FUJI SERVO SYSTEM

ALPHA5

USER'S MANUAL

RYT-VV type

ALPHA5

MEHT300b

This manual is "User's Manual for Fuji AC Servo System ALPHA5 Series".
The user's manual is in one volume and covers all handling methods of the product.

The following documents are included in the package of each device.

Device	Document name	Doc. No.
Servomotor	Operation Manual Fuji AC servomotor (GY□ Series)	ING-SI47-0863-JE
Servo amplifier	Operation manual Fuji AC servo ALPHA5 Series servo amplifier (RYT□□□D (C/B)-□□□)	INR-SI47-1126-JE

The target model of this manual is shown below.

Device	Model
Servomotor	GYS□□□D5-*** or GYC□□□D5-*** or GYG□□□C (B) 5-***
Servo amplifier	RYT□□□D (C/B)-VV□

* "□" in the model indicates a decimal point or number.
* "*" in the model indicates an alphabet or blank.

For uncertainties in the product or description given in this manual, contact the dealer or our sales office shown at the end of this volume.

■ Manual

Description given in this manual may be inconsistent to the product due to improvements added to the product. Description given in this manual is subject to change without notice.
Illustrations included in this manual show the servo amplifier or servomotor of a specific capacity and they may be different from the appearance of the product you purchased.

This product is not designed or manufactured for use in devices or systems related to human lives. To use this product for aeronautic devices, traffic controllers, space industry devices, nuclear reactor controllers, medical devices or systems including those devices, contact our sales window.
To use the product for equipment in which failure of the product will be engaged with human lives or serious material losses, install safety devices matching the equipment.

■ Icon

The following icons are used in the description of the manual when necessary.

Note	Negligence of description shown with this sign will undermine the true performance of the product.
Hint	Reference items helpful for operation and data entry of the servomotor or servo amplifier are described.

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CHAPTER 0 INTRODUCTION

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0.1 Safety Precautions

(1) Types and meanings of warning signs

Before starting installation, wiring work, maintenance or inspection, read through this manual and other attached documents.
Be familiar with the device, safety information and precautions before using.
In this manual, safety precautions are described in two categories: "WARNING" and "CAUTION."

Warning sign	Meaning
WARNING	Negligence of description will cause danger in which deaths or serious injuries may be caused.
CAUTION	Negligence of description will cause danger in which minor or medium injuries or material losses may be caused.

Description given in the "CAUTION" category may cause serious results under some circumstances.
All descriptions are critical and should be strictly observed.
After reading, keep the manual in a place where users can refer to it at any time.

(2) Graphic symbols

Graphic symbols are used when necessary.

Graphic symbol	Meaning
	Do not touch
	Do not disassemble
	Notice of general prohibition

Graphic symbol	Meaning
	Make sure to make grounding

■ Precautions on use

⚠ WARNING

- Do not touch the inside of the servo amplifier.
  There is a risk of electric shock.
- Make sure to ground the grounding terminal of the servo amplifier and servomotor.
  There is a risk of electric shock.
- Before performing wiring or inspection, turn the power off and wait for at least five minutes, and check that the charge LED is unlit.
  There is a risk of electric shock.
- Do not give damage or unreasonable stress to cables. Do not place a heavy matter on them or do not pinch them.
  It might cause failure, breakage and electric shock.
- Do not touch the rotating part of the servomotor during operation.
  It might cause injuries.

⚠ CAUTION

- Use the servomotor and servo amplifier in a designated set.
  It might cause fire and failure.
- Never use at places susceptible to water splashes, in corrosive atmosphere, in flammable gas atmosphere or near flammable matters.
  It might cause fire and failure.
- As the servo amplifier, servomotor and peripheral devices temperature will become high and requires careful considerations.
  There is a risk of burns.
- Do not touch the heat sink of the servo amplifier, braking resistor, servomotor and so on while they are turned on and for a while after they are turned off due to high temperature.
  There is a risk of burns.
- If the surface temperature of the servomotor exceeds 70 [°C] during operation of the servomotor of the final assembly, affix a "hot" caution label.
- If a braking resistor is used, take measures to turn the power off upon a fault signal output from the servo amplifier.
  Otherwise the braking resistor may be overheated and cause fire in the event of failure of the braking transistor.

■ Precautions on storage

⚠ CAUTION

- Do not store at places susceptible to rain or water splashes or toxic gases or liquid.
  It might cause failure.
- Store at places without direct sunshine within the predetermined temperature and humidity range (between -20 [°C] and 60 [°C], between 10 [%] and 90 [%] RH, without condensation).
  It might cause failure.
- To store in the installed state.
  Cover the entire servomotor with a sheet to protect against vapor, oil and water. Apply an anticorrosive agent on machined surfaces such as the shaft and flange face.
  To avoid rust on bearings, turn manually or operate for five minutes without a load about once a month.

■ Precautions on transportation

⚠ CAUTION

- Do not hold cables or motor shaft when transporting.
  It might cause failure and injuries.
- Overloaded products will cause collapse of cargo, hence observe the requirements.
- The eye bolt of the servomotor shall be applied exclusively for transportation of the servomotor. Do not use it to transport machineries.
  It might cause failure and injuries.

■ Precautions on installation

⚠ CAUTION

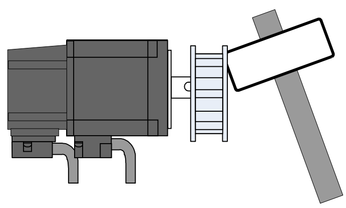
- Do not ride on the servomotor or place a heavy matter on it.
  It might cause failure, breakage, electric shock and injuries.
- Do not block the exhaust port or do not allow foreign substance to enter.
  It might cause fire and electric shock.
- Observe the installation orientation of the servo amplifier.
  Otherwise, it might cause fire and failure.
- Do not apply strong impact.
  It might cause failure.
- The shaft-through hole of the servomotor is not water proof or oil proof. Take measures on the machine side to block entry of water, coolant or similar from entering inside the servomotor.
  It might cause failure.
- If case of application when massive water or oil is splashed on the main body of the servomotor, install a water or oil splash guard or take similar measures on the machine side.
- In a humid and high oil mist environment, install the lead wires and connectors in a face down orientation.
  It might cause poor insulation, short circuit and resultant failure.

Do not disassemble

- Never remodel the servomotor and servo amplifier.
  It might cause fire and failure. It will not be covered by the warranty.

Do not hammer

- Do not apply strong impact on the output shaft of the servomotor.
  It might cause damage to the encoder inside the motor.



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■ Precautions on wiring

⚠ CAUTION

- Never apply the commercial power supply to the U, V and W terminals of the servomotor.
  It might cause fire and failure.
- Do not connect the grounding (E) cable to the U, V and W terminals of the servomotor. Do not connect the U, V and W terminals in inappropriate order.
  It might cause fire or failure.
- Never perform a dielectric, Megger or buzzer test to the encoder terminals.
  Otherwise the encoder will be damaged.
- To perform a dielectric, Megger or buzzer test to the U, V and W terminals of the servomotor, disconnect the servo amplifier.
- Do not connect encoder terminals in inappropriate order.
  Otherwise the encoder and servo amplifier will be damaged.
- In an adverse power supply environment, insert a protective device such as the AC reactor so that the voltage fluctuation is contained within the rating.
  Otherwise the servo amplifier will be damaged.
- Install a circuit breaker or similar safety devices for short circuits in external wiring.
  There is a risk of fire or failure.
- Do not remove the cover or disconnect the cable, connector or optional device with the servo amplifier turned on.
  There is a risk of electric shock to human body, product operation stop, and burnout.
- Use the servo system under the specified voltage range.
- Do not tie signal cables or route them in the same duct with main power cable or servo amplifier motor output cable.
- Use the designated wiring material. In particular, use the option cable or equivalent for the encoder cable.
- Do not insert a phase advance capacitor, various filter, reactor or similar on the output side of the servo amplifier.
- The servo amplifier cannot be fully protected from ground fault.

Ground

- Be sure to connect the grounding terminal of the servo amplifier to a grounding electrode.
  There is a risk of electric shock.

■ Precautions on operation

⚠ CAUTION

- In order to avoid unstable motions, never change adjustment radically.
  It might cause injuries.
- To perform test operation, fix the servomotor and leave it disconnected from the mechanical system. After checking the motion, connect to the machine.
  Otherwise, it might cause injuries.
- The retention brake incorporated in the servo motor is not a stopping unit for assuring safety of the machine. Install a stopping unit on the machine side to assure safety.
  It might cause failure and injuries.
- When an alarm occurs, resolve the cause and assure safety before performing alarm reset and restarting operation.
  It might cause injuries.
- Stay away from the machine after power failure and power restoration because sudden restart may be triggered. (Design the machine so that personal safety is secured even if the machine restarts suddenly.)
  It might cause injuries.
- The brake incorporated in the servomotor is for retention. Do not use it for regular braking operation.
  It might cause failures and injuries.
- Install an external emergency stop circuit so that operation can be stopped immediately and the power can be turned off.
  Otherwise, it might cause fire, failure, burns and injuries.
- Before installing to the machine and starting operation, enter parameters matching the machine. If the machine is operated without entering parameters, the machine may unexpectedly malfunction and cause failure.
- To use the servomotor in a vertical travel, install a safety device (Such as external brake) to prevent the mechanical movable part from dropping in case of alarm or similar.
- If auto tuning is not used, be sure to enter the "inertia ratio."

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■ General precautions

⚠ CAUTION

- Drawings in this manual may show the state without covers or shields for safety to explain in details. Restore the covers and shields in the original state when operating the product.
- In case of disposal of the product, comply with the following two laws and act in accordance with each regulation. These laws are effected in Japan. Outside Japan, local laws have priority. When necessary, give notification or indication on the final assembly to be compliant with legal requirements.

(1) Law Concerning Promotion of Effective Use of Resources (Law for Promotion of Effective Utilization of Resources)
Recycle and collect resources from the product to be discarded, as far as possible.
It is recommended to disassemble the product into iron dust, electric parts and so on and sell them to appropriate subcontractors to recycle and collect resources.

(2) Waste Disposal and Public Cleaning Law (Waste disposal & law public cleansing law)
It is recommended to recycle and collect resources from the product, which is to be discarded, according to the aforementioned law (Law for Promotion of Effective Utilization of Resources, and to reduce waste.
In case unnecessary product cannot be sold and will be discarded, the product falls in the category of industrial waste described in the law. The industrial waste must be handled in due course including to request an authenticated subcontractor to dispose of the product and control manifesto.
The battery used in the product falls in the category of called "primary battery" and must be discarded in the due course as required by the corresponding local government.

■ Harmonics suppression measures (for Japan)

(1) All models of the servo amplifier used by the special customer are applicable to "guideline of harmonics suppression measures for high voltage or special high voltage customers." The guideline requires the customer to calculate the equivalent capacity and harmonics outflow current according to the guideline and, if the harmonics current exceeds the limit stipulated for the contract wattage, corresponding countermeasures must be taken.
For details, refer to JEM-TR225.

(2) The servo amplifier was excluded from the scope of "guideline of harmonics suppression measure for electric appliances and general purpose products" from January 2004. JEMA is preparing a new technical document in the position to educate total harmonics suppression measures.
Harmonics suppression measures of the discrete device should be taken as far as possible.

Source: The Japan Electrical Manufacturers' Association (JEMA)

■ Compliance with EU directives

EU directives aim at integration of regulations among the EU member countries to promote distribution of safety assured products. It is required to satisfy basic safety requirements including machine directive (enacted in January 1995), EMC directive (enacted in January 1996), and low voltage directive (enacted in January 1997) and affix a CE mark (CE marking) on the product sold in EU member countries. Machines and devices housing the servo system are subjected to CE marking.
The servo system does not function independently but is a component to be used in combination with machines and equipments. For this reason, the servo system is not applicable to the EMC directive but the machine or equipment including the servo system is applicable.
In order to facilitate CE marking declaration on the assembly machine or equipment of the servo system, optional devices that are compliant with the low voltage directive and that support compliant with the EMC directive as well as a relevant guideline are prepared.

■ Compliance with RoHS directive

RoHS directive concerns with toxic materials and it was made into effective on July 1, 2006 in the EU member countries. The directive prohibits inclusion of toxic materials in electric and electronic devices. Regulated materials include Pb (lead), Cd (cadmium), Cr^{6+} (hexavalent chromium), Hg (mercury), PBB (polybromobiphenyl), PBDE (polybromobiphenyl ether).
This servo system is compliant with the RoHS directive.
The color (screw color, etc.), gloss and material may be different from those of conventional products in order to comply with the RoHS directive, but will not cause an effect in the performance and specifications.

■ Service life of EEPROM

This product is equipped with EEPROM for retaining parameter data in the event of power failure. The write enable frequency of EEPROM is about 100,000 cycles. After the following operation is repeated 100,000 times or more, the risk of the servo amplifier failure becomes higher.

- Parameter editing
- Position preset of absolute position system
- Batch transfer of parameters

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0.2 Outline of System

ALPHA 5 Series is an AC servo system that supports various host interfaces and realizes the best motion control for the target machine.

0.2.1 Servomotor

The variation of the servomotor includes three types: slim type (GYS), cubic type (GYC) and medium inertia type (GYG). Each type is provided with the INC-only 20-bit encoder model and the common ABS / INC 18-bit encoder model.

Model	Rated speed (max. speed)	Power supply	Rated output capacity	Servomotor type		Protective constructon	Encoder	Type
				Without brake	With brake			
 **GYS motor** Ultra-low inertia	3000r/min (0.75kW or less: 6000r/min 1.0kW or more: 5000r/min)	200V series	11 types 0.05 to 5.0kW	●	●	IP67 *1	18-bit ABS/INC	GYS***D5-HB2(-B) *2
							20-bit INC	GYS***D5-RB2(-B) *2
		100V series	4 types 0.05 to 0.375kW	●	●	IP67 *1	18-bit ABS/INC 20-bit INC	GYS***D5-HB6(-B) *2 GYS***D5-RB6(-B) *2
 **GYC motor** Low inertia	3000r/min (0.75kW or less: 6000r/min 1.0kW or more: 5000r/min)	200V series	7 types 0.1 to 2.0kW	●	●	IP67 *1	18-bit ABS/INC	GYC***D5-HB2(-B) *2
							20-bit INC	GYC***D5-RB2(-B) *2
 **GYG motor** Middle inertia	2000r/min (3000r/min)	200V series	5 types 0.5 to 2.0kW	●	●	IP67 *1	18-bit ABS/INC	GYG***C5-HB2(-B) *2
							20-bit INC	GYG***C5-RB2(-B) *2
 **GYG motor** Middle inertia	1500r/min (3000r/min)	200V series	3 types 0.5, 0.85, 1.3kW	●	●	IP67 *1	18-bit ABS/INC	GYG***B5-HB2(-B) *2
							20-bit INC	GYG***B5-RB2(-B) *2

*1: Except for shaft-through part (and connectors for GYS and GYC motors of 0.75 kW or less).

*2: Models with a brake has "-B" at the end.

0.2.2 Servo Amplifier

Three types of servo amplifiers are provided: general-purpose interface type (VV), high-speed serial bus type (VS) and positioning type (LS). (The positioning type and high-speed serial bus type are compatible with our SX bus.)

<table>
<tr><th colspan="2" rowspan="2">Model</th><th colspan="4">Command interface</th><th colspan="4">Control mode</th><th rowspan="2">Power supply</th><th rowspan="2">Capacity</th><th rowspan="2">Type</th><th rowspan="2">Applicable motor series</th></tr>
<tr><th>Pulse/ analog</th><th>Di/Do</th><th>Modbus -RTU</th><th>SX bus</th><th>Positioning</th><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td rowspan="3">
General-purpose interface</td><td rowspan="3">VV type</td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3"></td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3">●</td><td rowspan="3">●</td><td>Single-phase or 3-phase 200 to 240 VAC</td><td>0.05 to 0.75kW</td><td rowspan="2">RYT***□5-VV2</td><td rowspan="2">GYS
GYC
GYG</td></tr>
<tr><td>3-phase 200 to 240 VAC</td><td>0.85 to 5.0kW</td></tr>
<tr><td>Single-phase 100 to 120 VAC</td><td>0.05 to 0.375kW</td><td>RYT***□5-VV6</td><td>GYS</td></tr>
<tr><td rowspan="4">
High speed serial bus (SX bus)</td><td rowspan="2">VS type</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">●</td><td rowspan="2"></td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">●</td><td>Single-phase or 3-phase 200 to 240 VAC</td><td>0.05 to 0.75kW</td><td rowspan="3">RYT***□5-VS2
RYT***□5-LS2</td><td rowspan="3">GYS
GYC
GYG</td></tr>
<tr><td rowspan="2">3-phase 200 to 240 VAC</td><td rowspan="2">0.85 to 5.0kW</td></tr>
<tr><td rowspan="2">LS type</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2">●</td><td rowspan="2"></td></tr>
<tr><td>Single-phase 100 to 120 VAC</td><td>0.05 to 0.375kW</td><td>RYT***□5-VS6
RYT***□5-LS6</td><td>GYS</td></tr>
</table>

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0.3 Model Nomenclature

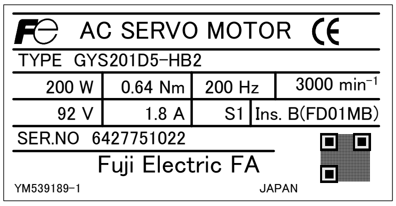
■ When unpacking

Check the following items.

- Check if the delivered item is what you have ordered.
- Check if the product is damaged during transportation.
- Check if the instruction manual is included.

If you have any uncertainties, contact the seller.

0.3.1 Servomotor



GYS 500 D 5 – H B 2 – B

Code	[Basic type]
GYS	Slim type (Ultra-low inertia)
GYC	Cubic type (Low inertia)
GYG	Middle inertia type

Code	[Rated output]
500	50×10^0=0.05kW
101	10×10^1=0.1kW
201	20×10^1=0.2kW
401	40×10^1=0.4kW, 0.375kW
501	50×10^1=0.5kW
751	75×10^1=0.75kW
851	85×10^1=0.85kW
102	10×10^2=1.0kW
132	13×10^2=1.3kW
152	15×10^2=1.5kW
202	20×10^2=2.0kW
302	30×10^2=3.0kW
402	40×10^2=4.0kW
502	50×10^2=5.0kW

Code	[Rated speed]
D	3000r/min series
C	2000r/min series
B	1500r/min series

Code	[Order of development]
5	5

Code	[Brake]
Blank	Not provided
B	Provided

Code	[Input voltage]
2	3-phase 200 VAC
6	Single-phase 100 VAC

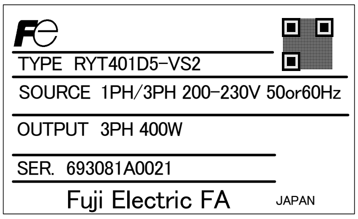
Code	[Oil seal/shaft]	Applicable motor GYS, GYC, GYG
A	Without an oil seal, straight shaft with a key	△ (*○)
B	Without an oil seal, straight shaft without a key	◎
C	Without an oil seal, straight shaft with a key, tapped	○
E	With an oil seal, straight shaft with a key	△
F	With an oil seal, straight shaft without a key	△
G	With an oil seal, straight shaft with a key, tapped	△

◎: Standard item ○: Semi-standard item
△: Made-to-order item
* Applicable with GYS and GYC motors of 0.1kW or less

Code	[Encoder]
H	18-bit ABS/INC
R	20-bit INC

0.3.2 Servo Amplifier

The model and serial number are also marked on the front panel of the main body of the servo amplifier.



RYT 500 D 5 – V S 2

Code	[Basic type]
RYT	ALPHA5 series

Code	[Applicable motor output]
500	50×10^{0}=0.05kW
101	10×10^{1}=0.1kW
201	20×10^{1}=0.2kW
401	40×10^{1}=0.4kW, 0.375kW
501	50×10^{1}=0.5kW
751	75×10^{1}=0.75kW
851	85×10^{1}=0.85kW
102	10×10^{2}=1.0kW
132	13×10^{2}=1.3kW
152	15×10^{2}=1.5kW
202	20×10^{2}=2.0kW
302	30×10^{2}=3.0kW
402	40×10^{2}=4.0kW
502	50×10^{2}=5.0kW

Code	[Series]
D	3000r/min series
C	2000r/min series
B	1500r/min series

Code	[Order of development]
5	5

Code	[Input voltage]
2	3-phase 200 VAC
6	Single-phase 100 VAC

Code	[Upper interface]
S	SX bus
V	General-purpose interface (pulse, analog voltage)

Code	[Major functions]
V	Position, speed and torque control
L	Built-in positioning function

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0.4 Combination between Servomotor and Servo Amplifier

Use the servomotor and servo amplifier in one of the following sets.

Do not use in other sets.

0.4.1 VV Type

Motor model	Rated rotation speed [r/min]	Motor model	Capacity [kW]	Servo amplifier model	Frame
GYS	3000	GYS500D5-□□2(6)-(B)	0.05	RYT500D5-VV2、VV6	1
		GYS101D5-□□2(6)-(B)	0.1	RYT101D5-VV2、VV6	1
		GYS201D5-□□2(6)-(B)	0.2	RYT201D5-VV2、VV6	1
		GYS401D5-□□6-(B)	0.375	RYT401D5-VV6	2
		GYS401D5-□□2-(B)	0.4	RYT401D5-VV2	2
		GYS751D5-□□2-(B)	0.75	RYT751D5-VV2	3
		GYS102D5-□□2-(B)	1.0	RYT102D5-VV2	4
		GYS152D5-□□2-(B)	1.5	RYT152D5-VV2	4
		GYS202D5-□□2-(B)	2.0	RYT202D5-VV2	5
		GYS302D5-□□2-(B)	3.0	RYT302D5-VV2	5
		GYS402D5-□□2-(B)	4.0	RYT402D5-VV2	6
		GYS502D5-□□2-(B)	5.0	RYT502D5-VV2	6
GYC	3000	GYC101D5-□□2-(B)	0.1	RYT101D5-VV2	1
		GYC201D5-□□2-(B)	0.2	RYT201D5-VV2	1
		GYC401D5-□□2-(B)	0.4	RYT401D5-VV2	2
		GYC751D5-□□2-(B)	0.75	RYT751D5-VV2	3
		GYC102D5-□□2-(B)	1.0	RYT102D5-VV2	4
		GYC152D5-□□2-(B)	1.5	RYT152D5-VV2	4
		GYC202D5-□□2-(B)	2.0	RYT202D5-VV2	5
GYG	2000	GYG501C5-□□2-(B)	0.5	RYT501C5-VV2	3
		GYG751C5-□□2-(B)	0.75	RYT751C5-VV2	3
		GYG102C5-□□2-(B)	1.0	RYT102C5-VV2	4
		GYG152C5-□□2-(B)	1.5	RYT152C5-VV2	5
		GYG202C5-□□2-(B)	2.0	RYT202C5-VV2	5
	1500	GYG501B5-□□2-(B)	0.5	RYT501B5-VV2	3
		GYG851B5-□□2-(B)	0.85	RYT851B5-VV2	4
		GYG132B5-□□2-(B)	1.3	RYT132B5-VV2	5

Motor=□□2, amplifier=VV2: power supply voltage 200V

Motor=□□6, amplifier=VV6: power supply voltage 100V

CHAPTER 1 INSTALLATION

1

1.1 Servomotor

1.1.1 Storage Environment

Select the following environment when storing the servomotor, or when resting the machine under the state without power distribution.

Item	Environmental condition
Ambient temperature	-20 [°C] to +60 [°C] (no freezing allowed)
Ambient humidity	10 [%] to 90 [%] RH (no condensation allowed)

1.1.2 Operating Environment

Operate the servomotor in the following environment.

Item	Environmental condition
Ambient temperature	-10 [°C] to +40 [°C] (no freezing allowed)
Ambient humidity	10 [%] to 90 [%] RH (no condensation allowed)
Vibration	49 [m/s^2] or less (3000 [r/min], 0.75 [kw] or less) 24.5 [m/s^2] or less (3000 [r/min], 1 [kw] or more) 24.5 [m/s^2] or less (1500 [r/min], 2000 [r/min])
Atmospheric pressure	70 [kPa] to 106 [kPa]

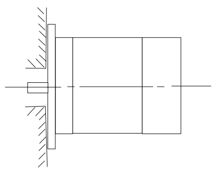
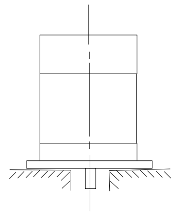
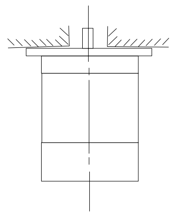
Observe the following when operating.

- Install indoors at a place free from rainwater and direct sunshine.
- Do not operate in corrosive atmosphere including hydrogen sulfides, sulfurous acid, chlorine, ammonia, sulfur, chlorine-based gases, acids, alkalis or salts or near flammable gases or matters.
- Install at a place free from splashes of coolant, oil mist, iron powder and chips.
- Install in a well ventilated environment with less vapor, oil and water content.
- Install at a place advantageous for inspection and cleaning.
- Install at a place with less vibration.
- Do not install in an airtight environment.

1.1.3 Installing the Servomotor

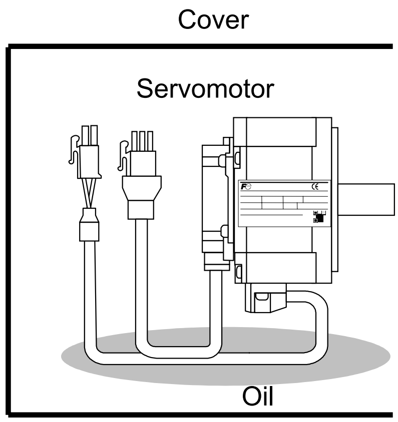
The servomotor can be installed horizontally or vertically with the shaft facing up or down. The same rule applies to the brake-incorporated servomotor and gear head.
The symbol in the figure is the installation method symbol specified by JEM. Description in parentheses ( ) indicates the earlier JEM symbol.

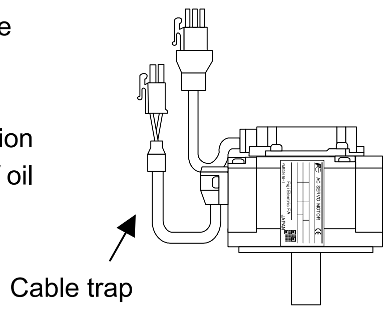
Flange type

IM B5 (L51)	IM V1 (L52)	IM V3 (L53)
		

1.1.4 Water Proof and Oil Proof Properties

- The servomotor itself has resistance against splashes in relatively small amount. However, the shaft-through part is not water proof or oil proof. Take mechanical protective measures to block entry of water and oil.
- Install a cover in environments susceptible to much water, oil or oil mist.
- Do not operate with cables immersed in oil.
- Some coolant types can provide on sealant, cable, case or similar.
- To install the servomotor horizontally, install so that the servomotor cables face down.
  To install the servomotor vertically or at an oblique direction, route the cables to secure a cable trap (see the figure on the right).
- In case of a servomotor equipped with an oil seal, although noise might be created from the oil seal, it will not effect any functional operation.
- To install the servomotor equipped with an oil seal in an orientation with the shaft facing up, take measures to avoid accumulation of oil at the oil seal lip.



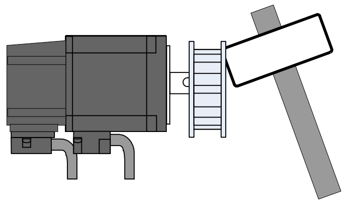


1.1.5 Servomotor Handling Precautions

1

Do not hammer

- Do not give a strong impact on the output shaft of the servomotor.
  Otherwise the encoder inside the motor will be broken.



- Align the center when connecting with the machine system. Use a flexible coupling.
  Use rigid one designed exclusively for servomotors whenever possible.
- Do not use a rigid coupling which does not allow errors between shafts.
  Otherwise mechanical vibration will be caused, resulting in damaged bearings and/or shorter service life.
- Do not supply commercial power directly to the servomotor. It will cause burnout.
  Test run with commercial power also shall not be performed.

1.1.6 Notes on Stress Given to Cable

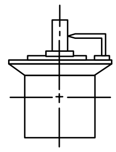
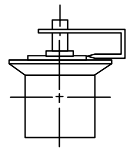
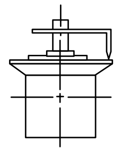
- In applications where the servomotor and machine movable part move, take measures to avoid stress given on the cable.
- Route the encoder cable and motor power cable in CABLEVEYOR.
- Fix the encoder cable and motor power cable attached to the servomotor (routed from the motor) with cable clamps or similar.
- Design the radius of bend as large as possible.
- Do not allow bending stress or stress caused by the self weight, at joints of the cable.

1.1.7 Assembling Accuracy

The assembling accuracy of the servomotor is shown below.

Unit: [mm]

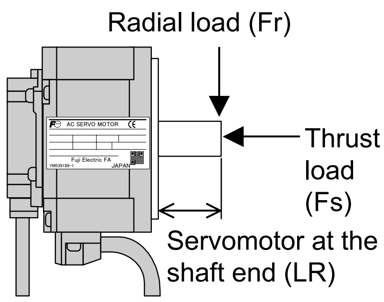
Servomotor model	Runout at shaft end	Misalignment (flange)	Perpendicularity of flange face
GYS□□□D5	Within 0.02	Within 0.06	Within 0.08
GYC□□□D5			
GYG□□□□5			

Runout at shaft end	Misalignment	Perpendicularity of flange face
		

1.1.8 Allowable Load

The allowable radial load (Fr) and allowable thrust load (Fs) of the servomotor at the shaft end (LR) are shown below.

Motor model	Radial load Fr[N]	Thrust load Fs[N]	Servomotor at the shaft end LR[mm]
GYS500D5-□B2(6)	127	19	25
GYS101D5-□B2(6)	127	19	25
GYS201D5-□B2(6)	264	58	30
GYS401D5-□B2(6)	264	58	30
GYS751D5-□B2	676	147	40
GYS102D5-□B2	637	107	45
GYS152D5-□B2	637	107	45
GYS202D5-□B2	637	107	45
GYS302D5-□B2	921	166	63
GYS402D5-□B2	921	166	63
GYS502D5-□B2	921	166	63
GYC101D5-□B2	107	19	25
GYC201D5-□B2	235	39	30
GYC401D5-□B2	235	39	30
GYC751D5-□B2	460	88	40
GYC102D5-□B2	646	127	58
GYC152D5-□B2	803	137	58
GYC202D5-□B2	803	137	58
GYG501C5-□B2	400	253	55
GYG751C5-□B2	400	253	55
GYG102C5-□B2	510	253	55
GYG152C5-□B2	510	253	55
GYG202C5-□B2	510	253	55
GYG501B5-□B2	449	253	58
GYG851B5-□B2	449	253	58
GYG132B5-□B2	575	253	58



Radial load: the load applied vertically to the motor shaft
Thrust load: the load applied horizontally to the motor shaft

1.1.9 Cautionary Items on Servomotor Equipped with a Brake

- Brake noise
  The brake lining may issue chattering noise during operation of the motor equipped with a brake. As it is caused by brake structure and is not abnormal, the noise will not effect functional operation.
- Others (shaft end magnetization)
  The shaft end of the servomotor equipped with a brake is subject to leaking magnetic flux during energization of the brake coil (when the brake is released). At the instance, chips, screws and other magnetic bodies will be attracted. Cautions are required.

1.2 Servo Amplifier

1.2.1 Storage Environment

Select the following environment when storing the servo amplifier, or when resting the machine under the state without power distribution.

Item	Environmental condition
Ambient temperature	-20 [°C] to +80 [°C] (no freezing allowed)
Ambient humidity	10 [%] to 90 [%] RH (no condensation allowed)
Location	Indoors at altitude ≤ 1000 [m] free from powder dust, corrosive gases and direct sunshine
Atmospheric pressure	70 [kPa] to 106 [kPa]
Vibration / impact	4.9 [m/s^2]/19.6 [m/s^2]

1.2.2 Operating Environment

Operate the servo amplifier in the following environment. The servo amplifier is neither dust proof nor water proof.

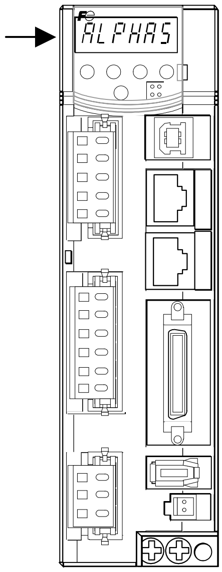
Item	Environmental condition
Ambient temperature	-10 [°C] to +55 [°C] (no freezing allowed)
Ambient humidity	10 [%] to 90 [%] RH (no condensation allowed)
Location	Indoors at altitude ≤ 1000 [m] free from powder dust, corrosive gases and direct sunshine
Vibration	4.9 [m/s^2]

Observe the following when operating.

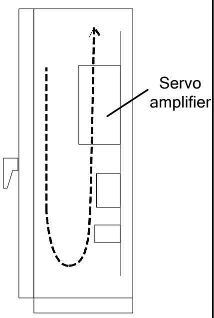
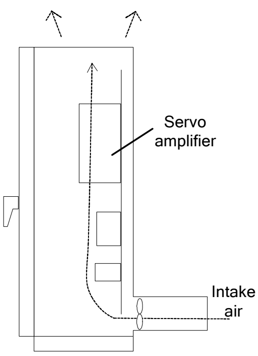
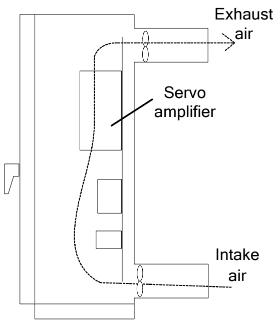
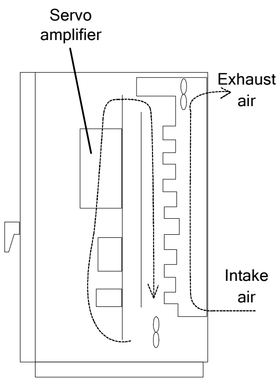
- Install indoors at a place free from rainwater and direct sunshine.
- Do not operate in corrosive atmosphere including hydrogen sulfides, sulfurous acid, chlorine, ammonia, sulfur, chlorine-based gases, acids, alkalis or salts or near flammable gases or matters.
- Install in a well ventilated environment with less vapor, oil and water content.
- Install at a place with less vibration.
- Do not operate in vacuum.

1.2.3 Installing the Servo Amplifier

(1) Install the servo amplifier vertically to the ground so that the "ALPHA5" characters (see the arrow in the figure on the right) on the front panel of the servo amplifier is horizontal.

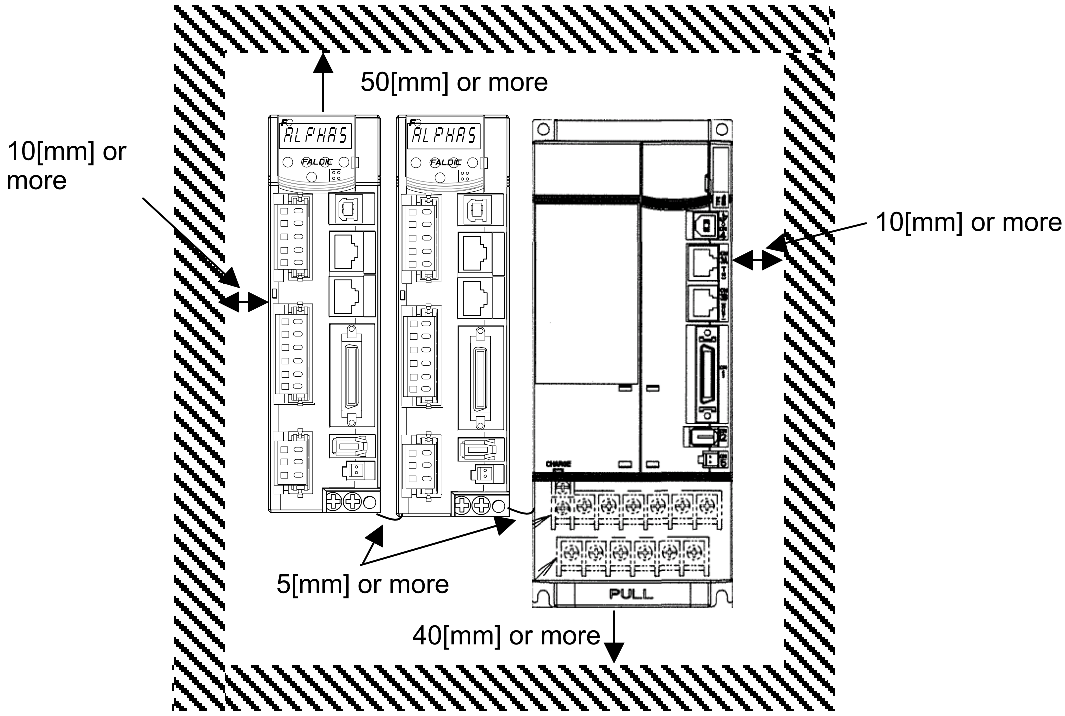


(2) Some parts of the servo amplifier generate heat during operation.
Cool the surroundings if the servo amplifier is installed inside the control panel.

Natural convection, air tight structure (totally enclosed type)	Air purge	Forced ventilation	Heat exchanger
			

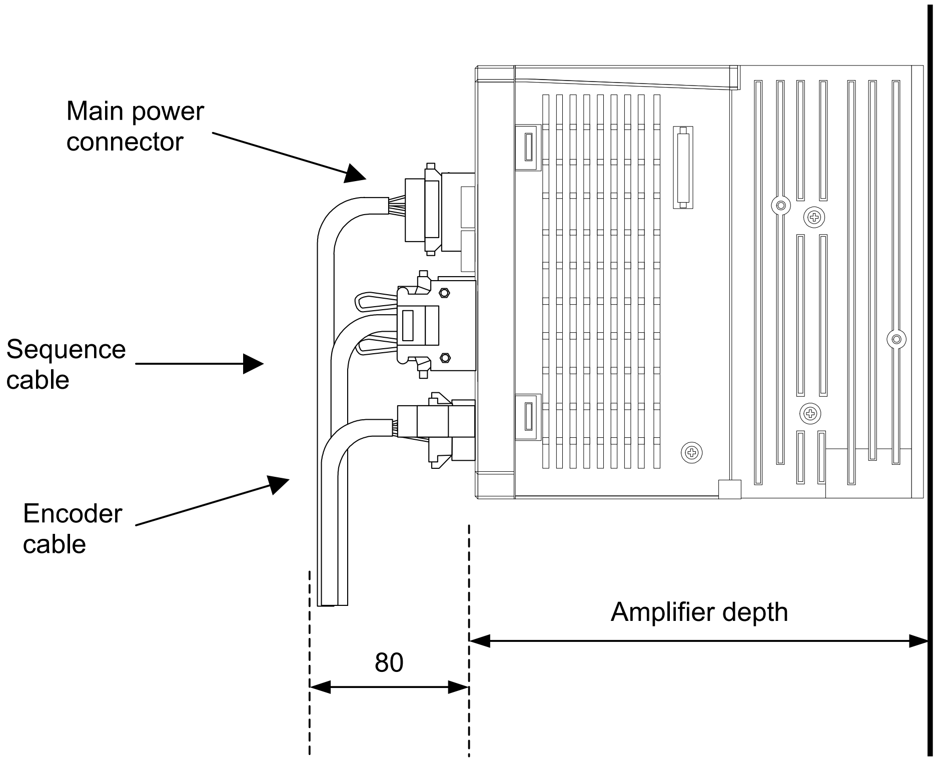
(3) To install two or more servo amplifiers in the same control panel, the following shall be taken into consideration.
Arrange transverse alignment in principle. The RYT type servo amplifier can be installed side by side closely. If servo amplifiers are installed completely side by side closely, operate them at the 80 [%ED] rating.
If the ambient temperature is 45 [°C] or lower in the close installation state, 100 [%ED] can be achieved.
If there is a clearance of 5 [mm] or over between adjacent servo amplifiers, there is no limitation in the operation frequency.

(4) To improve air convection, reserve a clearance indicated in the diagram below between servo amplifiers or a distance to the peripheral equipment.



1.2.4 Depth of Control Panel

Reserve 80 [mm] or a wider space in front of the servo amplifier which is connected with sequence I/O cables and encoder cable.



Unit : [mm]

CHAPTER 2 WIRING

2

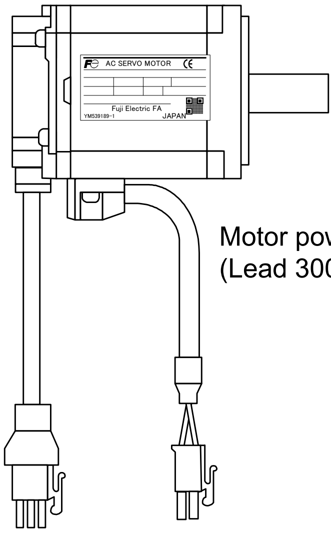
2.1 Configuration

2.1.1 Part Name

All wiring of the servo amplifier of 0.75 [kW] or less is connected via connectors.

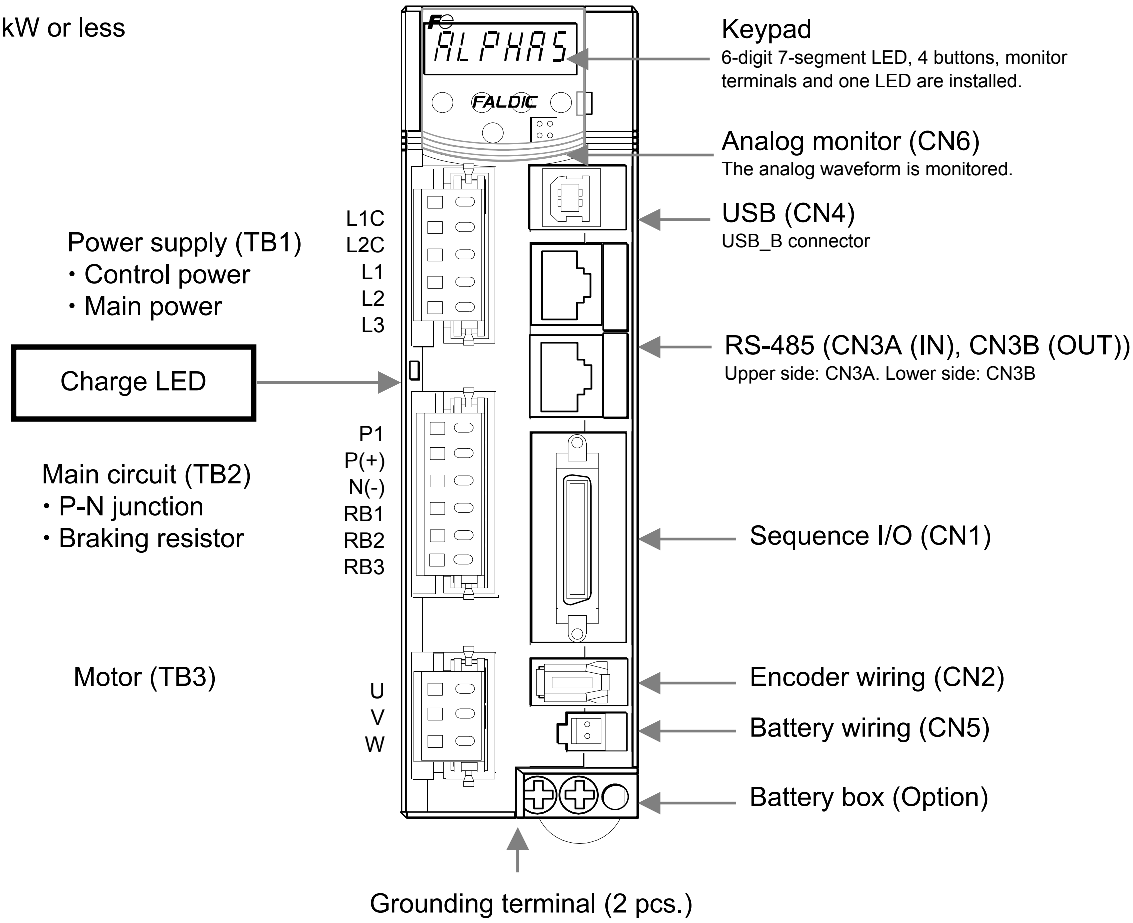
- Servomotor

GYS/GYC type 0.75kW or less



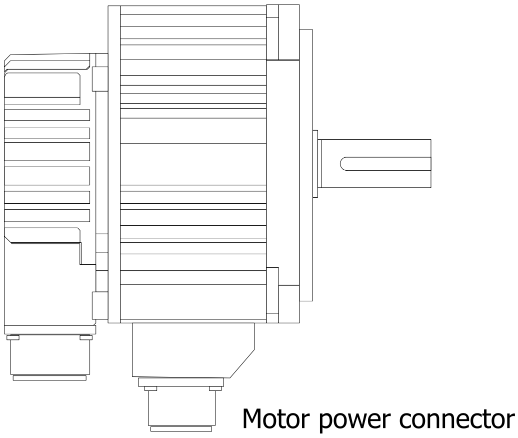
- Servo amplifier (frame 1, 2, and 3)

0.75kW or less

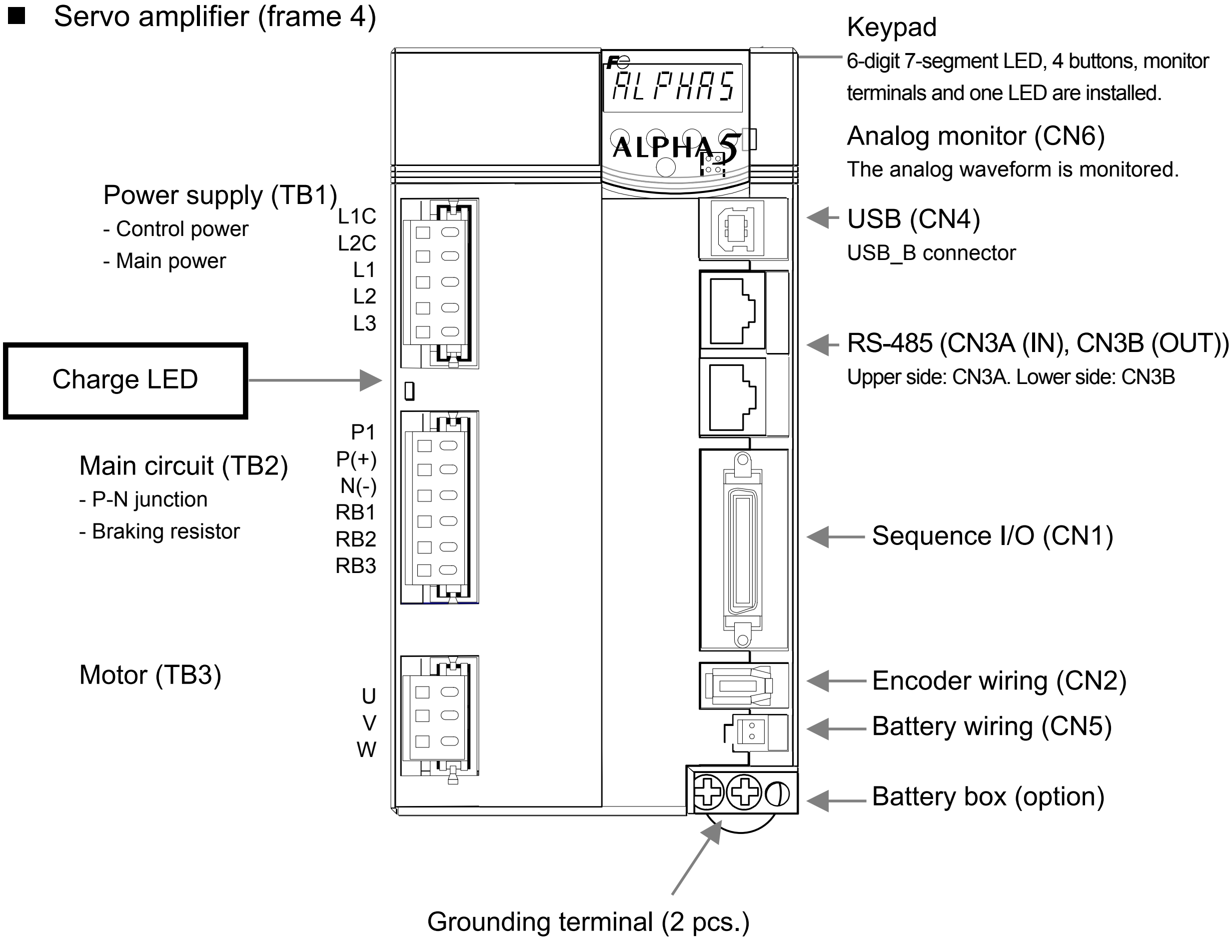


■ Servomotor

GYS/GYC type 1kW or more and GYG type

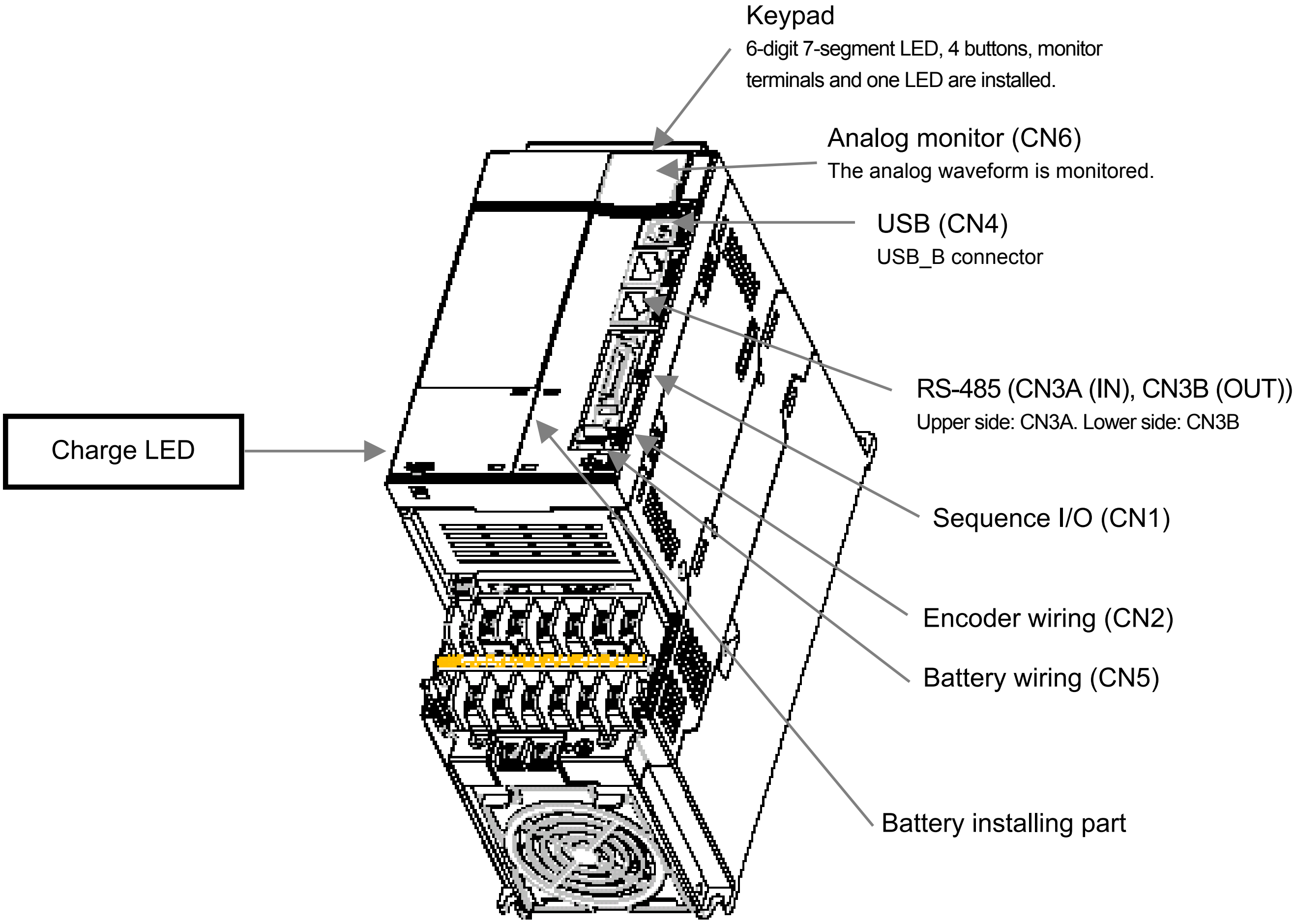


■ Servo amplifier (frame 4)

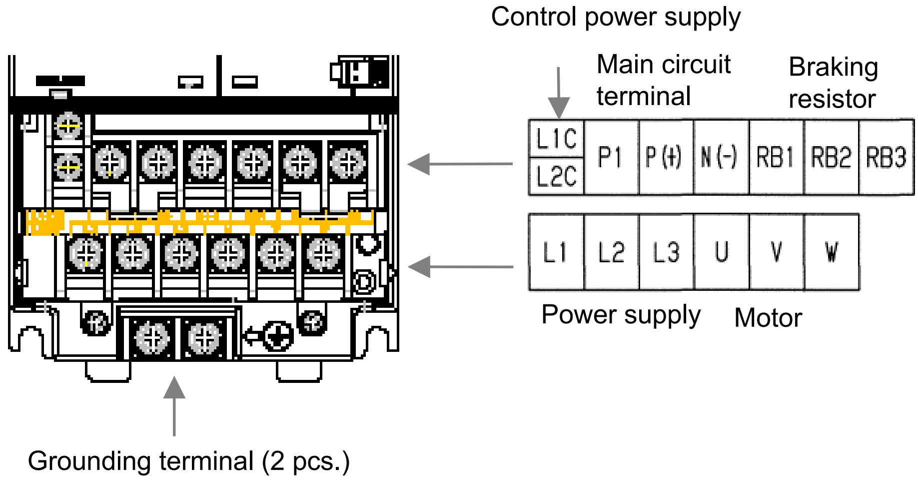


2

■ Servo amplifier (frame 5, 6)



<Terminal details>



2.1.2 Configuration

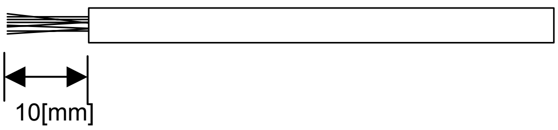
The figure on page 2-7 shows the general configuration of devices. There is no need to connect all devices.

- The size on each device in the figure is not drawn at the uniform scale. (same as other chapters)
- To supply single-phase power to the servo amplifier, use the L1 and L2 terminals.
  Supply power control power terminals L1C and L2C is required.
- The servo amplifier wiring connector is attached only to TB2. It is not provided for other devices.
  Use a connector kit or optional cable with a connector.
- Adopt a configuration for turning the main power off upon alarm detection (activation of protective function of servo amplifier).
  Otherwise overheat of the braking resistor, such as braking resistor transistor failure may cause fire.
- The maximum wiring length between the servo amplifier and servomotor is 50 [m].
- You may not turn the power wiring of the servo amplifier or servomotor on or off with a contactor or you may not drive multiple servomotors selectively with a single servo amplifier.
- Do not connect any of the following devices to the power wiring of the servo amplifier or servomotor.
  ・Phase advancing capacitor ・Various reactors ・Noise filter ・Surge absorber
- Be sure to ground the protective grounding terminal of the servo amplifier (terminal provided with a grounding mark) to the protective ground of the control panel to avoid electric shock.

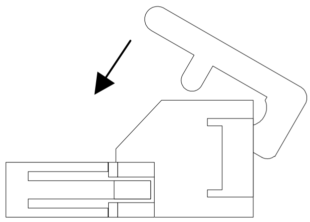
Use the accessory tool in the following procedure to connect the terminal to TB1, TB2 and TB3.

Wiring method

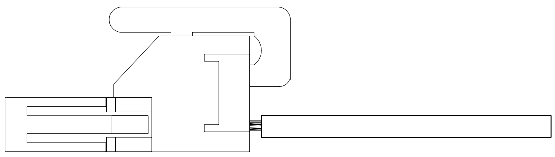
[1] Peel off the sheath about 10 [mm].



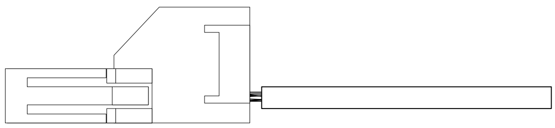
[2] Insert the tip of the accessory tool into the top of the connector.



[3] Push the tool toward the connector to insert the cable.

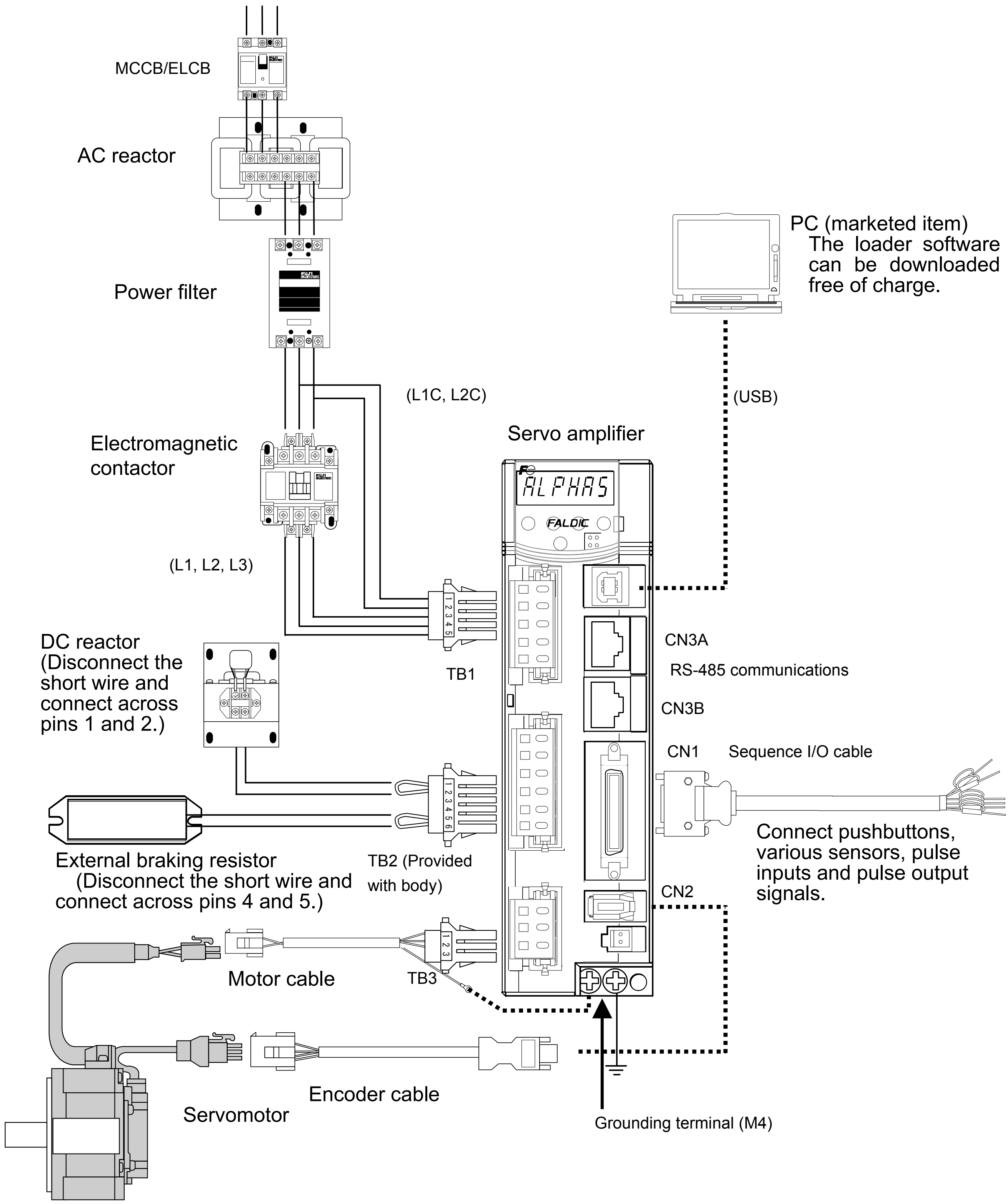


[4] Release the tool. The cable is fixed.

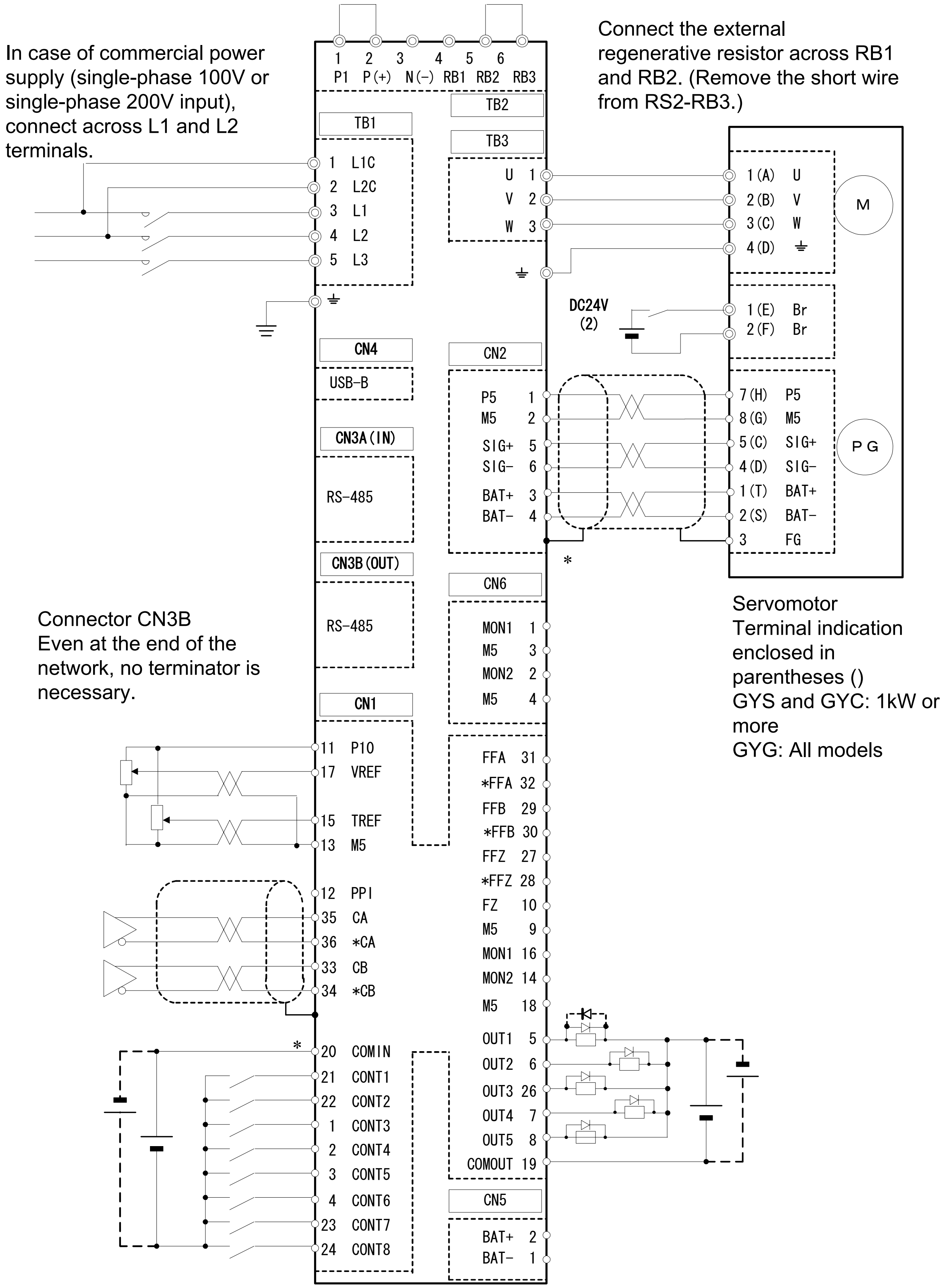


Note	Do not solder the cable. In case of the strand wire, do not twist cable forcibly.

1) For servo amplifier frames 1, 2 and 3 (except for RYT***B5, C5)
For lead wire type motors, connect cables as shown below.



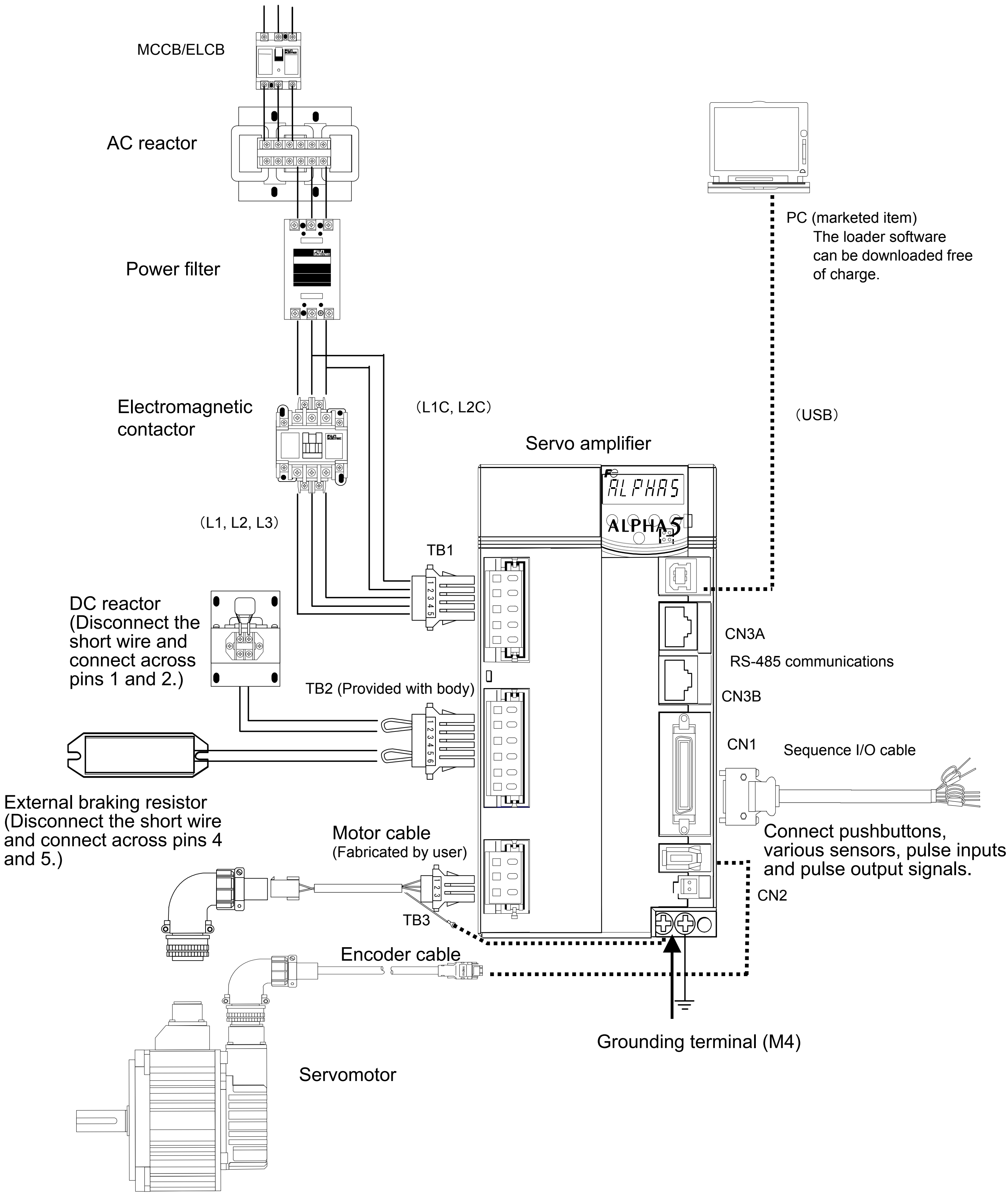
Connection Diagram (Servo amplifier frame 1, 2)



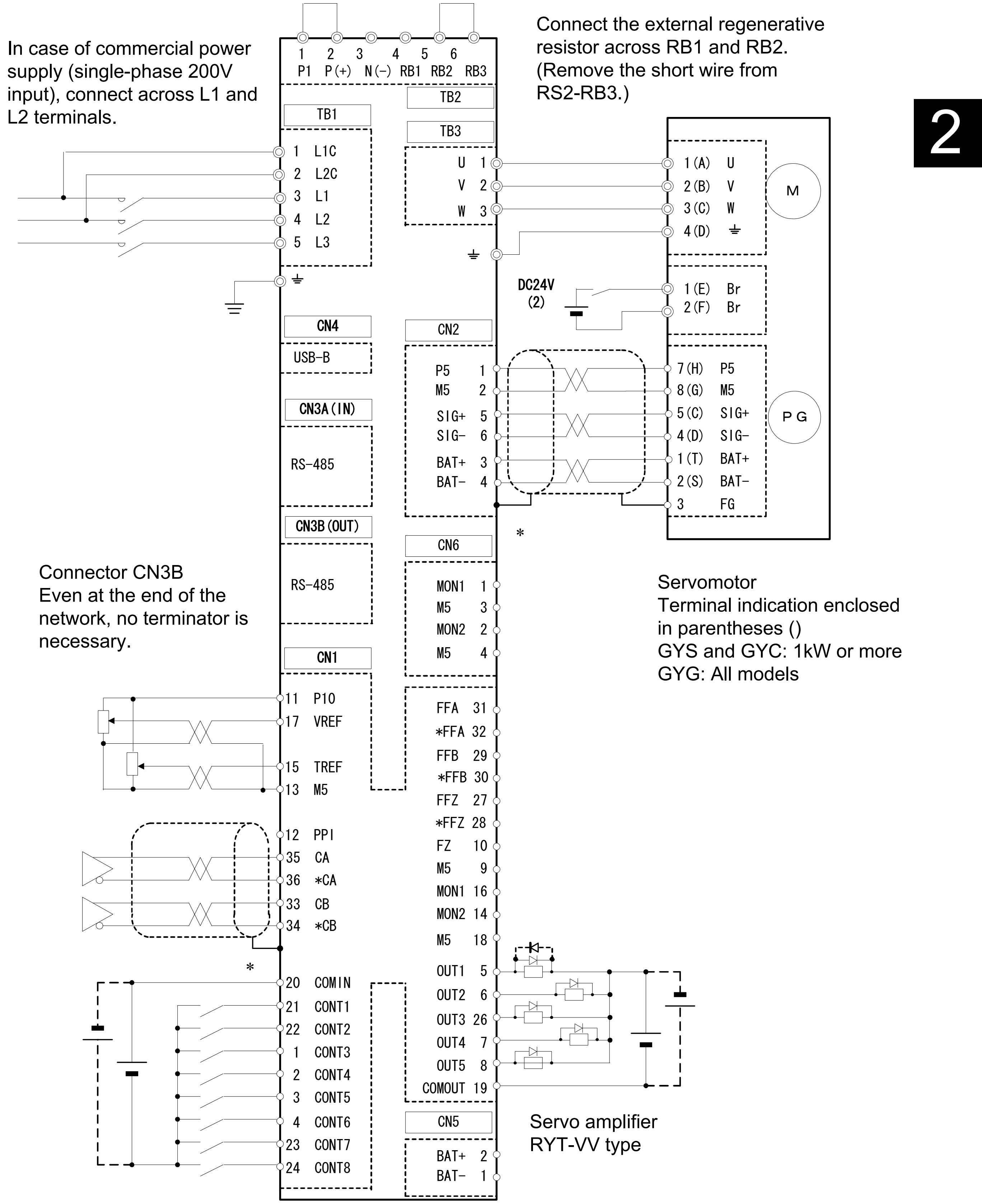
* Connect the shielding wire to the connector shell on the servo amplifier side.

2) In case of 3 or 4 (except for 751D5 in frame 3)

For Cannon connector type motors, connect cables as shown below.



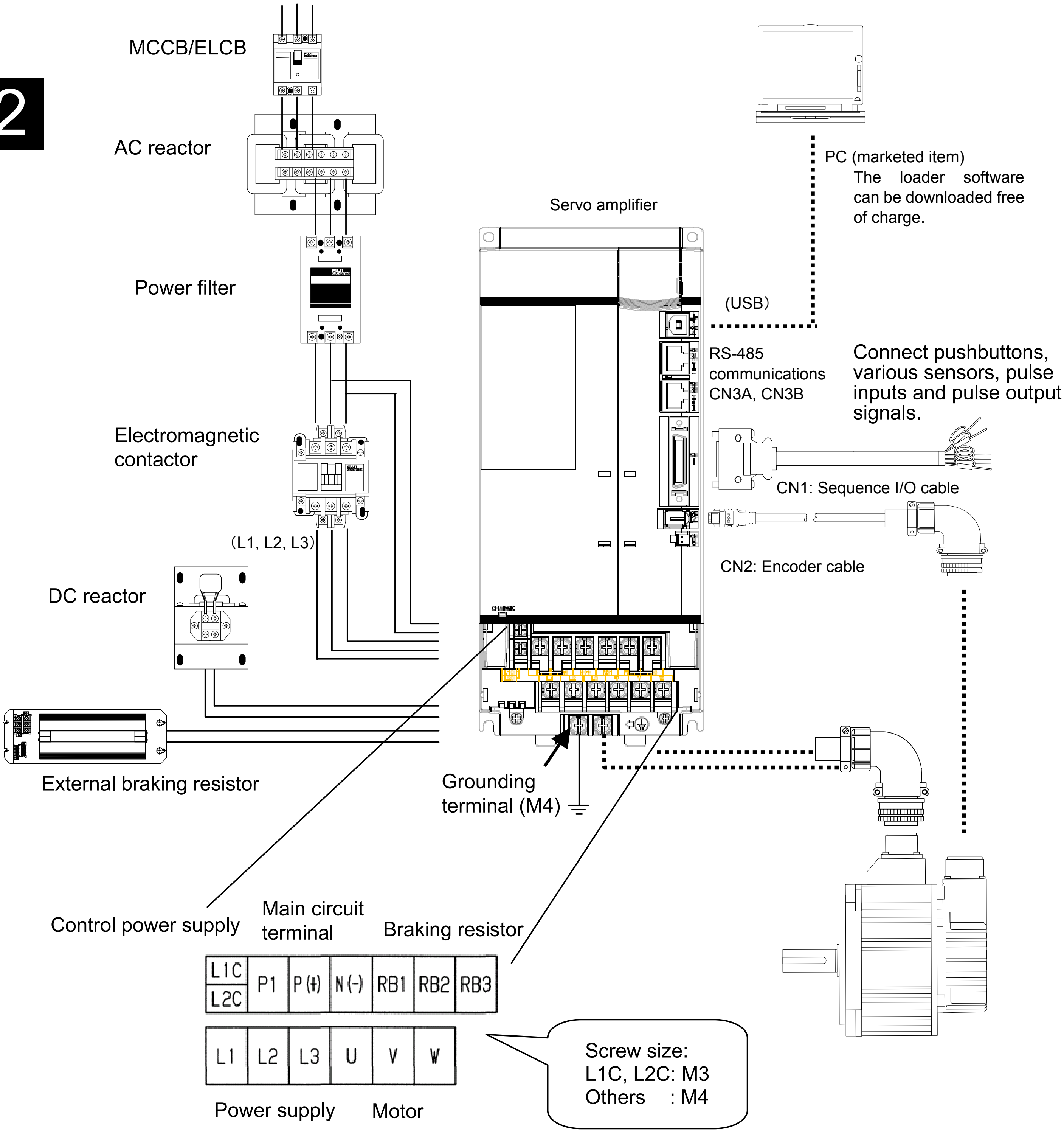
Connection Diagram (Servo amplifier frame 3, 4)



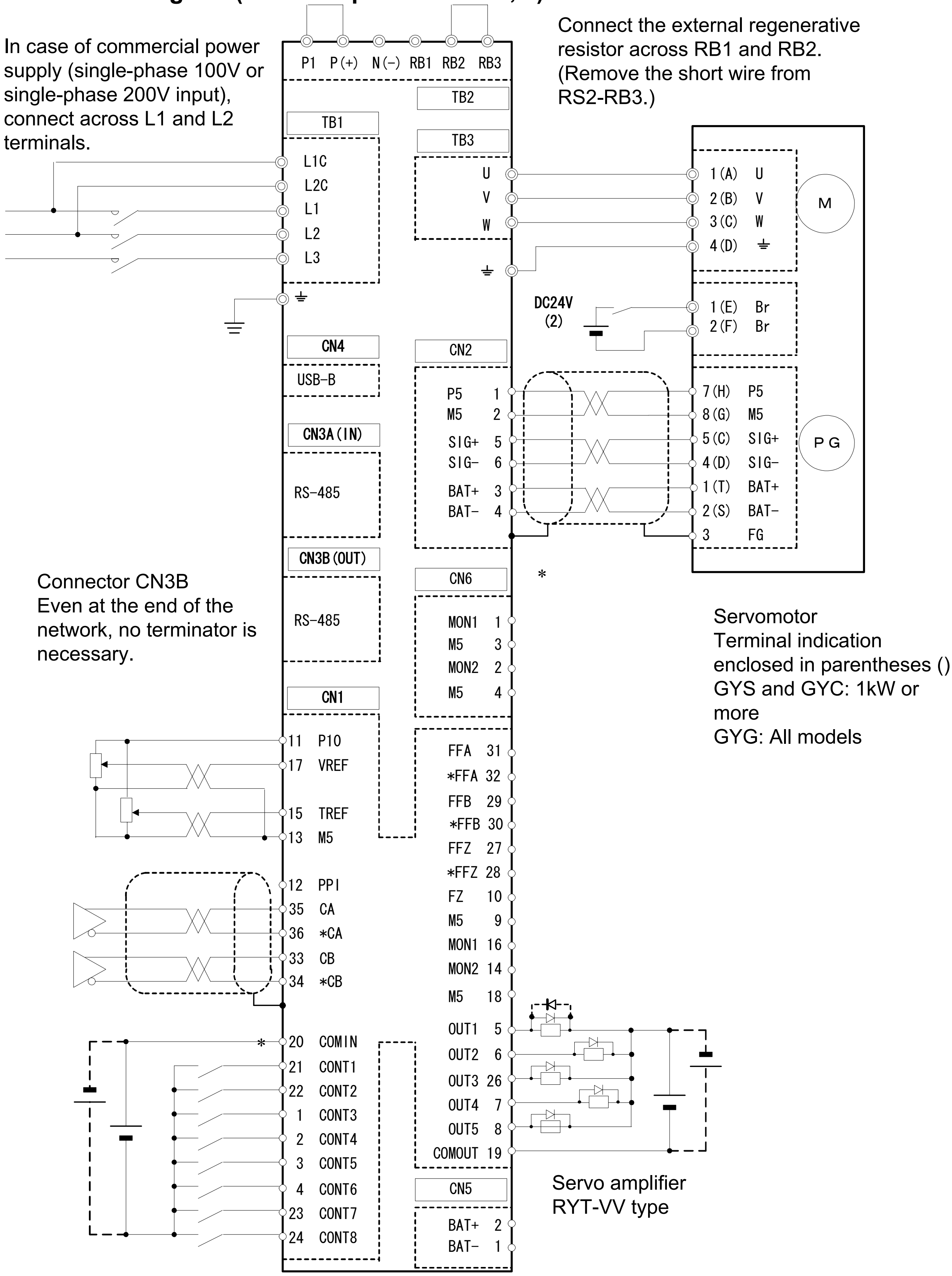
* Connect the shielding wire to the connector shell on the servo amplifier side.

3) In case of servo amplifier frames 5 or 6

For Cannon connector type motors, connect cables as shown below.



Connection Diagram (Servo amplifier frame 5, 6)



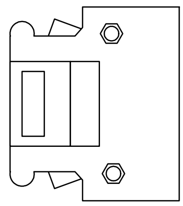
* Connect the shielding wire to the connector shell on the servo amplifier side.

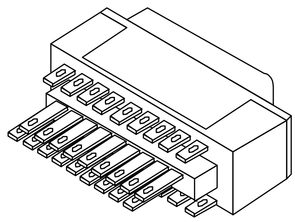
2.1.3 Sequence I/O

CN1 of RYT□□□□5-VV□ type. The wiring connector is not included in the servo amplifier.

Connector kit type: WSK-D36P

35	CA	36	*CA	17	VREF	18	M5
33	CB	34	*CB	15	TREF	16	MON1
31	FFA	32	*FFA	13	M5	14	MON2
29	FFB	30	*FFB	11	P10	12	PPI
27	FFZ	28	*FFZ	9	M5	10	FZ
25	M5	26	OUT3	7	OUT4	8	OUT5
23	CONT7	24	CONT8	5	OUT1	6	OUT2
21	CONT1	22	CONT2	3	CONT5	4	CONT6
19	COMOUT	20	COMIN	1	CONT3	2	CONT4



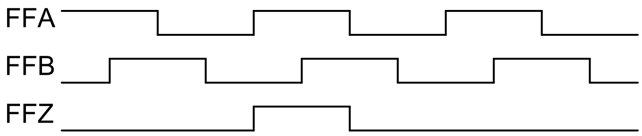


No	Terminal symbol	Function
12	PPI	Pull-up power input for pulse input 12 to 24 [V] DC
35	CA	Pulse input Max. input frequency 1 [MHz] (differential) or 200 [kHz] (open collector) Command pulse/direction, forward/reverse pulse, A/B phase pulse (A/B phase pulse are the frequency after multiplication by four.)
36	*CA	
33	CB	
34	*CB	
31	FFA	Pulse output (Differential output) The number of output pulses per motor revolution (16 to 262144) can be designated. Or the output pulse division ratio can be designated. The output is issued in A/B phase pulse. The FFZ and *FFZ terminals are for single revolution single pulse signal.
32	*FFA	
29	FFB	
30	*FFB	
27	FFZ	
28	*FFZ	
10	FZ	Z-phase output (Open collector) The FZ terminal is for single revolution single pulse signal. The M5 terminal serves as a reference potential.
9	M5	
16	MON1	Analog monitor voltage output (±10 [V]/0.5 [mA] max.) Analog voltage output terminal for meters. Two outputs are provided. The M5 terminal serves as a reference potential. Resolution: 14 bits
14	MON2	
13	M5	
25	M5	

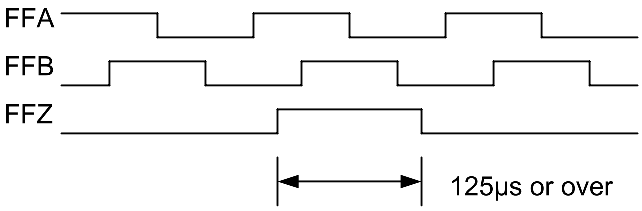
No.	Terminal symbol	Function
21	CONT1	Sequence input (For sink/source) Supply command signals to the servo amplifier through these terminals. 12 [V] to 24 [V] DC/20 [mA] (per point). Photo coupler isolated. The reference potential is the COMIN terminal. (Soft filter 0.5 [ms], agreement of two scans, except for interrupt input)
22	CONT2	
1	CONT3	
2	CONT4	
3	CONT5	
4	CONT6	
23	CONT7	
24	CONT8	
20	COMIN	
5	OUT1	Sequence output (For sink/source) Signal output terminals of servo amplifier. Max. 30 [V] DC/50 [mA]. Photo coupler isolated. The reference potential is the COMOUT terminal.
6	OUT2	
26	OUT3	
7	OUT4	
8	OUT5	
19	COMOUT	
11	P10	Power supply for speed/torque command voltage. +10 [V]/30 [mA] (Max.)
17	VREF	Speed command voltage input ±10 [V]. Resolution: 15 bits Torque command voltage input ±10 [V]. Resolution: 14 bits The reference potential is the M5 terminal.
15	TREF	
18	M5	

The output format of the FFZ, *FFZ and FZ outputs varies according to the pulse output setting.

- If the number of pulses per revolution is designated (PA1_08: 16 to 262144), synchronization is kept with the FFA and *FFA signals. Single pulse of FFA or *FFA is applicable.



- The output pulse division ratio designated with PA1_08 ("0"), PA1_09 and PA1_10 is asymmetrical to the FFA and *FFA signals. The pulse width is always 125μs or over.



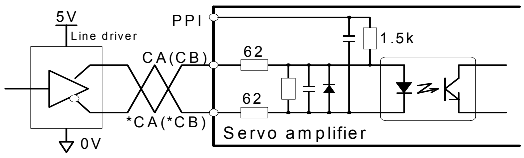
2.1.3.1 Pulse Input (PPI, CA, *CA, CB, *CA)

Pulse input terminal

- Format: Command pulse/direction, forward/reverse pulse, A/B phase pulse (parameter switch)
- Max. input frequency: 1MHz (differential output), 200kHz (open collector output)
  A/B phase pulse indicates the frequency after multiplication by four. It is always a multiple of four.

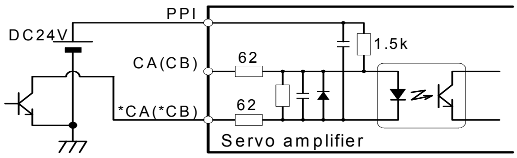
(1) Differential output

Do not use the PPI terminal.



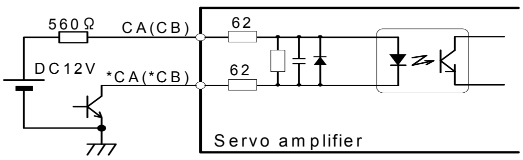
(2) Open collector (24 [V] DC)

Use the PPI terminal.



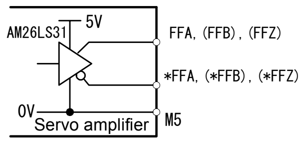
(3) Open collector output (12 [V] DC)

The CA(CB) terminal and an external resistor are necessary.



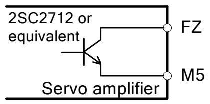
2.1.3.2 Pulse Output (FFA, *FFA, FFB, *FFB, FFZ, *FFZ)

The FFA, *FFA, FFB, and *FFB signals are output in a pulse proportionate to motor revolutions as two signals having a 90-degree phase difference (A/B phase pulse).
The number of output pulses per motor revolution can be specified in a parameter. The output frequency is in proportion to the rotation speed of the shaft. The relationship between the phase and the Z-phase can be specified in a parameter.
The FFZ and *FFZ signals are output in a single pulse during a motor revolution. The servo amplifier sets no limitation in the output frequency. 500 [kHz] is the upper limit.



2.1.3.3 Z-Phase Output (FZ, M5)

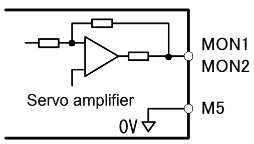
The Z-phase output is an open collector output of the FFZ or *FFZ signal.
The current can flow up to 30 [V] DC/50 [mA].



2.1.3.4 Analog Monitor Output (MON1, MON2, M5)

The analog monitor output is the analog voltage output terminal of the servo amplifier. The output is specified with a parameter.

- Max. ±10 [V]/0.5 [mA]
- Resolution: 14 bits

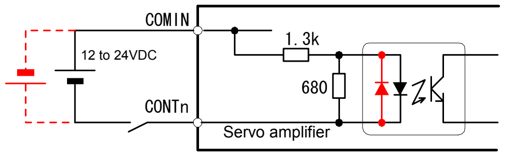


2

2.1.3.5　　Sequence Input (CONT1, CONT2, CONT3, ... COMIN)

The sequence input supports sink input and source input. A current of 24 [V] DC/20 [mA] is consumed at each point.

The ON/OFF effect of the terminal can be changed with a parameter. Therefore only necessary signals can be assigned. For signals that can be assigned, refer to page 2-22.

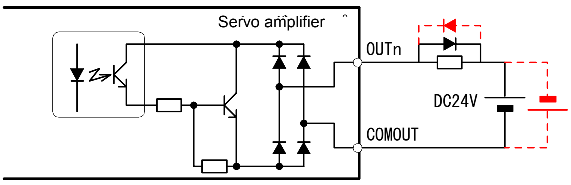


2.1.3.6　　Sequence Output (OUT1, OUT2, ... COMOUT)

The sequence output supports sink output and source output. The sink/source of maximum 30 [V] DC/50 [mA] can be output.

The output signal of this terminal can be specified with a parameter.

For signals that can be assigned, refer to page 2-24.



2.1.4 RS-485 Communications (CN3)

Use a marketed LAN cable to connect to the host controller or PC.

Use a marketed straight cable (RJ45) with all wires connected.

There is no need to connect the terminator.

Max. 31 servo amplifiers can be connected.

RS-485 communications includes two variations: Modbus-RTU protocol communications and PC Loader protocol communications.

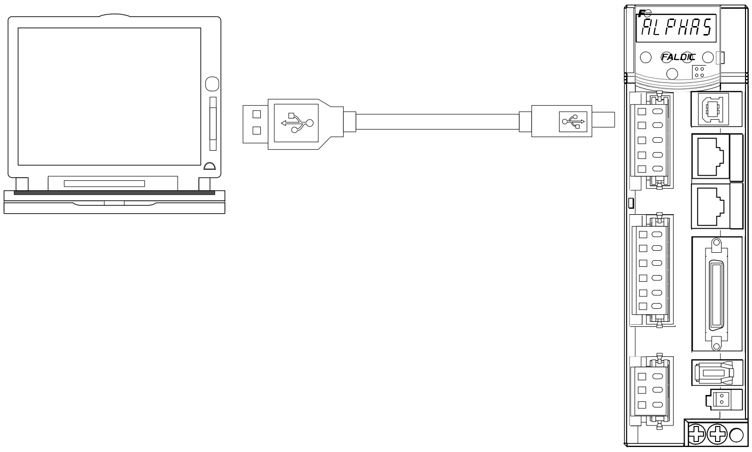
Use PA2_97 (communication protocol selection) to select the protocol.

However, select the Modbus-RTU protocol to perform immediate value operation.

For details, refer to “CHAPTER 13　RS-485 COMMUNICATIONS.”

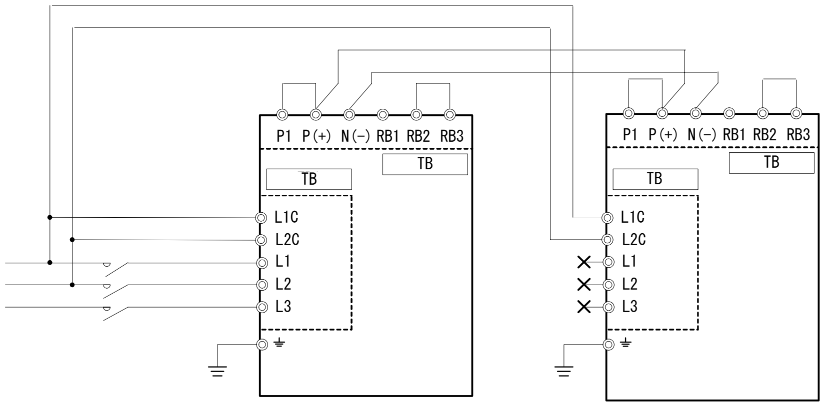
2.1.5 USB (CN4)

USB-B type 4-pin connector. Use a marketed cable.



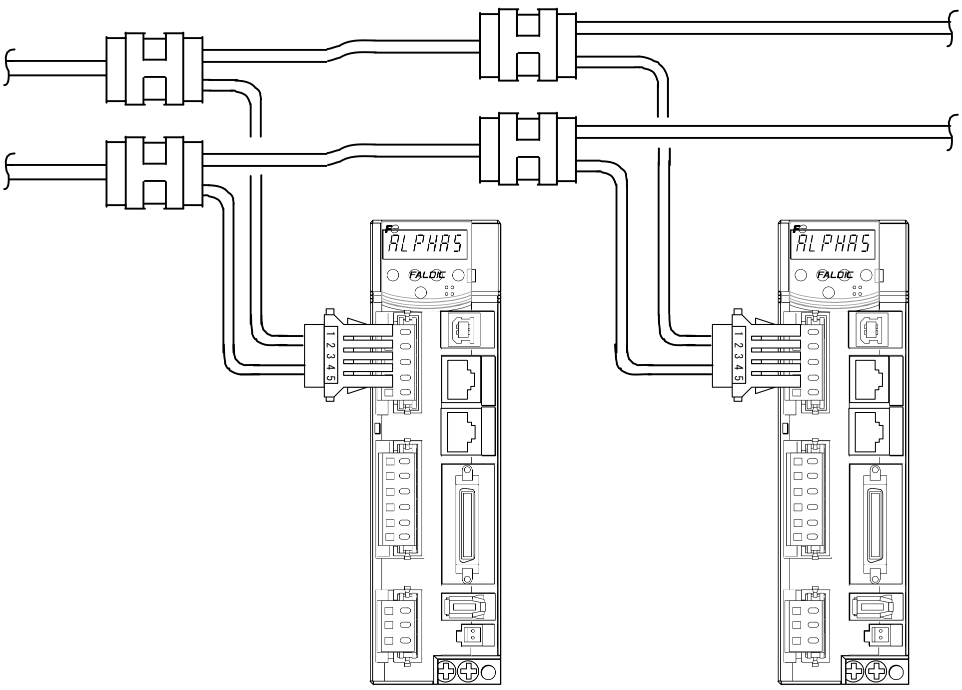
2.2 P-N Junction

Directly connect the DC link voltage of two servo amplifiers to exchange power.
In a system having a powering (driving) shaft and regenerating shaft such as the winder/unwinder unit, the power consumption of the entire system can be reduced. Do not supply main power to the servo amplifier on the other side of the P-N junction.
In addition, specify PA2-68 (the main power shutoff detection time) to 1000 [ms].



When performing PN junction as shown in the figure above, it is recommended to use a marketed connecter: CL-1814T (made by JST) by preparing it separately. It is because two wires cannot be connected to the connector (WSK-S05P-E, WSKR06P-E) of the servo amplifier of frame 4 or less.
(The following figure is a connection example of control power supply part.)

CL-1814T



2.3 Servomotor

There are wiring of the main body of the servomotor and that of the brake (servomotor equipped with a brake).

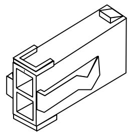
⚠CAUTION

- Keep consistency in the phase order between the servomotor and servo amplifier.
- Do not connect commercial power to the servomotor. Otherwise it may cause failure.

2.3.1 Brake Connector

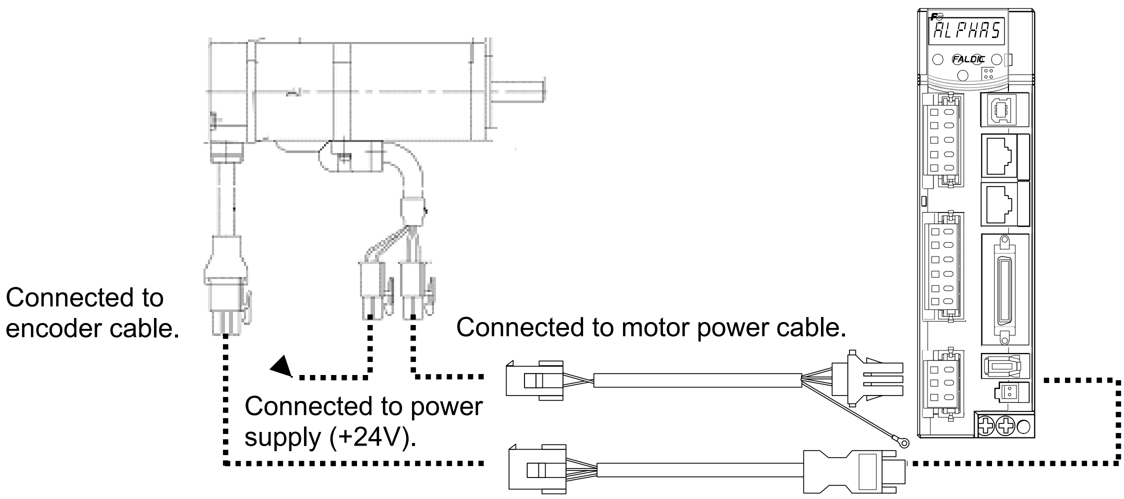
Connector kit type: WSK-M02P-E (servomotor side of GYC and GYS type 0.75 [kW] or less)

1	Br
2	Br



The brake of the servomotor equipped with a brake is a non-exciting brake. To turn the servomotor, +24 [V] must be supplied. There is no polarity in the brake input circuit.
If the brake is left released, although the periphery of the brake becomes hot it is not a fault.

The brake terminal of GYS type 1.0 to 2.0 [kW] and GYG type is located inside the motor power connector (WSK-M06P-CA).
The brake terminal of GYS type 3.0 to 5.0 [kW] and GYC type 1.0 to 2.0 [kW] is located inside the motor power connector (WSK-M06P-CB).



2.4 Encoder

2.4.1 Encoder Wiring Cable

Use the designated shielded cable for encoder wiring of the servomotor.
The optional cable for the servomotor is a UL-rated cable having bend resistance.
Use a regular twisted pair batch shield cable if the servomotor and cable do not move.

■ Cross linked polyethylene vinyl sheath cable for robot travel (Daiden Co., Ltd.)

RMCV-SB-A (UL2464) AWG#25/2P + AWG#23/2C (Twisted type)
(For 10 [m] or smaller wiring length)
RMCV-SB-A (UL2464) AWG#25/2P + AWG#17/2C
(For wiring lengths < 10 [m] and ≤ 50 [m])
The relationship between AWG and mm is shown below.

Gauge		SI unit		Inch unit	
A.W.G	In [mm^2]	Diameter [mm]	Cross section [mm^2]	Diameter [mil]	Cross section [CM]
16	1.25	1.291	1.309	50.82	2583
17	-	1.150	1.037	45.26	2048
18	-	1.024	0.8226	40.30	1624
19	-	0.9116	0.6529	35.89	1288
20	-	0.8118	0.5174	31.96	1021
21	-	0.7299	0.4105	28.46	810.0
22	-	0.6438	0.3256	25.35	642.6
23	-	0.5733	0.2518	22.57	509.4
24	-	0.5106	0.2024	20.10	404.0
25	-	0.4547	0.1623	17.90	320.4

2.4.2 Encoder Cable

To fabricate the encoder cable by yourself, take care of the following.

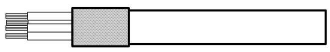
- Do not install a relaying terminal block between the servo amplifier and motor.
- Use a shielded cable.
- Connect the shielded cable with the designated connector pin, connector shell or cable clamp on both sides.
  The servo amplifier communicates with the encoder built in the servomotor through high speed serial communications.
  The shield treatment is important for the assurance of reliability of serial communications.
  The maximum encoder wiring length is 50m.

Perform shield treatment at the encoder according to the procedure specified below.
Despite motor capacity, wiring treatment at the servo amplifier is the same.

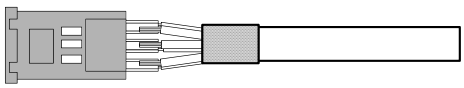
■ Encoder cable preparation method

Connect the end of the shielding wire to pin 3.

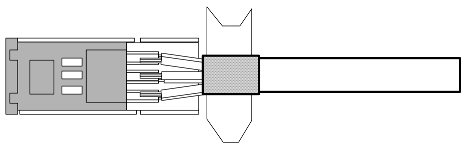
[1] Peel off the end of the shield about 15 [mm].
Fold back the shield.
Wind copper foil tape two or three turns around the shield.



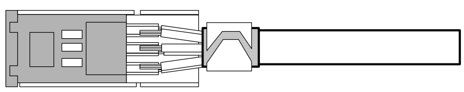
[2] Solder the wiring to the connector.
The shrink tube wrapping each element cable assures safety.



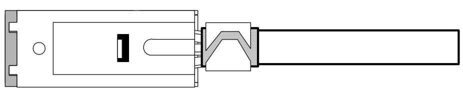
[3] Fix the connector to the shell cover.



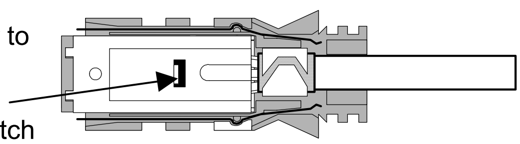
[4] Bend the shield to fix.



[5] While aligning the catches on both sides, fit the shell cover.



[6] Align the position of the catch to the mold cover to fix.



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2.5 Description of I/O Signals

List of input signals

The signal assigned to the sequence input terminal can be specified with a parameter.

No.	Name	Setting range	Default value	Change
PA03_01	CONT1 signal assignment	1 to 77	1	Power
PA03_02	CONT2 signal assignment		11	
PA03_03	CONT3 signal assignment		50	
PA03_04	CONT4 signal assignment		0	
PA03_05	CONT5 signal assignment		0	
PA03_06	CONT6 signal assignment		0	
PA03_07	CONT7 signal assignment		0	
PA03_08	CONT8 signal assignment		0	

Sequence input signal

No.	Function	No.	Function
1	Servo-on [S-ON]	34	External braking resistor overheat
2	Forward command [FWD]	35	Teaching
3	Reverse command [REV]	36	Control mode selection
4	Start positioning [START]	37	Position control
5	Homing [ORG]	38	Torque control
6	Home position LS [LS]	43	Override enable
7	+OT	44	Override 1
8	-OT	45	Override 2
10	Forced stop [EMG]	46	Override 4
11	Alarm reset [RST]	47	Override 8
14	ACC0	48	Interrupt input enable
16	Position preset	49	Interrupt input
17	Gain switch	50	Deviation clear
19	Torque limit 0	51	Multi-step speed selection 1 [X1]
20	Torque limit 1	52	Multi-step speed selection 2 [X2]
22	Immediate value continuation	53	Multi-step speed selection 3 [X3]
23	Immediate value change	54	Free-run
24	Electronic gear numerator selection 0	55	Edit permission
25	Electronic gear numerator selection 1	57	Anti resonance frequency selection 0
26	Command pulse inhibit	58	Anti resonance frequency selection 1
27	Command pulse ratio 1	60	AD0
28	Command pulse ratio 2	61	AD1
29	Proportional control	62	AD2
31	Pause	63	AD3
32	Positioning cancel	77	Positioning data selection

2

List of output signals

Specify the signals assigned to sequence output terminals, using parameters.

No.	Name	Setting range	Default value	Change
PA03_51	OUT1 signal assignment	Select among OUT signal assignment functions.	1	Power
PA03_52	OUT2 signal assignment		28	
PA03_53	OUT3 signal assignment		2	
PA03_54	OUT4 signal assignment		76	
PA03_55	OUT5 signal assignment		26	

Sequence output signal

No.	Function	No.	Function
1	Ready for servo-on [RDY]	35	Alarm code 3
2	In-position [INP]	36	Alarm code 4
11	Speed limit detection	38	+OT detection
13	Over write completion	39	-OT detection
14	Brake timing	40	Home position LS detection
16	Alarm detection (Normally open contact)	41	Forced stop detection
17	Point detection, area 1	45	Battery warning
18	Point detection, area 2	46	Life warning
19	Limiter detection	60	MD0
20	OT detection	61	MD1
21	Cycle end detection	62	MD2
22	Homing completion	63	MD3
23	Zero deviation	64	MD4
24	Zero speed	65	MD5
25	Speed coincidence	66	MD6
26	Torque limit detection	67	MD7
27	Overload warning	75	Position preset completion
28	Servo control ready [S-RDY]	76	Alarm detection (Normally closed contact)
29	Edit permission response	79	Immediate value continuation permission
30	Data error	80	Immediate value continuation completion
31	Address error	81	Immediate value change completion
32	Alarm code 0	82	Command positioning completion
33	Alarm code 1	83	Range1 of position
34	Alarm code 2	84	Range2 of position

Input signal

Servo-on [S-ON]: Sequence input signal (Reference value 1)

The signal makes the servomotor ready to rotate.

- Function

The servomotor is ready to rotate while the servo-on [S-ON] signal remains turned on.
When the servo-on signal is turned off, the gate for IGBT is turned off and the servomotor does not rotate. At this time, the servomotor in free-run and all rotation commands are ignored.
If the signal is turned off during rotation, controlled stop is caused according to the setting of PA2_61 (action sequence at servo-on OFF). The stopping profile follows the setting of PA2_61 (action sequence at servo-on OFF), too.
If there is no alarm, activation of servo-on [S-ON] and forced stop [EMG] arranges the state ready to rotate.

- Parameter setting

To assign the servo-on [S-ON] signal to a sequence input terminal, specify the corresponding value ("1") to the input terminal function setting parameter.
If this signal is not assigned to CONT input terminals, the signal is handled to be always turned on.

Forward command [FWD]: Sequence input signal (Reference value 2)
Reverse command [REV]: Sequence input signal (Reference value 3)

The signal makes the servomotor keep running while it remains turned on.

- Function

The servomotor keeps rotating in the positive (negative-) direction while the forward command [FWD] (reverse command [REV]) signal remains turned on. Acceleration begins at the rising edge, while the trailing edge triggers deceleration.

(1) Speed control
The motor rotates at a speed selected through combination of multi-step speed settings [X1] (= No. 51), [X2] (= No. 52) and [X3] (= No. 53) (see the table on the next page).
If both the forward command [FWD] and reverse command [REV] are turned on, the motor is controlled to stop.

X3	X2	X1	Rotation speed
OFF	OFF	OFF	Speed command (VREF terminal) voltage
OFF	OFF	ON	PA1_41: Manual feed speed 1
OFF	ON	OFF	PA1_42: Manual feed speed 2
ON	ON	ON	PA1_43: Manual feed speed 3
ON	OFF	OFF	PA1_44: Manual feed speed 4
ON	OFF	ON	PA1_45: Manual feed speed 5
ON	ON	OFF	PA1_46: Manual feed speed 6
ON	ON	ON	PA1_47: Manual feed speed 7

(2) Position control

In the position control mode, only pulse inputs are accepted.

To perform manual operation under position control, specify "6" to PA1_01 (control mode selection) and, while leaving the position control (37) signal turned on, turn the forward command [FWD] (or reverse command [REF]) signal on.

The speed setting is the same as that of speed control. The rising edge of the forward command [FWD] (or reverse command [REV]) signal starts to rotate at the ON level. Even if both signals are turned on simultaneously, no stoppage is caused.

To issue a reverse command after turning off a forward command [FWD], turn on the reverse command [REV] after controlled stop.

(3) Torque control

A torque is output at the servomotor shaft.

The torque is output according to the torque command [TREF terminal] voltage.

■ Parameter setting

To assign the forward command [FWD] signal to a sequence input terminal, specify the corresponding value ("2"; "3" for reverse command) to the input terminal function setting parameter.

The signal is handled to be always turned off if it is not assigned to the sequence input terminal.

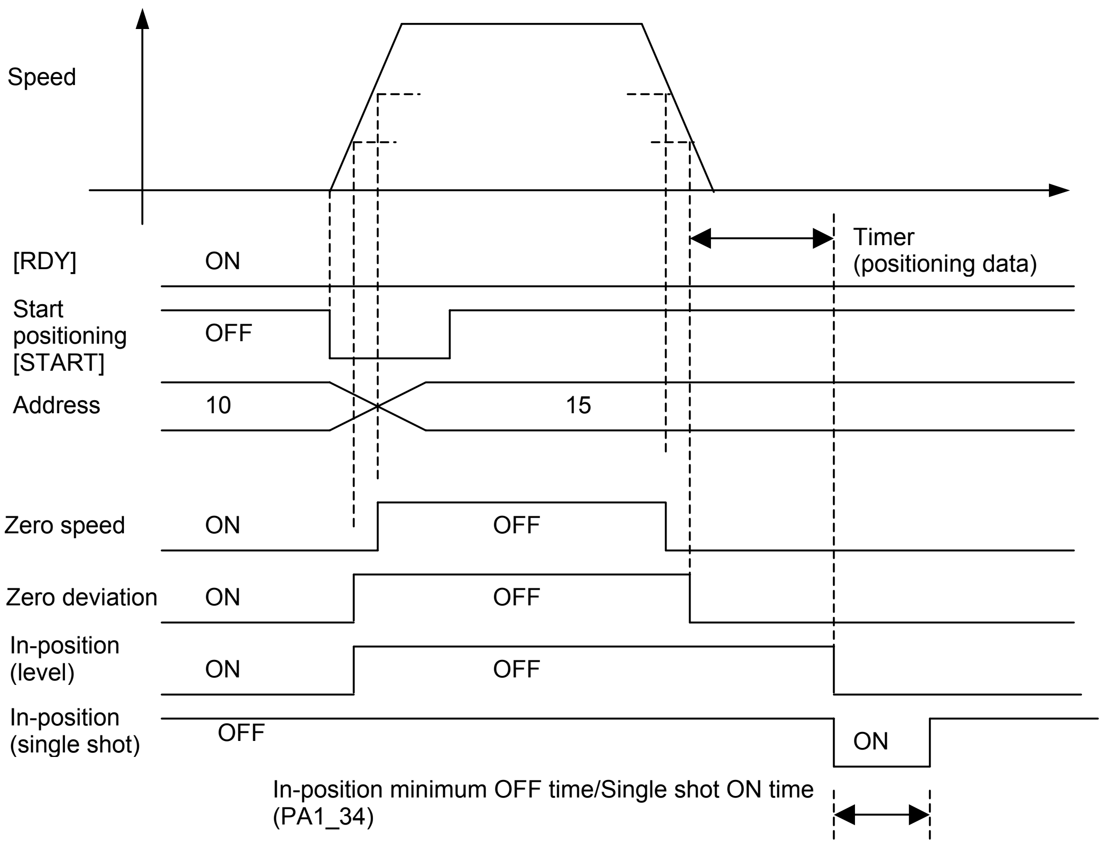
Start positioning [START]: Sequence input signal (Reference value 4)

Positioning motion is executed according to positioning data or immediate value data sent via RS-485 communications.

<u>This function is enabled only if parameter PA1_01 is “7” (positioning operation).</u>

■ Function

The positioning motion starts at the activating edge of the start positioning signal.
If PA2_40 (internal positioning data selection) is “1” (enable), the internal positioning data is enabled. Positioning is made according to positioning addresses AD0 through AD3.
If PA2_40 (internal positioning data selection) is “0” (disable), positioning is made according to the position data and speed data sent via RS-485 communications.



Check for the active state of the in-position signal (level) to turn the start positioning signal on. The motor starts to rotate. After rotation begins, the in-position signal is turned off.

■ Parameter setting

To assign the start positioning signal to a sequence input terminal, specify the corresponding value (“4”) to the input terminal function setting parameter.
The signal is handled to be always turned off if it is not assigned to the input terminal.

2

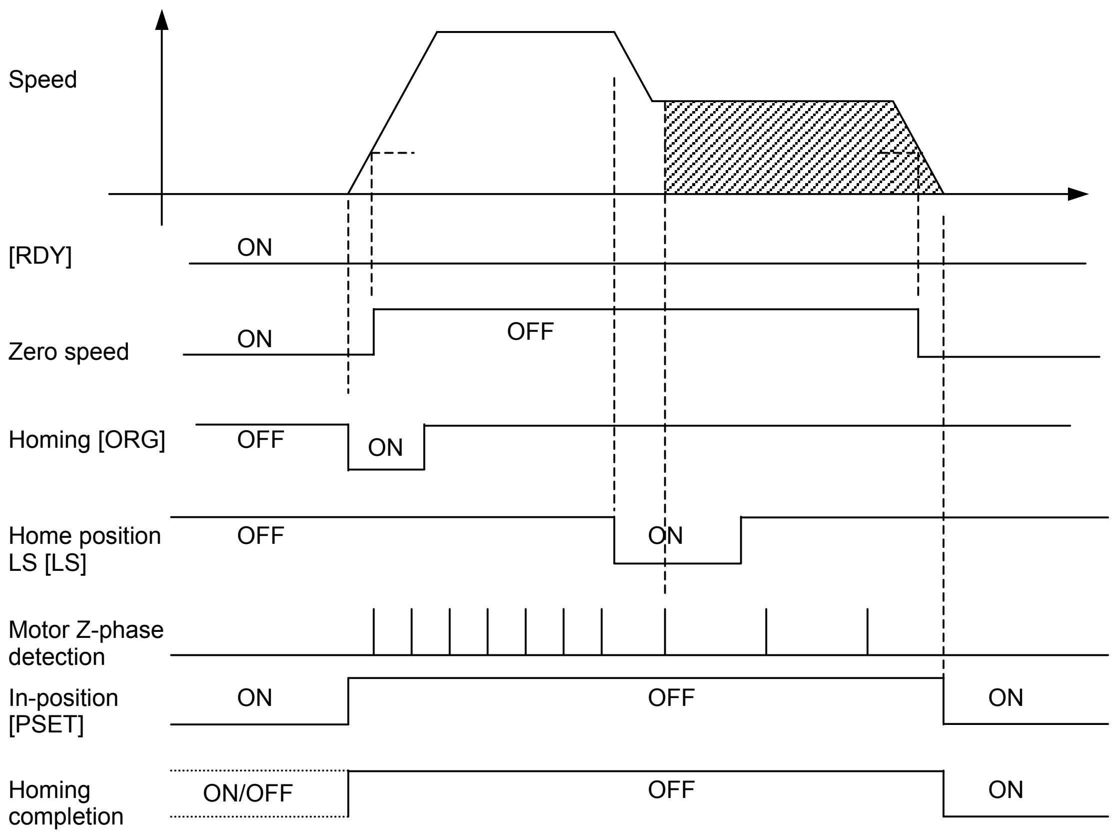
Homing [ORG]: Sequence input signal (Reference value 5)
Homing position LS [LS]: Sequence input signal (Reference value 6)
Interrupt input: Sequence input signal (Reference value 49)

A homing motion is executed and the home position is determined.

This function is enabled only if the extension mode (parameter PA1_01= 6) and the positioning operation (parameter PA1_01=7) are selected.

■ Function

The rising edge of the homing signal starts a homing motion. The homing motion follows the settings of PA2_06 through PA2_18. If parameters are factory shipment settings, the following motion is executed.



(1) After checking that the in-position signal is turned on, turn on the homing command.

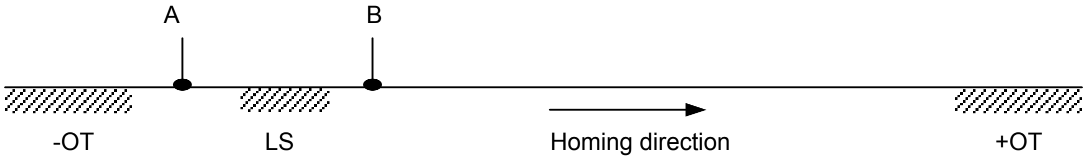
(2) Once the in-position signal is turned off, you can turn off the homing command.
The motor rotates in the direction of PA2_10 at a speed of PA2_06.

(3) When the home position LS signal is turned on, the speed changes to creep speed for homing (PA2_07).

(4) The motor moves the home position shift unit amount (PA2_14) from the first Z-phase after the rising (or trailing) edge of the home position LS, and then it is stopped.

(5) The in-position signal is turned on with the stopping position being home position after homing completion PA2_16. In addition, the homing completion signal is turned on.

To perform homing, use up positive over-travel [+OT] and negative over-travel [-OT] signals to assure safety.



- Detection of over-travel signal
  If homing is started from position A in the figure above, the home position LS is detected and stoppage is caused.
  If homing is started from position B in the figure above, the +OT signal is detected. In this case, the following motions follow.
  (6) Upon detection of +OT, controlled stop is caused according to deceleration time at OT during homing PA2_18.
  (7) A reverse travel begins at the homing speed.
  (8) Upon detection of the home position LS, controlled stop is caused. Then the procedure (1) to (5) described above is executed.

- Starting direction for homing (PA2_08)
  If homing is executed from B in the figure above, the distance to +OT must be traveled in a round trip and therefore much time is taken.
  If homing is set to negative starting direction, the home position LS will be detected first.

- Reverse traveling unit amount for homing (PA2_09)
  If homing is executed from B in the figure above, the distance to +OT must be traveled in a round trip and therefore much time is taken.
  If the reverse traveling unit amount for homing is specified, the next action is performed at the start of homing.

  (9) A travel occurs first at the homing speed by the reverse traveling unit amount for homing.

  Thereafter the motion (1) to (5) described above is executed.

- Reference signal for shift operation (PA2_11)
  In regular cases, a travel occurs by the home position shift unit amount in reference to the encoder Z-phase signal. Stoppage is caused at an accuracy of a single encoder pulse. If the Z-phase is not used positively due to a reduction ratio of 2 or similar, the home position LS can be made the standard.
  If the moving range is extremely narrow to install a home position LS signal, the +OT and -OT signals can be referred as the standard.
  If a quick response sensor is used instead of the Z-phase of the encoder, the interrupt input signal can be applied.

- Home position LS signal edge selection (PA2_13)
  After the trailing edge of the LS is detected, the Z-phase signal after the home position LS is detected.

- Deceleration operation for creep speed (PA2_15)
  Controlled stop is caused during homing upon detection of the home position LS (or reference signal for shift operation), followed by reverse rotation until the point before the home position LS is reached, and then homing is performed again at the creep speed.
  The home position LS creep speed becomes the same despite the homing speed setting.

- Interruption of homing motion
  Forced stop (sequence input signal) can interrupt the homing motion.
  Positioning cancel (sequence input signal) can interrupt the homing motion.

- Interruption of homing motion
  While a travel in the opposite direction automatically occurs upon detection of positive over-travel [+OT] or negative over-travel [-OT], stoppage is caused in the following cases. In every case, the homing completion signal will not be turned on.
  - Reverse rotation after a +OT signal, followed by a -OT signal without detecting a home position LS (reference signal)
  - Detection of an over-travel signal in the opposite direction to the traveling direction
  - Detection of an over-travel signal during travel of the home position shift traveling amount

Over-travel in positive direction [+OT]: Sequence input signal (Reference value 7)
Over-travel in negative direction [-OT]: Sequence input signal (Reference value 8)

A signal from a limit switch or similar can forcibly stop the machine travel.

■ Function

The signal is an input from a limit switch for avoiding over-travel (OT) beyond the limit of machine travel.
Each signal is always enabled except under torque control.
If the over-travel signal is turned off during operation, controlled stop is caused within the limit specified in PA2_60 (third torque limit).
Merely a pulse input in the direction opposite to the detection direction or manual feed (forward/reverse command) can be executed (normally closed contact).
If an OT signal is detected during positioning operation, the servomotor is forcibly stopped and therefore difference may be caused between the command position and feedback position.
Take care of the reference value and sensor position so that the OT signal will not be detected during regular operation.

■ Parameter setting

To assign the +OT signal to a sequence input terminal, specify the corresponding value ("7") to the input terminal function setting parameter. For the -OT signal, specify ("8").

This signal is handled to be always turned on if it is not assigned to the sequence input terminal.

■ Relevant description

(1) Direction of detection

The +OT signal is detected during a travel of the servomotor in the positive direction. The positive direction indicates the direction of forward rotation if PA1_4 (rotation direction selection) is set at "0" (positive direction). The servomotor is stopped, too, if a +OT signal is detected during rotation in the negative direction, but it will not rotate in either direction.

(2) Output signal: +OT detection (38), -OT detection (39), OT detection (20)

The +OT detection and -OT detection signals indicate that the servo amplifier detects the limit of travel in the mechanical system. A sequence output signal to the host controller can be notified the fact of detecting the +OT or -OT signal.

The OT detection signal is turned on upon detection of either +OT (7) or -OT (8) or software OT specified in PA2_27/28 (software OT detection position).

If the host controller is equipped with an OT input, connect to the host controller in general cases.

To specify this function, specify "38" (+OT detection), "39" (-OT detection) or "20" (OT detection) in the output terminal function setting parameter.

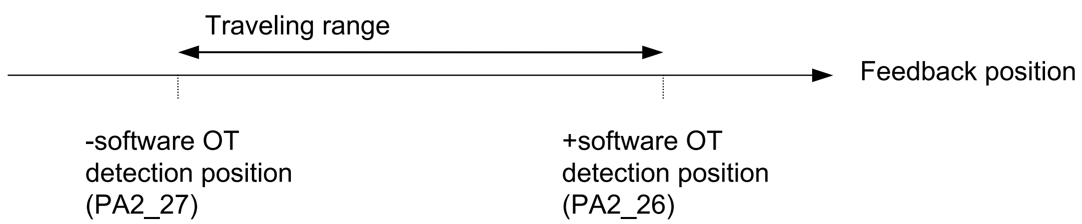
(3) Software OT

Specify "1" (enable) to PA2_25 (software OT selection) to operate in the position range between (PA2_26: + software OT detection position) and (PA2_27: - software OT detection position).

If this range is exceeded, forced stop will be caused with the OT detection sequence output.

Supply a pulse input in the direction opposite to the detected direction or perform manual feed (forward / reverse command) to reset and travel in both directions.

The +OT (-OT) sequence input is for mechanical position detection, while software OT is for position detection of the servo amplifier.



2

Forced stop [EMG]: Sequence input signal (Reference value 10)

Used to forcibly stop the servomotor.

■ Function

(1) Forced stop
The servomotor is forcibly stopped while the forced stop [EMG] signal remains turned off.
This signal is enabled in all control modes and it is given the highest priority. Because the safety and detection speed are significant, the forced stop signal is generally connected to the servo amplifier directly.
A self-locked pushbutton switch (command switch) (normally closed contact) provided on the operation panel or similar is connected in regular cases.
If forced stop is turned off during operation, controlled stop is caused within the limit specified in PA2_60 (third torque limit).

■ Parameter setting

To assign forced stop to a sequence input terminal, specify the corresponding value ("10") to the input terminal function setting parameter.
This signal is handled to be always turned on if it is not assigned to the sequence input terminal.

■ Relevant description

(1) Ready for servo-on [RDY]
If the forced stop signal is assigned to a sequence input terminal, the ready for servo-on [RDY] signal is turned on with the servo-on [S-ON] signal and forced stop signal turned on, so that the output shaft of the servomotor becomes ready to rotate. To assign the ready for servo-on signal to a sequence output terminal, specify the corresponding value ("1") to the output terminal function setting parameter.

(2) Forced stop detection
When the forced stop signal is turned off, the forced stop detection signal is turned on so that external equipment recognizes.
To assign forced stop detection to a sequence output terminal, specify the corresponding value ("41") to the output terminal function setting parameter.

(3) State of forced stop
If the forced stop signal is turned off under position or speed control, the servomotor is stopped in the zero speed state with the zero rotation speed command. At this time, all rotation commands are ignored.
The present position is not retained in the zero speed state. Because the present position is controlled, there is no need to perform a homing motion again even if the forced stop signal is turned off. Turn the forced stop signal on to arrange the state ready to operate.
If the forced stop signal is turned off under torque control, the torque command becomes zero and the servomotor free-run.
After removing the forced stop signal, there is no need to issue an alarm reset signal.

2

Alarm reset [RST]: Sequence input signal (Reference value 11)

The alarm reset signal resets alarm detection of the servo amplifier.

■ Function

The sequence input signal resets alarm detection of the servo amplifier.

The rising edge of the alarm reset [RST] signal resets alarm detection.

By starting the test operation mode at the keypad, operating the PC Loader or turning the power on again, the alarm can be reset.

■ Parameter setting

To assign the alarm reset [RST] signal to a sequence input terminal, specify the corresponding value ("11") to the input terminal function setting parameter.

This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

■ Relevant description

There are the following methods for resetting alarm detection.

- Rising edge of alarm reset [RST] of sequence input signal
- Press and hold the [SET/SHIFT] key for at least one second in the test operation mode [Fn_005].
- Press and hold the [∧] ad [∨] keys simultaneously for at least one second upon alarm detection [En_001].
- Alarm reset from PC Loader
- Shutdown and power-on again

ACC0: Sequence input signal (Reference value 14)

ACC0 switches the acceleration/deceleration time.

■ Function

(1) Acceleration/deceleration time switch

The acceleration time and deceleration time of the servomotor follow the setting of PA1_37 to 40 (acceleration time, deceleration time). The acceleration time and deceleration time can be set separately.

The setting through ON/OFF of the ACC0 signal despite the direction of rotation, as shown in the table below can be switched.

ACC0	Acceleration time	Deceleration time
OFF	PA1_37	PA1_38
ON	PA1_39	PA1_40

■ Parameter setting

To assign the ACC0 (acceleration/deceleration time selection) signal to a sequence input terminal, specify the corresponding value ("14") to the input terminal function setting parameter. This signal is handled to be always turned off if it is not assigned.

Position preset: Sequence input signal (Reference value 16)

The present command position and feedback position are preset (overwritten).

■ Function

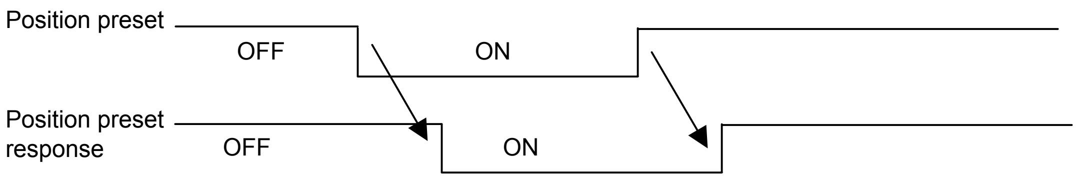
The present command position and the present feedback position are made the reference value of PA2_19 (preset position) at the rising edge. However, the deviation is subtracted from the feedback position.

The rising edge is the change point at which the sequence input signal having been switched off to on.

As zero speed signal [NZERO] can be performed during ON, it is recommended to conduct position preset while the servomotor is sustained. After position preset, homing is finished.

The following alarm detection can be reset.

- Absolute data lost (dL1, dL2, dL3)
- Multi-revolution overflow



The position preset response is turned off when position preset is turned off.

■ Parameter setting

To assign position preset to a sequence input terminal, specify the corresponding value ("16") to the input terminal function setting parameter.

This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Gain swtich: Sequence input signal (Reference value 17)

To switch the gain (response capability) of the servo system.

■ Function

When PA1_61 (gain changing factor) is set at "3" (external switch: CONT signal), the CONT signal assigned to this function switches the gain of the servo system.
The control gain parameters that are enabled with the gain switch are listed in the table below.
Use the function to change the gain of the servo system between the going path and returning path in a reciprocal motion or similar.

Gain switch	Control gain
OFF	PA1_55: Position loop gain 1
	PA1_56: Speed loop gain 1
	PA1_57: Speed loop integration time constant 1
	PA1_58: Feed forward gain 1
ON	PA1_64: Position loop gain 2
	PA1_65: Speed loop gain 2
	PA1_66: Speed loop integration time constant 2
	PA1_67: Feed forward gain 2

■ Parameter setting

To assign gain switch to a sequence input terminal, specify the corresponding value ("17") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Torque limit 0: Sequence input signal (Reference value 19)
Torque limit 1: Sequence input signal (Reference value 20)

Limitations are set on the output torque of the servomotor.

■ Function

Limitation on the output torque of the servomotor by turning on the torque limit signal can be set.
Specify the torque limit in increments of 1 [%] in the range from "0" to the maximum output torque.
The maximum output torque is 300 [%] if the rated torque is 100 [%].
The torque limit function is always enabled in all control modes.
Note that the setting of PA1_37 to 40 (acceleration and deceleration time) may be ineffective if the output torque is limited during acceleration or deceleration. The enabled torque limit is as follows.

- Torque limit under speed control and position control
  The following settings can be specified as a limitation set on the torque.
  [1] TREF terminal voltage (10 [V]/300 [%])
  [2] Forward rotation torque limit (PA1_27), reverse rotation torque limit (PA1_28)
  [3] Second torque limit (PA2_58)
  [4] Third torque limit (PA2_60)

If "0" is specified as torque limit selection (PA2_57), the settings of torque limit 0 and torque limit 1 are enabled.

Torque limit 1	Torque limit 0	Torque limit
OFF	OFF	Value of [2]
OFF	ON	[2] or [1], whichever is smaller
ON	OFF	[3] or [2], whichever is smaller
ON	ON	[3] or [1], whichever is smaller

If forced stop or servo-on is turned off, or if an over-travel or minor failure alarm is detected, limitation is set at [4] third torque limit (PA2_62: 4 or 5) the setting can be changed.

Torque limit 1	Torque limit 0	Torque limit
OFF	OFF	[4] or [2], whichever is smaller
OFF	ON	[3], [2] or [1], whichever is the smallest
ON	OFF	[4], [3] or [2], whichever is the smallest
ON	ON	[4], [3] or [1], whichever is the smallest

- Torque limit under torque control
  The limit [2] is always enabled.
- Deviation hold selection at torque limit
  Use deviation hold selection at torque limit (PA2_59) under position control to select the torque limit for retaining the deviation amount.

Torque limit 1	Torque limit 0	Torque limit
OFF	OFF	No torque limit
OFF	ON	Value of [1]
ON	OFF	Value of [3]
ON	ON	PA2_59: 1, value of [3]. PA2_59: 2, value of [1]

■ Parameter setting

If the torque limit signal is assigned to a sequence input terminal, specify the corresponding value ("19" or "20") to the input terminal function setting parameter.

If the torque limit signal is not assigned to the sequence input terminal, the settings of PA1_27 (forward rotation torque limit) and PA1_28 (reverse rotation torque limit) are always enabled.

■ Relevant description

(1) Torque limit detection signal

This signal is turned on while the output torque of the servomotor is equal to or larger than the torque limit.

The torque limit detection output is enabled in all control modes.

To assign the torque limit detection to a sequence output terminal, specify the corresponding value ("26") to the output terminal function setting parameter.

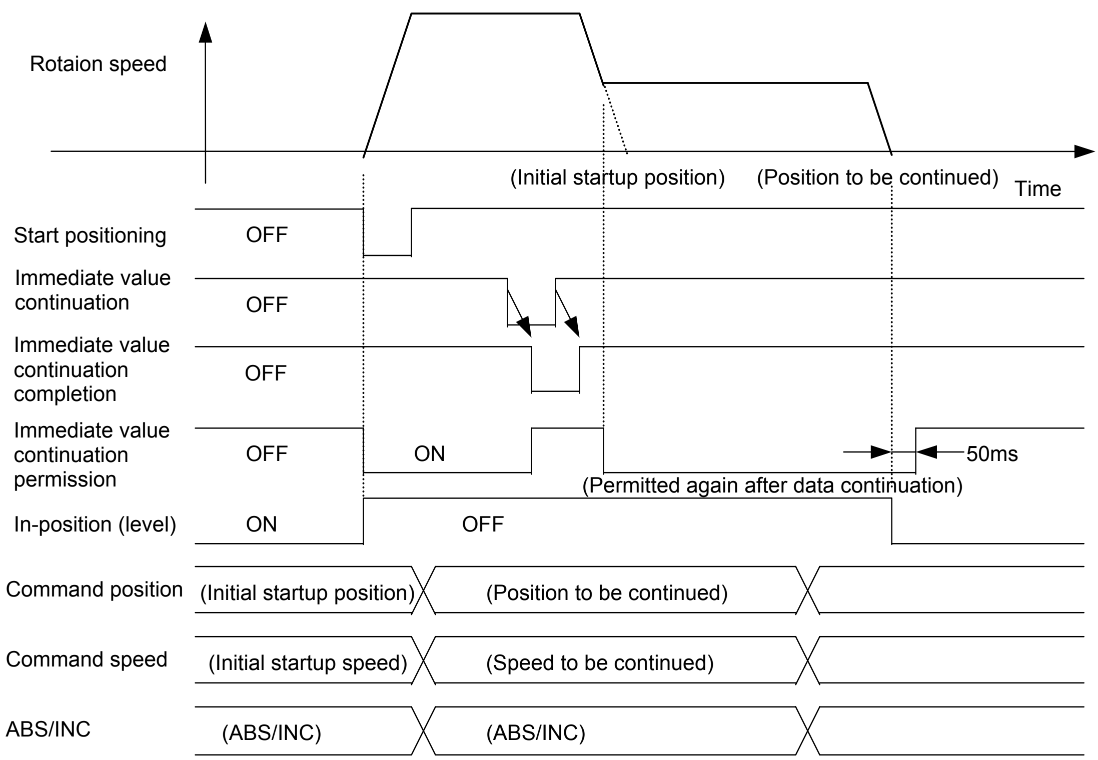
Immediate value continuation: Sequence input signal (Reference value 22)

Positioning motion can be continued according to the next data from the target position (speed) started in the immediate value mode.

This function is enabled only if “7” (positioning operation) is selected for parameter PA1 01.

■ Function

After immediate value operation starts with the first data, supply desired data in an immediate value continuation command. Operation continues with the next data, following execution of the first data.



■ Parameter setting

To allocate the immediate value continuation command to a sequence input terminal, enter the corresponding value ("22") in the input terminal function setting parameter. Relevant signal reference values include following.

Allocated signal	No.
Immediate value continuation: sequence input signal	22
Immediate value continuation completion: sequence output signal	80
Immediate value continuation permission: sequence output signal	79

■ Relevant description

(1) Immediate value continuation permission signal

The signal is turned on when the immediate value continuation command is ready to be issued to the servo amplifier. The immediate value continuation permission signal remains enabled for 50 [ms] after positioning is completed.

(2) Immediate value continuation completion signal

The signal is turned on after the immediate value continuation process is executed according to an immediate value continuation command, and it is turned off after the immediate value continuation command is turned off.

(3) Command position / command speed / ABS/INC

Each piece of data can be changed arbitrarily. The immediate value data at the activating edge of the immediate value continuation command is enabled.

(4) Immediate value change command

When the immediate value continuation command and the immediate value change command are turned on simultaneously, priority is given to the immediate value change command.

(5) Positioning cancel / pause

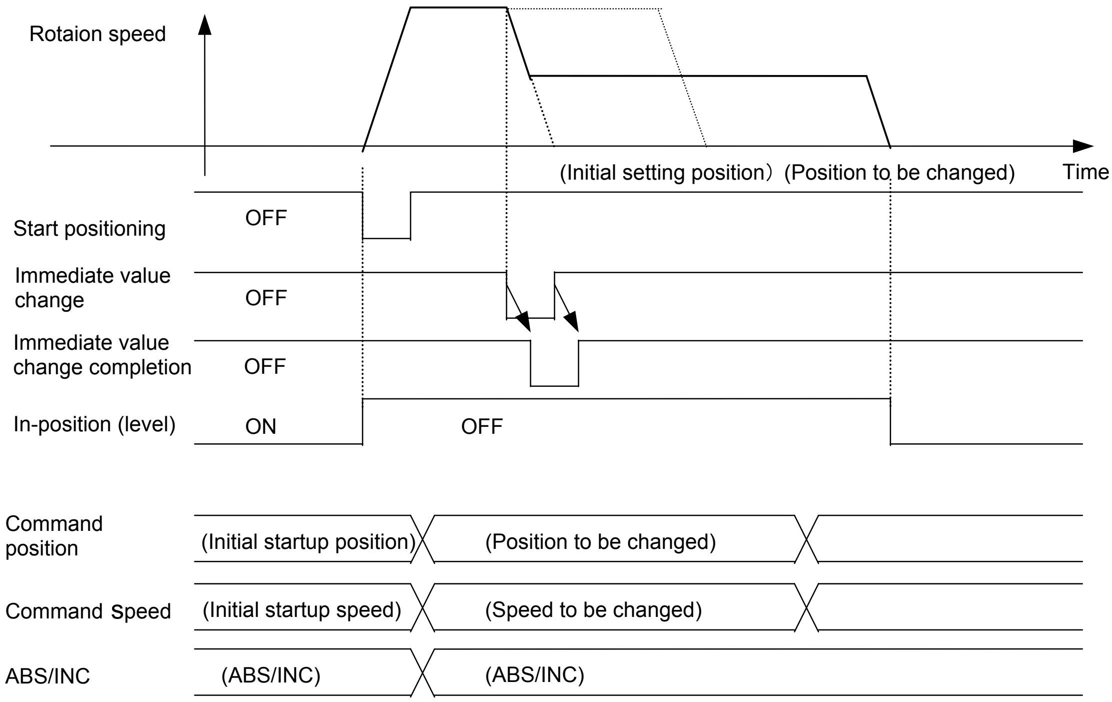
These signals are enabled at an arbitrary timing.

Immediate value change: Sequence input signal (Reference value 23)

The target position and target speed of immediate value start can be changed at an arbitrary timing.
<u>This function is enabled only if “7” (positioning operation) is selected for parameter PA1_01.</u>

■ Function

After immediate value operation is started and the in-position signal is turned off, the target position and target speed can be changed at an arbitrary timing.
Even if the positioning motion of the first data is not finished, the next data is executed immediately when the change command is accepted.



The command position and command speed change at the activating edge of the immediate value change command. They can be changed at an arbitrary timing while the in-position signal remains inactive.

■ Parameter setting

To allocate the immediate value change command to a sequence input terminal, enter the corresponding value (“23”) to the input terminal function setting parameter. Enter value (“81”) for the immediate value change completion signal.

■ Relevant description

(1) Change setting completion

The signal is turned on after the changing process is executed according to the immediate value change signal, and it is turned off after the immediate value change command is turned off.

(2) Command position / command speed / ABS/INC

Each piece of data can be changed arbitrarily. The data in the IQ area at the timing of activating edge of the immediate value continuation command is enabled. However, the ABS/INC signal retains the state enabled at the activating edge of the start positioning signal.

(3) Immediate value continuation command

When the immediate value continuation command and the immediate value change command are turned on simultaneously, priority is given to the immediate value change command.

(4) Positioning cancel / pause

The signal is enabled at an arbitrary timing.

Electronic gear numerator selection 0: Sequence input signal (Reference value 24)
Electronic gear numerator selection 1: Sequence input signal (Reference value 25)

To change the multiplication of the traveling amount of the mechanical system.

■ Function

Switch electronic gear numerator 0 or electronic gear numerator 1 to select one of four command pulse offsets.

The numerator of the electronic gear can be changed through these functions assigned to the CONT input signal, as shown in the table below.

Electronic gear numerator selection 1	Electronic gear numerator selection 0	Enabled electronic gear numerator selection
OFF	OFF	PA1_6: Numerator 0 of electronic gear
OFF	ON	PA2_51: Numerator 1 of electronic gear
ON	OFF	PA2_52: Numerator 2 of electronic gear
ON	ON	PA2_53: Numerator 3 of electronic gear

■ Parameter setting

To assign numerator 0 of electronic gear or numerator 1 of electronic gear to a sequence input terminal, specify the corresponding value ("24" or "25") to the input terminal function setting parameter.

This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Command Pulse inhibit: Sequence input signal (Reference value 26)

The pulse input in the position control mode is enabled or disabled.

■ Function

The command pulse is not accepted while the command pulse inhibit signal remains turned on.

■ Parameter setting

To assign pulse command inhibit to a sequence input terminal, specify the corresponding value ("26") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.
Accordingly, pulse input is always enabled while servo-on [S-ON] is turned on.

Command pulse ratio 1: Sequence input signal (Reference value 27)
Command pulse ratio 2: Sequence input signal (Reference value 28)

Use the parameters to change the multiplication of the command input pulse under position control in the extension mode.
<u>These parameters are enabled only with PA1_01 (extension mode) set at "6" and PA1_01 (positioning operation) set at "7".</u>

■ Function

To perform pulse operation in the extension mode (mode compatible with conventional α Series), be sure to assign command pulse ratio 1 or command pulse ratio 2 to a CONT input signal.
Turn servo-on, position control and command pulse ratio 1 (2) on to enable pulse operation.
If command pulse ratio 1 is turned on, the ratio set at PA2_54 (command pulse ratio 1) is enabled.
If command pulse ratio 2 is turned on, the ratio set at PA2_55 (command pulse ratio 2) is enabled.
The result of the following equation becomes the encoder-equivalent pulse.

(Number of input pulses) x ((Numerator 0 to 3 of electronic gear ratio)/(Denominator of electronic gear ratio)) x Command pulse ratio

■ Parameter setting

To assign command pulse ratio 1/2 to a sequence input terminal, specify the corresponding number ("27" or "28") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Proportional control: Sequence input signal (Reference value 29)

Proportional band control is adopted as a servo amplifier control method.

- **Function**

With [S-ON] signal turned on, the signal will be turned on while the servomotor shaft is mechanically locked.
If the proportional control is turned on during servomotor rotation, position control becomes unstable.
Do not turn on while the servomotor rotates.
If the brake is applied under position control with the servo locked, an overload (oL) alarm is detected. This is because the servo performs PI control, and generates a torque in an attempt to restore the original position even if fine deviation is produced. Be sure to turn off P motion before applying the brake from an external unit.

- **Parameter setting**

To assign the proportional control to a sequence input terminal, specify the corresponding value ("29") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is allocated to none of sequence input terminals.

Pause: Sequence input signal (Reference value 31)

This signal temporarily stops the start positioning, homing motion and interrupt positioning motion.

- **Function**

Deceleration starts at the activating edge of the pause signal (31). While the signal is turned on, the start positioning, homing and interrupt positioning motions are interrupted and stopped. After the signal is turned off, the remaining motion continues.
The signal is ineffective to pulse ratio 1, pulse ratio 2, and manual forward and reverse rotation.
Deceleration follows the designated acceleration/deceleration time, different from forced stop (10).
The pause is enabled to the current positioning motion.

- **Parameter setting**

To allocate positioning cancel to a sequence input terminal, enter the corresponding value (“31”) to the input terminal function setting parameter.
This signal is handled to be always turned off if it is allocated to none of sequence input terminals.

- **Relevant description**

(1) Positioning cancel
If positioning cancel (“32”) is executed while the pause (“31”) signal remains turned on, the positioning motion is canceled.

(2) ABS/INC (positioning data)

After the pause (“31”) signal is turned off, the remaining motion continues without relations to the absolute (ABS) or incremental (INC) mode of positioning data.

This signal is irrelevant to the setting of the INC/ABS selection parameter (PA1_02).

(3) Brake timing

The brake is not applied in a pause.

Positioning cancel: Sequence input signal (Reference value 32)

To cancel the homing motion and interrupt positioning motion on the way.

■ Function

To resume homing motion, turn on the positioning cancel signal and then turn on the homing signal again.

The interrupt positioning motion cancels the interrupt positioning motion after interrupt input is turned on.

This function is disabled for the pulse operation.

Unlike forced stop, controlled stop will be conducted within the selected deceleration time.

■ Parameter setting

To assign positioning cancel to a sequence input terminal, specify the corresponding value ("32") to the input terminal function setting parameter.

This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

External braking resistor overheat: Sequence input signal (Reference value 34)

The thermistor signal of the external braking resistor forcibly stops the servomotor.

■ Function

In a system where the regenerative power is relatively large, install an external braking resistor and connect the resistor thermistor signal to the CONT signal assigned as an external braking resistor overheat signal.

If the external braking resistor overheat input signal is turned off (normally closed contact), an external braking resistor overheat (AL-rH2) alarm is issued.

■ Parameter setting

To assign external braking resistor overheat to a sequence input terminal, specify the corresponding value ("35") to the input terminal function setting parameter.

This signal is handled to be always turned on if it is not assigned to the sequence input terminal.

Teaching: Sequence input signal (Reference value 35)

The current position of the servomotor is written as position data in the positioning data.

This function is enabled only if “7” (positioning operation) is selected for parameter PA1_01.

■ Function

The current command position of the servomotor is written as position data in the positioning data at the activating edge of the teaching signal. Enter the current position in an absolute (ABS) position.

The signal can be always executed without relations to the status of the forced stop and servo-on signals.

You can check the over write completion signal, one of sequence output signals, to check if overwriting of the current position is completed.

Teaching is executed generally according to the following procedure.

(1) Designate the address of positioning data, to which the current position is to be written, among AD0 to AD3.

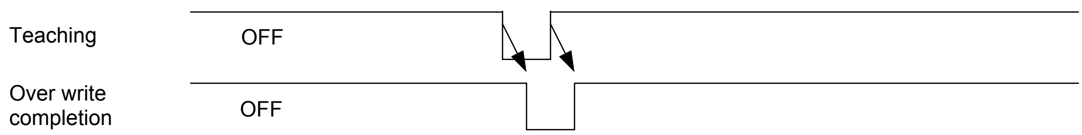
(2) Using the manual forward rotation command, pulse operation or the like, feed the mechanical system to the target position.

(3) The current command position is written as position data in the positioning data at the activating edge of the teaching signal. When the teaching signal is turned off, the over write completion signal is turned off, too.

■ Parameter setting

To allocate the teaching signal to a sequence input terminal, enter the corresponding value (“35”) to the input terminal function setting parameter.

This signal is handled to be always turned off if it is allocated to none of sequence input terminals.



Control mode selection: Sequence input signal (Reference value 36)

To switch the control mode.

■ Function

This function is to be used to switch to the control mode (control state) during servomotor operation or similar.

Turn the control mode selection signal, which is assigned to a CONT input signal, on or off to switch the control mode.

Control mode selection is enabled only if PA1_1 (control mode selection) is set at 3, 4 or 5.

■ Control mode

The enabled control mode includes the following.

PA1_1: Control mode selection	Control mode selection	
	OFF	ON
3	Position control	Speed control
4	Position control	Torque control
5	Speed control	Torque control

For details, refer to "CHAPTER 4 PARAMETER."

■ Parameter setting

To assign control mode selection to a sequence input terminal, specify the corresponding value ("36") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Position control: Sequence input signal (Reference value 37)

To be used to conduct position control (positioning by pulse) in the extension mode.

<u>This function is enabled only if "6" (extension mode) is selected for parameter PA1_01.</u>

■ Function

Turn on to perform position control in the extension mode (mode compatible with that of conventional α Series).
The position control state continues while the position control signal assigned to a CONT input signal remains turned on. Positioning, interrupt positioning and other functions can be executed with a pulse input.

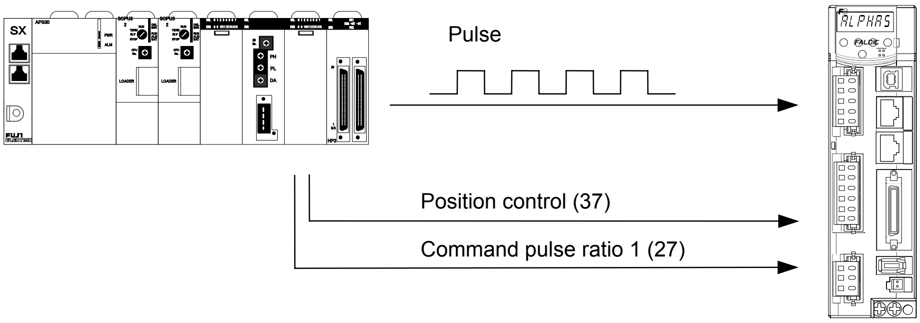
2

■ Parameter setting

To assign position control to a sequence input terminal, specify the corresponding value ("37") to the input terminal function setting parameter. For command pulse ratio 1, specify ("27"), while specify ("28") for command pulse ratio 2.
This signal is handled to be always turned off if it is not assigned to the sequence input signal.

[Example] To conduct operation with a command pulse input

Operation with a command pulse input is enabled while command pulse ratio 1 or command pulse ratio 2 remains turned on after the position control signal is turned on.



■ Relevant description

(1) PA1_6: numerator 0 of electronic gear /PA1_7: denominator of electronic gear

In the factory shipment state, each pulse of a pulse input turns the servomotor by 16 encoder pulses.
With an incremental encoder, each revolution of the motor shaft corresponds to 1048576 pulses (20 bits).
Use the electronic gear to change the rotation amount of the servomotor corresponding to each pulse of the pulse input.

(2) PA2_54: command pulse ratio 1/PA2_55: command pulse ratio 2

Numerator 0 of electronic gear and denominator of electronic gear convert the traveling amount of the mechanical system per each pulse of the pulse input into a unit amount.
Or the multiplication of the traveling amount of the mechanical system can be changed with command pulse ratio 1 or command pulse ratio 2.

2

The conditions for enabling position control with the command pulse input are shown below.

Servo-on [S-ON] = ON
Forced stop [EMG] = ON
(Control output ready for servo-on [RDY] = ON)

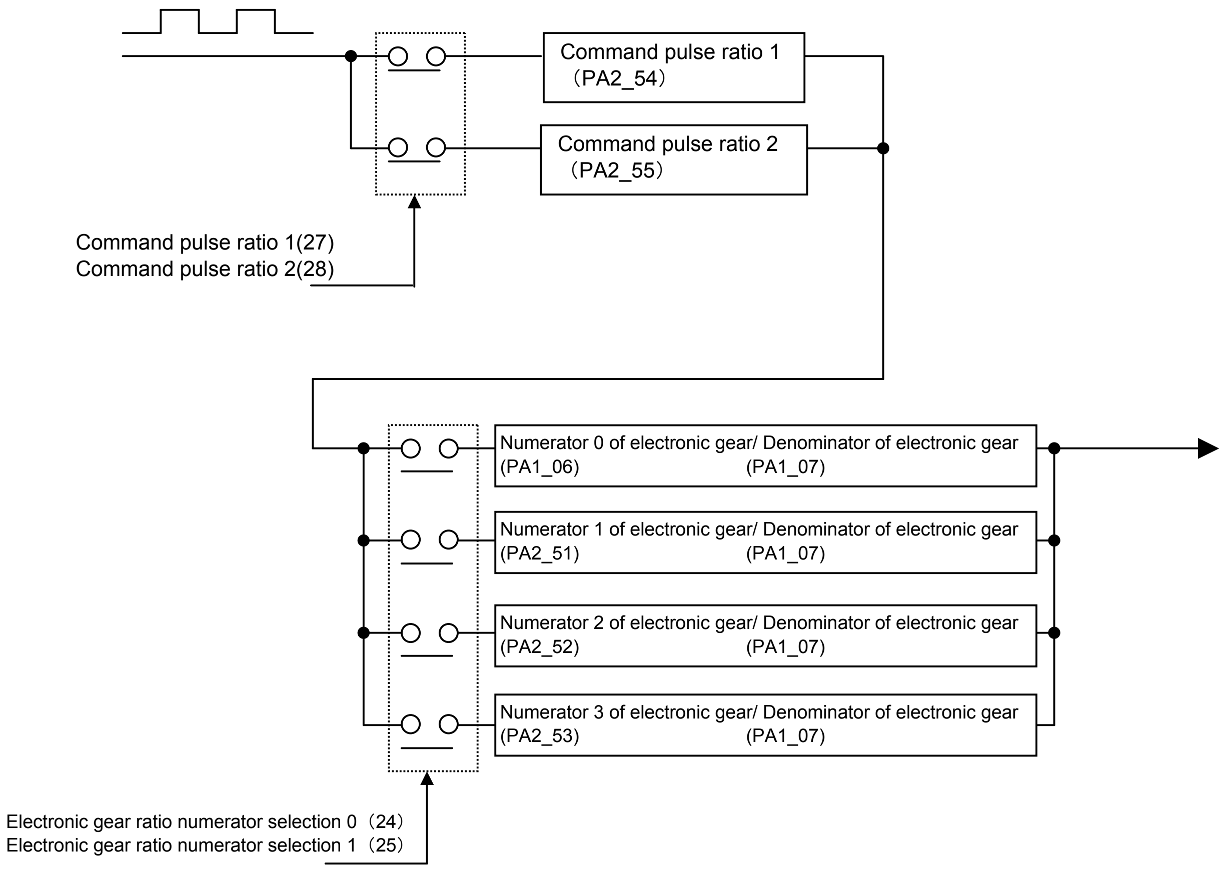
↓

Position control (37) = ON

↓

The command pulse is enabled while command pulse ratio 1 (27) or command pulse ratio 2 (28) remains turned on.

■ Function block diagram



Torque control: Sequence input signal (Reference value 38)

Use to conduct torque control in the extension mode.

This function is enabled only if "6" (extension mode) is selected for parameter PA1_01.

■ Function

Turn on to conduct torque control in the extension mode (mode compatible with that of conventional α Series).
The servo amplifier is in the torque control mode while the torque control signal assigned to a CONT input signal remains turned on.
The torque of the output shaft of the servomotor can be controlled.
The torque is actually output while the forward command [FWD] or reverse command [REV] signal remains turned on.
The torque command value depends on the input voltage applied to the TREF terminal. (Refer to the table below.)
The direction of rotation varies between the forward command [FWD] and reverse command [REV] signals.

Voltage applied to TREF terminal	Output torque (rated torque 100 [%])
±3[V]	±100[%] *

* PA3_33: If the torque command scale value is the default value.

■ Parameter setting

To assign torque control to a sequence input terminal, specify the corresponding value ("38") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

■ Relevant description

(1) Maximum rotation speed

If there is no load connected to the servomotor, the rotation speed is subject to a limitation on PA1_26 (maximum rotation speed (for torque control)) with a variation of about ±100 [r/min] (due to lack of speed control).
The speed limit can be selected with the setting of PA2_56 (speed limit selection at torque control).

- VV type: input voltage of speed command [VREF] terminal, multi-step speed setting

(2) Torque setting filter

A filter can be set to the input voltage applied to the torque command [TREF] terminal with the setting of PA1_60 (torque setting filter).

(3) Torque command scale/offset

The scale and offset of the input voltage applied to the torque command [TREF] terminal can be adjusted, using PA3_33 (torque command scale) and PA3_34 (torque command offset).

(4) Output torque

The output torque of the servomotor has individual differences (variation) of about 0 to +5 [%] under torque control. Continuous operation can be made if the output torque is within the rated torque.

(5) Torque limit

For details, refer to "Torque limit 0,1" on page 2-35.

Override enable: Sequence input signal (Reference value 43)
Override 1: Sequence input signal (Reference value 44)
Override 2: Sequence input signal (Reference value 45)
Override 4: Sequence input signal (Reference value 46)
Override 8: Sequence input signal (Reference value 47)

The rotation speed of the servomotor can be changed during operation.

■ Function

The rotation speed can be changed with the multiplication designated with override 1/2/4/8 while the override enable signal remains turned on. The speed can be increased up to 150 [%] of the current rotation speed (within the maximum rotation speed).

The weight of the multiplication corresponding to override 1/2/4/8 can be changed with the standard parameter.

This parameter is enabled for all rotation commands except for torque control and command pulse input (command pulse ratio 1/2). The function and corresponding number are shown on the next page.

■ Parameter setting

To assign override enable to a sequence input terminal, specify the corresponding value ("43") to the input terminal function setting parameter.

Similarly, specify the corresponding value ("44" to "47") for override 1/2/4/8.

This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

2

■ Relevant description

(1) Override multiplication

The multiplication applicable while the override enable signal remains turned on is shown in the table on the right. If override enable is turned off, the original speed (100 [%] traveling speed) becomes effective. Signals not assigned to sequence input terminals are assumed to be turned off.

Override ratio

Override 8	Override 4	Override 2	Override 1	Traveling speed %
OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	ON	10
OFF	OFF	ON	OFF	20
OFF	OFF	ON	ON	30
OFF	ON	OFF	OFF	40
OFF	ON	OFF	ON	50
OFF	ON	ON	OFF	60
OFF	ON	ON	ON	70
ON	OFF	OFF	OFF	80
ON	OFF	OFF	ON	90
ON	OFF	ON	OFF	100
ON	OFF	ON	ON	110
ON	ON	OFF	OFF	120
ON	ON	OFF	ON	130
ON	ON	ON	OFF	140
ON	ON	ON	ON	150

* If the weight of the override is the default value

(2) Weight of override

The weight can be changed, using PA2_36 to 39 (override 1/2/4/8).

No.	Name	Setting range	Default value	Change
PA2_36	Override 1	0[%] to 150[%] (In increments of 1)	10	Always
PA2_37	Override 2		20	
PA2_38	Override 4		40	
PA2_39	Override 8		80	

If all the override 1/2/4/8 settings are turned on, the weight is 150 (10 + 20 + 40 + 80). If the sum exceeds 150, the value immediately before is retained.

(3) Maximum rotation speed

Use the setting of PA1_25 (max. rotation speed (for position and speed control)) to specify the maximum rotation speed of the output shaft. However, the setting is disabled for command pulse inputs.

2

Interrupt input enable: Sequence input signal (Reference value 48)
Interrupt input: Sequence input signal (Reference value 49)

Use to realize the interrupt positioning function.

<u>This function is enabled only if "6" (extension mode) and "7" (positioning operation) are selected for parameter PA1_01.</u>

■ Function

If the interrupt input enable signal assigned to a CONT input signal is turned on, stoppage is caused after a travel of a certain amount since the interrupt input signal is turned on.
Specify the traveling amount after the interrupt input in PA2_20 (interrupt traveling unit amount).
The rotation speed follows the X1, X2 and X3 signals and input voltage applied to the speed command [VREF] terminal.
The rotation speed after an interrupt input keeps the speed at the rising edge effective.
The override is enabled even after the rising edge.
To change the rotation speed in the interrupt positioning mode, use the override.

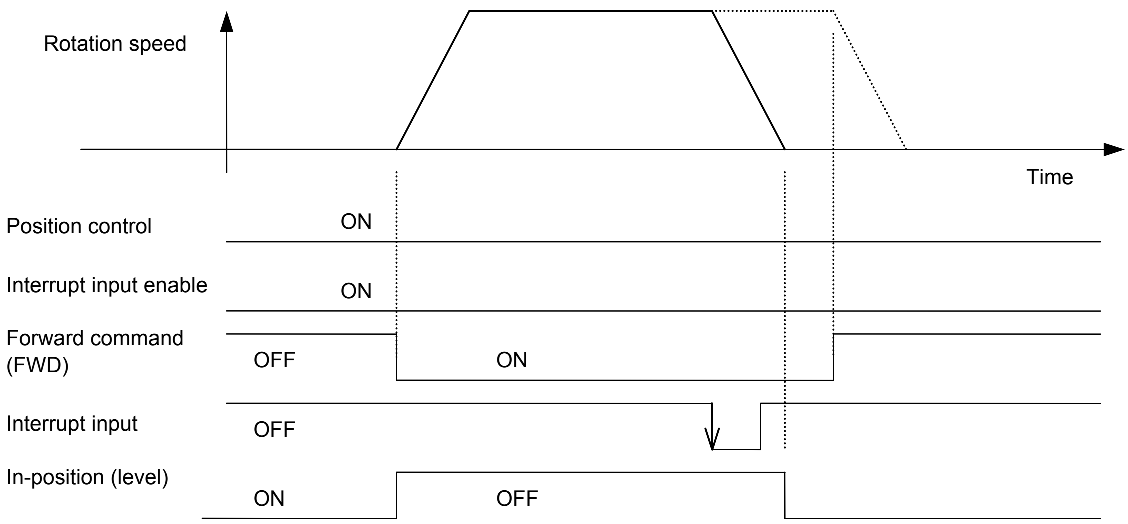
■ Parameter setting

To assign interrupt input enable to a sequence input terminal, specify the corresponding value ("48") to the input terminal function setting parameter. For the interrupt input, specify ("49").
These signals are handled to be always turned off if they are not assigned to sequence input terminals.

■ Relevant description

(1) Interrupt traveling unit amount

The traveling unit amount after the interrupt input signal is turned on is specified in PA2_20 (interrupt traveling unit amount).
The timing chart is shown in the figure below.



(2) Positioning accuracy

The traveling amount for interrupt positioning is the value corresponding to the present feedback position.
The interrupt input signal is subject to the variation of the hardware filter (0.1 [ms]).
The positioning accuracy at a mechanical system traveling speed of 1000 [mm/s] (60m/min) is: 1000 x 0.0001 = 0.1 [mm].
Consideration must be taken for the response capability and other particulars of the sensor used for the interrupt input.

Deviation clear: Sequence input signal (Reference value 50)

The difference (deviation) between the command position and feedback position is zeroed.

■ Function

The difference (deviation) between the command position and the feedback position is zeroed while the deviation clear signal remains turned on.
The present command position changes to the present feedback position.
Use PA3_36 (deviation clear input form) to select either the edge or level signal.
If the edge is selected, deviation is reset at the rising edge.
The activation time must be 2 [ms] or over.

■ Parameter setting

To assign deviation clear to a sequence input terminal, specify the corresponding value ("50") to the input terminal function setting parameter.
The signal is handled to be always turned off if it is not assigned to the sequence input terminal.

■ Relevant description

All rotation commands are ignored while the deviation clear signal is turned on.
If the deviation clear signal is turned on during servomotor rotation, the manual forward rotation [FWD] signal and so on are ignored. The feedback position does not change even if deviation clear is executed.
You can zero the accumulated deviation due to the mechanical stop or similar, thereby avoiding the travel by the deviation amount that may appear when the load is released.
After deviation clear is executed, the zero deviation sequence output signal is turned on.

Multi-step speed selection [X1]: Sequence input signal (Reference value 51)
Multi-step speed selection [X2]: Sequence input signal (Reference value 52)
Multi-step speed selection [X3]: Sequence input signal (Reference value 53)

The manual feed speed is specified for the position or speed control mode.

These values are used to select the speed limit in the torque control mode.

2

■ Function

The rotation speed while the forward command [FWD] (reverse command [REV]) signal is turned on is selected.

(1) Under speed and position control

The motor turns at the speed selected with multi-step speed [X1], [X2] and [X3].
The setting speed is shown in the table below.

X3	X2	X1	Parameter No.	Rotation speed for enabling
OFF	OFF	OFF	-	Speed command voltage (VREF)
OFF	OFF	ON	PA1_41	Manual feed speed 1
OFF	ON	OFF	PA1_42	Manual feed speed 2
OFF	ON	ON	PA1_43	Manual feed speed 3
ON	OFF	OFF	PA1_44	Manual feed speed 4
ON	OFF	ON	PA1_45	Manual feed speed 5
ON	ON	OFF	PA1_46	Manual feed speed 6
ON	ON	ON	PA1_47	Manual feed speed 7

(2) Under torque control

The rotation speed of the servomotor is limited with the speed selected with multi-step speed [X1], [X2] and [X3].
The speed limit under torque control is shown in the table below.

X3	X2	X1	Parameter No.	Speed limit for enabling
OFF	OFF	OFF	-	Speed command voltage (VREF)
OFF	OFF	ON	PA1_41	Speed limit 1
OFF	ON	OFF	PA1_42	Speed limit 2
OFF	ON	ON	PA1_43	Speed limit 3
ON	OFF	OFF	PA1_44	Speed limit 4
ON	OFF	ON	PA1_45	Speed limit 5
ON	ON	OFF	PA1_46	Speed limit 6
ON	ON	ON	PA1_47	Speed limit 7

■ Parameter setting

To assign multi-step speed selection to a sequence input terminal, specify the corresponding value ("51," "52" or "53") to the input terminal function setting parameter.
These signals are handled to be always turned off if they are not assigned to sequence input terminals.

Free-run [BX]: Sequence input signal (Reference value 54)

To put the servomotor forcibly into free-run (coast-to-stop).

Priority is given to this signal in all control modes.

■ Function

While the free-run [BX] signal assigned to a CONT input signal remains turned on, the output of the servo amplifier is shut off and the servomotor free-run.
The output shaft of the servomotor decelerates (accelerates) according to the torque of the load.
The free-run signal is enabled in all control modes (position control, speed control and torque control modes).
Under position control, the number of output pulses sent from the host controller deviates from the revolution amount of the servomotor because the servomotor free-run while the signal remains turned on.
Under speed control and torque control, as the servomotor automatically become free-run, in case it is used for vertical transportation purpose, note that there is a risk of falling.

■ Parameter setting

To assign free-run to a sequence input terminal, specify the corresponding value ("54") to the input terminal function setting parameter.
This signal is handled to be always turned off if it is not assigned to the sequence input terminal.

Edit permission: Sequence input signal (Reference value 55)

Editing operation for parameters and so on is limited with an external sequence input signal.

■ Function

The edit permission assigned to a CONT input signal controls editing operation and test operation made at the keypad or PC Loader.
The following operation can be executed only while the edit permission remains turned on.

- Parameter edit mode
- Test operation mode

When the edit permission assigned to a CONT input signal is turned off, only the monitor mode can be executed. This function can be used to avoid inadvertent operation of the keypad or PC Loader, thereby avoiding movement of the servomotor, drop of the machine, etc.

■ Parameter setting

To assign the edit permission to a sequence input terminal, specify the corresponding value ("55") to the input terminal function setting parameter.

■ Relevant description

(1) Parameter write protection

Specify "1" (write protection) to PA2_74 (parameter write protection) to disable key operation at the keypad and parameter editing at the PC Loader.
The relationship between the edit permission and PA2_74 (parameter write protection) is shown in the table below.

Edit permission	PA2_74	Parameter change operation	Edit permission response
Not assigned	0 : Write enable	ON	ON (Possible)
OFF	0 : Write enable	OFF	OFF (Impossible)
ON	0 : Write enable	ON	ON (Possible)
Not assigned	1: Write protect	OFF	OFF (Impossible)
OFF	1: Write protect	OFF	OFF (Impossible)
ON	1: Write protect	OFF	OFF (Impossible)

(2) Edit permission response

The edit permission response is an output signal.
The signal is output if it is assigned to an output signal and the edit permission is turned on.
To assign the edit permission response to a sequence output terminal, specify the corresponding value ("29") to the output terminal function setting parameter.

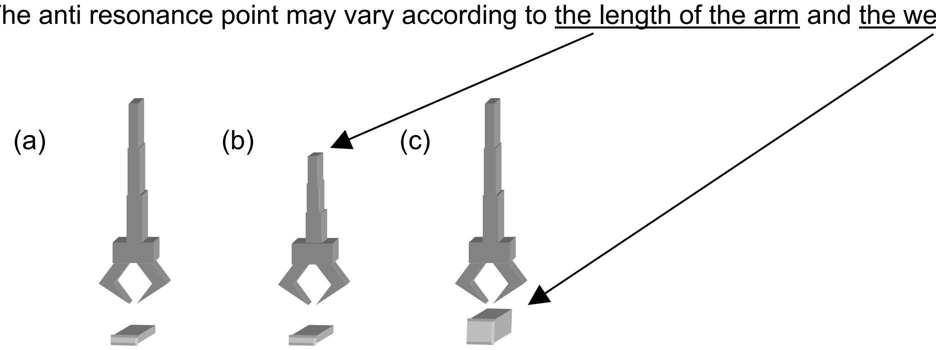
Anti resonance frequency selection 0: Sequence input signal (Reference value 57)
Anti resonance frequency selection 1: Sequence input signal (Reference value 58)

Select the anti resonance frequency, which is a vibration suppressing control function.

2

■ Function

In a spring characteristic structure such as the robot arm and transfer machine, vibration is caused at the end of the workpiece upon sudden acceleration or deceleration of the motor. Vibration suppressing control aims at suppression of vibration of the workpiece in such a system, thereby realizing positioning at a shorter cycle time.
Four points through combination of anti resonance frequency selection 0 and anti resonance frequency selection 1 can be specified.
The anti resonance point may vary according to the length of the arm and the weight of the load.



Selection of the anti resonance frequency is shown in the table below.

Anti resonance frequency selection 1	Anti resonance frequency selection 0	Vibration suppressing resonance frequency	Vibration suppressing workpiece inertia ratio
OFF	OFF	PA1_78	PA1_79
OFF	ON	PA1_80	PA1_81
ON	OFF	PA1_82	PA1_83
ON	ON	PA1_84	PA1_85

■ Parameter setting

To assign anti resonance frequency selection 0 or anti resonance frequency selection 1 to a sequence input terminal, specify the corresponding value ("57" or "58") to the input terminal function setting parameter.
These signals are handled to be always turned off if they are not assigned to sequence input signals.
In this case, PA1_78 (vibration suppressing resonance frequency 0) is always enabled.
To disable the anti resonance frequency, set the anti resonance frequency at 300.0Hz.
Because in-cycle switching of the anti resonance frequency causes a shock, switch during stoppage without fail.
In addition, it is recommended to use PA1_52 (low-pass filter (for S-curve) time constant) in parallel.

AD0: Sequence input signal (Reference value 60)
AD1: Sequence input signal (Reference value 61)
AD2: Sequence input signal (Reference value 62)
AD3: Sequence input signal (Reference value 63)

Enter the address of positioning data to be followed, among AD0 to AD3.
Refer to the table below when entering.

<Address No. selection table>

Address No.	AD3	AD2	AD1	AD0	Sequential start selection PA2_41	Operation mode　In case of internal positioning data selection: PA2_40=1 (enable)
0	OFF	OFF	OFF	OFF	0: Disable	Address error
					1: Enable	Sequential start
					2: Homing	Homing operation
1	OFF	OFF	OFF	ON	—	Operation with positioning data 1
2	OFF	OFF	ON	OFF	—	Operation with positioning data 2
3	OFF	OFF	ON	ON	—	Operation with positioning data 3
4	OFF	ON	OFF	OFF	—	Operation with positioning data 4
5	OFF	ON	OFF	ON	—	Operation with positioning data 5
6	OFF	ON	ON	OFF	—	Operation with positioning data 6
7	OFF	ON	ON	ON	—	Operation with positioning data 7
8	ON	OFF	OFF	OFF	—	Operation with positioning data 8
9	ON	OFF	OFF	ON	—	Operation with positioning data 9
10	ON	OFF	ON	OFF	—	Operation with positioning data 10
11	ON	OFF	ON	ON	—	Operation with positioning data 11
12	ON	ON	OFF	OFF	—	Operation with positioning data 12
13	ON	ON	OFF	ON	—	Operation with positioning data 13
14	ON	ON	ON	OFF	—	Operation with positioning data 14
15	ON	ON	ON	ON	—	Operation with positioning data 15

2

Positioning data selection: Sequence input signal (Reference value 77)

Positioning data operation and immediate value operation are switched over.

■ Function

The positioning method can be switched at an arbitrary timing between the following: positioning within 15 points with internal positioning data and positioning with immediate value data for frequent positioning data change.

If the CONT signal is turned on, the positioning data is enabled.

if the CONT signal is turned off, the immediate value data is enabled.

The switching timing is always enabled.

The data is recognized at the activating edge of the START signal.

If the timing is simultaneous, the data after signal change is enabled.

■ Parameter setting

To allocate positioning data selection to a sequence input terminal, enter the corresponding value ("77") to the input terminal function setting parameter.

This signal is handled to be always turned off if it is allocated to none of sequence input terminals.

Output signal

Ready for servo-on [RDY]: Sequence output signal (Reference value 1)

This signal is turned on if the servomotor is ready to operate.

■ Function

The ready for servo-on signal is turned on if the conditions shown in the table below are satisfied.

Signal division	Signal name	Function No.	Signal status
CONT input	Servo-on [S-ON]	1	ON
	Forced stop [EMG]	10	ON
	Free-run [BX]	54	OFF
OUT output	Alarm detection	16	OFF
	Servo control ready [S-RDY]	28	ON

The host sequence unit checks the ready for servo-on [RDY] signal to check if the servomotor is ready to rotate.

■ Parameter setting

To assign ready for servo-on [RDY] to a sequence output terminal, specify the corresponding value ("1") to the output terminal function setting parameter.

■ Relevant description

The servo control ready [S-RDY] (reference value 28) signal can be output.
The servo control ready signal is turned on if the conditions shown in the table below are satisfied.

Signal division	Signal name	Function No.	Signal status
CONT input	Forced stop [EMG]	10	ON
	Free-run [BX]	54	OFF
OUT output	Alarm detection	16	OFF
The internal CPU operates correctly.		-	
The L1, L2 and L3 terminals are turned on.		-	

In-position [INP]: Sequence output signal (Reference value 2)

This signal is turned on after a positioning motion is finished.

■ Function

(1) Status of in-position signal

The state under position control is shown in the table below.

Factor	Sequence status	Status of in-position signal
If servo-on [S-ON] is turned off	Free-run	ON
If servo-on [S-ON] is turned on	Servo lock	ON
Upon OT detection	Servo lock	ON
At deviation clear	Servo lock	ON
If forced stop [EMG] is turned off	Zero speed	ON
Upon alarm	Free-run	OFF

This signal is always turned on under speed control and torque control.

(2) In-position signal output format

PA1_33 (in-position output format) at either "0" (level) or "1" (single shot) can be set.

■ Parameter setting

To assign in-position [INP] to a sequence output terminal, specify the corresponding value ("2") to the output terminal function setting parameter.

■ Signal activation condition

(1) At power-on

Level: ON

Single shot: OFF

(2) During command pulse input operation

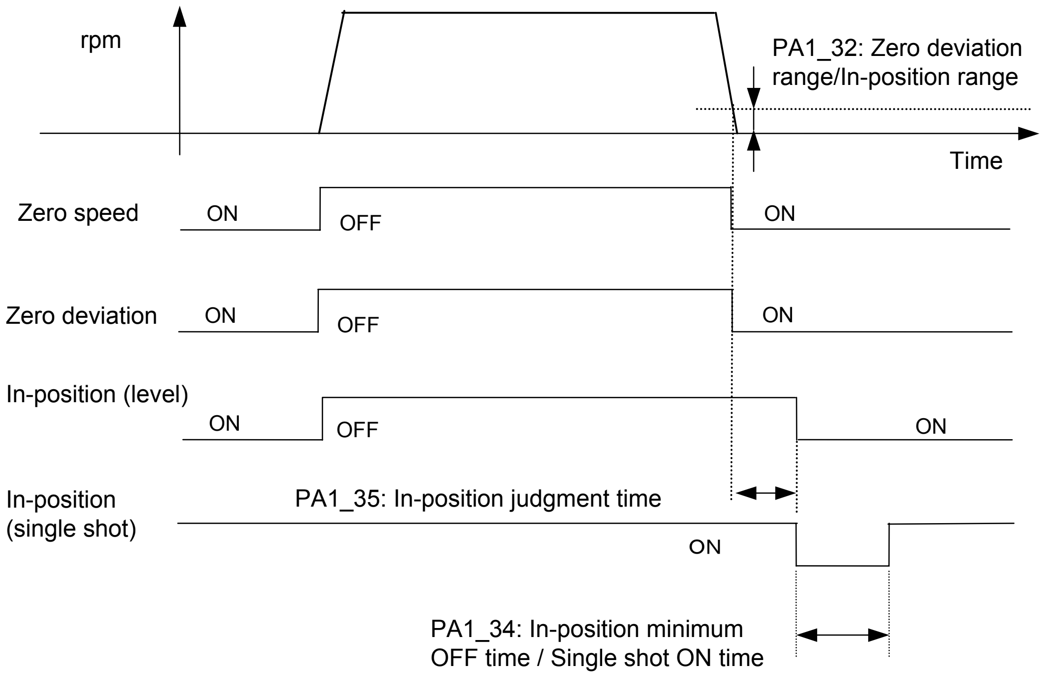
Level: The signal is turned on if conditions (A) and (B) below are satisfied.

(A) The rpm of the servomotor is within the setting of PA1_30 (zero speed range).

(B) The difference (deviation amount) between the command position (command pulse input) and feedback position is within the setting of PA1_32 (zero deviation range/in-position range).

Single shot: If conditions (A) and (B) above are satisfied, the signal is turned on for the time specified at PA1_34 (In-position min. OFF time/single shot ON time) and then it is turned off.

However, if the zero deviation signal is turned off while the signal remains turned on, the signal is forcibly turned off.



(3) Interrupt positioning

Level: The signal is turned on if conditions (A) and (B) below are satisfied.

(A) The rpm of the servomotor is within the setting of PA1_30 (zero speed range).

(B) The difference (deviation amount) between the command position (command pulse input) and feedback position is within the setting of PA1_32 (zero deviation range/in-position range).

Single shot: If conditions (A) and (B) above are satisfied, the signal is turned on for the time specified at PA1_34 (in-position minimum OFF time / single shot ON time) and then it is turned off.

However, if the zero deviation signal is turned off while the signal remains turned on, the signal is forcibly turned off.

(4) Homing/start positioning

Level: The signal is turned on if conditions (A) and (B) below are satisfied.

(A) The rpm of the servomotor is within the setting of PA1_30 (zero speed range).

(B) The difference (deviation amount) between the command position (command pulse input) and feedback position is within the setting of PA1_32 (zero deviation range/in-position range).

Single shot: If conditions (A) and (B) above are satisfied, the signal is turned on for the time specified at PA1_34 (in-position minimum OFF time / single shot ON time) and then it is turned off.

However, if the zero deviation signal is turned off while the signal remains turned on, the signal is forcibly turned off.

Speed limit detection: Sequence output signal (Reference value 11)

The signal is turned on if the rotation speed of the servomotor reaches the preset speed limit.

■ Function

The signal is output to an external device if the rpm of the servomotor reaches the preset speed limit.

- Under speed control and position control (except for command pulse operation), the speed limit depends on the setting of PA1_25 (maximum rotation speed).
- Under torque control, the speed limit depends on the setting of PA1_26 (maximum rotation speed (for torque control)).
  However, if PA2_56 (speed limit selection at torque control) is "1," the speed limit can be selected with multi-step speed settings X1 to X3.

■ Parameter setting

To assign speed limit detection to a sequence output terminal, specify the corresponding value ("11") to the output terminal function setting parameter.

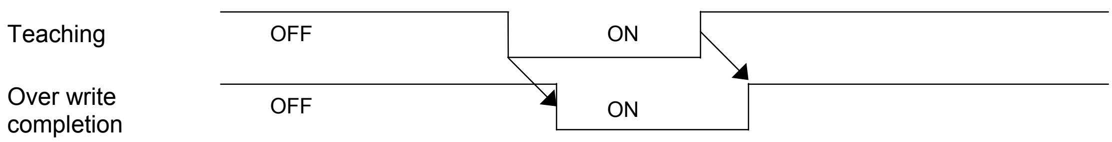
Over write completion: Sequence output signal (Reference value 13)

This signal is turned on after teaching is made and data is overwritten.

■ Function

(1) Data setting (overwriting)

The signal remains turned on while the teaching function enters data.



■ Parameter setting

To allocate the overwriting completion signal to a sequence output terminal, enter the corresponding value (“13”) to the output terminal function setting parameter.

Brake timing: Sequence output signal (Reference value 14)

The timing signal for applying or releasing the brake of the servomotor.
The signal is turned on during operation, while it is turned off after operation is stopped.

■ Function

The brake timing output is turned off if the servo-on [S-ON] signal is turned off. The ready signal is turned off after the torque keeping time to holding brake (PA2_64).

■ Parameter setting

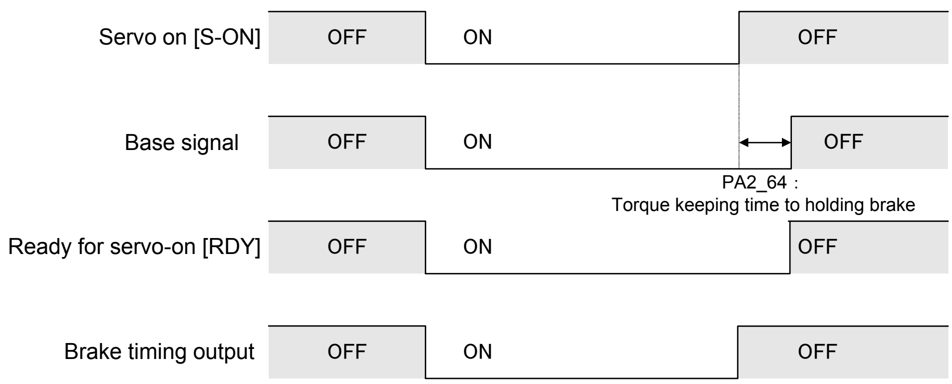
To assign the brake timing output to a sequence output terminal, specify the corresponding value ("14") to the output terminal function setting parameter.
The brake timing is issued at the specified OUT terminal.
This signal is handled to be always turned off if it is not assigned to the sequence output terminal.

Note	
Note	• The brake attached to the brake-attached servomotor is "for retention." Do not use it for braking. • Do not use the 24 [V] power supply for sequence I/O signals in parallel. Be sure to prepare a separate power supply for the brake. • To apply or release the brake with the brake timing output, turn the servo-on [S-ON] signal off first before turning the power off.

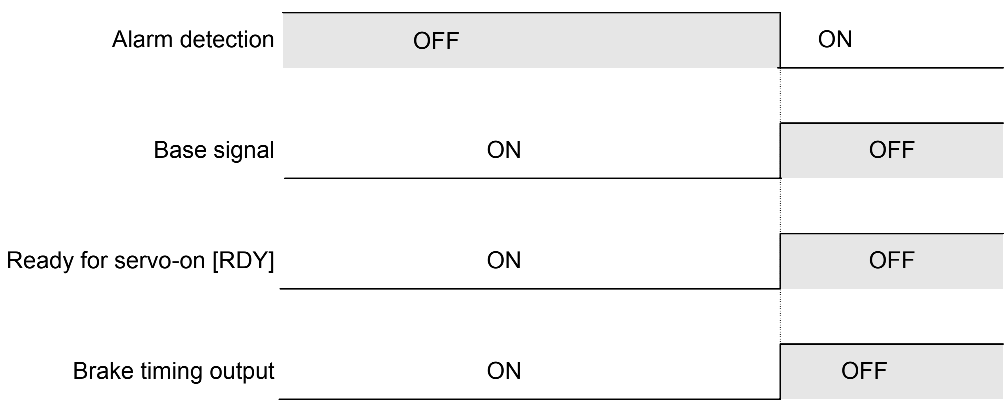
■ Relevant description

Timing chart

(1) ON/OFF of servo-on [S-ON] signal



(2) Upon alarm



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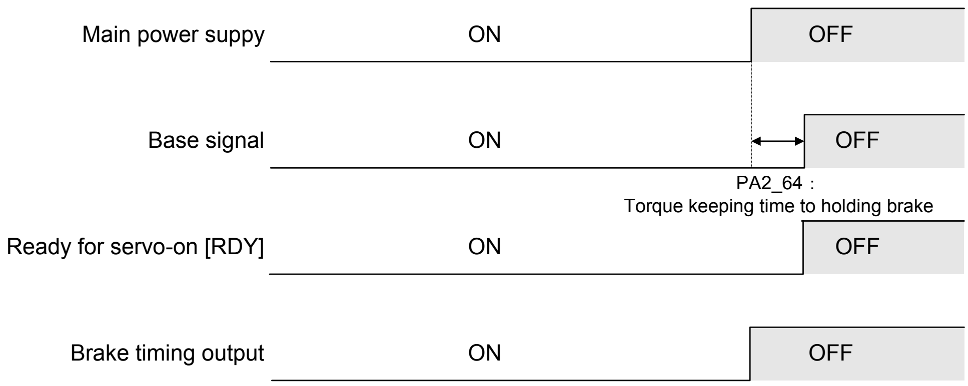
(3) Upon main power supply OFF

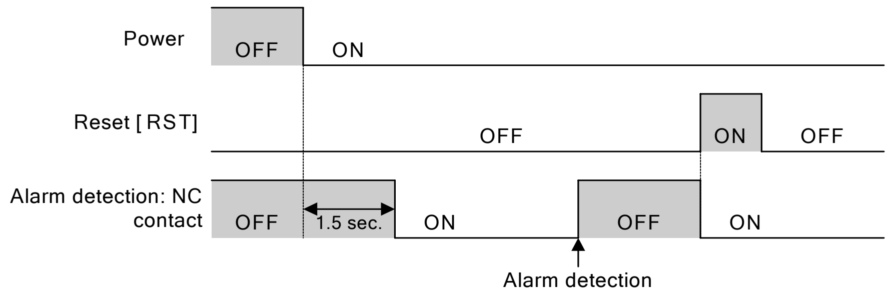


Alarm detection (normally open contact): Sequence output signal (Reference value 16)
Alarm detection (normally closed contact): Sequence output signal (Reference value 76)

Signals are turned on (off in case of normally closed contact) if the servo amplifier detects an alarm (activation of a protective function).

■ Function

The signal is turned on if the servo amplifier detects an alarm, and the state is retained on the servo amplifier side. After the cause of the alarm is removed, the signal is turned off (to be ready to operation) upon a rising edge of the alarm reset [RST] signal.
Alarm can be checked by having the host controller recognizes the alarm detection.
It can be also checked when the servo-on [S-ON] is ON and ready for servo-on [RDY] is OFF.
Precautions for using a normally closed contact for alarm detection



The contact remains turned off for about 1.5 seconds after the power is turned on.

■ Parameter setting

To assign alarm detection (normally open contact) to a sequence output terminal, specify the corresponding value ("16") to the output terminal function setting system parameter.
For alarm detection (normally closed contact), specify ("76").

■ Relevant description

The nature of the detected alarm can be output to the sequence output terminal in a code.

Alarm code 4 [ALM4] (36)

Alarm code 3 [ALM3] (35)

Alarm code 2 [ALM2] (34)

Alarm code 1 [ALM1] (33)

Alarm code 0 [ALM0] (32)

Point detection, area 1: Sequence output signal (Reference value 17)
Point detection, area 2: Sequence output signal (Reference value 18)

The current position of the servomotor is detected and output in these signals.

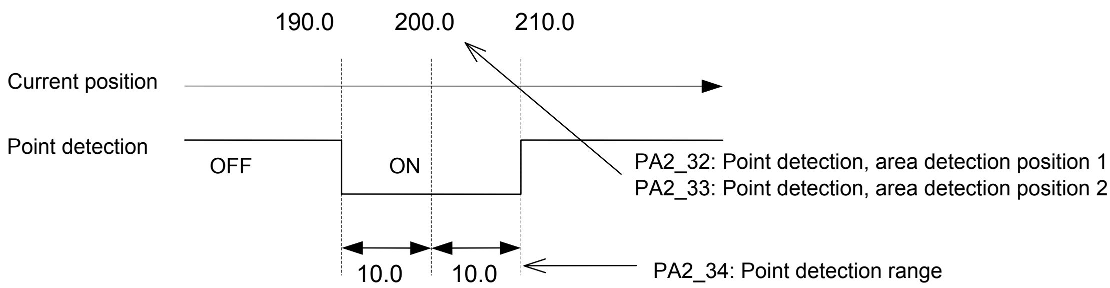
■ Function

Three types of the output format can be selected through settings of PA2_31 (point detection, area detection).

The signal can be output at two points with point detection, area 1, 2.

(1) PA2_31 (point detection, area detection) = 0: point detection

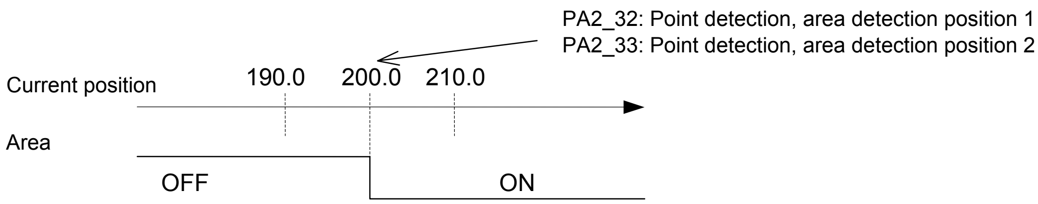
The signal is turned on near the position specified with PA2_32 or PA2_33.



(2) PA2_31 (point detection, area detection) = 1: area OFF → ON

The signal is turned on at a position beyond the setting of PA2_32 or PA2_33.

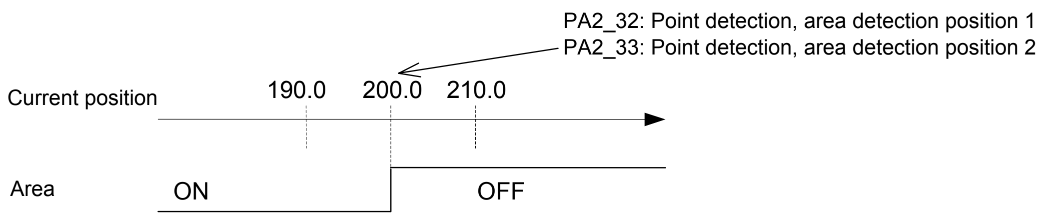
The signal is turned off below the setting.



(3) PA2_31 (point detection, area detection) = 2: area ON → OFF

The signal is turned on below the setting of PA2_32 or PA2_33.

The signal is turned off beyond the setting.



■ Parameter setting

To assign point detection and area 1 to a sequence output terminal, specify the corresponding value ("17") to the output terminal function setting parameter. Specify ("18") for point detection and area 2.

Limiter detection: Sequence output signal (Reference value 19)

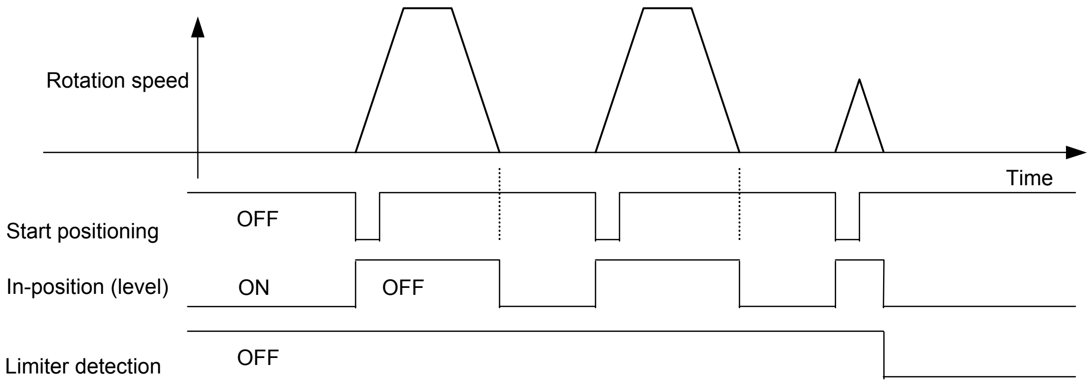
Whether the limiter function is enabled or not is checked.

■ Function

With the limiter function, a motion started with positioning data exceeding the positive limiter detecting position (PA2_28) or negative limiter detecting position (PA2_29) is stopped at the detecting position.

After the motion is stopped at the limiter detecting position, the limiter detection signal is output under the same conditions as those of issuance of the positioning completion signal.

If the motion is started with positioning data not exceeding the specified limiter position, the limiter detection signal is turned off.



The above positioning data assumes uniform incremental positioning data.

■ Parameter setting

To allocate limiter detection to a sequence output terminal, enter the corresponding value (“19”) to the output terminal function setting parameter.

■ Relevant description

The limiter function is helpful to move at a uniform interval to the preset parameter position.

There is no need to calculate the frequency of starting or remaining distance to go.

The limiter detection signal is issued after a timer time, similarly to positioning completion.

The limiter function is enabled even in the manual feed and pulse modes. In case of the pulse mode, the motor is forcibly stopped, causing deviation between the number of command pulses and the actual motor movement distance. The function is enabled during travel with positioning data or operation with immediate values.

2

OT detection: Sequence output signal (Reference value 20)

This signal is output if the over-travel (OT) signal is turned off.

■ Function

The OT detection ("20") sequence output is issued while the +OT (7) or -OT (8) sequence input signal terminal remains turned off.
In addition, OT detection ("20") is turned on if the current position reaches the reference value of the software OT detection position.
If "7" (positioning operation) is selected for PA1_01 (control mode selection), PA2_25 (position command format) is enabled.
Select "0" (regular PTP) with PA2_25 to enable the software OT function.
Select "1" (non-overflow) with PA2_25 to disable the software OT function.

■ Parameter setting

To assign OT detection to a sequence output terminal, specify the corresponding value ("20") to the output terminal function setting parameter.

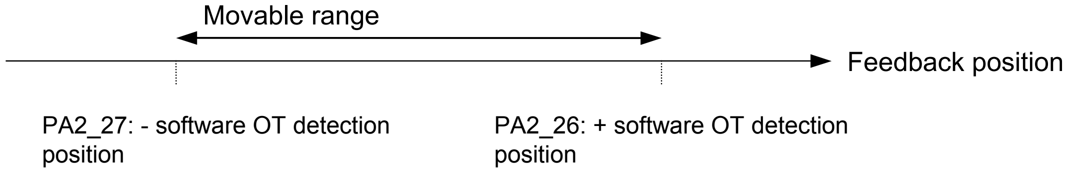
■ Relevant description

(1) +OT detection (38)/-OT detection (39)

A + OT signal is detected during servomotor travel in the positive direction, while a - OT signal is detected during travel in the negative direction.
Use sequence output signals to notify the host controller of detection of the + OT or - OT signal.
Connect to the host controller in general if the host controller is equipped with OT inputs.

(2) Software OT

Set PA2_25 (software OT selection) at "1" (enable) to limit the position range of motion between (PA2_26 (positive software OT detection position)) and (PA2_27 (negative software OT detection position)).
If the range is exceeded, the motion is forcibly stopped with the OT detection ("20") sequence output turned on.
Supply pulse inputs in the direction opposite to the detection direction or perform manual feed (forward/reverse command) to return to the range. The signal will be turned off and movement in both directions will be possible.
The + OT (or - OT) sequence input is mechanical position detection, while software OT is position detection of the servo amplifier. Software OT to reverse the homing motion shall not be applied.



Cycle end detection: Sequence output signal (Reference value 21)

Add a cycle end to positioning data to check if the data position is reached. PA2_41 (sequential start selection) must be set at “1” (enable). Change PA2_40 (internal positioning data selection) to “1” (enable).

■ Function

Starting at the positioning data at an arbitrary address, execute positioning data with merely the start positioning signal sequentially until positioning data including the “CEND” status is reached. Follow the procedure below to execute sequential start.

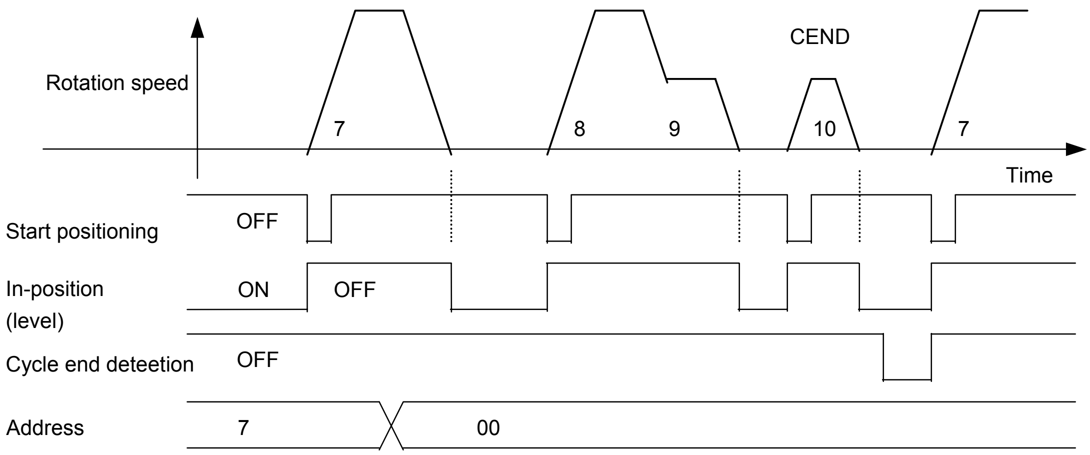
(1) Designate the first positioning data number and issue the start positioning signal to start the positioning motion.

(2) Turn all positioning data addresses off and issue the start positioning signal. The motion starts with the next positioning data.

(3) Step (2) is repeated until the positioning data including “CEND” is reached

(4) After positioning motions are completed up to the positioning data including “CEND,” the cycle end detection signal is turned on at the same timing as the in-position signal.

(5) You can supply the start positioning signal with all addresses turned off to repeat the above steps (1) through (4).



■ Parameter setting

To allocate cycle end detection to a sequence output terminal, enter the corresponding value (“21”) to the output terminal function setting parameter.

■ Relevant description

The cycle end detection signal is not output if sequential start cannot be executed.

- If the servo-on signal is turned off
- If the pulse ratio is enabled or a homing cycle is executed during sequential operation
- If +OT or -OT is detected or if software OT is detected

Neither positioning cancel nor pause gives effects on cycle end detection.

When positioning data number 15 is reached during sequential operation, the cycle end process is executed.

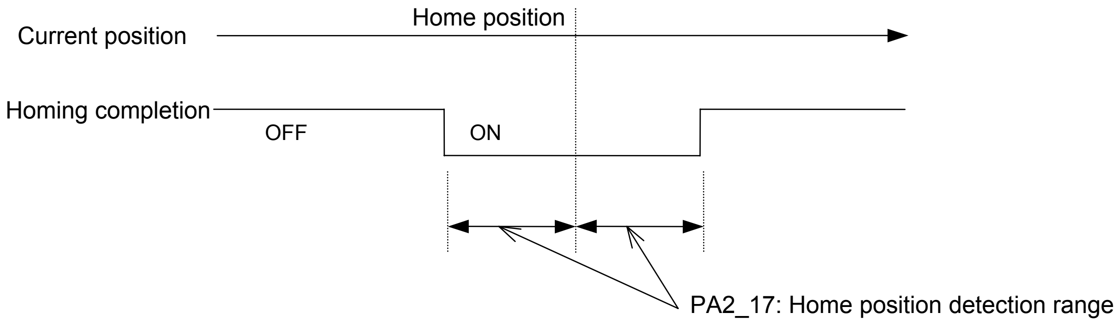
If data continuation designation is included in positioning data, operation starts at the next data having no data continuation designation.

Homing completion: Sequence output signal (Reference value 22)

This signal is turned on after the homing motion is finished.

■ Function

This signal is turned on after the homing motion is normally finished. It remains turned on if the feedback position is within PA2_17 (home position detection range) around PA2_16 (home position after homing completion).
The signal is always turned on after homing if PA2_17 (home position detection range) is "0" or the maximum value.



The home position is the stopping point after a homing motion is finished, or a position at which position preset is executed. It does not mean the "0" position.

■ Parameter setting

To assign homing completion to a sequence output terminal, specify the corresponding value ("22") to the output terminal function setting parameter.

Zero deviation: Sequence output signal (Reference value 23)

The signal is turned on if the deviation (deviation amount) retained in the servo amplifier becomes within the reference value under position control.

Whether the servomotor has reached close to the command position can be checked.

■ Function

The signal is turned on if the difference (deviation amount) between the command position and feedback position is within the reference value of PA1_32 (zero deviation width/in-position range).
The signal status is retained in control modes other than position control mode (such as torque control mode).
Position deviation will not be generated despite the reference value of PA1_32.

■ Parameter setting

To assign zero deviation to a sequence output terminal, specify the corresponding value ("23") to the output terminal function setting parameter.

Zero speed [NZERO]: Sequence output signal (Reference value 24)

The signal is turned on if the servomotor rotation speed is nearly zero.

■ Function

The signal is turned on if the servomotor rotation speed is within the reference value of PA1_30 (zero speed range).

The signal can be used as a motor stopping condition signal.

■ Parameter setting

To assign zero speed [NZERO] to a sequence output terminal, specify the corresponding value ("24") to the output terminal function setting parameter.

Speed coincidence [NARV]: Sequence output signal (Reference value 25)

The signal is turned on after the servomotor rotation speed has reached the command speed.

■ Function

The signal is turned on if the servomotor rotation speed is within the reference value of PA1_29 (speed coincidence range).
The command speed is the reference values of PA1_41 to 47 (manual feed speed 1 to 7) and the speed command voltage supplied to the VREF terminal.
The signal is enabled under speed control and position control (interrupt positioning) and in the homing cycle. It is turned off under torque control.
During manual operation, the signal is not output under the following conditions.

- If the [FWD] or [REV] signal is turned off
- If the speed does not reach due to PA1_25 (max. rotation speed (for position and speed control))
- If the deceleration time is too long to reach the command speed

■ Parameter setting

To assign the speed coincidence [NARV] signal to a sequence output terminal, specify the corresponding value ("25") to the output terminal function setting parameter.

2

■ Relevant description

PA1_25 (max. rotation speed (for position and speed))

Specify the upper limit of the servomotor rotation speed which is specified with a parameter.
If the maximum rotation speed is exceeded due to an override or similar, the servomotor rotates at the specified value.
Under torque control, there is a difference of about 100 [r/min] between the reference value and the actual servomotor rotation speed. (This is because the speed is not controlled).
The maximum rotation speed setting is disabled under command pulse input position control.

Torque limit detection: Sequence output signal (Reference value 26)

The signal remains turned on while the output torque of the servomotor is at the torque limit value.

■ Function

The torque limit value can be changed according to conditions. For details, refer to "Torque limit 0, 1" on page 2-36.
The torque limit detection (26) output is enabled in all control modes.

■ Parameter setting

To assign torque limit detection to a sequence output terminal, specify the corresponding value ("26") to the output terminal function setting parameter.

Overload warning detection: Sequence output signal (Reference value 27)

The signal is turned on if the servomotor load factor is at the reference value.
A warning can be issued before the servomotor is suddenly stopped due to an overload alarm or similar.

■ Function

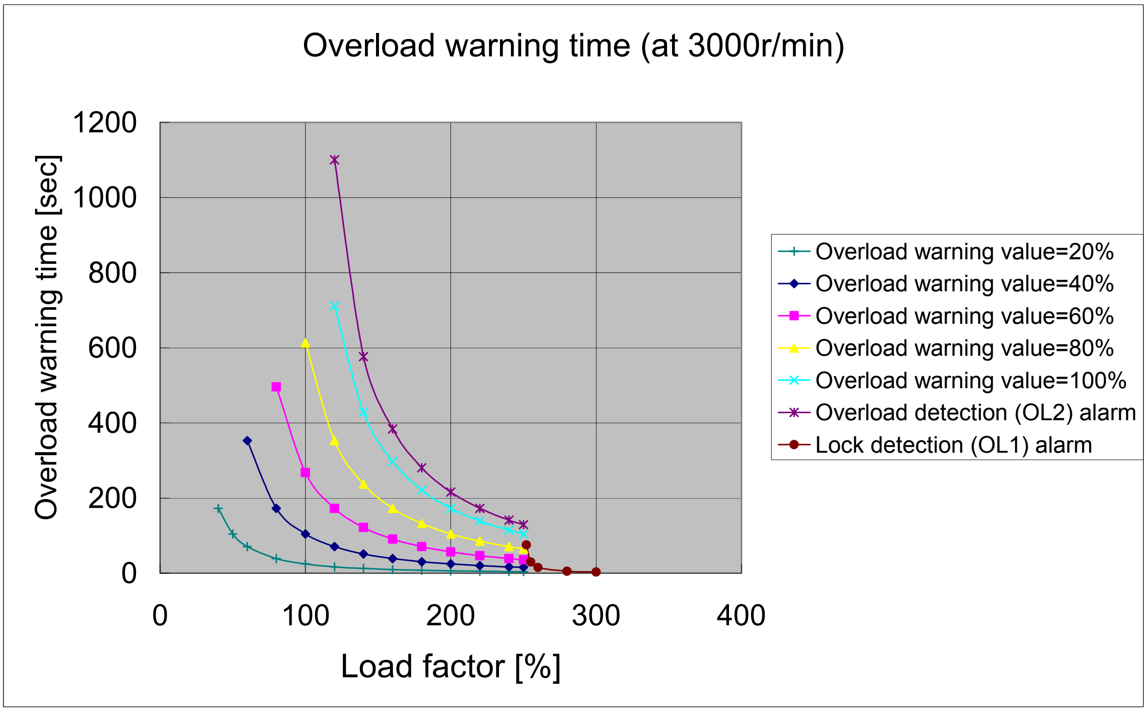
The signal is turned on if the load factor of the servomotor reaches the overload warning level of PA2_70 (overload warning value).
The signal is automatically turned off if the factor falls below the overload warning level. (There is no way to reset with a sequence input signal.)
The signal can be issued before the servo amplifier trips due to an overload alarm. Determine the reference value while referring to the characteristics diagram specified on the next page.

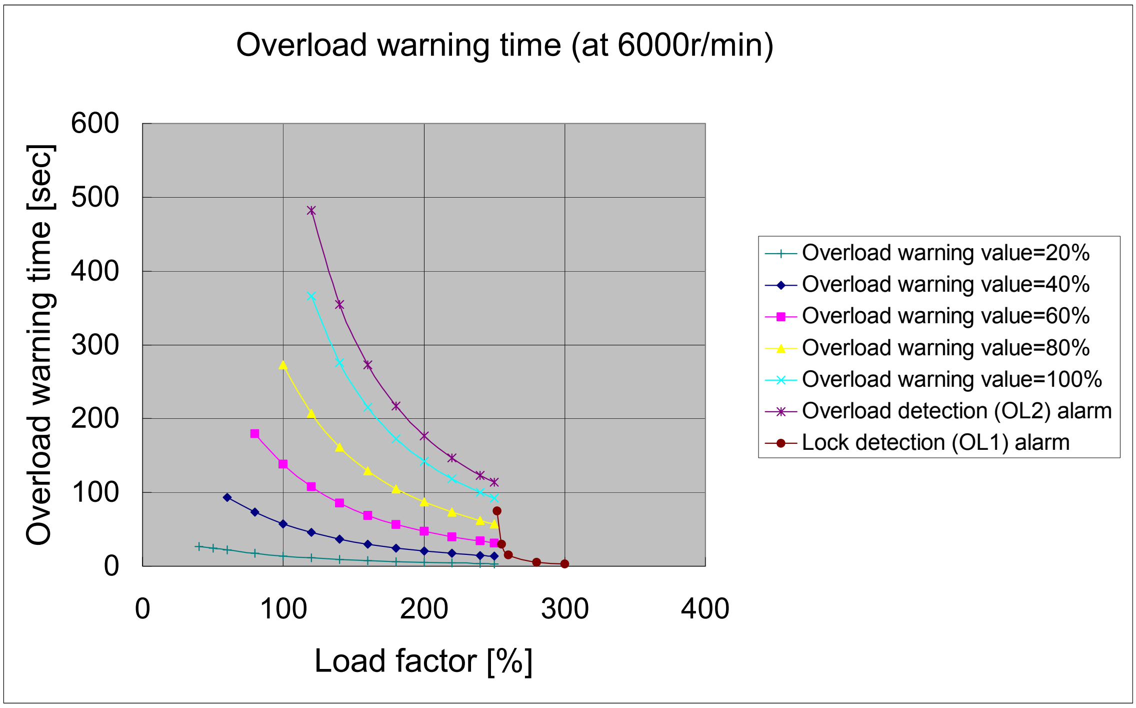
■ Parameter setting

To assign overload warning detection to a sequence output terminal, specify the corresponding value ("27") to the output terminal function setting parameter.

2

■ Standard series





Servo control ready [S-RDY]: Sequence output signal (Reference value 28)

Use the signal to check that the servo amplifier and servomotor operate correctly.

■ Function

The servo control ready signal remains turned on while the conditions listed in the table below are satisfied.

Signal division	Signal name	Function No.	Signal status
CONT input	Forced stop [EMG]	10	ON
	Free-run [BX]	54	OFF
OUT output	Alarm detection	16	OFF
The internal CPU operates correctly.		-	
The L1, L2 and L3 terminals are turned on.		-	

■ Parameter setting

To assign servo control ready to a sequence output terminal, specify the corresponding value ("28") to the output terminal function setting parameter.

Edit permission response: Sequence output signal (Reference value 29)

The signal is output if the "edit permission" input signal for enabling editing operation for parameters, etc. is turned on.

■ Function

After the edit permission assigned to a CONT input signal is on, under some conditions, the "edit permission response command" is turned on. The conditions are listed in the table below.

Edit permission	PA2_74	Parameter change operation	Edit permission response
Not assigned	0: Write enable	ON	Possible
OFF	0: Write enable	OFF	Impossible
ON	0: Write enable	ON	Possible
Not assigned	1: Write protect	OFF	Impossible
OFF	1: Write protect	OFF	Impossible
ON	1: Write protect	OFF	Impossible

■ Parameter setting

To assign edit permission response to a sequence output terminal, specify the corresponding value ("29") to the output terminal function setting parameter.

■ Relevant description

For details, refer to "Edit permission" on page 2-54.

Data error: Sequence output signal (Reference value 30)

The signal is turned on if the data reading or writing process via RS-485 communications does not proceed correctly.

■ Function

The signal is turned on if the data via RS-485 communications is incorrect (drifting beyond the specification limit).

Address error: Sequence output signal (Reference value 31)

The signal is turned on when deviation from the positioning data number range is detected.

■ Function

The signal is turned on if the start positioning (“4”) signal is turned on while AD3 through AD0 are turned off with PA2_41 (sequential start selection) being “0” (disable).
Start operation with a correct positioning data number to turn the signal off.

■ Parameter

To allocate the address error to a sequence output terminal, enter the corresponding value (“31”) to the output terminal function setting parameter.

Alarm code 0: Sequence output signal (Reference value 32)
Alarm code 1: Sequence output signal (Reference value 33)
Alarm code 2: Sequence output signal (Reference value 34)
Alarm code 3: Sequence output signal (Reference value 35)
Alarm code 4: Sequence output signal (Reference value 36)

Upon alarm, signal to output alarm details into code

■ Function

Alarm code 0 to 4 signals assigned to OUT output signals identifies the nature of the alarm.

■ Parameter setting

To assign alarm code 0 to 4 to sequence output terminals, specify the corresponding value ("32" to "36") to the output terminal function setting parameter.

2

■ List of alarm nature and code

Nature of alarm	ALM4	ALM3	ALM2	ALM1	ALM0	Code	Indication	Order
No alarm (during correct operation)						00H	-	-
Overload 1					1	01H	oL1	15
Overload 2					1	01H	oL2	16
Pulse command frequency error				1	0	02H	HF	29
Amplifier overheat				1	1	03H	AH	22
Internal braking resistor overheat			1	0	0	04H	rH1	18
External braking resistor overheat			1	0	0	04H	rH2	19
Braking transistor error			1	0	0	04H	rH3	20
Deviation overflow			1	0	1	05H	oF	21
Overcurrent 1			1	1	0	06H	oC1	1
Overcurrent 2			1	1	0	06H	oC2	2
Overspeed			1	1	1	07H	oS	3
Overvoltage		1	0	0	0	08H	Hv	5
Control power undervoltage		1	0	0	1	09H	LvC	4
Main power undervoltage		1	0	0	1	09H	LvP	17
Encoder trouble 1		1	0	1	0	0AH	Et1	6
Encoder trouble 2		1	0	1	0	0AH	Et2	7
Initial error		1	0	1	1	0BH	IE	28
Circuit trouble		1	1	0	0	0CH	Ct	8
Memory error		1	1	0	1	0DH	DE	9
Fuse broken		1	1	1	1	0FH	Fb	10
Encoder communication error	1	0	0	0	0	10H	EC	13
Motor combination error	1	0	0	0	1	11H	CE	11
Braking transistor overheat	1	0	0	1	0	12H	tH	12
CONT (Control signal) Error	1	0	0	1	1	13H	CtE	14
Encoder overheat	1	0	1	0	0	14H	EH	23
Absolute data lost 1	1	0	1	0	1	15H	dL1	24
Absolute data lost 2	1	0	1	0	1	15H	dL2	25
Absolute data lost 3	1	0	1	0	1	15H	dL3	26
Multi-turn data overflow	1	0	1	1	0	16H	AF	27

*1=ON, 0=OFF Indication indicates characters displayed at the keypad.

Type	Nature of alarm	Code
Address error	BCD error	19H
	Out-of-range error	1AH
Data error	Command rejection	1BH
	BCD error	1CH
	Out-of-range error, 0 data write	1DH
	Negative sign designation	1EH
Maintenance function	Battery warning	17H
	Life warning	18H

- If two or more alarms occur simultaneously, alarms are output in the priority specified in the table above.
- The life warning is for the capacitors in the main circuit inside the servo amplifier and the cooling fan (OR condition).

+OT detection: Sequence output signal (Reference value 38)
-OT detection: Sequence output signal (Reference value 39)

The state of over-travel (±OT) is output.

■ Function

The corresponding positive or - OT detection sequence output is turned on while the +OT or -OT sequence input signal terminal remains turned off.

■ Parameter setting

To assign positive or - OT detection to a sequence output terminal, specify the corresponding value ("38" or "39") to the output terminal function setting parameter.

■ Relevant description

(1) OT detection

The signal is turned on when the servomotor detects the OT signal in either the positive or negative direction. For details, refer to page 2-68.

(2) Software OT

Set PA2_25 (software OT selection) at "1" to allow movement in the position range between (PA2_26 (+software OT detection position)) and (PA2_27 (-software OT detection position)). For details, refer to "PA2_25 to 27 software OT selection/+software OT detection/-software OT detection position" on page 4-66.

Home position LS detection: Sequence output signal (Reference value 40)

The signal is output while the home position LS signal (input signal) remains turned on.

■ Function

The sequence output corresponding to home position LS detection is turned on while the home position LS sequence input signal remains turned on.

■ Parameter setting

To assign home position LS detection to a sequence output terminal, specify the corresponding value ("40") to the output terminal function setting parameter.

Forced stop detection: Sequence output signal (Reference value 41)

The signal is turned on while the forced stop signal (input signal) remains turned off.

■ Function

Forced stop detection is turned on when the forced stop sequence input signal is turned off. For details, refer to "Forced stop" on page 2-32.

■ Parameter setting

To assign forced stop detection to a sequence output terminal, specify the corresponding value ("41") to the output terminal function setting parameter.

Battery warning: Sequence output signal (Reference value 45)

The signal is output if the battery voltage is smaller than the rated value.

■ Function

If the battery voltage is smaller than the rated value in an established ABS system (absolute system), a battery warning signal is turned on.

■ Parameter setting

To assign battery warning to a sequence output terminal, specify the corresponding value ("45") to the output terminal function setting parameter.
Replace the battery immediately if this signal is turned on.

Life warning: Sequence output signal (Reference value 46)

The life of internal main circuit capacitors of the servo amplifier and that of the cooling fan are calculated and output its signal.

■ Function

The life of internal main circuit capacitors of the servo amplifier and that of the cooling fan are calculated and, if either exceeds the rated time, a life warning is turned on.
Use the PC Loader or keypad (En_003) to discriminate between the main circuit capacitors and cooling fan.

■ Parameter setting

To assign the life warning to a sequence output terminal, specify the corresponding value ("46") to the output terminal function setting parameter.

MD0: Sequence output signal (Reference value 60)
MD1: Sequence output signal (Reference value 61)
MD2: Sequence output signal (Reference value 62)
MD3: Sequence output signal (Reference value 63)
MD4: Sequence output signal (Reference value 64)
MD5: Sequence output signal (Reference value 65)
MD6: Sequence output signal (Reference value 66)
MD7: Sequence output signal (Reference value 67)

The M code of positioning data currently executed is output.

■ Function

The M code of the positioning data being executed is output.
Unlike JIS B 3614, M00, M02, M30, M98 and M99 are not provided with specific functions but are general-purpose code outputs. No interlock function is provided at M_{ON} and M_{OFF}.
The M code is output at M code sequence output terminals 0 to 7 (“60” to “67”).
The M code is a hexadecimal between 00H and FFH.
* The default value of the M code is FF.
In case of RS-485 communications, the code can be acquired through in-process positioning data read function.

■ Parameter setting

To allocate M codes 0 to 7 to sequence output terminals, enter corresponding value (“60” to “67”) to the system parameter.

2

■ Relevant description

(1) M code setting range

Enter the M code in a binary between 00h and FFh.

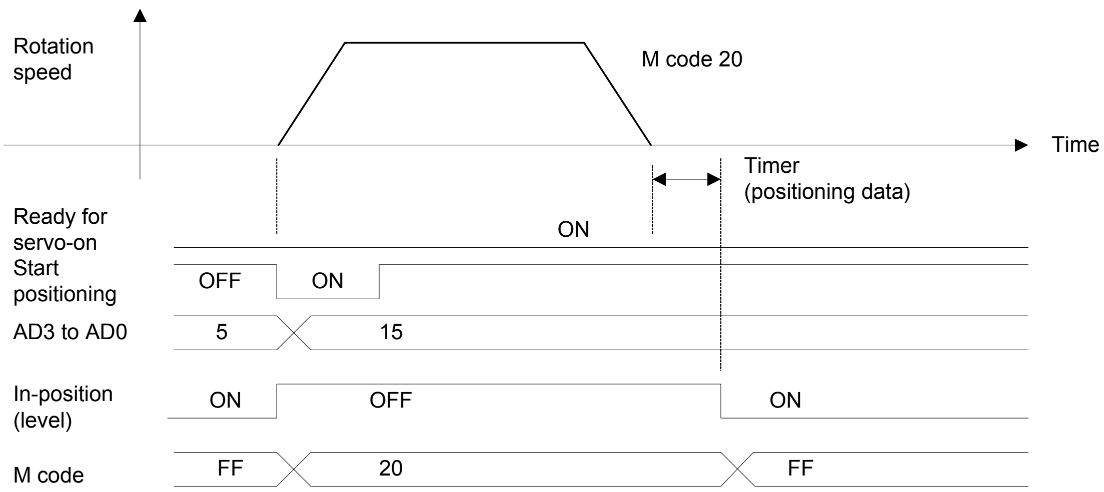
(2) Output at start (output in start) / output at completion (output after completion)

You can select the M code output timing between during execution of positioning data (output at start) and after execution of positioning data (output at completion).

Output at start (in-process output)

The signal is issued since the start of the positioning motion to the end. After the positioning motion is finished, the signal is turned off.

Simultaneous output of M code

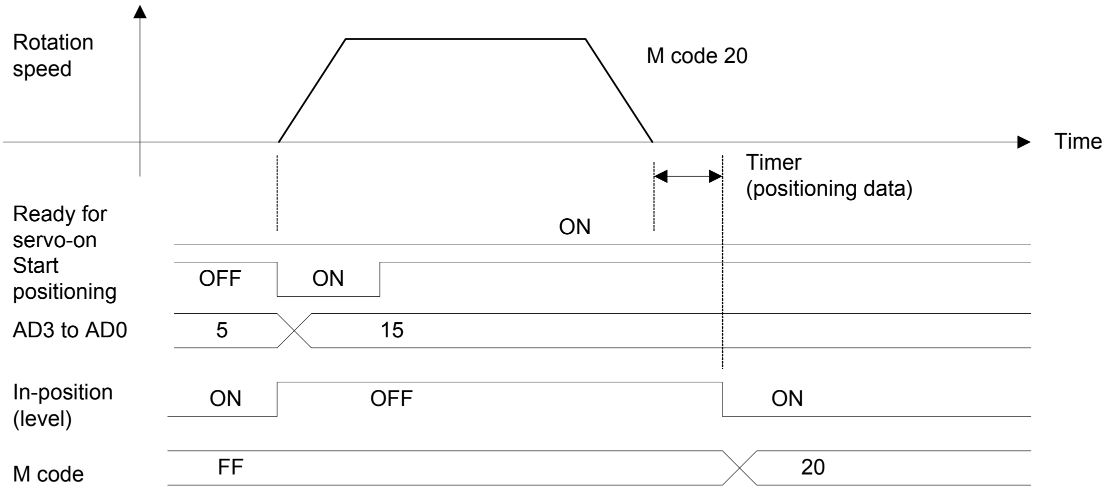


* Positioning data is executed while the timer time is counted.
* The default value of the M code is FF.

Output at completion (after-process output)

The signal is output at positioning completion and is hold.

Output after M code issuing



* Positioning data is executed while the timer time is counted.
* The default value of the M code is FF.

Position preset completion: Sequence output signal (Reference value 75)

This signal is output after position preset (position change) is executed and completed.

■ Function

If position preset is executed in an established ABS system (absolute system) to reset from an alarm or change the current position, the sequence output corresponding to position preset completion is turned on after position preset is finished.

■ Parameter setting

To assign position preset completion to a sequence output terminal, specify the corresponding value ("75") to the output terminal function setting parameter.

Alarm detection (normally closed contact): Sequence output signal (Reference value 76)

The signal is turned off if a protective function (alarm) of the servo amplifier is activated.

For details, refer to “Alarm code 0 to 4” on page 2-75.

Immediate value continuation permission: Sequence output signal (Reference value 79)

The signal is turned on when the system is ready to accept an immediate value continuation command.

■ Function

The immediate value continuation command can be accepted only if this signal is turned on after immediate value operation is started.
The signal is turned off after the continuation setting completion signal is turned on. It is turned on again after data continuation is made.
The signal is turned off 50ms after positioning based on the post-continuation data.

For details, refer to “Immediate value continuation” on page 2-37.

■ Parameter setting

Enter the corresponding value (“79”) to the output terminal function setting parameter. Relevant signal reference values are shown below.

Allocated signal	No.
Immediate value continuation: sequence input signal	22
Immediate value continuation completion: sequence output signal	80
Immediate value continuation permission: sequence output signal	79

Immediate value continuation completion: Sequence output signal (Reference value 80)

The signal is turned on after continuation of immediate value operation is processed according to an immediate value continuation command, and it is turned off after the immediate value continuation command is turned off.

■ Function

After immediate value operation is started and positioning is completed, the positioning motion continues according to new target position (speed) data. The positioning motion continues even if deceleration is already started with immediate value operation data.
For details, refer to “Immediate value continuation” on page 2-37.

■ Parameter setting

Enter the corresponding value (“80”) to the output terminal function setting parameter. The relevant signal reference values are shown below.

Allocated signal	No.
Immediate value continuation: sequence input signal	22
Immediate value continuation completion: sequence output signal	80
Immediate value continuation permission: sequence output signal	79

Immediate value change completion: Sequence output signal (Reference value 81)

The signal is turned on when the changing process is executed according to an immediate value change signal, and it is turned off after the immediate value change is turned off.

■ Function

While the in-position signal is turned off after immediate value operation is started, the target position and target speed can be changed at an arbitrary timing.
For details, refer to “Immediate value change” on page 2-39.
The command position and command speed change at the activating edge of the immediate value

change command. While the positioning completion signal is turned off, they can be changed at an arbitrary timing.

■ Parameter setting

Enter the corresponding value (“81”) to the output terminal function setting parameter. The relevant signal reference values are shown below.

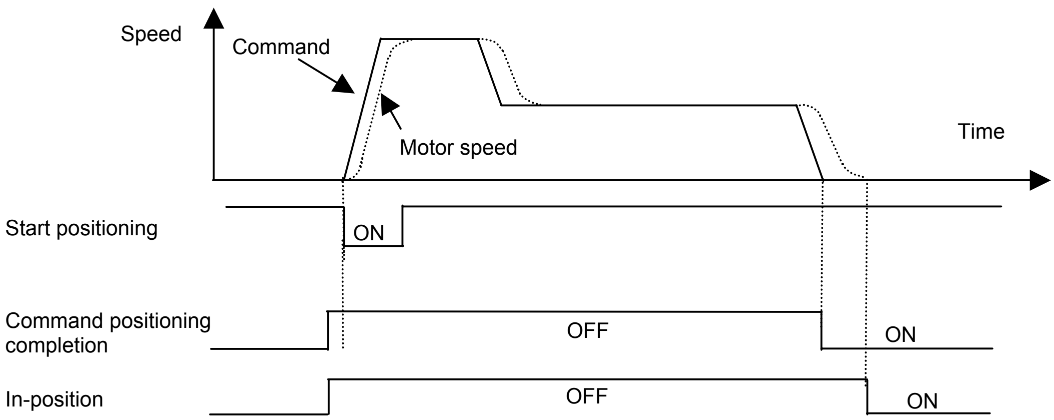
Allocated signal	No.
Immediate value change	23
Immediate value change completion	81

Command positioning completion: Sequence output signal (Reference value 82)

The signal is turned on after the command value inside the servo amplifier is completed.

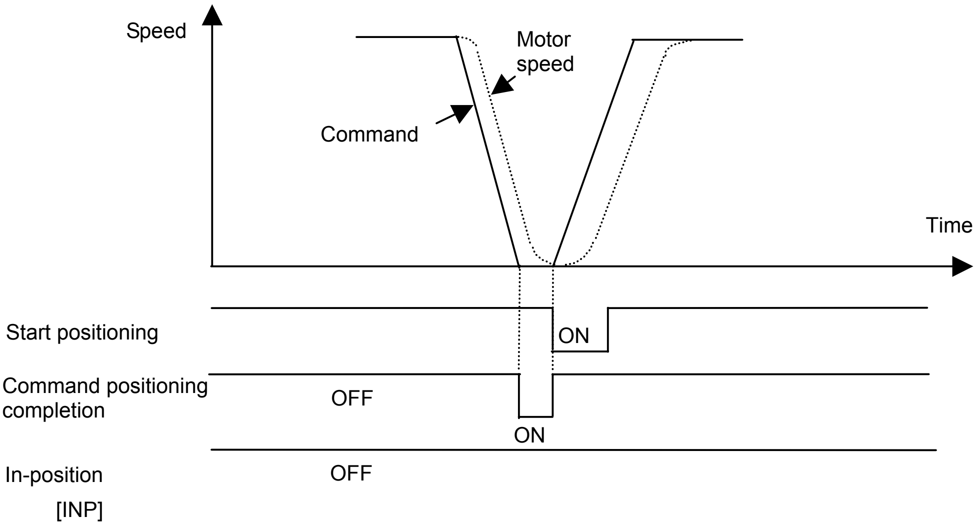
■ Function

The signal undergoes ON-to-OFF transition at the start of operation and OFF-to-ON transition upon elimination of the internal command during manual feed, positioning, homing or interrupt positioning. However, even if the command is eliminated, in the case of the automatic-operation continuation dwell timer counting cycle for example, the OFF state continues during operation. When continuation of operation is disabled due to alarm detection, emergency stop detection or OT detection, this signal is immediately turned on.



If the command positioning completion signal is allocated to an output signal, the condition for the next start signal is activation of the command positioning completion signal. Refer to the timing chart below.

(Example : Automatic operation continuation)



If a motion to the current position is started, the servomotor does not start but the in-position signal is turned off for the time specified in PA1_34 (in-position minimum OFF time / single shot ON time).

■ Parameter setting

Enter the corresponding value (“82”) to the output terminal function setting parameter.

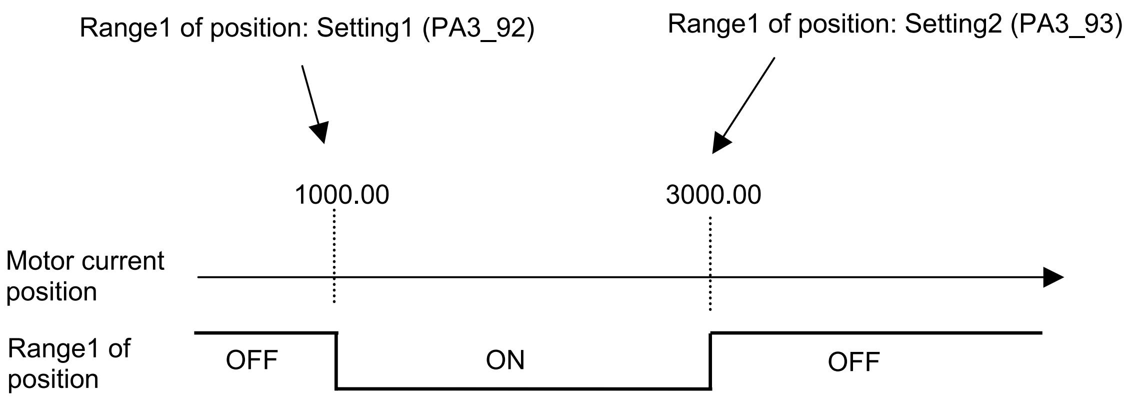
Range 1 of position: Sequence output signal (Reference value 83)
Range 2 of position: Sequence output signal (Reference value 84)

This signal is issued upon detection of the current servomotor position.

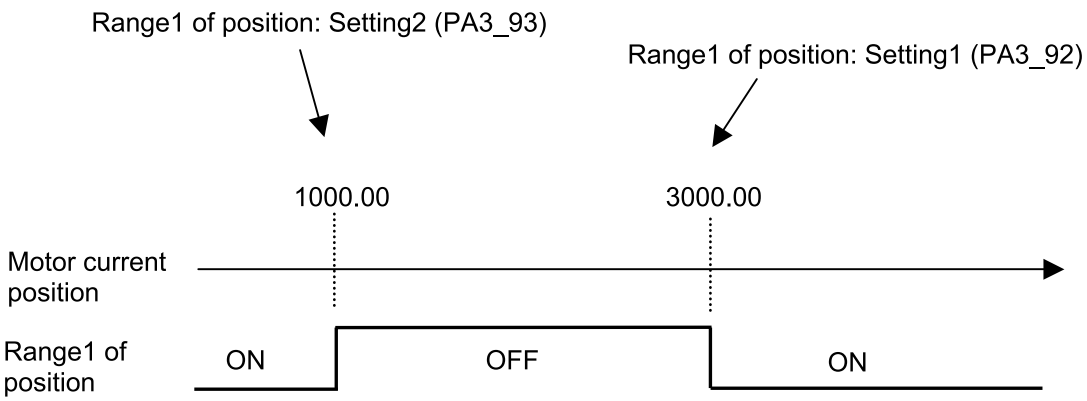
■ Parameter setting

The signal can be output at two positions: position range 1 and 2.
 Range 1 of position: Enter at PA3_92 and _93.
 Range 2 of position: Enter at PA3_94 and _95.

1) Setting value of PA3_92 < Setting value of PA3_93



2) Setting value of PA3_92 > Setting value of PA3_93



Note: If setting 1 of range 1 of position (PA3_92) is the same as setting 2 of range 1 of position (PA2_93), range 1 of position is always turned off. The same is true for range 2 of position.

2

2.6 Connection Example to Host Controller

For products not described in this manual, be sure to refer to the manual attached to the corresponding product. Refer to the connection diagram described here.

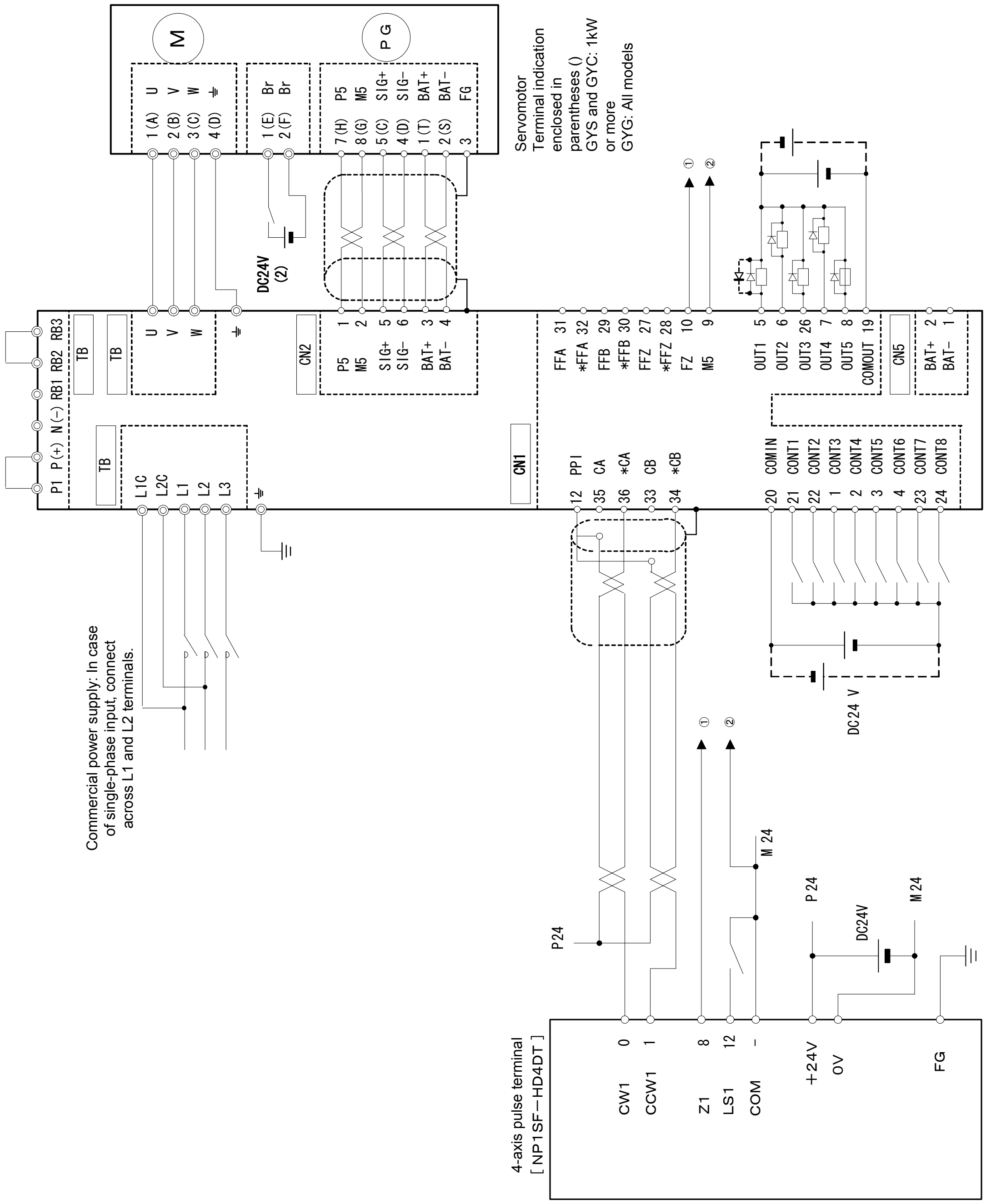
- The servomotor specified in the connection diagram is equipped with a brake. If the servomotor is equipped with no brake, the Br terminal is not provided.
- Connection of connector 6 (CN6) is unnecessary for the operation of the servomotor. Use it to measure or monitor the speed waveform and torque waveform of the servomotor with a measuring instrument or similar.
- Connect a battery at connector 5 (CN5) to configure an absolute system.
  It is unnecessary if the absolute system is not configured.
- Connector 4 (CN4) is for the PC Loader. It is irrelevant to operation or stopping of the servomotor.
- To drive a servomotor, the main power and control power must be supplied. To edit parameters or perform similar operation without rotating the motor, supply only the control power.
- Prepare separate power supplies for 24 [V] DC sequence I/O (CN1) and 24 [V] DC brake.
  This is to isolate the effects of voltage fluctuation caused by counter electromotive force generated by power-on and -off of the brake coil. There is no polarity in the brake power supply input.

2.6.1 Connection Example (Positioning terminal: NP1SF-HP4DT)

A connection example with MICREX-SX Series four-axis pulse output positioning terminal is shown below.

The maximum output frequency is 250kHz.

This terminal needs no FB. For details, refer to the manual prepared for the positioning terminal.



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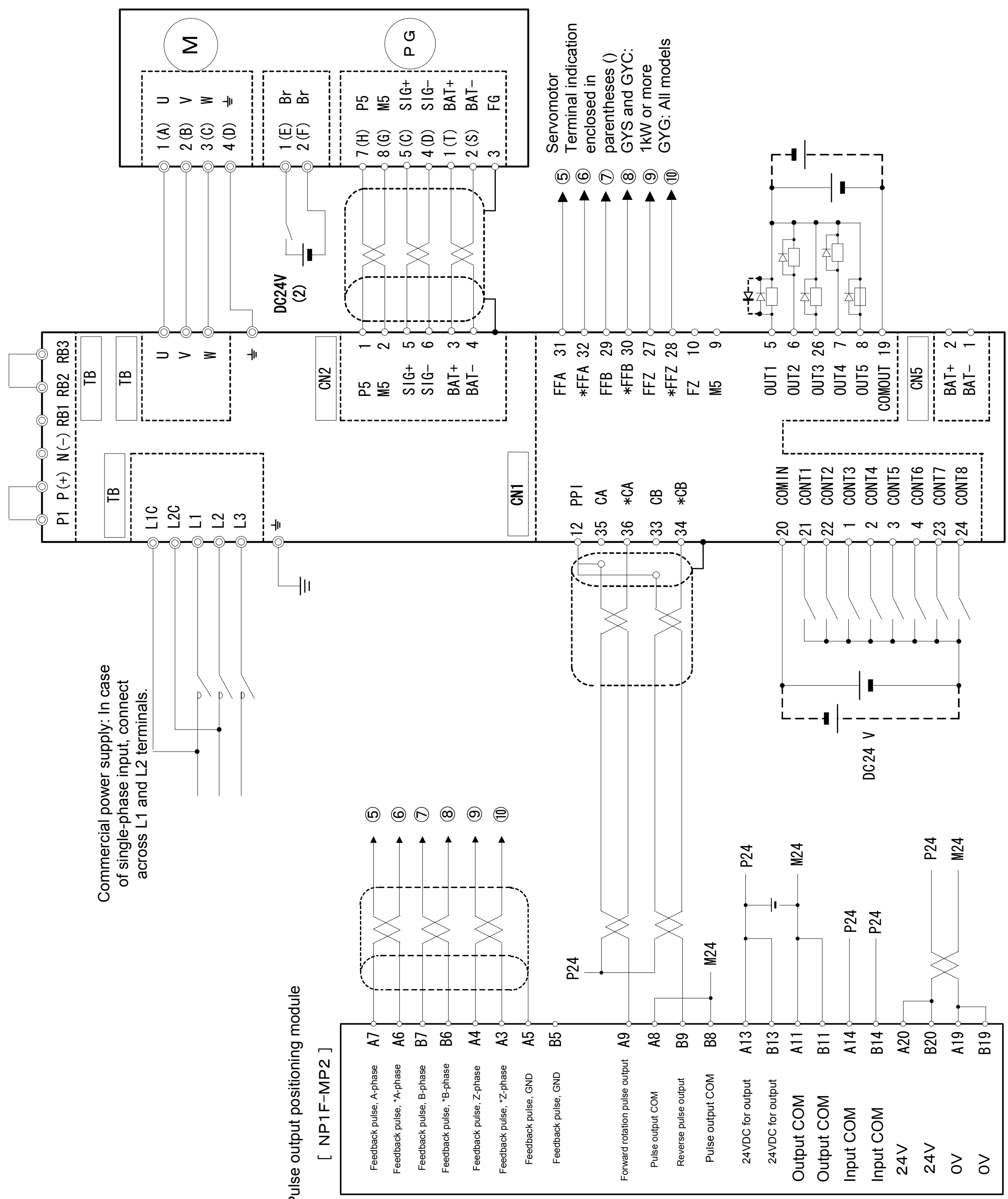
2.6.2 Connection Example (Positioning module: NP1F-MP2)

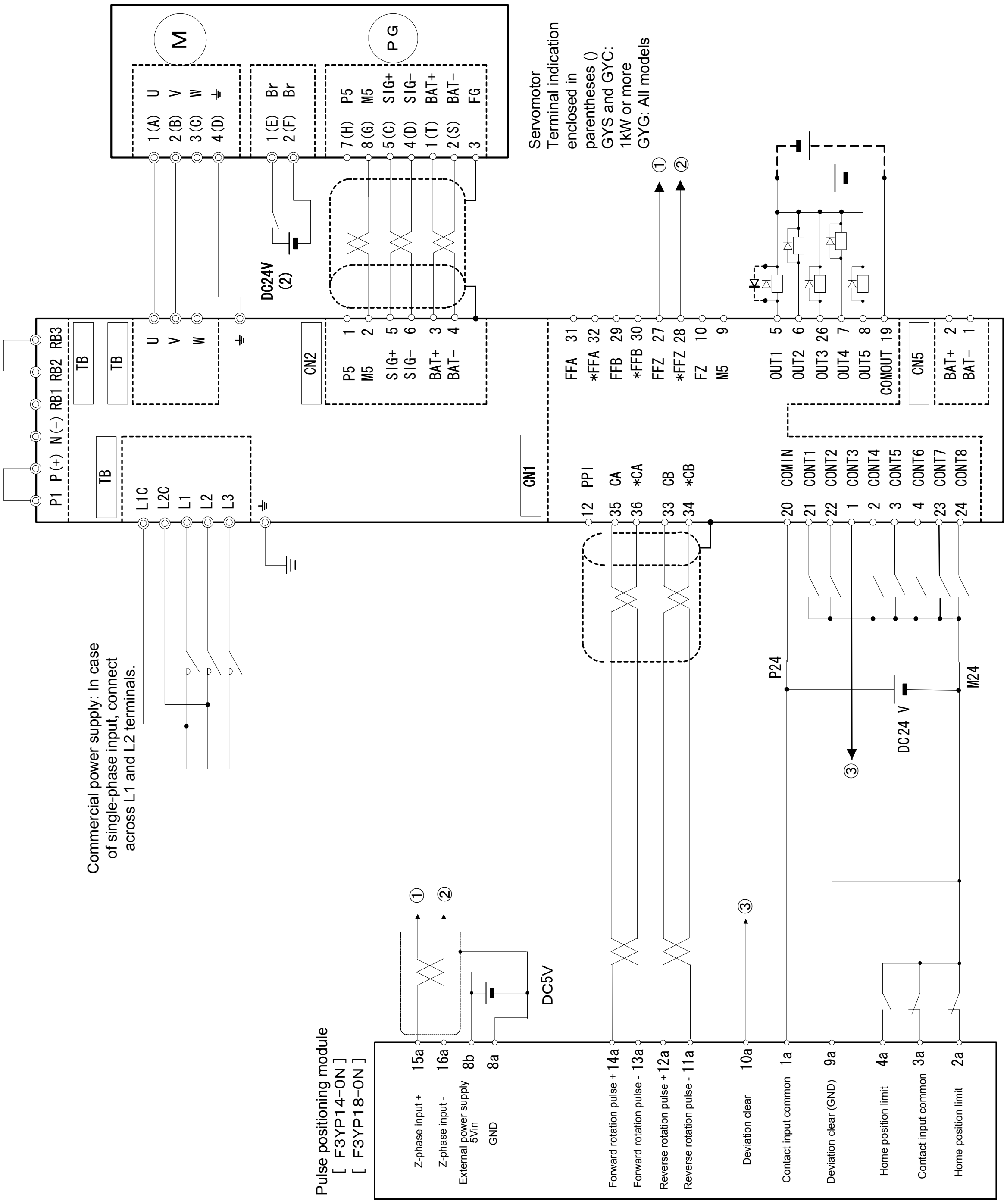
A connection example with MICREX-SX Series pulse two-axis positioning module is shown below. The maximum output frequency is 200kHz. For details, refer to the manual prepared for the positioning module.



2.6.3 Connection Example (Positioning module: F3YP14-0N/ F3YP18-0N)

A connection example with the F3YP14-0N type positioning module made by Yokogawa Electric is shown below.

For the PLC, refer to the corresponding manual.



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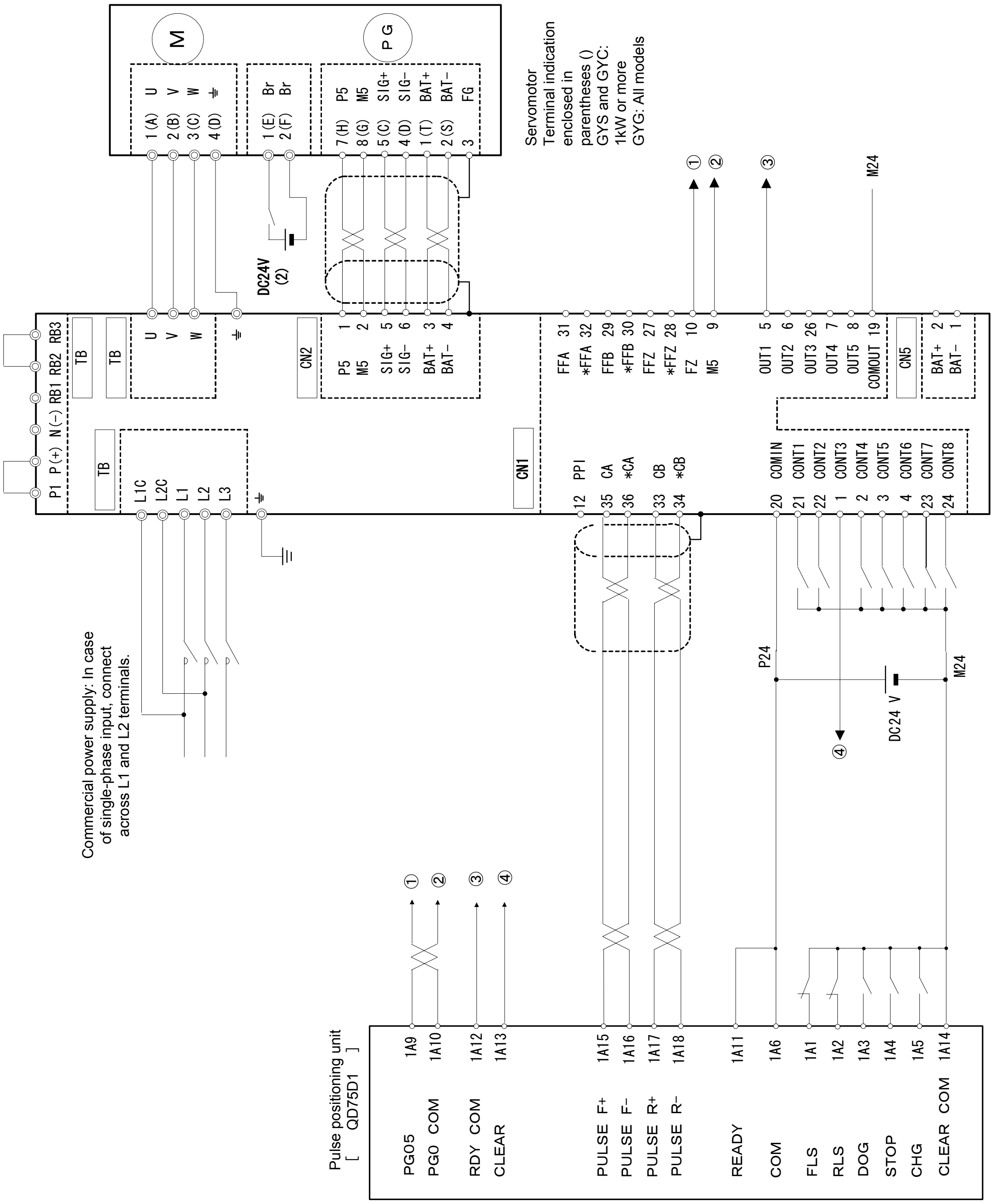
2.6.4 Connection Example (Positioning unit: QD75 type)

A connection example with the QD75 type positioning unit made by Mitsubishi Electric is shown below.
Connection between the QD75 type positioning unit and servo amplifier is shown.
For the PLC, refer to the corresponding manual.



CHAPTER 3 OPERATION

3

3.1 Signal Description (Priority among Input Signals)

Input signals of the servo amplifier for stopping the motor shaft are received first in view of safety.

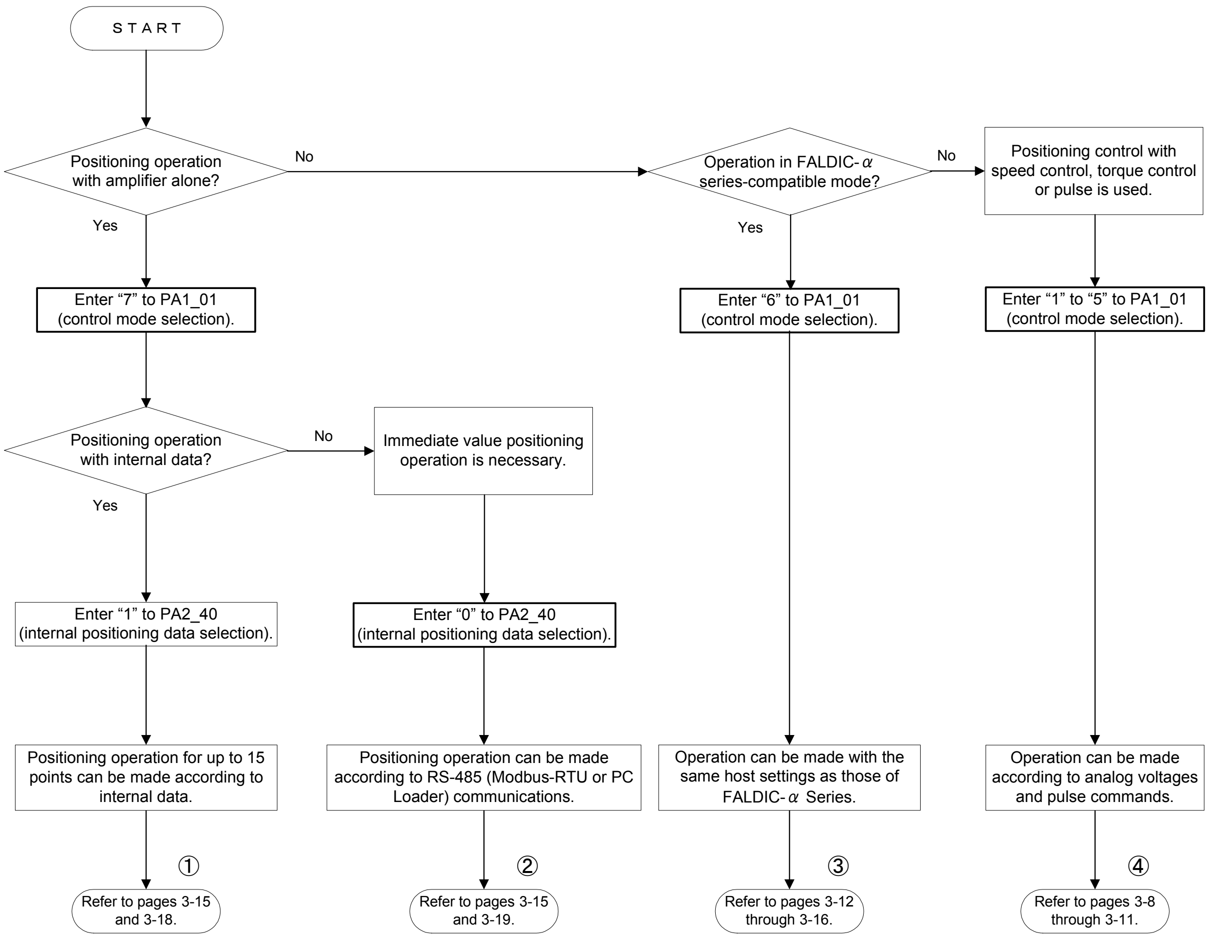
Section	Description	Applicable signal (Function No.)
01	Operation signal always given highest priority	• Free-run command (54) • Servo-on (1)
02	Operation signal always given priority	• Forced stop (10) • External braking resistor overheat (34)
03	Signal for controlling the torque	• Torque limit 0 (19) • Torque limit 1 (20)
04	Signal for stopping the motor	• +OT (7) • -OT (8) • Command pulse inhibit (26) • Pause (31) • Positioning cancel (32) • Deviation clear (50)
05	Signal for turning the motor	• FWD (2) • REV (3) • Start positioning (4) • Homing (5)
06	Signal for determining the home position	• Home position LS (6) • +OT (7) • -OT (8) • Interrupt input (49) • Position preset (16)
07	Signal irrelevant to motor operation	• Alarm reset (11) • Edit permission (55)

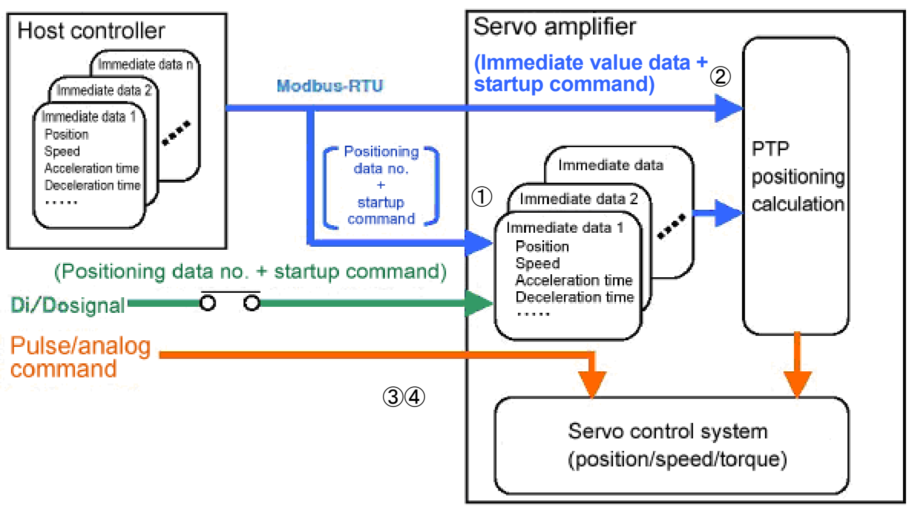
- The moving part of the mechanical system of the elevator may drop if a free-run command is used. Do not assign the command unless necessary.
- If +OT (7) is detected during rotation caused by an FWD (2) signal, priority is given to the +OT (7) signal.
  Even if the +OT (7) signal is detected, priority is given to the torque limit (30) signal.
  Priority is given to forced stop (10) during operation with a torque command (30) signal. However, if the free-run command (34) signal is issued, the servo amplifier output is stopped.
- The response time of the sequence input terminal and output terminal is about 1 [ms].
  If the zero deviation signal setting or similar is too small, the host PLC may fail to recognize.
  (The scanning cycle of a general PLC is several tens of milliseconds [ms].)

3.2 Selection of Operation Procedure

The VV type servo amplifier is capable of speed control and torque control with analog voltages, position control with pulse, positioning data operation with Di/Do signals or RS-485 communications, and immediate value data operation with RS-485 communications.

Follow the flow chart below to select the desired operation and enter parameters, etc.





3.3 Operation Check

3.3.1 Power On

Connect the commercial power supply and the servomotor to the servo amplifier.

For the wiring method, refer to "CHAPTER 2 WIRING."

■ Supplying commercial power

Operate MCCB/ELCB to supply power.

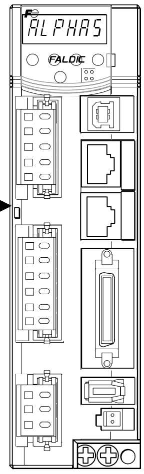
Supply main power simultaneously or later to the control power.

If necessary, insert an electromagnetic contactor in the upstream of the main power input so that the power can be shut off at any time.

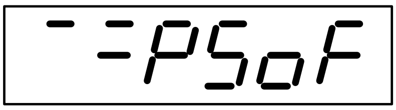
The main power (L1, L2 and L3) and control power (L1C and L2C) are separated internally. Be sure to supply power to both of them. The following results indicate the correct state.

(1) The charge LED lights up in red.

Charge LED



(2) If the servo amplifier is in the factory shipment state, the keypad shows the following.



■ If the charge LED fails to light up

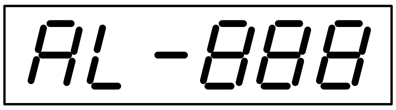
200 [V] is not supplied to the main power terminals (L1, L2 and L3). Check the source voltage. Operation does not start with single-phase 100 [V] power supply. In case of three-phase 400 [V], use a transformer to drop to 200 [V] to supply. (400 [V] will cause the servo amplifier to be broken.)

■ If the keypad does not light up

200 [V] is not supplied to the control power terminals (L1C and L2C). Check the source voltage. Operation does not start with signal-phase 100 [V] power supply. In case of three-phase 400 [V], use a transformer to drop to 200 [V] to supply. (400 [V] will damage the servo amplifier.)

■ If the keypad indicates differently

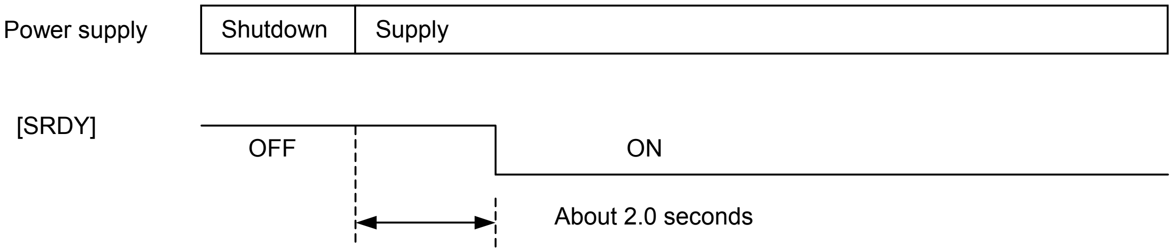
If three characters from the left is "AL-," an alarm is detected. In this case, the display blinks.



In addition, the orange LED below the keypad blinks upon an alarm.
If the keypad shows those other than specified above, the servo amplifier is not in the factory shipment state.

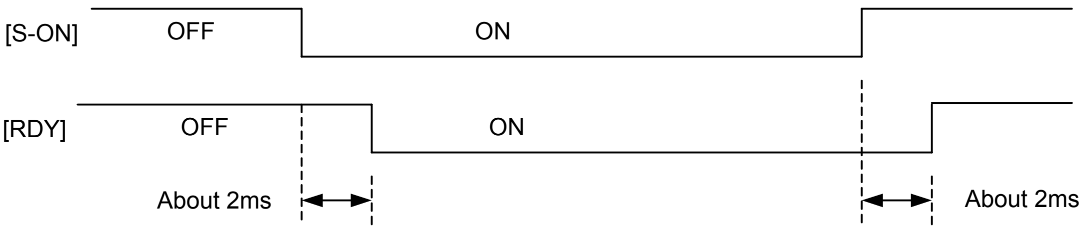
3.3.2 Power-On/Servo Control-Ready [S-RDY]

The servo control ready [S-RDY] signal is issued about 2.0 seconds after the control and main power supplies are turned on.
The CPU inside the servo amplifier diagnoses itself and, if the result is correct, the signal is issued and remains turned on until the power is shut down.



3.3.3 Servo-On [S-ON]/Ready for Servo-On [RDY]

Issue this signal to turn the servomotor on and make it ready to turn. If the signal is turned off in motor stoppage, the motor immediately free-run.
If the signal is turned off during motor rotation, the motor decelerates to stop and, after it is stopped, the motor free-run.
After servo-on is turned on and the motor becomes ready to rotate, the ready for servo-on [RDY] signal is turned on and the motor is in the ready-to-rotate state can be checked.



The servo amplifier input signal can be always enabled with parameters PA3_26 to PA3_30.
Servo-on [S-ON] turned on before power-on does not cause breakage to the servo amplifier.

3.3.4 If the Servomotor Fails to Start

If the servomotor fails to start or unexpected indication is given, it is recommended to undergo the procedure described in "14.5.8 Diagnosis to be Made If the Servomotor Fails to Start" on page 14-28, using PC Loader.

3.3.5 Shutdown

If the power is turned off with the servo-on signal turned on, the servo amplifier detects a low voltage alarm.

- If the main power is turned off for an interval longer than the main power shutoff detection time (PA2_68) with the servo-on signal being turned on, and if the power is supplied again, a main circuit low voltage alarm (LVP) is detected.
- If the motor power is turned on again with the servo-on signal being turned on after one second or more since the main power shutoff detection time (PA2_68) has elapsed, the main circuit low voltage alarm is not detected.
- If the DC link voltage drops below about 200V and the power is restored within one second with the servo-on signal being turned on, the main circuit low voltage is detected. If the duration exceeds one second, the main power undervoltage is not detected.

Even if the main circuit low voltage alarm is detected, there is no effect on the servo amplifier.
However, do not repeat to turn the power on or off to start or stop the servomotor.
Repetitive power-on and shutdown will cause breakage to the servo amplifier.
If the operation command is turned off before the power is shut off, the main circuit low voltage is not detected.
This type of the servo amplifier does not cause the output shaft of the servomotor to coast to stop even if an alarm reset signal is supplied.
The alarm reset signal resets alarm detection (activation of a protective function of the servo amplifier).

If the power is shut off during operation, the servo amplifier turns off operation preparation completion [RDY] to stop the internal CPU.

3.4 Operation

3.4.1 Test Operation at Keypad

Using the test operation mode of the keypad, check the motor rotation.
In case of a servomotor equipped with a brake, supply 24 [V] DC to release the brake.
The motor rotates even without a sequence I/O signal.
The relevant parameter settings and default values are shown below.

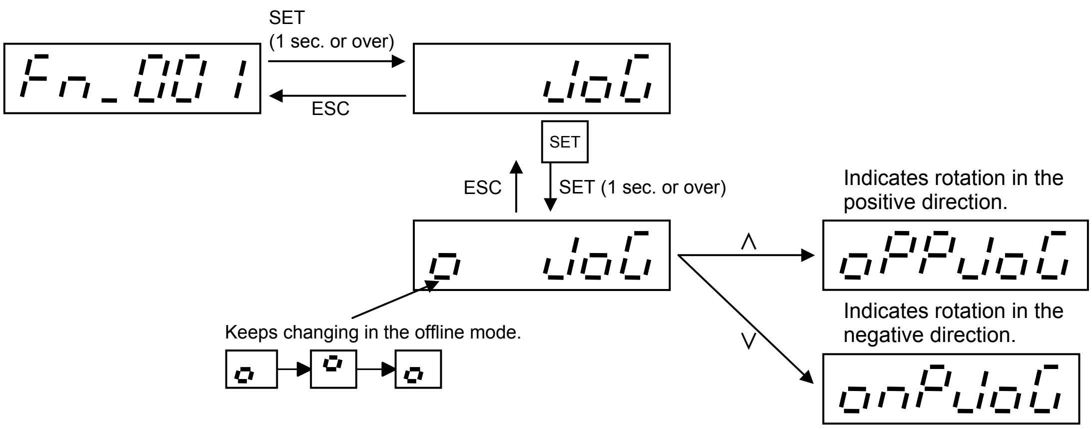
Parameter No.	Name	Setting range	Default value
PA1_37	Acceleration time 1	0.0 [ms] to 99999.9 [ms]	100.0 [ms]
PA1_38	Deceleration time 1	0.0 [ms] to 99999.9 [ms]	100.0 [ms]
PA1_41	Manual feed speed 1	0.01 [r/min] to (max. speed) [r/min]	100.0

■ Test operation at keypad

Follow the procedure below to check that the output shaft of the servomotor rotates.

[1] Use the [MODE/ESC] key to start the test operation mode [Fn_001].

[2] The servomotor rotates while the key on the keypad is held down.



After checking shaft rotation in the test operation mode, press the [MODE/ESC] key to return until [Fn_001] is displayed again.
Unless [Fn_001] is displayed again, rotation with the sequence I/O signal is impossible.

Hint

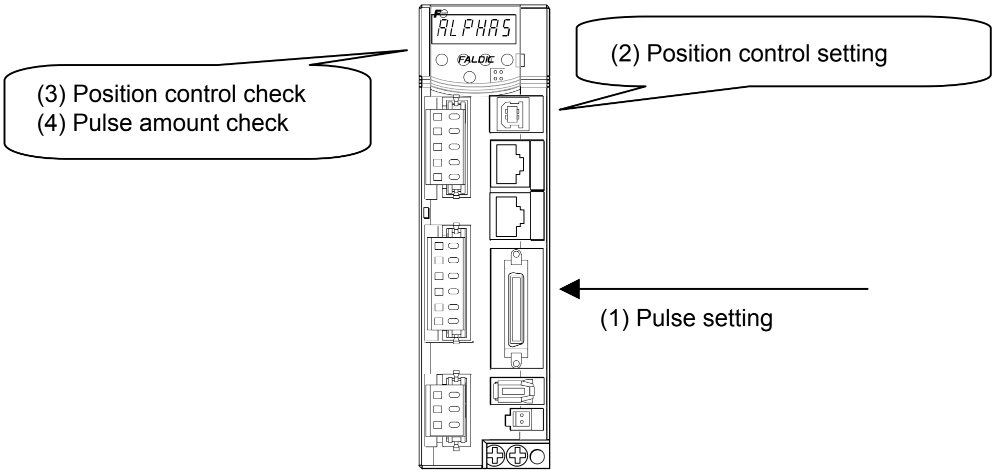
Notation of key
In this chapter, keys on the keypad may be simply specified as shown below.

- [MODE/ESC] key
  In case of [MODE] function: MODE
  In case of [ESC] function: ESC
- [SET/SHIFT] key
  In case of [SET] function: SET (1 sec. or above)
  In case of [SHIFT] function: SHIFT

3.4.2 Position Control (Pulse)

The shaft rotation position is controlled under position control according to the pulse input of the servo amplifier.

The pulse operation procedure is shown below.



(1) Pulse setting

According to the pulse format of the host pulse generator, enter the following parameters.

No.	Name	Setting range	Default value
PA1_03	Command pulse form selection	0: Command pulse/direction 1: Forward/reverse pulse 2: A/B phase pulse	1
PA1_05	Number of command input pulses per revolution	0: Electronic gear is enabled 64 to 1048576 [pulses]	0
PA1_06	Numerator 0 of electronic gear ratio	1 to 4194304	16
PA1_07	Denominator of electronic gear ratio	1 to 4194304	1

- To assign 4000 pulses per revolution of the servomotor
  PA1_05 = 4000
- To connect a 5 [mm] ball screw directly and change the per-pulse mechanical system traveling amount to 0.001 [mm] (18-bit)
  Because (5/262144)×(PA1_06/PA1_07) = 1/1000
  PA1_05=0,PA1_06=32768,PA1_07 = 625

(2) Position control setting

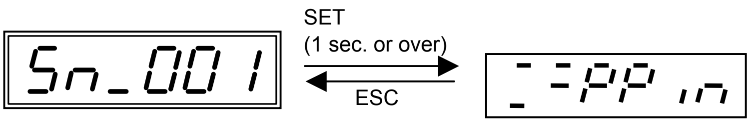
The factory shipment settings of the VV type (RYT□□□□5-VV2 type) servo amplifier are as follows.

- Assignment of input terminal (CONT input signal)
  CONT1: Servo-on [S-ON] (Function No. 1)
  CONT2: Alarm reset [RST] (Function No. 11)
  CONT3: Deviation clear (Function No. 50)
  CONT4 to CONT24: (No designation)
- Parameter PA1_01: Control mode selection 0 (position control)

Therefore the power-on state is the position control mode.
CONT1: Turn on servo-on [S-ON] and supply a pulse to turn the motor.

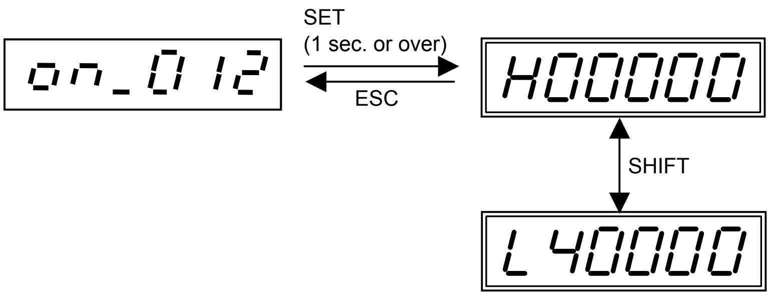
(3) Confirmation of position control

Confirm the position control mode. The third character "P" from the left indicates position control.



(4) Confirmation of pulse amount

Issue a pulse from the host controller. Check that the count agrees with that of the servo amplifier.



The display example for 40000 is shown.

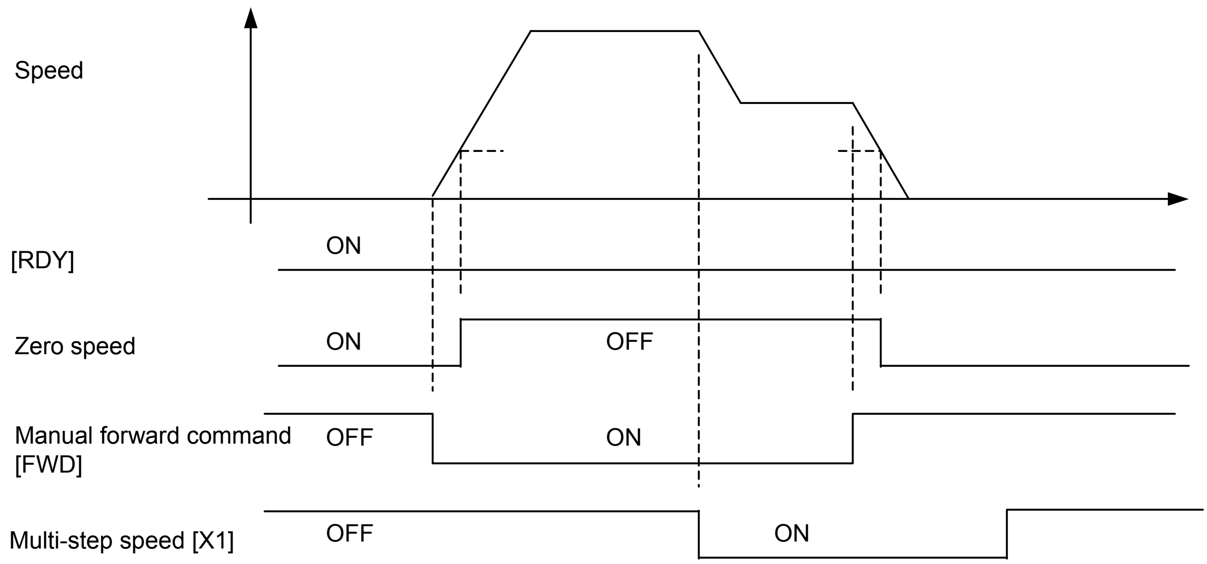
・ With A/B phase pulse, four times the pulse count is displayed.

3.4.3 Speed Control

The shaft rotation speed is controlled in the speed control mode according to the speed command voltage input [VREF] of the servo amplifier or parameter setting.
If parameter PA1_01 is set at "1," the speed control mode starts after the RDY signal is turned on.
While the manual forward command [FWD] or manual reverse command [REV] signal is turned on, the motor accelerates and turns at a constant speed, and deceleration starts when the signal is turned off.
Use the ACC (14) input signal to switch the acceleration/deceleration time.
The acceleration/deceleration time follows the parameter setting.
The rotation speed follows the X1 (51), X2 (52) and X3 (53) input signals or speed command voltage [VREF].

3

In the below chart, the operation is executed with the speed corresponding to VREF.
First when the X1 signal is turned on, the operation is executed with the speed corresponding to the X1 signal (rotation speed setting in PA1_41).
Then the operation decelerates and stops after turning the FWD signal off.



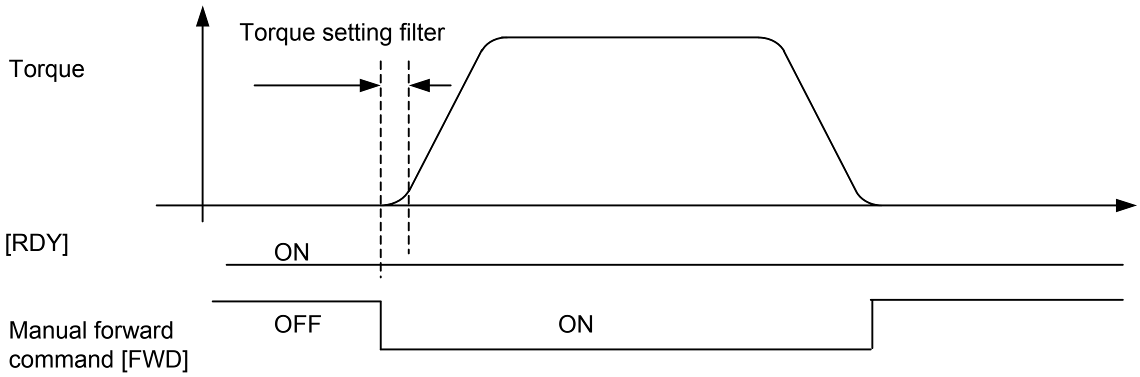
Use parameter PA3_35 to specify the zero clamp level in relation to the [VREF] input.

The following signal is active in the speed control mode.

- Zero speed
  The signal is turned on if the feedback speed of the motor (present shaft rotation speed of motor) falls below a certain value.

3.4.4 Torque Control

The shaft output torque is controlled under the torque control according to torque command voltage input [TREF] of the servo amplifier or a parameter setting.
If parameter PA1_01 is set at "2," the torque control mode starts after the RDY signal is turned on. The torque is output while the manual forward command [FWD] or manual reverse command [REV] signal is turned on, while the torque is reduced to zero after the signal is turned off.



Use parameter PA1_60 to specify the torque setting filter.

The maximum motor rotation speed can be controlled.

No.	Name	Setting
PA2_56	Speed limit selection at torque control	0: Limitation upon PA1_26 setting 1: Limitation at a speed selected with X3, X2 or X1

- The speeds corresponding to X3, X2 and X1 are given with PA1_41 to PA1_47, or [VREF] terminal.
- Because the speed control is not performed, the actual speed limit level is different.

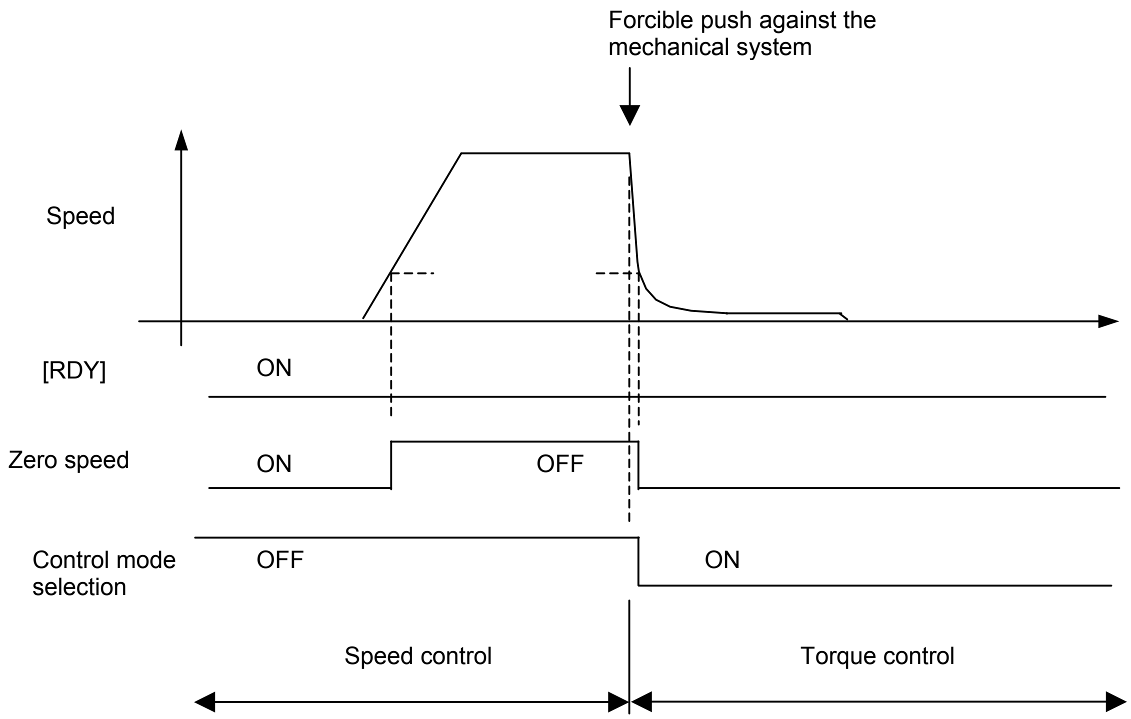
3

3.4.5 Mode Selection

The operation control mode can be changed with parameter settings shown below and control mode switching signal.

PA1_01:Control mode selection	Control mode (function No.36)	
	Control mode selection=OFF	Control mode selection=ON
3	Position control	Speed control
4	Position control	Torque control
5	Speed control	Torque control

The operation pattern with “5” specified in PA1_01 (speed control ⇔ torque control) is shown below.



To forcibly push against the mechanical system as shown in the figure above, torque limit should be adopted with a pushing material or the like.

For the torque control, refer to Section 3.4.4.

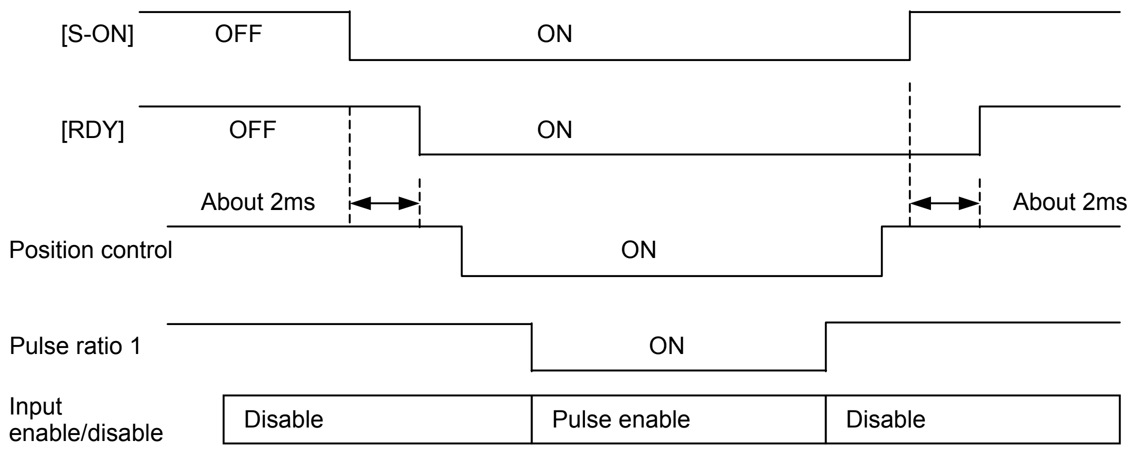
The control mode switching condition is activation of the zero speed signal.

The same rule applies to the case where the control mode is “6” (extension mode).

3.4.6 Extension Mode

Compatible mode with standard type of FALDIC-α Series
If parameter PA1_01 is “6,” operation is made with control signal inputs similar to those of the α Series.

If the pulse operation is performed, pulses are active while "position control" and "pulse ratio 1 (2)" are turned on.



■ Command pulse multiplication (PA1_01 = 0)

Numerator 0 of electronic gear (PA1_06), numerator 1 of electronic gear (PA2_51), numerator 2 of electronic gear (PA2_52) or numerator 3 of electronic gear (PA2_53) with an input signal can be selected.

■ Position control

The following signals are enabled in the position control mode.

- Zero deviation
  The difference between the command position (pulse input) and feedback position (present motor position) is the deviation. The signal is turned on if the present deviation is below a certain value. You can check that the motor has reached the command position.
- Zero speed
  The signal is turned on if the feedback speed of the motor (present shaft rotation speed of motor) is below a certain value.
- In-position
  Parameter PA1_34 to switch between level output and single-shot output can be used. The level output is the same as the zero deviation signal, The single-shot output is turned on for a certain time after the zero deviation signal is turned on.

3

- Deviation clear

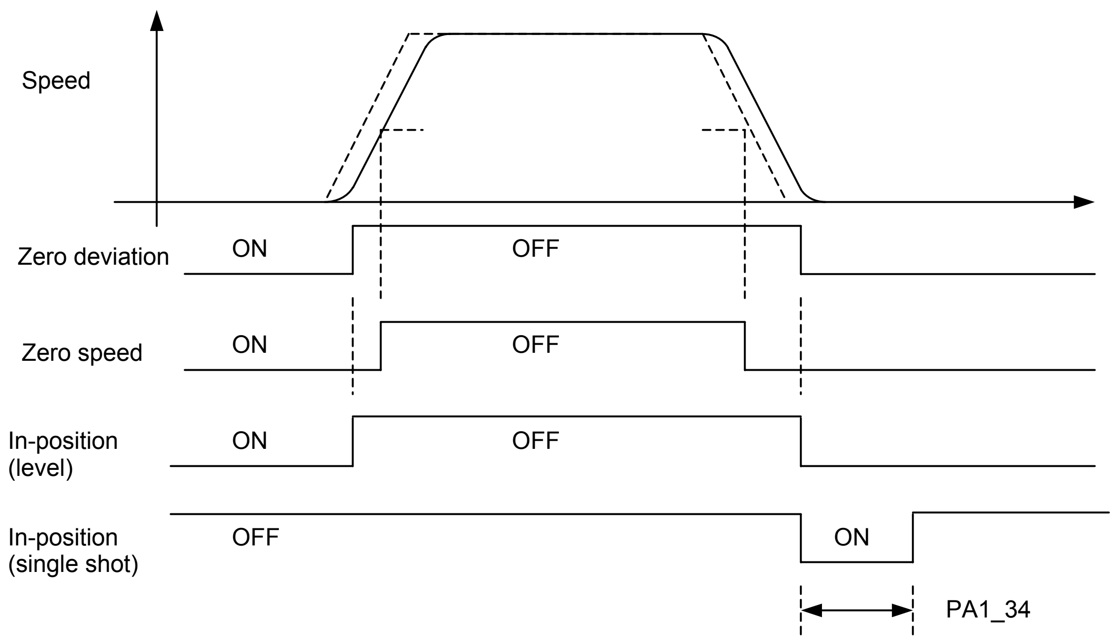
  The difference between the command position (pulse input) and feedback position (present motor position) is the deviation.

  Issue a deviation clear signal to zero the internal deviation. The command position becomes the same as the feedback position.

  Deviation clear is always effective and active even during rotation.

  Either edge or level can be selected with parameter PA3_36 to switch the input format of the deviation clear signal.

  Because the deviation is forcibly zeroed, the motor is stopped.

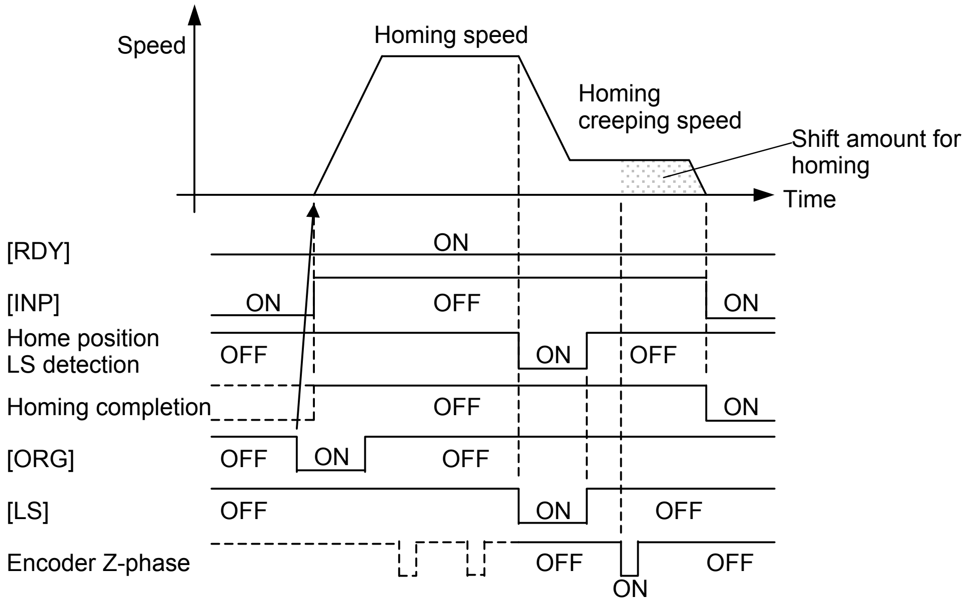


・The single-shot output is forcibly turned off if the zero deviation signal is turned off.

To perform homing and interrupt positioning, select the extension mode. For details, refer to the following pages.

3.4.7 Homing

When in-position [INP] is turned on, activation of the homing command [ORG] starts a homing motion. Enter parameters PA2_06 through 18 and 24 to configure the homing pattern.



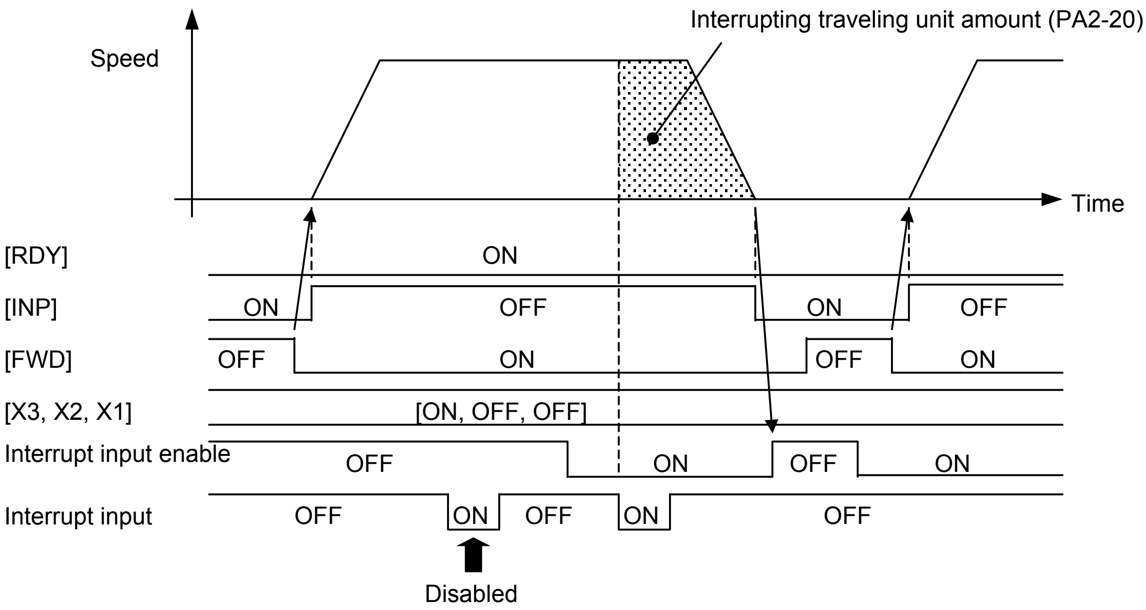
For details of the homing pattern settings, refer to “CHAPTER 4 PARAMETER.”

The homing motion can be interrupted with forced stop [EMG].

Note	The in-position [INP] signal shown in the figure assumes the level output mode. If positioning completion single shot output is selected with basic setting parameter No. 33, check for stoppage with an external circuit before executing operation.

3.4.8 Interrupt Positioning

Turn interrupt input enable signal on during operation with a forward [FWD] or reverse [REV] rotation command to start to move by an interrupt traveling unit amount, which is specified at parameter PA2_20, at the activating edge (OFF-to-ON transition) of the interrupt input.
Allocate interrupt input enable and interrupt input to CONT signals with input terminal function parameters.



Note	(1) After the interrupt input enable signal is turned on, the activating edge (OFF-to-ON transition) of the first interrupt input is enabled. (2) Allocate the interrupt input to the CN1 terminal of CONT1 to 5. The filter circuit of CONT1 to 5 causes a delay of about 0.05 [ms]. (3) To execute interrupt positioning again after interrupt positioning, turn the interrupt input enable signal off temporarily and turn it on again. (4) The in-position [INP] signal shown in the figure assumes the level output mode.

3.4.9 Torque Limit

Torque limit is always enabled in the position control, speed control and torque control mode.
If the torque is limited under position or speed control, the designated position or designated speed may not be achieved.

(1) Position/Speed control

The following limits can be set through combination of the "torque limit 0" and "torque limit 1" sequence inputs.

Torque limit 1	Torque limit 0	Torque limit
OFF	OFF	Value set at PA1_27 and PA1_28
OFF	ON	Smaller value between torque command voltage [TREF] and PA1_27 (PA1_28)
ON	OFF	Smaller value between PA1_27 (PA1_28) and PA2_58
ON	ON	Smaller value between torque command voltage [TREF] and PA2_58

If neither "torque limit 0" nor "torque limit 1" is used, PA1_27 and PA1_28 are enabled.

(2) Torque control

Forward rotation torque limit PA1_27 and reverse rotation torque limit PA1_28 are always enabled under torque control.

The output torque is in proportion to the voltage applied at the torque command voltage [TREF] terminal.

(3) Forced stop

The torque limit in forced stop follows parameter PA2_60.

3

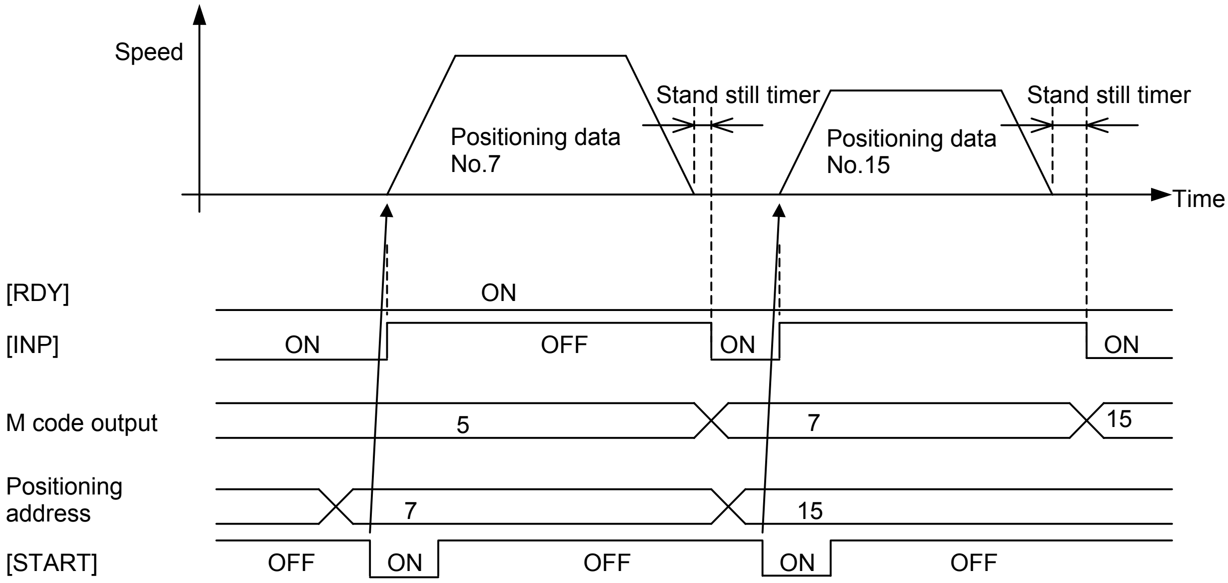
3.4.10 Positioning Data Operation

Enter “1” to parameter PA2_40 (internal positioning data selection) to perform positioning data operation. PTP (point-to-point) positioning operation is made according to Di/Do signals or commands sent via RS-485 communications.

When in-position [INP] is active, enter the desired positioning address (AD0 to AD3) and turn start positioning [START] on (activating edge) to execute positioning.

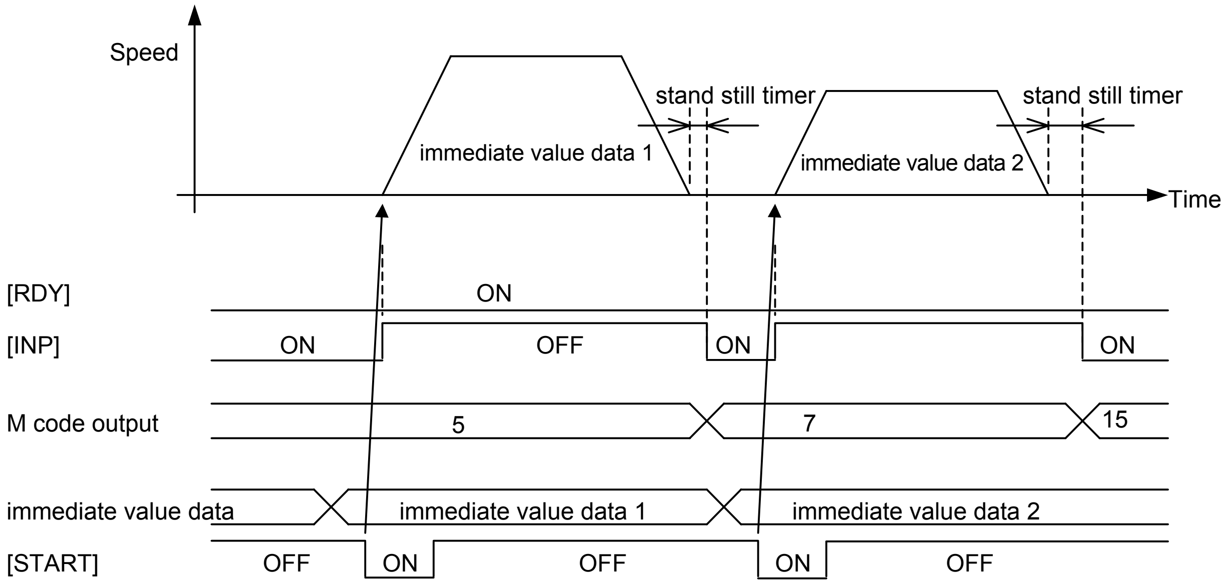
The positioning data can be registered with the PC Loader or keypad (front panel of amplifier) or through teaching. To enable positioning data operation, you can allocate “77” (positioning data selection) to a CONT signal and turn the signal on.

For details, refer to “CHAPTER 12 POSITIONING DATA.”



3.4.11 Immediate Value Data Operation

Enter “0” to parameter PA2_40 (internal positioning data selection) to enable operation with immediate value data. Point-to-point (PTP) positioning operation is made according to commands sent via RS-485 communications. When In-position [INP] is active, enter desired positioning data and so on and turn start positioning [START] on (activating edge) to execute positioning.
To enable immediate value data operation, you can allocate “77” (positioning data selection) to a CONT signal and turn the signal off. Use the Modbus-RTU protocol. (Immediate value data operation is impossible with the PC Loader protocol.)
For details, refer to “CHAPTER 13　RS-485 COMMUNICATIONS”



Hint	To perform immediate value data operation with the Modbus-RTU protocol in a system consisting of two or more servo system axes, you can use broadcasting to start multiple axes simultaneously, so that pseudo interpolation operation is realized. For details, refer to “CHAPTER 13　RS-485 COMMUNICATIONS.”

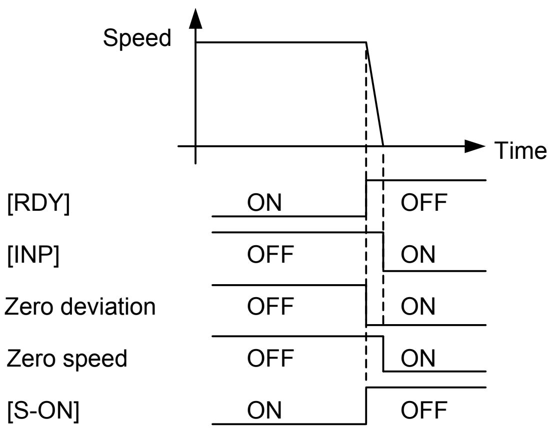
3.4.12 Interrupting/Stopping Operation

The following input signals interrupt or stop each operation.

- Servo-on [S-ON]
- +OT/-OT
- Forced stop [EMG]
- Pause
- Positioning cancel
- Deviation clear
- Free-run

(1) Servo-on [S-ON]

If servo-on [S-ON] is turned off during motor rotation, operation is stopped and the motor is stopped according to the setting of parameter PA2_61 (action sequence at servo-on OFF). If immediate deceleration is selected, deceleration is made at the torque specified in parameter PA2_60 (third torque limit).

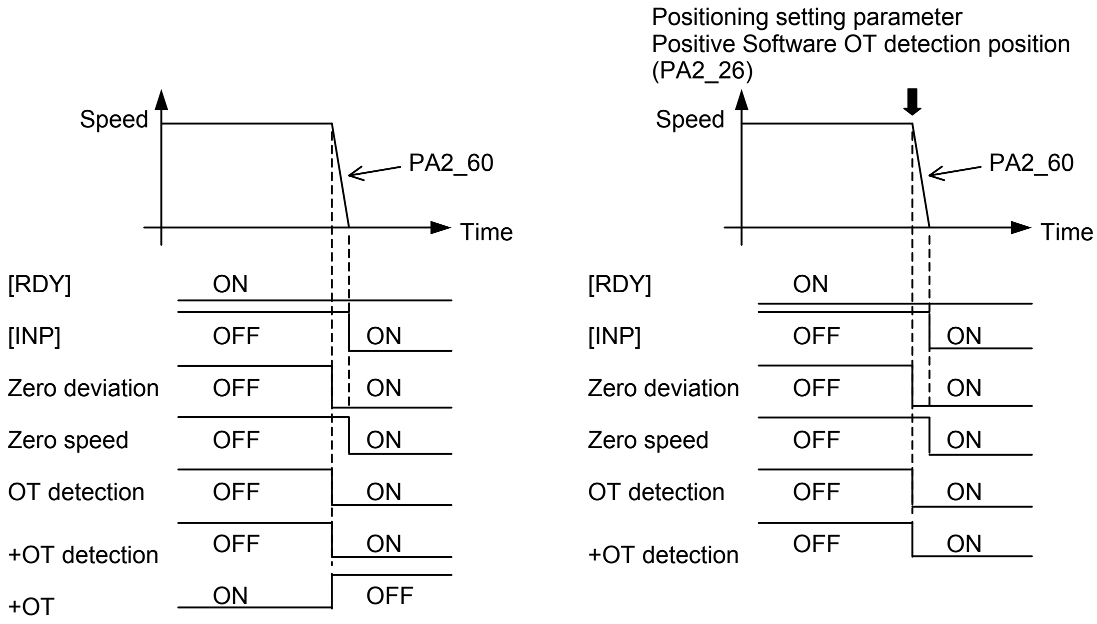


Note

(1) If "free-run at deceleration" is selected at parameter PA2_61 (action sequence at servo-on OFF), the motor coasts for a while due to inertia.
(2) The in-position [INP] signal shown in the figure indicates the state in the level output mode.
(3) If the forward torque limit (parameter PA1_27) or reverse torque limit (PA1_28) is smaller than the third torque limit (parameter PA2_60), the torque settings of the forward torque limit and reverse torque limit are effective.

(2) +OT/-OT / positive software OT / negative software OT

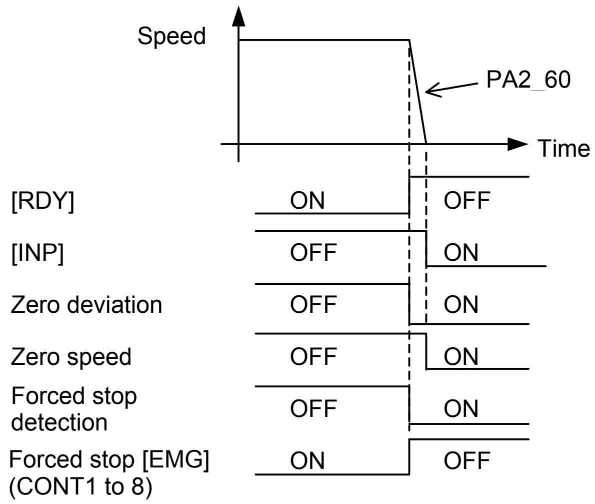
If +OT or -OT is detected during motor rotation (inactive due to normally closed contacts) or positive software OT or negative software OT is detected, operation is stopped and immediate controlled stop is caused according to the torque specified in parameter PA2_60 (third torque limit).



Note	(1) OT detection, +OT detection and -OT detection do not turn on if OT detection at homing is reverse. In addition, deceleration follows the setting of parameter PA2_18 (selection of operation at OT during homing). (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode. (3) If the forward torque limit (parameter PA1_27) or reverse torque limit (PA1_28) is smaller than the third torque limit (parameter PA2_60), the torque settings of the forward torque limit and reverse torque limit are effective.

(3) Forced stop [EMG]

If forced stop [EMG] is detected during motor rotation, operation is stopped and immediate controlled stop is caused according to the torque specified in parameter PA2_60 (third torque limit). While forced stop [EMG] is detected, the motor is stopped at the zero speed and the current position is not retained.



Note

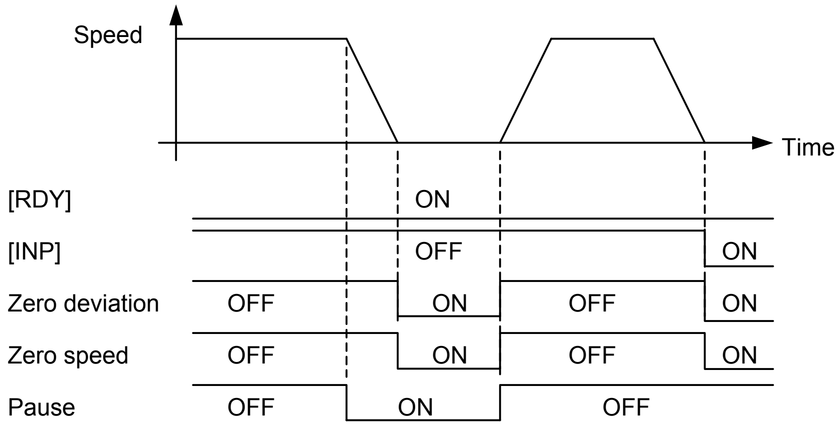
(1) Forced stop [EMG] is a normally closed contact signal if it is allocated to CONT 1 to 8 signals.

(2) The in-position [INP] signal shown in the figure indicates the state in the level output mode.

(3) If the forward torque limit (parameter PA1_27) or reverse torque limit (PA1_28) is smaller than the third torque limit (parameter PA2_60), the torque settings of the forward rotation torque limit and reverse rotation torque limit are effective.

(4) Pause

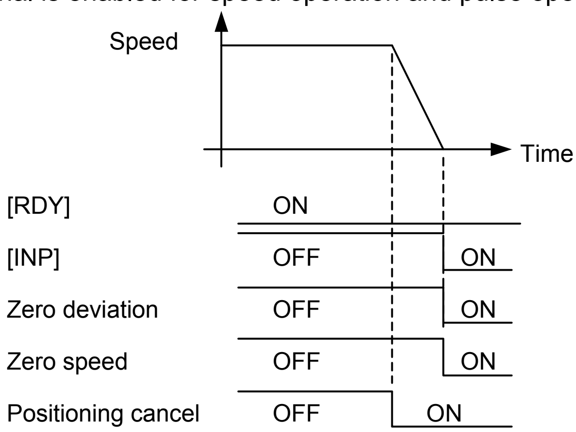
If the pause signal is turned on during homing, interrupt positioning, positioning data operation or immediate value data operation, operation is interrupted and the motor is stopped while the signal remains turned on. After the signal is turned off, the operation continues. In-position [INP] is not turned on in a pause.



Note	(1) Acceleration/deceleration follows the settings of parameters PA1_37 through 40 and the state of input signal ACC0, or the settings of acceleration/deceleration time data. (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode.

(5) Positioning cancel

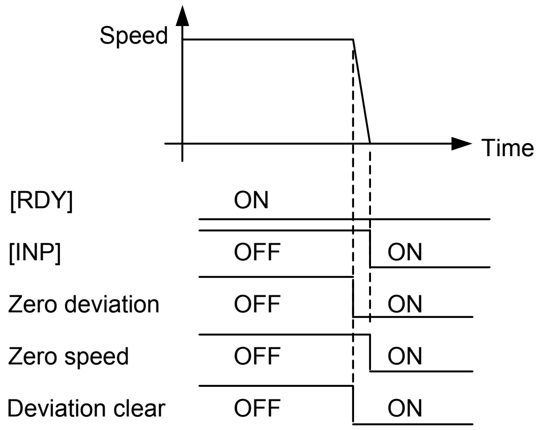
If the positioning cancel signal is turned on during motor rotation, operation is stopped and controlled stop is caused according to the deceleration time setting. While the positioning cancel signal remains active, homing, interrupt positioning, positioning data operation or immediate value data operation does not start.
The signal is enabled for speed operation and pulse operation.



Note	(1) Acceleration/deceleration follows the settings of parameters PA1_37 through 40 and the state of input signal ACC0, or the settings of acceleration/deceleration time data. (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode.

(6) Deviation clear

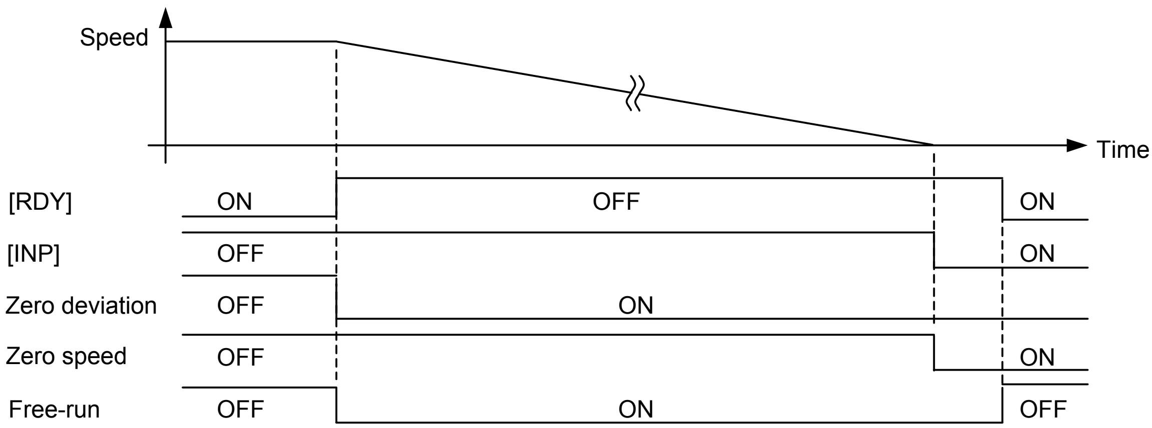
If the deviation clear signal is detected during motor rotation, operation is stopped and immediate controlled stop is caused according to the selected torque limit. (The maximum torque is assumed if parameter setting is selected with the default setting). If “1” (level signal) is selected for parameter PA3_36 (deviation clear input form), the motor is stopped at the zero speed and the current position is not retained while the deviation reset signal remains active.



Note	The in-position [INP] signal shown in the figure indicates the state in the level output mode.

(7) Free-run

While the free-run signal is turned on, outputs of the servo amplifier are turned off and the servomotor coasts to stop (at zero torque). (The motor rotation is not controlled.) If the free-run signal is turned on during motor rotation, operation is stopped and the motor keeps rotating due to the inertia of the load.



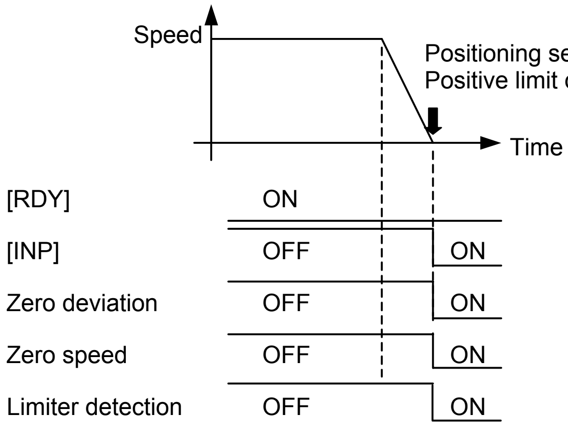
Note	In regular cases, free-run is not used for vertical traveling machines. If the function is used for a vertical traveling machine, examine adaptability with the brake carefully.

In addition to operation stop and interruption caused by input signals, detection of an alarm causes the operation to be stopped. The stopping motion upon an alarm follows the setting of parameter PA2_62 (serious alarms: fixed at free-run).

(8) Positive limiter detection / negative limiter detection

If the target position is set with overshooting positive/negative limiter detection value, operation is canceled before reaching to the target positon and stopped at positive/negative limiter detection position.

Limiter detection signals are turned on after the stopping.



Note	
Note	(1) Acceleration/deceleration follows the settings of parameters PA1_38 and 40 and the state of input signal ACC0, or the setting of deceleration time data. (2) During pulse operation, the motor is stopped at the limiter detecting position when the pulse input position reaches the limiter detecting position. The stopping motion follows the torque limit specified in a parameter. (3) The in-position [INP] signal shown in the figure indicates the state in the level output mode.

CHAPTER 4 PARAMETER

4

4

4.1 Parameter Division

⚠ CAUTION

- Never add an extreme change to parameters. Otherwise machine motion will become unstable.
  Risk of injuries

Parameters of the ALPHA5 servo amplifiers are divided into the following setting items according to the function.

Parameter setting item	Major description	Ref. page
Basic parameters (No.PA1_01 to 50)	Be sure to check or enter these parameters before starting operation.	4-2
Control gain and filter setting parameter (No.PA1_51 to 99)	Use to adjust the gain manually.	4-24
Automatic operation setting parameter (No.PA2_01 to 50)	Use to enter or change the positioning operation speed and homing function.	4-34
Extended function setting parameter (No.PA2_51 to 99)	Use to enter or change the extended functions such as the torque limit.	4-72
Input terminal function setting parameter (No.PA3_01 to 50)	Use to enter or change input signals of the servo amplifier.	4-85
Output terminal function setting parameter (No.PA3_51 to 99)	Use to enter or change output signals of the servo amplifier.	4-91

4.2 Basic Parameters

Note Parameters marked "○" in the "Power" field are enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.2.1 List (PA1_□□)

No. PA1_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
01	Control mode selection	0	○	○	○	○	
02	INC/ABS system selection	0	○	○	○	○	
03	Command pulse form selection	1	○	○	-	-	
04	Rotation direction selection	0	○	○	○	○	
05	Number of command input pulses per revolution	0	○	○	-	-	
06	Numerator 0 of electronic gear	16	-	○	-	-	
07	Denominator of electronic gear	1	-	○	-	-	
08	Number of output pulses per revolution	2048	○	○	○	○	
09	Numerator of electric gear for output pulses	1	○	○	○	○	

No. PA1_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
10	Denominator of electric gear for output pulses	16	○	○	○	○	
11	Output pulse phase selection at CCW rotation	0	○	○	○	○	
12	Z-phase position offset	0	○	○	○	○	
13	Tuning mode selection	0	-	○	○	-	
14	Load inertia ratio	1.0	-	○	○	-	
15	Auto tuning gain 1	12	-	○	○	-	
16	Auto tuning gain 2	4	-	○	-	-	
20	Easy tuning: stroke setting	2.00	-	○	○	○	
21	Easy tuning: speed setting	500.00	-	○	○	○	
22	Easy tuning: timer setting	1.500	-	○	○	○	
23	Easy tuning: direction selection	0	-	○	○	○	
25	Max. rotation speed (for position and speed control)	6000.00 （GYS,GYC 750W or less）	-	○	○	-	
26	Max. rotation speed (for torque control)	5000.00 (GYS,GYC 1kW or more) 3000.00 (GYG)	-	-	-	○	
27	Forward rotation torque limit	300	-	○	○	○	
28	Reverse rotation torque limit	300	-	○	○	○	
29	Speed coincidence range	50	-	○	○	-	
30	Zero speed range	50	-	○	○	○	
31	Deviation unit selection	0	-	○	-	-	
32	Zero deviation range/In-position range	100	-	○	-	-	
33	In-position output format	0	○	○	-	-	
34	In-position minimum OFF time/ Single shot ON time	20	-	○	-	-	
35	In-position judgment time	0	-	○	-	-	
36	Acceleration / deceleration selection at speed control	0	-	-	○	○	
37	Acceleration time 1	100.0	-	○	○	○	
38	Deceleration time 1	100.0		○	○	○	
39	Acceleration time 2	500.0		○	○	○	
40	Deceleration time 2	500.0		○	○	○	
41	Manual feed speed 1 for position and speed control/ speed limit 1 for torque control	100.00	-	○	○	○	
42	Manual feed speed 2 for position and speed control/ speed limit 2 for torque control	500.00		○	○	○	
43	Manual feed speed 3 for position and speed control/ speed limit 3 for torque control	1000.00		○	○	○	
44	Manual feed speed 4 for position and speed control/ speed limit 4 for torque control	100.00		○	○	○	
45	Manual feed speed 5 for position and speed control/ speed limit 5 for torque control	100.00		○	○	○	
46	Manual feed speed 6 for position and speed control/ speed limit 6 for torque control	100.00		○	○	○	
47	Manual feed speed 7 for position and speed control/ speed limit 7 for torque control	100.00		○	○	○	

Parameters marked "○" in the table are enabled in the corresponding control mode.

4.2.2 Description of Each Parameter

PA1_01 Control mode selection

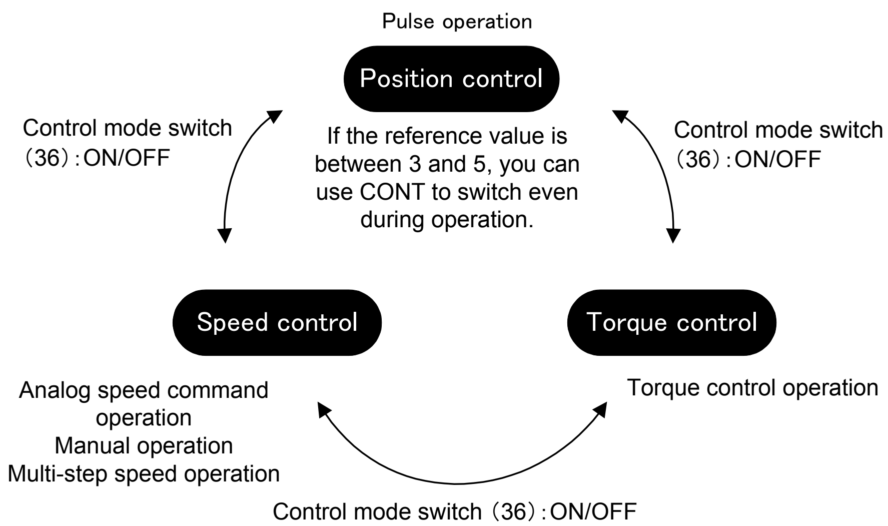
No.	Name	Setting range	Default value	Change
01	Control mode selection	0: Position 1: Speed 2: Torque 3: Position ⇔ speed 4: Position ⇔ torque 5: Speed ⇔ torque 6: Extended mode 7: Positioning operation	0	Power

Specify the desired control mode in the parameter with a value.
To switch during operation, change over the control mode selection (function No. 36) signal.
For details, refer to the table below.

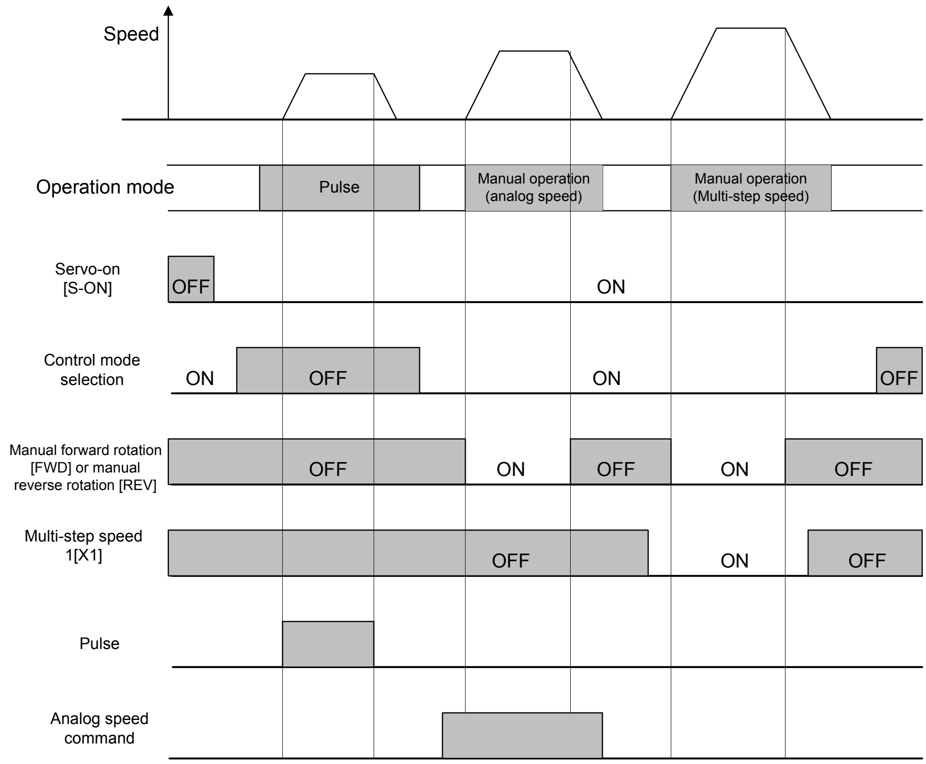
Reference value of PA1_01 (control mode selection)	Control mode	
	Control mode selection = OFF	Control mode selection = ON
0	Position control	
1	Speed control	
2	Torque control	
3	Position control	Speed control
4	Position control	Torque control
5	Speed control	Torque control
6	Extended mode	
7	Positioning operation mode	

(1) If PA1_01 (control mode selection) is between 0 and 5

Change over the control mode selection (function No. 36) signal to change the control mode even during operation.
Position control can be made only during pulse operation.
For the transition of the control mode, see the figure below.

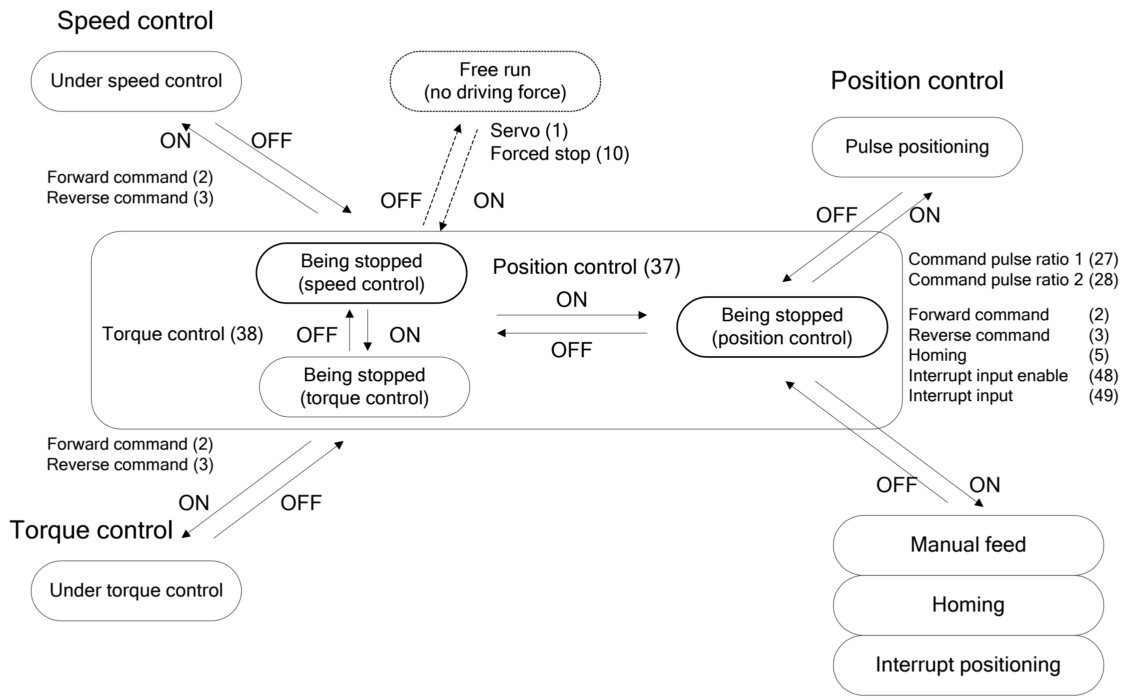


[Example] The operation pattern of control mode selection 3 (position ⇔ speed) is shown in the figure below.



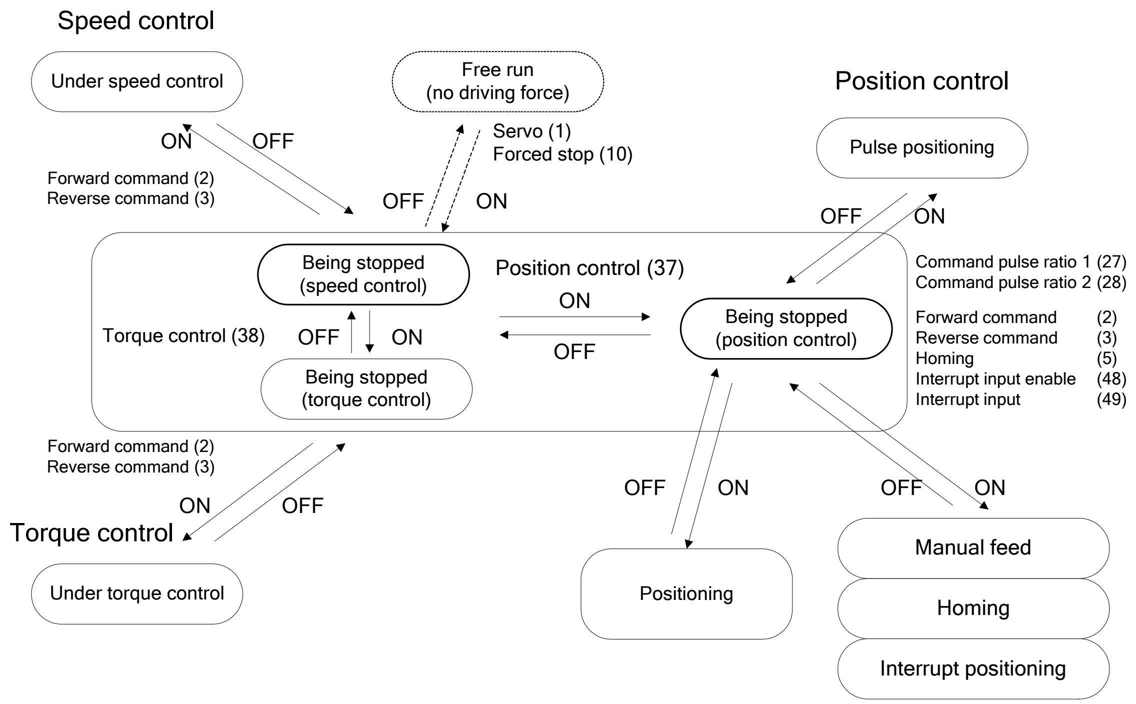
(2) If PA1_01 (control mode selection) is 6

This control mode is compatible with that of the existing α Series.
The power-on state is the speed control mode (see the figure below).
To perform homing and interrupt positioning, select this mode.



(3) If PA1_01 (positioning operation mode selection) is “7”

Positioning (positioning data operation, immediate value data operation and homing) can be made. The position control mode is selected immediately after the power is turned on (see the figure below).



PA1_02 INC/ABS system selection

No.	Name	Setting range	Default value	Change
02	INC/ABS selection	0:Incremental system 1:Absolute system 2: Endless absolute system	0	Power

Select either the relative position (incremental) system or absolute position system.

Reference value	Function	Description
0	Relative position (incremental) system	The current position is lost after the control power is turned off. Homing must be performed again.
1	Absolute position system	The current position is stored in memory even after the control power is turned off. Homing is unnecessary. You can operate in the limited range. If the operation range is exceeded, an alarm and stoppage are caused. (Operation range: between -32768 and +32768 revolutions of motor shaft)
2	Endless absolute position system	The current position is stored in memory even after the control power is turned off. Homing is unnecessary. Because there is no limit in the operation range, this system is best for the control of the rotating body. (The multi-turn data over flow alarm is not detected.) Multi-rotation data should be processed at the host controller suitably. Specify so that the ratio of PA1_06 to 07 = $2^n/1$.

To establish an absolute position system, set this parameter at "1" or "2." In addition, install the optional absolute backup battery.

Because a multi-rotation data loss alarm (dL1 alarm) is detected when the power is turned on, perform position presetting to remove the alarm and start operation.

- To use in an absolute position system, refer to "CHAPTER 11 ABSOLUTE POSITION SYSTEM."

PA1_03 Command pulse form selection

No.	Name	Setting range	Default value	Change
03	Command pulse form selection	0: Command pulse/direction 1: Forward/reverse pulse 2: A / B phase pulse	1	Power

This parameter is enabled only under position control.

You can select the signal format of the command pulse input terminal.

The pulse format of the command pulse input terminals [CA], [*CA], [CB] and [*CB] of the servo amplifier can be specified.

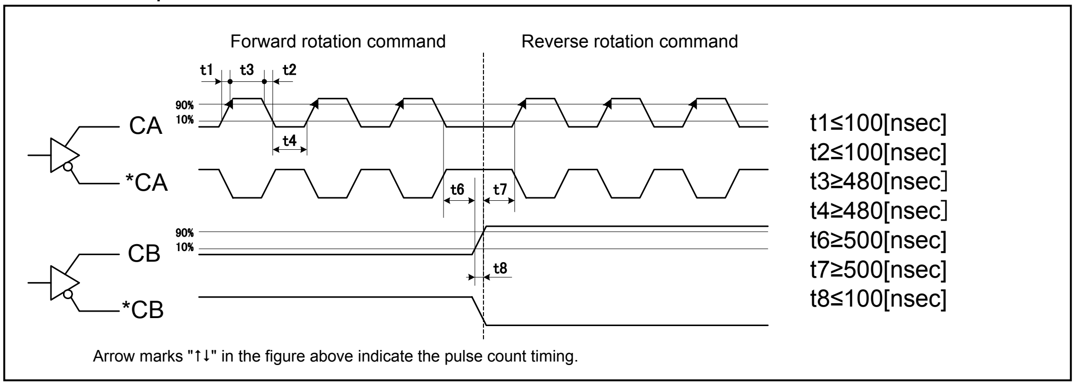
The maximum input frequency is 1.0 [MHz] at differential input or 200 [kHz] at open collector input. However, enter each signal so that the following conditions are satisfied (the same signal conditions apply to CA, *CA, CB and *CB).

In case of A/B phase pulse, the rising or falling edge of the A-phase signal or B-phase signal is counted as a single pulse, so that a single-pulse input is equivalent to four pulse counts.

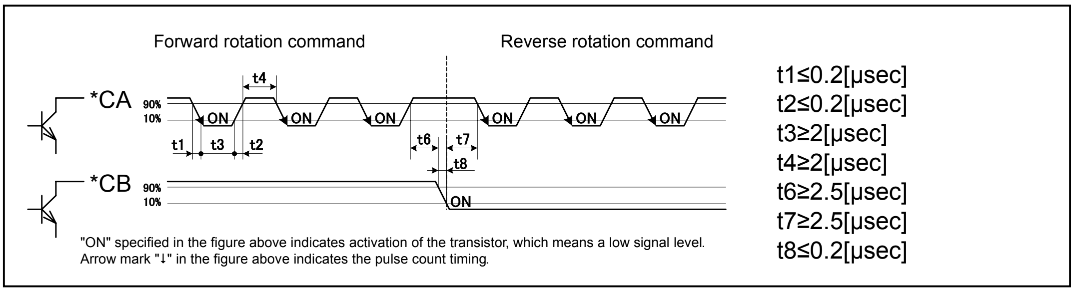
■ Command pulse / sign (reference value of parameter 03: 0)

The command pulse indicates the rotation amount (CA, *CA), while the command sign (CB, *CB) indicates the direction of rotation.
If (CB) is at the low level and (*CB) is at the high level, a forward direction command is issued.

・Differential input



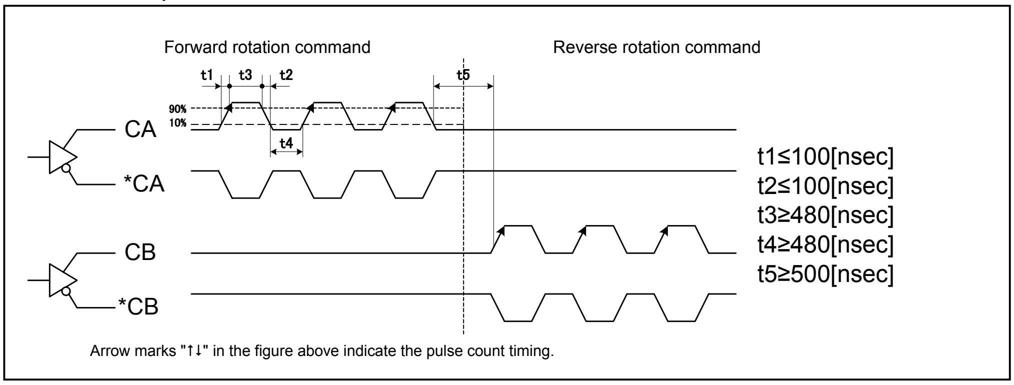
・Open collector input



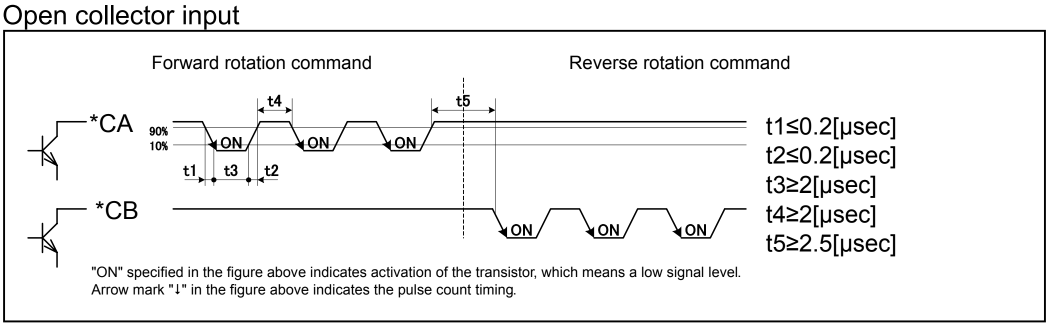
■ Forward / reverse pulse (reference value of parameter 03: 1)

The forward rotation pulse (CA, *CA) indicates the rotation amount in the forward direction, while the reverse rotation pulse (CB, *CB) indicates that in the reverse direction.

・Differential input



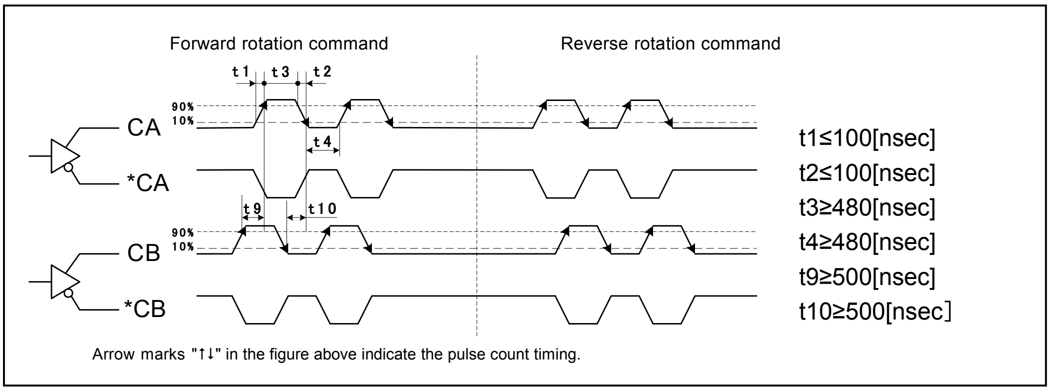
・Open collector input



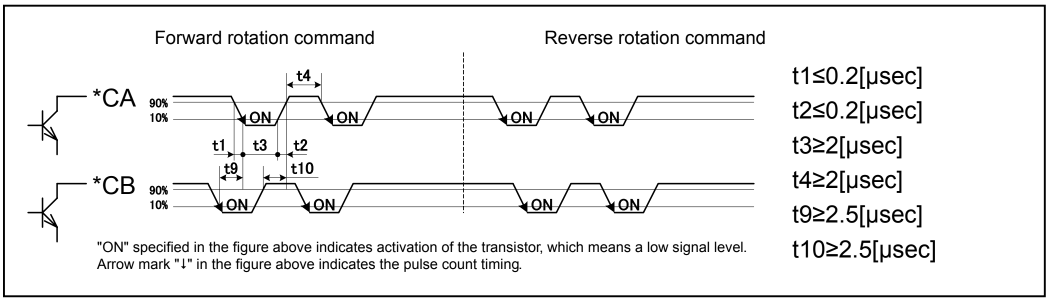
■ A/B phase pulse (reference value of parameter 03: 2)

The A-phase signal (CA, *CA) and B-phase signal (CB, *CB) indicate the direction of rotation and rotation amount, respectively.
Each edge of the A-phase and B-phase signals corresponds to one pulse. (It is four-fold frequency in the amplifier.)

・Differential input



・Open collector input



PA1_04 Rotation direction selection

No.	Name	Setting range	Default value	Change
04	Rotation direction selection	0: Rotation direction at forward command. 1: Rotation direction at reverse command.	0	Power

This parameter keeps consistency between the direction of rotation of the servomotor and the traveling direction of the machine.

In case of operation with pulse

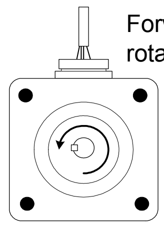
The direction of rotation caused upon an input of a forward rotation pulse and high level command sign or a B-phase pulse lead pulse with A / B phase pulse becomes the forward direction, making the servomotor rotate forward.
To switch the phase of the output pulse, select the phase of counterclockwise (CCW) rotation of the servomotor.

In case of operation with speed command voltage

The direction of rotation caused by a positive speed command voltage in a forward command (FWD) signal is the forward direction, causing the servomotor to rotate forward.

■ Forward/Reverse rotation

The servomotor rotates forward if it rotates counterclockwise (CCW: figure on the right) when the output shaft is viewed from the front. Clockwise rotation is reverse rotation.



PA1_05 Number of command input pulses per revolution

No.	Name	Setting range	Default value	Change
05	Number of command input pulses per revolution	0: Electronic gear is enabled Other than 0: The specified value is enabled (64 to 1048576).	0	Power

This parameter is enabled only under position control.
Enter the number of command pulses necessary to rotate the servomotor a full turn.
The setting range is 64 to 1048576 [pulses]. However, if the end of the model number of the servomotor is "HB2" (18-bit encoder), the maximum value is 262144 [pulses].
With the default value ("0"), the settings of PA1_06 and _07 (electronic gear numerator and denominator) are enabled.

PA1_06 Numerator 0 of electronic gear, PA1_07 Denominator of electronic gear

No.	Name	Setting range	Default value	Change
06	Numerator 0 of electronic gear	1 to 4194304 (in increments of 1)	16	Always
07	Denominator of electronic gear	1 to 4194304 (in increments of 1)	1	Always

These parameters are enabled only under position control.
With these parameters, the traveling amount of the mechanical system per each command pulse is adjusted to a unit amount.
If parameter PA1_05 is "0," the settings of these parameters are enabled.
The following equation is used to calculate.

■ Equation of numerator 0 of electronic gear and denominator of electronic gear

Cancel down so that numerator 0 divided by the denominator of the electronic gear is an integer (4194304 or less).

$$\frac{\text{(Traveling amount of mechanical system per servomotor revolution)}}{\text{Number of encoder pulses *}} \times \frac{\text{Numerator 0 of electronic gear}}{\text{Denominator of electronic gear}} = \text{(Unit amount) *}$$

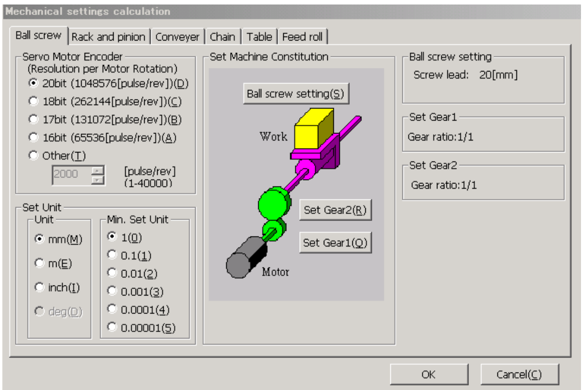
* The unit amount is "1," "0.1," "0.01," "0.001," etc. Its unit is [unit].

* The number of encoder pulses is 262144 for an 18-bit encoder or 1048576 for a 20-bit encoder.

$$\frac{\text{Numerator 0 of electronic gear}}{\text{Denominator of electronic gear}} = \frac{\text{Number of encoder pulses}}{\text{(Traveling amount of mechanical system per servomotor revolution)}} \times \text{(Unit amount)}$$

■ Entering from PC Loader

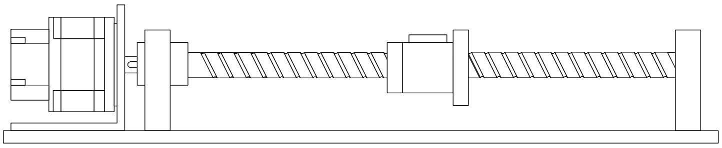
Use the "electronic gear setting (T) from mechanical configuration" button provided at the lower part of the parameter editing screen (PA1: fundamental setting) of PC Loader to specify the electronic gear simply.



Enter the specifications of the machine to automatically calculate the settings. Parameters grouped according to each mechanical configuration helps you enter simply.

[Example of calculation of electronic gear ratio]

To connect the ball screw (lead 10 [mm]) directly to the output shaft of the servomotor and set the unit amount at 1/100, the number of encoder pulses (20-bits) is 1048576 revolutions.

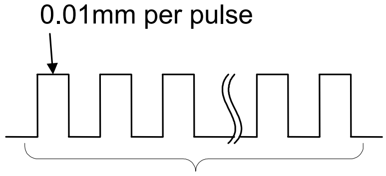


$$\frac{\text{(Traveling amount of mechanical system per servomotor revolution)}}{\text{1048576 pulses/revolution}} \times \frac{\text{Numerator 0 of electronic gear}}{\text{Denominator of electronic gear}} = \text{(Unit amount)}$$

$$\frac{\text{10mm}}{\text{1048576 pulses/revolution}} \times \frac{\text{Numerator 0 of electronic gear}}{\text{Denominator of electronic gear}} = 1/100$$

$$\frac{\text{Numerator 0 of electronic gear}}{\text{Denominator of electronic gear}} = 1/100 \times \frac{\text{1048576 pulses/revolution}}{\text{10mm}} = \frac{131072}{125}$$

Therefore numerator 0 and denominator of the electronic gear are 131072 and 125, respectively.

Hint	If the traveling amount of the mechanical system per servomotor revolution includes π, you can approximate to 355/113. The number of output pulses is irrelevant to command pulse correction. A / B phase pulse in B-phase advance are output according to the reference value of PA1_08 (number of output pulses per revolution) during forward rotation of the motor shaft. 0.01mm per pulse  10mm per 1000 pulses (one full motor revolution)

PA1_08 Number of output pulses per revolution

No.	Name	Setting range	Default value	Change
08	Number of output pulses per revolution	0: Entered values at PA1_09 and _10 are enabled. Other than 0: The entered value is enabled (16 to 262144).	2048	Power

Enter the number of pulses output per motor rotation from pulse output terminal (FFA, *FFA, FFB and *FFB).
The setting range is 16 to 262144 [pulses]. However, if the end of the model of the servomotor is "HB2" (18-bit encoder), the maximum value is 65536 [pulses]. (The output pulse value is deducted -2bit from encoder resolution.)
If the reference value is other than 0, the Z-phase output synchronizes with the A-phase output, and an output having the same pulse width as that of the A-phase is obtained.
With default value "0," settings of parameters PA1_09 and _10 (The output pulse value is deducted -2bit from encoder resolution.) are followed.

PA1_09 Numerator of electric gear for output pulses
PA1_10 Denominator of electric gear for output pulses

No.	Name	Setting range	Default value	Change
09	Numerator of electric gear for output pulses	1 to 4194304 (in increments of 1)	1	Power
10	Denominator of electric gear for output pulses	1 to 4194304 (in increments of 1)	16	Power

Specify the ratio of the output pulse per revolution of the servomotor.
If parameter PA1_08 is "0," settings of these parameters are enabled.
Calculate according to the following equation.

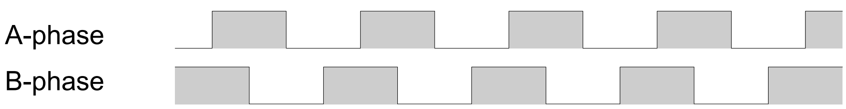
- In case of an 18-bit encoder, specify "1/32" to output 2048 (65536 x 1/32) A-phase and B-phase pulses per revolution.
- The Z-phase output is issued asynchronously to the A- and B-phases at a constant pulse width of 125μs.
  Enter parameters so that PA1_09 ≤ PA1_10. If PA1_09 > PA1_10, the division ratio is 1.

PA1_11 Output pulse phase selection at CCW rotation

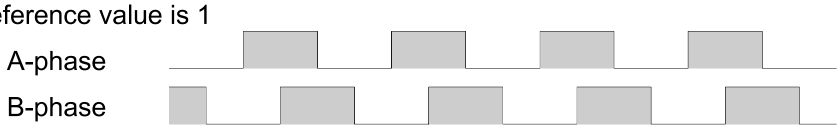
No.	Name	Setting range	Default value	Change
11	Output pulse phase selection at CCW rotation	0: B-phase pulse lead at CCW rotation 1: A-phase pulse lead at CCW rotation	0	Power

The phase of the output pulse of the servomotor is adjusted to the traveling direction of the machine.
Select the phase of forward rotation (CCW rotation) of the servomotor.
The pulse is output at connector CN1 (FFA, *FFA, FFB and *FFB).

・If the reference value is 0



・If the reference value is 1



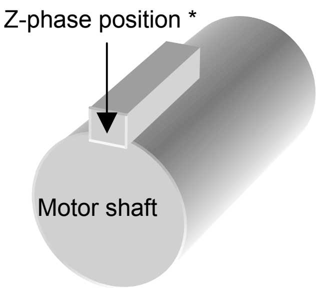
PA1_12 Z-phase position offset

No.	Name	Setting range	Default value	Change
12	Z-phase position offset	20bitPG：0 [pulse] to 1048575 [pulse] 18bitPG：0 [pulse] to 262143 [pulse]	0	Power

The Z-phase output position shifts. The Z-phase output position shifts in the CCW direction by the specified pulse amount. For servomotors having "HB2" at the end of the model name (18-bit encoder), the maximum value is 262143 [pulses].
This parameter is irrelevant to the rotation direction selection (parameter PA1_04).
The Z-phase used for homing is also the position that is offset with this parameter.

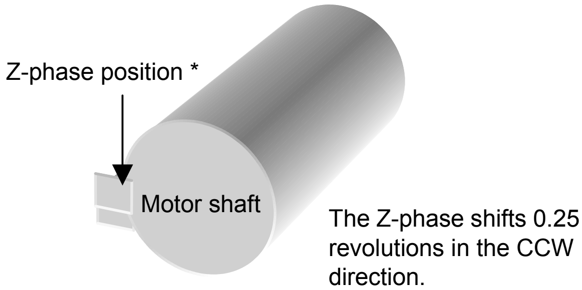
■ Z-phase output position

・If the Z-phase position offset is [0]



・If the Z-phase position offset is [262144]

$$\frac{262144 \text{ pulses}}{1048576 \text{ pulses/revolution}} = 0.25 \text{ [revolutions]}$$



* The position of the key is not always the Z-phase position.
The position of the key is supposed to be the Z-phase position in this explanation.

PA1_13 Tuning mode selection

No.	Name	Setting range	Default value	Change
13	Tuning mode selection	0: Auto tuning 1: Semi-auto tuning 2: Manual tuning 3: Interpolation control mode	0	Always

This parameter is enabled under position and speed control.
Select the tuning method of the servo amplifier. Refer to the following description to select the mode.

■ Auto tuning (default value)

In this mode, the ratio of moment of inertia of the load of the machine is always assumed inside the amplifier and the gain is automatically adjusted to the best one. "0" is entered, too, in case of easy tuning.

■ Semi-auto tuning

Use this mode if the ratio of moment of inertia of the load of the machine has relatively large fluctuation or the ratio of moment of inertia of the load is not estimated correctly inside the amplifier.
The gain is automatically adjusted to the best one in relation to the setting of PA1_14 (load inertia ratio).

4

■ Manual tuning

Use this mode if auto tuning and semi-auto tuning modes do not function satisfactorily. Manually enter the ratio of moment of inertia of the load and various gains.

■ Interpolation control mode

Use this mode to adjust responses of each shaft to the command during interpolation of two or more servomotor axes of an X-Y table or similar.
In this mode, PA1_51 (moving average S-curve time) and PA1_54 (position command response time constant) that determine the following characteristics to commands must be entered manually.
As well, PA1_14 (load inertia ratio) must be entered, too, manually.
The other gain adjustment parameters are automatically entered.

Parameters that must be entered in each tuning mode and automatically adjusted parameters are shown below.

No. PA1_	Name	Tuning mode selection			
		0: Auto	1: Semi-auto	2: Manual	3: Interpolation control
14	Load inertia ratio	-	○	○	○
15	Auto tuning gain 1	○	○	×	○
51	Moving average S-curve time	-	-	○	○
54	Position command response time constant	-	-	○	○
55	Position loop gain 1	-	-	○	-
56	Speed loop gain 1	-	-	○	-
57	Speed loop integration time constant 1	-	-	○	-
59	Torque filter time constant for position and speed control	△	△	△	△
87	Model torque filter time constant for position	-	-	○	-
88	Position loop integration time constant	-	-	○	-

○: Items that must be entered
△: The item is entered automatically or manually according to a parameter (PA1_94: torque filter setting mode).
- : Entry is unnecessary. (The item is automatically calculated inside the amplifier and the result is reflected on the parameter.)
×: Entry can be made, but the setting is ineffective.

・ For detail description of tuning, refer to "CHAPTER 5 SERVO ADJUSTMENT."

PA1_14 Load inertia ratio

No.	Name	Setting range	Default value	Change
14	Load inertia ratio	GYS and GYC, 750 [W] or less: 0.0 to 300.0 [times] GYS and GYC, 1 [kW] or more: 0.0 to 100.0 [times] GYG : 0.0 to 30.0 [times]	1.0	Always

This parameter is enabled under position and speed control.
Enter the moment of inertia of the load of the mechanical system in relation to the motor shaft (moment of inertia of load converted to motor shaft) in a ratio to the moment of inertia of the motor.

$$\text{Load inertia ratio} = \frac{\text{Load inertia of converted to motor shaft}}{\text{Inertia of motor}}$$

The parameter must be entered according to some settings of PA1_13 (tuning mode selection).
With auto tuning, the value is automatically updated and saved in EEPROM every 10 minutes.
The value must be entered in the semi-auto, manual and interpolation control modes.

■ How to enter the ratio of inertia of load

(1) Entering the value monitored at keypad

Use the monitor mode [on_014] of the keypad to monitor.

Enter the monitored value.

- If the value drifts, enter an average value.
  If fluctuation is substantial and the ratio of the maximum to the minimum exceeds two, adopt entry method (2).

(2) Entering the calculated value

Calculate the moment of inertia of load converted to the motor shaft and enter the ratio to the moment of inertia of the motor. For the moment of inertia calculation method, refer to "CHAPTER 14 APPENDICES."

- The value is automatically calculated with the capacity selection software (visit Fuji Electric's home page to download).

PA1_15 Auto tuning gain 1

No.	Name	Setting range	Default value	Change
15	Auto tuning gain 1	1 to 40 (in increments of 1)	12	Always

This parameter is enabled under speed and position control.
Specify the response of the servomotor of auto tuning, semi-auto tuning and interpolation control modes.
While a larger setting shortens command following characteristic and positioning settling time, too large a value causes vibration of the motor.

■ Setting method

(1) Parameter entry with PC Loader and keypad (parameter setting mode)

After the parameter is established, the setting is updated.

(2) Entry using "auto tuning gain setting (Fn_011)" of keypad (test operation mode)

After the value is switched, the setting is updated at real time.

Approximate reference value

Mechanical configuration (division by mechanism)	Auto tuning gain 1 (approximate reference value)
Large transfer machine	1 to 10
Arm robot	5 to 20
Belt mechanism	10 to 25
Ball screw + Belt mechanism	15 to 30
Mechanism directly coupled with ball screw	20 to 40

- For details of tuning, refer to "CHAPTER 5 SERVO ADJUSTMENT."

PA1_16 Auto tuning gain 2

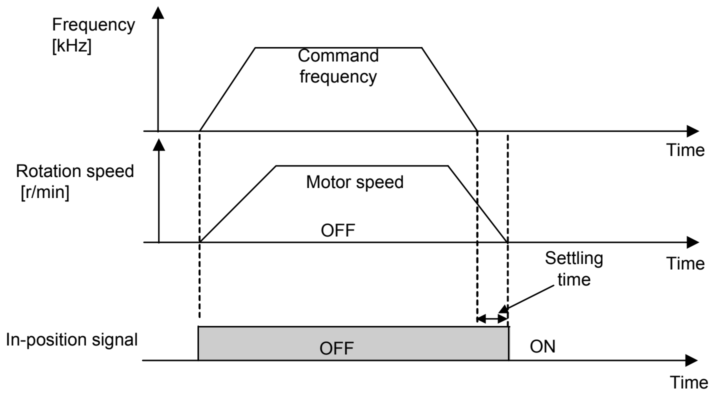
No.	Name	Setting range	Default value	Change
16	Auto tuning gain 2	1 to 12 (in increments of 1)	4	Always

This parameter is enabled only under position control.
The parameter is enabled if PA1_13 (tuning mode selection) is 0 (auto tuning) or 1 (semi-auto tuning).
Adjust auto tuning gain 1 before adjusting this parameter.
With this parameter, the positioning and settling time of auto tuning and semi-auto tuning is reduced, so that the cycle time is effectively reduced. While a larger value reduces the positioning and settling time, an overshoot is likely to be caused.
PA1_51 (moving average S-curve time) and PA1_54 (position command response time constant) are automatically adjusted in relation to the reference value of this parameter.

Hint

What is positioning and settling time

Time from completion of issuance of command frequency to issuance of in-position signal
The time varies according to various conditions such as the frequency matching the traveling distance, acceleration/deceleration rate, and stopping accuracy. Adjustment of the entire system including the host and servo to optimum conditions is necessary to reduce the positioning and settling time.



- For details of tuning, refer to "CHAPTER 5 SERVO ADJUSTMENT."

PA1_20 to 23　Easy tuning settings

No.	Name	Setting range	Default value	Change
20	Easy tuning: stroke setting	0.01 [rev] to 200.00 [rev] (in increments of 0.01)	2.00	Always
21	Easy tuning: speed setting	10.00 [r/min] to Max. rotation speed [r/min] (in increments of 0.1)	500.00	Always
22	Easy tuning: timer setting	0.000 [s] to 5.000 [s] (in increments of 0.001)	1.500	Always
23	Easy tuning: direction selection	0: Forward ⇔ reverse rotation 1: Forward rotation only 2: Reverse rotation only	0	Always

Enter the parameter to perform easy tuning.

- For details of tuning, refer to "CHAPTER 5 SERVO ADJUSTMENT."

PA1_25 and 26　Max. rotation speed

No.	Name	Setting range	Default value	Change
25	Max. rotation speed (for position and speed control)	GYS and GYC,750 [W] or less ：0.01 to 6000 [r/min] GYS and GYC,1 [kW] or more ：0.01 to 5000 [r/min] GYG：0.01 to 3000 [r/min]	6000 (GYS and GYC of 750 [W] or less) 5000 (GYS and GYC of 1 [kW] or more) 3000 (GYG)	Always
26	Max. rotation speed (for torque control)			

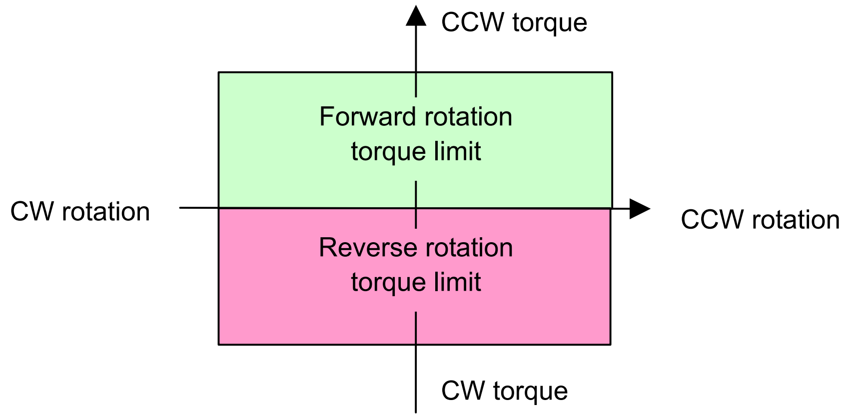
Enter the maximum rotation speed of the servomotor for position, speed and torque control.
However, this parameter is disabled during pulse operation.
There is a difference of about 100 [r/min] between the reference value and actual servomotor rotation speed under torque control.
Use PA1_96 (speed limit gain for torque control) to adjust the error.

4

PA1_27 Forward rotation torque limit, PA1_28 Reverse rotation torque limit

No.	Name	Setting range	Default value	Change
27	Forward rotation torque limit	0 [%] to 300 [%]	300	Always
28	Reverse rotation torque limit			

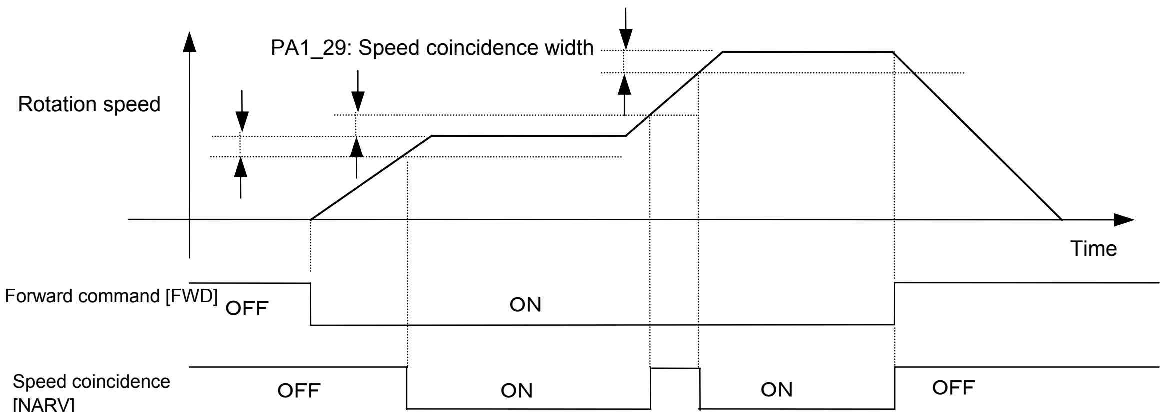
Enter the limit to be set on the output torque of the servomotor.
If the input signal (CONT signal: torque limit 0, 1, etc.) is turned off, this limit is enabled.
For description of the input signal (such as torque limit 0 and 1), refer to "CHAPTER 3 OPERATION."



PA1_29 Speed coincidence range

No.	Name	Setting range	Default value	Change
29	Speed coincidence range	10 [r/min] to max. rotation speed [r/min]	50	Always

Enter the range in which the "speed coincidence" output signal is turned on.
The speed coincidence signal is turned on if the actual servomotor rotation speed is nearly the command speed.
In case of a default value of 50 [r/min], the speed coincidence signal is turned on in the range of ±50 [r/min] to the command speed.
If the command speed is not reached due to PA1_25 (maximum rotation speed), override or similar, the signal is turned off.
The speed coincidence signal does not turn on if the [FWD] or [REV] signal is turned off.



- For the speed coincidence signal, refer to "Speed coincidence [NARV]" on page 2-69.

PA1_30 Zero speed range

No.	Name	Setting range	Default value	Change
30	Zero speed range	10 [r/min] to max. rotation speed [r/min]	50	Always

Enter the activation level of the "zero speed" output signal.
The signal is turned on at servomotor rotation speeds within the reference value.

PA1_31 Deviation unit selection

No.	Name	Setting range	Default value	Change
31	Deviation unit selection	0: Unit amount [unit amount] 1: Pulse amount [pulse]	0	Always

Enter the unit of position deviation.
Select 0 (unit amount) for the unit after multiplication by the electronic gear ratio. [Unit] is displayed.
Select 1 (pulse amount) for the unit before multiplication by the electronic gear ratio. (Unit of encoder pulse amount)
<u>This setting is related to the unit of all position deviation monitored with the keypad, PC Loader or monitor 1/2 signal.</u>

4

PA1_32 Zero deviation range/In-position range

No.	Name	Setting range	Default value	Change
32	Zero deviation range/ In-position range	0 [pulse] to 200000 [pulse]/ [unit amount]	100	Always

- Zero deviation range
  Enter the activation level of the "zero deviation" output signal.
  The signal is turned on at position deviation within the reference value.
- In-position range
  Enter the deviation condition of the "in-position (INP)" output signal.
  The in-position (INP) signal is turned on if position deviation is within this reference value and the motor rotation speed is within the reference value of the "zero speed range."
  However, the condition includes completion of pulse elimination from the inside of the servo amplifier for homing.
- <u>The setting unit is the one specified with PA1_31 (deviation unit selection).</u>

PA1_33 to 35 In-position output signals

No.	Name	Setting range	Default value	Change
33	In-position output format	0: Level 1: Single shot	0	Power
34	In-position minimum OFF time/ Single shot ON time	1 [ms] to 1000 [ms]	20	Always
35	In-position judgment time	0 [ms] to 1000 [ms]	0	Always

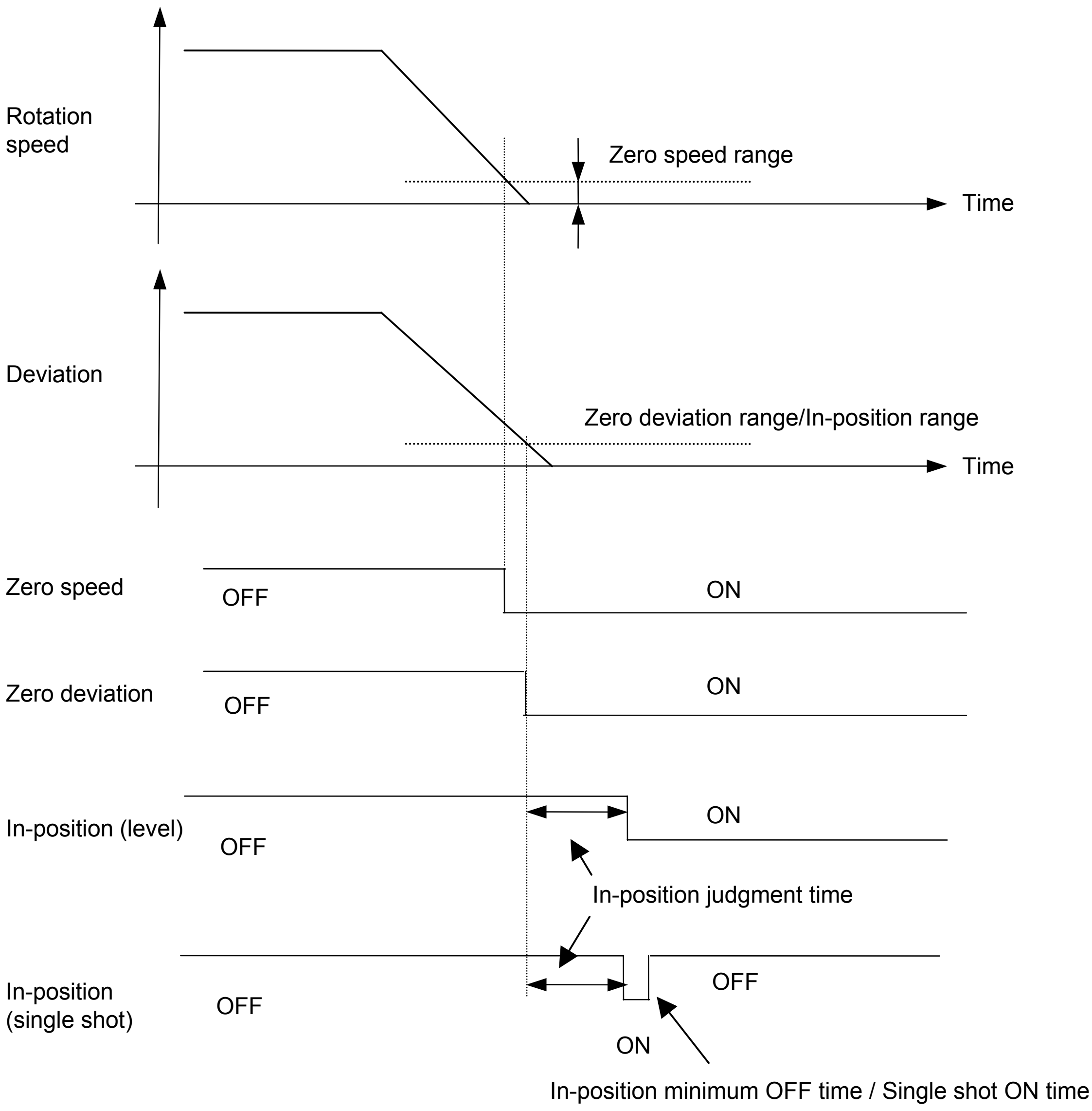
Enter the output format, minimum OFF time / Single shot ON time and judgment time of the in-position [INP] signal.
In-position output format: Select the format of the output signal (refer to the timing chart shown below).
In-position minimum OFF time / Single shot ON time: For the single shot output format, enter the time for which the output signal is turned on.
In-position judgment time: Enter the judgment time needed to recognize in-position.

Hint

In-position signal

The in-position signal is turned on if position deviation is within the reference value of "zero deviation range" and the motor rotation speed is within the reference value of "zero speed range" (AND condition of zero speed and zero deviation).
The output timing of this signal substantially varies according to the setting of PA1_31 (deviation unit selection).
Check the reference value to use. Refer to the following timing chart.

Timing chart



PA1_36 to 40 Acceleration time and deceleration time settings

No.	Name	Setting range	Default value	Change
36	Acceleration / deceleration selection at speed control	0: Disable 1: Enable	0	Always
37	Acceleration time 1	0.0 [ms] to 99999.9 [ms]	100.0	Always
38	Deceleration time 1		100.0	
39	Acceleration time 2		500.0	
40	Deceleration time 2		500.0	

Specify the acceleration and deceleration of the servomotor with PA1_37 to _40 (acceleration/deceleration time).
The parameter is enabled for acceleration and deceleration motions under speed control and position control (automatic operation, homing and manual position control operation). Acceleration and deceleration follow these parameters during profile operation, too.
These parameters are disabled during pulse operation.
<u>The acceleration/deceleration time setting indicates the time from 0 (zero) [r/min] to 2000 [r/min].</u>

Acceleration time 2 and deceleration time 2 are enabled while the "ACC0" selection signal remains turned on.
ACC0 can be turned on or off at any time and the acceleration time and deceleration time are similarly changed.
ACC0 is assigned to an input signal (CONT signal). Selection follows the table below.
The deceleration time with a load in a carrier drive mechanism can be specified separately from that without a load.

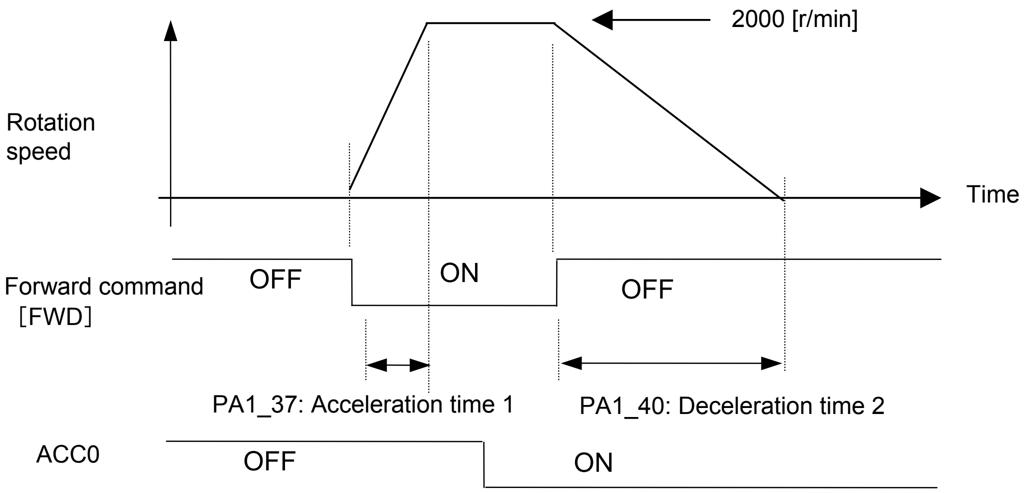
ACC0 (14)	Acceleration time	Deceleration time
OFF	PA1_37	PA1_38
ON	PA1_39	PA1_40

Use PA1_36 (acceleration / deceleration selection at speed control) to select acceleration/deceleration of speed control.
To perform position control at the host control unit and to perform speed control at the servo system, enter "0" to PA1_36 (control method to output analog speed command voltage at host control unit).
To perform speed control independently in the servo system, enter "1" to PA1_36 to enable PA1_37 through PA1_40. To perform position control independently in the servo system, PA1_37 through PA1_40 are enabled without relations to the setting of PA1_36.
Acceleration/Deceleration with the speed limit of torque control also follows this parameter (PA1_36: acceleration / deceleration selection at speed control).
Acceleration and deceleration occurs according to the table shown above if PA1_36 is set at "1" (enable).
If the acceleration/deceleration time data is “0” during operation with position data, the values specified in these parameters are enabled.

4

4

Timing chart



PA1_41 to 47 Manual feed speed/speed limit for torque control

No.	Name	Setting range	Default value	Change
41	Manual feed speed 1 for position and speed control/ speed limit 1 for torque control	0.01 [r/min] to max. rotation speed [r/min]	100.00	Always
42	Manual feed speed 2 for position and speed control/ speed limit 2 for torque control		500.00	Always
43	Manual feed speed 3 for position and speed control/ speed limit 3 for torque control		1000.00	Always
44	Manual feed speed 4 for position and speed control/ speed limit 4 for torque control		100.00	Always
45	Manual feed speed 5 for position and speed control/ speed limit 5 for torque control		100.00	Always
46	Manual feed speed 6 for position and speed control/ speed limit 6 for torque control		100.00	Always
47	Manual feed speed 7 for position and speed control/ speed limit 7 for torque control		100.00	Always

Enter the speed of manual feed for speed control and position control.
For torque control, if PA2_56 (speed limit selection at torque control) is "0," the reference value of PA1_26 (maximum rotation speed) becomes the speed limit.
If PA2_56 (speed limit selection at torque control) is "1," the speed limit is enabled as shown on the next page.
Combine input signals (CONT signal: multi-step speed selection 1 [X1] to 3 [X3]) to select.

Multi-step speed selection			Enabled parameter	
X3	X2	X1	Under speed/position control *1	Under torque control
OFF	OFF	OFF	VREF terminal voltage (analog speed limit)	VREF terminal voltage (analog speed limit)
OFF	OFF	ON	41: Manual feed speed 1	41: Speed limit 1 for torque control 1
OFF	ON	OFF	42: Manual feed speed 2	42: Speed limit 1 for torque control 2
OFF	ON	ON	43: Manual feed speed 3	43: Speed limit 1 for torque control 3
ON	OFF	OFF	44: Manual feed speed 4	44: Speed limit 1 for torque control 4
ON	OFF	ON	45: Manual feed speed 5	45: Speed limit 1 for torque control 5
ON	ON	OFF	46: Manual feed speed 6	46: Speed limit 1 for torque control 6
ON	ON	ON	47: Manual feed speed 7	47: Speed limit 1 for torque control 7

*1) Position control specified in the table above indicates the state of PA1_01 (control mode) set at "6" (extension mode).

4

4.3 Control Gain and Filter Setting Parameter

Note	Parameters marked "○" in the "Power" field is enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.3.1 List (PA1_□□)

Default value: *** Determined in auto tuning.

No. PA1_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
51	Moving average S-curve time	***	-	○	-	-	
52	Low-pass filter (for S-curve) time constant	0.0	-	○	○	-	
53	Command pulse smoothing function	0	-	○	-	-	
54	Position command response time constant	***	-	○	-	-	
55	Position loop gain 1	***	-	○	-	-	
56	Speed loop gain 1	***	-	○	○	-	
57	Speed loop integration time constant 1	***	-	○	○	-	
58	Feed forward gain 1	0.000	-	○	-	-	
59	Torque filter time constant for position and speed control	***	-	○	○	-	
60	Torque filter time constant for torque control	0.00	-	-	-	○	
61	Gain changing factor	1	-	○	○	-	
62	Gain changing level	50	-	○	○	-	
63	Gain changing time constant	1	-	○	○	-	
64	Position loop gain 2	100	-	○	-	-	
65	Speed loop gain 2	100	-	○	○	-	
66	Speed loop integration time constant 2	100	-	○	○	-	
67	Feed forward gain 2	100	-	○	-	-	
68	Acceleration compensation gain for position control	0	-	○	-	-	
70	Automatic notch filter selection	1	-	○	○	-	
71	Notch filter 1, frequency	4000	-	○	○	-	
72	Notch filter 1, attenuation	0	-	○	○	-	
73	Notch filter 1, width	2	-	○	○	-	
74	Notch filter 2, frequency	4000	-	○	○	-	
75	Notch filter 2, attenuation	0	-	○	○	-	
76	Notch filter 2, width	2	-	○	○	-	
77	Automatic vibration suppression selection	0	-	○	-	-	
78	Vibration suppressing anti resonance frequency 0	300.0	-	○	-	-	
79	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 0	0	-	○	-	-	
80	Vibration suppressing anti resonance frequency 1	300.0	-	○	-	-	
81	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 1	0	-	○	-	-	
82	Vibration suppressing anti resonance frequency 2	300.0	-	○	-	-	
83	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 2	0	-	○	-	-	

No. PA1_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
84	Vibration suppressing anti resonance frequency 3	300.0	-	○	-	-	
85	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 3	0	-	○	-	-	
86	Vibration suppressing damping coefficient	0.0000	-	○	-	-	
87	Model torque filter time constant	***	-	○	○	-	
88	Position loop integration time constant	***	-	○	-	-	
89	Position loop integration limiter	0	-	○	-	-	
90	Load torque observer	0	-	○	○	-	
91	P/PI automatic change selection	0	-	○	○	-	
92	Speed range for friction compensation	10.0	-	○	○	-	
93	Coulomb friction torque for friction compensation	0	-	○	○	-	
94	Torque filter setting mode	1	-	○	○	-	
95	Model torque calculation selection, speed observer selection	3	-	○	○	-	
96	Speed limit gain for torque control	10.0	-	-	-	○	

Paremeters marked "○" in the table are enabled in the corresponding control mode.

4

4.3.2 Description of Each Parameter

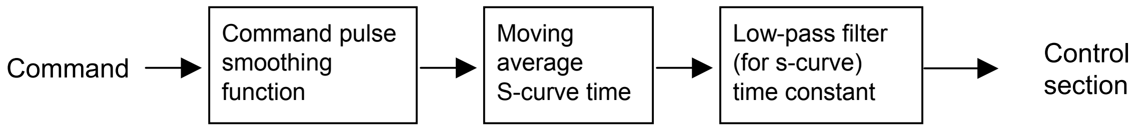
PA1_51 to 53 Command filter settings

No.	Name	Setting range	Default value	Change
51	Moving average S-curve time	0, 2 to 500 (×0.125 [ms])	***	Always
52	Low-pass filter (for S-curve) time constant	0.0 [ms] to 1000.0 [ms]	0.0	Always
53	Command pulse smoothing function	0: Disable 1: Enable	0	Always

Filters can be added to commands for smoother follow-up.

Moving average S-curve time	This parameter is enabled under position control. Specify the moving average S-curve filter time to position commands. A larger setting at low command pulse frequencies or large electronic gear ratios can reduce the torque ripple caused by fluctuation of the command pulse. The new setting of this parameter is reflected when both the position command and filter accumulation pulse are "0". If PA1_13 (tuning mode selection) is 0 (auto tuning) or 1 (semi-auto tuning), automatic adjustment is made inside the amplifier.
Low-pass filter (for S-curve) time constant	Enter the low-pass filter (for S-curve) filter time constant in relation to position commands and speed commands. Acceleration and deceleration are made so that an approximate S-curve is drawn.
Command pulse smoothing function	The parameter is enabled under position control. If the function is enabled, smoothing is added to the position command every 2 [ms] intervals. A larger setting at low command pulse frequencies or large electronic gear ratios can reduce the torque ripple caused by fluctuation of the command pulse. While the setting can be changed at any time, the new setting is reflected when both the position command and filter accumulation pulse are "0".

Function configuration block



- For details of tuning, refer to "CHAPTER 5 SERVO ADJUSTMENT."

PA1_54 Position command response time constant

No.	Name	Setting range	Default value	Change
54	Position command response time constant	0.00 [ms] to 250.00 [ms]	***	Always

Specify the following response characteristics to commands. A smaller setting improves the response characteristics.
Automatic adjustment is made inside the amplifier if PA1_13 (tuning mode selection) is 0 (auto tuning) or 1 (semi-auto tuning).

PA1_55 to 57 Response to disturbance settings

No.	Name	Setting range	Default value	Change
55	Position loop gain 1	1 [rad/s] to 2000 [rad/s]	***	Always
56	Speed loop gain 1	1 [Hz] to 2000 [Hz]	***	Always
57	Speed loop integration time constant	0.5 [ms] to 1000.0 [ms]	***	Always

Position loop gain 1: Position disturbance response setting. A larger setting improves the response characteristics.
Speed loop gain 1: Speed disturbance setting. A larger setting improves the response characteristics.
Speed loop integration time constant 1: Integration time constant setting of speed response. A smaller setting improves the response.
Too much a response characteristic may cause vibration or noise.
Automatic adjustment is made inside the amplifier if PA1_13 (tuning mode selection) is other than 2 (manual tuning).

PA1_58 Feed forward gain 1

No.	Name	Setting range	Default value	Change
58	Feed forward gain 1	0.000 to 1.500	0.000	Always

A larger setting decreases the position deviation amount, improving the response characteristics.
Set at 1.000 to reduce the position deviation at a constant speed to almost zero (except during acceleration or deceleration).
Use this parameter to increase the synchronization accuracy between two axes of synchronous control or similar.
For regular point-to-point operation, set the parameter at 0.500 or less (approximate value).

PA1_59 Torque filter time constant for position and speed control
PA1_60 Torque filter time constant for torque control

No.	Name	Setting range	Default value	Change
59	Torque filter time constant for position and speed control	0.00 [ms] to 20.00 [ms]	***	Always
60	Torque filter time constant for torque control	0.00 [ms] to 20.00 [ms]	0.00	Always

Torque filter time constant for position and speed control	This parameter is enabled under speed and position control. Add a filter to internal torque commands. The response of the servo system is improved and resonance is suppressed. In particular, the reference value should be larger with large load inertia. Automatic adjustment is made inside the amplifier in other than the manual tuning mode. Set PA1_94 at 0 to allow manual settings.
Torque filter time constant for torque control	The parameter is enabled under torque control. Add a filter to external torque commands. Good effects can be expected for a system prone to electric noise or one with fluctuation in the command voltage.

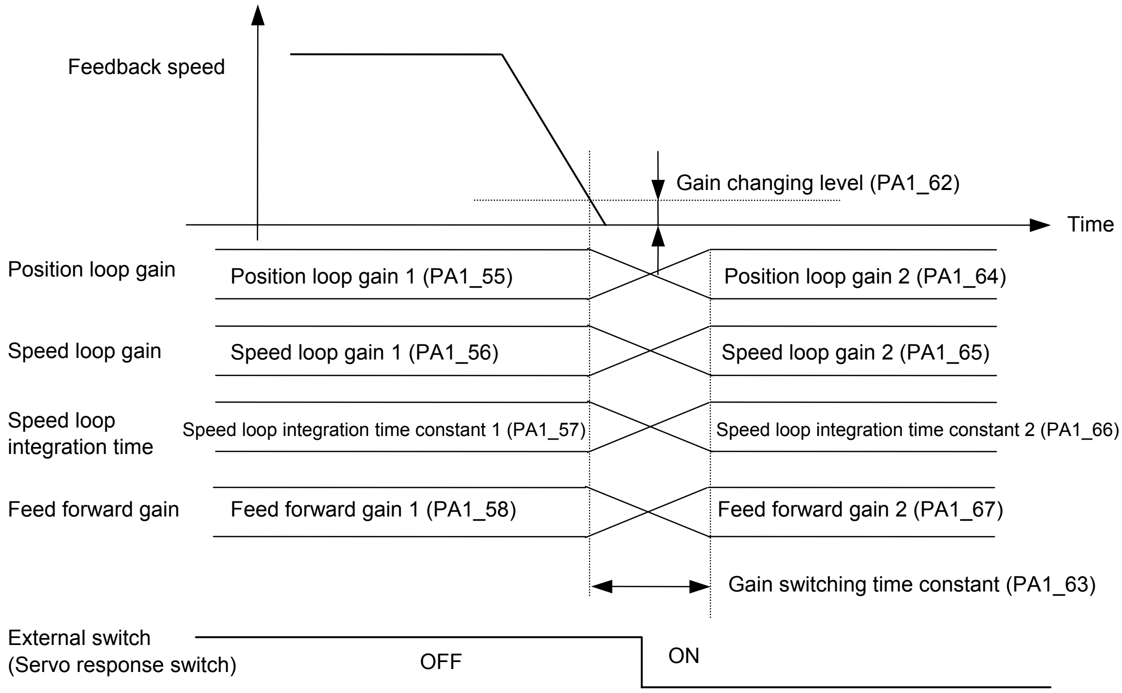
PA1_61 to 67 Second gain settings

No.	Name	Setting range	Default value	Change
61	Gain changing factor	0: Position deviation (x10) 1: Feedback speed 2: Command speed 3: External switch (CONT signal switch)	1	Always
62	Gain changing level	1 to 1000 (in increments of 1)	50	Always
63	Gain changing time constant	0 [ms] to 100 [ms] (in increments of 1)	1	Always
64	Position loop gain 2	30 [%] to 200 [%] (in increments of 1)	100	Always
65	Speed loop gain 2	30 [%] to 200 [%] (in increments of 1)	100	Always
66	Speed loop integration time constant 2	30 [%] to 200 [%] (in increments of 1)	100	Always
67	Feed forward gain 2	30 [%] to 200 [%] (in increments of 1)	100	Always

The gain of the servo system is switched from the first gain (PA1_55 to _58) to the second gain (PA1_64 to _67).
Noise and vibration during stoppage can be reduced through gain switching.
Select the gain changing factor with PA1_61.
The unit of the reference value of the second gain (PA1_64 to _67) is "%." Specify the ratio to the first gain.

[Example] If PA1_56 (speed loop gain 1) is 100 [Hz] and PA1_65 (speed loop gain 2) is 80 [%], the second gain is 80 [Hz]. PA1_64 (position loop gain 2) is similar. If PA1_57 (speed loop integration time constant 1) is 20 [ms] and PA1_66 (speed loop integration time constant 2) is 50 [%], integration time constant 2 is 40 [ms].

The timing chart of each signal is shown below.



If external switch is selected as a gain changing factor, changeover to the second gain occurs during OFF-to-ON transition as shown above. In this case, you can turn on or off at an arbitrary timing without relations to the motor motion.
The gain of the go stroke and that of the return stroke of a reciprocal motion can be switched.

PA1_68 Acceleration compensation gain for position control

No.	Name	Setting range	Default value	Change
68	Acceleration compensation gain for position control	0 [%] to 200 [%]	0	Always

Enter the following characteristics to the command.
A larger reference value reduces the position deviation caused during acceleration or deceleration while improving following characteristic to position commands.
Too much reference value may cause vibration or noise.

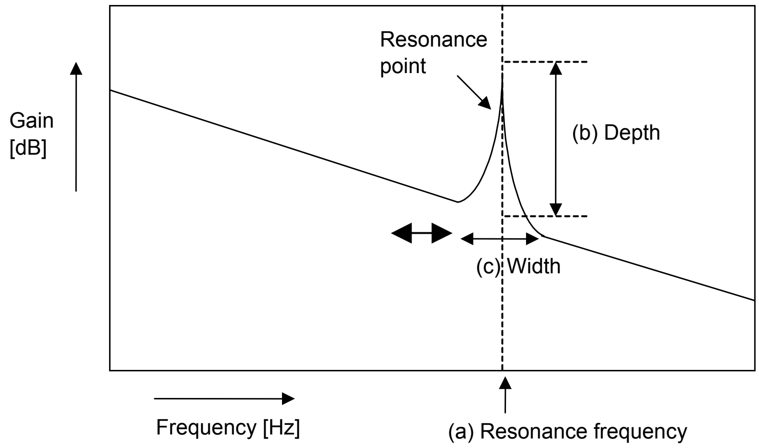
PA1_70 to 76 Notch filter settings

No.	Name	Setting range	Default value	Change
70	Automatic notch filter selection	0: Disable 1: Enable	1	Always
71	Notch filter 1, frequency	10 [Hz] to 4000 [Hz] (in increments of 1)	4000	Always
72	Notch filter 1, attenuation	0 [dB] to 40 [dB] (in increments of 1)	0	Always
73	Notch filter 1, width	0 to 3	2	Always
74	Notch filter 2, frequency	10 [Hz] to 4000 [Hz] (in increments of 1)	4000	Always
75	Notch filter 2, attenuation	0 [dB] to 40 [dB] (in increments of 1)	0	Always
76	Notch filter 2, width	0 to 3	2	Always

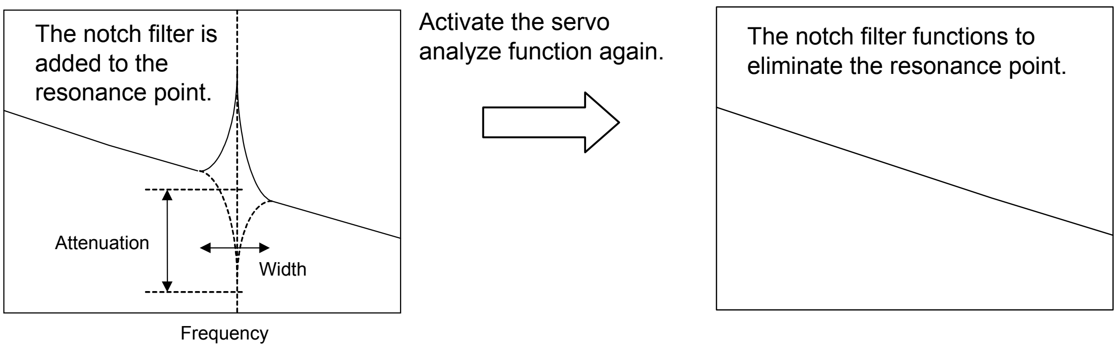
Specify to suppress resonance of the mechanical system. Up to two resonance points can be suppressed. Select 1 (enable) for automatic notch filter selection to adjust the notch filter automatically to the best value and suppress resonance.
Parameters automatically adjusted in this case include PA1_71 to _76. Values are stored in the EEPROM every 10 minutes.

■ How to set the notch filter

(1) If there is resonance in the mechanical system, a notch filter is automatically set. If resonance is not suppressed, set PA1_70 (automatic notch filter selection) at 0 (disable) and follow the procedure below to manually adjust the notch filter.
(2) Using the servo analyze function of PC Loader, determine the resonance point of the machine.



(3) Enter the resonance frequency of and attenuation of the resonance point of the machine into parameters.
   (a) Resonance frequency PA1_71: Notch filter 1, frequency
   (b) Depth PA1_72: Notch filter 1, attenuation *
   (c) Width PA1_73: Notch filter 1, width
      * Too much attenuation may undermine stability of the control. Do not enter too much setting. (Set at 0dB to disable the notch filter.)



(4) Approximate reference value
Refer to the table below for the approximate reference value.

Frequency [Hz]	200	500	700	1000
Attenuation [dB]	-5	-10	-15	-20
Width	2,3			

PA1_77 to 86 Vibration suppressing control settings

No.	Name	Setting range	Default value	Change
77	Automatic vibration suppressing control selection	0: Disable 1: Enable 2: Communication setting	0	Always
78	Vibration suppressing anti resonance frequency 0	1 [Hz] to 300.0 [Hz] (in increments of 1)	300.0	Always
79	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 0	0 [%] to 80 [%] (in increments of 1)	0	Always
80	Vibration suppressing anti resonance frequency 1	1 [Hz] to 300.0 [Hz] (in increments of 1)	300.0	Always
81	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 1	0 [%] to 80 [%](in increments of 1)	0	Always
82	Vibration suppressing anti resonance frequency 2	1 [Hz] to 300.0 [Hz] (in increments of 1)	300.0	Always
83	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 2	0 [%] to 80 [%] (in increments of 1)	0	Always
84	Vibration suppressing anti resonance frequency 3	1 [Hz] to 300.0 [Hz] (in increments of 1)	300.0	Always
85	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 3	0 [%] to 80 [%] (in increments of 1)	0	Always
86	Vibration suppressing control damping coefficient	0.0000 to 0.1000	0.0000	Always

These parameters are enabled only under position control.
Use these parameters to specify the anti resonance frequency to suppress workpiece vibration (vibration control).
Set at 300.0 [Hz] (factory shipment setting) to disable vibration suppressing control function.
Set PA1_77 (automatic vibration suppressing control selection) at 1 (enable) to repeat starting and stopping the motor multiple times while automatically detecting the anti resonance frequency of the machine and adjusting PA1_78 (vibration suppressing anti resonance frequency 0) to the best value.
To use this function, always reserve 1.5s or longer stopping time.
Use vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 0 to enter the ratio of a vibrating inertial body such as the arm to the inertia of the entire system.
The enabled parameter is selected through the CONT input signal as shown in the table on the next page.
The RS-485 communications setting is enabled if the parameter PA1-77 (automatic vibration suppressing control selection) is set at 2 (comunication setting).

Anti resonance frequency 1	Anti resonance frequency 0	Enabled vibration suppressing anti resonance frequency	Enabled vibration suppressing workpiece inertia ratio
OFF	OFF	PA1_78	PA1_79
OFF	ON	PA1_80	PA1_81
ON	OFF	PA1_82	PA1_83
ON	ON	PA1_84	PA1_85

For details of vibration suppressing control, refer to Section 5.8 "Special Adjustment (Vibration Suppressing Control)."

PA1_87 Model torque filter time constant

No.	Name	Setting range	Default value	Change
87	Model torque filter time constant	0.00 [ms] to 20.00 [ms]	***	Always

Specify the feed forward control filter time constant of the torque for a model of inertia moment.
Automatic adjustment is made inside the amplifier in other than the manual tuning mode.

PA1_88 and 89 Position loop integration time constant, position loop integration limiter

No.	Name	Setting range	Default value	Change
88	Position loop integration time constant	1.0 [ms] to 1000.0 [ms]	***	Always
89	Position loop integration limiter	0 [r/min] to Max. rotation speed [r/min]	0	Always

Use to improve interpolation accuracy of axes when interpolating two or more servomotor axes of an X-Y table or similar.
PA1_88 (position loop integration time constant) is automatically adjusted inside the amplifier in other than the manual tuning mode.
The position loop integration time constant is disabled if PA1_89 (position loop integration limiter) is 0.
To enter manually, enter settings so that the following equation is satisfied: Position loop integration time constant ≥ Speed loop integration time constant x 5

PA1_90 Load torque observer

No.	Name	Setting range	Default value	Change
90	Load torque observer	0: Disable 1: Enable	0	Always

Set at 1 (enable) to suppress effects of load disturbance torque and improve speed fluctuation.
Use the parameter to reduce the positioning settling time due to effects of the load torque such as friction.

4

PA1_91 P/PI automatic change selection

No.	Name	Setting range	Default value	Change
91	P/PI automatic change selection	0: Disable 1: Enable	0	Always

The speed adjuster switches to P (proportional) or PI (proportional + integral) control.
Set at 1 (enable) to automatically switch according to the setting of PA1_61 (gain changing factor).
The switching level follows the reference value of PA1_62 (gain changing level).
The state at switching is shown below.

PA1_61: Gain changing factor	Condition	State
Position deviation, feedback speed Command frequency, command speed	Reference value level or over	P control
	Reference value level or less	PI control
External signal switch (CONT signal switch)	ON	P control
	OFF	PI control

To apply the brake from an external unit, arrange the P control state.

PA1_92 and 93 Friction compensation settings

No.	Name	Setting range	Default value	Change
92	Speed range for friction compensation	0.1 [r/min] to 20.0 [r/min]	10.0	Always
93	Coulomb friction torque for friction compensation	0 [%] to 50 [%]	0	Always

Specify in a system with reversing speeds if smooth reversing motions are not obtained due to friction.
Specify the speed at which static friction changes to dynamic friction, in these parameters.
Set PA1_92 (speed range for friction compensation) at about 1.0 [r/min] to 10.0 [r/min].
Set PA1_93 (Coulomb friction torque for friction compensation) at the torque equivalent to dynamic friction (Coulomb friction).
Friction compensation is disabled if the friction compensation torque reference value is 0.

PA1_94 Torque filter setting mode

No.	Name	Setting range	Default value	Change
94	Torque filter setting mode	0: Not set automatically 1: Set automatically	1	Always

This parameter is enabled under position and speed control.
Select either to automatically set the torque filter automatically or not during auto tuning operation.
Set at 0 (not set automatically) to manually specify PA1_59 (torque command filter) without relations to the setting of PA1_13 (tuning mode selection).
Set at 1 (set automatically) to automatically adjust inside the amplifier in other than the manual tuning mode.

PA1_95 Model torque calculation and speed observer selection

<table>
<tr><th>No.</th><th>Name</th><th colspan="3">Setting range</th><th>Default value</th><th>Change</th></tr>
<tr><td rowspan="5">95</td><td rowspan="5">Model torque calculation and speed observer selection</td><td>Setting</td><td>Model torque calculation</td><td>Speed observer</td><td rowspan="5">3</td><td rowspan="5">Always</td></tr>
<tr><td>0</td><td>Disable</td><td>Disable</td></tr>
<tr><td>1</td><td>Enable</td><td>Disable</td></tr>
<tr><td>2</td><td>Disable</td><td>Enable</td></tr>
<tr><td>3</td><td>Enable</td><td>Enable</td></tr>
</table>

This parameter is enabled under position and speed control.
Select whether model torque calculation and speed observer are enabled or disabled.
If model torque calculation is disabled, the torque feed forward calculation using a model of moment of inertia of load is disabled.
Use the parameter to perform position and speed control at the host controller.
Select "enable" for speed observer during regular operation. Speed compensation is made and stability is improved.
Parameters related to response of the control system are automatically adjusted according to the setting of auto tuning 1 or 2. However, the function of PA1_54 (position command response time constant) is canceled internally.

PA1_96 Speed limit gain for torque control

No.	Name	Setting range	Default value	Change
96	Speed limit gain for torque control	0.0 to 50.0	10.0	Always

This parameter is enabled under torque control.
If the rotation speed exceeds the reference value of PA1_26 (maximum rotation speed (under torque control)) under torque control, the command torque is reduced so that the rotation speed becomes near the reference value. At this time, an error is caused in the rotation speed in relation to the reference value. Take into consideration that the parameter adjusts the error. While a larger reference value decreases the error, excessive value will cause instability.

4

4.4 Automatic Operation Setting Parameter

Note	Parameters marked "○" in the "Power" field are enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.4.1 List (PA2_□□)

No. PA2_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
01	Decimal point position of positioning data	0	-	○	○	○	
06	Homing speed	500.00	-	○	-	-	
07	Creep speed for homing	50.00	-	○	-	-	
08	Starting direction for homing	0	○	○	-	-	
09	Reverse traveling unit amount for homing	0	-	○	-	-	
10	Homing direction after reference signal detection	0	○	○	-	-	
11	Reference signal for shift operation	1	○	○	-	-	
12	Reference signal for homing (Deceleration starting signal)	0	○	○	-	-	
13	Home position LS signal edge selection	0	○	○	-	-	
14	Home position shift unit amount	1000	-	○	-	-	
15	Deceleration operation for creep speed	0	○	○	-	-	
16	Home position after homing completion	0	-	○	-	-	
17	Home position detection range	0	○	○	-	-	
18	Deceleration time at OT during homing	100.0	-	○	-	-	
19	Preset position	0	-	○	-	-	
20	Interrupt traveling unit amount	100000	-	○	-	-	
22	Detection time for contact-stopper	0	-	○	-	-	
23	Torque limit for contact-stopper	0	-	○	-	-	
24	Selection of operation at OT during homing	0	○	○			
25	Software OT selection	0	○	○	○	-	
26	Positive software OT detection position	2000000000	-	○	○	-	
27	Negative software OT detection position	-2000000000	-	○	○	-	
28	Positive limiter detection time	2000000000	-	○	-	-	
29	Negative limiter detection time	-2000000000	-	○	-	-	
31	Point detection, area detection	0	-	○	○	○	
32	Point detection, area detection position 1	0	-	○	○	○	
33	Point detection, area detection position 2	0	-	○	○	○	
34	Point detection range	100	-	○	○	○	

No. PA2_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
36	Override 1	10	-	○	○	-	
37	Override 2	20					
38	Override 4	40					
39	Override 8	80					
40	Internal positioning data selection	0	-	○	○	-	
41	Sequential start selection	0	○	○	-	-	
42	Decimal point position of stand still timer	0	-	○	-	-	
43	Output selection at M code OFF	1	○	○	-	-	

Parameters marked "○" in the table are enabled in the corresponding control mode.

4

4.4.2 Description of Each Parameter

PA2_01 Decimal point position of positioning data

No.	Name	Setting range	Default value	Change
01	Decimal point position of positioning data	0:0 1:0.1 2:0.01 3:0.001 4:0.0001 5:0.00001	0	Always

Specify the decimal point position of the displayed position data.

PA2_06 to 18 and 24 Homing settings

No.	Name	Setting range	Default value	Change
06*	Homing speed	0.01 [r/min] to Max. rotation speed [r/min]	500.00	Always
07	Creep speed for homing	0.01 [r/min] to Max. rotation speed [r/min]	50.00	Always
08*	Starting direction for homing	0:Forward rotation 1:Reserve rotation 2:Condition judgment start	0	Power
09	Reverse traveling unit amount for homing	0 to 2000000000 [unit amount]	0	Always
10*	Homing direction after reference signal detection	0: Forward 1: Reverse	0	Power
11*	Reference signal for shift operation	0: Home position LS 1: Encoder Z-phase 2: +OT 3:-OT 4: Interrupt input 5: Stopper	1	Power
12	Reference signal for homing (Deceleration starting signal)	0: Home position LS 1:+OT 2:-OT	0	Power
13	Home position LS signal edge selection	0: Rising edge detection 1: Trailing edge detection	0	Power
14*	Home position shift unit amount	0 to 2000000000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation disable 1: Reverse rotation enable	0	Power
16	Home position after homing completion	-2000000000 to 2000000000 [unit amount]	0	Always

No.	Name	Setting range	Default value	Change
17	Home position detection range	0: Always ON after homing completion 1 to 2000000000 [unit amount]	0	Always
18	Deceleration time at OT during homing	0.0 [ms] to 99999.9 [ms]	100.0	Always
22	Detection time for contact-stopper	0 [ms] to 10000 [ms]	0	Always
23	Torque limit for contact-stopper	0 [%] to 100 [%]	0	Always
24	Selection of operation at OT during homing	0: Reverse rotation upon OT detection 1: Stopped upon OT detection (homing cancel)	0	Power

*: Compulsory setting item

ALPHA5 can combine parameter settings to create the desired homing profile.
The homing profile is configured with combination of the following parameters.

(1) Starting direction for homing
Specify the starting direction (forward/reverse rotation) of homing. The direction opposite to the homing direction after reference signal detection can be specified.

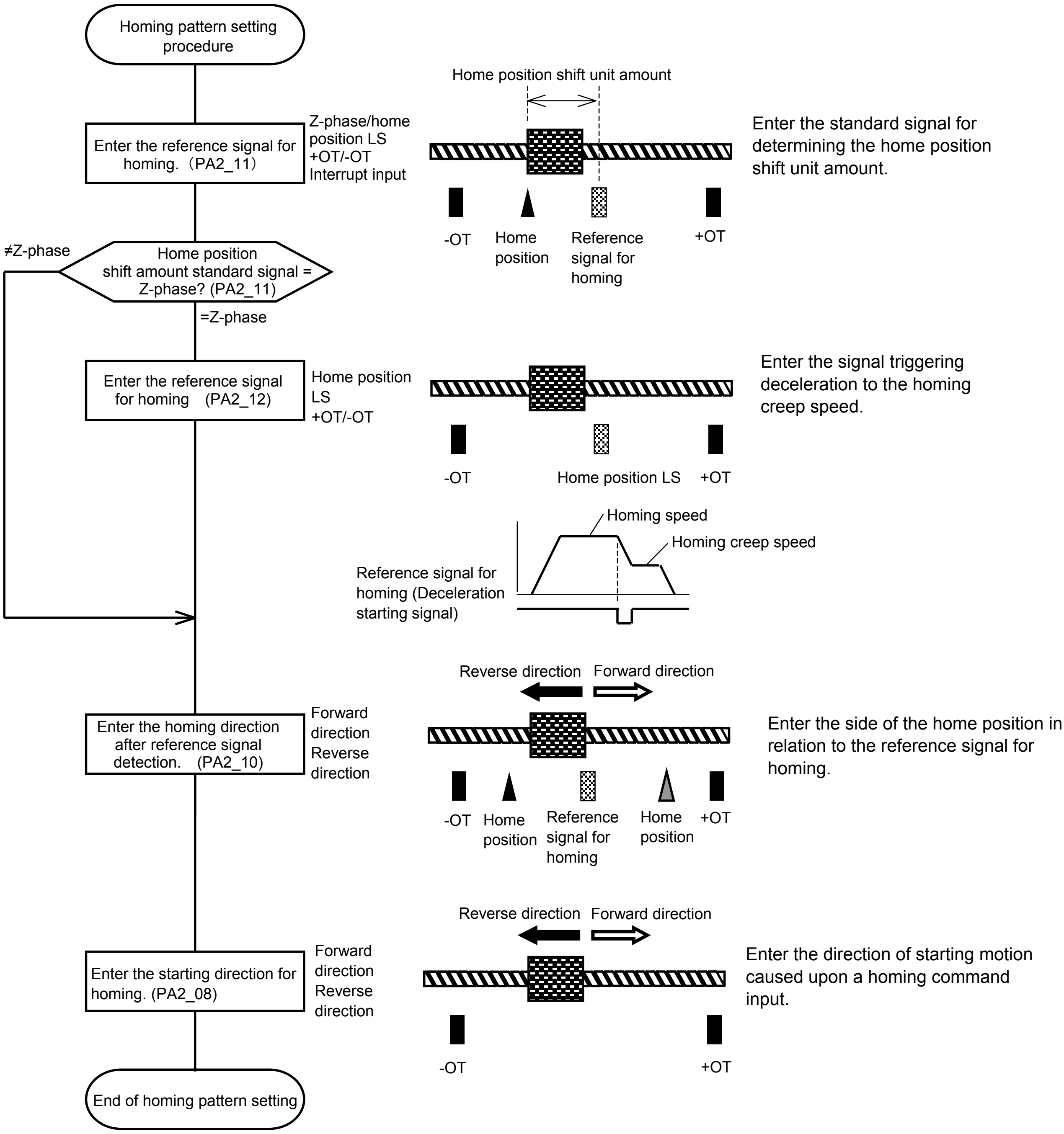
(2) Homing direction after reference signal detection
Select the side of the home position (forward or reverse rotation side) in relation to the reference signal for homing (Deceleration starting signal) and reference signal for shift operation.

(3) Reference signal for shift operation
Select the signal serving as the direct standard of the zero position. You can select +OT or -OT.

(4) Reference signal for homing (Deceleration starting signal)
Specify the creep speed deceleration signal that is used if the encoder Z-phase is selected as a reference signal for shift operation. You can select +OT or -OT.

(1) Homing profile setting procedure

The basic procedure for specifying the homing profile (homing parameter) is described.



- Parameter setting examples of typical homing profiles are described on page 4-46.

(2) Homing motion setting parameter

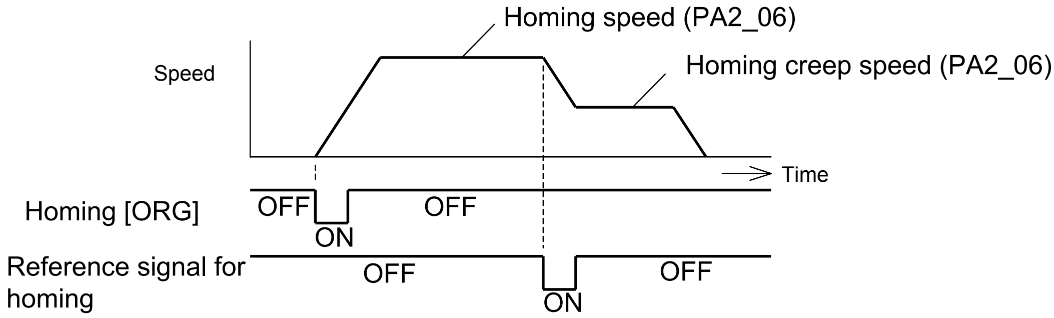
Parameters are combined to determine the homing motion.

4

PA2_06 Homing speed

No.	Name	Setting range	Default value	Change
06	Homing speed	0.01 [r/min] to Max. rotation speed [r/min]	500.00	Always

Specify the homing speed.



PA2_07 Creep speed for homing

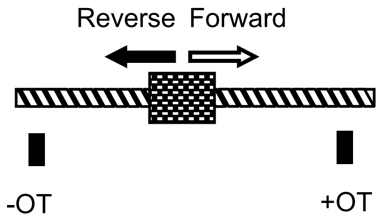
No.	Name	Setting range	Default value	Change
07	Creep speed for homing	0.01 [r/min] to Max. rotation speed [r/min]	50.00	Always

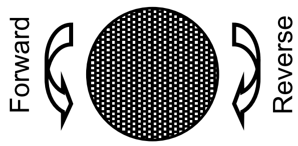
Specify the motion speed taken after the reference signal for homing (deceleration starting signal) is detected.

PA2_08 Starting direction for homing

No.	Name	Setting range	Default value	Change
08	Starting direction for homing	0:Forward rotation 1:Reverse rotation 2:Condition judgment start	0	Power

Specify the starting direction of the homing motion.





For the direction of 2: condition judgment start, refer to page 4-62.

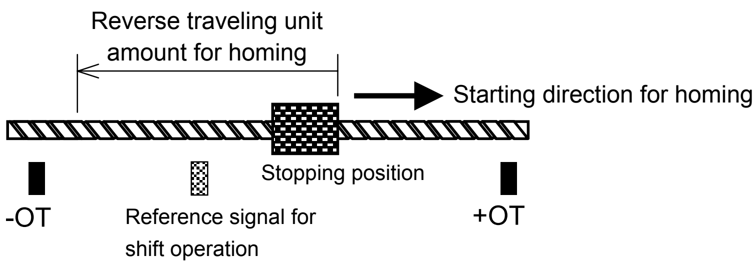
- Forward direction: direction of position increase Reverse direction: direction of position decrease
  The forward/reverse direction depends on parameter PA1_04 (rotation direction selection).

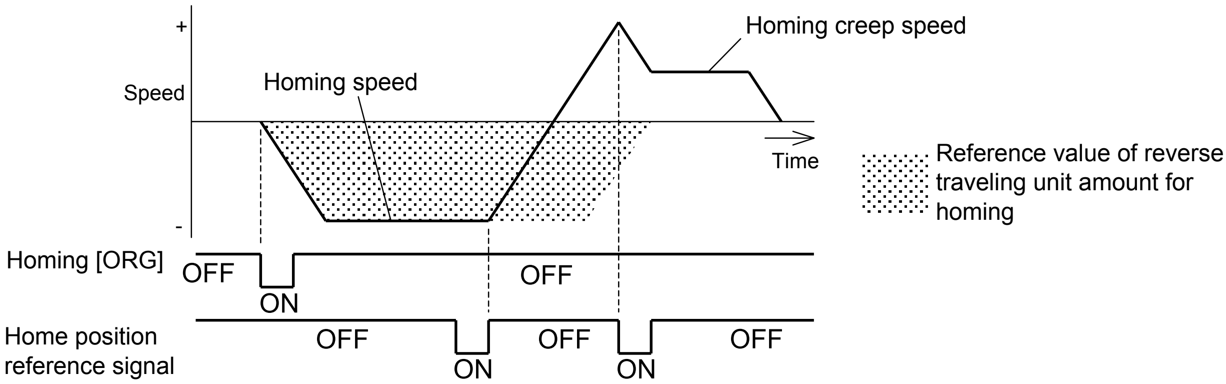
PA2_09 Reverse traveling unit amount for homing

No.	Name	Setting range	Default value	Change
09	Reverse traveling unit amount for homing	0 to 2000000000 [unit amount]	0	Always

Not a compulsory item

Specify the reverse traveling amount taken in the direction opposite to the starting direction for homing at the start of homing motion.
If a reference signal for homing (deceleration starting signal) or reference signal for shift operation is detected during reverse travel, movement toward the homing direction after reference signal detection begins. Use the setting to reduce the homing time.
Use if the stopping position is in the direction opposite to the starting direction for homing and the maximum distance from the stopping position to the zero position is always known.
The unit amount depends on PA1_06 (numerator 0 of electronic gear) and PA1_07 (denominator of electronic gear).
If neither the reference signal for homing (deceleration starting signal) nor reference signal for shift operation is detected during reverse motion, movement in the starting direction for homing begins after reverse motion by the preset traveling amount.

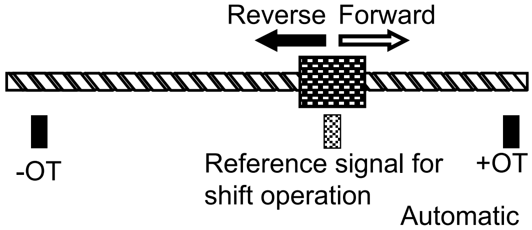




PA2_10 Homing direction after reference signal detection

No.	Name	Setting range	Default value	Change
10	Homing direction after reference signal detection	0: Forward 1: Reverse	0	Power

Specify the direction of the zero position when viewed from the reference signal for shift operation. The reference signal for shift operation is passed during home position shift unit amount travel in this direction.

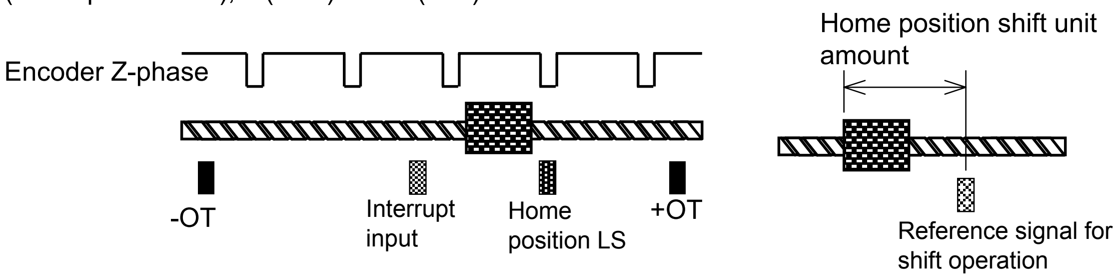


- If +OT or -OT is set as a reference signal for homing (deceleration starting signal), this parameter is disabled and the direction opposite to the one toward the specified OT signal is the homing direction after reference signal detection.
  The definition of the direction of motion is shown below.
  Forward: direction of position increase Reverse: direction of position decrease

PA2_11 Reference signal for shift operation

No.	Name	Setting range	Default value	Change
11	Reference signal for shift operation	0: Home position LS 1: Encoder Z-phase 2: +OT 3:-OT 4: Interrupt input 5: Stopper	1	Power

Specify the signal serving as a standard of the home position.
The position of a travel from the specified reference signal toward the homing direction after reference signal detection by the home position shift unit amount is the home position.
The home position accuracy (reproducibility of zero position) is the highest with 3 (encoder Z-phase).
If the Z-phase is selected, the reference signal for shift operation (deceleration starting signal) can be installed.
Next to the encoder Z-phase, 4 (interrupt input) has the highest home position accuracy (reproducibility of zero position). This is because 4 (interrupt input) detects the interrupt position with a signal while 0 (home position LS), 2 (+OT) and 3 (-OT) detects a level.

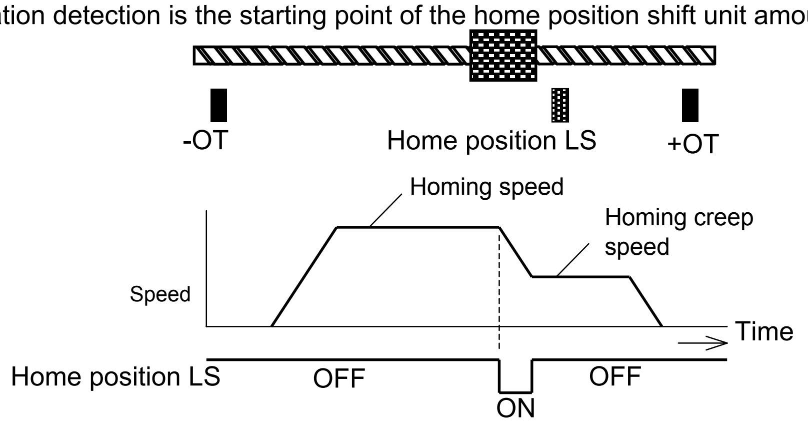


- If one among 0 (home position LS), 2 (+OT) and 3 (-OT) is selected, there is an error of ±250 [pulses] in the zero position at a creep speed for homing of 50 [r/min].

PA2_12 Reference signal for homing

No.	Name	Setting range	Default value	Change
12	Reference signal for homing	0: Home position LS　1:+OT　2:-OT	0	Power

<u>If the encoder Z-phase is selected as a reference signal for shift operation</u>, specify the timing signal for deceleration to the creep speed for homing. The first encoder Z-phase after reference signal for shift operation detection is the starting point of the home position shift unit amount.



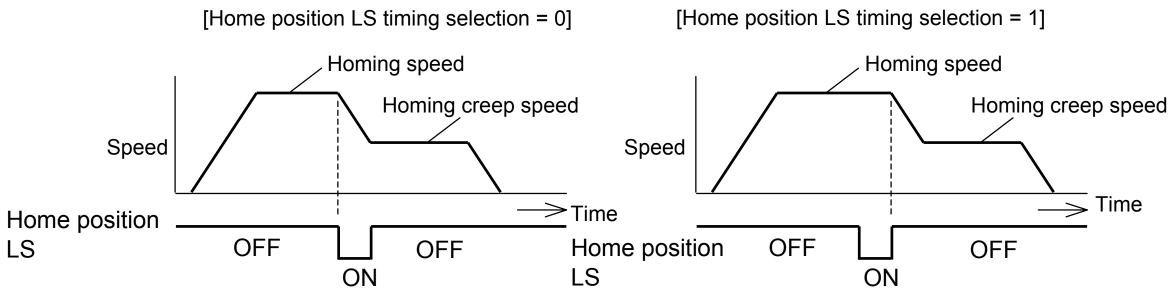
Example where the home position LS is the reference signal for homing

PA2_13 Home position LS signal edge selection

No.	Name	Setting range	Default value	Change
13	Home position LS signal edge selection	0: Rising edge detection 1: Trailing edge detection	0	Power

<u>Not a compulsory item</u>

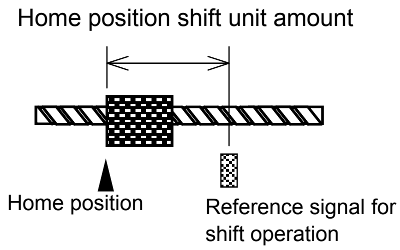
Specify the enabling timing of the home position LS signal if the home position LS is specified as a reference signal for shift operation reference signal for homing (Deceleration starting signal).



PA2_14 Home position shift unit amount

No.	Name	Setting range	Default value	Change
14	Home position shift unit amount	0 to 2000000000 [unit amount]	1000	Always

Specify the distance (traveling amount) from the reference signal for shift operation to the home position.

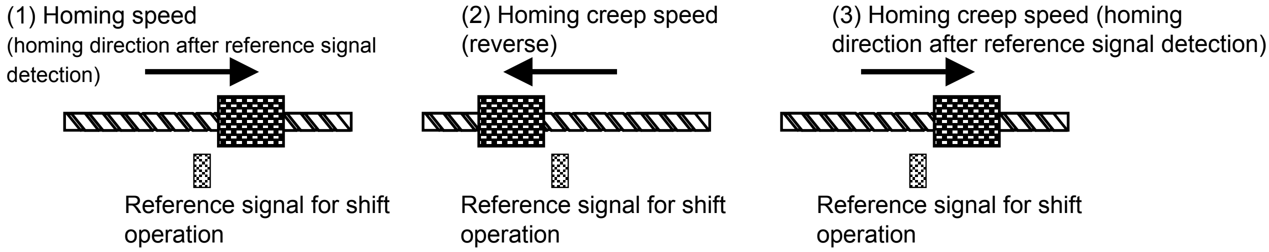


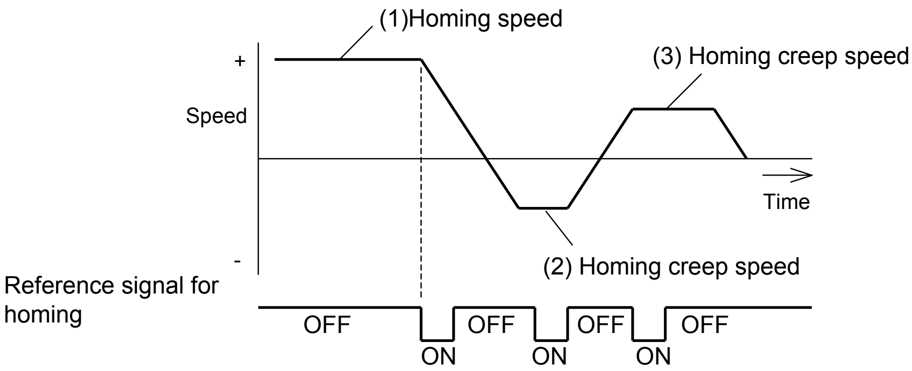
PA2_15 Deceleration operation for creep speed

No.	Name	Setting range	Default value	Change
15	Deceleration operation for creep speed	0: Reverse rotation disable 1: Reverse rotation enable	0	Power

Not a compulsory item

Specify 1 (reverse rotation enable) to return upon detection of the reference signal for shift operation during movement at the homing speed in the homing direction after reference signal detection temporarily to the point ahead of the reference signal for shift operation and move at the creep speed for homing again in the homing direction after reference signal detection to the position (home position) the home position shift unit amount away from the reference signal for shift operation.
Accurate homing can be executed only with the reference signal for shift operation without a reference signal for homing (deceleration starting signal).



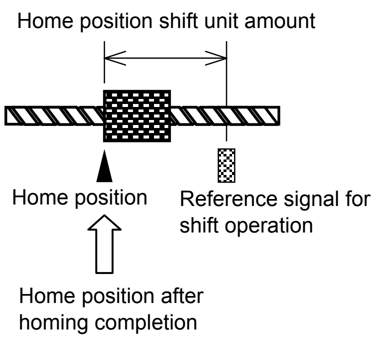


PA2_16 Home position after homing completion

No.	Name	Setting range	Default value	Change
16	Home position after homing completion	-2000000000 to 2000000000 [unit amount]	0	Always

Not a compulsory item

Specify the coordinate position of the homing completion point.
After a homing is normally finished, the current position is replaced with the reference value of this parameter.
Specify if the homing motion completion point is other than zero.

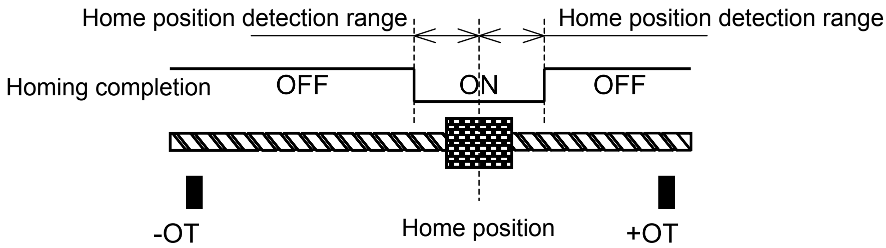


PA2_17 Home position detection range

No.	Name	Setting range	Default value	Change
17	Home position detection range	0: Always ON after homing completion 1 to 2000000000 [unit amount]	0	Always

Not a compulsory item

Specify the range in which the homing completion signal is turned on.
If the current position is between the positive home position detection range and negative home position detection range around the home position, homing completion is turned on.
Specify 0 to always turn the homing completion signal on after a homing is finished.



The zero position is not necessarily 0. The home position is the position specified as a home position after homing completion (PA2_16) or preset position (PA2_19).

PA2_18 Deceleration time at OT during homing

No.	Name	Setting range	Default value	Change
18	Deceleration time at OT during homing	0.0 [ms] to 99999.9 [ms]	100.0	Always

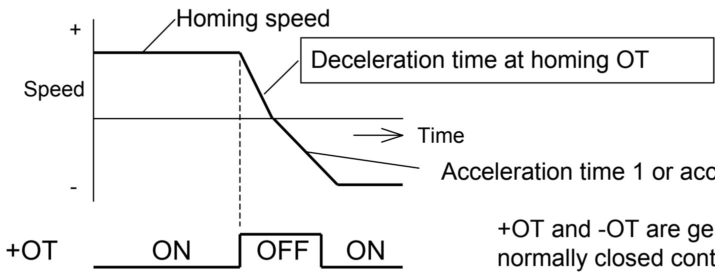
Specify the deceleration time taken after +OT or -OT is detected during homing motion.
Specify the time taken to decelerate from 2000 [r/min] to 0 [r/min]. Determine the setting under consideration of the homing speed and moving range after the OT sensor. ("0.7" in the equation indicates the safety factor.)

[Example of calculation of reference value]

Moving range after OT × 0.7 = Homing speed × Reduction ratio × Ball screw lead
× (Homing speed/2000 [r/min] × Deceleration time after homing OT/1000/60) × 1/2

30[mm] ×0.7 = 1000.00 [r/min] × (1/5) × 20 [mm]
× (1000.00 [r/min]/2000 [r/min] × Deceleration time at OT during homing /1000/60) × 1/2

Deceleration time at OT during homing = 1260.0 [ms]



The acceleration time and deceleration time are based on 2000 [r/min].

+OT and -OT are generally normally closed contact signals.

- If 1 (stop) is selected with parameter PA2_24 (selection of operation at OT during homing), stoppage occurs according to parameter PA2_60 (third torque limit). In this case, the homing motion is stopped upon detection of OT.

PA2_22 Detection time for contact-stopper
PA2_23 Torque limit for contact-stopper

No.	Name	Setting range	Default value	Change
22	Detection time for contact-stopper	0 [ms] to 10000 [ms]	0	Power
23	Torque limit for contact-stopper	0 [%] to 100 [%]	0	Power

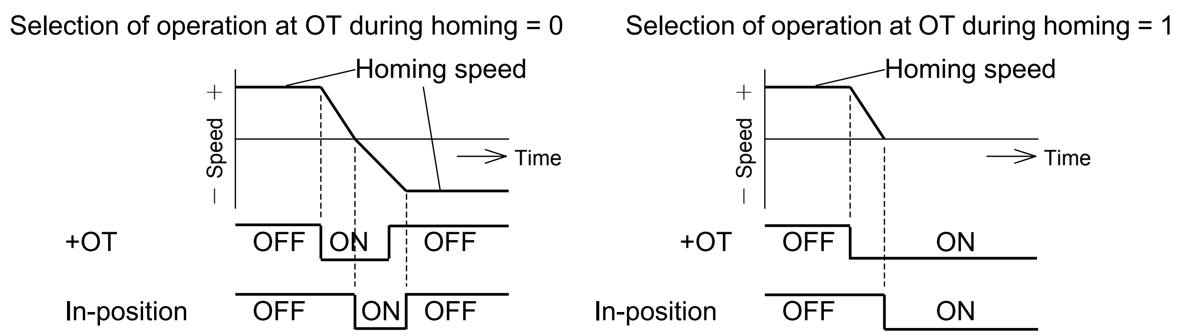
These parameters are enabled if “5” (stopper) is selected for PA2_11 (home position shift amount reference signal).
Enter these parameters to perform homing in applications such as positioning of a cylinder or the like where the home position LS or +/-OT cannot be used.
Enter the stopper contact detection time and dead stop torque limit.
For details, refer to “(7) Homing Pattern Using the Stopper” on page 4-64.

4

PA2_24 Selection of operation at OT during homing

No.	Name	Setting range	Default value	Change
24	Selection of operation at OT during homing	0: Reverse rotation upon OT detection 1: Stop upon OT detection (homing cancel)	0	Power

Specify the motion taken upon first OT detection during homing motion.
Specify 0 to reverse the motion upon first OT detection.
Specify 1 to cancel homing and stop upon detection of OT.



■ Parameters related to homing

PA1_12 (Z-phase position offset)

No.	Name	Setting range	Default value	Change
12	Z-phase position offset	0 [pulse] to 1048575 [pulse]: 20 bits	0	Power

The encoder Z-phase position can be adjusted.
The Z-phase output position shifts by the pulse amount (pulse units) specified in the CCW direction.
If the encoder Z-phase is selected as a reference signal for shift operation, adjust the encoder Z-phase position with this parameter after motor replacement so that homing can be made to the original position without changing the reference signal for homing (deceleration starting signal) or homing parameters.
For details, refer to "PA1_12 Z-phase position offset" on page 4-13.

PA1_37 to 40 (acceleration times, deceleration times)

No.	Name	Setting range	Default value	Change
37	Acceleration time 1	0.0 [ms] to 99999.9 [ms]	100.0	Always
38	Deceleration time 1		100.0	
39	Acceleration time 2		500.0	
40	Deceleration time 2		500.0	

Specify acceleration and deceleration in the homing motion.
The acceleration/deceleration time is the time from 0 [r/min] to 2000 [r/min].
For details, refer to "PA1_36 to 40 Acceleration time and deceleration time settings" on page 4-21.

PA2_60 (third torque limit)

No.	Name	Setting range	Default value	Change
60	Third torque limit	0 [%] to 300 [%]	0	Always

Specify the deceleration torque for stopping upon detection of +OT or -OT during homing motion.
If 1 (stop) is selected as parameter PA2_24 (selection of operation at OT during homing) and OT is detected, the homing process is canceled and controlled stop is caused according to this parameter.
For details, refer to "PA2_57 to 60 Torque limit settings" on page 4-74.

■ Typical homing profiles

(1) Basic homing profile (equivalent to homing profile 1 of FALDIC-α Series)

Described here is the homing profile of the most basic motion, in which homing is started, the reference signal for homing (deceleration starting signal) is detected and deceleration to the creep speed for homing occurs, and the reference signal for shift operation is detected and movement by the home position shift unit amount is caused until the motion is stopped.
Use the profile if the machine stopping position is less than the reference signal for homing (deceleration starting signal) or reference signal for shift operation.
Because neither +OT nor -OT is installed for homing of a rotating body as an indicator of the traveling limit, this homing profile is used in principle.

[Parameter setting example]

4

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	0: Forward	0	Power
09	Reverse traveling unit amount for homing	0 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for shift operation	1: Encoder Z-phase	1	Power
12	Reference signal for homing (Deceleration starting signal)	0: Home position LS	0	Power
13	Home position LS signal edge selection	0: Rising edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation disable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
18	Deceleration time at OT during homing	100.0 [ms]	100.0	Always
24	Selection of operation at OT during homing	0: Reverse rotation	0	Power

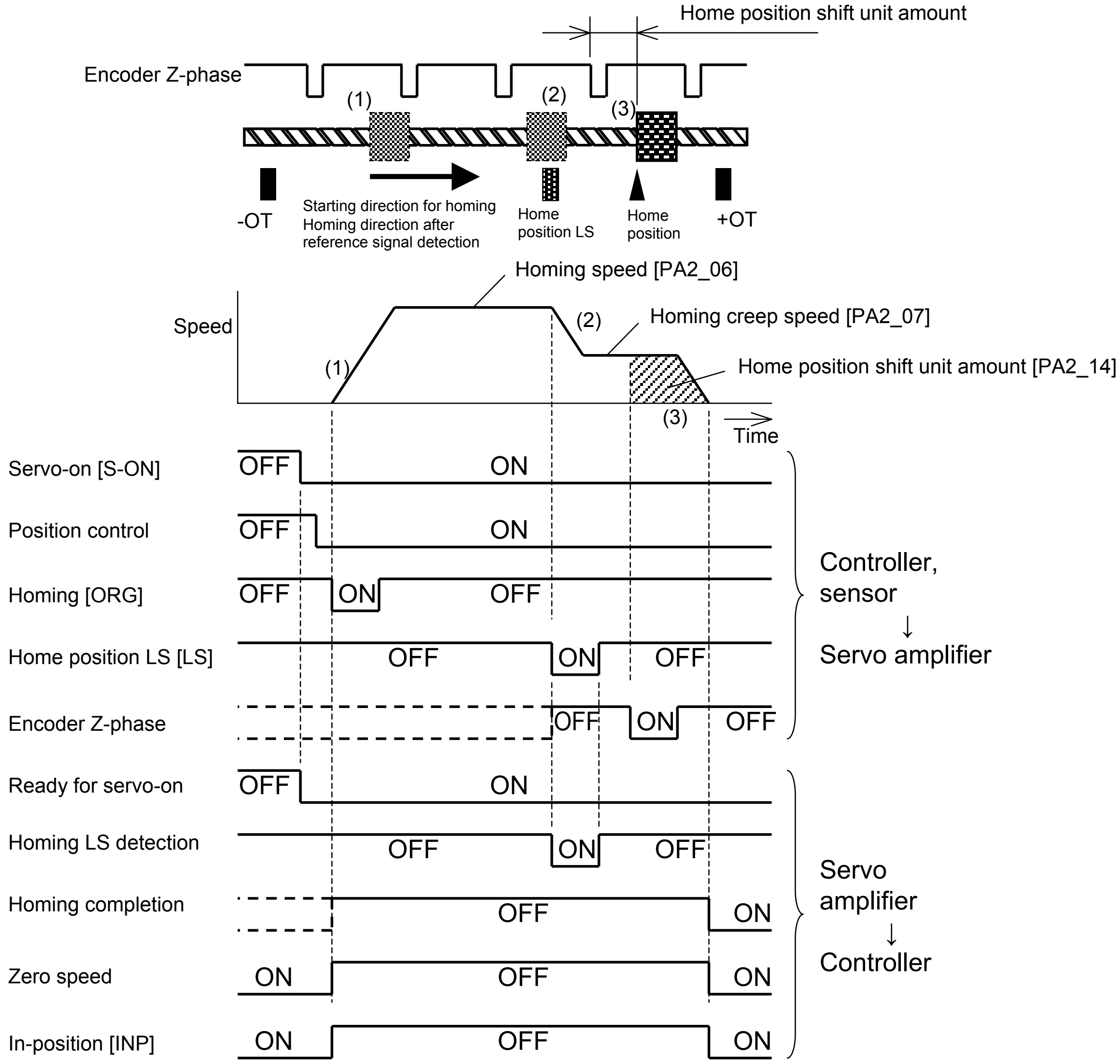
- To cancel homing upon detection of +OT or -OT, specify 1 (stop) to parameter PA2_24 (selection of operation at OT during homing).

The motion proceeds in the following procedure.

(1) The motion starts upon homing [ORG] (OFF → ON) in the starting direction for homing (PA2_08) at homing speed (PA2_06).

(2) When the home position LS (PA2_12, PA2_13) is detected, the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(3) After the home position LS (PA2_12) is detected during travel in the homing direction after reference signal detection and the first encoder Z-phase (PA2_11) is detected, a travel occurs by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.



(2) OT reference homing profile (equivalent to homing profile 2 of FALDIC-α Series)

If the OT located in the starting direction for homing is detected after homing is started before the reference signal for homing (deceleration starting signal) is detected, the motion reverses automatically and a travel occurs in the opposite direction for a reference signal for shift operation in this homing profile.
Secure homing is realized even if the direction of the reference signal for homing (deceleration stating signal) or reference signal for shift operation in relation to the machine stopping position is not known.

[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

4

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	0: Forward	0	Power
09	Reverse traveling unit amount for homing	0 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for shift operation	1: Encoder Z-phase	1	Power
12	Reference signal for homing (Deceleration starting signal)	0: Home position LS	0	Power
13	Home position LS signal edge selection	0: Rising edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation disable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
18	Deceleration time at OT during homing	100.0 [ms]	100.0	Always
24	Selection of operation at OT during homing	0: Reverse rotation	0	Power

- Because the reverse rotation upon OT detection is enabled with the standard homing setting of ALPHA5, the OT reference homing is executed with the same parameter settings as those of the basic homing profile.
  If the reference signal for homing (deceleration starting signal) is detected before OT is detected, the motion profiles the same as that of (1) basic homing profile.

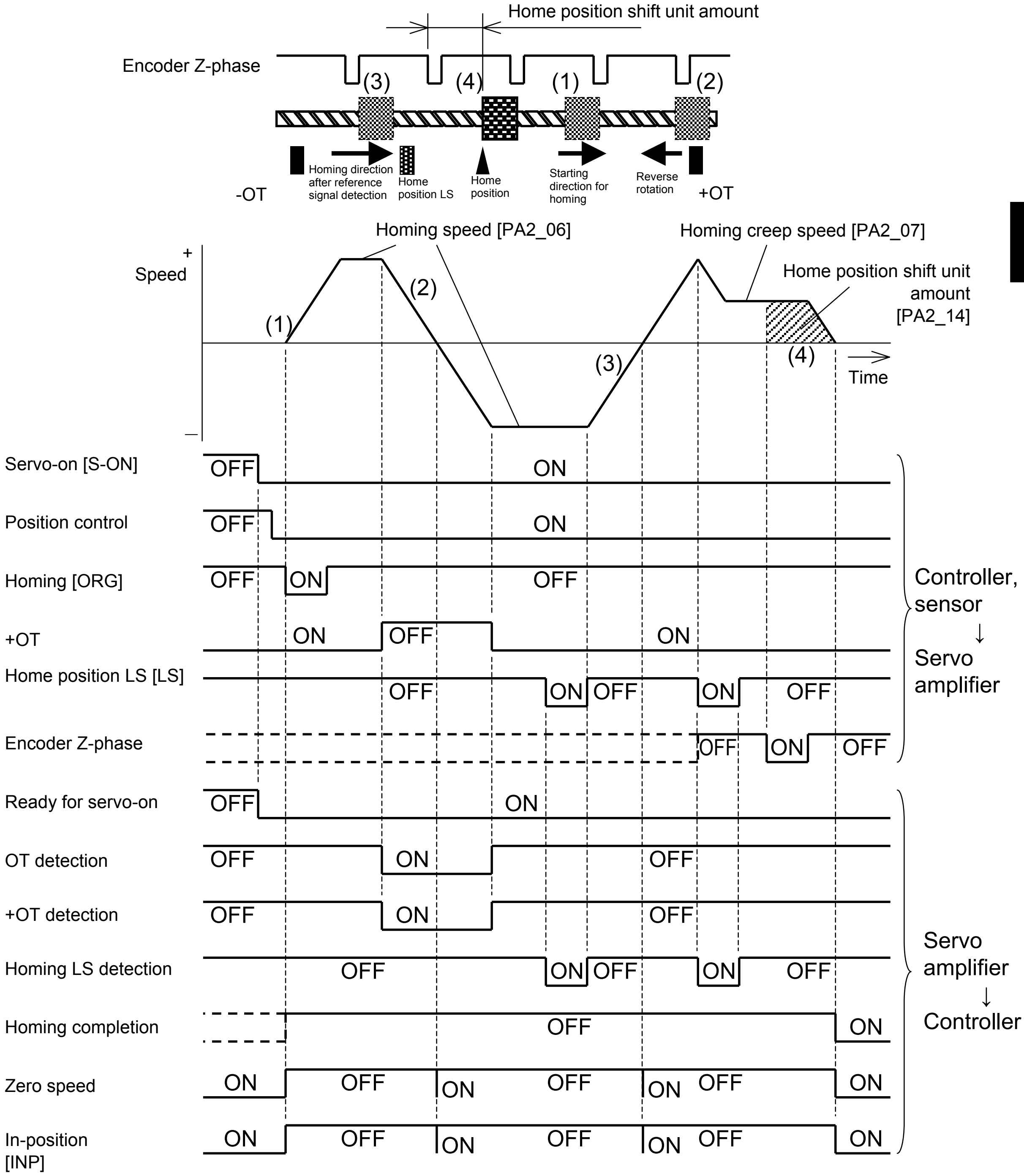
If OT is detected in the starting direction for homing during homing motion, the motion proceeds in the following procedure.

(1) The motion starts at the rising edge (OFF → ON) of homing [ORG] in the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(2) If OT is detected in the starting direction for homing (PA2_08) before the home position LS (PA2_12) is detected, the motion reverses at the homing speed (PA2_06).

(3) If the home position LS (PA2_12) is detected during reverse rotation, the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(4) Upon detection of the first encoder Z-phase (PA2_11) after detection of the home position LS (PA2_12) during travel in the homing direction after reference signal detection (PA2_10), a travel continues by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.



- At the rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

4

(3) At-start reverse rotation homing profile1 (equivalent to homing profile 3 of FALDIC-α Series)

After homing is started, a travel occurs in the direction opposite to the starting direction for homing by the specified reverse traveling unit amount for homing while the reference signal for homing (deceleration starting signal) is searched for.

This profiles used if the machine stopping position is larger than the reference signal for homing (deceleration starting signal) or reference signal for shift operation.

[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	0: Forward	0	Power
09	Reverse traveling unit amount for homing	20000 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for shift operation	1: Encoder Z-phase	1	Power
12	Reference signal for homing (Deceleration starting signal)	0: Home position LS	0	Power
13	Home position LS signal edge selection	0: Rising edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation disable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
18	Deceleration time at OT during homing	100.0 [ms]	100.0	Always
24	Selection of operation at OT during homing	0: Reverse rotation	0	Power

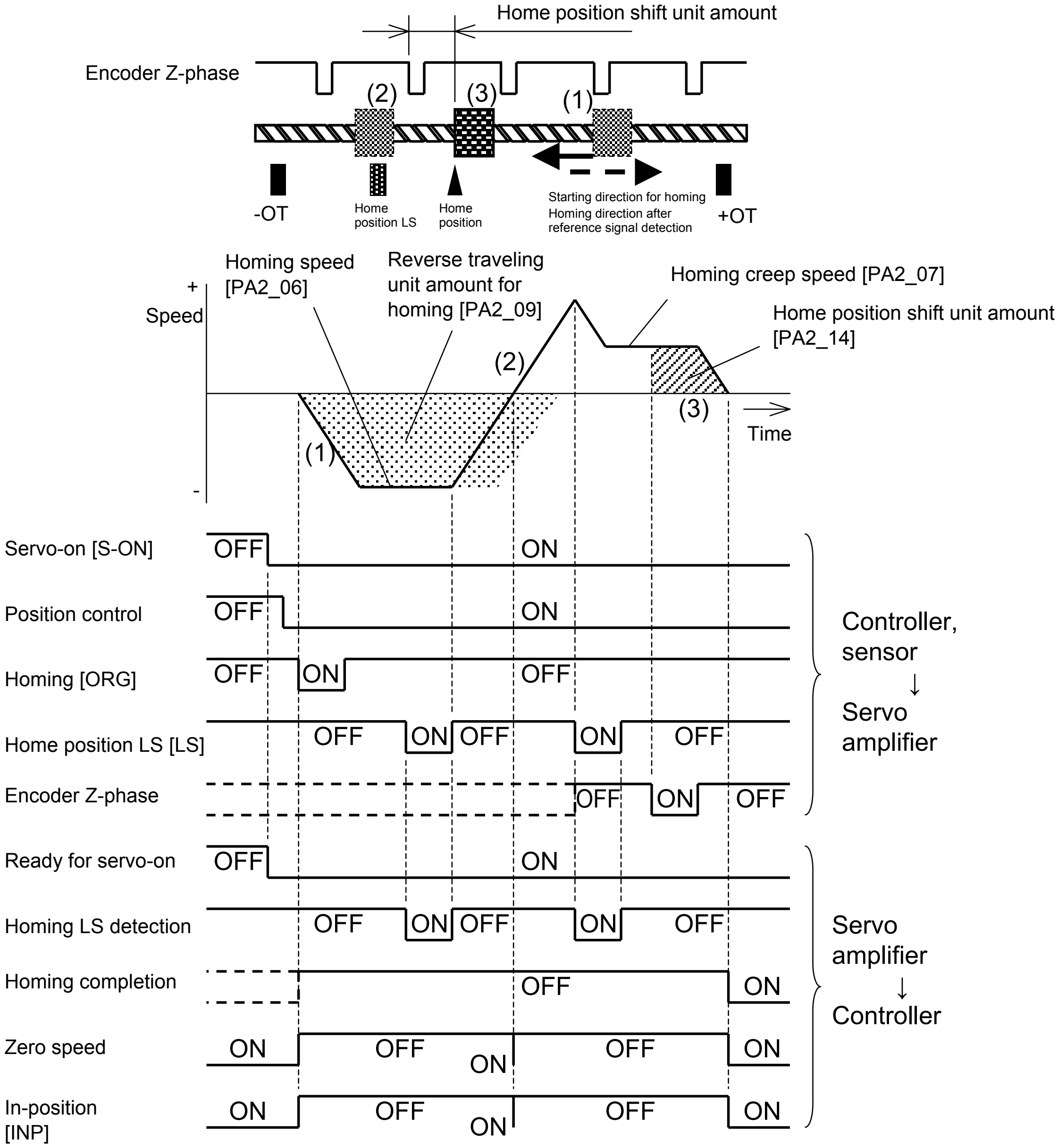
- Because rotation reverses in the direction opposite to the OT direction upon OT detection to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation, secure homing is realized. The reverse rotation after OT detection follows (2) OT reference homing profile.

The motion proceeds in the following procedure.

(1) The motion starts at the rising edge (OFF → ON) of homing [ORG] in the direction opposite to the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(2) If the home position LS (PA2_12) is detected during travel by the reverse traveling unit amount for homing (PA2_09), the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(3) Upon detection of the first encoder Z-phase (PA2_11) after detection of the home position LS (PA2_12) during travel in the homing direction after reference signal detection (PA2_10), a travel continues by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.



- At the direction of rotation switch rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

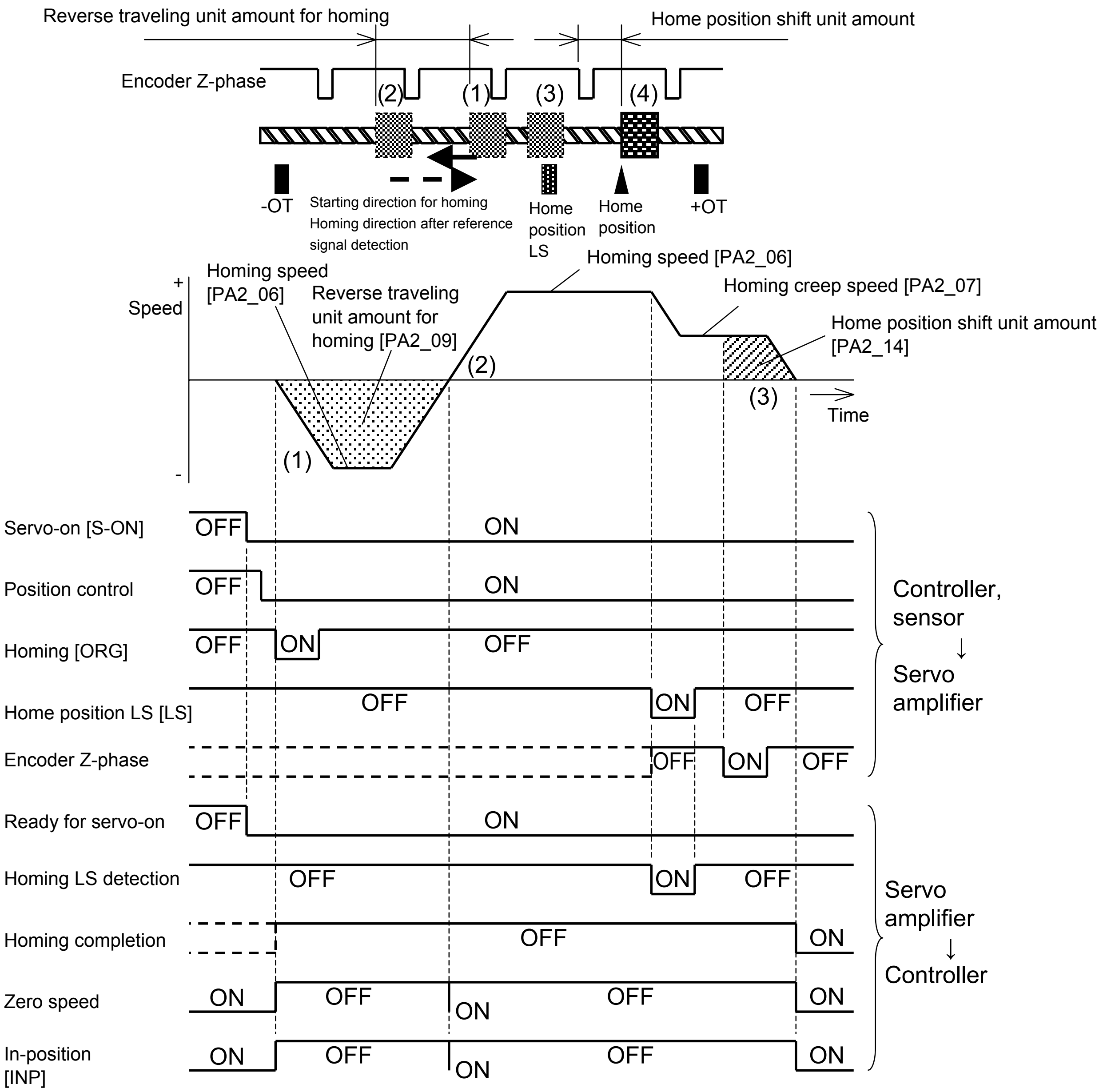
If the home position LS (PA2_12) is not found during travel from the homing starting position in the reverse traveling unit amount for homing (PA2_09), the motion continues in the starting direction for homing to search for the home position LS (PA2_12).

(1) The motion starts at the rising edge (OFF → ON) of homing [ORG] in the direction opposite to the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(2) If the home position LS (PA2_12) is not found during travel by the reverse traveling unit amount for homing (PA2_09), the motion changes in the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(3) If the home position LS (PA2_12, PA2_13) is detected, the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(4) Upon detection of the first encoder Z-phase (PA2_11) after detection of the home position LS (PA2_12) during travel in the homing direction after reference signal detection, a travel continues by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.



- At the rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

If the home position LS (PA2_12) is not found during travel from the homing starting position in the reverse traveling unit amount for homing (PA2_09), the motion changes in the starting direction for homing and the home position LS (PA2_12) is searched for. If the home position LS (PA2_12) is not found during the motion in the starting direction for homing until OT in the starting direction for homing is detected, the motion reverses and the reference signal for homing (Deceleration starting signal) and reference signal for shift operation are searched for.

(1) The motion starts upon at the rising edge (OFF → ON) of homing [ORG] in the direction opposite to the starting direction for homing (PA2_08) at the homing speed (PA2_06).

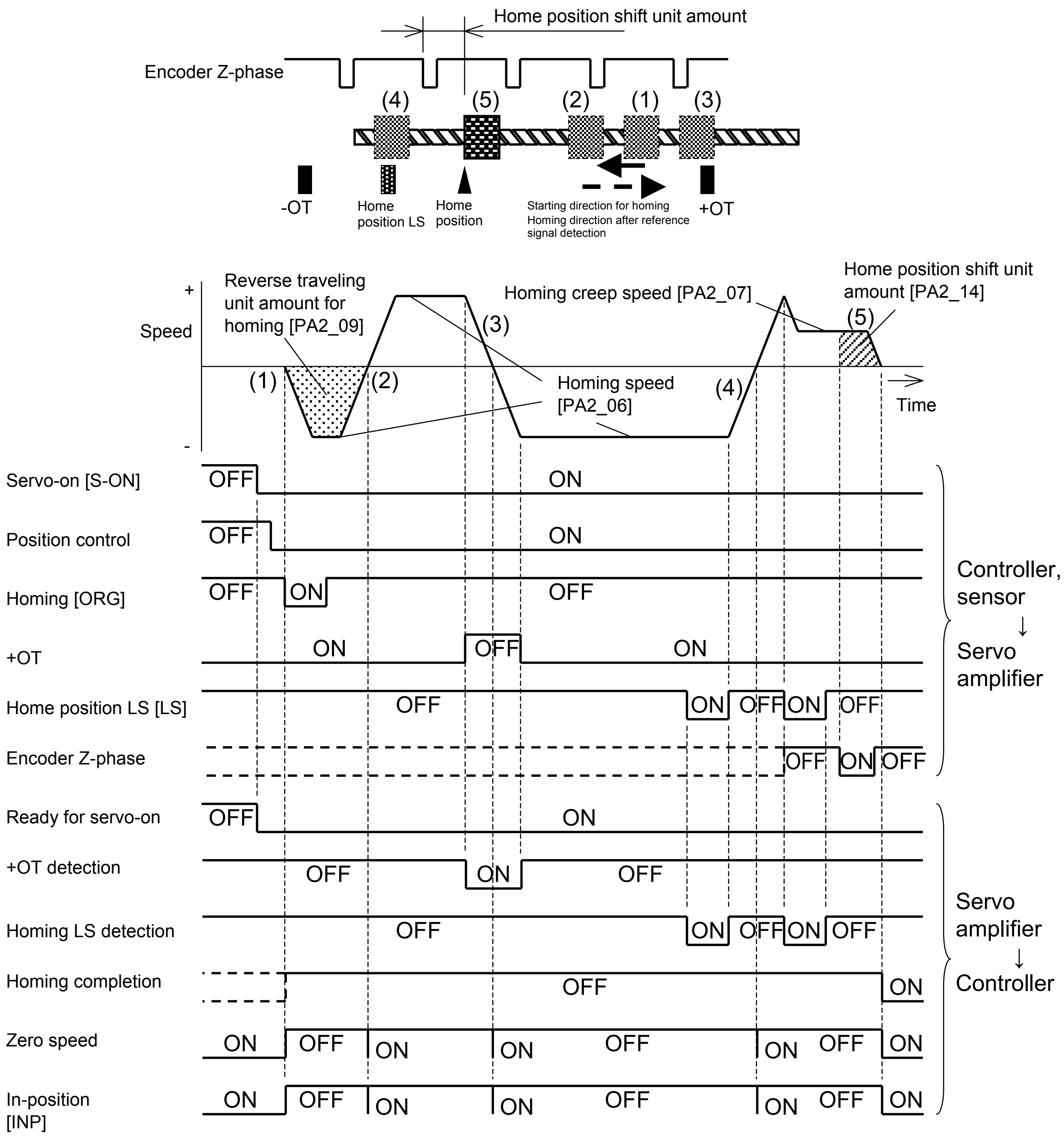
(2) If the home position LS (PA2_12) is not found during travel by the reverse traveling unit amount for homing (PA2_09), the motion changes in the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(3) If OT in the starting direction for homing (PA2_08) is found while the home position LS (PA2_12) is not found, the motion reverses at the homing speed (PA2_06).

(4) If the home position LS (PA2_12) is found during reverse rotation, the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(5) Upon detection of the first encoder Z-phase (PA2_11) after detection of the home position LS (PA2_12) during travel in the homing direction after reference signal detection (PA2_10), a travel by the home position shift unit amount (PA2_14) continues, followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.

4



Home position shift unit amount
Encoder Z-phase
(4) (5) (2) (1) (3)
-OT
Home position LS
Home position
Starting direction for homing
Homing direction after reference signal detection
+OT
Reverse traveling unit amount for homing [PA2_09]
Homing creep speed [PA2_07]
Home position shift unit amount [PA2_14]
Speed
Homing speed [PA2_06]
Time
Servo-on [S-ON]
Position control
Homing [ORG]
+OT
Home position LS [LS]
Encoder Z-phase
Ready for servo-on
+OT detection
Homing LS detection
Homing completion
Zero speed
In-position [INP]
OFF
ON
Controller, sensor
↓
Servo amplifier
Servo amplifier
↓
Controller

(4) Reference signal for shift operation homing profile (equivalent to homing profile 4 of FALDIC-α Series)

Upon detection of a reference signal for shift operation after the start of homing, the motion reverses to the point ahead of the reference signal for shift operation, and then the motion continues at the creep speed for homing to detect the reference signal for shift operation and determine the home position.
Accurate homing (highly reproducible zero position) is realized only with the reference signal for shift operation without using the reference signal for homing (deceleration starting signal).

[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	0: Forward	0	Power
09	Reverse traveling unit amount for homing	0 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for shift operation	0: Home position LS	1	Power
12	Reference signal for homing (Deceleration starting signal)	3: None	0	Power
13	Home position LS signal edge selection	0: Rising edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	1: Reverse rotation enable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
18	Deceleration time at OT during homing	100.0 [ms]	100.0	Always
24	Selection of operation at OT during homing	0: Reverse rotation	0	Power

- Because rotation reverses in the direction opposite to the OT direction upon OT detection to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation, homing can be secured. The reverse rotation after OT detection follows (2) OT reference homing profile.

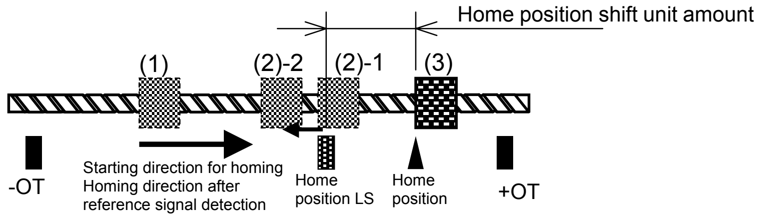
4

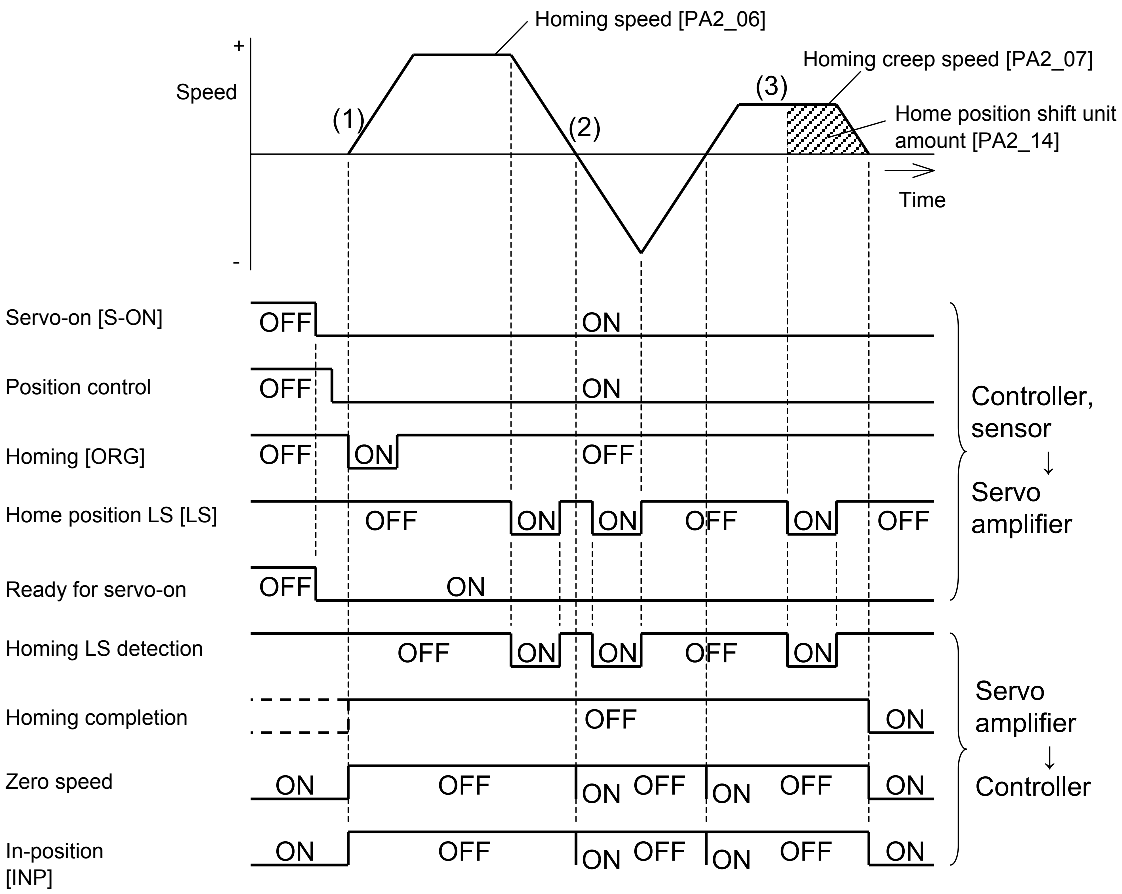
The motion proceeds in the following procedure.

(1) The motion starts at the rising edge (OFF → ON) of homing [ORG] in the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(2) Upon detection of the home position LS (PA2_12, PA2_13), the motion reverses in the direction opposite to the homing direction after reference signal detection (PA2_10) to the point ahead of the home position LS (PA2_12).

(3) The motion changes in the homing direction after reference signal detection (PA2_10) to detect the home position LS (PA2_12, PA2_13), and it changes to the creep speed for homing (PA2_07) by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.





- At the rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

(5) At-start reverse rotation homing profile2

The motion occurs in the direction opposite to the homing direction after reference signal detection (direction of home position when viewed from the reference signal for homing) to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation. This profile is used if the machine stopping position is larger than the reference signal for homing or reference signal for homing.

[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	1: Reverse	0	Power
09	Reverse traveling unit amount for homing	0 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for homing	1: Encoder Z-phase	1	Power
12	Reference signal for homing	0: Home position LS	0	Power
13	Home position LS signal edge selection	0: Rising edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation disable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
18	Deceleration time at OT during homing	100.0 [ms]	100.0	Always
24	Selection of operation at OT during homing	0: Reverse rotation	0	Power

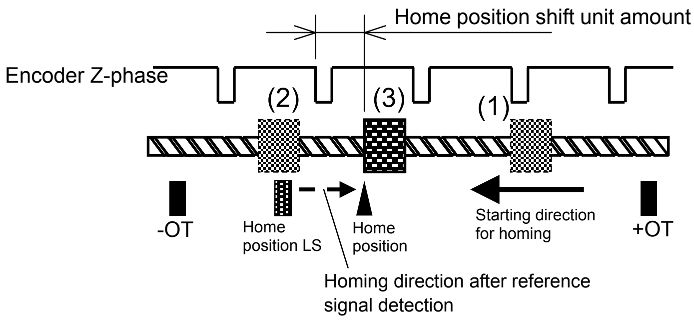
- Because rotation reverses in the direction opposite to the OT direction upon OT detection to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation, secure homing is realized. The reverse rotation after OT detection follows (2) OT reference homing profile.
- The direction of movement is defined as follows.
  Forward: direction of position increase Reverse: direction of position decrease.

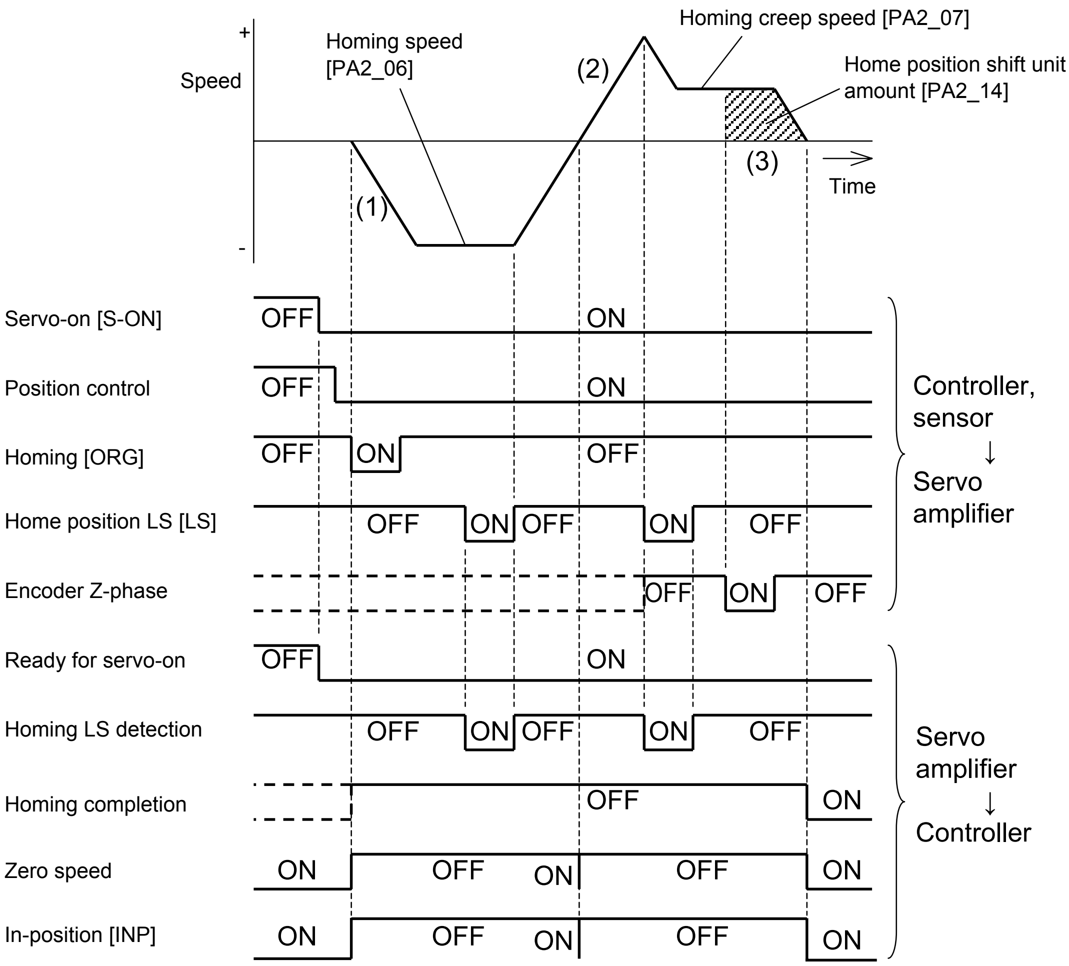
The motion proceeds in the following procedure.

(1) The motion starts at the rising edge (OFF → ON) of homing [ORG] in the starting direction for homing (PA2_08; direction opposite to homing direction after reference signal detection in this case) at the homing speed (PA2_06).

(2) Upon detection of the home position LS (PA2_12, PA2_13), the motion changes in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(3) Upon detection of the first encoder Z-phase (PA2_11) after detection of the home position LS (PA2_12), the travel continues by the home position shift unit amount (PA2_14), followed by stoppage. The stopping point changes to the home position and homing completion is turned on and the homing process is finished.



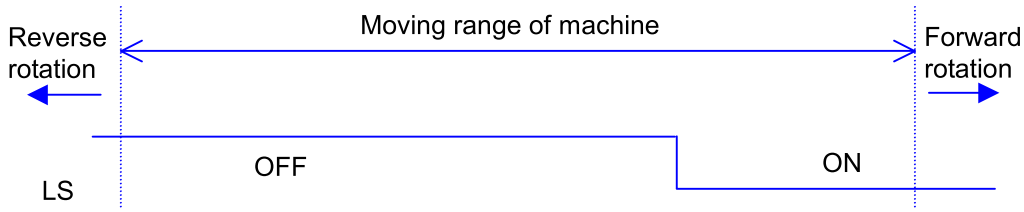


- At the rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

(6) Homing profile without using OT

Below is an example of the setting for returning to the home position with the home position LS signal without the OT signal. Use this profile for mechanical configurations where one of directions of the moving part of the mechanical system is turned on with the home position LS signal as shown in the figure below. The starting direction for homing is automatically determined according to the setting of PA2_10 (homing direction after reference signal detection) and the ON/OFF state of the home position LS at which return begins.

[An example of relationship between moving range of machine and home position LS]



[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	6: Extension mode	0	Power

PA2_

No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	2: Condition judgment start	0	Power
09	Reverse traveling unit amount for homing	0 [unit amount]	0	Always
10	Homing direction after reference signal detection	0: Forward direction	0	Power
11	Reference signal for shift operation	1: Z-phase of encoder	1	Power
12	Reference signal for homing (Deceleration starting signal)	0: Home position LS	0	Power
13	Home position LS signal edge selection	0: ON-edge detection	0	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
15	Deceleration operation for creep speed	1: Reverse rotation enable	0	Power
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always

- PA2_13: Home position LS signal edge selection indicates selection of the edge of the home position LS corresponding to the direction of homing.

If PA2_08 is set at “2,” use of the home position LS is assumed. Accordingly the following conditions are included in combination conditions.

PA2_11 (Reference signal for shift operation) = 0 (home position LS) or

PA2_11 (Reference signal for shift operation) = 1 (encoder Z-phase) and PA2_12 (reference signal for homing) = 0 (home position LS)

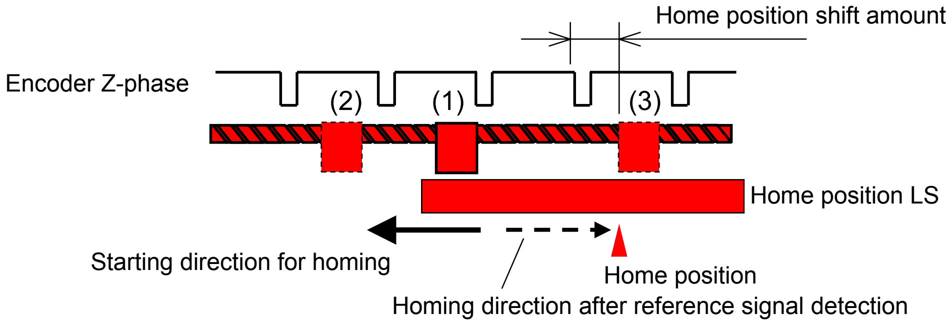
If PA2_08 = “2” and neither of the above conditions is satisfied, the starting direction for homing follows the setting of PA2_10 (homing direction after reference signal detection). If PA2_08 is set at “2,” PA2_09 (reverse traveling unit amount for homing) is internally handled as zero forcibly.

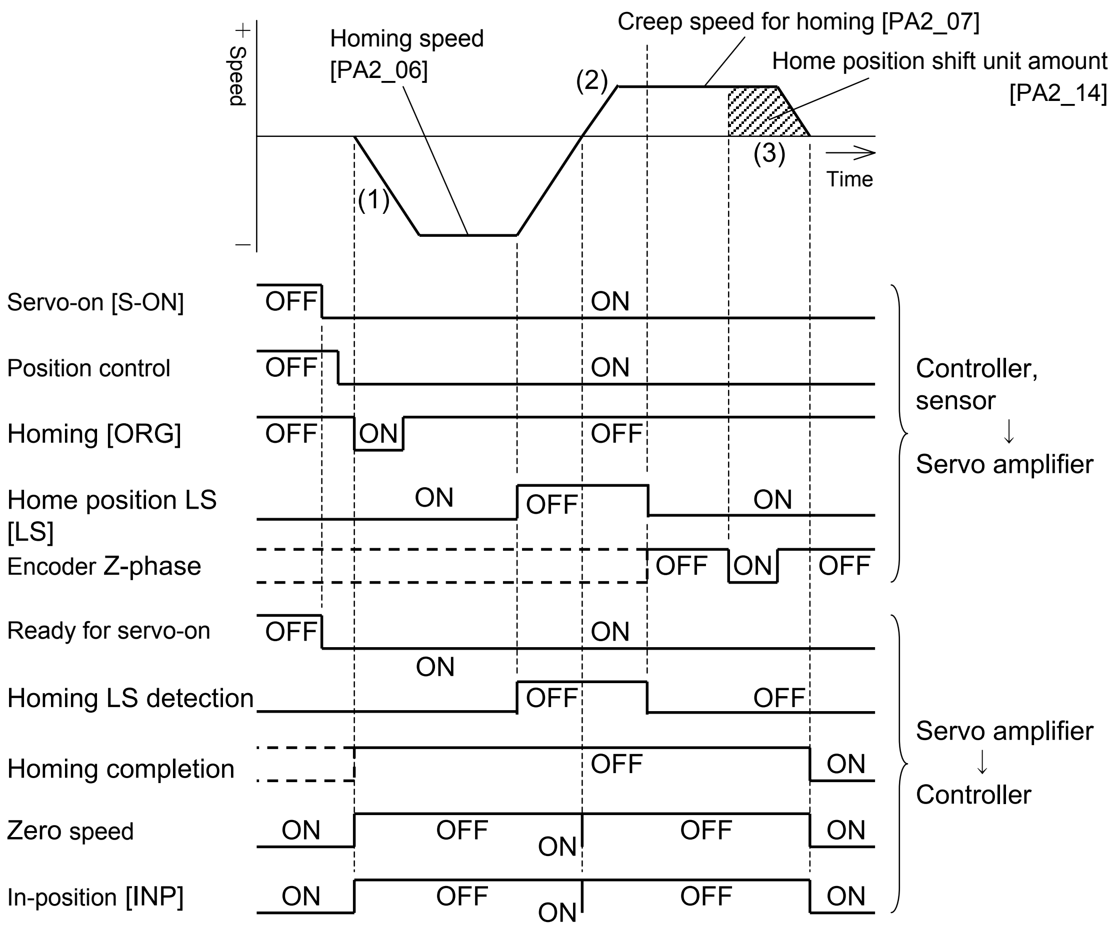
Operation proceeds in the following order.

(1) Condition judgment start is made upon the rising edge (OFF-to-ON transition) of homing [ORG] in the reverse rotation direction at the zero return speed (PA2_06).

(2) Upon deactivation of home position LS (PA2_12, PA2_13), movement is temporarily stopped, then continues in the homing direction after reference signal detection (PA2_10) at the creep speed for homing (PA2_07).

(3) The travel continues by the home position shift unit amount (PA2_14) after the first encoder Z-phase (PA2_11) is detected since the home position LS (PA_12) is detected, followed by stoppage. The stopping point changes to the home position and homing completion is turned on, finishing the homing process.

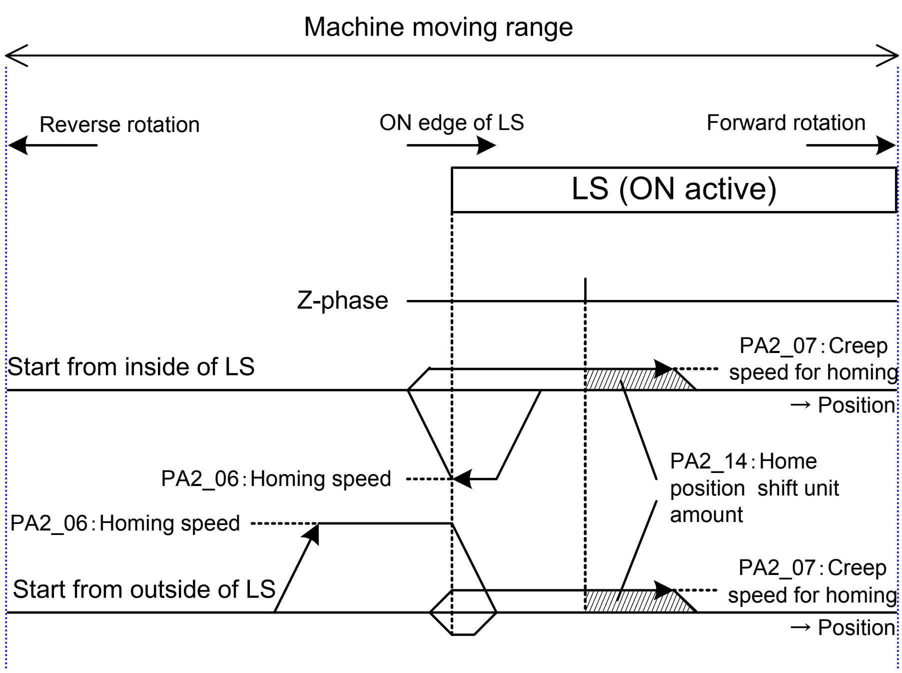




- Zero speed and in-position [INP] are temporarily turned on when the speed is reduced to zero at changeover of the direction of rotation. Signal transition may not be detected according to some scanning frequencies of the host controller.

- **[Supplement] Operation example showing the machine position in lateral direction**
  [Homing starting after LS activation]
  (1) A travel in the reverse direction starts at the homing speed (PA2_06).
  (2) When the falling edge (ON-to-OFF transition) of the zero LS is detected, reverse rotation continues to decelerate to the creep speed for homing (PA2_07).
  (3) When the first encoder Z-phase (PA2_11) is detected after the rising edge (OFF-to-ON transition) of the home position LS is detected, a travel is made by the home position shift unit amount (PA2_14), followed by stoppage.

  [Homing starting after LS deactivation]
  (1) A travel in the forward direction starts at the homing speed (PA2_06).
  (2) Because the deceleration operation for creep speed (PA2_15) is set at “1” (reverse rotation enable), reverse rotation is made upon detection of the rising edge (OFF-to-ON transition) of the home position LS while decelerating to the creep speed for homing (PA2_07).
  (3) Changeover to forward rotation is made again upon detection of the falling edge (ON-to-OFF transition) of the home position LS.
  (4) When the first encoder Z-phase (PA2_11) is detected after the rising edge (OFF-to-ON transition) of the home position LS is detected, a travel is made by the home position shift unit amount (PA2_14), followed by stoppage.



4

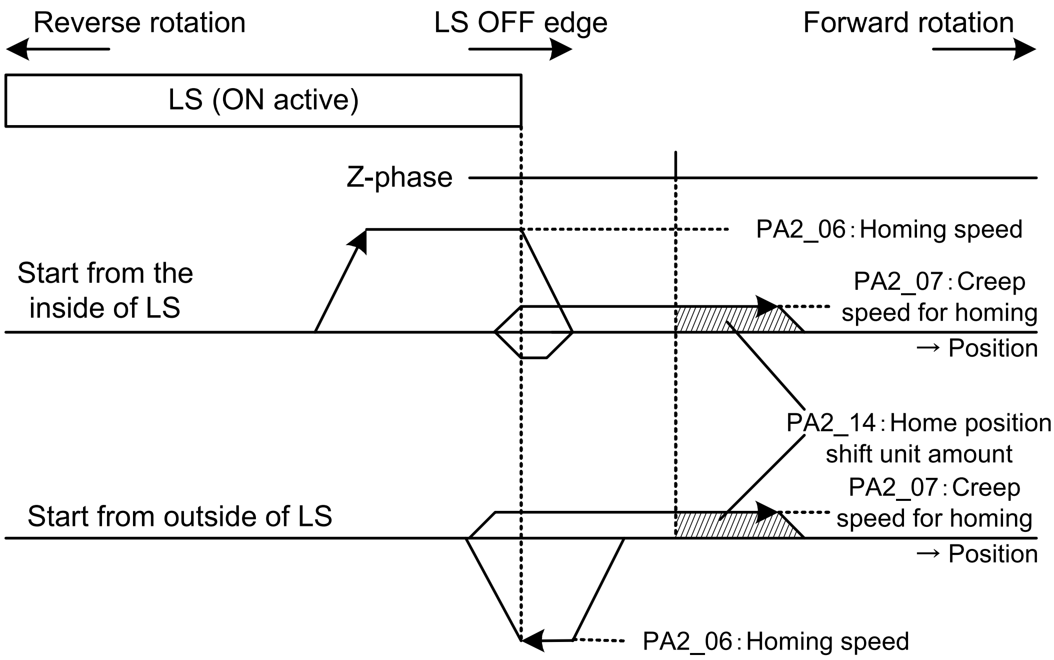
- Operation example at parameter setting change
  Operation examples after a parameter change necessitated due to the position, etc. of the home position LS (see Table a for the setting example) are shown in Figs. a to c.

Table a

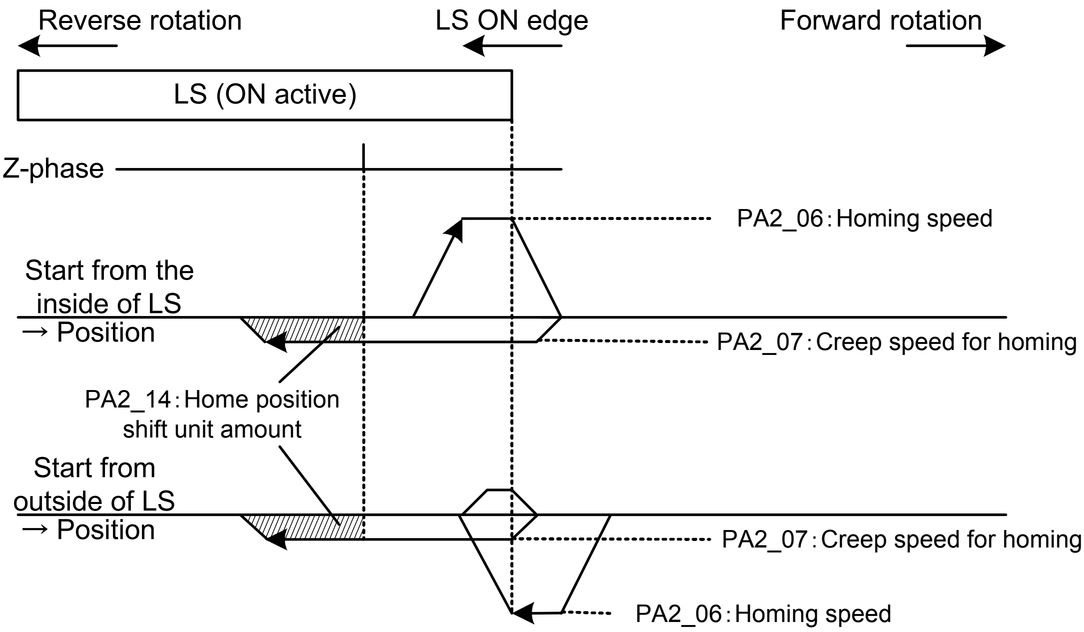
No.	Name	Setting example of Fig. a	Setting example of Fig. b	Setting example of Fig. c
PA2_08	Starting direction for homing	2:Condition judgment start		
PA2_10	Homing direction after reference signal detection	0:Forward rotation	1:Reverse rotation	
PA2_11	Reference signal for shift operation	1:Encoder Z-phase		
PA2_12	Reference signal for homing (Deceleration starting signal)	0:Home position LS		
PA2_13	Home position LS signal edge selection	1:OFF edge	0:ON edge	1:OFF edge
PA2_15	Deceleration operation for creep speed	1:Reverse rotation enable		

Figs. a through c assume that the machine position is in the lateral direction.

[Fig. a]

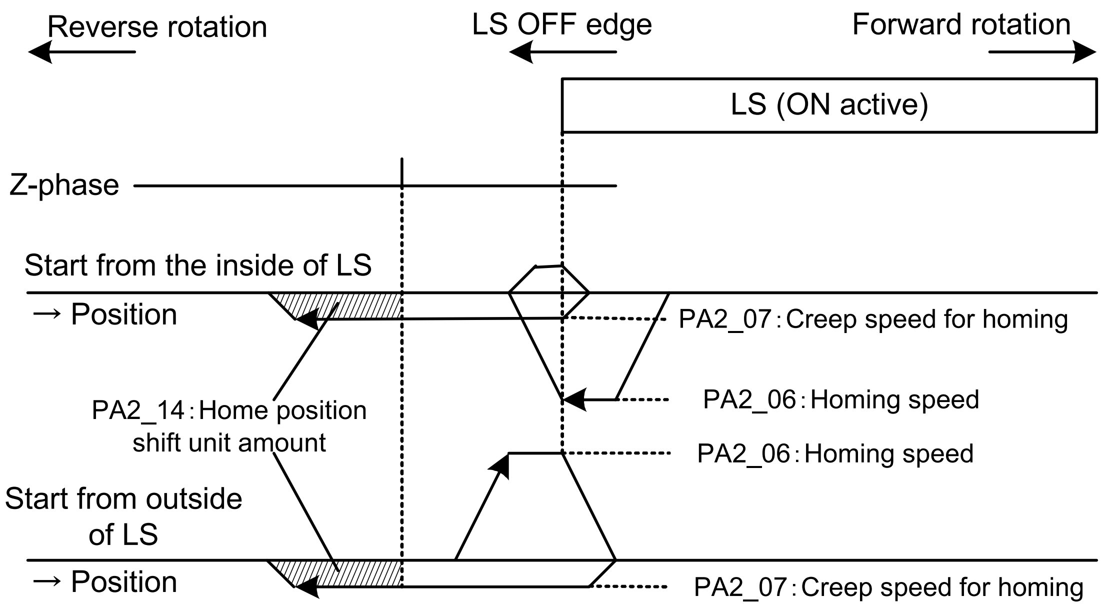


[Fig. b]



Reverse rotation
LS ON edge
Forward rotation
LS (ON active)
Z-phase
PA2_06 : Homing speed
Start from the inside of LS
→ Position
PA2_07 : Creep speed for homing
PA2_14 : Home position shift unit amount
Start from outside of LS
→ Position
PA2_07 : Creep speed for homing
PA2_06 : Homing speed

[Fig. c]



Reverse rotation
LS OFF edge
Forward rotation
LS (ON active)
Z-phase
Start from the inside of LS
→ Position
PA2_07 : Creep speed for homing
PA2_06 : Homing speed
PA2_14 : Home position shift unit amount
PA2_06 : Homing speed
Start from outside of LS
→ Position
PA2_07 : Creep speed for homing

(7) Homing pattern using the stopper

[Parameter setting example]

PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	7: Positioning operation	0	Power

PA2_

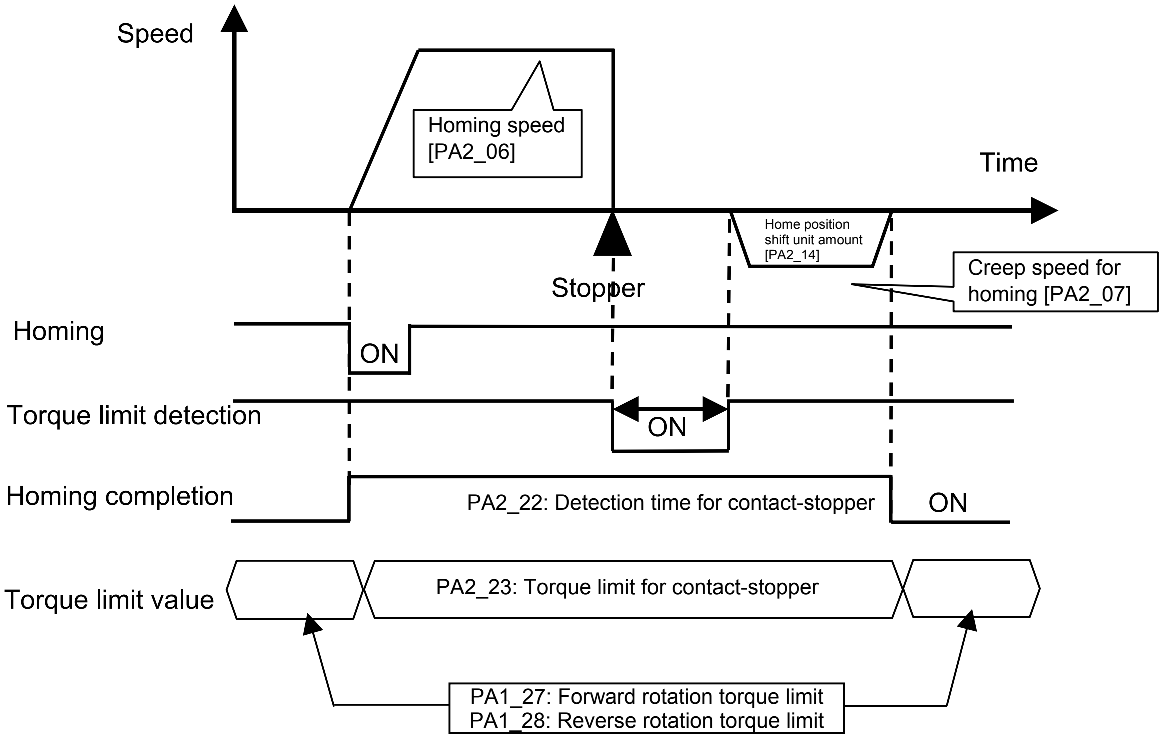
No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
10	Homing direction after reference signal detection	0: Forward	0	Power
11	Reference signal for shift operation	5: Stopper	1	Power
14	Home position shift unit amount	1000 [unit amount]	1000	Always
16	Home position after homing completion	0 [unit amount]	0	Always
17	Home position detection range	0: Always ON after homing completion	0	Always
22	Detection time for contact-stopper	50 [ms]	0	Always
23	Torque limit for contact-stopper	30 [%]	0	Always

- Select “5” (stopper) for the home position shift amount reference signal (PA2_11). Be sure to enter the output torque generated upon contact with the stopper, as a torque limit for contact-stopper (PA2_23), and enter the time between contact with the stopper and completion of homing as a Detection time for contact-stopper (PA2_22).

  (i) If the home position sift amount (PA2_14) is zero, homing is finished at the stopping position after the detection time for contact-stopper.

  (ii) If the home position shift amount (PA2_14) is other than zero, the motor moves by the home position shift amount from the stopping position after the detection time for contact-stopper in the reverse direction to the dead stop, and homing is finished there.

Timing chart



(1) The activating edge of the homing signal starts operation at the homing speed (PA2_06) in the homing starting direction (PA2_10).

(2) Upon contact with the stopper or the like, the motor is stopped and the output torque is limited to the torque limit for contact-stopper (PA2_23).
After limitation is set in the output torque, the detection time for contact-stopper (PA2_22) is counted for the specified time, then a return is caused by the home position shift amount (PA2_14), and homing is finished.
If the home position shift amount is zero, homing is finished at the contact position.

PA2_19 Preset position

No.	Name	Setting range	Default value	Change
19	Preset position	-2000000000 to 2000000000 [unit amount]	0	Always

Specify the new position to be substituted with the current position upon an input signal ("position preset (16)" assigned to a CONT signal). After position preset is turned on, the current position changes to the reference value of this parameter.

PA2_20 Interrupt traveling unit amount

No.	Name	Setting range	Default value	Change
20	Interrupt traveling unit amount	1 to 2000000000 [unit amount]	100000	Always

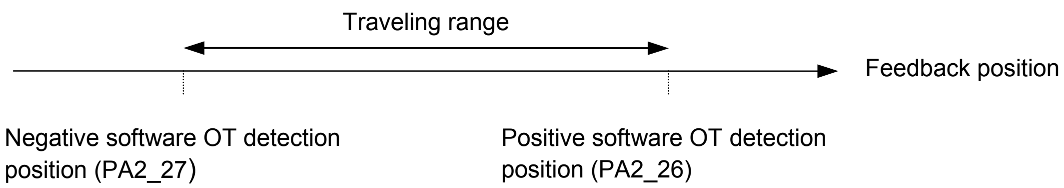
Specify to perform interrupt positioning.
Specify the traveling amount based on the position located at the timing of activation of an input signal ("interrupt input (49)" assigned to CONT signal).

PA2_25 to 27 Software OT selection･position command format, software OT detection position

No.	Name	Setting range	Default value	Change
25	Software OT selection (PA1_01 = 1 to 6)	0: Disable 1: Enable	0	Power
	Position command format (PA1_01 = 7)	0: Normal PTP 1: Non-overflow		
26	Positive software OT detection position	-2000000000 to 2000000000 [unit amount]	2000000000	Always
27	Negative software OT detection position	-2000000000 to 2000000000 [unit amount]	-2000000000	Always

(1) Software OT selection.

Forced stop is caused, different from +OT or -OT external input signal, if the servomotor position exceeds the reference value.
Enter settings so that + software OT detection position is larger than - software OT detection position.



(2) Position command format

Normal PTP: Motion is conducted in the range from -2000000000 to 2000000000 [unit amount]. Absolute/incremental positioning data designation and various position detection functions can be used.

Non-overflow: Repetitive rotation in the same direction can be made.
The position is preset at the start, and all position data is handled as an incremental value. The OT function, software OT and hardware OT functions allocated to input signals are disabled.

PA2_28 to 29 Limiter detection position

No.	Name	Setting range	Default value	Change
28	Positive limiter detection position	-2000000000 to 2000000000 [unit amount]	2000000000	Always
29	Negative limiter detection position		-2000000000	

Enter the position of the limiter detection function.

While each setting can be positive or negative, the setting of PA2_28 must not be smaller than the setting of PA2_29.

For detail description of limiter detection, refer to “CHAPTER 2 WIRING.”

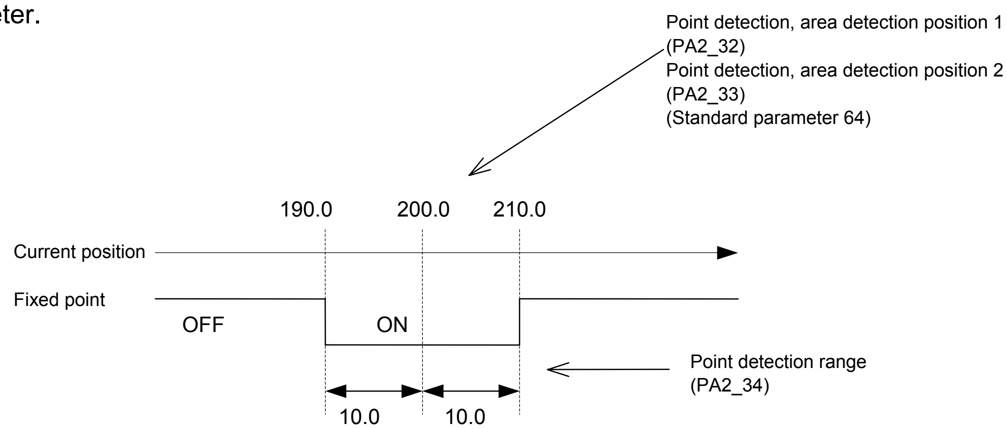
PA2_31 to 34 Point detection, area settings

No.	Name	Setting range	Default value	Change
31	Point detection, area detection	0: Fixed point 1: Passing point OFF/ON 2: Passing point ON/OFF	0	Always
32	Point detection, area detection position 1	-2000000000 to 2000000000 [unit amount]	0	Always
33	Point detection, area detection position 2	-2000000000 to 2000000000 [unit amount]	0	Always
34	Point detection range	0 to 2000000000 [unit amount]	100	Always

Specify the output format of the "point detection, area detection" signal that is output as an output signal (OUT signal).
In case of point detection setting, the signal is output if the servomotor is located nearly in the reference value (point detection range)
In case of area setting, the signal is turned on or off if the servomotor position exceeds the reference value.

(1) Point detection (If PA2_31 (point detection, area detection) is 0)

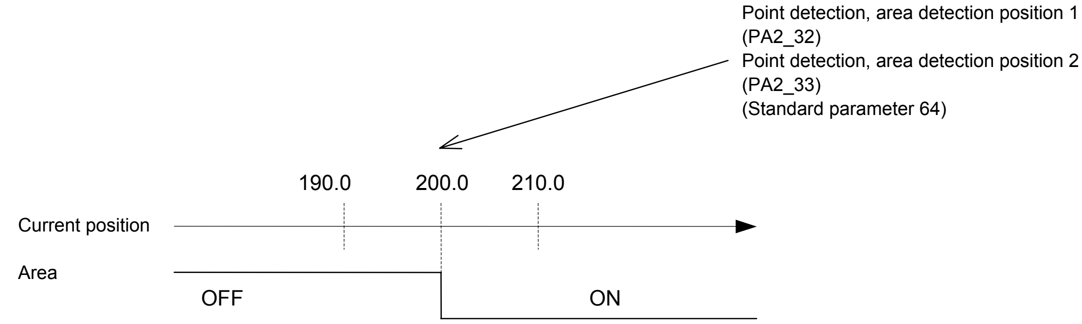
The signal is turned on if the current position is nearly the position specified in the standard parameter.



(2)　Area OFF → ON (If PA2_31 (point detection, area detection) is 1)

The signal is turned on if the current position is exactly or larger than the setting of the standard parameter.

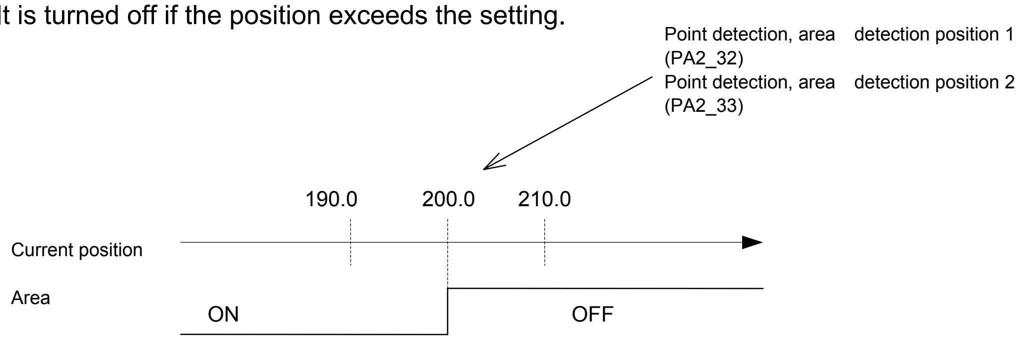
It is turned off if the position is less than the setting.



(3)　Area ON → OFF (If PA2_31 (point detection, area detection) is 2)

The signal is turned on if the current position is exactly or less than the setting of the standard parameter.

It is turned off if the position exceeds the setting.



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PA2_36 to 39 Override settings

No.	Name	Setting range	Default value	Change
36	Override 1	0 [%] to 150 [%]	10	Always
37	Override 2		20	Always
38	Override 4		40	Always
39	Override 8		80	Always

These parameters are enabled under speed and position control.
To use these signals, be sure to turn on "override enable."
With this setting, the speed can be changed during operation. For the weight of the override, refer to the table below.

Ratio of override

Override 8	Override 4	Override 2	Override 1	Traveling speed %
OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	ON	10
OFF	OFF	ON	OFF	20
OFF	OFF	ON	ON	30
OFF	ON	OFF	OFF	40
OFF	ON	OFF	ON	50
OFF	ON	ON	OFF	60
OFF	ON	ON	ON	70
ON	OFF	OFF	OFF	80
ON	OFF	OFF	ON	90
ON	OFF	ON	OFF	100
ON	OFF	ON	ON	110
ON	ON	OFF	OFF	120
ON	ON	OFF	ON	130
ON	ON	ON	OFF	140
ON	ON	ON	ON	150

* For default override weight

PA2_40 Internal positioning data selection

No.	Name	Setting range	Default value	Change
40	Internal positioning data selection	0: Disable 1: Enable	10	Power

Select whether the internal positioning data is enabled or disabled.

Setting “0”: Immediate value data operation over RS-485 Modbus communications

Setting “1”: Positioning data operation with address settings AD0 to AD3

PA2_41 Sequential start selection

No.	Name	Setting range	Default value	Change
41	Sequential start selection	0: Disable 1: Enable 2: Homing	0	Power

Select whether sequential start is enabled or disabled.

If “1” is selected and AD0 through AD3 are inactive, sequential start operation is conducted.

For details of sequential start, refer to “CHAPTER 12 POSITIONING DATA”

If “2” is selected and AD0 through AD3 are inactive, homing is conducted.

PA2_42 Decimal point position of stand still timer

No.	Name	Setting range	Default value	Change
42	Decimal point position of stand still timer	0: 0.01 1: 0.001	0	Always

Select the least input increment of the stand still timer.

Selection can be made between 1 [ms] and 10 [ms].

PA2_43 Output selection at M code OFF

No.	Name	Setting range	Default value	Change
43	Output selection at M code OFF	0: 00‘H 1: FF’H	1	Power

Select the output signal status at M code shutoff.
For details of the M code, refer to “CHAPTER 12 POSITIONING DATA”

4.5 Extended Function Setting Parameter

Note	Parameters marked "○" in the "Power" field are enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.5.1 List (PA2_□□)

4

No. PA2_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
51	Numerator 1 of electronic gear ratio	1	–	○	–	–	
52	Numerator 2 of electronic gear ratio						
53	Numerator 3 of electronic gear ratio						
54	Command pulse ratio 1	1.00	–	○	–	–	
55	Command pulse ratio 2	10.00	–	○	–	–	
56	Speed limit selection at torque control	0	○	–	–	○	
57	Torque limit selection	0	○	○	○	–	
58	Second torque limit	300	–	○	○	–	
59	Deviation hold selection at torque limit	0	○	○	–	–	
60	Third torque limit	300	–	○	○	–	
61	Action sequence at servo-on OFF	5	○	○	○	○	
62	Action sequence at alarm	0	○	○	○	○	
63	Action sequence at main power shutoff	0	○	○	○	○	
64	Torque keeping time to holding brake	0.00	–	○	○	○	
65	Braking resistor selection	1	○	○	○	○	
66	Flying start at speed control	0	○	–	○	–	
67	Alarm detection at undervoltage	1	○	○	○	○	
68	Main power shutoff detection time	35	○	○	○	○	
69	Deviation detection overflow value	15.0	–	○	–	–	
70	Overload warning value	50	–	○	○	○	
72	Station number	1 (RS-485)	○	○	○	○	
73	Communication baud rate (RS-485)	0	○	○	○	○	
74	Parameter write protection	0	–	○	○	○	
75	Positioning data write protection	0	–	○	–	–	
77	Initial display of the keypad	0	○	○	○	○	
78	Display transition at warning detection	0	○	○	○	○	
80	Parameter in RAM 1	0	○	○	○	○	
81	Parameter in RAM 2						
82	Parameter in RAM 3						
83	Parameter in RAM 4						
84	Parameter in RAM 5						
85	Parameter in RAM 6						
86	Positioning data in RAM 1	0	○	○	–	–	
87	Positioning data in RAM 2	0	○	○	–	–	
88	Positioning data in RAM 3	0	○	○	–	–	
89	Sequence test mode: mode selection	0	○	○	○	○	

No. PA2_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
90	Sequence test mode: encoder selection	0	○	○	○	○	
93	Parity/stop bit selection (for Modbus)	0	○	○	–	–	
94	Response time (for Modbus)	0.00	–	○	–	–	
95	Communication time over time (for Modbus)	0	–	○	–	–	
97	Communication protocol selection	0	–	○	–	–	

Parameters marked ○ in the table are enabled in the corresponding control mode.

4.5.2 Description of Each Parameter

4

PA2_51 to 53 Electronic gear ratio numerator 1, 2, 3

No.	Name	Setting range	Default value	Change
51	Numerator 1 of electronic gear ratio 1	1 to 4194304	1	Always
52	Numerator 1 of electronic gear ratio 2			
53	Numerator 1 of electronic gear ratio 3			

Specify the electronic gear ratio, using the input signal ("electronic gear numerator selection 0, 1" assigned to CONT signal).

Electronic gear numerator selection 1	Electronic gear numerator selection 0	Numerator of electronic gear
OFF	OFF	PA1_6 Basic setting
OFF	ON	PA2_51 Extended function setting
ON	OFF	PA2_52 Extended function setting
ON	ON	PA2_53 Extended function setting

Do not change the electronic gear ratio in case of interrupt positioning or homing.

PA2_54 and 55 Command pulse ratio 1, 2

No.	Name	Setting range	Default value	Change
54	Command pulse ratio 1	0.01 to 100.00	1.00	Always
55	Command pulse ratio 2		10.00	

Specify the multiplication of the command pulse.
The reference value selected with an input signal ("command pulse ratio 1, 2" assigned to a CONT signal) is enabled.

PA2_56 Speed limit selection at torque control

No.	Name	Setting range	Default value	Change
56	Speed limit selection at torque control	0: Parameter 1: Multi-step speed selection, VREF terminal voltage	0	Power

Select the method of setting limitation on the speed under torque control.
If the setting is 0, the reference value of PA1_26 (maximum rotation speed) is the speed limit.
If the setting is 1, the limit is shown in the table below.

CONT INPUT SIGNAL			Enabled speed limit
X3	X2	X1	
OFF	OFF	OFF	VREF terminal voltage (analog speed limit)
OFF	OFF	ON	Speed limit 1 under torque control
OFF	ON	OFF	Speed limit 2 under torque control
OFF	ON	ON	Speed limit 3 under torque control
ON	OFF	OFF	Speed limit 4 under torque control
ON	OFF	ON	Speed limit 5 under torque control
ON	ON	OFF	Speed limit 6 under torque control
ON	ON	ON	Speed limit 7 under torque control

PA2_57 to 60 Torque limit settings

No.	Name	Setting range	Default value	Change
57	Torque limit selection	0: Torque limit 0,1 setting of CONT input 1:TREF	0	Power
58	Second torque limit	0 [%] to 300 [%]	300	Always
59	Deviation hold selection at torque limit	0: No deviation hold 1: Deviation hold at second torque limit 2: TREF	0	Power
60	Third torque limit	0 [%] to 300 [%]	300	Always

The enabled torque limit is described below.

(1) In case of position control and speed control (If PA2_57 is 0)

<table>
<tr><th colspan="2">CONT signal *</th><th>State of each limit</th><th colspan="2">Enabled torque limit</th></tr>
<tr><th>Torque limit 1</th><th>Torque limit 0</th><th>TL: TREF (analog torque limit)</th><th>CCW: Powering, CW: Regeneration</th><th>CW: Powering, CCW: Regeneration</th></tr>
<tr><td>OFF</td><td>OFF</td><td>No condition judgment</td><td>Forward rotation torque limit</td><td>Reverse rotation torque limit</td></tr>
<tr><td rowspan="2">OFF</td><td rowspan="2">ON</td><td>TL ≥ Forward/Reverse rotation torque limit</td><td>Forward rotation torque limit</td><td>Reverse rotation torque limit</td></tr>
<tr><td>TL < Forward/reverse rotation torque limit</td><td>TL</td><td>TL</td></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">OFF</td><td>Second torque limit ≥ Forward/Reverse rotation torque limit</td><td>Forward rotation torque limit</td><td>Reverse rotation torque limit</td></tr>
<tr><td>Second torque limit < Forward/Reverse torque limit</td><td>Second torque limit</td><td>Second torque limit</td></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">ON</td><td>TL ≥ Second torque limit</td><td>Second torque limit</td><td>Second torque limit</td></tr>
<tr><td>TL < Second torque limit</td><td>TL</td><td>TL</td></tr>
</table>

Add a positive voltage to TL. The negative voltage is limited to zero.
A negative setting is limited to zero.
If PA2_57 is 1, the torque limit is always the TL value.

(2) In case of torque control

The forward rotation torque limit and reverse rotation torque limit are followed.

(3) Torque limit for controlled stop action (under position or speed control) (If PA2_57 is 0)

<table>
<tr><th colspan="2">CONT signal *</th><th>State of each limit</th><th colspan="2">Enabled torque limit</th></tr>
<tr><th>Torque limit 1</th><th>Torque limit 0</th><th>TL: TREF (analog torque limit)</th><th>CW deceleration stop</th><th>CCW deceleration stop</th></tr>
<tr><td rowspan="2">OFF</td><td rowspan="2">OFF</td><td>Forward rotation torque limit ≥ Third torque limit</td><td>Third torque limit</td><td>Third torque limit</td></tr>
<tr><td>Forward/Reverse rotation torque limit < Third torque limit</td><td>Forward rotation torque limit</td><td>Reverse rotation torque limit</td></tr>
<tr><td rowspan="2">OFF</td><td rowspan="2">ON</td><td>TL, forward/reverse torque limit ≥ Third torque limit</td><td>Third torque limit</td><td>Third torque limit</td></tr>
<tr><td>TL, forward/reverse torque limit < Third torque limit</td><td>TL or forward rotation torque limit, whichever is less</td><td>TL or reverse rotation torque limit, whichever is less</td></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">OFF</td><td>Second torque limit, forward/reverse rotation torque limit ≥ Third torque limit</td><td>Third torque limit</td><td>Third torque limit</td></tr>
<tr><td>Second torque limit, forward/reverse rotation torque limit < Third torque limit</td><td>Second torque limit or forward rotation torque, whichever is less</td><td>Second torque limit or reverse rotation torque, whichever is less</td></tr>
<tr><td rowspan="2">ON</td><td rowspan="2">ON</td><td>TL, second torque limit ≥ Third torque limit</td><td>Third torque limit</td><td>Third torque limit</td></tr>
<tr><td>TL, second torque limit < Third torque limit</td><td>TL or second torque limit, whichever is less</td><td>TL or second torque limit, whichever is less</td></tr>
</table>

If PA2_57 is 1, the torque limit is always the TL value.

(4) Third torque limit

This parameter is enabled under position or speed control.
The reference value of this parameter becomes the torque limit under the following conditions.

- Sudden controlled stop caused by servo-on (function No. 1) turned off
- Sudden controlled stop caused by forced stop (function No. 10) turned off
- Sudden controlled stop caused by ±OT (function No. 7, 8) turned off
- Controlled stop caused by minor failure alarm (If PA2_62 is 4 or 5)

(5) Deviation holds selection at torque limit

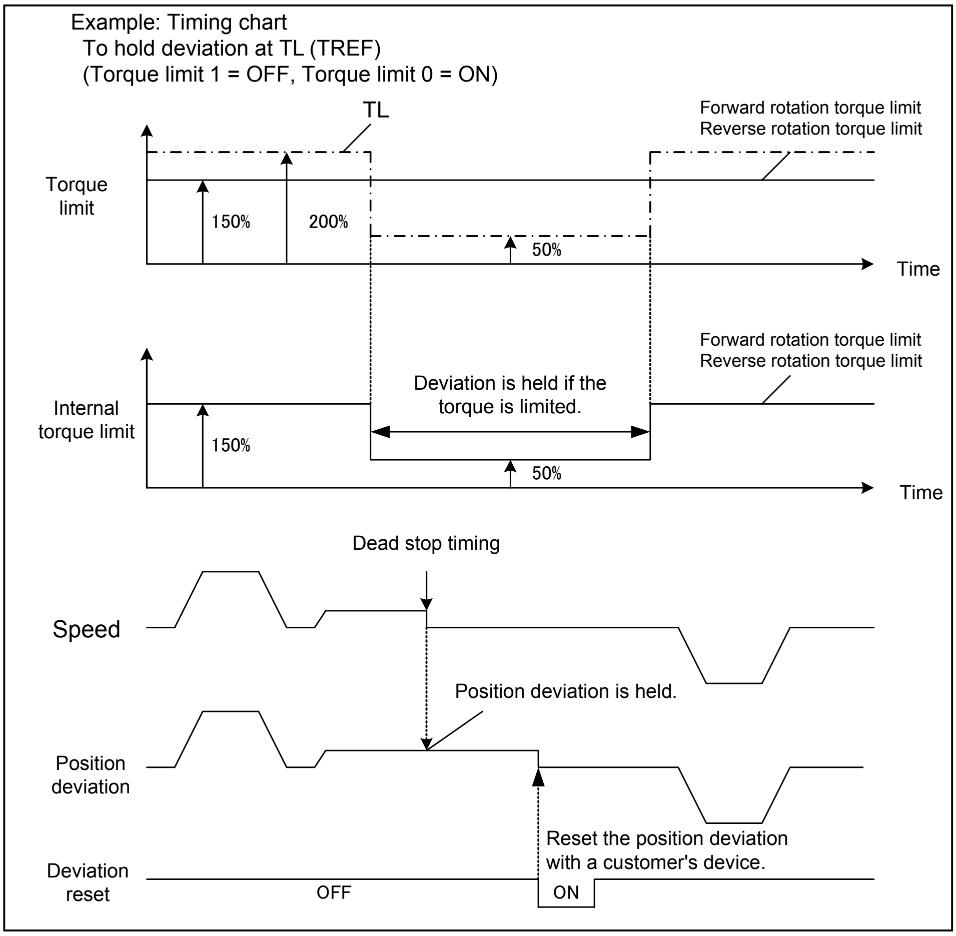
4

This parameter is enabled under position control.
If a motion is stopped at a dead stop, position deviation is held with this function. Position deviation is held so that the position deviation count does not reach the limit at the dead stop.
The function is enabled under the following conditions. (If PA2_57 is 0)

CONT signal *		P59 Deviation hold selection at torque limit	Torque limit for holding deviation
Torque limit 1	Torque limit 0		
OFF	OFF	-	None
OFF	ON	1: Second torque limit	None
		2: TREF	TL
ON	OFF	1: Second torque limit	Second torque limit
		2: TREF	None
ON	ON	1: Second torque limit	Second torque limit
		2: TREF	TL

If PA2_57 is 1 and PA2_59 is 2, TL is TREF.

[Reference example]



PA2_61 to 63 Action sequence settings

No.	Name	Setting range	Default value	Change
61	Action sequence at servo-on OFF	0: DB at deceleration, DB at stop 1: DB at deceleration, free-run at stop 2: Free-run at deceleration, DB at stop 3: Free-run at deceleration, free-run at stop 4: Emergency stop at deceleration /, DB at stop 5: Emergency stop at deceleration /, free-run at stop	5	Power
62	Action sequence at alarm	0: DB at deceleration, DB at stop 1: DB at deceleration, free-run at stop 2: Free-run at deceleration, DB at stop 3: Free-run at deceleration, free-run at stop 4: Emergency stop at deceleration / (*1), DB at stop 5: Emergency stop at deceleration / (*1), free-run at stop	0	Power
63	Action sequence at main power shutoff	0: DB at deceleration, DB at stop 1: DB at deceleration, free-run at stop 2: Free-run at deceleration, DB at stop 3: Free-run at deceleration, free-run at stop 4: Emergency stop at deceleration /, DB at stop 5: Emergency stop at deceleration /, free-run at stop	0	Power

(*1) DB causes deceleration upon serious failure alarm.
Specify the deceleration and stopping states for each condition as shown in the previous table.
- DB: Dynamic braking with short circuiting of three motor phases
  Use DB under the following conditions.
  - Frequency: Once in 10 min.
  - Number of times: Up to 1000 times.
- Sudden deceleration: Regenerative braking using braking resistor

PA2_64 Torque keeping time to holding brake

No.	Name	Setting range	Default value	Change
64	Torque keeping time to holding brake	0.00 [s] to 9.99 [s]	0.00	Always

Assign the "brake timing (function No. 14)" signal to the output signal.
The reference value of this parameter indicates the delay taken from shutoff of servo-on (function No. 1) CONT input signal to free-run.
Specify a time larger than the one taken from excitation of the brake to actual brake application.
The brake timing signal is turned off when servo-on is turned off.

PA2_65 Braking resistor selection

No.	Name	Setting range	Default value	Change
65	Braking resistor selection	0: None 1: Built-in resistor 2: External resistor	1	Power

Select the braking resistor.
If the reference value is 1, the temperature of the braking resistor is calculated inside the amplifier and monitored as a regenerative thermal value. 100 [%] indicates an overheated internal braking resistor (RH1).
To install an external braking resistor for elevator operation or high operation frequency, set at 2.
If the reference value is 2, connect the thermistor of the external resistor to the external braking resistor overheat (function No. 34).
Because of a normally closed contact, shutoff indicates an overheated external braking resistor (RH2).

PA2_66 Flying start at speed control

No.	Name	Setting range	Default value	Change
66	Flying start at speed control	0: No flying start 1: Flying start	0	Power

The parameter is enabled under speed control.
If servo-on is turned on during free-run operation, the speed at the timing is picked and acceleration begins at the speed.
If the control power of the servo amplifier is turned off, the dynamic brake is applied, causing sudden stop.
The speed at the timing of control power-on is not picked in this case.

PA2_67 Alarm detection at undervoltage

No.	Name	Setting range	Default value	Change
67	Alarm detection at undervoltage	0: No detection 1: Detection	1	Power

Select whether or not to detect alarms when undervoltage is detected.
The detected alarms include control power undervoltage and main power undervoltage.

PA2_68 Main power shutoff detection time

No.	Name	Setting range	Default value	Change
68	Main power shutoff detection time	35 [ms] to 1000 [ms]	35	Power

Specify the time for detecting shutoff of the main power. Power supply phases to be detected are L1 and L2.
The AC power is detected.
If power is restored after the time specified in this parameter since the main power is turned off with servo-on turned on, a main circuit power undervoltage alarm (LVP) is caused.
Avoid repeating turning on or off frequently in a short time.
However, if power is restored after the time specified in this parameter and 1 [s], no alarm is detected.
To supply DC power, set at 1000 [ms]. If this is the case, the detection function is canceled.
To supply AC power, leave the default value unchanged in regular cases.

PA2_69 Deviation detection overflow value

No.	Name	Setting range	Default value	Change
69	Deviation detection overflow value	0.1 [rev] to 100.0 [rev]	15.0	Always

Specify the value for detecting an "excessive deviation" alarm.
Enter the parameter in a rotation amount of the motor output shaft.

PA2_70 Overload warning value

No.	Name	Setting range	Default value	Change
70	Overload warning value	10 [%] to 100 [%]	50	Always

Specify the output level of the "overload warning (27) signal that is issued as an output signal (OUT signal).
Use the signal as a warning of an "overload (OL)" alarm.
Characteristics of the overload warning are specified in "CHAPTER 9 CHARACTERISTICS."

4

4

PA2_72 Station number

No.	Name	Setting range	Default value	Change
72	Station number	RS-485: 1 to 31	1	Power

Specify the station number of the amplifier.

- RS-485 type: Specify the station number of each station.

PA2_73 Communication baud rate (RS-485)

No.	Name	Setting range	Default value	Change
73	Communication baud rate (RS-485)	0: 38400 [bps] 1: 19200 [bps] 2: 9600 [bps]	0	Power

Specify the communication baud rate of the system combined over RS-485.

PA2_74 Parameter write protection

No.	Name	Setting range	Default value	Change
74	Parameter write protection	0: Write enable 1: Write protect	0	Always

Specify parameter write protection.
Enter "1" to prohibit parameter editing. Only this parameter can be changed.

PA2_75 Positioning data write protection

No.	Name	Setting range	Default value	Change
75	Positioning data write protection	0: Write enable 1: Write protect	0	Always

Specify positioning data write protection.
Enter "1" to prohibit positioning data editing.

PA2_77 Initial display of the keypad (Keypad)

No.	Name	Setting range	Default value	Change
77	Initial display of the keypad (Data displayed on keypad)	0: Sequence mode. 1: Feedback speed. 2: Command speed. 3: Command torque. 4: Motor current. 5: Peak torque. 6: Effective torque. 7: Feedback position. 8: Command position. 9: Position deviation. 10: Command pulse frequency. 11: Feedback cumulative pulse. 12: Command cumulative pulse. 13: LS-Z pulse. 14: Load inertia ratio. 15: DC link voltage (max.). 16: DC link voltage (min.). 17: VREF input voltage. 18: TREF input voltage. 19: Input signals. 20: Output signals. 21: OL thermal value. 22: Braking resistor thermal value. 23: Power (W). 24: Motor temperature. 25: Overshoot unit amount. 26: Settling time. 27: Resonance frequency 1. 28: Resonance frequency 2. 40: Station number. 41: Alarm at present. 42: Alarm history . 43: Warning at present. 44: Total time - main power supply. 45: Total time - control power supply. 46: Motor running time.	0	Power

Specify the data displayed on the keypad at the upper part of the front of the amplifier when the power is turned on.

PA2_78 Display transition at warning detection

No.	Name	Setting range	Default value	Change
78	Display transition at warning detection	0: No transition 1: Transition to warning	0	Power

Select whether or not a warning sign is displayed at the keypad on the front panel of the amplifier when a "cooling fan life expiration," "main circuit capacitor life expiration," or "low battery voltage" warning is detected.

If the replacement timing is drawing near after several years of operation, change this parameter to "1" to show a warning on the keypad in front of the servo amplifier.

If the battery voltage is low, the orange status indication LED blinks at 0.5[s] intervals without relations to the setting of this parameter.

4

PA2_80 to 85 Parameter in RAM 1 to 6

No.	Name	Setting range	Default value	Change
80	Parameter in RAM 1	0: No setting 1 to 299: Parameter No.	0	Power
81	Parameter in RAM 2			
82	Parameter in RAM 3			
83	Parameter in RAM 4			
84	Parameter in RAM 5			
85	Parameter in RAM 6			

If you change some parameters frequently, store them in RAM.
With this setting, you can change parameters infinitely.
Parameters that can be stored in RAM are those marked "Always" in the "Change" field.
The parameter stored in RAM is in the default value when the amplifier is turned on.
[Setting example] 1 to 99 = PA1_1 to 99, 101 to 199 = PA2_1 to 99, 201 to 299 = PA3_1 to 99

PA2_86 to 88 Positioning data in RAM 1 to 3

No.	Name	Setting range	Default value	Change
86	Positioning data in RAM1	0: No setting 1 to 15: Positioning data No.	0	Power
87	Positioning data in RAM2			
88	Positioning data in RAM3			

If you change positioning data frequently, store them in RAM.
With this setting, you can change positioning data infinitely.
The positioning data stored in RAM is in the default value when the amplifier is turned on.

PA2_89 and 90 Sequence test mode: Mode selection and encoder selection

No.	Name	Setting range	Default value	Change
89	Sequence test mode: Mode selection	0: Normal mode 1: Sequence test mode	0	Power
90	Sequence test mode: Encoder selection	0: 20 bits 1: 18 bits	0	Power

PA2_89 (sequence test mode):

Select 0 to start the sequence test mode from the PC Loader or keypad. Turn the power off then on again to return to the normal mode.
Specify the encoder bit according to the type of the servomotor.
"RB2" at the end of servomotor model: 20-bit encoder. "HB2": 18-bit encoder

PA2_89 (sequence test mode):

Select 1 to always start the sequence test mode. To return to the normal mode, change PA2_89 to 0 and turn the power off then on again.
Specify the encoder bit according to the type of the servomotor.
"RB2" at the end of servomotor: 20-bit encoder. "HB2": 18-bit encoder
In the sequence test mode, the status indication LED on the front panel of the servo amplifier blinks quickly at very short intervals.

PA2_90: Specify the parameter according to the connected motor encoder bit.

ALPHA5 RB type (20 bits) = 0

ALPHA5 HB type (18 bits) = 1

PA2_93 Parity/stop bit selection (for Modbus)

No.	Name	Setting range	Default value	Change
93	Parity/stop bit selection	0: Even parity with 1 stop bit 1: Odd parity with 1 stop bit 2: No parity with 1 stop bit 3: Even parity with 2 stop bits 4: Odd parity with 2 stop bits 5: No parity with 2 stop bits	0	Power

Set existence and logic of a parity and a stop bit length.

Characters are organized for each setting as follows:

<table>
<tr><td>PA2_93</td><td>LSB
0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>MSB
11</td></tr>
<tr><td>0, 1</td><td>Start</td><td colspan="8">Data (8 bits)</td><td>Parity</td><td>Stop</td><td></td></tr>
<tr><td>2</td><td>Start</td><td colspan="8">Data (8 bits)</td><td>Stop</td><td></td><td></td></tr>
<tr><td>3, 4</td><td>Start</td><td colspan="8">Data (8 bits)</td><td>Parity</td><td colspan="2">Stop (2 bits)</td></tr>
<tr><td>5</td><td>Start</td><td colspan="8">Data (8 bits)</td><td colspan="2">Stop (2 bits)</td><td></td></tr>
</table>

PA2_94 Response time (for Modbus)

PA2_95 Communication time over time (for Modbus)

No.	Name	Setting range	Default value	Change
94	Response time	0.00 to 1.00 [s] (*)	0.00	Always
95	Communication time over	0.00 [s]···No detection 0.01 to 9.99 [s]	0.00	Always

* The actual response time is the setting of PA2_94 or the sum of {time of 3 characters + amplifier's processing time}, whichever is longer.

Enter the response time of the servo amplifier.

Enter the response time and communication time-over time when necessary.

For details, refer to "CHAPTER 13　RS-485 COMMUNICATIONS."

PA2_97 Communication protocol selection

No.	Name	Setting range	Default value	Change
97	Communication protocol selection	0: PC Loader protocol 1: Modbus RTU	0	Always

Select either the PC Loader protocol or Modbus RTU communications.

The factory shipment setting is "0" (PC Loader protocol). To use Modbus RTU communications, do not fail to change to "1."

4.6 Input Terminal Function Setting Parameter

Note	Parameters marked "○" in the "Power" field are enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.6.1 List (PA3_□□)

<table>
<tr><th rowspan="2">No. PA3_</th><th rowspan="2">Name</th><th rowspan="2">Default value</th><th rowspan="2">Power</th><th colspan="3">Control mode</th><th rowspan="2">Record of reference value</th></tr>
<tr><th>Position</th><th>Speed</th><th>Torque</th></tr>
<tr><td>01</td><td>CONT1 signal assignment</td><td rowspan="24">Refer to the table on the next page.</td><td rowspan="28">○</td><td rowspan="28">○</td><td rowspan="28">○</td><td rowspan="28">○</td><td></td></tr>
<tr><td>02</td><td>CONT2 signal assignment</td><td></td></tr>
<tr><td>03</td><td>CONT3 signal assignment</td><td></td></tr>
<tr><td>04</td><td>CONT4 signal assignment</td><td></td></tr>
<tr><td>05</td><td>CONT5 signal assignment</td><td></td></tr>
<tr><td>06</td><td>CONT6 signal assignment</td><td></td></tr>
<tr><td>07</td><td>CONT7 signal assignment</td><td></td></tr>
<tr><td>08</td><td>CONT8 signal assignment</td><td></td></tr>
<tr><td>09</td><td>CONT9 signal assignment</td><td></td></tr>
<tr><td>10</td><td>CONT10 signal assignment</td><td></td></tr>
<tr><td>11</td><td>CONT11 signal assignment</td><td></td></tr>
<tr><td>12</td><td>CONT12 signal assignment</td><td></td></tr>
<tr><td>13</td><td>CONT13 signal assignment</td><td></td></tr>
<tr><td>14</td><td>CONT14 signal assignment</td><td></td></tr>
<tr><td>15</td><td>CONT15 signal assignment</td><td></td></tr>
<tr><td>16</td><td>CONT16 signal assignment</td><td></td></tr>
<tr><td>17</td><td>CONT17 signal assignment</td><td></td></tr>
<tr><td>18</td><td>CONT18 signal assignment</td><td></td></tr>
<tr><td>19</td><td>CONT19 signal assignment</td><td></td></tr>
<tr><td>20</td><td>CONT20 signal assignment</td><td></td></tr>
<tr><td>21</td><td>CONT21 signal assignment</td><td></td></tr>
<tr><td>22</td><td>CONT22 signal assignment</td><td></td></tr>
<tr><td>23</td><td>CONT23 signal assignment</td><td></td></tr>
<tr><td>24</td><td>CONT24 signal assignment</td><td></td></tr>
<tr><td>26</td><td>CONT always ON 1</td><td>0</td><td></td></tr>
<tr><td>27</td><td>CONT always ON 2</td><td>0</td><td></td></tr>
<tr><td>28</td><td>CONT always ON 3</td><td>0</td><td></td></tr>
<tr><td>29</td><td>CONT always ON 4</td><td>0</td><td></td></tr>
</table>

No. PA3_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
30	CONT always ON 5	0	○	○	○	○	
31	Speed command scale	5.0	-	○	○	○	
32	Speed command offset	Shipment setting	-	○	○	○	
33	Torque command scale	3.0	-	○	○	○	
34	Torque command offset	Shipment setting	-	○	○	○	
35	Zero clamp level	0	-	○	○	-	
36	Deviation clear input form	0	○	○	-	-	
39	Speed command fine adjustment gain	1.0000	-	○	○	○	
40	Torque command fine adjustment gain	1.0000	-	○	○	○	

Paremeters marked "○" in the table are enabled in the corresponding control mode.

4.6.2 Description of Each Parameter

PA3_01 to 08 CONT 1 to 8 signal assignment (turned on/off by hardware CONT signal)

No.	Name	Setting range	Default value	Change
01	CONT1 signal assignment	Select among CONT signal assignment functions. (See below.)	1	Power
02	CONT2 signal assignment		11	
03	CONT3 signal assignment		50	
04	CONT4 signal assignment		0	
05	CONT5 signal assignment		0	
06	CONT6 signal assignment		0	
07	CONT7 signal assignment		0	
08	CONT8 signal assignment		0	

PA3_09 to 24 (CONT9 to 24 signal assignment) can be set only by RS-485 communications.

(1) Input terminal (CONT input signal) list

Select the input terminal function assigned to the CONT signal in the table below.
The number and the function have one-on-one relationship. To specify a desired function, assign the corresponding number to the CONT input signal (CONT 1 to 8).
Communication data setting is enabled from CONT9 through CONT24.
However, the setting of "48" (interrupt input enable) must be assigned to from CONT1 to 8.
For details of each function, refer to "CHAPTER 2 WIRING."

Function list

No.	Name	No.	Name	No.	Name
1	Servo-on [S-ON]	24	Electronic gear numerator selection 0	47	Override 8
2	Forward command [FWD]	25	Electronic gear numerator selection 1	48	Interrupt input enable
3	Reverse command [REV]	26	Command pulse inhibit [INH]	49	Interrupt input
4	Start positioning	27	Command pulse ratio 1	50	Deviation clear
5	Homing [ORG]	28	Command pulse ratio 2	51	Multi-step speed selection 1 [X1]
6	Home position LS [LS]	29	Proportional control	52	Multi-step speed selection 2 [X2]
7	+OT	31	Pause	53	Multi-step speed selection 3 [X3]
8	-OT	32	Positioning cancel	54	Free-run
10	Forced stop [EMG]	34	External braking resistor overheat	55	Edit permission
11	Alarm reset [RST]	35	Teaching	57	Anti resonance frequency selection 0
14	ACC0	36	Control mode selection	58	Anti resonance frequency selection 1
16	Position preset	37	Position control	60	AD0
17	Gain switch	38	Torque control	61	AD1
19	Torque limit 0	43	Override enable	62	AD2
20	Torque limit 1	44	Override 1	63	AD3
22	Immediate value continuation	45	Override 2	77	Positioning data selection
23	Immediate value change	46	Override 4		

4

(2) Connector pin layout

The pin layout of each signal is shown in the figure below.

Assign desired functions to signals CONT1 through CONT8.

CN1

35	CA	36	*CA	17	VREF	18	M5
33	CB	34	*CB	15	TREF	16	MON1
31	FFA	32	*FFA	13	M5	14	MON2
29	FFB	30	*FFB	11	P10	12	PPI
27	FFZ	28	*FFZ	9	M5	10	FZ
25	M5	26	OUT3	7	OUT4	8	OUT5
23	CONT7	24	CONT8	5	OUT1	6	OUT2
21	CONT1	22	CONT2	3	CONT5	4	CONT6
19	COMOUT	20	COMIN	1	CONT3	2	CONT4

PA3_26 to 30 CONT always effective 1 to 5

No.	Name	Setting range	Default value	Change
26	CONT always ON 1	Specify the number corresponding to desired function (0 to 77)	0	Power
27	CONT always ON 2			
28	CONT always ON 3			
29	CONT always ON 4			
30	CONT always ON 5			

Specify the CONT input signal that is always enabled after the power is turned on.

The normally open contact signal is always turned on. The normally closed contact signal is always turned off.

Functions that may not be specified with a normally open signal include alarm reset, deviation clear and free-run.

Functions that may not be specified with a normally closed signal include forced stop and external braking resistor overheat. (Functions that can be specified with a normally closed signal are +OT and -OT.)

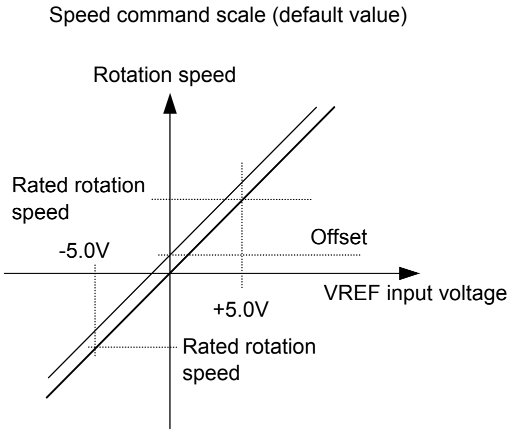
For example, to turn forward command [FWD] always on, specify "2," which corresponds to the forward command, to one of CONT always ON signals 1 to 5.

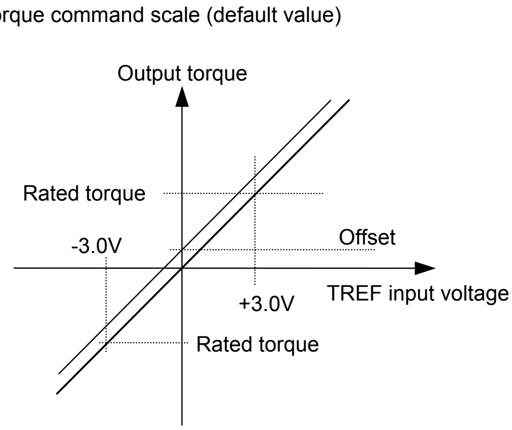
The signal assigned to CONT input signal can be also assigned to CONT always enabled setting redundantly.

PA3_31 to 34 Speed and torque command scale and offset settings

No.	Name	Setting range	Default value	Change
31	Speed command scale	±1.0 [V]/ to ±100.0 [V]/ Rated rotation speed	5.0	Always
32	Speed command offset	-2000 [mV] to 2000 [mV]	Shipment setting	Always
33	Torque command scale	±1.0 [V] to ±10.0 [V]/ Torque command offset	3.0	Always
34	Torque command offset	-200×10 [mV] to 200×10 [mV]	Shipment setting	Always

Specify the scale (gain) and offset of the analog input signal.





PA3_35 Zero clamp level

No.	Name	Setting range	Default value	Change
35	Zero clamp level	0 [r/min] to 500 [r/min]	0	Always

The parameter is enabled under speed or position control.
Rotation speeds less than the specified value are clamped (fixed) at 0 [r/min].
This parameter is not affected by offsets or similar for the prevention of drifting upon nearly zero speed command input value.

PA3_36 Deviation clear input form

No.	Name	Setting range	Default value	Change
36	Deviation clear input form	0: Edge 1: Level	0	Power

Specify the deviation clear input signal format.

Select 0 (edge) to reset position deviation at the rising edge timing.

PA3_39 Speed command fine adjustment gain

No.	Name	Setting range	Default value	Change
39	Speed command fine adjustment gain	0.8000 to 1.2000	1.0000	Always

The gain is finely adjusted in relation to the speed command.
In an X-Y table or similar where two or more servomotor axes are interpolated with analog speed commands, you can make the D/A scale of the host unit match the A/D scale of the servo amplifier. Interpolation accuracy is improved with this.
[Example]
If the VREF voltage is 5 [V] and PA3_39 is 1.0100, the speed command inside the servo amplifier is 5.05 [V] (5 x 1.0100).

PA3_40 Torque command fine adjustment gain

No.	Name	Setting range	Default value	Change
40	Torque command fine adjustment gain	0.8000 to 1.2000	1.0000	Always

The gain can be finely adjusted in relation to the torque command.
The function is similar to that of PA3_39 (speed command fine adjustment gain).
[Example]
If TREF voltage is 3 [V] and PA3_40 is 1.0100, the torque command inside the servo amplifier is 3.03 [V] (3 × 1.0100).

4.7 Output Terminal Function Setting Parameter

Note	Parameters marked "○" in the "Power" field are enabled after the control power is turned off then turned on again. (Check that the keypad (7-segment display) of the servo amplifier is unlit when the control power is turned off.)

4.7.1 List (PA3_□□)

No. PA3_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
51	OUT1 signal assignment	Refer to the table below.	○	○	○	○	
52	OUT2 signal assignment						
53	OUT3 signal assignment						
54	OUT4 signal assignment						
55	OUT5 signal assignment						
55	OUT6 signal assignment						
56	OUT7 signal assignment						
57	OUT8 signal assignment						
58	OUT9 signal assignment						
59	OUT10 signal assignment						
60	OUT11 signal assignment						
61	OUT12 signal assignment						
62	OUT13 signal assignment						
63	OUT14 signal assignment						
64	OUT15 signal assignment						
65	OUT16 signal assignment						
66	OUT17 signal assignment						
67	OUT18 signal assignment						
68	OUT19 signal assignment						
69	OUT20 signal assignment						
70	OUT21 signal assignment						
81	Monitor 1 signal assignment	2	-	○	○	○	
82	Monitor 2 signal assignment	3	-	○	○	○	
83	Monitor 1 scale	7.0	-	○	○	○	
84	Monitor 1 offset	0	-	○	○	○	
85	Monitor 2 scale	6.0	-	○	○	○	
86	Monitor 2 offset	0	-	○	○	○	
87	Monitor 1/2 output format	0	-	○	○	○	
88	Command pulse frequency sampling time for monitor	3	-	○	-	-	
89	Feedback speed sampling time for monitor	1	-	○	○	○	
92	Range1 of position: Setting1	0	-	○	-	-	

No. PA3_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
93	Range1 of position: Setting2	0	-	○	-	-	
94	Range2 of position: Setting1	0	-	○	-	-	
95	Range2 of position: Setting2	0	-	○	-	-	

Paremeters marked "○" in the table are enabled in the corresponding control mode.

4.7.2 Description of Each Parameter

4

PA3_51 to 55 OUT 1 to 5 signal assignment (turned on/off by hardware OUT signal)

No.	Name	Setting range	Default value	Change
51	OUT1 signal assignment	Select among OUT signal assignment functions (refer to the following table).	1	Power
52	OUT2 signal assignment		28	
53	OUT3 signal assignment		2	
54	OUT4 signal assignment		76	
55	OUT5 signal assignment		26	

PA3_56 to 71 (OUT6 to 21 signal assignment) can be set only by RS-485 communications.

(1) Output terminal (OUT output signal) list
Select the input terminal function assigned to the OUT signal in the table below.
The number and the function have one-on-one relationship. To specify a desired function, assign the corresponding number to the OUT output signal (OUT 1 to 5).
Communication data setting is enabled from OUT6 through OUT21.
For details of each function, refer to "CHAPTER 2 WIRING."

Function list

No.	Name	No.	Name	No.	Name
1	Ready for servo-on [RDY]	30	Data error	66	MD6
2	In-position [INP]	31	Address error	67	MD7
11	Speed limit detection	32	Alarm code 0	75	Position preset completion
13	Over write completion	33	Alarm code 1	76	Alarm detection (normally closed contact)
14	Brake timing	34	Alarm code 2	79	Immediate value continuation permission
16	Alarm detection (normally open contact)	35	Alarm code 3	80	Immediate value continuation completion
17	Point detection, area 1	36	Alarm code 4	81	Immediate value change completion
18	Point detection, area 2	38	+OT detection	82	Command position completion
19	Limiter detection	39	-OT detection	83	Range1 of position
20	OT detection	40	Home position LS detection	84	Range2 of position
21	Cycle end detection	41	Forced stop detection		
22	Homing completion	45	Battery warning		
23	Zero deviation	46	Life warning		
24	Zero speed	60	MD0		
25	Speed coincidence	61	MD1		
26	Torque limit detection	62	MD2		
27	Overload warning	63	MD3		
28	Servo control ready [S-RDY]	64	MD4		
29	Edit permission response	65	MD5		

(2) Connector pin layout

The pin layout of each signal is shown in the figure below.
Assign desired function to signals OUT1 through OUT5.

CN1

35	CA	36	*CA	17	VREF	18	M5
33	CB	34	*CB	15	TREF	16	MON1
31	FFA	32	*FFA	13	M5	14	MON2
29	FFB	30	*FFB	11	P10	12	PPI
27	FFZ	28	*FFZ	9	M5	10	FZ
25	M5	26	OUT3	7	OUT4	8	OUT5
23	CONT7	24	CONT8	5	OUT1	6	OUT2
21	CONT1	22	CONT2	3	CONT5	4	CONT6
19	COMOUT	20	COMIN	1	CONT3	2	CONT4

4

PA3_81 to 87 Monitor output scale and offset settings

No.	Name	Setting range	Default value	Change
81	Monitor 1 signal assignment	1: Command speed. 2: Feedback speed. 3: Torque command. 4: Position deviation [unit amount/pulse]. 5: Position deviation 1/10 [unit amount/pulse]. 6: Position deviation 1/100 [unit amount/pulse]. 7: Command pulse frequency. 8: Speed deviation. 9: Motor current. 10: Effective torque. 11: DC link voltage. 12: OL thermal value. 13: Braking resistor thermal value. 14: Power (W). 15: Motor temperature. 16: Command speed (filtered)	2	Always
82	Monitor 2 signal assignment		3	Always
83	Monitor 1 scale	±2.0 [V] to ±100.0 [V]	7.0	Always
84	Monitor 1 offset	-50 to 50	0	Always
85	Monitor 2 scale	±2.0 [V] to ±100.0 [V]	6.0	Always
86	Monitor 2 offset	-50 to 50	0	Always
87	Monitor 1/2 output format	0: Monitor 1 (both voltage output) / 2 (both voltage output) 1: Monitor 1 (single voltage output) / Monitor 2 (both voltage output) 2: Monitor 1 (both voltage output) / Monitor 2 (single voltage output) 3: Monitor 1 (single voltage output) / Monitor 2 (single voltage output)	0	Always

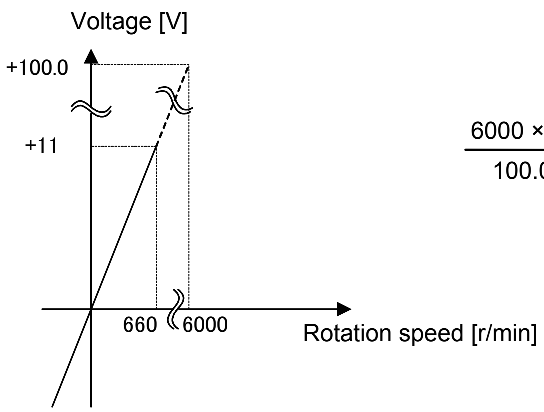
■ Monitor 1/2 signal assignment

Specify the data to be output at the monitor 1 [MON1] and monitor 2 [MON2] terminals.

Monitoring item	Description	Specifications
1: Command speed	Speed command given to servomotor	Output voltage corresponding to maximum rotation speed
2: Feedback speed	Actual rotation speed given to servomotor	
3: Torque command	Torque reference value given to servomotor	Output voltage corresponding to maximum torque
4: Position deviation	Difference (deviation) between position command and position feedback	Output voltage corresponding to 1000 [pulses]
5: Position deviation (1/10)		Output voltage corresponding to 10000 [pulses]
6: Position deviation (1/100)		Output voltage corresponding to 100000 [pulses]
7: Command pulse frequency	Input pulse frequency reference value	Output voltage corresponding to 1 [MHz]
8: Speed deviation	Difference between speed command and speed feedback	Output voltage corresponding to maximum speed
9: Motor current	Amperage supplied to servomotor	Output voltage corresponding to maximum current
10: Actual torque	Actual torque given to servomotor	Output voltage corresponding to rated torque
11: DC link voltage	DC voltage inside servo amplifier	Output voltage corresponding to 400 [V]
12: OL thermal value	Load factor	OL alarm upon 100 [%]
13: Braking resistor thermal value	Load factor of braking resistor	Braking resistor alarm upon 100 [%]
14: Power (W)	Motor power (W)	Output voltage corresponding to rated rotation speed and rated torque
15: Motor temperature	Internal detected temperature of encoder	Output voltage corresponding to 100 [°C]
16: Command speed (filtered)	Speed reference value after internal filter	Output voltage corresponding to maximum rotation speed

■ Monitor 1/2 scale

Specify the full scale to be output at the monitor 1 [MON1] and monitor 2 [MON2] terminals.
Specify a negative sign to reverse the polarity of the output voltage.
Though up to 100.0 [V] can be entered, the maximum output voltage is 11.0 [V].
[Example] If the monitor 1 scale is set at 100.0 [V] (with a maximum rotation speed of 6000 [r/min])



$$\frac{6000 \times 11}{100.0} = 660 \text{ [r/min]}$$

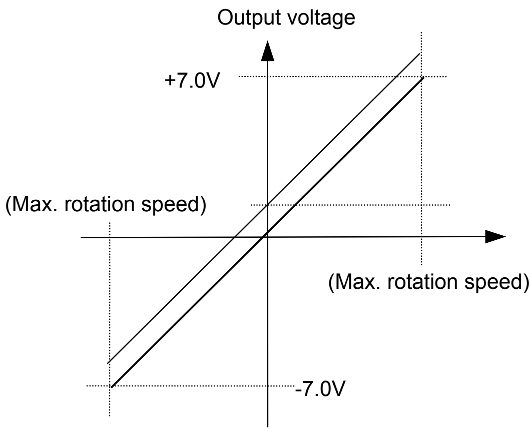
■ Monitor 1/2 offset

The offset voltage between the monitor 1 [MON1] and monitor 2 [MON2] terminals can be adjusted. The setting range is from -50 to 0 to 50 in increments of 1. The reference value has no unit.
Every increment corresponds to about 6.1 [mV].

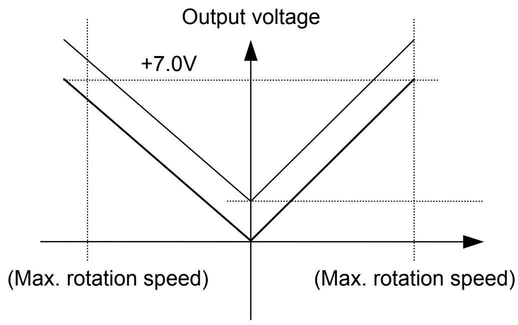
■ Monitor 1/2 output format

You can select either swing on both sides or swing on a single side for the signal, scale and offset assigned to the monitor 1 [MON1] and monitor 2 [MON2] terminals.

Monitor 1 terminal (swing on both sides)



Monitor 1 terminal (swing on single side)



Specify the negative sign for the monitor 1/2 scale to reverse the polarity of the output voltage.

■ Resolution of monitor 1/2 output

The resolution is 14 bits (16384) at the full scale (between -12.5 [V] and +12.5 [V]).
The resolution (*) is 1.5 [mV] (-12.5 to +12.5) [V]/2^{14}).
* While the maximum or minimum output voltage is ±11 [V], ±12.5 [V] is used for the calculation of the resolution.

PA3_88 Command pulse frequency sampling time for monitor

No.	Name	Setting range	Default value	Change
88	Command pulse frequency sampling time for monitor	0: 62.5 [μs] 1: 125 [μs] 2: 250 [μs], 3: 500 [μs] 4: 1 [ms] 5: 2 [ms], 6: 4 [ms] 7: 8 [ms]	3	Always

Specify the command pulse frequency sampling time for monitor.
The sampling time is for the monitoring function. No effect is caused to the control even if the value is changed.

PA3_89 Feedback speed sampling time for monitor

No.	Name	Setting range	Default value	Change
89	Feedback speed sampling time for monitor	0: 62.5 [μs] 1: 125 [μs] 2: 250 [μs], 3: 500 [μs] 4: 1 [ms] 5: 2 [ms], 6: 4 [ms] 7: 8 [ms]	1	Always

Specify the feedback speed sampling time for monitor.
The sampling time is for the monitoring function. No effect is caused to the control even if the value is changed.

PA3_92 Range1 of position: Setting1
PA3_93 Range1 of position: Setting2
PA3_94 Range2 of position: Setting1
PA3_95 Range2 of position: Setting2

No.	Name	Setting range	Default value	Change
92	Range1 of position: Setting1	-2000000000 to 2000000000 [unit amount]	0	Always
93	Range1 of position: Setting2	-2000000000 to 2000000000 [unit amount]	0	Always
94	Range2 of position: Setting1	-2000000000 to 2000000000 [unit amount]	0	Always
95	Range2 of position: Setting2	-2000000000 to 2000000000 [unit amount]	0	Always
51 to 71	OUT1 to OUT 21 signal assignment	<Additional signals> 83: Range 1 of position 84: Range 2 of position	Refer to the parameter table.	Power

The current servomotor position is detected and output in these signals.
The output signal can be turned on or off according to the current motor position. The parameter that can be specified for range 1 of position signal includes range 1 of position - setting 1 (PA3_92) and range 1 of position - setting 2 (PA3_93).
For example, if the setting of range 1 of position - setting 1 (PA3_92) is smaller than the setting of range 1 of position - setting 2 (PA3_93) and the position specified for range 1 of position - setting 1 (PA3_92) passes during forward motion, the range 1 of position signal undergoes OFF-to-ON transition. If the position specified for range 1 of position - setting 2 (PA3_93) passes, the range 1 of position signal undergoes ON-to-OFF transition.
Similarly to the above description, range 2 of position is related to parameters PA3_94 and 95.
This function is enabled after homing is finished.
For details of the position range, refer to “CHAPTER 2 WIRING.”

4

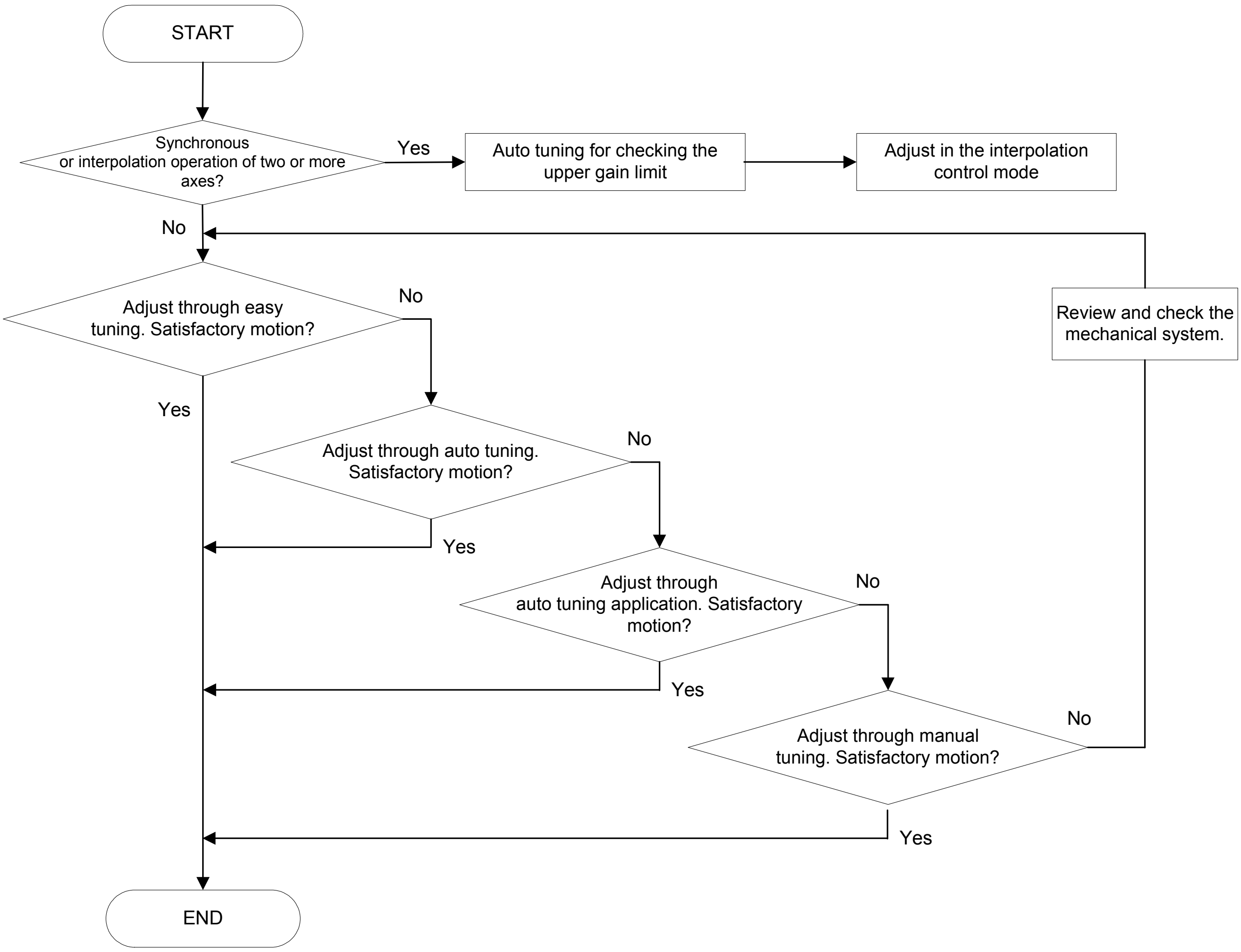
CHAPTER 5 SERVO ADJUSTMENT

5

5.1 Adjustment Procedure

Adjustment (tuning) of the servo amplifier is necessary so that the servomotor operates according to commands sent from the host control unit.
Proceed servo amplifier tuning as in the following chart.

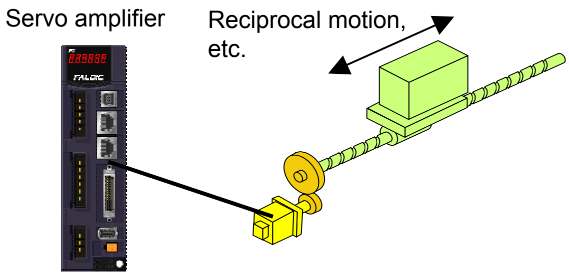
■ Using the tuning procedure and mode selection



5.2 Easy Tuning

5.2.1 What is Easy Tuning?

Disconnect the servo amplifier from the host control unit and operate only the servo amplifier and servomotor to automatically tune internal parameters of the amplifier.
With this function, even if the host control unit program is incomplete, the servomotor can be operated in advance which can lead to the reduction of the setup time.



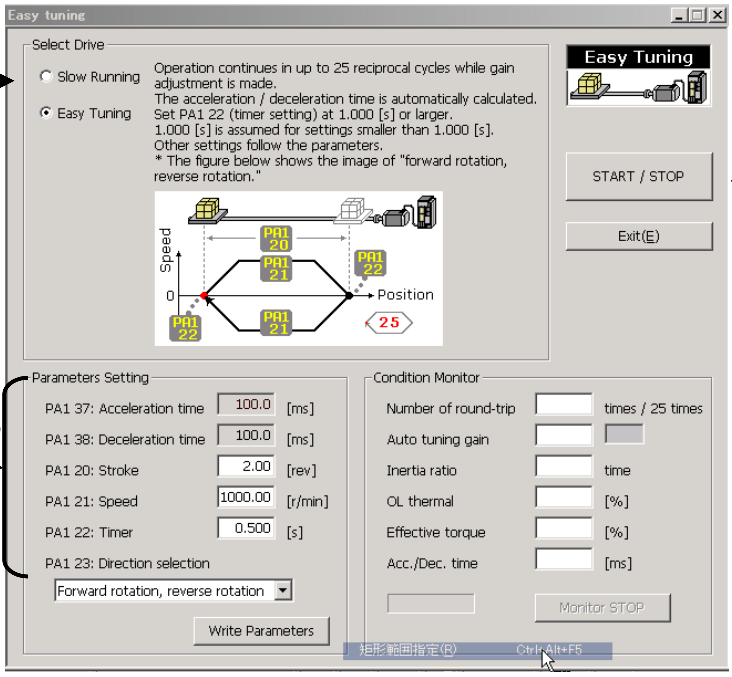
5.2.2 Easy Tuning Operation Profile

Easy tuning is operated by PC Loader or keypad.
To install PC Loader, refer to "CHAPTER 14 PC LOADER."

Note	Start operation after checking no collision exists in the moving parts of the machine.

■ To operate with PC Loader

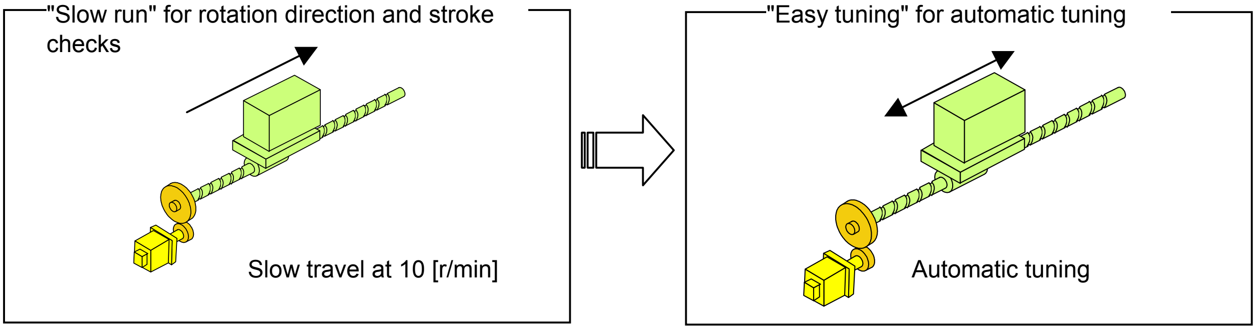
[1] Slow running
For machines with a linear driving system, follow the procedure below to perform slow running before performing easy tuning.
Turn the motor at 10 [r/min] (fixed) while checking the rotation direction and stroke.
Select "slow running" (1) on the PC Loader screen shown on the right and enter the "stroke setting" and "direction selection" parameters (2), and then press the "START/STOP" button (3).



Hint	Slow running is unnecessary for machines with a rotary driving system.

[2] Easy tuning

Select "easy tuning" on the aforementioned screen . Enter the "stroke," "speed" and other particulars and press the "START/STOP" button. Up to 25 reciprocal motions occur while parameters are automatically tuned.



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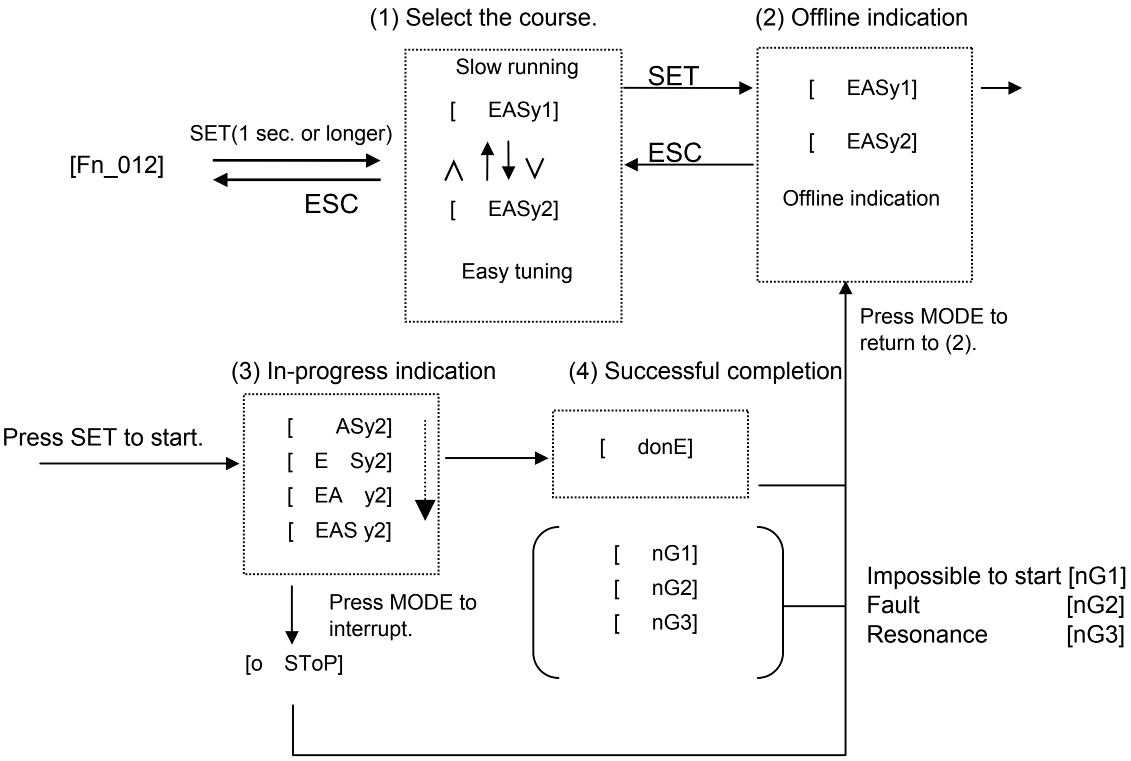
■ To operate with keypad



Fault indication

If "NG1" to "NG3" is indicated during slow running, easy tuning or profile operation, see the table below and take the corresponding action.

Indication	State	Action
NG1	Failure to start	Check the starting conditions (see the following pages).
NG2	Interrupted	Check the conditions of interruption (see the following pages).
NG3	Though tuning is finished, adjustment is necessary.	Perform auto tuning or manual tuning to adjust again.

5.2.3 Description of Operation

Two operation patterns of easy tuning are described.

■ Slow running

Starting conditions

Conditions for starting slow running are indicated "○" in the table below.
Slow running does not start if the conditions shown below are not satisfied ("NG1" is indicated).
If none of conditions are satisfied during operation, operation is stopped ("NG2" is indicated).
The gain reference value at the time of the start is kept as far as no resonance is observed.

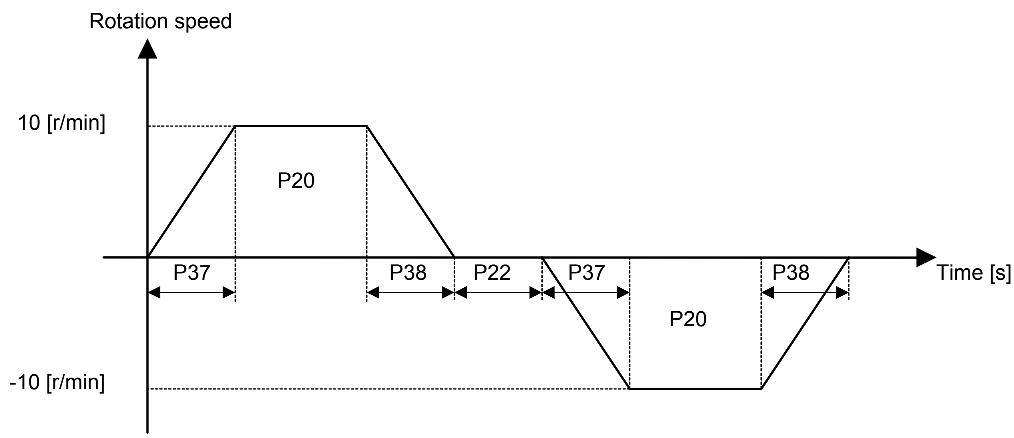
Power supply to main circuit	No alarm	Neither ±OT nor EMG	BX signal OFF	Auto tuning*1	Parameter write enable*2
○	○	○	○	○	○

*1) PA1_13 (tuning mode selection): other than 2 (manual tuning)
*2) PA2_74 (parameter write protection): 0 (write enable)

5

Operation pattern (in case of reciprocal motion)

The operation pattern is shown below. "P□□" in the table indicates the number of the basic setting parameter (PA1_□□).



Traveling distance	Operation frequency	Acceleration time	Deceleration time	Rotation speed	Timer	Rotation direction	
						Go stroke	Return stroke
P20	Once	P37	P38	10 [r/min]	P22	P23	

Details of tuning

No tuning is performed in slow running.
However, the auto tuning gain is automatically decreased if resonance is observed in the machine.
In this case, the automatic notch filter function is activated.

Details of completion of action

The action completion method includes three patterns: normal completion, interruption by user, and faulty termination. Each profile is described below.

Normal completion	Interruption by user	Faulty termination	
		NG2	NG3
Stopped after the specified stroke action. If mechanical resonance is found, the notch filter is automatically adjusted and the auto tuning gain automatically decreases.	The auto tuning gain at the start of operation is restored.	The auto tuning gain at the start of operation is restored.	The auto tuning gain automatically changes to the one that will suppress resonance (re-adjustment is necessary).

■ Easy tuning

Starting condition

Conditions necessary to start easy tuning are indicated "○" in the table below.
Easy tuning does not start if the following conditions are not satisfied ("NG1" is indicated).
Easy tuning is interrupted if any condition is unsatisfied during operation ("NG2" is indicated).

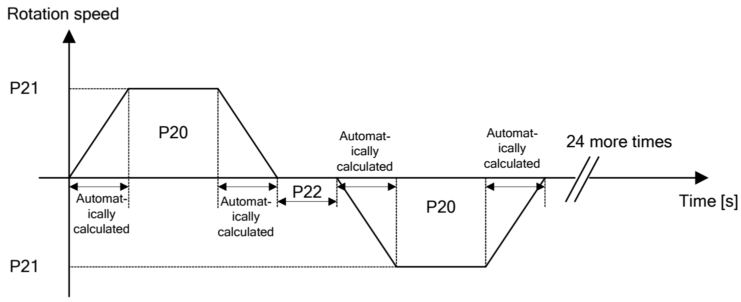
Power supply to main circuit	No alarm	Neither ±OT nor EMG	BX signal OFF	Auto tuning*1	Parameter write enable*2
○	○	○	○	○	○

*1) PA1_13 (tuning mode selection): other than 2 (manual tuning)
*2) PA2_74 (parameter write protection): 0 (write enable)

Hint	Easy tuning may not function correctly in mechanisms listed below. • Machines susceptible to vibration due to small rigidity • Machines with large backlash • Machines with large viscous friction • Machines with very small rotation speed (example: 100 [r/min] or less) • Machines with large load inertia of load (GYS motor: 100 times or over. GYG motor: 30 times or over) • Machines with large and fluctuating load inertia

Operation profile (in case of reciprocal motion)

The operation profile is shown below. "P□□" in the table indicates the number of the basic setting parameter (PA1_□□).



Traveling distance	Operation frequency	Acceleration time	Deceleration time	Rotation speed	Timer	Rotation direction*1	
						Go stroke	Return stroke
P20	Max. 25 times	Automatically calculated*1	Automatically calculated*1	P21	P22*2	P23	

*1) The result of automatic calculation can be checked with the PC Loader.

*2) 1 [s] or less reference values are assumed to be 1 [s] for easy tuning.

The frequency of a reciprocal motion is 25 cycles maximum, and that of a single-direction motion is 50 cycles maximum.

Details of tuning

Up to 50 easy tuning cycles are repeated while auto tuning gain 1 is automatically adjusted in the range from 5 to 30.

Details of completion of action

The action completion method includes three profiles: normal completion, interruption by user, and faulty termination. Each profile is described below.

Normal completion	Interruption by user	Faulty termination	
		NG2	NG3
Completion of easy tuning is indicated. Auto tuning gain 1 (range between 5 and 30) is automatically adjusted to the best value.	Auto tuning gain 1 at the start of operation is restored.	Auto tuning gain 1 at the start of operation is restored.	Auto tuning gain 1 automatically changes to the one that will suppress resonance (re-adjustment is necessary).

Results of easy tuning

After easy tuning is normally finished, the gain and load inertia ratio automatically adjusted in tuning are reflected on parameters.
If resonance is observed during easy tuning, a notch filter is automatically set to suppress resonance, and the filter is reflected on parameters.
Perform regular operation under the above status and if satisfactory actions are obtained, there is no need to perform tuning described on following pages.

Notes on easy tuning

With easy tuning, automatic operation is performed according to functions of the servo amplifier. Sufficient care should be taken on the safety.
If ill effects are expected to the machine due to resonance of the motor with the mechanical system, assign the servo-on (S-ON) signal to a CONT signal before starting easy tuning.
If a fault is found during operation, turn the signal off immediately.
If the excessive stroke cause damage to the machine, assign ± over-travel (±OT) signals to CONT signals and install over-travel sensors at both ends of the motion stroke before starting easy tuning.

Easy tuning for vertical transportation

When performing easy tuning with the servomotor for vertical transportation, to prevent a carried object from falling due to its own weight, turn the servo-on signal to ON and check that the servo lock is activated before releasing the brake.
Then performe easy tuning, refer to P5-6 procedure.

5.3 Auto Tuning

If satisfactory results are not obtained after easy tuning, perform "auto tuning." In this mode, the load inertia ratio of the machine is always estimated, and optimum gain is automatically settled.

5.3.1 Conditions for Auto Tuning

Auto tuning may not function correctly if the following conditions are not satisfied.

- The load inertia ratio of the mechanical system is within 100 times of the servomotor.
- Required time to reach 2000 [r/min] is 5 [s] or shorter with the acceleration/deceleration time constant.
- The motor rotation speed is 100 [r/min] or more.
- There is no substantial load fluctuation during operation or acceleration/deceleration.
- The friction force is not large and does not apply pressure.

5.3.2 Parameters Used for Auto Tuning

Parameters used for gain adjustment are listed in the table below.

No.	Name	Approximate reference value	
PA1_13	Tuning mode selection	0: Auto tuning	1: Semi-auto tuning
PA1_14	Load inertia ratio	No need to enter (automatically updated)	Enter a stable estimated value (or average value).
PA1_15	Auto tuning gain 1	Refer to "5.3.3 Approximate Reference Value of Auto Tuning Gain 1" for adjustment.	
PA1_16	Auto tuning gain 2	Enter when necessary.	

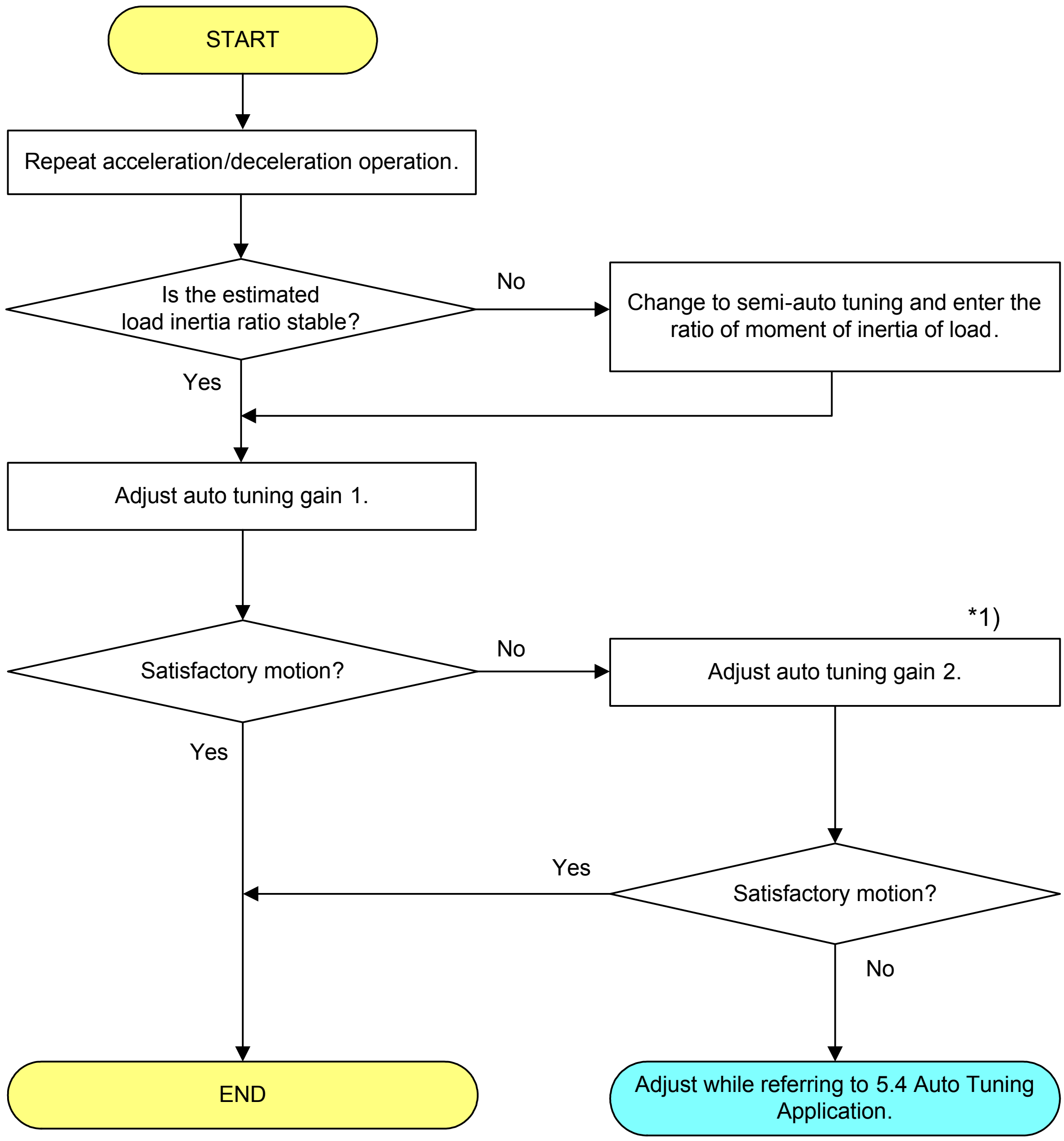
- During auto tuning, by adjusting PA1_15: auto tuning gain 1, other parameters are automatically adjusted. The values are always updated.
- During semi-auto tuning, enter PA1_14 (load inertia ratio) and by adjusting PA1_15: (auto tuning gain 1 other parameter are automatically adjusted.
  Values are fixed as far as the setting is left unchanged.

5.3.3 Approximate Reference Value of Auto Tuning Gain 1

By increasing auto tuning gain, response will be improved while possibly causing vibration or other ill effects. Change the value at intervals of about 2 points.
If resonance with the mechanical system or abnormal noises are not caused, auto tuning gain 1 can be increased and the settling time can be decreased.

Machine configuration (Division by mechanism)	Auto tuning gain 1 (Approximate reference value)
Large transfer machine	1 to 10
Arm robot	5 to 20
Belt mechanism	10 to 25
Ball screw + Belt mechanism	15 to 30
Mechanism directly coupled with ball screw	20 to 40

5.3.4 Auto Tuning Adjustment Procedure



*1) There is no need to adjust auto tuning gain 2 under speed control.

5.4 Auto Tuning Application

If the results of "auto tuning" are not satisfactory, perform adjustment according to "auto tuning application." In this mode, manually enter the second gain, notch filter and other particulars. Conditions for adjustment are the same as those of auto tuning.

5.4.1 Parameters Used for Auto Tuning Application

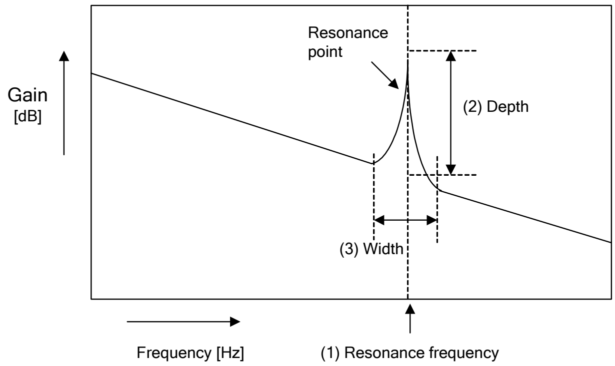
Parameters used for auto tuning application adjustment are shown in the table below.

No.	Name	Approximate reference value	
PA1_13	Tuning mode selection	0: Auto tuning	1: Semi-auto tuning
PA1_14	Load inertia ratio	No need to enter (automatically updated)	Enter a stable estimated value (or average value).
PA1_15	Auto tuning gain 1	Refer to "5.3.3 Approximate Reference Value of Auto Tuning Gain 1" for adjustment.	
PA1_16	Auto tuning gain 2	Enter when necessary.	
PA1_59	Torque filter time constant for position and speed control	Increase in increments of 0.5 [ms], starting at the current setting.	
PA1_64	Position loop gain 2	70	
PA1_65	Speed loop gain 2	70	
PA1_66	Speed loop integration time constant 2	70	
PA1_70	Automatic notch filter selection	Select 0 (disable).	
PA1_71	Notch filter 1, frequency	Use the servo analyze function of the PC Loader for adjustment.	
PA1_72	Notch filter 1, attenuation		
PA1_73	Notch filter 1, width		
PA1_94	Torque filter setting mode	Select 0 (no automatic setting).	

During auto tuning application adjustment, based on the adjustment in auto tuning, potential manually settling parameters will be manually adjusted.

5.4.2 Notch Filter Setting Method

[1] Set PA1_70 (automatic notch filter selection) at 0 (disable).
[2] Using the servo analyze function of the PC Loader, determine the mechanical resonance point.

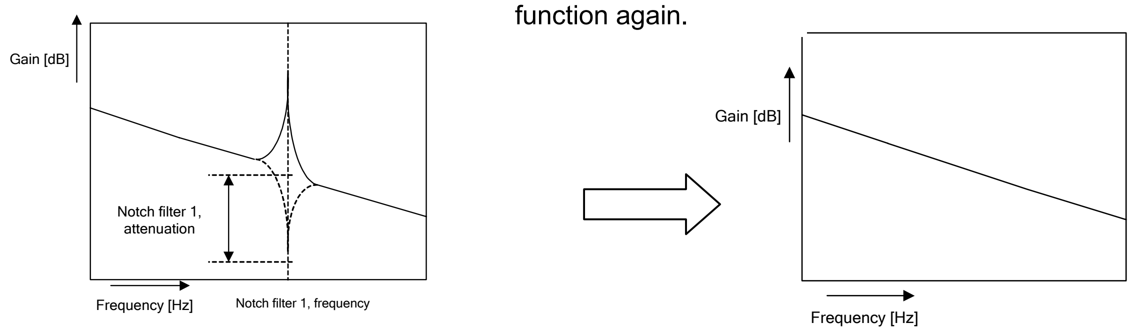


[3] Enter the resonance frequency of the mechanical resonance point and attenuation in parameters.

(1) Resonance frequency	PA1_71 (notch filter 1, frequency)
(2) Depth	PA1_72 (notch filter 1, attenuation)
(3) Width	PA1_73 (notch filter 1, width)

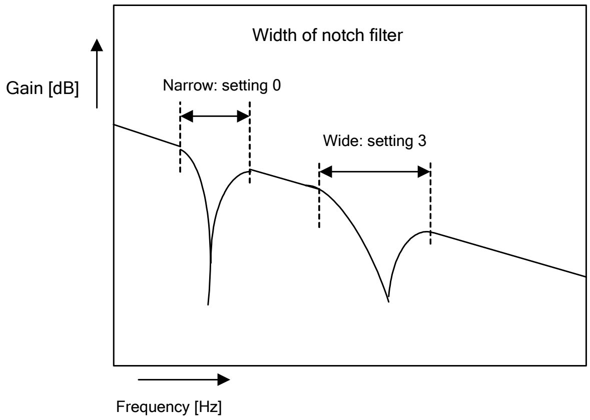
Note	Excessive attenuation might undermine control stability. Setup beyond necessity shall be avoided.

Use the servo analyze function again.



The notch filter is added to the resonance point as shown in the figure above.

[4] Specify the width of the notch filter.
The width of the notch filter can be specified in four levels.
A large setting covers a wide frequency range.
A reference value of 2 is recommended in general.



The notch filter is added to eliminate the resonance point.

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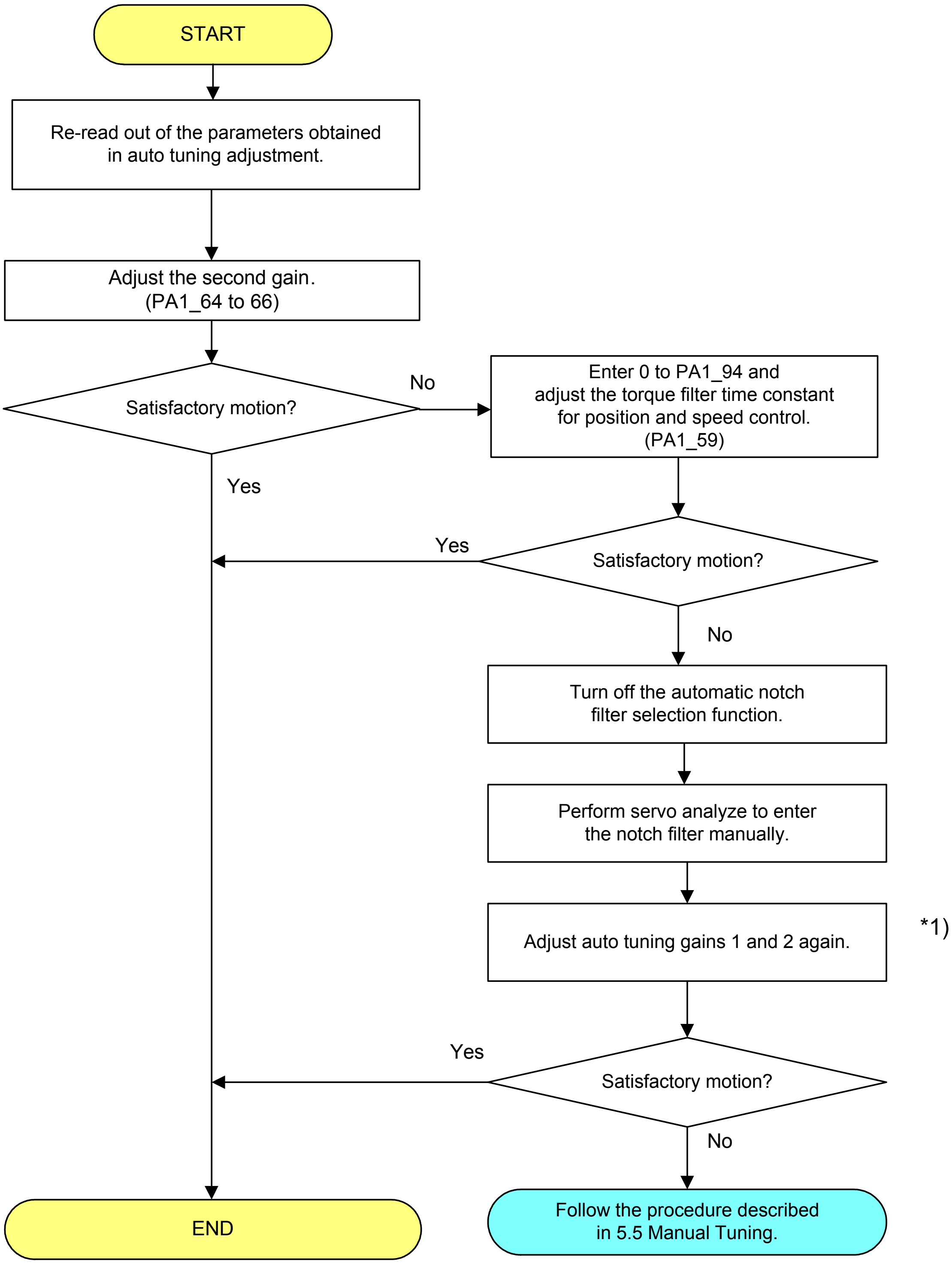
Hint	Use PA1_74 to 76 to add a notch filter to two resonance points simultaneously.

5.4.3 Adjustment Procedure with Auto Tuning Application



*1) Adjustment of auto tuning gain 2 is unnecessary under speed control.

5.5 Manual Tuning

If the result of "auto tuning application" is not satisfactory or if faster response is intended, perform manual adjustment of all gains.

5.5.1 Conditions for Manual Tuning

Check the following conditions when adjusting.

- The load inertia ratio of the mechanical system is within 100 times of the servomotor.
- The backlash of the mechanical system is not large and the belt is free from deflection.
- Auto tuning has been performed.

5

5.5.2 Parameters Used for Manual Tuning

Parameters used for gain adjustment are shown in the table in the next section.

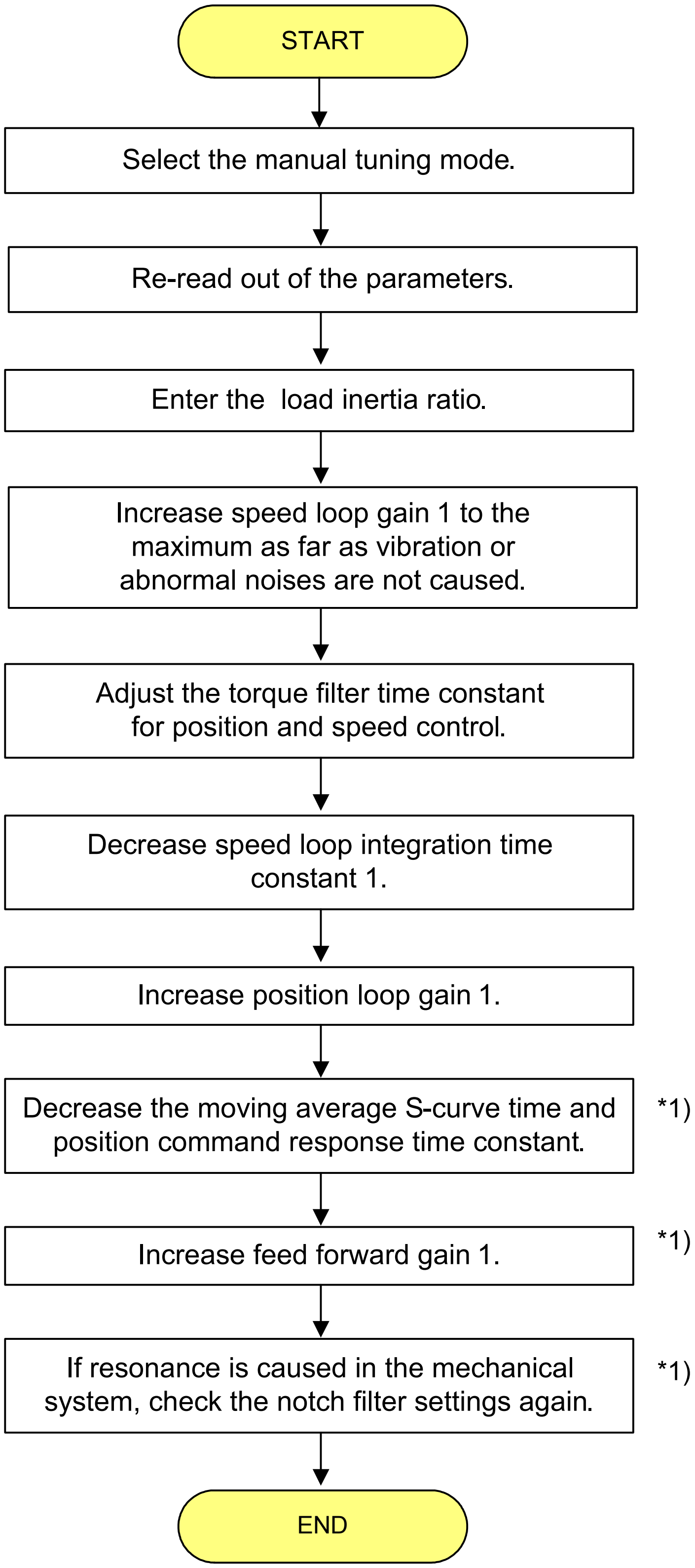
5.5.3 Approximate Gain Reference Value

Note	If manual tuning is performed to change parameters without performing auto tuning, the control system in the servo amplifier becomes imbalanced and triggers hazard. Be sure to perform re-read out of the parameters after auto tuning, and conduct adjustment based on those parameters.

No.	Name	Approximate reference value	Position control	Speed control
PA1_13	Tuning mode selection	2: Manual tuning	○	○
PA1_14	Load inertia ratio (JI)	Enter a stable assumed value (or average value).	○	○
PA1_51	Moving average S-curve time	16 or over	○	-
PA1_54	Position command response time constant (Kpt)	Kpt ≥ 600/Kp1	○	-
PA1_55	Position loop gain 1 (Kp1)	Kp1 ≤ Kv1 × (1 to 3)	○	-
PA1_56	Speed loop gain 1 (Kv1)	Kv1 ≤ 2000/ (1+JI)	○	○
PA1_57	Speed loop integration time constant 1 (Ki1)	Ki1 ≥ 500/Kv1	○	○
PA1_58	Feed forward gain 1	Specify when necessary.	○	-
PA1_59	Torque filter time constant for position and speed control (Tt)	0.1 ≤ Tt ≤ 1.0	○	○

Approximate values specified in the table above are reference values for a general mechanical configuration of the transfer system.
The approximate gain reference value varies according to the configuration of the mechanical system, load inertia ratio, etc.
Refer to the next page for the adjustment procedure. Parameters marked "-" in the speed control field in the table above need no adjustment.

5.5.4 Manual Tuning Adjustment Procedure



*1) Adjustment is unnecessary under speed control.

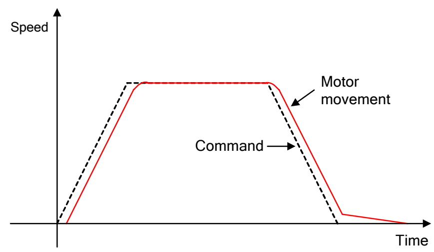
5.5.5 Individual Adjustment

The adjustment method for the individual case is described (for position control).
The method varies according to the configuration of the mechanical system and other particulars.
Use the procedure as a basic adjustment procedure.
Before making adjustment, use historical trace of the PC Loader to measure the action time and output timing of in-position signal.

■ Adjustment for faster response (reduced settling time)

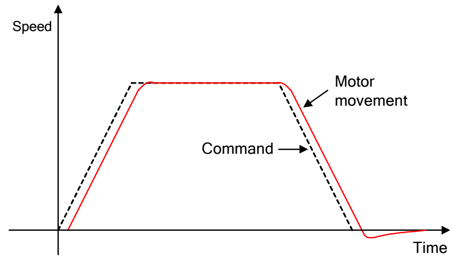
In case of shortage in travel

(1) Decrease PA1_51 (moving average S-curve time).
(2) Decrease PA1_54
(position command response time constant).
(3) Increase PA1_58 (feed forward gain 1).
(4) Decrease PA1_14 (load inertia ratio).
(Each change should be within ±10 [%].)



In case of overshoot

(1) Increase PA1_51 (moving average S-curve time).
(2) Increase PA1_54
(position command response time constant).
(3) Decrease PA1_58 (feed forward gain 1).
(4) Increase PA1_14 (load inertia ratio).
(Each change should be within ±10 [%].)



■ Adjustment checking method

The overshoot unit amount and settling time can be monitored with PC Loader during adjustment to reduce the settling time.
The motion waveform can be monitored, as well.
For details, refer to "CHAPTER 14 PC LOADER."

5.6 Interpolation Control Mode

Use the "interpolation control mode" to adjust command responses of a system with two or more servomotor axes such as the X-Y table when performing synchronous operation or interpolation operation.

5.6.1 Conditions for Interpolation Control Mode

Check the following conditions to perform adjustment.

- Keep consistency in the mechanical configuration and specifications of each axis to the largest extent (ball screw pitch, diameter, length, etc.).
- The backlash of the mechanical system is not large and the belt is free from deflection.
- Commands sent from the host are common among axes.

5.6.2 Parameters Used for Interpolation Control Mode

Parameters used for gain adjustment are shown in the table below.

No.	Name	Approximate reference value
PA1_13	Tuning mode selection	3: Interpolation control mode
PA1_14	Load inertia ratio	Enter a stable assumed value (or average value).
PA1_15	Auto tuning gain 1	Enter while referring to "5.3.3 Approximate Reference Value of Auto Tuning Gain 1."
PA1_51	Moving average S-curve time	0
PA1_54	Position command response time constant	5 or over

The other parameters are automatically adjusted.
However, auto tuning gain 2 becomes disabled.

5.6.3 Adjustment Procedure in Interpolation Control Mode

[1] Specify PA1_13 (semi-auto tuning mode).
[2] Specify PA1_14 (load inertia ratio).
[3] Increase PA1_15 (auto tuning gain 1).
[4] If vibration or abnormal noises are caused in the mechanical system, reset the gain and set that value as the upper limit.
[5] Select the interpolation control mode with PA1_13.
[6] Set PA1_51 (moving average S-curve time) at 0.
[7] Gradually decrease PA1_54 (position command response time constant) (min: 5).
[8] Position command response time constant shall tune to the larger parameter between two axes.
[9] While observing interpolation characteristics and rotation state, finely adjust PA1_15 (auto tuning gain 1) and PA1_54 (position command response time constant).

5.7 Profile Operation

5.7.1 What is Profile Operation?

Even if the host control unit is not connected, automatic operation can be executed according to the specified operation pattern.

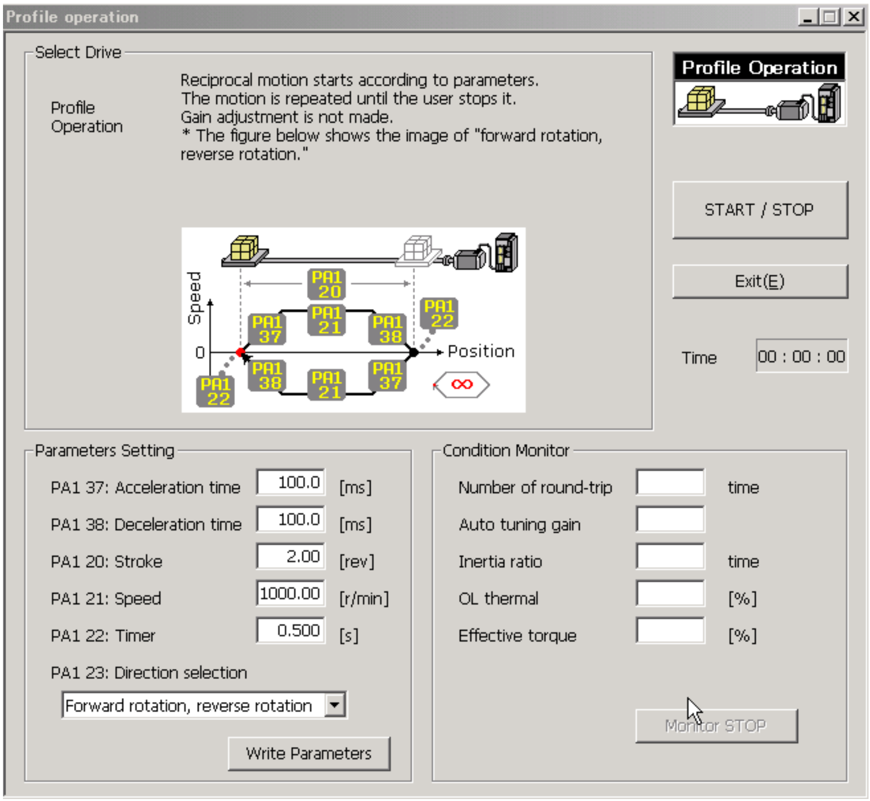
The motion continues until the user stops it. Use this feature to check the load condition of the mechanical system, effective torque, etc.

During profile operation, parameters are not tuned.

Operate the PC Loader or keypad to perform profile operation.

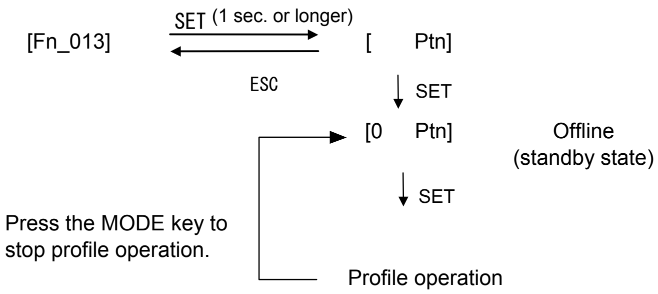
Select the operation pattern and press the "START/STOP" button to start to operate.

■ In case of operation at PC Loader



■ In case of operation at keypad

With this method, profile operation is performed at the keypad.



5.7.2 Description of Operation

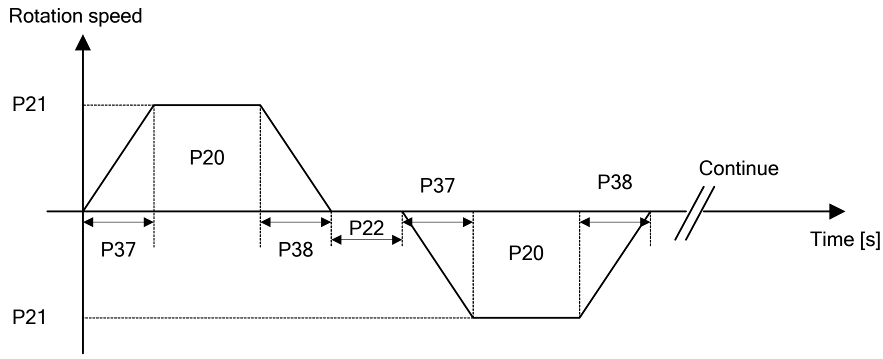
Starting conditions

Conditions for starting profile operation are described. Necessary conditions are indicated with "○."
The operation does not start if the following conditions are not satisfied ("NG1" is indicated).
Operation is interrupted if any condition is dissatisfied during operation ("NG2" is indicated).
The gain reference value is left unchanged at the start level as far as resonance is not observed.

Power supply to main circuit	No alarm state	BX signal turned off	Neither ±OT nor EMG
○	○	○	○

Operation pattern

The operation pattern is shown below. "P□□" in the table indicates the number of the basic setting parameter (PA1_□□).



Moving distance	Operation frequency	Acceleration time	Deceleration time	Rotation speed	Timer	Rotation direction	
						Go stroke	Return stroke
P20	Continuous	P37	P38	P21	P22	P23	

How to stop profile operation

Profile operation is stopped by the user or upon an error*.

* The error includes the following events.

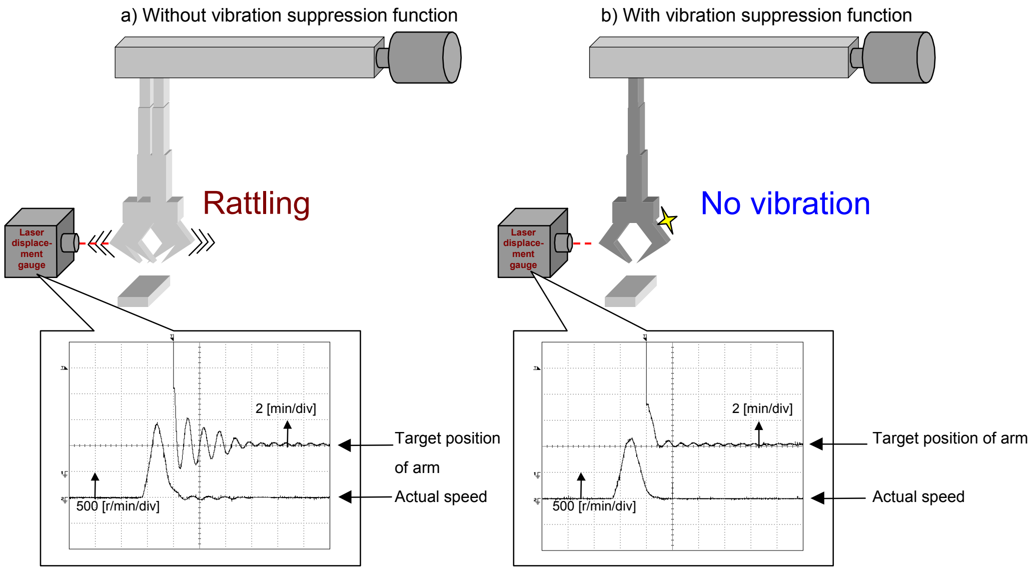
- ±OT, EMG or external braking resistor overheat is detected in the middle.
- BX (Free-run signal) is turned on in the middle.
- The servo-on (S-ON) signal is turned off in the middle.

5.8 Special Adjustment (Vibration Suppression)

5.8.1 What is Vibration Suppression ?

■ Purpose of vibration suppression

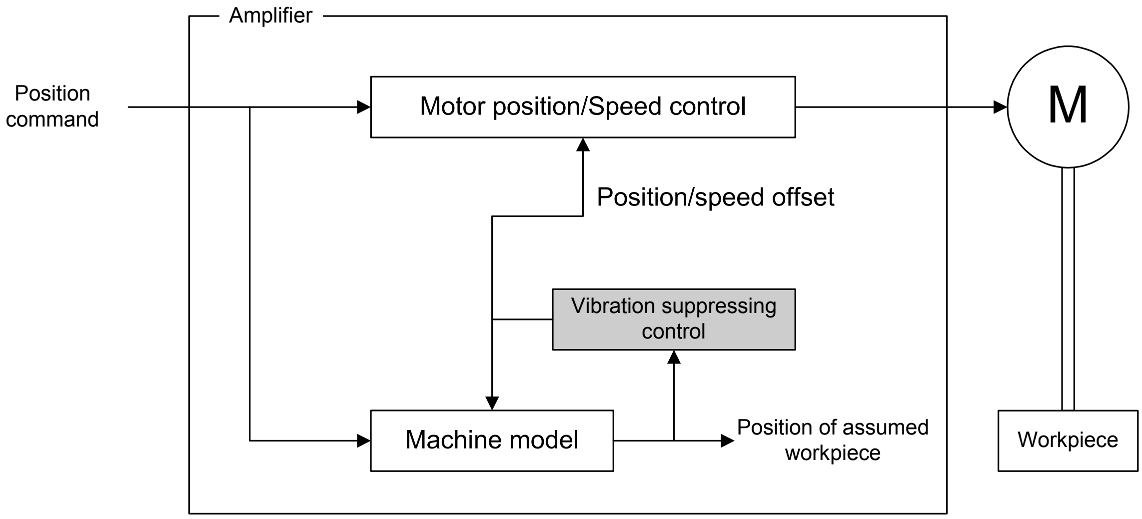
The end of the workpiece held in a structure having a spring characteristic such as the robot arm and transfer machine vibrates during quick acceleration or deceleration of the motor. The vibration suppression function aims at suppression of the workpiece and realization of positioning in a shorter cycle time in such a system.



Hint	Not only vibration of the tip of the machine but also vibration of the entire machine can be suppressed. • System without vibration suppression At motor acceleration / deceleration, torque tends to reach maximum value. This acceleration / deceleration shock could cause vibration to the entire machine. • System with vibration suppression Because the torque is controlled during acceleration / deceleration of the motor, the shock of acceleration/deceleration is reduced, and even with machine that is relatively less rigid, the vibration to the entire machine can be reduced.

■ Principles of vibration suppression

A machine model is contained inside, and the control works inside the model to eliminate vibration of the position of the assumed workpiece held in the model. The control amount is added as an offset to the position and speed control of the motor, thereby suppressing vibration of the actual workpiece position.



■ Mechanical characteristics and conditions that make vibration suppression effective

Applicable machine characteristics and conditions

- Vibration is caused at the end of the arm due to the shock of traveling/stopping of the robot arm or similar.
- The machine itself vibrates due to the shock of traveling / stopping of a part of the machine.
- The vibration frequency is about 1 [Hz] to 300 [Hz].

Inapplicable mechanical characteristics and conditions

- Vibration is observed continuously without relations to traveling / stopping.
- Eccentric vibration is caused in synchronization to the rotation of the motor or machine.
- The vibration frequency is less than 1 [Hz] or more than 300 [Hz].
- The traveling time is less than the vibration period.
- There is backlash in the mechanical joint to the vibrating mechanism.
- (Numerator 0 of electronic gear ratio / Denominator of electronic gear ratio) > 250 (18-bit encoder)
- (Numerator 0 of electronic gear ratio / Denominator of electronic gear ratio) > 1000 (20-bit encoder)
- If the command pulse train frequency is equal to or less than 20 [kHz]

5.8.2 Automatic Vibration Suppression

Automatic vibration suppression is a function for automatically adjusting the vibration suppressing anti resonance frequency to the optimum value.
Follow the procedure below.

■ Automatic vibration suppression setting procedure

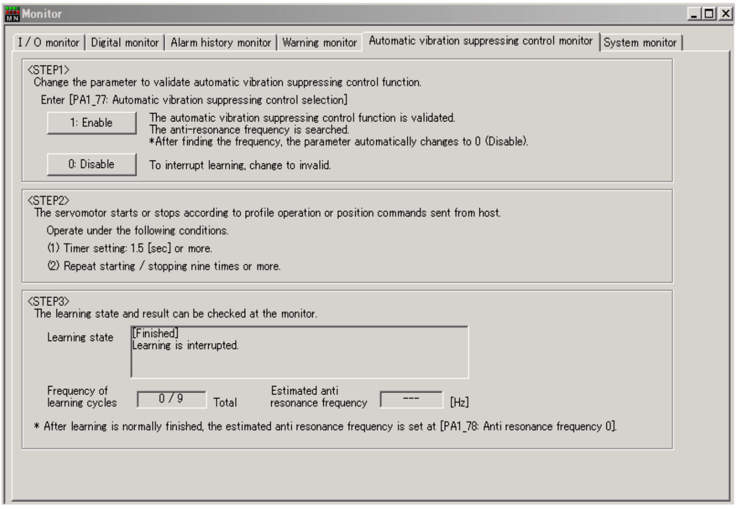
[1] Set PA1_77 (automatic vibration suppression selection) at 1 (enable).
[2] Perform profile operation or issue position commands from the host unit to start and stop the servomotor nine times.
[3] Set the dwell at 1.5 [s] or longer.
[4] After operation is normally finished, the optimum value is automatically stored in PA1_78 (vibration suppressing anti resonance frequency 0).
[5] Upon a fault (if no effect is verified), PA1_78 (vibration suppressing anti resonance frequency 0) remains the default value.
[6] After normal or faulty completion, PA1_77 (automatic vibration suppression selection) automatically changes to 0 (disable).

* The applicable frequency is 1 [Hz] to 100 [Hz].

If the procedure is interrupted at eight or fewer cycles and the main power is turned off, the cycle count begins from 1 again.

■ Learning state of automatic vibration suppression

Use the monitor of the PC Loader to monitor the learning state of the automatic vibration suppression.



If no expected effect is obtained under automatic vibration suppression, refer to the following "5.8.3 Manual Adjustment of Vibration Suppression."

5.8.3 Manual Adjustment of Vibration Suppression

■ Adjustment flow chart

(1) Adjust the servo gain.
↓
(2) Check the vibration suppressing anti resonance frequency.
↓
(3) Enter the vibration suppressing anti resonance frequency (parameters PA1_78, _80, _82 and _84).
↓
(4) Enter the S-curve (parameters PA1_51, 52). * May not be entered in case of auto or semi-auto tuning.
↓
(5) Check the effects.
↓
(6) Finely adjust the vibration suppressing anti resonance frequency (parameters PA1_78, _80, _82 and _84).
↓
(7) Adjust the inertia ratio of vibration suppressing workpiece (parameters PA1_79, _81, _83 and _85).

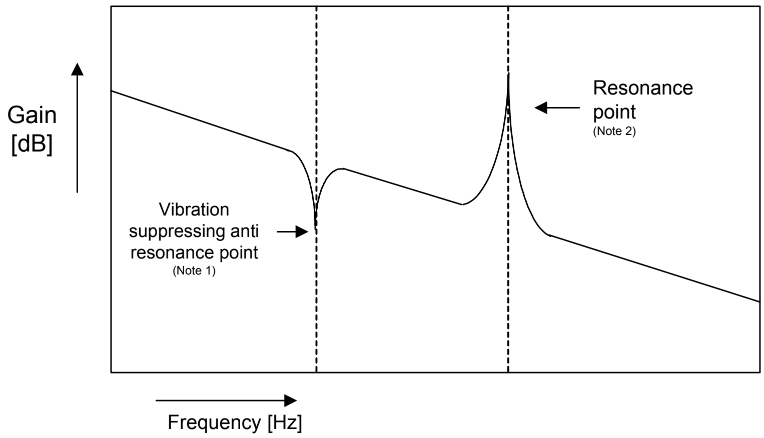
(1) Adjusting the servo gain
To ignore the vibration of the tip of the machine and reserve smooth stopping action of the servomotor free from overshoot, refer to the description given in sections 5.1 through 5.5 to adjust the servo gain.

Note	If gain-related parameters are adjusted after the vibration suppressing anti resonance frequency is set, the vibration suppressing anti resonance frequency must be adjusted again. Perform gain adjustment first.

(2) Checking the vibration suppressing anti resonance frequency

Using the PC Loader

Use the servo analyze function to check the vibration suppressing anti resonance point.



Note 1 The vibration suppressing anti resonance point may not be observed with the servo analyze function in the following machine configuration.

・Machine with large friction

・Machine with relatively large mechanical loss such as reduction gear and ball screw

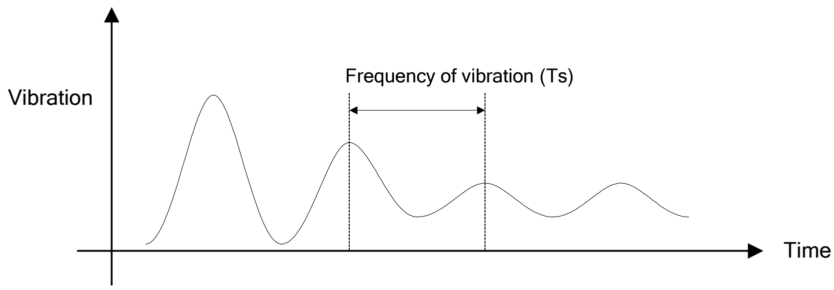
Note 2 Use the notch filter for the resonance point.

Hint	What are the resonance point and vibration suppressing anti resonance point? Vibration of the machine includes the "resonance point" and "vibration suppressing anti resonance point." The "resonance point" and "vibration suppressing anti resonance point" mentioned here are machine characteristics viewed from the motor. "Resonance point": Frequency at which the motor vibrates without arm tip vibration "Vibration suppressing anti resonance point": Frequency at which the arm tip vibrates without vibration of the motor shaft In general, the vibration suppressing anti resonance frequency is less than the resonance frequency.

Not using the PC Loader

There are two checking methods.
If measurement of the vibration frequency can be made with a laser displacement gauge or similar, adopt method 1). In other cases, adopt method 2).

1) Measure the vibration of the arm tip with a laser displacement gauge or similar.



Vibration suppressing anti resonance frequency = $\frac{1}{Ts}$ [Hz]

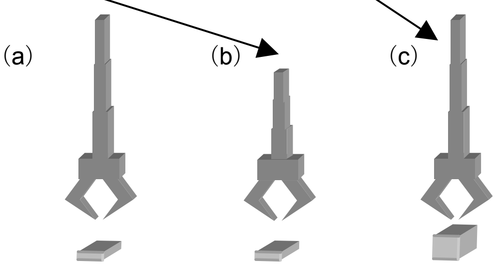
2) Starting at 300.0 [Hz] (maximum setting), decrease the reference values of parameters PA1_78, _80, _82 and _84 gradually while visually checking vibration, to find the best value.

(3) Entering the vibration suppressing anti resonance frequency
Enter the vibration suppressing anti resonance frequency obtained in step (2) to one of parameters PA1_78, _80, _82 and _84*.

No.	Name	Setting range	Default value	Change
PA1_78	Vibration suppressing anti resonance frequency 0	1.0 to 300.0 [Hz] (in increments of 0.1)	300.0	Always
PA1_80	Vibration suppressing anti resonance frequency 1	1.0 to 300.0 [Hz] (in increments of 0.1)	300.0	Always
PA1_82	Vibration suppressing anti resonance frequency 2	1.0 to 300.0 [Hz] (in increments of 0.1)	300.0	Always
PA1_84	Vibration suppressing anti resonance frequency 3	1.0 to 300.0 [Hz] (in increments of 0.1)	300.0	Always

* Parameters for up to four points can be entered.

While combining the "anti resonance frequency selection 0" and "anti resonance frequency selection 1" CONT input signals, up to four points can be specified.
The vibration suppressing anti resonance point may vary according to the arm length and weight of the load.



The vibration suppressing anti resonance frequency varies according to conditions a, b and c.

In such a case, assign this function to CONT input signals and switch the vibration suppressing anti resonance frequency setting.

Anti resonance frequency selection 1	Anti resonance frequency selection 0	Vibration suppressing anti resonance frequency
OFF	OFF	PA1_78
OFF	ON	PA1_80
ON	OFF	PA1_82
ON	ON	PA1_84

* This signal is always handled to be turned off if it is not assigned to the sequence input signal. In this case, PA1_78 (vibration suppressing anti resonance frequency 0) is always enabled.
To disable the vibration suppressing anti resonance frequency, set the vibration suppressing anti resonance frequency at 300.0 Hz.

Be sure to switch while the motion is stopped. Otherwise shock will be caused.

(4) Entering the S-curve
To attain effective vibration suppression, enter the S-curve.
Enter either PA1_51 (moving average S-curve time*) or PA1_52 (low-pass filter for S-curve time constant).
The approximate reference value is shown below.

No.	Name	Setting range	Default value	Change
PA1_51	Moving average S-curve time*	0.1 to 500[× 0.125msec] (in increments of 1)	20	Always
PA1_52	low-pass filter for S-curve time constant	0.0 to 1000.0[msec] (in increments of 0.1)	0.0	Always

* Cannot be set during auto or semi-auto tuning.

PA1_78/80/82/84 (Vibration suppressing anti resonance frequency)	α/β *1 ≤ 50 (PG=18bit) α/β *1 ≤ 200 (PG=20bit)		50 < α/β *1 ≤ 250 (PG=18bit) 200 < α/β *1 ≤ 1000 (PG=20bit)	
	PA1_51 *2 (Moving average S-curve time)	PA1_52 (Low-pass filter for S-curve time constant)	PA1_51 *2 (Moving average S-curve time)	PA1_52 (Low-pass filter for S-curve time constant)
< 10Hz	80	10ms	160	20ms
10Hz to 20Hz	40	5ms	80	10ms
> 20Hz	16 to 24	2 to 3ms	40	5ms

$$ {}^{*1}\quad \frac{\alpha}{\beta} = \frac{\text{PA1\_06 (numerator 0 of electronic gear)}}{\text{PA1\_07 (denominator of electronic gear)}} $$

* 2 Cannot be set during auto or semi-auto tuning.

(5) Checking the effects

There are three checking methods.

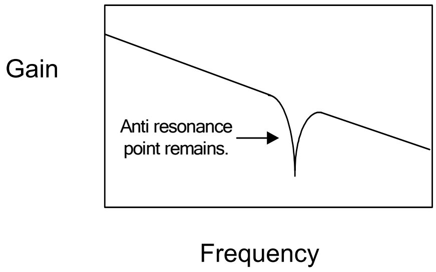
(1) Observe vibration of the arm tip with a laser displacement gauge or similar measuring instrument.

(2) Take a motion picture of the arm tip with a high speed video to check vibration.

(3) Visually observe.

Note

The vibration suppressing anti resonance frequency is not reflected on the servo analyze function even if it is entered.



(6) Finely adjusting the vibration suppressing anti resonance frequency

While checking effects of vibration suppression, finely adjust the reference value (in increments of 0.1 or 0.2).

(7) Entering the vibration suppressing workpiece inertia ratio

Ratio of the inertia of the vibrating point such as the arm specifies the portion of the total load inertia. By setting the vibration suppressing workpiece inertia ratio which is equivalent to amount to be applied when receiving reaction force from mechanical system (workpiece), the vibration can be further suppressed.

Setting method

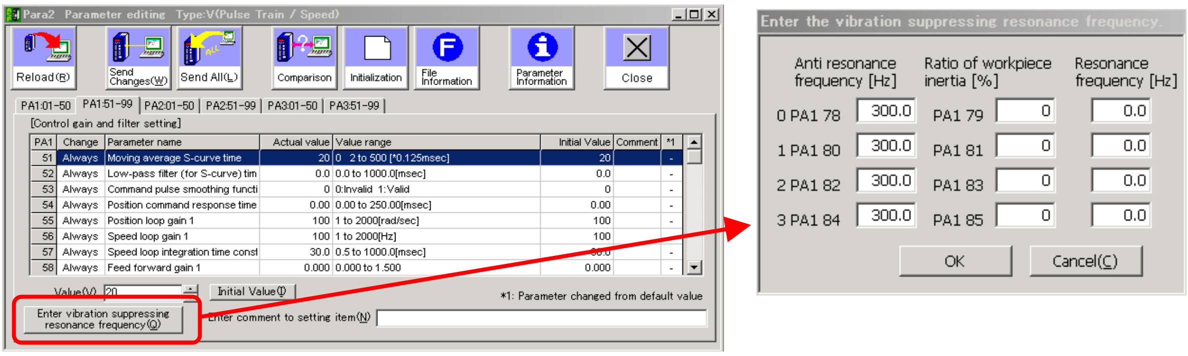
[1] Calculate the inertia of the vibrating point according to specifications of the machine.

$$\text{Vibration suppressing workpiece inertia ratio} = \frac{\text{Vibrating point inertia}}{\text{Entire load inertia}}$$

[2] Entering with the PC Loader

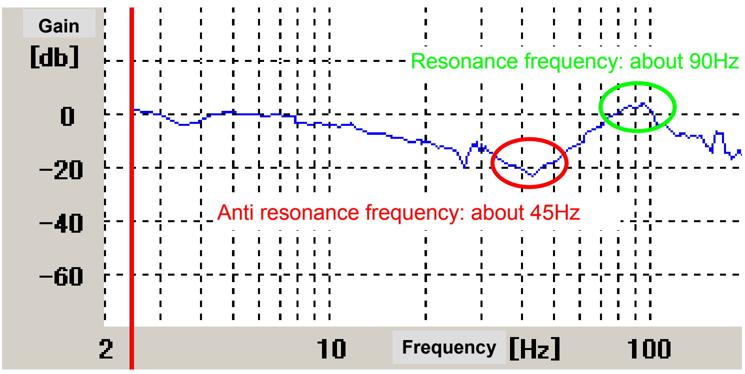
(1) Check the anti resonance frequency and resonance frequency by using the servo analyze function.

(2) Select [Parameter Edit] - [PA1: Control Gain - Filter Setting] and press the "enter vibration suppressing anti resonance frequency" button to open the exclusive window.
Enter the anti resonance frequency and resonance frequency* to automatically calculate the ratio of inertia of the workpiece.



* The resonance frequency is not the resonance frequency suppressed with the notch filter.
Use the servo analyze function to check this resonance frequency.
This resonance frequency appears as a set with the anti resonance frequency, and it is about two times the anti resonance frequency.

[Example of resonance frequency]

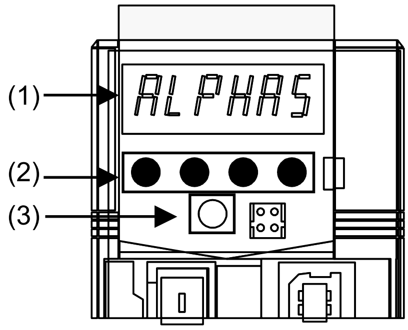


CHAPTER 6 KEYPAD

6

6.1 Display

The servo amplifier is equipped with a keypad (see the figure on the right).
The keypad is fixed.
The keypad is equipped with six-digit seven-segment LEDs (1), four keys (2), and a status indication LED (3) (lift the front cover).
Numbers and letters are displayed on the six-digit seven-segment LEDs.
Keys are [MODE/ESC], [∧], [∨], [SET/SHIFT] from the leftmost one.
The status indication LED (orange) shows the following conditions.



- Lit: Online state and servo ready ON
- Blink 1: Alarm or battery warning (lit for 0.35 sec. and unlit for 0.15 sec.)
- Blink 2: Sequence test mode (lit for 0.95 sec. and unlit for 1.2 sec.)
- Unlit: Offline state

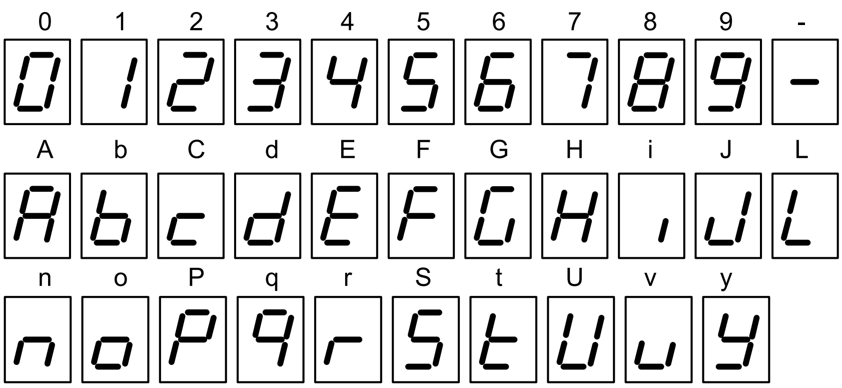
  The offline state indicates execution of test operation (manual operation, profile operation, etc.) made at the PC Loader or keypad, which accompanies motor rotation. The servo amplifier functions online in other cases.

6.1.1 Mode

The keypad functions in seven modes.
Some modes are unavailable for some models of the servo amplifier.

- Sequence mode: The control and operation statuses of the servo amplifier are displayed.
- Monitor mode: Various servomotor states, I/O signals and so on are monitored.
- Station No. mode: The station number specified with a parameter is displayed.
- Maintenance mode: Alarm at presents and alarm history are displayed.
- Parameter edit mode: Parameters can be edited.
- Positioning data edit mode: Positioning data can be edited.
- Test operation mode: Servomotor operates through key operation at the keypad.

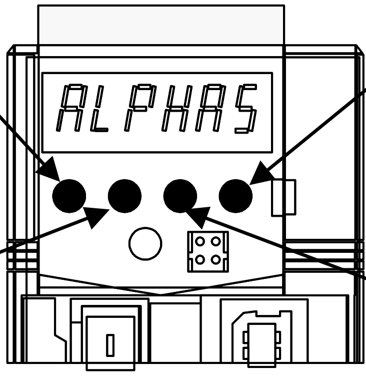
7-segment display



6.1.2 Key

[MODE/ESC]
- The mode is switched (MODE).
- The mode is deselected (ESC).

[SET/SHIFT]
- The cursor digit shifts to the right (SHIFT).
- The mode or value settles (SET).
- Press and hold for at least one second to settle.



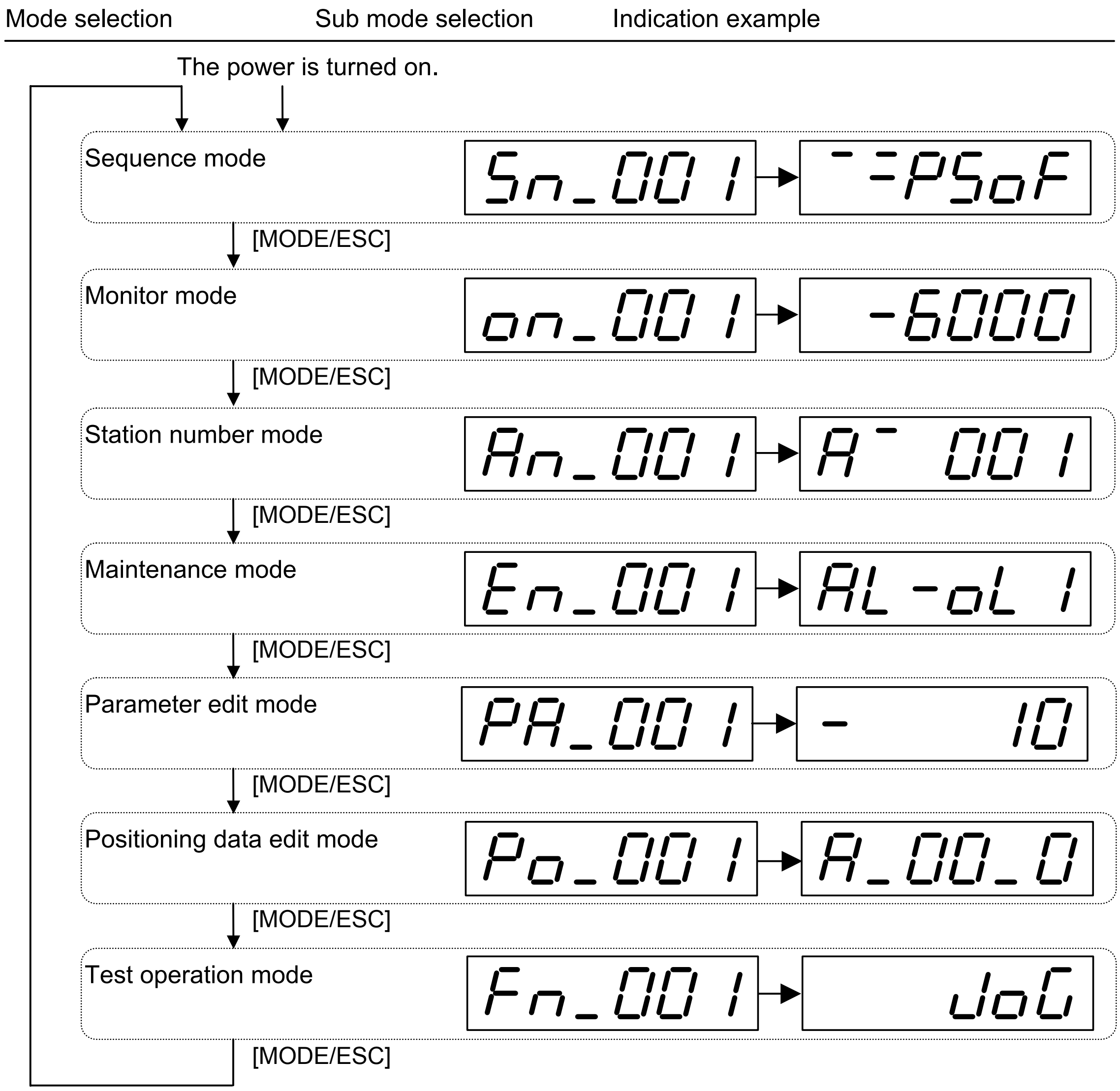
[∧]
The sub mode is selected.
The value increases by one (+1).

[∨]
The sub mode is selected.
The value decreases by one (-1).

- To show five or more digits, alternate the upper and lower five digits.

6.1.3 Mode Selection

Use the [MODE/ESC] key to select each mode.



6.2 Function List

In the parameter edit mode and the positioning data edit mode reference values can be checked and changed.

Mode	Sub mode	Sub mode selection	Indication and entry example
Sequence mode	Sequence mode	Sn_001	- =PSoF
	Amplifier setting	Sn_002	ud 201
	Motor setting	Sn_003	5.201-7
Monitor mode	Feedback speed	on_001	-6000
	Command speed	on_002	-6000
	Command torque	on_003	-300
	Motor current	on_004	-300
	Peak torque	on_005	-300
	Effective torque	on_006	300
	Feedback position	on_007	H99999
	Command position	on_008	H99999
	Position deviation	on_009	H99999
	Command pulse frequency	on_010	- 1000.0
	Feedback cumulative pulse	on_011	H99999
	Command cumulative pulse	on_012	H99999
	LS-Z pulse	on_013	H 10
	Load inertia ratio	on_014	300.0
	DC link voltage (max.)	on_015	400

Mode	Sub mode	Sub mode selection	Indication and entry example
Monitor mode	DC link voltage (min.)	on_016	400
	VREF input voltage	on_017	- 10.0
	TREF input voltage	on_018	- 10.0
	Input signal	on_019	HIIIIIIIII
	Output signal	on_020	HIIIIIIIII
	OL thermal value	on_021	100
	Braking resistor thermal value	on_022	100
	Power (w)	on_023	-300
	Motor temperature	on_024	100
	Overshoot unit amount	on_025	H99999
	Settling time	on_026	1000.0
	Resonance frequency 1	on_027	1000
	Resonance frequency 2	on_028	1000
Station number mode	Station number display	An_001	A‾ 001
Maintenance mode	Alarm at present	En_001	AL-oL 1
	Alarm history	En_002	A01. rH
	Warning at present	En_003	Er0111

Mode	Sub mode	Sub mode selection	Indication and entry example
Maintenance mode	Total time main power supply	En_004	P99999
	Total time - control power supply	En_005	c99999
	Motor running time	En_006	o .05.09
Parameter edit mode	Parameter page 1	PA_001	- 10
	Parameter page 2	PA_002	- 3210
	Parameter page 3	PA_003	H 65
Positioning data edit mode			
	Positioning status	Po01_1	A_00_0
	Target position	Po01_2	H00000
	Rotation speed	Po01_3	0000.01
	Stand still timer	Po01_4	000.00
	M code	Po01_5	FF
	Acceleration time	Po01_6	00000.1
	Deceleration time	Po01_7	00000.1

6

Mode	Sub mode	Sub mode selection	Indication and entry example
Test operation mode	Manual operation	Fn_001	JoG
	Position preset	Fn_002	PrESEt
	Homing	Fn_003	orG
	Automatic operation	Fn_004	AUto
	Alarm reset	Fn_005	AL rSt
	Alarm history initialization	Fn_006	AL ini
	Parameter initialization	Fn_007	PA ini
	Positioning data initialization	Fn_008	Po ini
	Auto offset adjustment	Fn_009	AdoFFt
	Z-phase offset adjustment	Fn_010	EnoFFt
	Auto tuning gain	Fn_011	AttUnE
	Easy tuning	Fn_012	EASY1
	Profile operation	Fn_013	Ptn
	Sequence test mode	Fn_014	SEqtSt
	Teaching	Fn_015	tEAcH

6.3 Sequence Mode

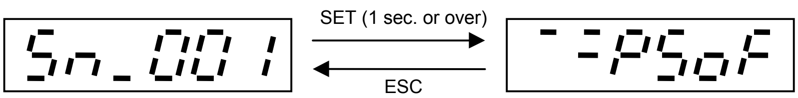
In the sequence mode, the state of the servo amplifier and amplifier setting are displayed.
Press the [MODE/ESC] key until [Sn_00n] is displayed, and press and hold the [SET/SHIFT] key for at least one second to show data.

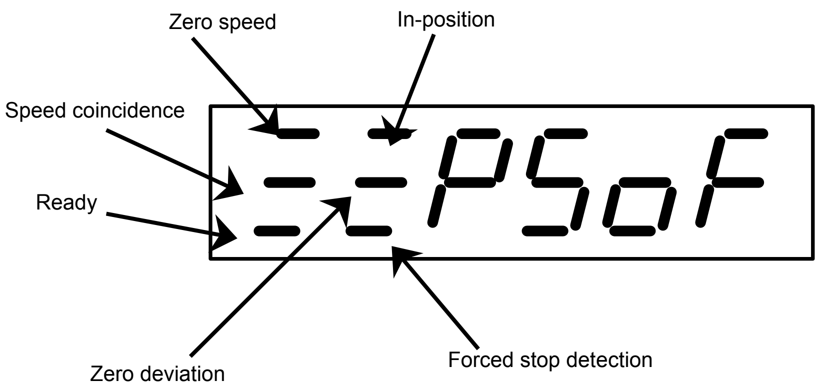
Sn_001 : Sequence mode
Sn_002 : Amplifier setting
Sn_003 : Motor setting

Hint	Key notation In this chapter, keypad keys may be simply described as shown below. • [MODE/ESC] key When using as a [MODE] key: MODE When using as an [ESC] key: ESC • [SET/SHIFT] key When using as a [SET] key: SET (for at least one second) When using as a [SHIFT] key: SHIFT

(1) Sequence mode

The status of the output signal of the servo amplifier and operation status are displayed.





Indication	Control mode	Name	Description
PSoF	Position control	Servo off	The motor is not turned on. The servomotor has no driving force.
PSon		Servo on	The servomotor is ready to rotate.
PJoG		Manual operation	Manual feed rotation state
PP in		Pulse train operation (position command operation)	During pulse input operation (During operation according to position command sent over SX)
PAUt		Positioning	Positioning is being executed.
PorG		Homing	Homing is being executed.
P int		Interrupt positioning	Interrupt positioning is being executed.
PPot		+OT	The positive over-travel signal is being detected.
Pnot		-OT	The negative over-travel signal is being detected.
P_n0		Zero speed stop	Stopped at zero speed due to forced stop signal
P_Lu		In LV	In undervoltage. For details, see the pages about undervoltage on 7-7 and 7-10.
nSoF	Speed control	Servo off	The motor is not turned on. The servomotor has no driving force.
nSon		Servo on	The servomotor is ready to rotate.
nJoG		Manual operation	Manual feed rotation state
nPot		+OT	The positive over-travel signal is being detected.
nnot		-OT	The negative over-travel signal is being detected.
n_n0		Zero speed stop	Stopped at zero speed due to forced stop signal
n_Lu		In LV	In undervoltage. For details, see the pages about undervoltage on 7-7 and 7-10.
tSoF	Torque control	Servo off	The motor is not turned on. The servomotor has no driving force.
tSon		Servo on	The servomotor is ready to rotate.
tJoG		Manual operation	Manual feed rotation state
t_Lu		In LV	In undervoltage. For details, see the pages about undervoltage on 7-7 and 7-10.

6

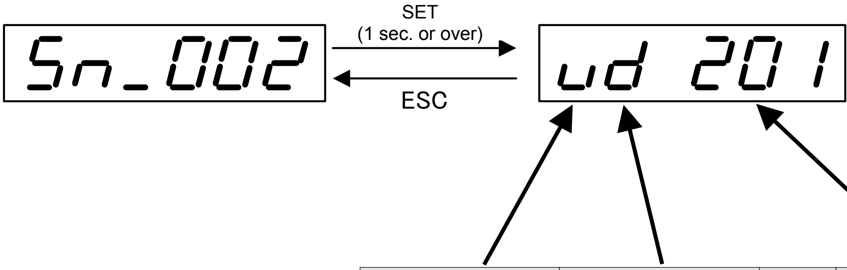
Hint	When the servo amplifier power is turned on, "sequence mode operation mode" is shown. The indication contents at power-on can be changed with parameter PA2_77.

Reference value	Initial display	
0	Sn_001	Sequence mode
1	on_001	Feedback speed
2	on_002	Command speed
3	on_003	Command torque
4	on_004	Motor current
5	on_005	Peak torque
6	on_006	Effective torque
7	on_007	Feedback position
8	on_008	Command position
9	on_009	Position deviation
10	on_010	Command pulse frequency
11	on_011	Feedback cumulative pulse
12	on_012	Command cumulative pulse
13	on_013	LS-Z pulse
14	on_014	Load inertia ratio
15	on_015	DC link voltage (max.)
16	on_016	DC link voltage (min.)
17	on_017	VREF input voltage
18	on_018	TREF input voltage

Reference value	Initial display	
19	on_019	Input signals
20	on_020	Output signals
21	on_021	OL thermal value
22	on_022	Braking resistor thermal value
23	on_023	Power (W)
24	on_024	Motor temperature
25	on_025	Overshoot unit amount
26	on_026	Settling time
27	on_027	Resonance frequency 1
28	on_028	Resonance frequency 2
40	An_001	Station No
41	En_001	Alarm at present
42	En_002	Alarm history
43	En_003	Warning at present
44	En_004	Total time-main power supply
45	En_005	Total time-control power supply
46	En_006	Motor running time

(2) Amplifier setting

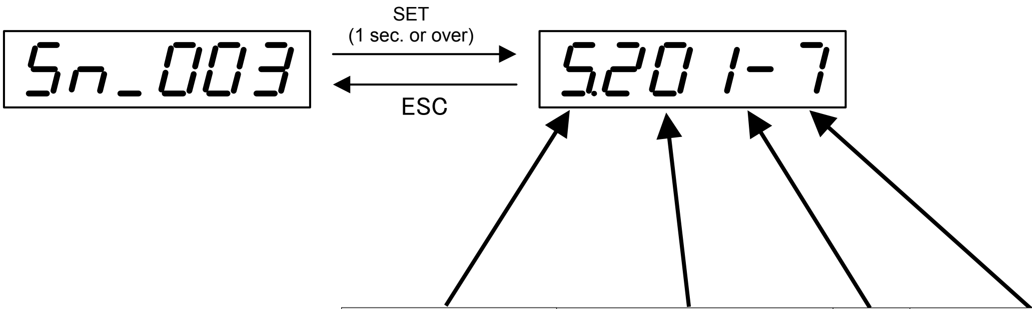
The servo amplifier control function, interface format and capacity are displayed.



1st digit		2nd digit		3rd digit	4th to 6th digits	
Indication	Control function	Indication	Connection format		Indication	Capacity
u	Speed control	d	DI/DO standard		201	0.2 [kW] (20 × 10^1)
		S	SX bus		202	2.0 [kW] (20 × 10^2)

(3) Motor setting

The type of servomotor connected to the servo amplifier, capacity and encode type are displayed.



1st digit		2nd to 4th digits		5th digit	6th digit	
Indication	Motor profile	Indication	Capacity		Indication	Encoder type
S	Slim	201	0.2 [kW] (20 × 10^1)	-	6	18bit-ABS
c	Cubic	202	2.0 [kW] (20 × 10^2)		7	20bit-INC
G	Medium inertia					

6

6.4 Monitor Mode

In the monitor mode, the servomotor rotation speed, cumulative input pulse and so on are displayed.
Press the [MODE/ESC] key until [on_00n] is displayed, and press and hold the [SET/SHIFT] key for at least one second to display data.

- on_001 : Feedback speed
- on_002 : Command speed
- on_003 : Command torque
- on_004 : Motor current
- on_005 : Peak torque
- on_006 : Effective torque
- on_007 : Feedback position
- on_008 : Command position
- on_009 : Position deviation
- on_010 : Command pulse frequency
- on_011 : Feedback cumulative pulse
- on_012 : Command cumulative pulse
- on_013 : LS-Z pulse
- on_014 : Load inertia ratio
- on_015 : DC link voltage (max.)
- on_016 : DC link voltage (min.)
- on_017 : VREF input voltage
- on_018 : TREF input voltage
- on_019 : Input signal
- on_020 : Output signal
- on_021 : OL thermal value
- on_022 : Braking resistance thermal value
- on_023 : Power (W)
- on_024 : Motor temperature
- on_025 : Overshoot unit amount
- on_026 : Settling time
- on_027 : Resonance frequency 1
- on_028 : Resonance frequency 2

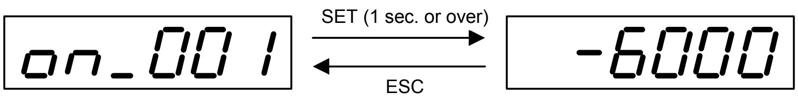
6

(1) Feedback speed (displayed digits: signed four digits)

Current rotation speed of servomotor.

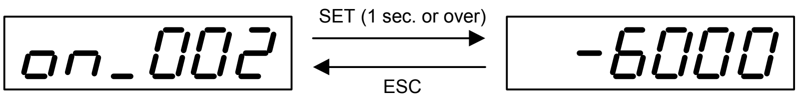
The correct value is displayed even if the load (mechanical system) rotates the motor.

The speed is displayed in r/min and a negative sign is attached for reverse rotation (clockwise rotation when viewed against the motor shaft).



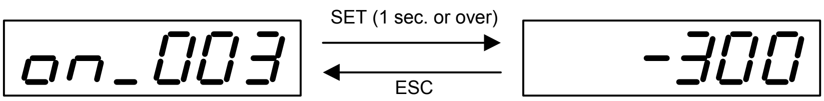
(2) Command speed (displayed digits: signed four digits)

Current speed command issued to the servomotor. The command speed is given in a speed command voltage, multi-step speed, pulse or similar. The speed is displayed in [r/min] and a negative sign is attached for reverse rotation (clockwise rotation when viewed against the motor shaft).

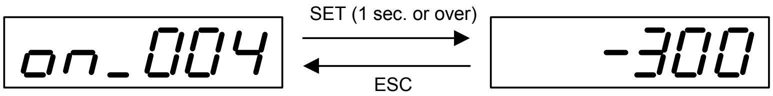


(3) Command torque (displayed digits: signed three digits)

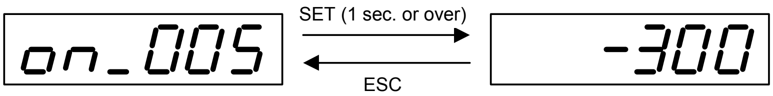
Average torque issued from the servo amplifier to the servomotor; the torque is displayed in percent [%] to the rated torque. The range from 0 [%] to the maximum torque is displayed in increments of 1 [%]. In case of a negative average torque, a negative sign is attached to the most significant digit.



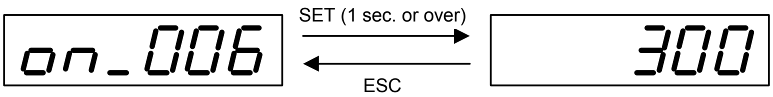
(4) Motor current (displayed digits: signed three digits)
Current flowing through the servomotor; the current is displayed in percent [%] to the rated current. The range from 0 [%] to the maximum current is displayed in increments of 1 [%]. In case of a negative motor current, a negative sign is attached to the most significant digit.



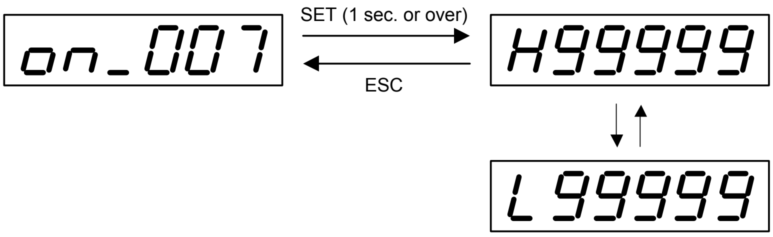
(5) Peak torque (displayed digits: signed three digits)
Peak torque value of the servomotor at every two seconds; the torque is displayed in percent [%] to the rated torque.
The range from 0 [%] to the maximum torque is displayed in increments of 1 [%]. In case of a negative peak torque, a negative sign is attached to the most significant digit.



(6) Effective torque (displayed digits: signed three digits)
The load ratio of the servomotor; displayed in percent [%] to the rated torque.
The range from 0 [%] to the maximum torque is displayed in increments of 1 [%].

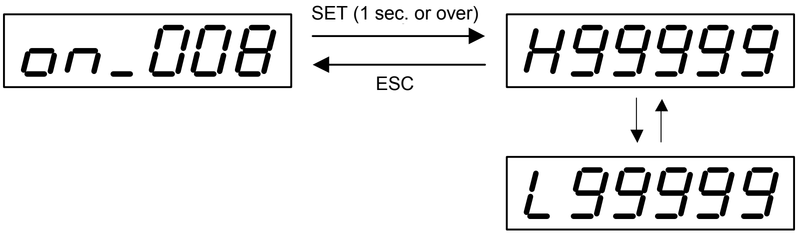


(7) Feedback position (displayed digits: signed 10 digits)
The rotation amount of the servomotor is displayed in the unit amount after correction with an electronic gear. If the electronic gear is unused, the data indicates the exact rotation amount of the motor shaft encoder (1048576 pulses/revolution for the 20-bit serial encoder).
In case of a negative feedback position, "H" or "L" and a negative sign alternate at the most significant digit.



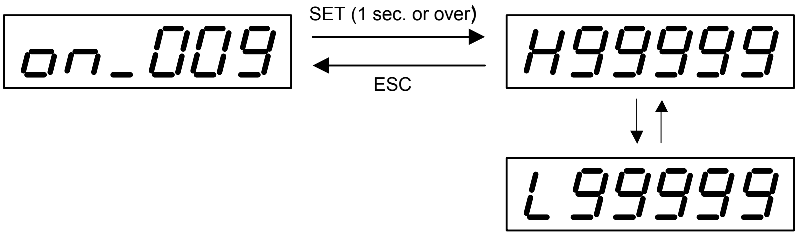
Press the SHIFT key to alternate between high order and low order five digits.

(8) Command position (displayed digits: signed 10 digits)
The position of the servomotor controlled by the servo amplifier is displayed in the unit amount after correction with an electronic gear. If the operation command is turned off and the load (mechanical system) rotates the motor after the target position is reached, the position is not correct. For indication, refer to "(7) Feedback position."
In case of a negative command position, "H" or "L" and a negative sign alternate at the most significant digit.



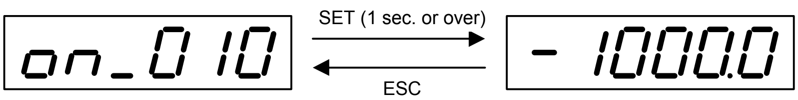
Press the SHIFT key to alternate between the high order and low order five digits.

(9) Position deviation (displayed digits: signed 10 digits)
The difference between the command position and feedback position is displayed. The deviation amount is in encoder pulses.
For the indication, refer to "(7) Feedback position."
In case of a negative position deviation, "H" or "L" and a negative sign alternate at the most significant digit.



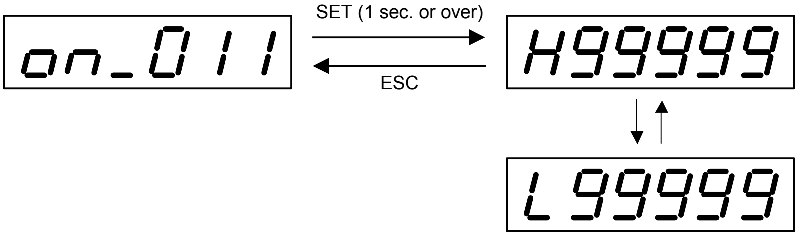
Press the SHIFT key to alternate between the high order and low order five digits.

(10) Command pulse frequency (displayed digits: signed five digits)
The pulse frequency supplied to the pulse input terminal is displayed. The value is displayed in 0.1 [kHz].
The displaying range is from -1000.0 [kHz] to 1000.0 [kHz].



(11) Feedback cumulative pulse (displayed digits: signed 10 digits)

The cumulative pulses of servomotor rotation amount are displayed in encoder pulses (1048576 pulses per revolution). Reverse rotation decreases the cumulative value. Even if the load (mechanical system) rotates the motor, the correct value is displayed. For the indication, refer to "(7) Feedback position."



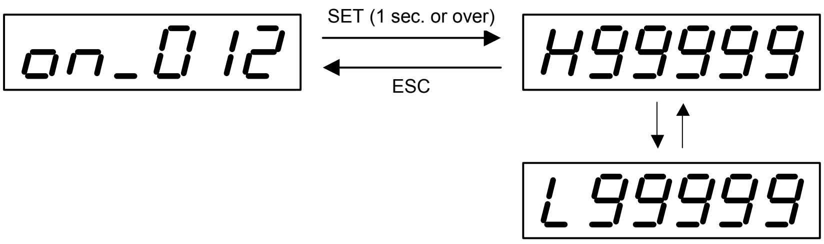
Press the SHIFT key to alternate between the high order and low order five digits.

Hint	Press and hold the [∧] and [∨] keys simultaneously for at least one second to reset the feedback cumulative pulses.

(12) Command cumulative pulse (displayed digits: signed 10 digits)

The number of pulses supplied to the pulse input terminal is displayed. The cumulative value increases upon forward direction pulses, while it decreases upon reverse direction pulses. With two signals at A/B phase pulse, each edge is counted (multiple of four). The count increases upon B-phase advance.

For the indication, refer to "(7) Feedback position."



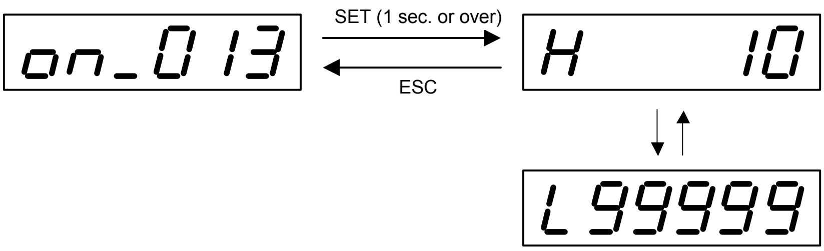
Press the SHIFT key to alternate between the high order and low order five digits.

Hint	Press and hold the [∧] and [∨] keys simultaneously for at least one second to reset the command cumulative pulses.

(13) LS-Z pulse (displayed digits: unsigned seven digits)

The number of pulses in a homing counted since the home position LS signal is turned off until the Z-phase of the encoder of the servomotor is detected is displayed. The indication is updated every time homing is performed. Because the value is in the homing direction, no negative sign is attached.

- Displayed only if the Z-phase is enabled.



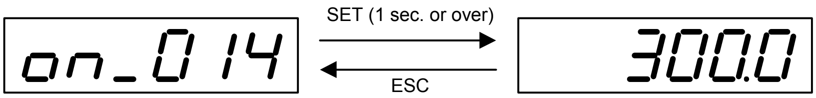
Press the SHIFT key to alternate between the high order and low order five digits.

(14) Load inertia ratio (displayed digits: unsigned four digits)

The load inertia ratio recognized by the servo amplifier without relations to parameter PA1_13 (tuning mode selection) is displayed. The value is displayed in a multiple (in 0.1 increments) to the inertia of the servomotor itself.

The displaying range is from 0.0 to 300.0 times.

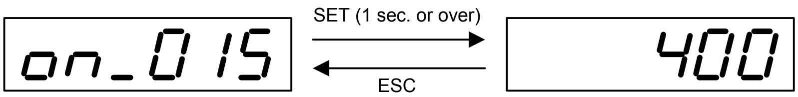
$$\text{(Load inertia ratio)} = \frac{\text{(Load inertia recognized by servo amplifier)}}{\text{(Inertia of servomotor itself)}}$$



(15) DC link voltage (max.) (displayed digits: unsigned three digits)

The DC link voltage (max.) of the servo amplifier at every two seconds is displayed.

The displaying range is from 0 [V] to 500 [V].

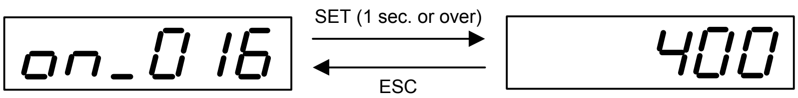


Hint	If the DC link voltage (max.) exceeds 390 [V] during operation, an external braking resistor is necessary. "HV" (overvoltage) is detected at 420 [V].

(16) DC link voltage (min.) (displayed digits: unsigned three digits)

The DC link voltage (min.) of the servo amplifier at every two seconds is displayed.

The displaying range is from 0 [V] to 500 [V].

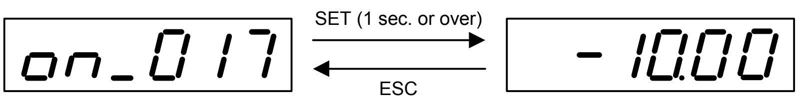


Hint	"LV" (under-voltage) is detected at 200 [V].

(17) VREF input voltage (displayed digits: signed four digits)

The input voltage of the analog input terminal [VREF] is displayed in 0.01 [V]. The negative sign indicates a negative voltage.

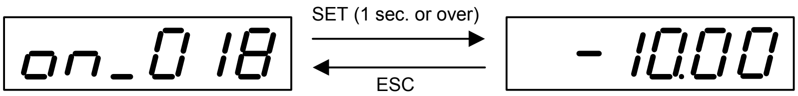
The displaying range is from -10.50 [V] to 10.50 [V].



(18) TREF input voltage (displayed digits: signed four digits)

The input voltage of the analog input terminal [TREF] is displayed in 0.01 [V]. The negative sign indicates a negative voltage.

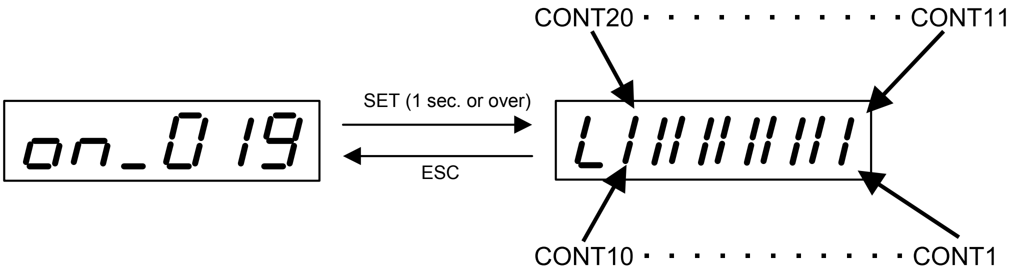
The displaying range is from -10.50 [V] to 10.50 [V].



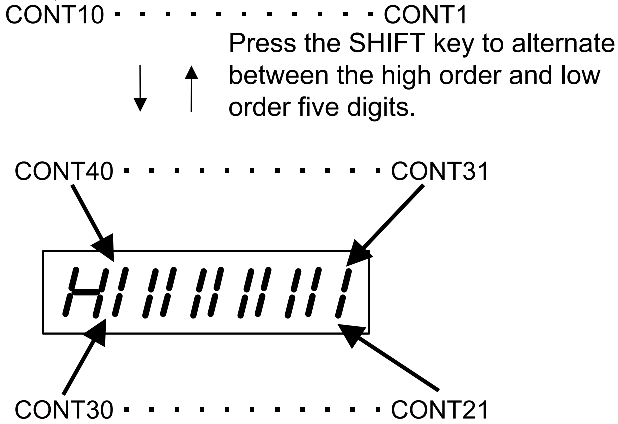
(19) Input signals

The ON/OFF status of sequence input signals supplied to the servo amplifier is displayed.

The corresponding LED lights up when the input signal is turned on.

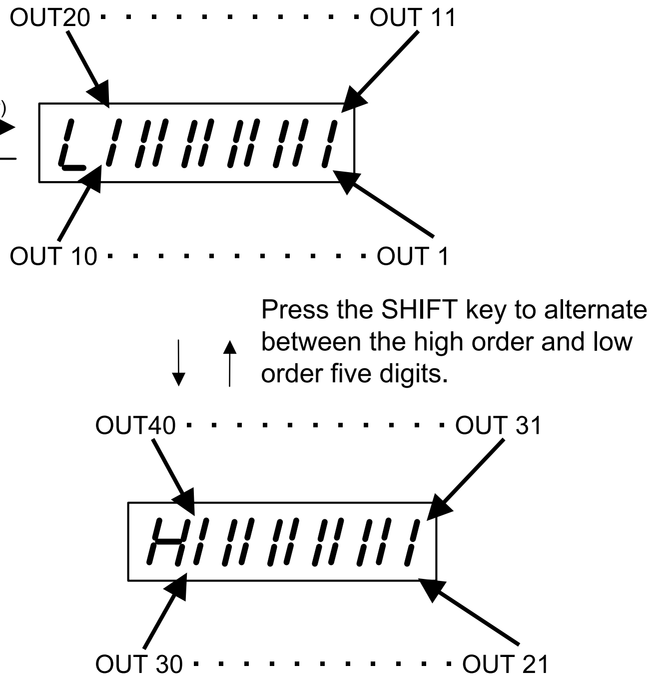


Hint	The number of sequence input signals varies according to the type of the servo amplifier.



(20) Output signals

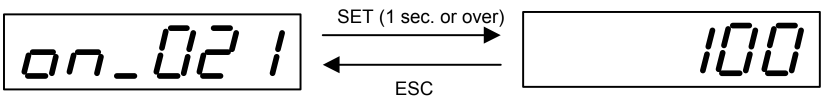
The ON/OFF status of sequence output signals issued by the servo amplifier is displayed.
The corresponding LED lights up when the output signal is turned on.



Hint	The number of sequence output signals varies according to the type of the servo amplifier.

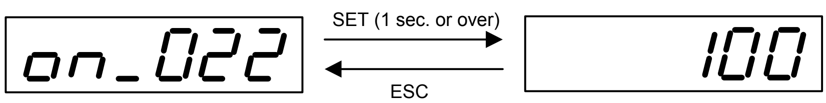
(21) OL thermal value (displayed digits: unsigned three digits)

The load ratio to the load alarm level is displayed in percent. An overload alarm is caused if this value reaches 100. The minimum increment is 1 [%]. The displaying range is from 0 [%] to 100 [%].

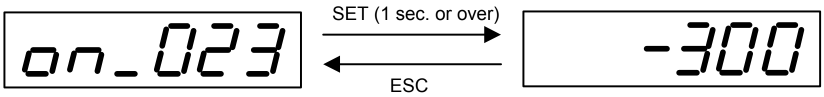


(22) Braking resistor thermal value (displayed digits: unsigned three digits)

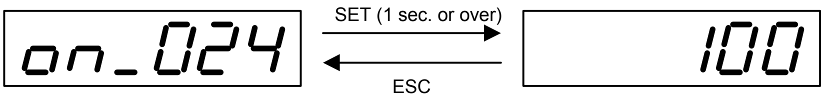
The regeneration load ratio to the braking resistor overheat alarm level is displayed in percent. A braking resistor overheat alarm is caused if this value is 100. The regeneration load ratio is calculated for 0.4 [kW] or larger motor capacities if PA2_65 (braking resistor selection) is set at 1 (internal resistor).
The minimum increment is 1 [%]. The displaying range is from 0 [%] to 100 [%].



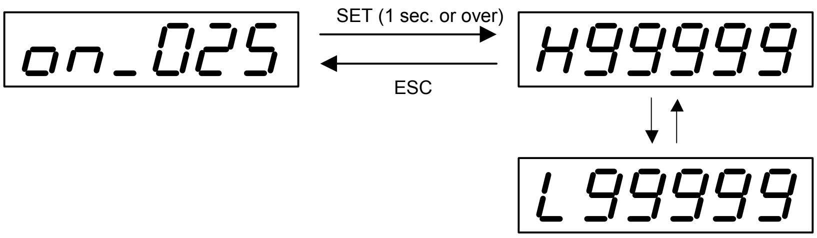
(23) Power (w) (displayed digits: signed three digits)
The servomotor power (w) is displayed in percent [%] to the rating.
The data is displayed in the range from 0 [%] to 900 [%] in increments of 1 [%].



(24) Motor temperature (displayed digits: unsigned three digits)
The servomotor temperature is displayed. The range from 0 [°C] to 120 [°C] is displayed in increments of 1 [°C].

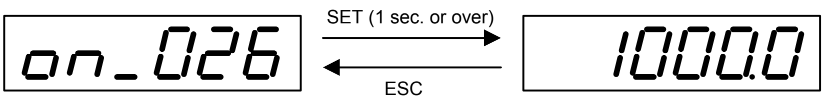


(25) Overshoot unit amount (displayed digits: signed 10 digits)
The overshoot unit amount under position control is displayed. The data is displayed in the unit amount after correction by the electronic gear.
If the overshoot unit amount is negative, "H" or "L" and a negative sign alternate at the most significant digit.

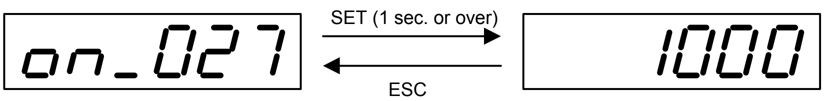


Press the SHIFT key to alternate between the high order and low order five digits.

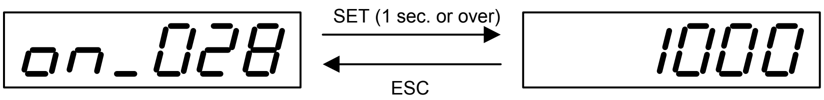
(26) Settling time (displayed digits: unsigned five digits)
The settling time under position control is displayed.
The displaying range is from 0 [ms] to 1000.0 [ms]. If the settling time exceeds 1000.0 [ms], "1000.0 [ms] is displayed.



(27) Resonance frequency 1 (displayed digits: unsigned four digits)
The resonance frequency recognized by the servo amplifier is displayed.
The displaying range is from 100 [Hz] to 2000 [Hz]. If no resonance is detected, "4000 [Hz]" is displayed.



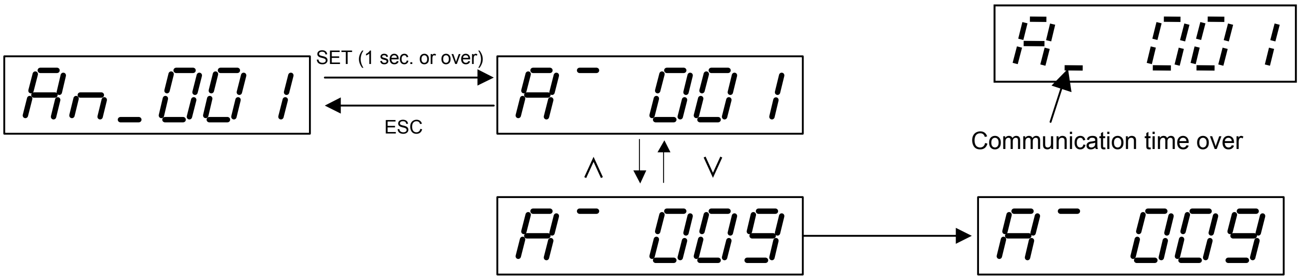
(28) Resonance frequency 2 (displayed digits: unsigned four digits)
The resonance frequency recognized by the servo amplifier is displayed.
The displaying range is from 100 [Hz] to 2000 [Hz]. If no resonance is detected, "4000 [Hz]" is displayed.



6.5 Station No Mode

In the station no mode, the station no of the servo amplifier is displayed and a new station no can be entered.
Press the [MODE/ESC] key until [An_00n] is displayed, and press and hold the [SET/SHIFT] key for at least one second to display data.

An_00n : Station no



- Press the SHIFT key to move among digits.
- Parameter PA2_72 is updated.

6.6 Maintenance Mode

In the maintenance mode, detected alarms, total time - main power supply and so on are displayed. Press the [MODE/ESC] key until [En_00n] is displayed and press and hold the [SET/SHIFT] key for at least one second to display data.

En_001	: Alarm at present	En_004	: Total time - main power supply
En_002	: Alarm history	En_005	: Total time - control power supply
En_003	: Warning at present	En_006	: Motor running time

(1) Alarm at present

The alarm detected currently is displayed in a code.

- If an alarm is detected, the status indication LED blinks. After an alarm reset, indication changes to AL----. Use [En_002] to display the history.
  After an alarm is detected, the following is displayed automatically. Supplementary data to the alarm can be displayed, too.

En_001 —SET (1 sec. or over)→ AL-oL1
AL-oL1 —ESC→ En_001

SET (1 sec. or over)

∧ ↓↑ ∨

P99999	(Total time-main power supply)
c99999	(Total time-control power supply)
o 9999	(Motor running time)
n-6000	(Feedback speed)
b-6000	(Feedback speed before five min)
y-6000	(Command speed)
t -300	(Command torque)
i -300	(Motor current)
r 300	(Effective torque)
u 400	(DC link voltage)
E 12345	(EC error counts)
H99999	(Command position H)
L99999	(Command position L)
S PSon	(Sequence mode)

6

■ Alarm indication

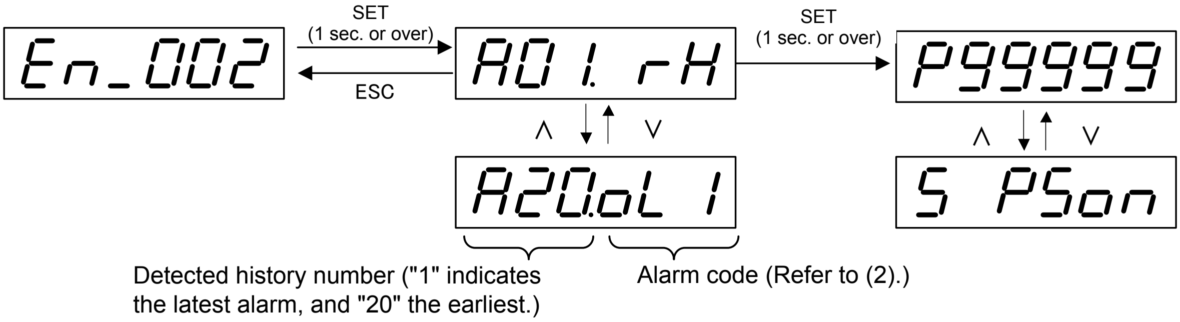
Order	Indication	Name
1	AL-oc 1	Overcurrent 1
2	AL-oc2	Overcurrent 2
3	AL- oS	Overspeed
4	AL-Luc	Control power undervoltage
5	AL- Hu	Overvoltage
6	AL-Et 1	Encoder trouble 1
7	AL-Et2	Encoder trouble 2
8	AL- ct	Circuit trouble
9	AL- dE	Memory Error
10	AL- Fb	Fuse Broken
11	AL- cE	Motor Combination Error
12	AL- tH	Braking transistor overheat
13	AL- Ec	Encoder Communication error
14	AL-ctE	CONT (control signal) Error
15	AL-oL 1	Overload 1

Order	Indication	Name
16	AL-oL2	Overload 2
17	AL-LuP	Main power undervoltage
18	AL-rH 1	Internal braking resistor overheat
19	AL-rH2	External braking resistor overheat
20	AL-rH3	Braking transistor error
21	AL- oF	Deviation overflow
22	AL- AH	Amplifier overheat
23	AL- EH	Encoder overheat
24	AL-dL 1	Absolute data Lost 1
25	AL-dL2	Absolute data Lost 2
26	AL-dL3	Absolute data Lost 3
27	AL- AF	Multi-turn data over flow
28	AL- iE	Initial Error
29	AL- HF	Command Pulse Frequency Error

Hint

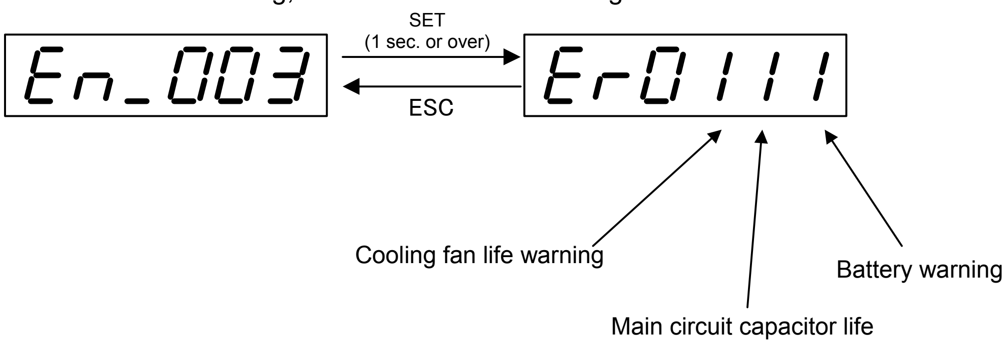
- The alarm is automatically displayed upon detection.
- If an alarm is detected, indication blinks quickly (at 0.5-second intervals) (when compared with regular blinks at 1-second intervals).
- The alarm can be reset even in the test operation mode.
- When an alarm is displayed, press and hold the [∧] and [∨] keys simultaneously for at least one second to reset the alarm.
- After an alarm reset, indication changes to AL----.
  Next, initial display is automatically restored.

(2) Alarm history
Up to 20 past alarms can be displayed.
Press the [∧] or [∨] key to scroll in the history.

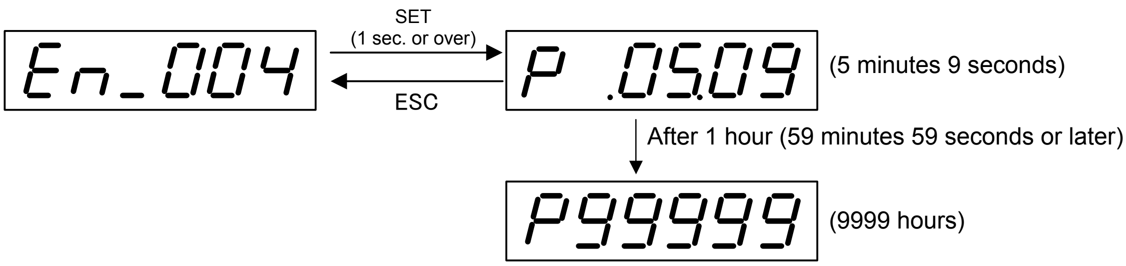


Hint	The history can be cleared in the test operation mode [Fn_005].

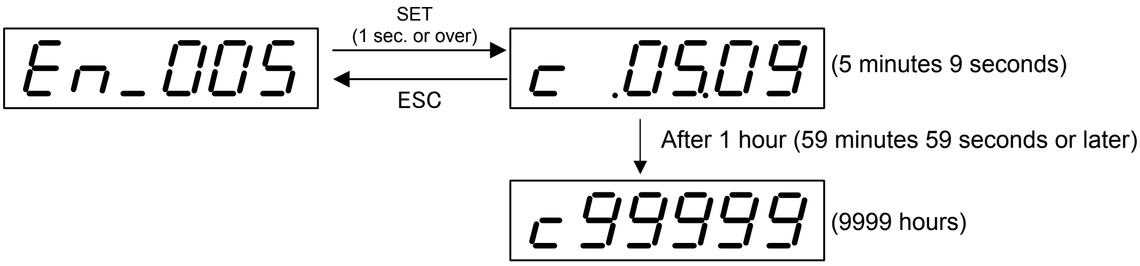
(3) Warning at present
Warnings in the ABS battery, main circuit capacitors and cooling fan are displayed.
"0" indicates no warning, and "1" indicates a warning.



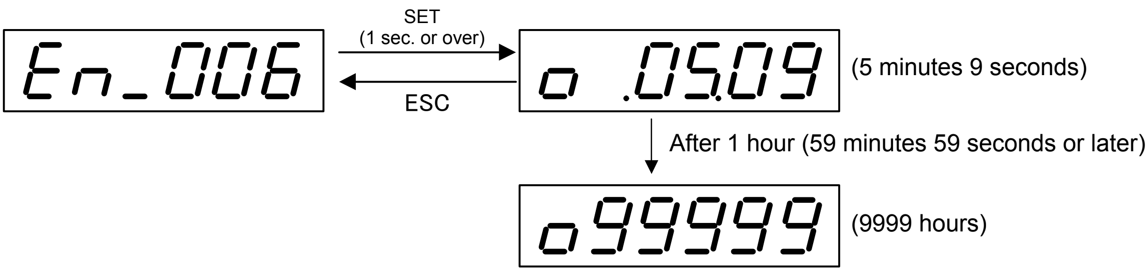
(4) Total time - main power supply
The cumulative time of turning the main power (L1, L2 and L3) on is displayed.
The displaying range is from 0 [h] to 9999 [h].



(5) Total time - control power supply
The cumulative time of turning the control power (L1C and L2C) on is displayed.
The displaying range is from 0 [h] to 9999 [h].



(6) Motor running time
The cumulative time of turning the servomotor on is displayed.
The displaying range is from 0 [h] to 9999 [h].



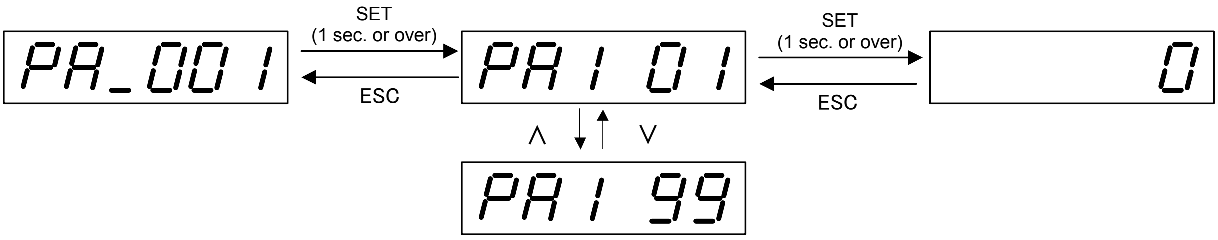
6.7 Parameter Edit Mode

Parameters can be edited in the parameter edit mode.
Press the [MODE/ESC] key until [PA_00n] is displayed and press and hold the [SET/SHIFT] key for at least one second to select parameter editing.
After selecting parameter editing, press the [∧] or [∨] key to select the number of the desired parameter to be edited.

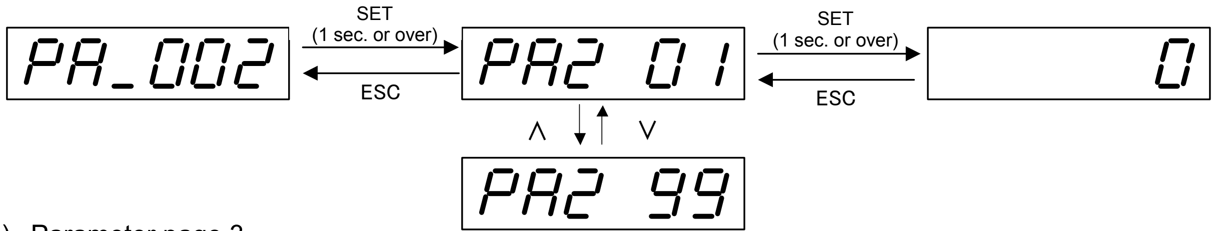
Press and hold the [SET/SHIFT] key for at least one second to edit the data.

PA_001 : Parameter page 1
PA_002 : Parameter page 2
PA_003 : Parameter page 3

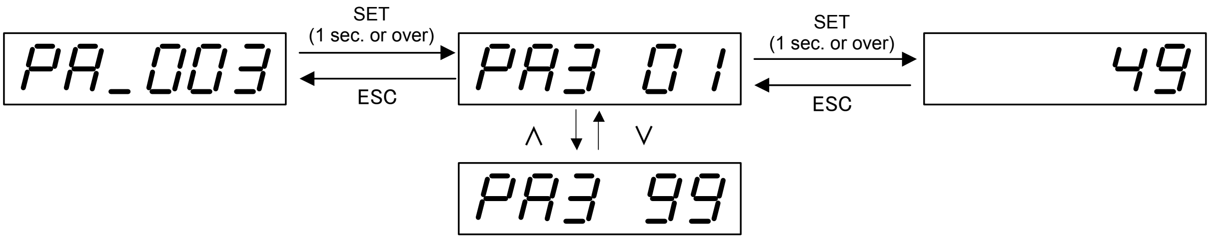
(1) Parameter page 1
On parameter page 1, relatively frequently used parameters are registered. Changes in most parameters are reflected on the servo amplifier and servomotor operation immediately.



(2) Parameter page 2
On parameter page 2, parameters related to system setting such as the homing functions are registered. Changes in parameters become enabled after the power is turned off then on again.



(3) Parameter page 3
On parameter page 3, parameters related to system setting such as sequence I/O terminals are registered. Changes in parameters become enabled after the power is turned off then on again.



■ Indication and editing

The parameter indication and editing methods are described below.

・Value indication

<Unsigned parameter with six or less digits>

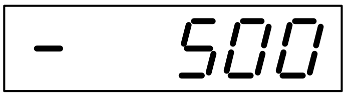
Unsigned values with six or less digits are displayed in the exact value.

Example shown on the left indicates a two-digit value.

To indicate the number of digits of the value explicitly, digits other than those that can be entered are also displayed.

<Signed parameter with six or less digits>

Signed value with six or less digits has a negative sign at the left end and the value is displayed in the remaining digits in the exact value. In case of a six-digit number, the negative sign at the left end and the most significant digit alternate.

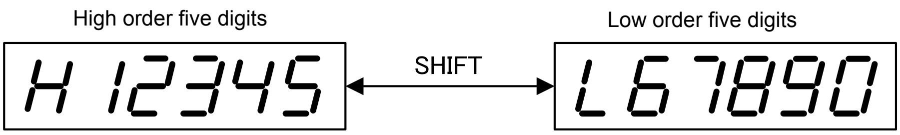


6

<Unsigned parameter with seven to ten digits>

"H" is displayed at the left end for the high order five digits.

"L" is displayed at the left end for the low order five digits.

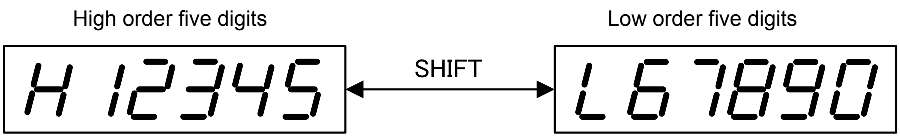


<Signed parameter with seven to 10 digits>

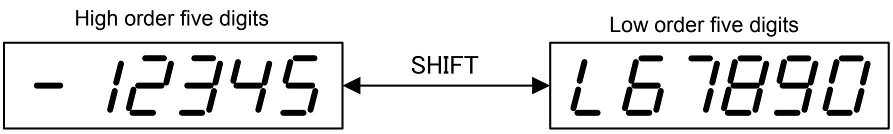
"H" is displayed at the left end of a positive high order five digits, while "-" and "H" alternate in case of a negative high order five digits.

"L" is displayed at the left end for the low order five digits.

In case of positive value

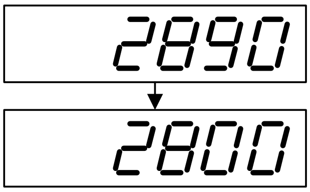


In case of negative value



Value editing

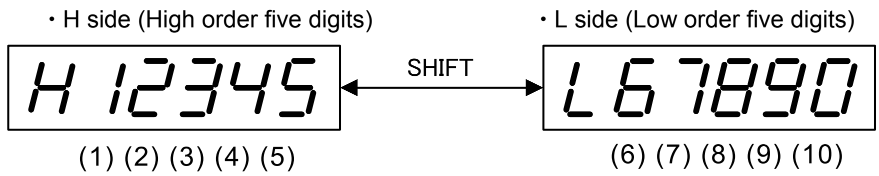
When a parameter is loaded, the units digit (rightmost digit) blinks (for parameters consisting of high and low orders, the high order data is displayed). The blinking digit can be edited (the digit blinks at about 1-second intervals). Press the [∧] or [∨] key to change the value.
Even if "9" changes to "0," no carry-over occurs (the higher order number does not change). Similarly, the higher order number does not change when "0" changes to "9."



Press the [∧] key at the tens digit to increase "9."

The tens digit changes to "0" but no change occurs to the higher order number.

Press the [SET/SHIFT] key to shift the digit to be edited. The shifting order is from (1) to (10).



Settling the value

Press and hold the [SET/SHIFT] key for at least one second to settle the value. All digits blink three times. The settled value remains. (The value blinks at about 0.5-second intervals when it is settled.)
Press the [MODE/ESC] key to return to the parameter number selection screen.

Value out of range

Values out of the allowable setting range can be entered as far as the number of digits allows.

[Example] In case of parameter PA1_7, you can enter in the range from 0 to 9999999 (setting range: 1 to 4194304). However, the value out of the permissible setting range is not reflected on the parameter (NG indication is caused).

6

■ An example of editing operation

Change parameter PA1_7 (denominator of electronic gear) to100000.

Key operation	Display	Remarks
	- -PSoF	An example of indication in sequence mode
[MODE]	Sn_001	Return to mode selection.
[MODE]	PA_001	Select the parameter editing mode.
[SET] (1 sec. or over)	PA1 01	The parameter number is displayed.
[∧]	PA1 07	Select parameter PA1_7.
[SET] (1 sec. or over)	H 00 Blink	The set data of PA1_7 is displayed. The most significant digit of the high order five digits blinks (the high order two digits of default value "1" is displayed).
[SET]	H 00 Blink	Shift to the desired editing digit.
[∧]	H 01 Blink	Increase the value to "1."
[SET]	L00001 Blink	Show the low order five digits.
[SET]	L00001 Blink	Shift to the desired editing digit.
[∨]	L00000 Blink	Change the value to "0."
[SET] (1 sec. or over)	L00000	Settle the new value.
	L00000	After being settled, the value remains.

6.8 Positioning Data Edit Mode

In the positioning edit mode, you can edit positioning status, target position, rotation speed, stand still timer, M code, and acceleration and deceleration time.

Ponn_ 1 : Positioning status
Ponn_ 2 : Target position
Ponn_ 4 : Rotation speed
Ponn_ 3 : Stand still timer
Ponn_ 5 : M code
Ponn_ 6 : Acceleration time
Ponn_ 7 : Deceleration time

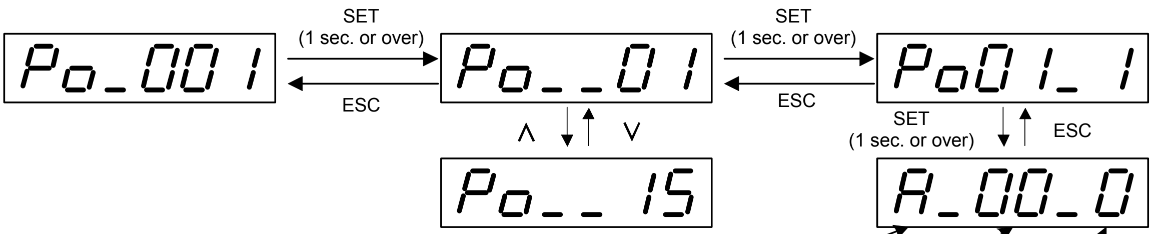
[Example]

The following shows the example with address 1 selected. (For how to edit, refer to "Indication and editing" on page 6-26 (only for (2) to (5)).

6

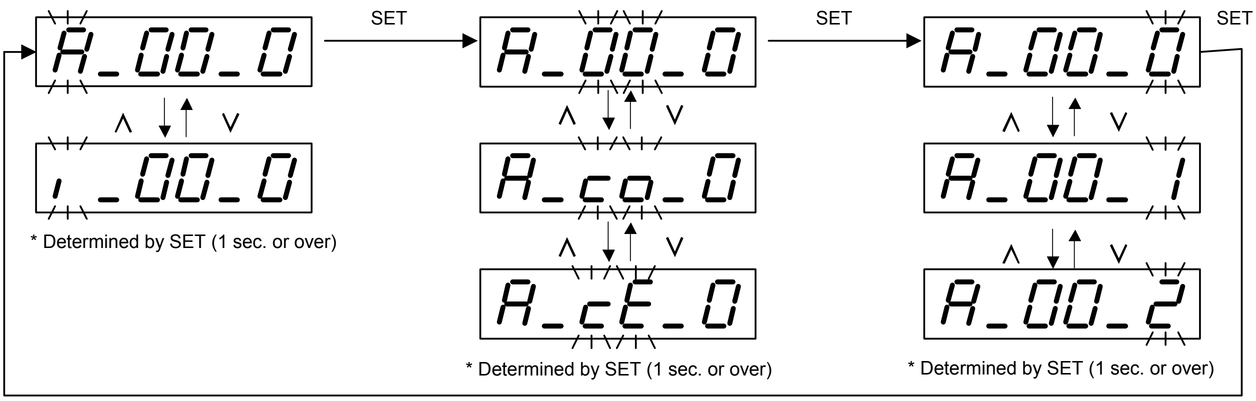
(1) Positioning status

Set data relevant to the positioning data.



1st digit		3rd and 4th digits		6th digit	
Indication	Command method	Indication	Step mode	Indication	M-code
A	ABS	00	No designation	0	Disable
i	INC	co	Continuous	1	Output at startup
		cE	Cycle end	2	Output at completion

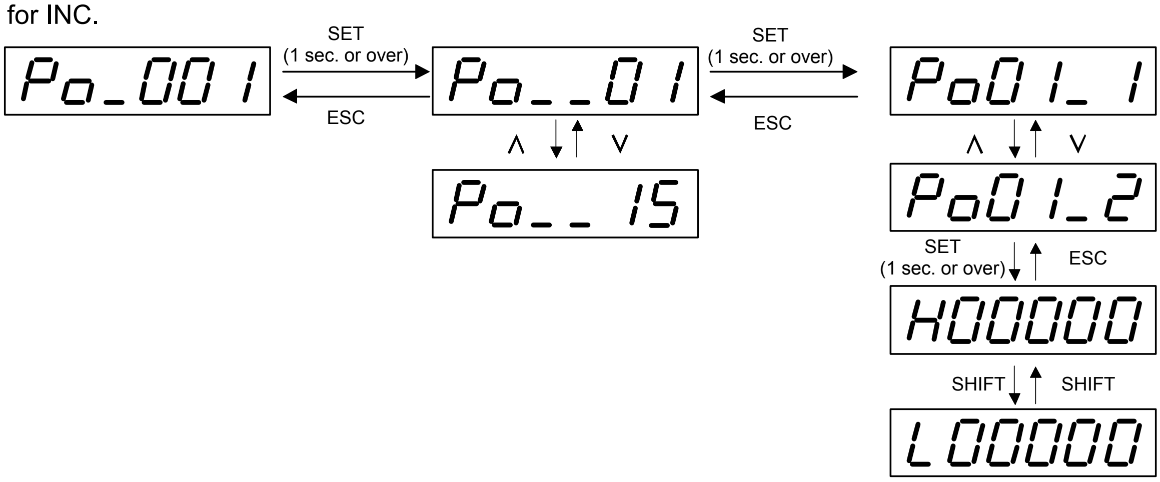
- How to edit positioning status



(2) Target position

Set the target position of the motor. The setting value range is from -2000000 to 2000000 in increments of 1.

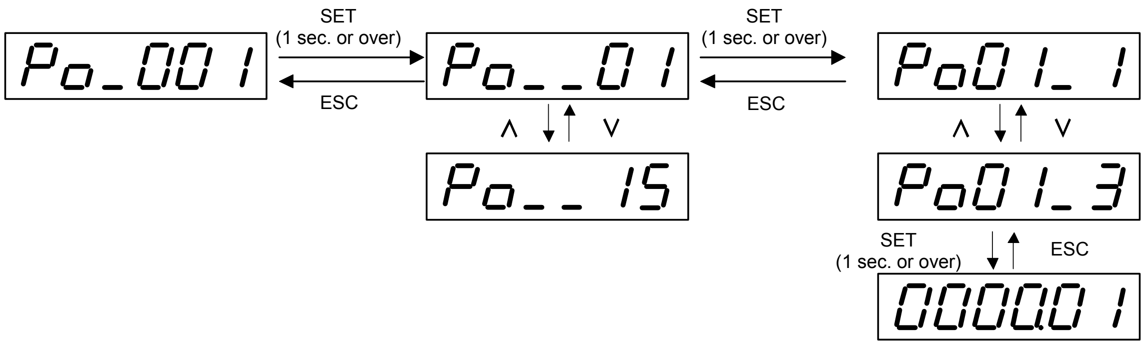
Set the target position of the servomotor for ABS command method, and set the incremental value for INC.



(3) Rotation speed

Set the travel speed to the motor target position. Use the motor shaft rotation speed for the setting value. The setting value range is from 0.01 to 6000 [r/min] in increments of 0.01.

Note that the setting speed is not the machine travel speed.

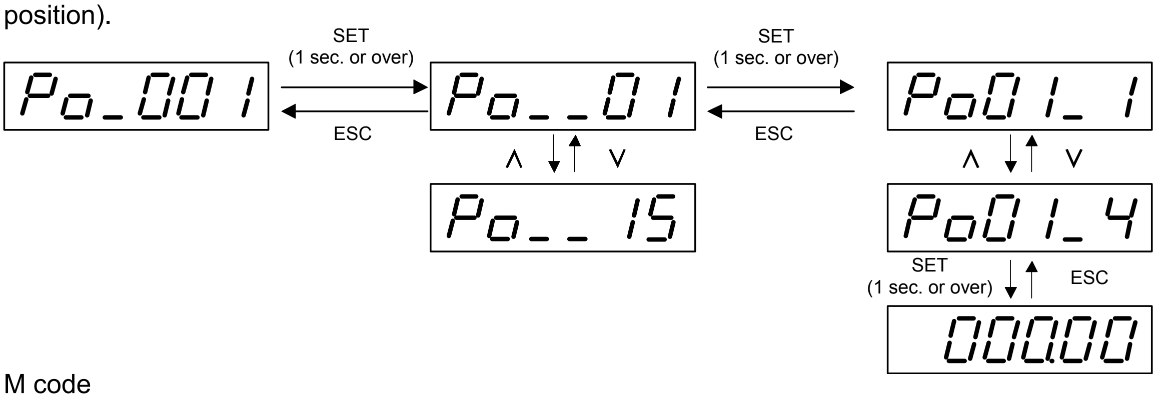


(4) Stand still timer

Set the stop time after the motor has reached the target position. The setting value range is from 0.00 to 655.35 [s] in increments of 0.01.

After the stop time has elapsed, the sequence output signal (in-position signal [INP]) turns on.

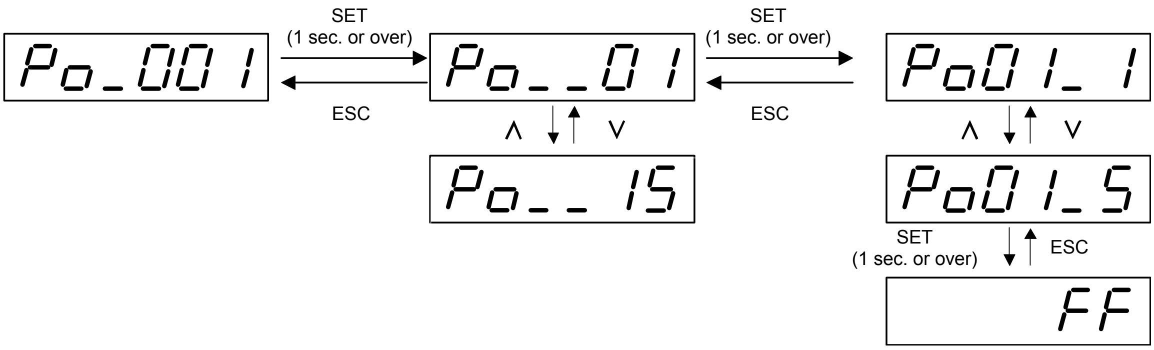
The decimal point position can be changed in the parameter PA2-42 (timer data decimal point position).



(5) M code

The M code output by executing positioning data can be edited. The setting range is from 00 to FF in hexadecimal. The minimum increment is 1.

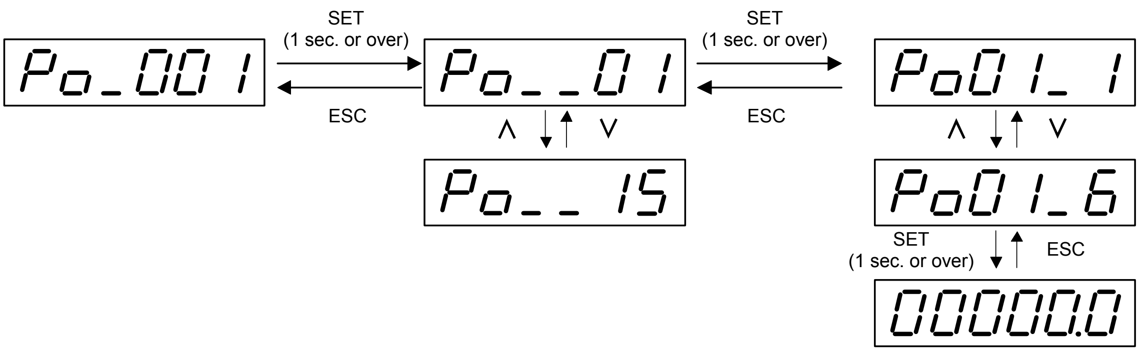
The default value is FF.



(6) Acceleration time

Set the motor acceleration time. The setting value range is from 0.0 [ms] to 99999.9 [ms] in increments of 0.01 [ms].

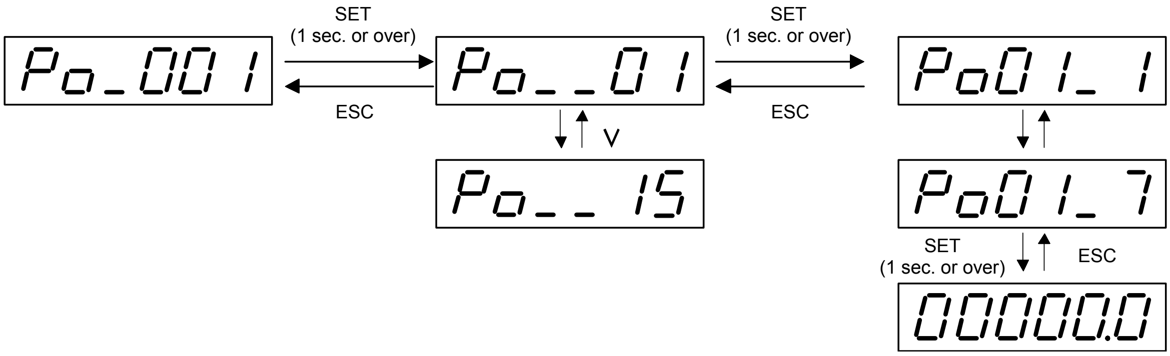
The setting value is the time until the motor rotation speed reaches 2000 [r/min].



(7) Deceleration time

Set the motor deceleration time. The setting value range is from 0.0 [ms] to 99999.9 [ms] in increments of 0.01 [ms].

The setting value is the time until the motor rotation speed reaches 2000 [r/min].



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6.9 Test Operation Mode

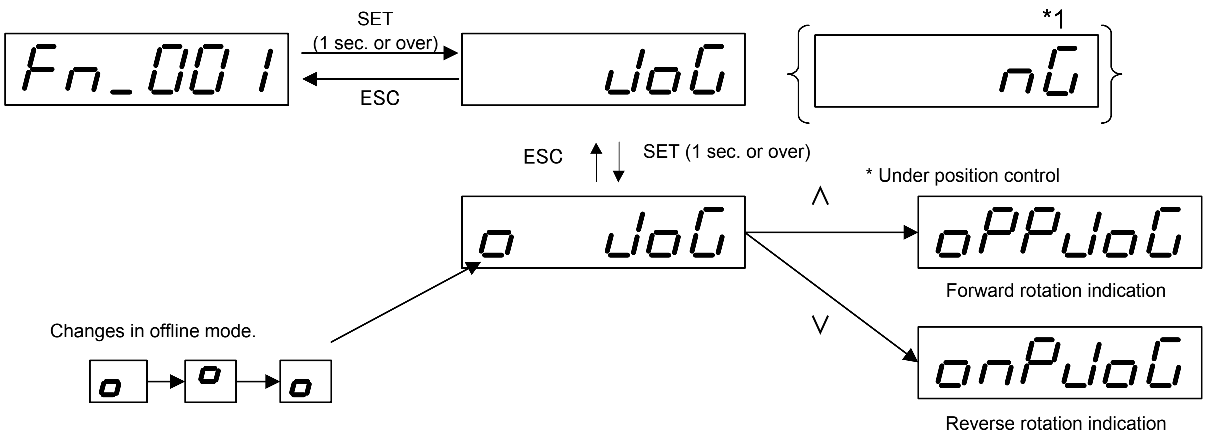
In the test operation mode, you can operate keypad keys to rotate the servo amplifier or reset various data. Press the [MODE/SET] key until [Fn_00n] is displayed, and press and hold the [SET/SHIFT] key for at least one second to execute test operation.

Fn_001	: Manual operation
Fn_002	: Position preset
Fn_003	: Homing
Fn_004	: Automatic operation
Fn_005	: Alarm reset
Fn_006	: Alarm history initialization
Fn_007	: Parameter initialization
Fn_008	: Positioning data initialization
Fn_009	: Auto offset adjustment
Fn_010	: Z-phase position adjustment
Fn_011	: Auto tuning gain
Fn_012	: Easy tuning
Fn_013	: Profile operation
Fn_014	: Sequence mode
Fn_015	: Teaching

(1) Manual operation

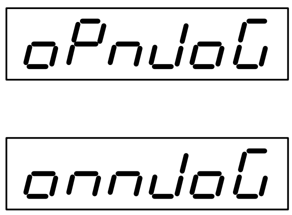
The servomotor rotates while a keypad key is held down.

The rotation speed of the servomotor depends on the setting of parameter PA1_41.



・The servomotor keeps rotating while the [∧] or [∨] key is held down.

・Under speed control



[NG] is indicated while the servomotor rotates upon a sequence I/O signal.

*1) Cause of NG indication

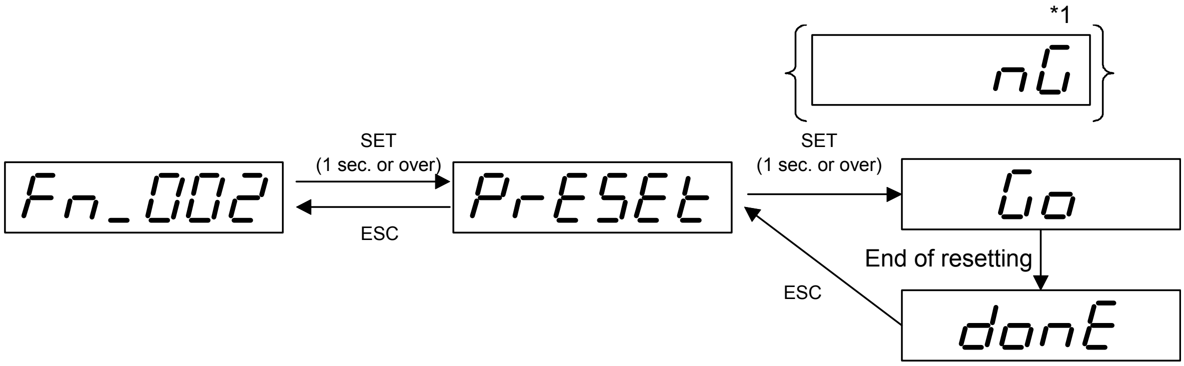
・The S-ON and FWD/REV signals are turned on.

・The motor is during rotation.

Note	The forced stop, external braking resistor overheat, ±OT and free-run signals are enabled even during test operation. Check these signals if test operation does not start.

(2) Position preset

The command position and feedback position of the servomotor are reset to zero.



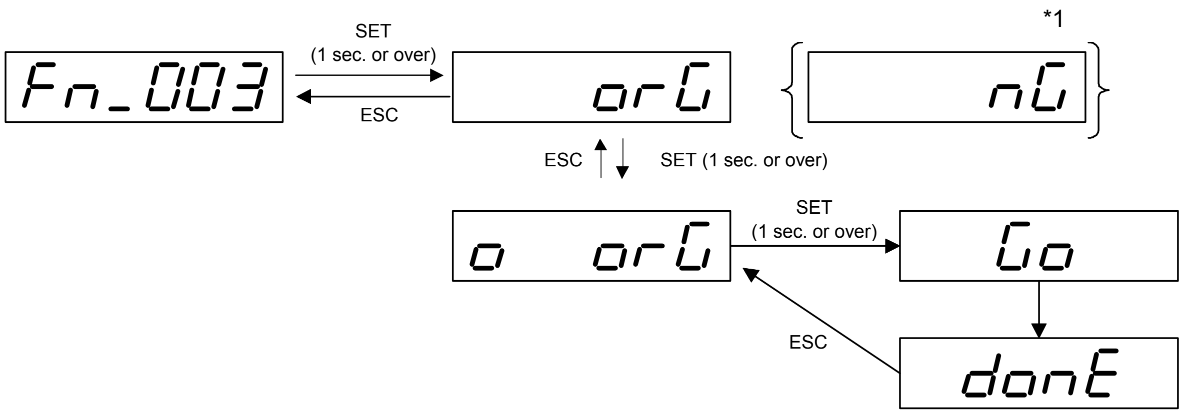
*1) Cause of NG indication

・The S-ON and FWD/REV signals are turned on.

・The motor is during rotation.

(3) Homing

Operate keypad keys to perform homing. The homing profile follows settings of parameters PA2_6 through PA2_18.
After homing complete, indication remains [donE].
Press the [MODE/ESC] key to return to mode selection.



*1) Cause of NG indication

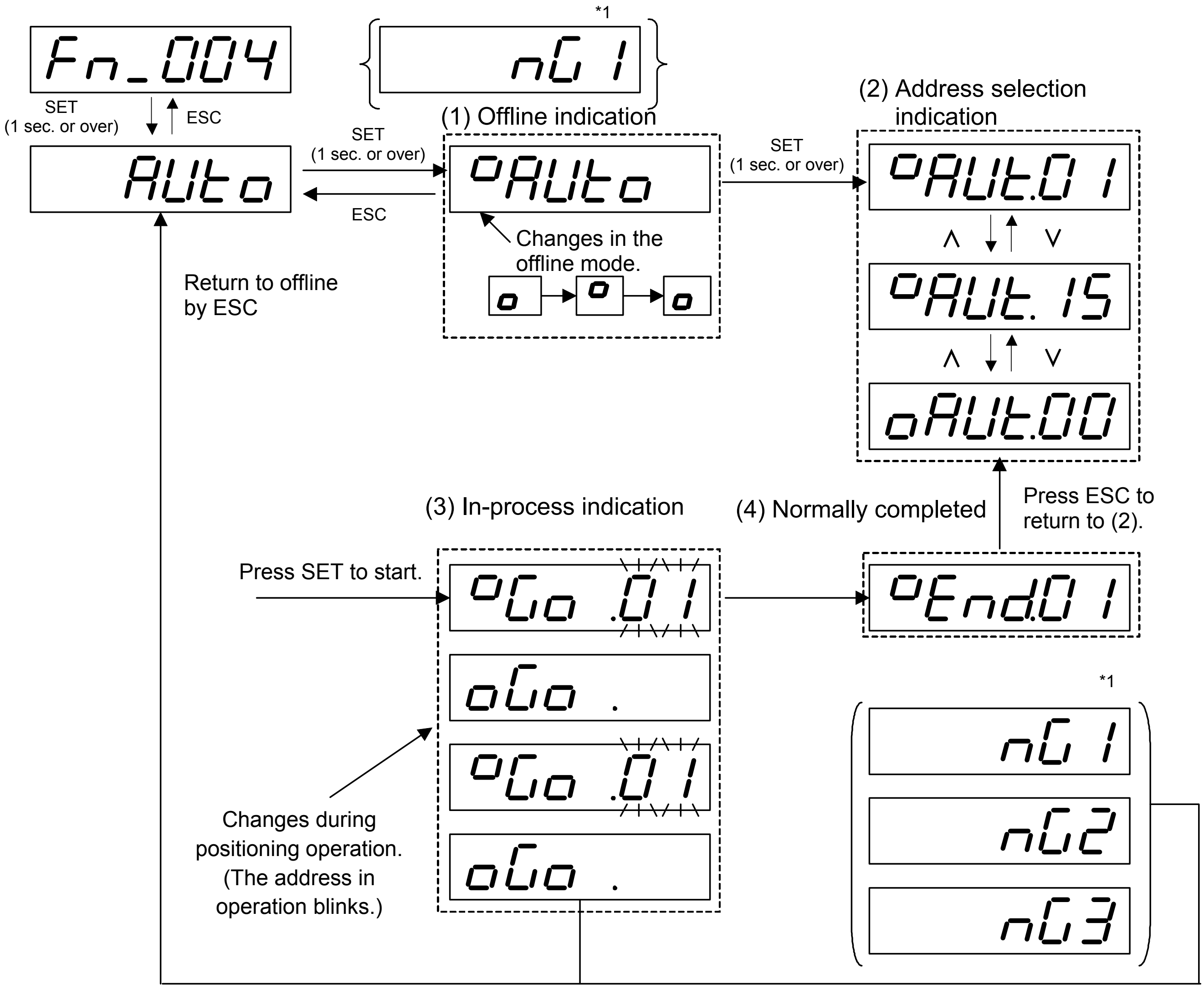
・The S-ON and FWD/REV signals are turned on.

・The motor is during rotation.

(4) Automatic operation

Operate keypad keys to perform automatic operation.

Positioning is executed according to registered positioning data.



*1 If NG indication is shown, remove the cause of the fault and press the [MODE/ESC] key to return to the offline state (2) .

<Cause of NG1 indication> - Offline switching impossible

・The motor is during rotation. (Operation such as manual feed, homing is being executed.)

<Cause of NG2 indication> - Startup failure

・The S-ON and FWD/REV signals are turned on.

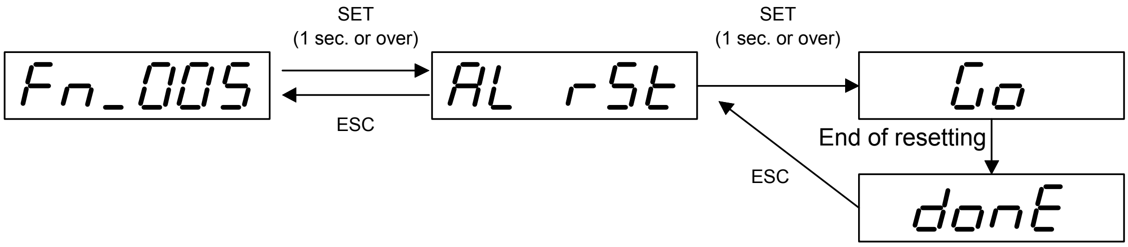
・The motor is during rotation.

<Cause of NG2 indication> -Abnormality during operation

Note	The forced stop, external braking resistor overheat, ±OT and free-run signals are enabled even during test operation. Check these signals if test operation does not start.

(5) Alarm reset

The alarm currently detected in the servo amplifier is reset.



・The servo amplifier is not reset from some alarms through alarm resetting. To reset these alarms, turn the power off then on again.

■ Alarms removed through alarm resetting

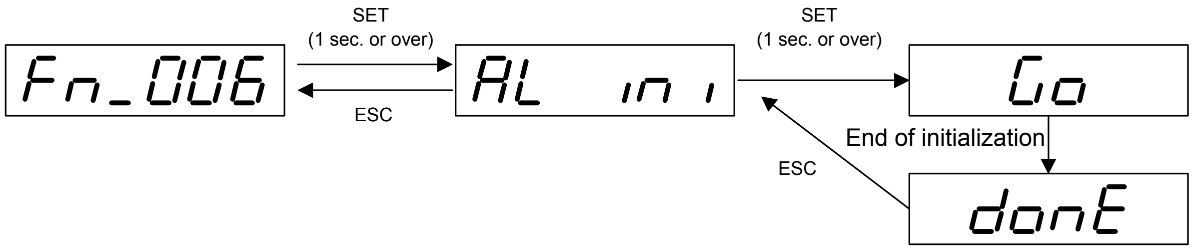
Indication	Name
AL-oc1	Overcurrent 1
AL-oc2	Overcurrent 2
AL- oS	Overspeed
AL-Luc	Control power undervoltage
AL- Hu	Overvoltage
AL- tH	Braking transistor overheat
AL- Ec	Encoder Communication error
AL-oL1	Overload 1
AL-oL2	Overload 2
AL-LuP	Main power undervoltage
AL-rH1	Internal braking resistor overheat
AL-rH2	External braking resistor overheat
AL- oF	Deviation overflow
AL- AH	Amplifier overheat
AL- EH	Encoder overheat
AL- HF	Command Pulse Frequency Error

■ Alarms not removed through alarm resetting

Indication	Name
AL-Et1	Encoder trouble 1
AL-Et2	Encoder trouble 2
AL- ct	Circuit trouble
AL- dE	Memory Error
AL- Fb	Fuse Broken
AL- cE	Motor Combination Error
AL-ctE	CONT (control signal) Error
AL-rH3	Braking transistor error
AL-dL1	Absolute data Lost 1
AL-dL2	Absolute data Lost 2
AL-dL3	Absolute data Lost 3
AL- AF	Multi-turn data over flow
AL- iE	Initial Error

(6) Alarm history initialization

The history of detected alarms recorded in the servo amplifier is deleted. The alarm detection history (alarm history) can be monitored with [En_002] in the sequence mode.

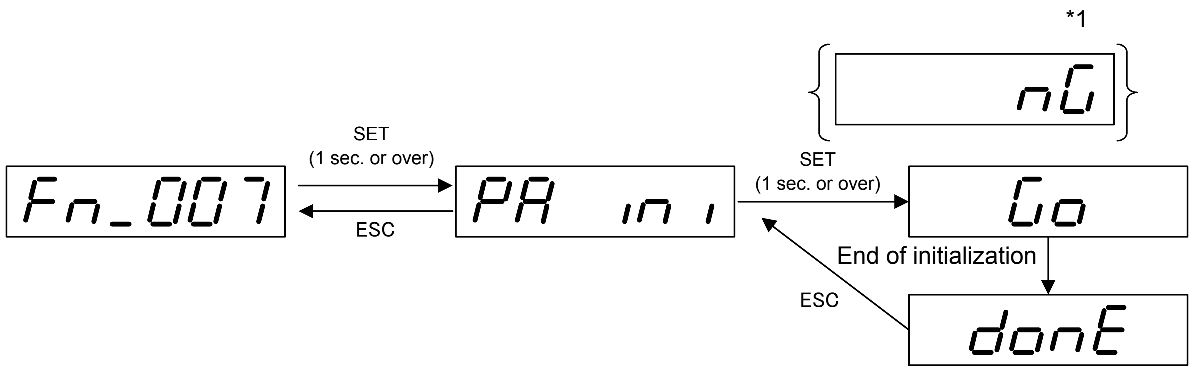


・The alarm history is retained even after the power is turned off.

(7) Parameter initialization

Parameters are initialized.

After initializing parameters, be sure to turn the power off then on again.



*1) Cause of NG indication

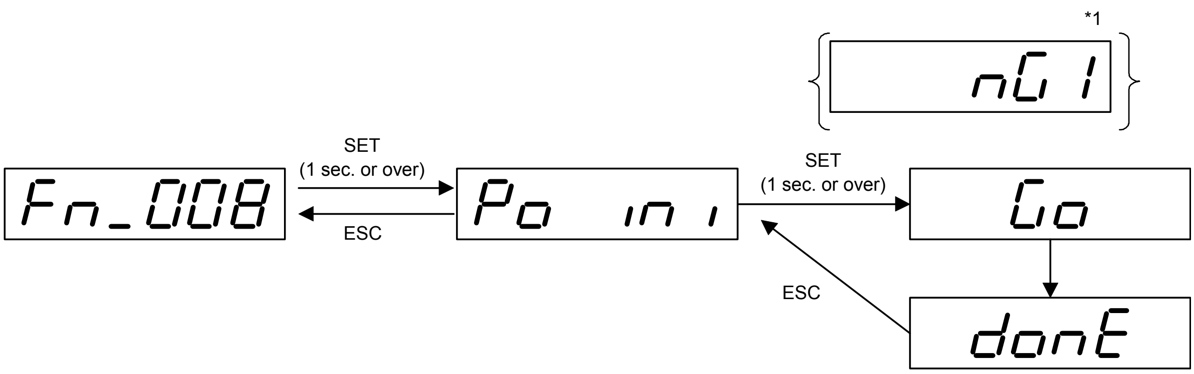
・The S-ON signal is turned on.

・Parameter PA2_74 (parameter write protection) is set at 1 (write protect).

(8) Positioning data initialization

All positioning data is reset to initial values.

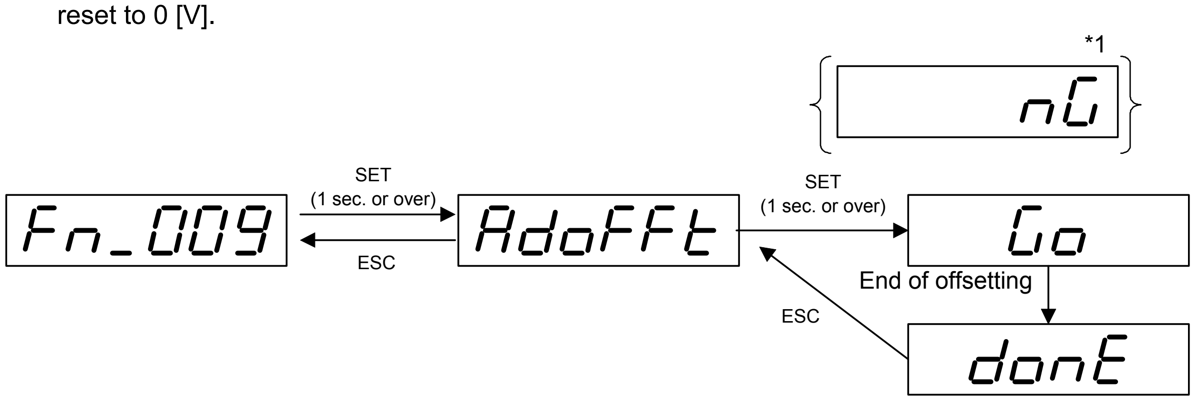
After initializing, turn the power off then on again.



*1) Cause of NG indication

・The S-ON signal is turned on.
・Parameter PA2_74 (parameter write protection) is set at 1 (write protect).

(9) Auto offset adjustment (only for RYT□□□□5-VV□)
The current input voltage supplied at the analog speed command voltage input [VREF] terminal is reset to 0 [V].



If both the X1 and X2 terminals of multi-step speed selection are turned off with the FWD (REV) signal, the output shaft of the servomotor rotates according to the analog speed command voltage. The output shaft of the servomotor may rotate at a small speed even if the speed command voltage is 0 [V].
Use the "zero clamp function (parameter PA3_35)" when necessary.

Follow the procedure below to adjust the offset voltage.

[1] Supply 0 [V] to the [VREF] terminal. The operation command can be given or not given.
[2] Select [Fn_009] at the keypad and press the [SET/SHIFT] key to automatically adjust the offset.
[3] Turn the operation command [S-ON] signal on and check that the output shaft of the servomotor does not rotate.

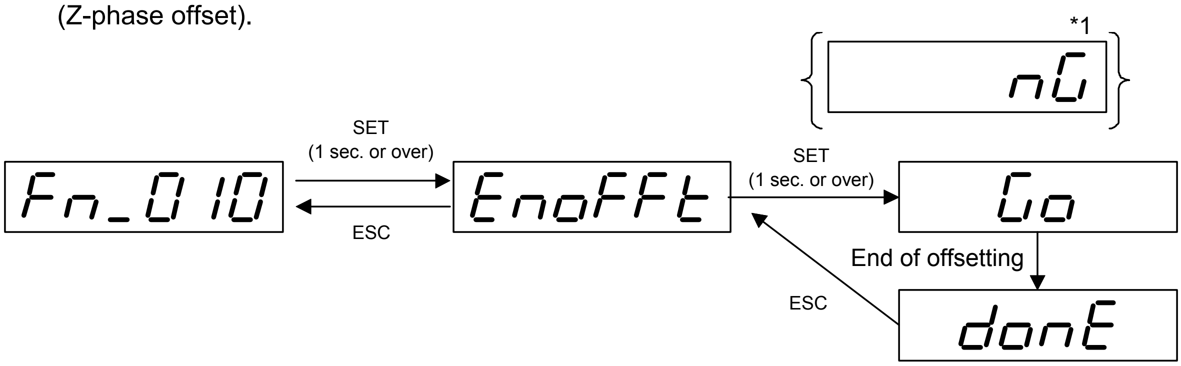
*1) Cause of NG indication

・Parameter PA2_75 (positioning data write protection) is set at 1 (write protected).

Hint	• Results of adjustment are stored in parameter PA3_32. • According to variation in the ambient environment of the servo amplifier, offset adjustment may become necessary. However, do not select if the host controller uses the speed command voltage and division output pulse (feedback) to control the servo amplifier.

(10) Z-phase position offset

The current position is defined to be the Z-phase position. After the Z-phase offset is defined, the distance between the current position and Z-phase is automatically entered in parameter PA1_12 (Z-phase offset).



*1) Cause of NG indication

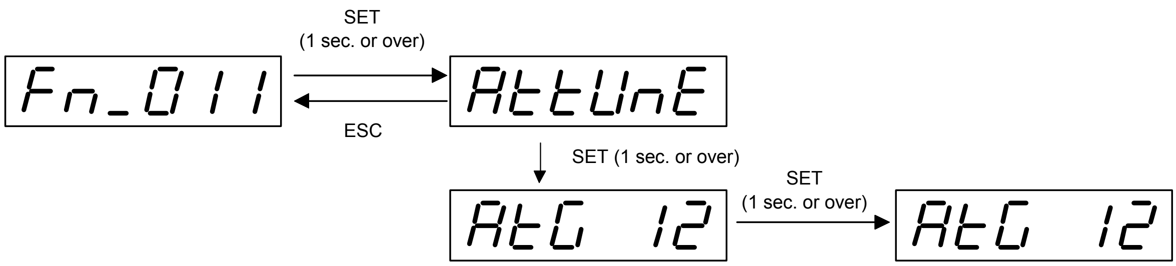
・Parameter PA2_74 (parameter write protection) is set at 1 (write protect).

・The zero position (Z-phase) of the encoder is not established (immediately after the power is turned on). In this case, turn the motor shaft two or more turns to establish the Z-phase.

(11) Auto tuning gain

Parameter PA1_15 (auto tuning gain 1) is updated at real time.

The data is reflected at real time merely through increase/decrease of data, different from regular parameter entry (parameter PA1_15 is not updated if no operation is made; press the [SET/SHIFT] key to register parameter PA1_15).



Press the [∧] or [∨] key to change the value.

Parameter PA1_15 is updated.

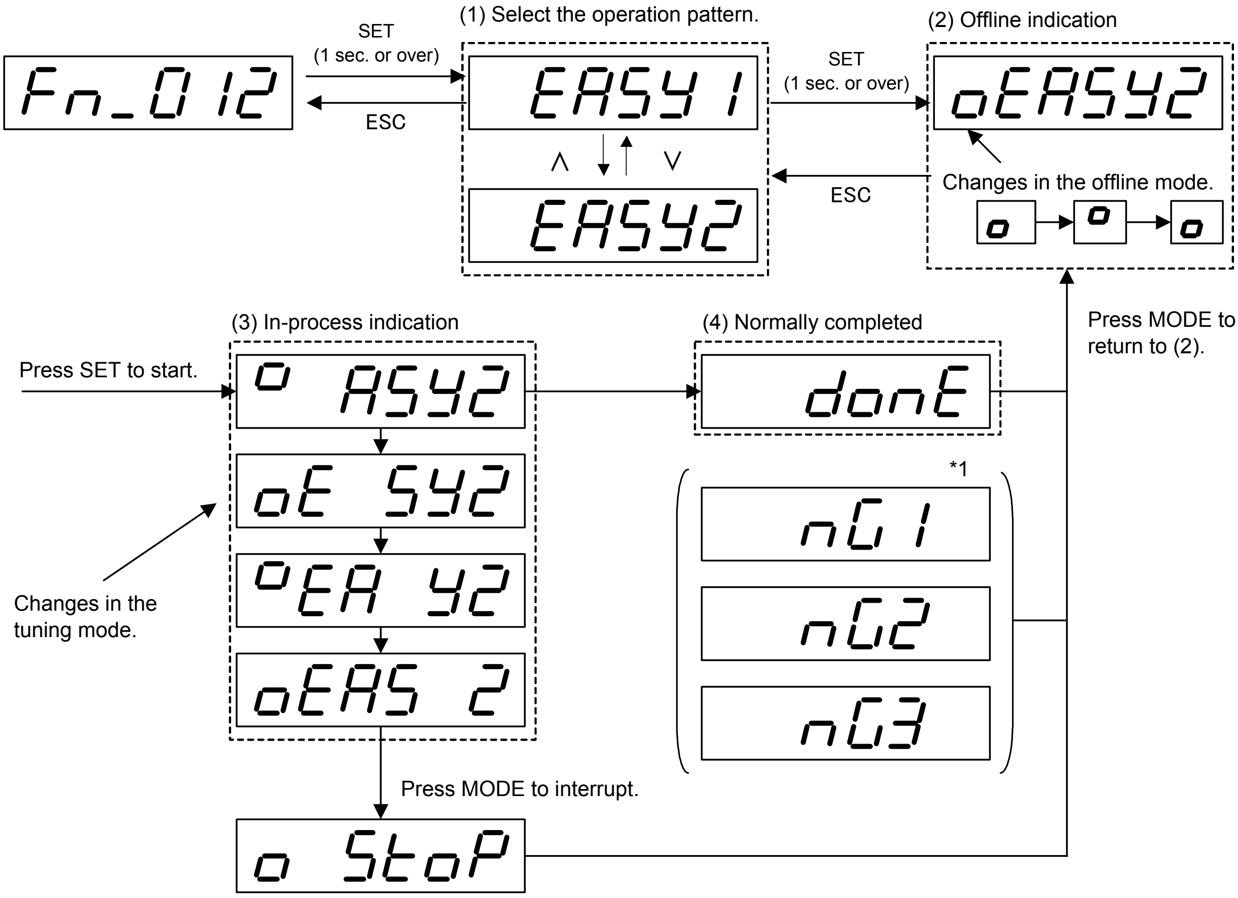
*1) Cause of NG indication

・Parameter PA2_74 (parameter write protection) is set at 1 (write protect).

(12) Easy tuning

Operate the servomotor automatically and adjust the auto tuning gains automatically.
Best adjustment can be obtained according to the machine even if cables to the host control unit are not connected.
The operation pattern includes two variations: slow running and easy tuning.
For details, refer to "CHAPTER 5 SERVO ADJUSTMENT."

Operation pattern name	Travel distance	Operation frequency	Acceleration time	Deceleration time	Rotation speed	Timer	Direction of rotation	
							Go path	Return path
Slow running	PA1_20	Once	PA1_37	PA1_38	10r/min	PA1_22	PA1_23	
Easy tuning	PA1_20	Max. 50 times	Automatically calculated	Automatically calculated	PA1_21	PA1_22	PA1_23	



*1) If NG indication is shown, remove the cause of the fault and press the [MODE/ESC] key to return to the offline state (2).

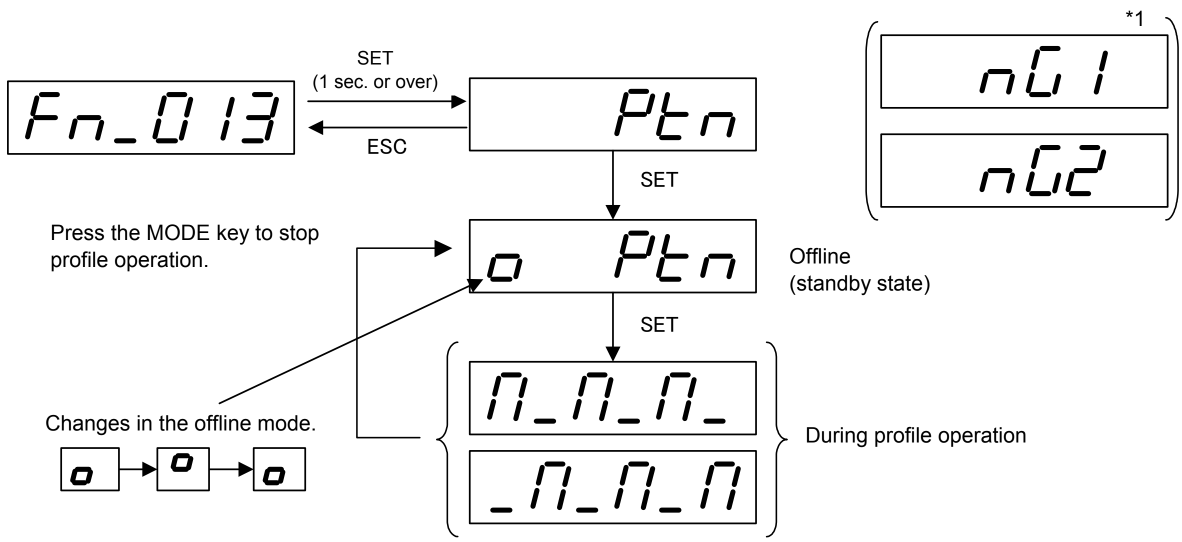
<Cause of NG1 indication>

・Parameter PA2_74 (parameter write protection) is set at 1 (write protect).
・±OT, EMG, or external braking resistor overheat is detected.
・Parameter PA1_13 (tuning mode) is other than 0 (auto tuning).
・The power is not supplied to the main circuit.

<Cause of NG2 indication>
・±OT, EMG or external braking resistor overheat is detected in the middle (the free-run signal is ignored).
・The S-ON signal is turned off.
<Cause of NG3 indication>
・The motor oscillates even if the auto tuning gain is "4" or less.

(13) Profile operation
Operate the servomotor continuously. Once started, reciprocal operation (depending on parameter PA1_23) continues until operation is stopped.
Continuous operation is possible even if cables to the host control unit are not connected. Use this mode to check the effective torque or for other purposes.

Operation pattern name	Travel distance	Operation frequency	Acceleration time	Deceleration time	Rotation speed	Timer	Direction of rotation	
							Go path	Return path
Profile operation	PA1_20	Endless	PA1_37	PA1_38	PA1_21	PA1_22	PA1_23	

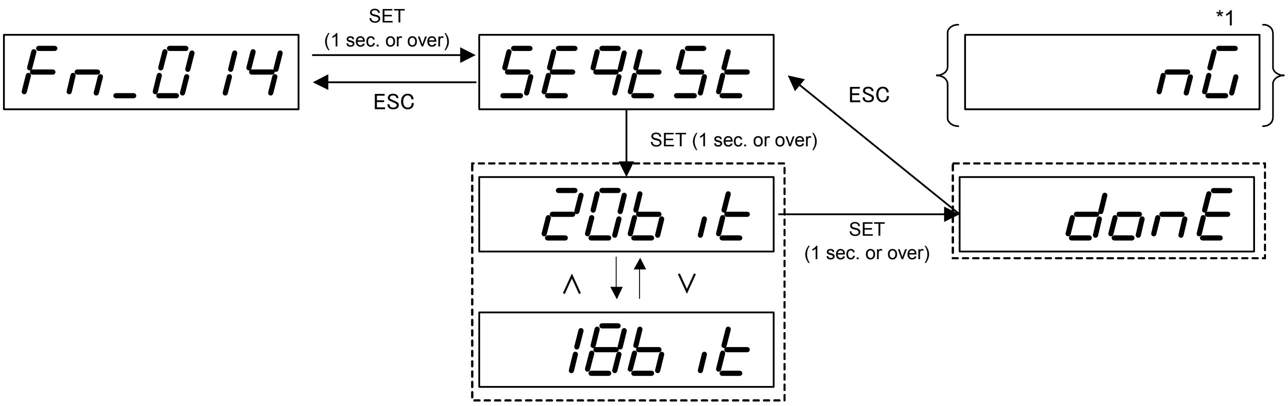


*1) If NG indication is shown, remove the cause of the fault and press the [MODE/ESC] key to restart the offline state.
<Cause of NG1 indication>
・±OT, EMG or external braking resistor overheat is detected.
・The power is not supplied to the main circuit.
<Cause of NG2 indication>
・±OT, EMG or external braking resistor overheat is detected in the middle (the free-run signal is ignored).
・The S-ON signal is turned off.

(14) Sequence test mode

You can issue sequence output signals and show statuses without connecting the servomotor as if the servomotor actually operates in response to sequence input signals.

Use this mode to check the program (sequence) of the host controller or similar.



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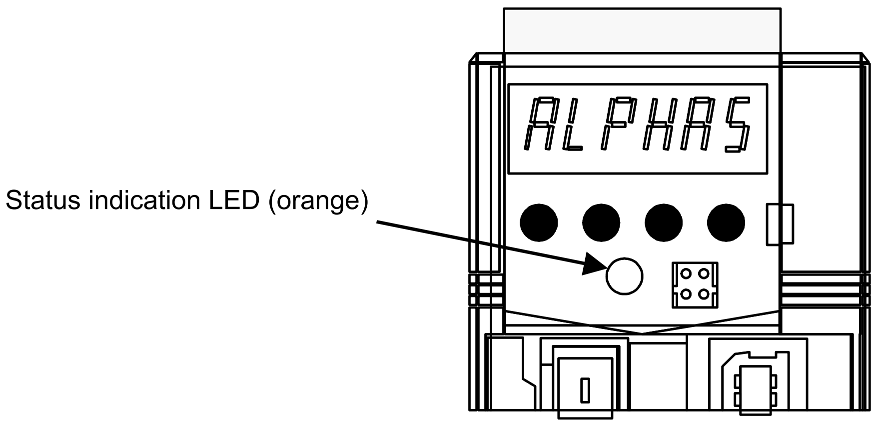
*1) Cause of NG indication

・The S-ON signal is turned on in advance.

Hint

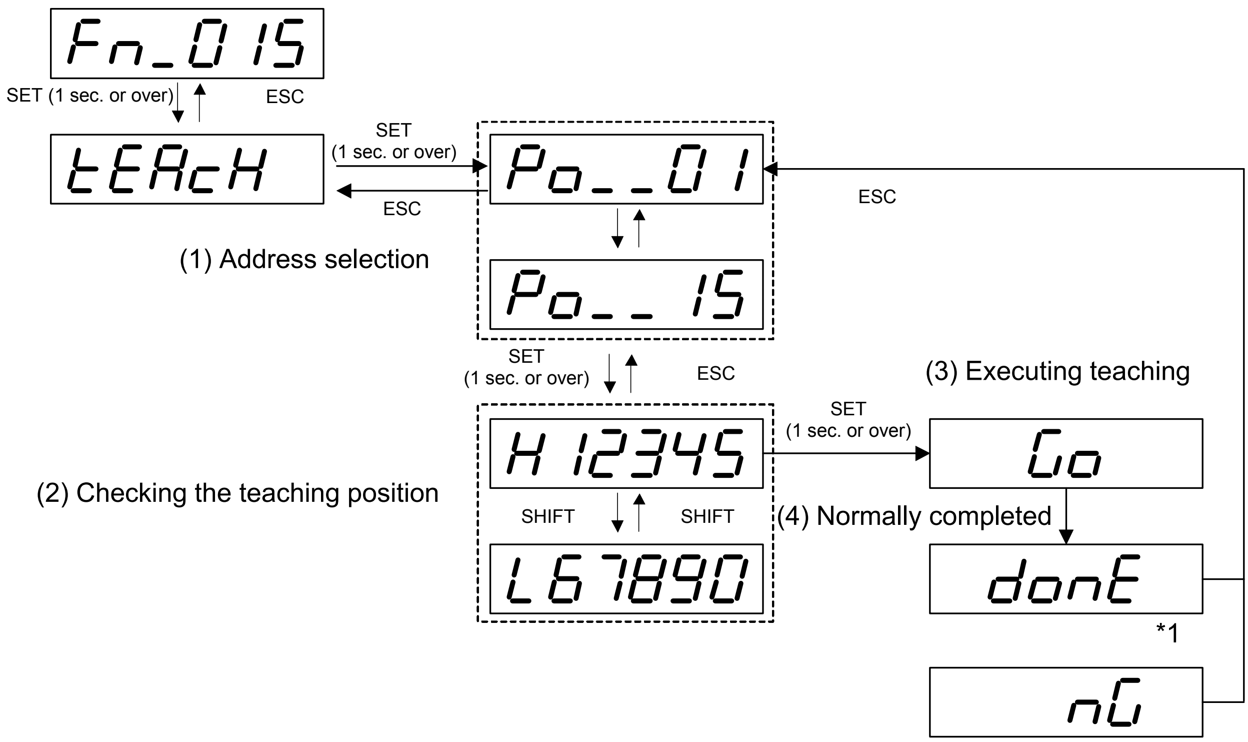
- The orange status indication LED blinks in the sequence test mode.
  Interval of blinks: 0.95 sec. lit and 1.2 sec. unlit
- The sequence test mode is not finished even if another mode other than "Fn_014" indication is started. To exit from the mode, turn the main power off then on again.
  If parameter PA2_89 is set at 1, change the reference value to 0 before turning the power off and on.



(15) Teaching mode

After operating the servomotor in the manual operation or pulse train operation or similar, the target position can be written to the specified address as the positioning data.

・Only the target position can be written and other data need to be set separately.
(Positioning status, rotation speed, stand still timer)
If the initial positioning data is selected for teaching, the command method of positioning status is set to ABS.



*1 If NG indication is shown, remove the cause of the fault and press the [MODE/ESC] key to return to the address selection (2).

<Cause of NG indication>

・The teaching position exceeds the positioning data stop position [-2000000000 to 2000000000].
・Parameter PA2_75 (positioning data write protection) is set at 1 (write protect).
・The edit permission is allocated to an input terminal CONTn and the CONTn is not turned on.

CHAPTER 7 MAINTENANCE AND INSPECTION

7

7.1 Inspection

The servo amplifier and servomotor are maintenance free and no special daily inspection is necessary. However, to avoid accidents and operate the devices for a long term at a stable reliability, perform periodical inspection.

⚠ WARNING

- After turning the power off, wait for at least five minutes and check that the charge LED is unlit before performing inspection.
  There is a risk of electric shock.
- Do not touch the servomotor, servo amplifier and cables in the power-on state.
  There is a risk of electric shock.
- Never disassemble or remodel the servomotor and servo amplifier.
  It might cause fire and failure. It will not be covered by the warranty.

■ Periodic inspection items

The periodic inspection items are shown below.

Device	Description of inspection
Servomotor	• There is no deviation *1) in the linkage between the servomotor shaft and mechanical system. • The servomotor is free from direct splashes of water, vapor or oil. • The servomotor itself does not vibrate excessively.
Servo amplifier	• Screws of the terminal block and mounting sections are not loose. • Connectors are inserted correctly. • There is no massive dust on the servo amplifier. • There is no malodor, damage, breakage or faults in appearance.

*1) Indicates faults in installation such as an angle error, parallelism eccentricity, axial displacement or similar in the linkage between the servomotor shaft and mechanical system.

Note	Before checking cables of the servomotor and servo amplifier, turn the power off and wait at least five minutes and check that the charge LED is unlit.

⚠ CAUTION

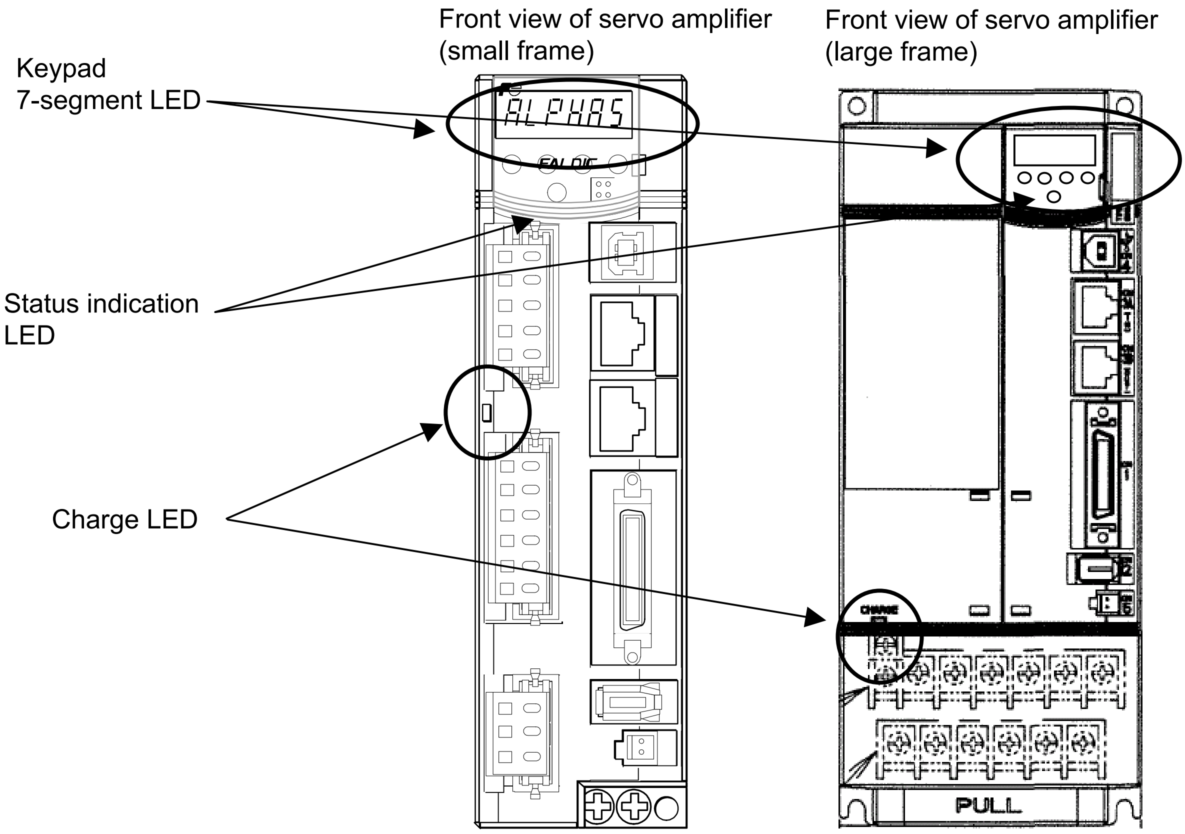
- Do not perform a Megger test of the printed circuit board and terminal block.
  Otherwise the servo amplifier or the encoder built in the servomotor may be damaged.

7.2 Status Display

7.2.1 Initial State

(1) After the control power (L1C, L2C) is supplied to the servo amplifier, the seven-segment LED of the keypad lights up.
(2) After the main circuit power (L1, L2, L3) is supplied to the servo amplifier, the "charge LED" lights up.

To operate the servomotor, states (1) and (2) must be arranged.
If nothing is displayed even though the power is supplied or either (1) or (2) is not arranged, perform ”Immobility diagnosis” described in 14.5.8 (on page 14-28), or contact us.



7.2.2 State at Alarm

If an alarm is alerted, display of the servo amplifier will be as follows.
(1) An alarm code is displayed at the seven-segment LED of the keypad.
For the description of display, refer to the following pages.
(2) The orange status indication LED blinks. (The LED blinks at 0.5-second intervals.)

Be sure to check the alarm code to clarify the cause of the alarm.

7.2.3 Alarm Display List

When an alarm is detected, the keypad of the servo amplifier automatically shows alarm data.

Order of descrip-tion	Indication	Name (in English)	Type
1	AL-oc1	Overcurrent1	Serious failure
	AL-oc2	Overcurrent2	
2	AL- oS	Overspeed	
3	AL-Luc	Control power undervoltage	
4	AL- Hu	Overvoltage	
5	AL-Et1	Encoder trouble1	
	AL-Et2	Encoder trouble2	
6	AL- ct	Circuit trouble	
7	AL- dE	Memory Error	
8	AL- Fb	Fuse Broken	
9	AL- cE	Motor Combination Error	
10	AL- tH	Braking transistor overheat	
11	AL- Ec	Encoder Communication error	
12	AL-ctE	Cont(control signal) Error	
13	AL-oL1	Overload1	
	AL-oL2	Overload2	
14	AL-LuP	Main power undervoltage	Minor failure
15	AL-rH1	Internal braking resistor overheat	
16	AL-rH2	External braking resistor overheat	
17	AL-rH3	Braking transistor error	
18	AL- oF	Deviation overflow	
19	AL- AH	Amplifier overheat	
20	AL- EH	Encoder overheat	
21	AL-dL1	Absolute data Lost1	
	AL-dL2	Absolute data Lost2	
	AL-dL3	Absolute data Lost3	
22	AL- AF	Multi-turn data over flow	
23	AL- iE	Initial Error	
24	AL- HF	Command pulse Frequency Error	

To reset the alarm, perform one of the following methods.

- Turn alarm reset (RST: sequence input signal) on temporarily and then turn it off.
- From the keypad, select the test operation mode [Fn_005] and execute alarm reset.
- On the alarm screen, press and hold the [∧] and [∨] keys of the keypad simultaneously for at least one second.
- From the PC Loader, use alarm reset in the "monitor" command.

After an alarm reset, the data specified with parameter "PA2_77 (initial display of the keypad)" is displayed.

■ Alarm reset

Some alarms cannot be canceled through alarm resetting. To remove the alarm that is not canceled through alarm resetting, reset it by turning the power off then on again.

Alarms canceled through alarm resetting

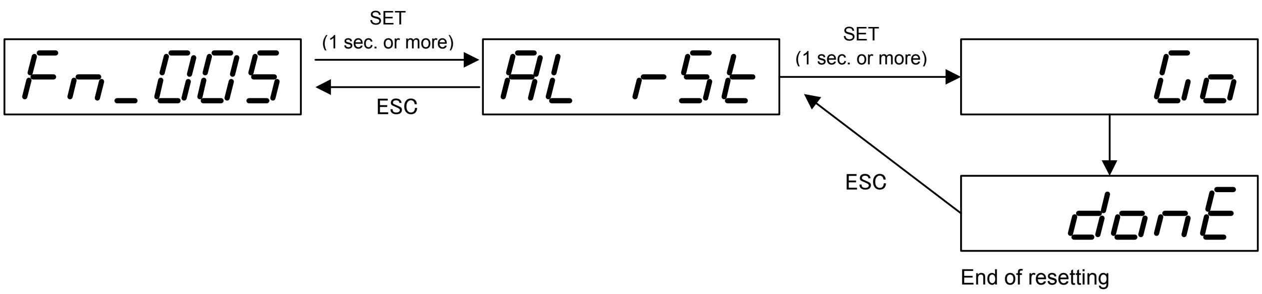
Indication	Name
AL-oc1	Overcurrent 1
AL-oc2	Overcurrent 2
AL- oS	Overspeed
AL-Luc	Control power undervoltage
AL- Hu	Overvoltage
AL- tH	Braking transistor overheat
AL- Ec	Encoder Communication error
AL-oL1	Overload 1
AL-oL2	Overload 2
AL-LuP	Main power undervoltage
AL-rH1	Internal braking resistor overheat
AL-rH2	External braking resistor overheat
AL- oF	Deviation overflow
AL- AH	Amplifier overheat
AL- EH	Encoder overheat
AL- HF	Command pulse Frequency Error

Alarms not canceled through alarm resetting

Indication	Name
AL-Et1	Encoder trouble1
AL-Et2	Encoder trouble2
AL- ct	Circuit trouble
AL- dE	Memory Error
AL- Fb	Fuse Broken
AL- cE	Motor Combination Error
AL-ctE	Cont(control signal) Error
AL-rH3	Braking transistor error
AL-dL1	Absolute data Lost1
AL-dL2	Absolute data Lost2
AL-dL3	Absolute data Lost3
AL- AF	Multi-turn data over flow
AL- iE	Initial Error

Alarm reset at keypad

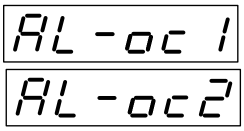
The alarm currently detected at the servo amplifier is reset.



7.3 Troubleshooting Method

1. Overcurrent

[Display]



[Description of detected alarm]

The output current of the servo amplifier exceeds the rated value.

OC1: Direct detection by internal transistor of servo amplifier

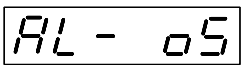
OC2: Indirect detection with software of servo amplifier

[Cause and remedy]

Cause	Remedy
Wrong servomotor output wiring	• Correct the wiring of power cables (U, V and W). • Check cables visually or through continuity check and replace the defective cable.
Short circuit or grounding fault in servomotor output wiring	
Servomotor insulation fault	Measure the insulation resistance. (Several MΩ or over to ground)
Failure of servomotor	Measure the resistance across cables. (Several Ω between cables)
Incorrect resistance of braking resistor	Replace with the braking resistor within the rating.
Current imbalance caused by an encoder fault	Replace the servomotor.
Unconnected grounding cable	Connect the grounding cable.

2. Overspeed

[Display]

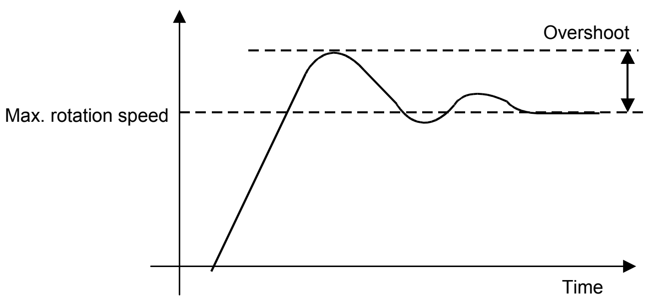


[Description of detected alarm]

The rotation speed of the servomotor exceeds 1.1 times the maximum speed.

[Cause and remedy]

Cause	Remedy
Wrong servomotor output wiring	Correct the wiring of power cables (U, V and W).
The rotation speed of the servomotor overshoots.	Check the speed waveform during acceleration with the PC Loader or similar (see the figure below) and take the following countermeasures. • Increase PA1_37 (acceleration time). • Increase PA1_52 (S-curve time constant). • Increase PA1_56 (speed loop gain 1).



3. Control Power Undervoltage

[Display]

AL-Luc

[Description of detected alarm]

The voltage of the control power supplied to the servo amplifier temporarily drops below the minimum specification limit.

[Cause and remedy]

Cause	Remedy
The source voltage drops due to momentary power failure or similar.	• Check the power supply environment for momentary power failure and improve the power supply environment. • Check and improve the power supply capacity and transformer capacity.
Poor power supply capacity of transformer, etc.	Replace the transformer, etc.
DC input is under execution.	Set PA2_68 (main power shutoff detection time) at 1000 [ms].

4. Overvoltage

[Display]

AL- Hu

[Description of detected alarm]

The DC voltage inside the servo amplifier exceeds the upper limit.

[Cause and remedy]

Cause	Remedy
The source voltage is too high (immediately after power-on).	• Check if the source voltage is within the specification limits. • Insert a reactor if there is a power factor improvement capacitor.
Unconnected external braking resistor or wrong wiring	• Connect the external braking resistor. • Correct the wiring of the external braking resistor.
Broken braking transistor	Replace the servo amplifier.

The internal DC voltage can be checked in the monitor mode of the keypad.
[on_015]: Internal DC link voltage (max. value)
Approximately over 420 [V], overvoltage is detected.

5. Encoder Trouble

[Display]

AL-Et1

AL-Et2

[Description of detected alarm]

There is a fault in the encoder built in the servomotor.
(Communications are normal.)

- Et1: Single revolution position detection fault of encoder
- Et2: Encoder memory data reading fault

[Cause and remedy]

Cause	Remedy
Fault in data sent from encoder	Use shielded cables to eliminate noise effects.
Failure of encoder	Replace the servomotor.

6. Circuit Trouble

[Display] [Description of detected alarm]

AL- ct

There is a fault in the source control power voltage inside the servo amplifier. There may be a failure in the internal circuit.

[Cause and remedy]

Cause	Remedy
Failure of servo amplifier	Turn the power off then on again. If restoration is not obtained, replace the servo amplifier.

7. Memory Error

[Display] [Description of detected alarm]

AL- dE

The parameter data stored in the servo amplifier is damaged.

[Cause and remedy]

Cause	Remedy
Failure of stored data	• Using the PC Loader, read parameters and enter those indicated in red. • Initialize parameters. • Turn the power off then on again. If restoration is not obtained, replace the servo amplifier.
The parameter overwriting frequency has exceeded 100,000 cycles.	Store the parameters, which need to be overwritten, in the RAM.

8. Fuse Broken

[Display] [Description of detected alarm]

AL- Fb

The fuse in the main circuit of the servo amplifier is blown. This alarm is only generated in servo amplifiers with 2 [kW] or larger capacities.

[Cause and remedy]

Cause	Remedy
Blown fuse	Replace the servo amplifier.

The fuse of the main circuit is installed for prevention of secondary disaster such as fire.

Note	The end user cannot replace the fuse. Do not turn the power on. Contact us.

9. Motor Combination Error

[Display]

AL- cE

[Description of detected alarm]

The capacity and model of the servo amplifier do not agree with those of the connected servomotor.

[Cause and remedy]

Cause	Remedy
The capacity and model of the servo amplifier do not agree with those of the servomotor.	Check the capacity and model of the servomotor and those of the servo amplifier.

10. Braking Transistor Overheat

[Display]

AL- tH

[Description of detected alarm]

The regeneration handling transistor built in the servo amplifier is overheated.

[Cause and remedy]

Cause	Remedy
High source voltage (immediately after power-on)	• Check if the source voltage is within the specification limits. • Insert a reactor if there is a power factor improvement capacitor.
Too large regeneration power	• Increase the deceleration time. • Decrease the servomotor rotation speed. • Increase the dwell and decrease the regeneration frequency.

11. Encoder Communication Error

[Display]

AL- Ec

[Description of detected alarm]

Communications with the internal encoder of the servomotor fails.

[Cause and remedy]

Cause	Remedy
Interrupted encoder communications	• Check cables visually and through continuity check and correct faults. • Check for the broken wire in the encoder cable and correct. • Insert ferrite cores.
Broken wire or poor contact	

The servo amplifier and encoder communicate through high speed serial communications. The encoder cable has a voltage amplitude of about +5 [V]. Do not route the encoder cable in a strong magnetic or electric field. Route the encoder cable separately from the main body of the servo amplifier, inverter, electromagnetic contactor or similar (reserve at least 100 [mm]).

12. CONT (control signal) Error

[Display]

AL-ctE

[Description of detected alarm]

There is duplication in allocation of sequence input terminals of the servo amplifier.

[Cause and remedy]

Cause	Remedy
The same input signal is allocated to two or more terminals.	Do not specify the same number among CONT signal settings.

13. Overload

[Display]

AL-oL1

AL-oL2

[Description of detected alarm]

- OL1: Instantaneous alarm such as a locked shaft. (3s/300%)
- OL2: The effective torque exceeds the allowable limit of the servomotor. (Detection at electronic thermal relay built in servo amplifier) (About 200s/200%)

[Cause and remedy]

Cause	Remedy
The servomotor fails to rotate mechanically.	• Check the wiring of power cables (U, V and W) and correct faults. • Check if the brake is active.
The mechanical system is too heavy against the servomotor capacity.	• Examine the servomotor capacity, based on the load factor. • If the rotation speed can be reduced, add a reduction gear. • Apply the brake to retain a stopped elevator.
The acceleration/deceleration frequency and operation frequency are too high.	Increase the cycle time and decrease the operation frequency.
Servo amplifier is damaged.	Replace the servo amplifier.

If an OL2 alarm is caused but no damaged servo amplifier or incorrect wiring is found, the servomotor capacity must be examined.
Check the OL thermal value with the PC Loader or monitor mode of the keypad in both cases.

14. Main Power Undervoltage

[Display]

AL-LuP

[Description of detected alarm]

The power supplied to the servo amplifier falls below the minimum specification voltage limit.

[Cause and remedy]

Cause	Remedy
The source voltage drops due to momentary power failure or similar.	• Check the power supply environment whether momentary power failure is generated or not, and improve the power supply environment. • Check and improve the power supply capacity and transformer capacity.
The power is turned on or off intentionally.	Do not turn the power on after the time specified in PA2_68 (main power shutoff detection time) has elapsed. (Detection fails after about 2 [s].)
DC input is under execution.	Set PA2_68 (main power shutoff detection time) at 1000 [ms].

If the power supply environment is adverse, PA2_67 (alarm detection at undervoltage) can be applied to ignore undervoltage detection. In this case, operation can be continued with the setting of PA2_66 (flying start at speed control) in the event of momentary power failure. Undervoltage detection is set at about 200 [V] by the DC voltage in the servo amplifier.

15. Internal Braking Resistor Overheat

[Display]

AL-rH1

[Description of detected alarm]

The power consumption of the braking resistor built in the servo amplifier exceeds the upper limit. (Detection is made at the internal electronic thermal relay of the servo amplifier.)

[Cause and remedy]

Cause	Remedy
Excessive source voltage (immediately after power-on)	• Check if the source voltage is within specification limits. • Insert a reactor if there is a power factor improvement capacitor.
Due to vertical transfer or winding purpose, etc. the regenerative power cannot be consumed.	• Increase the deceleration time. • Decrease the servomotor rotation speed. • Increase the cycle time and decrease the operation frequency.
	• Connect an external braking resistor. • Install a counterweight.
The braking resistor is not connected.	Connect correctly. Set PA2_65 at 0 or 2.

16. External Braking Resistor Overheat

[Display]

AL-rH2

[Description of detected alarm]

The external braking resistor overheat signal (normally closed contact signal) is turned off.

[Cause and remedy]

Cause	Remedy
Excessive source voltage (immediately after power-on)	Check if the source voltage is within the specification limits.
Due to vertical transfer or winding purpose, etc. the regenerative, power cannot be consumed.	• Increase the deceleration time. • Decrease the servomotor rotation speed. • Increase the cycle time and decrease the operation frequency.
	• Connect an external braking resistor. • Install a counterweight.
Wrong wiring of external braking resistor overheat signal	Connect correctly.

17. Braking Transistor Error

[Display]

AL-rH3

[Description of detected alarm]

The regeneration handling transistor built in the servo amplifier is damaged.

[Cause and remedy]

Cause	Remedy
The braking transistor is short circuited or damaged.	Turn the power off then on again. If the alarm persists, replace the servo amplifier.

Note	If the braking transistor is short circuited or damaged, fire may be caused. If the braking transistor fault alarm signal is output, turn the power off immediately.

18. Deviation Overflow

[Display]

AL- oF

[Description of detected alarm]

A position deviation amount equivalent to servomotor revolutions specified in PA2_69 (deviation detection overflow value) is accumulated inside the servo amplifier.

[Cause and remedy]

Cause	Remedy
Wrong connection of power cables (The alarm is alerted immediately when servo-on is turned on.)	Check and correct the wiring of power cables (U, V and W).
The servomotor fails to rotate mechanically.	Check if the brake is applied.
Low output torque	Increase PA1_27, _28 (torque limit).
The deviation detection width is small.	Increase PA2_69 (deviation detection overflow value).
The amplifier is in the P control mode.	Turn off the P motion signal.
Low gain	Perform gain adjustment.
Acceleration/deceleration of pulse train frequency is too acute.	Increase the acceleration/deceleration time.

The default setting of PA2_69 (deviation detection overflow value) is 15 (rev), that is, 20 bits x 15 pulses. During regular servo system operation, the deviation amount increases in proportion to the rotation speed.

19. Amplifier Overheat

[Display]

AL- AH

[Description of detected alarm]

The temperature of the servo amplifier has exceeded the allowable limit.

[Cause and remedy]

Cause	Remedy
The ambient temperature exceeds 55 [°C].	Reduce the ambient temperature to 55 [°C] or lower. (40 [°C] or lower temperatures are recommended for regular operation.)
	Move heat generating bodies near the servo amplifier as far away as possible.

Perform operation at a continuous load factor within 100%.

20. Encoder Overheat

[Display]

AL- EH

[Description of detected alarm]

The encoder inside the servomotor may be overheated.

[Cause and remedy]

Cause	Remedy
Excessive ambient temperature	• Reduce the ambient temperature of the servomotor to 40 [°C] or lower. • Remove shields interrupting heat radiation, if there are any.
The effective torque exceeds the rating.	Increase the cycle time and reduce the operation frequency.

The main body of the encoder detects this alarm according to results of self-diagnosis.

21. Absolute Data Lost

[Display]

AL-dL1

AL-dL2

AL-dL3

[Description of detected alarm]

The absolute data of the encoder is lost.

- dL1: Battery voltage drop, broken encoder cable, loss of multi-rotation data
- dL2: Multi-turn data fault in encoder
- dL3: Detection at power-on after an ET alarm

[Cause and remedy]

Cause	Remedy
dL1 alarm	• Replace the battery and check if the encoder cable is not broken and correct. • A warning is displayed at the keypad if the battery voltage is low. (If PA2_78 is set at 1)
dL2 alarm	Perform position preset. If the alarm persists, replace the servomotor.
dL3 alarm	After position preset, dL3 is canceled but the ET alarm persists. If the ET alarm is not canceled, replace the servomotor.

For details, refer to "CHAPTER 11 ABSOLUTE POSITION SYSTEM."

22. Multi-turn Data Overflow

[Display]

AL- AF

[Description of detected alarm]

Rotation of the output shaft of the servomotor exceeds the range between -32766 and +32765.

[Cause and remedy]

Cause	Remedy
Excessive servomotor revolutions	Check the servomotor revolutions. Use the PC Loader or take similar measures to check the current position.

23. Initial Error

[Display]

AL- iE

[Description of detected alarm]

The initial position inside the encoder is not established.

[Cause and remedy]

Cause	Remedy
The encoder is damaged.	Replace the servomotor.
The power is turned on while the servomotor rotates due to an external force (at 250 [r/min] or over).	Stop the servomotor and turn the power off then on again. If restoration is not obtained, replace the servomotor.

24. Command Pulse Frequency Error

[Display]

AL- HF

[Description of detected alarm]

The frequency of the command pulse inside the servo amplifier is high.
200 [MHz] or a higher frequency is detected at the inlet of the position deviation counter inside the servo amplifier.

[Cause and remedy]

Cause	Remedy
The command pulse frequency is high.	Reduce the command pulse frequency.
The pulse reference value such as the input electronic gear setting is high.	Change the pulse ratio setting to a correct reference value.

7.4 Items to be Inquired upon Trouble

If an alarm is alerted due to any cause, take corrective actions according to description given in "7.3 Troubleshooting Method." If the servo amplifier is reset to continue operation though the cause is unknown, damage may be caused to the servomotor and/or servo amplifier. When contacting us, notify the following information.

Item	Information to Be Provided
Description of nameplate	Model of servomotor and that of servo amplifier [Example] RYT201D5-VS2
Device configuration	Host control unit, external braking resistor, etc. [Example] External braking resistor (model: WSR-401)
Configuration of mechanical system	Outline of configuration of mechanical system driven by motor [Example] Spring feed, vertical, reduction ratio 1/2
Details of trouble	(1) Operation years, whether the equipment has functioned correctly even once or not (2) Frequency of alarm detection and control method (pulse operation, etc.) and other circumstances [Example] An alarm is displayed whenever a certain device functions. (3) Description of alarm display (4) Repeatability of alarm (5) Timing of alarm occurrence - during acceleration, during rotation at constant speed, during deceleration, ... (6) Difference in alarm occurrence between forward and reverse rotation (7) Whether the alarm occurs under certain circumstances or not [Example] When the servo-on (S-ON) signal is turned on [Example] When the table advances to reach a certain point (8) Whether the similar phenomenon is observed or not if the servo amplifier is replaced with another one used for a machine of the same specification

7.5 Maintenance and Discarding

7.5.1 Operating Environment

Use in the operating environment specified in "CHAPTER 1 INSTALLATION."

(1) Power-on
Power can be supplied continuously to the servo amplifier.

⚠ WARNING

- Do not touch the servomotor, servo amplifier or cables in the power-on state.
  There is a risk of electric shock.

(2) Specifications
The rating of the GYC, GYS, and GYG type servomotors is continuous rating.

(3) Power supply
Avoid repeating power-on and shutdown of the commercial power supply to start or stop the servomotor. The service life of parts inside the servo amplifier may be affected.

(4) Radio noise
The servomotor and servo amplifier are devices for general industrial machines and no countermeasures against radio noise are taken. For this reason, noise effects may be observed under the following circumstances.

- Electric noise may be observed at AM radios placed near the servo amplifier or servomotor.
- Electric noise may be added to radio broadcasting systems or similar installed near cables.
- Electric noise may be added to measuring instruments and commercial devices.

For countermeasures against electric noise and installation method, refer to "CHAPTER 10 PERIPHERAL EQUIPMENT."

7.5.2 Life

The servomotor and servo amplifier have service lives even if they are used under regular operating conditions.
Contact our service division for parts replacement. Never disassemble or repair by yourself.

(1) Bearing of servomotor
The service life of the servomotor varies according to the operating conditions.
Replacement is necessary if abnormal noise or excessive vibration is found during inspection.

(2) Cooling fan built in servo amplifier
Set parameter PA2_78 (Display transition at warning detection) at 1 to show a warning on the keypad of the front panel of the servo amplifier when the limit of the service life of the cooling fan draws near.
The cooling fan operates in the ready for servo-on (RDY) state. If the cooling fan fails to rotate in the state, the cooling fan must be replaced.

(3) Brake built in servomotor
The brake built in the servomotor is a non-exciting type retention-only brake. Do not use it for braking. Failure will be caused if the brake is used for braking, resulting in substantial reduction of the service life. Use it only for retention of a stopped servomotor.

(4) Capacitor built in servo amplifier
The electrolytic capacitors used for the main circuit and control circuit of the servo amplifier have service lives.
For capacitors used in the main circuit, set parameter PA2_78 (Display transition at warning detection) at 1 to show a warning at the keypad on the front panel of the servo amplifier when the limit of the service life draws near.

(5) Battery (for ABS system)
The battery used in an absolute position system has a service life.
If the battery voltage is lower than the rated value, a warning is displayed at the keypad on the front panel of the servo amplifier. The orange status indication LED blinks at 0.5-second intervals simultaneously.
Replace the battery soon while leaving the control power turned on.

7.5.3 Discarding

(1) Servomotor
Handle the servomotor as a general industrial waste.

(2) Servo amplifier
Handle the servo amplifier as a general industrial waste.

7.6 Approximate Replacement Timing

The approximate replacement timings of parts for the following operating conditions are shown below. However, note that the timing varies according to the operation method, environmental conditions and so on. For the replacement method, contact us.

[Operating conditions]

Ambient temperature: Annual average 30 [°C]
Load factor: Within 80 [%]
Operation rate: Within 20 hours/day

■ Servomotor

Part name	Standard service life	Method
Bearing	20,000 to 30,000 hours	Send the product back to us for repair.
Oil seal	5000 hours	

7

■ Servo amplifier

Part name	Standard service life	Method
Capacitors of main circuit	73,000 hours	Send the product back to us for repair.
Aluminum electrolytic capacitors of printed circuit board	73,000 hours	
Cooling fan	73,000 hours	
Fuse	73,000 hours	
Battery for absolute system	35,000 hours *1	Replace with a new part.

*1 Cumulative operation hours without tuning the power on

CHAPTER 8 SPECIFICATIONS

8

8.1 Specifications of Servomotor

8.1.1 GYS Motor

200V series

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYS500D5 -□□ 2 (-B)	GYS101D5 -□□ 2 (-B)	GYS201D5 -□□ 2 (-B)	GYS401D5 -□□ 2 (-B)	GYS751D5 -□□ 2 (-B)
Rated output [kW]	0.05	0.1	0.2	0.4	0.75
Rated torque [N · m]	0.159	0.318	0.637	1.27	2.39
Rated speed [r/min]	3000				
Max. speed [r/min]	6000*1				
Max. torque [N · m]	0.478	0.955	1.91	3.82	7.17
Inertia [kg · m²] ( ) indicates brake-incorporated type.	0.0192×10^{-4} (0.0223×10^{-4})	0.0371×10^{-4} (0.0402×10^{-4})	0.135×10^{-4} (0.159×10^{-4})	0.246×10^{-4} (0.270×10^{-4})	0.853×10^{-4} (0.949×10^{-4})
Recommended load inertia ratio	30 times or less*2				
Rated current [A]	0.85	0.85	1.5	2.7	4.8
Max. current [A]	2.55	2.55	4.5	8.1	14.4
Winding insulation class	Class B				
Operation duty type	Continuous				
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing and connectors)				
Terminals (motor)	Cable 0.3m (with connector)				
Terminals (encoder)	Cable 0.3m (with connector)				
Overheat protection	Not provided (The servo amplifier detects temperature.)				
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)				
Shaft extension	Straight shaft				
Paint color	N1.5				
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)				
Vibration level	V5 or below				
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust				
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)				
Vibration resistance [m/s²]	49				
Mass [kg] ( ) indicates brake-incorporated type.	0.45 (0.62)	0.55 (0.72)	1.2 (1.7)	1.8 (2.3)	3.4 (4.2)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive				

*1 The maximum rotation speed is 5000r/min when using the motor in combination with Fuji's gear head.
*2 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.

Motor type (-B) indicates the brake-incorporated type.	GYS102D5 -□□ 2 (-B)	GYS152D5 -□□ 2 (-B)	GYS202D5 -□□ 2 (-B)	GYS302D5 -□□ 2 (-B)	GYS402D5 -□□ 2 (-B)	GYS502D5 -□□ 2 (-B)
Rated output [kW]	1.0	1.5	2.0	3.0	4.0	5.0
Rated torque [N · m]	3.18	4.78	6.37	9.55	12.7	15.9
Rated speed [r/min]	3000					
Max. speed [r/min]	5000					
Max. torque [N · m]	9.55	14.3	19.1	28.7	38.2	47.8
Inertia [kg · m²] ( ) indicates brake-incorporated type.	1.73×10^{-4} (2.03×10^{-4})	2.37×10^{-4} (2.67×10^{-4})	3.01×10^{-4} (3.31×10^{-4})	8.32×10^{-4} (10.42×10^{-4})	10.8×10^{-4} (12.9×10^{-4})	12.8×10^{-4} (14.9×10^{-4})
Recommended load inertia ratio	20 times or less*1					
Rated current [A]	7.1	9.6	12.6	18.0	24.0	30.0
Max. current [A]	21.3	28.8	37.8	54.0	72.0	90.0
Winding insulation class	Class F					
Operation duty type	Continuous					
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing)*2					
Terminals (motor)	Cannon connector					
Terminals (encoder)	Cannon connector					
Overheat protection	Not provided (The servo amplifier detects temperature.)					
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)					
Shaft extension	Straight shaft					
Paint color	N1.5					
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)					
Vibration level	Up to rated rotation speed: V10 or below Over rated rotation speed and up to 5000r/min: V15 or below					
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust					
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)					
Vibration resistance [m/s²]	24.5					
Mass [kg] ( ) indicates brake-incorporated type.	4.4 (5.9)	5.2 (6.8)	6.3 (7.9)	11.0 (13.0)	13.5 (15.5)	16.0 (18.0)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive					

*1 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.
*2 If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.

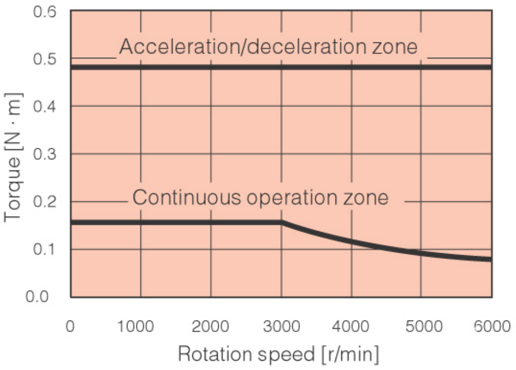
■ Brake specification (motor equipped with a brake)

Motor type	GYS500D5 - □□ 2-B	GYS101D5 - □□ 2-B	GYS201D5 - □□ 2-B	GYS401D5 - □□ 2-B	GYS751D5 - □□ 2-B
Static friction torque [N · m]	0.34		1.27		2.45
Rated DC voltage [V]	DC24±10%				
Attraction time [ms]	35		40		60
Release time [ms]	10		20		25
Power consumption [W]	6.1 (at 20°C)		7.3 (at 20°C)		8.5 (at 20°C)

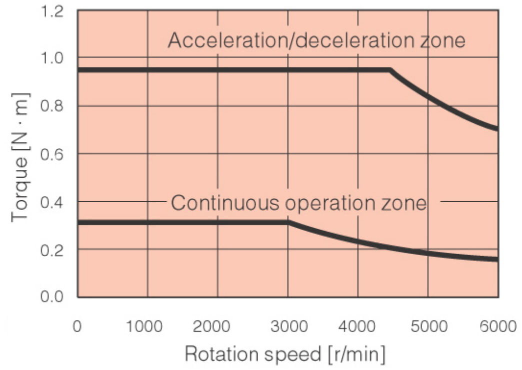
Motor type	GYS102D5 - □□ 2-B	GYS152D5 - □□ 2-B	GYS202D5 - □□ 2-B	GYS302D5 - □□ 2-B	GYS402D5 - □□ 2-B	GYS502D5 - □□ 2-B
Static friction torque [N · m]	6.86			17		
Rated DC voltage [V]	DC24±10%					
Attraction time [ms]	100			120		
Release time [ms]	40			30		
Power consumption [W]	17.7 (at 20°C)			12 (at 20°C)		

■ Torque characteristics drawing (at 3-phase 200 [V] or single-phase 230 [V] source voltage)

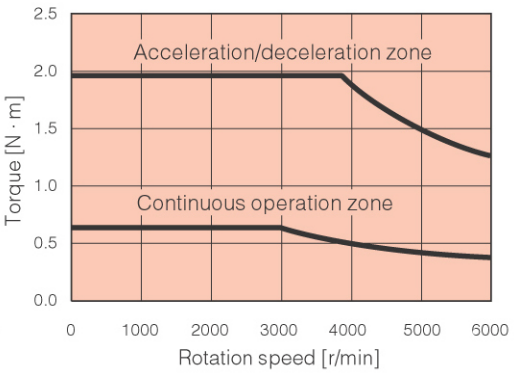
GYS500D5-□□2 (0.05[kW])



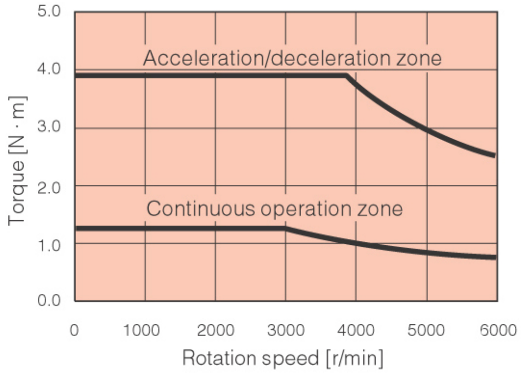
GYS101D5-□□2 (0.1[kW])



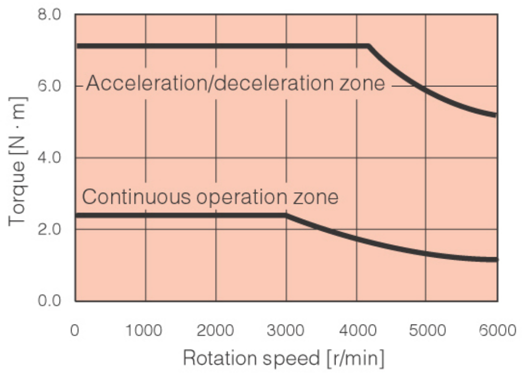
GYS201D5-□□2 (0.2[kW])



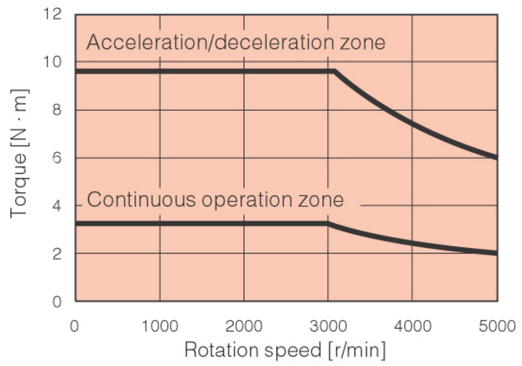
GYS401D5-□□2 (0.4[kW])



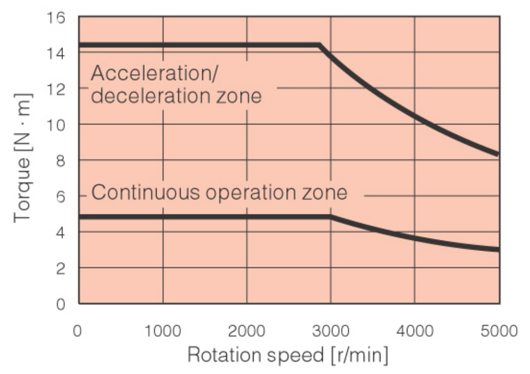
GYS751D5-□□2 (0.75[kW])



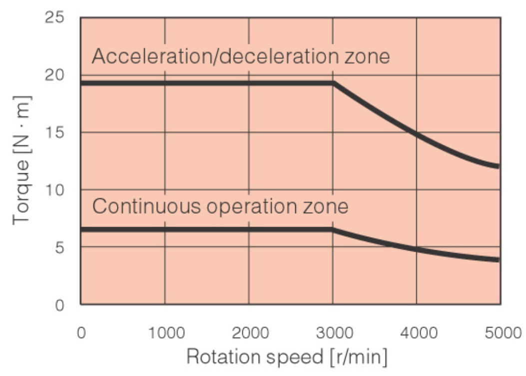
GYS102D5-□□2 (1.0[kW])



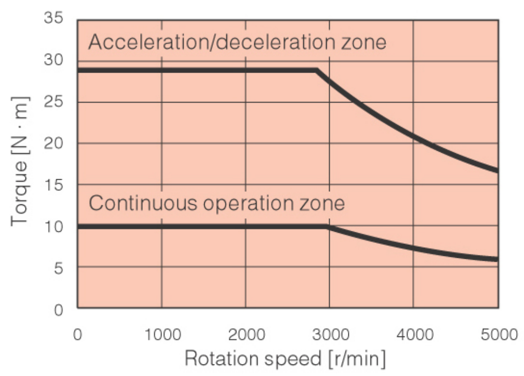
GYS152D5-□□2 (1.5[kW])



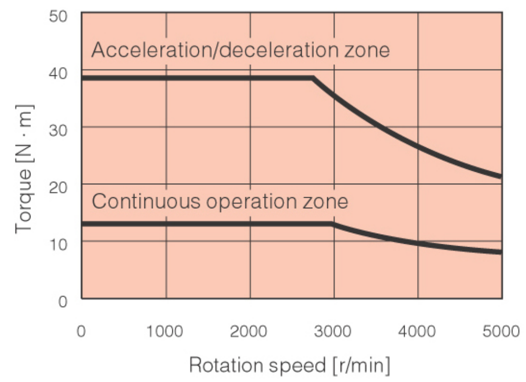
GYS202D5-□□2 (2.0[kW])



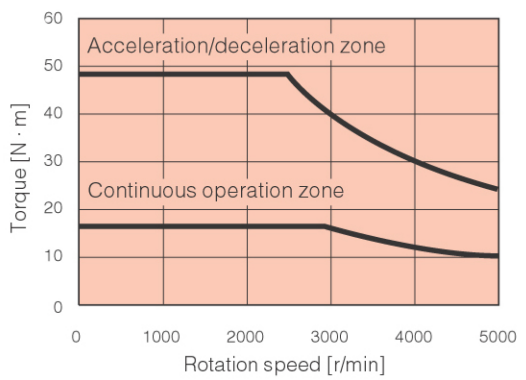
GYS302D5-□□2 (3.0[kW])



GYS402D5-□□2 (4.0[kW])



GYS502D5-□□2 (5.0[kW])



These characteristics indicate typical values of each servomotor combined with the corresponding RYT type servo amplifier. The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYS500, 101 : 200 × 200 × 6 [mm]
- Model GYS201, 401 : 250 × 250 × 6 [mm]
- Model GYS751 : 300 × 300 × 6 [mm]
- Model GYS102, 152, 202 : 350 × 350 × 8 [mm]
- Model GYS302, 402, 502 : 400 × 400 × 12 [mm]

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100V series

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYS500D5 - □□ 6 (-B)	GYS101D5 - □□ 6 (-B)	GYS201D5 - □□ 6 (-B)	GYS401D5 - □□ 6 (-B)
Rated output [kW]	0.05	0.1	0.2	0.375
Rated torque [N · m]	0.159	0.318	0.637	1.19
Rated speed [r/min]	3000			
Max. speed [r/min]	6000*1			
Max. torque [N · m]	0.478	0.955	1.91	3.58
Inertia [kg · m²] ( ) indicates brake-incorporated type.	0.0192×10^{-4} (0.0223×10^{-4})	0.0371×10^{-4} (0.0402×10^{-4})	0.135×10^{-4} (0.159×10^{-4})	0.246×10^{-4} (0.270×10^{-4})
Recommended load inertia ratio	30 times or less*2			
Rated current [A]	0.85	1.5	2.7	4.8
Max. current [A]	2.55	4.5	8.1	14.4
Winding insulation class	Class B			
Operation duty type	Continuous			
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing and connectors)			
Terminals (motor)	Cable 0.3m (with connector)			
Terminals (encoder)	Cable 0.3m (with connector)			
Overheat protection	Not provided (The servo amplifier detects temperature.)			
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)			
Shaft extension	Straight shaft			
Paint color	N1.5			
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)			
Vibration level	V5 or below			
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust			
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)			
Vibration resistance [m/s²]	49			
Mass [kg] ( ) indicates brake-incorporated type.	0.45 (0.6)	0.55 (0.7)	1.2 (1.7)	1.8 (2.3)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive			

*1 The maximum rotation speed is 5000r/min when using the motor in combination with Fuji's gear head.
*2 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.

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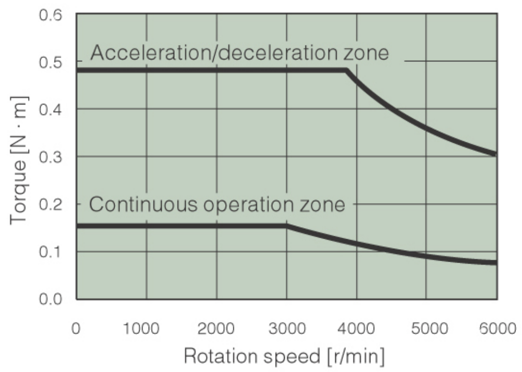
■ Brake specification (motor equipped with a brake)

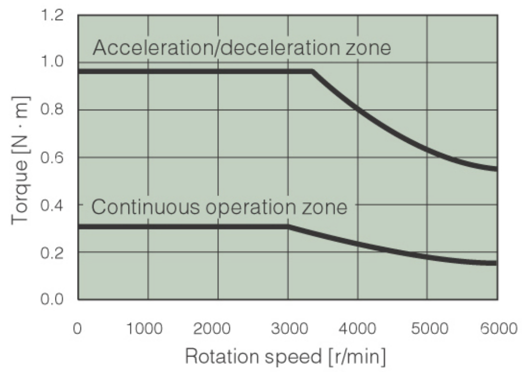
Motor type	GYS500D5 - □□ 6-B	GYS101D5 - □□ 6-B	GYS201D5 - □□ 6-B	GYS401D5 - □□ 6-B
Static friction torque [N · m]	0.34		1.27	
Rated DC voltage [V]	DC24±10%			
Attraction time [ms]	35		40	
Release time [ms]	10		20	
Power consumption [W]	6.1 (at 20°C)		7.3 (at 20°C)	

■ Torque characteristics drawing (at single-phase 100 [V] source voltage)

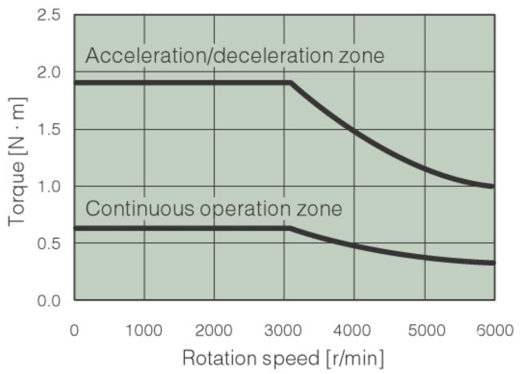
GYS500D5-□□6 (0.05[kW])



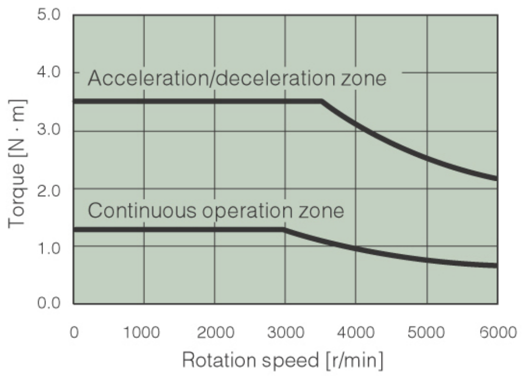
GYS101D5-□□6 (0.1[kW])



GYS201D5-□□6 (0.2[kW])



GYS401D5-□□6 (0.375[kW])



These characteristics indicate typical values of each servomotor combined with the corresponding RYT type servo amplifier. The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYS500, 101 : 200 × 200 × 6 [mm]
- Model GYS201, 401 : 250 × 250 × 6 [mm]

8.1.2 GYC Motor

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYC101D5 -□□ 2 (-B)	GYC201D5 -□□ 2 (-B)	GYC401D5 -□□ 2 (-B)	GYC751D5 -□□ 2 (-B)	GYC102D5 -□□ 2 (-B)	GYC152D5 -□□ 2 (-B)	GYC202D5 -□□ 2 (-B)
Rated output [kW]	0.1	0.2	0.4	0.75	1.0	1.5	2.0
Rated torque [N · m]	0.318	0.637	1.27	2.39	3.18	4.78	6.37
Rated speed [r/min]	3000						
Max. speed [r/min]	6000*1				5000		
Max. torque [N · m]	0.955	1.91	3.82	7.17	9.55	14.3	19.1
Inertia [kg · m²] ( ) indicates brake-incorporated type.	0.0577×10^{-4} (0.0727×10^{-4})	0.213×10^{-4} (0.288×10^{-4})	0.408×10^{-4} (0.483×10^{-4})	1.21×10^{-4} (1.66×10^{-4})	3.19×10^{-4} (5.29×10^{-4})	4.44×10^{-4} (6.54×10^{-4})	5.69×10^{-4} (7.79×10^{-4})
Recommended load inertia ratio	30 times or less*2				20 times or less*2		
Rated current [A]	1.0	1.5	2.6	4.8	6.7	9.6	12.6
Max. current [A]	3.0	4.5	7.8	14.4	20.1	28.8	37.8
Winding insulation class	Class B				Class F		
Operation duty type	Continuous						
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing and connectors)				Totally enclosed, self-cooled (IP 67. excluding the shaft sealing)*3		
Terminals (motor)	Cable 0.3m (with connector)				Cannon connector		
Terminals (encoder)	Cable 0.3m (with connector)				Cannon connector		
Overheat protection	Not provided (The servo amplifier detects temperature.)						
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)						
Shaft extension	Straight shaft						
Paint color	N1.5						
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)						
Vibration level	V5 or below				Up to rated rotation speed: V10 or below Over rated rotation speed and up to 5000r/min: V15 or below		
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust						
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)						
Vibration resistance [m/s²]	49				24.5		
Mass [kg] ( ) indicates brake-incorporated type.	0.75 (1.0)	1.3 (1.9)	1.9 (2.6)	3.5 (4.3)	5.7 (8.0)	7.0 (9.8)	8.2 (11.0)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive						

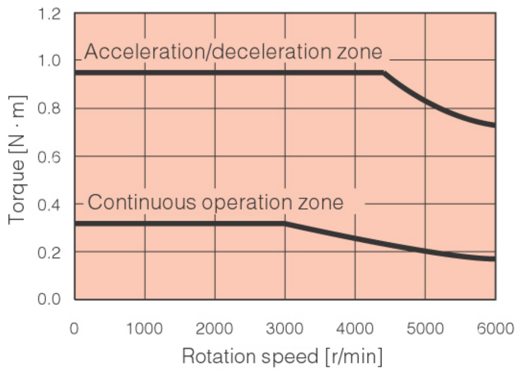
*1 The maximum rotation speed is 5000r/min when using the motor in combination with Fuji's gear head.
*2 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.
*3 If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.

■ Brake specification (motor equipped with a brake)

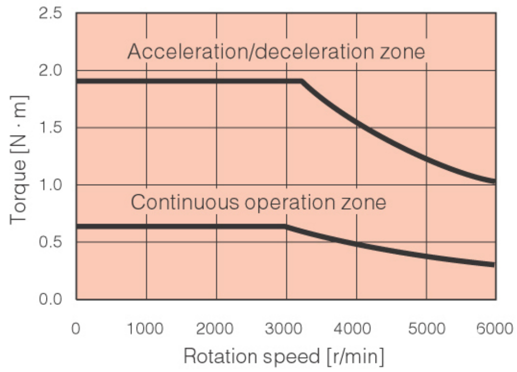
Motor type	GYC101D5 -□□ 2-B	GYC201D5 -□□ 2-B	GYC401D5 -□□ 2-B	GYC751D5 -□□ 2-B	GYC102D5 -□□ 2-B	GYC152D5 -□□ 2-B	GYC202D5 -□□ 2-B
Static friction torque [N · m]	0.318	1.27		2.39	17		
Rated DC voltage [V]	DC24±10%						
Attraction time [ms]	60	80		50	120		
Release time [ms]	40			80	30		
Power consumption [W]	6.5 (at 20°C)	9.0 (at 20°C)		8.5 (at 20°C)	12 (at 20°C)		

■ Torque characteristics drawing (at 3-phase 200 [V] or single-phase 230 [V] source voltage)

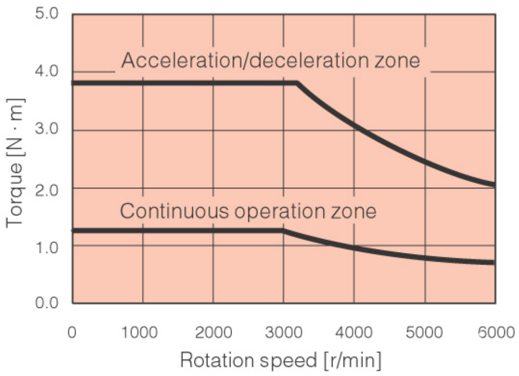
GYC101D5-□□2 (0.1[kW])



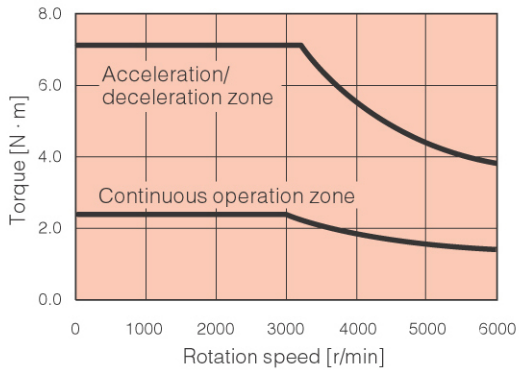
GYC201D5-□□2 (0.2[kW])



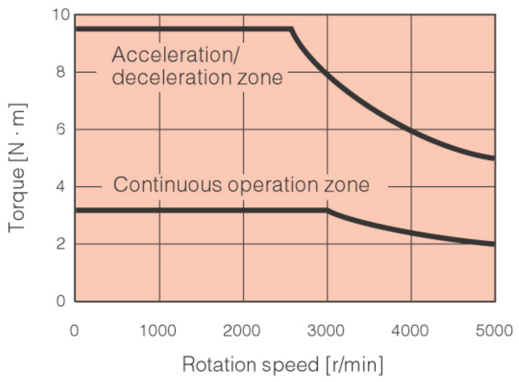
GYC401D5-□□2 (0.4[kW])



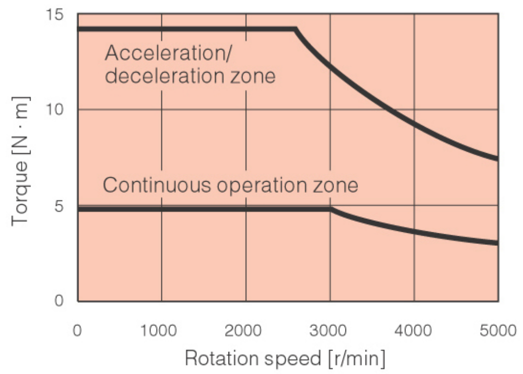
GYC751D5-□□2 (0.75[kW])



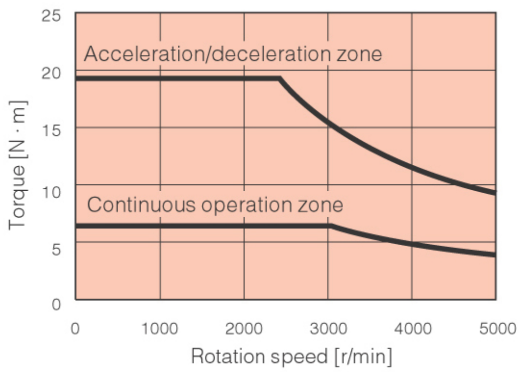
GYC102D5-□□2 (1.0[kW])



GYC152D5-□□2 (1.5[kW])



GYC202D5-□□2 (2.0[kW])



These characteristics indicate typical values of each servomotor combined with the corresponding RYT type servo amplifier.

The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYC101, 201, 401 : 250 × 250 × 6 [mm]
- Model GYC751 : 300 × 300 × 6 [mm]
- Model GYC102D : 300 × 300 × 12 [mm]
- Model GYC152D, 202D : 400 × 400 × 12 [mm]

8.1.3 GYG Motor [2000 r/min]

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYG501C5 -□□ 2 (-B)	GYG751C5 -□□ 2 (-B)	GYG102C5 -□□ 2 (-B)	GYG152C5 -□□ 2 (-B)	GYG202C5 -□□ 2 (-B)
Rated output [kW]	0.5	0.75	1.0	1.5	2.0
Rated torque [N · m]	2.39	3.58	4.77	7.16	9.55
Rated speed [r/min]	2000				
Max. speed [r/min]	3000				
Max. torque [N · m]	7.2	10.7	14.3	21.5	28.6
Inertia [kg · m²] ( ) indicates brake-incorporated type.	7.96×10^{-4} (10.0×10^{-4})	11.55×10^{-4} (13.6×10^{-4})	15.14×10^{-4} (17.2×10^{-4})	22.33×10^{-4} (24.4×10^{-4})	29.51×10^{-4} (31.6×10^{-4})
Recommended load inertia ratio	10 times or less*1				
Rated current [A]	3.5	5.2	6.4	10	12.3
Max. current [A]	10.5	15.6	19.2	30.0	36.9
Winding insulation class	Class F				
Operation duty type	Continuous				
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing)*2				
Terminals (motor)	Cannon connector				
Terminals (encoder)	Cannon connector				
Overheat protection	Not provided (The servo amplifier detects temperature.)				
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)				
Shaft extension	Straight shaft				
Paint color	N1.5				
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)				
Vibration level	V10 or below				
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust				
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)				
Vibration resistance [m/s²]	24.5				
Mass [kg] ( ) indicates brake-incorporated type.	5.3 (7.5)	6.4 (8.6)	7.5 (9.7)	9.8 (12.0)	12.0 (14.2)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive				

*1 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.
*2 If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.

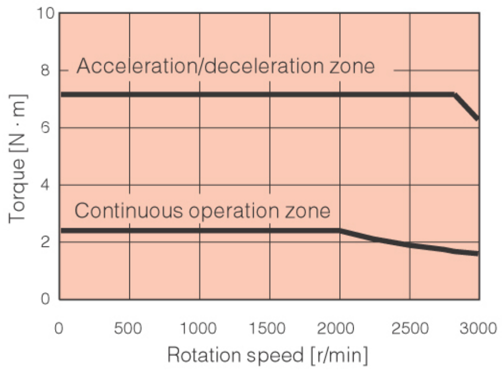
■ Brake specification (motor equipped with a brake)

Motor type	GYG501C5 -□□ 2-B	GYG751C5 -□□ 2-B	GYG102C5 -□□ 2-B	GYG152C5 -□□ 2-B	GYG202C5 -□□ 2-B
Static friction torque [N · m]	17				
Rated DC voltage [V]	DC24±10%				
Attraction time [ms]	120				
Release time [ms]	30				
Power consumption [W]	12 (at 20°C)				

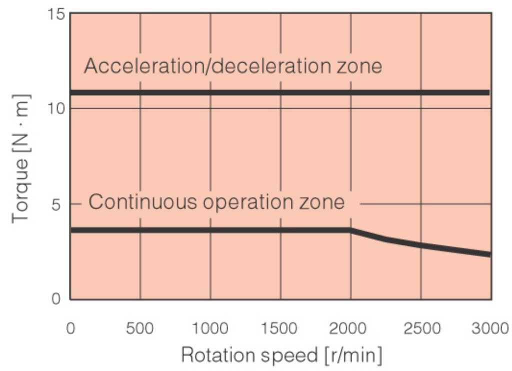
8

■ Torque characteristics drawing (at 3-phase 200 [V] source voltage)

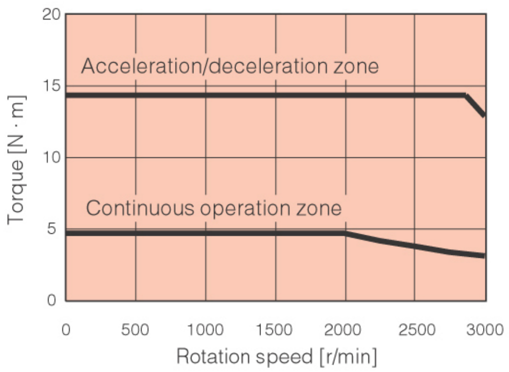
GYG501C5-□□2 (0.5[kW])



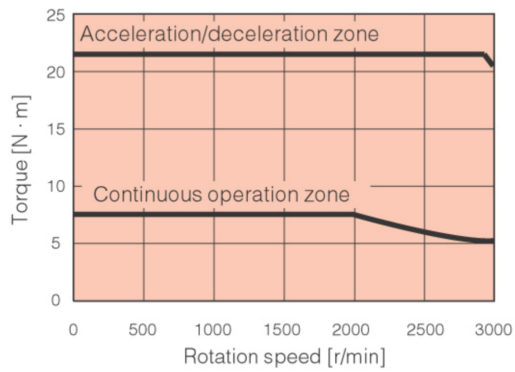
GYG751C5-□□2 (0.75[kW])



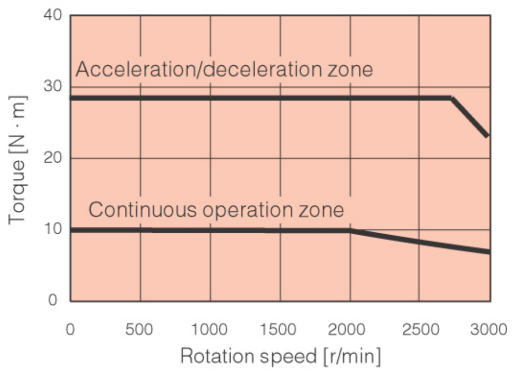
GYG102C5-□□2 (1.0[kW])



GYG152C5-□□2 (1.5[kW])



GYG202C5-□□2 (2.0[kW])



These characteristics indicate typical values of each servomotor combined with the corresponding RYT type servo amplifier.

The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYG501C, 751C, 102C : 300 × 300 × 12 [mm]
- Model GYG152, 202 : 400 × 400 × 12 [mm]

8.1.4 GYG Motor [1500 r/min]

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYG501B5 - □□ 2 (-B)	GYG851B5 - □□ 2 (-B)	GYG132B5 - □□ 2 (-B)
Rated output [kW]	0.5	0.85	1.3
Rated torque [N · m]	3.18	5.41	8.28
Rated speed [r/min]	1500		
Max. speed [r/min]	3000		
Max. torque [N · m]	9.5	16.2	24.8
Inertia [kg · m²] ( ) indicates brake-incorporated type.	11.55×10^{-4} (13.6×10^{-4})	15.15×10^{-4} (17.3×10^{-4})	22.33×10^{-4} (24.5×10^{-4})
Recommended load inertia ratio	10 times or less*1		
Rated current [A]	4.7	7.3	11.5
Max. current [A]	14.1	21.9	34.5
Winding insulation class	Class F		
Operation duty type	Continuous		
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft sealing)*2		
Terminals (motor)	Cannon connector		
Terminals (encoder)	Cannon connector		
Overheat protection	Not provided (The servo amplifier detects temperature.)		
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)		
Shaft extension	Straight shaft		
Paint color	N1.5		
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)		
Vibration level	V10 or below		
Installation place, altitude and environment	For indoor use (free from direct sunlight), 1000m or below, locations without corrosive and flamable gases, oil mist and dust		
Ambient temperature, humidity	-10 to +40°C, within 90% RH max.(without condensation)		
Vibration resistance [m/s²]	24.5		
Mass [kg] ( ) indicates brake-incorporated type.	6.4 (8.6)	7.5 (9.7)	9.8 (12.0)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive		

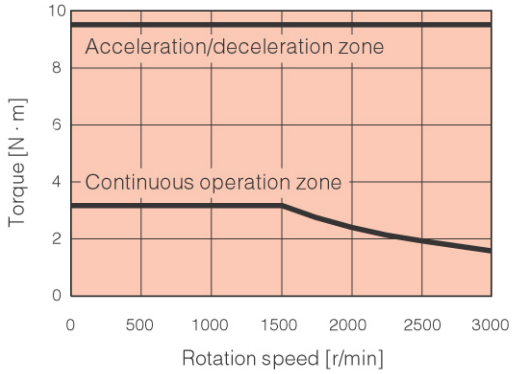
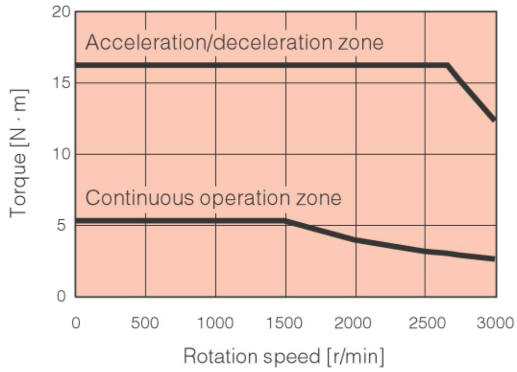
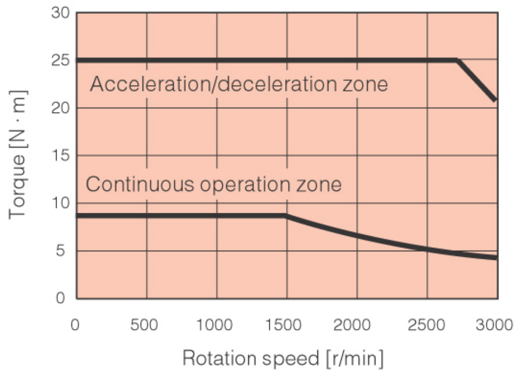
*1 The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.
*2 If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.

■ Brake specification (motor equipped with a brake)

Motor type	GYG501B5 - □□ 2-B	GYG851B5 - □□ 2-B	GYG132B5 - □□ 2-B
Static friction torque [N · m]	17		
Rated DC voltage [V]	DC24±10%		
Attraction time [ms]	120		
Release time [ms]	30		
Power consumption [W]	12 (at 20°C)		

8

■ Torque characteristics drawing (at 3-phase 200 [V] source voltage)

GYG501B5-□□2 (0.5[kW])	GYG851B5-□□2 (0.85[kW])
	
GYG132B5-□□2 (1.3[kW])	
	

These characteristics indicate typical values of each servomotor combined with the corresponding RYT type servo amplifier.

The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYG501B, 851B : 300 × 300 × 12 [mm]
- Model GYG132 : 400 × 400 × 12 [mm]

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8.2 Specifications of Servo Amplifier

8.2.1 Common Specifications

Applicable motor rated speed		3000r/min				3000r/min											2000r/min					1500r/min		
Applicable motor output [kW]		0.05	0.1	0.2	0.375	0.05	0.1	0.2	0.4	0.75	1.0	1.5	2.0	3.0	4.0	5.0	0.5	0.75	1.0	1.5	2.0	0.5	0.85	1.3
Amplifier type RYT□□□	D5-△△○	500	101	201	401	500	101	201	401	751	102	152	202	302	402	502								
	C5-△△2																501	751	102	152	202			
	B5-△△2																					501	851	132
Outer frame number		Frame 1		Frame 2	Frame 3	Frame 1			Frame 2	Frame 3	Frame 4		Frame 5		Frame 6		Frame 3		Frame 4	Frame 5		Frame 3	Frame 4	Frame 5
Mass [kg]		0.9		1.1	1.3	0.9			1.1	1.3	1.5		2.6		3.8		1.3		1.5	2.9		1.3	1.5	2.9
Protective construction / cooling		Open / self-cooling			Open / forced air cooling	Open / self-cooling				Open / forced air cooling							Open / forced air cooling					Open / forced air cooling		
Power supply: Main power supply	Phase	Single-phase				Single-phase, 3-phase					3-phase						Single-phase, 3-phase		3-phase			Single-phase, 3-phase	3-phase	
Power supply: Main power supply	Voltage frequency	AC100 to 120V 50/60Hz				AC200 to 240V 50/60Hz																		
Power supply: Main power supply	Allowable voltage fluctuation	AC85 to 132V				3-phase: AC170 to 262V, Single-phase: AC190 to 262V																		
Power supply: Control power supply	Phase	Single-phase																						
Power supply: Control power supply	Voltage frequency	AC100 to 120V 50/60Hz				AC200 to 240V 50/60Hz																		
Power supply: Control power supply	Allowable voltage fluctuation	AC85 to 132V				AC170 to 262V																		
Control system		IGBT PWM sinusoidal PWM drive																						
Max voltage for regenerative resistance [W]	Built-in resistor	-	-	8	20	-	-	-	8	20	20	20	30	30	60	60	20	20	20	30	30	20	20	30
	External resistor *1	17	17	25	25	17	17	17	17	50	50	50	260	260	300	300	50	50	50	260	260	50	50	260

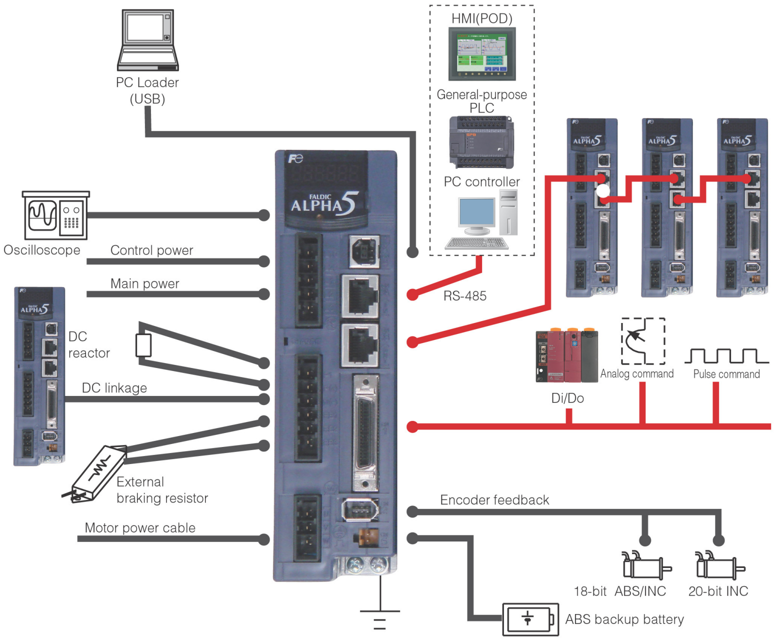
Dynamic brake		Built-in *2
Feedback		18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)
Overload capability		300% / 3 sec.
Speed fluctuation ratio	Load fluctuation	Within ±1 r/min (load fluctuation 0 to 100%)
	Power supply fluctuation	Within ±1 r/min (power supply fluctuation -10 to +10%)
	Temperature fluctuation	Within ±0.2% (25 ±10°C at rated operation speed and analog input operation)
Capability and function: VV type	Speed control function	Closed loop control with speed adjuster, acceleration/deceleration time setting, manual feed rate/max. rotation speed, speed command zero clamp, etc.
	Number of position data sets	15-point (position, speed, acceleration/deceleration time setting, timer, M code and various statuses)
	Positon control function	Closed loop control with position adjuster, electronic gear, output pulse setting, feed forward, homing, interrupt positioning, auto startup, etc.
	Torque control function	Closed loop control with current adjuster (proportional open loop control of current and torque), torque limit, speed limit at torque control, etc.
	Accessory functions	Easy tuning, profile operation, sequence test mode, auto tuning, auto notch filter, vibration suppressing online learning, etc.
Capability and function: VS type	Speed control function	Closed loop control with speed adjuster, acceleration/deceleration time setting, manual feed rate/max. rotation speed, etc.
	Positon control function	Closed loop control with position adjuster, electronic gear, output pulse setting, feed forward, homing, interrupt positioning, etc.
	Torque control function	Closed loop control with current adjuster (proportional open loop control of current and torque), torque limit, speed limit at torque control, etc.
	Accessory functions	Easy tuning, profile operation, sequence test mode, auto tuning, auto notch filter, vibration suppressing online learning, etc.
Capability and function: LS type	Positon control function	Automatic startup, manual operation, pulse train, homing
	Number of position data sets	99-point (position, speed, timer, M code and various statuses)
	Max positioning value	±2,000,000,000
	Positioning method	Absolute / incremental
	Accessory functions	Easy tuning, profile operation, sequence test mode, auto tuning, auto notch filter, vibration suppressing online learning, etc.
Protective function (Alarm indication)		Overcurrent(oc1, oc2), Overspeed(oS), Control power undervoltage(Lvc), Overvoltage(Hv), Encoder trouble(Et1, Et2), Circuit trouble(ct), Memory Error(dE), Fuse Broken(Fb), Motor Combination Error(cE), Braking transistor overheat(tH), Encoder Communication error(Ec), CONT(Control signal) Error(ctE), Overload(oL1, oL2), Main power undervoltage(LvP), Braking resistor overheat(rH1, rH2, rH3), Deviation overflow(oF), Amplifier overheat(AH), Encoder overheat(EH), Absolute data Lost(dL1, dL2, dL3), Multi-turn data over flow(AF), Initial Error(iE), Command pulse Frequency Error(HF)
Operation and display section of main body (keypad)		6-digit alphanumeric display with 7-segment LED 4 operation switches Analog monitor connector (CN6), status indication LED
Working conditions	Installation place	Indoors (free from direct sunshine), altitude ≤ 1000m, free from corrosive and flammable gases, oil mist and dust In case of compliance with CE marking Models compliant with EU directive: pollution degree 2, over voltage category III
	Temperature/humidity	-10 to 55°C/10 to 90%RH (without condensation)
	Vibration / shock resistance	4.9m/s²/19.6m/s²
Standards		UL/cUL (UL508c), CE marking (low voltage directive EN61800-5-1) (acquisition being applied for model of 2.0kW or more), RoHS directive

*1: The figure is data determined when the amplifier is connected with an external resistor dedicated for each model.
*2: We will accept custom orders for models without dynamic brake.

8

8.2.2 Specifications of VV Type

■ Outline of system configuration



■ Interface specifications

Item		Specifications
Command interface	Positioning function	RS-485 (Modbus-RTU), Di/Do
	Position control	Pulse input
	Speed control	Analog voltage input
	Torque control	Analog voltage input
Communication interface		Two RS-485 ports (for parameter editing and monitor)
		Our original protocol Modbus-RTU
		9600/19200/38400 bps, connection of max. 31 axes

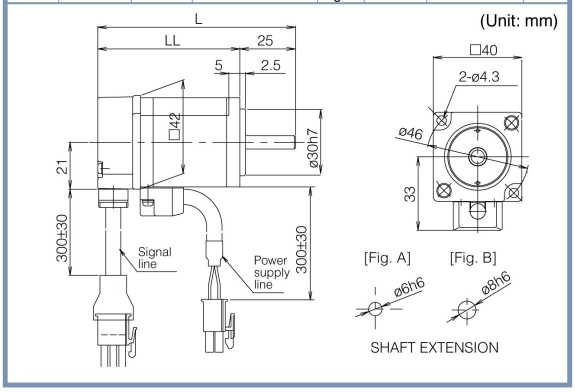
Terminal name	Symbol	Specifications
Pulse input	CA,*CA CB,*CB	Pulse input under position control Differential input: max. input frequency ≤ 1.0MHz Open collector input: max. input frequency ≤ 200kHz (in case of signals at 90-degree phase difference, the above relationship is true for the four-fold frequency.) Pulse format Command pulse/Command direction Forward/Reverse pulse Two signals at 90-degree phase difference } Select one of these formats with a parameter setting.
	PPI	Pull-up power input at open collector input (24VDC ±10%)
Pulse output	FFA,*FFA FFB,*FFB	Differential output: max. output frequency ≤ 1MHz Two signals at 90-degree phase difference Pulse output count setting n pulses/rev): 16 ≤ n ≤ 262144
	FFZ,*FFZ	Differential output: 1 pulse/rev
	FZ	Open collector output: 1 pulse/rev
	M5	Reference potential (0V)
Analog monitor voltage output	MON1 MON2	0V to ±10VDC Resolution: 14bits / ±full scale The output data depends on internal parameter.
	M5	Reference potential (0V)
Common for sequence I/O	COMIN	Common for sequence input signal
	COMOUT	Common for sequence output signal
Sequence input signal	CONT1 to CONT8	ON upon short circuit across contacts, OFF upon open circuit 12VDC-10% to 24VDC+10% Current consumption 20mA (per contact; used at 24VDC circuit voltage) Function of each signal depends on parameter setting Compatible with both sink and source input methods
Sequence output signal	OUT1 to OUT5	Short circuit upon ON, open circuit upon OFF 30VDC / 50mA (max.) Function of each signal depends on parameter setting Compatible with both sink and source output methods
Analog voltage input	VREF	Speed command input for speed control Input range: from -10 to 0 to -10V, input impedance 20kΩ Resolution: 15 bits / ±full scale
	TREF	Torque command input for torque control Input range: from -10 to 0 to +10V, input impedance 20kΩ Resolution: 14 bits / ±full scale
	P10	Power supply output for analog command (+10 VDC), output capacity 30 mA
	M5	Reference potential (0V)

8.3 Dimensions of Servomotor

8.3.1 GYS Motor

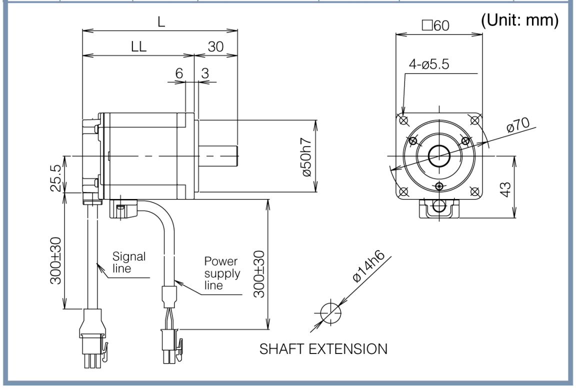
Power supply	Rated speed	Rated output	Type	Shaft shape	Over length L	Dimensions(flange) LL	Mass [kg]
100V series	3000r/min	0.05kW	GYS500D5- □ B6	Fig. A	89	64	0.45
		0.1kW	GYS101D5- □ B6	Fig. B	107	82	0.55
200V series		0.05kW	GYS500D5- □ B2	Fig. A	89	64	0.45
		0.1kW	GYS101D5- □ B2	Fig. B	107	82	0.55

(Unit: mm)



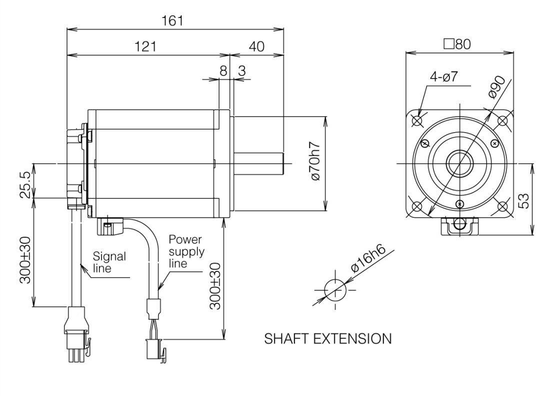
Power supply	Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Mass [kg]
100V series	3000r/min	0.2kW	GYS201D5- □ B6	107.5	77.5	1.2
		0.375kW	GYS401D5- □ B6	135.5	105.5	1.8
200V series		0.2kW	GYS201D5- □ B2	107.5	77.5	1.2
		0.4kW	GYS401D5- □ B2	135.5	105.5	1.8

(Unit: mm)



Rated speed	Rated output	Type
3000r/min	0.75kW	GYS751D5- □ B2

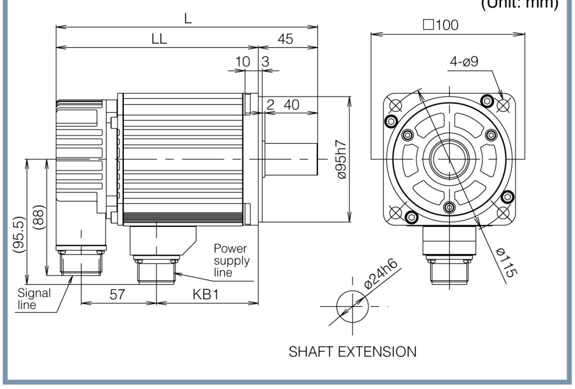
(Unit: mm)



[Mass: 3.4kg]

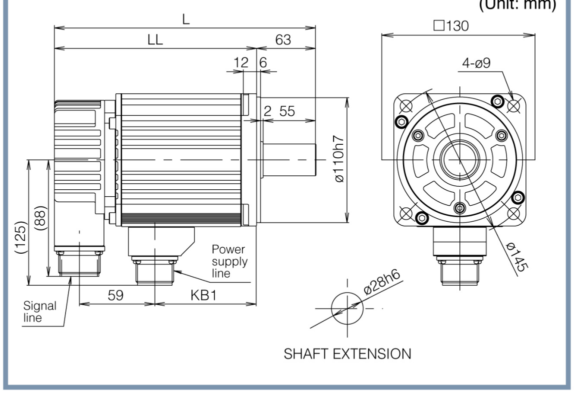
Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
3000r/min	1kW	GYS102D5- □ B2	198	153	77	4.4
	1.5kW	GYS152D5- □ B2	220.5	175.5	99.5	5.2
	2kW	GYS202D5- □ B2	243	198	122	6.3

(Unit: mm)



Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
3000r/min	3kW	GYS302D5- □ B2	266.5	203.5	125.5	11
	4kW	GYS402D5- □ B2	296.5	233.5	155.5	13.5
	5kW	GYS502D5- □ B2	326.5	263.5	185.5	16

(Unit: mm)

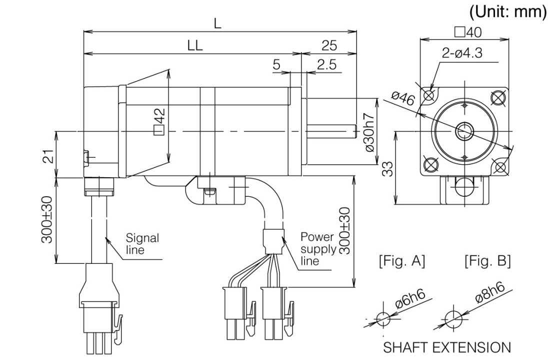


* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.2 GYS Motor (With a Brake)

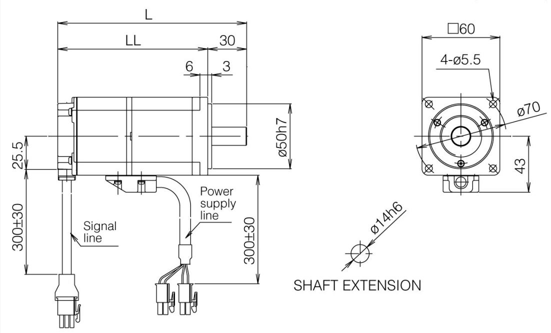
Power supply	Rated speed	Rated output	Type	Shaft shape	Over length L	Dimensions(flange) LL	Mass [kg]
100V series	3000r/min	0.05kW	GYS500D5- □ B6-B	Fig. A	123.5	98.5	0.62
		0.1kW	GYS101D5- □ B6-B	Fig. B	141.5	116.5	0.72
200V series		0.05kW	GYS500D5- □ B2-B	Fig. A	123.5	98.5	0.62
		0.1kW	GYS101D5- □ B2-B	Fig. B	141.5	116.5	0.72

(Unit: mm)



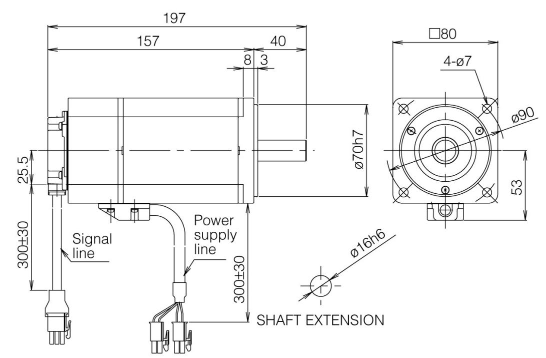
Power supply	Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Mass [kg]
100V series	3000r/min	0.2kW	GYS201D5- □ B6-B	145.5	115.5	1.7
		0.375kW	GYS401D5- □ B6-B	173.5	143.5	2.3
200V series		0.2kW	GYS201D5- □ B2-B	145.5	115.5	1.7
		0.4kW	GYS401D5- □ B2-B	173.5	143.5	2.3

(Unit: mm)



Rated speed	Rated output	Type
3000r/min	0.75kW	GYS751D5- □ B2-B

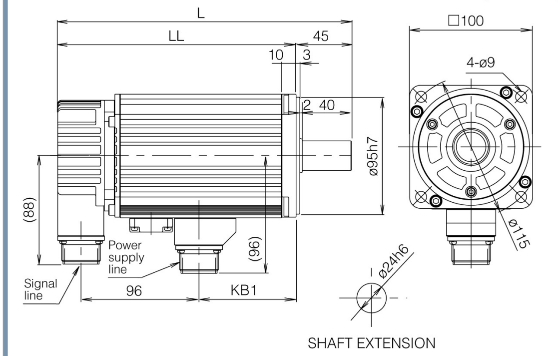
(Unit: mm)



[Mass: 4.2kg]

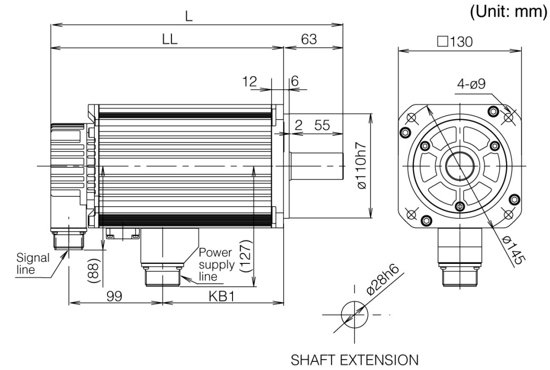
Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
3000r/min	1kW	GYS102D5- □ B2-B	239	194	79	5.9
	1.5kW	GYS152D5- □ B2-B	261.5	216.5	101.5	6.8
	2kW	GYS202D5- □ B2-B	284	239	124	7.9

(Unit: mm)



Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
3000r/min	3kW	GYS302D5- □ B2-B	308.5	245.5	127.5	13
	4kW	GYS402D5- □ B2-B	338.5	275.5	157.5	15.5
	5kW	GYS502D5- □ B2-B	368.5	305.5	187.5	18

(Unit: mm)

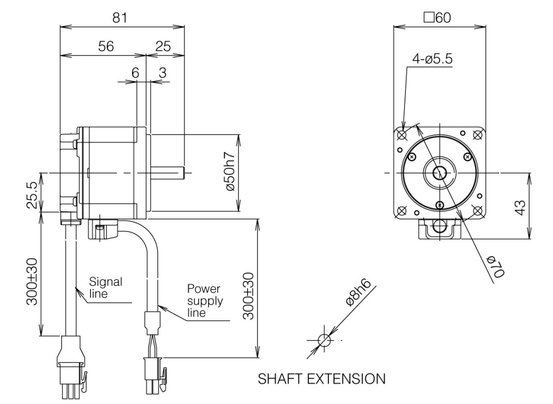


* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.3 GYC Motor

Rated speed	Rated output	Type
3000r/min	0.1kW	GYC101D5- □ B2

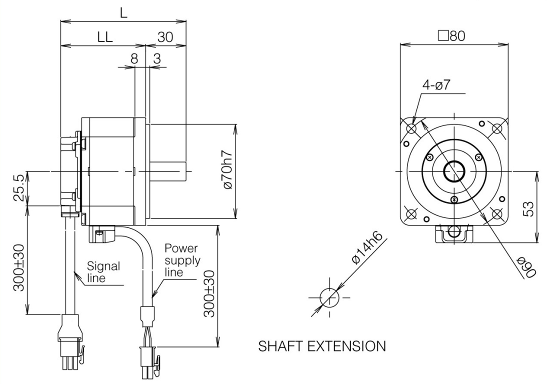
(Unit: mm)



[Mass: 0.75kg]

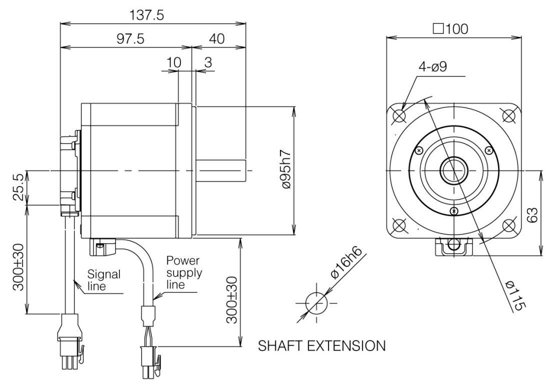
Rated speed	Rated output	Type	Over length	Dimensions(flange)	Mass [kg]
			L	LL	
3000r/min	0.2kW	GYC201D5- □ B2	93	63	1.3
	0.4kW	GYC401D5- □ B2	108	78	1.9

(Unit: mm)



Rated speed	Rated output	Type
3000r/min	0.75kW	GYC751D5- □ B2

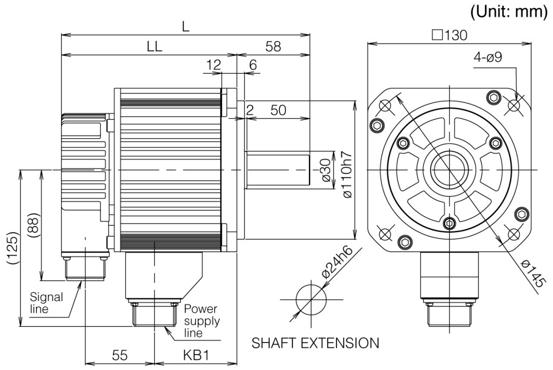
(Unit: mm)



[Mass: 3.5kg]

Rated speed	Rated output	Type	Over length	Dimensions(flange)	Terminal	Mass [kg]
			L	LL	KB1	
3000r/min	1kW	GYC102D5- □ B2	197.5	139.5	65.5	5.7
	1.5kW	GYC152D5- □ B2	212.5	154.5	80.5	7.0
	2kW	GYC202D5- □ B2	227.5	169.5	95.5	8.2

(Unit: mm)

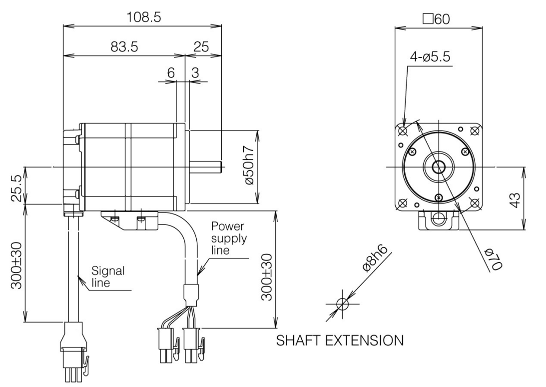


* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.4 GYC Motor (With a brake)

Rated speed	Rated output	Type
3000r/min	0.1kW	GYC101D5- □ B2-B

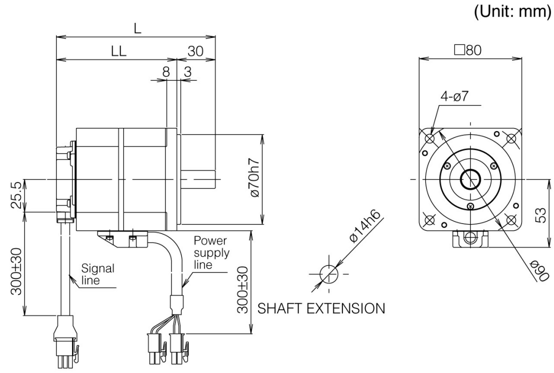
(Unit: mm)



[Mass: 1.0kg]

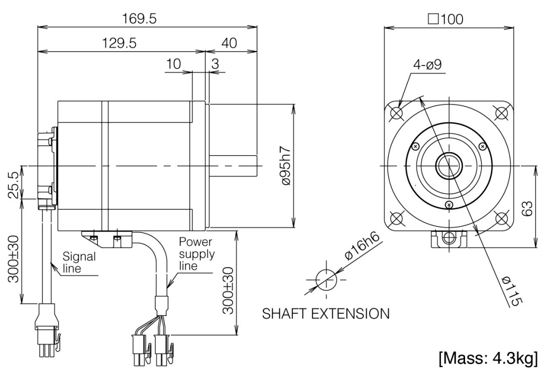
Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Mass [kg]
3000r/min	0.2kW	GYC201D5- □ B2-B	124	94	1.9
	0.4kW	GYC401D5- □ B2-B	139	109	2.6

(Unit: mm)



Rated speed	Rated output	Type
3000r/min	0.75kW	GYC751D5- □ B2-B

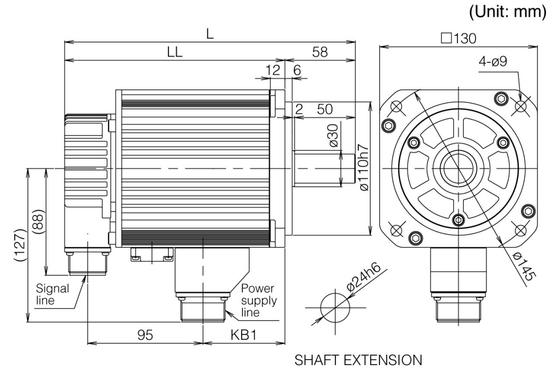
(Unit: mm)



[Mass: 4.3kg]

Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
3000r/min	1kW	GYC102D5- □ B2-B	239.5	181.5	67.5	8.0
	1.5kW	GYC152D5- □ B2-B	254.5	196.5	82.5	9.8
	2kW	GYC202D5- □ B2-B	269.5	211.5	97.5	11

(Unit: mm)

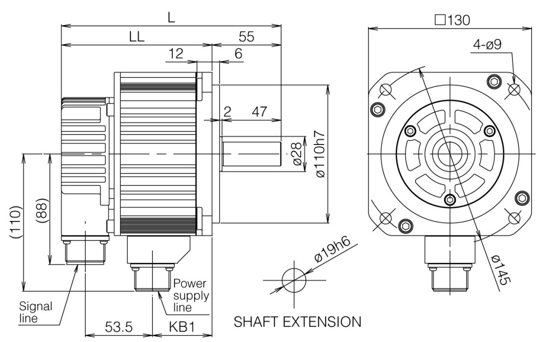


* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.5 GYG Motor (2000[r/min])

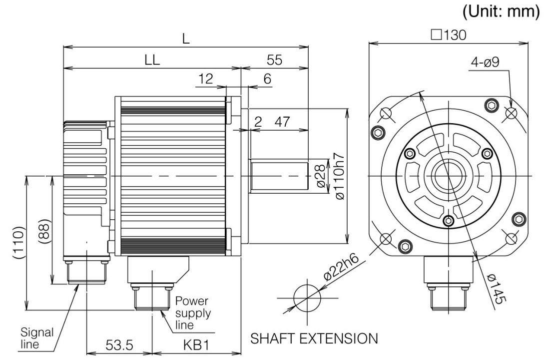
Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
2000r/min	0.5kW	GYG501C5-☐B2	175	120	47.5	5.3
	0.75kW	GYG751C5-☐B2	187.5	132.5	60	6.4

(Unit: mm)



Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
2000r/min	1kW	GYG102C5-☐B2	200	145	72.5	7.5
	1.5kW	GYG152C5-☐B2	225	170	97.5	9.8
	2kW	GYG202C5-☐B2	250	195	122.5	12

(Unit: mm)

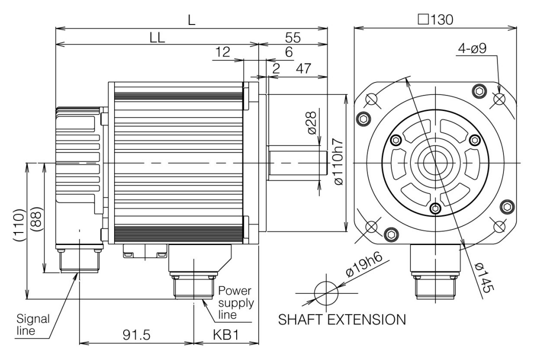


* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.6 GYG Motor (2000[r/min]) (With a brake)

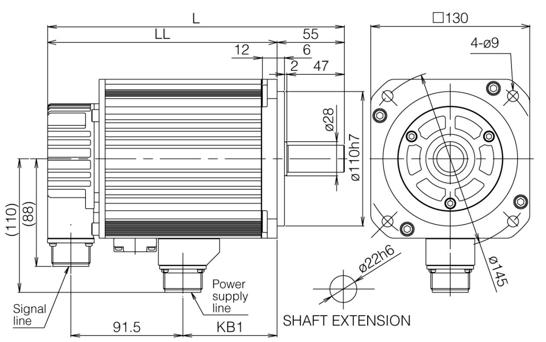
Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
2000r/min	0.5kW	GYG501C5-☐B2-B	217.5	162.5	52	7.5
	0.75kW	GYG751C5-☐B2-B	230	175	64.5	8.6

(Unit: mm)



Rated speed	Rated output	Type	Over length L	Dimensions(flange) LL	Terminal KB1	Mass [kg]
2000r/min	1kW	GYG102C5-☐B2-B	242.5	187.5	77	9.7
	1.5kW	GYG152C5-☐B2-B	267.5	212.5	102	12
	2kW	GYG202C5-☐B2-B	292.5	237.5	127	14.2

(Unit: mm)



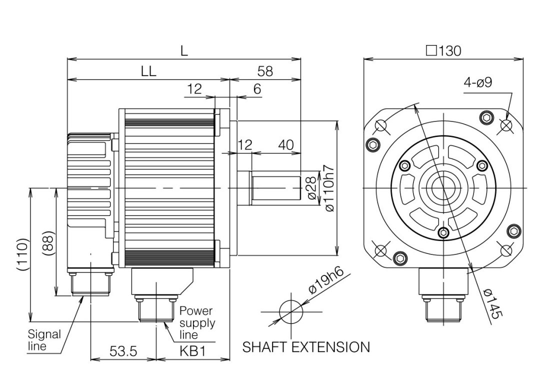
* See page 8-27 for the shaft extension specification of the motor with a key.

8

8.3.7 GYG Motor (1500[r/min])

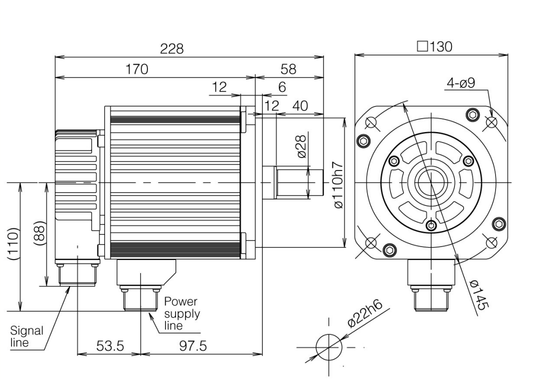
Rated speed	Rated output	Type	Over length	Dimensions(flange)	Terminal	Mass
			L	LL	KB1	[kg]
1500r/min	0.5kW	GYG501B5- □ B2	190.5	132.5	60	6.4
	0.85kW	GYG851B5- □ B2	203	145	72.5	7.5

(Unit: mm)



Rated speed	Rated output	Type
1500r/min	1.3kW	GYG132B5- □ B2

(Unit: mm)



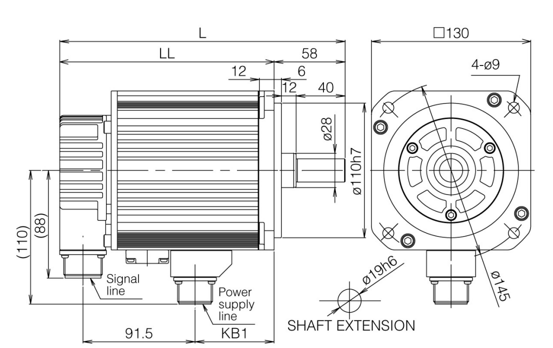
[Mass: 9.8kg]

* See page 8-27 for the shaft extension specification of the motor with a key.

8.3.8 GYG Motor (1500[r/min]) (With a brake)

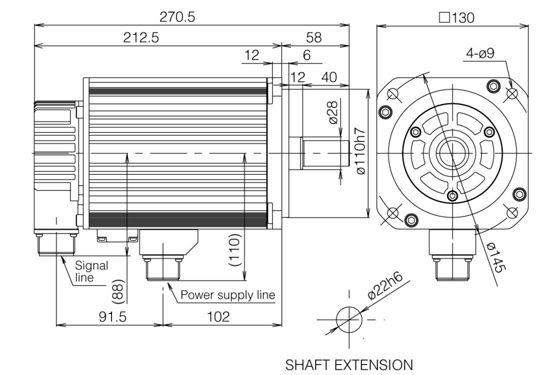
Rated speed	Rated output	Type	Over length	Dimensions(flange)	Terminal	Mass
			L	LL	KB1	[kg]
1500r/min	0.5kW	GYG501B5- □ B2-B	233	175	64.5	8.6
	0.85kW	GYG851B5- □ B2-B	245.5	187.5	77	9.7

(Unit: mm)



Rated speed	Rated output	Type
1500r/min	1.3kW	GYG132B5- □ B2-B

(Unit: mm)



[Mass: 12kg]

* See page 8-27 for the shaft extension specification of the motor with a key.

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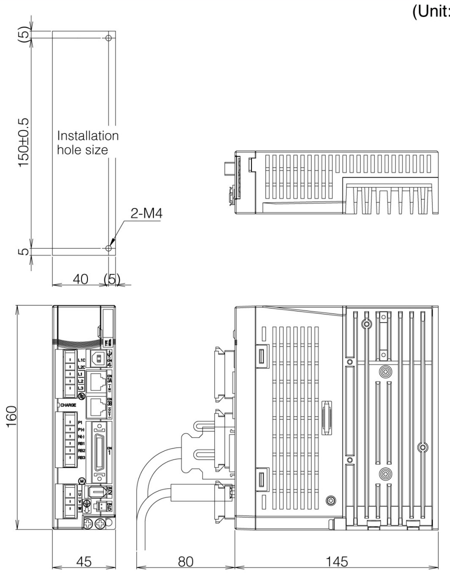
8.4 Dimensions of Servo Amplifier

Power supply	Rated speed	Applicable motor output	Type
100V series	3000r/min	0.05kW	RYT500D5- □□ 6
		0.1kW	RYT101D5- □□ 6
200V series		0.05kW	RYT500D5- □□ 2
		0.1kW	RYT101D5- □□ 2
		0.2kW	RYT201D5- □□ 2

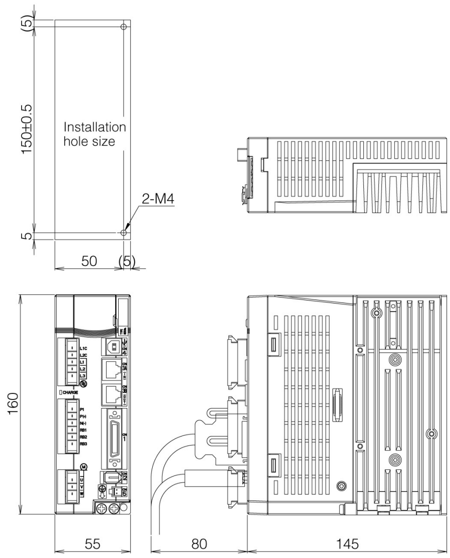
(Unit: mm)



[Mass: 0.7kg]

Power supply	Rated speed	Applicable motor output	Type
100V series	3000r/min	0.2kW	RYT201D5- □□ 6
200V series		0.4kW	RYT401D5- □□ 2

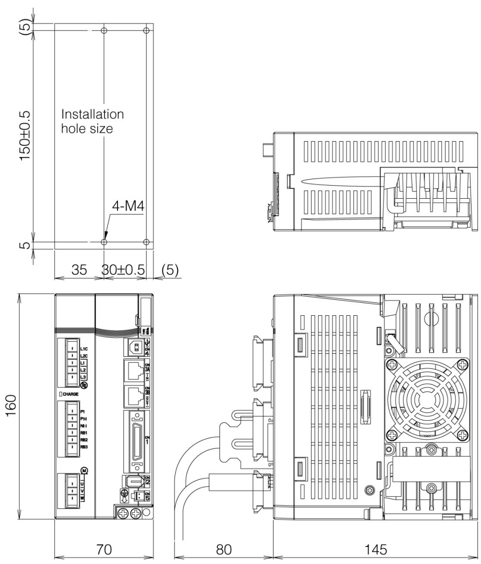
(Unit: mm)



[Mass: 0.9kg]

Power supply	Rated speed	Applicable motor output	Type
100V series	3000r/min	0.375kW	RYT401D5- □□ 6
200V series	1500r/min	0.5kW	RYT501B5- □□ 2
	2000r/min	0.5kW	RYT501C5- □□ 2
		0.75kW	RYT751C5- □□ 2
	3000r/min	0.75kW	RYT751D5- □□ 2

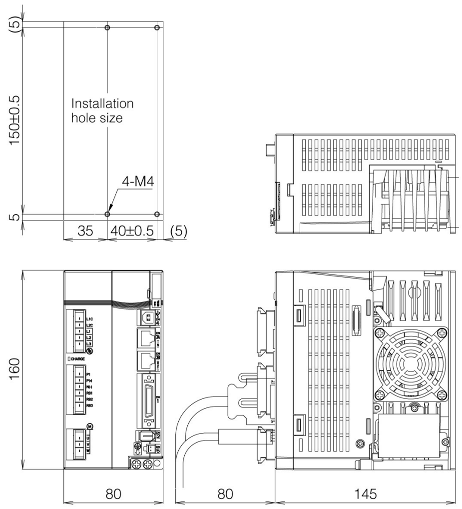
(Unit: mm)



[Mass: 1.3kg]

Rated speed	Applicable motor output	Type
1500r/min	0.85kW	RYT851B5- □□ 2
2000r/min	1.0kW	RYT102C5- □□ 2
3000r/min	1.0kW	RYT102D5- □□ 2
	1.5kW	RYT152D5- □□ 2

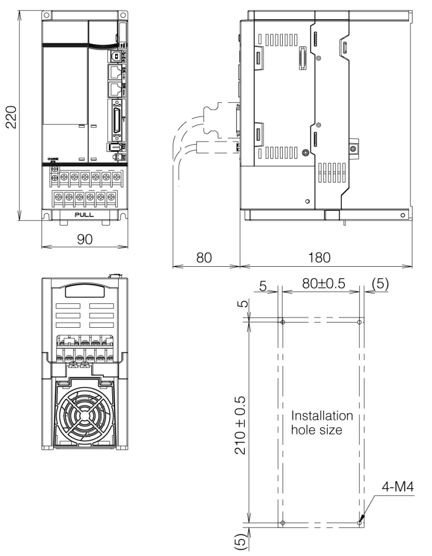
(Unit: mm)



[Mass: 1.4kg]

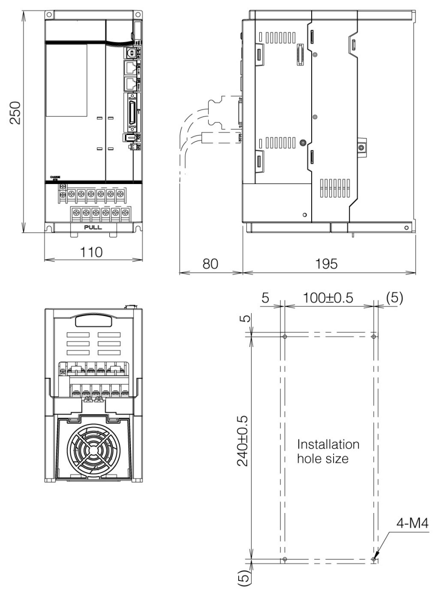
Rated speed	Applicable motor output	Type	Mass
1500r/min	1.3kW	RYT132B5- □□ 2	2.9kg
2000r/min	1.5kW	RYT152C5- □□ 2	
	2.0kW	RYT202C5- □□ 2	
3000r/min	2.0kW	RYT202D5- □□ 2	2.6kg
	3.0kW	RYT302D5- □□ 2	

(Unit: mm)



Rated speed	Applicable motor output	Type
3000r/min	4.0kW	RYT402D5- □□ 2
	5.0kW	RYT502D5- □□ 2

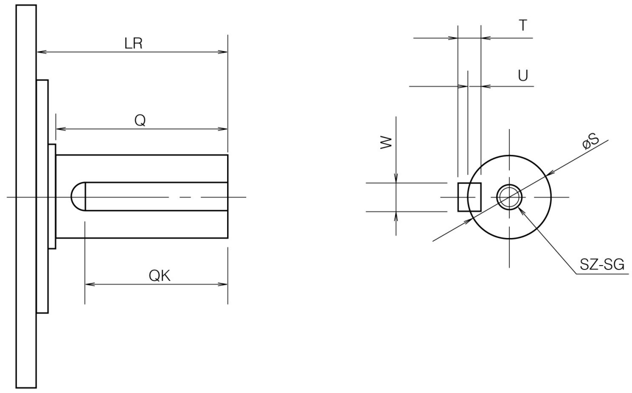
(Unit: mm)



[Mass: 3.8kg]

8

8.5 Optional Specification of Shaft Extension [With a Key, Tapped]



Motor type	LR	Q	QK	S	T	U	W	SZ	SG
GYS Motor									
GYS500D5-□A□-□ *1	25	-	14	ø6h6	2	1.2	2	-	-
GYS101D5-□A□-□ *1				ø8h6	3	1.8	3	-	-
GYS201D5-□C□-□	30		20	ø14h6	5	3	5	M5	8
GYS401D5-□C□-□									
GYS751D5-□C2-□	40		30	ø16h6					
GYS102D5-□C2-□	45	40	32	ø24h6	7	4	8	M8	16
GYS152D5-□C2-□									
GYS202D5-□C2-□									
GYS302D5-□C2-□	63	55	45	ø28h6					
GYS402D5-□C2-□									
GYS502D5-□C2-□									
GYC Motor									
GYC101D5-□A2-□ *1	25	-	14	ø8h6	3	1.8	3	-	-
GYC201D5-□C2-□	30		16	ø14h6	5	3	5	M5	8
GYC401D5-□C2-□									
GYC751D5-□C2-□	40		22	ø16h6					
GYC102D5-□C2-□	58	50	40	ø24h6	7	4	8	M8	16
GYC152D5-□C2-□									
GYC202D5-□C2-□									
GYG Motor 2000r/min									
GYG501C5-□C2-□	55	47	35	ø19h6	6	3.5	6	M6	12
GYG751C5-□C2-□									
GYG102C5-□C2-□				ø22h6	7	4	8	M8	16
GYG152C5-□C2-□									
GYG202C5-□C2-□									
GYG Motor 1500r/min									
GYG501B5-□C2-□	58	40	30	ø19h6	6	3.5	6	M6	12
GYG851B5-□C2-□									
GYG132B5-□C2-□				ø22h6	7	4	8	M8	16

*1 The shaft extension of the GYS and GYC motors of 0.1kW or less is not tapped.

8

8

CHAPTER 9 CHARACTERISTICS

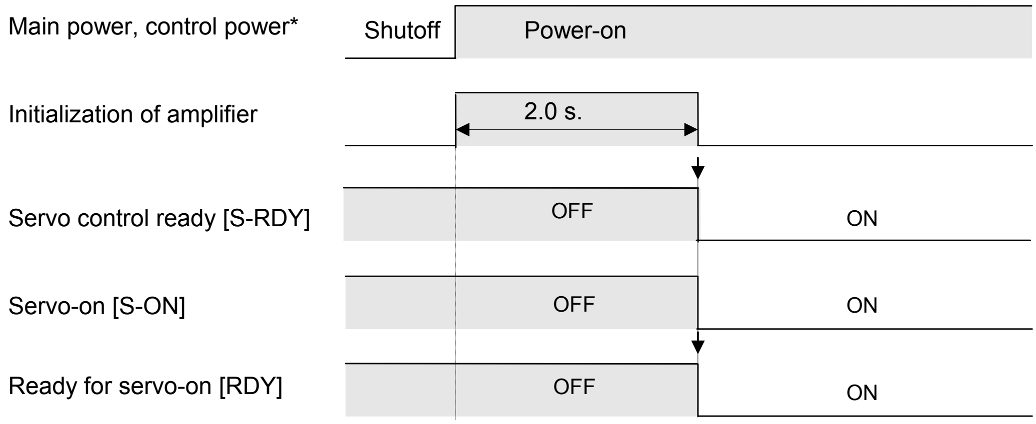
9

9.1 Timing Chart

9.1.1 Power-On Timing

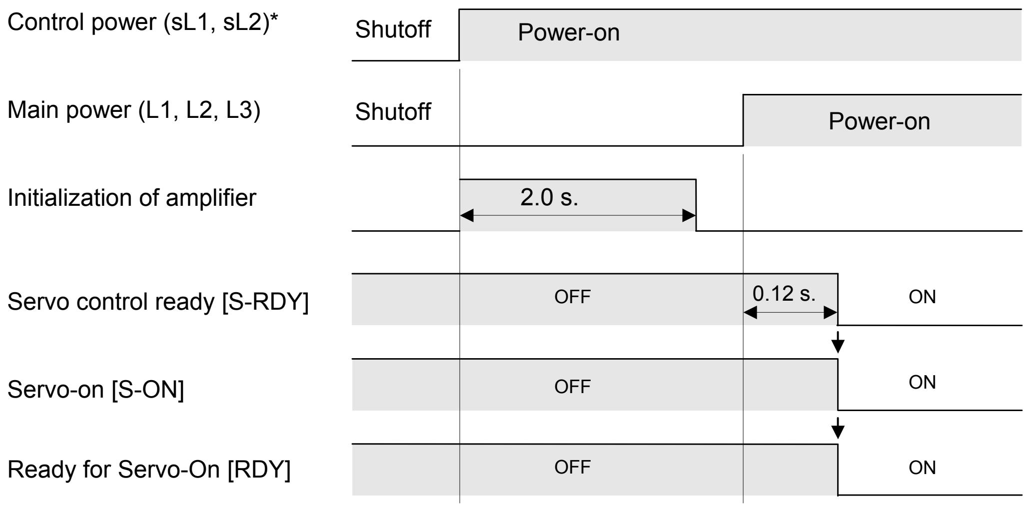
■ If the motor power and control power are turned on simultaneously

(1) After power-on, it takes about 2.0 seconds until initialization of the servo amplifier is finished.
(2) Completion of initialization is indicated by activation of servo control ready [S-RDY].
(3) After (2) is verified, the servo-on [S-ON] signal is turned on.
(4) After ready for servo-on [RDY] is turned on, the servo amplifier is ready to operate.



■ If the control power is turned on first

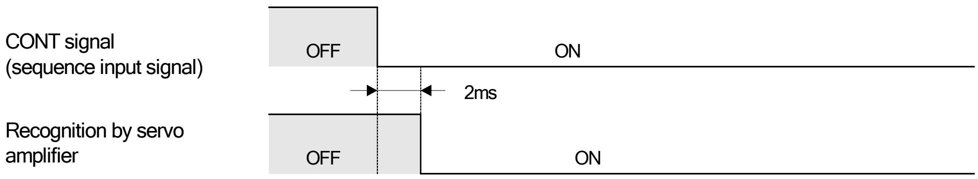
(1) It takes about 2.0 seconds until initialization of the servo amplifier is finished since the control power is turned on.
(2) Completion of initialization is indicated by activation of the servo control ready [S-RDY] signal after power-on.
(3) After (2) is verified, the motor power is turned on and the servo-on [S-ON] signal is turned on.
(4) After ready for servo-on [RDY] is turned on, the servo amplifier is ready to operate.



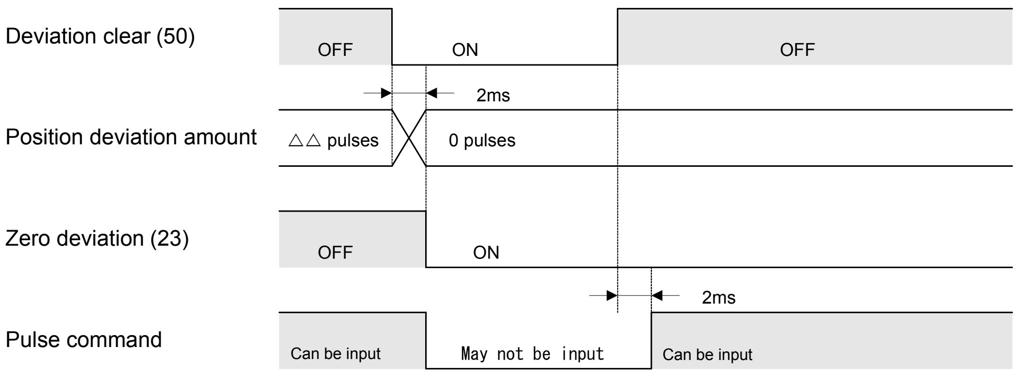
9.1.2 Each Signal Timing

■ Sequence input signal response time

The response time from sequence signal activation to signal recognition inside the servo amplifier is 2 [ms]. Leave the sequence input signal turned on for at 1 [ms] or more.



[Example] Deviation clear signal



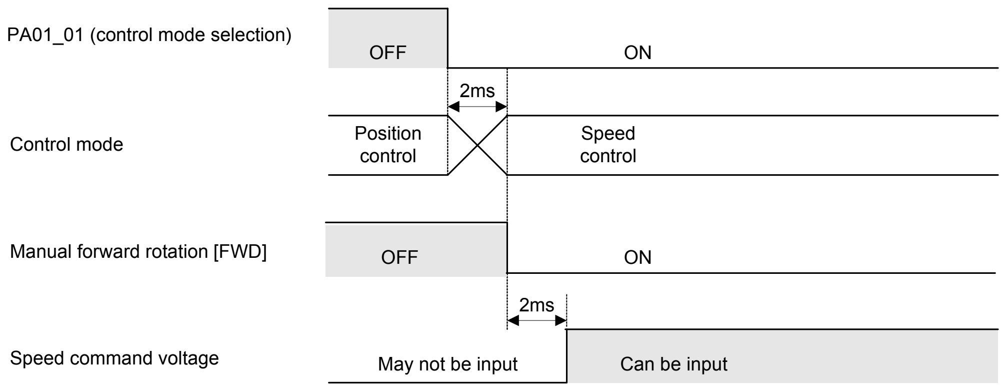
9

9.1.3 Control Mode Selection Timing

Transition time for each control mode is 2 [ms].

After issuing a selection signal, wait for 2 [ms] or more before issuing next commands.

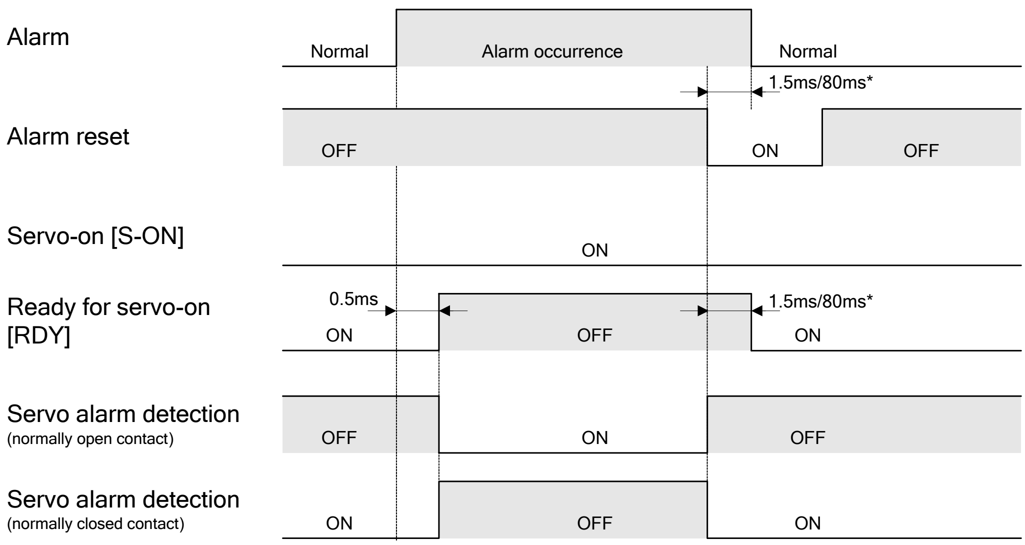
[Example] Switching from position control to speed control



9.1.4 Alarm Reset Timing

After an alarm occurs, it takes about 0.5 [ms] until alarm detection output.

It takes about 1.5 [ms] or 80 [ms]* after an alarm reset signal is issued until the alarm is actually removed.



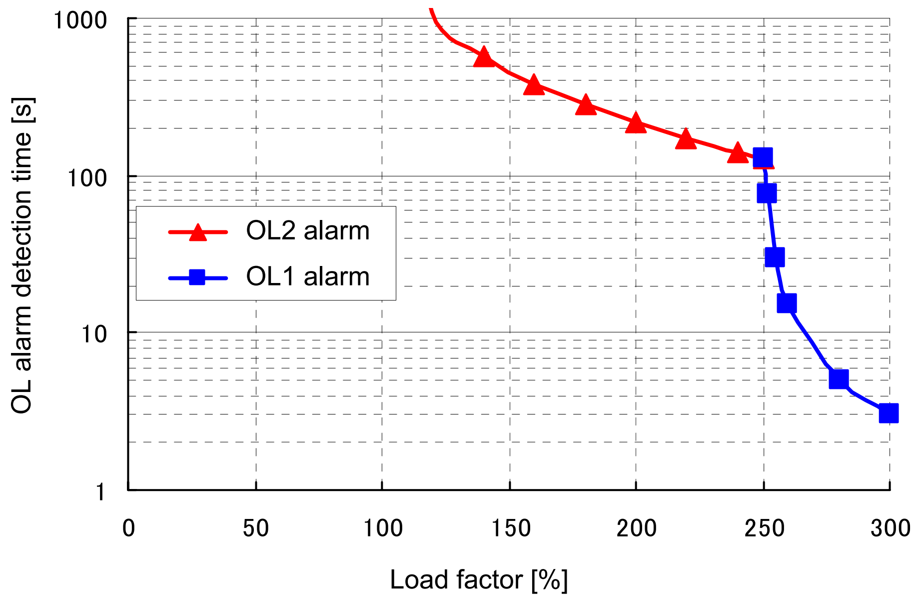
* The time varies according to the setting of PA2_62 (Action sequence at alarm).
If the action at stop is free-run (reference value: 1, 3 or 5): 1.5 [ms]
If the action at stop is DB (dynamic brake) (reference value: 0, 2 or 4): 80 [ms]

9.2 Overload Characteristic

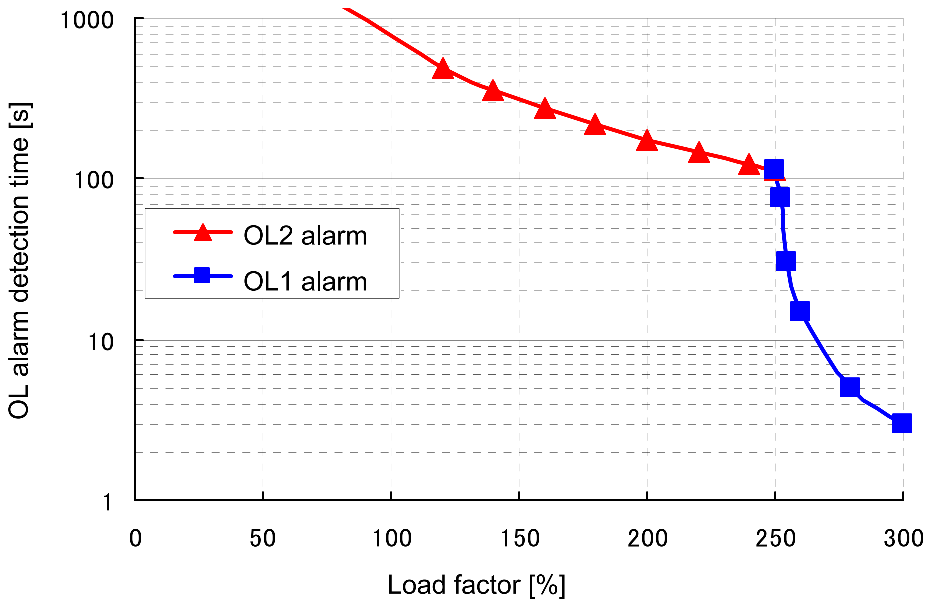
The detection time and load factor characteristics until an overload alarm (OL1/OL2) occurs are indicated by rotation speed.

9.2.1 GYS/GYC Motor

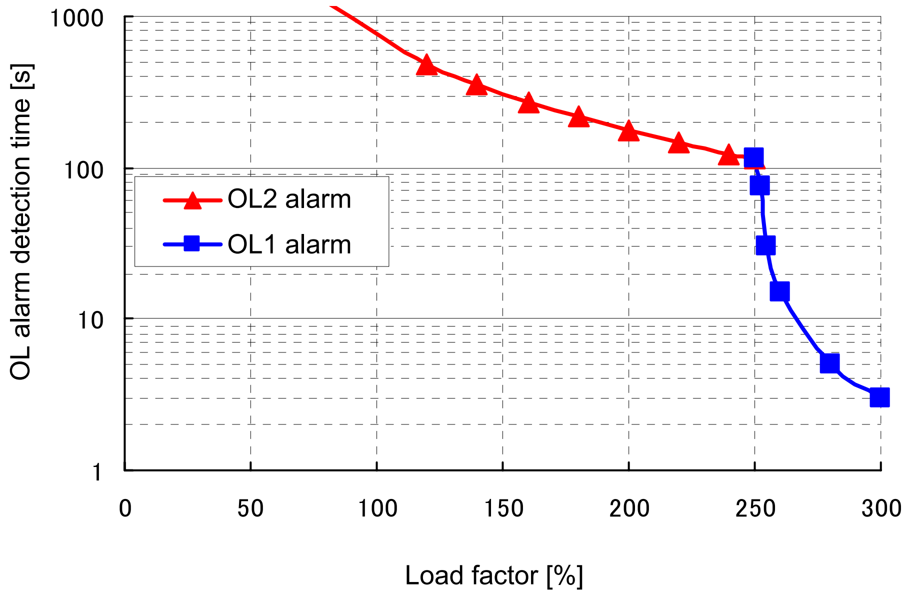
(1) In case of operation at rated rotation speed (3000 [r/min])



(2) In case of operation at maximum rotation speed (6000 [r/min])



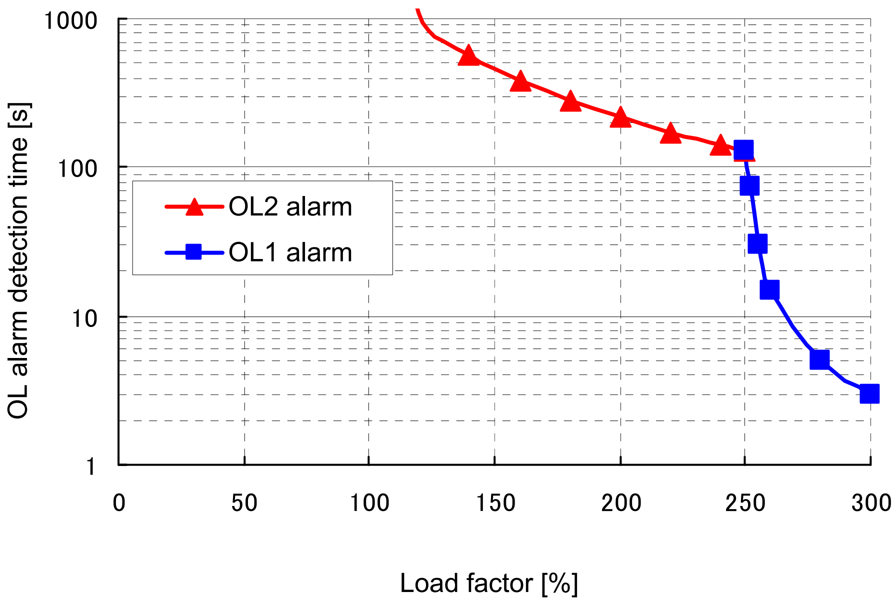
(3) In case of operation at max. rotation speed (5000 [r/min])
Target capacity: 1.0 [kW], 1.5 [kW]



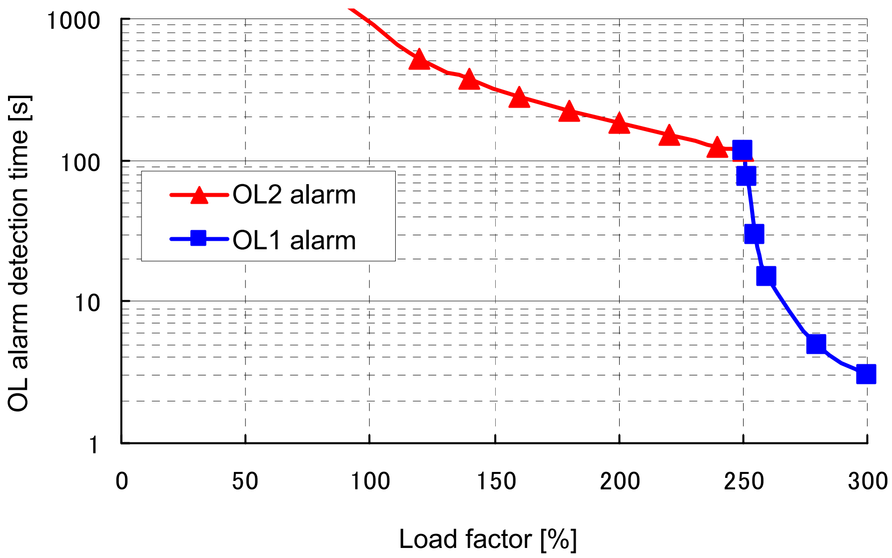
9

9.2.2 GYG Motor

(1) In case of operation at rated rotation speed (1500/2000 [r/min])

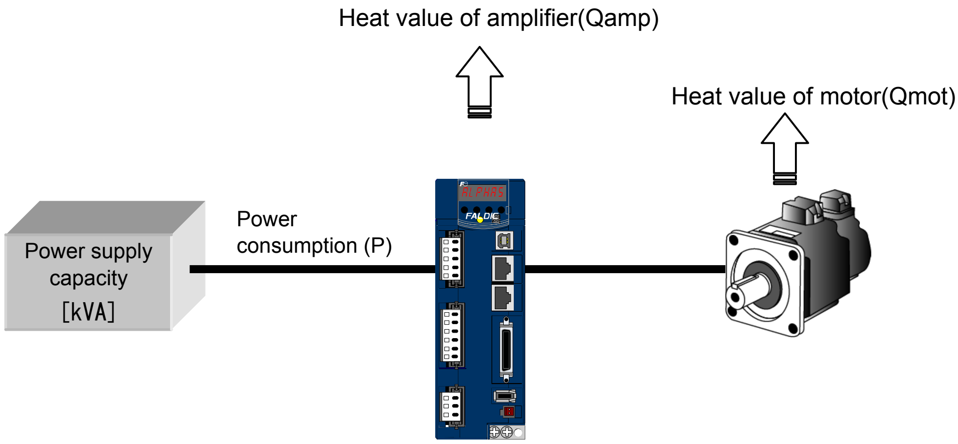


(2) In case of operation at max. rotation speed (3000 [r/min])



9

9.3 Power Supply Capacity and Generated Loss



Rated rotation speed	Servo amplifier model	Servomotor model	Capacity [kW]	Power supply capacity [kVA]	Power consumption (P) [kW]	Heat value of amplifier (Qamp) [kW]	Heat value of motor (Qmot) [kW]
3000 [r/min]	RYT500D5-□□2 (6)	GY□500D5-□□2 (6)	0.05	0.1	0.074	0.018	0.006
	RYT101D5-□□2 (6)	GY□101D5-□□2 (6)	0.1	0.2	0.13	0.021	0.011
	RYT201D5-□□2 (6)	GY□201D5-□□2 (6)	0.2	0.4	0.25	0.027	0.022
	RYT401D5-□□6	GY□401D5-□□6	0.375	0.8	0.48	0.038	0.044
	RYT401D5-□□2	GY□401D5-□□2	0.4	0.8	0.48	0.038	0.044
	RYT751D5-□□2	GY□751D5-□□2	0.75	1.5	0.89	0.059	0.083
	RYT102D5-□□2	GY□102D5-□□2	1.0	2.0	1.2	0.073	0.11
	RYT152D5-□□2	GY□152D5-□□2	1.5	2.9	1.8	0.103	0.17
	RYT202D5-□□2	GY□202D5-□□2	2.0	3.9	2.4	0.13	0.22
	RYT302D5-□□2	GY□302D5-□□2	3.0	5.9	3.5	0.19	0.33
	RYT402D5-□□2	GY□402D5-□□2	4.0	7.8	4.7	0.25	0.44
	RYT502D5-□□2	GY□502D5-□□2	5.0	9.8	5.9	0.31	0.56
2000 [r/min]	RYT501C5-□□2	GY□501C5-□□2	0.5	1.0	0.60	0.044	0.056
	RYT751C5-□□2	GY□751C5-□□2	0.75	1.5	0.89	0.059	0.083
	RYT102C5-□□2	GY□102C5-□□2	1.0	2.0	1.20	0.073	0.11
	RYT152C5-□□2	GY□152C5-□□2	1.5	2.9	1.8	0.103	0.17
	RYT202C5-□□2	GY□202C5-□□2	2.0	3.9	2.4	0.13	0.22
1500 [r/min]	RYT501B5-□□2	GY□501B5-□□2	0.5	1.0	0.6	0.044	0.056
	RYT851B5-□□2	GY□851B5-□□2	0.85	1.7	1.0	0.065	0.094
	RYT132B5-□□2	GY□132B5-□□2	1.3	2.6	1.5	0.091	0.14

9.4 Inrush Current

The allowable inrush current of the servo amplifier is specified below.

Rated rotation speed	Servo amplifier model	Servomotor model	Capacity [kW]	Inrush current [A]
3000 [r/min]	RYT500D5-□□6	GY□500D5-□□6	0.05	3.6
	RYT101D5-□□6	GY□101D5-□□6	0.1	
	RYT201D5-□□6	GY□201D5-□□6	0.2	
	RYT401D5-□□6	GY□401D5-□□6	0.375	11.8
	RYT500D5-□□2	GY□500D5-□□2	0.05	7.2
	RYT101D5-□□2	GY□101D5-□□2	0.1	
	RYT201D5-□□2	GY□201D5-□□2	0.2	
	RYT401D5-□□2	GY□401D5-□□2	0.4	
	RYT751D5-□□2	GY□751D5-□□2	0.75	23.5
	RYT102D5-□□2	GY□102D5-□□2	1.0	
	RYT152D5-□□2	GY□152D5-□□2	1.5	34.4
	RYT202D5-□□2	GY□202D5-□□2	2.0	
	RYT302D5-□□2	GY□302D5-□□2	3.0	68.8
	RYT402D5-□□2	GY□402D5-□□2	4.0	
	RYT502D5-□□2	GY□502D5-□□2	5.0	
2000 [r/min]	RYT501C5-□□2	GY□501C5-□□2	0.5	23.5
	RYT751C5-□□2	GY□751C5-□□2	0.75	
	RYT102C5-□□2	GY□102C5-□□2	1.0	
	RYT152C5-□□2	GY□152C5-□□2	1.5	34.4
	RYT202C5-□□2	GY□202C5-□□2	2.0	
1500 [r/min]	RYT501B5-□□2	GY□501B5-□□2	0.5	23.5
	RYT851B5-□□2	GY□851B5-□□2	0.85	
	RYT132B5-□□2	GY□132B5-□□2	1.3	34.4

・The inrush current indicates the maximum peak current.

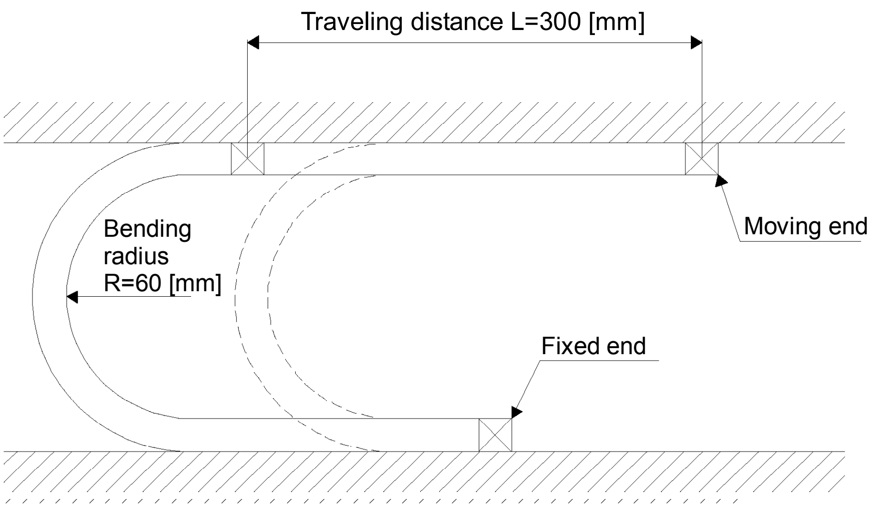
9.5 Bending Strength of Cable

The bending life of the cable used at a bending radius larger than the recommended bending radius R of 60 [mm] is 5,000,000 cycles or over when tested under the following conditions.

<Testing conditions>

(1) Use testing apparatus shown in the figure below to cause the cable to be bent in a traveling distance L of 300 [mm].

(2) Count each reciprocal test cycle. Count the bending frequency until conductors are broken.



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Note	The cable life depends largely on the handling method. The bending life is a reference value for the testing conditions specified above.

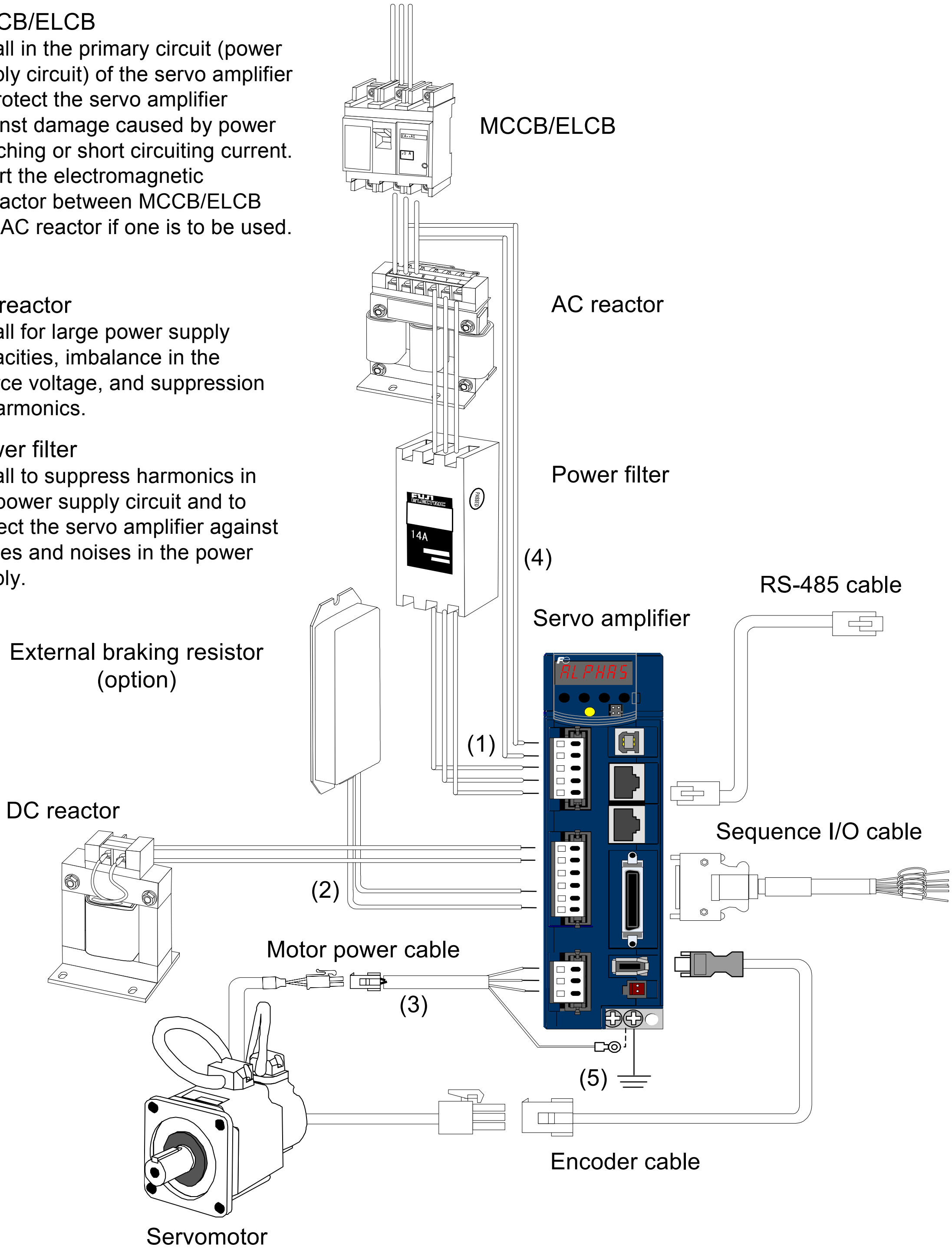
CHAPTER 10 PERIPHERAL EQUIPMENT

10.1 Overall Configuration of Peripheral Equipment

MCCB/ELCB
Install in the primary circuit (power supply circuit) of the servo amplifier to protect the servo amplifier against damage caused by power switching or short circuiting current. Insert the electromagnetic contactor between MCCB/ELCB and AC reactor if one is to be used.

AC reactor
Install for large power supply capacities, imbalance in the source voltage, and suppression of harmonics.

Power filter
Install to suppress harmonics in the power supply circuit and to protect the servo amplifier against surges and noises in the power supply.



Wiring connectors do not come with the servo amplifier or servomotor.
Prepare the necessary option cable or connector kit.

10.2 Cable Size

- Main circuit section

600V class 2 vinyl cable, or 600V polyethylene insulated cable (HIV cable)

When compared with the IV cable, the cable size is smaller and the cable is superior in flexibility and the maximum allowable temperature as an insulated cable is as high as 75 [°C]. Therefore this cable is used both for the main circuit and for the control circuit.

However, if the cable is used for the control circuit, the wiring distance must be short and the cable must be twisted.

600V cross linked polyethylene insulated cable

Mainly used for the main circuit and grounding circuit. When compared with the IV and HIV cables, the cable size is smaller and the cable is superior in flexibility. Due to these features, the cable is used for higher ambient temperatures (50 [°C], etc.), reduced cable space, improved actuation efficiency, etc. The maximum allowable temperature as an insulated cable is 90 [°C].

[Example]:BOARDLEX made by FURUKAWA ELECTRIC

- Control circuit section

Twisted shielded cable for electronic and electric devices

Used for control circuits. Use this cable for applications susceptible to (potential) radiant noise and inductive noise. The cable has a large shielding effect. Even inside panels, use this cable without fail if the wiring distance is long.

[Example]: BEAMEX S shielded cable XEBV or XEWV made by FURUKAWA ELECTRIC

Encoder section

The encoder cable of the servomotor is a composite 2C (cable), 2P (pair) shielded cable housing different cable sizes shown below.

Cross linked polyethylene vinyl sheath cable for robot travel (composite cable) (DAIDEN Co., Ltd.)

RMCV-SB-A (UL2464) AWG#25/2P+AWG#23/2C (wiring length ≤ 10 [m])

RMCV-SB-A (UL2464) AWG#25/2P+AWG#17/2C (10 [m] < wiring length ≤ 50 [m])

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10.2.1 Main Circuit Section Cable Size

The following cable sizes are recommended for parts (1), (2), (3), (4) and (5) specified on page 10-2.

■ Single-phase 100V

Rating [r/min]	Capacity [W]	Recommended cable size [mm^2]				
		(1) Power supply (L1,L2,L3) (3) Motor power (U,V,W) (5) Earthing (E)		(2) Braking resistor (RB1, RB2, RB3)		(4) Control power (L1C,L2C)
		75 [℃] (HIV)	90 [℃]	75 [℃] (HIV)	90 [℃]	Common
3000	50 to 375	1.25	0.75	1.25	1.25	0.75

■ Single-phase 200V

Rating [r/min]	Capacity [W]	Recommended cable size [mm^2]				
		(1) Power supply (L1,L2,L3) (3) Motor power (U,V,W) (5) Earthing (E)		(2) Braking resistor (RB1, RB2, RB3)		(4) Control power (L1C,L2C)
		75[℃] (HIV)	90[℃]	75[℃] (HIV)	90[℃]	Common
3000	50 to 750	1.25	0.75	1.25	1.25	0.75
2000	500					
	750					
1500	500					

■ 3-phase 200V

Rating [r/min]	Capacity [W]	Recommended cable size [mm²]				
		(1) Power supply (L1,L2,L3) (3) Motor power (U,V,W) (5) Earthing (E)		(2) Braking resistor (RB1, RB2, RB3)		(4) Control power (L1C,L2C)
		75 [℃] (HIV)	90 [℃]	75 [℃] (HIV)	90 [℃]	Common
3000	50 to 1000	1.25	0.75	1.25	1.25	0.75
	1500	2.0				
	2000					
	3000		1.25			
	4000	3.5	2.0			
	5000		3.5			
2000	500 to 1000	1.25	0.75			
	1500	2.0				
	2000					
1500	500	1.25				
	850					
	1300					

If the servo system requires to fit the overseas standard, use the following cable size.
(Cable: 75 [℃] (HIV))

<Power supply and motor power>
(1) 1kW or less (100V and 200 V series) = 1.25mm²
(2) 1.5kW = 2.0mm²
(3) 2kW or more = 5.5mm²

<Braking resistor, control power supply, etc.>
Same as above table.

10.2.2 Encode Wiring Cable

Use the specified shield cable for encoder wiring of the servomotor.

The optional cable for the servomotor is a UL-rated cable having bend resistance.

Use a regular twisted pair batch shield cable if the servomotor and cable do not move.

- Cross linked polyethylene vinyl sheath cable for robot travel (flame-resistant) (Daiden Co., Ltd.)

  RMCV-SB-A AWG#25/2P + AWG#23/2C
  (For 10 [m] or smaller wiring length)
  RMCV-SB-A AWG#25/2P + AWG#17/2C
  (For wiring lengths < 10 [m] and ≤ 50 [m])

  The relationship between AWG and mm is shown below.

Gauge		SI unit		Inch unit	
A.W.G	In [mm^2]	Diameter [mm]	Cross section [mm^2]	Diameter [mil]	Cross section [CM]
16	1.25	1.291	1.309	50.82	2583
17	-	1.150	1.037	45.26	2048
18	-	1.024	0.8226	40.30	1624
19	-	0.9116	0.6529	35.89	1288
20	-	0.8118	0.5174	31.96	1021
21	-	0.7299	0.4105	28.46	810.0
22	-	0.6438	0.3256	25.35	642.6
23	-	0.5733	0.2518	22.57	509.4
24	-	0.5106	0.2024	20.10	404.0
25	-	0.4547	0.1623	17.90	320.4

10.2.3 How to Calculate the Servo Amplifier Input Current

Calculate the servo amplifier input current in the following equation to select peripheral equipment.

Formula

Input current (single-phase 100/200 [V]): $I_{in} = (P_o + P_i) / (V_{ac} \times 1.35 \times \eta_{amp} \times \eta_{mot}) \times 1.27 \times \sqrt{3}$

Input current (3-phase 200 [V]): $I_{in} = (P_o + P_i) / (V_{ac} \times 1.35 \times \eta_{amp} \times \eta_{mot}) \times 1.27$

η_{amp} (amplifier efficiency) = 0.95 and η_{mot} (motor efficiency) = 0.90 are common among all models.

■ In case of single-phase 100V

Rated rotation speed	Capacity (Po) [W]	Input voltage (Vac) [V]	Internal power consumption (Pi) [W]	Input current (Iin) [A]	Input current for selection of peripheral equipment (Iin×1.5) [A]
3000 [r/min]	50	85	15	1.5	2.3
	100			2.6	3.9
	200			4.8	7.2
	375			8.7	13.1

■ In case of single-phase 200V

Rated rotation speed	Capacity (Po) [W]	Input voltage (Vac) [V]	Internal power consumption (Pi) [W]	Input current (Iin) [A]	Input current for selection of peripheral equipment (Iin×1.5) [A]
3000 [r/min]	50	170*	15	0.7	1.1
	100			1.3	2.0
	200			2.4	3.6
	400			4.7	7.1
	750			8.6	13.0
2000 [r/min]	500			5.8	8.7
	750			8.6	13.0
1500 [r/min]	500			5.8	8.7

* -15% of 200V

■ In case of 3-phase 200V

Rated rotation speed	Capacity (Po) [W]	Input voltage (Vac) [V]	Internal power consumption (Pi) [W]	Input current (Iin) [A]	Input current for selection of peripheral equipment (Iin×1.5) [A]
3000 [r/min]	50	170*	15	0.4	0.6
	100			0.7	1.1
	200			1.4	2.1
	400			2.7	4.0
	750			5.0	7.4
	1000			6.6	9.8
	1500			9.8	14.7
	2000			13.0	19.5
	3000			19.5	29.3
	4000			26.0	39.0
	5000			32.5	48.8
2000 [r/min]	500			3.3	5.0
	750			5.0	7.4
	1000			6.6	9.8
	1500			9.8	14.7
	2000			13.0	19.5
1500 [r/min]	500			3.3	5.0
	850			5.6	8.4
	1300			8.5	12.8

* -15% of 200V

10.2.4 Conditions for Selecting Peripheral Equipment of Servo Amplifier

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■ To select peripheral equipment for a single servo amplifier

Obtain "1.5 times" the input current (Iin) obtained above.

■ To select peripheral equipment for two or more servo amplifiers

Multiply "1.5 times" the sum of the input currents (Iin) of all servo amplifiers.

[Example] In case of two 200 [W] units and three 400 [W] units (In case of single-phase 200V)

I = {(2.4 × 2) + (4.7 × 3)} × 1.5 = 28.35 [A]

Select peripheral equipment having 25.5 [A] or a larger rated current.

10.3 MCCB/ELCB (Molded Case Circuit Breaker/Earth Leakage Breaker)

Install MCCB (molded case circuit breaker) or ELCB (earth leakage breaker) in the primary circuit (power supply circuit) of the servo amplifier to protect the servo amplifier against losses caused by the power switching current and short circuit current. Models for a single servo amplifier are described here. Because the servo amplifier is provided with protective functions against output circuits such as the overcurrent, protective devices such as the thermal relay are unnecessary.

Model of molded case circuit breaker and earth leakage breaker

■ In case of single-phase 100V

Rated rotation speed	Capacity [kW]	MCCB	ELCB (Sensed current: 30mA)
3000 [r/min]	0.05	EA32AC/3	EG32AC/3
	0.1	EA32AC/5	EG32AC/5
	0.2	EA32AC/10	EG32AC/10
	0.375	EA32AC/15	EG32AC/15

■ In case of single-phase 200V

Rated rotation speed	Capacity [kW]	MCCB	ELCB (Sensed current: 30mA)
3000 [r/min]	0.05	EA32AC/3	EG32AC/3
	0.1		
	0.2	EA32AC/5	EG32AC/5
	0.4	EA32AC/10	EG32AC/10
	0.75	EA32AC/15	EG32AC/15
2000 [r/min]	0.5	EA32AC/10	EG32AC/10
	0.75	EA32AC/15	EG32AC/15
1500 [r/min]	0.5	EA32AC/10	EG32AC/10

■ In case of 3-phase 200V

Rated rotation speed	Capacity [kW]	MCCB	ELCB (Sensed current: 30mA)
3000 [r/min]	0.05	EA33AC/3	EG33AC/3
	0.1		
	0.2		
	0.4	EA33AC/5	EG33AC/5
	0.75	EA33AC/10	EG33AC/10
	1.0	EA33AC/15	EG33AC/15
	1.5	EA33AC/20	EG33AC/20
	2.0	EA33AC/30	EG33AC/30
	3.0	EA53AC/40	EG53AC/40
	4.0	EA53AC/50	EG53AC/50
	5.0		
2000 [r/min]	0.5	EA33AC/10	EG33AC/10
	0.75		
	1.0	EA33AC/15	EG33AC/15
	1.5	EA33AC/20	EG33AC/20
	2.0	EA33AC/30	EG33AC/30
1500 [r/min]	0.5	EA33AC/10	EG33AC/10
	0.85		
	1.3	EA33AC/15	EG33AC/15

10.4 Electromagnetic Contactor

Connect the electromagnetic contactor to disconnect the servo amplifier from the power supply with an external signal or to turn the power on or off from a remote operation panel.
The model is to turn the primary circuit of a single servo amplifier of 500 [kVA] or less power capacities with the designated cable size and 20 [m] or less wiring length.
If the power supply capacity exceeds 500 [kVA], connect an AC reactor.

Model of electromagnetic contactor

■ In case of single-phase 100V

Rated rotation speed / Capacity	Capacity [kW]	MC
3000 [r/min]	0.05	SC-03
	0.1	
	0.2	
	0.375	SC-0

■ In case of single-phase 200V

Rated rotation speed / Capacity	Capacity [kW]	MC
3000 [r/min]	0.05	SC-03
	0.1	
	0.2	
	0.4	
	0.75	SC-0
2000 [r/min]	0.5	SC-03
	0.75	SC-0
1500 [r/min]	0.5	SC-03

■ In case of 3-phase 200V

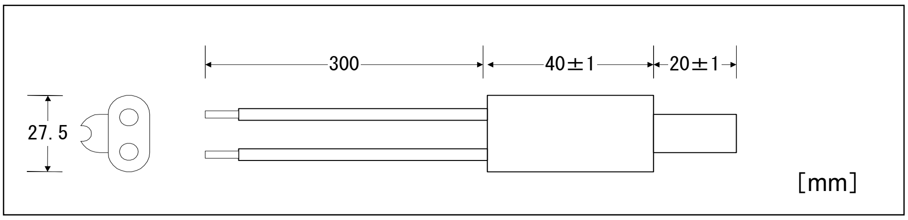
Rated rotation speed / Capacity	Capacity [kW]	MC
3000 [r/min]	0.05	SC-03
	0.1	
	0.2	
	0.4	
	0.75	
	1.0	
	1.5	SC-4-1
	2.0	
	3.0	SC-N1
	4.0	SC-N2
	5.0	
2000 [r/min]	0.5	SC-03
	0.75	
	1.0	
	1.5	SC-4-1
	2.0	
1500 [r/min]	0.5	SC-03
	0.85	
	1.3	SC-0

10.5 Surge Absorber

To install a surge absorber to peripheral equipment (electromagnetic contactor, solenoid, electromagnetic brake, etc.) of the servo amplifier, use the following one.
When an inductive load such as the clutch and solenoid is turned off, a counter electromotive force of several hundreds or several thousands of volts [V] is generated. The surge absorber suppresses the surge voltage.
For DC devices, install a diode to suppress the surge voltage.

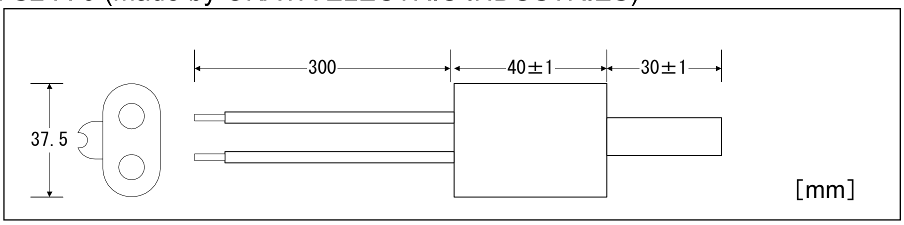
Control relay, etc.

Model: S1-B-0 (made by OKAYA ELECTRIC INDUSTRIES)



Electromagnetic contactor, etc.

Model: S2-A-0 (made by OKAYA ELECTRIC INDUSTRIES)



Applicable to 250 [V] AC or less voltages
A non-inductive capacitor and a non-inductive resistor are connected in series and filled in epoxy resin.
S1-B-0:200Ω (1/2 [W])+0.1 [μF]
S2-A-0:500Ω (1/2 [W])+0.2 [μF]

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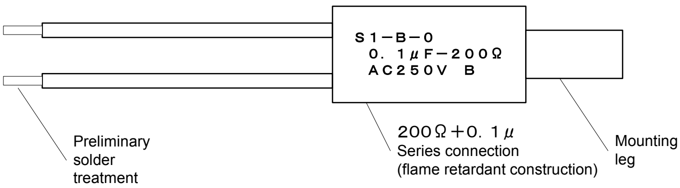
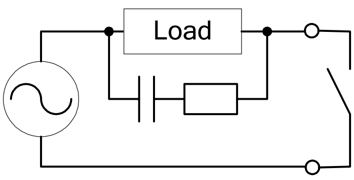


The purpose of the surge absorber is suppression of the surge voltage.

・Protection in AC circuit

C-R circuit

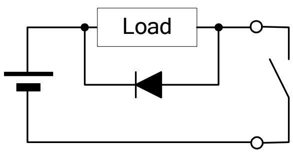
(Protection of the DC circuit is also provided.)



・Protection in DC circuit

Diode

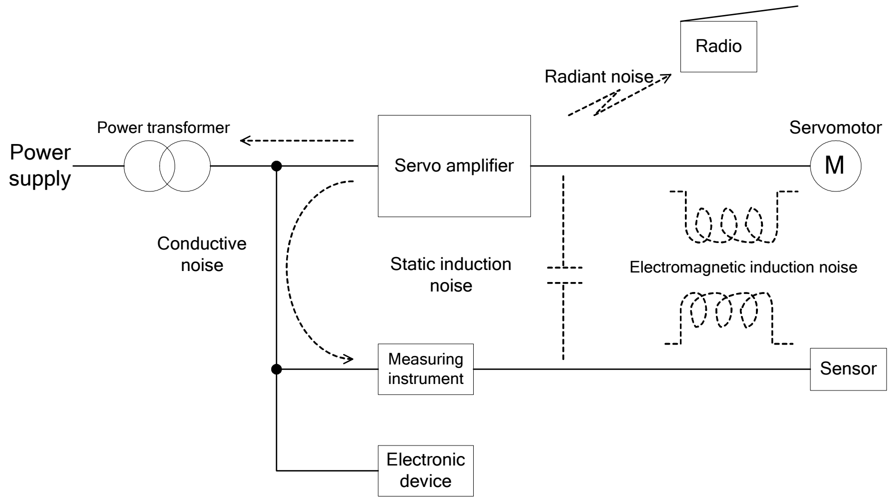
(Be aware of the orientation of the diode.)



10.6 Power Filter

The servo amplifier performs high frequency switching under PWM control similarly to general-purpose inverters. Therefore radiant noise, conductive noise and so on may give effect on peripheral equipment.

The following method is effective as a countermeasure.



(1) House the servo amplifier in an iron (conductive) control panel and ground the control panel. Do not install a PC or measuring instrument nearby.

(2) If devices connected to the same power supply are affected, install a power filter in the primary circuit of the servo amplifier.
If devices in different power supplies are affected, install an obstruction wave preventive transformer (TRAFY).

(3) Route cables between the servo amplifier and servomotor in a conductive duct and ground the duct (multi-point grounding allowed).

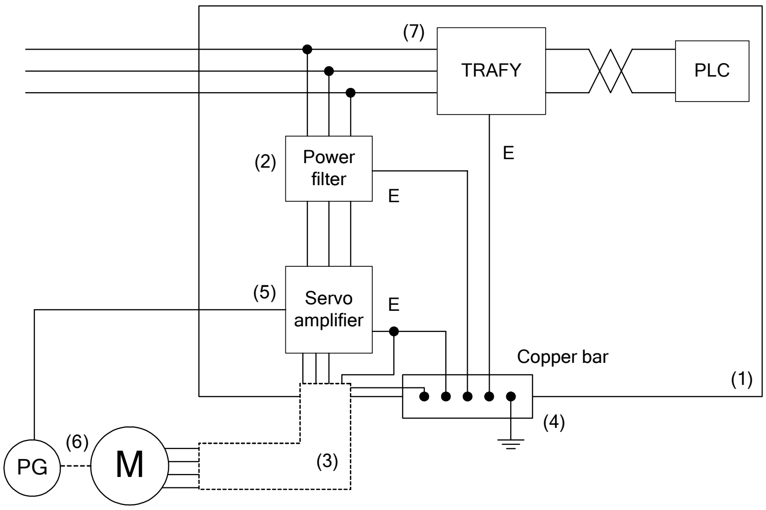
(4) Use a grounding cable as thick and short as possible.
Connect the grounding cable directly from the copper bar to individual device (do not use a jumper cable). A twisted or net cable has a larger effect.

(5) Never connect the following signals.

Grounding terminal FG (Frame ground)	×	0 [V] of +24 [V] DC power supply for sequence I/O	×	0 [V] of encoder power supply

(6) Do not tie the main circuit cable and control circuit cable together. Do not route these cables in parallel.
Main circuit: Commercial power supply, motor power cable between servo amplifier and servomotor
Control circuit: +24 [V] DC or less voltage signal cable
Servomotor encoder cable

(7) Use an obstruction wave preventive transformer (TRAFY) to connect 100 [V] devices (such as the programmable logic controller and general-purpose PC) to the 200 [V] power supply.



Numbers (1), (2), ... in the figure indicate the paragraph number given on the previous page.

Power filter model

■ In case of single-phase 100V

Rated rotation speed	Capacity [kW]	Power filter
3000 [r/min]	0.05	RNFTC06-20
	0.1	
	0.2	RNFTC10-20
	0.375	RNFTC20-20

■ In case of single-phase 200V

Rated rotation speed	Capacity [kW]	Power filter
3000 [r/min]	0.05	RNFTC06-20
	0.1	
	0.2	
	0.4	RNFTC10-20
	0.75	RNFTC20-20
2000 [r/min]	0.5	RNFTC10-20
	0.75	RNFTC20-20
1500 [r/min]	0.5	RNFTC10-20

■ In case of 3-phase 200V

Rated rotation speed	Capacity [kW]	Power filter
3000 [r/min]	0.05	RNFTC06-20
	0.1	
	0.2	
	0.4	
	0.75	RNFTC10-20
	1.0	
	1.5	RNFTC20-20
	2.0	
	3.0	RNFTC30-20
	4.0	RNFTC50-20
	5.0	
2000 [r/min]	0.5	RNFTC06-20
	0.75	RNFTC10-20
	1.0	
	1.5	RNFTC20-20
	2.0	
1500 [r/min]	0.5	RNFTC06-20
	0.85	RNFTC10-20
	1.3	RNFTC20-20

The purpose of the power filter is suppression of high frequency voltage fluctuation caused by the servo amplifier in the commercial power supply.

Because the filter effect is bi-directional, the servo amplifier is also protected against high frequency voltage fluctuation in the power supply.

10.7 AC/DC Reactor

Connect an AC or DC reactor in following cases.

(1) Large power supply capacity
With power supply capacities exceeding 500 [kVA], the power-on input current fed to the servo amplifier may become too large and cause damage to the internal rectifying diode.
(The power supply capacity depends on the 20 [m] wiring length and the designated cable size.)

(2) Imbalance in source voltage
If there is imbalance in the source voltage, the current gathers to the phase of a higher voltage. Connect the AC reactor if the ratio of voltage imbalance is 3 [%] or above.

$$\text{(Ratio of power supply imbalance)} = \frac{\text{(Max. voltage [V]) - (Min. voltage [V])}}{\text{(Average voltage of three phases [V])}} \times 100$$

Insert an AC reactor to balance the input current among phases. The AC reactor also provides protection against loss of source voltage or similar hazards.

(3) Suppression of harmonics
The servo amplifier generates harmonics currents because it is a capacitor input type. The AC reactor suppresses current distortion in the power supply system, protecting devices in the same system against damage. Imbalance in the source voltage increases harmonics currents. Insert an AC reactor in the primary circuit of the servo amplifier. Heat generation is caused with types of a small rated conductive current, and the suppression effect is reduced with types of a large rated conductive current.

10

Model of AC/DC reactor

■ In case of single-phase 100V

Rated rotation speed	Capacity [kW]	AC reactor	DC reactor
3000 [r/min]	0.05	ACR2-0.4A	DCR2-0.4
	0.1	ACR2-0.75A	DCR2-0.75
	0.2	ACR2-1.5A	DCR2-1.5
	0.375	ACR2-2.2A	DCR2-2.2

■ In case of single-phase 200V

Rated rotation speed	Capacity [kW]	AC reactor	DC reactor
3000 [r/min]	0.05	ACR2-0.4A	DCR2-0.2
	0.1		DCR2-0.4
	0.2	ACR2-0.75A	DCR2-0.75
	0.4	ACR2-1.5A	DCR2-1.5
	0.75	ACR2-2.2A	DCR2-2.2
2000 [r/min]	0.5	ACR2-1.5A	DCR2-1.5
	0.75	ACR2-2.2A	DCR2-2.2
1500 [r/min]	0.5	ACR2-1.5A	DCR2-1.5

■ In case of 3-phase 200V

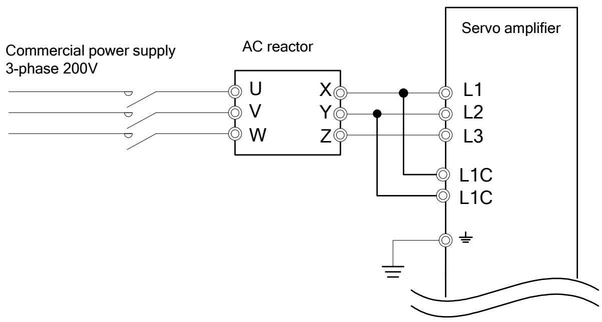
Rated rotation speed	Capacity [kW]	AC reactor	DC reactor
3000 [r/min]	0.05	ACR2-0.4A	DCR2-0.2
	0.1		
	0.2		DCR2-0.4
	0.4	ACR2-0.75A	DCR2-0.75
	0.75	ACR2-1.5A	DCR2-1.5
	1.0	ACR2-2.2A	DCR2-2.2
	1.5		
	2.0	ACR2-3.7A	DCR2-3.7
	3.0	ACR2-5.5A	DCR2-5.5
	4.0	ACR2-7.5A	DCR2-7.5
	5.0	ACR2-11A	DCR2-11
2000 [r/min]	0.5	ACR2-0.75A	DCR2-0.75
	0.75	ACR2-1.5A	DCR2-1.5
	1.0	ACR2-2.2A	DCR2-2.2
	1.5		
	2.0	ACR2-3.7A	DCR2-3.7
1500 [r/min]	0.5	ACR2-0.75A	DCR2-0.75
	0.85	ACR2-1.5A	DCR2-1.5
	1.3	ACR2-2.2A	DCR2-2.2

■ Harmonics suppression measures

1. All servo amplifier models are applicable to the "guideline of harmonics suppression measures for high voltage or extra high voltage consumers" if they are used at a specific consumer. If you are a consumer to whom the guideline is applicable, calculate the equivalent capacity and harmonics outflow current and, if the harmonics current exceeds the limit predetermined for the contract wattage, take adequate countermeasures. (For details, refer to JEM-TR225.)
2. The servo amplifier was excluded from the target of "guideline of harmonics suppression measures for electric appliances and general-purpose products" in January 2004. However, JEMA prepares a JEMA technical document in the view point of educating general harmonics suppression measures. It is recommended to take harmonics suppression measures of the discrete device as far as possible. (For details, refer to JEM-TR227.)
   Source: The Japan Electrical Manufacturers' Association (JEMA)

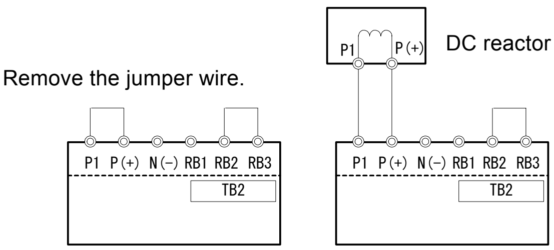
   Limitations set in the guideline for harmonics suppression measures are satisfied if the servo amplifier is connected with an AC/DC reactor.

・ How to connect the AC reactor
  Connect in the primary circuit of the servo amplifier as shown in the figure below.



Purpose of AC reactor
(1) Improvement of input power factor
(2) Protection against imbalance in voltage or similar
(3) Harmonics suppression
(4) Suppression of power supply capacity

・ How to connect the DC reactor
  Disconnect the jumper wire from the P1 and P(+) terminals and connect the DC reactor.



Purpose of DC reactor
(1) Improvement of input power factor
(2) Protection against imbalance in voltage or similar
(3) Harmonics suppression
(4) Suppression of power supply capacity

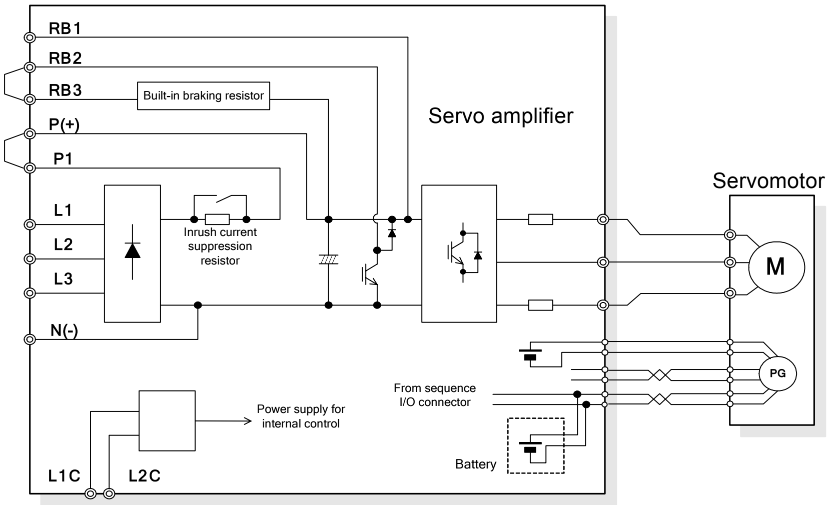
10.8 External Braking Resistor

The external braking resistor consumes regenerative power generated by the servomotor.
Use an external braking resistor if the elevating load is large and the operation frequency is high.

Rated rotation speed	Servo amplifier model	Capacity [kW]	Built-in resistor*	External Braking Resistor	Applicable resistance [Ω]
3000 [r/min]	RYT500D5-□□6	0.05	—	WSR-401 (68Ω, 17W)	20 to 75
	RYT101D5-□□6	0.1	—		
	RYT201D5-□□6	0.2	8W/20Ω	WSR-751 (15Ω, 25W)	15 to 39
	RYT401D5-□□6	0.375	20W/20Ω		10 to 22
	RYT500D5-□□2	0.05	—	WSR-401 (68Ω,17W)	39 to 160
	RYT101D5-□□2	0.1	—		
	RYT201D5-□□2	0.2	—		
	RYT401D5-□□2	0.4	8W/40Ω		39 to 80
	RYT751D5-□□2	0.75	20W/40Ω	WSR-152 (15Ω, 50W)	15 to 40
	RYT102D5-□□2	1.0	20W/15Ω		12 to 27
	RYT152D5-□□2	1.5			
	RYT202D5-□□2	2.0	30W/12Ω	DB11-2 (10Ω, 260W)	7.5 to 20
	RYT302D5-□□2	3.0			7.5 to 13
	RYT402D5-□□2	4.0	60W/6Ω	DB22-2 (5.8Ω, 300W)	3.9 to 8
	RYT502D5-□□2	5.0			
2000 [r/min]	RYT501C5-□□2	0.5	20W/40Ω	WSR-152 (15Ω, 50W)	15 to 40
	RYT751C5-□□2	0.75			
	RYT102C5-□□2	1.0	20W/15Ω		12 to 27
	RYT152C5-□□2	1.5	30W/12Ω	DB11-2 (10Ω, 260W)	7.5 to 20
	RYT202C5-□□2	2.0			
1500 [r/min]	RYT501B5-□□2	0.5	20W/40Ω	WSR-152 (15Ω, 50W)	15 to 40
	RYT851B5-□□2	0.85	20W/15Ω		12 to 27
	RYT132B5-□□2	1.3	30W/12Ω	DB11-2 (10Ω, 260W)	7.5 to 20

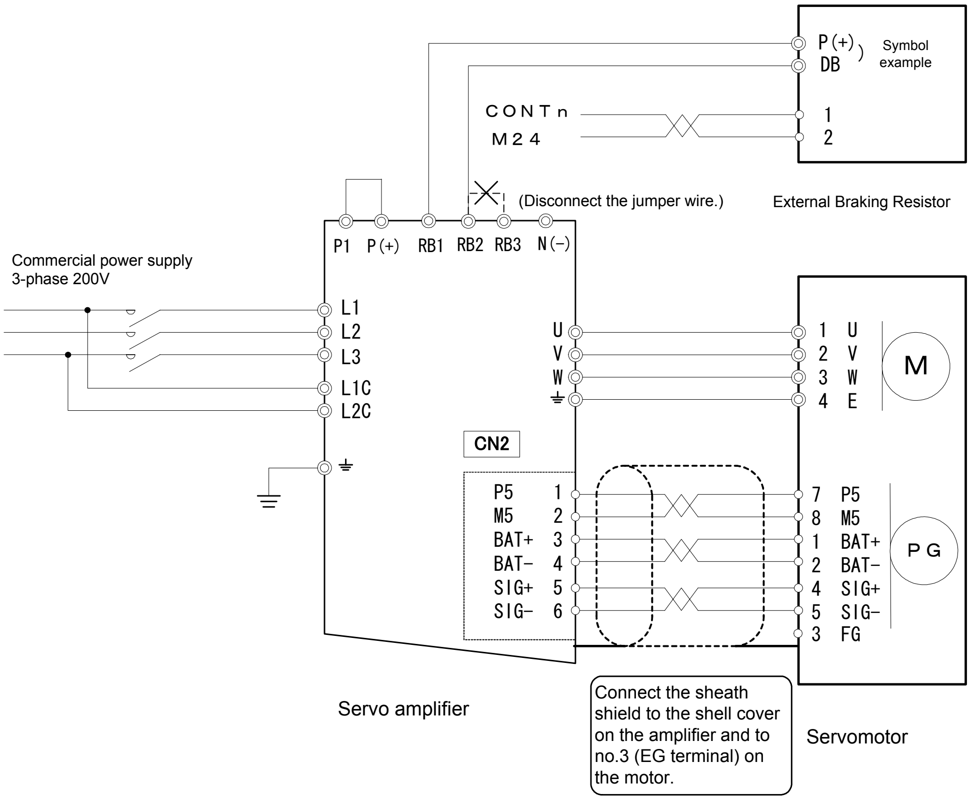
* The allowable wattage of the built-in braking resistor varies according to the ambient temperature.

Block diagram of main circuit section (Amplifier for 1.5kW/3000r/min (frame4) or less)



Note	Use the external braking resistor in the designated set without fail. There is a risk of fire.

■ To connect the optional external braking resistor



To use an external braking resistor, wiring and parameter setting are necessary.

- Wiring of thermistor output of external braking resistor
  - Connect to the host device so that the servo amplifier is shut off upon activation of the thermistor*.
  - Allocate external braking resistor overheat (34) to a CONT input terminal.
- Parameter setting
  - Set PA2_65 (braking resistor selection) at 2 (external resistor).

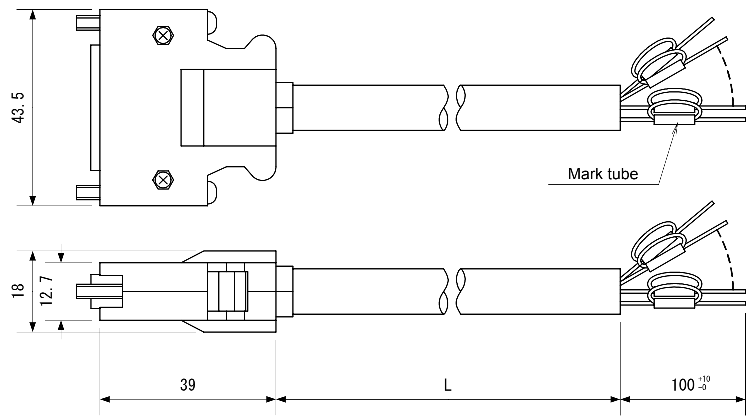
Note	* The external braking resistor will become excessively hot in the event of failure of the braking transistor, possibly causing fire.

10.9 Optional Equipment

Optional sequence I/O cable

Model: WSC-D36P03

Applicable range: All models (for CN1)



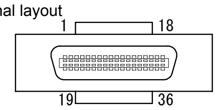
■ Model and manufacturer

Connector 1

Plug	10136-3000PE
Shell	10336-52A0-008

Made by Sumitomo 3M Ltd.

■ Terminal layout



■ Cable color

Connector 1	1	2	3	4	5	6	7	8	9	11*	10	12	13	15*	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Mark tube	1	2	3	4	5	6	7	8	9	11	10	12	13	15	14	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Cable color: Color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
Cable color: Mark	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3	Red 4	Black 4	Red 4	Black 4	Red 4	Black 4

* Take care of the pin number.

■ Length

Model	L [mm]
WSC-D36P03	3000^{+300}_{0}

* Contact Fuji Electric representative if the cable of lengths other than 3 [m] is necessary.

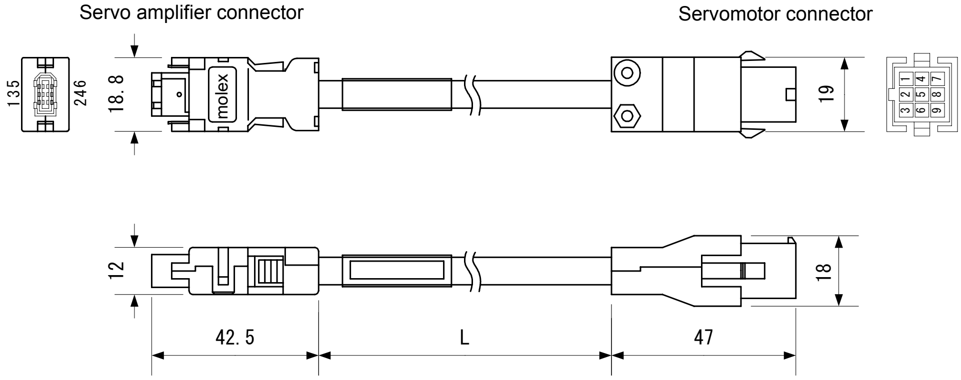
・ The manufacturer of the connector is subject to change without notice.

Optional encoder wiring cable (1)

Model: WSC-P06P02-E to WSC-P06P20-E

Applicable range: GYS model ... 0.75 [kW] or less (for CN2)

GYC model ... 0.75 [kW] or less (for CN2)



■ Model and manufacturer

Servo amplifier connector

Main body of plug housing	54180-0619
Plug shell cover	58299-0626
Plug shell body	58300-0626
Plug mold cover (A)	54181-0615
Plug mold cover (B)	54182-0605
Cable clamp	58303-0000
Clamp screw	59832-0009

Made by Molex Japan Co., Ltd.

Servomotor connector

Cap housing	1-172332-9
Socket	170361-1
Cover (×2)	316455-1
Screw (×2)	XPB M2.6×10
Nut (×2)	M2.6

Made by Tyco Electronics Amp K.K.

■ Cable color

Servo amplifier side		1	2	3	4	5	6	Shell
Servomotor side		7	8	1	2	5	4	3
Cable color	(1)	Red	Black	Orange	Orange / White	Blue / White	Blue	Shield
	(2)	White	Black	Yellow	Brown	Blue	Red	Shield
Signal name		P5	M5	BAT+	BAT-	SIG+	SIG-	FG

The cable color is either (1) or (2).

■ Length

Model	L [mm]
WSC-P06P02-E	2000^{+200}_{0}
WSC-P06P05-E	5000^{+500}_{0}
WSC-P06P10-E	10000^{+1000}_{0}
WSC-P06P20-E	20000^{+2000}_{0}

- The manufacturer of the connector is subject to change without notice.
- The movable cable is used.

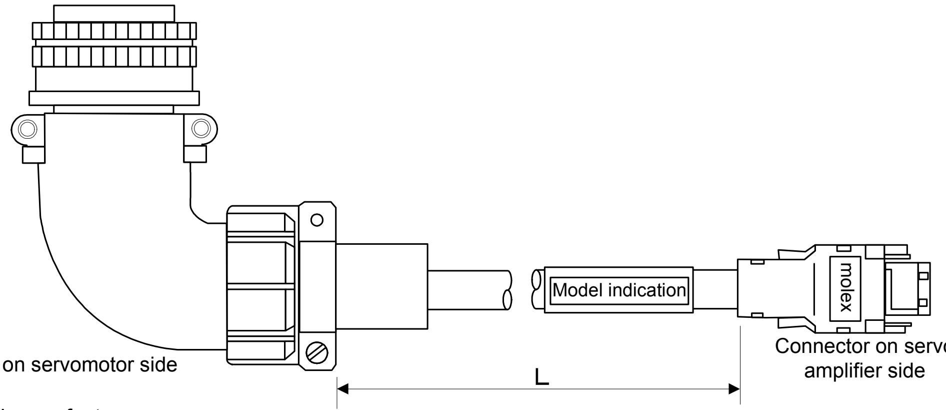
⚠ CAUTION

Do not join two or more encoder wiring cables and extend the wiring distance.
Otherwise the voltage drop caused by connector contact resistance will cause sudden stoppage.

Option cable for encoder wiring (2)

Model: WSC-P06P05-C to WSC-P06P20-C

Applicable range: GYS model ... 1.0 to 5.0 [kW] (for CN2)
GYC model ... 1.0 to 2.0 [kW] (for CN2)
GYG model ... 0.5 to 2.0 [kW] (for CN2)



■ Model and manufacturer

Connector on servomotor side

Connector	MS3108B20-29S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo

Connector on servo amplifier side

Main body of plug housing	54180-0619
Plug shell cover	58299-0626
Plug shell body	58300-0626
Plug mold cover (A)	54181-0615
Plug mold cover (B)	54182-0605
Cable clamp	58303-0000
Clamp screw	59832-0009

Made by Molex Japan

■ Cable cover

Servomotor side		H	G	T	S	C	D
Servo amplifier side		1	2	3	4	5	6
Cable Color	(1)	Red	Black	Orange	Orange/ white	Light blue	Light blue/ white
	(2)	White	Black	Yellow	Brown	Red	Blue

The cable cover is either (1) or (2).

■ Length

Model	L[mm]
WSC-P06P05-C	5000^{+500}_{0}
WSC-P06P10-C	10000^{+1000}_{0}
WSC-P06P20-C	20000^{+2000}_{0}

- The manufacturer of the connector is subject to change without notice.
- The movable cable is used.

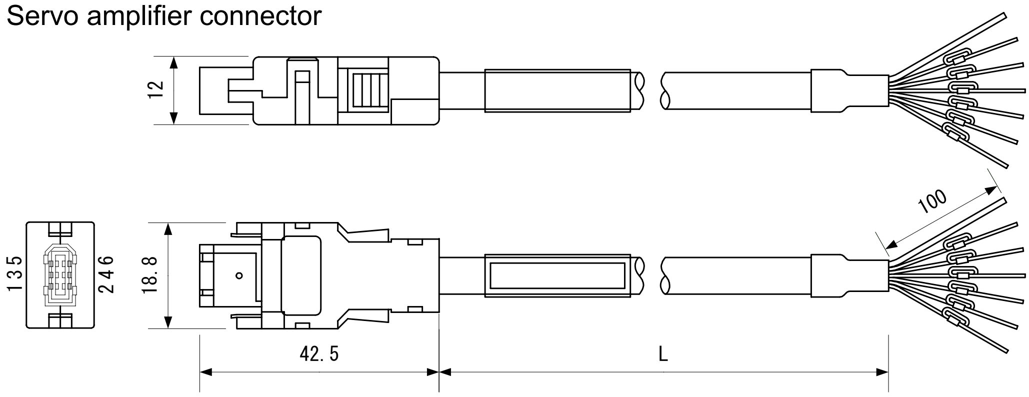
⚠ CAUTION

Do not join two or more encoder wiring cables and extend the wiring distance.
Otherwise the voltage drop caused by connector contact resistance will cause sudden stoppage.

Option cable for encoder wiring (3)

Model: WSC-P06P05-W to WSC-P06P20-W

Applicable range: All models (for CN2)



■ Model and manufacturer

	Servo amplifier connector
Main body of plug housing	54180-0619
Plug shell cover	58299-0626
Plug shell body	58300-0626
Plug mold cover (A)	54181-0615
Plug mold cover (B)	54182-0605
Cable clamp	58303-0000
Clamp screw	59832-0009

Made by Molex Japan Co., Ltd.

■ Cable color

Pin number		1	2	3	4	5	6	Case
Cable color	(1)	Red	Black	Orange	Orange/ White	Light blue	Light blue /White	Protective tube
	(2)	White	Black	Yellow	Brown	Red	Blue	
Signal name		P5	M5	BAT+	BAT-	SIG+	SIG-	-

The cable color is either (1) or (2).

■ Length

Model	L [mm]
WSC-P06P05-W	5000^{+500}_{0}
WSC-P06P10-W	10000^{+1000}_{0}
WSC-P06P15-W	15000^{+1500}_{0}
WSC-P06P20-W	20000^{+2000}_{0}

- The manufacturer of the connector is subject to change without notice.
- The movable cable is used.

⚠ CAUTION

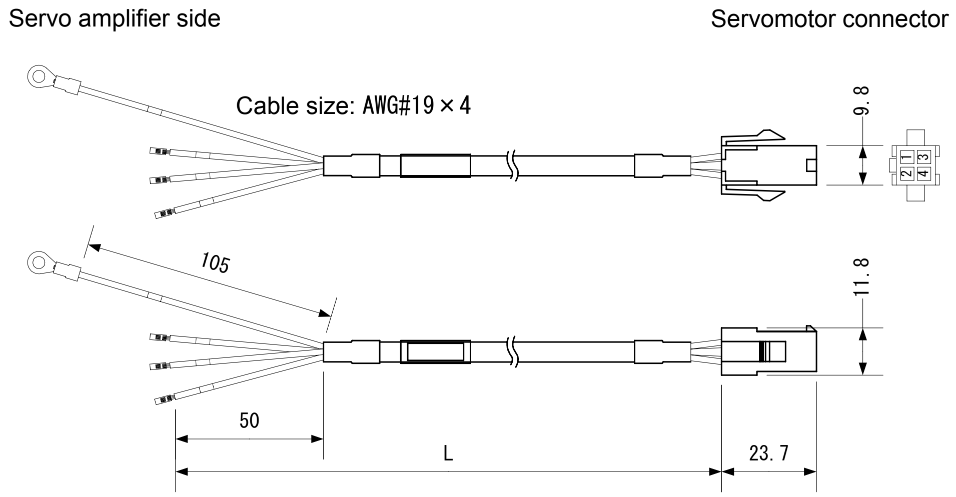
Do not join two or more encoder wiring cables and extend the wiring distance.
Otherwise the voltage drop caused by connector contact resistance will cause sudden stoppage.

Optional servomotor power cable

Model: WSC-M04P02-E to WSC-M04P20-E

Applicable range: GYS model ... 0.75 [kW] or less

GYC model ... 0.75 [kW] or less



■ Model and manufacturer

Servomotor connector

Cap housing	172159-9
Socket	170362-1

Made by Tyco Electronics Amp K.K.

■ Cable color

Servo amplifier side	U	V	W	E
Servomotor side	1	2	3	4
Cable color	Red	White	Black	Green / yellow
Signal name	U	V	W	E

■ Length

Model	L [mm]
WSC-M04P02-E	2000^{+200}_{0}
WSC-M04P05-E	5000^{+500}_{0}
WSC-M04P10-E	10000^{+1000}_{0}
WSC-M04P20-E	20000^{+2000}_{0}

- The manufacturer of the connector is subject to change without notice.
- The movable cable is used.

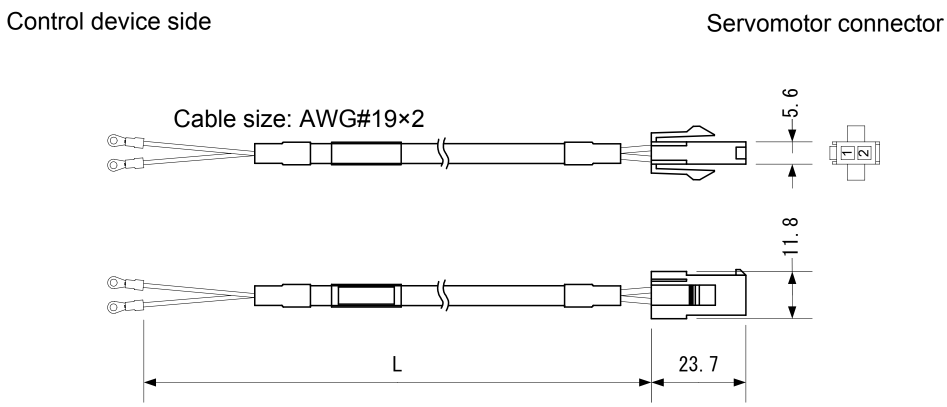
10

Optional servomotor brake cable

Model: WSC-M02P02-E to WSC-M02P20-E

Applicable range: GYS model ... 0.75 [kW] or less (With brake)

GYC model ... 0.75 [kW] or less (With brake)



■ Model and manufacturer

Servomotor connector

Cap housing	172157-9
Socket	170362-1

Made by Tyco Electronics Amp K.K.

■ Cable color

Control device side	–	–
Servomotor side	1	2
Cable color	Red	Black
Signal name	B	B

■ Length

Model	L [mm]
WSC-M02P02-E	2000^{+200}_{0}
WSC-M02P05-E	5000^{+500}_{0}
WSC-M02P10-E	10000^{+1000}_{0}
WSC-M02P20-E	20000^{+2000}_{0}

- The manufacturer of the connector is subject to change without notice.
- The movable cable is used.

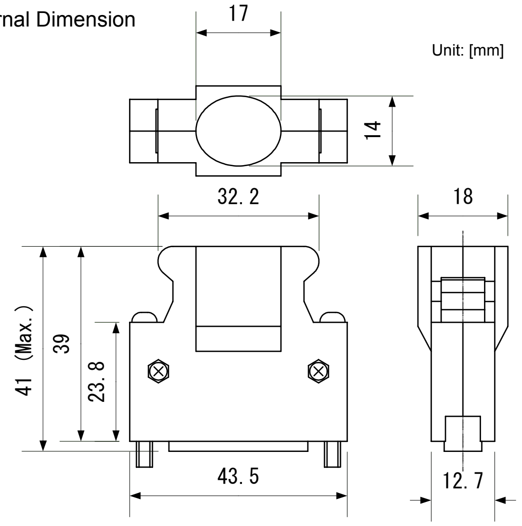
Sequence I/O connector kit

Model: WSK-D36P

Applicable range: All models

■ External Dimension

Unit: [mm]

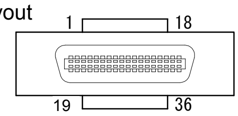


■ Model and manufacturer

Soldered plug	10136-3000PE
Shell kit	10336-52A0-008

Made by Sumitomo 3M

■ Terminal layout



- The model of the connector kit is different from that of the optional cable.
- The manufacturer of the connector is subject to change without notice.

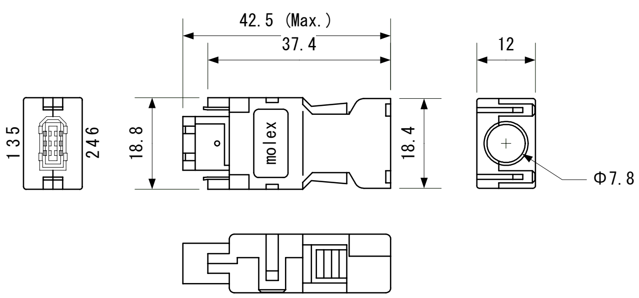
Encoder wiring connector kit (amplifier side)

Model: WSK-P06P-M

Applicable range: All models

■ External Dimension

Unit: [mm]



■ Model and manufacturer

Main body of plug housing	54180-0619
Plug shell cover	58299-0626
Plug shell body	58300-0626
Plug mold cover (A)	54181-0615
Plug mold cover (B)	54182-0605
Cable clamp	58303-0000
Clamp screw	59832-0009

Made by Molex Japan

- The model of the connector kit is different from that of the optional cable.
- The manufacturer of the connector is subject to change without notice.

Encoder wiring connector kit (motor side)

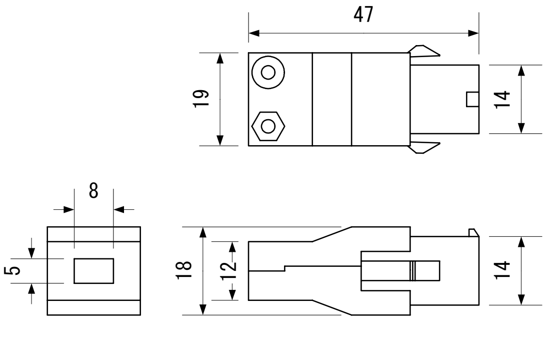
Model: WSK-P09P-D

Applicable range: GYS model ... 0.75 [kW] or less

GYC model ... 0.75 [kW] or less

■ External Dimension

Unit: [mm]

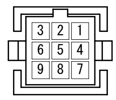


■ Model and manufacturer

Cap	172161-9
Cap cover	316455-1
Socket (SIG+,SIG-,FG)	170365-1 (bulk) 170361-1 (chain)
Socket (P5,M5)	170366-1 (bulk) 170362-1 (chain)

Made by Tyco Electronics Amp K.K.

■ Terminal layout



- The model of the connector kit is different from that of the optional cable.
- The manufacturer of the connector is subject to change without notice.

Connector kit for encoder wiring (motor side)

Model: WSK-P06P-C

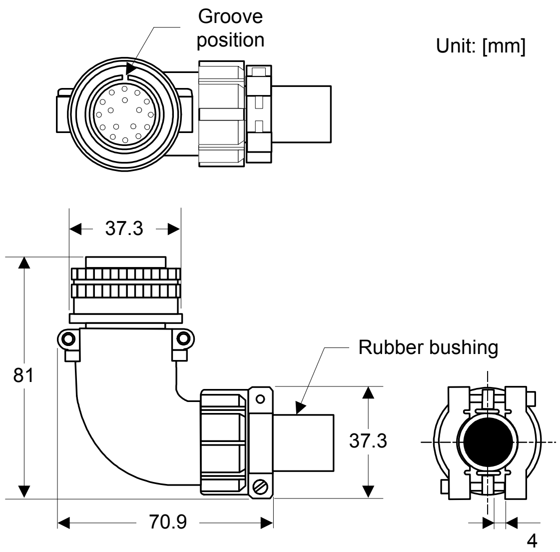
Applicable range: GYS model ... 1.0 to 5.0 [kW]

GYC model ... 1.0 to 2.0 [kW]

GYG model ... 0.5 to 2.0 [kW]

■ External dimension

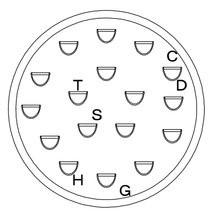
Unit: [mm]



■ Model and manufacturer

Connector	MS3108B20-29S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo



H	P5
G	M5
C	SIG+
D	SIG−
T	BAT+
S	BAT−

- The connector model is different from that of the option cable.
- The manufacturer of the connector is subject to change without notice.

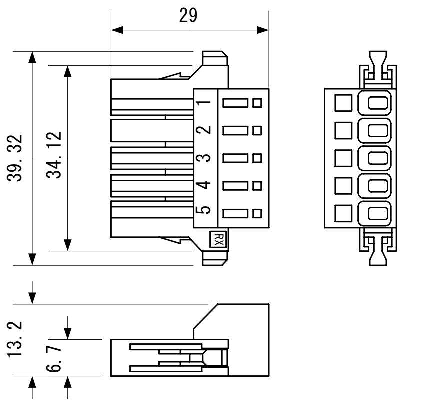
Power cable connector kit (amplifier side)

Model: WSK-S05P-E

Applicable range: GYS model ... 1.5 [kW] or less
GYC model ... 1.5 [kW] or less
GYG model ... 1.0 [kW] or less

■ External Dimension

Unit: [mm]

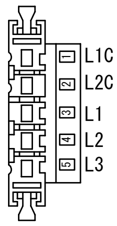


■ Model and manufacturer

Connector Kit	05JFAT-SBXGF-I

J.S.T. Mfg. Co., Ltd.

■ Terminal layout



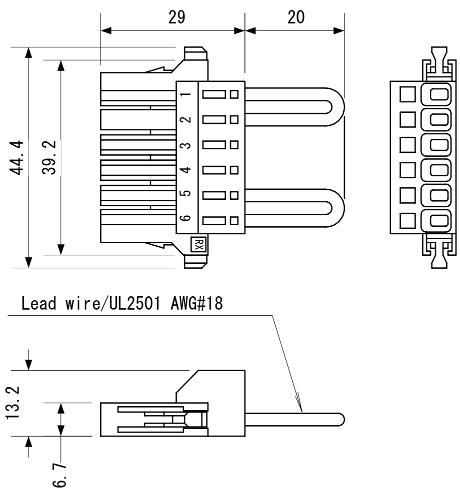
Intermediate circuit wiring connector kit (amplifier side) * Provided with amplifier.

Model: WSK-R06P-E

Applicable range: GYS model ... 1.5 [kW] or less
GYC model ... 1.5 [kW] or less
GYG model ... 1.0 [kW] or less

■ External Dimension

Unit: [mm]

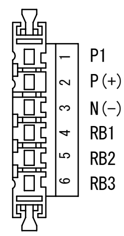


■ Model and manufacturer

Connector Kit	06JFAT-SBXGF-I

J.S.T. Mfg. Co., Ltd.

■ Terminal layout



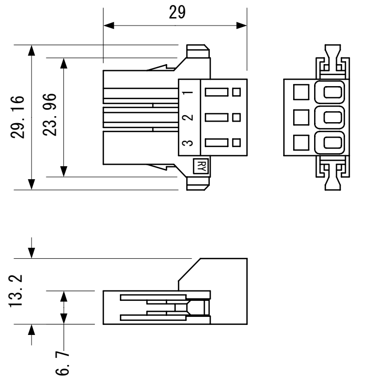
Motor power cable connector kit (amplifier side)

Model: WSK-M03P-E

Applicable range: GYS model ... 1.5 [kW] or less
GYC model ... 1.5 [kW] or less
GYG model ... 1.0 [kW] or less

■ External Dimension

Unit: [mm]

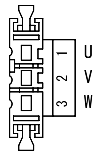


■ Model and manufacturer

Connector Kit	03JFAT-SBYGF-I

J.S.T. Mfg. Co., Ltd.

■ Terminal layout



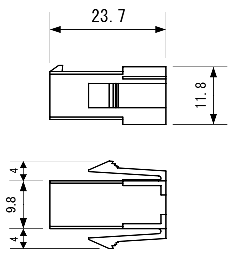
Motor power cable connector kit (motor side)

Model: WSK-M04P-E

Applicable range: GYS model ... 0.75 [kW] or less
GYC model ... 0.75 [kW] or less

■ External Dimension

Unit: [mm]

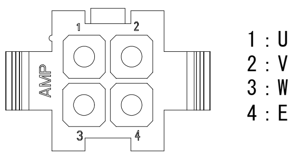


■ Model and manufacturer

Cap housing	172159-9
Socket	170362-1

Made by Tyco Electronics Amp K.K.

■ Terminal layout



Connector kit for motor power wiring (motor side)

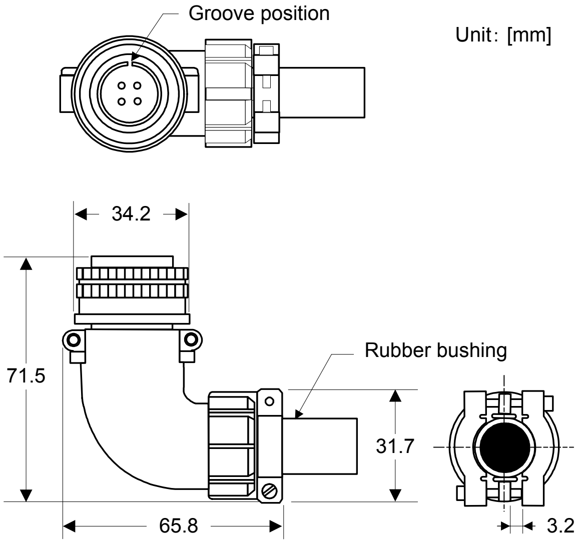
Model: WSK-M04P-CA

Applicable range: GYS model ... 1.0 to 2.0 [kW]

GYG model ... 0.5 to 2.0 [kW]

■ External Dimension

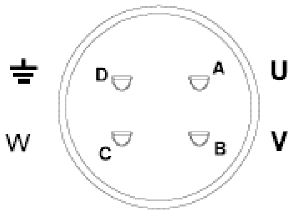
Unit: [mm]



■ Model and manufacturer

Connector	MS3108B18-10S
Cable clamp	MS3057－10A

Made by Daiichi Denshi Kogyo



A	U
B	V
C	W
D	⏚

Connector kit for motor power wiring (motor side : with brake)

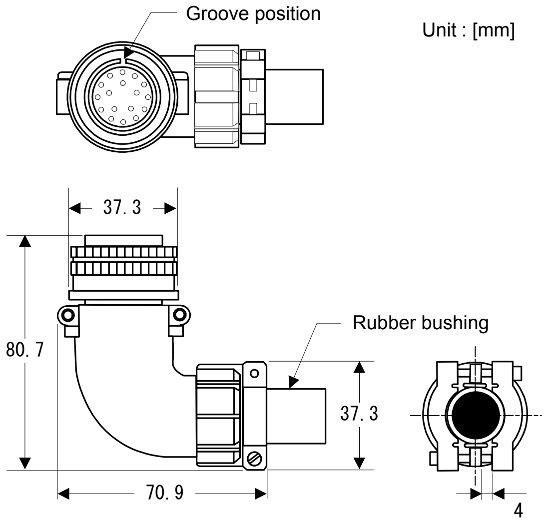
Model: WSK-M06P-CA

Applicable range: GYS model ... 1.0 to 2.0 [kW] (with brake)

GYG model ... 0.5 to 2.0 [kW] (with brake)

■ External Dimension

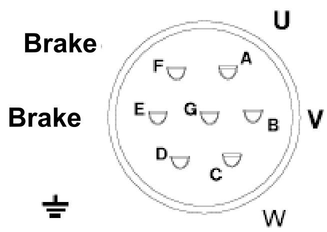
Unit : [mm]



■ Model and manufacturer

Connector	MS3108B20-15S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo



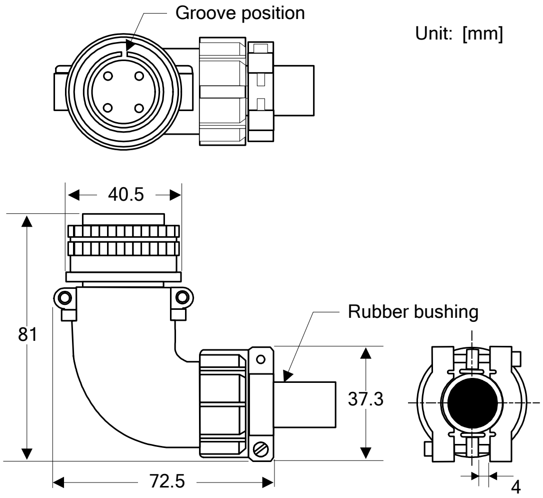
A	U
B	V
C	W
D	⏚
E	Br
F	Br
G	─

Connector kit for motor power wiring (motor side)

Model: WSK-M04P-CB

Applicable range: GYS model ... 3.0 to 5.0 [kW]
GYC model ... 1.0 to 2.0 [kW]

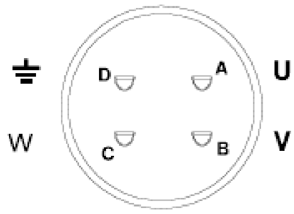
■ External Dimension



■ Model and manufacturer

Connector	MS3108B22-22S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo



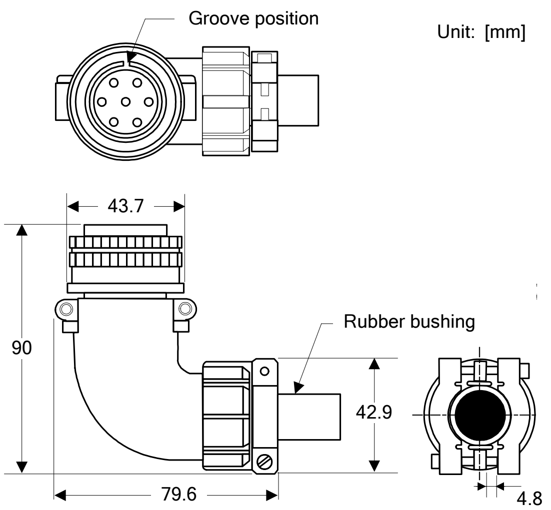
A	U
B	V
C	W
D	⏚

Connector kit for motor power wiring (motor side : with brake)

Model: WSK-M06P-CB

Applicable range: GYS model ... 3.0 to 5.0[kW]　(with brake)
GYC model ... 1.0 to 2.0[kW]　(with brake)

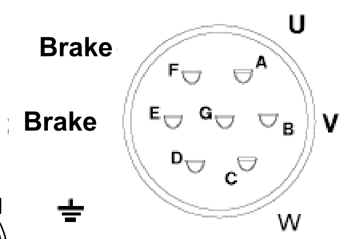
■ External Dimension



■ Model and manufacturer

Connector	MS3108B24-10S
Cable clamp	MS3057-16A

Made by Daiichi Denshi Kogyo



A	U
B	V
C	W
D	⏚
E	Br
F	Br
G	—

Brake wiring connector kit (motor side)

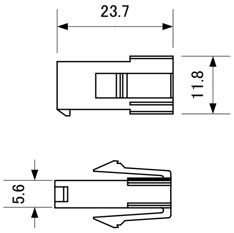
Model: WSK-M02P-E

Applicable range: GYS model ... 0.75 [kW] or less (with brake)

GYC model ... 0.75 [kW] or less (with brake)

■ External Dimension

Unit: [mm]

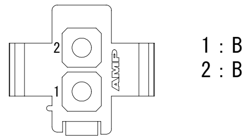


■ Model and manufacturer

Cap housing	172157-9
Socket	170362-1

Made by Tyco Electronics Amp K.K.

■ Terminal layout

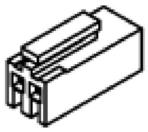


Battery (CN5)

Connect the optional battery.

When using a battery, use WSB-SC.

1	BAT-	2	BAT+



■ Model and manufacturer

Housing	IL-2S-S3L-(N)
Crimp terminal	IL-C2-1-10000

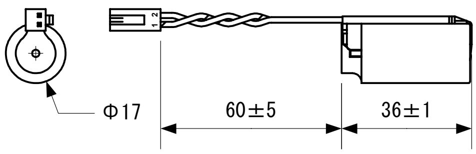
Japan Aviation Electronics Industry, Ltd.

Battery + Battery case

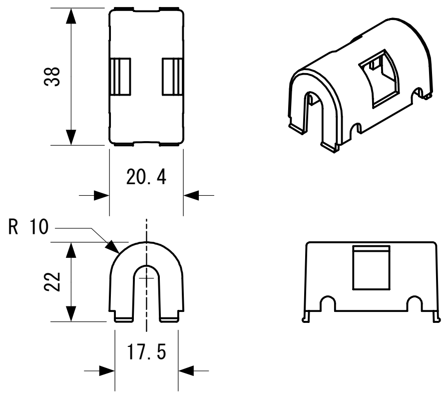
Model: WSB-SC

Applicable range: All models

■ Battery



■ Battery case



■ Model and manufacturer

Battery	ER1733WK41 1PP

Hitachi Maxell Ltd.

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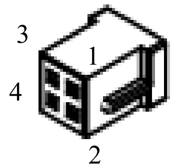
Monitor (CN6)

A measuring instrument or similar is connected to the connector 6 (CN6) of the servo amplifier.
The signal of this connector is analog output voltage for measuring instrument and is not necessary for servo amplifier operation.
This connector is not prepared as option.

1	MON1	3	M5(0V)
2	MON2	4	M5(0V)



■ Model and manufacturer

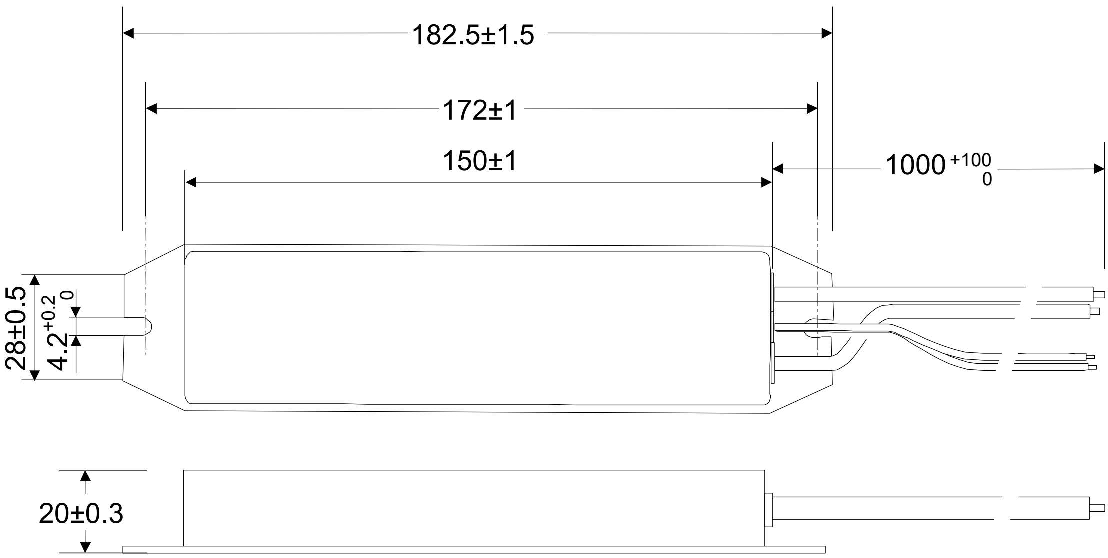
Crimp socket	DF11-4DS-2C
Crimp terminal	DF11-2428SC

Hirose Electric Co., Ltd.

External braking resistor (1)

Model: WSR-401

Applicable range: servo amplifier model: RYT500D5 to 1RYT401D5



* Thickness of the installed section: 1.2mm

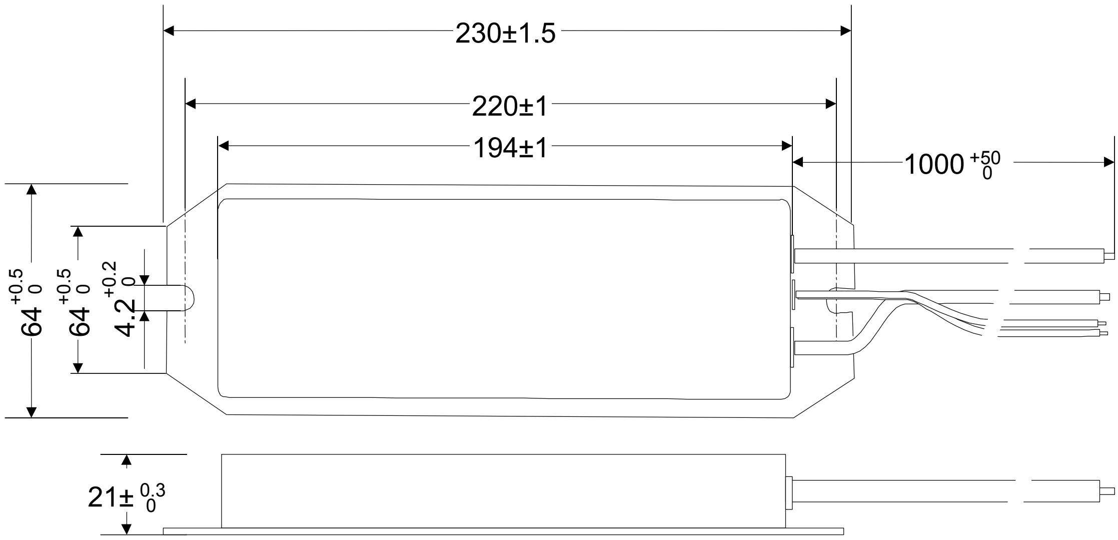
Item		Specifications
Model		WSR-401
Resistor	Resistance	68 [Ω]
	Allowable power	17 [W] (cont.)
Thermistor	Operating temperature	Open at 135 ±10°C
	Dielectric strength	For 1 minutes at 1.5kV AC
	Contact capacity	30VDC 3A

- Connect the braking resistor to the servo amplifier with a 10 [m] or shorter cable.
- The external braking resistor becomes hot. Keep flammable matters away from the external braking resistor.
- For connection of the external braking resistor, refer to "10.8 External Braking Resistor."

External braking resistor (2)

Model: WSR-751

Applicable range: servo amplifier model: RYT201D5－□□6、RYT401D5－□□6



* Thickness of the installed section: 1.5mm

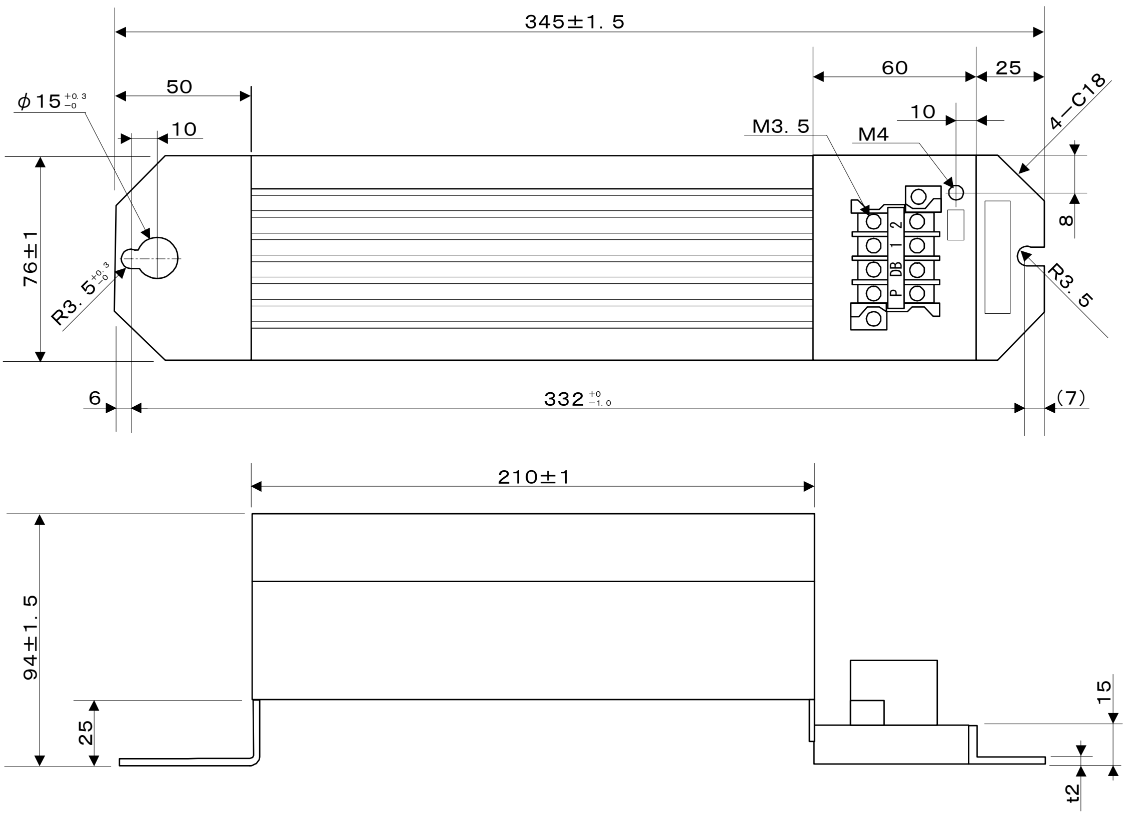
Item		Specifications
Model		WSR-751
Resistor	Resistance	15 [Ω]
	Allowable power	25 [W] (cont.)
Thermistor	Operating temperature	Open at 135 ±10°C
	Dielectric strength	For 1 minutes at 2.5kV AC
	Contact capacity	30VDC 3A

- Connect the braking resistor to the servo amplifier with a 10 [m] or shorter cable.
- The external braking resistor becomes hot. Keep flammable matters away from the external braking resistor.
- For connection of the external braking resistor, refer to "10.8 External Braking Resistor."

External braking resistor (3)

Model: WSR-152

Applicable range: servo amplifier model: RYT751D5 to RYT152D5, RYT501C5 to RYT102C5, RYT501B5 to RYT851B5



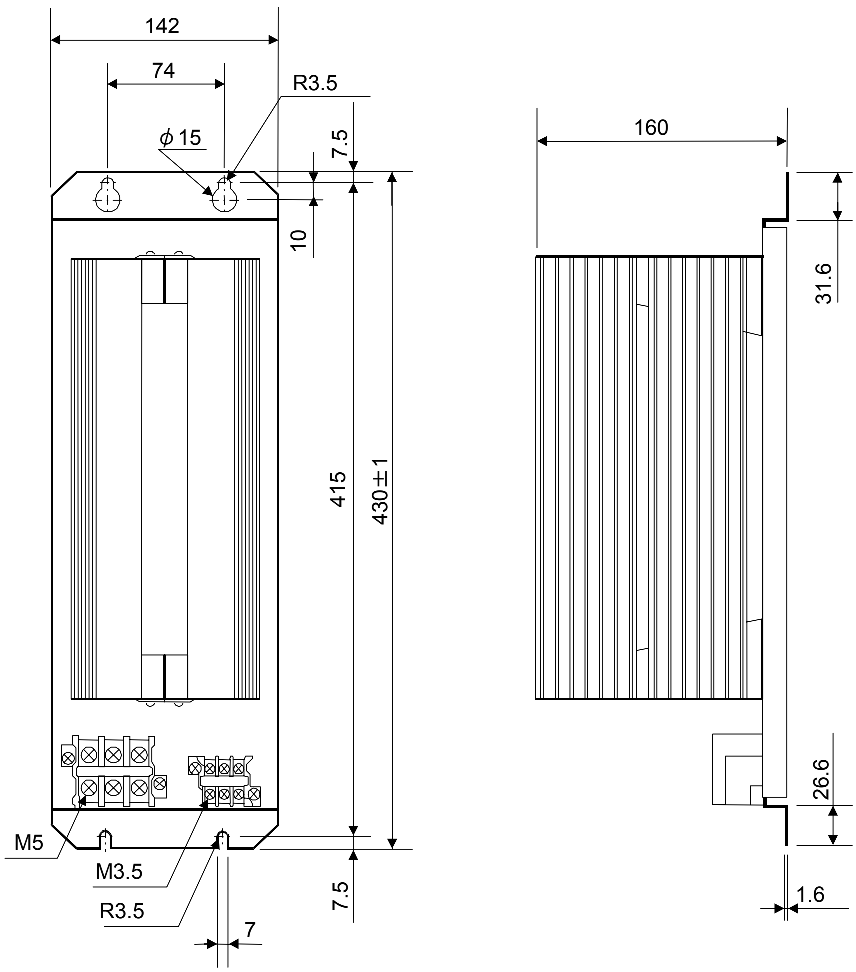
Item		Specifications
Model		WSR-152
Resistor	Resistance	15 [O]
	Allowable power	50 [W] (cont.)
Thermistor	Operating temperature	Open at 150 ±10°C
	Dielectric strength	For 1 minutes at 2.5kV AC
	Contact capacity	30VDC 3A

- Connect the braking resistor to the servo amplifier with a 10 [m] or shorter cable.
- The external braking resistor becomes hot. Keep flammable matters away from the external braking resistor.
- For connection of the external braking resistor, refer to "10.8 External Braking Resistor."

External braking resistor (4)

Model: DB11-2

Applicable range: servo amplifier model: RYT202D5 to RYT302D5, RYT152C5 to RYT202C5, RYT132B5



Item		Specifications
Model		DB11-2
Resistor	Resistance	10 [Ω]
	Allowable power	260 [W] (cont.)
Thermistor	Operating temperature	Open at 150 ±10°C
	Dielectric strength	For 1 minutes at 2.5kV AC
	Contact capacity	120VAC/30VDC 0.1A

- Connect the braking resistor to the servo amplifier with a 10 [m] or shorter cable.
- The external braking resistor becomes hot. Keep flammable matters away from the external braking resistor.
- For connection of the external braking resistor, refer to "10.8 External Braking Resistor."

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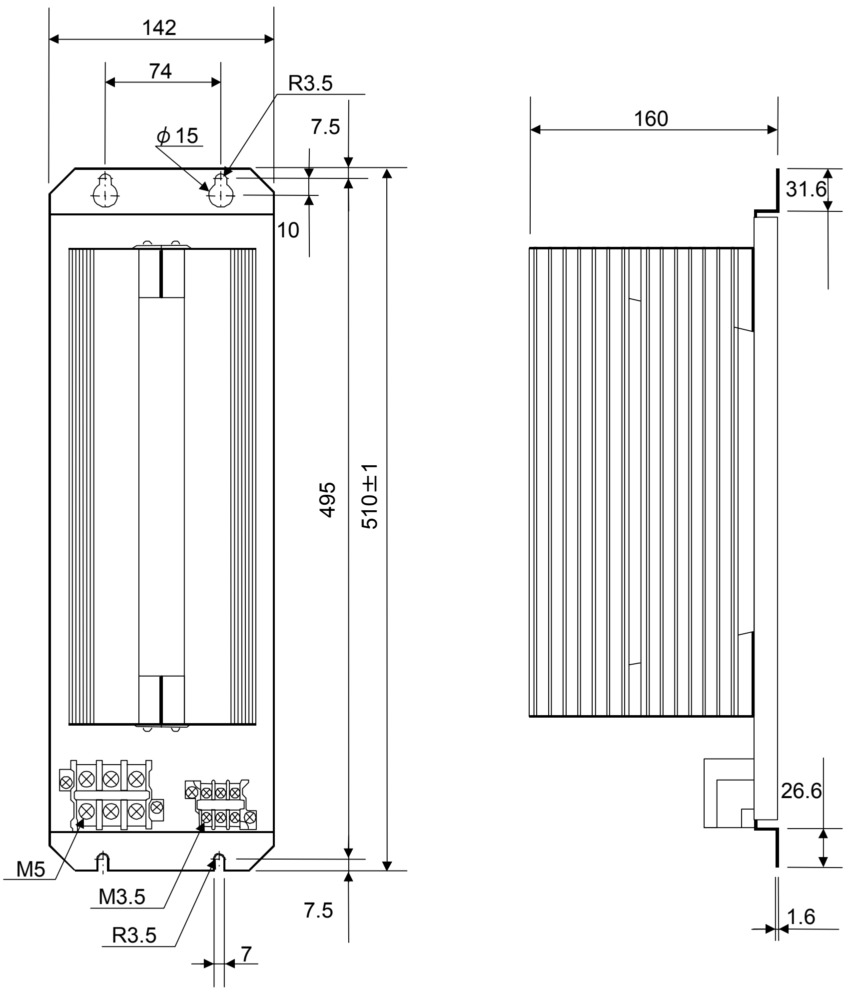
External braking resistor (5)

Model: DB22-2

Applicable range: servo amplifier model: RYT402D5 to RYT502D5



Item		Specifications
Model		DB22-2
Resistor	Resistance	5.8 [Ω]
	Allowable power	300 [W] (cont.)
Thermistor	Operating temperature	Open at 150 ±10°C
	Dielectric strength	For 1 minutes at 2.5kV AC
	Contact capacity	120VAC/30VDC 0.1A

- Connect the braking resistor to the servo amplifier with a 10 [m] or shorter cable.
- The external braking resistor becomes hot. Keep flammable matters away from the external braking resistor.
- For connection of the external braking resistor, refer to "10.8 External Braking Resistor."

CHAPTER 11 ABSOLUTE POSITION SYSTEM

11.1 Specifications

11.1.1 Specification List

Item	Description
Method	Battery backup method
Battery	Lithium battery (primary battery, nominal +3.6 [V])
Max. rotation range	Home position ±32767 [rev]
Max. rotation speed at power failure	6000 [r/min]
Service life of battery	About 35000 hours (life without power turned on)

Hint	It is recommended to replace the battery periodically (every three years or more frequently) despite the power-on or shutdown state.

11.1.2 Precautions

■ Aerial transport of battery

A revision (volume 44) of hazardous material rules of International Air Transport Association (IATA) was made into effect on January 1, 2003 and the "rule about lithium and lithium ion battery" was revised. This battery is a non-hazardous matter (with 1.0g or less lithium; non-class 9) and is out of the scope of the rule if the quantity is within 24 pieces. If the quantity exceeds 24, the package must be compliant to the rule. For details, contact Fuji Electric representative. (As of August 2006)

■ Conditions blocking establishment of absolute position system

The absolute position system is not established under the following conditions.

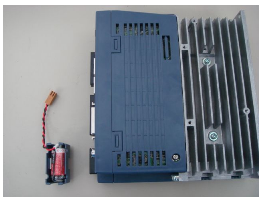
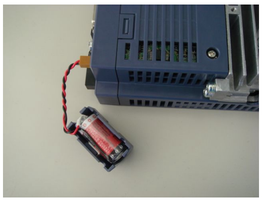
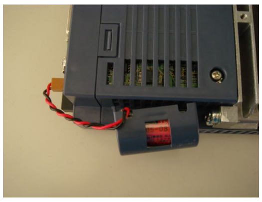
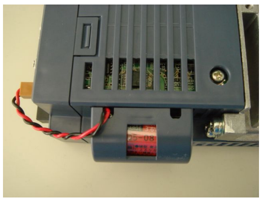
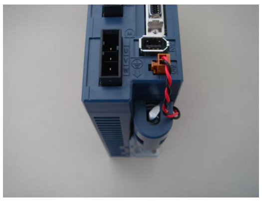
- The electronic gear setting is changed after position preset.
- The command pulse ratio is changed after position preset.

The absolute position system can be established even under speed control or torque control.

11.2 Battery Installation and Replacement Procedures

11.2.1 Battery Installation Procedure (for Amplifier of 1.5kW/3000r/min [Frame 4] or Less)

Install the battery in the following procedure.

[1]		Prepare the servo amplifier, battery and battery case.
[2]		Connect the lead wire connector of the battery to CN5 on the front panel of the servo amplifier.
[3]		Engage one catch of the battery case with the bottom of the servo amplifier.
[4]		Engage the other catch of the battery case with the bottom of the servo amplifier. Installation is finished.
[5]		After installing, check if both the connector and case are securely connected and fixed as shown in the photo on the left.

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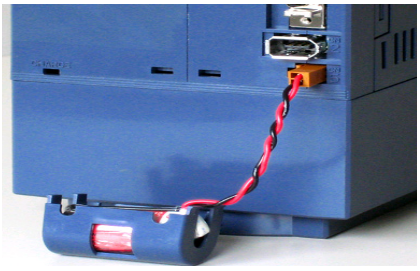
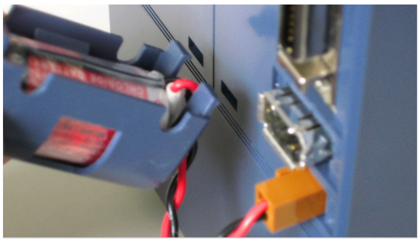
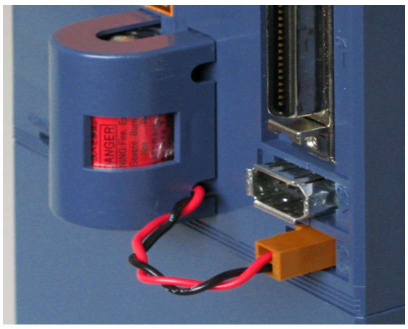
11.2.2 Battery Installation Procedure (for Amplifier of 2kW/3000r/min [Frame 5] or More)

[1]		Prepare the servo amplifier, battery and battery case.
[2]		Connect the lead wire connector of the battery to CN5 on the front panel of the servo amplifier.
[3]		Engage one catch of the battery case with the front of the servo amplifier.
[4]		Engage the other catch of the battery case with the front of the servo amplifier. Installation is finished.
[5]		After installing, check if both the connector and case are securely connected and fixed as shown in the photo on the left.

11.2.3 Battery Replacement Procedure

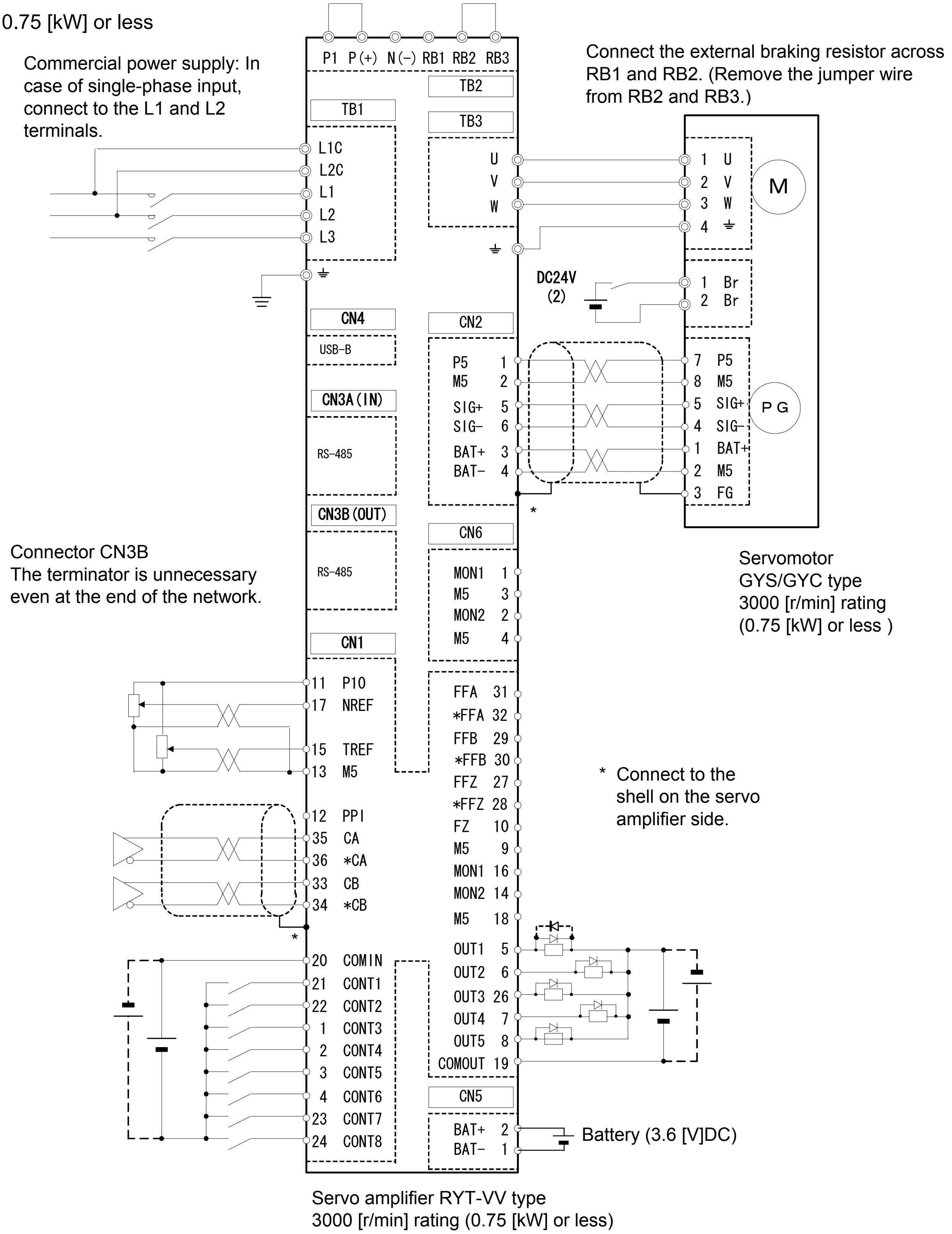
Reverse the installation procedure to remove and install the new battery according to the installation procedure.

Note	• Be sure to leave the control power supplied when working (turn the main power off). • Leave the encoder cable connected.

11.3 Connection Diagram

11.3.1 VV Type

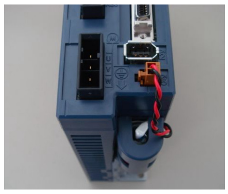
0.75 [kW] or less



11.4 Starting Up Procedure

Follow the procedure below to start up the absolute position system.

	Step	Description
[1]	Install the battery.	Follow the description of section 11.2 to install the battery correctly.
[2]	Enter PA1_02.	Set PA1_02 (INC/ABS system) at 1 (ABS) or 2 (endless non-overflow ABS).
[3]	Turn the main power and control power off then on again.	To make new parameters enabled, turn the power off then on again.
	AL-dL1	
[4]	Perform position preset.	An absolute data lost alarm (dL1) is caused when the power is turned on first after the absolute position system is established. Execute position preset to remove the alarm.
[5]	Perform homing.	To establish the coordinate system of the absolute position system, execute regular homing.
[6]	Execute regular operation.	After above steps [1] through [5] are finished, the absolute position system is established. You can start regular operation.



- If the encoder cable is disconnected due to transportation or device changes, repeat the procedure from step [4].

11

11.5 Battery Warning

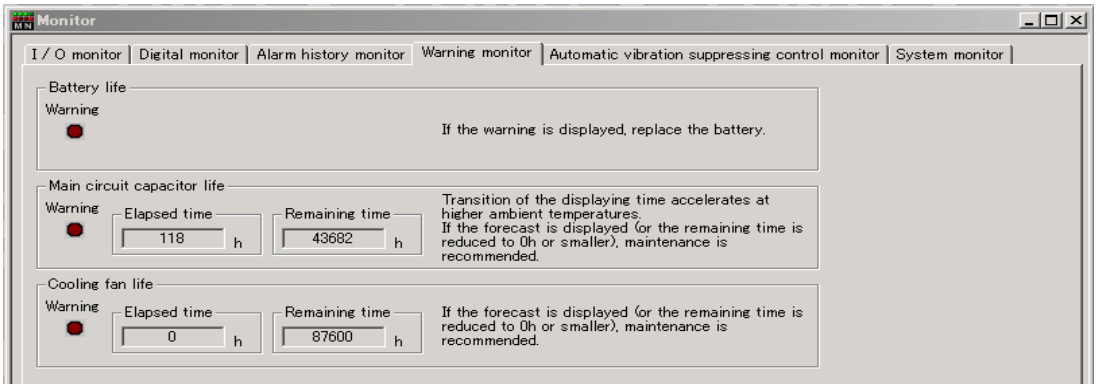
A battery warning is issued if the battery voltage is lower than the value preset in the servo amplifier. If this warning* is issued, replace the battery immediately.

* The battery warning is detected when the control power is turned on. If the battery is kept installed and the system is left shut off for a long time, the battery life limit may be reached before the battery warning is issued.

There are the following four ways to check the battery warning.

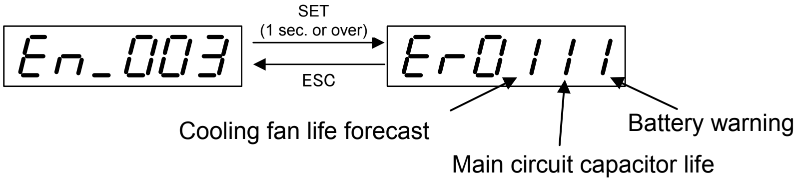
(1) OUT signal (assignment number: 45)

(2) [Monitor] - [Warning/Forecast monitor] of PC Loader



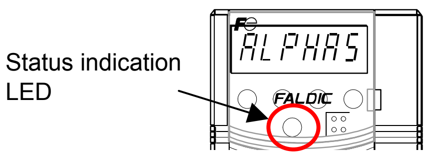
(3) Maintenance mode of keypad

The battery warning can be checked in the maintenance mode of the keypad.



(4) Blink of orange status indication LED of keypad

The blink of the status indication LED indicates an alarm in regular cases. If the indication status LED blinks though no alarm (AL----) is shown at the keypad, it states the battery warning*.



* Set PA2_78 (display transition at warning detection) at 1 (transition to warning display) to automatically show (3) at the keypad.

11.6 Calculation of Battery Life

The battery life elapses if the control power of the servo amplifier is left turned off for 35,000 hours. During actual operation, the power-on and shutoff cycles are repeated. An example of calculation of the service life in this case is shown as a reference. Note that the value is merely a calculated value and it is not guaranteed. Note, too, that the service life becomes shorter under some ambient environmental conditions.

■ Operation condition

	Operation	No operation
1 day	10 hours	14 hours
1 year*	About 261 days (= 365 days x 5 / 7)	About 104 days (= 365 days x 2 / 7)

* Assumption: operation on Monday through Friday, no operation on Saturday and Sunday

■ Current consumption

Current consumption in power-on phase: 0.0075 [mA]

Current consumption in shutoff phase: 0.0415 [mA] (= 0.0075 [mA] + 0.034 [mA])

■ Calculation of service life

Annual battery capacity consumption

(10 [Hr] × 0.0075 [mA] + 14 [Hr] × 0.0415 [mA]) × 261 [days] + 24 [Hr] × 0.0415 [mA] × 104 [days] = 275 [mAh]

Annual battery life estimation

1600 [mAh] / 275 [mAh/year] = 5.8 [years]

Hence the service life of the battery is about 5.8 years* under the above operation conditions.

* However, the battery manufacturer recommends to stop using the battery after three years of operation. Periodic replacement within three years is recommended without relations to the operation conditions.

CHAPTER 12 POSITIONING DATA

12

12.1 Operation Modes

12.1.1 Operation Method

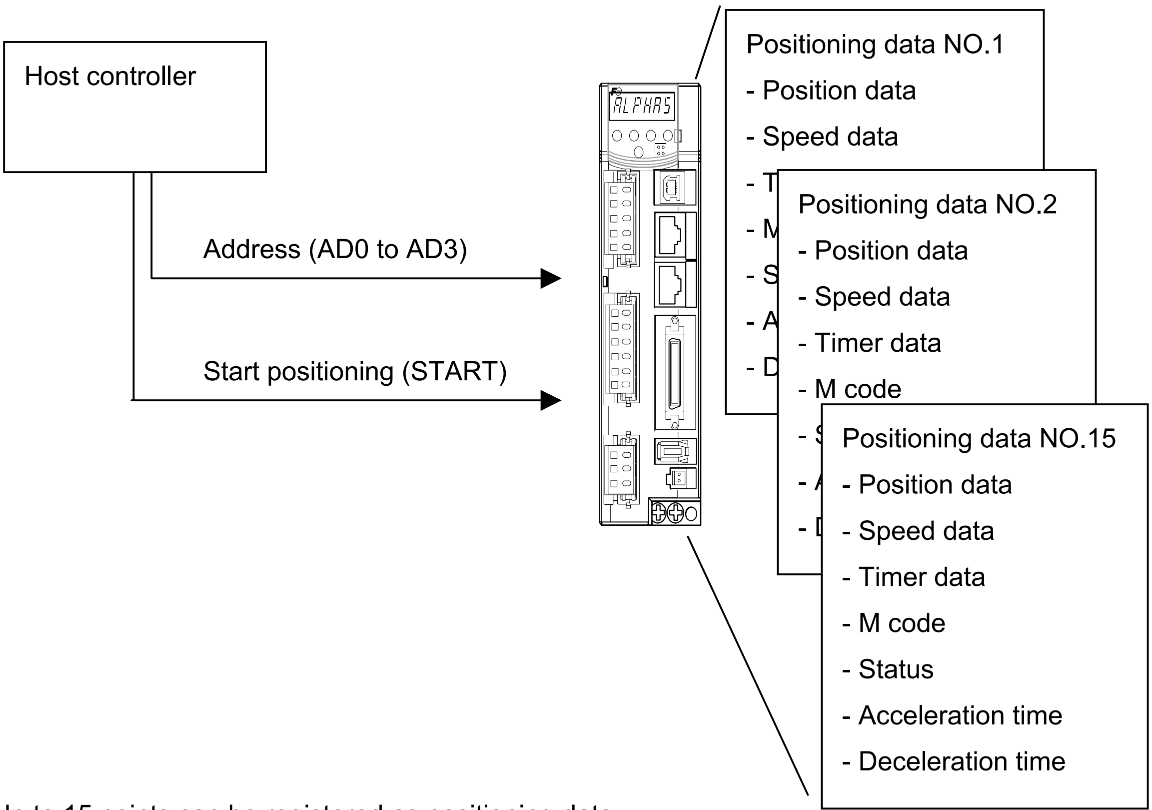
Positioning operation based on positioning data and immediate value data can be conducted with this servo amplifier.

(1) Positioning data operation

Set data items to positioning data inside the servo amplifier in advance and designate the address (data number) of the desired operation data among AD0 to AD3 at the host controller, etc.

Turn on the start positioning (START) to execute the positioning operation according to the preset data.

Interface: Di / Do signal or RS-485 communications (Modbus-RTU)



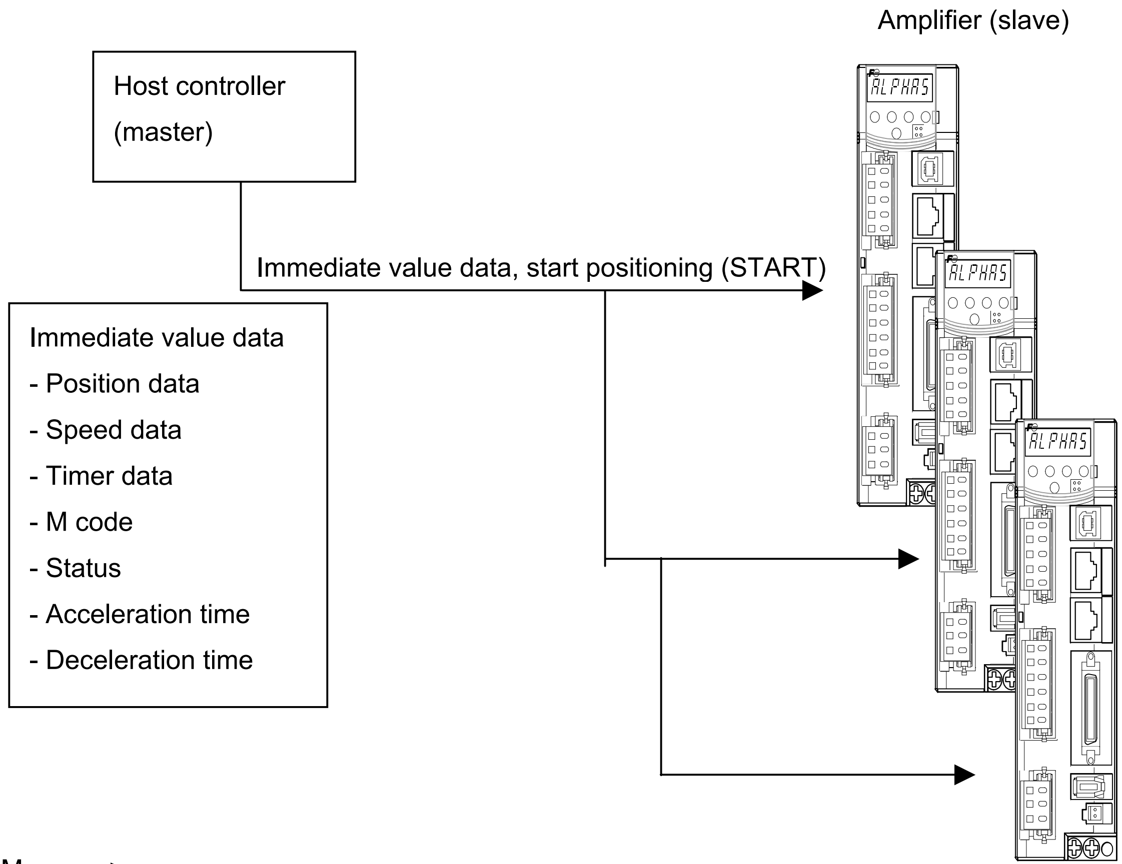
Up to 15 points can be registered as positioning data.

Register data, using PC Loader or at the keypad.

(2) Immediate value data operation

Designate position data, speed data and so on at the host controller directly to execute positioning operation.

Interface: RS-485 communications (Modbus-RTU)



<Message>

- Messages are sent from the master to the slave in the uni-cast method where the immediate value data, monitor data and so on are sent with the station number of the slave and then a response message is sent.
- To start two or more axes simultaneously, you can use the broadcasting method where transmission is made to all slaves through designation of station number 0.
  In the broadcasting method, no response message is sent. For this reason, you can send the start positioning signal in a broadcasting message to execute motions under pseudo interpolation control.

<Message>

The following parameters must be entered for operation based on immediate data.

- PA1_01: control mode selection = 7 (positioning operation)
- PA2_40: internal positioning data selection = 0 (disable)
- PA2_97: communication protocol = 1 (Modbus-RTU)

12.1.2 Operation Mode Selection

Positioning operation based on positioning data and immediate value data can be conducted with this servo amplifier.
To change the operation mode, enter parameters shown in the table below and supply an input signal.
The setting in operation mode (1) is enabled if “77” (positioning data selection) is not specified with the CONT signal.

<Operation mode (1)>

Control mode selection: PA1_01	Internal positioning data selection: PA2_40	Sequential start selection: PA2_41	AD3	AD2	AD1	AD0	Operation
7: Positioning operation	1: Enable	0: Disable	OFF	OFF	OFF	OFF	Address error
		1: Enable					Sequential start
		2: Homing					Homing
			OFF	OFF	OFF	ON	Operation with positioning data No. 1
			~				~
			ON	ON	ON	ON	Operation with positioning data No. 15
	0: Disable	PA2_97: Communication protocol selection = 1 *					Operation with immediate value data

Immediate value data operation is impossible with the PC Loader protocol.

If “77” (positioning data selection) is specified with the CONT signal, the setting in operation mode (2) is enabled.

＜Operation mode (2)＞

Control mode selection: PA1_01	Internal positioning data selection: CONT signal: 77	Sequential start selection: PA2_41	AD3	AD2	AD1	AD0	Operation
7: Positioning operation	ON	0: Disable	OFF	OFF	OFF	OFF	Address error
		1: Enable					Sequential start
		2: Homing					Homing
			OFF	OFF	OFF	ON	Operation with positioning data No. 1
			≀				≀
			ON	ON	ON	ON	Operation with positioning data No. 15
	OFF	PA2_97: Communication protocol selection = 1					Operation with immediate value data

12.2 Settings

12.2.1 Positioning Data Specifications

By providing a start positioning signal as assigned from an external address (AD3-AD0), positioning operation is started according to the settings.

The content of the internal positioning data is as follows:

Item		Setting range	Default value
No. of positioning data addresses		15 (addresses 1-F)	
Positioning data setting	Status (ABS/INC)	ABS, INC, CO, CEND, and M code enable/disable M code output during positioning/after positioning completion	INC and M code disable
	Position (stop position)	-2000000000 to +2000000000 [unit amount] (in increments of 1)	0
	Speed (rotation speed)	0.01 to max. rotation speed [r/min] (in increments of 0.01)	0.01
	Stand still timer	0.00-655.35 [sec] (by 0.01s) or 0.000-65.535 [sec] (by 0.001s) (Note 1)	0.00
	Acceleration time	0.0-99999.9 [ms] (in increments of 0.1) However, when 0.0 is set, the amplifier follows the acceleration time 1 (PA1_37) or 2 (PA1_39) (Note 2) selected by ACC0.	0.0
	Deceleration time	0.0-99999.9 [ms] (in increments of 0.1) However, when 0.0 is set, the amplifier follows the deceleration time 1 (PA1_38) or 2 (PA1_40) (Note 2) selected by ACC0.	0.0
	M code	0 to 0xFF	0xFF

Note 1: Set by the decimal point position of stand still timer (PA2_42).

Note 2: If ACC0 (set to 14) has not been assigned to the CONT signal, acceleration/deceleration time values follow acceleration time 1 (PA1_37) and deceleration time 1 (PA1_38).

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12.2.1.1 Position data (stop position)

Specify a position at which the servo motor stops when the status is ABS. Specify an increment when the status is INC.
To travel the mechanical system for the same amount (20.00 [mm]) as the setting of positioning data (ex. 20.00), the following parameter setting is necessary.
For the details of setting, refer to “PA1_06 Numerator 0 of electronic gear, PA1_07 Denominator of electronic gear” and “PA2_01 Decimal point position of positioning data.”

PA1_06 Numerator 0 of electronic gear, PA1_07 Denominator of electronic gear

No.	Name	Setting range	Default value	Change
06	Numerator 0 of electronic gear	1-4194304 (in increments of 1)	16	Always
07	Denominator of electronic gear	1-4194304 (in increments of 1)	1	Always

PA2_01 Decimal point position of positioning data

No.	Name	Setting range	Default value	Change
01	Decimal point position of positioning data	0:0 1:0.1 2:0.01 3:0.001 4:0.0001 5:0.00001	0	Always

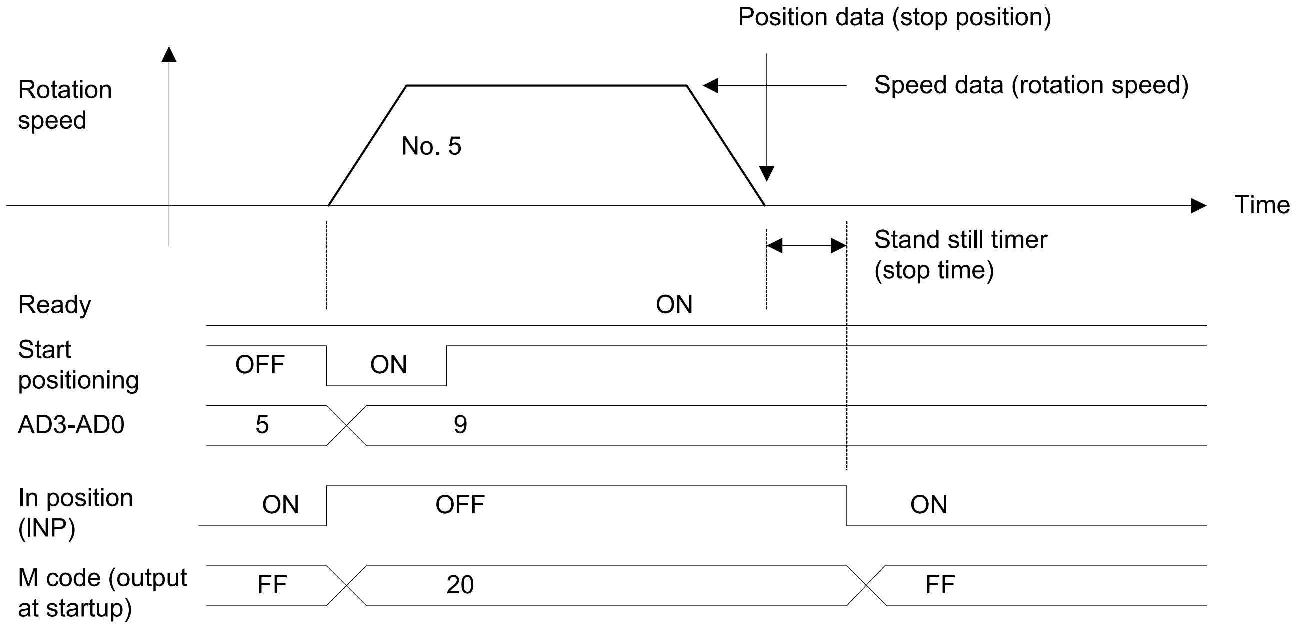
12.2.1.2 Speed data (motor axis rotation speed)

Set a rotation speed at which the servo motor rotates up to a specified position of positioning data. This setting is not a traveling speed of the mechanical system but a rotation speed of the servo motor axis [r/min].
Speed data can be set from the minimum value, 0.01, to the maximum rotation speed of the servo motor by 0.01 [r/min].

12.2.1.3 Stand still timer (stop time)

After the motor has reached a specified position of the positioning data, when the set time of the stand still timer has passed, the in position [INP] signal is output outside. (It is impossible to set the stand still timer on immediate value data.)
This timer can be set from 0.00 to 655.35 [s] in increments of 0.01 [s].
By changing the setting of the PA2_42 decimal point position of stand still timer, it is also allowed to set from 0.000 to 65.535 [s].

Stand still timer of positioning data



・Positioning data are regarded as being executed while the timer is measured.
・The default value of the M code is "FF" (changeable into "00" by PA2_43).

12.2.1.4 Acceleration time and deceleration time

Set an acceleration/deceleration time of the servo motor.
Setting value of the acceleration/deceleration time is a time setting before reaching 0 to 2000 [r/min]. However, if the setting is 0.0 (default value), as shown in the table below, the motor follows the acceleration/deceleration time is set by parameters by turning ON/OFF ACC0.

ACC0 (14)	Acceleration time	Deceleration time
OFF	PA1_37	PA1_38
ON	PA1_39	PA1_40

For details of acceleration time and deceleration time, refer to “PA1_36 to 40 Acceleration time and deceleration time settings” in CHAPTER 4 on page 4-21.

12.2.1.5 Status (command system, step mode)

To set status, ABS/INC, CO, CEND, and M code enable/disable are usable.
It is also allowed not to specify CO or CEND.
Use CO when operate data continuously.
Use CEND when starting up the motor in series.

■ Absolute (ABS) / Incremental (INC)

When ABS specification is applied, the current position of the motor moves up to the setting of the positioning data.
When positioning data is set to 0 and the motor is started up by the positioning data of ABS, the motor moves up to the zero point from any position.

When INC specification is applied, the servo motor moves from the current position by the setting of the positioning data.
When positioning data is set to 100.0, the servo motor moves from the current position by 100.0 in the positive direction.

■ Data continuation (CO)

When the motor is started up by positioning data with data continuation specified, positioning is completed by the data, and then the motor moves according to the setting of the next positioning data.

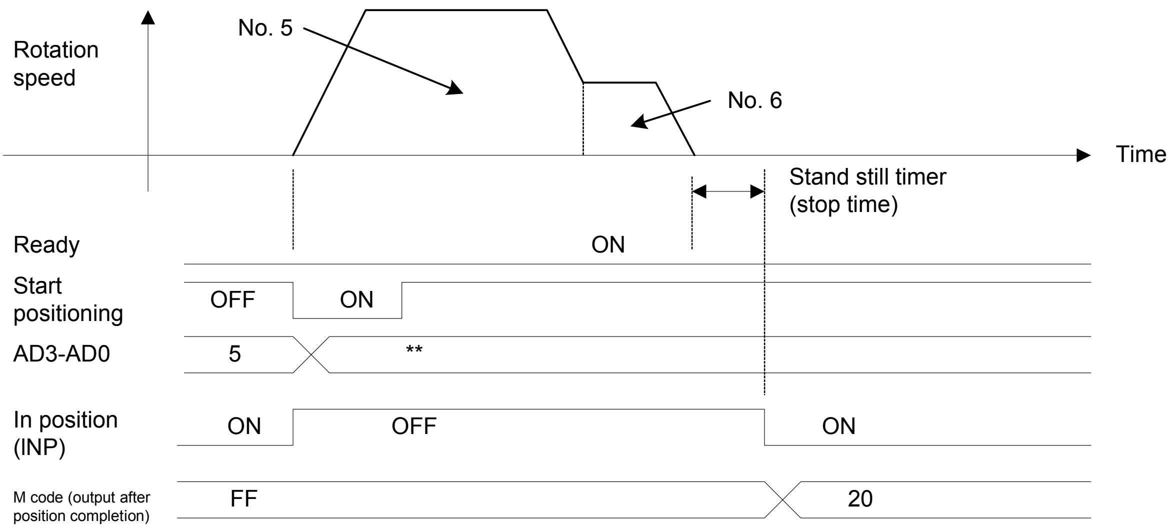
If data continuation is specified on positioning data 5, the motor moves according to positioning data 6.

In the same way, if data continuation is specified on positioning data 6, the motor moves according to positioning data 7.

If the stop timer is set to 0.00 [s], traveling speed varies continuously.

If the stop timer is set to 0.00 [s], speed varies depending on the setting of positioning data.

Data continuation of positioning data



・Positioning data are regarded as being executed while timer is measured.
・The default value of the M code is "FF" (changeable into "00" by PA2_43).

(1) When data with a high speed is continued to data with a low speed, speed has already been reduced to the next speed data at the specified position of the positioning data.
(2) When data with a low speed is continued to data with a high speed, acceleration is started from the specified position of the positioning data.

Data continuation is executed in the order of positioning data numbers (addresses).

When the motor is started up at positioning data while data continuation is executed, the positioning data before the start up are ignored.

(Data continuation is not executed as tracing back positioning data.)

When the motor is started up from No.7 using the following positioning data, the setting of No.6 is ignored.

Data continuation of positioning data

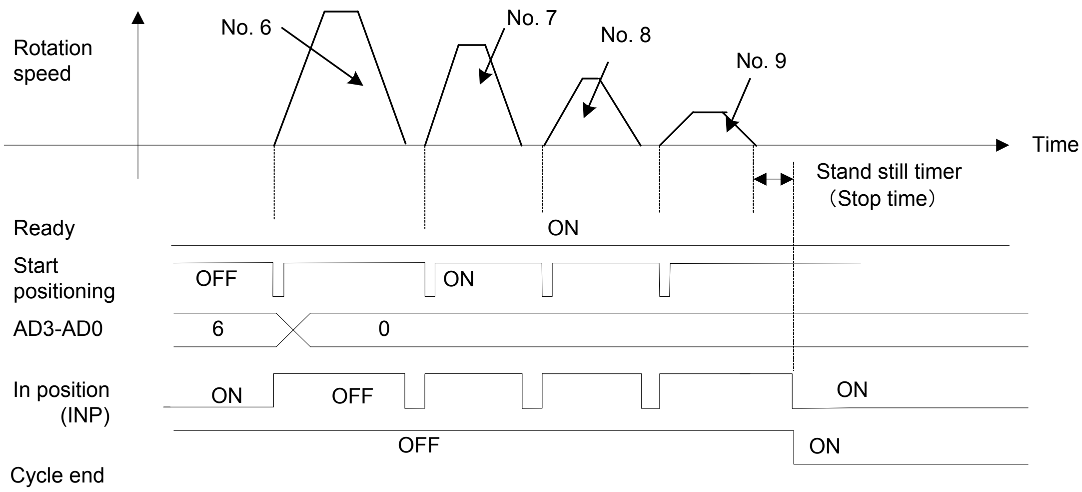
No.	Command style	Step mode	Stop position	Rotation speed	＊＊	＊＊
6	ABS	CO	0.00	0.00		
7	ABS	CO	5000.00	5000.00		
8	ABS	CO	5200.00	500.00		
9	ABS		5400.00	50.00		

■ Cycle end (CEND)

After the motor has been moved completely by positioning data with cycle end specified, the cycle end signal assigned to OUT is output.
It is not allowed to specify data continuation and cycle end on a set of positioning data simultaneously.
Cycle end is used when performing sequential start operation.
Operation by sequential start can be selected by PA2_41: sequential start selection.

After an address at which you wish to start up is set, if start positioning is turned on, operation will be started up. When the address is changed to 0 afterward, positioning operation is automatically continued up to the positioning data on which cycle end is specified.

Data continuation of positioning data



・Positioning data are regarded as being executed while timer is measured.

Sample setting of positioning data

No.	Command style	Step mode	Stop position	Rotation speed	＊＊	＊＊
6	ABS		500.00	3000.00		
7	ABS		1000.00	2000.00		
8	ABS		1500.00	1000.00		
9	ABS	CEND	2000.00	500.00		

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■ M code

By specifying an M code on positioning data, it is able to output an arbitrary numerical value outside while positioning is executed (output at startup) or after positioning has been complete (output at completion).
The figure above shows an output of M code after positioning has been complete.

12.2.2 Immediate Value Data Specifications

After immediate value data are set by the RS-485 communications, when the start positioning signal is set, positioning is started according to the setting.
The content of immediate value data is as follows:

Item	Setting range	Default value
Status (ABS/INC)	ABS, INC, and M code enable/disable M code output during positioning/after positioning completion	INC and M code disable
Position (stop position)	-2000000000 to +2000000000 [unit amount] (in increments of 1)	0
Speed (rotation speed)	0.01 to max. rotation speed [r/min] (in increments of 0.01)	0.01
Acceleration time	0.0-99999.9 [ms] (in increments of 0.1) However, when 0.0 is set, the amplifier follows the acceleration time 1 (PA1_37) or 2 (PA1_39) (Note 1) selected by ACC0.	0.0
Deceleration time	0.0-99999.9 [ms] (in increments of 0.1) However, when 0.0 is set, the amplifier follows the deceleration time 1 (PA1_38) or 2 (PA1_40) (Note 1) selected by ACC0.	0.0
M code	0 to 0xFF	0xFF(Note 2)

Note 1: If ACC0 (setting 14) is not assigned to the CONT signal, the motor follows acceleration time 1 (PA1_37) and deceleration time 1 (PA1_38), respectively.

Note 2: The OUT signals (MD0 to MD7) of the M code follow the selection of output when PA2_43: output when M code off.

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Immediate value data are different from positioning data in the continuing function of status setting (CO and CEND) and setting of the stand still timer.

For details of each data, refer to sections 12.2.1.1 to 12.2.1.5.

12.3 Startup

■ Operation with positioning data

It is able to register 15 sets of positioning data in the servo amplifier.

Register the positioning data described in section 12.2.1 from the PC Loader or keypad, and set address numbers according to the table below:

Positioning is started at the ON edge of the start positioning [START] signal.

Even if homing or position presetting has not been complete, the start positioning signal is enabled.

Address No. selection table

Address No.	AD3	AD2	AD1	AD0	Sequential start selection: PA2_41	Operation mode
0	OFF	OFF	OFF	OFF	0: Disable	Address error
					1: Enable	Sequential startup
					2: Homing	Homing
1	OFF	OFF	OFF	ON	—	Operation with positioning data 1
2	OFF	OFF	ON	OFF	—	Operation with positioning data 2
3	OFF	OFF	ON	ON	—	Operation with positioning data 3
4	OFF	ON	OFF	OFF	—	Operation with positioning data 4
5	OFF	ON	OFF	ON	—	Operation with positioning data 5
6	OFF	ON	ON	OFF	—	Operation with positioning data 6
7	OFF	ON	ON	ON	—	Operation with positioning data 7
8	ON	OFF	OFF	OFF	—	Operation with positioning data 8
9	ON	OFF	OFF	ON	—	Operation with positioning data 9
10	ON	OFF	ON	OFF	—	Operation with positioning data 10
11	ON	OFF	ON	ON	—	Operation with positioning data 11
12	ON	ON	OFF	OFF	—	Operation with positioning data 12
13	ON	ON	OFF	ON	—	Operation with positioning data 13
14	ON	ON	ON	OFF	—	Operation with positioning data 14
15	ON	ON	ON	ON	—	Operation with positioning data 15

■ Operation with immediate value data

When immediate value data are directly set by the RS-485 communications, if the start positioning signal is set, positioning is started according to the setting.

This operation differs from the operation with positioning data in the continuation function and setup of the stand still timer.
For the continuation function, a similar function can be realized by assigning the immediate value continuation to the CONT signal.
In addition, if you wish to change data immediately during operation, the function of the immediate value change is usable.
For the function of the stand still timer, adjust timing using the host controller.
For details, refer to “CHAPTER 13 RS-485 COMMUNICATIONS”.

■ Stop method

The servo motor is decelerated before the specified position set by positioning data, and stopped automatically at that position.
The method for stopping the motor forcibly after moving has started is as follows:

- Turn off the operation command [RUN].
- Turn off the forced stop [EMG].
- Turn on the positioning cancel.
- Turn off the external error input.
- Turn on the pause (By turning it off, the remaining operation is executed).
- Turn on free run.

After the motor has started moving, if one of the signals below is detected, the specified position of positioning data might not be reached.

- Software OT (overtravel), +OT, and -OT signals
- Limiter detection

12.4 Setting Change

The setting of positioning data can be edited by the following method.

- Edit on the keypad of the servo amplifier
- Edit using the PC loader
- Change positioning data by the teaching signal assigned to control
- Edit positioning data using the RS-485 communications

Editing positioning data by the PC Loader or keypad can be restricted by setting PA2_75: positioning data write protection.
Editing can be limited by the external control input signal using the editing permission signal assigned to the CONT signal.

After positioning data are set, if PA2_01: decimal point position of positioning data is changed, the setting might be increased (or decreased). The significant figure 10 digits long is not changed.

12.5 Response Time

The response time of start positioning (operation according to positioning data) is as follows:

■ Starting up by the CONT signal

Start positioning [START] terminal sampling time	Approx. 1.0 [ms]
Automatic startup software processing time	Approx. 0.5 [ms]
Total	Approx. 1.5 [ms]

CHAPTER 13 RS-485 COMMUNICATIONS

13

13.1 Modbus RTU Communications

13.1.1 Settings for Servo Amplifier

Set up the parameters of the servo amplifier (hereinafter called amplifier) to perform the Modbus communications.

(1) Protocol selection

No.	Parameter name	Setting range	Default value	Change
PA2_97	Communication protocol selection	0: PC Loader protocol 1: Modbus RTU	0	Power

Set to 1 (Modbus RTU).

Since this parameter is set to 0 (PC Loader protocol) at factory shipment, be sure to change it to 1.

(2) Station number/communication baud rate

No.	Parameter name	Setting range	Default value	Change
PA2_72	Station number	1 to 31	1	Power
PA2_73	Communication baud rate	0・・・38400 [bps] 1・・・19200 [bps] 2・・・ 9600 [bps]	0	Power

Set an amplifier’s station number (slave’s station number) and a communication baud rate.

(3) Character configuration

No.	Parameter name	Setting range	Default value	Change
PA2_93	Selection of parity/stop bit	0: Even parity with 1 stop bit 1: Odd parity with 1 stop bit 2: No parity with 1 stop bit 3: Even parity with 2 stop bits 4: Odd parity with 2 stop bits 5: No parity with 2 stop bits	0	Power

Set existence and logic of a parity and a stop bit length.

Characters are organized for each setting as follows:

PA2_93	LSB 0	1	2	3	4	5	6	7	8	9	10	MSB 11
0, 1	Start	Data (8 bits)								Parity	Stop	
2	Start	Data (8 bits)								Stop		
3, 4	Start	Data (8 bits)								Parity	Stop (2 bits)	
5	Start	Data (8 bits)								Stop (2 bits)		

(4) Response time and communication time over

No.	Parameter name	Setting range	Default value	Change
PA2_94	Response time	0.00 to 1.00 [sec] (*)	0.00	Always
PA2_95	Communication time over	0.00 [sec]: No detection 0.01 to 9.99 [sec]	0.00	Always

(*) Actual response time is set to PA2_94 setting or {time for 3 characters + amplifier's processing time}, whichever is longer.

Set the response time and communication time over parameters if needed.

For details, refer to pages 13-18 (response time) and 13-19 (communication time over).

13.1.2 Communication Specifications

Item		Specifications	Remarks (PA is a parameter No.)
Communication	Electric I/F	RS-485	
	Communication speed	38400／19200／9600 [bps]	Set by parameter PA2_73
	Synchronization method	Asynchronous (UART)	
	Communication method	Semi-duplex communication	
	Transmission format	Master-slave (servo amplifier) = 1:N (1≤N≤31)	Max. 31 units connected simultaneously
	Connection cable	LAN cable (straight) or equivalent	
	Terminator treatment	Master side :100[Ω] recommended Slave side : Unnecessary	
	Character configuration	Start bit : 1 bit Data length : 8 bits Parity : Even/odd/none Stop bit : 1 or 2 bits	Set by parameter PA2_93
Protocol	Communications protocol	Compliant with Modbus RTU protocol	
	Communications mode	RTU mode	The ASCII mode is not supported.
	Station number	0: Broadcast 1-31: Slave station No.	Set by parameter PA2_72
	Function code (FC)	3(03h): Read out various data 8(08h): Maintenance (echo back) 16(10h): Write in various data	Responses other than those in the left cell are exceptional responses (improper FC).
	Error check method	CRC-16 method	
	Message length	Max. 189 bytes	When positioning data are written in (9 sets)
	Frame synchronization method	Timing synchronization	Frames are initialized if time data for three characters are absent.

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13.1.3 Transmission Protocol

1. Message types

Communications are configured as the single master and multiple slaves method. The amplifier operates as a slave.
The messages sent/received between the master and amplifier are classified into the two types below:

- Query: Messages transferred from the master to the amplifier
- Response message: Messages transferred from the amplifier to the master

Communications are started by a query from the master. Communications are not performed between the amplifiers.

2. Message fields

The message frame is as follows for both the query from the master and the response message from the amplifier.

<table>
<tr><td>Station No.</td><td colspan="2">1 byte</td><td>・0: Broadcast query to all amplifiers.
(No response message is issued.)
・1-31: Query for each station number.
Self station numbers 1-31 are responded in the response messages from the amplifiers.</td></tr>
<tr><td>FC (function code)</td><td colspan="2">1 byte</td><td>・Master: Specify an FC according to the processing that you wish to execute.
・Amplifier: Returns the specified FC.
(If the amplifier has not finished processing successfully, the message is returned with the MSB of the FC set to 1.)
...Exceptional response</td></tr>
<tr><td>Information</td><td colspan="2">Variable length</td><td>・Query/response message: Data are set according to the FC.
・An exceptional code (1 byte) is returned in the exceptional response from the amplifier.</td></tr>
<tr><td rowspan="2">CRC check</td><td rowspan="2">16 bits
(2 bytes)</td><td>(L)</td><td rowspan="2">・Query/response message: CRC-16 is added to the bottom of the frame.
・The sender calculates CRC-16 for the data sent, add it to the bottom of the frame, and send the frame.
・The receiver calculates CRC-16 of the received data. If the calculation results are not equal to the received CRC-16, an error occurs.
If an error is detected, no response message is returned.</td></tr>
<tr><td>(H)</td></tr>
</table>

3. Function codes (FC)

The three types of FC below are supported:

03h : Readout of various data

08h : Maintenance (Only echo back is supported.)

10h : Write of various data

■ FC 03h (Readout of various data)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		··· 03h
Information	Address	2 bytes	(H)	··· Specify the data address.
			(L)	
	No. of registers	2 bytes	(H)	··· Specify the number of sets of data n × 2. * Specify n × 10 on the positioning data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from an amplifier

Station No.		1 byte		
FC		1 byte		··· 03h
Information	No. of data bytes	1 byte		··· n × 4 * The positioning data are n × 20.
	Data 1	4 bytes	(HH)	··· Readout data for n sets from the specified address * The positioning data are 20 bytes per data. * For the data format, refer to page 13-8 [Table 13-1].
			(HL)	
			(LH)	
			(LL)	
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

■ FC 08h (maintenance echo back)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		··· 08h
Information	Sub-code	2 bytes	(H)	··· Specify the sub-code of echo back, 0000h.
			(L)	
	Data	2 bytes	(H)	··· Specify arbitrary data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from an amplifier

Item		Size	Byte	Remarks
Station No.		1 byte		
FC		1 byte		··· 08h
Information	Sub-code	2 bytes	(H)	··· 0000h
			(L)	
	Data	2 bytes	(H)	··· The specified data are echoed back.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

■ FC 10h (Write of various data)

(1) Query from the master

Item		Size	Byte	Remarks
Station No.		1 byte		
FC		1 byte		··· 10h
Information	Address	2 bytes	(H)	··· Specify the data address.
			(L)	
	No. of registers	2 bytes	(H)	··· Specify the number of sets of data n × 2.
			(L)	* Specify n × 10 on the positioning data.
	No. of data bytes	1 byte		··· n × 4 * The positioning data are n × 20.
	Data 1	4 bytes	(HH)	··· Write data for n sets from the specified address
			(HL)	* The positioning data are 20 bytes per data.
			(LH)	* For the data format, refer to page 13-8.
			(LL)	
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from a slave

Item		Size	Byte	Remarks
Station No.		1 byte		
FC		1 byte		··· 10h
Information	Address	2 bytes	(H)	··· Specified address
			(L)	
	No. of registers	2 bytes	(H)	··· Number of sets of actually written data, m × 2
			(L)	* The positioning data are m × 10.
CRC check		16 bits (2 bytes)	(L)	
			(H)	

4. Data addresses

The addresses of various data are as follows:

[Table 13-1] Address list

Data type	Data name	Address (hex.)	Applicable FC 03h	Applicable FC 10h	Format (with a sign)	Setting range (default value)
Communication CONT/ OUT signals	Communication CONT signal	0000	○	○	Refer to page 13-10.	0-FFFFh (0: OFF all)
	Communication OUT signal	0100	○	×	Refer to page 13-10.	–
Monitor	Feedback speed	1000	○	×	1h=1 [r/min] (Yes)	–
	Command speed	1001	○	×	1h=1 [r/min] (Yes)	–
	Command torque	1002	○	×	1h=1 [%] (Yes)	–
	Peak current	1003	○	×	1h=1 [%] (Yes)	–
	Motor current	1004	○	×	1h=1 [%] (Yes)	–
	Effective torque	1005	○	×	1h=1 [%] (No)	–
	Feedback position	1006	○	×	1h=1 [unit amount] (Yes)	–
	Command position	1007	○	×	1h=1 [unit amount] (Yes)	–
	Position deviation	1008	○	×	1h=1 [(*)] (Yes)	–
	Command pulse frequency	1009	○	×	1h=0.1 [kHz] (No)	–
	Feedback cummulative pulses	100A	○	×	1h=1 [pulse] (Yes)	–
	Cummulative input pulses	100B	○	×	1h=1 [pulse] (Yes)	–
	LS-Z pulse	100C	○	×	1h=1 [pulse] (No)	–
	Load inertia ratio	100D	○	×	1h=0.1 [times] (No)	–
	DC link voltage (max.)	100E	○	×	1h=1 [V] (No)	–
	DC link voltage (min.)	100F	○	×	1h=1 [V] (No)	–
	VREF input voltage	1010	○	×	1h=0.01 [V] (Yes)	–
	TREF input voltage	1011	○	×	1h=0.01 [V] (Yes)	–
	OL thermal value	1012	○	×	1h=1 [%] (No)	–

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Data type	Data name	Address (hex.)	Applicable FC 03h	Applicable FC 10h	Format (with a sign)	Setting range (default value)
Monitor	Braking resistor thermal value	1013	○	×	1h=1 [%] (No)	–
	Power (W)	1014	○	×	1h=1 [%] (Yes)	–
	Motor temperature	1015	○	×	1h=1 [°C] (No)	–
	Overshoot unit amount	1016	○	×	1h=1 [(*)] (Yes)	–
	Settling time	1017	○	×	1h=0.1 [ms] (No)	–
	Resonance frequency 1	1018	○	×	1h=1 [Hz] (No)	–
	Resonance frequency 2	1019	○	×	1h=1 [Hz] (No)	–
Sequence monitor	Hardware CONT signal	2000	○	×	Refer to page 13-10.	–
	Hardware OUT signal	2001	○	×	Refer to page 13-10.	–
	Control mode	2100	○	×	Refer to page 13-11.	–
	Sequence mode	2101	○	×	Refer to page 13-11.	–
	Alarm at present	2200	○	×	Refer to page 13-11.	–
	Alarm history 1-20	2201-2214	○	×		
Various commands	Anti resonance frequency	3002	○	○	1h=0.1 [Hz] (No)	0.0, 1.0-300.0 (0.0: The vibration suppressing control function is disabled.)
	Workpiece inertia ratio	3003	○	○	1h=1 [%] (No)	0-80 (0)
Parameter	PA1_1-99	4000-4062	○	○	The parameter is followed.	The parameter is followed.
	PA2_1-99	4100-4162	○	○		
	PA3_1-99	4200-4262	○	○		
Immediate value data	Immediate value status	5100	○	○	Refer to page 13-12.	–
	Immediate value position	5101	○	○	1h=1 [unit amount] (Yes)	0-±2000000000 (0)
	Immediate value speed	5102	○	○	1h=0.01 [r/min] (No)	0.01-Max. rotation speed (0.01)
	Immediate value acceleration time	5103	○	○	1h=0.1 [ms] (No)	0.0-99999.9 (0.0)
	Immediate value deceleration time	5104	○	○	1h=0.1 [ms] (No)	0.0-99999.9 (0.0)
Positioning data	Positioning data 1-15	D000-D00E	○	○	Refer to page 13-12.	–

(*) By setting PA1_31 (selection of deviation unit), 0 and 1 are defined as unit amount and pulse, respectively.

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5. Data formats

■ CONT/OUT signals

The CONT/OUT signals are classified into hardware signals (sequence I/O terminal) and communication signals (Modbus communications), respectively as shown in the table below according to the I/O format.

	Hardware signal	Communication signal
CONT signal	CONT 1-8 (8 bits)	CONT 9-24 (16 bits)
OUT signal	OUT 1-5 (5 bits)	OUT 6-21 (16 bits)

For readout and write, signals of the same type (5 to 16 bits) are handled as batch data.
Signals are arranged as follows in the data. Applicable bits mean ON and OFF when they are 1 and 0, respectively.

(1) Hardware CONT signal (CONT1-8)

Data	4 bytes	00h							
		00h							
		00h							
		CONT8	CONT7	CONT6	CONT5	CONT4	CONT3	CONT2	CONT1

(2) Communication CONT signal (CONT9-24)

Data	4 bytes	00h							
		00h							
		CONT24	CONT23	CONT22	CONT21	CONT20	CONT19	CONT18	CONT17
		CONT16	CONT15	CONT14	CONT13	CONT12	CONT11	CONT10	CONT9

(3) Hardware OUT signal (OUT1-5)

Data	4 bytes	00h							
		00h							
		00h							
		0	0	0	OUT5	OUT4	OUT3	OUT2	OUT1

(4) Communication OUT signal (OUT6-21)

Data	4 bytes	00h							
		00h							
		OUT21	OUT20	OUT19	OUT18	OUT17	OUT16	OUT15	OUT14
		OUT13	OUT12	OUT11	OUT10	OUT9	OUT8	OUT7	OUT6

■ Sequence monitor

Data in the sequence monitor are 1-byte code data (except hardware CONT/OUT signals).

Data	4 bytes	00h
		00h
		00h
		Code

Code is different for each data. For details, refer to the tables below.

Control modes

Code	Control mode
00h	Position control
01h	Speed control
02h	Torque control

Sequence modes

Code	Operation mode
00h	Servo off
01h	Servo on
02h	Zero speed stop
03h	Manual feed (JOG)
04h	Pulse train operation
05h	+OT
06h	-OT
07h	In LV (under voltage)
08h	Positioning
09h	Homing
0Ah	Interrupt positioning

Alarms at present and alarm histories

Code	Alarm	Symbol (*)	Code	Alarm	Symbol (*)
00h	None	---			
01h	Overcurrent 1	oc1	21h	Main power undervoltage	LvP
02h	Overcurrent 2	oc2	22h	Braking resistor overheat 1	rH1
03h	Overspeed	oS	23h	Braking resistor overheat 2	rH2
04h	Control power undervoltage	Lvc	24h	Braking resistor overheat 3	rH3
05h	Overvoltage	Hv	25h	Deviation overflow	oF
06h	Encoder trouble 1	Et1	26h	Amplifier overheat	AH
07h	Encoder trouble 2	Et2	27h	Encoder overheat	EH
08h	Control power error	ct	28h	Absolute data lost 1	dL1
09h	Data error	dE	29h	Absolute data lost 2	dL2
0Ah	Fuse broken	Fb	2Ah	Absolute data lost 3	dL3
0Bh	Motor combination error	cE	2Bh	Multi-turn data overflow	AF
0Ch	Braking transistor overheat	tH	2Ch	Initial error	iE
0Dh	Encoder communication error	Ec	2Dh	Command pulse frequency error	FE
0Eh	CONT error	ctE			
0Fh	Overload 1	oL1			
10h	Overload 2	oL2			

(*) Displayed on the keypad on the front of the servo amplifier.

■ Immediate value data

The immediate value status of immediate data is configured as follows:

	Configuration			Format (default value)
Data	4 bytes	Immediate value status	1 byte	Refer to [Table 13-2].
		Immediate value M code	1 byte	0-FFh (FFh)
		Not used	2 bytes	00h fixed

[Table 13-2] Immediate value status

Bit	Item	Description		Default value
5	M code output timing	0: Output during start up	1: Output after positioning completion	0
4	M code selection	0: Disable	1: Enable	0
0	Command method	0: ABS	1: INC	1
Others	Not used	0 fixed		0

■ Positioning data

Positioning data are 20 bytes long for each set, organized as follows:

	Configuration				Format, setting range (default value)
Data	20 bytes	Positioning status	1byte		Refer to [Table 13-3].
		M code	1byte		0-FFh (FFh)
		Stop timer	2 bytes	(H)	1h = 0.01 [ms] (*)
				(L)	0.00-655.35 (0.00)
		Stop position	4 bytes	(HH)	1h = 1 [unit amount]
				(HL)	0 - ±2000000000 (0)
				(LH)	
				(LL)	
		Rotation speed	4 bytes	(HH)	1h = 0.01 [r/min]
				(HL)	0.01 - Max. rotation speed (0.01)
				(LH)	
				(LL)	
		Acceleration time	4 bytes	(HH)	1h = 0.1 [ms]
				(HL)	0.0 - 99999.9 (0.0)
				(LH)	
				(LL)	
		Deceleration time	4 bytes	(HH)	
				(HL)	
				(LH)	
				(LL)	

(*) By setting PA2_42 (stop timer decimal point position), 0 and 1 indicate 0.01 [ms] and 0.001 [ms], respectively.

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[Table 13-3] Positioning status

Bit	Item	Description		Default value
5	M code output timing	0: Output during startup	1: Output after positioning completion	0
4	M code Selection	0: Disable	1: Enable	0
2,1	Step mode	0,0: No specification 0,1: Continuation (CO) 1,0: End of cycle (CEND) 1,1: Setup impossible		0,0
0	Command method	0: ABS	1: INC	1
Others	Not used	fixed to 0		0

6. Exceptional responses

The amplifier returns an exceptional response if it has not succeed the process specified by a query.

The message frame is as follows. This is common to all FC values.

<table>
<tr><td>Station No.</td><td colspan="2">1byte</td></tr>
<tr><td>FC</td><td colspan="2">1byte</td></tr>
<tr><td>Exceptional code</td><td colspan="2">1byte</td></tr>
<tr><td rowspan="2">CRC check</td><td rowspan="2">16 bits (2 bytes)</td><td>(L)</td></tr>
<tr><td>(H)</td></tr>
</table>

Function code (FC) field

Exceptional responses from slaves are returned as one is set on the MSB of the FC specified by the query.

Query	Exceptional response
03h	83h
08h	88h
10h	90h

(2) Exceptional code field

Exceptional responses from slaves are returned as exceptional response which indicates exceptional content with the query.

Exceptional code	Description and sample queries
01h	Incorrect FC (An incorrect FC is specified.) ・An FC other than 03h/08h/10h, which are supported, is specified.
02h	Incorrect address (An incorrect address is specified) ・An address not included in the address list is specified. ・An address corresponding to FC 03h only is specified with FC 10h.
03h	Incorrect data (An abnormal value is specified in the information field.) ・Zero, an odd number, or 192 bytes or more is specified in the register. ・A value different from the number specified in the register x2 is specified. ・A value out of the range is specified in the data to be written in.

7. CRC-16

(1) Outline of CRC

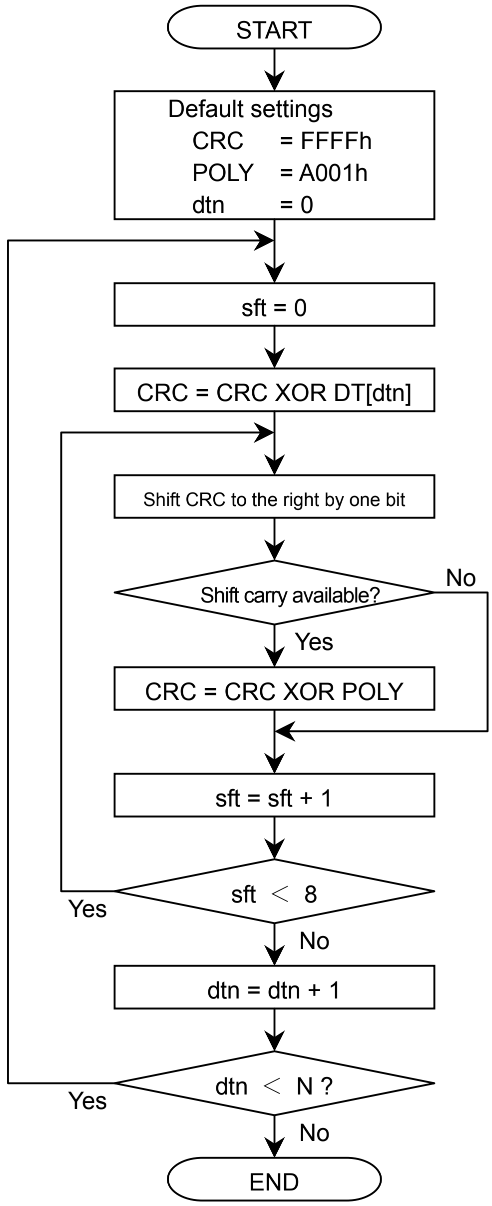
CRC (Cyclic Redundancy Check) is a system to check if communications data are correct.

In the CRC calculation, data expressed as a polynomial are divided by a generating polynomial, and the residue is used as CRC data.

Modbus RTU uses the CRC-16 which performs calculation using $X^{16} + X^{15} + X^2 + 1$ as the generating polynomial.

(2) CRC-16 calculation algorithm

The algorism for calculating CRC-16 on the data (N bytes) from the station number field to the information field is as follows:



CRC ··· Calculated value of CRC-16
POLY ··· Generating polynomial
dtn ··· Data counter
sft ··· Shift counter
DT[dtn] ··· Nth data (one byte)
N ··· Number of data bytes
XOR ··· exclusive OR

DT[0] is station number, DT[1] is FC, and DT[2]-DT[N-1] are data in the information field.

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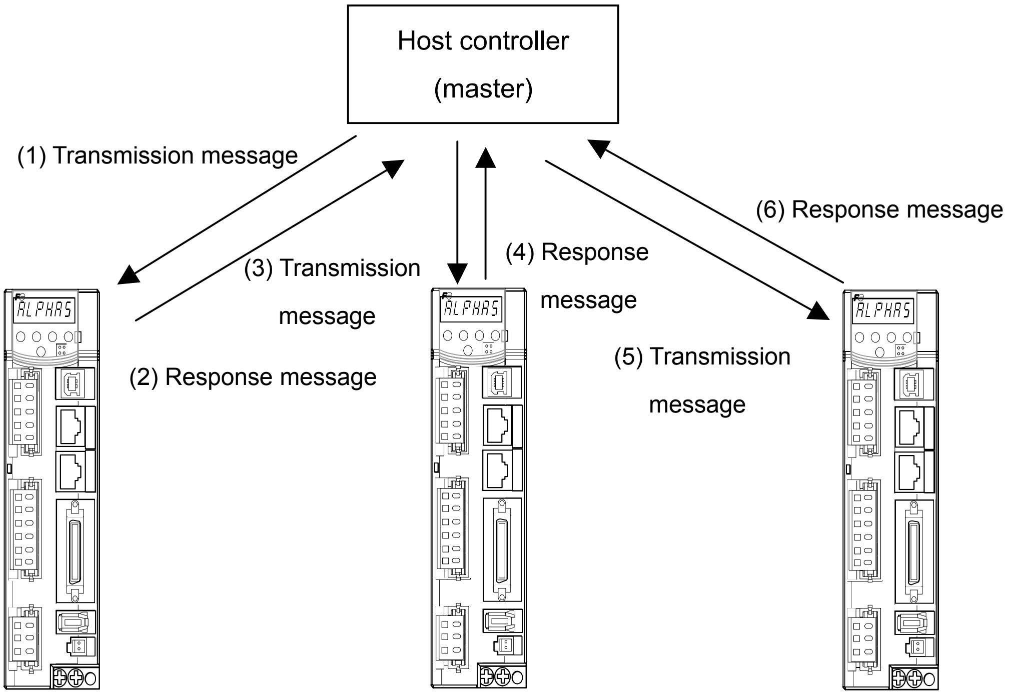
8. Communication operating method

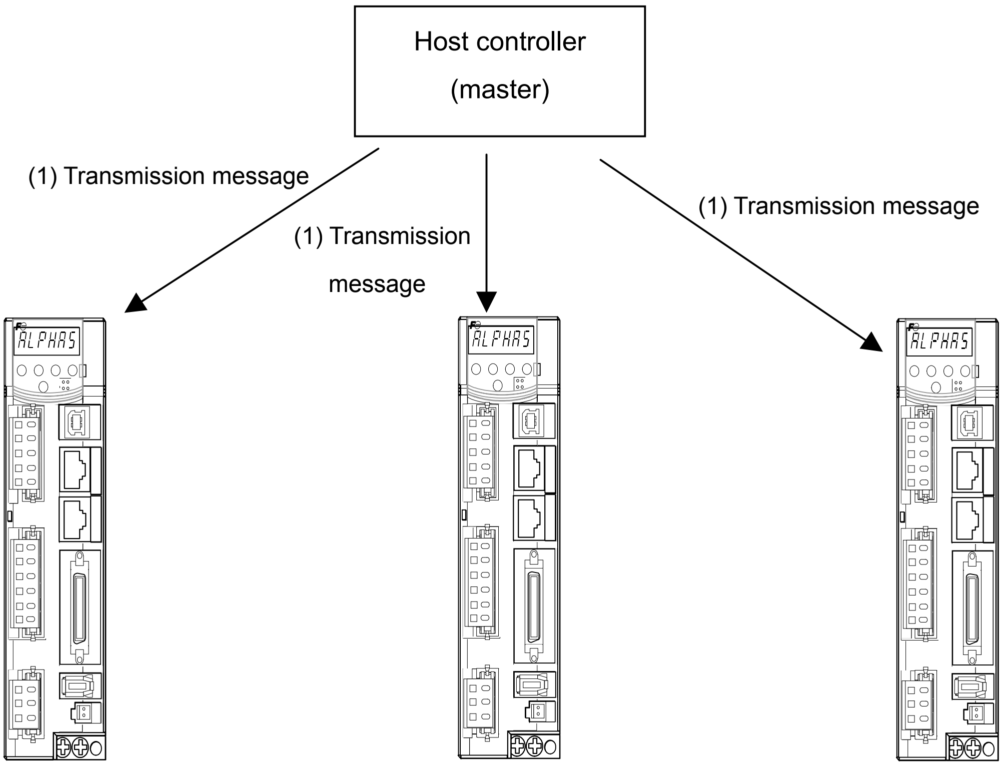
<Unicast method>

Messages are sent in the following order in this method: (1) → (2) → (3) → (4) → (5) → (6).



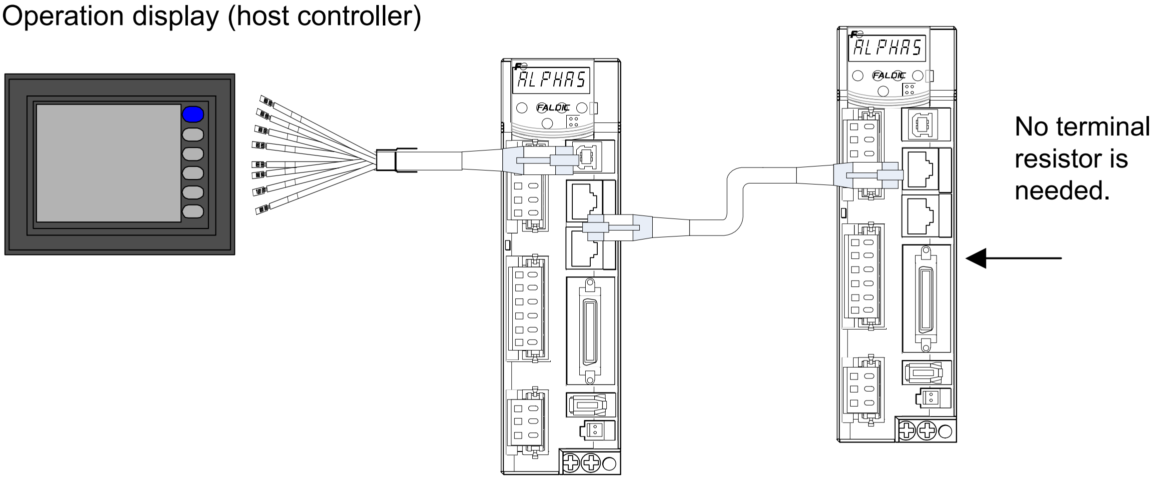
<Broadcasting method>

A transmission message is sent to slaves simultaneously in this method. No response message is sent back.



13.1.4 Sample Wiring with Host Controller

Operation display (host controller)



In case of using Fuji's V8

Touch Screen Operator Panel （MJ1/MJ2）

Signal name	Pin.NO
-RD/-SD	2
+RD/+SD	1
SG	5
FG	Shell

ALPHA5 （CN3A）

Pin.NO	Signal name
8	P5
7	M5 (0V)
6	*TXD
5	RXD
4	*RXD
3	TXD
2	M5 (0V)
1	P5

RJ45 connector

・Connect between ALPHA5 and ALPHA5 with a commercial LAN cable (straight).

13.1.5 Communications Procedures

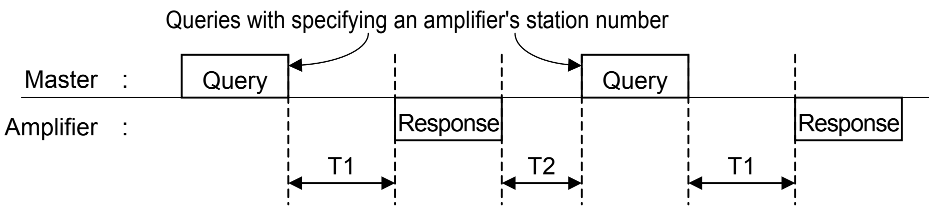
1. Start of communications

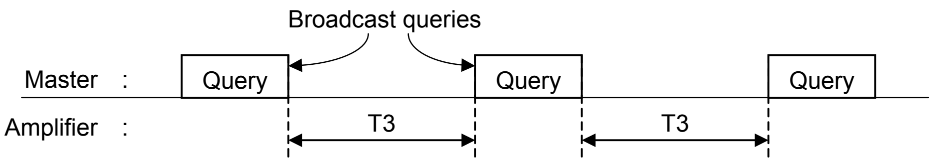
The amplifier cannot perform communications after the control power supply is turned on until the internal initialization has been complete. When turning on the amplifier, perform the procedure below, and then start normal communications.

1. Turn on the control power supply, and wait for approximately 1.5 [sec].
2. Send an FC 08h (maintenance echo back) query from the master.
3. Confirm that a response message (echo back) is returned from the amplifier.

2. Communications timings

Communications timings are as follows:





(1) Amplifier's response time (T1)

This is the time passing after a query is sent from the master until the amplifier starts sending a response message. When communication timeout is monitored by the master, time around T1 + 100 [ms] is recommended.

(2) Sending/receiving switching time (T2)

This is the time passing after a response message is sent by an amplifier until the amplifier becomes able to receive the next query.

When the master has received a response message from the amplifier, it must wait for T2 or more before sending the next query.

(3) Waiting time after a broadcast query is sent (T3)

This is the time passing after a broadcast query is sent by the master until the amplifier becomes able to receive the next query. When the master has sent a broadcast query, it must wait for T3 or more before sending the next query.

(4) Definition of amplifier's timings

Timings on the amplifier side are defined as follows:

<table>
<tr><th>FC</th><th>Information field</th><th>T1</th><th>T2</th><th>T3</th><th>Recommended timeout setting</th></tr>
<tr><td>03h</td><td>-</td><td rowspan="3">38400 [bps] : 5 [ms]
19200 [bps] : 10 [ms]
9600 [bps] : 10 [ms]</td><td rowspan="4">38400 [bps] : 5 [ms]
19200 [bps] : 10 [ms]
9600 [bps] : 10 [ms]</td><td rowspan="4">Same as T1</td><td rowspan="3">100 [ms]</td></tr>
<tr><td>08h</td><td>-</td></tr>
<tr><td rowspan="2">10h</td><td>Other than below</td></tr>
<tr><td>Specify that <u>n sets</u> of parameters or positioning data are written in</td><td>Within (n+2)×10 [ms]</td><td>250 [ms]</td></tr>
</table>

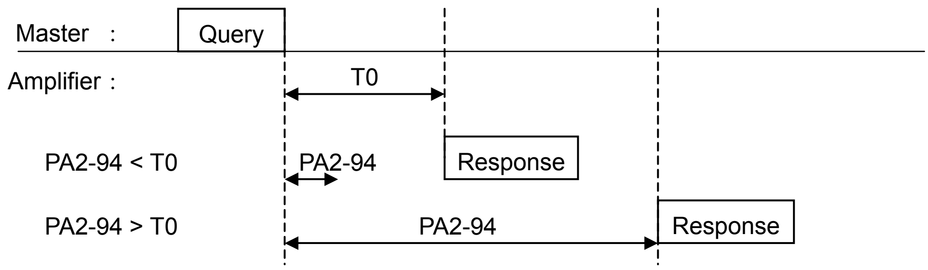
■ Response time

It is able to specify a response time of the amplifier (T1) by PA2_94 (response time).

However, actual response time becomes <u>{time for 3 characters + time for executing processing} (T0) or longer.</u>

* Although T0 varies depending on communications baud rate, FC, and so on, the shortest time is 2.5 [ms] for 38,400 [bps].

If any time longer than T0 is specified, the amplifier responses after waiting for the specified time.



After the master has sent a query, if it takes a long time until the master switches into the receiving state, set PA2_94 (response time) as needed because responses from the amplifiers might not be received correctly.

3. Error processing

Errors are classified into the following:

(a) Physical/character-level errors : Parity error, framing error, and so on

(b) Protocol level error (1) : CRC error

(c) Protocol level error (2) : Incorrect FC/address/data

(1) Amplifier's operation when an error is detected

An amplifier operates as follows when it has detected one of various errors while receiving a query from the master:

If an error of type (a) or (b) is detected:

The amplifier discards the data which have been received up to that time, and returns to the reception waiting state. No response message is returned.

It is recommended that the master monitors timeout after sending a query.

If an error of type (c) is detected:

The amplifier returns an exceptional response. It must confirm the content of the query according to the exceptional code.

(2) Master's operation when an error is detected (recommended)

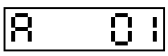
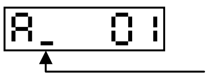
While the master is receiving a response message from an amplifier, if it has detected one of the various errors, it is recommended to send the same query again (retry processing) after waiting for T2 after the reception has been complete.

4. Communication time over

Communication time over is detected if any time other than 0.00 [sec] is set on PA2_95 (communication time over).

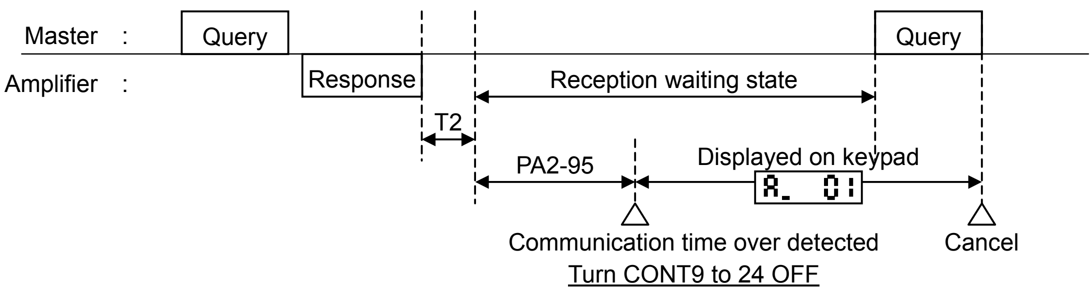
If an amplifier has been in the state of waiting for receiving a message over the time specified by PA2_95, a communication time over has occurred, and all the communication CONT signals (CONT9-24) operated by the Modbus communications are set off.

When communication time over has occurred, the station number mode of the keypad is displayed as follows (an example of station number 01):

- Normal display of station number 
- Communication time over 

Communication time over detected
("_" is displayed at the second leftmost digit.)

Even if communication time over has occurred, communications can be performed as usual. When the amplifier receives a query from the master to the self station number or a broadcast query, communication time over is cancelled, and the keypad returns to the normal display.



If PA2_95 is set to 0.00 [sec], communication time over is not detected. Use this setting as needed, for example, if the system communicates periodically and you wish to detect discontinuation of the communications.

5. Communications example

5-1. Immediate value data operation

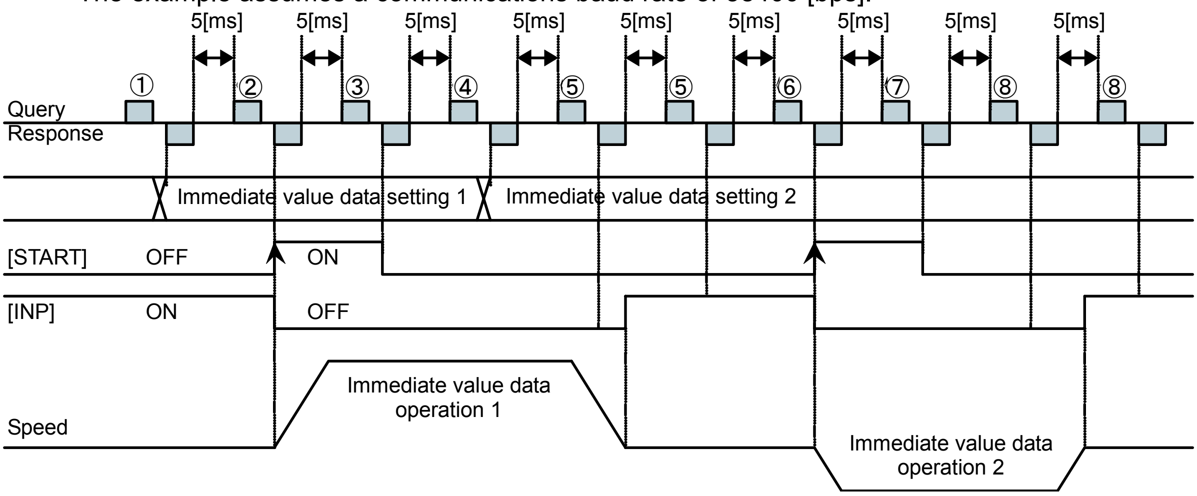
A Communications example for conducting positioning operation with immediate value data is described.

■ Preparation

- Select the positioning operation control mode.
  ・・・ PA1_01: Control mode selection =7: Positioning operation
- Assign [START] to CONT9. ・・・ PA3_09: CONT9 signal assignment =4: [START]
- Assign [INP] to OUT6. ・・・ PA3_56: OUT6 signal assignment =2: [INP]

■ Communications example

- Turn on [S-ON] assigned to CONT1 to arrange the operation state, and perform communications as shown below.
- The example assumes a communications baud rate of 38400 [bps].



(1) Write immediate value data setting 1 as immediate value data.

Setting 1: Designation method = ABS. Immediate value position = 500000 [unit amount]. Immediate value speed = 500.00 [r/min]

Query: 01 10 5100 0006 0C 00000000 0007A120 0000C350 D9EC (21 bytes)

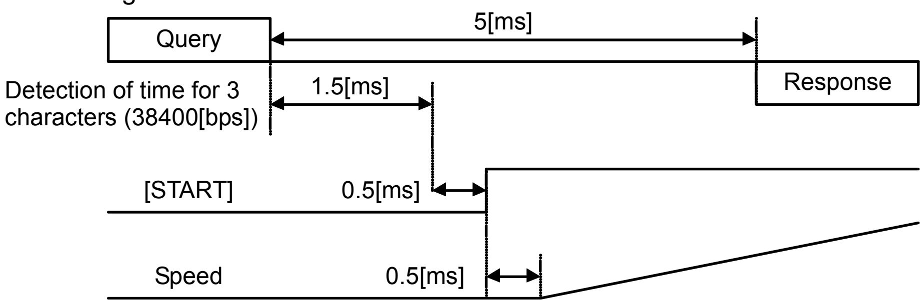
Response: 01 10 5100 0006 50F7 (8 bytes)

(2) Write “1” (ON) to [START] to start positioning operation. (Immediate value data operation 1 based on immediate value data setting 1 starts.)

Query: 01 10 0000 0002 04 00000001 326F (13 bytes)

Response: 01 10 0000 0002 41C8 (8 bytes)

The detail timing at this time is shown below.



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(3) Write “0” (OFF) to [START]. (This is to generate a rising edge in the next start.)

Query: 01 10 0000 0002 04 00000000 F3AF (13 bytes)

Response: 01 10 0000 0002 41C8 (8 bytes)

(4) Write immediate value data setting 2, which is for the next operation, as immediate value data. The immediate value data operation follows the immediate value data read at the start (rising edge of [START]). After operation is started, you can write the following setting as immediate value data.

Setting 2: Immediate value position = -100000 [unit amount]. Immediate value speed = 200.00 [r/min]

Query: 01 10 5101 0004 08 FFFE7960 00004E20 667A (17 bytes)

Response: 01 10 5101 0004 80F6 (8 bytes)

(5) Read [INP] and check that immediate value data operation 1 is finished.

If [INP] is turned off, immediate value data operation 1 is in progress. (5) is repeated until [INP] is turned on.

Query: 01 03 0100 0002 C5F7 (8 bytes)

Response: 01 03 04 0000 000**0** FA33 (9 bytes)

↑ If “**1**”, [INP] is turned on.

Because immediate value data operation 1 is finished, the process proceeds to step (6).

(6) Write “1” (ON) at [START] to start positioning operation. (Immediate value data operation 2 based on immediate value data setting 2 starts.)

Query: 01 10 0000 0002 04 00000001 326F (13 bytes)

Response: 01 10 0000 0002 41C8 (8 bytes)

(7) Write “0” (OFF) at [START]. (This is to generate a rising edge at the next start.)

Query: 01 10 0000 0002 04 00000000 F3AF (13 bytes)

Response: 01 10 0000 0002 41C8 (8 bytes)

(8) Read [INP] and check that immediate value data operation 2 is finished.

If [INP] is OFF, immediate value data operation 1 is in progress. Repeat step (8) until [INP] is turned on.

Query: 01 03 0100 0002 C5F7 (8 bytes)

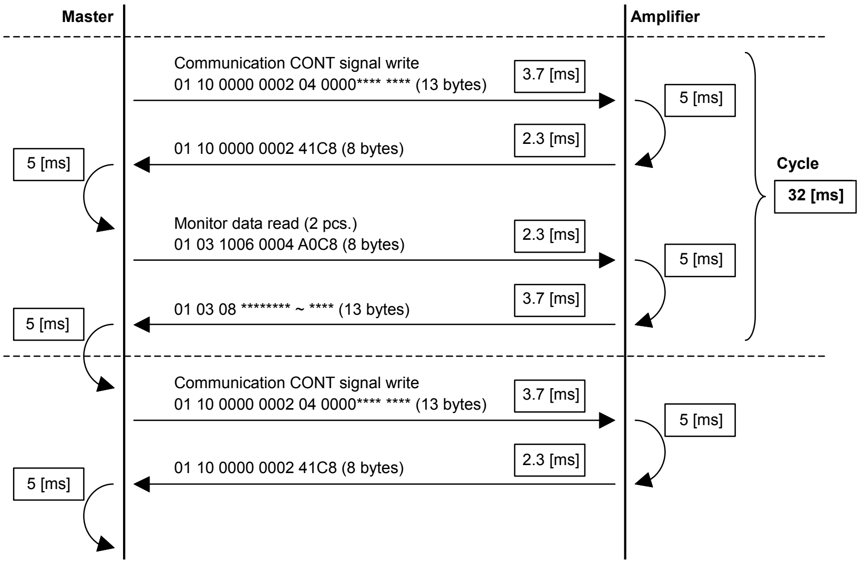
Response: 01 03 04 0000 000**0** FA33 (9 bytes)

↑ If “**1**”, [INP] is turned on.

Immediate value data operation 1 is finished.

5-2. Monitoring cycle

A communications cycle example for writing the CONT signal to read monitored data is shown as a communication method for starting operation and monitoring the state. The example assumes a communications baud rate of 38400 [bps] and 11-bit characters.



13.2 PC Loader Communications

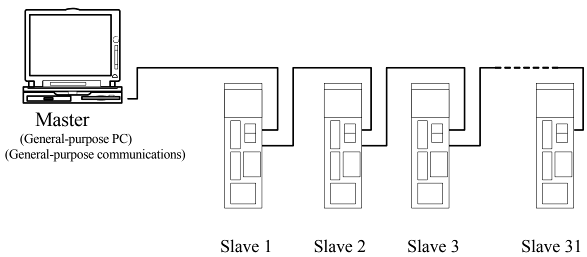
The transmission and reception commands of the RYT□□□□5-VV2 type servo amplifier are described in details.
The RYT□□□□5-VV2 type servo amplifier is capable of reading data and writing parameters via serial communications.

13.2.1 Station Number

The station number to the servo amplifier (parameter PA2_72: station number) setting determines the station number of the message. After changing the parameter, by shutting down and turning on the power, the station number will be enabled.

13.2.2 Communication Specifications

RS-485 Communications Specifications

Item	Specifications
Signal level	RS-485
Synchronization method	Asynchronous, no protocol
Communication method	4-wire type, semi-duplex communication
Transmission speed	9600/19200/38400bps (Set at parameter PA2_72.)
Transmission code	8 bits
Transmission configuration	Start bit: 1 bit Data bit: 8 bits Parity bit: 1 bit (even) Stop bit: 1 bit
Transmission control	Transparent mode (No separation with DLE character)
Error control	Check sum
Transmission length	Reception 128 bytes, transmission 128 bytes (max.)
Transmission format	One-to-n communications (1≤n≤1) The servo amplifier functions as a slave and responds to master commands. No communications are made between slaves. 
Total wiring length	500m
Station No.	1 to 31 (Set at PA2_73.)
Connection cable	LAN cable (straight) or equivalent
Terminator treatment	On master side: 100 [Ω] recommended. Slave side: Unnecessary
Response time	Operation command: Within 100ms Data (parameter) transfer: Within 100ms

* Some pieces of software do not allow eight data bits and a stop bit simultaneously.

13.2.3 Transmission Protocol

Transmission format

Order	Description (Hexadecimal value)	Transmission command (From host to amplifier)	Reception command (From amplifier to host)
(1)	Start code	5A	5A
(2)	Count of No. of pieces of data	No. of pieces of data	No. of pieces of data
(3)	Fixed value used by system	00	00
(4)	Process status	FF	00
(5)	Connection method	7A	7A
(6)	Amplifier station No.	00: Fixed	00: Fixed
		Station number of target amplifier	Amplifier station No.
(7)	Fixed value used by system	11	11
		00	00
		FF	FF
		FF	FF
		FF	FF
		FF	FF
(8)	CMND	As per command	As per command
(9)	MODE	00	00
(10)	End data	00	00
(11)	Sequence No.	01	01
(12)	Data section count	No. of pieces of data of data section	No. of pieces of data of data section
(13)	Fixed value used by system	00	00
(14)	Data section	Memory type	Memory type
		Address (L)	Address (L)
		Address (M)	Address (M)
		Address (H)	Address (H)
		No. of loaded or written bytes	No. of loaded or written bytes
		00	00
		As per command	STR1
			STR2
			As per command
(15)	BCC	Calculated BCC	Calculated BCC

*1: The range of calculation of the BCC is from (2) to (14).
*2: The range of counting of the number of data pieces is from (4) to (15).

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13.2.4 Description of Transmission Data

Transmission code

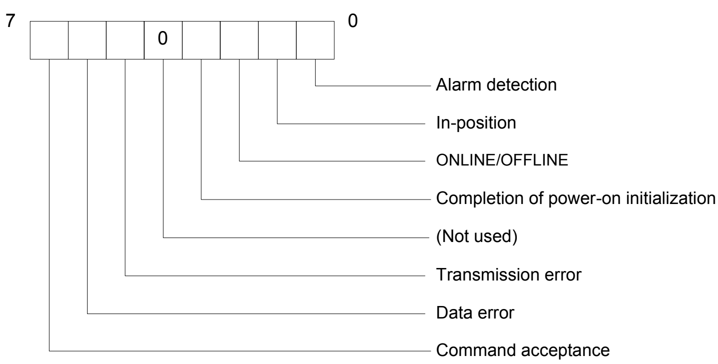
Item	Description (Hex.)	Function
Start code	5AH (Fixed)	Start code
Count of No. of pieces of data	XXH (Variable)	Byte counter Enter the number of bytes from the process status to BCC.
Fixed value used by system	00H (Fixed) or XXH (Fixed)	Enter the value specified in the transmission format table.
Process status	00H or FFH	0xFF for a request command, or 0x00 for a response command.
Connection method	7AH (Fixed)	
Station No. of amplifier	01H to 1FH (Variable)	Station number Enter the station number identifying the servo amplifier (1 to 31).
CMND	XXH (Variable)	Designate the command given to the servo amplifier.
MODE	00H (Fixed)	
End data	00H (Fixed)	
Sequence No.	01H (Fixed)	
Count of data section	XXH (Variable)	Enter the number of bytes of data section. Max. 108 bytes.
Data section	XXH (Variable)	Enter the value of each command.
BCC	XXH (Variable)	Check sum 0x00 - (sum of number of bytes from data number count to data section)

13.2.5 Status Data

・Status data (STR1, STR2)

Code	Bit position	Function	Description
STR1	7	Command acceptance	0: Accepted. 1: Not accepted
	6	Data error	0: None. 1: Yes
	5	Transmission error	0: None. 1: Yes
	4	Not used	0: Fixed
	3	Completion of power-on initialization	0: Initialization finished. 1: Being initialized
	2	ONLINE/OFFLINE	0: ONLINE,1: OFFLINE
	1	In-position	0: Moving. 1: Motion finished
	0	Alarm detection	0: None. 1: Yes
STR2	7 to 0	Not used	0: Uncertain (Area used by manufacturer)

・Bit position (STR1)



13.2.6 Command List

Command list

No.	Function	CMND	Data section			
			Memory type	Address (L)	Address (M)	Address (H)
Monitor relations						
01	Data readout with multiple monitors	50H	01H	00H	00H	04H
Sequence monitor relations						
02	Sequence mode readout	50H	02H	00H	00H	01H
03	System status readout					04H
04	Alarm at present readout					10H
05	Alarm history readout					11H
06	Sequence I/O signal readout					12H
Parameter editing relations						
07	PA1 parameter readout	50H	21H	Quantity (1 to 15)	No. (1 to 99)	00H
08	PA1 parameter write	51H				01H
09	PA2 parameter readout	50H	22H	Quantity (1 to 15)	No. (1 to 99)	00H
10	PA2 parameter write	51H				01H
11	PA3 parameter readout	50H	23H	Quantity (1 to 15)	No. (1 to 99)	00H
12	PA3 parameter write	51H				01H
Operation command relations						
13	Alarm reset	51H	08H	00H	01H	17H
14	Alarm history Initialization				01H	23H

13.2.7 Command Transmission Specifications

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The message exchanged between the host and amplifier is categorized into the following two types:

- Request command: Message sent from host to amplifier
- Response command: Message sent from amplifier to host

Communication is not made between amplifiers.

13.2.8 Communications Starting Procedure

The amplifier does not respond to the host until power is turned on and the internal initialization process is finished. Conduct the following procedure at power-on, and then start regular communications.

(1) After the amplifier is turned on, wait for about 1.5 [s].

(2) The host issues any command and checks if the amplifier responds.
At the time, the "status data (STR1)" in the response data is checked if "completion of power-on initialization (bit 3)" is 0 (OFF). If the bit is 1 (ON), initialization is in progress.

13.2.9 Regular Communications Procedure

(1) The host sends a request command to the amplifier.

(2) When receiving a request command, the amplifier processes the requested command and sends back a response command.
The host sends the next request command after checking the response command. Do not send the request command without checking the response command.

(3) The amplifier is constantly in command state from the host unless process (2) is in progress.

[Example of processing procedure upon an error for improvement of reliability]

(1) Transmission error at physical or character level (detected by amplifier)
If a transmission error at the physical or character level (such as a parity error) is caused during reception of a request command sent from the host, the amplifier does not send back the response command (considered as nonresponse).
If there is no response from the amplifier, the host should send the same request command again.
- The timer for judging absence of response (time-out) is counted after transmission of the request command is finished.
- Time-out period shall be as below according to the transmission speed.

	Parameter interrupt command	Other commands
38400 [bps]:	250 [ms] or over	100 [ms] or over
19200 [bps]:	350 [ms] or over	200 [ms] or over
9600 [bps]:	550 [ms] or over	400 [ms] or over

- The retry frequency depends on each application, but recommend being more than twice.

(2) Transmission error at physical or character level (detected by host)
If there is a transmission error at the physical or character level during reception of a response command from an amplifier, the host should send the same request command again.
- Re-transmission should be performed after the following timing after the transmission error.

38400 [bps]:	50 [ms] or over
19200 [bps]:	100 [ms] or over
9600 [bps]:	200 [ms] or over

- The retry frequency depends on each application, but recommend being more than twice.

13.2.10 Protocol Level Error

If an error (data error) is found in the protocol, the amplifier does not process the requested command but it sends error data in "status data (STR1)" of the response command.

For the description of STR1, refer to "13.2.5 Status Data."

It is recommended to check error data during development of host application software.

Debug the protocol according to the error data.

- The data error is caused if there is an error in the request command data (header, BCC, setting range of parameter data, etc.). Correct data.
- A command reception error is caused if parameter writing is attempted in the parameter write protection state. Check the setting of parameter PA2_74 (parameter write protection).
- In the LV (under-voltage) state, memory access to the amplifier is limited and command acceptance may be rejected if parameter reading or writing or alarm history reading is attempted. Check the power supply state.

13.2.11 Wiring (CN3)

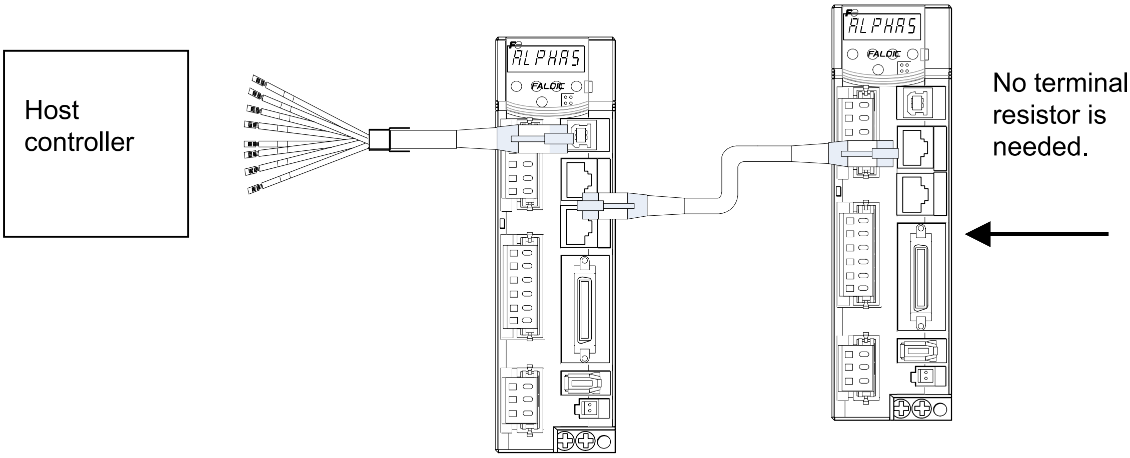
Connect to the host controller with marketed LAN cable.

Connect between the host (master) and servo amplifier (slave) so that the output of the host controller becomes the input of the servo amplifier.

Connect between a servo amplifier (slave) and another servo amplifier (slave) with a straight cable.

The connector is RJ-45 (8 pins). No termination is necessary.

Up to 31 servo amplifiers can be connected.



■ Pin layout of connector

IN port (CN3A)

8	P5
7	M5(0V)
6	*TXD
5	RXD
4	*RXD
3	TXD
2	M5(0V)
1	P5

(Upper side)

OUT port(CN3B)

8	N.C.
7	M5(0V)
6	*TXD
5	RXD
4	*RXD
3	TXD
2	M5(0V)
1	N.C.

(Lower side)

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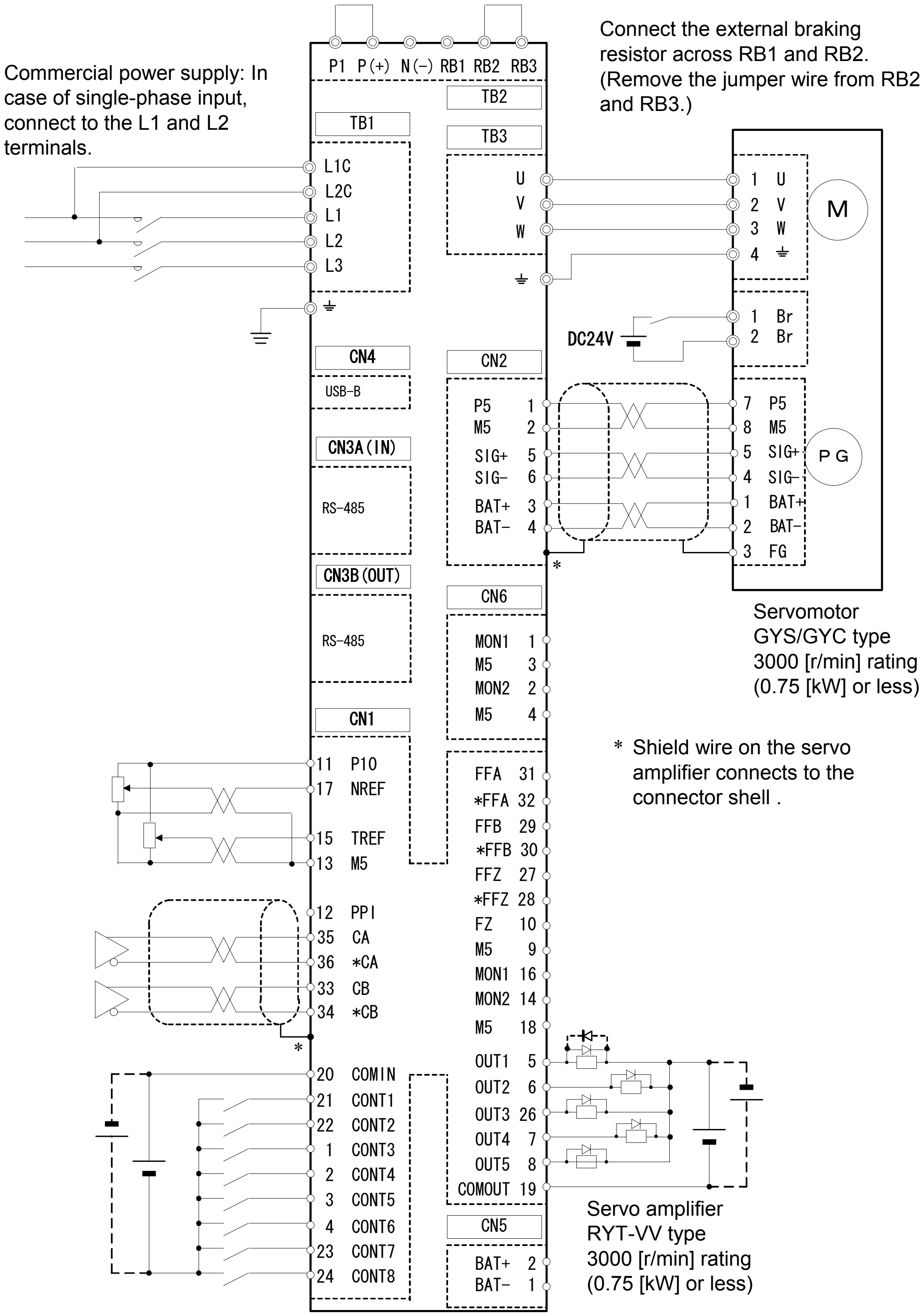
■ Standard connection diagram

0.75 [kW] or less



13.2.12 Communication

■ Reading multi-monitor data

The designated multi-monitor data is read in hexadecimals.

The number of monitor data read at a time is four.

CMND **50H**

DATA (n)

Sent from host controller

	7 0
Memory type	01H
Address (L)	00H
Address (M)	00H
Address (H)	04H
Number of loaded bytes	16H
Dummy	00H
Data 1 designation	BCD (See below.)
Data 2 designation	BCD (See below.)
Data 3 designation	BCD (See below.)
Data 4 designation	BCD (See below.)

Sent from servo amplifier

	7 0
Memory type	01H
Address (L)	00H
Address (M)	00H
Address (H)	04H
Number of loaded bytes	Same as request
Dummy	00H
STR1	Status data
STR2	
Data 1 designation	Same as request
Data 2 designation	Same as request
Data 3 designation	Same as request
Data 4 designation	Same as request
Monitor data 1	LL
	LH
	HL
	HH
Monitor data 2	LL
	LH
	HL
	HH
Monitor data 3	LL
	LH
	HL
	HH
Monitor data 4	LL
	LH
	HL
	HH
For manufacturer	Reserved

Code	Monitor name
00 H	No designation
01 H	Feedback speed
02 H	Command speed
03 H	Command torque
04 H	Peak torque
05 H	Motor current
06 H	Effective torque
07 H	Feedback position
08 H	Command position
09 H	Position deviation
10 H	Command Pulse frequency
11 H	Feedback cumulative pulse
12 H	Command cumulative pulse
13 H	LS-Z pulse
14 H	Load inertia ratio

Code	Monitor name
15 H	DC link voltage (max.)
16 H	DC link voltage (min.)
17 H	VREF input voltage
18 H	TREF input voltage
19 H	OL thermal value
20 H	Braking resistor thermal value
21 H	Power
22 H	Motor temperature
23 H	Overshoot unit amount
24 H	Settling time
25 H	Resonance frequency 1
26 H	Resonance frequency 2

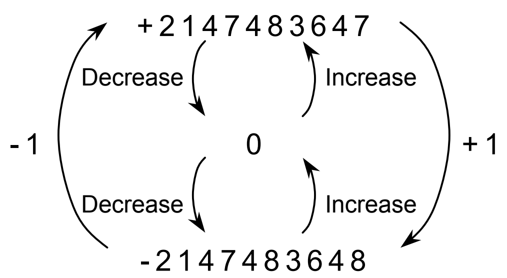
For details of monitor data, refer to the next page.

Details of monitor data

No.	Monitor data	Data (32-bit long binary)	Max. value
1	Feedback speed	±3000 [r/min]/±3000H	± Max. rotation speed × 1.1
2	Command speed		
3	Command torque	±300 [%]/±1FFFH	±300%
4	Peak torque		
5	Motor current		
6	Effective torque		
7	Feedback position	±1 [unit amount] / ±1H	*2
8	Command position		
9	Position deviation	±1 [selection unit (*1)]/ ±1H	*2
10	Command pulse frequency	±0.1 [kHz]/±1H	1 [MHz]
11	Feedback cumulative pulses	±1 [pulse]/±1H	*2
12	Cumulative input pulses		
13	LS-Z pulse	±1 [pulse]/±1H	Encoder pulse [pulse]
14	Load inertia ratio	1 [time] / 100H	300 [times]
15	DC link voltage (max.)	550 [V]/3FFH	550 [V]
16	DC link voltage (min.)		
17	VREF input voltage	±10.6765 [V]/±7080H	±12 [V]
18	TREF input voltage	±10.6765 [V]/±1FFFH	
19	OL thermal value	100 [%]/1000H	100% (trip level)
20	Regenerative resistor thermal value		
21	Power Wattage	±300 [%]/±1FFFH	±300 [%]
22	Motor temperature	±1 [°C]/±4H	100 [°C]
23	Overshoot unit amount	±1 [selection unit (*1)] /±1H	*2
24	Settling time	0.1 [ms]/1H	100.0 [ms]
25	Resonance frequency 1	10 [Hz]/1H	4000 [Hz]
26	Resonance frequency 2		

*1 The unit depends on that designated with PA1_31 (deviation unit selection).

*2 The data range is from -2147483648 to +2147483647.
(In signed hexadecimal notation, from 80000000h to 7FFFFFFFh)
If the range is exceeded, the count cycles are as shown below.



■ Sequence mode readout

CMND	50H

DATA (n)

Sent from host controller

	7 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	01H
Number of loaded bytes	05H
Dummy	00H

Sent from servo amplifier

	7 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	01H
Number of loaded bytes	05H
Dummy	00H
STR1	Status data
STR2	
Control mode	See the table below.
Action mode	See the table below.
Sub mode	00H

Code	Control mode
00H	Position control
01H	Speed control
02H	Torque control

Code	Sequence mode
00H	Servo OFF
01H	Servo ON
02H	Zero speed stop
03H	Manual feed
04H	Pulse train/ Position command operation
05H	+OT
06H	-OT
07H	Under voltage
08H	Positioning
09H	Homing
0AH	Interrupt positioning

■ System status readout

CMND **50H**

DATA (n)

Sent from host controller

	7 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	04H
Number of loaded bytes	11H
Dummy	00H

Sent from servo amplifier

	7 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	04H
Number of loaded bytes	11H
Dummy	00H
STR1	Status data
STR2	
Dummy	00H
Amplifier type	See below.
ALPHA5 identification	30H
Amplifier rating	See the table below.
Amplifier voltage	See the table below.
Amplifier capacity	See the table below.
Amplifier ZNO.	BCD
Motor type	See the table below.
Motor voltage	See the table below.
Motor capacity	See the table below.
Encoder model	See the table below.
I/F	00H
For manufacturer	Reserved
For manufacturer	Reserved
For manufacturer	Reserved

<Amplifier-related data>

Code	Amplifier type
00H	V type

Code	Amplifier rating (r/min)
00H	3000
01H	2000
02H	1500

Code	Amplifier voltage (V)
00H	200
02H	100

<Motor-related data>

Code	Motor type
00H	GYC 5000
01H	GYS 5000
03H	GYC 6000
05H	GYS 6000
06H	GYG 2000
07H	GYG 1500

Code	Motor voltage (V)
00H	200
02H	100

Code	Motor, amplifier capacity [W] (GYS,GYC)	Motor, amplifier capacity [W] (GYG)
00H	-	500
01H	50	750
02H	100	850
03H	200	1000
04H	400	1300
05H	750	1500
06H	1000	1800
07H	1500	2000
08H	2000	2900
09H	3000	-
0AH	4000	-
0BH	5000	-

<Encoder-related data>

Code	Motor type
06H	18bit ABS
07H	20bit INC

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■ Alarm at present readout

CMND **50H**

DATA (n)

Sent from host controller

	7 ... 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	10H
Number of loaded bytes	0AH
Dummy	00H

Sent from servo amplifier

	7 ... 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	10H
Number of readed bytes	0AH
Dummy	00H
STR1	Status data
STR2	
Alarm code	(L)
	(H)
Total time-main power supply	(L)
	(H)
Total time-control power supply	(L)
	(H)
Motor running time	(L)
	(H)

<Alarm-related data>

Code	Symbol	Name
00H	—	(No detection)
01H	oc1	Overcurrent 1
02H	oc2	Overcurrent 2
03H	oS	Overspeed
04H	Lvc	Control power undervoltage
05H	Hv	Overvoltage
06H	Et1	Encoder trouble 1
07H	Et2	Encoder trouble 2
08H	ct	Circuit trouble
09H	dE	Memory error
0AH	Fb	Fuse broken
0BH	cE	Motor Combination error
0CH	tH	Braking transistor overheat
0DH	Ec	Encoder communication error
0EH	ctE	CONT (control signal) error
0FH	oL1	Overload 1
10H	oL2	Overload 2
21H	LvP	Main power undervoltage
22H	rH1	Internal braking resistor overheat
23H	rH2	External braking resistor overheat
24H	rH3	Braking transistor error
25H	oF	Deviation overflow
26H	AH	Amplifier overheat
27H	EH	Encoder overheat
28H	dL1	Absolute data lost 1
29H	dL2	Absolute data lost 2
2AH	dL3	Absolute data lost 3
2BH	AF	Multi-turn data over flow
2CH	IE	Initial error
2DH	HF	Command pulse frequency error

■ Alarm history readout

CMND **50H**

DATA (n)

Sent from host controller

	7 … 0
Memory type	02H
Address (L)	Quantity (01 to 02H)
Address (M)	Starting No. (01 to 20H)
Address (H)	11H
Number of loaded bytes (L) Number of loaded bytes (H)	(Quantity × 32) + 2

Designate addresses (L) and (M) in a BCD.

Sent from servo amplifier

	7 … 0	
Memory type	02H	
Address (L)	Quantity (01 to 10H)	
Address (M)	No. (01 to 20H)	
Address (H)	11H	
Number of loaded bytes (L) Number of loaded bytes (H)	(Quantity × 32) + 2	
STR1 STR2	Status data	
Alarm history of designated number (32 bytes)	Alarm code	(L) (H)
	Total time-main power supply	(L) (H)
	Cumulative excitation time of control circuit	(L) (H)
	Motor running time	(L) (H)
	Feedback speed	(L) (H)
	Feedback speed (5ms before)	(L) (H)
	Command speed	(L) (H)
	Command torque	(L) (H)
	Motor current	(L) (H)
	Effective torque	(L) (H)
	DC link voltage	(L) (H)
	EC error count	(L) (H)
	Command position (high order word)	(L) (H)
	Command position (low order word)	(L) (H)
	Sequence mode	(L) (H)
	Dummy	00H 00H
Alarm history of designated number by designated quantity (32 bytes)		

<Alarm-related data>

Code	Symbol	Name
00H	—	(No detection)
01H	oc1	Overcurrent 1
02H	oc2	Overcurrent 2
03H	oS	Overspeed
04H	Lvc	Control power undervoltage
05H	Hv	Overvoltage
06H	Et1	Encoder trouble 1
07H	Et2	Encoder trouble 2
08H	ct	Circuit trouble
09H	dE	Memory error
0AH	Fb	Fuse broken
0BH	cE	Motor Combination error
0CH	tH	Braking transistor overheat
0DH	Ec	Encoder communication error
0EH	ctE	CONT (control signal) error
0FH	oL1	Overload 1
10H	oL2	Overload 2
21H	LvP	Main power undervoltage
22H	rH1	Internal braking resistor overheat
23H	rH2	External braking resistor overheat
24H	rH3	Braking transistor error
25H	oF	Deviation overflow
26H	AH	Amplifier overheat
27H	EH	Encoder overheat
28H	dL1	Absolute data lost 1
29H	dL2	Absolute data lost 2
2AH	dL3	Absolute data lost 3
2BH	AF	Multi-turn data over flow
2CH	IE	Initial error
2DH	HF	Command pulse frequency error

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■ Sequence I/O signal readout

CMND **50H**

DATA (n)

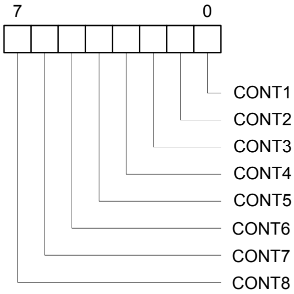
Sent from host controller

	7 … 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	12H
Number of loaded bytes	0AH
Dummy	00H

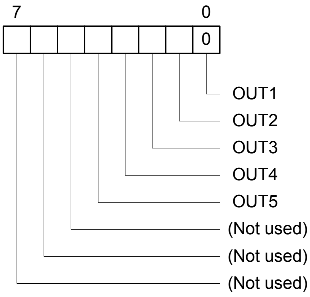
Sent from servo amplifier

	7 … 0
Memory type	02H
Address (L)	00H
Address (M)	00H
Address (H)	12H
Number of loaded bytes	0AH
Dummy	00H
STR1	Status data
STR2	
Input signal	See the figure on the left.
Dummy	00H
Dummy	00H
Dummy	00H
Output signal	See the figure on the left.
Dummy	00H
Dummy	00H
Dummy	00H

Input signal



Output signal



13

■ Parameter readout

CMND	**50H**

DATA (n)

Sent from host controller

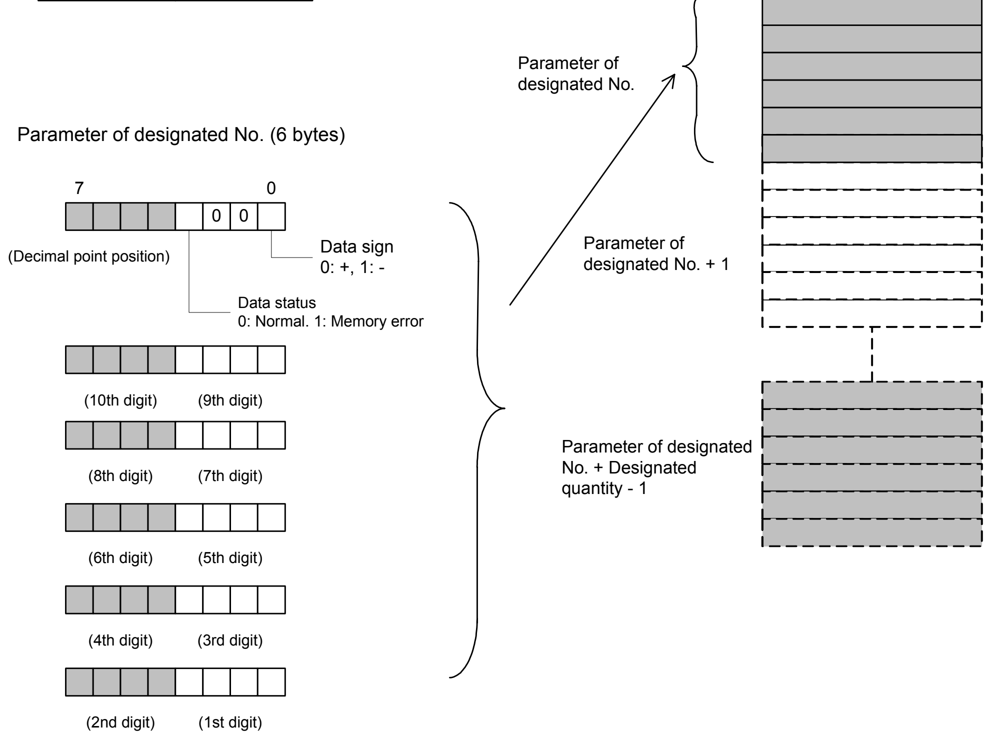
	7 0
Memory type	See the table below.
Address (L)	Quantity (01H to 15H)
Address (M)	No.(01H to 99H)
Address (H)	00H
Number of readed out bytes (L)	(Designated No. × 6) + 2
Number of readed out bytes (H)	00H

* Designate addresses (L) and (M) in a BCD.
Example: 49 → 49H, 50 → 50H

Memory type	Parameter
21H	PA1_
22H	PA2_
23H	PA3_

Sent from servo amplifier

	7 0
Memory type	See the table on the left.
Address (L)	Quantity (01H to 4H)
Address (M)	No.(01H to 99H)
Address (H)	00H
Number of readed out bytes (L)	(Designated No. × 6) + 2
Number of readed out bytes (H)	00H
STR1	Status data
STR2	



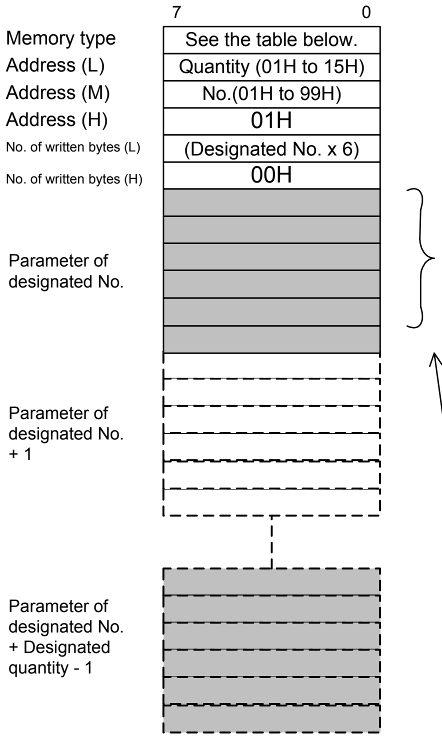
* The data is a 10-digit BCD.

13

■ Parameter write

CMND	51H
DATA (n)	

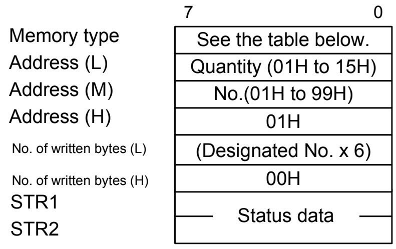
Sent from host controller



* Designate addresses (L) and (M) in a BCD.
Example: 49 → 49H, 50 → 50H

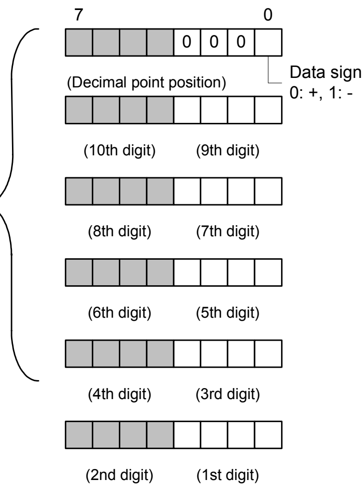
Memory type	Parameter
21H	PA1_
22H	PA2_
23H	PA3_

Sent from servo amplifier



* If the entire data is correct, the data of the designated quantity is written.
If an error is found, the following data is not written.
Bit 6 of STR1 (data error) is turned on and the number of data pieces actually written is sent back.

Parameter of designated No. (6 bytes)



* The data is a 10-digit BCD.

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■ Alarm reset

CMND **51H**

DATA (n)

Sent from host controller

	7 0
Memory type	08H
Address (L)	00H
Address (M)	01H
Address (H)	17H
No. of written bytes	00H
Dummy	00H

Sent from servo amplifier

	7 0
Memory type	08H
Address (L)	00H
Address (M)	01H
Address (H)	17H
No. of written bytes	00H
Dummy	00H
STR1	Status data
STR2	

■ Alarm history initialization

CMND **51H**

DATA (n)

Sent from host controller

	7 0
Memory type	08H
Address (L)	00H
Address (M)	01H
Address (H)	23H
No. of written bytes	00H
Dummy	00H

Sent from servo amplifier

	7 0
Memory type	08H
Address (L)	00H
Address (M)	01H
Address (H)	23H
No. of written bytes	00H
Dummy	00H
STR1	Status data
STR2	

CHAPTER 14 PC LOADER

14

14.1 Operating Environment

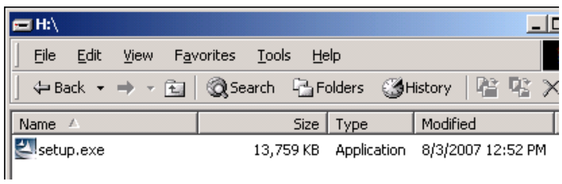
To run PC Loader, a PC having the following environment is necessary.

- Operating system
  Windows 2000 Professional (Service Pack 4 or later)
  Windows XP Professional (Service Pack 1 or later)
  Windows XP Home Edition (Service Pack 1 or later)
- CPU
  Pentium 133MHz or faster (Windows 2000 Professional)
  Pentium 300MHz or faster (Windows XP Professional, Windows XP Home Edition)
- Memory environment
  64 [MB] or more (Windows 2000 Professional)
  128 [MB] or more (Windows XP Professional, Windows XP Home Edition)
- Display
  Windows-compatible display having XGA (1024 x 768 [pixels]) or better resolution
- Free space of hard disk
  80 [MB] minimum

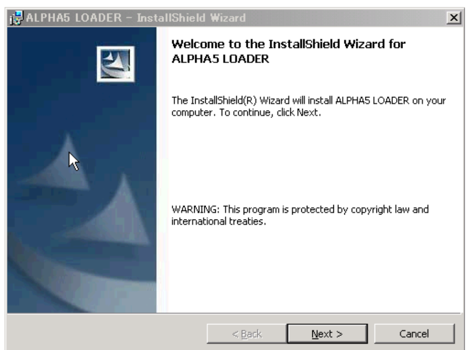
14.2 Installation Method

Before starting installation, exit from Message Manager (MM) (see page 14-8).

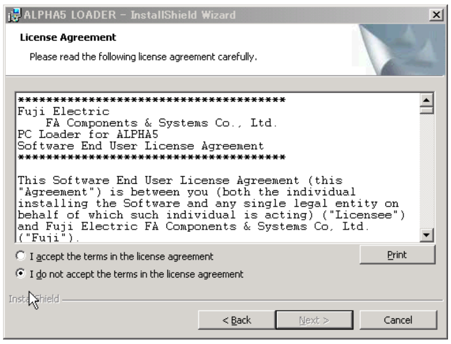
[1] Run the ALPHA5 PC Loader setup program.
Click setup.exe.



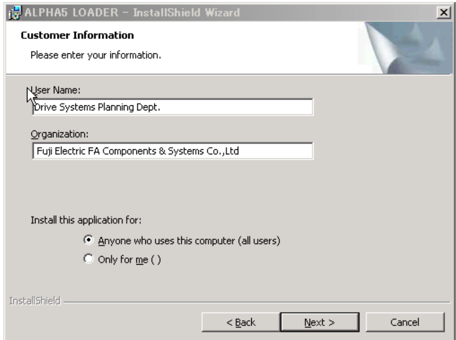
[2] The installation preparation screen is displayed.
Click "Next "



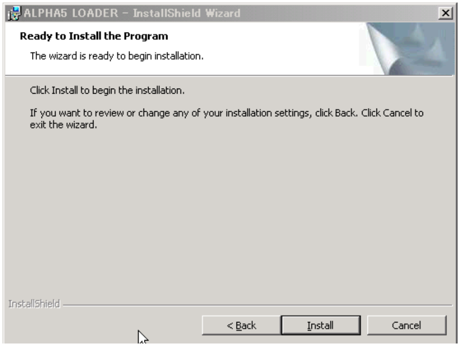
[3] The ALPHA5 PC Loader software license agreement is displayed.
Carefully read the license agreement.
To accept, click "I accept the terms in the license agreement " then "Next ."



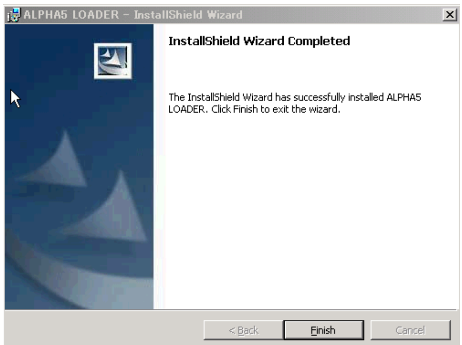
[4] Enter user information.
Enter the user name and the division you belong to.
Designate the user of the PC Loader.
After entering and selecting, click "Next ."



[5] The installation preparation start screen is displayed.
Click "Install ."
File copying begins.



[6] The installation end screen is displayed.
Click "Finish " to finish installation.



14

■ Procedure of USB hardware search wizard

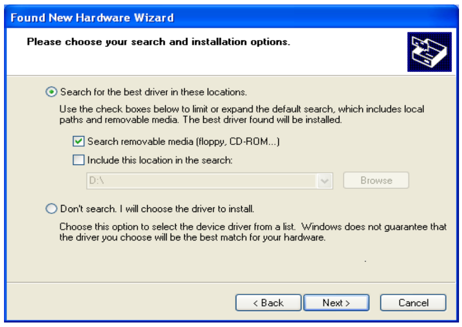
<u>For Windows XP</u>

[1] Using a USB cable, connect the PC with the amplifier.
Turn the amplifier on. The PC recognizes the amplifier as a USB device.
Install the ALPHA5 USB driver.
Select "Install from a list or specific location (Advanced)" and click "Next."

[2] Select the USB driver file.

Select "Search for the best driver in these locations " and place a check mark at "Include this location in the search ."

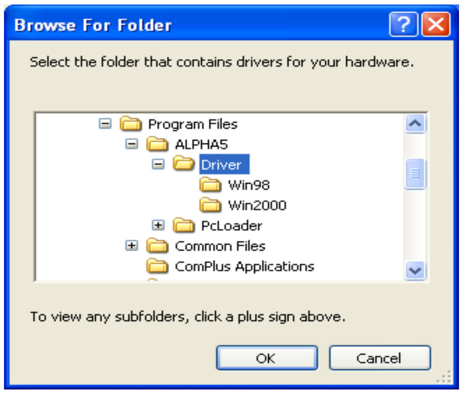
Click the "Browse" button and select the USB driver.



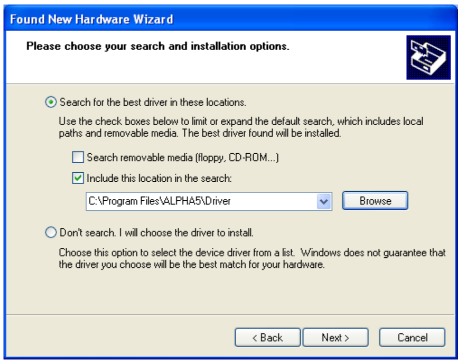
[3] Select the folder containing the driver file.

The USB driver is copied in the folder* where PC Loader is installed.
* C: \Program Files\ALPHA5\Driver

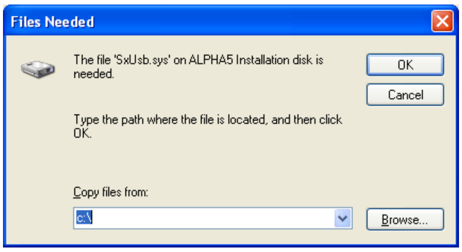
Select the folder and click "OK."



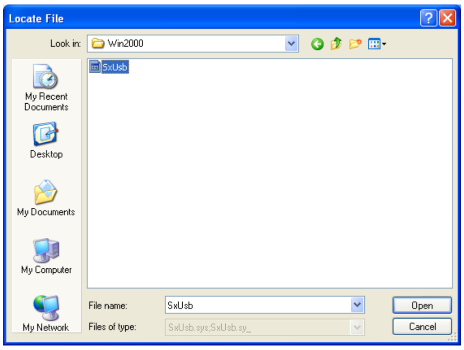
[4] The folder is designated.
Click "Next" to start to install the driver.



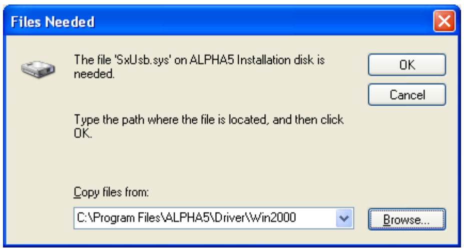
[5] Select the SxUsb.sys file.
Click the "Browse " button to open the browse screen.
The SxUsb.sys file is found in the following folder in the default state.
C:\Program Files\ALPHA5\Driver\Win2000



[6] Select the SxUsb.sys file and click the "Open" button.

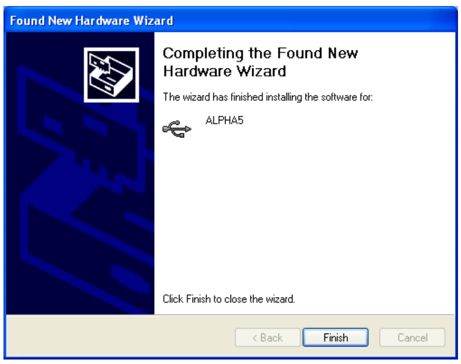


[7] "Copy from " is designated.
Click the "OK" button.



[8] The file is copied and the completion screen is displayed.

Click the "Finish" button to exit from driver installation.



For Windows 2000

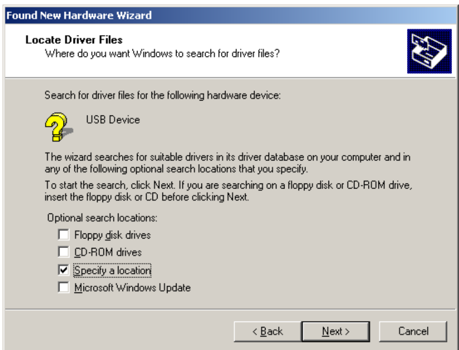
[1] Using a USB cable, connect the PC with the amplifier.

Turn the amplifier on. The PC recognizes the amplifier as a USB device.
Install the ALPHA5 USB driver.

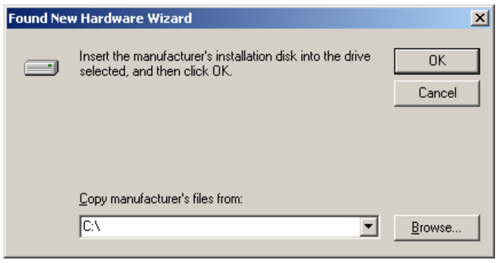
[2] Select "Search for a suitable driver for my device (recommended) " and click "Next ."

[3] Designate the location of the driver file.

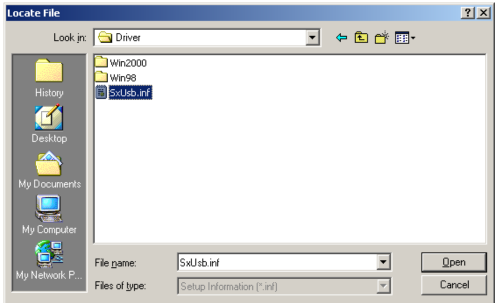
Select "Specify a location " and click "Next ."



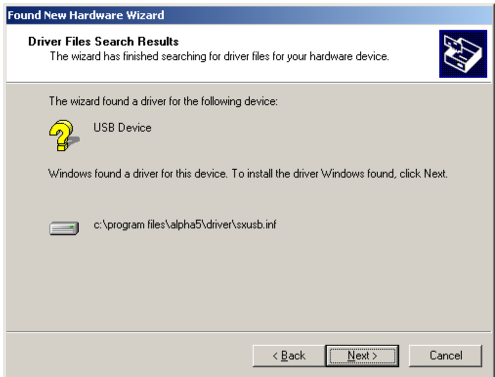
[4] Select the driver file.
Click the "Browse " button to open the file selection screen.
The USB driver is copied in the folder* where the PC Loader is installed.
* C: \Program Files\ALPHA5\Driver



[5] Select the SxUsb.inf file and click "OK."



[6] Click "Next " to start to install the driver.



[7] The file is copied and the completion screen is displayed.
Click the "Finish" button to exit from installation of the driver.

■ On Message Manager (MM)

Message Manager (hereinafter referred to as "MM") controls the communications port when multiple pieces of loader software run. It automatically runs after ALPHA5 PC Loader is launched. Keep MM running during operation of ALPHA5 PC Loader.

If the PC Loader for the following Fuji Electric FA's products is used, the MM controlling the communications function of the PC is launched in addition to the loader software of the corresponding device. If the version of the loader of each device is applicable to the one shown in the following table, terminate MM and launch ALPHA5 PC Loader. The version of the MM of the PC Loader found in the following list is too early to allow operation of ALPHA5 PC Loader.
If the ALPHA5 PC Loader is launched first, the PC Loader in the following list can be used.

(As of November 2007)

Applicable device	Applicable model	Name and model of loader	Version
Fuji's integral controller	MICREX-SX	SX Programmer Expert (D300winVer2) / NP4H-SEDBV2	All versions
		SX Programmer Expert (D300winVer3) / NP4H-SEDBV3	V3.3.4.* or earlier
		SX Programmer Standard / NP4H-SWN	V2.2.3.* or earlier
		SX communications middle ware / NP4N-MDLW	All versions
Fuji's inverter	FRENIC-Mini FRENIC-Eco	The FRENIC Loader	Ver.2.1.0.0
	FRENIC-Multi	FRENIC Loader	Ver.4.1.0.0

"*" indicates a number.

Look at the Windows task bar to check whether the MM runs or not.

Follow the procedure below to terminate MM (description is for the right handed mouse).

[1] Move the mouse cursor to the MM icon and click the right mouse button. "Exit Message Manager" is displayed.

[2] Move the mouse cursor to "Exit Message Manager" and click the left mouse button. The termination confirmation screen is displayed. Move the mouse cursor to "Yes" and click the left mouse button.

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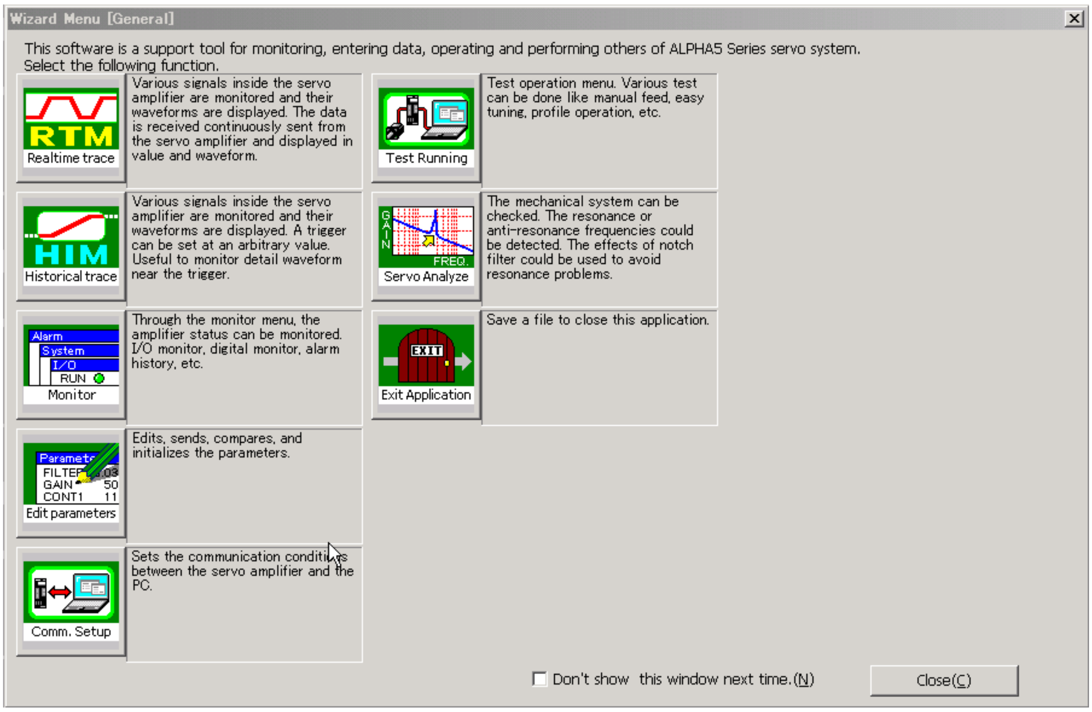
[3] MM is terminated and the  icon disappears from the task bar.

14.3 Function List

After the PC Loader is launched, the wizard Menu [General] shown below is displayed.



- Real time trace
  The speed, torque waveform and so on can be obtained easily with a single click.
- Historical trace
  Enter trigger settings to obtain waveforms in more details than those obtained with real time trace.
- Monitor
  Monitor [I/O check], [Various numerical data], [Alarm history], [Warning/Forecast monitor], [Automatic vibration suppressing monitor], or [System configuration].
- Edit Parameters
  Parameters can be edited, transferred, compared or initialized.
- Communication setup
  Set up communication conditions between the servo amplifier and PC.
- Test running
  Various test operations can be conducted independently between the servo amplifier and servomotor.
- Servo analyze
  The resonance point and anti resonance point of the mechanical system are located.

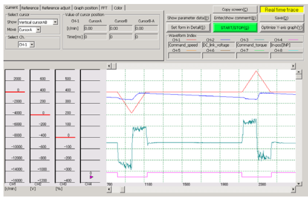
For the description of buttons provided on each screen, refer to the Help of PC Loader.

14.4 Use Method at Setting Up

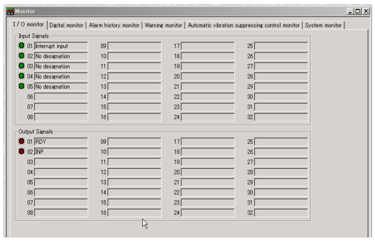
When setting up the equipment, follow the procedure below for smoother work.

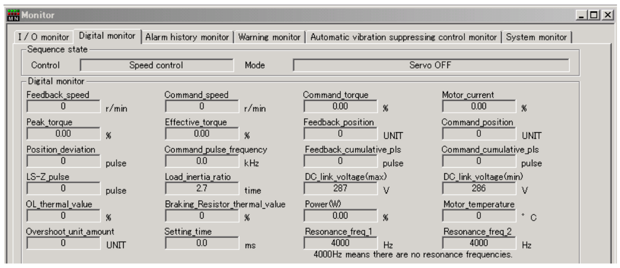
<table>
<tr><th>Step</th><th>Description</th><th>Items to be confirmed</th><th>Operation of PC Loader</th></tr>
<tr><td>[1]</td><td>Operate the discrete motor to check if the motor functions correctly.</td><td>• Perform manual operation [JOG] to check if the motor operates according to commands.</td><td>
Select Test Operation → Manual Operation.

Use real time trace to check the motion waveform.

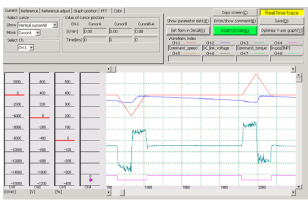


<Acquired waveform (reference)>
Ch1: Command speed (analog)
Ch2: Feedback speed (analog)
Ch3: Command torque (analog)
</td></tr>
<tr><td rowspan="2">[2]</td><td rowspan="2">Connect with the host controller and perform motion to check if the sequence program functions correctly.</td><td>• Perform I/O check.
• If necessary, perform forced OUT signal output and forced pulse output.</td><td>
Perform I/O monitor in the monitor mode to check.


</td></tr>
<tr><td>• Give commands from the host and check for motions.</td><td>
Use digital monitor in the monitor mode to check the command pulse frequency and command cumulative pulses.



</td></tr>
<tr><td>[3]</td><td>Install the motor to the machine and operate to check if the mechanical equipment functions correctly.</td><td>• Operate the motor in the final state to check for faults in the motion.</td><td>
Use real time trace to check the motion waveform.



<Acquired waveform (reference)>
Ch1: Command pulse frequency (analog)
Ch2: Position deviation (analog)
Ch3: Command torque (analog)
Ch4: INPOS (digital)
</td></tr>
</table>

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14.5 Detail Description of Function

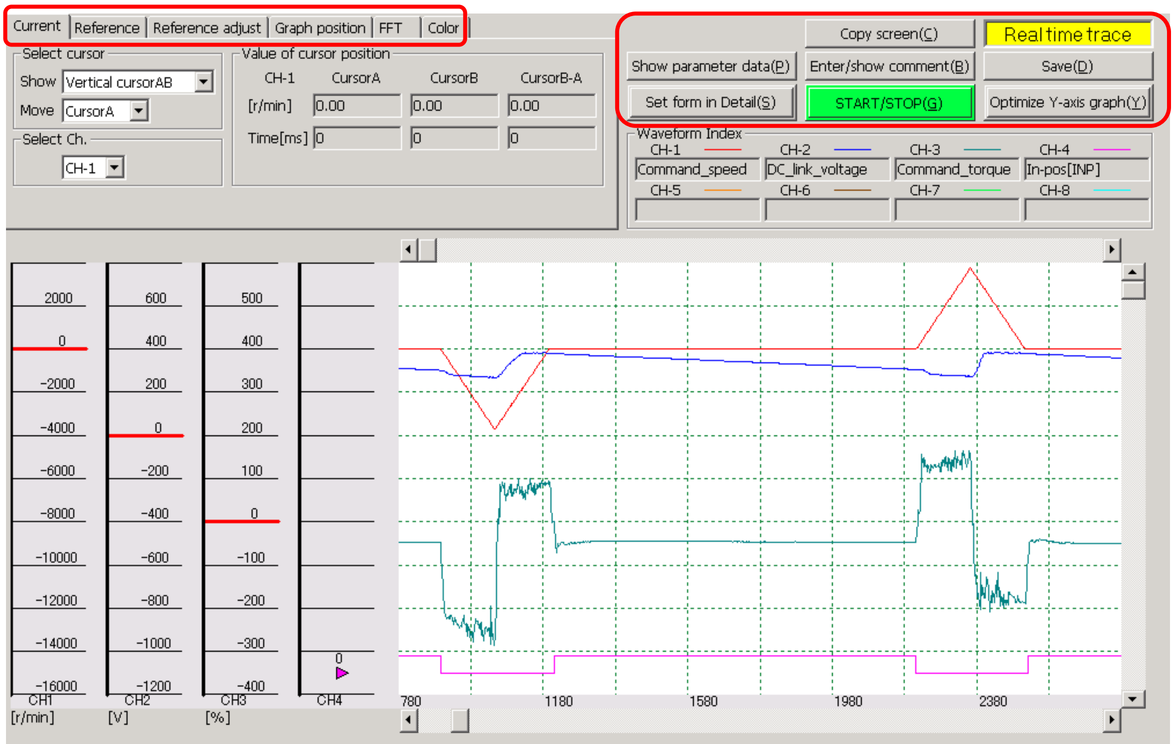
14.5.1 Real-Time Trace

Servomotor motion waveforms are drawn. Data of about 60000 points can be acquired continuously. The trace is automatically terminated when the limit of 60000 points is exceeded.
Select the desired waveform and press the "START/STOP" button to acquire the waveform.

Relationship between sampling time and tracing time

Sampling time [ms]	Tracing time [s]
1	60
2	120
5	300
10	600
20	1200
50	3000
100	6000
200	12000

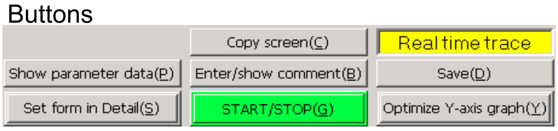
[Example of real time trace screen]



You can show the interval between two points, overlap waveforms, perform FFT analysis, copy the screen, show parameter data of the acquired waveform, save the waveform (in a CSV file), or do other things.

Tabs

Buttons



For detail description of each tab and button, refer to the Help of PC Loader.

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■ Tracing procedure

[1] Select the desired waveform.
[2] Select the sampling time.
[3] Press the "START/STOP" button to start to trace.
[4] Press the "START/STOP" button to stop tracing.

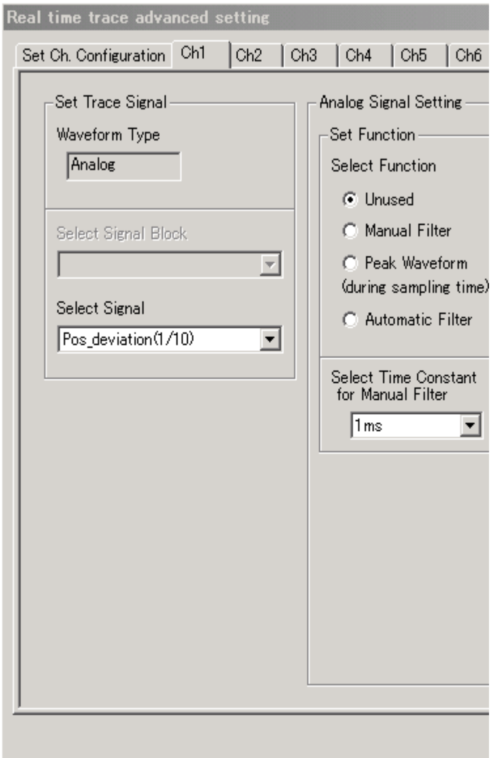
■ Waveform that can be acquired

Up to eight channels* of analog or digital signals can be acquired.

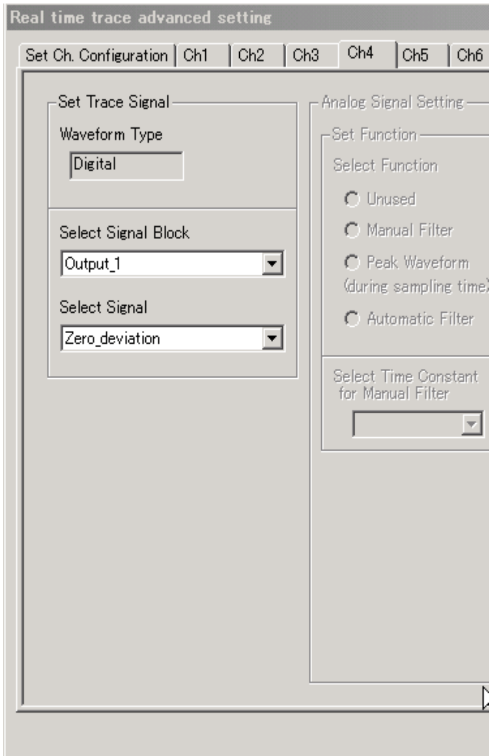
Waveforms that can be acquired are shown below. (All digital I/O signals can be traced.)

* Up to four analog signals can be acquired. If four analog signals are selected, no more digital signals are acquired.

[Example of analog signal selection screen]



[Example of digital signal selection screen]



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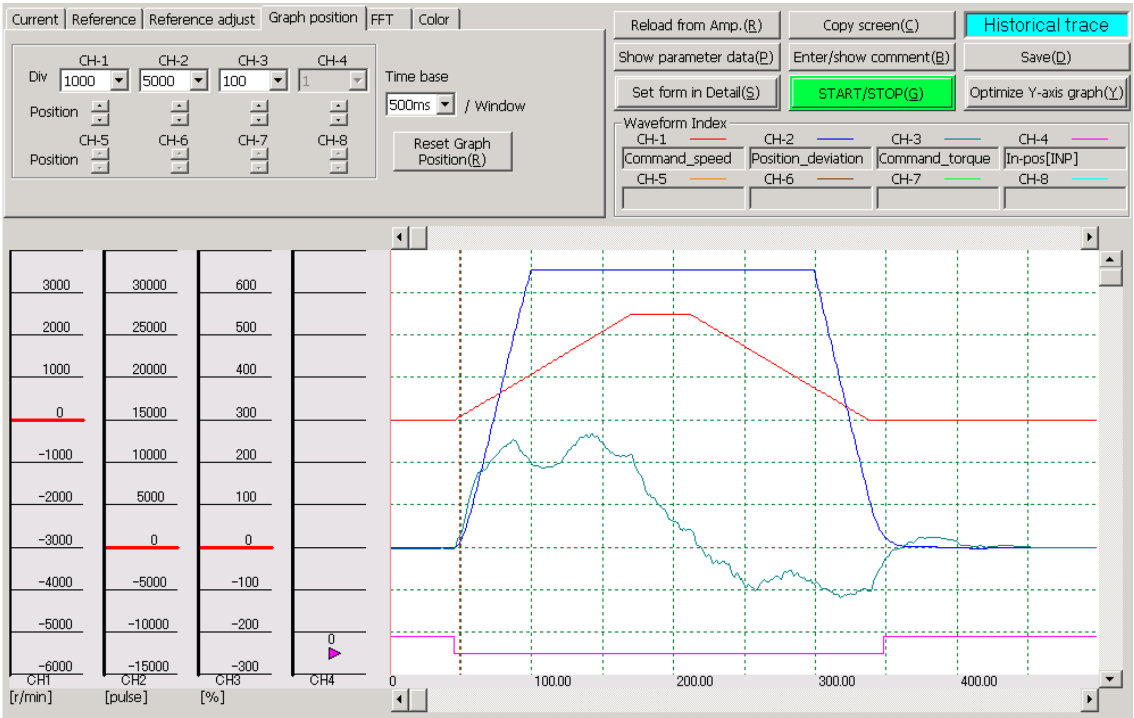
14.5.2 Historical Trace

The motion waveform of the servomotor is drawn.
Data of 500 points is acquired.
Enter trigger settings to acquire the local waveform to be observed.

Relationship between sampling time and tracing time

Sampling time [ms]	Tracing time [s]
0.125	0.0625
0.250	0.125
0.500	0.25
1	0.5
2	1
5	2.5
10	5
20	10
50	25
100	50
200	100

[Historical trace screen]



You can show the interval between two points, overlap waveforms, perform FFT analysis, re-load the waveform, copy the screen, show parameter data of the acquired waveform, save the waveform (in a CSV file), or do other things.

Tabs

Buttons

For detail description of each tab and button, refer to the Help of PC Loader.

■ Tracing procedure

[1] Select the desired waveform.
[2] Enter trigger conditions.
[3] Select the sampling time.
[4] Enter the trace number starting at the trigger position.
[5] Press the "START/STOP" button to start to trace.
If trigger conditions are satisfied, the waveform is acquired and the procedure is automatically stopped.

■ Waveform that can be acquired

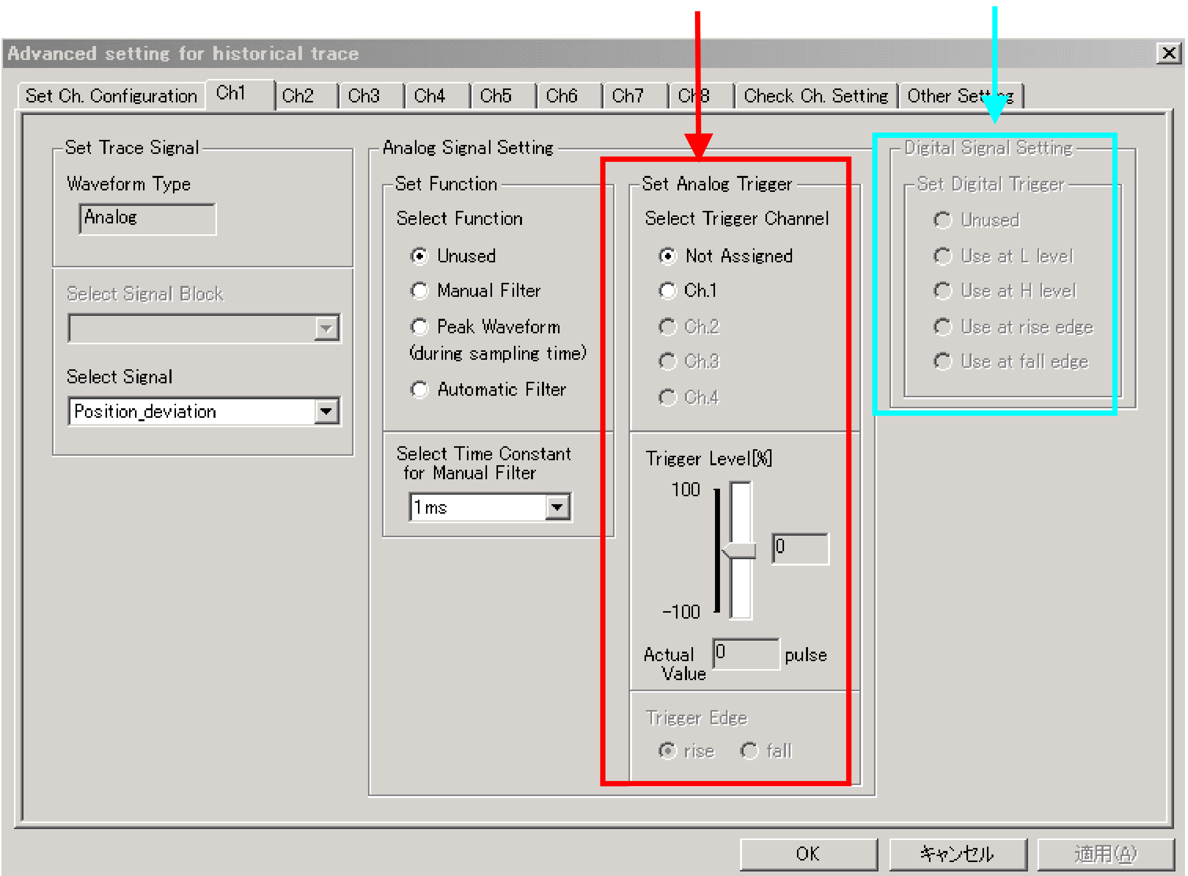
Same as that of real time trace

■ Trigger setting

Both analog and digital waveforms can be used for the trigger setting*.

* The trigger setting is only for the single channel.

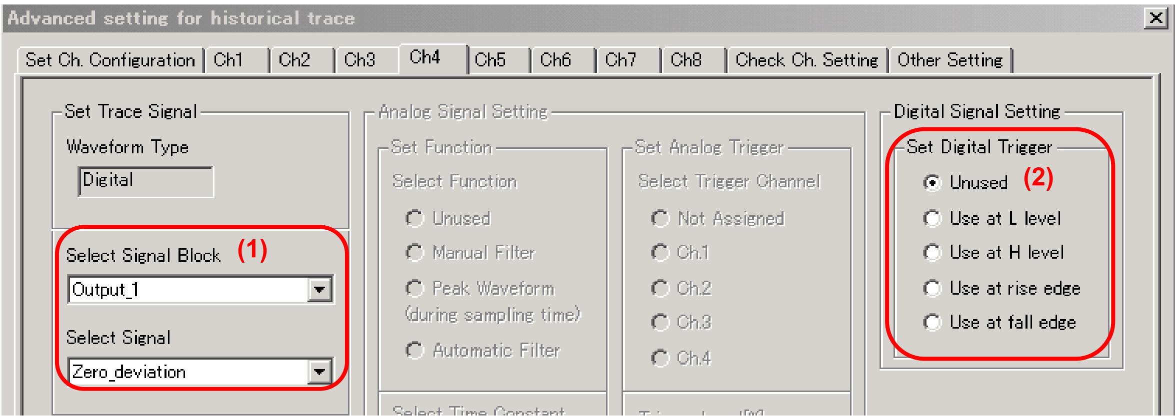
Analog trigger setting　　Digital trigger setting

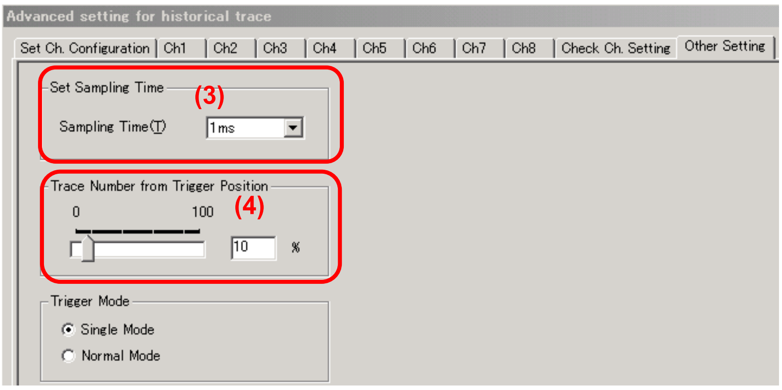


■　Example of setting method for measurement of waveform in stoppage

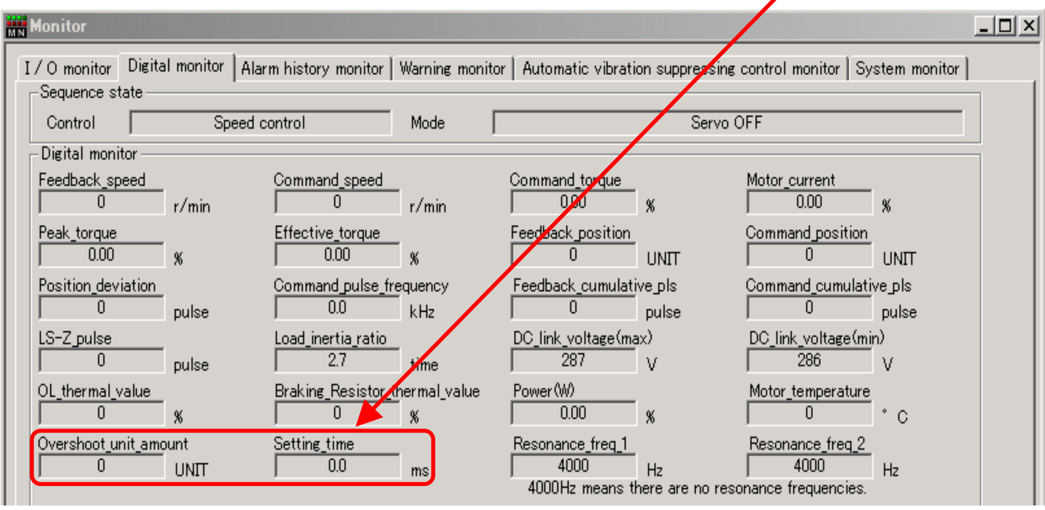
(1)　3 analog waveforms (command speed, position deviation and command torque)
　　1 digital waveform (in-position (INP))
(2)　Select "Use at ↑ edge" as a digital trigger signal of the digital waveform (in-position (INP)).
(3)　Set the sampling time at "1ms."
(4)　Set the trace count from the trigger position at 250.

After entering above, press the "START/STOP" button to start to trace.





Hint	Select [Monitor] → [Digital monitor] to show <u>the overshoot unit amount and settling time</u> at real time.



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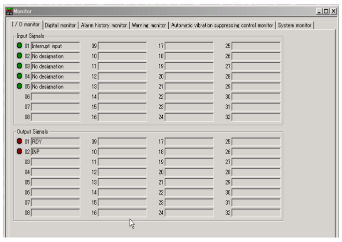
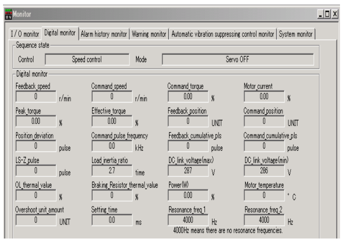
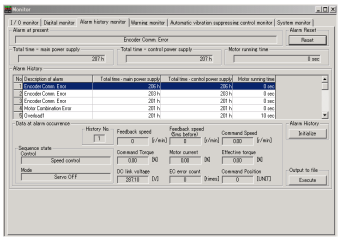
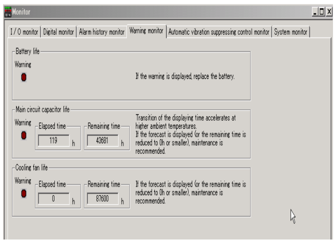
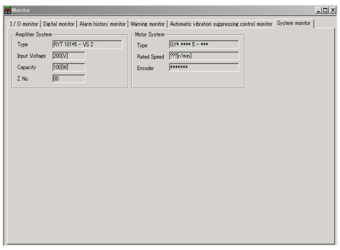
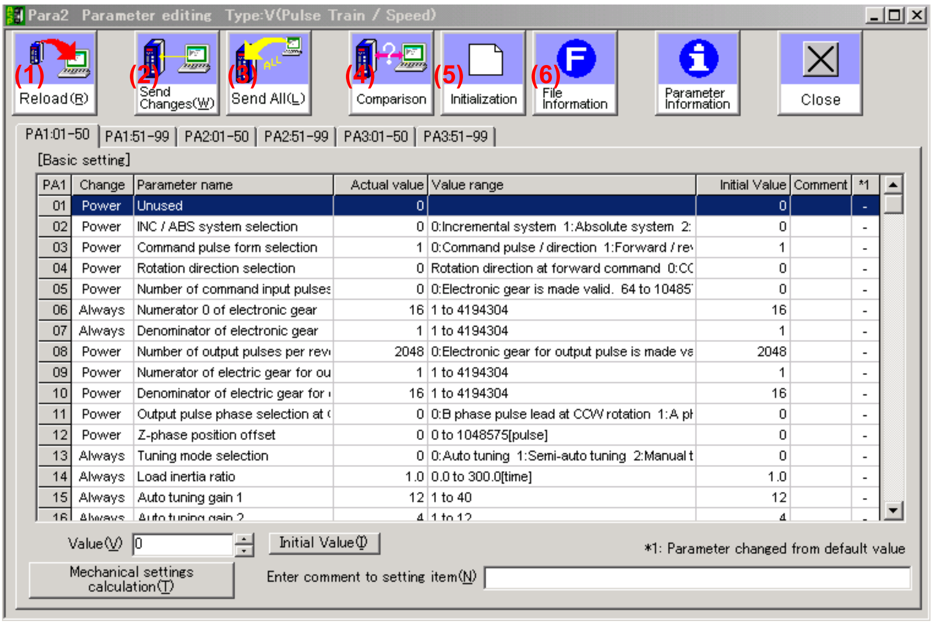
14.5.3 Monitor

The state of the servo amplifier and servomotor is monitored.

Item	Description	Screen example
I/O monitor	Check the ON/OFF status of the digital I/O signal.	
Digital monitor	Monitor various pieces of data* during operation (the data is not saved). * Data that can be monitored in the monitor mode of the keypad	
Alarm history monitor	The history (incl. accompanying data*) of past 20 alarms is displayed. * Feedback speed at alarm, torque command, DC link voltage, etc.	
Warning/ Forecast monitor	The warnings and forecasts indicated at the servo amplifier are displayed.	
Automatic vibration suppressing monitor	The state of learning of automatic vibration suppressing is displayed.	
System monitor	The model of the connected servo amplifier and servomotor is displayed.	

14.5.4 Parameter Editing

Servo amplifier parameters are edited.



The following functions can be used on this screen.

(1) Reload
Parameters are read out from the connected servo amplifier.

(2) Send changes
Changed parameters are sent to the connected servo amplifier.

(3) Send all
All parameters are sent to the connected servo amplifier.

(4) Comparison
The edited parameters are compared with those of the connected servo amplifier or those having been saved in a file.

(5) Initialization
Currently edited parameters or those of the connected servo amplifier* are reset to default values.
* This function can be executed only while the servo is turned off. After initializing, turn the servo amplifier off then on again.

(6) File information
Data about currently edited parameter file. The type, date, comment and so on of the servo amplifier and servomotor connected at the time of loading can be monitored.

Note	Send parameters ((2) and (3)) while the servomotor is stopped to make sure of safety. Otherwise movement characteristics may change, possibly giving damage to equipment.

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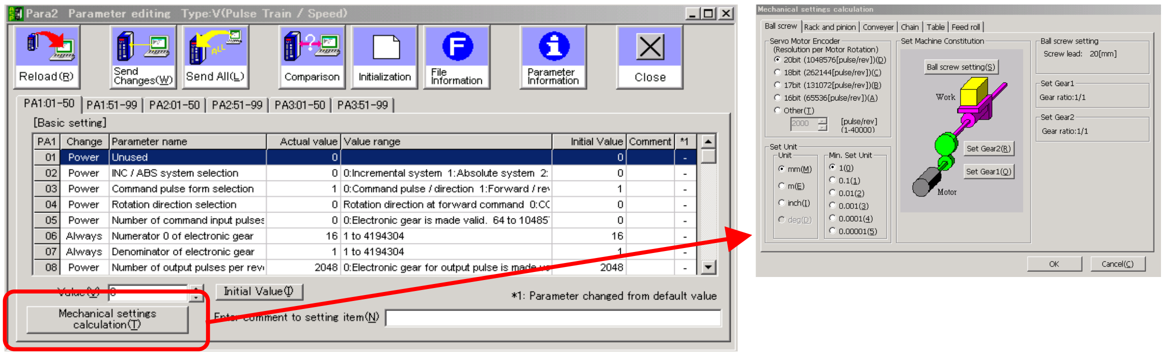
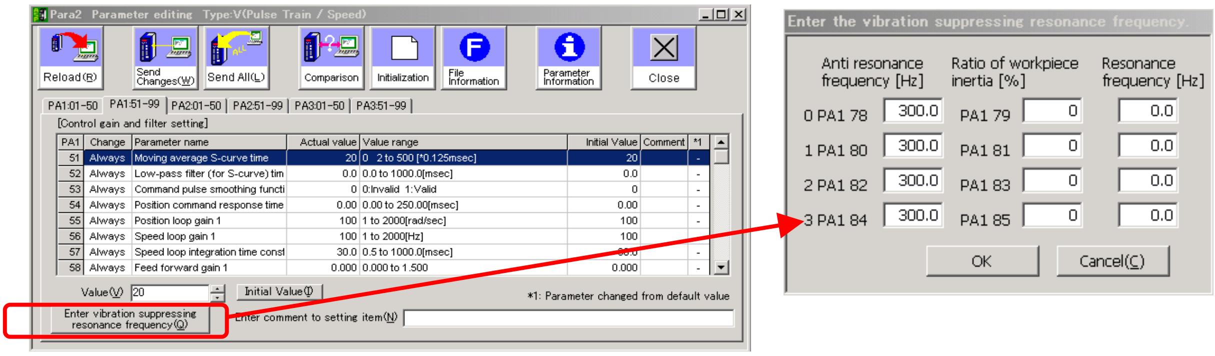
■ Automatic calculation of electronic gear

Press the "Mechanical settings calulation" button at [PA1: Basic setting] to open a special window. Enter specifications of each mechanical system to automatically calculate the electronic gear.



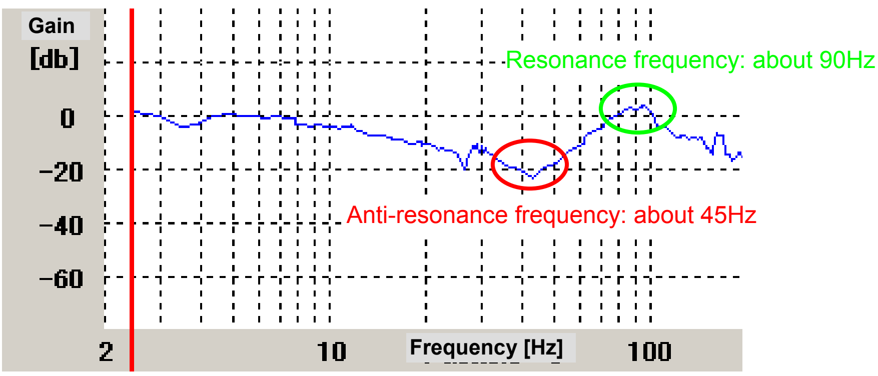
■ Automatic calculation of workpiece inertia ratio

Press the "Enter vibration suppressing resonance frequency" at [PA1: Control gain and filter setting] and enter the anti resonance frequency and resonance frequency* to automatically calculate the workpiece inertia ratio.



* The resonance frequency is not the one suppressed with the notch filter.
Perform servo analyze to check this resonance frequency.
This resonance frequency appears as a set with the anti resonance frequency, and the value is about twice the anti resonance frequency.

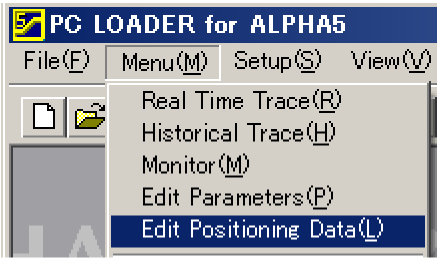
[Example of resonance frequency]

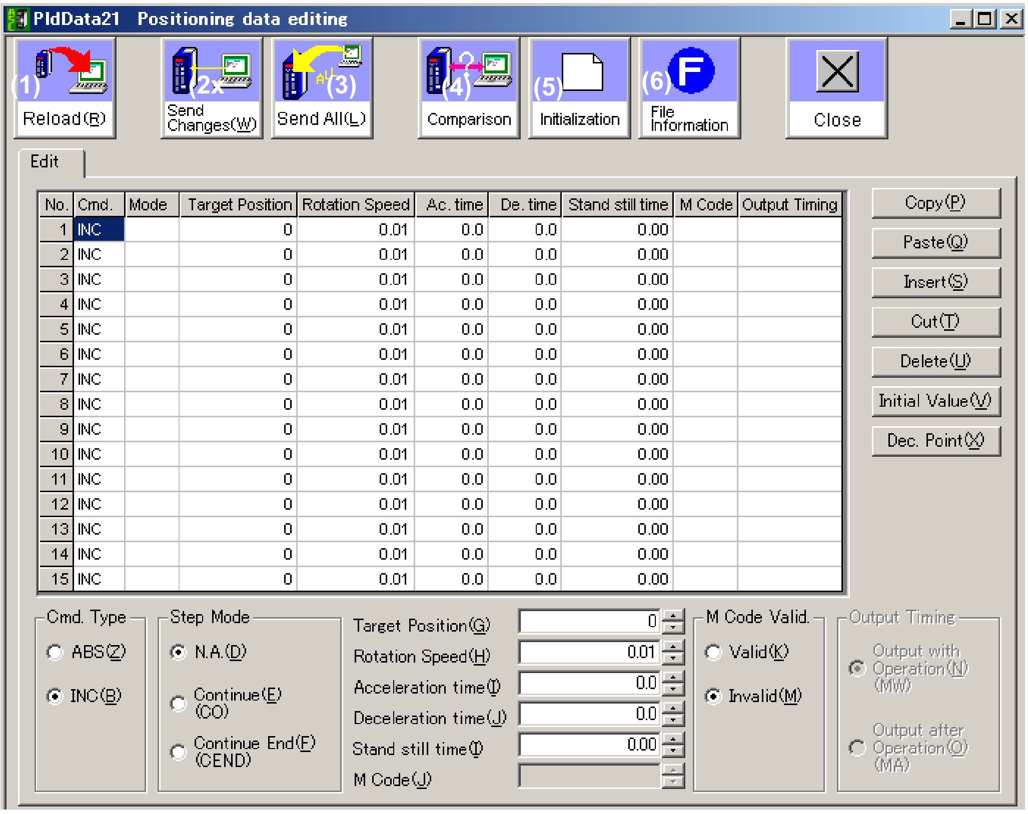


14.5.5 Positioning Data Edit

Positioning data are registered to the servo amplifier.

Launch the screen by selecting [Menu] →[Positioning data edit].





The following functions can be used on this screen.

(1) Reload
Positioning data are read out from the connected servo amplifier.

(2) Send changes
Changed positioning data are sent to the connected servo amplifier.

(3) Send all
All positioning data are sent to the connected servo amplifier.

(4) Comparison
Currently edited parameters are compared with those of the connected servo amplifier or those having been saved in a file.

(5) Initialization
Currently edited parameters or those of the connected servo amplifier* are reset to default values.

(6) File information
Data about currently edited parameters file. The type, date, comment and so on of the servo amplifier and servomotor connected at the time of loading can be monitored.

- Refer to the Loader help for explanation of other buttons.

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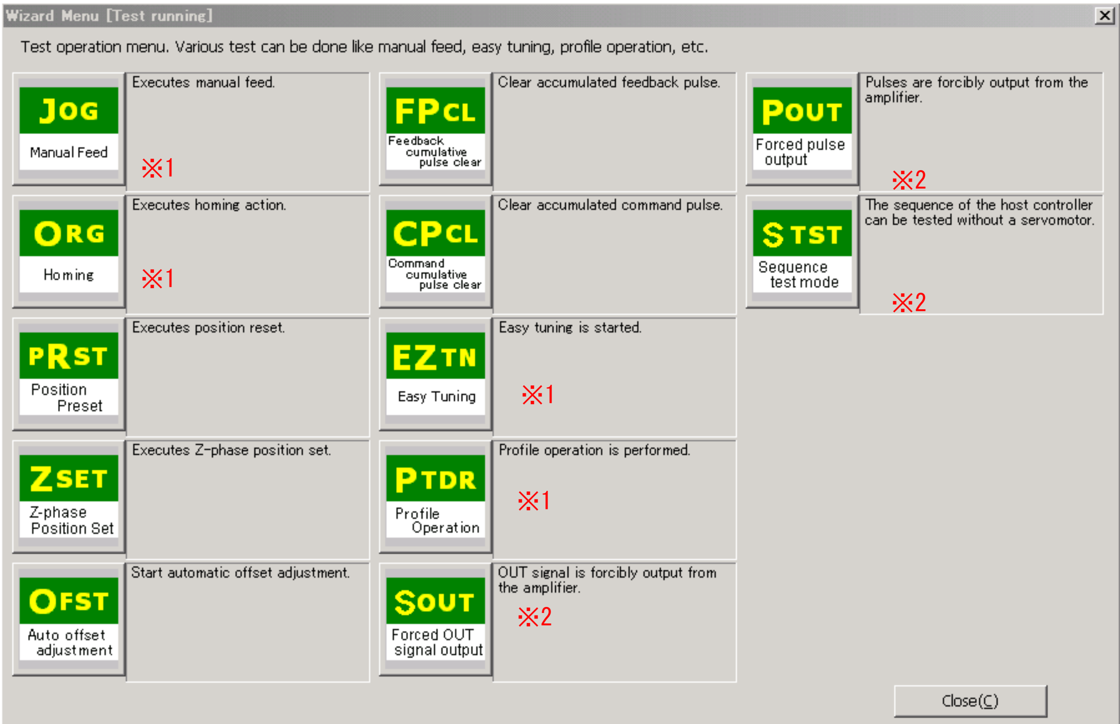
14.5.6 Test Operation

Disconnect the servo amplifier from the host to perform test operation of the servomotor from the main body of the servo amplifier.
Use this function if the servomotor does not operate correctly according to host commands, if the motor fails to start or to check the direction of rotation.



*1 Servo-on is automatically turned on and the motor rotates. Be careful.
*2 To return to the regular mode, turn the servo amplifier off. Be careful.

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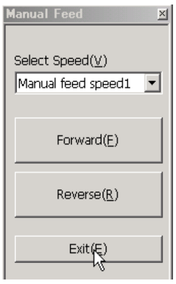
■ Each test operation screen

(1) Manual operation

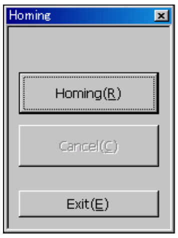


Select the speed (parameters PA1_41 through _47).

The motor rotates forward while the button is clicked on.

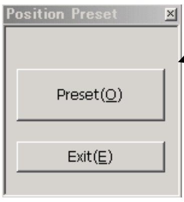
The motor reverses while the button is clicked on.

(2) Homing



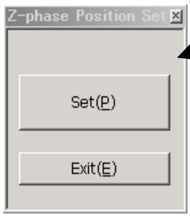
Press the "Homing" button to start the motor according to the setting of homing-related parameters PA2_06 through _14.
After the homing motion is finished, the motion is finished.

(3) Position preset



Press the "Preset" button to change the current position to the one specified in parameter PA2_19 (preset position).

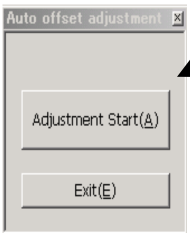
(4) Z-phase position set



Press the "Set" button to output the Z-phase at the current position and automatically change parameter PA1_12 (Z-phase offset).
* "Z-phase position set" fails in the following cases.

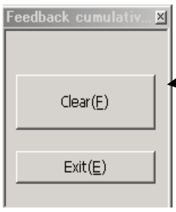
- PA2_74 (parameter write-protection) is set at 1 (write-protect).
- The zero position (Z-phase) of the encoder is not established.
  In this case, turn the motor shaft twice or more.

(5) Offset adjustment

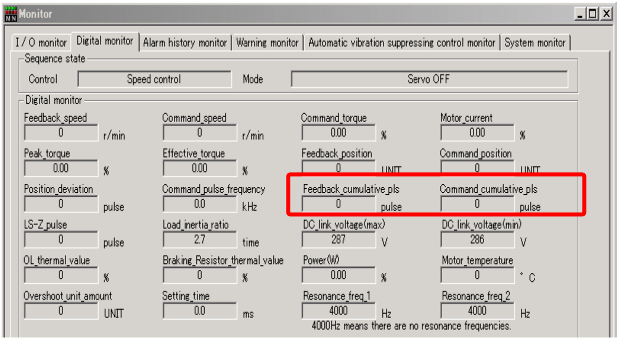


Press the "Adjustment Start" button to adjust the offset of the VREF and TREF analog input terminals and change parameters PA3_32 (speed command offset) and PA3_34 (torque command offset).
Offset adjustment is impossible if PA2_74 (parameter write-protection) is set at 1 (write-protect).

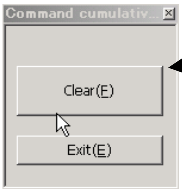
(6) Feedback cumulative pulse clear



Press the "Clear" button to reset the cumulative feedback pulse to "zero."



(7) Command cumulative pulse clear

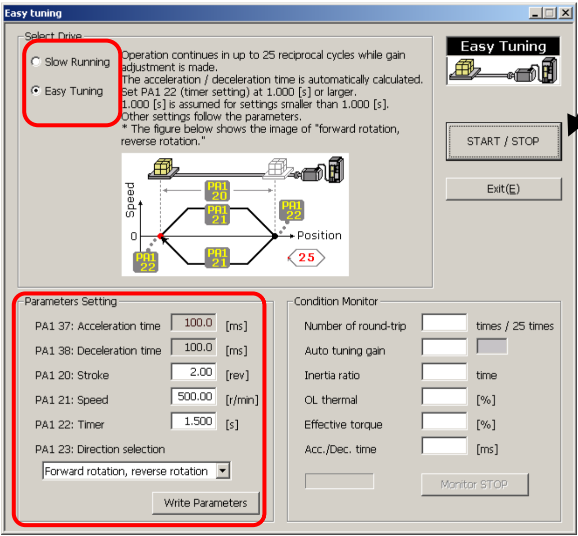


Press the "Clear" button to reset the command cumulative pulse to "zero."

(8) Easy tuning

(a)

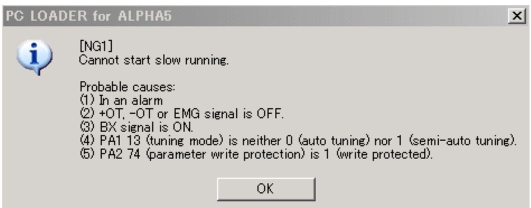
(b)

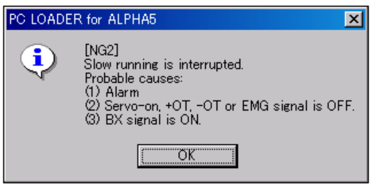


Press the "START/STOP" button to start one of motions (a).
Press the START/STOP button during the motion to stop immediately.

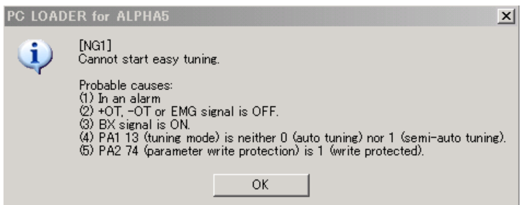
- Slow running
  A motion starts according to parameter settings (b).
  The speed is fixed at 10 [r/min].
  The function is for the check of the traveling amount and direction.
- Easy tuning
  A motion starts according to parameter settings (2) while the auto tuning gain 1 is adjusted. However, the acceleration and deceleration time is automatically adjusted.

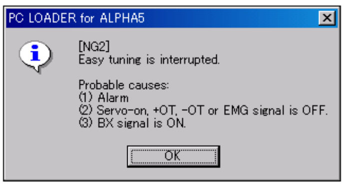
[Slow running fault screen]

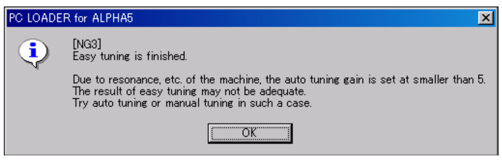




[Easy tuning fault screen]

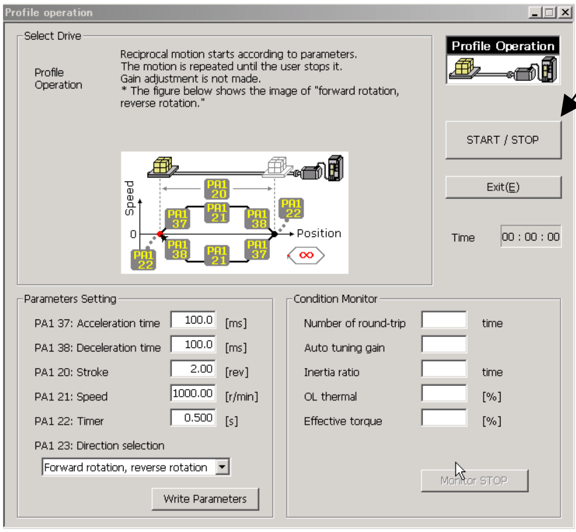






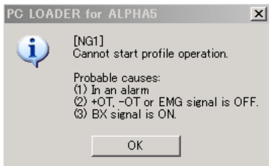
14

(9) Profile operation



Press the "START/STOP" button to start profile operation.
Press the "START/STOP" button during the motion to stop after the current cycle.

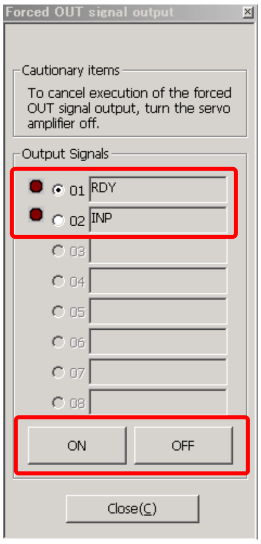
[Profile operation fault screen]



(10) Forced OUT signal output

(a)

(b)

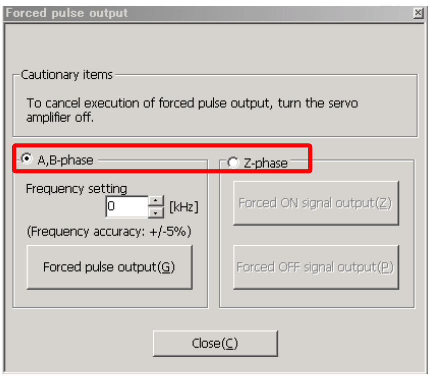


Select the OUT signal output at (a) and select ON or OFF at (b).

To exit from this mode, turn the power off.

(11) Forced pulse output

(a)



Select the pulse signal to be output, at (a).
Phase-A/B
Enter the frequency and press the "Forced pulse output" button to issue pulses.
Frequency setting range: 0 to ±1000 [kHz] in increments of 1 [kHz]
Z-phase
The Z-phase signal alternates each time the "Forced H signal output" or "Forced L signal output" button is pressed.
To exit from this mode, turn the power off.

14

(12) Sequence test mode

Even if the servomotor is not connected, you can simulate servomotor connection state.

Use this function to efficiently debug host programs.

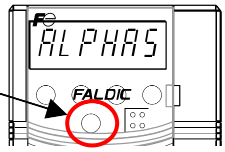
Notes

- Operation conditions and I/O signal functions are the same as those of motor connection state.
- Be sure to supply the main power (L1, L2 and L3) to the amplifier as a condition for operation.
- Simulation follows the encoder bit count setting. Enter the encoder bit count.
- No current flows in the motor. (Transistors in the main circuit do not turn on or off.)
- The motor current, effective torque, OL thermal value and braking resistor thermal value do not change.
- The overload warning does not function.
- Under torque control, simulation proceeds in the powering state. The motor rotates in the same direction as the sign included in the torque command. The speed at the time follows the setting of easy tuning speed setting (PA1_21).
- INC/ABS system selection (PA1_2) is handled as 0 (INC) internally. (The absolute system is not simulated.)
- To exit from the sequence test mode, turn the control power (sL1, sL2) of the amplifier off.

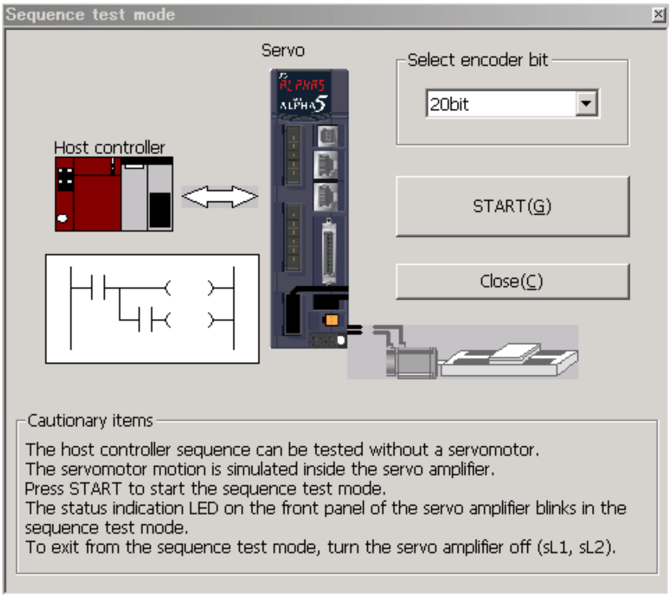
Checking the sequence test mode state

If the servo amplifier is in the sequence test mode, the orange status indication LED on the front panel of the amplifier blinks at very short intervals.

Status indication LED



Startup screen



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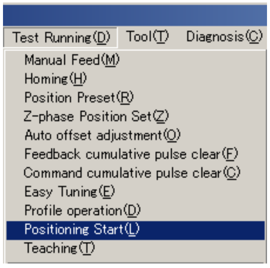
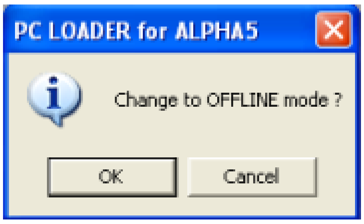
(13) Positioning start

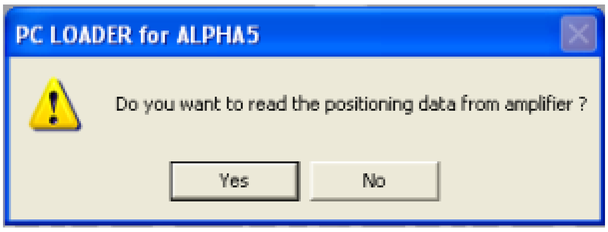
Launch the positioning start by selecting [Test running] → [Positioning start].

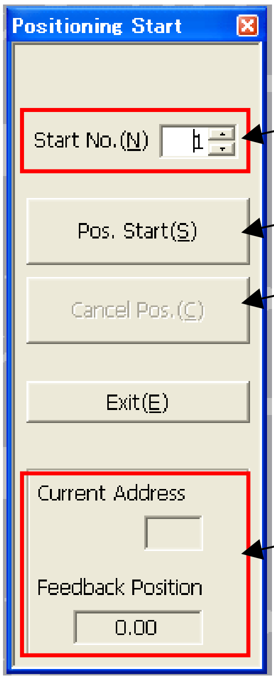


The following window appears with launching.



(The positioning data edit screen can be launched at the same time for checking the positioning data.)





Select the positioning data to be launched.

Pressing this button starts automatic operation with selected positioning data.

Positioning operation is canceled and stops if this button is pressed during operation.

Currently executed positioning data address and feedback current position are monitored.

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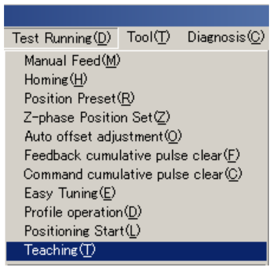
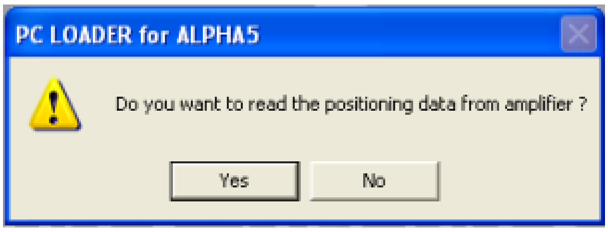
(14) Teaching

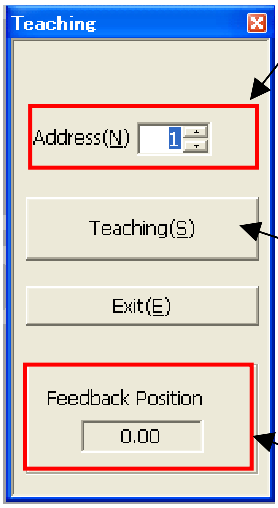
Launch the teaching by selecting [Test running] →[Teaching].



The following window appears with launching.

(The positioning data edit screen can be launched at the same time for checking the positioning data.)



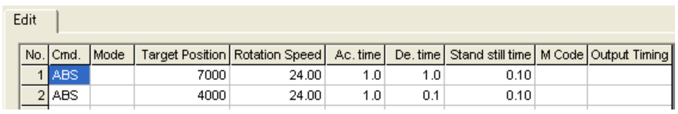


Select the positioning data to write data.

Pressing this button executes teaching.

Data are written to the address selected for the feedback current position shown here.

* The address to which the teaching was executed will have the ABS type command method. Other setting will not be changed.


Edit

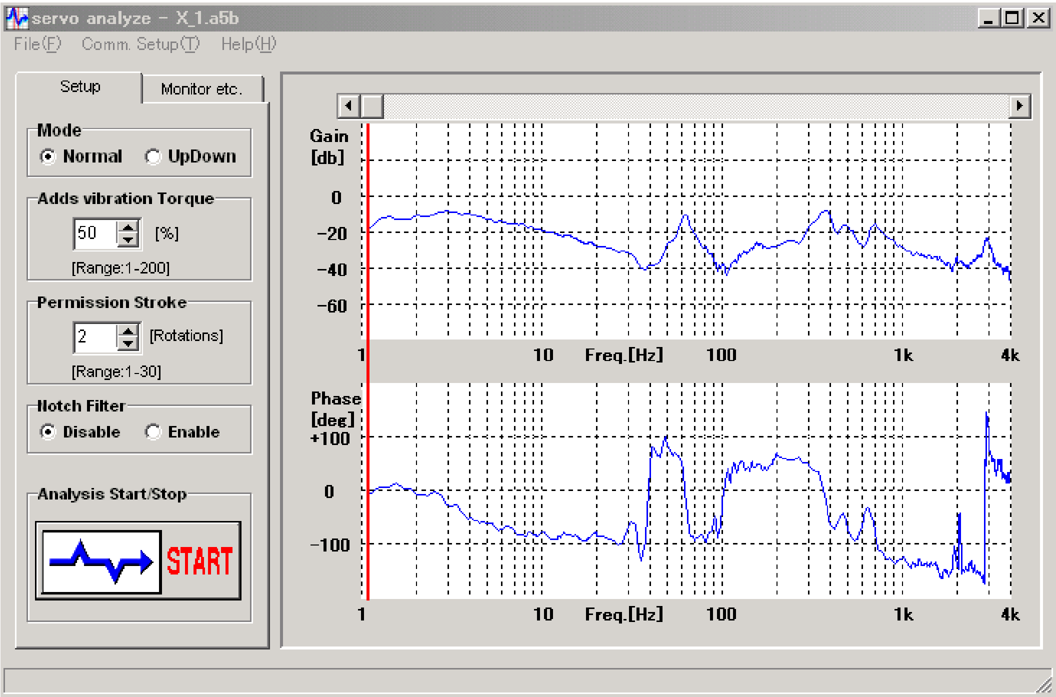
No.	Cmd.	Mode	Target Position	Rotation Speed	Ac. time	De. time	Stand still time	M Code	Output Timing
1	ABS		7000	24.00	1.0	1.0	0.10		
2	ABS		4000	24.00	1.0	0.1	0.10		

14.5.7 Servo Analyze

Servo analyze is a tool for measuring frequency characteristics of the mechanical equipment. Execute the servo analyze function to visually show the resonance point and anti resonance point of the mechanical equipment, providing you with approximate measures of these parameter settings (anti resonance frequency and notch filter relations).

During servo analyze operation, a torque is added three times. For this reason, the servomotor actually moves. Note that the motor may turn substantially according to some vibration torque settings. (Enter a suitable allowable stroke setting to set a limit.)

(1)
(2)
(3)
(4)



■ Each setting

(1) Mode
In case of horizontally driven equipment, select "Normal." In case of vertically driven equipment, select "UpDown."

(2) Adds vibration torque
Larger the value, better the accuracy. But the shock is larger, causing a larger burden to the equipment. In regular cases, select the default setting (50 [%]).

(3) Permission stroke
An error is caused if the servomotor moves beyond this reference value. A travel of the rotation setting is not guaranteed.

(4) Notch filter
Select "Disable" to check mechanical characteristics such as the resonance point.
Select "Enable" to check effects of the notch filter.

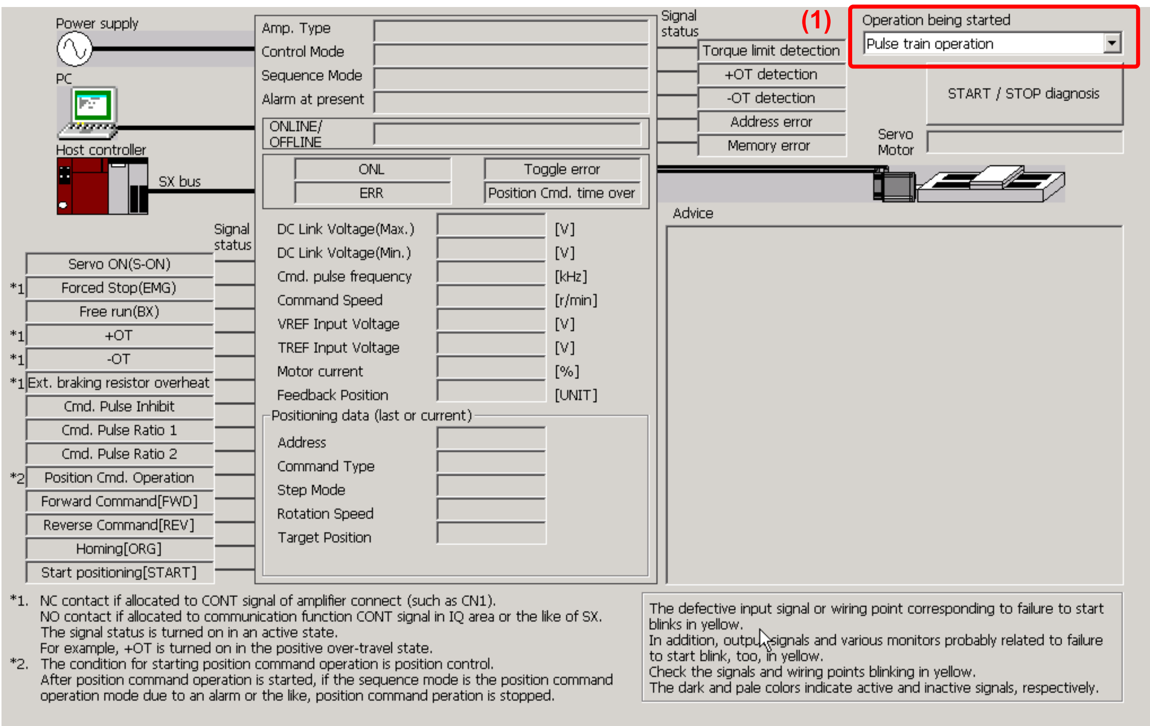
14.5.8 Diagnosis to be Made if the Servomotor Fails to Start

If the servomotor fails to start or unexpected message is shown, launch "Immobility diagnosis" to analyze probable causes at real time.

■ Starting method

Select [Diagnosis] → [Immobility diagnosis] from the menu or click the icon to start.

■ Reference screen



■ Operation method

Select from the list of "Operation being started" (1) in the screen above.

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Press the "Diagnosis START/STOP" button to show the amplifier state and estimate the cause of immobility.

14.5.9 Language Selection

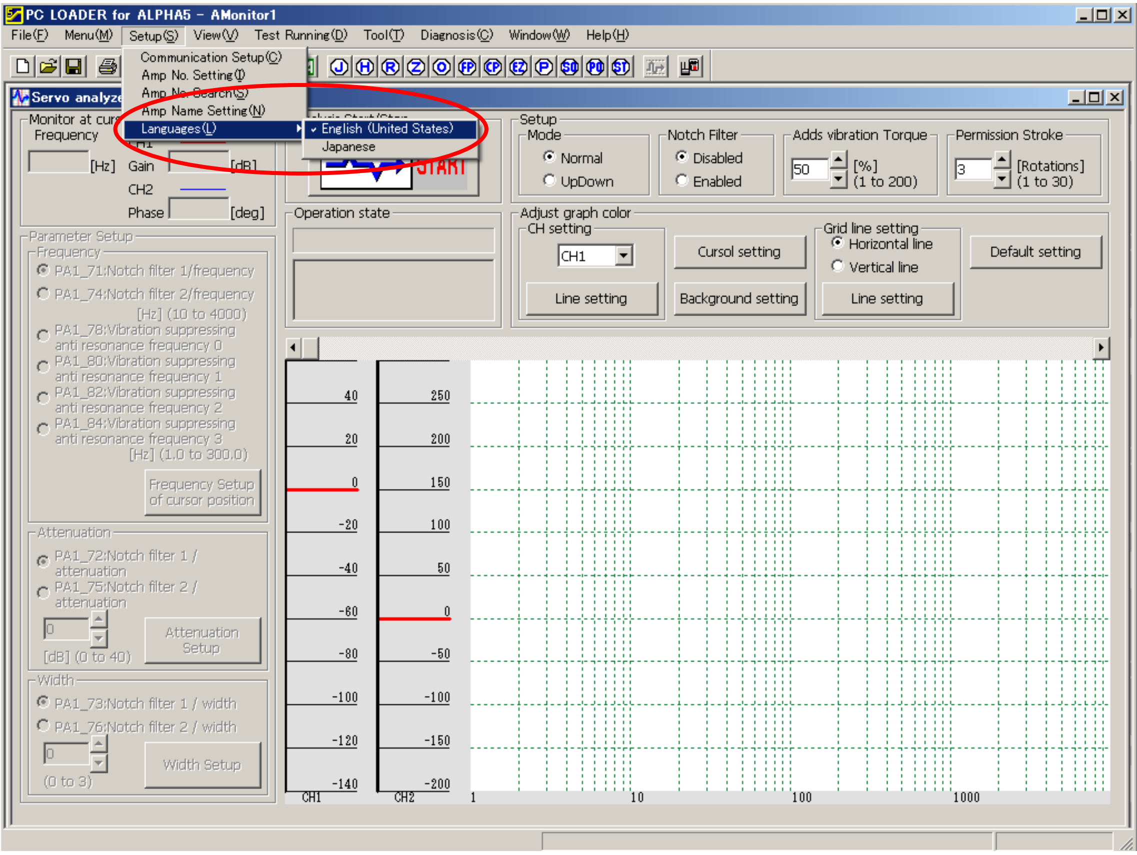
The PC Loader supports Japanese and English.

■ Applicable version

The version of PC Loader supporting Japanese and English is V1.3 or later.

■ Selecting procedure

Select the desired language by selecting [Setup] →[Language] in the menu bar.



Exit the PC Loader after the following window is shown.

The language will be updated when the PC Loader is restarted.

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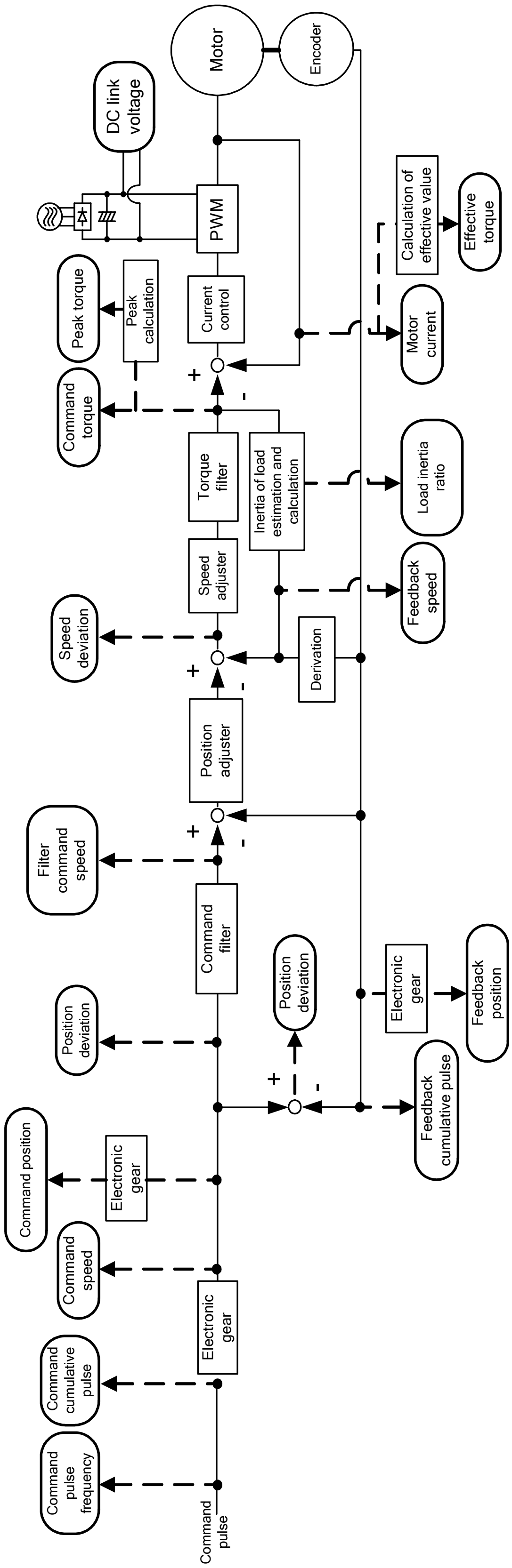
CHAPTER 15 APPENDIXES

15

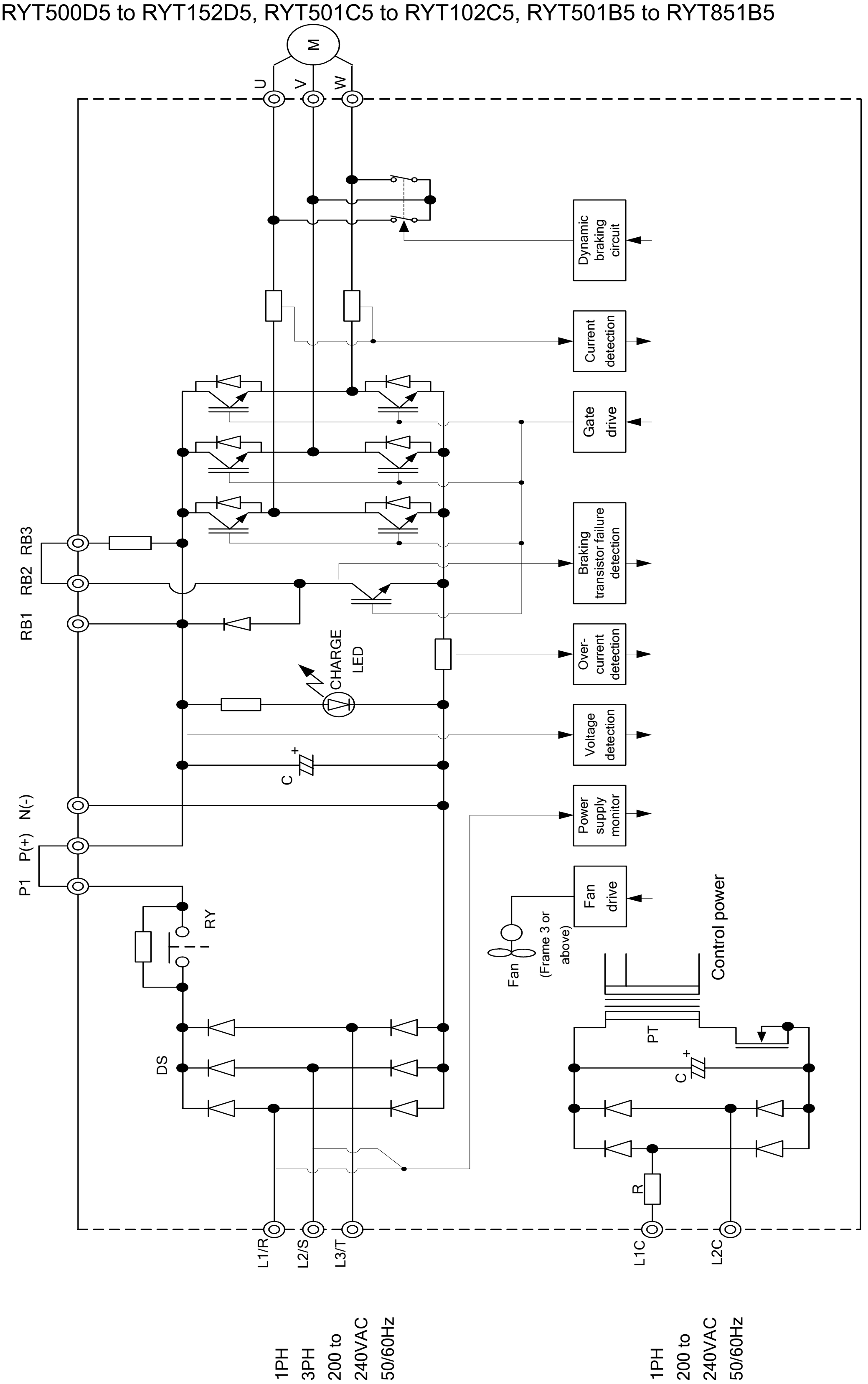
15.1 Status Indication Block Diagram



15.2 Main Circuit Block Diagram

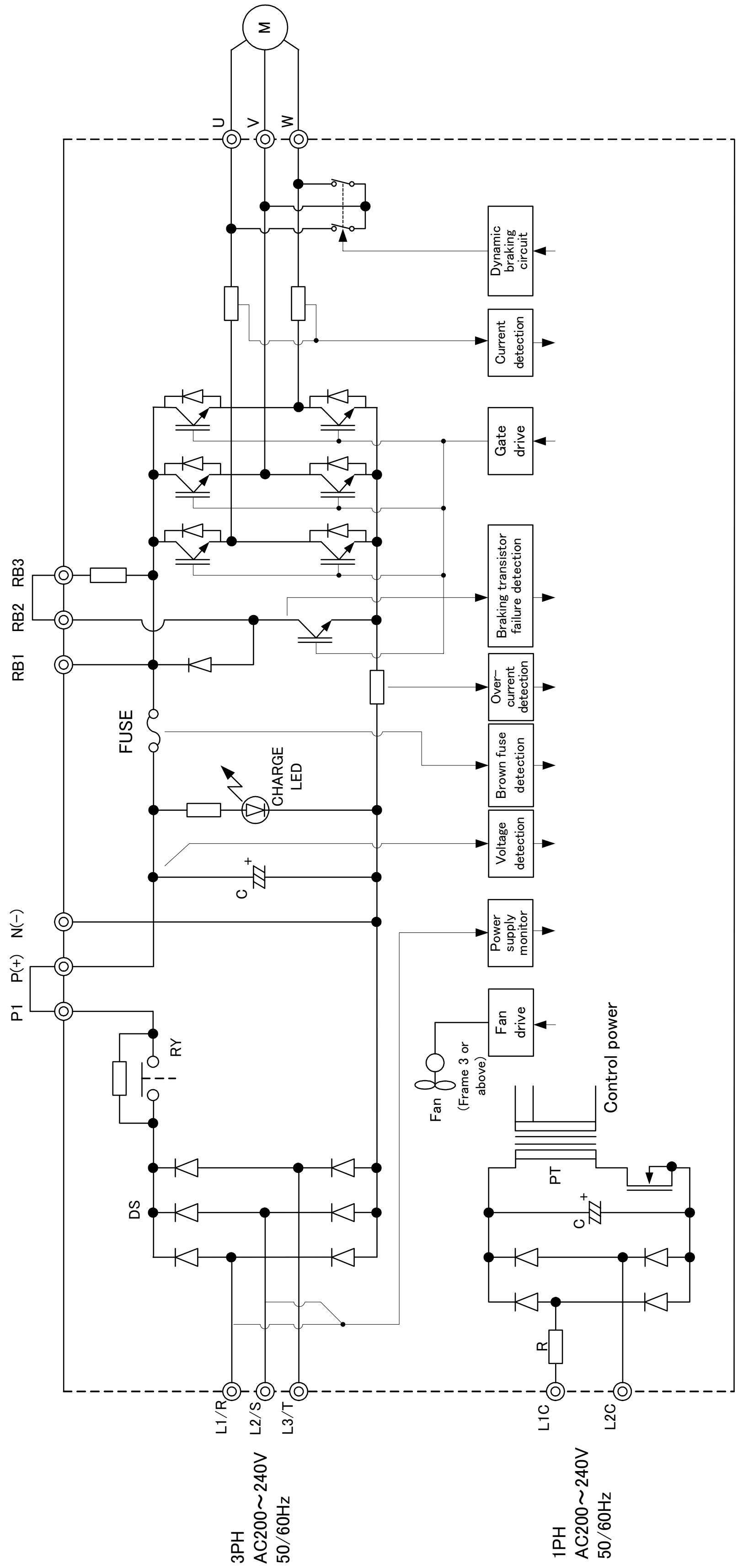
Applicable models :

RYT500D5 to RYT152D5, RYT501C5 to RYT102C5, RYT501B5 to RYT851B5

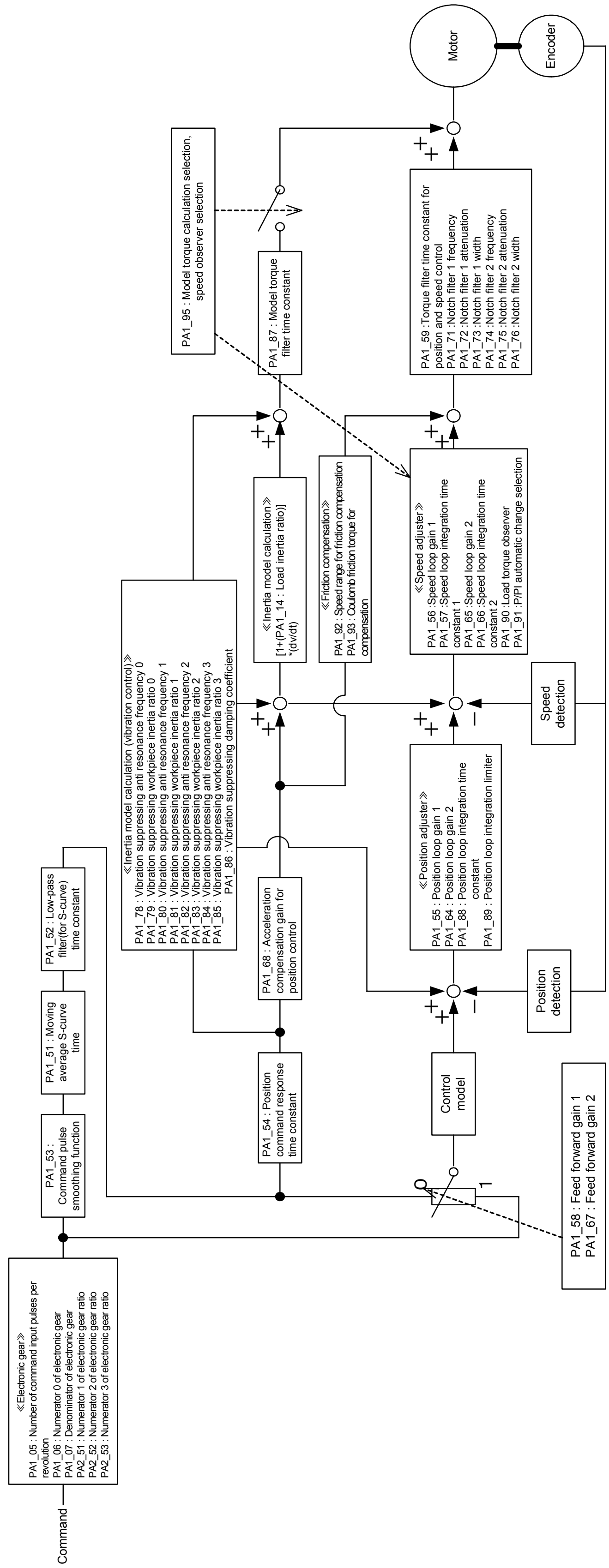


Applicable models :

RYT202D5 to RYT502D5, RYT152C5 to RYT202C5, and RYT132B5



15.3 Control Circuit Block Diagram



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15.4 Parameter List

■ PA1_: Basic setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
01	Control mode selection	○	○	○	○	
02	INC/ABS system selection	○	○	○	○	
03	Command pulse form selection	○	○	-	-	
04	Rotation direction selection	○	○	○	○	
05	Number of command input pulses per revolution	○	○	-	-	
06	Numerator 0 of electronic gear	-	○	-	-	
07	Denominator of electronic gear	-	○	-	-	
08	Number of output pulses per revolution	○	○	○	○	
09	Numerator of electric gear for output pulses	○	○	○	○	
10	Denominator of electric gear for output pulses	○	○	○	○	
11	Output pulse phase selection at CCW rotation	○	○	○	○	
12	Z-phase offset	○	○	○	○	
13	Tuning mode selection	-	○	○	-	
14	Load inertia ratio	-	○	○	-	
15	Auto tuning gain 1	-	○	○	-	
16	Auto tuning gain 2	-	○	-	-	
20	Easy tuning: stroke setting	-	○	○	○	
21	Easy tuning: speed setting	-	○	○	○	
22	Easy tuning: timer setting	-	○	○	○	
23	Easy tuning: direction selection	-	○	○	○	
25	Max. rotation speed (for position and speed control)	-	○	○	-	
26	Max. rotation speed (for torque control)	-	-	-	○	
27	Forward rotation torque limit	-	○	○	○	
28	Reverse rotation torque limit	-	○	○	○	
29	Speed coincidence range	-	○	○	-	
30	Zero speed range	-	○	○	○	
31	Deviation unit selection	-	○	-	-	
32	Zero deviation range/In-position range	-	○	-	-	
33	In-position output format	○	○	-	-	
34	In-position minimum OFF time/ Single shot ON time	-	○	-	-	
35	In-position judgment time	-	○	-	-	

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
36	Acceleration / deceleration selection at speed control	-	-	○	○	
37	Acceleration time 1	-	○	○	○	
38	Deceleration time 1		○	○	○	
39	Acceleration time 2		○	○	○	
40	Deceleration time 2		○	○	○	
41	Manual feed speed 1 for position and speed control / speed limit 1 for torque control	-	○	○	○	
42	Manual feed speed 2 for position and speed control / speed limit 2 for torque control		○	○	○	
43	Manual feed speed 3 for position and speed control / speed limit 3 for torque control		○	○	○	
44	Manual feed speed 4 for position and speed control / speed limit 4 for torque control		○	○	○	
45	Manual feed speed 5 for position and speed control / speed limit 5 for torque control		○	○	○	
46	Manual feed speed 6 for position and speed control / speed limit 6 for torque control		○	○	○	
47	Manual feed speed 7 for position and speed control / speed limit 7 for torque control		○	○	○	

Parameters marked "○" in the table are enabled in the corresponding control mode.

■ PA1_: Control gain and filter setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
51	Moving average S-curve time	-	○	-	-	
52	Low-pass filter (for S-curve) time constant	-	○	○	-	
53	Command pulse smoothing function	-	○	-	-	
54	Position command response time constant	-	○	-	-	
55	Position loop gain 1	-	○	-	-	
56	Speed loop gain 1	-	○	○	-	
57	Speed loop integration time constant 1	-	○	○	-	
58	Feed forward gain 1	-	○	-	-	
59	Torque filter time constant for position and speed control	-	○	○	-	
60	Torque filter time constant for torque control	-	-	-	○	
61	Gain changing factor	-	○	○	-	
62	Gain changing level	-	○	○	-	
63	Gain changing time constant	-	○	○	-	

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No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
64	Position loop gain 2	-	○	-	-	
65	Speed loop gain 2	-	○	○	-	
66	Speed loop integration time constant 2	-	○	○	-	
67	Feed forward gain 2	-	○	-	-	
68	Acceleration compensation gain for position control	-	○	-	-	
70	Automatic notch filter selection	-	○	○	-	
71	Notch filter 1 frequency	-	○	○	-	
72	Notch filter 1 attenuation	-	○	○	-	
73	Notch filter 1 width	-	○	○	-	
74	Notch filter 2 frequency	-	○	○	-	
75	Notch filter 2 attenuation	-	○	○	-	
76	Notch filter 2 width	-	○	○	-	
77	Automatic vibration suppressing selection	-	○	-	-	
78	Vibration suppressing anti resonance frequency 0	-	○	-	-	
79	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 0	-	○	-	-	
80	Vibration suppressing anti resonance frequency 1	-	○	-	-	
81	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 1	-	○	-	-	
82	Vibration suppressing anti resonance frequency 2	-	○	-	-	
83	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 2	-	○	-	-	
84	Vibration suppressing anti resonance frequency 3	-	○	-	-	
85	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 3	-	○	-	-	
86	Vibration suppressing damping coefficient	-	○	-	-	
87	Model torque filter time constant	-	○	○	-	
88	Position loop integration time constant	-	○	-	-	
89	Position loop integration limiter	-	○	-	-	
90	Load torque observer	-	○	○	-	
91	P/PI automatic change selection	-	○	○	-	
92	Speed range for friction compensation	-	○	○	-	
93	Coulomb friction torque for friction compensation	-	○	○	-	
94	Torque filter setting mode	-	○	○	-	
95	Model torque calculation selection, speed observer selection	-	○	○	-	

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
96	Speed limit gain for torque control	-	-	-	○	

■ PA2_: Automatic operation setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
01	Decimal point position of positioning data	-	○	○	○	
06	Homing speed	-	○	-	-	
07	Creep speed for homing	-	○	-	-	
08	Starting direction for homing	○	○	-	-	
09	Reverse traveling unit amount for homing	-	○	-	-	
10	Homing direction after reference signal detection	○	○	-	-	
11	Reference signal for shift operation	○	○	-	-	
12	Reference signal for homing (Deceleration starting signal)	○	○	-	-	
13	Home position LS signal edge selection	○	○	-	-	
14	Home position shift unit amount	-	○	-	-	
15	Deceleration operation for creep speed	○	○	-	-	
16	Home position after homing completion	-	○	-	-	
17	Home position detection range	-	○	-	-	
18	Selection of operation at OT during homing	-	○	-	-	
19	Preset position	-	○	-	-	
20	Interrupt traveling unit amount	-	○	-	-	
22	Detection time for contact-stopper	-	○	-	-	
23	Torque limit for contact-stopper	-	○	-	-	
24	Reverse motion selection at homing OT	○	○	-	-	
25	Software OT selection	○	○	○	-	
26	+ software OT detection position	-	○	○	-	
27	- software OT detection position	-	○	○	-	
28	+ limiter detection position	-	○	-	-	
29	- limiter detection position	-	○	-	-	
31	Point detection, area detection	-	○	○	○	
32	Point detection, area detection position 1	-	○	○	○	
33	Point detection area detection position 2	-	○	○	○	
34	Point detection range	-	○	○	○	
36	Override 1	-	○	○	-	
37	Override 2					
38	Override 4					

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No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
39	Override 8	-	○	○	-	
40	Internal positioning data selection	-	○	○	-	
41	Sequential start selection	○	○	-	-	
42	Decimal point position of stand still timer	-	○	-	-	
43	Output selection at M code OFF	○	○	-	-	

Parameters marked ○ in the table are enabled in the corresponding control mode.

■ PA2_: Extended function setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
51	Numerator 1 of electronic gear ratio	-	○	-	-	
52	Numerator 2 of electronic gear ratio					
53	Numerator 3 of electronic gear ratio					
54	Command pulse ratio 1	-	○	-	-	
55	Command pulse ratio 2	-	○	-	-	
56	Speed limit selection at torque control	○	-	-	○	
57	Torque limit selection	○	○	○	-	
58	Second torque limit	-	○	○	-	
59	Deviation hold selection at torque limit	○	○	-	-	
60	Third torque limit	-	○	○	-	
61	Action sequence at servo-on OFF	○	○	○	○	
62	Action sequence at alarm	○	○	○	○	
63	Action sequence at main power shutoff	○	○	○	○	
64	Torque keeping time to holding brake	-	○	○	○	
65	Braking resistor selection	○	○	○	○	
66	Flying start at speed control	○	-	○	-	
67	Alarm detection at undervoltage	○	○	○	○	
68	Main power shutoff detection time	○	○	○	○	
69	Deviation detection overflow value	-	○	-	-	
70	Overload warning value	-	○	○	○	
72	Station number	○	○	○	○	
73	Communication baud rate (RS-485)	○	○	○	○	
74	Parameter write protection	-	○	○	○	
75	Positioning data write protection	-	○	-	-	
77	Initial display of the keypad	○	○	○	○	
78	Display transition at warning detection	○	○	○	○	
80	Parameter in RAM 1	○	○	○	○	
81	Parameter in RAM 2					

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
82	Parameter in RAM 3	○	○	○	○	
83	Parameter in RAM 4					
84	Parameter in RAM 5					
85	Parameter in RAM 6					
86	Positioning data in RAM 1	○	○	-	-	
87	Positioning data in RAM 2	○	○	-	-	
88	Positioning data in RAM 3	○	○	-	-	
89	Sequence test mode: mode selection	○	○	○	○	
90	Sequence test mode: encoder selection	○	○	○	○	
93	Parity/stop bit selection (for Modbus)	○	○	-	-	
94	Response time (for Modbus)	-	○	-	-	
95	Communication time over time (for Modbus)	-	○	-	-	
97	Communication protocol selection	-	○	-	-	

Parameters marked ○ in the table are enabled in the corresponding control mode.

■ PA3_: Input terminal function setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
01	CONT1 signal assignment	○	○	○	○	
02	CONT2 signal assignment					
03	CONT3 signal assignment					
04	CONT4 signal assignment					
05	CONT5 signal assignment					
06	CONT6 signal assignment					
07	CONT7 signal assignment					
08	CONT8 signal assignment					
09	CONT9 signal assignment					
10	CONT10 signal assignment					
11	CONT11 signal assignment					
12	CONT12 signal assignment					
13	CONT13 signal assignment					
14	CONT14 signal assignment					
15	CONT15 signal assignment					
16	CONT16 signal assignment					
17	CONT17 signal assignment					
18	CONT18 signal assignment					
19	CONT19 signal assignment					

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
20	CONT20 signal assignment	○	○	○	○	
21	CONT21 signal assignment					
22	CONT22 signal assignment					
23	CONT23 signal assignment					
24	CONT24 signal assignment					
26	CONT always ON 1					
27	CONT always ON 2					
28	CONT always ON 3					
29	CONT always ON 4					
30	CONT always ON 5					
31	Speed command scale	-	○	○	○	
32	Speed command offset	-	○	○	○	
33	Torque command scale	-	○	○	○	
34	Torque command offset	-	○	○	○	
35	Zero clamp level	-	○	○	-	
36	Deviation detection overflow input form	○	○	-	-	
39	Speed command fine adjustment gain	-	○	○	○	
40	Torque command fine adjustment gain	-	○	○	○	

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■ PA3_: Output terminal function setting parameter

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
51	OUT1 signal assignment	○	○	○	○	
52	OUT2 signal assignment	○	○	○	○	
53	OUT3 signal assignment	○	○	○	○	
54	OUT4 signal assignment	○	○	○	○	
55	OUT5 signal assignment	○	○	○	○	
56	OUT6 signal assignment	○	○	○	○	
57	OUT7 signal assignment	○	○	○	○	
58	OUT8 signal assignment	○	○	○	○	
59	OUT9 signal assignment	○	○	○	○	
60	OUT10 signal assignment	○	○	○	○	
61	OUT11 signal assignment	○	○	○	○	
62	OUT12 signal assignment	○	○	○	○	
63	OUT13 signal assignment	○	○	○	○	
64	OUT14 signal assignment	○	○	○	○	
65	OUT15 signal assignment	○	○	○	○	
66	OUT16 signal assignment	○	○	○	○	
67	OUT17 signal assignment	○	○	○	○	
68	OUT18 signal assignment	○	○	○	○	
69	OUT19 signal assignment	○	○	○	○	
70	OUT20 signal assignment	○	○	○	○	
71	OUT21 signal assignment	○	○	○	○	
81	Monitor 1 signal allocation	-	○	○	○	
82	Monitor 2 signal allocation	-	○	○	○	
83	Monitor 1 scale	-	○	○	○	
84	Monitor 1 offset	-	○	○	○	
85	Monitor 2 scale	-	○	○	○	
86	Monitor 2 offset	-	○	○	○	
87	Monitor 1/2 output format	-	○	○	○	
88	Command pulse frequency sampling time for monitor	-	○	-	-	
89	Feedback speed sampling time for monitor	-	○	○	○	
92	Range1 of position: Setting1	-	○	-	-	
93	Range1 of position: Setting2	-	○	-	-	
94	Range2 of position: Setting1	-	○	-	-	
95	Range2 of position: Setting2	-	○	-	-	

Parameters marked "○" in the table are enabled in the corresponding control mode.

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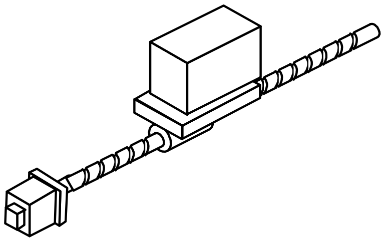
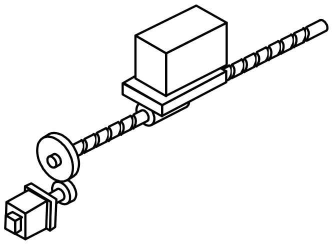
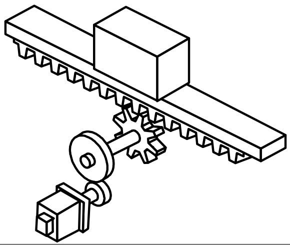
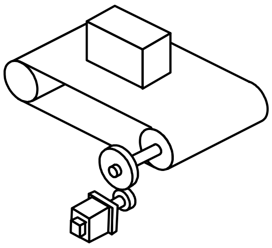
15.5 Capacity Selection Calculation

15.5.1 Type of Mechanical System

The mechanical system driven by a variable speed motor includes the following types.

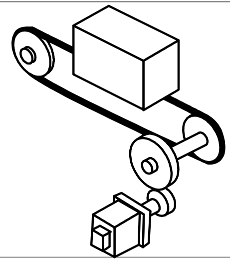
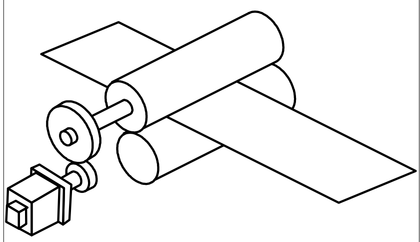
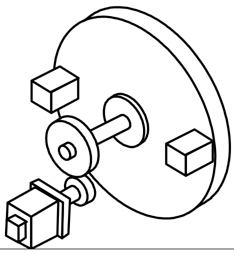
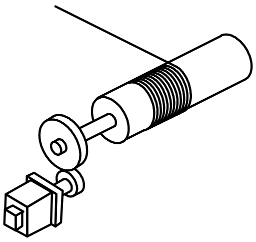
Mechanism	Features
	Ball screw (direct coupling) Used for a relatively short distance and accurate positioning. The motor is connected with the ball screw via a coupling and no play is included.
	Ball screw (geared) A reduction gear is included so that the torque transmitted to the mechanical system becomes large. Because of a gear backlash, compensation measures are necessary.
	Rack & Pinion Used for positioning of a relatively long distance (such as carrier drive). Because a π value is included in each pinion rotation, compensation measures are necessary.
	Timing belt (conveyor) Has a relatively large degree of freedom when compared with chain. Mainly for small loads. Because a π value is included in the traveling distance of each pulley rotation, compensation measures are necessary.

When applying the servo system to a mechanical system, take care of the following points.

(1) Reduction ratio
Use nearly at the rated speed (maximum rotation speed) of the motor to take advantage of the servomotor power. The continuous output torque at the maximum rotation speed is smaller than the rated torque.

(2) Preload torque
The load torque of a preloaded screw is large while the rigidity is increased. For the friction torque caused by the preload, refer to the specifications of the ball screw.

(3) Retention torque
The servomotor keeps outputting the retention force in the stopping state of a hoisting machine. Use of a retention brake is recommended if the time allows.

Mechanism	Features
	**Chain drive** Mainly used for the transfer line. Countermeasures against elongation of the chain itself are necessary. Used mainly for relatively large reduction ratios; the traveling speed of the mechanical system is small.
	**Feed roll** The material on a plate (band) is sandwiched between rolls and fed. Because the roll diameter is not obtained accurately, there is an error in a long distance. π compensation is necessary. Sudden acceleration causes slippage, resulting in shortage in the feeding amount.
	**Table indexing** Because the moment of inertia of the table is large, a sufficiently large reduction ratio is necessary. The table rotation speed is low and a worm gear is usually used.
	**Spindle drive** Because winding of a wire material results in a larger moment of inertia, a sufficiently large reduction ratio is necessary. To achieve a constant surface speed, examination must be made, including peripheral equipment.

■ Approximate machine constants

Approximate friction coefficient μ

Mechanism	Friction coefficient
Rail and iron wheel (Carrier and crane)	0.05
Linear guide	0.05 to 0.2
Ball spline	
Roller table	
Roller system	

Material density

Material	Density kg/m ^{3}
Copper	8.96×10^3
Brass	8.54×10^3
Stainless steel	7.91×10^3
Iron	7.85×10^3
Aluminum	2.7×10^3
Polyacetals	1.43×10^3

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Approximate mechanical efficiency η

Mechanism	Mechanical efficiency
Trapezoidal screw thread	0.5 to 0.8
Ball screw	0.9
Rack & Pinion	0.8
Gear reducer	0.8 to 0.95
Worm reducer (starting)	0.5 to 0.7
Worm reducer (during operation)	0.6 to 0.8
Belt transmission	0.95
Chain transmission	0.9

Module

$$(\text{Module}) = \frac{(\text{Pitch circle diameter of gear})}{(\text{Number of teeth})}$$

* Metric gear

* Module
0.5 0.75 0.8 1 1.5 2 2.5 3 4 5 6 7

Chain size

No.	Pitch	No.	Pitch
15	4.762	80	25.4
25	6.35	100	31.75
35	9.525	120	38.1
40	12.7	140	44.45
50	15.875	160	50.8
60	19.05	180	57.15

15.5.2 Capacity Selection Calculation

Perform capacity selection calculation to obtain the servomotor capacity necessary for machine specifications (configuration).
Items necessary for capacity selection calculation include the following.

- Load inertia (moment of inertia of mechanical system)
- Load torque (torque necessary to move the machine)
- Acceleration/Deceleration time
- Operation profile

In general, there is no way to measure the inertia of the mechanical system and load torque, calculate approximate values according to the configuration of the machine.

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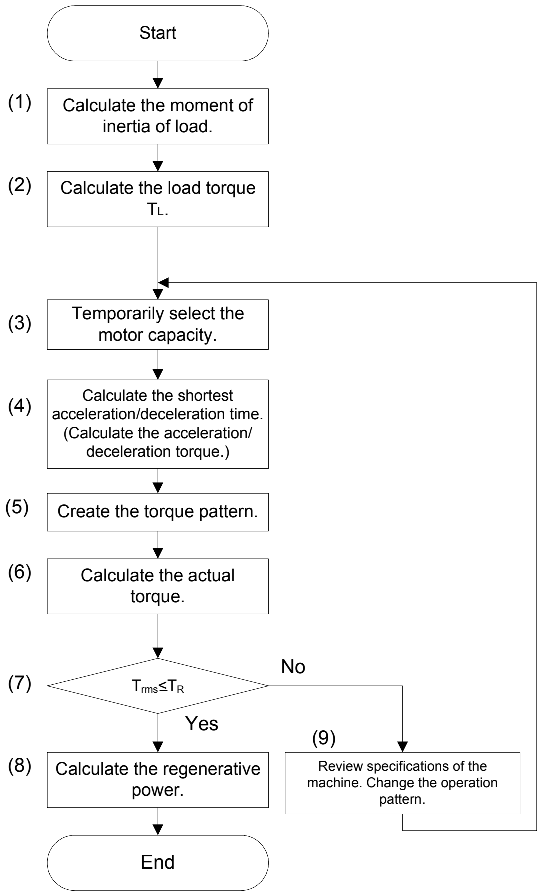
Follow the procedure below to perform capacity selection calculation.

Capacity selection flow chart



(1) Calculate the load inertia according to the configuration of the machine.

(2) Calculate the load torque according to the configuration of the machine.

(3) Temporarily select the motor capacity.

(4) Check the shortest acceleration/ deceleration time. If the time is designated, calculate the necessary acceleration/deceleration torque.

(5) Create the torque pattern according to the operation pattern.

(6) Calculate the effective torque according to the torque pattern.

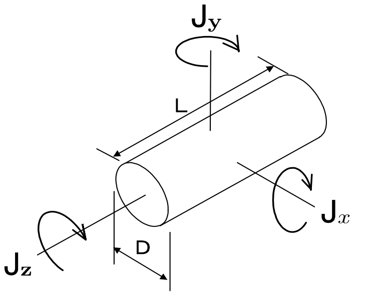
(7) If the effective torque (T_{rms}) is smaller than the rated torque (T_R), operation can be made with the designated operation pattern.

(8) Calculate the regenerative power and, if necessary, select the braking resistor.

(9) Review the specifications of the machine if possible.

■ Calculation of inertia

Shape

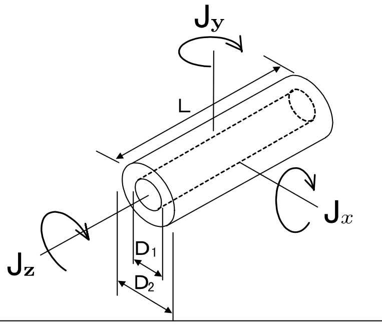


$$J_z = \frac{W}{8}\left(\frac{D}{10^3}\right)^2 = \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^4$$

$$J_x = J_y = \frac{W}{16}\left(\frac{D}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^2$$

W : [kg]
D : [mm]
L : [mm]
ρ : [kg/m^3]

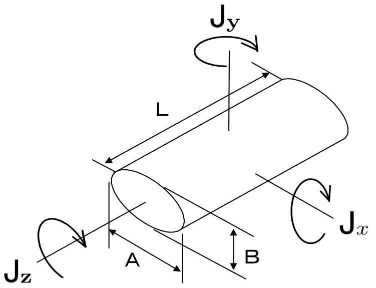


$$J_z = \frac{W}{8}\left\{\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right\} = \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left\{\left(\frac{D_2}{10^3}\right)^4 - \left(\frac{D_1}{10^3}\right)^4\right\}$$

$$J_x = J_y = \frac{W}{16}\left\{\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right\} + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left\{\left(\frac{D_2}{10^3}\right)^2 - \left(\frac{D_1}{10^3}\right)^2\right\}$$

W : [kg]
D : [mm]
L : [mm]
ρ : [kg/m^3]



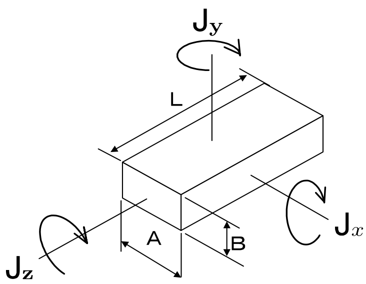
$$J_z = \frac{W}{16}\left\{\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right\}$$

$$J_x = \frac{W}{16}\left(\frac{B}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$J_y = \frac{W}{16}\left(\frac{A}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]



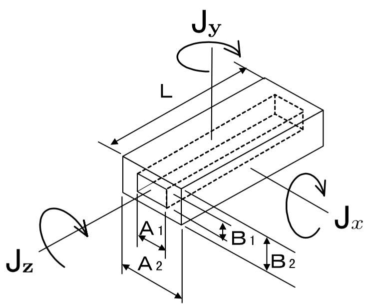
$$J_x = \frac{W}{12}\left\{\left(\frac{B}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_y = \frac{W}{12}\left\{\left(\frac{L}{10^3}\right)^2 + \left(\frac{A}{10^3}\right)^2\right\}$$

$$J_z = \frac{W}{12}\left\{\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right\}$$

$$W = \rho\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]



$$J_x = \frac{W_2}{12}\left\{\left(\frac{B_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{B_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_y = \frac{W_2}{12}\left\{\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_z = \frac{W_2}{12}\left\{\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{B_2}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{B_1}{10^3}\right)^2\right\}$$

$$W = \rho\left\{\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right) - \left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\right\}\left(\frac{L}{10^3}\right)$$

$$W_2 = \rho\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right)\left(\frac{L}{10^3}\right) \qquad W_1 = \rho\left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]

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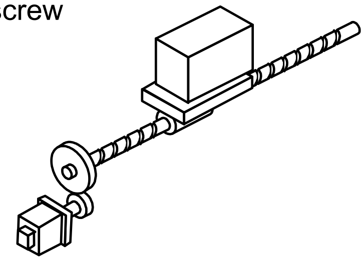
Conversion

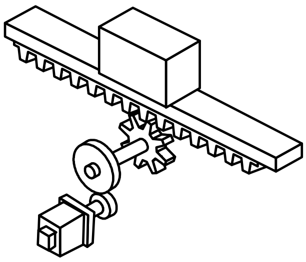
Ball screw



$$J_1 = W\left(\frac{1}{2\pi} \times \frac{BP}{10^3}\right)^2 \times GL^2$$

W: Total mass of moving parts [kg]
BP: Thread lead [mm]
GL: Reduction ratio (no unit)

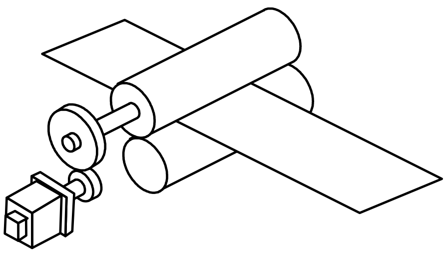
Rack & Pinion, conveyor and chain drive



$$J_2 = \frac{W}{4}\left(\frac{D}{10^3}\right)^2 \times GL^2$$

W: Total mass of moving parts [kg]
D: Diameter of pinion [mm]
Diameter of sprocket [mm]
GL: Reduction ratio (no unit)

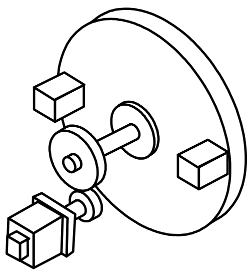
Feed roll



$$J_3 = \frac{W}{4}\left(\frac{D}{10^3}\right)^2 \times GL^2$$

W: Total mass of moving parts [kg]
D: Roll diameter [mm]
GL: Reduction ratio (no unit)

Rotating body and table drive



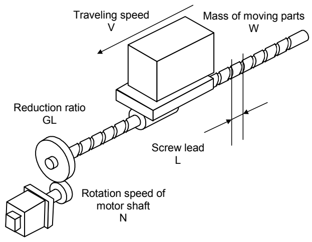
Obtain the sum of inertia of each shape.
Inertia of body located at a distance from the axis of rotation (J_4)

$$J_4 = \left(J + W\left(\frac{L}{10^3}\right)^2\right) \times GL^2$$

J: Inertia around the center of gravity of body
W: Mass of body [kg]
L: Distance between body and axis of rotation [mm]
GL: Reduction ratio (no unit)

■ Calculation of load torque (T_L)

Ball screw



$$T_L = \frac{(\mu W + F) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

μ: Friction coefficient BP: Screw lead [mm]
W, W_1: Mass of moving parts [kg]
W_2: Mass of counterweight [kg]
GL: Reduction ratio (no unit) F: Thrust [kg]

• Hoisting (vertically)

$$T_L = \frac{((\mu + 1)W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

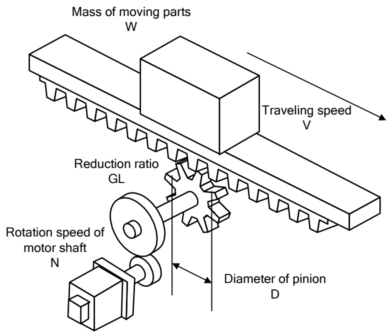
• Descending (vertically)

$$T_L = \frac{((\mu - 1)W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

• At a stop (vertically)

$$T_L = \frac{(W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

Conveyor and rack & pinion



$$T_L = \frac{(\mu W + F) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

μ: Friction coefficient D: Diameter [mm]
W, W_1: Mass of moving parts [kg]
W_2: Mass of counterweight [kg]
GL: Reduction ratio (no unit)

• Hoisting (vertically)

$$T_L = \frac{((\mu + 1)W_1 - W_2) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

• Descending (vertically)

$$T_L = \frac{((\mu - 1)W_1 - W_2) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

• At a stop (vertically)

$$T_L = \frac{(W_1 - W_2) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3}\right) \times GL$$

(1) Calculating the load inertia (J_L)
Calculate the inertia (GD^2) of the load of the mechanical system converted to the motor axis.
Calculate the inertia of the parts rotating (moving) along with motor rotation, and obtain the sum of all.

(2) Calculating the load torque (T_L)
Calculate the load torque converted to the motor axis.

(3) Temporarily select the motor capacity
Select the motor capacity satisfying the following two conditions.

- Allowable load inertia
  $J_L \le J_M \times 100\ (30)$ ························ In case of slow travel under speed control
  $J_L \le J_M \times 30\ (10)$ ·························· In case of positioning under position control
  $J_L \le J_M \times 10\ (-)$ ···························· In case of frequent positioning
  (Approximate measure: Starting and stopping at every 0.5 seconds or more frequently)
  Values in parentheses indicate operation with the GYG motor.
- Load torque
  $T_L \le T_R \times 0.9$ ································ 0.9 indicates a typical margin of safety.

(4) Calculating the shortest acceleration/deceleration time (calculating the accelerating/decelerating torque)
Check the shortest acceleration/deceleration under consideration of load conditions. If the acceleration/deceleration time is designated, calculate the acceleration/deceleration torque.

- Shortest acceleration/Deceleration time

$$t_{AC} = \frac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60\ (T_{AC} - T_L)}$$

- Acceleration/Deceleration torque

$$t_{AC} = \frac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60\ (t_{AC})} + T_L$$

where
t_{AC}: Acceleration/Deceleration time [s]
J_M: Inertia of servomotor [kgm^2]
J_L: Inertia of load converted to motor axis [kgm^2]
T_L: Load torque converted to motor axis [Nm]
T_{AC}: Acceleration/Deceleration torque [Nm]

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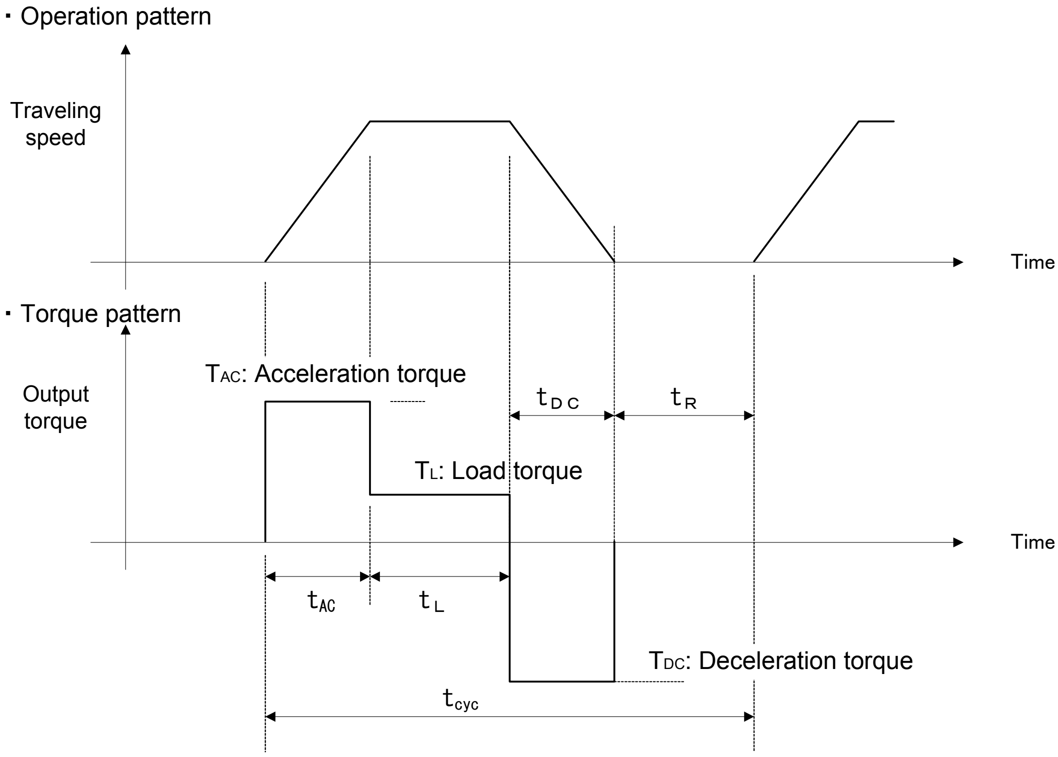
(5) Creating the torque pattern
Create the pattern of the output torque according to the operation pattern.



(6) Calculating the effective torque (T_{rms})
Calculate the effective torque of each cycle of the operation pattern.

$$T_{rms} = \sqrt{\frac{(T_{AC}^2 \times t_{AC}) + (T_L^2 \times t_L) + (T_{DC}^2 \times t_{DC})}{t_{CYC}}}$$

Obtain the sum of each of the product of the squared output torque multiplied by the output time and divide the sum by the cycle time, and obtain the square root of the result.

(7) $T_{rms} \leq T_R$
If the effective torque is equal to or smaller than the rated torque, continuous operation in the designated operation pattern is possible.

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(8) Calculating the regenerative power
Regenerative operation is caused in general in the following state.
Horizontal feed: During deceleration
Vertical feed: During constant speed feed in the lowering cycle and during deceleration

Regenerative power during deceleration (P_1)

$$P_1\,[\mathrm{W}] = (2\pi/60) \times T_{DC}\,[\mathrm{Nm}] \times N_1\,[\mathrm{r/min}] \times (1/2)$$

Constant speed feed in lowering cycle (P_2)

$$P_2\,[\mathrm{W}] = (2\pi/60) \times T_{DC}\,[\mathrm{Nm}] \times N_1\,[\mathrm{r/min}]$$

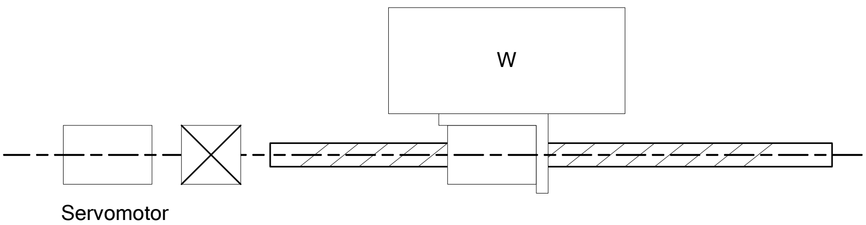
Calculate the average regenerative power (P) of each cycle of the operation pattern to check if P is within the braking resistor capacity. If it is not, an external braking resistor is necessary.

(9) Reviewing the operation pattern and mechanical configuration
If T_{rms} exceeds T_R, review the following items.
- Increase the acceleration/deceleration time a little in the allowable range.
- Reduce the operation frequency (increase the cycle time).
- If the rotation speed allows, increase the reduction ratio.
- Increase the motor capacity.
- If the stopping time of a hoisting machine is too long, adopt a mechanical brake.
- In case of operation at a high frequency, increase the reduction ratio and reduce the inertia.

15.5.3 Capacity Selection Calculation Example

■ Mechanical configuration

Reduction ratio 1/1 (direct coupling)



Screw pitch 10 [mm], transfer mass 20 [kg], thrust 0 [kg] (absent)

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(1) Max. traveling speed (v)
If the reduction ratio is 1/1 and the rotation speed of the motor shaft is 3000 [r/min]

v = (3000/60) × 10×(1/1) = 500 [mm/s]

(2) Load inertia converted to motor axis (J_L)
- Screw (J_1) Suppose Ø20 and 500 [mm] in length.

$$J_1 = \frac{\pi \rho}{32}\left[\frac{L}{1000}\right]\left[\frac{D_1}{1000}\right]^4 \times GL^2$$

$$= \frac{\pi \times 7.85 \times 10^3}{32}\left[\frac{500}{1000}\right]\left[\frac{20}{1000}\right]^4 \times (1/1)^2$$

$$= 0.6 \times 10^{-4}\ [\text{kg m}^2]$$

- Moving parts (J_2) Suppose a transfer mass of 20 [kg].

$$J_2 = W\left[\frac{1}{2\pi}\ \frac{BP}{1000}\right]^2 \times (GL)^2$$

$$= 20\left[\frac{1}{2\pi}\ \frac{10}{1000}\right]^2 \times (1/1)^2$$

$$= 0.5 \times 10^{-4}\ [\text{kg m}^2]$$

$$J_L = 1.1 \times 10^{-4}\ [\text{kg m}^2]$$

(3) Load torque converted to motor axis (T_L)
Suppose a transfer mass of 20kg, friction coefficient (μ) of 0.1 and machine efficiency (η) of 0.9.

$$T_L = \frac{(\mu W + F) \times 9.81}{2\pi\eta}\left[\frac{BP}{1000}\right] \times GL$$

$$= \frac{(0.1 \times 20 + 0) \times 9.81}{2\pi \times 0.9}\left[\frac{10}{1000}\right] \times (1/1)$$

$$= 0.03\ [\text{Nm}]$$

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(4) Capacity selection condition

$T_L \leq T_R \times 0.9$

$J_L \leq J_M \times 5$ (Frequent feed)

$T_L = 0.03$ [Nm]

$J_L = 1.1 \times 10^{-4}$ [kg m^2]

(5) Temporary selection

According to the capacity selection condition, GYS201D5-HB2 (0.2 [kW]) is found.

($J_M = 0.135 \times 10^{-4}$ [kgm^2], $T_R = 0.637$ [Nm], $T_{AC} = 1.91$ [Nm])

(6) Shortest acceleration/deceleration time (t_{AC})

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60\,(T_{AC} - T_L)}$$

$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60\,(1.91 - 0.03)}$$

$$= 0.021 \quad [s]$$

Acceleration/Deceleration torque at an acceleration/Deceleration time of 0.05 seconds

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60\,(T_{AC})} + T_L$$

$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 \times 0.05} + 0.03$$

$$= 0.78 \quad [Nm]$$

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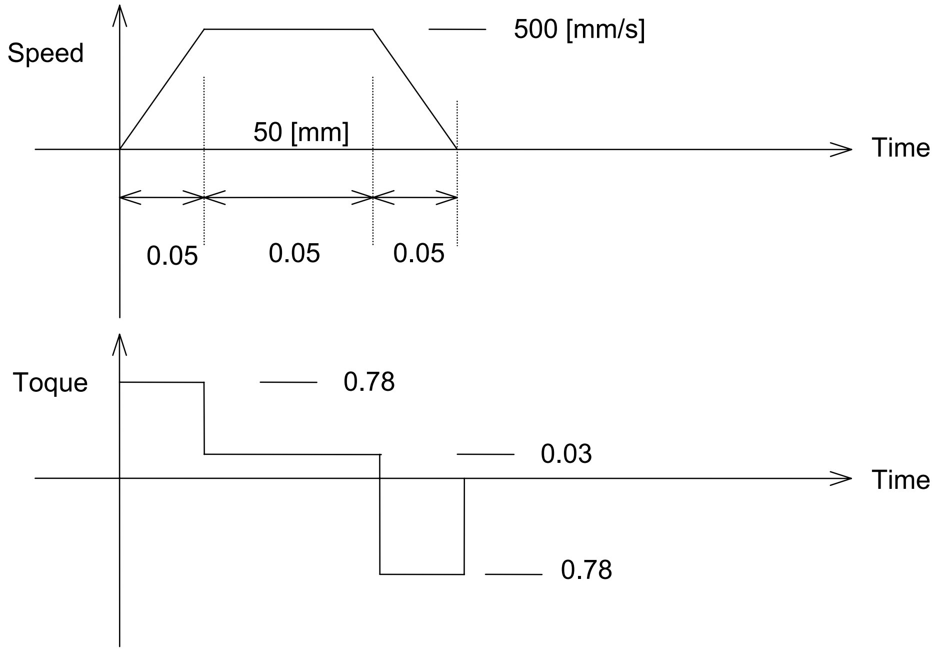
(7) Operation profile



This profile is based on calculation selection. The operation cycle time supposes 0.5 sec.

(8) Effective torque (T_{rms})
Time-average output torque

$$T_{rms} = \sqrt{\frac{T_{AC}^2 \times t_a + T_L^2 \times t_L + T_{DC}^2 \times t_d}{t_{cyc}}}$$

$$= \sqrt{\frac{(0.78^2 \times 0.05) \times 2 + (0.03^2 \times 0.05) \times 1}{0.5}}$$

$$= 0.25 \text{ [Nm]}$$

Because the result is smaller than rated torque (0.637 [Nm]) of the GYS201D5-HB2 type, continuous operation can be made in the designated profile.

(9) Result of selection
Servomotor: GYS201D5-HB2 (0.2 [kW])

(10) Regenerative power

Regenerative power is caused during deceleration.

$$P_1\ [W] = (2\pi/60) \times T\ [Nm] \times N\ [r/min] \times (1/2)$$

$$= (2\pi/60) \times 0.78 \times 3000 \times (1/2)$$

$$\approx 123\ [W]$$

Average regenerative power of cycle operation

$P = (123 \times 0.05)/0.5$

$\approx 12.3\ [W]$

The RYT201D5 type servo amplifier is not equipped with a built-in braking resistor.

Follow the procedure below to check if the braking resistor is necessary or not.

[1] Obtain the energy (E_G) of the mechanical system in the deceleration cycle.

$$E_G = \frac{1}{2}(J_M+J_L)\cdot(2\pi N/60)^2$$

$$= \frac{1}{2}(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times \left(\frac{2\pi \times 3000}{60}\right)^2$$

$$= 6.1\ [J]$$

[2] Calculate the energy (E_L) consumed by the load torque.

$$E_L = (2\pi/60) \times T_L \times N \times t_{DC} \times (1/2)$$

$$= (2\pi/60) \times 0.03 \times 3000 \times 0.05 \times (1/2)$$

$$= 0.24\ [J]$$

[3] Calculate the energy (E_M) consumed by the coil of the servomotor.

$$E_M = 3 \times (R \times I^2) \times t_{DC}$$

$$= 3 \times R \times ((T_{DC}/T_R \times I_R)^2) \times t_{DC}$$

$$= 3 \times 2.3 \times ((0.78/0.637 \times 1.5)^2) \times 0.05$$

$$= 1.2\ [J]$$

Phase resistance of GYS201D5-HB2 type: 2.3 [Ω]

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[4] Calculate the energy (E_S) that can be absorbed by the servo amplifier.

$$E_S = \frac{1}{2} C\,(V_{DB}^2 - V_{DC}^2)$$

$$= \frac{1}{2}(300 \times 10^{-6}) \times (390^2 - (200 \times \sqrt{2})^2)$$

$$= 10.8 \text{ [J]}$$

- DC link capacity (RYT201): 300 [μF], source voltage 200 [V] (actual value)
- The capacitor of 0.2 [kW] or smaller capacity servo amplifiers is 300 [μF].
- V_{DB}: DB transistor activation level (390 [V]). V_{DC}: DC link voltage (200 x √2 [V])

The energy that can be processed by the mechanical system, servo amplifier and servomotor is:

$E_L + E_M + E_S = 0.24 + 1.2 + 10.8 \approx 12.2$ [J]

Because $E_G = 6.1$ [J], no external braking resistor is necessary.

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■ Constants

■200V series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia 10^{-4}[kg·m^2]	Capacity of capacitor [μF]
GYS	0.05	0.85	4.7	0.0192	300
	0.1		7.8	0.0371	
	0.2	1.5	2.3	0.135	
	0.4	2.7	1.1	0.246	660
	0.75	4.8	0.36	0.853	940
	1.0	7.1	0.35	1.73	
	1.5	9.6	0.25	2.37	1360
	2.0	12.6	0.19	3.01	1880
	3.0	18.0	0.07	8.32	2720
	4.0	24.0	0.05	10.8	4080
	5.0	30.0	0.05	12.8	

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia 10^{-4}[kg·m^2]	Capacity of capacitor [μF]
GYC	0.1	1.0	3.6	0.0577	300
	0.2	1.5	2.1	0.213	
	0.4	2.6	0.9	0.408	660
	0.75	4.8	0.38	1.21	940
	1.0	6.7	0.27	3.19	
	1.5	9.6	0.15	4.44	1360
	2.0	12.6	0.11	5.69	1880

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia 10^{-4}[kg·m^2]	Capacity of capacitor [μF]
GYG 2000r/min	0.5	3.5	0.71	7.96	940
	0.75	5.2	0.40	11.55	
	1.0	6.4	0.32	15.14	
	1.5	10.0	0.17	22.33	1880
	2.0	12.3	0.14	29.51	
GYG 1500r/min	0.5	4.7	0.40	11.55	940
	0.85	7.3	0.32	15.15	
	1.3	11.5	0.17	22.33	1880

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■100V series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia 10^{-4}[kg·m^2]	Capacity of capacitor [μF]
GYS	0.05	0.85	4.7	0.0192	2000
	0.1	1.5	2.5	0.0371	
	0.2	2.7	0.66	0.135	
	0.375	4.8	0.31	0.246	2400

15.6 Revision History

Date of printing	Index	Description of revision
September 30, 2007	None	First version
December 20, 2007	a	Capacity expamded (up to 5kW)
April 20, 2008	b	Version up with VV type Description divided into VVtype and SX type 100V series added

15.7 Product Warranty

■ Dear Customers of Fuji Electric Product,

The warranty of this product is as follows unless the special instructions state otherwise in the quote, contract, catalogue, or specifications at the time of quote or order.
The purpose or area of use may be limited, and a routine checkup may be required depending on the product. Please contact the distributor from which you purchased the product from, or Fuji Electric for further information.
Please conduct prompt incoming inspection of the product upon purchase or delivery. Also, please give enough consideration to management and maintenance of the product prior to accepting the product.

1. Period and coverage of the warranty

1-1 Period

(1) The period of the warranty is effective until the earliest of either a year from the date of purchase or, eighteen (24) months from the date of manufacture printed on the plate.

(2) The above period may not be applicable in case the particular environment, conditions or frequency of use affects the lifetime of the product.

(3) The warranty for the parts repaired by Fuji Electric service department is effective for six months from the date of repair.

1-2 Coverage

(1) If malfunction occurs in the period of warranty due to Fuji Electric, the malfunctioning parts are exchanged or repaired for free at the point of purchase or delivery. However, the warranty does not apply to the following cases.

1) The malfunction occurs due to inappropriate conditions, environment, handling or usage that is not instructed in a catalogue, instruction book or user's manual.
2) The malfunction is caused by the factors that do not originate in the purchased or delivered product.
3) The malfunction is caused by other devices or software design that does not originate in Fuji Electric products.
4) The malfunction occurs due to an alteration or repair that is not performed by Fuji Electric.
5) The malfunction occurs because the expendable parts listed in an instruction book or catalogue were not maintained nor exchanged in an appropriate manner.
6) The malfunction occurs due to factors that were not foreseeable by the practical application of science and technology at the time of purchase or delivery.
7) The malfunction occurs because the product is used for an unintended purpose.
8) The malfunction occurs due to a disaster or natural disaster that Fuji Electric is not responsible for.

(2) The warranty is only applicable to the single purchased delivered product.

(3) The warranty covers only the area stated in above (1). Any damage induced by the malfunction of the purchased or delivered product, including the damage or loss to a device or machine and passive damages, is not covered by the warranty.

1-3 Malfunction diagnosis

(1) Malfunction is to be diagnosed temporarily by the purchaser. This diagnosis can be conducted by Fuji Electric or its delegated service provider with due charge upon the request from the purchaser. The charge is to be paid by the purchaser at the rate stipulated in the rate schedule of Fuji Electric.

2. Liability for opportunity loss
   Regardless of the time period of the occurrence, Fuji Electric is not liable for the damage caused by the factors Fuji Electric is not responsible for, opportunity loss of the purchaser caused by malfunction of Fuji Electric product, passive damages, damage caused due to special situations regardless of whether it was foreseeable or not, and secondary damage, accident compensation, damage to products that were not manufactured by Fuji Electric, and compensation towards other operations.
3. Period for repair and provision of spare parts after the production is discontinued (maintenance period)
   The discontinued models (products) can be repaired for seven years from the date of discontinuation. Also, most spare parts used for repair are provided for seven years from the date of discontinuation. However, some electric parts may not be obtained due to their short life cycle. In this case, repair or provision of the parts may be difficult in the above period. Please contact Fuji Electric or its service providers for further information.
4. Delivered term
   Standard products that do not entail application setting or adjustment are regarded as received by the purchaser upon delivery. Fuji Electric is not responsible for local adjustments and test runs.
5. Service
   The price of the delivered or purchased products does not include the service fee for the technician. Please contact Fuji Electric or its service providers for further information.
6. Scope of application
   Above contents shall be assumed to apply to transactions and use of the country where you purchased the products. Consult the local supplier or Fuji Electric for the detail separately.

15.8 Service Network

Fuji FA Service Centers

- Overseas Service Center
  [Service Area: Far East Asia]
  5-7, Nihonbashi
  Odemma-cho, Chuo-ku, Tokyo, 103-0011, Japan
  Phone: (03)5847-8072
- USA Service Center
  [Service Area: USA, Canada, Central & South America]
  5550 Cerritos Ave. Suite H Cypress, CA. 90630 USA
  Phone: (714)220-1879
- CHICAGO Service Station
  4825 N. Scott St. Suite 210, Schiller Park, IL 60176 USA
  Phone: (847)233-9844
- EC Service Center
  [Service Area: Europe, Middle East & Africa]
  Goethering 58, 63067
  Oftenbach/ Main Germany
  Phone: (69)669029-0
- South East Asia & Oceania Service Center
  [Service Area: SE & S Asia, Oceania]
  171 Chin Swee Road, #12-01,
  San Centre, Singapore 169877
  Phone: (6481)5079
- FUJI-ELECTRIC TECHNOLOGY AND SERVICE (SHENZHEN) CO., LTD
  [Service Area: China]
  5F, Liming Bldg., No.144,
  Zhongxing Rd., Luohu District, Shenzhen
  Phone: (0755)8220-2745, 8218-4287

Contracted Service Companies

- **USA, Canada, Central & South America Area**
  USA
  OESS CORPORATION(Head Office:NEW JERSEY)

❶ NEW JERSEY
800 Huyler Street Teterboro, NJ 07608, USA
Phone: (201)288-4422

❷ CHICAGO
4825 N Scott Suite 210, Schiller park, IL 60176, USA
Phone: (847)233-9412

❸ LOS ANGELES
5550 Cerritos Ave. Suite H, Cypress, CA 90630 USA
Phone: (714)220-1879

❹ SAN JOSE
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Phone: (408)437-1582

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Phone: (02)3463-0766

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❼ TAIWAN
Full Key International Technology Ltd
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Phone: (02)2995-2008

- **Europe, Middle East & Africa Area**

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OESS GmbH.
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The Inverter Value Engineering Center (Suzuka Area) has acquired environment management system ISO14001 and quality management system ISO9001 certifications.

Fuji Electric Systems Co., Ltd.

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