Doc. no. LEC-OM02601

Operation Manual

PRODUCT NAME

AC Servo Motor Controller

MODEL/ Series

LECSA Series

SMC Corporation

LECSA□-□ Series / Controller

1. Safety Instructions

These safety instructions are intended to prevent hazardous situations and/or equipment damage.
These instructions indicate the level of potential hazard with the labels of “Caution,” “Warning” or “Danger.”
They are all important notes for safety and must be followed in addition to International Standards (ISO/IEC), Japan Industrial Standards (JIS)*1) and other safety regulations*2).

*1) ISO 4414: Pneumatic fluid power -- General rules relating to systems
ISO 4413: Hydraulic fluid power -- General rules relating to systems
IEC 60204-1: Safety of machinery -- Electrical equipment of machines (Part 1: General requirements)
ISO 10218-1992: Manipulating industrial robots -- Safety
JIS B 8370: General rules for pneumatic equipment.
JIS B 8361: General rules for hydraulic equipment.
JIS B 9960-1: Safety of machinery – Electrical equipment for machines. (Part 1: General requirements)
JIS B 8433-1993: Manipulating industrial robots - Safety. etc.

*2) Labor Safety and Sanitation Law, etc.

⚠ **Caution**	**Caution** indicates a hazard with a low level of risk which, if not avoided, could result in minor or moderate injury.
⚠ **Warning**	**Warning** indicates a hazard with a medium level of risk which, if not avoided, could result in death or serious injury.
⚠ **Danger**	**Danger** indicates a hazard with a high level of risk which, if not avoided, will result in death or serious injury.

Warning

1. The compatibility of the product is the responsibility of the person who designs the equipment or decides its specifications.
Since the product specified here is used under various operating conditions, its compatibility with specific equipment must be decided by the person who designs the equipment or decides its specifications based on necessary analysis and test results.
The expected performance and safety assurance of the equipment will be the responsibility of the person who has determined its compatibility with the product.
This person should also continuously review all specifications of the product referring to its latest catalog information, with a view to giving due consideration to any possibility of equipment failure when configuring the equipment.

2. Only personnel with appropriate training should operate machinery and equipment.
The product specified here may become unsafe if handled incorrectly.
The assembly, operation and maintenance of machines or equipment including our products must be performed by an operator who is appropriately trained and experienced.

3. Do not service or attempt to remove product and machinery/equipment until safety is confirmed.
The inspection and maintenance of machinery/equipment should only be performed after measures to prevent falling or runaway of the driven objects have been confirmed.
When the product is to be removed, confirm that the safety measures as mentioned above are implemented and the power from any appropriate source is cut, and read and understand the specific product precautions of all relevant products carefully.
Before machinery/equipment is restarted, take measures to prevent unexpected operation and malfunction.

4. Contact SMC beforehand and take special consideration of safety measures if the product is to be used in any of the following conditions.
1) Conditions and environments outside of the given specifications, or use outdoors or in a place exposed to direct sunlight.
2) Installation on equipment in conjunction with atomic energy, railways, air navigation, space, shipping, vehicles, military, medical treatment, combustion and recreation, or equipment in contact with food and beverages, emergency stop circuits, clutch and brake circuits in press applications, safety equipment or other applications unsuitable for the standard specifications described in the product catalog.
3) An application which could have negative effects on people, property, or animals requiring special safety analysis.
4) Use in an interlock circuit, which requires the provision of double interlock for possible failure by using a mechanical protective function, and periodical checks to confirm proper operation.

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.

⃠	**Prohibition**	Indicates what must not be done. For example, "No Fire" is indicated by
●	**Compulsion**	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.

LECSA□-□ Series / Controller
1. Safety Instructions

⚠Caution
The product is provided for use in manufacturing industries. The product herein described is basically provided for peaceful use in manufacturing industries. If considering using the product in other industries, consult SMC beforehand and exchange specifications or a contract if necessary. If anything is unclear, contact your nearest sales branch.

Limited warranty and Disclaimer/Compliance Requirements

The product used is subject to the following "Limited warranty and Disclaimer" and "Compliance Requirements".
Read and accept them before using the product.

Limited warranty and Disclaimer

The warranty period of the product is 1 year in service or 1.5 years after the product is delivered.*3)
Also, the product may have specified durability, running distance or replacement parts. Please consult your nearest sales branch.

For any failure or damage reported within the warranty period which is clearly our responsibility, a replacement product or necessary parts will be provided.
This limited warranty applies only to our product independently, and not to any other damage incurred due to the failure of the product.

Prior to using SMC products, please read and understand the warranty terms and disclaimers noted in the specified catalog for the particular products.

***3) Vacuum pads are excluded from this 1 year warranty.**
A vacuum pad is a consumable part, so it is warranted for a year after it is delivered.
Also, even within the warranty period, the wear of a product due to the use of the vacuum pad or failure due to the deterioration of rubber material are not covered by the limited warranty.

Compliance Requirements

When the product is exported, strictly follow the laws required by the Ministry of Economy, Trade and Industry (Foreign Exchange and Foreign Trade Control Law).

1. To prevent electric shock, note the following

⚠ WARNING

- Before wiring, be sure to turn off the power, wait for 15 minutes or longer, and then make sure that the charge lamp is off to prevent an electric shock. In addition, always confirm if the charge lamp is off or not from the front of the servo amplifier.
- Ground the servo amplifier and the servo motor securely.
- Only qualified personnel should attempt wiring and inspection.
- Wire the servo amplifier and the servo motor after installation is complete to prevent an electric shock.
- Do not operate the switches with wet hands as it may cause an electric shock.
- Do not damage, stress excessively, place heavy objects or pinch the cable to prevent an electric shock.

2. To prevent fire, note the following

⚠ CAUTION

- Install the servo amplifier, the servo motor and the regenerative option on incombustible material. Installing them directly or close to combustibles may cause a fire.
- Connect a magnetic contactor (MC) between the main circuit power supply, and L_1 and L_2 of the servo amplifier to configure a circuit that shuts off the power on the servo amplifier's power supply side. If a magnetic contactor (MC) is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
- When using a regenerative resistor, configure a circuit that shuts off the power if abnormality is found. Otherwise, the regenerative resistor may overheat, causing a fire due to a regenerative transistor fault.
- When using a regenerative option, remove the built-in regenerative resistor and its wiring from the servo amplifier.

3. To prevent injury, note the follow

⚠ CAUTION

- Do not apply voltage other than specified in this Instruction Manual to each terminal as it may cause burst, damage, etc.
- Connect the wires to correct terminals to prevent burst, damage, etc.
- Ensure that polarity (+, −) is correct. Otherwise, a burst, damage, etc. may occur.
- The servo amplifier heat sink, the regenerative option, the servo motor can be very hot during power-on and for some time after power-off, and it may result burns or damages to parts (cables, etc.) Take measures, e.g. provide covers, to prevent accidental contact of hands and parts with them.
- Never touch the rotating parts of the servo motor during operation as it may cause injury.

4. Additional instructions

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

(1) Transportation and installation

⚠ CAUTION

- Carry the products in a suitable way according to their weights.
- Do not stack the product packages exceeding the maximum number specified on the package.
- Do not hold the lead of the built-in regenerative resistor when carrying the servo amplifier.
- Do not hold the cable, the shaft or the encoder when carrying the servo motor.
- Install the equipment on a weight-bearing place in accordance with this Instruction Manual.
- Do not get on or place heavy objects on the equipment.
- Install the equipment in the specified direction. Improper installation causes oil leakage, leading to a fire and malfunction.
- Leave specified clearances between the servo amplifier and inner wall of the control box or other equipment.
- Do not install or operate a servo amplifier and a servo motor which are damaged or have any part missing.
- Do not drop or shock the servo amplifier or the servo motor as they are precision equipment.
- Provide an adequate protection to prevent conductive matters such as screws or metal pieces or combustible matters such as oil from entering the servo amplifier and the servo motor.
- When storing the equipment, please fulfill the following environmental conditions.

<table>
<tr><th colspan="3" rowspan="2">Environment</th><th colspan="3">Conditions</th></tr>
<tr><th>Servo amplifier</th><th colspan="2">Servo motor</th></tr>
<tr><td rowspan="4">Ambient temperature</td><td rowspan="2">In operation</td><td>[°C]</td><td>0 to ＋ 55 (non-freezing)</td><td colspan="2">0 to ＋ 40 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>32 to 131 (non-freezing)</td><td colspan="2">32 to 104 (non-freezing)</td></tr>
<tr><td rowspan="2">In storage</td><td>[°C]</td><td>－20 to ＋ 65 (non-freezing)</td><td colspan="2">－15 to ＋ 70 (non-freezing)</td></tr>
<tr><td>[°F]</td><td>4 to 149 (non-freezing)</td><td colspan="2">5 to 158 (non-freezing)</td></tr>
<tr><td rowspan="2">Ambient humidity</td><td colspan="2">In operation</td><td rowspan="2">90%RH or less (non-condensing)</td><td colspan="2">80%RH or less (non-condensing)</td></tr>
<tr><td colspan="2">In storage</td><td colspan="2">90%RH or less (non-condensing)</td></tr>
<tr><td colspan="3">Ambience</td><td colspan="3">Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt</td></tr>
<tr><td colspan="3">Altitude</td><td colspan="3">Max. 1000m (3280 ft) above sea level</td></tr>
<tr><td colspan="3" rowspan="2">Vibration</td><td rowspan="2">5.9 m/s^2 or less, 10 to 55Hz
(directions of X, Y, and Z axes)</td><td>LECS□□-S1
LECS□□-S3
LECS□□-S4
Series</td><td rowspan="2">X・Y: 49m/s^2</td></tr>
<tr><td>LECS□□-S5
LECS□□-S7
LECS□□-S8
Series (Note)</td></tr>
</table>

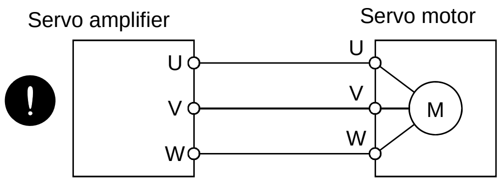
Note. For the standard servo motor (without reduction gear.)

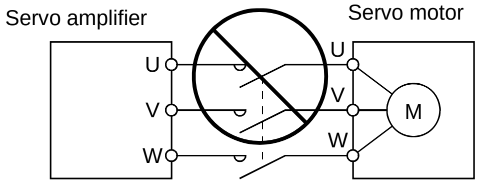
- Couple the servo motor to a machine securely. Insecure coupling may cause the servo motor to come off.
- Install the servo motor with a reduction gear in the specified direction to prevent oil leakage.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
- Never hit the servo motor or shaft, especially when coupling the servo motor to a machine as it may damage the encoder.
- Do not apply load exceeding the permissible load as it may break the shaft.
- When the equipment has been stored for an extended period of time, contact your local sales office.
- When handling the servo amplifier, be careful with the edged parts such as the corners of the servo amplifier.
- Be sure to install the servo amplifier in a metal control box.

(2) Wiring

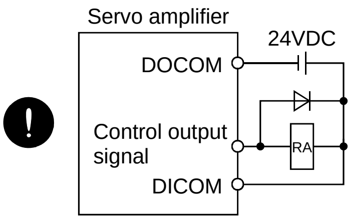
⚠ CAUTION

- Before unplugging CNP1 connector from the servo amplifier, disconnect the lead of the built-in regenerative resistor from CNP1 connector first.
- Wire the equipment correctly and securely. Improper wiring may cause unexpected operation.
- Do not install a power capacitor, a surge absorber or a radio noise filter (optional FR-BIF) between the servo motor and the servo amplifier.
- Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and the servo motor. Not doing so may cause unexpected operation.
- Connect the servo motor power terminals (U, V, W) of the servo amplifier to the servo motor power input terminals (U, V, W) directly. Do not install a magnetic contactor, etc. between the servo amplifier and the servo motor.

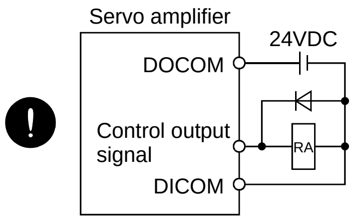




- Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur.
- Install a surge absorbing diode on the DC relay designed for control output signal in the specified direction. Improper installation of the surge absorbing diode may cause the servo amplifier to malfunction such that the signals are not output, and emergency stop and other safety circuits are inoperable.



Sink output interface



Source output interface

(3) Test run adjustment

⚠ CAUTION

- Check and adjust the parameter setting before operation. Improper settings may cause some machines to perform unexpected operation.
- Never adjust or change the parameter values extremely as it makes operation instable.

(4) Usage

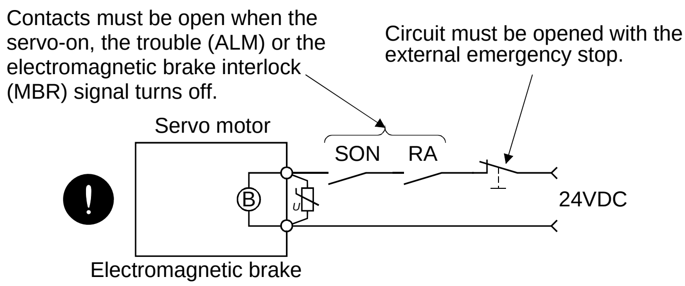
⚠ CAUTION

- Configure an external emergency stop circuit in order to stop the operation immediately and shut off the power.
- Do not disassemble or repair the equipment.
- If an alarm is reset while the operation signal is input to the servo amplifier, the equipment starts suddenly. Be sure that the operation signal is off before resetting the alarm to prevent an accident.
- Do not modify the equipment.
- Electromagnetic interference from the servo amplifier may affect the surrounding electronic equipment. Minimize the influence of the electromagnetic interference by using a noise filter, etc.
- Toxic gases may be generated by burning or disassembling the servo amplifier. Do not burn or disassemble the servo amplifier.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ball screw and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions

⚠ CAUTION

- When it is assumed that a hazardous condition may take place at the occur due to a power failure or a product fault, use a servo motor with an electromagnetic brake or provide an external brake mechanism for the purpose of prevention.
- Configure the electromagnetic brake operation circuit which interlocks with an external emergency stop.



- When an alarm occurs, remove its cause. Then, ensure safety and reset 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) Storing of servo motor

⚠ CAUTION
・Note the following points when storing the servo motor for an extended period of time (guideline: three or more months). ・Be sure to store the servo motor indoors in a clean and dry place. ・If it is stored in a dusty or damp place, make adequate provision, e.g. cover the whole product. ・If the insulation resistance of the winding decreases, reexamine the storage method. ・Though the servo motor is rust-proofed before shipment using paint or rust prevention oil, rust may be produced depending on the storage conditions or storage period. If the servo motor is to be stored for longer than six months, apply rust prevention oil again especially to the machined surfaces of the shaft, etc. ・Before using the servo motor that has been stored for an extended period of time, hand-turn the servo motor output shaft to confirm that nothing is wrong with the servo motor. (For the servo motor with an electromagnetic brake, turn ON the power supply of the electromagnetic brake, first. Then, release the electromagnetic brake before hand-turn.) ・When the equipment has been stored for an extended period of time, contact your local sales office.

(7) Maintenance, inspection and parts replacement

⚠ CAUTION
・With age, the electrolytic capacitor of the servo amplifier will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment. Please contact your local sales office.

(8) General instruction

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

● About processing of waste ●

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

⚠ FOR MAXIMUM SAFETY

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

⚠ EEP-ROM life

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

- Write to the EEP-ROM due to parameter setting changes
- Home position setting in the absolute position detection system
- Write to the EEP-ROM due to device changes

Precautions for Choosing the Products

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

COMPLIANCE WITH EC DIRECTIVES

Refer to appendix 7 for the compliance with EC directives.

CONFORMANCE WITH UL/CSA STANDARD

Refer to appendix 8 for the conformance with UL/CSA standard.

<<About the manuals>>

This Instruction Manual is required if you use the General-Purpose AC servo MR-JN-A for the first time.

Relevant manuals

Manual name	Manual No.
LECSA□-□ Series Instructions and Cautions for Safe Use of AC Servos (Enclosed in servo amplifier.)	IB(NA)0300157
QUICK INSTALLATION GUIDE	L(NA)03052ENG
LECSA□-□Servo Motor Instruction Manual Vol.2	SH(NA)030041
EMC Installation Guidelines	IB(NA)67310

<<About the wires used for wiring>>

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

Introduction

The Mitsubishi LECSA□-□ series general-purpose AC servo is based on the LECSB□-□ series, and retains its high performance, with some limitations in functions. For details of functions, performance and specifications of the LECSB□-□ series, refer to chapters 1 to 12 and appendices of this Instruction Manual. This section describes the how-to (startup, actual operation, and others) for users who use the MELSERVO-JN series AC servo for the first time.

⚠ CAUTION	・The lead of the built-in regenerative resistor is connected between P and C terminals on the controller power supply connectors (CNP1) of the LECSB□-□ 20A/40A. When taking the controller out from the shipping box, do not hold the lead of the built-in regenerative resistor.

Unpack the product and check the rating plate to see if the servo motor and controller are as you ordered.

(1) Controller

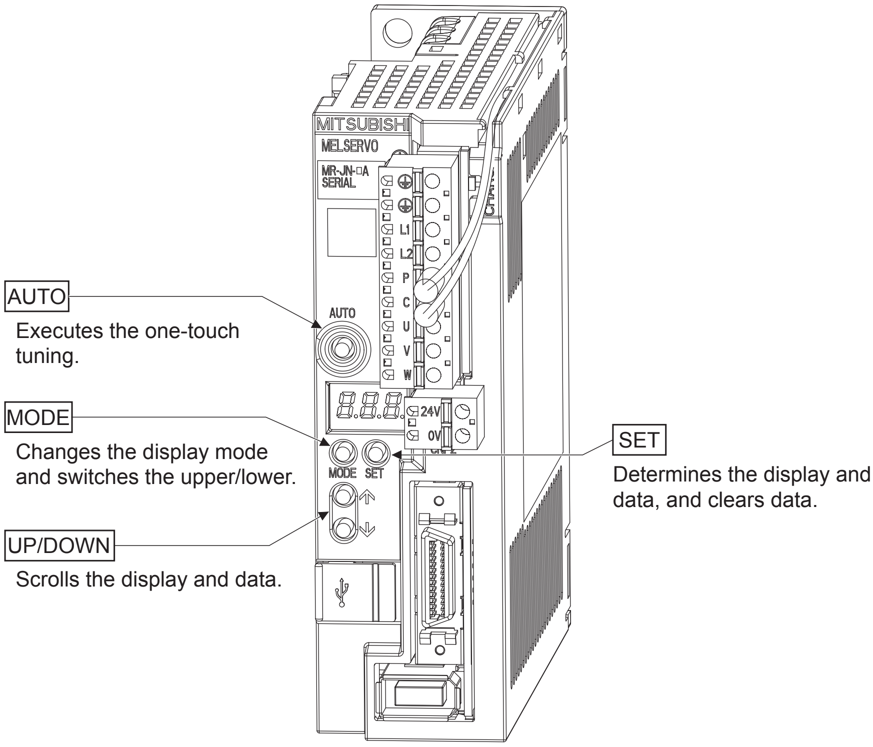
Packaged product	Quantity
Controller	1
Controller power supply connectors for CNP1 and CNP 2	1 each
LECSA□-□ series Instructions and Cautions for Safe Use of AC Servos	1

(2) Servo motor

Packaged product	Quantity
Servo motor	1
Instructions and Cautions for Safe Use of AC Servos (Motor)	1

1. Operation and setting

Operation and settings of the controller are easily performed only on the display section (3-digit, 7-segment LED) and on the operation section (four pushbuttons and one-touch tuning button) located on the front panel of the controller.



(1) One-touch tuning function (refer to section 6.1)
Gain and filter adjustment of the servo is easily made by the AUTO button located on the front panel of the controller.

(2) Status display, diagnosis, and parameter setting (refer to chapter 5)
The controller status display (cumulative feedback pulses, servo motor speed, and others), diagnosis (servo operation-ready complete status, external I/O signal ON/OFF, test operation), and parameter settings can be easily performed by the MODE, SET, UP and DOWN buttons located on the front panel of the controller.

2. Startup

When switching the power on for the first time, follow the startup procedure below.

Visual wiring check	Refer to (1) in this section.
↓	
Surrounding environment check	Check the surrounding environment (cable routing and impurity such as wire offcuts or metallic dust) of the controller and the servo motor.
↓	
Power-on of the control circuit power supply	Refer to (2) (a) in this section.
↓	
I/O signal wiring check during power-on	Refer to (3) in this section.
↓	
Parameter setting	Refer to (4) in this section.
↓	
Power-on of the main circuit power supply	Refer to (2) (a) in this section.
↓	
Operation confirmation before actual operation	Refer to (5) in this section.
↓	
One-touch tuning	Refer to (6) in this section.
↓	
Actual operation	
↓	
Stop	Refer to (7) in this section.

When switching the power off, follow (2) (b) in this section.

(1) Visual wiring check

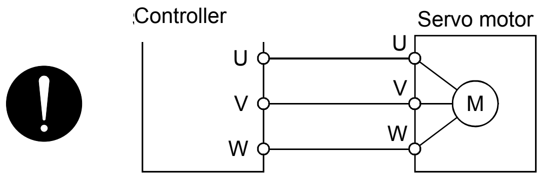
Before switching on the main circuit and control circuit power supplies, check the following items.

Power supply system wiring

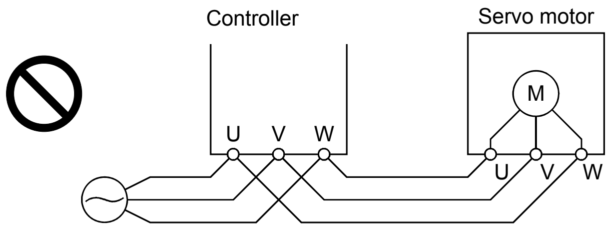
・The power supplied to the power input terminals (L_1, L_2, +24V, 0V) of the controller should satisfy the defined specifications. (Refer to section 1.3.)

Connection of controller and servo motor

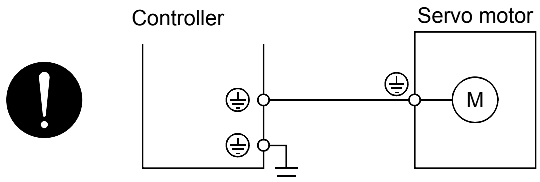
・The servo motor power supply terminals (U, V, W) of the controller should match in phase with the power input terminals (U, V, W) of the servo motor.



・The power supplied to the controller should not be connected to the servo motor power supply terminals (U, V, W). The connected controller and servo motor will be damaged.



・The earth terminal of the servo motor should be connected to the PE terminal of the controller.



When regenerative option is used

・The built-in regenerative resistor and its wirings should be removed from the controller.

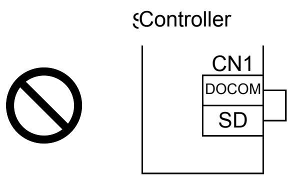
・The regenerative option should be connected to P and C terminals.

・A twisted cable should be used. (Refer to section 11.2 (4).)

I/O signal wiring

・The power supplied to CN1 connector (DICOM and DOCOM) of the controller should satisfy the defined specifications. (Refer to section 1.3.)

・SD and DOCOM of CN1 connector should not be shorted.



(2) Power on and off procedures

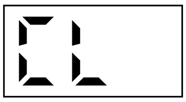
(a) Power-on

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

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

2) Make sure that command and start signal from the PC or PLC...etc are not input.

3) Switch on the control circuit power supply.
At power-on, "888" appears instantaneously, but it is not an error.
After displaying "CL" (cumulative feedback pulses in pulse unit) (initial value), data is displayed in 2[s] or later, or by pressing the "MODE", "UP" or "DOWN" button.



4) Switch on the main circuit power supply.

(b) Power-off

1) Make sure that command and start signal from the PC or PLC...etc are not input.

2) Turn off the servo-on (SON).

3) Switch off the main circuit power supply.

4) Switch off the control circuit power supply.

(3) I/O signal wiring check during the energization

Input signal wiring check

- On/off status of the input signals of CN1 connector can be checked using the external I/O signal display. By using this function, input signal wiring can be checked. (Refer to section 5.7.)

Output signal wiring check

- Output signals of CN1 connector can be turned on/off forcibly using the DO output. By using this function, output signal wiring can be checked. (Refer to section 5.8.)

(4) Parameter setting

POINT

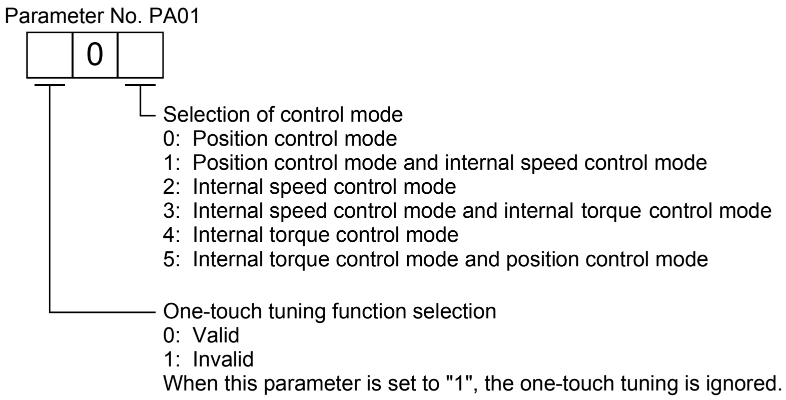
- Some parameters are made valid when power is switched off, then on after setting. Refer to chapter 4 for details.

Set the parameters as necessary, such as selecting the control mode and the regenerative option.
In the position control mode, the controller can be used just by changing the basic setting parameters (parameter No. PA□□) mainly.
As necessary, set the gain/filter parameters (parameter No. PB□□), the extension setting parameters (parameter No. PC□□) and the I/O setting parameters (parameter No. PD□□).
For the internal speed control mode and the internal torque control mode, refer to chapter 4.

The following shows the main parameters, which must be changed, among parameter No. PA□□.

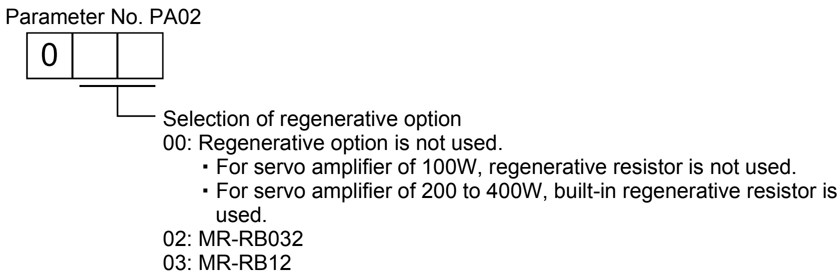
PA01 Selection of control mode (refer to section 4.1.3)

Select the control mode of the controller, and whether to enable or not the one-touch tuning function.



PA02 Selection of regenerative option (refer to section 4.1.4)

Set this parameter when using the regenerative option.

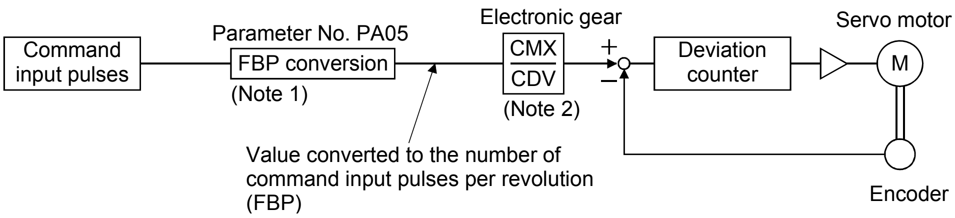


PA05 Number of command input pulses per servo motor revolution (refer to section 4.1.6)

Set the number of command input pulses necessary to rotate the servo motor one turn.

When "100 (10000[pulse/rev])" (initial value) is set to parameter No. PA05, the servo motor rotates one turn by inputting 1000 pulses of the command pulse to the controller. When "0" is set to parameter No. PA05, the servo motor rotates one turn by inputting the command pulse of servo motor resolution to the controller.

Parameter No. PA05 setting	Description
0	Servo motor resolution [pulse/rev]
100 to 500	Number of command input pulses necessary to rotate the servo motor one turn [×100 pulse/rev]



Note 1. This process converts the number of the pulses required to rotate the servo motor one turn to the value set in parameter No. PA05.

2. Electric gear numerator and denominator can be set by parameters No. PA06 and PA07. (Refer to section 4.1.7.)

PA13 Selection of command input pulse form (refer to section 4.1.11)

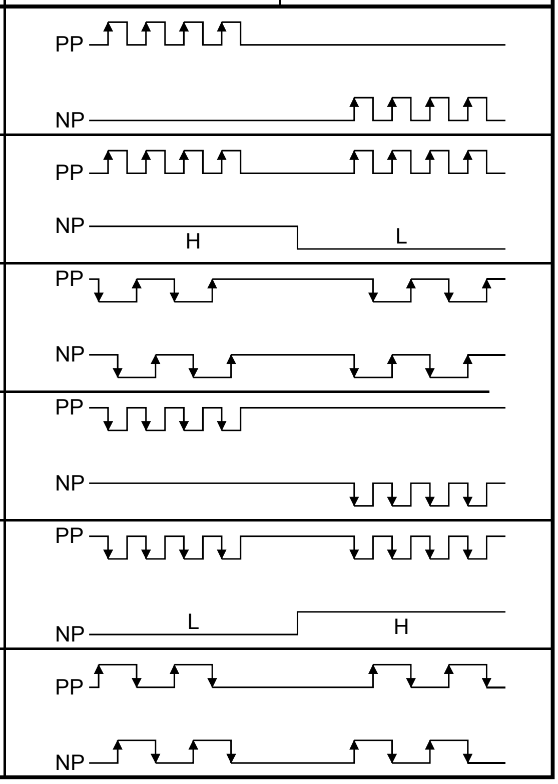
Select the input form of the pulse train input signal. Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen.

Arrow ↑ or ↓ in the table indicates the timing of importing a pulse train. A- and B-phase pulse trains are imported after being multiplied by 4.

Parameter No. PA13

Selection of command input pulse form

Setting		Pulse train form	Forward rotation command	Reverse rotation command
00	Positive logic	Forward rotation pulse train Reverse rotation pulse train		
01	Positive logic	Signed pulse train		
02	Positive logic	A-phase pulse train B-phase pulse train		
10	Negative logic	Forward rotation pulse train Reverse rotation pulse train		
11	Negative logic	Signed pulse train		
12	Negative logic	A-phase pulse train B-phase pulse train		



Pulse train input filter selection

Setting	Command pulse frequency
0	1Mpps or less
1	500kpps or less
2	200kpps or less

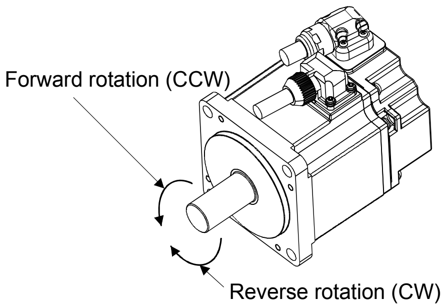
POINT

- The noise immunity can be enhanced by setting parameter No. PA13 to "1 □□" when the frequency of the command input pulse is 500kpps or less and "2 □□" when 200kpps or less.

PA14 Selection of servo motor rotation direction (refer to section 4.1.12)

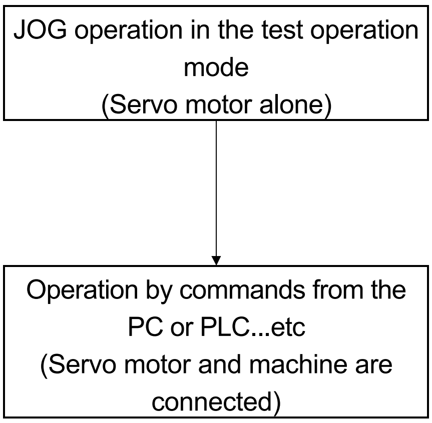
Select servo motor rotation direction relative to the input pulse train.

Parameter No. PA14 setting	Servo motor rotation direction	
	When forward rotation pulse is input	When reverse rotation pulse is input
0	CCW	CW
1	CW	CCW



(5) Operation confirmation before actual operation

Before starting actual operation, perform JOG operation to make sure that the machine operates properly. The LECSA□-□ can perform the JOG operation in the test operation mode on the operation section (four pushbuttons). (Refer to section 5.9.)



(a) Confirm that the controller and servo motor operate properly.
With the servo motor disconnected from the machine, use the test operation mode (JOG operation) at the slowest speed and check whether the servo motor rotates correctly.

(b) Confirm that the servo motor rotates correctly at the slowest speed under the commands from the PC or PLC...etc.
Make sure that the servo motor rotates in the following procedure.

1) Switch on the forced stop (EM1) and servo-on (SON). When the controller is in a servo-on status, the ready (RD) switches on.

2) Switch on the forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN).

3) In the position control mode, when command pulses are input from the PC or PLC...etc, the servo motor starts rotating. Give a low speed command at first and check the operation direction, etc. of the servo motor. If the servo motor does not rotate in the intended direction, check the input signal.

4) After checking that the machine operates properly, perform the automatic operation by the program of the PC or PLC...etc to check for any problem with the operation.

(6) One-touch tuning

Just by pressing the "AUTO" button on the front panel of the controller during operation, the gain/filter is easily adjusted.

(Refer to section 6.1.)

Startup of system	
↓	
Operation	Rotate the servo motor by an external command device, etc. (The one-touch tuning cannot be performed if the servo motor is not operating.)
↓	
Shift to the one-touch tuning mode	Press the "AUTO" button for 3[s] or longer while the servo motor is rotating. The display changes to "AT", and the mode shifts to the one-touch tuning mode.
↓	
Selection of the response mode	Press the "UP" or the "DOWN" button while "AT" is displayed to select the response mode. (Refer to (1) in section 6.1.2.)
↓	
Execution of the one-touch tuning	Start the one-touch tuning by pressing the "AUTO" button. The progress of the one-touch tuning is displayed in percentage. 000 → 100 0% 100%
↓	
One-touch tuning complete	When the one-touch tuning is completed properly, "Fin" is displayed and the gain/filter is automatically adjusted.

POINT
・For the fine adjustment after the one-touch tuning, refer to section 6.4.

(7) Stop

In any of the following statuses, the controller interrupts and stops the operation of the servo motor. Refer to section 3.11 for the servo motor with an electromagnetic brake.

(a) Servo-on (SON) OFF

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

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake activates to stop the servo motor immediately.

(c) Forced stop (EM1) OFF

The base circuit is shut off and the dynamic brake activates to stop the servo motor immediately. Forced stop warning alarm (E6.1) occurs.

(b) Forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) OFF

Position control mode: Droop pluses are cleared, and the servo motor shaft is locked. The servo motor can rotate in an opposite direction.

Internal speed control mode: The servo motor stops immediately, and the shaft is locked. The servo motor can rotate in an opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2) (only in the internal speed control mode)

The servo motor decelerates to a stop.

(f) Simultaneous ON or simultaneous OFF of forward rotation selection (RS1) and reverse rotation selection (RS2) (only in the internal torque control)

The servo motor coasts.

POINT

- In the internal speed control mode, the forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) operate as follows.
- Not assigned to the external input signals: automatically turns on regardless of the value set in parameter No. PD01.
- Assigned to the external input signals: depends on the value set in parameter No. PD01.
- In the internal torque control mode, the forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) become invalid. (Refer to section 3.5.)

3. Troubleshooting at startup

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

> POINT
> ・You can refer to reasons for servo motor rotation failure, etc. using MR Configurator.

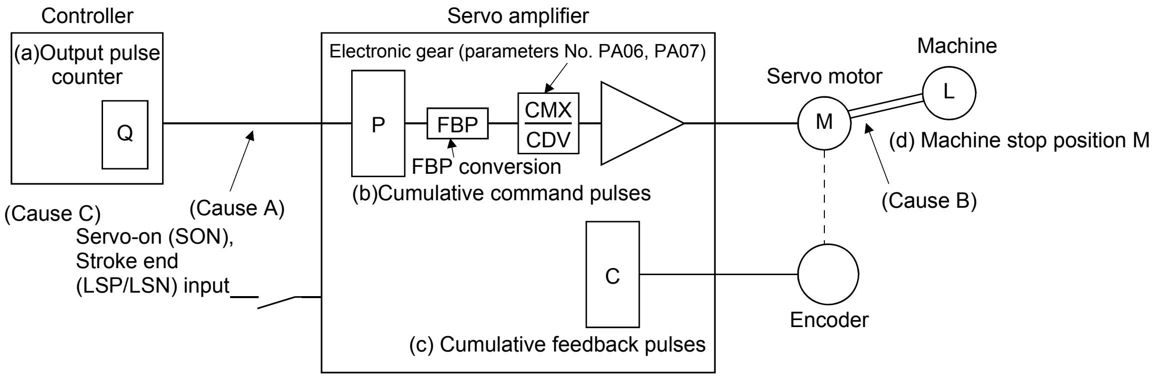
The following faults may occur at startup. If any of such faults occurs, take the corresponding action.

(1) Troubleshooting

No.	Step of occurrence	Fault	Investigation	Possible cause	Reference
1	Power on	・The 3-digit, 7-segment LED is not lit. ・The 3-digit, 7-segment LED flickers.	Not improved even if CN1, CN2 and CN3 connectors are disconnected.	1. Power supply voltage fault 2. Controller is faulty.	
			Improved when CN1 connector is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when CN2 connector is disconnected.	1. Power supply of encoder cabling is shorted. 2. Encoder is faulty.	
			Improved when CN3 connector is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Remove cause.		Section 8.2
2	Switch on servo-on (SON).	Alarm occurs.	Remove cause.		Section 8.2
		Servo motor shaft is free.	Check the followings. 1. Check the display to see if the controller is ready to operate. 2. Check the external I/O signal display to see if the servo-on (SON) is ON.	1. Servo-on (SON) is not input. (Wiring mistake) 2. External 24VDC power is not supplied to DICOM.	Section 5.7
3	Input command pulse. (Test operation) (In the position control mode)	Servo motor does not rotate.	Check the cumulative command pulses on the status display.	1. Wiring mistake (a) For open collector pulse train input, 24VDC power is not supplied to OPC. (b) LSP and LSN are not on. 2. No pulses are input. 3. Electromagnetic brake operates.	Section 3.11 Section 4.1.11 Section 5.3
			Check if the ready (RD) is ON.		
			Check the set value of parameter No.PA13 (command input pulse form).		
			Check if the electromagnetic brake interlock (MBR) is ON.		
		Servo motor rotates in reverse direction.	Check the cumulative command pulses on the status display.	1. Mistake in wiring to PC or PLC...etc. 2. Mistake in setting of parameter No. PA14.	Section 4.1.12 Section 5.3
			Check the set value of parameter No.PA14 (rotation direction selection).		

№	Step of occurrence	Fault	Investigation	Possible cause	Reference
4	Switch on forward rotation start (ST1) or reverse rotation start (ST2). (In the internal speed control mode)	Servo motor does not rotate.	Check the ON/OFF status of the input signal on the external I/O signal display (refer to section 5.7).	LSP, LSN, ST1 or ST2 is off.	Section 5.7
			Check the internal speed commands 0 to 7 (parameters No. PC05 to PC08 and PC31 to PC34).	Set value is 0.	Section 4.3.2
			Check the forward torque limit (parameter No. PA11) or reverse torque limit (parameter No. PA12).	Torque limit level is too low as compared to the load torque.	Section 4.1.10
5	Switch on forward rotation selection (RS1) or reverse rotation selection (RS2). (In the internal torque control mode)	Servo motor does not rotate.	Check the set value of parameter No.PC12 (internal torque command).	Internal torque command is too low as compared to the load torque.	Section 4.3.2
			Check the ON/OFF status of the input signal on the external I/O signal display	RS1 or RS2 is off.	Section 5.7
			Check the internal speed limits 0 to 7 (parameters No. PC05 to PC08 and PC31 to PC34).	Set value is 0.	Section 4.3.2
			Check the forward torque limit (parameter No. PA11) or reverse torque limit (parameter No. PA12).	Set value is 0.	Section 4.1.10
6	Gain adjustment (In the position control mode) (In the internal speed control mode)	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 6
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 6
7	Cyclic operation	Position shift occurs.	Confirm the cumulative command pulses, the cumulative feedback pulses and the actual servo motor position.	Pulse counting error, etc. due to noise.	(2) in this section

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter, (b) cumulative command pulse display, (c) cumulative feedback pulse display, and (d) machine stop position in the above diagram.

(Cause A), (Cause B) and (Cause C) indicate position shift causes. For example, (Cause A) indicates that noise entered the wiring between the PC or PLC...etc and controller, causing the command input pulse to be miss-counted.

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

1) Q = P (PC or PLC...etc's output pulse counter = controller's cumulative command pulses)

2) When using the electronic gear

$$P \cdot \frac{\text{CMX (parameter No. PA06)}}{\text{CDV (parameter No. PA07)}} \cdot \frac{\text{Servo motor encoder resolution}}{\text{FBP (parameter No. PA05) (Note)}}$$

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

Note. When "0" is set to the FBP (parameter No. PA05), the FBP becomes the servo motor encoder resolution.

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

Check for a position shift in the following sequence.

1) When $Q \neq P$
Noise entered in the pulse train signal wiring between the PC or PLC...etc and controller, causing command input pulses to be miss-counted. (Cause A)
Make the following check or take the following measures.
- Check the shielding.
- Run wiring away from the power circuit.
- Install a data line filter. (Refer to section 11.9 (2) (a).)

POINT
・The noise immunity can be enhanced by setting parameter No. PA13 to "1 □□" when the frequency of the command input pulse is 500kpps or less and "2 □□" when 200kpps or less.

2) When $P \cdot \frac{CMX}{CDV} \cdot \frac{\text{Servo motor encoder resolution}}{\text{FBP (parameter No. PA05) (Note)}} \neq C$

Note. When "0" is set to the FBP (parameter No. PA05), the FBP becomes the servo motor encoder resolution.

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

3) When $C \cdot \Delta\ell \neq M$
Mechanical slip occurred between the servo motor and machine. (Cause B)

4. Tough drive function

POINT
・For details of the tough drive function, refer to section 7.1.

The tough drive function continues the operation not to stop a machine in such situations when normally an alarm is activated.

The following shows the three types of the tough drive function.

(1) Overload tough drive function
This function reduces the effective load ratio before an overload alarm occurs to avoid the alarm.

(2) Vibration tough drive function
This function suppresses the machine resonance caused by aging distortion or individual difference of the machine.

(3) Instantaneous power failure tough drive function
This function avoids the instantaneous power failure during operation.

The tough drive function can be selected by parameter No. PA04.

Parameter No. PA04

Overload tough drive function selection
Set the tough drive function for overload.

Setting	Overload (alarm 50.1) avoidance
0	Invalid
1	Valid

Vibration tough drive function selection
Set the function for vibration suppression.

Setting	Aging distortion vibration suppression
0	Invalid
1	Valid

Instantaneous power failure tough drive function selection
Set tough drive function for instantaneous power failure of the main circuit power supply.

Setting	Instantaneous power failure (alarm 10.3)
0	Invalid
1	Valid

CONTENTS

13. POSITIONING MODE 13- 1 to 13-96

1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The LECSA□-□ series general-purpose AC servo is based on the LECSB□-□ series, and retains its high performance, with some limitations in functions.
It has position control, internal speed control and internal torque control modes. Further, it can perform operation with the control modes changed, e.g. position/internal speed control, internal speed/internal torque control and internal torque/position control. Hence, it is applicable to a wide range of fields, not only precision positioning and smooth speed control of machine tools and general industrial machines but also line control and tension control.
As this new series has the USB serial communication function, a MR Configurator installed personal computer or the like can be used to perform parameter setting, test operation, status display monitoring, gain adjustment, etc.
With one-touch tuning and real-time auto tuning, you can easily and automatically adjust the servo gains according to the machine.
The controller has an integrated tough drive function that continues the operation not to stop a machine in such situation when normally an alarm is activated.
The LECSA□-□ series servo motor is equipped with an incremental encoder which has the resolution of 131072 pulses/rev to ensure the positioning with a high accuracy.

(1) Position control mode

Up to 1Mpps high-speed pulse train is used to control the speed and the direction of a servo motor and execute precision positioning of 131072 pulses/rev resolution.
The position smoothing function provides a choice of two different modes appropriate for a machine, so a smoother start/stop can be made in response to a sudden position command.
A torque limit is imposed on the controller by the clamp circuit to protect the power transistor in the main circuit from overcurrent due to sudden acceleration/deceleration or overload. This torque limit value can be changed to any value with the parameter.

(2) Internal speed control mode

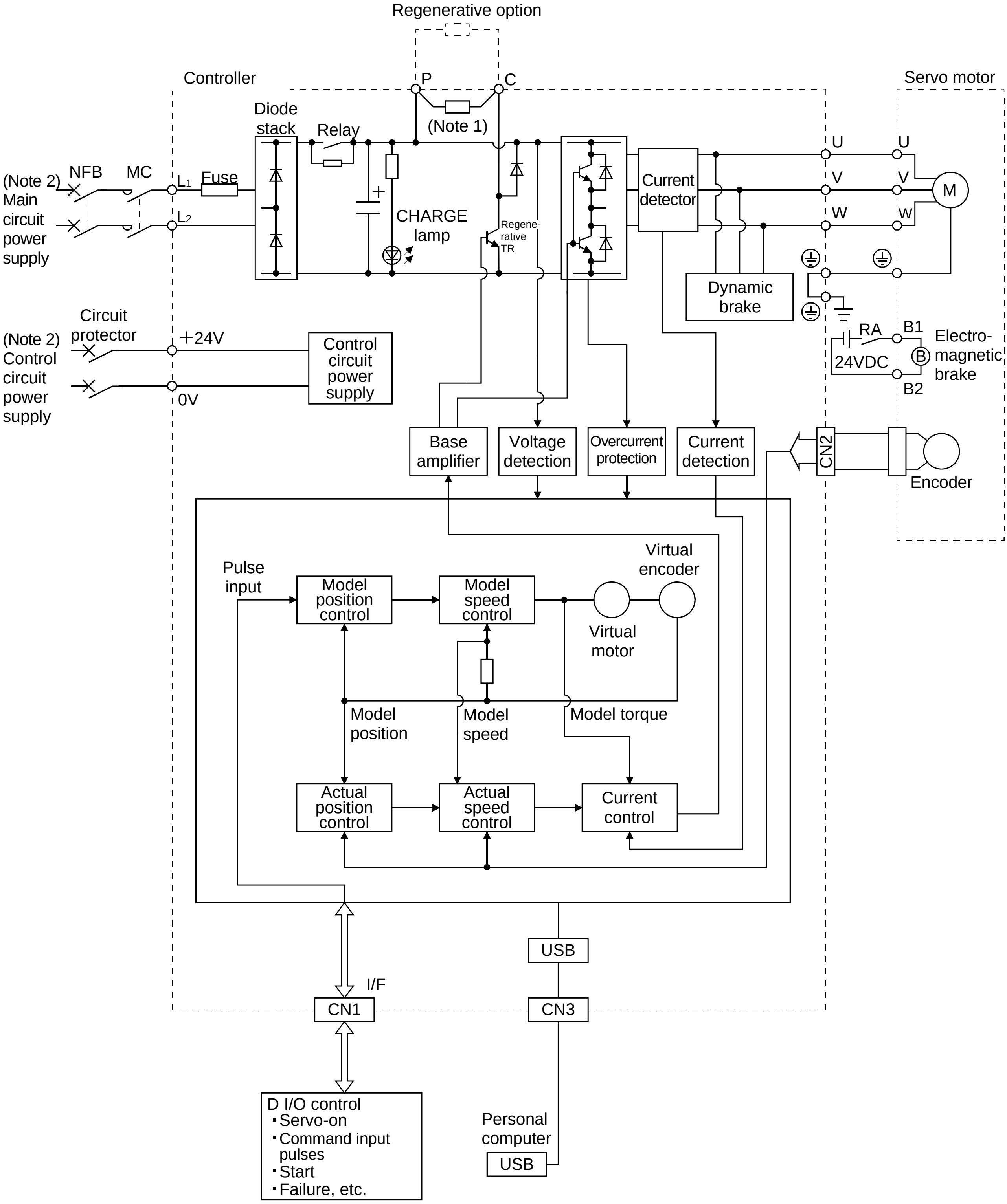
A parameter-driven internal speed command (max. 8 speeds) is used to control the speed and the direction of a servo motor precisely and smoothly.
There are also the acceleration/deceleration time constant setting in response to the speed command and the servo lock function at a stop time.

(3) Internal torque control mode

An internal torque command (0.0% to 100.0%) is used to control the torque output by the servo motor. To prevent unexpected operation under no load, the speed limit function (internal setting) is also available for application to tension control, etc.

1.2 Function block diagram

The function block diagram of this servo motor is shown below.



Note 1. The built-in regenerative resistor is not provided for LECSA□-S1

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

1.3 Controller standard specifications

Item				Controller LECSA□-□ 10A	20A	40A
Main circuit power supply	Voltage/frequency			1-phase 200 to 230VAC, 50/60Hz		
Main circuit power supply	Permissible voltage fluctuation			1-phase 170 to 253VAC		
Main circuit power supply	Permissible frequency fluctuation			Within ±5%		
Main circuit power supply	Power supply capacity			Refer to section 10.2		
Main circuit power supply	Inrush current			Refer to section 10.5		
Control circuit power supply	Voltage			24VDC		
Control circuit power supply	Permissible voltage fluctuation			Within ±10%		
Control circuit power supply	Input			10W		
Interface power supply	Voltage			24VDC ±10%		
Interface power supply	Power supply capacity			200mA (Note)		
Control System				Sine-wave PWM control, current control system		
Dynamic brake				Built-in		
Protective functions				Overcurrent shut-off, regenerative overvoltage shut-off, overload shut-off (electronic thermal relay), servo motor overheat protection, encoder error protection, regenerative error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection		
Position control mode	Max. input pulse frequency			1Mpps (for differential receiver), 200kpps (for open collector)		
Position control mode	Command pulse multiplying factor (electronic gear)			Electronic gear A/B, A: 1 to 65535, B: 1 to 65535, 1/50 < A/B < 500		
Position control mode	In-position range setting			0 to ±65535pulse (command pulse unit)		
Position control mode	Error excessive			±3 revolutions		
Position control mode	Torque limit			Parameter setting		
Internal speed control mode	Speed command input			Parameter setting		
Internal speed control mode	Speed control range			1:5000		
Internal speed control mode	Speed fluctuation ratio			±0.01% or less (load fluctuation 0 to 100%) 0% (power fluctuation ±10%)		
Internal speed control mode	Torque limit			Parameter setting		
Internal torque control mode	Torque command input			Parameter setting		
Internal torque control mode	Speed limit			Parameter setting		
Structure				Natural-cooling, open (IP20)		
Close mounting				When mounting the controllers closely, operate them at the ambient temperature of 0℃ to 45℃ or at 75% or less of the effective load ratio.		
Environment	Ambient temperature	In operation	[℃]	0 to +55 (non-freezing)		
Environment	Ambient temperature	In operation	[°F]	32 to +131 (non-freezing)		
Environment	Ambient temperature	In storage	[℃]	−20 to +65 (non-freezing)		
Environment	Ambient temperature	In storage	[°F]	−4 to +149 (non-freezing)		
Environment	Ambient humidity	In operation		90%RH or less (non-condensing)		
Environment	Ambient humidity	In storage		90%RH or less (non-condensing)		
Environment	Ambient			Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt		
Environment	Altitude			Max. 1000m above sea level		
Environment	Vibration			5.9 [m/s^2] or less, 10 to 55Hz (directions of X, Y and Z axes)		
Mass			[kg]	0.6	0.6	0.7
Mass			[lb]	1.32	1.32	1.54

Note. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points.

1.4 Function list

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

Function	Description	(Note) Control mode	Reference
Position control mode	This servo is used as position control servo.	P	Section 3.2.1 Section 3.6.1 Section 4.2
Internal speed control mode	This servo is used as internal speed control servo.	S	Section 3.2.2 Section 3.6.2
Internal torque control mode	This servo is used as internal torque control servo.	T	Section 3.2.3 Section 3.6.3
Position/internal speed control change mode	Using input device, control can be switched between position control and internal speed control.	P/S	Section 3.6.4
Internal speed/internal torque control change mode	Using input device, control can be switched between internal speed control and internal torque control.	S/T	Section 3.6.5
Internal torque/position control change mode	Using input device, control can be switched between internal torque control and position control.	T/P	Section 3.6.6
High-resolution encoder	The servo motor is equipped with high-resolution encoder of 131072 pulses/rev.	P, S, T	
Gain changing function	Gains can be switched between during rotation and servo lock. Gains also can be switched during operation using an input device.	P, S	Section 7.3
Advanced vibration suppression control	This function suppresses vibration of an arm end or residual vibration.	P	Section 7.2.4
Adaptive filter Ⅱ	This function sets the filter characteristics automatically by the one-touch tuning to suppress vibration of a mechanical system.	P, S	Section 7.2.2
Low-pass filter	This function is effective for suppressing high-frequency resonance which occurs as the servo system response is increased.	P, S	Section 7.2.5
Electronic gear	Input pulses can be multiplied by 1/50 to 500.	P	Parameters No. PA06, PA07
One-touch tuning	The gain of the controller can be adjusted by the push button on the front panel.	P, S	Section 6.1
Auto tuning	This function optimizes the servo gain automatically as load applied to the servo motor shaft changes.	P, S	Section 6.3
Position smoothing	Smooth acceleration is enabled in response to input pulse.	P	Parameter No. PB03
S-pattern acceleration/ deceleration time constant	Smooth acceleration and deceleration are enabled.	S, T	Parameter No. PC03
Regenerative option	Regenerative option is used when the built-in regenerative resistor of the controller does not have sufficient regenerative capability for the regenerative power generated.	P, S, T	Section 11.2
Alarm history clear	This function clears alarm history and the number of tough drive performed.	P, S, T	Parameter No. PC11

Function	Description	(Note) Control mode	Reference
Command pulse selection	Command input pulse form can be selected from among three different types.	P	Section 4.1.11
Input signal selection	Forward rotation start, reverse rotation start, servo-on (SON) and other input device can be assigned to specific pins.	P, S, T	Parameter No. PD03 to PD14
Output signal selection	Ready (RD), trouble (ALM) or other output device can be assigned to specific pins.	P, S, T	Parameter No. PD15 to PD18
Torque limit	The torque generated by the servo motor can be limited by setting a parameter.	P, S	Section 3.6.1 (4) Section 4.1.10
Speed limit	Servo motor speed can be limited by setting a parameter.	T	Section 3.6.3 (3) Parameter No. PC05 to PC08, PC31 to PC34
Status display	Servo status is shown on the 3-digit, 7-segment LED display	P, S, T	Section 5.3
External I/O signal display	ON/OFF statuses of external I/O signals are shown on the display.	P, S, T	Section 5.7
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	P, S, T	Section 5.8
Test operation mode	JOG operation, positioning operation, motor-less operation, DO forced output, and forced tough drive operation. However, MR Configurator MRZJW3-SETUP221E is necessary for the positioning operation.	P, S, T	Section 5.9
MR Configurator	Parameter setting, test operation, status display, etc. can be performed using a personal computer.	P, S, T	Section 11.4
Tough drive function	This function continues the operation not to stop a machine in such situation when normally an alarm is activated. Three types of the tough drive function are available: overload tough drive, vibration tough drive and instantaneous power failure tough drive. However, the overload tough drive is valid only in the position control mode.	P, S	Section 7.1

Note. P: Position control mode, S: Internal speed control mode, T: Internal torque control mode
P/S: Position/internal speed control change mode, S/T: Internal speed/internal torque control change mode, T/P: Internal torque/position control change mode

1.4.1 Applicable control mode for each actuator.

The following control mode can be selected for applicable actuators.
Please refer 「3. SIGNALS AND WIRING」 and「4. PARAMETERS」 about wiring and parameter setting.

Table. Applicable control mode.

（○ : Applicable, × : Inapplicable）

Controller type	Actuator type	Control mode Note 1) (Selected by parameter number PA1.)				
		Position control	Speed control	Torque control	Positioning	
					Point table method	Program method
LECSA (Incremental)	LEY	○	○ Note 2)	○ Note 3)	○ 3 Points (Max. 7 Points) Note 4)	○ 4 Programs (Max. 8 Programs Note4) 5)
	LJ1	○	×	×		
	LG1	○	×	×		
	LTF	○	×	×		
	LEF	○	×	×		
Command method		[Pulse train]	[ON/OFF Signal]	[ON/OFF Signal]	[ON/OFF Signal]	[ON/OFF Signal]
Operation method		Positioning operation	Setting speed operation	Setting torque operation	Positioning operation by point table No. setting	Positioning operation by program setting

Note 1. The control change mode cannot be used.
Note 2. Make the moving range limitation by external sensor etc to avoid actuator hitting to the work piece or stroke end.
Note 3. When using the pushing operation, the following parameter should be set.
If not, it will cause malfunction.
・LECSA : The value of the parameter value [PC12] "Internal torque command" should be 30% or less.
（30% = Maximum pushing force of the product.）
Note 4. To set the maximum value for the each method, it is necessary to change the setting.
Please refer 「13. POSITIONING MODE」.
Note 5. The MR Configurator is necessary to control by the program method. Please prepare separately.
・MR Configurator （Setup software Japanese version） / LEC-MR-STUP□□□
Please refer to "11.4 MR Configurator" for the system requirements of MR Configurator (setup software Japanese version).
MR Configurator (setup software English version), contact your nearest sales branch.

・USB cable for setup software (3m) / LEC-MR-J3USB

1.5 Model code definition

(1) Model

LECS A 1 — S1

Controller Type

A	Pulse input type (Incremental encoder)
B	Pulse input type (Absolute encoder)

Motor type

	Type	Capacity	Encoder
S1	AC Servo motor(S1,S2)	50,100W	Incremental
S3	AC Servo motor(S3)	200W	
S4	AC Servo motor(S4)	400W	
S5	AC Servo motor(S5,S6)	50,100W	Absolute
S7	AC Servo motor(S7)	100W	
S8	AC Servo motor(S8)	200W	

Power supply

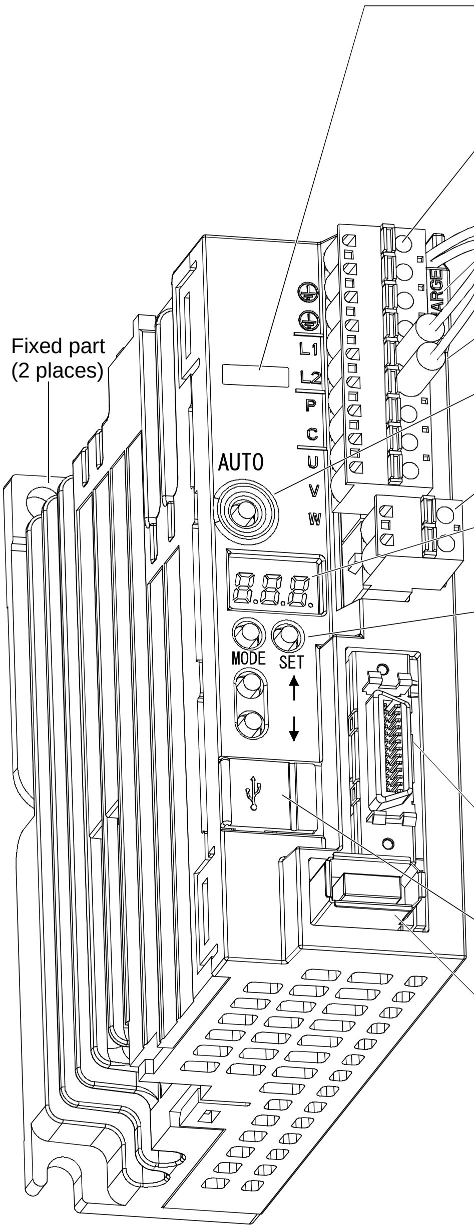
1	AC100～120V 50,60Hz
2	AC200～230V 50,60Hz

1.6 Combination with servo motor

The following table lists combinations of controllers and servo motors. The following combinations also apply to servo motors with an electromagnetic brake.

Controller	Servo motors
	LE-□-□
LECSA□-S1	053・13
LECSA□-S3	23
LECSA-□-S4	43

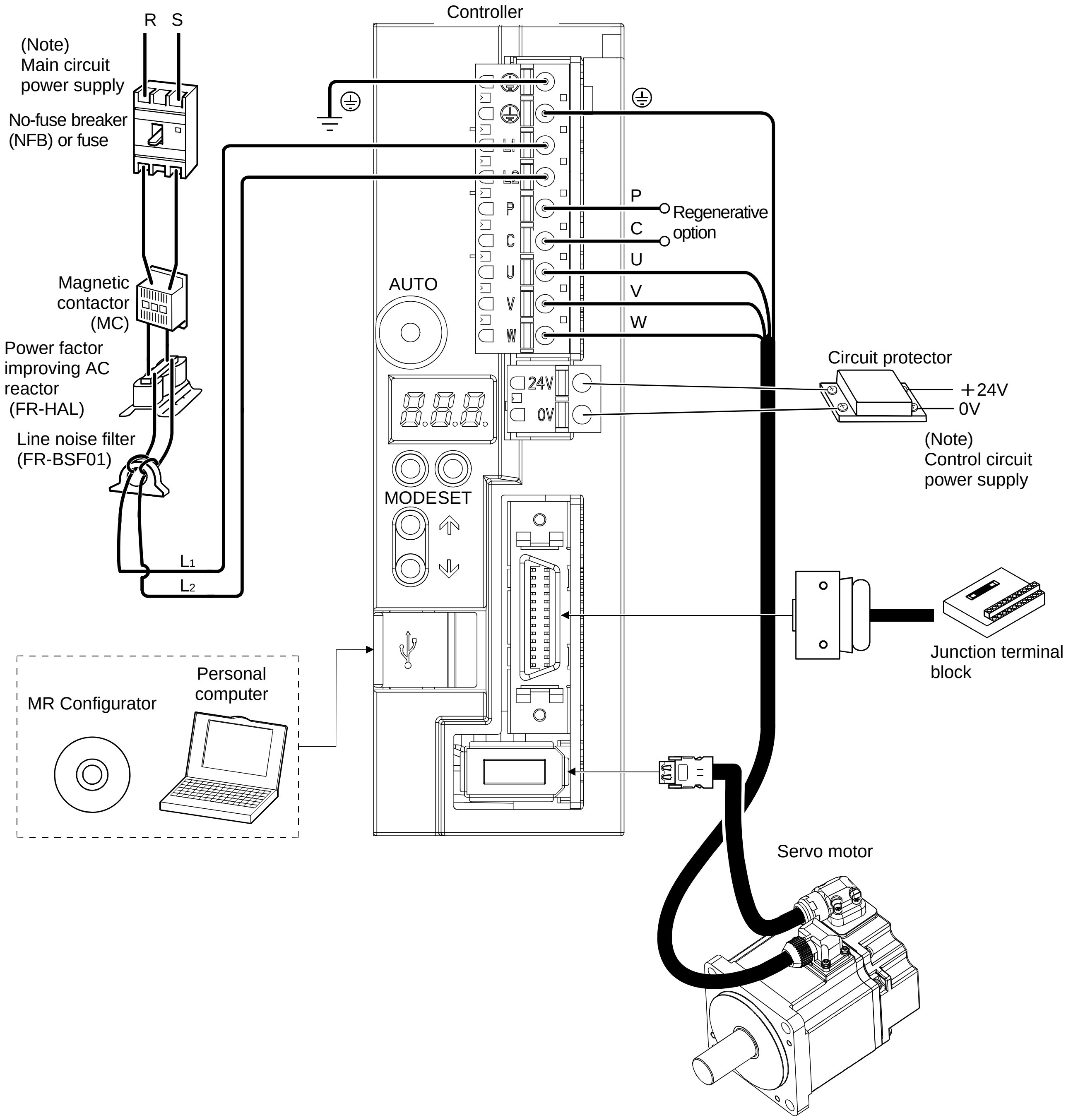
1.7 Parts identification



Name/Application	Detailed explanation
Serial number	
Main circuit power supply connector (CNP1) Connect the input power supply/built-in regenerative resistor/regenerative option/servo motor/earth.	Section 3.1 Section 3.3
Charge lamp Lit to indicate that the main circuit is charged. While this lamp is lit, do not reconnect the cables.	
Rating plate	Section 1.5
One-touch tuning button (AUTO) Press this button to perform the one-touch tuning.	Section 6.1
Control circuit power supply connector (CNP2) Connect the control circuit power supply.	Section 3.1 Section 3.3
Display The 3-digit, 7-segment LED shows the servo status and alarm number	Chapter 5
Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. MODE SET SET: Used to set data. MODE: Used to change the mode. ↑ ↓: Used to change the display or data in each mode.	Chapter 5
I/O signal connector (CN1) Used to connect digital I/O signals.	Section 3.2 Section 3.4
USB communication connector (CN3) Connect the personal computer.	Section 11.4
Encoder connector (CN2) Used to connect the servo motor encoder.	Section 3.4 Section 11.1

1.8 Configuration including auxiliary equipment

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



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

2. INSTALLATION

⚠ WARNING	・Be sure to ground the controller to prevent electric shocks.

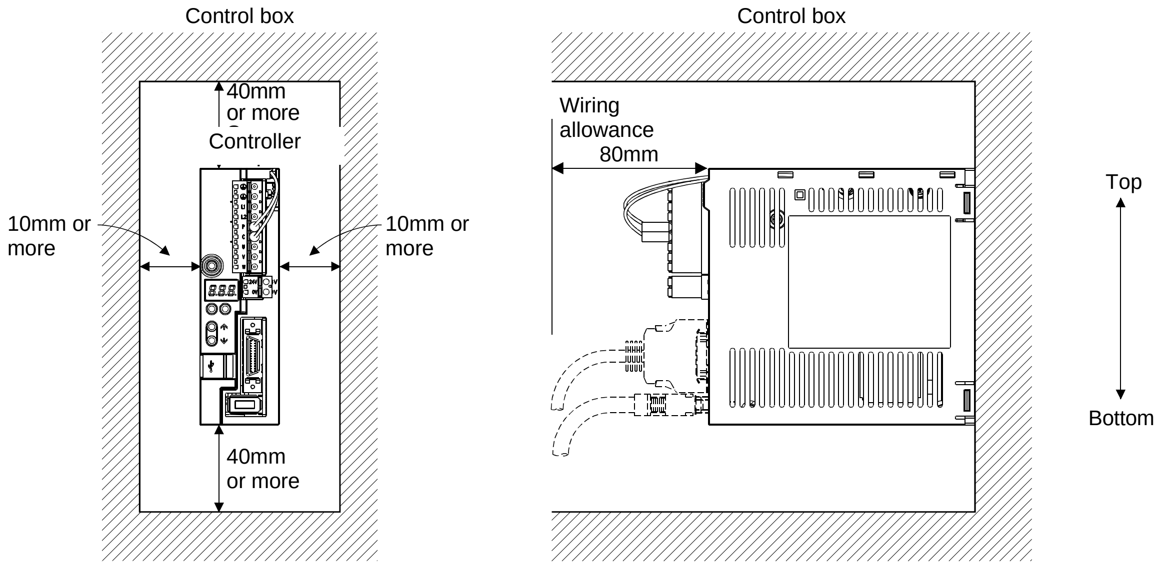
⚠ CAUTION	・Carry the products in a suitable way according to their weight. ・Stacking in excess of the limited number of product packages is not allowed. ・Do not hold the lead of the built-in regenerative resistor when transporting a controller. ・Install the equipment to incombustibles. Installing them directly or close to combustibles will lead to a fire. ・Install the equipment in a load-bearing place in accordance with this Instruction Manual. ・Do not get on or put heavy load on the equipment to prevent injury. ・Use the equipment within the specified environmental condition range. (For details of the environmental condition, refer to section 1.3.) ・Provide an adequate protection to prevent conductive matters like screws or combustible matters like oil from entering the controller. ・Do not block the intake/exhaust ports of the controller. Otherwise, a fault may occur. ・Do not subject the controller to drop impact or shock loads as they are precision equipment. ・Do not install or operate a faulty controller. ・ When the product has been stored for an extended period of time, contact your local sales office. ・When handling the controller, be careful about the edged parts such as the corners of the controller. ・Be sure to install the controller on a metal control panel.

2.1 Installation direction and clearances

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

A regenerative resistor is mounted on the back of this controller. The regenerative resistor causes a temperature rise of 100℃ relative to the ambient temperature. Fully examine heat dissipation and installation position before installing the controller.

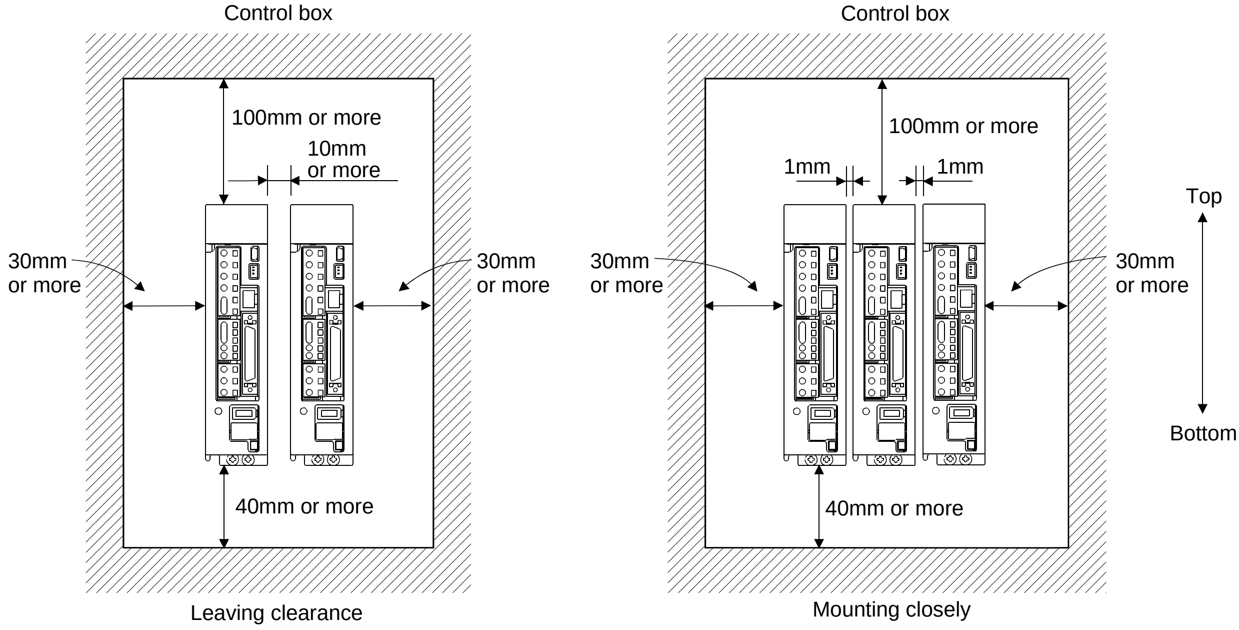
(1) Installation of one controller



(2) Installation of two or more controllers

POINT
・ LECSA□-□ series controller with any capacity can be mounted closely together.

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



(3) Others
When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the controller is not affected.
Install the controller on a perpendicular wall in the correct vertical direction.

2.2 Keep out foreign materials

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

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

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

2.3 Cable stress

(1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.

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

(3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.

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

2.4 Inspection items

⚠WARNING	・Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the controller whether the charge lamp is off or not. ・Due to risk of electric shock, only qualified personnel should attempt inspection. For repair and parts replacement, contact your local sales office.

POINT

・Do not perform insulation resistance test on the controller as damage may result.
・Do not disassemble and/or repair the equipment on customer side.

It is recommended to make the following checks periodically.

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

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

2.5 Parts having service lives

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

Part name	Life guideline
Smoothing capacitor	10 years
Relay	Number of power-on and number of forced stop times: 100,000 times

(1) Smoothing capacitor

Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment.

(2) 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.

MEMO

3. SIGNALS AND WIRING

⚠WARNING	・Any person who is involved in wiring should be fully competent to do the work. ・Before wiring, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the controller whether the charge lamp is off or not. ・Ground the controller and the servo motor securely. ・Do not attempt to wire the controller 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

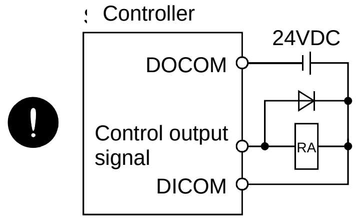
・Before unplugging the CNP1 connector from the controller, disconnect the lead of the built-in regenerative resistor from the CNP1 connector.

・Wire the equipment correctly and securely. Otherwise, the servo motor may operate unexpected resulting in injury.

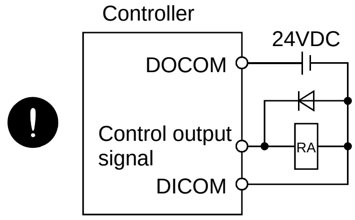
・Connect cables to correct terminals to prevent a burst, fault, etc.

・Ensure that polarity (+,－) is correct. Otherwise, a burst, damage, etc. may occur.

・The surge absorbing diode installed to the DC relay designed for control output should be fitted in the specified direction. Otherwise, the signal is not output due to a fault, disabling the emergency stop and other protective circuits.



Sink output interface



Source output interface

・Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be given to electronic equipment used near the controller.

・Do not install a power capacitor, surge suppressor or radio noise filter (FR-BIF option) with the power line of the servo motor.

・When using the regenerative resistor, switch power off with the alarm signal. Otherwise, a transistor fault or the like may overheat the regenerative resistor, causing a fire.

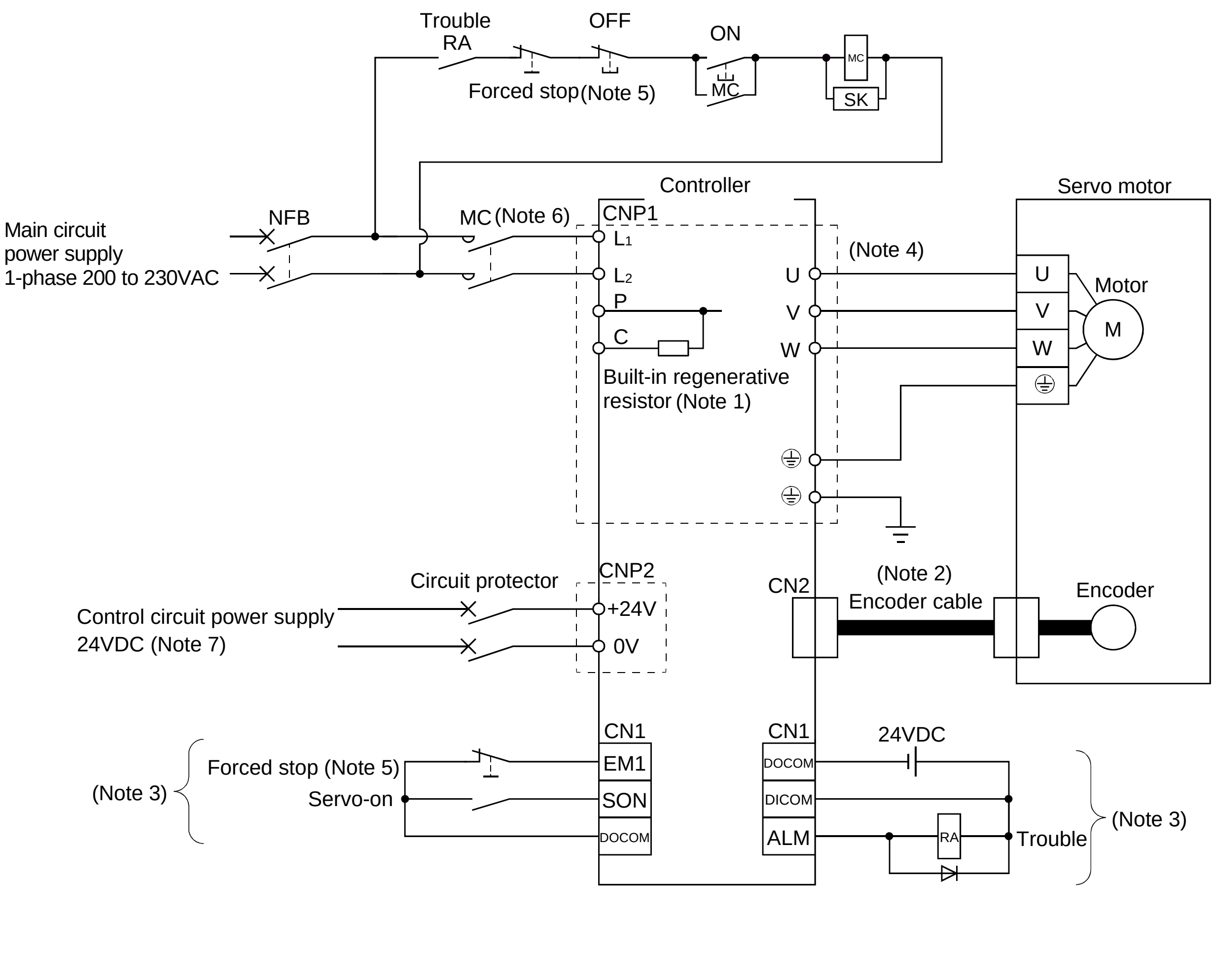
・Do not modify the equipment.

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

3.1 Input power supply circuit

⚠ CAUTION	· Always connect a magnetic contactor (MC) between the main circuit power supply, and L_1 and L_2 of the controller to configure a circuit that shuts down the power on the controller's power supply side. If a magnetic contactor (MC) is not connected, continuous flow of a large current may cause a fire when the controller malfunctions. · Use the trouble (ALM) to switch power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire. · Before unplugging the CNP1 connector from the controller, disconnect the lead of the built-in regenerative resistor from the CNP1 connector. Otherwise, the lead of the built-in regenerative resistor may break.

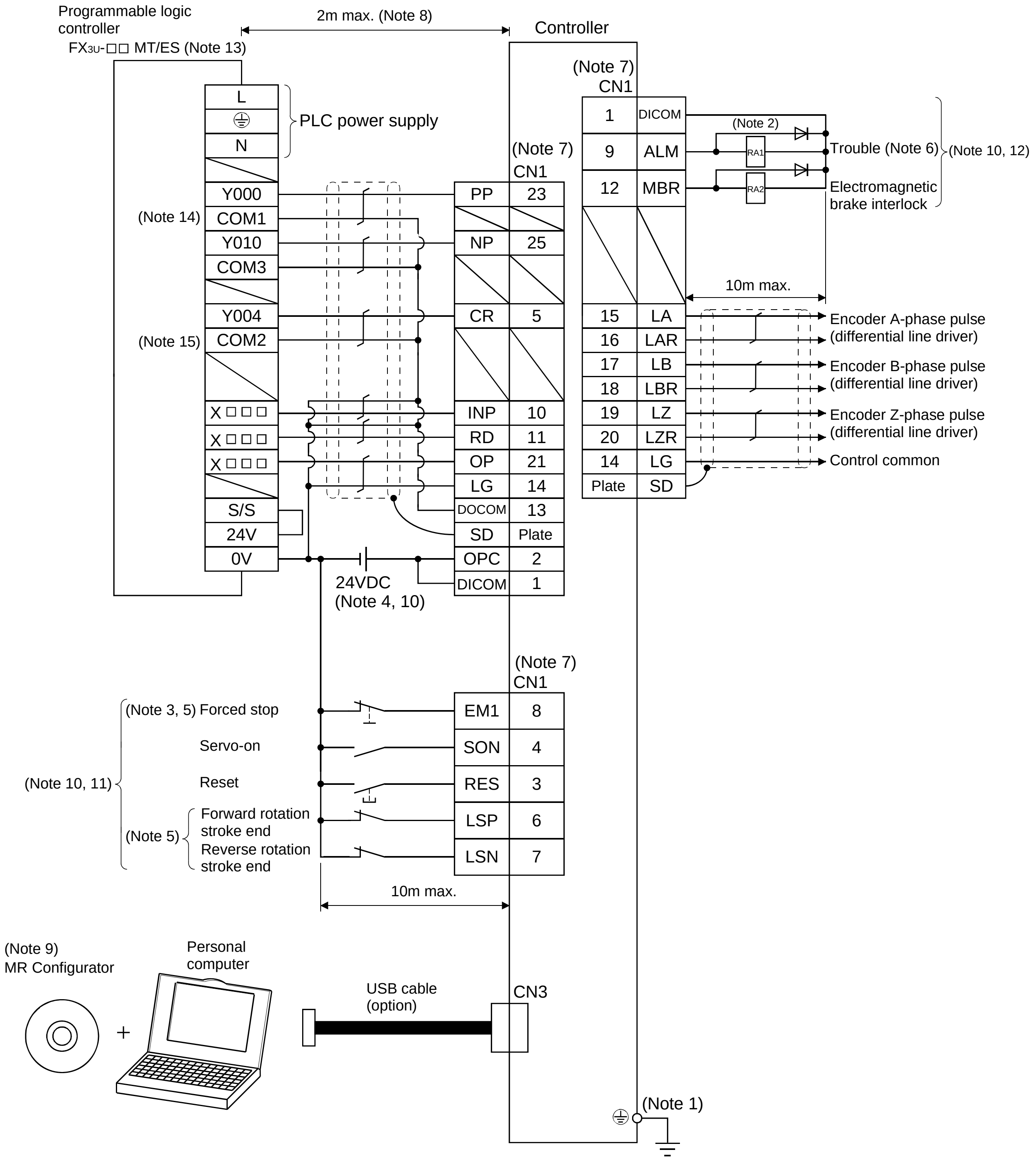
Wire the main circuit power supply as shown below so that the servo-on (SON) turns off as soon as alarm occurrence is detected and power is shut off.
A no-fuse breaker (NFB) must be used with the input cables of the main circuit power supply.



Note 1. The built-in regenerative resistor is provided for LECSA1-S3 and LECSA2-S4. (Factory-wired.) When using the regenerative option, refer to section 11.2.
2. For encoder cable, use of the option cable is recommended. Refer to section 11.1 for selection of the cable.
3. For the sink I/O interface.
For the source I/O interface, refer to section 3.8.3.
4. Refer to section 3.10.
5. Configure the circuit to shut off the main circuit power supply by an external sequence simultaneously with the forced stop (EM1) turning OFF.
6. Be sure to use a magnetic contactor (MC) with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.
7. Use the enhanced insulation power supply for the control circuit power supply 24VDC. In addition, do not use a power supply with an output voltage starting time of one second or more.

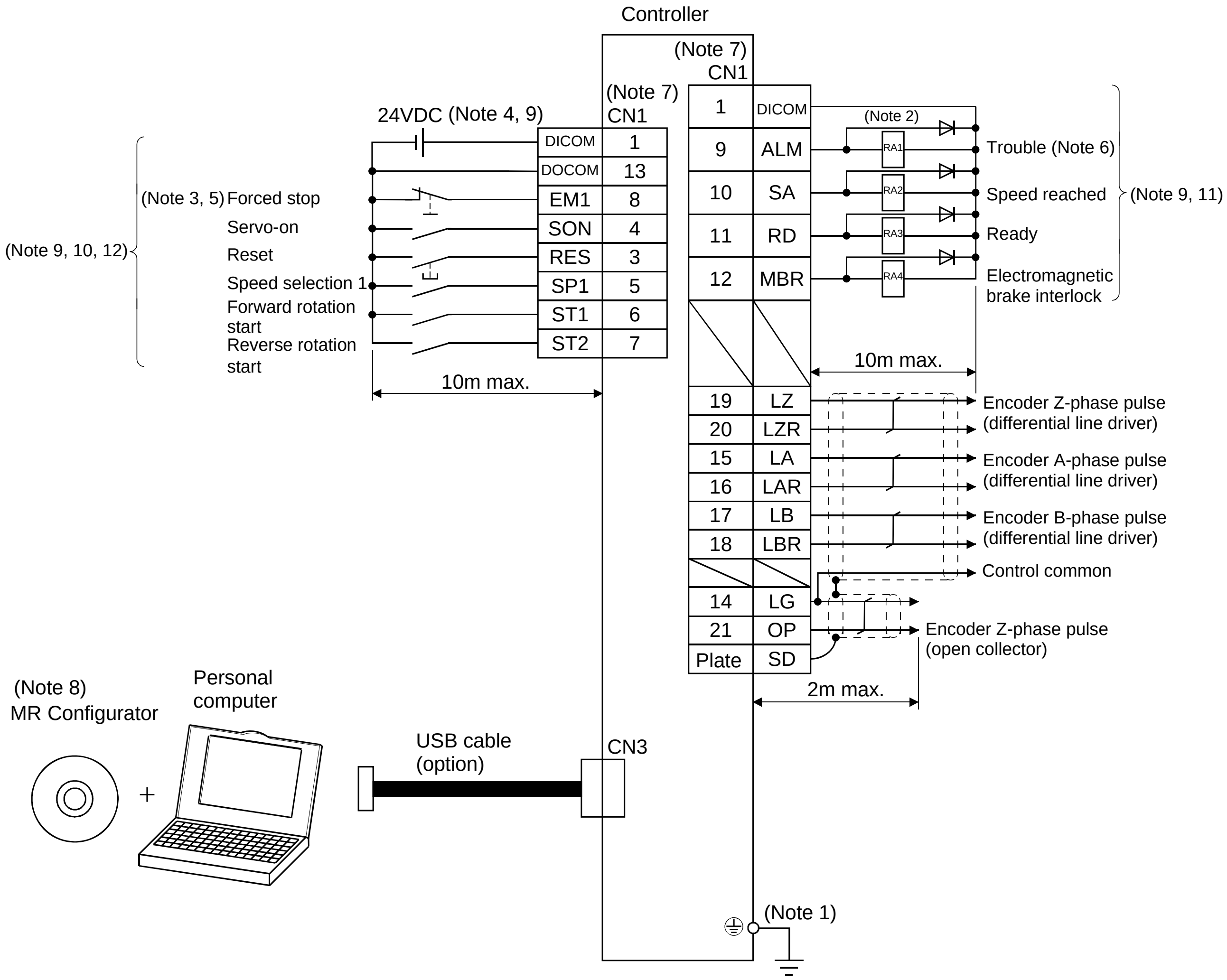
3.2 I/O signal connection example

3.2.1 Position control mode



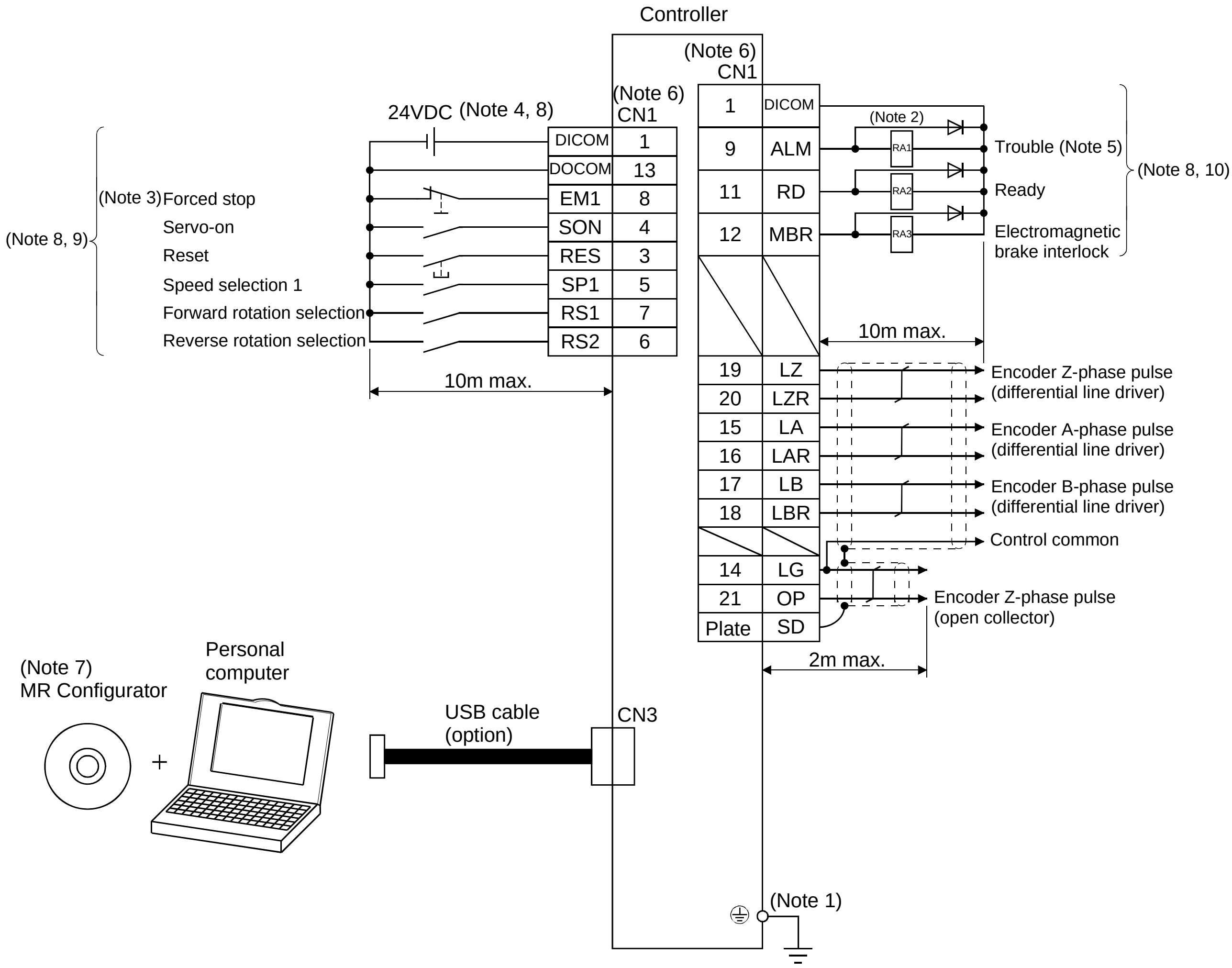
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the controller to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the controller will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 200mA current for interfaces from the outside. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. When starting operation, always switch on the forced stop (EM1) or the forward/reverse rotation stroke end (LSP, LSN). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the programmable logic controller should be stopped by the sequence program.
7. The pins with the same signal name are connected in the controller.
8. This length applies to the command input pulses in the open collector system. The wirings can be extended up to 10m when using positioning modules with the differential line driver system.
9. Use MRZJW3-SETUP221E (Version C3 or later).
10. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
11. The assigned signals can be changed using the settings of parameter No.PD03 to PD14.
12. The assigned signals can be changed using the settings of parameter No.PD15 to PD18.
13. Select the number of I/O points of the programmable logic controllers in accordance with the system.
14 It is COM0 for FX_{3U}-16TM/ES.
15 It is COM4 for FX_{3U}-16TM/ES.

3.2.2 Internal speed control mode



Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ⏚) of the controller to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the controller will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 200mA current for interfaces from the outside. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. When starting operation, always switch on the forced stop (EM1). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition.
7. The pins with the same signal name are connected in the controller.
8. Use MRZJW3-SETUP221E (Version C3 or later).
9. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
10. The assigned signals can be changed using the settings of parameter No.PD03 to PD14.
11. The assigned signals can be changed using the settings of parameter No.PD15 to PD18.
12. The forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN) automatically switch ON if not assigned to the external input signals.

3.2.3 Internal torque control mode



Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the (terminal marked ⏚) controller to the protective earth (PE) of the control box.
2. Connect the diode in the correct direction. If it is connected reversely, the controller will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 200mA current for interfaces from the outside. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. Trouble (ALM) turns on in normal alarm-free condition.
6. The pins with the same signal name are connected in the controller.
7. Use MRZJW3-SETUP221 (Version C3 or later).
8. This diagram is for sink I/O interface. For source I/O interface, refer to section 3.8.3.
9. The assigned signals can be changed using the settings of parameter No.PD03 to PD14.
10. The assigned signals can be changed using the settings of parameter No.PD15 to PD18.

3.3 Explanation of power supply system

3.3.1 Signal explanations

POINT
・For the layout of connector, refer to chapter 9 OUTLINE DRAWINGS.

Abbreviation	Connection target (application)	Description
L_1 L_2	Main circuit power supply	Supply the 1-phase power 200 to 230VAC 50/60Hz to L_1 and L_2.
P C	Built-in regenerative resistor or regenerative option	1) LECSA1-S1 When using the regenerative option, connect it to P and C. (LECSA1-S1 does not provide a built-in regenerative resistor.) 2) LECSA1-S3/ LECSA□-S4 When using the controller built-in regenerative resistor, connect the built-in regenerative resistor to P and C. (Factory-wired.) When using a regenerative option, ・first, disconnect the wirings to P and C, ・second, remove the built-in regenerative resistor from the controller, ・finally, connect the regenerative option to P and C.
+24V 0V	Control circuit power supply	Supply 24VDC power to +24V and 0V.
U V W	Servo motor power	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.
⏚	Protective earth (PE)	Connect to the earth terminal of the servo motor and to the protective earth (PE) of the control box to perform grounding.

3.3.2 Power-on sequence

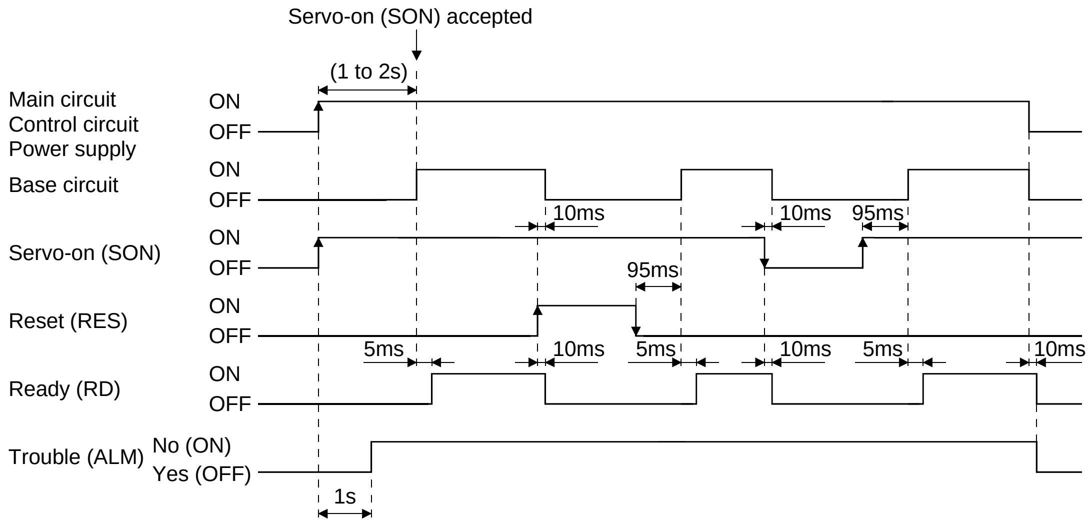
(1) Power-on procedure

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

2) The controller can accept the servo-on (SON) about 1 to 2s after the main circuit power supply is switched on. Therefore, when the servo-on (SON) is switched on simultaneously with the main circuit power supply, the base circuit will switch on in about 1 to 2s, and the ready (RD) will switch on in further about 5ms, making the controller ready to operate. (Refer to paragraph (2) of this section.)
If the main circuit power supply is OFF while the servo-on (SON) is ON, the display on the controller shows the corresponding warning. Switching ON the main circuit power supply discards the warning and the controller operates normally.

3) When the reset (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart

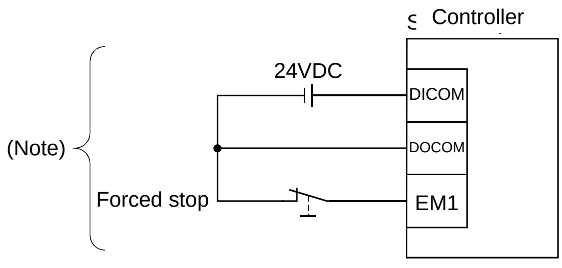


Power-on timing chart

(3) Forced stop

CAUTION	・Configure a circuit which interlocks with an external emergency stop switch in order to stop the operation immediately and shut off the power.

Configure a circuit that shuts off the main circuit power as soon as EM1 is turned off at an emergency stop. When EM1 is turned off, the dynamic brake is operated to stop the servo motor immediately. At this time, the display shows the servo forced stop warning (E6.1).
During the normal operation, do not use the forced stop (EM1) to alternate stop and run. The service life of the controller may be shortened.
Also, the servo motor rotates simultaneously with the reset of the forced stop if a forward rotation start (ST1) or the reverse rotation start (ST2) is ON, or if a pulse train is input during the forced stop. Be sure to shut off the operation instruction during the forced stop.



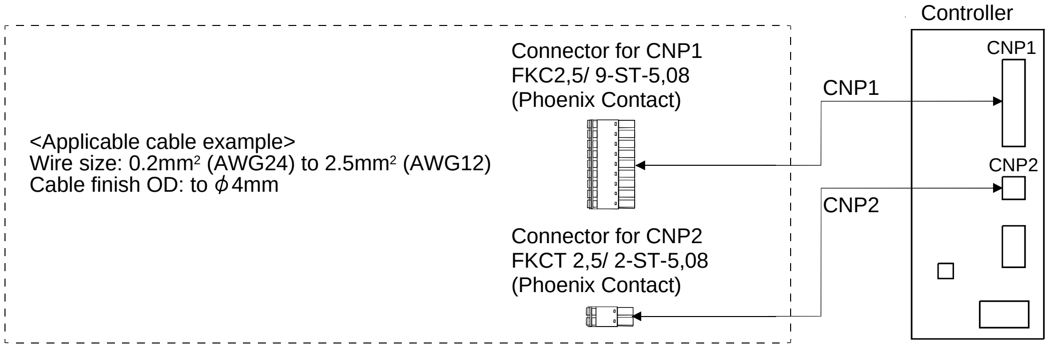
Note. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

3.3.3 CNP1 and CNP2 wiring method

POINT
・Refer to section 11.5, for the wire sizes used for wiring.

Use the supplied controller power supply connectors for wiring of CNP1 and CNP2.

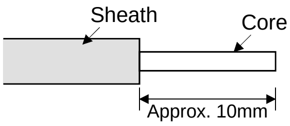
(1) Controller power supply connectors



(2) Termination of the wires

(a) Solid wire

The wire can be used just by stripping the sheath.



(b) Twisted wire

1) Inserting the wires directly to the terminals

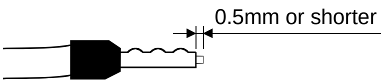
Use the wire after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault.

2) Putting the wires together using a ferrule

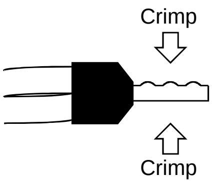
Use a ferrule as follows.

Cable size		Ferrule type		Crimping tool	Manufacturer
[mm^2]	AWG	For one wire	For two wires		
1.25/1.5	16	AI 1,5-10 BK	AI-TWIN 2 × 1,5-10 BK	CRIMPFOX ZA 3	Phoenix Contact
2/2.5	14	AI 2,5-10 BK			

Cut off the exceeding wire from the tip of the ferrule, leaving 0.5mm or less.



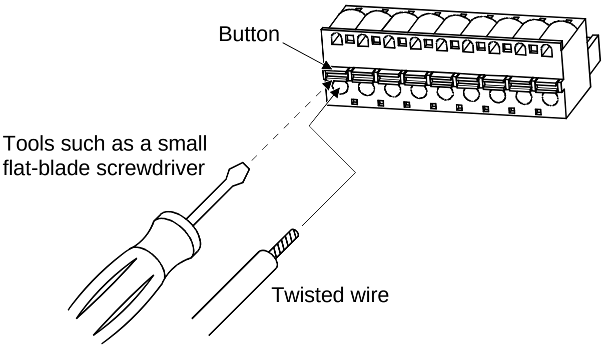
When using the ferrule for two wires, plug the wires in a direction in which insulating sleeves do not interfere the adjacent poles.



(3) Connection method

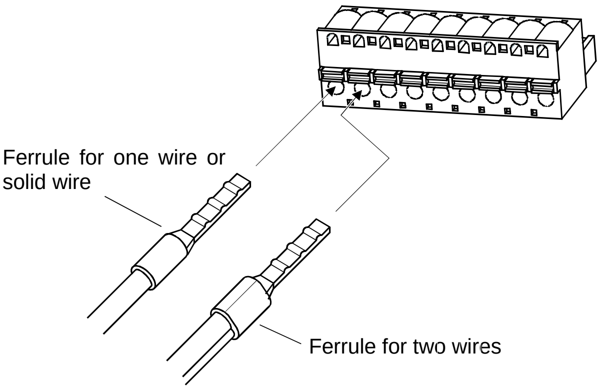
(a) Inserting the wires directly to the terminals

Insert the wire to the very end of the hole while pressing the button by a tool such as a small flat-blade screwdriver.



(b) Putting the wires together using a ferrule

Insert the wire as the uneven side of the crimped ferrule collar faces the button side.



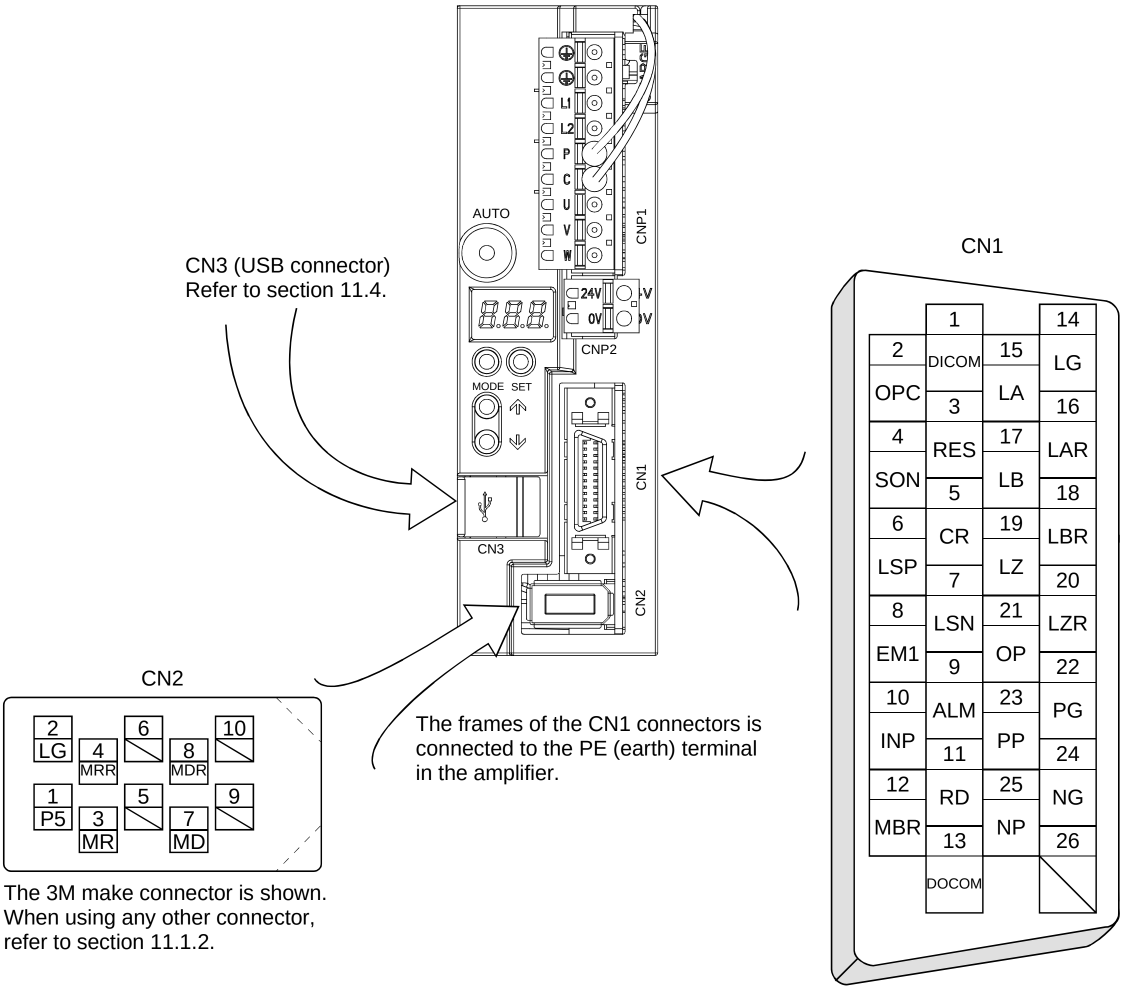
Use a ferrule for two wires when inserting two wires into one hole.

3.4 Connectors and signal arrangements

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

(1) Signal arrangement

The controller front view shown is that of the LECSA□-S3 or less. Refer to chapter 9 OUTLINE DRAWINGS for the appearances and connector layouts of the other controllers.



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

Signal assignments shown above are in the case of position control mode.

(2) CN1 signal assignment

The signal assignment of connector changes with the control mode as indicated below;
For the pins which are given parameter No. in the related parameter column, their signals can be changed using those parameters.

Pin No.	(Note 1) I/O	(Note 2) I/O signals in control modes						Related parameter No.
		P	P/S	S	S/T	T	T/P	
1		DICOM	DICOM	DICOM	DICOM	DICOM	DICOM	
2		OPC	OPC/-				-/OPC	
3	I	RES	RES	RES	RES	RES	RES	PD03・PD04
4	I	SON	SON	SON	SON	SON	SON	PD05・PD06
5	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD07・PD08
6	I	LSP	LSP/ST1	ST1	ST1/RS2	RS2	RS2/LSP	PD09・PD10
7	I	LSN	LSN/ST2	ST2	ST2/RS1	RS1	RS1/LSN	PD11・PD12
8	I	EM1	EM1	EM1	EM1	EM1	EM1	PD13・PD14
9	O	ALM	ALM	ALM	ALM	ALM	ALM	PD15
10	O	INP	INP/SA	SA	SA/-		-/INP	PD16
11	O	RD	RD	RD	RD	RD	RD	PD17
12	O	MBR	MBR	MBR	MBR	MBR	MBR	PD18
13		DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	DOCOM	
14		LG	LG	LG	LG	LG	LG	
15	O	LA	LA	LA	LA	LA	LA	
16	O	LAR	LAR	LAR	LAR	LAR	LAR	
17	O	LB	LB	LB	LB	LB	LB	
18	O	LBR	LBR	LBR	LBR	LBR	LBR	
19	O	LZ	LZ	LZ	LZ	LZ	LZ	
20	O	LZR	LZR	LZR	LZR	LZR	LZR	
21	O	OP	OP	OP	OP	OP	OP	
22	I	PG	PG/-				-/PG	
23	I	PP	PP/-				-/PP	
24	I	NG	NG/-				-/NG	
25	I	NP	NP/-				-/NP	
26								

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

2. P: Position control mode, S: Internal speed control mode, T: Internal torque control mode,
P/S: Position/internal speed control change mode, S/T: Internal speed/internal torque control change mode,
T/P: Internal torque/position control change mode

(3) Explanation of abbreviations

Abbreviation	Signal name	Abbreviation	Signal name
SON	Servo-on	ALM	Trouble
RES	Reset	INP	In-position
PC	Proportion control	SA	Speed reached
EM1	Forced stop	MBR	Electromagnetic brake interlock
CR	Clear	TLC	Limiting torque
ST1	Forward rotation start	VLC	Limiting speed
ST2	Reverse rotation start	WNG	Warning
RS1	Forward rotation selection	ZSP	Zero speed
RS2	Reverse rotation selection	MTTR	During tough drive
TL1	Internal torque limit selection	CDPS	During variable gain selection
LSP	Forward rotation stroke end	OP	Encoder Z-phase pulse (open collector)
LSN	Reverse rotation stroke end	LZ	Encoder Z-phase pulse (differential line driver)
SP1	Speed selection 1	LZR	
SP2	Speed selection 2	LA	Encoder A-phase pulse (differential line driver)
SP3	Speed selection 3	LAR	
LOP	Control change	LB	Encoder B-phase pulse (differential line driver)
CDP	Gain changing	LBR	
PP	Forward/reverse rotation pulse train	DICOM	Digital I/F power supply input
NP		OPC	Open collector power input
PG		DOCOM	Digital I/F common
NG		LG	Control common
RD	Ready	SD	Shield

3.5 Signal explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2.
In the control mode field of the table

P : Position control mode, S: Internal speed control mode, T: Internal torque control mode
○ : Denotes that the signal may be used in the initial setting status.
△ : Denotes that the signal may be used by setting the corresponding parameter No. PD03 to PD18.
The pin numbers in the connector pin No. column are those in the initial status.

(1) I/O devices

(a) Input devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-4</td><td>When SON is turned on, the power is supplied to the base circuit and the controller is ready to operate (servo-on).
When SON is turned off, the power to the base circuit is shut off and the servo motor coasts.
Set parameter No. PD01 to "□□□4" to switch this signal on (keep terminals connected) automatically in the controller.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td>CN1-3</td><td>When RES is turned on for 50ms or longer, an alarm can be reset.
Some alarms cannot be deactivated by the reset (RES). Refer to section 8.2.
Turning RES on in an alarm-free status shuts off the base circuit. The base circuit is not shut off when "□□1□" is set in parameter No. PD20.
This device is not designed to make a stop. Do not turn it ON during operation.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td>CN1-6</td><td rowspan="2">To start operation, turn LSP/LSN on. Turn it off to bring the motor to a sudden stop and make it servo-locked.
Set "□□□1" in parameter No. PD20 to make a slow stop.
(Refer to section 4.4.2.)
<table><tr><th colspan="2">(Note) Input device</th><th colspan="2">Operation</th></tr><tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr><tr><td>1</td><td>1</td><td>○</td><td>○</td></tr><tr><td>0</td><td>1</td><td></td><td>○</td></tr><tr><td>1</td><td>0</td><td>○</td><td></td></tr><tr><td>0</td><td>0</td><td></td><td></td></tr></table>Note. 0: off
1: on

When LSP or LSN turns OFF, an external stroke limit warning (99. □) occurs, and warning (WNG) turns OFF. However, when using WNG, set parameter No. PD15 to PD18 to make it usable.
In the internal speed control mode, LSP and LSN turns ON automatically if they are not assigned to the external input signals.</td><td rowspan="2">DI-1</td><td rowspan="2">○</td><td rowspan="2">△</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td>CN1-7</td></tr>
</table>

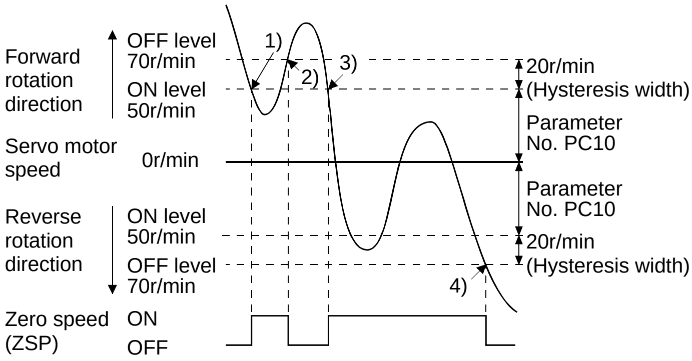
<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>The internal torque limit 2 (parameter No. PC14) becomes valid by turning TL1 on.
The forward torque limit (parameter No. PA11) and the reverse torque limit (parameter No. PA12) are always valid.
The smallest torque limit among the valid forward and reverse torque limits is the actual torque limit value.
<table>
<tr><th>(Note) Input device</th><th rowspan="2">Comparison between limit values</th><th colspan="2">Valid torque limit value</th></tr>
<tr><th>TL1</th><th>Forward rotation</th><th>Reverse rotation</th></tr>
<tr><td>0</td><td></td><td>Parameter No. PA11</td><td>Parameter No. PA12</td></tr>
<tr><td rowspan="2">1</td><td>Parameter No. PC14 > Parameter No. PA11 Parameter No. PA12</td><td>Parameter No. PA11</td><td>Parameter No. PA12</td></tr>
<tr><td>Parameter No. PC14 < Parameter No. PA11 Parameter No. PA12</td><td>Parameter No. PC14</td><td>Parameter No. PC14</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Forward rotation start</td><td>ST1</td><td></td><td rowspan="2">Used to start the servo motor in any of the following directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Servo motor starting direction</th></tr>
<tr><th>ST2</th><th>ST1</th></tr>
<tr><td>0</td><td>0</td><td>Stop (servo lock)</td></tr>
<tr><td>0</td><td>1</td><td>CCW</td></tr>
<tr><td>1</td><td>0</td><td>CW</td></tr>
<tr><td>1</td><td>1</td><td>Stop (servo lock)</td></tr>
</table>
Note. 0: off
1: on
If both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to parameter No. PC02 setting and servo-locked.
When "□□1" is set in parameter No. PC23, the servo motor is not servo-locked after deceleration to a stop.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2">○</td><td rowspan="2"></td></tr>
<tr><td>Reverse rotation start</td><td>ST2</td><td></td></tr>
<tr><td>Forward rotation selection</td><td>RS1</td><td></td><td rowspan="2">Used to select any of the following servo motor torque generation directions.
<table>
<tr><th colspan="2">(Note) Input device</th><th rowspan="2">Torque generation direction</th></tr>
<tr><th>RS2</th><th>RS1</th></tr>
<tr><td>0</td><td>0</td><td>Torque is not generated.</td></tr>
<tr><td>0</td><td>1</td><td>Forward rotation in driving mode / reverse rotation in regenerative mode</td></tr>
<tr><td>1</td><td>0</td><td>Reverse rotation in driving mode / forward rotation in regenerative mode</td></tr>
<tr><td>1</td><td>1</td><td>Torque is not generated.</td></tr>
</table>
Note. 0: off
1: on
Torque is not generated if both RS1 and RS2 are switched ON or OFF during the operation.</td><td rowspan="2">DI-1</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">○</td></tr>
<tr><td>Reverse rotation selection</td><td>RS2</td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Speed selection 1</td><td>SP1</td><td></td><td rowspan="3"><Internal speed control mode>
Used to select the command speed for operation. (Max. 8 speeds)
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed command</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Internal speed command 0 (parameter No. PC05)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed command 1 (parameter No. PC06)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed command 2 (parameter No. PC07)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed command 3 (parameter No. PC08)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed command 4 (parameter No. PC31)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed command 5 (parameter No. PC32)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed command 6 (parameter No. PC33)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed command 7 (parameter No. PC34)</td></tr>
</table>
Note. 0: off
1: on
<Internal torque control mode>
Used to select the limit speed for operation. (Max. 8 speeds)
<table>
<tr><th colspan="3">(Note) Input device</th><th rowspan="2">Speed limit</th></tr>
<tr><th>SP3</th><th>SP2</th><th>SP1</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Internal speed limit 0 (parameter No. PC05)</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Internal speed limit 1 (parameter No. PC06)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Internal speed limit 2 (parameter No. PC07)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Internal speed limit 3 (parameter No. PC08)</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Internal speed limit 4 (parameter No. PC31)</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Internal speed limit 5 (parameter No. PC32)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Internal speed limit 6 (parameter No. PC33)</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Internal speed limit 7 (parameter No. PC34)</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td></td><td>○</td><td>○</td></tr>
<tr><td>Speed selection 2</td><td>SP2</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>Speed selection 3</td><td>SP3</td><td></td><td>DI-1</td><td></td><td>△</td><td>△</td></tr>
<tr><td>Proportion control</td><td>PC</td><td></td><td>When PC is turned on, the type of the speed loop switches 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.
In case of locking the servo motor shaft for a long time, turn on the internal torque limit selection (TL1) simultaneously with the proportion control (PC). Then, set the internal torque limit 2 (parameter No. PC14) in order to make the torque lower than the rating.</td><td>DI-1</td><td>△</td><td>△</td><td></td></tr>
<tr><td>Forced stop</td><td>EM1</td><td>CN1-8</td><td>When EM1 is turned off (contact between commons is opened), the controller falls in a forced stop state in which the base circuit is shut off, and the dynamic brake activates.
When EM1 is turned on (contact between commons is shorted) in the forced stop state, the state can be reset.</td><td>DI-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Clear</td><td>CR</td><td>CN1-5</td><td>When CR is turned on, the droop pulses of the position control counter are cleared on its leading edge. The pulse width should be 10ms or more.
The delay amount set in parameter No. PB03 (position command acceleration/deceleration time constant) is also cleared. When parameter No. PD22 is set to " □□□ 1 ", the pulses are always cleared while CR is on.</td><td>DI-1</td><td>○</td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Gain changing</td><td>CDP</td><td></td><td>The values of the load to motor inertia moment ratio and the gains are changed to the value set in parameter No. PB29 to PB34 by turning CDP on.</td><td>DI-1</td><td>△</td><td>△</td><td>△</td></tr>
<tr><td>Control change</td><td>LOP</td><td></td><td><Position/internal speed control change mode>
Used to select the control mode in the position/internal speed control change mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Position</td></tr>
<tr><td>1</td><td>Internal speed</td></tr>
</table>
Note. 0: off
1: on
<Internal speed/internal torque control change mode>
Used to select the control mode in the internal speed/internal torque control change mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Internal speed</td></tr>
<tr><td>1</td><td>Internal torque</td></tr>
</table>
Note. 0: off
1: on
<Internal torque/position control mode>
Used to select the control mode in the internal torque/position control change mode.
<table>
<tr><th>(Note) LOP</th><th>Control mode</th></tr>
<tr><td>0</td><td>Internal torque</td></tr>
<tr><td>1</td><td>Position</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td colspan="3">Refer to Functions/Applications.</td></tr>
</table>

(b) Output devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connec-tor pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="3">Control mode</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>Trouble</td><td>ALM</td><td>CN1-9</td><td>ALM turns off when power is switched off or the protective circuit is activated to shut off the base circuit.
When there is no alarm, ALM turns on approximately 1s after power-on.</td><td>DO-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>Ready</td><td>RD</td><td>CN1-11</td><td>RD turns on when the servo motor is ready for the operation after turning on the servo-on (SON).</td><td>DO-1</td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>In-position</td><td>INP</td><td>CN1-10</td><td>INP turns on when the number of droop pulses is in the preset in-position range. The in-position range can be changed using parameter No. PA10. When the in-position range is increased, may be kept connected during low-speed rotation.
INP turns on when servo-on turns on.
If parameter No. PA04 (tough drive function selection) is set to " □□1 " and the overload tough drive function is enabled, the INP ON time in the overload tough drive mode is delayed. The delay time can be limited by parameter No. PC26 (detailed setting of overload tough drive).</td><td>DO-1</td><td>○</td><td></td><td></td></tr>
</table>

Device	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Speed reached	SA	CN1-10	SA turns on when the servo motor speed has nearly reached the preset speed. When the preset speed is 20r/min or less, SA always turns on. SA does not turn on even when the servo-on (SON) is turned off or the servo motor speed by the external force reaches the preset speed while both the forward rotation start (ST1) and the reverse rotation start (ST2) are off.	DO-1		○	
Limiting speed	VLC		VLC turns ON when the speed reaches the value limited by any of the internal speed limits 0 to 7 (parameter No. PC05 to PC08, and PC31 to PC34) in the internal torque control mode. VLC turns off when servo-on (SON) turns off.	DO-1			△
Limiting torque	TLC		TLC turns ON when the generated torque reaches the value set to the forward torque limit (parameter No. PA11), the reverse torque limit (parameter No. PA12) or the internal torque limit 2 (parameter No. PC14).	DO-1	△	△	
Zero speed	ZSP		ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No. PC10. Example Zero speed is 50r/min  ZSP turns on 1) when the servo motor is decelerated to 50r/min, and ZSP turns off 2) when the servo motor is accelerated to 70r/min again. ZSP turns on 3) when the servo motor is decelerated again to 50r/min, and turns off 4) when the servo motor speed has reached -70r/min. The range from the point when the servo motor speed has reached ON level, and ZSP turns on, to the point when it is accelerated again and has reached OFF level is called hysteresis width. Hysteresis width is 20r/min for the LECSA□-□ controller. If parameter No. PA04 (tough drive function selection) is set to "□□1" and the overload tough drive function is enabled, the ZSP ON time in the overload tough drive mode is delayed. The delay time can be limited by parameter No. PC26 (detailed setting of overload tough drive).	DO-1	△	△	△
Electromagnetic brake interlock	MBR		MBR turns off when the servo is switched off or an alarm occurs. At an alarm occurrence, MBR turns off regardless of the base circuit status.	DO-1	○	○	○
Warning	WNG		When a warning occurs, WNG turns on. When there is no warning, WNG turns off approximately 1s after power-on.	DO-1	△	△	△
During tough drive	MTTR		If the instantaneous power failure tough drive function selection is enabled, MTTR turns on when the instantaneous tough drive activates. If parameter No.PD20 is set to "□1□□", MTTR also turns on when the overload tough drive activates.	DO-1	△	△	△
During variable gain selection	CDPS		CDPS is on during gain changing.	DO-1	△	△	△

(2) Input signals

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Forward rotation pulse train Reverse rotation pulse train	PP NP PG NG	CN1-23 CN1-25 CN1-22 CN1-24	Used to input command pulses. ・In the open collector system (max. input frequency 200kpps) Forward rotation pulse train across PP-DOCOM Reverse rotation pulse train across NP-DOCOM ・In the differential receiver system (max. input frequency 1Mpps) Forward rotation pulse train across PG-PP Reverse rotation pulse train across NG-NP The command input pulse form can be changed using parameter No. PA13.	DI-2	○		

(3) Output signals

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Encoder Z-phase pulse (Open collector)	OP	CN1-21	Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP turns on when the zero-point position is reached. (Negative logic) The minimum pulse width is about 400μs. For home position return using this pulse, set the creep speed to 100r/min. or less.	DO-2	○	○	○
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1-15 CN1-16	Outputs pulses per servo motor revolution set in parameter No. PA15 in the differential line driver system. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of $\pi/2$. The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. PC13.	DO-2	○	○	○
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1-17 CN1-18					
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1-19 CN1-20	The same signal as OP is output in the differential line driver system.	DO-2	○	○	○

(4) Power supply

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Control mode P	Control mode S	Control mode T
Digital I/F power supply input	DICOM	CN1-1	Used to input 24VDC (200mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For a sink interface, connect the positive terminal of the 24VDC external power supply to DICOM. For a source interface, connect the negative terminal of the 24VDC external power supply to DICOM.		○	○	○
Open collector power input	OPC	CN1-2	When inputting a pulse train in the open collector system, supply this terminal with the positive (+) power of 24VDC.		○		
Digital I/F common	DOCOM	CN1-13	Common terminal for input signals such as SON and EM1. Pins are connected internally. Separated from LG. For a sink interface, connect the negative terminal of the 24VDC external power supply to DICOM. For a source interface, connect the positive terminal of the 24VDC external power supply to DICOM.		○	○	○
Control common	LG	CN1-14	Common terminal for OP.		○	○	○
Shield	SD	Plate	Connect the external conductor of the shield cable.		○	○	○

3.6 Detailed description of the signals

3.6.1 Position control mode

POINT
・The noise immunity can be enhanced by setting parameter No. PA13 to "1 □ □ " when the frequency of the command input pulse is 500kpps or less and "2 □ □ " when 200kpps or less. (Refer to section 4.1.11)

(1) Pulse train input

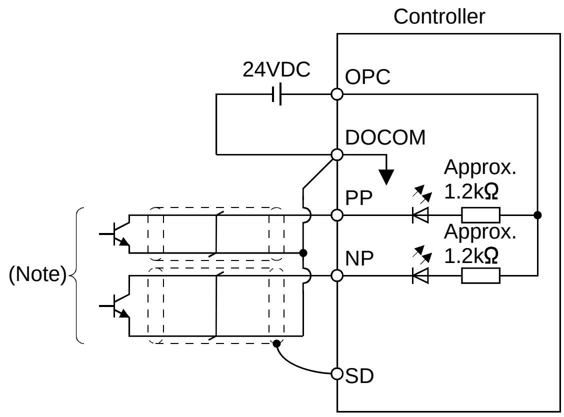
(a) Input pulse waveform selection

Command pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command input pulse form in parameter No. PA13. Refer to section 4.1.11 for details.

(b) Connections and waveforms

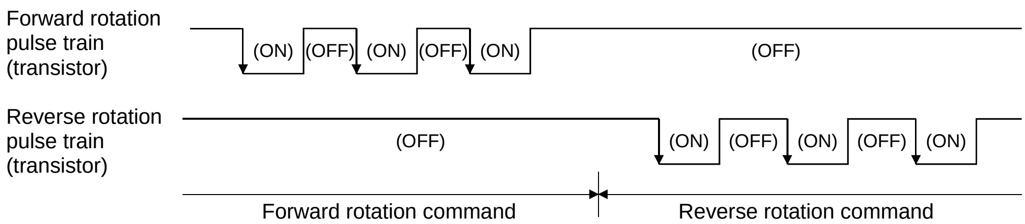
1) Open collector system

Connect as shown below.

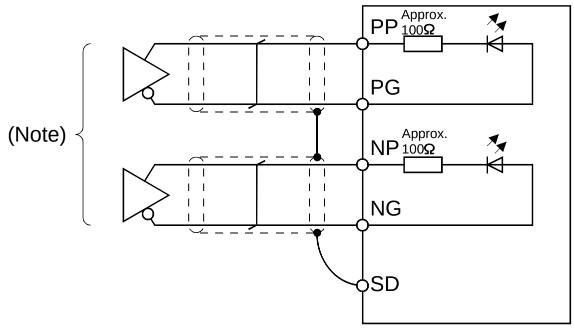


Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No. PA13 has been set to " □ 10 "). Their relationships with transistor ON/OFF are as follows.

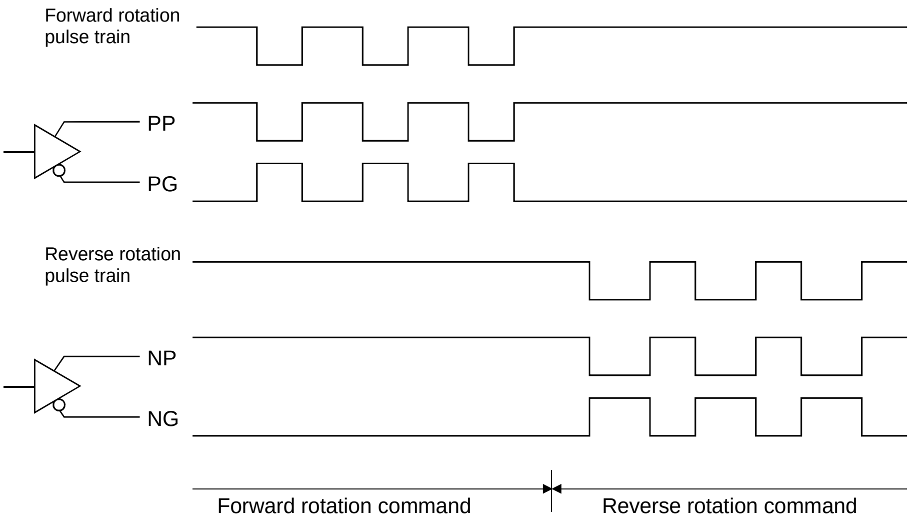


2) Differential line driver system
Connect as shown below.

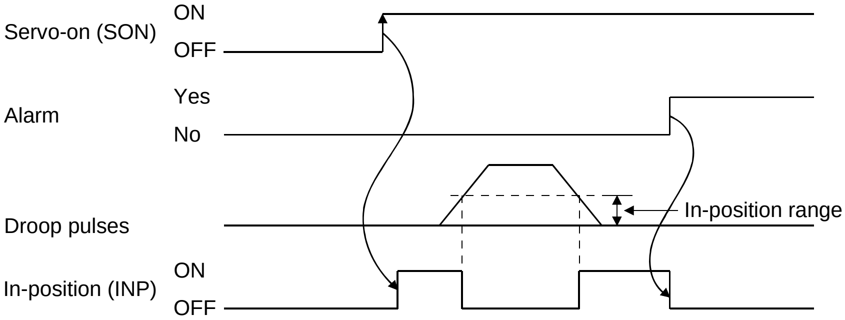


Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

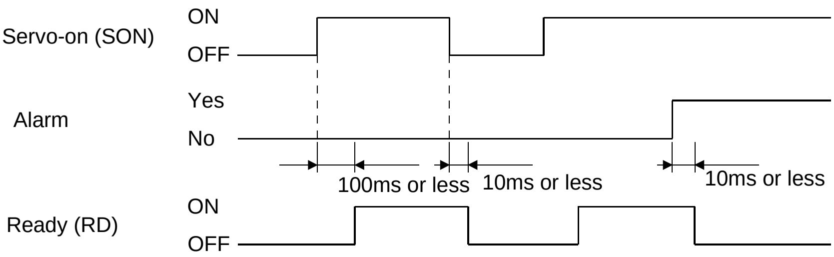
The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No. PA13 has been set to " □ 10 ").
The waveforms of PP, PG, NP and NG are based on that of the ground of the differential line driver.



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



(3) Ready (RD)

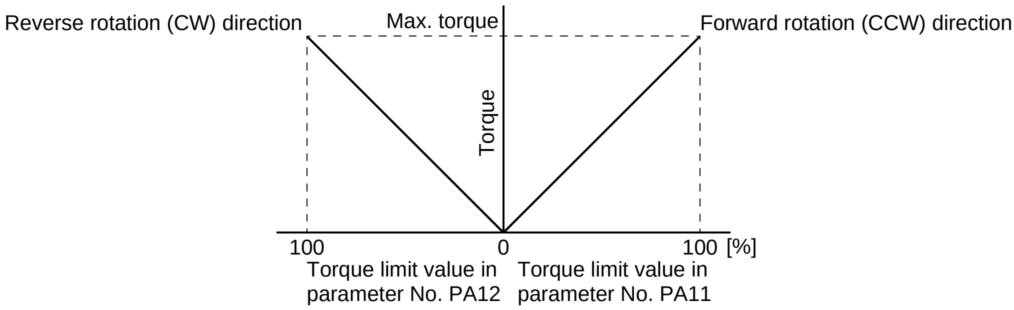


(4) Torque limit

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

(a) Torque limit and torque

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



(b) Torque limit value selection

As shown below, the internal torque limit selection (TL1) can be used for selecting the torque limit between the forward torque limit (parameter No. PA11) or the reverse torque limit (parameter No. PA12) and the internal torque limit 2 (parameter No. PC14).

However, if the value of parameter No. PA11 or parameter No. PA12 is lower than the limit value selected by TL1, the value of parameter No. PA11 or parameter No. PA12 is made valid.

(Note) Input device	Limit value status	Validated torque limit values	
TL1		Forward rotation (CCW) driving Reverse rotation (CW) regeneration	Reverse rotation (CW) driving Forward rotation (CCW) regeneration
0		Parameter No. PA11	Parameter No. PA12
1	Parameter No. PC14 > Parameter No. PA11 Parameter No. PA12	Parameter No. PA11	Parameter No. PA12
	Parameter No. PC14 < Parameter No. PA11 Parameter No. PA12	Parameter No. PC14	Parameter No. PC14

Note. 0: off
1: on

(c) Limiting torque (TLC)

TLC turns on when the servo motor torque reaches the torque limited by the forward torque limit, the reverse torque limit or the internal torque limit 2.

3.6.2 Internal speed control mode

(1) Internal speed command settings

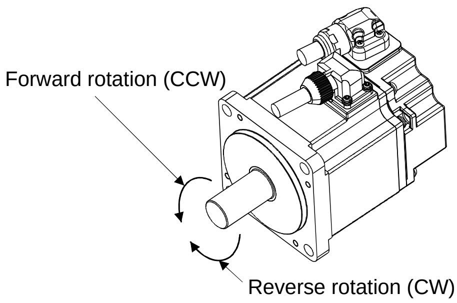
(a) Speed command and speed

The servo motor operates at the speed set in the parameters.

Up to 8 speeds can be set to the internal speed command.

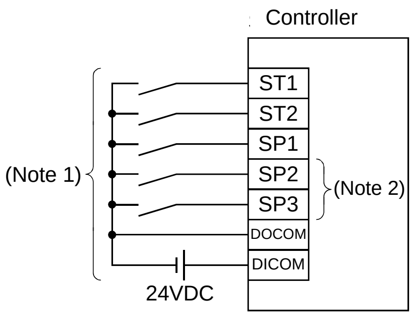
The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination.

(Note 1) Input device		(Note 2) Rotation direction
ST2	ST1	
0	0	Stop (Servo lock)
0	1	Forward rotation (CCW)
1	0	Reverse rotation (CW)
1	1	Stop (Servo lock)



Note 1. 0: off
1: on
2. If the torque limit is canceled during servo lock, the servo motor may suddenly rotate according to position deviation in respect to the command position.

Connect the wirings as follows when operating in forward or reverse rotation with the internal speed command set to the eighth speed.



Note 1. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
2. Set the input devices by parameter No. PD03 to PD14.

POINT

- The servo-on (SON) can be set to turn on automatically by parameter No. PD01 (input signal automatic ON selection 1).
- The forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN) switches as follows:
  - Not assigned to the external input signals: automatically turns on regardless of the value set in parameter No. PD01.
  - Assigned to the external input signals: depends on the value set in parameter No. PD01.
- If parameter No. PC23 (function selection C-2) is set to "□□0" (initial value), the servo motor is servo-locked regardless of the deceleration time constant when the zero speed (ZSP) turns on.

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

At the initial condition, the speed command values for the internal speed command 0 and 1 can be selected using the speed selection 1 (SP1).

(Note) Input device	Speed command value
SP1	
0	Internal speed command 0 (parameter No. PC05)
1	Internal speed command 1 (parameter No. PC06)

Note. 0: off
1: on

By making the speed selection 2 (SP2) and the speed selection 3 (SP3) usable by setting of parameter No.PD03 to PD14, the speed command values for the internal speed commands 0 to 7 can be selected.

(Note) Input device			Speed command value
SP3	SP2	SP1	
0	0	0	Internal speed command 0 (parameter No. PC05)
0	0	1	Internal speed command 1 (parameter No. PC06)
0	1	0	Internal speed command 2 (parameter No. PC07)
0	1	1	Internal speed command 3 (parameter No. PC08)
1	0	0	Internal speed command 4 (parameter No. PC31)
1	0	1	Internal speed command 5 (parameter No. PC32)
1	1	0	Internal speed command 6 (parameter No. PC33)
1	1	1	Internal speed command 7 (parameter No. PC34)

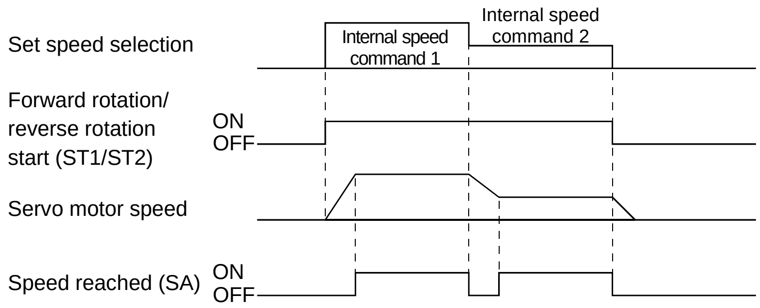
Note. 0: off
1: on

The speed may be changed during rotation. In this case, the values set in parameters No. PC01 and PC02 are used for acceleration/deceleration.

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

(2) Speed reached (SA)

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



(3) Torque limit

As in section 3.6.1 (4).

3.6.3 Internal torque control mode

(1) Internal torque command settings

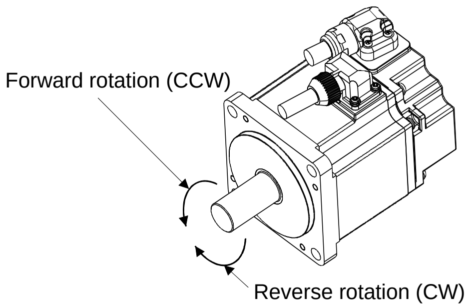
Torque is controlled by the internal torque command set in parameter No. PC12.

If the internal torque command is small, the torque may vary when the actual speed reaches the speed limit value. In such case, increase the speed limit value.

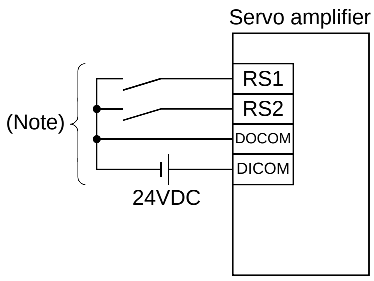
The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and the reverse rotation selection (RS2) when the internal torque command (parameter No. PC12) is used.

(Note) Input device		Rotation direction	
		Internal torque command (parameter No. PC12)	
RS2	RS1	0.1 to 100.0%	0.0%
0	0	Torque is not generated.	Torque is not generated.
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)	
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)	
1	1	Torque is not generated.	

Note. 0: off
1: on

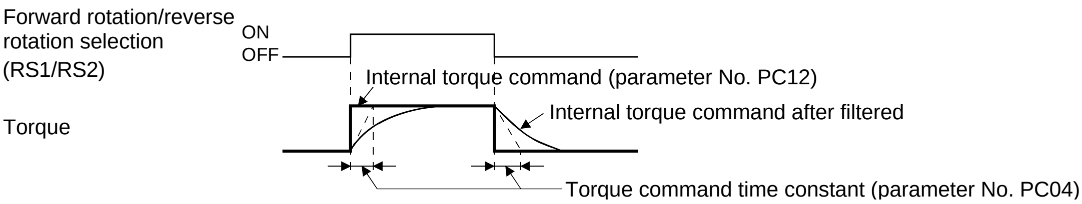


Generally, make connection as shown below.



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

The following shows the effect of the low-pass filter on the internal torque command.



(2) Torque limit

By setting parameter No. PA11 (forward torque limit) or parameter No. PA12 (reverse torque limit), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor torque is as in section 3.6.1 (4).

(3) Speed limit

(a) Speed limit value and speed

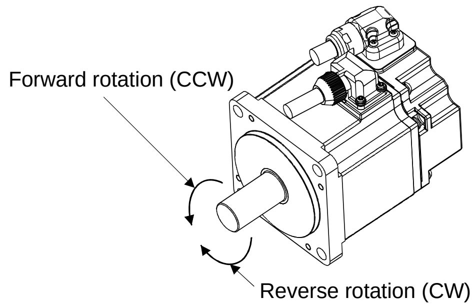
The speed is limited to the values set in parameters No. PC05 to PC08 and PC31 to PC34 (Internal speed limit 0 to 7).

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

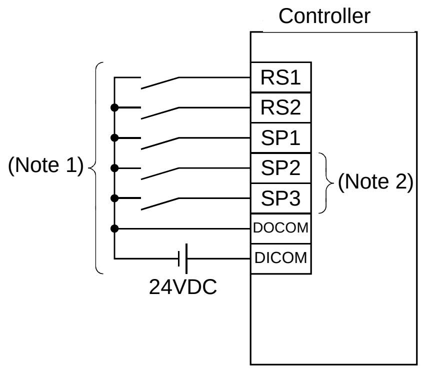
The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination.

(Note) Input device		Speed limit direction
RS1	RS2	
1	0	Forward rotation (CCW)
0	1	Reverse rotation (CW)

Note. 0: off
1: on



Connect the wirings as follows when setting the internal speed limit to the eighth speed.



Note 1. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.
2. Set the input devices by parameter No. PD03 to PD14.

POINT
- The servo-on (SON), the forward rotation stroke end (LSP), and the reverse rotation stroke end (LSN) can be set to turn on automatically by parameter No. PD01 (input signal automatic ON selection 1).

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

At the initial condition, the speed limit values for the internal speed limits 0 and 1 can be selected using the speed selection 1 (SP1).

(Note) Input device	Speed limit value
SP1	
0	Internal speed limit 0 (parameter No. PC05)
1	Internal speed limit 1 (parameter No. PC06)

Note. 0: off
1: on

By making the speed selection 2 (SP2) and the speed selection 3 (SP3) usable by setting parameter No.PD03 to PD14, the speed limit values for the internal speed commands 0 to 7 can be selected.

(Note) Input device			Speed limit value
SP3	SP2	SP1	
0	0	0	Internal speed limit 0 (parameter No. PC05)
0	0	1	Internal speed limit 1 (parameter No. PC06)
0	1	0	Internal speed limit 2 (parameter No. PC07)
0	1	1	Internal speed limit 3 (parameter No. PC08)
1	0	0	Internal speed limit 4 (parameter No. PC31)
1	0	1	Internal speed limit 5 (parameter No. PC32)
1	1	0	Internal speed limit 6 (parameter No. PC33)
1	1	1	Internal speed limit 7 (parameter No. PC34)

Note. 0: off
1: on

When the speed is limited by the internal speed limits 0 to 7, the speed does not vary with the ambient temperature.

(c) Limiting speed (VLC)

VLC turns on when the servo motor speed reaches the speed limited by the internal speed limits 0 to 7.

3.6.4 Position/speed control change mode

Set parameter No. PA01 to " □□ 1 " to switch to the position/internal speed control change mode.

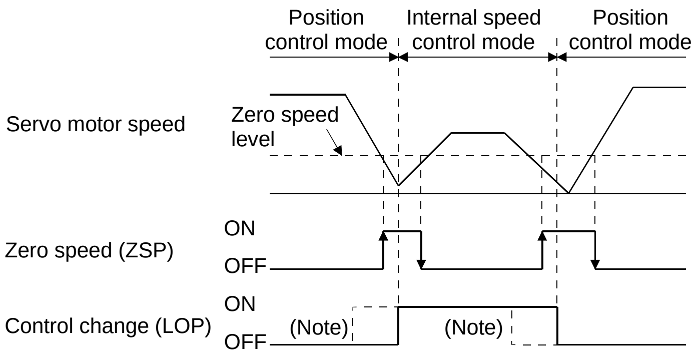
(1) Control change (LOP)

By using the control change (LOP), control mode can be switched between the position control and the internal speed control modes from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Control mode
0	Position control mode
1	Internal speed control mode

Note. 0: off
1: on

The control mode may be switched in the zero speed status. To ensure safety, switch the control mode after the servo motor has stopped. When the control mode is switched to the internal speed control mode from the position control mode, droop pulses are cleared.
Even if the speed is decreased to the zero speed or below after switching LOP, the control mode cannot be switched. A change timing chart is shown below.



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

(2) Torque limit in position control mode

As in section 3.6.1 (4).

(3) Speed setting in internal speed control mode

As in section 3.6.2 (1).

(4) Speed reached (SA)

As in section 3.6.2 (2).

3.6.5 Internal speed/internal torque control change mode

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

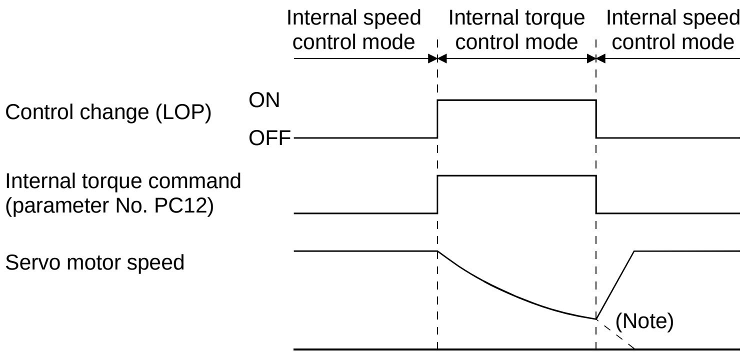
(1) Control change (LOP)

By using the control change (LOP), the control mode can be switched between the internal speed control and the internal torque control mode from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Servo control mode
0	Internal speed control mode
1	Internal torque control mode

Note. 0: off
1: on

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



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

(2) Speed setting in internal speed control mode

As in section 3.6.2 (1).

(3) Torque limit in internal speed control mode

As in section 3.6.1 (4).

(4) Speed limit in internal torque control mode

As in section 3.6.3 (3).

(5) Internal torque control setting in internal torque control mode

As in section 3.6.3 (1).

(6) Torque limit in internal torque control mode

As in section 3.6.3 (2).

3.6.6 Internal torque/position control change mode

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

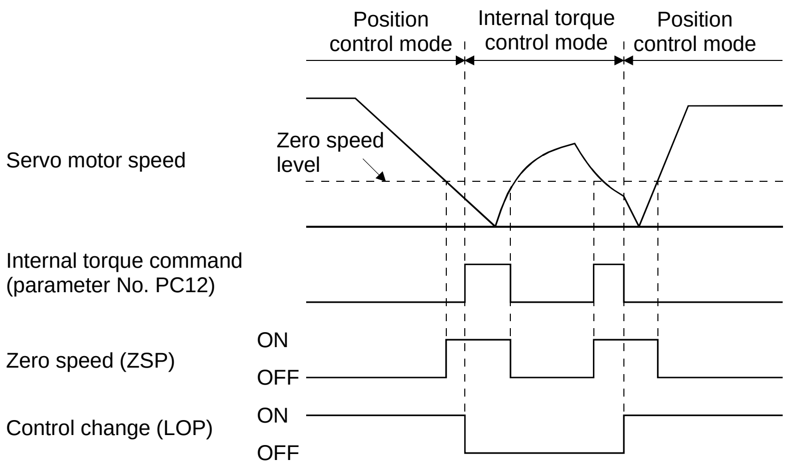
(1) Control change (LOP)

By using the control change (LOP), the control mode can be switched between the internal torque control and the position control modes from an external contact. Relationships between LOP and control modes are indicated below.

(Note) LOP	Servo control mode
0	Internal torque control mode
1	Position control mode

Note. 0: off
1: on

The control mode may be switched in the zero speed status.
To ensure safety, switch the control mode after the servo motor has stopped. When the control mode is switched to the internal torque control mode from the position control mode, droop pulses are cleared.
Even if the speed is decreased to the zero speed or below after switching LOP, the control mode cannot be switched. A change timing chart is shown below.



(2) Speed limit in internal torque control mode

As in section 3.6.3 (3).

(3) Internal torque control setting in internal torque control mode

As in section 3.6.3 (1).

(4) Torque limit in internal torque control mode

As in section 3.6.3 (2).

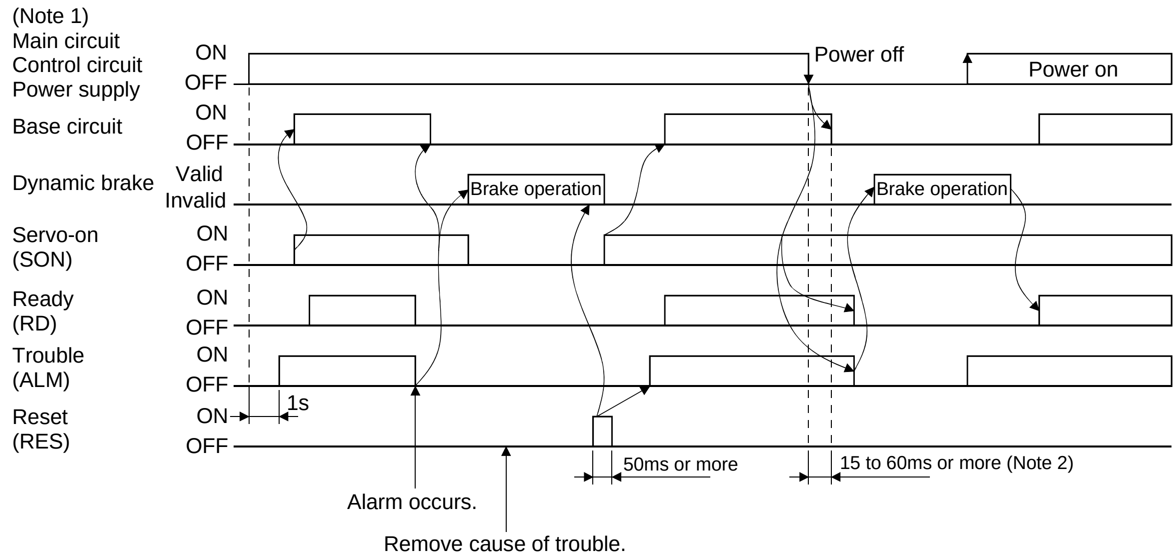
(5) Torque limit in position control mode

As in section 3.6.1 (4).

3.7 Alarm occurrence timing chart

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

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



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

(1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching control circuit power off, then on to reset the overcurrent (32. □), overload 1 (50. □) or overload 2 (51. □) alarm after its occurrence, without removing its cause, the controller 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 (30. □) alarm after its occurrence, the regenerative resistor will generate heat, resulting in an accident.

(3) Instantaneous power failure

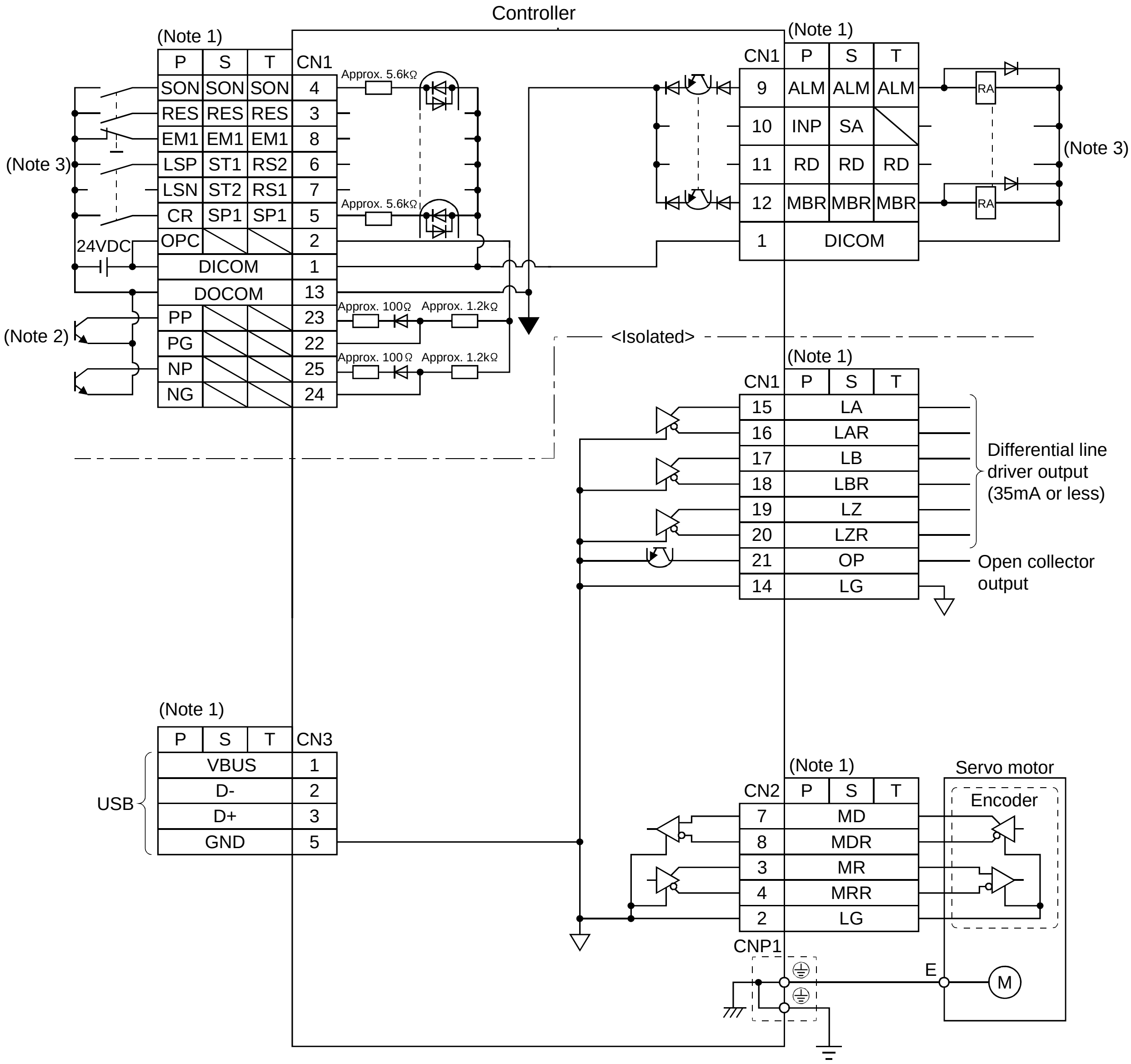
If power failure has occurred in the control circuit power supply, undervoltage (10.1) occurs when the power is recovered.

(4) In-position control mode

Once an alarm occurs, the servo motor command rejects the command pulse. When resuming the operation after resetting the alarm, make a home position return.

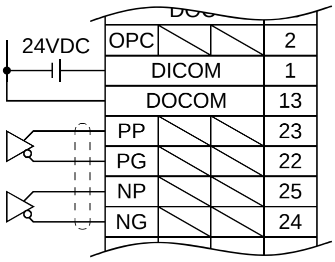
3.8 Interfaces

3.8.1 Internal connection diagram



Note 1. P: Position control mode, S: Internal speed control mode, T: Internal torque control mode

2. This diagram is for the open collector pulse train input. For the differential line driver pulse train input, make the following connection.



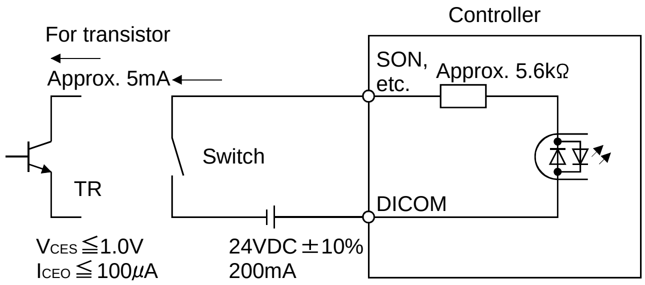
3. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3.

3.8.2 Detailed description of interfaces

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

(1) Digital input interface DI-1

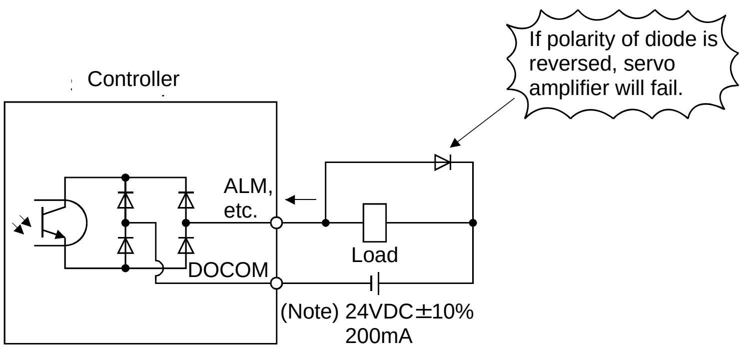
Give a signal with a relay or open collector transistor. Refer to section 3.8.3 for the source input.



(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Install a diode (D) for an inductive load, or install an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less) A maximum of 2.6V voltage drop occurs in the controller.

Refer to section 3.8.3 for the source output.



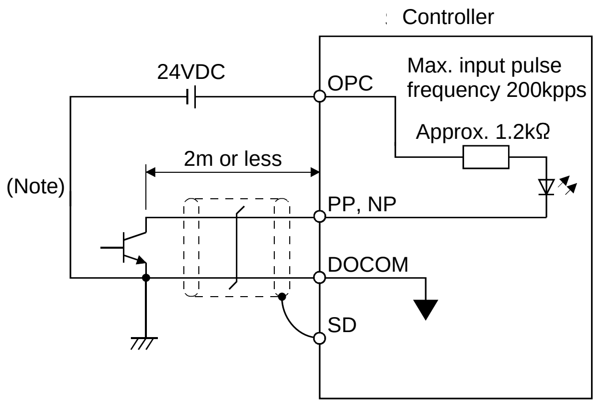
Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (up to 26.4V) from external source.

(3) Pulse train input interface DI-2

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

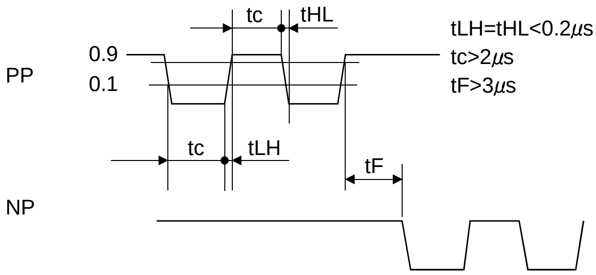
(a) Open collector system

1) Interface



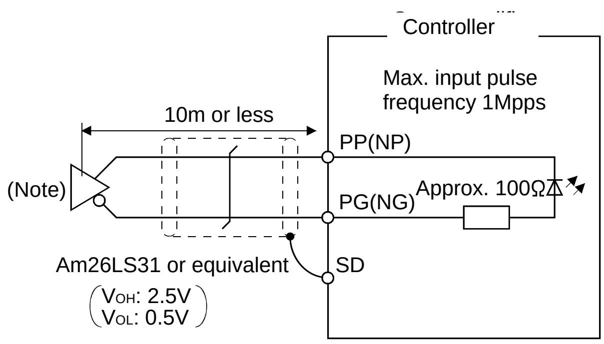
Note. Pulse train input interface is comprised of a photo coupler.
Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

2) Input pulse condition



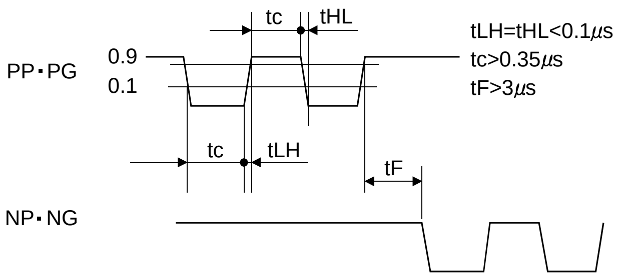
(b) Differential line driver system

1) Interface



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

2) Input pulse condition

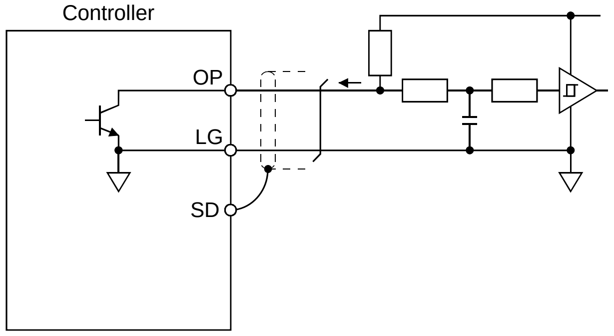


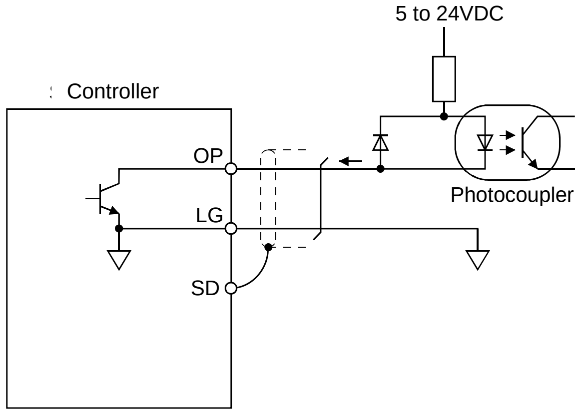
(4) Encoder output pulse DO-2

(a) Open collector system

Interface

Max. output current: 35mA

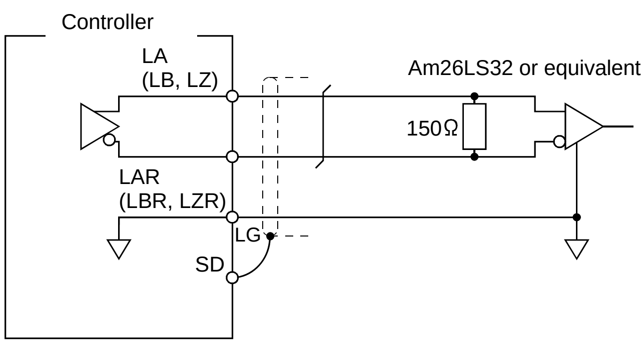


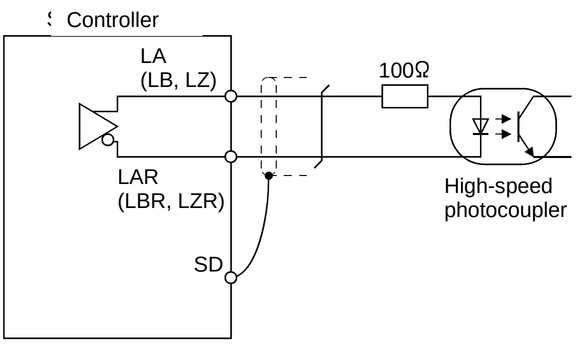


(b) Differential line driver system

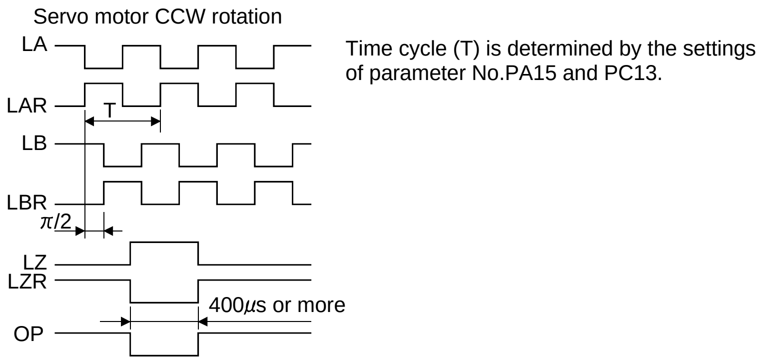
1) Interface

Max. output current: 35mA





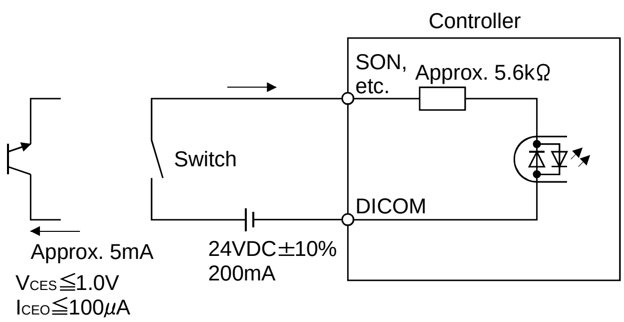
2) Output pulse



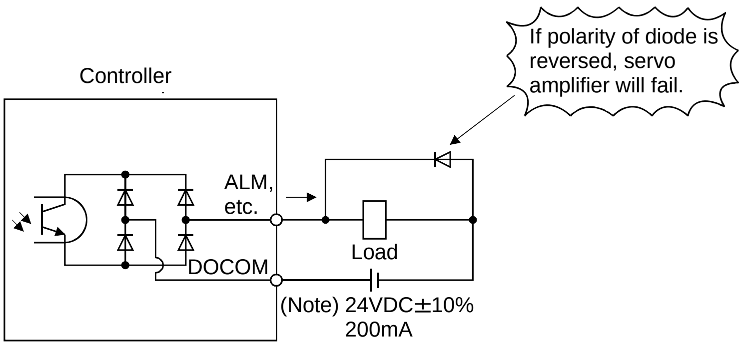
3.8.3 Source I/O interfaces

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

(1) Digital input interface DI-1



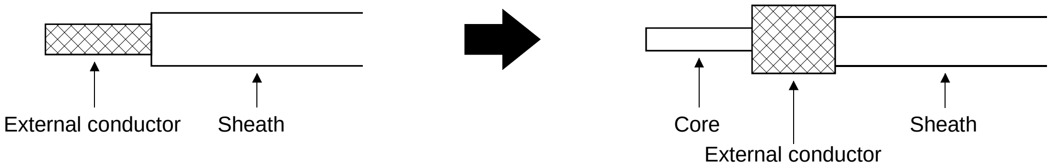
(2) Digital output interface DO-1
A maximum of 2.6V voltage drop occurs in the controller.



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

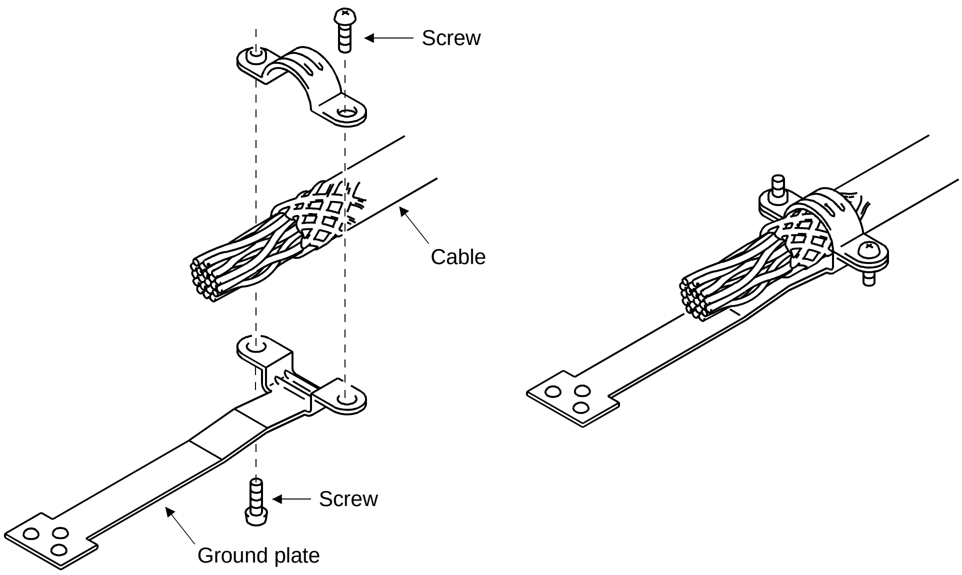
3.9 Treatment of cable shield external conductor

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

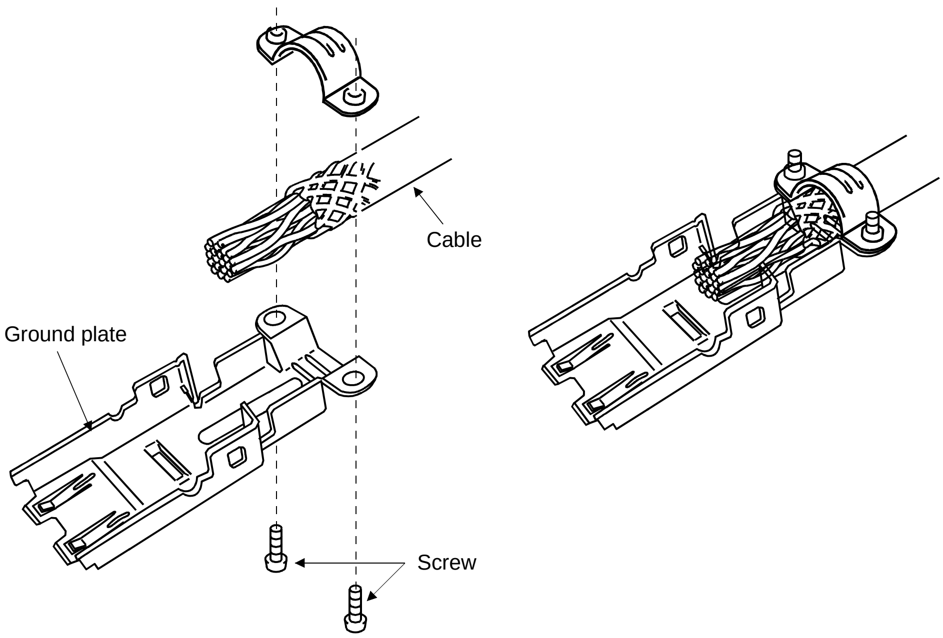


Strip the sheath. Pull back the external conductor to cover the sheath.

(1) For CN1 connector (3M connector)



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



3.10 Connection of controller and servo motor

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

3.10.1 Connection instructions

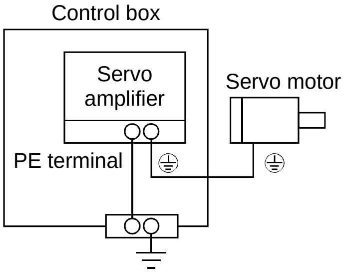
⚠WARNING	・Insulate the connections of the power supply terminals to prevent an electric shock.

⚠CAUTION	・Connect the wires to the correct phase terminals (U, V, W) of the controller and servo motor. Not doing so may cause unexpected operation. ・Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur.

POINT
・Refer to section 11.1 for the selection of the encoder cable.

This section indicates the connection of the servo motor power supply (U, V, W). Use of the optional cable or the connector set is recommended for connection between the controller and the servo motor. Refer to section 11.1 for details of the options.

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

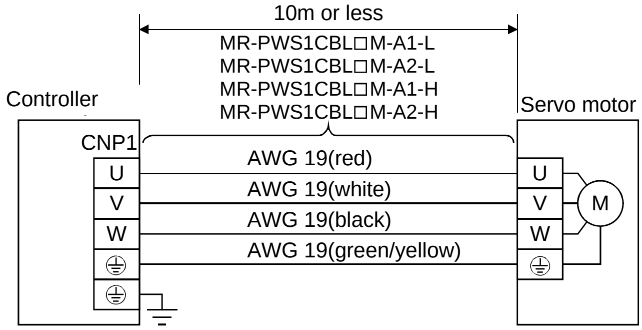


(2) Do not use the 24VDC interface and control circuit power supply for the electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.

3.10.2 Power supply cable wiring diagrams

(1) LE-□-□ series servo motor

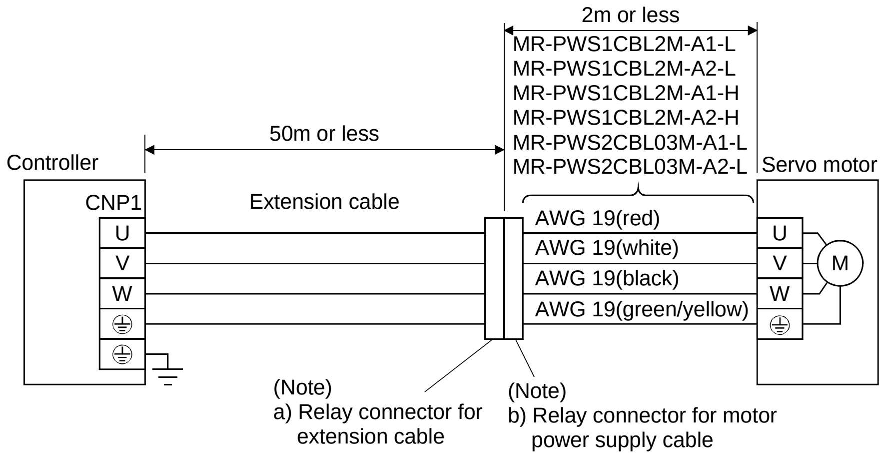
(a) When cable length is 10m or less



(b) When cable length exceeds 10m

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

Refer to section 11.5 for the wire used for the extension cable.



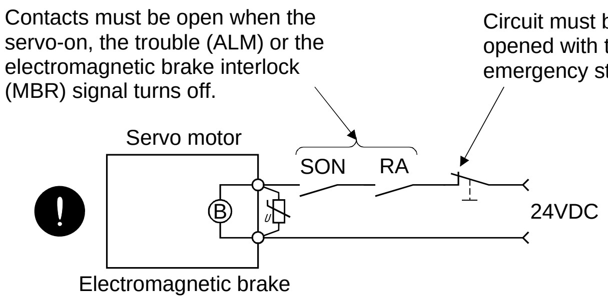
Note. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

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

3.11 Servo motor with an electromagnetic brake

3.11.1 Safety precautions

⚠ CAUTION	- Configure an electromagnetic brake operation circuit which interlocks with an external emergency stop switch.



- The electromagnetic brake is provided for holding purpose and must not be used for ordinary braking.
- Before performing the operation, be sure to confirm that the electromagnetic brake operates properly.

POINT

- Refer to chapter 12 for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Do not use the 24VDC interface and control circuit power supply for the electromagnetic brake. Always use the 24VDC power supply designed exclusively for the electromagnetic brake.
- Switch off the servo-on (SON) after the servo motor has stopped.
- Refer to (3) in section 12.1.3 for the selection of the surge absorbers for the electromagnetic brake.

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

1) Always assign the electromagnetic brake interlock (MBR) to CN1-pin 12 by parameter No. PD18. (MBR is assigned to CN1-pin 12 by default.)

2) The electromagnetic brake operates when the power (24VDC) turns off.

3) 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).

3.11.2 Setting

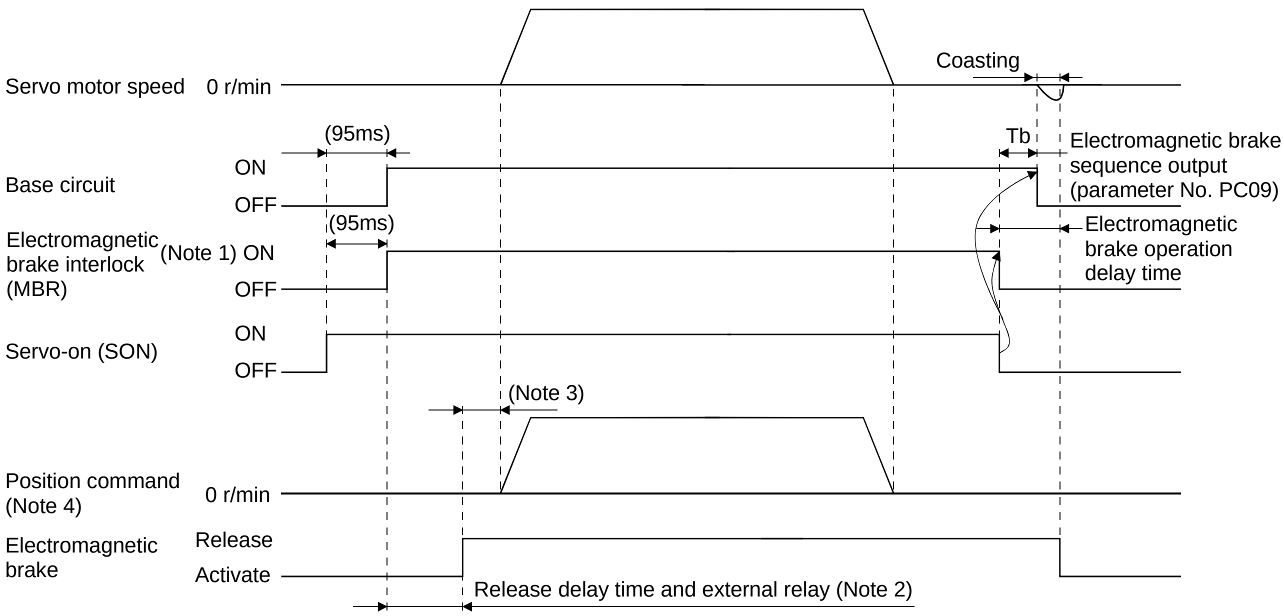
(1) Set " □□ 05 " to parameter No. PD18 to assign the electromagnetic brake interlock (MBR) to CN1-pin 12.

(2) Using parameter No. PC09 (electromagnetic brake sequence output), set a time delay (Tb) at servo-off from electromagnetic brake operation to base circuit shut-off as in the timing chart shown in section 3.11.3 (1).

3.11.3 Timing charts

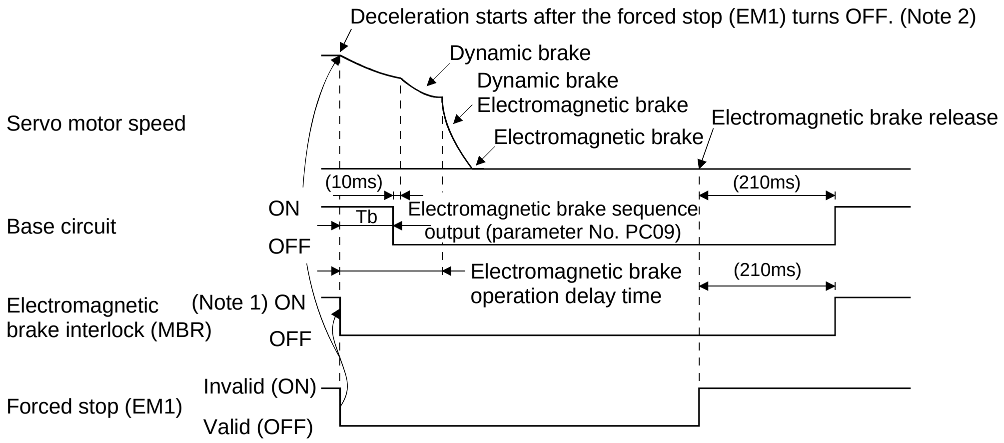
(1) Servo-on (SON) command (from controller) ON/OFF

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



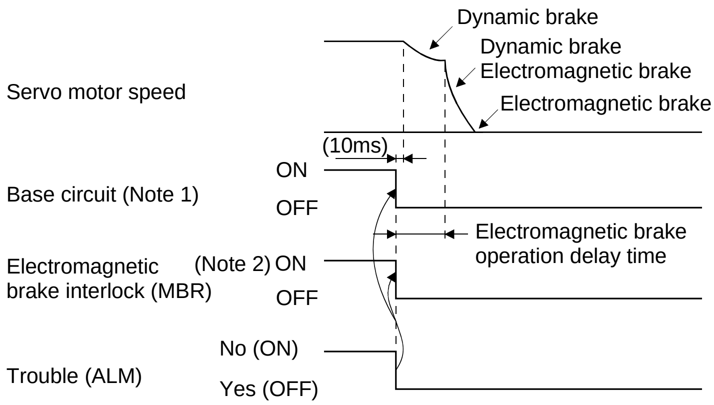
Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.
2. Electromagnetic brake is released after delaying for the release delay time of electromagnetic brake and operation time of external circuit relay. For the release delay time of electromagnetic brake, refer to section 12.5.3, 12.6.3.
3. Give a position command after the electromagnetic brake is released.
4. For the position control mode.

(2) Forced stop (EM1) ON/OFF



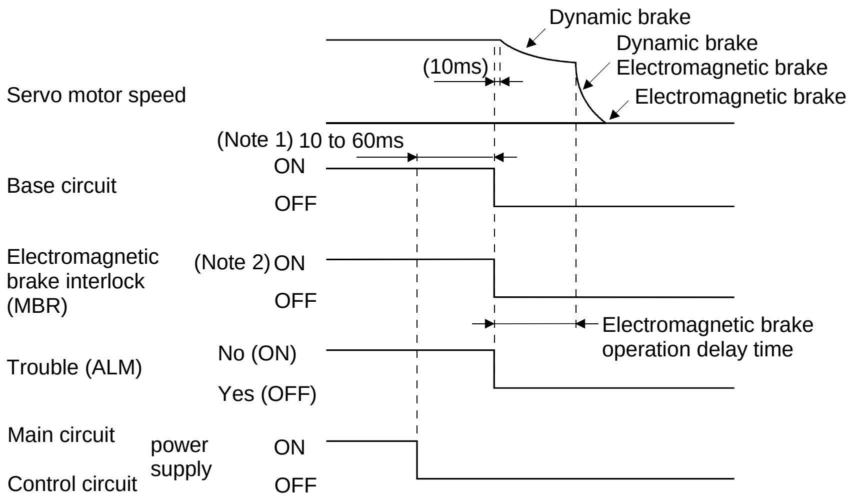
Note 1. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.
2. The operation differs from the operation of LECSB□-□ controller.

(3) Alarm occurrence



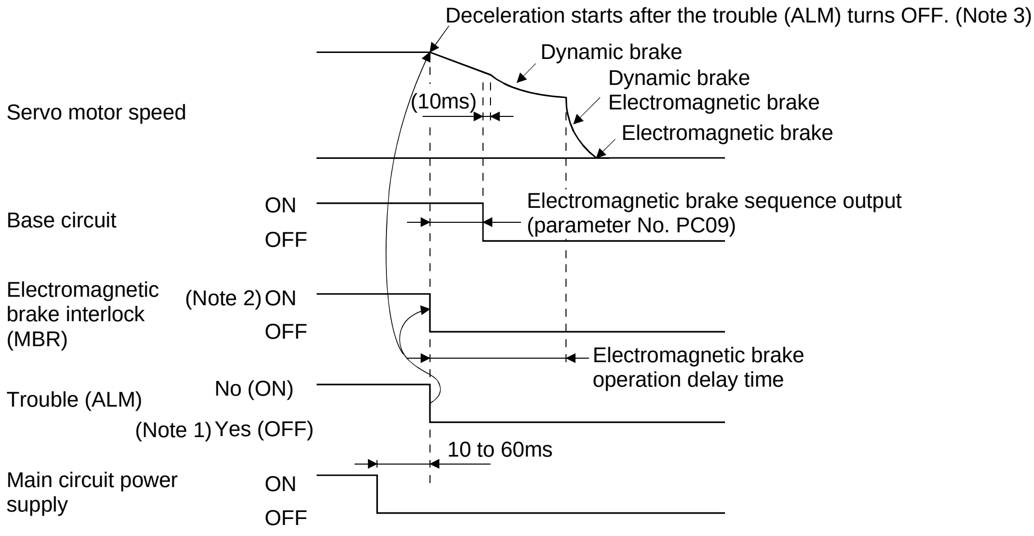
Note 1. Electromagnetic brake sequence output (parameter No. PC09) is invalid.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

(4) Both main and control circuit power supplies off



Note 1. Changes with the operating status.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.

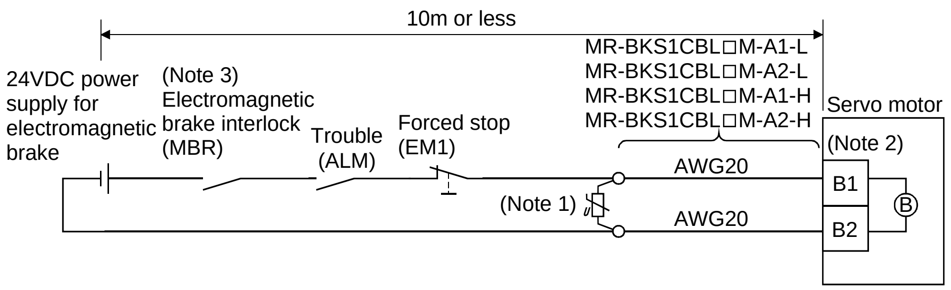
(5) Only main circuit power supply off (control circuit power supply remains on)



Note 1. When the main circuit power supply is off in a servo motor stop status, the main circuit off warning (E9.1) occurs and the trouble (ALM) does not turn off.
2. ON: Electromagnetic brake is not activated.
OFF: Electromagnetic brake is activated.
3. The operation differs from the operation of LECSB□-□ controller.

3.11.4 Wiring diagrams (LE-□-□series servo motor)

(1) When cable length is 10m or less



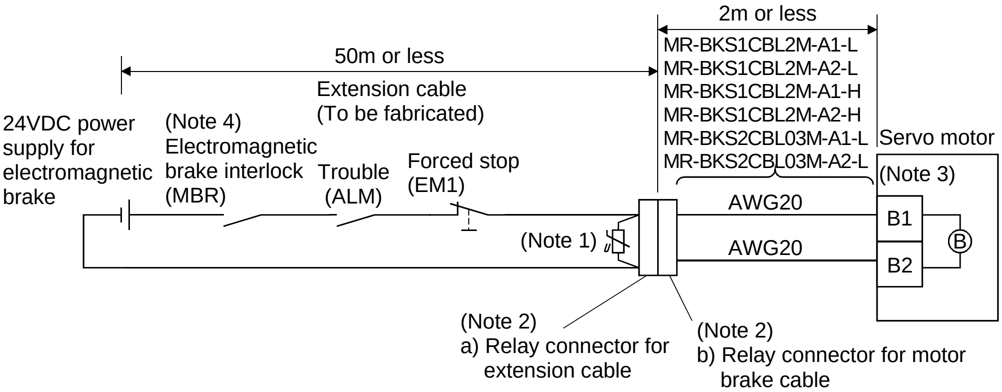
Note 1. Connect a surge absorber as close to the servo motor as possible.
2. There is no polarity in electromagnetic brake terminals (B1 and B2).
3. When using a servo motor with an electromagnetic brake, always assign the electromagnetic brake interlock (MBR) to CN1-pin 12 by parameter No. PD18.

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

(2) When cable length exceeds 10m

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

Refer to section 11.5 for the wire used for the extension cable.



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

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

Relay connector	Description	Protective structure
a) Relay connector for extension cable	CM10-CR2P-* (DDK) └Wire size: S, M, L	IP65
b) Relay connector for motor brake cable	CM10-SP2S-* (DDK) └Wire size: S, M, L	IP65

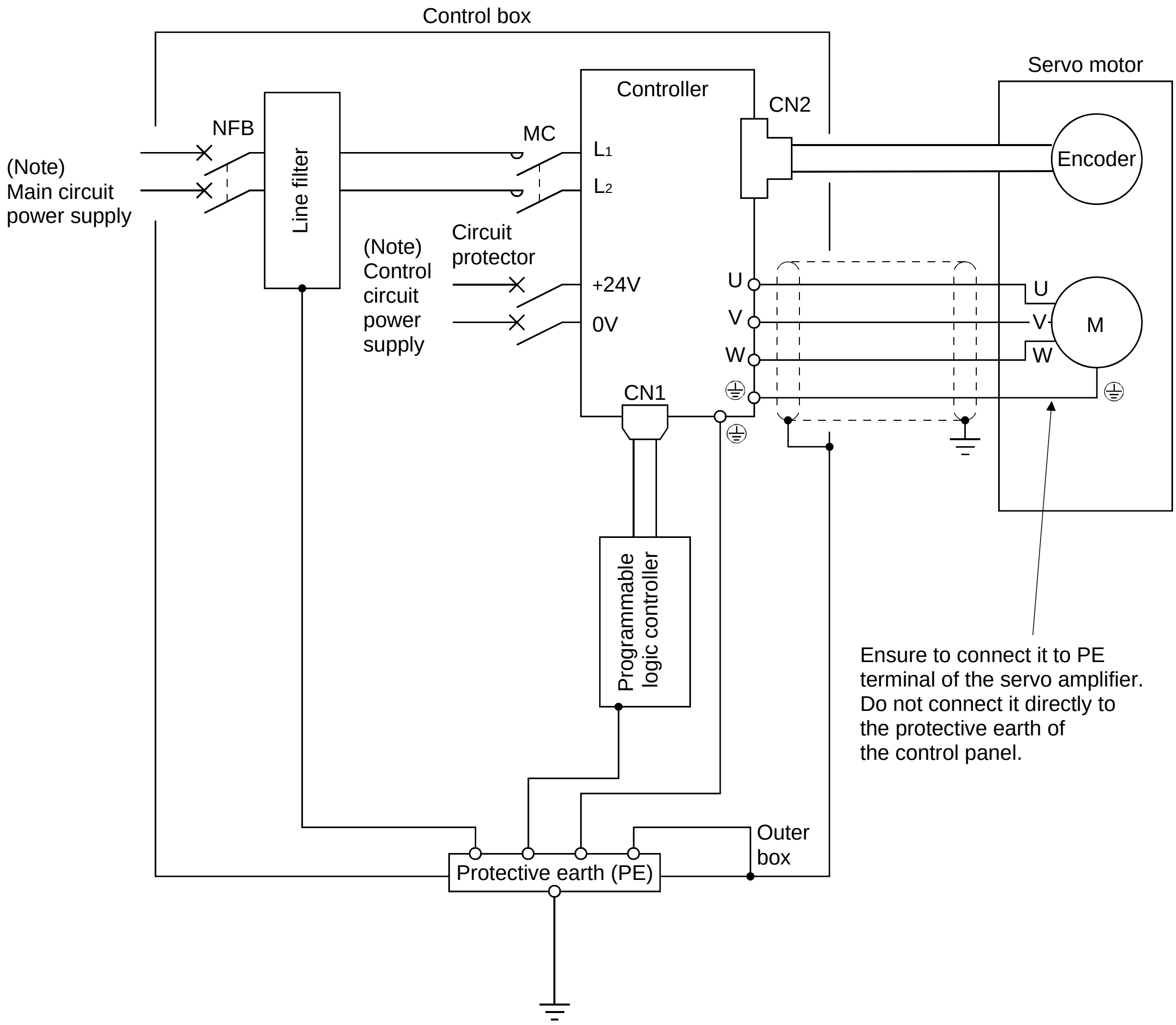
3. There is no polarity in electromagnetic brake terminals (B1 and B2).

4. When using a servo motor with an electromagnetic brake, always assign the electromagnetic brake interlock (MBR) to CN1-pin 12 by parameter No. PD18.

3.12 Grounding

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

The controller switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cable routing, the controller 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 the specification of power supply, refer to section 1.3.

4. PARAMETERS

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

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

Parameter group	Main description
Basic setting parameters (No. PA □□)	Make basic setting with these parameters when using this controller in the position control mode.
Gain/filter parameters (No. PB □□)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No. PC □□)	Use these parameters mainly when using this controller in the internal speed control mode or in the internal torque control mode.
I/O setting parameters (No. PD □□)	Use these parameters when changing the I/O signals of the controller.

When using this servo in the position control mode, mainly setting the basic setting parameters (No. PA□□) allows the setting of the basic parameters at the time of introduction.

4.1 Basic setting parameters (No. PA□□)

POINT

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

4.1.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Internal speed	Internal torque
PA01	*STY	Control mode	000h		○	○	○
PA02	*REG	Regenerative option	000h		○	○	○
PA03		For manufacturer setting	000h				
PA04	*AOP1	Tough drive function selection	000h		○	○	
PA05	*FBP	Number of command input pulses per revolution	100	×100 pulse/rev	○		
PA06	CMX	Electronic gear numerator (Command input pulse multiplying factor numerator)	1		○		
PA07	CDV	Electronic gear denominator (Command input pulse multiplying factor denominator)	1		○		
PA08	ATU	Auto tuning mode	001h		○	○	
PA09	RSP	Auto tuning response	6		○	○	
PA10	INP	In-position range	100	pulse	○		
PA11	TLP	Forward torque limit	100	%	○	○	○
PA12	TLN	Reverse torque limit	100	%	○	○	○
PA13	*PLSS	Command input pulse form	000h		○		
PA14	*POL	Rotation direction selection	0		○		
PA15	*ENR	Encoder output pulses	4000	pulse/rev	○	○	○
PA16	*ENR2	Encoder output pulse electronic gear	0		○	○	○
PA17		For manufacturer setting	000h				
PA18			000h				
PA19	*BLK	Parameter write inhibit	00Eh		○	○	○

4.1.2 Parameter write inhibit

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA19	*BLK	Parameter write inhibit	00Eh	Refer to the text.		○	○	○

POINT

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

In the factory setting, this controller allows to change all the setting parameters. With the setting of parameter No. PA19, writing can be disabled to prevent accidental changes.
The following table indicates the parameters which are enabled for reference and writing by the setting of parameter No. PA19. Operation can be performed for the parameters marked ○.

Parameter No. PA19 setting	Setting operation	Basic setting parameters No. PA □□	Gain/Filter parameters No. PB □□	Extension setting parameters No. PC □□	I/O setting parameters No. PD □□
000h	Reference	○			
	Writing	○			
00Ah	Reference	Parameter No. PA19 only			
	Writing	Parameter No. PA19 only			
00Bh	Reference	○	○	○	
	Writing	○	○	○	
00Eh (initial value)	Reference	○	○	○	○
	Writing	○	○	○	○
10Bh	Reference	○			
	Writing	Parameter No. PA19 only			
10Ch	Reference	○	○	○	○
	Writing	Parameter No. PA19 only			

4.1.3 Selection of control mode

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA01	*STY	Control mode	000h	Refer to the text.		○	○	○

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

Select the control mode of the controller, and valid or invalid the one-touch tuning function.

Parameter No. PA01

	0	

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

One-touch tuning function selection
0: Valid
1: Invalid
If "1" is set, the one-touch tuning is ignored.

4.1.4 Selection of regenerative option

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA02	*REG	Regenerative option	000h	Refer to the text.		○	○	○

> **POINT**
> - This parameter is made valid when power is switched off, then on after setting.
> - Incorrect setting may cause the regenerative option to burn.
> - If the regenerative option selected is not for use with the controller, parameter error (37.2) occurs.

Set this parameter when using the regenerative option.

Parameter No. PA02

0		

Selection of regenerative option
00: Regenerative option is not used
- For servo amplifier of 100W, regenerative resistor is not used.
- For servo amplifier of 200 to 400W, built-in regenerative resistor is used.

02: MR-RB032
03: MR-RB12

※ The following control mode can be selected for applicable actuators.
Please refer 「3. SIGNALS AND WIRING」 and「4. PARAMETERS」 about wiring and parameter setting.

Table. Applicable control mode.

(○ : Applicable, × : Inapplicable)

Controller type	Actuator type	Control mode Note 1) (Selected by parameter number PA1.)				
		Position control	Speed control	Torque control	Positioning	
					Point table method	Program method
LECSA (Incremental)	LEY	○	○ Note 2)	○ Note 3)	○ 3 Points (Max. 7 Points) Note 4)	○ 4 Programs (Max. 8 Programs Note4) 5)
	LJ1	○	×	×		
	LG1	○	×	×		
	LTF	○	×	×		
	LEF	○	×	×		
Command method		[Pulse train]	[ON/OFF Signal]	[ON/OFF Signal]	[ON/OFF Signal]	[ON/OFF Signal]
Operation method		Positioning operation	Setting speed operation	Setting torque operation	Positioning operation by point table No. setting	Positioning operation by program setting

Note 1. The control change mode cannot be used.
Note 2. Make the moving range limitation by external sensor etc to avoid actuator hitting to the work piece or stroke end.
Note 3. When using the pushing operation, the following parameter should be set.
If not, it will cause malfunction.
・LECSA : The value of the parameter value [PC12] “Internal torque command” should be 30% or less.
(30% = Maximum pushing force of the product.)
Note 4. To set the maximum value for the each method, it is necessary to change the setting.
Please refer 「13. POSITIONING MODE」.
Note 5. The MR Configurator is necessary to control by the program method. Please prepare separately.
・MR Configurator (Setup software Japanese version) / LEC-MR-STUP□□□
Please refer to "11.4 MR Configurator" for the system requirements of MR Configurator (setup software Japanese version).
MR Configurator (setup software English version), contact your nearest sales branch.

・USB cable for setup software (3m) / LEC-MR-J3USB

4.1.5 Selection of the tough drive function

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA04	*AOP1	Tough drive function selection	000h	Refer to the text.		○	○	

POINT

- This parameter is made valid when power is switched off, then on after setting.
- The tough drive function may not avoid the alarm depending on the conditions of the power supply and the load change.
- The during tough drive (MTTR) can be assigned to the pins 9 to 12 of CN1 connector using parameters No. PD15 to PD18.
- For details on tough drive function, refer to section 7.1.

By selecting the tough drive function, the operation is continued not to stop the machine in such situation when normally an alarm is activated.

Parameter No. PA04

Overload tough drive function selection
Set the tough drive function for overload.
The overload tough drive function is valid only in the position control mode.

Setting	Overload (alarm 50.1) avoidance
0	Invalid
1	Valid

The details on the overload tough drive function can be set in parameter No. PC26 (detailed setting of overload tough drive).

Vibration tough drive function selection
Set the function for vibration suppression.

Setting	Aging distortion vibration suppression
0	Invalid
1	Valid

The details on the vibration tough drive function can be set in parameter No. PC27 (detailed setting of vibration tough drive).

Instantaneous power failure tough drive function selection
Set the tough drive function for instantaneous power failure of the main circuit power.

Setting	Instantaneous power failure (alarm 10.3) avoidance
0	Invalid
1	Valid

The details on the instantaneous power failure tough drive function can be set in parameter No. PC28 (detailed setting of instantaneous power failure tough drive).

4.1.6 Number of command input pulses per servo motor revolution

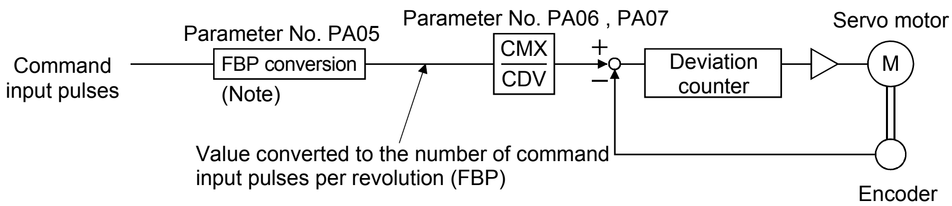
Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA05	*FBP	Number of command input pulses per revolution	100	0・100 to 500	× 100 pulse/rev	○		

POINT

- This parameter is made valid when power is switched off, then on after setting.
- Unlike the LECSB□-□ controller, the electronic gear is always valid regardless of the settings of parameter No. PA05.

Set the number of command input pulses necessary to rotate the servo motor one turn.
The setting of "100 (10000[pulse/rev])" (initial value) to parameter No. PA05 and the input of 10000 command pulses to the controller rotates the servo motor one turn. The settings of "0" to parameter No. PA05 and the input of the command pulses, corresponding to the servo motor resolution, to the controller rotates the servo motor one turn.

Parameter No. PA05 setting	Description
0	Servo motor resolution [pulse/rev]
100 to 500	Number of command input pulses necessary to rotate the servo motor one turn [×100pulse/rev]



Note. This process converts the number of the command input pulses required to rotate the servo motor one turn to the value set in parameter No. PA05.

4.1.7 Electronic gear

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA06	CMX	Electronic gear numerator (Command pulse multiplying factor numerator)	1	1 to 65535		○		
PA07	CDV	Electronic gear denominator (Command pulse multiplying factor denominator)	1	1 to 65535		○		

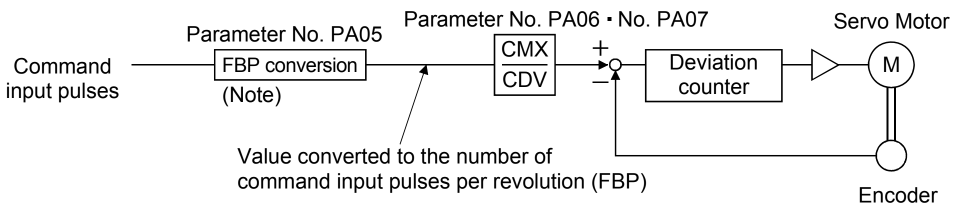
⚠CAUTION ・Incorrect setting may cause unexpectedly fast rotation, resulting injury.

POINT

- The electronic gear setting range is $\frac{1}{50} < \frac{CMX}{CDV} < 500$.
  If the set value is outside this range, noise may be generated during acceleration/deceleration, or operation may not be performed at the preset speed and/or acceleration/deceleration time constants.
- Always set the electronic gear with servo off state to prevent unexpected operation due to improper setting.

(1) Concept of electronic gear

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



Note. This process converts the number of the command input pulses required to rotate the servo motor one turn to the value set in parameter No. PA05.

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

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

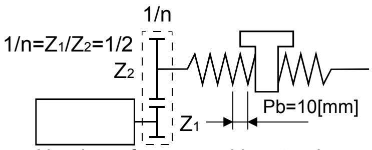
POINT

- The following specification symbols are required to calculate the electronic gear
  Pb : Ballscrew lead [mm]
  1/n : Reduction ratio
  $\Delta \ell_0$: Travel per command pulse [mm/pulse]
  ΔS : Travel per servo motor revolution [mm/rev]
  $\Delta\theta_0$: Angle per pulse [° /pulse]
  $\Delta\theta$: Angle per revolution [° /rev]

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

Machine specifications

Ballscrew lead Pb =10 [mm]
Reduction ratio: $1/n = Z_1/Z_2 = 1/2$
Z_1: Number of gear cogs on servo motor side
Z_2: Number of gear cogs on load side
Number of command input pulses per revolution:
10000 [pulse/rev]



$$\frac{CMX}{CDV} = \Delta\ell_0 \cdot \frac{10000}{\Delta S} = \Delta\ell_0 \cdot \frac{10000}{1/n \cdot Pb} = 10 \times 10^{-3} \cdot \frac{10000}{1/2 \cdot 10} = \frac{20}{1}$$

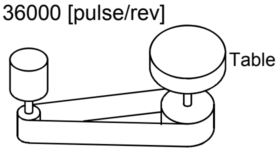
Hence, set 20 to CMX and 1 to CDV.

(b) Conveyor setting example

For rotation in increments of 0.01° per pulse

Machine specifications

Table : 360° /rev
Reduction ratio : $1/n=P_1/P_2=625/12544$
P_1: Pulley diameter on servo motor side
P_2: Pulley diameter on load side
Number of command input pulses per revolution:
36000 [pulse/rev]



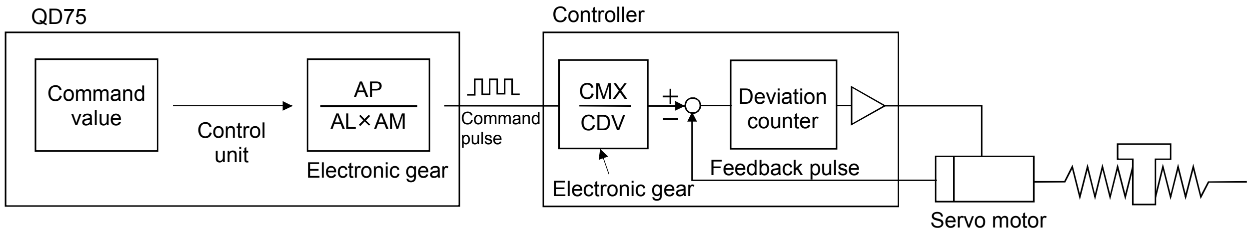
$$\frac{CMX}{CDV} = \Delta\theta_0 \cdot \frac{36000}{\Delta\theta} = 0.01 \cdot \frac{36000}{625/12544 \cdot 360} = \frac{12544}{625} \qquad (4.1)$$

POINT
・In the linear or rotary operation, setting the following values in the number of command input pulses per revolution (parameter No. PA05) simplifies the setting values of the electronic gear (parameter No. PA06, PA07). Liner operation: 100 (10000[pulse/rev]) Rotary operation: 360 (36000[pulse/rev])

(2) Setting for use of QD75

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

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



For example, if 100 (1000[pulse/rev]) is set to parameter No. PA05, the pulse command required to rotate the servo motor is as follows.

Servo motor speed [r/min]	Required pulse command
2000	10000×2000/60=333333 [pulse/s]
3000	10000×3000/60=500000 [pulse/s]

Use the electronic gear of the controller to rotate the servo motor under the maximum output pulse command of the QD75.

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

$$f \cdot \frac{CMX}{CDV} = \frac{N_0}{60} \cdot 10000$$

f : Input pulse frequency [pulse/s]
N_0 : Servo motor speed [r/min]

$$200 \cdot 10^3 \cdot \frac{CMX}{CDV} = \frac{3000}{60} \cdot 10000$$

$$\frac{CMX}{CDV} = \frac{3000}{60} \cdot \frac{10000}{200 \cdot 10^3} = \frac{3000 \cdot 10000}{60 \cdot 200000} = \frac{15}{6}$$

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

<table>
<tr><td colspan="4">Rated servo motor speed</td><td colspan="2">3000r/min</td><td colspan="2">2000r/min</td></tr>
<tr><td rowspan="4">Controller</td><td colspan="3">Input system</td><td>Open collector</td><td>Differential line driver</td><td>Open collector</td><td>Differential line driver</td></tr>
<tr><td colspan="3">Max. input pulse frequency [pulse/s]</td><td>200k</td><td>1M</td><td>200k</td><td>1M</td></tr>
<tr><td colspan="3">Feedback pulse/revolution [pulse/rev]</td><td colspan="2">10000</td><td colspan="2">10000</td></tr>
<tr><td colspan="3">Electronic gear (CMX/CDV)</td><td>15/6</td><td>1/2</td><td>5/3</td><td>1/3</td></tr>
<tr><td rowspan="8">AD75P</td><td colspan="3">Command pulse frequency [kpulse/s] (Note)</td><td>200k</td><td>1M</td><td>200k</td><td>1M</td></tr>
<tr><td colspan="3">Number of pulses per servo motor revolution as viewed from QD75[pulse/rev]</td><td>4000</td><td>20000</td><td>6000</td><td>30000</td></tr>
<tr><td rowspan="6">Electronic gear</td><td rowspan="3">Minimum command unit 1pulse</td><td>AP</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>AL</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>AM</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td rowspan="3">Minimum command unit 0.1μm</td><td>AP</td><td>4000</td><td>20000</td><td>6000</td><td>30000</td></tr>
<tr><td>AL</td><td>1000.0[μm]</td><td>1000.0[μm]</td><td>1000.0[μm]</td><td>1000.0[μm]</td></tr>
<tr><td>AM</td><td>10</td><td>10</td><td>10</td><td>10</td></tr>
</table>

Note. Command pulse frequency at rated speed

POINT

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

4.1.8 Auto tuning

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA08	ATU	Auto tuning mode	001h	Refer to the text.		○	○	
PA09	RSP	Auto tuning response	6	1 to 16		○	○	

> **POINT**
>
> - When executing one-touch tuning, the setting value of parameter No. PA08 is changed to "□□0", and the setting value of parameter No. PA09 is automatically set. (Refer to section 6.1.)

Make gain adjustment using auto tuning. Refer to section 6.3 for details.

(1) Auto tuning mode (parameter No. PA08)

Select the auto tuning mode.

Parameter No. PA08

0	0	

Auto tuning mode setting

Setting	Auto tuning mode	Estimated load to motor inertia moment ratio	Automatically set parameter No. (Note)	Manually set parameter No. (Note)
0	2-gain adjustment mode	Valid	PB06, PB08, PB09, PB10	PA09, PB07
1	Auto tuning mode 1	Valid	PB06, PB07, PB08, PB09, PB10	PA09
3	Manual mode	Invalid		PB06, PB07, PB08, PB09, PB10

Note. The parameters have the following names.

Parameter No.	Name
PA09	Auto tuning response
PB06	Load to motor inertia moment ratio
PB07	Model loop gain
PB08	Position loop gain
PB09	Speed loop gain
PB10	Speed integral compensation

(2) Auto tuning response (parameter No. PA09)

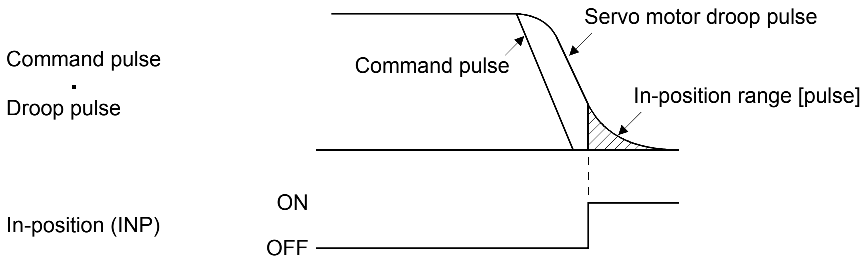
If the machine hunts or generates large gear sound, decrease the set value. To improve performance, e.g. shorten the settling time, increase the set value.

Setting	Response
1	Low response
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	High response

4.1.9 In-position range

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA10	INP	In-position range	100	0 to 65535	pulse	○		

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



4.1.10 Torque limit

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA11	TLP	Forward torque limit	100	0 to 100	%	○	○	○
PA12	TLN	Reverse torque limit	100	0 to 100	%	○	○	○

The torque generated by the servo motor can be limited. Refer to section 3.6.1 (4) and use these parameters.

(1) Forward torque limit (parameter No. PA11)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CCW driving mode or CW regeneration mode. Set this parameter to "0" to generate no torque.

(2) Reverse torque limit (parameter No. PA12)
Set this parameter on the assumption that the maximum torque is 100 [%]. Set this parameter when limiting the torque of the servo motor in the CW driving mode or CCW regeneration mode. Set this parameter to "0" to generate no torque.

4.1.11 Selection of command input pulse form

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA13	*PLSS	Command input pulse form	000h	Refer to the text.		○		

POINT

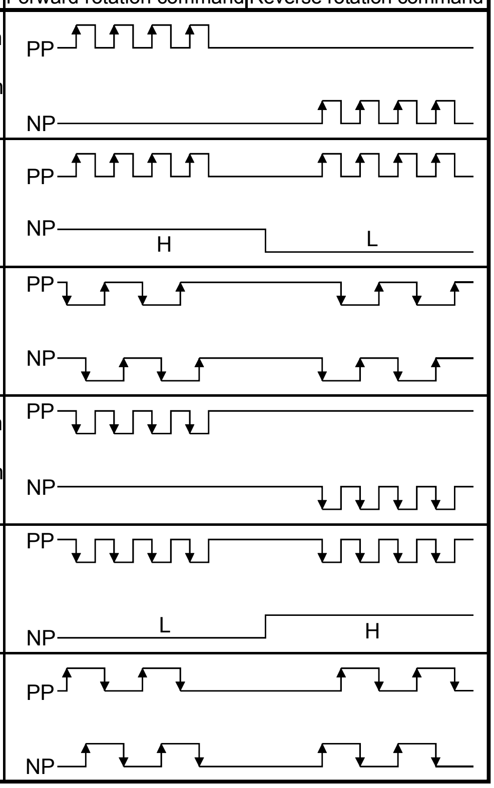
- This parameter is made valid when power is switched off, then on after setting.
- The noise immunity can be enhanced by setting parameter No. PA13 to "1□□" when the frequency of the command input pulse is 500kpps or less and "2□□" when 200kpps or less.

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

Parameter No. PA13

Selection of command input pulse form

Setting	Pulse train form		Forward rotation command / Reverse rotation command
00	Positive logic	Forward rotation pulse train Reverse rotation pulse train	
01	Positive logic	Signed pulse train	
02	Positive logic	A-phase pulse train B-phase pulse train	
10	Negative logic	Forward rotation pulse train Reverse rotation pulse train	
11	Negative logic	Signed pulse train	
12	Negative logic	A-phase pulse train B-phase pulse train	



Pulse train input filter selection

Setting	Command pulse frequency
0	1Mpps or less
1	500kpps or less
2	200kpps or less

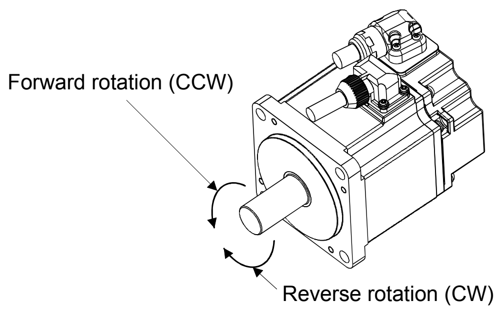
4.1.12 Selection of servo motor rotation direction

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA14	*POL	Rotation direction selection	0	0・1		○		

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

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

Parameter No. PA14 setting	Servo motor rotation direction	
	When forward rotation pulse is input	When reverse rotation pulse is input
0	CCW	CW
1	CW	CCW



4.1.13 Encoder output pulses

Parameter			Initial value	Setting range	Unit	Control mode		
No.	Symbol	Name				Position	Internal speed	Internal torque
PA15	*ENR	Encoder output pulses	4000	1 to 65535	pulse/rev	○	○	○
PA16	*ENR2	Encoder output pulse electronic gear	1	1 to 65535		○	○	○

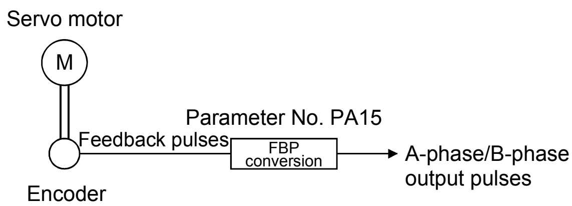
POINT

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

Used to set the encoder pulses (A-phase, B-phase) output by the controller.
Set the value 4 times greater than the A-phase or B-phase pulses.
You can use parameter No. PC13 to choose the output pulse setting or output division ratio setting.
The number of A/B-phase pulses actually output is 1/4 of the preset number of pulses.
The maximum output frequency is 4.6Mpps (after multiplied by 4). Use this parameter within this range.

(1) For output pulse designation
Set parameter No. PC13 to "□0□" (initial value).
Set the number of pulses per servo motor revolution.
Output pulse = set value [pulses/rev]
For instance, when parameter No. PA15 is set to "5600", the A/B-phase pulses actually output are as indicated below.

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



(2) For output division ratio setting

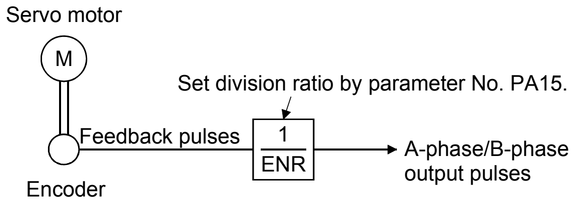
Set parameter No. PC13 to " □ 1 □ ".

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

$$\text{Output pulse} = \frac{\text{Resolution per servo motor revolution}}{\text{Setting valve}} \text{ [pulse/rev]}$$

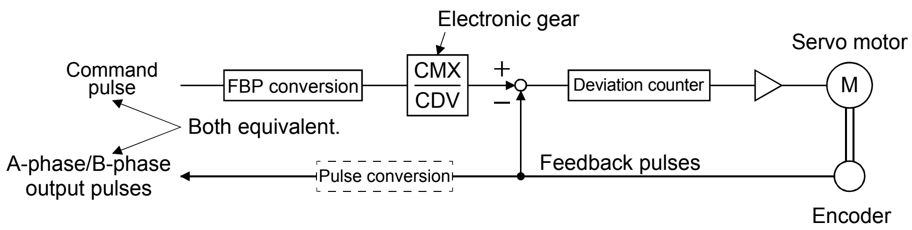
For instance, when parameter No. PA15 is set to "8", the A/B-phase pulses actually output are as indicated below.

$$\text{A/B-phase output pulses} = \frac{131072}{8} \cdot \frac{1}{4} = 4096 \text{ [pulse]}$$



(3) When outputting pulse same as command pulses

Set parameter No. PC13 to " □ 2 □ ". The feedback pulses from the encoder can be output after being converted to the same value as the command pulse.



(4) When multiplying A-phase/B-phase output pulses by the value of the electronic gear
Set parameter No. PC13 to "□3□".
The value resulted from multiplying the number of pulses per servo motor revolution by the value of the electronic gear becomes the output pulse.

(a) Set the electric gear numerator in the A-phase/B-phase output pulses to parameter No. PA15.

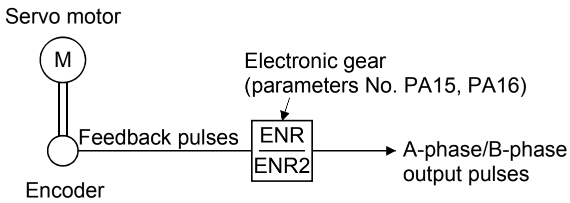
(b) Set the electric gear denominator in the A-phase/B-phase output pulses to parameter No. PA16.

(Example) When using the LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ servo motor series
When parameter No. PA15 is set to "5600" and PA16 to "4096", the A/B-phase pulses actually outputted are as follows.

A-phase/B-phase output pulses =

$$\text{Resolution per servo motor revolution} \cdot \frac{\text{parameter No.15}}{\text{parameter No.16}} \cdot \frac{1}{4}$$

$$= 131072 \cdot \frac{5600}{4096} \cdot \frac{1}{4} = 44800 \text{ [pulse]}$$



POINT
・Resolution per servo motor revolution depends on the servo motor as follows. LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ servo motor: 131072pulse/rev LE-S5-□, LE-S6-□, LE-S7-□,LE-S8-□ servo motor: 262144pulse/rev

4.2 Gain/filter parameters (No. PB□□)

POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid. ・Set any parameter with [Applied] written in the name column when using an advanced function.

4.2.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Internal speed	Internal torque
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	000h		○	○	
PB02	VRFT	Vibration suppression control tuning mode (Advanced vibration suppression control)	000h		○		
PB03	PST	Position command acceleration/deceleration time constant (Position smoothing)	3	ms	○		
PB04	FFC	Feed forward gain [Applied]	0	%	○		
PB05		For manufacturer setting	500				
PB06	GD2	Load to motor inertia moment ratio	70	×0.1	○	○	
PB07	PG1	Model loop gain	24	rad/s	○	○	
PB08	PG2	Position loop gain	37	rad/s	○		
PB09	VG2	Speed loop gain	823	rad/s	○	○	
PB10	VIC	Speed integral compensation	337	×0.1 ms	○	○	
PB11	VDC	Speed differential compensation [Applied]	980		○	○	
PB12	OVA	Overshoot amount compensation [Applied]	0	%	○	○	
PB13	NH1	Machine resonance suppression filter 1	4500	Hz	○	○	
PB14	NHQ1	Notch shape selection 1	000h		○	○	
PB15	NH2	Machine resonance suppression filter 2	4500	Hz	○	○	
PB16	NHQ2	Notch shape selection 2	000h		○	○	
PB17		Automatic setting parameter					
PB18	LPF	Low-pass filter setting [Applied]	3141	rad/s	○	○	
PB19	VRF1	Vibration suppression control vibration frequency setting [Applied]	1000	×0.1 Hz	○		
PB20	VRF2	Vibration suppression control resonance frequency setting [Applied]	1000	×0.1 Hz	○		
PB21		For manufacturer setting	0				
PB22			0				
PB23	VFBF	Low-pass filter selection [Applied]	000h		○	○	
PB24		For manufacturer setting	000h				
PB25	*BOP1	Function selection B-1 [Applied]	000h		○		
PB26	*CDP	Gain changing selection [Applied]	000h		○	○	
PB27	CDL	Gain changing condition [Applied]	10		○	○	
PB28	CDT	Gain changing time constant [Applied]	1	ms	○	○	
PB29	GD2B	Gain changing load to motor inertia moment ratio [Applied]	70	×0.1	○	○	
PB30	PG2B	Gain changing position loop gain [Applied]	37	rad/s	○		
PB31	VG2B	Gain changing speed loop gain [Applied]	823	rad/s	○	○	
PB32	VICB	Gain changing speed integral compensation [Applied]	337	×0.1 ms	○	○	
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting [Applied]	1000	×0.1 Hz	○		

No.	Symbol	Name	Initial value	Unit	Control mode Position	Control mode Internal speed	Control mode Internal torque
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting [Applied]	1000	×0.1 Hz	○		
PB35		For manufacturer setting	0				
PB36			0				
PB37			100				
PB38	NH3	Machine resonance suppression filter 3	4500	Hz	○	○	
PB39	NHQ3	Notch shape selection 3	000h		○	○	
PB40		For manufacturer setting	111h				
PB41			20				
PB42			000h				
PB43			000h				
PB44			000h				
PB45			000h				
PB46			000h				
PB47			000h				
PB48			000h				
PB49			000h				
PB50			000h				

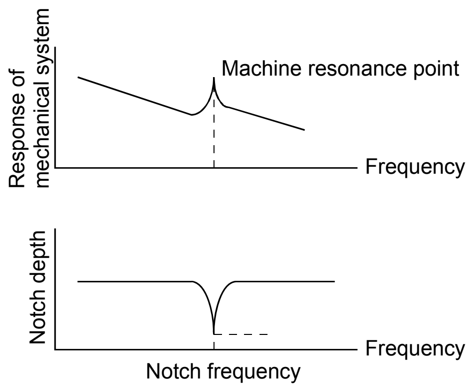
4.2.2 Detail list

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	000h	Refer to name and function column.		○	○	

POINT

- When executing one-touch tuning, the adaptive tuning mode starts automatically.
- When the adaptive filter is set during the one-touch tuning, this parameter is changed to "□□2" automatically.

Select if the adaptive tuning is used or not. Setting this parameter to "□□2" (manual mode) enables users to manually adjust the machine resonance suppression filter 1 (parameter No. PB13) and notch shape selection 1 (parameter No. PB14).
When this parameter is set to "□□0", the initial values are set for both the machine resonance suppression filter 1 and the notch shape selection 1.



0 0 □

Selection of adaptive tuning mode

Setting	Adaptive tuning mode	Parameter that can be set manually
0	Filter OFF	(Note)
2	Manual mode	Parameter No. PB13 Parameter No. PB14

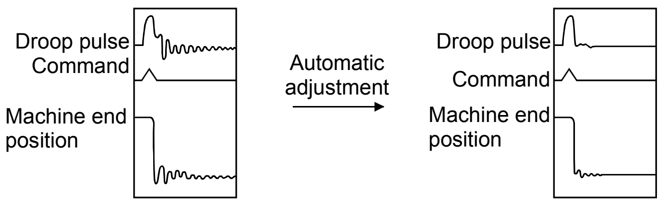
Note. Parameter No. PB13 and PB14 are fixed to the initial values.

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PB02	VRFT	Vibration suppression control tuning mode (Advanced vibration suppression control)	000h	Refer to name and function column.		○		

POINT

- When using the vibration suppression control tuning mode (advanced vibration suppression control) and the one-touch tuning simultaneously, refer to section 7.2.4 (3).

The vibration suppression is valid when parameter No. PA08 (auto tuning mode) is set to "□□3". When PA08 is set to"□□1", vibration suppression is always invalid.
Select the setting method for vibration suppression control tuning. Setting this parameter to "□□1" (vibration suppression control tuning mode) automatically changes the vibration suppression control vibration frequency setting (parameter No. PB19) and vibration suppression control resonance frequency setting (parameter No. PB20) after positioning is performed the predetermined number of times.



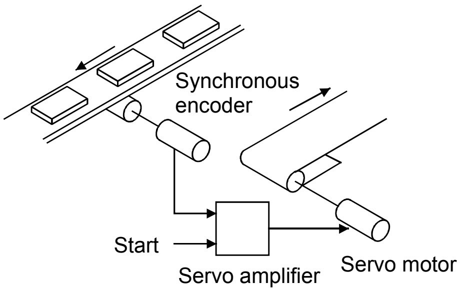
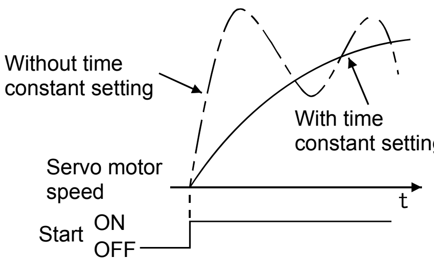
0	0	□

└ Vibration suppression control tuning mode

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

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

When this parameter is set to "□□1", the tuning is completed after positioning is performed the predetermined number of times for the predetermined period of time, and the setting changes to "□□2". When the vibration suppression control tuning is not necessary, the setting changes to "□□0". When this parameter is set to "□□0", the initial values are set to the vibration suppression control vibration frequency setting and vibration suppression control resonance frequency setting. However, this does not occur when the servo off.

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PB03	PST	Position command acceleration/deceleration time constant (Position smoothing) Used to set the time constant of a low-pass filter in response to the position command. When the one-touch tuning is executed, this parameter is automatically set. (Refer to section 6.1.) The control system of either the primary delay or the linear acceleration/deceleration can be selected by parameter No. PB25. When the linear acceleration/deceleration is selected, the setting range is 0 to 10ms. Setting of longer than 10ms is recognized as 10ms. **POINT** ・ When the linear acceleration/deceleration is selected, do not execute control switching. Doing so will cause the servo motor to make a sudden stop during the control switching. (Example) When a command is given from a synchronous encoder, synchronous operation can be started smoothly if started during line operation.  	3	0 to 20000	ms	○		
PB04	FFC	Feed forward gain [Applied] Set the feed forward gain. When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1s or more as the acceleration/deceleration time constant up to the rated speed.	0	0 to 100	%	○		
PB05		For manufacturer setting Do not change this value by any means.	500					
PB06	GD2	Load to motor inertia moment ratio Used to set the load to motor inertia moment ratio. When auto tuning mode 1 and 2-gain adjustment mode are selected, this parameter is automatically set. (Refer to section 6.2.) In this case, it varies between 0.0 and 100.0.	70	0 to 3000	×0.1	○	○	

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode Position	Internal speed	Internal torque
PB07	PG1	Model loop gain Set the response gain up to the target position. As the gain is increased, the track ability in response to the command is improved. When executing the one-touch tuning, the result of the one-touch tuning is automatically set in this parameter. When auto turning mode 1 is selected, the result of auto turning is automatically set in this parameter.	24	1 to 2000	rad/s	○	○	
PB08	PG2	Position loop gain 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 mode 1 and 2-gain adjustment mode are set, the result of auto tuning is automatically set in this parameter.	37	1 to 1000	rad/s	○		
PB09	VG2	Speed loop gain Set the gain of the speed loop. Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 and 2-gain adjustment mode are set, the result of auto tuning is automatically set in this parameter.	823	20 to 50000	rad/s	○	○	
PB10	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. Lower setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 and 2-gain adjustment mode are set, the result of auto tuning is automatically set in this parameter.	337	1 to 10000	×0.1 ms	○	○	
PB11	VDC	Speed differential compensation [Applied] Used to set the differential compensation. The set value is made valid when the proportion control (PC) is switched on or the PID control is set in the PI-PID changing.	980	0 to 1000		○	○	
PB12	OVA	Overshoot amount compensation [Applied] Set the suppression ratio of the overshoot suppression control. Set the suppression ratio for the friction torque in %. POINT ・This parameter can reduce the overshoot caused by a device having large friction.	0	0 to 100	%	○	○	
PB13	NH1	Machine resonance suppression filter 1 Set the notch frequency of the machine resonance suppression filter 1. Executing one-touch tuning automatically changes this parameter. When parameter No. PB01 is set to "□□0", the setting of this parameter is ignored.	4500	30 to 4500	Hz	○	○	

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Setting range</th><th rowspan="2">Unit</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Internal speed</th><th>Internal torque</th></tr>
<tr><td>PB14</td><td>NHQ1</td><td>Notch shape selection 1
Used to select the machine resonance suppression filter 1.
□□0
Notch depth selection
<table>
<tr><th>Setting</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width selection
<table>
<tr><th>Setting</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table>
Executing one-touch tuning automatically changes this parameter.
When parameter No. PB01 is set to "□□0", the setting of this parameter is ignored.</td><td>000h</td><td>Refer to name and function column.</td><td></td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB15</td><td>NH2</td><td>Machine resonance suppression filter 2
Set the notch frequency of the machine resonance suppression filter 2.
Set parameter No. PB16 (notch shape selection 2) to "□□1" to make this parameter valid.</td><td>4500</td><td>30
to
4500</td><td>Hz</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB16</td><td>NHQ2</td><td>Notch shape selection 2
Select the shape of the machine resonance suppression filter 2.
□□□
Machine resonance suppression filter 2 selection
0: Invalid
1: Valid
Notch depth selection
<table>
<tr><th>Setting</th><th>Depth</th><th>Gain</th></tr>
<tr><td>0</td><td>Deep</td><td>−40dB</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr>
<tr><td>2</td><td>−8dB</td></tr>
<tr><td>3</td><td>Shallow</td><td>−4dB</td></tr>
</table>
Notch width selection
<table>
<tr><th>Setting</th><th>Width</th><th>α</th></tr>
<tr><td>0</td><td>Standard</td><td>2</td></tr>
<tr><td>1</td><td rowspan="2">to</td><td>3</td></tr>
<tr><td>2</td><td>4</td></tr>
<tr><td>3</td><td>Wide</td><td>5</td></tr>
</table></td><td>000h</td><td>Refer to name and function column.</td><td></td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB17</td><td></td><td>Automatic setting parameter
The value of this parameter is set according to a set value of parameter No. PB06 (load to motor inertia moment ratio).</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PB18	LPF	Low-pass filter setting [Applied] Set the low-pass filter. Setting parameter No. PB23 (low-pass filter selection) to "□0□" automatically changes this parameter. When parameter No. PB23 is set to "□1□", this parameter can be set manually.	3141	100 to 9000	rad/s	○	○	
PB19	VRF1	Vibration suppression control vibration frequency setting [Applied] Set the vibration frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. Setting parameter No. PB02 (vibration suppression control tuning mode) to "□□1" automatically changes this parameter. When parameter No. PB02 is set to "□□2", this parameter can be set manually.	1000	1 to 1000	×0.1 Hz	○		
PB20	VRF2	Vibration suppression control resonance frequency setting [Applied] Set the resonance frequency for vibration suppression control to suppress low-frequency machine vibration, such as enclosure vibration. Setting parameter No. PB02 (vibration suppression control tuning mode) to "□□1" automatically changes this parameter. When parameter No. PB02 is set to "□□2", this parameter can be set manually.	1000	1 to 1000	×0.1 Hz	○		
PB21		For manufacturer setting	0					
PB22		Do not change this value by any means.	0					
PB23	VFBF	Low-pass filter selection [Applied] Select the low-pass filter. 0 □ 0 Low-pass filter selection 0: Automatic setting 1: Manual setting (parameter No. PB18 setting) When the automatic setting is selected, a filter with band width that is closed to the calculation result of the following formula is selected $\frac{VG2 \cdot 10}{1+GD2}$ [rad/s].	000h	Refer to name and function column.		○	○	
PB24		For manufacturer setting Do not change this value by any means.	000h					
PB25	*BOP1	Function selection B-1 [Applied] Select the control systems for position command acceleration/deceleration time constant (parameter No. PB03). 0 □ 0 Control of position command acceleration/ deceleration time constant 0: Primary delay 1: Linear acceleration/deceleration When linear acceleration/deceleration is selected, do not execute control switching after instantaneous power failure. The servo motor will make a sudden stop during the control switching.	000h	Refer to name and function column.		○		

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PB26	*CDP	Gain changing selection [Applied] Select the gain changing condition. (Refer to section 7.3.) 0 □ □ Gain changing selection (last digit) Under any of the following conditions, the gains change on the basis of parameter No. PB29 to PB34 settings. 0: Invalid 1: Input device (gain changing (CDP)) 2: Command frequency (parameter No.PB27 setting) 3: Droop pulse (parameter No.PB27 setting) 4: Servo motor speed (parameter No.PB27 setting) Gain changing condition (second digit) 0: Valid when the input device (gain changing (CDP)) is ON, or valid when the value is equal to or larger than the value set in parameter No. PB27. 1: Valid when the input device (gain changing (CDP)) is OFF, or valid when the value is equal to or smaller than the value set in parameter No. PB27.	000h	Refer to name and function column.		○	○	
PB27	CDL	Gain changing condition [Applied] Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No. PB26. The set value unit varies depending on the changing condition item. (Refer to section 7.3.)	10	0 to 9999	kpps pulse r/min	○	○	
PB28	CDT	Gain changing time constant [Applied] Used to set the time constant at which the gains change in response to the conditions set in parameters No. PB26 and PB27. (Refer to section 7.3.)	1	0 to 100	ms	○	○	
PB29	GD2B	Gain changing load to motor inertia moment ratio [Applied] Used to set the load to motor inertia moment ratio when gain changing is valid. This parameter is made valid when the auto tuning mode is invalid (parameter No. PA08: □□3).	70	0 to 3000	×0.1	○	○	
PB30	PG2B	Gain changing position loop gain [Applied] Set the position loop gain when the gain changing is valid. This parameter is made valid when the auto tuning mode is invalid (parameter No. PA08: □□3).	37	1 to 2000	rad/s	○		
PB31	VG2B	Gain changing speed loop gain [Applied] Set the speed loop gain when the gain changing is valid. This parameter is made valid when the auto tuning mode is invalid (parameter No. PA08: □□3).	823	20 to 50000	rad/s	○	○	
PB32	VICB	Gain changing speed integral compensation [Applied] Set the speed integral compensation when the gain changing is valid. This parameter is made valid when the auto tuning mode is invalid (parameter No. PA08: □□3).	337	1 to 50000	×0.1 ms	○	○	
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting [Applied] Set the vibration frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when parameter No. PB02 is set to "□□2" and parameter No. PB26 is set to "□□1". When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.	1000	1 to 1000	×0.1 Hz	○		

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Setting range</th><th rowspan="2">Unit</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Internal speed</th><th>Internal torque</th></tr>
<tr><td>PB34</td><td>VRF2B</td><td>Gain changing vibration suppression control resonance frequency setting [Applied]
Set the resonance frequency for vibration suppression control when the gain changing is valid. This parameter is made valid when parameter No. PB02 is set to "□□2" and parameter No. PB26 is set to "□□1".
When using the vibration suppression control gain changing, always execute the changing after the servo motor has stopped.</td><td>1000</td><td>1
to
1000</td><td>×0.1
Hz</td><td>○</td><td></td><td></td></tr>
<tr><td>PB35</td><td rowspan="3"></td><td rowspan="3">For manufacturer setting
Do not change this value by any means.</td><td>0</td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td></tr>
<tr><td>PB36</td><td>0</td></tr>
<tr><td>PB37</td><td>100</td></tr>
<tr><td>PB38</td><td>NH3</td><td>Machine resonance suppression filter 3
Set the notch frequency of the machine resonance suppression filter 3.
Set parameter No. PB39 (notch shape selection 3) to "□□1" to make this parameter valid.</td><td>4500</td><td>30
to
4500</td><td>Hz</td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB39</td><td>NHQ3</td><td>Notch shape selection 3
Used to select the machine resonance suppression filter 3.

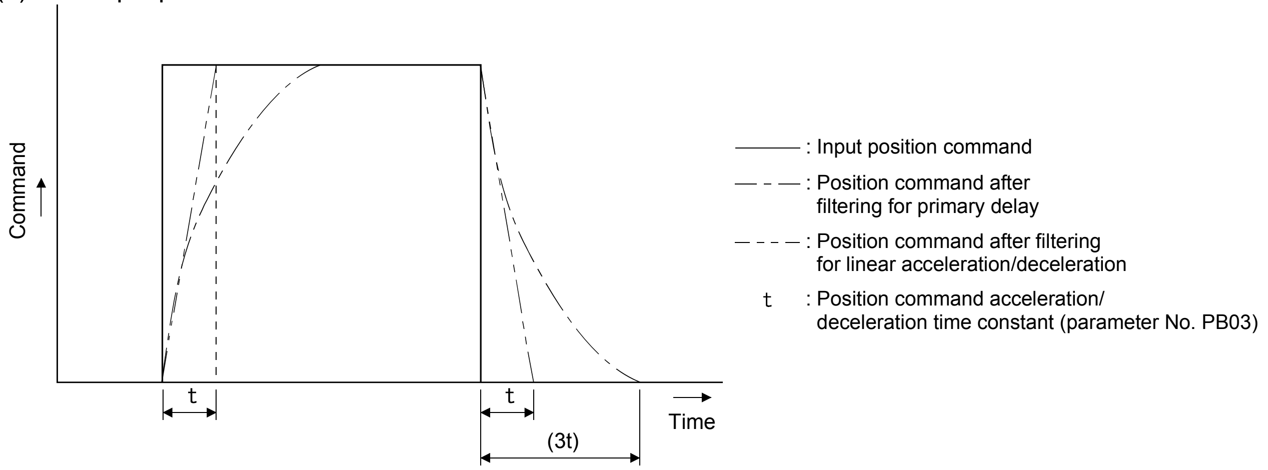
Machine resonance suppression filter 3 selection
0: Invalid
1: Valid

Notch depth selection
<table><tr><th>Setting</th><th>Depth</th><th>Gain</th></tr><tr><td>0</td><td>Deep</td><td>−40dB</td></tr><tr><td>1</td><td rowspan="2">to</td><td>−14dB</td></tr><tr><td>2</td><td>−8dB</td></tr><tr><td>3</td><td>Shallow</td><td>−4dB</td></tr></table>
Notch width selection
<table><tr><th>Setting</th><th>Width</th><th>α</th></tr><tr><td>0</td><td>Standard</td><td>2</td></tr><tr><td>1</td><td rowspan="2">to</td><td>3</td></tr><tr><td>2</td><td>4</td></tr><tr><td>3</td><td>Wide</td><td>5</td></tr></table></td><td>000h</td><td>Refer to name and function column.</td><td></td><td>○</td><td>○</td><td></td></tr>
<tr><td>PB40</td><td rowspan="11"></td><td rowspan="11">For manufacturer setting
Do not change this value by any means.</td><td>111h</td><td rowspan="11"></td><td rowspan="11"></td><td rowspan="11"></td><td rowspan="11"></td><td rowspan="11"></td></tr>
<tr><td>PB41</td><td>20</td></tr>
<tr><td>PB42</td><td>000h</td></tr>
<tr><td>PB43</td><td>000h</td></tr>
<tr><td>PB44</td><td>000h</td></tr>
<tr><td>PB45</td><td>000h</td></tr>
<tr><td>PB46</td><td>000h</td></tr>
<tr><td>PB47</td><td>000h</td></tr>
<tr><td>PB48</td><td>000h</td></tr>
<tr><td>PB49</td><td>000h</td></tr>
<tr><td>PB50</td><td>000h</td></tr>
</table>

4.2.3 Position smoothing

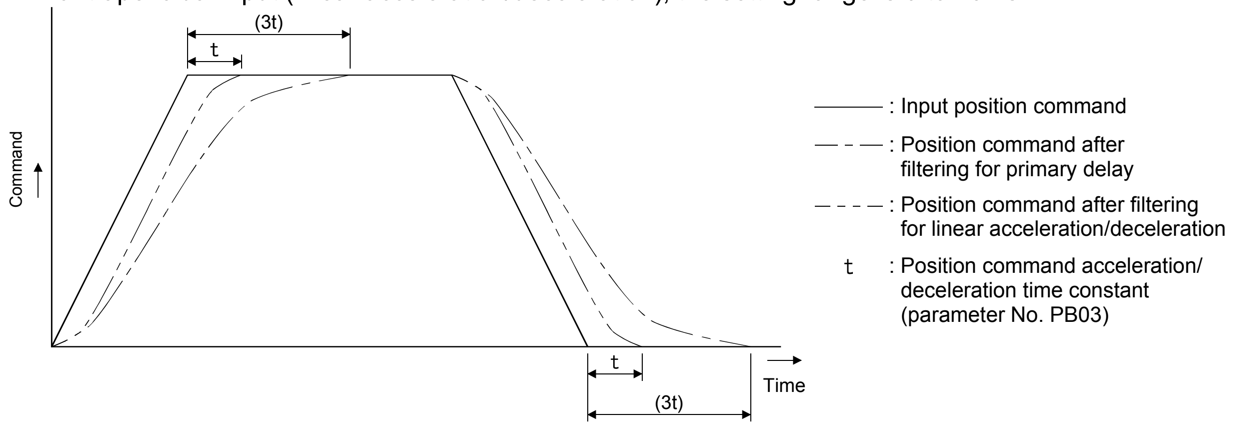
By setting the position command acceleration/deceleration time constant (parameter No. PB03), the servo motor is operated smoothly in response to a sudden position command.
The following diagrams show the operation patterns of the servo motor in response to a position command when the position command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

(1) For step input



(2) For trapezoidal input

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



4.3 Extension setting parameters (No. PC□□)

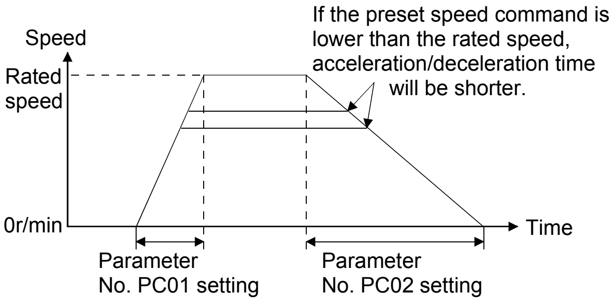
POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid. ・Set any parameter with [Applied] written in the name column when using an advanced function.

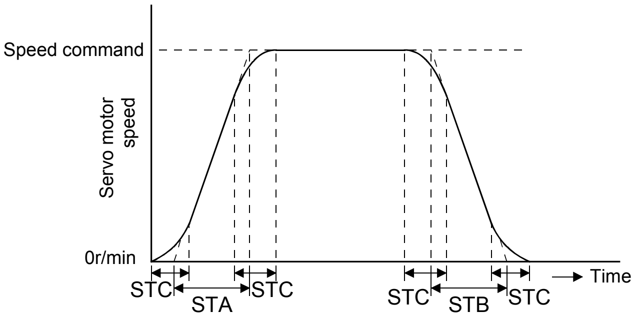
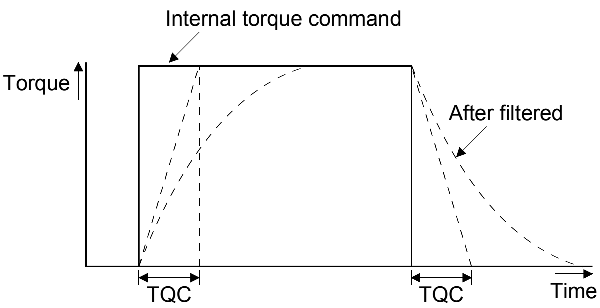
4.3.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Internal speed	Internal torque
PC01	STA	Acceleration time constant	0	ms		○	○
PC02	STB	Deceleration time constant	0	ms		○	○
PC03	STC	S-pattern acceleration/deceleration time constant	0	ms		○	○
PC04	TQC	Torque command time constant	0	ms			○
PC05	SC0	Internal speed command 0	0	r/min		○	
		Internal speed limit 0					○
PC06	SC1	Internal speed command 1	100	r/min		○	
		Internal speed limit 1					○
PC07	SC2	Internal speed command 2	500	r/min		○	
		Internal speed limit 2					○
PC08	SC3	Internal speed command 3	1000	r/min		○	
		Internal speed limit 3					○
PC09	MBR	Electromagnetic brake sequence output	100	ms	○	○	○
PC10	ZSP	Zero speed	50	r/min	○	○	○
PC11	*BPS	Alarm history clear	000h		○	○	○
PC12	TC	Internal torque command	0	×0.1%			○
PC13	*ENRS	Encoder output pulses selection	000h		○	○	○
PC14	TL2	Internal torque limit 2 [Applied]	100	%	○	○	○
PC15	ERZL	Error excessive alarm detection level	30	×0.1rev	○	○	○
PC16		For manufacturer setting	30				
PC17	*OSL	Overspeed alarm detection level	0	r/min	○	○	○
PC18		For manufacturer setting	1000				
PC19			0				
PC20			000h				
PC21			001h				
PC22	*COP1	Function selection C-1 [Applied]	000h		○	○	○
PC23	*COP2	Function selection C-2 [Applied]	000h			○	
PC24	*COP3	Function selection C-3 [Applied]	000h		○		
PC25	*COP4	Function selection C-4 [Applied]	000h		○	○	
PC26	ALDT	Detailed setting of overload tough drive [Applied]	200	×10ms	○	○	○
PC27	OSCL	Detailed setting of vibration tough drive [Applied]	50	%	○	○	
PC28	CVAT	Detailed setting of instantaneous power failure tough drive [Applied]	3	×10ms	○	○	○
PC29	*COP5	Function selection C-5 [Applied]	000h		○	○	○
PC30	*COP6	Function selection C-6 [Applied]	000h			○	
PC31	SC4	Internal speed command 4 [Applied]	200	r/min		○	
		Internal speed limit 4 [Applied]					○
PC32	SC5	Internal speed command 5 [Applied]	300	r/min		○	
		Internal speed limit 5 [Applied]					○

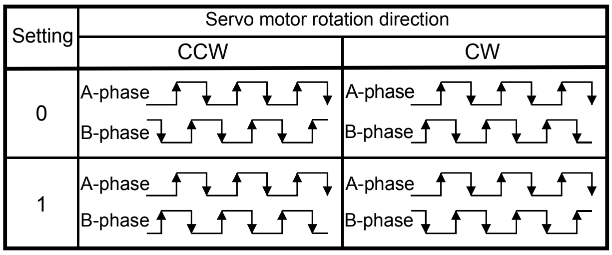
No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Internal speed	Internal torque
PC33	SC6	Internal speed command 6 [Applied]	500	r/min		○	
		Internal speed limit 6 [Applied]					○
PC34	SC7	Internal speed command 7 [Applied]	800	r/min		○	
		Internal speed limit 7 [Applied]					○
PC35		For manufacturer setting	000h				
PC36			0				
PC37			0				
PC38			0				
PC39			0				
PC40			0				
PC41			000h				
PC42			0				
PC43			000h				
PC44			000h				
PC45			000h				
PC46			000h				
PC47			000h				
PC48			000h				
PC49			000h				
PC50			000h				
PC51			000h				
PC52			000h				
PC53			000h				
PC54			000h				
PC55			000h				
PC56			000h				
PC57			000h				
PC58			000h				
PC59			000h				
PC60			000h				
PC61			000h				
PC62			000h				
PC63			000h				
PC64			000h				

4.3.2 List of details

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode Position	 Internal speed	 Internal torque
PC01	STA	Acceleration time constant Used to set the acceleration time required for the servo motor to reach the rated speed from 0r/min in response to the internal speed commands 0 to 7.  For example for the servo motor of 3000r/min rated speed, set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second.	0	0 to 50000	ms		○	○
PC02	STB	Deceleration time constant Used to set the deceleration time required for the servo motor to reach 0r/min from the rated speed in response to the internal speed commands 0 to 7.	0	0 to 50000	ms		○	○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PC03	STC	S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration. Set "0" to select the linear acceleration/deceleration.  STA: Acceleration time constant (parameter No. PC01) STB: Deceleration time constant (parameter No. PC02) STC: S-pattern acceleration/deceleration time constant (parameter No. PC03) Long setting of STA (acceleration time constant) or STB (deceleration time constant) may produce an error in the time of the arc part for the setting of the S-pattern acceleration/deceleration time constant. The upper limit for the actual time of the arc part is as follows: At acceleration: $\frac{2000000}{STA}$, At deceleration: $\frac{2000000}{STB}$ (Example) Settings of STA = 20000, STB = 5000 and STC = 200 limit the actual arc part times as follows: At acceleration: 100 [ms] (Since $\frac{2000000}{20000}$=100[ms]<200[ms], the time is limited to 100[ms].) At deceleration: 200 [ms] (Since $\frac{2000000}{5000}$=400[ms]>200[ms], the time is as-is.)	0	0 to 1000	ms		○	○
PC04	TQC	Torque command time constant Used to set the constant of a low-pass filter in response to the internal torque command.  TQC: Torque command time constant	0	0 to 20000	ms			○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PC05	SC0	Internal speed command 0 Used to set speed 0 of internal speed commands.	0	0 to instan-taneous permi-ssible speed	r/min		○	
		Internal speed limit 0 Used to set speed 0 of internal speed limits.						○
PC06	SC1	Internal speed command 1 Used to set speed 1 of internal speed commands.	100	0 to instan-taneous permi-ssible speed	r/min		○	
		Internal speed limit 1 Used to set speed 1 of internal speed limits.						○
PC07	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	0 to instan-taneous permi-ssible speed	r/min		○	
		Internal speed limit 2 Used to set speed 2 of internal speed limits.						○
PC08	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	0 to instan-taneous permi-ssible speed	r/min		○	
		Internal speed limit 3 Used to set speed 3 of internal speed limits.						○
PC09	MBR	Electromagnetic brake sequence output Used to set the delay time (Tb) from the electromagnetic brake interlock (MBR) turns off to the base drive circuit is shut-off.	100	0 to 1000	ms	○	○	○
PC10	ZSP	Zero speed Used to set the output range of the zero speed detection (ZSP). Zero speed detection (ZSP) has hysteresis width of 20r/min (refer to section 3.5 (1) (b))	50	0 to 10000	r/min	○	○	○
PC11	*BPS	Alarm history clear Used to clear the alarm history. [ ] [0] [ ] Alarm history clear 0: Invalid 1: Valid When alarm history clear is made valid, the alarm history and the number of tough drive are cleared at next power-on. After the alarm history and the number of tough drive are cleared, the setting is automatically made invalid (reset to 0). Presence or absence of drive recorder selection 0: Valid (drive recorder execution) 1: Invalid (drive recorder stop) MR Configurator is necessary referring to the drive recorder.	000h	Refer to the name and function field.		○	○	○
PC12	TC	Internal torque command Set the internal torque command during the internal torque control.	0	0 to 1000	×0.1%			○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PC13	*ENRS	Encoder output pulses selection Use to select the encoder output pulse direction and the encoder output pulse setting. 0 □ □ Encoder pulse output phase changing Changes the phases of A, B-phase encoder pulses output.  Encoder output pulse setting selection 0: Output pulse setting 1: Division ratio setting 2: Same output pulse setting as the command pulses. 3: A/B-phase pulses electronic gear setting Setting "2" makes parameter No. PA15 (encoder output pulses) setting invalid.	000h	Refer to the name and function field.		○	○	○
PC14	TL2	Internal torque limit 2 [Applied] Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced. The internal torque limit 2 is made valid when the internal torque limit selection (TL1) is turned on. (Refer to (4) in section 3.6.1.)	100	0 to 100	%	○	○	○
PC15	ERZL	Error excessive alarm detection level Set the error excessive alarm detection level in servomotor rotation angle unit.	30	1 to 999	×0.1 rev	○	○	○
PC16		For manufacturer setting Do not change this value by any means.	30					
PC17	*OSL	Overspeed alarm detection level Set the overspeed alarm detection level. When "0" or "value exceeding the maximum servo motor speed × 1.2" is set, the overspeed alarm detection level becomes "maximum motor speed × 1.2".	0	0 to 20000	r/min	○	○	○
PC18		For manufacturer setting Do not change this value by any means.	1000					
PC19			0					
PC20			000h					
PC21			001h					

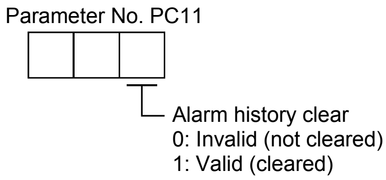
No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PC22	*COP1	Function selection C-1 [Applied] Select the encoder cable communication system. [ ][0][0] Encoder cable communication system 0: Two-wire type 1: Four-wire type The following encoder cables are of 4-wire type. MR-EKCBL30M-L MR-EKCBL30M-H MR-EKCBL40M-H MR-EKCBL50M-H All other encoder cables are 2-wire type. Incorrect setting will result in an encoder transmission data error3 (16.3).	000h	Refer to the name and function field.		○	○	○
PC23	*COP2	Function selection C-2 [Applied] Select the servo lock while the servo motor stops in internal speed control mode. [0][0][ ] Selection of servo lock while the servo motor stops in internal speed control mode. In the internal speed control mode, the servo motor shaft can be locked to prevent the shaft from being moved by the external force. 0: Valid (Servo-locked) The control to maintain the stop position is performed. 1: Invalid (Not servo-locked) The stop position is not maintained. The control to make the speed 0r/min is performed.	000h	Refer to the name and function field.			○	
PC24	*COP3	Function selection C-3 [Applied] Select the unit of the in-position range. [0][0][ ] In-position range unit selection 0: Command input pulse unit 1: Servo motor encoder pulse unit	000h	Refer to the name and function field.		○		
PC25	*COP4	Function selection C-4 [Applied] Select the stroke limit warning (99. □), tough drive warning (F0. □) and alarm history write. [ ][0][ ] Stroke limit warning (99. □) selection 0: Valid 1: Invalid When this parameter is set to "1", 99. □ will not occur even if the forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) turns OFF. Tough drive warning (F0. □) alarm history write selection 0: Writing to alarm history: Yes 1: Writing to alarm history: No The alarm is written to history at the tough drive warning (F0. □) occurrence when "0" is set.	000h	Refer to the name and function field.		○ ○	○ ○	

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PC26	ALDT	Detailed setting of overload tough drive [Applied] Limits the maximum value of the output time delay of the in-position (INP) and zero speed (ZSP) while the overload tough drive. Limit with the delay time permitted by the connected PC or PLC...etc side. When the tough drive function selection (parameter No. PA04) is set to " □□0" and this parameter (No. PC26) is set to "0", the output time delay of the in-position (INP) and zero speed (ZSP) are invalid.	200	0 to 999	×10 ms	○		
PC27	OSCL	Detailed setting of vibration tough drive [Applied] Set the filter re-adjustment detection range of parameter No. PB13 (machine resonance suppression filter 1) and parameter No. PB15 (machine resonance suppression filter 2). (Example) When this parameter is set to "50", it is re-adjusted when the oscillation detection level reaches 50% of the rated torque. When the tough drive function selection (parameter No. PA04) is set to " □0□", re-adjustments of the following filters are invalid: parameter No. PB13 (machine resonance suppression filter 1) and parameter No. PB15 (machine resonance suppression filter 2).	50	0 to 100	%	○	○	
PC28	CVAT	Detailed setting of instantaneous power failure tough drive [Applied] Set the time between the fall of the main circuit power supply to the alarm detection level and the occurrence of the instantaneous power failure alarm. When the tough drive function selection (parameter No. PA04) is set to "0□□", this parameter is invalid.	3	3 to 200	×10 ms	○	○	
PC29	*COP5	Function selection C-5 [Applied] Select the detection system of the main circuit power undervoltage alarm (10.2) [0][ ][0] Alarm selection at the main circuit power undervoltage level 0: Alarm (10.2) is detected regardless of the servo motor speed 1: When the servo motor speed is 50r/min or less, main circuit power off warning (E9. □) is detected	000h	Refer to the name and function field.		○	○	○
PC30	*COP6	Function selection C-6 [Applied] Select the speed command input unit. [0][0][ ] Selection of the speed command input unit (setting unit of internal speed command 0 to 7) 0: In unit of 1r/min 1: In unit of 0.1r/min	000h	Refer to the name and function field.			○	
PC31	SC4	Internal speed command 4 [Applied] Used to set speed 4 of internal speed commands.	200	0 to instan-taneous permi-ssible speed	r/min		○	
		Internal speed limit 4 [Applied] Used to set speed 4 of internal speed limits.						○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PC32	SC5	Internal speed command 5 [Applied] Used to set speed 5 of internal speed commands.	300	0 to instantaneous permissible speed	r/min		○	
		Internal speed limit 5 [Applied] Used to set speed 5 of internal speed limits.						○
PC33	SC6	Internal speed command 6 [Applied] Used to set speed 6 of internal speed commands.	500	0 to instantaneous permissible speed	r/min		○	
		Internal speed limit 6 [Applied] Used to set speed 6 of internal speed limits.						○
PC34	SC7	Internal speed command 7 [Applied] Used to set speed 7 of internal speed commands.	800	0 to instantaneous permissible speed	r/min		○	
		Internal speed limit 7 [Applied] Used to set speed 7 of internal speed limits.						○
PC35		For manufacturer setting Do not change this value by any means.	000h					
PC36			0					
PC37			0					
PC38			0					
PC39			0					
PC40			0					
PC41			000h					
PC42			0					
PC43			000h					
PC44			000h					
PC45			000h					
PC46			000h					
PC47			000h					
PC48			000h					
PC49			000h					
PC50			000h					
PC51			000h					
PC52			000h					
PC53			000h					
PC54			000h					
PC55			000h					
PC56			000h					
PC57			000h					
PC58			000h					
PC59			000h					
PC60			000h					
PC61			000h					
PC62			000h					
PC63			000h					
PC64			000h					

4.3.3 Alarm history clear

The controller stores past sixteen alarms since the power is switched on for the first time. To control alarms which will occur during the operation, clear the alarm history using parameter No. PC11 before starting the operation.
This parameter is made valid by switching the power from OFF to ON after setting.
The value in parameter No. PC11 automatically changes to " □□ 0 " after the alarm history is cleared.



4.4 I/O setting parameters (No. PD□□)

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

4.4.1 Parameter list

No.	Symbol	Name	Initial value	Unit	Control mode		
					Position	Internal speed	Internal torque
PD01	*DIA1	Input signal automatic ON selection 1	0000h		○	○	○
PD02		For manufacturer setting	0000h				
PD03	*DI1-1	Input signal device selection 1L (CN1-3)	0303h		○	○	
PD04	*DI1-2	Input signal device selection 1H (CN1-3)	2003h				○
PD05	*DI2-1	Input signal device selection 2L (CN1-4)	0202h		○	○	
PD06	*DI2-2	Input signal device selection 2H (CN1-4)	0202h				○
PD07	*DI3-1	Input signal device selection 3L (CN1-5)	0D06h		○	○	
PD08	*DI3-2	Input signal device selection 3H (CN1-5)	2C0Dh				○
PD09	*DI4-1	Input signal device selection 4L (CN1-6)	070Ah		○	○	
PD10	*DI4-2	Input signal device selection 4H (CN1-6)	0707h				○
PD11	*DI5-1	Input signal device selection 5L (CN1-7)	080Bh		○	○	
PD12	*DI5-2	Input signal device selection 5H (CN1-7)	0808h				○
PD13	*DI6-1	Input signal device selection 6L (CN1-8)	0505h		○	○	
PD14	*DI6-2	Input signal device selection 6H (CN1-8)	0505h				○
PD15	*DO1	Output signal device selection 1 (CN1-9)	0003h		○	○	○
PD16	*DO2	Output signal device selection 2 (CN1-10)	0004h		○	○	○
PD17	*DO3	Output signal device selection 3 (CN1-11)	0002h		○	○	○
PD18	*DO4	Output signal device selection 4 (CN1-12)	0005h		○	○	○
PD19	*DIF	Input filter setting	0002h		○	○	○
PD20	*DOP1	Function selection D-1	0000h		○	○	○
PD21		For manufacturer setting	0000h				
PD22	*DOP3	Function selection D-3	0000h		○		
PD23		For manufacturer setting	0000h				
PD24	*DOP5	Function selection D-5	0000h		○	○	○
PD25		For manufacturer setting	0000h				
PD26			0000h				

4.4.2 List of details

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Setting range</th><th rowspan="2">Unit</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Internal speed</th><th>Internal torque</th></tr>
<tr><td>PD01</td><td>*DIA1</td><td>Input signal automatic ON selection 1
Select the input devices to be automatically turned ON.

0 □ □ □
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td></td><td>0</td><td rowspan="4">0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td>Servo-on (SON)</td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
</table>
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td>Proportion control (PC)</td><td>0</td><td rowspan="4">0</td></tr>
<tr><td>Forced stop (EM1)</td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td></td><td>0</td></tr>
</table>
<table>
<tr><th rowspan="2">Signal name</th><th colspan="2">Initial value</th></tr>
<tr><th>BIN</th><th>HEX</th></tr>
<tr><td></td><td>0</td><td rowspan="4">0</td></tr>
<tr><td></td><td>0</td></tr>
<tr><td>Forward rotation stroke end (LSP)</td><td>0</td></tr>
<tr><td>Reverse rotation stroke end (LSN)</td><td>0</td></tr>
</table>
BIN 0: Used as external input signal
BIN 1: Automatic ON

Example 1: Turn ON SON
The setting is "□□□4".
Example 2: Turn ON LSP/LSN
・To turn ON LSP only: The setting is "□4□□".
・To turn ON LSN only: The setting is "□8□□".
・To turn ON both LSP and LSN: The setting is "□C□□".

POINT
・In the internal speed control mode, input status of LSP and LSN differs depending on their assignment conditions as follows.
・Not assigned to the external input signals: automatically turns on regardless of the value set in parameter No. PD01.
・Assigned to the external input signals: depends on the value set in parameter No. PD01.</td><td>000h</td><td>Refer to the name and function field.</td><td></td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PD02</td><td></td><td>For manufacturer setting
Do not change this value by any means.</td><td>0000h</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Setting range</th><th rowspan="2">Unit</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Internal speed</th><th>Internal torque</th></tr>
<tr><td>PD03</td><td>*DI1-1</td><td>Input signal device selection 1L (CN1-3)
Any input signal can be assigned to the CN1-3 pin.
Note that the setting digits and the signal that can be assigned vary depending on the control mode.

Position control mode
Internal speed control mode
Select the input device of the CN1-3 pin.

The devices that can be assigned in each control mode are indicated by symbols in the following table. If any other device is set, it is invalid.
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Control modes (Note 1)</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>00</td><td></td><td></td><td></td></tr>
<tr><td>01</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>02</td><td>SON</td><td>SON</td><td>SON</td></tr>
<tr><td>03</td><td>RES</td><td>RES</td><td>RES</td></tr>
<tr><td>04</td><td>PC</td><td>PC</td><td></td></tr>
<tr><td>05</td><td>EM1</td><td>EM1</td><td>EM1</td></tr>
<tr><td>06</td><td>CR</td><td></td><td></td></tr>
<tr><td>07</td><td></td><td>ST1</td><td>RS2</td></tr>
<tr><td>08</td><td></td><td>ST2</td><td>RS1</td></tr>
<tr><td>09</td><td>TL1</td><td>TL1</td><td></td></tr>
<tr><td>0A</td><td>LSP</td><td>LSP</td><td></td></tr>
<tr><td>0B</td><td>LSN</td><td>LSN</td><td></td></tr>
<tr><td>0C</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0D</td><td></td><td>SP1</td><td>SP1</td></tr>
<tr><td>0E</td><td></td><td>SP2</td><td>SP2</td></tr>
<tr><td>0F</td><td></td><td>SP3</td><td>SP3</td></tr>
<tr><td>10</td><td>LOP</td><td>LOP</td><td>LOP</td></tr>
<tr><td>11</td><td>CDP</td><td>CDP</td><td>CDP</td></tr>
<tr><td>12 to 3F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
</table>
Note 1. P: Position control mode
S: Internal speed control mode
T: Internal torque control mode
2. For manufacturer setting. Never set this value.</td><td>0303h</td><td>Refer to the name and function field.</td><td></td><td>○</td><td>○</td><td></td></tr>
<tr><td>PD04</td><td>*DI1-2</td><td>Input signal device selection 1H (CN1-3)
Any input signal can be assigned to the CN1-3 pin.
The devices that can be assigned and the setting method are the same as in parameter No. PD03.

2 0 □ □
Internal torque control mode
Select the input device of the CN1-3 pin.</td><td>2003h</td><td>Refer to the name and function field.</td><td></td><td></td><td></td><td>○</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PD05	*DI2-1	Input signal device selection 2L (CN1-4) Any input signal can be assigned to the CN1-4 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. Position control mode Internal speed control mode Select the input device of the CN1-4 pin.	0202h	Refer to the name and function field.		○	○	
PD06	*DI2-2	Input signal device selection 2H (CN1-4) Any input signal can be assigned to the CN1-4 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 2 Internal torque control mode Select the input device of the CN1-4 pin.	0202h	Refer to the name and function field.				○
PD07	*DI3-1	Input signal device selection 3L (CN1-5) Any input signal can be assigned to the CN1-5 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. Position control mode Internal speed control mode Select the input device of the CN1-5 pin.	0D06h	Refer to the name and function field.		○	○	
PD08	*DI3-2	Input signal device selection 3H (CN1-5) Any input signal can be assigned to the CN1-5 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 2 C Internal torque control mode Select the input device of the CN1-5 pin.	2C0Dh	Refer to the name and function field.				○
PD09	*DI4-1	Input signal device selection 4L (CN1-6) Any input signal can be assigned to the CN1-6 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. Position control mode Internal speed control mode Select the input device of the CN1-6 pin.	070Ah	Refer to the name and function field.		○	○	

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PD10	*DI4-2	Input signal device selection 4H (CN1-6) Any input signal can be assigned to the CN1-6 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 7 □ □ Internal torque control mode } Select the input device of the CN1-6 pin.	0707h	Refer to the name and function field.				○
PD11	*DI5-1	Input signal device selection 5L (CN1-7) Any input signal can be assigned to the CN1-7 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. □ □ □ □ Position control mode Internal speed control mode } Select the input device of the CN1-7 pin.	080Bh	Refer to the name and function field.		○	○	
PD12	*DI5-2	Input signal device selection 5H (CN1-7) Any input signal can be assigned to the CN1-7 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 8 □ □ Internal torque control mode } Select the input device of the CN1-7 pin.	0808h	Refer to the name and function field.				○
PD13	*DI6-1	Input signal device selection 6L (CN1-8) Any input signal can be assigned to the CN1-8 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. □ □ □ □ Position control mode Internal speed control mode } Select the input device of the CN1-8 pin.	0505h	Refer to the name and function field.		○	○	
PD14	*DI6-2	Input signal device selection 6H (CN1-8) Any input signal can be assigned to the CN1-8 pin. The devices that can be assigned and the setting method are the same as in parameter No. PD03. 0 5 □ □ Internal torque control mode } Select the input device of the CN1-8 pin.	0505h	Refer to the name and function field.				○

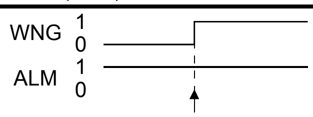
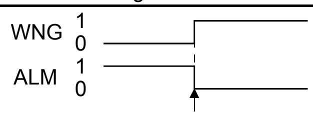
<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Symbol</th><th rowspan="2">Name and function</th><th rowspan="2">Initial value</th><th rowspan="2">Setting range</th><th rowspan="2">Unit</th><th colspan="3">Control mode</th></tr>
<tr><th>Position</th><th>Internal speed</th><th>Internal torque</th></tr>
<tr><td>PD15</td><td>*DO1</td><td>Output signal device selection 1 (CN1-9)
Any output signal can be assigned to the CN1-9pin. ALM is assigned as the initial value.
Note that the device that can be assigned varies depending on the control mode.

0 0
Select the output device of the CN1-9 pin.

The devices that can be assigned in each control mode are indicated by abbreviation in the following table. If any other device is set, it is invalid.
<table>
<tr><th rowspan="2">Setting</th><th colspan="3">Control modes (Note 1)</th></tr>
<tr><th>P</th><th>S</th><th>T</th></tr>
<tr><td>00</td><td>Always OFF</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>01</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>02</td><td>RD</td><td>RD</td><td>RD</td></tr>
<tr><td>03</td><td>ALM</td><td>ALM</td><td>ALM</td></tr>
<tr><td>04</td><td>INP</td><td>SA</td><td>Always OFF</td></tr>
<tr><td>05</td><td>MBR</td><td>MBR</td><td>MBR</td></tr>
<tr><td>06</td><td>Always OFF</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>07</td><td>TLC</td><td>TLC</td><td>VLC</td></tr>
<tr><td>08</td><td>WNG</td><td>WNG</td><td>WNG</td></tr>
<tr><td>09</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0A</td><td>Always OFF</td><td>SA</td><td>SA</td></tr>
<tr><td>0B</td><td>Always OFF</td><td>Always OFF</td><td>VLC</td></tr>
<tr><td>0C</td><td>ZSP</td><td>ZSP</td><td>ZSP</td></tr>
<tr><td>0D</td><td>MTTR</td><td>MTTR</td><td>MTTR</td></tr>
<tr><td>0E</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
<tr><td>0F</td><td>CDPS</td><td>Always OFF</td><td>Always OFF</td></tr>
<tr><td>10 to 3F</td><td colspan="3">For manufacturer setting (Note 2)</td></tr>
</table>
Note 1. P: Position control mode
S: Internal speed control mode
T: Internal torque control mode
2. For manufacturer setting. Never set this value.</td><td>0003h</td><td>Refer to the name and function field.</td><td></td><td>○</td><td>○</td><td>○</td></tr>
<tr><td>PD16</td><td>*DO2</td><td>Output signal device selection 2 (CN1-10)
Any output signal can be assigned to the CN1-10 pin. INP is assigned as the initial value.
The devices that can be assigned and the setting method are the same as in parameter No. PD15.

0 0
Select the output device of the CN1-10 pin.</td><td>0004h</td><td>Refer to the name and function field.</td><td></td><td>○</td><td>○</td><td>○</td></tr>
</table>

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PD17	*DO3	Output signal device selection 3 (CN1-11) Any output signal can be assigned to the CN1-11 pin. RD is assigned as the initial value. The devices that can be assigned and the setting method are the same as in parameter No. PD15. 0 0 _ _ Select the output device of the CN1-11 pin.	0002h	Refer to the name and function field.		○	○	○
PD18	*DO4	Output signal device selection 4 (CN1-12) Any output signal can be assigned to the CN1-12 pin. MBR is assigned as the initial value. The devices that can be assigned and the setting method are the same as in parameter No. PD15. 0 0 _ _ Select the output device of the CN1-12 pin.	0005h	Refer to the name and function field.		○	○	○
PD19	*DIF	Input filter setting Select the input filter. 0 _ _ _ Input filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 1.777[ms] 2: 3.555[ms] 3: 5.333[ms] Reset (RES) dedicated filter selection 0: Invalid 1: Valid (50[ms]) Clear (CR) dedicated filter selection 0: Invalid 1: Valid (50[ms])	0002h	Refer to the name and function field.		○	○	○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode: Position	Control mode: Internal speed	Control mode: Internal torque
PD20	*DOP1	Function selection D-1 Select the stop processing at forward rotation stroke end (LSP)/reverse rotation stroke end (LSN) OFF, the base circuit status at reset (RES) ON and the operation during tough drive (MTTR). 0 □ □ □ How to make a stop when forward rotation stroke end (LSP)/reverse rotation stroke end (LSN) is OFF. (Refer to Section 4.4.3.) 0: Sudden stop 1: Slow stop Selection of base circuit status at reset (RES) ON 0: Base circuit switched off 1: Base circuit not switched off Operation selection during tough drive (MTTR) 0: MTTR turns ON during the instantaneous power failure tough drive. 1: MTTR turns ON during the overload tough drive or the instantaneous power failure tough drive	0000h	Refer to the name and function field.		○ ○ ○	○ ○ ○	 ○
PD21		For manufacturer setting Do not change this value by any means.	0000h					
PD22	*DOP3	Function selection D-3 Set the clear (CR). 0 0 0 □ Clear (CR) selection 0: Droop pulses are cleared on the leading edge. 1: While on, droop pulses are always cleared.	0000h	Refer to the name and function field.		○		
PD23		For manufacturer setting Do not change this value by any means.	0000h					
PD24	*DOP5	Function selection D-5 Select the warning (WNG) outputs. 0 0 0 □ Selection of output device at warning occurrence Select the warning (WNG) and trouble (ALM) output status at warning occurrence. Setting 0 — (Note) Device status:  WNG 1/0, ALM 1/0, Warning occurrence Setting 1 — (Note) Device status:  WNG 1/0, ALM 1/0, Warning occurrence Note. 0: off 1: on	0000h	Refer to the name and function field.		○	○	○

No.	Symbol	Name and function	Initial value	Setting range	Unit	Control mode		
						Position	Internal speed	Internal torque
PD25		For manufacturer setting	0000h					
PD26		Do not change this value by any means.	0000h					

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

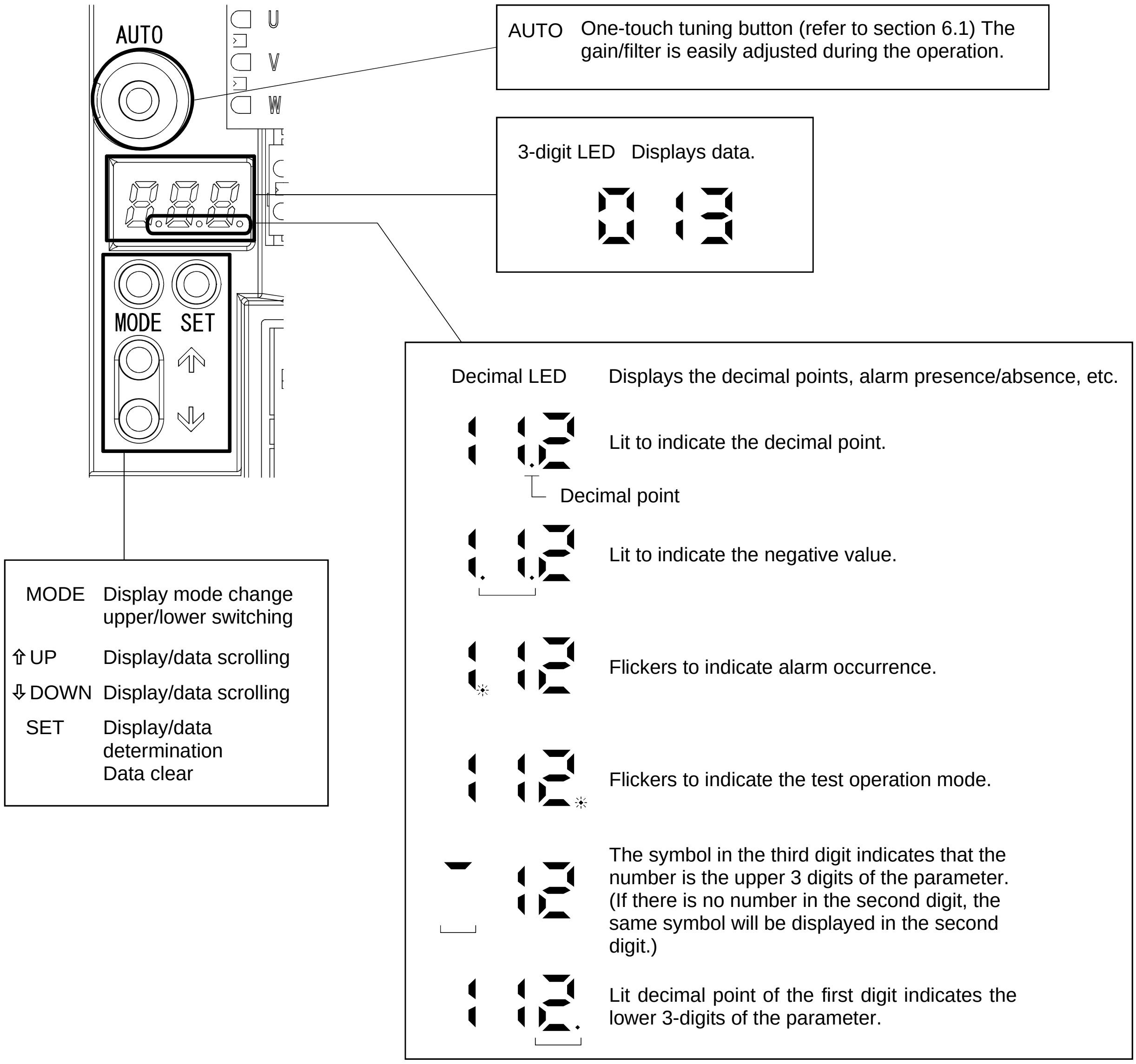
The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing parameter No. PD20 setting.

Parameter No. PD20 setting	Stopping method
□□□0 (initial value)	Sudden stop Position control mode : The servo motor stops by clearing the droop pulses. Internal speed control mode : The servo motor stops when the deceleration time constant is zero.
□□□1	Slow stop Position control mode : The servo motor decelerates to a stop in accordance with parameter No. PB03 setting. Internal speed control mode : The servo motor decelerates to a stop in accordance with parameter No. PC02 setting.

5. DISPLAY AND OPERATION SECTIONS

5.1 Overview

The LECSA□-□ controller has a display section (3-digit, 7-segment LED), operation section (4 pushbuttons) and a one-touch tuning button for controller status display, alarm display, parameter setting, etc.
The operation section and display data are described below.



5.2 Display sequence

Press the "MODE" button once to shift to the next display mode. Refer to section 5.3 and later for the description of the corresponding display mode.

To refer to or set the gain/filter parameters, extension setting parameters and I/O setting parameters, make them valid with parameter No. PA19 (parameter write inhibit).

Display mode transition	Initial screen	Function	Reference
Status display	CL	Servo status display. CL appears at power-on. (Note)	Section 5.3
Diagnosis	roF	Sequence display, external signal display, forced output of signal (DO), test operation, software version display, servo motor series ID display, servo motor type ID display, servo motor encoder ID display.	Section 5.4
Alarm	A--	Current alarm display, alarm history display, the number of tough drive display, parameter error No. display.	Section 5.5
Basic setting parameters MODE button	A01	Display and setting of basic setting parameters.	Section 5.6
Gain/filter parameters	b01	Display and setting of gain/filter parameters.	
Extension setting parameters	C01	Display and setting of extension setting parameters.	
I/O setting parameters	d01	Display and setting of I/O setting parameters.	

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

5.3 Status display

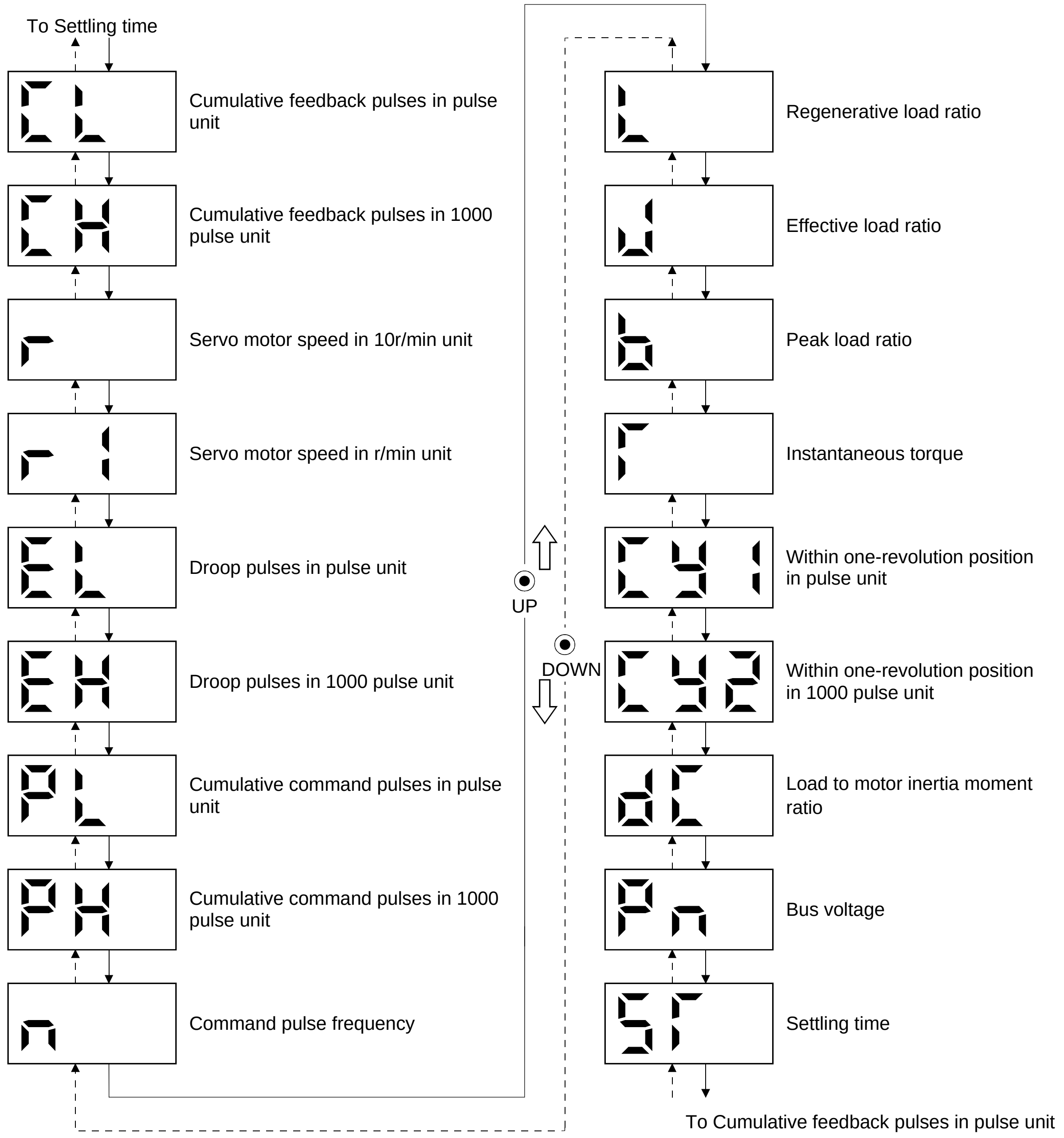
The servo status during operation is shown on the 3-digit, 7-segment LED display. Press the "UP" or the "DOWN" button to change the display data as desired. When the required data is selected, the corresponding symbol appears. Press the "SET" button to display the data.
At power-on, however, the data appears after the symbol of the status display for the respective control mode (refer to the following table) has been shown for 2[s].

Control mode	Status display at power-on
Position	Cumulative feedback pulses by the pulse
Position/internal speed	Cumulative feedback pulses by the pulse/servo motor speed in 10r/min
Internal speed	Servo motor speed in 10r/min
Internal speed/internal torque	Servo motor speed in 10r/min/instantaneous torque
Internal torque	Instantaneous torque
Internal torque/position	Instantaneous torque/cumulative feedback pulses by the pulse

The controller display shows the data of 18 items such as the motor speed in a 3-digit display.

5.3.1 Display transition

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

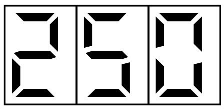
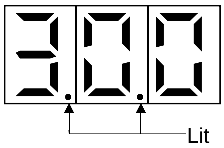
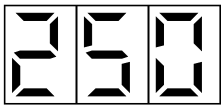
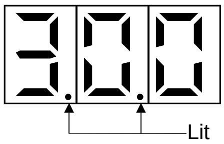


5.3.2 Display examples

POINT

- The following is priority order of the status display when two or more decimal points need to be displayed.
  1. Alarm occurrence, test operation
  2. Negative values

The following table lists display examples.

Item	Status	Displayed data Controller display
Servo motor speed in 10r/min unit	Forward rotation at 2500r/min	
	Reverse rotation at 3000r/min	 Reverse rotation is indicated by the lit decimal points in the upper two digits.
Servo motor speed in r/min unit	Forward rotation at 250r/min	
	Reverse rotation at 300r/min	 Reverse rotation is indicated by the lit decimal points in the upper two digits.

Item	Status		Displayed data Controller display
Cumulative feedback pulses	720000pulse	Pulse unit	000
		1000 pulse unit	720
	-680000pulse	Pulse unit	0.0.0 Lit Negative value is indicated by the lit decimal points in the upper two digits.
		1000 pulse unit	6.8.0 Lit Negative value is indicated by the lit decimal points in the upper two digits.
Load to motor inertia moment ratio	15 Multiplier		15

5.3.3 Status display list

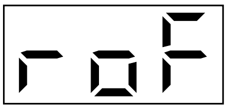
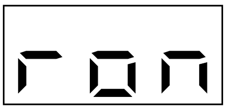
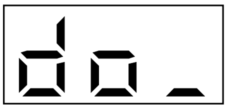
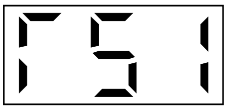
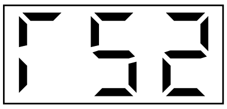
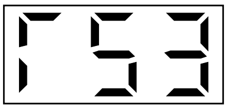
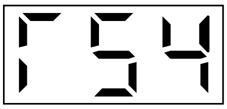
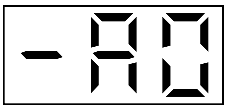
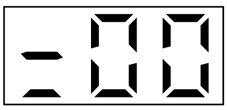
POINT
- Refer to appendix 4 for the measurement point.

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

Name	Symbol	Unit	Description	Display range
Cumulative feedback pulses in pulse unit	CL	pulse	Feedback pulses from the servo motor encoder are counted and displayed. Press the "SET" button to reset the display value to zero. Negative values are indicated by the lit decimal points in the upper two digits.	-999 to 999
Cumulative feedback pulses in 1000 pulse unit	CH	1000pulse		-999 to 999
Servo motor speed in 10r/min unit	r	10r/min	The servo motor speed is displayed in 10r/min unit.	-540 to 540
Servo motor speed in r/min unit	r1	r/min	The servo motor speed is displayed in r/min unit.	-999 to 999
Droop pulses in pulse unit	EL	pulse	The number of droop pulses in the deviation counter is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper two digits are lit. The displayed number of pulses is in the same pulse unit as the servo motor encoder resolution.	-999 to 999
Droop pulses in 1000 pulse unit	EH	1000pulse		-999 to 999
Cumulative command pulses in pulse unit	PL	pulse	The position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. Press the "SET" button to reset the display value to zero. Reverse rotation is indicated by the lit decimal points in the upper two digits.	-999 to 999
Cumulative command pulses in 1000 pulse unit	PH	1000pulse		-999 to 999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV). The value in excess of ±999 can be counted up to ±1500. However, the counter shows only the lower three digits since the controller display is three digits.	-999 to 999
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100
Effective load ratio	J	%	The continuous effective load current is displayed. The effective value in the past 15[s] is displayed relative to the rated current of 100%.	0 to 300
Peak load ratio	b	%	The maximum current is displayed. The highest value in the past 15[s] is displayed relative to the rated current of 100%.	0 to 400
Instantaneous torque	T	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rate torque of 100%.	0 to 400
Within one-revolution position in pulse unit	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to 0 when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation. The value is decremented in the CW direction of rotation.	0 to 999
Within one-revolution position in 1000 pulse unit	Cy2	1000pulse		0 to 999
Load to motor inertia moment ratio	dC	Multiplier ($\times 10^{-1}$)	The estimation value of load to motor inertia moment ratio to the servo motor shaft inertia moment is displayed.	0 to 300
Bus voltage	Pn		Status of the bus voltage is displayed in five steps. 5: Overvoltage (400V or more) 4: High voltage (375V or more) 3: Normal 2: Low voltage (200V or less) 1: Undervoltage (158V or less)	Refer to the contents.

Settling time	ST	ms	Settling time is displayed. The value in excess of 999 can be displayed. However, the counter shows only the lower three digits since the controller display is three digits.	0 to 999

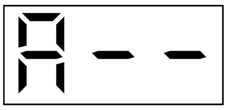
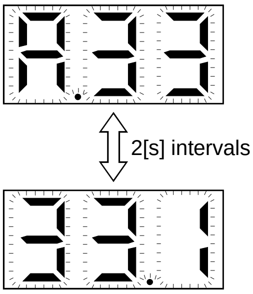
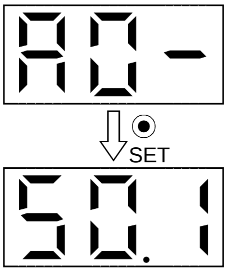
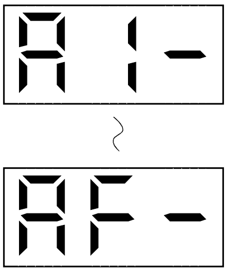
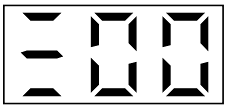
5.4 Diagnostic mode

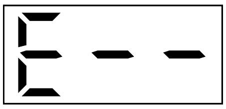
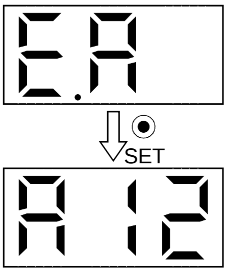
Name		Display	Description
Sequence			Not ready. Indicates that the controller is being initialized or an alarm has occurred.
			Ready. Indicates that the servo was switched on after completion of initialization and the controller is ready to operate.
External I/O signal display		Refer to section 5.7.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF
Output signal (DO) forced output			The digital output signal can be forced on/off. For details, refer to section 5.8.
Test operation mode	Jog feed		Jog operation can be performed when there is no command from the external command device. For details, refer to section 5.9.2.
	Positioning operation		The MR Configurator is required for positioning operation. This operation cannot be performed from the operation section of the controller. Positioning operation can be performed once when there is no command from the external command device. For details, refer to section 5.9.3.
	Motorless operation		Without connection of the servo motor, the controller provides output signals and displays the status as if the servo motor is running actually in response to the input device. For details, refer to section 5.9.4.
	Forced tough drive operation		Overload tough drive can be forced even in the normal status. For details, refer to section 5.9.5.
Software version low			Indicates the version of the software.
Software version high			Indicates the lower two digits of the system number of the software. Three digits are displayed by pressing the "SET" button.

Name	Display	Description
Servo motor series ID	H1	Series ID of the servo motor currently connected will be displayed by pressing the "SET" button. For details, refer to App. 2.
Servo motor type ID	H2	Type ID of the servo motor currently connected will be displayed by pressing the "SET" button. For details, refer to App. 2.
Servo motor Encoder ID	H3	Encoder ID of the servo motor currently connected will be displayed by pressing the "SET" button. For details, refer to App. 2.
For manufacturer setting	H4	

5.5 Alarm mode

The current alarm, the past alarm history, the number of tough drive, and the parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error.

Name	Display	Description
Current alarm		Indicates no occurrence of an alarm.
		Indicates the occurrence of alarm 33 (overvoltage: detail 1). Flickers at occurrence of the alarm. Alarm No. and detail No. are displayed alternately in 2[s] intervals.
Alarm history		Indicates the last alarm. If the last alarm is 50 (overload: detail 1), alarm No. 50 (with detail No.) is displayed while holding down the "SET" button.
		Indicates in hexadecimal for the second to the sixteenth alarm in the past as shown on the left. The alarm No. (with detail No.) is displayed while holding down the "SET" button.
The number of tough drive		Indicates the number of tough drive from 0 to 99. The number of tough drive can be cleared by setting parameter No. PC11 (alarm history clear) to "□□1".

Name	Display	Description
Parameter error No.		Indicates no occurrence of alarm 37 (parameter error).
		Indicates the parameter error No. If an error occurs in parameter No. PA12, A12 is displayed while holding down the "SET" button.

Functions at occurrence of an alarm

(1) Any mode screen displays the current alarm.

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

(3) For any alarm, remove its cause and clear it in any of the following methods (for clearable alarms, refer to section 8.1)

(a) Switch power OFF, then ON.

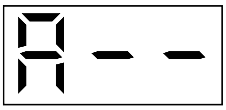
(b) Press the "SET" button on the current alarm screen.

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

(4) Use parameter No. PC11 to clear the alarm history.

(5) When the servo-on (SON) is off after clearing the alarm history, the display shifts to the status display screen at power-on.

When the servo-on (SON) is on, the following screen is displayed on the current alarm.



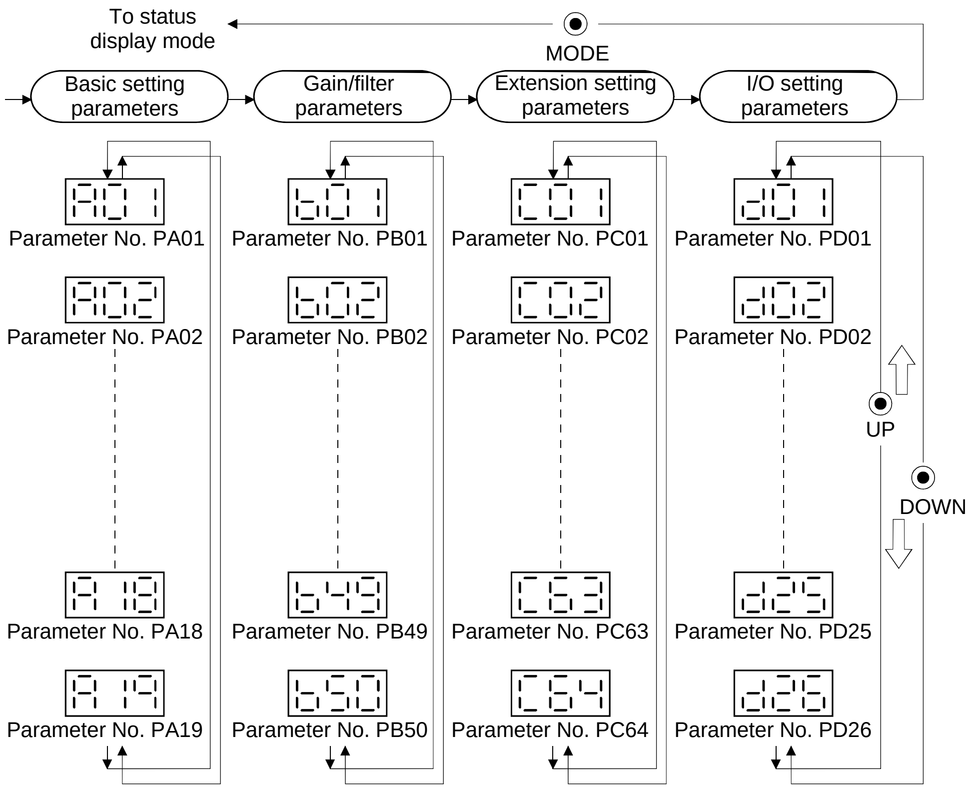
(6) Press the "UP" or the "DOWN" button to move to the next history.

5.6 Parameter mode

POINT
・To use the I/O setting parameters, change parameter No. PA19 (parameter write inhibit). (Refer to section 4.1.1.) ・The I/O signal settings can be changed using I/O setting parameter No. PD03 to PD18.

5.6.1 Parameter mode transition

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

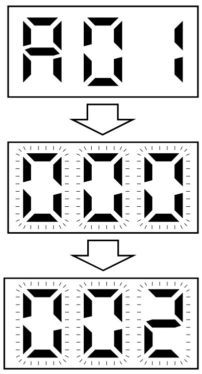


5.6.2 Operation example

POINT
・When the set value of a specified parameter is changed and entered, the entered set value is displayed. The set value can be cancelled by pressing the "MODE" button for 2[s] or longer immediately after entering the value. Then, the previous set value is displayed.

(1) Parameter of 3 or less digits

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



······The parameter number is displayed.

Press UP or DOWN to change the number.

Press SET twice.

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

Press UP twice.

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

Use UP or DOWN.

(□□2: Internal speed control mode)

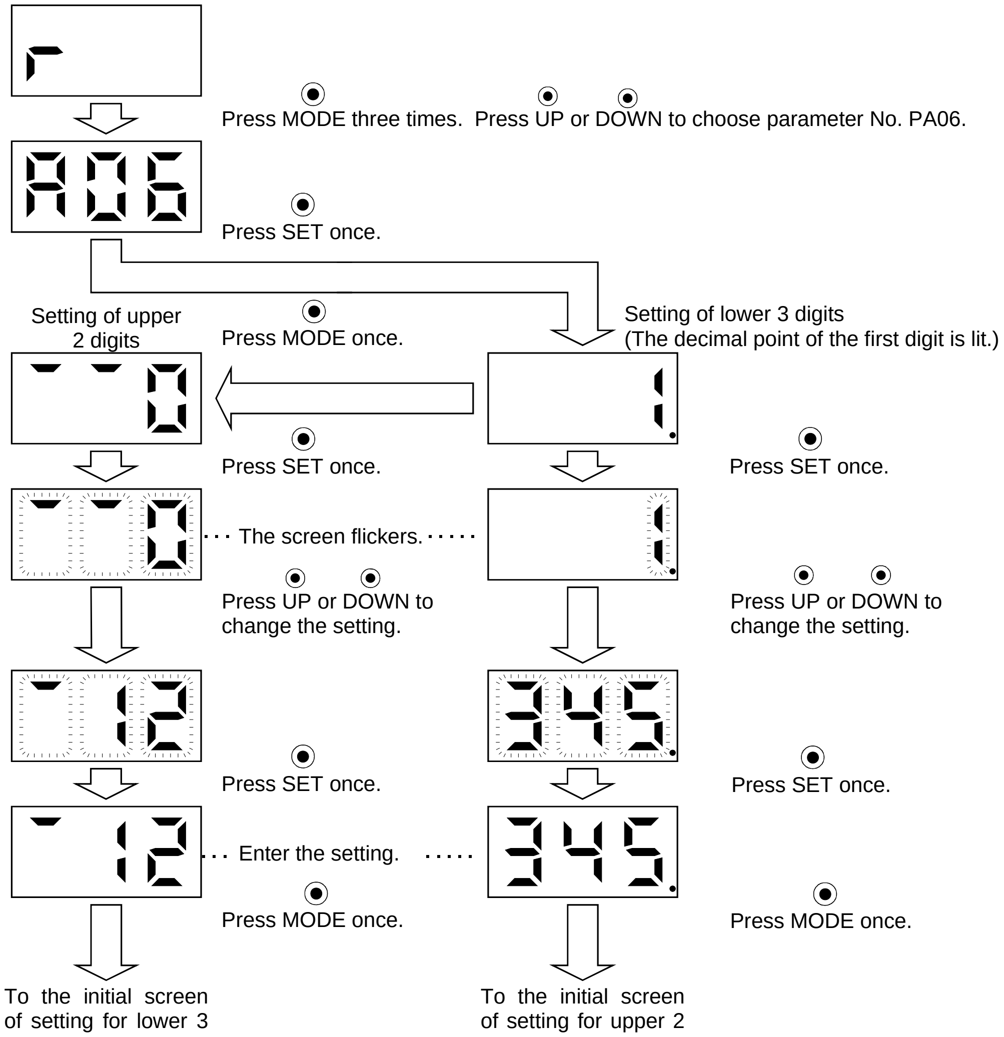
Press SET to enter.

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

When changing parameter No. PA01 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

(2) Parameter of 4 or more digits

The following example gives the operation procedure to change the electronic gear numerator (command pulse multiplication numerator) (parameter No. PA06) to "12345".



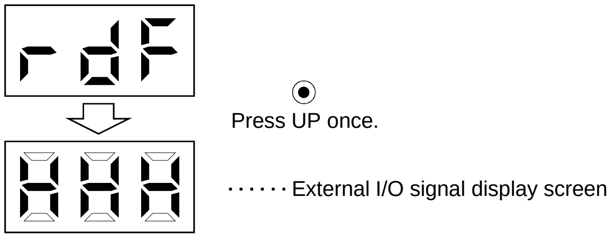
To proceed to the next parameter, press the "UP" or "DOWN" button.

5.7 External I/O signal display

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

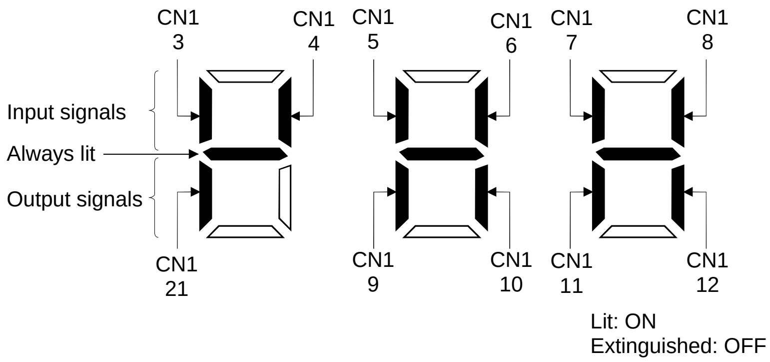
(1) Operation

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



(2) Display definition

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



The LED segment corresponding to the pin is lit to indicate ON, and is extinguished to indicate OFF.
The signals corresponding to the pins in the respective control modes are indicated below.

(a) Control modes and I/O signals

Connector	Pin No.	Signal input/output (Note 1) I/O	(Note 2) Symbols of I/O signals in control modes						Related parameter
			P	P/S	S	S/T	T	T/P	
CN1	3	I	RES	RES	RES	RES	RES	RES	PD03・PD04
	4	I	SON	SON	SON	SON	SON	SON	PD05・PD06
	5	I	CR	CR/SP1	SP1	SP1/SP1	SP1	SP1/CR	PD07・PD08
	6	I	LSP	LSP/ST1	ST1	ST1/RS2	RS2	RS2/LSP	PD09・PD10
	7	I	LSN	LSN/ST2	ST2	ST2/RS1	RS1	RS1/LSN	PD11・PD12
	8	I	EM1	EM1	EM1	EM1	EM1	EM1	PD13・PD14
	9	O	ALM	ALM	ALM	ALM	ALM	ALM	PD15
	10	O	INP	INP/SA	SA	SA/-		-/INP	PD16
	11	O	RD	RD	RD	RD	RD	RD	PD17
	12	O	MBR	MBR	MBR	MBR	MBR	MBR	PD18
	21	O	OP	OP	OP	OP	OP	OP	

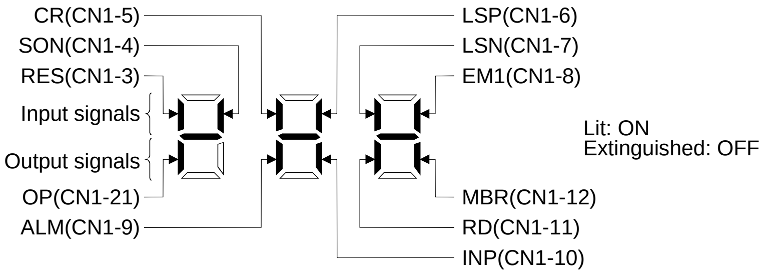
Note 1. I: Input signal, O: Output signal
2. P: Position control mode, S: Internal speed control mode, T: Internal torque control mode,
P/S: Position/internal speed control change mode, S/T: Internal speed/internal torque control change mode,
T/P: Internal torque/position control change mode

(b) Symbol and signal names

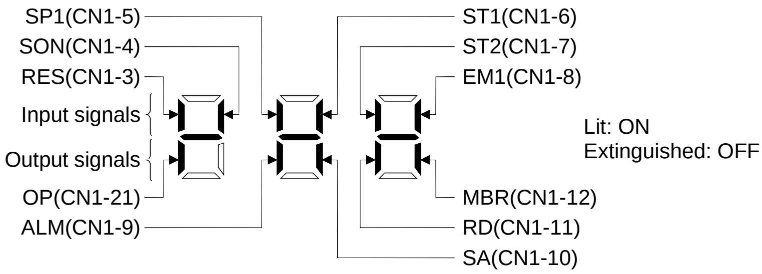
Symbol	Signal name	Symbol	Signal name
SON	Servo-on	LOP	Control change
RES	Reset	CDP	Gain changing
PC	Proportion control	RD	Ready
EM1	Forced stop	ALM	Trouble
CR	Clear	INP	In-position
ST1	Forward rotation start	SA	Speed reached
ST2	Reverse rotation start	MBR	Electromagnetic brake interlock
RS1	Forward rotation selection	TLC	Limiting torque
RS2	Reverse rotation selection	VLC	Limiting speed
TL1	Internal torque limit selection	WNG	Warning
LSP	Forward rotation stroke end	ZSP	Zero speed
LSN	Reverse rotation stroke end	MTTR	During tough drive
SP1	Speed selection 1	CDPS	During variable gain selection
SP2	Speed selection 2	OP	Encoder Z-phase pulse (open collector)
SP3	Speed selection 3		

(3) Display data at initial values

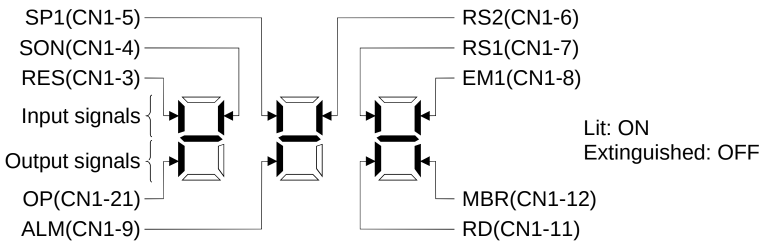
(a) Position control mode



(b) Internal speed control mode



(c) Internal torque control mode



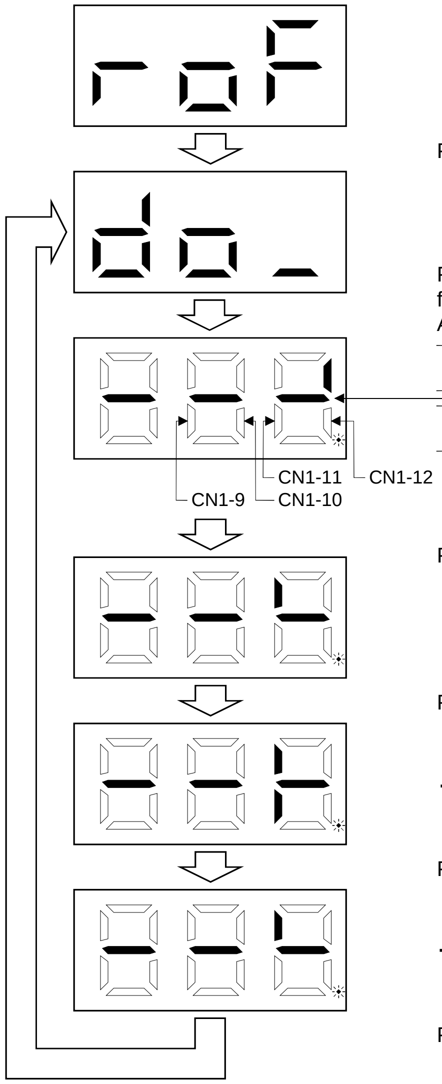
5.8 Output signal (DO) forced output

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

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

Operation

After power-on, change the display to the diagnostic screen using the "MODE" button.



Press UP twice.

Press SET for 2s or more to shift to the output signal (DO) forced output screen.
At this time, the decimal point in the first digit flickers.

······Switch on/off the signal below the lit segment.

Always lit

······Indicates the ON/OFF of the output signal. The correspondences between segments and signals are as in the output signals of the external I/O signal display.
(Lit: ON, extinguished: OFF)

Press MODE once.

······The segment above CN1-pin 11 is lit.

Press UP once.

······CN1-pin 11 is switched on.
(CN1-pin 11-DOCOM conduct.)

Press DOWN once.

······CN1-pin 11 is switched off.

Press SET for more than 2s.

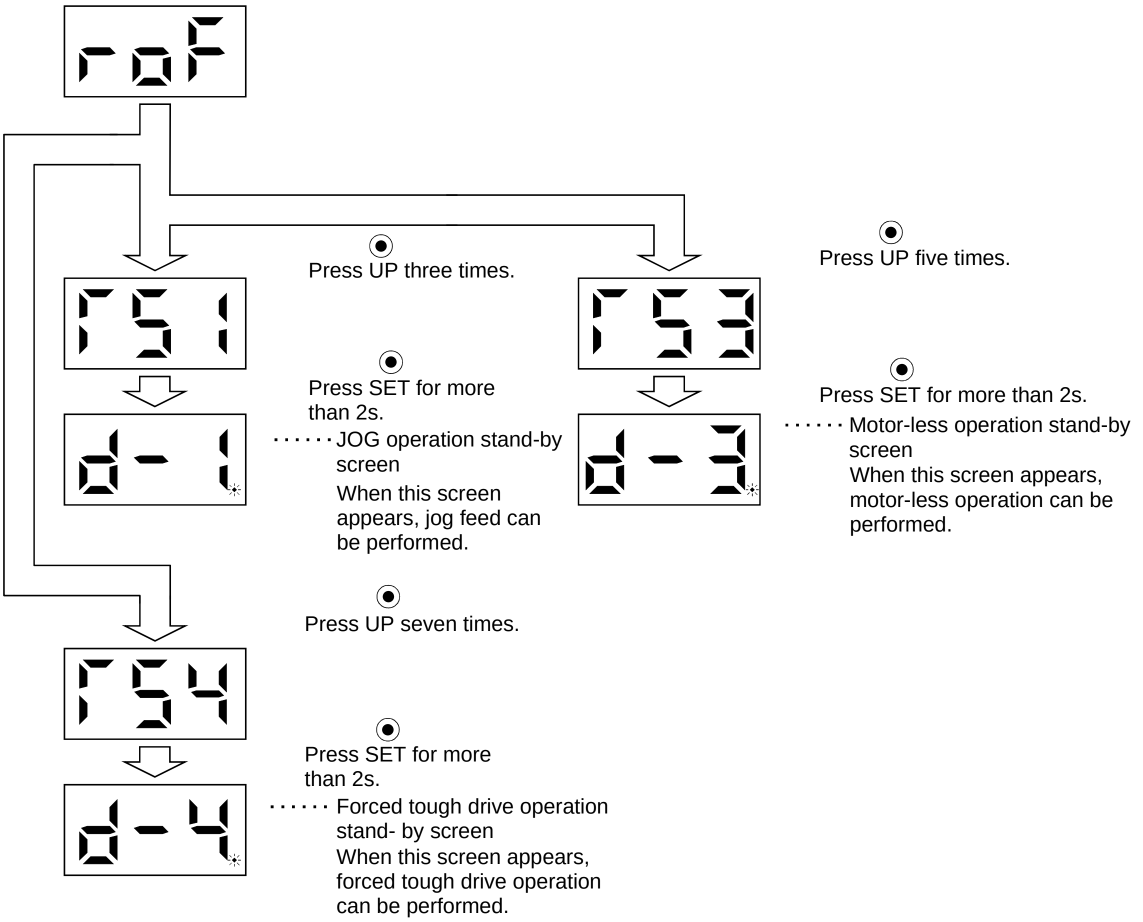
5.9 Test operation mode

⚠CAUTION	・The test operation mode is designed to confirm servo operation. Do not use it for actual operation. ・ If any operational fault has occurred, stop the operation using the forced stop (EM1) signal.

POINT
・The MR Configurator is required to perform positioning operation. ・ Test operation cannot be performed if the servo-on (SON) is not turned OFF.

5.9.1 Mode change

After power-on, change the display to the diagnostic screen using the "MODE" button. Select jog operation/motor-less operation/forced tough drive operation in the following procedure.



5.9.2 Jog operation

POINT
・When performing jog operation, turn ON the forced stop (EM1), the forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN). The forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN) can be set to automatic ON by setting parameter No. PD01 to "□C□□".

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

(1) Operation

The servo motor rotates while holding down the "UP" or the "DOWN" button. The servo motor stops rotating by releasing the button. The operation condition can be changed using the MR Configurator. The initial conditions and setting ranges for operation are listed below.

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

How to use the buttons is explained below.

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

If the communication cable is disconnected during the jog operation using the MR Configurator, the servo motor decelerates to a stop.

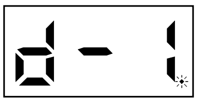
(2) Status display

Call the status display screen by pressing the "MODE" button in the JOG operation stand-by status. When the JOG operation is performed using the "UP" or the "DOWN" button, the servo status appears on the display.

The status display screen shifts to the next screen every time the "MODE" button is pressed. For details of the status display, refer to section 5.3. The status display screen returns to the JOG operation stand-by screen after one screen cycle. Note that the status display screen cannot be changed by the "UP" or the "DOWN" button in the JOG operation mode.

(3) Termination of jog operation

To end the jog operation, turn the power off once or press the "MODE" button to switch to the next screen, and then hold down the "SET" button for 2[s] or longer.

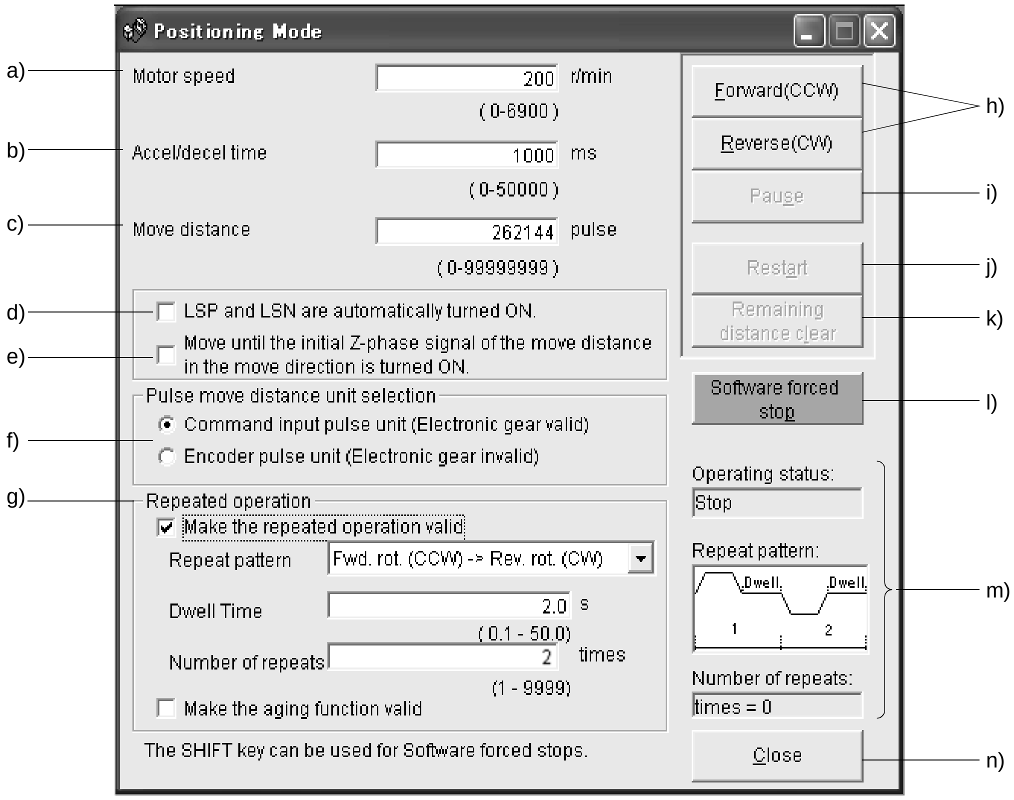


5.9.3 Positioning operation

POINT
・MR Configurator is required to perform positioning operation. ・Turn ON the forced stop (EM1) when performing positioning operation. ・During the positioning operation, the "UP" and the "DOWN" buttons are invalid.

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

(1) Operation



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

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

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

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

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

f) Pulse move distance unit selection/Command input pulse unit/Encoder pulse unit

Select with the option buttons whether the moving distance set in c) is in the command pulse unit or in the encoder pulse unit.

When the command input pulse unit is selected, the value, which is the set moving distance multiplied by the electronic gear ($\frac{CMX}{CDV}$), will be the command value. When the encoder pulse unit is selected, the moving distance is not multiplied by the electronic gear.

g) Repeated operation

Click the check box of "Make the repeated operation valid" to execute a repeated operation. The following lists the initial conditions and setting ranges for the repeated operation.

Item	Initial setting	Setting range
Repeated pattern	Forward rotation (CCW) to reverse rotation (CW)	Forward rotation (CCW) to reverse rotation (CW) Forward rotation (CCW) to Forward rotation (CCW) Reverse rotation (CW) to forward rotation (CCW) Reverse rotation (CW) to Reverse rotation (CW)
Dwell Times	2.0	0.1 to 50.0
Number of repeats (times)	1	1 to 9999

Click the check box of "Make the aging function valid" to execute the repeated operation with the repeated pattern and the dwell time set above.

h) Forward/Reverse

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

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

i) Pause

Click the "Pause" button during servo motor rotation to temporarily stop the servo motor.

This button is valid during servo motor rotation.

j) Restart

Click the "Restart" button during a temporary stop to restart the servo motor rotation.

This button is valid during a temporary stop of the servo motor.

k) Remaining move distance clear

Click the "Remaining distance clear" button during a temporary stop to erase the remaining distance.

This button is valid during a temporary stop of the servo motor.

l) Forced stop

Click the "S/W forced stop" button during servo motor rotation to make a hard stop.

This button is valid during servo motor rotation.

m) Repeated operation status
Operation status, repeated pattern, the number of repeats in the repeated operation is displayed.
n) Close
Click the "Close" button to cancel the positioning operation mode and close the window.

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

5.9.4 Motor-less operation

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

(1) Operation
Turn off the servo-on (SON), and then select motor-less operation. After that, perform external operation as in ordinary operation.

(2) Status display
Change the display to the status display screen by pressing the "MODE" button. (Refer to section 5.2.) The status display screen can be changed by pressing the "UP" or the "Down" button. (Refer to section 5.3.)

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

5.9.5 Forced tough drive operation

POINT
・Execute forced tough drive operation after ten minutes of normal operation.

The tough drive can be checked in advance by forcing the overload tough drive, even if the servo motor is in the normal status.

(1) Operation

Press the "SET" button for 2[s] or longer in normal operation to execute the forced tough drive operation.

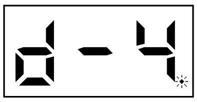
(2) Status display

Call the status display screen by pressing the "MODE" button in the forced tough drive operation stand-by status.

The status display screen shifts to the next screen every time the "MODE" button is pressed. For details of the status display, refer to section 5.3. The status display screen returns to the forced tough drive operation stand-by screen after one screen cycle. Note that the status display screen cannot be changed by the "UP" or the "DOWN" button in the forced tough drive operation mode.

(3) Termination of forced tough drive operation

To end the forced tough drive operation, turn the power off once, or press the "MODE" button to switch to the next screen and then hold down the "SET" button for 2[s] or longer.



5.10 One-touch tuning

POINT
・For full information of the one-touch tuning, refer to section 6.1.

Press the "AUTO" button for 3[s] or longer in the positioning control mode or the internal speed control mode, and then press it again to execute the one-touch tuning.

6. GENERAL GAIN ADJUSTMENT

> **POINT**
>
> - When using in the internal torque control mode, gain adjustment is not necessary.

6.1 One-touch tuning

Just by pressing the "AUTO" button on the front panel of the controller, the gain/filter is easily adjusted. The following parameters are automatically adjusted by the one-touch tuning.

Parameter No.	Symbol	Name
PA08	ATU	Auto tuning mode
PA09	RSP	Auto tuning response
PB03	PST	Position command acceleration/deceleration time constant (Position smoothing)
PB07	PG1	Model loop gain
PB12	OVA	Overshoot amount compensation
PB13	NH1	Machine resonance suppression filter 1
PB14	NHQ1	Notch shape selection 1
PB15	NH2	Machine resonance suppression filter 2
PB16	NHQ2	Notch shape selection 2

6.1.1 One-touch tuning procedure

Use the following procedure to perform the one-touch tuning.

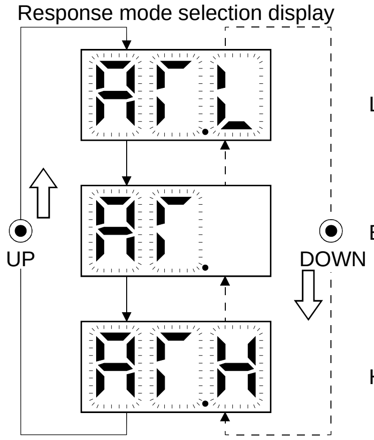
START	
Startup of system	Refer to "Introduction" in this manual, and start up the system.
Operation	Rotate the servo motor by an external command device, etc. (The one-touch tuning cannot be performed if the servo motor is not operating.)
Shift to the one-touch tuning mode	Press the "AUTO" button for 3[s] or longer while the servo motor is rotating. The display changes to "AT", and the mode shifts to the one-touch tuning mode.
Selection of the response mode	Press the "UP" or the "DOWN" button while "AT" is displayed to select the response mode.
Execution of the one-touch tuning	Start the one-touch tuning by pressing the "AUTO" button. When the one-touch tuning is completed normally, the gain/filter is automatically adjusted.
END	

6.1.2 Display transition and operation procedure of the one-touch tuning

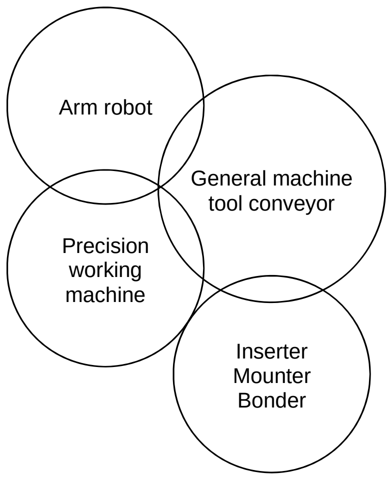
(1) Selection of the response mode

Select the response mode of the one-touch tuning (three types) by the "UP" and the "DOWN" buttons.

Response mode selection display



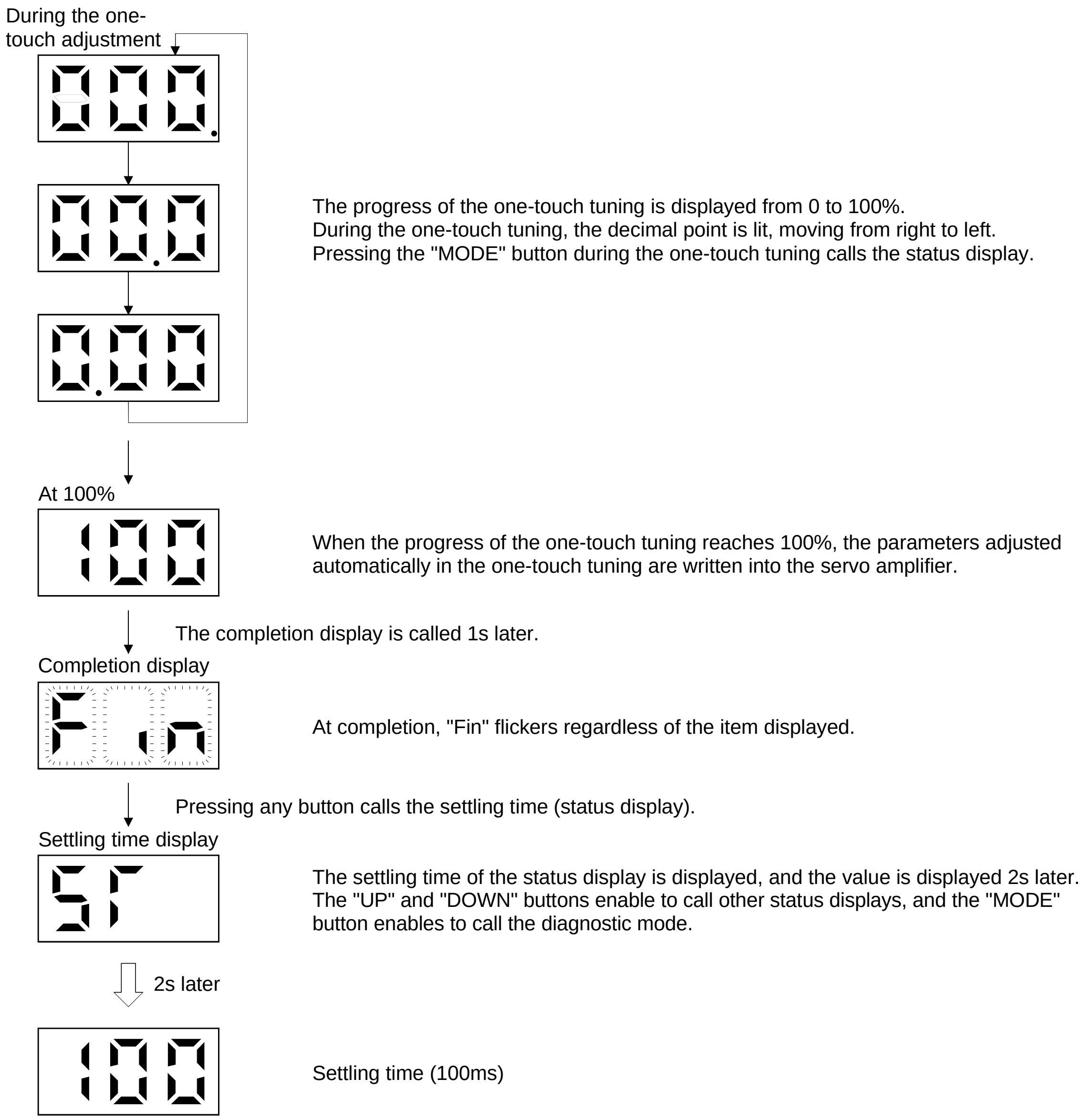
Low mode	:	Response mode for machines with low rigidity such as a belt drive.
Basic mode	:	Response mode for standard machines.
High mode	:	Response mode for machines with high rigidity such as a ballscrew drive.

Response mode			Response level	Machine characteristic
Low mode	Basic mode	High mode		Guideline of corresponding machine
			Low response High response	

The one-touch tuning mode will be canceled in 10[s] after shifting to the one-touch tuning mode. Then, the mode returns to the status display at power-on.

(2) Performing the one-touch tuning

Select the response mode in (1), and press the "AUTO" button to start the one-touch tuning.



POINT
▪ The settling time can also be checked in the status display mode. (Refer to section 5.3.)

(3) Cancelling the one-touch tuning

Cancel symbol display

Err

At 2s intervals

Error code

C00

Pressing any button calls the status display at power-on.

Status display at power-on (in the position control mode).

CL

In the one-touch tuning mode regardless of the item displayed, pressing "AUTO" button cancels the one-touch tuning mode.

The cancel symbol display and error code "C00" (cancel during the adjustment) are displayed alternately every 2s.

(4) At error occurrence

Cancel symbol display

Err

At 2s intervals

Error code

C01

C04

Pressing any button calls the status display at power-on.

Status display at power-on (in the position control mode).

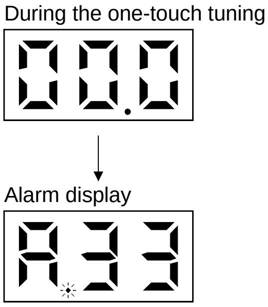
CL

If some error occurs during the one-touch tuning, the one-touch tuning is canceled, and the cancel symbol display and error code "C01" to "C04" are displayed alternately every 2s.

Refer to the following table to remove the cause of the error.

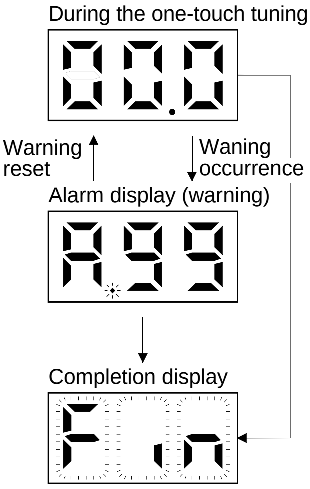
Display	Name	Description	Action
C00	Cancel during the adjustment	The "AUTO" button was pressed again during the adjustment.	
C01	Excessive overshoot	The overshoot is lager than the value set in the in-position range (parameter No. PA10).	Increase the in-position range (parameter No. PA10).
C02	Servo-off during the adjustment	The one-touch tuning was attempted while the servo-on (SON) was turned OFF.	Perform the one-touch tuning after turning on the servo-on (SON).
C03	Control mode fault	The one-touch tuning was attempted while the internal torque control mode was selected from the control modes.	Select the position control mode or internal speed control mode for the control mode, and perform the one-touch tuning.
C04	Time-out	1. 1 cycle time during the operation is over 30s.	Set the 1 cycle time during the operation to 30s or less.
		2. The servo motor speed is lower than 100r/min.	Set the servo motor speed to 100r/min or higher.
		3. The operation interval of the continuous operation is short.	Set the stop time during the operation longer.

(5) At alarm occurrence



If some alarm occurs during the one-touch tuning, the one-touch tuning is canceled, and the alarm display is called.

(6) At warning occurrence



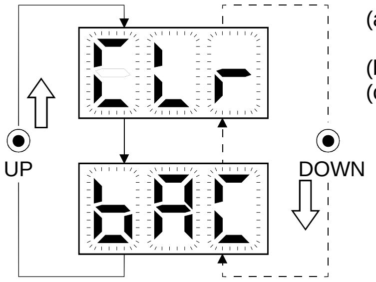
(a) If some warning occurs during the one-touch tuning, the alarm display is called, and the warning is displayed. However, one-touch tuning continues to be performed.
(b) When the warning is reset, the alarm display is shifted to the one-touch tuning.

One-touch tuning complete

(7) Clearing the one-touch tuning

POINT
・The one-touch tuning result can be reset to the initial value by the clear (CLr) mode and to the value before the adjustment by the back (bAC) mode.

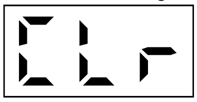
One-touch tuning clear mode selection



(a) Pressing the "AUTO" and "SET" buttons for 3s or longer at the same time calls the one-touch tuning clear mode.
(b) The symbol of the one-touch tuning clear mode flickers.
(c) Select "CLr" (the mode to return the initial value) or "bAC" (the mode to return the value before the one-touch tuning) with the "UP" and "DOWN" buttons.

Clear the one-touch tuning with the "SET" button. (If no operation is performed in 10s, the one-touch tuning clear mode is canceled. Then, it returns to the status display at power-on.)

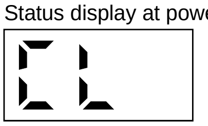
One-touch tuning clear mode display (when returning to the initial value)



The selected one-touch tuning clear mode is performed. During the operation, the symbol of the one-touch tuning clear mode is lit for 3s.

When the one touch adjustment clear is completed, the status display at power-on is called.

Status display at power-on (in the position control mode).



6.1.3 Precautions for one-touch tuning

(1) In the internal torque control mode, the "AUTO" button is invalid.

(2) When an alarm or a warning occurs, the one-touch tuning is not available.

(3) While performing the following test operation modes, the one-touch tuning is not available.

(a) Output signal (DO) forced output

(b) Motor-less operation

(c) Forced tough drive operation

6.2 Gain adjustment methods

The gain adjustment in this section can be made on a single controller. For the gain adjustment, refer to (3) in this section.

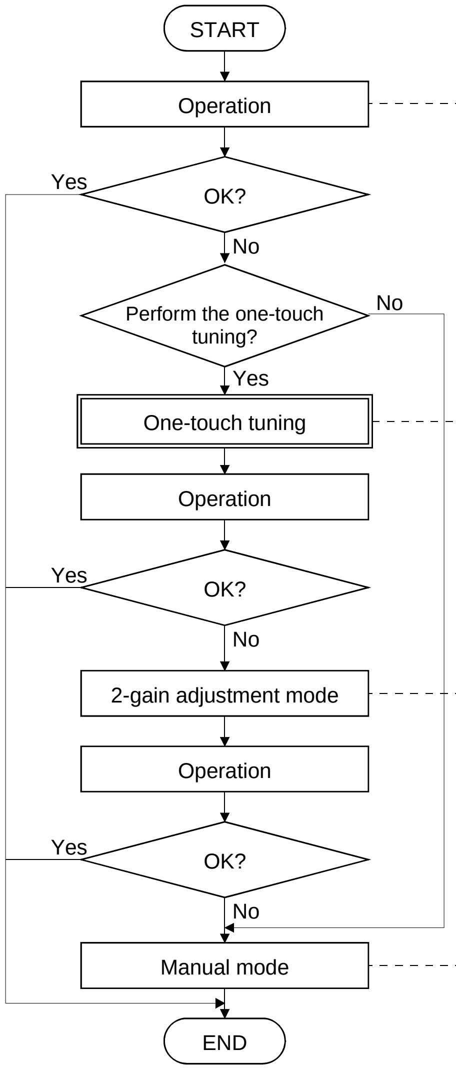
(1) Gain adjustment made by the auto tuning mode (parameter No. PA08)

Gain adjustment method	Parameter No. PA08 setting	Estimation of load to motor inertia moment ratio	Automatically set parameters	Manually set parameters
Auto tuning mode 1 (initial value)	001	Always estimated	GD2 (parameter No. PB06) PG1 (parameter No. PB07) PG2 (parameter No. PB08) VG2 (parameter No. PB09) VIC (parameter No. PB10)	RSP (parameter No. PA09)
2-gain adjustment mode	000	Always estimated	GD2 (parameter No. PB06) PG2 (parameter No. PB08) VG2 (parameter No. PB09) VIC (parameter No. PB10)	PG1 (parameter No. PB07) RSP (parameter No. PA09)
Manual mode	003	Fixed to parameter No. PB06 value		GD2 (parameter No. PB06) PG1 (parameter No. PB07) PG2 (parameter No. PB08) VG2 (parameter No. PB09) VIC (parameter No. PB10)

(2) One-touch tuning

Gain adjustment method	Parameter No. PA08 setting	Estimation of load to motor inertia moment ratio	Automatically set parameters	Manually set parameters
Operation of the one-touch tuning button (AUTO) on the front panel of the controller (Refer to section 6.1.)	・Automatically changes to "000", when the value before the one-touch tuning is "000" or "001". ・"003", when the value before the one-touch tuning is "003". (No change)	Always estimated	AUT (parameter No. PA08) RSP (parameter No. PA09) PST (parameter No. PB03) PG1 (parameter No. PB07) OVA (parameter No. PB12) NH1 (parameter No. PB13) NHQ1 (parameter No. PB14) NH2 (parameter No. PB15) NHQ2 (parameter No. PB16)	

(3) Adjustment sequence and mode usage



Usage
This controller enables the auto tuning mode 1 in the initial status. (Refer to section 6.3.1.)
Use the one-touch tuning button (AUTO) to make the adjustment. (Refer to section 6.1.)
After one-touch tuning, parameter No. PA08 (ATU: auto tuning mode) automatically changes to "000" (2-gain adjustment mode). (Refer to section 6.4.)
All gains can be adjusted manually for fast setting, etc. (Refer to section 6.5.)

6.3 Auto tuning mode

6.3.1 Overview

The controller has a real-time auto tuning function which estimates the machine characteristic (load to motor inertia moment ratio) in real time and automatically sets the optimum gains according to that value. This function permits ease of gain adjustment of the controller.
The controller is factory-set to the auto tuning mode 1.
In this mode, the load to motor inertia moment ratio of a machine is always estimated to set the optimum gains automatically.
The following parameters are automatically adjusted in the auto tuning mode 1.

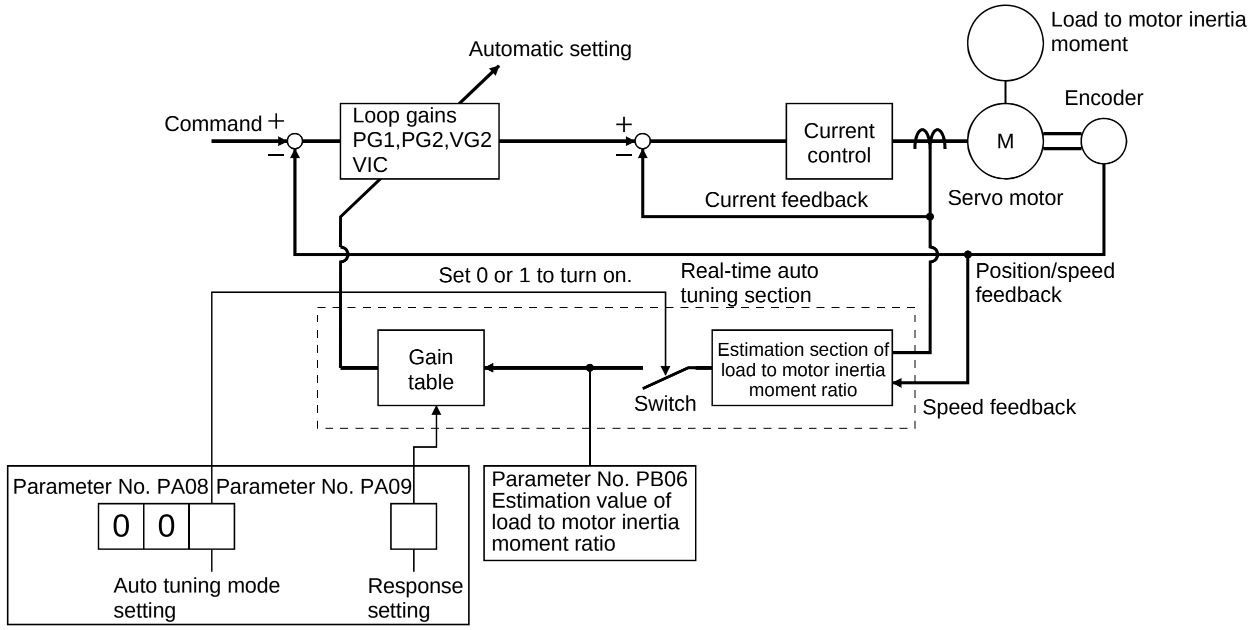
Parameter No.	Abbreviation	Name
PB06	GD2	Load to motor inertia moment ratio
PB07	PG1	Model loop gain
PB08	PG2	Position loop gain
PB09	VG2	Speed loop gain
PB10	VIC	Speed integral compensation

POINT

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

6.3.2 Auto tuning mode 1 operation

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



When a servo motor is accelerated/decelerated, the load to motor inertia moment ratio estimation section always estimates the load to motor inertia moment ratio from the current and the speed of the servo motor. The results of estimation are written to parameter No. PB06 (load to motor inertia moment ratio). These results can be confirmed on the status display screen of the MR Configurator section.

If the value of the load to motor inertia moment ratio is already known or if the estimation cannot be made properly, select "manual mode" by setting parameter No. PA08 to "003" (the switch in the above diagram turns off) to stop the estimation of the load to motor inertia moment ratio. Then, set the load to motor inertia moment ratio manually to parameter No. PB06.

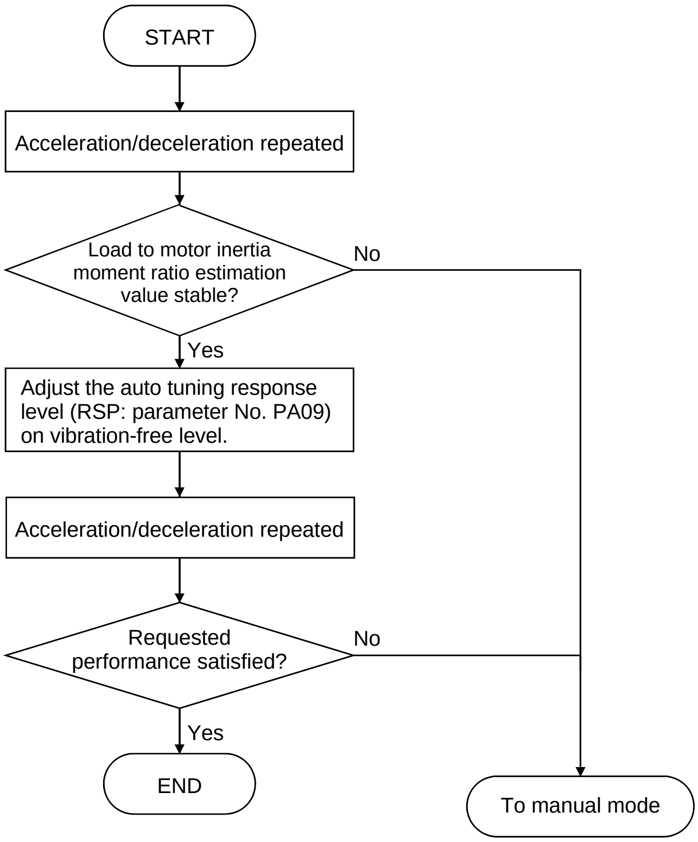
From the preset load to motor inertia moment ratio (parameter No. PB06) value and response level (parameter No. PA09), the optimum loop gains are automatically set on the basis of the internal gain tale.

The auto tuning results are saved in the EEP-ROM of the controller every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each loop gain saved in the EEP-ROM being used as an initial value.

> **POINT**
>
> - If sudden disturbance torque is imposed during the operation, the estimation of the load to motor inertia moment ratio may malfunction temporarily. In such a case, select the "manual mode" (parameter No. PA08: 003) and set the correct load to motor inertia moment ratio in parameter No. PB06.
> - When any of the auto tuning mode 1 and 2-gain adjustment mode settings is changed to the manual mode setting, the current loop gains and load to motor inertia moment ratio estimation value are saved in the EEP-ROM.

6.3.3 Adjustment procedure by auto tuning

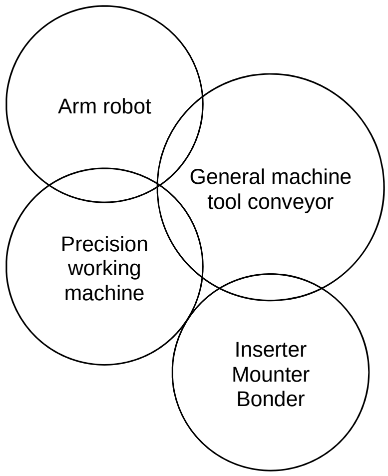
Since auto tuning is made valid before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.



6.3.4 Response level setting in auto tuning mode 1

Set the response (The first digit of parameter No. PA09) of the whole servo system. As the response level setting is increased, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range.
If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100Hz, adaptive tuning mode (parameter No. PB01) or machine resonance suppression filter (parameter No. PB13 to PB16, PB38, PB39) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase.
Refer to section 7.2 for adaptive tuning mode and machine resonance suppression filter.

Setting of parameter No. PA09

Response level setting	Machine characteristic	
	Machine rigidity	Guideline of corresponding machine
1	Low	
2		
3		
4		
5		
6		
7		
8	Middle	
9		
10		
11		
12		
13		
14		
15		
16	High	

6.4 2-gain adjustment mode

POINT
・Use this mode to improve the response level after the one-touch tuning. Use parameters No. PA09 or PB07 for fine adjustment.

Use the 2-gain adjustment mode for fine adjustment of the response level setting and the model loop gain.

(1) Parameters

(a) Automatically adjusted parameters

The following parameters are automatically adjusted by the auto tuning 1.

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

(b) Manually adjusted parameters

The following parameters are adjustable manually.

Parameter No.	Abbreviation	Name
PA09	RSP	Auto tuning response
PB07	PG1	Model loop gain

(2) Adjustment procedure

Step	Operation	Description
1	Set to the 2-gain adjustment mode.	Set parameter No. PA08 (auto tuning mode) to "□□0".
2	During the operation, increase the response level setting (parameter No. PA09), and reset the setting if vibration occurs.	Adjustment of the servo stability
3	During the operation, increase the model loop gain (parameter No. PB07), and reset the setting if overshoot occurs.	Adjustment of the position track ability

(3) Adjustment description

The droop pulse value is determined by the following expression.

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

6.5 Manual mode

If the adjustment made by the auto tuning mode 1 and 2-gain adjustment mode is not satisfactory, adjust the load to motor inertia moment and all gains in the manual mode.

POINT
- Use this mode if the estimation of the load to motor inertia moment ratio is not the normal value.
- Use this mode to perform the vibration suppression control tuning.

(1) For internal speed control

(a) Parameters

The following parameters are used for gain adjustment.

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

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.3.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 003).	
3	Set an estimated value to load to motor inertia moment ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the model loop gain.
8	If the gains cannot be increased due to mechanical system resonance or the like, and the desired response cannot be achieved, response may be increased by executing steps 3 to 7 after suppressing the resonance by the adaptive tuning mode or the machine resonance suppression filter.	Suppression of machine resonance. (Refer to section 7.2.)
9	While checking the rotational status, fine-adjust the each gain.	Fine adjustment

(c) Adjustment description

1) Speed loop gain (VG2: parameter No. PB09)

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

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

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

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

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

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

This parameter determines the response level for the position command. Increasing the model loop gain improves the track ability to a position command. If the gain is too high; however, overshooting is likely to occur when settling.

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

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment.

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

(b) Adjustment procedure

Step	Operation	Description
1	Brief-adjust with auto tuning. Refer to section 6.3.3.	
2	Change the setting of auto tuning to the manual mode (Parameter No.PA08: 003).	
3	Set an estimated value to the load to motor inertia moment ratio. (If the estimate value with auto tuning is correct, setting change is not required.)	
4	Set a slightly smaller value to the model loop gain and the position loop gain. Set a slightly larger value to the speed integral compensation.	
5	Increase the speed loop gain within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed loop gain.
6	Decrease the speed integral compensation within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
7	Increase the position loop gain, and return slightly if vibration takes place.	Increase the position loop gain.
8	Increase the model loop gain, and return slightly if overshooting takes place.	Increase the model loop gain.
9	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with adaptive tuning mode or machine resonance suppression filter and then executing steps 3 to 8.	Suppression of machine resonance. (Refer to section 7.2.)
10	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Speed loop gain (VG2: parameter No. PB09)

The same as for the internal speed control.

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

The same as for the internal speed control.

3) Position loop gain (PG2: parameter No. PB08)

This parameter determines the response level to the disturbance of the position control loop. Increasing position loop gain decreases the change at external disturbance. If the gain is too high; however, overshooting is likely to occur when settling.

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

4) Model loop gain (PG1: parameter No. PB07)

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

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

7. SPECIAL ADJUSTMENT FUNCTIONS

7.1 Tough drive function

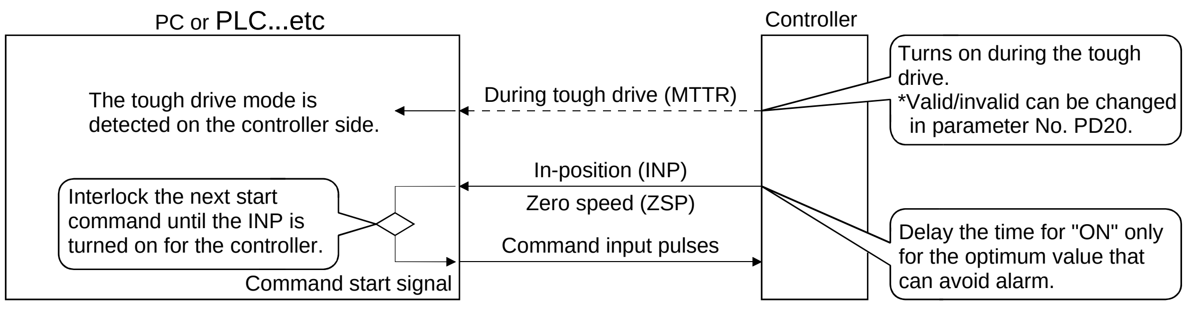
POINT
・Enable or disable the tough drive function by parameter No.PA04 (tough drive function selection). (Refer to section 4.1.5.)

The tough drive function continues the operation not to stop the machine in such situation when normally an alarm is activated.

7.1.1 Overload tough drive function

The overload tough drive function automatically reduces the load ratio to about 70% to avoid an alarm when the effective load ratio increases to near the overload alarm level. When the overload tough drive function activates, the controller delays the time for the in-position (INP) and the zero speed (ZSP) to turn on. The PC or PLC...etc holds the next command until the in-position (INP) turns on so that the machine tact and the effective load ratio are decreased. The during tough drive (MTTR) can be output from the controller by setting parameter No. PD20 (function selection D-1) to "□1□□".

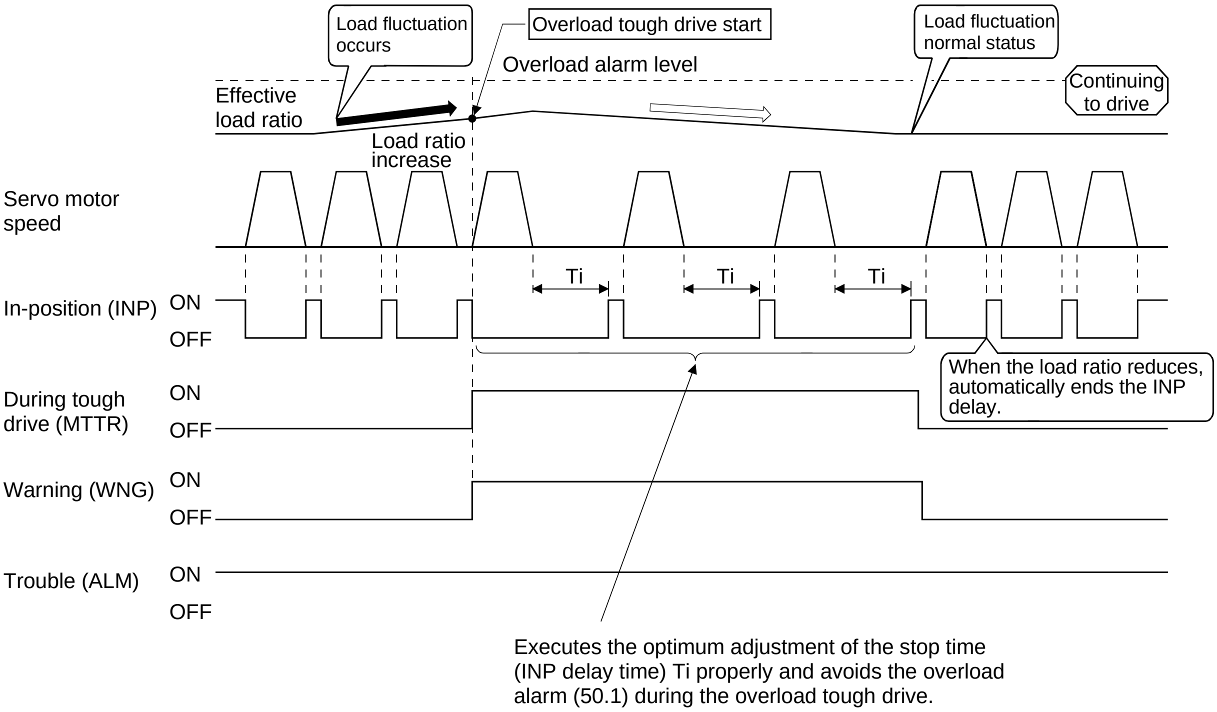
POINT
・The overload tough drive function is available only in the position control mode. ・The increase in the load ratio that is caused by temporary load fluctuations can be avoided by reducing the machine tact (operating time) so that the operation can be continued. An optimum in-position (INP) delay time is calculated automatically on the controller side. ・The maximum delay time of the in-position (INP) can be limited by parameter No. PC26 (detailed setting of overload tough drive) so as not to cause INP timeout error on the PC or PLC...etc side.



However, the overload tough drive function is not effective in the following cases.

(1) When the effective load ratio temporarily exceeds 200%.

(2) When the load increases at a stop such as a detent torque of a vertical lift.



When the overload tough drive function activates, the number of tough drive in the display mode (alarm mode) is increased by one. (Refer to section 5.5.)

7.1.2 Vibration tough drive function

The vibration tough drive function reset the filter instantaneously and prevents oscillation when a machine resonance is generated due to aging distortion or individual differences.
In order to reset the machine resonance suppression filter by the vibration tough drive function, parameters No. PB13 (machine resonance suppression filter 1) and No. PB15 (machine resonance suppression filter 2) are required to be set in advance. Perform either of the following to set parameters No. PB13 and No. PB15.

(1) Perform the one-touch tuning (refer to section 6.1).

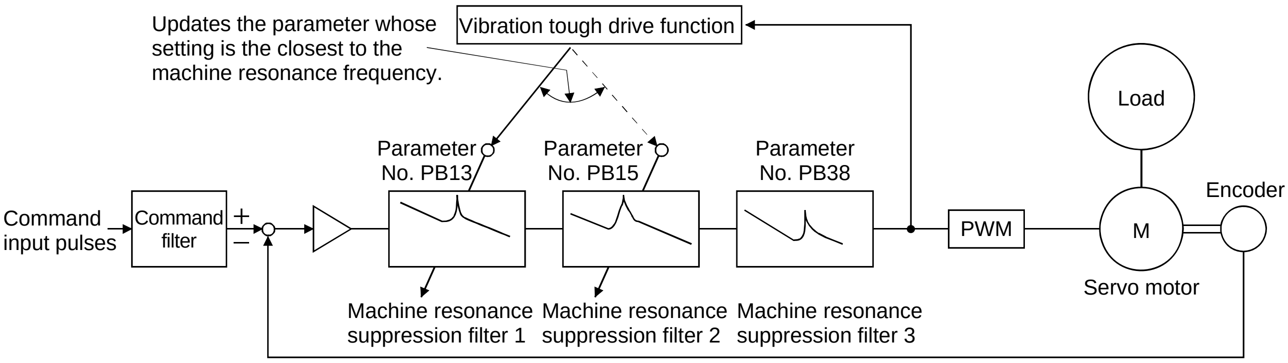
(2) Set the parameters manually (refer to section 4.2.2).

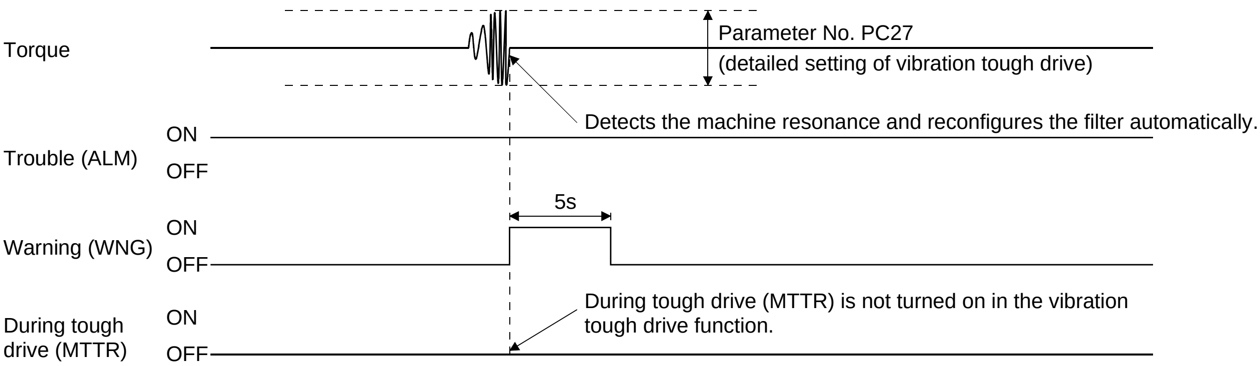
The vibration tough drive function activates when a detected frequency is within the range of ±30% in relation to the setting value of parameters No. PB13 (machine resonance suppression filter 1) and No. PB15 (machine resonance suppression filter 2).
The detection level of the vibration tough drive function can be set by parameter No. PC27 (detailed setting of vibration tough drive).

POINT

- Resetting of the parameters No. PB13 or No. PB15 by the vibration tough drive function is performed constantly. However, the number of write times to the EEP-ROM is limited to once per hour.
- The machine resonance suppression filter 3 (parameter No. PB38) is not reset by the vibration tough drive function.

The following shows the function block diagram of the vibration tough drive function. When a machine resonance is detected, the detected frequency is compared with the set values of parameters No. PB13 (machine resonance suppression filter 1) and No. PB15 (machine resonance suppression filter 2). Then, whichever parameter has a set value closer to the detected machine resonance frequency is reset to the value of the detected frequency.





When the vibration tough drive function activates, the number of tough drive in the display mode (alarm mode) is increased by one. (Refer to section 5.5.)

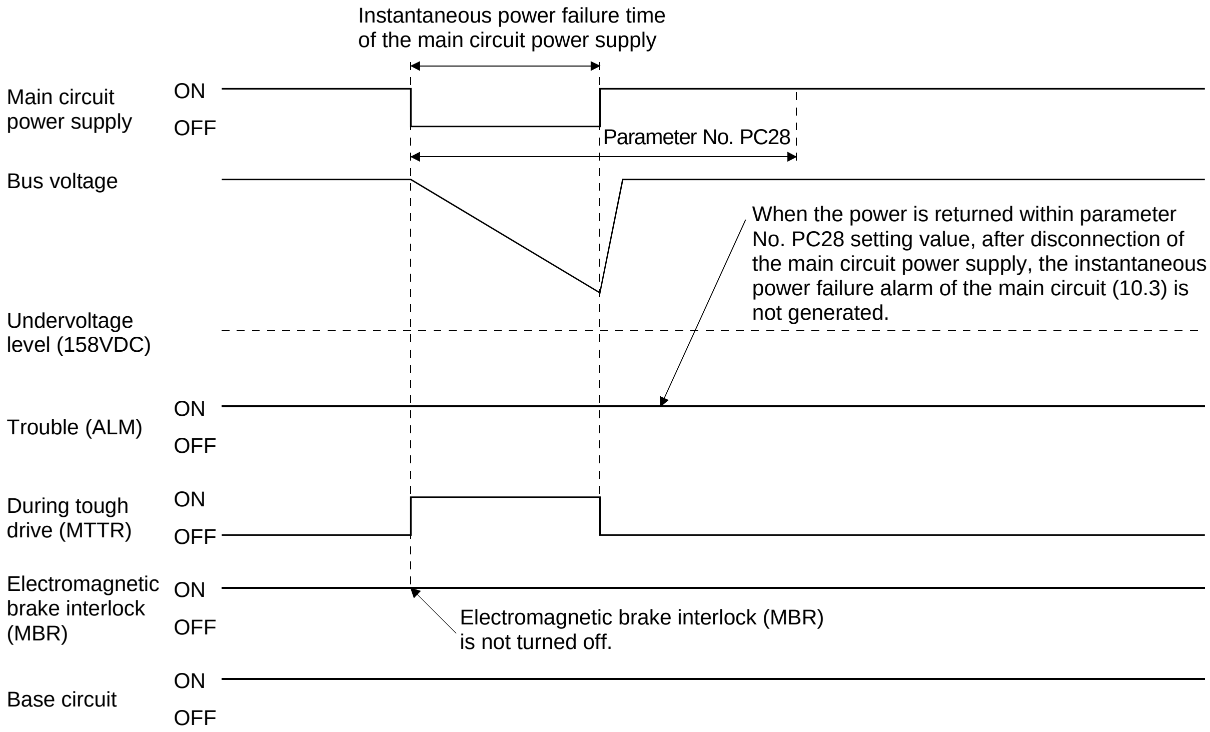
7.1.3 Instantaneous power failure tough drive function

The instantaneous power failure tough drive function avoids the instantaneous power failure alarm even when an instantaneous power failure occurs during operation. When the instantaneous power failure tough drive activates, the immunity to instantaneous power failures is increased by using the electrical energy charged in the main circuit capacitor during instantaneous power failures. The instantaneous power failure alarm judgment time for the main circuit power can be changed by parameter No. PC28 (detailed setting of instantaneous power failure tough drive).

POINT

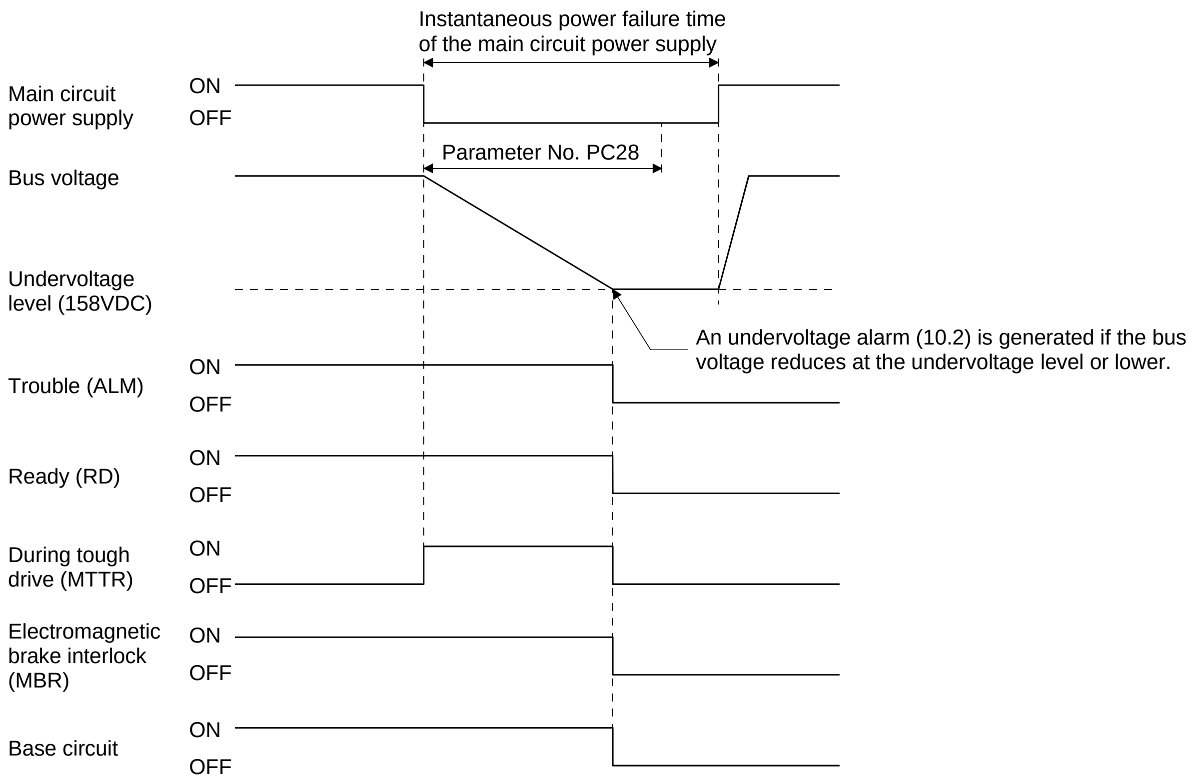
- The electromagnetic brake interlock (MBR) does not turn off during the instantaneous power failure tough drive.
- When the load of instantaneous power failure is heavy, the undervoltage alarm (10.2) caused by the bus voltage drop may occur regardless of the setting value of parameter No. PC28 (detailed setting of instantaneous power failure tough drive).
- The immunity to instantaneous power failures is increased by the instantaneous power failure tough drive function. However, it is not compliant with the SEMI-F47 specification.

(1) When the instantaneous main circuit power failure time is shorter than the set value of parameter No. PC28 (detailed setting of instantaneous power failure tough drive)



When the instantaneous power failure tough drive function activates, the number of tough drive of the display mode (alarm mode) is increased by one. (Refer to section 5.5.)

(2) When an undervoltage occurs during the instantaneous main circuit power failure



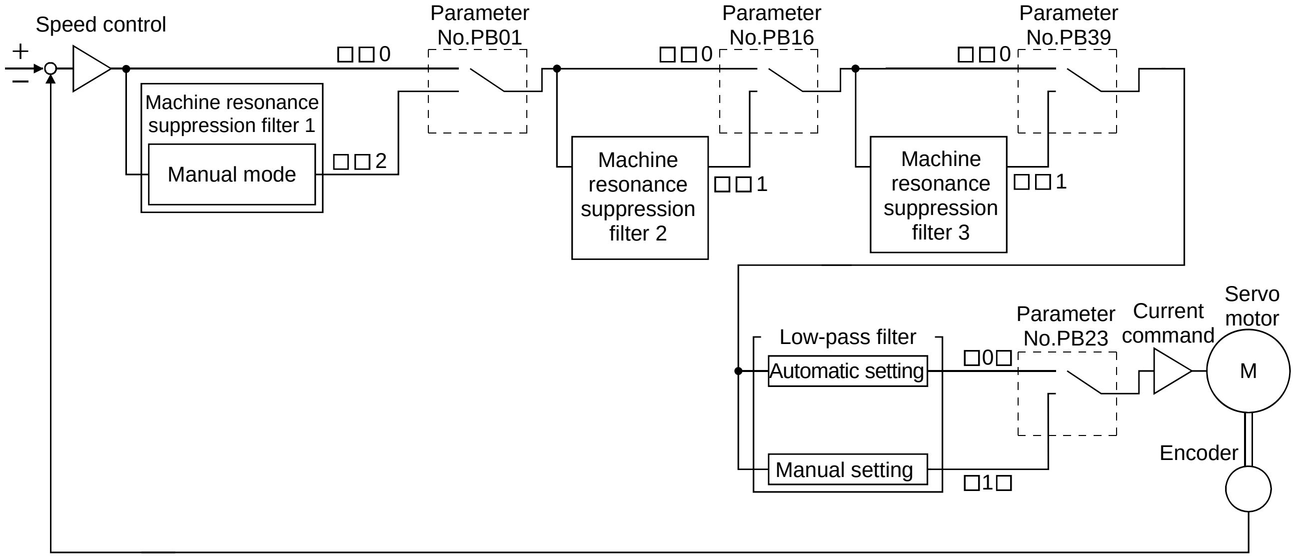
(3) When the instantaneous main circuit power failure time is longer than the set value of parameter No. PC28 (detailed setting of instantaneous power failure tough drive)
If the instantaneous main circuit power failure time exceeds the set value of parameter No. PC28, main circuit power supply failure (instantaneous power failure) alarm (10.3) occurs even if the instantaneous power failure tough drive function is valid.

7.2 Machine resonance suppression function

POINT
· The functions given in this section are not generally required to use. Use these functions when the machine status is not satisfactory after making adjustment in the methods given in chapter 6.

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

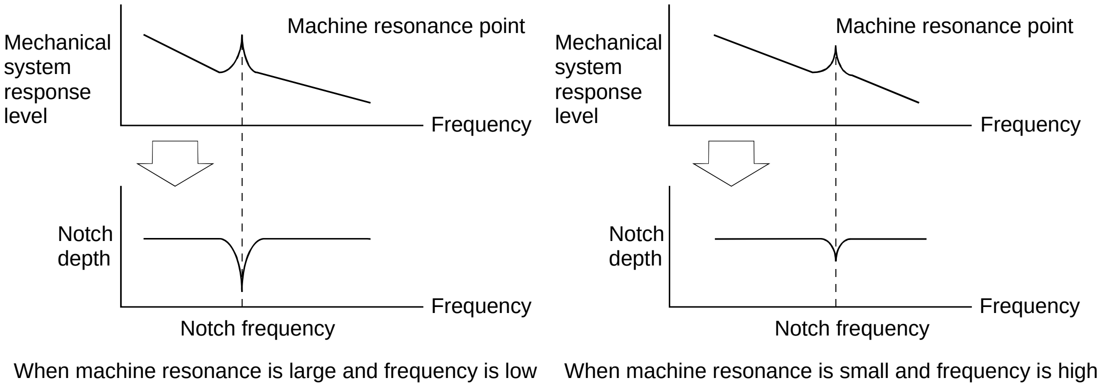
7.2.1 Function block diagram



7.2.2 Adaptive filter Ⅱ

(1) Function

The adaptive filter Ⅱ (adaptive tuning) sets the filter characteristics automatically with the one-touch tuning, and suppresses vibrations of the mechanical system. Since the filter characteristics (frequency, depth) are set automatically, you need not be conscious of the resonance frequency of a mechanical system.

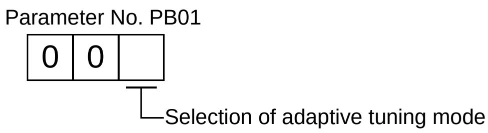


POINT

- When the one-touch tuning is performed, the adaptive tuning is performed, and the machine resonance suppression filter 1 (parameter No. PB13) and the notch shape selection 1 (parameter No. PB14) are set automatically.
- The machine resonance frequency which adaptive tuning mode can respond to is about 100 to 2.25kHz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range.
- Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics.

(2) Parameters

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



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

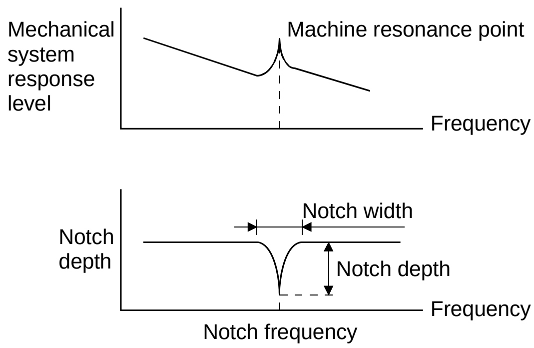
Note 1. Parameter No. PB13 and PB14 are fixed to the initial values.
2. When an adaptive filter is set, it is automatically updated to "2".

POINT
・"Filter OFF" enables a return to the factory-set initial value. ・During adaptive tuning, a filter having the best notch depth at the set control gain is generated. To allow a filter margin against machine resonance, increase the notch depth in the manual mode.

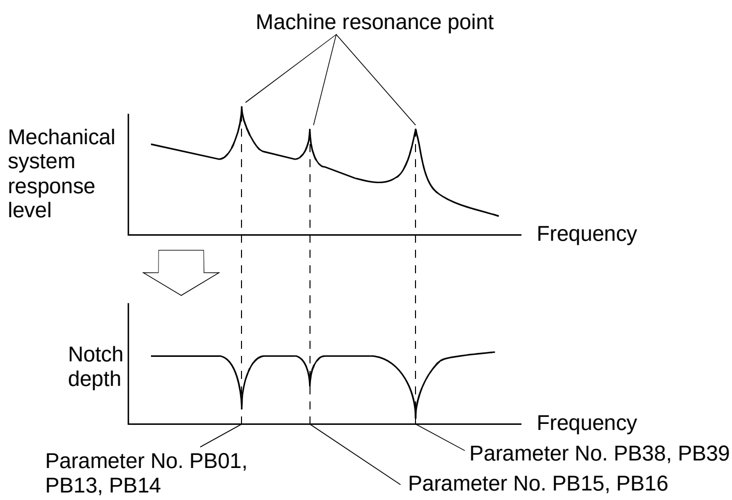
7.2.3 Machine resonance suppression filter

(1) Function

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



The vibration of three resonance frequency can be suppressed by the machine resonance suppression filter 1, machine resonance suppression filter 2 and machine resonance suppression filter 3.



(2) Parameters

Set the machine resonance suppression filters by the following parameters:

Item	Parameters to be set		Note
	Notch frequency	Notch depth and width	
Machine resonance suppression filter 1	Parameter No. PB13	Parameter No. PB14	The set values are valid when "manual mode" is selected in the adaptive tuning mode (parameter No. PB01).
Machine resonance suppression filter 2	Parameter No. PB15	Parameter No. PB16	The set values are always valid regardless of the set value of the adaptive tuning mode (parameter No. PB01).
Machine resonance suppression filter 3	Parameter No. PB38	Parameter No. PB39	

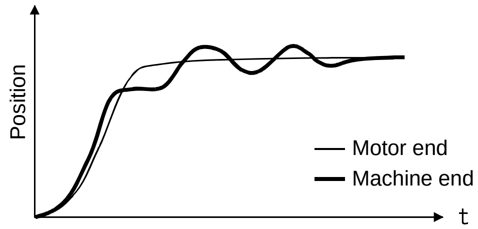
POINT

- The machine resonance suppression filter is a delay factor for the servo system. Hence, vibration may increase if an improper resonance frequency or an excessively deep notch is set.
- If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower. Set the notch frequency at the point where vibration is minimal.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- A wider notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.

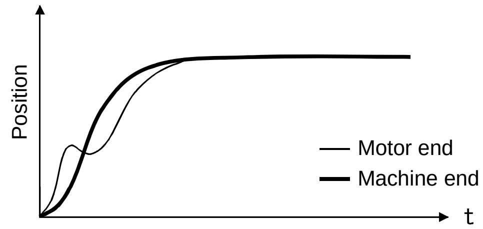
7.2.4 Advanced vibration suppression control

(1) Operation

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



Vibration suppression control OFF
(Normal control)

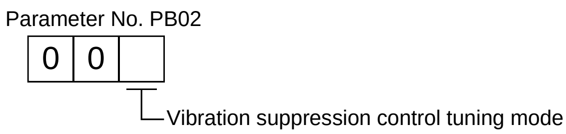


Vibration suppression control ON

When the advanced vibration suppression control (vibration suppression control tuning mode (parameter No. PB02)) is executed, the vibration frequency at machine end can be automatically estimated to suppress machine end vibration.
In addition, the vibration suppression control tuning mode shifts to the manual mode after positioning is performed the predetermined number of times. The manual mode enables manual setting using the vibration suppression control vibration frequency setting (parameter No. PB19) and the vibration suppression control resonance frequency setting (parameter No. PB20).

(2) Parameter

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



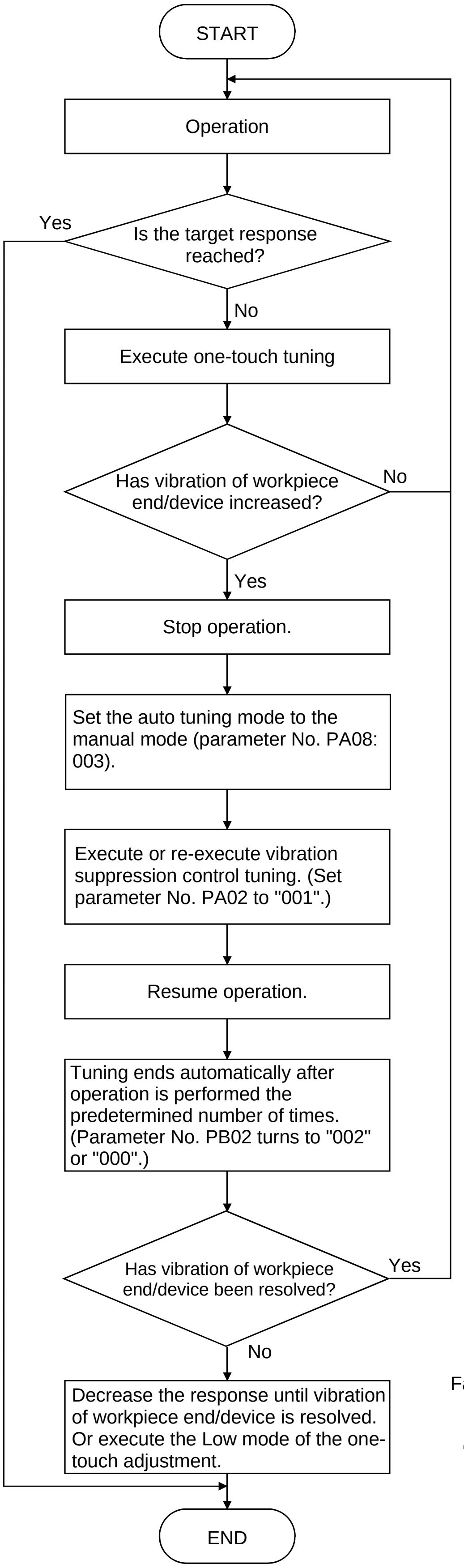
Setting	Vibration suppression control tuning mode	Automatically set parameter
0	Vibration suppression control OFF	(Note)
1	Vibration suppression control tuning mode (Advanced vibration suppression control)	Parameter No. PB19 Parameter No. PB20
2	Manual mode	

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

POINT

- When executing the vibration suppression control tuning mode (advanced vibration suppression control), follow the procedures of (3) in this section.
- This function is valid when the auto tuning mode (parameter No. PA08) is set to manual mode ("□□3").
- The machine resonance frequency supported by the vibration suppression control tuning mode is 1.0Hz to 100.0Hz. The function is not effective for vibration outside this range.
- To prevent unexpected operations, be sure to stop the servo motor before changing the vibration suppression control-related parameters (parameter No. PB02, PB19, PB20, PB33, PB34, PB38, PB39).
- For positioning operation during execution of vibration suppression control tuning, provide a stop time to ensure a stop after full vibration damping.
- Vibration suppression control tuning may not make an estimation properly if the residual vibration at the motor end is small.
- Vibration suppression control tuning sets the optimum parameter with the currently set control gains. When the response setting is increased, set the vibration suppression control tuning again.

(3) Vibration suppression control tuning mode procedure

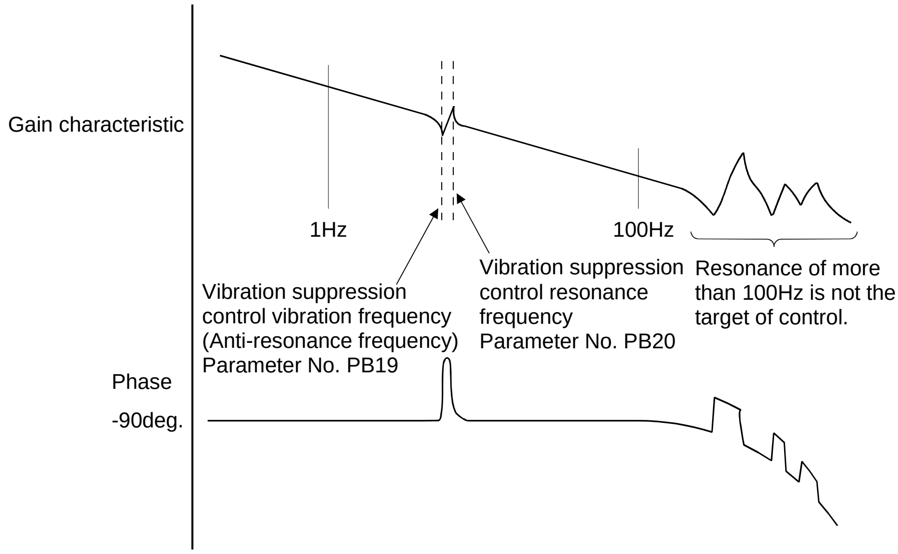


Factor
- Estimation cannot be made as machine end vibration has not been transmitted to the motor end.
- The response of the model loop gain has increased to the machine end vibration frequency (vibration suppression control limit).

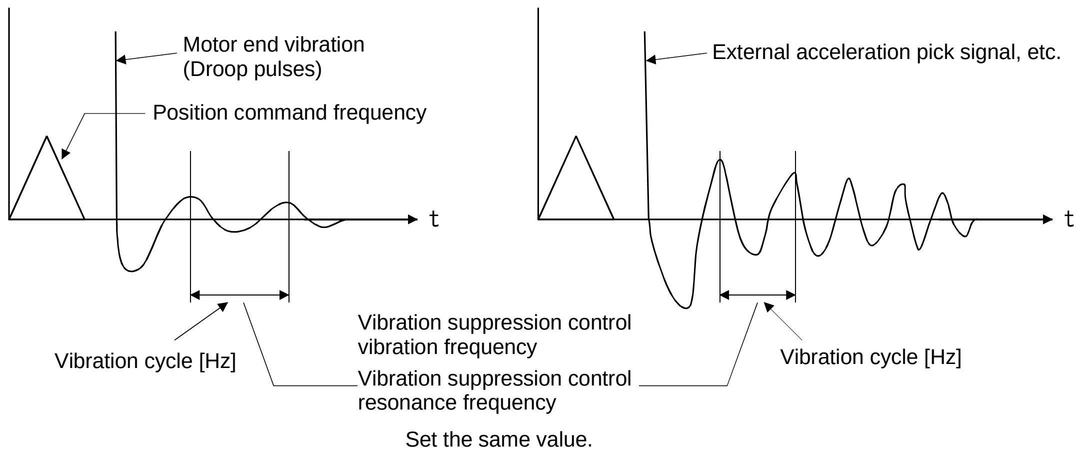
(4) Vibration suppression control manual mode

Vibration suppression control can be set manually by setting the vibration suppression control vibration frequency (parameter No. PB19) and the vibration suppression control resonance frequency (parameter No. PB20) after measuring work-end vibration and device shake using an external measuring instrument.

(a) When a vibration peak can be measured using an external measuring instrument



(b) When vibration can be measured using an external measuring instrument



> **POINT**
>
> - When the machine-end vibration does not travel to the motor end, setting the motor-end vibration frequency does not have any effect.
> - When vibration frequency (anti-resonance frequency) and resonance frequency can be measured using an external measuring instrument, setting different values in parameters No. PB19 and No. 20 separately improves the vibration suppression performance better rather than setting the same value.

7.2.5 Low-pass filter

(1) Function

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

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

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

(2) Parameter

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

Parameter No. PB23

0		0

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

7.3 Gain changing function

POINT
・The functions given in this section are not generally requied to use. Use these functions when the machine status is not satisfactory after making adjustment in the methods given in chapter 6.

This function can change the gains. Gains can be changed using an input device or gain switching conditions (servo motor speed, etc.)

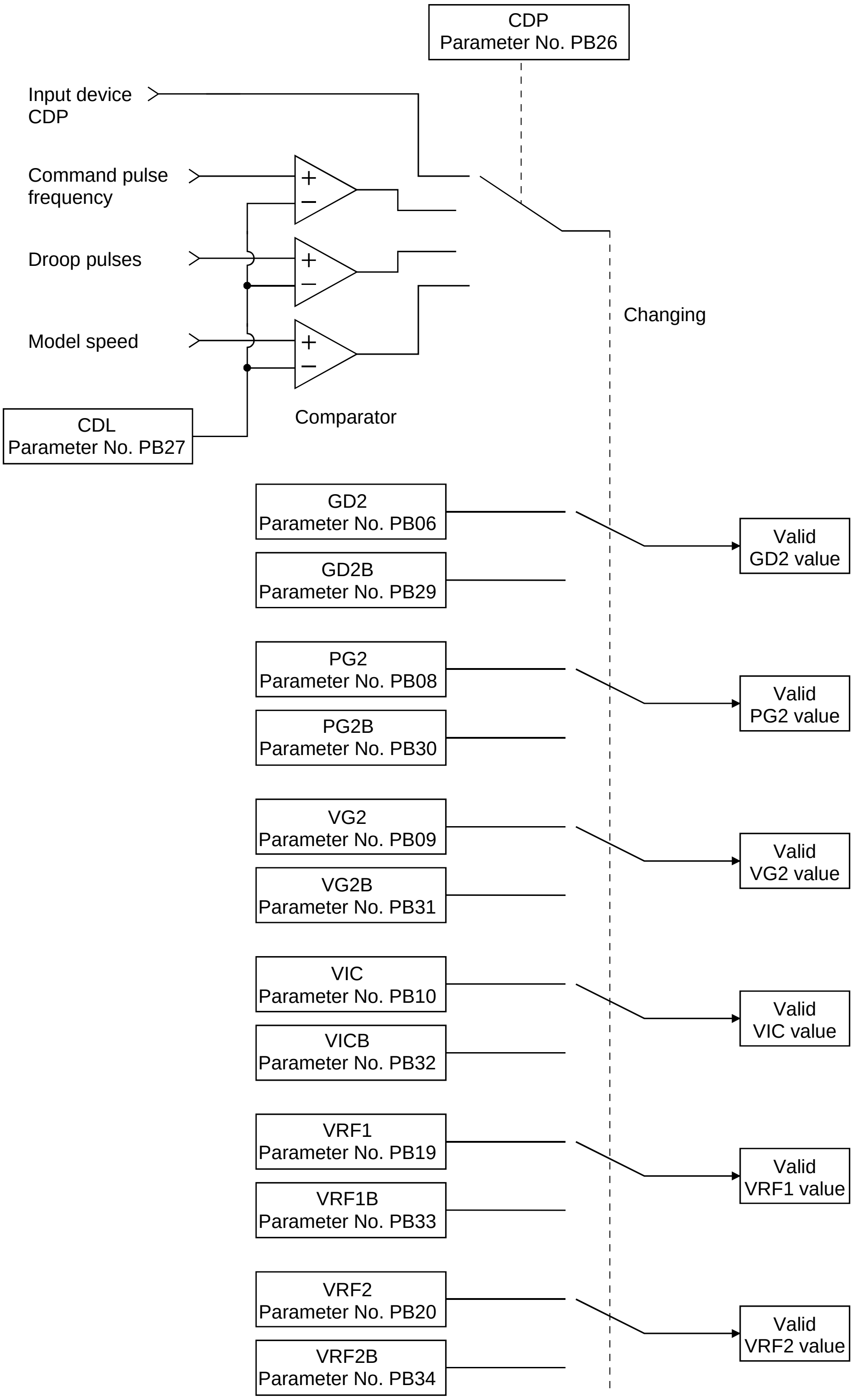
7.3.1 Applications

This function is used when:

(1) You want to increase the gains during servo lock but decrease the gains to reduce noise during rotation.
(2) You want to increase the gains during settling to shorten the stop settling time.
(3) You want to change the gains using an input device to ensure stability of the servo system since the load to motor inertia moment ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

7.3.2 Function block diagram

The valid loop gains PG2, VG2, VIC, GD2, VRF1 and VRF2 of the actual loop are changed according to the conditions selected by gain changing selection CDP (parameter No. PB26) and gain changing condition CDL (parameter No. PB27).



7.3.3 Parameters

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

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

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

(2) Gain changing load to motor inertia moment ratio (parameter No. PB29)
This parameter is used to set load to motor inertia moment ratio after changing the gains. If the load to motor inertia moment ratio does not change, set the same value in this parameter as the load to motor inertia moment ratio (parameter No. PB06).

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

(4) Gain changing selection (parameter No. PB26)

This parameter is used to set the gain changing condition. Select the changing condition in the first and second digits. If "1" is set in the first digit, the gain can be changed by the gain changing (CDP) input device. The gain changing (CDP) can be assigned to CN1-pin 3 to CN1-pin 8 using parameters No. PD03 to PD14.

0		

Gain changing selection
Under any of the following conditions, the gains change on the basis of parameter No. PB29 to PB34 settings.
0: Invalid
1: Input device (gain changing (CDP))
2: Command frequency (parameter No.PB27 setting)
3: Droop pulse (parameter No.PB27 setting)
4: Servo motor speed (parameter No.PB27 setting)

Gain changing condition
0: Valid when the input device (gain changing (CDP)) is ON, or valid when the value is equal to or larger than the value set in parameter No. PB27.
1: Valid when the input device (gain changing (CDP)) is OFF, or valid when the value is equal to or smaller than the value set in parameter No. PB27.

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

This parameter is used to set gain changing level when "command frequency", "droop pulse" or "servo motor speed" is selected in the gain changing selection (parameter No. PB26).

The setting unit is as follows.

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

(6) Gain changing time constant (parameter No. PB28)

In this parameter, a primary delay filter can be set to each gain at gain changing. This parameter is, for example, used to prevent unexpected operation if the gain difference is large at gain changing.

(7) Gain changing vibration suppression control

Gain changing vibration suppression control is used only when the gain is changed by on/off of the input device (gain changing (CDP)).

7.3.4 Gain changing operation

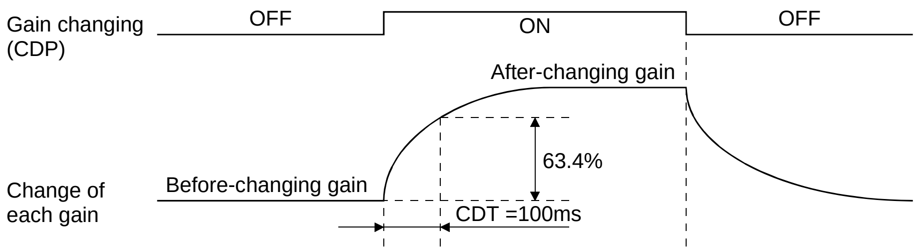
The operation is explained with setting examples below:

(1) When gain changing by an input device (CDP) is selected:

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Load to motor inertia moment ratio	4.0	Multiplier (×1)
PB07	PG1	Model loop gain	100	rad/s
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB19	VRF1	Vibration suppression control vibration frequency setting	50	Hz
PB20	VRF2	Vibration suppression control resonance frequency setting	50	Hz
PB29	GD2B	Gain changing load to motor inertia moment ratio	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	001 (Changed by ON/OFF of input device)	
PB28	CDT	Gain changing time constant	100	ms
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	60	Hz
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	60	Hz

(b) Changing operation



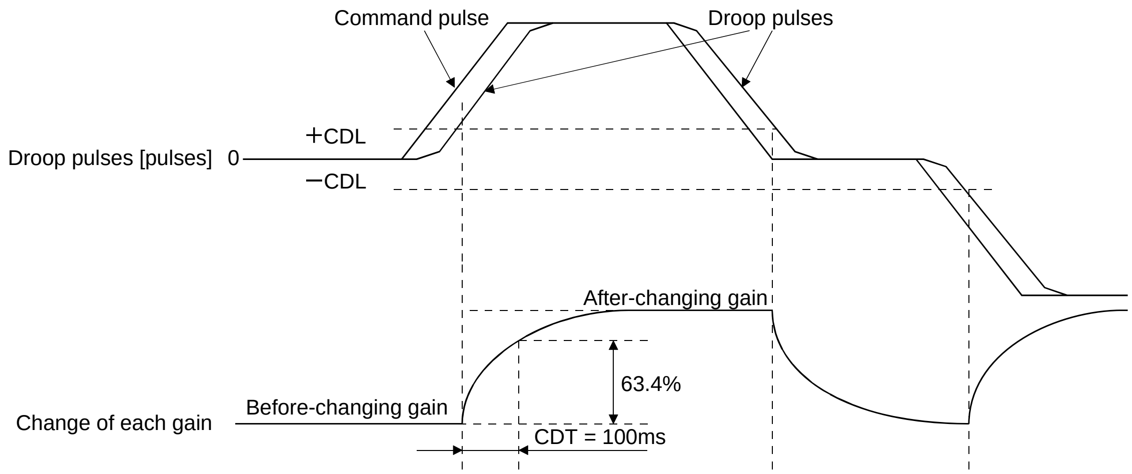
Model loop gain			100		
Load to motor inertia moment ratio	4.0	→	10.0	→	4.0
Position loop gain	120	→	84	→	120
Speed loop gain	3000	→	4000	→	3000
Speed integral compensation	20	→	50	→	20
Vibration suppression control vibration frequency setting	50	→	60	→	50
Vibration suppression control resonance frequency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

(2) When gain changing by droop pulses is selected:
In this case, gain changing vibration suppression control cannot be used.

(a) Setting

Parameter No.	Abbreviation	Name	Setting	Unit
PB06	GD2	Load to motor inertia moment ratio	4.0	Multiplier (×1)
PB07	PG1	Model loop gain	100	rad/s
PB08	PG2	Position loop gain	120	rad/s
PB09	VG2	Speed loop gain 2	3000	rad/s
PB10	VIC	Speed integral compensation	20	ms
PB29	GD2B	Gain changing load to motor inertia moment ratio	10.0	Multiplier (×1)
PB30	PG2B	Gain changing position loop gain	84	rad/s
PB31	VG2B	Gain changing speed loop gain	4000	rad/s
PB32	VICB	Gain changing speed integral compensation	50	ms
PB26	CDP	Gain changing selection	003 (Changed by droop pulses)	
PB27	CDL	Gain changing condition	50	pulse
PB28	CDT	Gain changing time constant	100	ms

(b) Changing operation



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

8. TROUBLESHOOTING

POINT
· As soon as an alarm occurs, turn off servo-on (SON) and the main circuit power supply.

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

8.1 Alarms and warning list

When a fault occurs during the operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 8.2 or 8.3 and take the appropriate action. When an alarm occurs, ALM turns off.
After removing the cause of the alarm, the alarm can be deactivated in any of the methods marked ○ in the alarm deactivation column.
The warning is automatically canceled after removing the cause of occurrence.

	No.	LED display	Name	Alarm deactivation		
				Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES)
Alarms	A.10	A. 10	Undervoltage	○	○	○
	A.12	A. 12	Memory error 1 (RAM)	○		
	A.13	A. 13	Clock error	○		
	A.15	A. 15	Memory error 2 (EEP-ROM)	○		
	A.16	A. 16	Encoder initial communication error1	○		
	A.17	A. 17	Board error	○		
	A.19	A. 19	Memory error 3 (Flash-ROM)	○		
	A.1A	A. 1A	Motor combination error	○		
	A.1C	A. 1C	Software combination error	○		
	A.1E	A. 1E	Encoder initial communication error 2	○		
	A.1F	A. 1F	Encoder initial communication error 3	○		
	A.20	A.20	Encoder normal communication error 1	○		
	A.21	A.21	Encoder normal communication error 2	○		
	A.24	A.24	Main circuit error	○	○	○
	A.30	A.30	Regenerative error	(Note 1) ○	(Note 1) ○	(Note 1) ○
	A.31	A.31	Overspeed	○	○	○
	A.32	A.32	Overcurrent	○		
	A.33	A.33	Overvoltage	○	○	○
	A.35	A.35	Command frequency error	○	○	○
	A.37	A.37	Parameter error	○		
	A.45	A.45	Main circuit device overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	A.46	A.46	Servo motor overheat	(Note 1) ○	(Note 1) ○	(Note 1) ○
	A.50	A.50	Overload 1	(Note 1) ○	(Note 1) ○	(Note 1) ○
	A.51	A.51	Overload 2	(Note 1) ○	(Note 1) ○	(Note 1) ○
	A.52	A.52	Error excessive	○	○	○
	A.8E	A.8E	USB communication error	○	○	○
	888	888	Watchdog	○		

	No.	LED display	Name	Alarm deactivation: Power OFF→ON	Alarm deactivation: Press "SET" on current alarm screen.	Alarm deactivation: Alarm reset (RES)	Stop (Note 2)
Warning	A.91	A.91	Amplifier overheat warning				No
	A.99	A.99	Stroke limit warning				No
	A.E0	A.E0	Excessive regeneration warning				No
	A.E1	A.E1	Overload warning 1				No
	A.E6	A.E6	Servo forced stop warning				Yes
	A.E9	A.E9	Main circuit off warning				No
	A.EC	A.EC	Overload warning 2				No
	A.ED	A.Ed	Output watt excess warning				No
	A.F0	A.F0	Tough drive warning				No

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.
2. Yes: Servo motor stops.
No: Servo motor does not stop.

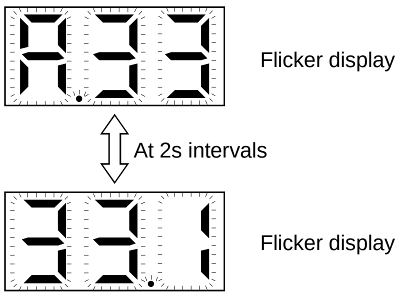
8.2 Remedies for alarms

⚠CAUTION	・When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur. ・As soon as an alarm occurs, turn off servo-on (SON) and the main circuit power supply. Otherwise, regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire.

POINT

- When any of the following alarms has occurred, do not deactivate the alarm and resume operation repeatedly. To do so will cause the controller/servo motor to fail. Remove the cause of occurrence, and leave a cooling time of more than 30 minutes before resuming operation.
  - Regenerative error (30. □)
  - Main circuit device overheat (45.1)
  - Servo motor overheat (46.1)
  - Overload 1 (50. □)
  - Overload 2 (51. □)
- The alarm can be deactivated by switching the power off and then on, by pressing the "SET" button on the current alarm screen or by turning on the reset (RES). For details, refer to section 8.1.

When an alarm occurs, the trouble (ALM) switches off and the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No.
The following shows the display example of alarm 33 (overvoltage: detail1)



Remove the cause of the alarm in accordance with this section. Use the MR Configurator to refer to a factor of alarm occurrence.

Alarm No.: A.10		Name: Undervoltage				
Description		・Control circuit power supply voltage dropped. ・Main circuit power supply voltage dropped. ・Main circuit power supply is turned off.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
10.1	Control power supply voltage dropped	1)	Control circuit power supply connector is disconnected. Contact failure.	Check the control circuit power supply connector.	The connector is disconnected or contact failure.	Connect correctly.
					No problem.	Check 2).
		2)	Control circuit power supply voltage is low.	Check if the control power supply voltage is 19VDC or less.	19VDC or less.	Raise the control power supply voltage.
					Above 19VDC.	Check 3).
		3)	Instantaneous power failure of 1ms or longer occurred.	Check for any problem with the power supply.	A problem is found.	Check the power supply.
10.2	Main circuit power supply voltage dropped	1)	Main circuit power supply connector is disconnected.	Check the main circuit power supply connector.	The connector is disconnected.	Connect correctly.
					No problem.	Check 2).
		2)	Main circuit power supply voltage is low.	Check if the main circuit power voltage is 160VAC or less.	160VAC or less.	Raise the main circuit power voltage.
					Above 160VAC.	Check 3).
		3)	The drop occurs during acceleration.	Check if the value of status display Pn (bus voltage) is "1" (undervoltage).	The value is "1" (undervoltage).	Increase the acceleration time constant or the power supply capacity.
					The value is not "1" (undervoltage).	Check 4).
		4)	Controller fault	Check the value of status display Pn (bus voltage) when the main circuit power is on.	The value of the status display Pn (bus voltage) is "1" (overvoltage).	Replace the controller.
10.3	Main circuit power supply failure (instantane-ous power failure)	1)	Power supply connector/wire is disconnected.	Check the main circuit power connector.	The connector is disconnected or contact failure.	Connect correctly.
					No problem.	Check 2).
		2)	Main circuit power supply voltage is low.	Check if the main circuit power supply voltage is 160VAC or less.	160VAC or less.	Raise the main circuit power supply voltage.
					Above 160VAC.	Check 3).
		3)	Instantaneous power failure of the main circuit power supply occurred.	Check the main circuit power supply.		

Alarm No.: A.12		Name: Memory error 1 (RAM)				
Description		▪ Controller internal part (CPU) is faulty.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
12.1	CPU built-in RAM fault	1)	Faulty parts in the controller	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Check 2).
		2)	Fault in the surrounding environment	Check if any noise entered the power supply. Check if any connector is shorted.	An error is found.	Take the appropriate measures according to the cause.

Alarm No.: A.13		Name: Clock error				
Description		▪ Printed board fault ▪ CPU clock fault				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
13.1	Clock error	1)	Printed board fault	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.
		2)	Parts fault		Alarm does not occur.	Check 3).
		3)	Fault in the surrounding environment	Check if any noise entered the power supply. Check if any connector is shorted.	An error is found.	Take the appropriate measures according to the cause.

Alarm No.: A.15		Name: Memory error 2 (EEP-ROM)				
Description		▪ Controller internal part (EEP-ROM) is faulty.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
15.1	EEP-ROM error at power-on	1)	EEP-ROM operation fault when the power is on.	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Check 2).
		2)	Fault in the surrounding environment	Check if any noise entered the power supply. Check if any connector is shorted.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Replace the controller.
15.2	EEP-ROM error during operation	1)	EEP-ROM operation fault during the normal operation	Check if the alarm occurs when the parameter is changed during the normal operation.	Alarm occurs.	Replace the controller.

Alarm No.: A.16		Name: Encoder initial communication error 1				
Description		▪ Communication error occurred between the encoder and the controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
16.0	Encoder transmission data error	1)	Encoder cable faulty	Check the shield status.	Error in the shield.	Repair the cable.
					No error in the shield.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, the ambient temperature, etc.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Check 3).
		3)	Controller fault	Check if the alarm occurs again.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Execute the checking methods mentioned in the alarm display "16.3".
16.1	Encoder transmission data error 1 (Controller receiving error)	1)	Encoder cable faulty	Execute the checking methods mentioned in the alarm display "16.0".		
		2)	Fault in the surrounding environment			
		3)	Controller fault			
16.2	Encoder transmission data error 2 (Frame error)	1)	Encoder cable faulty	Execute the checking methods mentioned in the alarm display "16.0".		
		2)	Fault in the surrounding environment			
		3)	Controller fault			
16.3	Encoder transmission data error 3 (The controller not receiving)	1)	Encoder cable is disconnected.	Check if the encoder cable is connected correctly.	Disconnected.	Connect correctly.
					Connected correctly.	Check 2).
		2)	Encoder cable faulty	Check if the encoder cable is disconnected or shorted. Check the shield status.	An error is found.	Repair or replace the cable.
					No error.	Check 3).
		3)	Encoder cable type (2-wire, 4-wire) selection is incorrect in the parameter setting.	Check the set value of parameter No.PC22. 2-wire: "0 □□ " 4-wire: "1 □□ "	Incorrect set value is set.	Set correctly.
					No problem.	Check 4).
		4)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
					Alarm occurs.	Check 5).
		5)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
					Alarm occurs.	Check 6).
		6)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.

Alarm No.: A.16		Name: Encoder initial communication error 1				
Description		▪ Communication error occurred between the encoder and the controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
16.5	Encoder receive data error 1 (Parity error)	1)	Encoder cable faulty	Check the shield status.	Error in the shield.	Repair the cable.
					No error in the shield.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Check 3).
		3)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
16.6	Encoder receive data error 2 (Frame error)	1)	Encoder cable faulty	Execute the checking methods mentioned in the alarm display "16.5".		
		2)	Fault in the surrounding environment			
		3)	Encoder fault			
16.7	Encoder receive data error 3 (Request discrepancy)	1)	Encoder cable faulty	Execute the checking methods mentioned in the alarm display "16.5".		
		2)	Fault in the surrounding environment			
		3)	Encoder fault			

Alarm No.: A.17		Name: Board error				
Description		▪ Controller internal part is faulty.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
17.1	AD converter error	1)	Current detection circuit fault	Turn off the servo-on (SON) and check if the alarm occurs.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, the ambient temperature, etc.	An error is found.	Take the appropriate measures according to the cause.
17.2	Current feedback data error	1)	Power supply detection circuit fault	Execute the checking methods mentioned in the alarm display "17.1".		
		2)	Fault in the surrounding environment			
17.3	Custom IC error	1)	Power supply detection circuit fault			
		2)	Fault in the surrounding environment			
17.4	Amplifier identification signal error	1)	Controller identification signal could not be read correctly.	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.

Alarm No.: A.19		Name: Memory error 3 (Flash ROM)				
Description		▪ Controller internal part (Flash-ROM) is faulty.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
19.1	Flash-ROM error1	1)	Flash-ROM fault	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.
19.2	Flash-ROM error2	1)	Flash-ROM fault	Execute the checking methods mentioned in the alarm display "19.1".		

Alarm No.: A.1A		Name: Motor combination error				
Description		▪ Incorrect combination of controller and servo motor.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
1A.1	Motor combination error	1)	Incorrect combination of controller and servo motor is connected.	Check the model of the servo motor and the combination with the controller.	Incorrect combination.	Use correct combination.

Alarm No.: A.1C		Name: Software combination error				
Description		▪ Software checksum error				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
1C.1	Software combination error	1)	Flash-ROM fault	Remove all cables except for the control circuit power supply and check if the alarm occurs.	Alarm occurs.	Replace the controller.

Alarm No.: A.1E		Name: Encoder initial communication error 2				
Description		▪ Faulty parts in the encoder				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
1E.1	Encoder fault	1)	Encoder fault	Check if alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
					Alarm occurs.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, the ambient temperature, etc.	An error is found.	Take the appropriate measures according to the cause.

Alarm No.: A.1F		Name: Encoder initial communication error 3				
Description		▪ Incompatible encoder is connected.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
1F.1	Incompatible encoder	1)	Incompatible servo motor (encoder) is connected with the controller.	Check the model of servo motor.	Servo motor is incompatible.	Replace the servo motor.

Alarm No.: A.20		Name: Encoder normal communication error 1				
Description		▪ Communication error occurred between the encoder and the controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
20.1	Encoder transmission data error (Controller receiving error)	1)	Encoder cable is disconnected.	Check if the encoder cable is connected correctly.	Disconnected.	Connect correctly.
					Connected correctly.	Check 2).
		2)	Encoder cable faulty	Check if the encoder cable is disconnected or shorted.	An error is found.	Repair or replace the cable.
					No error.	Check 3).
		3)	Encoder cable shielding is faulty	Check the shield status.	An error is found.	Repair the cable.
					No error.	Check 4).
		4)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
					Alarm occurs.	Check 5).
		5)	Fault in the surrounding environment	Check the external noise, the ambient temperature, etc.	An error is found.	Take the appropriate measures according to the cause.
20.5	Encoder receive data error 1 (Frame error)	1)	Encoder cable shielding is faulty	Check the shield status.	An error is found.	Repair the cable.
					No error.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Check 3).
		3)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
20.7	Encoder receive data error2 (Request discrepancy)	1)	Encoder cable shielding is faulty	Execute the checking methods mentioned in the alarm display "20.5".		
		2)	Fault in the surrounding environment			
		3)	Encoder fault			

Alarm No.: A.21		Name: Encoder normal communication error 2				
Description		▪ Encoder data fault				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
21.1	Encoder data error	1)	Excessive acceleration is detected by oscillation, etc.	Check if the alarm occurs after the loop gain is decreased.	Alarm does not occur.	Operate with the loop gain decreased.
					Alarm occurs.	Check 2).
		2)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Check 3).
		3)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
21.2	Encoder data updating error	1)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
21.3	Encoder waveform error	1)	Encoder fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.

Alarm No.: A.24		Name: Main circuit error				
Description		▪ Ground fault occurred in the servo motor power cables. ▪ Ground fault occurred in the servo motor				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
24.1	Ground fault detected by the hardware detection circuit	1)	Controller fault	Alarm occurs even if the power cables (U, V, W) are disconnected.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Check 2).
		2)	Ground fault or short of the servo motor power cables	Check if the power cables themselves (between U, V, W and ⏚) are shorted.	Cables are shorted.	Replace the power cables.
					No problem.	Check 3).
		3)	Ground fault in the servo motor	Remove the power cables from the servo motor and check if short occurs in the servo motor (between U, V, W and ⏚).	Servo motor is shorted.	Replace the servo motor.
					No problem.	Check 4).
		4)	Power supply cables and servo motor power cables are shorted.	Check if there is a contact between the power supply cables and the servo motor power cables at power-off.	There is a contact.	Connect correctly.
					No contact.	Check 5).
		5)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
24.2	Ground fault detected by the software detection	1)	Controller fault	Execute the checking methods mentioned in the alarm display "24.1".		
		2)	Ground fault or short of the servo motor power cables			
		3)	Ground fault in the servo motor			
		4)	Power supply cables and servo motor power cables are shorted.			
		5)	Fault in the surrounding environment			

Alarm No.: A.30		Name: Regenerative error				
Description		▪ Permissible regenerative power of the built-in regenerative resistor or the regenerative option is exceeded. ▪ Regenerative transistor faulty in the controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
30.1	Regenerative heat generation error	1)	Incorrect setting of the built-in regenerative resistor (regenerative option)	Check the built-in regenerative resistor (regenerative option) being used and the set value of parameter No. PA02.	The set value is incorrect.	Set correctly.
					The set value is correct.	Check 2).
		2)	Built-in regenerative resistor (regenerative option) is disconnected.	Check if the built-in regenerative resistor (regenerative option) is connected correctly.	Incorrect connection.	Connect correctly.
					Correct connection.	Check 3).
		3)	Power supply voltage is high.	Check the input power supply.	230VAC or more.	Decrease the power supply voltage.
					Below 230VAC.	Check 4).
		4)	The regenerative load ratio is over 100%.	Call the status display or MR Configurator and check the regenerative load ratio at alarm occurrence.	100% or more.	Reduce the frequency of positioning. Increase the deceleration time constant. Reduce the load. Use the regenerative option if it is not used.
30.2	Regenerative transistor fault	1)	Regenerative transistor is faulty.	Check if the built-in regenerative resistor (regenerative option) is overheated abnormally.	Overheated abnormally.	Replace the controller.
30.3	Regenerative transistor feedback data error	1)	Controller detection circuit is faulty	Remove the wiring of P and C, and execute the operation.	Alarm occurs.	Replace the controller.

Alarm No.: A.31		Name: Overspeed				
Description		▪ Servo motor speed has exceeded the instantaneous permissible speed.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
31.1	Motor speed error	1)	Command speed is high.	Check if the command speed exceeds the permissible speed.	The command speed is higher than the permissible speed.	Check the operation pattern.
					The command speed is lower than the permissible speed.	Check 2).
		2)	Servo motor operates with the maximum torque, and speed overshoot occurs.	Check if the acceleration torque is the maximum.	Performed with the maximum torque.	Increase the acceleration/deceleration time constant, or reduce the load.
					Performed with the torque lower than the maximum.	Check 3).
		3)	Servo system is instable and oscillating.	Check if the servo motor is oscillating.	Servo motor is oscillating.	Adjust the servo gain by the auto tuning mode 1 or the one-touch tuning. Reduce the load.
					Servo motor is not oscillating.	Increase the acceleration time constant.
						Check 4).
		4)	The overshoot of speed waveform occurs.	Check if the overshoot occurs due to saturated torque caused by short acceleration time constant.	Overshoot occurs.	Increase the acceleration/deceleration time constant.
					Overshoot does not occur.	Check 5).
		5)	Encoder faulty.	Check if the alarm occurs when the actual speed is under the instantaneous permissible speed.	Alarm occurs.	Replace the servo motor.

Alarm No.: A.32		Name: Overcurrent				
Description		▪ The flowed current is higher than the permissible current of the controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
32.2	Overcurrent was detected by the software detection (during operation)	1)	High servo gain	Check if the oscillation occurs.	Oscillation occurs.	Decrease the speed loop gain.
					Oscillation does not occur.	Check 2).
		2)	Controller fault	Check if the alarm occurs even if the power cables (U, V, W) are disconnected.	Alarm occurs.	Replace the controller.
					Alarm does not occur.	Check 3).
		3)	Ground fault or other fault in the servo motor power cables	Check if the power cables themselves are shorted.	Cables are shorted.	Replace the power cables.
					No problem.	Check 4).
		4)	Servo motor fault	Remove the power cables from the servo motor edge and check if short occurs (between U, V, W and ⏚).	Ground fault occurs in the servo motor	Replace the servo motor.
					Ground fault does not occur in the servo motor	Check 5).
		5)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
32.3	Overcurrent was detected by the hardware detection circuit (during a stop)	1)	Controller fault	Execute the checking methods mentioned in the alarm display "32.2".		
		2)	Ground fault or other fault in the servo motor power cables			
		3)	Servo motor fault			
		4)	Fault in the surrounding environment			
32.4	Overcurrent was detected by the software detection (during a stop)	1)	High servo gain	Execute the checking methods mentioned in the alarm display "32.2".		
		2)	Controller fault			
		3)	Ground fault or short of the servo motor power cables			
		4)	Servo motor fault			
		5)	Fault in the surrounding environment			

Alarm No.: A.33		Name: Overvoltage				
Description		▪ The value of the status display Pn (bus voltage) is "5" (overvoltage).				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
33.1	Main circuit voltage error	1)	The regenerative option is used, but the set value of the parameter is not correct.	Check the set value of parameter No.PA02.	Incorrect setting.	Correct the set value.
					Correct setting.	Check 2).
		2)	Regenerative option is not used. Lead of the built-in regenerative resistor or the regenerative option is open or disconnected.	Check the wiring and the lead of the built-in regenerative resistor (regenerative option).	Open or disconnected.	Connect correctly.
					No problem.	Check 3).
		3)	Check the built-in regenerative resistor (regenerative option).	Check the resistance value.	Error in the built-in regenerative resistor (regenerative option).	When using the built-in regenerative resistor, replace the controller. When using the regenerative option, replace the regenerative option.
					No problem.	Check 4).
		4)	Regenerative capacity is insufficient.	Check if alarm occurs when the deceleration time constant is increased.	Alarm does not occur.	Use the regenerative option if it is not used. Increase the deceleration time constant.
					Alarm occurs.	Check 5).
		5)	Power supply voltage is high.	Check the input voltage.	253VAC or more.	Decrease the input voltage.

Alarm No.: A.35		Name: Command frequency error				
Description		▪ Input command frequency is too high.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
35.1	Command frequency error	1)	Command frequency is 1.5 times or more of the maximum command pulse frequency.	▪ Check the speed command. ▪ Check the set value of parameter No.PA13 (command input pulse form). "0□□": The maximum command pulse frequency is 1Mpps or less. "1□□": The maximum command pulse frequency is 500kpps or less. "2□□": The maximum command pulse frequency is 200kpps or less.	The set value of the speed command is high.	Check operation pattern.
						Check the set value of parameter No.PA13.
					The set value of the speed command is within the range.	Check 2).
		2)	Controller fault	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the controller.
					Alarm occurs.	Check 3).
		3)	Fault in the surrounding environment	Check the noise, the ambient temperature, etc.	An error is found.	Take the appropriate measures according to the cause.

Alarm No.: A.37		Name: Parameter error				
Description		▪ Parameter setting is incorrect.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
37.1	Parameter setting range error	1)	Parameter is set outside the setting range.	Check the set value according to the parameter error No.	Outside the setting range.	Correct the value within the setting range.
					Within the setting range.	Check 2).
		2)	EEP-ROM fault	Write the parameter set value within the normal range, and check if the value is written correctly.	Abnormal value is written.	Replace the controller.
					Normal value is written.	Check 3).
		3)	Controller fault causes the change in the parameter setting.	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
37.2	Parameter combination error	1)	Unavailable parameter combination is set.	Check the set value according to the parameter error No.	The set value is incorrect.	Correct the set value.

Alarm No.: A.45		Name: Main circuit device overheat				
Description		▪ Overheat in controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
45.1	Board temperature error	1)	Ambient temperature is over 55℃.	Check if the ambient temperature is 55℃ or less.	Ambient temperature is over 55℃.	Lower the ambient temperature.
					Ambient temperature is 55℃ or less.	Check 2).
		2)	Used beyond the specifications of close mounting.	Check the specifications of close mounting.	Used beyond the specifications.	Use within the range of specifications.
					Satisfying the specifications.	Check 3).
		3)	The power was turned on and off continuously in overloaded status.	Check if the overloaded status occurred repeatedly.	Occurred repeatedly.	Check operation pattern.
					Not occurred.	Check 4).
		4)	Heat sink and opening are clogged.	Check if the alarm occurs after cleaning the heat sink and the opening.	Alarm does not occur.	Clean periodically.
					Alarm occurs.	Check 5).
		5)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Use the normal controller.

Alarm No.: A.46		Name: Servo motor overheat				
Description		▪ Servo motor is overheated.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
46.1	Servo motor temperature error	1)	Ambient temperature of the servo motor is over 40℃.	Check the ambient temperature of the servo motor.	Ambient temperature is over 40℃.	Lower the ambient temperature of servo motor.
					Ambient temperature is 40℃ or less.	Check 2).
		2)	Servo motor is overheated.	Check the effective load ratio.	The effective load ratio is too high.	Reduce the load or take heat dissipation measures.
					The effective load ratio is small	Check 3).
		3)	Thermal sensor fault in the encoder.	Check the temperature of the servo motor.	The temperature of the servo motor is low.	Replace the servo motor.

Alarm No.: A.50		Name: Overload 1				
Description		▪ Load exceeded overload protection characteristic of controller.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
50.1	Overload thermal 1 error during operation (Continuous operation protection)	1)	Electromagnetic brake operates.	Check if the electromagnetic brake does not operate during operation.	Operates	Check the wiring.
					Does not operate.	Check 2).
		2)	Controller is used exceeding its continuous output current.	Check the effective load ratio.	Effective load ratio is too high.	Reduce load. Check operation pattern. Replace the servo motor to one that provides larger output.
					Effective load ratio is small.	Check 3).
		3)	Servo system is instable and resonating.	Check if resonance occurs.	Resonance occurs.	Execute the gain adjustment.
					Resonance does not occur.	Check 4).
		4)	After the overload alarm occurrence, the operation is restarted without the cooling time.	Check if the alarm was reset after 30 minutes had past since the alarm occurrence.	No.	Reset the alarm after the sufficient time.
					Yes.	Check 5).
		5)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
50.2	Overload thermal 2 error during operation (Short-time operation protection)	1)	The work collided against the structural part.	Check if the work collided against the structural part.	Collided.	Check the operation pattern.
					Did not collide.	Check 2).
		2)	Power cables breakage	Check the power cables.	An error is found.	Repair the power cables.
					No error.	Check 3).
		3)	Incorrect connection with the servo motor	Check the wiring of U, V and W.	An error is found.	Wire correctly.
					No error.	Check 4).
		4)	Electromagnetic brake operates.	Execute the checking methods mentioned in the alarm display "50.1".		
		5)	Controller is used exceeding its continuous output current.			
		6)	Servo system is instable and oscillating.			
		7)	Controller fault			
		8)	Encoder faulty.	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.

Alarm No.: A.50		Name: Overload 1				
Description		▪ Load exceeded overload protection characteristic of controller.				
Detailed display	Detailed Name		Cause	Checking method	Result	Action
50.4	Overload thermal 1 error at a stop (Continuous operation protection)	1)	Electromagnetic brake operates.	Check if the electromagnetic brake does not operate during operation.	Operated.	Check the wiring.
					Not operated.	Check 2).
		2)	Controller is used exceeding its continuous output current.	Check the effective load ratio.	Effective load ratio is too high.	Reduce the load. Check operation pattern. Replace the servo motor to one that provides larger output.
					Effective load ratio is small.	Check 3).
		3)	Hunting at servo lock	Check if hunting occurs.	Hunting occurs.	Execute the gain adjustment.
					Hunting does not occur.	Check 4).
		4)	After the overload alarm occurs, the operation is restarted without the cooling time.	Check if the alarm was reset after 30 minutes had past since the alarm occurrence.	No.	Reset the alarm after the sufficient time.
					Yes.	Check 5).
		5)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.

Alarm No.: A.50		Name: Overload 1				
Description		▪ Load exceeded overload protection characteristic of controller.				
Detailed display	Detailed Name		Cause	Checking method	Result	Action
50.5	Overload thermal 2 error at a stop (Short-time operation protection)	1)	The load is large at a stop.	Check if the work collided against the structural part.	Collided.	Check the operation pattern.
					Did not collide.	Check 2).
		2)	Power cables breakage	Check the power cables.	An error is found.	Repair the power cables.
					No error.	Check 3).
		3)	Incorrect connection with the servo motor	Check the wiring of U, V and W.	An error is found.	Wire correctly.
					No error.	Check 4).
		4)	Electromagnetic brake operates.	Execute the checking methods mentioned in the alarm display "50.4".		
		5)	Controller is used exceeding its continuous output current.			
		6)	A hunting occurs at a stop.			
		7)	Controller fault			
		8)	Encoder faulty.	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.

Alarm No.: A.51		Name: Overload 2				
Description		▪ Machine collision or the like caused continuous flow of the maximum output current for a few seconds.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
51.1	Overload thermal 3 error during operation	1)	Power cables breakage	Check the power cables.	An error is found.	Repair the power cables.
					No error.	Check 2).
		2)	Incorrect connection with the servo motor	Check the wiring of U, V and W.	An error is found.	Wire correctly.
					No error.	Check 3).
		3)	Incorrect connection of the encoder cable	Check if the encoder cable is connected correctly.	An error is found.	Correct the connection.
					No error.	Check 4).
		4)	The work collided against the structural part.	Check if the work collided against the structural part.	Collided.	Check the operation pattern.
					Did not collide.	Check 5).
		5)	Torque is saturated.	Check the torque during the operation.	Torque is saturated.	Check the operation pattern.
					Torque is not saturated.	Check 6).
		6)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
					Alarm occurs.	Check 7).
		7)	Encoder faulty.	Check if the alarm occurs after replacing the servo motor.	Alarm does not occur.	Replace the servo motor.
51.2	Overload thermal 3 error at a stop	1)	Power cables breakage	Execute the checking methods mentioned in the alarm display "51.1".		
		2)	Incorrect connection with the servo motor			
		3)	Incorrect connection of the encoder cable			
		4)	The work collided against the structural part.			
		5)	Torque is saturated.			
		6)	Controller fault			
		7)	Encoder faulty.			

Alarm No.: A.52		Name: Error excessive				
Description		▪ The droop pulse between the command position and the current position exceeds the alarm level.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
52.zz3	Droop pulses excessive	1)	Servo motor power cables are not connected. (missing phase)	Check the wiring.	Not connected (missing phase).	Correct the wiring.
					No error.	Check 2).
		2)	Incorrect connection with the servo motor	Check the wiring of U, V and W.	Incorrect connection.	Correct the wiring.
					Correct connection.	Check 3).
		3)	Incorrect connection of the encoder cable	Check if the encoder cable is connected correctly.	Incorrect connection.	Correct the wiring.
					Correct connection.	Check 4).
		4)	Torque limit value is small.	Check the torque limit value.	Torque limit value is small.	Increase the torque limit value.
					Normal range	Check 5).
		5)	The work collided against the structural part.	Check if the work collided against the structural part.	Collided.	Check the operation pattern.
					Did not collide.	Check 6).
		6)	Torque shortage	Check if the torque is saturated.	Saturated	Reduce load. Check operation pattern. Replace the servo motor to one that provides larger output.
					Not saturated	Check 7).
		7)	Servo motor cannot be started due to torque shortage caused by power supply voltage drop.	Check the value of status display Pn (bus voltage).	The value is "1" (undervoltage) or "2" (low voltage).	Check the power supply voltage.
					The value is "4" (high voltage) or "5" (overvoltage).	Check 8).
		8)	Acceleration/deceleration time constant is short.	Check if the alarm occurs after the deceleration time constant is increased.	Alarm does not occur.	Check operation pattern.
					Alarm occurs.	Check 9).
		9)	Gain adjustment is not made well.	Check the load to motor inertia moment ratio.	Load to motor inertia moment ratio is normal.	Use the manual mode to make gain adjustment.
					Load to motor inertia moment ratio is not normal.	Check 10).
		10)	Estimation of the load to motor inertia moment ratio is not estimated well.	Check if the alarm occurs after changing the load to motor inertia moment ratio manually.	Alarm does not occur.	Check the load to motor inertia moment ratio.
					Alarm occurs.	Check 11).
		11)	Position loop gain value is small.	Check if the alarm occurs after the position loop gain is changed.	Alarm does not occur.	Check the position loop gain.
					Alarm occurs.	Check 12).

Alarm No.: A.52		Name: Error excessive				
Description		▪ The droop pulse between the command position and current position exceeds the alarm level.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
52.3	Droop pulses excessive	12)	Servo motor is rotated by external force.	Measure the actual position on the servo lock status.	The servo motor is rotated by an external force.	Check the machine.
					Servo motor is not rotated by an external force.	Check 13).
		13)	Encoder faulty	Check if the alarm occurs after replacing with the servo operating normally.	Alarm does not occur.	Replace the servo motor.
52.4	Error excessive at torque limit value zero	1)	Torque limit value is "0".	Check the torque limit value.	Torque limit value is "0".	Increase the torque limit value.

Alarm No.: A.8E		Name: USB communication error				
Description		▪ USB communication error occurred between the controller and the communication device (e.g. personal computer).				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
8E.1	USB communication receive error	1)	Communication cable fault	Check if the alarm occurs after replacing the USB cable.	Alarm does not occur.	Replace the USB cable.
					Alarm occurs.	Check 2).
		2)	Communication device (e.g. personal computer) setting error	Check the communication setting of the communication device.	Incorrect setting	Check the setting.
					Correct setting	Check 3).
		3)	Fault in the surrounding environment	Check the noise, etc.	An error is found.	Take the appropriate measures according to the cause.
					No error.	Check 4).
		4)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.
8E.2	USB communication checksum error	1)	Communication cable fault	Execute the checking methods mentioned in the alarm display "8E.1".		
		2)	Communication device (e.g. personal computer) setting error			
		3)	Fault in the surrounding environment			
		4)	Controller fault			

Alarm No.: A.8E		Name: USB communication error				
Description		▪ USB communication error occurred between the controller and the communication device (e.g. personal computer).				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
8E.3	USB communication character error	1)	Communication cable fault	Execute the checking methods mentioned in the alarm display "8E.1".		
		2)	Communication device (e.g. personal computer) setting error			
		3)	Fault in the surrounding environment			
		4)	Controller fault			
8E.4	USB communication command error	1)	Communication cable fault	Execute the checking methods mentioned in the alarm display "8E.1".		
		2)	Communication device (e.g. personal computer) setting error			
		3)	Fault in the surrounding environment			
		4)	Controller fault			
8E.5	USB communication data No. error	1)	Communication cable fault	Execute the checking methods mentioned in the alarm display "8E.1".		
		2)	Communication device (e.g. personal computer) setting error			
		3)	Fault in the surrounding environment			
		4)	Controller fault			

Alarm No.: 888 (Note)		Name: Watchdog				
Description		▪ CPU or part is faulty.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
		1)	Fault of parts in the controller			Replace the controller.

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

8.3 Remedies for warnings

POINT

- When any of the following alarms has occurred, do not resume operation by switching power of the controller OFF/ON repeatedly. The controller and servo motor may become faulty. If the power of the controller is switched OFF/ON during the alarms, allow more than 30 minutes for cooling before resuming operation.
  - Excessive regenerative warning (E0.1)
  - Amplifier overheat warning (91.1)
  - Overload warning 1 (E1. □)

When the warning "Stop: Not stopped" described in the following table occurs, the servo-off occurs and the servo motor stops. If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed.
Remove the cause of warning according to this section. Use the MR Configurator to refer to a factor of warning occurrence.

Alarm No.: A.91		Name: Amplifier overheat warning			The operation does not stop.	
Warning contents		▪ The temperature inside of the controller exceeds the warning level.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
91.1	Amplifier inside overheat warning	1)	The temperature in the controller is high.	Check the ambient temperature of the controller.	Ambient temperature is high. (over 55℃)	Lower the ambient temperature.
					Ambient temperature is low.	Check 2).
		2)	Used beyond the specifications of close mounting.	Check the specifications of close mounting.	Used beyond the specifications.	Use within the range of specification.

Alarm No.: A.99		Name: Stroke limit warning			The operation does not stop.	
Description		▪ Reached to the stroke limit of the moving direction while pulse command (signal off).				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
99.1	Forward rotation stroke end: OFF	1)	The forward rotation limit switch became valid.	Check if the forward rotation stroke end (LSP) is ON or OFF in the external I/O signal display.	The forward rotation stroke end (LSP) is OFF.	Reexamine the operation pattern to turn ON the forward rotation stroke end (LSP).
99.2	Reverse rotation stroke end: OFF	2)	The reverse rotation limit switch became valid.	Check if the reverse rotation stroke end (LSN) is ON or OFF in the external I/O signal display.	The reverse rotation stroke end (LSN) is OFF.	Reexamine the operation pattern to turn ON the reverse rotation stroke end (LSN).

Alarm No.: A.E0		Name: Excessive regenerative warning			The operation does not stop.	
Warning contents		▪ There is a possibility that regenerative power may exceed the permissible regenerative power of the built-in regenerative resistor or the regenerative option.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
E0.1	Excessive regenerative warning	1)	Regenerative power exceeded 85% of the permissible regenerative power of the built-in regenerative resistor or the regenerative option.	Call the status display or MR Configurator and check the regenerative load ratio.	85% or more.	Reduce the frequency of positioning. Increase the deceleration time constant. Reduce the load. Use the regenerative option, if it is not used.

Alarm No.: A.E1		Name: Overload warning 1			The operation does not stop.	
Warning contents		▪ The overload alarm (50. □, 51. □) may occur.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
E1.1	Warning while the overload thermal 1 is operating	1)	Load exceeded 85% of the alarm level of the overload alarm (50.1).	Execute the checking methods mentioned in the alarm display "50.1".		
E1.2	Warning while the overload thermal 2 is operating	1)	Load exceeded 85% of the alarm level of the overload alarm (50.2).	Execute the checking methods mentioned in the alarm display "50.2".		
E1.3	Warning while the overload thermal 3 is operating	1)	Load increased to 85% or more against the alarm level of the overload alarm (51.1).	Execute the checking methods mentioned in the alarm display "51.1".		
E1.5	Warning during the overload thermal 1 stops	1)	Load exceeded 85% of the alarm level of the overload alarm (50.4).	Execute the checking methods mentioned in the alarm display "50.4".		
E1.6	Warning during the overload thermal 2 stops	1)	Load exceeded 85% of the alarm level of the overload alarm (50.5).	Execute the checking methods mentioned in the alarm display "50.5".		
E1.7	Warning during the overload thermal 3 stops	1)	Load exceeded 85% of the alarm level of the overload alarm (51.2).	Execute the checking methods mentioned in the alarm display "51.1".		

Alarm No.: A.E6		Name: Servo forced stop warning			The operation stops.	
Warning contents		▪ The forced stop signal is turned OFF.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
E6.1	Servo forced stop warning	1)	Forced stop (EM1) is turned OFF.	Check the forced stop (EM1).	OFF	Ensure safety and turn ON the forced stop (EM1).
					ON	Check 2).
		2)	The external 24VDC power supply is not input.	Check if the external 24VDC power supply is input.	Not input.	Input 24VDC.
					Input.	Check 3).
		3)	Controller fault	Check if the alarm occurs after replacing the controller.	Alarm does not occur.	Replace the controller.

Alarm No.: A.E9		Name: Main circuit off warning			The operation does not stop.	
Warning contents		▪ Servo-on (SON) was switched on when the main circuit power is off. ▪ The bus voltage decreased while the servo motor speed operates at 50r/min or slower.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
E9.1	Servo-on (SON) OFF when the main circuit is OFF.	1)	Main circuit power supply is off.	Check if the main circuit power supply is input.	Not input.	Switch on the main circuit power.
					Input.	Check 2).
		2)	Main circuit power supply connector is disconnected.	Check the main circuit power supply connector.	The connector is disconnected.	Connect properly.
					No problem.	Check 3).
		3)	Bus voltage dropped.	Check the value of status display Pn (bus voltage).	The value is "1" (undervoltage) or "2" (low voltage).	Revise the wiring. Check the power supply capacity.
E9.2	Bus voltage drop at low-speed rotation	1)	When the set value of parameter No. PC29 (function selection C-5) is "□1□", the bus voltage decreased while the servo motor operates at 50r/min or slower.	Check the value of status display Pn (bus voltage).	The value is "1" (undervoltage).	Check the power supply capacity. Increase the acceleration time constant.

Alarm No.: A.E9		Name: Main circuit off warning			The operation does not stop.	
Warning contents		▪ Servo-on (SON) was switched on when the main circuit power is off. ▪ The bus voltage decreased while the servo motor speed operates at 50r/min or slower.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
E9.3	Main circuit power supply failure	1)	When the set value of parameter No. PC29 (function selection C-5) is "□1□", the main circuit power supply turned OFF while the servo motor operates at 50r/min or slower.	Check if the main circuit power supply is input.	Not input.	Switch on the main circuit power.
					Input.	Check 2).
		2)	When the set value of parameter No. PC29 (function selection C-5) is "□1□", the connector of the main circuit power supply came off when the servo motor operates at 50r/min or slower.	Check the main circuit power supply connector.	The connector is disconnected.	Connect properly.
					No problem.	Check 3).
		3)	When the set value of parameter No. PC29 (function selection C-5) is "□1□", the instantaneous power failure occurred while the servo motor operates at 50r/min or slower.	Check the main circuit power.		

Alarm No.: A.EC		Name: Overload warning 2			The operation does not stop.	
Warning contents		▪ Operation, in which a current exceeding the rating flowed intensively in any of the U, V and W phases of the servo motor, was repeated.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
EC.1	Overload warning 2	1)	Current flowed intensively in specific phases of the servo motor during a stop. Also, this situation was continued.	Check if the alarm occurs after changing the stop position.	Alarm does not occur.	Reduce the frequency of positioning at the specific position.
					Alarm occurs.	Check 2).
		2)	The load is large, or the capacity is insufficient.	Measure the effective load ratio during a stop.	Effective load ratio is too high.	Reduce the load. Replace the controller and servo motor with the ones with larger capacity.

Alarm No.: A.ED		Name: Output watt excess warning			The operation does not stop.	
Warning contents		▪ The status, in which the output wattage (speed × torque) of the servo motor exceeded the rated output, continued steadily.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
ED.1	Output wattage over	1)	Output wattage of the servo motor (speed × torque) exceeded 120% of the rated output.	Call the status display or MR Configurator and check the servo motor speed and torque.	The output wattage is 120% or more of the rate.	Reduce the servo motor speed. Reduce the load.

Alarm No.: A.F0	Name: Tough drive warning	The operation does not stop.

Warning contents		▪ Switched to "during tough drive" status.				
Detailed display	Detailed Name	Cause		Checking method	Result	Action
F0.1	Instantaneous power failure tough drive warning	1)	An instantaneous power failure in the main circuit power supply was detected.	Check the main circuit power supply.		
F0.2	Overload tough drive warning	1)	Effective load ratio exceeded 90% the alarm level of the overload alarm.	Measure the effective load ratio in the continuous operation.	The effective load is over the overload warning level.	Reduce the load.
F0.3	Vibration tough drive warning	1)	The reconfiguration of machine resonance suppression filter 1 or machine resonance suppression filter 2 occurred due to the machine resonance.	Check the alarm history.	Vibration tough drive warning (F0.3) occurs consecutively.	Adjust the servo gain by the auto tuning 1 or the one-touch tuning. Lower the response.

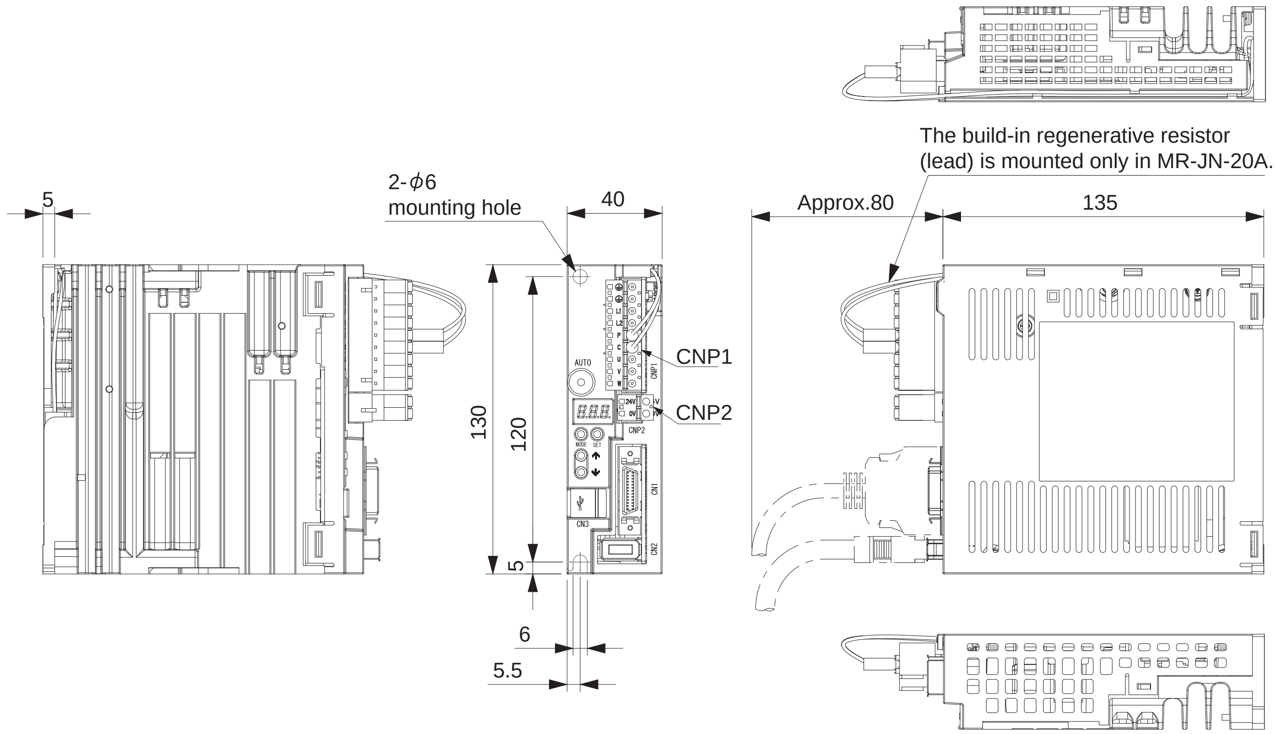
MEMO

9. OUTLINE DRAWINGS

9.1 Controller

(1) LECSA□-S1・LECSA□-S3

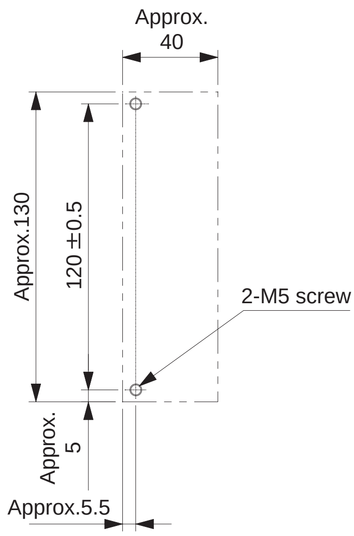
[Unit: mm]



Mass: 0.6[kg] (1.32[lb])

Terminal layout

CNP1	CNP2
⏚	24V
⏚	0V
L_1	
L_2	
P	
C	
U	
V	
W	

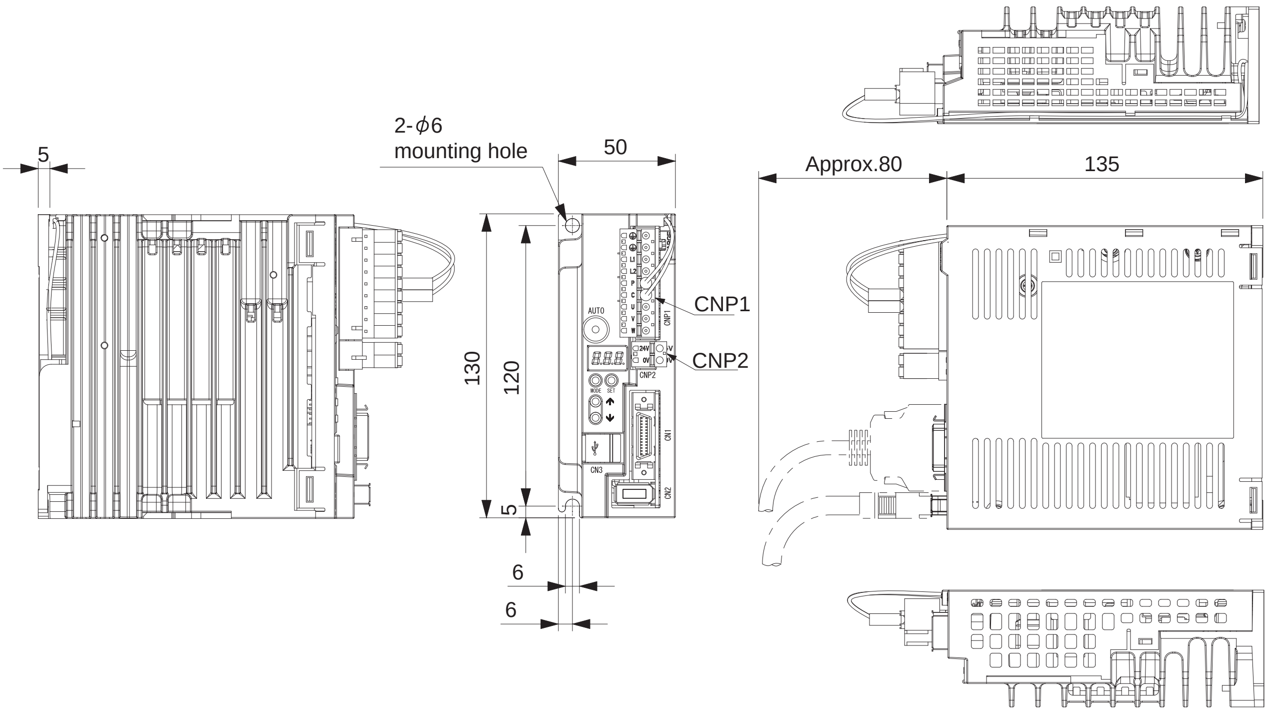


Mounting hole process drawing

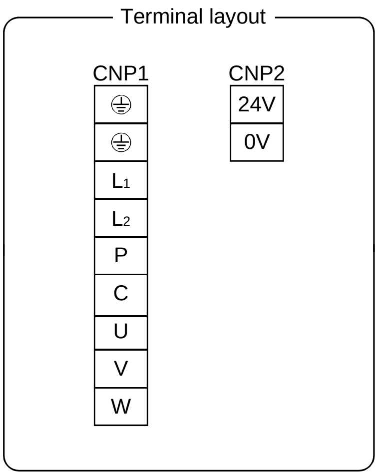
Mounting screw
Screw size: M5
Tightening torque: 3.24[N・m] (28.7[lb・in])

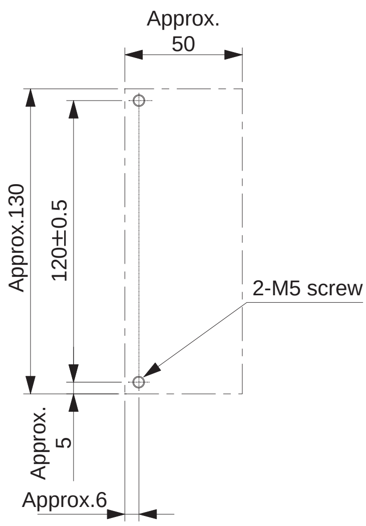
(2) LECSA□-S4

[Unit: mm]



Mass: 0.7[kg] (1.54[lb])





Mounting hole process drawing

Mounting screw

Screw size: M5

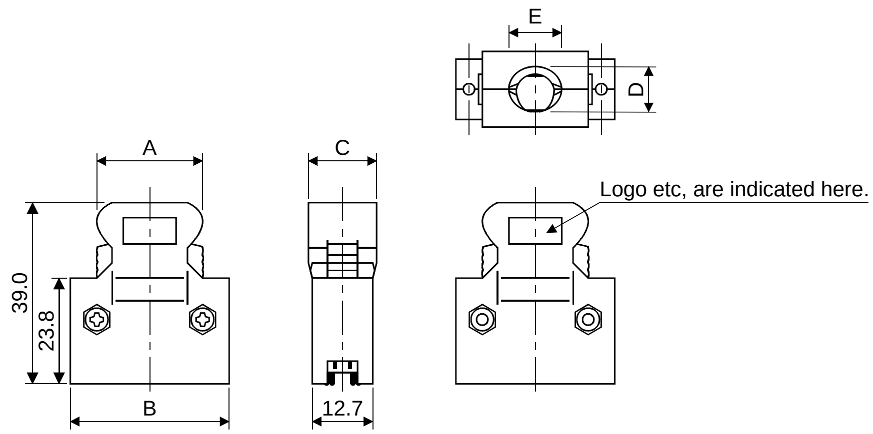
Tightening torque: 3.24[N・m] (28.7[lb・in])

9.2 Connector

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

(a) One-touch lock type

[Unit: mm]

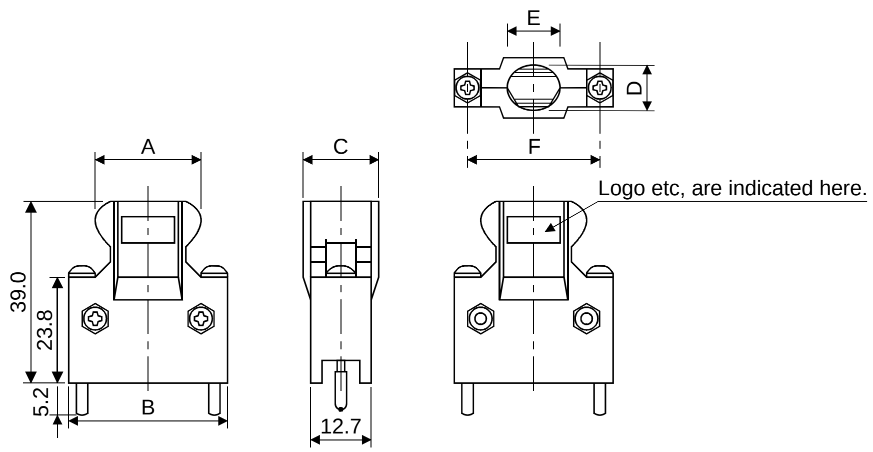


Connector	Shell kit	Each type of dimension				
		A	B	C	D	E
10126-3000PE	10326-52F0-008	25.8	37.2	14.0	10.0	12.0

(b) Jack screw M2.6 type

This is not available as option.

[Unit: mm]

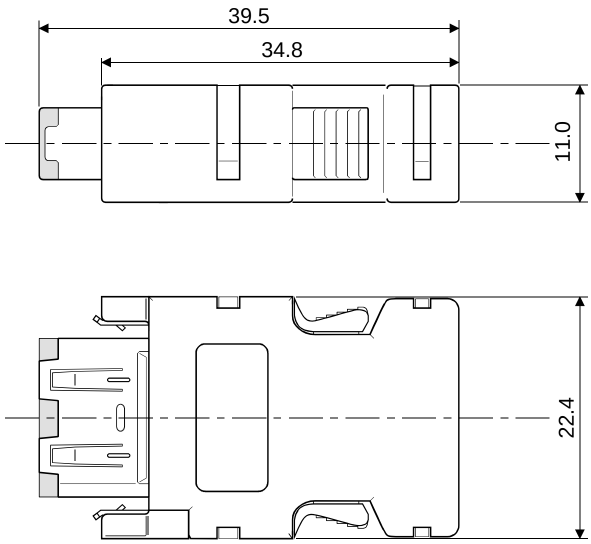


Connector	Shell kit	Each type of dimension					
		A	B	C	D	E	F
10126-3000PE	10326-52A0-008	25.8	37.2	14.0	10.0	12.0	27.4

(2) SCR connector system (3M)

Receptacle : 36210-0100PL
Shell kit : 36310-3200-008

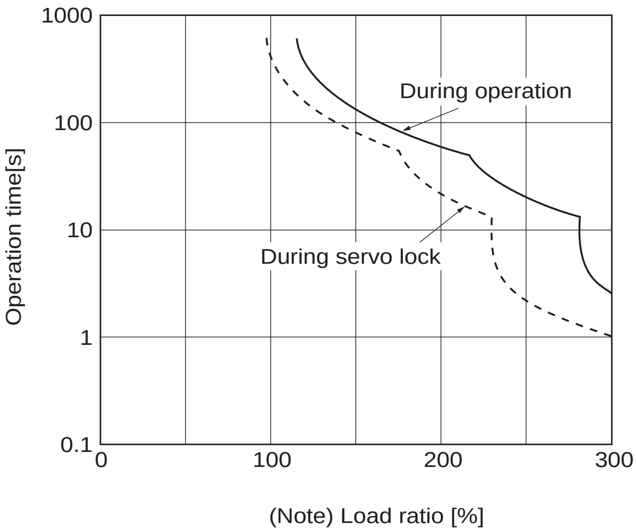
[Unit: mm]



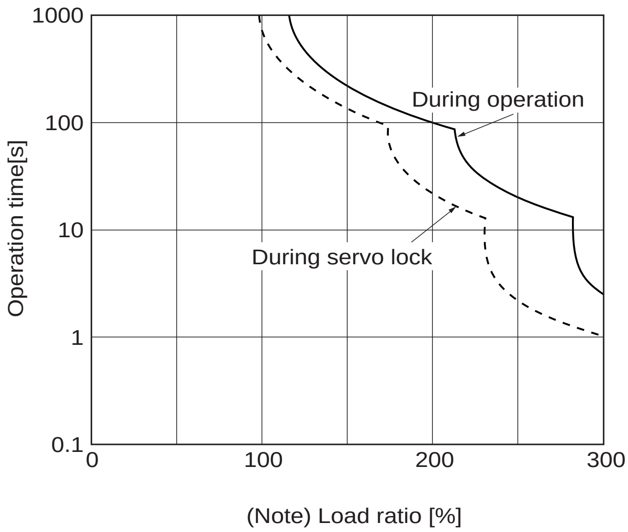
10. CHARACTERISTICS

10.1 Overload protection characteristics

An electronic thermal relay is built in the controller to protect the servo motor and controller from overloads. Overload 1 alarm (50.☐) occurs if overload operation that exceeds the electronic thermal relay protection curve shown in Figs 10.1. is performed. Overload 2 alarm (51.☐) occurs if the maximum current flows continuously for several seconds due to machine collision, etc. Keep the load ratio within the area in the left side of the solid line or the dotted line.
For a machine used in vertical lift application which generates unbalanced torque, it is recommended to keep the unbalanced torque within 70% or lower of the rated torque. When closely mounting the controllers, operate them at the ambient temperature of 0 to 45℃ (32 to 113℉) or at 75% or smaller effective load ratio.



LECSA1-S1



LECSA1-S3・LECSA2-S4

Note. If operation that generates torque equal to or higher than the rating is performed with an abnormally high frequency under servo motor stop status (servo lock status) or in low-speed operation at 30r/min or less, the controller may malfunction even when the servo system is used within the electric thermal protection area.

Fig 10.1 Electronic thermal relay protection characteristics

10.2 Power supply capacity and generated loss

(1) Amount of heat generated by the controller

Table 10.1 indicates controllers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 10.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and servo off according to the duty used during operation. When the servo motor is operated at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the controller's generated heat will not change.

Table 10.1 Power supply capacity and generated heat per controller at rated output

Controller	Servo motor	(Note 1) Power supply capacity[kVA]	(Note 2) Controller-generated heat[W]		Area required for heat dissipation [m^2]
			At rated torque	With servo off	
LECSA1-S1	LE-S1-□, LE-S2-□	0.3	20	10	0.5
LECSA1-S3	LE-S3-□	0.5	20	10	0.5
LECSA2-S4	LE-S4-□	0.9	30	10	0.5

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

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

(2) Heat dissipation area for enclosed controller

The enclosed control box (hereafter called the control box) which will contain the controller should be designed to ensure that its temperature rise is within +10℃ at the ambient temperature of 40℃. (With a 5℃ (41°F) safety margin, the system should operate within a maximum 55℃ (131°F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 10.1.

A = エラー! ブックマークが定義されていません。エラー! ブックマークが定義されていません。 $\frac{P}{K \cdot \Delta T}$ .... (10.1)

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

When calculating the heat dissipation area with Equation 10.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 10.1 for heat generated by the controller. "A" indicates the effective area for heat dissipation, but if the enclosure is directly installed on an insulated wall, that extra amount must be added to the enclosure's surface area. The required heat dissipation area will vary wit the conditions in the enclosure. Therefore, arrangement of the equipment in the enclosure and the use of a cooling fan should be considered. Table 10.1 lists the enclosure dissipation area for each controller when the controller is operated at the ambient temperature of 40℃ (104°F) under rated load.

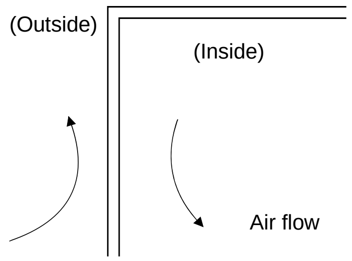


Fig. 10.2 Temperature distribution in enclosure

When air flows along the outer wall of the enclosure, effective heat exchange will be possible, because the temperature slope inside and outside the enclosure will be steeper.

10.3 Dynamic brake characteristics

POINT
・The dynamic brake is operated when an alarm occurs, a servo forced stop warning occurs, or the power turns off. The dynamic break is a function for emergency stops. Do not use this function for normal stops.
・The criteria for the number of times the dynamic break is used is 1000 times, in the condition that the machine with recommended load to motor inertia moment ratio or less, stops from the rated speed in a frequency of once per 10 minutes.
・When using the forced stop (EM1) frequently for other than emergencies, be sure to turn off the forced stop (EM1) after the servo motor stops.

10.3.1 Dynamic brake operation

(1) Calculation of coasting distance

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

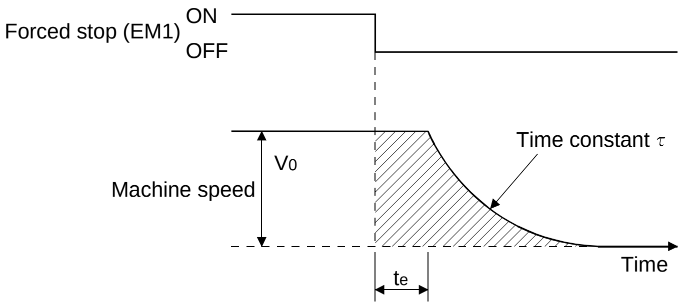


Fig. 10.3 Dynamic brake operation diagram

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

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

V_0 : Machine rapid feed rate .... [mm/min][in/min]

J_M : Servo motor inertial moment .... [kg・cm²][oz・cm²]

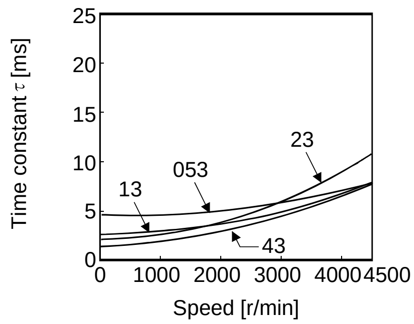
J_L : Load inertia moment converted into equivalent value on servo motor shaft .... [kg・cm²][oz・cm²]

τ : Brake time constant .... [s]

t_e : Delay time of control section .... [s]
There is internal relay delay of about 10ms.

(2) Dynamic brake time constant

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



LE-S5-□,LE-S6-□
LE-S7-□,LE-S8-□
series

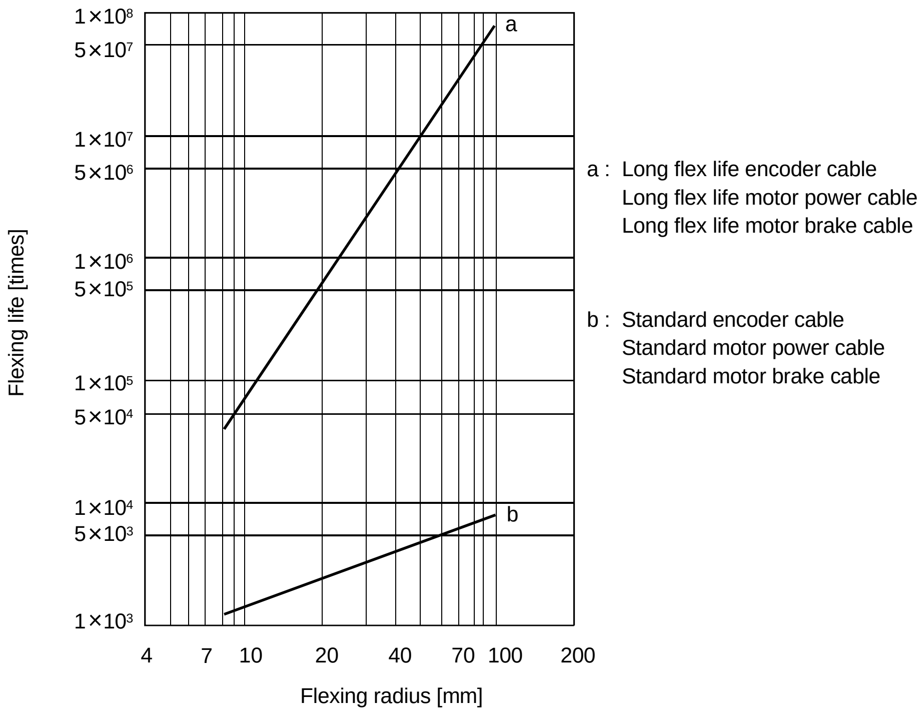
10.3.2 The dynamic brake at the load inertia moment

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

Controller	Servo motor
	LE-□-□
LECSA2-S1	30
LECSA2-S3	30
LECSA2-S4	30

10.4 Cable flexing life

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



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

The following table indicates the inrush currents (reference data) that flow when the maximum permissible voltage (main circuit power supply: 253VAC, control circuit power supply: 26.4VDC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

Controller	Inrush currents ($A_{0\text{-}P}$)	
	Main circuit power supply (L_1 ・ L_2)	Control circuit power supply (+24V ・ 0V)
LECSA2-□	130A (Attenuated to approx. 5A in 5ms)	25A (Attenuated to approx. 0A in 4 to 6ms)

Since large inrush currents flow in the main circuit power supply, always use no-fuse breakers and magnetic contactors. (Refer to section 11.6.)
When a circuit protector is used for the main circuit power supply, it is recommended to use the inertia delay type that will not be tripped by an inrush current.
Always use a circuit protector for the control circuit power supply. (Refer to section 11.11.)

11. OPTIONS AND AUXILIARY EQUIPMENT

⚠WARNING	· Before connecting options and peripheral equipment, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the controller whether the charge lamp is off or not.

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

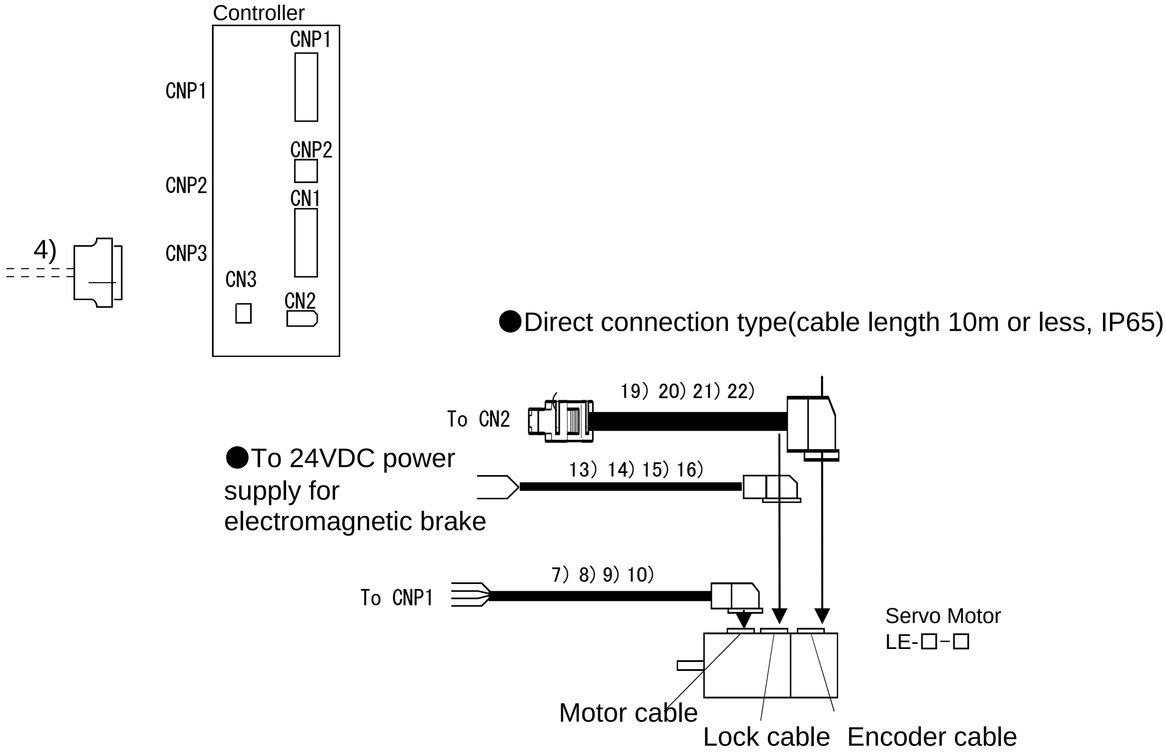
11.1 Cable/connector sets

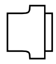
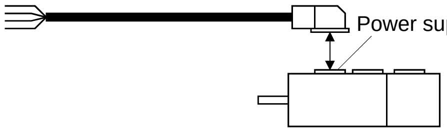
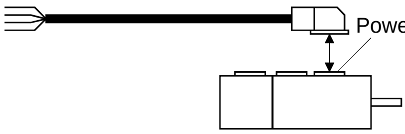
POINT

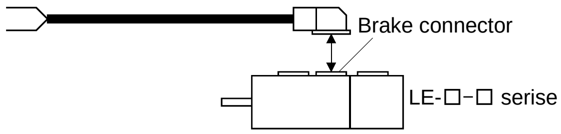
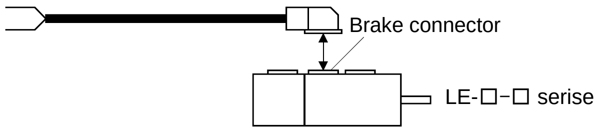
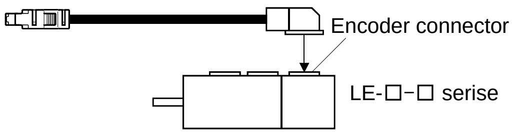
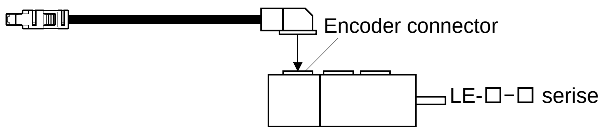
· Protective structure indicated for cables and connecters is for a cable or connector alone. When the cables and connectors are used to connect the controller and servo motor, and if protective structures of the controller and servo motor are lower than that of the cable and connector, specifications of the controller and servo motor apply.

As the cables and connectors used with this servo, purchase the options indicated in this section.

11.1.1 Combinations of cable/connector sets



No.	Product	Model	Description	Application
4)	CN1 connector set	LE-CS-□□	Connector: 10126-3000PE Shell kit: 10326-52F0-008 (3M or equivalent) 	
5)	Junction terminal block	MR-TB26A	Refer to section 11.3.	
7)	Motor cable	LE-CSM-S□A Cable length: 2・5・10m	 Refer to section 11.1.3 for details.	IP65 Load side lead
8)	Motor cable	LE-CSM-R□A Cable length: 2・5・10m		IP65 Load side lead Long flex life
9)	Motor cable	LE-CSM-S□B Cable length: 2・5・10m	 Refer to section 11.1.3 for details.	IP65 Opposite-to-load side lead
10)	Motor cable	LE-CSM-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Long flex life

No.	Product	Model	Description	Application
13)	Lock cable	LE-CSB-S□A Cable length: 2・5・10m	 Refer to section 11.1.4 for details.	IP65 Load side lead
14)	Lock cable	LE-CSB-R□A Cable length: 2・5・10m		IP65 Load side lead Long flex life
15)	Lock cable	LE-CSB-S□B Cable length: 2・5・10m	 Refer to section 11.1.4 for details.	IP65 Opposite-to-load side lead
16)	Lock cable	LE-CSB-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Long flex life
19)	Encoder cable	LE-CSE-S□A Cable length: 2・5・10m	 Refer to section 11.1.2 (1) for details.	IP65 Load side lead
20)	Encoder cable	LE-CSE-R□A Cable length: 2・5・10m		IP65 Load side lead Long flex life
21)	Encoder cable	LE-CSE-S□B Cable length: 2・5・10m	 Refer to section 11.1.2 (1) for details.	IP65 Opposite-to-load side lead
22)	Encoder cable	LE-CSE-R□B Cable length: 2・5・10m		IP65 Opposite-to-load side lead Long flex life

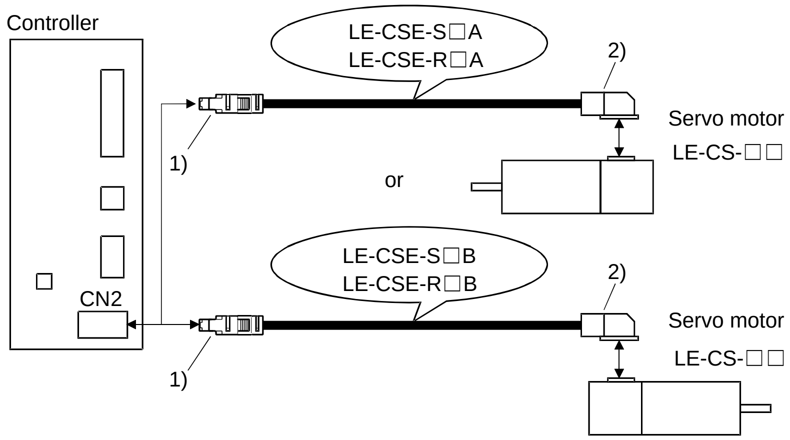
11.1.2 Encoder cable

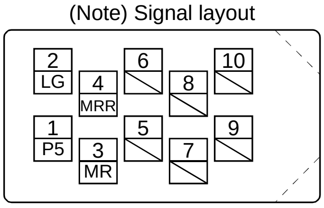
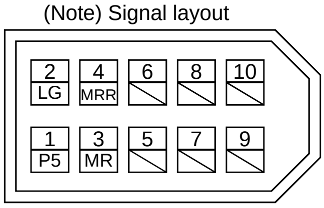
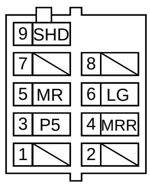
(1) LE-CSE-□□A・LE-CSE-□□B

These are encoder cables for the LE-CS-□□ servo motors. The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.

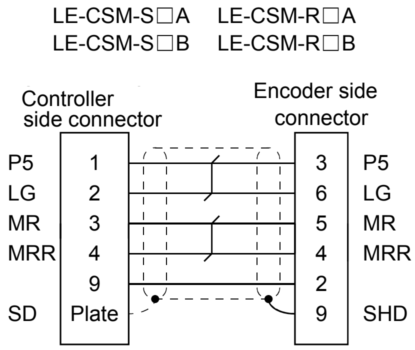
Cable model	Cable length							Protective structure	Flex life	Application
	2m	5m	10m	20m	30m	40m	50m			
LE-CSE-S□A	2	5	10					IP65	Standard	LE-CS-□□ servo motor Load side lead
LE-CSE-R□A	2	5	10					IP65	Robot cable	
LE-CSE-S□B	2	5	10					IP65	Standard	LE-CS-□□ servo motor Opposite-to-load side lead
LE-CSE-R□B	2	5	10					IP65	Robot cable	

(a) Connection of controller and servo motor



\Cable model	1) For CN2 connector	2) For encoder connector
LE-CSE-S□A LE-CSE-R□A LE-CSE-S□B LE-CSE-R□B	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) (Note) Signal layout  View seen from wiring side. or Connector set: 54599-1019(Molex) (Note) Signal layout  View seen from wiring side. Note. Keep open the pins shown with ⧅. Especially, pin 10 is provided for manufacturer adjustment. If it is connected with any other pin, the controller cannot operate normally.	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle contact: 1596847-1 (Tyco Electronics) (Note) Signal layout  View seen from wiring side. Note. Keep open the pins shown with ⧅.

(b) Cable internal wiring diagram

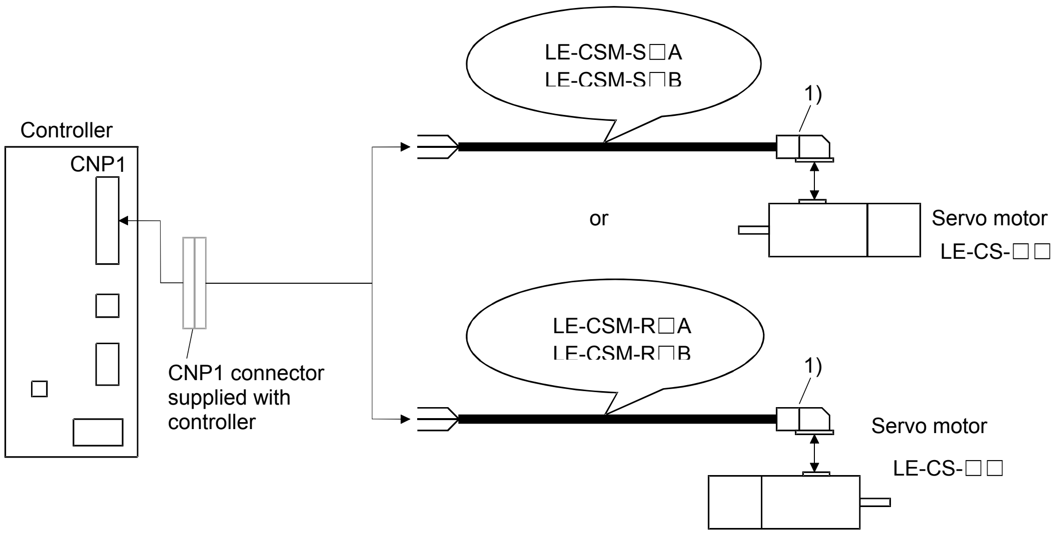


11.1.3 Motor cable

These are motor cables for the LE-CS-□□ servo motors.
The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.
Refer to section 3.10.2 when wiring.

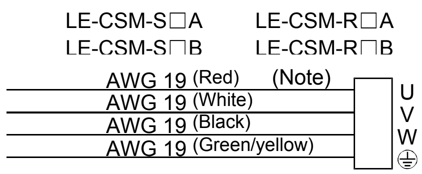
Cable model	Cable length				Protective structure	Flex life	Application
	0.3m	2m	5m	10m			
LE-CSM-S□A		2	5	10	IP65	Standard	LE-CS-□□servo motor Load side lead
LE-CSM-S□B		2	5	10	IP65	Standard	LE-CS-□□servo motor Opposite-to-load side lead
LE-CSM-R□A		2	5	10	IP65	Robot cable	LE-CS-□□servo motor Load side lead
LE-CSM-R□B		2	5	10	IP65	Robot cable	LE-CS-□□servo motor Opposite-to-load side lead

(1) Connection of controller and servo motor



Cable model	1) For motor connector	
LE-CSM-S□A LE-CSM-S□B LE-CSM-R□A LE-CSM-R□B	Connector: JN4FT04SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout 1 ⏚ 2 U 3 V 4 W View seen from wiring side.

(2) Internal wiring diagram



Note. These are not shielded cables.

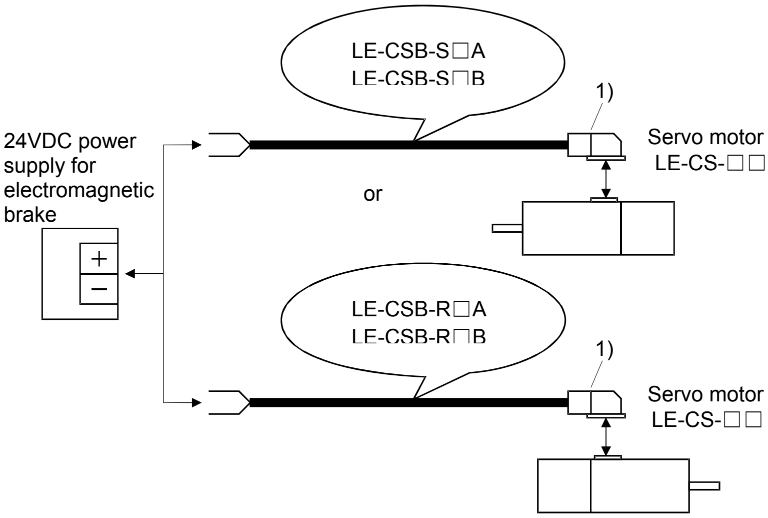
11.1.4 Lock cables

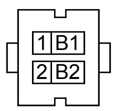
These are lock cables for the LE-CS-□□ servo motors. The numerals in the Cable Length field of the table are the symbols entered in the □ part of the cable model. The cables of the lengths with the symbols are available.

Refer to section 3.11.4 when wiring.

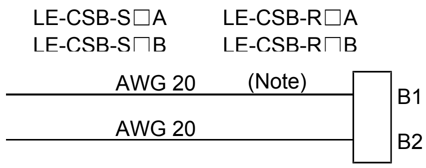
Cable model	Cable length				Protective structure	Flex life	Application
	0.3m	2m	5m	10m			
LE-CSB-S□A		2	5	10	IP65	Standard	LE-CS-□□servo motor Load side lead
LE-CSB-S□B		2	5	10	IP65	Standard	LE-CS-□□servo motor Opposite-to-load side lead
LE-CSB-R□A		2	5	10	IP65	Robot cable	LE-CS-□□servo motor Load side lead
LE-CSB-R□B		2	5	10	IP65	Robot cable	LE-CS-□□servo motor Opposite-to-load side lead

(1) Connection of power supply for electromagnetic brake and servo motor



Cable model	1) For lock connector	
LE-CSB-S□A LE-CSB-S□B LE-CSB-R□A LE-CSB-R□B	Connector: JN4FT02SJ1-R Hood, socket insulator Bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	Signal layout  View seen from wiring side.

(2) Internal wiring diagram



Note. These are not shielded cables.

11.2 Regenerative options

CAUTION	・The specified combinations of regenerative options and servo amplifiers may only be used. Otherwise, a fire may occur.

(1) Combination and regenerative power

The power values in the table are resistor-generated powers and not rated powers.

Servo amplifier	Regenerative power[W]		
	Built-in regenerative resistor	LEC-MR-RB-032 [40Ω]	LEC-MR-RB-12 [40Ω]
LECSA1-S1		30	
LECSA1-S3	10	30	100
LECSA2-S4	10	30	100

(2) Selection of the regenerative option

Please refer to the manual and the catalog of each actuator when the selection of the regenerative option.

(3) Parameter setting

Set parameter No. PA02 according to the regenerative option to be used.

Parameter No. PA02

0		

Selection of regenerative option
00: Regenerative option is not used
・For servo amplifier of 100W, regenerative resistor is not used.
・For servo amplifier of 200 to 400W, built-in regenerative resistor is used.
02: MR-RB032
03: MR-RB12

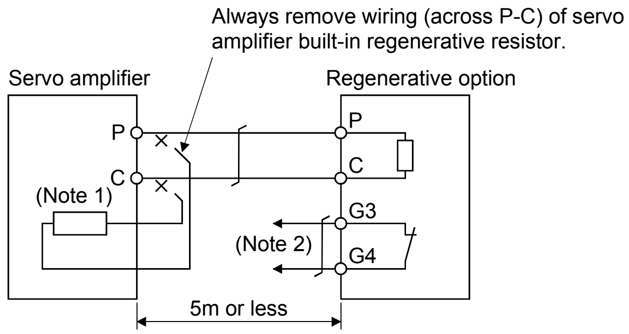
(4) Connection of the regenerative option

POINT

- When using a regenerative option, remove the built-in regenerative resistor and its wirings from the servo amplifier.
- For the sizes of wires used for wiring, refer to section 11.5.
- Avoid installing and removing the built-in regenerative resistor frequently, as much as possible.
- When reinstalling the removed built-in regenerative resistor, check if there is no damage on the lead of the built-in regenerative resistor.

The regenerative option causes a temperature rise of 100℃ relative to the ambient temperature. Fully examine heat dissipation, installation position and used wires, etc. before installing the option. For wiring, use flame-resistant wire and keep them clear of the regenerative option body. Always use twisted cables of max. 5m length for connection with the servo amplifier.

When using a regenerative option for LECSA2-S3・LECSA2-S4, disconnect the wiring to P and C, remove the built-in regenerative resistor from the servo amplifier, and then connect the regenerative option to P and C. G3 and G4 are thermal sensor output terminals. G3-G4 is disconnected when the regenerative option overheats abnormally.



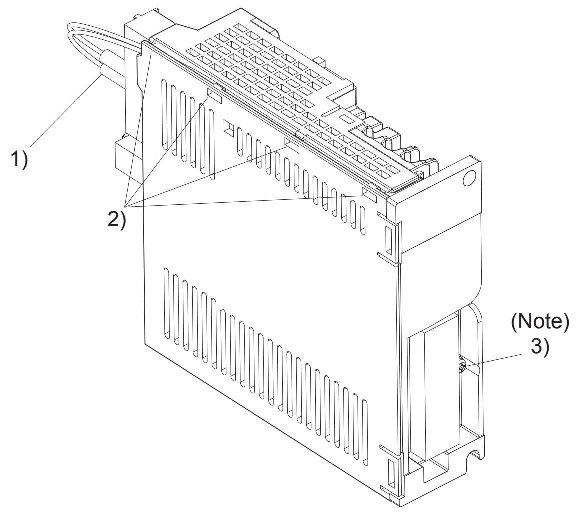
Note 1. A built-in regenerative resistor is not provided for the LECSA1-S1
2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.
G3-G4 contact specifications
Maximum voltage: 120V AC/DC
Maximum current: 0.5A/4.8VDC
Maximum capacity: 2.4VA

Remove the built-in regenerative resistor in the procedures of 1) to 3), referring to the following diagram.

1) Disconnect the wires of the built-in regenerative resistor from the main circuit power supply connector (CNP1). (Refer to (3) in section 3.3.3)

2) Remove the wires of the built-in regenerative resistor from the servo amplifier, starting from the closest to the main circuit power supply connector (CNP1). At this time, be careful so as not to break the wires.

3) Remove the screw which fixes the built-in regenerative resistor, and then remove the built-in regenerative resistor.

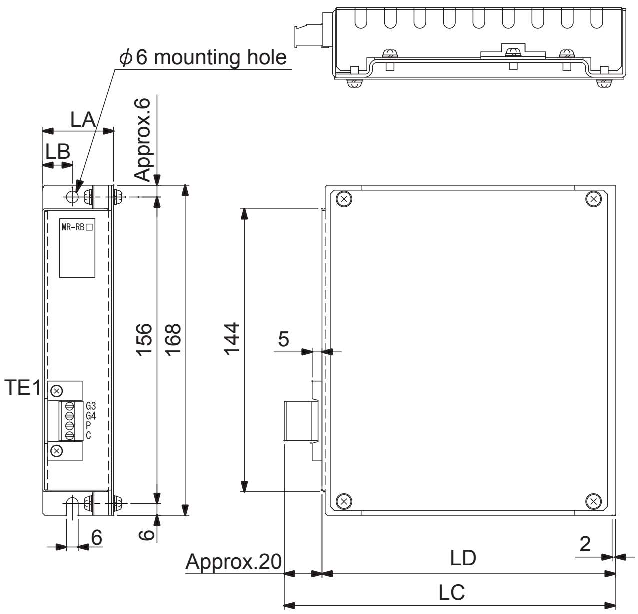


Note. Screw size: M3
Tightening torque: 0.72 [N・m]

(5) Outline dimension drawings

LEC-MR-RB032・LEC-MR-RB12

[Unit: mm]



・TE1 terminal block

G3
G4
P
C

Applicable wire size: AWG24 to

Tightening torque: 0.5 to 0.6 [N・m] (4 to 5 [lb・in])

・Mounting screw

Screw: M5

Tightening torque: 3.24 [N・m] (28.7 [lb・in])

Regenerative option	Variable dimensions				Mass [kg]
	LA	LB	LC	LD	
LEC-MR-RB032	30	15	119	99	0.5
LEC-MR-RB12	40	15	169	149	1.1

11.3 Junction terminal block MR-TB26A

(1) How to use the junction terminal block

Always use the junction terminal block (MR-TB26A) with the junction terminal block cable (MR-TBNATBL □ M) as a set.

Use the junction terminal block by mounting it onto the DIN rail.

MR-TBNATBL□M

Cable length:
05: 0.5m
1 : 1m

The terminal numbers described on the junction terminal block match the pin numbers of the controller's CN1 connector.

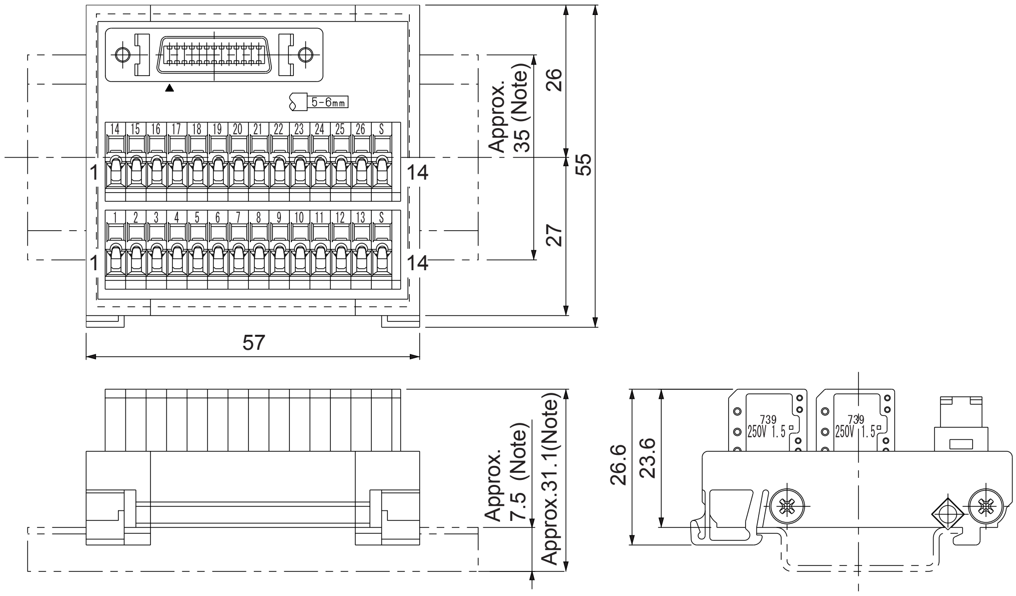
In addition, S means a shield.

(2) Specifications

Item \ Junction terminal block		MR-TB26A
Rating		30V/0.5A
applicable wires	Twisted wire	0.08mm^2(AWG28) to 1.5mm^2(AWG14)
	Single wire	ϕ 0.32 to 1.2mm
	Outside diameter of the cable coating	ϕ Wires with 3.4 mm or less
Operation tools		Equivalent to 210-619 (manufactured by WAGO JAPAN) Equivalent to 210-119SB (manufactured by WAGO JAPAN)
Length of the removed coating		5 to 6 mm

(3) Outline drawing

[Unit: mm]



Note. The measure in ( ) is applicable when a DIN 35mm rail is installed.

11.4 MR Configurator

MR Configurator (LEC-MR-SETUP) performs parameter setting changes, graph display, test operation, etc. on a personal computer using the communication function of the controller.

(1) Specifications

Item	Description
Compatibility with a controller	The MR Configurator software version compatible with the controller is C3 or later.
Monitor	Display, Input/Output I/F display, high speed monitor, graph display (Minimum resolution changes with the processing speed of the personal computer.)
Alarm	Display, history, amplifier data
Diagnostic	No motor rotation, system information display, tuning data, Axis name setting.
Parameters	Parameter list, turning, change list, detailed information
Test operation	Jog operation, positioning operation, motor-less operation, Do forced output, program operation.
File operation	Data read, save, delete, print
Others	Help display

(2) System configuration

(a) Components

To use this software, the following components are required in addition to the controller and servo motor.

Equipment		(Note 1) Description
(Note 2, 3) Personal computer	OS	Windows®98, Windows®Me, Windows®2000 Professional, Windows®Xp Professional / Home Edition, Windows Vista® Home Basic / Home Premium, / Business / Ultimate / Enterprise Windows 7® Starter / Home Premium / Professional / Ultimate / Enterprise operates
	Hard Disk	130MB or more of free space
Browser		Internet Explorer 4.0 or more
Display		One whose resolution is 1024 × 768 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.
Keyboard		Connectable with the above personal computer.
Mouse		Connectable with the above personal computer.
Printer		Connectable with the above personal computer.

Note 1. Windows and Windows Vista are the registered trademarks of Microsoft Corporation in the United States and other countries.

2. On some personal computers, MR Configurator may not run properly.

3. 64-bit Windows XP and 64-bit Windows Vista are not supported.

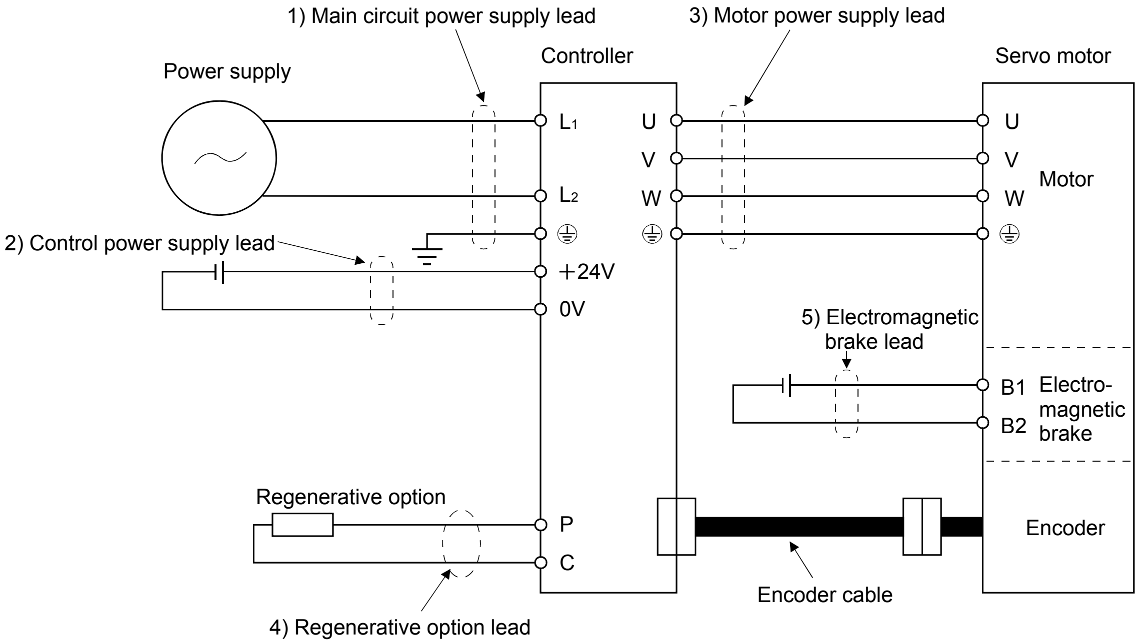
MR Configurator (setup software English version), contact your nearest sales branch.

11.5 Selection example of wires

POINT
・Wires indicated in this section are separated wires. When using a cable for power line (U, V, and W) between the controller and servo motor, use a 600V grade EP rubber insulated chloroprene sheath cab-tire cable (2PNCT). ・ When complying with the UL/CSA standard, use the wires shown in App. 8 for wiring. To comply with other standards, use a wire that is complied with each standard. ・Selection condition of wire size is as follows. Construction condition: One wire is constructed in the air Wire length: 30m or less

(1) Wires for power supply wiring

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



(a) When using the 600V Polyvinyl chloride insulated wire (IV wire)
Selection example of wire size when using IV wires is indicated below.

Table 11.1 Wire size selection example 1 (IV wire)

Controller	Wires [mm^2] (Note)				
	1) L_1 ・ L_2 ・ ⏚	2) ＋24V ・ 0V	3) U ・ V ・ W ・ ⏚	4) P ・ C	5) B1 ・ B2
LECSA2-S1 LECSA2-S3 LECSA2-S4	2(AWG14)	2(AWG14)	2(AWG14)	2(AWG14)	1.25(AWG16)

Note. Wires are selected based on the highest rated current among combining servo motors.

(b) When using the 600V Grade heat-resistant polyvinyl chloride insulated wire (HIV wire)
Selection example of wire size when using HIV wires is indicated below.

Table 11.2 Wire size selection example 2 (HIV wire)

Controller	Wires [mm^2] (Note)				
	1) L_1 ・ L_2 ・ ⏚	2) ＋24V ・ 0V	3) U ・ V ・ W ・ ⏚	4) P ・ C	5) B1 ・ B2
LECSA2-S1 LECSA2-S3 LECSA2-S4	2(AWG14)	2(AWG14)	2(AWG14)	2(AWG14)	1.25(AWG16)

Note. Wires are selected based on the highest rated current among combining servo motors.

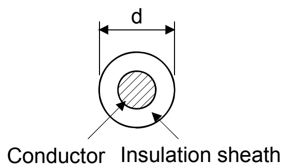
(2) Wires for cables

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

Table 11.3 Wires for option cables

Type	Model	Length [m]	Core size	Number of Cores	Characteristics of one core: Structure [Wires/mm]	Characteristics of one core: Conductor resistance [Ω/km]	Characteristics of one core: Insulation coating OD d [mm] (Note 1)	(Note 2) Finishing OD [mm]	Wire model
Encoder cable	LE-CSE-S□A	2 to 10	AWG22	6 (3 pairs)	7/0.26	53 or less	1.2	7.1±0.3	(Note 3) VSVP 7/0.26 (AWG#22 or equivalent)-3P Ban-gi-shi-16823
	LE-CSE-S□B								
	LE-CSE-R□A	2 to 10	AWG22	6 (3 pairs)	70/0.08	56 or less	1.2	7.1±0.3	(Note 3) ETFE SVP 70/0.08 (AWG#22 or equivalent)-3P Ban-gi-shi-16824
	LE-CSE-□B								
Motor cable	LE-CSM-□SA	2 to 10	AWG18	4	34/0.18	21.8 or less	1.71	6.2±0.3	HRZFEV-A(CL3)AWG18 4 cores
	LE-CSM-□SB	2 to 10							
	LE-CSM-R□A	2 to 10	(Note 5) AWG19 (0.75mm²)	4	150/0.08	29.1 or less	1.63	5.7±0.5	(Note 4) RMFES-A(CL3X)AWG19 4 cores
	LE-CSM- R□B	2 to 10							
	LE-CSB-S□A	0.3							
Lock cable	LE-CSB-S□A	2 to 10	AWG20	2	21/0.18	34.6 or less	1.35	4.7±0.1	HRZFEV-A(CL3)AWG20 2 cores
	LE-CSB-R□B	2 to 10							
	LE-CSB-R□A	2 to 10	(Note 5) AWG20	2	110/0.08	39.0 or less	1.37	4.5±0.3	(Note 4) RMFES-A(CL3X) AWG20 2 cores
	LE-CSE-R□B	2 to 10							

Note 1. d is as shown below.



2. Standard OD. Max. OD is about 10% greater.
3. Purchase from Toa Electric Industry
4. Purchase from TAISEI CO., LTD.
5. These wire sizes assume that the UL-compliant wires are used at the wiring length of 10m.

11.6 No-fuse breakers, fuses, magnetic contactors

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

Controller	No-fuse breaker: Current [A]: Not using power factor improving reactor	No-fuse breaker: Current [A]: Using power factor improving reactor	No-fuse breaker: Voltage AC [V]	Fuse: (Note 1) Class	Fuse: Current [A]	Fuse: Voltage AC [V]	(Note 2) Magnetic contactor
LECSA2-S1	30A frame 5A	30A frame 5A	240V	T	10A	300V	S-N10
LECSA2-S3	30A frame 10A	30A frame 10A			15A		
LECSA2-S4	30A frame 15A	30A frame 10A			20A		

Note 1. When not using the controller as a UL/CSA Standard compliant product, K5 class fuse can be used.

2. Be sure to use a magnetic contactor (MC) with an operation delay time of 80ms or less. The operation delay time is the time interval between current being applied to the coil until closure of contacts.

11.7 Noise reduction techniques

Noises are classified into external noises which enter the controller to cause it to malfunction and those radiated by the controller to cause peripheral devices to malfunction. Since the controller is an electronic device which handles small signals, the following general noise reduction techniques are required.
Also, the controller 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 controller, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

(1) Noise reduction techniques

(a) General reduction techniques

- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
- Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
- Ground the controller, servo motor, etc. together at one point (refer to section 3.12).

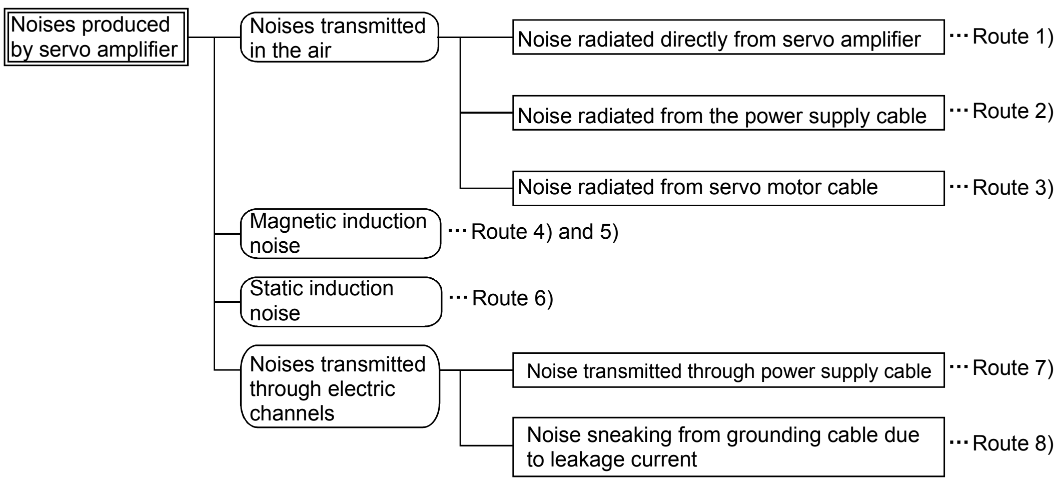
(b) Reduction techniques for external noises that cause the controller to malfunction

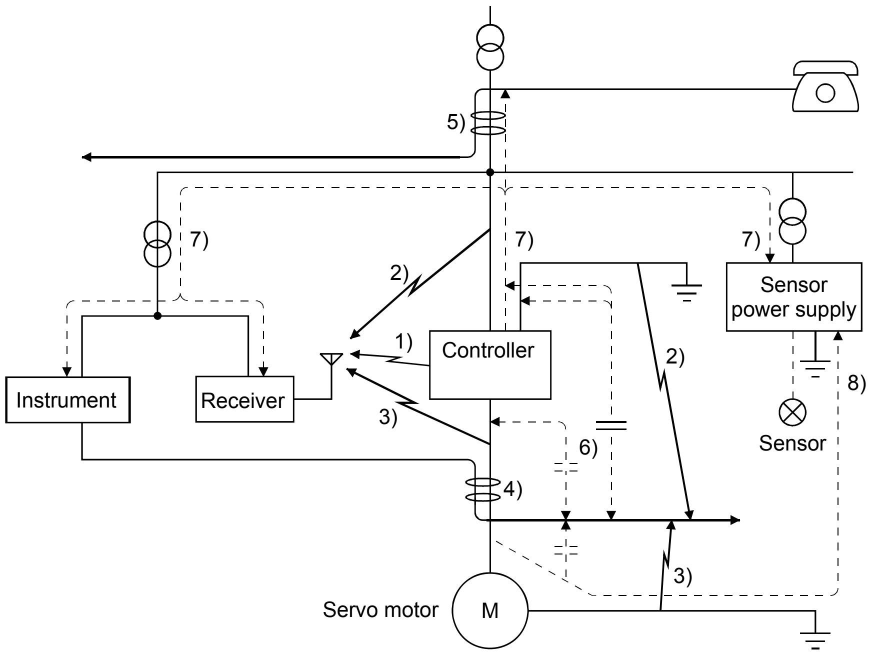
If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the controller and the controller may malfunction, the following countermeasures are required.

- Provide surge absorbers on the noise sources to suppress noises.
- Attach data line filters to the signal cables.
- Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.
- Although a surge absorber is built into the controller, to protect the controller and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.

(c) Techniques for noises radiated by the controller that cause peripheral devices to malfunction

Noises produced by the controller are classified into those radiated from the cables connected to the controller and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.





Noise transmission route	Suppression techniques
1) 2) 3)	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction due to noise and/or their signal cables are contained in a control box together with the controller or run near the controller, 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 controller. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the controller. 3. Avoid laying the power lines (Input cables of the controller) 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 controller. 2. Provide maximum clearance between easily affected signal cables and the I/O cables of the controller. 3. Avoid laying the power lines (I/O cables of the controller) 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 controller system, noises produced by the controller 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 controller. 2. Insert the line noise filter (FR-BSF01) on the power cables of the controller.
8)	When the cables of peripheral devices are connected to the controller to make a closed loop circuit, leakage current may flow to malfunction the peripheral devices. If so, malfunction may be prevented by disconnecting the grounding cable of the peripheral device.

(2) Noise reduction products

(a) Data line filter (Recommended)

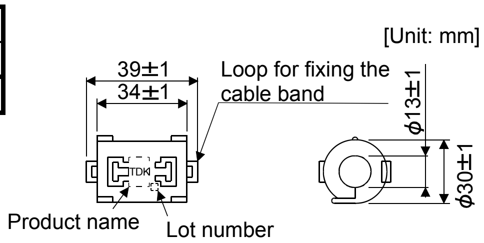
Noise can be prevented by installing a data line filter onto the encoder cable, etc.

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

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

These impedances are reference values and not guaranteed values.

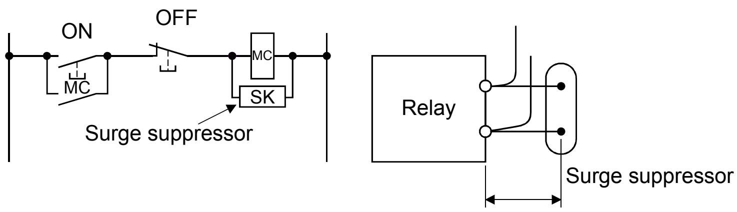
Impedance [Ω]	
10 to 100MHz	100 to 500MHz
80	150



Outline drawing (ZCAT3035-1330)

(b) Surge suppressor (Recommended)

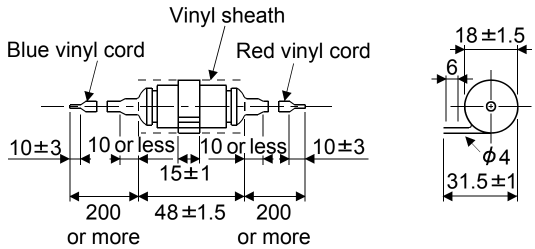
The recommended surge suppressor for installation to an AC relay, AC valve or the like near the controller is shown below. Use this product or equivalent.



(Ex.)972A-2003 50411
(Matsuo Electric Co.,Ltd.)

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

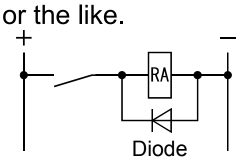
Outline drawing [Unit: mm]



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

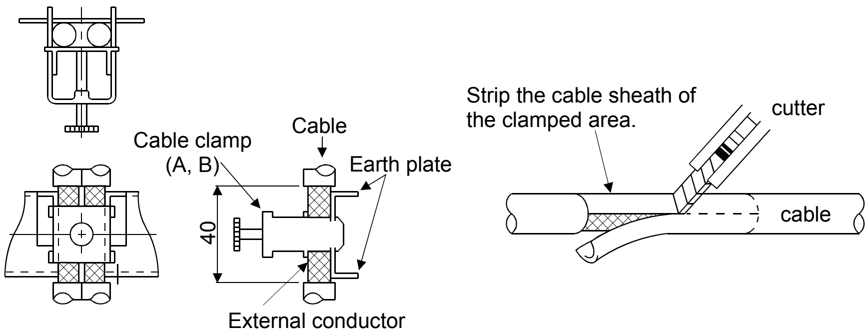
Maximum current: Not less than twice the drive current of the relay or the like



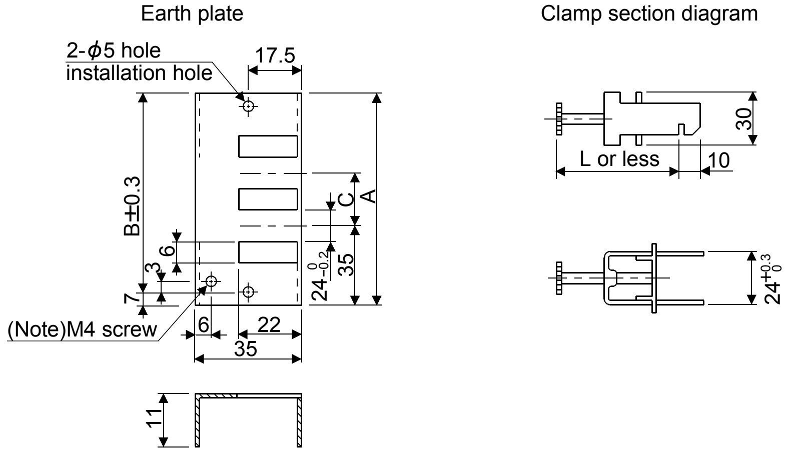
(c) Cable clamp fitting (AERSBAN-□SET)

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 controller 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.



・Outline drawing



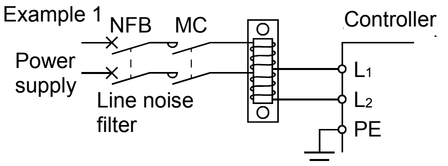
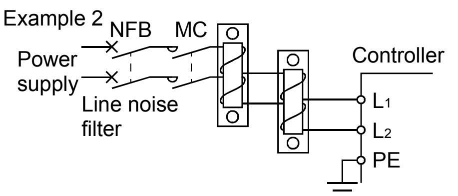
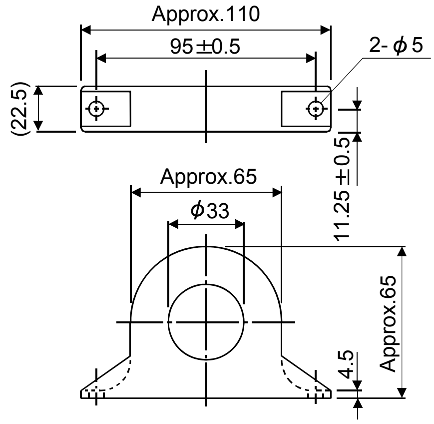
Note. Screw hole for grounding. Connect it to the earth plate of the control box.

Type	A	B	C	Accessory fittings
AERSBAN-DSET	100	86	30	clamp A: 2pcs.
AERSBAN-ESET	70	56		clamp B: 1pc.

Clamp fitting	L
A	70
B	45

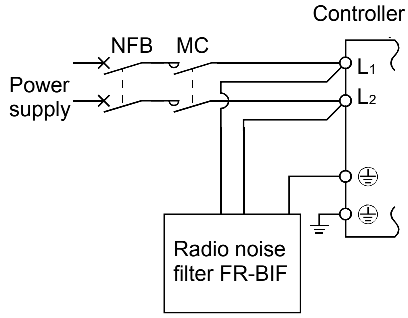
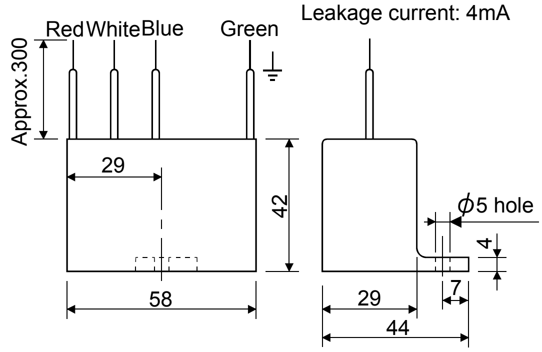
(d) Line noise filter (FR-BSF01)

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

Connection diagram	Outline drawing [Unit: mm]
Use the line noise filters for wires of the main power supply (L_1 L_2) and of the motor power supply (U V W). Pass each of the main circuit wires through the line noise filter an equal number of times in the same direction. For the main power supply, the effect of the filter rises as the number of passes increases, but generally four passes would be appropriate. For the motor power supply, passes must be four times or less. Do not pass the grounding (earth) wire through the filter, or the effect of the filter will drop. Wind the wires by passing through the filter to satisfy the required number of passes as shown in Example 1. If the wires are too thick to wind, use two or more filters to have the required number of passes as shown in Example 2. Place the line noise filters as close to the controller as possible for their best performance.  (Number of turns: 4)  Two filters are used (Total number of turns: 4)	FR-BSF01 (for wire size 3.5mm^2 (AWG12) or less) 

(e) Radio noise filter (FR-BIF)

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

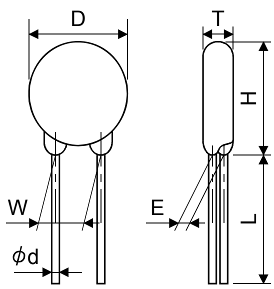
Connection diagram	Outline drawing (Unit: mm)
Make the connection wires as short as possible. Grounding is always required. Make sure to insulate the wires that are not used for wiring. 	

(f) Varistors for input power supply (Recommended)

Varistors are effective to prevent exogenous noise and lightning surge from entering the controller. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K and TND20V-471K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

Power supply voltage	Varistor	Maximum rating					Maximum limit voltage		Static capacity (reference value)	Varistor voltage rating (range) V1mA
		Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power				
		AC[Vrms]	DC[V]	8/20μs[A]	2ms[J]	[W]	[A]	[V]	[pF]	[V]
200V class	TND20V-431K	275	350	10000/1 time	195	1.0	100	710	1300	430(387 to 473)
	TND20V-471K	300	385	7000/2 time	215			775	1200	470(423 to 517)

[Unit: mm]



Model	D Max.	H Max.	T Max.	E ±1.0	(Note)L min.	ϕd ±0.05	W ±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			

Note. For special purpose items for lead length (L), contact the manufacturer.

11.8 Leakage current breaker

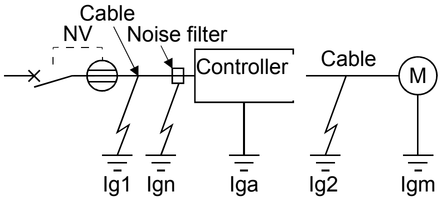
(1) Selection method

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 controller, servo motor, etc. securely.

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

Rated sensitivity current $\geq$ 10 · {Igl+Ign+Iga+K · (Ig2+Igm)} [mA]...................(11.1)



Leakage current breaker: Type	Leakage current breaker: Mitsubishi products	K
Models provided with harmonic and surge reduction techniques	NV-SP NV-SW NV-CP NV-CW NV-HW	1
General models	BV-C1 NFB NV-L	3

Ig1: Leakage current on the electric channel from the leakage current breaker to the input terminals of the controller (Found from Fig. 11.1.)

Ig2: Leakage current on the electric channel from the output terminals of the controller to the servo motor (Found from Fig. 11.1.)

Ign: Leakage current when a filter is connected to the input side (4.4mA per one FR-BIF)

Iga: Leakage current of the controller (Found from Fig. 11.5.)

Igm: Leakage current of the servo motor (Found from Fig. 11.4.)

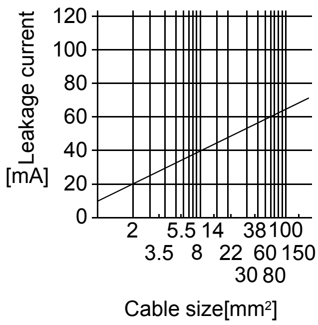


Fig. 11.1 Leakage current example (Ig1, Ig2) for CV cable run in metal conduit

Table 11.4 Servo motor's leakage current example (Igm)

Servo motor power [kW]	Leakage current [mA]
0.05 to 0.4	0.1

Table 11.5 Controller's leakage current example (Iga)

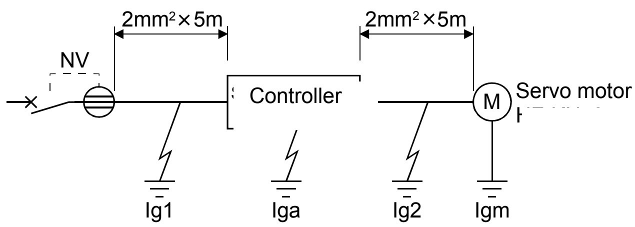
Controller capacity [kW]	Leakage current [mA]
0.1 to 0.4	0.1

Table 11.6 Leakage circuit breaker selection example

Controller	Rated sensitivity current of leakage circuit breaker [mA]
LECSA2-□	15

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions.



Use a leakage current breaker generally available.

Find the terms of Equation (11.1) from the diagram.

$$Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

$$Ig2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (11.1).

$$Ig \geq 10 \cdot \{0.1+0+0.1+1 \cdot (0.1+0.1)\}$$

$$\geq 4.0 \text{ [mA]}$$

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 4.0[mA] or more. A leakage current breaker having Ig of 15[mA] is used with the NV-SP/SW/CP/CW/HW series.

11.9 Circuit protector

Use the circuit protector for the control circuit power supply (+24V, 0V).

Controller	Circuit protector
LECSA2-S1	CP30-BA2P1M3A
LECSA2-S3	
LECSA2-S4	

11.10 EMC filter (recommended)

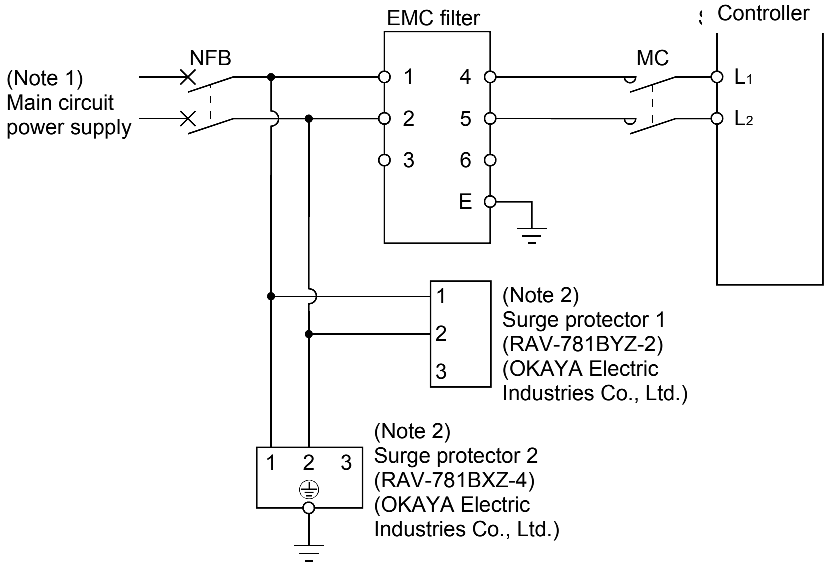
For compliance with the EMC directive of the EN Standard, it is recommended to use the following filter. Some EMC filters are large in leakage current.

(1) Combination with the controller

Controller	Recommended filter (Soshin Electric)		Mass [kg]([lb])
	Model	Leakage current [mA]	
LECSA2-□	(Note) HF3010A-UN	5	3

Note. A surge protector is separately required to use any of these EMC filters. (Refer to section11.11.)

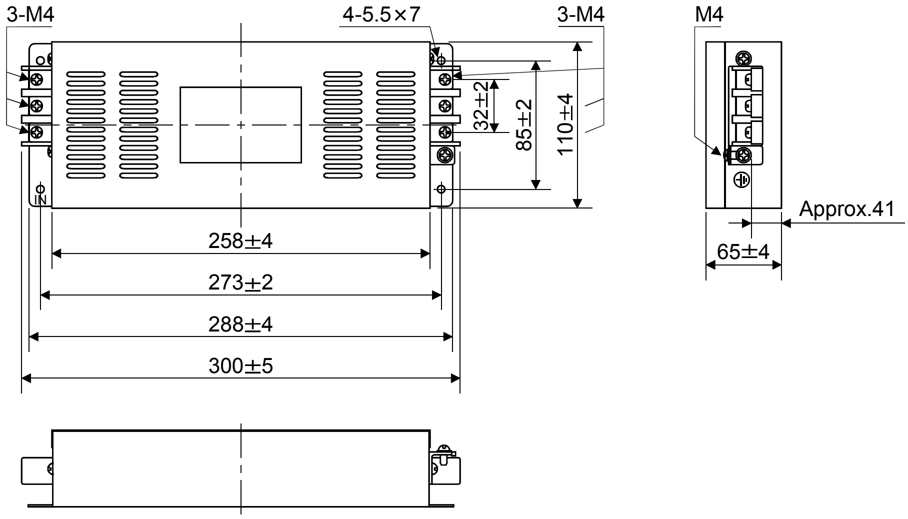
(2) Connection example



Note 1. Refer to section 1.3 for the power supply specification.
2. The example is when a surge protector is connected.

(3) Outline drawing
HF3010A-UN

[Unit: mm]



11.11 Surge protector (recommended)

To avoid damages caused by surges (such as lightning and sparking) applied on AC power line, connecting the following surge protectors to the main circuit power (L_1 ・ L_2) is recommended.

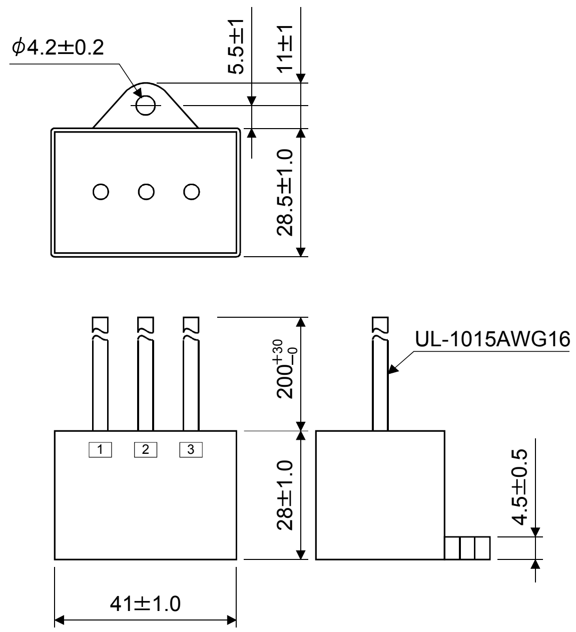
(1) Specifications

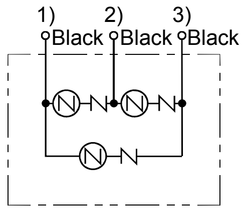
Surge protector model	Circuit voltage 50/60Hz	Maximum permissible circuit voltage	Clamp voltage	Surge immunity 8/20μs	Surge compression 1.2/50μs	Static capacity	Operating temperature
RAV-781BYZ-2	3AC 250V	300V	783V±10%	2500A	20kV	75pF	−20 to 70℃
RAV-781BXZ-4	3AC 250V	300V	1700V±10%	2500A	2kV	75pF	−20 to 70℃

(2) Outline drawing

RAV-781BYZ-2

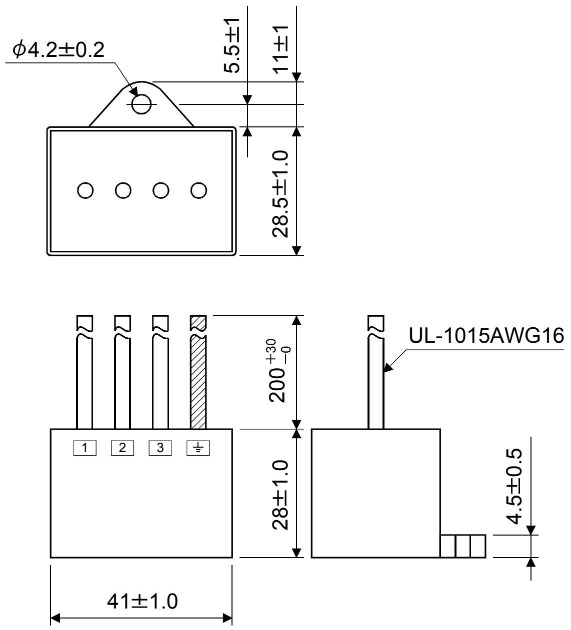
[Unit: mm]

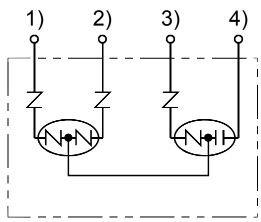




RAV-781BXZ-4

[Unit: mm]



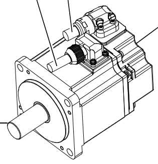


MEMO

UUAEAEAEAEAEAAAAA12. SERVO MOTOR

12.1.1. Parts identification

Refer to section 11.1 for details of the cables and connectors.



Note 1. The encoder cable and the power supply cable are options.

2. An electromagnetic brake cable is separately required for the servo motor with an electromagnetic brake.

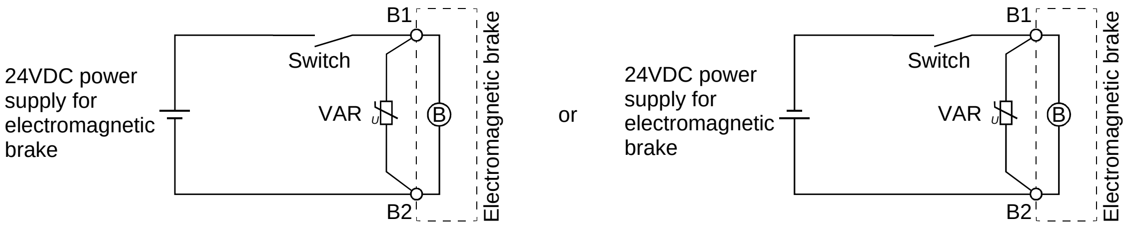
12.1.2 Electromagnetic brake characteristics

⚠ CAUTION	・The electromagnetic brake is provided for preventing a drop at power failure or at servo alarm occurrence during vertical drive, or for holding a shaft at stop. Do not use it for normal braking (including braking at servo lock). ・The brake has a time lag. Use the brake so that servo motor control is started after the brake has completely opened. ・Configure an electromagnetic brake operation circuit which interlocks with an external emergency stop. ・Refer to section 3.11 for details of the circuit configuration and the timing chart.

The servo motor with an electromagnetic brake can be used to prevent a drop in vertical lift applications or to ensure double safety at an emergency stop, for example. When performing servo motor operation, supply power to the electromagnetic brake to release the brake. Switching power off makes the brake effective.

(1) Electromagnetic brake power supply

Prepare the following power supply exclusively used for the electromagnetic brake. The electromagnetic brake terminals (B1, B2) do not have polarity.



A surge absorber (VAR) must be installed between B1 and B2. Refer to "Electromagnetic brake characteristics" in section of each servo motor series for selecting surge absorbers.

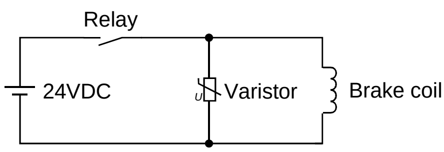
(2) Noise generation

Though the brake lining may rattle during operation in the low-speed area, it poses no functional problem.
If braking noise occurs, it may be improved by setting the machine resonance suppression filter or adaptive vibration suppression control in the controller parameters. Refer to section 7.2 for details.

(3) Selection of surge absorbers for electromagnetic brake circuit

(a) Selection condition

Item	Conditions
Electromagnetic brake specification	R[Ω] : Resistance L[H] : Inductance Vb[V] : Power supply voltage
Desired suppressed voltage	Vs[V] or less
Durable surge application time	N times



(b) Tentative selection and verification of surge absorber

1) Maximum permissible circuit voltage of varistor

Tentatively select a varistor whose maximum allowable voltage is larger than Vb [V].

2) Brake current (Ib)

$$Ib = \frac{Vb}{R} \text{ [A]}$$

3) Energy (E) generated in the brake coil

$$E = \frac{L \times Ib^2}{2} \text{ [J]}$$

4) Varistor limit voltage (Vi)

From the energy (E) generated in the brake coil and the varistor characteristic diagram, calculate the varistor limit voltage (Vi) when the brake current (Ib) flows into the tentatively selected varistor during opening of the circuit.
Vi is favorable when the varistor limit voltage (Vi)[V] is smaller than the desired suppressed voltage (Vs)[V].
If Vi is not smaller than Vs, reselect a varistor or improve the withstand voltage of devices.

5) Surge current width (τ)

Given that the varistor absorbs all energies, the surge current width (τ) is as follows.

$$\tau = \frac{E}{Vi \times Ib} \text{ [s]}$$

6) Inspection of surge life of varistor

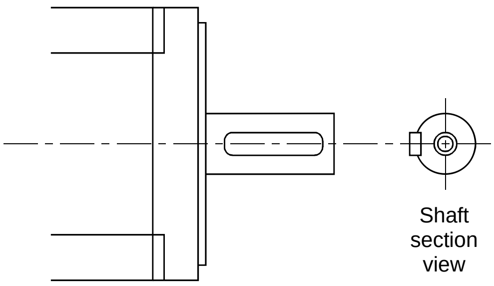
From the varistor characteristic diagram, calculate the guaranteed value current (Ip) in which the number of the surge application life is N at the surge current width (τ).
Calculate the ratio (Ip/Ib) of the guaranteed value current (Ip) to the brake current (Ib).
If an enough margin is ensured for Ip/Ib, the number of the surge application life N [Time] can be considered as favorable.

(4) Others

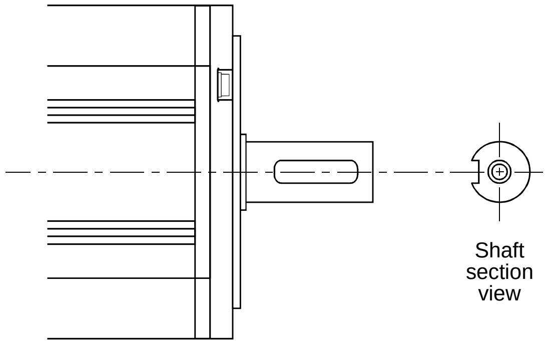
A leakage magnetic flux occurs at the shaft end of the servo motor with an electromagnetic brake. Note that chips, screws and other magnetic substances are attracted.

12.1.4 Servo motor shaft shapes

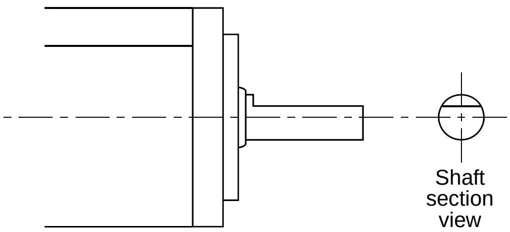
In addition to the straight shaft, keyway shaft and D cut shaft are available as the servo motor shafts.
The keyway shaft and the D cut shaft cannot be used in frequent start/stop applications. Since we cannot warrant the servo motor against fracture and similar accidents attributable to a loose key, use a friction coupling, etc. when coupling the shaft with a machine.
The shaft shape of the standard servo motor varies depending on the capacity. Refer to sections 12.5.4.



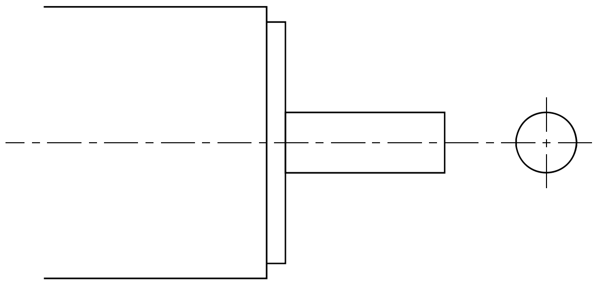
Keyway shaft (with key)



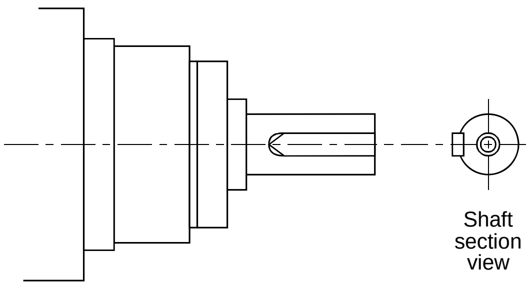
Keyway shaft (without key)



D cut shaft



Straight shaft



Keyway shaft (with single pointed key)

12.2 Installation

⚠ WARNING	· Be sure to ground the servo motor to prevent an electric shock.

⚠ CAUTION	· Do not stack the product packages exceeding the maximum number specified on the package. · Install the equipment to incombustibles. Installing it directly or close to combustibles may cause a fire. · Install the equipment on a weight-bearing place in accordance with this Instruction Manual. · Do not get on or place heavy objects on the equipment as it may cause injury. · Use the equipment within the specified environmental condition range. Refer to sections 12.5.2 (1) and 12.6.2 (1). · Do not drop or shock the servo motor as it is precision equipment. · Do not install or operate a servo motor which is damaged or has any part missing. · Do not hold the cable, the shaft or the encoder when carrying the servo motor as it may cause malfunction or injury. · Install the servo motor with a reduction gear in the specified direction. Improper installation causes oil leakage, leading to a fire and malfunction. · Couple the servo motor to a machine securely. Insecure coupling may cause the servo motor to come off, resulting in injury. · Never hit the shaft end of the servo motor, especially when coupling the servo motor to a machine as it may damage the encoder. When coupling a load to the servo motor, do not use a rigid coupling as it may break the shaft. · Balance the load to the extent possible. Failure to do so can cause vibration during servo motor operation or damage the bearings and the encoder. · Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation. · Do not apply load exceeding the permissible load as it may break the shaft, causing injury. · When the equipment has been stored for an extended period of time, consult your local sales office. · When handling the servo motor, be careful with the edged parts such as the corners of the servo motor.

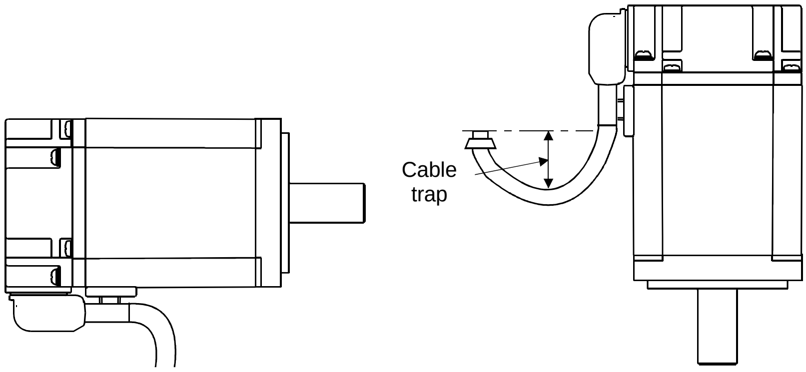
12.2.1 Installation direction

(1) Standard servo motor

The following table indicates the installation direction of the standard servo motor.

Servo motor series	Installation direction	Remarks
LE-□-□	Any directions	For installation in the horizontal direction, it is recommended to set the connector section downward.

When installing the servo motor in horizontal direction, it is recommended to set the connector section downward. When installing it vertically or obliquely, provide a cable trap for the cable.



(2) Servo motor with an electromagnetic brake

The servo motor with an electromagnetic brake can also be installed in the same direction as the standard servo motor. When the servo motor with an electromagnetic brake is installed with the shaft upward, the brake plate may generate a sliding sound, but it is not a fault.

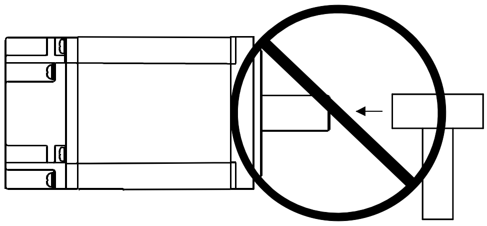
(3) Servo motor with a reduction gear (HF-KP□G1/G5/G7)

Installation direction of the servo motor with a reduction gear varies depending on the reduction gear type. Be sure to install it in the specified direction. Refer to section 12.6.4 for details.

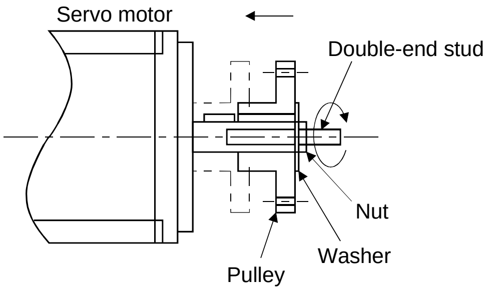
12.2.2 Precautions for load remove

POINT

- During assembling, never hit the shaft end of the servo motor by a hammer, etc. It may damage the encoder.



(1) When mounting a pulley to the servo motor shaft with a keyway, use the screw hole on the shaft end. To fit the pulley, first insert a double-end stud into the screw hole on the shaft, put a washer against the end face of the coupling, and insert and tighten a nut to force the pulley in.



(2) For the shaft without a keyway, use a friction coupling or the like.

(3) When removing the pulley, use a pulley remover to protect the shaft from hard load or impact.

(4) To ensure safety, fit a protective cover or the like on the rotating part, such as the pulley, mounted to the shaft.

(5) When a threaded shaft end part is needed to mount a pulley on the shaft, please contact your local sales office.

(6) The direction of the encoder on the servo motor cannot be changed.

(7) For installation of the servo motor, use spring washers, etc. and fully tighten the bolts so that they do not become loose due to vibration.

12.2.3 Permissible load for the shaft

POINT
· Do not use a rigid coupling as it may apply excessive bending load to the shaft, leading to shaft breakage.

For the permissible shaft load specific to the servo motor, refer to sections 12.5.2 (1).

(1) Use a flexible coupling and make sure that the misalignment of the shaft is less than the permissible radial load.

(2) When using a pulley, sprocket or timing belt, select a diameter that will fit into the permissible radial load.

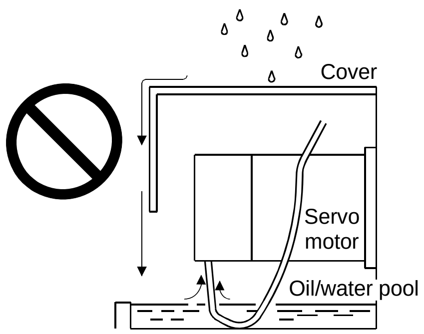
(3) Excess of the permissible load can shorten the bearing life and damage the shaft.

(4) The load indicated in this section is static load in a single direction and does not include eccentric load. Make eccentric load as small as possible. Not doing so may damage the servo motor.

12.2.4 Protection from oil and water

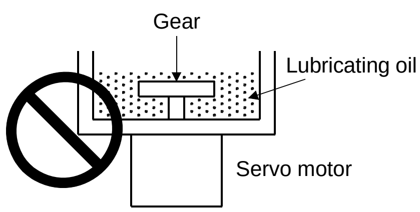
Provide adequate protection to prevent foreign matter such as oil from entering the servo motor shaft. When installing the servo motor, consider the following in this section.

(1) Do not use the servo motor with its cable soaked in oil or water.



<Incorrect> Capillary phenomenon

(2) When the servo motor is installed with the shaft upward, provide measures to prevent the servo motor being exposed to oil or water from a machine side, gear box, etc.



(3) If the servo motor is exposed to oil such as coolant, the sealant, packing, cable and others may be affected depending on the oil type.

(4) In the environment where the servo motor is exposed to oil mist, oil, water and/or grease, a standard specification servo motor may not be usable. Contact your local sales office for more details.

12.2.5 Cable

The power supply and encoder cables routed from the servo motor should be fixed to the servo motor to keep them unmovable. Otherwise, the cables may break. In addition, do not modify the connectors on the cable ends.

12.2.6 Inspection

⚠ WARNING	・Before wiring, be sure to turn off the power, wait for 15 minutes or longer, and then make sure that the charge lamp is off to prevent an electric shock. In addition, always confirm if the charge lamp is off or not from the front of the controller. ・Due to a risk of an electric shock, only qualified personnel should attempt inspection. For repair and parts replacement, contact your local sales office.

POINT

・Do not disassemble and/or repair the equipment.

It is recommended to make the following checks periodically.

(a) Check the bearings, the brake section, etc. for unusual noise.

(b) Check the cables and the like for scratches and cracks. Especially when the junction cable is movable, perform periodic inspection according to operating conditions.

(c) Check the servo motor shaft and coupling for misalignment.

(d) Check the power supply connector, brake connector, and encoder connector tightening screws for looseness.

12.2.7 Life

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

Part name	Life guideline	Remarks
Bearing	20,000 to 30,000 hours	The Life guideline field gives the reference time. If any fault is found before this time is reached, the part must be changed.
Encoder	20,000 to 30,000 hours	

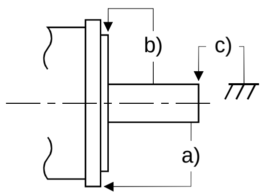
When the servo motor is operated at the rated speed under the rated load, replace the bearings in 20,000 to 30,000 hours as a guideline. However, this service life varies depending on the operating conditions. The bearings must be replaced if unusual noise or vibration is found during inspection.

12.2.8 Machine accuracies

The following table indicates the machine accuracies of the servo motor around the output shaft and mounting (except the special purpose products).

Accuracy [mm]	Measuring position	Flange size
		Less than □100
Runout of flange surface about output shaft	a)	0.05
Runout of fitting outer diameter of flange surface	b)	0.04
Runout of output shaft end	c)	0.02

Reference diagram



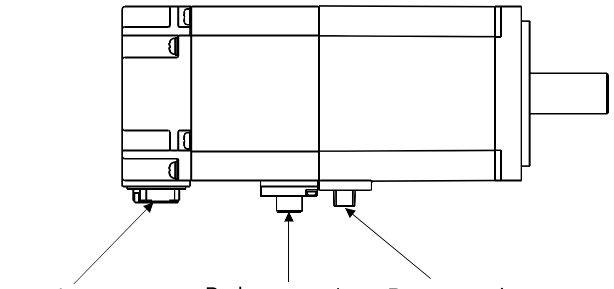
12.3 Connectors used for servo motor wiring

POINT
・Protective structure indicated for connectors indicates the dust and water proofing levels when the connectors are installed to a controller or servo motor. If the protective structure of the connector and the controller/servo motor differs, the overall protective structure depends on the lowest of all.

12.3.1 Selection of connectors

Use the connector configuration products given in the table as the connectors for connection with the servo motor. Refer to section 12.3.2 for the compatible connector configuration products.

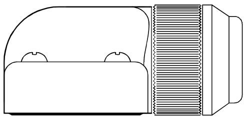
LE-□-□



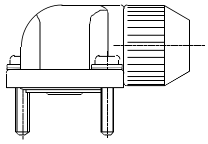
Servo motor	Wiring connector		
	For encoder	For power supply	For brake
LE-□-□	Connector configuration A	Connector configuration B	Connector configuration C

12.3.2 Wiring connectors (Connector configurations A B C)

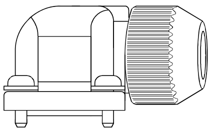
These connectors comply with the EN and UL/CSA standards.



Connector configuration	Configuration product		Servo motor encoder connector
	Connector (IP65)	Crimping tool	
A	Connector: 1674320-1 (Tyco Electronics)	For Ground clip: 1596970-1 For REC. contact: 1596847 (Tyco Electronics)	1674339-1 (Tyco Electronics)



Connector configuration	Configuration product		Servo motor power supply connector
	Connector (IP65)	Crimping tool	
B	Connector: JN4FT04SJ1-R Hood, socket insulator, bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) (JAE)	CT160-3-TMH5B (JAE)	JN4AT04NJ1 (JAE)



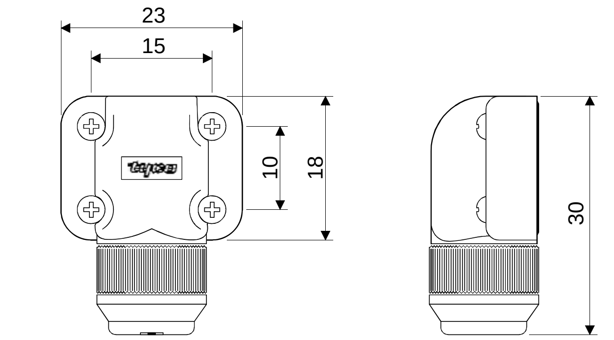
Connector configuration	Configuration product		Servo motor brake connector
	Connector (IP65)	Crimping tool	
C	Connector: JN4FT02SJ1-R Hood, socket insulator, bushing, ground nut Contact: ST-TMH-S-C1B-100-(A534G) (JAE)	CT160-3-TMH5B (JAE)	JN4AT02PJ1 (JAE)

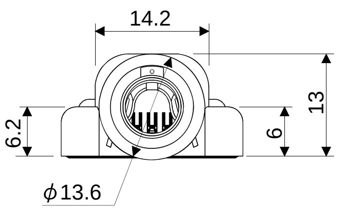
12.4 Connector outline drawings

The connector outline drawings for wiring the servo motor are shown below.

(1) Tyco Electronics
1674320-1

[Unit: mm]

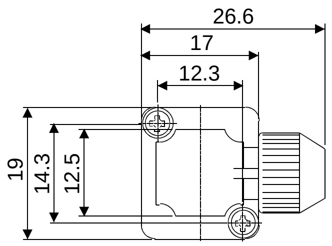


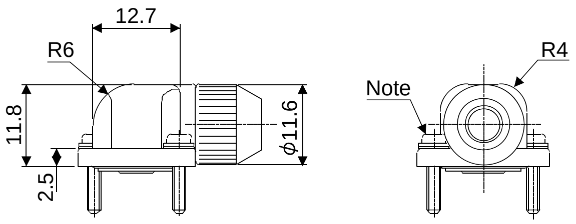


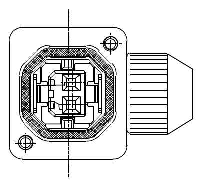
Crimping tool: 1596970-1 (For ground clip)
1596847 (For receptacle contact)

(2) JAE
JN4FT02SJ1-R

[Unit: mm]





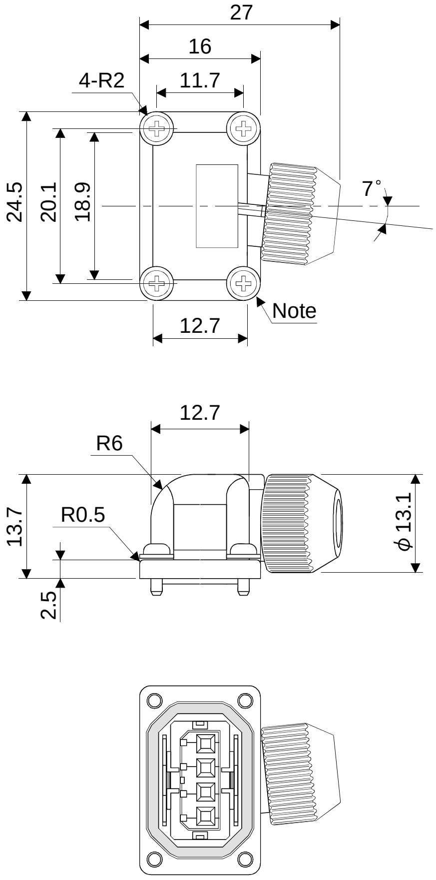


Note. The recommended screw tightening torque is 0.2N・m.

Crimping tool: CT160-3-TMH5B

JN4FT04SJ1-R

[Unit: mm]



Note. The recommended screw tightening torque is 0.2N • m.

Crimping tool: CT160-3-TMH5B

12.5 LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ series servo motor

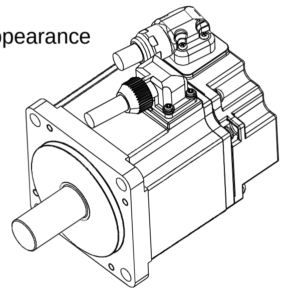
This section provides information on the servo motor specifications and characteristics. When using the LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ series servo motor, always read the Safety Instructions in the beginning of this manual and sections 12.1 to 12.4, in addition to this section.

12.5.1 Model definition

The following describes what each block of a model name indicates. Note that not all the combinations of the symbols exist.

LE-S1-□

Appearance



● Motor Option

Symbol	Brake
None	None
B	With

● Correspondence motor

S1	AC servo（Incremental）	50W
S2		100W
S3		200W
S4		400W

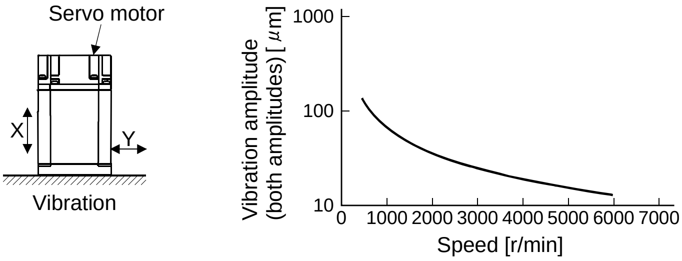
12.5.2 Standard specifications

(1) Standard specifications

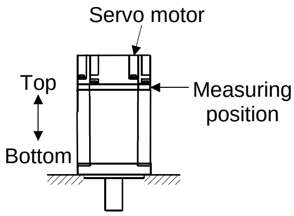
Item			Servo motor: LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ series (Low inertia, small capacity) 053	13	23	43
Applicable controller	LECSA2-□		10		20	40
Continuous running duty (Note 1)	Rated output	[kW]	0.05	0.1	0.2	0.4
	Rated torque	[N ▪ m]	0.16	0.32	0.64	1.3
		[oz ▪ in]	22.7	45.3	90.6	184
Rated speed (Note 1)		[r/min]	3000			
Maximum speed		[r/min]	4500			
Instantaneous permissible speed		[r/min]	5175			
Maximum torque		[N ▪ m]	0.48	0.95	1.9	3.8
		[oz ▪ in]	68.0	135	269	538
Power rate at continuous rated torque		[kW/s]	4.87	11.5	16.9	38.6
Inertia moment (Note 3)	J	[$\times 10^{-4}$kg ▪ m^2]	0.052	0.088	0.24	0.42
	WK^2	[oz ▪ in^2]	0.284	0.481	1.31	2.30
Recommended load to motor inertia moment ratio (Note 2)			15 times or less		24 times or less	22 times or less
Power supply capacity			Refer to section 10.2.			
Rated current		[A]	0.9	0.8	1.4	2.7
Maximum current		[A]	2.7	2.4	4.2	8.1
Speed/position encoder			Incremental 17 bits encoder (Resolution per servo motor 1 rotation: 131072pulse/rev)			
Accessory						
Insulation class			Class B			
Structure			Totally-enclosed, self-cooled (protection type: IP65 (Note 4))			
Environmental conditions (Note 5)	Ambient temperature	In operation [°C]	0 to +40 (non-freezing)			
		In operation [°F]	32 to 104 (non-freezing)			
		In storage [°C]	-15 to +70 (non-freezing)			
		In storage [°F]	5 to 158 (non-freezing)			
	Ambient humidity	In operation	80%RH or less (non-condensing)			
		In storage	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 above sea level			
	Vibration (Note 6)		X, Y : $49m/s^2$			
Vibration rank (Note 7)			V-10			
Permissible load to the shaft (Note 8)	L	[mm]	25		30	
	Radial	[N]	88		245	
		[lb]	19.8		55.1	
	Thrust	[N]	59		98	
		[lb]	13.3		22.0	
Mass (Note 3)		[kg]	0.4	0.5	1.0	1.4
		[lb]	0.88	1.10	2.21	3.09

Note 1. When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
2. If the load to motor inertia moment ratio exceeds the indicated value, please contact your local sales office.
3. Refer to the outline drawings for the servo motors with an electromagnetic brake.
4. Except for the shaft-through portion.
5. In the environment where the servo motor is exposed to oil mist, oil and/or water, a standard specification servo motor may not be usable. Contact your local sales office.

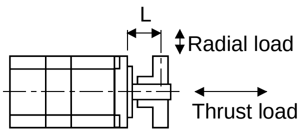
6. The vibration direction is as shown in the figure. The value is the one at the part that indicates the maximum value (normally the opposite-to-load side bracket). When the servo motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value.



7. V-10 indicates that the amplitude of a single servo motor is 10μm or less. The following figure shows the servo motor installation position for measurement and the measuring position.



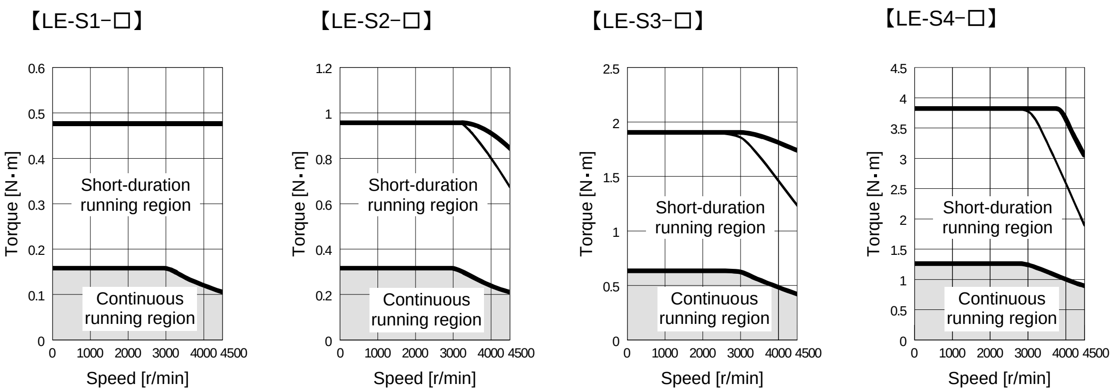
8. For the symbols in the table, refer to the following diagram. Do not subject the shaft to load greater than these values in the table. These values are applicable when the loads are applied independently.



(2) Torque characteristics

POINT
・For a machine used in a vertical lift application which generates unbalanced torque, it is recommended to keep the unbalanced torque within 70% or lower of the rated torque.

When the input power supply specifications of the controller are 1-phase 230VAC, the torque characteristics are indicated by heavy lines. For the 1-phase 200VAC power supply, torque characteristics are partially indicated by solid lines.



12.5.3 Electromagnetic brake characteristics

CAUTION	
⚠ CAUTION	・The electromagnetic brake is provided for preventing a drop at power failure or at servo alarm occurrence during vertical drive, or for holding a shaft at stop. Do not use it for normal braking (including braking at servo lock). ・Before performing the operation, be sure to confirm that the electromagnetic brake operates properly.

The characteristics of the electromagnetic brake provided for the servo motor with an electromagnetic brake are indicated below.

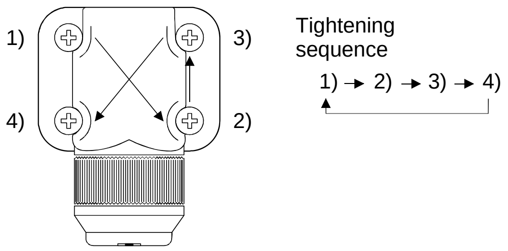
Item \ Servo motor		LE-S1-□, LE-S2-□, LE-S3-□, LE-S4 series			
		LE-S1−□	LE-S2−□	LE-S3−□	LE-S4−□
Type (Note 1)		Spring-loaded safety brake			
Rated voltage (Note 4)		$24VDC^{0}_{-10\%}$			
Power consumption	[W]at20℃	6.3		7.9	
Coil resistance (Note 6)	[Ω]	91.0		73.0	
Inductance (Note 6)	[H]	0.15		0.18	
Brake static friction torque	[N・m]	0.32		1.3	
	[oz・in]	45.3		184	
Release delay time (Note 2)	[s]	0.03		0.03	
Braking delay time (Note 2) [s]	DC off	0.01		0.02	
Permissible braking work	Per braking [J]	5.6		22	
	Per hour [J]	56		220	
Brake looseness at servo motor shaft (Note 5)	[degrees]	2.5		1.2	
Brake life (Note 3)	Number of braking cycles [times]	20000		20000	
	Work per braking [J]	5.6		22	
Selection example of surge absorbers to be used (Note 7, 8)	For the suppressed voltage 125V	TND20V-680KB			
	For the suppressed voltage 350V	TND10V-221KB			

Note 1. There is no manual release mechanism. Use a 24VDC power supply to release the brake electrically.
2. The value for initial ON gap at 20℃ (68℉).
3. Brake gap increases as the brake lining wears, but the gap is not adjustable. Therefore, the brake life is indicated as the number of braking cycles available before the gap adjustment is required.
4. Always prepare the power supply exclusively used for the electromagnetic brake.
5. The above values are typical initial values and not guaranteed values.
6. These values are measured values and not guaranteed values.
7. Select the electromagnetic brake control relay properly, considering the characteristics of the electromagnetic brake and surge absorber.
8. Manufactured by Nippon Chemi-Con Corporation.

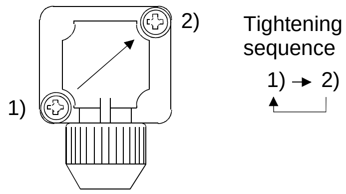
12.5.4 Connector installation

If the connector is not fixed securely, it may come off or may not produce a splash-proof effect during operation. To achieve the protective rating of IP65, pay attention to the following points and install the connectors.

(1) When screwing the connector, hold the connector still and gradually tighten the screws in a crisscross pattern.

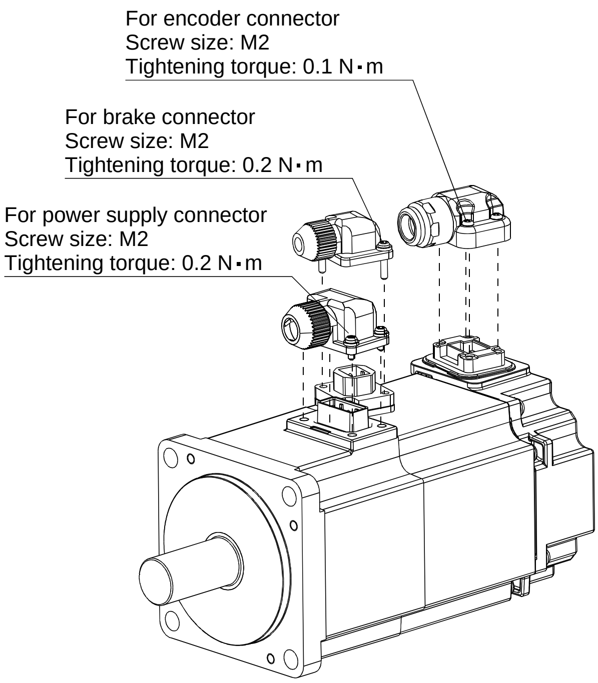


For power supply and encoder connectors



For brake connector

(2) Tighten the screws evenly. Tightening torques are as indicated below.



(3) The servo motor fitting part of each connector is provided with a splash-proof seal (O ring). When installing the connector, take care to prevent the seal (O ring) from dropping and being pinched. If the seal (O ring) has dropped or is pinched, a splash-proof effect is not produced.

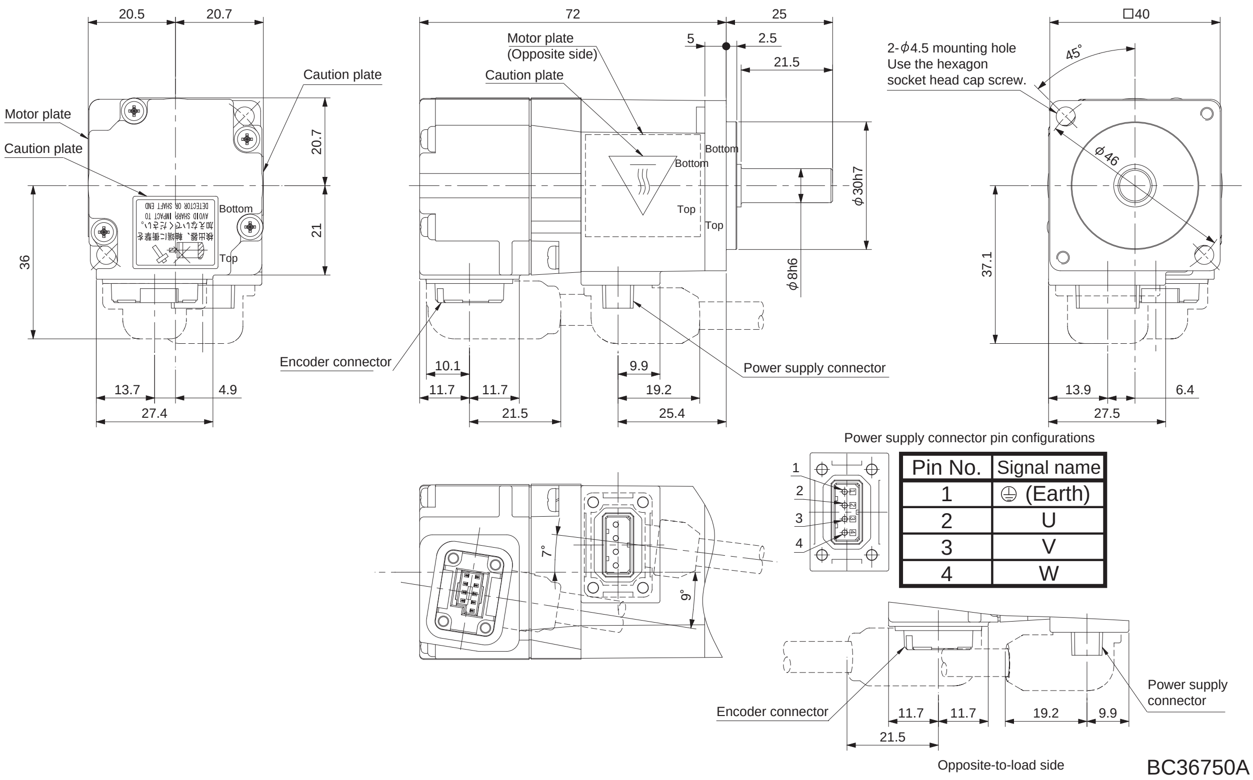
12.5.5 Outline drawings

The actual dimensions may be 1 to 3mm larger than the drawing dimensions. Design the machine side with allowances.
When running the cables to the load side, take care to avoid interference with the machine. The dimensions in the drawings without tolerances are the reference dimensions.
The inertia moments in the table are the value calculated by converting the total value of inertia moment for servo motor and electromagnetic brake to the servo motor shaft.

(1) Standard (without an electromagnetic brake)

Model	Output [W]	Inertia moment J [$\times 10^{-4}$kg・m^2] (WK^2 [oz・in^2])	Mass [kg] ([lb])
LE-S1-□	50	0.052 (0.284)	0.4 (0.882)

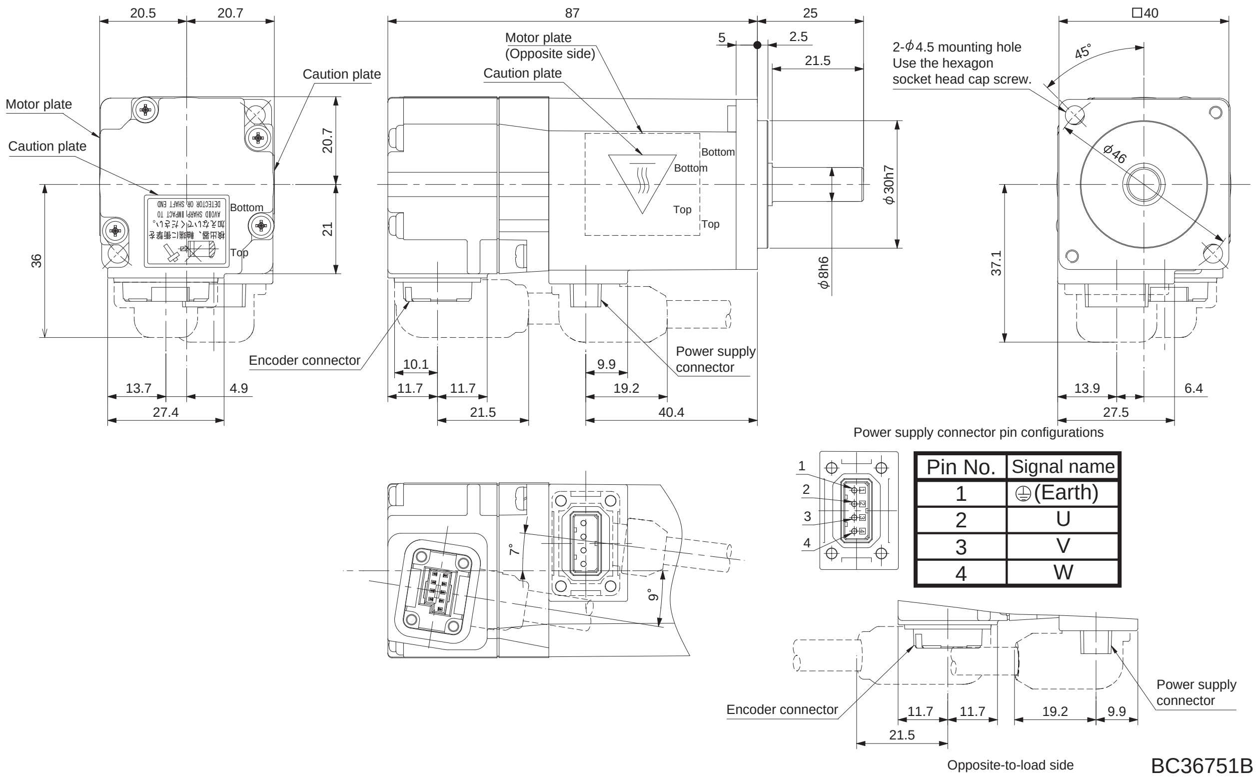
[Unit: mm]



Pin No.	Signal name
1	⏚ (Earth)
2	U
3	V
4	W

Model	Output [W]	Inertia moment J [×10^{-4}kg・m^2] (WK^2 [oz・in^2])	Mass [kg] ([lb])
LE-S2−□	100	0.088 (0.481)	0.5 (1.10)

[Unit: mm]

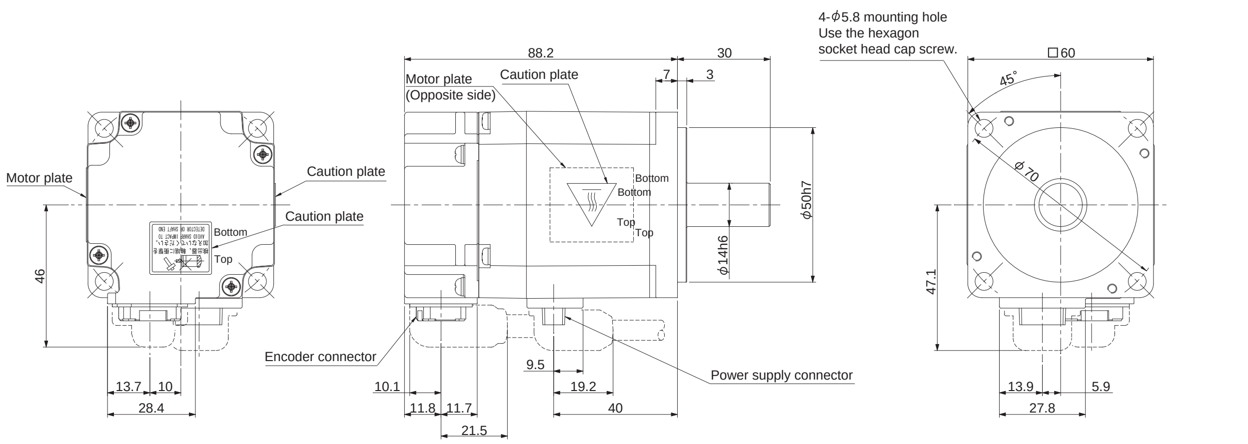


Pin No.	Signal name
1	⏚(Earth)
2	U
3	V
4	W

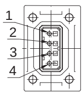
BC36751B

Model	Output [W]	Inertia moment J [×10^{-4}kg・m^2] (WK^2 [oz・in^2])	Mass [kg] ([lb])
LE-S3−□	200	0.24 (1.31)	1.0 (2.21)

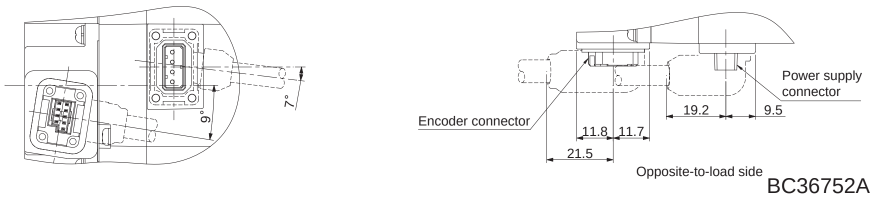
[Unit: mm]



Power supply connector pin configurations



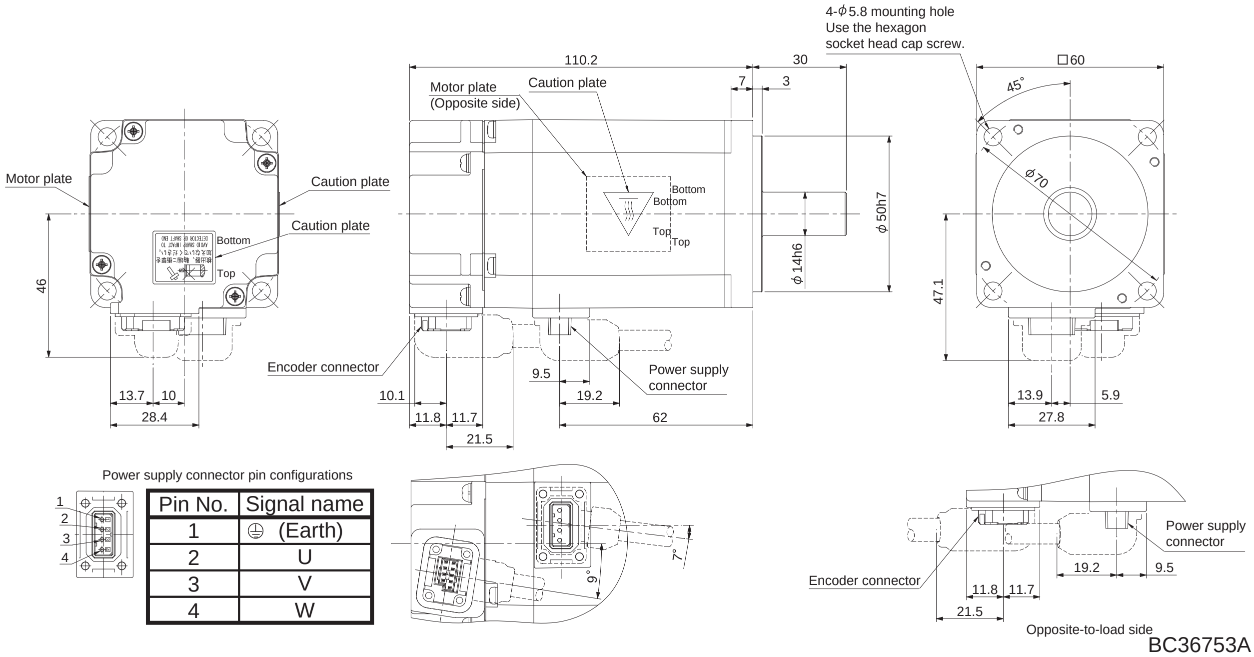
Pin No.	Signal name
1	⊕ (Earth)
2	U
3	V
4	W



BC36752A

Model	Output [W]	Inertia moment J [×10⁻⁴kg・m²] (WK² [oz・in²])	Mass [kg] ([lb])
LE-S4−□	400	0.42 (2.30)	1.4 (3.09)

[Unit: mm]



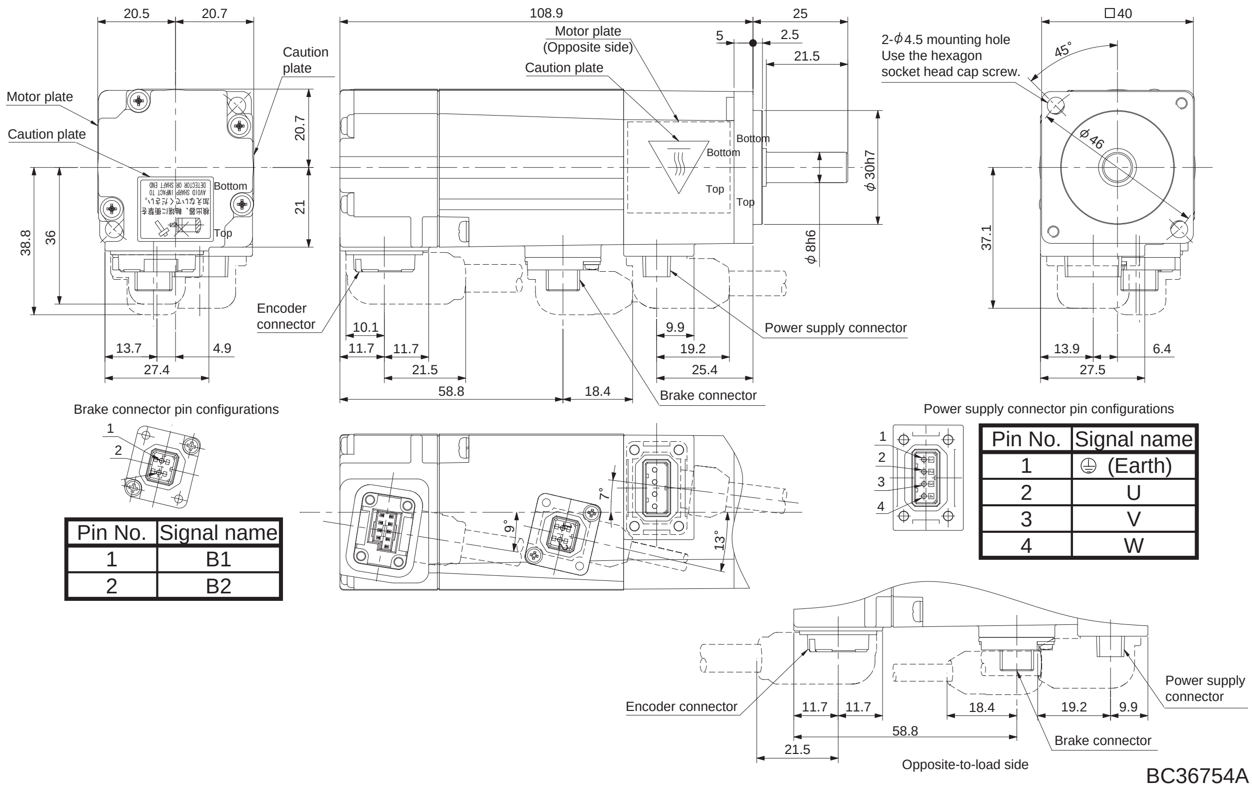
Pin No.	Signal name
1	⏚ (Earth)
2	U
3	V
4	W

BC36753A

(2) With an electromagnetic brake

Model	Output [W]	Brake static friction torque [N・m]	Inertia moment J [×10⁻⁴kg・m²] (WK² [oz・in²])	Mass [kg] ([lb])
LE-S1−B	50	0.32	0.054 (0.295)	0.6 (1.32)

[Unit: mm]



Brake connector pin configurations

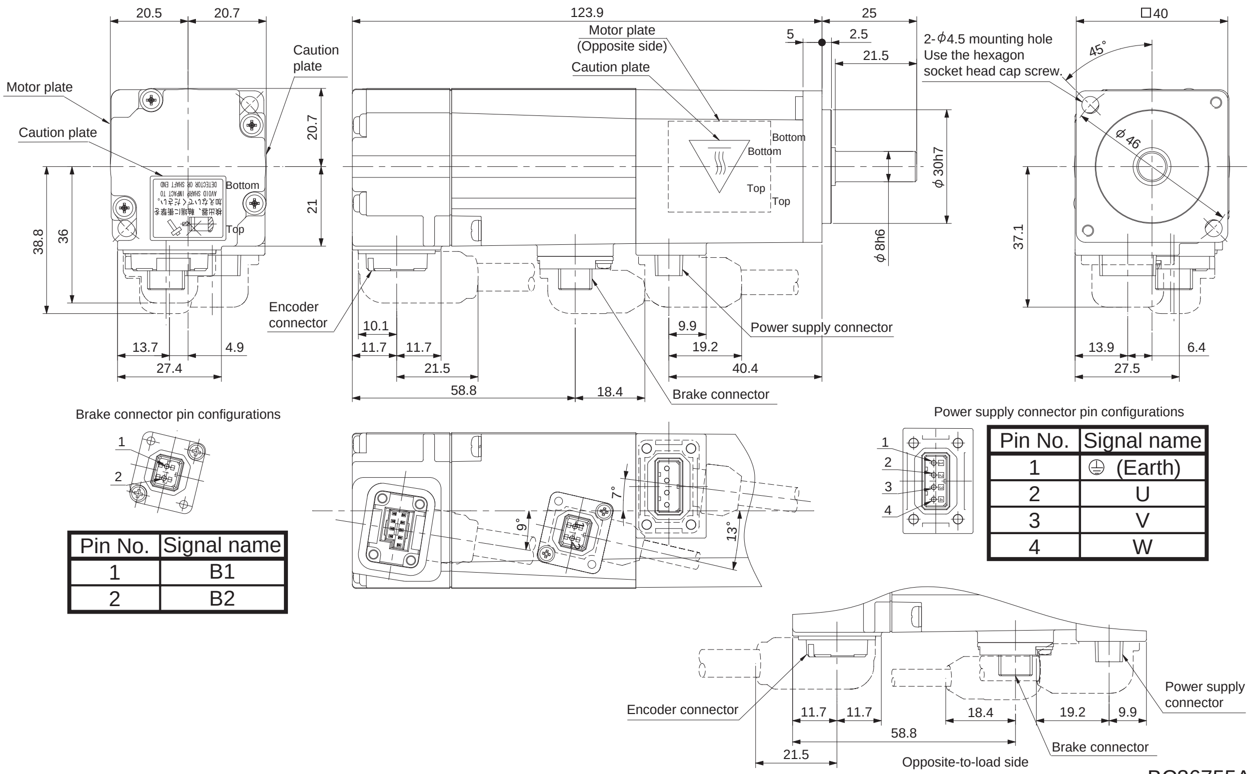
Pin No.	Signal name
1	B1
2	B2

Power supply connector pin configurations

Pin No.	Signal name
1	⏚ (Earth)
2	U
3	V
4	W

Model	Output [W]	Brake static friction torque [N・m] ([oz・in])	Inertia moment J [×10^{-4}kg・m^2] (WK^2 [oz・in^2])	Mass [kg] ([lb])
LE-S2−B	100	0.32 (45.3)	0.09 (0.492)	0.7 (1.54)

[Unit: mm]



Brake connector pin configurations

Pin No.	Signal name
1	B1
2	B2

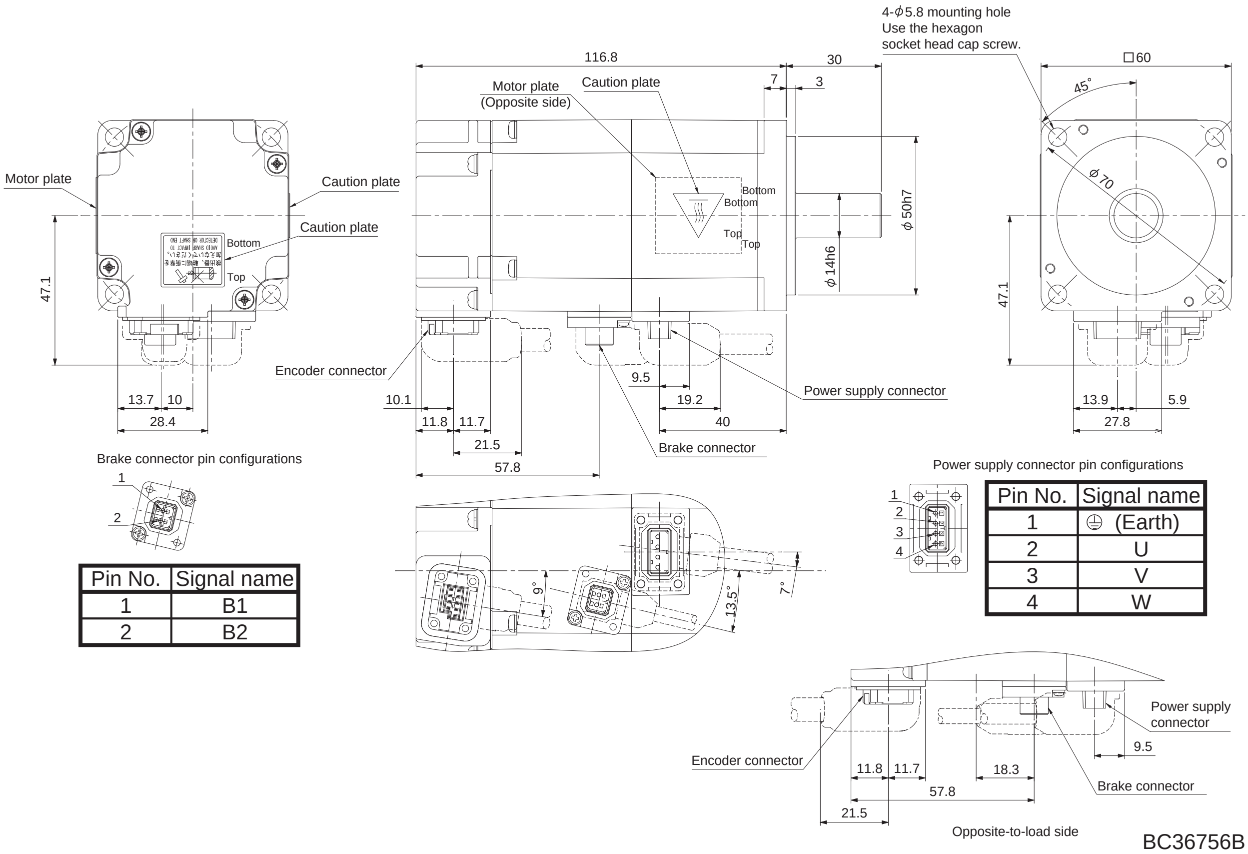
Power supply connector pin configurations

Pin No.	Signal name
1	⏚ (Earth)
2	U
3	V
4	W

BC36755A

Model	Output [W]	Brake static friction torque [N • m] ([oz • in])	Inertia moment J [×10^{-4}kg • m^2] (WK^2 [oz • in^2])	Mass [kg] ([lb])
LE-S3-B	200	1.3 (184)	0.31 (1.70)	1.4 (3.09)

[Unit: mm]



Brake connector pin configurations

Pin No.	Signal name
1	B1
2	B2

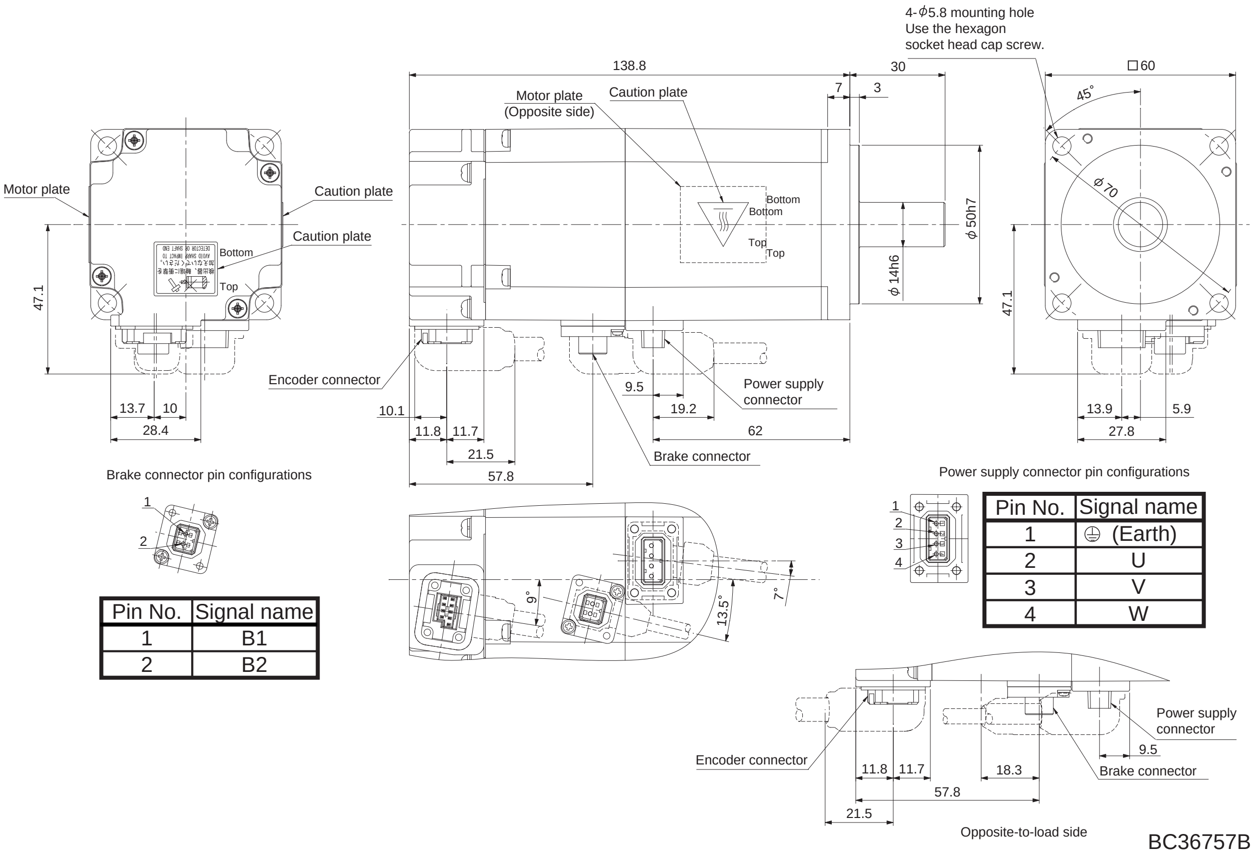
Power supply connector pin configurations

Pin No.	Signal name
1	⏚ (Earth)
2	U
3	V
4	W

BC36756B

Model	Output [W]	Brake static friction torque [N・m] ([oz・in])	Inertia moment J [$\times 10^{-4}$kg・m^2] (WK^2 [oz・in^2])	Mass [kg] ([lb])
LE-S4−B	400	1.3 (184)	0.50 (2.73)	1.8 (3.97)

[Unit: mm]



Brake connector pin configurations

Pin No.	Signal name
1	B1
2	B2

Power supply connector pin configurations

Pin No.	Signal name
1	⊕ (Earth)
2	U
3	V
4	W

BC36757B

12.6 LE-S5-□, LE-S6-□, LE-S7-□, LE-S8-□ series servo motor

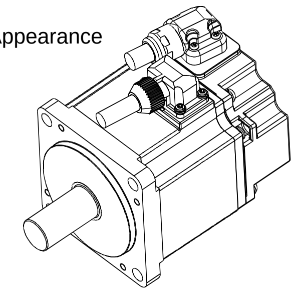
POINT
・For the outline drawings of the LE-S5-□, LE-S6-□, LE-S7-□, LE-S8-□servo motor, refer to sections 6.8.3 to 6.8.8 in the Servo Motor INSTRUCTION MANUAL (Vol.2).

This section provides information on the servo motor specifications and characteristics. When using the HF-KP series servo motor, always read the Safety Instructions in the beginning of this manual and sections 12.1 to 12.4, in addition to this section.

12.6.1 Model definition

The following describes what each block of a model name indicates. Note that not all the combinations of the symbols exist.

Appearance



LE−S5−□

Motor Option

Symbol	Brake
None	None
B	With

Correspondence motor

S5	AC servo（Absolute）	50W
S6		100W
S7		200W
S8		400W

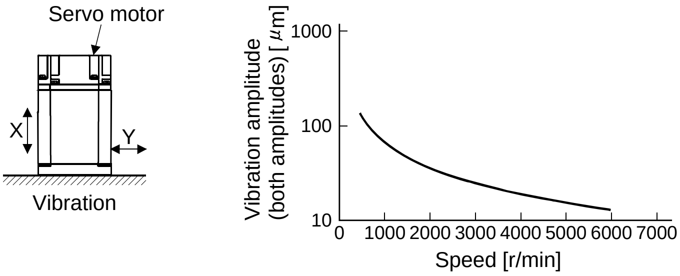
12.6.2 Specifications

(1) Specifications list

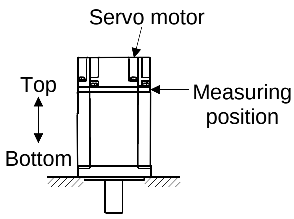
Item			Servo motor	LE-S5-□, LE-S6-□, LE-S7-□, LE-S8 series (Low inertia, small capacity)			
				LE-S5−□	LE-S6−□	LE-S7−□	LE-S8−□
Applicable controller	MR-JN-□ A			10		20	40
Continuous running duty (Note 1)	Rated output		[kW]	0.05	0.1	0.2	0.4
	Rated torque (Note 10)		[N・m]	0.16	0.32	0.64	1.3
			[oz・in]	22.7	45.3	90.6	184
Rated speed (Note 1, 3)			[r/min]	3000			
Maximum speed (Note 3)			[r/min]	4500 (Note 9)			
Instantaneous permissible speed			[r/min]	Refer to section 12.6.4.			
Maximum torque (Note 10)			[N・m]	0.48	0.95	1.9	3.8
			[oz・in]	68.0	135	269	538
Power rate at continuous rated torque (Note 10)			[kW/s]	4.87	11.5	16.9	38.6
Inertia moment		J	[$\times 10^{-4}$kg・m^2]	Refer to sections 6.8.3 to 6.8.8 in the Servo Motor INSTRUCTION MANUAL (Vol.2).			
		WK^2	[oz・in^2]				
Recommended load to motor inertia moment ratio (Note 2)				15 times or less		24 times or less	22 times or less
Power supply capacity				Refer to section 10.2.			
Rated current			[A]	0.9	0.8	1.4	2.7
Maximum current			[A]	2.7	2.4	4.2	8.1
Speed/position encoder				18 bits encoder common to absolute position and incremental (Resolution per servo motor 1 rotation: 262144pulse/rev) (Note 8)			
Accessory							
Insulation class				Class B			
Structure				Totally-enclosed, self-cooled (protection type: IP44 (Note 4))			
Environmental conditions (Note 5)	Ambient temperature	In operation	[°C]	0 to +40 (non-freezing)			
			[°F]	32 to 104 (non-freezing)			
		In storage	[°C]	-15 to +70 (non-freezing)			
			[°F]	5 to 158 (non-freezing)			
	Ambient humidity	In operation		80%RH or less (non-condensing)			
		In storage		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 above sea level			
	Vibration (Note 6)			X, Y : 49m/s^2			
Vibration rank (Note 7)				V-10			
Permissible load for the shaft				Refer to section 12.6.4.			
Mass			[kg] ([lb])	Refer to sections 6.8.3 to 6.8.8 in the Servo Motor INSTRUCTION MANUAL (Vol.2).			

Note 1. When the power supply voltage drops, the output and the rated speed cannot be guaranteed.
2. If the load to motor inertia moment ratio exceeds the indicated value, please contact your local sales office.
3. The above values are in the reduction gear input shaft.
4. Except for the shaft-through portion.
5. In the environment where the servo motor is exposed to oil mist, oil and/or water, a standard specification servo motor may not be usable. Contact your local sales office.

6. For the single servo motor. The vibration direction is as shown in the figure. The value is the one at the part that indicates the maximum value (normally the opposite-to-load side bracket). When the servo motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value. Note that this does not apply to the servo motor with a reduction gear.



7. V-10 indicates that the amplitude of a single servo motor is 10μm or less. The following figure shows the servo motor installation position for measurement and the measuring position.



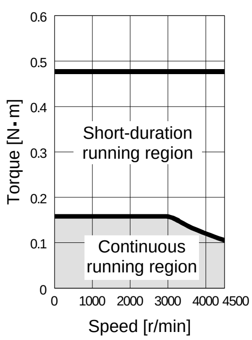
8. When combined with the MR-JN series controller, the resolution performance becomes equivalent to an incremental 17 bits encoder.
9. When combining with the MR-JN series controller.
10. For the single servo motor.

(2) Torque characteristics

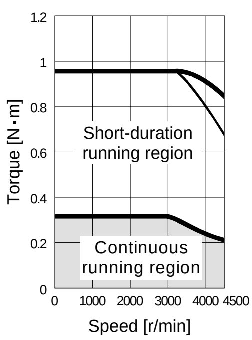
POINT
・For a machine used in a vertical lift application which generates unbalanced torque, it is recommended to keep the unbalanced torque within 70% or lower of the rated torque.

The torque characteristics shown in the following graph are for the servo motor itself. When the input power supply specifications of the controller are 1-phase 230VAC, the torque characteristics are indicated by heavy lines. For the 1-phase 200VAC power supply, torque characteristics are partially indicated by solid lines.

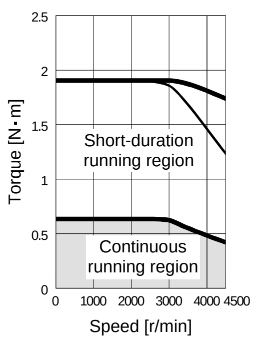
【LE-S5-□】



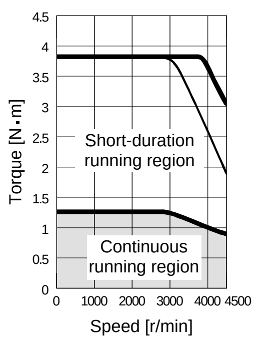
【LE-S6-□】



【LE-S7-□】



【LE-S8-□】



12.6.3 Electromagnetic brake characteristics

⚠ CAUTION	· The electromagnetic brake is provided for preventing a drop at power failure or at servo alarm occurrence during vertical drive, or for holding a shaft at stop. Do not use it for normal braking (including braking at servo lock). · Before performing the operation, be sure to confirm that the electromagnetic brake operates properly.

The characteristics of the electromagnetic brake provided for the servo motor with an electromagnetic brake are indicated below.

Item \ Servo motor			LE-S5-□, LE-S6-□, LE-S7-□, LE-S8 series			
			LE-S5-□	LE-S6-□	LE-S7-□	LE-S8-□
Type (Note 1)			Spring-loaded safety brake			
Rated voltage (Note 4)			$24VDC^{0}_{-10\%}$			
Power consumption		[W]at20℃	6.3		7.9	
Coil resistance (Note 6)		[Ω]	91.0		73.0	
Inductance (Note 6)		[H]	0.15		0.18	
Brake static friction torque		[N・m]	0.32		1.3	
		[oz・in]	45.3		184	
Release delay time (Note 2)		[s]	0.03		0.03	
Braking delay time (Note 2) [s]	DC off		0.01		0.02	
Permissible braking work	Per braking	[J]	5.6		22	
	Per hour	[J]	56		220	
Brake looseness at servo motor shaft (Note 5)		[degrees]	2.5		1.2	
Brake life (Note 3)	Number of braking cycles	[times]	20000		20000	
	Work per braking	[J]	5.6		22	
Selection example of surge absorbers to be used (Note 7, 8)	For the suppressed voltage 125V		TND20V-680KB			
	For the suppressed voltage 350V		TND10V-221KB			

Note 1. There is no manual release mechanism. Use a 24VDC power supply to release the brake electrically.
2. The value for initial ON gap at 20℃ (68℉).
3. Brake gap increases as the brake lining wears, but the gap is not adjustable. Therefore, the brake life is indicated as the number of braking cycles available before the gap adjustment is required.
4. Always prepare the power supply exclusively used for the electromagnetic brake.
5. The above values are typical initial values and not guaranteed values.
6. These values are measured values and not guaranteed values.
7. Select the electromagnetic brake control relay properly, considering the characteristics of the electromagnetic brake and surge absorber.
8. Manufactured by Nippon Chemi-Con Corporation.

MEMO

13. POSITIONING MODE

13.1 Selection method of each operation mode

This section provides the selection method of each operation mode.

(1) Point table method

Operation mode	Selection item of operation mode		Parameter No. PA01 setting	Input device setting (Note)		Refer to
				MD0	DI0 to DI2	
Automatic operation mode for point table method	One-time positioning operation		□□□6	ON	Option	Section 13.3.2 (1)
	Automatic continuous operation	Varied speed operation				Section 13.3.2 (2) (b)
		Automatic continuous positioning operation				Section 13.3.2 (2) (c)
Manual operation mode	JOG operation			OFF		Section 13.5.1
	Manual pulse generator operation					Section 13.5.2
Home position return mode	Dog type			ON	All OFF	Section 13.6.3
	Count type					Section 13.6.4
	Data set type					Section 13.6.5
	Stopper type					Section 13.6.6
	Home positic [illegible] position as h[illegible]					Section 13.6.7
	Dog type rear end reference					Section 13.6.8
	Count type front end reference					Section 13.6.9
	Dog cradle type					Section 13.6.10

Note. MD0: Automatic/manual selection
DI0 to DI2: Point table No./Program No. selection 1 to 3

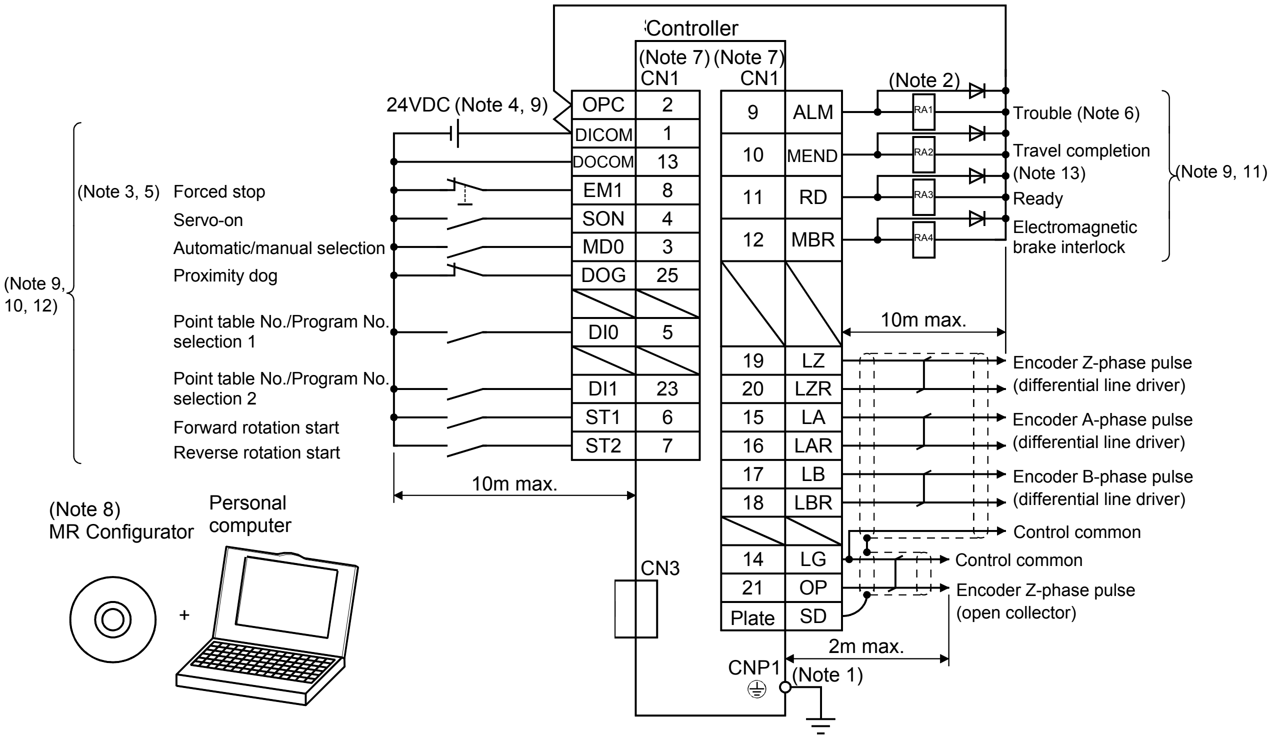
(2) Program method

Operation mode	Selection item of operation mode	Parameter No. PA01 setting	Input device setting (Note 1)		Refer to
			MD0	DI0 to DI2	
Automatic operation mode for program method		□□□7	ON	Option	Section 13.4
Manual operation mode	JOG operation		OFF		Section 13.5.1
	Manual pulse generator operation				Section 13.5.2
Home position return mode	Dog type		ON	(Note 2) Option	Section 13.6.3
	Count type				Section 13.6.4
	Data set type				Section 13.6.5
	Stopper type				Section 13.6.6
	Home position ignorance (Servo-on position as home position)				Section 13.6.7
	Dog type rear end reference				Section 13.6.8
	Count type front end reference				Section 13.6.9
	Dog cradle type				Section 13.6.10

Note 1. MD0: Automatic/manual selection
DI0 to DI2: Point table No./Program No. selection 1 to 3
2. Select a program that has the home position return "ZRT" command.

13.2 Signals

13.2.1 I/O signal connection example



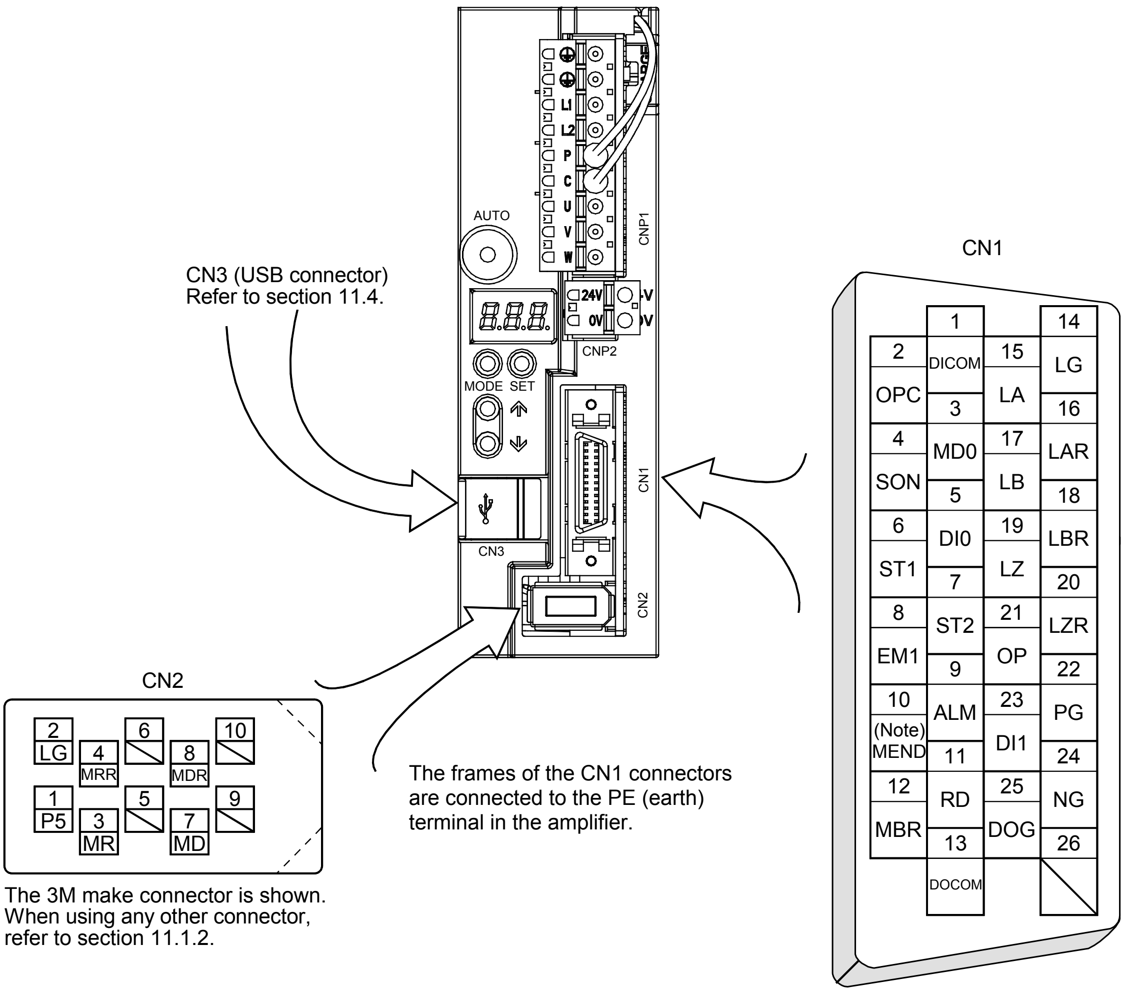
Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal of the (terminal marked ⏚) controller to the protective earth (PE) of the control box.

2. Connect the diode in the correct direction. If it is connected reversely, the controller will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
3. The forced stop switch (normally closed contact) must be installed.
4. Supply 24VDC±10% 200mA current for interfaces from the outside. 200mA is the value applicable when all I/O signals are used. The current capacity can be decreased by reducing the number of I/O points. Refer to section 3.8.2 (1) that gives the current value necessary for the interface.
5. When starting operation, always turn on the forced stop (EM1). (Normally closed contacts)
6. Trouble (ALM) turns on in normal alarm-free condition.
7. The pins with the same signal name are connected in the controller.
8. Use MRZJW3-SETUP221E (version C4 or later).
9. For the sink I/O interface. For the source I/O interface, refer to section 3.8.3. However, pin 23 and pin 25 cannot be used at the source interface.
10. The assigned signals can be changed using parameter No. PD02, PD04, PD06, PD08, PD10, PD12, or PD14.
11. The assigned signals can be changed using parameter No.PD15 to PD18.
12. The forward rotation stroke end (LSP) and the reverse rotation stroke end (LSN) automatically switch ON if not assigned to the external input signals.
13. Set " □□ 24 " in parameter No. PD16 to assign travel completion (MEND).

13.2.2 Connectors and signal arrangements

POINT
・The pin configurations of the connectors are as viewed from the cable connector wiring section.

The front view shown below is that of LECSA1-S3or smaller. Refer to chapter 9 OUTLINE DRAWINGS for the appearances and connector layouts of the other controllers.



Note. Set " □□ 24 " in parameter No. PD16 to assign travel completion (MEND).

13.2.3 Signal explanations

For the I/O interfaces (symbols in I/O division column in the table), refer to section 3.8.2. In the positioning mode field of the table

CP : Point table method CL: Program method

○ : Denotes that the signal may be used in the initial setting status.

△ : Denotes that the signal may be used by setting parameter No. PD02, PD04, PD06, PD08, PD10, PD12, and PD14 to PD18.

The pin No.s in the connector pin No. column are those in the initial status.

(1) I/O devices

(a) Input devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="2">Positioning mode</th></tr>
<tr><th>CP</th><th>CL</th></tr>
<tr><td>Forced stop</td><td>EM1</td><td>CN1-8</td><td>When EMG is turned off (contact between commons is opened), the controller falls in a forced stop state in which the base circuit is shut off, and the dynamic brake activates.
When EM1 is turned on (contact between commons is shorted) in the forced stop state, the state can be reset.</td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Proximity dog</td><td>DOG</td><td>CN1-25</td><td>When DOG is turned OFF, the proximity dog is detected. The polarity of dog detection can be changed using parameter No. PE03.
<table>
<tr><th>Parameter No. PE03</th><th>Proximity dog (DOG) detection polarity</th></tr>
<tr><td>□0□□ (initial value)</td><td>OFF</td></tr>
<tr><td>□1□□</td><td>ON</td></tr>
</table></td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Forward rotation stroke end</td><td>LSP</td><td></td><td>To start operation, turn LSP/LSN on. Turn it off to bring the motor to a sudden stop and make it servo-locked.
<table>
<tr><th colspan="2">(Note) Device</th><th colspan="2">Operation</th></tr>
<tr><th>LSP</th><th>LSN</th><th>CCW direction</th><th>CW direction</th></tr>
<tr><td>1</td><td>1</td><td>○</td><td>○</td></tr>
<tr><td>0</td><td>1</td><td></td><td>○</td></tr>
<tr><td>1</td><td>0</td><td>○</td><td></td></tr>
<tr><td>0</td><td>0</td><td></td><td></td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td>△</td><td>△</td></tr>
<tr><td>Reverse rotation stroke end</td><td>LSN</td><td></td><td>A stopping method can be changed by parameter No. PD20.
Set parameter No. PD01 as indicated below to switch on the signals (keep terminals shorted) automatically in the controller.
<table>
<tr><th rowspan="2">Parameter No. PD01</th><th colspan="2">Status</th></tr>
<tr><th>LSP</th><th>LSN</th></tr>
<tr><td>□4□□</td><td>Automatic ON</td><td></td></tr>
<tr><td>□8□□</td><td></td><td>Automatic ON</td></tr>
<tr><td>□C□□</td><td>Automatic ON</td><td>Automatic ON</td></tr>
</table></td><td>DI-1</td><td>△</td><td>△</td></tr>
</table>

			If LSP and LSN are not assigned to the external input signals, they turn ON automatically regardless of the value set in parameter No. PD01. When LSP or LSN turns OFF, an external stroke limit warning (99. □) occurs, and warning (WNG) turns OFF. However, when using WNG, set parameter No. PD15 to PD18 to make it usable.			

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="2">Positioning mode</th></tr>
<tr><th>CP</th><th>CL</th></tr>
<tr><td>Servo-on</td><td>SON</td><td>CN1-4</td><td>When SON is turned on, the power is supplied to the base circuit and the controller is ready to operate (servo-on).
When SON is turned off, the power to the base circuit is shut off and the servo motor coasts.
Set parameter No. PD01 to " □□□4 " to switch this signal on (keep terminals connected) automatically in the controller.</td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Reset</td><td>RES</td><td></td><td>When RES is turned on for 50ms or longer, an alarm can be deactivated.
Some alarms cannot be deactivated by the reset (RES). Refer to section 8.1.
Turning RES on in an alarm-free status shuts off the base circuit. The base circuit is not shut off when " □□1□ " is set in parameter No. PD20.
This device is not designed to make a stop. Do not turn it ON during operation.</td><td>DI-1</td><td>△</td><td>△</td></tr>
<tr><td>Automatic /manual selection</td><td>MD0</td><td>CN1-3</td><td>Turning MD0 ON selects the automatic operation mode, and turning it OFF selects the manual operation mode.</td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Internal torque limit selection</td><td>TL1</td><td></td><td>The internal torque limit 2 (parameter No. PC14) becomes valid by turning TL1 on.
The forward torque limit (parameter No. PA11) and the reverse torque limit (parameter No. PA12) are always valid.
The smallest torque limit among the valid forward and reverse torque limits is the actual torque limit value.
<table>
<tr><th>(Note) Input device</th><th rowspan="2" colspan="3">Comparison between limit values</th><th colspan="2">Valid torque limit value</th></tr>
<tr><th>TL1</th><th>Forward rotation</th><th>Reverse rotation</th></tr>
<tr><td>0</td><td colspan="3"></td><td>Parameter No. PA11</td><td>Parameter No. PA12</td></tr>
<tr><td rowspan="2">1</td><td>Parameter No. PC14</td><td>></td><td>Parameter No. PA11
Parameter No. PA12</td><td>Parameter No. PA11</td><td>Parameter No. PA12</td></tr>
<tr><td>Parameter No. PC14</td><td><</td><td>Parameter No. PA11
Parameter No. PA12</td><td>Parameter No. PC14</td><td>Parameter No. PC14</td></tr>
</table>
Note. 0: off
1: on

Refer to section 3.6.1(4).</td><td>DI-1</td><td>△</td><td>△</td></tr>
</table>

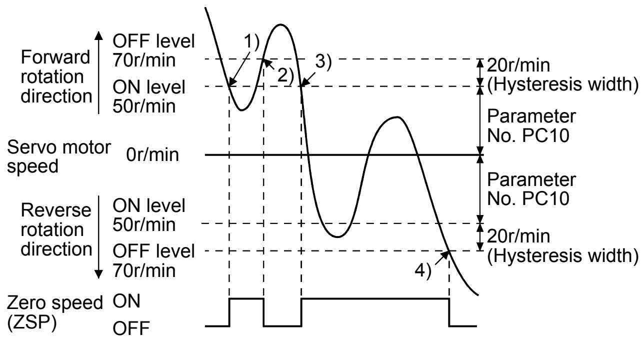
Temporary stop/Restart	TSTP		Turning TSTP ON during automatic operation makes a temporary stop. Turning TSTP ON again makes a restart. Forward rotation start (ST1) or Reverse rotation start (ST2) is ignored if it is turned ON during a temporary stop. When the automatic operation mode is changed to the manual operation mode during a temporary stop, the movement remaining distance is erased. During a home position return or during JOG operation, Temporary stop/ Restart input is ignored.	DI-1	△	△

Device	Symbol	Connector pin No.	Functions/Applications	I/O division	Positioning mode CP	Positioning mode CL
Proportion control	PC		When PC is turned on, the type of the speed loop switches 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 travel completion (MEND), switching on the proportion control (PC) upon travel completion (MEND) will suppress the unnecessary torque generated to compensate for a position shift. In case of locking the servo motor shaft for a long time, turn on the internal torque limit selection (TL1) simultaneously with the proportion control (PC). Then, set the internal torque limit 2 (parameter No. PC14) in order to make the torque lower than the rating.	DI-1	△	△
Forward rotation start	ST1	CN1-6	1. In absolute value command system Turning ST1 ON for automatic operation executes positioning once on the basis of the position data set to the point table. Turning ST1 ON for a home position return immediately starts a home position return. Keeping ST1 ON for JOG operation performs rotation in the forward rotation direction. Forward rotation indicates the address increasing direction. 2. In incremental value command system Turning ST1 ON for automatic operation executes positioning once in the forward rotation direction on the basis of the position data set to the point table. Turning ST1 ON for a home position return immediately starts a home position return. Keeping ST1 ON for JOG operation performs rotation in the forward rotation direction. Forward rotation indicates the address increasing direction.	DI-1	○	
Reverse rotation start	ST2	CN1-7	Use this device in the incremental value command system. Turning ST2 ON for automatic operation executes positioning once in the reverse rotation direction on the basis of the position data set to the point table. Keeping ST2 ON for JOG operation performs rotation in the reverse rotation direction. Reverse rotation indicates the address decreasing direction.	DI-1	○	
Forward rotation start	ST1	CN1-6	1. For automatic operation mode Turning ST1 ON executes the program operation selected in DI0 to DI2. 2. For JOG operation in manual operation mode Keeping ST1 ON performs rotation in the forward rotation direction. Forward rotation indicates the address increasing direction.	DI-1		○
Reverse rotation start	ST2	CN1-7	Keeping ST2 ON in JOG operation in manual operation mode performs rotation in the reverse rotation direction. Reverse rotation indicates the address decreasing direction. ST2 is invalid in other operation modes.	DI-1		○
Gain changing	CDP		The values of the load to motor inertia moment ratio and the gains are changed to the value set in parameter No. PB29 to PB34 by turning CDP on.	DI-1	△	△

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="2">Positioning mode</th></tr>
<tr><th>CP</th><th>CL</th></tr>
<tr><td>Point table No. /Program No. selection 1</td><td>DI0</td><td>CN1-5</td><td rowspan="3"><In point table method>
The point table No. and the home position return mode are selected by DI0 to DI2.
<In program method>
The program No. is selected by DI0 to DI2.
<table>
<tr><th colspan="3">(Note) Device</th><th colspan="2">Selection description</th></tr>
<tr><th>DI2</th><th>DI1</th><th>DI0</th><th>Point table method</th><th>Program method</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>Home position return mode</td><td>Program No. 1</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Point table No. 1</td><td>Program No. 2</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Point table No. 2</td><td>Program No. 3</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Point table No. 3</td><td>Program No. 4</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Point table No. 4</td><td>Program No. 5</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Point table No. 5</td><td>Program No. 6</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Point table No. 6</td><td>Program No. 7</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Point table No. 7</td><td>Program No. 8</td></tr>
</table>
Note. 0: off
1: on</td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Point table No. /Program No. selection 2</td><td>DI1</td><td>CN1-23</td><td>DI-1</td><td>○</td><td>○</td></tr>
<tr><td>Point table No. /Program No. selection 3</td><td>DI2</td><td></td><td>DI-1</td><td>△</td><td>△</td></tr>
<tr><td>Program input 1</td><td>PI1</td><td></td><td>Turn PI1 on to resume the step stopped by the SYNC (1) command in the program.</td><td>DI-1</td><td></td><td>△</td></tr>
</table>

(b) Output devices

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="2">Positioning mode</th></tr>
<tr><th>CP</th><th>CL</th></tr>
<tr><td>Trouble</td><td>ALM</td><td>CN1-9</td><td>ALM turns off when power is switched off or the protective circuit is activated to shut off the base circuit.
When there is no alarm, ALM turns on approximately 1s after power-on.</td><td>DO-1</td><td>○</td><td>○</td></tr>
<tr><td>Ready</td><td>RD</td><td>CN1-11</td><td>RD turns on when the servo motor is ready for the operation after turning on the servo-on (SON).</td><td>DO-1</td><td>○</td><td>○</td></tr>
<tr><td>In-position</td><td>INP</td><td>CN1-10</td><td>INP turns on when the number of droop pulses is in the preset in-position range. The in-position range can be changed using parameter No. PA10.
When the in-position range is increased, may be kept connected during low-speed rotation.
INP turns on when servo-on turns on.
If parameter No. PA04 is set to " □□ 1 " and the overload tough drive function is enabled, the INP ON time during the overload tough drive is delayed. The delay time can be limited by parameter No. PC26.</td><td>DO-1</td><td>○</td><td>○</td></tr>
<tr><td>Electromagnetic brake interlock</td><td>MBR</td><td>CN1-12</td><td>MBR turns off when the servo is switched off or an alarm occurs.
At an alarm occurrence, MBR turns off regardless of the base circuit status.</td><td>DO-1</td><td>○</td><td>○</td></tr>
<tr><td>Home position return completion</td><td>ZP</td><td></td><td>ZP turns ON when operation is ready to start, but turns OFF in any of the following cases.
1) Home position return has not been made.
2) While a home position return is being made.
When any of 1) or 2) has not occurred and a home position return is already completed at least once, Home position return completion (ZP) turns to the same output status as Ready (RD).</td><td>DO-1</td><td>△</td><td>△</td></tr>
</table>

Device	Symbol	Connector pin No.	Functions/Applications	I/O division	Positioning mode	
					CP	CL
Temporary stop	PUS		PUS turns ON when deceleration is started to make a stop by Temporary stop/Restart (TSTP). When Temporary stop/Restart (TSTP) is made valid again to resume operation, PUS turns OFF.	DO-1	△	△
Travel completion	MEND		MEND turns ON when In-position (INP) turns ON and the command remaining distance is "0". MEND turns ON when servo-on turns ON. If parameter No. PA04 is set to " □□ 1 " and the overload tough drive function is enabled, the INP ON time during the overload tough drive is delayed. ON time of MEND is also delayed interlocked with this.	DO-1	△	△
Rough match	CPO		CP0 turns ON when the command remaining distance becomes less than the rough match output range set in the parameter. CP0 is not output while the base circuit is off. CP0 turns ON at servo-on.	DO-1	△	
Zero speed	ZSP		ZSP turns on when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No. PC10. Example Zero speed is 50r/min  ZSP turns on 1) when the servo motor is decelerated to 50r/min, and ZSP turns off 2) when the servo motor is accelerated to 70r/min again. ZSP turns on 3) when the servo motor is decelerated again to 50r/min, and turns off 4) when the servo motor speed has reached -70r/min. The range from the point when the servo motor speed has reached ON level, and ZSP turns on, to the point when it is accelerated again and has reached OFF level is called hysteresis width. Hysteresis width is 20r/min for LECSA2-□ controller. If parameter No. PA04 is set to " □□ 1 " and the overload tough drive function is enabled, the ZSP ON time during the overload tough drive is delayed. The delay time can be limited by parameter No. PC26.	DO-1	△	△
Limiting torque	TLC		TLC turns ON when the generated torque reaches the value set to the forward torque limit (parameter No. PA11), the reverse torque limit (parameter No. PA12) or the internal torque limit 2 (parameter No. PC14). (Refer to section 3.6.1(4).)	DO-1	△	△
Warning	WNG		When a warning occurs, WNG turns on. When there is no warning, WNG turns off approximately 1s after power-on.	DO-1	△	△
During variable gain selection	CDPS		CDPS is on during gain changing.	DO-1	△	△

<table>
<tr><th rowspan="2">Device</th><th rowspan="2">Symbol</th><th rowspan="2">Connector pin No.</th><th rowspan="2">Functions/Applications</th><th rowspan="2">I/O division</th><th colspan="2">Positioning mode</th></tr>
<tr><th>CP</th><th>CL</th></tr>
<tr><td>During tough drive</td><td>MTTR</td><td></td><td>If the instantaneous power failure tough drive function selection is enabled, MTTR turns on when the instantaneous tough drive activates.
If parameter No.PD20 is set to "□1□□", MTTR also turns on when the overload tough drive activates.</td><td>DO-1</td><td>△</td><td>△</td></tr>
<tr><td>Position range</td><td>POT</td><td></td><td>POT turns ON when the actual current position falls within the range set in the parameter.
It is OFF when a home position return is not yet completed or while the base circuit is shut off.</td><td>DO-1</td><td>△</td><td>△</td></tr>
<tr><td>Point table No. output 1</td><td>PT0</td><td></td><td rowspan="3">As soon as travel completion (MEND) turns ON, the point table No. is output in 3-bit code.
<table><tr><th colspan="3">(Note) Device</th><th rowspan="2">Description</th></tr><tr><th>PT2</th><th>PT1</th><th>PT0</th></tr><tr><td>0</td><td>0</td><td>1</td><td>Point table No. 1</td></tr><tr><td>0</td><td>1</td><td>0</td><td>Point table No. 2</td></tr><tr><td>0</td><td>1</td><td>1</td><td>Point table No. 3</td></tr><tr><td>1</td><td>0</td><td>0</td><td>Point table No. 4</td></tr><tr><td>1</td><td>0</td><td>1</td><td>Point table No. 5</td></tr><tr><td>1</td><td>1</td><td>0</td><td>Point table No. 6</td></tr><tr><td>1</td><td>1</td><td>1</td><td>Point table No. 7</td></tr></table></td><td>DO-1</td><td>△</td><td></td></tr>
<tr><td>Point table No. output 2</td><td>PT1</td><td></td><td>DO-1</td><td>△</td><td></td></tr>
<tr><td>Point table No. output 3</td><td>PT2</td><td></td><td>DO-1</td><td>△</td><td></td></tr>
<tr><td>Program output 1</td><td>OUT1</td><td></td><td>OUT1 turns on when the OUTON (1) command in the program is given. OUT1 turns off when the OUTOF command is given.
By setting parameter No. PE14, the time to turn it off can be set.</td><td>DO-1</td><td></td><td>△</td></tr>
<tr><td>SYNC synchronous output</td><td>SOUT</td><td></td><td>Waiting for input of program SYNC (1).</td><td>DO-1</td><td></td><td>△</td></tr>
</table>

(3) Output signals

Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Positioning mode CP	Positioning mode CL
Encoder Z-phase pulse (Open collector)	OP	CN1-21	Outputs the zero-point signal of the encoder. One pulse is output per servo motor revolution. OP turns on when the zero-point position is reached. (Negative logic) The minimum pulse width is about 400μs. For home position return using this pulse, set the creep speed to 100r/min. or less.	DO-2	○	○
Encoder A-phase pulse (Differential line driver)	LA LAR	CN1-15 CN1-16	Outputs pulses per servo motor revolution set in parameter No. PA15 in the differential line driver system. In CCW rotation of the servo motor, the encoder B-phase pulse lags the encoder A-phase pulse by a phase angle of $\pi/2$. The relationships between rotation direction and phase difference of the A- and B-phase pulses can be changed using parameter No. PC13.	DO-2	○	○
Encoder B-phase pulse (Differential line driver)	LB LBR	CN1-17 CN1-18				
Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1-19 CN1-20	The same signal as OP is output in the differential line driver system.	DO-2	○	○

(4) Power supply

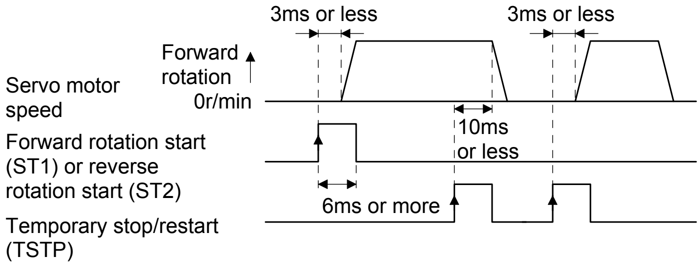
Signal	Symbol	Connector pin No.	Functions/Applications	I/O division	Positioning mode CP	Positioning mode CL
Digital I/F power supply input	DICOM	CN1-1	Used to input 24VDC (24VDC±10% 200mA) for I/O interface. The power supply capacity changes depending on the number of I/O interface points to be used. For a sink interface, connect the positive terminal of the 24VDC external power supply to DICOM. For a source interface, connect the negative terminal of the 24VDC external power supply to DICOM.		○	○
Open collector power input	OPC	CN1-2	When inputting a pulse train in the open-collector system, supply this terminal with the positive (+) power of 24VDC.		○	○
Digital I/F common	DOCOM	CN1-13	Common terminal for input signals such as SON and EM1. Separated from LG. For a sink interface, connect the negative terminal of the 24VDC external power supply to DOCOM. For a source interface, connect the positive terminal of the 24VDC external power supply to DOCOM.		○	○
Control common	LG	CN1-14	Common terminal for OP.		○	○
Shield	SD	Plate	Connect the external conductor of the shielded wire.		○	○

13.2.4 Detailed description of the signals

(1) Forward rotation start, reverse rotation start, temporary stop/restart

(a) A forward rotation start (ST1) or a reverse rotation start (ST2) should make the sequence which can be used after the main circuit has been established. These signals are invalid if it is switched on before the main circuit is established. Normally, it is interlocked with the ready (RD).

(b) A start in the controller is made when a forward rotation start (ST1) or a reverse rotation start (ST2) changes from OFF to ON. The delay time of the controller's internal processing is max. 3ms. The delay time of other devices is max. 10ms.



(c) When a programmable PC or PLC...etc is used, the ON time of a forward rotation start (ST1), a reverse rotation start (ST2) or temporary start/stop (TSTP) signal should be 6ms or longer to prevent a malfunction.

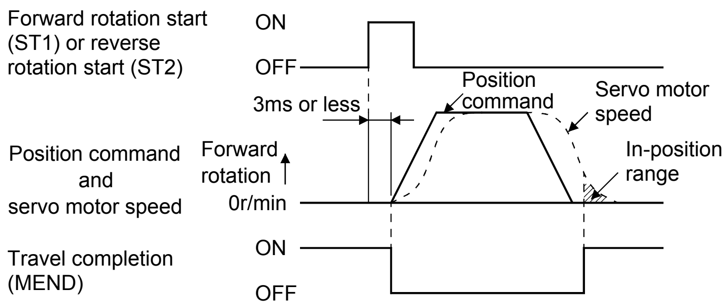
(d) During operation, the forward rotation start (ST1) or reverse rotation start (ST2) is not accepted. The next operation should always be started after the rough match (CPO) is output with the rough match output range set to "0" or after the travel completion (MEND) is output.

(2) Travel completion, rough match, in-position

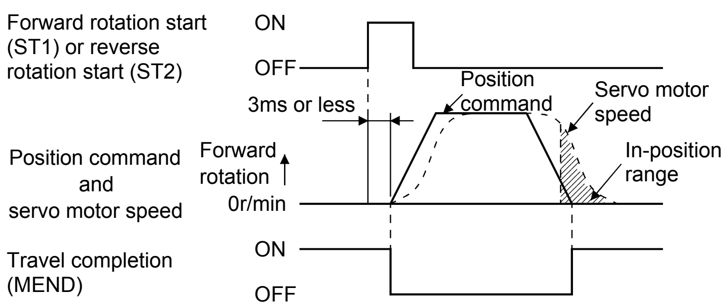
POINT
· If an alarm cause, etc. are removed and servo-on occurs after a stop is made by servo-off, alarm occurrence or forced stop (EM1) ON during automatic operation, travel completion (MEND), rough-match, (CPO) and in-position (INP) are turned on. To resume operation, confirm the current position and the selected point table No. and program No. for preventing unexpected operation.

(a) Travel completion

The following timing charts show the output timing relationships between the position command generated in the controller and the travel completion (MEND). This timing can be changed using parameter No. PA10 (in-position range). MEND turns ON in the servo-on status. MEND does not turn ON during automatic operation.



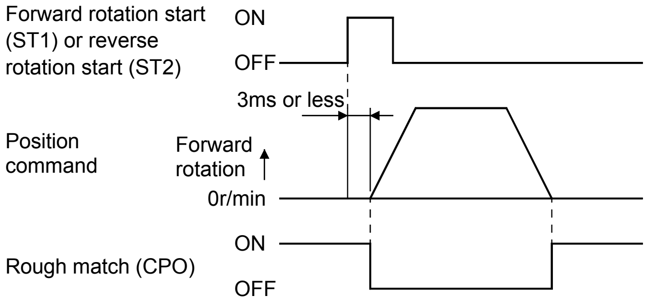
When parameter No. PA10 is small



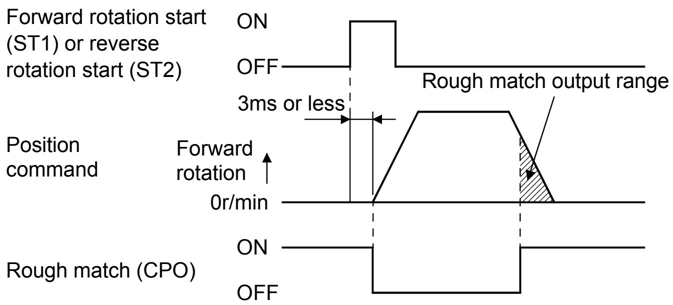
When parameter No. PA10 is large

(b) Rough match

The following timing charts show the relationships between the signal and the position command generated in the controller. This timing can be changed using parameter No. PE12 (rough match output range). CPO turns ON in the servo-on status. CPO does not turn ON during automatic operation.



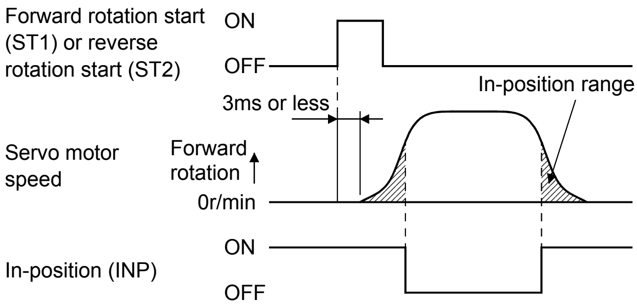
When parameter No. PE12 is set to "0"



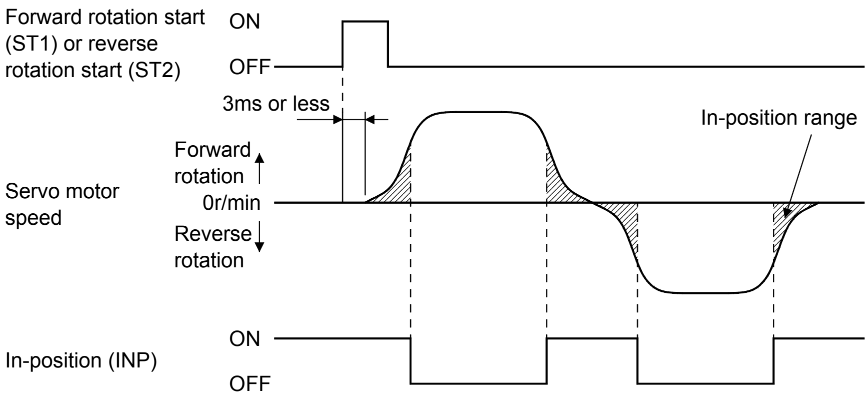
When parameter No. PE12 is set to more than "0"

(3) In-position

The following timing charts show the relationships between the signal and the feedback pulse of the servo motor. This timing can be changed using parameter No.PA10 (in-position range). INP turns ON in the servo-on status.



When positioning operation is performed once



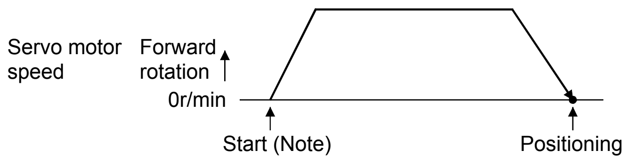
When servo motor reverses rotation direction during automatic continuous operation

13.3 Automatic operation mode for point table method

13.3.1 What is automatic operation mode?

(1) Concept of automatic operation

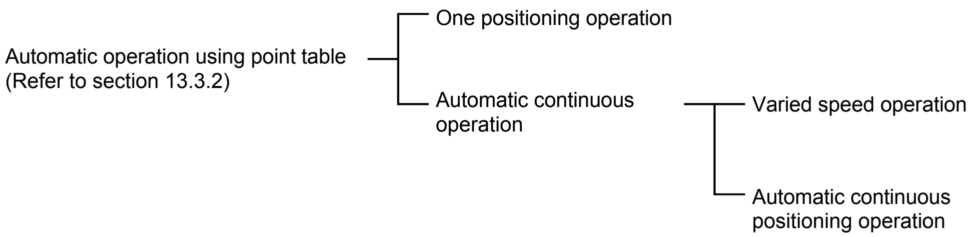
Automatic operation is a positioning function to automatically start and stop at a target position with one-time start signal. The data required for positioning is set in the point table.



Note. For the start, use the forward rotation start (ST1) or reverse rotation start (ST2).

(2) Automatic operation types

With this servo, the following automatic operations are available.



There are two types of command systems; the absolute value command system which requires specifying the positioning addresses to move to for each automatic operation and the incremental value command system which requires specifying the travel distance from the current position to the target position.

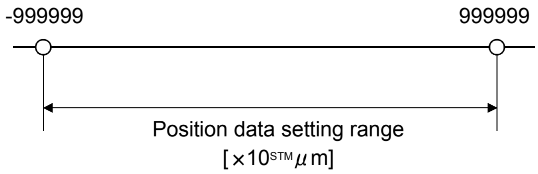
(3) Command system

Make selection with the input signals from among the point tables that have been set in advance, and perform operation with 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.

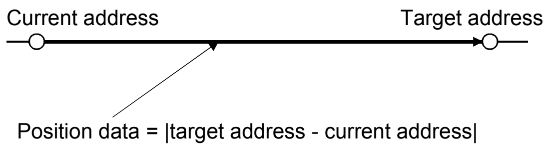
Setting range: -999999 to 999999 [×10^{STM}μm] (STM = feed length multiplication parameter No. PE02)



(b) Incremental value command system

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

Setting range: 0 to 999999 ×10^{STM}μm] (STM = feed length multiplication parameter No. PE02)



13.3.2 Automatic operation using point table

(1) One-time positioning operation

(a) Absolute value command system

1) Point table

Set the point table values by using MR Configurator or the operation section.
Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell and auxiliary function in the point table.
Setting "0" or "1" in the auxiliary function sets the point table to the absolute value command system.
Setting "2" or "3" in the auxiliary function sets the point table to the incremental value command system.

Item	Setting range	Unit	Description
Position data	-999999 to 999999	$\times 10^{STM}$μm	(1) When using this point table as absolute value command system, set the target address (absolute value). (2) When using this point table as incremental value command system, set the travel distance. A "-" sign indicates a reverse rotation command.
Servo motor speed	0 to permissible speed	r/min	Set the command speed 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 time until the servo motor reaches to the rated speed.
Deceleration time constant	0 to 20000	ms	Set the time until the servo motor stops from the rated speed.
Dwell	0 to 20000	ms	When dwell is set and the set dwell has passed after the position command of the selected point table is completed, the position command of the next point table is started. Set "0" in the auxiliary function to make the dwell invalid. Set "1" in the auxiliary function and 0 in the dwell to perform varied speed operation.
Auxiliary function	0 to 3		(1) When using this point table in the absolute value command system 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. (2) When using this point table in the incremental value command system 2: Automatic operation is performed in accordance with a single point table chosen. 3: Operation is performed in accordance with consecutive point tables without a stop. When a different rotation direction is set, smoothing zero (command output) is confirmed and the rotation direction is then reversed. Setting "1" in point table No. 7 results in an error. (Refer to paragraph (2) of this section.)

2) Parameter setting

Set the following parameters to perform automatic operation.

Select the absolute value command system with parameter No. PE01 (Command mode selection).

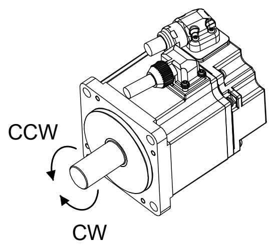
Parameter No. PE01

			0

Absolute value command system (initial value)

By using parameter No. PA14 (Rotation direction selection), select servo motor rotation direction at the time when the forward rotation start (ST1) turns ON.

Parameter No. PA14 setting	Servo motor rotation direction when forward rotation start (ST1) turns on
0	CCW rotation with + position data CW rotation with - position data
1	CW rotation with + position data CCW rotation with - position data



Set the feed length multiplication (STM) of position data in parameter No. PE02 (Feeding function selection).

Parameter No. PE02 setting	Feed unit [μm]	Position data input range [mm]
□□□0	1	-999.999 to +999.999
□□□1	10	-9999.99 to +9999.99
□□□2	100	-99999.9 to +99999.9
□□□3	1000	-999999 to +999999

3) Operation

Choosing the point table using DI0 to DI2 and turning ST1 ON starts positioning to the position data at the preset speed, acceleration time constant and deceleration time constant. At this time, reverse rotation start (ST2) is invalid.

Item	Device/Parameter used	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
Point table selection	Point table No./Program No. selection 1 (DI0) Point table No./Program No. selection 2 (DI1) Point table No./Program No. selection 3 (DI2)	Refer to the text.
Start	Forward rotation start (ST1)	Turn ST1 ON to start.

Select a point table using the point table No./program No. selection 1 (DI0) to point table No./program No. selection 3 (DI2) as shown in the following table.

Input device			Selected point table No.
DI2	DI1	DI0	
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

(b) Incremental value command system

1) Point table

Set the point table values by using MR Configurator or the operation section.

Set the position data, servo motor speed, acceleration time constant, deceleration time constant, dwell and auxiliary function in the point table.

Item	Setting range	Unit	Description
Position data	0 to 999999	$\times 10^{STM}$μm	Set the travel distance. The unit can be changed using feed length multiplication selection of parameter No. PE02.
Servo motor speed	0 to permissible speed	r/min	Set the command speed 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 time until the servo motor reaches to the rated speed.
Deceleration time constant	0 to 20000	ms	Set the time until stops from the rated speed.
Dwell	0 to 20000	ms	When dwell is set and the set dwell has passed after the position command of the selected point table is completed, the position command of the next point table is started. Set "0" in the auxiliary function to make the dwell invalid. Set "1" in the auxiliary function and 0 in the dwell to perform varied speed operation.
Auxiliary function	0, 1		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 zero (command output) is confirmed and the rotation direction is then reversed. Setting "1" in point table No. 7 results in an error. (Refer to (2) in this section.)

2) Parameter setting

Set the following parameters to perform automatic operation.

Select the incremental value command system with parameter No. PE01 (command mode selection) as shown below.

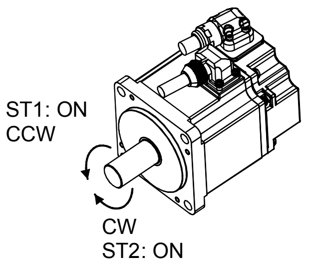
Parameter No. PE01

			1

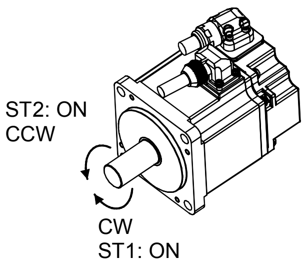
Incremental value command system

By using parameter No. PA14 (Rotation direction selection), select servo motor rotation direction at the time when the forward rotation start (ST1) or reverse rotation start (ST2) is turns ON.

Parameter No. PA14 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)



Parameter No. PA14: 0



Parameter No. PA14: 1

Set the feed length multiplication (STM) of position data with parameter No. PE02 (Feeding function selection).

Parameter No. PE02 setting	Feed unit [μm]	Position data input range [mm]
□□□0	1	0 to +999.999
□□□1	10	0 to +9999.99
□□□2	100	0 to +99999.9
□□□3	1000	0 to +999999

3) Operation

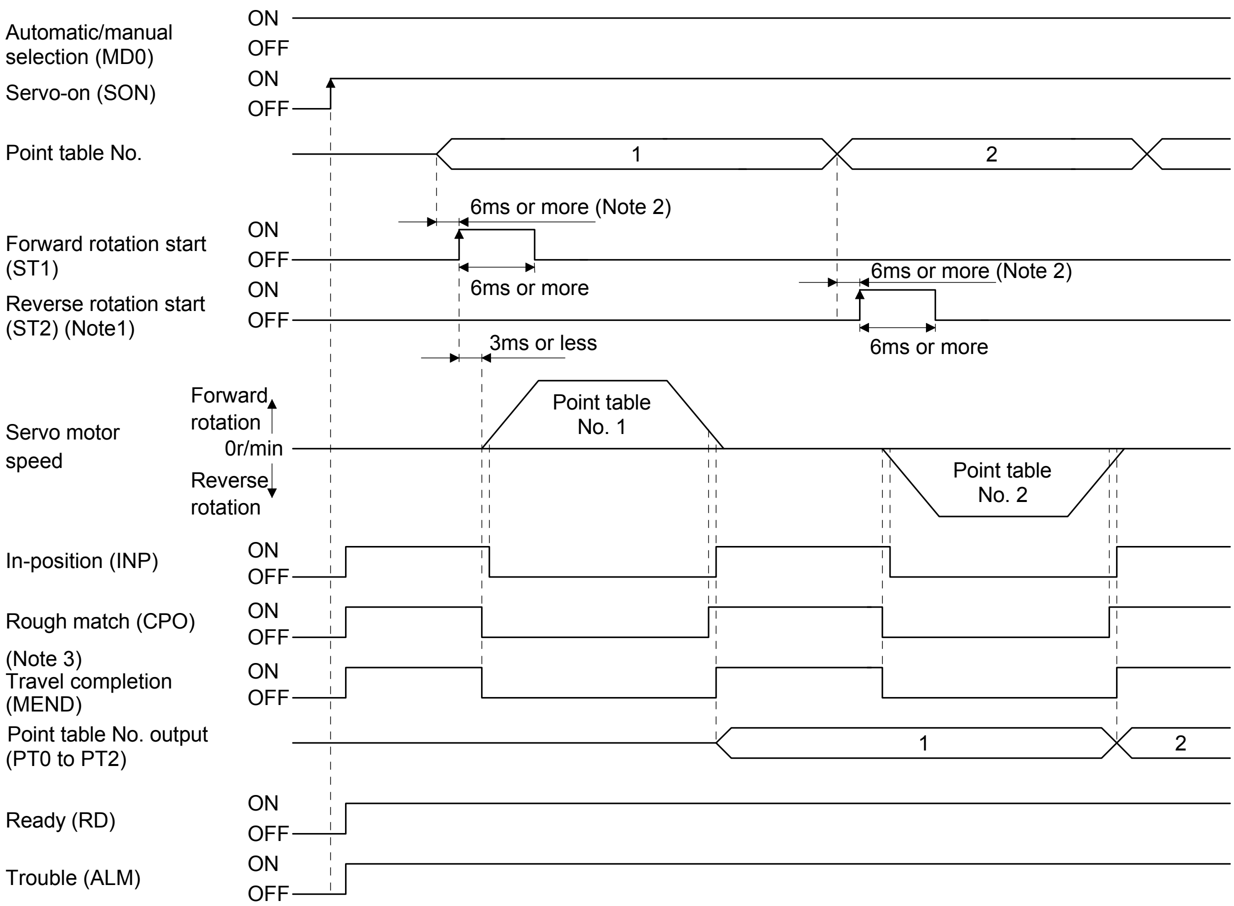
Choosing the point table using DI0 to DI2 and turning ST1 ON starts a motion in the forward rotation direction over the travel distance of the position data at the preset speed and acceleration time constant.

Turning ST2 ON starts a motion in the reverse rotation direction according to the values set to the selected point table.

Item	Device/Parameter used	Description
Automatic operation mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
Point table selection	Point table No./Program No. selection 1 (DI0) Point table No./Program No. selection 2 (DI1) Point table No./Program No. selection 3 (DI2)	Refer to (1) (a) 3) in this section.
Start	Forward rotation start (ST1) Reverse rotation start (ST2)	Turn ST1 ON to start motion in forward rotation direction. Turn ST2 ON to start motion in reverse rotation direction.

(c) Automatic operation timing chart

The timing chart is shown below.



Note 1. Reverse rotation start (ST2) is invalid in the absolute value command system.

2. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes the point table selection ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

3. If the over load tough drive function is enabled by setting parameter No. PA04 to "□□ 1", INP turn-on delays during the overload tough drive. MEND turn-on also delays together with INP.

(2) Automatic continuous operation

(a) What is Automatic continuous operation?

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

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

Either type may be selected as follows.

1) In absolute value command system

Automatic continuous operation
- Varied speed operation
- Automatic continuous positioning operation

Point table setting		
Dwell	Auxiliary function	
	When position data is in absolute value	When position data is in incremental value
0	1	3
1 or more	1	3

2) In incremental value command system

Automatic continuous operation
- Varied speed operation
- Automatic continuous positioning operation

Point table setting	
Dwell	Auxiliary function
0	1
1 or more	1

(b) Varied speed operation

When "1" or "3" is set to the auxiliary function in the point tables up to No.6, varied speed operation can be performed at a maximum of 7 speeds. Set "0" to the auxiliary function in the last point table.

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

The following table gives a setting example.

Point table No.	Dwell [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" or "2" to the auxiliary function in the last point table among the consecutive point tables.

1) Absolute value command system

This system is an auxiliary function for point tables to perform automatic continuous operation by specifying the absolute value command or incremental value command.

・Positioning in single direction

The operation pattern given below assumes that the setting values are as indicated in the following table. Here, the point table No.1 uses the absolute value command system, the point table No.2 the incremental value command system, the point table No.3 the absolute value command system, and the point table No.4 the incremental value command system.

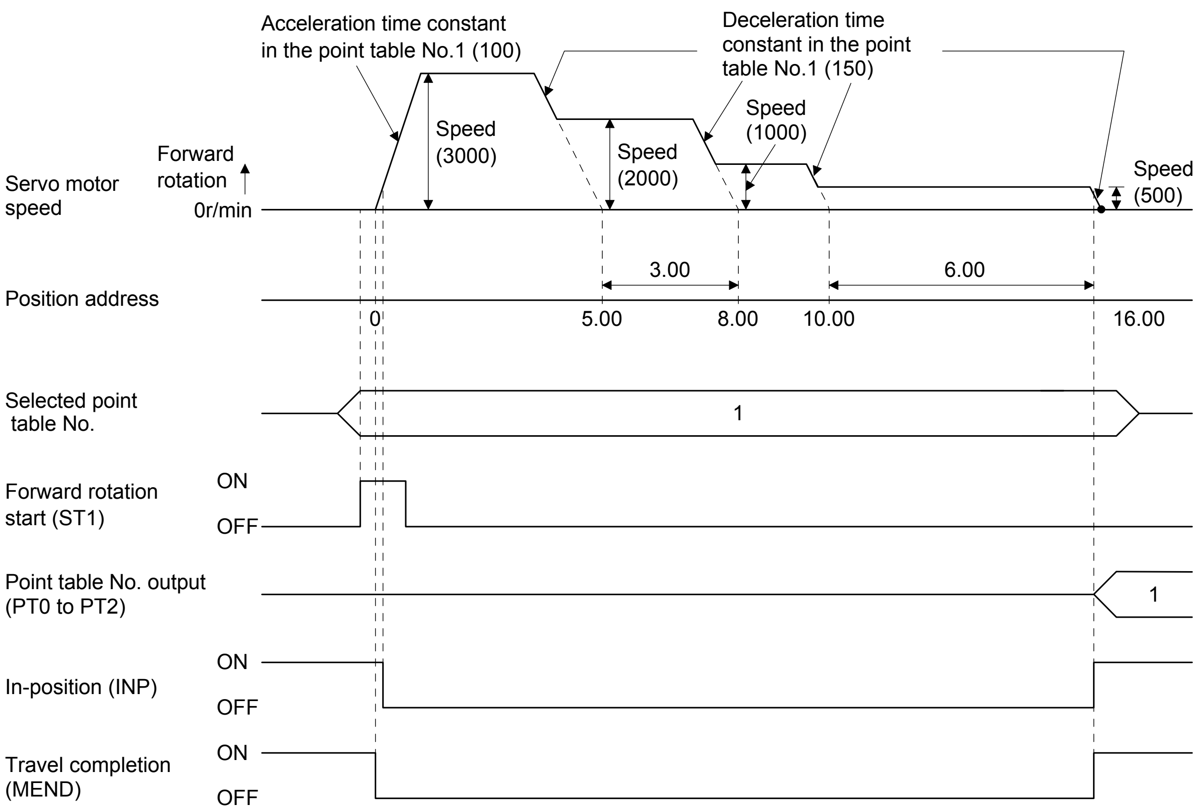
Point table No.	Position data [×10^{STM}μm]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	(Note 1) Dwell [ms]	Auxiliary function
1	5.00	3000	100	150	0	1
2	3.00	2000	Invalid	Invalid	0	3
3	10.00	1000	Invalid	Invalid	0	1
4	6.00	500	Invalid	Invalid	0	2 (Note 2)

Note 1. Always set "0".

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

0: When point table is used in absolute value command system

2: When point table is used in incremental value command system



· Positioning that reverses the direction midway

The operation pattern given below assumes that the setting values are as indicated in the following table. Here, the point table No.1 uses the absolute value command system, the point table No.2 the incremental value command system, and the point table No.3 the absolute value system.

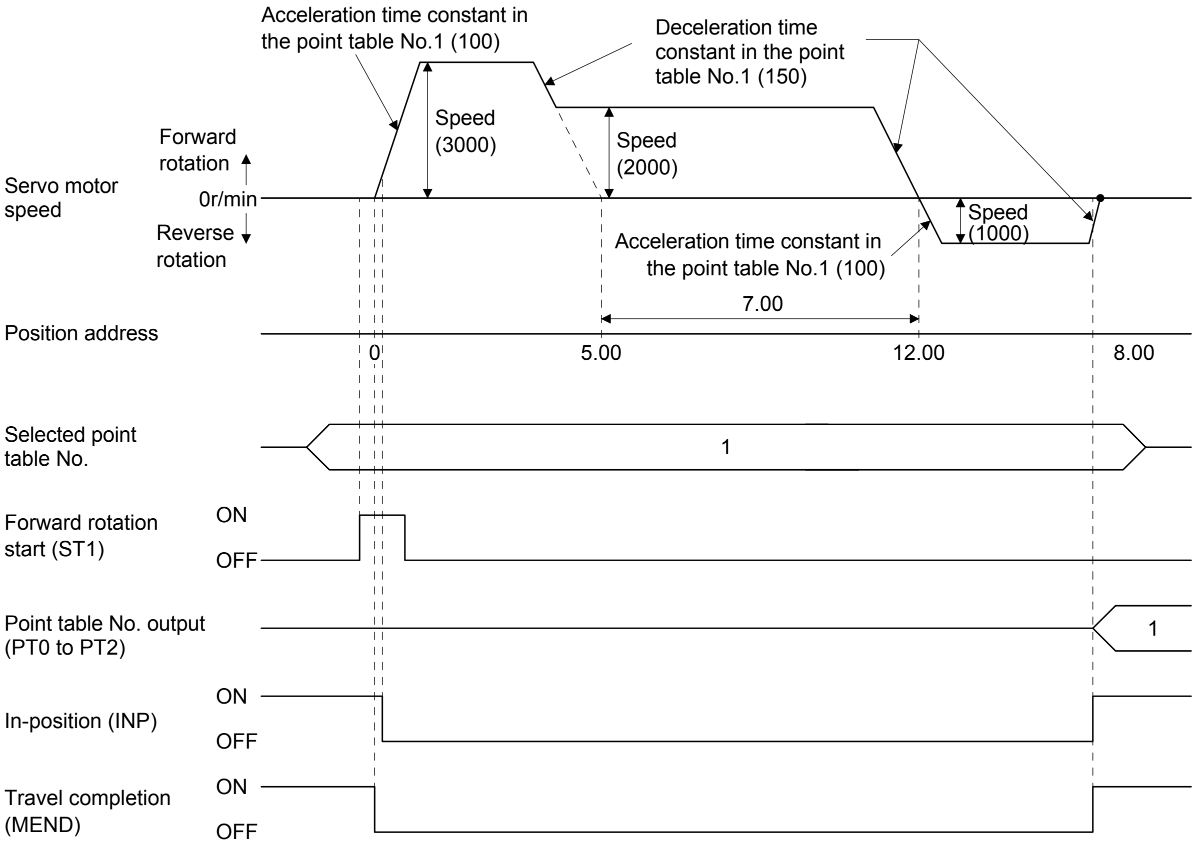
Point table No.	Position data [×10^{STM}μm]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	(Note 1) Dwell [ms]	Auxiliary function
1	5.00	3000	100	150	0	1
2	7.00	2000	Invalid	Invalid	0	3
3	8.00	1000	Invalid	Invalid	0	0 (Note 2)

Note 1. Always set "0".

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

0: When point table is used in absolute value command system

2: When point table is used in incremental value command system



2) Incremental value command system

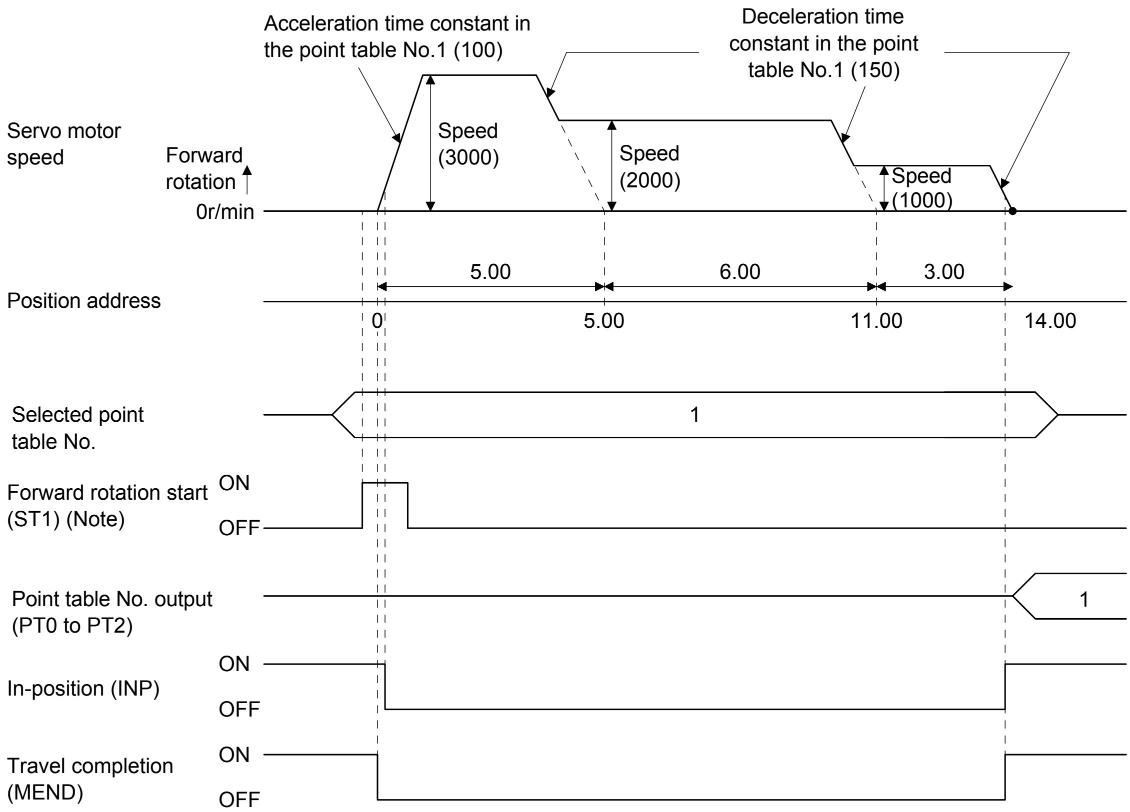
The position data of the incremental value command system is the sum of the position data of the consecutive point tables.

The operation pattern given below assumes that the setting values are as indicated in the following table.

Point table No.	Position data [×10^{STM}μm]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	(Note 1) Dwell [ms]	Auxiliary function
1	5.00	3000	100	150	0	1
2	6.00	2000	Invalid	Invalid	0	1
3	3.00	1000	Invalid	Invalid	0	0 (Note 2)

Note 1. Always set "0".

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



Note. Turning on reverse rotation start (ST2) starts positioning in the reverse rotation direction.

(c) Automatic continuous positioning operation

When "1" or "3" is set to the auxiliary function in the point table, positioning of the next point table No. is executed continuously.

When "1" or "3" is set to the auxiliary function in the point tables up to No.6, a maximum of 7 points of automatic continuous positionings are possible. Set "0" to the auxiliary function in the last point table.

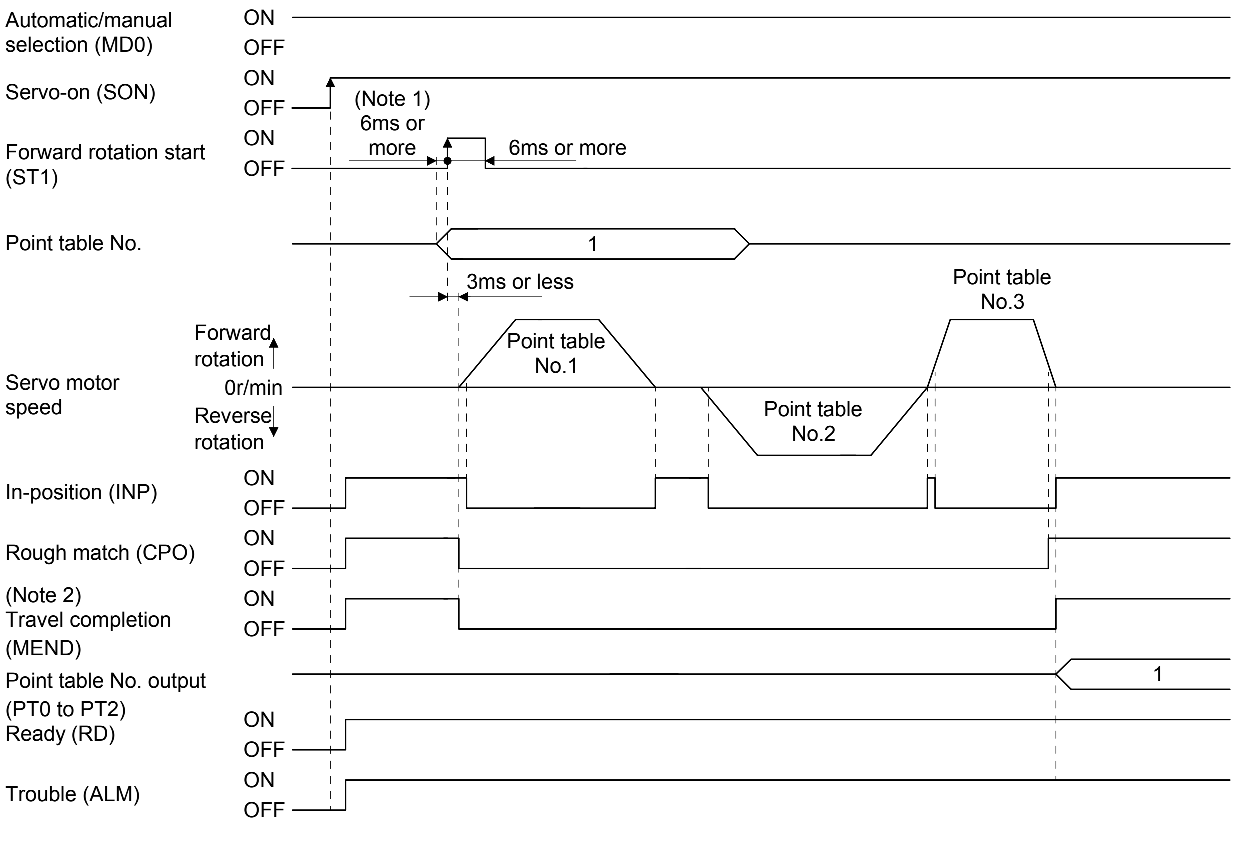
As an example, the operation in the absolute value command system is shown using the set values in the following table. Here, the point table No.1 uses the absolute value command system, the point table No.2 the incremental value command system, and the point table No.3 the absolute value command system.

Point table No.	Position data [×10^{STM}μm]	Servo motor speed [r/min]	Acceleration time constant [ms]	Deceleration time constant [ms]	Dwell [ms]	Auxiliary function
1	5.00	3000	100	150	100	1
2	-6.00	2000	100	100	0	3
3	3.00	3000	50	50	0	0 (Note)

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

0: When point table is used in absolute value command system

2: When point table is used in incremental value command system



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes the point table selection ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. If the over load tough drive function is enabled by setting parameter No. PA04 to "□□ 1", INP turn-on delays during the overload tough drive. MEND turn-on also delays together with INP. However, MEND does not turn ON during automatic continuous positioning operation.

(3) Temporary stop/restart during automatic operation

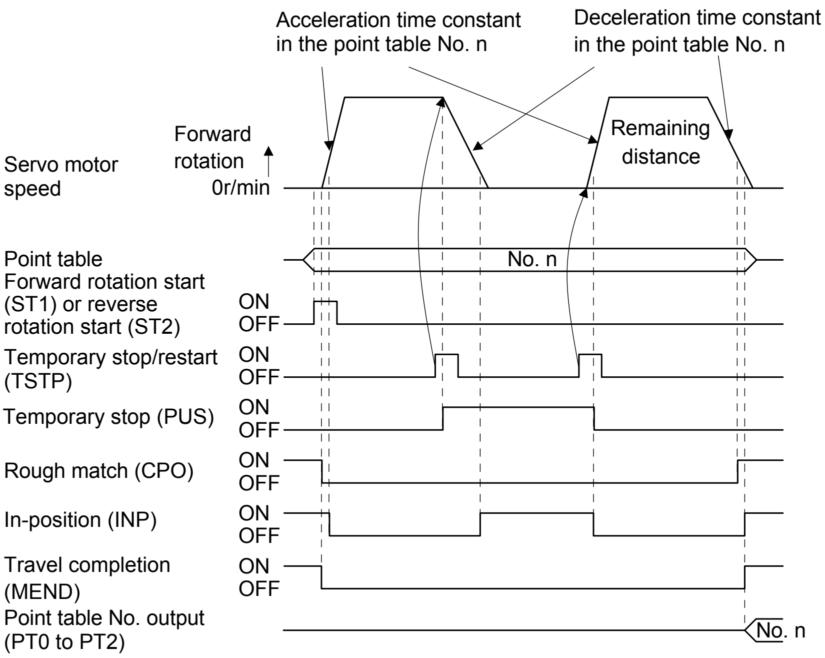
When TSTP is turned ON during automatic operation, the motor is decelerated to a temporary stop at the deceleration time constant in the point table being executed. When TSTP is turned ON again, the remaining distance is executed.

Forward rotation start (ST1) or reverse rotation start (ST2) is ignored if it is turned ON during a temporary stop.

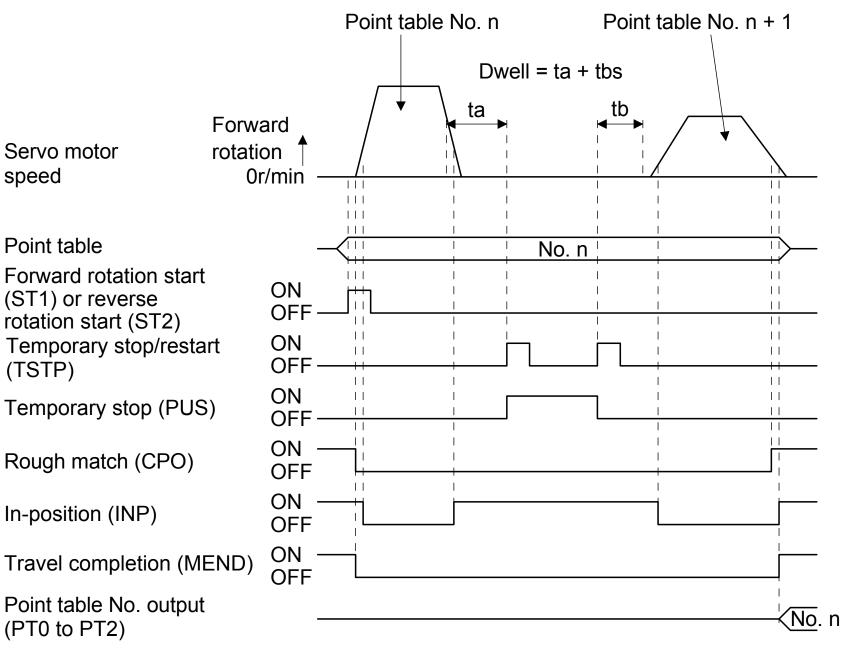
The remaining moving distance is cleared when the operation mode is changed from the automatic mode to the manual mode during a temporary stop.

The temporary stop/restart input is ignored during a home position return or during JOG operation.

(a) When the servo motor is rotating



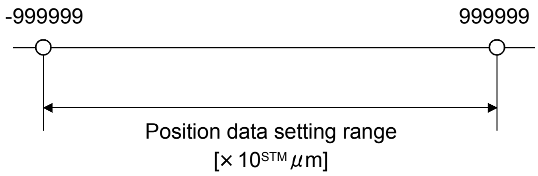
(b) During dwell



13.4 Automatic operation mode for program method

13.4.1 What is automatic operation mode for program method?

Make selection with the input signals from among the programs that have been created in advance using MR Configurator, and perform operation with Forward rotation start (ST1).
This controller is factory-set to the absolute value command system.
As the position data, the absolute move command ("MOV" command) used to specify the target address or the incremental move command ("MOVI" command) used to specify the travel distance can be set. Note that the movable range is -999999 to 999999 [$\times 10^{STM}$μm]. Positioning is enabled within this range.
Setting range: -999999 to 999999 [$\times 10^{STM}$μm] (STM = feed length multiplication parameter No. PE02)



13.4.2 Programming language

The maximum number of program steps is 120. Though up to 8 programs can be created, the total number of each program steps is up to 120.
The set program can be selected using point table No./program No. selection 1 (DI0) to point table No./program No. selection 3 (DI2).

(1) Command list

Command	Name	Setting	Setting range	Unit	Indirect addressing	Description
SPN (Note 2)	Speed (Motor speed)	SPN (Setting value)	0 to instantaneous permissible speed	r/min	○	Used to set the command speed of the servo motor for positioning. The set value should be equal to or less than the instantaneous permissible speed of the servo motor.
STA (Note 2)	Acceleration time constant	STA (Setting value)	0 to 20000	ms	○	Used to set the acceleration time constant. The set value is the time in which the servo motor reaches the rated speed from a stop. It cannot be changed during command output.
STB (Note 2)	Deceleration time constant	STB (Setting value)	0 to 20000	ms	○	Used to set the deceleration time constant. The set value is the time in which the servo motor stops from the rated speed. It cannot be changed during command output.
STC (Note 2)	Acceleration/ deceleration time constant	STC (Setting value)	0 to 20000	ms	○	Used to set the acceleration/deceleration time constants. The set value is the time in which the servo motor reaches the rated speed from a stop or stops from the rated speed. When this command is used, the acceleration time constant and deceleration time constant are equal. "STA" and "STB" commands can set the acceleration time constant and deceleration time constant individually. It cannot be changed during command output.
STD (Note 2, 5)	S-pattern acceleration/deceleration time constant	STD (Setting value)	0 to 100	ms	○	Used to set the S-pattern acceleration/deceleration time constant. Set this command when inserting an S-pattern acceleration/deceleration time constant for the acceleration/deceleration time constant of the program.
MOV	Absolute move command	MOV (Setting value)	-999999 to 999999	$\times 10^{STM}$ μm	○	The set value is regarded as an absolute value for movement.
MOVA	Absolute continuous move command	MOVA (Setting value)	-999999 to 999999	$\times 10^{STM}$ μm	○	The set value is regarded as an absolute value for continuous movement. Always use this command with the "MOV" command.
MOVI	Incremental move command	MOVI (Setting value)	-999999 to 999999	$\times 10^{STM}$ μm	○	The set value is regarded as an incremental value for movement.
MOVIA	Incremental continuous move command	MOVIA (Setting value)	-999999 to 999999	$\times 10^{STM}$ μm	○	The set value is regarded as an incremental value for movement. Always use this command with the "MOVI" command.

Command	Name	Setting	Setting range	Unit	Indirect addressing	Description
SYNC (Note 1)	Waiting external signal to switch on	SYNC (Setting value)	1			Stops the next step until program input 1 (PI1) turns ON after the output of SYNC synchronous output (SOUT).
OUTON (Note 1, 3)	External signal ON output	OUTON (Setting value)	1			Turns ON program output 1 (OUT1). By setting the ON time with parameter No. PE14, the signal can also be turned OFF in the preset time.
OUTOF (Note 1)	External signal OFF output	OUTOF (Setting value)	1			Turns OFF program output 1 (OUT1) to that has been turned ON by the "OUTON" command.
TRIP (Note 1)	Absolute trip point	TRIP (Setting value)	-999999 to 999999	$\times 10^{STM}$μm		When the trip point is reached, the next step will be executed.
TRIPI (Note 1)	Incremental trip point	TRIPI (Setting value)	-999999 to 999999	$\times 10^{STM}$μm		Executes the next step when the travel distance set to the "TRIPI" command is traveled from when "MOVI" and "MOVIA" started during the movement executed by the "MOV" and "MOVIA" commands. The command should be programmed after "MOVI" and "MOVIA" command, otherwise program error occurs.
ITP (Note 1, 4)	Interrupt positioning command	ITP (Setting value)	0 to 999999	$\times 10^{STM}$μm		Makes a stop using the interrupt signal when the preset travel distance is reached. Use this command in combination with the "SYNC" command, and describe it after "SYNC". An error will occur if this command is described after any other command.
COUNT (Note 1)	External pulse counter	COUNT (Setting value)	-999999 to 999999	pulse		Executes the next step when the pulse counter value becomes greater than the count value set to the "COUNT" command. "COUNT (0)" clears the pulse counter.
FOR NEXT	Step repeat command	FOR (Setting value) NEXT	0, 1 to 10000	times		Repeats the steps located between the "FOR (setting value)" command and "NEXT" command by the preset number of times. Set "0" to select endless repetition.
TIM	Dwell command time	TIM (Setting value)	1 to 20000	ms	○	Holds the next step until the preset time elapses.
ZRT	Zeroing	ZRT				Executes a home position return.
TIMES	Program repeat command	TIMES (Setting value)	0, 1 to 10000	times	○	Place the "TIMES (setting value)" command at the beginning of the program and set the number of program execution times. When executing the program only once, this setting is not required. Set "0" to select endless repetition.
STOP	Program end	STOP				Stops the executing program. Always describe this command on the last line.

Note 1. "SYNC", "OUTON", "OUTOF", "TRIP", "TRIPI", "COUNT" and "ITP" commands are available to be validated during command outputting.
2. The "SPN" command is valid when the "MOV", "MOVA", "MOVI" or "MOVIA" command is executed. The "STA", "STB", "STC" and "STD" commands are valid when the "MOV" or "MOVI" command is executed.
3. When the ON time has been set in parameter No. PE14, the next command is executed after the preset time has elapsed.
4. The remaining moving distance by "ITP" command is lower than setting value, the command would be ignored and skip to the next program command.
5. S-pattern acceleration/deceleration time constant of this command is valid during the time from this command start to the program end. For other than that, S-pattern acceleration/deceleration time constant of parameter No. PC03 is valid.

(2) Detailed description of commands

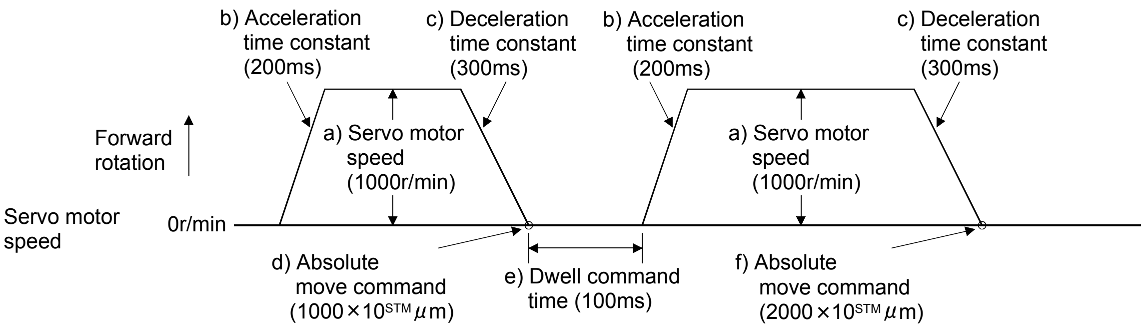
(a) Positioning conditions (SPN, STA, STB, STC, STD)

The "SPN", "STA", "STB", "STC" and "STD" commands are valid when the "MOV" and "MOVA" commands are executed. The set values remain valid until they are reset.

1) Program example 1

When operation is to be performed in two patterns that have the same servo motor speed, acceleration time constant and deceleration time constant but different move commands.

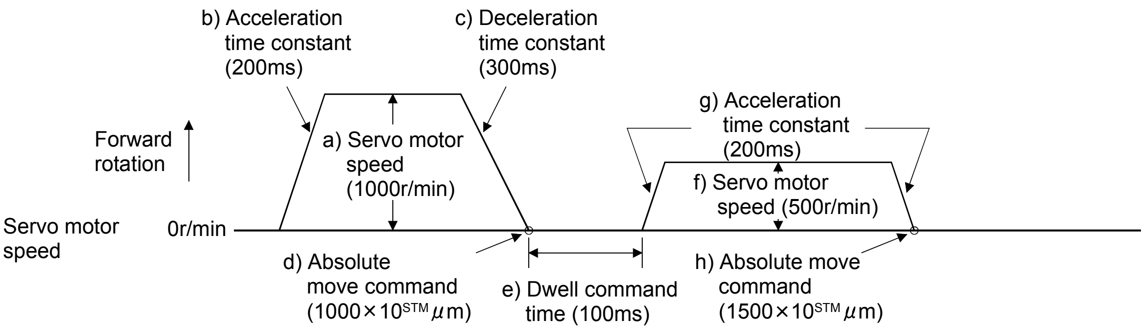
Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	a)
STA(200)	Acceleration time constant	200[ms]	b)
STB(300)	Deceleration time constant	300[ms]	c)
MOV(1000)	Absolute move command	1000[×10^{STM}μm]	d)
TIM(100)	Dwell command time	100[ms]	e)
MOV(2000)	Absolute move command	2000[×10^{STM}μm]	f)
STOP	Program end		



2) Program example 2

When operation is to be performed in two patterns that have different servo motor speeds, acceleration time constants, deceleration time constants and move commands.

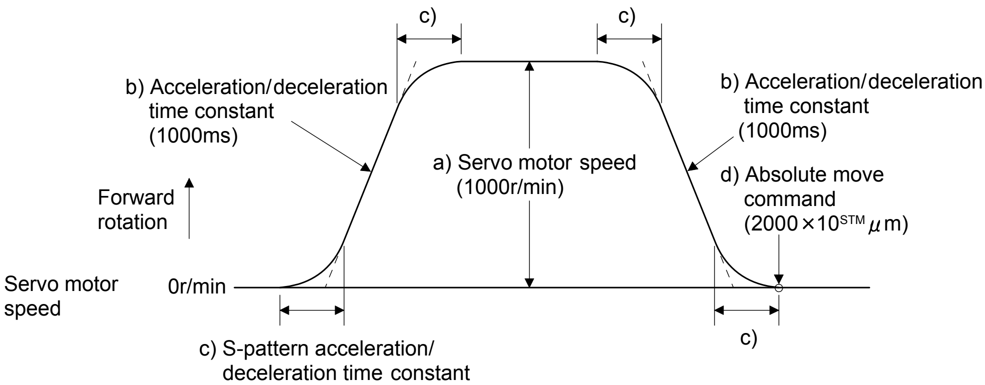
Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	a)
STA(200)	Acceleration time constant	200[ms]	b)
STB(300)	Deceleration time constant	300[ms]	c)
MOV(1000)	Absolute move command	1000[×10^{STM}μm]	d)
TIM(100)	Dwell command time	100[ms]	e)
SPN(500)	Speed (Motor Speed)	500[r/min]	f)
STC(200)	Acceleration/deceleration time constant	200[ms]	g)
MOV(1500)	Absolute move command	1500[×10^{STM}μm]	h)
STOP	Program end		



3) Program example 3

Use of an S-pattern acceleration/deceleration time constant allows sudden operation to be eased at the time of acceleration/deceleration. When the "STD" command is used, parameter No. PC03 (S-pattern acceleration/deceleration time constant) is ignored.

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	a)
STC(100)	Acceleration/deceleration time constant	1000[ms]	b)
STD(10)	S-pattern acceleration/deceleration time constant	10[ms]	c)
MOV(2000)	Absolute move command	2000[×10^{STM}μm]	d)
STOP	Program end		



(b) Continuous move command (MOVA, MOVIA)

POINT

- "MOV" cannot be used with "MOVIA", and "MOVI" cannot be used with "MOVA".

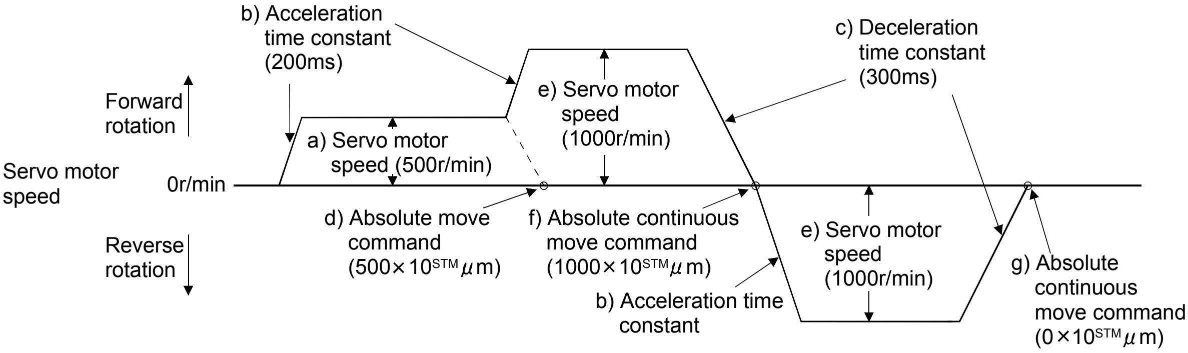
The "MOVA" command is a continuous move command for the "MOV" command. After execution of the movement by the "MOV" command, the movement of the "MOVA" command can be executed continuously without a stop.
The speed changing point of the "MOVA" command is the deceleration starting position of the operation performed by the preceding "MOV" and "MOVA" commands.
The acceleration/deceleration time constant of the "MOVA" command is the value at execution of the preceding "MOV" command.
The "MOVIA" command is a continuous move command for the "MOVI" command. After execution of the movement by the "MOVI" command, the movement of the "MOVIA" command can be executed continuously without a stop.
The speed changing point of the "MOVIA" command is the deceleration starting position of the operation performed by the preceding "MOVI" and "MOVIA" commands.
The acceleration/deceleration time constant of the "MOVIA" command is the value at execution of the preceding "MOVI" command.

Command	Name	Setting	Unit	Description
MOV	Absolute move command	MOV (Setting value)	×10^{STM}μm	Absolute move command
MOVA	Absolute continuous move command	MOVA (Setting value)	×10^{STM}μm	Absolute continuous move command
MOVI	Incremental move command	MOVI (Setting value)	×10^{STM}μm	Incremental move command
MOVIA	Incremental continuous move command	MOVIA (Setting value)	×10^{STM}μm	Incremental continuous move command

1) Program example 1

For the absolute move command in the absolute value command system

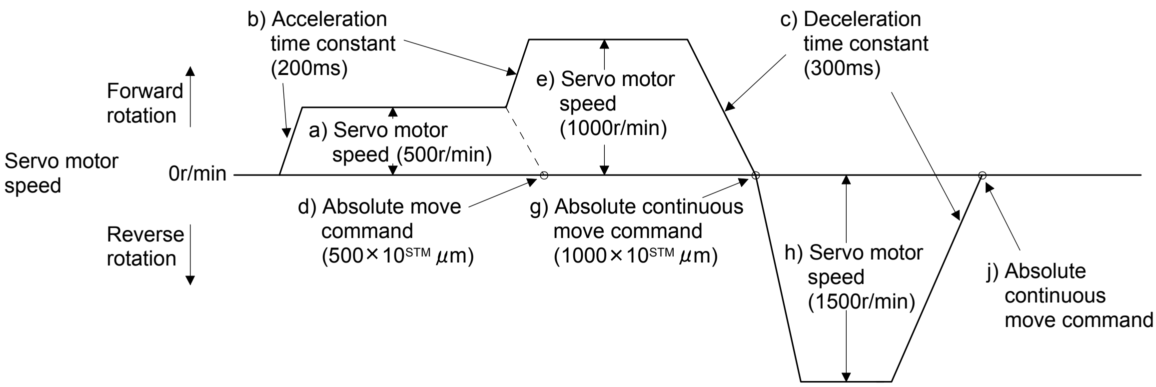
Program	Description		
SPN(500)	Speed (Motor speed)	500[r/min]	a)
STA(200)	Acceleration time constant	200[ms]	b)
STB(300)	Deceleration time constant	300[ms]	c)
MOV(500)	Absolute move command	500[$\times 10^{STM}$μm]	d)
SPN(1000)	Speed (Motor speed)	1000[r/min]	e)
MOVA(1000)	Absolute continuous move command	1000[$\times 10^{STM}$μm]	f)
MOVA(0)	Absolute continuous move command	0[$\times 10^{STM}$μm]	g)
STOP	Program end		



2) Program example 2 (Wrong usage)

In continuous operation, the acceleration or deceleration time constant cannot be changed at each speed change. Hence, the "STA", "STB" or "STD" command is ignored if it is inserted for a speed change.

Program	Description			
SPN(500)	Speed (Motor speed)	500[r/min]	a)	
STA(200)	Acceleration time constant	200[ms]	b)	
STB(300)	Deceleration time constant	300[ms]	c)	
MOV(500)	Absolute move command	500[$\times 10^{STM}$μm]	d)	
SPN(1000)	Speed (Motor speed)	1000[r/min]	e)	
STC(500)	Acceleration/deceleration time constant	500[ms]	f)	Ignored.
MOVA(1000)	Absolute continuous move command	1000[$\times 10^{STM}$μm]	g)	
SPN(1500)	Speed (Motor speed)	1500[r/min]	h)	
STC(100)	Acceleration/deceleration time constant	100[ms]	i)	Ignored.
MOVA(0)	Absolute continuous move command	0[$\times 10^{STM}$μm]	j)	
STOP	Program end			

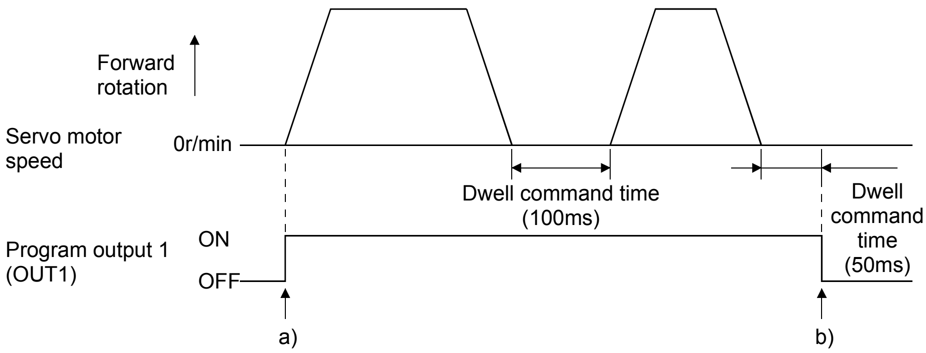


(c) Input/output command (OUTON, OUTOF), trip point command (TRIP, TRIPI)

1) Program example 1

As soon as the program is executed, program output 1 (OUT1) is turned ON. When the program ends, program output 1 (OUT1) turns OFF.

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOV(500)	Absolute move command	500[×10^{STM}μm]	
OUTON(1)	Program output 1 (OUT 1) is turned ON.		a)
TIM(100)	Dwell command time	100[ms]	
MOV(250)	Absolute move command	250[×10^{STM}μm]	
TIM(50)	Dwell command time	50[ms]	
STOP	Program end		b)

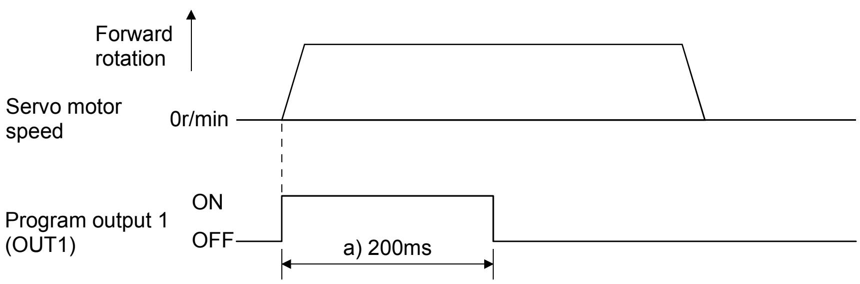


2) Program example 2

Using parameter No. PE14, program output 1 (OUT1) can be turned off automatically.

Parameter No.	Name	Setting	Description
PE14	OUT1 output time selection	200	OUT1 is turned off in 200 [ms]. a)

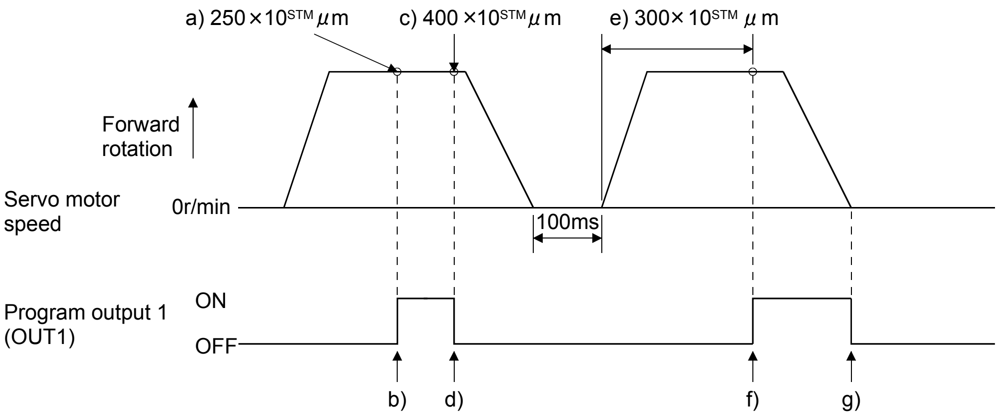
Program	Description	
SPN(500)	Speed (Motor speed)	500[r/min]
STA(200)	Acceleration time constant	200[ms]
STB(300)	Deceleration time constant	300[ms]
MOV(1000)	Absolute move command	1000[×10^{STM}μm]
OUTON(1)	Program output 1 (OUT 1) is turned ON.	
STOP	Program end	



3) Program example 3

When the "TRIP" and "TRIPI" commands are used to set the position addresses where the "OUTON" and "OUTOF" commands will be executed.

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOV(500)	Absolute move command	500[×10^{STM}μm]	
TRIP(250)	Absolute trip point	250[×10^{STM}μm]	a)
OUTON(1)	Program output 1 (OUT 1) is turned ON.		b)
TRIP(400)	Absolute trip point	400[×10^{STM}μm]	c)
OUTOF(1)	Program output 1 (OUT 1) is turned OFF.		d)
TIM(100)	Dwell command time	100[ms]	
MOVI(500)	Incremental move command	500[×10^{STM}μm]	
TRIPI(300)	Incremental trip point	300[×10^{STM}μm]	e)
OUTON(1)	Program output 1 (OUT 1) is turned ON.		f)
STOP	Program end		g)

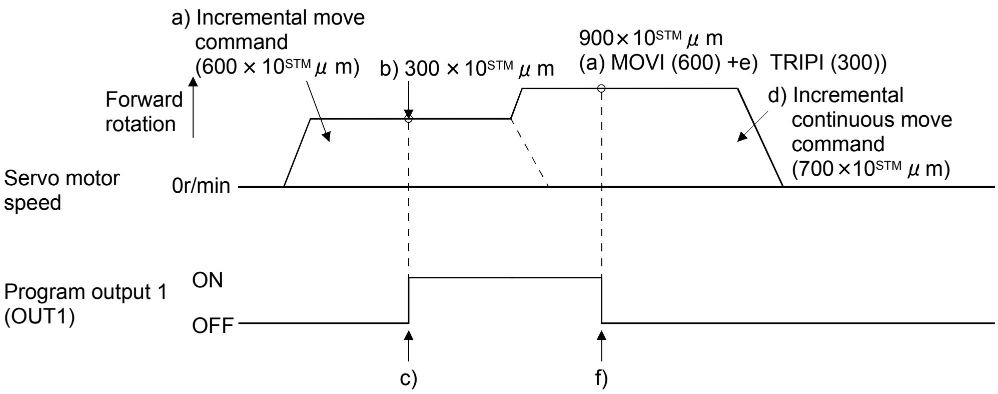


4) Program example 4

POINT
· "MOV" cannot be used with "TRIPI".

Note that the "TRIP" and "TRIPI" commands do not execute the next step unless the axis passes the preset address or travels the preset travel distance.

Program	Description		
SPN(500)	Speed (Motor speed)	500[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOVI(600)	Incremental move command	600[$\times 10^{STM}$μm]	a)
TRIPI(300)	Incremental trip point	300[$\times 10^{STM}$μm]	b)
OUTON(1)	Program output 1 (OUT 1) is turned ON.		c)
SPN(700)	Speed (Motor speed)	700[r/min]	
MOVIA(700)	Incremental continuous move command	700[$\times 10^{STM}$μm]	d)
TRIPI(300)	Incremental trip point	300[$\times 10^{STM}$μm]	e)
OUTOF(1)	Program output 1 (OUT 1) is turned OFF.		f)
STOP	Program end		



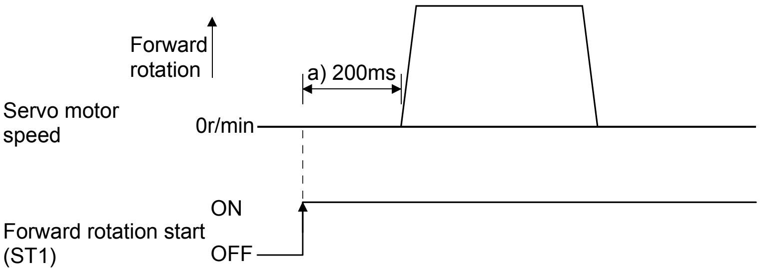
(d) Dwell (TIM)

To the "TIM (setting value)" command, set the time from when the command remaining distance is "0" until the next step is executed.

For reference, the following examples show the operations performed when this command is used with the other commands.

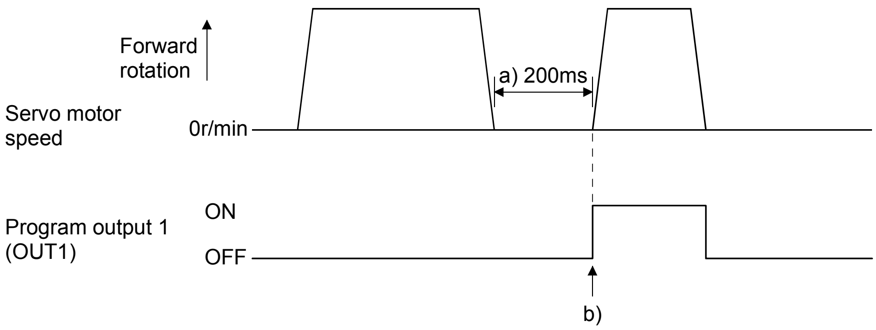
1) Program example 1

Program	Description		
TIM(200)	Dwell command time	200[ms]	a)
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOV(1000)	Absolute move command	1000[$\times 10^{STM}$μm]	
STOP	Program end		



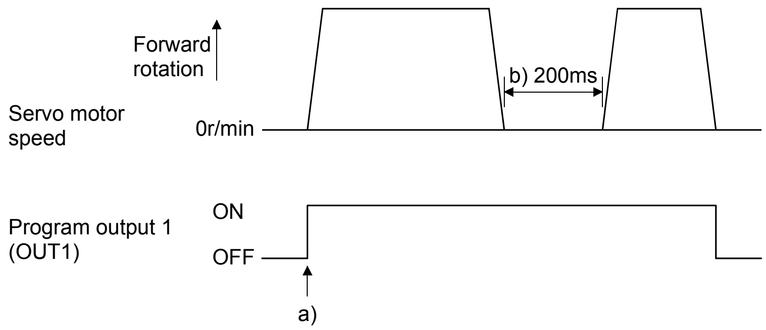
2) Program example 2

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[$\times 10^{STM}$μm]	
TIM(200)	Dwell command time	200[ms]	a)
OUTON(1)	Program output 1 (OUT 1) is turned ON.		b)
MOVI(500)	Incremental move command	500[$\times 10^{STM}$μm]	
STOP	Program end		



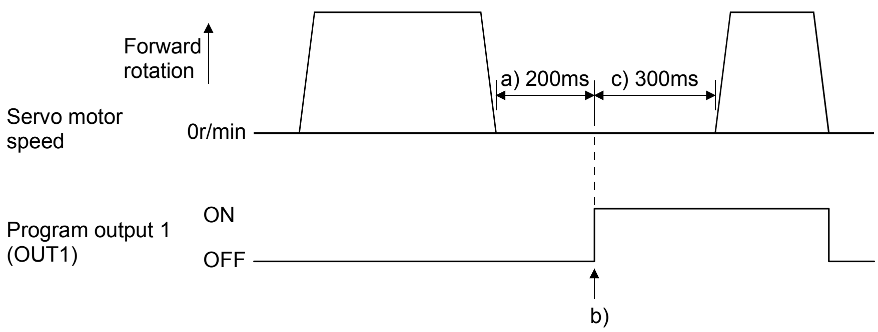
3) Program example 3

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[×10^{STM}μm]	
OUTON(1)	Program output 1 (OUT 1) is turned ON.		a)
TIM(200)	Dwell command time	200[ms]	b)
MOVI(500)	Incremental move command	500[×10^{STM}μm]	
STOP	Program end		



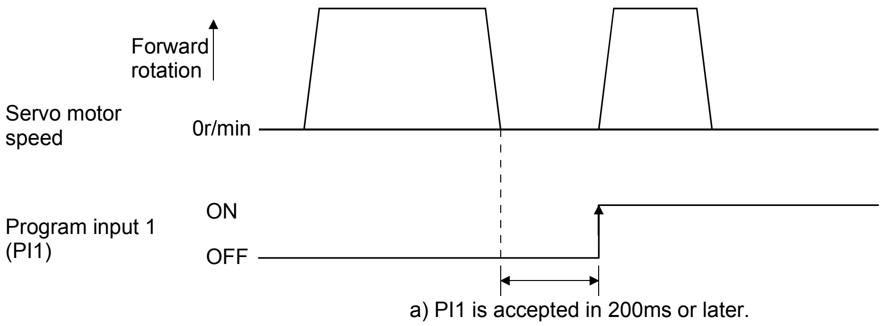
4) Program example 4

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[×10^{STM}μm]	
TIM(200)	Dwell command time	200[ms]	a)
OUTON(1)	Program output 1 (OUT 1) is turned ON.		b)
TIM(300)	Dwell command time	300[ms]	c)
MOVI(500)	Incremental move command	500[×10^{STM}μm]	
STOP	Program end		



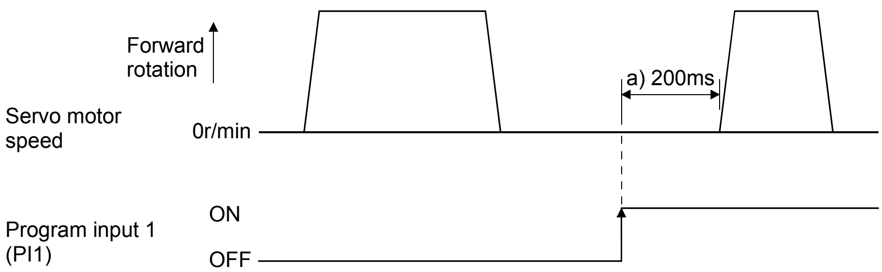
5) Program example 5

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[$\times 10^{STM}$μm]	
TIM(200)	Dwell command time	200[ms]	a)
SYNC(1)	Step is suspended until program input (PI1) turns ON.		
MOVI(500)	Incremental move command	500[$\times 10^{STM}$μm]	
STOP	Program end		



6) Program example 6

Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[$\times 10^{STM}$μm]	
SYNC(1)	Step is suspended until program input (PI1) turns ON.		
TIM(200)	Dwell command time	200[ms]	a)
MOVI(500)	Incremental move command	500[$\times 10^{STM}$μm]	
STOP	Program end		



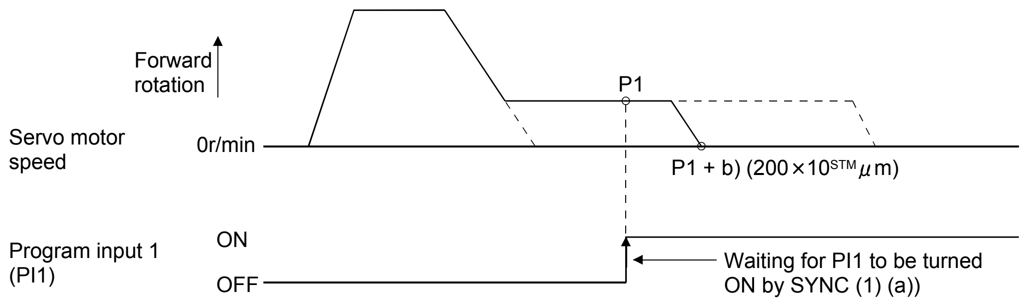
(e) Interrupt positioning command (ITP)

POINT
・When interrupt positioning command (ITP) is used for positioning, a stop position differs depending on the servo motor speed provided when the "ITP" command is enabled.

When the "ITP" command is used in a program, the axis stops at the position by the set value farther from the position where any of program input 1 (PI1) turned ON.
If the move command set with the "MOV", "MOVI", "MOVA" or "MOVIA" command is less than the setting value of the "ITP (setting value)" command, the program proceeds to the next step without executing the "ITP (setting value)" command.
When using the "ITP" command, always place the "SYNC" command immediately before the "ITP" command.

1) Program example 1

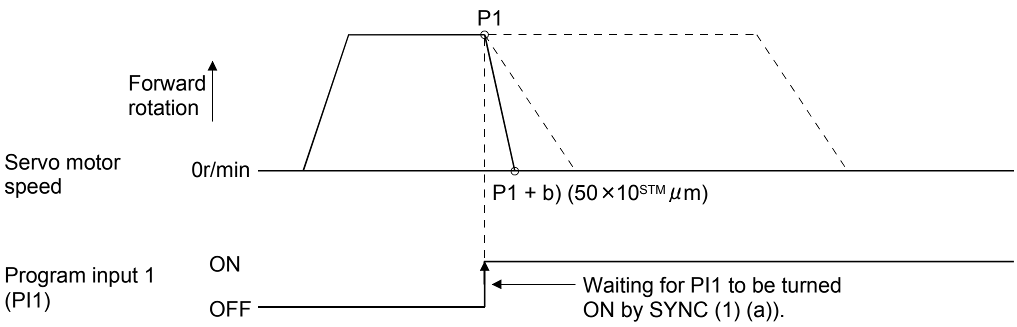
Program	Description		
SPN(500)	Speed (Motor speed)	500[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOV(600)	Absolute move command	600[×10^{STM}μm]	
SPN(100)	Speed (Motor speed)	100[r/min]	
MOVA(600)	Continuous move command	600[×10^{STM}μm]	
SYNC(1)	Step is suspended until program input (PI1) turns ON.		a)
ITP(200)	Interrupt positioning command	200[×10^{STM}μm]	b)
STOP	Program end		



2) Program example 2

If the travel distance of the "ITP" command is less than the travel distance necessary for deceleration, the actual deceleration time constant becomes less than the set value of the "STB" command.

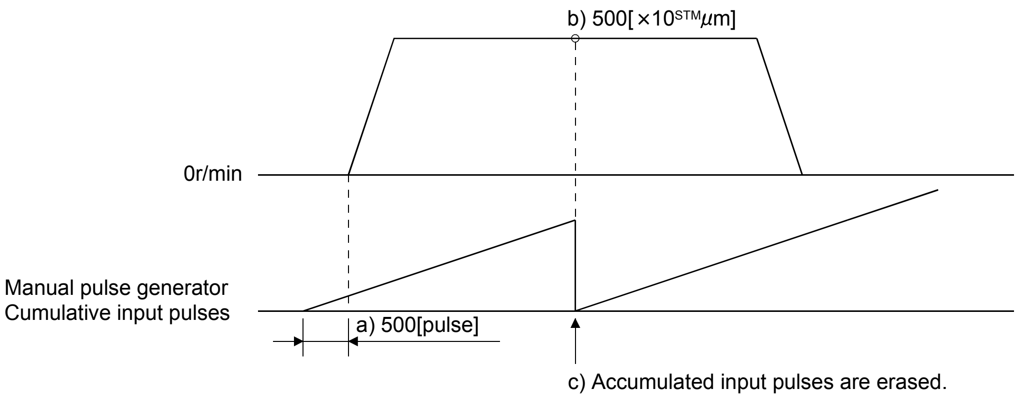
Program	Description		
SPN(500)	Speed (Motor speed)	500[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOV(1000)	Absolute move command	1000[×10^{STM}μm]	
SYNC(1)	Step is suspended until program input (PI1) turns ON.		a)
ITP(50)	Interrupt positioning command	50[×10^{STM}μm]	b)
STOP	Program end		



(f) External pulse counter (COUNT)

When the number of input pulses of the manual pulse generator becomes greater than the value set with the "COUNT" command, the next step is started. Set "0" to erase the accumulated input pulses.

Program	Description		
COUNT(500)	The next step is held until the number of input pulses of the manual pulse generator reaches 500 [pulses].		a)
SPN(500)	Speed (Motor speed)	500[r/min]	
STA(200)	Acceleration time constant	200[ms]	
STB(300)	Deceleration time constant	300[ms]	
MOV(1000)	Absolute move command	1000[×10^{STM}μm]	
TRIP(500)	Trip point	500[×10^{STM}μm]	b)
COUNT(0)	Cumulative input pulses are cleared.		c)
STOP	Program end		

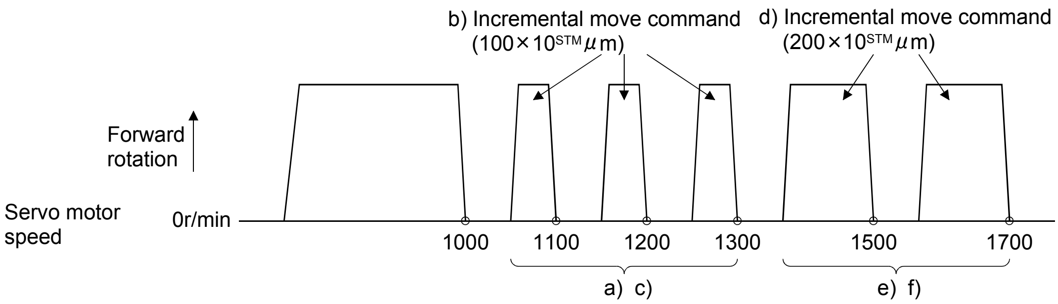


(g) Step repeat command (FOR ... NEXT)

POINT
・"FOR ... NEXT" cannot be placed within "FOR ... NEXT".

The steps located between the "FOR (setting value)" command and "NEXT" command is repeated by the preset number of times.

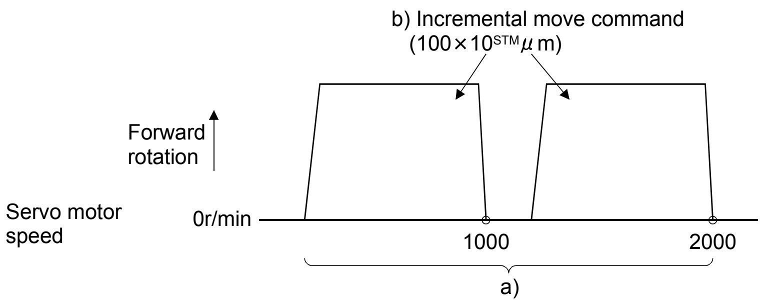
Program	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOV(1000)	Absolute move command	1000[$\times 10^{STM}$μm]	
TIM(100)	Dwell command time	100[ms]	
FOR(3)	Step repeat command start	3 [times]	a)
MOVI(100)	Incremental move command	100[$\times 10^{STM}$μm]	b)
TIM(100)	Dwell command time	100[ms]	
NEXT	Step repeat command end		c)
FOR(2)	Step repeat command start	2 [times]	d)
MOVI(200)	Incremental move command	200[$\times 10^{STM}$μm]	e)
TIM(100)	Dwell command time	100[ms]	
NEXT	Step repeat command end		f)
STOP	Program end		



(h) Program repeat command (TIMES)

By setting the number of times to the "TIMES (setting value)" command placed at the beginning of a program, the program can be executed repeatedly. When the program is to be executed once, the "TIMES (setting value)" command is not necessary. Set "0" to select endless repetition.

Program	Description		
TIMES(2)	Program repeat command	2 [times]	a)
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(20)	Acceleration/deceleration time constant	20[ms]	
MOVI(1000)	Incremental move command	1000[$\times 10^{STM}$μm]	b)
TIM(100)	Dwell command time	100[ms]	
STOP	Program end		



13.4.3 Basic setting of signals and parameters

Create programs in advance using MR Configurator. (Refer to sections 13.4.2, and 13.9.)

(1) Parameter

(a) Command mode selection (parameter No. PE01)

Make sure that the absolute value command system has been selected as shown below.

Parameter No. PE01

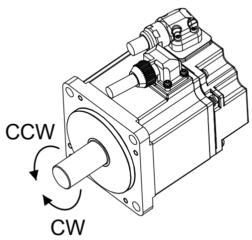
| | | | 0 |

Absolute value command system (initial value)

(b) ST1 coordinate system selection (parameter No. PA14)

Select the servo motor rotation direction at the time when the forward rotation start (ST1) turns ON.

Parameter No. PA14 setting	Servo motor rotation direction when forward rotation start (ST1) is turned on
□□□0 (initial value)	CCW rotation with + position data CW rotation with - position data
□□□1	CW rotation with + position data CCW rotation with - position data



(c) Feed length multiplication (parameter No. PE02)

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

Parameter No. PE02 setting	Position data input range [mm]
□□□0 (initial value)	-999.999 to +999.999
□□□1	-9999.99 to +9999.99
□□□2	-99999.9 to +99999.9
□□□3	-999999 to +999999

(2) Signals

Choosing the program using DI0 to DI2 and turning ON ST1 performs positioning operation according to the set program. At this time, reverse rotation start (ST2) is invalid.

Item	Setting method	Description
Selection of program operation mode	Automatic/manual selection (MD0)	Turn MD0 ON.
Program selection	Point table No./Program No. selection 1 (DI0) Point table No./Program No. selection 2 (DI1) Point table No./Program No. selection 3 (DI2)	Refer to section 13.2.3.(1).
Start	Forward rotation start (ST1)	Turn ON ST1 to start the program operation

13.4.4 Program operation timing chart

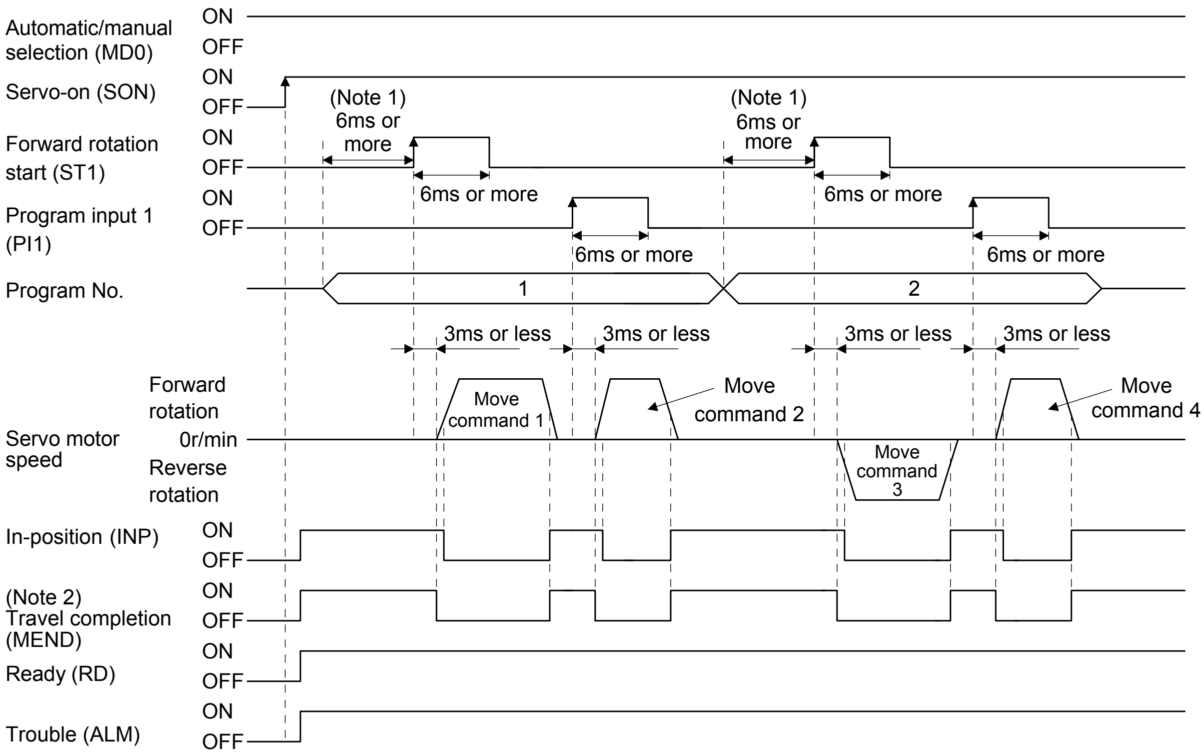
(1) Operation conditions

The timing chart shown below assumes that the following program is executed in the absolute value command system where a home position return is completed.

Program No. 1	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(100)	Acceleration/deceleration time constant	100[ms]	
MOV(5000)	Absolute move command	5000[×10^{STM}μm]	Move command 1
SYNC(1)	Step is suspended until program input (PI1) turns ON.		
STC(50)	Acceleration/deceleration time constant	50[ms]	
MOV(7500)	Absolute move command	7500[×10^{STM}μm]	Move command 2
STOP	Program end		

Program No. 2	Description		
SPN(1000)	Speed (Motor speed)	1000[r/min]	
STC(100)	Acceleration/deceleration time constant	100[ms]	
MOV(2500)	Absolute move command	2500[×10^{STM}μm]	Move command 3
SYNC(1)	Step is suspended until program input (PI1) turns ON.		
STC(50)	Acceleration/deceleration time constant	50[ms]	
MOV(5000)	Absolute move command	5000[×10^{STM}μm]	Move command 4
STOP	Program end		

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes the program selection ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. If the over load tough drive function is enabled by setting parameter No. PA04 to "□□1", INP turn-on delays during the overload tough drive. MEND turn-on also delays together with INP.

13.5 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.

13.5.1 JOG operation

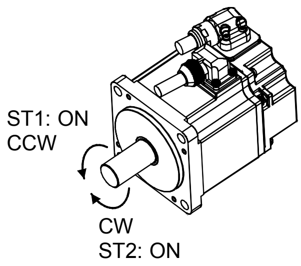
(1) Setting

Set the input device and parameters as follows according to the purpose of use. In this case, the point table No./program No. selection 1 to 3 (DI0 to DI2) are invalid.

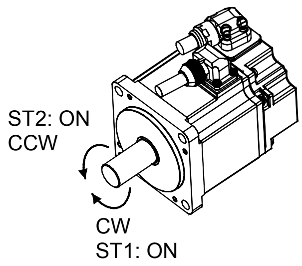
Item	Device/Parameter used	Description
Manual operation mode selection	Automatic/manual selection (MD0)	Turn MD0 OFF.
Servo motor rotation direction	Parameter No. PA14	Refer to (2) in this section.
JOG speed	Parameter No. PE13	Set the speed of the servo motor.
Acceleration/deceleration time constant	Parameter No. PE07	Set the acceleration/deceleration time constants.
S-pattern acceleration/deceleration time constant	Parameter No. PC03	Set the S-pattern acceleration/deceleration time constant.

(2) Servo motor rotation direction

Parameter No. PA14 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



Parameter No. PA14: 0

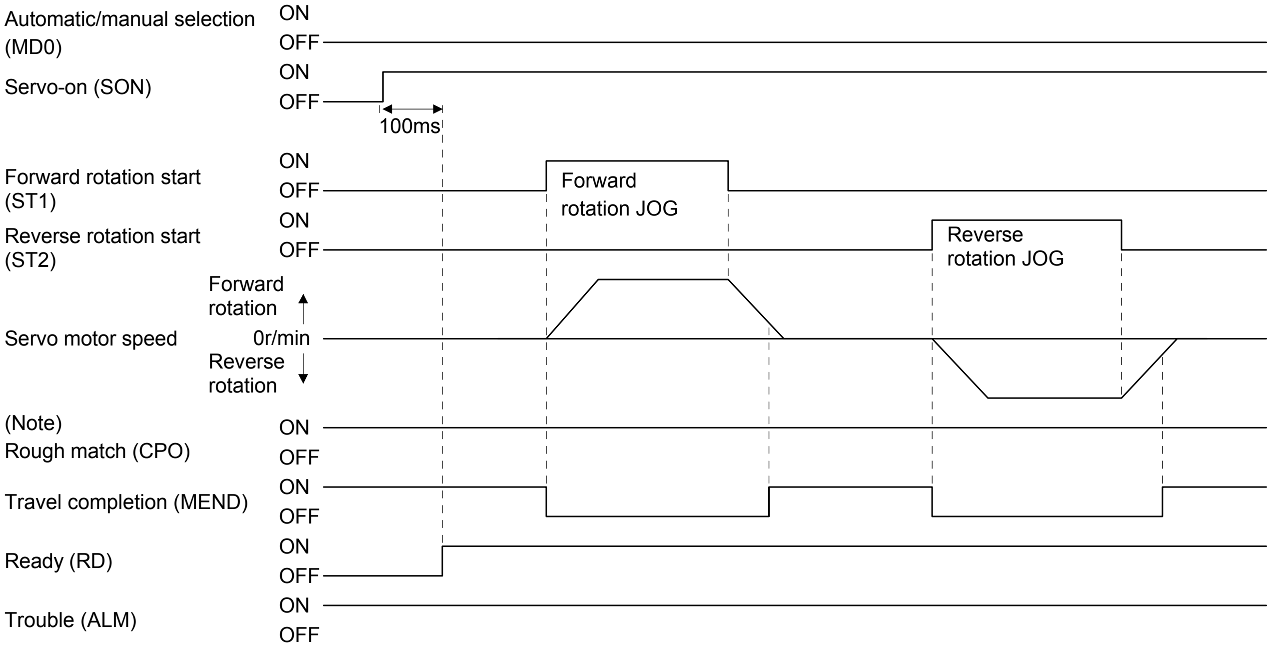


Parameter No. PA14: 1

(3) Operation

By turning ST1 ON, operation is performed under the conditions of the JOG speed set in the parameter and the acceleration and deceleration time constants in set parameter No. PE07. For the rotation direction, refer to (2) in this section. By turning ST2 ON, the servo motor rotates in the reverse direction to forward rotation start (ST1).

(4) Timing chart



Note. For the point table method. For the program method, it is always OFF.

13.5.2 Manual pulse generator operation

POINT

- For the positioning mode, PP or NP is not assigned in the initial status. When using the manual pulse generator, assign PP to CN1-23 pin and NP to CN1-25 pin by parameter No. PD02. (Refer to sections 4.4.2 and 11.14.)
- When the manual pulse generator is used during JOG operation, pulses of the manual pulse generator are added.

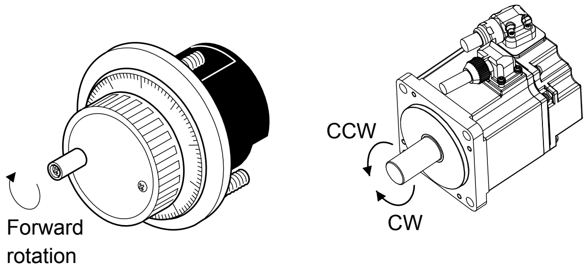
(1) Setting

Set the input device and parameters as follows according to the purpose of use. In this case, the point table No./program No. selection 1 to 3 (DI0 to DI2) are invalid.

Item	Device/Parameter used	Description
Manual operation mode selection	Automatic/manual selection (MD0)	Turn MD0 OFF.
Manual pulse generator multiplication	Parameter No. PE02	Set the multiplication ratio for generated pulses of the manual pulse generator. For more information, refer to (3) in this section.
Servo motor rotation direction	Parameter No. PA14	Refer to (2) in this section.

(2) Servo motor rotation direction

Parameter No. PA14 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

Use parameter No.PA05 to set the multiplication ratio of the servo motor rotation to the manual pulse generator rotation.

Parameter No. PA05 setting	Multiplication ratio of servo motor rotation to manual pulse generator rotation	Travel distance
□□0□	1 time	1[μm]
□□1□	10 times	10[μm]
□□2□	100 times	100[μm]

(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.

13.6 Home position return mode

13.6.1 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.
This controller has the home position return methods given in this section. Choose the most appropriate method for your machine structure and application.
This controller 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 on the proximity dog. Manual motion by JOG operation or the like is not required.

(1) Home position return types
Choose the optimum home position return according to the machine type, etc.

Type	Home position return method	Features
Dog type	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. ・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	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 set type	An arbitrary position is defined as a home position.	・No proximity dog required.
Stopper type	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.	
Dog type rear end reference	The position where the axis, which had started decelerating at the front end of a proximity dog, has moved the after-proximity dog moving distance and home position shift distance after it passed the rear end is defined as a home position.	・The Z-phase signal is not needed.
Count type front end reference	The position where the axis, which had started decelerating at the front end of a proximity dog, has moved the after-proximity dog moving distance and home position shift distance is defined as a home position.	・The Z-phase signal is not needed.
Dog cradle type	The position where the first Z-phase signal is issued after detection of the proximity dog front end is defined as a home position.	

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

(2) Home position return parameter

When performing home position return, set parameter No. PE03 (home position return type) as follows.

Parameter No. PE03

0			

Home position return type ....(a)
0: Dog type
1: Count type
2: Data set type
3: Stopper type
4: Home position ignorance
(Servo-on position as home position)
5: Dog type rear end reference
6: Count type front end reference
7: Dog cradle type

Home position return direction ....(b)
0: Address increasing direction
1: Address decreasing direction

Proximity dog input polarity ....(c)
0: OFF indicates detection of the dog
1: ON indicates detection of the dog

(a) Choose the home position return type.

(b) 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.

(c) Choose the polarity at which the proximity dog is detected. Set "0" to detect the dog when the proximity dog device (DOG) is OFF, or "1" to detect the dog when the device is ON.

(3) Instructions

(a) Before starting home position return, always make sure that the limit switch operates.

(b) Confirm the home position return direction. Incorrect setting will cause the machine to run reversely.

(c) Confirm the proximity dog input polarity. Not doing so may cause unexpected operation.

13.6.2 Selection of home position return mode

Set the input device as shown in the following table to select the home position return mode.

Input device	Device setting	
	Point table method	Program method
Automatic/manual selection (MD0)	OFF	OFF
Point table No./Program No. selection 1 (DI0)	All OFF (The home position return mode is selected.)	Select a program that has the home position return "ZRT" command.
Point table No./Program No. selection 2 (DI1)		
Point table No./Program No. selection 3 (DI2)		

The explanations in the following sections apply when the home position return mode is selected by MD0, MI0, DI1, and DI2.

13.6.3 Dog type home position return

This is a home position return method using the 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) Devices and parameters

Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Dog type home position return	Parameter No. PE03	□□□0: Dog type home position return is selected.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Dog input polarity	Parameter No. PE03	Refer to section 13.6.1 (2) and select the proximity dog input polarity.
Home position return speed	Parameter No. PE04	Set the speed till the dog is detected.
Creep speed	Parameter No. PE05	Set the speed after the dog is detected.
Home position shift distance	Parameter No. PE06	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	Parameter No. PE07	Set the acceleration/deceleration time constants during a home position return.
Home position return position data	Parameter No. PE08	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 (13.1) and (13.2).

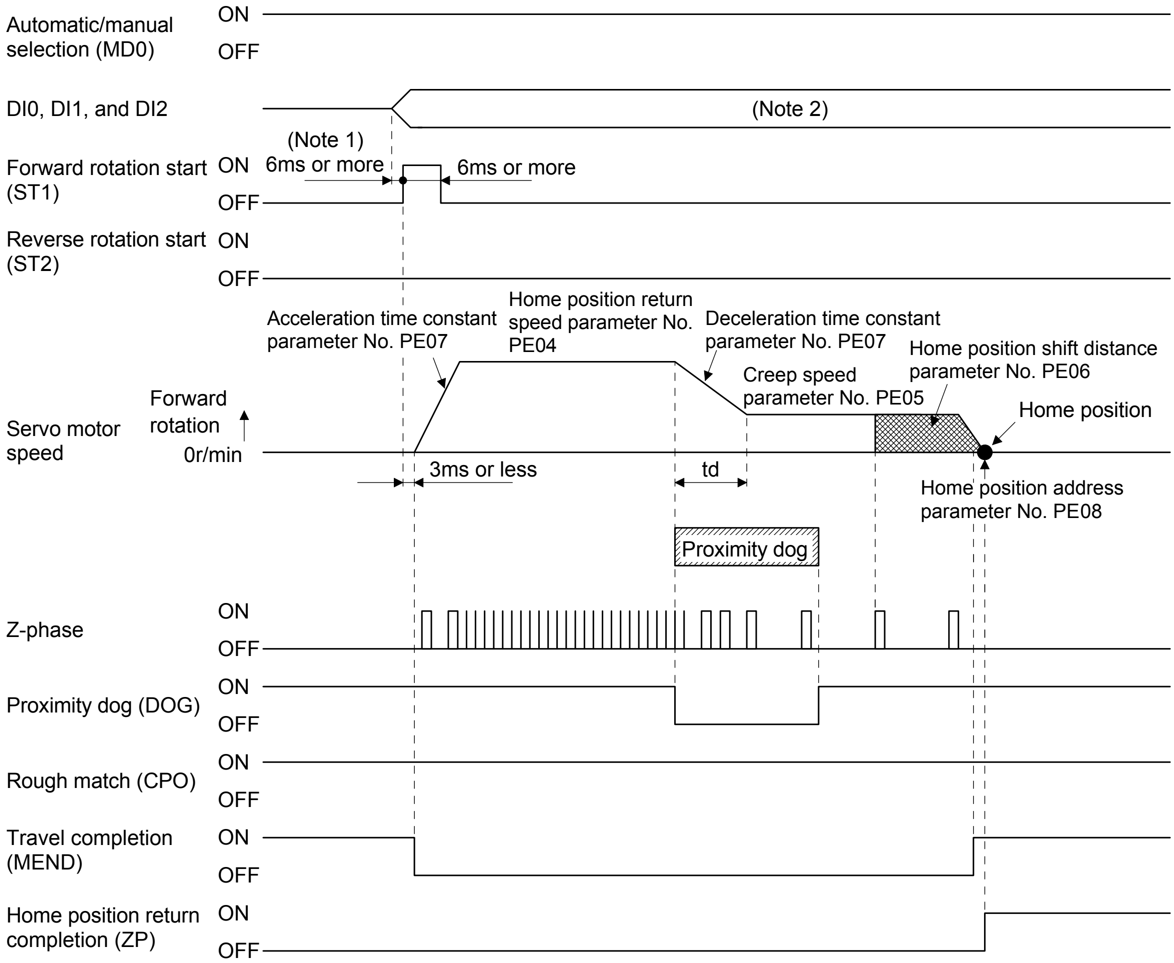
$$L_1 \geq \frac{V}{60} \cdot \frac{td}{2} \cdots\cdots (13.1)$$

L_1 : Proximity dog length [mm]
V : Home position return speed [mm/min]
Td : Deceleration time [s]

$$L_2 \geq 2 \cdot \Delta S \cdots\cdots (13.2)$$

L_2 : Proximity dog length [mm]
ΔS: Travel distance per servo motor revolution [mm]

(3) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

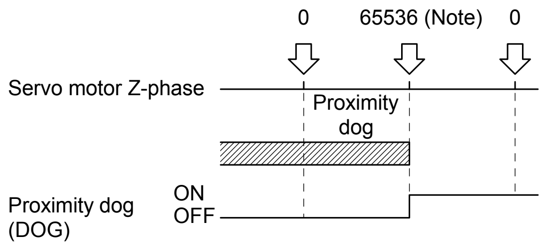
2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

(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" of MR Configurator.



Note. When using the LE-S1-□, LE-S2-□, LE-S3-□, LE-S4-□ servo motor series

13.6.4 Count type home position return

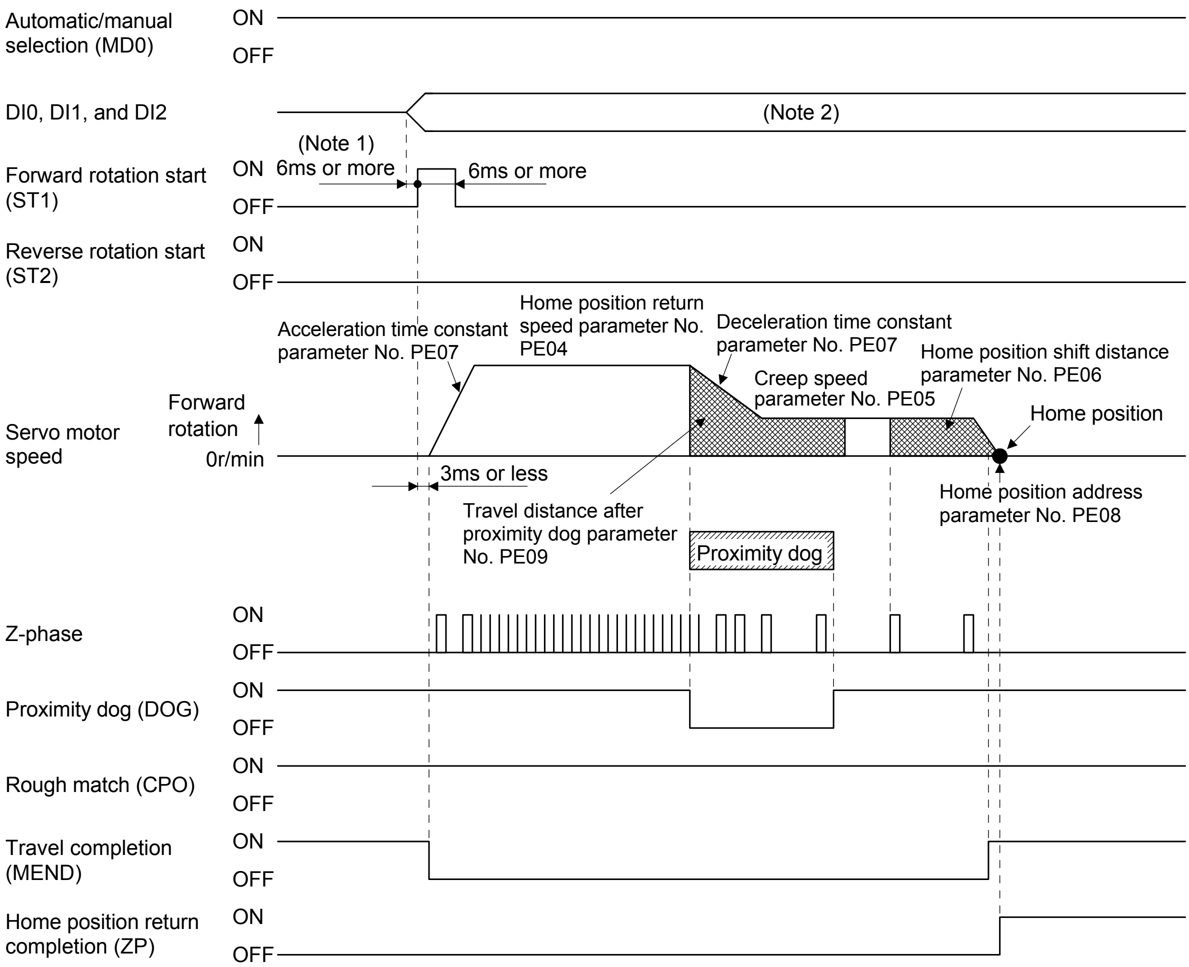
In count type home position return, a motion is made over the distance set in parameter No. PE09 (moving distance after proximity dog) after detection of the proximity dog front end. The position where the first Z-phase signal is given after that is defined as a home position. Hence, if the proximity 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 PC or PLC...etc or the like.

(1) Devices and parameters

Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Count type home position return	Parameter No. PE03	□□□1: Count type home position return is selected.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Dog input polarity	Parameter No. PE03	Refer to section 13.6.1 (2) and select the dog input polarity.
Home position return speed	Parameter No. PE04	Set the speed till the dog is detected.
Creep speed	Parameter No. PE05	Set the speed after the dog is detected.
Home position shift distance	Parameter No. PE06	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 travel distance.
Travel distance after proximity dog	Parameter No. PE09	Set the travel distance after passage of proximity dog front end.
Home position return acceleration/deceleration time constants	Parameter No. PE07	Set the acceleration/deceleration time constants during a home position return.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.5 Data set type home position return

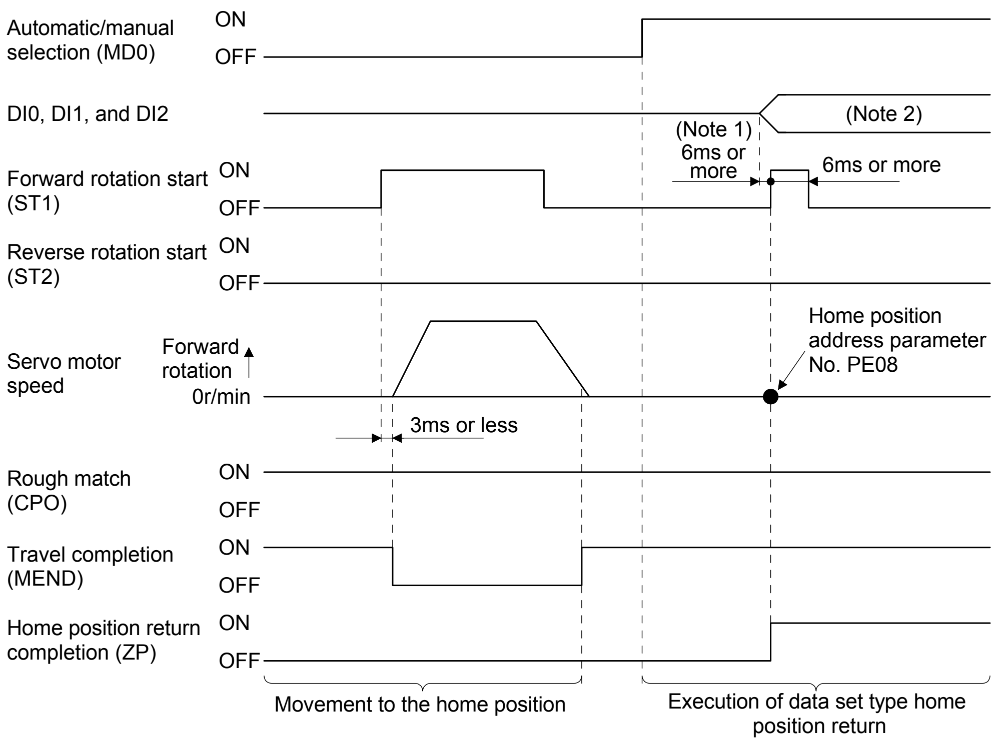
Data set type home position return is used when it is desired to determine any position as a home position. JOG operation can be used for movement.

(1) Devices and parameters

Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Data set type home position return	Parameter No. PE03	□□□2: Data set type home position return is selected.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.6 Stopper type home position return

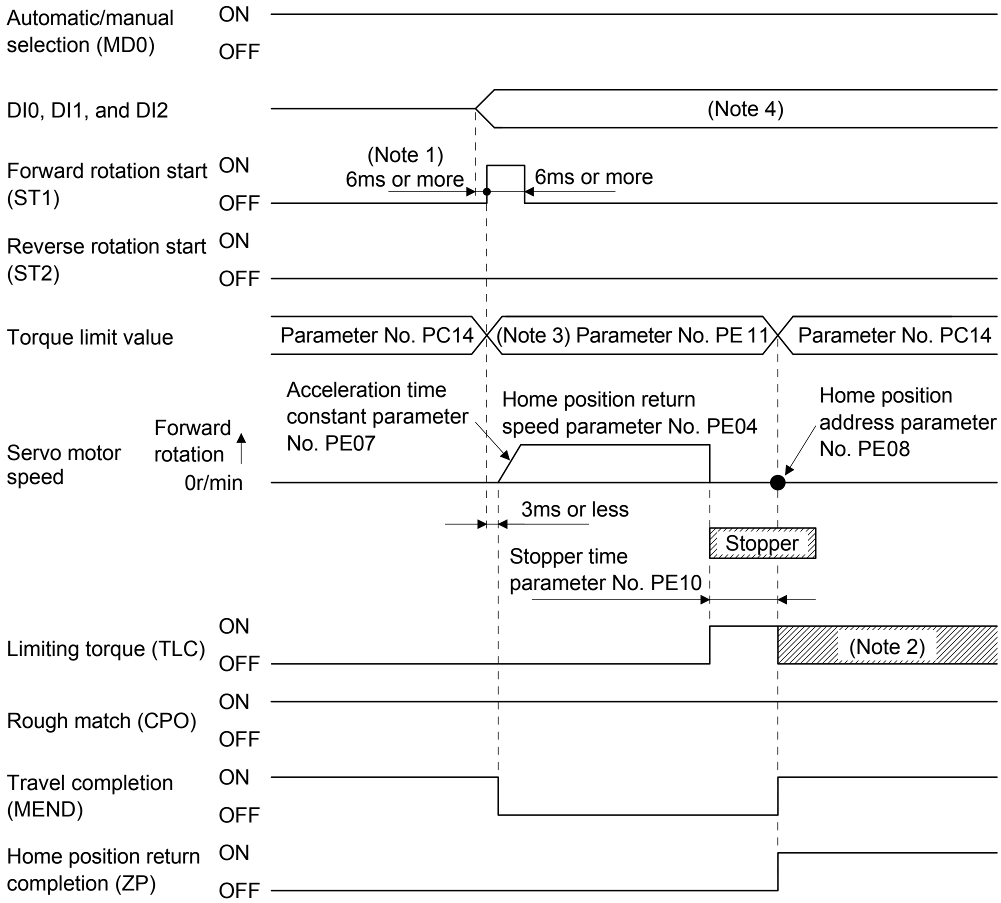
In stopper type home position return, a machine part is pressed against a stopper or the like by JOG operation to make a home position return and that position is defined as a home position.

(1) Devices and parameters

Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Stopper type home position return	Parameter No. PE03	□□□3: Stopper type home position return is selected.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Home position return speed	Parameter No. PE04	Set the speed till contact with the stopper.
Stopper time	Parameter No. PE10	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 value	Parameter No. PE11	Set the servo motor torque limit value for execution of stopper type home position return.
Home position return acceleration time constant	Parameter No. PE07	Set the acceleration time constant during a home position return.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. TLC turns ON when the torque reaches the value set in forward torque limit (parameter No. PA11), reverse torque limit (parameter No. PA12) or internal torque limit (parameter No. PC14).

3. The torque limit that is enabled at this point is as follows.

(Note) Input device TL1	Limit value status			Validated torque limit values
0				Parameter No. PE11
1	Parameter No. PC14	>	Parameter No. PE11	Parameter No. PE11
	Parameter No. PC14	<	Parameter No. PE11	Parameter No. PC14

Note. 0: off
1: on

4. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select the program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.7 Home position ignorance (Servo-on position as home position)

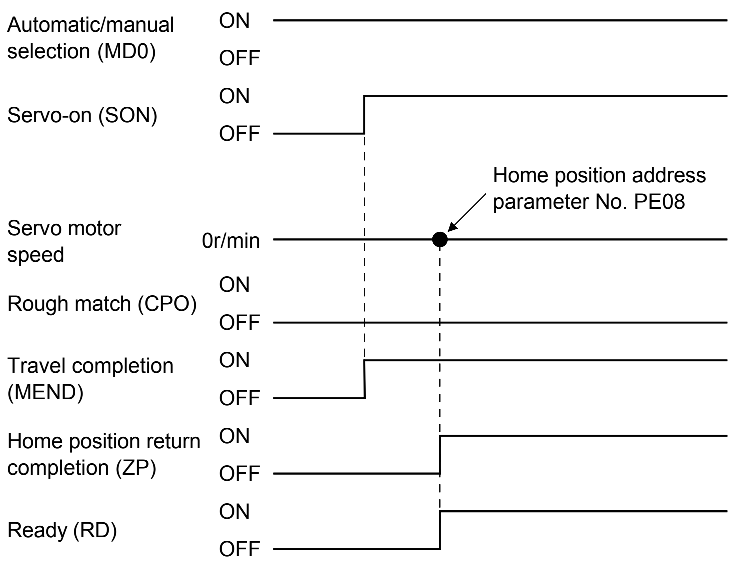
The position where servo is switched on is defined as a home position.

(1) Devices and parameters

Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Home position ignorance	Parameter No. PE03	□□□4: Home position ignorance is selected.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.8 Dog type rear end reference home position return

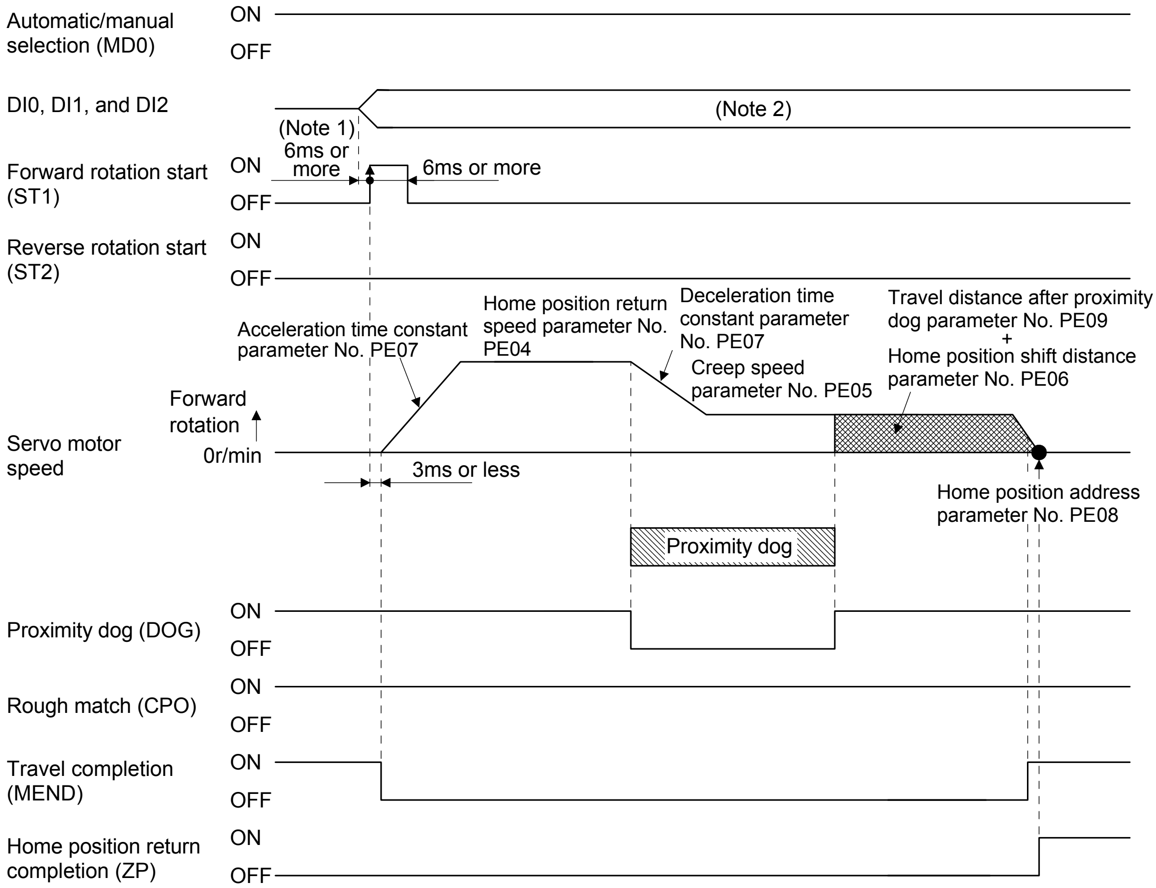
> **POINT**
>
> - This home position return method depends on the timing of reading proximity dog (DOG) that has detected the rear end of a proximity dog. Hence, if a home position return is made at the creep speed of 100r/min, an error of ±400 pulses will occur in the home position. The error of the home position is larger as the creep speed is higher.

The position where the axis, which had started decelerating at the front end of a proximity dog, has moved the after-proximity dog moving distance and home position shift distance after it passed the rear end is defined as a home position. A home position return that does not depend on the Z-phase signal can be made.

(1) Devices and parameters
Set the input devices and parameters as follows.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Dog type rear end reference home position return	Parameter No. PE03	□□□5: Select the dog type rear end reference.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Dog input polarity	Parameter No. PE03	Refer to section 13.6.1 (2) and select the dog input polarity.
Home position return speed	Parameter No. PE04	Set the speed till the dog is detected.
Creep speed	Parameter No. PE05	Set the speed after the dog is detected.
Home position shift distance	Parameter No. PE06	Set when the home position is moved from where the axis has passed the proximity dog front end.
Travel distance after proximity dog	Parameter No. PE09	
Home position return acceleration/deceleration time constants	Parameter No. PE07	Set the acceleration/deceleration time constants during a home position return.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.9 Count type front end reference home position return

POINT
・This home position return method depends on the timing of reading the proximity dog (DOG) that has detected the front end of a proximity dog. Hence, if a home position return is made at the home position return speed of 100r/min, an error of ±400 pulses will occur in the home position. The error of the home position is larger as the home position return speed is higher.

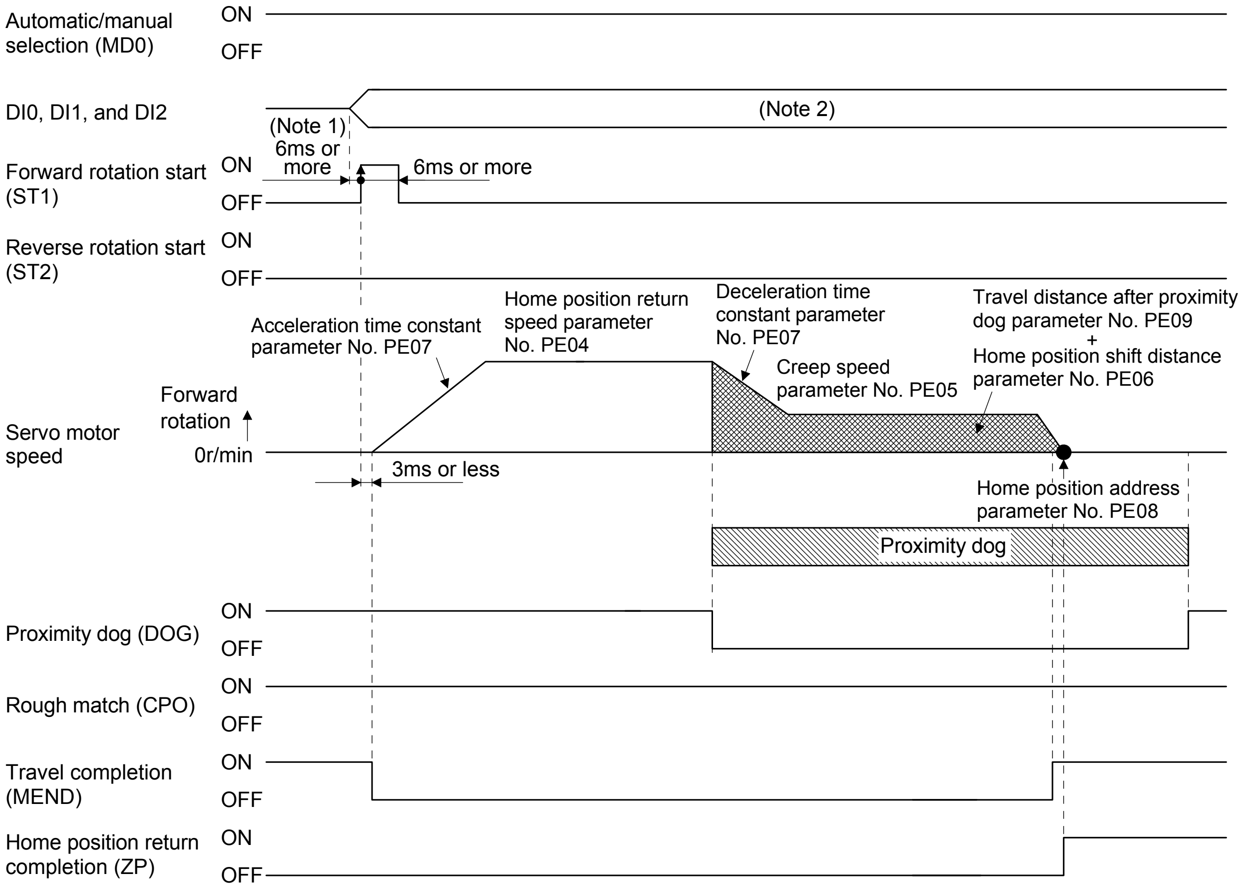
The position where the axis, which had started decelerating at the front end of a proximity dog, has moved the after-proximity dog travel distance and home position shift distance is defined as a home position. A home position return that does not depend on the Z-phase signal can be made. The home position may change if the home position return speed varies.

(1) Devices and parameters

Set the input devices and parameters as indicated below.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Count type dog front end reference home position return	Parameter No. PE03	□□□6: Select the count type dog front end reference.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Dog input polarity	Parameter No. PE03	Refer to section 13.6.1 (2) and select the dog input polarity.
Home position return speed	Parameter No. PE04	Set the speed till the dog is detected.
Creep speed	Parameter No. PE05	Set the speed after the dog is detected.
Home position shift distance	Parameter No. PE06	Set when the home position is moved from where the axis has passed the proximity dog front end.
Travel distance after proximity dog	Parameter No. PE09	
Home position return acceleration/deceleration time constants	Parameter No. PE07	Set the acceleration/deceleration time constants during a home position return.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.10 Dog cradle type home position return

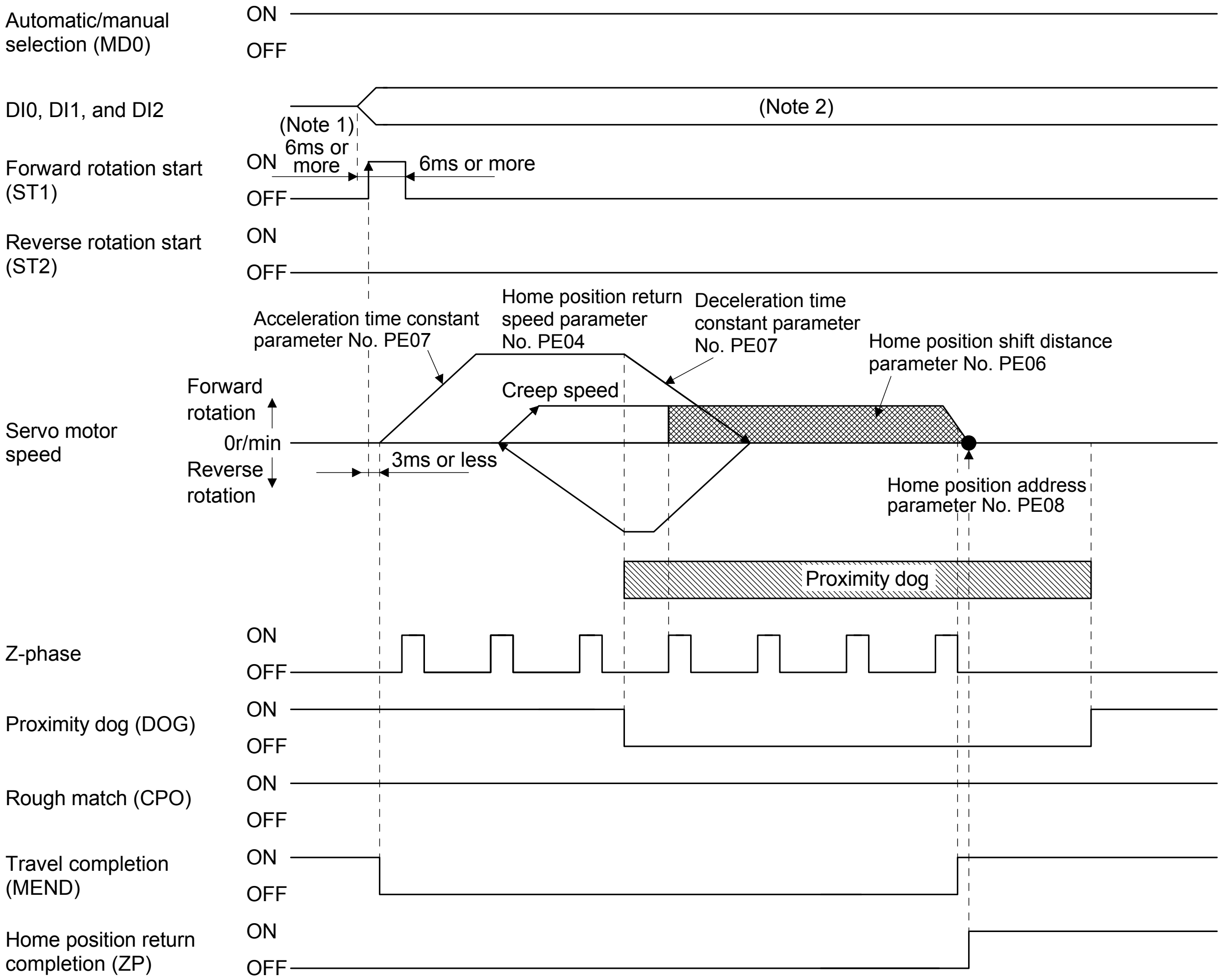
The position where the first Z-phase signal is issued after detection of the proximity dog front end can be defined as a home position.

(1) Devices and parameters

Set the input devices and parameters as indicated below.

Item	Device/Parameter used	Description
Manual home position return mode selection	Automatic/manual selection (MD0)	Turn MD0 ON.
	Point table No./Program No. selection 1 to 3 (DI0 to DI2)	Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2. Program method: Select a program that has the home position return "ZRT" command.
Dog cradle type home position return	Parameter No. PE03	□□□7: Select the dog cradle type.
Home position return direction	Parameter No. PE03	Refer to section 13.6.1 (2) and select the home position return direction.
Dog input polarity	Parameter No. PE03	Refer to section 13.6.1 (2) and select the dog input polarity.
Home position return speed	Parameter No. PE04	Set the speed till the dog is detected.
Creep speed	Parameter No. PE05	Set the speed after the dog is detected.
Home position shift distance	Parameter No. PE06	Set when the home position is moved from the Z-phase signal position.
Home position return acceleration/deceleration time constants	Parameter No. PE07	Set the acceleration/deceleration time constants during a home position return.
Home position return position data	Parameter No. PE08	Set the current position at home position return completion.

(2) Timing chart



Note 1. External input signal detection delays by the input filter setting time of parameter No. PD19. Additionally, make up a sequence that changes DI0, DI1 and DI2 ahead of time by considering delays in output signal sequence from the PC or PLC...etc and variations of a signal change due to hardware.

2. Point table method: Select the home position return mode by turning OFF DI0, DI1 and DI2.
Program method: Select a program that has the home position return "ZRT" command.

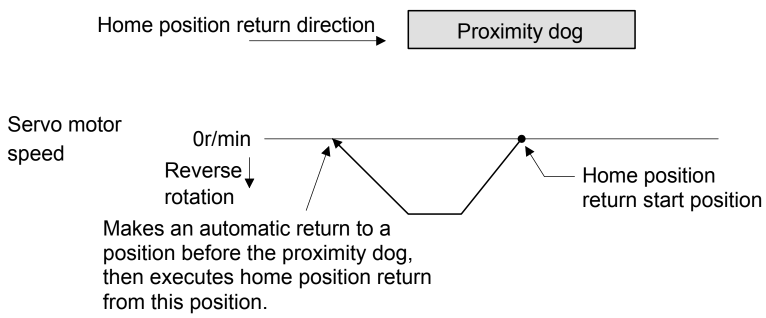
The set value in parameter No. PE08 (home position return position data) is applied as position address at the time of the home position return being completed.

13.6.11 Home position return automatic return function

If the current position is on or beyond the proximity dog in the home position return using the proximity dog, this function starts home position return after making a return to the position where the home position return can be made.

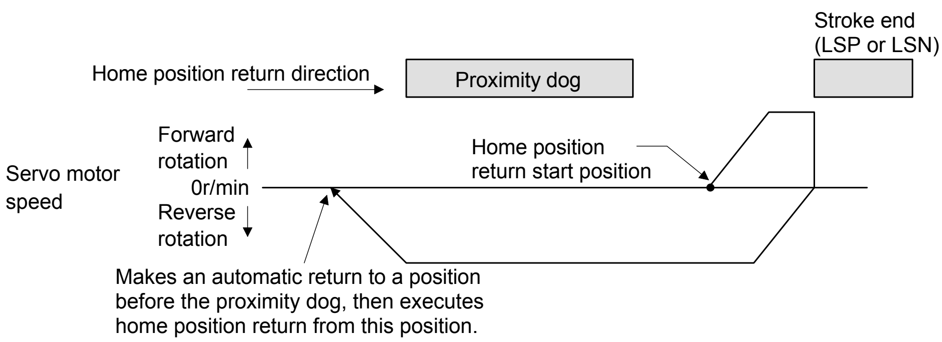
(1) When the current position is on the proximity dog

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



(2) When the current position is beyond the proximity dog

The current position moves in the home return direction at a start. When the stroke end (LSP or LSN) is detected, the position moves in the opposite direction. The motion stops when the position passes the front end of the proximity dog. Then, a home position return is resumed from this position. If the proximity dog is not detected, the motion stops where the opposite side of the stroke end is detected, and home position return incomplete warning (90.2) occurs.



Software limit cannot be used with these functions.

13.7 Parameters

⚠ CAUTION	· Never adjust or change the parameter values extremely as it will make operation instable. · If a fixed value is indicated in a digit of a parameter, do not change the fixed value.

POINT
· This chapter describes the parameters exclusively used for positioning mode. Refer to chapter 4 for other parameters.

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

Parameter group	Main description
Basic setting parameters (No. PA □□)	Make basic setting with these parameters when using this controller in the position control mode.
Gain/Filter parameters (No. PB □□)	Use these parameters when making gain adjustment manually.
Extension setting parameters (No. PC □□)	Use these parameters mainly when using this controller in the internal speed control mode or in the internal torque control mode.
I/O setting parameters (No. PD □□)	Use these parameters when changing the I/O signals of the controller.
Positioning setting parameters (No. PE □□)	Use these parameters only for the positioning mode.

13.7.1 Basic setting parameters (No. PA□□)

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.
- Never change parameters for manufacturer setting.

(1) Parameter list

No.	Symbol	Name	Initial value	Unit	Reference
PA01	*STY	Control mode	000h		Section 4.1.3
PA02	*REG	Regenerative option	000h		Section 4.1.4
PA03		For manufacturer setting	000h		
PA04	*AOP1	Tough drive function selection	000h		Section 4.1.5
PA05	*FBP	Number of virtual pulses per revolution	100	×100 pulse/rev	(2) in this section
PA06	*CMX	Electronic gear numerator (Virtual pulse multiplying factor numerator)	1		(3) in this section
PA07	*CDV	Electronic gear denominator (Virtual pulse multiplying factor denominator)	1		
PA08	ATU	Auto tuning mode	001h		Section 4.1.8
PA09	RSP	Auto tuning response	6		Section 4.1.8
PA10	INP	In-position range	100	μm (Note)	Section 4.1.9
PA11	TLP	Forward torque limit	100	%	Section 4.1.10
PA12	TLN	Reverse torque limit	100	%	Section 4.1.10
PA13		This parameter is not used. Do not change this value by any means.	000h		
PA14	*POL	Rotation direction selection	0		(4) in this section
PA15	*ENR	Encoder output pulses	4000	pulse/rev	Section 4.1.13
PA16	*ENR2	Encoder output pulse electronic gear	0		Section 4.1.13
PA17		For manufacturer setting	000h		
PA18			000h		
PA19	*BLK	Parameter writing inhibit	00Eh		Section 4.1.2

Note. The setting range is the same although the unit differs from that of the position control mode.

(2) Number of virtual pulses per servo motor revolution

Parameter			Initial value	Setting range	Unit
No.	Symbol	Name			
PA05	*FBP	Number of virtual pulses per revolution	100	0, 100 to 500	× 100 pulse/rev

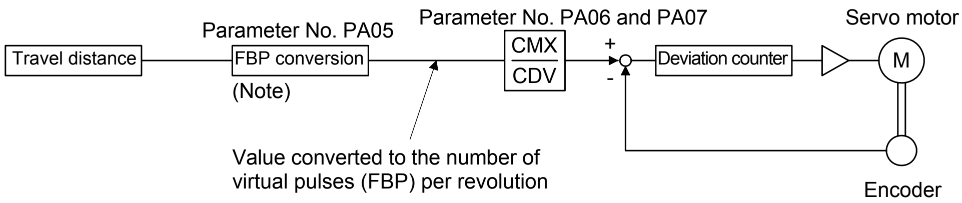
CAUTION	
⚠ CAUTION	・When this parameter is changed, turn off and on the power before starting the operation. Otherwise, the set value will not be validated, causing an unexpected operation.

POINT

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

Set the number of virtual pulses necessary to rotate the servo motor one turn.
When parameter No. PA05 is set to "100 (10000[pulse/rev])" (initial value), the number of pulses necessary to rotate the servo motor one turn is 10000 pulses. When parameter No. PA05 is set to "0", the number of pulses necessary to rotate the servo motor one turn equals to the encoder resolution of the servo motor.

Parameter No. PA05 setting	Description
0	Servo motor encoder resolution [pulse/rev]
100 to 500	Number of virtual pulses necessary to rotate the servo motor one turn [× 100 pulse/rev]



Note. This process converts the number of the virtual pulses required to rotate the servo motor one turn to the value set in parameter No. PA05.

(3) Electronic gear

Parameter			Initial value	Setting range	Unit
No.	Symbol	Name			
PA06	*CMX	Electronic gear numerator (Virtual pulse multiplying factor numerator)	1	1 to 65535	
PA07	*CDV	Electronic gear denominator (Virtual pulse multiplying factor denominator)	1	1 to 65535	

CAUTION

- Incorrect setting may cause unexpectedly fast rotation, resulting injury.

POINT

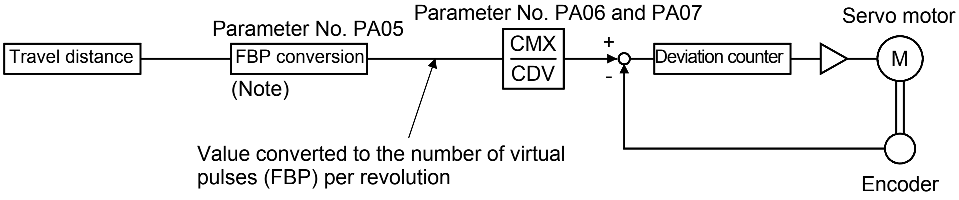
- In the positioning mode, this parameter is made valid when power is switched off, then on after setting.
- The setting range of the electronic gear is as follows. If you set any value outside this range, a parameter error (37.1) occurs.

  Setting range of the electronic gear: Min. value < $\frac{CMX}{CDV}$ < Max. value

Parameter No. PA05	Min. value	Max. value
100 (10000[pulse/rev])	1/131	76
200 (20000[pulse/rev])	1/65	152
300 (30000[pulse/rev])	1/43	228
360 (36000[pulse/rev])	1/36	274
400 (40000[pulse/rev])	1/32	305
500 (50000[pulse/rev])	1/26	381
0 (servo motor encoder resolution)	1/10	1000

(a) Concept of electronic gear

Adjust the electronic gear (parameters No. PA06 and PA07) to make the controller setting match the travel distance of the machine. Also, by changing the electronic gear value, the machine can be moved at any multiplication ratio to the travel distance set in the controller.



Note. This process converts the number of the virtual pulses required to rotate the servo motor one turn to the value set in parameter No. PA05.

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

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

POINT

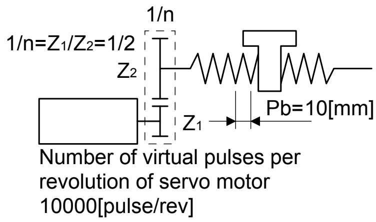
- The following specification symbols are required to calculate the electronic gear
  - Pb : Ballscrew lead [mm]
  - 1/n : Reduction ratio
  - ΔS : Travel distance per servo motor revolution [μm/rev]
  - Δθ : Angle per revolution [0.001° /rev]

(b) Setting example

1) Ballscrew setting example

Machine specifications

Ballscrew lead Pb = 10 [mm]
Reduction ratio: $1/n = Z_1/Z_2 = 1/2$
Z_1: Number of gear cogs on servo motor side
Z_2: Number of gear cogs on load side
Number of virtual pulses per revolution: 10000 [pulse/rev]



$$\frac{CMX}{CDV} = \frac{10000}{\Delta S} = \frac{10000}{1/n \cdot Pb \cdot 1000} = \frac{10000}{1/2 \cdot 10 \cdot 1000} = \frac{2}{1}$$

Hence, set 2 to CMX and 1 to CDV.

2) Conveyor setting example

0.001° is set to be 1 μm.

Machine specifications

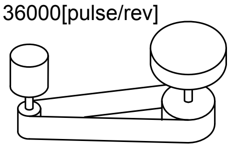
Table : 360° /rev

Reduction ratio : $1/n=P_1/P_2=625/12544$

P_1: Pulley diameter on servo motor side

P_2: Pulley diameter on load side

Number of virtual pulses per revolution: 36000 [pulse/rev]



$$\frac{CMX}{CDV}=\frac{36000}{\Delta\theta}=\frac{36000}{625/12544 \cdot 360 \cdot 1000}=\frac{6272}{3125}$$

POINT

- In the linear or rotary operation, setting the following values in the number of virtual pulses per revolution (parameter No. PA05) simplifies the setting values of the electronic gear (parameter No. PA06, PA07).
  Liner operation: 100 (10000[pulse/rev])
  Rotary operation: 360 (36000[pulse/rev])

(4) Selection of servo motor rotation direction

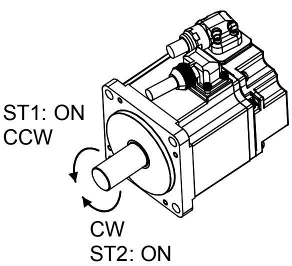
Parameter			Initial value	Setting range	Unit
No.	Symbol	Name			
PA14	*POL	Rotation direction selection	0	0, 1	

POINT

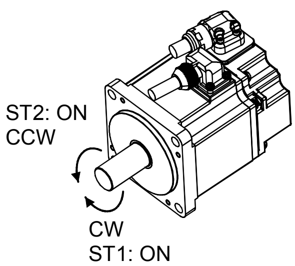
- This parameter is made valid when power is switched off, then on after setting.
- In program method, ST2 can be used only for JOG operation in the test mode.

Select the servo motor rotation direction when the forward rotation start (ST1) or reverse rotation direction (ST2) is turned ON.

Parameter No. PA14 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)



Parameter No. PA14: 0



Parameter No. PA14: 1

13.7.2 Gain/filter parameters (No. PB□□)

POINT

- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.
- Set any parameter with [Applied] written in the name column when using an advanced function.
- Never change parameters for manufacturer setting.

No.	Symbol	Name		Initial value	Unit	Reference
PB01	FILT	Adaptive tuning mode (Adaptive filter II)		000h		Section 4.2.2
PB02	VRFT	Vibration suppression control tuning mode (Advanced vibration suppression control)		000h		
PB03		This parameter is not used. Do not change this value by any means.				
PB04	FFC	Feed forward gain	[Applied]	0	%	Section 4.2.2
PB05		For manufacturer setting		500		
PB06	GD2	Load to motor inertia moment ratio		7.0	Multiplier	Section 4.2.2
PB07	PG1	Model loop gain		24	rad/s	
PB08	PG2	Position loop gain		37	rad/s	
PB09	VG2	Speed loop gain		823	rad/s	
PB10	VIC	Speed integral compensation		33.7	ms	
PB11	VDC	Speed differential compensation	[Applied]	980		
PB12	OVA	Overshoot amount compensation	[Applied]	0	%	
PB13	NH1	Machine resonance suppression filter 1		4500	Hz	
PB14	NHQ1	Notch shape selection 1		000h		
PB15	NH2	Machine resonance suppression filter 2		4500	Hz	
PB16	NHQ2	Notch shape selection 2		000h		
PB17		Automatic setting parameter				
PB18	LPF	Low-pass filter setting	[Applied]	3141	rad/s	Section 4.2.2
PB19	VRF1	Vibration suppression control vibration frequency setting	[Applied]	100.0	Hz	
PB20	VRF2	Vibration suppression control resonance frequency setting	[Applied]	100.0	Hz	
PB21		For manufacturer setting		0		
PB22				0		
PB23	VFBF	Low-pass filter selection	[Applied]	000h		Section 4.2.2
PB24		For manufacturer setting		000h		
PB25	*BOP1	Function selection B-1	[Applied]	000h		Section 4.2.2
PB26	*CDP	Gain changing selection	[Applied]	000h		
PB27	CDL	Gain changing condition	[Applied]	10		
PB28	CDT	Gain changing time constant	[Applied]	1	ms	
PB29	GD2B	Gain changing load to motor inertia moment ratio	[Applied]	7.0	Multiplier	
PB30	PG2B	Gain changing position loop gain	[Applied]	37	rad/s	
PB31	VG2B	Gain changing speed loop gain	[Applied]	823	rad/s	
PB32	VICB	Gain changing speed integral compensation	[Applied]	33.7	ms	
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	[Applied]	100.0	Hz	
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	[Applied]	100.0	Hz	
PB35		For manufacturer setting		0		
PB36				0		
PB37				100		
PB38	NH3	Machine resonance suppression filter 3		4500	Hz	Section 4.2.2
PB39	NHQ3	Notch shape selection 3		000h		

No.	Symbol	Name	Initial value	Unit	Reference
PB40		For manufacturer setting	111h		
PB41			20		
PB42			000h		
PB43			000h		
PB44			000h		
PB45			000h		
PB46			000h		
PB47			000h		
PB48			000h		
PB49			000h		
PB50			000h		

13.7.3 Extension setting parameters (No. PC□□)

POINT

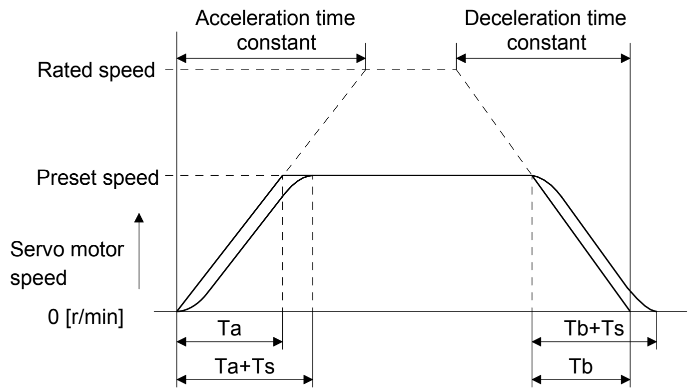
- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.
- Set any parameter with [Applied] written in the name column when using an advanced function.
- Never change parameters for manufacturer setting.

(1) Parameter list

No.	Symbol	Name	Initial value	Unit	Reference
PC01		This parameter is not used. Do not change this value by any means.	0		
PC02			0		
PC03	STC	S-pattern acceleration/deceleration time constant	0	ms	(2) in this section
PC04		This parameter is not used. Do not change this value by any means.	0		
PC05			0		
PC06			100		
PC07			500		
PC08			1000		
PC09	MBR	Electromagnetic brake sequence output	100	ms	Section 4.3.2
PC10	ZSP	Zero speed	50	r/min	
PC11	*BPS	Alarm history clear	000h		
PC12		This parameter is not used. Do not change this value by any means.	0		
PC13	*ENRS	Encoder output pulses selection	000h		Section 4.3.2
PC14	TL2	Internal torque limit 2 [Applied]	100	%	
PC15	ERZL	Error excessive alarm detection level	3.0	rev	
PC16		For manufacturer setting	30		
PC17	*OSL	Overspeed alarm detection level	0	r/min	Section 4.3.2
PC18		For manufacturer setting	1000		
PC19			0		
PC20			000h		
PC21			001h		
PC22	*COP1	Function selection C-1 [Applied]	000h		Section 4.3.2
PC23		This parameter is not used. Do not change this value by any means.	000h		
PC24	*COP3	Function selection C-3 [Applied]	000h		
PC25	*COP4	Function selection C-4 [Applied]	000h		Section 4.3.2
PC26	ALDT	Detailed setting of overload tough drive [Applied]	200	×10ms	
PC27	OSCL	Detailed setting of vibration tough drive [Applied]	50	%	
PC28	CVAT	Detailed setting of instantaneous power failure tough drive [Applied]	3	×10ms	
PC29	*COP5	Function selection C-5 [Applied]	000h		
PC30		This parameter is not used. Do not change this value by any means.	000h		
PC31			200		
PC32			300		
PC33			500		
PC34			800		

No.	Symbol	Name	Initial value	Unit	Reference
PC35		For manufacturer setting	000h		
PC36			0		
PC37			0		
PC38			0		
PC39			0		
PC40			0		
PC41			000h		
PC42			0		
PC43			000h		
PC44	RECT	Drive recorder alarm specifying	000h		Section 4.3.2
PC45		For manufacturer setting	000h		
PC46			000h		
PC47			000h		
PC48			000h		
PC49			000h		
PC50			000h		
PC51			000h		
PC52			000h		
PC53			000h		
PC54			000h		
PC55			000h		
PC56			000h		
PC57			000h		
PC58			000h		
PC59			000h		
PC60			000h		
PC61			000h		
PC62			000h		
PC63			000h		
PC64			000h		

(2) List of details

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and functon</th><th>Initial value</th><th>Setting range</th><th>Unit</th></tr>
<tr><td rowspan="2">PC03</td><td rowspan="2">STC</td><td rowspan="2">S-pattern acceleration/deceleration time constant
In servo operation, linear acceleration/deceleration is usually made. By setting the S-pattern acceleration/deceleration time constant (parameter No.PC03), 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 the travel completion (MEND).


Ta: Time until preset speed is reached
Tb: Time until stop
Ts: S-pattern acceleration/deceleration time constant (parameter No. PC03)
Setting range 0 to 100ms (S-pattern acceleration/deceleration time constant at setting value 101 to 1000 is 100ms)
In the program method, S-pattern acceleration/deceleration time constant of STD command is valid during the time from the STD command start to the program end. For other than that, S-pattern acceleration/deceleration time constant of parameter No. PC03 is valid.</td><td rowspan="2">0</td><td>0
to
100</td><td>ms</td></tr>
<tr><td>101
to
1000</td><td></td></tr>
</table>

13.7.4 I/O setting parameters (No. PD□□)

POINT
・For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid. ・Never change parameters for manufacturer setting.

(1) Parameter list

No.	Symbol	Name	Initial value	Unit	Reference
PD01	*DIA1	Input signal automatic ON selection 1	0000h		Section 4.4.2
PD02	*DI0	Input signal device selection 0 (CN1-23, CN1-25)	262Dh		
PD03	*DI1-1	Input signal device selection 1L (CN1-3)	0303h		
PD04	*DI1-2	Input signal device selection 1H (CN1-3)	2003h		
PD05	*DI2-1	Input signal device selection 2L (CN1-4)	0202h		
PD06	*DI2-2	Input signal device selection 2H (CN1-4)	0202h		
PD07	*DI3-1	Input signal device selection 3L (CN1-5)	0D06h		
PD08	*DI3-2	Input signal device selection 3H (CN1-5)	2C0Dh		
PD09	*DI4-1	Input signal device selection 4L (CN1-6)	070Ah		
PD10	*DI4-2	Input signal device selection 4H (CN1-6)	0707h		
PD11	*DI5-1	Input signal device selection 5L (CN1-7)	080Bh		
PD12	*DI5-2	Input signal device selection 5H (CN1-7)	0808h		
PD13	*DI6-1	Input signal device selection 6L (CN1-8)	0505h		
PD14	*DI6-2	Input signal device selection 6H (CN1-8)	0505h		
PD15	*DO1	Output signal device selection 1 (CN1-9)	0003h		
PD16	*DO2	Output signal device selection 2 (CN1-10)	0004h		
PD17	*DO3	Output signal device selection 3 (CN1-11)	0002h		
PD18	*DO4	Output signal device selection 4 (CN1-12)	0005h		
PD19	*DIF	Input filter setting	0002h		
PD20	*DOP1	Function selection D-1	0000h		(2) in this section
PD21		For manufacturer setting	0000h		
PD22	*DOP3	Function selection D-3	0000h		Section 4.4.2
PD23		For manufacturer setting	0000h		
PD24	*DOP5	Function selection D-5	0000h		Section 4.4.2
PD25		For manufacturer setting	0000h		
PD26			0000h		

(2) List of details

No.	Symbol	Name and function	Initial value	Setting range	Unit
PD20	*DOP1	Function selection D-1 Select the stop processing at LSP/LSN OFF or when the software limit is detected, the base circuit status at reset (RES) ON and the operation during tough drive (MTTR). 0 □ □ □ Stop processing at LSP/LSN OFF or when the software limit is detected 0: Sudden stop (Home position is not erased.) 1: Slow stop (Home position is not erased.) Selection of base circuit status at reset (RES) ON 0: Base circuit switched off 1: Base circuit not switched off Operation selection during tough drive (MTTR) 0: MTTR turns ON during the instantaneous power failure tough drive 1: MTTR turns ON during the overload tough drive or the instantaneous power failure tough drive	0000h	Refer to the name and function filed.	

13.7.5 Positioning setting parameters (No. PE□□)

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.
- Never change parameters for manufacturer setting.

(1) Parameter list

No.	Symbol	Name	Initial value	Unit	Reference
PE01	*CTY	Command mode selection	0000h		(2) in this section
PE02	*FTY	Feeding function selection	0000h		
PE03	*ZTY	Home position return type	0010h		
PE04	ZRF	Home position return speed	500	r/min	
PE05	CRF	Creep speed	10	r/min	
PE06	ZST	Home position shift distance	0	μm	
PE07	FTS	Home position return/JOG operation acceleration/deceleration time constants	100	ms	
PE08	*ZPS	Home position return position data	0	$\times 10^{STM}$μm	
PE09	DCT	Travel distance after proximity dog	1000	$\times 10^{STM}$μm	
PE10	ZTM	Stopper type home position return stopper time	100	ms	
PE11	ZTT	Stopper type home position return torque limit value	15	%	
PE12	CRP	Rough match output range	0	$\times 10^{STM}$μm	
PE13	JOG	JOG speed	100	r/min	
PE14	OUT1	OUT1 output time selection This parameter is used only for the program method. This is not used in the point table method.	0	ms	
PE15	*BKC	Backlash compensation	0	pulse	
PE16	*LMPL	Software limit +	0	$\times 10^{STM}$μm	
PE17	*LMPH		0		
PE18	*LMNL	Software limit -	0	$\times 10^{STM}$μm	
PE19	*LMNH		0		
PE20	*LPPL	Position range output address +	0	$\times 10^{STM}$μm	
PE21	*LPPH		0		
PE22	*LNPL	Position range output address -	0	$\times 10^{STM}$μm	
PE23	*LNPH		0		
PE24	*EOP1	Function selection E-1	0000h		
PE25		For manufacturer setting	10		
PE26			100		
PE27			0000h		
PE28			0000h		

(2) List of details

<table>
<tr><th>No.</th><th>Symbol</th><th>Name and function</th><th>Initial value</th><th>Setting range</th><th>Unit</th></tr>
<tr><td>PE01</td><td>*CTY</td><td>Command mode selection
Select the command system.

0 0 0 □

Selection of command system
(Refer to section 13.3 and 13.4)
0: Absolute value command system
1: Incremental value command system</td><td>0000h</td><td>Refer to the name and function filed.</td><td></td></tr>
<tr><td>PE02</td><td>*FTY</td><td>Feeding function selection
Select the feed length multiplication and the manual pulse generator input multiplication.

0 0 □ □

<table>
<tr><th>Set value</th><th>Feed length multipli-cation (STM) [Multiplier]</th><th>Feed unit [μm]</th><th colspan="2">Position data input range [mm]</th></tr>
<tr><th></th><th></th><th></th><th>Absolute value command system</th><th>Incremental value command system</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>-999.999 to +999.999</td><td>0 to +999.999</td></tr>
<tr><td>1</td><td>10</td><td>10</td><td>-9999.99 to +9999.99</td><td>0 to +9999.99</td></tr>
<tr><td>2</td><td>100</td><td>100</td><td>-99999.9 to +99999.9</td><td>0 to +99999.9</td></tr>
<tr><td>3</td><td>1000</td><td>1000</td><td>-999999 to +999999</td><td>0 to +999999</td></tr>
</table>

Manual pulse generator multiplication
0: 1 time
1: 10 times
2: 100 times</td><td>0000h</td><td>Refer to the name and function filed.</td><td></td></tr>
<tr><td>PE03</td><td>*ZTY</td><td>Home position return type
Select the home position return type, home position return direction and proximity dog input polarity. (Refer to section 13.6.)

0 □ □ □

Home position return type
0: Dog type
1: Count type
2: Data set type
3: Stopper type
4: Home position ignorance
(Servo-on position as home position)
5: Dog type rear end reference
6: Count type front end reference
7: Dog cradle type

Home position return direction
0: Address increasing direction
1: Address decreasing direction

Proximity dog input polarity
0: OFF indicates detection of the dog
1: ON indicates detection of the dog</td><td>0010h</td><td>Refer to the name and function filed.</td><td></td></tr>
<tr><td>PE04</td><td>ZRF</td><td>Home position return speed
Used to set the servo motor speed for home position return. (Refer to section 13.6.)</td><td>500</td><td>0 to permissible speed</td><td>r/min</td></tr>
</table>

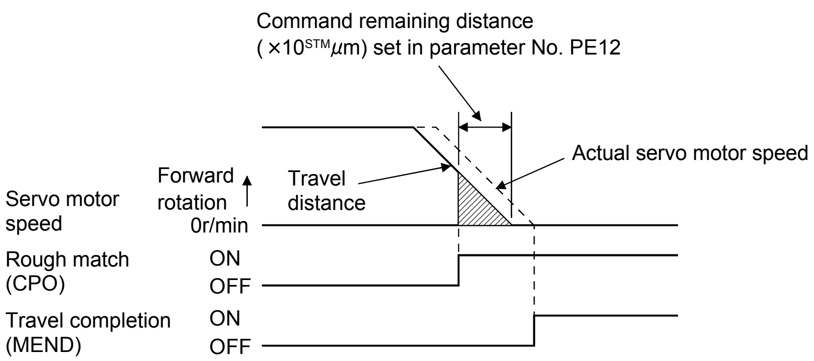
No.	Symbol	Name and function	Initial value	Setting range	Unit
PE05	CRF	Creep speed Used to set the creep speed after proximity dog detection. (Refer to section 13.6.)	10	0 to permissible speed	r/min
PE06	ZST	Home position shift distance Used to set the travel distance from the home position. (Refer to section 13.6.)	0	0 to 65535	μm
PE07	FTS	Home position return/JOG operation acceleration/deceleration time constants Used to set the acceleration/deceleration time constants during a home position return or JOG operation.	100	0 to 20000	ms
PE08	*ZPS	Home position return position data Used to set the current position on completion of home position return. (Refer to section 13.6.)	0	-32768 to 32767	$\times 10^{STM}$μm
PE09	DCT	Travel distance after proximity dog Used to set the travel distance after proximity dog detection. (Refer to section 13.6.)	1000	0 to 65535	$\times 10^{STM}$μm
PE10	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. PE11 is reached to when the home position is set. (Refer to section 13.6.6.) However, the stopper type home position return stopper time for the setting value 0 to 4 is 5ms.	100	0 to 4	
				5 to 1000	ms
PE11	ZTT	Stopper type home position return torque limit value Used to set the torque limit value relative to the max. torque in [%] in stopper type home position return. (Refer to section 13.6.6.) However, the stopper type home position return torque limit value for the setting value 0 is 1%.	15	0	
				1 to 100	%
PE12	CRP	Rough match output range Used to set the command remaining distance range where the rough match (CPO) is output.	0	0 to 65535	$\times 10^{STM}$μm
PE13	JOG	JOG speed Used to set the JOG speed command.	100	0 to permissible speed	r/min
PE14	OUT1	OUT1 output time selection This parameter is used only for the program method. It is not used in the point table method. Used to set the output time of OUT1. The OUT1 is turned on by OUTON program command. If "0" is set, it keeps ON.	0	0 to 20000	ms
PE15	*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. For the home position ignorance (servo-on position as home position), this function compensates for the number of backlash pulses in the opposite direction to the first rotating direction after establishing the home position by switching ON the servo-on (SON).	0	0 to 32000	pulse

No.	Symbol	Name and function	Initial value	Setting range	Unit
PE16	LMPL	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 -". (Refer to (4) in this section.) Set the same sign to parameters No. PE16 and No. PE17. Setting of different signs will result in a parameter error. Set address: □□□□□□ Upper three digits Lower three digits Parameter No. PE16 Parameter No. PE17 The software limit + is a set of upper digits and lower digits. To change the value, set in the order of lower digits to upper digits.	0	-999999 to 999999	$\times 10^{STM}$μm
PE17	LMPH				
PE18	LMNL	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 +". (Refer to (4) in this section.) Set the same sign to parameters No. PE18 and No. PE19. Setting of different signs will result in a parameter error. Set address: □□□□□□ Upper three digits Lower three digits Parameter No. PE18 Parameter No. PE19 The software limit - is a set of upper digits and lower digits. To change the value, set in the order of lower digits to upper digits.	0	-999999 to 999999	$\times 10^{STM}$μm
PE19	LMNH				
PE20	*LPPL	Position range output address + Used to set the address increment side position range output address. Set the same sign to parameters No. PE20 and No. PE21. Setting of different signs will result in a parameter error. In parameters No. PE20 to PE23, set the range where position range (POT) turns on. Set address: □□□□□□ Upper three digits Lower three digits Parameter No. PE20 Parameter No. PE21 Position range output address + is a set of upper digits and lower digits. To change the value, set in the order of lower digits to upper digits.	0	-999999 to 999999	$\times 10^{STM}$μm
PE21	*LPPH				

No.	Symbol	Name and function	Initial value	Setting range	Unit
PE22	*LNPL	Position range output address - Used to set the address decrement side position range output address. Set the same sign to parameters No. PE22 and No. PE23. Setting of different signs will result in a parameter error. Set address: □□□□□□ Upper three digits (Parameter No. PE23) / Lower three digits (Parameter No. PE22) Position range output address - is a set of upper digits and lower digits. To change the value, set in the order of lower digits to upper digits.	0	-999999 to 999999	×10^{STM}μm
PE23	*LNPH				
PE24	*EOP1	Function selection E-1 Used to permit/inhibit editing the point table/program or to select the polarity of program input 1 (PI1). 0 □ 0 □ Point table/program edit 0: Permit 1: Inhibit Polarity selection of program input 1 (PI1) This setting is used only for the program method. It is not used in the point table method. 0: Positive logic 1: Negative logic	0000h	Refer to the name and function filed.	
PE25		For manufacturer setting Do not change this value by any means.	10		
PE26			4100		
PE27			0000h		
PE28			0000h		

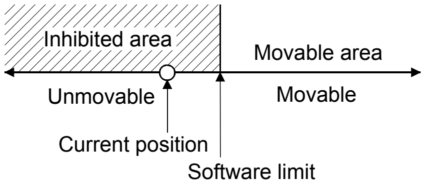
(3) Rough match output

Rough match (CPO) is output when the command remaining distance reaches the value set in parameter No. PE12 (rough match output range). The setting range is 0 to 65535 [×10^{STM}μm].



(4) Software limit

A limit stop using a software limit (parameter No. PE16 to PE19) 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. A parameter error (37.1) will occur if the software limit + setting is less than the software limit - setting.

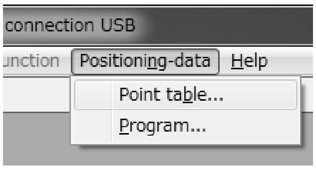


13.8 Point table setting method

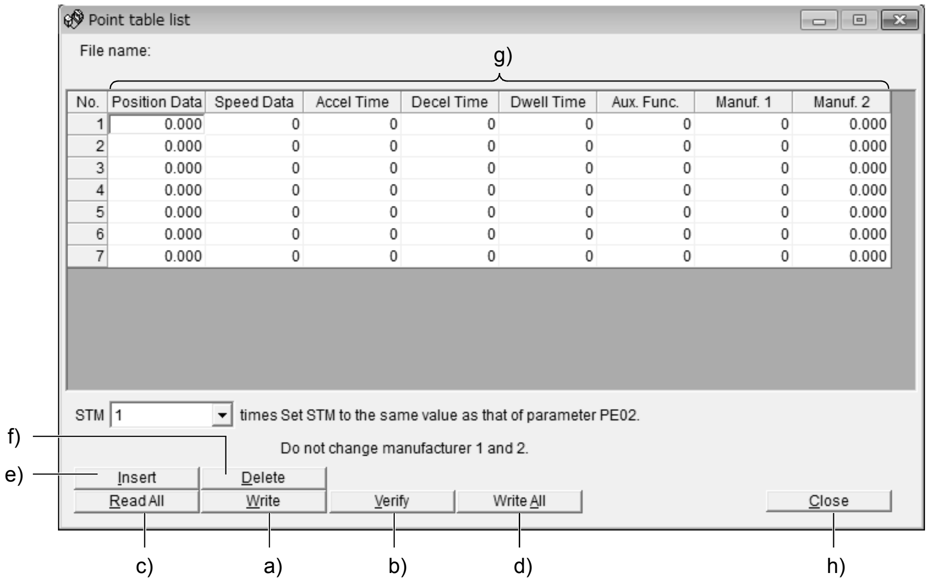
This section provides the method for setting the point table by using MR Configurator.

POINT
・ Positioning mode is supported by MR Configurator with software version C4 or later. ・The value of the parameter No. PE02 set on the parameter setting screen is not interlocked with the STM (feed length multiplication) value on the point table list screen. Set the STM (feed length multiplication) value to the same as set in the parameter No. PE02 on the point table list screen.

Click "Positioning-data" on the menu bar, and click "Point table" on the menu.



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



(1) Writing point table data (a))
Click the point table data changed, and click the "Write" button to write the new point table data to the controller.

(2) Verifying point table data (b))
Click the "Verify" button to verify all data being displayed and the data of the controller.

(3) Batch-reading point table data (c))
Click the "Read All" button to read and display all point table data from the controller.

(4) Batch-writing point table data (d))
Click the "Write All" button to write all point table data to the controller.

(5) Inserting point table data (e))
Click the "Insert" button to insert one row just above the selected point table No. The rows of the selected table No. and below are shifted down.

(6) Deleting point table data (f))
Click the "Delete" button to delete all data in the selected point table No. The rows below the selected table No. are shifted up.

(7) Changing point table data (g))
Click the data to be changed, enter a new value into the input field, and press the enter key.

(8) Reading point table data
Point table data in a file can be read and displayed. Click "Project" on the menu bar to read the point table data.

(9) Saving point table data
All displayed point table data on the window can be saved. Click "Project" on the menu bar to save the point table data.

(10) Printing point table data
All displayed point table data on the window can be printed. Click "Project" on the menu bar to print the point table data.

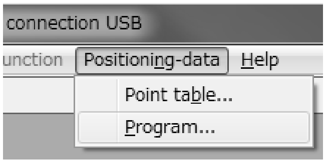
(11) Closing point table data (h))
Click the "Close" button to close the window.

13.9 Program setting method

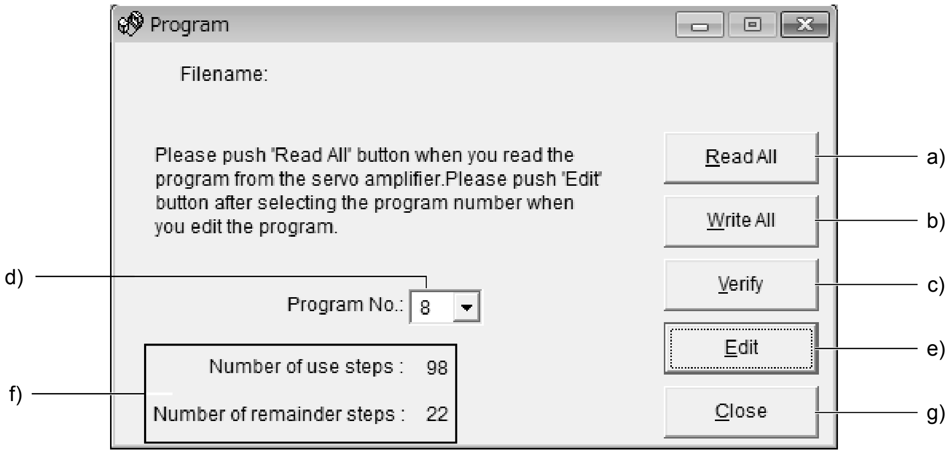
This section provides the method for setting programs using MR Configurator.

POINT
・ Positioning mode is supported by MR Configurator with software version C4 or later.

(1) How to open the setting screen
Click "Positioning-data" on the menu bar, and click "Program" on the menu.



(2) Explanation of Program window



(a) Reading the program (a))
Click the "Read All" button to read the program stored in the controller.

(b) Writing the program (b))
Click the "Write All" button to write the program, whose setting has been changed, to the controller.

(c) Verifying the programs (c))
Click the "Verify" button to verify the program contents on the personal computer and the program contents of the controller.

(d) Selecting the program No. (d))
Used to select the program No. to be edited.

(e) Editing the program (e))
Used to edit the program selected in d). Click the "Edit" button to open the Program Edit window. Refer to (3) in this section for the edit screen.

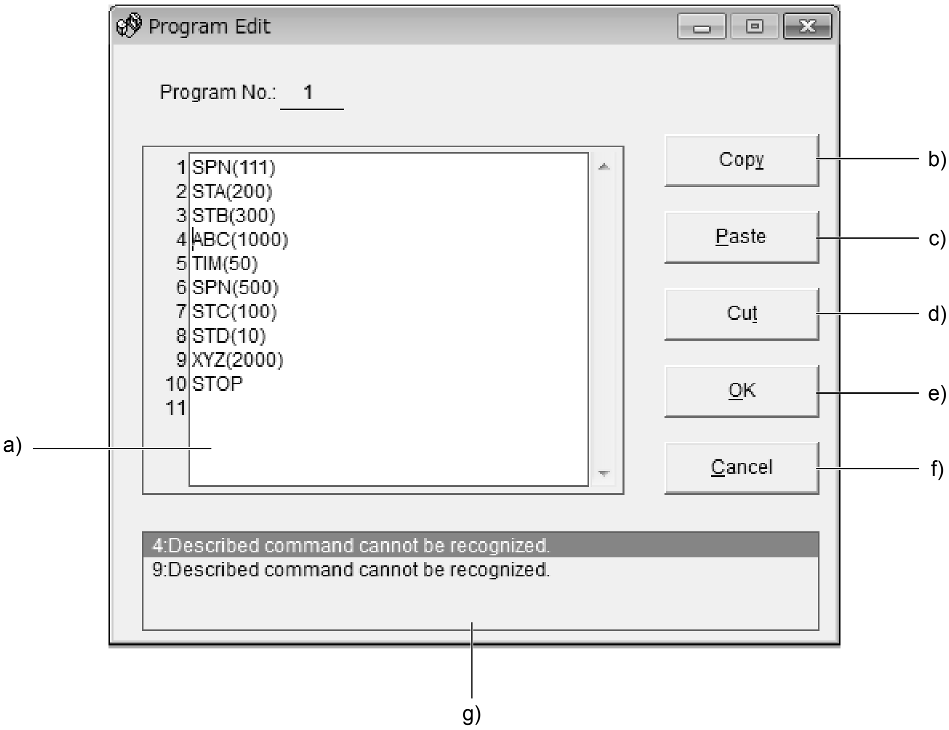
(f) Reading and saving the program file
A program can be saved/read as a file. Click "Project" on the menu bar to save or read the project.

(g) Printing the program
The read and edited program can be printed. Click "Project" on the menu bar to print the program.

(h) Referring to the number of steps (f))
The numbers of steps used and remaining steps in all programs are displayed.

(i) Closing the Program Data window (g))
Click the "Close" button to close the window.

(3) Explanation of Program Edit window
Create a program in the Program Edit window.



(a) Editing the program (a))
Enter commands into the program edit area (a)) in a text format.

(b) Copying the text (b))
Select the text of the program edit area and click the "Copy" button to store the selected text into the clipboard.

(c) Pasting the text (c))
Click the "Paste" button to paste the text stored in the clipboard to the specified position of the program edit area.

(d) Deleting the text (d))
Select the text of the program edit area and click the "Cut" button to delete the selected text.

(e) Closing the Program Data window (e))
Click the "OK" button to execute the edit check. If the check is completed without any problem, editing will be terminated and Program Data window will close. If any problem is found, an error will be displayed.

(f) Canceling the Program Edit window (f))
Click the "Cancel" button to discard the program being edited and close the Program Edit window.

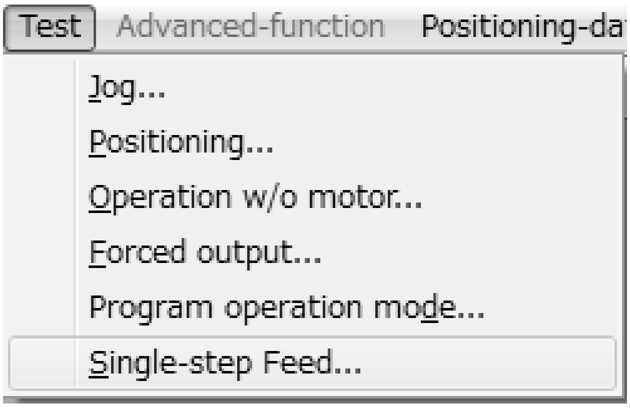
(g) Error display (g))
If a problem is found when the edit check is executed in (e), the line number and content of the error will be displayed. Click the error content to move the cursor to the corresponding line in the program.

13.10 Single-step feed usage in the test operation mode

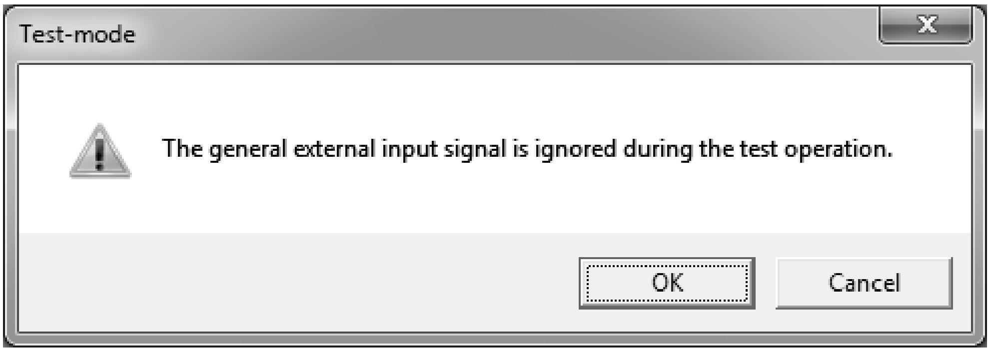
This section provides the usage of single-step feed using MR Configurator.

POINT
・The single-step feed is supported by controller with software version B0 or later, and MR Configurator with software version C4 or later. ・The servo motor will not operate if the forced stop (EM1), forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) are off. Make automatic ON setting to turn on these devices or turn on between DOCOM. (Refer to section 4.4.2.)

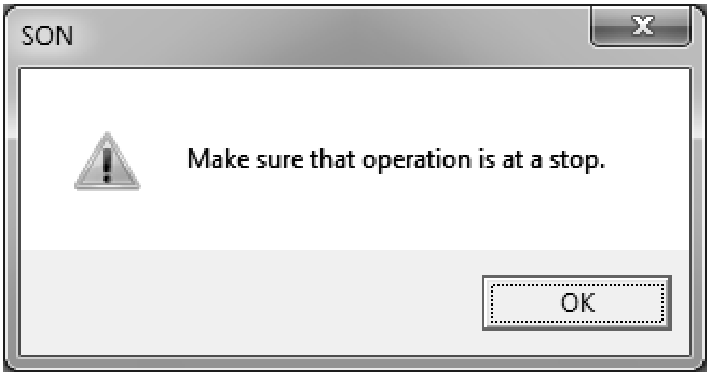
Operation is performed in accordance with the preset point table No./program No.
Click "Test" on the menu bar and click "Single-step Feed" on the menu.



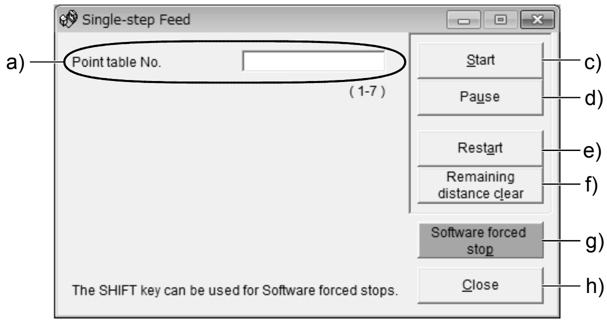
Clicking displays the confirmation window for switching to the test operation mode.



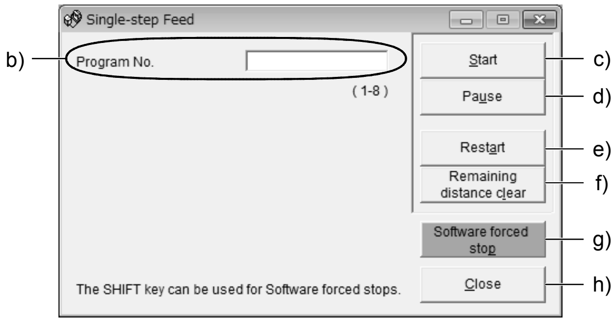
Click the "OK" button to display the setting screen of the single-step feed.
During the servo-on, the following window is displayed to confirm that the operation is in a stop status.



After confirming that the operation is in the stop status, click the "OK" button.



<In point table operation>



<In program operation>

(a) Point table No. setting (a))
Enter the point table No. into the "Point table No." input field and press the enter key.

(b) Program No. setting (b))
Enter the program No. into the "Program No." input field and press the enter key.

(c) Servo motor start (c))
Click the "Start" button to rotate the servo motor.

(d) Temporary stop of servo motor (d))
Click the "Pause" button to stop the servo motor temporarily.

(e) Servo motor stop (e))
Click the "Pause" button again during a temporary stop of the servo motor to clear the remaining moving distance.

(f) Servo motor restart (f))
Click the "Restart" button during the temporary stop to restart the rotations for the remaining move distance.

(g) Travel distance clear (g))
Click the "Remaining distance clear" during the temporary stop to clear the remaining travel distance.

(h) Servo motor software forced stop (h))

Click the "Software forced stop" button to stop the servo motor rotation immediately. When the "Software forced stop" button is enabled, the "Start" button cannot be used. Click the "Software forced stop" button again to make the "Start" button enabled.

(i) Single-step feed window closing (i))

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

(j) Switching to normal operation mode

To switch from the test operation mode to the normal operation mode, turn OFF the power of the controller.

MEMO

App. 1 Parameter list

POINT

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

Basic setting parameters (PA □□)

No.	Symbol	Name	Control mode
PA01	*STY	Control mode	P, S, T
PA02	*REG	Regenerative option	P, S, T
PA03		For manufacturer setting	
PA04	*AOP1	Tough drive function selection	P, S, T
PA05	*FBP	Number of command input pulses per revolution	P
PA06	CMX	Electronic gear numerator (Command input pulse multiplying factor numerator)	P
PA07	CDV	Electronic gear denominator (Command input pulse multiplying factor denominator)	P
PA08	ATU	Auto tuning mode	P, S
PA09	RSP	Auto tuning response	P, S
PA10	INP	In-position range	P
PA11	TLP	Forward torque limit	P, S, T
PA12	TLN	Reverse torque limit	P, S, T
PA13	*PLSS	Command input pulse form	P
PA14	*POL	Rotation direction selection	P
PA15	*ENR	Encoder output pulses	P, S, T
PA16	*ENR2	Encoder output pulse electronic gear	P, S, T
PA17 PA18		For manufacturer setting	
PA19	*BLK	Parameter write inhibit	P, S, T

Gain/filter parameters (PB □□)

No.	Symbol	Name	Control mode
PB01	FILT	Adaptive tuning mode (Adaptive filter Ⅱ)	P, S
PB02	VRFT	Vibration suppression control filter tuning mode (Advanced vibration suppression control)	P
PB03	PST	Position command acceleration/ deceleration time constant (Position smoothing)	P
PB04	FFC	Feed forward gain	P
PB05		For manufacturer setting	
PB06	GD2	Load to motor inertia moment ratio	P, S
PB07	PG1	Model loop gain	P, S
PB08	PG2	Position loop gain	P
PB09	VG2	Speed loop gain	P, S
PB10	VIC	Speed integral compensation	P, S
PB11	VDC	Speed differential compensation	P, S
PB12	OVA	Overshoot amount compensation	P, S
PB13	NH1	Machine resonance suppression filter 1	P, S
PB14	NHQ1	Notch shape selection 1	P, S
PB15	NH2	Machine resonance suppression filter 2	P, S
PB16	NHQ2	Notch shape selection 2	P, S
PB17		Automatic setting parameter	
PB18	LPF	Low-pass filter setting	P, S
PB19	VRF1	Vibration suppression control vibration frequency setting	P
PB20	VRF2	Vibration suppression control resonance frequency setting	P
PB21 PB22		For manufacturer setting	
PB23	VFBF	Low-pass filter selection	P, S
PB24		For manufacturer setting	
PB25	*BOP1	Function selection B-1	P
PB26	*CDP	Gain changing selection	P, S
PB27	CDL	Gain changing condition	P, S
PB28	CDT	Gain changing time constant	P, S
PB29	GD2B	Gain changing load to motor inertia moment ratio	P, S
PB30	PG2B	Gain changing position loop gain	P
PB31	VG2B	Gain changing speed loop gain	P, S
PB32	VICB	Gain changing speed integral compensation	P, S
PB33	VRF1B	Gain changing vibration suppression control vibration frequency setting	P
PB34	VRF2B	Gain changing vibration suppression control resonance frequency setting	P
PB35 to PB37		For manufacturer setting	
PB38	NH3	Machine resonance suppression filter 3	P, S
PB39	NHQ3	Notch shape selection 3	P, S
PB40 to PB50		For manufacturer setting	

Extension setting parameters (PC □□)			
No.	Symbol	Name	Control mode
PC01	STA	Acceleration time constant	S, T
PC02	STB	Deceleration time constant	S, T
PC03	STC	S-pattern acceleration/deceleration time constant	S, T
PC04	TQC	Torque command time constant	T
PC05	SC0	Internal speed command 0	S
		Internal speed limit 0	T
PC06	SC1	Internal speed command 1	S
		Internal speed limit 1	T
PC07	SC2	Internal speed command 2	S
		Internal speed limit 2	T
PC08	SC3	Internal speed command 3	S
		Internal speed limit 3	T
PC09	MBR	Electromagnetic brake sequence output	P, S, T
PC10	ZSP	Zero speed	P, S, T
PC11	*BPS	Alarm history clear	P, S, T
PC12	TC	Internal torque command	T
PC13	*ENRS	Encoder output pulses selection	P, S, T
PC14	TL2	Internal torque limit 2	P, S, T
PC15	ERZL	Error excessive alarm detection level	P, S, T
PC16		For manufacturer setting	
PC17	*OSL	Overspeed alarm detection level	P, S, T
PC18		For manufacturer setting	
PC19			
PC20			
PC21			
PC22	*COP1	Function selection C-1	P, S, T
PC23	*COP2	Function selection C-2	S
PC24	*COP3	Function selection C-3	S
PC25	*COP4	Function selection C-4	P, S
PC26	ALDT	Detailed setting of overload tough drive	P, S, T
PC27	OSCL	Detailed setting of vibration tough drive	P, S
PC28	CVAT	Detailed setting of instantaneous power failure tough drive	P, S, T
PC29	*COP5	Function selection C-5	P, S, T
PC30	*COP6	Function selection C-6	S
PC31	SC4	Internal speed command 4	S
		Internal speed limit 4	T
PC32	SC5	Internal speed command 5	S
		Internal speed limit 5	T
PC33	SC6	Internal speed command 6	S
		Internal speed limit 6	T
PC34	SC7	Internal speed command 7	S
		Internal speed limit 7	T
PC35 to PC64		For manufacturer setting	

I/O setting parameters (PD □□)			
No.	Symbol	Name	Control mode
PD01	*DIA1	Input signal automatic ON selection 1	P, S, T
PD02		For manufacturer setting	
PD03	*DI1-1	Input signal device selection 1L (CN1-3)	P, S, T
PD04	*DI1-2	Input signal device selection 1H (CN1-3)	P, S, T
PD05	*DI2-1	Input signal device selection 2L (CN1-4)	P, S, T
PD06	*DI2-2	Input signal device selection 2H (CN1-4)	P, S, T
PD07	*DI3-1	Input signal device selection 3L (CN1-5)	P, S, T
PD08	*DI3-2	Input signal device selection 3H (CN1-5)	P, S, T
PD09	*DI4-1	Input signal device selection 4L (CN1-6)	P, S, T
PD10	*DI4-2	Input signal device selection 4H (CN1-6)	P, S, T
PD11	*DI5-1	Input signal device selection 5L (CN1-7)	P, S, T
PD12	*DI5-2	Input signal device selection 5H (CN1-7)	P, S, T
PD13	*DI6-1	Input signal device selection 6L (CN1-8)	P, S, T
PD14	*DI6-2	Input signal device selection 6H (CN1-8)	P, S, T
PD15	*DO1	Output signal device selection 1 (CN1-9)	P, S, T
PD16	*DO2	Output signal device selection 2 (CN1-10)	P, S, T
PD17	*DO3	Output signal device selection 3 (CN1-11)	P, S, T
PD18	*DO4	Output signal device selection 4 (CN1-12)	P, S, T
PD19	*DIF	Input filter setting	P, S, T
PD20	*DOP1	Function selection D-1	P, S, T
PD21		For manufacturer setting	
PD22	*DOP3	Function selection D-3	P
PD23		For manufacturer setting	
PD24	*DOP5	Function selection D-5	P, S, T
PD25		For manufacturer setting	
PD26			

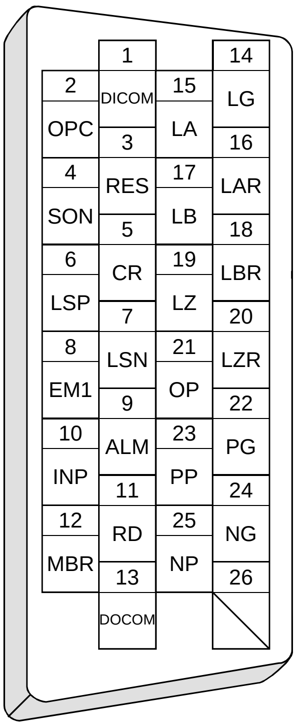
App. 2 Servo motor ID codes

Servo motor series ID	Servo motor type ID	Servo motor encoder ID	Servo motor
16	F053	0044	LE-□-□
	FF13		
	FF23		
	FF43		

App. 3 Signal layout recording paper

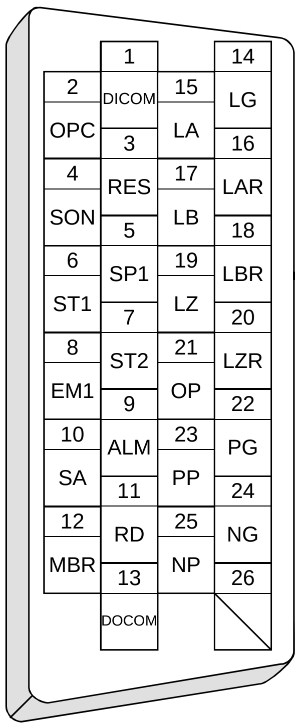
Position control mode

CN1



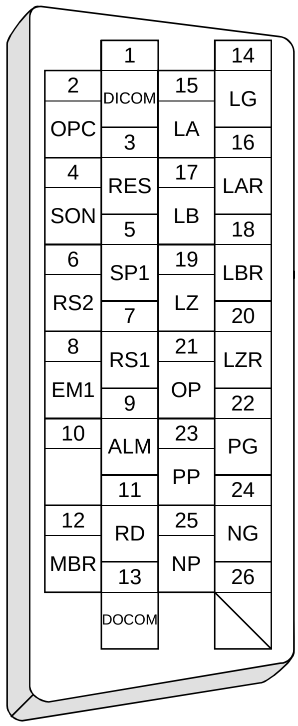
Internal speed control mode

CN1

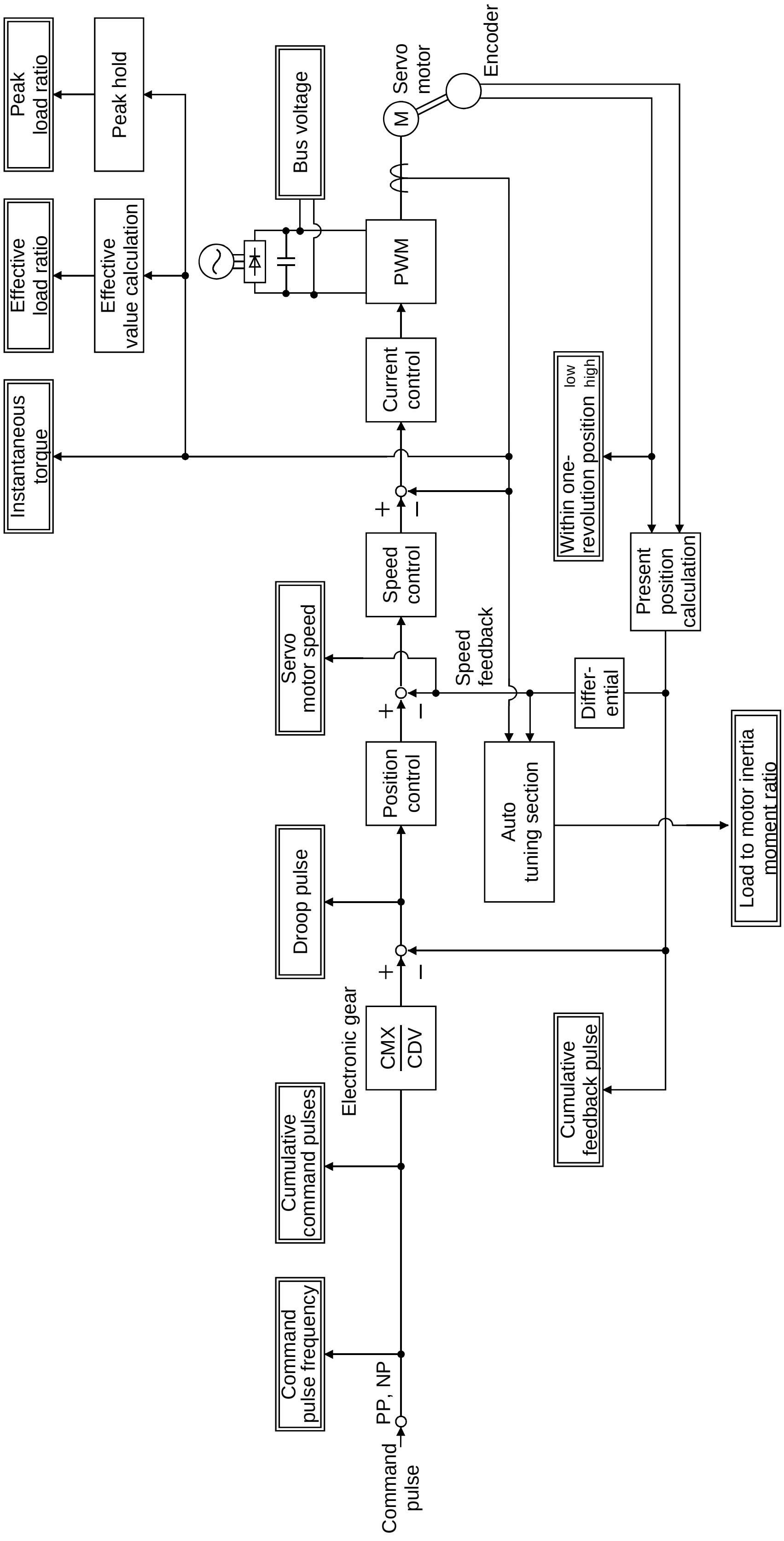


Internal torque control mode

CN1



App. 4 Status display block diagram



App.5 Compliance with EC directives

App.5.1 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 have been installed.

(1) EMC directive
The EMC directive applies not to the servo units alone but to servo-incorporated machines and equipment. This requires the EMC filters to be used with the servo-incorporated machines and equipment to comply with the EMC directive. For specific EMC directive conforming methods, refer to the EMC Installation Guidelines (IB(NA)67310).

(2) Low voltage directive
The low voltage directive applies also to servo units alone. Hence, they are designed to comply with the low voltage directive. This servo is certified to comply with the low voltage directive.

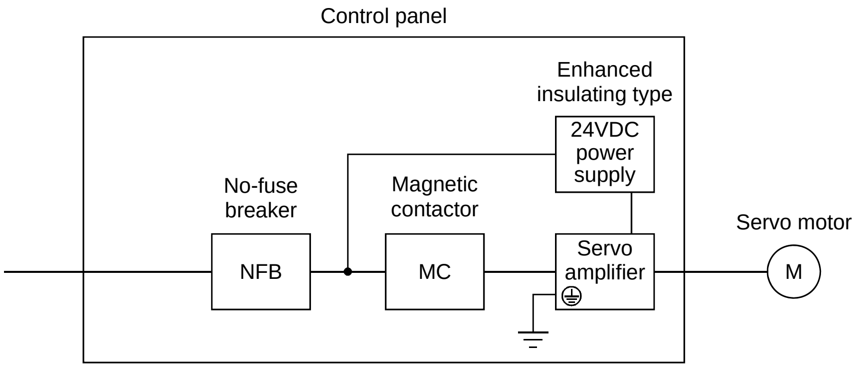
(3) Machine directive
Not being machines, the converter unit, servo amplifiers need not comply with this directive.

App.5.2 Precautions for compliance

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

Servo amplifier	Servo motor
	LE-□-□
LECSA□-S5	053・13
LECSA□-S7	23
LECSA-□-S8	43

(2) Configuration
The control circuit provides safe separation to the main circuit in the servo amplifier.



(3) Environment

(a) Operate the servo amplifier at or above the contamination level 2 set forth in IEC/EN60664-1. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

(b) Use the servo motor under the following environmental conditions.

Environment		Conditions
(Note 1) Ambient temperature	In operation	(Note 2) 0℃ to 55℃
	Under preservation or under transportation	-20℃ to 65℃
Ambient humidity	In operation, under preservation or under transportation	90%RH or less
Altitude	In operation or under preservation	1000m or lower
	Under transportation	10000m or lower

Note 1. The ambient temperature here represents the temperature within the control panel.

2. Close mounting of servo amplifiers is possible. In case of mounting servo amplifiers closely, bring the ambient temperature within 0 to 45℃, or use it at 75% or lower effective load ratio.

(4) Power supply

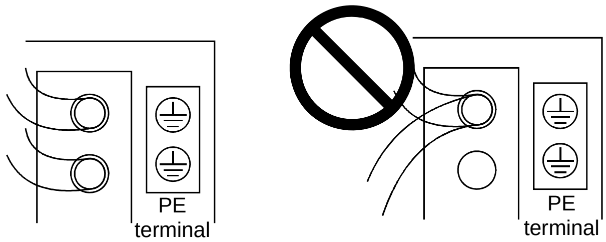
(a) This servo amplifier can be supplied from star-connected supply with earthed neutral point of overvoltage category III set forth in IEC/EN60664-1. However, when using the neutral point of 400V class for single-phase supply, a reinforced insulating transformer is required in the power input section.

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

(5) Grounding

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

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



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

(6) Wiring and installation

(a) When wiring the CNP1 and CNP2 connectors with the twisted wire, strip its sheath and twist its 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.

(b) Be sure to install the servo amplifier on a metallic control panel.

(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 MR-JN-□A SERVO AMPLIFIER INSTRUCTION MANUAL. Use a type B (Note) breaker. When it is not used, provide insulation between the servo amplifier and other device by double insulation or reinforced insulation, or install a transformer between the main power supply and servo amplifier.

Note. •Type A: AC and pulse detectable
•Type B: Both AC and DC detectable

(b) The sizes of the cables described in MR-JN-□A SERVO AMPLIFIER INSTRUCTION MANUAL meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in IEC/EN60204-1.

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

(c) Use the EMC filter for noise reduction.

(8) Performing EMC tests

When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

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

App.6 Conformance with UL/CSA standard

(1) Servo amplifiers and servo motors used

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

Servo amplifier	Servo motor
	LE-□-□
LECSA□-S5	053・13
LECSA□-S7	23
LECSA-□-S8	43

(2) Installation

LECSA-□-□ series products cannot be installed on any other place than within control panels. Design the control panel as follows.

・The volume of the control panel is more than 150% of the total volume of each module.

・The temperature within the control panel is kept at 55℃ or lower.

Be sure to install the servo amplifier on a metallic control panel.

(3) Short circuit rating: SCCR (Short Circuit Current Rating)

This servo amplifier conforms to the circuit whose peak current is limited to 100kA or less, 500Volts Maximum. Having been subjected to the short-circuit tests of the UL in the alternating-current circuit, the servo amplifier conforms to the above circuit.

(4) Flanges

Install the servo motor to the flanges, whose sizes are shown below. Otherwise, install the servo motor to flanges providing equivalent or superior heat dissipation effects than the following ones.

Flange size [mm]	Servo motor
250×250×6	053・13・23
250×250×12	43

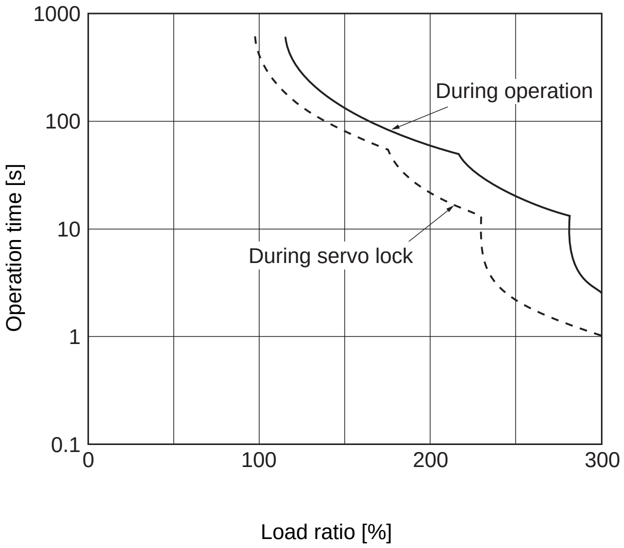
(5) Capacitor discharge time

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

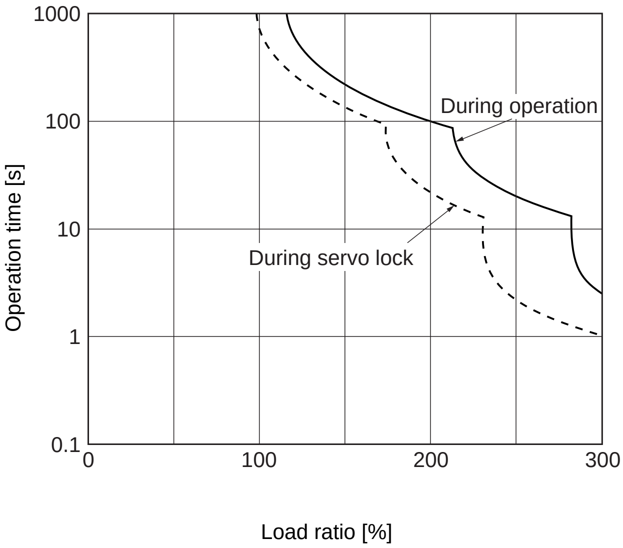
Servo amplifier	Discharge time [min]
LECSA□-S1 LECSA□-S3 LECSA□-S4	2

(6) Overload protection characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. The operation characteristics of the electronic thermal relay are shown below. In a machine like the one for vertical lift application where unbalanced torque is produced, it is recommended to use the machine so that the unbalanced torque is 70% or less of the rated torque. When you carry out adhesion mounting of the servo amplifier, make circumference temperature into 0 to 45℃ or use it with 75% or less of effective load torque.



LECSA□-S1



LECSA□-S3, LECSA□-S4

(7) Selection example of wires

To comply with the UL/CSA Standard, use UL-approved copper wires rated at 60/75℃ for wiring.

The following table shows the wire sizes [AWG] and the crimping terminal symbols rated at 60℃. The sizes and the symbols rated at 75℃ are shown in the brackets.

Servo amplifier	Wire [AWG]				
	L_1 ▪ L_2 ▪ ⏚	24V ▪ 0V	U ▪ V ▪ W ▪ ⏚	P ▪ C	B1 ▪ B2
LECSA□-S1 LECSA□-S3 LECSA□-S4	14(14)	14(14)	(Note) 14(14)	14(14)	16(16)

Note. To wire the servo amplifier and a servo motor, use the MR-PWS1CBL (option). To extend the wiring, use the AWG14 wire size.

(8) 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.

(9) Options, peripheral devices

Use the UL/CSA Standard-compliant products.

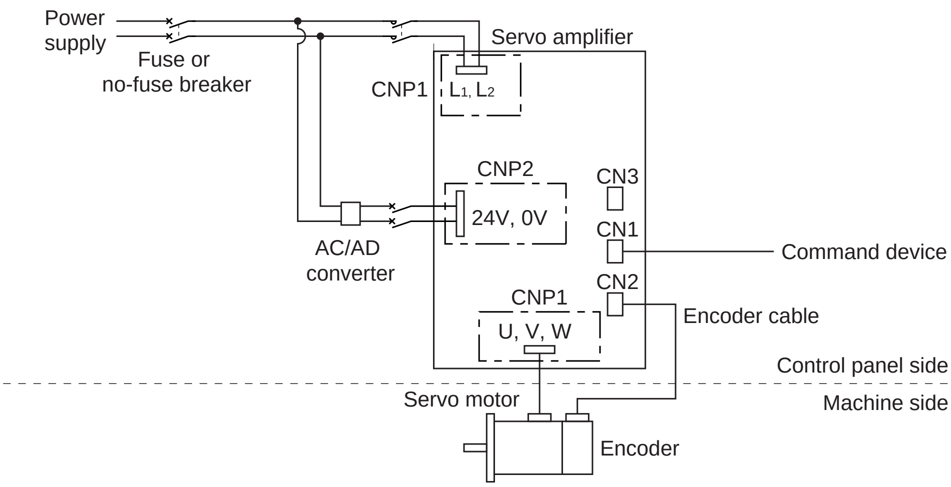
Use the no-fuse breaker (UL489 Listed MCCB) or a Class T fuse indicated in the table below.

Servo amplifier	No-fuse breaker (Note)		Fuse	
	Current	Voltage AC	Current	Voltage AC
LECSA□-S1	30A frame 5A	240V	10A	300V
LECSA□-S3	30A frame 10A		15A	
LECSA□-S4	30A frame 15A		20A	

Note. Listed no-fuse breakers are for when the power factor improving reactor is not used.

(10) Configuration diagram

Representative configuration example to conform to the UL/C-UL standard is shown below. The earth wiring is excluded from the figure configuration.



Revision history

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