

General-Purpose AC Servo

MELSERVO-J2 Series

Built-In Positioning Function

MODEL

MR-J2-□C

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".



WARNING

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



CAUTION

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

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

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



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



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

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

After reading this installation guide, always keep it accessible to the operator.

1. To prevent electric shock, note the following:

WARNING

- Before wiring or inspection, switch power off and wait for more than 15 minutes. Then, confirm the voltage is safe with voltage tester. Otherwise, you may get an electric shock.
- Connect the servo amplifier and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed loaded, or pinched. Otherwise, you may get an electric shock.
- During power-on or operation, do not open the front cover of the servo amplifier. You may get an electric shock.
- Do not operate the servo amplifier with the front cover removed. High-voltage terminals and charging area are exposed and you may get an electric shock.
- Except for wiring or periodic inspection, do not remove the front cover even of the servo amplifier if the power is off. The servo amplifier is charged and you may get an electric shock.

2. To prevent fire, note the following:

CAUTION

- Do not install the servo amplifier, servo motor and regenerative 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.
- Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the servo amplifier heat sink, regenerative brake resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged.
- During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

4. Additional instructions

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

(1) Transportation and installation

CAUTION

- Transport the products correctly according to their weights.
- Stacking in excess of the specified number of products is not allowed.
- Do not carry the servo motor by the cables, shaft or encoder.
- Do not hold the front cover to transport the controller. The controller may drop.
- Install the servo amplifier in a weight-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.
- When you keep or use it, please fulfill the following environmental conditions.

Environment		Conditions		
		Servo Amplifier		Servo Motor
Ambient temperature	Operation	[°C]	0 to +55 (non-freezing)	0 to +40 (non-freezing)
		[°F]	32 to 131 (non-freezing)	32 to 104 (non-freezing)
	Storage	[°C]	−20 to +65 (non-freezing)	−15 to +70 (non-freezing)
		[°F]	−4 to 149 (non-freezing)	5 to 158 (non-freezing)
Ambient humidity	Operation	90%RH or less (non-condensing)		80%RH or less (non-condensing)
	Storage	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		
(Note) Vibration	[m/s ²]	5.9 {0.6G} or less	MC-MF series HU-UF13 to 73 HA-FF series	X • Y: 19.6
			HC-SF81 HC-RF series HC-SF52 to 152 HC-UF72 • 152 HC-SF53 to 153	X: 9.8 Y: 24.5
			HC-SF121 • 201 HC-SF203 • 353 HC-SF202 • 352 HC-UF202	X: 19.6 Y: 49
			HC-SF301	X: 11.7 Y: 29.4
			MC-MF series HU-UF13 to 73 HA-FF series	X • Y: 64
	[ft/s ²]	19.4 or less	HC-SF81 HC-RF series HC-SF52 to 152 HC-UF72 • 152 HC-SF53 to 153	X: 32 Y: 80
			HC-SF121 • 201 HC-SF203 • 353 HC-SF202 • 352 HC-UF202	X: 64 Y: 161
			HC-SF301	X: 38 Y: 96
			MC-MF series HU-UF13 to 73 HA-FF series	X • Y: 64
			HC-SF81 HC-RF series HC-SF52 to 152 HC-UF72 • 152 HC-SF53 to 153	X: 32 Y: 80

Note. Except the servo motor with reduction gear.

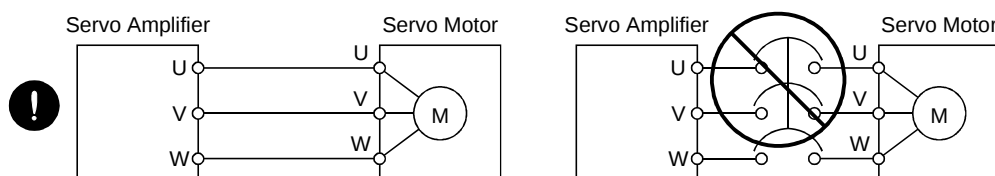
⚠ CAUTION

- 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.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.
- When the equipment has been stored for an extended period of time, consult Mitsubishi.

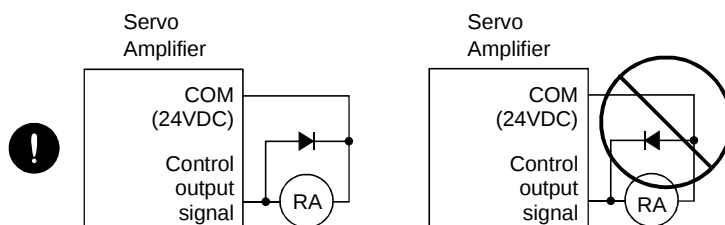
(2) Wiring

⚠ CAUTION

- Wire the equipment correctly and securely. Otherwise, the servo motor may misoperate.
- Do not install a power capacitor, surge absorber or radio noise filter (FR-BIF option) between the servo motor and servo amplifier.
- Connect the output terminals (U, V, W) correctly. Otherwise, the servo motor will operate improperly.
- Connect the servo motor power terminal (U, V, W) to the servo motor power input terminal (U, V, W) directly. Do not let a magnetic contactor, etc. intervene.



- Do not connect AC power directly to the servo motor. Otherwise, a fault may occur.
- The surge absorbing diode installed on the DC output signal relay must be wired in the specified direction. Otherwise, the forced stop (EMG) and other protective circuits may not operate.



(3) Test run adjustment



CAUTION

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

(4) Usage



CAUTION

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

(5) Corrective actions

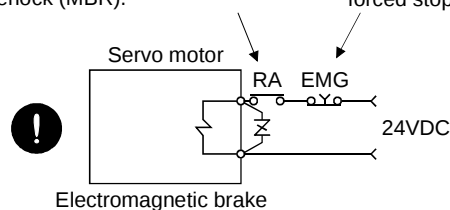


CAUTION

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

Contacts must be open when servo-on (SON) is off, when a trouble (ALM) is present and when an electromagnetic brake interlock (MBR).

Circuit must be opened during forced stop (EMG).



CAUTION

- 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) General instruction

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

● About processing of waste ●

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

FOR MAXIMUM SAFETY

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

EEPROM life

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

- Write to the EEPROM due to parameter setting changes
- Home position setting in the absolute position detection system
- Write to the EEPROM due to device changes
- Write to the EEPROM due to point table changes
- Execution of forced stop, shut off of main circuit power

Precautions for Choosing the Products

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

COMPLIANCE WITH EC DIRECTIVES

1. WHAT ARE EC DIRECTIVES?

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

(1) EMC Directive

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

(2) Low Voltage Directive

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

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

(3) Machinery Directive

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

2. PRECAUTIONS FOR COMPLIANCE

Use the standard model of servo amplifier and the EN Standard-compliant model of HC-MF/HA-FF or the standard model of HC-SF/HC-RF/HC-UF. In addition to the instructions provided in this Instruction Manual, also follow the instructions below. If the model is not specifically described to comply with the EN Standard in this Instruction Manual, it has the same specifications as those of the standard models:

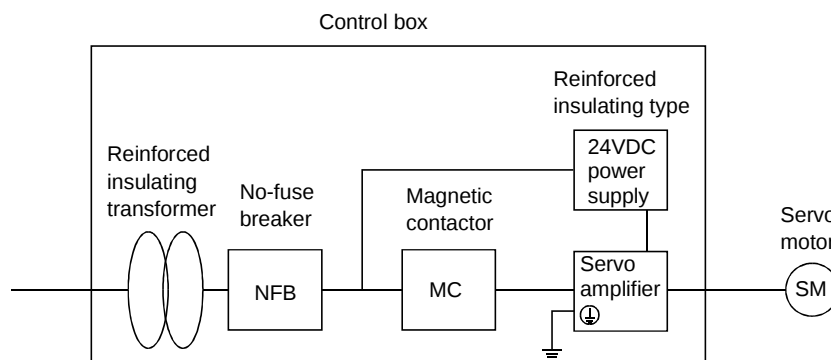
(1) Servo amplifiers and servo motors used

Use the following models of servo amplifiers and servo motors:

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

Servo motor series : HA-FF□-UE
HC-MF□(-UE)
HC-SF□
HC-RF□
HC-UF□

(2) Structure



(3) Environment

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

(4) Power supply

- (a) Operate the servo amplifier to meet the requirements of the overvoltage category II set forth in IEC60664-1. 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

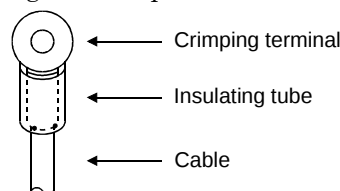
- (a) To prevent an electric shock, always connect the protective earth (PE) terminals (marked $\oplus$) of the servo amplifier to the protective earth (PE) of the control box.
- (b) Do not connect two ground cables to the same protective earth (PE) terminal as shown at right below. Always connect the cables to the terminals one-to-one.



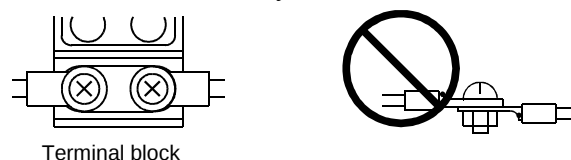
- (c) If a leakage current breaker is used to prevent an electric shock, the protective earth (PE) terminals of the servo amplifier must be connected to the corresponding earth terminals.

(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.



- (c) Use the servo motor side power connector which complies with the EN Standard. The EN Standard-compliant power connector sets are available from us as options.

(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 14.2.2.
- (b) The sizes of the cables described in Section 14.2.2 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 needed.

(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 way of dealing with the EMC Directive on servo amplifiers, refer to the "EMC INSTALLATION GUIDELINES(IB(NA)67310)".

CONFORMANCE WITH UL/C-UL STANDARD

(1) Servo amplifiers and servo motors used

Use the following models of servo amplifiers and servo motors:

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

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

(2) Installation

Install a fan of 100CFM (2.8m³/min) air flow 4in (10.16cm) above the servo amplifier or provide cooling of at least equivalent capability.

(3) Short circuit rating

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

(4) Capacitor discharge time

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

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

(5) Options and auxiliary equipment

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

(6) Attachment of a servo motor

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

(7) About wiring protection

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

About the Manuals

This Servo Amplifier Instruction Manual and the MELSERVO Servo Motor Instruction Manual are required if you use the MELSERVO-J2-C for the first time. Always purchase them and use the MELSERVO-J2-C safely.

Relevant Manual

Manual Name	Manual No.
MELSERVO-J2-C Installation Guide	IB(NA)67367
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

3. CONNECTORS USED FOR SERVO MOTOR WIRING

4. INSPECTION

5. SPECIFICATIONS

6. CHARACTERISTICS

7. OUTLINE DIMENSION DRAWINGS

8. CALCULATION METHOD FOR DESIGN

1. FUNCTIONS AND CONFIGURATION

1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The MR-J2-C AC servo amplifier with built-in positioning functions is the MR-J2-A general-purpose AC servo amplifier which incorporate single-axis positioning functions. These functions perform positioning operation by merely setting the position data (target positions), servo motor speeds, acceleration and deceleration time constants, etc. to point tables as if setting them in parameters. The servo amplifier is the most appropriate to configure a program-free, simple positioning system or to simplify a system, for example.

There are 3 points of point tables as standard, and they can be increased up to 15 points by using the optional set-up software.

You can choose a configuration suitable for your purpose, e.g. simple positioning system using external I/O signals (DI/O), operation using DI/O and RS-422 serial communication, or multi drop operation using RS-422 serial communication.

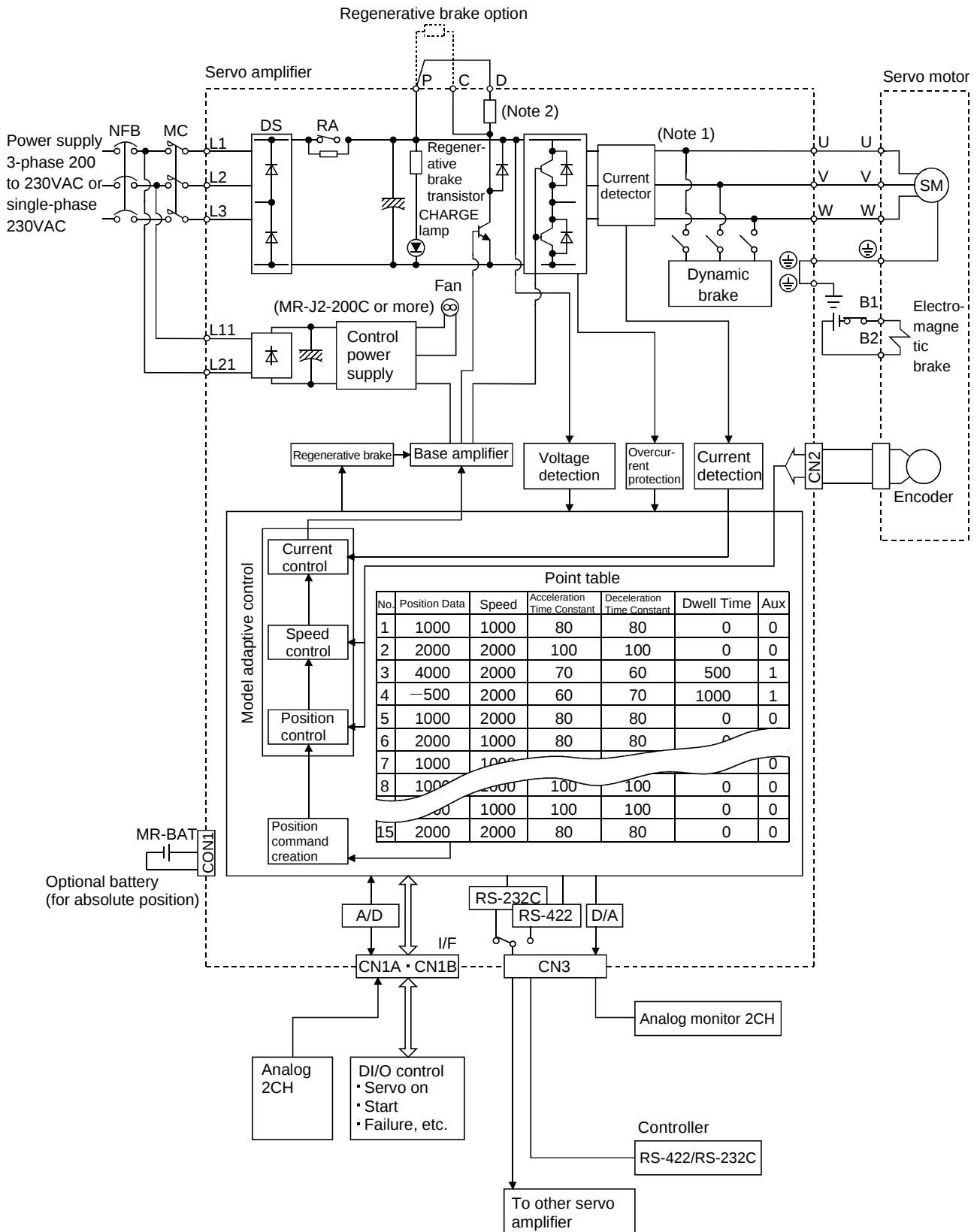
All servo motors are equipped with an absolute position encoder as standard. An absolute position detection system can be configured by merely adding a battery to the servo amplifier. Once the home position has been set, home position return is not required at power on, alarm occurrence, etc.

The MR-J2-C AC servo amplifier with positioning function is made easier to use and higher in function by using it with the set-up software.

1. FUNCTIONS AND CONFIGURATION

1.1.1 Function block diagram

The function block diagram of this servo is shown below.



Note: 1. There is no wiring to the U phase for the MR-J2-100C or less.

2. The built-in regenerative brake resistor is not provided for the MR-J2-10C.

1. FUNCTIONS AND CONFIGURATION

1.1.2 System configuration

This section describes operations using the MELSERVO-J2-C.

You can arrange any configurations from a single-axis to max. 32-axis systems. Further, the connector pins in the interface section allow you to assign the optimum signals to respective systems. (Refer to Sections 1.1.3 and 3.3.3.) The Set-up Software (refer to Chapter 6) and personal computer are required to change or assign devices.

Set the following values to the point table:

Name	Setting Range	Unit
Position data	–999999 to 999999	×0.001[mm] × 0.01[mm] × 0.1[mm] × 1[mm]
Servo motor speed	0 to max. speed	[r/min]
Acceleration time constant	0 to 20000	[ms]
Deceleration time constant	0 to 20000	[ms]
Dwell time	0 to 20000	[ms]
Auxiliary function	0 • 1	0: 1-point automatic operation 1: Automatic continuous operation

(1) Operation using external input signals

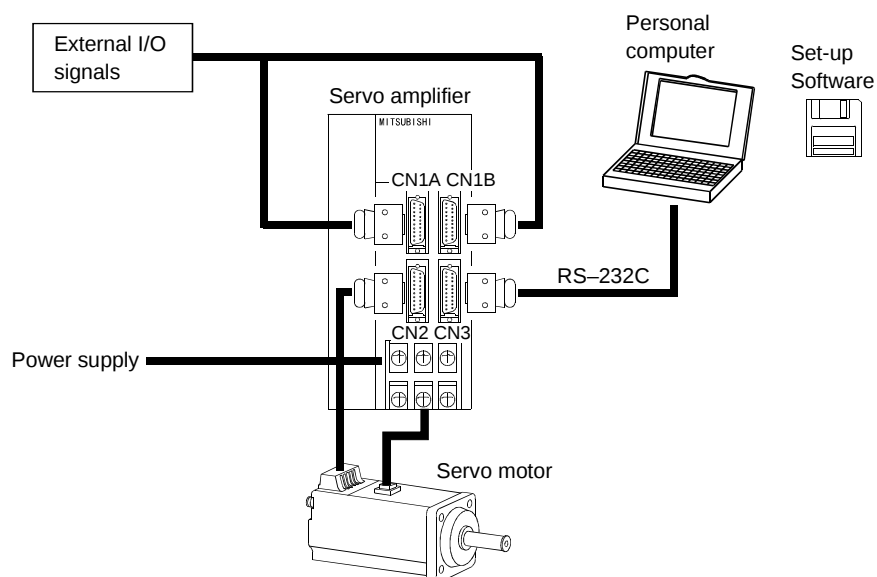
(a) Description

The following configuration example assumes that external input signals are used to control all signals (devices).

The I/O signals are as factory-set.

(b) Configuration

The following configuration uses external I/O signals. The personal computer is used with the Set-up Software to set, change and monitor the parameters and point tables.



1. FUNCTIONS AND CONFIGURATION

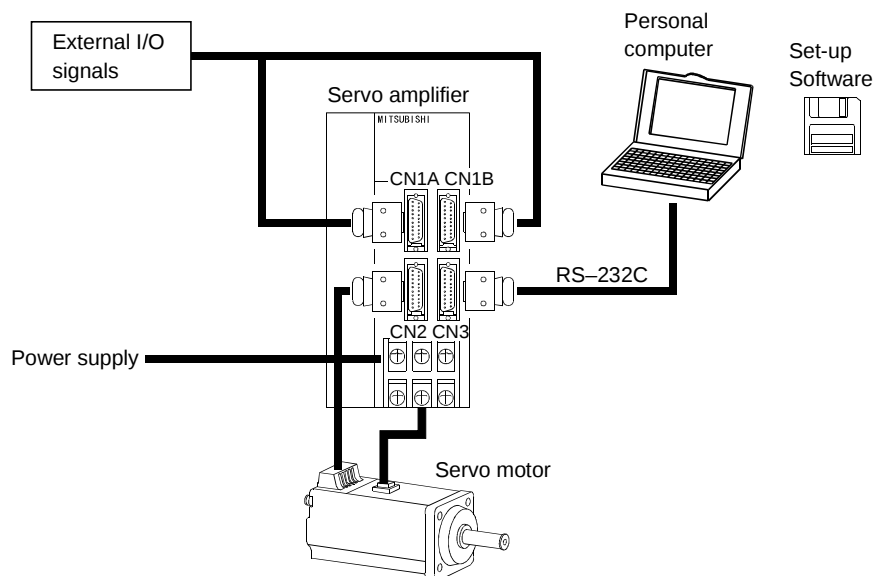
(2) Operation using external input signals and communication

(a) Description

Communication can be used to change the point table data, choose the point table, change parameter values, and confirm monitor data, for example. Enter a forward rotation start (ST1) or reverse rotation start (ST2) through the external I/O. Use this system when position data/speed setting or the host personal computer or the like is used to change the parameter values, for example.

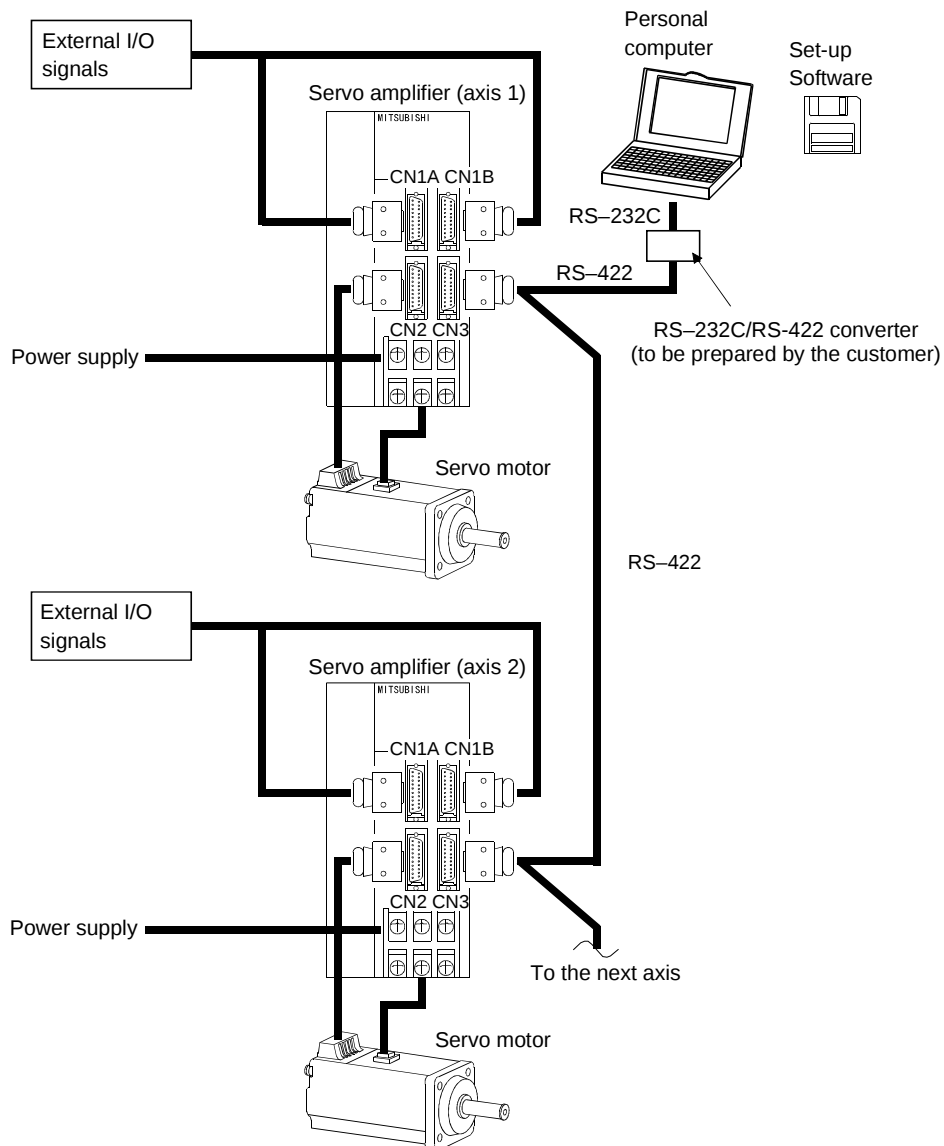
(b) Configuration

- 1) One servo amplifier is connected with the personal computer by RS-232C.



1. FUNCTIONS AND CONFIGURATION

- 2) Several (up to 32) servo amplifiers are connected with the personal computer by RS-422. Use parameter No. 16 to change the communication system.



1. FUNCTIONS AND CONFIGURATION

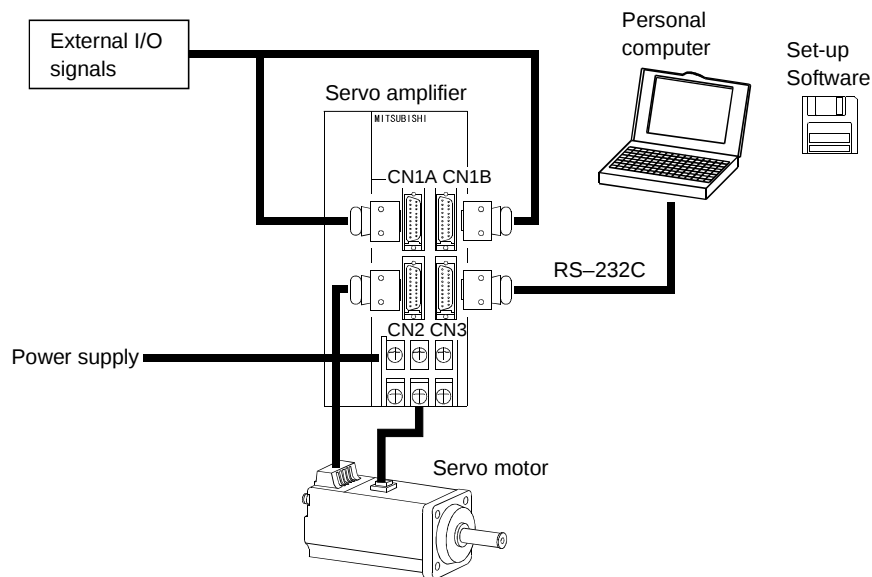
(3) Operation using communication

(a) Description

Analog input, forced stop (EMG) and other signals are controlled by external I/O signals and the other devices controlled through communication. Also, you can set each point table, choose the point table, and change or set parameter values, for example. Up to 32 axes may be controlled.

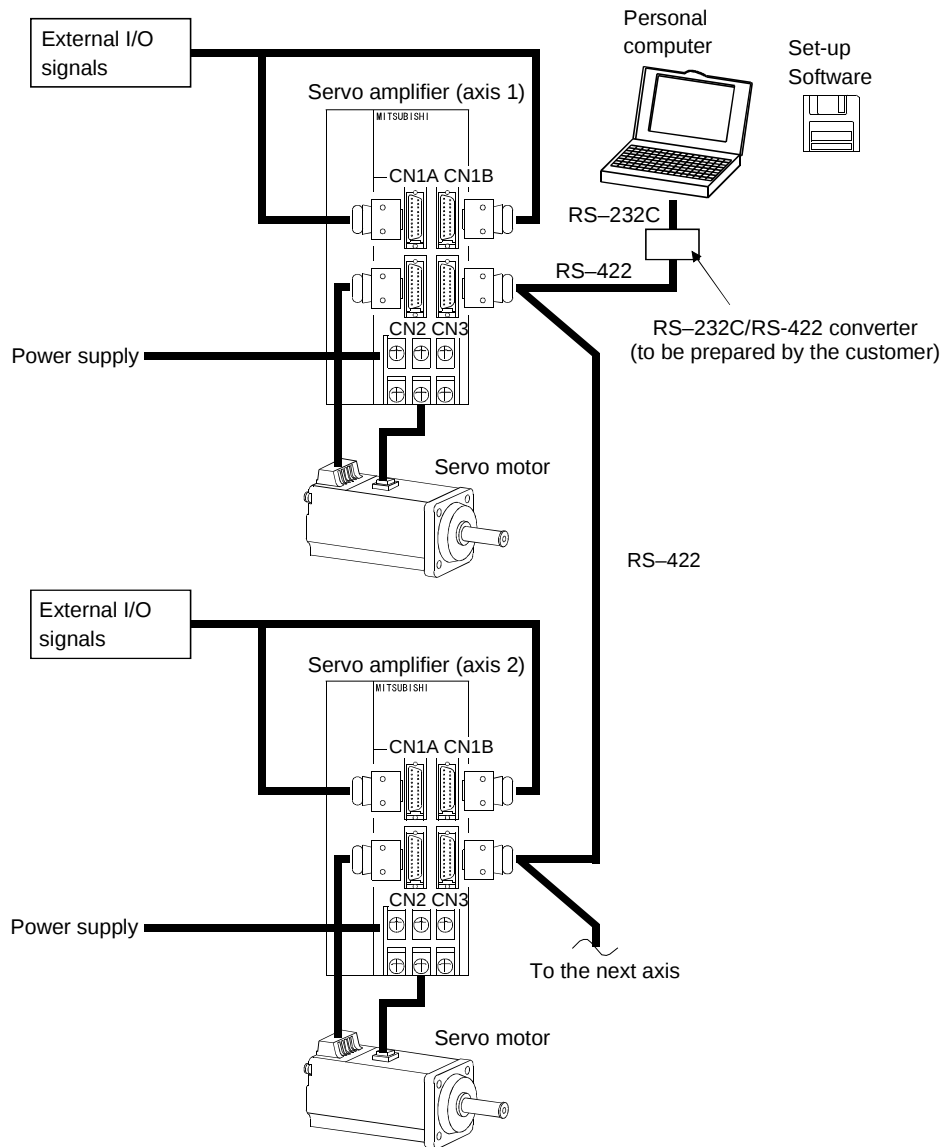
(b) Configuration

- 1) One servo amplifier is connected with the personal computer by RS-232C.



1. FUNCTIONS AND CONFIGURATION

- 2) Several (up to 32) servo amplifiers are connected with the personal computer by RS-422. Use parameter No. 16 to change the communication system.



1. FUNCTIONS AND CONFIGURATION

1.1.3 I/O devices

The MELSERVO-J2-C allows devices to be allocated to the pins of connector CN1A/CN1B as desired. The following devices can be allocated. For device details, refer to Section 3.3.3.

Input Device	Symbol	Factory-Allocated Pin
Proximity dog	DOG	CN1A-8
Servo-on	SON	CN1B-15
Forward rotation stroke end	LSP	CN1B-16
Reverse rotation stroke end	LSN	CN1B-17
Forward rotation start	ST1	CN1B-8
Reverse rotation start	ST2	CN1B-9
Automatic/manual selection	MDO	CN1B-7
Point table No. selection 1	DI0	CN1B-5
Point table No. selection 2	DI1	CN1B-14
Point table No. selection 3	DI2	
Point table No. selection 4	DI3	
Forced stop	EMG	
Reset	RES	
Override selection	OVR	
External torque limit selection	TL	
Internal torque limit selection	TL2	
Proportion control	PC	
Temporary stop/restart	STP	
Manual pulse generator multiplication 1	TP0	
Manual pulse generator multiplication 2	TP1	

Output Device	Symbol	Factory-Allocated Pin
Home position return completion	ZP	CN1A-18
Rough match	CPO	CN1B-4
In position	INP	CN1B-6
Trouble	ALM	CN1B-18
Ready	RD	CN1B-19
Electromagnetic brake interlock	MBR	
Position range output	POT	
Warning output	WNG	
Battery warning output	BWNG	
Limiting torque	TLC	
Temporary stop	PUS	

1. FUNCTIONS AND CONFIGURATION

1.2 Function list

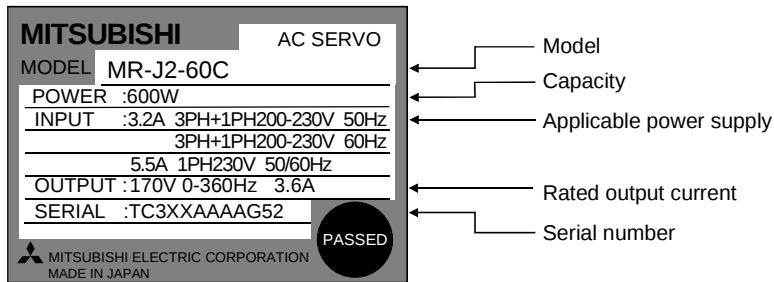
The following table lists the functions of the MELSERVO-J2-C. For details of the functions, refer to the reference field.

Function	Description	Reference
Positioning by automatic operation	Select the required ones from among 15 preset point tables (moving distance, speed, acceleration time constant, deceleration time constant, auxiliary function) and perform operation in accordance with the set values. Use the external input signal or communication function to choose the point tables.	Section 4.2
Varied speed operation	Servo motor speed can be varied continuously until the preset moving distance is reached. (Max. set speeds: 15 speeds)	Section 4.2.5 (2)
Automatic continuous positioning operation	By merely choosing one point table and starting operation, positioning can be executed continuously in accordance with several point tables.	Section 4.2.5 (1)
Manual home position return	Dog type, count type, data setting type, stopper type, home position ignorance	Section 4.4
Multidrop communication	Up to 32 axes of MR-J2-C are controllable simultaneously by RS-422 communication.	Section 4.6.3 Chapter 8
Absolute position detection system	By merely setting the home position once, home position return need not be done at each power on.	Section 4.5
Slight vibration suppression control	Vibration of ± 1 pulse at servo motor stop is suppressed.	Section 9.5
Electronic gear	The electronic gear is used to make adjustment so that the servo amplifier setting matches the machine moving distance. Also, changing the electronic gear value allows the machine to be moved at any multiplication ratio to the moving distance using the servo amplifier.	Section 5.2.1
Real-time auto tuning	The servo gain is automatically adjusted to the optimum value at each start/stop.	Section 9.4
Manual gain adjustment	The gain is manually adjustable if the gain could not be adjusted to the ideal value by real-time auto tuning.	Section 9.2
S-pattern acceleration/deceleration time constant	Acceleration/deceleration can be made smoothly.	Section 5.2.3
Analog monitor output	The servo status is output in terms of voltage in real time.	Section 5.2.4
Alarm history	By using the Set-up Software, the current alarm and five past alarm numbers are stored and displayed.	Section 6.8
I/O signal selection (Device setting)	By using the Set-up Software, any devices can be assigned to 9 input, 5 output and 1 I/O pins.	Section 6.6
Torque limit	Servo motor-torque is limited. Parameter $\times 2$ limit value Analog input $\times 1$ limit value	Section 3.2.5
Override (speed limit)	The servo motor speed is limited by analog input. The ratio of override to the set speed can be changed between 0 to 200%.	Section 3.2.4
Status display	The servo status is displayed. The servo amplifier display can show up to 7 types or 15 types when the Set-up Software is used.	Section 7.2
Test operation mode	Jog operation, positioning operation, motor-less operation, DO forced output, 1-step feed	Section 6.7
Limit switch	The servo motor travel region can be limited using the forward rotation stroke end (LSP)/reverse rotation stroke end (LSN).	Section 5.2.5
Software limit	The travel region is limited using parameters in terms of address. The function similar to that of a limit switch is limited by software.	Section 5.2.9

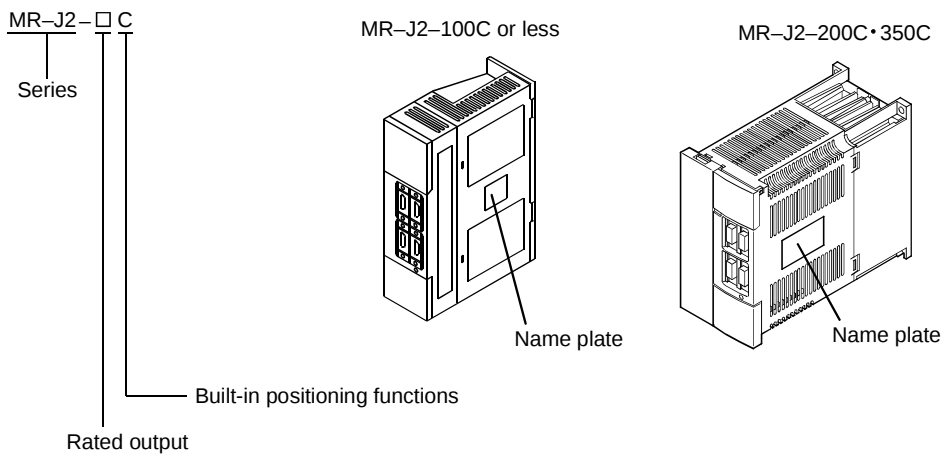
1. FUNCTIONS AND CONFIGURATION

1.3 Model name make-up

(1) Name plate



(2) Model



Symbol	Rated output [W]	Symbol	Rated output [W]
10	100	70	750
20	200	100	1000
40	400	200	2000
60	600	350	3500

1.4 Combination with servo motor

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

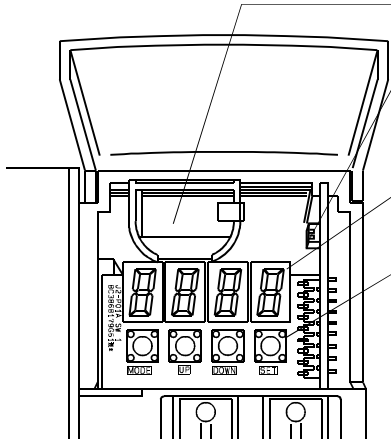
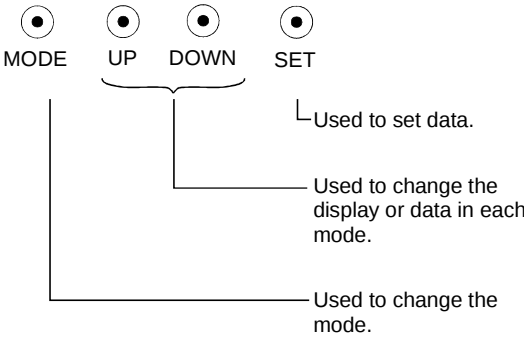
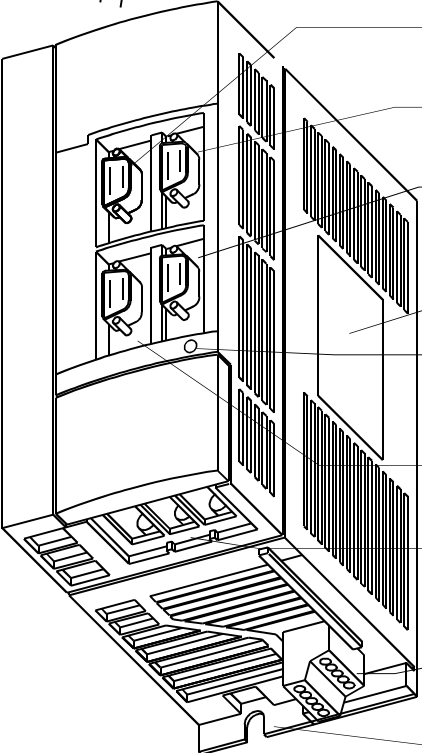
Servo Amplifier	Servo Motors							
	HC-MF□	HA-FF□	HC-SF□ (Note)			HC-RF□	HC-UF□ (Note)	
			1000r/min	2000r/min	3000r/min		2000r/min	3000r/min
MR-J2-10C	053 • 13	053 • 13						13
MR-J2-20C	23	23						23
MR-J2-40C	43	33 • 43						43
MR-J2-60C		63		52	53			
MR-J2-70C	73						72	73
MR-J2-100C			81	102	103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

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

1. FUNCTIONS AND CONFIGURATION

1.5 Parts identification

(1) MR-J2-100C or less

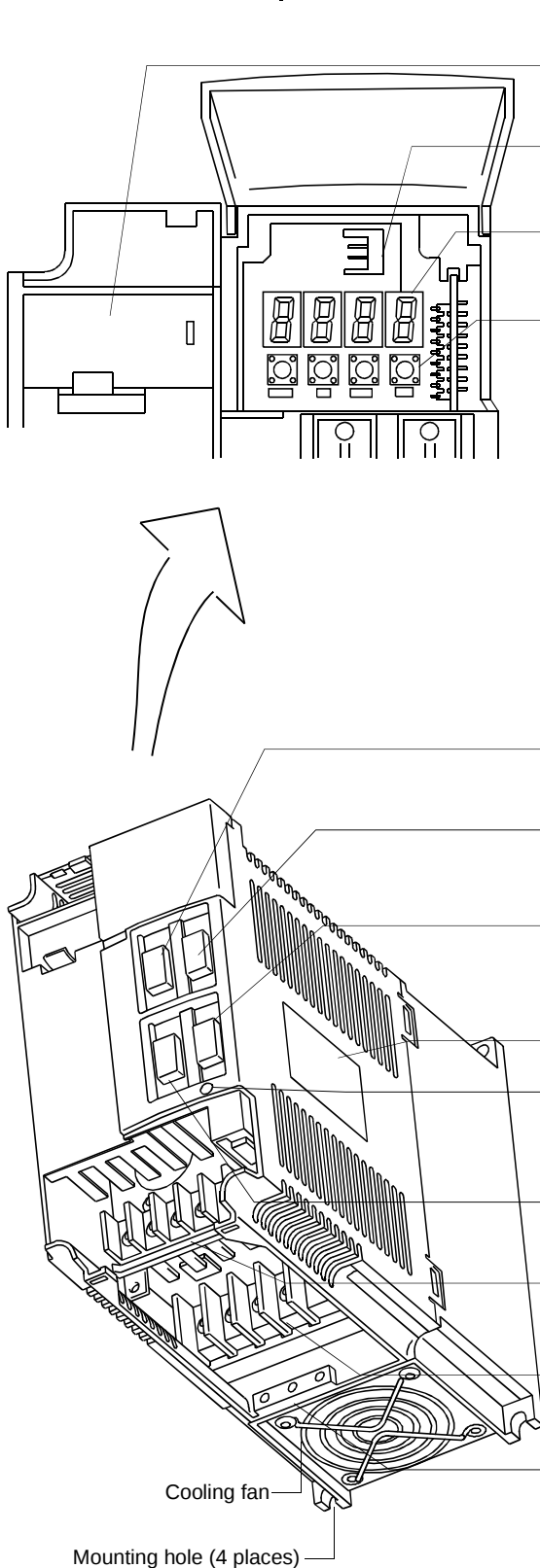
	Name/Application	Reference
	Battery holder Contains the battery for absolute position data backup.	Section4.5
	Battery connector (CON1) Used to connect the battery for absolute position data backup.	Section4.5
	Display The four-digit, seven-segment LED shows the servo status and alarm number.	Chapter7
	Operation section Used to perform status display, diagnostic, alarm and parameter and point table setting operations.  MODE UP DOWN SET Used to set data. Used to change the display or data in each mode. Used to change the mode.	Chapter7
	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.	Chapter6 Chapter8 Section14.1.2
	Name plate	Section1.3
	Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
	Encoder connector (CN2) Connector for connection of the servo motor encoder.	Section3.3 Section14.1.2
	Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section3.7.2
	Control circuit terminal block (TE2) Used to connect the control circuit power supply and regenerative brake option.	Section3.7.2 Section14.1.1
	Protective earth (PE) terminal (⊕) Ground terminal.	Section3.10

1. FUNCTIONS AND CONFIGURATION

(2) MR-J2-200C or more

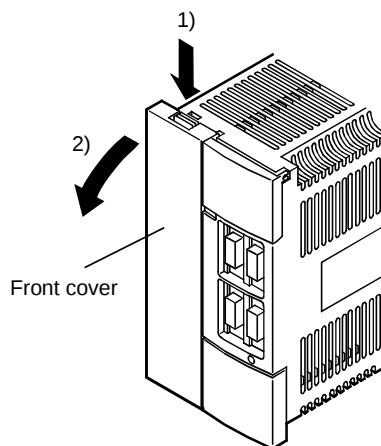
POINT

- This diagram shows the unit from which the front cover has been removed. Refer to the next page for removal of the front cover.

	Name/Application	Reference
	Battery holder Contains the battery for absolute position data backup.	Section4.5
	Battery connector (CON1) Used to connect the battery for absolute position data backup.	Section4.5
	Display The four-digit, seven-segment LED shows the servo status and alarm number.	Chapter7
	Operation section Used to perform status display, diagnostic, alarm and parameter and point table setting operations.  MODE  UP  DOWN  SET └ Used to set data. └ Used to change the display or data in each mode. └ Used to change the mode.	Chapter7
	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.	Chapter6 Chapter8 Section14.1.2
	Name plate	Section1.3
	Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
	Encoder connector (CN2) Connector for connection of the servo motor encoder.	Section3.3 Section14.1.2
	Main circuit terminal block (TE1) Used to connect the input power supply and servo motor.	Section3.2.1
	Control circuit terminal block (TE2) Used to connect the control circuit power supply and regenerative brake option.	Section3.2.1 Section14.1.1
	Protective earth (PE) terminal (⌚) Ground terminal.	Section3.10

1. FUNCTIONS AND CONFIGURATION

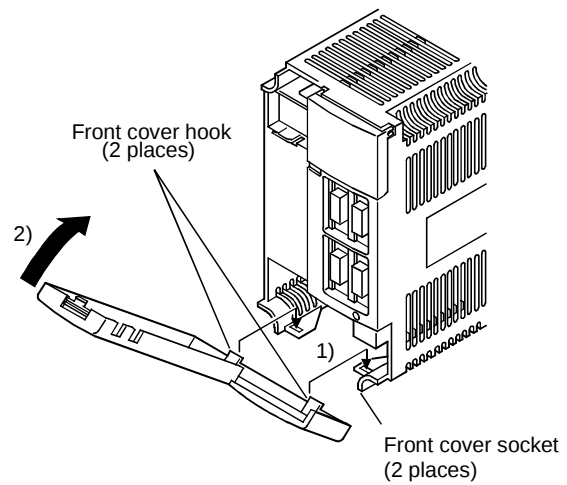
Removal of the front cover



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

1.6 Servo system with auxiliary equipment



WARNING

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.

(1) MR-J2-100C or less

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

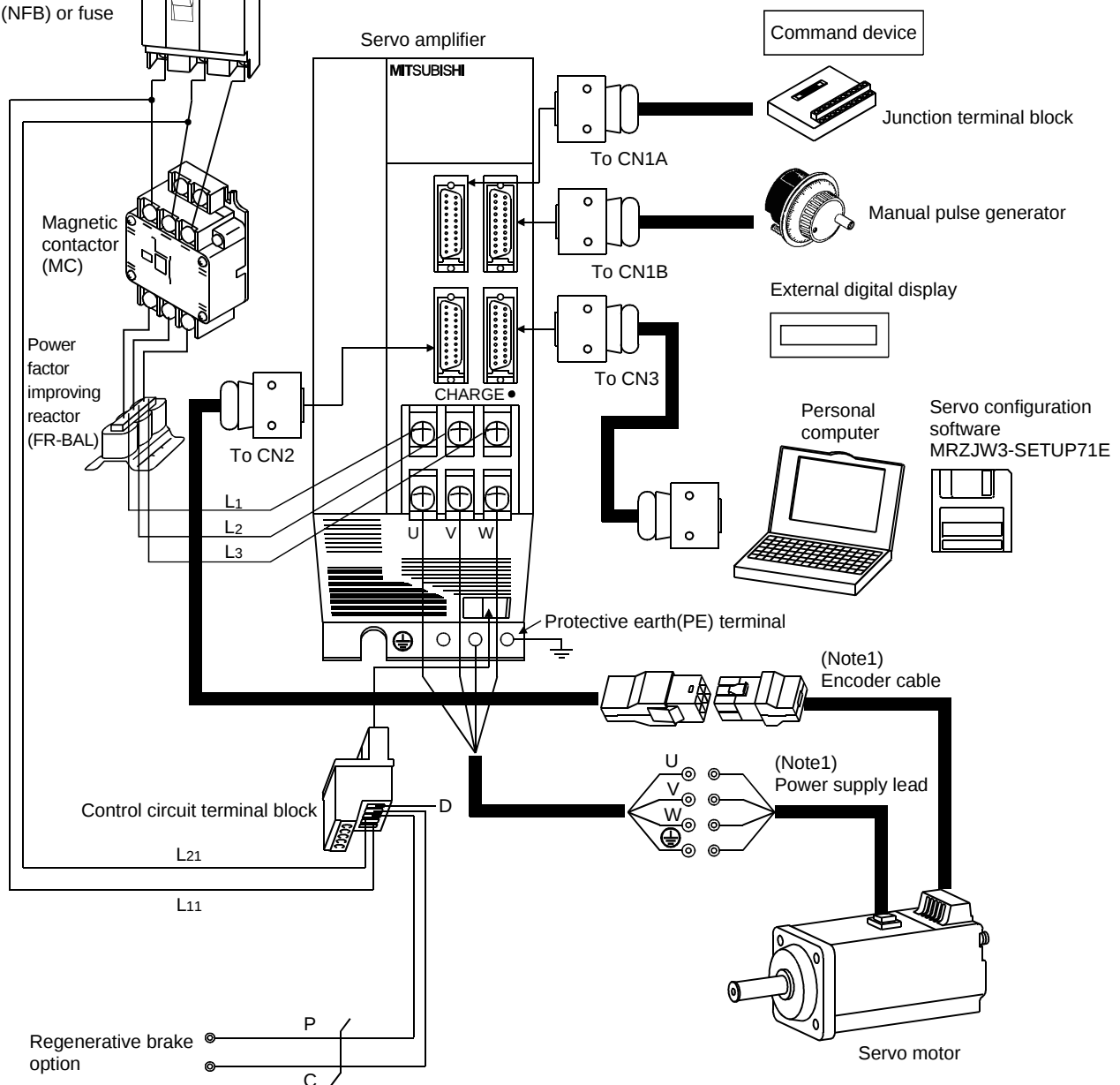
No-fuse breaker
(NFB) or fuse

Magnetic
contactor
(MC)

Power factor
improving
reactor
(FR-BAL)

Options and Auxiliary Equipment	Reference
No-fuse breaker	Section 14.2.2
Magnetic contactor	Section 14.2.2
Set-up software	Chapter 6
Regenerative brake option	Section 14.1.1

Options and Auxiliary Equipment	Reference
Cables	Section 14.2.1
Manual pulse generator	Section 14.1.6
External digital display	Section 14.1.5
Power factor improving reactor	Section 14.2.3

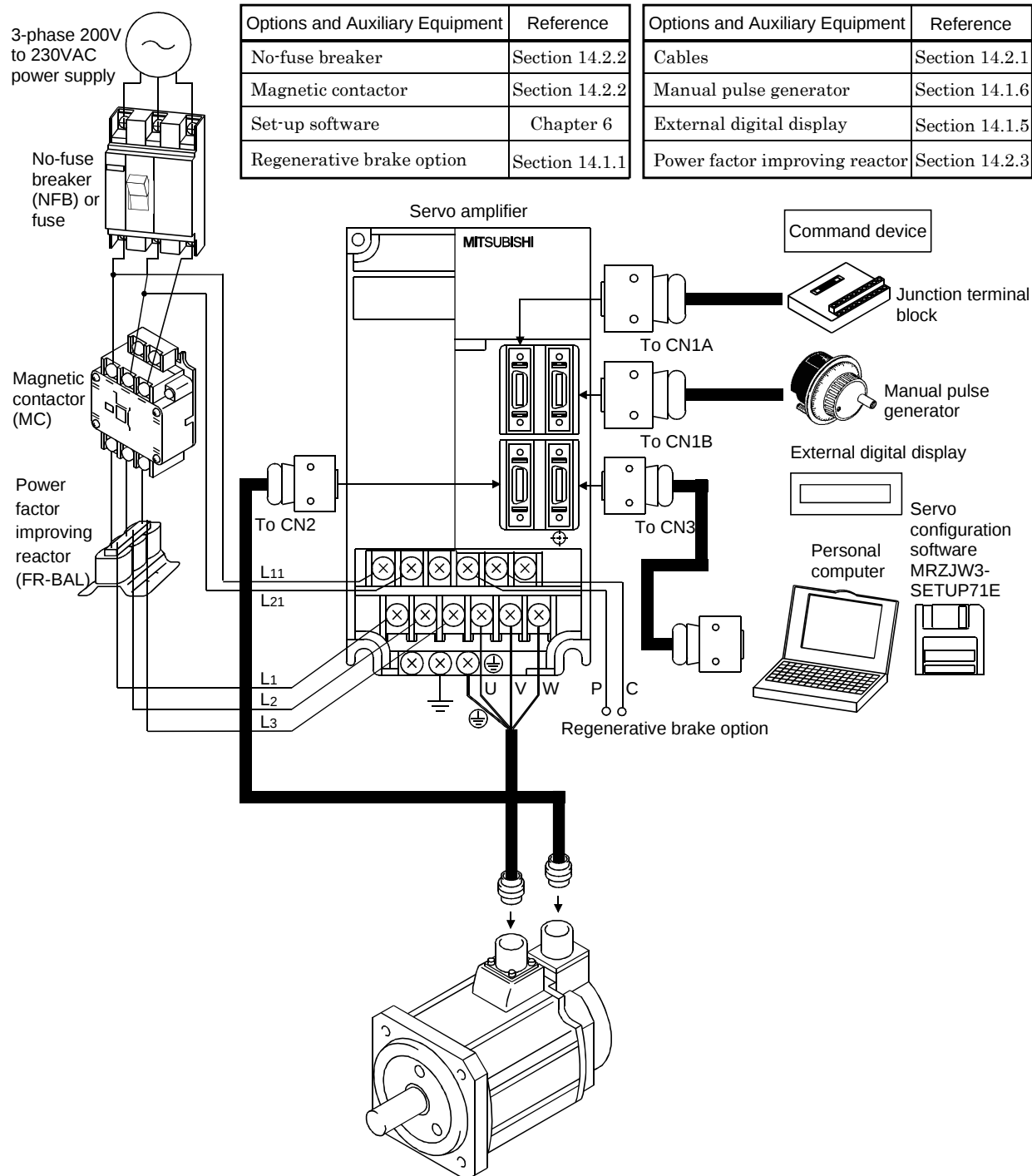


Note: 1. The HA-FF-UE, HC-SF, HC-RF series have cannon connectors.

2. A 1-phase 230VAC power supply may be used with the servo amplifier of J2-70C or less. Connect the power supply to L1 and L2 terminals and leave L3 open.

1. FUNCTIONS AND CONFIGURATION

(2) MR-J2-200C or more



This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

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.
- When treating the servo amplifier, be careful about the edged parts such as the corners of the servo amplifier.

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 ²]	5.9 [m/s ²] or less	
	[ft/s ²]	19.4 [ft/s ²] or less	

2. INSTALLATION

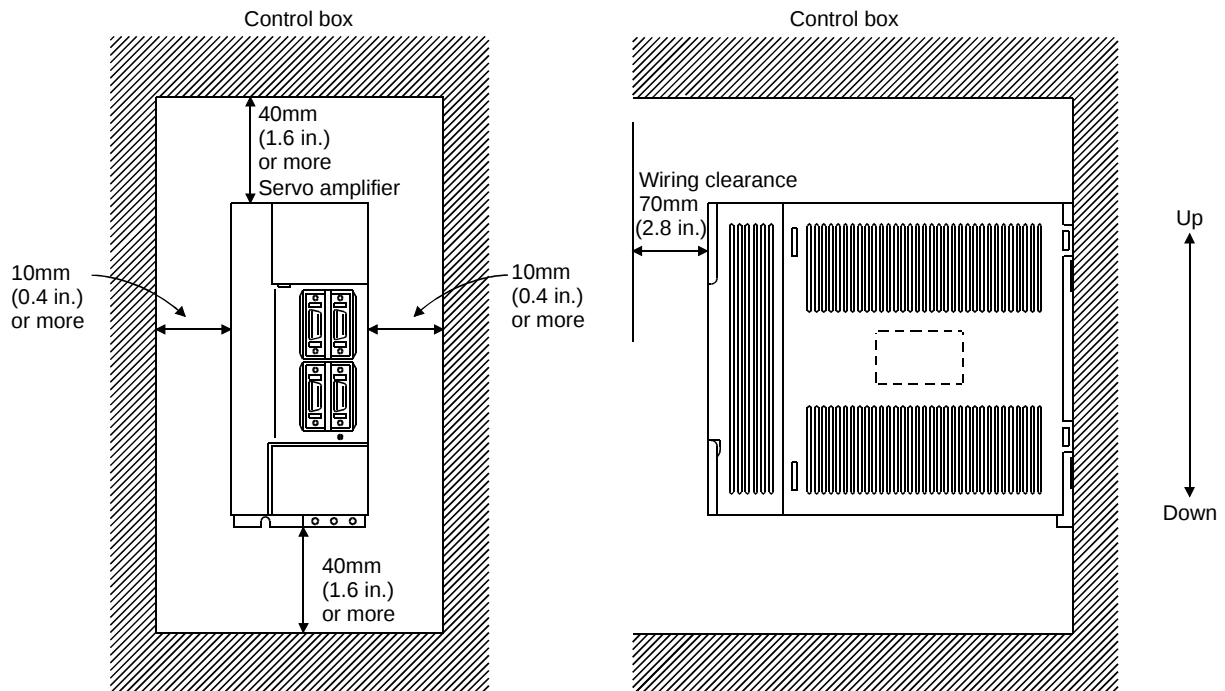
2.2 Installation direction and clearances



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.

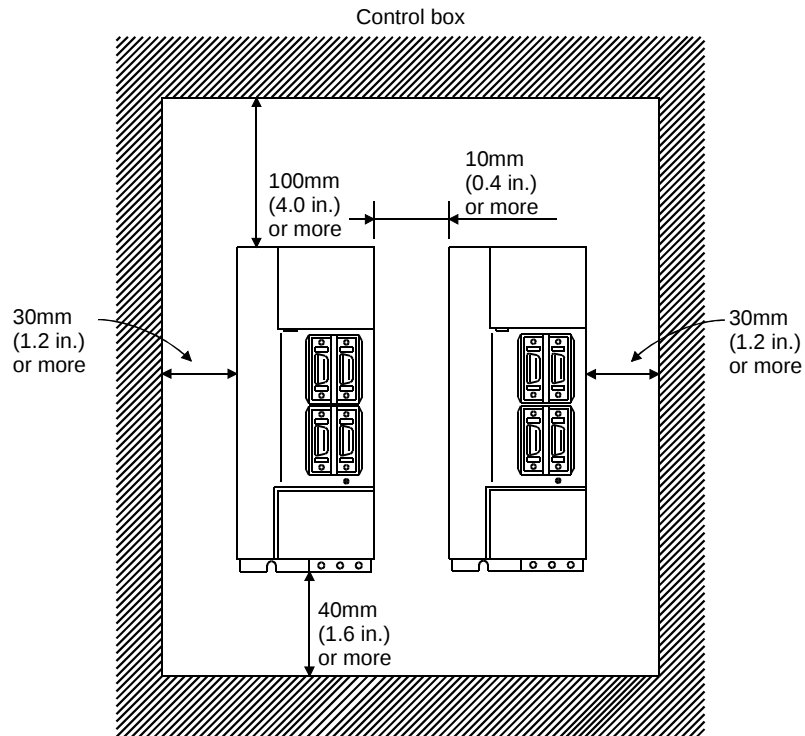
(1) Installation of one servo amplifier



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 much toxic gas, dirt and dust, conduct an air purge (force clean air into the control box from outside to make the internal pressure higher than the external pressure) to prevent such materials from entering the control box.

2. 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) For use in any application where the servo motor moves, fix the cables (encoder, power supply, brake) supplied with the servo motor, and flex the optional encoder cable or the power supply and brake wiring cables. Use the optional encoder cable within the flexing life range. Use the power supply and brake wiring cables within the flexing life of the cables.
- (3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.
- (4) The flexing lives of the cables are shown below. In actuality, provide a little allowance for these values. For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to Section 13.4 for the flexing life.

3. SIGNALS AND WIRING

3. SIGNALS AND WIRING



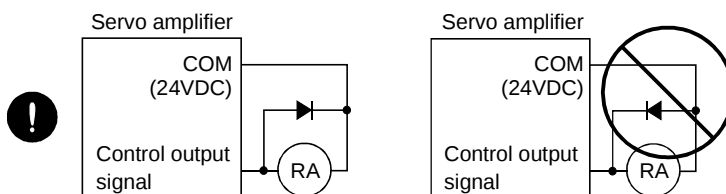
WARNING

- Any person who is involved in wiring should be fully competent to do the work.
- Before starting wiring, make sure that the voltage is safe in the tester more than 15 minutes after power-off. 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 forced stop (EMG) and other protective circuits.



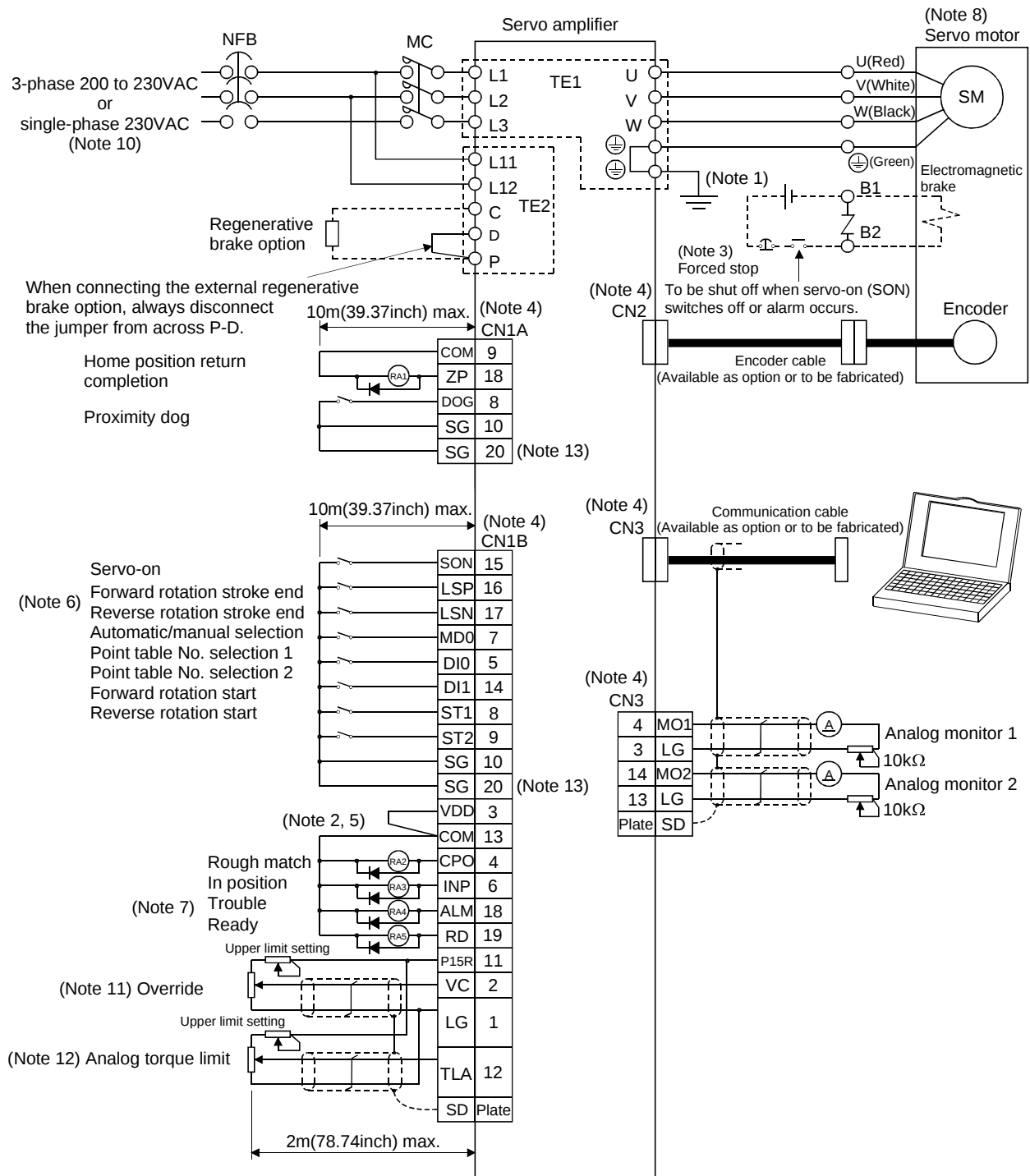
- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the servo amplifier.
- Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) with the power line of the servo motor.
- When using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

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



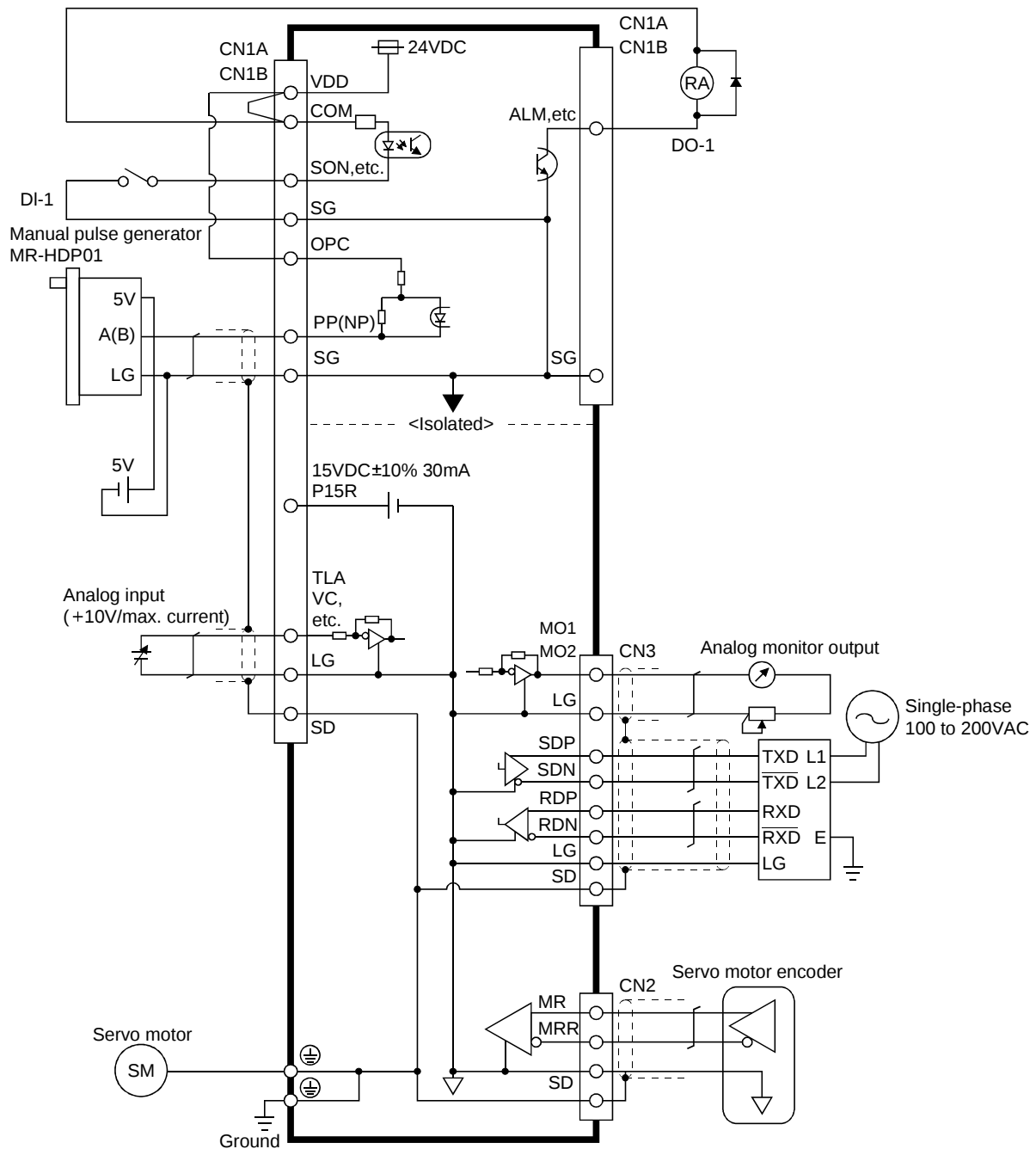
3. SIGNALS AND WIRING

- 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. 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 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.
 6. When starting operation, always connect the forward/reverse rotation stroke end (LSN/LSP) with SG. (Normally closed contacts)
 7. Trouble (ALM) is connected with COM in normal alarm-free condition.
 8. The connection method changes with the servo motor series.
Refer to Section 3.3.
 9. The pins with the same signal name are connected in the servo amplifier.
 10. A single-phase 230V power supply may be used with the servo amplifier of MR-J2-70C or less. However, it cannot be used when the servo amplifier is combined with the HC-SF52/53 servo motor. Connect the power supply to L1 and L2 terminals and leave L3 open.
 11. When using override (VC), make the override selection (OVR) device available.
 12. When using analog torque limit (TLA), make the external torque limit selection (TL) devices available.
 13. Connect to CN1A-10 when using the junction terminal block (MR-TB20).

3. SIGNALS AND WIRING

3.2 Common line

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



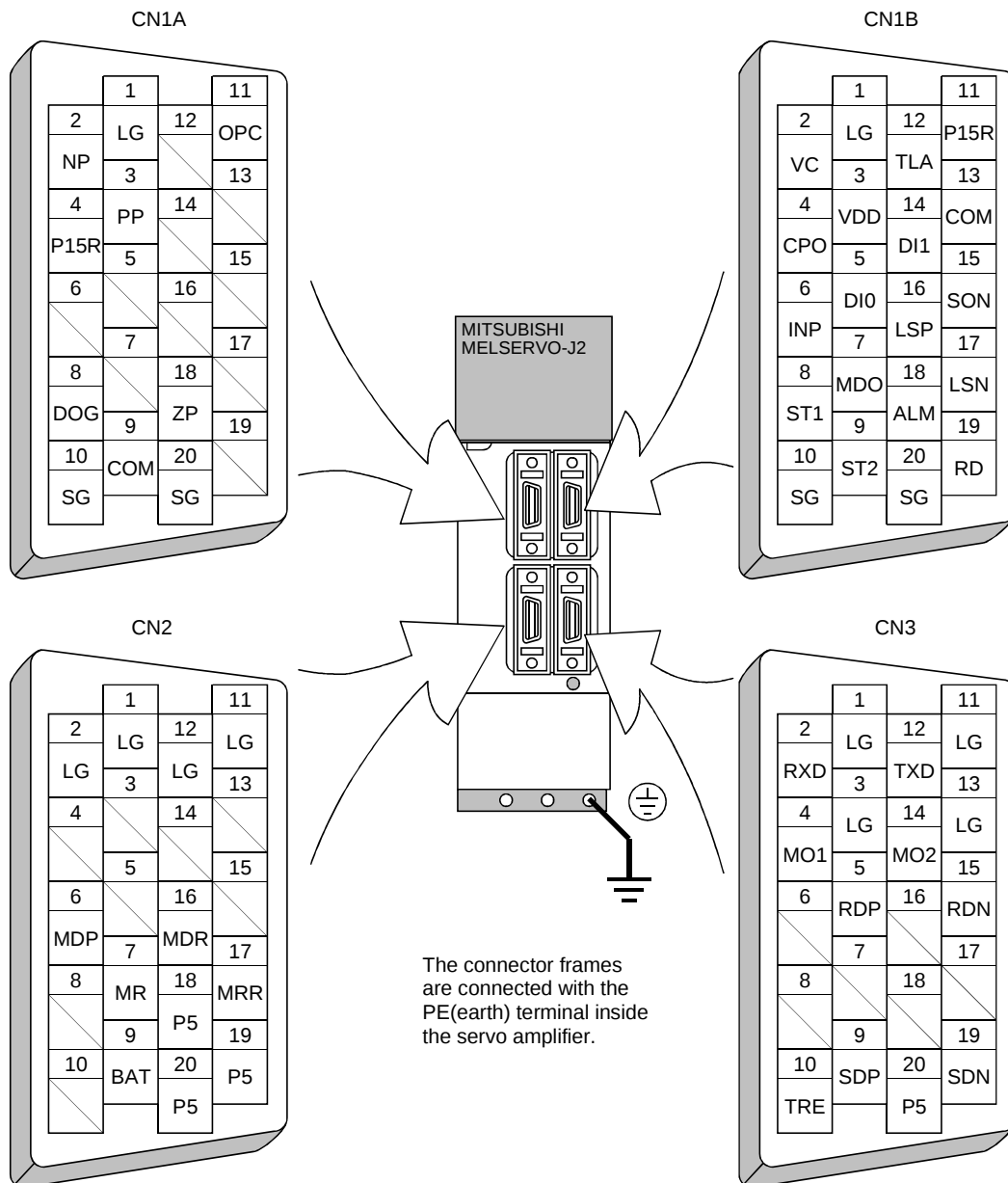
3. SIGNALS AND WIRING

3.3 I/O signals

3.3.1 Connectors and signal arrangements

POINT

- The pin configurations of the connectors are as viewed from the cable connector wiring section.
- For assignment of the CN1A and CN1B signals, refer to the next page.



3. SIGNALS AND WIRING

3.3.2 Signal explanations

1) CN1A

Signal Name	Symbol	Pin No.	Description	I/O Division						
Digital I/F power supply input	COM	9	Used to input 24VDC (200mA or more) for input interface. Connect the positive (+) terminal of the 24VDC external power supply. 24VDC±10%							
Open collector power input	OPC	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	10, 20	Common terminal for input signals such as SON and EMG. Pins are connected internally. Separated from LG.							
15VDC power supply	P15R	4	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA							
Control common	LG	1	Common terminal for TLA, VC, OP ,MO1, MO2 and P15R. Pins are connected internally.							
Manual pulse generator	PP	3	Used to connect the manual pulse generator (MR-HDP01). (Refer to Section 14.1.6.)							
	NP	2								
Proximity dog	DOG	8	When terminals DOG-SG are shorted, the proximity dog (DOG) is detected. The polarity of dog detection input can be changed with the parameter. <table border="1"><thead><tr><th>Parameter No.8</th><th>Polarity of Proximity Dog Detection Input</th></tr></thead><tbody><tr><td>☐ 0☐ (initial value)</td><td>DOG-SG are opened.</td></tr><tr><td>☐ 1☐</td><td>DOG-SG are shorted.</td></tr></tbody></table>	Parameter No.8	Polarity of Proximity Dog Detection Input	☐ 0 ☐ (initial value)	DOG-SG are opened.	☐ 1 ☐	DOG-SG are shorted.	DI-1
Parameter No.8	Polarity of Proximity Dog Detection Input									
☐ 0 ☐ (initial value)	DOG-SG are opened.									
☐ 1 ☐	DOG-SG are shorted.									
Home position return completion	ZP	18	ZP-SG are connected on completion of home position return. In the absolute position system, ZP-SG are connected when the servo amplifier is ready to operate but are disconnected if: 1) SON-SG are opened; 2) EMG-SG are opened; 3) RES-SG are shorted; 4) Alarm occurs; 5) Limit switch opens; 6) Home position return has not been made after the purchase of the product; 7) Home position return has not been made after the occurrence of absolute position erasure (A. 25) or absolute position counter warning (A. E3); 8) Home position return has not been made after the changing of the electronic gear value; 9) Home position return has not been made after the absolute position system was made valid; or 10) The ST1 coordinate system (000 ☐ in parameter No.1) has been changed. When the status is not any of 1) to 10) and home position setting has already been completed at least once, the home position return completion (ZP) is in the same output status as the ready (RD).	DO-1						
		19	In the initial status, devices have not yet been assigned. You can assign I/O devices using the Servo Configuration software.	DI-1 DO-1						
Shield	SD	Plate	Connect the external conductor of the shield cable.							

3. SIGNALS AND WIRING

2) CN1B

Signal Name	Symbol	Pin No.	Description	I/O Division																								
I/F Internal power supply	VDD	3	Used to output +24V±10% to across VDD-COM. When using this power supply for digital interface, connect it with COM. Permissible current: 80mA																									
Digital I/F power supply input	COM	13	Used to input 24VDC (200mA or more) for input interface. Connect the positive (+) terminal of the 24VDC external power supply. 24VDC±10%																									
15VDC power supply	P15R	11	Outputs 15VDC to across P15R-LG. Available as power for TC, TLA, VC, VLA. Permissible current: 30mA																									
Digital I/F Common	SG	10, 20	Common terminal for input signals such as SON and EMG. Pins are connected internally. Separated from LG.																									
Control common	LG	1	Common terminal for TLA, VC, OP, MO1, MO2 and P15R. Pins are connected internally.																									
Servo-on	SON	15	When SON-SG are shorted, the base circuit is switched on and the servo amplifier is ready to operate. When they are opened, the base circuit is shut off and the servo motor coasts.	DI-1																								
Forward rotation stroke end	LSP	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 5.2.5.)	DI-1																								
Reverse rotation stroke end	LSN	17	<table border="1"><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></td><td>○</td></tr><tr><td>1</td><td>0</td><td>○</td><td></td></tr><tr><td>0</td><td>0</td><td></td><td></td></tr></tbody></table> Note. 0: LSP/LSN-SG off (open) 1: SP/LSN-SG on (short)	(Note) Input signals		Operation		LSP	LSN	CCW direction	CW direction	1	1	○	○	0	1		○	1	0	○		0	0			DI-1
(Note) Input signals		Operation																										
LSP	LSN	CCW direction	CW direction																									
1	1	○	○																									
0	1		○																									
1	0	○																										
0	0																											
Forward rotation start	ST1	8	1. In the case of the absolute value command system. When ST1-SG are shorted in the automatic operation mode, positioning is executed once on the basis of the position data set to the point table. In home position return mode, home position return starts as soon as ST1-SG are shorted. In jog operation mode, the servo motor rotates in the forward rotation direction while ST1-SG are shorted. Forward rotation denotes the direction in which the address is incremented. 2. In the case of the incremental value command system. When ST1-SG are shorted in the automatic operation mode, positioning is executed once in the forward rotation direction on the basis of the position data set to the point table. In home position return mode, home position return starts as soon as ST1-SG are shorted. In jog operation mode, the servo motor rotates in the forward rotation direction while ST1-SG are shorted. Forward rotation denotes the direction in which the address is incremented.	DI-1																								

3. SIGNALS AND WIRING

Signal Name	Symbol	Pin No.	Description	I/O Division																	
Reverse rotation start	ST2	9	This device is used in the incremental value command system. When ST2-SG are shorted in the automatic operation mode, positioning is executed once in the reverse rotation direction on the basis of the position data set to the point table. In jog operation mode, the servo motor rotates in the reverse rotation direction while ST2-SG are shorted. Reverse rotation denotes the direction in which the address is decremented.	DI-1																	
Automatic/manual selection	MDO	7	Short MDO-SG to choose the automatic operation mode, or open them to choose the manual operation mode.	DI-1																	
Point table No. selection 1	DI0	5	The following table lists the point table numbers which may be chosen by the combinations of DI0 and DI1: <table><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Point table No.</th></tr><tr><th>DI1</th><th>DI0</th></tr><tr><td>0</td><td>0</td><td>0 (Manual home position return)</td></tr><tr><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>2</td></tr><tr><td>1</td><td>1</td><td>3</td></tr></table> Note: 0: DI1/DI0-SG open 1: DI1/DI0-SG shorted	(Note) Input signals		Point table No.	DI1	DI0	0	0	0 (Manual home position return)	0	1	1	1	0	2	1	1	3	DI-1
(Note) Input signals		Point table No.																			
DI1	DI0																				
0	0	0 (Manual home position return)																			
0	1	1																			
1	0	2																			
1	1	3																			
Point table No. selection 2	DI1	14																			
Rough match	CPO	4	CPO-SG are connected when the remaining command distance falls within the parameter-set rough match output range. This signal is not output while the base circuit is off. Switching the servo-on connects CPO-SG.	DO-1																	
In position	INP	6	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. 6. When the in-position range is increased, INP-SG may be kept connected during low-speed rotation. Switching the servo-on connects INP-SG.	DO-1																	
Trouble	ALM	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	19	RD-SG are connected when the servo is switched on and the servo amplifier is ready to operate.	DO-1																	
Override	VC	2	−10 to +10V is applied to across VC-LG to limit the servo motor speed. Apply −10[V] for 0[%] override, 0[V] for 100[%], or 10[V] for 200[%].	Analog input																	
Analog torque limit	TLA	12	To use this signal, make external torque limit selection (TL) usable with the Servo Configuration software. Then 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																	
Shield	SD	Plate	Connect the external conductor of the shield cable.																		

3. SIGNALS AND WIRING

3) CN3

Signal Name	Symbol	Pin No.	Description	I/O Division
Analog monitor 1	MO1	4	Used to output the data set in parameter No.17 to across MO1-LG in terms of voltage. Resolution 8 bits	Analog output
Analog monitor 2	MO2	14	Used to output the data set in parameter No.17 to across MO2-LG in terms of voltage. Resolution 8 bits	Analog output
RS-422 I/F	SDP	9	RS-422 and RS-232C functions cannot be used together. Choose either one in parameter No. 16 (Communication baudrate selection).	
	SDN	19		
	RDP	5		
	RDN	15		
RS-422 termination	TRE	10	Termination resistor connection terminal of RS-422 interface. When the servo amplifier is the termination axis, connect this terminal to RDN (CN3-15).	
RS-232C I/F	RXD	2	RS-422 and RS-232C functions cannot be used together. Choose either one in parameter No. 16.	
	TXD	12		
Monitor common	LG	1, 3, 11, 13	Monitoring common for control common	
Ground	SD	Plate	Connect the external conductor of the shield cable.	

3.3.3 Additional function devices

By using the Set-up Software, you can assign the signals given in this section to the pins of connectors CN1A and CN1B, in addition to the signals in Section 3.3.2.

(1) Pins which accept different signals

Pin Type	Connector Pin No.	Device in Initial Status	Device Symbol
Input-only pins	CN1B-5	Point table No. selection 1	DI0
	CN1B-14	Point table No. selection 2	DI1
	CN1A-8	Proximity dog	DOG
	CN1B-15	Servo-on	SON
	CN1B-16	Forward rotation stroke end	LSP
	CN1B-17	Reverse rotation stroke end	LSN
	CN1B-7	Automatic/manual selection	MDO
	CN1B-8	Forward rotation start	ST1
	CN1B-9	Reverse rotation start	ST2
I/O pin	CN1A-19	Empty	
Output-only pins	CN1B-4	Rough match	CPO
	CN1B-6	In position	INP
	CN1B-18	Trouble	ALM
	CN1B-19	Ready	RD
	CN1A-18	Home position return completion	ZP

3. SIGNALS AND WIRING

(2) Assignable devices

1) Input devices

Device Name	Symbol	Description	I/O Division																																																																																									
No assigned function		No function is assigned.																																																																																										
Forced stop	EMG	When EMG-SG are opened, the servo amplifier is placed in the forced stop status, the servo switches off, and the dynamic brake is operated to bring the servo motor to a sudden stop. Short EMG-SG in the forced stop status to cancel the forced stop status.	DI-1																																																																																									
Override selection	OVR	Short OVR-SG to make override (VC) valid.	DI-1																																																																																									
External torque limit selection	TL	Short TL-SG to make analog torque limit (TLA) valid. (Refer to Section 3.4.4.)	DI-1																																																																																									
Internal torque limit selection	TL2	Open TL2-SG to make the torque limit value set in parameter No.28 (internal torque limit 1) valid, or short them to make the value set in parameter No.29 (internal torque limit 2) valid. (Refer to Section 3.4.4.)	DI-1																																																																																									
Proportion control	PC	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 (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 (TL) at the same time to make the torque less than the rated by the analog torque limit (TLA).	DI-1																																																																																									
Reset	RES	Disconnect RES-SG for more than 50ms to reset the alarm. Some alarms cannot be deactivated by the reset (RES). (Refer to Section 11.2.1.) 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. 22 (function selection 4). Since this device is not designed for stopping, do not switch it on during operation.	DI-1																																																																																									
Point table No. selection 1	DI0	Valid in the automatic mode. The following table lists the point table numbers that may be chosen by the combinations of DI0, DI1, DI2 and DI3:	DI-1																																																																																									
Point table No. selection 2	DI1																																																																																											
Point table No. selection 3	DI2																																																																																											
Point table No. selection 4	DI3																																																																																											
<table><tr><th colspan="4">(Note) Input signals</th><th rowspan="2">Point table No.</th></tr><tr><th>DI3</th><th>DI2</th><th>DI1</th><th>DI0</th></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0 (Manual home position return)</td></tr><tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>2</td></tr><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>4</td></tr><tr><td>0</td><td>1</td><td>0</td><td>1</td><td>5</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>6</td></tr><tr><td>0</td><td>1</td><td>1</td><td>1</td><td>7</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>8</td></tr><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>9</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>10</td></tr><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>11</td></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>12</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>13</td></tr><tr><td>1</td><td>1</td><td>1</td><td>0</td><td>14</td></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>15</td></tr></table>				(Note) Input signals				Point table No.	DI3	DI2	DI1	DI0	0	0	0	0	0 (Manual home position return)	0	0	0	1	1	0	0	1	0	2	0	0	1	1	3	0	1	0	0	4	0	1	0	1	5	0	1	1	0	6	0	1	1	1	7	1	0	0	0	8	1	0	0	1	9	1	0	1	0	10	1	0	1	1	11	1	1	0	0	12	1	1	0	1	13	1	1	1	0	14	1	1	1	1	15
(Note) Input signals				Point table No.																																																																																								
DI3	DI2	DI1			DI0																																																																																							
0	0	0		0	0 (Manual home position return)																																																																																							
0	0	0		1	1																																																																																							
0	0	1		0	2																																																																																							
0	0	1	1	3																																																																																								
0	1	0	0	4																																																																																								
0	1	0	1	5																																																																																								
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0	1	1	1	7																																																																																								
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1	1	1	0	14																																																																																								
1	1	1	1	15																																																																																								
Note:0: DI3/DI2/DI1/DI0-SG open 1: DI3/DI2/DI1/DI0-SG shorted																																																																																												

3. SIGNALS AND WIRING

Device Name	Symbol	Description	I/O Division																	
Temporary stop/Restart	STP	Short STP-SG during automatic operation to make a temporary stop. Short STP-SG again to make a restart. Shorting a forward rotation start (ST1) or reverse rotation start (ST2) during a temporary stop is ignored. Switching from automatic mode to manual mode during a temporary stop clears the remaining moving distance. During home position return and jog operation, the temporary stop/restart (STP) input is ignored. (Refer to Section 4.2.5, (4).)	DI-1																	
Manual pulse generator multiplication 1	TP0	Used to select the multiplication factor of the manual pulse generator. When it is not selected, the parameter No.1 (feeding function selection) setting is made valid.																		
Manual pulse generator multiplication 2	TP1	<table border="1"><thead><tr><th colspan="2">(Note) Input signals</th><th rowspan="2">Manual Pulse Generator Multiplication Factor</th></tr><tr><th>TP1</th><th>TP2</th></tr></thead><tbody><tr><td>0</td><td>0</td><td>Parameter No.1 setting</td></tr><tr><td>0</td><td>1</td><td>1 time</td></tr><tr><td>1</td><td>0</td><td>10 times</td></tr><tr><td>1</td><td>1</td><td>100 times</td></tr></tbody></table> Note: 0: TP1/TP0-SG open 1: TP1/TP0-SG shorted		(Note) Input signals		Manual Pulse Generator Multiplication Factor	TP1	TP2	0	0	Parameter No.1 setting	0	1	1 time	1	0	10 times	1	1	100 times
(Note) Input signals		Manual Pulse Generator Multiplication Factor																		
TP1	TP2																			
0	0	Parameter No.1 setting																		
0	1	1 time																		
1	0	10 times																		
1	1	100 times																		

2) Output devices

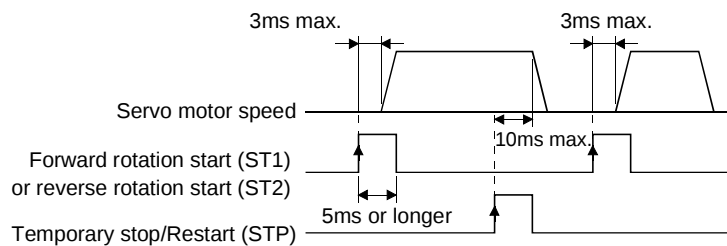
Device Name	Symbol	Description	I/O Division
No assigned function		No function is assigned.	
Electromagnetic brake interlock	MBR	Used to output the interlock signal for electromagnetic brake. MBR-SG are disconnected at servo-off or alarm occurrence.	DO-1
Position range	POT	POT-SG are connected when the actual current position is within the parameter-set range. The output is open when home position return completion is incomplete or the base circuit is off.	DO-1
Warning	WNG	WNG-SG are connected when warning occurs. Open in normal condition.	DO-1
Battery warning	BWNG	BWNG-SG are connected when the open battery cable warning (A. 92) or battery warning (A. 9F) occurs. Open in normal condition.	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 (SON) switches off.	DO-1
Temporary stop	PUS	PUS-SG are connected when deceleration to a stop is started by the temporary stop/restart (STP). PUS-SG is disconnected when operation is resumed by making the temporary stop/restart (STP) valid again.	DO-1

3. SIGNALS AND WIRING

3.4 Detailed description of the signals

3.4.1 Forward rotation start, reverse rotation start, temporary stop/restart

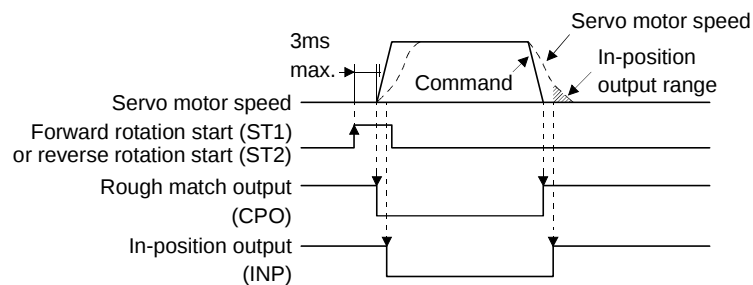
- (1) Make up a sequence so that the forward rotation start (ST1) or reverse rotation start (ST2) is switched on after the main circuit has been established. The forward rotation start (ST1) or reverse rotation start (ST2) is invalid if it is switched on before the main circuit is established. Normally, it is interlocked with the ready (RD).
- (2) A start in the servo amplifier is made when the forward rotation start (ST1) or reverse rotation start (ST2) changes from OFF to ON. The delay time of the servo amplifier's internal processing is max. 3ms. The delay time of other signals is max. 10ms.



- (3) When a programmable controller is used, the ON time of the forward rotation start (ST1), reverse rotation start (ST2) or temporary stop/restart (STP) should be 5ms or longer to prevent a malfunction.
- (4) During operation, the forward rotation start (ST1) or reverse rotation start (ST2) is not accepted. The next operation should always be started after the rough match signal is output with the rough match output range set to 0 or after the in-position signal is output.

3.4.2 Rough match, in-position

The following chart shows the output timings of the rough match (CPO) and in-position (INP):



3. SIGNALS AND WIRING

3.4.3 Override

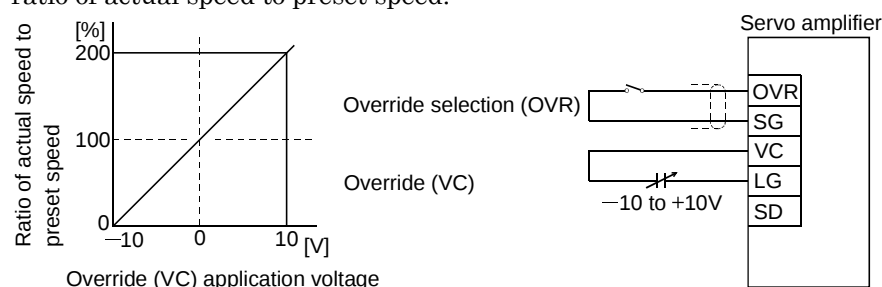
POINT	
	When using the override (VC), make the override selection (OVR) device available.

The override (VC) may be used to change the servo motor speed. The following table lists the signals and parameter related to the override:

Item	Name	Remarks
Analog input signal	Override (VC)	Set-up Software setting required.
Contact input signal	Override selection (OVR)	
Parameter	No.25 override offset	−999 to 999mV

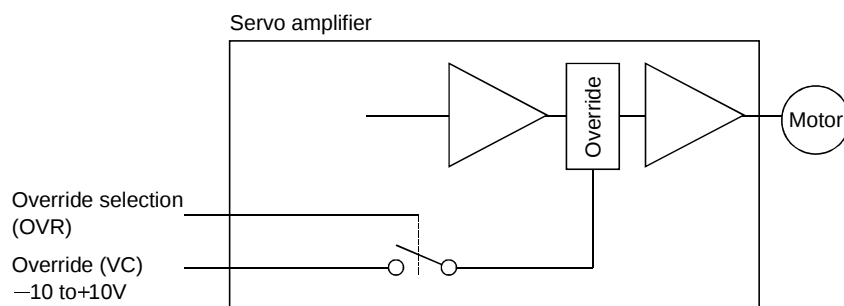
(1) Override (VC)

By applying a voltage (−10 to +10V) to the override (VC) terminal, change values can be set from outside consecutively. The following graph shows the relationship between the input voltage and the ratio of actual speed to preset speed.



(2) Override selection (OVR)

Used to make the override (VC) valid or invalid.



Using the override selection (OVR), choose a change value as follows:

External Input Signal	Speed Change Value
OVR	
0	No change
1	Override (VC) setting is made valid.

Note. 0 : Off (open) across OVR-SG

1 : On (shorted) across OVR-SG

(3) Override offset (parameter No.25)

Using parameter No.25, the offset voltage can be set relative to the input voltage for the override (VC). The setting is between −999 to 999mV.

3. SIGNALS AND WIRING

3.4.4 Torque limit

POINT	
	To use the torque limit, make the external torque limit selection (TL) and internal torque limit selection (TL2) available.

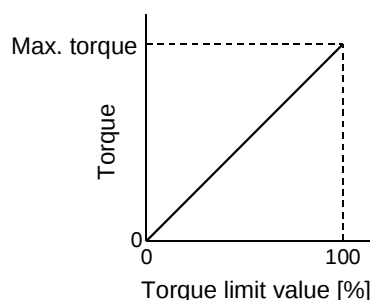
The following table lists the signals and parameters related to the torque limit:

Item	Name	Remarks
Analog input signal	Analog torque limit (TLA)	Servo Configuration Software setting required.
Contact input signals	External torque limit selection (TL)	
	Internal torque limit selection (TL2)	
Contact output signal	Limiting torque (TLC)	
Parameters	No.28 (internal torque limit 1)	0 to 100%
	No.29 (internal torque limit 2)	0 to 100%
	No.26 (torque limit offset)	—999 to 999mV
	No.20 (selection function 2)	Selection of the rotation direction in which torque limit is executed

The torque limit is available in two types: internal torque limit set in parameters and analog torque limit (TLA) using analog input signal. This function limits torque on the assumption that the maximum torque of the servo motor is 100%.

(1) Internal torque limits 1, 2

Use parameter No.28 and 29 to set the internal torque limit values. The following graph shows the torque relative to the setting.

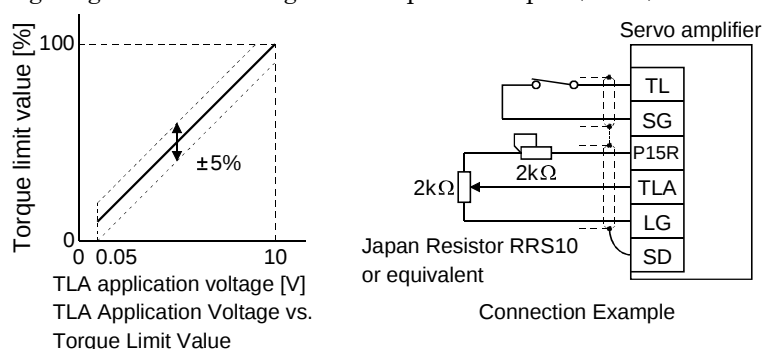


(2) Analog torque limit (TLA)

By applying a voltage (0 to 10V) to the analog torque limit (TLA) terminal, limit values can be set from outside consecutively. The following graph shows the relationship between input voltage and limit value.

Depending on the servo amplifier, the limit value has about 5% variations to the input voltage. As this may not cause torque to be limited sufficiently at less than 0.05V, use this function at the voltage of 0.05V or more.

Refer to the following diagram when using the 15V power output (P15R) of the servo amplifier:



3. SIGNALS AND WIRING

(3) External torque limit selection (TL), internal torque limit selection (TL2)

To use the external torque limit selection (TL) and internal torque limit selection (TL2), make them available using the Set-up Software (refer to Chapter 6).

These input signals may be used to choose the torque limit values made valid.

(Note) External input signals		Torque limit value made valid
TL2	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. 29 > Parameter No. 28: Parameter No. 28 Parameter No. 29 < Parameter No. 28: Parameter No. 29
1	1	TLA > Parameter No. 76: Parameter No. 29 TLA < Parameter No. 29: TLA

Note.0: TL/TL2-SG off (open)

1: TL/TL2-SG on (short)

(4) External torque limit offset (parameter No.26)

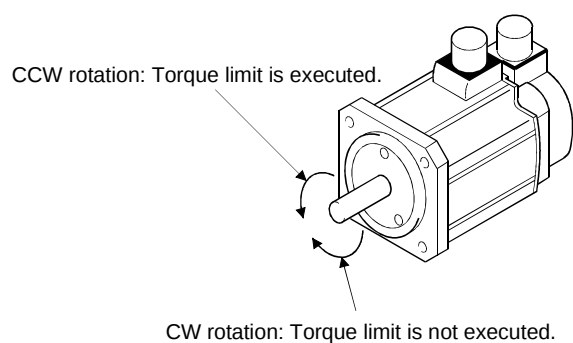
Using parameter No.26, the offset voltage can be set relative to the input voltage of the analog torque limit (TLA). The setting is between -999 to 999mV .

(5) Selection of rotation direction for torque limit execution (parameter No.20)

Using parameter No.20, the rotation direction for torque limit execution can be selected.

Parameter No.20 Setting	Rotation Direction for Torque Limit Execution	
	CCW direction	CW direction
□□□0 (initial value)	○	○
□□□1	○	○
□□□2	○	○

For example, when “□□□1” is set in parameter No.20, torque limit is executed in the CCW direction but not in CW direction.



3. SIGNALS AND WIRING

3.5 Alarm occurrence timing chart

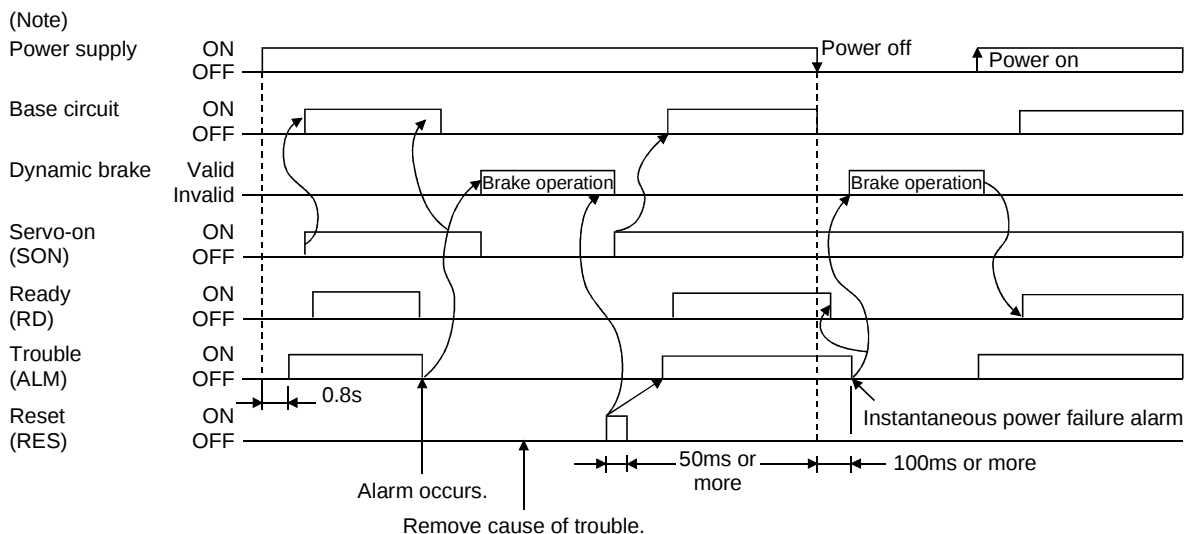


CAUTION

- When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.
- As soon as an alarm occurs, turn off Servo-on (SON) and power off.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. Switch off the main circuit power supply in the external sequence. To reset the alarm, switch the control circuit power supply off, then on.

However, the alarm cannot be reset unless its cause of occurrence is removed.



Note. Shut off the main circuit power as soon as an alarm occurs.

Precautions for alarm occurrence

1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching control circuit power off, then on to reset the overcurrent (A.32), overload 1 (A.50) or overload 2 (A.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 (A.30) alarm after its occurrence, the external regenerative brake resistor will generate heat, resulting in an accident.

3) Instantaneous power failure

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

- A power failure of the control circuit power supply continues for 100ms or longer and the control circuit is not completely off.
- The bus voltage dropped to 200VDC or less.

4) Incremental system

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

3. SIGNALS AND WIRING

3.6 Interfaces

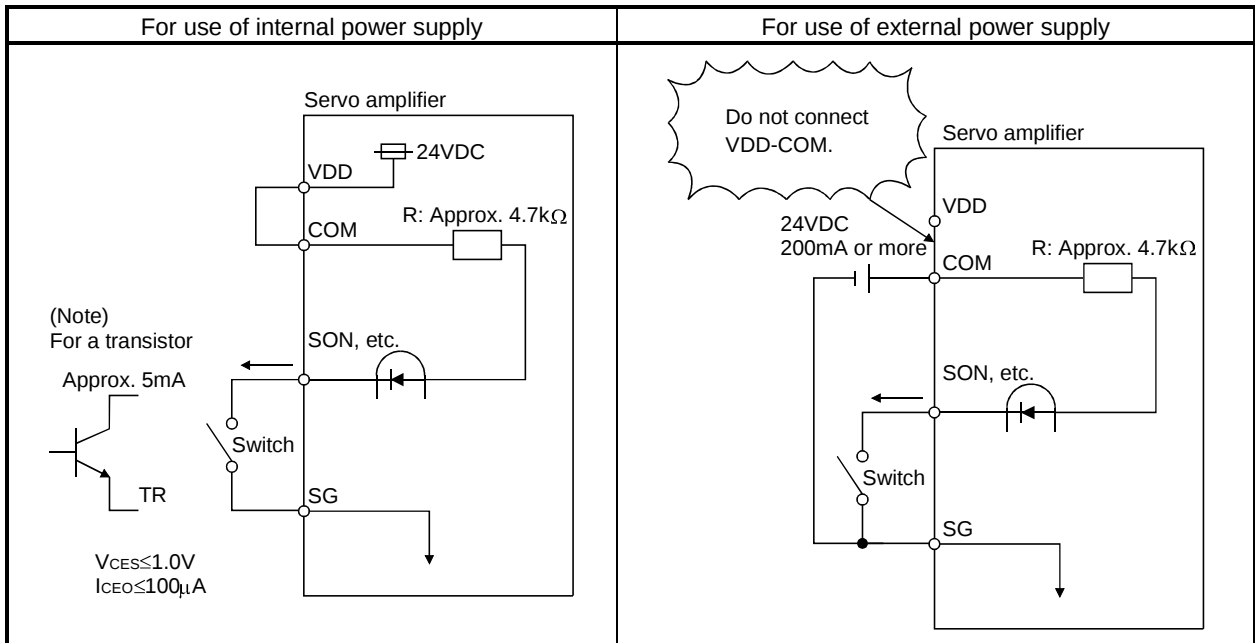
This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in Sections 3.3.2 and 3.3.3.

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 (5) in this section.

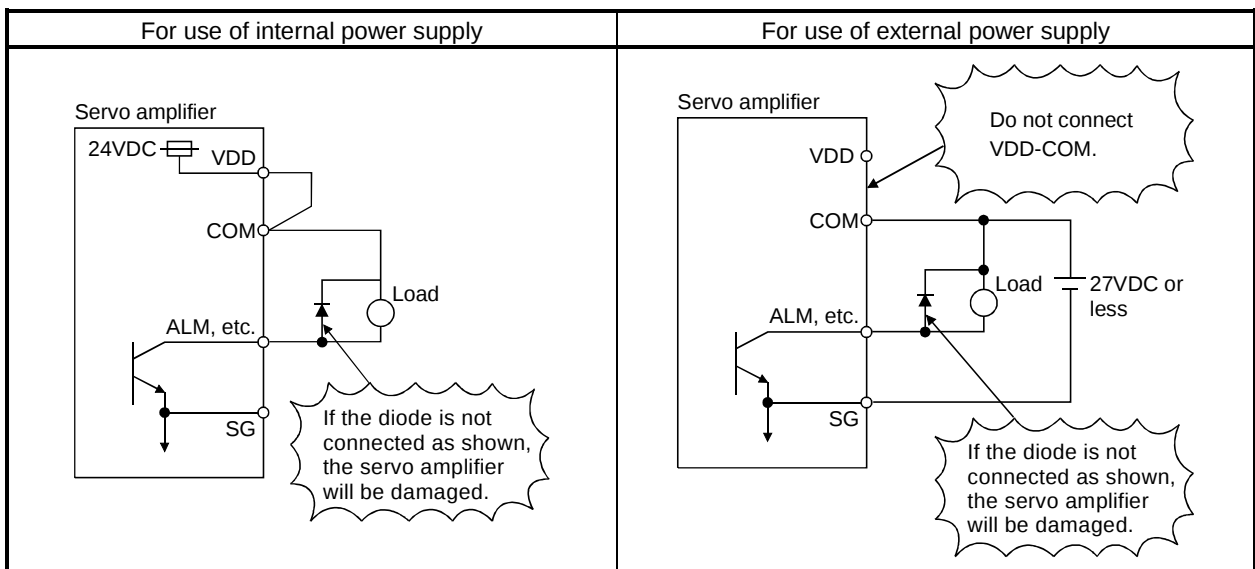


Note: This also applies to the use of the external power supply.

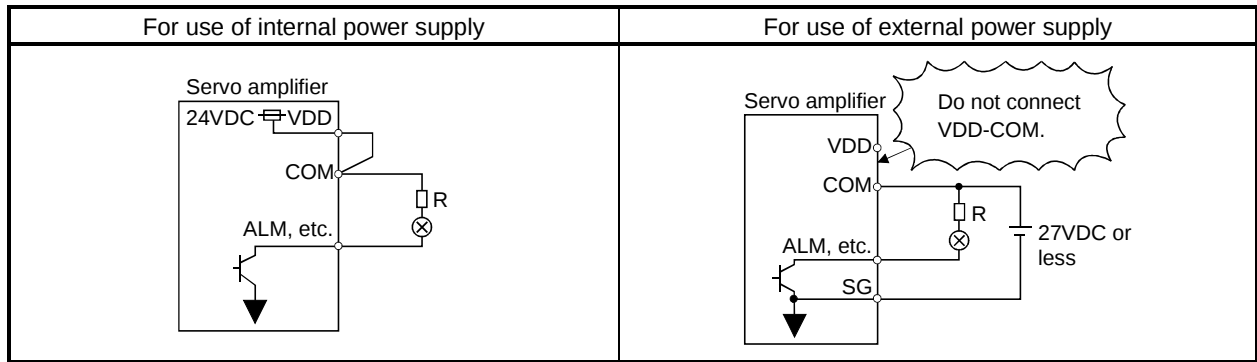
(2) Digital output interface DO-1

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)

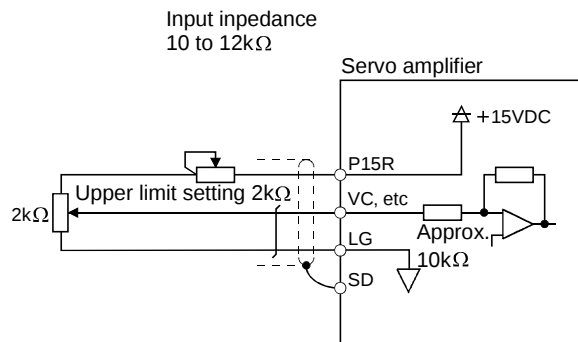
1) Inductive load



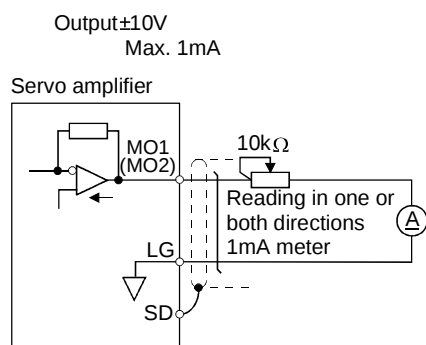
3. SIGNALS AND WIRING



(3) Analog input



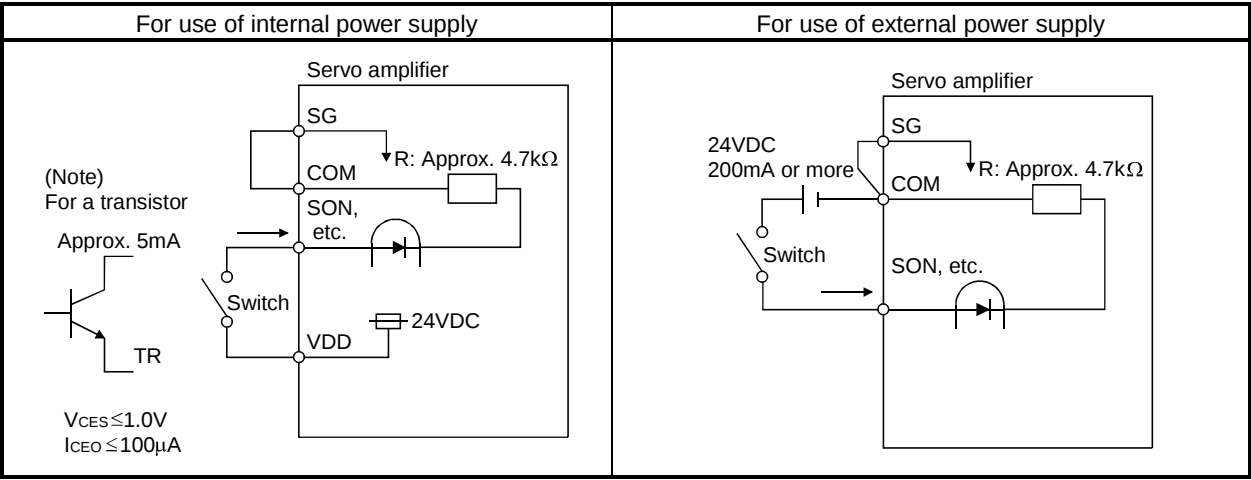
(4) Analog output



3. SIGNALS AND WIRING

(5) 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

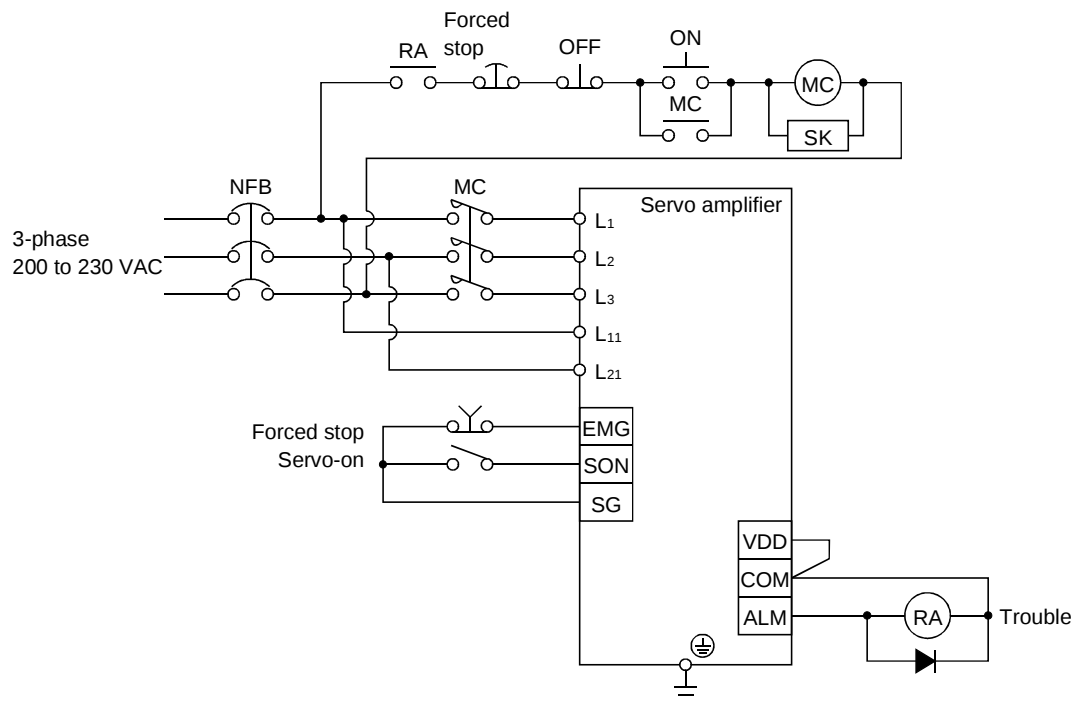
- When the servo amplifier has become faulty, switch power off on the servo amplifier power side. Continuous flow of a large current may cause a fire.
- Use the trouble (ALM) to switch power off. Otherwise, a regenerative brake transistor fault or the like may overheat the regenerative brake resistor,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

3.7.1 Connection example

Wire the power supply and main circuit as shown below so that the servo-on (SON) turns off as soon as alarm occurrence is detected and power is shut off.

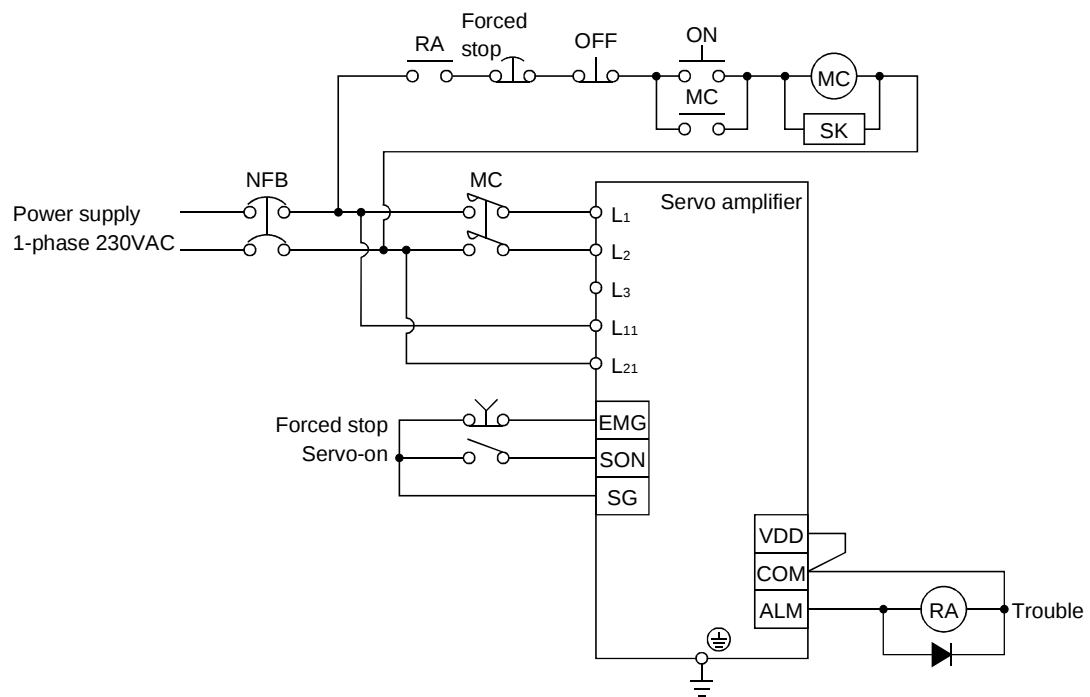
A no-fuse breaker (NFB) must be used with the input cables of the power supply.

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



3. SIGNALS AND WIRING

(2) For 1-phase 230VAC power supply



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 12.2.1.

Symbol	Signal	Description									
L1, L2, L3	Main circuit power supply	Supply L1, L2 and L3 with the following power. For a single-phase 230VAC power supply, connect the power supply to L1 and L2 and keep L3 open: <table border="1"> <tr> <td>Servo amplifier Power supply</td><td>MR-J2-10C to 70C</td><td>MR-J2-100C to 350C</td></tr> <tr> <td>3-phase 200 to 230VAC, 50/60Hz</td><td colspan="2">L1 • L2 • L3</td></tr> <tr> <td>Single-phase 230VAC, 50/60Hz</td><td>L1 • L2</td><td></td></tr> </table> Cannot be used for combination with the servo motor HC-SF52 • 53.	Servo amplifier Power supply	MR-J2-10C to 70C	MR-J2-100C to 350C	3-phase 200 to 230VAC, 50/60Hz	L1 • L2 • L3		Single-phase 230VAC, 50/60Hz	L1 • L2	
Servo amplifier Power supply	MR-J2-10C to 70C	MR-J2-100C to 350C									
3-phase 200 to 230VAC, 50/60Hz	L1 • L2 • L3										
Single-phase 230VAC, 50/60Hz	L1 • L2										
U, V, W	Servo motor output	Connect to the servo motor power supply terminals (U, V, W). During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.									
L11, L21	Control circuit power supply	Control circuit power input terminals Supply L11 and L21 with single-phase 200-230VAC, 50/60Hz power.									
P, C, D	Regenerative brake option	C and D (Servo amplifier built-in regenerative brake version) are factory-connected. When using the regenerative brake option, always remove wiring from across P-D and connect the regenerative brake option across P-C.									
N		Do not connect.									
	Protective earth (PE)	Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.									

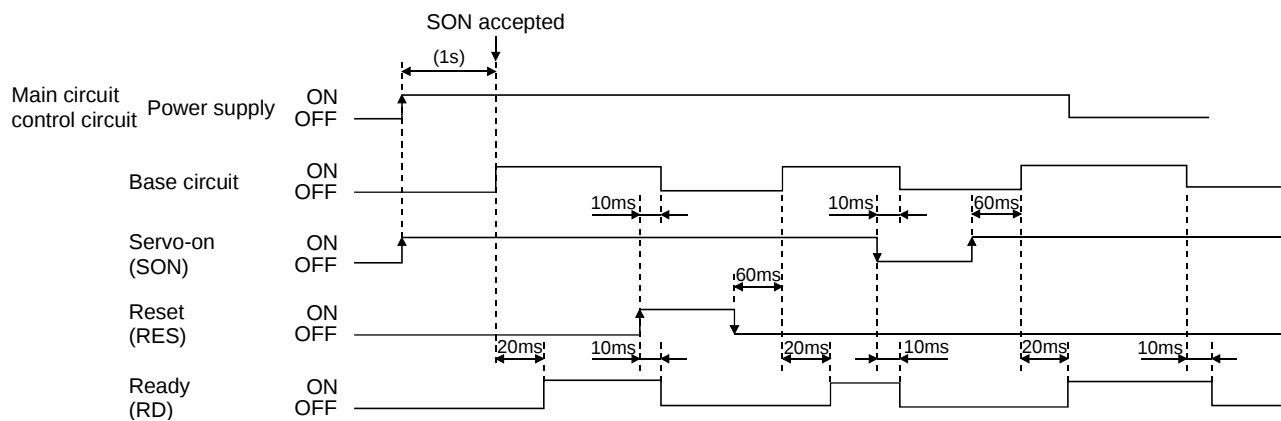
3. SIGNALS AND WIRING

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 (SON) about 1 second after the main circuit power supply is switched on. Therefore, when SON is switched on simultaneously with the three-phase power supply, the base circuit will switch on in about 1 second, and the ready (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 (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart



3. SIGNALS AND WIRING

(3) Forced stop



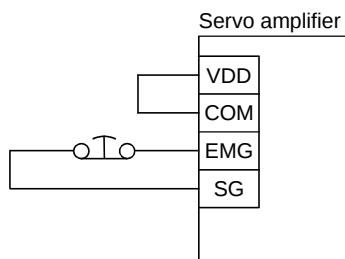
CAUTION

- Provide an external forced stop circuit to ensure that operation can be stopped and power switched off immediately.

Forced stop (EMG) can be used by making device setting on the Servo Configuration Software.

Make up a circuit which shuts off main circuit power as soon as EMG-SG are opened at a forced stop. To ensure safety, always install an external forced 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 forced stop warning (A. E6).

During ordinary operation, do not use the external forced stop (EMG) to alternate stop and run. The servo amplifier life may be shortened. Also, if the forward rotation start (ST1) or reverse rotation start (ST2) is on during a forced stop, the servo motor will rotate as soon as the warning is reset. During a forced 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

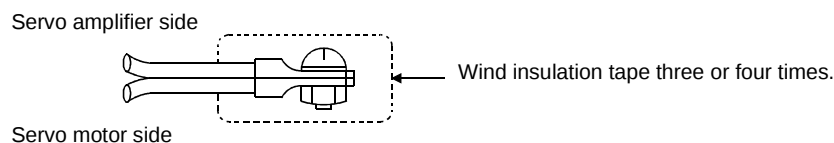
- Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and servo motor. Otherwise, the servo motor will operate improperly.
- Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur.

POINT

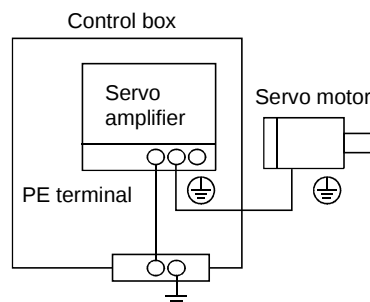
- Do not apply the test lead bars or like of a tester directly to the pins of the connectors supplied with the servo motor. Doing so will deform the pins, causing poor contact.

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



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



- (3) 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. SIGNALS AND WIRING

3.8.2 Connection diagram



WARNING

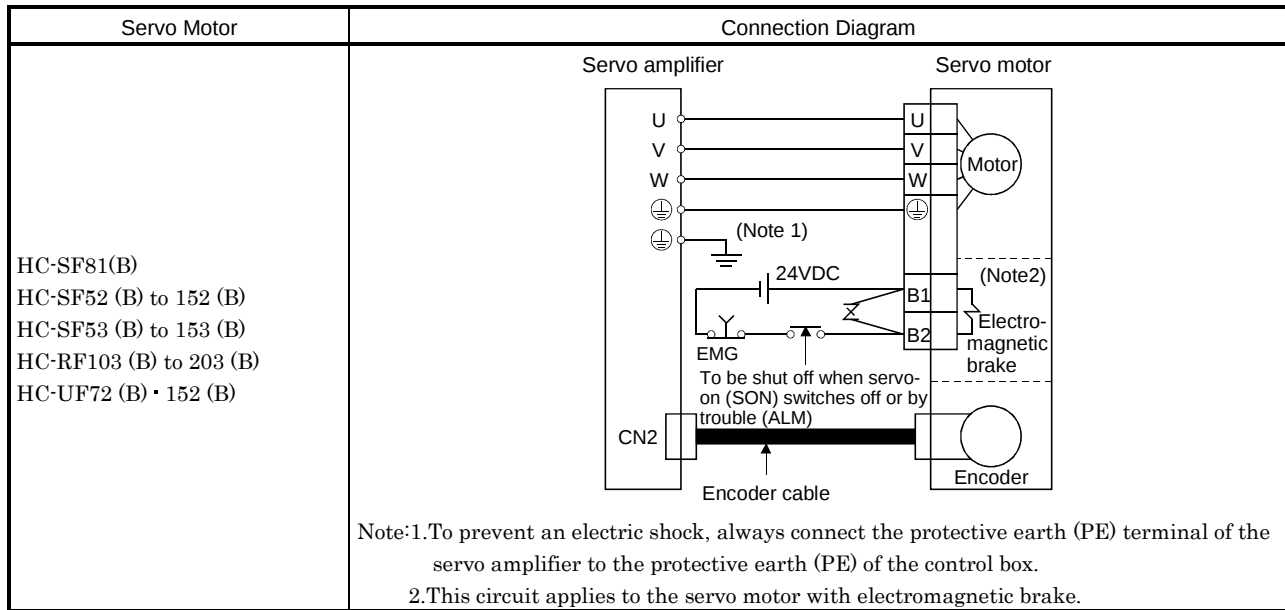
During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur.

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 14.2.1. For encoder cable connection, refer to Section 14.1.2. For the signal layouts of the connectors, refer to Section 3.8.3.

For the servo motor connector, refer to Chapter 3 of the Servo Motor Instruction Manual.

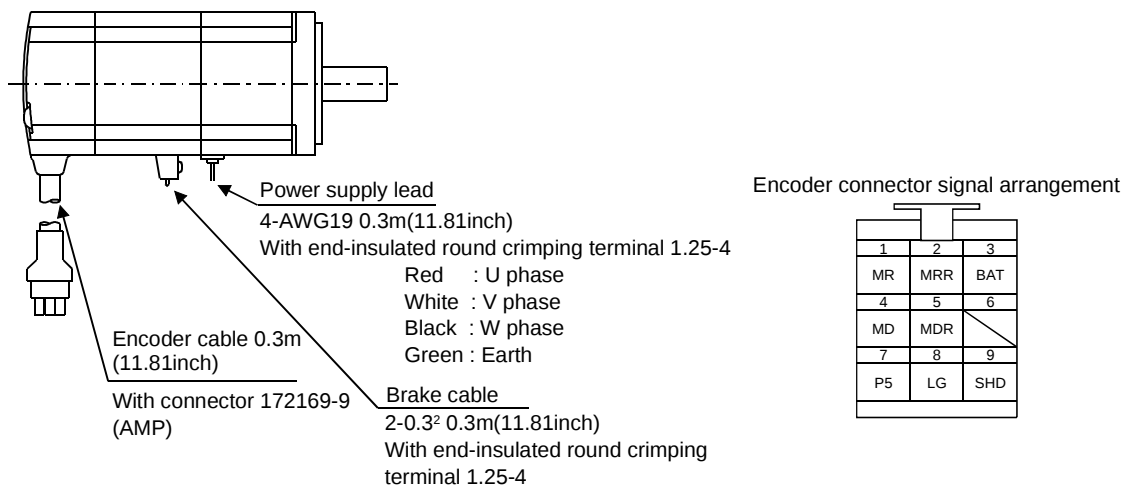
Servo Motor	Connection Diagram
HC-MF053 (B) (-UE) to 73 (B) (-UE) HA-FF053 (B) to 63 (B) HC-UF13 (B) to 73 (B)	Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box. 2. This circuit applies to the servo motor with electromagnetic brake. 3. For the HA-FF series, connect the ground cable to the earth terminal of the servo motor.
HA-FF053 (B)-UE to 63 (B)-UE HC-SF121 (B) to 301 (B) HC-SF202 (B) • 352 (B) HC-SF203 (B) • 353 (B) HC-UF202 (B)	Note:1. To prevent an electric shock, always connect the protective earth (PE) terminal of the servo amplifier to the protective earth (PE) of the control box. 2. This circuit applies to the servo motor with electromagnetic brake.

3. SIGNALS AND WIRING

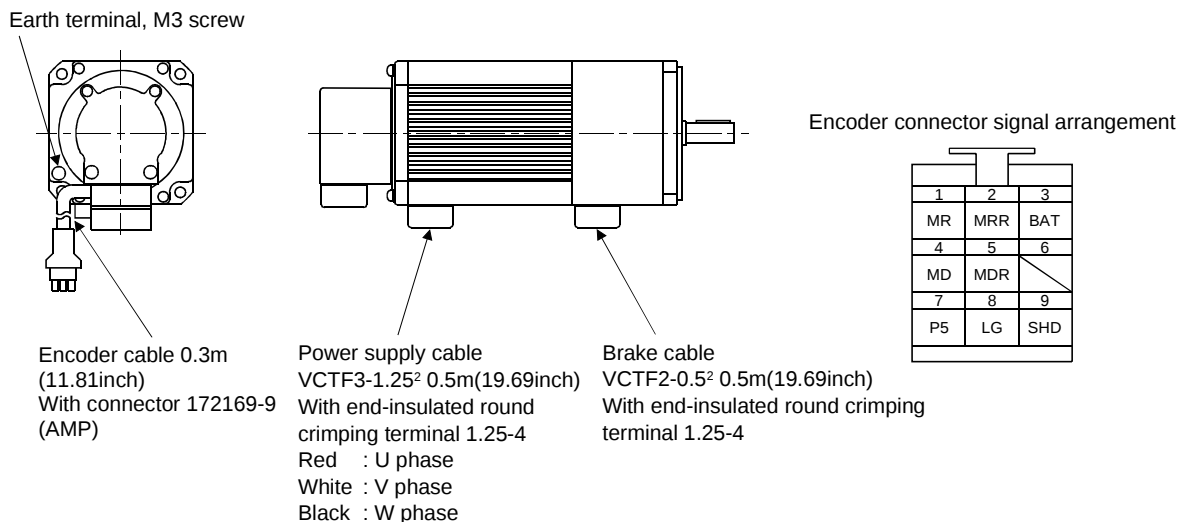


3.8.3 I/O terminals

(1) HC-MF(-UE) series

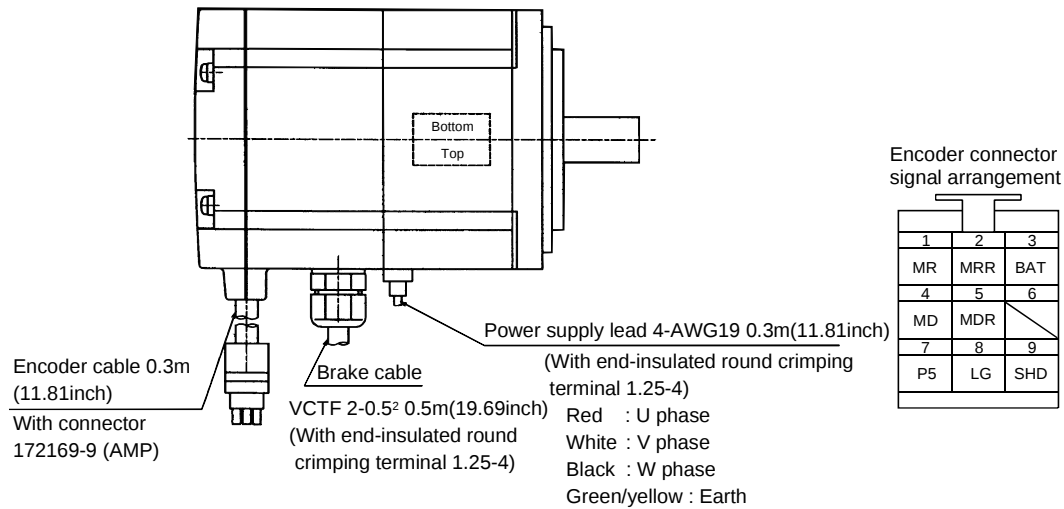


(2) HA-FF series

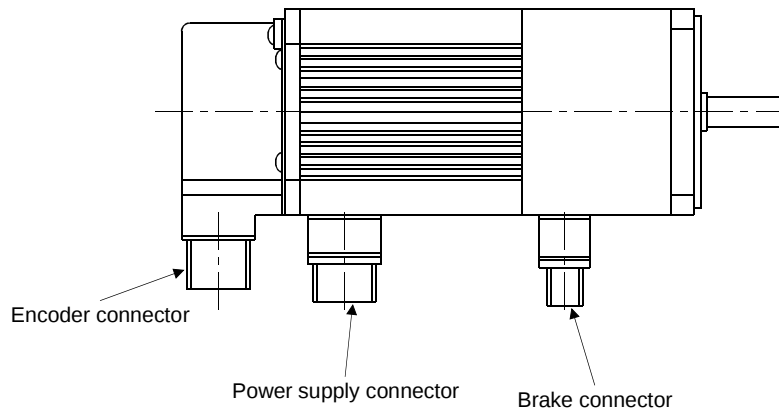


3. SIGNALS AND WIRING

(3) HC-UF 3000r/min series

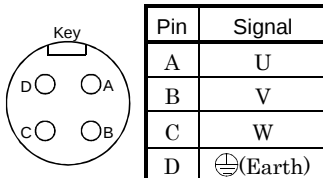


(4) HA-FF□C-UE series

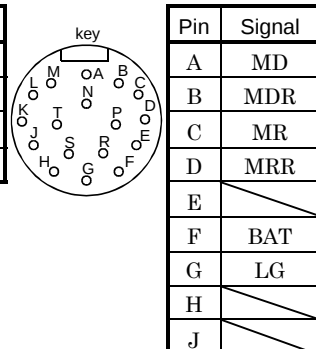


Servo Motor	Connector		
	For power supply	For encoder	For brake
HA-FF053C(B)-UE to HA-FF63C(B)-UE	CE05-2A14S-2PD-B	MS3102A20-29	MS3102E10SL-4P

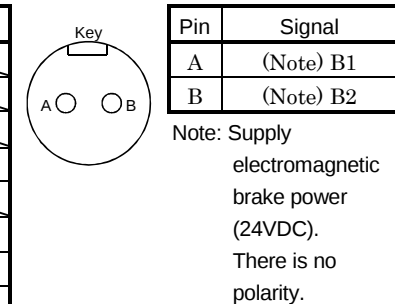
Power supply connector
signal arrangement
CE05-2A14S-2PD-B



Encoder connector
signal arrangement
MS3102A20-29P

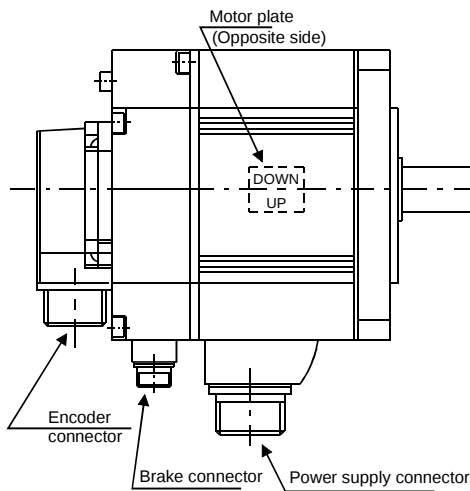


Brake connector signal
arrangement
MS3102E10SL-4P



3. SIGNALS AND WIRING

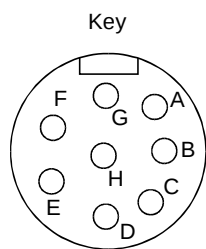
(5) HC-SF • HC-RF • HC-UF2000 r/min series



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

Power supply connector signal arrangement

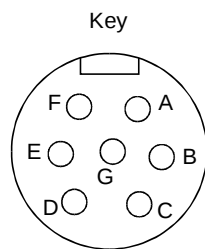
CE05-2A22-23PD-B



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

Note: Supply electromagnetic brake power (24VDC). There is no polarity.

CE05-2A24-10PD-B

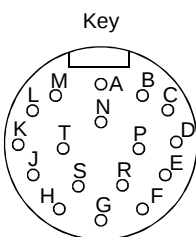


Pin	Signal
A	U
B	V
C	W
D	(Earth)
E	(Note) B1
F	(Note) B2
G	

Note: Supply electromagnetic brake power (24VDC). There is no polarity.

Encoder connector signal arrangement

MS3102A20-29P

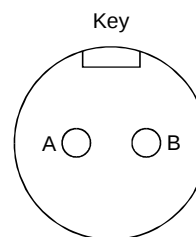


Pin	Signal
A	MD
B	MDR
C	MR
D	MRR
E	
F	BAT
G	LG
H	
J	

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

Electromagnetic brake connector signal pin-outs

MS3102E10SL-4P



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

Note: Supply electromagnetic brake power (24VDC). There is no polarity.

3. SIGNALS AND WIRING

3.9 Servo motor with electromagnetic brake

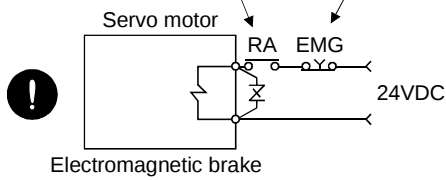
CAUTION



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

Contacts must be open when servo-on (SON) is off or when a trouble (ALM) is present and when an electromagnetic brake interlock (MBR).

Circuit must be opened during forced stop (EMG).



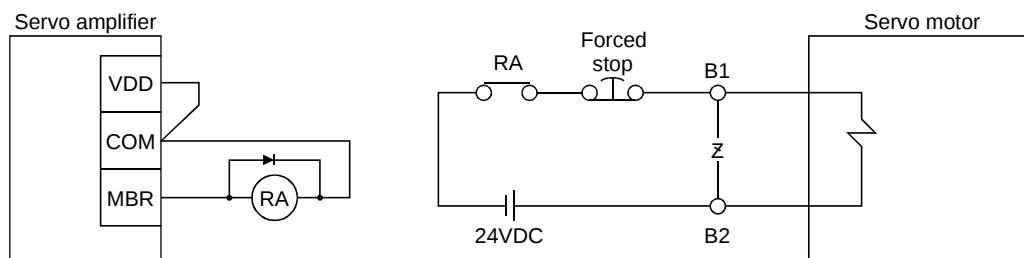
- The electromagnetic brake is provided for holding the motor shaft. Do not use it for ordinary braking.
- Before performing the operation, be sure to confirm that the electromagnetic brake operates properly.

POINT
For the power supply capacity, operation delay time and other specifications of the electromagnetic brake, refer to the Servo Motor Instruction Manual.

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

- 1) In the device setting of the Servo Configuration software, make the electromagnetic brake interlock (MBR) available.
- 2) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.
- 3) The brake will operate when the power (24VDC) switches off.
- 4) While the reset (RES) is on, the base circuit is shut off. When using the servo motor with a vertical shaft, use the electromagnetic brake interlock (MBR).
- 5) Turn off the servo-on (SON) after the servo motor has stopped.

(1) Connection diagram



(2) Setting

- 1) In the device setting of the Set-up Software, make the electromagnetic brake interlock (MBR) available.
- 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

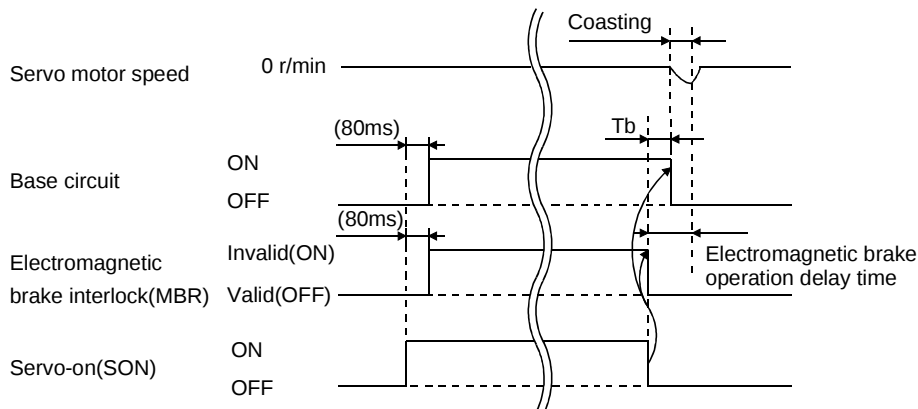
(3) Timing charts

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

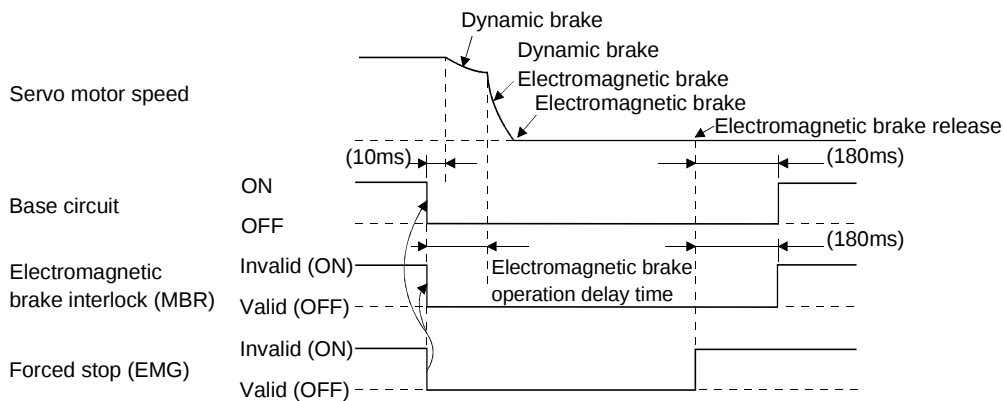
T_b (ms) after servo-on (SON) is switched off, servo lock is released and the servo motor coasts.

If the electromagnetic brake is made valid in the servo lock status, the brake life may be shorter.

For use in vertical lift and similar applications, therefore, set delay time (T_b) to the time which is about equal to the electromagnetic brake operation delay time and during which the load will not drop.

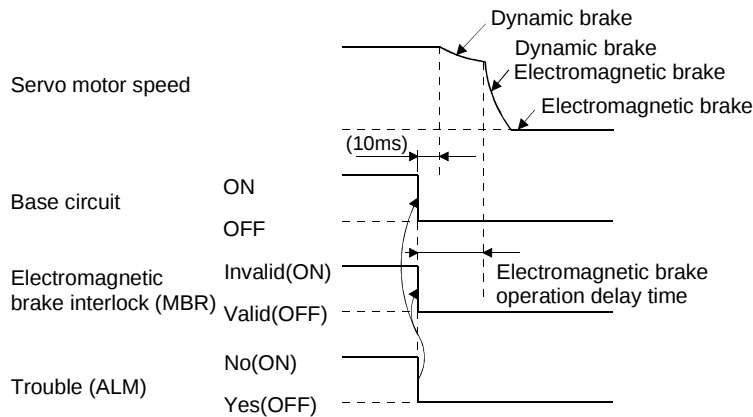


(b) Forced stop (EMG) ON/OFF

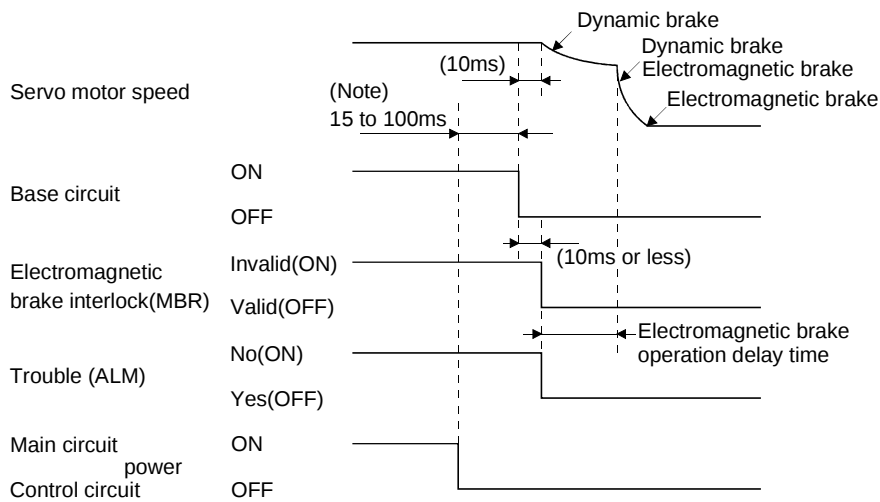


3. SIGNALS AND WIRING

(c) Alarm occurrence

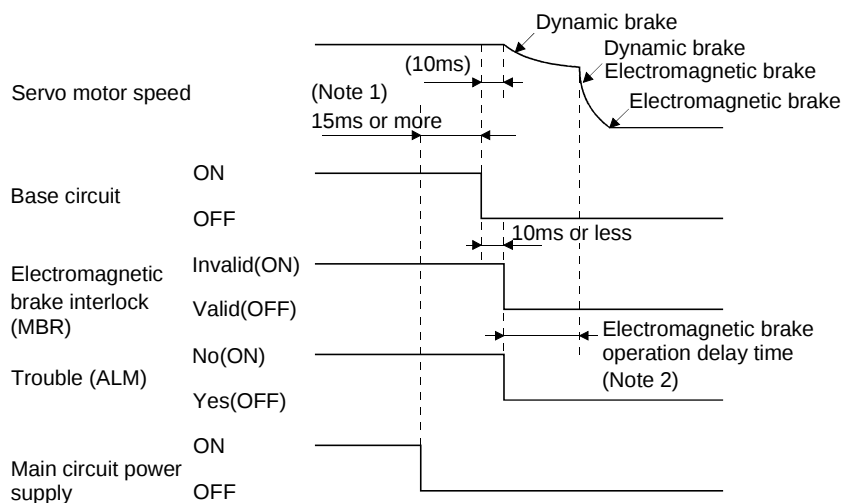


(d) Both main and control circuit power supplies off



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 trouble (ALM) does not turn off.

3. SIGNALS AND WIRING

3.10 Grounding

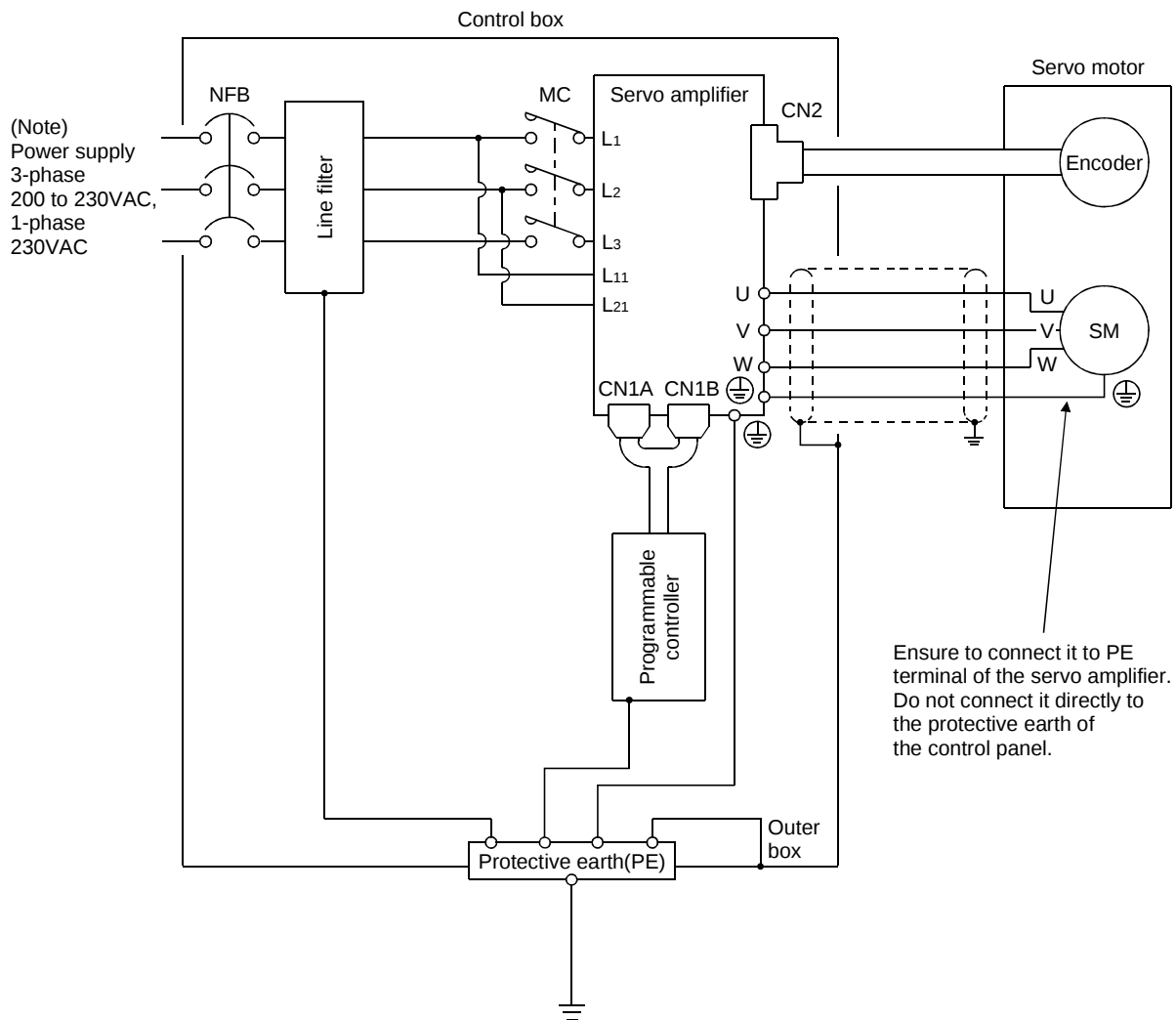


WARNING

- 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.

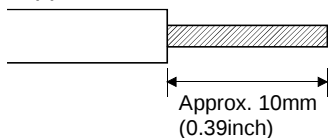
3. SIGNALS AND WIRING

3.11 Servo amplifier terminal block (TE2) wiring method

POINT	
	Refer to Table 14.1 in Section 14.2.1 for the wire sizes used for wiring.

(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 2.5mm²)



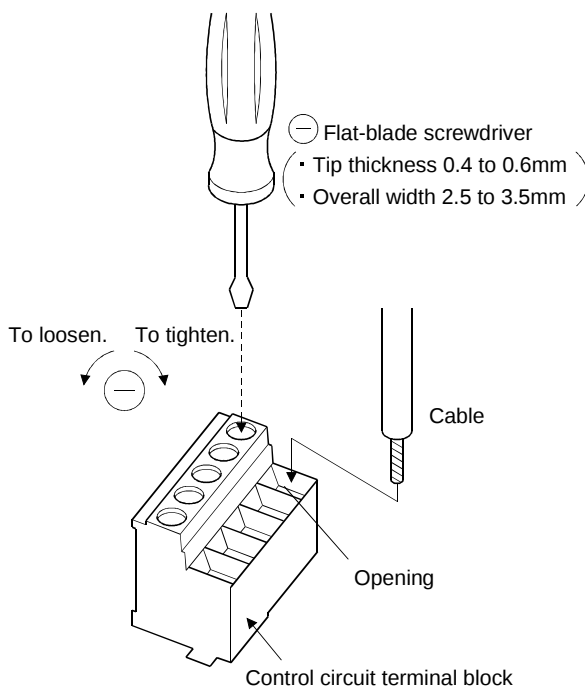
Twisted wire: Use the cable after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault. Alternatively, a bar terminal may be used to put the wires together.

Cable Size		Bar Terminal Type		Crimping Tool	Maker
[mm ²]	AWG	For 1 cable	For 2 cables		
1.25/1.5	16	AI1.5-10BK	AI-TWIN×1.5-10BK	CRIMPFOX ZA 3 or CRIMPFOX UD 6	Phoenix Contact
2/2.5	14	AI2.5-10BU			

(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: 0.3 to 0.4N · m(2.7 to 3.5 lb · in)) Before inserting the cable into the opening, make sure that the screw of the terminal is fully loose.

When using a cable of 1.5mm² or less, two cables may be inserted into one opening.



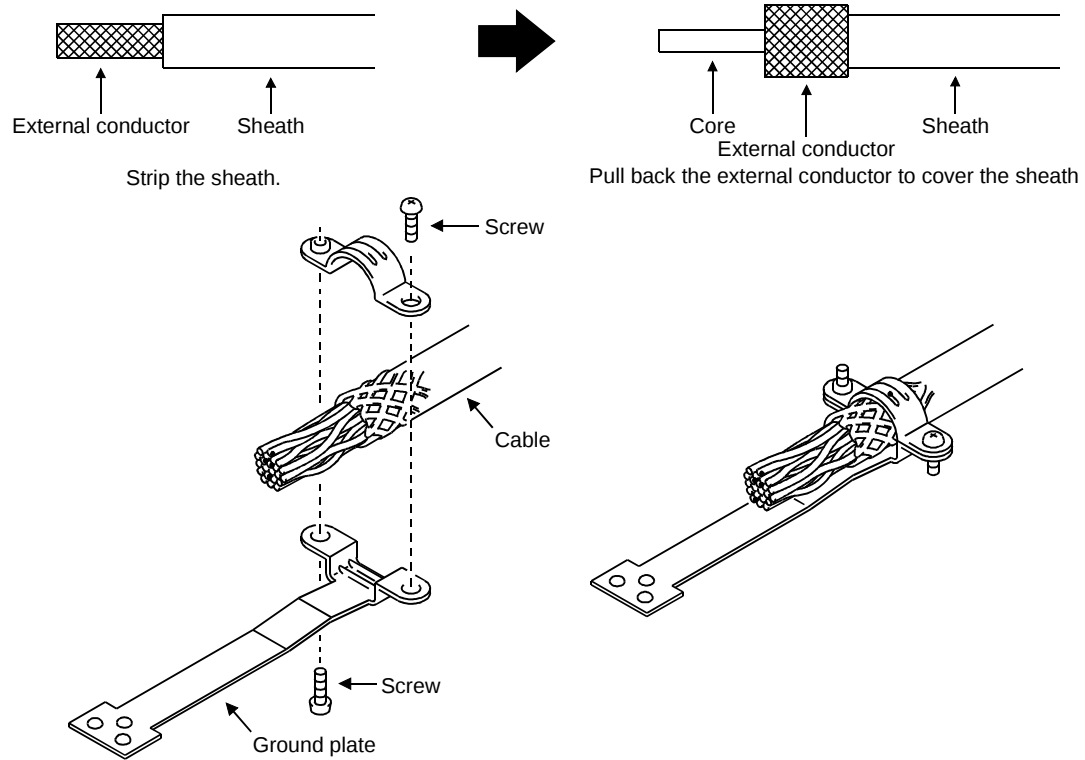
Use of a flat-blade torque screwdriver is recommended to manage the screw tightening torque. The following table indicates the recommended products of the torque screwdriver for tightening torque management and the flat-blade bit for torque screwdriver. When managing torque with a Phillips bit, please consult us.

Product	Model	Maker/Representative
Torque screwdriver	N6L TDK	Nakamura Seisakusho
Bit for torque screwdriver	B-30, flat-blade, H3.5 X 73L	Shiro Sangyo

3. SIGNALS AND WIRING

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.



This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

4. OPERATION

4. OPERATION

4.1 When switching power on for the first time

4.1.1 Pre-operation checks

Before starting operation, check the following:

(1) Wiring

- (a) A correct power supply is connected to the power input terminals (L₁, L₂, L₃) 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 earth terminal of the servo motor is connected to the PE terminal of the servo amplifier.
- (e) When the regenerative brake option is used, the lead has been removed across D-P of the control circuit terminal block. Also, twisted cables are used for its wiring.
- (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

4.1.2 Startup



WARNING

Do not operate the switches with wet hands. You may get an electric shock.

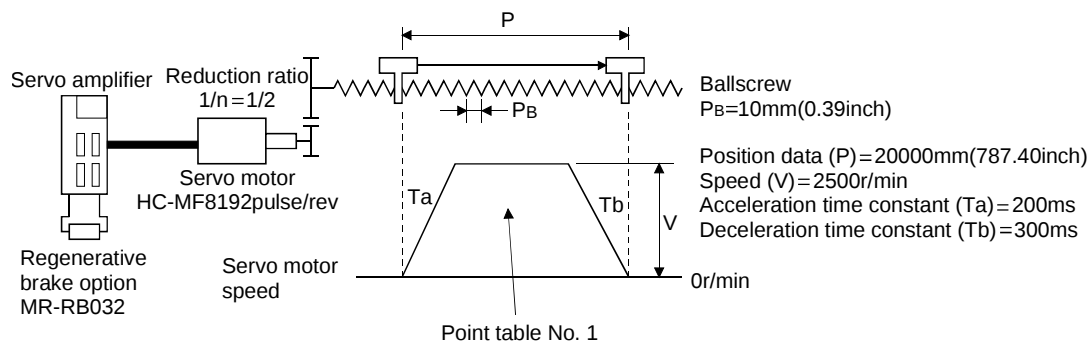


CAUTION

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

Connect the servo motor with a machine after confirming that the servo motor operates properly alone. For startup reference, a single machine structure will be described. Refer to this section and start up the machine safely.

(1) Machine conditions



- 1) Absolute position detection system used
- 2) Command resolution: 10μm
- 3) Command system: Absolute value command system
- 4) Electronic gear calculation

$$\frac{CMX(\text{pulse})}{CDV(\mu\text{m})} = \frac{8192}{\frac{1}{n} \cdot P_B \cdot 1000} = \frac{8192}{\frac{1}{2} \cdot 10 \cdot 1000} = \frac{8192}{5000} \dots\dots\dots (4.1)$$

CMX=8192
CDV=5000

- 5) For the device command method, external input signals are used by the point table selection, forward rotation start (ST1), servo-on (SON) and other commands.
- 6) Point table No.1 is used to execute automatic operation once.

4. OPERATION

(2) Startup procedure

(a) Power on

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

2) When main circuit power/control circuit power is switched on, "r" (motor speed) appears on the servo amplifier display.

In the absolute position detection system, first power-on results in the absolute position lost (A.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.

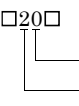
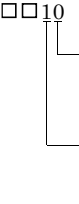
Also in the absolute position detection system, if power is switched on at the servo motor speed of 500r/min or higher, position mismatch may occur due to external force or the like. Power must therefore be switched on when the servo motor is at a stop.

(b) Test operation

Using jog operation in the test operation mode, operate at the lowest speed to confirm that the servo motor operates. (Refer to Section 6.7.1.)

(c) 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 6.4 and 7.6 for the setting method.

Parameter	Name	Setting	Description
No.0	Command system, regenerative brake option selection		Absolute value command system. MR-RB032 regenerative brake option is used.
No.1	Feeding function selection		When forward rotation start (ST1) is valid, address is incremented in CCW direction. Since command resolution is 10 times, feed length multiplication factor of 10 times is selected.
No.2	Function selection 1		Absolute position detection system.
No.4	Electronic gear numerator (CMX)	8192	From calculation result of formula (4.1)
No.5	Electronic gear denominator (CDV)	5000	From calculation result of formula (4.1)

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

(d) Point table setting

Set the point table according to the operation pattern. Refer to Section 4.2 for the point table definitions and to Sections 6.5 and 7.5 for the setting method.

Position Data [$\times 10^{\text{STM}}$ μm]	Servo Motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms]	Auxiliary Function
20000	2500	200	300	0	0

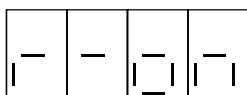
(e) Servo-on

Switch the servo-on in the following procedure:

1) Switch on main circuit/control circuit power.

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

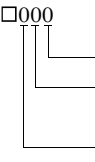
When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked. By using the sequence in the diagnostic mode in Section 7.3, the ready status can be shown on the servo amplifier display. In the operation-ready status, the following screen appears.



4. OPERATION

(f) Home position return

Perform home position return as required. Refer to Section 4.4 for home position return types. A parameter setting example for dog type home position return is given here.

Parameter	Name	Setting	Description
No.8	Home position return type		Dog type home position return is selected. Home position return is started in address incremented direction. Proximity dog (DOG) is valid when DOG-SG are opened.
No.9	Home position return speed	1000	Motion is made up to proximity dog at 1000r/min.
No.10	Creep speed	10	Motion is made up to home position at 10r/min.
No.11	Home position shift distance	0	No home position shift
No.42	Home position return position data		Set the current position at home position return completion.
No.43	Moving distance after proximity dog		Not used in dog type home position return.

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

Set the input signals as listed below and switch on the forward rotation start (ST1) to execute home position return.

Device Name	Symbol	ON/OFF	Description
Automatic/manual selection	MD0	ON	Home position return mode is selected.
Point table No. selection 1	DI0	OFF	
Point table No. selection 2	DI1	OFF	
Servo-on	SON	ON	Servo is switched on.

(g) Automatic operation

Set the input signals as listed below and switch on the forward rotation start (ST1) to execute automatic operation in accordance with point table No.1.

Device Name	Symbol	ON/OFF	Description
Automatic/manual selection	MD0	ON	Automatic operation mode is selected.
Servo-on	SON	ON	Servo is switched on.
Forward rotation stroke end	LSP	ON	Forward rotation side limit switch is turned on.
Reverse rotation stroke end	LSN	ON	Reverse rotation side limit switch is turned on.
Point table No. selection 1	DI0	ON	Point table No.1 is selected.
Point table No. selection 2	DI1	OFF	

(h) Stop

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

When the servo motor used is equipped with an electromagnetic brake, refer to Section 3.9 (3).

Note that forward rotation stroke end (LSP), reverse rotation stroke end (LSN) off has the same stopping pattern as described below.

1) Servo-on (SON) OFF

The base circuit is shut off and the servo motor coasts.

2) 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.

3) Forced stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Servo forced warning (A.E6) occurs.

4) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF

The droop pulse value is erased and the servo motor is stopped and servo-locked. It can be run in the opposite direction.

4. OPERATION

4.2 Automatic operation mode

4.2.1 What is automatic operation mode?

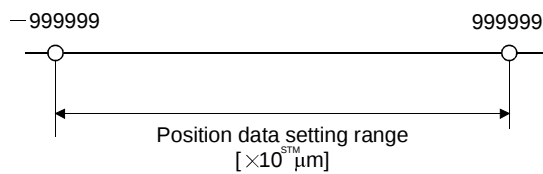
(1) Command system

After selection of preset point tables using the input signals or communication, operation is started by the forward rotation start (ST1) or reverse rotation start (ST2). Automatic operation has the absolute value command system and incremental value command system.

(a) Absolute value command system

As position data, set the target address to be reached.

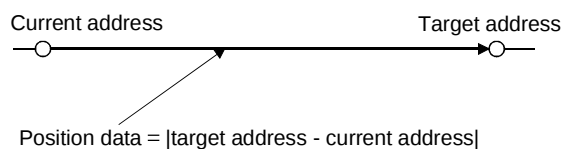
Setting range: -999999 to 999999 [$\times 10^{\text{STM}}$ μm] (STM = feed length multiplication parameter No.1)



(b) Incremental value command system

As position data, set the moving distance from the current address to the target address.

Setting range: 0 to 999999 [$\times 10^{\text{STM}}$ μm] (STM = feed length multiplication parameter No.1)



4. OPERATION

(2) Point table

(a) Point table setting

Up to 15 point tables may be set. To use point table No.s 4 to 15, however, the point table No. selection 3 (DI2) and/or point table No. selection 4 (DI3) should be made valid in "I/O Devices" on the Servo Configuration Software.

Set the point tables using the Servo Configuration Software or the servo amplifier operation section. The following table lists what to set:

Name	Setting Range	Unit	Description
Position data	Absolute value command system: -999999 to 999999 Incremental value command system: 0 to 999999	$[\times 10^{\text{STM}}\mu\text{m}]$	In the absolute value command system, motion is made to the set address. In the incremental value command system, motion is made over the set distance. Use the parameter to select the incremental value command or absolute value command. A negative value cannot be set to the incremental value command.
Servo motor speed	0 to permissible speed	r/min	Set the speed command of the servo motor for execution of positioning. The setting should be equal to or less than the instantaneous permissible speed of the servo motor.
Acceleration time constant	0 to 20000	ms	Set the acceleration time constant. Set the time until the rated speed of the servo motor is reached.
Deceleration time constant	0 to 20000	ms	Set the deceleration time constant. Set the time until the servo motor running at rated speed comes to a stop.
Dwell time	0 to 20000	ms	Set the dwell time. Set "0" in the auxiliary function to make the dwell time invalid. Set "1" in the auxiliary function and 0 in the dwell time to perform continuous operation. When the dwell time is set, the position command of the selected point table is completed, and after the set dwell time has elapsed, the position command of the next point table is started.
Auxiliary function	0 • 1		Set the auxiliary function. Set "1" to execute point tables consecutively without a stop. 0: Automatic operation is performed in accordance with a single point table chosen. 1: Operation is performed in accordance with consecutive point tables without a stop. When a different rotation direction is set, smoothing home position (command output) is confirmed and the rotation direction is then reversed. Setting "1" in point table No.15 results in an error. (Refer to Section 4.2.5.)

(b) Selection of point table

Using the input signal or communication function, select the point table No. with a command from the command device (controller) such as a personal computer.

The following table lists the point table No. selected in response to the input signals/commands. Note that when the input signals are used, the point tables used as standard are No.1 to 3. To use No.4 to 15, the point table No. selection 3 (DI2) and/or point table No. selection 4 input (DI3) should be made valid in "I/O Devices" (Refer to Chapter 6) on the Servo Configuration.

When the communication function is used to select the point tables, refer to Chapter 8 for details of the command transmission method, etc.

4. OPERATION

(Note 2) Input Signals				Selected Point Table No.
(Note 1) Across DI3-SG	(Note 1) Across DI2-SG	Across DI1-SG	Across DI0-SG	
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	10
1	0	1	1	11
1	1	0	0	12
1	1	0	1	13
1	1	1	0	14
1	1	1	1	15

Note: 1. Make signals valid in "I/O Devices" on the Servo Configuration Software.

2. "1": short

"0": open

(3) Parameter setting

Set the following parameters to perform automatic operation:

(a) Command mode selection (parameter No.0)

Select the absolute value command system or incremental value command system.

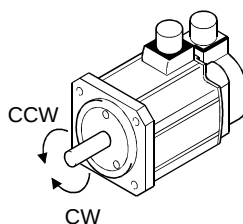
Parameter No. 0 Setting	Positioning System
☐ ☐ ☐ 0 ☐	Absolute value command
☐ ☐ ☐ 1 ☐	Incremental value command

(b) ST1 coordinate system selection (parameter No.1)

Choose the servo motor rotation direction at the time when the forward rotation start (ST1) or reverse rotation start (ST2) is switched on.

1) Absolute value command

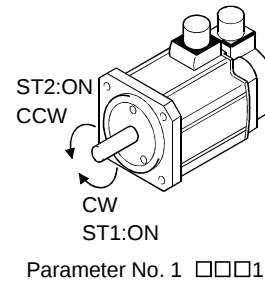
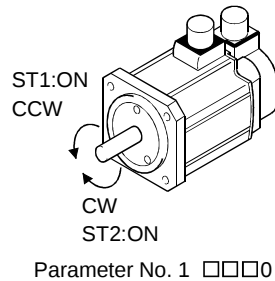
Parameter No. 1 Setting	Servo Motor Rotation Direction When Forward Rotation Start (ST1) Is Switched On
☐ ☐ ☐ 0	CCW rotation with + position data CW rotation with - position data
☐ ☐ ☐ 1	CW rotation with + position data CCW rotation with - position data



4. OPERATION

2) Incremental value command system

Parameter No.1 Setting	Servo Motor Rotation Direction	
	Forward Rotation Start (ST1) ON	Reverse Rotation Start (ST2) ON
□□□0	CCW rotation (address incremented)	CW rotation (address decremented)
□□□1	CW rotation (address incremented)	CCW rotation (address decremented)



(c) Feed length multiplication (parameter No.1)

Set the feed length multiplication factor (STM) of position data.

1) Absolute value command

Parameter No.1 Setting	Position Data Input Range [mm]
□□0□	−999.999 to +999.999
□□1□	−9999.99 to +9999.99
□□2□	−99999.9 to +99999.9
□□3□	−999999 to +999999

2) Incremental value command system

Parameter No.1 Setting	Position Data Input Range [mm]
□□0□	0 to 999.999
□□1□	0 to 9999.99
□□2□	0 to 99999.9
□□3□	0 to 999999

4. OPERATION

4.2.2 Absolute value command system

(1) Setting

(a) Signal, parameters

Set the input signal and parameters as follows according to the purpose of use:

Item	Setting Method	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON).
Absolute value command system selection	Parameter No.0	Setting: □□0□
Servo motor rotation direction	Parameter No.1	Refer to Section 4.2.1, (3).
Feed length multiplication (STM)	Parameter No.1	Refer to Section 4.2.1, (3).

(b) Point table

Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell time and auxiliary function to the point table. The following table gives a setting example:

Point Table No.	Position Data [$\times 10^{\text{STM}} \mu\text{m}$]	Servo motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms]	Auxiliary Function
1	2000	3000	200	150	0	0
2	−100	1500	250	200	0	0
3	500	200	150	250	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
14	15000	1800	200	250	0	0
15	12000	2500	200	250	0	0

(2) Operation

Choose the point table using DI0 to DI3 and short ST1-SG to perform positioning to the position data under the conditions of the preset speed, acceleration time constant and deceleration time constant. At this time, reverse rotation start (ST2) is invalid.

Item	Setting Method	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
Point table selection	Point table No. selection 1 (DI0) Point table No. selection 2 (DI1) Point table No. selection 3 (DI2) Point table No. selection 4 (DI3)	Refer to Section 4.2.1, (2).
Start	Forward rotation start (ST1)	Short ST1-SG (ON) to start.

4. OPERATION

4.2.3 Incremental value command system

(1) Setting

(a) Signal, parameters

Set the input signal and parameters as follows according to the purpose of use:

Item	Setting Method	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON)
Incremental value command system selection	Parameter No.0	Setting: ☐ ☐ ☐ ☐
Servo motor rotation direction	Parameter No.1	Refer to Section 4.2.1, (3).
Feed length multiplication	Parameter No.1	Refer to Section 4.2.1, (3).

(b) Point table

Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell time and auxiliary function to the point table. The following table gives a setting example:

Point Table No.	Position Data [$\times 10^{\text{STM}}$ μm]	Servo motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms]	Auxiliary Function
1	2000	3000	200	150	0	0
2	100	1500	250	200	0	0
3	500	200	150	250	0	0
⋮	⋮	⋮	⋮	⋮	⋮	⋮
14	15000	1800	200	250	0	0
15	12000	2500	200	250	0	0

(2) Operation

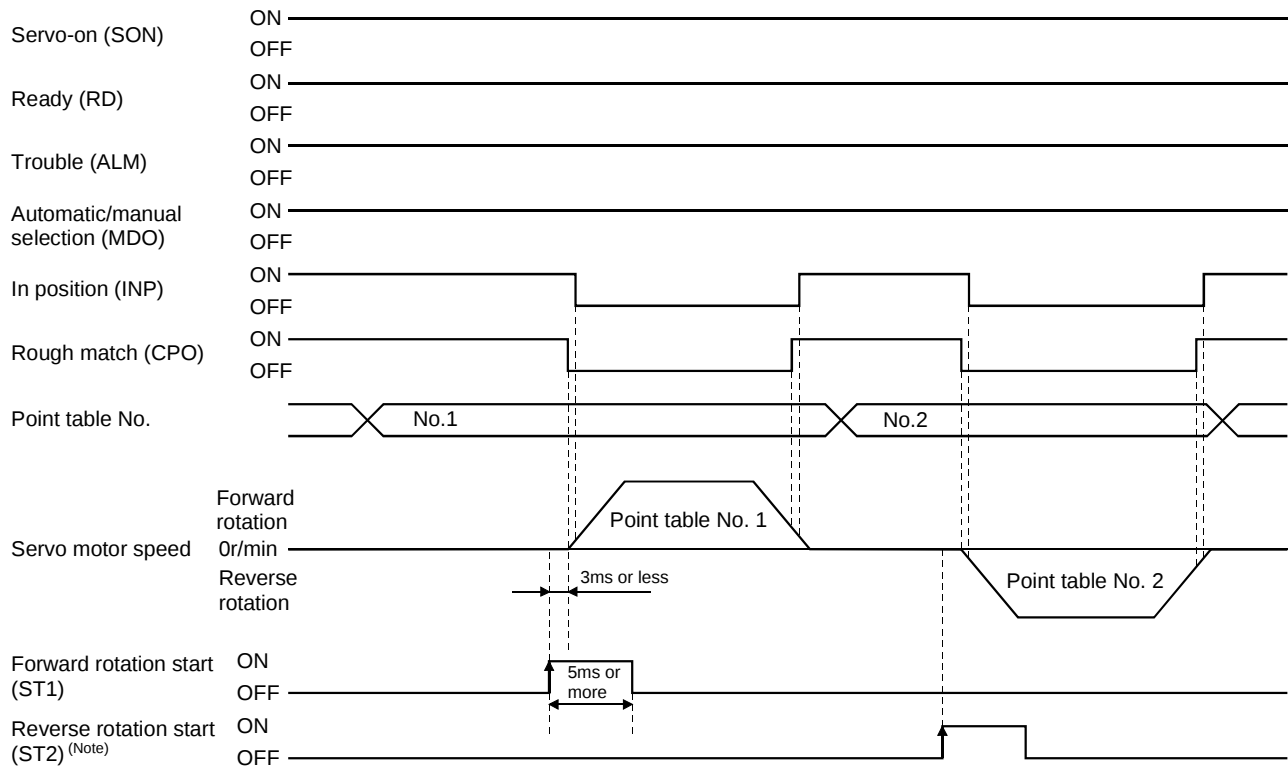
Choose the point table using DI0 to DI3 and short ST1-SG to make a motion in the forward rotation direction over the distance of the position data under the conditions of the preset speed, acceleration time constant and deceleration time constant. Short ST2-SG to make a motion in the reverse rotation direction in accordance with the point table settings.

Item	Setting Method	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
Point table selection	Point table No. selection 1 (DI0) Point table No. selection 2 (DI1) Point table No. selection 3 (DI2) Point table No. selection 4 (DI3)	Refer to Section 4.2.1, (2).
Start	Forward rotation start (ST1)	Short ST1-SG (ON) to start motion in forward rotation direction.
	Reverse rotation start (ST2)	Short ST2-SG (ON) to start motion in reverse rotation direction.

4. OPERATION

4.2.4 Automatic operation timing chart

The following is the timing chart.



Note: Reverse rotation start (ST2) is invalid for absolute value command system.

4. OPERATION

4.2.5 Automatic continuous operation

(1) What is automatic continuous operation?

By merely choosing one point table and making a forward rotation start (ST1) or reverse rotation start (ST2), operation can be performed in accordance with the point tables having consecutive numbers.

Automatic operation is available in two types: varied speed operation and automatic continuous positioning operation.

Either type may be selected as follows:

Automatic continuous operation

Varied speed operation

Automatic continuous positioning operation

Point Table Setting	
Dwell time	Auxiliary function
0	1
1 or more	1

(2) Varied speed operation

Speed during positioning operation can be changed by setting the auxiliary function of the point table. Use the number of point tables equal to the number of speeds to be set.

By setting "1" to the auxiliary function, operation is performed at the speed set in the next point table during positioning. The position data valid at this time is the data selected at start and the position data and acceleration and deceleration time constants of the subsequent point tables are made invalid.

By setting "1" to the auxiliary function of up to point table No.14, operation can be performed at a maximum of 15 speeds. Set "0" to the auxiliary function of the last point table.

When performing varied speed operation, always set "0" to the dwell time. If "1" or more is set, automatic continuous positioning operation is made valid.

The following table gives a setting example:

Point Table No.	Dwell Time [ms] (Note 1)	Auxiliary Function	Variable Speed Operation
1	0	1	Consecutive point table data
2	0	1	
3	0	0 (Note 2)	
4	0	1	Consecutive point table data
5	0	1	
6	0	1	
7	0	0 (Note 2)	

Note: 1. Always set "0".

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

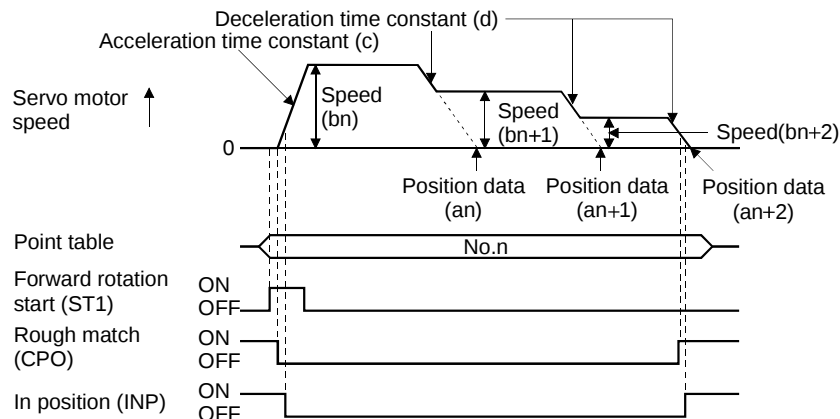
In the absolute value command system, the position data (addresses) of the midway point tables are not used for positioning and speed is changed continuously to move to the set address in the last point table.

In the incremental value command system, the position data is the total of the position data of the consecutive point tables.

4. OPERATION

(a) Absolute value command system

1) Positioning in the same direction

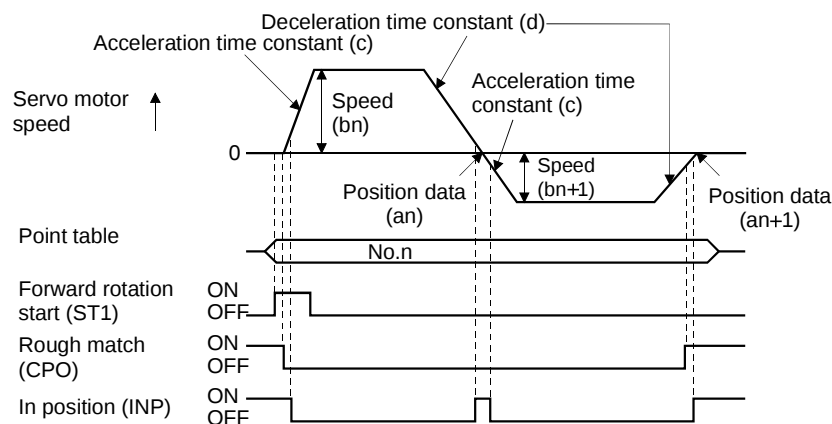


Point Table No.	Position Data [$\times 10^{\text{STM}} \mu\text{m}$]	Servo motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms] (Note 1)	Auxiliary Function
n	an	bn	c	d	0	1
n + 1	an + 1	bn + 1	Invalid	Invalid	0	1
n + 2	an + 2	bn + 2	Invalid	Invalid	0	0 (Note 2)

Note: 1. Always set "0".

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

2) Positioning changed in direction midway



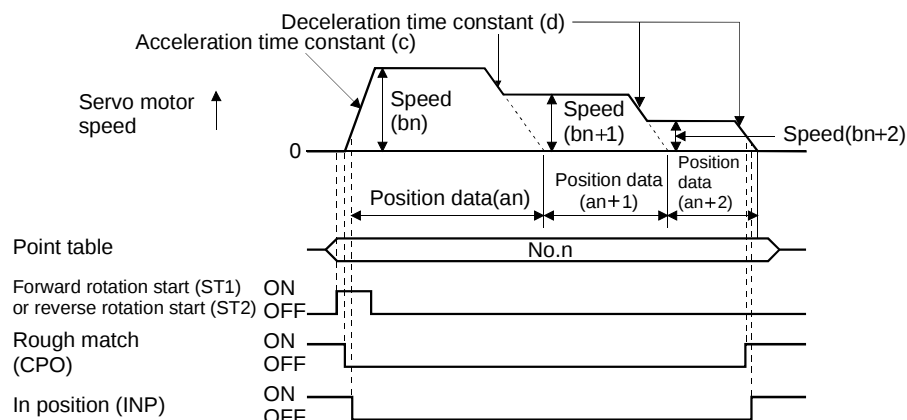
Point Table No.	Position Data [$\times 10^{\text{STM}} \mu\text{m}$]	Servo motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms] (Note 1)	Auxiliary Function
n	an	bn	c	d	0	1
n + 1	an + 1	bn + 1	Invalid	Invalid	0	0 (Note 2)

Note: 1. Always set "0".

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

4. OPERATION

(b) Incremental value command system



Point Table No.	Position Data [$\times 10^{\text{STM}} \mu\text{m}$]	Servo motor Speed [r/min]	Acceleration Time Constant [ms]	Deceleration Time Constant [ms]	Dwell Time [ms] (Note 1)	Auxiliary Function
n	a_n	b_n	c	d	0	1
n + 1	a_{n+1}	b_{n+1}	Invalid	Invalid	0	1
n + 2	a_{n+2}	b_{n+2}	Invalid	Invalid	0	0 (Note 2)

Note: 1. Always set "0".

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

(3) Automatic continuous positioning operation

By merely choosing one point table and performing operation, operation can be performed in accordance with consecutive point tables. Set the period from a stop to the next start in the dwell time of the point table.

By setting "1" to the auxiliary function of up to point table No.14 (S-pattern acceleration/deceleration time constant), automatic continuous positioning operation can be performed in accordance with a maximum of 15 point tables.

Always set "0" to the auxiliary function of the last point table. Note that if "0" is set to the dwell time, varied speed operation will be performed.

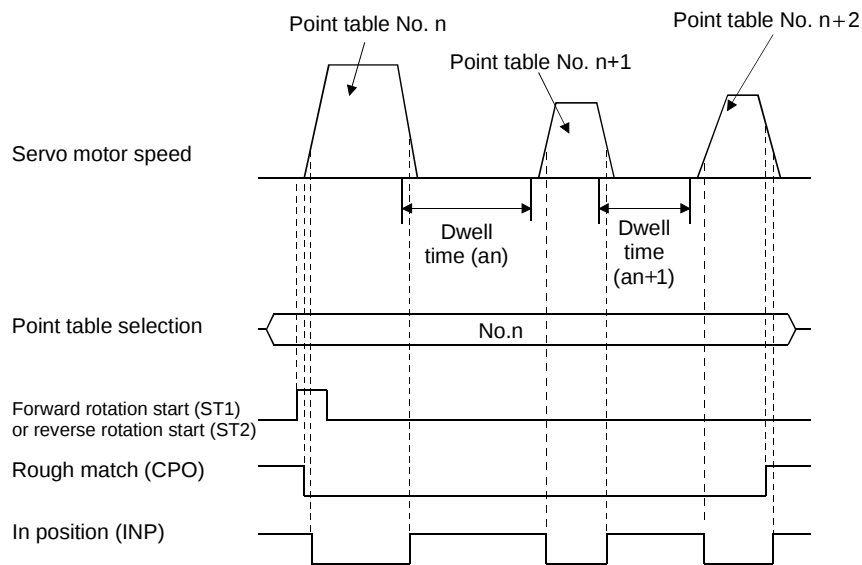
The following table gives a setting example:

Point Table No.	Dwell Time [ms] (Note 1)	Auxiliary Function	Variable Speed Operation
1	3000	1	Consecutive point table data
2	1000	1	
3		0 (Note 2)	
4	5000	1	Consecutive point table data
5	1000	1	
6	1000	1	
7		0 (Note 2)	

Note: 1. Always set "1" or more.

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

4. OPERATION



Point Table No.	Dwell Time [ms] (Note 1)	Auxiliary Function
n	a_n	1
n + 1	$a_n + 1$	1
n + 2	Invalid	0 (Note 2)

Note: 1. Always set "1" or more.

2. Always set "0" to the auxiliary function of the last point table among the consecutive point tables.

4. OPERATION

(4) Temporary stop/restart

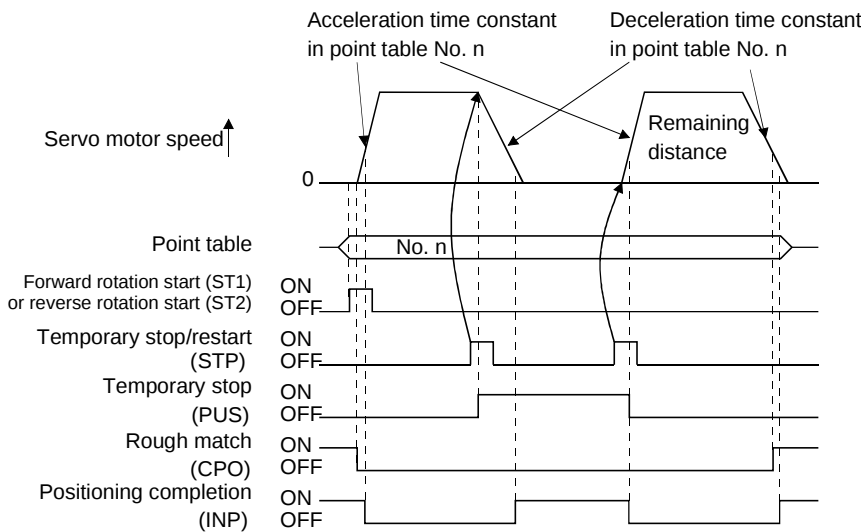
When STP-SG are connected during automatic operation, the motor is decelerated to a temporary stop at the deceleration time constant in the point table being executed. When STP-SG are connected again, the remaining distance is executed.

If the forward rotation start (ST1) or reverse rotation start (ST2) is ignored if it is switched on during a temporary stop.

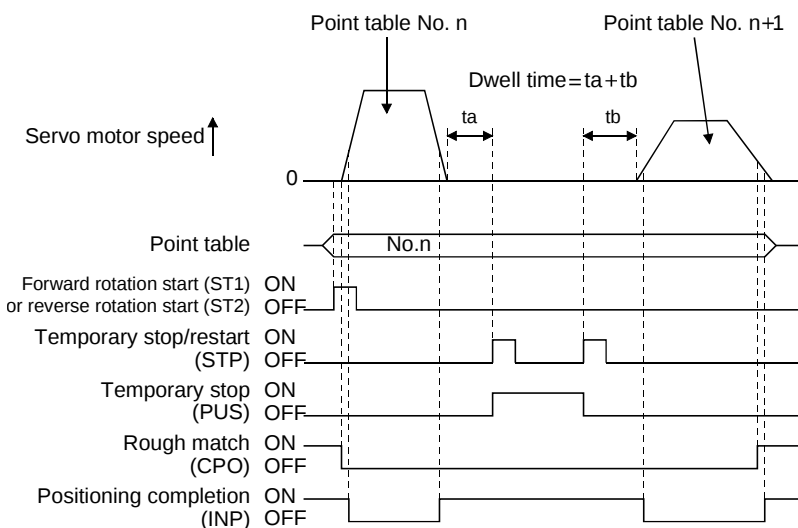
The remaining moving distance is cleared when the operation mode is changed from the automatic mode to the manual mode during a temporary stop.

The temporary stop/restart input is ignored during home position return and jog operation.

(a) When the servo motor is rotating



(b) During dwell time



4. OPERATION

4.3 Manual operation mode

For machine adjustment, home position matching, etc., jog operation or a manual pulse generator may be used to make a motion to any position.

4.3.1 Jog operation

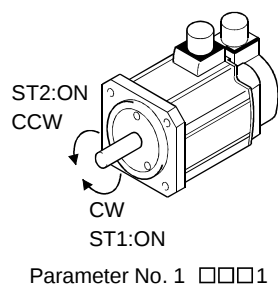
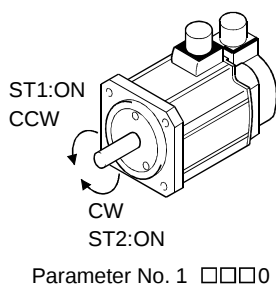
(1) Setting

Set the input signal and parameters as follows according to the purpose of use. In this case, the point table No. selection 1 to 4 signals (DI0 to DI3) are invalid:

Item	Setting Method	Description
Manual operation mode selection	Automatic/manual selection (MDO)	Open MDO-SG (OFF).
Servo motor rotation direction	Parameter No.1	Refer to (2) in this section.
Jog speed	Parameter No.13	Set the speed of the servo motor.
Acceleration/deceleration time constant	Point table No.1	Use the acceleration/deceleration time constants in point table No.1.

(2) Servo motor rotation direction

Parameter No. 1 Setting	Servo Motor Rotation Direction	
	Forward Rotation Start (ST1) ON	Reverse Rotation Start (ST2) ON
□□□0	CCW rotation	CW rotation
□□□1	CW rotation	CCW rotation

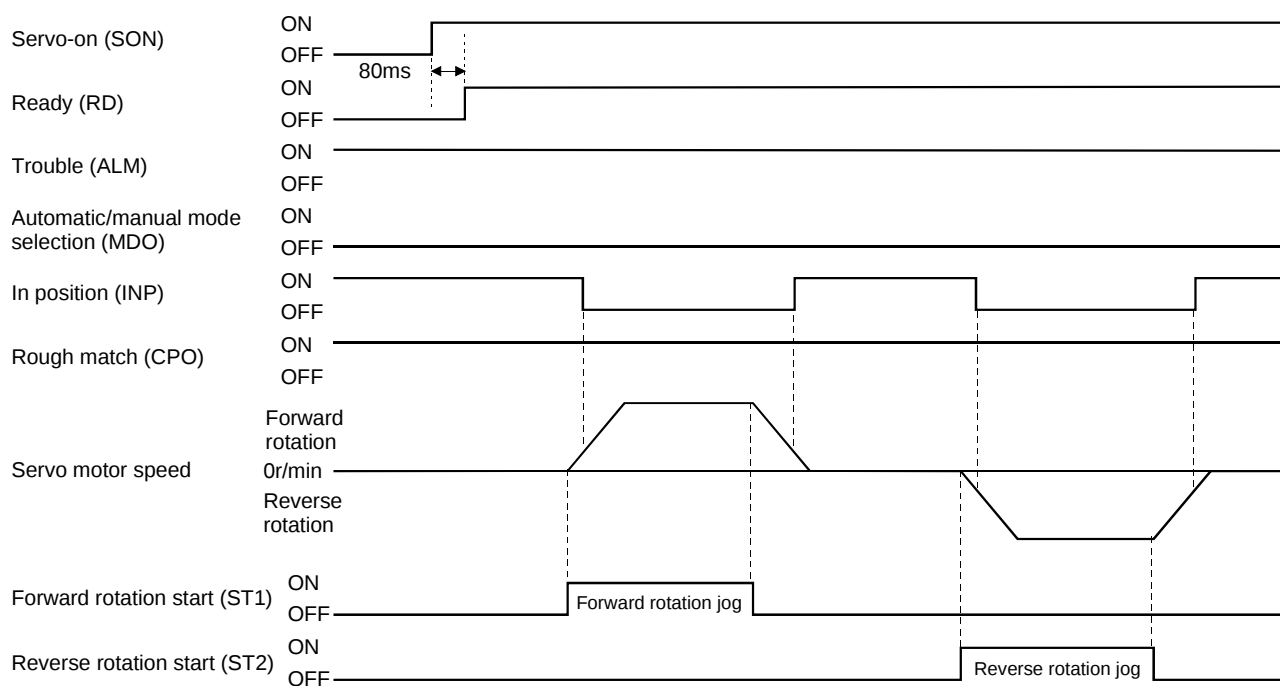


(3) Operation

By shorting ST1-SG, operation is performed under the conditions of the jog speed set in the parameter and the acceleration and deceleration time constants in set point table No.1. For the rotation direction, refer to (2) in this section. By shorting ST2-SG, the servo motor rotates in the reverse direction to forward rotation start (ST1).

4. OPERATION

(4) Timing chart



4. OPERATION

4.3.2 Manual pulse generator operation

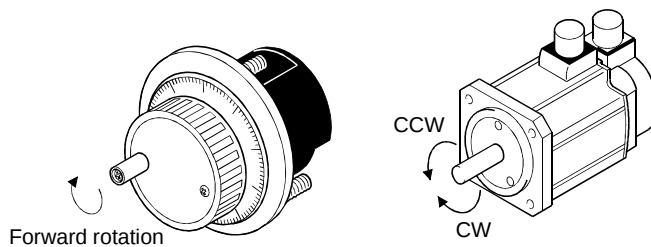
(1) Setting

Set the input signal and parameters as follows according to the purpose of use. In this case, the point table No. selection 1 to 4 signals (DI0 to DI3) are invalid:

Item	Setting Method	Description
Manual operation mode selection	Automatic/manual selection (MD0)	Open MD0-SG (OFF).
Manual pulse generator multiplication	Parameter No.1	Set the multiplication ratio of servo motor rotation to the pulses generated by the manual pulse generator. For more information, refer to (3) in this section.
Servo motor rotation direction	Parameter No.1	Refer to (2) in this section.

(2) Servo motor rotation direction

Parameter No. 1 Setting	Servo Motor Rotation Direction	
	Manual pulse generator: Forward rotation	Manual pulse generator: Reverse rotation
☐ ☐ ☐ ☐ 0	CCW rotation	CW rotation
☐ ☐ ☐ ☐ 1	CW rotation	CCW rotation



(3) Manual pulse generator multiplication

(a) Using the parameter for setting

Use parameter No.1 to set the multiplication ratio of the servo motor rotation to the manual pulse generator rotation.

Parameter No. 1 Setting	Multiplication Ratio of Servo Motor Rotation to Manual Pulse Generator Rotation	Moving Distance
☐ 0 ☐ ☐ ☐	1 time	1[μm]
☐ 1 ☐ ☐ ☐	10 times	10[μm]
☐ 2 ☐ ☐ ☐	100 times	100[μm]

4. OPERATION

(b) Using the input signals for setting

Set the pulse generator multiplication 1 (TP0) and pulse generator multiplication 2 (TP1) to the input signals in "Device setting" on the Servo Configuration Software (refer to Chapter 6).

Pulse Generator Multiplication 2 (across TP1)	Pulse Generator Multiplication 1 (across TP0)	Multiplication Ratio of Servo Motor Rotation to Manual Pulse Generator Rotation	Moving Distance
0	0	Parameter No.1 setting valid	
0	1	1 time	1[μm]
1	0	10 times	10[μm]
1	1	100 times	100[μm]

Note. 0: Open across TP1/TP0-SG

1: Shorted across TP1/TP0-SG

(4) Operation

Turn the manual pulse generator to rotate the servo motor. For the rotation direction of servo motor, refer to (2) in this section.

4. OPERATION

4.4 Manual home position return mode

4.4.1 Outline of home position return

Home position return is performed to match the command coordinates with the machine coordinates. In the incremental system, home position return is required every time input power is switched on. In the absolute position detection system, once home position return is done at the time of installation, the current position is retained if power is switched off. Hence, home position return is not required when power is switched on again.

This servo amplifier has the home position return methods given in this section. Choose the most appropriate method for your machine structure and application.

This servo amplifier has the home position return automatic return function which executes home position return by making an automatic return to a proper position if the machine has stopped beyond or at the proximity dog. Manual motion by jog operation or the like is not required.

(1) Manual home position return types

Five manual home position return types are available. Choose the optimum home position return according to the machine type, etc.

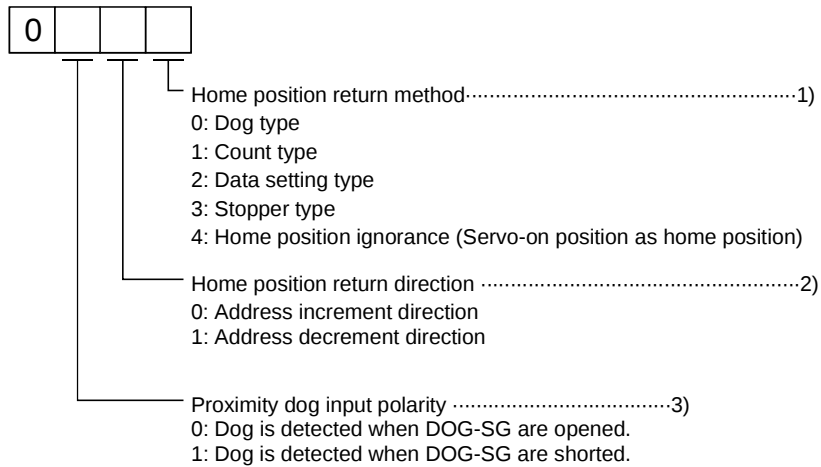
Type	Home position return Method	Features
Dog type home position return	With deceleration started at the front end of a proximity dog, the position where the first Z-phase signal is given past the rear end of the dog or a motion has been made over the home position shift distance starting from the Z-phase signal is defined as a home position. (Note)	General home position return method using a proximity dog. Repeatability of home position return is excellent and the machine is less burdened. Used when the width of the proximity dog can be set greater than the deceleration distance of the servo motor.
Count type home position return	With deceleration started at the front end of a proximity dog, the position where the first Z-phase signal is given after advancement over the preset moving distance after the proximity dog or a motion has been made over the home position shift distance starting from the Z-phase signal is defined as a home position.	Home position return method using a proximity dog. Used when it is desired to minimize the length of the proximity dog.
Data setting type home position return	The position reached after any automatic motion is defined as a home position.	No proximity dog required.
Stopper type home position return	The position where the machine stops when its part is pressed against a machine stopper is defined as a home position.	• Since the machine part collides with the machine be fully lowered. • The machine and stopper strength must be increased.
Home position ignorance (Servo-on position as home position)	The position where servo is switched on is defined as a home position.	

Note: The Z-phase signal is a signal recognized in the servo amplifier once per servo motor revolution and cannot be used as an output signal.

4. OPERATION

(2) Home position return parameter

When performing home position return, set parameter No.8 as follows:



- 1) Choose the home position return method.
- 2) Choose the starting direction of home position return. Set "0" to start home position return in the direction in which the address is incremented from the current position, or "1" to start home position return in the direction in which the address is decremented.
- 3) Choose the polarity at which the proximity dog is detected. Set "0" to detect the dog when the proximity dog device (across DOG-SG) is opened, or "1" to detect the dog when the device is shorted.

(3) Instructions

- 1) Before starting home position return, always make sure that the limit switch operates.
- 2) Confirm the home position return direction. Incorrect setting will cause the machine to run reversely.
- 3) Confirm the proximity dog input polarity. Otherwise, misoperation can occur.

4. OPERATION

4.4.2 Dog type home position return

A home position return method using a proximity dog. With deceleration started at the front end of the proximity dog, the position where the first Z-phase signal is given past the rear end of the dog or a motion has been made over the home position shift distance starting from the Z-phase signal is defined as a home position.

(1) Signals, parameters

Set the input signals and parameters as follows:

Item	Device/Parameter Used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON).
	Point table No. selection 1 (DI0)	Open DI0-SG (OFF).
	Point table No. selection 2 (DI1)	Open DI1-SG (OFF).
Dog type home position return	Parameter No.8	☐ ☐ ☐ 0 :Dog type home position return is selected.
Home position return direction	Parameter No.8	Refer to (3) in this section and choose home position return direction.
Dog input polarity	Parameter No.8	Refer to (3) in this section and choose dog input polarity.
Home position return speed	Parameter No.9	Set speed until detection of dog.
Creep speed	Parameter No.10	Set speed after detection of dog.
Home position shift distance	Parameter No.11	Set when shifting the home position starting at the first Z-phase signal after passage of proximity dog rear end.
Home position return acceleration/deceleration time constants	Point table No.1	Use the acceleration/deceleration time constants of point table No.1.
Home position return position data	Parameter No.42	Set the current position at home position return completion.

(2) Length of proximity dog

To ensure that the Z-phase signal of the servo motor is generated during detection of the proximity dog (DOG), the proximity dog should have the length which satisfies formulas (4.2) and (4.3):

$$L_1 \geq \frac{V}{60} \cdot \frac{td}{2} \dots\dots\dots (4.2)$$

L_1 : Proximity dog length [mm]

V : Home position return speed [mm/min]

td : Deceleration time [s]

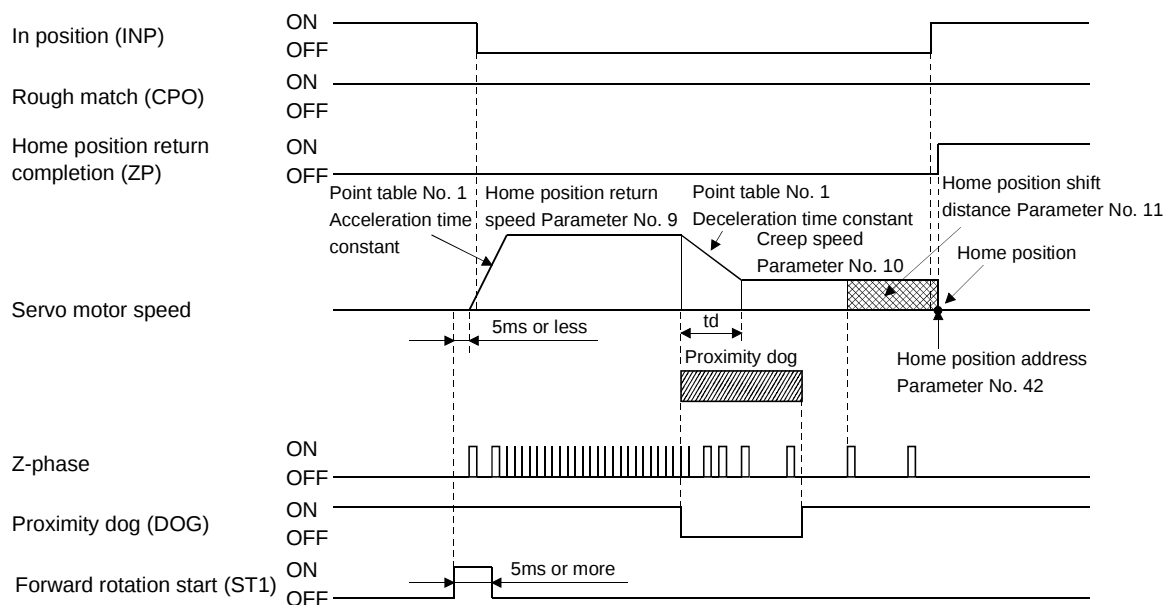
$$L_2 \geq 2 \cdot \Delta S \dots\dots\dots (4.3)$$

L_2 : Proximity dog length [mm]

ΔS : Moving distance per servo motor revolution [mm]

4. OPERATION

(3) Timing chart



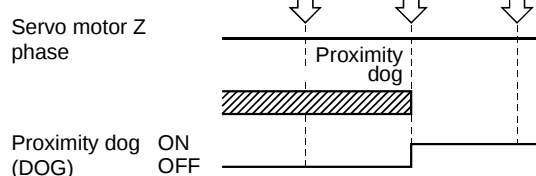
The address on completion of home position return is the value automatically set in parameter No.42 (home position return position data).

(4) Adjustment

In dog type home position return, adjust to ensure that the Z-phase signal is generated during dog detection. Locate the rear end of the proximity dog (DOG) at approximately the center of two consecutive Z-phase signals.

The position where the Z-phase signal is generated can be monitored in "Within one-revolution position" of "Status display".

Servo motor	Within one-revolution position		
HC-MF HA-FF HC-UF 3000 r/min	0	4096	0
HC-SF RF-UF 2000 r/min	0	8192	0



4. OPERATION

4.4.3 Count type home position return

In count type home position return, a motion is made over the distance set in parameter No.43 (moving distance after proximity dog) after detection of the proximity dog front end. The position where the first Z-phase signal is given after that is defined as a home position. Hence, if the proximity dog (DOG) is 10ms or longer, there is no restriction on the dog length. This home position return method is used when the required proximity dog length cannot be reserved to use dog type home position return or when the proximity dog (DOG) is entered electrically from a controller or the like.

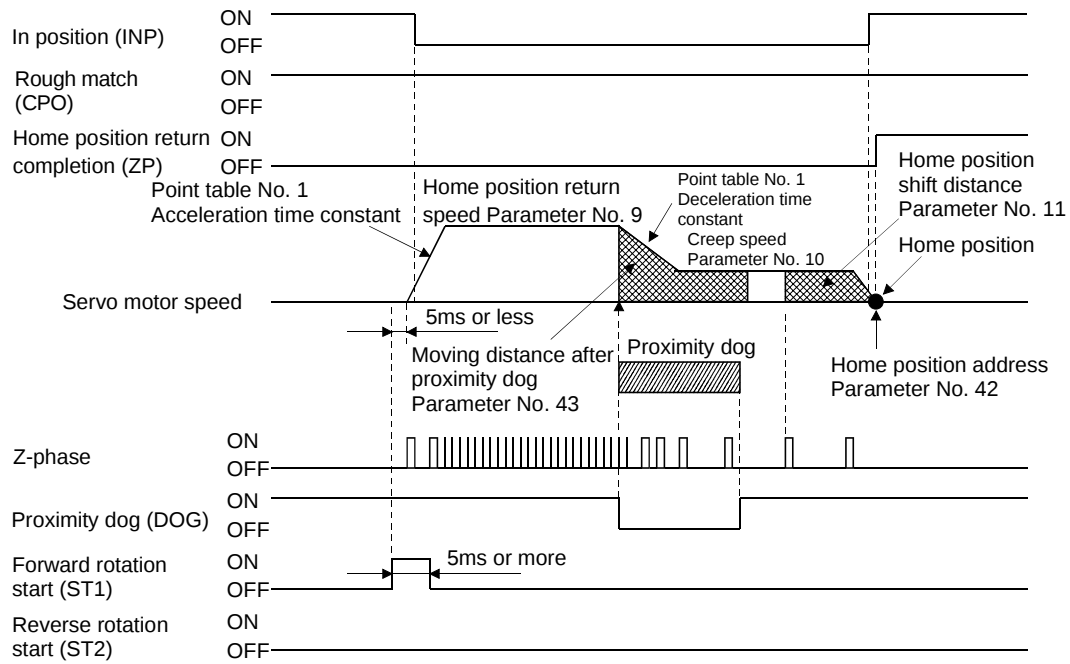
(1) Signals, parameters

Set the input signals and parameters as follows:

Item	Device/Parameter Used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON).
	Point table No. selection 1 (DI0)	Open DI0-SG (OFF).
	Point table No. selection 2 (DI1)	Open DI1-SG (OFF).
Count type home position return	Parameter No.8	☐ ☐ ☐ 1: Count type home position return is selected.
Home position return direction	Parameter No.8	Refer to (3) in this section and choose home position return direction.
Dog input polarity	Parameter No.8	Refer to (3) in this section and choose dog input polarity.
Home position return speed	Parameter No.9	Set speed until detection of dog.
Creep speed	Parameter No.10	Set speed after detection of dog.
Home position shift distance	Parameter No.11	Set when shifting the home position, starting at the first Z-phase signal given after passage of the proximity dog front end and movement over the moving distance.
Moving distance after proximity dog	Parameter No.43	Set the moving distance after passage of proximity dog front end.
Home position return acceleration/deceleration time constants	Parameter No.1	Use the acceleration/deceleration time constants of point table No.1.
Home position return position data	Parameter No.42	Set the current position at home position return completion.

4. OPERATION

(2) Timing chart



The address on completion of home position return is the value automatically set in parameter No.42 (home position return position data).

4. OPERATION

4.4.4 Data setting type home position return

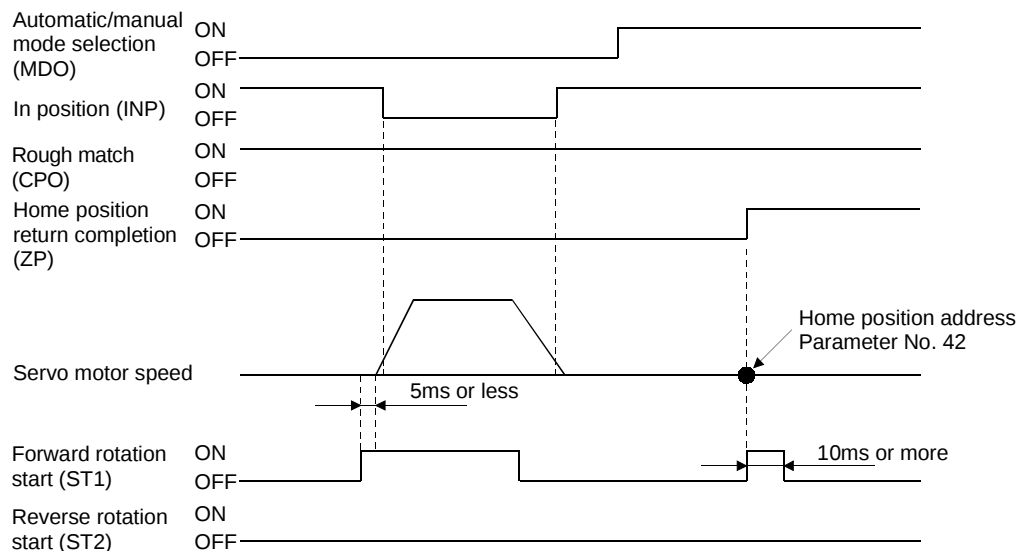
In data setting type home position return, a motion is made to any position by jog operation, manual pulse generator operation or the like to make a home position return, and the position reached is defined as a home position.

(1) Signals, parameters

Set the input signals and parameters as follows:

Item	Device/Parameter Used	Description
Data setting type home position return	Parameter No.8	☐ ☐ ☐ 2: Data setting type home position return is selected.
Home position return position data	Parameter No.42	Set the current position at home position return completion.

(2) Timing chart



The address on completion of home position return is the value automatically set in parameter No.42 (home position return position data).

4. OPERATION

4.4.5 Stopper type home position return

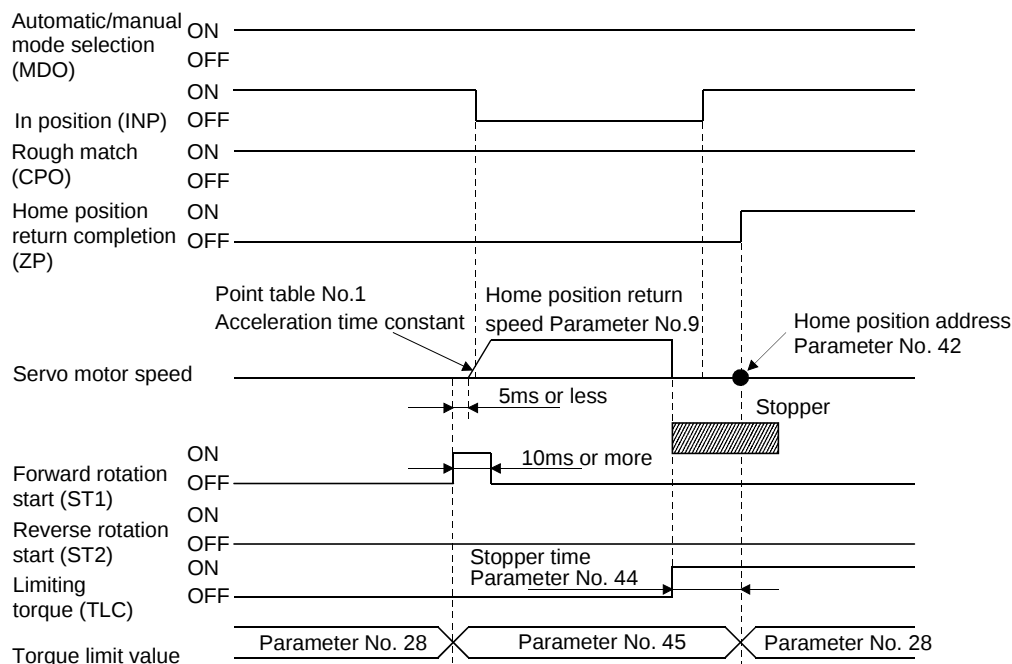
In stopper type home position return, a machine part is pressed against a stopper or the like by jog operation, manual pulse generator operation or the like to make a home position return and that position is defined as a home position.

(1) Signals, parameters

Set the input signals and parameters as follows:

Item	Device/Parameter Used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON).
	Point table No. selection 1 (DI0)	Open DI0-SG (OFF).
	Point table No. selection 2 (DI1)	Open DI1-SG (OFF).
Stopper type home position return	Parameter No.8	☐ ☐ ☐ 3:Stopper type home position return is selected.
Home position return direction	Parameter No.8	Refer to Section 4.4.1 (2) and choose the home position return direction.
Home position return speed	Parameter No.9	Set the speed till contact with the stopper.
Stopper time	Parameter No.44	Time from when the part makes contact with the stopper to when home position return data is obtained to output home position return completion (ZP)
Stopper type home position return torque limit	Parameter No.45	Set the servo motor torque limit value for execution of stopper type home position return.
Home position return acceleration time constant	Point table No.1	Use the acceleration time constant of point table No.1.
Home position return position data	Parameter No.42	Set the current position at home position return completion.

(2) Timing chart



The address on completion of home position return is the value automatically set in parameter No.42 (home position return position data).

4. OPERATION

4.4.6 Home position ignorance (servo-on position defined as home position)

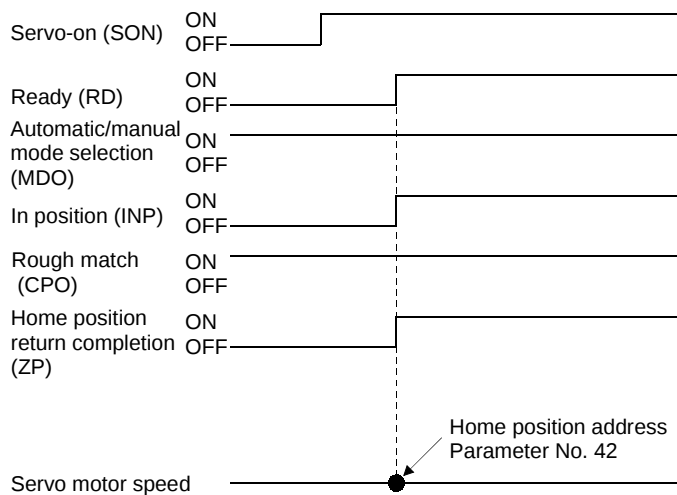
The position where servo is switched on is defined as a home position.

(1) Signals, parameter

Set the input signals and parameter as follows:

Item	Device/Parameter Used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Short MD0-SG (ON).
	Point table No. selection 1 (DI0)	Open DI0-SG (OFF).
	Point table No. selection 2 (DI1)	Open DI1-SG (OFF).
Home position ignorance	Parameter No.8	□□□4: Home position ignorance is selected.
Home position return position data	Parameter No.42	Set the current position at home position return completion.

(2) Timing chart



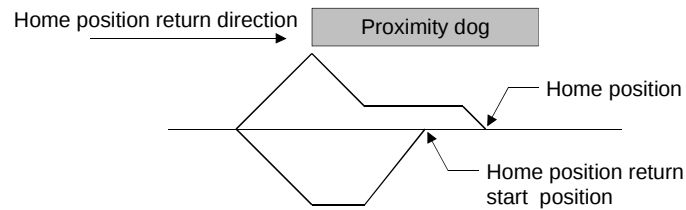
The address on completion of home position return is the value automatically set in parameter No.42 (home position return position data).

4. OPERATION

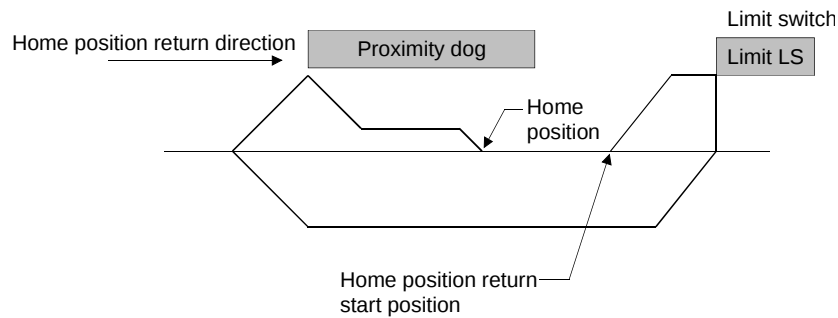
4.4.7 Home position return automatic return function

If the current position is at or beyond the proximity dog in dog or count type home position return, you need not make a start after making a return by jog operation or the like.

When the current position is at the proximity dog, an automatic return is made before home position return.



At a start, a motion is made in the home position return direction and an automatic return is made on detection of the limit switch. The motion stops past the front end of the proximity dog, and home position return is resumed at that position. If the proximity dog cannot be detected, the motion stops on detection of the opposite limit switch and A. 90 occurs.



Software limit cannot be used with these functions.

4. OPERATION

4.5 Absolute position detection system



CAUTION

- If an absolute position erase alarm (A.25) or absolute position counter warning (A.E3) has occurred, always perform home position setting again. Not doing so can cause runaway.

This servo amplifier contains a single-axis controller. Also, all servo motor encoders are compatible with an absolute position system. Hence, an absolute position detection system can be configured up by merely loading an absolute position data back-up battery and setting parameter values.

(1) Restrictions

An absolute position detection system cannot be built under the following conditions:

- 1) Stroke-less coordinate system, e.g. rotary shaft, infinite positioning.
- 2) Operation performed in incremental value command type positioning system.

(2) Specifications

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 ± 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.

(3) Structure

Component	Description
Servo amplifier	Use standard models.
Servo motor	
Battery	MR-BAT or A6BAT
Encoder cable	Use a standard model. When fabricating, refer to (2), Section 14.1.2.

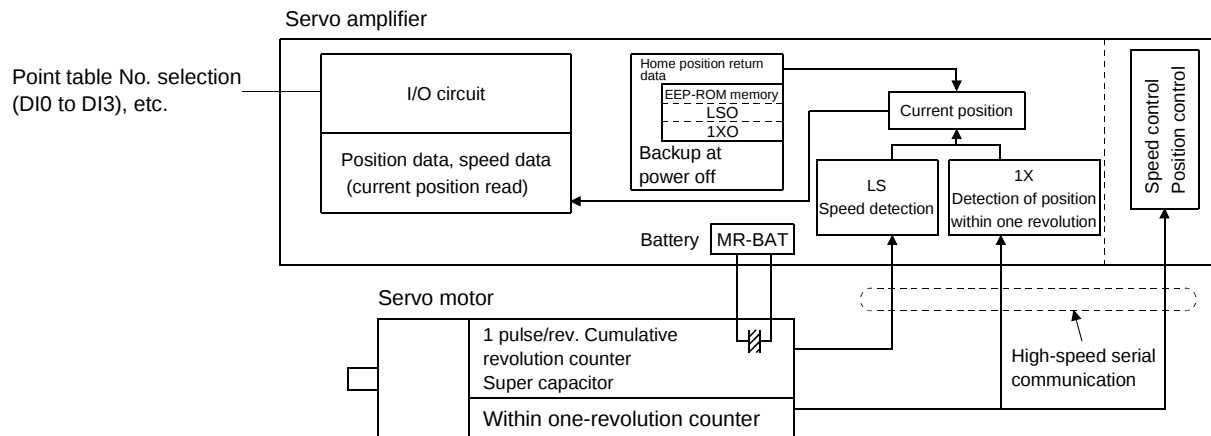
4. OPERATION

(4) Outline of absolute position detection data communication

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.

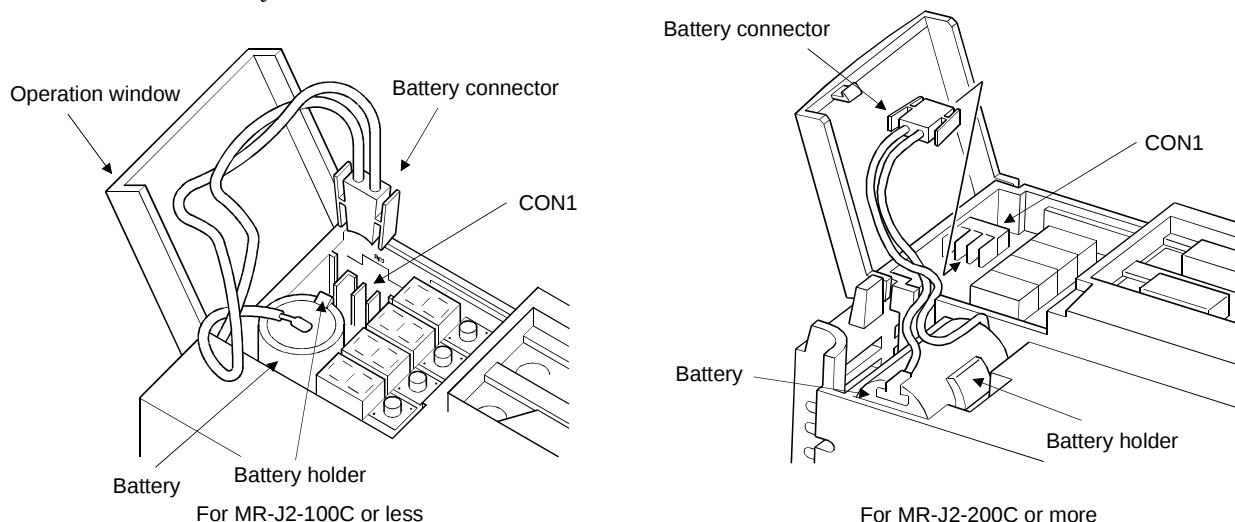
Also, the absolute position data, which is battery-backed by the super capacitor in the encoder, can be retained within the specified period (cumulative revolution counter value retaining time) if the cable is unplugged or broken.



(5) Battery installation procedure

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-J2-200C 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.



4. OPERATION

(6) Parameter setting

Set parameter No.2 (Function selection 1) as indicated below to make the absolute position detection system valid:

Parameter No.2

1			
---	--	--	--

Selection of absolute position detection system
0: Incremental system
1: Absolute position detection system

4.6 Serial communication operation

The RS-422 or RS-232C communication function may be used to operate the servo amplifier from a command device (controller) such as a personal computer. Positioning operation can be performed with the positioning operation/position specified by selection of the point tables. Note that the RS-422 and RS-232C communication functions cannot be used at the same time.

This section provides a data transfer procedure. Refer to Chapter 8 for full information on the connection and transferred data between the controller and servo amplifier.

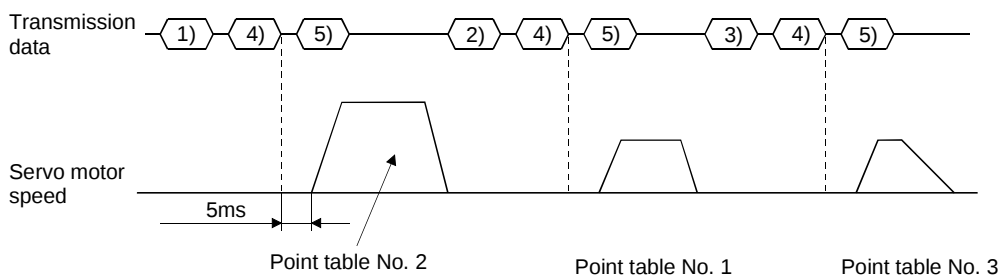
4.6.1 Positioning operation in accordance with point tables

By selecting the point table No. and switching on the forward rotation start (ST1) or reverse rotation start (ST2) using the communication function, positioning operation in accordance with point tables can be started.

(1) Selection of point tables

Using the device forced output from the controller (command [9][2], data No. [6][0]), choose point tables from among No.1 to 15.

(2) Timing chart



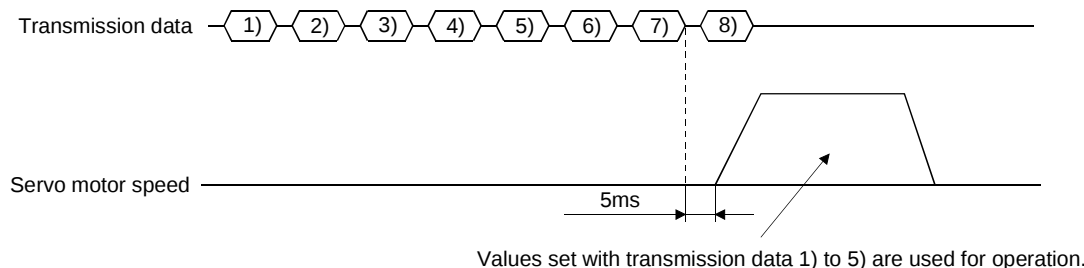
No.	Transmission Data	Command	Data No.
1)	Point table No.2 selection	[9] [2]	[6] [0]
2)	Point table No.1 selection	[9] [2]	[6] [0]
3)	Point table No.3 selection	[9] [2]	[6] [0]
4)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
5)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]

4. OPERATION

4.6.2 Positioning operation

Positioning operation can be performed by changing the point table settings and making a start. For example, positioning operation can be performed by writing the data of point table No.1, then specifying point table No.1, and making a start.

For transmission data details, refer to Chapter 8.

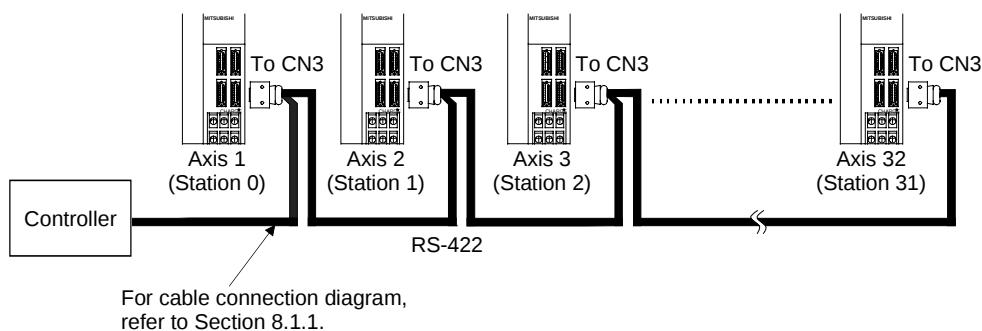


No.	Transmission Data	Command	Data No.
1)	Point table No.1 position data write	[C] [0]	[0] [1]
2)	Point table No.1 speed	[C] [6]	[0] [1]
3)	Point table No.1 acceleration time constant	[C] [7]	[0] [1]
4)	Point table No.1 deceleration time constant	[C] [8]	[0] [1]
5)	Point table No.1 auxiliary function	[C] [B]	[0] [1]
6)	Point table No.1 selection	[9] [2]	[6] [0]
7)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
8)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]

4.6.3 Multidrop system

The RS-422 communication function can be used to operate several servo amplifiers on the same bus. In this case, set the station numbers to the servo amplifiers to determine the destination servo amplifier of the currently transmitted data. Use parameter No.15 to set the station numbers.

Always set one station number to one servo amplifier. Normal communication cannot be made if one station number is set to two or more servo amplifiers. When using one command to operate several servo amplifiers, use the group designation function described in Section 4.6.4.



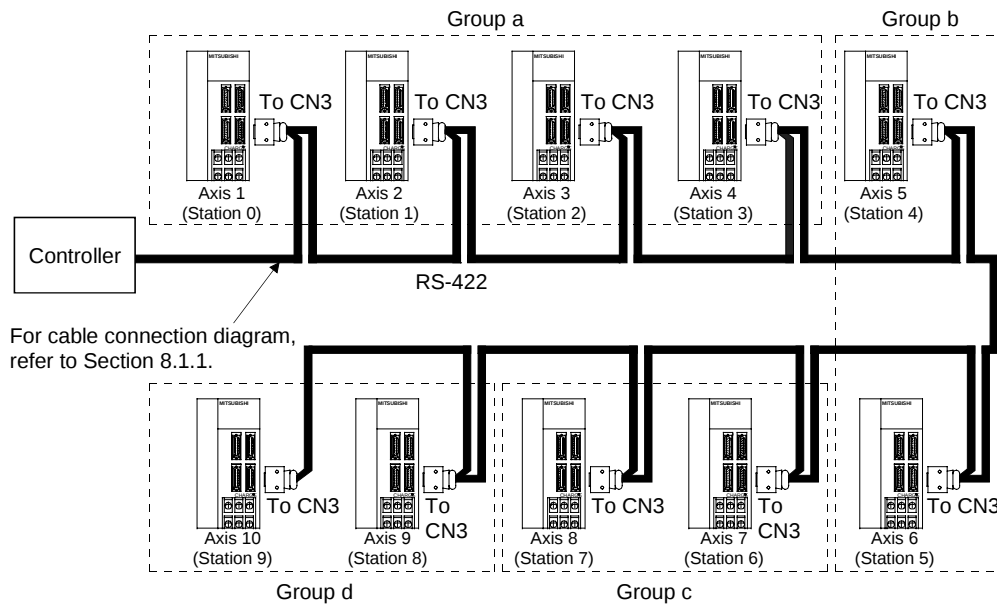
4. OPERATION

4.6.4 Group designation

When using several servo amplifiers, command-driven parameter settings, etc. can be made on a group basis.

You can set up to six groups, a to f. Set the group to each station using the communication command.

(1) Group setting example

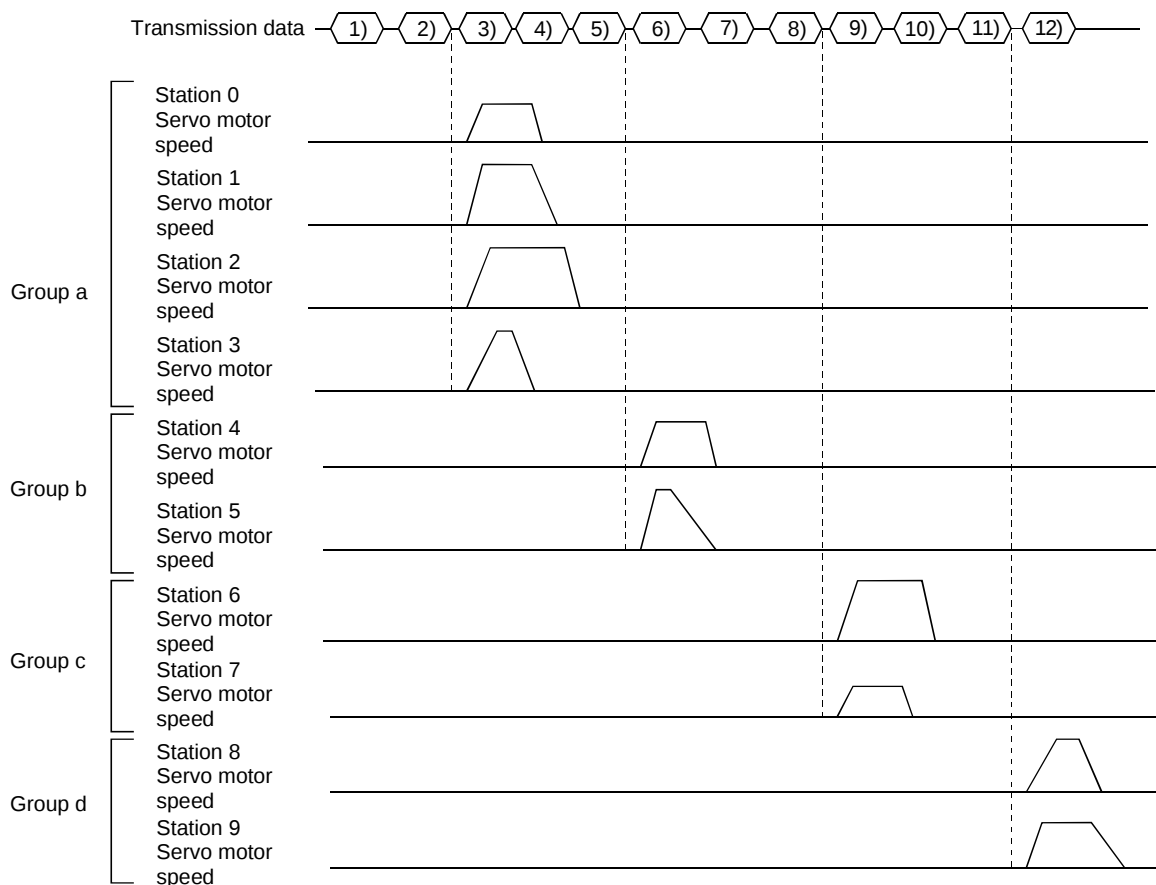


Servo Amplifier Station No.	Group Setting
Station 0	a
Station 1	
Station 2	
Station 3	
Station 4	b
Station 5	
Station 6	c
Station 7	
Station 8	d
Station 9	

4. OPERATION

(2) Timing chart

In the following timing chart, operation is performed group-by-group in accordance with the values set in point table No.1.



No.	Transmission Data	Command	Data No.
1)	Selection of point table No.1 of group a	[9] [2]	[6] [0]
2)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
3)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]
4)	Selection of point table No.1 of group b	[9] [2]	[6] [0]
5)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
6)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]
7)	Selection of point table No.1 of group c	[9] [2]	[6] [0]
8)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
9)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]
10)	Selection of point table No.1 of group d	[9] [2]	[6] [0]
11)	Forward rotation start (ST1) ON	[9] [2]	[6] [0]
12)	Forward rotation start (ST1) OFF	[9] [2]	[6] [0]

In addition, parameter values common to the stations of each group can be written and alarm reset can be made, for example.

(3) Group setting instructions

Only one servo amplifier may send a reply in any group. If two or more servo amplifiers send reply data at the same time, they may become faulty.

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

- Set "000E" when using the Servo Configuration Software to make device setting.
- After setting the parameter No.19 value, switch power off, then on to make that setting valid.

In the servo amplifier, its parameters are classified into the basic parameters (No.0 to 19) and expansion parameters (No.20 to 66) 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 lists the parameters whose values are made valid for reference/write by setting parameter No. 19. Operation can be performed for the parameters marked ○.

Parameter No.19 Setting	Operation	Basic Parameters No.0 to 19	Expansion Parameters No.20 to 53	Expansion Parameters No.54 to 66
0000 (initial value)	Reference	○		
	Write	○		
000A	Reference	No.19 only		
	Write	No.19 only		
000B	Reference	○	○	
	Write	○		
000C	Reference	○	○	
	Write	○	○	
000E	Reference	○	○	○
	Write	○	○	○

5. PARAMETERS

5.1.2 Lists

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

For details of the parameters, refer to the corresponding items.

(1) Item list

Class	No.	Symbol	Name and Function	Initial Value	Unit	Customer Setting
Basic parameters	0	*STY	Command system, regenerative brake option selection	0000		
	1	*FTY	Feeding function selection	0000		
	2	*OP1	Function selection 1	0002		
	3	AUT	Auto tuning	0102		
	4	*CMX	Electronic gear numerator	1		
	5	*CDV	Electronic gear denominator	1		
	6	INP	In-position range	100	pulse	
	7	PG1	Position loop gain 1	36	rad/s	
	8	*ZTY	Home position return type	0010		
	9	*ZRF	Home position return speed	500	r/min	
	10	CRF	Creep speed	10	r/min	
	11	ZST	Home position shift distance	0	μm	
	12	CRP	Rough match output range	0	× 10 ^{STM} μm	
	13	JOG	Jog speed	100	r/min	
	14	*STC	S-pattern acceleration/deceleration time constant	0	ms	
	15	*SNO	Station number setting	0	station	
	16	*BPS	Communication baudrate	0000		
	17	MOD	Analog monitor output	0100		
	18	*DMD	Status display selection, alarm history clear	0000		
	19	*BLK	Parameter write inhibit	0000		

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Customer Setting
Expansion parameters	20	*OP2	Function selection 2	0000		
	21		For manufacturer setting	0002		
	22	*OP4	Function selection 4	0000		
	23	SIC	Serial communications time-out selection	0		
	24	FFC	Feed forward gain	0	%	
	25	VCO	Override offset	0	mV	
	26	TLO	Torque limit offset	0	mV	
	27		For manufacturer setting	0		
	28	TL1	Internal torque limit 1	100	%	
	29	TL2	Internal torque limit 2	100	%	
	30	*BKC	Backlash compensation	0	pulse	
	31	MO1	Analog monitor ch1 offset	0	mV	
	32	MO2	Analog monitor ch2 offset	0	mV	
	33	MBR	Electromagnetic brake sequence output	100	ms	
	34	DG2	Ratio of load inertia moment to servo motor inertia moment	70	0.1 times	
	35	PG2	Position loop gain 2	30	rad/s	
	36	VG1	Speed loop gain 1	216	rad/s	
	37	VG2	Speed loop gain 2	714	rad/s	
	38	VIC	Speed integral compensation	20	ms	
	39	VDC	Speed differential compensation	980		
	40		For manufacturer setting	0		
	41			0		
	42	*ZPS	Home position return position data	0	$\times 10^{\text{STM}}\mu\text{m}$	
	43	DCT	Moving distance after proximity dog	1000	$\times 10^{\text{STM}}\mu\text{m}$	
	44	ZTM	Stopper type home position return stopper time	100	ms	
	45	ZTT	Stopper type home position return torque limit value	15	%	
	46	*LMP	Software limit +	0	$\times 10^{\text{STM}}\mu\text{m}$	
	47					
	48	*LMN	Software limit -	0	$\times 10^{\text{STM}}\mu\text{m}$	
	49					
	50	*LPP	Position range output address +	0	$\times 10^{\text{STM}}\mu\text{m}$	
	51					
	52	*LNP	Position range output address -	0	$\times 10^{\text{STM}}\mu\text{m}$	
	53					
	54		For manufacturer setting	0001		
	55			0009		
	56			080A		
	57			0706		
	58			020B		
	59			0504		
	60			0002		
	61			0000		
	62			0005		
	63			0304		
	64			0102		
	65			0		
	66			0		

5. PARAMETERS

(2) Detail list

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference
Basic parameters	0	*STY	Command system, regenerative brake option selection Used to select the command system and regenerative brake option.  Selection of command mode 0: Absolute value command 1: Incremental value command Selection of regenerative brake option 0: Not used 1: Spare (do not set) 2:MR-RB032 3:MR-RB12 4:MR-RB32 5:MR-RB30 6:MR-RB50	0000		Refer to Name and function column.	Section 4.2 Section 14.1.1
	1	*FTY	Feeding function selection Used to set the feed length multiplication factor and manual pulse generator multiplication factor.  ST1 coordinate system selection 0: Address is incremented in CCW direction 1: Address is incremented in CW direction When "1" is set, pressing the start switch for test operation starts rotation in the reverse direction. Feed length multiplication factor (STM) 0: 1 time 1: 10 times 2: 100 times 3: 1000 times Manual pulse generator multiplication factor 0: 1 time 1: 10 times 2: 100 times Servo-on (SON) -off, forced stop (EMG) -off follow-up for absolute value command in incremental system 0: Invalid 1: Valid Normally, when this servo amplifier is used in the absolute value command method of the incremental system, placing it in a servo off or forced stop status will erase the home position. When "1" is set in this parameter, the home position will not be erased if the servo amplifier is placed in a servo off or forced stop status. Operation can be resumed when servo-on (SON) is turned on again or forced stop (EMG) is canceled.	0000		Refer to Name and function column.	Section 4.2.1 Section 4.2.1 Section 4.3.2

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference												
Basic parameters	2	*OP1	Function selection 1 Used to select the input filter and absolute position detection system. 00 Input filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 1.77[ms] 2: 3.55[ms] Selection of absolute position detection system 0: Incremental system 1: Absolute position detection system	0002		Refer to Name and function column.	Section 4.5												
	3	AUT	Auto tuning Used to set the response level, etc. for execution of auto tuning. 0 Auto tuning response level setting <table><tr><th>Set value</th><th>Response level</th></tr><tr><td>1</td><td>Low response</td></tr><tr><td>2</td><td>↕</td></tr><tr><td>3</td><td>Middle response</td></tr><tr><td>4</td><td>↕</td></tr><tr><td>5</td><td>High response</td></tr></table> • Decrease the set value if the machine hunts or generates large gear sound. • Increase the set value to improve performance, e.g. shorten the settling time. Select the machine For example, used to improve the position settling characteristic when friction is large. 0: Ordinary machine 1: Machine with large friction Auto tuning selection 0: Auto tuning for use of interpolation axis control or the like under position control (For speed loop only. Not used normally.) 1: Auto tuning for ordinary 2: Not executed	Set value	Response level	1	Low response	2	↕	3	Middle response	4	↕	5	High response	0102		Refer to Name and function column.	Chapter 9
	Set value	Response level																	
	1	Low response																	
	2	↕																	
	3	Middle response																	
4	↕																		
5	High response																		
4	CMX	Electronic gear numerator Set the value of electronic gear numerator.	1		1 to 32767	Section 5.2.1													
5	CDV	Electronic gear denominator Set the value of electronic gear denominator.	1		1 to 32767	Section 5.2.1													
6	INP	In-position range Used to set the droop pulse range when the in-position (INP) is output.	100	pulse	0 to 10000														

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference
Basic parameters	7	PG1	Position loop gain 1 Used to set the gain of position loop 1. Increase the gain to improve tracking performance in response to the position command.	36	rad/s	4 to 1000	Chapter 9
	8	*ZTY	Home position return type Used to set the home position return system, home position return direction and proximity dog input polarity. 0 Home position return system 0: Dog type 1: Count type 2: Data setting type 3: Stopper type 4: Home position ignorance (Servo-on position as home position) Home position return direction 0: Address increment direction 1: Address decrement direction Proximity dog input polarity 0: Dog is detected when DOG-SG are opened 1: Dog is detected when DOG-SG are shorted	0010		Refer to Name and function column.	Section 4.4
	9	ZRF	Home position return speed Used to set the servo motor speed for home position return.	500	r/min	0 to permissible speed	Section 4.4
	10	CRF	Creep speed Used to set the creep speed after proximity dog detection.	10	r/min	0 to permissible speed	Section 4.4
	11	ZST	Home position shift distance Used to set the shift distance starting at the Z-phase pulse detection position inside the encoder.	0	μm	0 to 65535	Section 4.4
	12	CRP	Rough match output range Used to set the command remaining distance range where the rough match (CPO) is output.	0	$\times 10^{\text{STM}}$ μm	0 to 65535	Section 5.2.7
	13	JOG	Jog speed Used to set the jog speed command.	100	r/min	0 to permissible speed	
	14	*STC	S-pattern acceleration/deceleration time constant Set when inserting an S-pattern time constant into the acceleration/deceleration time constant of the point table. This time constant is invalid for home position return.	0	ms	0 to 100	Section 5.2.3
	15	*SNO	RS-422 station number setting Used to specify the station number for RS-422 multidrop communication. Always set one station to one axis of servo amplifier. If one station number is set to two or more stations, normal communication cannot be made.	0	Station	0 to 31	

5. PARAMETERS

Basic parameters

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference
	16	*BPS	Communication baudrate Used to select the RS-422/RS-232C communication baudrate and choose various conditions for communication.				

Basic parameters

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference																		
Expansion parameters	20	*OP2	Function selection 2 Used to select slight vibration suppression control. 0 0 <table><tr><th rowspan="2">Setting</th><th colspan="2">Rotation Direction in Which Torque Limit Is Made Valid</th></tr><tr><th>CCW direction</th><th>CW direction</th></tr><tr><td>0</td><td>○</td><td>○</td></tr><tr><td>1</td><td>○</td><td></td></tr><tr><td>2</td><td></td><td>○</td></tr></table> Slight vibration suppression control selection 0: Invalid 1: Valid	Setting	Rotation Direction in Which Torque Limit Is Made Valid		CCW direction	CW direction	0	○	○	1	○		2		○	0000		Refer to Name and function column.	Section 3.4.4 Section 9.5				
	Setting	Rotation Direction in Which Torque Limit Is Made Valid																							
		CCW direction	CW direction																						
0	○	○																							
1	○																								
2		○																							
21			For manufacturer setting Must not be change	0002																					
22	*OP4		Function selection 4 Used to select stop processing at forward rotation stroke end (LSP), reverse rotation stroke end (LSN) off and choose the machine resonance suppression filter. 0 Stopping method used when forward rotation stroke end (LSP), reverse rotation stroke end (LSN) device or software limit is valid (Refer to Section5.2.5) 0: Sudden stop 1: Slow stop Processing of base circuit performed when reset (RES) device is valid 0: Base circuit not switched off 1: Base circuit switched off Machine resonance suppression filter <table><tr><th>Set value</th><th>Machine Resonance Frequency [Hz]</th></tr><tr><td>0</td><td>Not used</td></tr><tr><td>1</td><td>1125</td></tr><tr><td>2</td><td>563</td></tr><tr><td>3</td><td>375</td></tr><tr><td>4</td><td>282</td></tr><tr><td>5</td><td>225</td></tr><tr><td>6</td><td>188</td></tr><tr><td>7</td><td>161</td></tr></table>	Set value	Machine Resonance Frequency [Hz]	0	Not used	1	1125	2	563	3	375	4	282	5	225	6	188	7	161	0000		Refer to Name and function column.	Section 5.2.5 Chapter 9
Set value	Machine Resonance Frequency [Hz]																								
0	Not used																								
1	1125																								
2	563																								
3	375																								
4	282																								
5	225																								
6	188																								
7	161																								

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference						
Expansion parameters	23	SIC	Serial communication time-out selection Used to choose the time-out period of communication protocol. <table><tr><td>Setting</td><td>Description</td></tr><tr><td>0</td><td>No time-out check</td></tr><tr><td>1 to 60</td><td>Time-out check period setting Check period = setting [s]</td></tr></table>	Setting	Description	0	No time-out check	1 to 60	Time-out check period setting Check period = setting [s]	0		0 to 60	
	Setting	Description											
	0	No time-out check											
	1 to 60	Time-out check period setting Check period = setting [s]											
	24	FFC	Feed forward gain Used to set the feed forward gain. At the setting of 100%, droop pulses during constant-speed operation will be almost “zero”. Note that sudden acceleration/deceleration will increase overshoot. 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%. When setting this parameter, always set auto tuning (parameter No.3) to "Not executed".	0	%	0 to 100	Chapter 9						
	25	VCO	Override offset Used to set the offset voltage to analog override.	0	mV	−999 to 999	Section 3.4.3						
	26	TL0	Torque limit offset Used to set the offset voltage to analog torque limit (TLA).	0	mV	−999 to 999	Section 3.4.4						
	27		For manufacturer setting Must not be change	0									
	28	TL1	Internal torque limit 1 Used to limit servo motor-torque on the assumption that the maximum torque is 100%. When 0 is set, torque is not produced.	100	%	0 to 100	Section 3.4.4						
	29	TL2	Internal torque limit 2 Used to limit servo motor-torque on the assumption that the maximum torque is 100%. When 0 is set, torque is not produced. Made valid by switching on the internal torque limit selection (TL2).	100	%	0 to 100	Section 3.4.4						
30	*BKC	Backlash compensation Used to set the backlash compensation made when the command direction is reversed. This function compensates for the number of backlash pulses in the opposite direction to the home position return direction. In the absolute position detection system, this function compensates for the backlash pulse count in the direction opposite to the operating direction at power-on.	0	pulse	0 to 1000								
31	MO1	Analog monitor 1 (MO1) offset Used to set the offset voltage of the analog monitor 1 (MO1) output.	0	mV	−999 to 999	Section 5.2.4							
32	MO2	Analog monitor 2 (MO2) offset Used to set the offset voltage of the analog monitor 2 (MO2) output.	0	mV	−999 to 999	Section 5.2.4							

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference
Expansion parameters	33	MBR	Electromagnetic brake sequence output Used to set the delay time (Tb) between when the electromagnetic brake interlock (MBR) switches off and when the base circuit is shut off.	100	ms	0 to 1000	Section 3.9
	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 is selected, the result of auto tuning is automatically set.	70	× 0.1 times	0 to 1000	Chapter 9
	35	PG2	Position loop gain 2 Used to set the gain of the position loop. Set this parameter to increase the position response level to load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically set.	30	rad/s	1 to 500	Chapter 9
	36	VG1	Speed loop gain 1 Normally this parameter value need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning is selected, the result of auto tuning is automatically set.	216	rad/s	20 to 5000	Chapter 9
	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 is selected, the result of auto tuning is automatically set.	714	rad/s	20 to 8000	Chapter 9
	38	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. When auto tuning is selected, the result of auto tuning is automatically set.	20	ms	1 to 1000	Chapter 9
	39	VDC	Speed differential compensation Used to set the differential compensation. Made valid when the proportion control (PC) is switched on.	980		0 to 1000	Chapter 9
	40		For manufacturer setting	0			
	41		Must not change	0			
	42	*ZPS	Home position return position data Used to set the current position on completion of home position return.	0	× 10 ^{STM} μm	−32768 to 32767	Section 4.4
	43	DCT	Moving distance after proximity dog Used to set the moving distance after proximity dog in count type home position return.	1000	× 10 ^{STM} μm	0 to 65535	Section 4.4.3
	44	ZTM	Stopper type home position return stopper time In stopper type home position return, used to set the time from when the machine part is pressed against the stopper and the torque limit set in parameter No.45 is reached to when the home position is set.	100	ms	5 to 1000	Section 4.4.5
	45	ZTT	Stopper type home position return torque limit Used to set the torque limit value relative to the max. torque in [%] in stopper type home position return.	15	%	1 to 100	Section 4.4.5

5. PARAMETERS

Class	No.	Symbol	Name and Function	Initial Value	Unit	Setting Range	Reference
Expansion parameters	46 47	*LMP	Software limit + Used to set the address increment side software stroke limit. The software limit is made invalid if this value is the same as in "software limit -". Set the same sign to parameters No.46 and 47. Setting of different signs will result in a parameter error. Set address: $\square\square\square\square\square$ Upper 3 digits Lower 3 digits Parameter No. 47 Parameter No. 46	0	$\times 10^{\text{STM}}$ μm	-999999 to 999999	Section 5.2.8
	48 49	*LMN	Software limit - Used to set the address decrement side software stroke limit. The software limit is made invalid if this value is the same as in "software limit +". Set the same sign to parameters No.48 and 49. Setting of different signs will result in a parameter error. Set address: $\square\square\square\square\square$ Upper 3 digits Lower 3 digits Parameter No. 49 Parameter No. 48	0	$\times 10^{\text{STM}}$ μm	-999999 to 999999	Section 5.2.8
	50 51	*LPP	Position range output address + Used to set the address increment side position range output address. Set the same sign to parameters No.50 and 51. Setting of different signs will result in a parameter error. Set address: $\square\square\square\square\square$ Upper 3 digits Lower 3 digits Parameter No. 51 Parameter No. 50	0	$\times 10^{\text{STM}}$ μm	-999999 to 999999	
	52 53	*LNP	Position range output address - Used to set the address decrement side position range output address. Set the same sign to parameters No.52 and 53. Setting of different signs will result in a parameter error. Set address: $\square\square\square\square\square$ Upper 3 digits Lower 3 digits Parameter No. 53 Parameter No. 52	0	$\times 10^{\text{STM}}$ μm	-999999 to 999999	
	54		For manufacturer setting	0001			
	55		The setting is automatically changed.	0009			
	56			080A			
	57			0706			
	58			020B			
	59			0504			
	60			0002			
	61			0000			
	62			0005			
	63			0304			
	64			0102			
	65		For manufacturer setting	0			
	66		Never change the setting.	0			

5. PARAMETERS

5.2 Detailed explanation

5.2.1 Electronic gear



CAUTION

▪ False setting will result in unexpected fast rotation, causing injury.

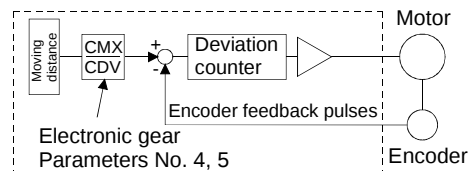
POINT

- The range of the electronic gear setting is $\frac{1}{20} < \frac{CMX}{CDV} < 20$. If you set any value outside this range, a parameter error (A.37) occurs.
- Always make electronic gear setting in the servo off status to prevent runaway due to false setting.

(1) Concept of electronic gear

Use the electronic gear (parameters No.4, 5) to make adjustment so that the servo amplifier setting matches the moving distance of the machine. Also, by changing the electronic gear value, the machine can be moved at any multiplication ratio to the moving distance on the servo amplifier.

$$\frac{CMX}{CDV} = \frac{\text{Parameters No. 4}}{\text{Parameters No. 5}}$$



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

POINT

- The following specification symbols are needed for electronic gear calculation:
 - Pb : Ballscrew lead [mm]
 - n : Reduction ratio
 - Pt : Servo motor resolution [pulse/rev]
 - ΔS : Travel per servo motor revolution [mm/rev]

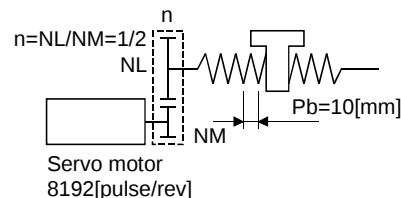
(a) Ballscrew setting example

Machine specifications

Ballscrew lead: Pb = 10 [mm]

Reduction ratio: n = 1/2

Servo motor resolution: Pt = 8192 [pulse/rev]



$$\frac{CMX}{CDV} = \frac{p_t}{\Delta S} = \frac{p_t}{n \cdot p_b \cdot 1000} = \frac{8192}{1/2 \cdot 10 \cdot 1000} = \frac{8192}{5000} = \frac{1024}{625}$$

Hence, set 1024 to CMX and 625 to CDV.

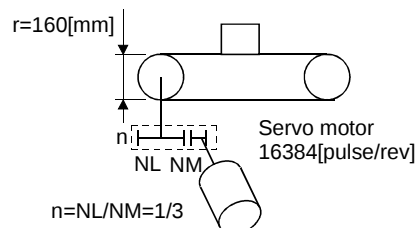
(b) Conveyor setting example

Machine specifications

Pulley diameter: r = 160 [mm]

Reduction ratio: n = 1/3

Servo motor resolution: Pt = 16384 [pulse/rev]



$$\frac{CMX}{CDV} = \frac{p_t}{\Delta S} = \frac{p_t}{n \cdot r \cdot \pi \cdot 1000} = \frac{16384}{1/3 \cdot 160 \cdot \pi \cdot 1000} = \frac{16384}{167551.61} \approx \frac{4096}{41888} \approx \frac{2048}{20944}$$

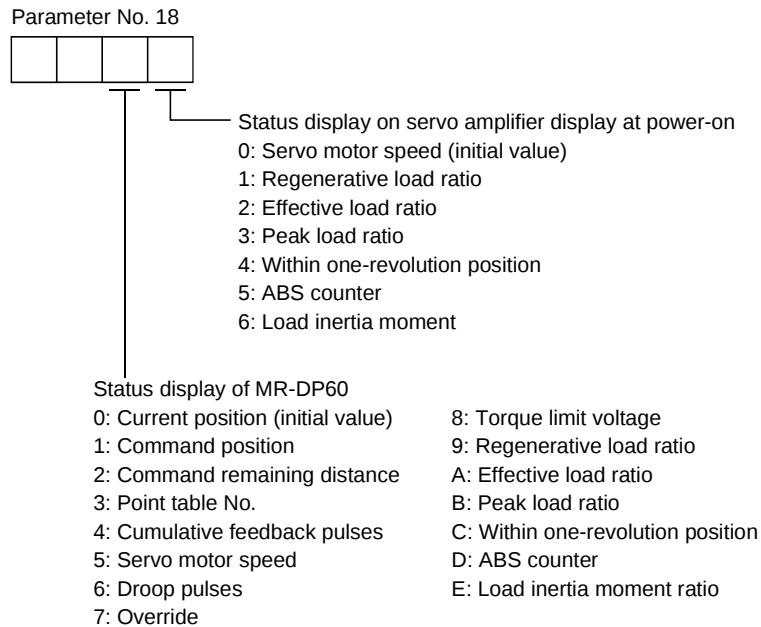
Reduce CMX and CDV to the setting range or less, and round off the first decimal place.
Hence, set 2048 to CMX and 20944 to CDV.

5. PARAMETERS

5.2.2 Changing the status display screen

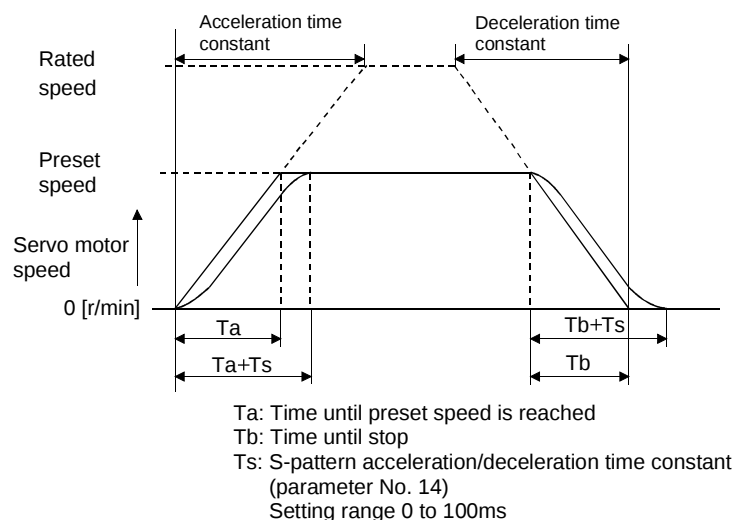
The status display item of the servo amplifier display and the display item of the external digital display (MR-DP60) shown at power-on can be changed by changing the parameter No.18 (status display selection) settings. In the initial condition, the servo amplifier display shows the servo motor speed and the MR-DP60 shows the current position.

For display details, refer to Section 7.2.



5.2.3 S-pattern acceleration/deceleration

In servo operation, linear acceleration/deceleration is usually made. By setting the S-pattern acceleration/deceleration time constant (parameter No.14), a smooth start/stop can be made. When the S-pattern time constant is set, smooth positioning is executed as shown below. Note that the time equivalent to the S-pattern time constant setting increases until positioning is complete.

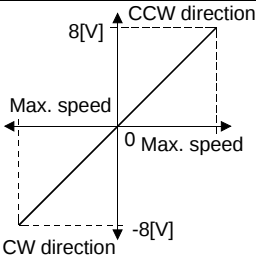
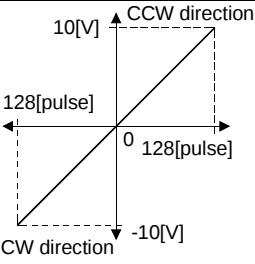
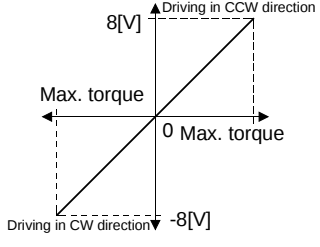
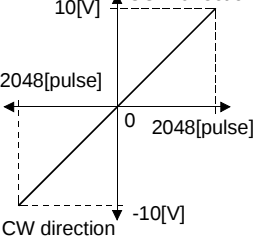
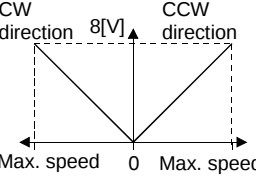
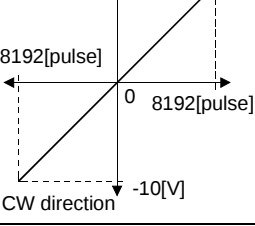
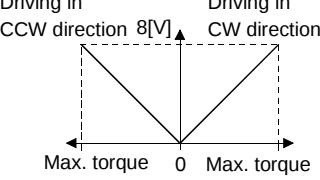
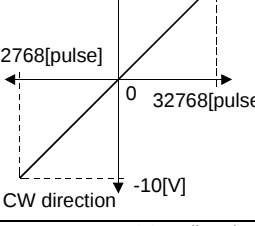
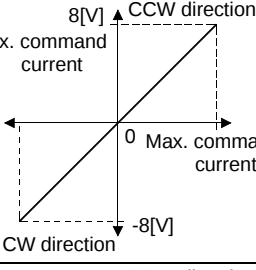
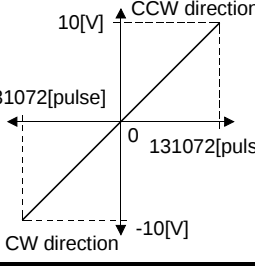
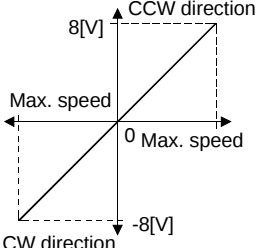


5. PARAMETERS

5.2.4 Analog output

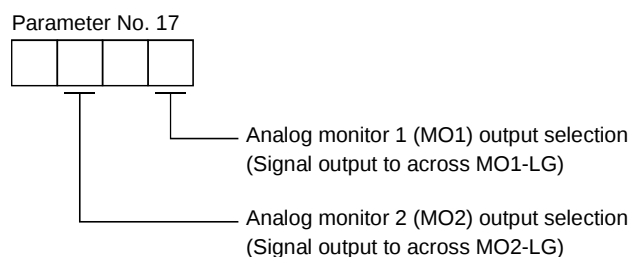
The servo status can be output to two channels in terms of voltage. The servo status can be monitored using an ammeter.

The servo amplifier is factory-set to output the servo motor speed to analog monitor 1 and the torque to analog monitor 2. The setting can be changed as listed below by changing the parameter No.17 (analog monitor output) value:

Setting	Output Item	Description	Setting	Output Item	Description
0	Servo motor speed		6	Droop pulses ($\pm 10\text{V}/128\text{pulse}$)	
1	Torque		7	Droop pulses ($\pm 10\text{V}/2048\text{pulse}$)	
2	Servo motor speed		8	Droop pulses ($\pm 10\text{V}/8192\text{pulse}$)	
3	Torque		9	Droop pulses ($\pm 10\text{V}/32768\text{pulse}$)	
4	Current command		A	Droop pulses ($\pm 10\text{V}/131072\text{pulse}$)	
5	Speed command				

5. PARAMETERS

Change the following digits of parameter No.17:



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

Parameter	Description	Setting Range [mV]
Parameter No.31	Used to set the offset voltage for the analog monitor 1 (MO1) output.	-999 to 999
Parameter No.32	Used to set the offset voltage for the analog monitor 2 (MO2) output.	

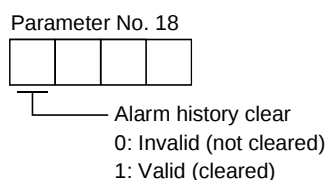
5.2.5 Changing the stop pattern using a limit switch

The servo amplifier is factory-set to make a sudden stop when the limit switch or software limit is made valid. When a sudden stop is not required, e.g. when there is an allowance from the limit switch installation position to the permissible moving range of the machine, a slow stop may be selected by changing the parameter No.22 setting.

Parameter No. 22 setting	Description
□□□0 (initial value)	Droop pulses are reset to make a stop. (Sudden stop)
□□□1	Droop pulses are drawn out to make a slow stop. (Slow stop)

5.2.6 Alarm history clear

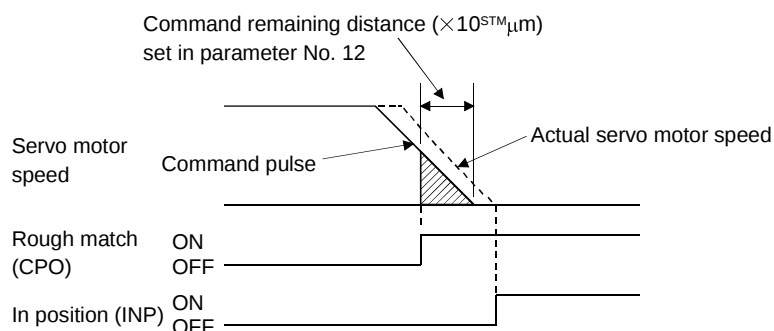
The alarm history can be confirmed by using the Set-up Software or communication function. The servo amplifier stores one current alarm and five past alarms from when its power is switched on first. To control alarms which will occur during operation, clear the alarm history using parameter No.18 (alarm history clear) before starting operation. Clearing the alarm history automatically returns to “0 □ □ □”. This parameter is made valid by switching power off, then on after setting.



5. PARAMETERS

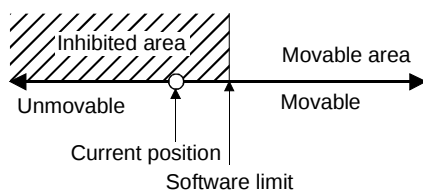
5.2.7 Rough match output

Rough match (CPO) is output when the command remaining distance reaches the value set in parameter No. 12 (rough match output range). The set remaining distance is 0 to 65535 [$\times 10^{STM}\mu m$].



5.2.8 Software limit

A limit stop using a software limit is made as in stroke end operation. When a motion goes beyond the setting range, the motor is stopped and servo-locked. This function is made valid at power-on but made invalid during home position return. This function is made invalid when the software limit + setting is the same as the software limit - setting.



[illegible]

6. SERVO CONFIGURATION SOFTWARE

6. SERVO CONFIGURATION SOFTWARE

POINT
▪ Some functions of the Servo Configuration software may be unavailable for some versions. For details, please contact us.

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.

6.1 Specifications

Item	Description
Communication signal	Conforms to RS-232C.
Baudrate	19200bps, 9600bps
System	Station selection
Monitor	Batch display, high-speed display, graph display
Alarm	Alarm display, alarm history, data display at alarm occurrence
Diagnostic	I/O display, function device display, total power-on time, software number display, tuning data display, ABS data display
Parameters	Data setting, list display, change list display, detailed information display, I/O Devices
Test operation	Jog operation, positioning operation, motor-less operation, output signal forced output, single-step feed
Position Data	Point Tables setting
File operation	Data read, save, print
Others	Station setting, help display

6.2 System configuration

(1) 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 where the English version of Windows® 95, Windows® 98, Windows® Me, Windows NT® Workstation 4.0, Windows® 2000 Professional, Windows® XP Professional or Windows® XP Home Edition operates Processor: Pentium® 133MHz or more (Windows® 95, Windows® 98, Windows NT® Workstation 4.0, Windows® 2000 Professional) Pentium® 150MHz or more (Windows® Me) Pentium® 300MHz or more (Windows® XP Professional, Windows® XP Home Edition) Memory: 16MB or more (Windows® 95), 24MB or more (Windows® 98) 32MB or more (Windows® Me, Windows NT® Workstation 4.0, Windows® 2000 Professional) 128MB or more (Windows® XP Professional, Windows® XP Home Edition) Free hard disk space: 60MB or more Serial port used
OS	Windows® 95, Windows® 98, Windows® Me, Windows NT® Workstation 4.0, Windows® 2000 Professional, Windows® XP Professional, Windows® XP Home Edition (English version)
Display	One whose resolution is 800×600 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.
Keyboard	Connectable with the above personal computer.
Mouse	Connectable with the above personal computer. Note that a serial mouse is not used.
Printer	Connectable with the above personal computer.
Communication cable	MR-CPCATCBL3M /MR-CPCATCBL3M When this cannot be used, refer to (3) Section 14.1.2 and fabricate.

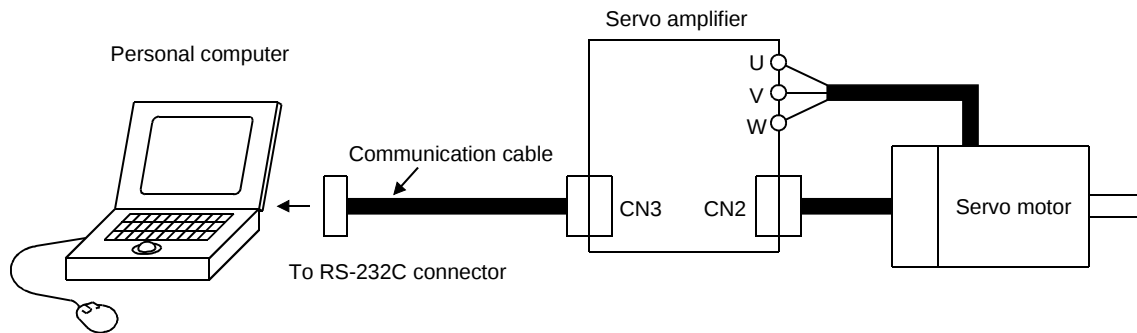
Note 1. Windows and Windows NT are the registered trademarks of Microsoft Corporation in the United State and other countries.
Pentium is the registered trademarks of Intel Corporation.

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

6. SERVO CONFIGURATION SOFTWARE

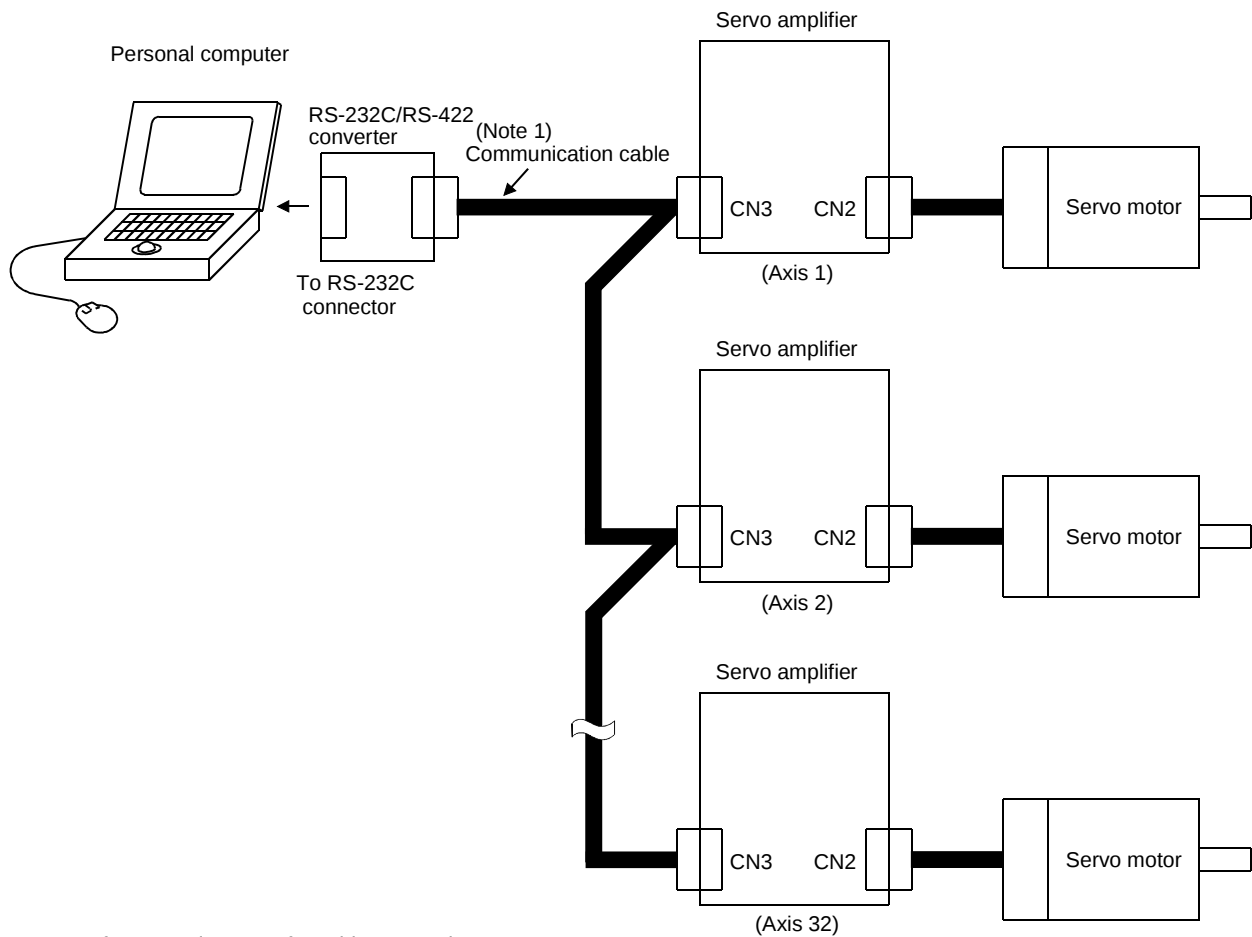
(2) Configuration diagram

(a) For use of RS-232C



(b) For use of RS-422

Up to 32 axes may be multidropped.

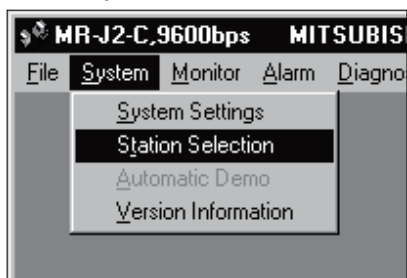


Note. Refer to Section 8.1.1 for cable connections.

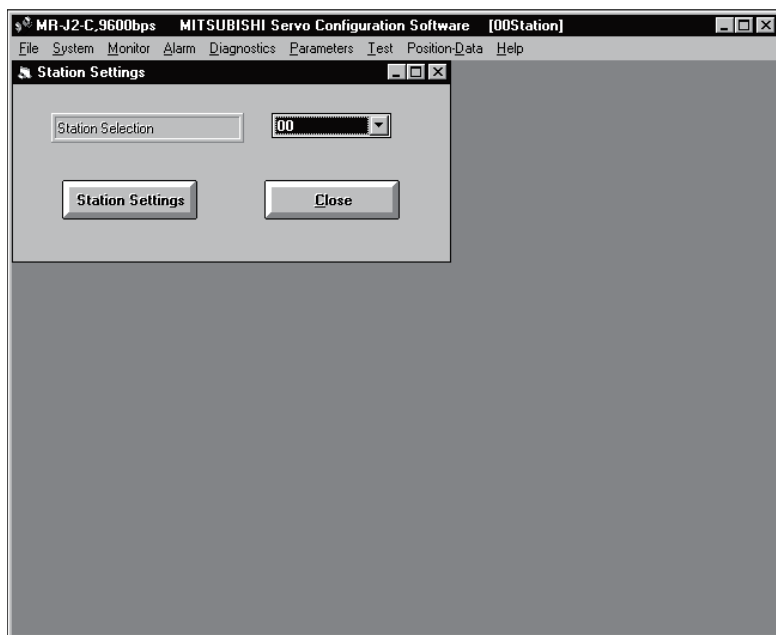
6. SERVO CONFIGURATION SOFTWARE

6.3 Station setting

Click “System” on the menu bar and click “Station Selection” on the menu.



When the above choices are made, the following window appears:



(1) Station number setting

Choose the station number in the combo box and click the “Station Settings” button to set the station number.

POINT

- This setting should be the same as the station number which has been set in the parameter in the servo amplifier used for communication.

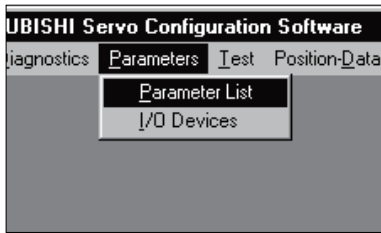
(2) Closing of the station setting window

Click the “Close” button to close the window.

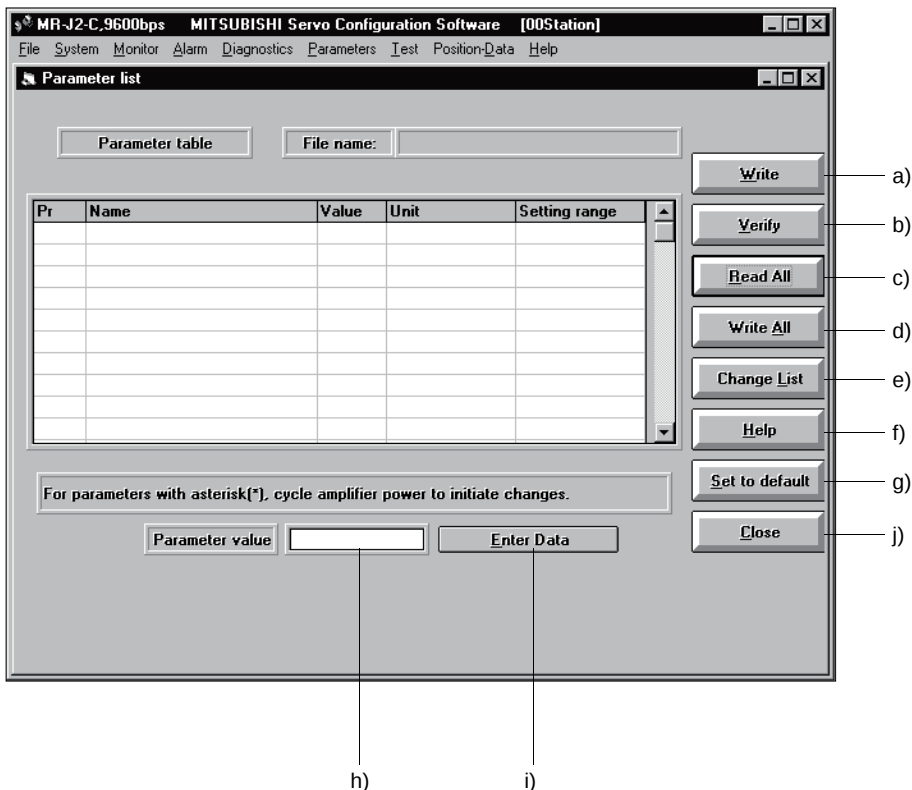
6. SERVO CONFIGURATION SOFTWARE

6.4 Parameters

Click “Parameters” on the menu bar and click “Parameter List” on the menu.



When the above choices are made, the following window appears:



(1) Parameter value write (a)

Click the parameter whose setting was changed and press the “Write” button to write the new parameter setting to the servo amplifier.

(2) Parameter value verify (b)

Click the “Verify” button to verify all parameter values being displayed and the parameter values of the servo amplifier.

6. SERVO CONFIGURATION SOFTWARE

(3) Parameter value batch-read (c)

Click the “Read All” button to read and display all parameter values from the servo amplifier.

(4) Parameter value batch-write (d)

Click the “Write All” button to write all parameter values to the servo amplifier.

(5) Parameter change list display (e)

Click the “Change List” button to show the numbers, names, initial values and current values of the parameters whose initial value and current value are different. In the offline mode, the parameter change list is not shown.

(6) Parameter detail information (f)

Click the “Help” button or double-click the display field to show the detailed explanation of each parameter.

(7) Parameter default value indication (g)

Click the “Set to default” button to show the initial value of each parameter.

(8) Parameter value change (h) ,i)

Choose the parameter to be changed, enter a new value into the “Parameter value” input field, and press the enter key or Enter Data button.

(9) Parameter data file read

Used to read and display the parameter values stored in the file. Use the file selection window to read.

(10) Parameter value storage

Used to store all parameter values being displayed on the window into the specified file. Use the file selection window to store.

(11) Parameter data list print

Used to print all parameter values being displayed on the window. Use the “File” menu on the menu bar to print.

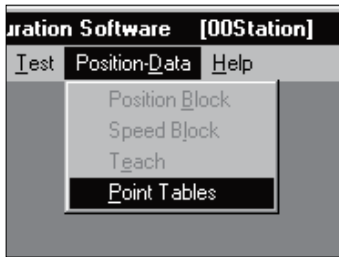
(12) Parameter list window closing (j)

Click the “Close” button to close the window. If the “Close” button is clicked without (1) parameter value write or (4) parameter value batch-write being performed, the parameter value changed is made invalid.

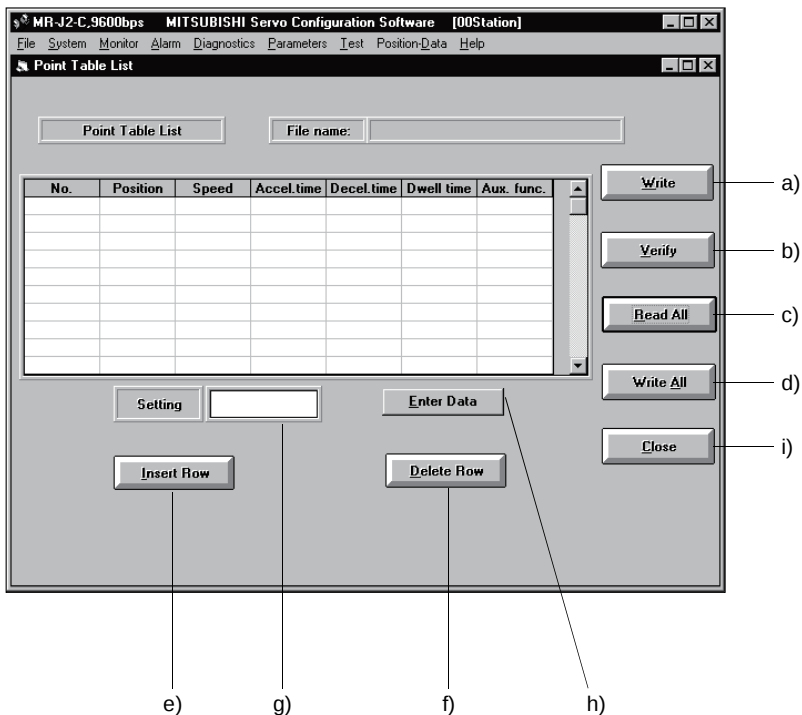
6. SERVO CONFIGURATION SOFTWARE

6.5 Point table

Click “Position-Data” on the menu bar and click “Point Tables” on the menu.



When the above choices are made, the following window appears:



(1) Point table data write (a)

Click the point table data changed and press the “Write” button to write the new point table data to the servo amplifier.

(2) Point table data verify (b)

Click the “Verify” button to verify all data being displayed and the data of the servo amplifier.

6. SERVO CONFIGURATION SOFTWARE

(3) Point table data batch-read (c)

Click the “Read All” button to read and display all point table data from the servo amplifier.

(4) Point table data batch-write (d)

Click the “Write All” button to write all point table data to the servo amplifier.

(5) Point table data insertion (e)

Click the “Insert Row” button to insert one block of data into the position before the point table No. chosen. The blocks after the chosen point table No. are shifted down one by one.

(6) Point table data deletion (f)

Click the “Delete Row” button to delete all data in the point table No. chosen. The blocks after the chosen point table No. are shifted up one by one.

(7) Point table data change (g ,h)

Click the data to be changed, enter a new value into the “Setting” input field, and press the enter key or Enter Data button.

(8) Point table data file read

Used to read and display the point table data stored in the file. Use the “File” menu on the menu bar to read.

(9) Point table data storage

Used to store all point table data being displayed on the window into the specified file. Use the “File” menu on the menu bar to store.

(10) Point table data list print

Used to print all point table data being displayed on the window. Use the “File” menu on the menu bar to print.

(11) Point table data list window closing (i)

Click the “Close” button to close the window.

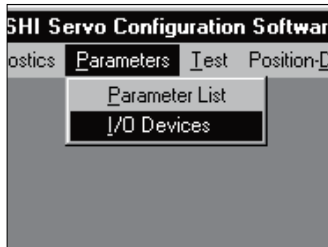
6. SERVO CONFIGURATION SOFTWARE

6.6 Device setting

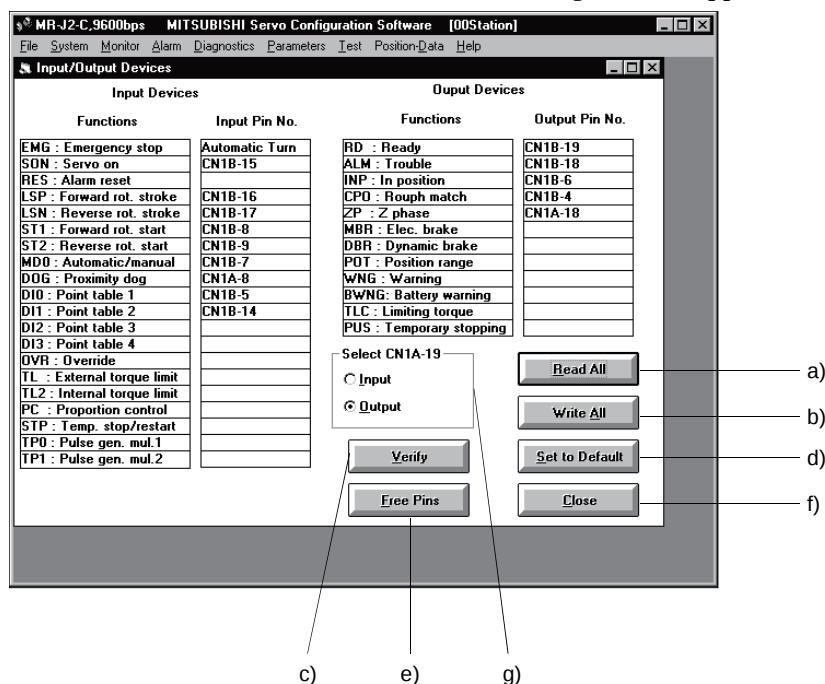
POINT

- When using the device setting, preset "000E" in parameter No.19.

Click “Parameters” on the menu bar and click “I/O Devices” on the menu.



When the above choices are made, the following window appears:



(1) Function assignment batch-read (a)

Click the “Read All” button to read and display from the servo amplifier the pins which have been assigned functions.

(2) Function assignment batch-write (b)

Click the “Write All” button to write to the servo amplifier the pins which have been assigned functions.

6. SERVO CONFIGURATION SOFTWARE

(3) Function assignment verify (c)

Click the “Verify” button to verify the function assignment being displayed and the function assignment in the servo amplifier.

(4) Function assignment default value indication (d)

Click the “Set to Default” button to show the initial values of function assignment.

(5) Function assignment changing

(a) Function assignment changing

Drag the pin number whose function assignment is to be changed and drop it in the new function to change the setting. Automatic on setting cannot be dragged.

(b) Automatic on setting

Double-click the pin number field to set the function assignment to the automatic on mode. Double-click it again to cancel the automatic on mode.

When the pin number has already been assigned a function and the setting is changed to automatic on, that pin becomes empty.

(c) Automatic assignment of empty pin

Double-click the function name field to assign the function to the currently empty pin automatically. Double-click it again to cancel the assignment.

When there is no empty pin, no assignment is made.

(6) CN1A-19 selection (g)

Select whether the CN1A-19 pin is used as an input or output pin.

In the initial setting, it is defined as an empty output pin.

When this selection is changed, the CN1A-19 pin is set as the empty pin of the chosen one.

(7) Indication of the pins to which functions are currently not assigned (e)

Click the “Free Pins” button to show the currently empty pin numbers.

(8) Closing of I/O device setting window (f)

Click the “Close” button to close the window.

When (1) function assignment batch-read is not made, clicking the “Close” button makes the function assignment change invalid.

6. SERVO CONFIGURATION SOFTWARE

6.7 Test operation



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).

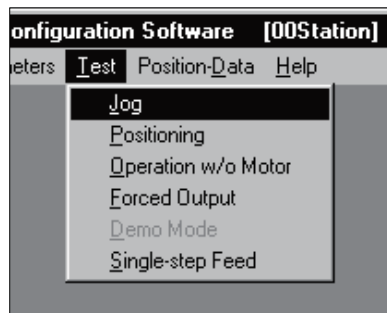
6.7.1 Jog operation

POINT

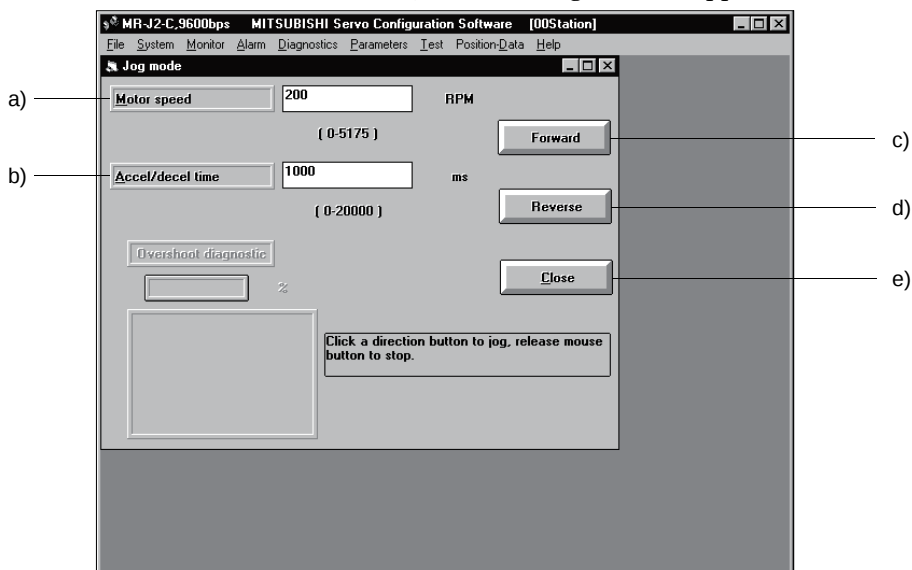
- In the jog operation mode, do not rewrite data from the point table list screen or the servo amplifier's front panel. Otherwise, the set values are made invalid.
- The servo motor will not operate if the forced stop (EMG), forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) are off. Make automatic ON setting to turn on these devices or make device setting to assign them as external input signals and turn off across these signals and SG. (Refer to Section 6.6.)

Hold down the “Forward” or “Reverse” button to rotate the servo motor. Release the “Forward” or “Reverse” button to stop.

Click “Test” on the menu bar and choose “Jog” on the menu.



When the above choices are made, the following window appears:



6. SERVO CONFIGURATION SOFTWARE

(1) Servo motor speed setting (a))

Enter a new value into the “Motor speed” input field and press the enter key.

(2) Acceleration/deceleration time constant setting (b))

Enter a new value into the “Accel/decel time” input field and press the enter key.

(3) Servo motor start (c), d)

Hold down the “Forward” button to rotate the servo motor in the forward rotation direction.

Hold down the “Reverse” button to rotate the servo motor in the reverse rotation direction.

(4) Servo motor stop

Release the “Forward” or “Reverse” button to stop the rotation of the servo motor.

(5) Jog operation window closing (e))

Click the “Close” button to cancel the jog operation mode and close the window.

6. SERVO CONFIGURATION SOFTWARE

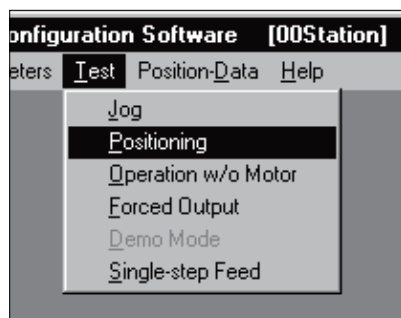
6.7.2 Positioning operation

POINT

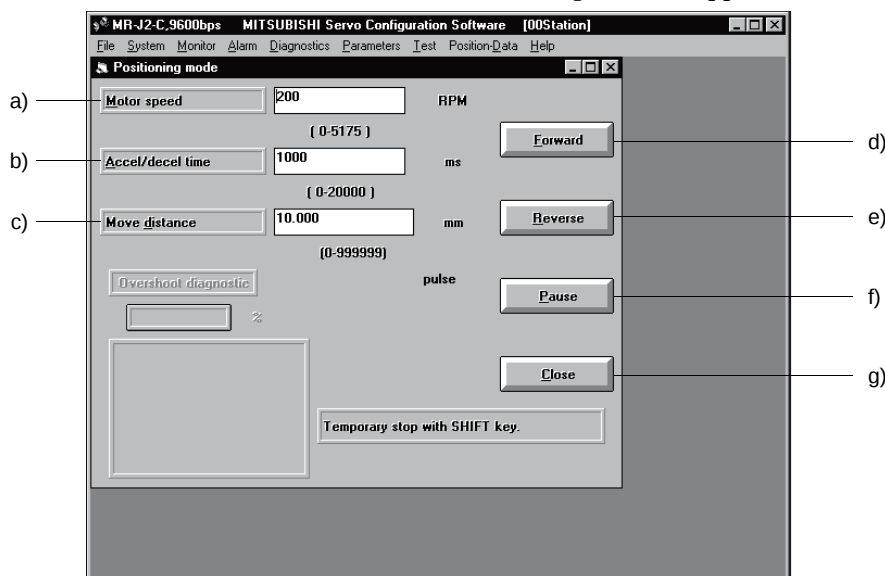
- In the positioning operation mode, do not rewrite data from the point table list screen or the servo amplifier's front panel. Otherwise, the set values are made invalid.

Click the “Forward” or “Reverse” button to start and rotate the servo motor by the preset moving distance and then stop.

Click “Test” on the menu bar and click “Positioning” on the menu.



When the above choices are made, the following window appears:



6. SERVO CONFIGURATION SOFTWARE

(1) Servo motor speed setting (a))

Enter a new value into the “Motor speed” input field and press the enter key.

(2) Acceleration/deceleration time constant setting (b))

Enter a new value into the “Accel/decel time” input field and press the enter key.

(3) Moving distance setting (c))

Enter a new value into the “Move distance” input field and press the enter key.

(4) Servo motor start (d), e))

Click the “Forward” button to rotate the servo motor in the forward rotation direction.

Click the “Reverse” button to rotate the servo motor in the reverse rotation direction.

(5) Temporary stop of servo motor (f))

Click the “Pause” button to stop the servo motor temporarily.

Click the “Forward” and “Reverse” buttons to resume rotation.

(6) Positioning operation window closing (g))

Click the “Close” button to cancel the positioning operation mode and close the window.

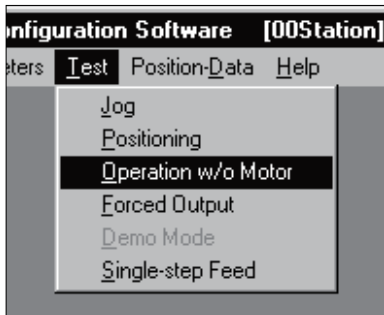
6. SERVO CONFIGURATION SOFTWARE

6.7.3 Motor-less operation

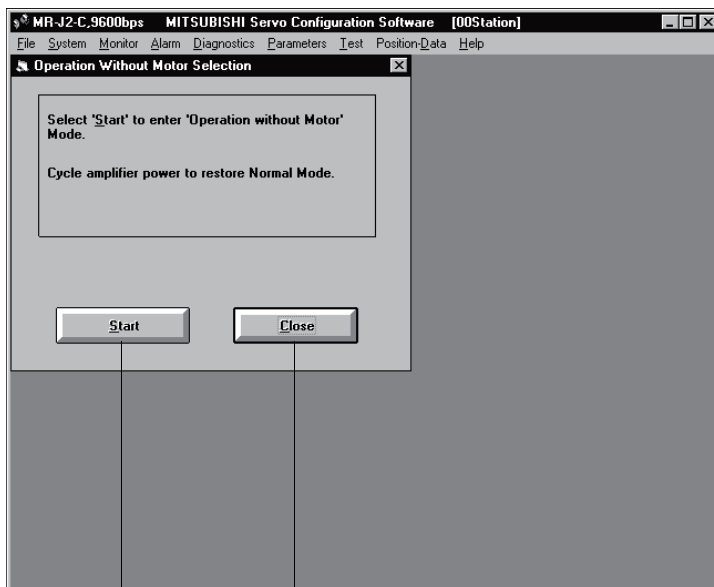
Without a servo motor being connected, the output signals are provided and the servo amplifier display shows the status as if a servo motor is actually running in response to the external I/O signals.

The sequence of the host programmable controller (PC) can be checked without connection of a servo motor.

Click “Test” on the menu bar and click “Operation w/o Motor” on the menu.



When the above choices are made, the following window appears:



a)

b)

(1) Execution of motor-less operation (a)

Click “Start” to perform motor-less operation.

(2) Termination of motor-less operation (b)

Click “Close” to close the window.

(3) Cancel of motor-less operation

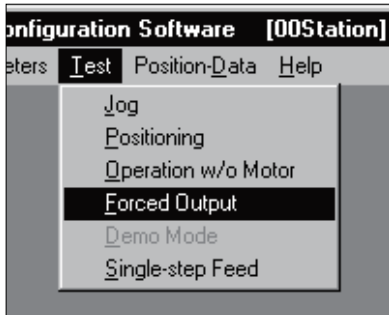
To cancel motor-less operation, switch off the power of the servo amplifier.

6. SERVO CONFIGURATION SOFTWARE

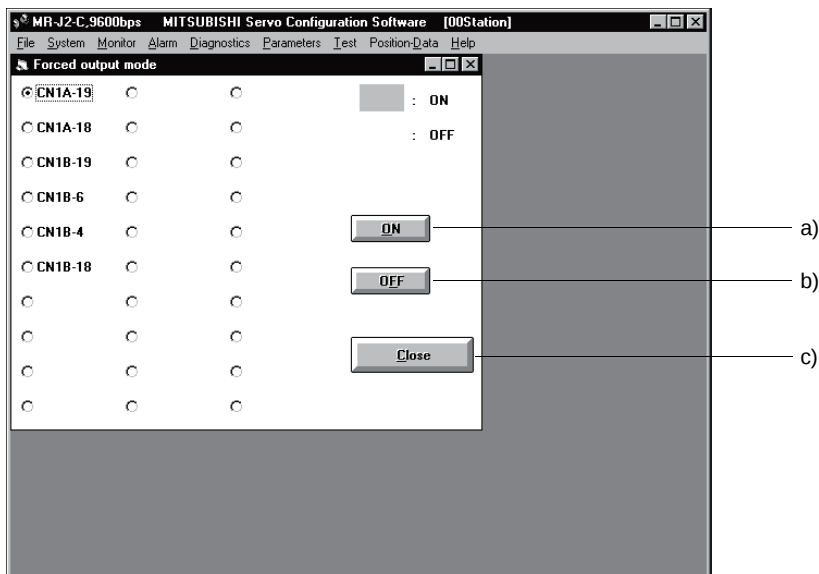
6.7.4 Output signal (DO) forced output

Each servo amplifier output signal is forcibly switched on/off independently of the output condition of the output signal.

Click “Test” on the menu bar and click “Forced Output” on the menu.



When the above choices are made, the following window appears:



(1) Signal ON/OFF setting (a), b))

Choose the signal name or pin number and click the “ON” or “OFF” button to write the corresponding signal status to the servo amplifier.

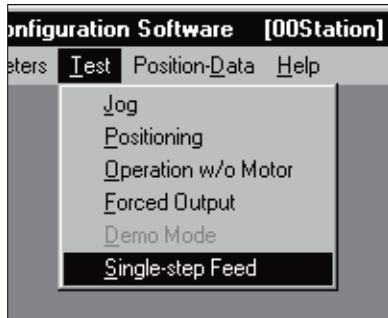
(2) DO forced output window closing (c))

Click the “Close” button to cancel the DO forced output mode and close the window.

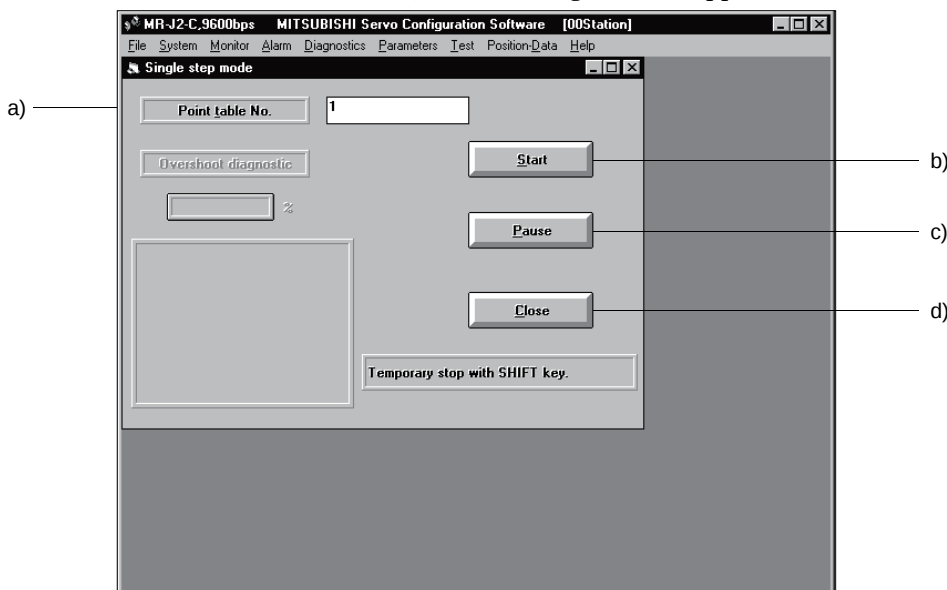
6. SERVO CONFIGURATION SOFTWARE

6.7.5 Single-step feed

Operation is performed in accordance with the preset point table No.
Click “Test” on the menu bar and click “Single-step Feed” on the menu.



When the above choices are made, the following window appears:



(1) Point table No. setting (a)

Enter the point table No. into the “Point table No.” input field and press the enter key.

(2) Servo motor start (b)

Click the “Start” button to rotate the servo motor.

(3) Temporary stop of servo motor (c)

Press the “Pause” button to stop the servo motor temporarily.

Click the “Start” button to resume rotation.

(4) Servo motor stop (d)

Click the “Pause” button again during a temporary stop of the servo motor to clear the remaining moving distance.

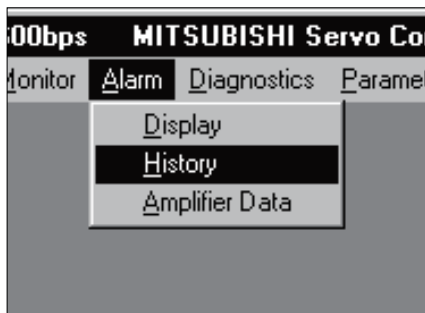
(5) Single-step feed window closing (e)

Click the “Close” button to cancel the single-step feed mode and close the window.

6. SERVO CONFIGURATION SOFTWARE

6.8 Alarm history

Click “Alarms” on the menu bar and click “History” on the menu.



When the above choices are made, the following window appears:



(1) Alarm history display

The most recent six alarms are displayed. The smaller numbers indicate newer alarms.

(2) Alarm history clear

Click the “Clear” button to clear the alarm history stored in the servo amplifier.

(3) Closing of alarm history window

Click the “Close” button to close the window.

[illegible]

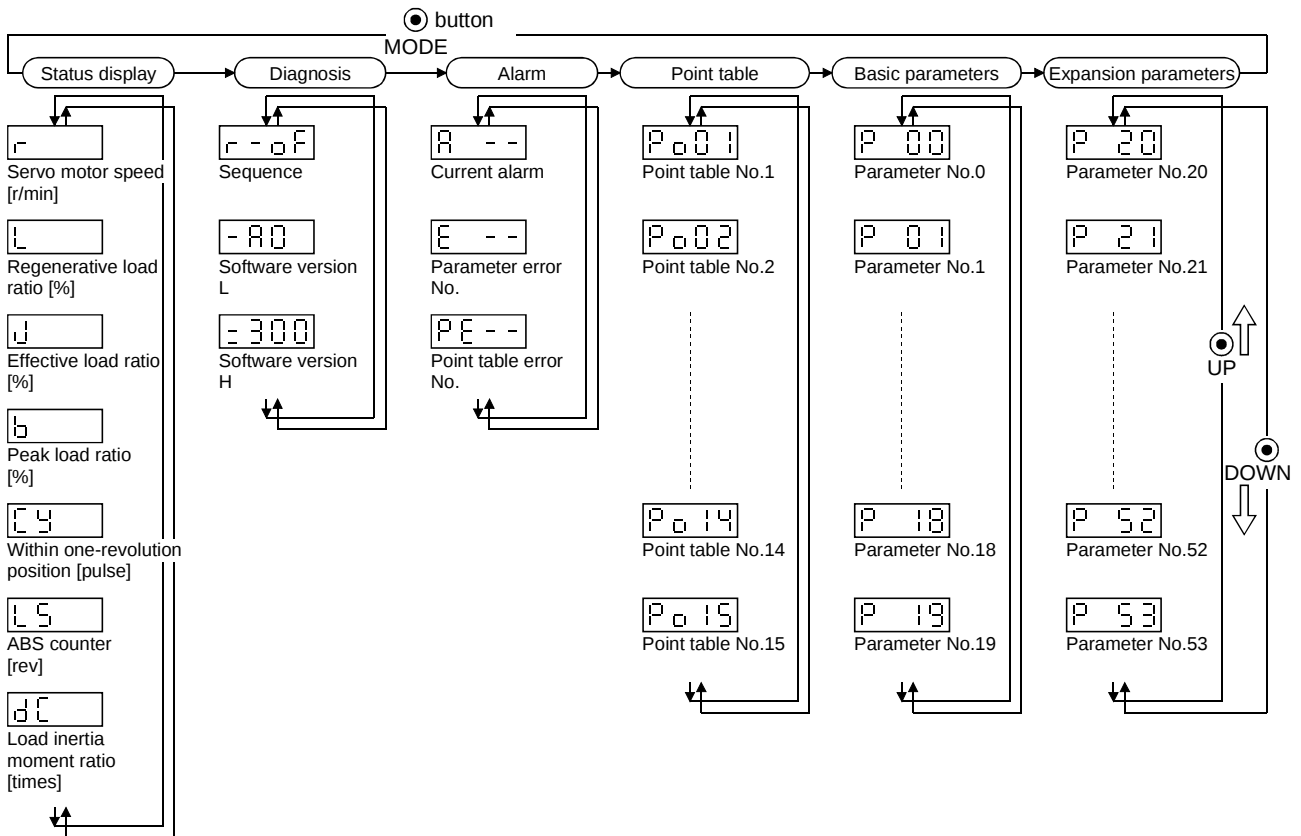
7. DISPLAY AND OPERATION

7. DISPLAY AND OPERATION

7.1 Display flowchart

Use the display (4-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).



7. DISPLAY AND OPERATION

7.2 Status display

The servo status during operation is shown on the 4-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.

The servo amplifier display shows the lower four digits of seven data items such as the servo motor speed. In addition, use of the optional external digital display (MR-DP60) allows the statuses of 15 items to be shown in up to six digits. For the usage and parameter setting method, refer to Section 5.2.2.

The following table lists display examples:

Item	Status	Displayed Data	
		Servo amplifier display	MR-DP60
Servo motor speed	Forward rotation at 2500r/min		
	Reverse rotation at 3000r/min	 Reverse rotation is indicated by the lit decimal points in the upper three digits.	
Load inertia moment	15.5 times	 Value of $\times 0.1$ times is shown.	
ABS counter	11252pulse		
	-12566pulse	 Negative value is indicated by the lit decimal points in the upper three digits.	

7. DISPLAY AND OPERATION

The following table lists the servo statuses that may be shown:

Status Display	Symbol	Unit	Description	Display Range	
				Servo amplifier display	MR-DP60
Current position		mm	The current position from the machine home position of 0 is displayed.	Cannot be displayed.	—999999 to 999999
Command position		mm	The position data in the point table or the preset command position is displayed.	Cannot be displayed.	—999999 to 999999
Command remaining distance		mm	During operation, the remaining distance from the current position to the command position is displayed. During a stop, the next feed distance is displayed.	Cannot be displayed.	—999999 to 999999
Point table No.			The point table No. being executed is displayed.	Cannot be displayed.	0 to 15
Cumulative feedback pulses		pulse	Feedback pulses from the servo motor encoder are counted and displayed. When the value exceeds ± 9999999 , it returns to zero. Press the "SET" button to reset the display value to zero.	Cannot be displayed.	—9999999 to 9999999
Servo motor speed	r	r/min	The servo motor speed is displayed. "—" is added to the speed of the servo motor rotating in the reverse direction	—5400 to 5400	—5400 to 5400
Droop pulses		pulse	The number of droop pulses in the deviation counter is displayed. "—" is added to the droop pulses in the reverse direction. The displayed number of pulses is not yet multiplied by the electronic gear value.	Cannot be displayed.	—9999999 to 9999999
Override		%	The override setting is displayed. 100% is displayed when override is invalid.	Cannot be displayed.	0 to 200
Analog torque limit voltage		V	The voltage of the analog torque limit (TLA) is displayed.	Cannot be displayed.	0.00 to 10.00
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100	0 to 100
Effective load ratio	J	%	The continuous effective load torque is displayed. Rated torque is defined as 100% and the effective value for the past 15 seconds is displayed.	0 to 300	0 to 300
Peak load ratio	b	%	The peak torque is displayed. Rated torque is defined as 100% and the peak torque for the past 15 seconds is displayed.	0 to 300	0 to 300
Within one-revolution position	Cy	pulse	Position within one revolution is displayed in terms of encoder pulses. When the value exceeds the maximum number of pulses, it returns to 0. The servo amplifier display shows the 4 lower digits of the actual within one-revolution position. It is incremented by CCW rotation.	HC-MF • HA-FF • HC-UF 3000r/min: 0 to 8191 HC-SF • RF • UF2000r/min: 0 to 9999	HC-MF • HA-FF • HC-UF • HC-UF 3000r/min: 0 to 8191 HC-SF • RF • UF2000r/min: 0 to 16383
ABS counter	LS	rev	Moving distance from the home position in the absolute position detection system is displayed in terms of the absolute position detector's counter value. Because of 4-digit indication, the servo amplifier display shows the 4 lower digits of the actual ABS counter value.	—9999 to 9999	—32768 to 32767
Load inertia moment ratio	dC	Times	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	0.0 to 100.0	0.0 to 100.0

7. DISPLAY AND OPERATION

7.3 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.
Software version Low		Indicates the version of the software.
Software version High		Indicates the system number of the software.

7.4 Alarm mode

The current alarm, past 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 alarm 33 (overvoltage). Flickers at occurrence of the alarm.
Parameter error No.		Indicates no occurrence of alarm 37 (parameter error).
		Indicates that the data of parameter No.1 is faulty.
Point table error No.		Indicates no occurrence of point table error.
		Indicates that the data of parameter No.1 is faulty.

Function at occurrence of an alarm

- (1) Any mode screen display the current alarm.
- (2) If during alarm occurrence, the other screen can be viewed by pressing the button in the operation section. At this time, the decimal point in the fourth digit remains flickering.
- (3) To clear any alarm, remove its cause and use any of the following methods:
 - (a) Switch power off, then on.
 - (b) Press the "SET" button on the present alarm screen.
 - (c) Turn on the reset (RES). (Refer to Section 11.2.1 for alarms that may be cleared.)
- (4) Use parameter No. 18 to clear the alarm history.

7. DISPLAY AND OPERATION

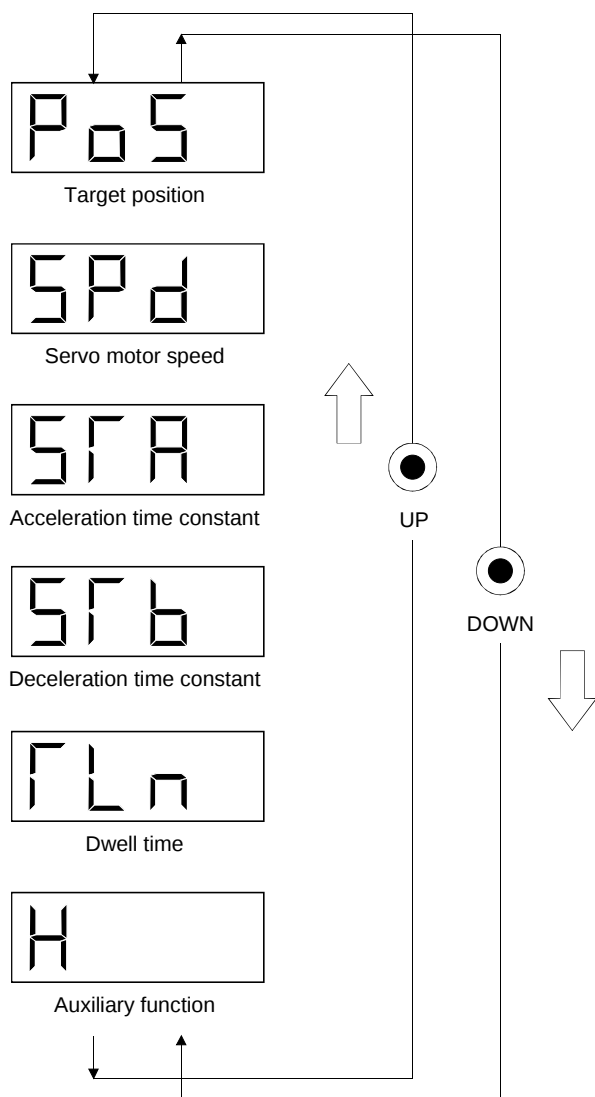
7.5 Point table mode

You can set the target position, servo motor speed, acceleration time, deceleration time, dwell time and auxiliary function.

(1) Point table mode setting screen sequence

Press "SET" in the point table mode. The following screen appears.

Press "UP" or "DOWN" to move to the next screen.

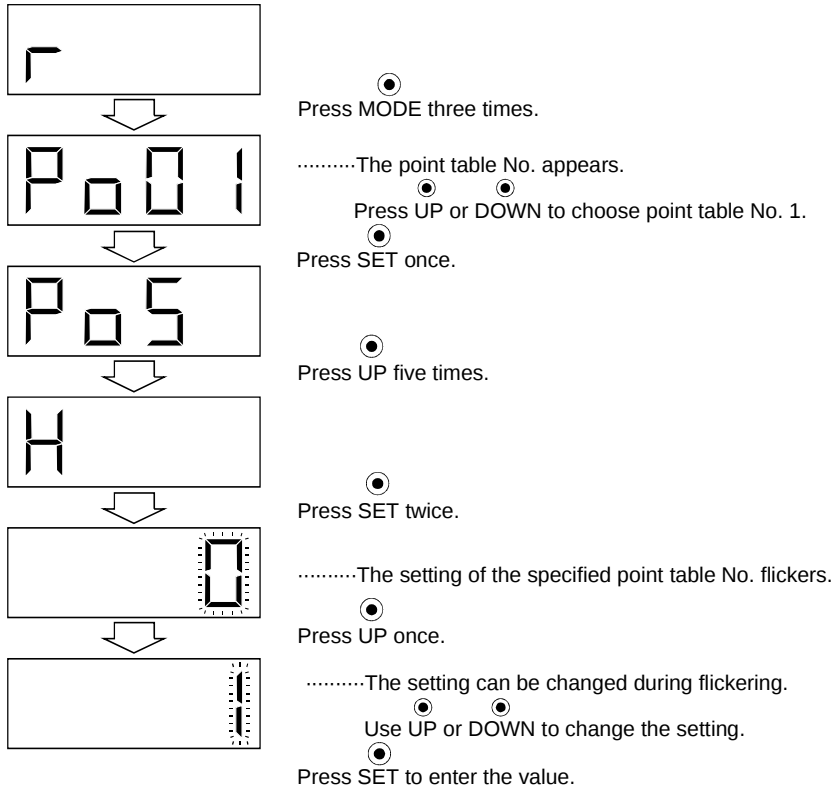


7. DISPLAY AND OPERATION

(2) Operation method

(a) Setting of 4 or less-digit value

The following example provides the after-power-on operation procedure to set "1" in the auxiliary function of point table No.1:

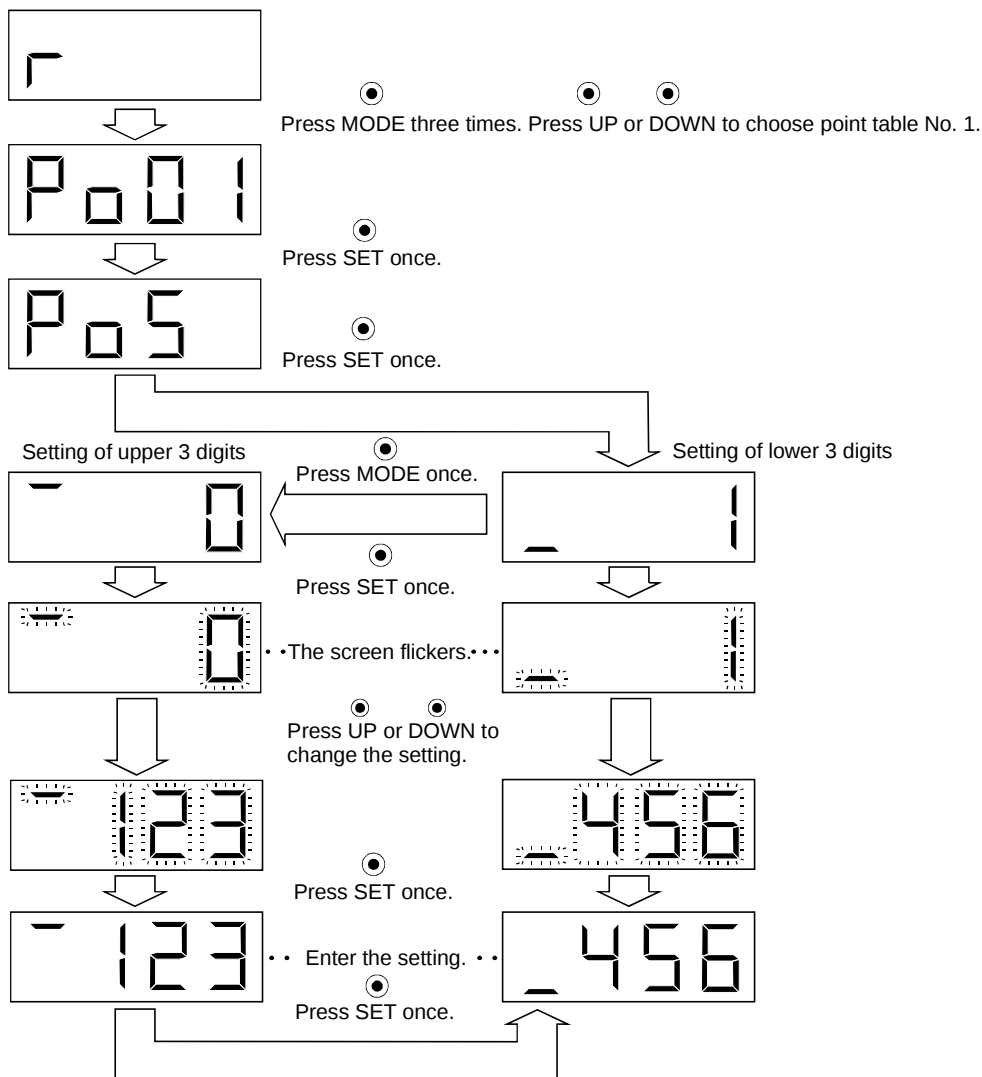


Press "UP" or "DOWN" after completion of the setting to return to the setting item screen. Further, press "UP" and "DOWN" together to return to the point table No. display screen.

7. DISPLAY AND OPERATION

(b) Setting of 5 or more-digit value

The following example gives the after-power-on operation procedure to change the target value of point table No.1 to "123456":



Press "UP" or "DOWN" after completion of the setting to return to the setting item screen. Further, press "UP" and "DOWN" together to return to the point table No. display screen.

7. DISPLAY AND OPERATION

7.6 Parameter mode

Change the parameter settings when:

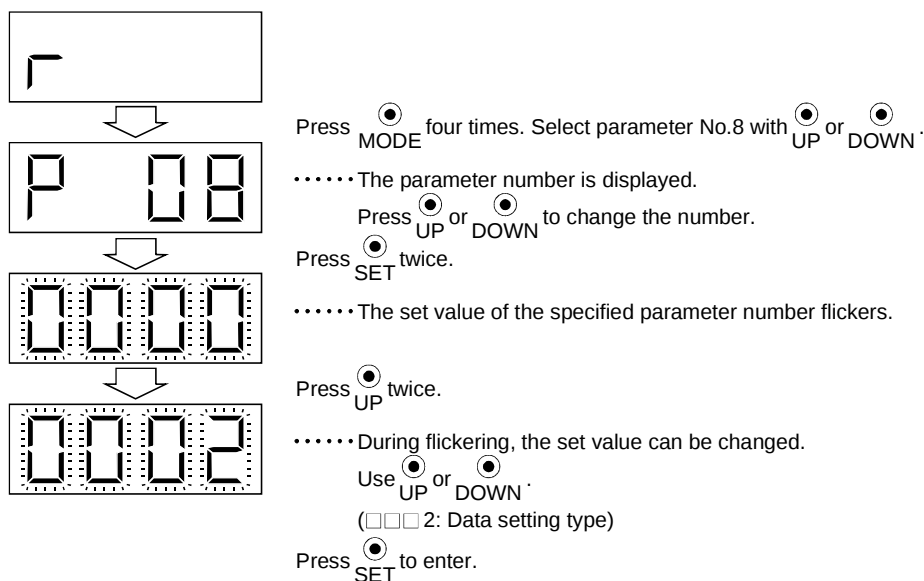
- The regenerative brake option is used;
- The number of pulse per servo motor revolution is changed
- The machine mounted with the servo motor hunts or operational performance is further improved.

The parameter whose abbreviation is marked * is made valid by switching power off, then on after changing its setting. (Refer to Section 5.2.1.)

(1) Operation example

1) 4-digit parameter

The following example shows the operation procedure performed after power-on to change the home position setting method (Parameter No.8) into the data setting type.



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

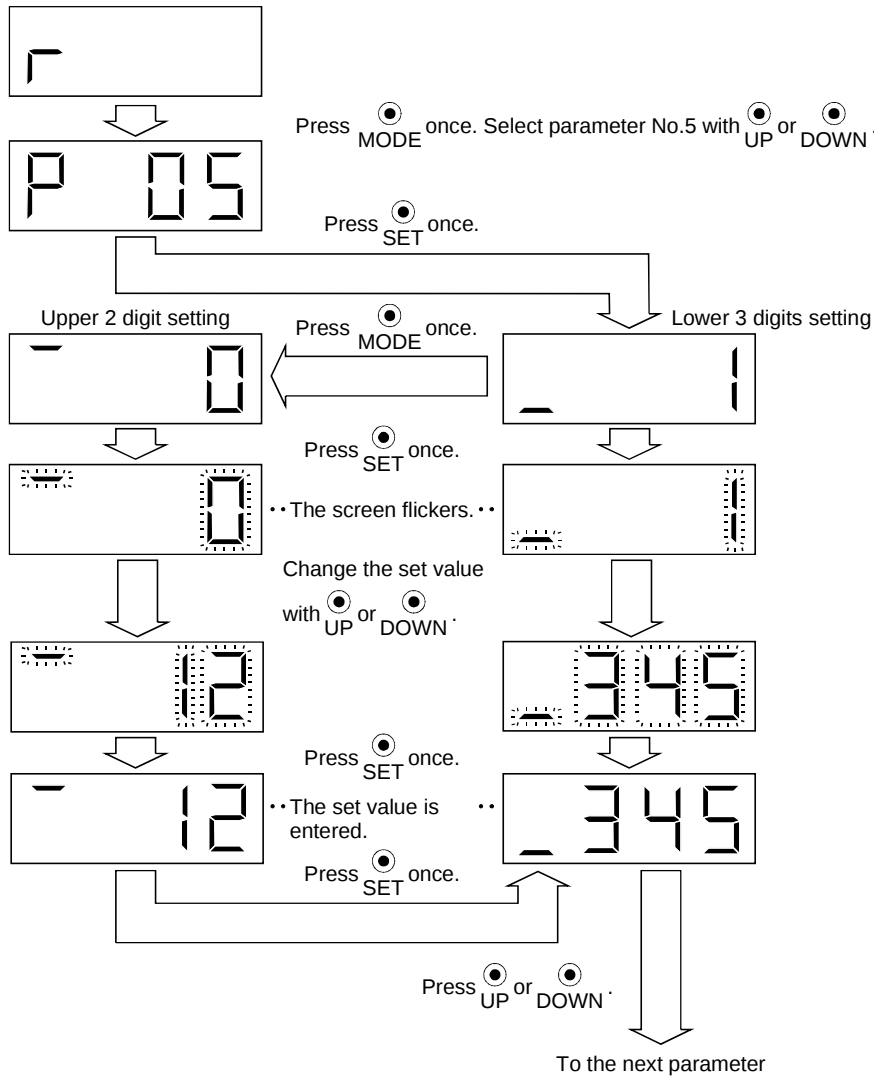
When changing the parameter No.8 (home position return type) setting, change its set value, then switch power off once and switch it on again to make the new value valid.

7. DISPLAY AND OPERATION

2) 5-digit parameter

The following example shows the operation procedure performed to change the electronic gear denominator (parameter No.5) into "12345":

Call the display screen shown after power-on.



When changing the parameter No.5 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).

[illegible]

8. COMMUNICATION FUNCTIONS

8. 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.

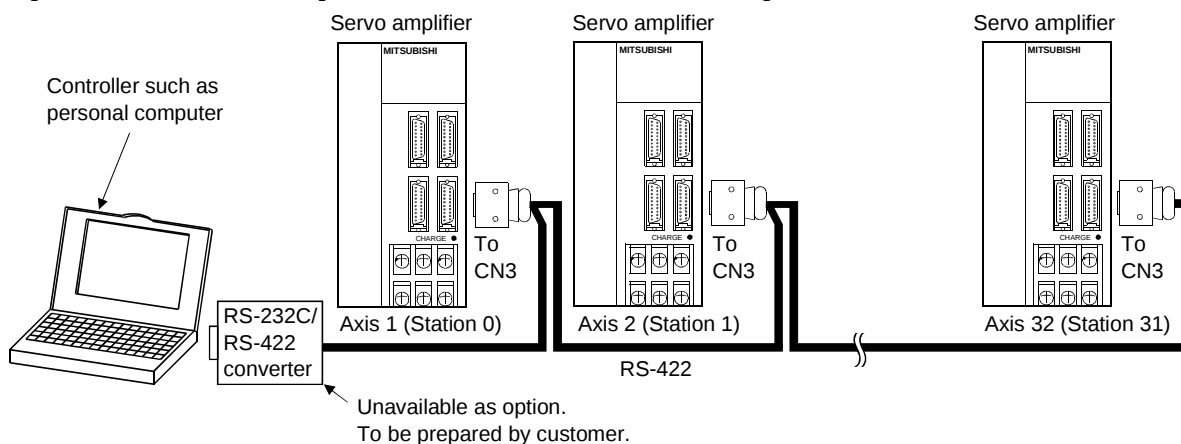
However, the RS-422 and RS-232C communication functions cannot be used together. Select between RS-422 and RS-232C with parameter No.16 (communication baudrate). (Refer to Section 8.2.2.)

8.1 Configuration

8.1.1 RS-422 configuration

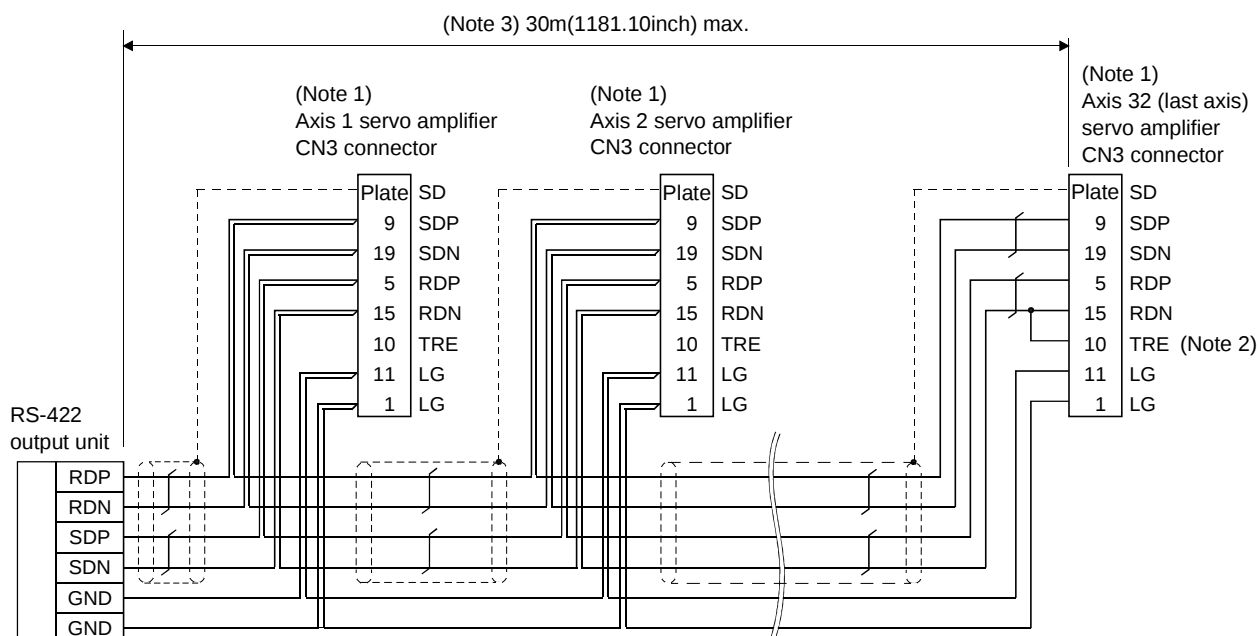
(1) Outline

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. 3 Connector set MR-J2CN1 (3M)

Connector: 10120-3000VE

Shell kit: 10320-52F0-008

2. In the last axis, connect TRE and RDN.

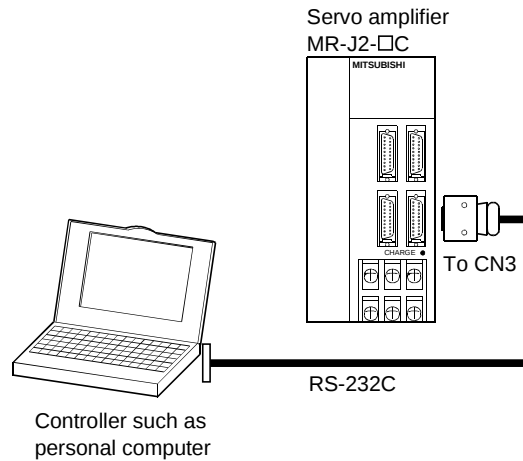
3. 30m(1181.10inch) max. in environment of little noise.

8. COMMUNICATION FUNCTIONS

8.1.2 RS-232C configuration

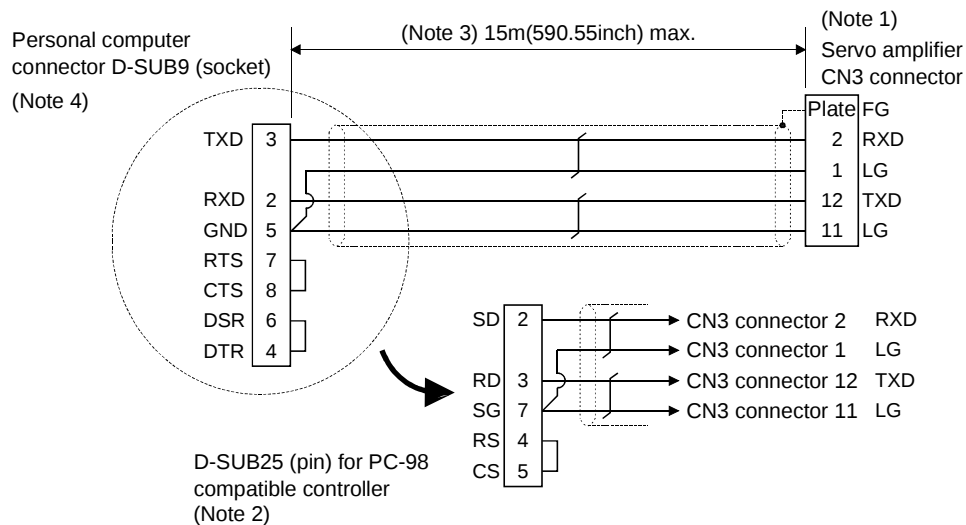
(1) Outline

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 • MR-CPC98CBL3M) is available. (Refer to Section 14.1.2.)



Note: 1. Connector set MR-J2CN1 (3M)

Connector: 1020-3000VE

Shell kit: 10320-52F0-008

2. For the PC-98 series. The PC-98 series also has the half-pitch type.

3. 15m(590.55inch) max. in environment of little noise.

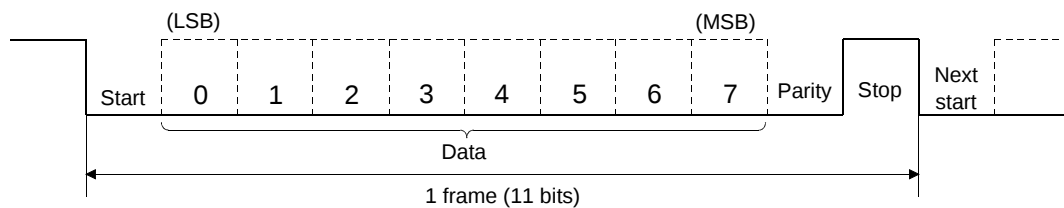
4. For the PC-AT compatible.

8. COMMUNICATION FUNCTIONS

8.2 Communication specifications

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	4800/9600/19200 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



8.2.1 Parameter setting

When the RS-422/RS-232C communication function is used to operate the servo, choose the communication specifications with parameter No.16.

After setting the values of these parameters, they are made valid by switching power off once, then on again.

(1) 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: 4800[bps]

(2) Checksum

The checksum added to data can be deleted. When the checksum is not needed for the communication specifications of the master station, delete the checksum with this parameter.

Parameter No. 16

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Checksum

0: Yes (checksum added)

1: No (checksum not added)

8. COMMUNICATION FUNCTIONS

(3) RS-422/RS-232C serial interface selection

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

Parameter No. 16

--	--	--	--

RS-422/RS-232C communication standard selection

0: RS-422 used

1: RS-232C used

(4) Communication 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 400 μ s or "1" to send back data in 400 μ s or more.

Parameter No. 16

--	--	--	--

Communication delay time

0: Invalid, reply sent in less than 400 μ s

1: Valid, reply sent in 400 μ s or more

(5) Serial communication time-out

No communication for a given period of time between the master and slave stations may be judged as a communication cable or master station fault to stop the servo motor.

Setting	Description
0	No time-out check
1 to 60	Time-out check period setting Check period = setting (S)

8.3 Protocol

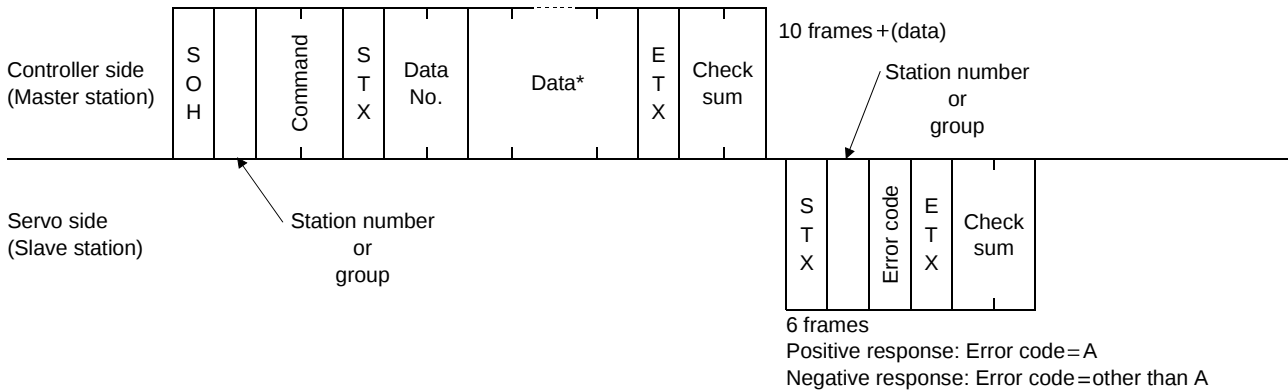
POINT	
	▪ Whether station number setting will be made or not must be selected if the RS-232C communication function is used.

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.

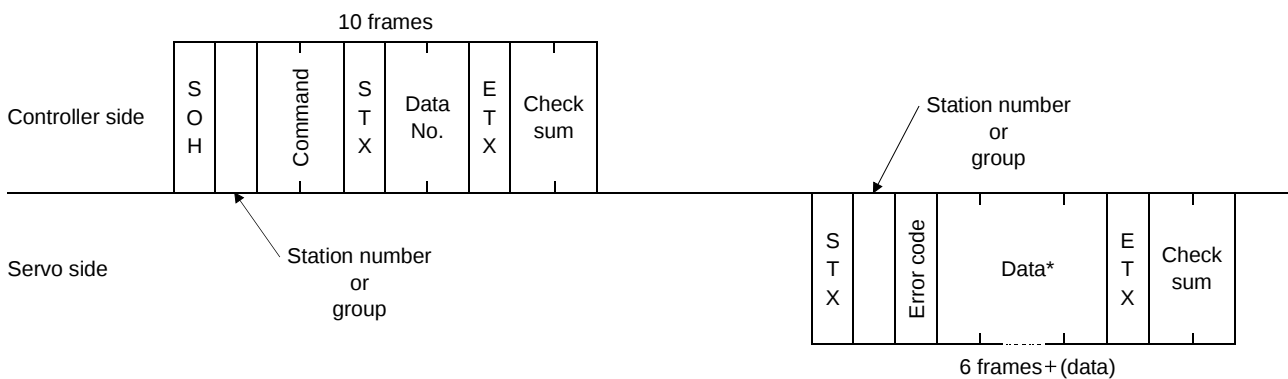
When " * " is set as the station number added to the transmission data, the transmission data is made valid for all servo amplifiers connected. However, when return data is required from the servo amplifier in response to the transmission data, set "0" to the station number of the servo amplifier which must provide the return data.

8. COMMUNICATION FUNCTIONS

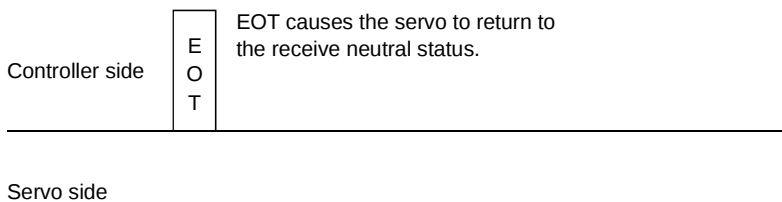
(1) Transmission of data from the controller to the servo



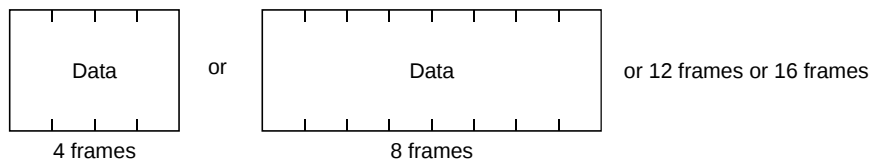
(2) Transmission of data request from the controller to the servo



(3) Recovery of communication status by time-out



*Data: Choose the data length from among 4, 8, 12 and 16 frames (data length depends on the command).



8.4 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

ASCII codes are used.

The diagram illustrates the mapping of 8-bit data to a 16-bit bus. The 8-bit data is split into two 4-bit nibbles. The upper nibble (b8 to b5) is mapped to the upper 4 bits of the bus (C, R, 0-3), and the lower nibble (b4 to b1) is mapped to the lower 4 bits of the bus (C, R, 4-7). The bus is labeled with C, R, and 0-7.

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	0	1	2	3	4	5	6	7
0	NUL	DLE	Space	0	@	P	`	p
1	SOH	DC ₁	!	1	A	Q	a	q
2	STX	DC ₂	"	2	B	R	b	r
3	ETX	DC ₃	#	3	C	S	c	s
4			\$	4	D	T	d	t
5			%	5	E	U	e	u
6			&	6	F	V	f	v
7			'	7	G	W	g	w
8			(	8	H	X	h	x
9			)	9	I	Y	i	y
10			*	:	J	Z	j	z
11			+	;	K	[	k	{
12			,	<	L	¥	l	
13			-	=	M	]	m	}
14			.	>	N	^	n	-
15			/	?	O	_	o	DEL

(3) Station numbers

You may set 32 station numbers from station 0 to station 31 and the ASCII codes are used to specify the stations.

Station number	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASCII code	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

Station number	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ASCII code	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V

For example, "30H" is transmitted in hexadecimal when the station number is "0" (first axis).

(4) Group

Group	a	b	c	d	e	f	All group
ASCII code	a	b	c	d	e	f	*

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

8. COMMUNICATION FUNCTIONS

8.5 Error codes

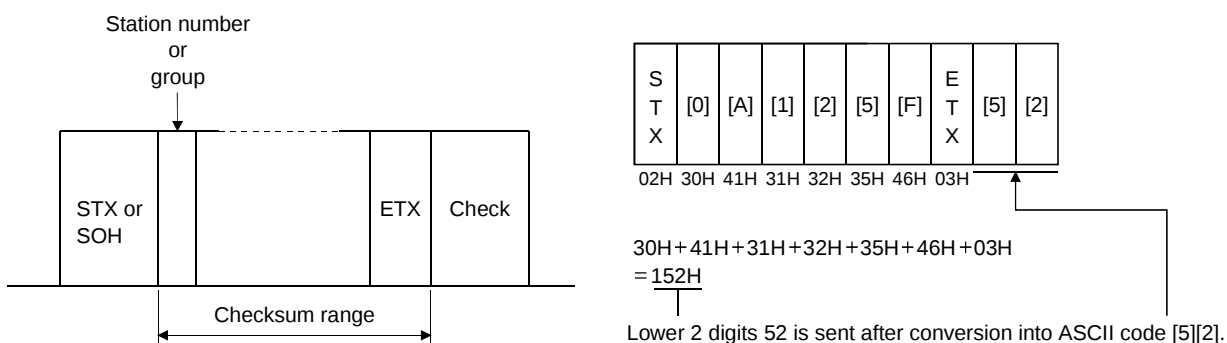
Error codes are used in the following cases and an error code of single-code length is transmitted.

On receipt of data from the master station, the slave station sends the error code corresponding to that data to the master station. The code transmitted in uppercase indicates that the servo is normal and the one in lowercase indicates that an alarm has 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.	

8.6 Checksum

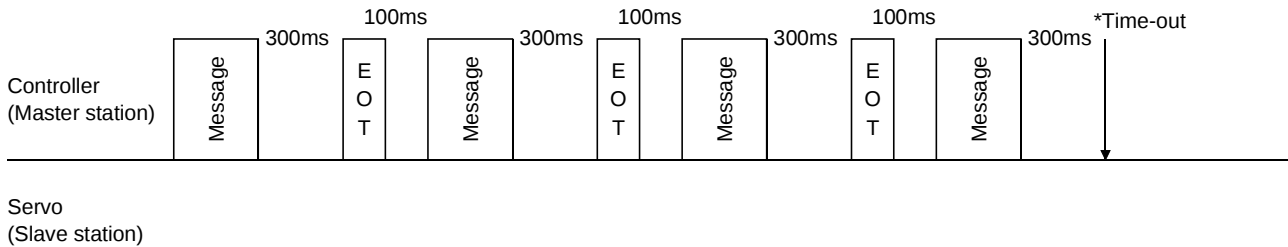
The checksum is sent as a ASCII coded hexadecimal code representing the lower two digits of the sum of ASCII coded hexadecimal values up to ETX, with the exception of the first control code (STX or SOH).



8. COMMUNICATION FUNCTIONS

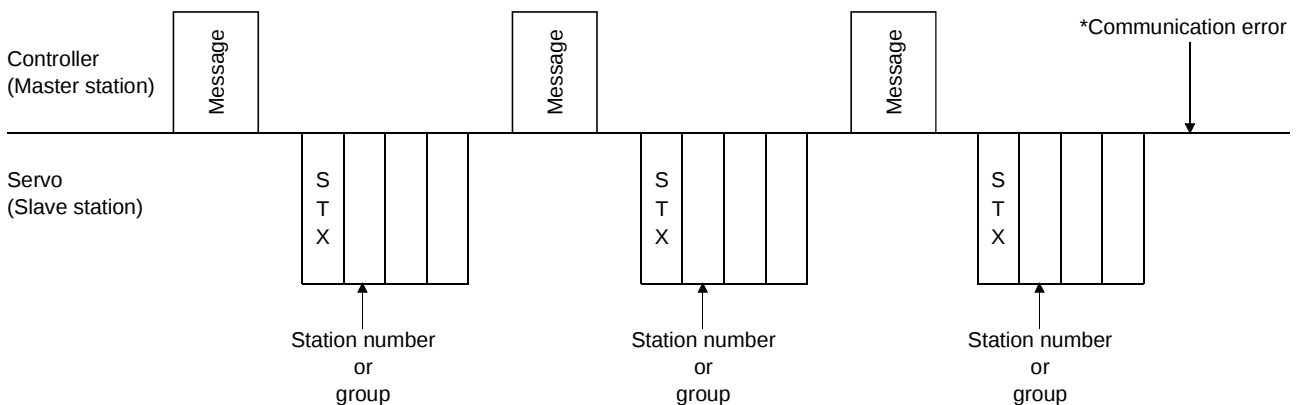
8.7 Time-out operation

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)



8.8 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.

8. COMMUNICATION FUNCTIONS

8.11 Command and data No. list

POINT	
▪ If the command/data No. is the same, its data may be different from the interface and drive units and other servo amplifiers.	

8.11.1 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	Current position	12
[0][1]	[8][1]		Command position	12
[0][1]	[8][2]		Command remaining distance	12
[0][1]	[8][3]		Point table No.	12
[0][1]	[8][4]		Cumulative feedback pulses	12
[0][1]	[8][5]		Servo motor speed	12
[0][1]	[8][6]		Droop pulses	12
[0][1]	[8][7]		Override	12
[0][1]	[8][8]		Torque limit voltage	12
[0][1]	[8][9]		Regenerative load ratio	12
[0][1]	[8][A]		Effective load ratio	12
[0][1]	[8][B]		Peak load ratio	12
[0][1]	[8][C]		Within one-revolution position	12
[0][1]	[8][D]		ABS counter	12
[0][1]	[8][E]		Load inertia moment ratio	12

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

Command	Data No.	Description	Frame Length
[0][5]	[0][0] to [3][5]	Current value of each parameter Decimal number of data No. corresponds to the parameter number.	8

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

Command	Data No.	Description	Frame Length
[1][2]	[0][0]	Input device statuses	8
[1][2]	[4][0]	External input pin statuses	8
[1][2]	[6][0]	Statuses of input devices switched on through communication	8
[1][2]	[8][0]	Output device statuses	8
[1][2]	[C][0]	External output pin statuses	8

8. COMMUNICATION FUNCTIONS

(4) Alarm history (Command [3][3])

Command	Data No.	Description	Alarm Occurrence Sequence	Frame Length
[3][3]	[1][0]	Alarm number in alarm history	Most recent alarm	4
[3][3]	[1][1]		First alarm in past	4
[3][3]	[1][2]		Second alarm in past	4
[3][3]	[1][3]		Third alarm in past	4
[3][3]	[1][4]		Fourth alarm in past	4
[3][3]	[1][5]		Fifth alarm in past	4
[3][3]	[2][0]	Alarm occurrence time in alarm history	Most recent alarm	8
[3][3]	[2][1]		First alarm in past	8
[3][3]	[2][2]		Second alarm in past	8
[3][3]	[2][3]		Third alarm in past	8
[3][3]	[2][4]		Fourth alarm in past	8
[3][3]	[2][5]		Fifth alarm in past	8

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

Command	Data No.	Description	Frame Length
[0][2]	[0][0]	Current alarm number	4

Command	Data No.	Description	Status Display Item	Frame Length
[3][5]	[8][0]	Status display data value and processing information at alarm occurrence	Current position	12
[3][5]	[8][1]		Command position	12
[3][5]	[8][2]		Command remaining distance	12
[3][5]	[8][3]		Point table No.	12
[3][5]	[8][4]		Cumulative feedback pulses	12
[3][5]	[8][5]		Servo motor speed	12
[3][5]	[8][6]		Droop pulses	12
[3][5]	[8][7]		Override	12
[3][5]	[8][8]		Torque limit voltage	12
[3][5]	[8][9]		Regenerative load ratio	12
[3][5]	[8][A]		Effective load ratio	12
[3][5]	[8][B]		Peak load ratio	12
[3][5]	[8][C]		Within one-revolution position	12
[3][5]	[8][D]		ABS counter	12
[3][5]	[8][E]		Load inertia moment ratio	12

8. COMMUNICATION FUNCTIONS

(6) Point table/position data (Command [4][0])

Command	Data No.	Description	Frame Length
[4][0]	[0][1] to [0][F]	Position data read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

(7) Point table/speed data (Command [5][0])

Command	Data No.	Description	Frame Length
[5][0]	[0][1] to [0][F]	Speed data read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

(8) Point table/acceleration time constant (Command [5][4])

Command	Data No.	Description	Frame Length
[5][4]	[0][1] to [0][F]	Acceleration time constant read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

(9) Point table/deceleration time constant (Command [5][8])

Command	Data No.	Description	Frame Length
[5][8]	[0][1] to [0][F]	Deceleration time constant read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

(10) Point table/dwell time (Command [6][0])

Command	Data No.	Description	Frame Length
[6][0]	[0][1] to [0][F]	Dwell time read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

(11) Point table/auxiliary function (Command [6][4])

Command	Data No.	Description	Frame Length
[6][4]	[0][1] to [0][F]	Auxiliary function read The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	8

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

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

(13) 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

8. COMMUNICATION FUNCTIONS

8.11.2 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 [3][5]	Each parameter write Decimal number of data No. corresponds to the parameter number.	Depends on the parameter.	8

(3) External I/O signal (Command [9][2])

Command	Data No.	Description	Setting Range	Frame Length
[9][2]	[6][0]	Communication input device signal	Refer to Section 8.12.5	8

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

Command	Data No.	Description	Setting Range	Frame Length
[8][2]	[2][0]	Alarm history clear	1EA5	4

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

Command	Data No.	Description	Setting Range	Frame Length
[8][2]	[0][0]	Alarm reset	1EA5	4

8. COMMUNICATION FUNCTIONS

(6) Point table/position data (Command [C][0])

Command	Data No.	Description	Setting Range	Frame Length
[C][0]	[0][1] to [0][F]	Position data write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	–999999 to 999999	8

(7) Point table/speed data (Command [C][6])

Command	Data No.	Description	Setting Range	Frame Length
[C][6]	[0][1] to [0][F]	Speed data write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	0 to Permissible instantaneous speed	8

(8) Point table/acceleration time constant (Command [C][7])

Command	Data No.	Description	Setting Range	Frame Length
[C][7]	[0][1] to [0][F]	Acceleration time constant write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	0 to 20000	8

(9) Point table/deceleration time constant (Command [C][8])

Command	Data No.	Description	Setting Range	Frame Length
[C][8]	[0][1] to [0][F]	Deceleration time constant write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	0 to 20000	8

(10) Point table/dwell time (Command [C][A])

Command	Data No.	Description	Setting Range	Frame Length
[C][A]	[0][1] to [0][F]	Dwell time write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	0 to 20000	8

(11) Point table/auxiliary function (Command [C][B])

Command	Data No.	Description	Setting Range	Frame Length
[C][B]	[0][1] to [0][F]	Auxiliary function write The decimal equivalent of the data No. value (hexadecimal) corresponds to the Point table No.	0,1	8

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

Command	Data No.	Description	Setting Range	Frame Length
[9][F]	[0][0]	Group setting	a to f	4

8. COMMUNICATION FUNCTIONS

8.12 Detailed explanations of commands

8.12.1 Data processing

When the command + data number or the command + data number + data are sent from the master station to a slave station, a reply or data is returned from the servo amplifier according to the purpose.

In these send data and receive data, numerical values are represented in decimal, hexadecimal, etc.

Hence, data must be processed to meet their purposes.

Follow the corresponding explanation since whether data must be processed or not and how to process them changes with monitoring, parameters, etc.

How to process send/receive data when reading and writing data will be described below.

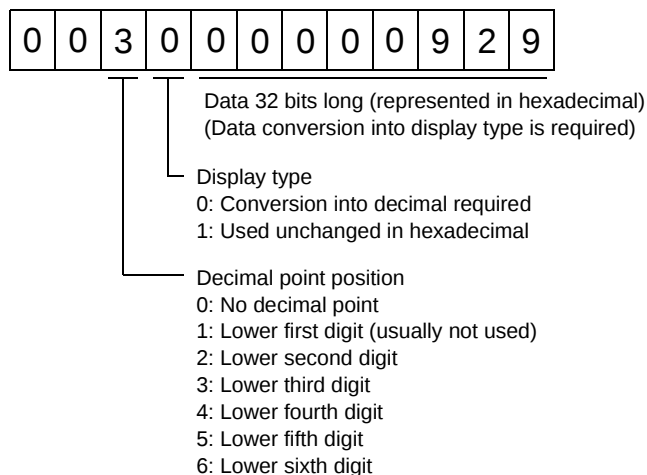
(1) Processing read data

For the display type of 0, eight-character data is converted from a hexadecimal number to a decimal number and a decimal point is provided from the decimal point information.

For the display type of 1, eight-character data is used as-is.

How to process receive data "00300000929" to show the status is explained here by way of example.

Receive data is as follows:



As the display type is "0" in this case, the hexadecimal data is converted into a decimal number.

00000929H→2345

Since the decimal point position is "3", the decimal point is put in the third lower digit.

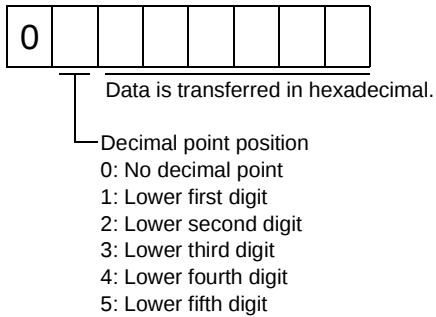
Hence, "23.45" appears.

8. COMMUNICATION FUNCTIONS

(2) Writing processed data

When written data is handled as a decimal number, the decimal point position must be specified. If it is not specified, data cannot be written. When data is handled as a hexadecimal number, specify "0" for the decimal point position.

The data to be sent is as follows:



How to process set data to the value of "15.5" is explained here by way of example.

Since the decimal point position is the second digit, the decimal point data is "2".

As the data to be transmitted is a hexadecimal number, the decimal data is converted into a hexadecimal number.

115→9B

Hence, "0200009B" is sent.

8. COMMUNICATION FUNCTIONS

8.12.2 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.

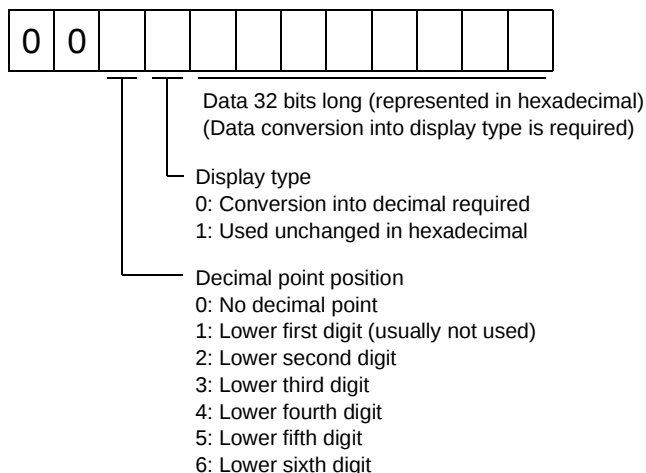
(a) Transmission

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

Refer to Section 8.11.1.

(b) 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 "0".

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 "0".

8. COMMUNICATION FUNCTIONS

8.12.3 Parameter

(1) Parameter read

Read the parameter setting.

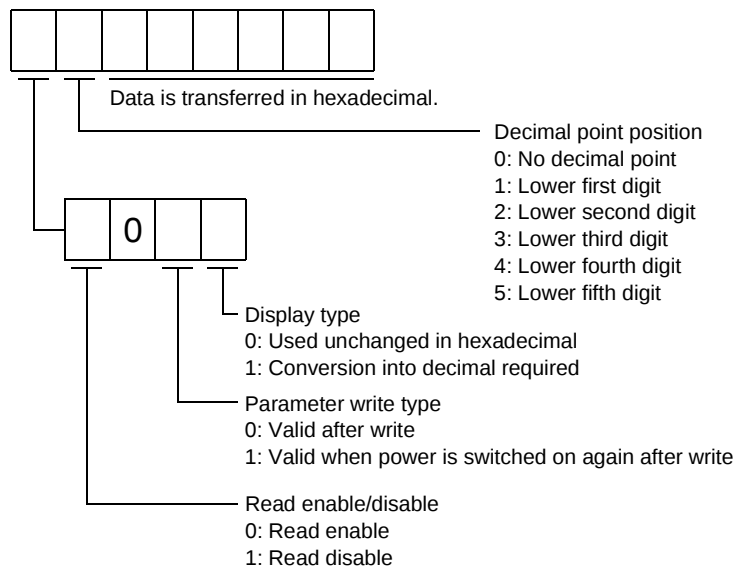
1) Transmission

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

Command	Data No.	Data No. Definition
[0][5]	[0][0] to [3][5]	Corresponds to the parameter No.

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.

8. COMMUNICATION FUNCTIONS

(2) Parameter write

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 number is represented in hexadecimal. The decimal value converted from the data number value corresponds to the parameter number. Refer to (1)(a) in this section.

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 [3][5]	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 the parameter data is changed frequently through communication, set "3" to the write mode to change only the RAM data in the servo amplifier.

When changing data frequently (once or more within one hour), do not write it to the EEPROM.

8. COMMUNICATION FUNCTIONS

8.12.4 External I/O signal statuses

(1) Reading of input device statuses

Read the statuses of the input devices.

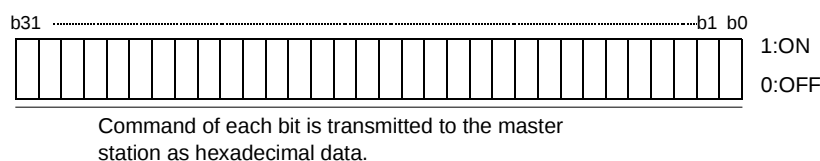
(a) Transmission

Transmit command [1][2] and data No. [0][0].

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

(b) Reply

The slave station sends back the statuses of the input pins.



bit	Signal Name	bit	Signal Name	bit	Signal Name
0	Servo-on (SON)	10	Forward rotation stroke limit (LSP)	20	Point table No. selection 2 (DI1)
1	Forward rotation stroke limit (LSP)	11	Forward rotation start (ST1)	21	Point table No. selection 3 (DI2)
2	Reverse rotation stroke limit (LSN)	12	Reverse rotation start (ST2)	22	Point table No. selection 4 (DI3)
3	External torque limit selection (TL)	13		23	Override selection (OVR)
4	Internal torque limit selection (TL2)	14		24	Temporary stop/restart (STP)
5	Proportion control selection (PC)	15		25	Manual pulse generator multiplication 1 (TP0)
6	Reset (RES)	16	Forced stop (EMG)	26	Manual pulse generator multiplication 2 (TP1)
7		17	Automatic/manual selection (MDO)	27	
8		18	Proximity dog (DOG)	28	
9		19	Point table No. selection 1 (DI0)	29	

(2) External input pin status read

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

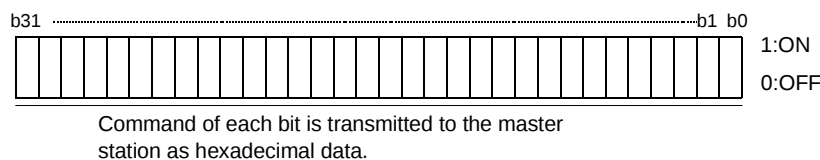
(a) Transmission

Transmit command [1][2] and data No. [4][0].

Command	Data No.
[1][2]	[4][0]

(b) Reply

The ON/OFF statuses of the input pins are sent back.



bit	External Input Pin	bit	External Input Pin
0	CN1B-16	5	CN1A-8
1	CN1B-17	6	CN1B-7
2	CN1B-15	7	CN1B-8
3	CN1B-5	8	CN1B-9
4	CN1B-14	9	CN1A-19

8. COMMUNICATION FUNCTIONS

(3) Read of the statuses of input devices switched on through communication

Read the ON/OFF statuses of the input devices switched on through communication.

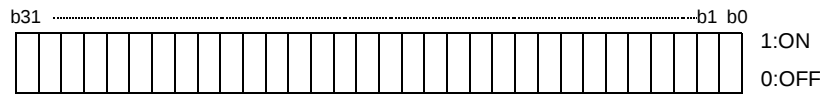
(a) Transmission

Transmit command [1][2] and data No. [6][0].

Command	Data No.
[1][2]	[6][0]

(b) Reply

The slave station sends back the statuses of the input pins.



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

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	Servo-on (SON)	10		20	Point table No. selection 2 (DI1)
1	Forward rotation stroke limit (LSP)	11	Forward rotation start (ST1)	21	Point table No. selection 3 (DI2)
2	Reverse rotation stroke limit (LSN)	12	Reverse rotation start (ST2)	22	Point table No. selection 4 (DI3)
3	External torque limit selection (TL)	13		23	Override selection (OVR)
4	Internal torque limit selection (TL2)	14		24	Temporary stop/restart (STP)
5	Proportion control selection (PC)	15		25	Manual pulse generator multiplication 1 (TP0)
6	Reset (RES)	16	Forced stop (EMG)	26	Manual pulse generator multiplication 2 (TP1)
7		17	Automatic/manual selection (MDO)	27	
8		18	Proximity dog (DOG)	28	
9		19	Point table No. selection 1 (DI0)	29	

(4) External output pin status read

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

(a) Transmission

Transmit command [1][2] and data No. [C][0].

Command	Data No.
[1][2]	[C][0]

(b) Reply

The slave station sends back the ON/OFF statuses of the output pins.



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

bit	External output Pin	bit	External output Pin
0	CN1A-19	5	CN1B-18
1	CN1A-18		
2	CN1B-19		
3	CN1B-6		
4	CN1B-4		

8. COMMUNICATION FUNCTIONS

(5) Read of the statuses of output devices

Read the ON/OFF statuses of the output devices.

(a) Transmission

Transmit command [1][2] and data No. [8][0].

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

(b) Reply

The slave station sends back the statuses of the output devices.



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

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	Ready (RD)	8	Trouble (ALM)	16	Rough match (CPO)
1		9		17	Home position return completion (ZP)
2		10	Electromagnetic brake (MBR)	18	Position range (POT)
3	Limiting torque (TLC)	11	Dynamic brake interlock (DBR)	19	Temporary stop (PUS)
4		12		20	
5	In position (INP)	13		21	
6		14		22	
7	Warning (WNG)	15	Battery warning (BWNG)	23	

8.12.5 Device ON/OFF

POINT
The ON/OFF states of all devices in the servo amplifier are the states of the data received last. Hence, when there is a device which must be kept ON, send data which turns that device ON every time.

Each input device can be switched on/off. However, when the device to be switched off exists in the external input signal, also switch off that input signal.

Send command [9][2], data No. [6][0] and data.

Command	Data No.	Set Data
[9][2]	[6][0]	See below.



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

bit	Signal Name	bit	Signal Name	bit	Signal Name
0	Servo-on (SON)	10		20	Point table No. selection 2 (DI1)
1	Forward rotation stroke limit (LSP)	11	Forward rotation start (ST1)	21	Point table No. selection 3 (DI2)
2	Reverse rotation stroke limit (LSN)	12	Reverse rotation start (ST2)	22	Point table No. selection 4 (DI3)
3	External torque limit selection (TL)	13		23	Override selection (OVR)
4	Internal torque limit selection (TL2)	14		24	Temporary stop/restart (STP)
5	Proportion control selection (PC)	15		25	Manual pulse generator multiplication 1 (TP0)
6	Reset (RES)	16	Forced stop (EMG)	26	Manual pulse generator multiplication 2 (TP1)
7		17	Automatic/manual selection (MDO)	27	
8		18	Proximity dog (DOG)	28	
9		19	Point table No. selection 1 (DI0)	29	

8. COMMUNICATION FUNCTIONS

8.12.6 Alarm history

(1) Alarm No. read

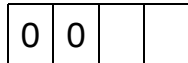
Read the alarm No. which occurred in the past. The alarm numbers and occurrence times of No.0 (last alarm) to No.5 (sixth alarm in the past) are read.

(a) Transmission

Send command [3][3] and data No. [1][0] to [1][5]. Refer to Section 8.11.1.

(b) Reply

The alarm No. corresponding to the data No. is provided.



└ Alarm No. is transferred in decimal.

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

(2) Alarm occurrence time read

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

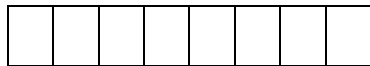
The alarm occurrence time corresponding to the data No. is provided in terms of the total time beginning with operation start, with the minute unit omitted.

(a) Transmission

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

Refer to Section 8.11.1.

(b) Reply



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

For example, data [0][1][F][5] indicates that the alarm occurred 501 hours after start of operation.

8. COMMUNICATION FUNCTIONS

(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

8.12.7 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 A.32 and "00FF" A._ (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.

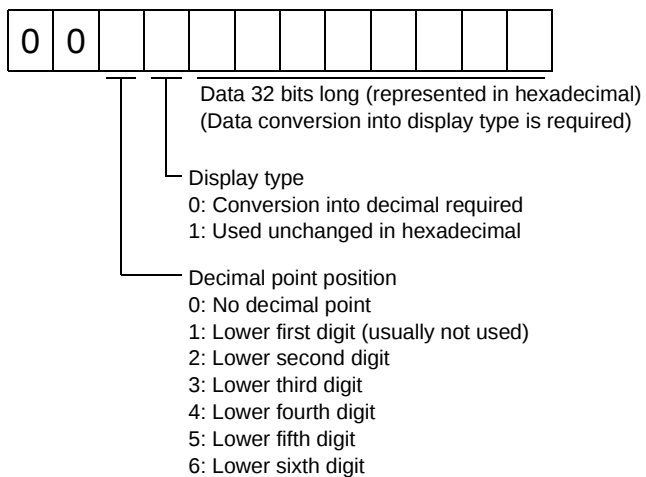
(a) Transmission

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 8.11.1.

(b) Reply

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

8. COMMUNICATION FUNCTIONS



(3) Current alarm clear

As by the entry of the RES, 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.

Transmission

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

8. COMMUNICATION FUNCTIONS

8.12.8 Point table

(1) Position data read

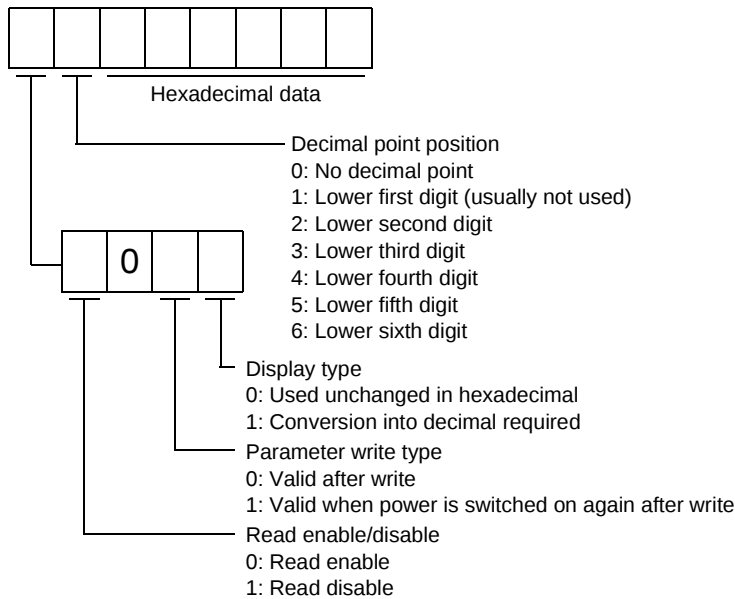
Read the position data of the point table.

(a) Transmission

Transmit command [4][0] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the position data of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

(2) Speed data read

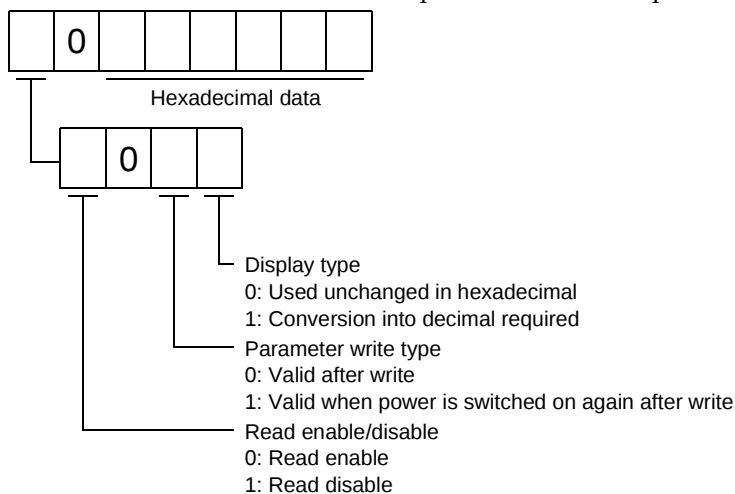
Read the speed data of the point table.

(a) Transmission

Transmit command [5][0] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the speed data of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

8. COMMUNICATION FUNCTIONS

(3) Acceleration time constant read

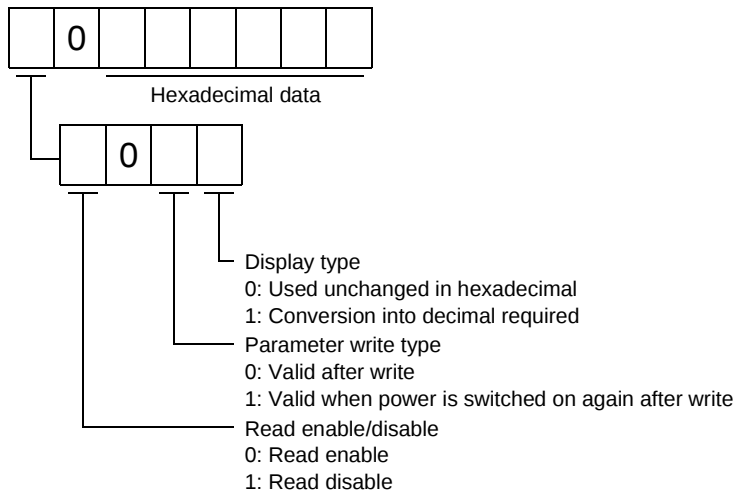
Read the acceleration time constant of the point table.

(a) Transmission

Transmit command [5][4] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the acceleration time constant of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

(4) Deceleration time constant read

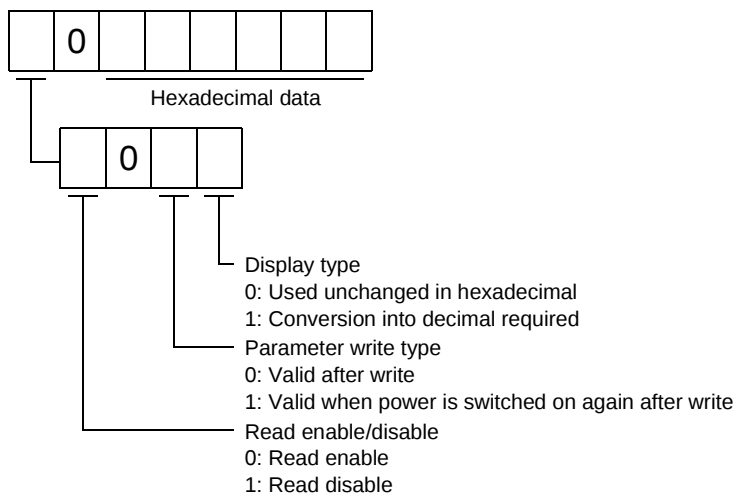
Read the deceleration time constant of the point table.

(a) Transmission

Transmit command [5][8] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the deceleration time constant of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

8. COMMUNICATION FUNCTIONS

(5) Dwell time read

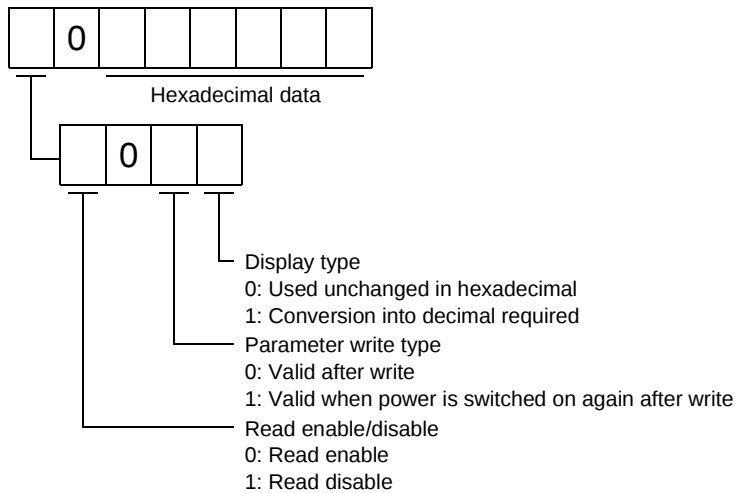
Read the dwell time of the point table.

(a) Transmission

Transmit command [6][0] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the dwell time of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

(6) Auxiliary function read

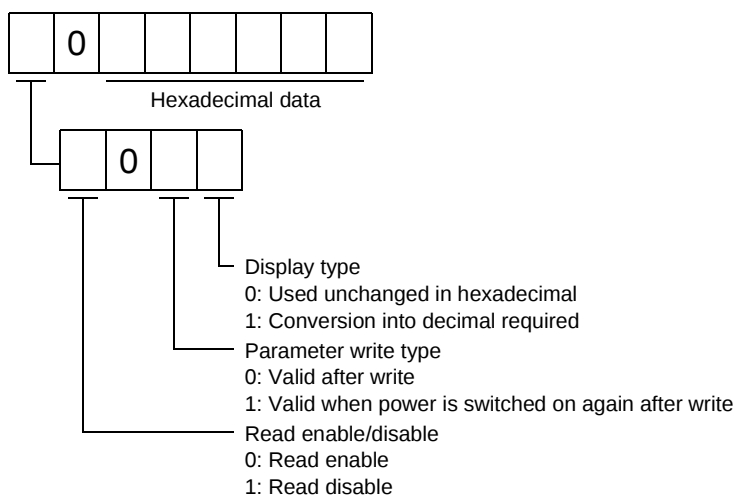
Read the auxiliary function of the point table.

(a) Transmission

Transmit command [6][4] and any of data No. [0][1] to [0][F] corresponding to the point table to be read. Refer to Section 8.11.1.

(b) Reply

The slave station sends back the auxiliary function of the requested point table.



When the enable/disable setting is read disable, ignore the data part and process it as unreadable.

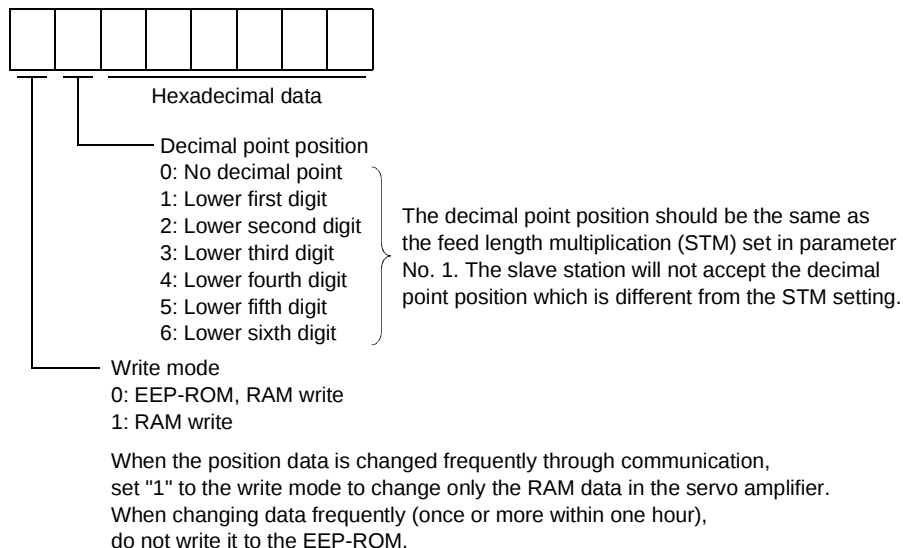
8. COMMUNICATION FUNCTIONS

(7) Position data write

Write the position data of the point table.

Transmit command [C][0], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][0]	[0][1] to [0][F]	See below.

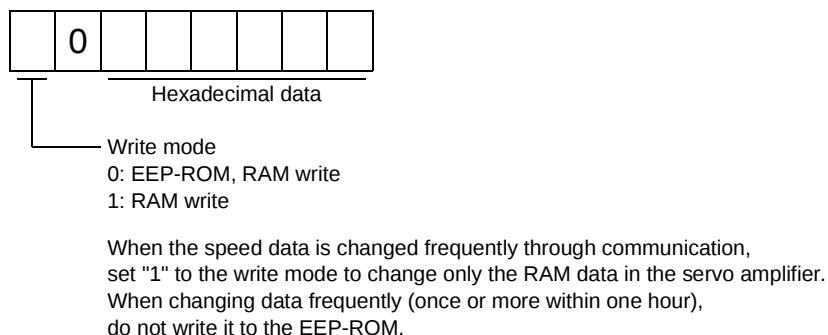


(8) Speed data write

Write the speed data of the point table.

Transmit command [C][6], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][6]	[0][1] to [0][F]	See below.



8. COMMUNICATION FUNCTIONS

(9) Acceleration time constant write

Write the acceleration time constant of the point table.

Transmit command [C][7], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][7]	[0][1] to [0][F]	See below.



Write mode

0: EEP-ROM, RAM write

1: RAM write

When the acceleration time constant is changed frequently through communication, set "1" to the write mode to change only the RAM data in the servo amplifier.

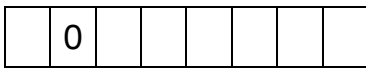
When changing data frequently (once or more within one hour), do not write it to the EEP-ROM.

(10) Deceleration time constant write

Write the deceleration time constant of the point table.

Transmit command [C][8], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][8]	[0][1] to [0][F]	See below.



Write mode

0: EEP-ROM, RAM write

1: RAM write

When the deceleration time is changed frequently through communication, set "1" to the write mode to change only the RAM data in the servo amplifier.

When changing data frequently (once or more within one hour), do not write it to the EEP-ROM.

8. COMMUNICATION FUNCTIONS

(11) Dwell time write

Write the dwell time of the point table.

Transmit command [C][A], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][A]	[0][1] to [0][F]	See below.

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

Hexadecimal data

Write mode

0: EEP-ROM, RAM write

1: RAM write

When the dwell time constant is changed frequently through communication,

set "1" to the write mode to change only the RAM data in the servo amplifier.

When changing data frequently (once or more within one hour),

do not write it to the EEP-ROM.

(12) Auxiliary function write

Write the auxiliary function of the point table.

Transmit command [C][B], any of data No. [0][1] to [0][F] corresponding to the point table to be written to, and the data. Refer to Section 8.11.2.

Command	Data No.	Data
[C][B]	[0][1] to [0][F]	See below.

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

Hexadecimal data

Write mode

0: EEP-ROM, RAM write

1: RAM write

When the auxiliary function constant is changed frequently through communication,

set "1" to the write mode to change only the RAM data in the servo amplifier.

When changing data frequently (once or more within one hour),

do not write it to the EEP-ROM.

8. COMMUNICATION FUNCTIONS

8.12.9 Servo amplifier group designation

With group setting made to the slave stations, data can be transmitted simultaneously to two or more slave stations set as a group through RS-422 communication.

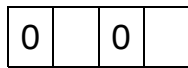
(1) Group setting write

Write the group designation value to the slave station.

Transmission

Transmit command [9][F], data No. [0][0] and data.

Command	Data No.	Data
[9][F]	[0][0]	See below.



- Group designation
0: No group designation
1: Group a
2: Group b
3: Group c
4: Group d
5: Group e
6: Group f
- Response command enable
Set whether data can be sent back or not in response to the read command of the master station.
0: Response disable
Data cannot be set back.
1: Response enable
Data can be set back.

(2) Group setting read

Read the set group designation value from the slave station.

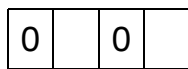
(a) Transmission

Transmit command [1][F] and data No. [0][0].

Command	Data No.
[1][F]	[0][0]

(b) Reply

The slave station sends back the group setting of the point table requested.



- Group designation
0: No group designation
1: Group a
2: Group b
3: Group c
4: Group d
5: Group e
6: Group f
- Response command enable
0: Response disable
1: Response enable

8. COMMUNICATION FUNCTIONS

8.12.10 Other commands

(1) Servo motor end pulse unit absolute position

Read the absolute position in the servo motor end pulse unit.

(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)

[illegible]

9. ADJUSTMENT

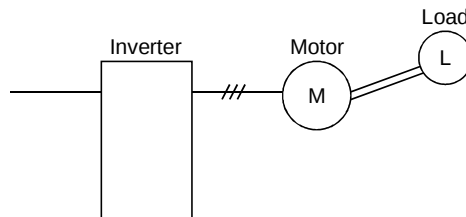
9. ADJUSTMENT

9.1 What is gain adjustment?

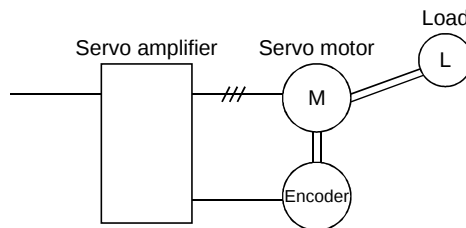
9.1.1 Difference between servo amplifier and other drives

Besides the servo amplifier, there are other motor drives such as an inverter and stepping driver. Among these drives, the servo amplifier requires gain adjustment.

The inverter and stepping driver are in an open loop (actual motor speed and position are not detected on the driver side).



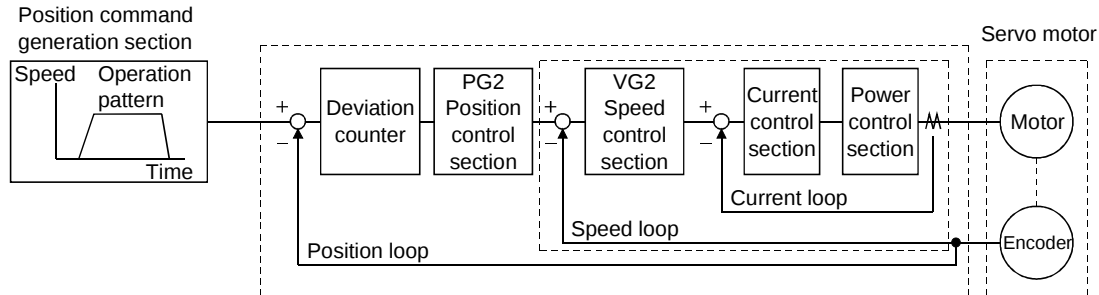
On the other hand, the servo amplifier always detects the positions and speeds of the motor and machine using the servo motor encoder, and exercises control to match the position and speed commands with the actual motor (machine) position and speed. In the servo system, adjustment is needed because:



- (1) Response level changes according to the inertia moment of the machine;
- (2) Vibration occurs due to the resonance point, etc. peculiar to the machine; and
- (3) Operation delay and accuracy specification differ between machines and response level should satisfy this specification.

9. ADJUSTMENT

9.1.2 Basics of the servo system



A general servo system configuration is shown above. The servo control system consists of three loops: current loop, speed loop and position loop. Among these three loops, the response of the inside loop must be increased 4 to 6 times higher. If this condition is not satisfied, vibration will be generated. If the condition further worsens, hunting will occur.

(1) Current loop

For the servo amplifier, the response level of the current loop is factory-set to a high value and need not be adjusted. If the motor is installed to the machine, the response of the current loop will hardly vary.

(2) Speed loop

Response will vary according to the inertia moment of the machine. When the load inertia moment increases, the response of the speed loop will reduce. Use the speed loop gain (VG2) to compensate for the reduction of the response level.

$$\text{Speed loop response } f_v[\text{rad/s}] = \frac{\text{Amplifier gain setting VG2}[\text{rad/s}]}{1 + m}$$

$$m : \text{Loop inertia moment ratio} \left(= \frac{J_L}{J_M} \right)$$

J_L = load inertia moment

J_M = servo motor shaft inertia moment

(3) Position loop

The response level will not vary according to machine conditions.

$$\text{Position loop response } f_p[\text{rad/s}] = \text{amplifier gain setting PG2}[\text{rad/s}]$$

When the motor is installed to the machine, the gain must be adjusted to satisfy $f_v = 4$ to $6f_p$ according to the load inertia moment ratio m .

9. ADJUSTMENT

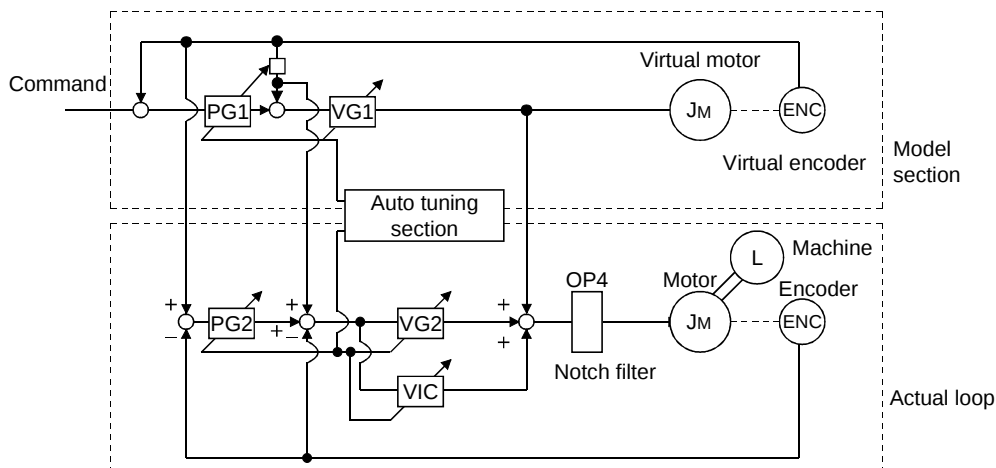
9.2 Gain adjustment

9.2.1 Parameters required for gain adjustment

Parameter No.	Symbol	Name
3	ATU	Auto tuning
7	PG1	Position loop gain 1
22	*OP4	Function selection 4 (machine resonance filter)
34	GD2	Ratio of load inertia moment to motor inertia moment
35	PG2	Position loop gain 2
36	VG1	Speed loop gain 1
37	VG2	Speed loop gain 2
38	VIC	Speed integral compensation

9.2.2 Block diagram

The block diagram of the servo amplifier servo control section is shown above. (The current loop is omitted.)



(1) Actual loop section

A control loop designed to control the actual motor and acts to control the servo system stably in response to the load torque of the machine.

(2) Model section

Acts to provide the ideal operation values to the current loop in response to the command.

(3) Auto tuning section

Judges the load inertia moment of the machine fitted with the actual motor from the operation error of the motor to change each control gain in real time.

The gains changed by auto tuning are PG1, VG1, PG2, VG2 and VIC.

9. ADJUSTMENT

9.2.3 What is auto tuning?

The angular speed (ω) and torque (T) are estimated in accordance with the equation of motion (9.1) used for motor acceleration/deceleration. In actuality, the acceleration/deceleration characteristics of the model and those of the actual motor are compared to estimate the inertia moment of the load in real time.

$$J \frac{d\omega}{dt} = T \dots\dots\dots (9.1)$$

J : Inertia moment

ω : Angular speed

T : Torque

Real-time auto tuning is performed in the following procedure:

- (1) When the motor makes acceleration/deceleration, load inertia moment JL is estimated in the above method to calculate the load inertia moment ratio (GD2).
- (2) Each gain (PG1, VG1, PG2, VG2, VIC) to the calculated load inertia moment ratio (GD2) is changed according to the response level set in parameter No.3. Note that these gains have been patterned beforehand to satisfy the aforementioned stabilization condition.

9. ADJUSTMENT

9.3 Gain adjustment by auto tuning

9.3.1 Adjustment method

In the factory setting of the servo amplifier, auto tuning is valid and the response level setting is "2" (parameter No.3 : 0104).

The initial settings provide sufficient tuning for general machines. Higher-level tuning can be provided by adjusting the response level setting (parameter No.3) according to machine rigidity.

The following table lists guidelines for response level setting to drive systems. Choose slow response when using a reduction gear having backlash:

Main Drive System		Fast Response	Middle Response	Slow Response
Ball screw	Direct coupling	←	→	
	With reduction gear		←	→
Rack & pinion	Direct coupling		←	→
	With reduction gear		←	→
Timing belt	Direct coupling		←	→
	With reduction gear		←	→
Chain	Direct coupling		←	→
	With reduction gear		←	→

The following is how to adjust the response setting level to machine phenomena:

Actual Machine Operation	Ideal Machine Operation	Parameter No.3 Setting
Settling time is long (Note)	Reduce settling time.	Increase response level setting.
Large overshoot at stop	Reduce overshoot.	Decrease response level setting. Set machine selection setting to "large friction".
Gear sound generated from machine	Reduce gear sound.	Decrease response level setting.

Note: Settling time indicates time from zero command pulse to servo motor stop.

9.3.2 Valid conditions

POINT
▪ If the acceleration/deceleration time is long or the servo motor speed used is only low speed, the valid conditions of auto tuning are not satisfied. Therefore, it may result in false tuning. In this case, after performing operation which satisfies the auto tuning conditions, set auto tuning selection to "Not executed" (parameter No.3: ☐ 2 ☐ ☐).

This section provides constraints on the operation pattern to enable excellent auto tuning. If the conditions in this section cannot be satisfied, normal auto tuning may not be performed. In this case, after executing auto tuning in operation which satisfies the conditions given in this section, make auto tuning invalid to disallow the gain setting from being changed.

- (1) Set the acceleration time (time until the preset speed is reached) to 5s or less and the acceleration/deceleration current to 50% or more.
- (2) Perform operation several times until the cumulative acceleration/deceleration time is 1s or more.
- (3) Set the servo motor speed to 500r/min or more.

9. ADJUSTMENT

9.4 Manual gain adjustment

On some machines, gain adjustment may not be made by auto tuning or excellent gain setting may not be made if gain adjustment is performed by auto tuning. In this case, adjust the gains manually. Use any of the methods given in this section to adjust the gains.

9.4.1 When machine rigidity is low

(1) Machine condition

Because of low machine rigidity, the response level setting of auto tuning is set to slow response and it takes too much time to reach the target position.

When the machine or motor shaft is moved lightly at a stop, it moves easily.

(2) Adjustment procedure

(a) Adjustment 1

- 1) Execute auto tuning with the response level setting of the level at which machine will not vibrate.
Set "0101" in parameter No.3.
- 2) Set "Not executed" (parameter No.3: ☐ 2 ☐ ☐) by the auto tuning selection.
- 3) Gradually decrease the speed integral compensation VIC (parameter No.38) setting.

(b) Adjustment 2

- 1) Perform auto tuning with the response level setting of slow response.
Set "0101" in parameter No.3.
- 2) Set 563Hz or 375Hz to the machine resonance filter (Parameter No.22).
- 3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
- 4) If the machine condition does not become excellent after the above adjustment, reduce the setting of speed integral compensation (parameter No.38) as in Adjustment 1.

9. ADJUSTMENT

9.4.2 When the machine vibrates due to machine resonance frequency

(1) Machine condition

The servo motor shaft is oscillating at high frequency (100Hz or more).

The servo motor shaft motion cannot be confirmed visually. However, if the machine generates large noise and vibrates, make Adjustment 1.

If higher "response level setting" of auto tuning increases vibration, make Adjustment 2.

(2) Adjustment procedure

(a) Adjustment 1

- 1) Perform auto tuning with the response level setting of slow response.
Set "0101" in parameter No.3.
- 2) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No.22).
- 3) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
- 4) Decrease the machine resonance suppression filter gradually and repeat step 3).
The optimum value is provided at the point where vibration is minimum.
- 5) To further shorten the settling time, gradually increase the response level setting in parameter No.3 and repeat steps 1) to 4).

(b) Adjustment 2

- 1) Choose the response level setting of slow response.
Set "0101" in parameter No.3.
- 2) Set the load inertia moment ratio (parameter No.34).
If an exact machine inertia moment ratio is unknown, enter an approximate value.
When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the load inertia moment ratio (parameter No.34) value.

Parameter No.	Symbol	Name
7	PG1	Position loop gain 1
35	PG2	Position loop gain 2
36	VG1	Speed loop gain 1
37	VG2	Speed loop gain 2
38	VIC	Speed integral compensation

- 3) Set "not executed" (parameter No.3: ☐ 2 ☐ ☐) by the auto tuning selection.
- 4) Decrease the speed loop gain 2 (parameter No. 37) to a value about 100 to 200 smaller than the automatically set value.
- 5) Set 563Hz or 375Hz to the machine resonance suppression filter (Parameter No.22).
- 6) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.
- 7) Decrease the machine resonance suppression filter gradually and repeat step 6).
The optimum value is provided at the point where vibration is minimum.
- 8) When there is no machine resonance, check the operating status and gradually increase the speed loop gain 2 (parameter No.37) and repeat steps 5) to 7) in (b) Adjustment 2.
Set the value about 50 to 100 smaller than the value at which gear sound begins to be generated. Make this gain a little smaller if there is variation in the machine because a timing belt or the like is used.
- 9) To further shorten the settling time, gradually increase the response level setting (parameter No.3) and repeat steps 1) to 8).

9. ADJUSTMENT

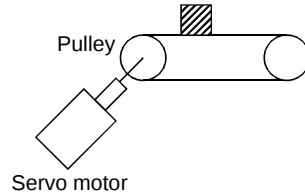
9.4.3 Load inertia moment is 20 or more times

(1) Machine condition

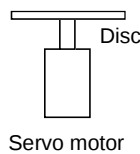
The machine inertia moment is 20 times or more and the servo motor oscillates at low frequency (5Hz or more). At this time, servo motor shaft vibration can be confirmed visually.

This adjustment method is valid for the following machines:

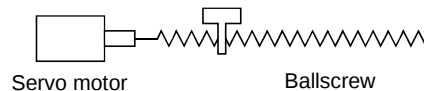
(a) Machine in which a timing belt is driven without reduction gear



(b) Machine in which a disc is rotated without reduction gear



(c) Machine of which ballscrew lead is long



(2) Adjustment procedure

1) Choose the response level setting of slow response.

Set "0101" in parameter No.3.

2) Set the load inertia moment ratio (parameter No.34).

If an exact machine inertia moment ratio is unknown, enter an approximate value.

When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the load inertia moment ratio (parameter No.34) value.

Parameter No.	Symbol	Name
7	PG1	Position loop gain 1
35	PG2	Position loop gain 2
36	VG1	Speed loop gain 1
37	VG2	Speed loop gain 2
38	VIC	Speed integral compensation

3) Set "not executed" (parameter No.3: ☐ 2 ☐ ☐) by the auto tuning selection.

4) Alternate a start and a stop several times and check whether the machine does not vibrate.

5) If vibration still persists, repeat steps 1) and 4).

6) If vibration still persists, make (a) Adjustment 1 and (b) Adjustment 2 in paragraph (2) of Section 9.4.2.

7) If you want to further raise the response level, set parameter No. 3 to "auto tuning executed" (third digit) with operation stopped, and increase the response level setting (first digit). After that, set that parameter to "auto tuning not executed" (third digit). For example, set parameter No. 3 to "0102" and then change it to "0202".

8) Reducing the speed loop's integral time constant (parameter No.38) may improve the performance. However, making it too small may generate vibration.

9. ADJUSTMENT

9.4.4 When shortening the settling time

(1) Machine condition

The settling time will be increased by the gains provided by auto tuning.

(2) Adjustment procedure

- 1) Choose the response level setting of slow response.

Set 0101 in parameter No.3.

- 2) Alternate a start and a stop several times, execute auto tuning, and check whether the machine does not vibrate.

- 3) Set the load inertia moment ratio (machine inertia moment ratio in parameter No.34).

If an exact machine inertia moment ratio is unknown, enter an approximate value.

When the value is set in this parameter, the following parameters are set automatically. When there is no machine resonance, the value of each parameter is set to the ideal gain for the load inertia moment ratio (parameter No.34) value.

Parameter No.	Symbol	Name
7	PG1	Position loop gain 1
35	PG2	Position loop gain 2
36	VG1	Speed loop gain 1
37	VG2	Speed loop gain 2
38	VIC	Speed integral compensation

- 4) Set "not executed" (parameter No.3: ☐ 2 ☐ ☐) by the auto tuning selection.

Make the parameter No.7, 35 to 38 settings manually adjustable.

- 5) Check the operating status and adjust the following parameter values:

Parameter No.	Symbol	Name	Description
7	PG1	Position loop gain 1	Higher setting shortens the settling time but is liable to cause overshooting.
35	PG2	Position loop gain 2	
36	VG1	Speed loop gain 1	Higher setting improves the servo response level but is liable to cause vibration.
37	VG2	Speed loop gain 2	
38	VIC	Speed integral compensation	Lower setting keeps the speed constant to load disturbance and increases holding force at a stop (servo rigidity) but is liable to cause overshooting.

Make adjustment by gradually increasing the parameter No.7, 35 to 37 settings at the same ratio and reducing the speed integral compensation (parameter No.38). The optimum value is provided at the point just before vibration increases. Use of the machine resonance suppression filter (parameter No.22) may increase the limit point. Note that since the maximum value of the speed loop gain is "2000", do not set a value greater than that.

9. ADJUSTMENT

9.4.5 When the same gain is used for two or more axes

(1) Machine condition

To perform interpolation operation with two or more axes of servo amplifiers, the position loop gains of the axes are set to the same value.

(2) Adjustment procedure

1) To adjust the gains of each axis, adjust the gains of all axes in the adjustment procedures in Sections 9.4.1 to 9.4.5.

2) Set "□0□□" or "□2□□" in parameter No.3.

□2□□ : Interpolation control..... The following parameter values change at the next start/stop.

Parameter No.	Symbol	Name
35	PG2	Position loop gain 2
37	VG2	Speed loop gain 2
38	VIC	Speed integral compensation

□2□□ : No auto tuningMake auto tuning invalid and set each gain manually.

3) Match position loop gain 1 to the minimum value of each axis to make the gains of all axes equal.

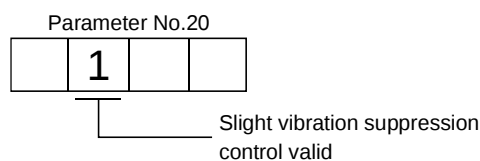
9.5 Slight vibration suppression control

The slight vibration suppression control mode is used to reduce servo-specific ± 1 pulse vibration at the time of a stop. This mode produces an effect especially when the ratio of load inertia moment to servo motor inertia moment is small (2 to 5 times). Note that when vibration is attributable to looseness (such as gear backlash) or machine resonance, use the machine resonance suppression filter (parameter No.22). The slight vibration suppression control mode should be used after real-time auto tuning or manual gain adjustment.

Usage

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

Set "□1□□" in parameter No.20 to enter the slight vibration suppression mode at the time of a stop.



10. INSPECTION

10. INSPECTION



WARNING

- Before starting maintenance and/or inspection, make sure that the charge lamp is off more than 15 minutes after power-off. Then, confirm that the voltage is safe in the tester or the like. Otherwise, you may get an electric shock.
- Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your sales 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 forced stop times : 100,000 times
	Cooling fan	10,000 to 30,000hours (2 to 3 years)
	Absolute position battery	Refer to Section 4.5

(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 forced 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.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

11. TROUBLESHOOTING

11. TROUBLESHOOTING

11.1 Trouble at start-up



CAUTION

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

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

No	Start-Up Sequence	Fault	Investigation	Possible Cause	Reference
1	Power on	• LED is not lit. • LED flickers.	Not improved if connectors 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 is shorted.	
		Alarm occurs.	Refer to Section 11.2 and remove cause.		Section 11.2
2	Switch on servo-on (SON).	Alarm occurs.	Refer to Section 11.2 and remove cause.		Section 11.2
		Servo motor shaft is not servo-locked (is free).	Check the display to see if the servo amplifier is ready to operate.	1) Servo-on (SON) is not input. (Wiring mistake) 2) 24VDC power is not supplied to COM.	Section 7.3
3	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 9
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	Make gain adjustment in the following procedure: If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 9
4	Cyclic operation	Position shift occurs	Confirm the cumulative command pulses, cumulative feedback pulses and actual servo motor position.	Communication command error, machine slip, etc.	

11. TROUBLESHOOTING

11.2 When alarm or warning has occurred

POINT
• If an alarm has occurred, detect the trouble (ALM) and turn off the servo-on (SON).

11.2.1 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 11.2.2 or 11.2.3 and take the appropriate action.

After its cause has been removed, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column.

	Display	Name	Alarm Deactivation		
			Power OFF → ON	Press "SET" on present alarm screen	Reset (RES)
Alarms	A.10	Undervoltage	○	○	○
	A.11	Board error 1	○		
	A.12	Memory error 1	○		
	A.13	Clock error	○		
	A.15	Memory error 2	○		
	A.16	Encoder error 1	○		
	A.17	Board error 2	○		
	A.18	Board error 3	○		
	A.20	Encoder error 2	○		
	A.24	Main circuit error	○		
	A.25	Absolute position erase	○		
	A.30	Regenerative error	(Note) ○	○	(Note) ○
	A.31	Overspeed	○	○	○
	A.32	Overcurrent	○	○	○
	A.33	Overvoltage	○		
	A.35	Command pulse frequency error	○	○	○
	A.37	Parameter error	○		
	A.46	Servo motor overheat	(Note) ○	○	(Note) ○
	A.50	Overload 1	(Note) ○	○	(Note) ○
	A.51	Overload 2	(Note) ○	○	(Note) ○
	A.52	Error excessive	○	○	○
	A.61	Operation alarm	○	○	○
	A.8A	Serial communication time-out	○	○	○
	A.8E	Serial communication error	○	○	○
	8888	Watchdog	○		
Warnings	A.90	Home position return incomplete	Removing the cause of occurrence deactivates the alarm automatically.		
	A.92	Open battery cable warning			
	A.96	Home position setting warning			
	A.98	Software limit warning			
	A.9F	Battery warning			
	A.E0	Excessive regenerative load warning			
	A.E1	Overload warning			
	A.E3	Absolute position counter warning			
	A.E6	Servo emergency stop			
	A.E9	Main circuit off warning			

Note: After removing the cause of occurrence, allow about 30 minutes for cooling before resuming operation.

11. TROUBLESHOOTING

11.2.2 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 (A.25) occurred, always make home position setting again. Otherwise, misoperation may occur.
- As soon as an alarm occurs, turn off Servo-on (SON) and power off the main circuit.

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, servo motor and regenerative brake option may become faulty.
 - Regenerative alarm (A.30)
 - Overload 1 (A.50)
 - Overload 2 (A.51)
- Deactivate the alarm by switching power off, then on.
- When reset (RES) is made valid in "I/O Devices" on the Servo Configuration Software, reset (RES) may be used to deactivate the alarm. Refer to Section 11.2.1 for details.

When an alarm occurs, the trouble (ALM) switches off and the servo motor is stopped by the dynamic brake. At this time, the display shows the corresponding alarm number.

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
A.10	Undervoltage	Power supply voltage dropped.MR-J2-□C :160V or less	1. Power supply voltage is low.	Review the power supply.
			2. Power failed instantaneously for 60ms or longer.	
			3. Shortage of power supply capacity caused the power supply voltage to drop at start, etc.	
			4. Power was restored after bus voltage had dropped to 200VDC. (Main circuit power was switched on within 5s after it had been switched off.)	
			5. Faulty parts in the servo amplifier — Checking method — Alarm (A.10) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
A.11	Board error 1	Printed board faulty	Faulty parts in the servo amplifier — Checking method — Alarm (any of A.11 to 13) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
A.12	Memory error 1	RAM, ROM memory fault		
A.13	Clock error	Printed board fault		

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.15	Memory error 2	EEP-ROM fault	1. Faulty parts in the servo amplifier Checking method Alarm (A.15) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
			2. The number of write times to EEPROM exceeded 100,000.	
A.16	Encoder error 1	Communication error occurred between encoder and servo amplifier.	1. Encode connector (CN2) disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. Encoder cable faulty (wire breakage or short)	Repair or change the cable.
			4. Wrong combination of servo amplifier and servo motor	Use correct combination.
A.17	Board error 2	CPU/parts fault	1. Faulty parts in the servo amplifier. Checking method Alarm (A.17) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
		The output terminals U, V, W of the servo amplifier and the input terminals U, V, W of the servo motor are not connected.	2. The wiring of U, V, W is disconnected or not connected.	Correctly connect the output terminals U, V, W of the servo amplifier and the input terminals U, V, W of the servo motor.
A.19	Memory error 3	ROM memory fault	Faulty parts in the servo amplifier. Checking method Alarm (A.19) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change the servo amplifier.
A.20	Encoder error 2	Communication error occurred between encoder and servo amplifier.	1. Encoder connector (CN2) disconnected.	Connect correctly.
			2. Encoder fault	Change the servo motor.
			3. Encoder cable faulty (wire breakage or short)	Repair or change the cable.
A.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.
			Checking method AL.24 occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	
A.25	Absolute position erase	Absolute position data in error	1. Reduced voltage of super capacitor in encoder	After leaving the alarm occurring for a few minutes, switch power off, then on again. Always make home position setting again.
			2. Battery voltage low	Change battery. Always make home position setting again.
			3. Battery cable or battery is faulty.	Change battery. Always make home position setting again.
		Power was switched on for the first time in the absolute position detection system.	4. Super capacitor of 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.

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.30	Regenerative alarm	Permissible regenerative power of the built-in regenerative brake resistor or regenerative brake option is exceeded.	1. Wrong setting of parameter No. 0	Set correctly.
			2. Built in regenerative brake resistor or regenerative brake option is not connected.	Connect correctly
			3. High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative brake option to be exceeded. Checking method Call the status display and check the regenerative load ratio.	1. Reduce the frequency of positioning. 2. Use the regenerative brake option of larger capacity. 3. Reduce the load.
			Power supply voltage is abnormal. MR-J2-□C: 260V or more	Review power supply
		Regenerative transistor fault	4. Regenerative transistor faulty. Checking method 1) The regenerative brake option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative brake resistor or regenerative brake option.	Change the servo amplifier.
			5. Built-in regenerative brake resistor or regenerative brake option faulty.	Change servo amplifier or regenerative brake option.
A.31	Overspeed	Speed has exceeded the instantaneous permissible speed.	6. Unusual overheat due to cooling fan stop	1. Change the servo amplifier or cooling fan. 2. Reduce ambient temperature.
			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. Encoder faulty.	Change the servo motor.
A.32	Overcurrent	Current that flew is higher than the permissible current of the servo amplifier.	1. Short occurred in servo amplifier output phases U, V and W.	Correct the wiring.
			2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (A.32) occurs if power is switched on after disconnection of the U, V, W power cables.	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.

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.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.
A.35	Command pulse frequency error	Input pulse frequency of the manual pulse generator is too high.	1. Pulse frequency of the manual pulse generator is too high.	Change the pulse frequency to a proper value.
			2. Noise entered the pulses of the manual pulse generator.	Take action against noise.
			3. Manual pulse generator failure	Change the manual pulse generator.
A.37	Parameter error	Parameter or point table 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.
			3. Point table data is in error.	Set the point table data correctly.
A.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.
A.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 level 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.

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.50	Overload 1	Load exceeded overload protection characteristic of servo amplifier. Load ratio 300%: 2.5s or more Load ratio 200%: 100s or more	5. Encoder faulty. Checking method When the servo motor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.
A.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 level setting. 3. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. Checking method When the servo motor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.
A.52	Error excessive	Droop pulse value of the deviation counter exceeded 80k pulses.	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.7) 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.

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.61	Operation alarm	"1" is set in auxiliary function of point table No.15.	Setting error of auxiliary function of point table No.15	Set "0" in auxiliary function of point table No.15.
A.8A	Serial communication time-out	Valid command has not been transmitted from communication device (e.g. personal computer) to servo amplifier within time-out period.	1. Communication connector disconnected.	Connect correctly.
			2. Communication cable fault	Repair or change the cable.
			3. Valid command has not been transmitted from communication device (e.g. personal computer) within time-out period.	Transmit valid command from communication device (e.g. personal computer) within time-out period.
A.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).
8888	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier — Checking method — Alarm (8888) occurs if power is switched on after disconnection of all cables but the control circuit power supply cables.	Change servo amplifier.

11.2.3 Remedies for warnings

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

POINT	▪ When any of the following alarms has occurred, do not resume operation by switching power of the servo amplifier OFF/ON repeatedly. The servo amplifier and servo motor may become faulty. If the power of the servo amplifier is switched OFF/ON during the alarms, allow more than 30 minutes for cooling before resuming operation. ▪ Excessive regenerative warning (A.E0) ▪ Overload warning 1 (A.E1)
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If servo forced stop warning (A.E6) 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
A.90	Home position return incomplete	In incremental system: 1. Positioning operation was performed without home position return. 2. Home position return ended abnormally.	1. Positioning operation was performed without home position return. 2. Home position return speed could not be decreased to creep speed. 3. Limit switch was actuated during home position return starting at other than position beyond dog.	1. Perform home position return. 2. Review home position return speed/creep speed/moving distance after proximity dog.
		In absolute position detection system: 1. Positioning operation was performed without home position setting. 2. Home position setting ended abnormally.	1. Positioning operation was performed without home position setting. 2. Home position setting speed could not be decreased to creep speed. 3. Limit switch was actuated during home position setting starting at other than position beyond dog.	1. Perform home position setting. 2. Review home position setting speed/creep speed/moving distance after proximity dog.

11. TROUBLESHOOTING

Display	Name	Definition	Cause	Action
A.92	Open battery cable warning	Absolute position detection system battery voltage is low.	1. Battery cable is open. 2. Battery voltage dropped to 2.8V or less.	Repair cable or change battery. Change battery.
A.96	Home position setting warning	1. In incremental system: Home position return could not be made. 2. In absolute position detection system: Home position setting could not be made.	Droop pulses remaining are greater than the in-position range setting.	Remove the cause of droop pulse occurrence.
A.98	Software limit warning	Command position exceeded software limit.		1. Review the operation pattern. 2. Review the software limit setting.
A.9F	Battery warning	Voltage of battery for absolute position detection system reduced.	Battery voltage fell to 3.2V or less.	Change the battery.
A.E0	Excessive regenerative load warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative brake resistor or regenerative brake option.	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative brake resistor or regenerative brake option. — Checking method — Call the status display and check regenerative load ratio.	1. Reduce frequency of positioning. 2. Change regenerative brake option for the one with larger capacity 3. Reduce load.
A.E1	Overload warning	There is a possibility that overload alarm 1 or 2 may occur.	Load increased to 85% or more of overload alarm 1 or 2 occurrence level — Cause, checking method — Refer to A.50,51.	Refer to A. 50, A. 51.
A.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.
A.E6	Servo emergency stop	EMG-SG are open.	External emergency stop was made valid. (EMG-SG opened.)	Ensure safety and deactivate emergency stop.
A.E9	Main circuit off warning	Servo was switched on with main circuit power off.		Switch on main circuit power.

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12. SPECIFICATIONS

12. SPECIFICATIONS

12.1 Servo amplifier standard specifications

Servo Amplifier MR-J2-□			10C	20C	40C	60C	70C	100C	200C	350C
Item										
Power supply	Voltage/frequency		Three-phase 200 to 230VAC, 50/60Hz or single-phase 230VAC, 50/60Hz (Note)					Three-phase 200 to 230VAC, 50/60Hz		
	Permissible voltage fluctuation		Three-phase 200 to 230VAC: 170 to 253VAC Single-phase 230VAC: 207 to 253VAC					Three-phase 170 to 253VAC		
	Permissible frequency fluctuation		Within ±5%							
	Power supply capacity		Refer to Section13.2							
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 fault protection, regenerative fault protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection							
Speed frequency response			250Hz or more							
Command system	Point table number input	Operational specifications	Positioning by specifying the point table No. (15 points)							
		Position command input	Set in point table. 1-point feed length setting range: ±1[μm] to ±999.999[mm]							
		Speed command input	Set in point table. Acceleration/deceleration time is set in point table. S-pattern acceleration/deceleration time constant is set in parameter No.14.							
		System	Signed absolute value command, incremental value command							
		Operational specifications	Positioning using RS-422 (232C) communication data							
	Position data input	Position command input	Setting through RS-422 (232C) communication 1-point feed length setting range: ±1[μm] to ±999.999[mm]							
		Speed command input	Setting through RS-422 (232C) communication Acceleration/deceleration time is also set through RS-422 (232C) communication. S-pattern acceleration/deceleration time constant is set in parameter No.14.							
		System	Signed absolute value command, incremental value command							
Operation mode	Automatic operation mode	Point table	Point table number input, position data input system Positioning operation is performed once in accordance with the position and speed commands.							
		Automatic continuous operation	Varied speed operation (2 to 15 speeds), automatic continuous positioning operation (2 to 15 points)							
	Manual operation mode	Jog	Jog operation is performed in accordance with the parameter-set speed command by contact input or through RS-422 (232C) communication.							
		Manual pulse generator	Manual feed is made by manual pulse generator. Command pulse multiplication: ×1, ×10 or ×100 is selected using parameter.							
	Manual home position return mode	Dog type	Home position return is made starting with Z-phase pulse after passage of proximity dog. Home position address may be set. Home position shift distance may be set. Home position return direction may be selected. Automatic at-dog home position return return/automatic stroke return function							
		Count type	Home position return is made by counting encoder pulses after contact with proximity dog. Home position address may be set. Home position shift value may be set. Home position return direction may be set. Automatic at-dog home position return return/automatic stroke return function							
		Data setting type	Home position return is made without dog. Home position may be set at any position by manual operation, etc. Home position address may be set.							
		Stopper type	Home position return is made by pressing machine part against stroke end. Home position address may be set. Home position return direction may be set.							
		Home position ignorance (Servo-on position as home position)	Position where SON is switched on is defined as home position. Home position address may be set.							

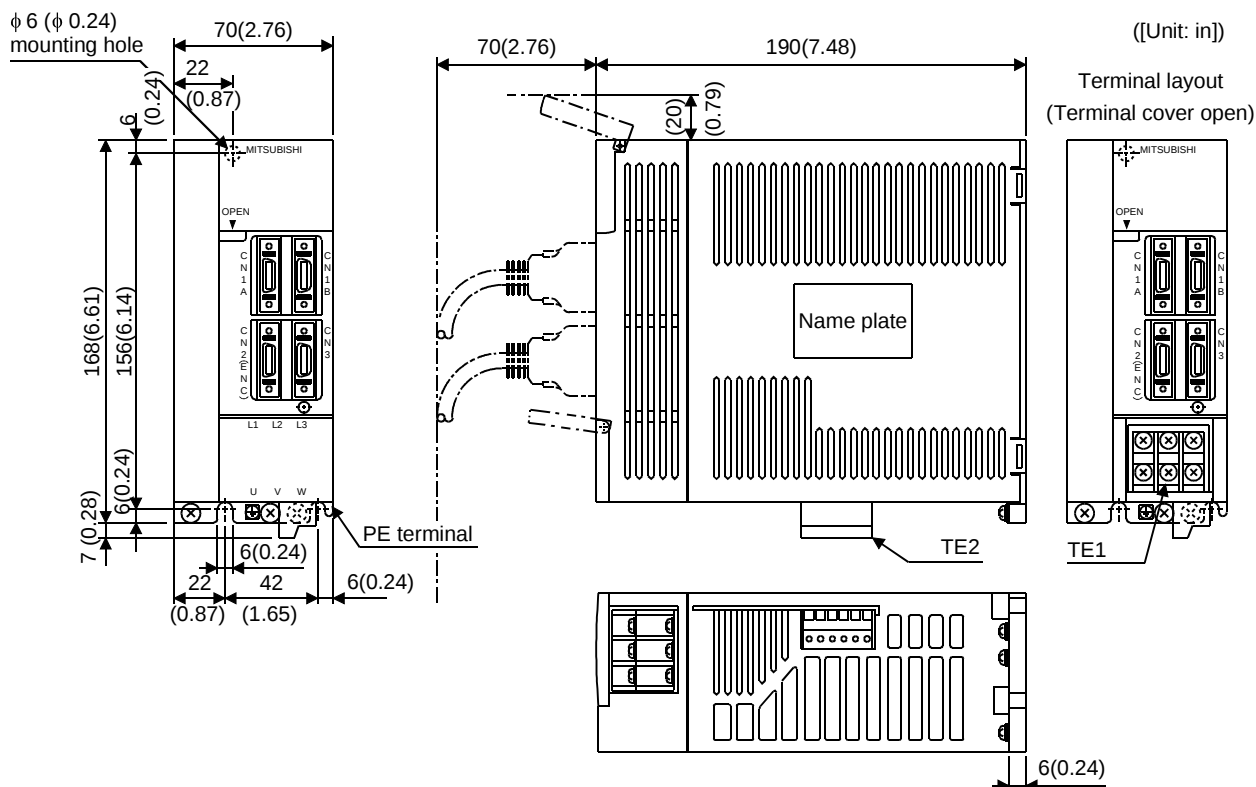
12. SPECIFICATIONS

Servo Amplifier MR-J2-□		10C	20C	40C	60C	70C	100C	200C	350C
Item									
Other functions		Absolute position detection, backlash function							
		Overtravel prevention using external limit switch							
		Software stroke limit, override using external analog signal							
Structure		Open (IP00)							
Environment	Ambient temperature	0 to +55 [°C] (non-freezing)							
		32 to +131 [°F] (non-freezing)							
	Ambient humidity	90%RH or less (non-condensing)							
	Storage temperature	− 20 to +65 [°C] (non-freezing)							
		− 4 to +149 [°F] (non-freezing)							
	Storage humidity	90%RH or less (non-condensing)							
	Ambient	Indoors (no direct sunlight)							
		Free from corrosive gas, flammable gas, oil mist, dust and dirt							
	Altitude	Max. 1000m (3280ft) above sea level							
Vibration	5.9 [m/s ²] {0.6G} or less								
	19.4 [ft/s ²] or less								
Weight	[kg]	0.7	0.7	1.1	1.1	1.7	1.7	2.0	2.0
	[lb]	1.5	1.5	2.4	2.4	3.75	3.75	4.4	4.4

Note: The single-phase 230VAC power supply cannot be used when the servo amplifier is combined with the HC-SF52/53.

12. SPECIFICATIONS

(2) MR-J2-70C • MR-J2-100C



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

TE1

L1	L2	L3
U	V	W

Terminal screw: M4×0.7

Tightening torque: 1.2 [N · m] (10 [lb · in])

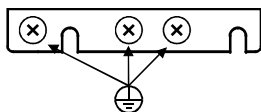
TE2

← Front

D	C	P	L21	L11	N
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Tightening torque: 0.3 to 0.4 [N · m] (2.7 to 3.5 [oz · in])

PE terminals



Terminal screw: M4×0.7

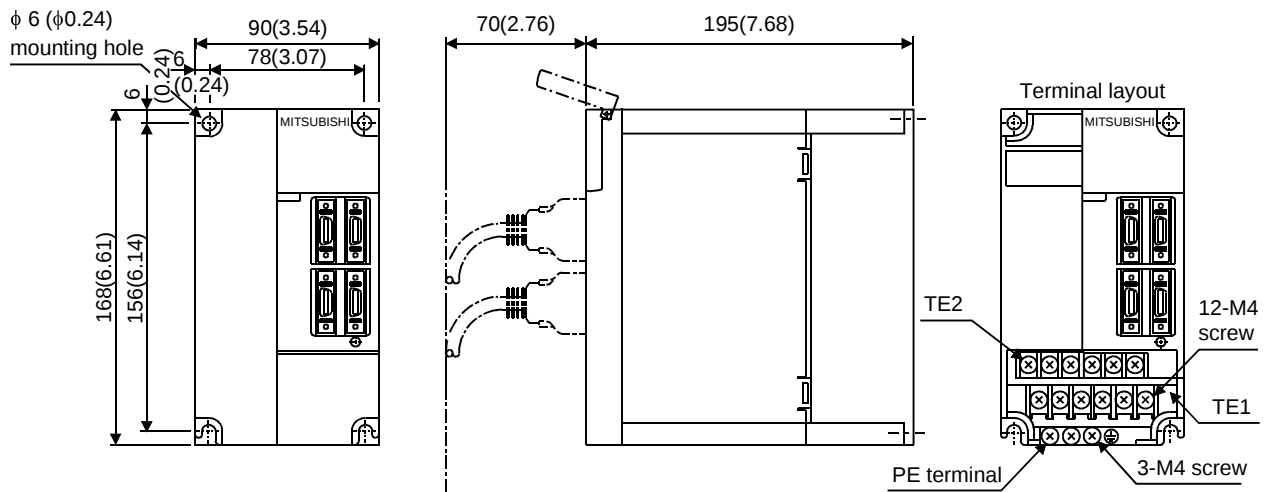
Tightening torque: 1.2 [N · m] (10 [lb · in])

12. SPECIFICATIONS

(3) MR-J2-200C • MR-J2-350C

[Unit: mm]

[Unit: in])



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

TE1

L1 L2 L3 U V W

Terminal screw: M4×0.7

Tightening torque: 1.2 [N · m] (10 [lb · in])

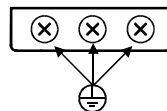
TE2

L11 L21 D P C N

Terminal screw: M4×0.7

Tightening torque: 1.2 [N · m] (10 [lb · in])

PE terminals



Terminal screw: M4×0.7

Tightening torque: 1.2 [N · m] (10 [lb · in])

12. SPECIFICATIONS

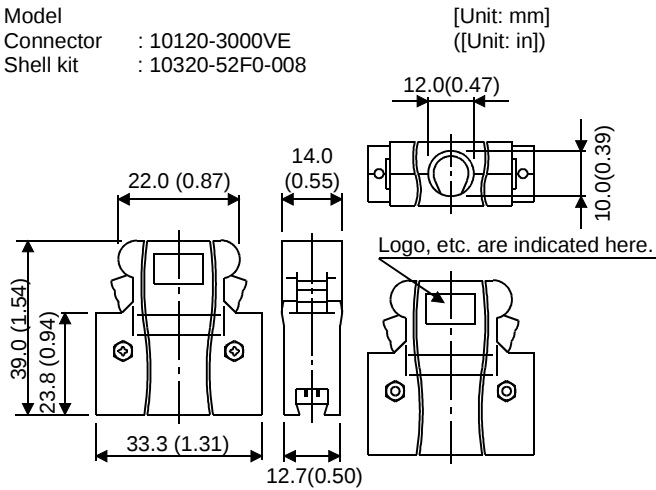
12.2.2 Connectors

(1) Servo amplifier side

<3M>

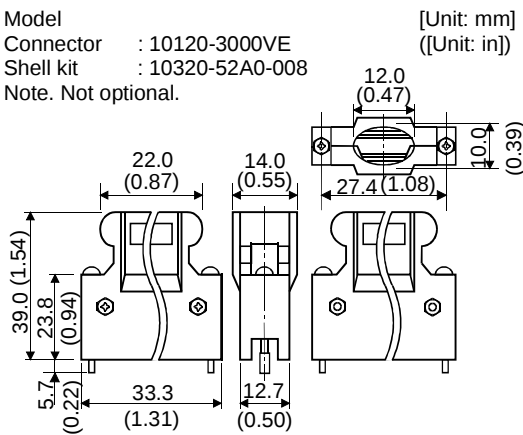
(a) Soldered type

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



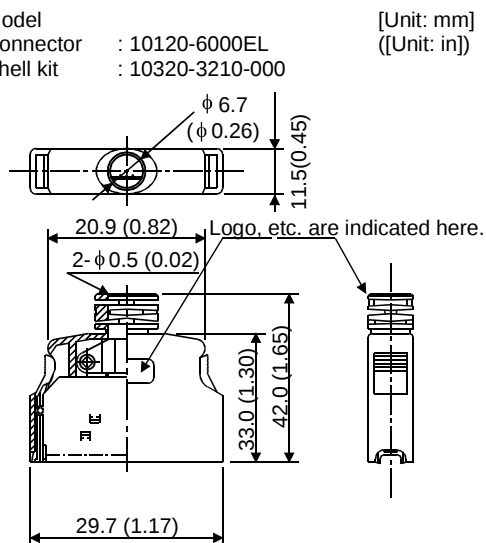
(b) Threaded type

Model
Connector : 10120-3000VE
Shell kit : 10320-52A0-008
Note. Not optional.



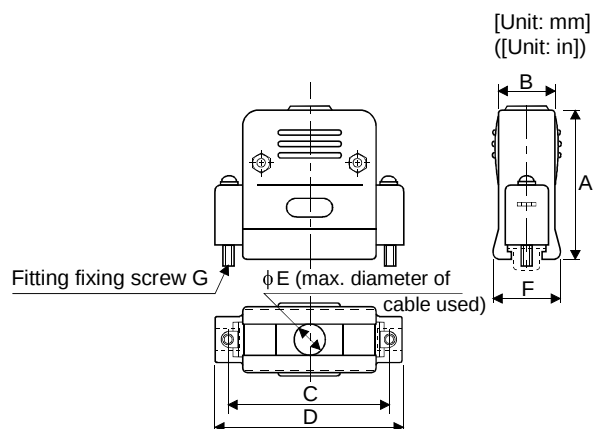
(c) Insulation displacement type

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



12. SPECIFICATIONS

(2) Communication cable connector <JAE>



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

[illegible]

13. CHARACTERISTICS

13. CHARACTERISTICS

13.1 Overload protection characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. Overload 1 alarm (A.50) occurs if overload operation performed is above the electronic thermal relay protection curve shown in any of Figs. 13.1 to 13.3, or overload 2 alarm (A.51) occurs if the maximum current flows 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-J2-10C to MR-J2-100C

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

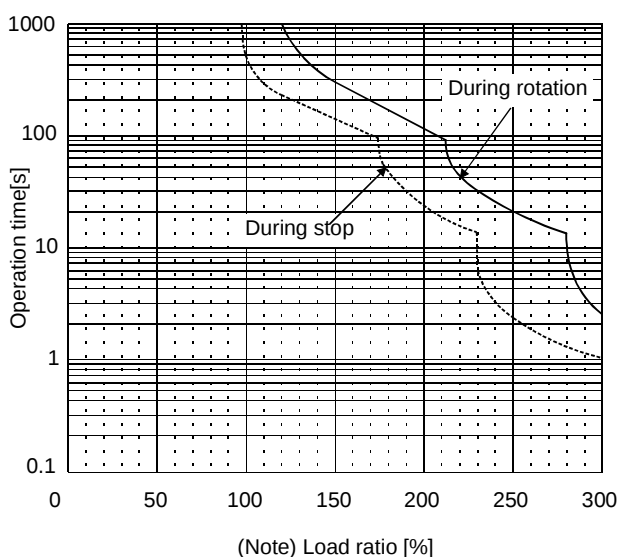


Fig 13.1 Electronic Thermal Relay Protection Characteristics

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

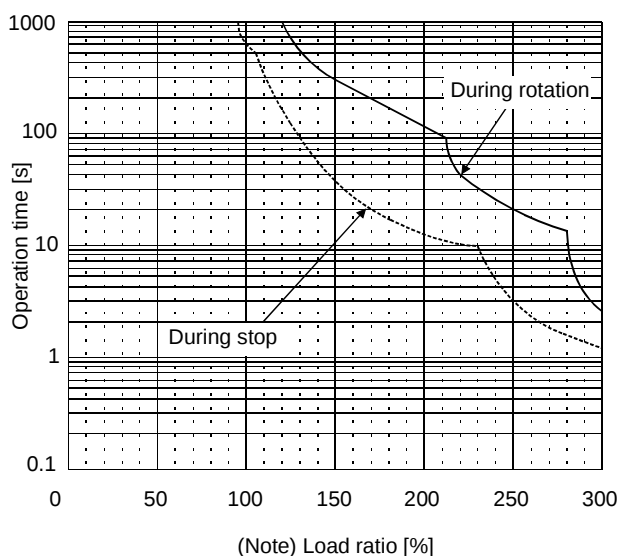


Fig. 13.2 Electronic Thermal Relay Protection Characteristics 2

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

13. CHARACTERISTICS

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

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

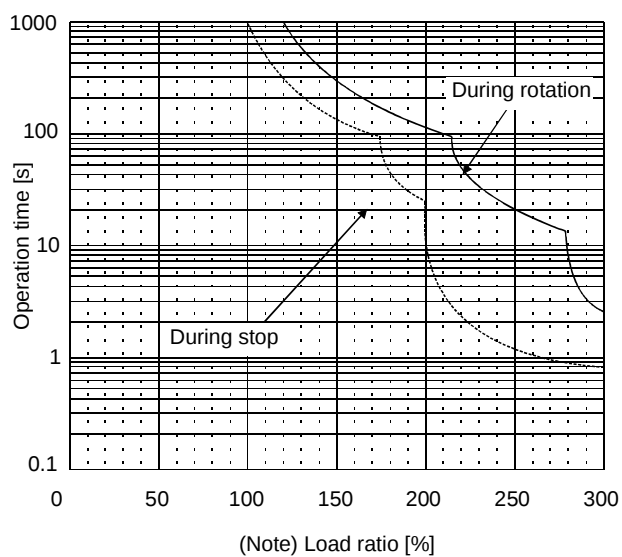


Fig 13.3 Electronic Thermal Relay Protection Characteristics 3

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

13. CHARACTERISTICS

13.2 Power supply equipment capacity and generated loss

(1) Amount of heat generated by the servo amplifier

Table 13.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 13.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and servo off according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Table 13.1 Power Supply Capacity and Generated Heat Per Servo Amplifier at Rated Output

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

Note: 1. Note that the power supply capacity will vary according to the power supply impedance. This value assumes that the power factor improving reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative brake option, use in Section 14.1.1.

13. CHARACTERISTICS

(2) Heat dissipation area for enclosed servo amplifier

The enclosed control box (hereafter referred to as the control box) which will contain the servo amplifier should be designed to ensure a temperature rise of 10°C max. 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 13.1:

$$A = \frac{P}{K \cdot \Delta T} \dots \dots \dots (13.1)$$

where, A : Heat dissipation area [m²]

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 13.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 13.1 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 13.1 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.

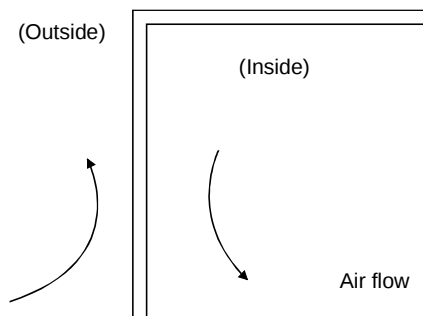


Fig. 13.4 Temperature Distribution in Enclosure

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.

13. CHARACTERISTICS

13.3 Dynamic brake characteristics

Fig. 13.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 13.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to Fig. 13.6 and Table 13.2.)

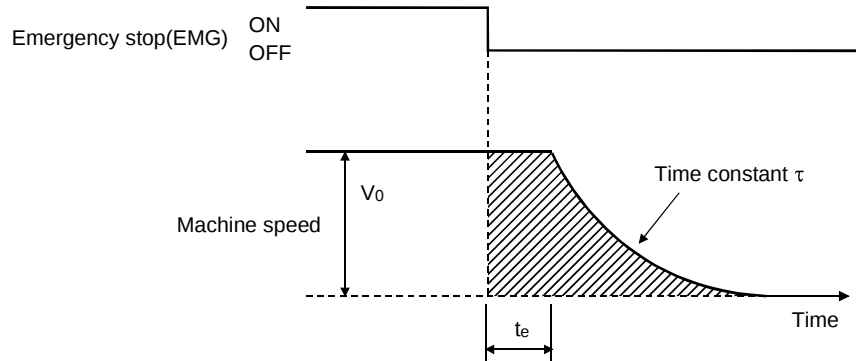
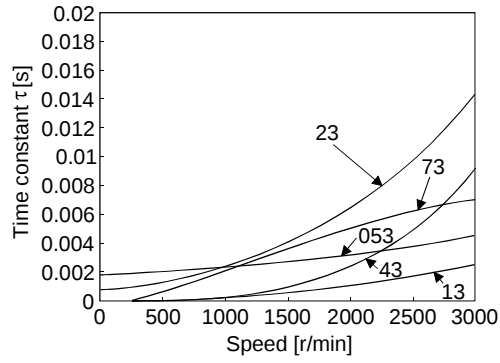


Fig. 13.5 Dynamic Brake Operation Diagram

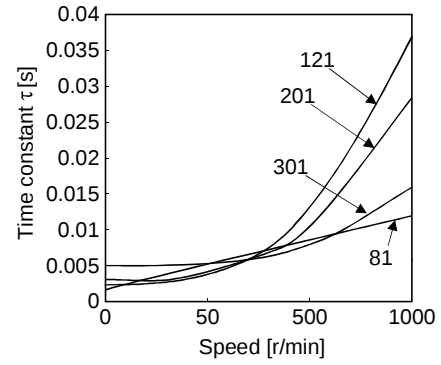
$$L_{\max} = \frac{V_0}{60} \cdot \left\{ t_e + \tau \left[1 + \frac{J_L}{J_M} \right] \right\} \dots \dots \dots (13.2)$$

- $L_{\max}$: Maximum coasting distance[mm][in]
 V_0 : Machine rapid feedrate [mm/min][in/min]
 J_M : Servo motor inertial moment.....[kg · cm²][oz · in²]
 J_L : Load inertia moment converted into equivalent value on servo motor shaft [kg · cm²][oz · in²]
 τ : Brake time constant (Fig. 13.6 Table 13.2) [s]
 t_e : Delay time of control section (Fig. 13.5) [s]
 (There is internal relay delay time of about 30ms.)

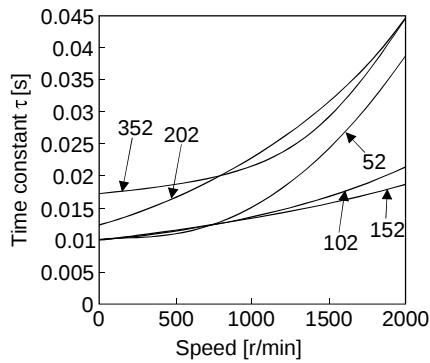
13. CHARACTERISTICS



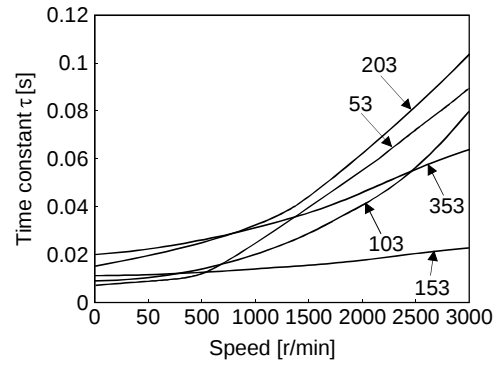
a. HC-MF Series



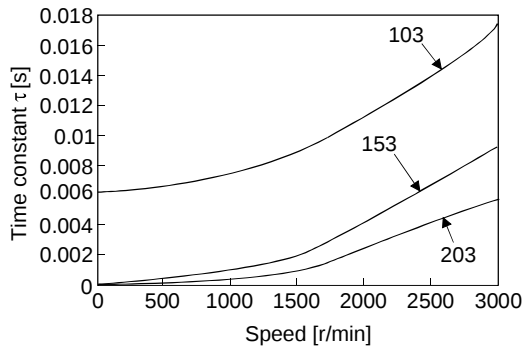
b. HC-SF1000r/min Series



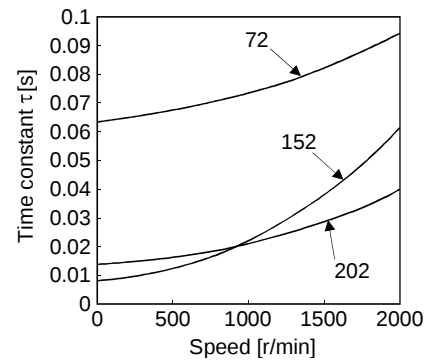
c. HC-SF2000r/min Series



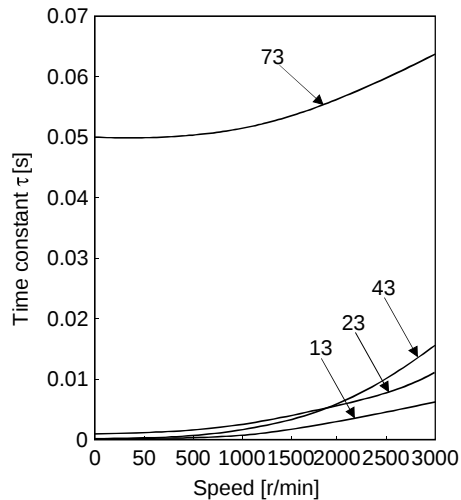
d. HC-SF3000r/min Series



e. HC-RF Series



f. HC-UF 2000r/min Series



g. HC-UF3000r/min Series

Fig. 13.6 Dynamic Brake Time Constant

13. CHARACTERISTICS

Table 13.2 HA-FF Dynamic Brake Time Constant

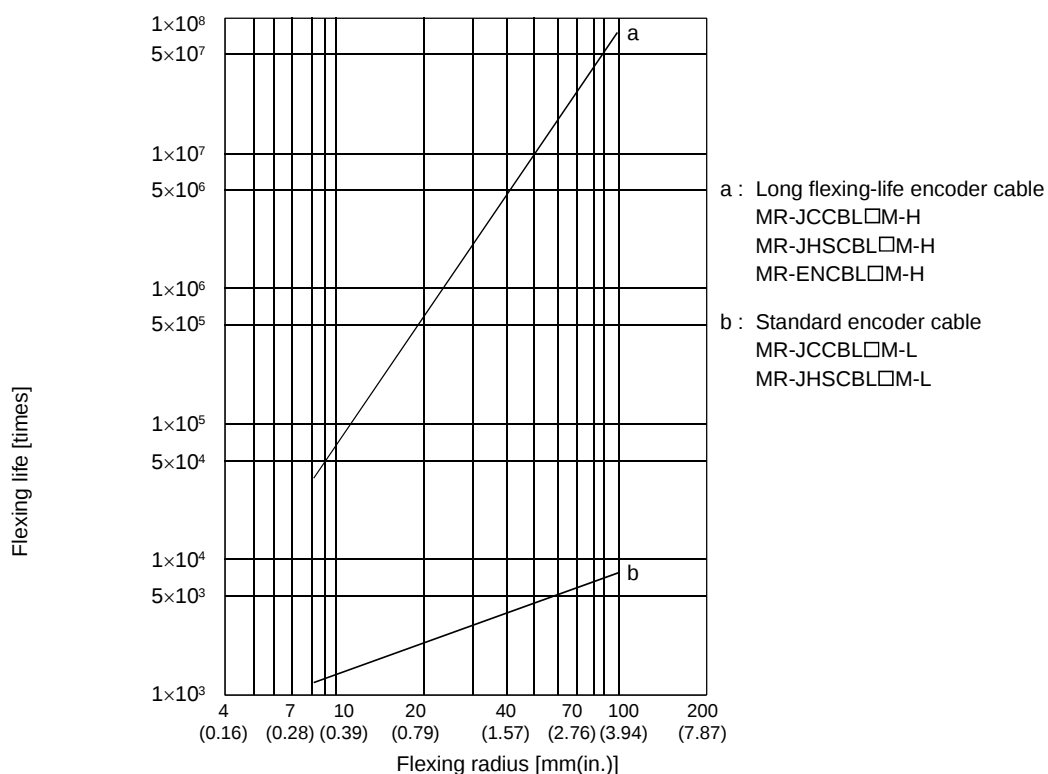
Servo Motor	Brake Time Constant τ [s]
HA-FF053 • 13	0.02
HA-FF23	0.05
HA-FF33	0.07
HA-FF43	0.09
HA-FF63	0.12

Use the dynamic brake at the load inertia moment indicated 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-J2-10C to MR-J2-200C	30
MR-J2-350C	16

13.4 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.



This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

14. OPTIONS AND AUXILIARY EQUIPMENT

14. OPTIONS AND AUXILIARY EQUIPMENT



WARNING

- Before connecting any option or auxiliary equipment, make sure that the charge lamp is off more than 15 minutes after power-off, then confirm the voltage with a tester or the like. Otherwise, you may get an electric shock.



CAUTION

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

14.1 Options

14.1.1 Regenerative brake options



CAUTION

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

(1) Combination and regenerative power

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

Note. Always install a cooling fan.

(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 the standard specifications (Section 5.1 in 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.

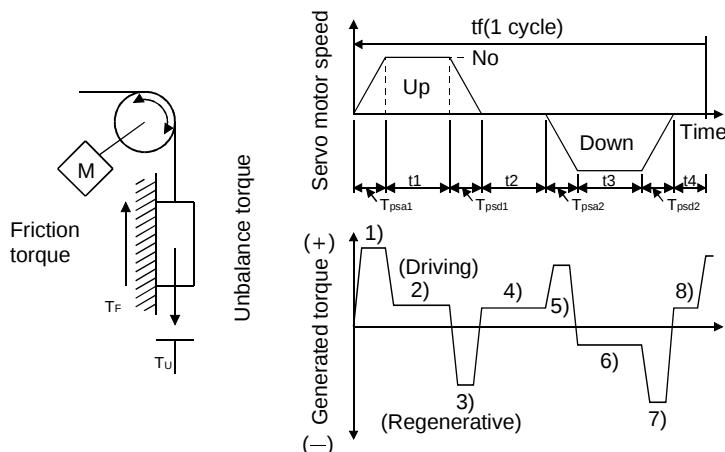
14. OPTIONS AND AUXILIARY EQUIPMENT

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:

1) 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)	$T_2 = T_U + T_F$	$E_2 = 0.1047 N_0 T_2 t_1$
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)	$T_6 = -T_U + T_F$	$E_6 = 0.1047 N_0 T_6 t_3$
7)	$T_7 = \frac{-(J_L + J_M) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psd2}} - T_U + T_F$	$E_7 = \frac{0.1047}{2} \cdot N_0 \cdot T_7 \cdot T_{psd2}$

From the calculation results in 1) to 8), find the absolute value (Es) of the sum total of negative energies.

2) Losses of servo motor and servo amplifier in regenerative mode

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

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

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

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

14. OPTIONS AND AUXILIARY EQUIPMENT

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.

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

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

$$PR [W] = ER/t_f \dots\dots\dots (14.1)$$

(3) Connection of the regenerative brake option

POINT
▪ When the MR-RB50 is used, a fan is required to cool it. The cooling fan should be prepared by the customer. ▪ For the sizes of wires used for wiring, refer to Section 14.2.1.

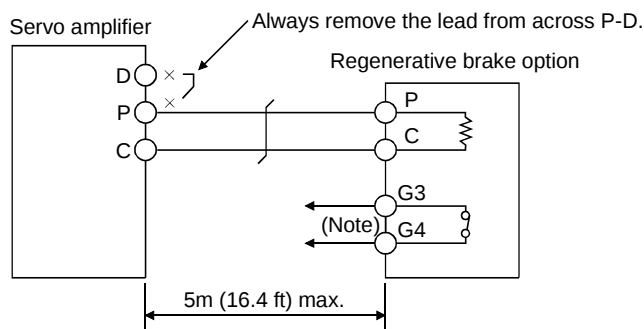
When using the regenerative brake option, always remove wiring from across P-D and install the regenerative brake option across P-C. Set parameter No.0 according to the option to be used. The regenerative brake option will generate heat of about 100°C. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use fire-retarding 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.

The G3 and G4 terminals act as a thermal sensor. G3-G4 are disconnected when the regenerative brake option overheats abnormally.

Parameter No.0

--	--	--	--

Selection of regenerative
 0: Not used.
 2: MR-RB 032
 3: MR-RB 12
 4: MR-RB 32
 5: MR-RB 30
 6: MR-RB 50



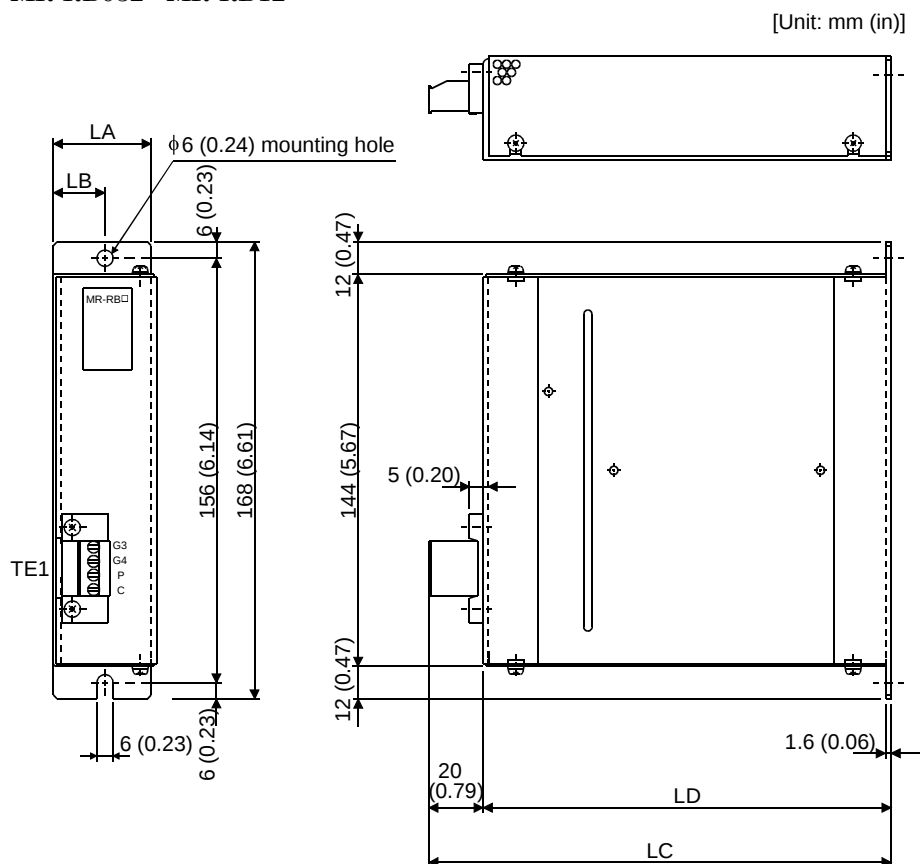
Note: Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.

G3-G4 contact specifications
 Maximum voltage: 120V AC/DC
 Maximum current: 0.5A/4.8VDC
 Maximum capacity: 2.4VA

14. OPTIONS AND AUXILIARY EQUIPMENT

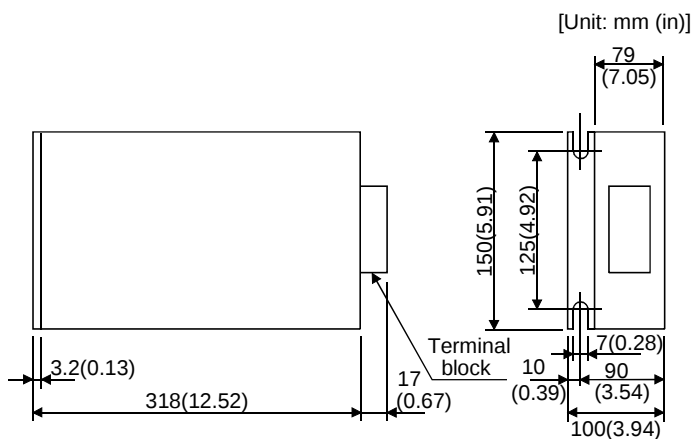
(4) Outline drawing

1) MR-RB032 • MR-RB12



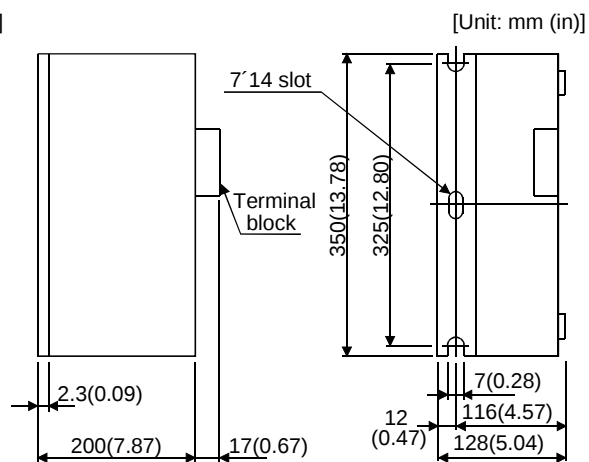
Regenerative Brake Option	Regenerative Power[W]	Resistance [Ω]	Variable Dimensions				Weight	
			LA	LB	LC	LD	[kg]	[lb]
MR-RB032	30	40	30 (1.18)	15 (0.59)	119 (4.69)	99 (3.9)	0.5	1.1
MR-RB12	100	40	40 (1.57)	15 (0.59)	169 (6.69)	149 (5.87)	1.1	2.4

2) MR-RB32 • MR-RB30



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

3) MR-RB50



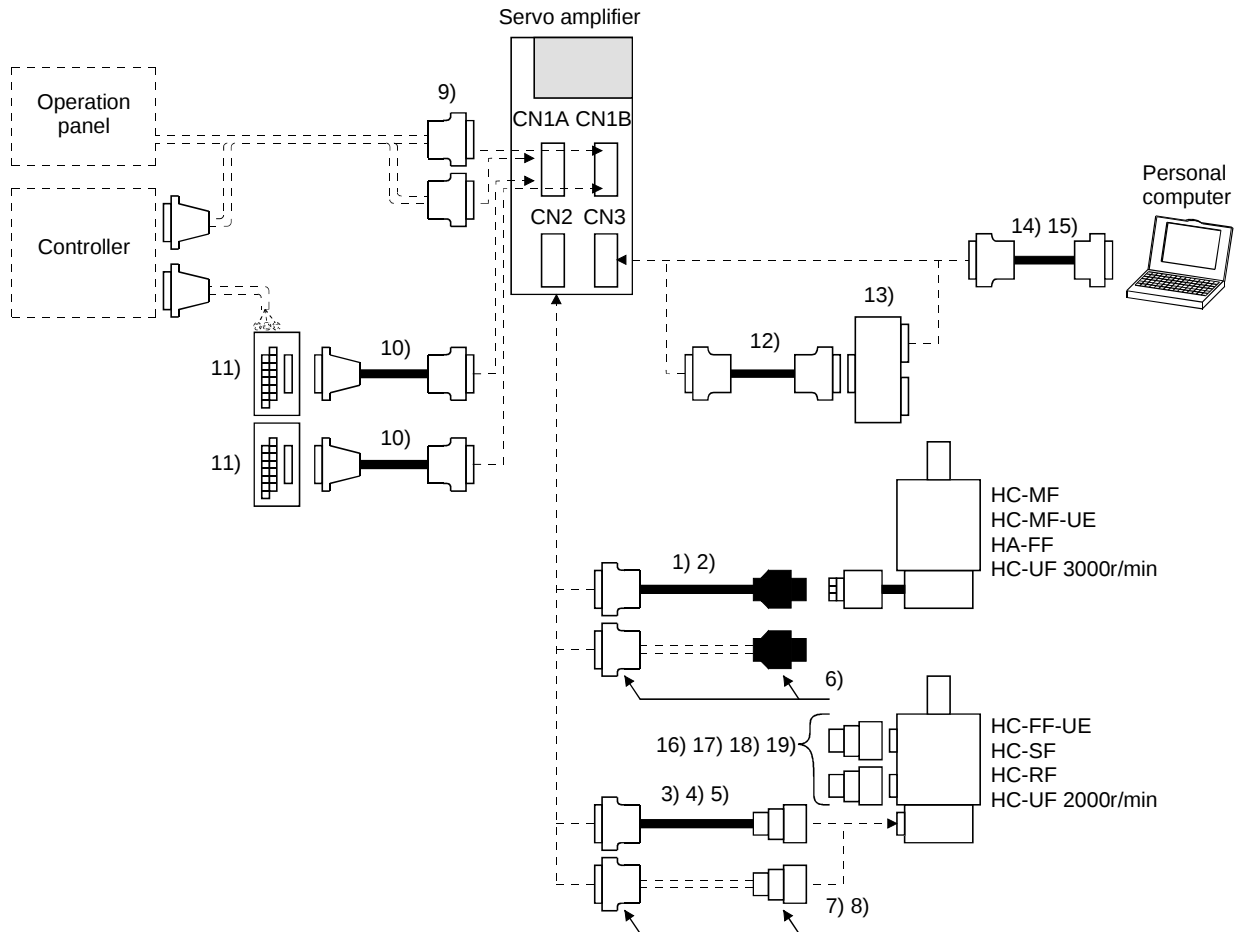
Regenerative Brake Option	Regenerative Power [W]	Resistance [Ω]	Weight	
			[kg]	[lb]
MR-RB50	500	13	5.6	12.3

14. OPTIONS AND AUXILIARY EQUIPMENT

14.1.2 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.



14. 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 Pin: 170359-1 (AMP or equivalent) Cable clamp: MTI-0002 (Toa Electric Industry)	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)	Plug: MS3106B20-29S Cable clamp: MS3057-12A (DDK)	Standard flexing life IP20
4)	Long flexing life encoder cable	MR-JHSCBL□M-H Refer to (2) in this section.			Long flexing life IP20
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)	Plug: MS3106A20-29S (D190) Cable clamp : CE3057-12A-3 (D265) Back shell: CE02-20BS-S (DDK)	Long flexing life IP65 compliant Not oil-proof
6)	Encoder connector set	MR-J2CNM	Connector: 10120-3000VE Shell kit: 10320-52F0-008 (3M or equivalent)	Housing: 1-172161-9 Pin: 170359-1 (AMP or equivalent) Cable clamp: MTI-0002 (Toa Electric Industry)	IP20
7)	Encoder connector set	MR-J2CNS	Connector: 10120-3000VE Shell kit: 10320-52F0-008 (3M or equivalent)	Plug: MS3106B20-29S Cable clamp: MS3057-12A (DDK)	IP20
8)	Encoder connector set	MR-ENCNS	Connector: 10120-3000VE Shell kit: 10320-52F0-008 (3M or equivalent)	Plug: MS3106A20-29S (D190) Cable clamp: CE3057-12A-3 (D265) Back shell: CE02-20BS-S (DDK)	IP65

14. 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 □M Refer to (3) Section 14.1.3	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 14.1.3.	
12)	Bus cable	MR-J2HBUS □M Refer to (4) Section 14.1.4	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 14.1.4.	
14)	Communication cable	MR-CPC98CBL3M Refer to (3) in this section.	Connector: 10120-6000EL Shell kit: 10320-3210-000 (3M or equivalent) Connector: DE-25PF-N Case: DB-C2-J9 (JAE) 	For connection with PC-98 personal computer
15)	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: DB-C1-J6-S6 (JAE) 	For connection with PC-AT-compatible personal computer
16)	Power supply connector set	MR-PWCNF	 Plug : CE05-6A14S-2SD-B (DDK) Cable connector: YSO14-9 to 11 (Daiwa Dengyo)	EN Standard-compliant IP65
17)	Power supply connector set	MR-PWCNS1	 Plug: CE05-6A22-23SD-B-BSS Cable clamp: CE3057-12A-2 (D265) (DDK)	EN Standard-compliant IP65
18)	Power supply connector set	MR-PWCNS2	 Plug: CE05-6A24-10SD-B-BSS Cable clamp: CE3057-16A-2 (D265) (DDK)	EN Standard-compliant IP65
19)	Brake connector set	MR-BKCN	 Plug: MS3106A10SL-4S (D190) (DDK) Cable connector: YSO10-5-8 (Daiwa Dengyo)	EN Standard-compliant IP65 compliant

14. OPTIONS AND AUXILIARY EQUIPMENT

(2) Encoder cable



CAUTION

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

POINT

- The encoder cable is not oil resistant.
- Refer to Section 12.4 for the flexing life of the encoder cable.
- When the encoder cable is used, the sum of the resistance values of the cable used for P5 and the cable used for LG should be within 2.4Ω.
- When soldering the wire to the connector pin, insulate and protect the connection portion using heat-shrinkable tubing.

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-□

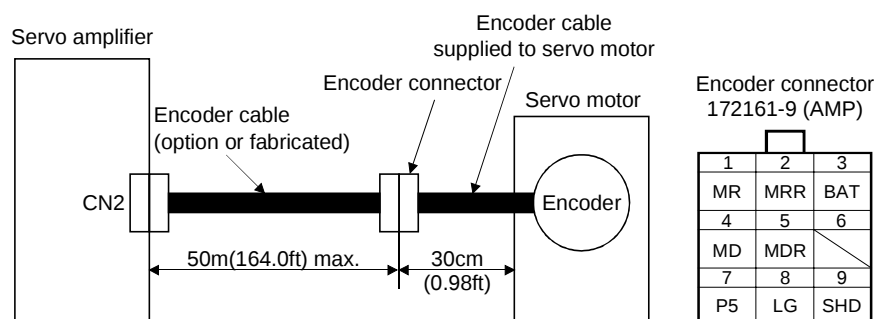
Symbol	Specifications
L	Standard flexing life
H	Long flexing life

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)

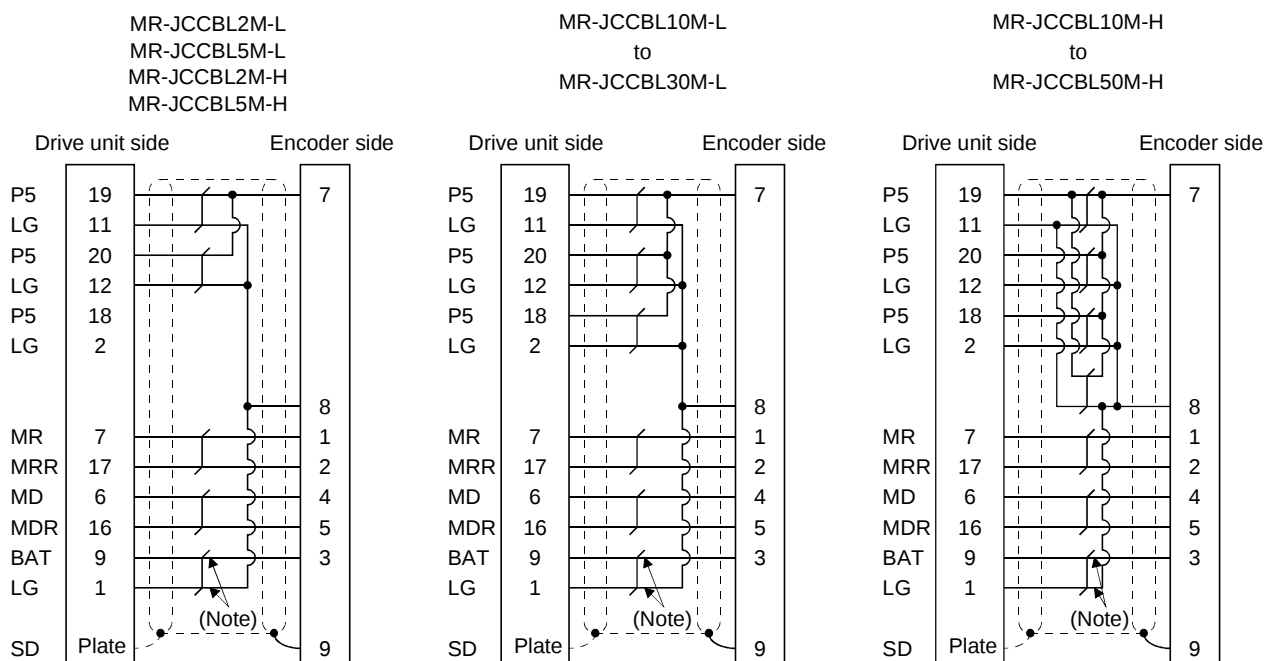
Note: MR-JCCBL□M-H has no 40(131.2) and 50m(164.0ft) sizes.

2) Connection diagram

For the pin assignment on the servo amplifier side, refer to Section 3.2.2.



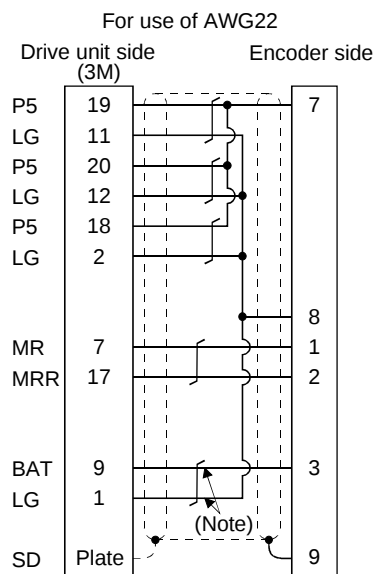
14. OPTIONS AND AUXILIARY EQUIPMENT



Note. Always make connection for use in an absolute position detection system.
This wiring is not needed for use in an incremental system.

When fabricating an encoder cable, use the recommended wires given in Section 14.2.1 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 manual and choose the encode side connector according to the servo motor installation environment.



Note. Always make connection for use in an absolute position detection system.
This wiring is not needed for use in an incremental system.

14. 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)

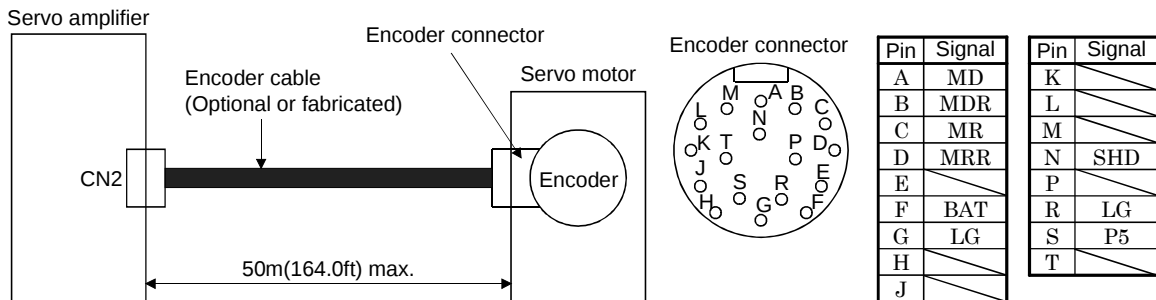
Note: MR-JHSCBL□M-L has no 40(131.2) and 50m(164.0ft) sizes.

Model: MR-ENCBL□M-H

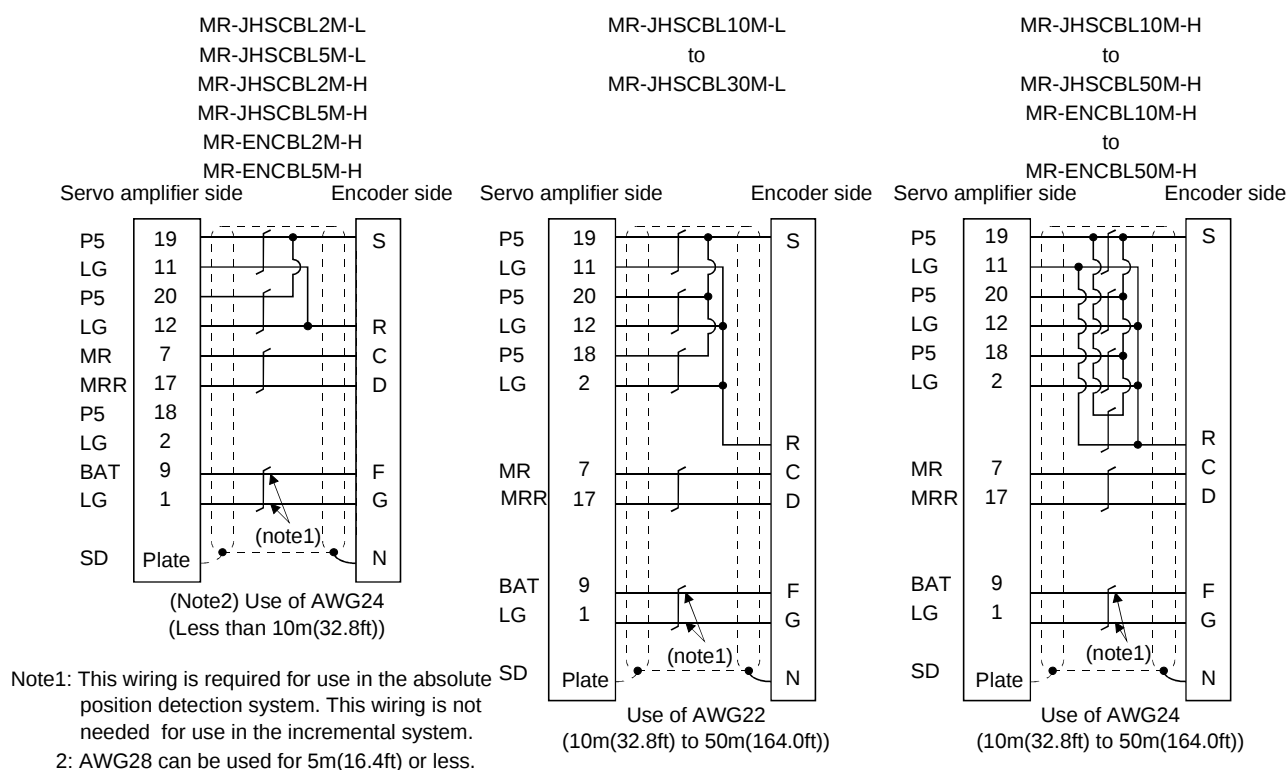
Symbol	Cable length [m(ft)]
2	2 (6.56)
5	5 (16.4)
10	10 (32.8)
20	20 (65.6)
30	30 (98.4)
40	40 (131.2)
50	50 (164.0)

2) Connection diagram

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



14. OPTIONS AND AUXILIARY EQUIPMENT



When fabricating an encoder cable, use the recommended wires given in Section 14.2.1 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.

14. OPTIONS AND AUXILIARY EQUIPMENT

(3) Communication cable

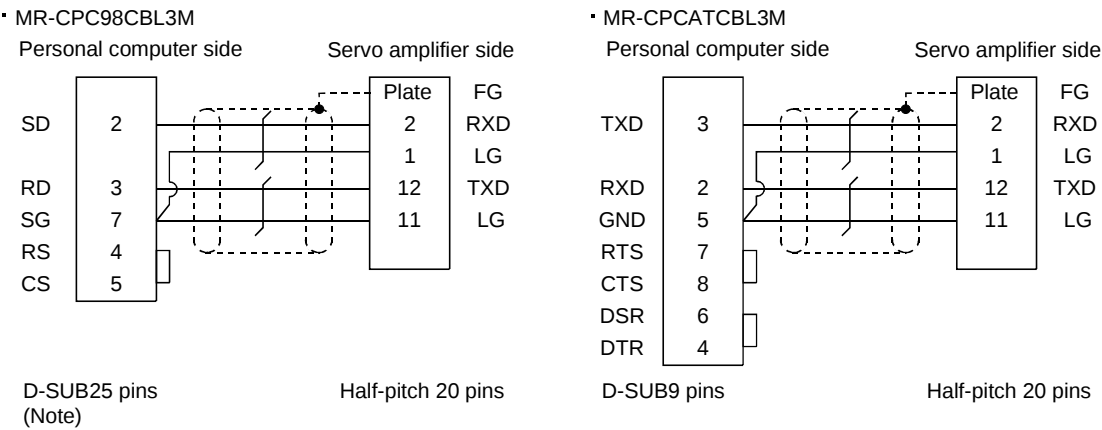
POINT
▪ This cable may not be used with some personal computers. After fully examining the signals of the RS-232C connector, refer to this section and fabricate the cable.

Select the communication cable according to the shape of the RS-232C connector of the personal computer used. When fabricating the cable, refer to the connection diagram in this section.

The following must be observed in fabrication:

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

Connection diagram



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

14. OPTIONS AND AUXILIARY EQUIPMENT

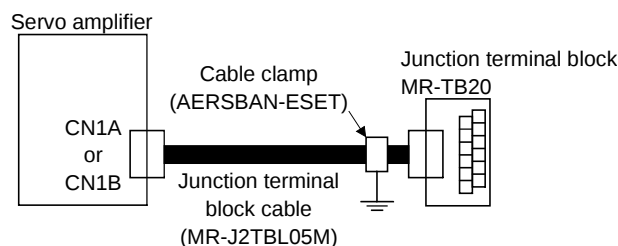
14.1.3 Junction terminal block (MR-TB20)

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 14.2.6, (2)(c).

(2) Terminal labels

The junction terminal block is supplied with terminal block labels which indicate signal assignment. Among these labels, use the two for MR-J2-C. When changing the input signals on the Servo Configuration Software, refer to Section 14.1.2 (3) and Section 3.2.2 and apply the accessory signal seals to the labels.

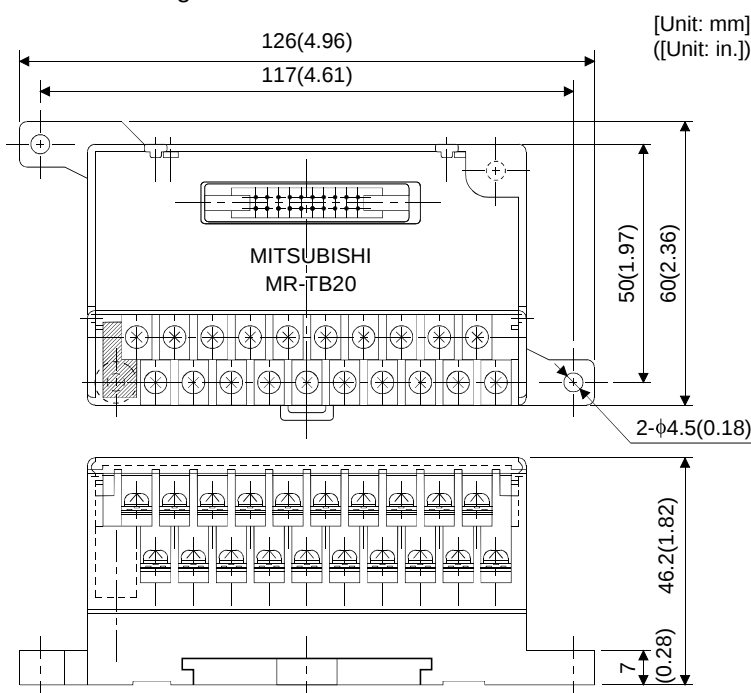
1) For CN1A

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
LG	PP	2	3	COM	OPC	PG													
NP	P15R		DOG	SG	NG														
0	1	2	3	4	5	6	7	8	9										

2) For CN1B

10	11	12	13	14	15	16	17	18	19	20
LG	VDD	DIO	MDO	ST2	P15R	COM	SON	LSN	RD	
VC	CPO	INP	ST1	SG	TLA	DI1	LSP	ALM	SD	
0	1	2	3	4	5	6	7	8	9	

(3) Outline drawing



Terminal screw: M3.5
Applicable cable: Max. 2mm²
(Crimping terminal width: 7.2mm (0.283 in) max.)

14. 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)

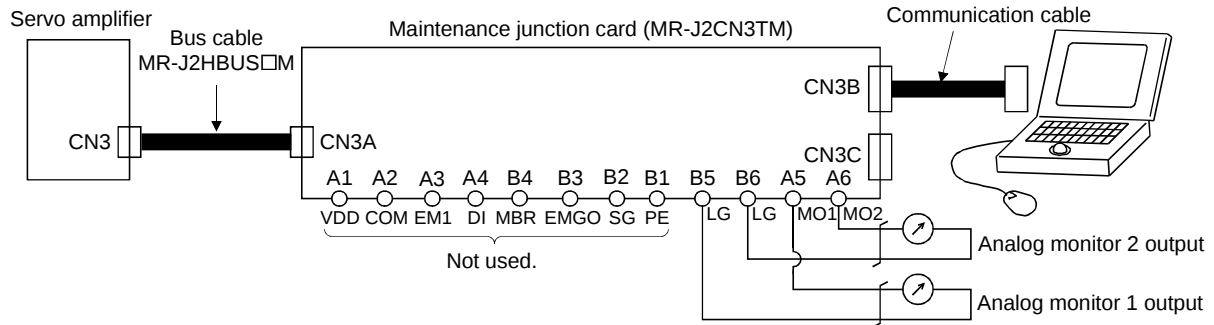
Terminal block label		Junction terminal block terminal No.	Pin No.		Pin No.
For CN1A	For CN1B				
LG	LG	10	B1		1
NP	VC	0	A1		2
PP	VDD	11	B2		3
P15R	CPO	1	A2		4
	DIO	12	B3		5
	INP	2	A3		6
	MDO	13	B4		7
DOG	ST1	3	A4		8
COM	ST2	14	B5		9
SG	SG	4	A5		10
OPC	P15R	15	B6		11
NG	TLA	5	A6		12
PG	COM	16	B7		13
	DI1	6	A7		14
	SON	17	B8		15
	LSP	7	A8		16
	LSN	18	B9		17
ZP	ALM	8	A9		18
	RD	19	B10		19
SD	SD	9	A10		20
					Plate

14. OPTIONS AND AUXILIARY EQUIPMENT

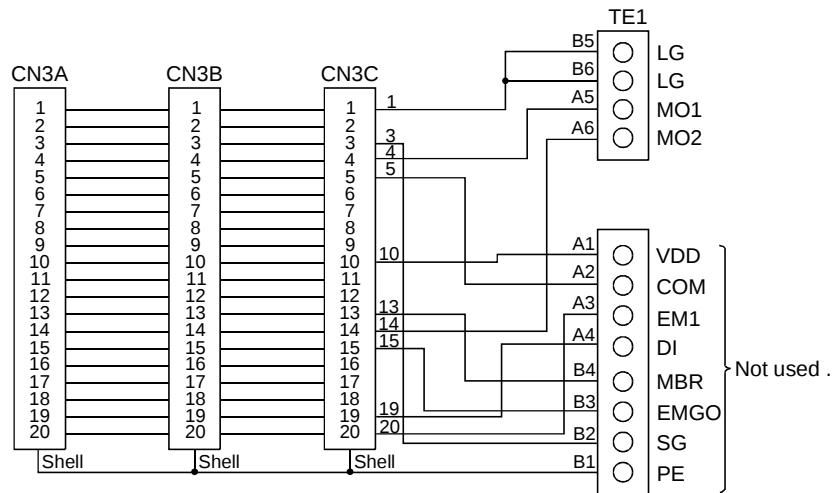
14.1.4 Maintenance junction card (MR-J2CN3TM)

(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.

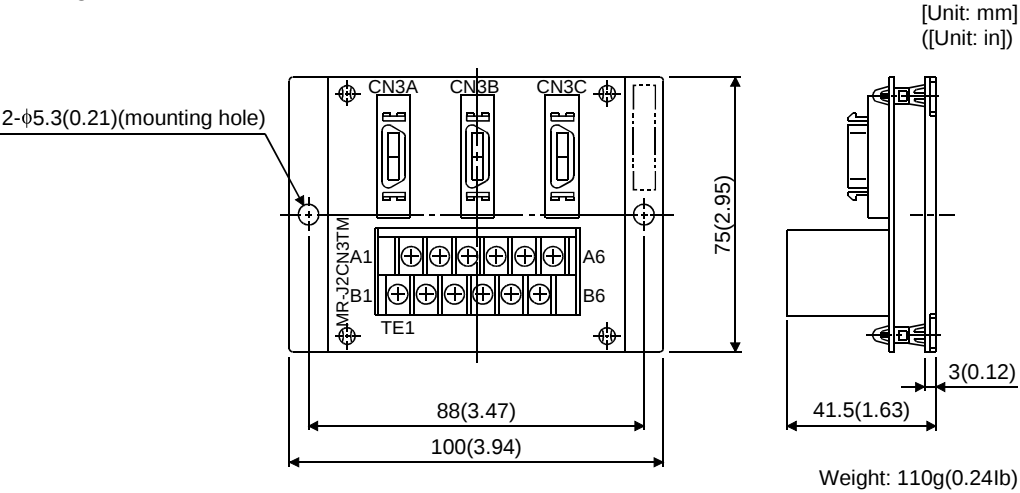


(2) Connection diagram



14. OPTIONS AND AUXILIARY EQUIPMENT

(3) Outline drawing



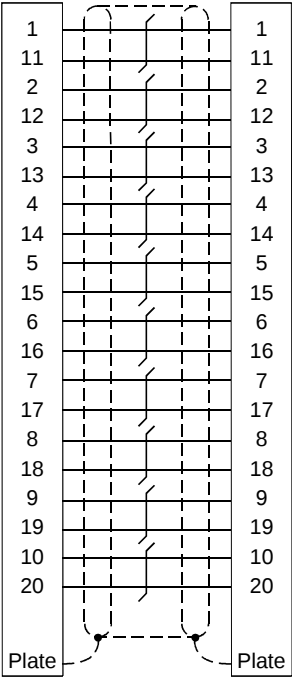
(4) Bus cable (MR-J2HBUS□M)

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)



14. OPTIONS AND AUXILIARY EQUIPMENT

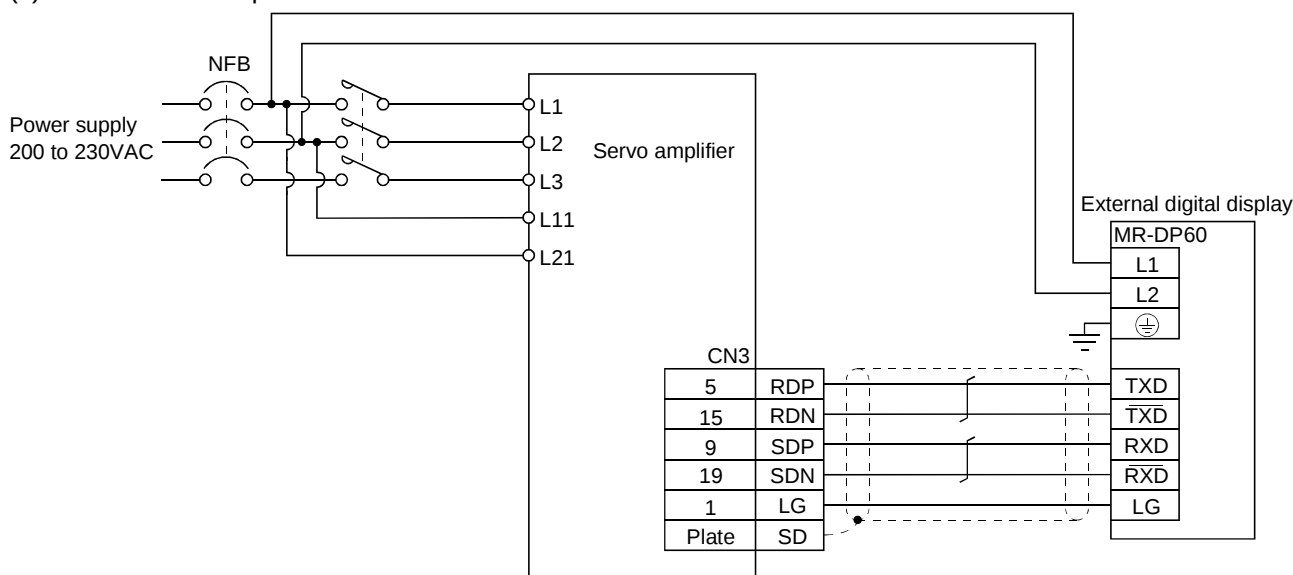
14.1.5 External digital display (MR-DP60)

The data equivalent to the servo amplifier status display can be displayed on the MR-DP60. When using the MR-DP60, set "□0□2" in parameter No. 16. The items that appear at the time of power-on can be selected in parameter No.18.

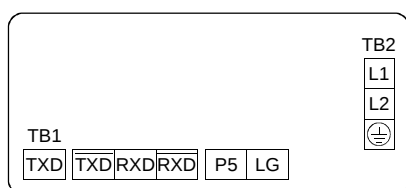
(1) Specifications

Item		Specifications
Display		Red seven-segment LED, signed, six digits
Power supply	Permissible voltage fluctuation	Single phase, 85 to 253VAC, 50/60Hz
	Current consumption	Within 200mA
Communication	Interface	Conforms to RS-422A.
	Baudrate	4800bps, asynchronous
	Bit length	Start bit=1, data bit=8, parity bit=1, stop bit=1
	Protocol	MELSERVO protocol
	Communication commands	Commands dedicated to MELSERVO
Operating temperature / humidity range		0°C to + 60°C, 90%RH or less, non-condensing
Storage temperature range		−5°C to + 70°C

(2) Connection example



(3) Terminal arrangement



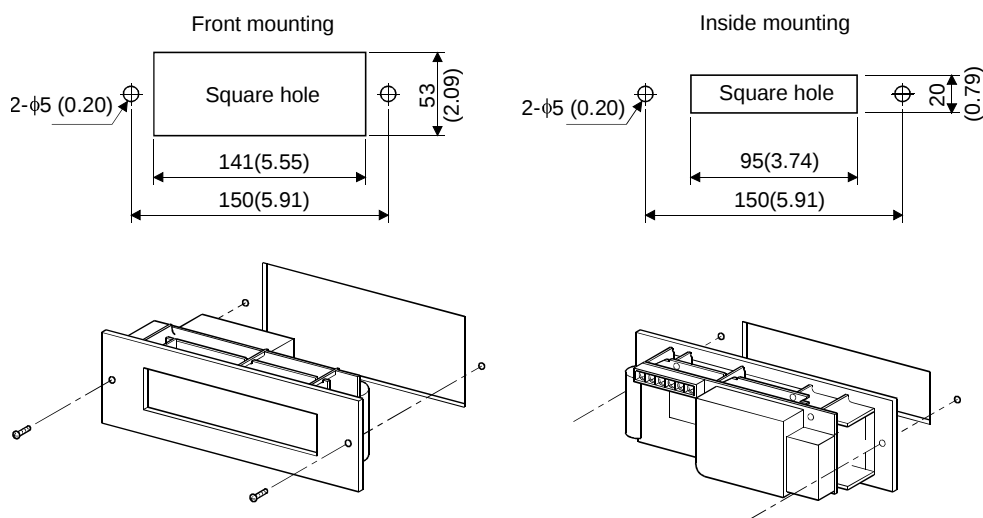
Signal	Description
L1	100 to 230VAC power input
L2	
⊕	Ground
RXD	Receive signal input
$\overline{\text{RXD}}$	Inverse receive signal input
$\overline{\text{TXD}}$	Inverse transmission signal output
TXD	Transmission signal output
P5	5VDC output (Note)
LG	Control common

Note: The 5VDC output is designed for the internal control circuit and used to make a voltage check, etc. Do not use this terminal to supply a voltage to the other equipment.

14. OPTIONS AND AUXILIARY EQUIPMENT

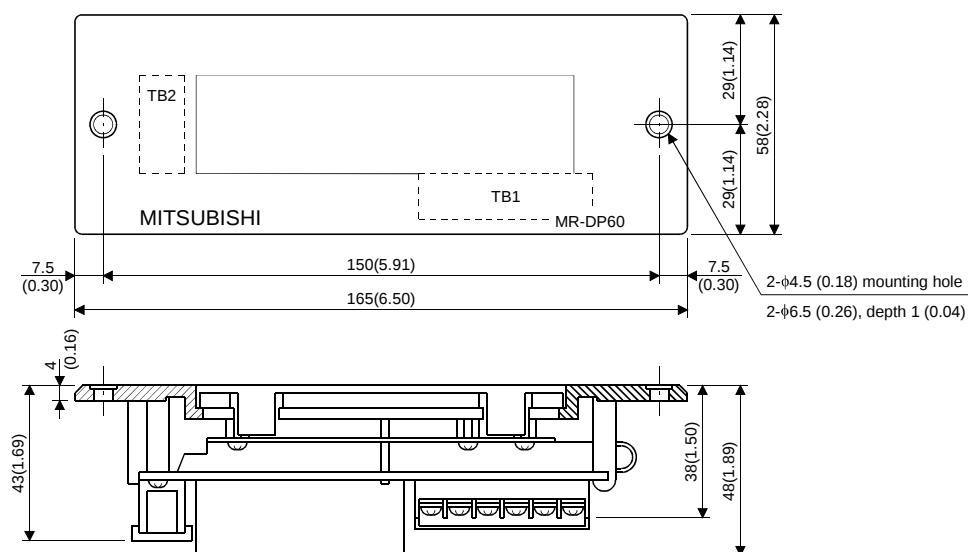
(4) Mounting

[Unit: mm (in)]



(5) Outline dimension drawing

[Unit: mm (in)]



14. OPTIONS AND AUXILIARY EQUIPMENT

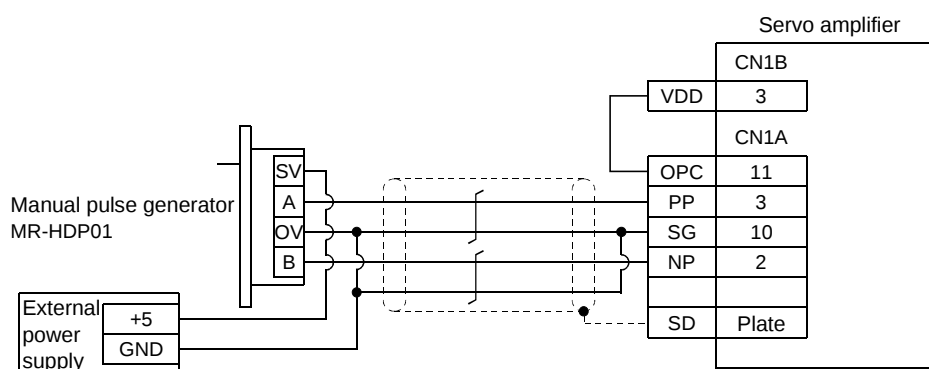
14.1.6 Manual pulse generator (MR-HDP01)

(1) Specifications

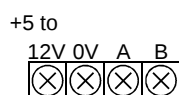
Item		Specifications
Power supply	Voltage	4.5 to 13.2VDC
	Current consumption	60mA max.
Interface		Output current max. 20mA for open collector output
Pulse signal form		2 A-phase and B-phase signals with 90° phase difference
Pulse resolution		100pulse / rev
Max. speed		Instantaneous max. 600r/min, ordinary 200r/min
Operating temperature range		−10°C to +60°C
Storage temperature range		−30°C to +80°C

(2) Connection example

Use an external power supply to supply power to the manual pulse generator.



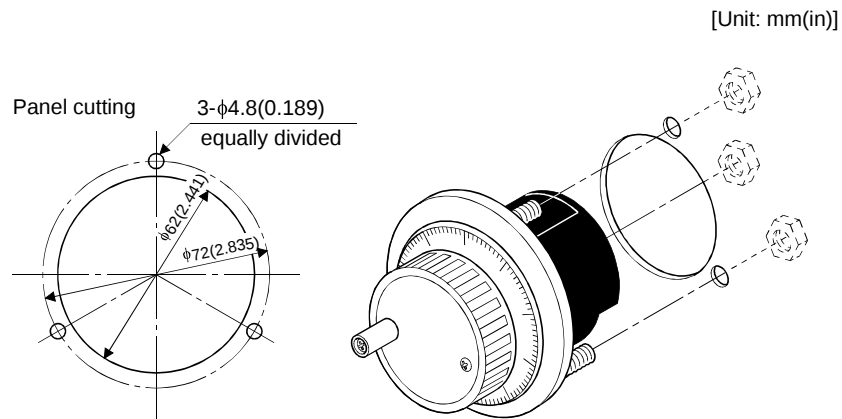
(3) Terminal arrangement



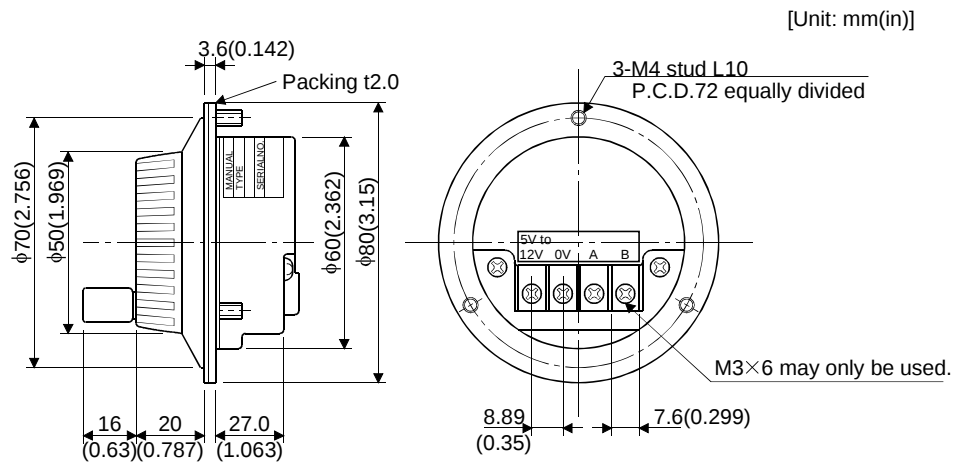
Signal Name	Description
+5 to 12V	Power input
0V	Power and signal common
A	A-phase pulse output
B	B-phase pulse output

14. OPTIONS AND AUXILIARY EQUIPMENT

(4) Mounting

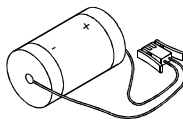


(5) Outline dimension drawing



14.1.7 Battery (MR-BAT, A6BAT)

Use the battery to build an absolute position detection system.



14. OPTIONS AND AUXILIARY EQUIPMENT

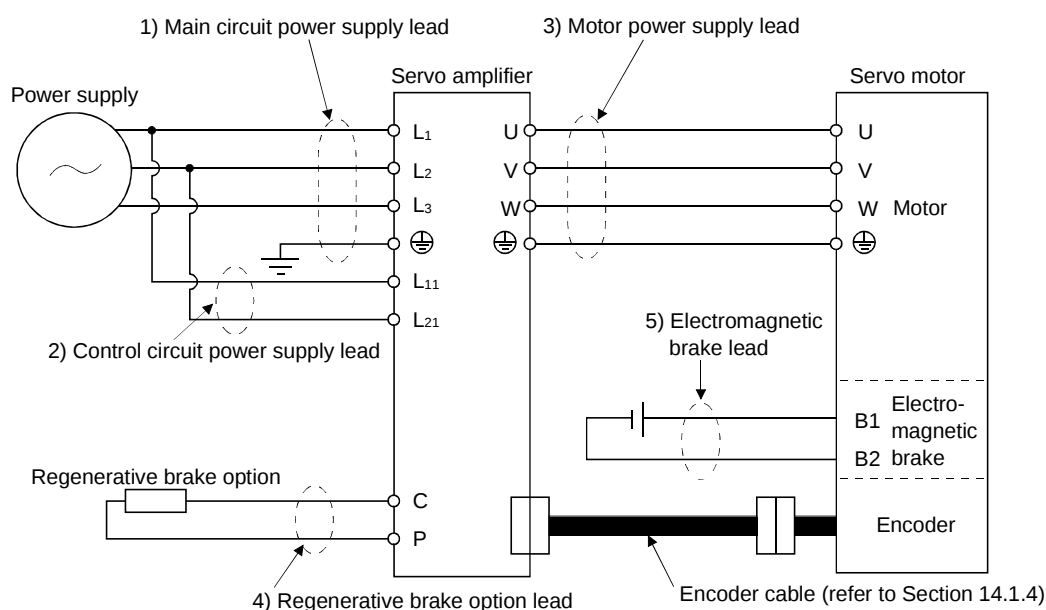
14.2 Auxiliary equipment

Always use the devices indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL (CS4) Standard, use the products which conform to the corresponding standard.

14.2.1 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 14.2) used to wire the servo amplifier. For connection with the terminal block TE2 of the MR-J2-100C or less, refer to Section 3.7.

The servo motor side connection method depends on the type and capacity of the servo motor. Refer to Section 3.3.

To comply with the UL/C-UL (CS4) Standard, use UL-recognized copper wires rated at 60 (140) or more for wiring.

Table 14.1 Recommended wires

Servo amplifier	(Note 1) Wires [mm ²]				
	1) L1・L2・L3・⊕	2) L11・L21	3) U・V・W・⊕	4) P・C	5) B1・B2
MR-J2-10C(1)	2 (AWG14) : a	1.25 (AWG16)	1.25 (AWG16) : a	2 (AWG14) : a	1.25 (AWG16)
MR-J2-20C(1)					
MR-J2-40C(1)					
MR-J2-60C					
MR-J2-70C					
MR-J2-100C					
MR-J2-200C	3.5 (AWG12) : b		2 (AWG14) : a		
			3.5 (AWG12) : b		
MR-J2-350C	5.5 (AWG10) : b		(Note 2) 5.5 (AWG10) : b		

Note: 1. For the crimping terminals and applicable tools, refer to table 14.2:

2. 3.5mm² for use of the HC-RFS203 servo motor.

14. OPTIONS AND AUXILIARY EQUIPMENT

Note: For the crimping terminals and applicable tools, see the following table:

Table 14.2 Recommended Crimping Terminals

Symbol	Servo Amplifier Side Crimping Terminals (AMP)	
	Crimping terminal	Applicable tool
a	32959	47387
b	32968	59239

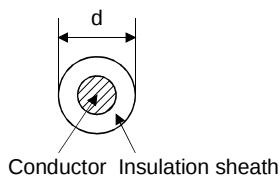
(2) Wires for cables

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

Table 14.3 Wires for option cables

Type	Model	Length [m(ft)]	Core size [mm ²]	Number of Cores	Characteristics of one core			(Note 3) Finishing OD [mm]	Wire model
					Structure [Wires/mm]	Conductor resistance[Ω/mm]	Insulation coating ODd[mm] (Note 1)		
Encoder cable	MR-JCCBL□M-L	2 to 10 (6.56 to 32.8)	0.08	12 (6 pairs)	7/0.127	222	0.38	5.6	UL20276 AWG#28 6pair (BLAK)
		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 (BLAK)
	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 (BLAK)
		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 (BLAK)
	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 (BLAK)
	MR-CPC98CBL3M								
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.

14. OPTIONS AND AUXILIARY EQUIPMENT

14.2.2 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-J2-10C	30 frame 5A	K5	10	250AC	S-N10
MR-J2-20C	30 frame 5A	K5	10		
MR-J2-40C	30 frame 10A	K5	15		
MR-J2-60C	30 frame 15A	K5	20		
MR-J2-70C	30 frame 15A	K5	20		
MR-J2-100C	30 frame 15A	K5	25		
MR-J2-200C	30 frame 20A	K5	40		S-N18
MR-J2-350C	30 frame 30A	K5	70		S-N20

14.2.3 Power factor improving reactors

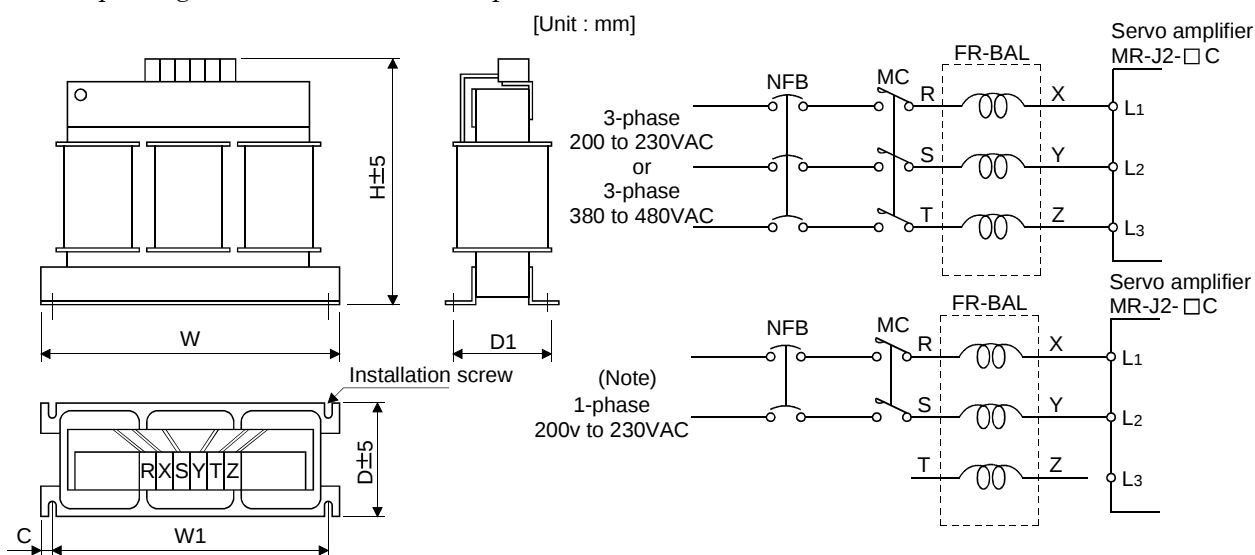
The power factor improving reactors improve the phase factor by increasing the form factor of servo amplifier's input current.

It can reduce the power capacity.

The input power factor is improved to be about 90%. For use with a 1-phase power supply, it may be slightly lower than 90%.

In addition, it reduces the higher harmonic of input side.

When using power factor improving reactors for two servo amplifiers or more, be sure to connect a power factor improving reactor to each servo amplifier.



Note. For the 1-phase 200V to 230V power supply, Connect the power supply to L1, L2 and leave L3 open.

Servo amplifier	Model	Dimensions [mm]						Mounting screw size	Terminal screw size	Mass [kg (lb)]
		W	W1	H	D	D1	C			
MR-J2-10C/20C	FR-BAL-0.4K	135	120	115	59	45 $\frac{9}{5}$	7.5	M4	M3.5	2.0 (4.4)
MR-J2-40C	FR-BAL-0.75K	135	120	115	69	57 $\frac{9}{5}$	7.5	M4	M3.5	2.8 (6.17)
MR-J2-60C/70C	FR-BAL-1.5K	160	145	140	71	55 $\frac{9}{5}$	7.5	M4	M3.5	3.7 (8.16)
MR-J2-100C	FR-BAL-2.2K	160	145	140	91	75 $\frac{9}{5}$	7.5	M4	M3.5	5.6 (12.35)
MR-J2-200C	FR-BAL-3.7K	220	200	192	90	70 ± 5	10	M5	M4	8.5 (18.74)
MR-J2-350C	FR-BAL-7.5K	220	200	194	120	100 ± 5	10	M5	M5	14.5 (32.0)

14. OPTIONS AND AUXILIARY EQUIPMENT

14.2.4 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

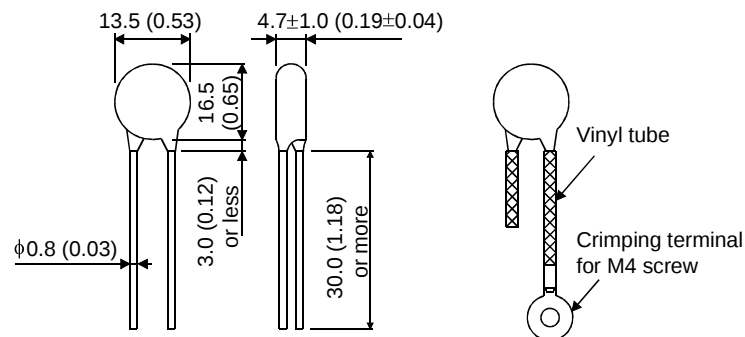
14.2.5 Surge absorbers

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)



14. OPTIONS AND AUXILIARY EQUIPMENT

14.2.6 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 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 3.6).

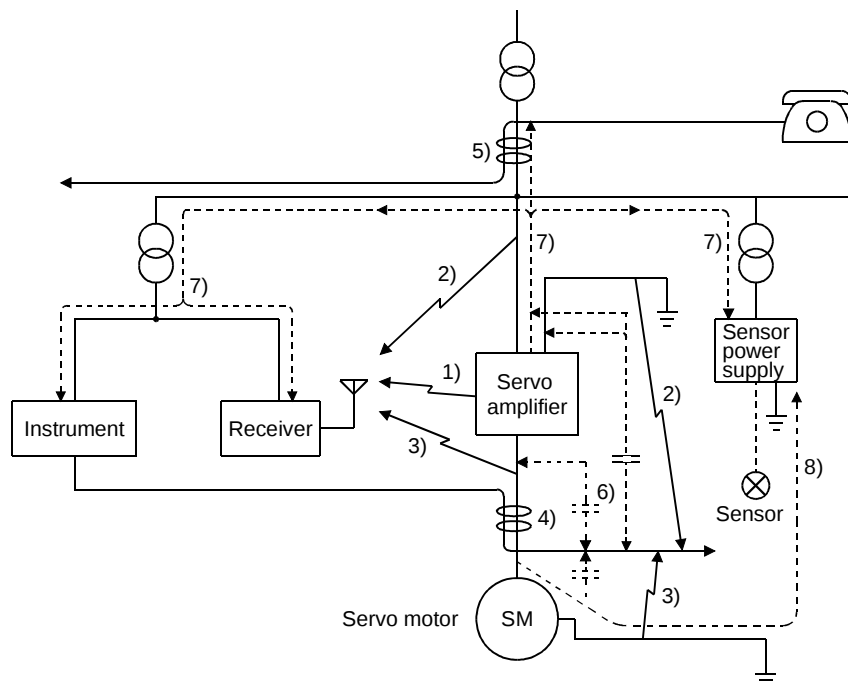
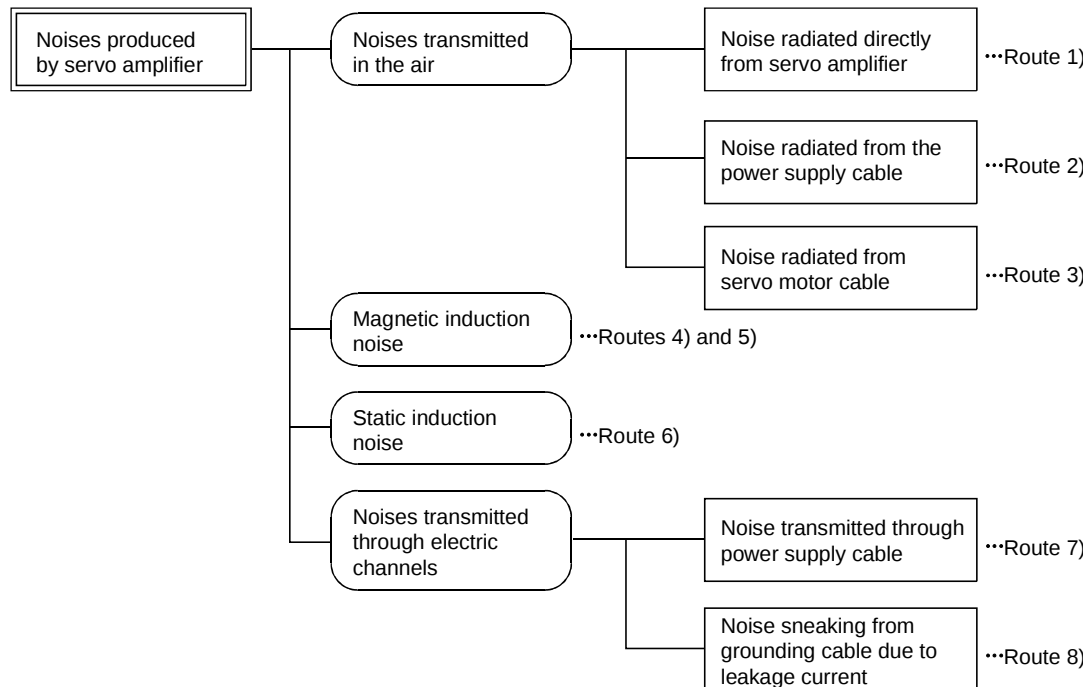
(b) Reduction techniques for external noises that cause the servo amplifier to malfunction

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.

14. OPTIONS AND AUXILIARY EQUIPMENT

- (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.



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

(2) Noise reduction products

(a) Data line filter

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

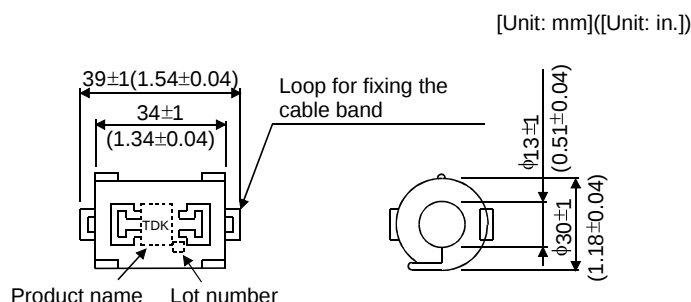
Example: Data line filter: ZCAT3035-1330 [TDK]

ESD-SR-25 [NEC Tokin]

Impedance specifications (ZCAT3035-1330)

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

The above impedances are reference values and not guaranteed values.

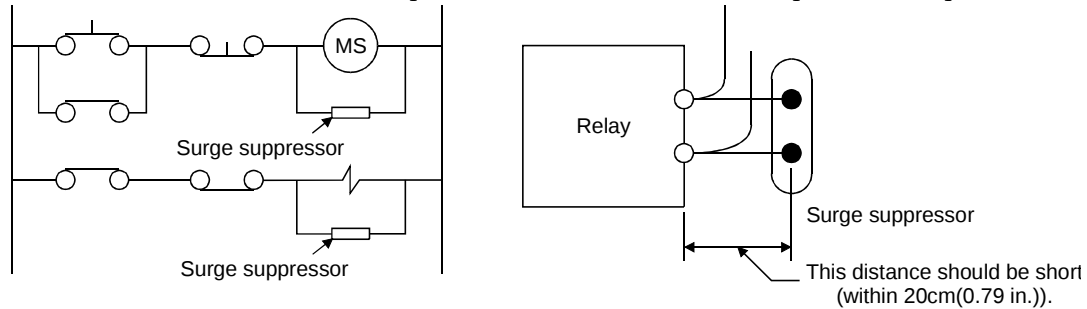


Outline drawing (ZCAT3035-1330)

14. OPTIONS AND AUXILIARY EQUIPMENT

(b) Surge suppressor

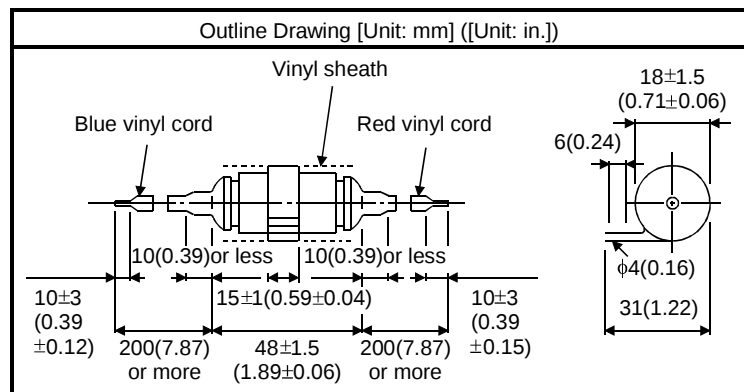
The recommended surge suppressor for installation to an AC relay, AC valve, AC electromagnetic brake or the like near the servo amplifier is shown below. Use this product or equivalent.



(Ex.) 972A.2003 50411

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

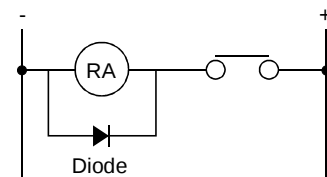
Rated Voltage AC[V]	C [μ F]	R [Ω]	Test Voltage AC[V]
200	0.5	50 (1W)	Across T-C 1000(1 to 5s)



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

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

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



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

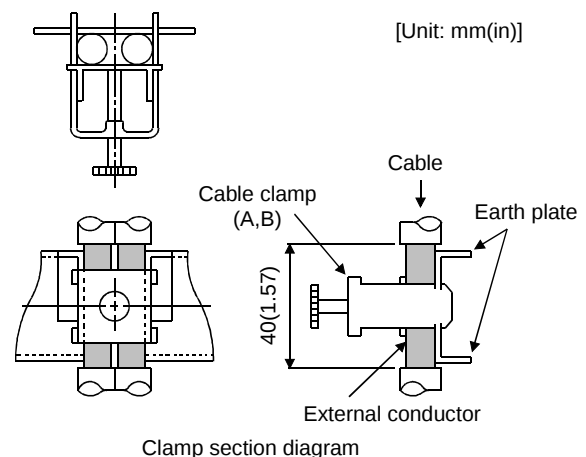
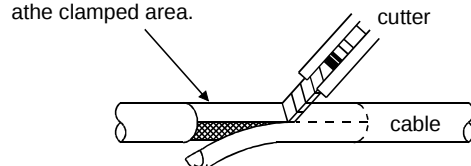
Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below.

Install the earth plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp.

If the cable is thin, clamp several cables in a bunch.

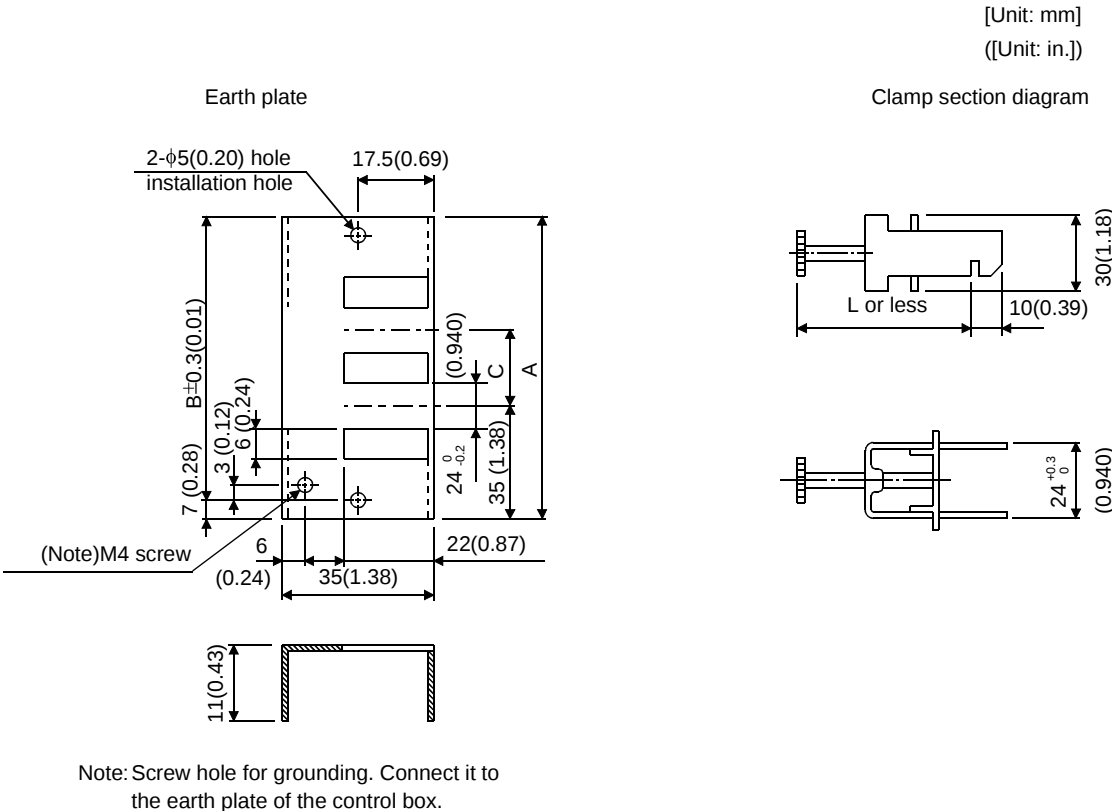
The clamp comes as a set with the earth plate.

Srip the cable sheath of the clamped area.



14. OPTIONS AND AUXILIARY EQUIPMENT

▪ Outline drawing



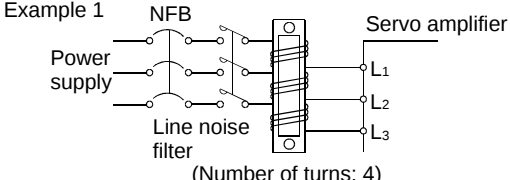
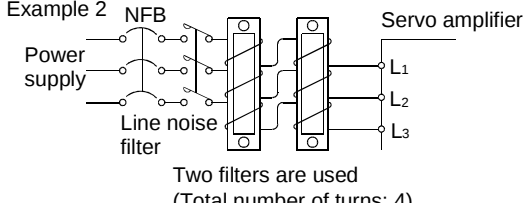
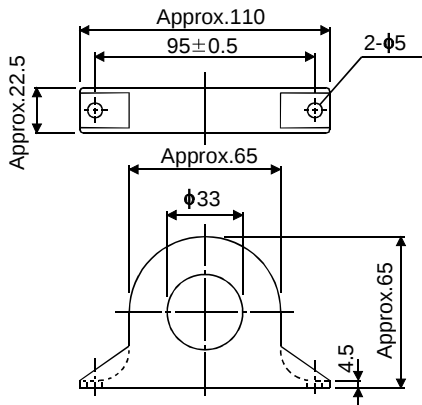
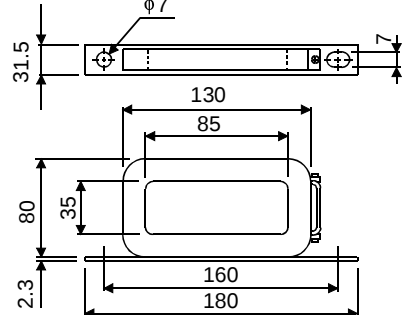
Type	A	B	C	Accessory Fittings
AERSBAN-DSET	100 (3.94)	86 (3.39)	30 (1.18)	clamp A: 2pcs.
AERSBAN-ESET	70 (2.76)	56 (2.20)		clamp B: 1pc.

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

14. OPTIONS AND AUXILIARY EQUIPMENT

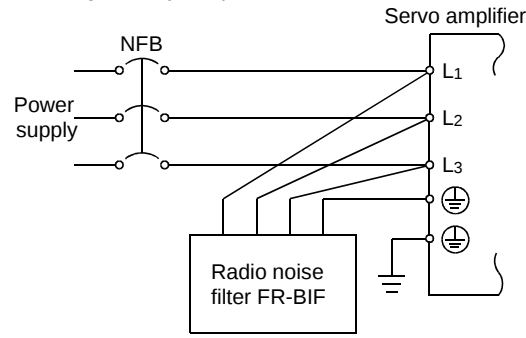
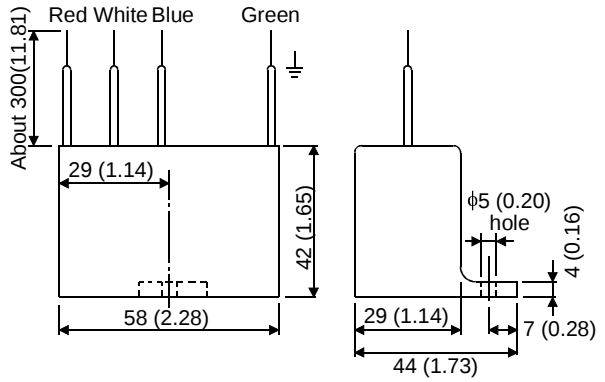
(d) Line noise filter (FR-BLF, FR-BSF01)

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.])
Wind the 3-phase wires by the equal number of times in the same direction, and connect the filter to the power supply side and output side of the servo amplifier. The effect of the filter on the power supply side is higher as the number of winds is larger. The number of turns is generally four. If the wires are too thick to be wound, use two or more filters and make the total number of turns as mentioned above. On the output side, the number of turns must be four or less. Do not wind the grounding wire together with the 3-phase wires. The filter effect will decrease. Use a separate wire for grounding. Example 1  (Number of turns: 4) Example 2  Two filters are used (Total number of turns: 4)	FR-BSF01 (for MR-J2-200C or less)  FR-BLF(MR-J2-350C or more) 

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

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

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

14. OPTIONS AND AUXILIARY EQUIPMENT

14.2.7 Leakage current breaker

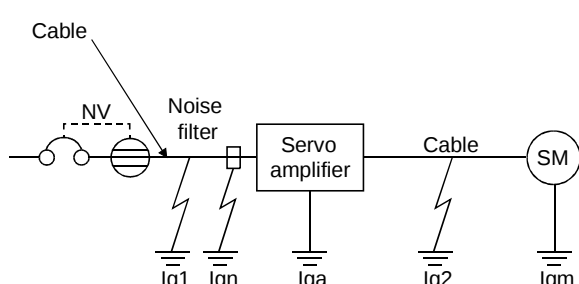
(1) Selection method

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.

$$\text{Rated sensitivity current} \geq 10 \cdot \{I_{g1} + I_{gn} + I_{ga} + K \cdot (I_{g2} + I_{gm})\} \text{ [mA]} \dots\dots\dots(14.2)$$



K: Constant considering the harmonic contents

Leakage current breaker		K
Type	Mitsubishi products	
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-L	1
General models	BV-C1 NFB NV-L	3

I_{g1}: Leakage current on the electric channel from the leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 14.1.)

I_{g2}: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 14.1.)

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

I_{ga}: Leakage current of the servo amplifier (Found from Table 14.6.)

I_{gm}: Leakage current of the servo motor (Found from Table 14.5.)

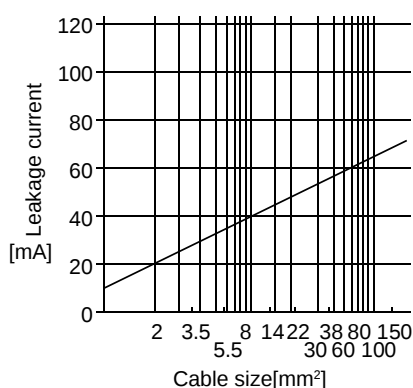


Fig. 14.1 Leakage Current Example (I_{g1}, I_{g2}) for CV Cable Run in Metal Conduit

Table 14.5 Servo Motor's Leakage Current Example (I_{gm})

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

Table 14.6 Servo Amplifier's Leakage Current Example (I_{ga})

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

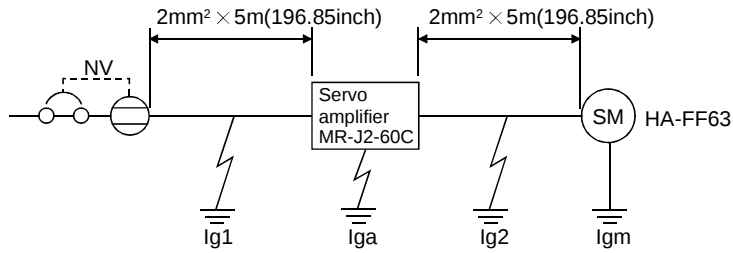
Table 14.7 Leakage Circuit Breaker Selection Example

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

14. 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 designed for suppressing harmonics/surges.

Find the terms of Equation (14.2) 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 (14.2):

$$I_g \geq 10 \cdot \{0.1+0+0.1+1 \cdot (0.1+0.1)\} \\ \geq 4 \text{ [mA]}$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (I_g) of 4[mA] or more. A leakage current breaker having I_g of 15[mA] is used with the NV-SP/CP/SW/CW/HW series.

14. OPTIONS AND AUXILIARY EQUIPMENT

14.2.8 EMC filter

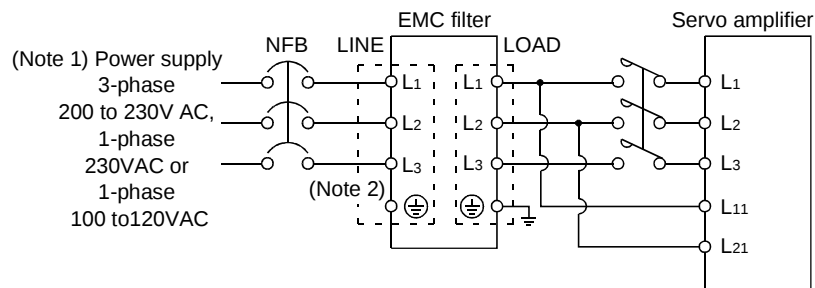
For compliance with the EMC directive of the EN Standard, it is recommended to use the following filter:
Some EMC filters are large in leakage current.

(1) Combination with the servo amplifier

Servo Amplifier	Recommended Filter		Weight [kg] ([lb])
	(Note) Type	Leakage current [mA]	
MR-J2-10C to MR-J2-100C	SF1252	38	0.75 (1.65)
MR-J2-200C • MR-J2-350C	SF1253	57	1.37 (3.01)

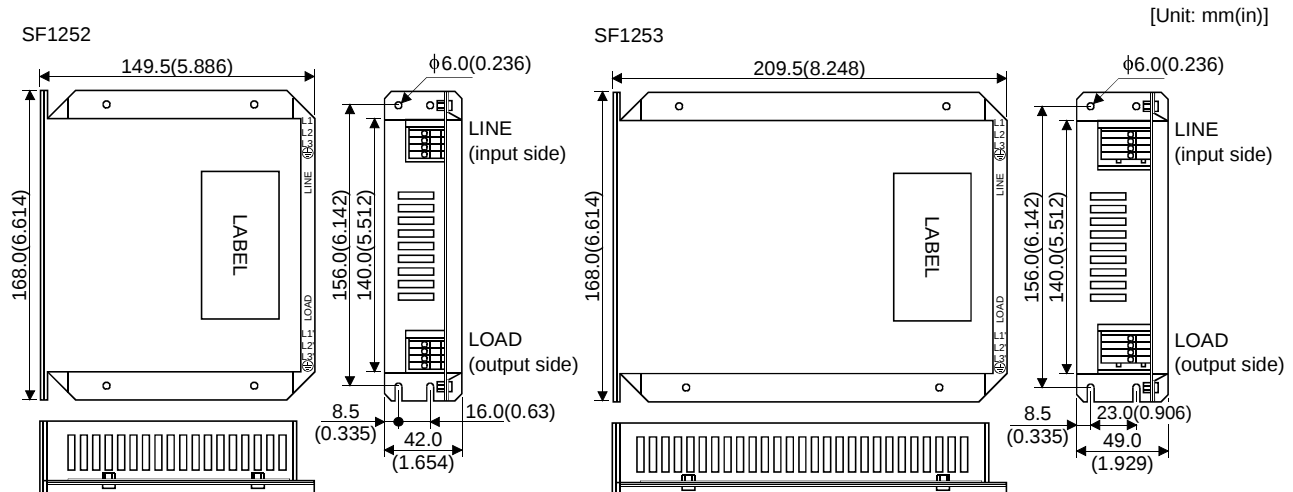
Note: ROXBURGH

(2) Connection example



Note: 1. For 1-phase 230VAC power supply, connect the power supply to L1, L2 and leave L3 open.
2. Connect when the power supply has earth.

(3) Outline drawing



REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Data	*Manual Number	Revision
Jul., 1998	SH(NA)3179-A	First edition
Dec., 1998	SH(NA)3179-B	Correction of missing pages in Chapters 9 and 13
Mar., 2000	SH(NA)3179-C	(1) and (8) added to Instructions for Conformance in CONFORMANCE WITH EUROPEAN COMMUNITY DIRECTIVES (1) and (5) added to UL/C-UL STANDARD (3) changed to short circuit rating Section 1.3 (1) Rating plate change Section 3.2 Common line diagram modification Section 3.6 (2) 2) Lamp load connection diagram modification Section 3.8.3 CNT added to 6 in encoder connector signal layout diagram Section 3.9 (3) 1) Change to 60ms for base circuit in timing chart Section 4.1.2 (2)(h) Sentences added Section 4.3.2 (3)(b) Table modification, note addition Section 5.2.7 Selection of communication specifications deleted Section 6.2 (2)(b) For use of RS-422 added Section 7.4 (3) (a), (b) and (c) added Section 7.4 (4) Addition Section 7.6 Sentence added Section 8.1.1 (1) General diagram modification Section 8.1.1 (2) Cable connection diagram modification Section 8.2.2 Parameter setting added Section 8.12 Detailed Explanation of Commands changed Section 8.12.3 (2) Sentences added to Parameter write Chapter 9 All pages changed Section 11.2.1 Alarm deactivation added to Alarm and warning list Section 11.2.2 Deletion of deactivation using alarm reset (RES) Section 11.2.3 Sentences added Section 12.2.2 (1) Connectors added Section 13.4 Addition of encoder cable flexing life Section 14.1.1 (2) 1) Section 12.1 in sentence is changed to 5.1 in separately available Servo Motor Instruction Manual Section 14.1.2 (1) Change to pin 170359-1 Change to connector 10120-6000EL Change to shell kit 10320-3210-000 Section 14.1.2 (2) 2) Connection diagram modification Section 14.1.2 (3) Change to connector 10120-6000EL Change to shell kit 10320-3210-000 Section 14.1.3 POINT added Section 14.1.5 (2) Diagram modification Section 14.2.2 Fuse models deleted Section 14.2.5 (2)(b) Diode installation diagram changed Section 14.2.5 (5) Connection diagram changed Section 14.2.9 Analog input setting potentiometer addition Chapter 15 Deleted

Print Data	*Manual Number	Revision
Jan., 2002	SH(NA)3179-D	Safety precautions Servo motor vibration conditions changed UL/C-UL Standard Addition of (6) Servo motor installation Section 1.1.3 Table changed Section 1.6 Power factor improving reactor added Section 3.3.2 Table reexamined Section 3.3.3 Table reexamined Section 3.3.4 (3) Contents changed Section 3.7 Contents changed Section 3.8 Contents changed Section 3.8.3 Note changed Section 3.11 Contents changed Section 4.1.2 (2)(a) Sentence added Section 4.2.1 (3)(b)2) Diagram changed Section 4.2.4 Diagram modified Section 4.2.5 (4)(a) Diagram changed Section 4.4.6 (1) Table changed Section 5.1.2 (2) Parameter No. 24 sentence changed Section 8.11.1 (6) to (11) Table reexamined Section 8.11.2 (6) to (11) Table reexamined Section 8.12.1 (8) Write mode sentence changed Section 8.12.1 (9) Write mode sentence changed Section 8.12.1 (10) Write mode sentence changed Section 8.12.1 (11) Write mode sentence changed Section 8.12.1 (12) Write mode sentence changed Section 8.12.3 (2) Change to sentence in figure Section 8.12.8 (7) Change to sentence in figure Section 8.12.10 (3) Software version added Section 11.2.2 A.20 contents added A.24 contents changed Section 13.3 Sentence changed Section 14.1.1 (2)(b)1) Table changed Section 14.1.1 (3) Text added, diagram modified, note added Section 14.1.2 (1) Diagram changed Section 14.1.2 (2) Contents changed Section 14.2.1 Contents changed Section 14.2.2 Table contents modified Section 14.2.3 Diagram changed Section 14.2.5 TNR-12G221X deleted
Oct., 2002	SH(NA)3179-E	Section 3.11 (2) Change of tightening torque to 0.3 - 0.4N • m Addition of recommended torque screwdriver Section 12.2.1 (1), (2) Change of TE2 installation torque to 0.3 - 0.4 [N • m]
Jun., 2006	SH(NA)3179-F	Safety precautions 1. To prevent electrical shock sentence added 3. To prevent injury sentence added 4.(1) Tranpotation and installation sentence changed (2) Wiring sentence added (4) Usage sentence added About processing of waste added FOR MAXIMUM SAFETY sentence changed CONFORMANCE WITH UL/C-UL STANDARD (7) About wiring protection sentence added Chapter 2 CAUTION added Section 2.4 (2) Sentence changed Chapter 3 CAUTION added Section 3.2 RDP, SDP, RDP, and RDN modified

Print Data	*Manual Number	Revision
Jun.,2006	SH(NA)3179-F	Section 3.3.2 (1) PG,NG deleted Initial value “□1□□” of proximity dog(DOG), parameter No.8 is modified Section 3.5 CAUTION added Section 3.7.2 Description of U,V,and W terminal added Section 3.7.3 (3) CAUTION added Section 3.8.1 POINT added Section 3.8.2 CAUTION added Section 3.9 CAUTION added Section 3.11 Bar terminal changed Section 4.1.1 (1)(d) Sentence changed Section 4.1.2 CAUTION added and changed Section 4.1.2 (2)(f) Position data for home position return changed Section 4.2.1 (3)(c) Sentence changed, “feed length mulltiplication(STM)” in table deleted Section 4.2.2 (2) “Automatic/manual selection(MD0)” in table added Section 4.2.3 (2) “Automatic/manual selection(MD0)” in table added Section 4.3.2 (1) “Parameter No.13, 1” in table deleted Section 4.4.2 (1) Position data for home position return changed Section 4.4.2 (3) “ST2” in diagram added Section 4.4.3 (1) Position data for home position return changed Section 4.4.3 (2) “ST2” in diagram added Section 4.4.4 (1) Position data for home position return changed Section 4.4.4 (2) “ST2” in diagram modified Section 4.4.5 (1) Position data for home position return changed Section 4.4.5 (2) “ST2” in diagram modified Section 4.4.6 (1) Position data for home position return changed Section 4.5 CAUTION added Section 5.2.1 POINT changed Section 5.2.4 Sentence changed Section 6.2 (1) “Personal computer” in table changed Section 7.4 (2) Sentence changed Section 8.4 “JIS8 unit code” to “ASCII code” changed Section 11.2.2 CAUTION added Section 11.2.2 A.15,A.16,A.17,A.19, and A.20 changed Section 11.2.3 CAUTION and POINT added Section 13.1 Note added Section 13.2 (1) Amount of heat generated by the servo amplifier: “At zero torque” to “With servo off” changed Sentence in Note 1 added Section 14.1.1 (1) Note in table changed Section 14.1.1 (2)(b) Formulas changed Section 14.1.1 (3) POINT added Section 14.1.2 (2) POINT added Section 14.1.5 Sentence added Section 14.1.5 (2) Connection example changed Section 14.2.3 Sentence changed, Outline drawing changed Section 14.2.6 (2)(d) Outline drawing changed Section 14.2.8 Sentence added Section 14.2.9 Outline drawing changed

MODEL	MR-J2-C INSTRUCTION
MODEL CODE	1CW923



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