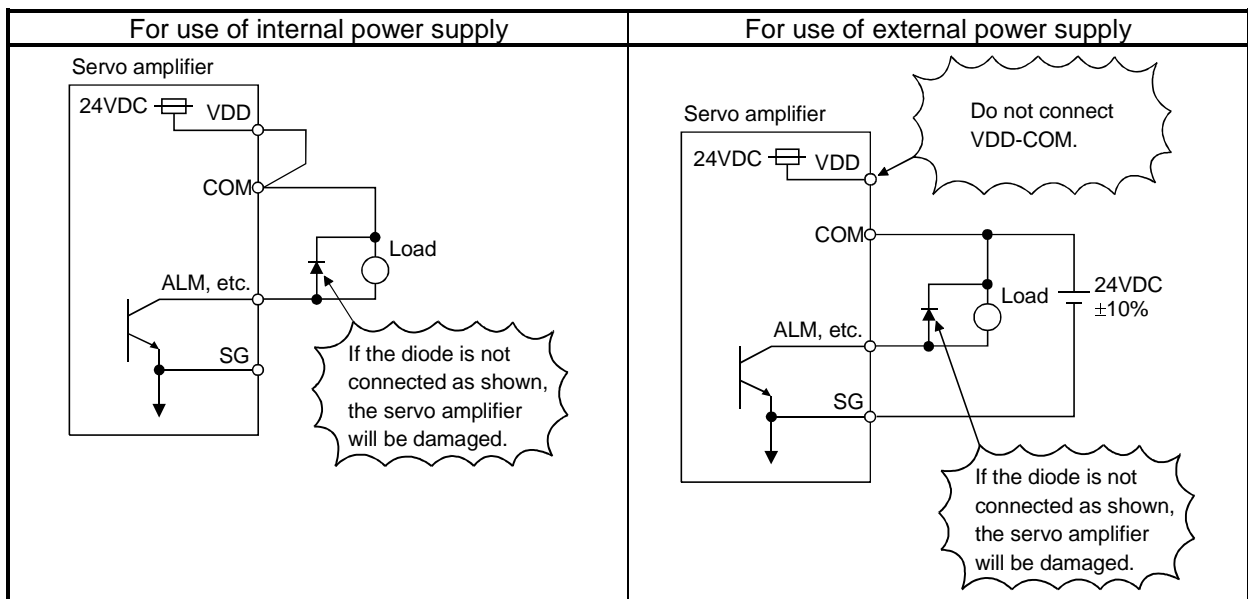


Note: This also applies to the use of the external power supply.

##### (2) Digital output interface DO-1

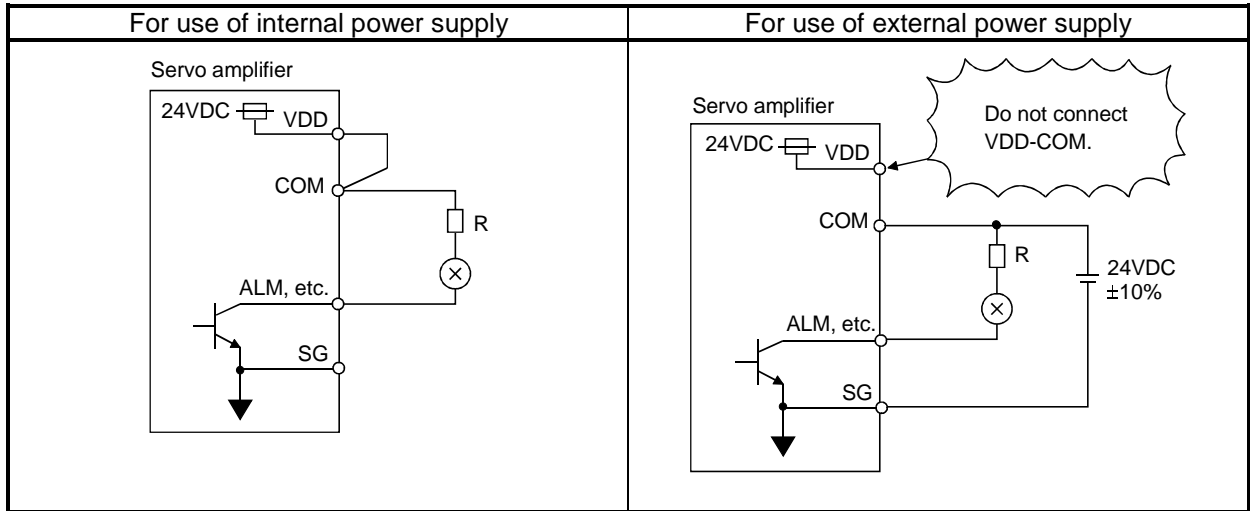
A lamp, relay or photocoupler can be driven. Provide a diode (D) for an inductive load, or an inrush current suppressing resistor (R) for a lamp load. (Permissible current: 40mA or less, inrush current: 100mA or less)

##### (a) Inductive load



### 3. SIGNALS AND WIRING

#### (b) Lamp load

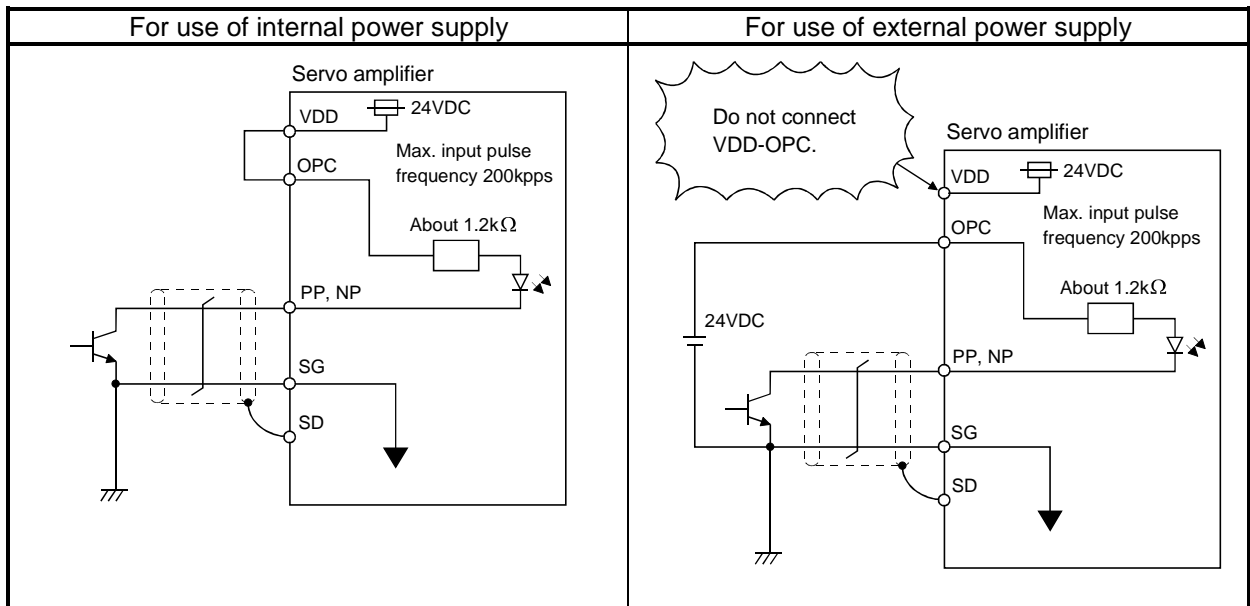


#### (3) Pulse train input interface DI-2

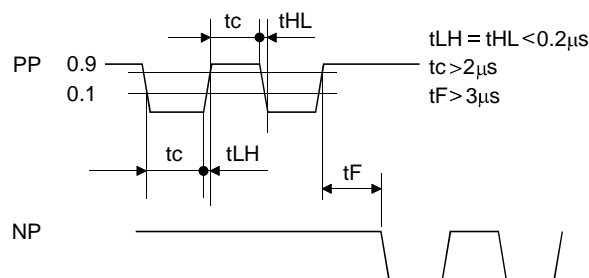
Provide a pulse train signal in the open collector or differential line driver system.

##### (a) Open collector system

##### 1) Interface



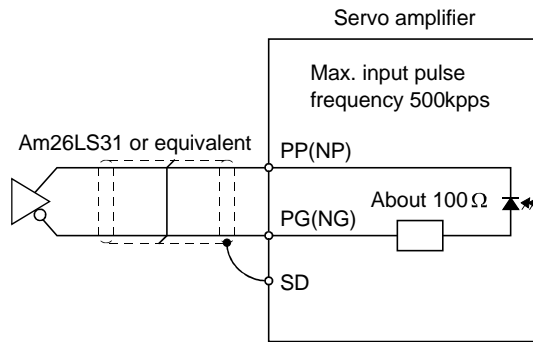
##### 2) Conditions of the input pulse



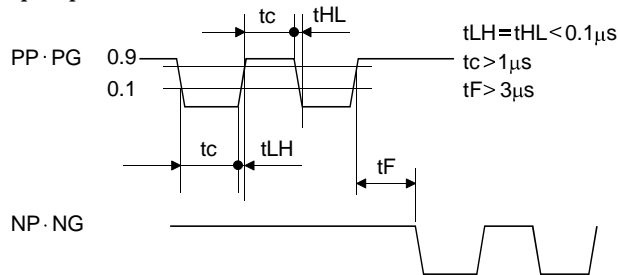


### 3. SIGNALS AND WIRING

- (b) Differential line driver system
  - 1) Interface



- 2) Conditions of the input pulse



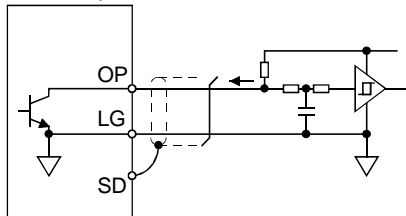
- (4) Encoder pulse output DO-2

- (a) Open collector system

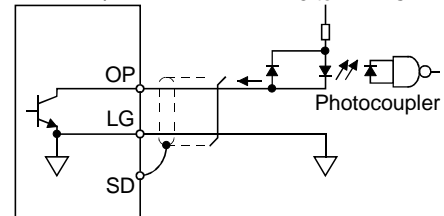
Interface

Max. output current : 35mA

Servo amplifier



Servo amplifier

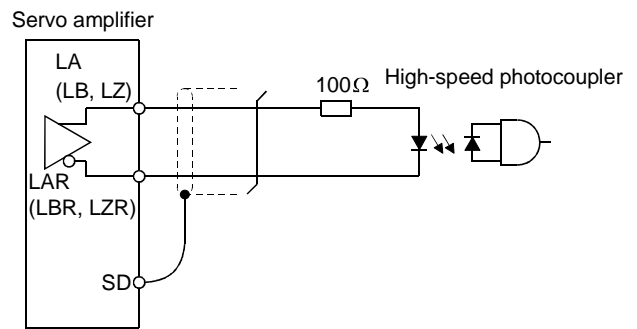
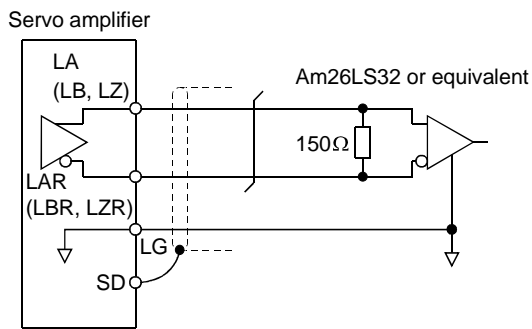


### 3. SIGNALS AND WIRING

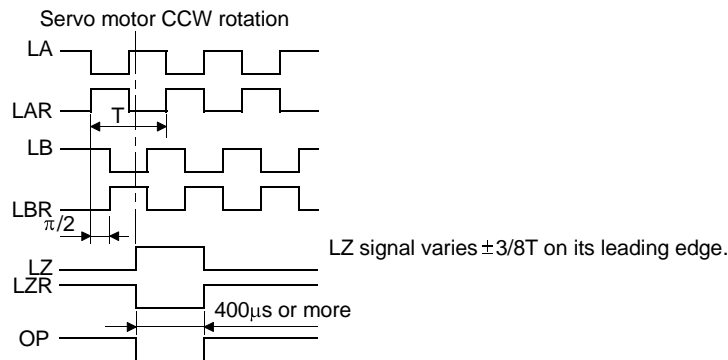
(b) Differential line driver system

1) Interface

Max. output current: 35mA

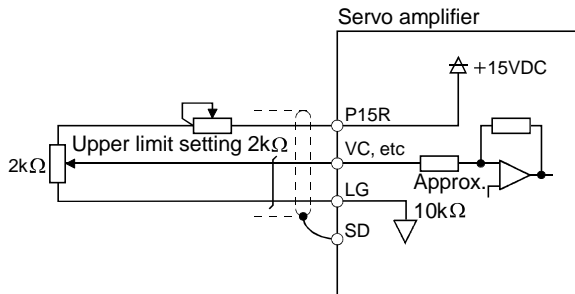


2) Output pulse



(5) Analog input

Input impedance 10 to 12kΩ



(6) Analog output

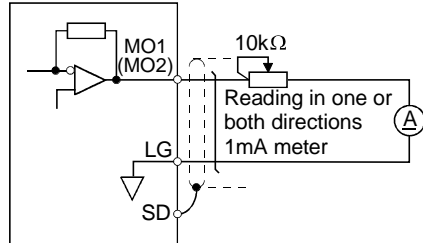
Output voltage  $\pm 10V$

Max. 1mA

Max. output current

Resolution : 10bit

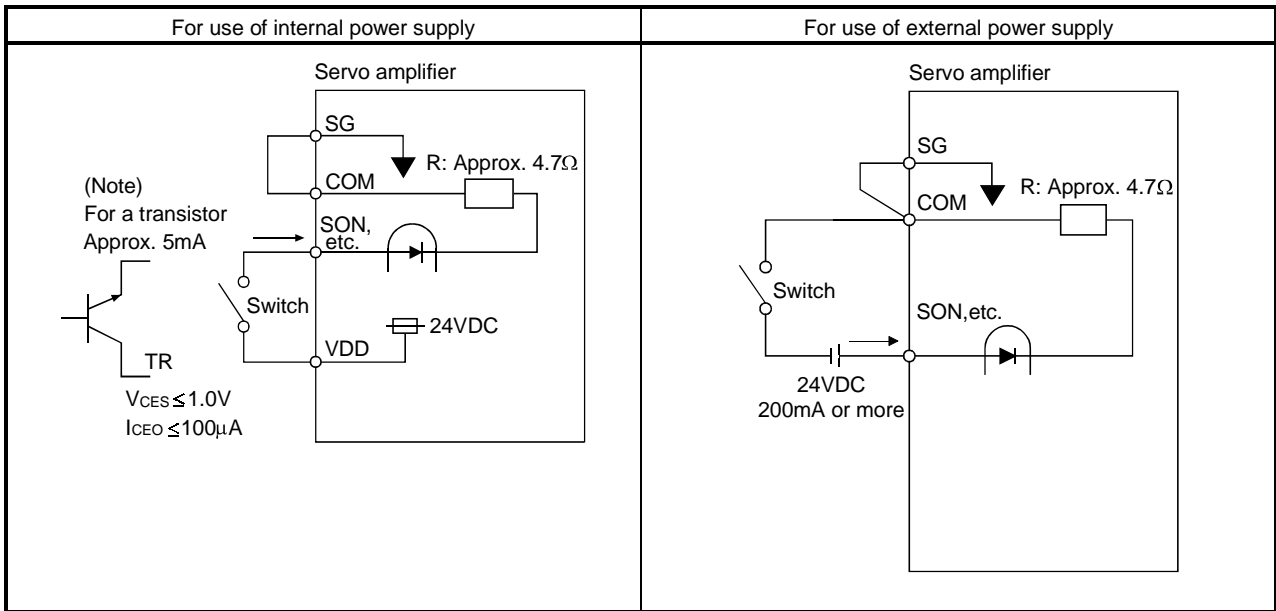
Servo amplifier



### 3. SIGNALS AND WIRING

#### (7) Source input interface

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



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

### 3. SIGNALS AND WIRING

#### 3.7 Input power supply circuit



#### CAUTION

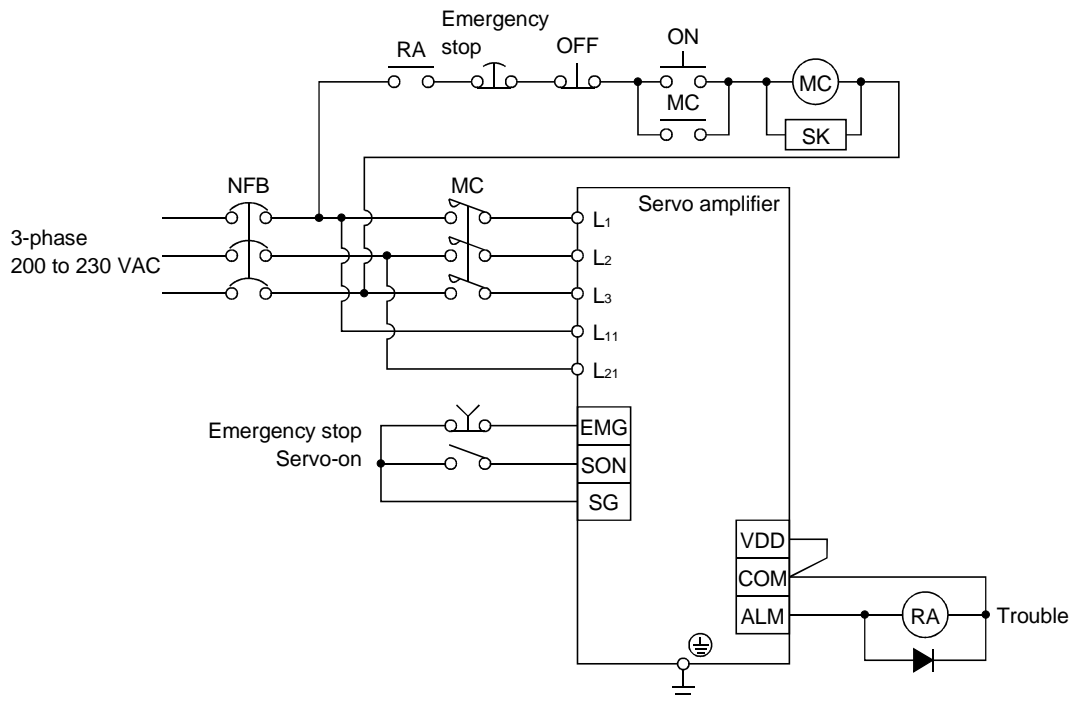
- When the servo amplifier has become faulty, switch power off on the servo amplifier power side. Continuous flow of a large current may cause a fire.
- Use the trouble signal to switch power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor,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

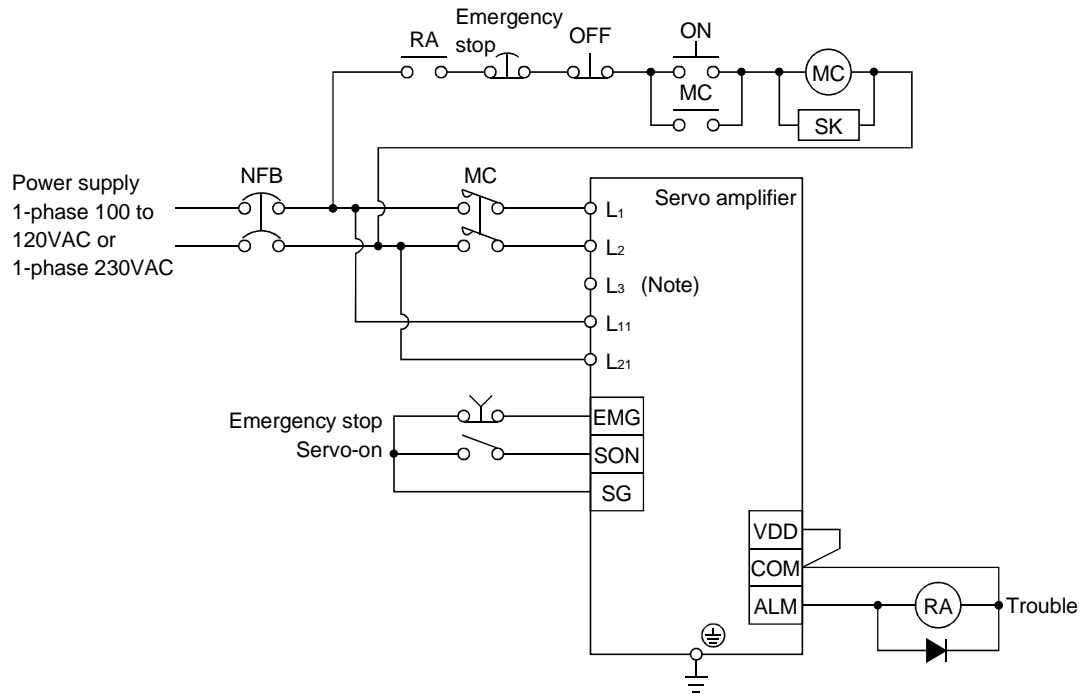
A no-fuse breaker (NFB) must be used with the input cables of the power supply.

(1) For 3-phase 200 to 230VAC power supply



### 3. SIGNALS AND WIRING

(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. SIGNALS AND WIRING

#### 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.

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

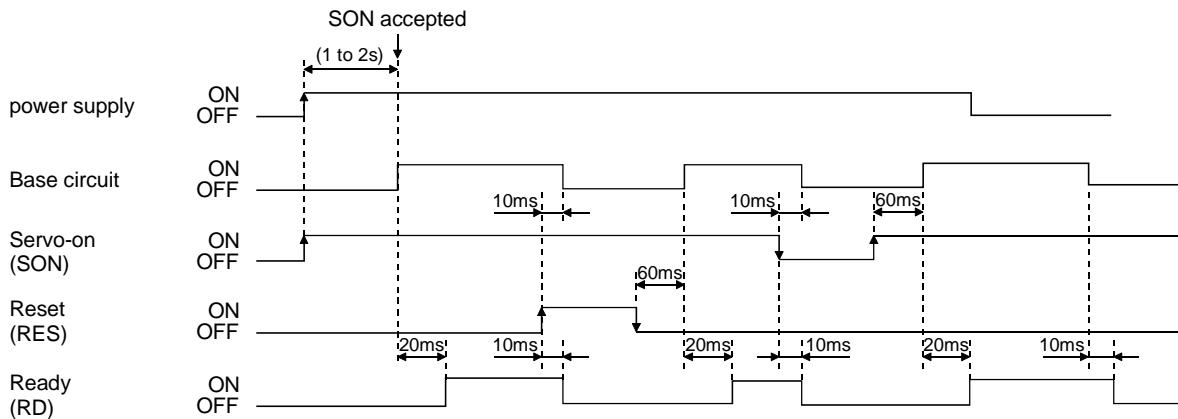
### 3. SIGNALS AND WIRING

#### 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: L1, L2, L3, single-phase 230V: L1, L2). 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 L11, L21 simultaneously with the main circuit power supply or before switching on the main circuit power supply. If the main circuit power supply is not on, the display shows the corresponding warning. However, by switching on the main circuit power supply, the warning disappears and the servo amplifier will operate properly.
- 3) The servo amplifier can accept the servo-on signal (SON) about 1 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



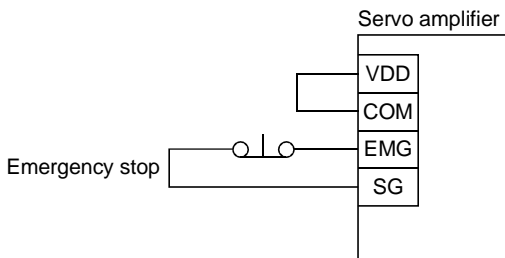
##### (3) Emergency stop

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. SIGNALS AND WIRING

#### 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.

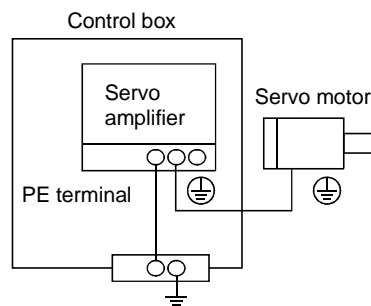


#### CAUTION

- 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.
- 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.

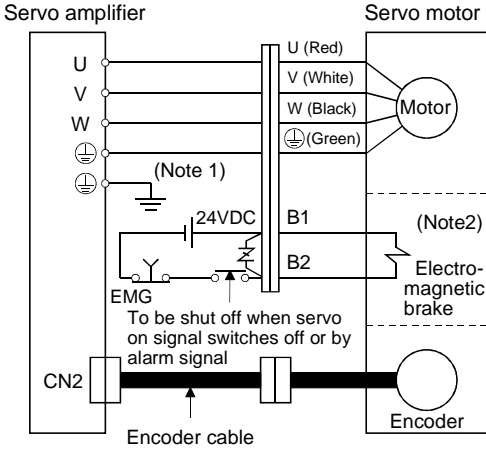
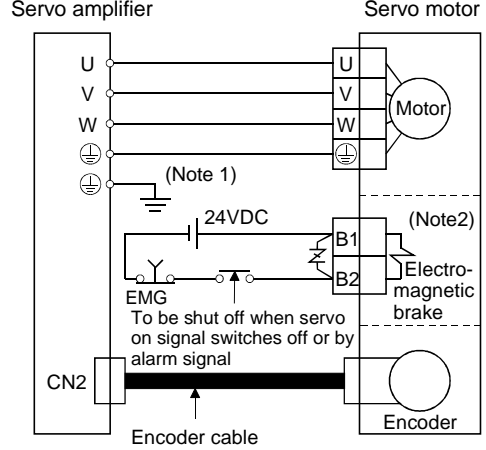
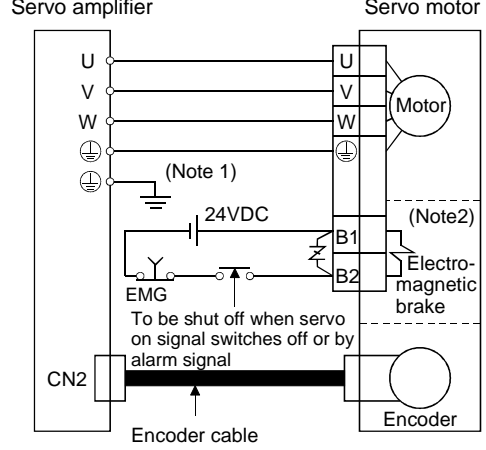
##### 3.8.2 Connection diagram

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.



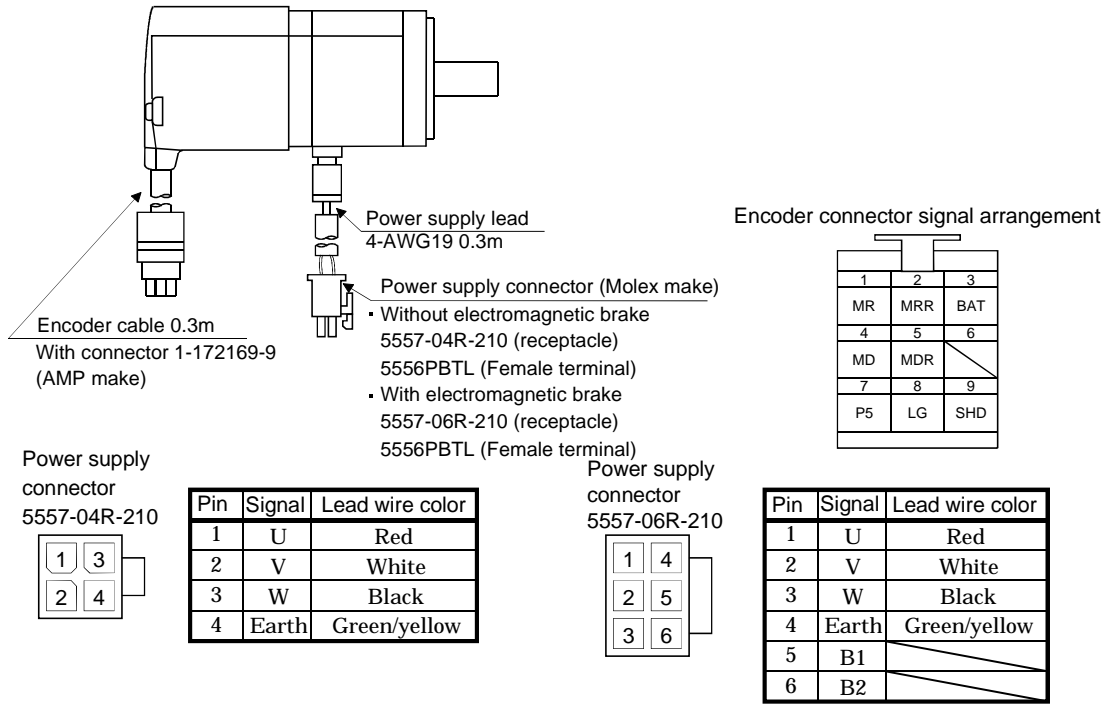
### 3. SIGNALS AND WIRING

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

### 3. SIGNALS AND WIRING

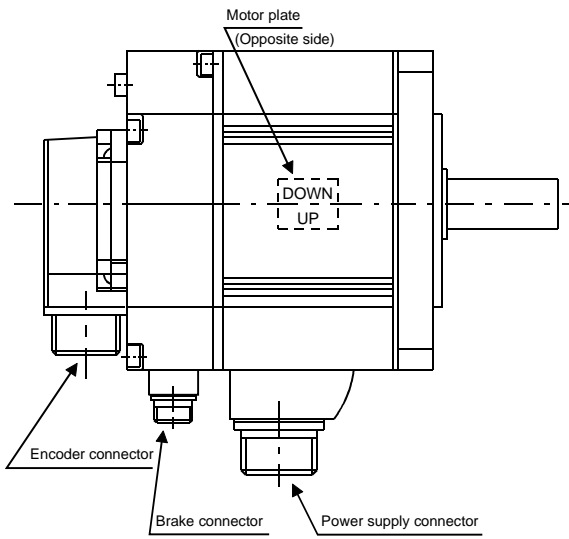
#### 3.8.3 I/O terminals

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



### 3. SIGNALS AND WIRING

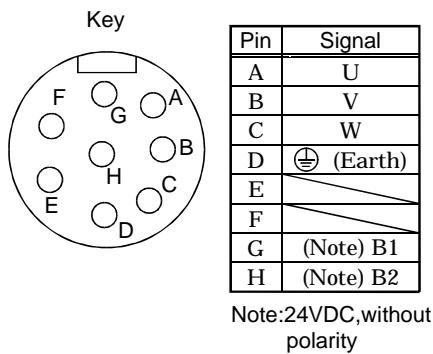
#### (2) HC-SFS • HC-RFS • HC-UFS2000 r/min series



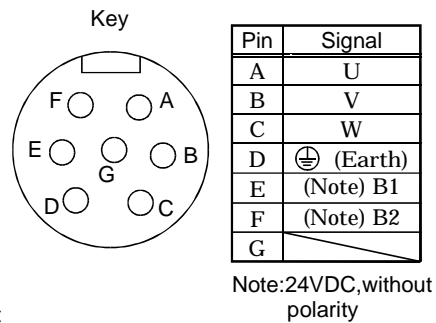
Servo motor	Servo motor side connectors		
	For power supply	For encoder	Electromagnetic brake connector
HC-SFS81(B) HC-SFS52(B) to 152(B) HC-SFS53(B) to 153(B)	CE05-2A22-23PD-B	MS3102A20-29P	The connector for power is shared.
HC-SFS121(B) to 301(B) HC-SFS202(B) to 502(B) HC-SFS203(B) • 353(B)	CE05-2A24-17PD-B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

Power supply connector signal arrangement

CE05-2A22-23PD-B

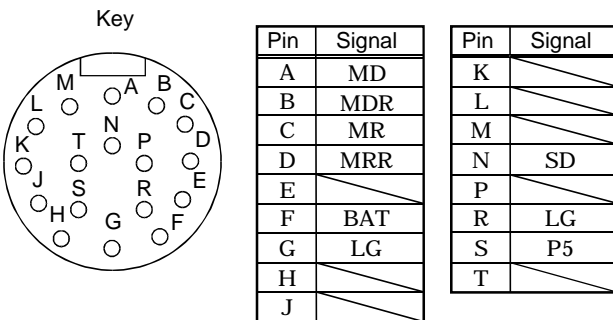


CE05-2A24-10PD-B



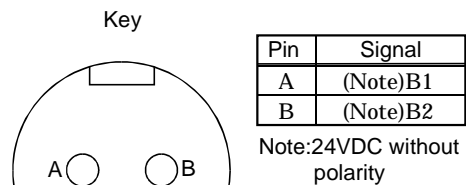
Encoder connector signal arrangement

MS3102A20-29P



Electromagnetic brake connector signal arrangement

MS3102A10SL-4P




### 3. SIGNALS AND WIRING

#### 3.9 Servo motor with electromagnetic brake

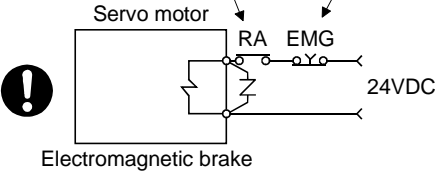
▪ Configure the electromagnetic brake operation circuit so that it is activated not only by the servo amplifier signals but also by an external emergency stop signal.

Contacts must be open when servo-on signal is off or when an alarm (trouble) is present and when an electromagnetic brake signal.

Circuit must be opened during emergency stop signal.



**CAUTION**



Servo motor

Electromagnetic brake

▪ The electromagnetic brake is provided for holding purpose and must not be used for ordinary braking.

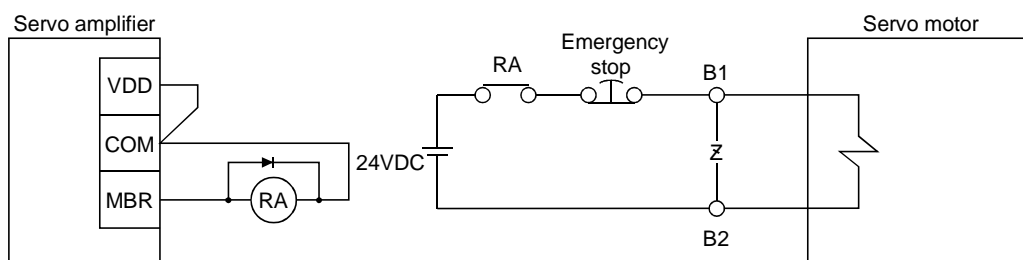
**POINT**

▪ 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

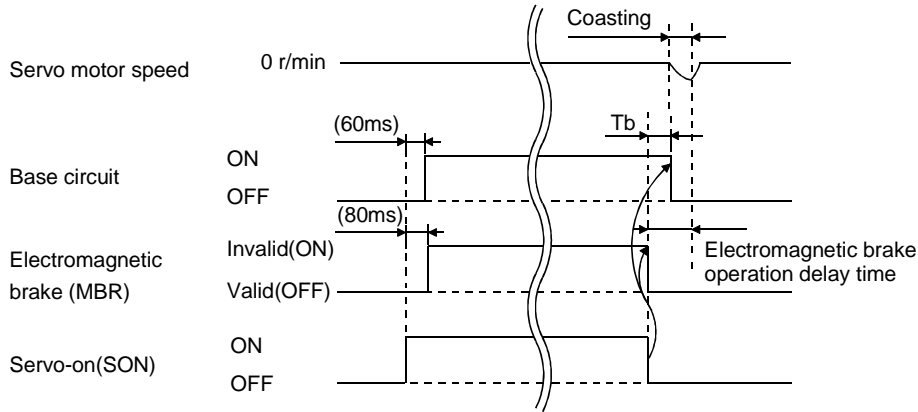
- 1) Set "□□1□" in parameter No.1 to make the electromagnetic brake interlock signal (MBR) valid.
- 2) Using parameter No. 33 (electromagnetic brake sequence output), set a time delay (Tb) at servo-off from electromagnetic brake operation to base circuit shut-off as in the timing chart shown in (3) in this section.

### 3. SIGNALS AND WIRING

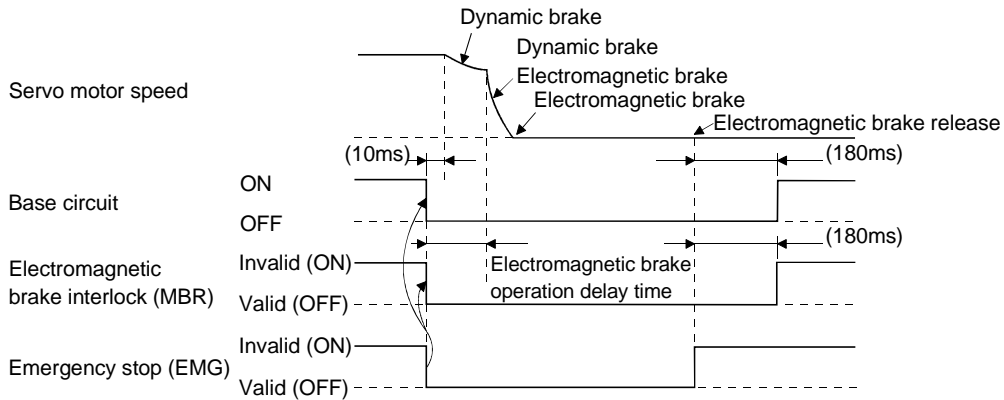
#### (3) Timing charts

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

T<sub>b</sub> [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 T<sub>b</sub> to about the same as the electromagnetic brake operation delay time to prevent a drop.

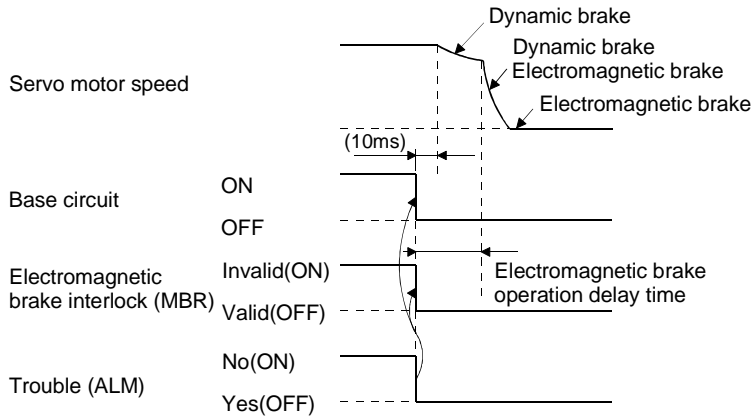


##### (b) Emergency stop signal (EMG) ON/OFF

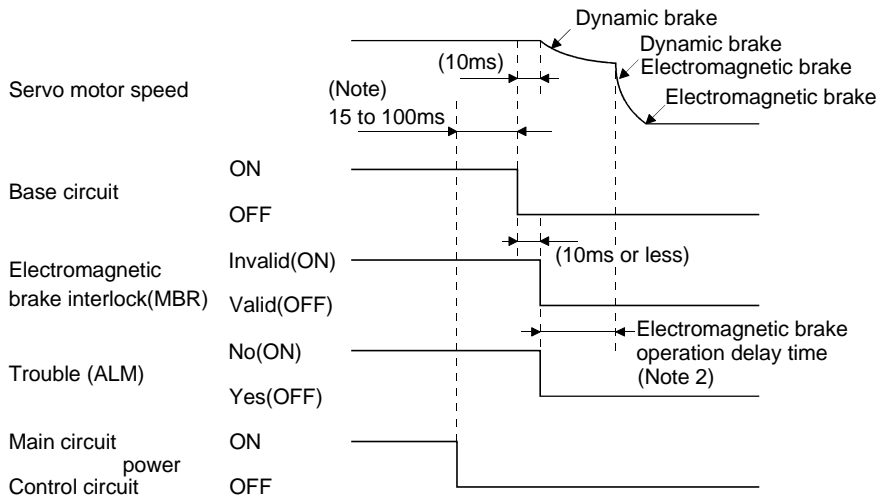


### 3. SIGNALS AND WIRING

#### (c) Alarm occurrence

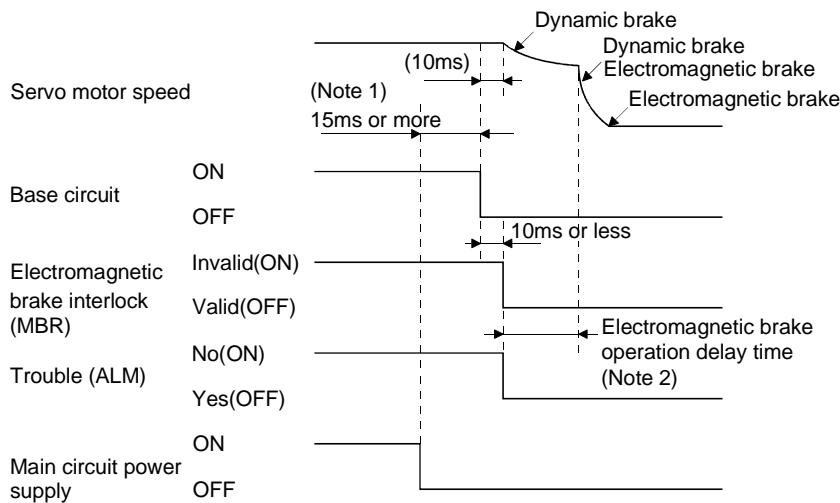


#### (d) Both main and control circuit power supplies off



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. SIGNALS AND WIRING

#### 3.10 Grounding

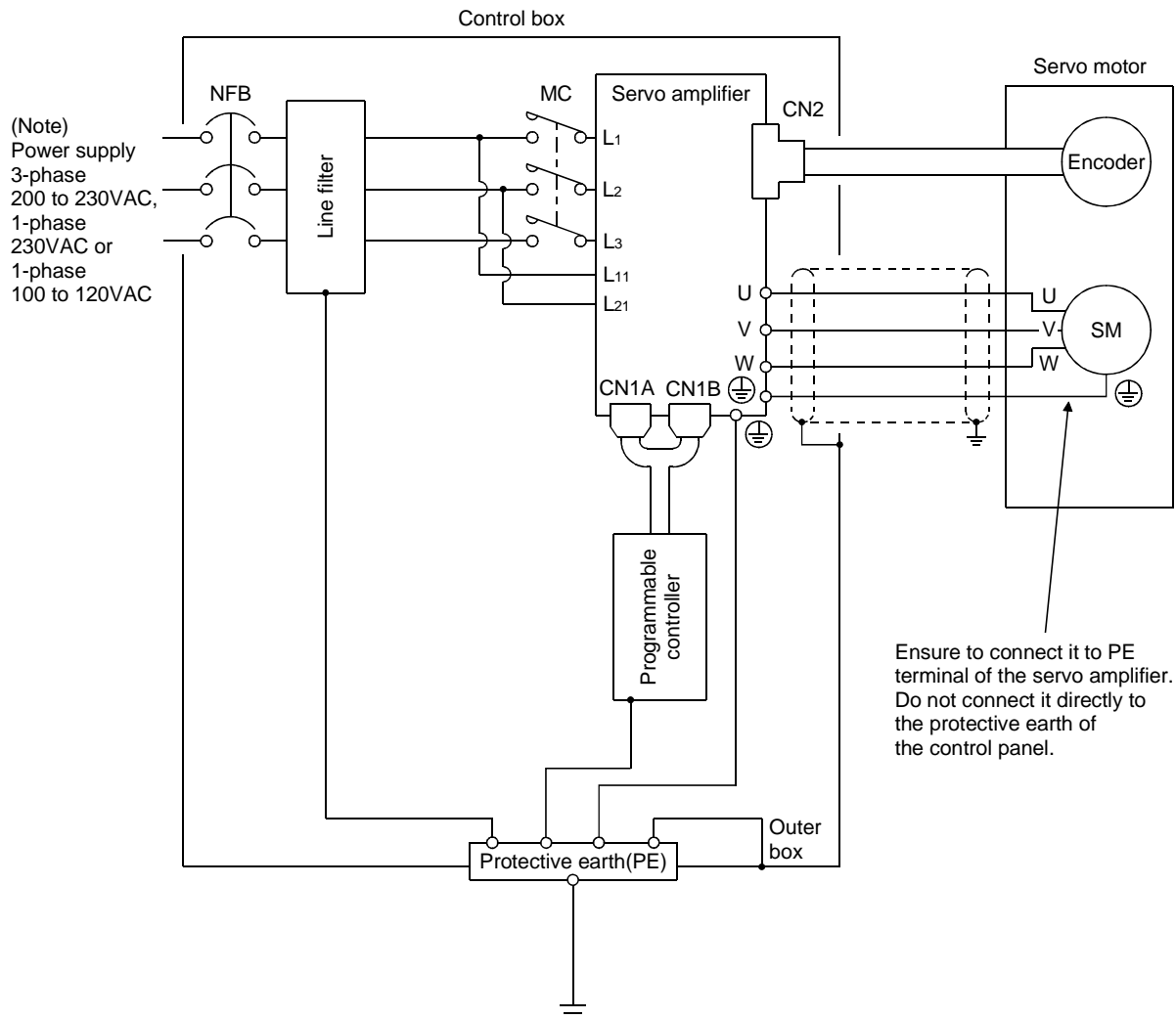


**WARNING**

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

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



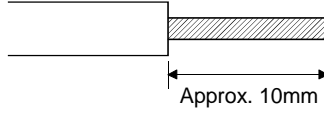
Note: For 1-phase 230VAC, connect the power supply to L1 · L2 and leave L3 open.  
There is no L3 for 1-phase 100 to 120VAC power supply.

### 3. SIGNALS AND WIRING

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

##### (1) Termination of the cables

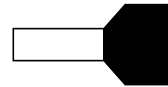
**Solid wire:** After the sheath has been stripped, the cable can be used as it is. (Cable size: 0.2 to 2.5mm<sup>2</sup>)



**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<sup>2</sup>) 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 <sup>2</sup> ]	AWG	For 1 cable	For 2 cables	
0.25	24	AI0.25-6YE		CRIMPFOX-UD6
		AI0.25-8YE		
0.5	20	AI0.5-6WH		
		AI0.5-8WH		
0.75	18	AI0.75-6GY	AI-TWIN2 × 0.75-8GY	
		AI0.75-8GY	AI-TWIN2 × 0.75-10GY	
1	18	AI1-6RD	AI-TWIN2 × 1-8RD	
		AI1-8RD	AI-TWIN2 × 1-10RD	
1.5	16	AI1.5-6BK	AI-TWIN2 × 1.5-8BK	
		AI1.5-8BK	AI-TWIN2 × 1.5-12BK	
2.5	14	AI2.5-8BU	AI-TWIN2 × 2.5-10BU	
		AI2.5-8BU-1000	AI-TWIN2 × 2.5-13BU	

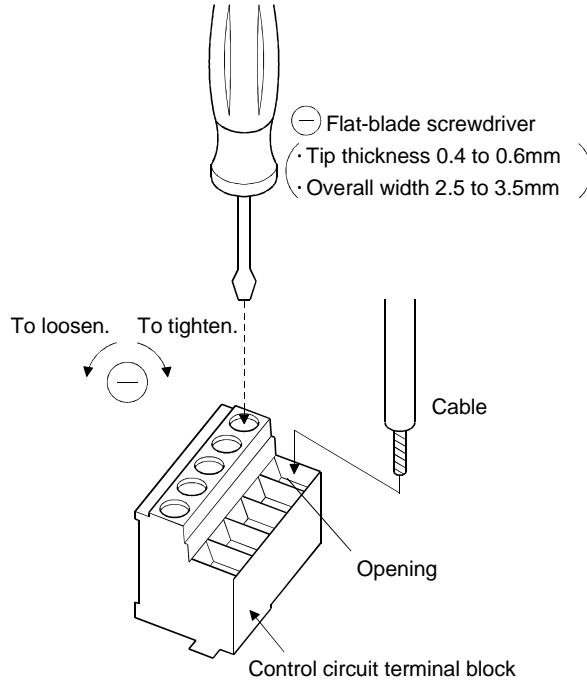


### 3. SIGNALS AND WIRING

#### (2) Connection

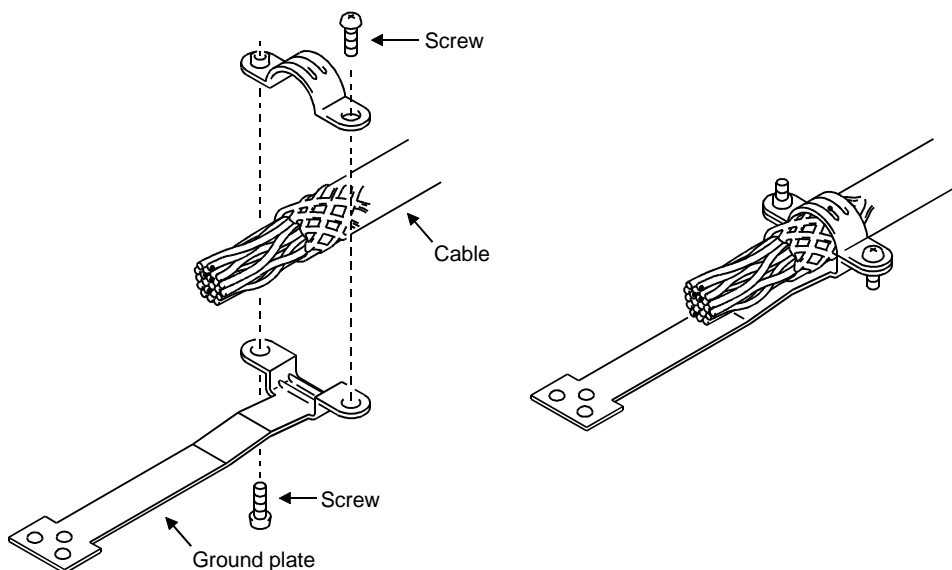
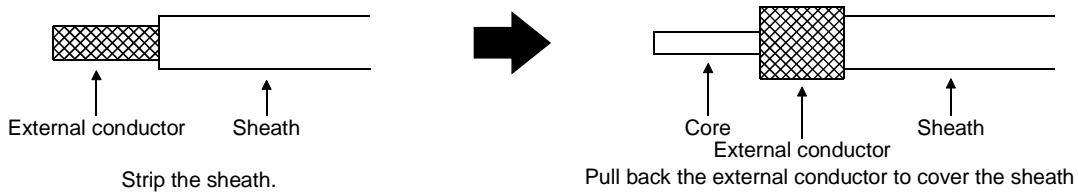
Insert the core of the cable into the opening and tighten the screw with a flat-blade screwdriver so that the cable does not come off. (Tightening torque: 0.5 to 0.6N · m) Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose.

When using a cable of 1.5mm<sup>2</sup> 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. 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 (L1, L2, L3, L11, L21) 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 (L1, L2, L3) 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. OPERATION

### 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.  
 ▪ 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	<input type="checkbox"/> 3 <input type="checkbox"/> 0	Position control mode MR-RB12 regenerative brake option is used.
1	Function selection 1	<input type="checkbox"/> 0 <input type="checkbox"/> 2	Input filter 3.555ms (initial value) Electromagnetic brake interlock signal is not used. Used in incremental positioning system.
2	Auto tuning	<input type="checkbox"/> 1 <input type="checkbox"/> 5	Middle response (initial value) is selected. 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. OPERATION

---

### (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. OPERATION

### 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	<input type="checkbox"/> 0 <input type="checkbox"/> 2	Speed control mode Regenerative brake option is not used.
1	Function selection 1	<input type="checkbox"/> <input type="checkbox"/> 12	Input filter 3.555ms (initial value) Electromagnetic brake interlock signal is used.
2	Auto tuning	<input type="checkbox"/> 1 <input type="checkbox"/> 5	Middle response (initial value) is selected. 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)

## 4. OPERATION

### (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
<ul style="list-style-type: none"> <li>A sudden stop indicates that a stop is made at the deceleration time constant of zero.</li> </ul>

### 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	<input type="checkbox"/> 0 <input type="checkbox"/> 4	<ul style="list-style-type: none"> <li>Torque control mode</li> <li>Regenerative brake option is not used.</li> </ul>
1	Function selection 1	<input type="checkbox"/> 0 <input type="checkbox"/> 2	<ul style="list-style-type: none"> <li>Input filter 3.555ms (initial value)</li> <li>Electromagnetic brake interlock signal is not used.</li> </ul>
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. OPERATION

---

### (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

### 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. PARAMETERS

### 5.1.2 Lists

POINT
<ul style="list-style-type: none"> <li>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.</li> </ul>

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			

## 5. PARAMETERS

	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.

## 5. PARAMETERS

No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
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.

## 5. PARAMETERS

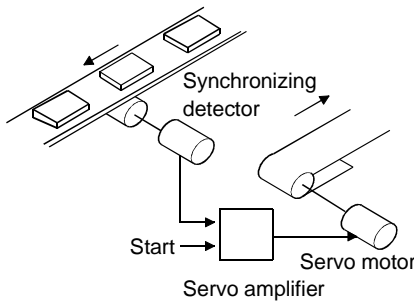
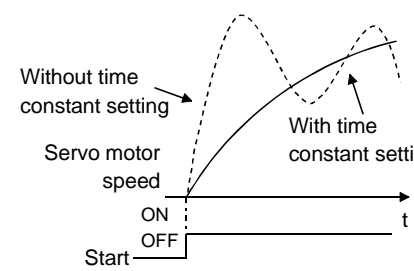
### (2) Details list

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode				
Basic parameters	0	*STY	<p>Control mode, regenerative brake option selection Used to select the control mode and regenerative brake option.</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <table border="1" style="width: 100px; text-align: center;"> <tr> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> </tr> </table> </div> <p> <span style="margin-left: 40px;">—</span>Select the control mode.            0:Position            1:Position and speed            2:Speed            3:Speed and torque            4:Torque            5:Torque and position    <span style="margin-left: 40px;">—</span>Selection of regenerative brake option            0:Not used            1:FR-RC, FR-BU            2:MR-RB032            3:MR-RB12            4:MR-RB32            5:MR-RB30            6:MR-RB50            8:MR-RB31            9:MR-RB51         </p> <div style="border: 1px solid black; padding: 5px; margin-top: 10px;"> <p><b>POINT</b></p> <ul style="list-style-type: none"> <li>▪ Wrong setting may cause the regenerative brake option to burn.</li> <li>▪ If the regenerative brake option selected is not for use with the servo amplifier, parameter error (AL.37) occurs.</li> </ul> </div>	0		0		0000		Refer to Name and function column.	P·S·T
	0		0								
1	*OP1	<p>Function selection 1 Used to select the input signal filter, pin CN1B-19 function and absolute position detection system.</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <table border="1" style="width: 100px; text-align: center;"> <tr> <td style="width: 20px;"> </td> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> <td style="width: 20px;"> </td> </tr> </table> </div> <p> <span style="margin-left: 40px;">—</span>Input signal filter            If external input signal causes chattering due to noise, etc., input filter is used to suppress it.            0:None            1:1.777[ms]            2:3.555[ms]            3:5.333[ms]    <span style="margin-left: 40px;">—</span>CN1B-pin 19's function selection            0:Zero Speed detection signal            1:Electromagnetic brake interlock signal    <span style="margin-left: 40px;">—</span>Selection of absolute position detection system (Refer to Chapter 15)            0: Used in incremental system            1: Used in absolute position detection system         </p>		0			0002		Refer to Name and function column.	P·S·T	
	0										

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																																						
Basic parameters	2	ATU	<p>Auto tuning Used to selection the response level, etc. for execution of auto tuning. Refer to Chapter 7.</p> <div style="display: flex; align-items: center;"> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">0</div> <div style="border: 1px solid black; width: 20px; height: 20px; margin-right: 5px;"></div> <div style="border: 1px solid black; padding: 2px; margin-right: 5px;">0</div> <div style="border: 1px solid black; width: 20px; height: 20px;"></div> </div> <p style="margin-left: 40px;">Auto tuning response level setting</p> <table border="1" style="margin-left: 40px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Set value</th> <th>Response level</th> <th>Machine resonance frequency guideline</th> </tr> </thead> <tbody> <tr><td>1</td><td rowspan="5">Low 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 rowspan="5">Middle response</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 rowspan="5">High response</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> </tbody> </table> <ul style="list-style-type: none"> <li>· If the machine hunts or generates large gear sound, decrease the set value.</li> <li>· To improve performance, e.g. shorten the settling time, increase the set value.</li> </ul> <p style="margin-left: 40px;">Gain adjustment mode selection (For more information, refer to Section 7.1.1.)</p> <table border="1" style="margin-left: 40px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Set value</th> <th>Gain adjustment mode</th> <th>Description</th> </tr> </thead> <tbody> <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> </tbody> </table>	Set value	Response level	Machine resonance frequency guideline	1	Low response	15Hz	2	20Hz	3	25Hz	4	30Hz	5	35Hz	6	Middle response	45Hz	7	55Hz	8	70Hz	9	85Hz	A	105Hz	B	High response	130Hz	C	160Hz	D	200Hz	E	240Hz	F	300Hz	Set value	Gain adjustment mode	Description	0	Interpolation mode	Fixes position control gain 1 (parameter No. 6).	1	Auto tuning mode 1	Ordinary auto tuning.	2	Auto tuning mode 2	Fixes the load inertia moment ratio set in parameter No. 34. Response level setting can be changed.	3	Manual mode 1	Simple manual adjustment.	4	Manual mode 2	Manual adjustment of all gains.	0105		Refer to Name and function column.	P·S
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	3	CMX	<p>Electronic gear numerator Used to set the electronic gear numerator value. For the setting, refer to Section 5.2.1. Setting "0" automatically sets the resolution of the servo motor connected. For the HC-MFS series, 131072 pulses are set for example.</p>	1		0 1 to 65535	P																																																						
	4	CDV	<p>Electronic gear denominator Used to set the electronic gear denominator value. For the setting, refer to Section 5.2.1.</p>	1		1 to 65535	P																																																						

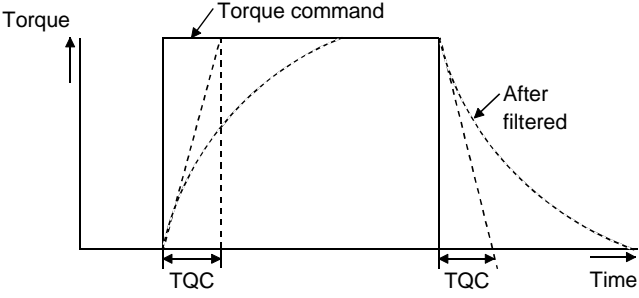
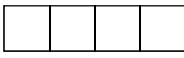
## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Basic parameters	5	INP	<p>In-position range</p> <p>Used to set the in-position signal (INP) output range in the command pulse increments prior to electronic gear calculation.</p> <p>For example, when you want to set <math>\pm 10\mu\text{m}</math> 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:</p> $\frac{10 \times 10^{-6}}{10 \times 10^{-3}} \cdot 8192 = 8.192 \approx 8$	100	pulse	0 to 10000	P
	6	PG1	<p>Position loop gain 1</p> <p>Used to set the gain of position loop.</p> <p>Increase the gain to improve trackability in response to the position command.</p> <p>When auto turning mode 1,2 is selected, the result of auto turning is automatically used.</p>	35	red/s	4 to 2000	P
	7	PST	<p>Position command acceleration/deceleration time constant (position smoothing)</p> <p>Used to set the time constant of a low pass filter in response to the position command.</p> <p>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.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p><b>POINT</b></p> <ul style="list-style-type: none"> <li>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.</li> </ul> </div> <p>Example: When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation.</p>  	3	ms	0 to 20000	P
8	SC1	<p>Internal speed command 1</p> <p>Used to set speed 1 of internal speed commands.</p> <hr/> <p>Internal speed limit 1</p> <p>Used to set speed 1 of internal speed limits.</p>	100	r/min	0 to instantaneous permissible speed	S T	

## 5. PARAMETERS

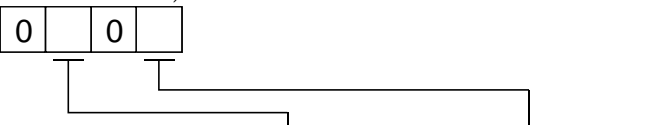
Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Basic parameters	9	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	r/min	0 to instantaneous permissible speed	S
			Internal speed limit 2 Used to set speed 2 of internal speed limits.				T
	10	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	r/min	0 to instantaneous permissible speed	S
			Internal speed limit 3 Used to set speed 3 of internal speed limits.				T
	11	STA	<p>Acceleration time constant Used to set the acceleration time required to reach the rated speed from 0r/min in response to the analog speed command and internal speed commands 1 to 7.</p> <p>If the preset speed command is lower than the rated speed, acceleration/deceleration time will be shorter.</p> <p>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.</p>	0	ms	0 to 20000	S·T
	12	STB	<p>Deceleration time constant Used to set the deceleration time required to reach 0r/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.</p>	0			
13	STC	<p>S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration.</p> <p>STA: Acceleration time constant (parameter No.11) STB: Deceleration time constant (parameter No.12) STC: S-pattern acceleration/deceleration time constant (parameter No.13)</p> <p>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.</p> <p>The upper limit value of the actual arc part time is limited by <math>\frac{2000000}{STA}</math> for acceleration or by <math>\frac{2000000}{STB}</math> for deceleration.</p> <p>(Example) At the setting of STA=20000, STB=5000 and STC=200, the actual arc part times are as follows:</p> <p>During acceleration: 100[ms] <math>\left[ \begin{array}{l} \text{Limited to 100[ms] since} \\ \frac{2000000}{20000} = 100[\text{ms}] &lt; 200[\text{ms}]. \end{array} \right.</math></p> <p>During deceleration: 200[ms] <math>\left[ \begin{array}{l} 200[\text{ms}] \text{ as set since} \\ \frac{2000000}{5000} = 400[\text{ms}] &gt; 200[\text{ms}]. \end{array} \right.</math></p>	0	ms	0 to 1000	S·T	

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Basic parameters	14	TQC	<p>Torque command time constant</p> <p>Used to set the constant of a low pass filter in response to the torque command.</p>  <p>TQC: Torque command time constant</p>	0	ms	0 to 20000	T
	15	*SNO	<p>Station number setting</p> <p>Used to specify the station number for serial communication.</p> <p>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.</p>	0	station	0 to 31	P·S·T
	16	*BPS	<p>Serial communication function selection, alarm history clear</p> <p>Used to select the serial communication baudrate, select various communication conditions, and clear the alarm history.</p>  <ul style="list-style-type: none"> <li>Serial baudrate selection <ul style="list-style-type: none"> <li>0: 9600 [bps]</li> <li>1: 19200[bps]</li> <li>2: 38400[bps]</li> <li>3: 57600[bps]</li> </ul> </li> <li>Alarm history clear <ul style="list-style-type: none"> <li>0: Invalid</li> <li>1: Valid</li> </ul> <p>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).</p> </li> <li>Serial communication standard selection <ul style="list-style-type: none"> <li>0: RS-232C used</li> <li>1: RS-485 used</li> </ul> </li> <li>Serial communication response delay time <ul style="list-style-type: none"> <li>0: Invalid</li> <li>1: Valid, reply sent after delay time of 800μs or more</li> </ul> </li> </ul>	0000		Refer to Name and function column.	P·S·T



## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																									
Basic parameters	17	MOD	<p>Analog monitor output Used to selection the signal provided to the analog monitor output. (Refer to Section 5.3)</p> <div style="display: flex; align-items: center; margin-bottom: 5px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"></div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"></div> </div>  <table border="1" style="margin-left: 40px; margin-top: 10px;"> <thead> <tr> <th rowspan="2">Setting</th> <th colspan="2">Analog monitor output selection</th> </tr> <tr> <th>ch2</th> <th>ch1</th> </tr> </thead> <tbody> <tr> <td>0</td> <td colspan="2">Servo motor speed (<math>\pm 8V/\text{max. speed}</math>)</td> </tr> <tr> <td>1</td> <td colspan="2">Torque (<math>\pm 8V/\text{max. torque}</math>)</td> </tr> <tr> <td>2</td> <td colspan="2">Motor speed (<math>+8V/\text{max. speed}</math>)</td> </tr> <tr> <td>3</td> <td colspan="2">Torque (<math>+8V/\text{max. torque}</math>)</td> </tr> <tr> <td>4</td> <td colspan="2">Current command (<math>\pm 8V/\text{max. current command}</math>)</td> </tr> <tr> <td>5</td> <td colspan="2">Command pulse frequency (<math>\pm 10V/500\text{kpulse/s}</math>)</td> </tr> <tr> <td>6</td> <td colspan="2">Droop pulses (<math>\pm 10V/128</math> pulses)</td> </tr> <tr> <td>7</td> <td colspan="2">Droop pulses (<math>\pm 10V/2048</math> pulses)</td> </tr> <tr> <td>8</td> <td colspan="2">Droop pulses (<math>\pm 10V/8192</math> pulses)</td> </tr> <tr> <td>9</td> <td colspan="2">Droop pulses (<math>\pm 10V/32768</math> pulses)</td> </tr> <tr> <td>A</td> <td colspan="2">Droop pulses (<math>\pm 10V/131072</math> pulses)</td> </tr> <tr> <td>B</td> <td colspan="2">Bus voltage (<math>+8V/400V</math>)</td> </tr> </tbody> </table>	Setting	Analog monitor output selection		ch2	ch1	0	Servo motor speed ( $\pm 8V/\text{max. speed}$ )		1	Torque ( $\pm 8V/\text{max. torque}$ )		2	Motor speed ( $+8V/\text{max. speed}$ )		3	Torque ( $+8V/\text{max. torque}$ )		4	Current command ( $\pm 8V/\text{max. current command}$ )		5	Command pulse frequency ( $\pm 10V/500\text{kpulse/s}$ )		6	Droop pulses ( $\pm 10V/128$ pulses)		7	Droop pulses ( $\pm 10V/2048$ pulses)		8	Droop pulses ( $\pm 10V/8192$ pulses)		9	Droop pulses ( $\pm 10V/32768$ pulses)		A	Droop pulses ( $\pm 10V/131072$ pulses)		B	Bus voltage ( $+8V/400V$ )		0100		Refer to Name and function column.	P•S•T
	Setting	Analog monitor output selection																																														
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## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode														
Basic parameters	18	*DMD	<p>Status display selection</p> <p>Used to select the status display shown at power-on.</p> <div style="display: flex; align-items: center; gap: 5px;"> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px;"> </div> </div> <p>Selection of status display at power-on</p> <ul style="list-style-type: none"> <li>0: Cumulative feedback pulses</li> <li>1: Servo motor speed</li> <li>2: Droop pulses</li> <li>3: Cumulative command pulses</li> <li>4: Command pulse frequency</li> <li>5: Analog speed command voltage (Note 1)</li> <li>6: Analog torque command voltage (Note 2)</li> <li>7: Regenerative load ratio</li> <li>8: Effective load ratio</li> <li>9: Peak load ratio</li> <li>A: Instantaneous torque</li> <li>B: Within one-revolution position low</li> <li>C: Within one-revolution position high</li> <li>D: ABS counter</li> <li>E: Load inertia moment ratio</li> <li>F: Bus voltage</li> </ul> <p>Note: 1. In speed control mode. Analog speed limit voltage in torque control mode.</p> <p>2. In torque control mode. Analog torque limit voltage in speed or position control mode.</p> <p>Status display at power-on in corresponding control mode</p> <p>0: Depends on the control mode.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">Control Mode</th> <th>Status display at power-on</th> </tr> </thead> <tbody> <tr> <td>Position</td> <td>Cumulative feedback pulses</td> </tr> <tr> <td>Position/speed</td> <td>Cumulative feedback pulses/servo motor speed</td> </tr> <tr> <td>Speed</td> <td>Servo motor speed</td> </tr> <tr> <td>Speed/torque</td> <td>Servo motor speed/analog torque command voltage</td> </tr> <tr> <td>Torque</td> <td>Analog torque command voltage</td> </tr> <tr> <td>Torque/position</td> <td>Analog torque command voltage/cumulative feedback pulses</td> </tr> </tbody> </table> <p>1: Depends on the first digit setting of this parameter.</p>	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	0000		Refer to Name and function column.	P•S•T
			Control Mode	Status display at power-on																	
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## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																																																													
Basic parameters	19	*BLK	Parameter block Used to select the reference and write ranges of the parameters. Operation can be performed for the parameters marked ○.	0000		Refer to Name and function column.	P·S·T																																																																													
			<table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table>					Set value	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		
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	Write	No. 19 only																																																																																		
Expansion parameters 1	20	*OP2	Function selection 2 Used to select restart after instantaneous power failure, servo lock at a stop in speed control mode, and slight vibration suppression control.	0000		Refer to Name and function column.																																																																														
			<p>Restart after instantaneous power failure            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.            0: Invalid            1: Valid</p> <p>Stop-time servo lock selection            The shaft can be servo-locked to remain still at a stop in the speed control mode.            0: Valid            1: Invalid</p> <p>Slight vibration suppression control            Made valid when auto tuning selection is set to "0400" in parameter No. 2.            Used to suppress vibration at a stop.            0: Invalid            1: Valid</p>			S	P																																																																													

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode															
Expansion parameters 1	21	*OP3	<p>Function selection 3 (Command pulse selection)</p> <p>Used to select the input form of the pulse train input signal. (Refer to Section 3.4.1.)</p> <div style="display: flex; align-items: center;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">0</td> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> <td style="width: 20px;"> </td> </tr> </table> <div style="margin-left: 10px;"> <p>— Command pulse train input form 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A/B phase pulse train</p> <p>— Pulse train logic selection 0: Positive logic 1: Negative logic</p> </div> </div>	0	0			0000		Refer to Name and function column.	P											
	0	0																				
22	*OP4	<p>Function selection 4</p> <p>Used to select stop processing at LSP/LSN signal off and choose VC/VLA voltage averaging.</p> <div style="display: flex; align-items: center;"> <table border="1" style="border-collapse: collapse; text-align: center;"> <tr> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> <td style="width: 20px;">0</td> <td style="width: 20px;"> </td> </tr> </table> <div style="margin-left: 10px;"> <p>— How to make a stop when LSP/LSN signal is valid. (Refer to Section 5.2.3.) 0: Sudden stop 1: Slow stop</p> <p>— VC/VLA voltage averaging Used to set the filtering time when the analog speed command (VC) voltage or analog speed limit (VLA) is imported. Set 0 to vary the speed to voltage fluctuation in real time. Increase the set value to vary the speed slower to voltage fluctuation.</p> </div> </div> <table border="1" style="margin-top: 10px; width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Set value</th> <th>Filtering time [ms]</th> </tr> </thead> <tbody> <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> </tbody> </table>	0		0		Set value	Filtering time [ms]	0	0	1	0.444	2	0.888	3	1.777	4	3.555	0000		Refer to Name and function column.	P·S  P·S·T
0		0																				
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## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode					
Expansion parameters 1	23	FFC	<p>Feed forward gain</p> <p>Used to set the feed forward gain.</p> <p>At the setting of 100%, droop pulses during constant-speed operation will be almost "zero".</p> <p>Note that sudden acceleration/deceleration will increase overshoot.</p> <p>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%.</p>	0	%	0 to 100	P					
	24	ZSP	<p>Zero speed</p> <p>Used to set the output range of the zero speed signal (ZSP).</p>	50	r/min	0 to 10000	P•S•T					
	25	VCM	<p>Analog speed command maximum speed</p> <p>Used to set the speed at the maximum input voltage (10V) of the analog speed command (VC).</p> <p>Set "0" to select the rated speed of the servo motor connected.</p>	0	r/min	0 to 50000	S					
			<p>Analog speed limit maximum speed</p> <p>Used to set the speed at the maximum input voltage (10V) of the analog speed limit (VLA).</p> <p>Set "0" to select the rated speed of the servo motor connected.</p>	0	r/min	0 to 50000	T					
	26	TLC	<p>Analog torque command maximum output</p> <p>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.</p>	100	%	0 to 1000	T					
	27	*ENR	<p>Encoder output pulses</p> <p>Used to set the encoder pulses (A-phase, B-phase) output by the servo amplifier.</p> <p>Set the value 4 times greater than the A-phase or B-phase pulses.</p> <p>You can use parameter No. 54 to choose the output pulse setting or output division ratio setting.</p> <p>The number of A/B-phase pulses actually output is 1/4 times greater than the preset number of pulses.</p> <p>The maximum output frequency is 1.3Mpps (after multiplication by 4). Use this parameter within this range.</p> <ul style="list-style-type: none"> <li>For output pulse designation           <p>Set "0□□□" (initial value) in parameter No. 54.</p> <p>Set the number of pulses per servo motor revolution.</p> <p>Output pulse = set value [pulses/rev]</p> <p>At the setting of 5600, for example, the actually output A/B-phase pulses are as indicated below:</p> <math display="block">A \cdot B\text{-phase output pulses} = \frac{5600}{4} = 1400[\text{pulse}]</math> </li> <li>For output division ratio setting           <p>Set "1□□□" in parameter No. 54.</p> <p>The number of pulses per servo motor revolution is divided by the set value.</p> <math display="block">\text{Output pulse} = \frac{\text{Resolution per servo motor revolution}}{\text{Set value}} [\text{pulses/rev}]</math> <p>At the setting of 8, for example, the actually output A/B-phase pulses are as indicated below:</p> <math display="block">A \cdot B\text{-phase output pulses} = \frac{131072}{8} \cdot \frac{1}{4} = 4096[\text{pulse}]</math> </li> </ul>	4000	pulse/rev	1 to 65535	P•S•T					
28	TL1	<p>Internal torque limit 1</p> <p>Set this parameter to limit servo motor-generated torque on the assumption that the maximum torque is 100[%].</p> <p>When 0 is set, torque is not produced.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;">(Note) TL</th> <th style="text-align: center;">Torque limit</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">0</td> <td>Internal torque limit 1 (Parameter No. 28)</td> </tr> <tr> <td style="text-align: center;">1</td> <td>Analog torque limit &lt; internal torque limit 1 : Analog torque limit Analog torque limit &gt; internal torque limit 1 : Internal torque limit 1</td> </tr> </tbody> </table> <p>Note.0 :TL-SG off (open) 1 :TL-SG on(short)</p> <p>When torque is output in analog monitor output, this set value is the maximum output voltage (+8V). (Refer to Section 3.4.1, (5))</p>	(Note) TL	Torque limit	0	Internal torque limit 1 (Parameter No. 28)	1	Analog torque limit < internal torque limit 1 : Analog torque limit Analog torque limit > internal torque limit 1 : Internal torque limit 1	100	%	0 to 100	P•S•T
(Note) TL	Torque limit											
0	Internal torque limit 1 (Parameter No. 28)											
1	Analog torque limit < internal torque limit 1 : Analog torque limit Analog torque limit > internal torque limit 1 : Internal torque limit 1											

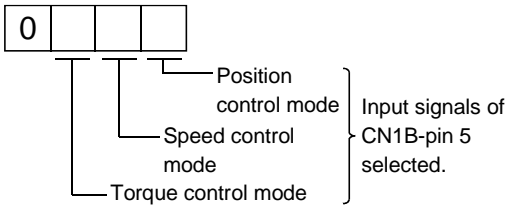
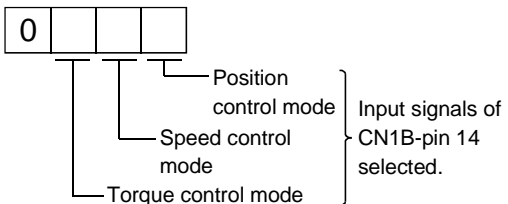
## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Expansion parameters 1	29	VCO	Analog speed command offset Used to set the offset voltage of the analog speed command (VC). For example, if CCW rotation is provided by switching on forward rotation start (ST1) with 0V applied to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to Section6.3.) 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 Used to set the offset voltage of the analog speed limit (VLA). For example, if CCW rotation is provided by switching on forward rotation selection (RS1) with 0V applied to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to Section6.3.) 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 Used to set the offset voltage of the analog torque command (TC).	0	mV	-999 to 999	T
			Analog torque limit offset Used to set the offset voltage of the analog torque limit (TLA).				S
	31	MO1	Analog monitor 1 offset 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 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 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 Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used. (Refer to section 7.1.1) In this case, it varies between 0 and 1000.	70	0.1 times	0 to 3000	P·S
	35	PG2	Position loop gain 2 Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1,2 and interpolation mode is selected, the result of auto tuning is automatically used.	35	rad/s	1 to 1000	P
	36	VG1	Speed loop gain 1 Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. 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 Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 · 2 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 Used to set the integral time constant of the speed loop. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 · 2 and interpolation mode is selected, the result of auto tuning is automatically used.	48	ms	1 to 1000	P·S	

## 5. PARAMETERS

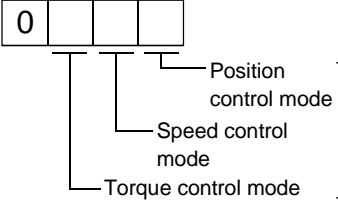
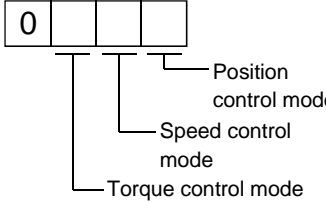
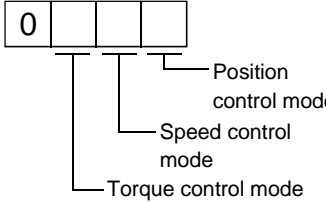
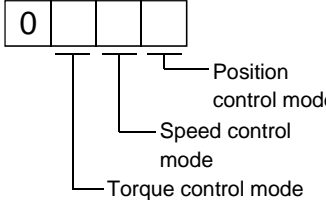
Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																	
Expansion parameters 1	39	VDC	Speed differential compensation Used to set the differential compensation. Made valid when the proportion control signal is switched on.	980		0 to 1000	P·S																	
	40		For manufacturer setting Must not be changed.	0																				
	41	*DIA	Input signal automatic ON selection Used to set automatic ON of SON, LSP and LSN.  <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td>0</td><td></td><td></td><td></td></tr> </table> <ul style="list-style-type: none"> <li>— Servo-on signal (SON) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring)</li> <li>— Forward rotation stroke end signal (LSP) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring)</li> <li>— Reverse rotation stroke end signal (LSN) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring)</li> </ul>	0				0000		Refer to Name and function column.	P·S·T  ----- P·S													
0																								
42	*DI1	Input signal selection 1 Used to assign the control mode changing signal input pins and to set the clear signal.  <table border="1" style="display: inline-table; vertical-align: middle;"> <tr><td>0</td><td>0</td><td></td><td></td></tr> </table> <ul style="list-style-type: none"> <li>— Control change signal (LOP) input pin assignment 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.   <table border="1" style="display: inline-table; vertical-align: middle;"> <thead> <tr> <th>Set value</th> <th>Connector pin No.</th> </tr> </thead> <tbody> <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> </tbody> </table> </li> <li>— Clear signal (CR) selection 0: Droop pulses are cleared on the leading edge. 1: While on, droop pulses are always cleared.</li> </ul>	0	0			Set value	Connector pin No.	0	CN1B-5	1	CN1B-14	2	CN1A-8	3	CN1B-7	4	CN1B-8	5	CN1B-9	0003		Refer to Name and function column.	----- P/S S/T T/P  ----- P·S·T
0	0																							
Set value	Connector pin No.																							
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## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																																																			
Expansion parameters 1	43	*DI2	<p>Input signal selection 2 (CN1B-5)</p> <p>This parameter is unavailable when parameter No.42 is set to assign the control change signal (LOP) to CN1B-pin 5.</p> <p>Allows any input signal to be assigned to CN1B-pin 5.</p> <p>Note that the setting digit and assigned signal differ according to the control mode.</p>  <p>Signals that may be assigned in each control mode are indicated below by their symbols.</p> <p>Setting of any other signal will be invalid.</p> <table border="1" data-bbox="406 795 1053 1444"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <p>Note: P: Position control mode S: Speed control mode T: Torque control mode</p>	Set value	(Note) Control mode			P	S	T	0	/	/	/	1	SON	SON	SON	2	RES	RES	RES	3	PC	PC	/	4	TL	TL	/	5	CR	CR	CR	6	/	SP1	SP1	7	/	SP2	SP2	8	/	ST1	RS2	9	/	ST2	RS1	A	/	SP3	SP3	B	CM1	/	/	C	CM2	/	/	D	TL1	TL1	TL1	E	CDP	CDP	CDP	0111		Refer to Name and function column.	P•S•T
	Set value	(Note) Control mode																																																																								
P		S	T																																																																							
0	/	/	/																																																																							
1	SON	SON	SON																																																																							
2	RES	RES	RES																																																																							
3	PC	PC	/																																																																							
4	TL	TL	/																																																																							
5	CR	CR	CR																																																																							
6	/	SP1	SP1																																																																							
7	/	SP2	SP2																																																																							
8	/	ST1	RS2																																																																							
9	/	ST2	RS1																																																																							
A	/	SP3	SP3																																																																							
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C	CM2	/	/																																																																							
D	TL1	TL1	TL1																																																																							
E	CDP	CDP	CDP																																																																							
	44	*DI3	<p>Input signal selection 3 (CN1B-14)</p> <p>Allows any input signal to be assigned to CN1B-pin 14.</p> <p>The assignable signals and setting method are the same as in input signal selection 2 (parameter No. 43).</p>  <p>This parameter is unavailable when parameter No. 42 is set to assign the control change signal (LOP) to CN1B-pin 14.</p>	0222		Refer to Name and function column.	P•S•T																																																																			



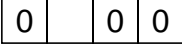

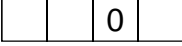
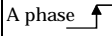
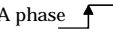


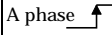
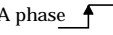





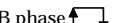


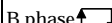
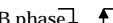
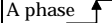
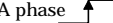
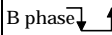

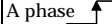
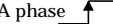
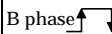
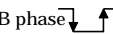
## 5. PARAMETERS

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

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																																																																																										
Expansion parameters 1	49	*DO1	<p>Output signal selection 1</p> <p>Used to select the connector pins to output the alarm code, warning (WNG) and battery warning (BWNG).</p> <p>0 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/></p> <p>Setting of alarm code output</p> <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <table border="1"> <thead> <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> </thead> <tbody> <tr> <td rowspan="8">0</td> <td rowspan="8">0</td> <td rowspan="8">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 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 rowspan="2">0</td> <td rowspan="2">1</td> <td rowspan="2">0</td> <td>AL.10</td> <td>Undervoltage</td> </tr> <tr> <td>AL.45</td> <td>Main circuit device overheat</td> </tr> <tr> <td rowspan="3">0</td> <td rowspan="3">1</td> <td rowspan="3">1</td> <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> </tbody> </table> <p>Note: 0:Pin-SG off (open) 1:Pin-SG on (short)</p> <p>Setting of warning (WNG) output</p> <p>Select the connector pin to output warning. The old signal before selection will be unavailable.</p> <table border="1"> <thead> <tr> <th>Set value</th> <th>Connector pin No.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p>Setting of battery warning (BWNG) output</p> <p>Select the connector pin to output battery warning. The old signal before selection will be unavailable. Set this function as in the second digit of this parameter. Parameter No. 1 setting has priority.</p>	Set value	Connector pins			CN1B-19	CN1A-18	CN1A-19	0	ZSP	INP or SA	RD	1	Alarm code is output at alarm occurrence.			(Note) Alarm code			Alarm display	Name	CN1B pin 19	CN1A pin 18	CN1A pin 19	0	0	0	88888	Watchdog	AL.12	Memory error 1	AL.13	Clock error	AL.15	Memory error 2	AL.17	Board error 2	AL.19	Memory error 3	AL.37	Parameter error	AL.8A	Serial communication time-out error	0	0	1	AL.30	Regenerative error	AL.33	Overvoltage	0	1	0	AL.10	Undervoltage	AL.45	Main circuit device overheat	0	1	1	AL.46	Servo motor overheat	AL.50	Overload 1	AL.51	Overload 2	1	0	0	AL.24	Main circuit	AL.32	Overcurrent	1	0	1	AL.31	Overspeed	AL.35	Command pulse frequency error	AL.52	Error excessive	1	1	0	AL.16	Encoder error 1	AL.1A	Motor combination error	AL.20	Encoder error 2	AL.25	Absolute position erase	Set value	Connector pin No.	0	Not output.	1	CN1A-19	2	CN1B-18	3	CN1A-18	4	CN1B-19	5	CN1B-6	0000		Refer to Name and function column.	P·S·T
	Set value	Connector pins																																																																																																															
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## 5. PARAMETERS

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

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode																																																																																					
Expansion parameters 2	55	*OPA	Function selection A Used to select the position command acceleration/deceleration time constant (parameter No. 7) control system. <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px;">0</div> </div> <div style="margin-left: 20px; margin-top: 10px;">           Position command acceleration/deceleration time constant control            0: Primary delay            1: Linear acceleration/deceleration         </div>	0000		Refer to Name and function column.	P																																																																																					
	56	SIC	Serial communication time-out selection Used to set the communication protocol time-out period in [s]. When you set "0", time-out check is not made.	0		0	P·S·T																																																																																					
	57		For manufacturer setting Must not be changed.	10		s 1 to 60																																																																																						
	58	NH1	Machine resonance suppression filter 1 Used to selection the machine resonance suppression filter. (Refer to Section 8.1.) <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px;"> </div> </div> <div style="margin-left: 20px; margin-top: 10px;">           Notch frequency selection            Set "00" when you have set adaptive vibration suppression control to be "valid" or "held"            (parameter No. 60: <input type="checkbox"/>1<input type="checkbox"/><input type="checkbox"/> or <input type="checkbox"/>2<input type="checkbox"/><input type="checkbox"/>).         </div> <table border="1" style="margin-left: 20px; margin-top: 10px; border-collapse: collapse; text-align: center;"> <thead> <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> </thead> <tbody> <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> </tbody> </table> <div style="margin-left: 20px; margin-top: 10px;">           Notch depth selection           <table border="1" style="margin-left: 20px; margin-top: 5px; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>Setting value</th> <th>Depth</th> <th>Gain</th> </tr> </thead> <tbody> <tr> <td>0</td> <td rowspan="2">Deep</td> <td>-40dB</td> </tr> <tr> <td>1</td> <td>-14dB</td> </tr> <tr> <td>2</td> <td rowspan="2">Shallow</td> <td>-8dB</td> </tr> <tr> <td>3</td> <td>-4dB</td> </tr> </tbody> </table> </div>	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	Setting value	Depth	Gain	0	Deep	-40dB	1	-14dB	2	Shallow	-8dB	3	-4dB	0000		Refer to Name and function column.	P·S·T
	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																																																																																					
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1		-14dB																																																																																										
2	Shallow	-8dB																																																																																										
3		-4dB																																																																																										
59	NH2	Machine resonance suppression filter 2 Used to set the machine resonance suppression filter. <div style="display: flex; align-items: center; margin-top: 10px;"> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;">0</div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px; margin-right: 5px;"> </div> <div style="border: 1px solid black; padding: 2px 5px;"> </div> </div> <div style="margin-left: 20px; margin-top: 10px;">           Notch frequency            Same setting as in parameter No. 58            However, you need not set "00" if you have set adaptive vibration suppression control to be "valid" or "held".            Notch depth            Same setting as in parameter No. 58         </div>	0000		Refer to Name and function column.	P·S·T																																																																																						

## 5. PARAMETERS

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

## 5. PARAMETERS

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode				
Expansion parameters 2	65	*CDP	<p>Gain changing selection Used to select the gain changing condition. (Refer to Section 8.3.)</p> <table border="1" style="margin-left: 20px;"> <tr> <td style="width: 20px; height: 20px; text-align: center;">0</td> <td style="width: 20px; height: 20px; text-align: center;">0</td> <td style="width: 20px; height: 20px; text-align: center;">0</td> <td style="width: 20px; height: 20px;"></td> </tr> </table> <p style="margin-left: 40px;">└ 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) 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</p>	0	0	0		0000		Refer to Name and function column.	P·S
	0	0	0								
	66	CDS	<p>Gain changing condition 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.)</p>	10	kpps pulse r/min	10 to 9999	P·S				
	67	CDT	<p>Gain changing time constant Used to set the time constant at which the gains will change in response to the conditions set in parameters No. 65 and 66. (Refer to Section 8.3.)</p>	1	ms	0 to 100	P·S				
	68		<p>For manufacturer setting Must not be changed.</p>	0							
	69	CMX2	<p>Command pulse multiplying factor numerator 2 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.</p>	1		0·1 to 65535	P				
	70	CMX3	<p>Command pulse multiplying factor numerator 3 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.</p>	1		0·1 to 65535	P				
	71	CMX4	<p>Command pulse multiplying factor numerator 4 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.</p>	1		0·1 to 65535	P				
72	SC4	<p>Internal speed command 4 Used to set speed 4 of internal speed commands.</p>	200	r/min	0 to instantaneous permissible speed	S					
		<p>Internal speed limit 4 Used to set speed 4 of internal speed limits.</p>				T					

## 5. PARAMETERS

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

## 5. PARAMETERS

### 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  $\frac{1}{50} < \frac{CMX}{CDV} < 500$ .

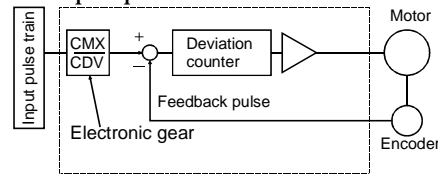
If the set value is outside this range, noise may be generated during acceleration/ deceleration or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.

- 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]  
 $\Delta \theta^\circ$  : Angle per pulse [ $^\circ$ /pulse]  
 $\Delta \Theta$  : Angle per revolution [ $^\circ$ /rev]

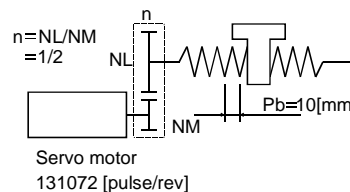
#### (a) For motion in increments of 10 $\mu$ m per pulse

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.



## 5. PARAMETERS

### (b) Conveyor setting example

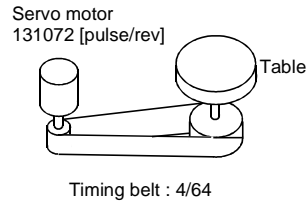
For rotation in increments of  $0.01^\circ$  per pulse

Machine specifications

Table :  $360^\circ$  /rev

Reduction ratio:  $n = 4/64$

Servo motor resolution:  $Pt = 131072$  [pulses/rev]



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

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
<p>For unlimited one-way rotation, e.g. an index table, indexing positions will be missed due to cumulative error produced by rounding off.</p> <p>For example, entering a command of 36000 pulses in the above example causes the table to rotate only:</p> $36000 \cdot \frac{26214}{450} \cdot \frac{1}{131072} \cdot \frac{4}{64} \cdot 360^\circ = 359.995^\circ$ <p>Therefore, indexing cannot be done in the same position on the table.</p>

### (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.

$$\frac{CMX}{CDV} = \frac{65536}{1125} = 58.25422 \dots\dots\dots (5.2)$$

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

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

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

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

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.

## 5. PARAMETERS

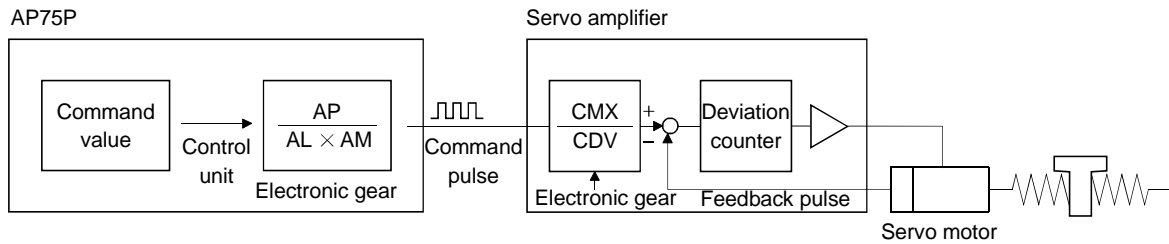
### (3) Setting for use of AD75P

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	$131072 \times 2000/60 = 4369066$ pulse/s
3000	$131072 \times 3000/60 = 6553600$ 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.

## 5. PARAMETERS

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<sub>0</sub> : 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. PARAMETERS

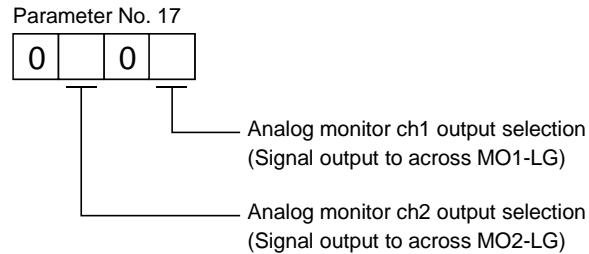
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### 5.2.2 Analog output

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  $999$ mV.

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.	

## 5. PARAMETERS

### (2) Set content

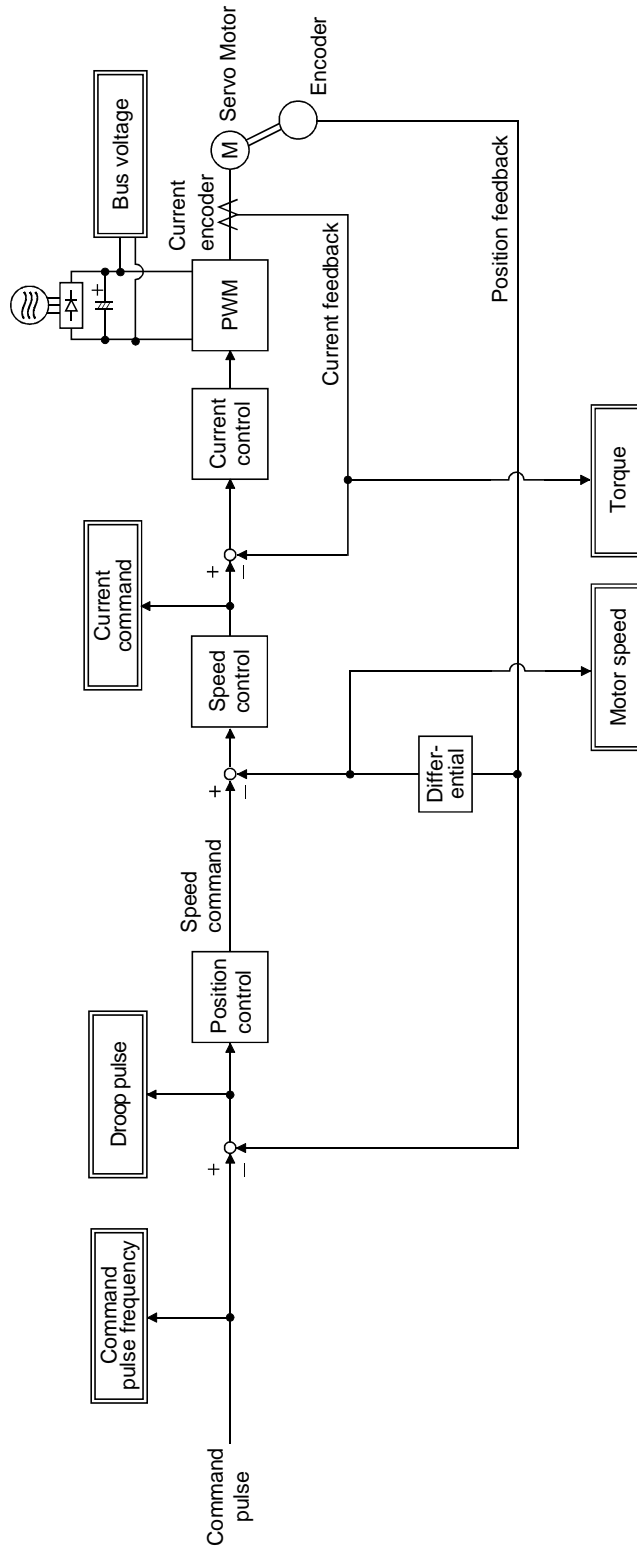
The servo amplifier is factory-set to output the motor speed to ch1 and the torque to ch2. The setting can be changed as listed below by changing the parameter No.17 value:

Refer to Appendix 2 for the measurement point.

Setting	Output item	Description	Setting	Output item	Description
0	Motor speed		6	Droop pulses ( $\pm 10V/128$ pulse)	
1	Torque		7	Droop pulses ( $\pm 10V/2048$ pulse)	
2	Motor speed		8	Droop pulses ( $\pm 10V/8192$ pulse)	
3	Torque		9	Droop pulses ( $\pm 10V/32768$ pulse)	
4	Current command (Torque command)		A	Droop pulses ( $\pm 10V/131072$ pulse)	
5	Command pulse frequency		B	Bus voltage	

# 5. PARAMETERS

(3) Analog monitor block diagram



## 5. PARAMETERS

### 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 (initial value)	<b>Sudden stop</b> Position control mode : Motor stops with droop pulses cleared. Speed control mode : Motor stops at deceleration time constant of zero.
□□□1	<b>Slow stop</b> Position control mode : The motor is decelerated to a stop in accordance with the parameter No. 7 value. 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.

Parameter No.16

—	—	□	—
---	---	---	---

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

## 5. PARAMETERS

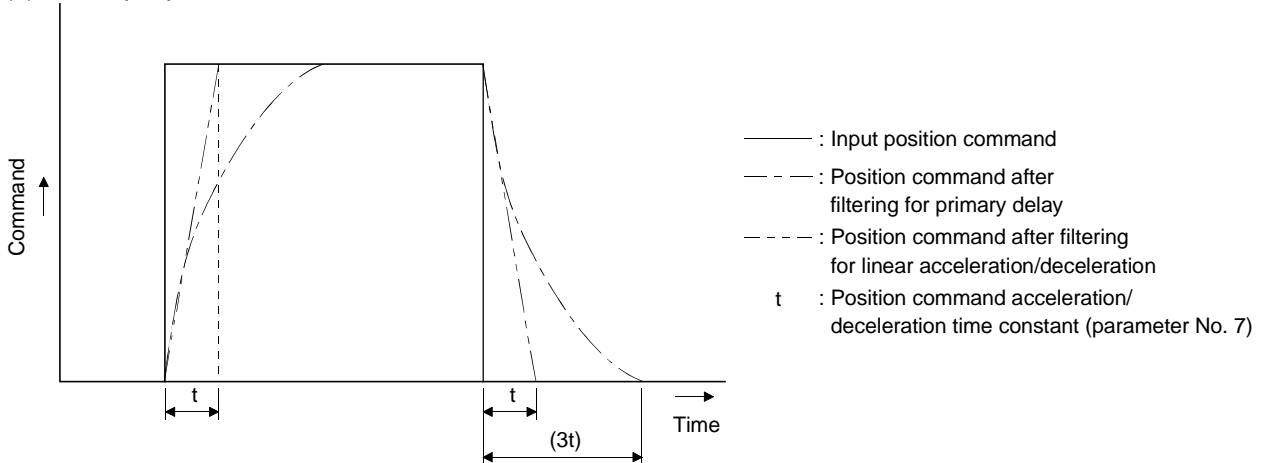
### 5.2.5 Position smoothing

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.

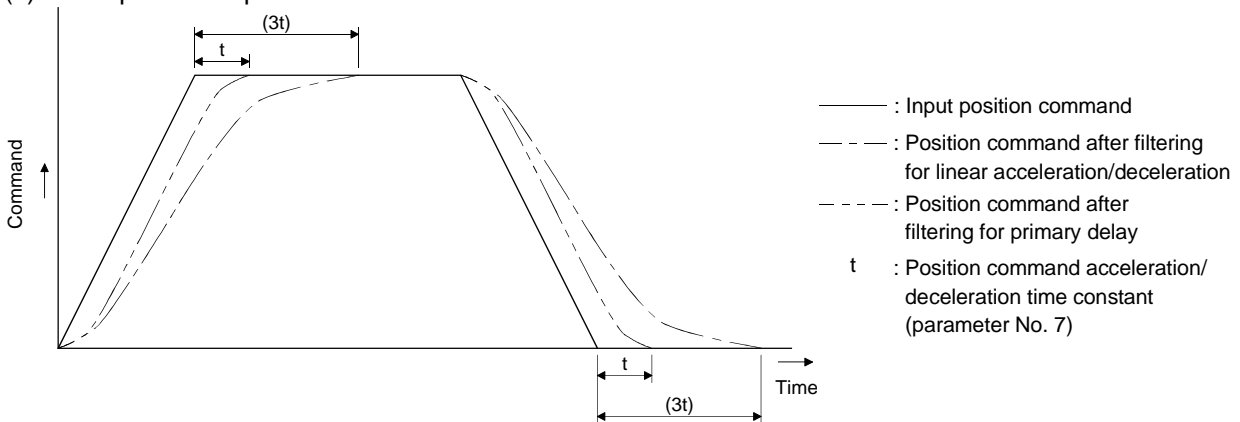
The following diagrams show the operation patterns of the servo motor in response to a position command when you have set the position command acceleration/deceleration time constant.

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







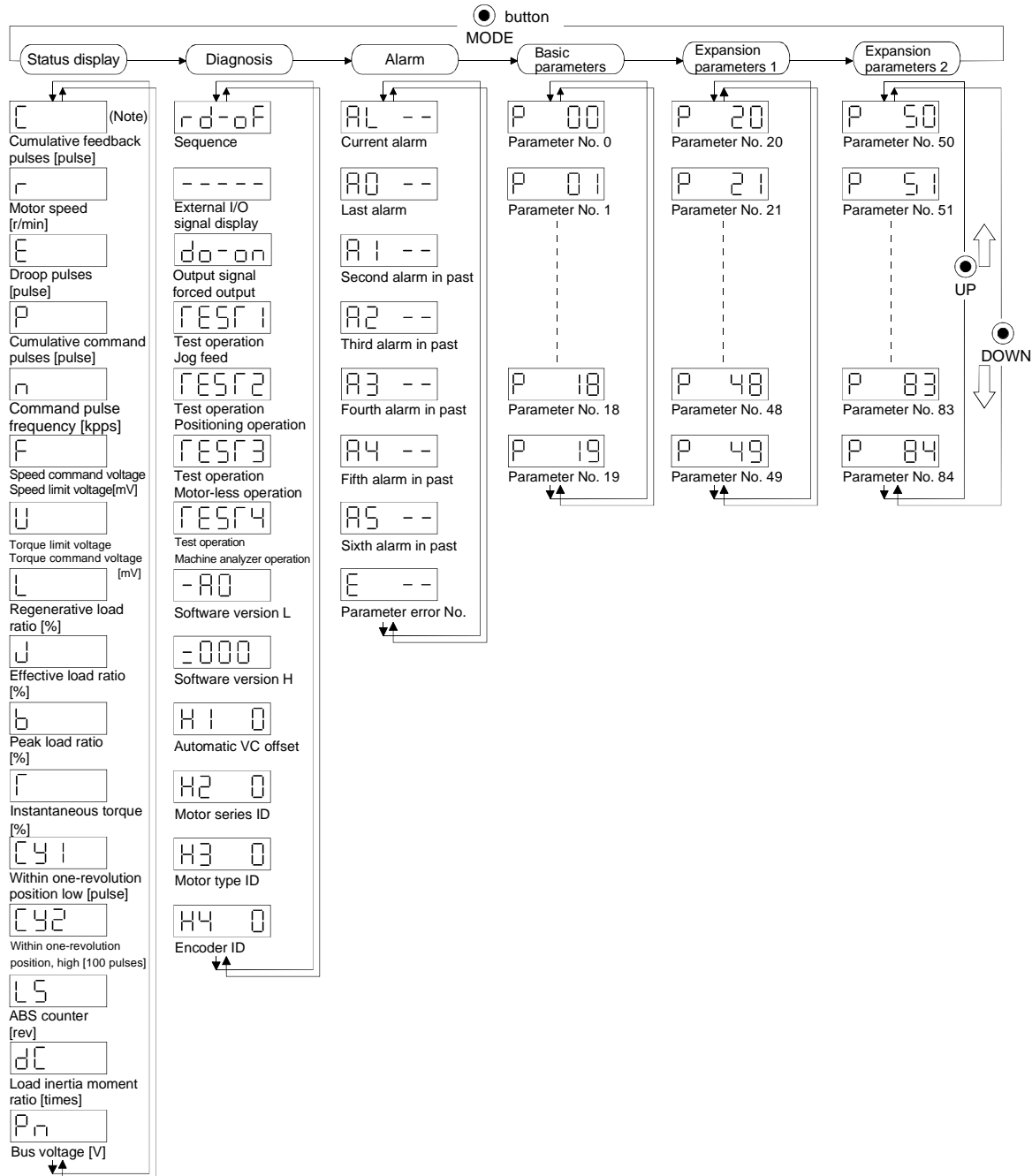
# 6. DISPLAY AND OPERATION

## 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. DISPLAY AND OPERATION

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

## 6. DISPLAY AND OPERATION

### 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 $\pm 99999$ 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. 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. The value rounded off is displayed in $\times 0.1$ r/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. Since the servo amplifier display is five digits, it shows the lower five digits of the actual value. 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. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. The value in excess of $\pm 99999$ is counted, but since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit.	-99999 to 99999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).	-800 to 800
Analog speed command voltage Analog speed limit voltage	F	V	(1) Torque control mode Analog speed limit (VLA) voltage is displayed. (2) Speed control mode Analog speed command (VC) voltage is displayed.	-10.00 to 10.00
Analog torque command voltage Analog torque limit voltage	U	V	(1) Position control mode, speed control mode Analog torque limit (TLA) voltage is displayed. (2) Torque control mode Analog torque command (TLA) voltage is displayed.	0 to +10V  -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. 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. The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Instantaneous torque	T	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rated torque of 100%.	0 to 400
Within one-revolution position low	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 99999

## 6. DISPLAY AND OPERATION

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


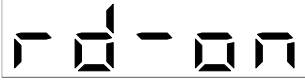
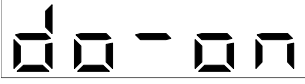



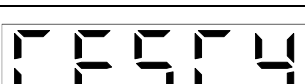



The status display item of the servo amplifier display shown at power-on can be changed by changing the parameter No. 18 settings.

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. DISPLAY AND OPERATION

### 6.3 Diagnostic mode

Name		Display	Description
Sequence			Not ready. Indicates that the servo amplifier is being initialized or an alarm has occurred.
			Ready. Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
External I/O signal display		Refer to section 6.6.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF 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. 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. 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. 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. 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. 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. 1) Press "SET" once. 2) Set the number in the first digit to 1 with "UP"/"DOWN". 3) Press "SET". You cannot use this function if the input voltage of VC or VLA is $\pm 0.4V$ or more.

## 6. DISPLAY AND OPERATION






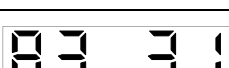

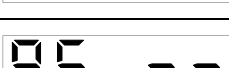
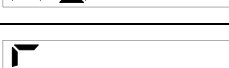
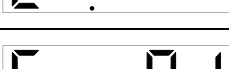
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Name	Display	Description
Motor series		Press the "SET" button to show the motor series ID of the servo motor currently connected. For indication details, refer to the optional MELSERVO Servo Motor Instruction Manual.
Motor type		Press the "SET" button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

## 6. DISPLAY AND OPERATION

### 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). 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. DISPLAY AND OPERATION

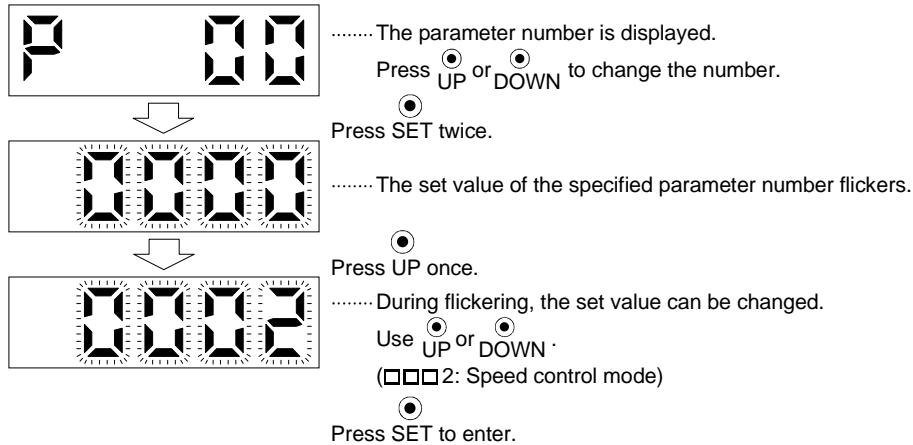
### 6.5 Parameter mode

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.



To shift to the next parameter, press the 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. DISPLAY AND OPERATION

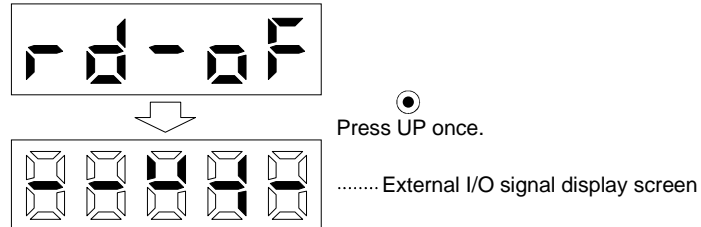
### 6.6 External I/O signal display

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

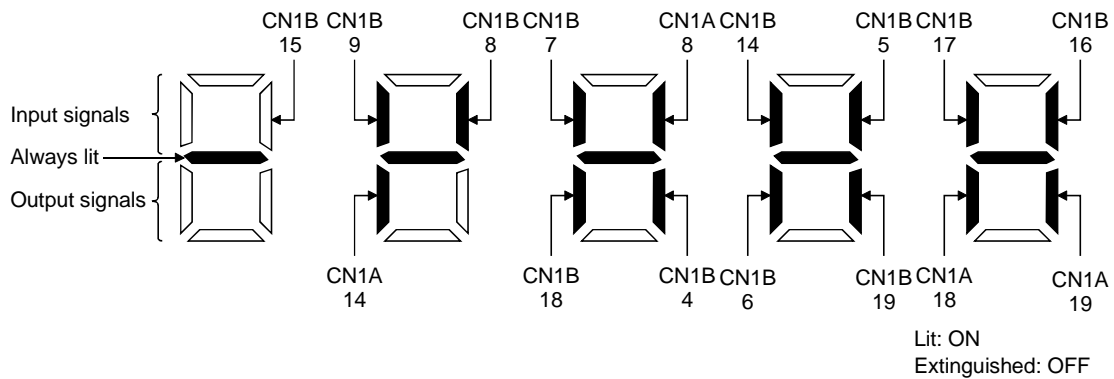
#### (1) Operation

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:

## 6. DISPLAY AND OPERATION

### (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.

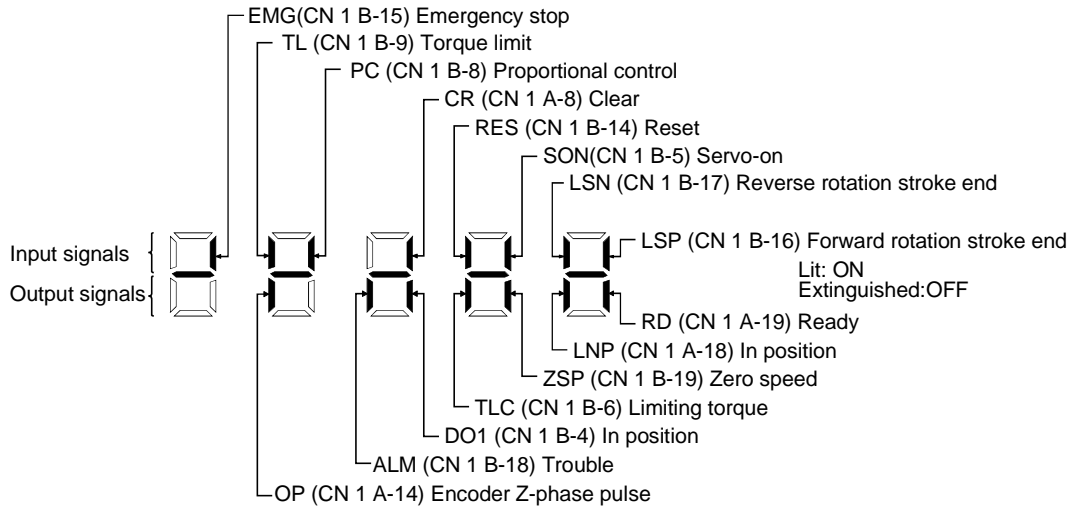
### (b) Symbol and signal names

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		

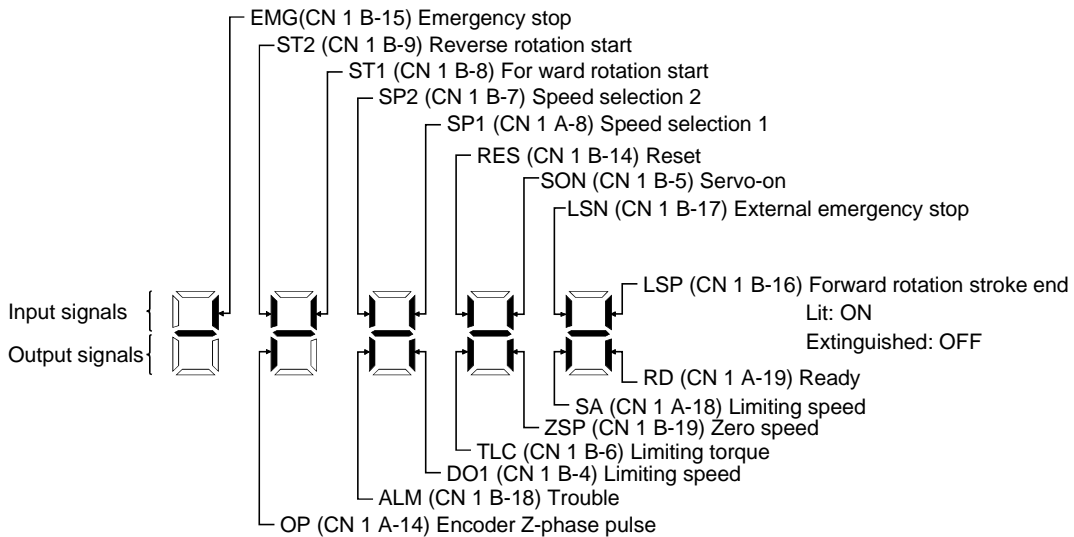
## 6. DISPLAY AND OPERATION

### (3) Default signal indications

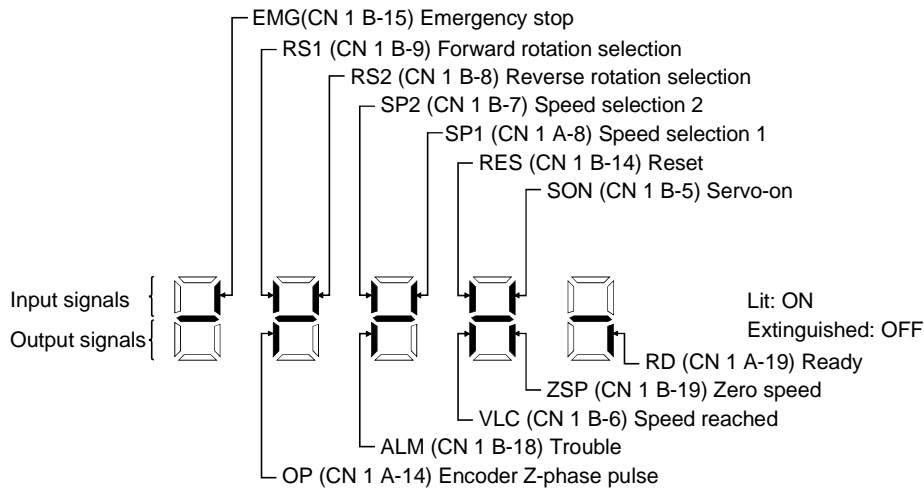
#### (a) Position control mode



#### (b) Speed control mode



#### (c) Torque control mode



## 6. DISPLAY AND OPERATION

### 6.7 Output signal (DO) forced output

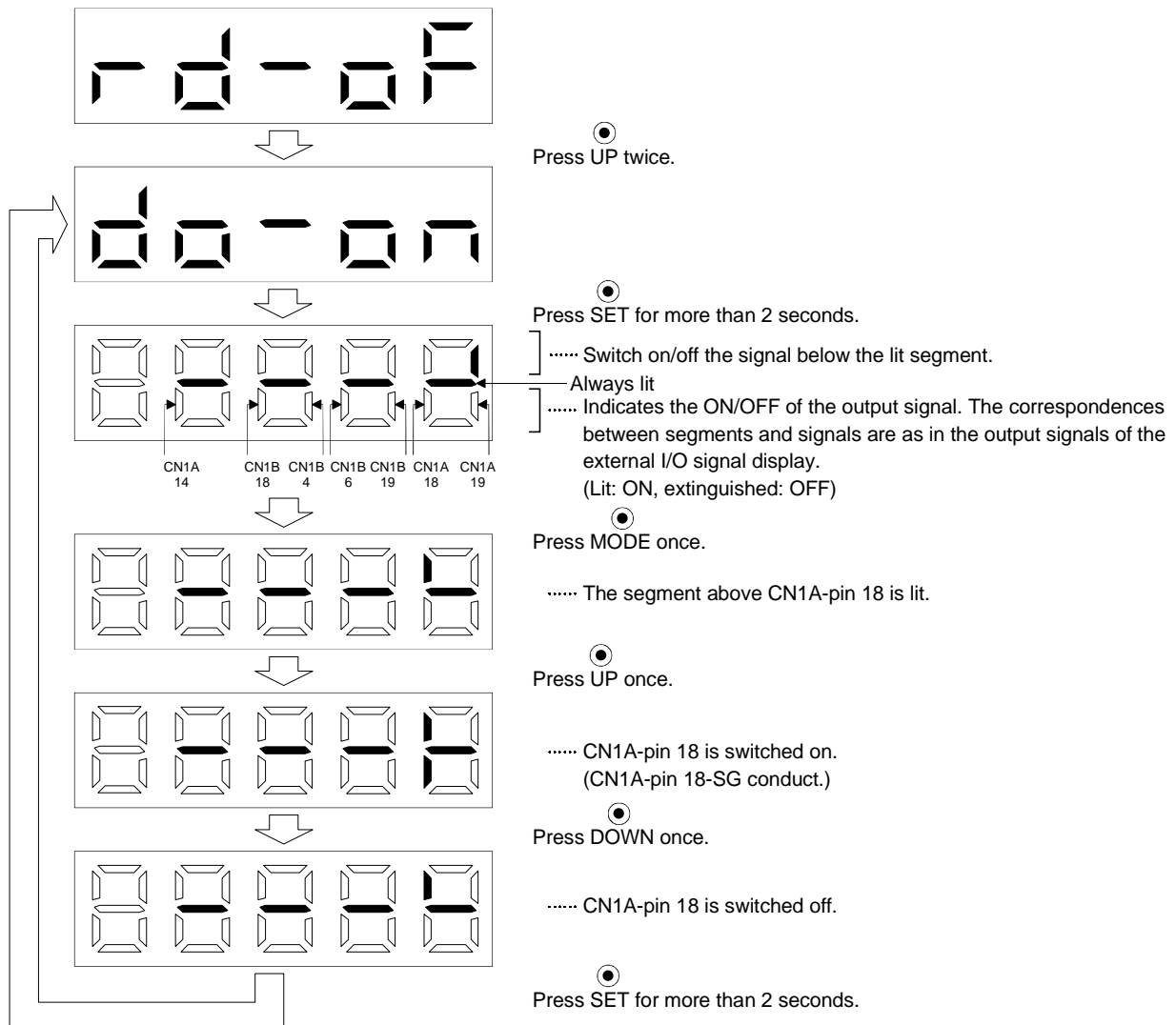
POINT
<ul style="list-style-type: none"> <li>When the servo system is used in a vertical lift application, turning on the electromagnetic brake interlock signal after assigning it to pin CN1B-19 will release the electromagnetic brake, causing a drop. Take drop preventive measures on the machine side.</li> </ul>

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. DISPLAY AND OPERATION

### 6.8 Test operation mode



**CAUTION**

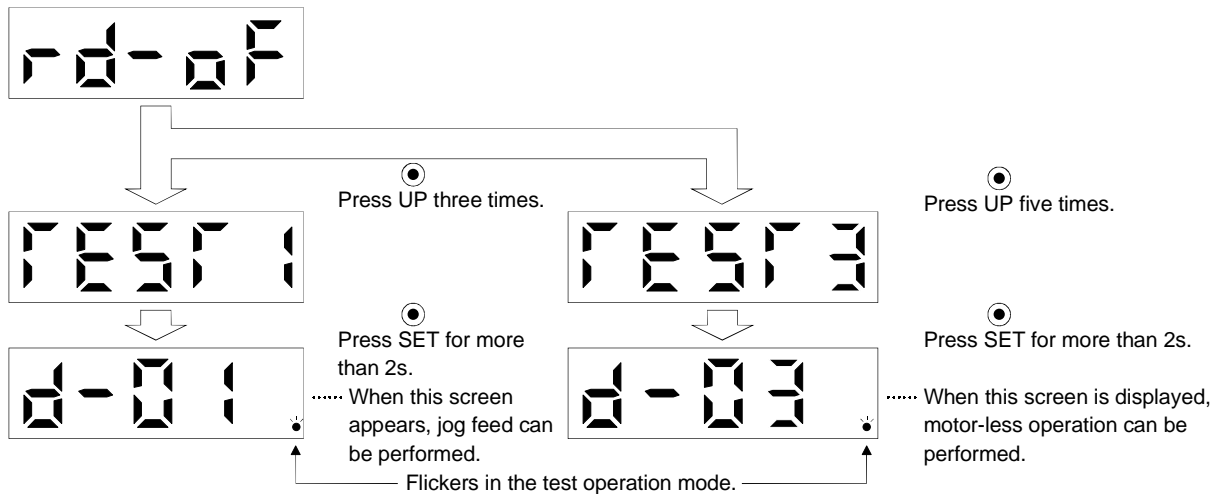
- The test operation mode is designed to confirm servo operation and not to confirm machine operation. In this mode, do not use the servo motor with the machine. Always use the servo motor alone.
- If any operational fault has occurred, stop operation using the forced stop (EMG) signal.

#### 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. DISPLAY AND OPERATION

### 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. Release to stop.
"DOWN"	Press to start CW rotation. Release to stop.

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

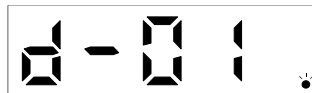
#### (2) Status display

You can confirm the servo status during jog operation.

Pressing the "MODE" button in the jog operation-ready status calls the status display screen. With this screen being shown, perform jog operation with the "UP" or "DOWN" button. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the jog operation-ready status screen. For full information of the status display, refer to Section 6.2. 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. DISPLAY AND OPERATION

### 6.8.3 Positioning operation

POINT	<ul style="list-style-type: none"> <li>The servo configuration software is required to perform positioning operation.</li> </ul>
-------	--

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. 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. DISPLAY AND OPERATION

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### 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

### 7. GENERAL GAIN ADJUSTMENT

POINT
<ul style="list-style-type: none"> <li>For use in the torque control mode, you need not make gain adjustment.</li> </ul>

#### 7.1 Different adjustment methods

##### 7.1.1 Adjustment on a single servo amplifier

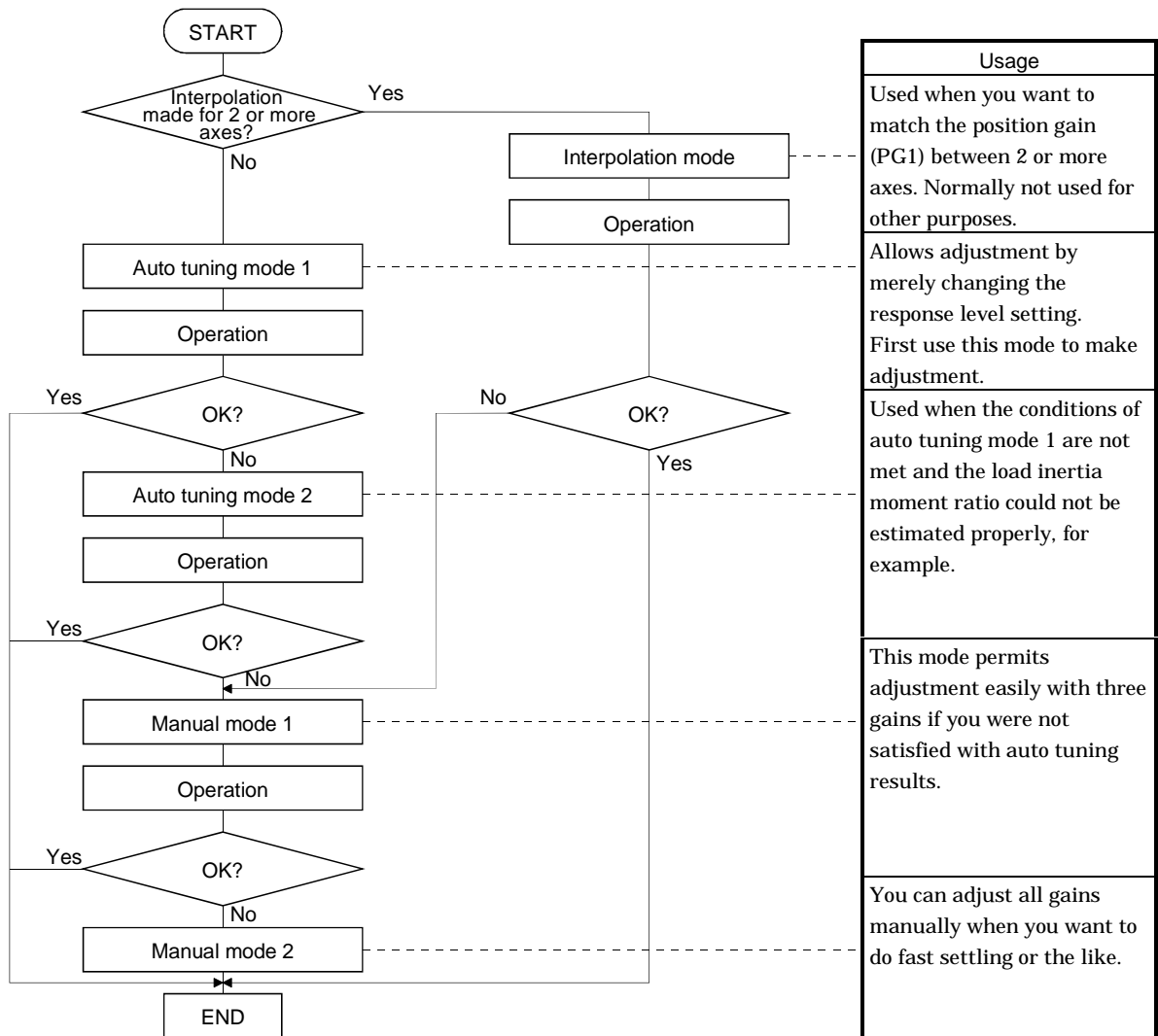
The gain adjustment in this section can be made on a single servo amplifier. For gain adjustment, first execute auto tuning mode 1. If you are not satisfied with the results, execute auto tuning mode 2, manual mode 1 and manual mode 2 in this order.

##### (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) GD2 (parameter No. 34) PG2 (parameter No. 35) VG1 (parameter No. 36) VG2 (parameter No. 37) 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) PG2 (parameter No. 35) VG1 (parameter No. 36) VG2 (parameter No. 37) VIC (parameter No. 38)	GD2 (parameter No. 34) Response level setting of parameter No. 2
Manual mode 1	030□		PG2 (parameter No. 35) VG1 (parameter No. 36)	PG1 (parameter No. 6) GD2 (parameter No. 34) VG2 (parameter No. 37) VIC (parameter No. 38)
Manual mode 2	040□		/	PG1 (parameter No. 6) GD2 (parameter No. 34) PG2 (parameter No. 35) VG1 (parameter No. 36) VG2 (parameter No. 37) VIC (parameter No. 38)
Interpolation mode	000□		Always estimated	GD2 (parameter No. 34) PG2 (parameter No. 35) VG2 (parameter No. 37) VIC (parameter No. 38)

## 7. GENERAL GAIN ADJUSTMENT

### (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.	<ul style="list-style-type: none"> <li>You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter.</li> <li>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.</li> </ul>
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.	<ul style="list-style-type: none"> <li>You can automatically set gains which make positioning settling time shortest.</li> </ul>
Machine simulation	Response at positioning settling of a machine can be simulated from machine analyzer results on personal computer.	<ul style="list-style-type: none"> <li>You can optimize gain adjustment and command pattern on personal computer.</li> </ul>

## 7. GENERAL GAIN ADJUSTMENT

### 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
<ul style="list-style-type: none"><li>▪ The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.<ul style="list-style-type: none"><li>▪ Time to reach 2000r/min is the acceleration/deceleration time constant of 5s or less.</li><li>▪ Speed is 150r/min or higher.</li><li>▪ The ratio of load inertia moment to motor inertia moment is not more than 100 times.</li><li>▪ The acceleration/deceleration torque is 10% or more of the rated torque.</li></ul></li><li>▪ 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.</li></ul>

##### (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).

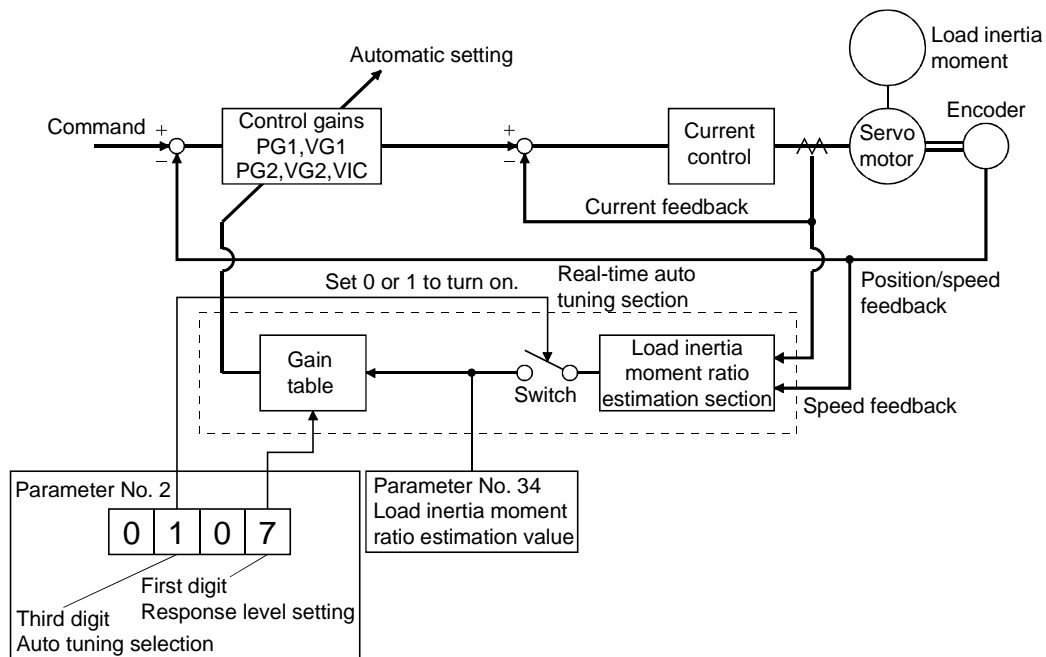
The following parameters are automatically adjusted in the auto tuning mode 2.

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. GENERAL GAIN ADJUSTMENT

### 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, choose the "auto tuning mode 2" (parameter No.2:  $\square 2 \square \square$ ) 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 table.

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.

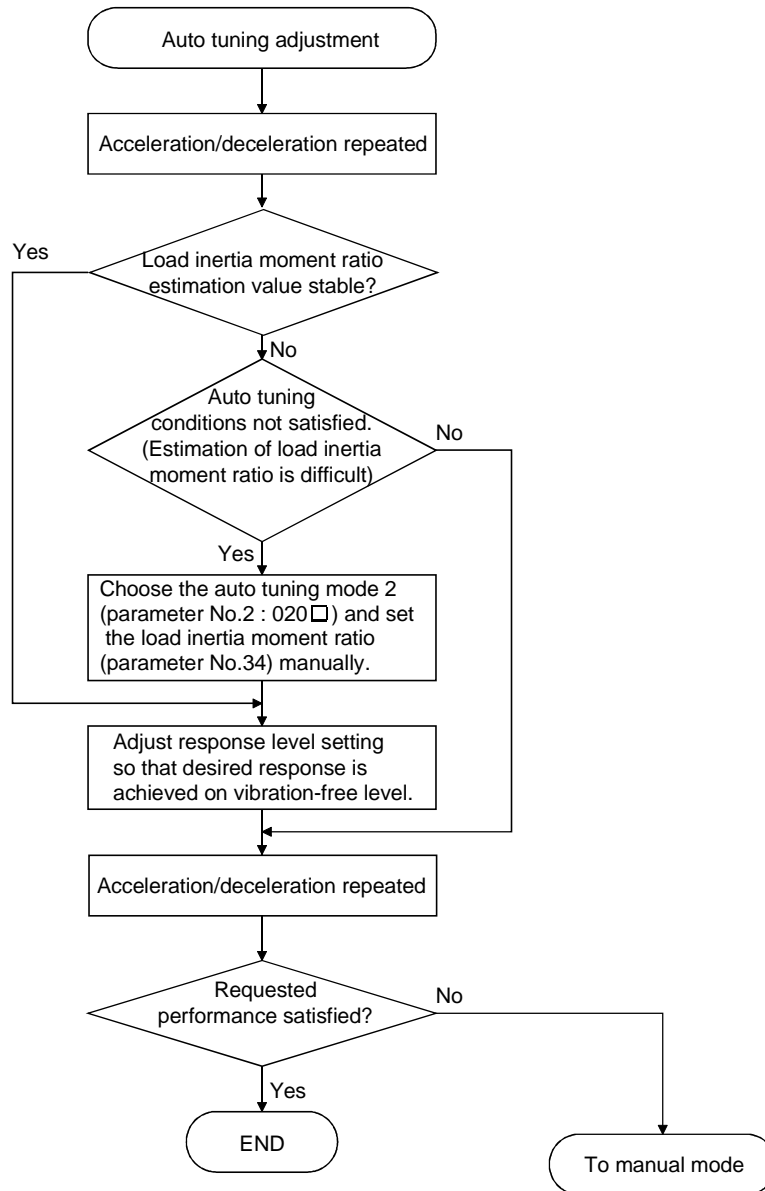
POINT
<ul style="list-style-type: none"> <li>If sudden disturbance torque is imposed during operation, the estimation of the inertia moment ratio may malfunction temporarily. In such a case, choose the "auto tuning mode 2" (parameter No. 2: 020<math>\square</math>) and set the correct load inertia moment ratio in parameter No. 34.</li> </ul>

## 7. GENERAL GAIN ADJUSTMENT

### 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

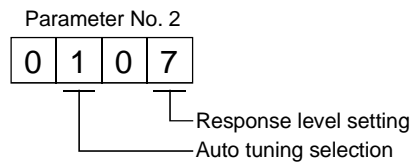


## 7. GENERAL GAIN ADJUSTMENT

### 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	

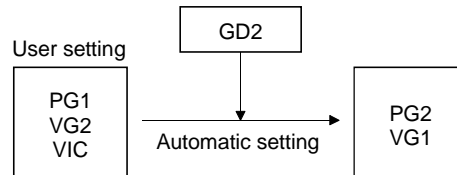
## 7. GENERAL GAIN ADJUSTMENT

### 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
<ul style="list-style-type: none"> <li>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.)</li> </ul>

#### (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. Refer to Section 8.2, 8.3.
5	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment



## 7. GENERAL GAIN 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. Refer to Section 8.1.
7	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

## 7. GENERAL GAIN 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:

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

## 7. GENERAL GAIN ADJUSTMENT

### 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.

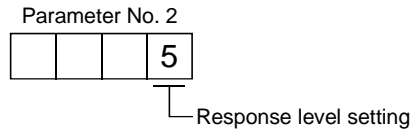
$$\text{Speed control gain 1 setting} \geq \text{Position control gain 1 setting} \times 3$$

## 7. GENERAL GAIN ADJUSTMENT

### 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.

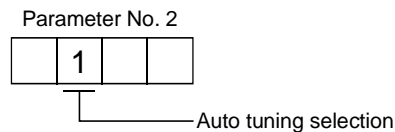


MELSERVO-J2 series		MELSERVO-J2-Super series	
Response level setting	Machine resonance frequency	Response level setting	Machine resonance frequency guideline
1	20Hz	1	15Hz
		2	20Hz
2	40Hz	3	25Hz
		4	30Hz
		5	35Hz
3	60Hz	6	45Hz
		7	55Hz
4	80Hz	8	70Hz
5	100Hz	9	85Hz
5	100Hz	A	105Hz
		B	130Hz
		C	160Hz
		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	Ordinary auto tuning
	Auto tuning mode 2	2	Estimation of load inertia moment ratio stopped. Response level setting valid.
Auto tuning invalid	Manual mode 1	3	Simple manual adjustment
	Manual mode 2	4	Manual adjustment of all gains



# 8. SPECIAL ADJUSTMENT FUNCTIONS

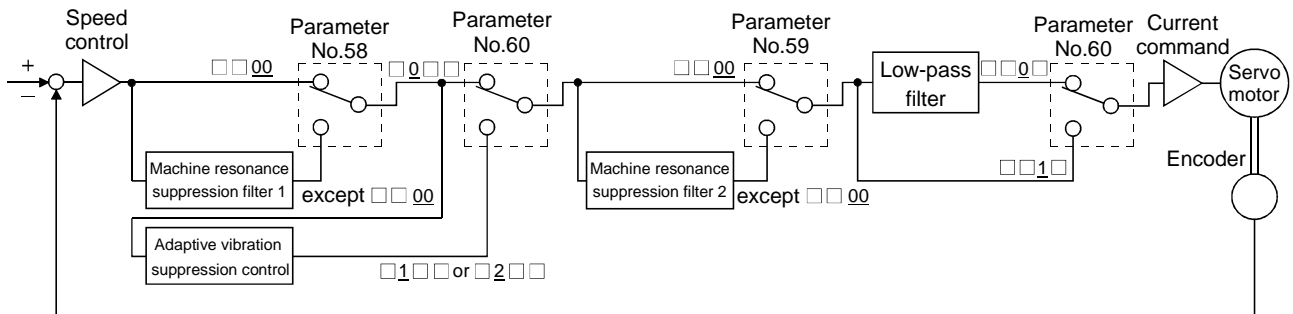
## 8. SPECIAL ADJUSTMENT FUNCTIONS

**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.

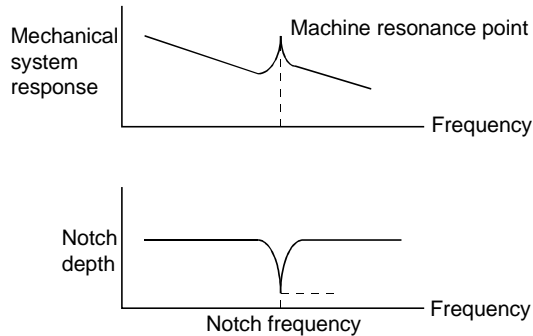
### 8.1 Function block diagram



### 8.2 Machine resonance suppression filter

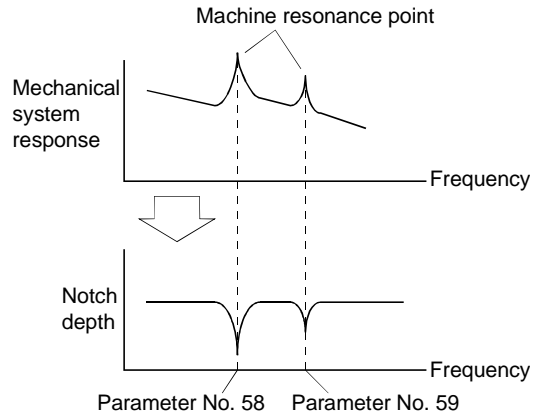
#### (1) Function

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.



## 8. SPECIAL ADJUSTMENT FUNCTIONS

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)

## 8. SPECIAL ADJUSTMENT FUNCTIONS

POINT
<ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.</li> <li>▪ 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.</li> <li>▪ Resonance may occur if parameter No. 58 • 59 is used to select a close notch frequency and set a deep notch.</li> </ul>

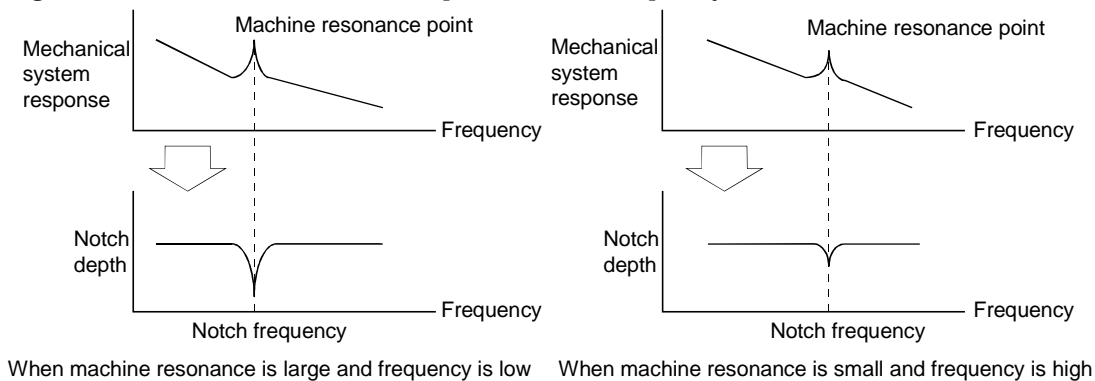
### (b) Machine resonance suppression filter 2 (parameter No. 59)

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.



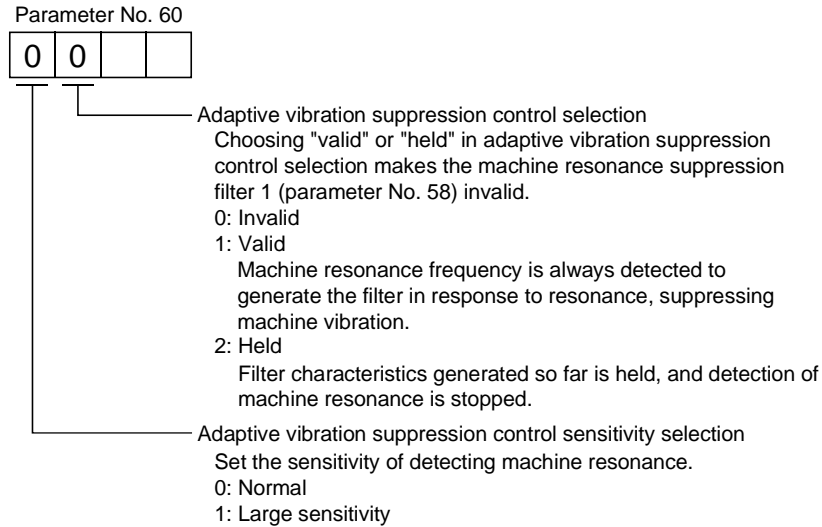
POINT
<ul style="list-style-type: none"> <li>▪ The machine resonance frequency which adaptive vibration suppression control can respond to is about 150 to 500Hz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range. Use the machine resonance suppression filter for the machine resonance of such frequency.</li> <li>▪ Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics or which has too large resonance.</li> <li>▪ 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: <input type="checkbox"/> 2 <input type="checkbox"/> ) to fix the characteristics of the adaptive vibration suppression control filter.</li> </ul>



## 8. SPECIAL ADJUSTMENT FUNCTIONS

### (2) Parameters

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



POINT
<ul style="list-style-type: none"> <li>▪ Adaptive vibration suppression control is factory-set to be invalid (parameter No. 60: 0000).</li> <li>▪ The filter characteristics generated are saved in the EEPROM every 6 minutes since power-on. At next power-on, vibration suppression control is performed with this data saved in the EEPROM being used as an initial value.</li> <li>▪ 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.</li> </ul>

### 8.4 Low-pass filter

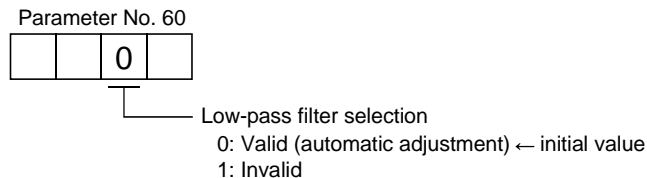
#### (1) Function

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
<ul style="list-style-type: none"> <li>▪ 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.</li> </ul>

## 8. SPECIAL ADJUSTMENT FUNCTIONS

### 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.

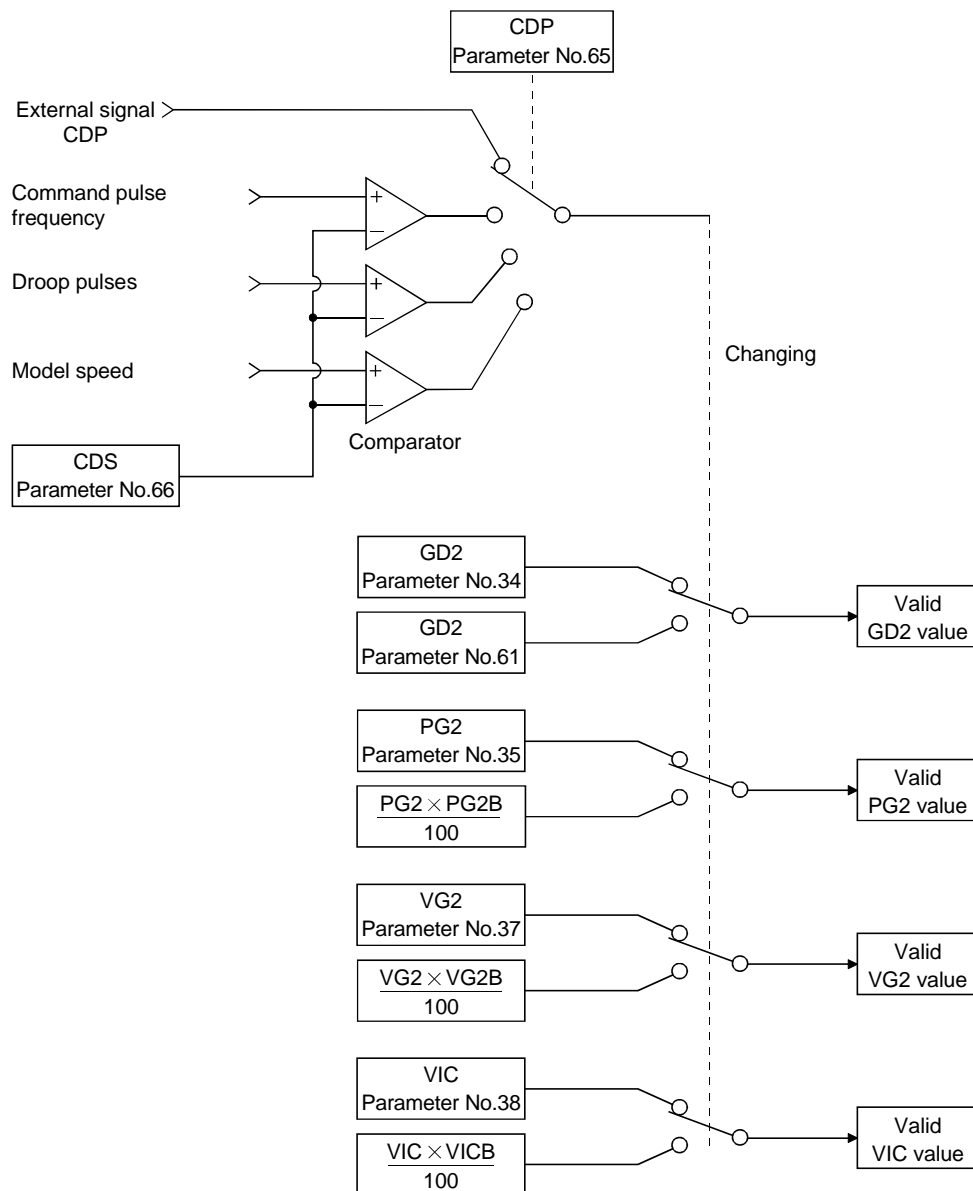
#### 8.5.1 Applications

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. SPECIAL ADJUSTMENT FUNCTIONS

### 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 pulse 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.

## 8. SPECIAL ADJUSTMENT FUNCTIONS

### (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.

Parameter No. 65  

0	0	0	
---	---	---	--

└ 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. SPECIAL ADJUSTMENT FUNCTIONS

### 8.5.4 Gain changing operation

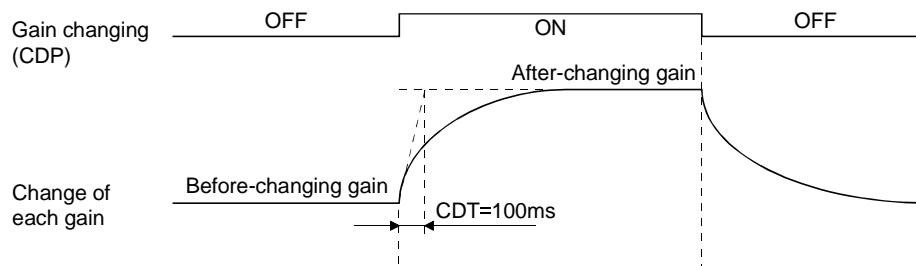
This operation will be described by way of setting examples.

(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

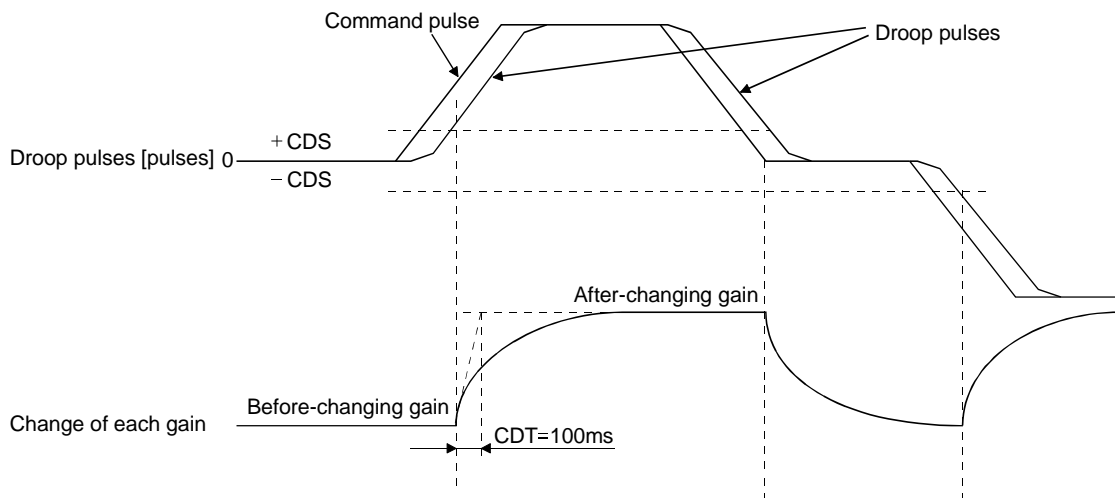
## 8. SPECIAL ADJUSTMENT FUNCTIONS

(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



## 9. INSPECTION

### 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.
- 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.






# 10. TROUBLESHOOTING

## 10. TROUBLESHOOTING

### 10.1 Trouble at start-up

	<b>CAUTION</b>	▪ Excessive adjustment or change of parameter setting must not be made as it will make operation instable.
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<b>POINT</b>	▪ Using the optional servo configuration software, you can refer to unrotated servo motor reasons, etc.
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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

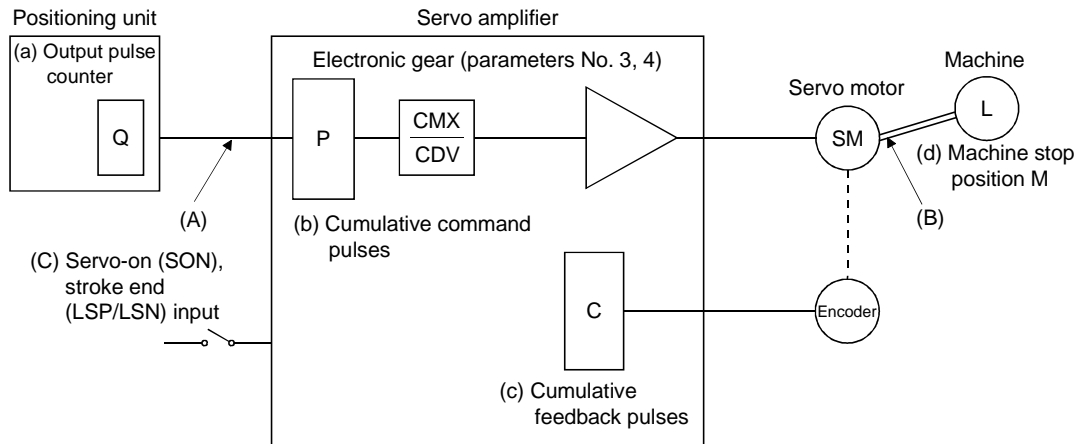
No.	Start-up sequence	Fault	Investigation	Possible cause	Refer to
1	Power on	<ul style="list-style-type: none"> <li>▪ LED is not lit.</li> <li>▪ LED flickers.</li> </ul>	Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected.	<ul style="list-style-type: none"> <li>1. Power supply voltage fault</li> <li>2. Servo amplifier is faulty.</li> </ul>	/
			Improved when connectors CN1A and CN1B are disconnected.	Power supply of CNP1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	<ul style="list-style-type: none"> <li>1. Power supply of encoder cabling is shorted.</li> <li>2. Encoder is faulty.</li> </ul>	
			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).	<ul style="list-style-type: none"> <li>1. Check the display to see if the servo amplifier is ready to operate.</li> <li>2. Check the external I/O signal indication to see if the servo-on (SON) signal is ON.</li> </ul>	<ul style="list-style-type: none"> <li>1. Servo-on signal is not input. (Wiring mistake)</li> <li>2. 24VDC power is not supplied to COM.</li> </ul>	Section 6.6
3	Enter input command. (Test operation)	Servo motor does not rotate.	Check cumulative command pulses.	<ul style="list-style-type: none"> <li>1. Wiring mistake                             <ul style="list-style-type: none"> <li>(a) For open collector pulse train input, 24VDC power is not supplied to OPC.</li> <li>(b) LSP/LSN-SG are not connected.</li> </ul> </li> <li>2. No pulses is input.</li> </ul>	Section 6.2
		Servo motor run in reverse direction.		<ul style="list-style-type: none"> <li>1. Mistake in wiring to controller.</li> <li>2. Mistake in setting of parameter No. 54.</li> </ul>	Chapter 5

## 10. TROUBLESHOOTING

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: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
5	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Pulse counting error, etc. due to noise.	(2) in this section

## 10. TROUBLESHOOTING

### (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  $\times$  electronic gear = cumulative feedback pulses)
- 3)  $C \cdot \Delta \ell = M$  (cumulative feedback pulses  $\times$  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. TROUBLESHOOTING

### 10.1.2 Speed control mode

No.	Start-up sequence	Fault	Investigation	Possible cause	Refer to
1	Power on	<ul style="list-style-type: none"> <li>• LED is not lit.</li> <li>• LED flickers.</li> </ul>	Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected.	1. Power supply voltage fault 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. 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. 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) 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: 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7

## 10. TROUBLESHOOTING

### 10.1.3 Torque control mode

No.	Start-up sequence	Fault	Investigation	Possible cause	Refer to
1	Power on	<ul style="list-style-type: none"> <li>• LED is not lit.</li> <li>• LED flickers.</li> </ul>	Not improved if connectors CN1A, CN1B, CN2 and CN3 are disconnected.	1. Power supply voltage fault 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. 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) 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. TROUBLESHOOTING

## 10.2 When alarm or warning has occurred

<b>POINT</b>
<ul style="list-style-type: none"> <li>Configure up a circuit which will detect the trouble (ALM) signal and turn off the servo-on (SON) signal at occurrence of an alarm.</li> </ul>

### 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. TROUBLESHOOTING

### 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. MR-J2S-□A:160V or less 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	Change the servo amplifier.	
			— Checking method — Alarm (AL.10) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.		
AL.12	Memory error 1	RAM, memory fault	Faulty parts in the servo amplifier	Change the servo amplifier.	
AL.13	Clock error	Printed board fault	— Checking method — Alarm (any of AL.12,13 and 15) occurs if power is switched on after CN1A, CN1B and CN3 all connectors are disconnected.		
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.	



## 10. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
AL.17	Board error 2	CPU/parts fault	Faulty parts in the servo amplifier	Change the servo amplifier.
AL.19	Memory error 3	ROM memory fault	<p>Checking method</p> <p>Alarm (AL.17 or AL.19) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.</p>	
AL.1A	Motor combination error	Wrong combination of servo amplifier and servo motor.	Wrong combination of servo amplifier and servo motor connected.	Use correct combination.
AL.20	Encoder error 2	Communication error occurred between encoder and servo amplifier.	1. Encoder connector (CN2) disconnected.	Connect correctly.
			2. Encoder cable faulty (Wire breakage or shorted)	Repair or change the cable.
AL.24	Main circuit error	Ground fault occurred at the servo motor outputs (U, V and W phases) of the servo amplifier.	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.	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.
			3. Battery cable or battery is faulty.	Always make home position setting again.
		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.	1. Reduce the frequency of positioning. 2. Use the regenerative brake option of larger capacity. 3. Reduce the load.
			<p>Checking method</p> <p>Call the status display and check the regenerative load ratio.</p>	
			4. Power supply voltage is abnormal. MR-J2S-□A:260V or more 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.	Change the servo amplifier.
			<p>Checking method</p> <p>1) The regenerative brake option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.</p>	

## 10. TROUBLESHOOTING

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. 2. If servo gain cannot be set to proper value: 1) Reduce load inertia moment ratio; or 2) Reexamine acceleration/ deceleration time constant.
			4. Electronic gear ratio is large (parameters No. 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. <div style="border: 1px solid black; padding: 5px; width: fit-content; margin: 5px auto;">Checking method Alarm (AL.32) occurs if power is switched on after U,V and W are disconnected.</div>	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. 2. Connect correctly.
			2. Regenerative transistor faulty.	Change servo amplifier
			3. Wire breakage of built-in regenerative brake resistor or regenerative brake option	1. For wire breakage of built-in regenerative brake resistor, change servo amplifier. 2. For wire breakage of regenerative brake option, change regenerative brake option.
			4. Capacity of built-in regenerative brake resistor or regenerative brake option is insufficient.	Add regenerative brake option or increase capacity.
			5. Power supply voltage high.	Review the power supply.

## 10. TROUBLESHOOTING

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. 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°C.	Review environment so that ambient temperature is 0 to 40°C.
			2. Servo motor is overloaded.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			3. Thermal protector in encoder is faulty.	Change servo motor.
AL.50	Overload 1	Load exceeded overload protection characteristic of servo amplifier. Load ratio 300%: 2.5s or more Load ratio 200%: 100s or more	1. Servo amplifier is used in excess of its continuous output current.	1. Reduce load. 2. Review operation pattern. 3. Use servo motor that provides larger output.
			2. Servo system is instable and hunting.	1. Repeat acceleration/ deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			3. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			4. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			5. Encoder faulty.	Change the servo motor.
		<p style="text-align: center;">— Checking method —</p> <p>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.</p>		

## 10. TROUBLESHOOTING

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. 2. Install limit switches.
			2. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
			3. Servo system is instable and hunting.	1. Repeat acceleration/deceleration to execute auto tuning. 2. Change auto tuning response setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. <div style="border: 1px solid black; padding: 5px; margin-top: 5px;">                     Checking method                      When the servo motor shaft is rotated slowly with the servo off, the cumulative feedback pulses should vary in proportion to the rotary angle. If the indication skips or returns midway, the encoder is faulty.                 </div>	Change the servo motor.
AL.52	Error excessive	The droop pulse value of the deviation counter exceeded the encoder resolution $\times 10$ [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. 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. 2. Reduce load. 3. Use servo motor that provides larger output.
			6. Machine struck something.	1. Review operation pattern. 2. Install limit switches.
			7. Encoder faulty	Change the servo motor.
			8. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W.	Connect correctly.
AL.8A	Serial communication time-out error	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).

## 10. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
88888	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier  <div style="border: 1px solid black; padding: 5px; width: fit-content;">                     Checking method                      Alarm (88888) occurs if power is switched on after CN1A, CN1B and CN3 connectors are disconnected.                 </div>	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.

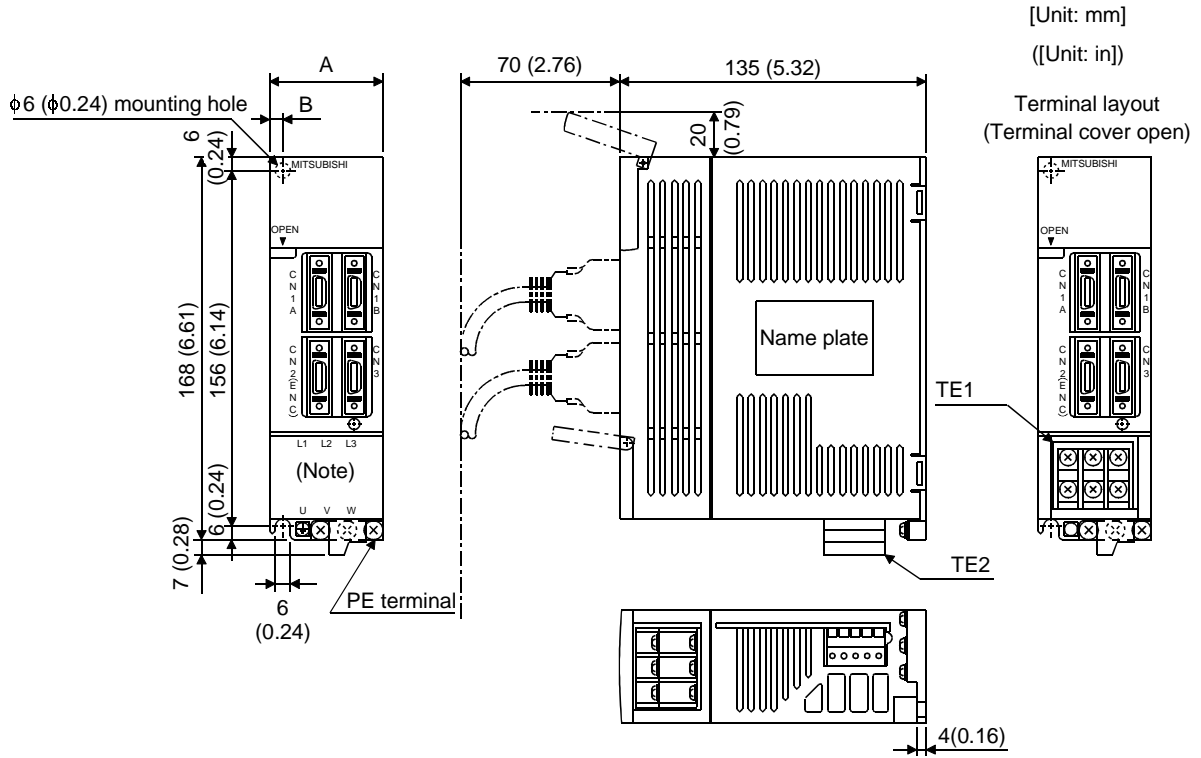
Display	Name	Definition	Cause	Action
AL.92	Open battery cable warning	Absolute position detection system battery voltage is low.	1. Battery cable is open.	Repair cable or changed.
			2. Battery voltage dropped to 2.8V or less.	Change battery.
AL.96	Home position setting warning	Home position setting 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.  <div style="border: 1px solid black; padding: 5px; width: fit-content;">                     Checking method                      Call the status display and check regenerative load ratio.                 </div>	1. Reduce frequency of positioning. 2. Change regenerative brake option for the one with larger capacity. 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.  <div style="border: 1px solid black; padding: 5px; width: fit-content;">                     Cause, checking method                      Refer to AL.50,51.                 </div>	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 ladder 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. OUTLINE DIMENSION DRAWINGS

### 11.1 Servo amplifiers

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

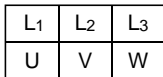


Servo amplifier	Variable dimensions		Weight [kg]([lb])
	A	B	
MR-J2S-10A(1)	50 (1.97)	6 (0.24)	0.7 (1.54)
MR-J2S-20A(1)			
MR-J2S-40A(1)	70 (2.76)	22 (0.87)	1.1 (2.43)
MR-J2S-60A			

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

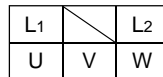
#### TE1

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



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

- For 1-phase 100 to 120VAC



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

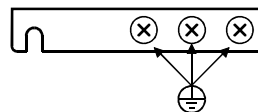
#### TE2

← Front



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)

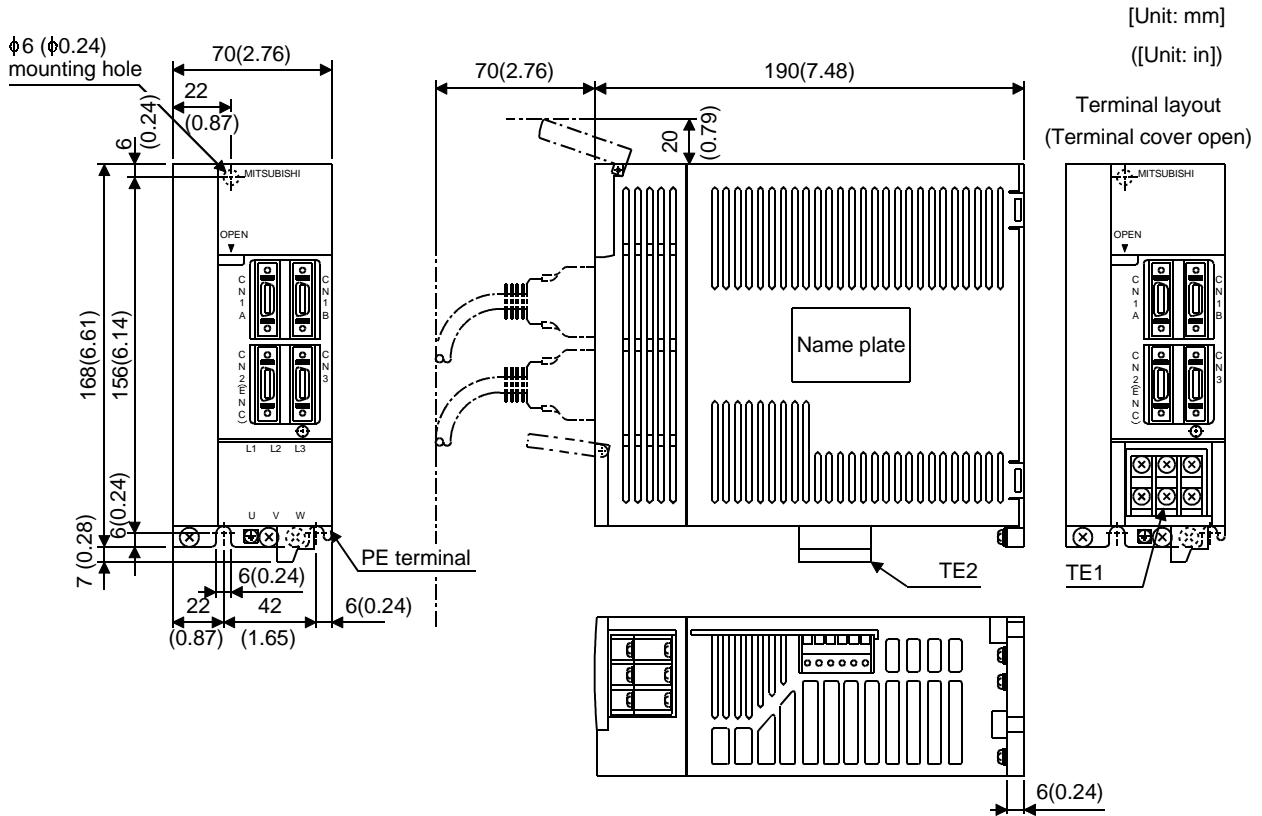
#### PE terminals



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

# 11. OUTLINE DIMENSION DRAWINGS

## (2) MR-J2S-70A • MR-J2S-100A



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

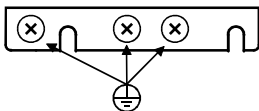
D	C	P	L21	L11	N
---	---	---	-----	-----	---

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

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

(Phoenix Contact make)

### PE terminals



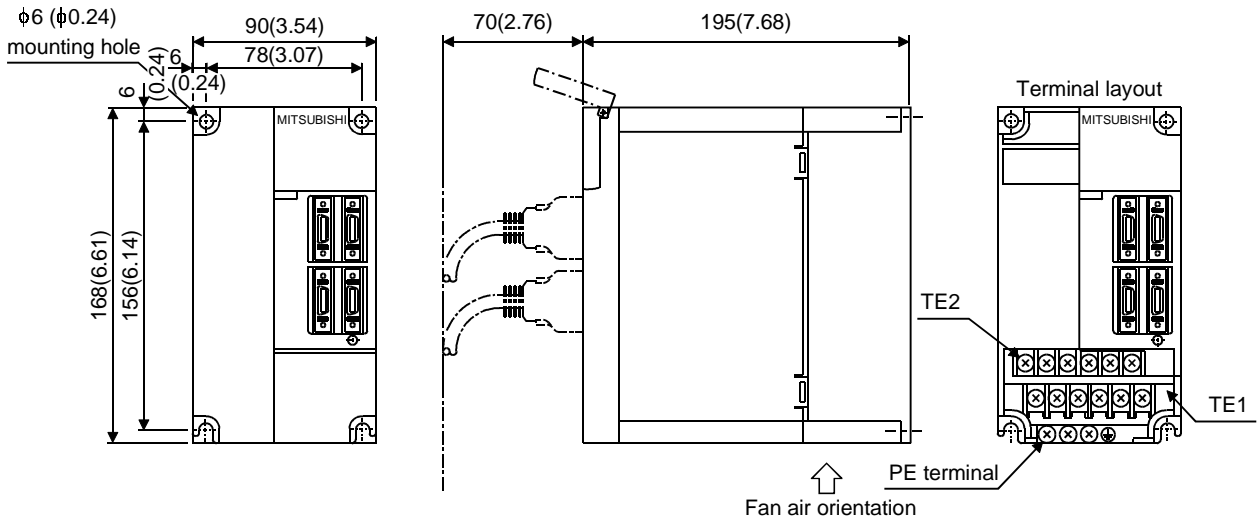
Terminal screw: M4

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

# 11. OUTLINE DIMENSION DRAWINGS

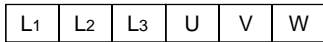
## (3) MR-J2S-200A • MR-J2S-350A

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



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

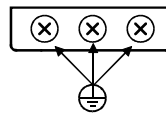
### TE1



Terminal screw: M4

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

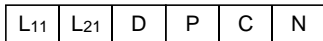
### PE terminals



Terminal screw: M4

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

### TE2



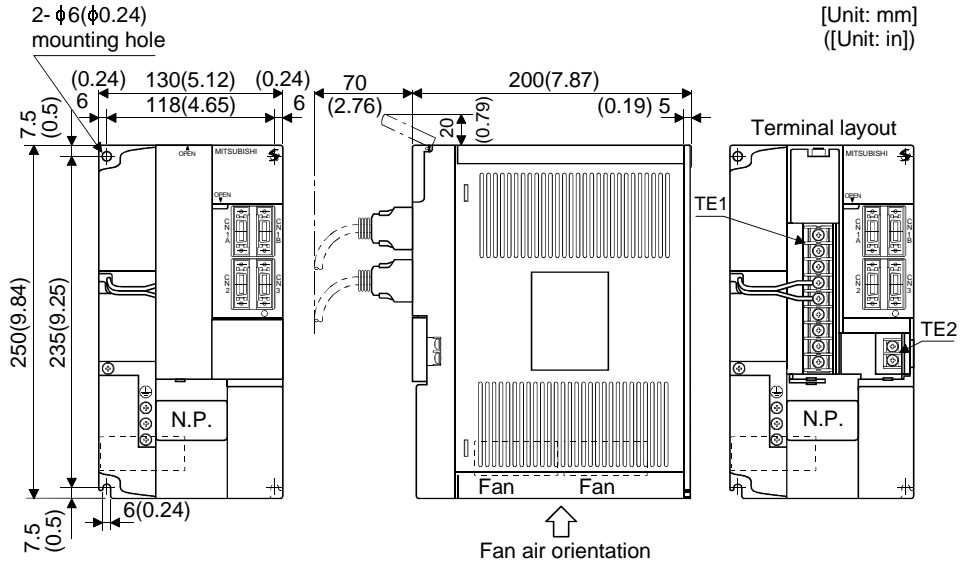
Terminal screw: M4

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



# 11. OUTLINE DIMENSION DRAWINGS

## (4) MR-J2S-500A

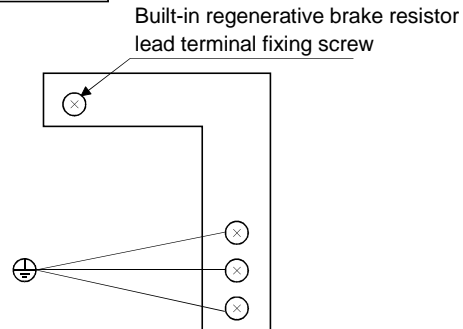


Servo amplifier	Weight [kg]([lb])
MR-J2S-500A	4.9(10.8)

### TE1

L <sub>1</sub>	Terminal screw : M4 Tightening torque : 1.2 [N·m](169.9[oz·in])
L <sub>2</sub>	
L <sub>3</sub>	
C	
P	
N	
U	
V	
W	

### PE terminals



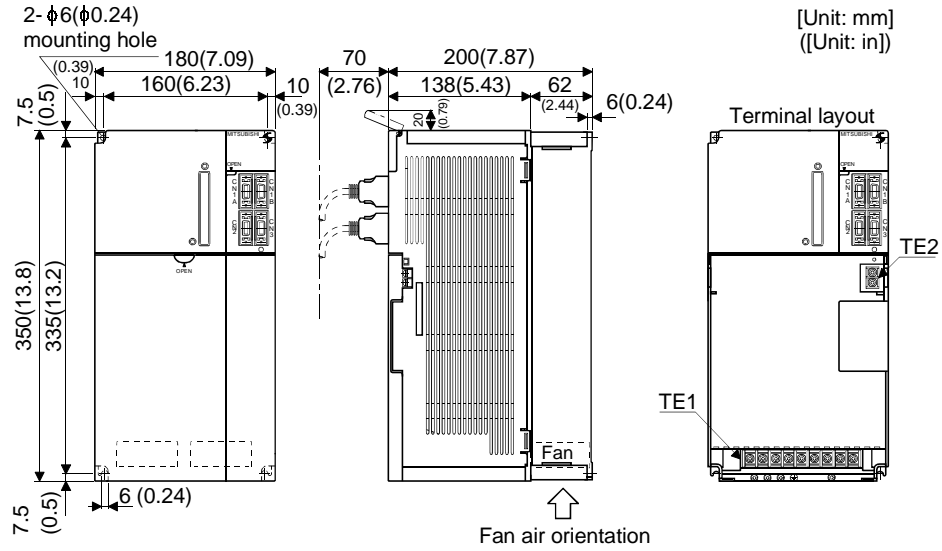
Terminal screw : M4  
Tightening torque : 1.2 [N·m](169.9[oz·in])

### TE2

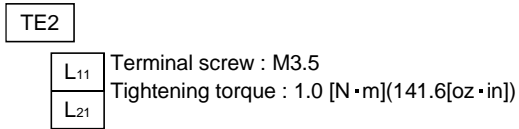
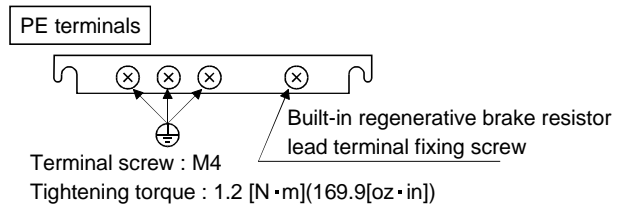
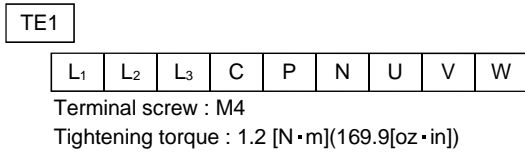
L <sub>11</sub>	Terminal screw : M3.5 Tightening torque : 1.0 [N·m](141.6[oz·in])
L <sub>21</sub>	

# 11. OUTLINE DIMENSION DRAWINGS

## (5) MR-J2S-700A



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



# 11. OUTLINE DIMENSION DRAWINGS

## 11.2 Connectors

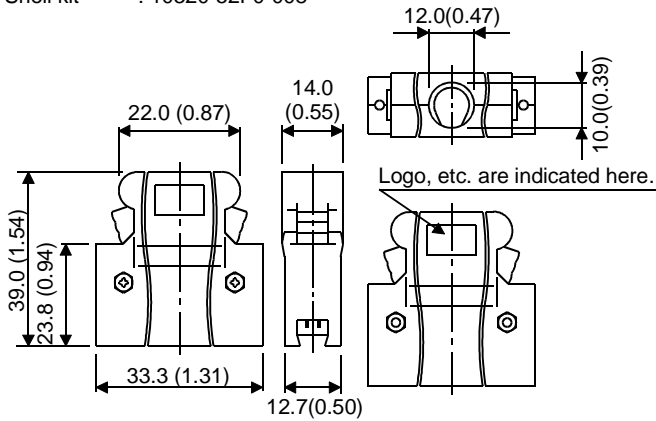
### (1) Servo amplifier side

<3M >

#### (a) Soldered type

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

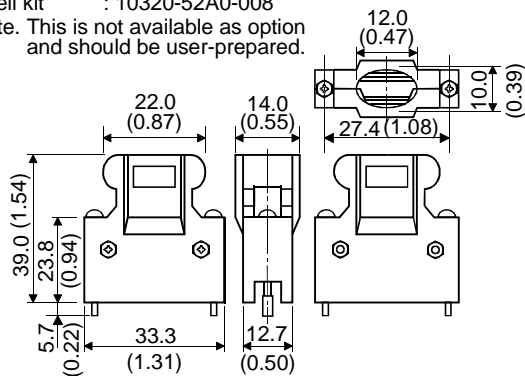
[Unit: mm]  
 ([Unit: in])



#### (b) Threaded type

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

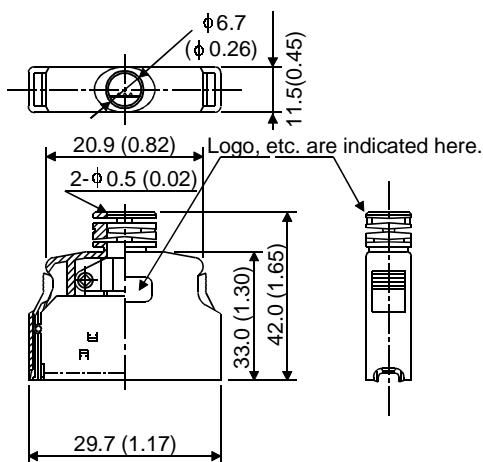
[Unit: mm]  
 ([Unit: in])



#### (c) Insulation displacement type

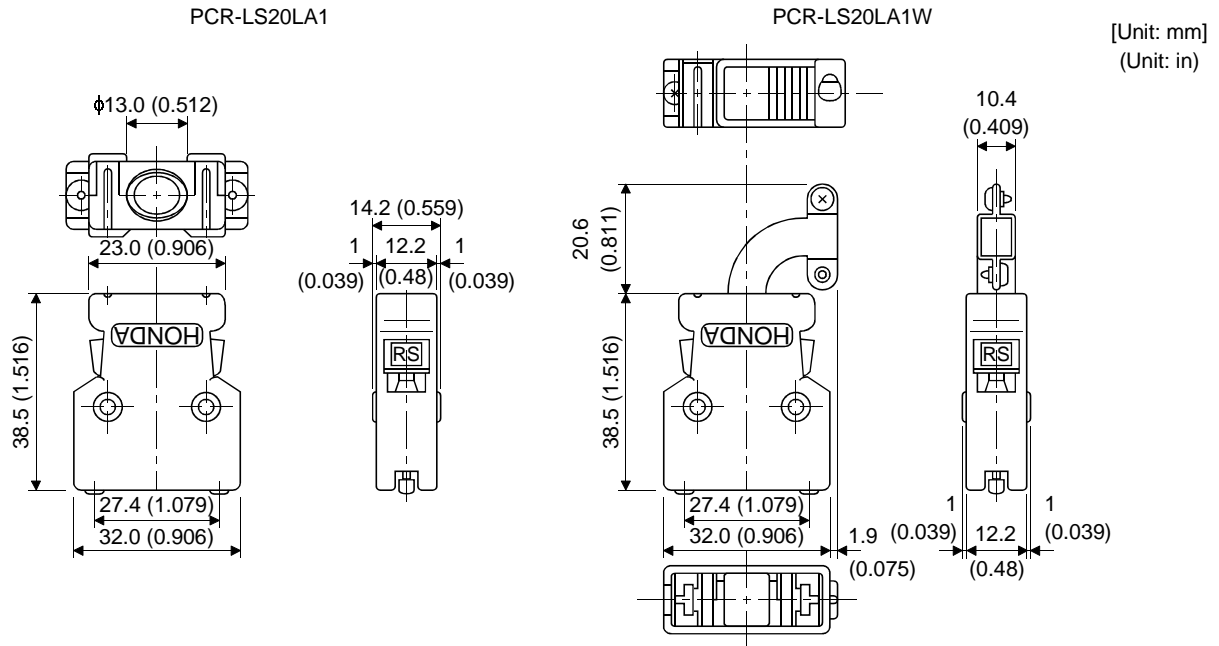
Model  
 Connector : 10120-6000EL  
 Shell kit : 10320-3210-000

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



# 11. OUTLINE DIMENSION DRAWINGS

## (2) Bus cable connector <Honda Tsushin>

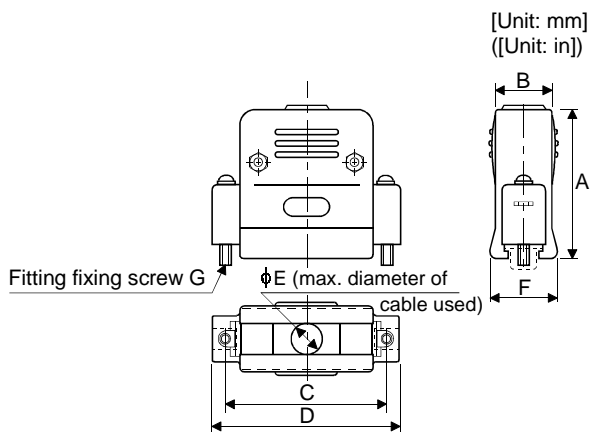


Number of Pins	Model	
	Connector	Case
20	PCR-S20FS (soldering type)	PCR-LS20LA1
	PCR-S20F (insulation displacement type)	PCR-LS20LA1W

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	B	C	D	φ E	F	G
DE-C1-J6-S6	±1	±1	±0.25	±1	6(0.24)	Reference	#4-40



# 12. CHARACTERISTICS

## 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

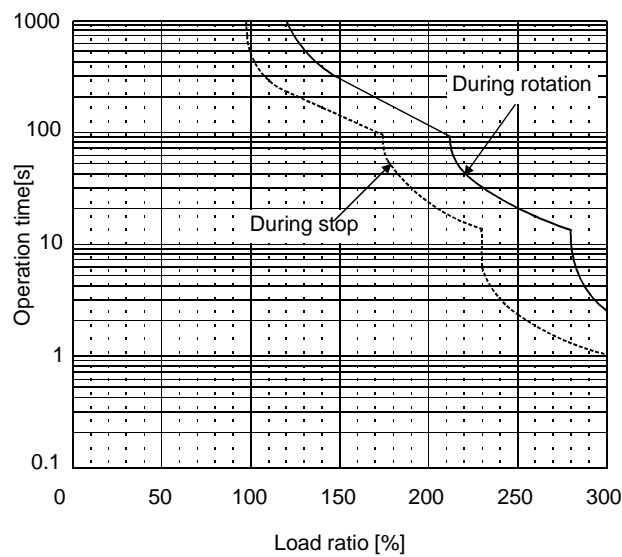


Fig 12.1 Electronic thermal relay protection characteristics 1

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

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

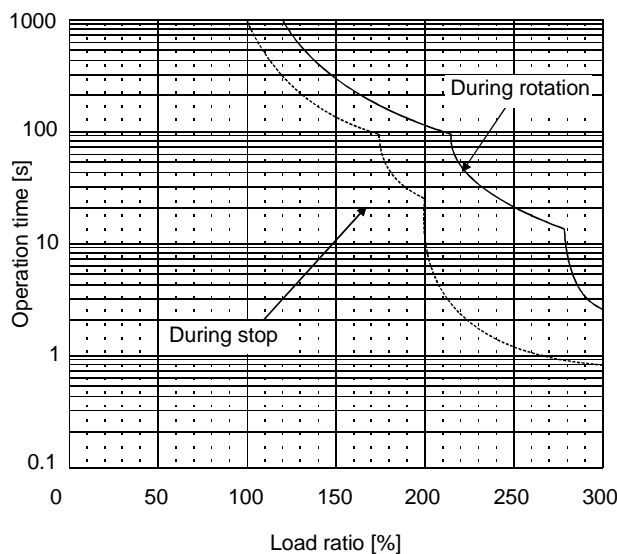


Fig 12.2 Electronic thermal relay protection characteristics 2

## 12. CHARACTERISTICS

(3) MR-J2S-500A • MR-J2S-700A

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

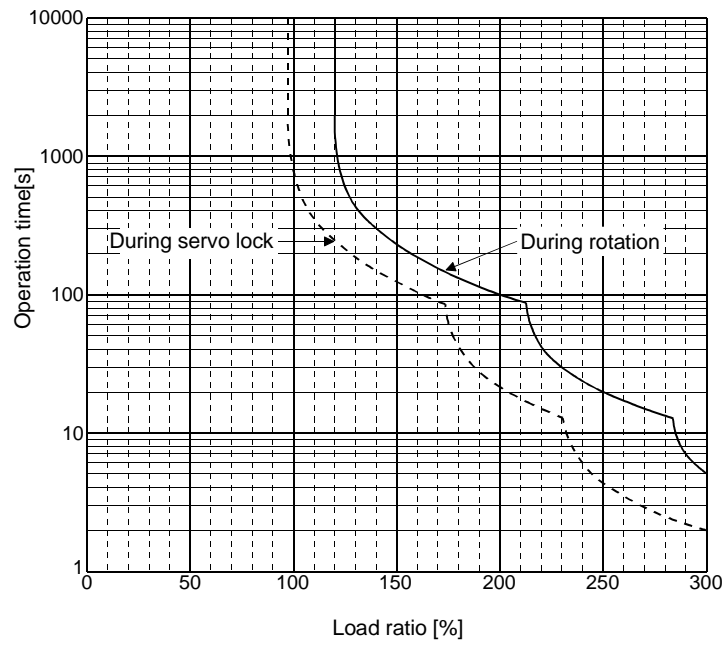


Fig 12.3 Electronic thermal relay protection characteristics 3

## 12. CHARACTERISTICS

### 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	[m <sup>2</sup> ]	[ft <sup>2</sup> ]
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.



## 12. CHARACTERISTICS

### (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°C at the ambient temperature of 40°C. (With a 5°C (41°F) safety margin, the system should operate within a maximum 55°C (131°F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 12.1:

$$A = \frac{P}{K \cdot \Delta T} \dots\dots\dots (12.1)$$

- where, A : Heat dissipation area [m<sup>2</sup>]
- P : Loss generated in the control box [W]
- ΔT : Difference between internal and ambient temperatures [°C]
- 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 with 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°C (104°F) under rated load.

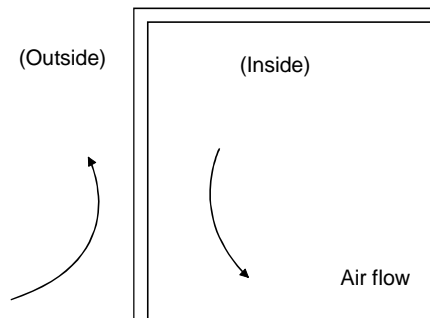


Fig. 12.4 Temperature distribution in enclosure

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. CHARACTERISTICS

### 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  $\tau$  varies with the servo motor and machine operation speeds. (Refer to Fig. 12.5)

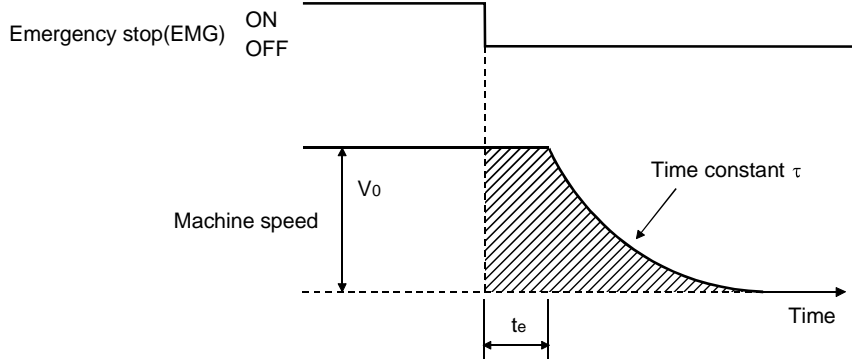
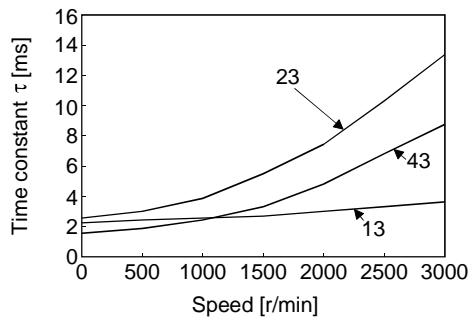


Fig. 12.5 Dynamic brake operation diagram

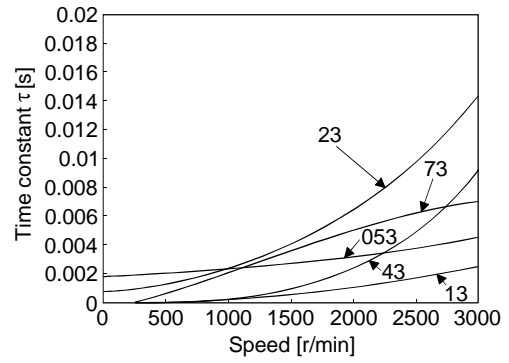
$$L_{\max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left( 1 + \frac{J_L}{J_M} \right) \right\} \dots \dots \dots (12.2)$$

- $L_{\max}$  : Maximum coasting distance ..... [mm][in]
- $V_0$  : Machine rapid feedrate ..... [mm/min][in/min]
- $J_M$  : Servo motor inertial moment ..... [kg · cm<sup>2</sup>][oz · in<sup>2</sup>]
- $J_L$  : Load inertia moment converted into equivalent value on servo motor shaft..... [kg · cm<sup>2</sup>][oz · in<sup>2</sup>]
- $\tau$  : 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.)

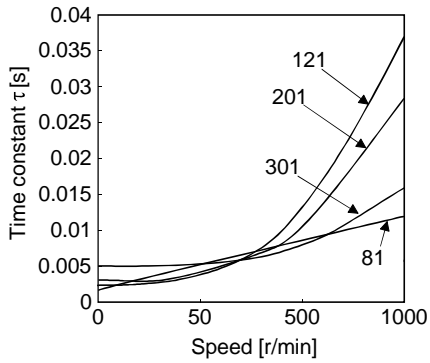
## 12. CHARACTERISTICS



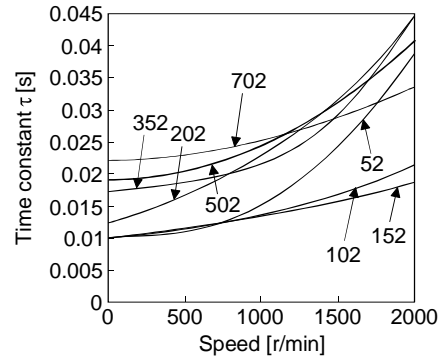
a. HC-KFS series



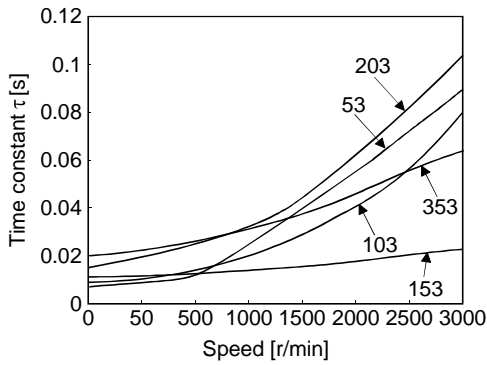
b. HC-MFS series



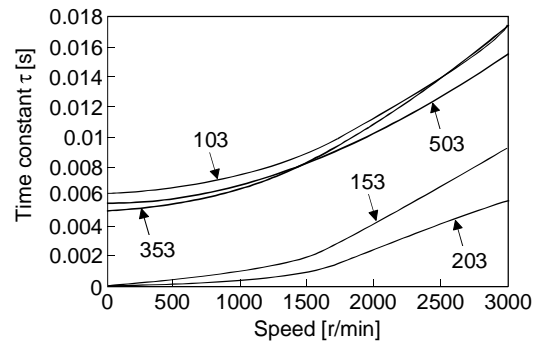
c. HC-SFS1000r/min series



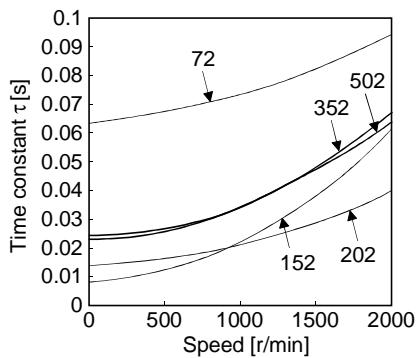
d. HC-SFS2000r/min series



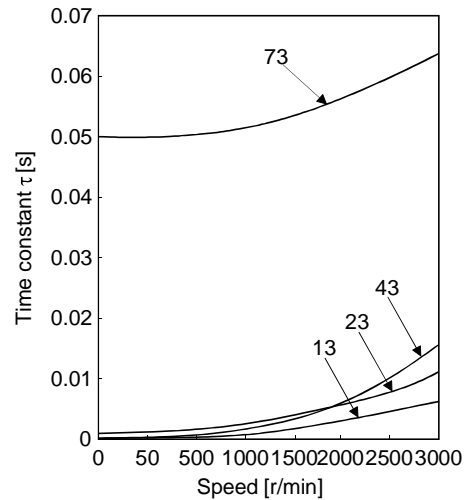
e. HC-SFS3000r/min series



f. HC-RFS series



g. HC-UFS 2000r/min series



h. HC-UFS3000r/min series

Fig. 12.6 Dynamic brake time constant

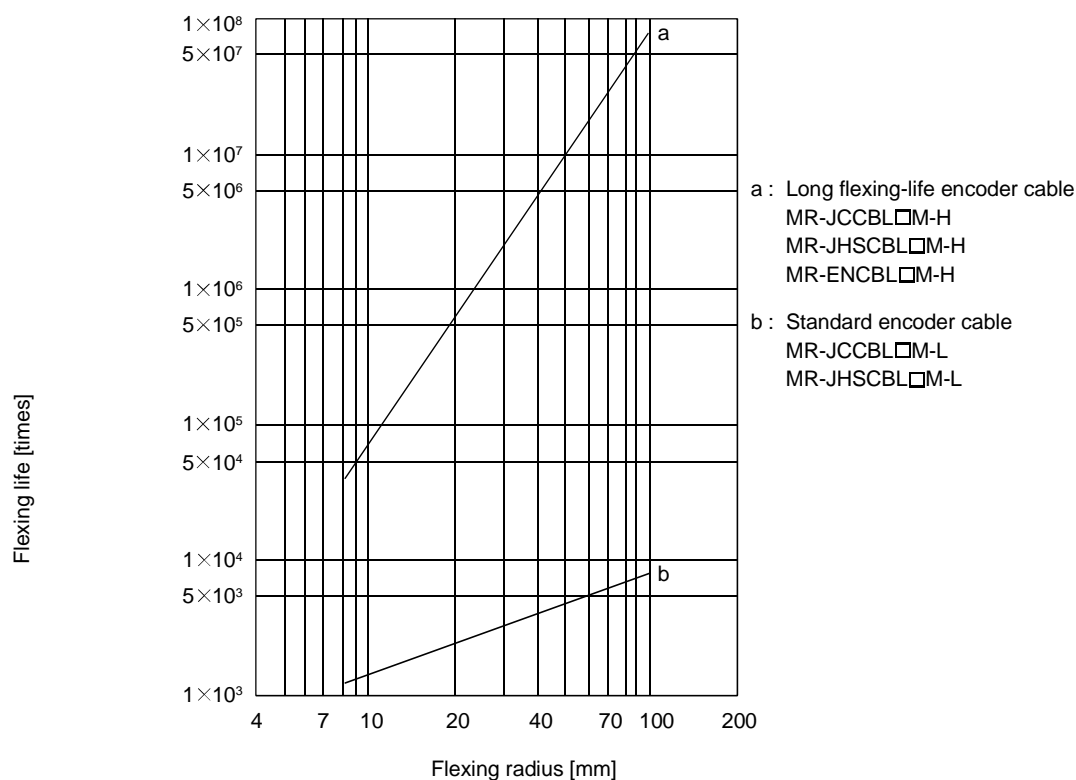
## 12. CHARACTERISTICS

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 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.






# 13. OPTIONS AND AUXILIARY EQUIPMENT


## 13. OPTIONS AND AUXILIARY EQUIPMENT

 <b>WARNING</b>	<ul style="list-style-type: none"> <li>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.</li> </ul>
--	--

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>Use the specified auxiliary equipment and options. Unspecified ones may lead to a fault or fire.</li> </ul>
--	--

### 13.1 Options

#### 13.1.1 Regenerative brake options

 <b>CAUTION</b>	<ul style="list-style-type: none"> <li>The specified combinations of regenerative brake options and servo amplifiers may only be used. Otherwise, a fire may occur.</li> </ul>
--	--

#### (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:

$$\text{Permissible duty} = \frac{\text{Permissible duty for servo motor with no load (value indication Section 5.1 in Servo Motor Instruction Manual)}}{(m+1)}$$

$$\times \left[ \frac{\text{rated speed}}{\text{running speed}} \right]^2 \text{ [times/min]}$$

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.

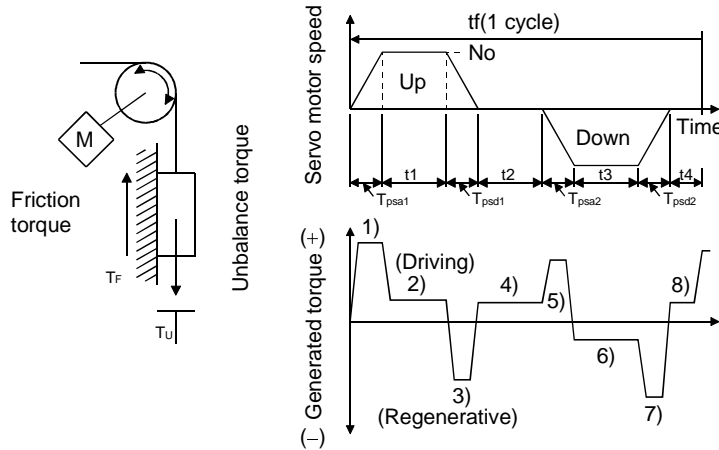
### 13. OPTIONS AND AUXILIARY EQUIPMENT

(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 ( $\eta$ ) :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 ( $E_c$ ) :Energy charged into the electrolytic capacitor in the servo amplifier.

## 13. OPTIONS AND AUXILIARY EQUIPMENT

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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.

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

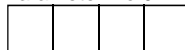
Calculate the power consumption of the regenerative brake option on the basis of single-cycle operation period  $t_f$  [s] to select the necessary regenerative brake option.

$$PR [W] = ER/t_f \dots\dots\dots (13.1)$$

### (3) Connection of the regenerative brake option

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

Parameter No.0



Selection of regenerative

- 0: Not used.
- 2: MR-RB032
- 3: MR-RB12
- 4: MR-RB32
- 5: MR-RB30
- 6: MR-RB50
- 8: MR-RB31
- 9: MR-RB51



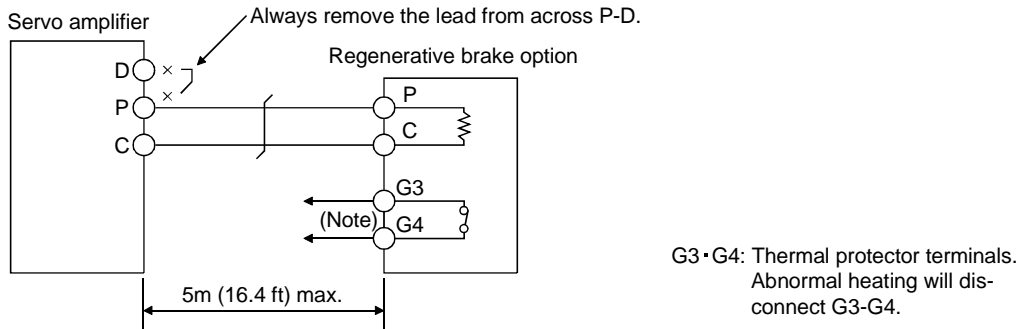
### 13. OPTIONS AND AUXILIARY EQUIPMENT

(4) Connection of the regenerative brake option

The regenerative brake option will generate heat of about 100°C. 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

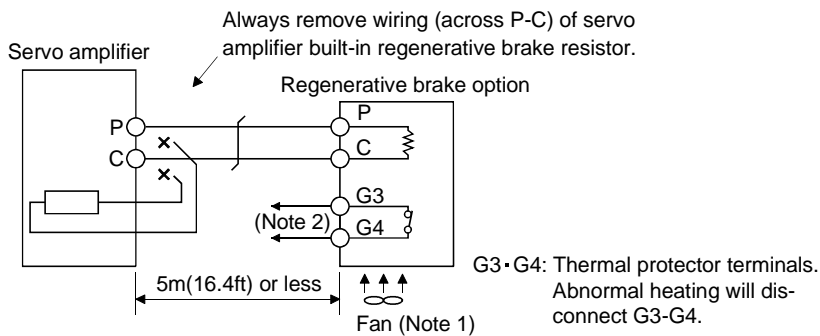
Always remove the wiring from across P-D and fit the regenerative brake option across P-C.



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.

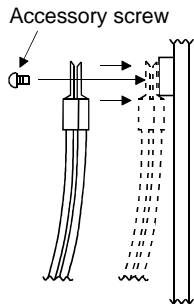


- Note 1. When using the MR-RB51, forcibly cool it with a cooling fan (1.0m<sup>3</sup>/min, □92 or so).
- 2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.

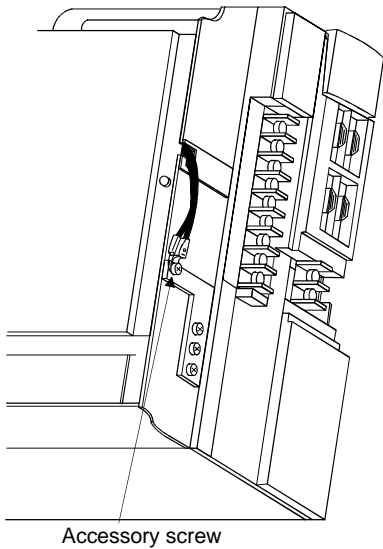
## 13. OPTIONS AND AUXILIARY EQUIPMENT

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.

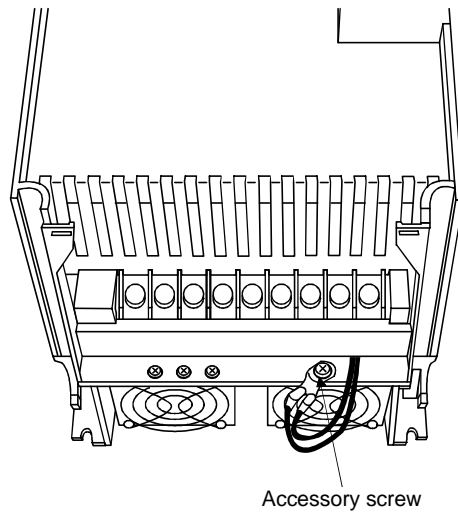
### Mounting method



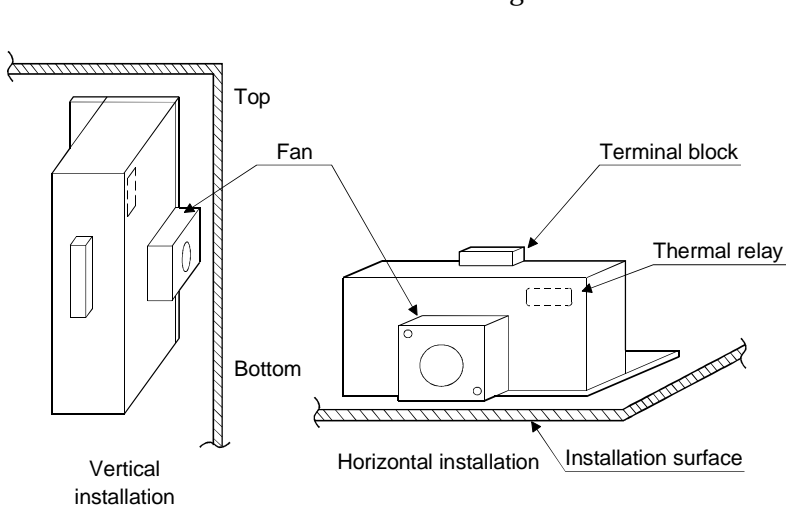
For MR-J2S-500A



For MR-J2S-700A

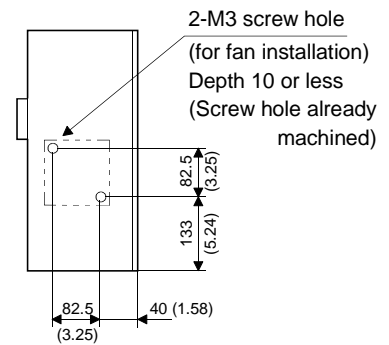


For the MR-RB51 install the cooling fan as shown.



[Unit : mm(in)]

### Fan installation screw hole dimensions

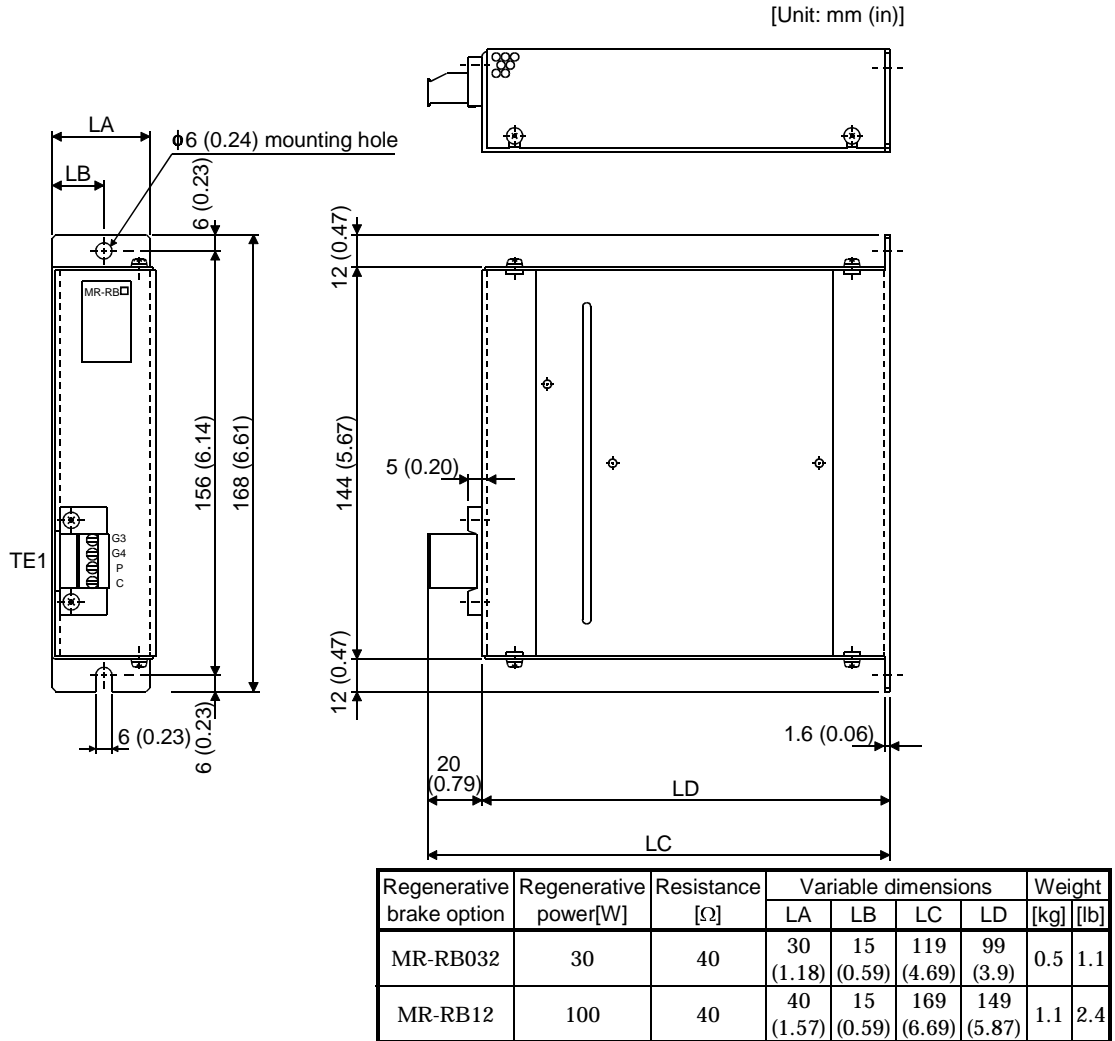


Recommended fan:  
Toyo Denki's TL396A or equivalent

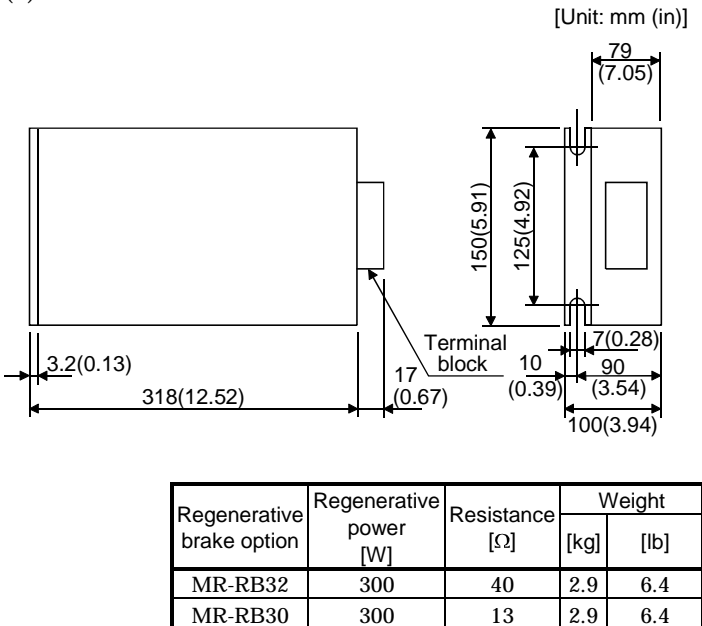
### 13. OPTIONS AND AUXILIARY EQUIPMENT

(5) Outline drawing

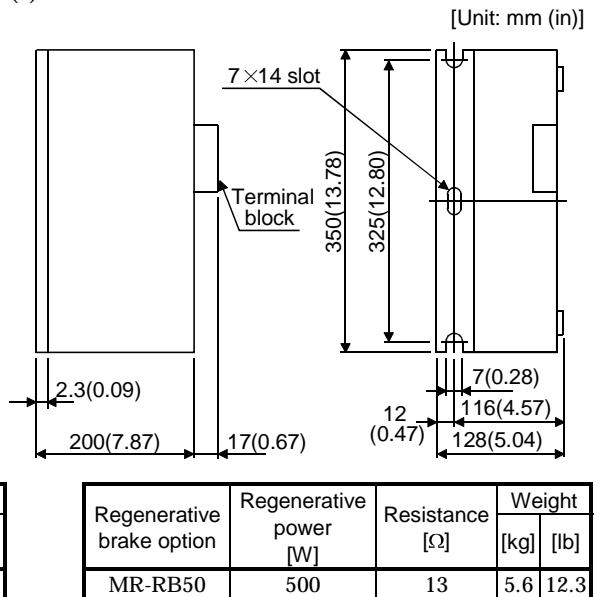
(a) MR-RB032 · MR-RB12



(b) MR-RB32 · MR-RB30 · MR-RB31



(c) MR-RB50 · MR-RB51



## 13. OPTIONS AND AUXILIARY EQUIPMENT

### 13.1.2 Brake unit

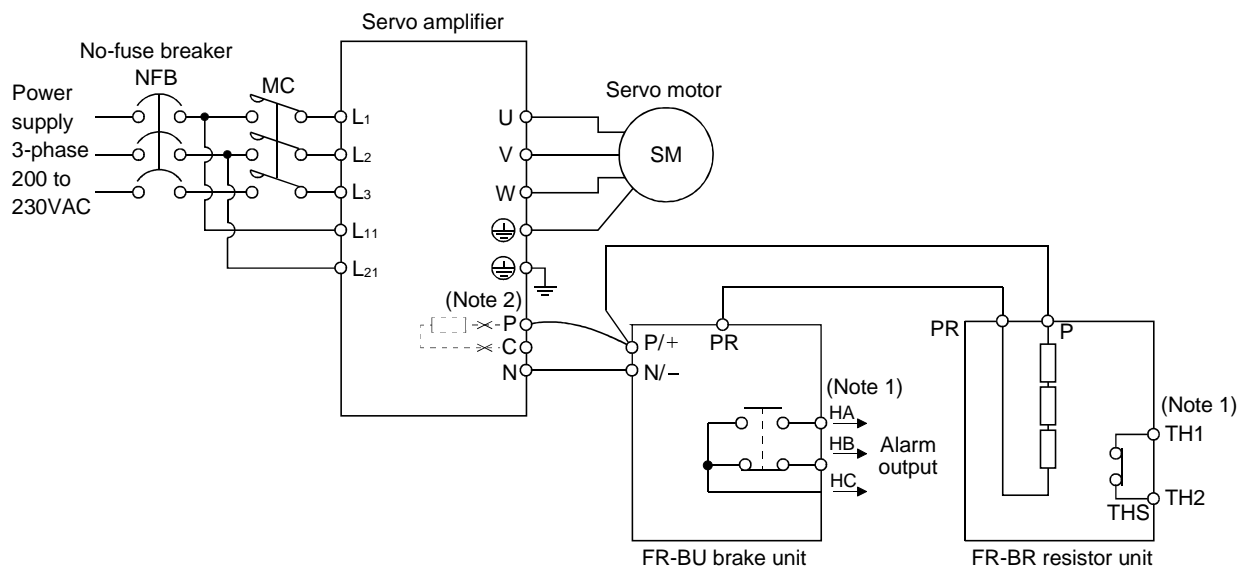
POINT
<ul style="list-style-type: none"> <li>▪ The brake unit and resistor unit of other than 200V class are not applicable to the servo amplifier.</li> <li>▪ The brake unit and resistor unit of the same capacity must be combined. The units of different capacities may result in damage.</li> <li>▪ The 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.</li> <li>▪ The temperature of the resistor unit casing rises to higher than 100°C. Do not cause cables and combustibles to make contact with the casing.</li> </ul>

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

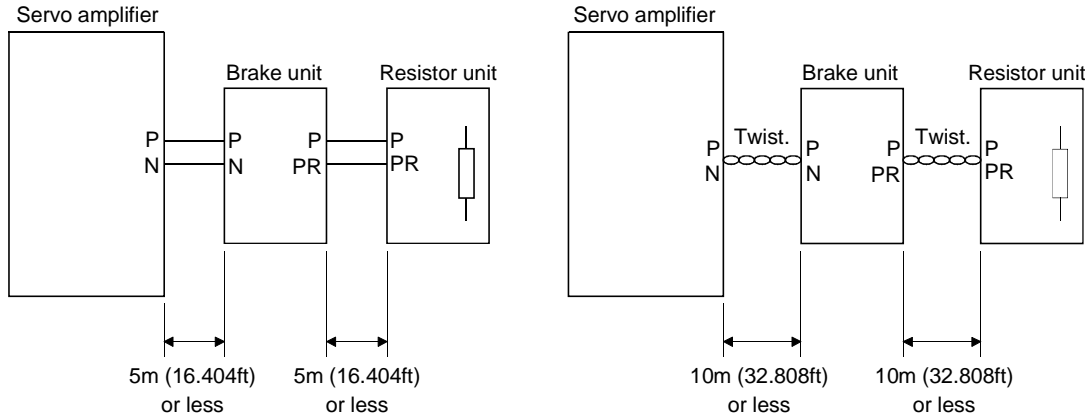


- Note 1. Make up the external sequence to switch the power off when an alarm occurs or when the thermal relay is actuated.  
 2. Always remove the wiring (across P-C) of the servo amplifier built-in resistor.

### 13. OPTIONS AND AUXILIARY EQUIPMENT

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).

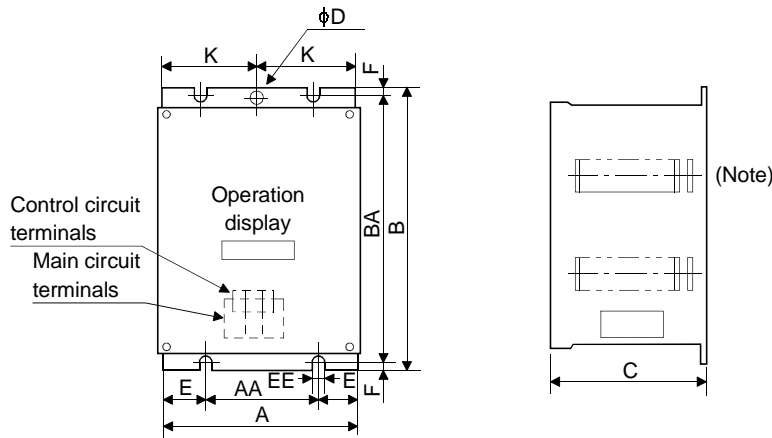
The cable size should be equal to or larger than the recommended size. See the brake unit instruction manual. You cannot connect one set of brake unit to two servo amplifiers or two sets of brake units to one servo amplifier.



#### (3) Outside dimensions

##### (a) Brake unit (FR-BU)

[Unit : mm(in)]



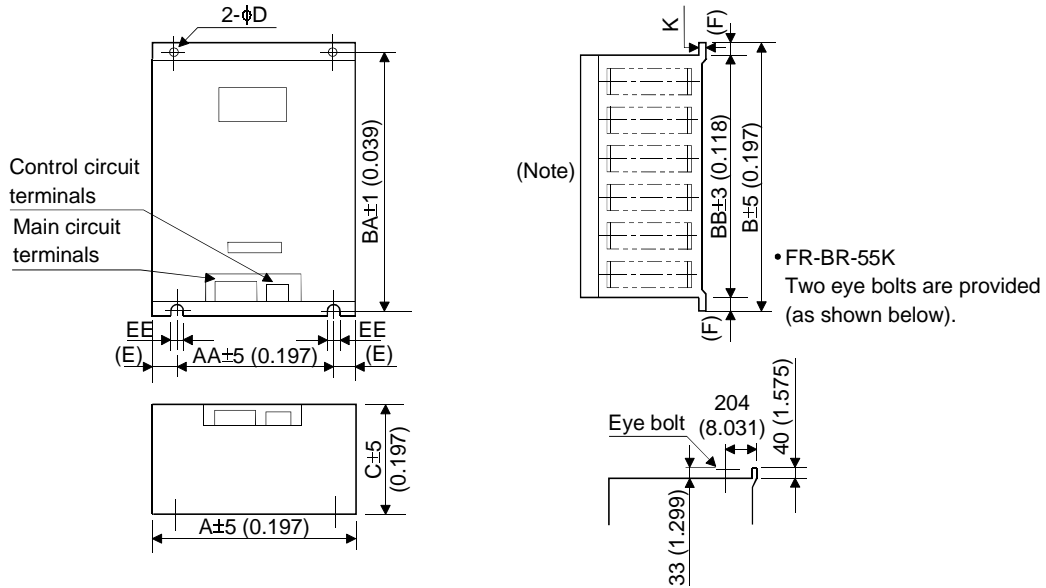
Note: Ventilation ports are provided in both side faces and top face. The bottom face is open.

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)

### 13. OPTIONS AND AUXILIARY EQUIPMENT

(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.

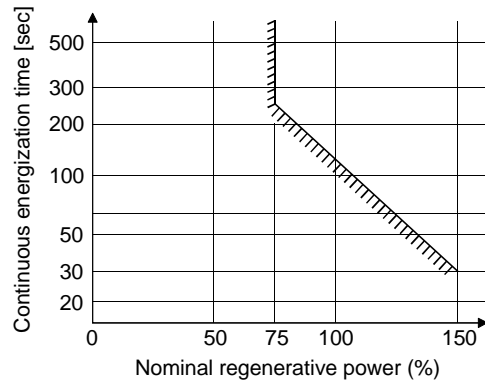
Resistor Unit Model	A	AA	B	BA	BB	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-BR-15K	170 (6.693)	100 (3.937)	450 (17.717)	432 (17.008)	410 (16.142)	220 (8.661)	6 (0.236)	35 (1.378)	6 (0.236)	1.6 (0.063)	20 (0.787)	15 (66.139)
FR-BR-30K	340 (11.389)	270 (10.63)	600 (23.622)	582 (22.913)	560 (22.047)	220 (8.661)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

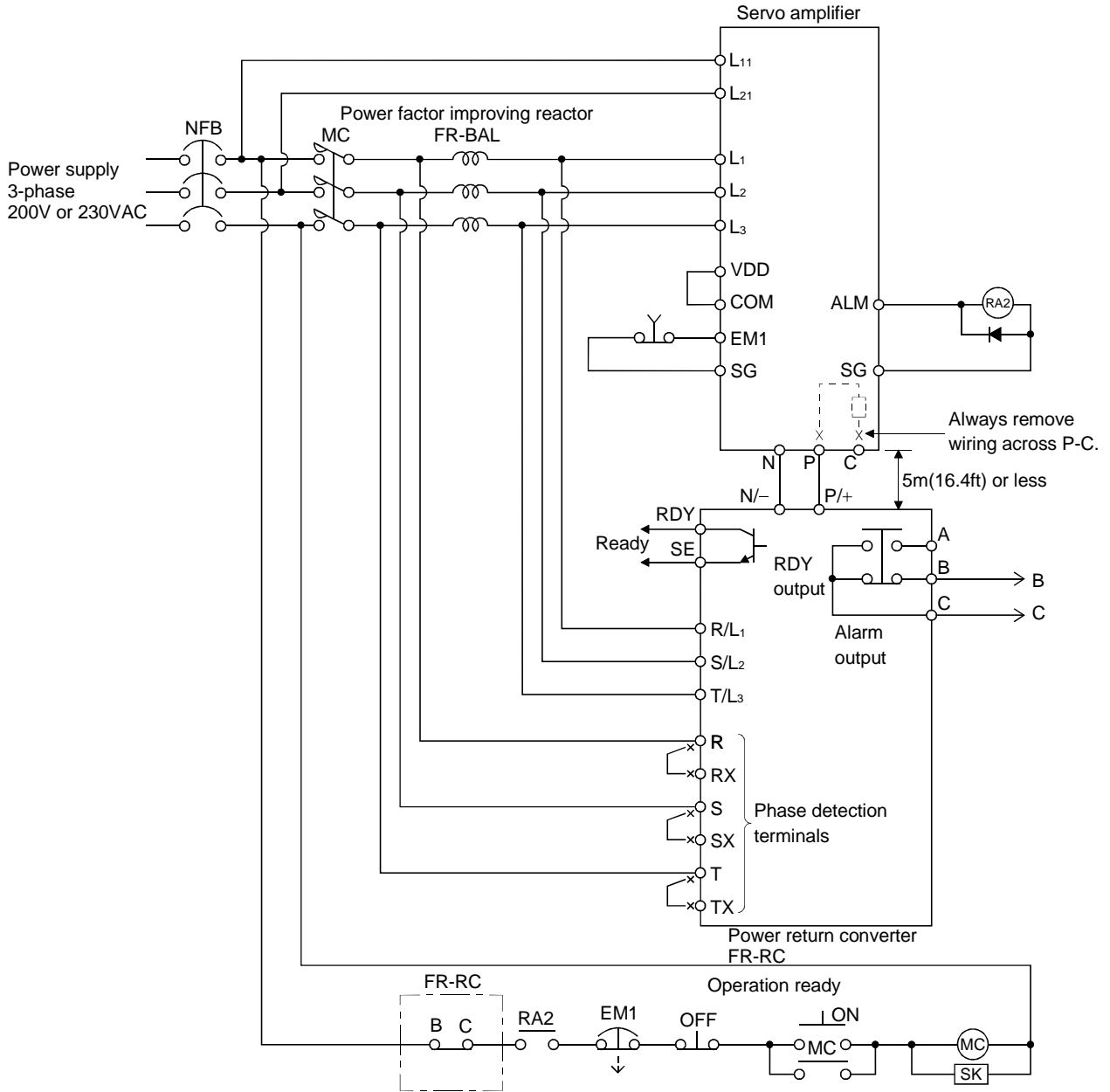
The converters can continuously return 75% of the nominal regenerative power. They are applied to the servo amplifiers of the MR-J2S-500A and MR-J2S-700A.

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



# 13. OPTIONS AND AUXILIARY EQUIPMENT

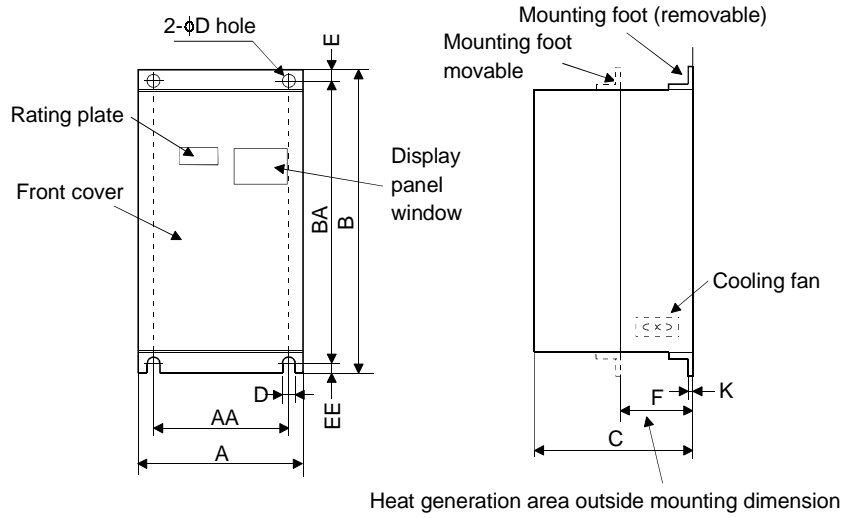
## (2) Connection example



### 13. OPTIONS AND AUXILIARY EQUIPMENT

#### (3) Outside dimensions of the power return converters

[Unit : mm(in)]

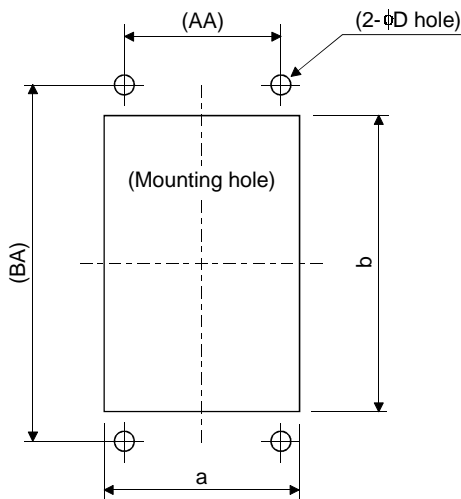


Power return converter	A	AA	B	BA	C	D	E	EE	K	F	Approx. Weight [kg(lb)]
FR-RC-15K	270 (10.630)	200 (7.874)	450 (17.717)	432 (17.008)	195 (7.677)	10 (0.394)	10 (0.394)	8 (0.315)	3.2 (0.126)	87 (3.425)	19 (41.888)
FR-RC-30K	340 (13.386)	270 (10.630)	600 (23.622)	582 (22.913)	195 (7.677)	10 (0.394)	10 (0.394)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

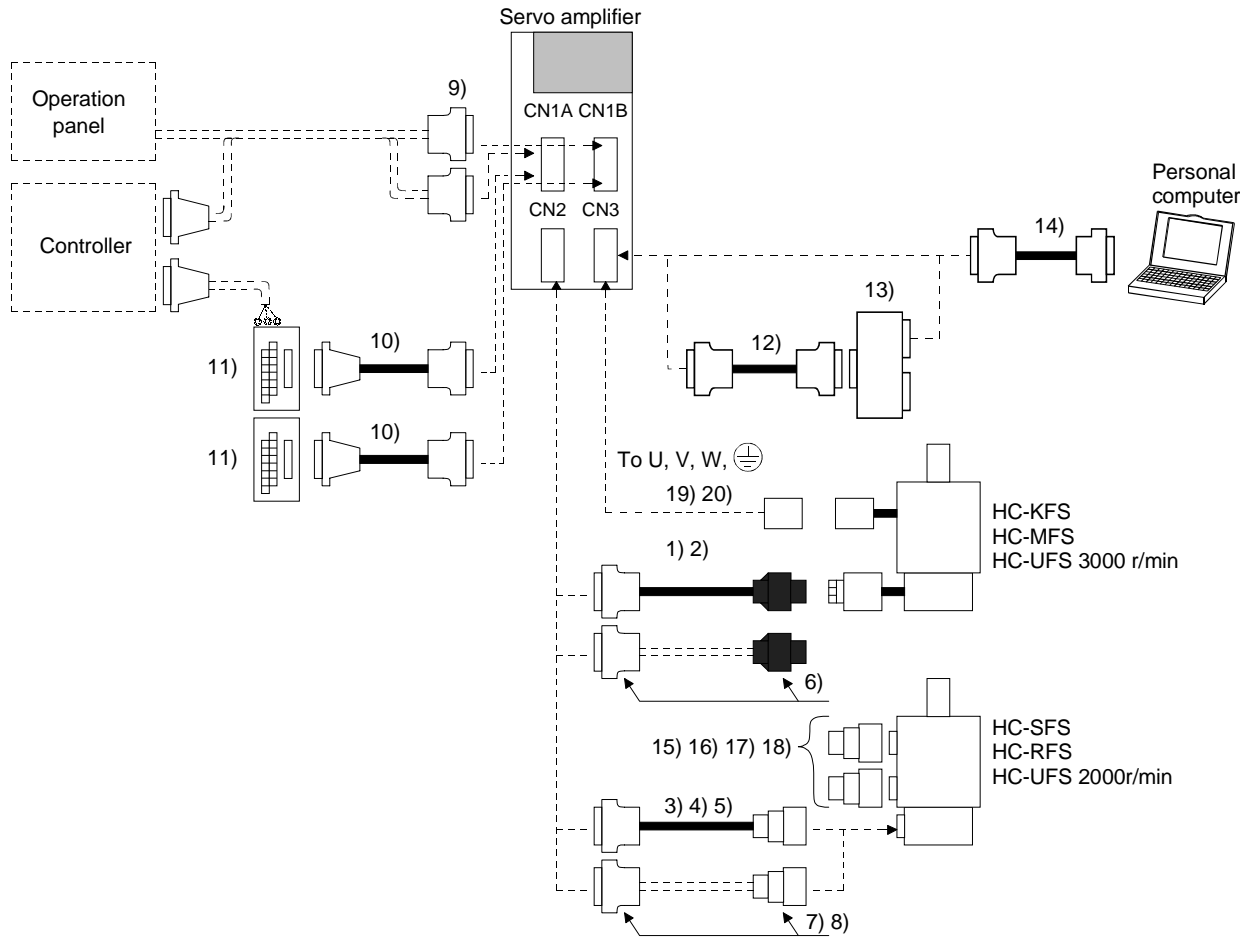


## 13. OPTIONS AND AUXILIARY EQUIPMENT



### 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.



### 13. OPTIONS AND AUXILIARY EQUIPMENT

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

### 13. OPTIONS AND AUXILIARY EQUIPMENT

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

## 13. OPTIONS AND AUXILIARY EQUIPMENT

### (2) Encoder cable



• 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-□

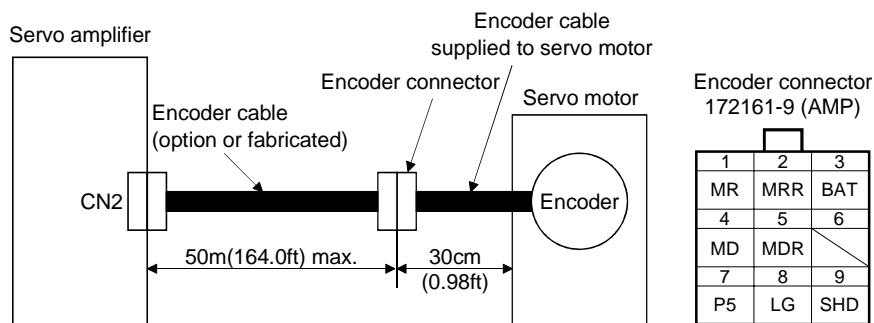
Symbol	Specifications
L	Standard flexing life
H	Long flexing life

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)

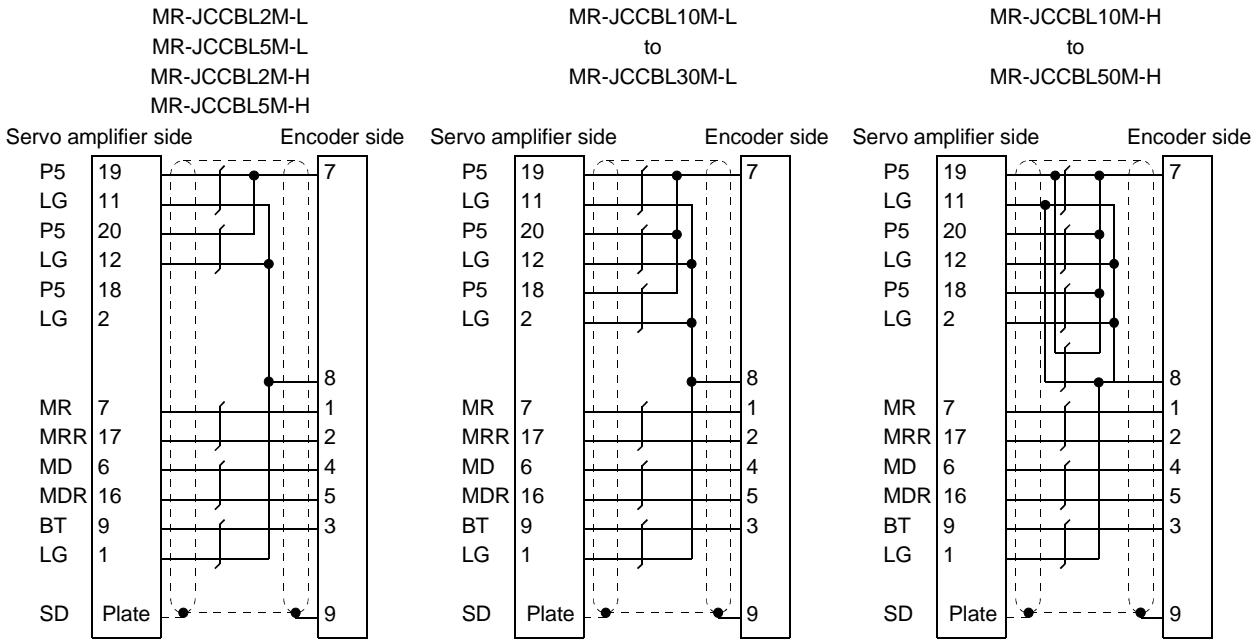
Note: MR-JCCBL□M-H has no 40(131.2) and 50m(164.0ft) sizes.

#### 2) Connection diagram

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



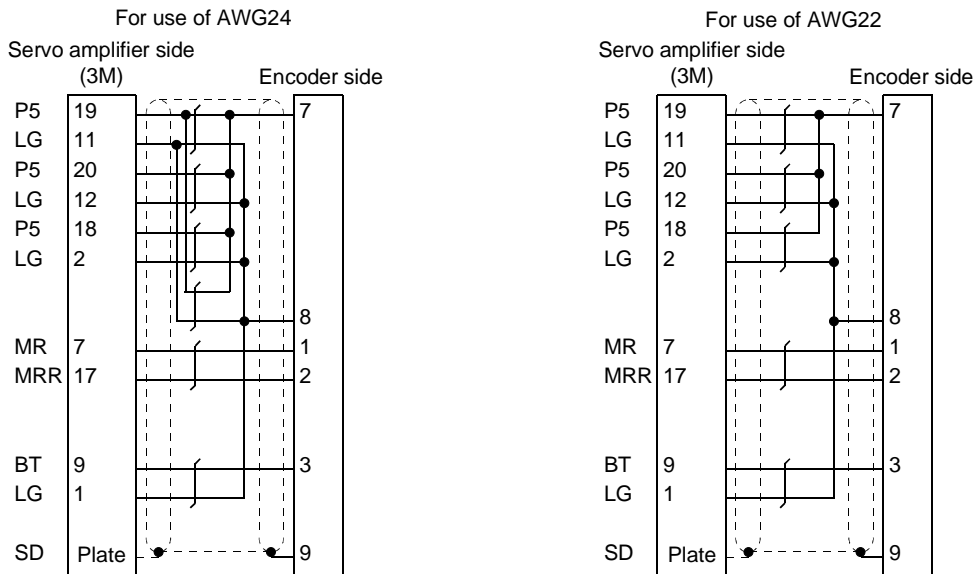
# 13. OPTIONS AND AUXILIARY EQUIPMENT



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.



# 13. OPTIONS AND AUXILIARY EQUIPMENT

## (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.

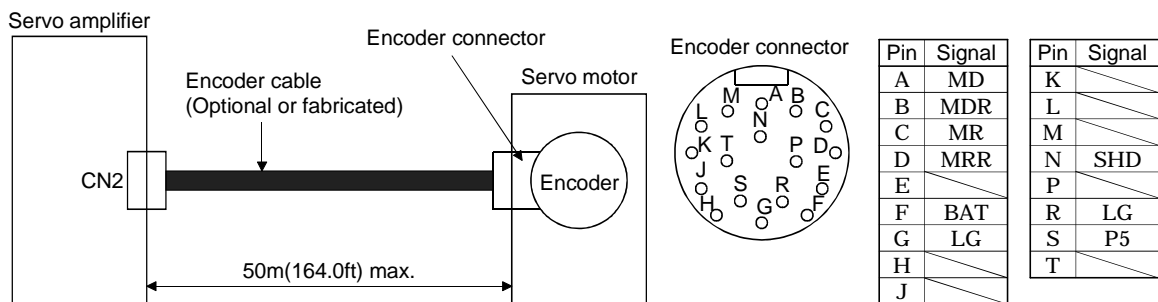
Model: MR-ENCBL□M-H

Long flexing life

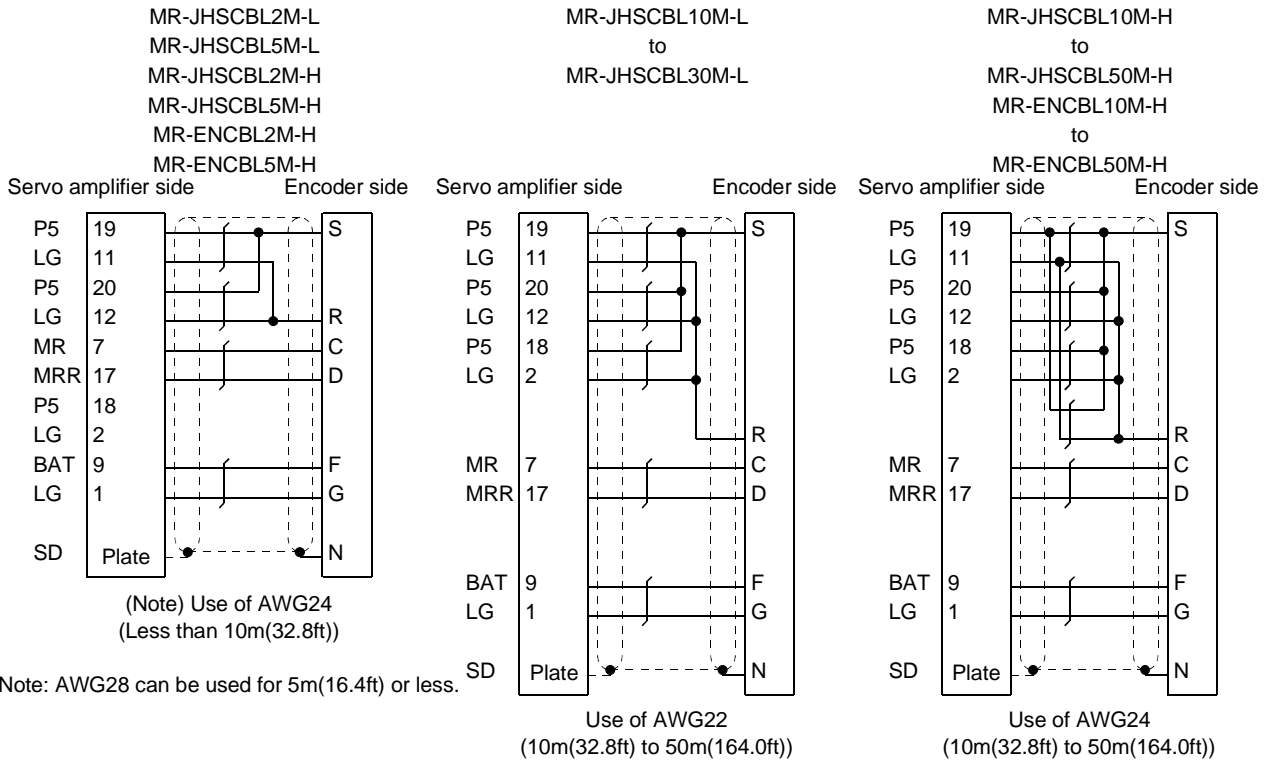
Symbol	Cable length [m(ft)]
2	2 (6.56)
5	5 (16.4)
10	10 (32.8)
20	20 (65.6)
30	30 (98.4)
40	40 (131.2)
50	50 (164.0)

### 2) Connection diagram

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



# 13. OPTIONS AND AUXILIARY EQUIPMENT



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.

## 13. OPTIONS AND AUXILIARY EQUIPMENT

### (3) Communication cable

<b>POINT</b>
<ul style="list-style-type: none"> <li>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.</li> </ul>

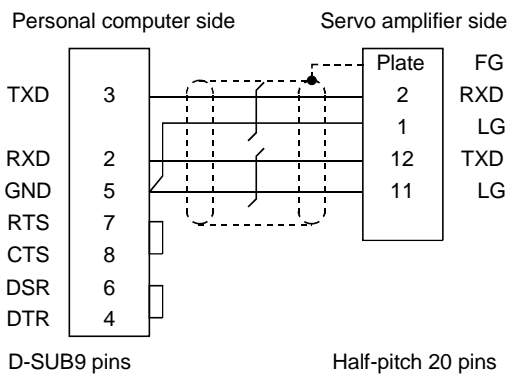
#### (a) Model definition

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. OPTIONS AND AUXILIARY EQUIPMENT

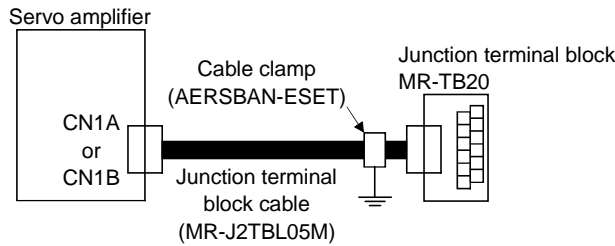
## 13.1.5 Junction terminal block (MR-TB20)

**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.

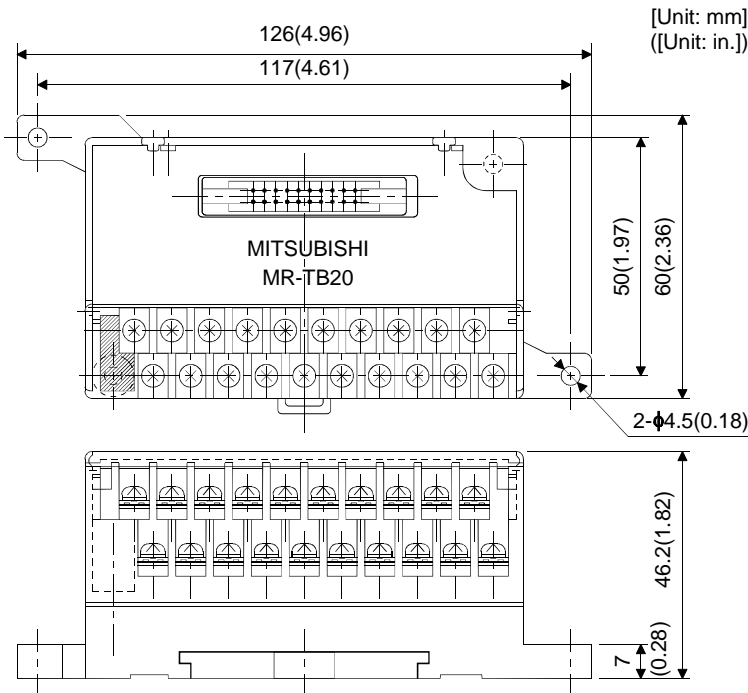
#### 1) For CN1A

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

#### 2) For CN1B

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

### (3) Outline drawing



Terminal screw: M3.5  
 Applicable cable: Max. 2mm<sup>2</sup>  
 (Crimping terminal width: 7.2mm (0.283 in) max.)

### 13. OPTIONS AND AUXILIARY EQUIPMENT

(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

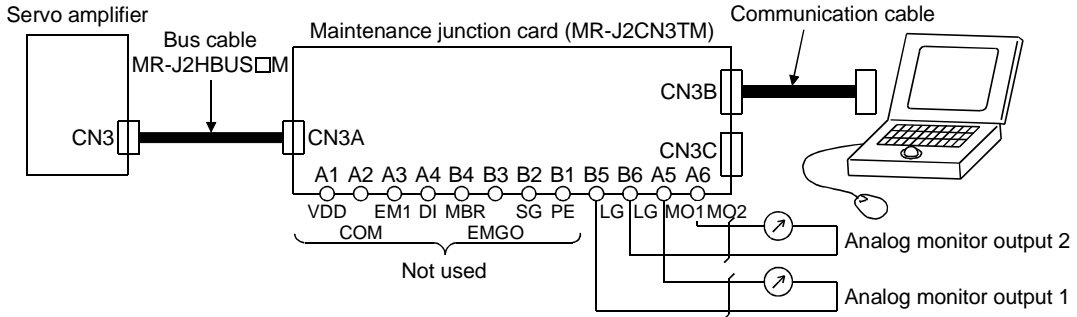
Note: The labels supplied to the junction terminal block are designed for the position control mode. When using the junction terminal block in the speed or torque control mode, change the signal abbreviations using the accessory signal seals.

# 13. OPTIONS AND AUXILIARY EQUIPMENT

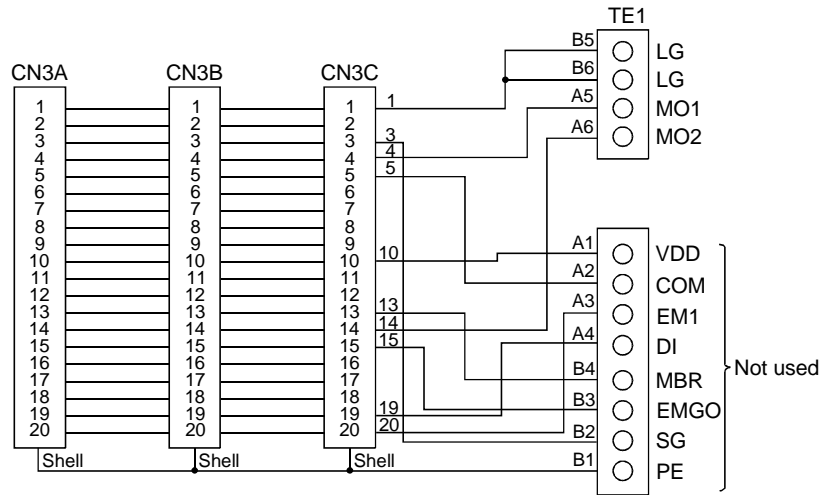
## 13.1.6 Maintenance junction card (MR-J2CN3TM)

### (1) Usage

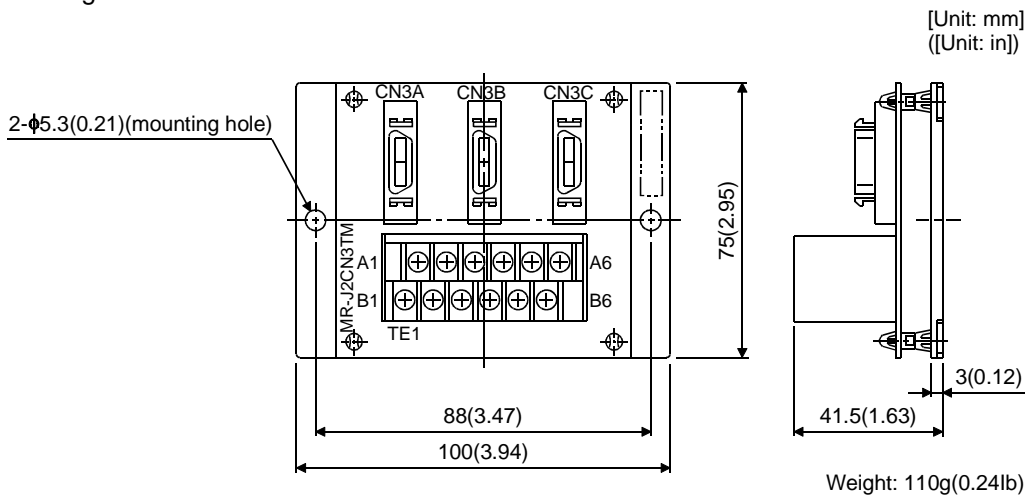
The maintenance junction card (MR-J2CN3TM) is designed for use when a personal computer and analog monitor outputs are used at the same time.



### (2) Connection diagram



### (3) Outline drawing



## 13. OPTIONS AND AUXILIARY EQUIPMENT

### (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

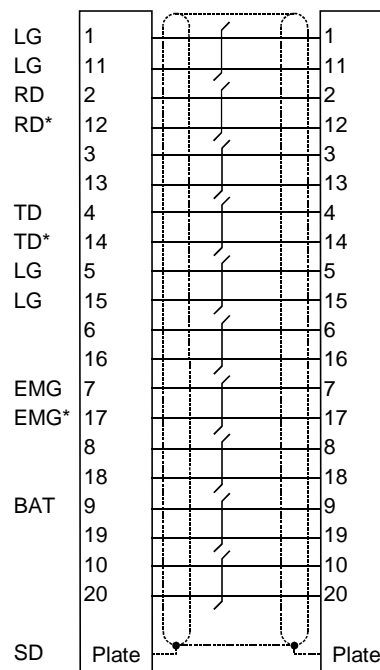
MR-J2HBUS5M

10120-6000EL (connector)

10120-6000EL (connector)

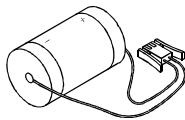
10320-3210-000 (shell kit)

10320-3210-000 (shell kit)



### 13.1.7 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



## 13. OPTIONS AND AUXILIARY EQUIPMENT

### 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 (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) Personal computer	IBM PC-AT compatible on which Windows 95 or 98 (English) runs (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 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.

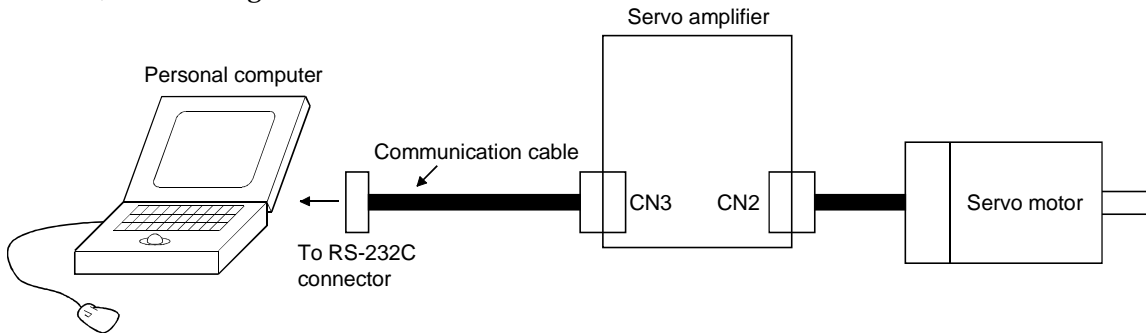
Note: 1. Windows is a trade mark of Microsoft Corporation.

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

# 13. OPTIONS AND AUXILIARY EQUIPMENT

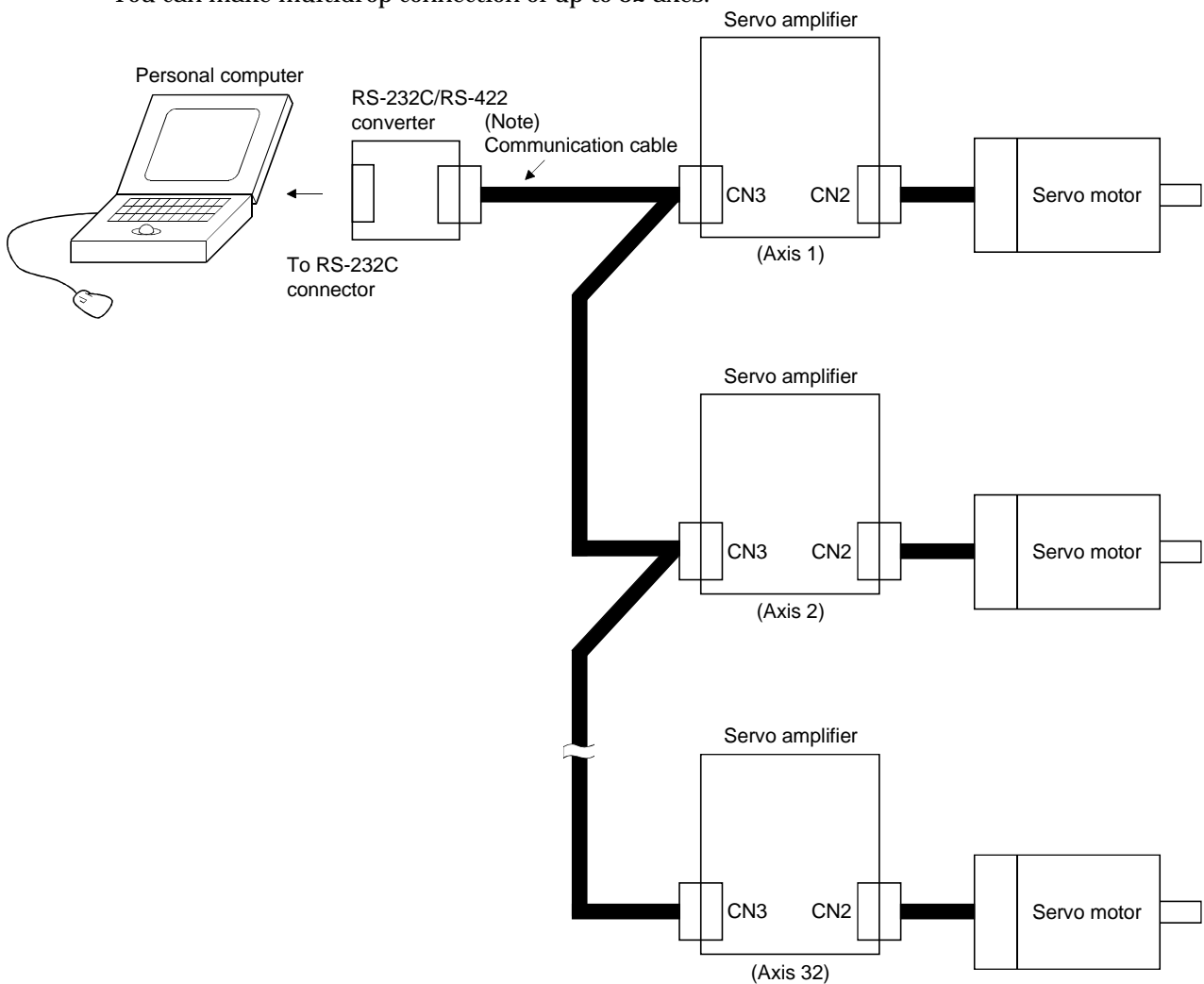
## (b) Configuration diagram

### 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. OPTIONS AND AUXILIARY EQUIPMENT

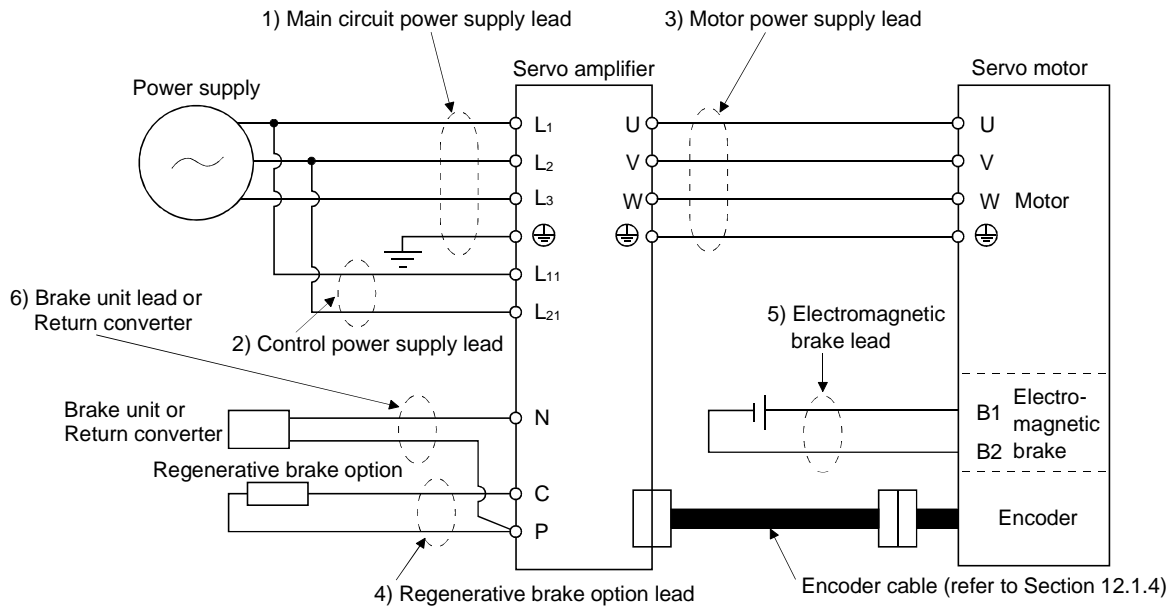
## 13.2 Auxiliary equipment

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 <sup>2</sup> ]				
	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	3.5 (AWG12) : b	1.25 (AWG16)	2 (AWG14) : a	2 (AWG14) : a	1.25 (AWG16)
MR-J2S-200A					
MR-J2S-350A	5.5 (AWG10) : b	1.25 (AWG16)	(Note 2) 5.5 (AWG10) : b	2 (AWG14) : a	1.25 (AWG16)
MR-J2S-500A					
MR-J2S-700A					
MR-J2S-700A	8 (AWG8) : c	1.25 (AWG16)	8 (AWG8) : c	3.5(AW12) : c	1.25 (AWG16)

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

2. 3.5mm<sup>2</sup> for use of the HC-RFS203 servo motor.

## 13. OPTIONS AND AUXILIARY EQUIPMENT

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

Model	Wires[mm <sup>2</sup> ]
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 Head YNE-38 Die DH-111 · DH-121	Japan Solderless Terminal

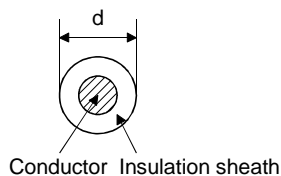
### (2) Wires for cables

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 <sup>2</sup> ]	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 to 30 (65.6 to 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 to 5 (6.56 to 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 to 5 (6.56 to 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 to 5 (6.56 to 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 to 5 (6.56 to 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. OPTIONS AND AUXILIARY EQUIPMENT

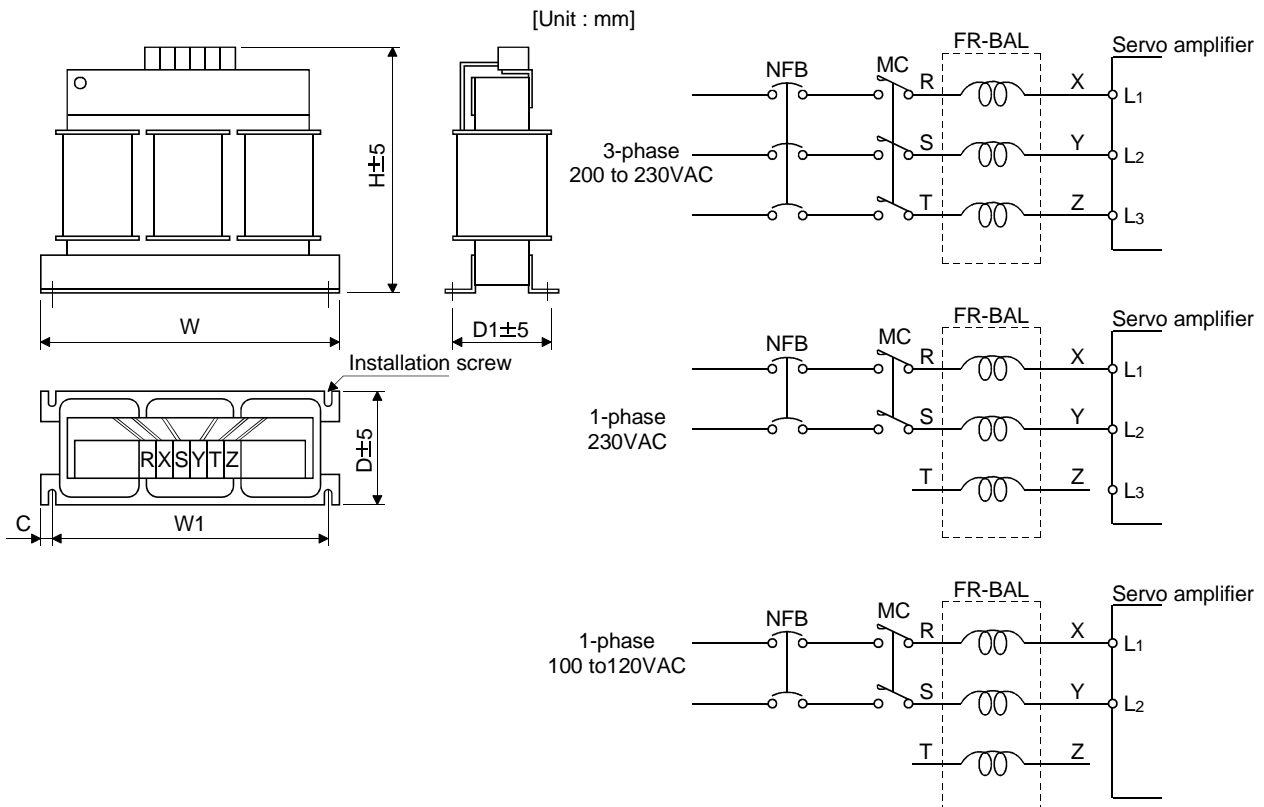
### 13.2.2 No-fuse breakers, fuses, magnetic contactors

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%.



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. OPTIONS AND AUXILIARY EQUIPMENT

### 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). (Ex.) Omron : type G2A , MY
Relay used for digital output signals (interface DO-1)	Small relay with 12VDC or 24VDC of 40mA or less (Ex.) Omron : type MY

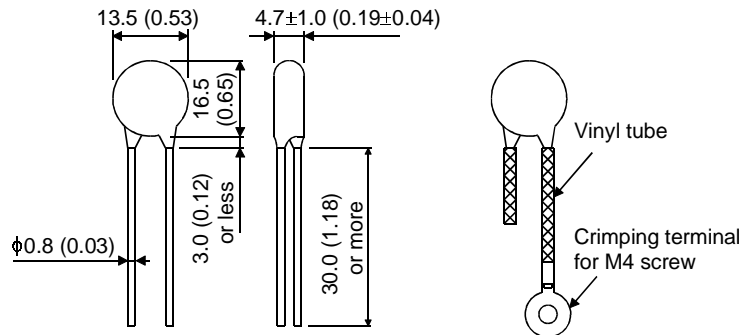
### 13.2.5 Surge absorbers

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) 500/time	5	0.4	25	360	300	220 (198 to 242)

Note: 1 time =  $8 \times 20\mu\text{s}$

(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.

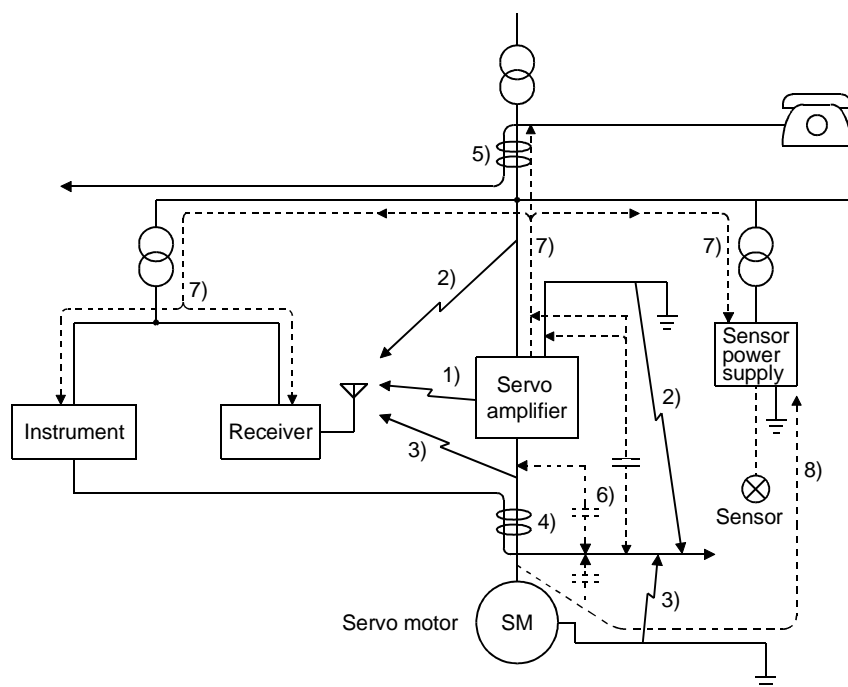
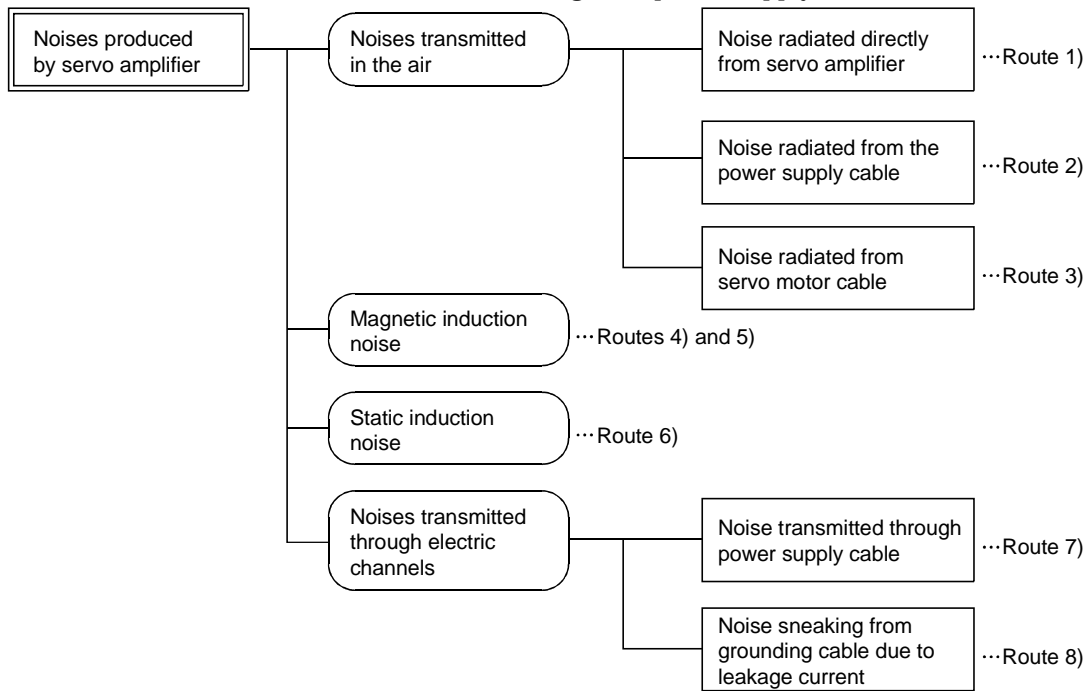
#### (1) Noise reduction techniques

##### (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).

### 13. OPTIONS AND AUXILIARY EQUIPMENT

- (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.



## 13. OPTIONS AND AUXILIARY EQUIPMENT

Noise transmission route	Suppression techniques
1) 2) 3)	<p>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.</p> <p>(1) Provide maximum clearance between easily affected devices and the servo amplifier.            (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier.            (3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or bundling them together.            (4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line.            (5) Use shielded wires for signal and power cables or put cables in separate metal conduits.</p>
4) 5) 6)	<p>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.</p> <p>(1) Provide maximum clearance between easily affected devices and the servo amplifier.            (2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo amplifier.            (3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or bundling them together.            (4) Use shielded wires for signal and power cables or put the cables in separate metal conduits.</p>
7)	<p>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.</p> <p>(1) Insert the radio noise filter (FR-BIF) on the power cables (Input cables) of the servo amplifier.            (2) Insert the line noise filter (FR-BSF01 · FR-BLF) on the power cables of the servo amplifier.</p>
8)	<p>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.</p>

### (2) Noise reduction products

#### (a) Data line filter

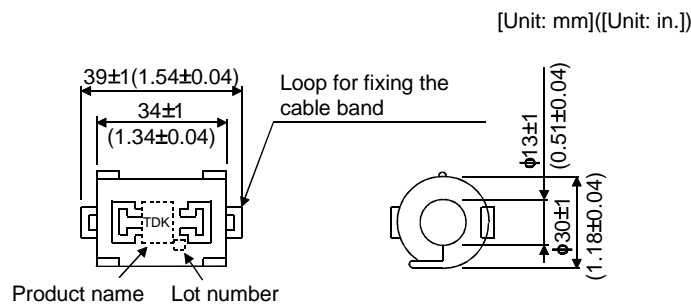
Noise can be prevented by installing a data line filter onto the encoder cable, etc.

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

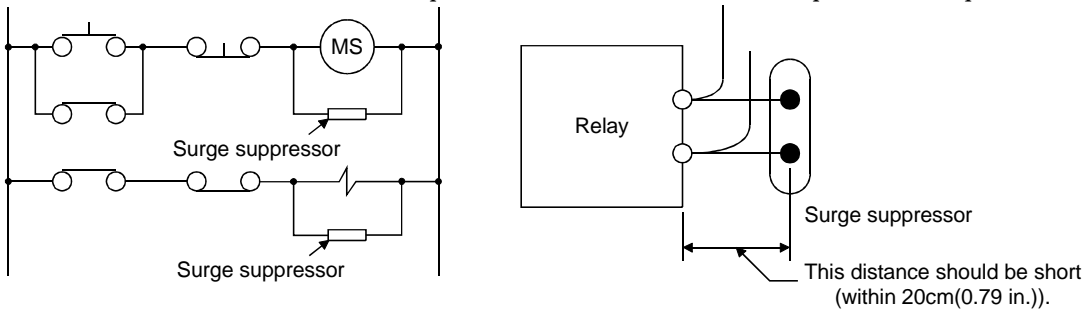


Outline drawing (ZCAT3035-1330)

### 13. OPTIONS AND AUXILIARY EQUIPMENT

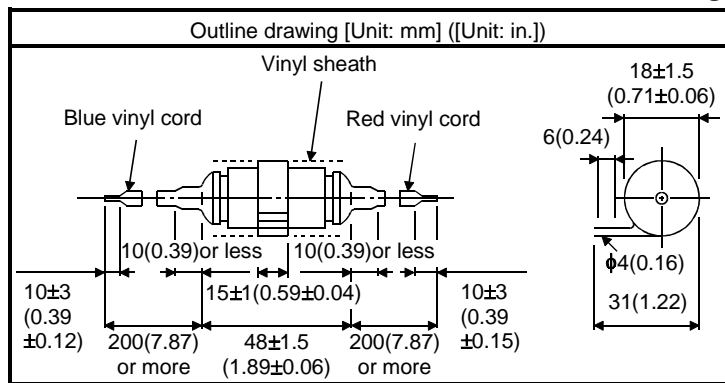
(b) Surge suppressor

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)

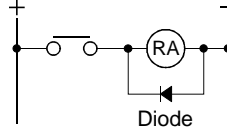
Rated voltage AC[V]	C [ $\mu$ F]	R [ $\Omega$ ]	Test voltage AC[V]
200	0.5	50 (1W)	Across T-C 1000(1 to 5s)



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



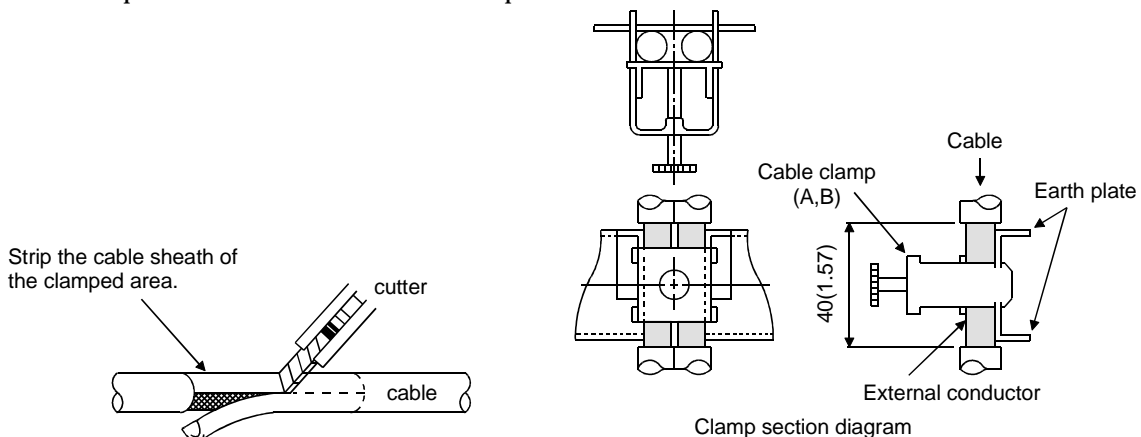
(c) Cable clamp fitting (AERSBAN □-SET)

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.

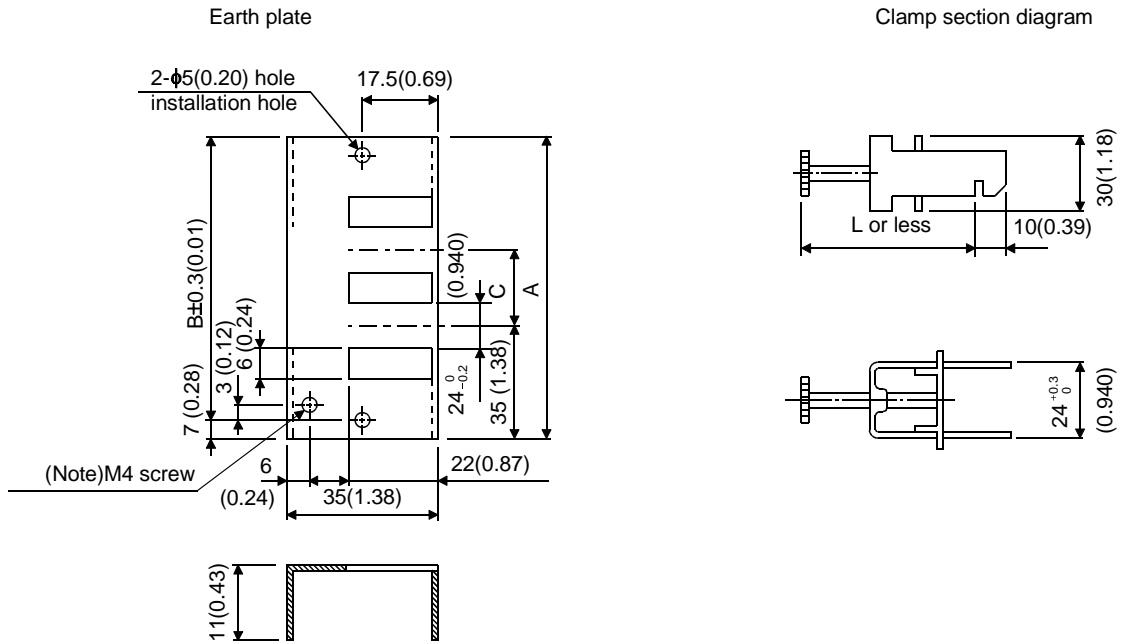
The clamp comes as a set with the earth plate.



# 13. OPTIONS AND AUXILIARY EQUIPMENT

• Outline drawing

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



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

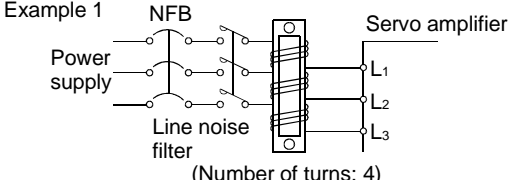
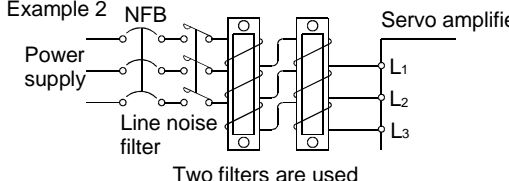
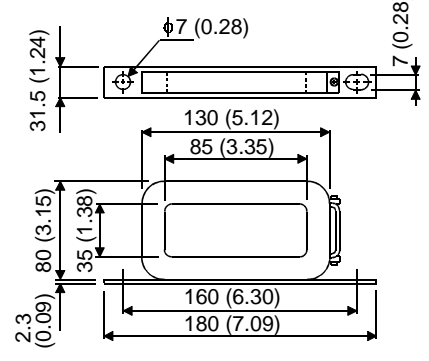
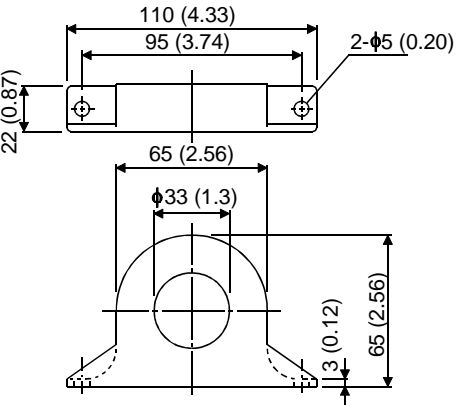
Type	A	B	C	Accessory fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

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

### 13. OPTIONS AND AUXILIARY EQUIPMENT

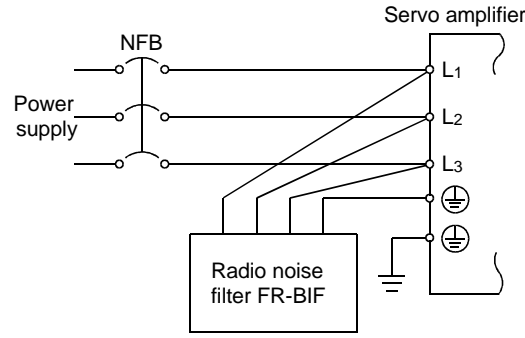
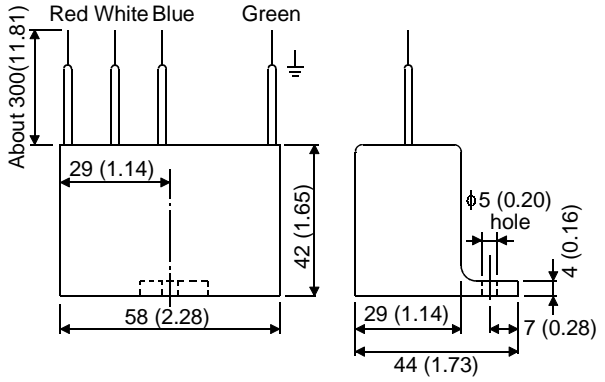
(d) Line noise filter (FR-BLF, FR-BSF01)

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.])
<p>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.</p> <p>The effect of the filter on the power supply side is higher as the number of winds is larger. The number of turns is generally four. If the wires are too thick to be wound, use two or more filters and make the total number of turns as mentioned above.</p> <p>On the output side, the number of turns must be four or less.</p> <p>Do not wind the grounding wire together with the 3-phase wires. The filter effect will decrease. Use a separate wire for grounding.</p> <p><b>Example 1</b></p>  <p>(Number of turns: 4)</p> <p><b>Example 2</b></p>  <p>Two filters are used (Total number of turns: 4)</p>	<p><b>FR-BLF(MR-J2S-350A) or more</b></p>  <p><b>FR-BSF01(for MR-J2S-200A or less)</b></p> 

(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.])
<p>Make the connection cables as short as possible. Grounding is always required.</p> 	<p>Leakage current: 4mA</p> 

# 13. OPTIONS AND AUXILIARY EQUIPMENT

## 13.2.7 Leakage current breaker

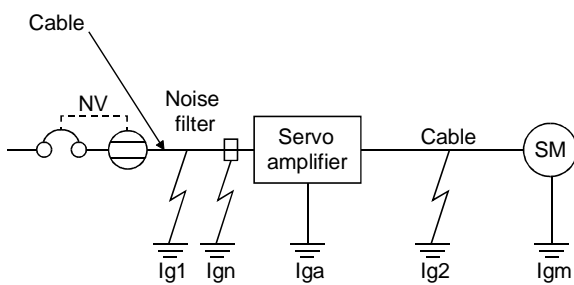
### (1) Selection method

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.

$$\text{Rated sensitivity current} \geq 10 \cdot \{I_{g1} + I_{gn} + I_{ga} + K \cdot (I_{g2} + I_{gm})\} \text{ [mA]} \dots\dots\dots (13.2)$$



K: Constant considering the harmonic contents

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

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

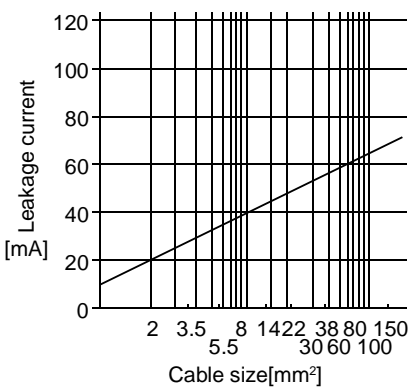


Fig. 13.1 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

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

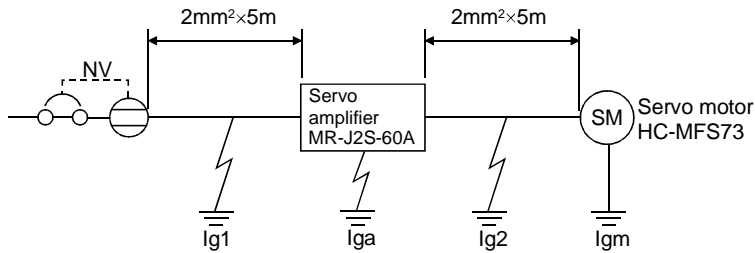
Servo amplifier	Rated sensitivity current of leakage circuit breaker [mA]
MR-J2S-10A to MR-J2S-350A MR-J2S-10A1 to MR-J2S-40A1	15
MR-J2S-500A	30
MR-J2S-700A	50



## 13. OPTIONS AND AUXILIARY EQUIPMENT

### (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:

$$I_{g1} = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$I_{g2} = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$I_{gn} = 0 \text{ (not used)}$$

$$I_{ga} = 0.1 \text{ [mA]}$$

$$I_{gm} = 0.1 \text{ [mA]}$$

Insert these values in Equation (13.2):

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

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

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

# 13. OPTIONS AND AUXILIARY EQUIPMENT

## 13.2.8 EMC filter

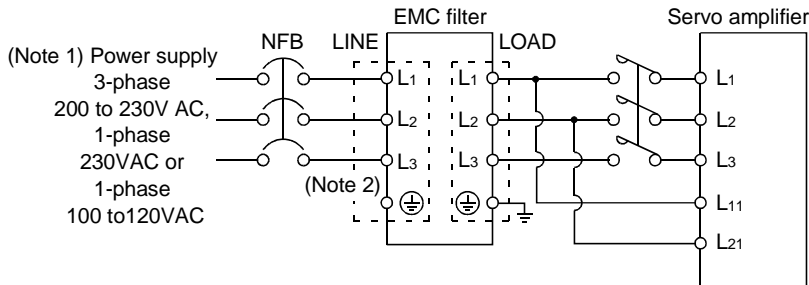
For compliance with the EMC Directive of the EN Standard, it is recommended to use the following filter:

### (1) Combination with the servo amplifier

Servo amplifier	Recommended filter		Weight [kg](lb)
	Model	Leakage current [mA]	
MR-J2S-10A to MR-J2S-100A 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)

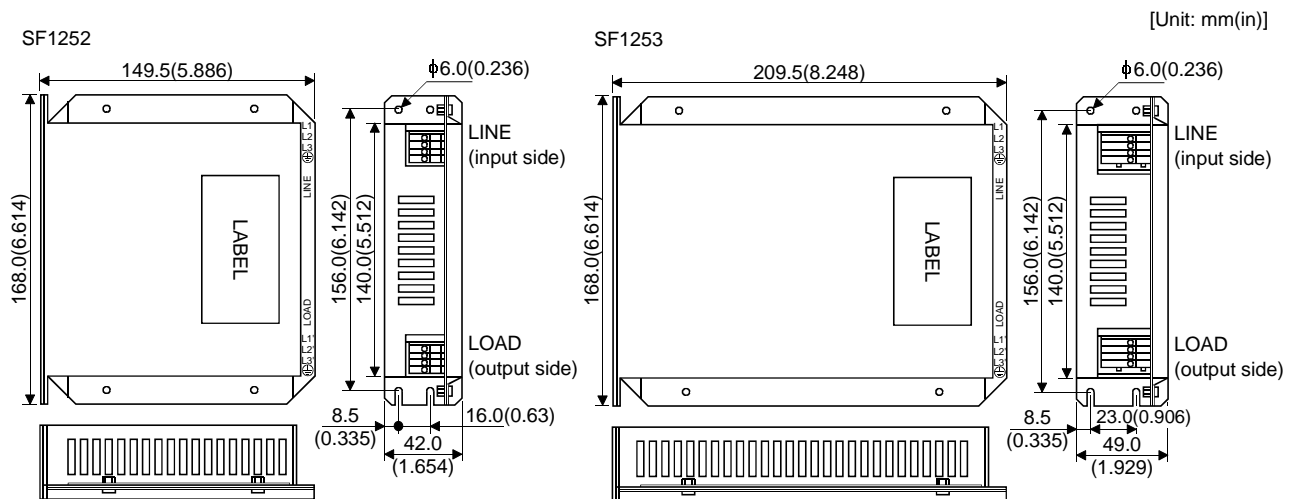
Note : Soshin Electric

### (2) Connection example



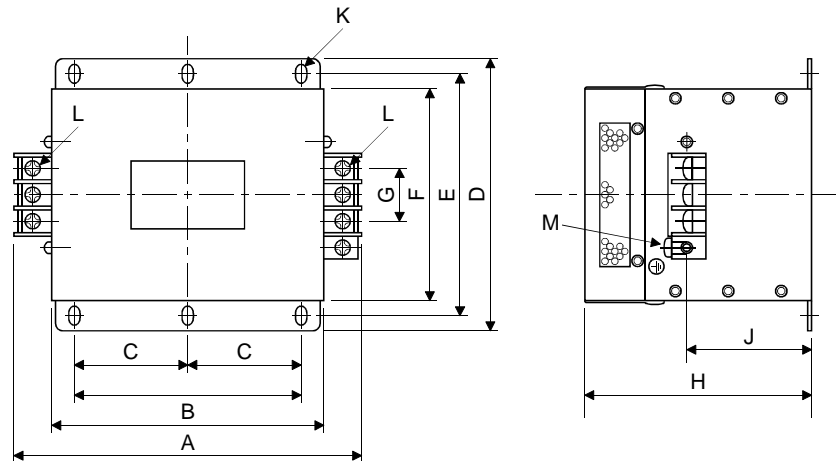
- Note: 1. For 1-phase 230VAC power supply, connect the power supply to L1, L2 and leave L3 open. There is no L3 for 1-phase 100 to 120VAC power supply.  
2. Connect when the power supply has earth.

### (3) Outline drawing



## 13. OPTIONS AND AUXILIARY EQUIPMENT

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

## 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.

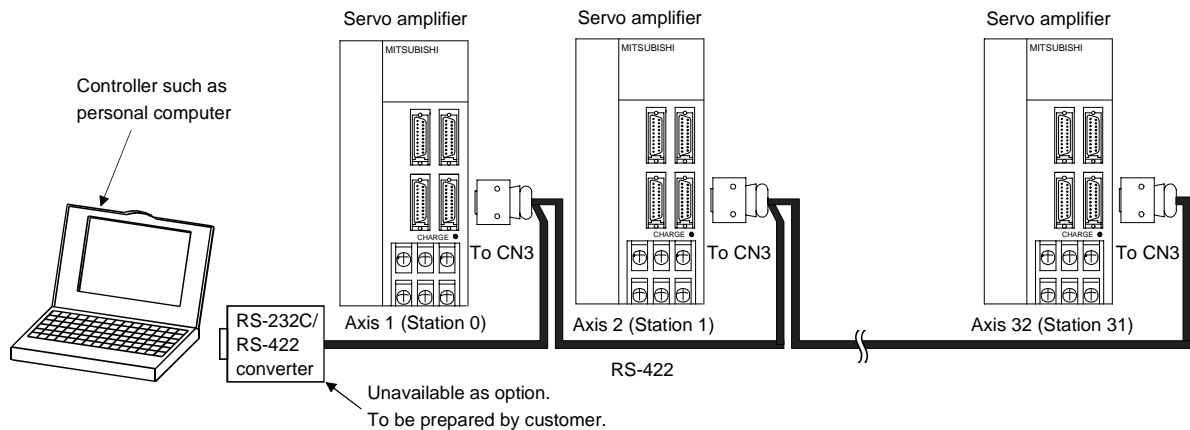
However, the RS-422 and RS-232C communication functions cannot be used together. Select between RS-422 and RS-232C with parameter No.16. (Refer to Section 14.2.2.)

### 14.1 Configuration

#### 14.1.1 RS-422 configuration

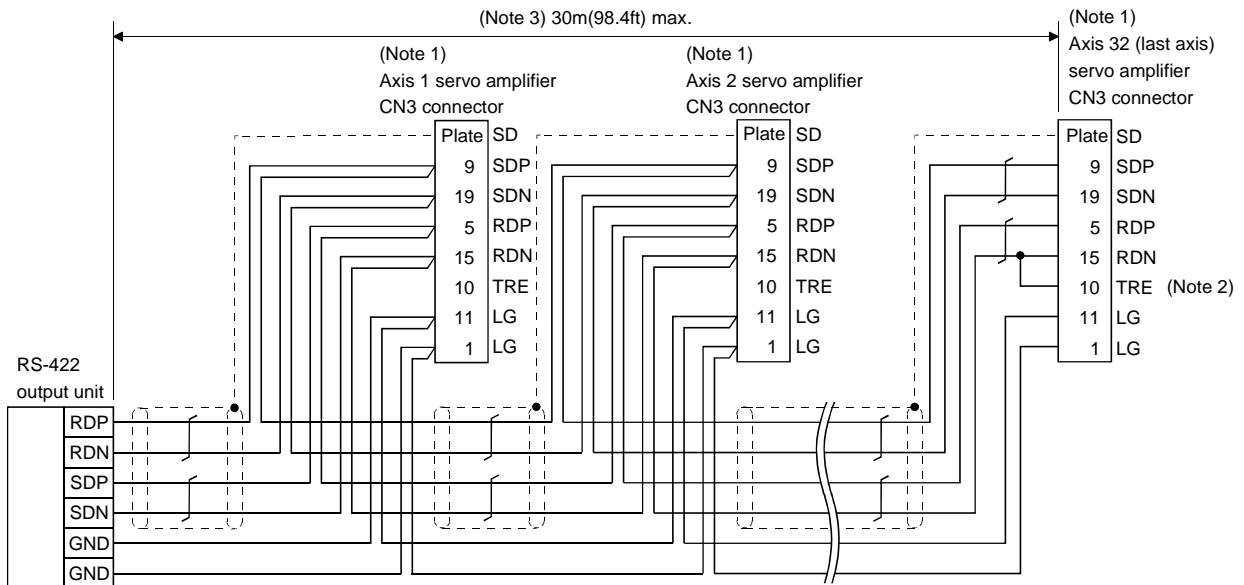
##### (1) Outline

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.

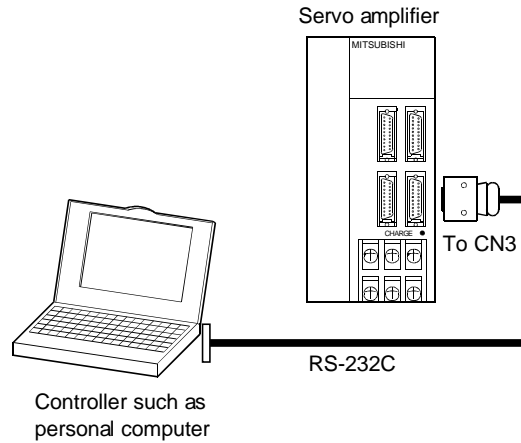
3. 30m max. in environment of little noise.

# 14. COMMUNICATION FUNCTIONS

## 14.1.2 RS-232C configuration

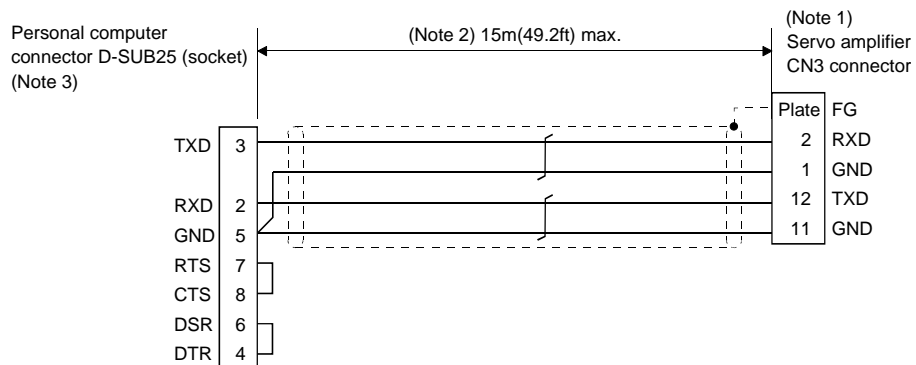
### (1) Outline

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.

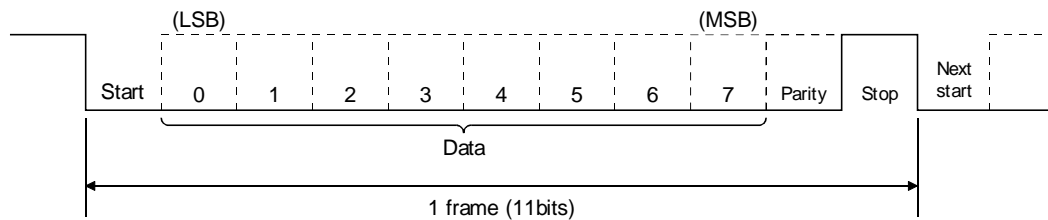
## 14. COMMUNICATION FUNCTIONS

### 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 Data bit : 8 bits Parity bit : 1 bit (even) Stop bit : 1 bit
Transfer protocol	Character system, half-duplex communication system



## 14. COMMUNICATION FUNCTIONS

---

### 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 800 $\mu$ s or "1" to send back data in 800 $\mu$ s or more.

Parameter No. 16

-	-	-	-
---	---	---	---

Serial communication response delay time

0: Invalid

1: Valid, reply sent in 800 $\mu$ s 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

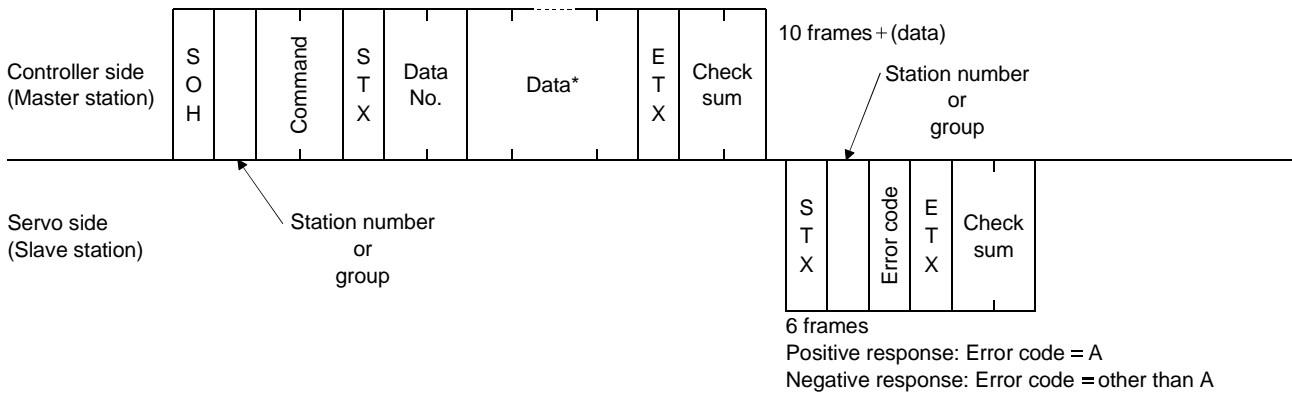
# 14. COMMUNICATION FUNCTIONS

## 14.3 Protocol

POINT	<ul style="list-style-type: none"> <li>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.</li> </ul>
-------	---

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.

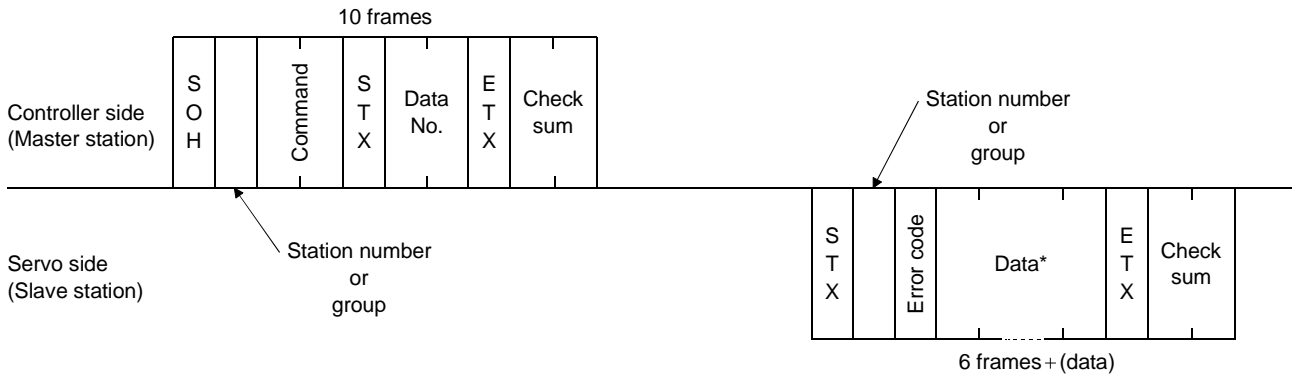
### (1) Transmission of data from the controller to the servo



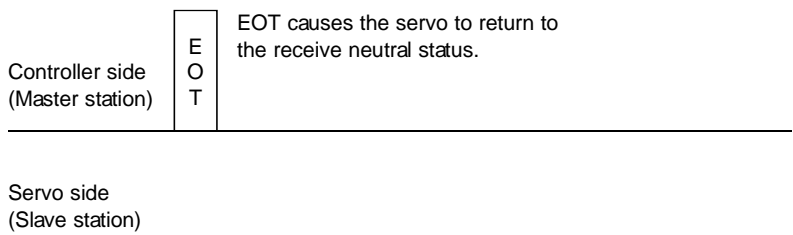


# 14. COMMUNICATION FUNCTIONS

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

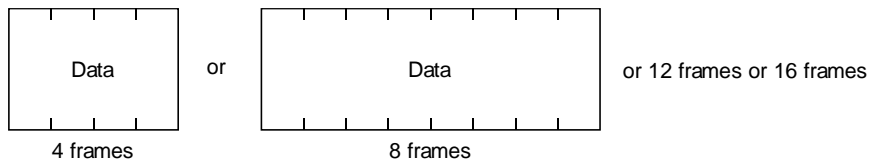


(3) Recovery of communication status by time-out



(4) Data frames

The data length depends on the command.



# 14. COMMUNICATION FUNCTIONS

## 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.

→	b8	0	0	0	0	0	0	0	0
→	b7	0	0	0	0	1	1	1	1
→	b6	0	0	1	1	0	0	1	1
→	b5	0	1	0	1	0	1	0	1

b8 to b5	b4	b3	b2	b1
	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	DC1	!	1	A	Q	a	q
2	STX	DC2	"	2	B	R	b	r
3	ETX	DC3	#	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. COMMUNICATION FUNCTIONS

### 14.5 Error codes

Error codes are used in the following cases and an error code of single-code length is transmitted.

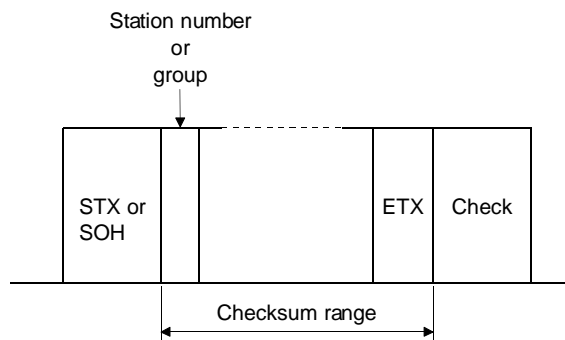
On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station.

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 SOH).

(Example)

S	[0]	[A]	[1]	[2]	[5]	[F]	E	[5]	[2]
T							T		
X							X		
	02H	30H	41H	31H	32H	35H	46H	03H	

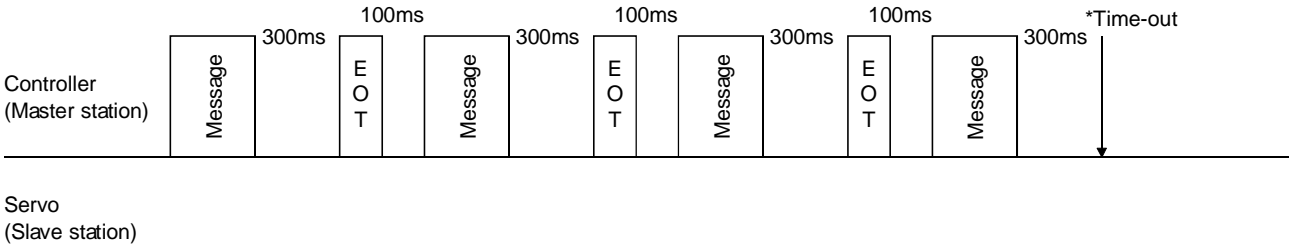
$$30H + 41H + 31H + 32H + 35H + 46H + 03H = 152H$$

Lower 2 digits 52 is sent after conversion into ASCII code [5][2].

# 14. COMMUNICATION FUNCTIONS

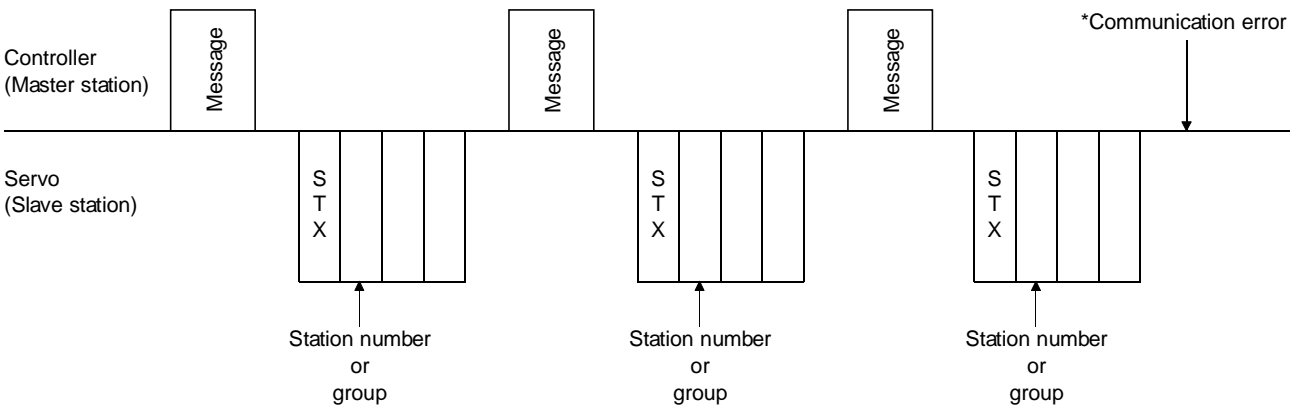
## 14.7 Time-out operation

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. COMMUNICATION FUNCTIONS

## 14.9 Initialization

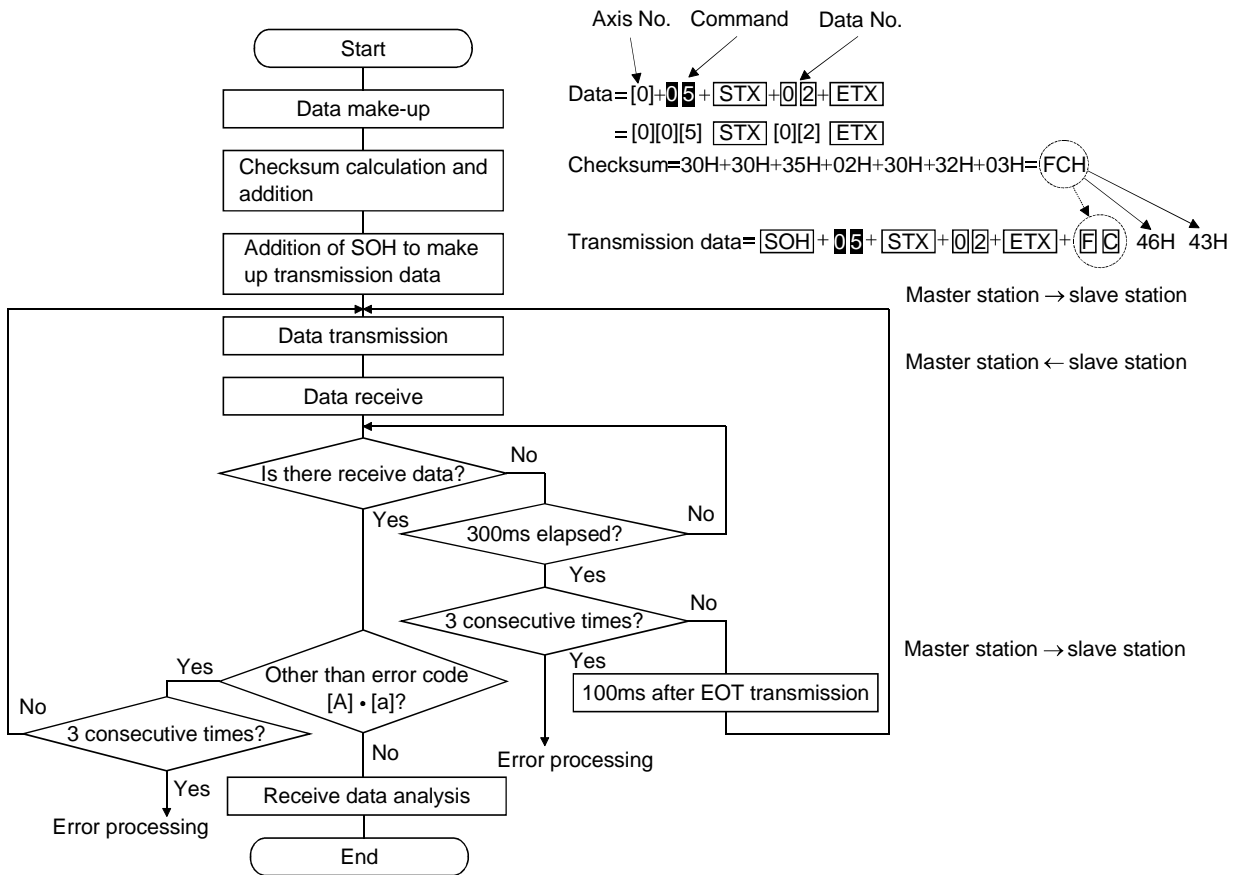
After the slave station is switched on, it cannot reply to communication until the internal initialization processing terminates. Hence, at power-on, ordinary communication should be started after:

- (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. COMMUNICATION FUNCTIONS

### 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	12
			analog speed limit voltage	
[0][1]	[8][6]		analog torque command voltage	12
			analog torque limit voltage	
[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 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

## 14. COMMUNICATION FUNCTIONS

### (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 analog speed limit voltage	12
[3][5]	[8][6]		analog torque command voltage 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 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

## 14. COMMUNICATION FUNCTIONS

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

Command	Data No.	Description	Setting range	Frame length
[8][B]	[0][0]	Operation mode changing 0000: Exit from test operation mode 0001: Jog operation 0002: Positioning operation 0003: Motor-less operation 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. COMMUNICATION FUNCTIONS

### 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.

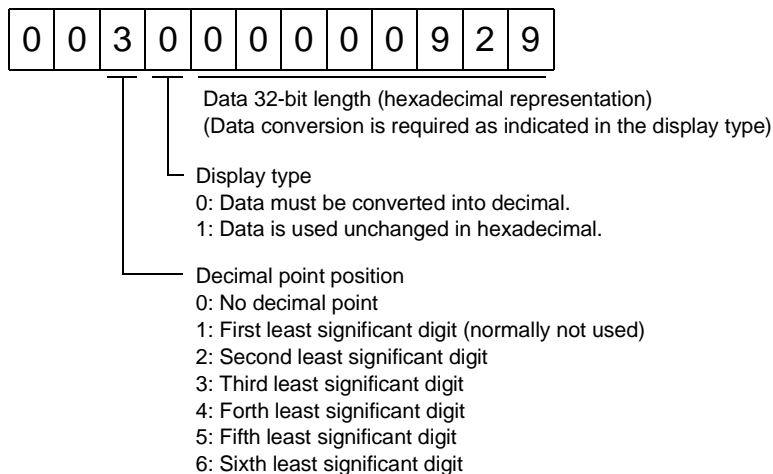
#### (1) Processing the read data

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 "00300000929" 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.

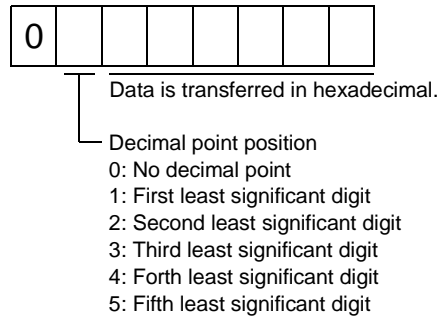
## 14. COMMUNICATION FUNCTIONS

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### (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. COMMUNICATION FUNCTIONS

### 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.

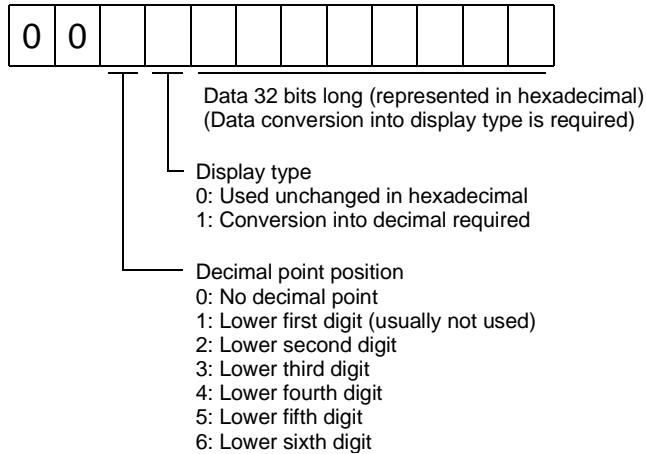
##### 1) Transmission

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. COMMUNICATION FUNCTIONS

### 14.12.3 Parameter

#### (1) Parameter read

Read the parameter setting.

##### 1) Transmission

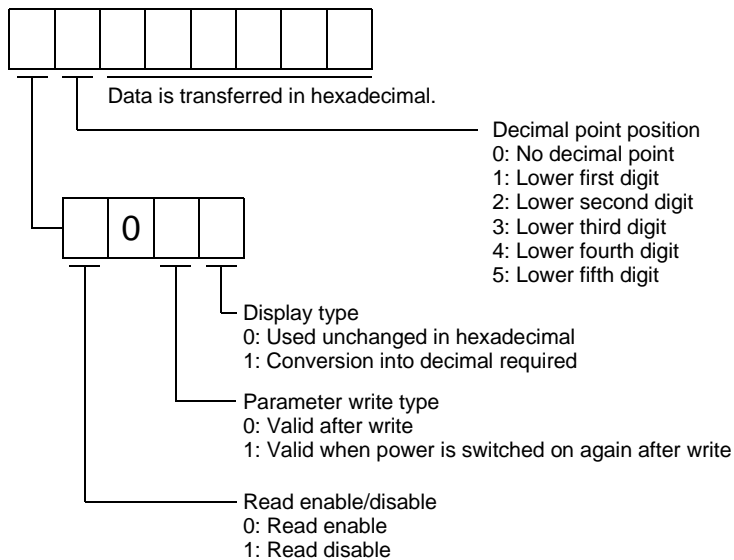
Transmit command [0][5] and the data No. corresponding to the parameter No.

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.

## 14. COMMUNICATION FUNCTIONS

### (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 fourth digit

5: Lower fifth digit

Write mode

0: Write to EEPROM

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 EEPROM data may cause the permissible write times (1 million times) of EEPROM to be exceeded, leading to a failure.

# 14. COMMUNICATION FUNCTIONS

## 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.

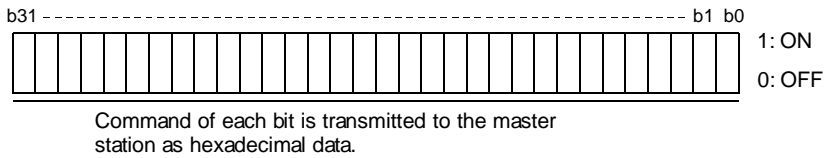
#### (a) Transmission

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.



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.

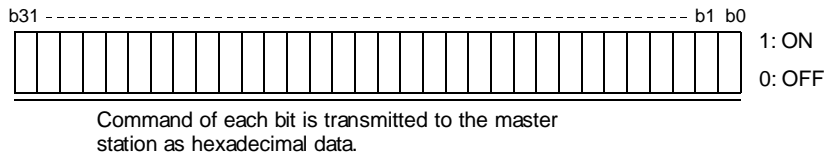
#### (a) Transmission

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.



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. COMMUNICATION FUNCTIONS

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### 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

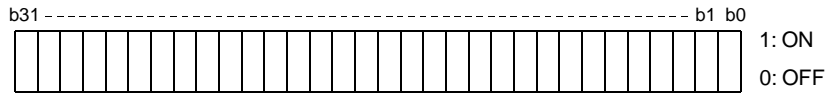
Command	Data No.	Data
[9][0]	[1][3]	1EA5

# 14. COMMUNICATION FUNCTIONS

## 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. COMMUNICATION FUNCTIONS

### 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

## 14. COMMUNICATION FUNCTIONS

### (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.

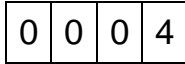
# 14. COMMUNICATION FUNCTIONS

## 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.

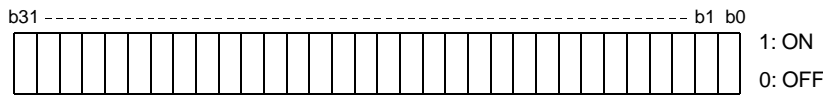


Selection of test operation mode  
4: DO forced output (output signal forced output)

### (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. COMMUNICATION FUNCTIONS

### 14.12.9 Alarm history

#### (1) Alarm No. read

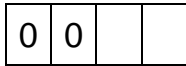
Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No. 0 (last alarm) to No. 5 (sixth alarm in the past) are read.

##### (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.



└ Alarm No. is transferred in decimal.

For example, "0032" means AL.32 and "00FF" means AL.\_ (no alarm).

#### (2) Alarm occurrence time read

Read the occurrence time of alarm which occurred in the past.

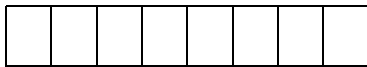
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

##### (a) Transmission

Send command [3][3] and data No. [2][0] to [2][5].

Refer to Section 14.11.1.

##### (b) Reply



└ The alarm occurrence time is transferred in decimal.  
Hexadecimal must be converted into decimal.

For example, data "01F5" means that the alarm occurred in 501 hours after start of operation.

#### (3) Alarm history clear

Erase the alarm history.

Send command [8][2] and data No. [2][0].

Command	Data No.	Data
[8][2]	[2][0]	1EA5

## 14. COMMUNICATION FUNCTIONS

### 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.

0	0		
---	---	--	--

└ Alarm No. is transferred in decimal.

For example, "0032" means AL.32 and "00FF" means AL.\_ (no alarm).

#### (2) Read of the status display at alarm occurrence

Read the status display data at alarm occurrence. When the data No. corresponding to the status display item is transmitted, the data value and data processing information are sent back.

##### (a) Transmission

Send command [3][5] and any of data No. [8][0] to [8][E] corresponding to the status display item to be read. Refer to Section 14.11.1.

##### (b) Reply

The slave station sends back the requested status display data at alarm occurrence.

0	0										
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Data 32 bits long (represented in hexadecimal)  
(Data conversion into display type is required)

Display type  
0: Conversion into decimal required  
1: Used unchanged in hexadecimal

Decimal point position  
0: No decimal point  
1: Lower first digit (usually not used)  
2: Lower second digit  
3: Lower third digit  
4: Lower fourth digit  
5: Lower fifth digit  
6: Lower sixth digit

#### (3) Current alarm clear

As by the 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. COMMUNICATION FUNCTIONS

### 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

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# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 15. ABSOLUTE POSITION DETECTION SYSTEM

 <b>CAUTION</b>	• If an absolute position erase alarm (AL.25) has occurred, always perform home position setting again. Not doing so can cause runaway.
--	---

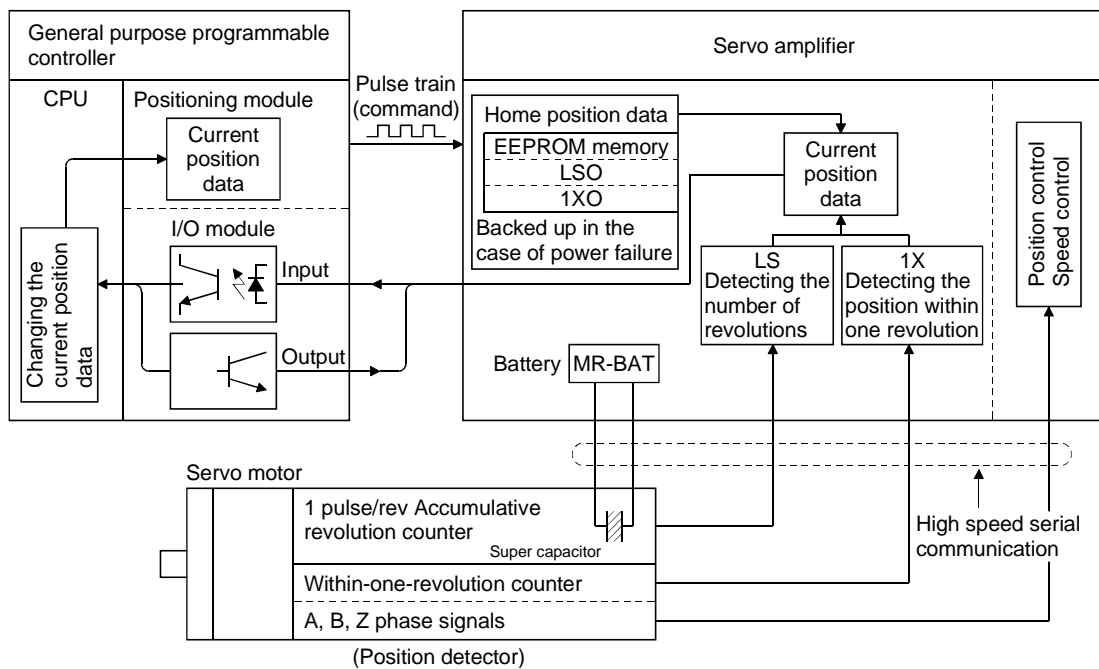
### 15.1 Outline

#### 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. ABSOLUTE POSITION DETECTION SYSTEM

## 15.2 Specifications

### (1) Specification list

Item	Description
System	Electronic battery backup system
Battery	1 piece of lithium battery ( primary battery, nominal + 3.6V) Type: MR-BAT or A6BAT
Maximum revolution range	Home position $\pm$ 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.

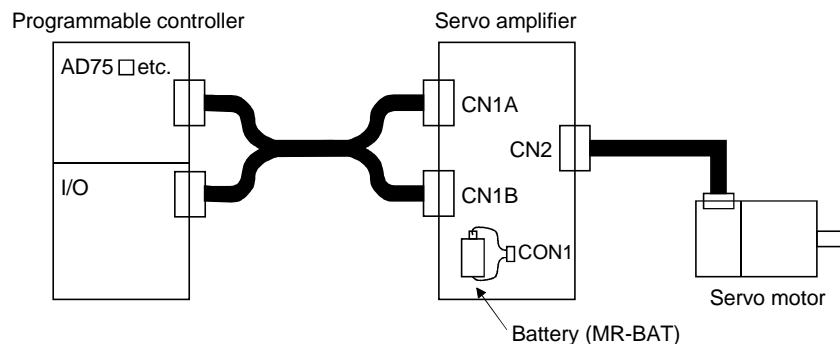
2. Time to hold data by a battery with power off. It is recommended to replace the battery in three years independently of whether power is kept on or off.

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 A1SD71S2 · A1SD71S7 AD75□ A1SD75□	AX40 · 41 · 42 AY40 · 41 · 42
FX-1PG · FX-1GM 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	-	-	-
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Selection of absolute position detection system

0: Incremental system

1: Absolute position detection system

## 15. ABSOLUTE POSITION DETECTION SYSTEM

### 15.3 Battery installation procedure



#### WARNING

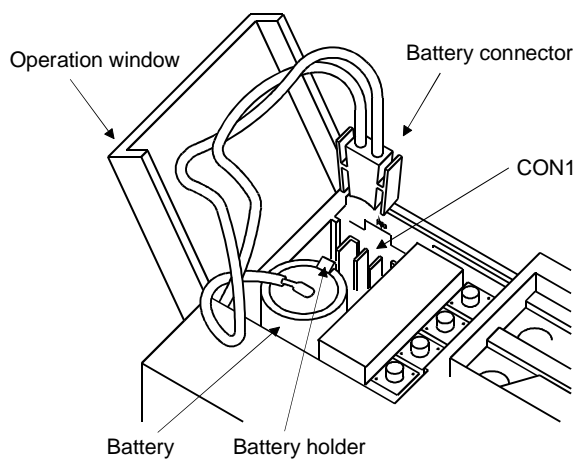
- Before starting battery installation procedure, make sure that the charge lamp is off more than 10 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock.

#### POINT

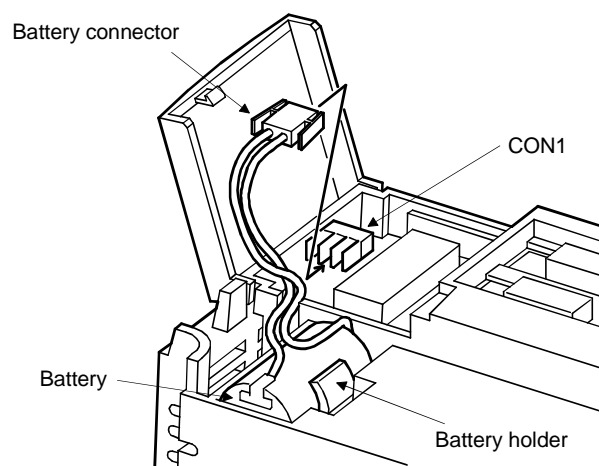
The internal circuits of the servo amplifier may be damaged by static electricity. Always take the following precautions:

- Ground human body and work bench.
- Do not touch the conductive areas, such as connector pins and electrical parts, directly by hand.

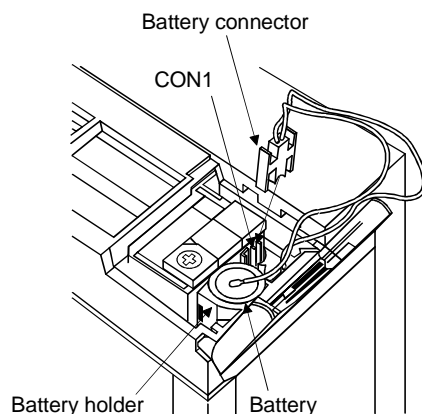
- (1) Open the operation window. (When the model used is the MR-J2S-200A • MR-J2S-350A or more, also remove the front cover.)
- (2) Install the battery in the battery holder.
- (3) Install the battery connector into CON1 until it clicks.



For MR-J2S-100A or less



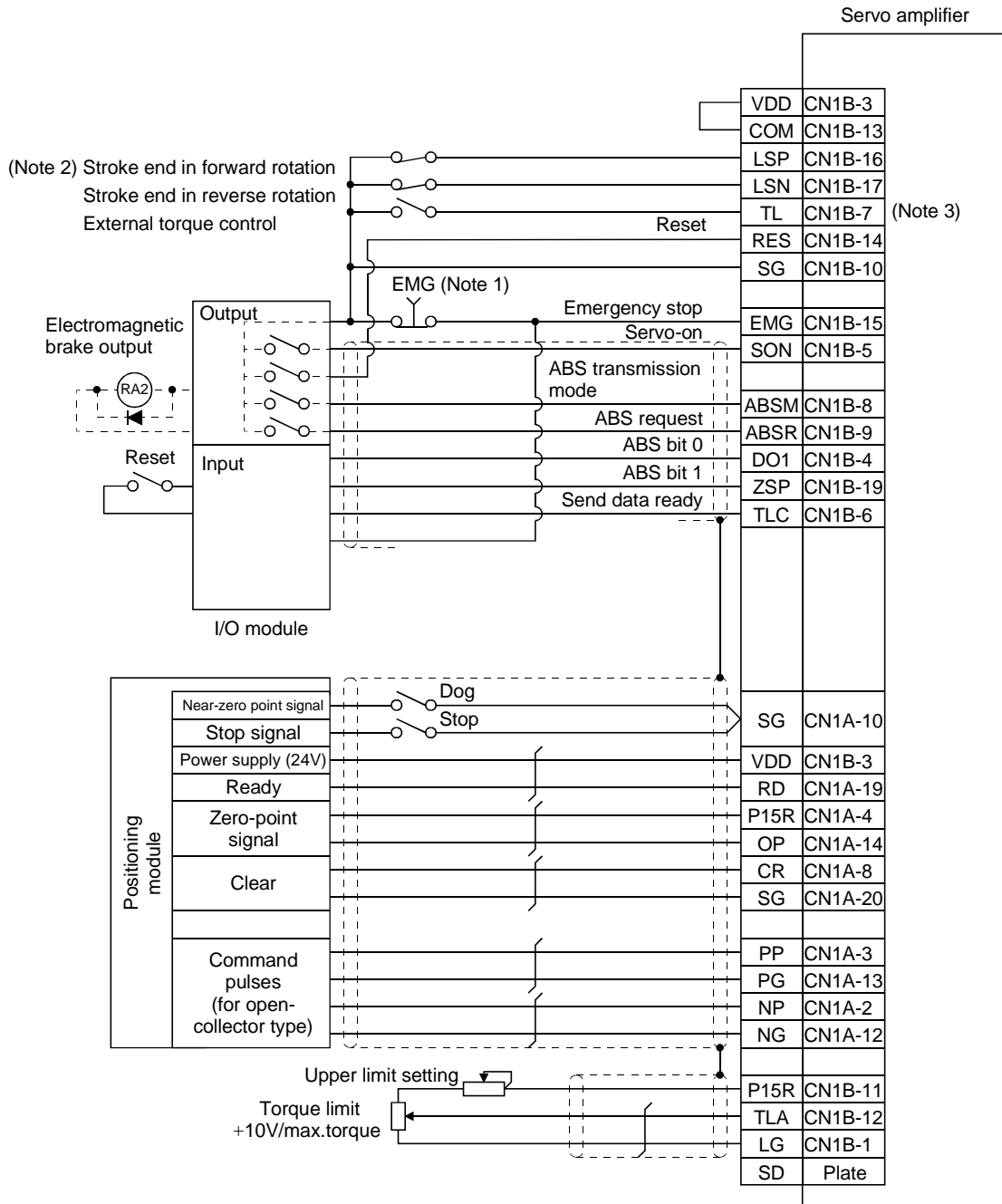
For MR-J2S-200A • MR-J2S-350A



For MR-J2S-500A • MR-J2S-700A

# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 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. ABSOLUTE POSITION DETECTION SYSTEM

### 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. 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. 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. ABSOLUTE POSITION DETECTION SYSTEM

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### 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. ABSOLUTE POSITION DETECTION SYSTEM

## 15.7 Absolute position data transfer protocol

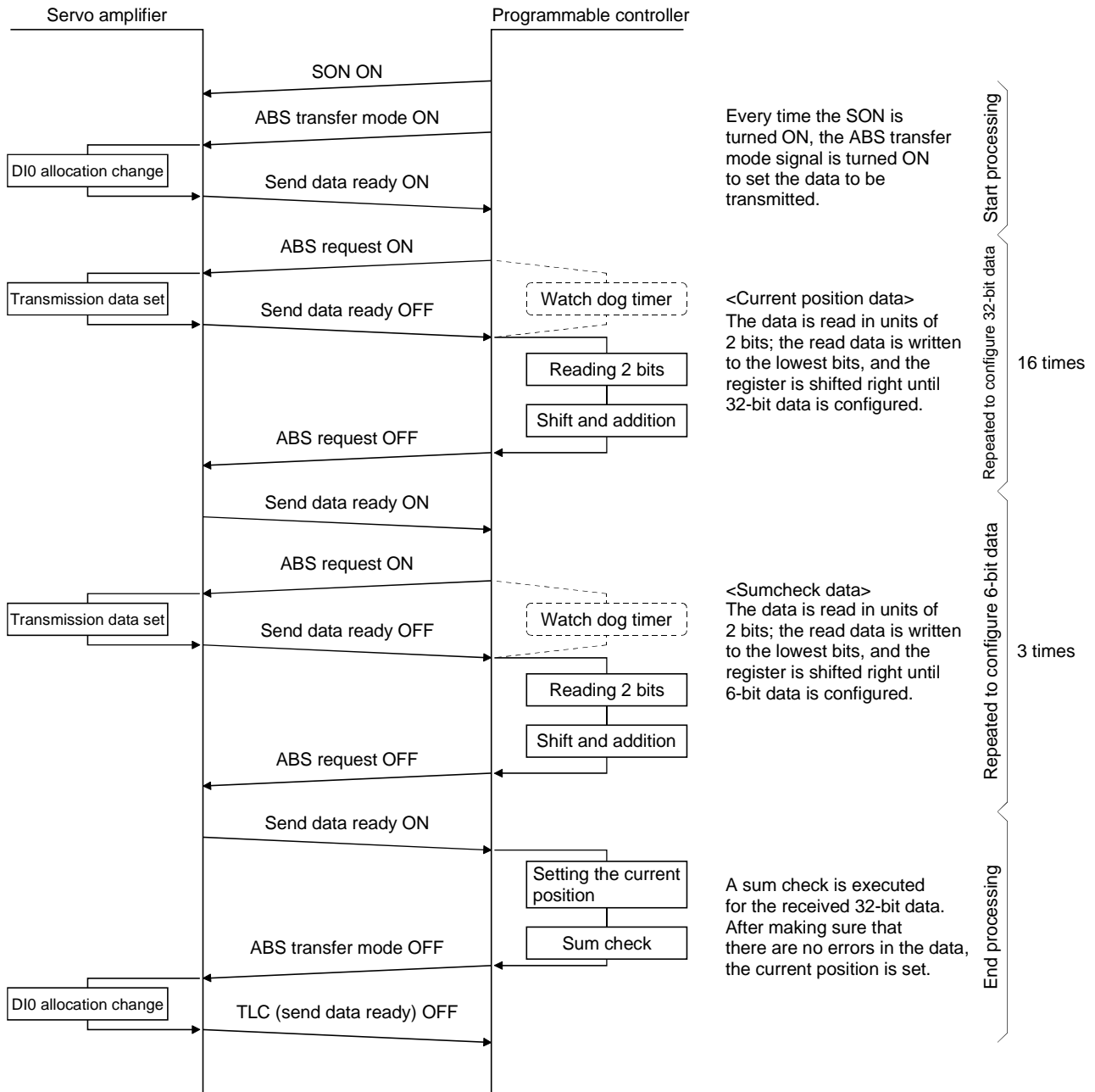
**POINT**

- 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.



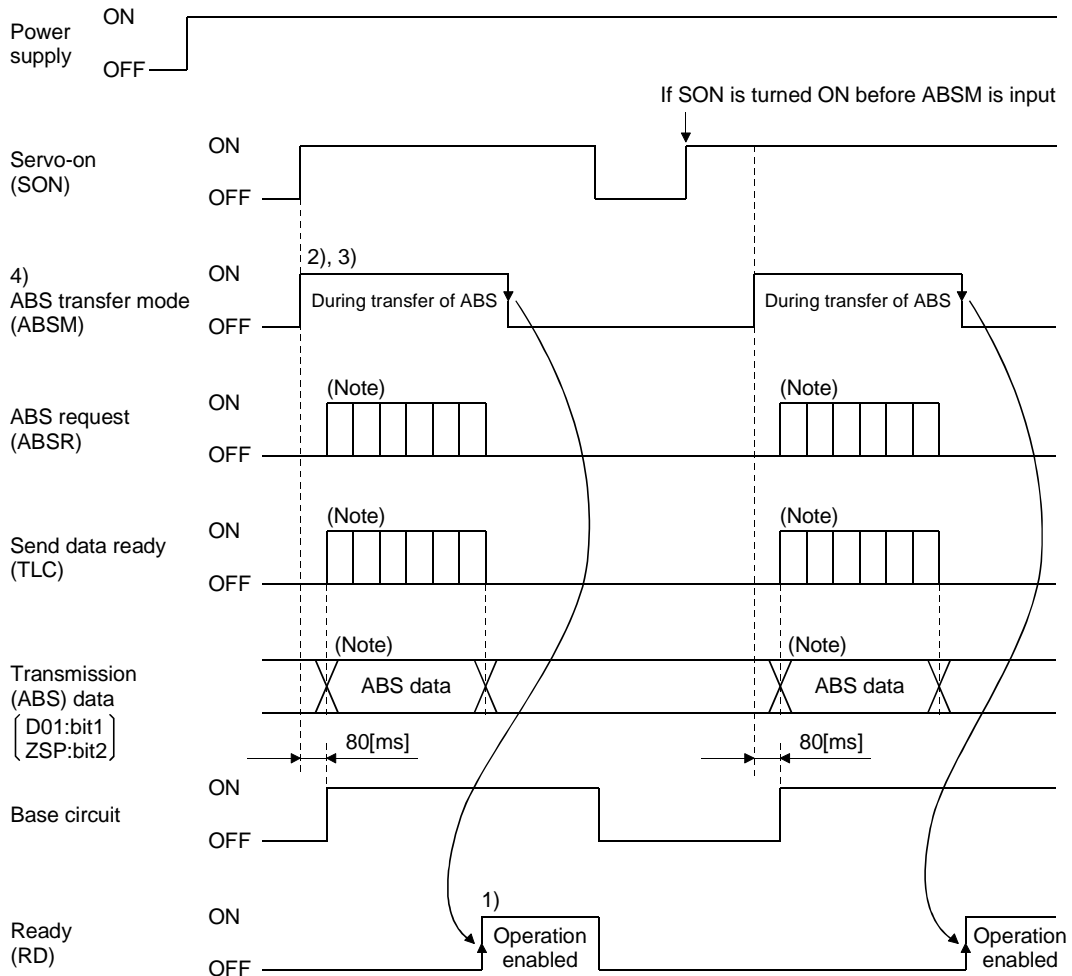
# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 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.

## 15. ABSOLUTE POSITION DETECTION SYSTEM

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.

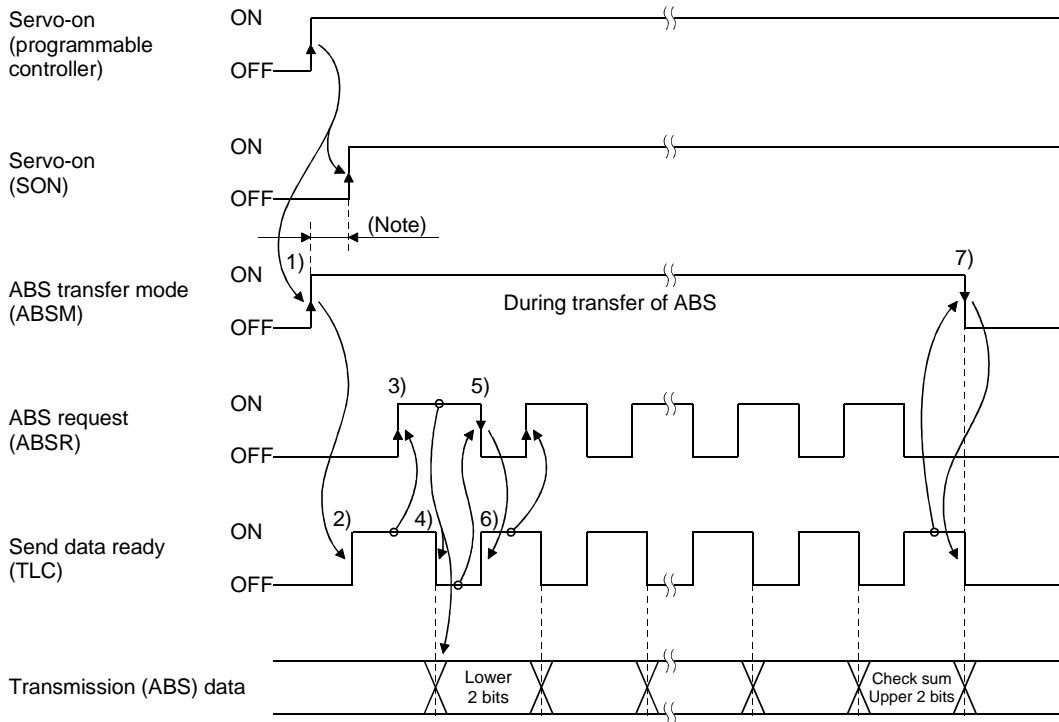
Symbol	Pin No.	Output signal	
		ABS transfer mode (ABSM): OFF	ABS transfer mode (ABSM): ON
(Note) D01	CN1B-4	Positioning completion	ABS data bit 0
ZSP	CN1B-19	Zero speed	ABS data bit 1
TLC	CN1B-6	During torque limit control	Send data ready
(Note) INP	CN1A-18	Positioning completion	ABS data bit 0

Note: CN1B-4 and CN1A-18 output the same signals. (To enter the positioning completion signal into INPS of the AD75, connect CN1A-18.)



## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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.

# 15. ABSOLUTE POSITION DETECTION SYSTEM

(c) Checksum

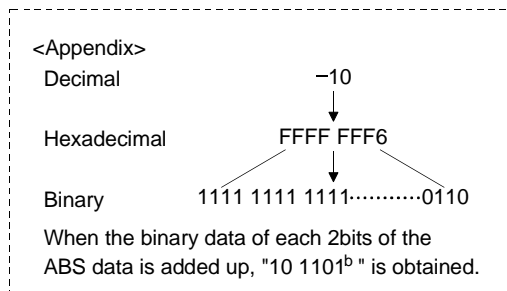
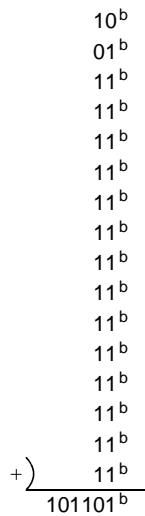
The check sum is the code which is used by the programmable controller to check for errors in the received ABS data. The 6-bit check sum is transmitted following the 32-bit ABS data.

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 (FFFFFF6H)



Therefore, the check sum of "-10" (ABS data) is "2D<sup>b</sup>"

# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (2) Transmission error

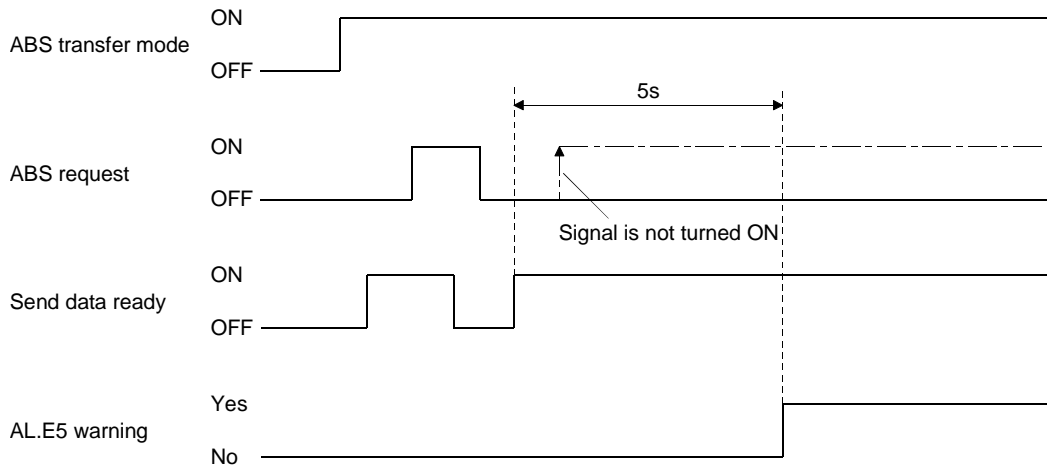
### (a) Time-out warning(AL.E5)

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.

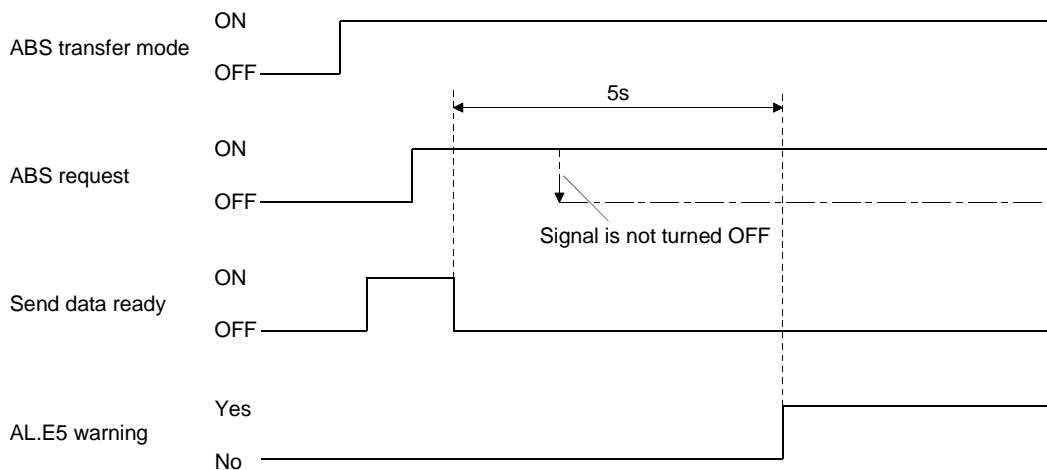
#### 1) ABS request OFF-time time-out check (applied to 32-bit ABS data in 2-bit units + check sum)

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)

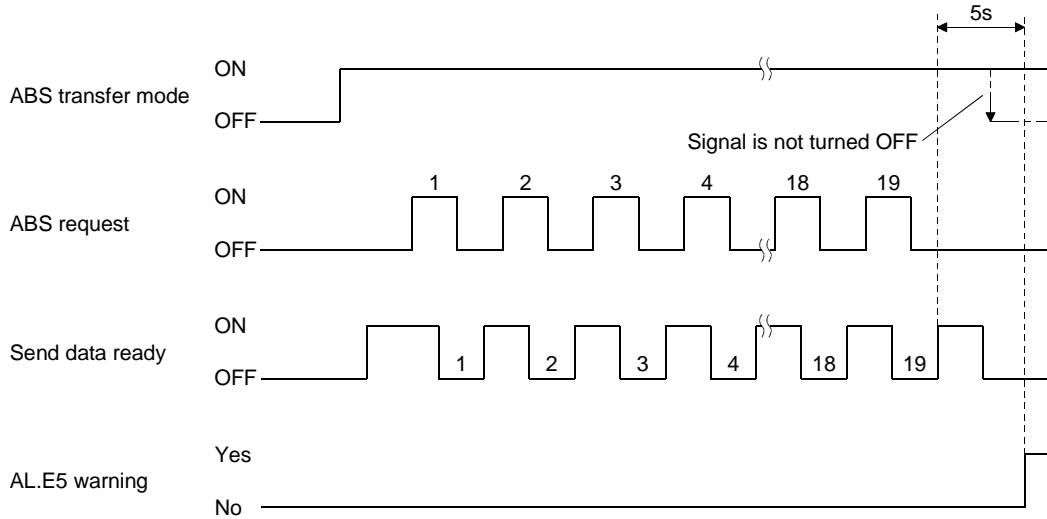
If the ABS request signal is not turned OFF by the programmable controller within 5s after the send data ready signal is turned OFF, this is regarded as the transmission error and the ABS time-out warning (AL.E5) is output.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 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.



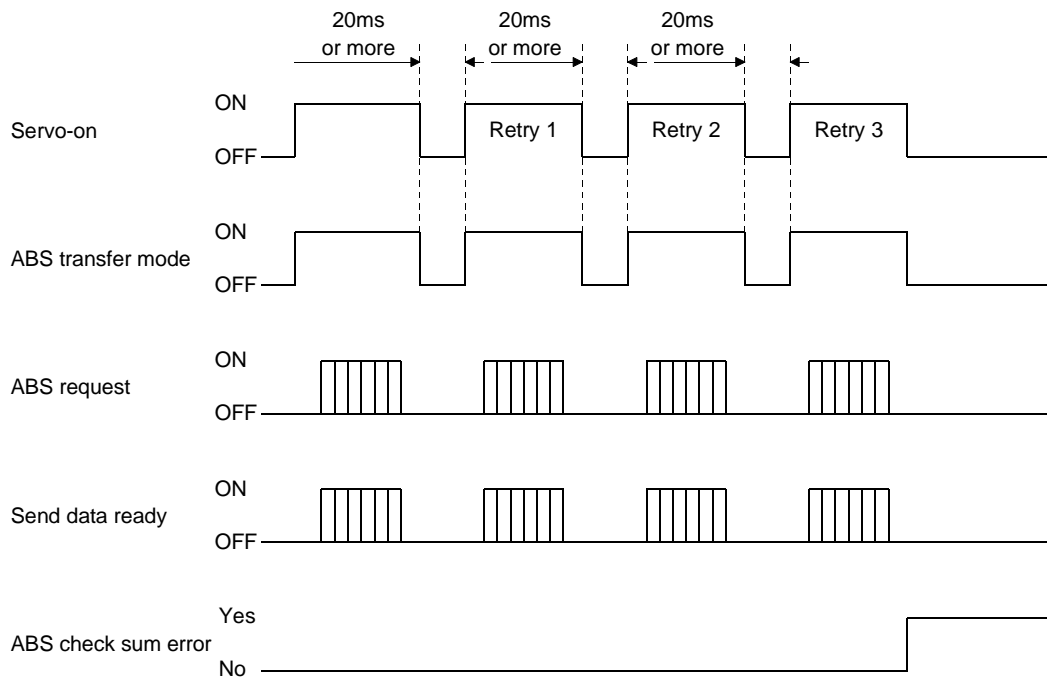
## (b) Check sum error

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 a check sum error occurs.



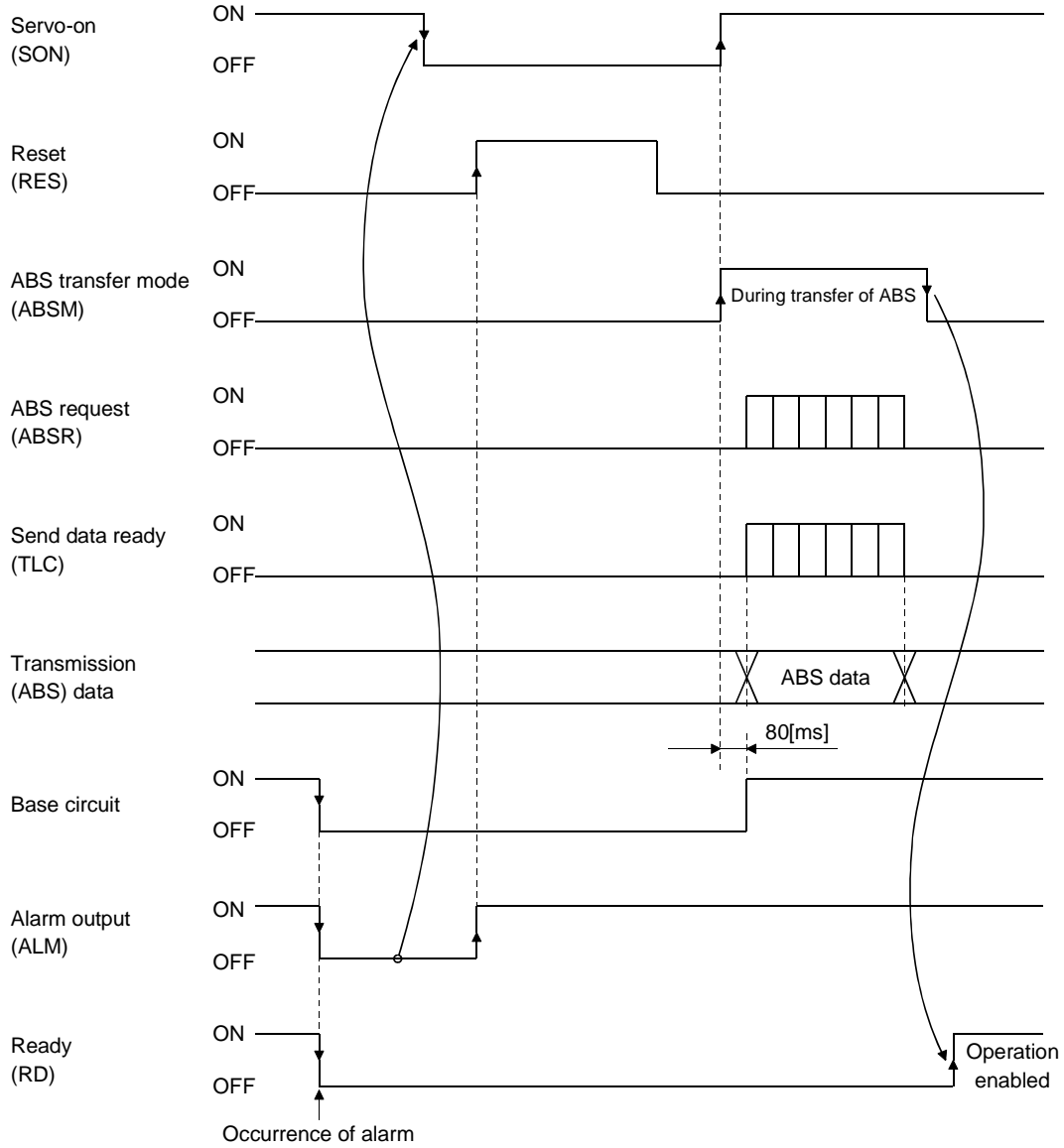
# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (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.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

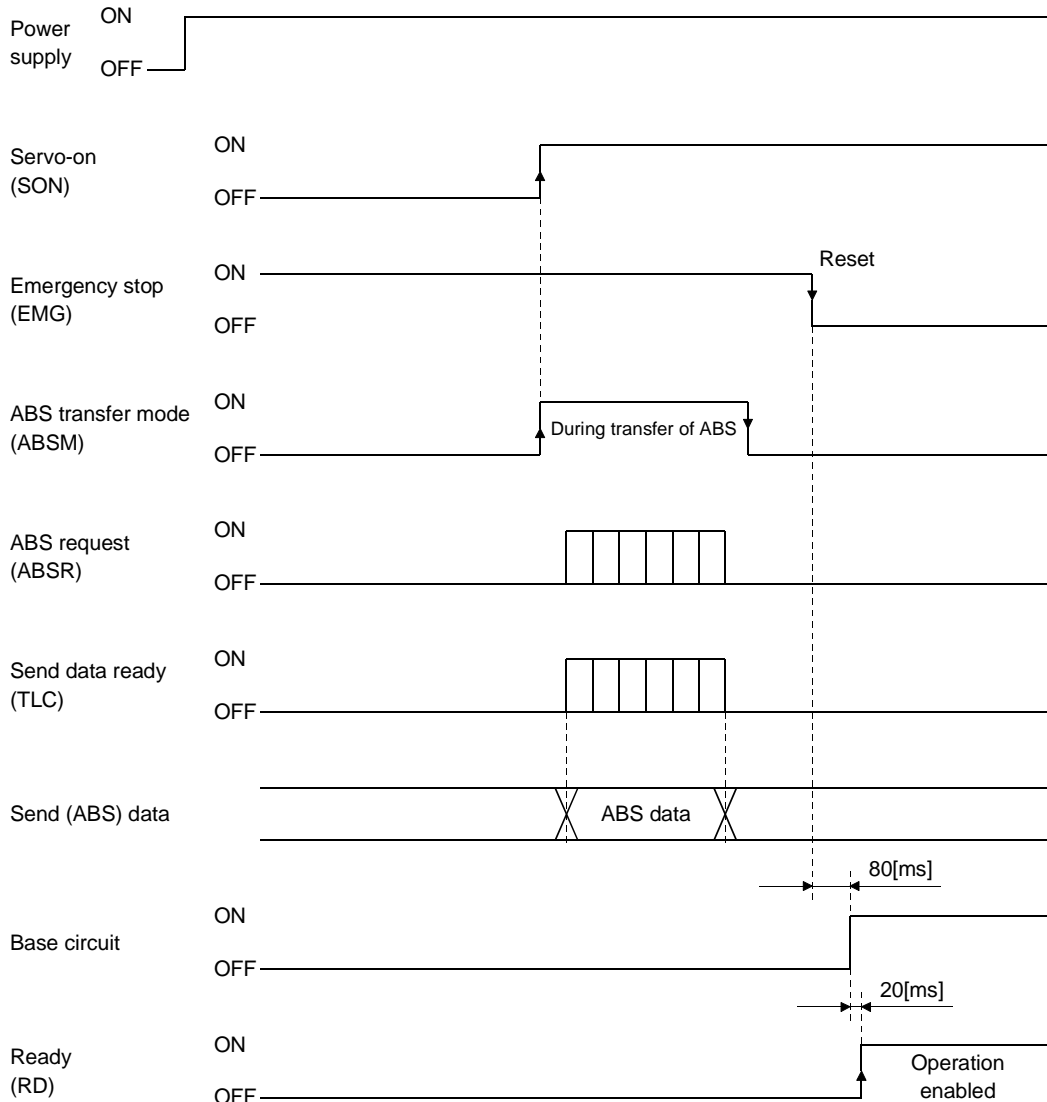
## (4) At the time of emergency stop reset

### (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.

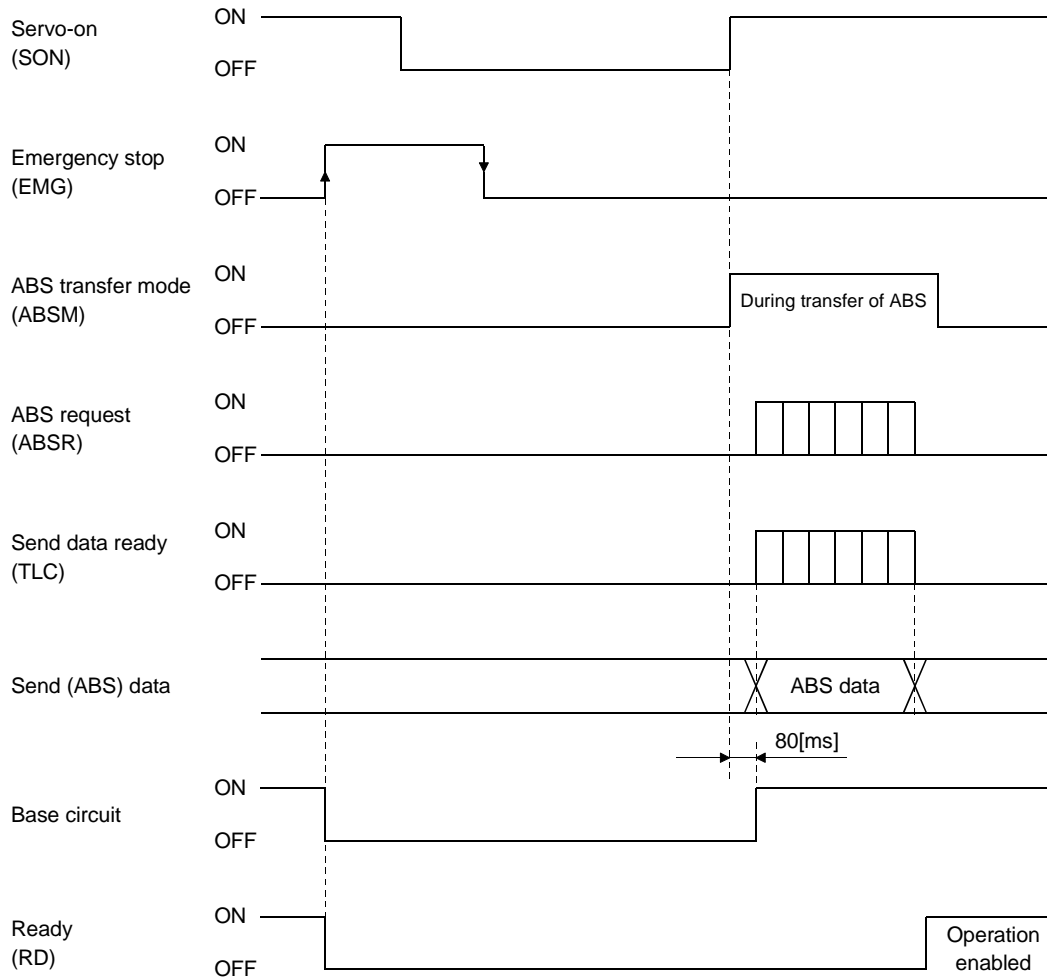
The current position in the servo amplifier is updated even during an emergency stop. When servo-on (SON) and ABS transfer mode (ABSM) are turned ON during an emergency stop as shown below, the servo amplifier transmits to the controller the current position latched when the ABS transfer mode (ABSM) 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.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

(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. ABSOLUTE POSITION DETECTION SYSTEM

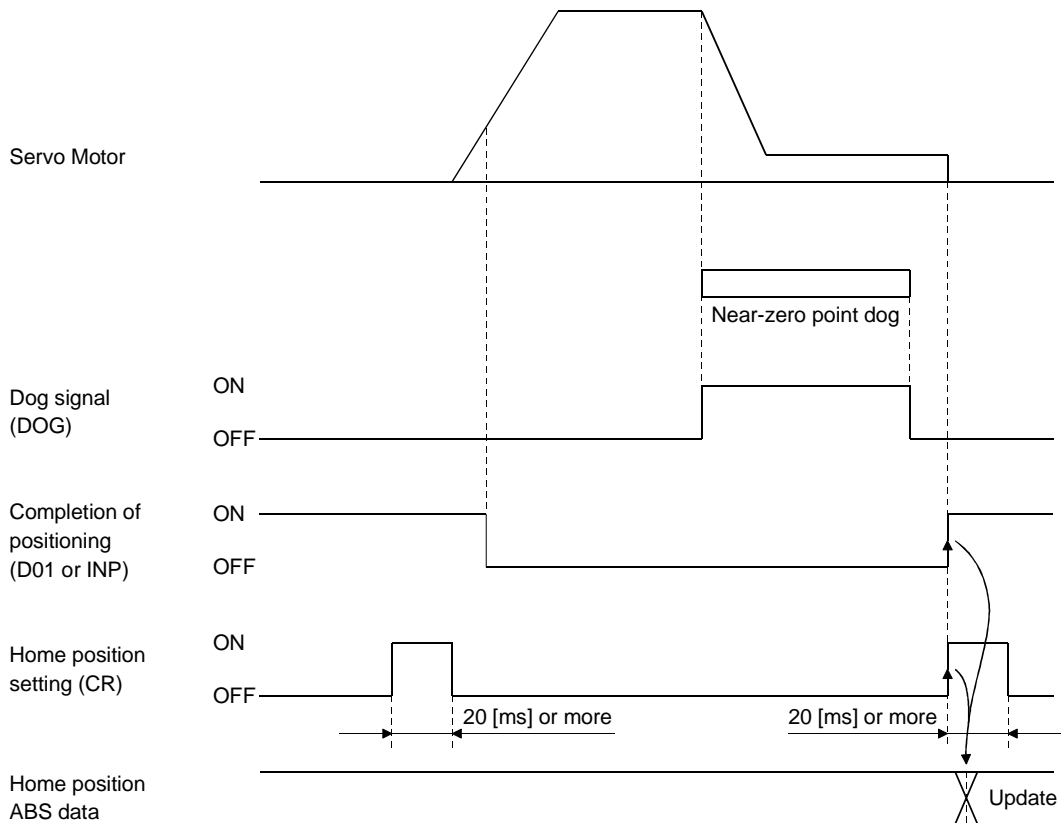
## 15.7.3 Home position setting

### (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.





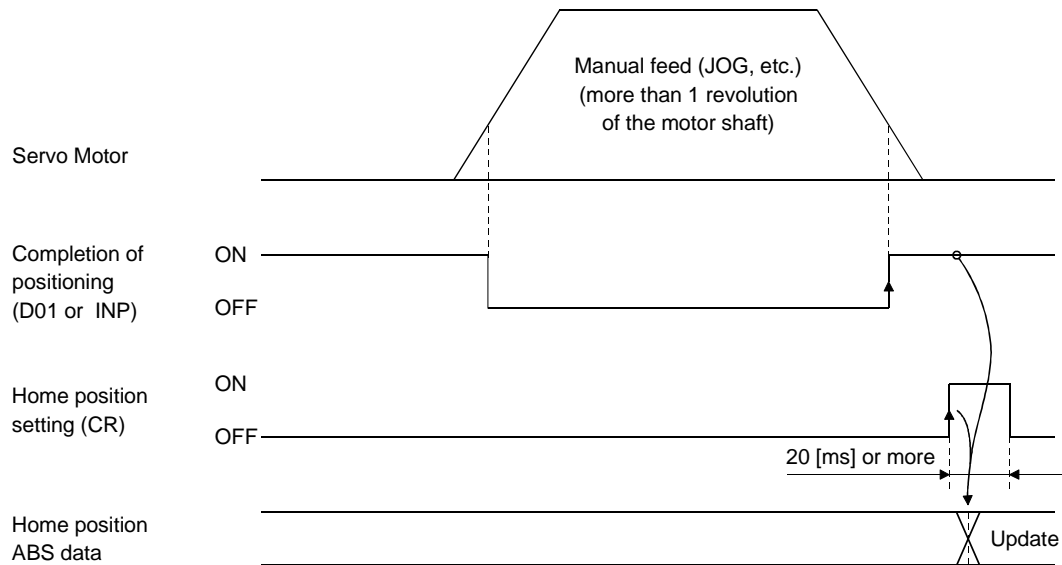
## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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. ABSOLUTE POSITION DETECTION SYSTEM

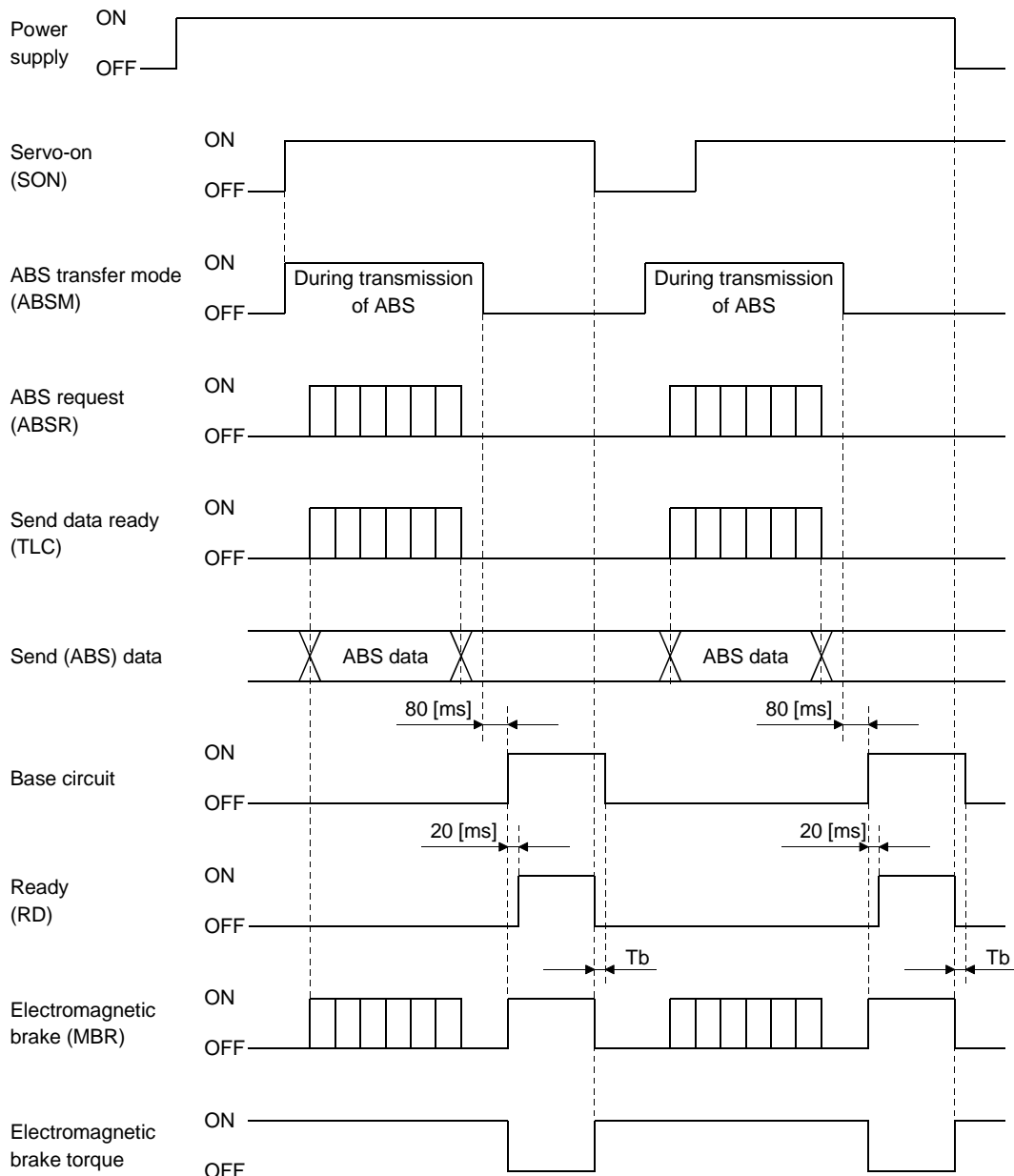
## 15.7.4 Use of servo motor with electromagnetic brake

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. ABSOLUTE POSITION DETECTION SYSTEM

---

### 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. ABSOLUTE POSITION DETECTION SYSTEM

## 15.8 Examples of use

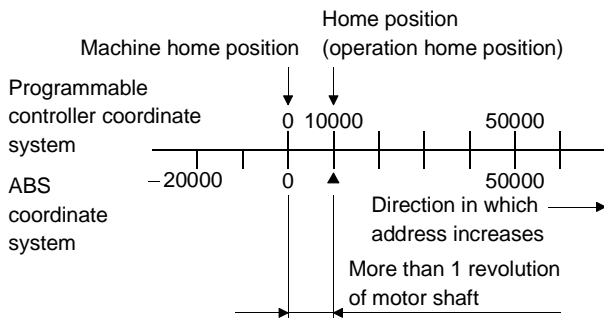
### 15.8.1 MELSEC-A1S (A1SD71)

#### (1) Instructions

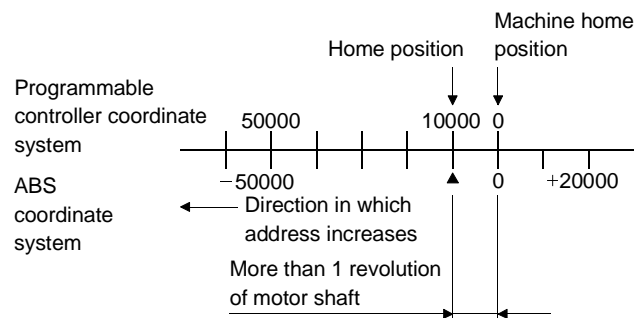
The absolute coordinate system (programmable controller coordinate system) of the A1SD71 (AD71) only covers the range in which the address increases (positive coordinate values) on moving away from the machine home position (the position reached in the home position return operation). Therefore, if the 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.

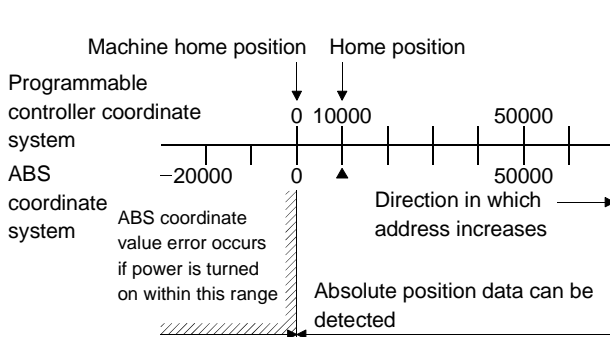


a) If revolution direction parameter (Pr. 14)=0

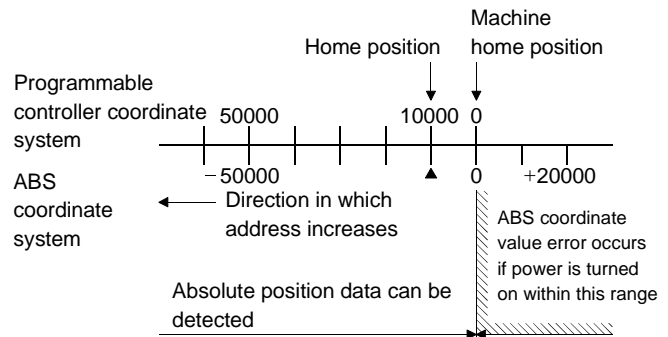


b) If revolution direction parameter (Pr. 14)=1

(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

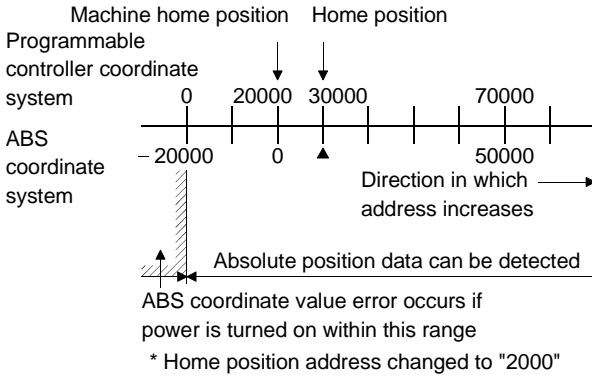


b) If revolution direction parameter (Pr. 14)=1

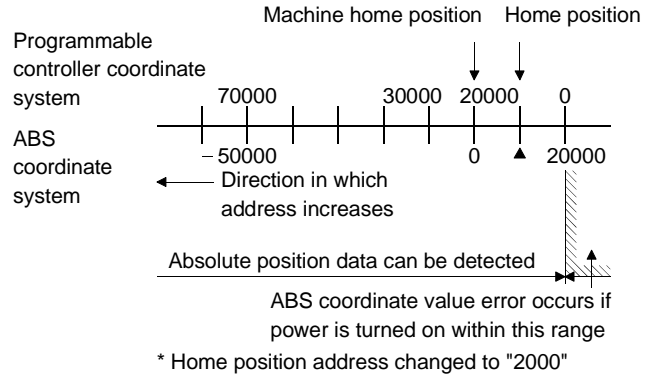
# 15. ABSOLUTE POSITION DETECTION SYSTEM

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

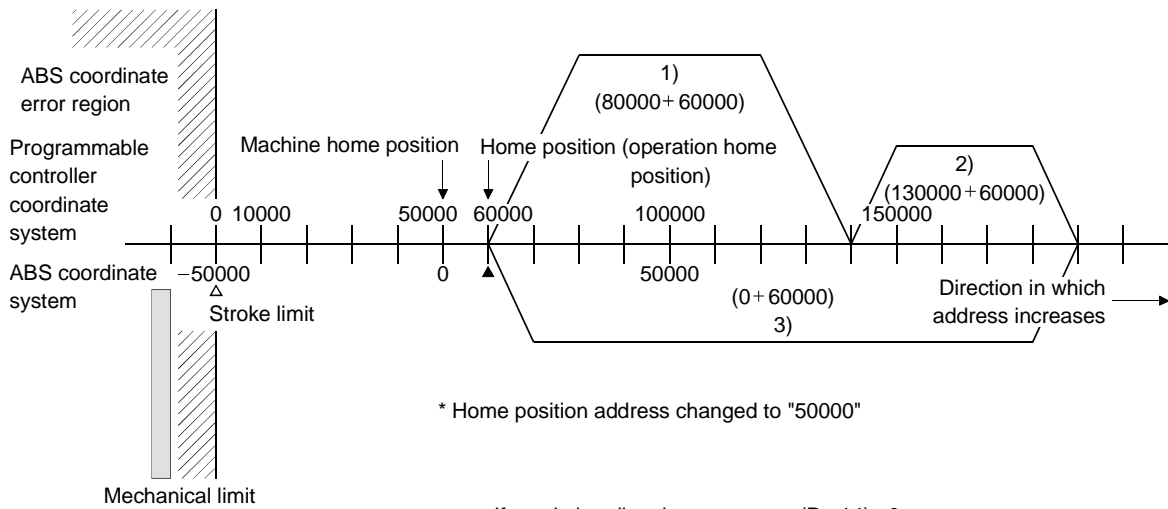


b) If revolution direction parameter (Pr. 14) = 1

(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)



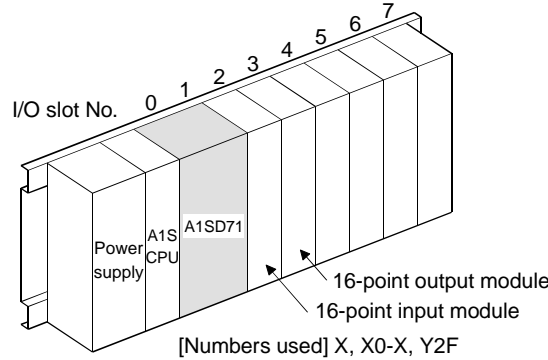
If revolution direction parameter (Pr. 14) = 0

# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (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

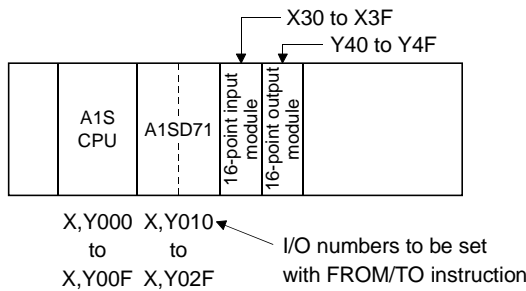
## (e) Points

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.

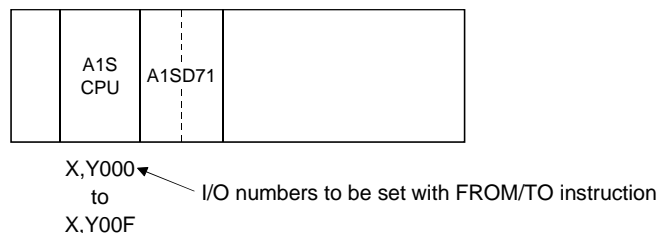


Note: The program example given in (3) in this section is for 1-axis control. Slot allocations are as illustrated to the left. To use the system for 2-axis control, increase the number of I/O points.

Therefore, the I/O number to be set with the FROM/TO instruction is head I/O number allocated to the A1SD71 + 010H.

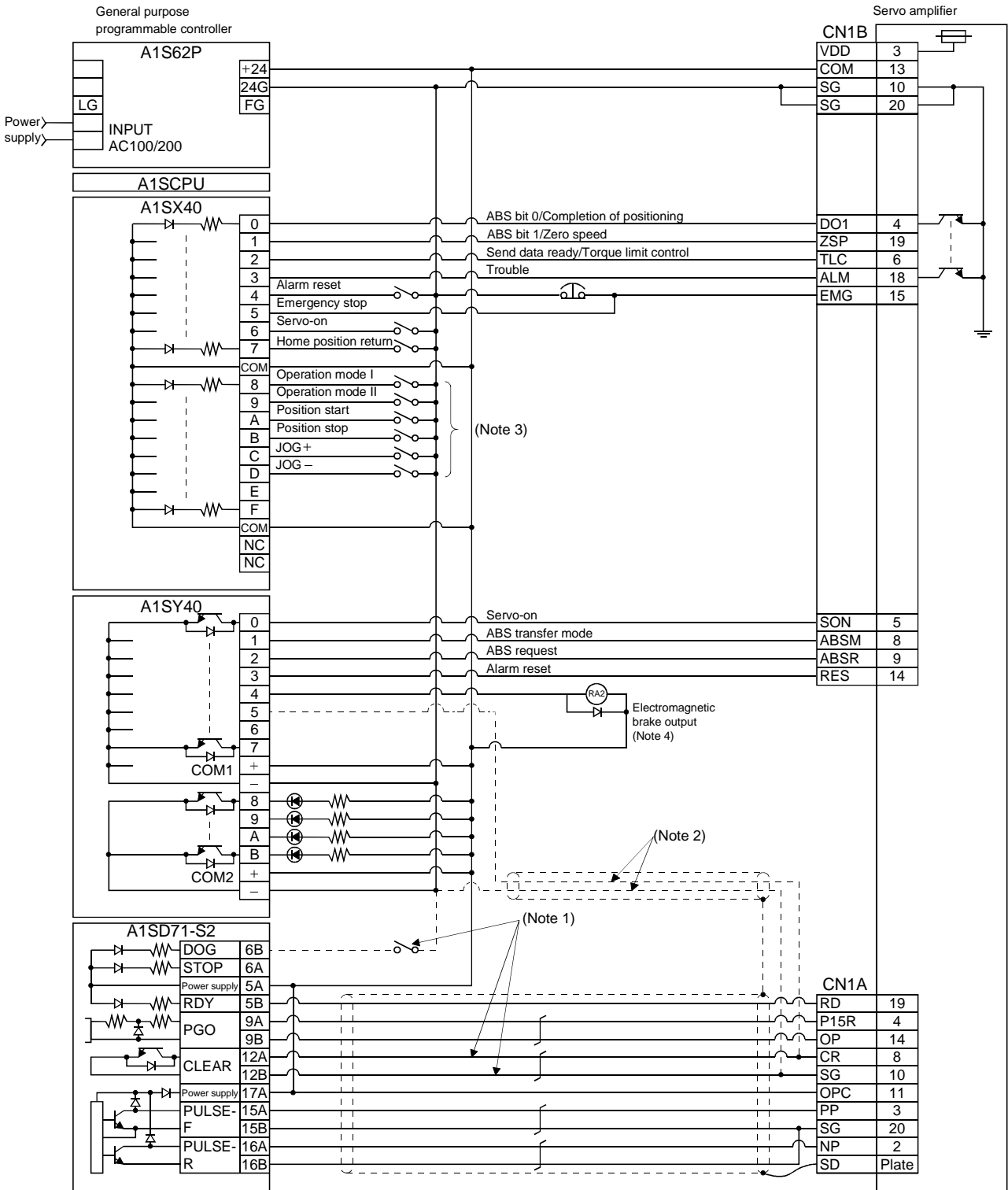
3) By setting "0 point of vacant slot" for the first slot of the A1SD71 in the "I/O allocation" of the GPP function, the 16 points in the first slot can be saved.

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.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (2) Connection diagram



## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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 ( $\pm$ ) 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.

Note 2: Necessary in the event of electromagnetic brake output.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (c) ABS data transfer program for X axis

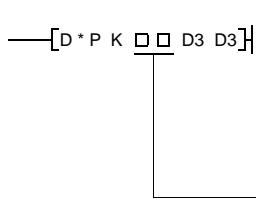
This sequence program example assumes the following conditions:

• 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.

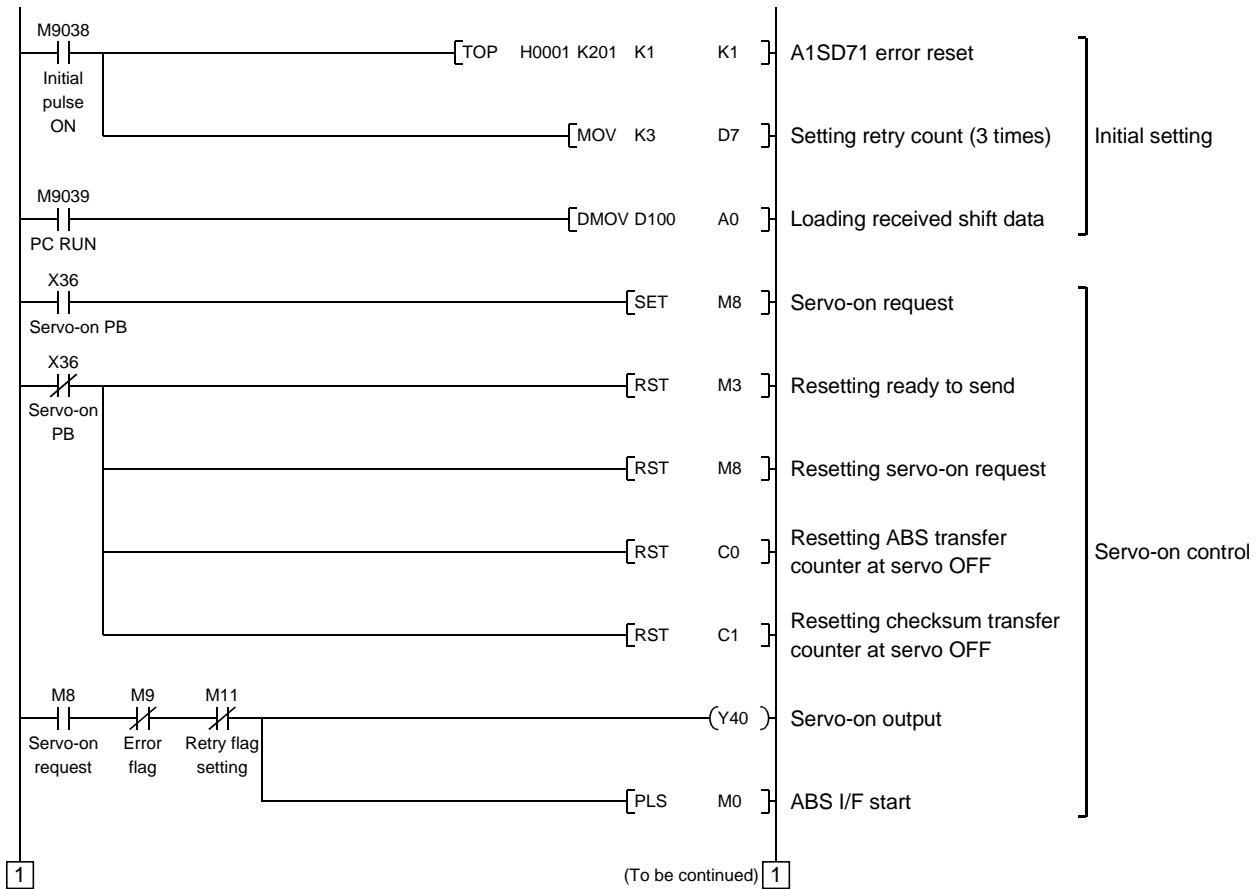
### <Additional program>



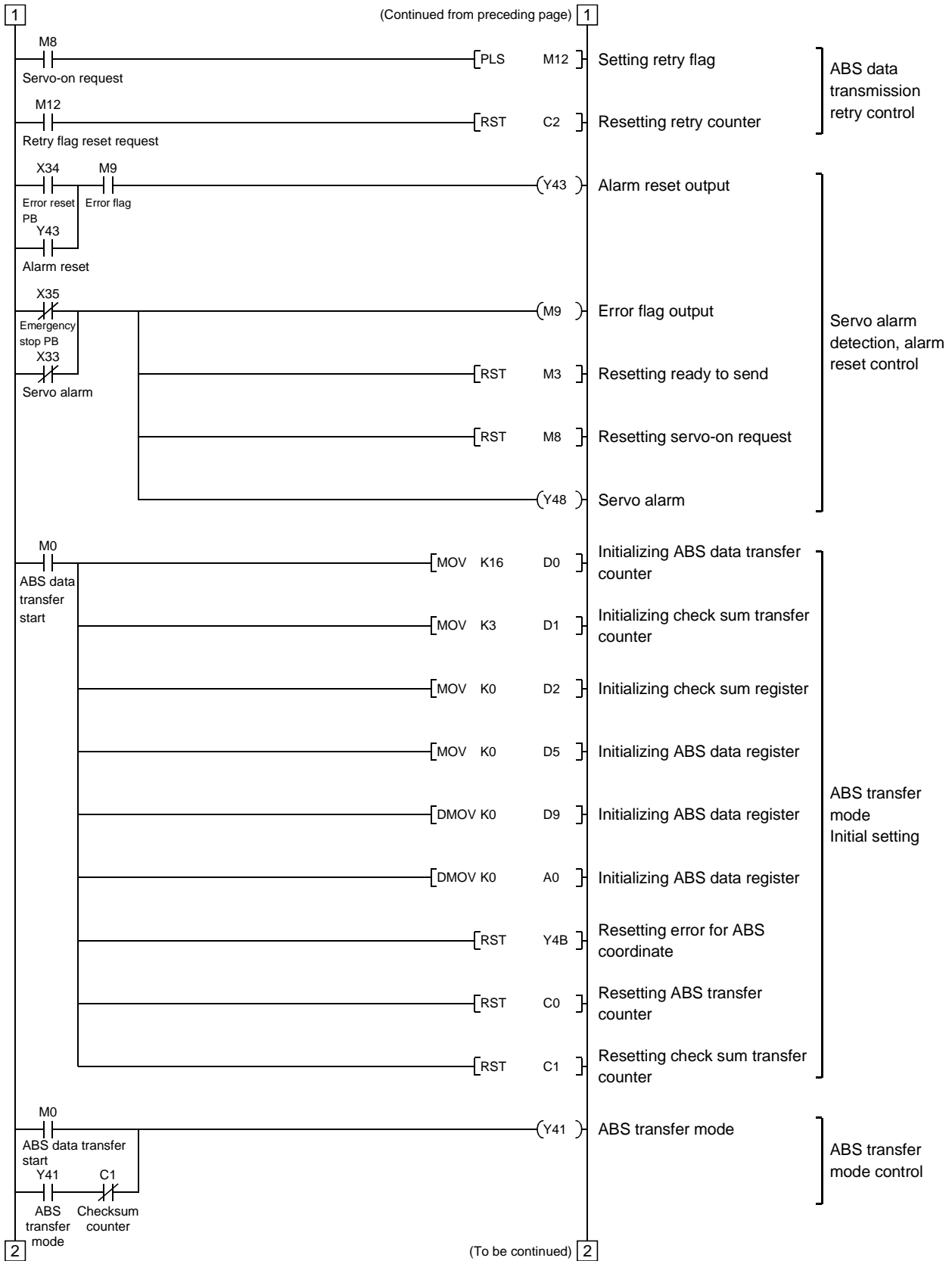
Item	mm			inch			degree			pulse
Unit setting	0			1			2			3
Travel per pulse	0.1 to	1.0 to	10.0	0.00001 to	0.0001 to	0.001 to	0.00001 to	0.0001 to	0.001 to	/
Unit of travel	μm/PLS			inch/PLS			degree/PLS			
Constant K for conversion into unit of travel	1 to	10 to	100	1 to	10 to	100	1 to	10 to	100	None

#### Reference

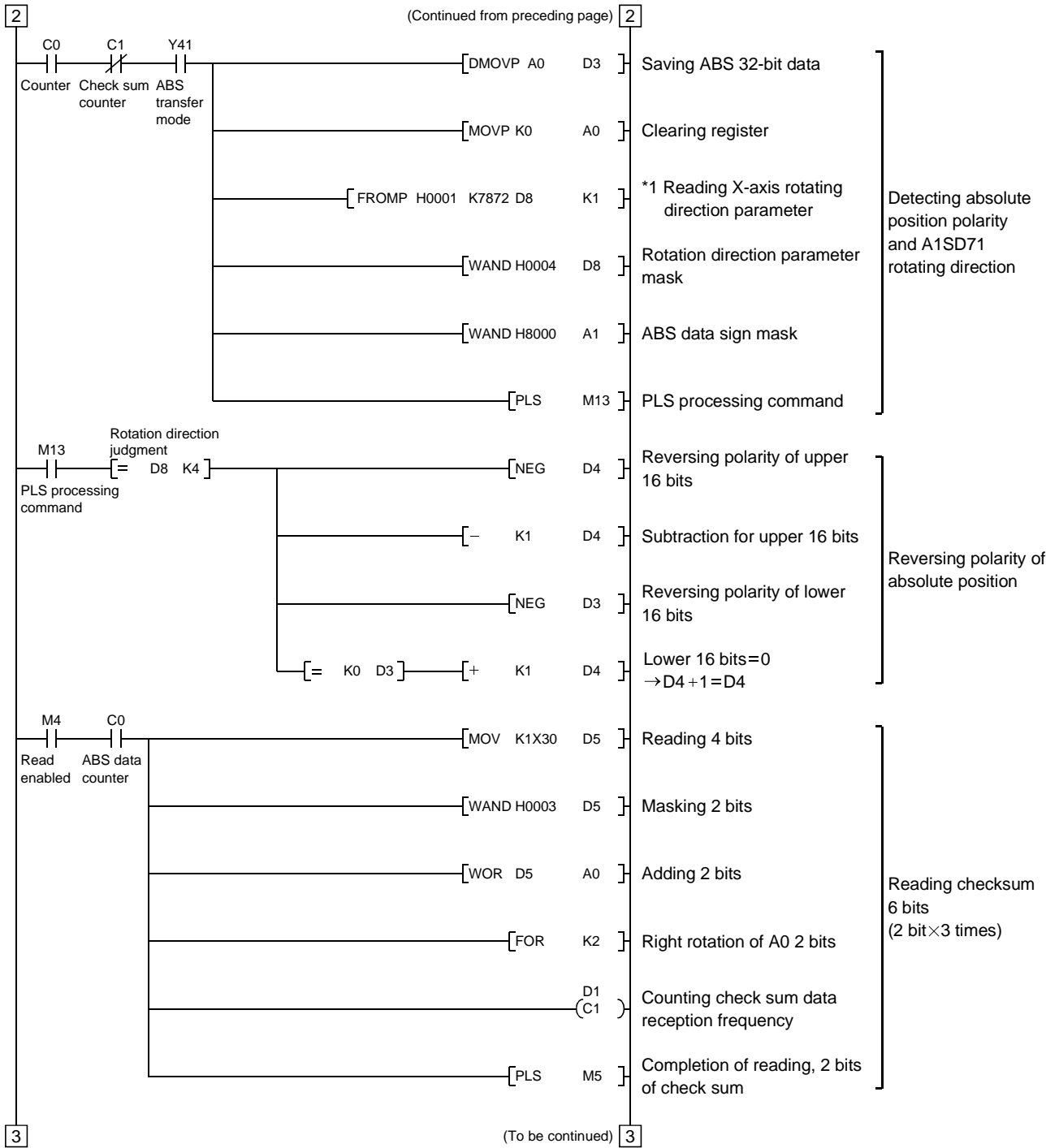
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- When the unit setting is pulse, the additional program is not required.



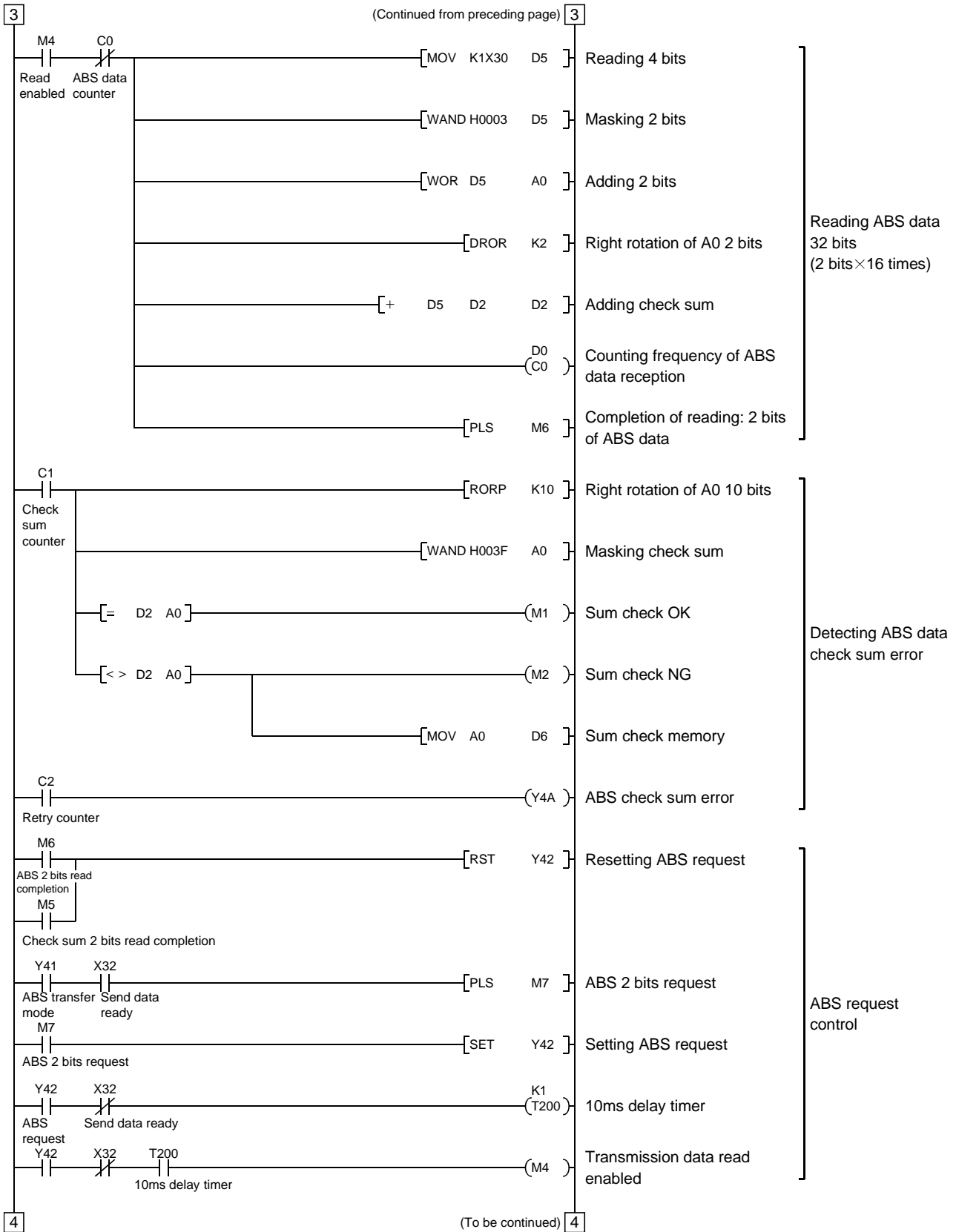
# 15. ABSOLUTE POSITION DETECTION SYSTEM



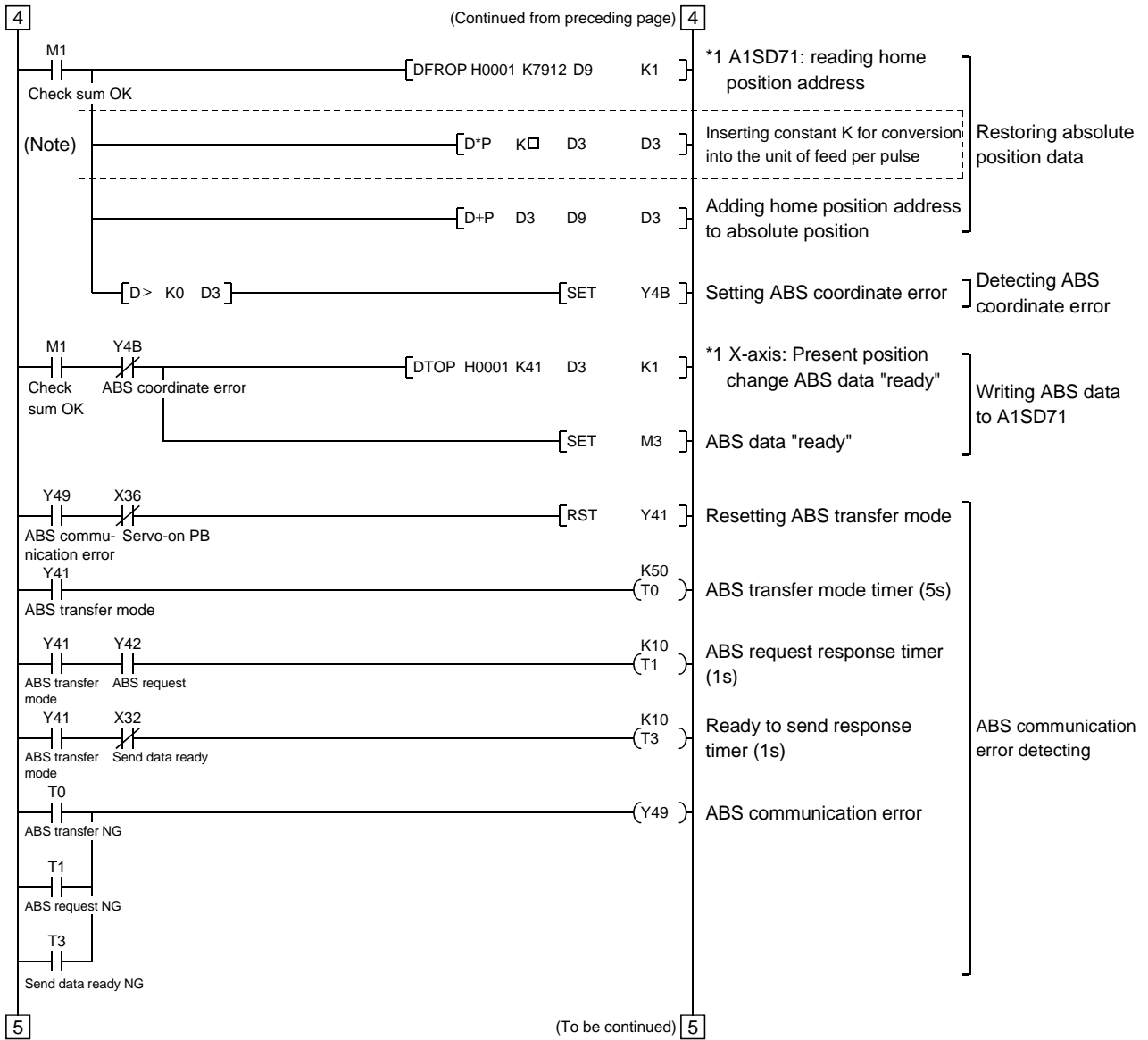
# 15. ABSOLUTE POSITION DETECTION SYSTEM



# 15. ABSOLUTE POSITION DETECTION SYSTEM

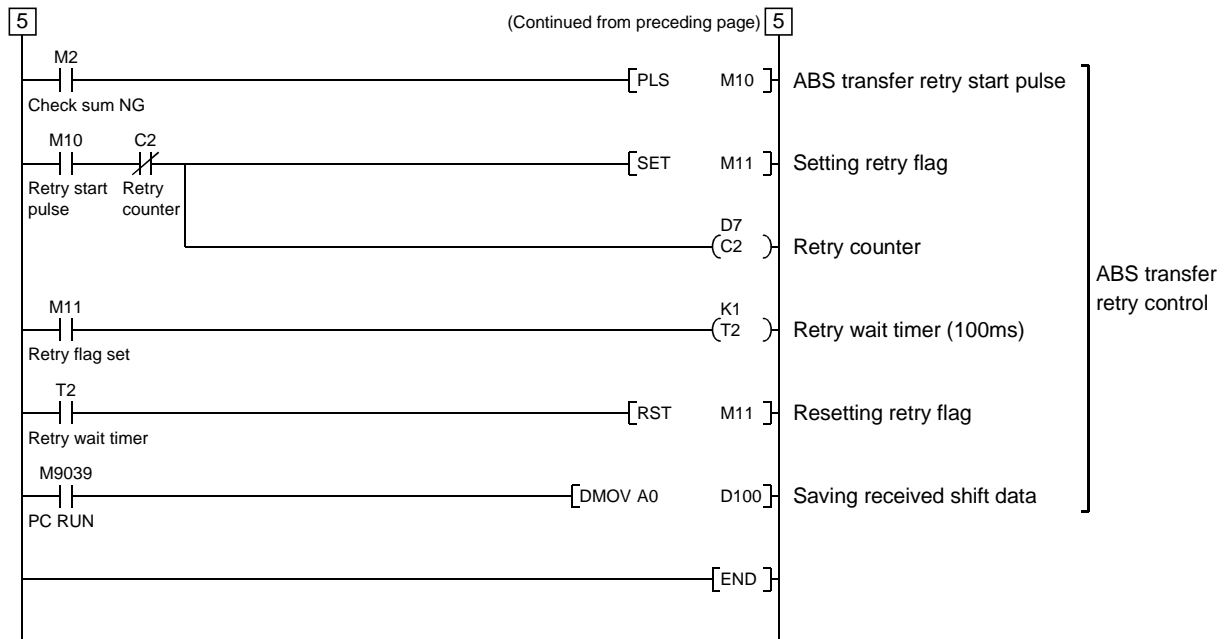


# 15. ABSOLUTE POSITION DETECTION SYSTEM



Note: When the unit setting parameter value of the AD71 positioning module is changed from "3" (pulse) to "0" (mm), the unit is  $\times 0.1\mu\text{m}$  for the input value. To change the unit to  $\times 1\mu\text{m}$ , and this program to multiple the feed value by 10.

# 15. ABSOLUTE POSITION DETECTION SYSTEM



POINT
<ul style="list-style-type: none"> <li>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.</li> </ul>

## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (d) X-axis control program

This precludes execution of the X-axis start program while M3 (ready to send the ABS data) is OFF.



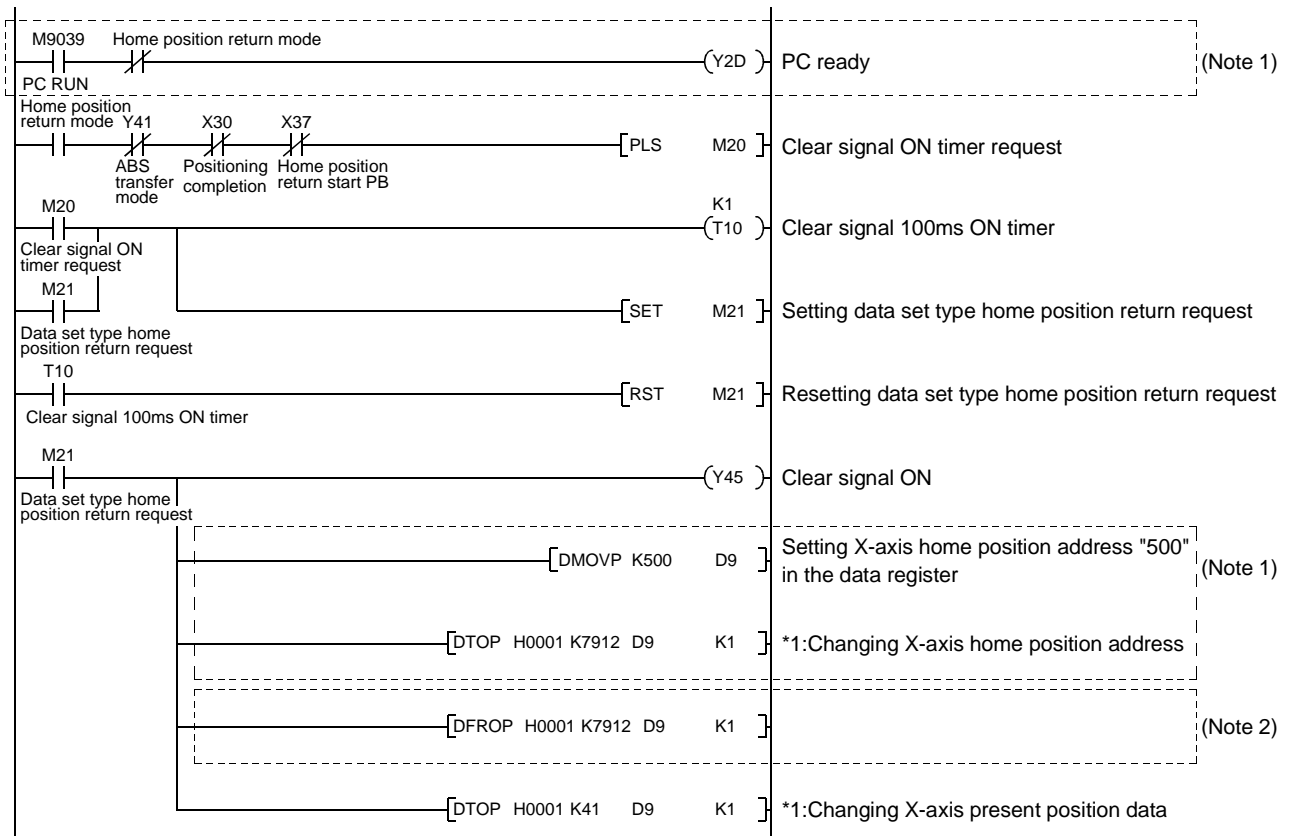
### (e) Dog type home position return

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 tool, 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.

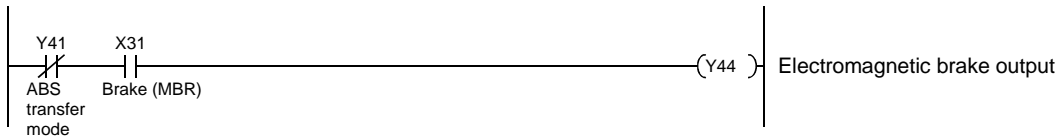
2: Contrary to Note 1 above, if the home position address is written in the home position address parameter. the circuit indicated by Note 3 is necessary and the circuits indicated by Note 1 are not necessary.

## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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.

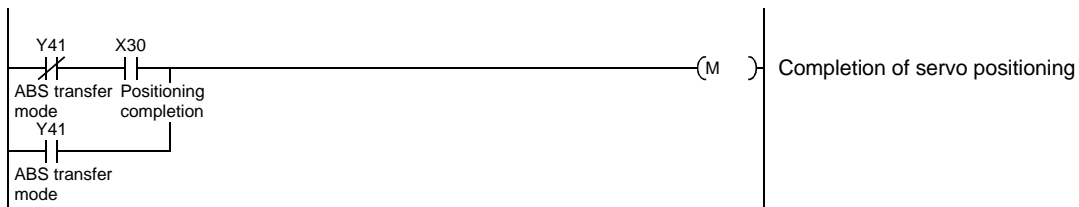
Set "1 □ 1 □" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.



### (h) Positioning completion

To create the status information for servo positioning completion.

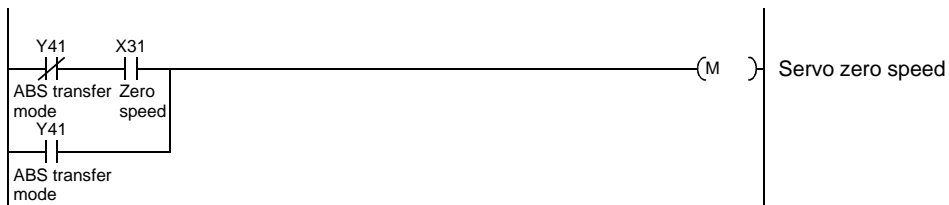
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (i) Zero speed

To create the status information for servo zero speed

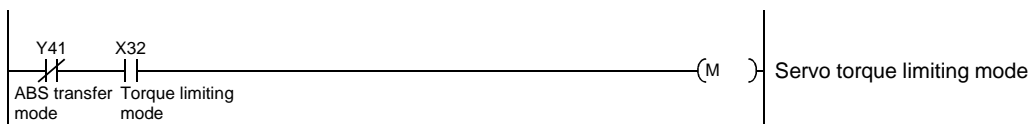
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (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.





# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (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

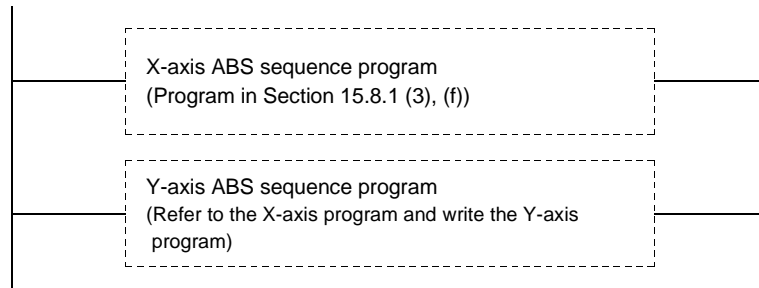
Refer to the X-axis ABS sequence program and create the Y-axis program.

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.

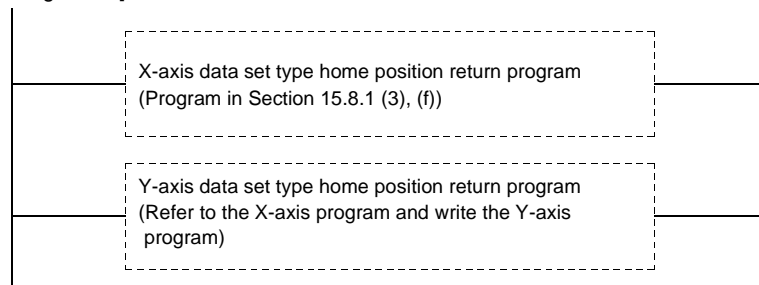
Refer to the X-axis data set type home position return program and create the Y-axis program.

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]

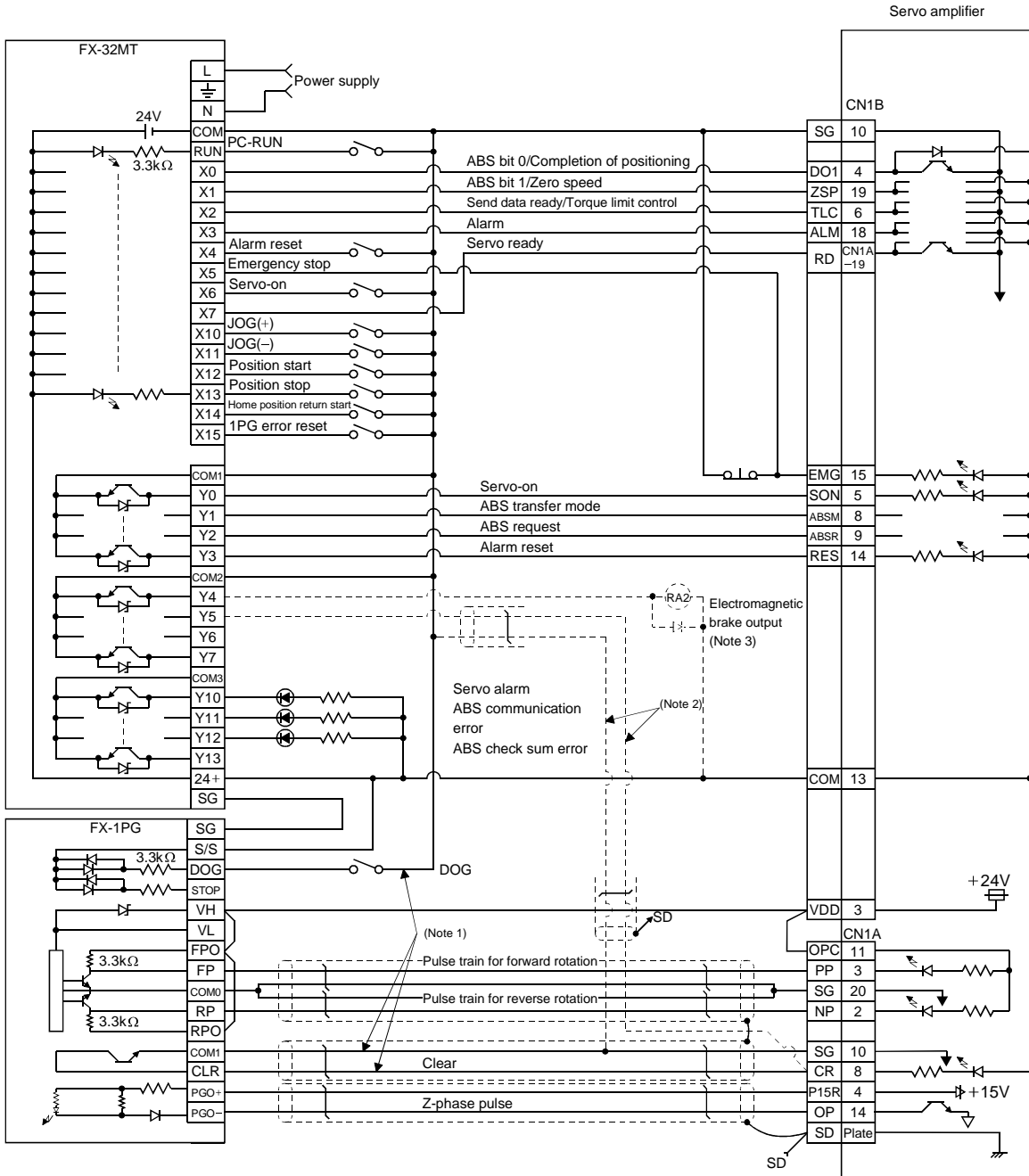


# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 15.8.2 MELSEC FX(2N)-32MT (FX(2N)-1PG)

### (1) Connection diagram

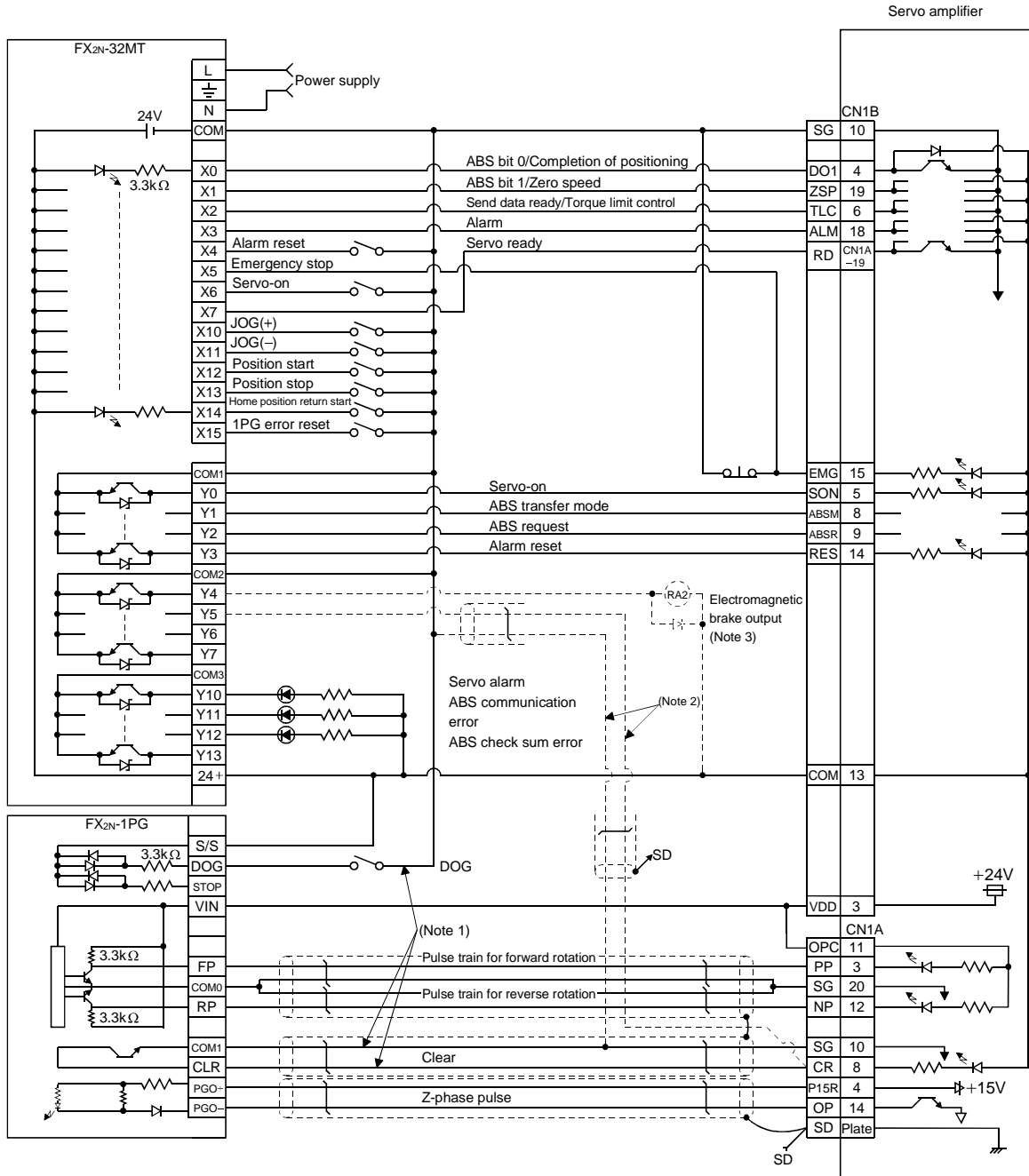
#### (a) FX-32MT (FX-1PG)



- Note 1: To be connected for the dog type home position setting. At this time, do not connect the portions marked (Note 2).
- Note 2: To be connected for the data set type home position setting. At this time, do not connect the portions marked (Note 1).
- Note 3: The electromagnetic brake interlock signal should be controlled by connecting the programmable controller output to a relay.

# 15. ABSOLUTE POSITION DETECTION SYSTEM

(b) FX2N-32MT (FX2N-1PG)



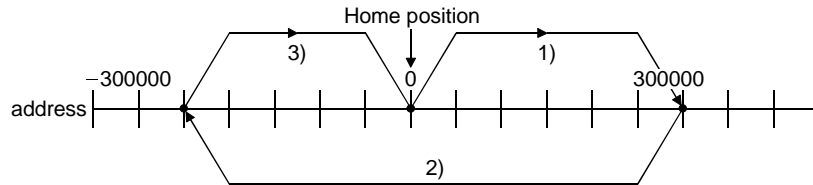
## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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 BMF#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	Command unit: Pulses	
#2	#1	Feed rate B	1000		
-	#3	Parameter	H0000		
#5	#4	Max. speed Vmax	10000PPS		
-	#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		Initial value: 100
-	#15	Acceleration/deceleration time Ta	200ms		
-	#16	Not usable			
#18	#17	Target address (I) P(I)	0		
#20	#19	Operation speed (I) V(I)	100000		
#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).

## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (b) Device list

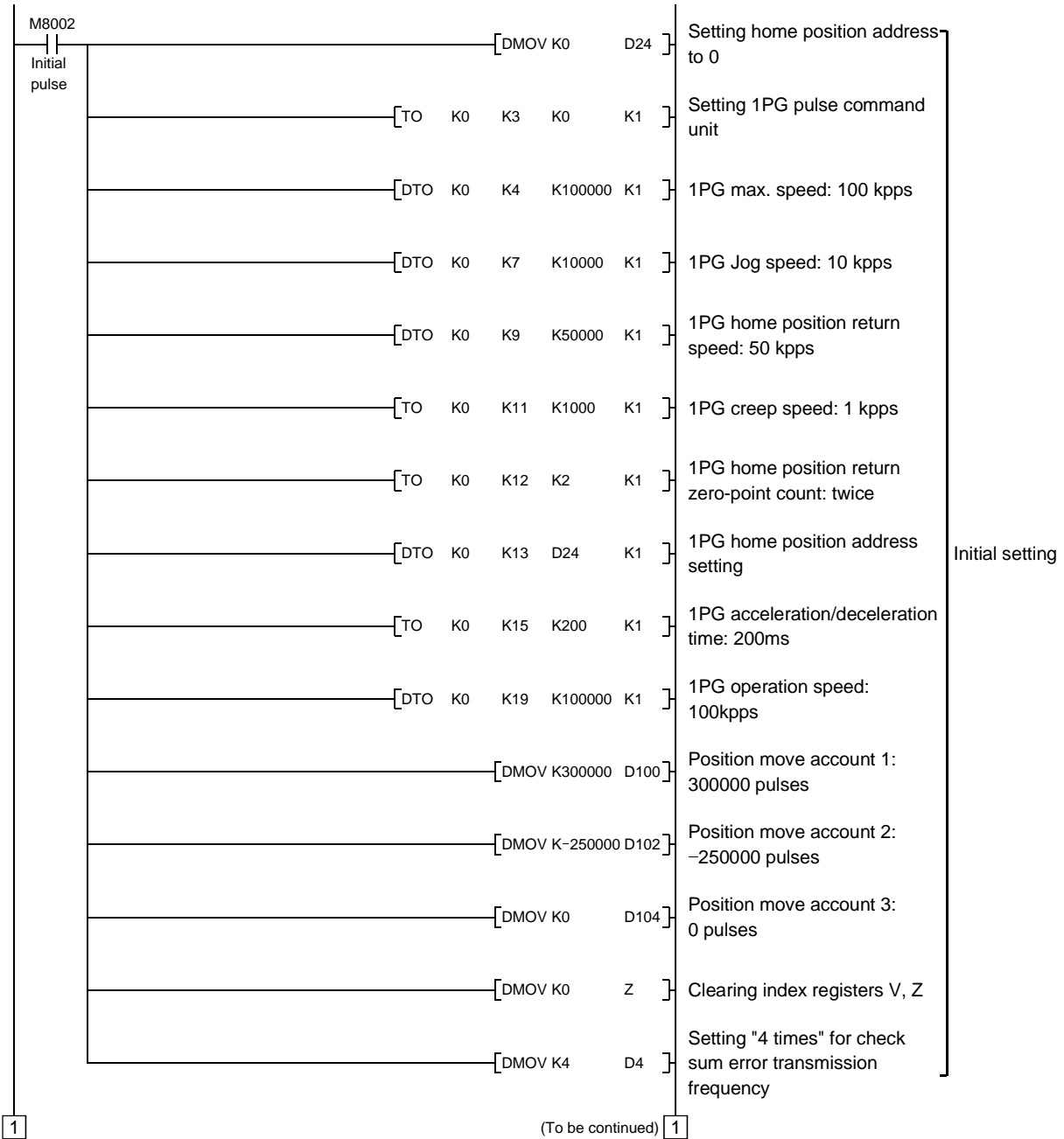
X input contact		Y output contact	
X0	ABS bit 0 / completion of positioning	Y0	Servo-on
X1	ABS bit 1 / zero speed	Y1	ABS transfer mode
X2	Send ABS data ready/ torque limit control	Y2	ABS request
X3	Servo alarm	Y3	Alarm reset
X4	Alarm reset PB	Y4 (Note 2)	Electromagnetic brake output
X5	Servo emergency stop	Y5 (Note 1)	Clear
X6	Servo-on PB	Y10	Servo alarm
X7	Servo ready	Y11	ABS communication error
X10	JOG (+) PB	Y12	ABS check sum error
X11	JOG (-) PB		
X12	Position start PB		
X13	Position stop PB		
X14	Home position return start PB		
X15	1PG error reset		
D register		M contact	
D0	ABS data: Lower 16 bits	M0	Error flag
D1	ABS data: Upper 16 bits	M1	ABS data transmission start
D2	Check sum addition counter	M2	Retry command
D3	Check data in case of check sum error	M3	ABS data read
D4	Transmission retry count in check sum discrepancy	M4	Spare
D24	Home position address: Lower 16 bits	M5	Servo-on request
D25	Home position address: Upper 16 bits	M6	Retry flag
D106	1PG present position address: Lower 16 bits	M10	ABS data 2 bit receiving buffer
D107	1PG present position address: Upper 16 bits	M11	
		M12	
		M13	
		M20	ABS data 32 bit buffer
		↓	
		M51	Check sum 6 bit buffer
		M52	
		↓	
		M57	For checksum comparison
		M58	
		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
T timer		C counter	
T200	Retry wait timer	C0	All data reception frequency counter (19 times)
T201	ABS transfer mode timer	C1	Check sum reception frequency counter
T202	ABS request response timer	C2	ABS data reception frequency counter (16 times)
T203	Ready to send response timer		
T204	ABS data waiting timer		
T210 (Note 1)	Clear signal ON timer		

Note 1: Necessary when data set type home position return is executed.

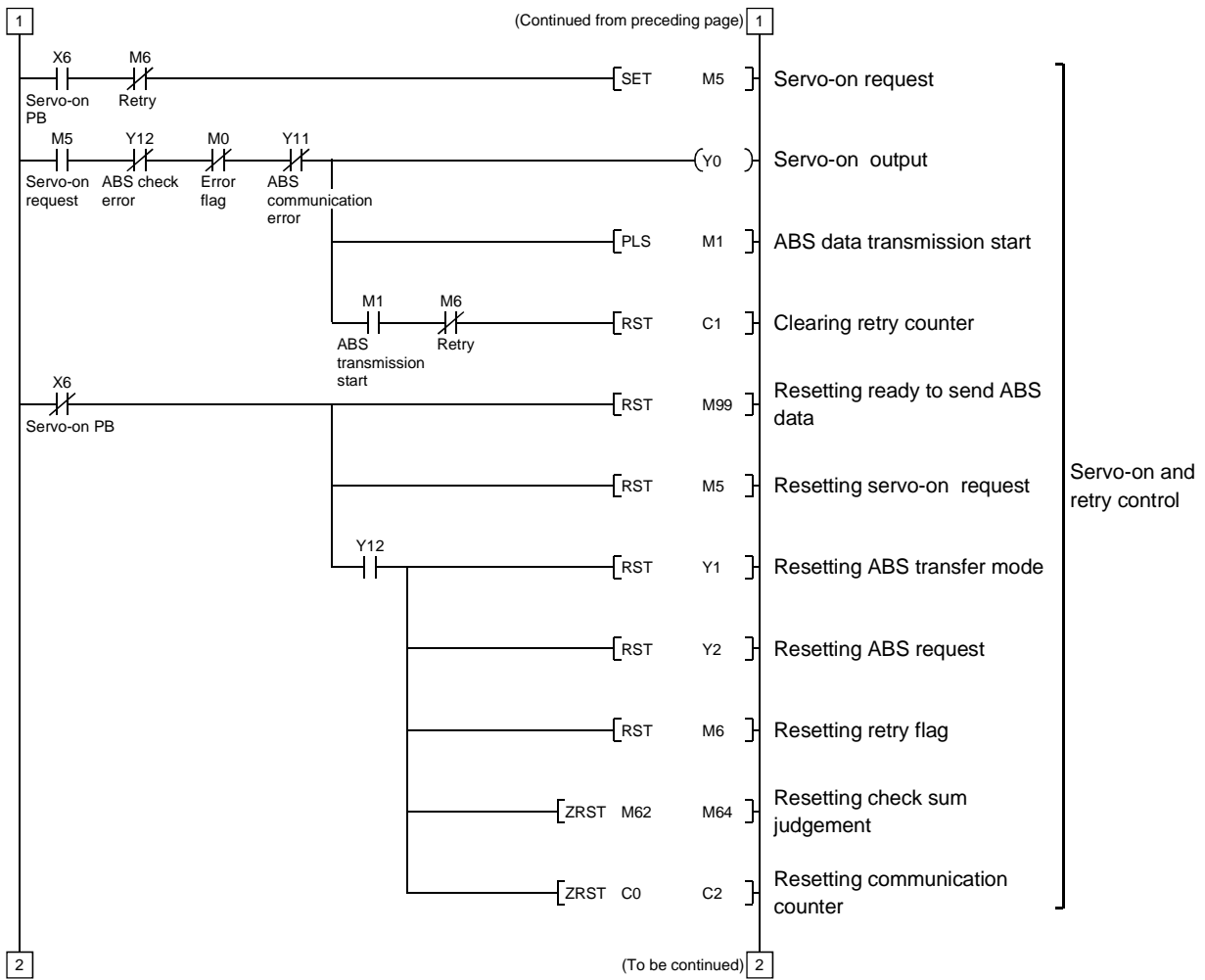
2: Necessary in the event of electromagnetic brake output.

# 15. ABSOLUTE POSITION DETECTION SYSTEM

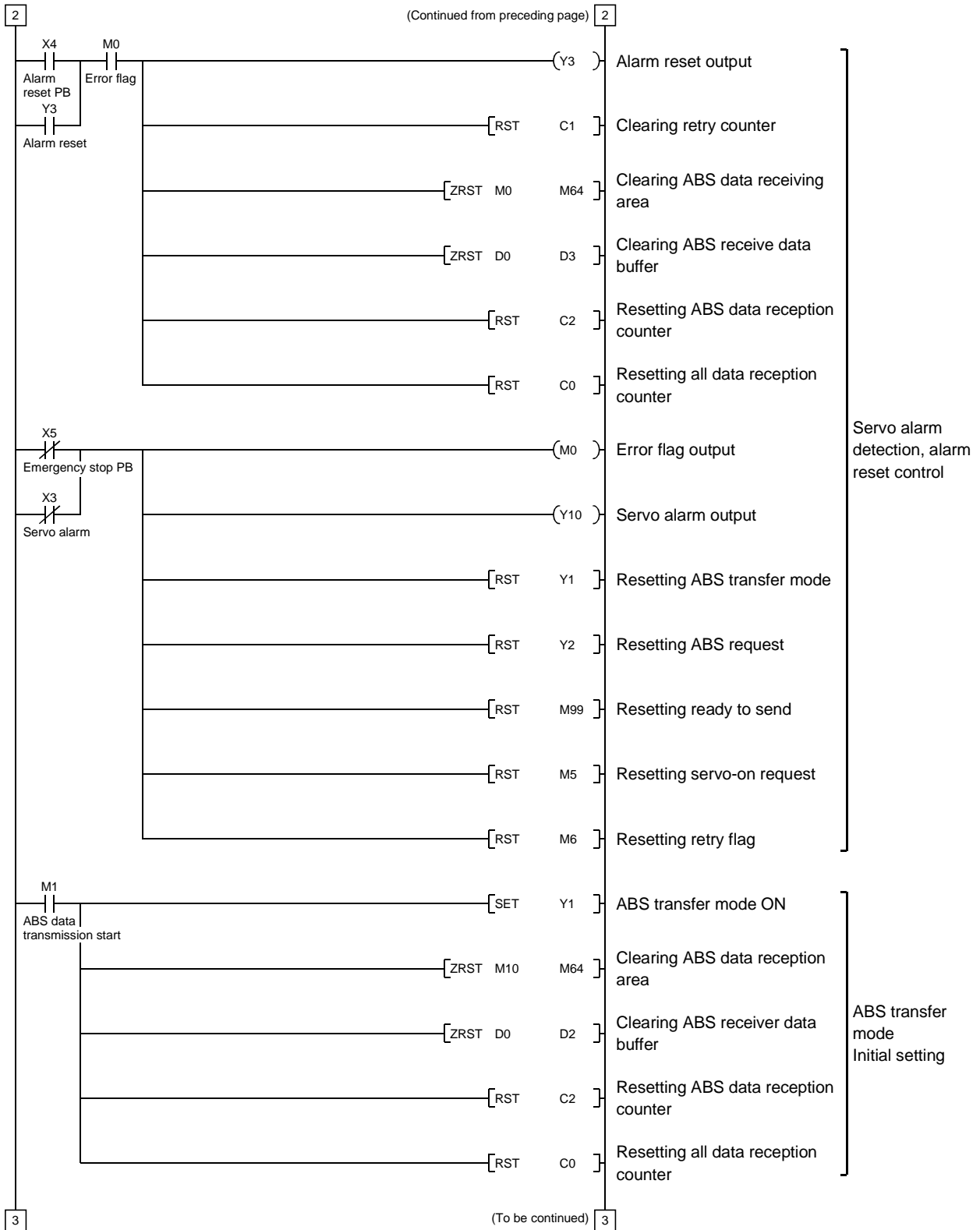
(c) ABS data transfer program for X-axis



# 15. ABSOLUTE POSITION DETECTION SYSTEM

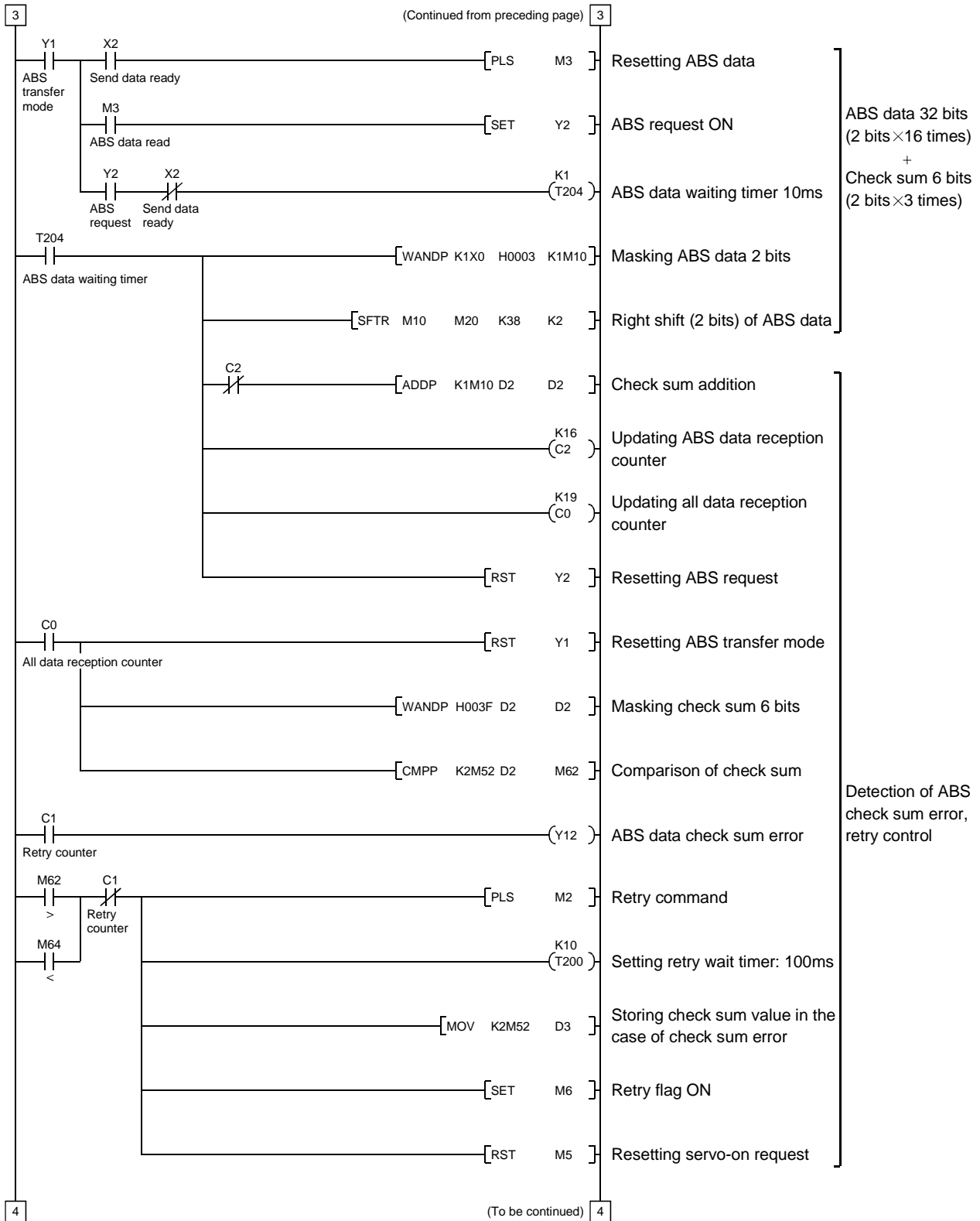


# 15. ABSOLUTE POSITION DETECTION SYSTEM

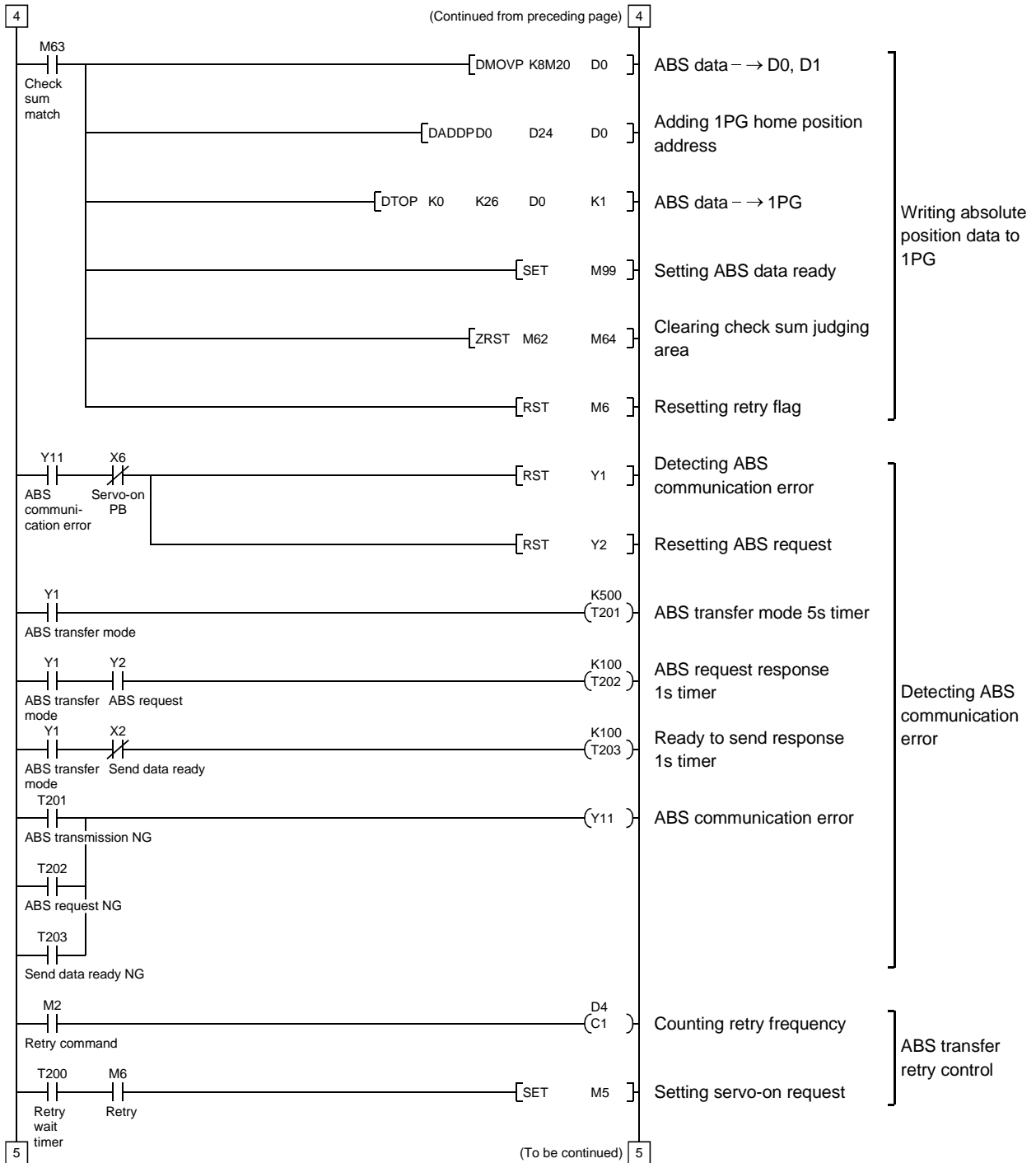




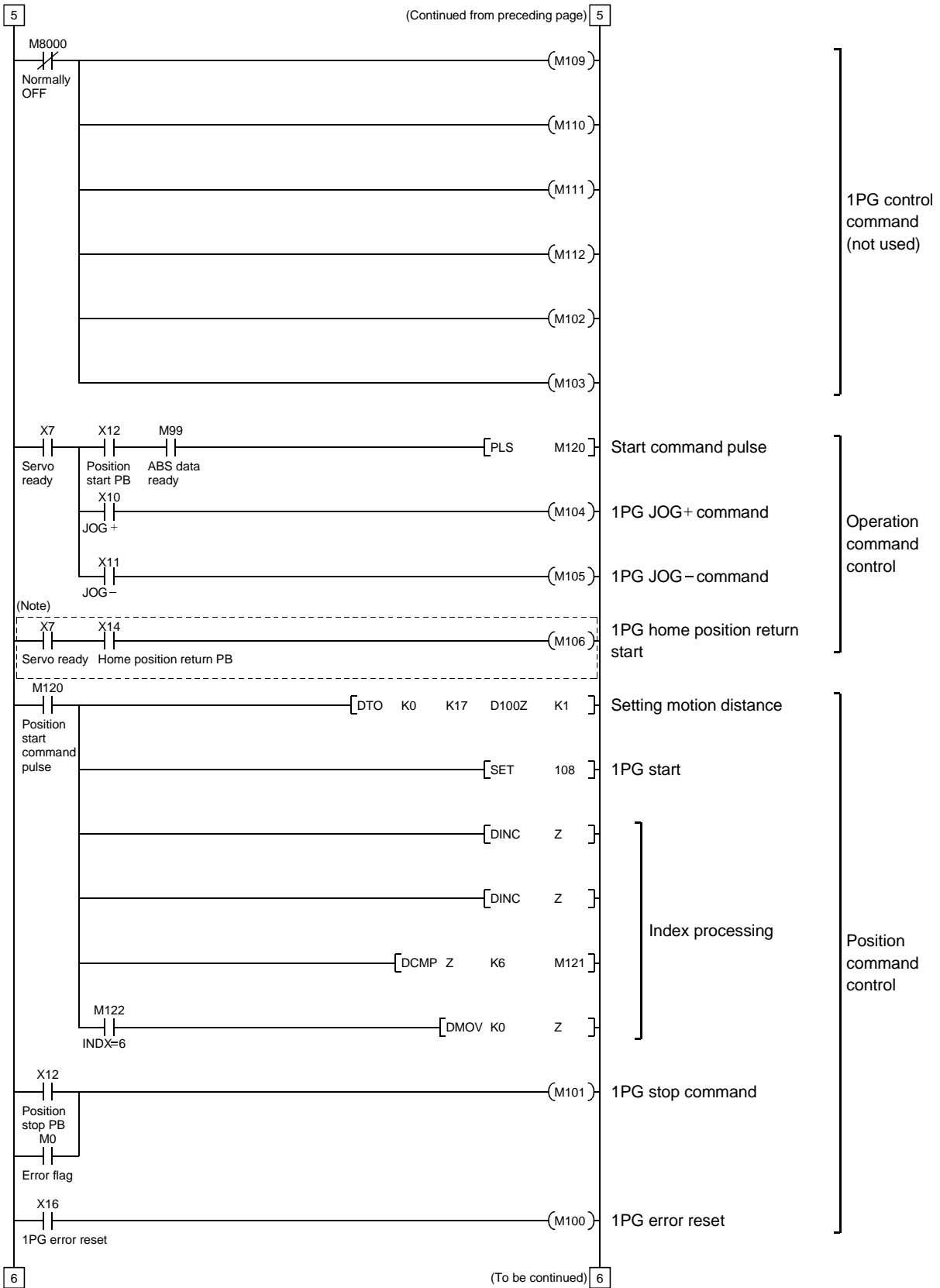
# 15. ABSOLUTE POSITION DETECTION SYSTEM



# 15. ABSOLUTE POSITION DETECTION SYSTEM

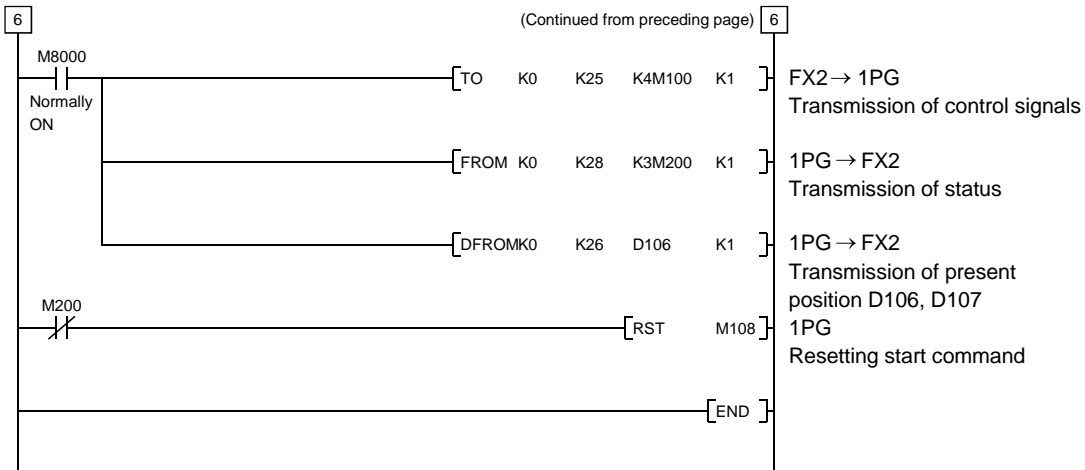


# 15. ABSOLUTE POSITION DETECTION SYSTEM



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.

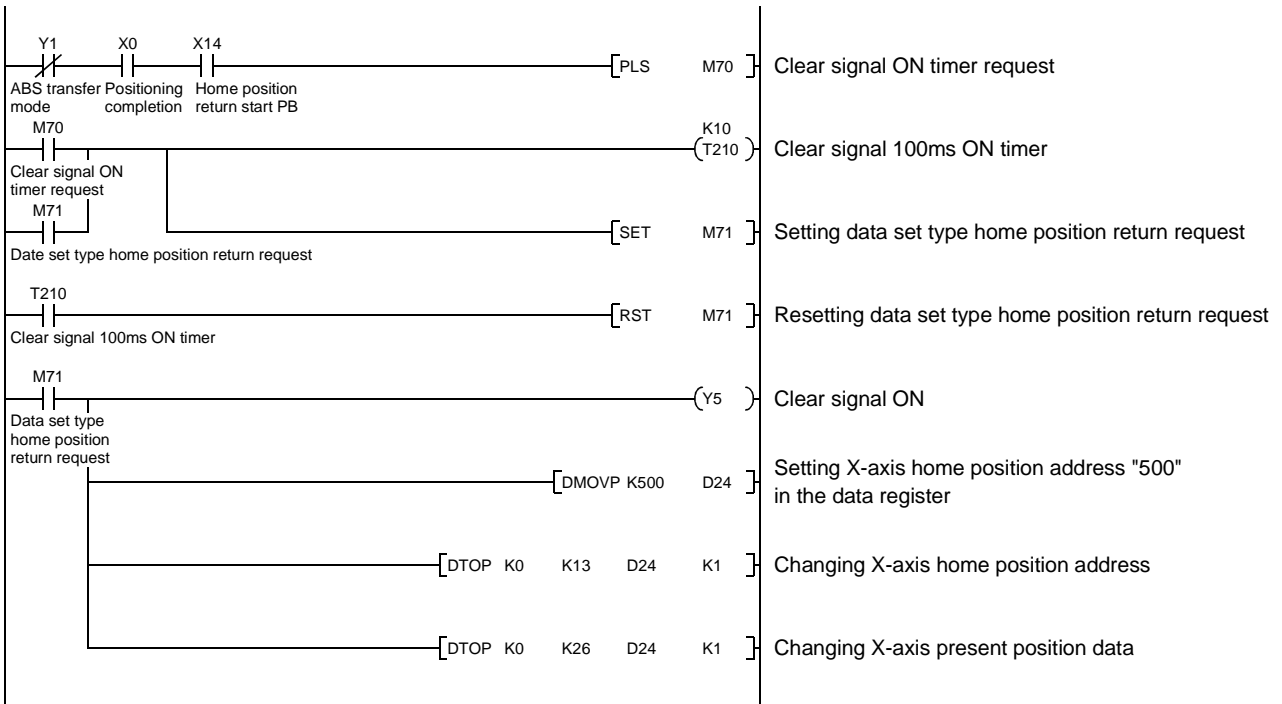
# 15. ABSOLUTE POSITION DETECTION SYSTEM



### (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.

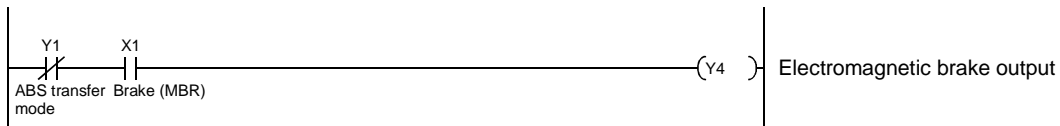


## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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.

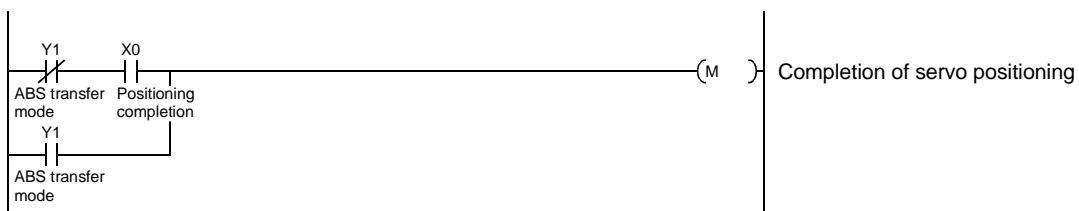
Set "1□1□" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.



### (f) Positioning completion

To create the status information for servo positioning completion.

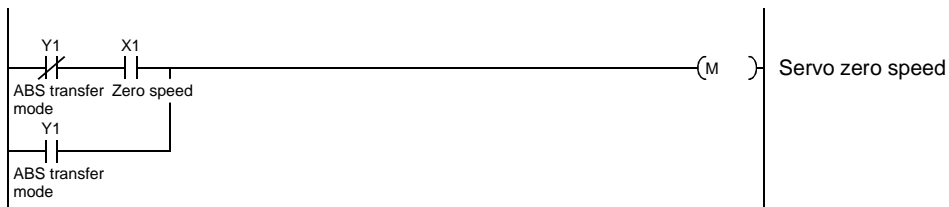
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (g) Zero speed

To create the status information for servo zero speed.

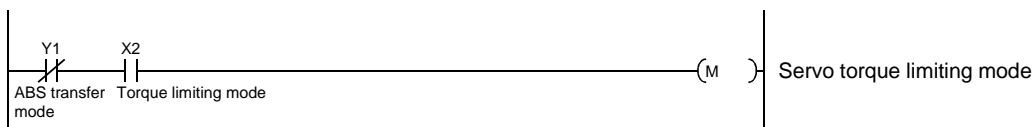
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (h) Torque limiting

To create the status information for the servo torque limiting mode.

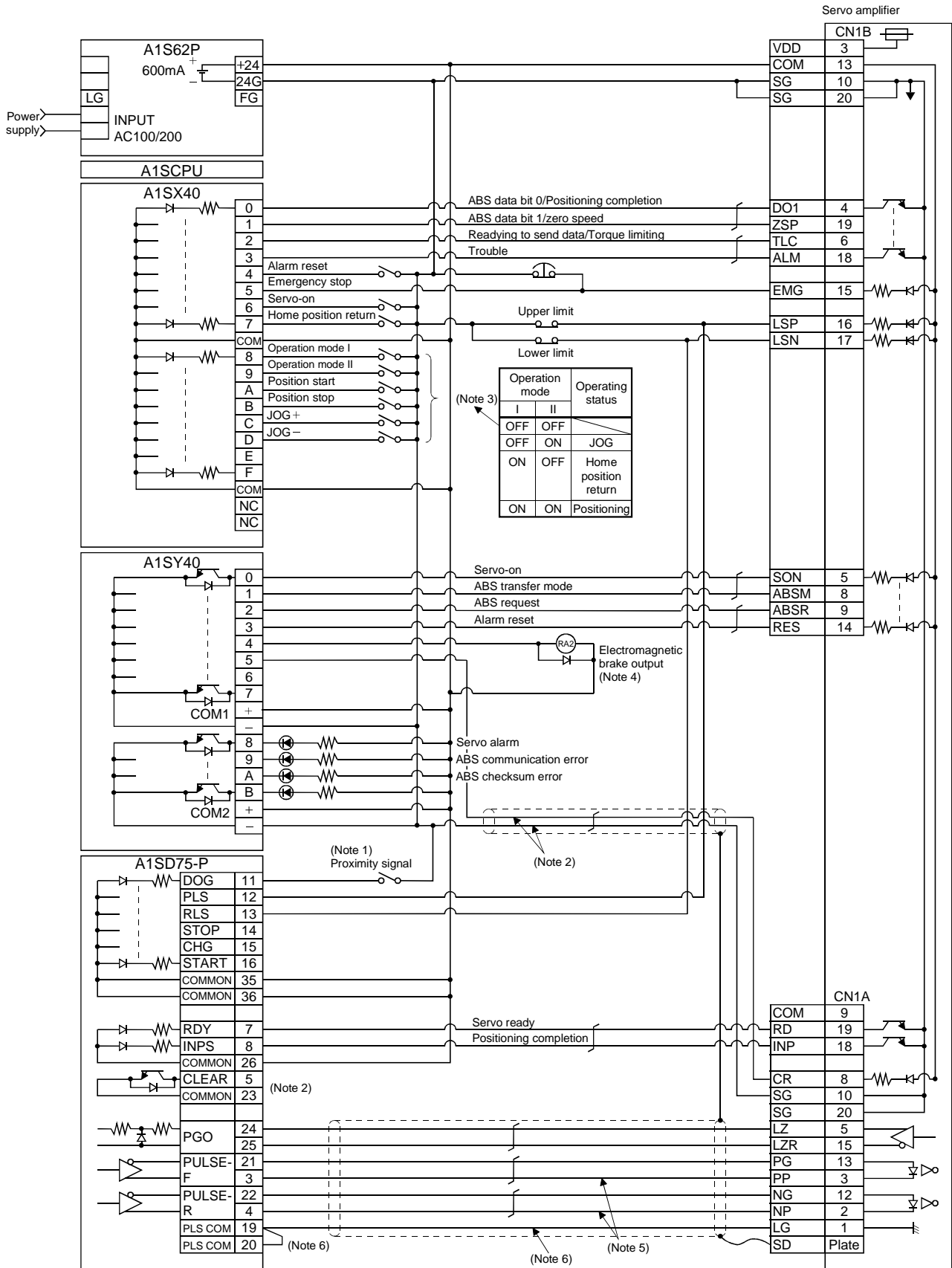
During ABS data transfer (for several seconds after the servo-on signal is turned on), the torque limiting must be off.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

## 15.8.3 MELSEC A1SD75(AD75)

### (1) Connection diagram



## 15. ABSOLUTE POSITION DETECTION SYSTEM

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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.

## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (2) Sequence program example

#### (a) Conditions

- 1) When the servo-on signal and power supply GND are shorted, the ABS data is transmitted at power-on of the servo amplifier or on the leading edge of the RUN signal after a PC reset operation (PC-RESET). The ABS data is also transmitted when an alarm is reset or when an emergency stop is reset.
- 2) 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	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	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	M23	Current position change processing instruction
T2	Retry wait timer	M24	Current position change flag
T3	ABS data send reading response timer		
T10 (Note 1)	Clear signal ON timer	C counter	
T200	Transmitted data read 10ms delay timer	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.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

(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:

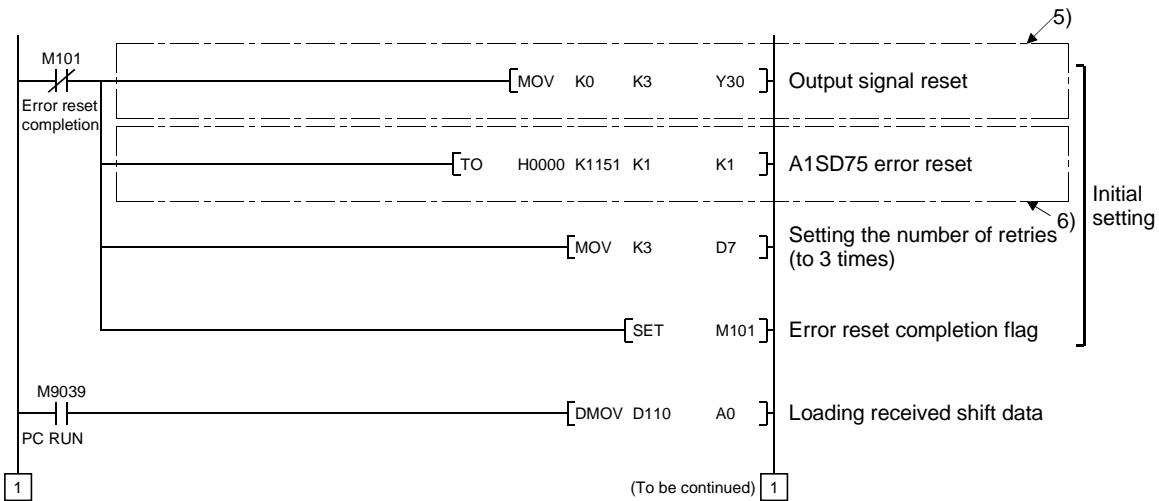
<Additional program>

[D \* P K □ □ D3 D3]

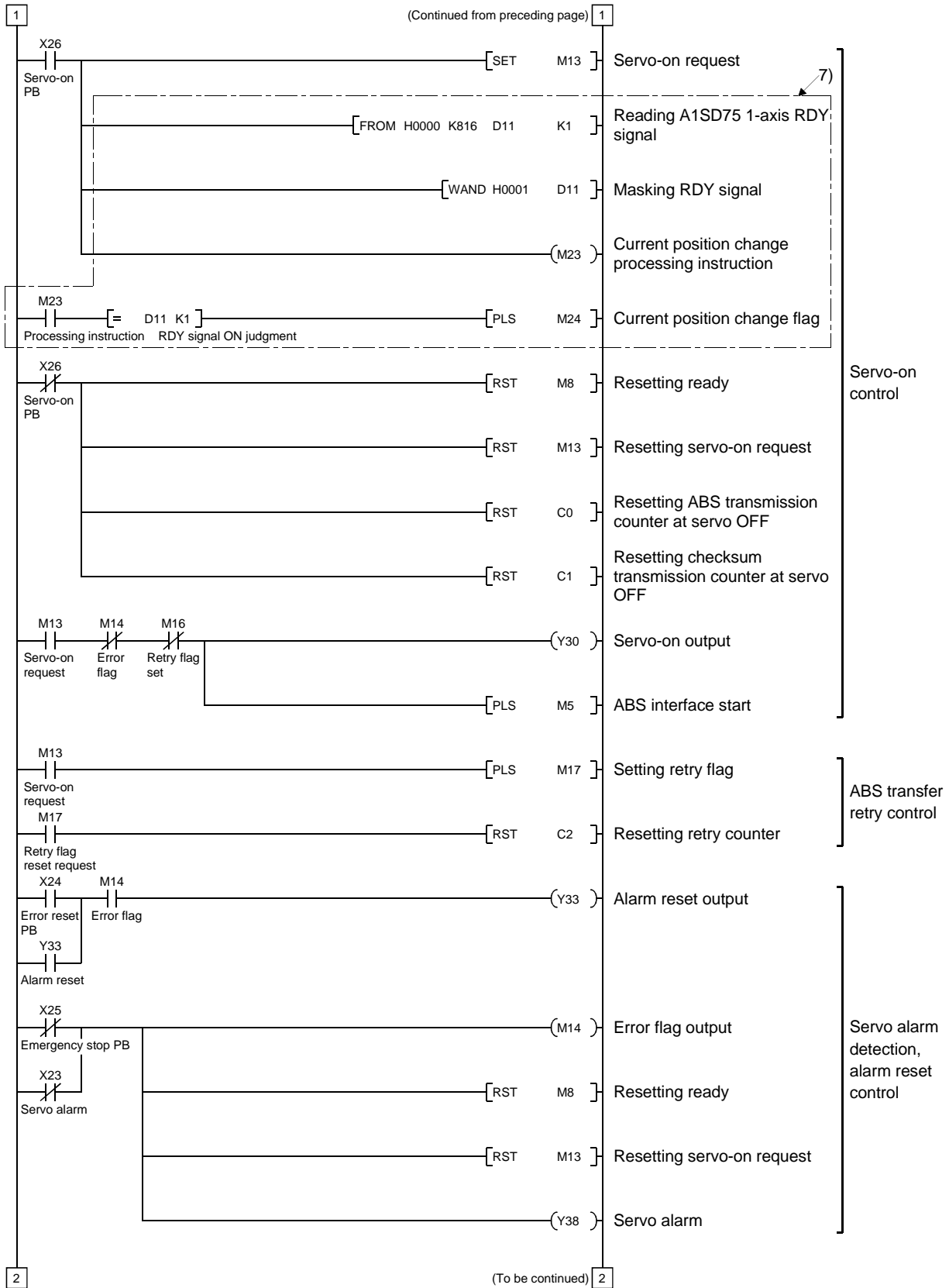
Item	mm				inch				degree				pulse
Unit setting	0				1				2				3
Travel per pulse	0.1 to	1 to	10 to	100	0.00001 to	0.0001 to	0.001 to	0.01 to	0.00001 to	0.0001 to	0.001 to	0.01 to	
Unit of travel	μm/PLS				inch/PLS				degree/PLS				PLS
Constant K for conversion into unit of travel	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	1 to	10 to	100 to	1000	None

**Reference**

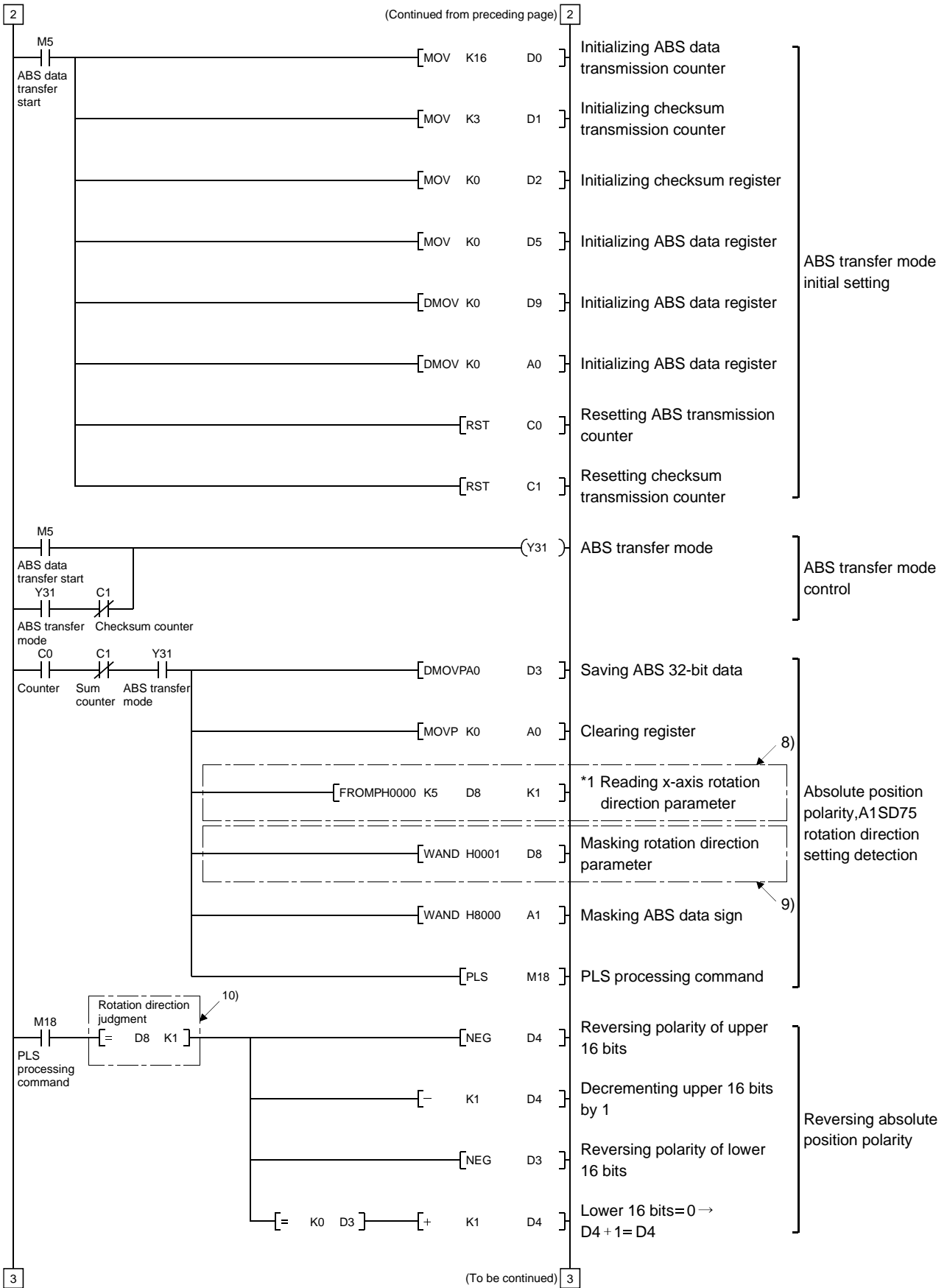
- For 1μm/PLS, set constant K to 10
- For 5μm/PLS, set constant K to 50
- The additional program is not required for the unit setting is PLS.



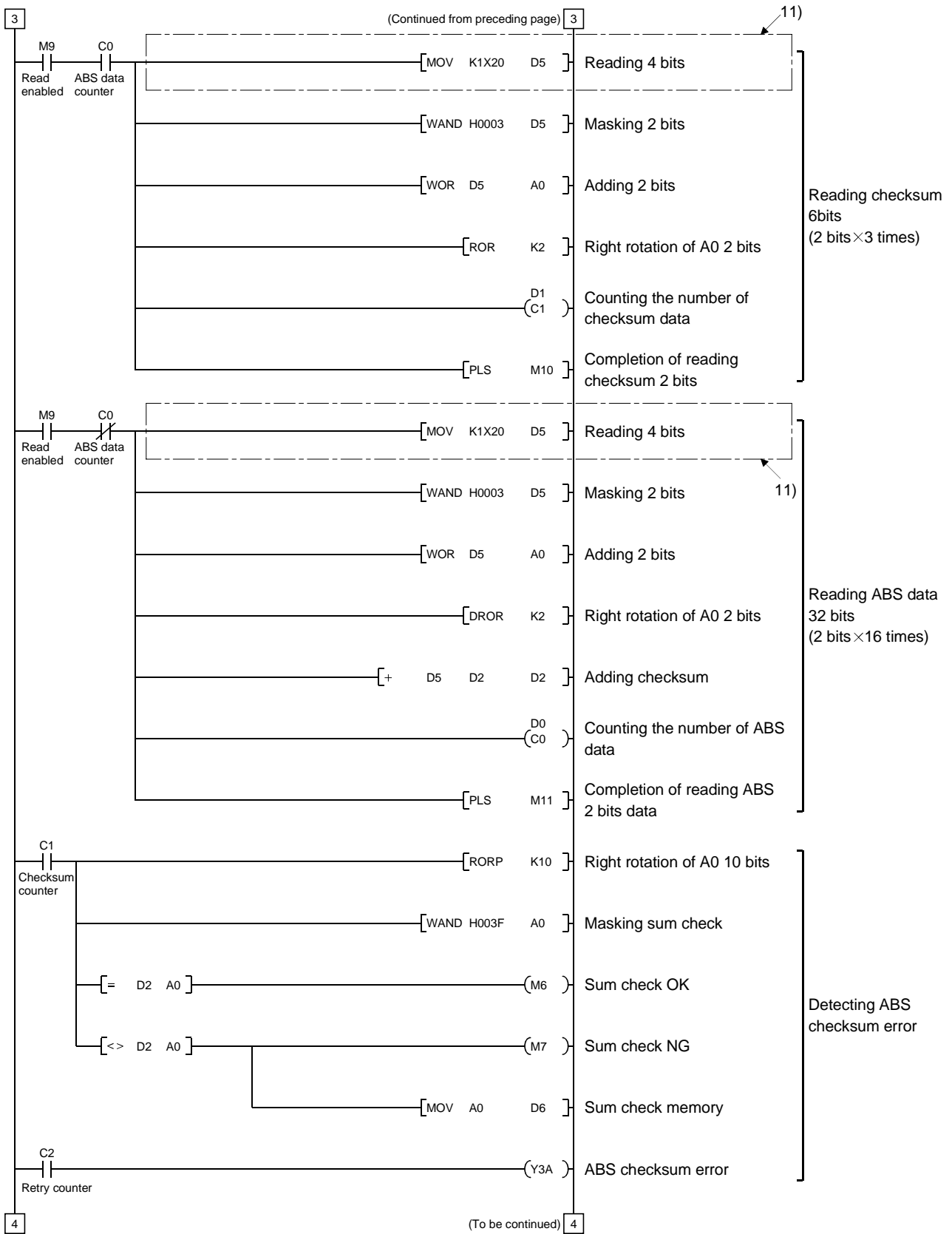
# 15. ABSOLUTE POSITION DETECTION SYSTEM



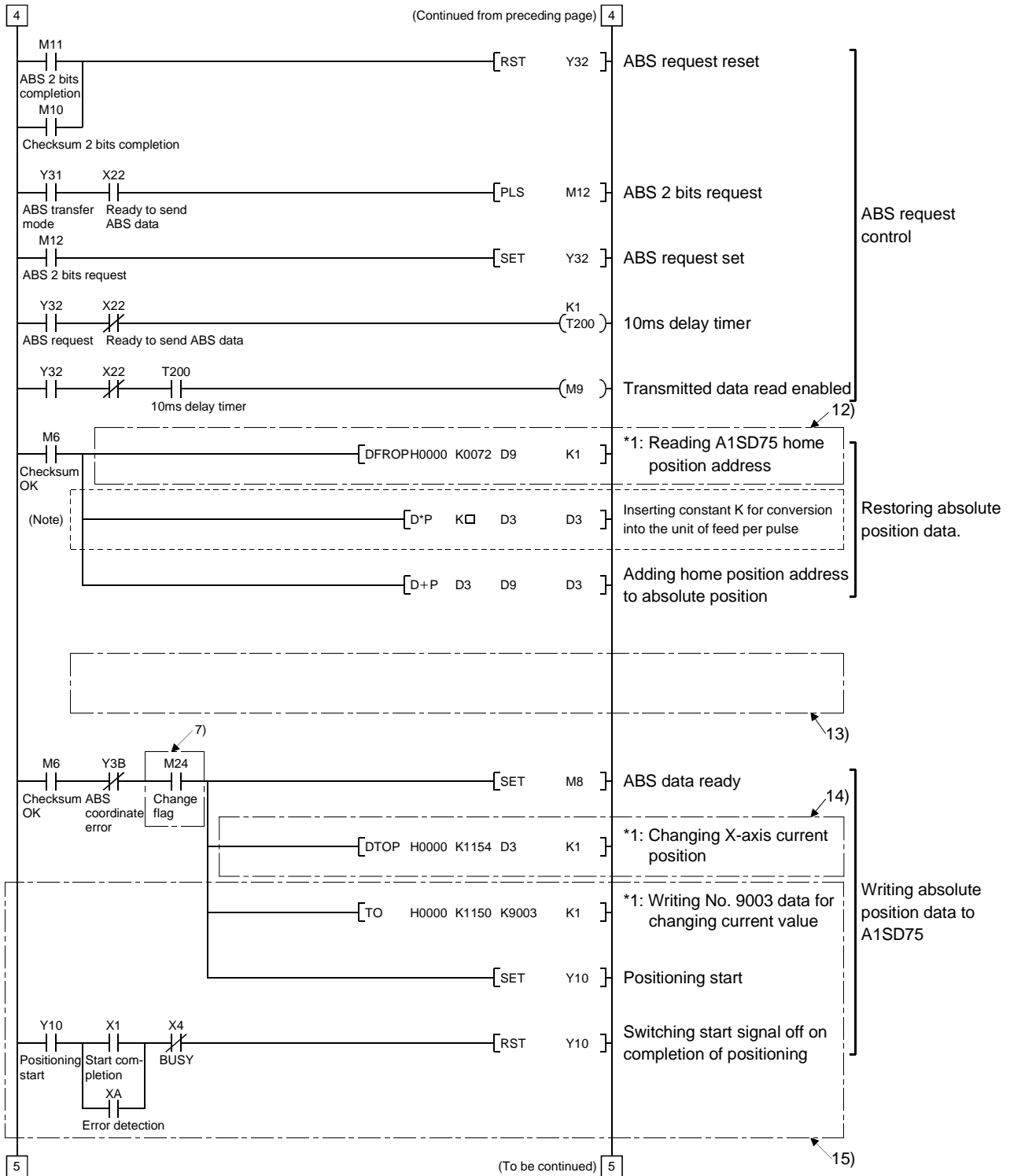
# 15. ABSOLUTE POSITION DETECTION SYSTEM



# 15. ABSOLUTE POSITION DETECTION SYSTEM

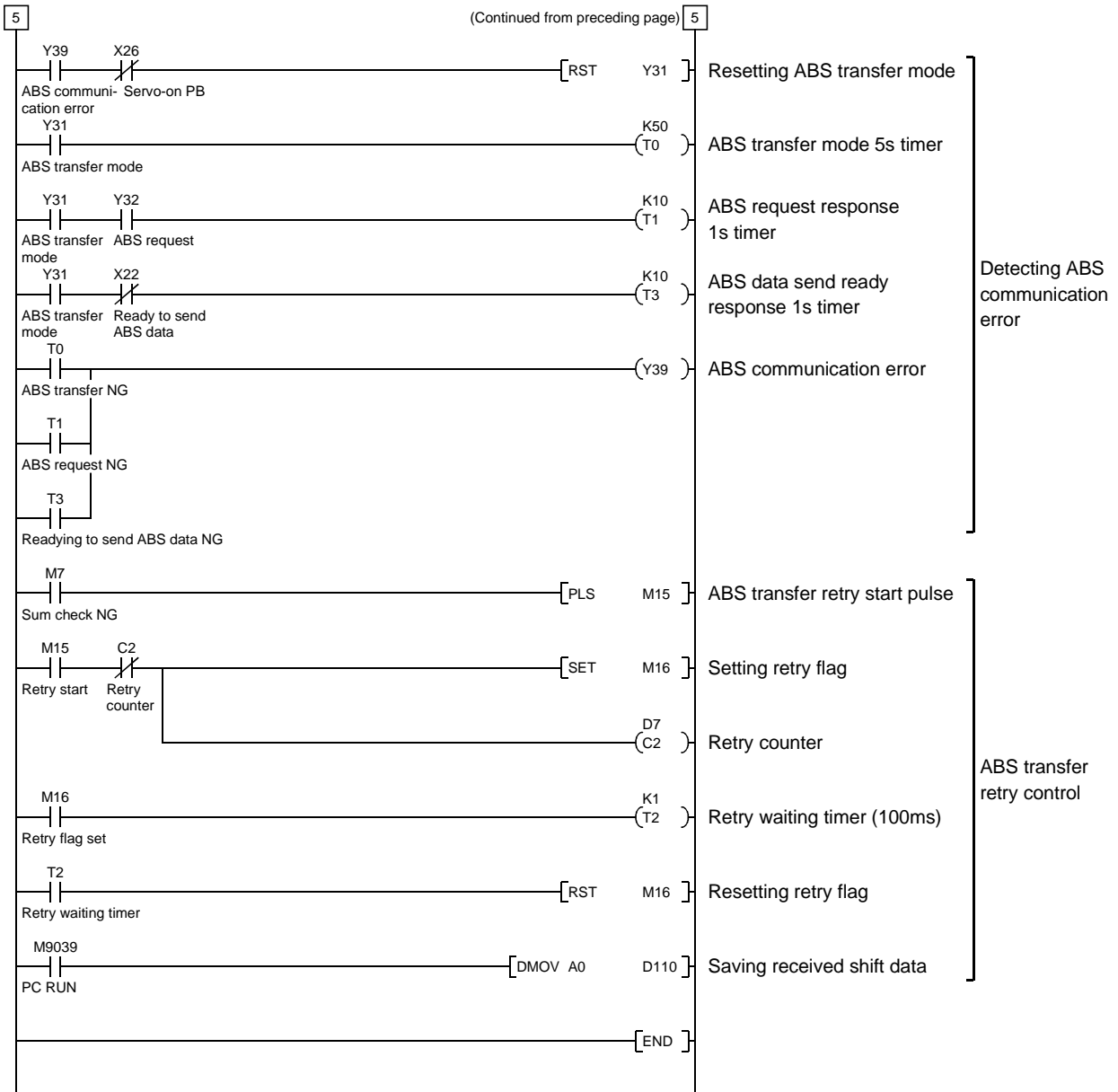


# 15. ABSOLUTE POSITION DETECTION SYSTEM



Note: When the unit setting parameter value of the AD75 positioning module is changed from "3" (pulse) to "0" (mm), the unit is  $\times 0.1\mu\text{m}$  for the input value. To set the unit to  $\times 1\mu\text{m}$ , add this program to multiply the feed value by 10.

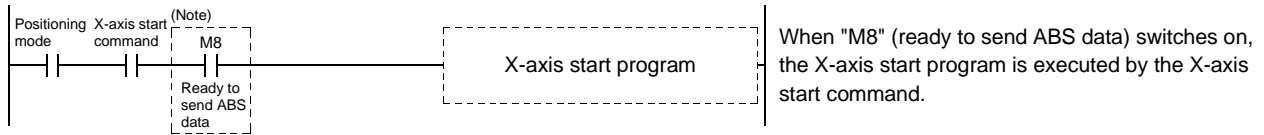
# 15. ABSOLUTE POSITION DETECTION SYSTEM



## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (d) X-axis program

Do not execute the X-axis program while the ABS ready (M8) is off.

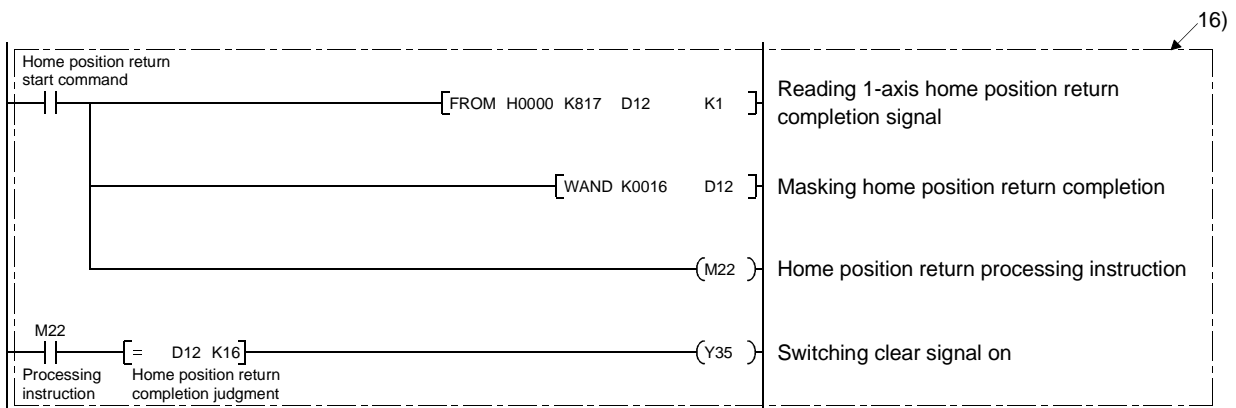


### (e) Dog type home position return

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:

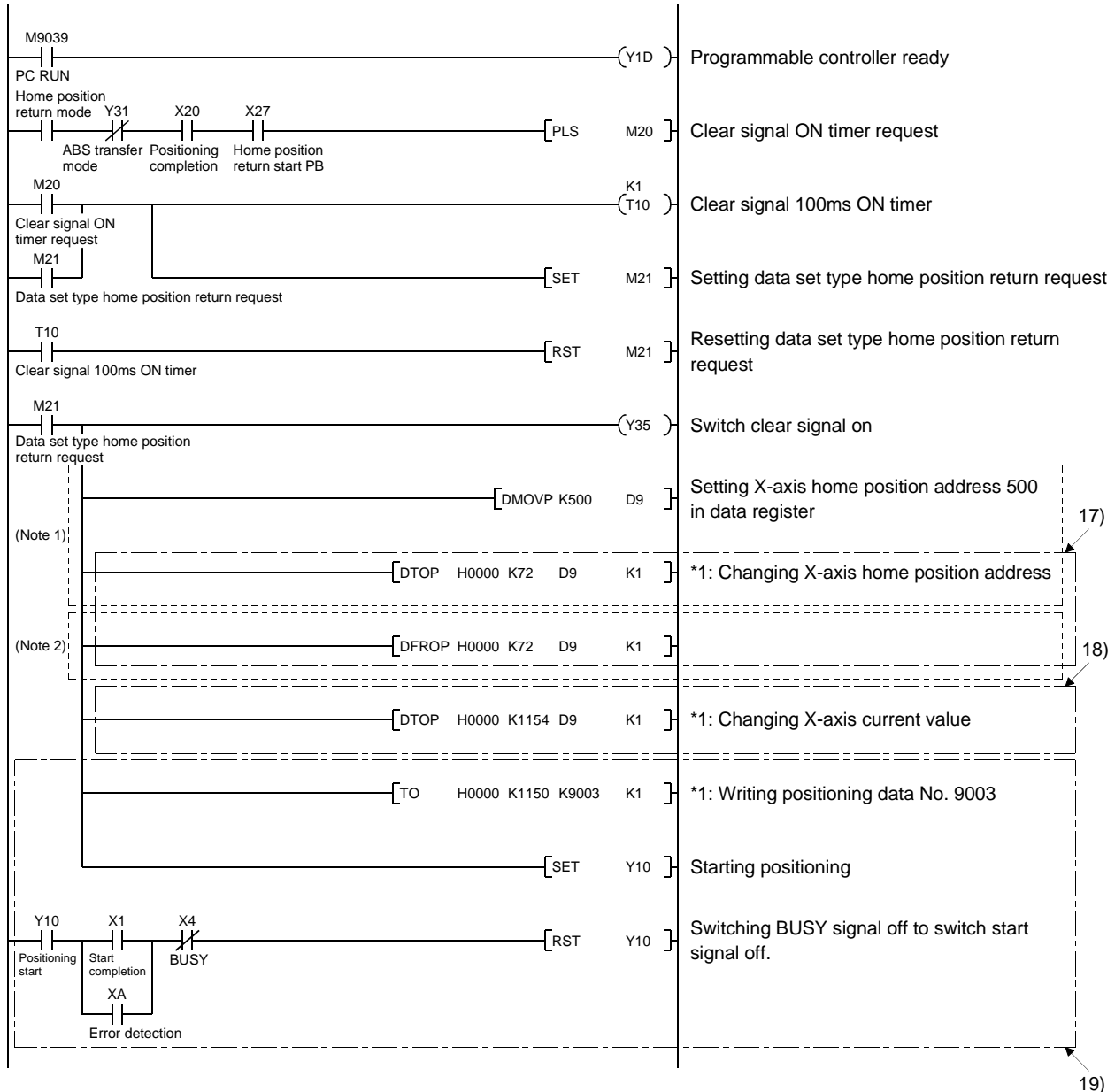


# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (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.

Note 2: Contrary to above 2, if the home position address is written in the home position address parameter, the sequence circuit (Note 1) is not required but this sequence circuit (Note 1) is required.

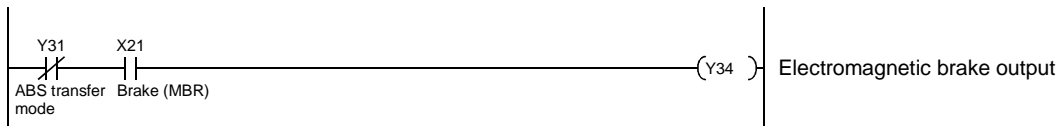


## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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.

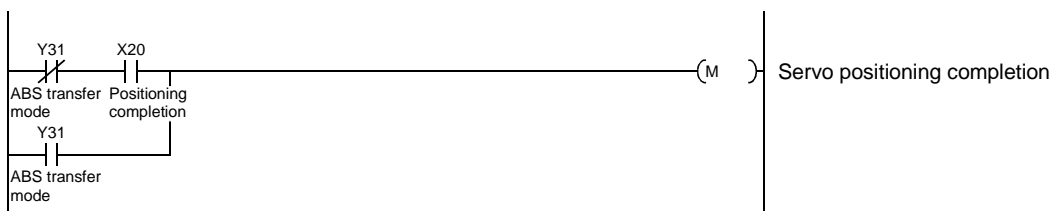
Set "1 □ 1 □" in parameter No. 1 of the servo amplifier to choose the electromagnetic brake interlock signal.



### (h) Positioning completion

To create the status information for servo positioning completion.

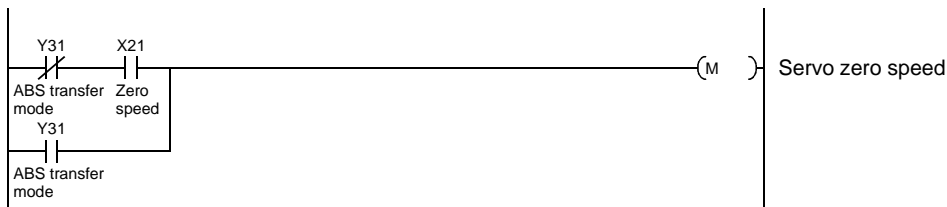
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (i) Zero speed

To create the status information for servo zero speed.

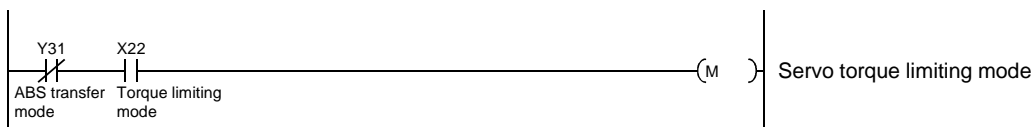
During ABS data transfer (for several seconds after the servo-on signal is turned on), the servo motor must be at a stop.



### (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.



# 15. ABSOLUTE POSITION DETECTION SYSTEM

## (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.

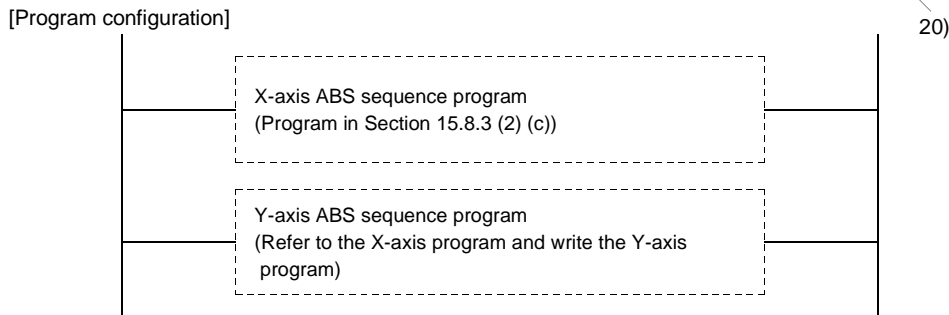
### (a) Y-axis program

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 <u>K155</u> D8 K1]
[DFROP H0000 K0072 D9 K1]	→	[DFROP H0000 <u>K222</u> D9 K1]
[DTOP H0000 K1154 D3 K1]	→	[DTOP H0000 <u>K1204</u> D3 K1]
[TO H0000 K1150 K9003 K1]	→	[TO H0000 <u>K1200</u> K9003 K1]



### (b) Data set type home position return

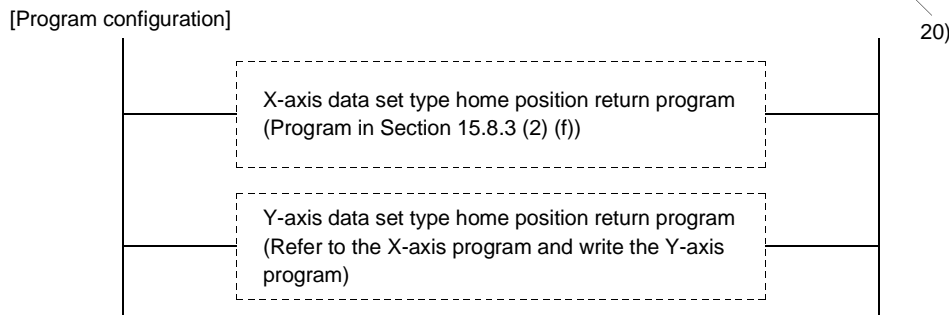
Arrange the data set type home position return programs given in Section 15.8.3 (2), (f) in series to control two axes.

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 <u>K222</u> D9 K1]
[DTOP H0000 K1154 D9 K1]	→	[DTOP H0000 <u>K1204</u> D3 K1]
[TO H0000 K1150 K9003 K1]	→	[TO H0000 <u>K1200</u> K9003 K1]



## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (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
	Axis 1	Axis 2	Axis 3		Data register	:Stored data
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)

## 15. ABSOLUTE POSITION DETECTION SYSTEM

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### 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

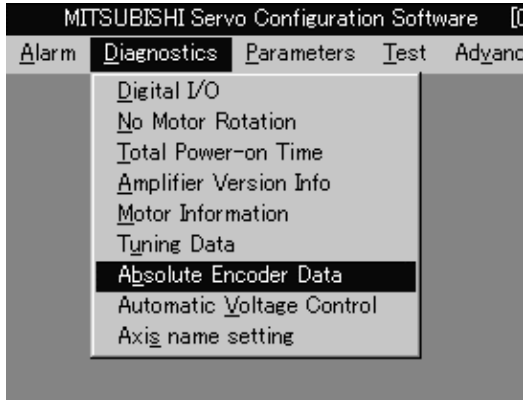
Due to the changes in wiring described in (4), (a), 4) of this section, the program for outputting the clear signal (Y35) after completion of a home position return is required. 16)

## 15. ABSOLUTE POSITION DETECTION SYSTEM

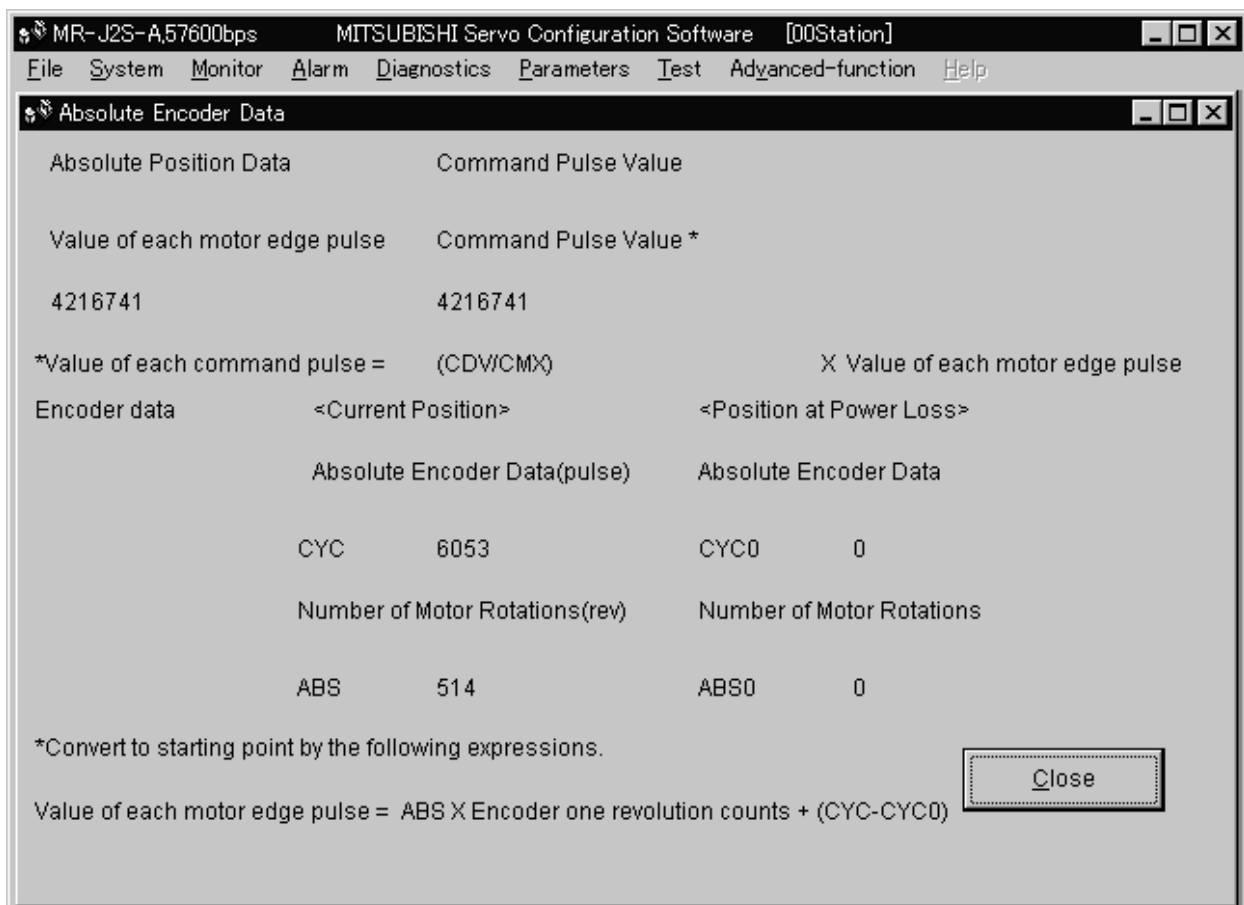
### 15.9 Confirmation of absolute position detection data

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. ABSOLUTE POSITION DETECTION SYSTEM

### 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. 2. The ready to send signal (X32) is not turned OFF within 1s after the ABS data request signal (Y42) is turned ON. 3. The ready to send signal (X32) remains OFF for longer than 1s.	1. Wiring for ABS transfer mode signal, ABS data request signal, or ready to send signal is disconnected or connected to the 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	Y10	• 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. 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.

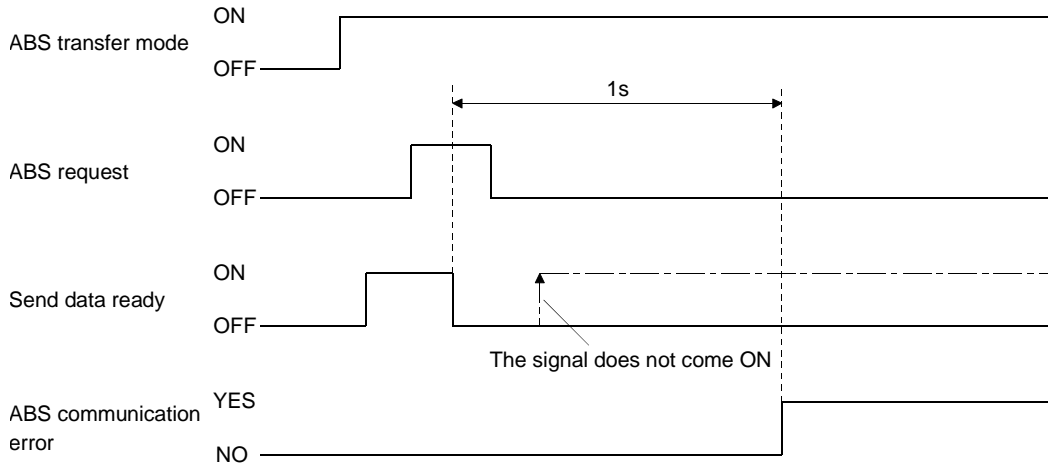
## 15. ABSOLUTE POSITION DETECTION SYSTEM

### (2) ABS communication error

- (a) The OFF period of the send data ready signal output from the servo amplifier is checked.

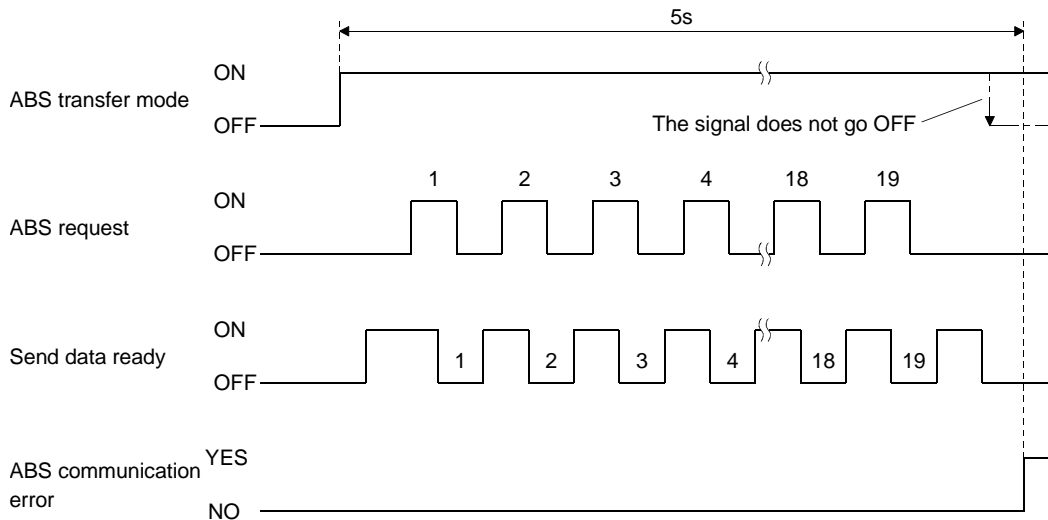
If the OFF period is 1s or longer, this is regarded as a transfer fault and the ABS communication error is generated.

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.



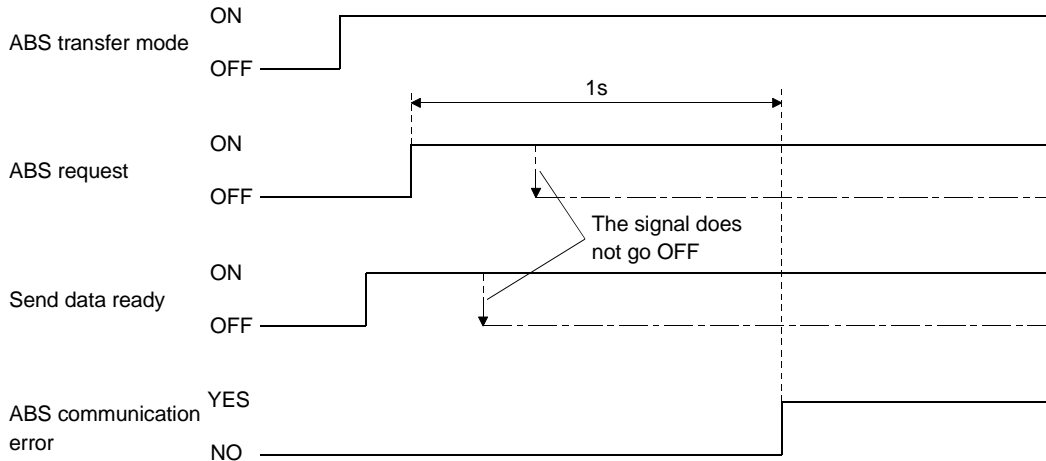
- (b) The time required for the ABS transfer mode signal to go OFF after it has been turned ON (ABS transfer time) is checked.

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.



## 15. ABSOLUTE POSITION DETECTION SYSTEM

- (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 a 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 Reset when servo-on PB (X36) signal turns from off to on.
				For FX-1PG 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.

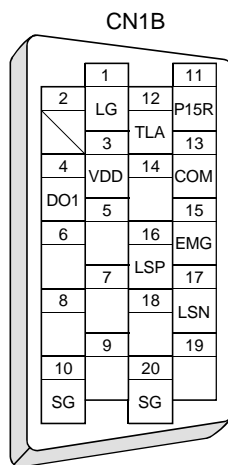
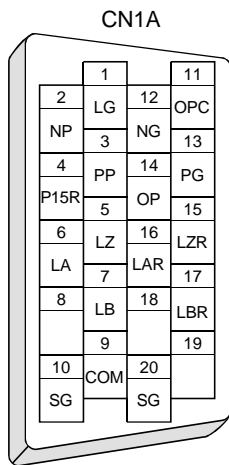




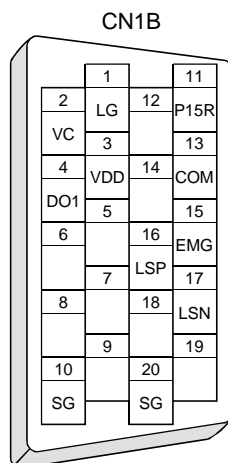
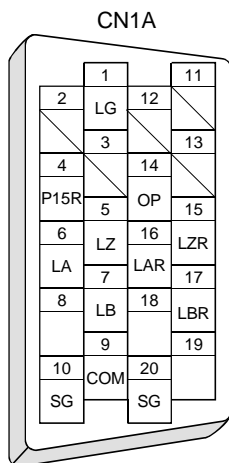
# Appendix

## App 1. Signal arrangement recording sheets

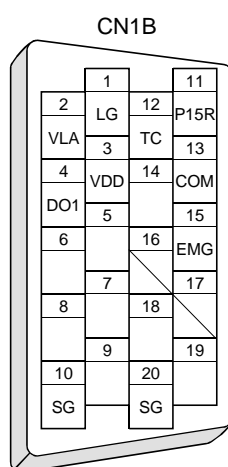
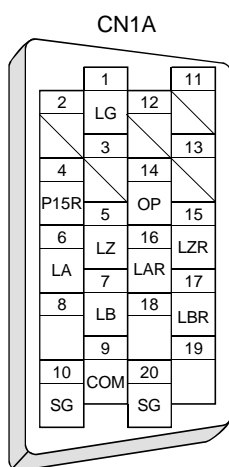
### (1) Position control mode



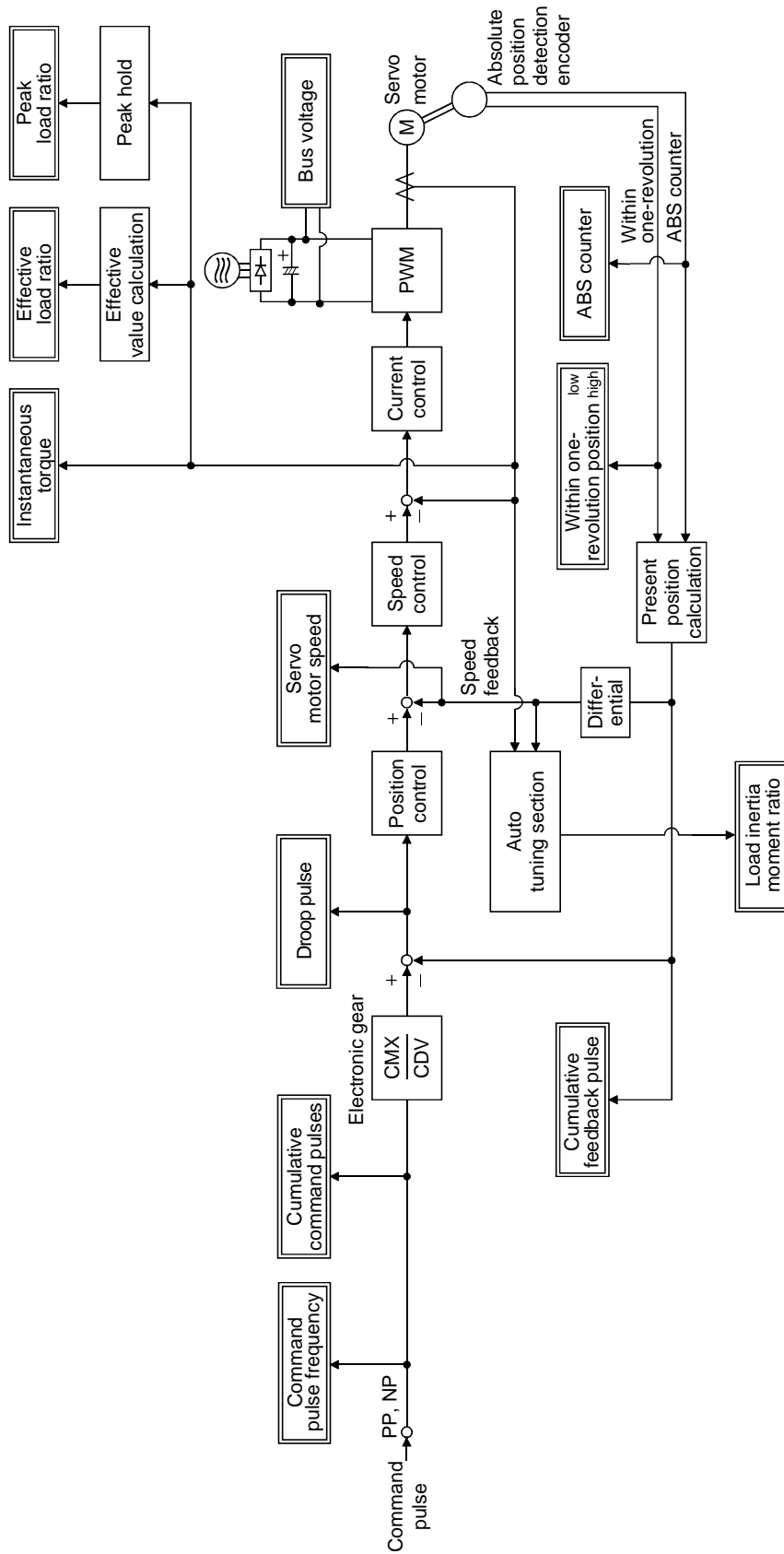
### (2) Speed control mode



### (3) Torque control mode



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	<p>Addition of single-phase 100VAC specifications</p> <p>Compatible Servo Configuration software model name change</p> <p>Compliance with EC Directives 1: Review of sentence</p> <p>Section 1.2: Review of function block diagram</p> <p>Section 1.3: Moving of servo amplifier standard specifications</p> <p style="padding-left: 40px;">Review of torque limit description in position control mode</p> <p style="padding-left: 40px;">Review of torque limit description in speed control mode</p> <p style="padding-left: 40px;">Deletion of torque linearity in torque limit mode</p> <p style="padding-left: 40px;">Addition of speed limit in torque control mode</p> <p>Section 3.1.1 (1): Addition of encoder Z-phase pulse connection</p> <p style="padding-left: 40px;">Addition of Note for use of junction terminal block</p> <p>Section 3.1.1 (2): Addition of Note for increased noise immunity</p> <p>Section 3.1.2: Addition of Note for input of negative voltage</p> <p>Section 3.1.3: Addition of Note for input of negative voltage</p> <p>Section 3.3.1 (2): Review of Note</p> <p>Section 3.4.1 (4): Addition of description about electronic gear switching</p> <p>Section 3.4.3 (1)(a): Review of description for low voltage</p> <p>Section 3.5: Change in timing chart</p> <p>Section 3.5 3): Review of description</p> <p>Section 3.6.2 (7): Review of connection</p> <p>Section 3.9: Review of POINT</p> <p>Section 3.9 (3)(b),(c): Change in timing chart</p> <p>Section 3.9 (3)(d),(e): Addition</p> <p>Section 5.1.2 (2): Deletion of description as to parameter No. 22 TC, TLA</p> <p style="padding-left: 40px;">Addition of parameter No. 27 setting example</p> <p style="padding-left: 40px;">Correction of parameter No. 35 setting range</p> <p style="padding-left: 40px;">Review of parameter No. 47, 48 sentences</p> <p>Section 5.2.5: Correction of operation pattern diagram</p> <p>Section 6.2.2: Review of within one-revolution position sentence</p> <p>Section 6.3: Review of automatic VC offset description</p> <p>Section 6.6 (2)(a): Review of Note</p> <p>Section 6.8: Review of PL sentence</p> <p>Chapter 7: Addition of POINT</p> <p>Section 7.3.2 (1), (2): Review of sentence makeup</p> <p>Section 7.4: Addition</p> <p>Section 8.1.1: Addition</p> <p>Section 8.3.2: Addition</p> <p>Section 10.1.1 (1): Addition of Investigation item at power-on</p> <p>Section 10.1.2: Addition of Investigation item at power-on</p> <p style="padding-left: 40px;">Addition of Investigation item at on of ST1 or ST2</p> <p>Section 10.1.3: Addition of Investigation item at power-on</p> <p style="padding-left: 40px;">Addition of Investigation item at on of ST1 or ST2</p> <p>Section 10.2: Addition of POINT</p> <p>Section 10.2.2: Review of Cause of AL.10</p> <p style="padding-left: 40px;">Deletion of Cause 4 of AL.16</p> <p style="padding-left: 40px;">Review of Cause and Action of AL.24</p> <p style="padding-left: 40px;">Addition of description to AL.25</p>

Print data	*Manual number	Revision
Sep.,2000	SH(NA)030006-B	<p>Section 10.2.2: Addition of description to AL.30  Addition of Cause to AL.33</p> <p>Chapter 11: Changed to only outline dimensional drawing</p> <p>Section 11.2 (2): Addition</p> <p>Section 12.2 (1): Review of Note for Table 12.1</p> <p>Section 12.3: Correction of dynamic brake time constant graph</p> <p>Chapter 13: Deletion of MR-CPC98CBL3M communication cable</p> <p>Section 13.1.1 (4)(c): Review of outline drawing</p> <p>Section 13.1.2 (1): Deletion of MR-PWCNF power supply connector set</p> <p>Section 13.1.2 (1)1), 6): Change of encoder side connector models</p> <p>Section 13.1.2 (1)19), 20): Change of terminal models</p> <p>Section 13.1.2 (2)(a)2): Addition of description for fabrication</p> <p>Section 13.1.3: Addition of POINT</p> <p>Section 13.1.3 (4): Addition of cable length  Change in connection diagram</p> <p>Section 13.2.1 (1): Addition of Note for recommended wires</p> <p>Section 13.2.8 (1): Addition of leakage current to recommended filter</p> <p>Section 14.1.2 (2): Deletion of MR-CPC98CBL3M communication cable</p> <p>Section 14.11.1 (6): Addition</p> <p>Section 14.11.2 (8): Addition</p> <p>Section 15.7: Addition of POINT</p> <p>Section 15.8.1 (1)(b): Change in b) Coordinates when zero address is changed  to other than 0</p> <p>Section 15.8.2 (1)(b): Review of connection diagram</p> <p>Section 15.9: Change of display screen</p> <p>Section 15.10.1 (1): Deletion of Cause 5 of ABS checksum error</p>
Feb.,2001	SH(NA)030006-C	<p>Addition of MR-J2S-500A, 700A servo amplifiers</p> <p>Addition of HC-KFS73, HC-SFS502, HC-SFS702, HC-RFS353, HC-RFS503, HC-UFS502, HC-UFS353 servo motors</p> <p>Section 1.2: Function block diagram modification</p> <p>Section 1.7: Overall reexamination</p> <p>Section 3.7.1(2): Addition of single-phase 100 to 120VAC</p> <p>Section 3.7.2: Addition of regenerative brake converter and brake unit</p> <p>Section 5.1.2(2): No. 0, Item addition to regenerative brake option selection  No. 5, Example addition  No. 27, Setting range change  No. 49, AL.26 addition</p> <p>Section 5.2.2: Overall reexamination</p> <p>Section 7.4(1): Reexamination</p> <p>Chapter 8: Hierarchy reexamination</p> <p>Section 10.2.2: AL.30, Reexamination  AL.8E, Reexamination of Cause and Action</p> <p>Section 11.1(4)(5): Addition</p> <p>Section 11.2(3): Addition</p> <p>Section 12.1(3): Addition</p> <p>Chapter 13: Hierarchy reexamination</p> <p>Section 13.1.4(1): Connection diagram change  Cable addition</p> <p>Section 13.1.4(3): Reexamination</p> <p>Section 13.2.1(1): Connection diagram change  Wire table addition</p> <p>Chapter 15: Addition of Note on AL.25</p>