Fuji Electric

Innovating Energy Technology

FUJI SERVO SYSTEM
ALPHA5 Smart
USER'S MANUAL

ALPHA5 Smart

24C7-E-0016c

This manual is "User's Manual for Fuji AC Servo System ALPHA5 Smart 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 (GYB/GYH/GYG/GYC/GYS Series)	ING-SI47-0863
Servo amplifier	Operation manual Fuji AC servo ALPHA5 Smart Series servo amplifier (RYH□□□F5-VV2)	INR-SI47-1439-JE

The target model of this manual is shown below.

Device	Model
Servomotor	GYB□□□D5-**2 or GYH□□□C6-**2 or GYG□□□C(B)5-**2 or GYC□□□D5-**2 or GYS□□□D5-**2
Servo amplifier	RYH□□□F5-VV2

* "□" 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

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

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■ 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.
- If the charge LED is off even though the power is turnd on, the fuse inside the servo amplifier may be blown. To check the fuse, wait five minutes or more after turning off the power.
  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.
- Perform the wiring correctly and firmly.
  It might cause 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, regenerative 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 regenerative resistor is used, take measures to turn the power off upon a fault signal output from the servo amplifier.
  Otherwise the regenerative gresistor may be overheated and cause fire in the event of failure of the regenerative transistor.

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■ 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.
- For detailed description regarding lithium batteries, refer to "CHAPTER 15. APPENDIXES."
- Fumigation process before shipment
  The internal parts of servo amplifiers may get corroded due to a halogen compound gas such as methyl bromide which is used for fumigation process in packaging, resulting in damage of the product.
  When shipping servo amplifiers by installing them to a board or unit, pack them using wooden materials which have been processed with fumigation treatment.

■ Precautions on installation

⚠ CAUTION

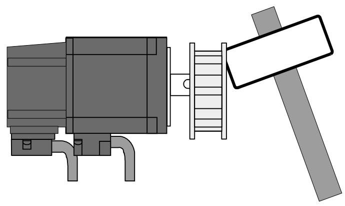
- Do not ride on the servomotor or place a heavy matter on it.
  It might cause failure, breakage, electric shock and injuries.
- Do not block the exhaust port or do not allow foreign substance to enter.
  It might cause fire and electric shock.
- Observe the installation orientation of the servo amplifier.
  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. Also there is a risk of damaging your mechanical equipment due to motor malfunction.
- Make sure to check if the motor cable is connected properly. If open phase faulty has been occurred with the motor power cable wiring (U, V, and W), the motor will not rotate even if a command is given, failing in detecting any alarm such as OL and OS.
- When fabricating an encorder cable, be careful not to reverse the porality between BAT+ and BAT-. If the battery is connected with wrong polarity, the both battery terminals may become short circuit, generating abnormal heat or causing damage to the battery.
- 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 protected from ground fault fully.

GROUND

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

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■ 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 regenerative 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

■ EC Directive and UL/CSA Standard

- UL (North American Standards for Safety)

	UL standard
Servo amplifier	UL508C
Servomotor	UL1004

- EC Directive

	Low Voltage Directive	EMC Directive	
		EMI	EMS
Servo amplifier	EN61800-5-1	EN55011 Class A group 1	EN61800-3
Servomotor	EN60034-1 EN60034-5	EN55011 Class A group 1	EN61800-3

(Note) The machine on your shop floor needs to be certified to each standard or directive when used as the servo amplifier and the servo motor are devices to be embedded. Some of the models are in the process to be certified.

0.2 Outline of System

ALPHA5 Smart 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 five types: Middle inertia type (GYB), (GYH), (GYG), low inertia type (GYC), Ultra-low Inertia type (GYS).

Type		Voltage(V)	Applicable motor capacity(kW)															
			0.05	0.1	0.2	0.4	0.5	0.75	0.85	1.0	1.3	1.5	2.0	3.0	4.0	5.0	5.5	7.0
 GYB motor Middle inertia	GYB motor 2000r/min (Max. speed 3000r/min)	200V series (5 models)			■	■		■										
 GYH motor Middle inertia	GYH motor 2000r/min (Max. speed 2500r/min)	200V series (7 models)								■		■	■	■	■		■	■
 GYG motor Middle inertia	GYG motor 2000r/min (Max. speed 3000r/min)	200V series (5 models)					■	■		■		■	■					
 GYG motor Middle inertia	GYG motor 1500r/min (Max. speed 3000r/min)	200V series (3 models)					■		■		■							
 GYC motor Low inertia	GYC motor 3000r/min (Max. speed 0.75kW or less: 6000r/min 1.0kW or more: 5000r/min)	200V series (7 models)		■	■	■		■		■		■	■					
 GYS motor Ultra-low inertia	GYS motor 3000r/min (Max. speed 0.75kW or less: 6000r/min 1.0kW or more: 5000r/min)	200V series (11 models)	■	■	■	■		■		■		■	■	■	■	■		

*1: Except for the shaft-through part (and the connectors for GYB, GYC and GYSmotors of 0.75 kW or less)
*2: Models with a brake have "-B" at the end of the code.

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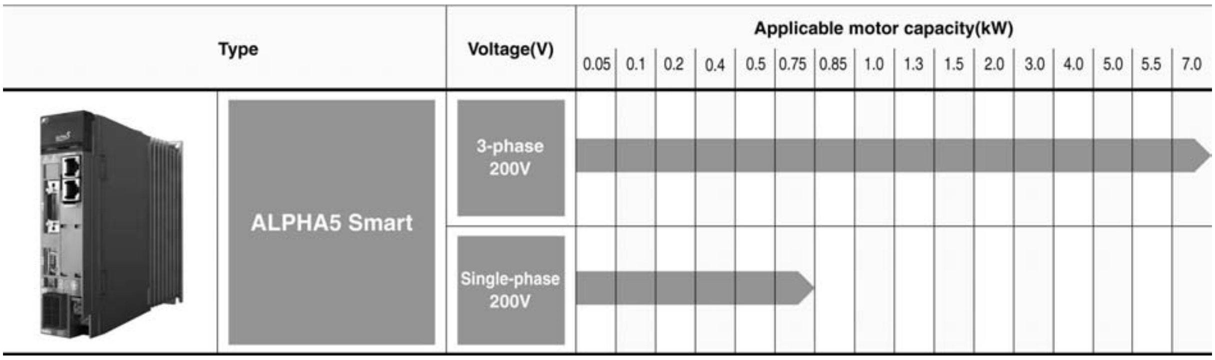
0.2.2 Servo Amplifier

The servo amplifier of general-purpose interface type (VV) is prepared.



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0.3 Model Nomenclature

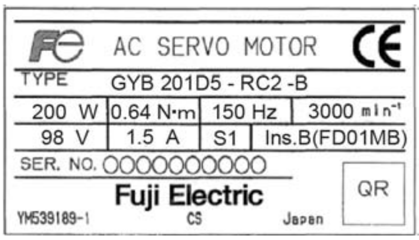
■ When unpacking

Check the following items.

- Check if the delivered item is what you have ordered.
- Check if the product is not damaged during transportation.
- Check if the instruction manual is included.

If you have any uncertainties, contact the seller.

0.3.1 Servomotor



GYB 201 D 5 - R C 2 - B

Code	[Basic Type]
GYB	Middle Inertia Type
GYH	Middle Inertia Type
GYG	Middle Inertia Type
GYC	Low Inertia Type
GYS	Ultra-low Inertia Type

Code	[Rated Output]
500	$50\times10^0 = 50W$
101	$10\times10^1 = 100W$
201	$20\times10^1 = 200W$
401	$40\times10^1 = 400W$
751	$75\times10^1 = 750W$
851	$85\times10^1 = 850W$
102	$10\times10^2 = 1.0kW$
132	$13\times10^2 = 1.3kW$
152	$15\times10^2 = 1.5kW$
202	$20\times10^2 = 2.0kW$
302	$30\times10^2 = 3.0kW$
402	$40\times10^2 = 4.0kW$
502	$50\times10^2 = 5.0kW$
552	$55\times10^2 = 5.5kW$
702	$70\times10^2 = 7.0kW$

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

Code	[Development Order]
5	5
6	6

Code	[Brake]
Blank	Without
B	With

Code	[Input voltage]
2	3-phase 200V

Code	[Oil seal/shaft]
A	Without oil seal, straight shaft, with key
B	Without oil seal, straight shaft, without key
C	Without oil seal, straight shaft, with key, tapped
E	With oil seal, straight shaft, with key
F	With oil seal, straight shaft, without key
G	With oil seal, straight shaft, with key, tapped

Code	[Encoder]
H	ABS/INC(18bit)*
R	INC(20bit)
T	INC(17bit)

* Battery is necessary for ABS type.
Note: Please see the model list on page 16, 17 for the combination detail.

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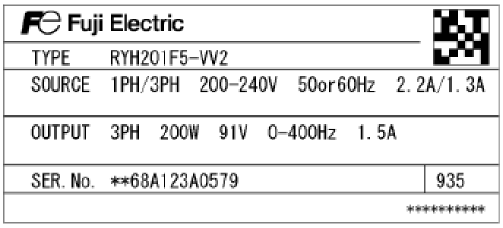
0.3.2 Servo Amplifier

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



RYH 201 F 5 - V V 2

Code	[Basic Type]
RYH	ALPHA5 Smart series

Code	[Applicable Motor Output]
201	20×10^1 = 200W,100W,50W
401	40×10^1 = 400W
751	75×10^1 = 750W,500W
152	15×10^2 = 1.5kW,1.0kW,850W
202	20×102 = 2.0kW
302	30×10^2 = 3.0kW,4.0kW
402	40×10^2 = 4.0kW,5.5kW
502	50×10^2 = 5.0kW,7.0kW

Code	[Series]
F	1500 to 3000r/min series

Code	[Input voltage]
2	3-phase 200V

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

Code	[Major functions]
V	Position, speed and torque control

Code	[Development Order]
5	5

0.4 Combination between Servomotor and Servo Amplifier

Use the servomotor and servo amplifier in one of the following sets.
Do not use them of other combinations.

0.4.1 VV Type

Inertia		Middle				Low	Ultra-low
Applicable Motor / Servo Amplifier	Applicable motor output	GYB Motor 3000 [r/m] Brake: without (with)	GYH Motor 2000 [r/min] Brake: without (with)	GYG Motor 2000 [r/min] Brake: without (with)	GYG Motor 1500 [r/min] Brake: without (with)	GYC Motor 3000 [r/min] Brake: without (with)	GYS Motor 3000 [r/min] Brake: without (with)
RYH201F5-VV2	0.05kW						GYS500D5-□□2 (-B)
	0.1kW					GYC101D5-□□2 (-B)	GYS101D5-□□2 (-B)
	0.2kW	GYB201D5-□□2 (-B)				GYC201D5-□□2 (-B)	GYS201D5-□□2 (-B)
RYH401F5-VV2	0.4kW	GYB401D5-□□2 (-B)				GYC401D5-□□2 (-B)	GYS401D5-□□2 (-B)
RYH751F5-VV2	0.5kW			GYG501C5-□□2 (-B)	GYG501B5-□□2 (-B)		
	0.75kW	GYB751D5-□□2 (-B)		GYG751C5-□□2 (-B)		GYC751D5-□□2 (-B)	GYS751D5-□□2 (-B)
	1.0kW		GYH102C6-TC2 (-B)				
RYH152F5-VV2	0.85kW				GYG851B5-□□2 (-B)		
	1.0kW			GYG102C5-□□2 (-B)		GYC102D5-□□2 (-B)	GYS102D5-□□2 (-B)
	1.5kW		GYH152C6-TC2 (-B)	GYG152C5-□□2 (-B)		GYC152D5-□□2 (-B)	GYS152D5-□□2 (-B)
	2.0kW		GYH202C6-TC2 (-B)				
RYH202F5-VV2	1.3kW				GYG132B5-□□2 (-B)		
	2.0kW			GYG202C5-□□2 (-B)		GYC202D5-□□2 (-B)	GYS202D5-□□2 (-B)
	3.0kW		GYH302C6-TC2 (-B)				
RYH302F5-VV2	3.0kW						GYS302D5-□□2 (-B)
	4.0kW		GYH402C6-TC2 (-B)				
RYH402F5-VV2	4.0kW						GYS402D5-□□2 (-B)
	5.5kW		GYH552C6-TC2 (-B)				
RYH502F5-VV2	5.0kW						GYS502D5-□□2 (-B)
	7.0kW		GYH702C6-TC2 (-B)				

CHAPTER 1 INSTALLATION

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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 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 to +40°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 sunlight
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)

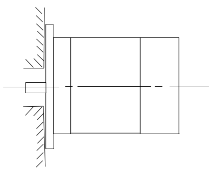
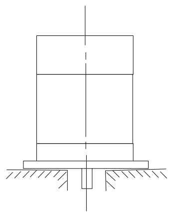
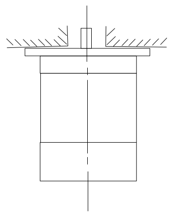
Observe the following when operating.

- 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 or impact.
- 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.

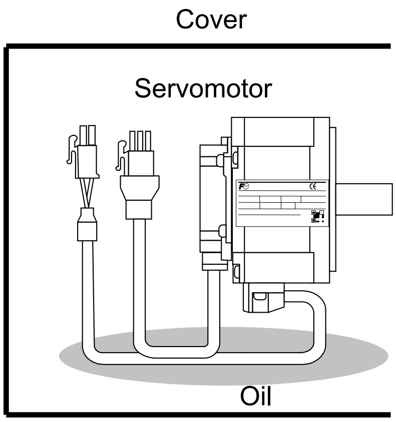
Flange type

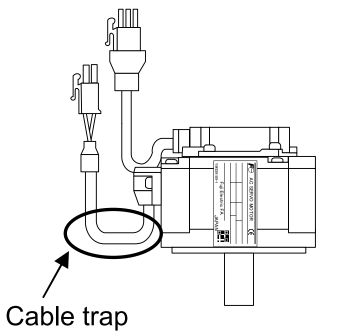
IM B5 (L51)	IM V1 (L52)	IM V3 (L53)
		

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.※Keep the temperature inside the cover to 40-degree or less.
- 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.





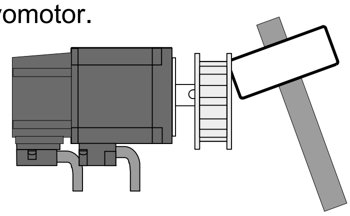
※The protection level is the initial property.

1

1.1.5 Servomotor Handling Precautions

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.
  The servomotor needs to be connected to an appropriate servo amplifier when used.
  For how to connect the servomotor to a servo amplifier, refer to "CHAPTER 2 WIRING."

1.1.6 Notes on Stress Given to Cable

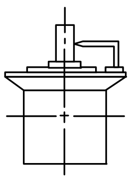
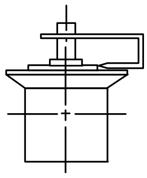
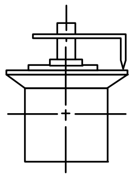
- In applications where the servomotor and machine movable part move, take measures to avoid stress given on the cable.
- Route the encoder cable and motor power cable in CABLEVEYOR.
- Fix the encoder cable and motor power cable attached to the servomotor (routed from the motor) with cable clamps or 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
GYB□□□D5	Within 0.02	Within 0.06	Within 0.08
GYG□□□□5			
GYC□□□D5			
GYS□□□D5			
GYH□□□C6	Within 0.03	Within 0.08	Within 0.10

Runout at shaft end	Misalignment (flange)	Perpendicularity of flange face
		

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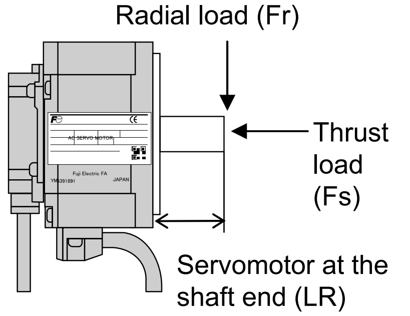
1.1.8 Allowable Load

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]
GYB201D5-□□2	245	98	25
GYB401D5-□□2	245	98	25
GYB751D5-□□2	392	147	35
GYH102C6-□□2	490	150	58
GYH152C6-□□2	490	190	58
GYH202C6-□□2	490	220	58
GYH302C6-□□2	740	180	58
GYH402C6-□□2	784	520	79
GYH552C6-□□2	784	550	79
GYH702C6-□□2	1176	390	113
GYG501C5-□□2	400	253	55
GYG751C5-□□2	400	253	55
GYG102C5-□□2	510	253	55
GYG152C5-□□2	510	253	55
GYG202C5-□□2	510	253	55
GYG501B5-□□2	449	253	58
GYG851B5-□□2	449	253	58
GYG132B5-□□2	575	253	58
GYC101D5-□□2	107	19	25
GYC201D5-□□2	235	39	30
GYC401D5-□□2	235	39	30
GYC751D5-□□2	460	88	40
GYC102D5-□□2	646	127	58
GYC152D5-□□2	803	137	58
GYC202D5-□□2	803	137	58
GYS500D5-□□2	127	19	25
GYS101D5-□□2	127	19	25
GYS201D5-□□2	264	58	30
GYS401D5-□□2	264	58	30
GYS751D5-□□2	676	147	40
GYS102D5-□□2	637	107	45
GYS152D5-□□2	637	107	45
GYS202D5-□□2	637	107	45
GYS302D5-□□2	921	166	63
GYS402D5-□□2	921	166	63
GYS502D5-□□2	921	166	63



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.
- The servomotor equipped with a brake may produce brake dust due to the brake timing shift generated between ON and OFF. Therefore when installing the motor to the machine, it is recommended to install the motor horizontal to the machine or under the shaft.

1

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 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 sunlight
Atmospheric pressure	70 to 106 kPa
Vibration	3 mm(Max. amplitude): Less than 2 to 9 Hz, 9.8 m/sec^2: Less than 9 to 20 Hz, 2 m/sec^2: Less than 20 to 55 Hz, 1 m/s^2: Less than 55 to 200 Hz

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 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 sunlight
Vibration	3 mm(Max. amplitude): Less than 2 to 9 Hz, 9.8 m/sec^2: Less than 9 to 20 Hz, 2 m/sec^2: Less than 20 to 55 Hz, 1 m/sec^2: Less than 55 to 200 Hz

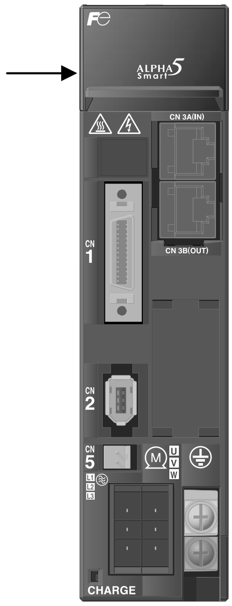
Observe the following when operating.

- 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 or impact.
- Do not operate in vacuum.

1.2.3 Installing the Servo Amplifier

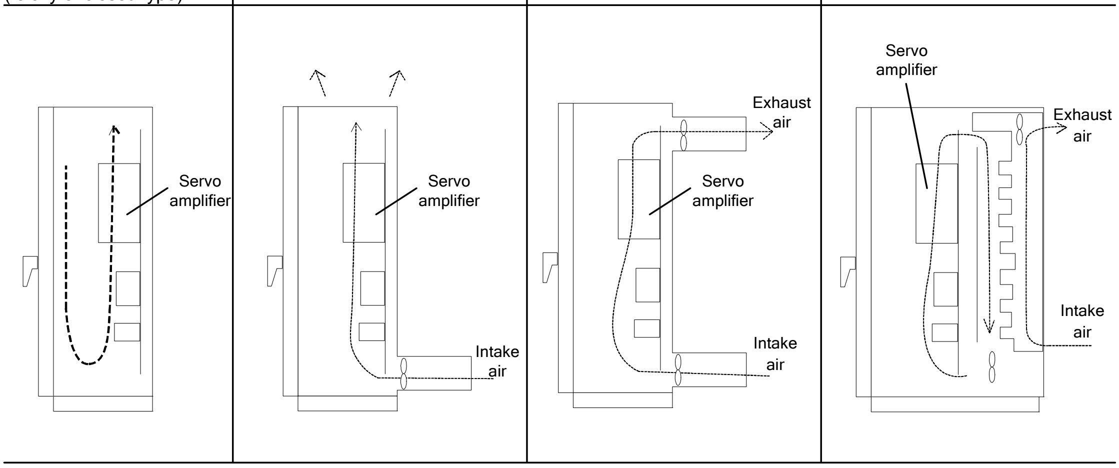
(1) Install the servo amplifier vertically to the ground so that the "ALPHA5" characters (see the arrow in the figure on the right) on the front panel of the servo amplifier is horizontal.

Use M4 screws with length between 12 and 20 mm for the mounting to the control panel.
Use screws together with plane washers or spring lock washers or use 3-piece sems screw to avoid looseness.
When using plane washers, select the finished round type (large size with φ9 mm).



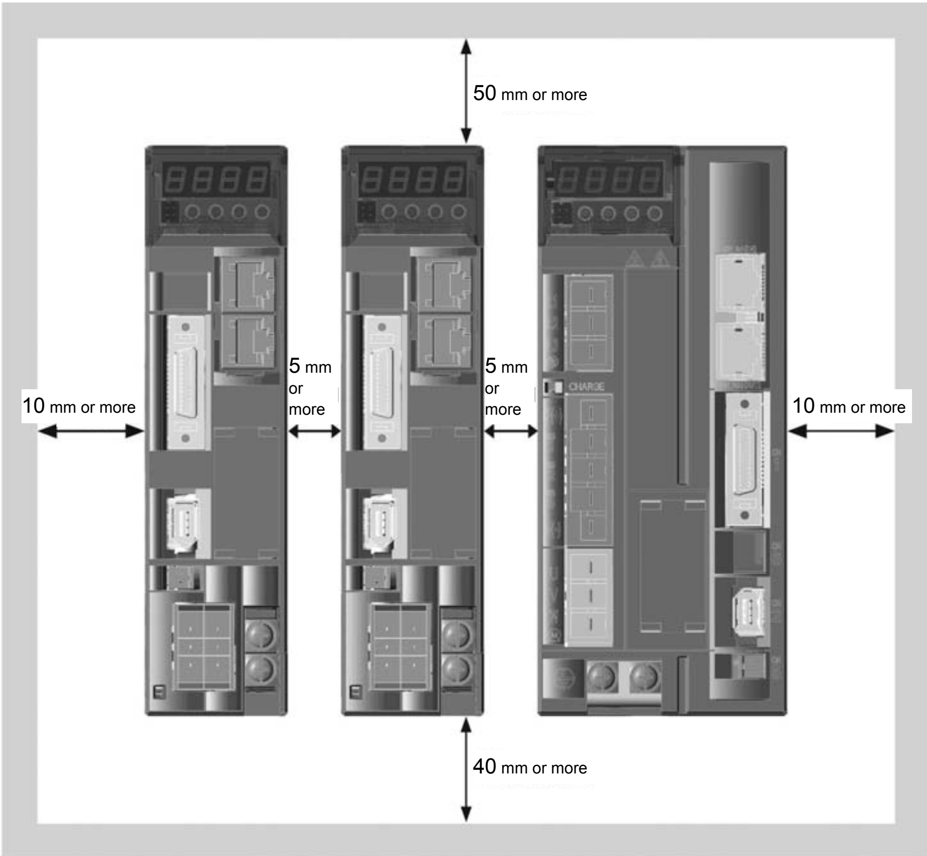
(2) Some parts of the servo amplifier generate heat during operation.
Cool the surroundings if the servo amplifier is installed inside the control panel.

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 the servo amplifiers transversely in principle in order to avoid thermal affection.
This servo amplifier is permitted to be installed side by side closely. However, when installing two or more servo amplifiers with clearance of 5 mm or less between them, operate them at 60% load factor or below with the ambient temperature 45°C or lower.
If clearance of 5 mm or over between adjacent servo amplifiers is provided, no limitation is imposed on the operation frequency.

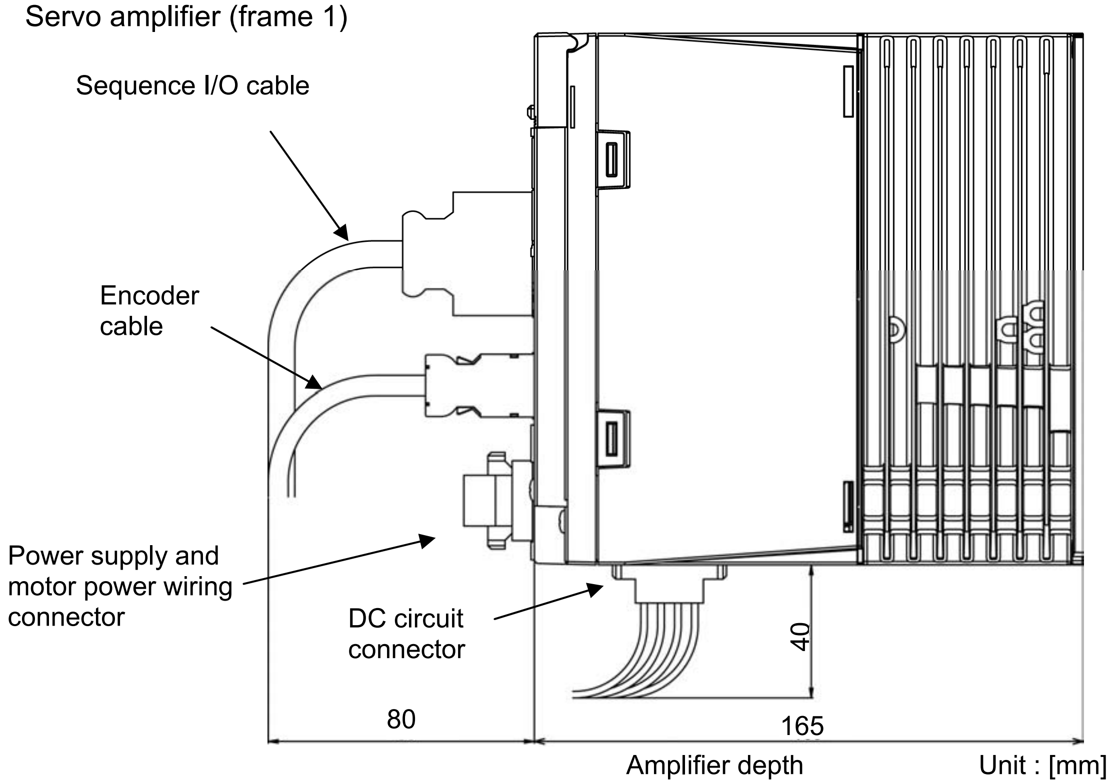
(4)　Keep the clearances shown below between a servo amplifier and a peripheral equipment respectively to avoid rise in temperature of the servo amplifier.



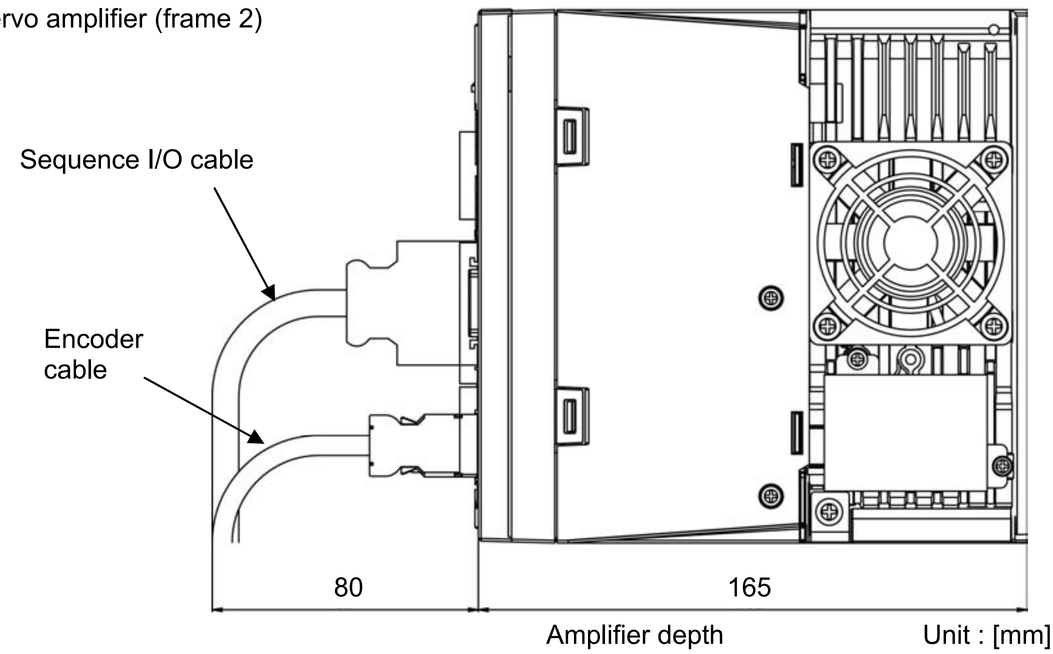
1.2.4 Depth of Control Panel

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

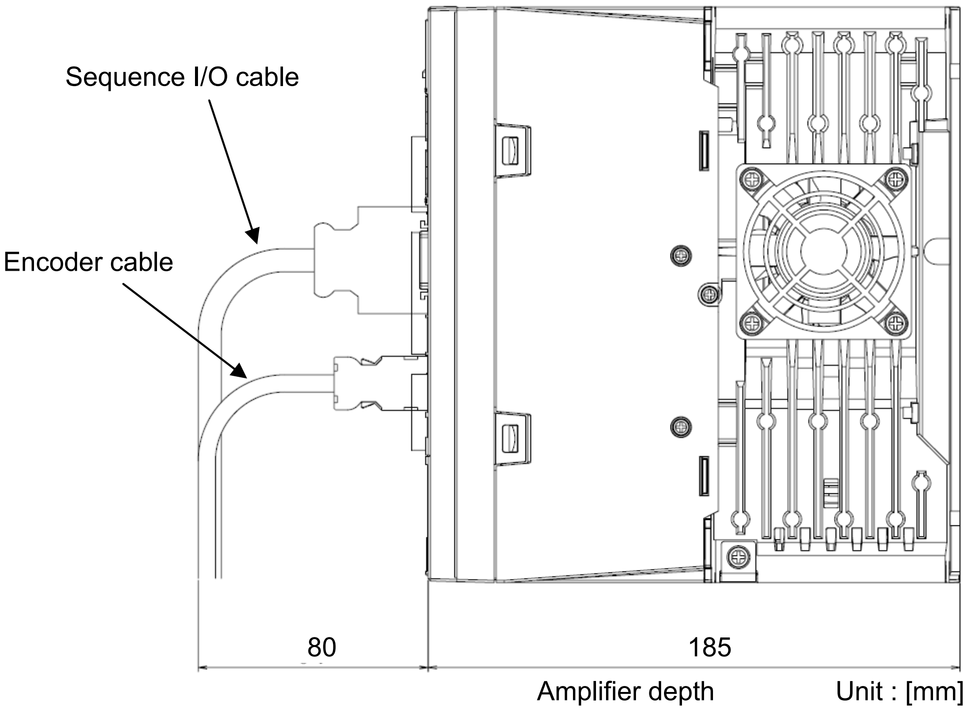
- Servo amplifier (frame 1)



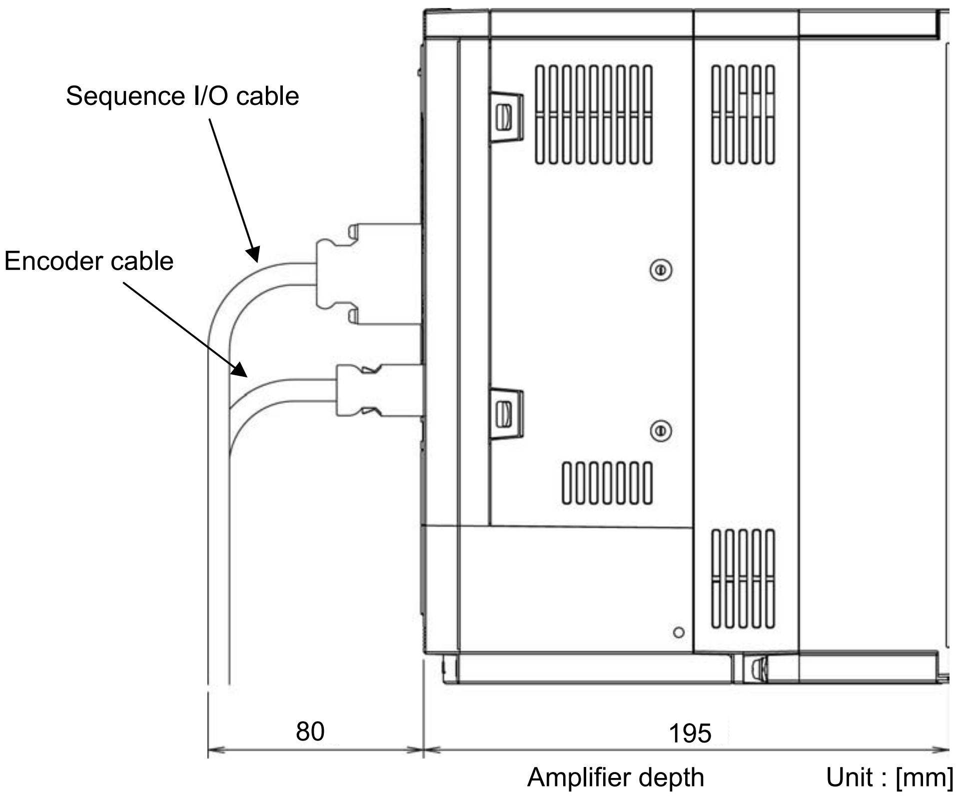
- Servo amplifier (frame 2)



■ Servo amplifier (frame 3)



■ Servo amplifier (frame 4)



CHAPTER 2 WIRING

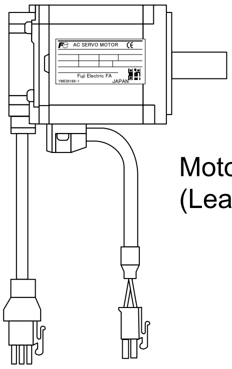
2.1 Configuration

2.1.1 Part Name

All wirings of the servo amplifier and servomotor of 3 kW or less are connected via connectors.

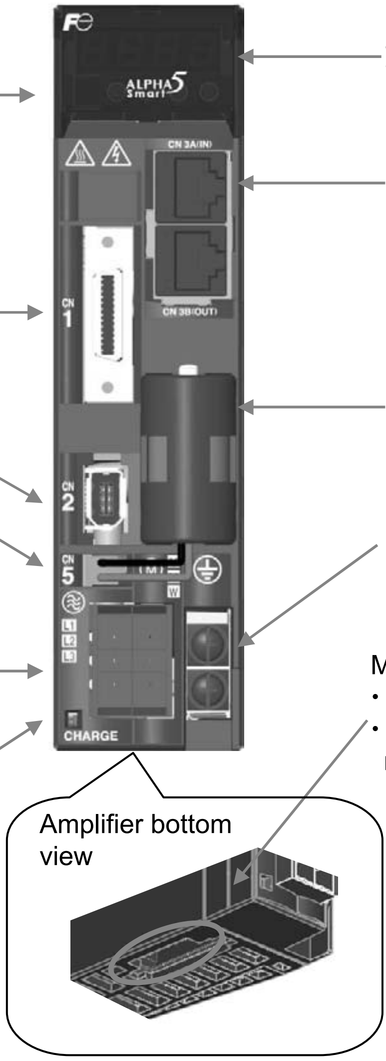
■ Servomotor

GYB/GYC/GYS type 0.4 kW or less



■ Servo amplifier (frame 1)

0.4 kW or less



Power supply (TB1)	Motor power (TB3)
L1	U
L2	V
L3	W

P(+)
RB1
RB2
N(-)

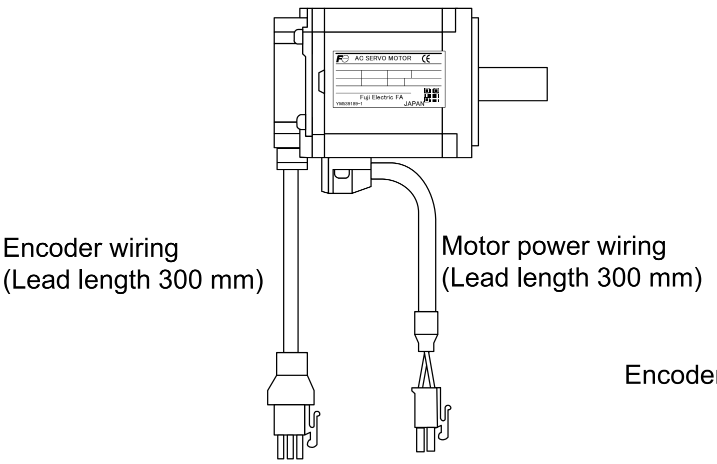
■ Servomotor

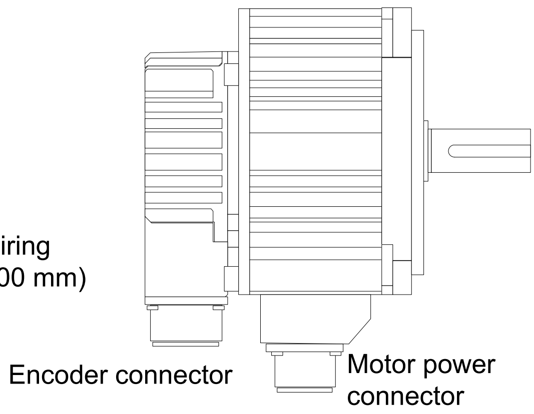
Lead extraction type

GYB/GYC/GYS type 0.75 kW

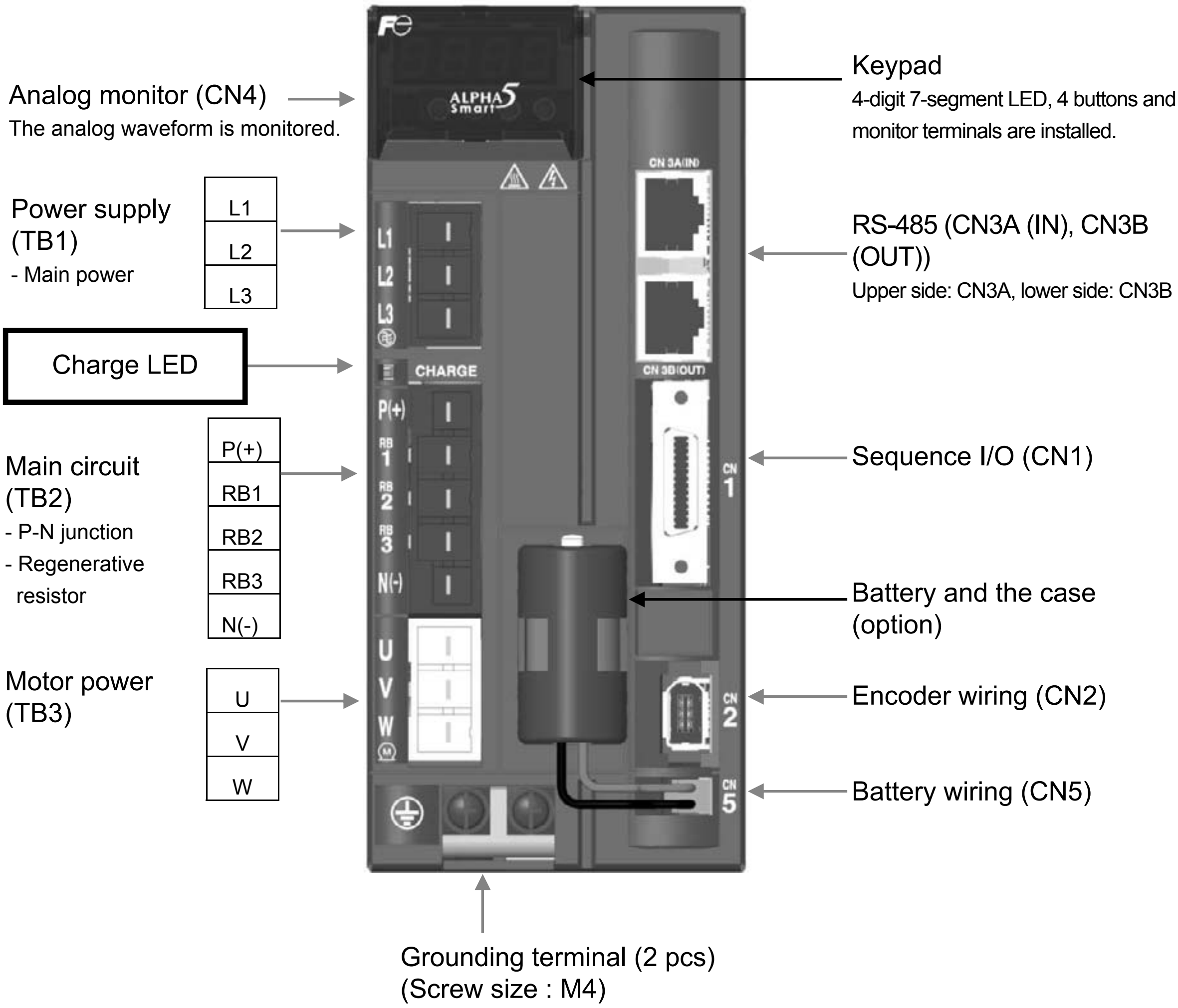
Connector type

GYB/GYC/GYS type 1 kW or more and GYG type

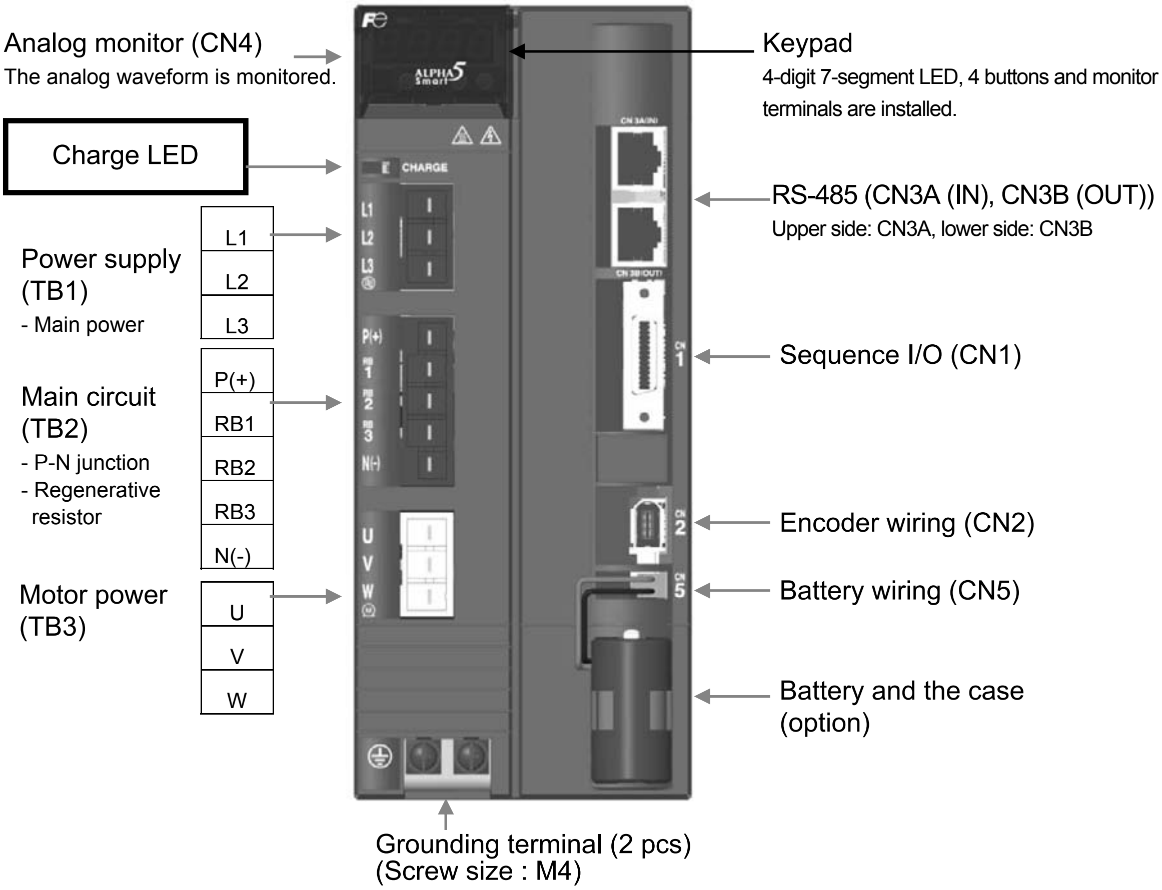




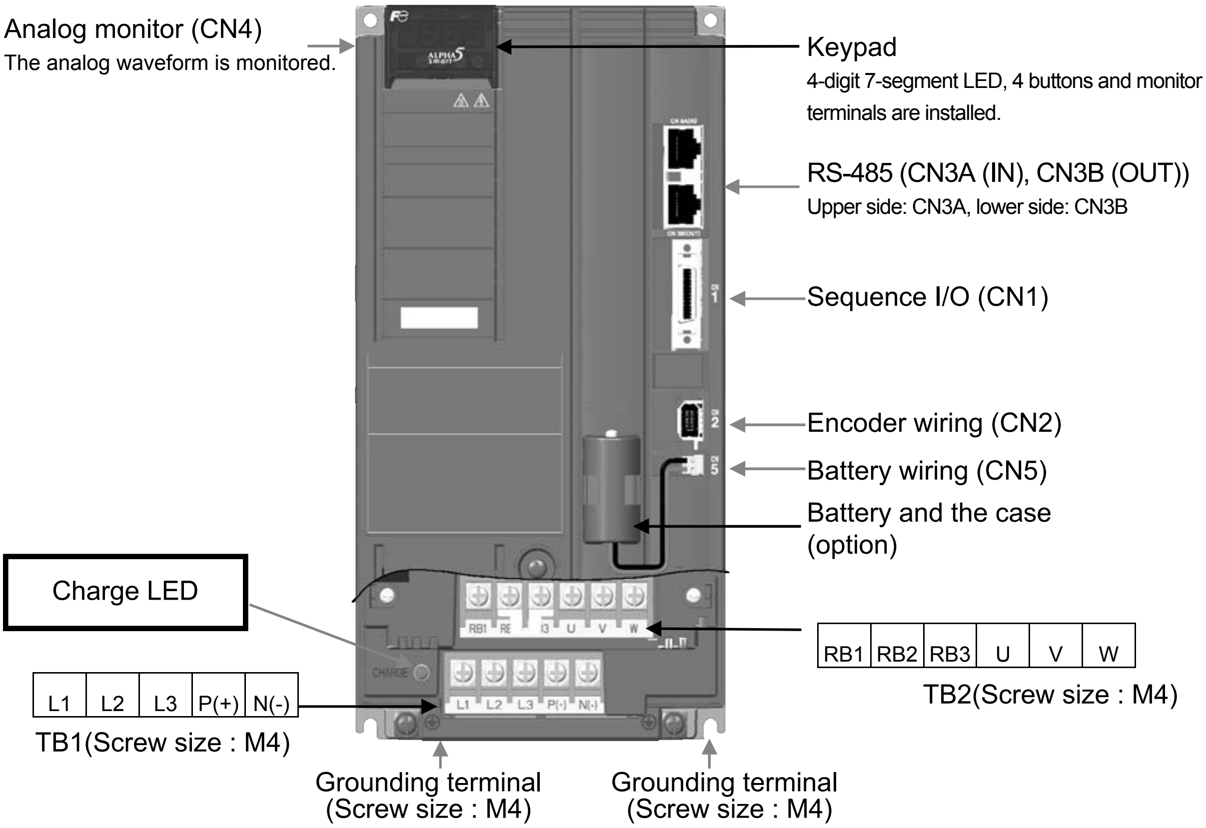
■ Servo amplifier (frame 2)



■ Servo amplifier (frame3)



■ Servo amplifier (frame4)



2.1.2 Configuration

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

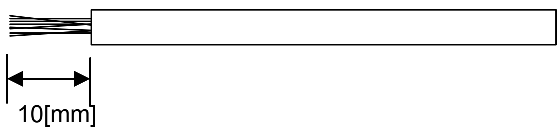
- The size on each device in the figure is not drawn at the uniform scale (same as other chapters).
- To supply single-phase power to the servo amplifier, use the L1 and L2 terminals.
- The servo amplifier wiring connector is attached only to TB2 on the frames 2 and 3. It is not provided for other devices.
  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 regenerative resistor, such as regenerative 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.

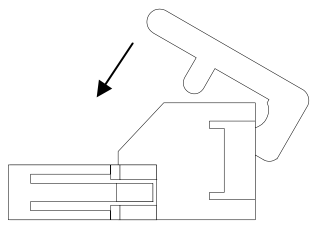
Wiring method

<Frame 1, 2, 3>

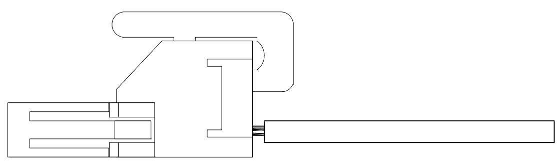
[1] Peel off the sheath about 10 mm.



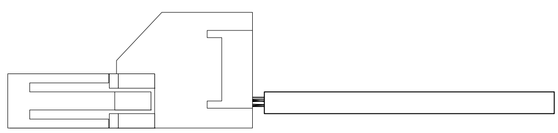
[2] Insert the tip of the accessory tool into the top of the connector.



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



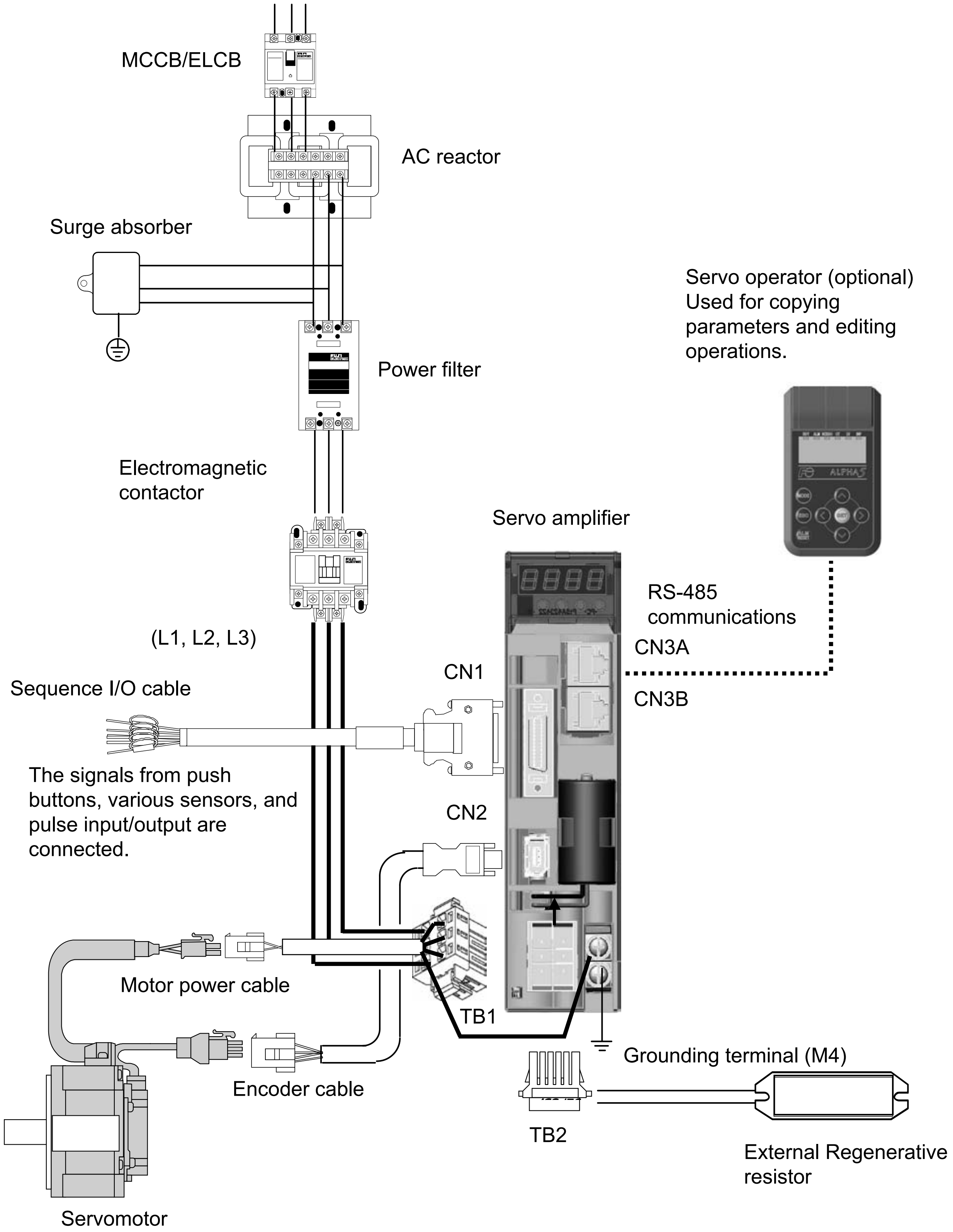
[4] Release the tool. The cable is fixed.



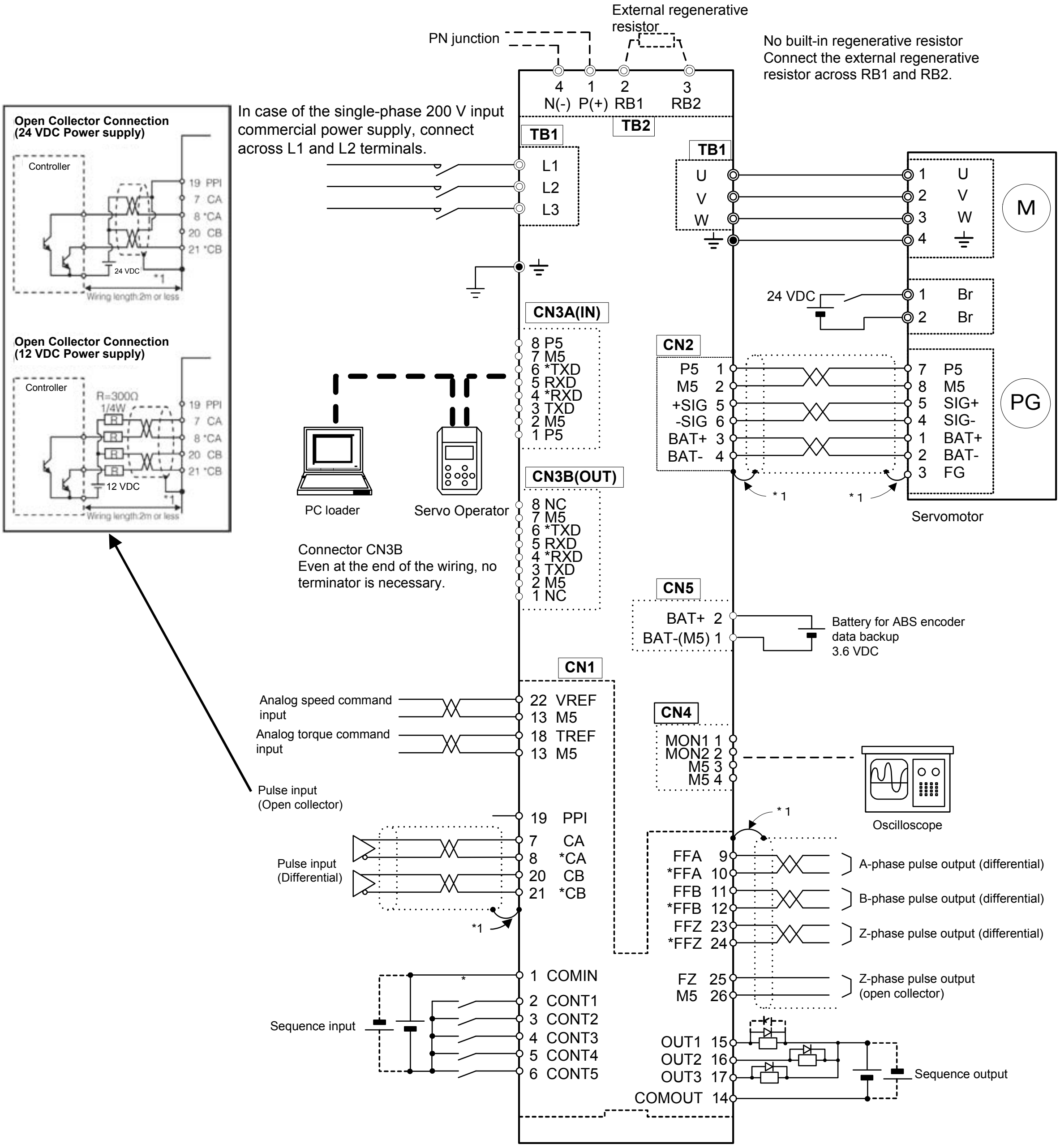
Note	Do not solder the cable. In case of the strand wire, do not twist cable forcibly.

1) Connecting to peripheral devices (Servo amplifier frame 1)

For lead wire type motors, connect cables as shown below.



Sample Connection Diagram (Servo amplifier frame 1)

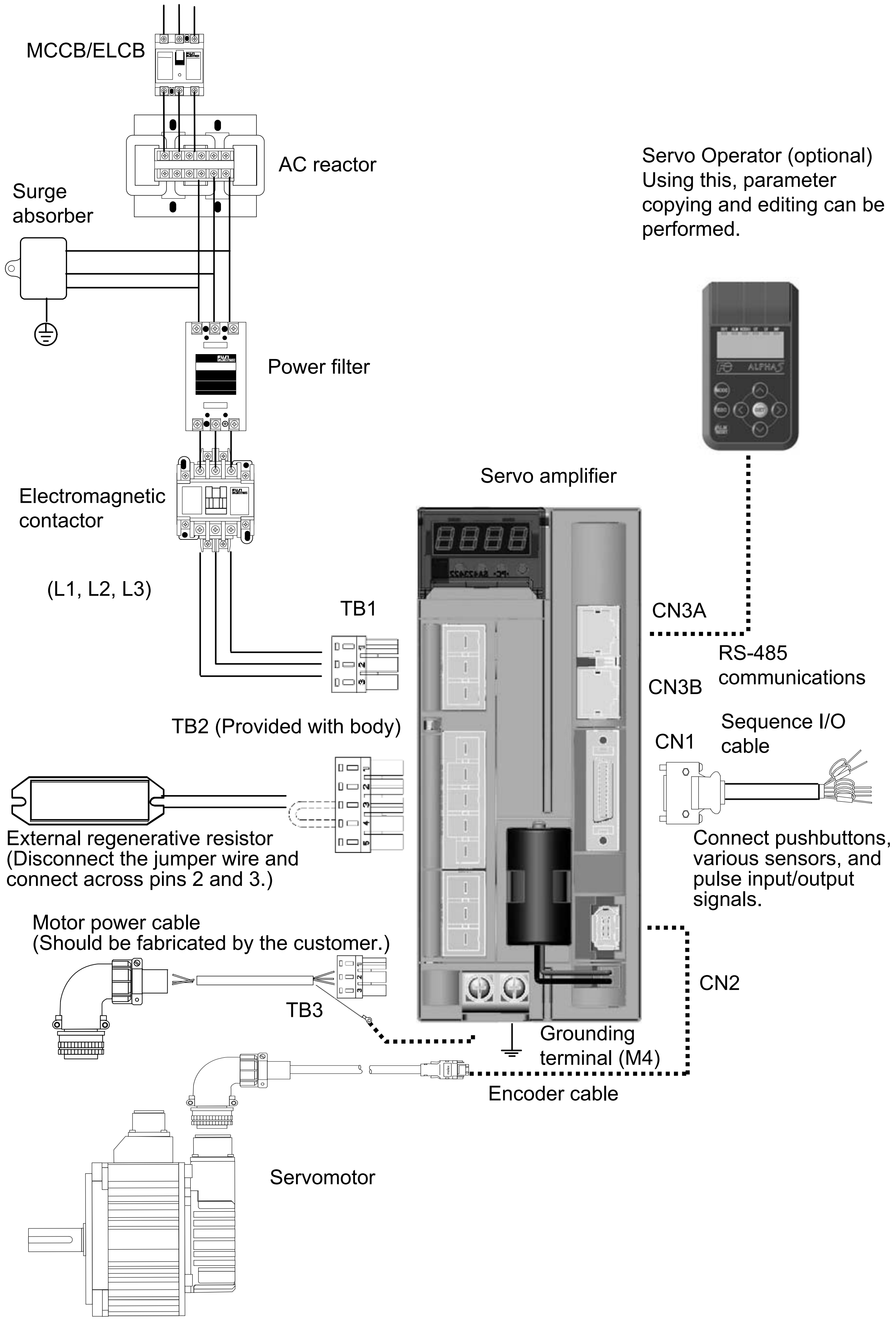


*1: Connect the shielding wire to the connector shell on CN1 and CN2, and then ground the connector shell.

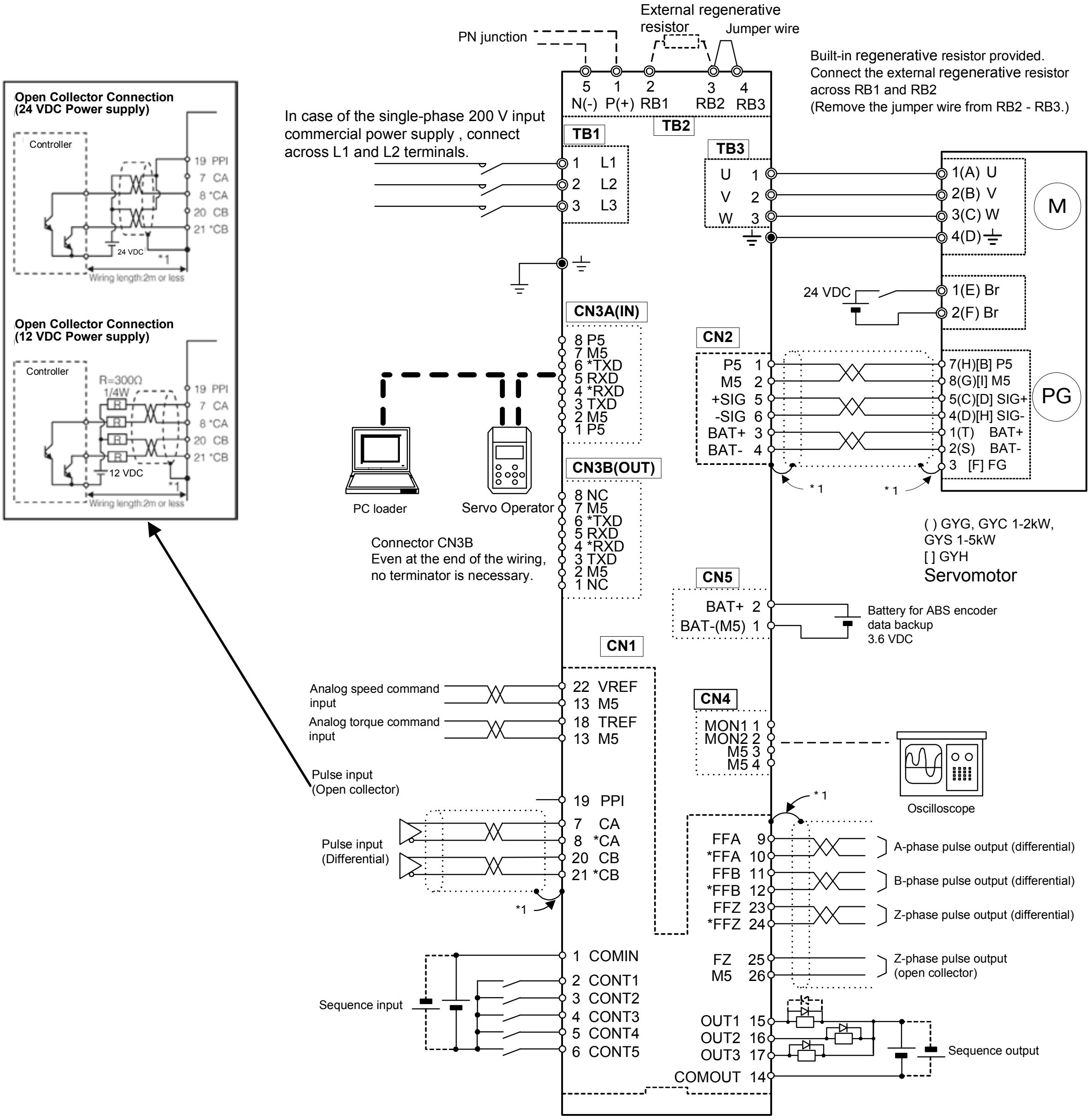
2

2) Connecting to peripheral devices (Servo amplifier frames 2, 3 and 4)

For the motors with the Cannon connector, connect cables as shown below.



Sample Connection Diagram (Servo amplifier frames 2, 3 and 4)



*1: Connect the shielding wire to the connector shell on CN1 and CN2, and then ground the connector shell.

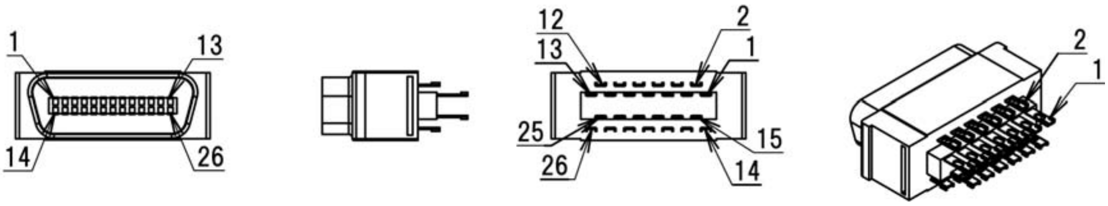
2.1.3 Sequence I/O

CN1 of RYH□□□F5-VV2 type. The wiring connectors are not included with the servo amplifier.

Connector kit type: WSK-D26P

2

26	M5	25	FZ	13	M5	12	*FFB
24	*FFZ	23	FFZ	11	FFB	10	*FFA
22	VREF	21	*CB	9	FFA	8	*CA
20	CB	19	PPI	7	CA	6	CONT5
18	TREF	17	OUT3	5	CONT4	4	CONT3
16	OUT2	15	OUT1	3	CONT2	2	CONT1
14	COMOUT			1	COMIN		

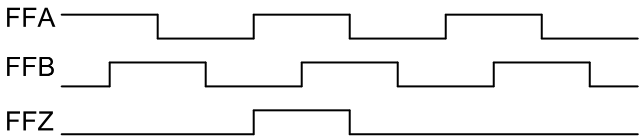


No	Terminal symbol	Function
19	PPI	Pull-up voltage input at open collector input
7	CA	Pulse input Max. input frequency 1 MHz (differential) or 200 kHz (open collector) Command pulse/direction, forward/reverse pulse, A/B phase pulse (A/B phase pulse is the frequency after multiplication by four.)
8	*CA	
20	CB	
21	*CB	
9	FFA	Pulse output (Differential output) The number of output pulses per motor revolution (16 to 262144) or the output pulse division ratio can be designated. The output is issued in A/B phase pulse. The FFZ and *FFZ are the terminals for single pulse per revolution signal.
10	*FFA	
11	FFB	
12	*FFB	
23	FFZ	
24	*FFZ	
25	FZ	Z-phase output (Open collector) The FZ is the terminal for single pulse per revolution signal. The M5 terminal serves as a reference potential.
26	M5	

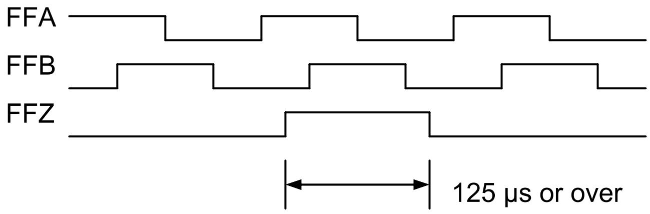
No	Terminal symbol	Function
2	CONT1	Sequence input (sink/source supported) Supply command signals to the servo amplifier through these terminals. 12 to 24 VDC/8 mA (per point). Photocoupler isolation. The COMIN is the reference potential terminal. (Soft filter 0.5 ms, agreement of two scans, except for interrupt input) The delay of hardware filter detection is 0.1 ms with interrupted input.
3	CONT2	
4	CONT3	
5	CONT4	
6	CONT5	
1	COMIN	
15	OUT1	Sequence output (sink/source supported) Signal output terminals of servo amplifier. Max. 30 VDC/50 mA. Photocoupler isolation. The COMOUT is the reference potential terminal.
16	OUT2	
17	OUT3	
14	COMOUT	
22	VREF	Speed command voltage ±10 V. Resolution: 15 bits/±full scale Torque command voltage ±10 V. Resolution: 14 bits/±full scale The M5 is the reference potential terminal.
18	TREF	
13	M5	
18	M5	

The output formats of the FFZ, *FFZ and FZ vary according to the pulse output setting.

- If the number of pulses per revolution is designed (PA1_08: 16 to 262144), outputs are synchronized with the FFA and *FFA signals, which apply one pulse of FFA and *FFA.



- If the output pulse division ratio designated with PA1_08: 0, PA1_09 and PA1_10, outputs are not synchronized with the FFA and *FFA signals. The pulse always has width of 125 μs or over.



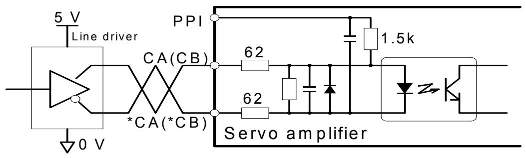
2.1.3.1 Pulse Input (PPI, CA, *CA, CB, *CA)

Pulse input terminal

- Format: Command pulse/direction, forward/reverse pulse, A/B phase pulse (parameter switch)
- Max. input frequency: 1 MHz (differential input), 200 kHz (open collector input)
  (A/B phase pulse: 250 kHz (differential input), 50 kHz (open collector input)

(1) Differential input

The PPI terminal is not used.

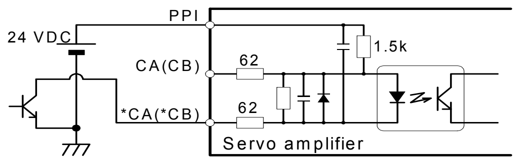


(2) Open collector input (24 VDC)

The PPI terminal is used.

* Do not connect wiring to the terminal CA (CB).

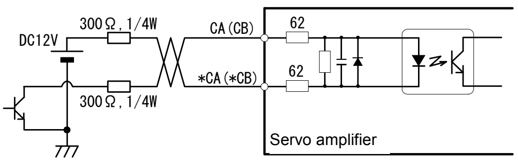
The wiring length to the host should be 2 m or less.



(3) Open collector input (12 VDC)

Perform the wiring using the resistor (300Ω, 1/4W) but not using the PPI terminal as shown below.

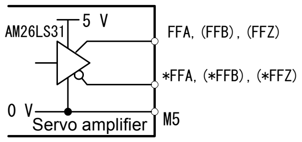
* The wiring length to the host should be 2 m or less.



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

The pulses proportional to the motor revolutions are output as A/B phase pulse.

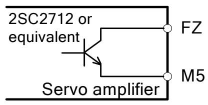
- The number of output pulses per motor revolution can be specified in the parameter (PA1_08).
- The output pulse frequency is proportionate to axis revolution speed. Although the output frequency is not limited, it has to be 500 kHz or lower considering the electrical limit of the output circuit.
- The output pulse phase (A or B phase advance) to the motor revolution direction can be specified in the parameter (PA1_11).
- The FFZ and *FFZ signals output one pulse per motor revolution. The output position can be adjusted in the parameter (PA1_12).
- In the case of GYB motor at speed of 100r/min or less after the power turned on the output of first Z phase will happen within 1 rotation after the motor becomes over 12-degree as worst.



2.1.3.3 Z-Phase Output (FZ, M5)

The Z-phase output is an open collector output of the FFZ or *FFZ signal.

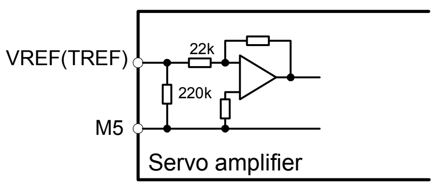
The current can flow up to 30 VDC/50 mA.



2.1.3.4 Analog Input (VREF(TREF),M5)

The analog input is the terminal used when performing the speed/torque control by analog commands.

- Input voltage: 0 to ±10 VDC
- Variable resistor: 1 to 5 kΩ (1/2 W)
- Input impedance: 20 kΩ



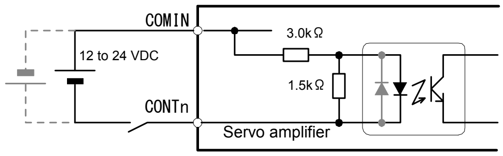
2

2

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

This is the input terminal for sequence control.

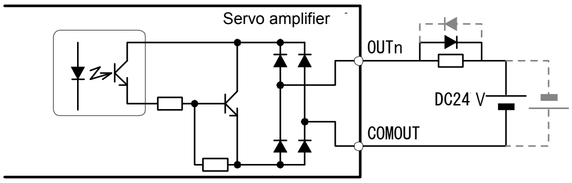
- The terminal allows sink input/source input.
- Use the terminal within the range from 12 VDC to 24 VDC.
- A current of approx. 8 mA (for 24 VDC) is consumed at each point.
- The terminal function can be changed by setting the parameter. For assignable signals, refer to page 2-20.



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

This is the output terminal for sequence control.

- The terminal allows sink output/source output.
- Use the terminal within the range from 12 VDC to 24 VDC.
- A current of approx. 8 mA (for 24 VDC) is consumed at each point.
- The terminal function can be changed by setting the parameter. For assignable signals, refer to page 2-21.



2.1.4 RS-485 Communications (CN3)

Use the RS-485 communications by connecting other servo amplifiers, 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 can be applied in two communications: Modbus-RTU protocol communications and PC Loader protocol communications.

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

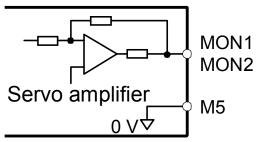
However, select the Modbus-RTU protocol to perform immediate value operation.

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

2.1.5 Analog Monitor Output (CN4: MON1, MON2, and M5)

This is the analog voltage output terminal from the servo amplifier, Set the details to be output using the parameter.

- Max. ±10 V/0.5 mA
- Resolution: 14 bits/±full scale



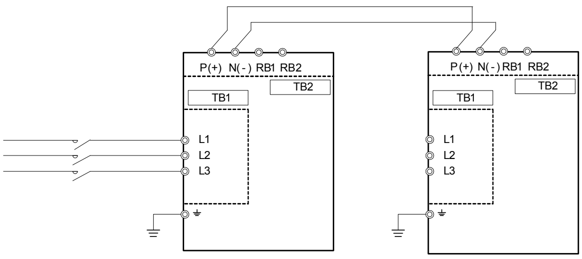
The signal takes two seconds to be activated after the power is turned on.
The output voltage may become unstable immediately afer the power is turned on or turned off.

2.2 P-N Junction

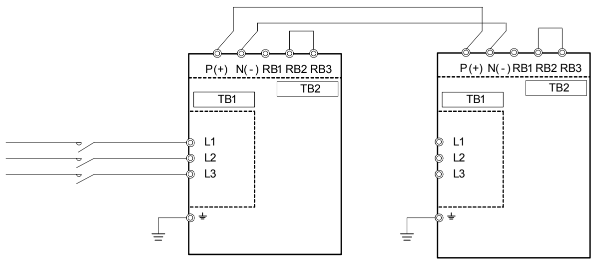
Directly connect the DC link circuit of two servo amplifiers to exchange power.
In a system having a powering (driving) shaft and regenerating (back tension) shaft such as the winder/unwinder unit, the power consumption of the entire system can be reduced. Do not supply main power to the servo amplifier on the other side of the P-N junction.
The capacity of the servo amplifier on the PN junction side must be equal to or less than that of the servo amplifier on the power supply side.

The capacity of the servo amplifier on the power supply side	≧	The capacity of the servo amplifier on the PN junction side

■Wiring example for frame 1



■Wiring example for frame 2 or over



For the details, contact the manufacturer.

2.3 Servomotor

There are wiring of the following three units: the main body of the servomotor, brake (servomotor equipped with a brake) and encoder.

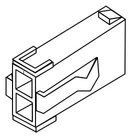
⚠CAUTION

- 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

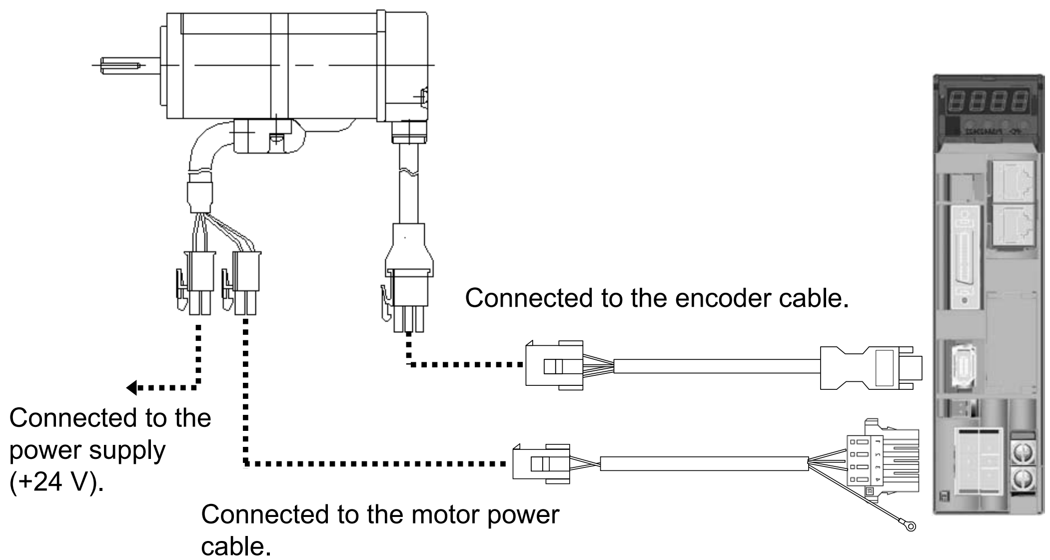
Connector kit type: WSK-M02P-E (GYB,GYC,GYS type servomotor side ,0.75 kW or less)

1	Br
2	Br



The brake of the servomotor equipped with a brake is a non-exciting brake. To rotate the servo motor, supply the power of 24 VDC to this connector and release the brake. 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 GYH type 1.0 to 3.0 kW, GYG type, GYC type 1.0 to 2.0 kW and GYS type 1.0 to 5.0 kW is located inside the motor power connector.
The brake terminal of GYH type 4.0 to 7.0 kW is located inside the motor brake connector.



2.4 Encoder

2.4.1 Encoder Cable

Use shielded cables for wiring of the servomotor encoder.

The optional cable for the servomotor is a cable having bend resistance, which is also UL standard compliant.

Use a regular twisted pair batch shield cable if the servomotor and cable do not work.

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

  RMCV-SB-A (UL2464) AWG#25/2P + AWG#23/2C (Twisted type) or AWG#23/3P

  (For 10 m or smaller wiring length)

  RMCV-SB-A (UL2464) AWG#25/2P + AWG#17/2C or its equivalent

  (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

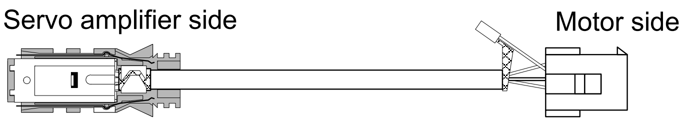
2.4.2 Encoder Cable

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 50 m.
- When twisting the cable, combine the following pair of signals.
  P5 and M5, SIG+ and SIG-, BAT+ and BAT- (See the sample connection diagrams on pages 2-6 and 2-8.)
- Please notice that wrong wiring may cause the encoder or battery trouble.

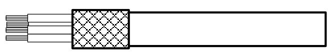
Perform shield treatment at the encoder according to the procedure specified below.
Despite motor capacity, wiring treatment at the servo amplifier is the same.

■ Encoder cable preparation method

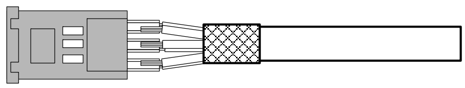


Connect the end of the shielding wire on the motor side to pin no.3.
Relay the shielding wire with a lead wire of AWG#22 to 26 and then crimp the wire to the connector pin.

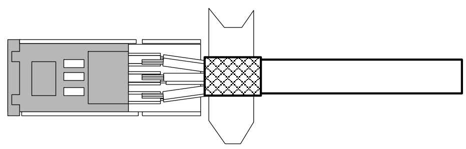
[1] Peel off the end of the shield about 15 mm.
Fold back the shield.
Wind copper foil tape two or three turns around the shield.



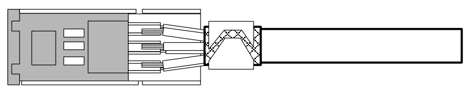
[2] Solder the wiring to the connector.
The shrink tube wrapping each element cable assures safety.



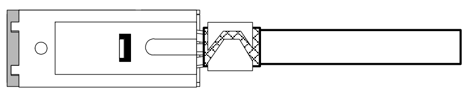
[3] Fix the connector to the shell cover.



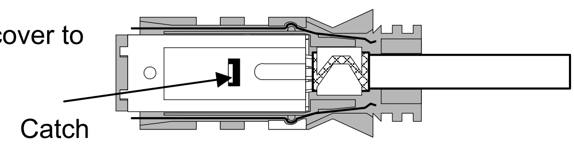
[4] Bend the shield to fix.



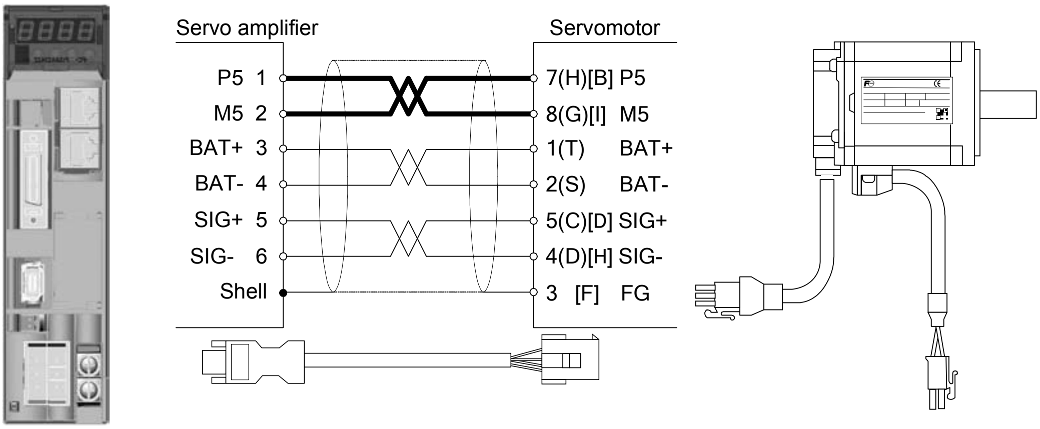
[5] While aligning the catches on both sides, fit the shell cover.



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

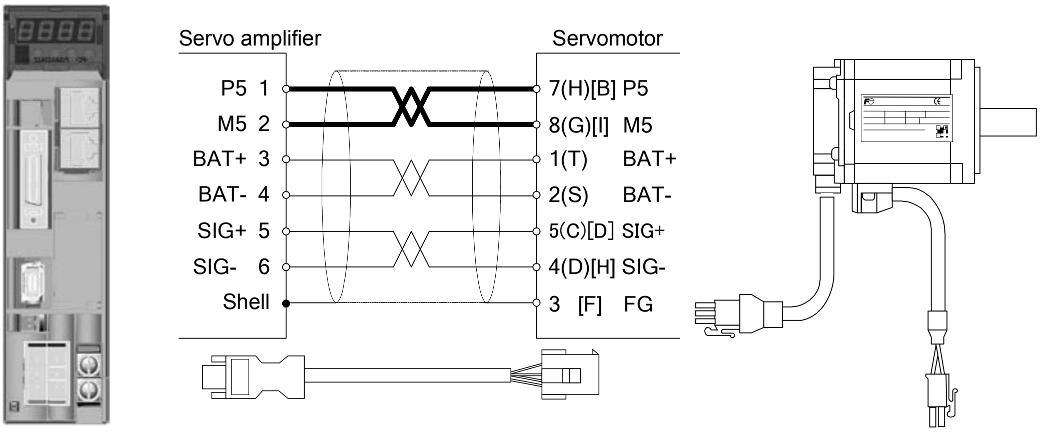


■ Wiring length within 10 m



Signal	Lead wire dia.	Connector no. on amplifier side	Connector no. on motor side		
			GYB, GYC, GYS 0.75 kW or less	GYG, GYC 1 to 2kW GYS 1 to 5 kW	GYH
P5	AWG23	1	7	H	B
M5	AWG23	2	8	G	I
BAT+	AWG25	3	1	T	N.C.
BAT-	AWG25	4	2	S	N.C.
SIG+	AWG25	5	5	C	D
SIG-	AWG25	6	4	D	H
FG	Shielding wire	Shell	3	N.C.	FG

■ Wiring length between 10 m and 50 m



Signal	Lead wire dia.	Connector no. on amplifier side	Connector no. on motor side		
			GYB, GYC, GYS 0.75 kW or less	GYG, GYC 1 to 2kW GYS 1 to 5 kW	GYH
P5	AWG17	1	7	H	B
M5	AWG17	2	8	G	I
BAT+	AWG25	3	1	T	N.C.
BAT-	AWG25	4	2	S	N.C.
SIG+	AWG25	5	5	C	D
SIG-	AWG25	6	4	D	H
FG	Shielding wire	Shell	3	N.C.	FG

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 78	1	Power
PA03_02	CONT2 signal assignment		11	
PA03_03	CONT3 signal assignment		0	
PA03_04	CONT4 signal assignment		0	
PA03_05	CONT5 signal assignment		0	

Sequence input signal

No.	Function	No.	Function
1	Servo-on [S-ON]	34	External regenerative 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
		78	Broadcast cancel

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	1 to 95	1	Power
PA03_52	OUT2 signal assignment		2	
PA03_53	OUT3 signal assignment		76	

Sequence output signal

No.	Function	No.	Function
1	Ready for servo-on [RDY]	39	-OT detection
2	In-position [INP]	40	Home position LS detection
11	Speed limit detection	41	Forced stop detection
13	Over write completion	45	Battery warning
14	Brake timing	46	Life warning
16	Alarm detection (Normally open contact)	60	MD0
17	Point detection, area 1	61	MD1
18	Point detection, area 2	62	MD2
19	Limiter detection	63	MD3
20	OT detection	64	MD4
21	Cycle end detection	65	MD5
22	Homing completion	66	MD6
23	Zero deviation	67	MD7
24	Zero speed	75	Position preset completion
25	Speed coincidence	76	Alarm detection (Normally closed contact)
26	Torque limit detection	79	Immediate value continuation permission
27	Overload warning	80	Immediate value continuation completion
28	Servo control ready [S-RDY]	81	Immediate value change completion
29	Edit permission response	82	Command positioning completion
30	Data error	83	Range1 of position
31	Address error	84	Range2 of position
32	Alarm code 0	85	Interrupt positioning detection
33	Alarm code 1	91	CONTa through
34	Alarm code 2	92	CONTb through
35	Alarm code 3	93	CONTc through
36	Alarm code 4	94	CONTd through
38	+OT detection	95	CONTe through

2

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 the CONT input terminals, it is treated as “always ON”.

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

The servomotor keeps running during turning the signals 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.

Control mode	Effective condition for FWD/REV signal	FWD/REV signal simultaneous
Speed control	ON level	Controlled stop
Position control	On edge	The last operation before simultaneous ON is retained
Torque control	ON level	Controlled stop

(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" (extension mode) or "7" (positioning operation) to PA1_01 (control mode selection) and, while leaving the position control (37) signal turned on (not necessary when "7" (positioning operation) is set to PA1_01), turn on the forward command [FWD] (or reverse command [REV]) signal.

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.

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

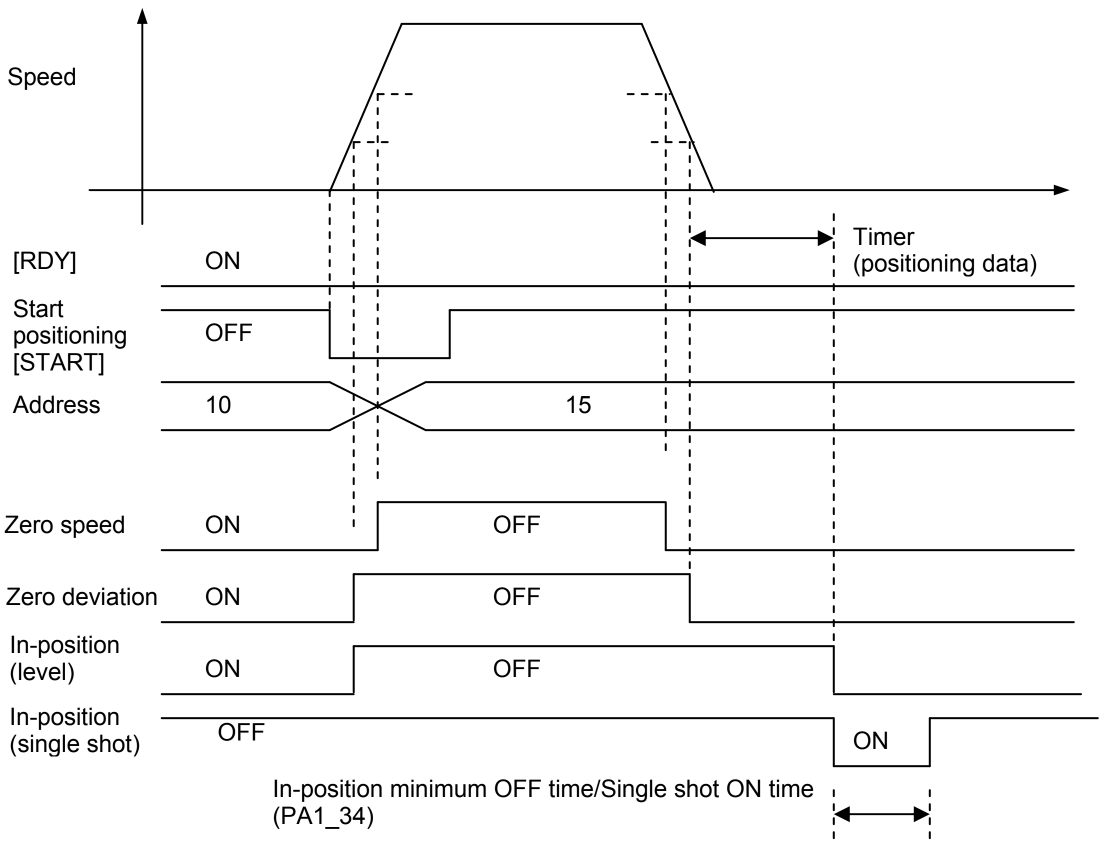
Positioning motion is executed according to positioning data or immediate value data sent via RS-485 communications.

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

2

■ 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.

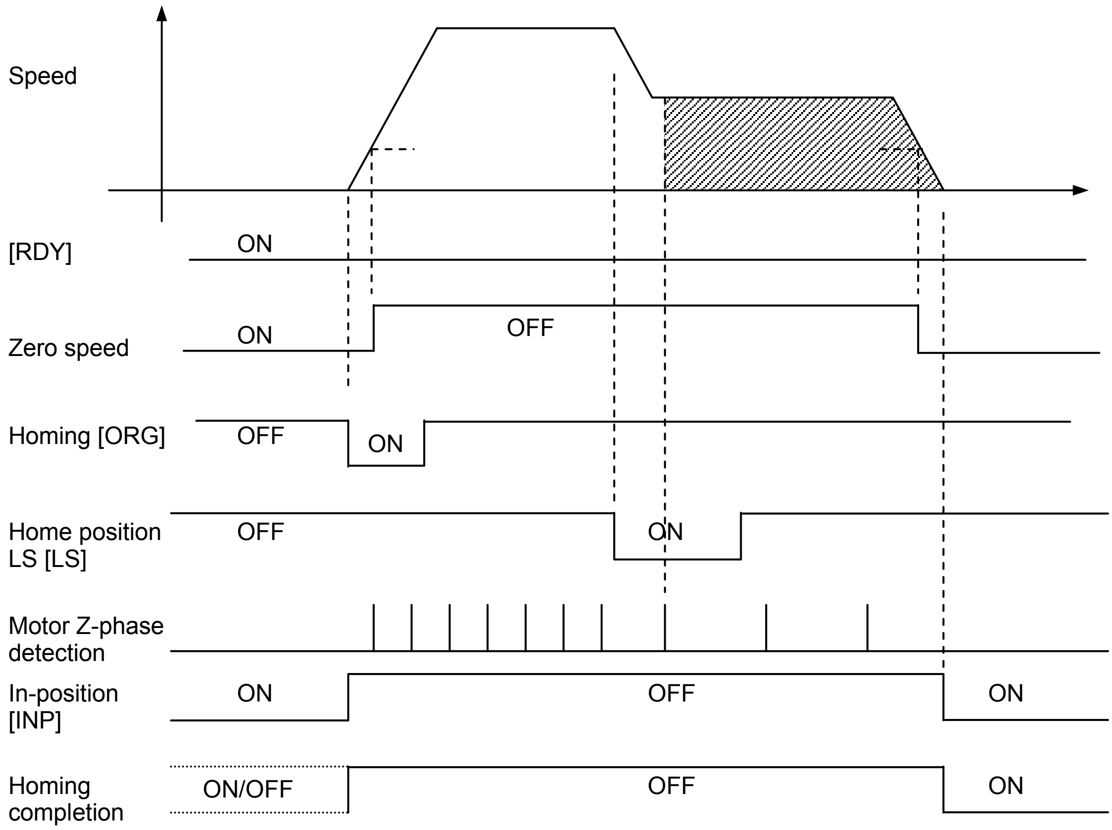
Homing [ORG]: Sequence input signal (Reference value 5)
Homing position LS [LS]: Sequence input signal (Reference value 6)

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

These functions are 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.

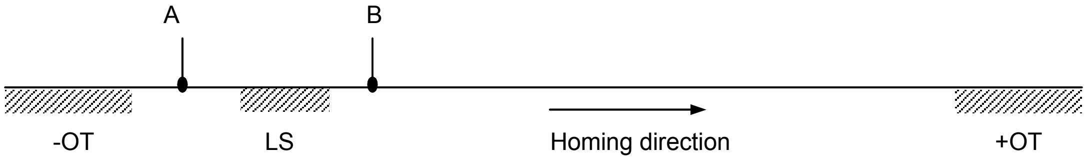
(2) Once the in-position signal is turned off, you can turn off the homing command.
The motor rotates in the direction of PA2_10 (homing direction after reference signal detection) at a speed of PA2_06 (homing speed).

(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.



2

- 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.

2

- 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. (nomally closed contact)

■ Function

These signals are input signals of the limit switch which prevents the over travel (OT) at the end in the machine travel direction.
Each signal is always enabled except under torque control.
If the over-travel signal is turned on (switch:open) 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").

■ 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_26/27 (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.

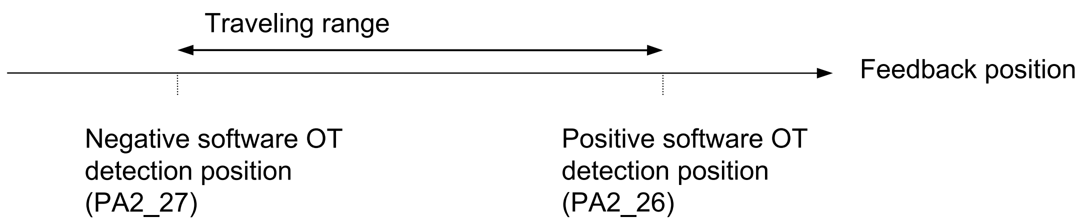
(3) Software OT

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.



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

This signal is used to forcibly stop the servomotor.

■ Function

The servomotor is forcibly stopped while the forced stop [EMG] signal remains turned on (switch:open).
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) 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.

■ 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 off (switch:closed), 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 on (switch:open), 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 on (switch:open) 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 on (switch:open). Turn the forced stop signal off (switch:closed) to arrange the state ready to operate.
If the forced stop signal is turned on (switch:open) 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.

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.

■ 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 [Fn05].
- Press and hold the [∧] and [∨] keys simultaneously for at least one second upon alarm detection [En01].
- Alarm reset from PC Loader
- Shutdown and power-on again

Alarms canceled through alarm resetting

Indication	Name
oc1	Overcurrent 1
oc2	Overcurrent 2
oS	Overspeed
Hu	Overvoltage
tH	Breaking Transistor Overheat
Ec	Encoder Communication Error
oL1	Overload 1
oL2	Overload 2
LuP	Main Power Undervoltage
rH1	Internal Breaking Resistor Overheat
rH2	External Breaking Resistor Overheat
oF	Deviation Overflow
AH	Amplifier Overheat
EH	Encoder Overheat

Alarms not canceled through alarm resetting

Indication	Name
Et1	Encoder Trouble 1
Et2	Encoder Trouble 2
ct	Circuit Trouble
dE	Memory Error
Fb	Fuse Blown
cE	Motor Combination Error
ctE	CONT (Control signal) Error
rH3	Breaking Transistor Error
rH4	Inrush Current Suppression Circuit Trouble
dL1	Absolute Data Lost 1*
dL2	Absolute Data Lost 2*
dL3	Absolute Data Lost 3*
AF	Multi-turn Data Over Flow*
iE	Initial Error

* The alarms dL1 to 3 and AF can be canceled by position preset.

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.

Position preset: Sequence input signal (Reference value 16)

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

■ Function

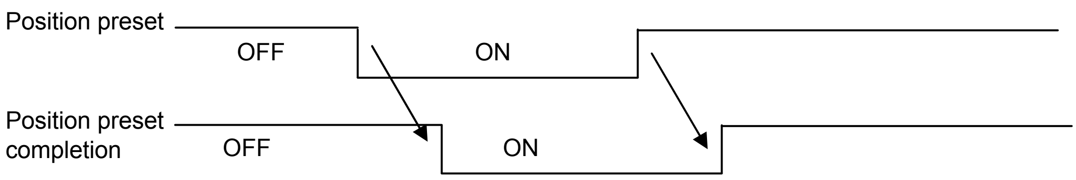
The command position and the feedback position are made the reference value of PA2_19 (preset position) at the rising edge. However, the deviation is subtracted from the feedback position.

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 stopped. After position preset, homing is finished.

The following alarm detection can be reset.

- Absolute data lost (dL1, dL2, dL3), multi-turn data over flow



The Position preset completion 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.

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.

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) 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]

2

■ 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.

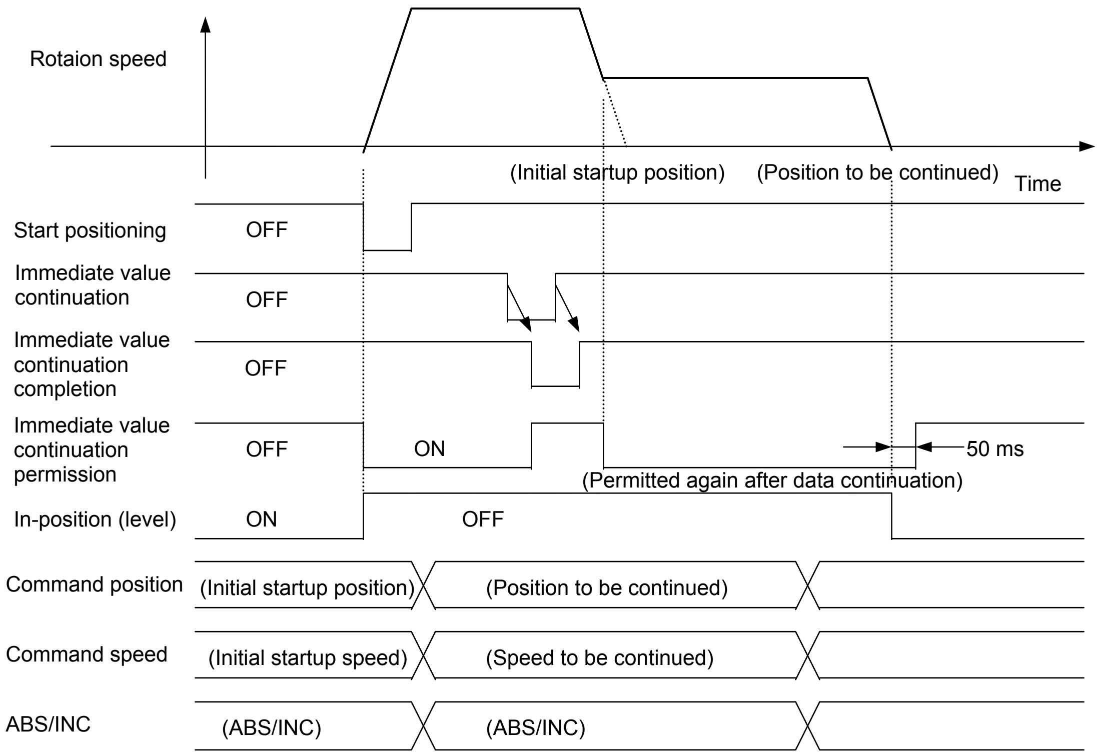
Immediate value continuation: Sequence input signal (Reference value 22)

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 assign 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 rising 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.

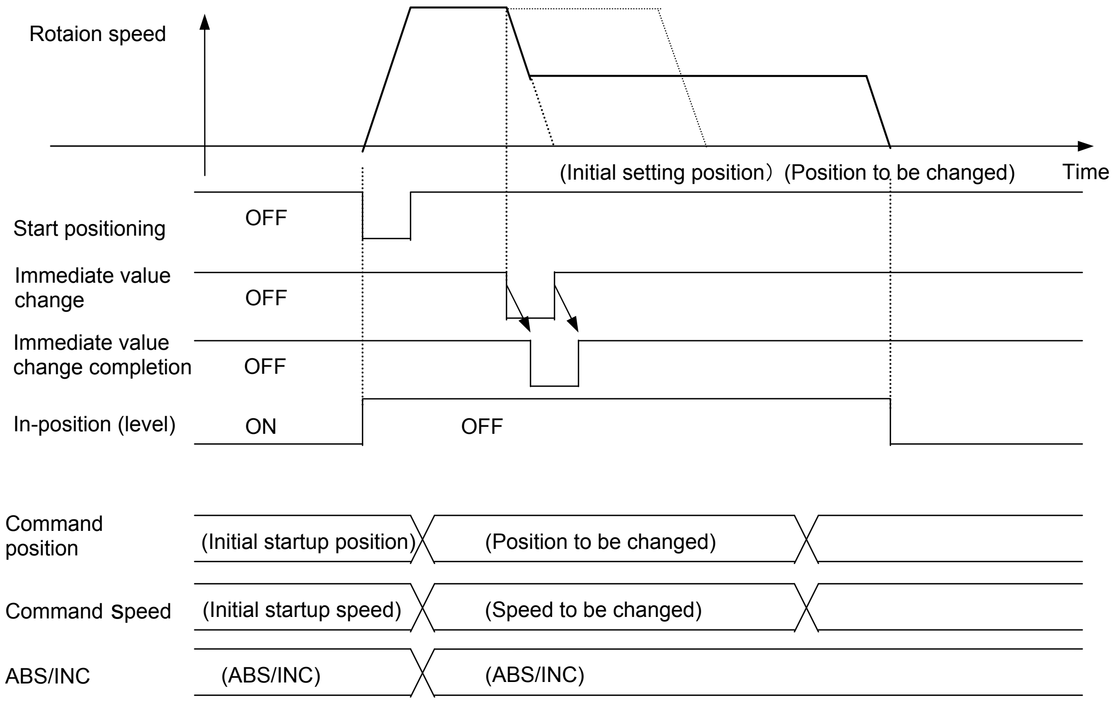
2

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

■ 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 rising 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 assign 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 at the timing of rising edge of the immediate value continuation command is enabled. However, the ABS/INC signal retains the state enabled at the rising 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)

These are used 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_06: 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.

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.

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.
These functions are enabled only if "6" (extension mode) or "7" (positioning operation) is selected for parameter PA1_01.

■ 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.

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.

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 rising 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 assign positioning cancel to a sequence input terminal, enter the corresponding value (“31”) to the input terminal function setting parameter.

■ 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 system selection parameter (PA1_02).

(3) Brake timing

The brake is not applied in a pause.

Positioning cancel: Sequence input signal (Reference value 32)

This signal is used to cancel the auto start, 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.

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

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

■ Function

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

If the external regenerative resistor overheat input signal is turned on (switch:open), an external regenerative resistor overheat (rH2) alarm is issued.

■ Parameter setting

To assign external regenerative resistor overheat to a sequence input terminal, specify the corresponding value ("34") to the input terminal function setting parameter.

Teaching: Sequence input signal (Reference value 35)

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

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

■ Function

The command current position of the servomotor is written to the position data in the positioning data at the rising edge of a teaching signal.

The current command position of the servomotor is written in the positioning data at the rising edge of the teaching signal. The status of the position is absolute (ABS).

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.

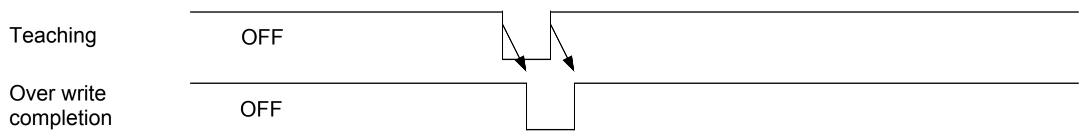
(1) Designate the address of positioning data, to which the current position is to be written, among AD0 to AD3.

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

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

■ Parameter setting

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



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.

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.

2

■ 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.

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

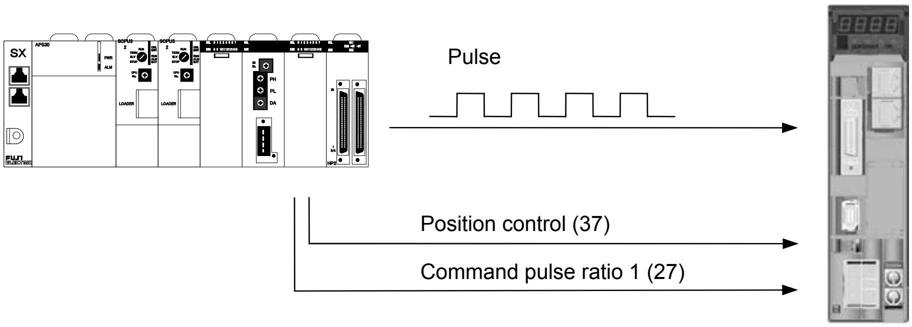
Turn on to perform position control in the extension mode (mode compatible with that of conventional α Series).
The position control state continues while the position control signal assigned to a CONT input signal remains turned on. Positioning, interrupt positioning and other functions can be executed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

■ 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.

[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_06: numerator 0 of electronic gear /PA1_07: 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.

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)

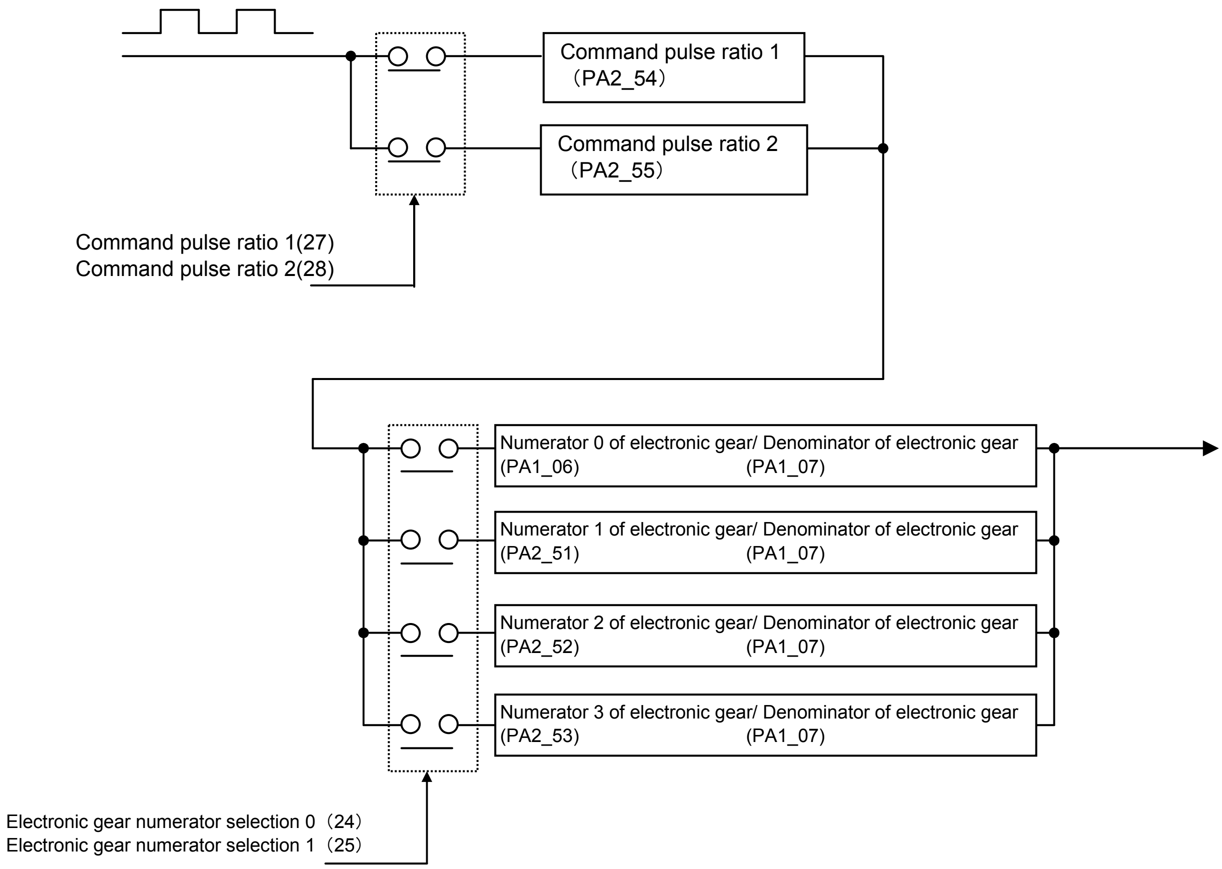
↓

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



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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.

■ 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."

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 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.

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.

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%	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>These functions are enabled only if "6" (extension mode) or "7" (positioning operation) is selected for parameter PA1_01.</u>
<u>These functions are enabled with the forward command [FWD] / reverse command [REV], positioning data operation, and immediate value operation.</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 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

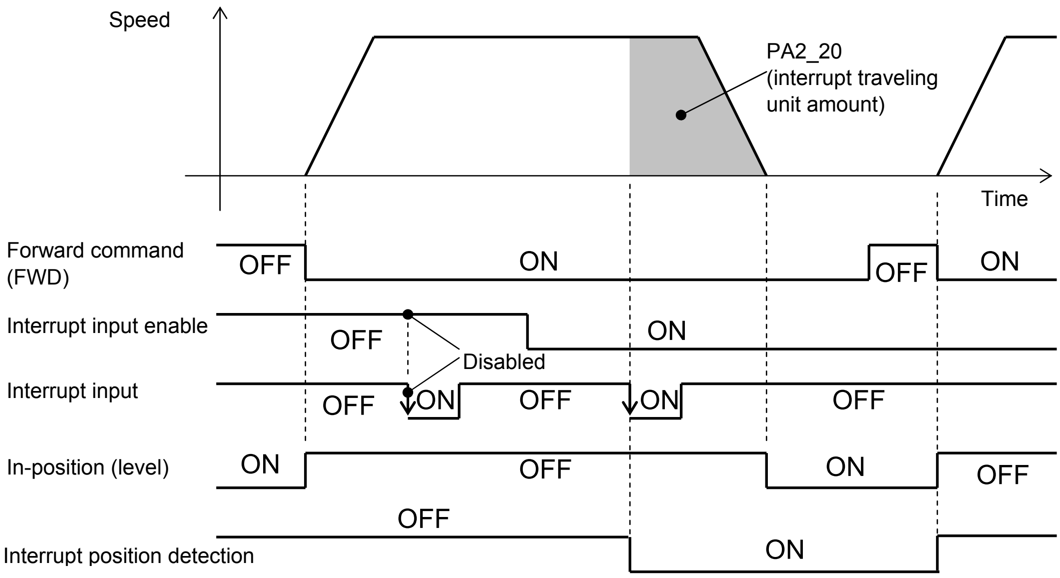
To assign interrupt input enable to a sequence input terminal, specify the corresponding value ("48") to the input terminal function setting parameter. For the interrupt input, specify ("49").

■ Relevant description

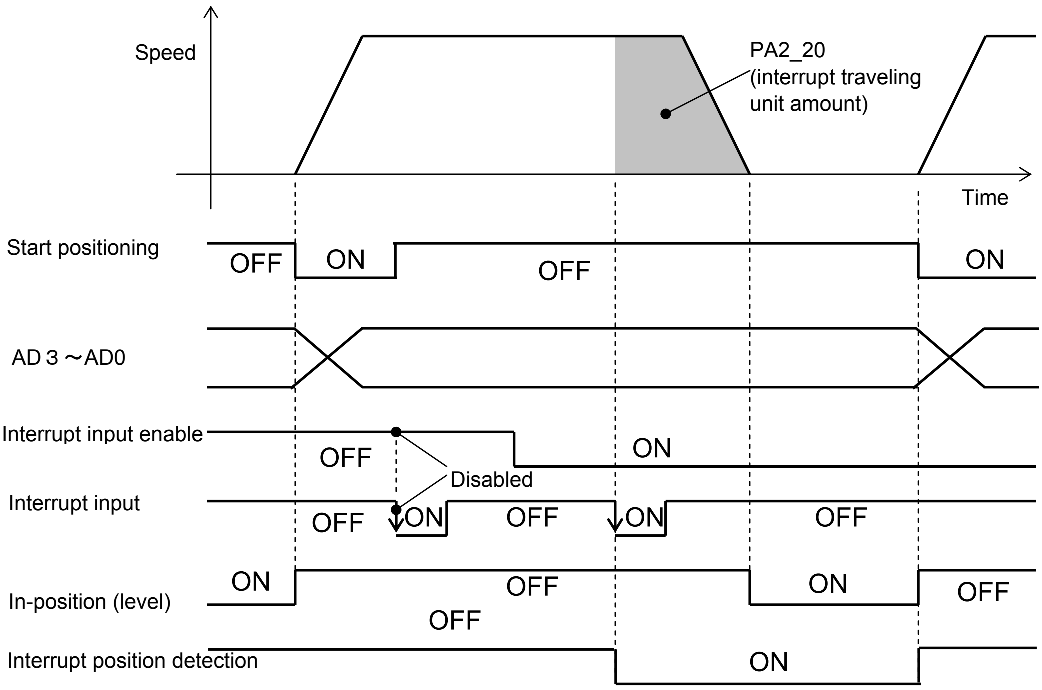
(1) Operation procedure

The operation is started with the FWD command or REV command. After the interrupt input enable is turned to ON, the interrupt positioning is executed to stop when the interrupt signal is turned to ON.

(Example: Manual operation)



(Example: Automatic operation)



(2) Positioning accuracy

The traveling amount for interrupt positioning is the value corresponding to the feedback position. The interrupt input signal is subject to the delay in detection of the hardware filter (0.05 ms)
The positioning accuracy at a mechanical system traveling speed of 1000 mm/s (60 m/min) is: 1000 x 0.00005 = 0.05 mm.
Generally, the sensor used for interrupt input has some delays from electrical factors, which are the deviation in detection and the delay in output. The interrupt positioning accuracy is determined after synthesizing these factors and mechanical accuracy (such as distortion, backlash, and expansion).

(3) Interrupt positioning detection

The interrupt positioning detection is an output signal, which is output during interrupt positioning motion by being assigned to the OUT output signals.
To assign interrupt positioning detection to a sequence input terminal, specify the corresponding value ("85") to the output terminal function setting parameter.

2

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 command position changes to the 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.

■ 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.

■ 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.

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.

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
- Positioning data 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.

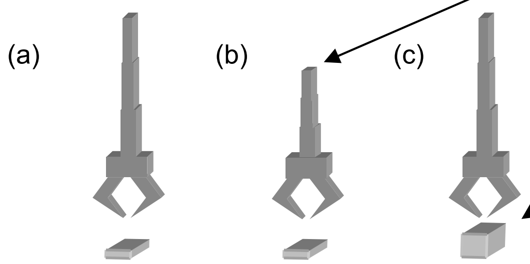
Anti resonance frequency selection 0: Sequence input signal (Reference value 57)
Anti resonance frequency selection 1: Sequence input signal (Reference value 58)

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 the sequence input terminals, specify the corresponding value ("57" or "58") to the input terminal function setting parameter.
If these signals are not assigned to the sequence input signals, they are treated as “always OFF”. Therefore, PA1_78 (vibration suppressing anti resonance frequency 0) is always enabled.
To disable the anti resonance frequency, set the anti resonance frequency at 300.0 Hz.
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
					3: Immediate value data operation	Immediate value data 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

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

Positioning data operation and immediate value operation are switched over.

■ Function

The positioning data 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 rising edge of the START signal.

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

■ Parameter setting

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

Broadcast cancel: Sequence input signal (Reference value 78)

The command using the broadcasting method via Modbus-RTU communications is canceled.

■ Function

The Modbus-RTU protocol can issue queries from the host controller, the master, to all the slave stations at the same time. For example, if the servo has a five-axis structure (of A, B, C, D, and E-axes), the servo at all the stations can be started with positioning simultaneously.

On the other hand, the Modbus-RTU protocol cannot perform the broadcast by allocating a group station no. separately. For example, if the servo has a five-axis structure (of A, B, C, D, and E-axes), the servo cannot be started with positioning simultaneously by selecting the A-axis and the B-axis only.

Thus by using this function, the broadcast in a separate group station no. can be performed. The broadcast enable/disable status can be switched using the broadcast cancel signal.

■ Parameter setting

To assign broadcast cancel to a sequence input terminal, enter the corresponding value ("78") to the input terminal function setting parameter.

Furthermore, if the broadcast cancel signal “78” is assigned to the parameter CONT always ON, the broadcast function is kept disabled. (The query of broadcast is always canceled.)

<Logic of broadcast cancel signals>

Broadcast cancel	Broadcast	Uni-cast
No allocation	Enabled	Enabled
OFF	Enabled	
ON	Disabled Cancels the queries of broadcast, without responding.	

■ Relevant descriptions

<Signal switching timing>

1) When switching the broadcast cancellation status between ON and OFF using the CONT signals (CONT9 to 24) via communications, see "2. Communications timings" on page 13-27

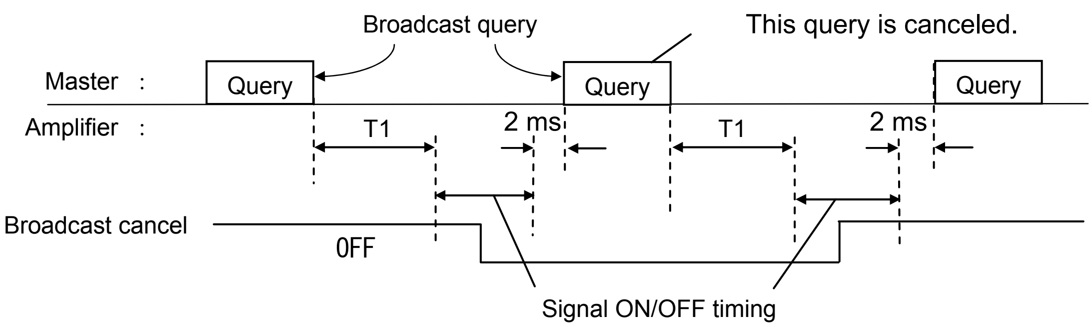
The timing is determined based on the standard communications timing. There is no individual timing prepared for the broadcast cancel.

2) When switching the broadcast cancel status between ON and OFF by using the CONT signals (CONT 1 to 5) by hard signals, see the chart below. Switch the ON and OFF of broadcast cancel under the following conditions:

(1) T1 or longer duration has elapsed after the timing the query is issued (end of telegraph), and

(2) within 2 ms before the timing the query is issued (top of telegraph).

The value "T1" corresponds to the parameter PA2_73 (Communication baud rate), and is provided as in the table below.



PA2_73: Communication baud rate	T1
0：38400 bps	5 ms
1：19200 bps	10 ms
2：9600 bps	
3：115200 bps	1.7 ms

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	54	OFF
OUT output	Alarm detection (Normally open contact)	16	OFF
	Servo control ready [S-RDY]	28	ON

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

■ 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	54	OFF
OUT output	Alarm detection (Normally open contact)	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

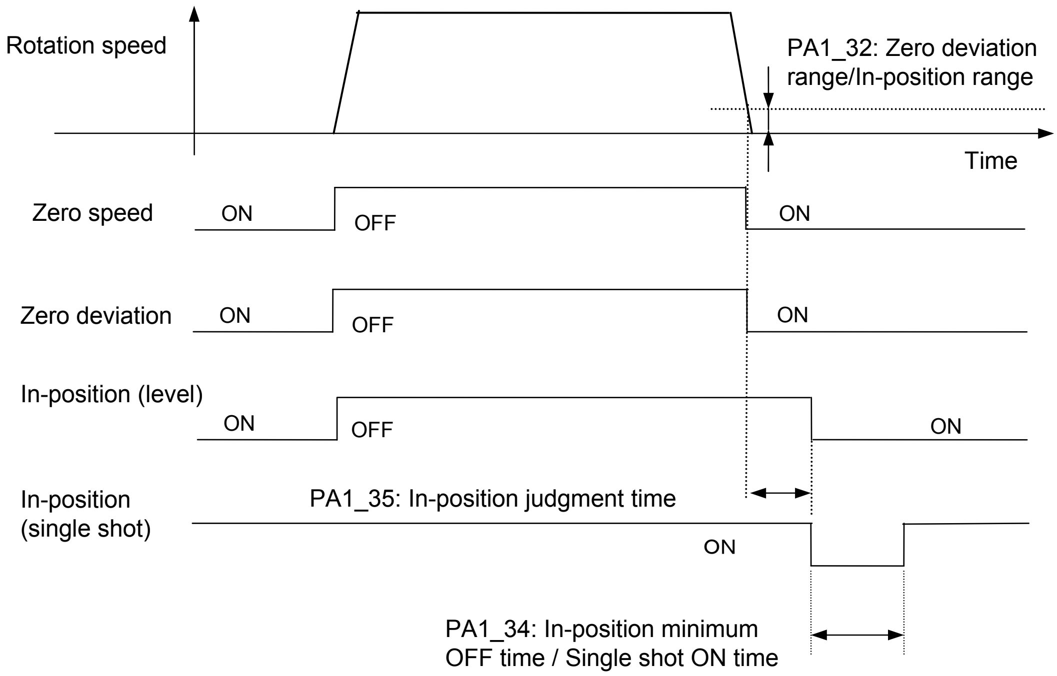
Level: The signal is turned on if conditions (A) and (B) below are satisfied.

(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 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.



(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 for position and speed control).
- 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.

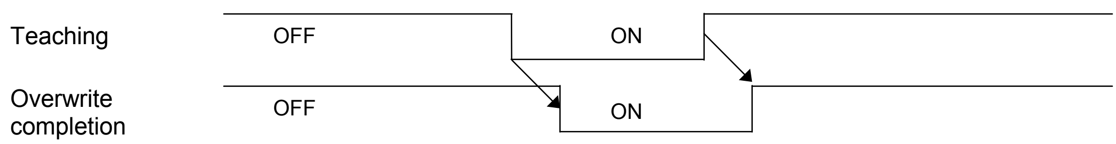
Over write completion: Sequence output signal (Reference value 13)

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 assign 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).

2

■ Parameter setting

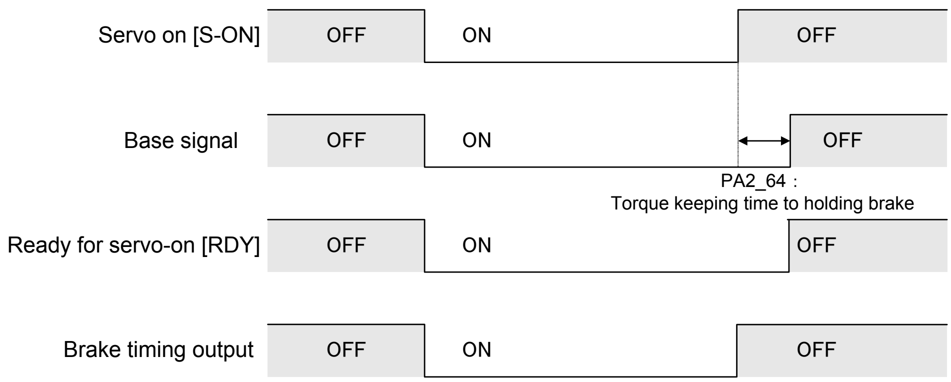
To assign the brake timing output to a sequence output terminal, specify the corresponding value ("14") to the output terminal function setting parameter.

Note	
Note	• The brake attached to the brake-attached servomotor is "for retention." Do not use it for regenerative. • 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.

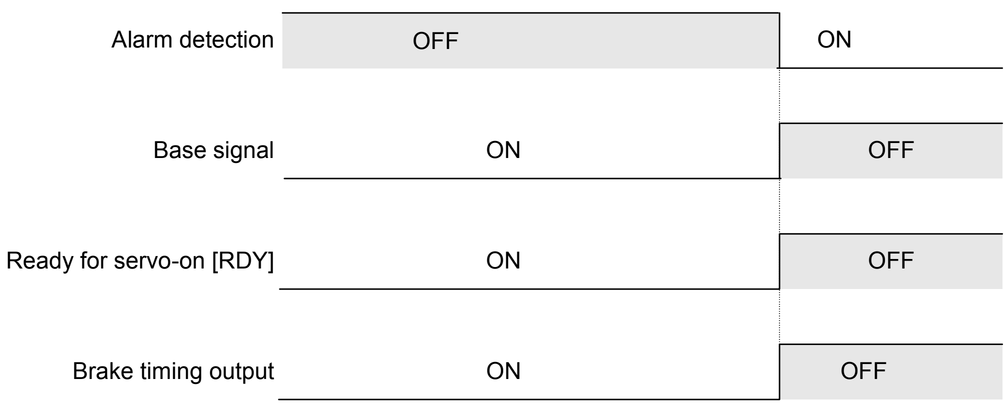
■ Relevant description

Timing chart

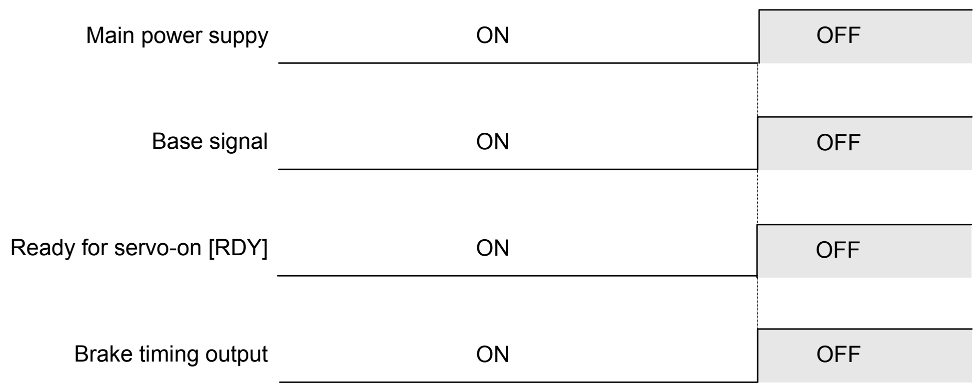
(1) ON/OFF of servo-on [S-ON] signal



(2) Upon alarm



(3) Upon main power supply OFF



2

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

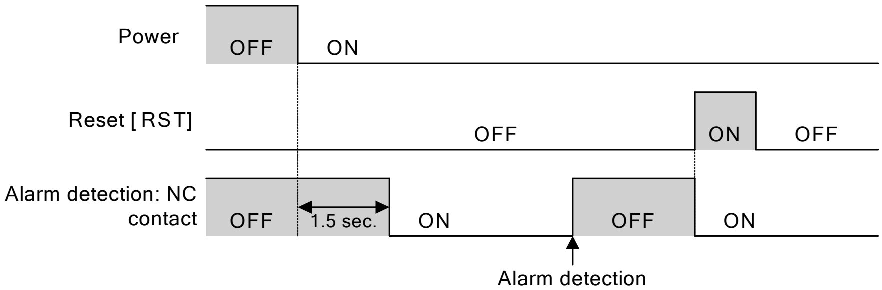
Normally open contact: Signal is turned on (switch: closed) if servo amplifier detects an alarm.

Normally closed contact: Signal is turned on (switch: open) if servo amplifier detects an alarm.

■ Function

These signals are 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 signal will be off for up to 1.5 seconds after the power is turned on. Check the signal status waiting for 1.5 seconds or more 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.

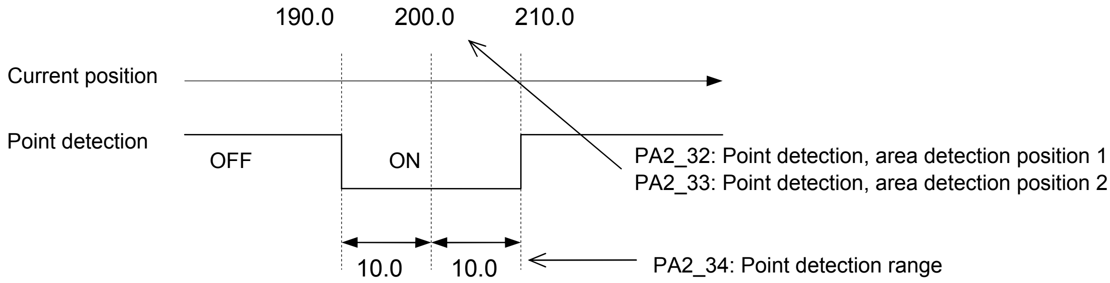
This function is enabled after homing or position preset.

■ 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 and 2.

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

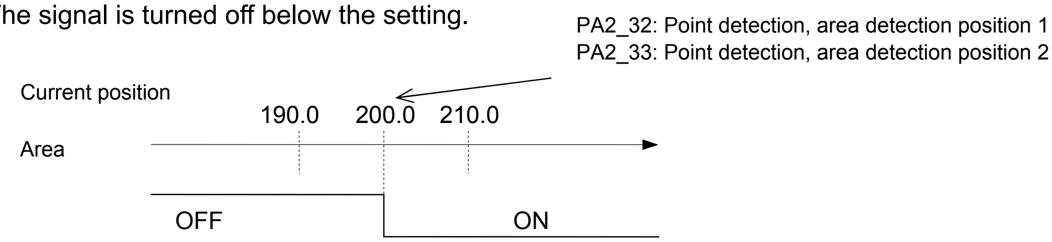
The signal is turned on near the position specified with PA2_32 (point detection, area detection 1) or PA2_33 (point detection, area detection 2).



(2) PA2_31 (point detection, area detection) = 1: ON for positive side

The signal is turned on at a position beyond the setting of PA2_32 (point detection, area detection 1) or PA2_33 (point detection, area detection 2).

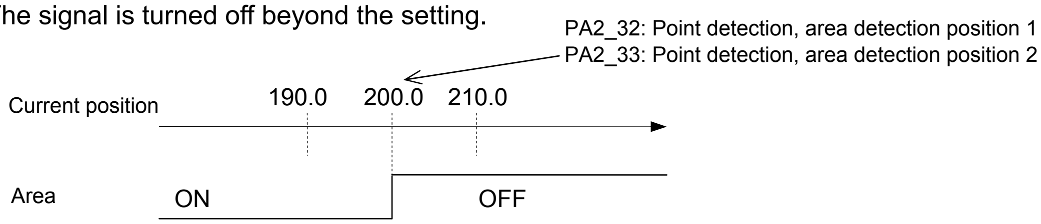
The signal is turned off below the setting.



(3) PA2_31 (point detection, area detection) = 2: ON for negative side

The signal is turned on below the setting of PA2_32 (point detection, area detection 1) or PA2_33 (point detection, area detection 2).

The signal is turned off beyond the setting.



■ Parameter setting

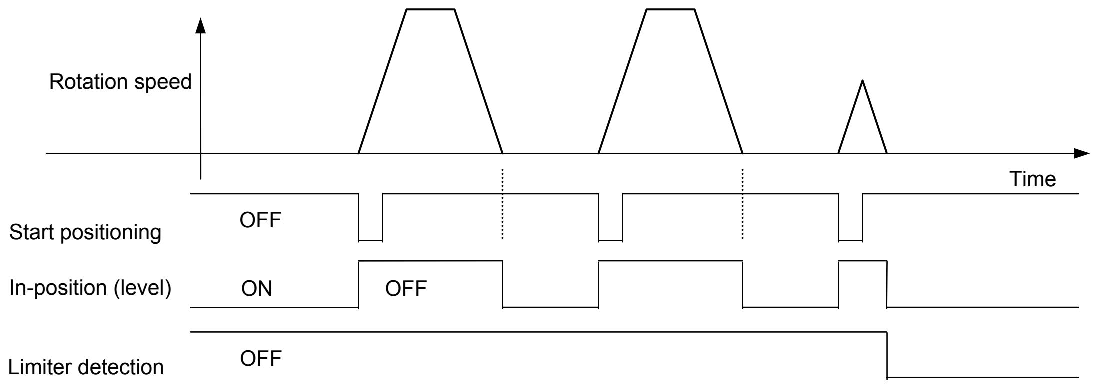
To assign point detection and area 1 to a sequence output terminal, specify the corresponding value ("17") to the output terminal function setting parameter. Specify ("18") for point detection and area 2.

Limiter detection: Sequence output signal (Reference value 19)

With this signal, the limiter function availability can be checked.
This function becomes enabled after homing or position preset.

■ Function

The limiter function is enabled in the position control mode, and not enabled in the interrupt positioning operation.
The limiter function always stops travels at the detection position even if a position command with the value exceeding the parameter of PA2_28 (positive limiter detecting position) or PA2_29 (negative limiter detecting position) is given, never allowing the travel to exceed the limiter detection position.
The deceleration time in stopping follows the parameters and the positioning data settings. (However, travels are stopped in rapid deceleration during pulse operation.)
After stopped at the limiter detection position, the limiter detection signal is output in the same condition as the In-position signal output.
To return from the limiter detection condition, shift the current position by giving a command in the opposite direction from the detection direction. The limiter detection signal will turn off, enabling travels in both directions.



The above positioning data assumes uniform incremental positioning data.

■ Parameter setting

To assign 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 a useful function. It allows the motor to travel at a uniform interval to the preset parameter position, which eliminates the need to calculate the frequency of starting or remaining distance to go to the set position.

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.

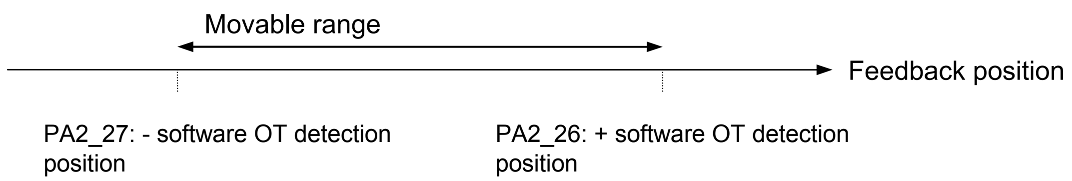
■ Relevant description

(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

This function is enabled after homing or position preset.
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.
Therefore, the motor stops at a position over the software OT detection position.
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)

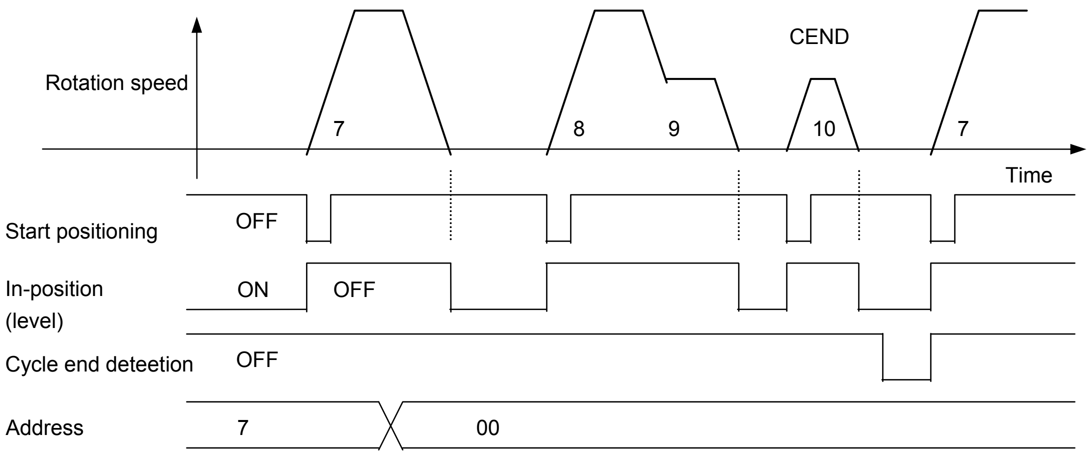
This signal is turned on after the cycle end position is reached if the cycle end is assigned to the positioning data. PA2_41 (sequential start selection) must be set at “1” (enable). Change PA2_40 (internal positioning data selection) to “1” (enable).

2

■ 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 assign 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.

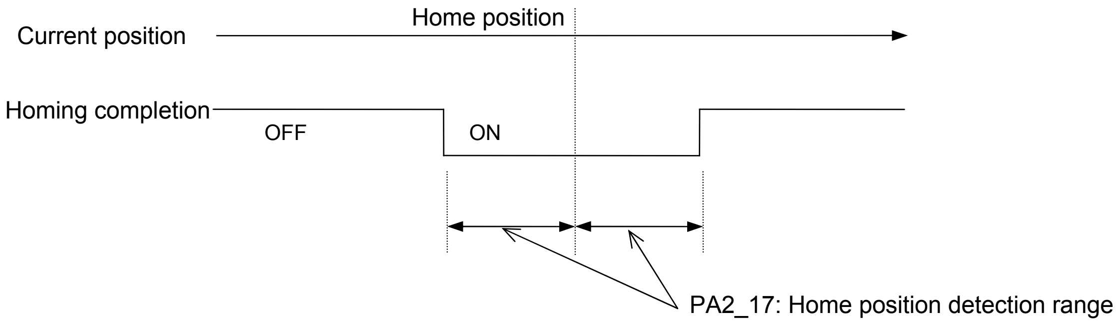
If data continuation designation is included in positioning data, operation starts at the next data having no data continuation designation.

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.

■ 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."
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.

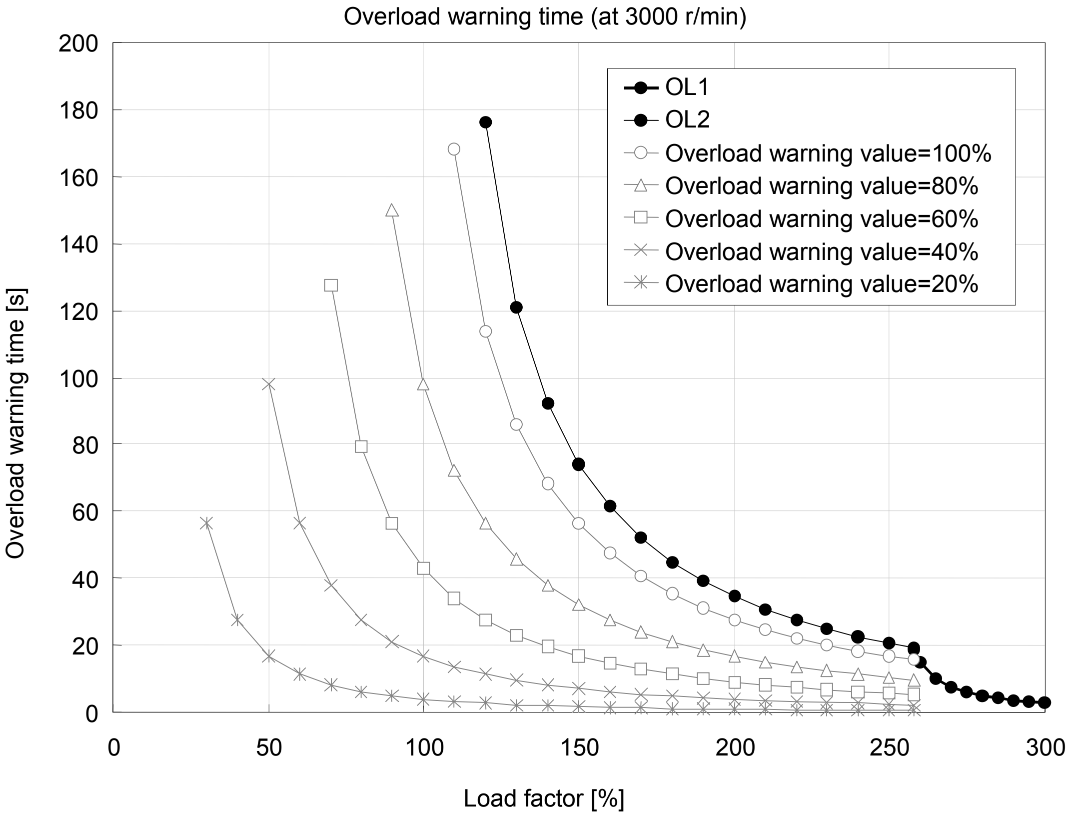
■ Function

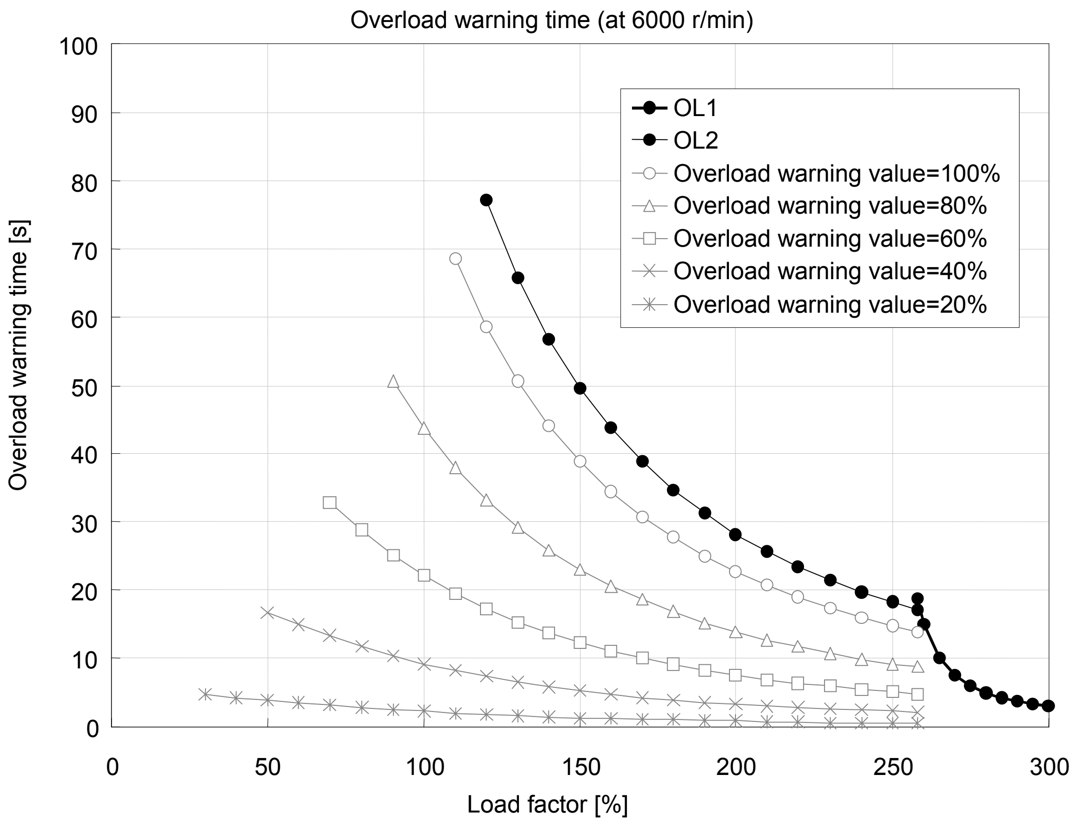
The signal is turned on if the load factor of the servomotor reaches the overload warning level of PA2_70 (overload warning value).
The signal is automatically turned off if the factor falls below the overload warning level. (There is no way to reset with a sequence input signal.)
The signal can be issued 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.

■ 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	54	OFF
OUT output	Alarm detection (Normally open contact)	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.

2

■ Relevant description

For details, refer to "Edit permission."

Data error: Sequence output signal (Reference value 30)

The signal is turned on if the data reading or writing process does not proceed correctly.

■ Function

The signal is turned on if the address and data are incorrect (drifting beyond the specification limit) when performing teaching.

■ Parameter setting

To assign the data error to a sequence output terminal, enter the corresponding value (“30”) to the output terminal function setting parameter.

Address error: Sequence output signal (Reference value 31)

The signal is turned on when deviation from the positioning data number range and speed data range (at start) 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 setting

To assign 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

When an alarm occurs, the detected alarm detail can be specified by checking the signal of the alarm code 0 to 4 assigned to OUT output signals.

■ 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.

■ List of alarm detail and code

Alarm detail	ALM4	ALM3	ALM2	ALM1	ALM0	Code	Indication	Order
No alarm (normal operation)						00H	nonE	-
Overload 1					1	01H	oL1	15
Overload 2					1	01H	oL2	16
- (Unused)				1	0	02H	-	-
Amplifier Overheat				1	1	03H	AH	22
Internal Breaking Resistor Overheat			1	0	0	04H	rH1	18
External Breaking Resistor Overheat			1	0	0	04H	rH2	19
Breaking Transistor Error			1	0	0	04H	rH3	20
Inrush Current Suppression Circuit Trouble			1	0	0	04H	rH4	17
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
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 Blown		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
Breaking 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 Over Flow*	1	0	1	1	0	16H	AF	27

*1=ON, 0=OFF Indication indicates characters displayed on the amplifier.

*The data of no.4 in order is void.

Type	Nature of alarm	ALM4	ALM3	ALM2	ALM1	ALM0	Code
Maintenance function	Battery warning	1	0	1	1	1	17H
	Life warning	1	1	0	0	0	18H
Address error	BCD error	1	1	0	0	1	19H
	Out-of-range error	1	1	0	1	0	1AH
Data error	Command rejection	1	1	0	1	1	1BH
	BCD error	1	1	1	0	0	1CH
	Out-of-range error, 0 data write	1	1	1	0	1	1DH
	Negative sign designation	1	1	1	1	0	1EH

- 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 negative 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 negative 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 2-67.

(2) Software OT

Set PA2_25 (software OT selection) at "1" to allow movement in the position range between (PA2_26 (positive software OT detection position)) and (PA2_27 (negative software OT detection position)).
For details, refer to "PA2_25 to 27 (software OT selection/position command format, software OT detection position)."

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 on (relay:open).

■ Function

Forced stop detection is turned on when the forced stop sequence input signal is turned on (relay:open). For details, refer to "Forced stop."

■ 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.

2

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 (En03) 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 assign M codes 0 to 7 to sequence output terminals, enter corresponding value (“60” to “67”) to the system parameter.

■ Relevant description

(1) M code setting range

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

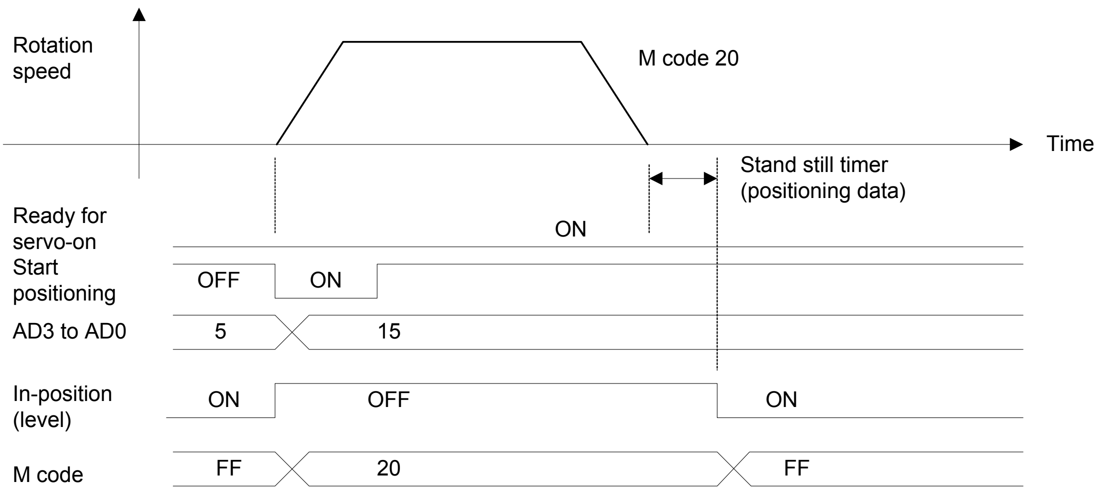
(2) Output at start (output in start) / output at completion (output after completion)

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



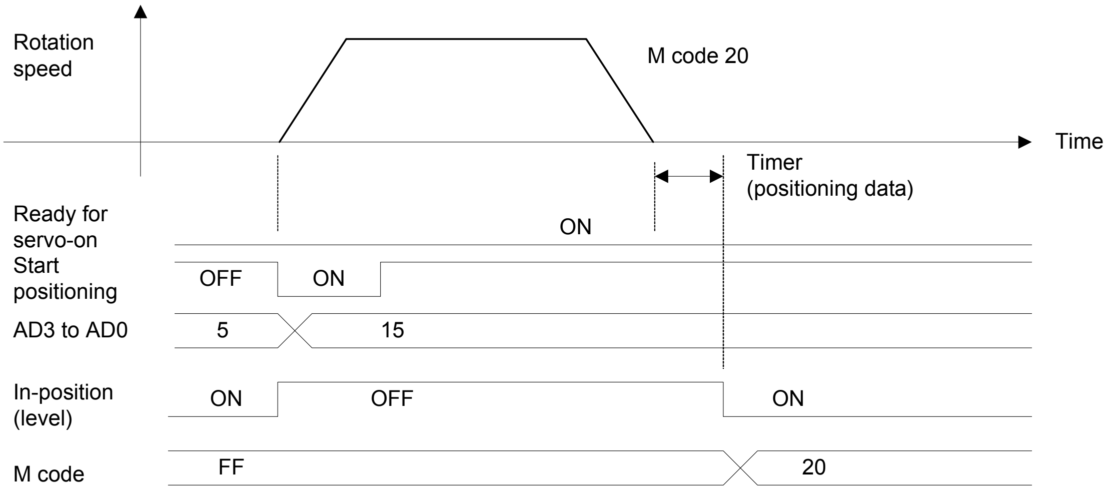
* Positioning data is executed while the timer time is counted.
* The default value of the M code is FF.

2

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.

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 50 ms after positioning based on the post-continuation data.

For details, refer to “Immediate value continuation.”

■ Parameter setting

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

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

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.”

■ 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 permission: sequence output signal	79
Immediate value continuation completion: sequence output signal	80

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.”
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.

2

■ Parameter setting

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

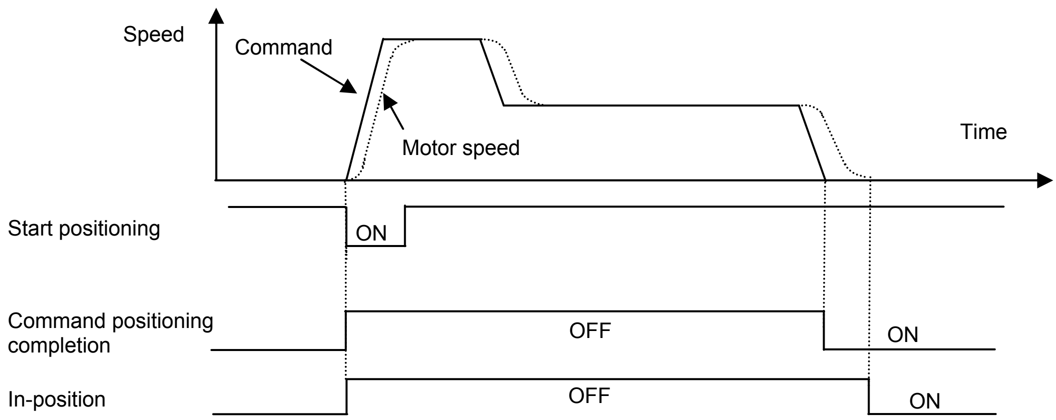
Allocated signal	No.
Immediate value change	23
Immediate value change completion	81

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

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

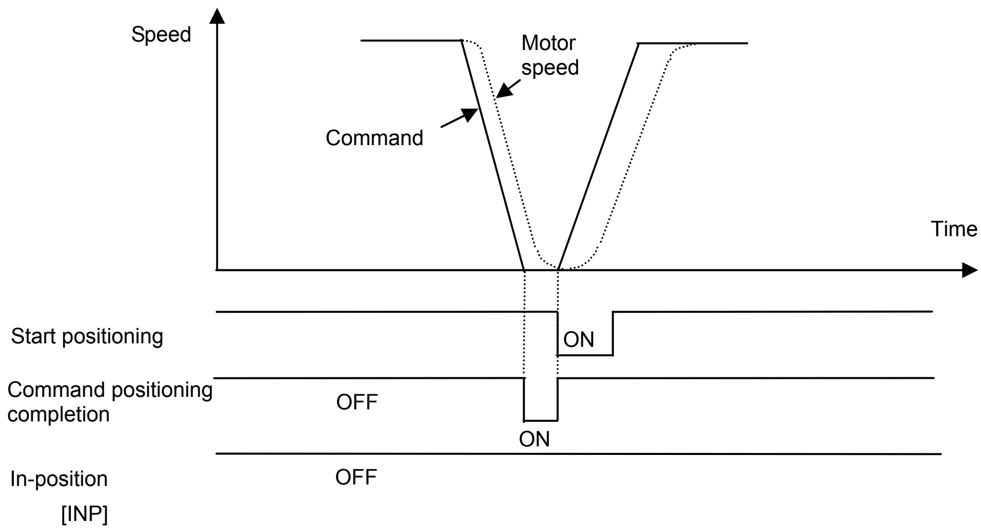
■ Function

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 stand still 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.

This function is enabled after homing or position preset.

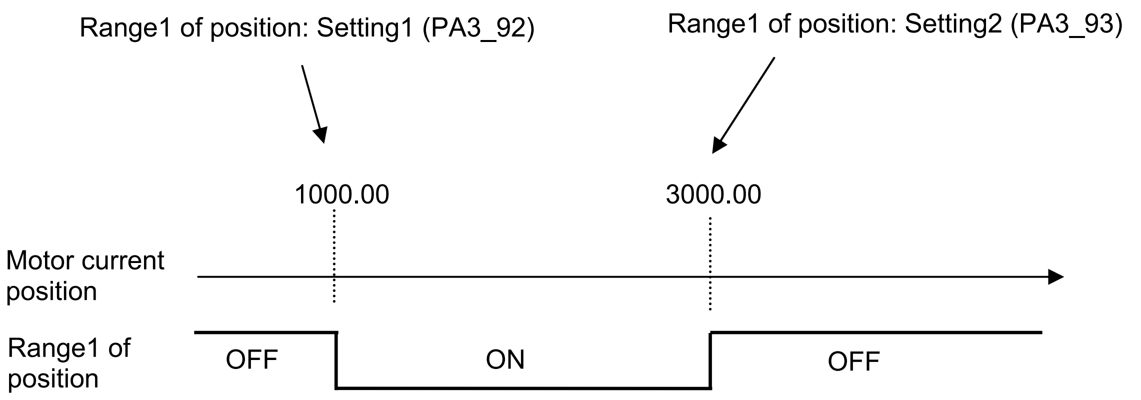
■ Parameter setting

The signal can be output at two positions: position range 1 and 2.

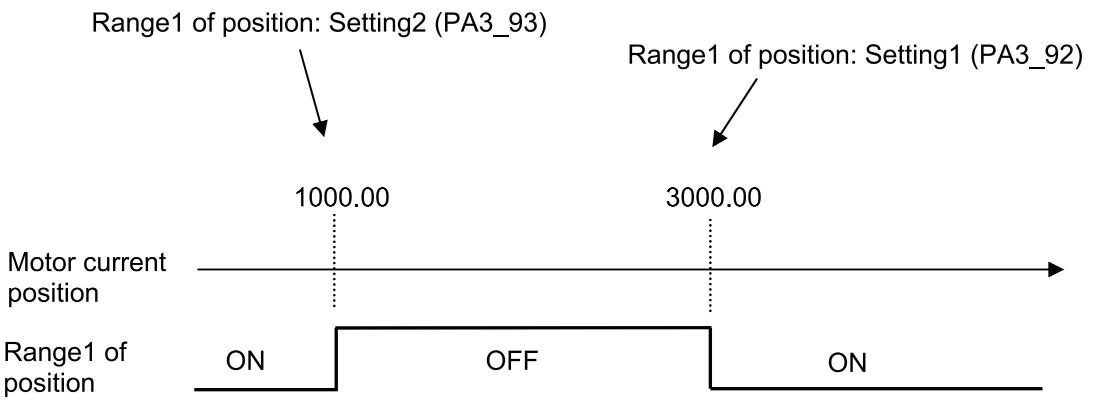
Range 1 of position: Enter at PA3_92 (range1 of position: setting1), and _93 (range1 of position: setting2).

Range 2 of position: Enter at PA3_94 (range2 of position: setting1), and _95 (range2 of position: setting2).

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.

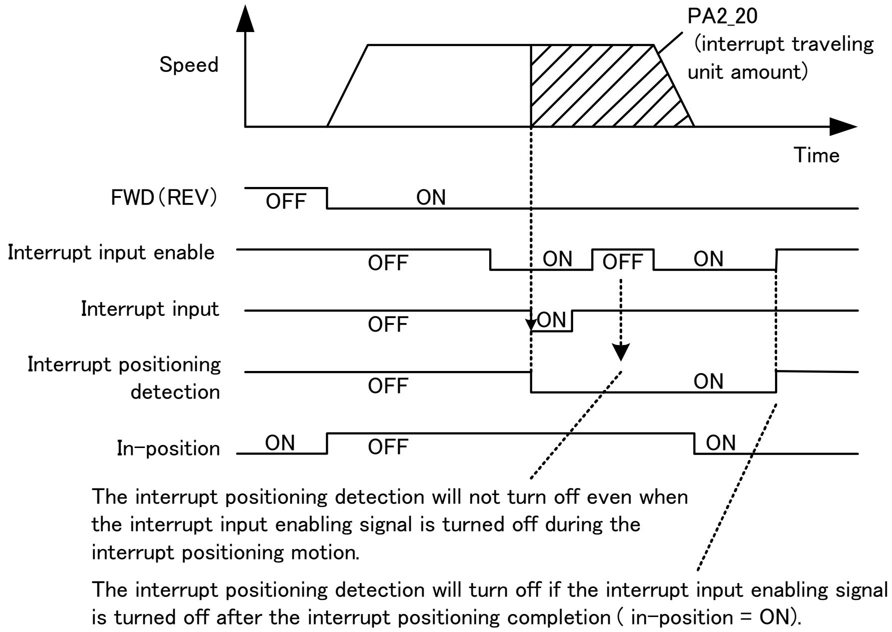
Interrupt positioning detection: Sequence output signal (Reference value 85)

This signal outputs the interrupt positioning motion mode status.

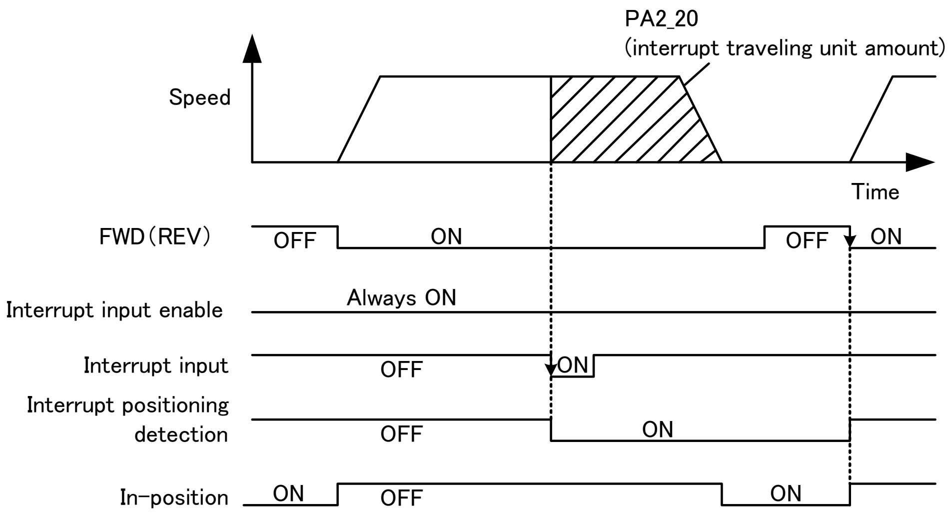
■ Function

The signal turns on during interrupt positioning motion, and turns off with any of the following conditions.

(1) When the interrupt input enabling signal is turned off after the positioning motion completion.



(2) When the next start signal (FWD, REV, START, or ORG) is turned on.



(3) When the positioning cancel signal is turned on during interrupt positioning motion.

(4) When changed to other than the position control servo-on mode from the interrupt positioning mode
Example) EMG: emergency stop by turning to OFF, alarm occurrence, changed to speed control, etc.

■ Parameter setting

Enter the corresponding value (“85”) to the output terminal function setting parameter.

■ Relevant description

If the temporary stop is turned on during interrupt positioning motion, the mode is regarded as the interrupt positioning mode.
(The interrupt positioning detection signal remains on.)

CONT Through: Sequence Output Signal (Setting value 91 to 95)

This function allows communications input signals to be output via OUT signals of the hardware.

■ Function

The signals set to CONT 20 to 24 can be output through OUT signals 1 to 3 of the hardware. When a CONT□ signal is allocated to an OUT signal, the ON/OFF status of the CONT signal is output as a through signal to the OUT signal regardless of the function allocation of the corresponding CONT signal.

CONT signals respectively correspond to CONT a to e

	Corresponding CONT signals
CONTa	CONT20
CONTb	CONT21
CONTc	CONT22
CONTd	CONT23
CONTe	CONT24

■ Parameter setting

Set the values (91 to 95) corresponds to the parameter of output terminal function setting. The setting values to the relevant signals are as follows.

PA3_51 to 53

No.	Name	Setting range	Change
51	OUT1 signal assignment	0 to 95 91 : CONTa through 92 : CONTb through 93 : CONTc through 94 : CONTd through 95 : CONTe through	Power
52	OUT2 signal assignment		
53	OUT3 signal assignment		

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.

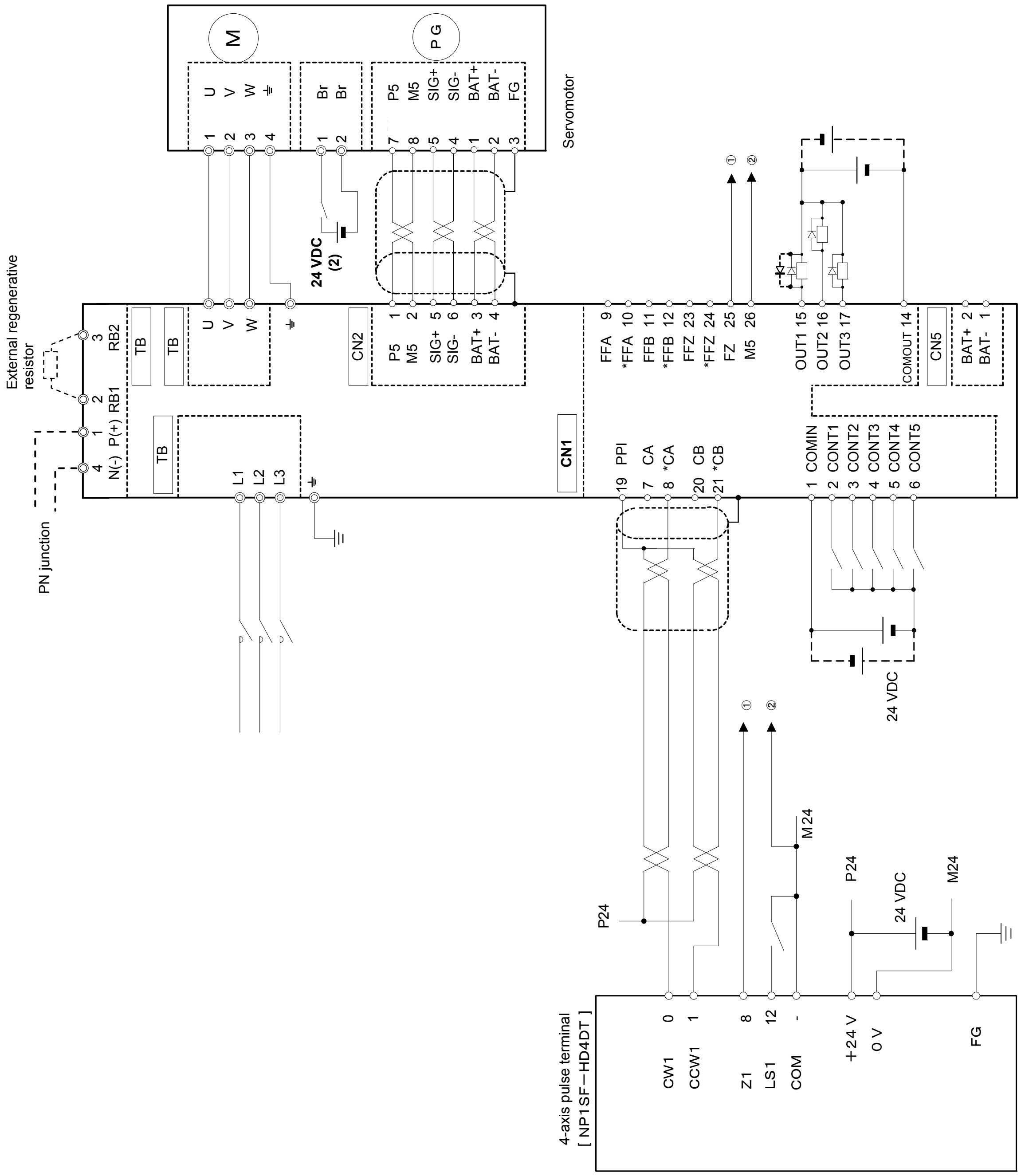
- The servomotor specified in the connection diagram is equipped with a brake. If the servomotor is equipped with no brake, the Br terminal is not provided.
- Connection of connector 4 (CN4) is unnecessary for the operation of the servomotor. Use it to measure or monitor the speed waveform and torque 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.
- To drive a servomotor, the main power must be supplied.
- Prepare separate power supplies for 24 VDC sequence I/O (CN1) and 24 VDC 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.

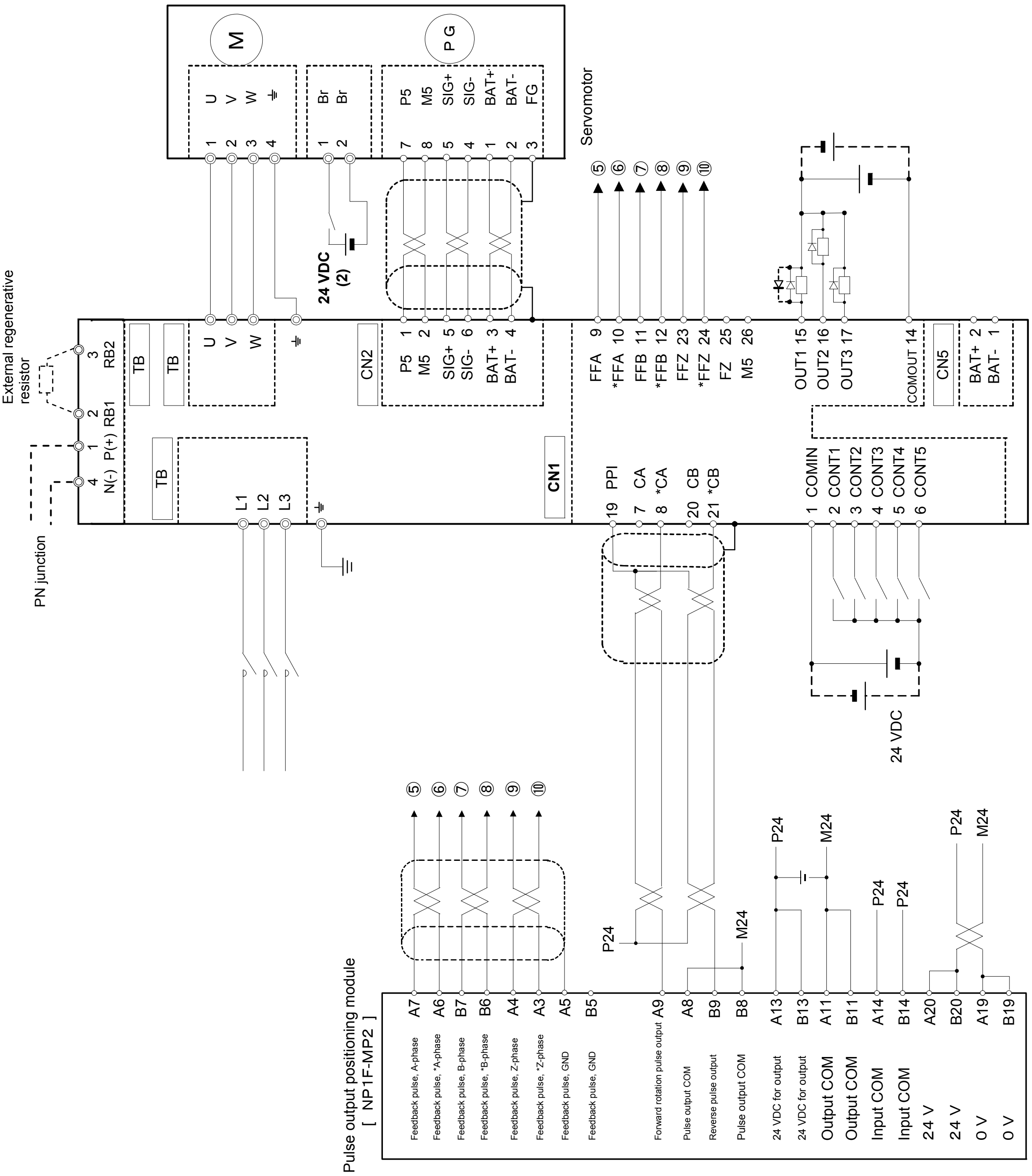
The maximum output frequency is 250 kHz.

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



2.6.2 Connection Example (Positioning module: NP1F-MP2)

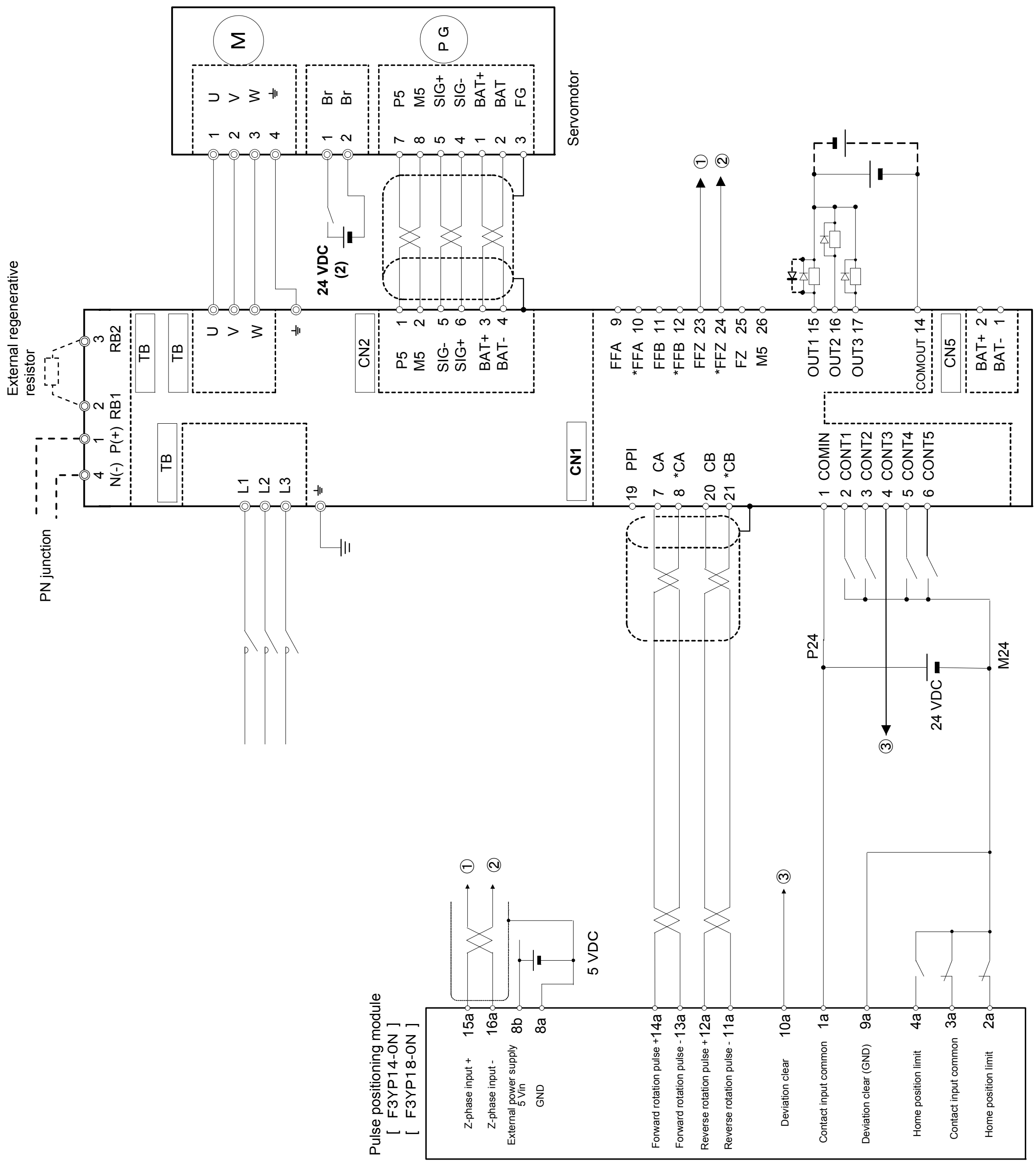
A connection example with MICREX-SX Series pulse two-axis positioning module is shown below.
The maximum output frequency is 200 kHz. For details, refer to the manual prepared for the positioning module.



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

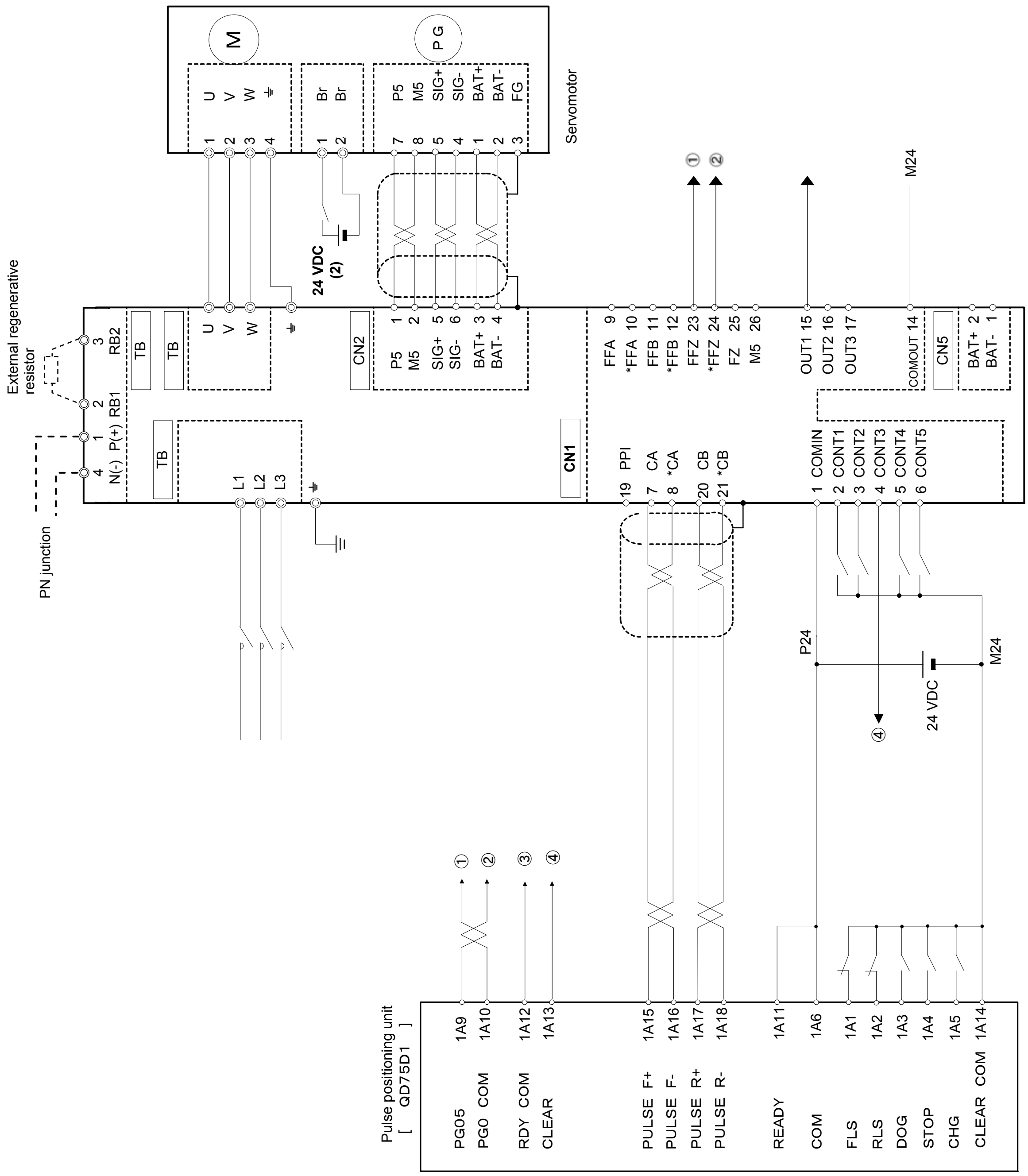
A connection example with the F3YP14-0N type positioning module made by Yokogawa Electric is shown below.

For the PLC, refer to the corresponding manual.



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.

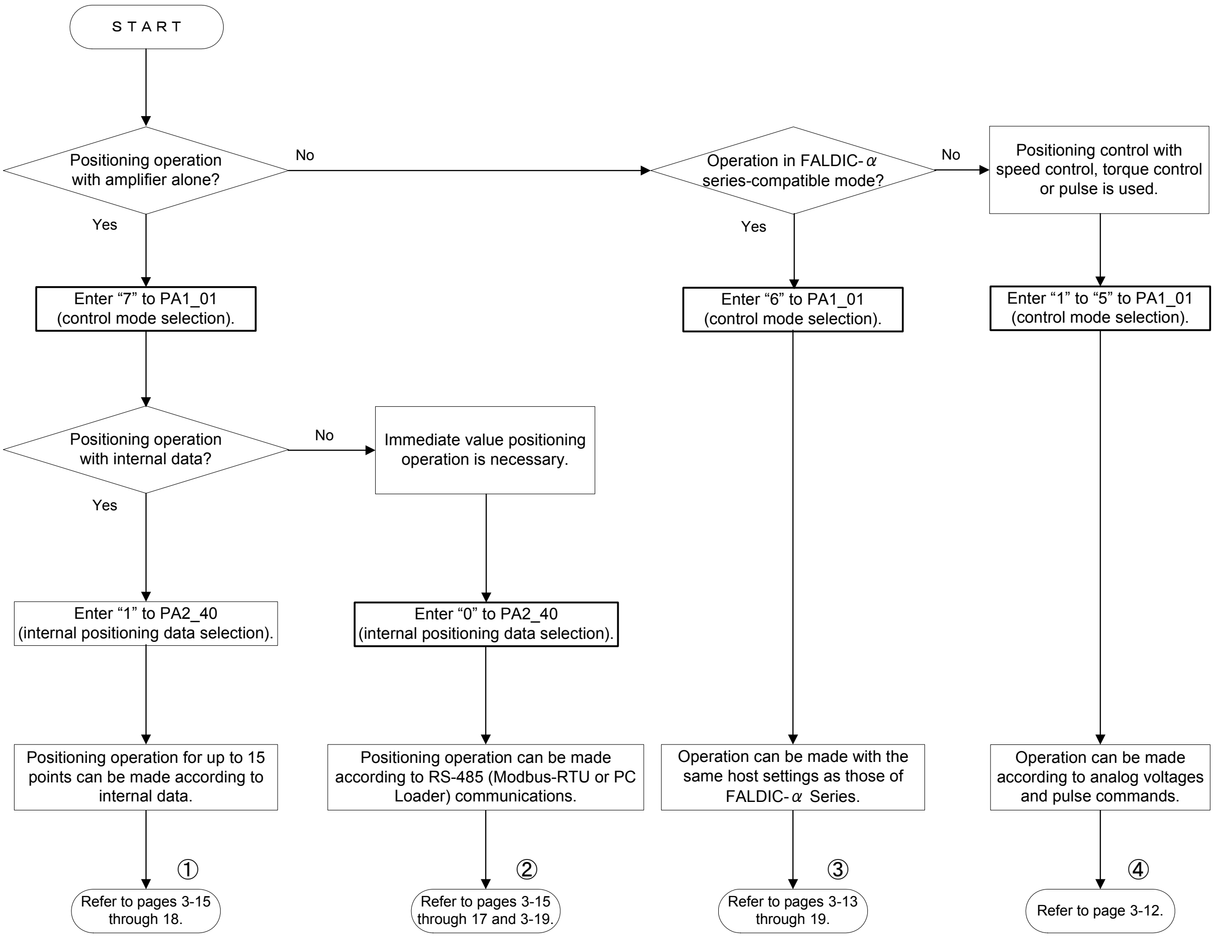
Section	Description	Applicable signal (Function No.)
01	Operation signal always given highest priority	• Free-run command (54) • Servo-on (1)
02	Operation signal always given priority	• Forced stop (10) • External regenerative resistor overheat (34)
03	Signal for controlling the torque	• Torque limit 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	• Forward rotation (2) • Reverse rotation (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)

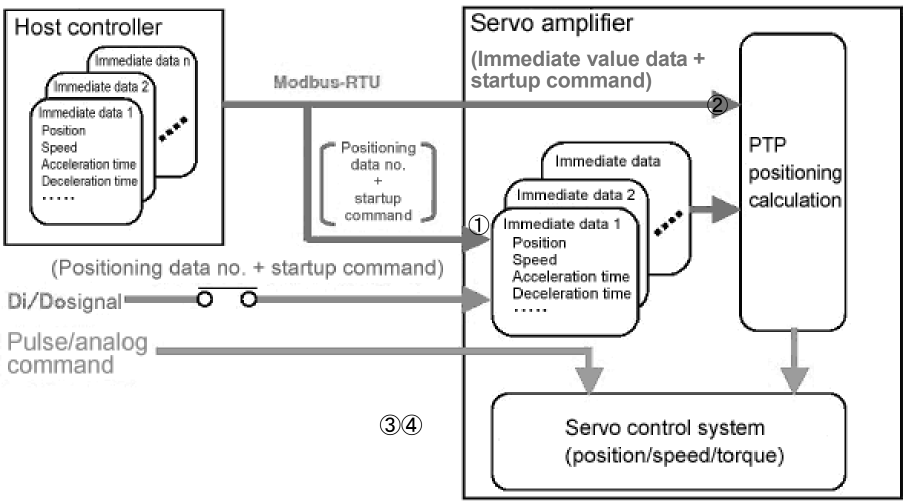
- The moving part of the mechanical system of the elevator may drop if a free-run command is used. Do not assign the command unless necessary.
- If +OT (7) is detected during rotation caused by a forward rotation (2) signal, priority is given to the +OT (7) signal.
  Even if the +OT (7) signal is detected, priority is given to the torque limit 0 and 1 (19 and 20) signal.
  Priority is given to forced stop (10) during operation with a torque limit 0 and 1 (19 and 20) signal.
  However, if the free-run command (54) 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

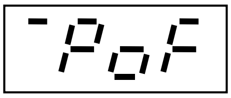
  Operate MCCB/ELCB to supply power.

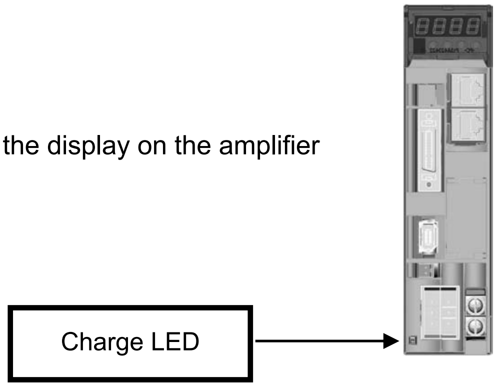
  If necessary, insert an electromagnetic contactor in the upstream of the main power input so that the power can be shut off at any time.

  The following results indicate the correct state.

  (1) The charge LED lights up in red.

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





- If the charge LED does not light up

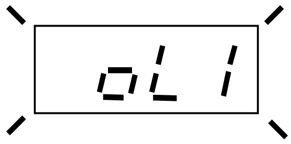
  200 V is not supplied to the main power terminals (L1, L2 and L3). Check the source voltage. Operation does not start with single-phase 100 V power supply. In case of three-phase 400 V, use a transformer to drop to 200 V to supply. (400 V will cause the servo amplifier to be broken.)

- If the display does not 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 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.)

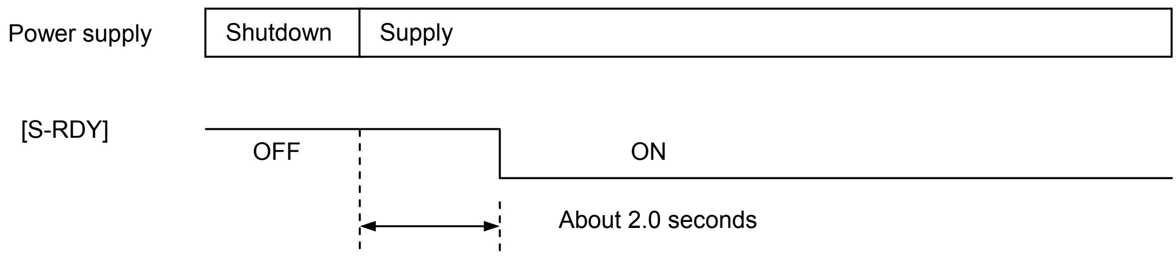
- If the error code on the display blinks

If the keypad display blinks, an alarm is detected.



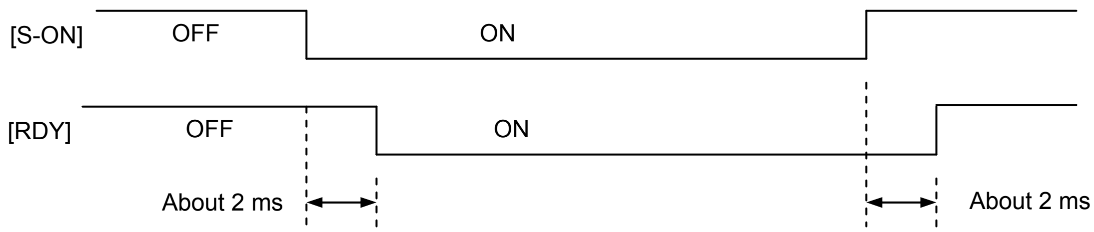
3.3.2 Power-On/Servo Control-Ready [S-RDY]

The servo control ready [S-RDY] signal is issued about 2.0 seconds after the main power is supplied. 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 “14.6.8 Diagnosis to be Made If the Servomotor Fails to Start” on page 14-34, 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 DC link voltage drops below about 200 V and the power is restored within one second with the servo-on signal being turned on, the main power undervoltage is detected. If the duration exceeds one second, the main power undervoltage is not detected.

Even if the main power undervoltage 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 power undervoltage is not detected.
Use the parameter PA2_67 (alarm detection at undervoltage) for determining the detection of main power undervoltage, and PA2_63 (action sequence at main power shutoff) for determining the stop action at main power shutoff.
If the power is shut off during operation, the servo amplifier turns off ready for servo-on [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 VDC to release the brake.
The motor rotates even without a sequence I/O signal.
The relevant parameter settings and default values are shown below.
To enable the acceleration / deceleration time with the speed control, set the parameter PA_36 (Acceleration / deceleration selection at speed control) to “1” (enable).

3

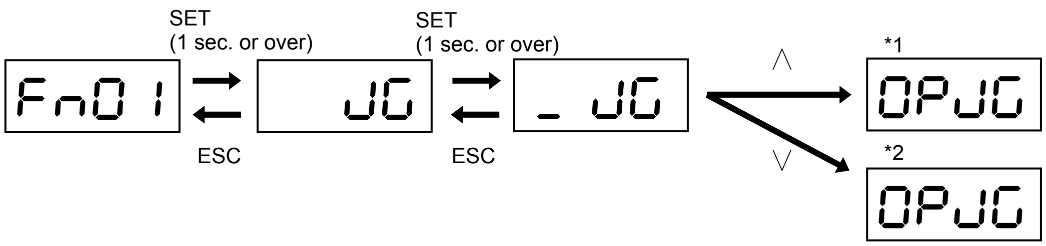
Parameter No.	Name	Setting range	Default value	Change
PA1_37	Acceleration time 1	0.0 to 99999.9 [ms]	100.0	Always
PA1_38	Deceleration time 1	0.0 to 99999.9 [ms]	100.0	Always
PA1_41	Manual feed speed 1	0.01 to (max. speed) [r/min]	100.0	Always

■ Test operation at keypad

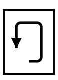
Follow the procedure below to check that the output shaft of the servomotor rotates.

[1] Use the [MODE/ESC] key to start the test operation mode [Fn01].

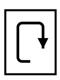
[2] The servomotor rotates while the key on the keypad is held down.



*1) [During forward rotation ((∧) being pressed)]

 The lit bar turns in CCW direction.

*2) [During reverse rotation ((∨) being pressed)]

 The lit bar turns in CW direction.

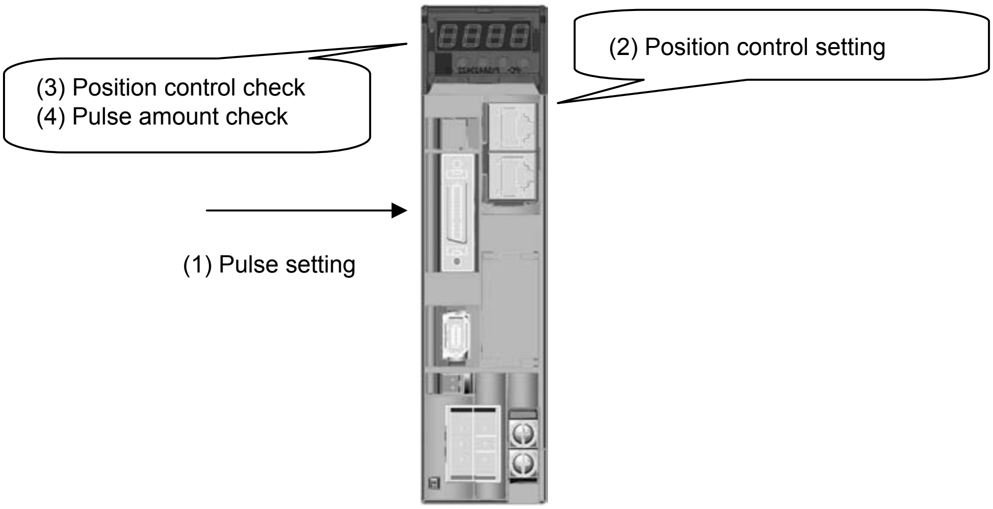
After checking shaft rotation in the test operation mode, press the [MODE/ESC] key to return until [Fn01] is displayed again.
Unless [Fn01] is displayed again, rotation with the sequence I/O signal is impossible.

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	Change
PA1_03	Command pulse input method and form selection	0: Differential input, command pulse/direction 1: Differential input, forward/reverse pulse 2: Differential input, A/B phase pulse 10: Open collector input, command pulse/direction 11: Open collector input, forward/reverse pulse 12: Open collector input, A/B phase pulse	1	Power
PA1_05	Number of command input pulses per revolution	0: Electronic gear (PA1_06/07) is enabled. 64 to 1048576 [pulses]: Number of command input pulses per revolution is enabled.	0	Power
PA1_06	Numerator 0 of electronic gear ratio	1 to 4194304	16	Always
PA1_07	Denominator of electronic gear ratio	1 to 4194304	1	Always

- 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 bits)

  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 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)

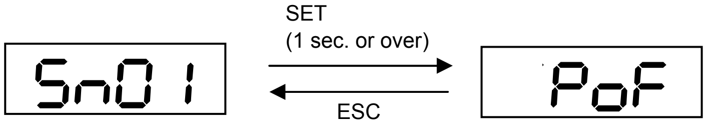
  CONT3 to CONT24: (No designation)

- 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.

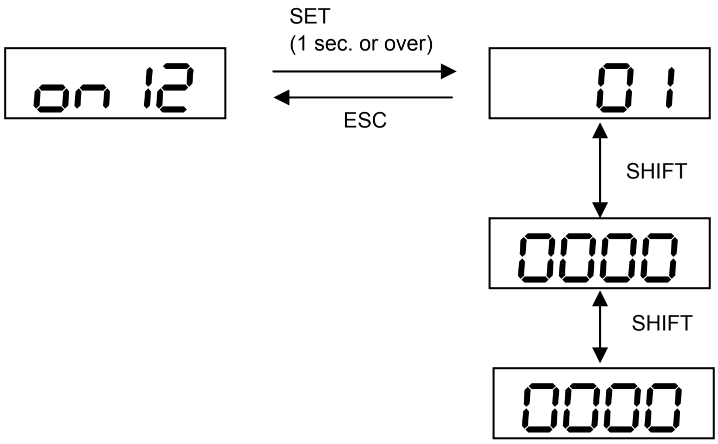
(3) Confirmation of position control

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 100000000-pulse is shown.

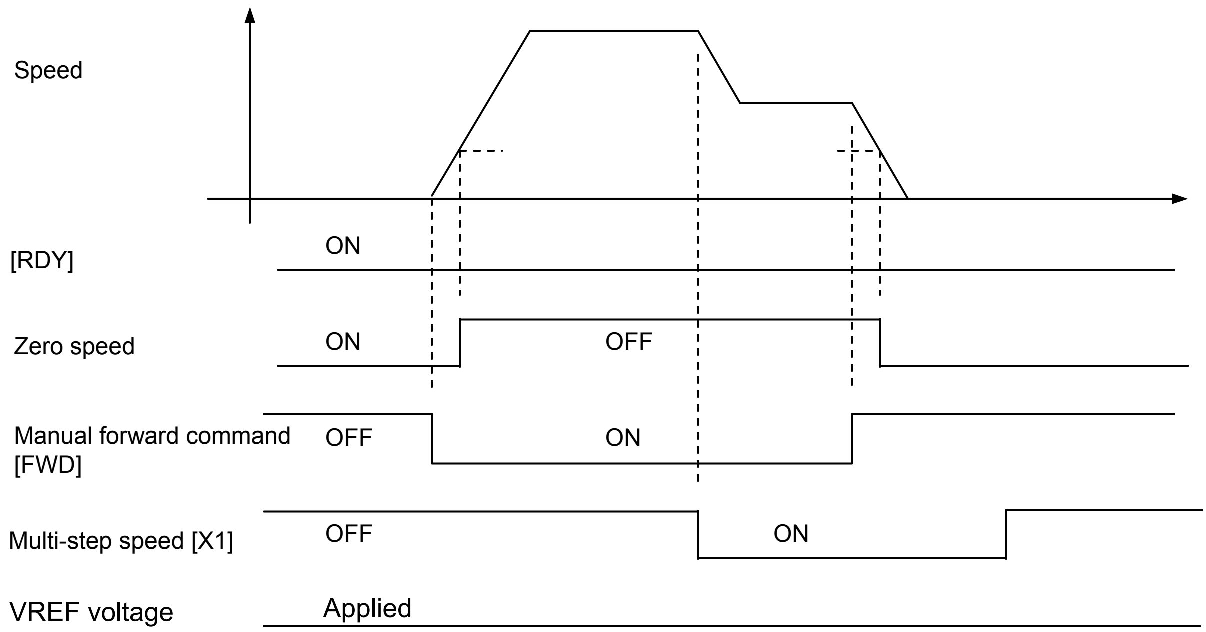
- With A/B phase pulse, four times the pulse count is displayed.

3

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].

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.



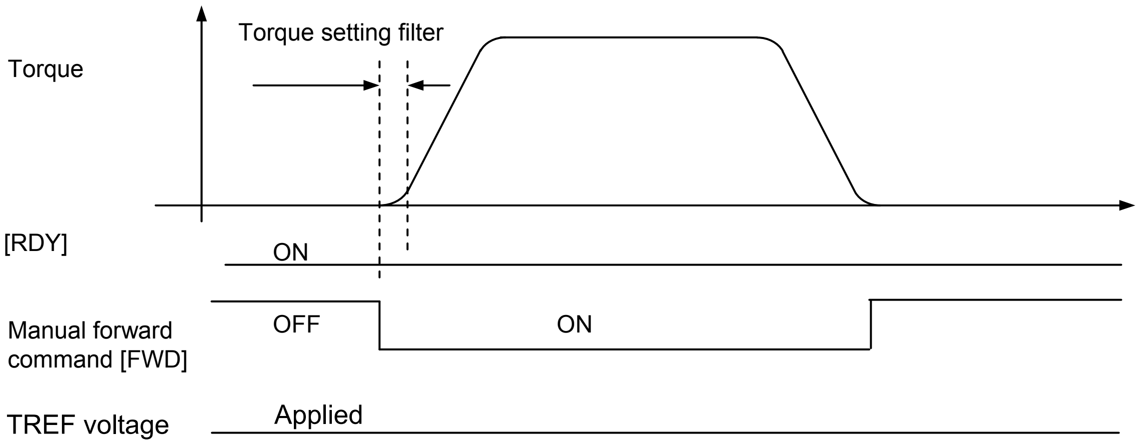
Use parameter PA3_35 to specify the zero clamp level in relation to the [VREF] input.

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	Default value	Change
PA2_56	Speed limit selection at torque control	0: Parameter (PA1_26) 1: As per multi-step speed selection incl. VREF terminal voltage	0	Power

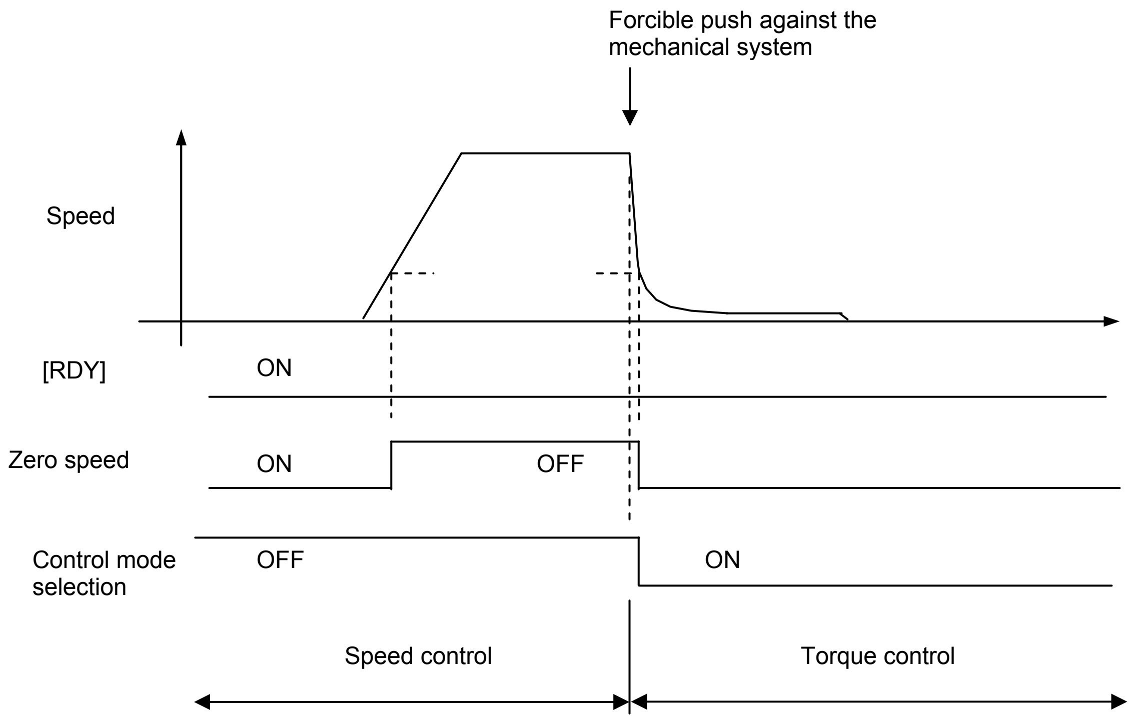
- The speeds corresponding to multi-step speed selection (X3, X2 and X1) are given with PA1_41 to PA1_47, or [VREF] terminal.
- Because the speed control is not performed, the actual speed limit level is different.

3.4.5 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. The command is issued by the voltage input of VREF and TREF.



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.

No control mode switching condition is provided. It can be switched at any time.

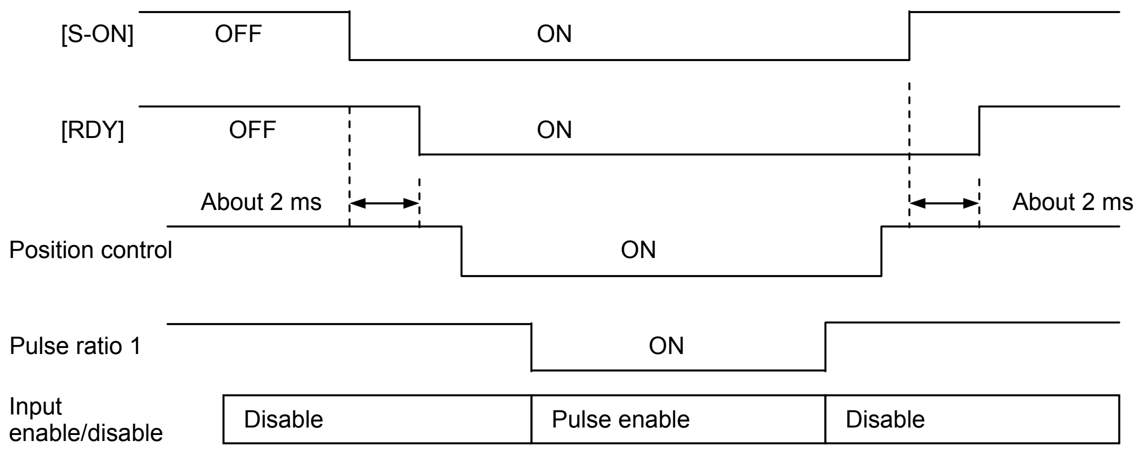
When the control mode is “6” (extension mode), the control mode is activated when the zero speed signal is turned on.

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.



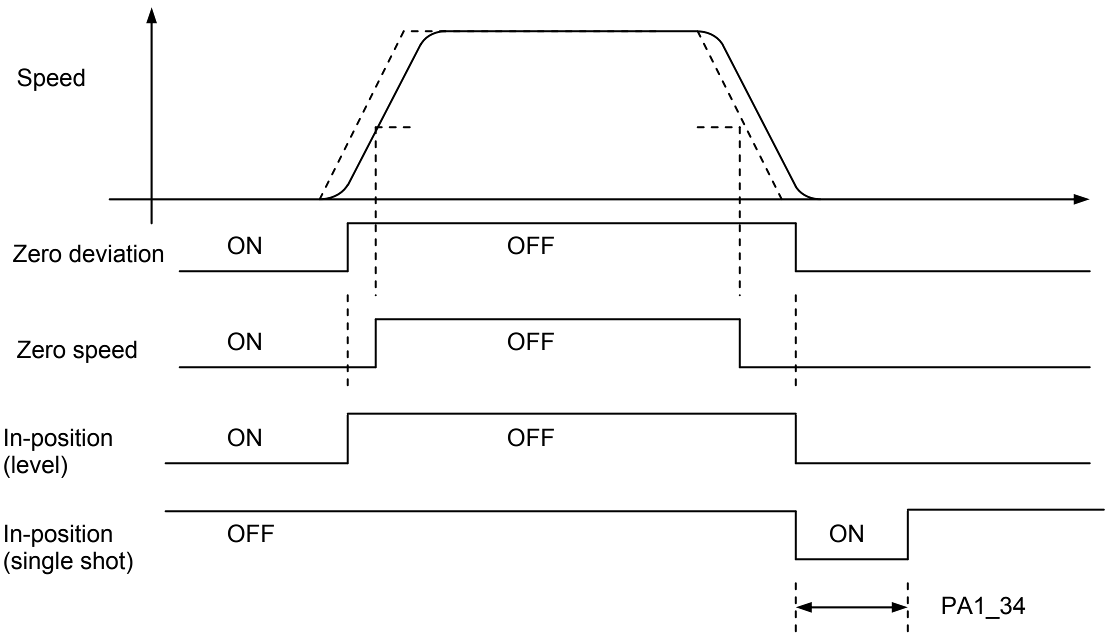
■ Command pulse multiplication (PA1_01 = 0)

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.



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

- 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.

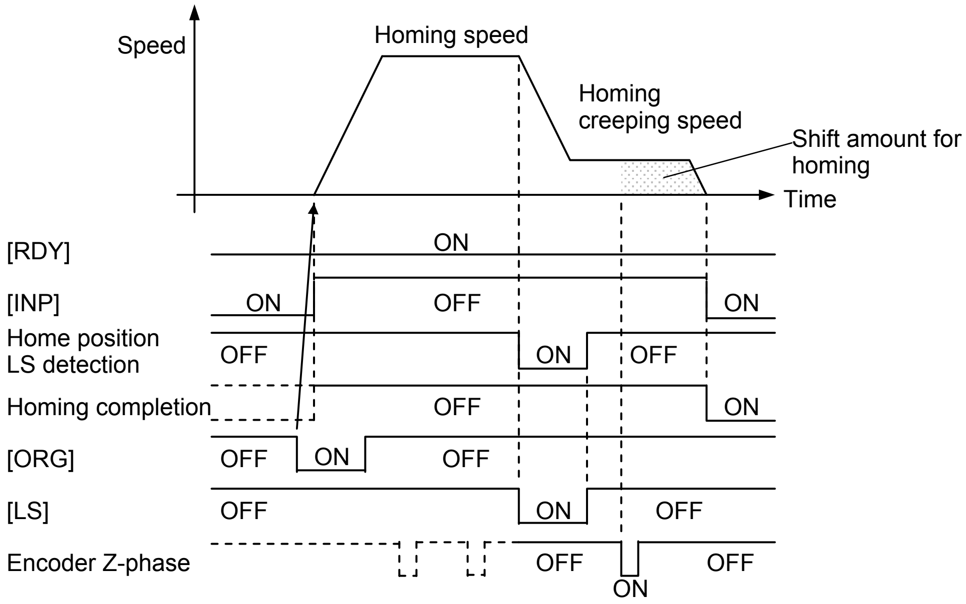
  Either edge or level can be selected with parameter PA3_36 to switch the input format of the deviation clear signal.

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

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].

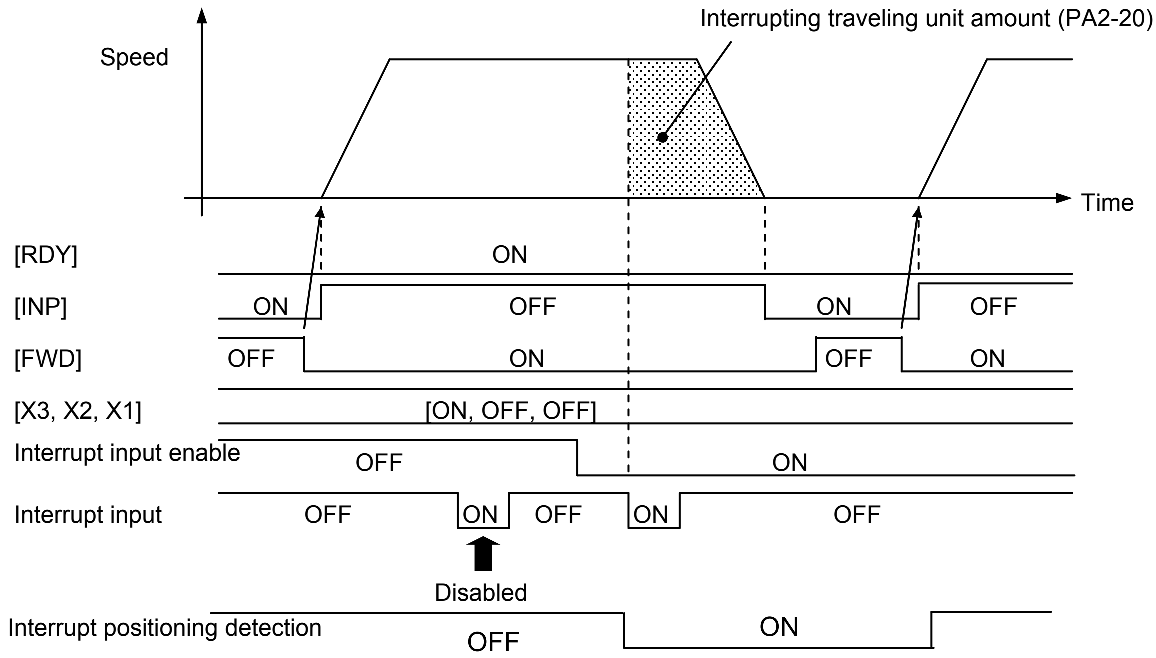
Note	The in-position [INP] signal shown in the figure assumes the level output mode. If positioning completion single shot output is selected at the parameter PA1_33, check for stoppage with an external circuit before executing operation.

3.4.8 Interrupt Positioning

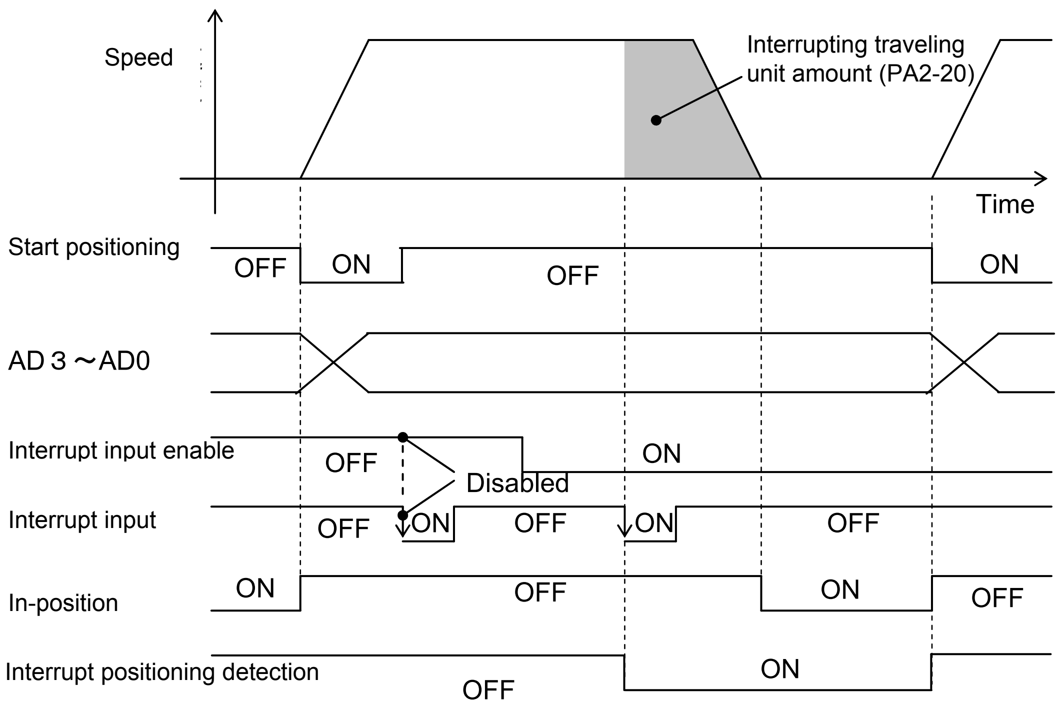
Turn interrupt input enable signal on during operation with a forward [FWD] or reverse [REV] command to start to move by an interrupt traveling unit amount, which is specified at parameter PA2_20, at the activating edge (OFF-to-ON transition) of the interrupt input.

The function is enabled in the operation with positioning data.

(1) Position control, FWD/REV operation



(2) Positioning data operation



Note	
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. Generally, the sequence input and output signals are recognized in about 1 to 2 ms by the software, however, the interrupt input detects the signals by the hardware. Therefore, delay in signal detection (about 0.05 ms) occurs only with the filter circuit of CONT1 to 5. (3) 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.
This function is enabled during positioning data operation.

(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.

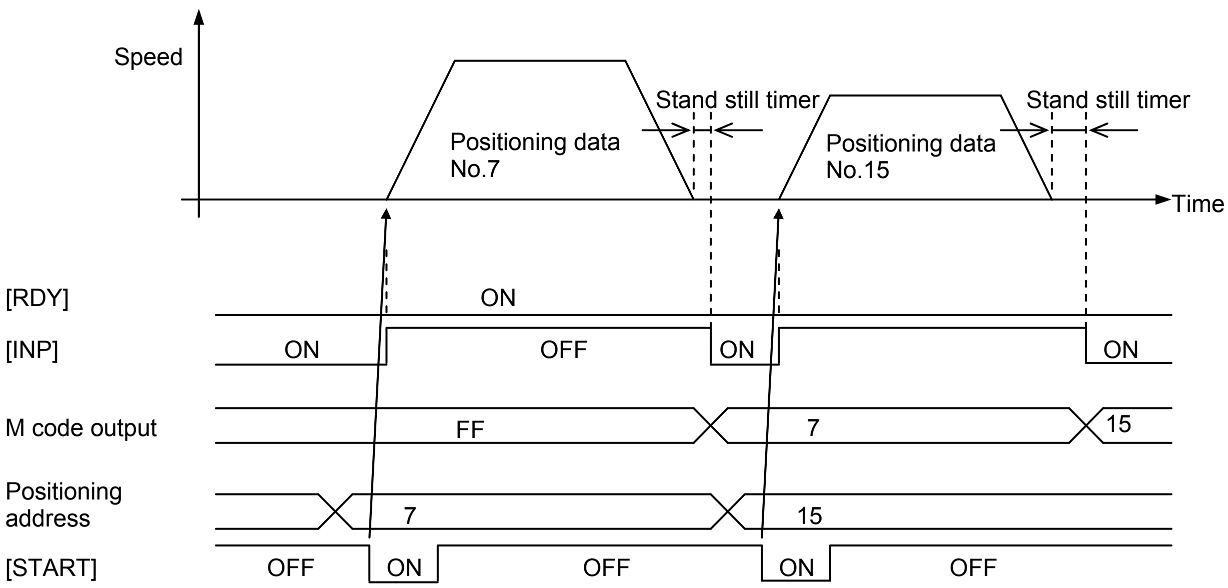
The output torque is in proportion to the voltage applied at the torque command voltage [TREF] terminal.

(3) Forced stop

The torque limit in forced stop follows parameter PA2_60.

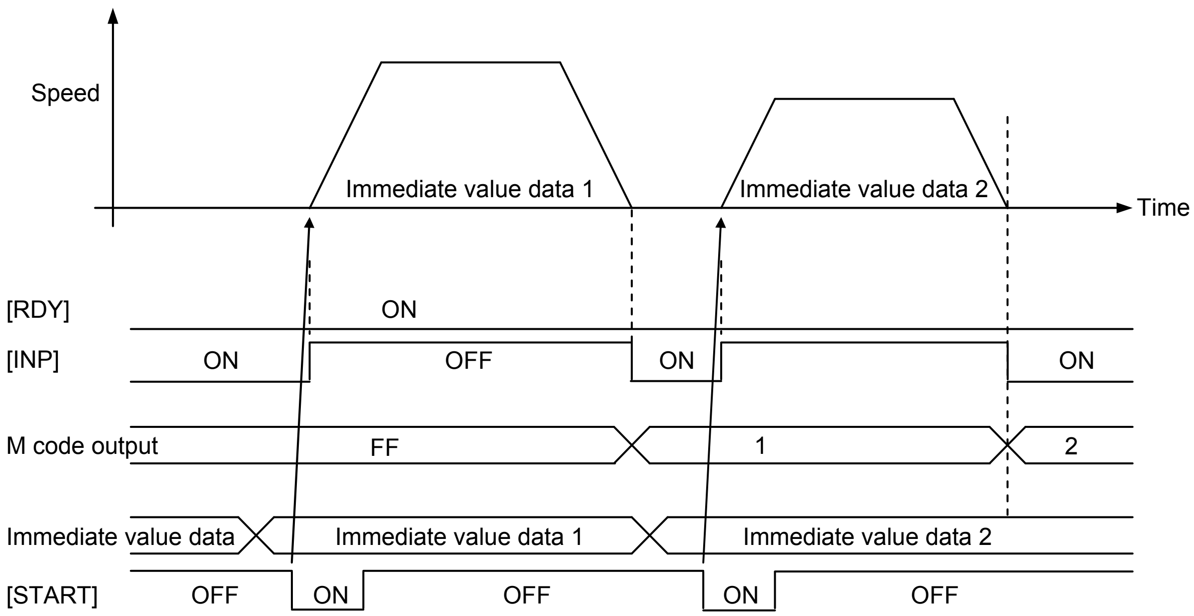
3.4.10 Positioning Data Operation

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

To enable operation with immediate value data, enter “0” to parameter PA2_40 (internal positioning data selection), or enter "1" to that parameter and "3" (immediate value data operation) to parameter PA2_41 (sequential start selection). 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.”

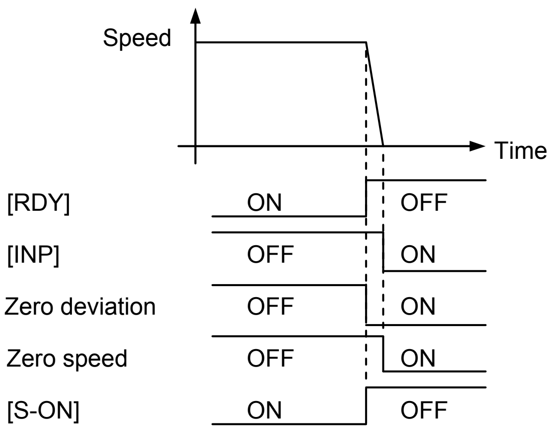
3.4.12 Interrupting/Stopping Operation

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).

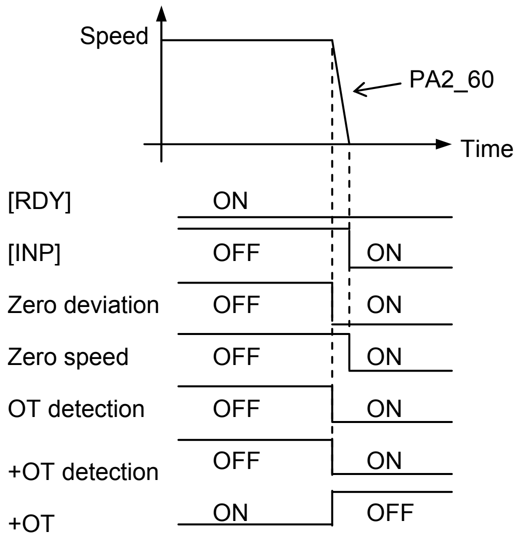


Note	
Note	(1) If “free-run at deceleration” is selected at parameter PA2_61 (action sequence at servo-on OFF), the motor coasts for a while due to inertia. (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode. (3) If the forward rotation torque limit (parameter PA1_27) or reverse rotation 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.

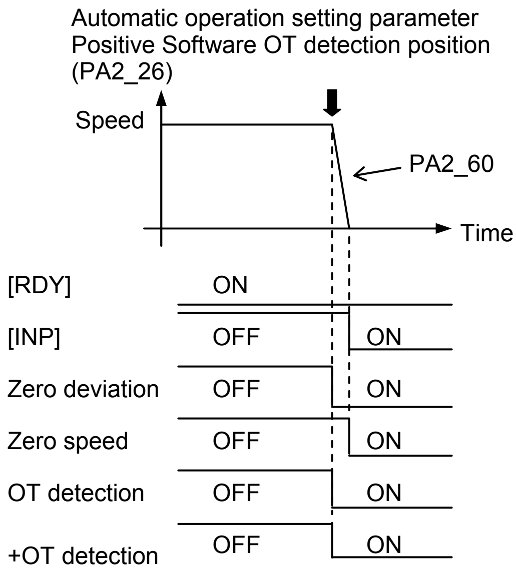
(2) +OT/-OT / positive software OT / negative software OT

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).

When +OT is detected with hardware:



When +OT is detected with software:

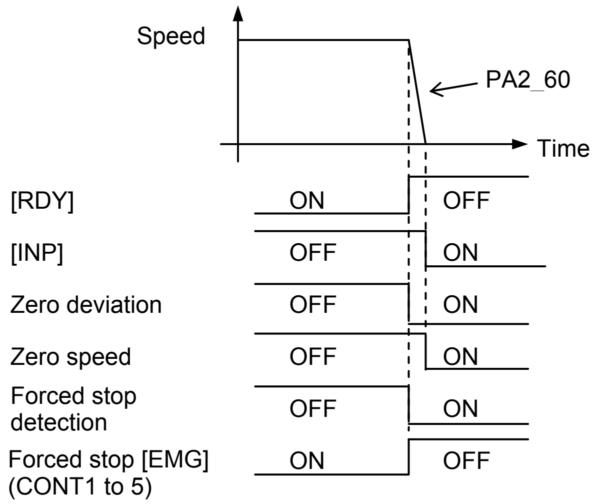


Note

(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.

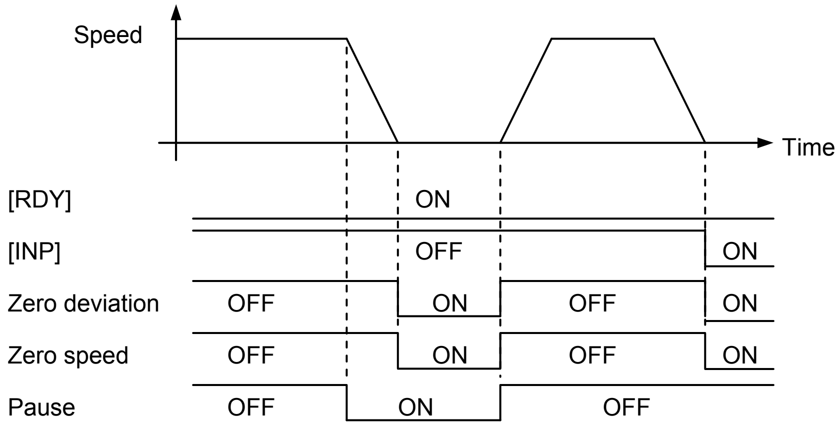


Note	(1) Forced stop [EMG] is a normally closed contact signal if it is allocated to CONT 1 to 5 signals. (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode. (3) If the forward torque limit (parameter PA1_27) or reverse torque limit (PA1_28) is smaller than the third torque limit (parameter PA2_60), the torque settings of the forward rotation torque limit and reverse rotation torque limit are effective.

3

(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.

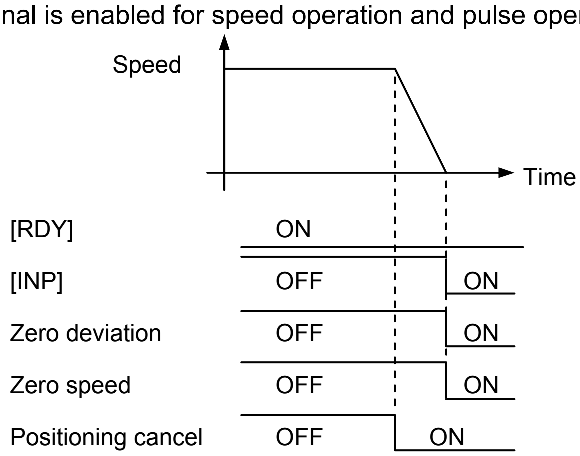


Note	(1) Acceleration/deceleration follows the settings of parameters PA1_37 through 40 and the state of input signal ACC0, or the settings of acceleration/deceleration time data. (2) The in-position [INP] signal shown in the figure indicates the state in the level output mode.

(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.

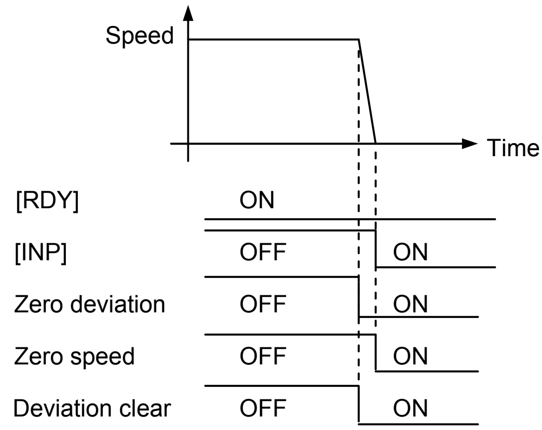
The signal is enabled for speed operation and pulse operation.



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

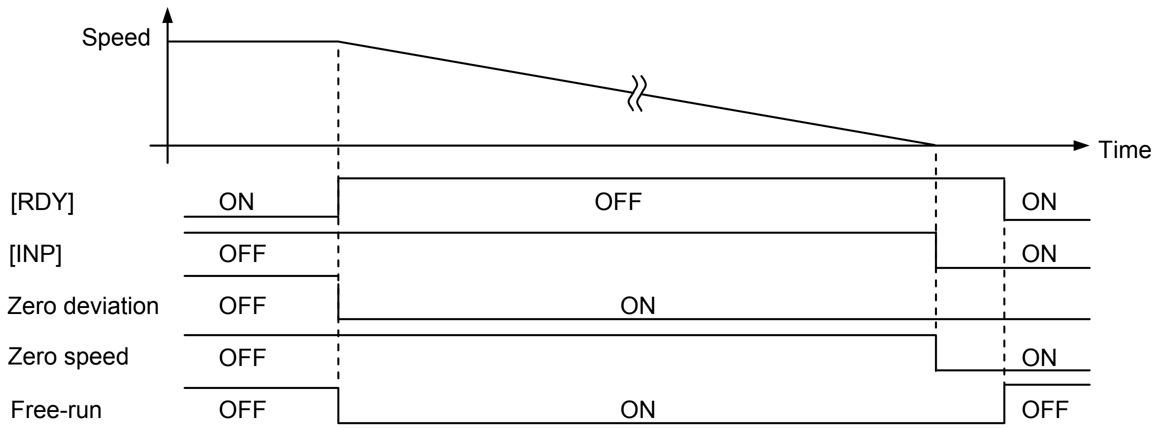
If the deviation clear signal is detected during motor rotation, operation is stopped and immediate controlled stop is caused according to the selected torque limit. (The maximum torque is assumed if parameter setting is selected with the default setting). If “1” (level signal) is selected for parameter 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.



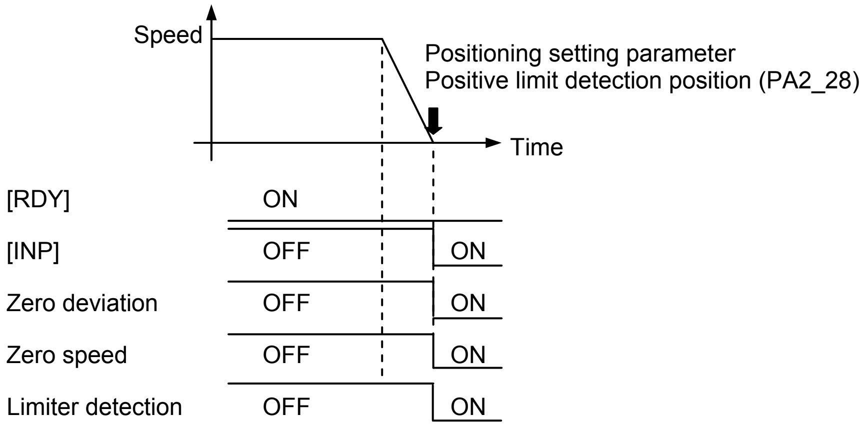
Note	In regular cases, free-run is not used for vertical traveling machines. If the function is used for a vertical traveling machine, examine adaptability with the brake carefully.

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	(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

4.1 Parameter Division

⚠ CAUTION

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

Parameters of the ALPHA5 smart 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.	4-26
Automatic operation setting parameter (No.PA2_01 to 50)	Use to enter or change the positioning operation speed and homing function.	4-37
Extended function setting parameter (No.PA2_51 to 99)	Use to enter or change the extended functions such as the torque limit.	4-75
Input terminal function setting parameter (No.PA3_01 to 50)	Use to enter or change input signals of the servo amplifier.	4-89
Output terminal function setting parameter (No.PA3_51 to 99)	Use to enter or change output signals of the servo amplifier.	4-95

4.2 Basic Parameters

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

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	10	-	○	○	-	
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 （GYB,GYC, GYS 750 W or less） 5000.00 (GYC,GYS 1 kW or more) 3000.00 (GYG)	-	○	○	-	
26	Max. rotation speed (for torque control)		-	-	-	○	
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: Extension mode 7: Positioning operation	0	Power

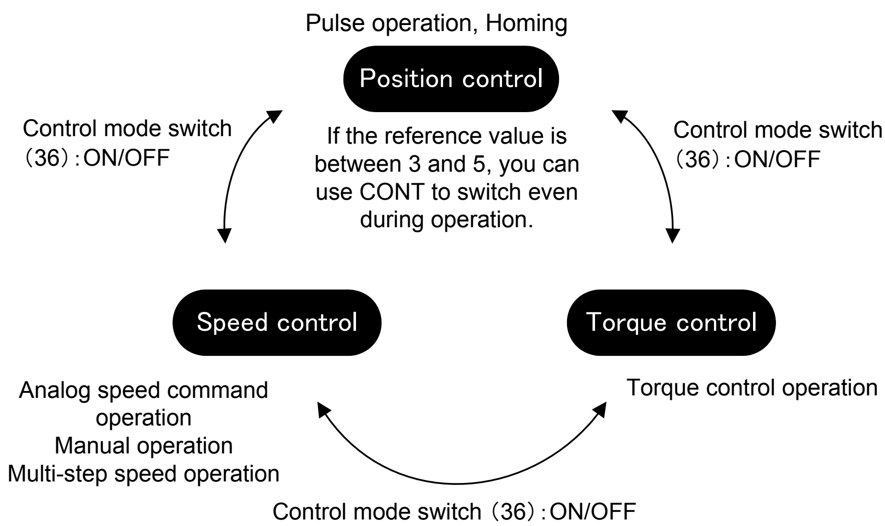
Specify the desired control mode in the parameter with a value.
To switch during operation, change over the control mode selection of the CONT input signal.
For details, refer to the table below.

4

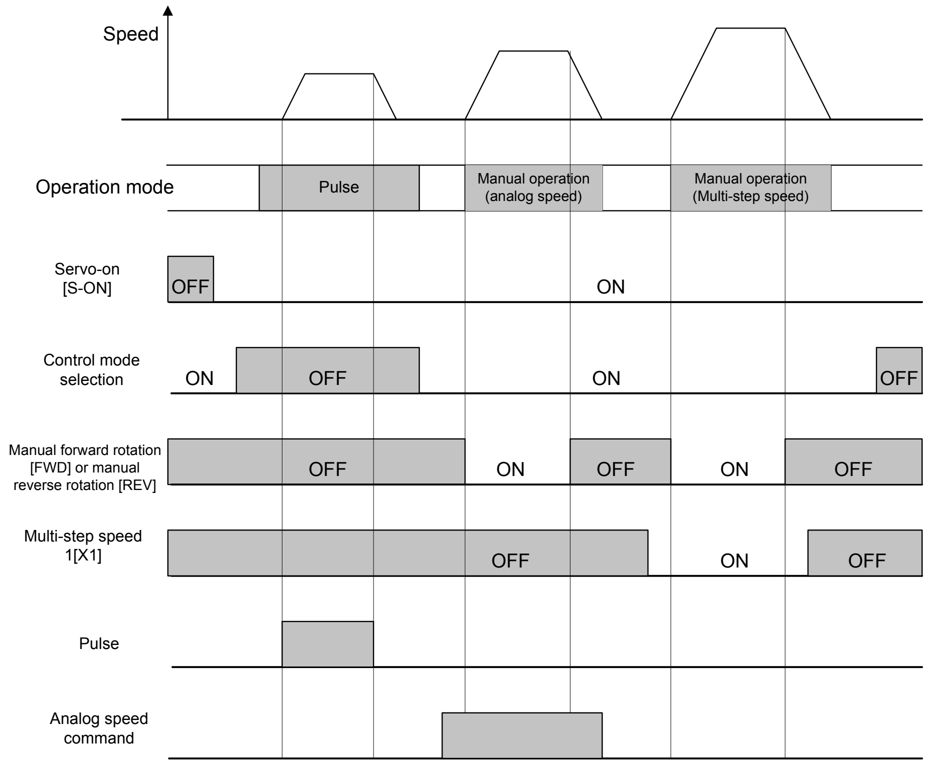
Reference value of PA1_01 (control mode selection)	Control mode	
	Control mode selection = OFF	Control mode selection = ON
0	Position control	
1	Speed control	
2	Torque control	
3	Position control	Speed control
4	Position control	Torque control
5	Speed control	Torque control
6	Extension mode	
7	Positioning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

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

Change over the control mode selection (sequence input signal) to change the control mode even during operation.
Position control can be made only during pulse operation and homing.
For the transition of the control mode, see the figure below.

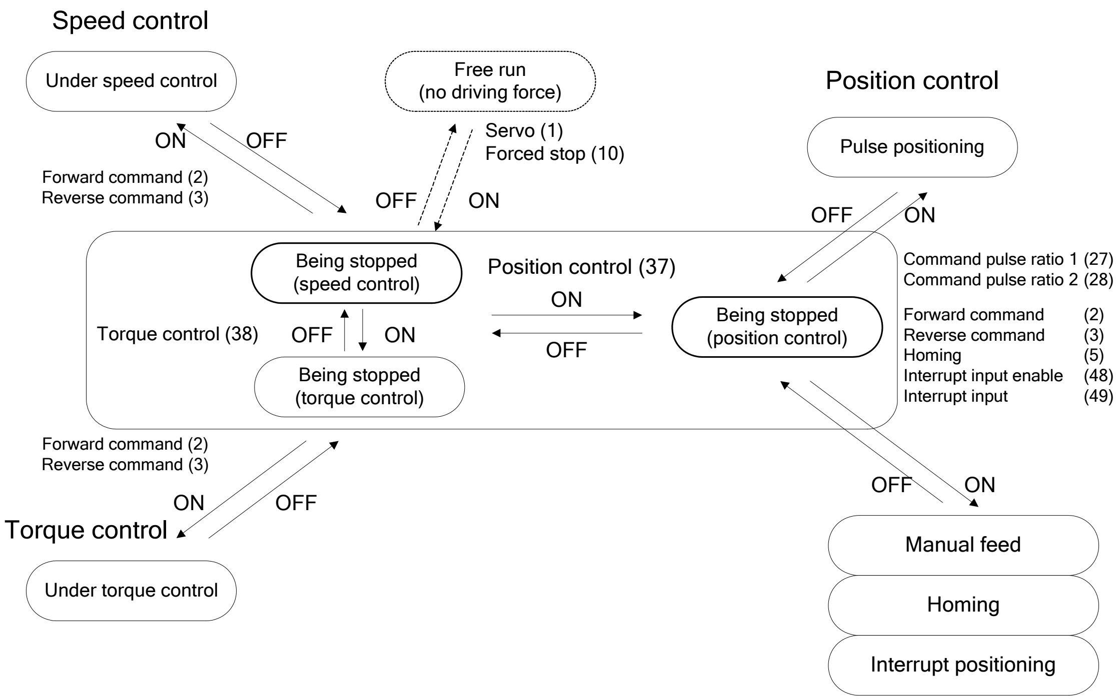


[Example] The operation pattern of control mode selection 3 (position ⇔ speed) is shown in the figure below.



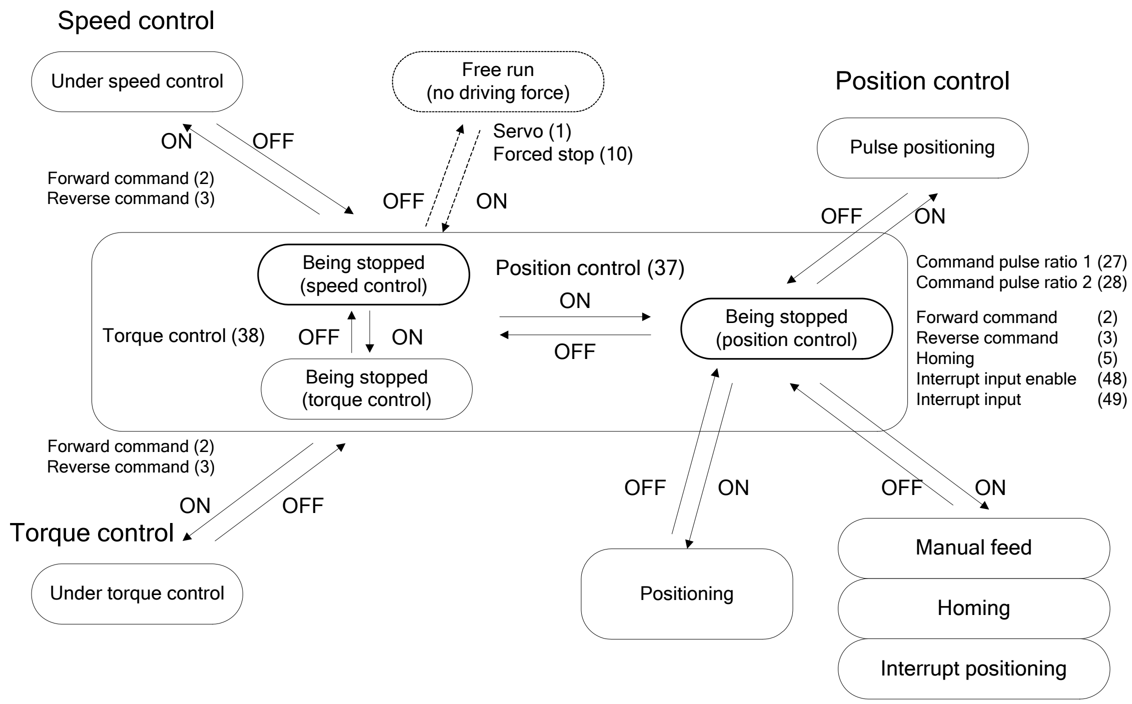
(2) If PA1_01 (control mode selection) is 6

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: Non-overflow absolute system (not detect the multi-turn overflow)	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 power is turned off. Homing must be performed again.
1	Absolute position system	The current position is stored in memory even after the 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 -32767 and +32766 revolutions of motor shaft)
2	Non-overflow absolute system (not detect the multi-turn overflow)	The current position is stored in memory even after the 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-turn data over flow 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."

4

■ Notes for setting the endless absolute system

<Notes regarding settings>

1) Set the electronic gear so that it obtains: PA1_06/07 = 2 n (n ≥ 2)
The absolute system encode works as a 34-bit ring counter consisting of 18-bit single-turn counter and 16-bit multi-turn counter. On the other hand, as the current position output to the host device via Modbus-RTU is given a 32-bit data, the size must be matched each other using the electronic gear setting.
2) Set the parameter PA2_25 (position command format) to "0" (normal PTP).
If set to "1" (endless), current position is reset (but the multi-turn data of the encoder is not cleared) every time the positioning operation (positioning data operation and immediate value operation) is started. Therefore, it will be difficult to recognize the current positions from the host device.

<Notes regarding functions>

1) The following functions are disabled: hardware OT, software OT and limiter detection.

<Notes regarding operations>

1) The positioning command range when the absolute system position command format is selected is;

$$-\left(\frac{34\text{ bits}}{\text{electronic gear*}} \times \frac{1}{2} -1\right) \text{ to } \left(\frac{34\text{ bits}}{\text{electronic gear*}} \times \frac{1}{2} -1\right)$$

2) The positioning command range when the incremental system position command format is selected is;

$$-\left(\frac{34\text{ bits}}{\text{electronic gear*}} -1\right) \text{ to } \left(\frac{34\text{ bits}}{\text{electronic gear*}} -1\right)$$

4

$$\text{*) electronic gear} = \frac{\text{PA1\_06 (numerator of electronic gear)}}{\text{PA1\_07 (denominator of electronic gear)}}$$

3) Do not apply the immediate value continuation operation.
If applied, the positioning after continuation will rely on the calculation timing if operation is shifted to continuous motion around the time when the multi-turn data is about to overflow.

4) Do not apply the immediate value change function.

- When using the absolute position system, refer to "CHAPTER 11 ABSOLUTE POSITION SYSTEM."

PA1_03 Command pulse input method and form selection

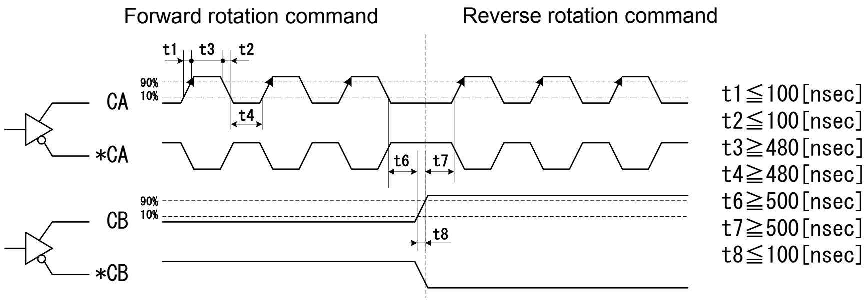
No.	Name	Setting range	Default value	Change
03	Command pulse input method and form selection	0: Differential input, command pulse/direction 1: Differential input, forward/reverse pulse 2: Differential input, A/B phase pulse 10: Open collector input, command pulse/direction 11: Open collector input, forward/reverse pulse 12: Open collector input, 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.

■ Differential input, command pulse/direction (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.

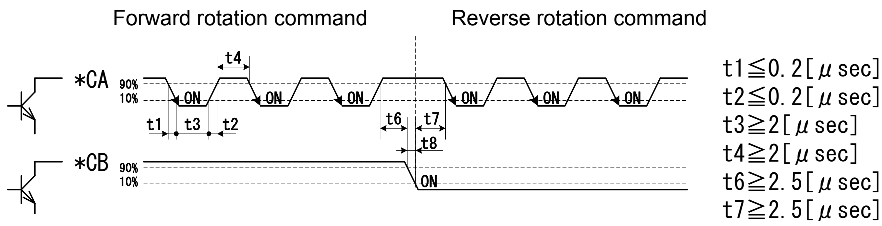
If (CB) is at the low level and (*CB) is at the high level, a forward direction command is issued.



Arrow marks "↑↓" in the figure above indicate the pulse count timing.

■ Open collector input, command pulse/direction (reference value of parameter 03: 10)

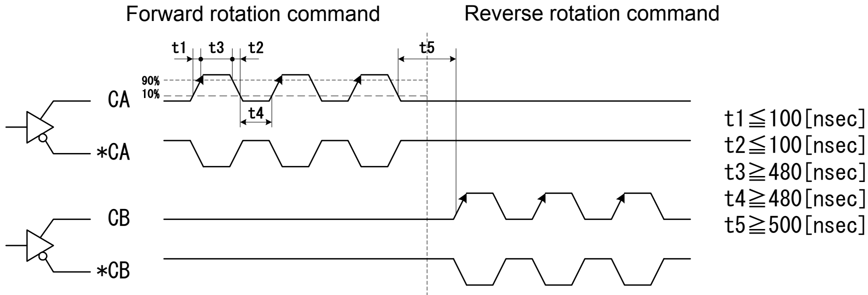
The command pulse indicates the rotation amount (CA, *CA), while the command sign (CB, *CB) indicates the direction of rotation. If (CB) is at the low level and (*CB) is at the high level, a forward direction command is issued.



"ON" specified in the figure above indicates activation of the transistor, which means a low signal level.
Arrow mark " ↓ " in the figure above indicates the pulse count timing.

■ Differential input, forward/reverse pulse (reference value of parameter 03: 1)

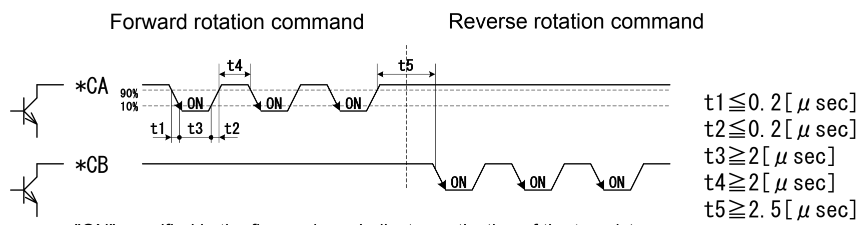
The forward rotation pulse (CA, *CA) indicates the rotation amount in the forward direction, while the reverse rotation pulse (CB, *CB) indicates that in the reverse direction.



Arrow marks "↑↓" in the figure above indicate the pulse count timing.

- Open collector input, forward/reverse pulse (reference value of parameter 03: 11)

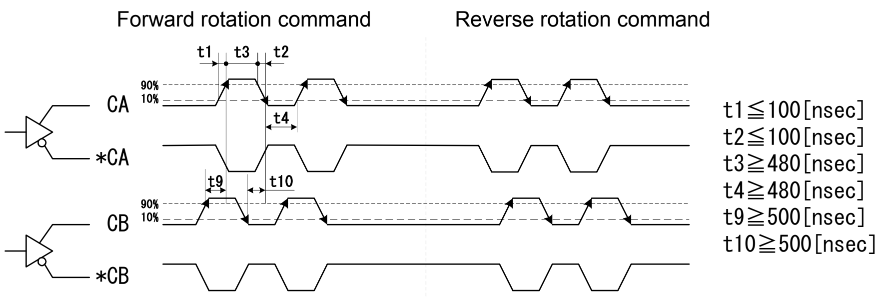
The forward rotation pulse (CA, *CA) indicates the rotation amount in the forward direction, while the reverse rotation pulse (CB, *CB) indicates that in the reverse direction.



"ON" specified in the figure above indicates activation of the transistor, which means a low signal level.
Arrow mark " ↓ " in the figure above indicates the pulse count timing.

- Differential input, A/B phase pulse (reference value of parameter 03: 2)

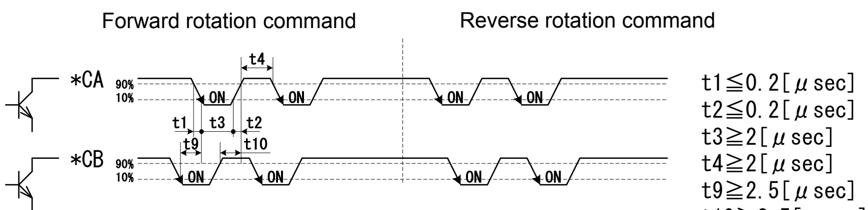
The A-phase signal (CA, *CA) and B-phase signal (CB, *CB) indicate the direction of rotation and rotation amount, respectively. Each edge of the A-phase and B-phase signals corresponds to one pulse. (It is four-fold frequency in the amplifier.)



Arrow marks "↑↓" in the figure above indicate the pulse count timing.

- Open collector input, A/B phase pulse (reference value of parameter 03: 12)

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.)



"ON" specified in the figure above indicates activation of the transistor, which means a low signal level.
Arrow mark " ↓ " in the figure above indicates the pulse count timing.

PA1_04 Rotation direction selection

No.	Name	Setting range	Default value	Change
04	Rotation direction selection	0: CCW rotation at forward command 1: CW rotation at forward 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.

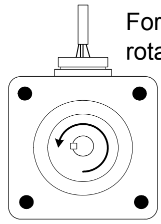
To switch the phase of the output pulse, select the phase of counterclockwise (CCW) rotation of the servomotor.

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 (PA1_06/07) is enabled 64 to 1048576 [pluse]: Number of command input pulses per revolution is enabled.	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	16	Always
07	Denominator of electronic gear	1 to 4194304	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).

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

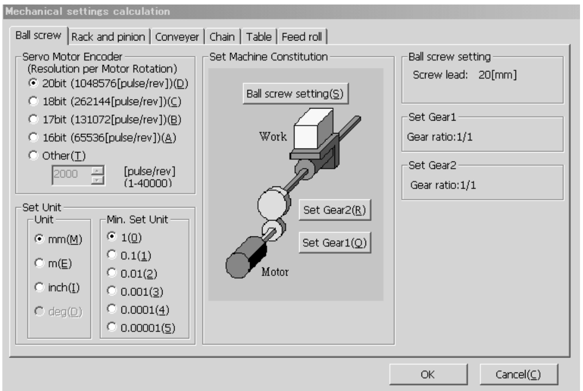
* The unit amount is the machine travel amount to one command pulse. Its unit is [unit].(mm/pulse. degree/pulse = [unit])

* 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 "Mechanical settings calculation(T)" button provided at the lower part of the parameter editing screen (PA1: Basic setting) of PC Loader to specify the electronic gear simply.

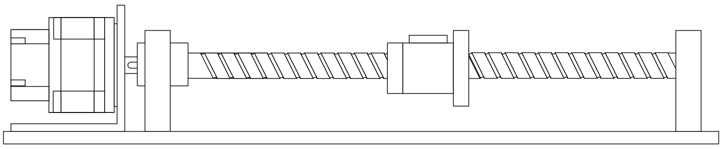


Enter the specifications of the machine to automatically calculate the settings. Parameters grouped according to each mechanical configuration helps you enter simply.

4

[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 rev.



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

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

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

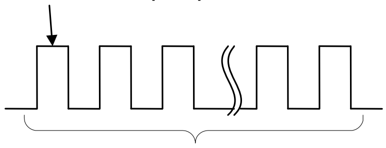
Therefore numerator 0 and denominator of the electronic gear are 131072 and 125, respectively.

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.



PA1_08 Number of output pulses per revolution

No.	Name	Setting range	Default value	Change
08	Number of output pulses per revolution	0: Electronic gear (PA1_06/07) is enabled. 16 to 262144 [pulses]: Number of output pulses per revolution is enabled.	2048	Power

Enter the number of pulses output per motor rotation from pulse output terminal (A-phase or B-phase).
As the output format applies A/B phase pulse, the setting range is set as follows (multiply by 4 on the host side).
20-bit motor: 16 to 262144 pulses, 18-bit motor: 16 to 65536 pulses
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 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	1	Power
10	Denominator of electric gear for output pulses	1 to 4194304	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.

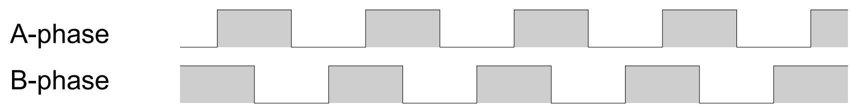
- In case of an 18-bit encoder, specify "1/32" to output 2048 (65536 x 1/32) A-phase and B-phase pulses per revolution.
- The Z-phase output is issued asynchronously to the A- and B-phases at a constant pulse width of 125μs.
  Enter parameters so that PA1_09 ≤ PA1_10. If PA1_09 > PA1_10, the division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

PA1_11 Output pulse phase selection at CCW rotation

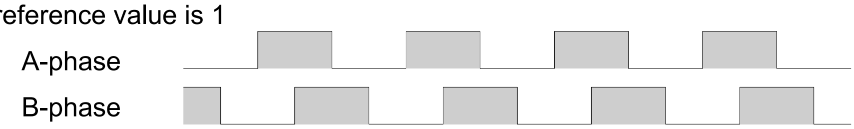
No.	Name	Setting range	Default value	Change
11	Output pulse phase selection at CCW rotation	0: B-phase pulse lead at CCW rotation 1: A-phase pulse lead at CCW rotation	0	Power

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



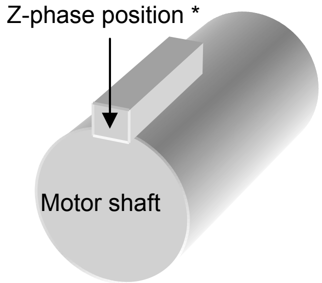
PA1_12 Z-phase position offset

No.	Name	Setting range	Default value	Change
12	Z-phase position offset	20-bit PG：0 to 1048575 [pulses] 18-bit PG：0 to 262143 [pulses]	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.

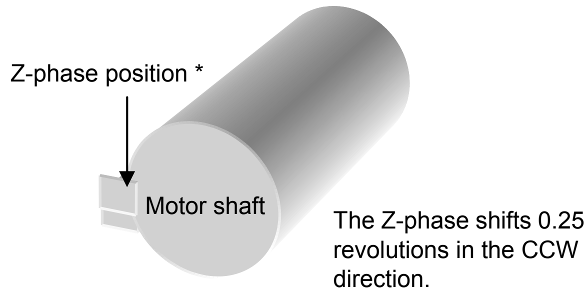
■ Z-phase output position (20-bit encoder)

・If the Z-phase position offset is 0



・If the Z-phase position offset is 262144

$$\frac{262144 \text{ pulses}}{1048576 \text{ pulses/rev}} = 0.25 \text{ rev}$$



* 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.

■ In the case of GYB motor,at speed of 100r/min or less after the power turned on,the output of first Z phase will happen within 1 rotation after the motor becomes over 12-degree as worst.

PA1_13 Tuning mode selection

No.	Name	Setting range	Default value	Change
13	Tuning mode selection	10: Auto tuning 11: Semi-auto tuning 12: Manual tuning 13: Interpolation operation mode 14: Trace operation mode 15: Shorter cycle time operation mode	10	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_15 (auto tuning gain 1), PA1_16 (auto tuning gain 2), and PA1_14 (load inertia ratio).

- 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 operation 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 according to the value of PA1_15 (auto tuning gain 1).

- Trace operation mode

Use this mode to adjust responses of each shaft to the command during trace control of two or more servomotor axes of an X-Y table or similar.
In this mode, PA1_14 (load inertia ratio) and PA1_51 (moving average S-curve time) must be entered manually. The parameter PA1_95 is set to "0" (model torque calculation is disabled/speed observer is disabled). PA_54 (position command response time constant) is enabled only when PA_1_58 (feed forward gain 1) is set to other than 0.000.
As well, PA1_14 (load inertia ratio) must be entered, too, manually.
The other gain adjustment parameters are automatically entered according to the value of PA1_15 (auto tuning gain 1).

- Shorter cycle time operation mode

Use this mode to improve tact (reduce the settling time) on a machine with high rigidity such as a ball screw.
PA1_14 (load inertia ratio) must be entered manually.
The other gain adjustment parameters are automatically entered according to the values of PA1_15 (auto tuning gain 1) and PA1_16 (auto tuning gain 2).

Parameters that must be entered in each tuning mode and automatically adjusted parameters are shown below.

No. PA1_	Name	Tuning mode selection					
		10: Auto	11: Semi-auto	12: Manual	13: Interpolation	14: Trace	15: Shorter cycle time
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."

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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 mode other than auto tuning.

■ How to enter the ratio of inertia of load

(1) Entering the value monitored on display

Use the monitor mode [on 14] of the display 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	12	Always

This parameter is enabled under speed and position control.

Specify the response of the servomotor in the mode other than manual tuning.

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 (Fn11)" 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	4	Always

This parameter is enabled only under position control.

The parameter is enabled if PA1_13 (tuning mode selection) is 10 (auto tuning), 11 (semi-auto tuning) or 15(Shorter cycle time operation mode).

Adjust PA1_15(Auto tuning gain 1) before adjusting this parameter.

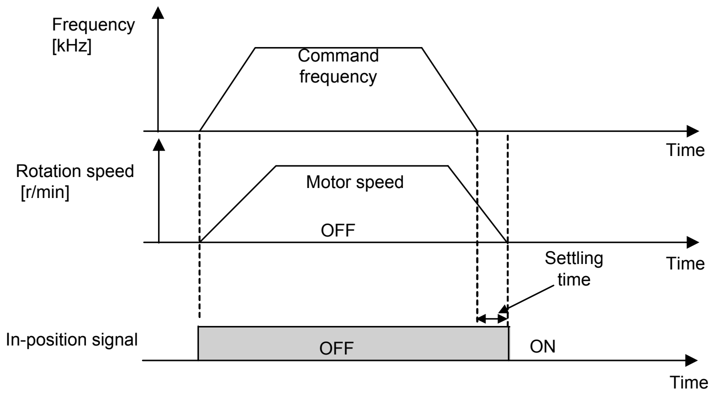
With this parameter, the positioning and settling time of auto tuning and semi-auto tuning is reduced, so that the cycle time is effectively reduced. While a larger value reduces the positioning and settling time, an overshoot is likely to be caused.

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 to 200.00 [rev]	2.00	Always
21	Easy tuning: speed setting	10.00 to Max. rotation speed [r/min]	500.00	Always
22	Easy tuning: timer setting	0.000 to 5.000 [s]	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 to 26 Max. rotation speed

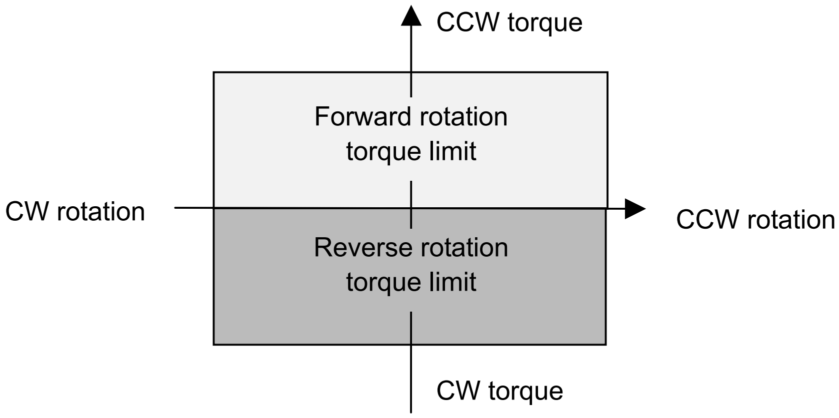
No.	Name	Setting range	Default value	Change
25	Max. rotation speed (for position and speed control)	GYB,GYC,GYS,750 [W] or less : 0.01 to 6000 [r/min] GYC and GYS,1 [kW] or more : 0.01 to 5000 [r/min] GYG : 0.01 to 3000 [r/min]	6000(GYB, GYC ,GYSof 750 [W] or less) 5000 (GYCand GYS of 1 [kW] or more) 3000 (GYG)	Always
26	Max. rotation speed (for torque control)			

Enter the maximum rotation speed of the servomotor for position, speed and torque control.
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.

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			

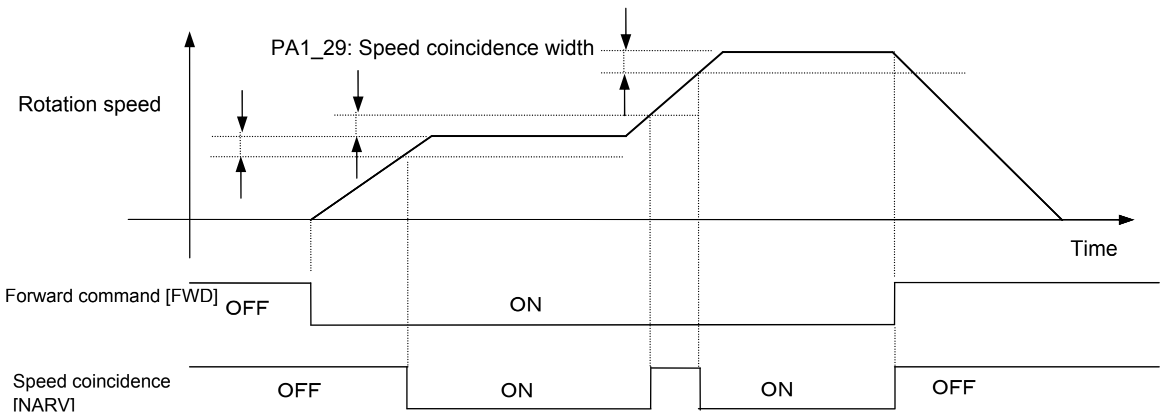
Enter the limit to be set on the output torque of the servomotor.
If the input signal (CONT signal: torque limit 0, 1, etc.) is turned off, this limit is enabled.
For description of the input signal (such as torque limit 0 and 1), refer to "CHAPTER 3 OPERATION."



PA1_29 Speed coincidence range

No.	Name	Setting range	Default value	Change
29	Speed coincidence range	10 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 2-70.

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PA1_30 Zero speed range

No.	Name	Setting range	Default value	Change
30	Zero speed range	10 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 1: Pulse	0	Always

Enter the unit of position deviation.
Select 0 (unit) for the unit after multiplication by the electronic gear ratio. Unit is displayed.
Select 1 (pulse) 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>

PA1_32 Zero deviation range/In-position range

No.	Name	Setting range	Default value	Change
32	Zero deviation range/ In-position range	0 to 200000 [pulses] or [units]	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 motion by positioning, homing and manual position control.
- <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 to 1000 [ms]	20	Always
35	In-position judgment time	0 to 1000 [ms]	0	Always

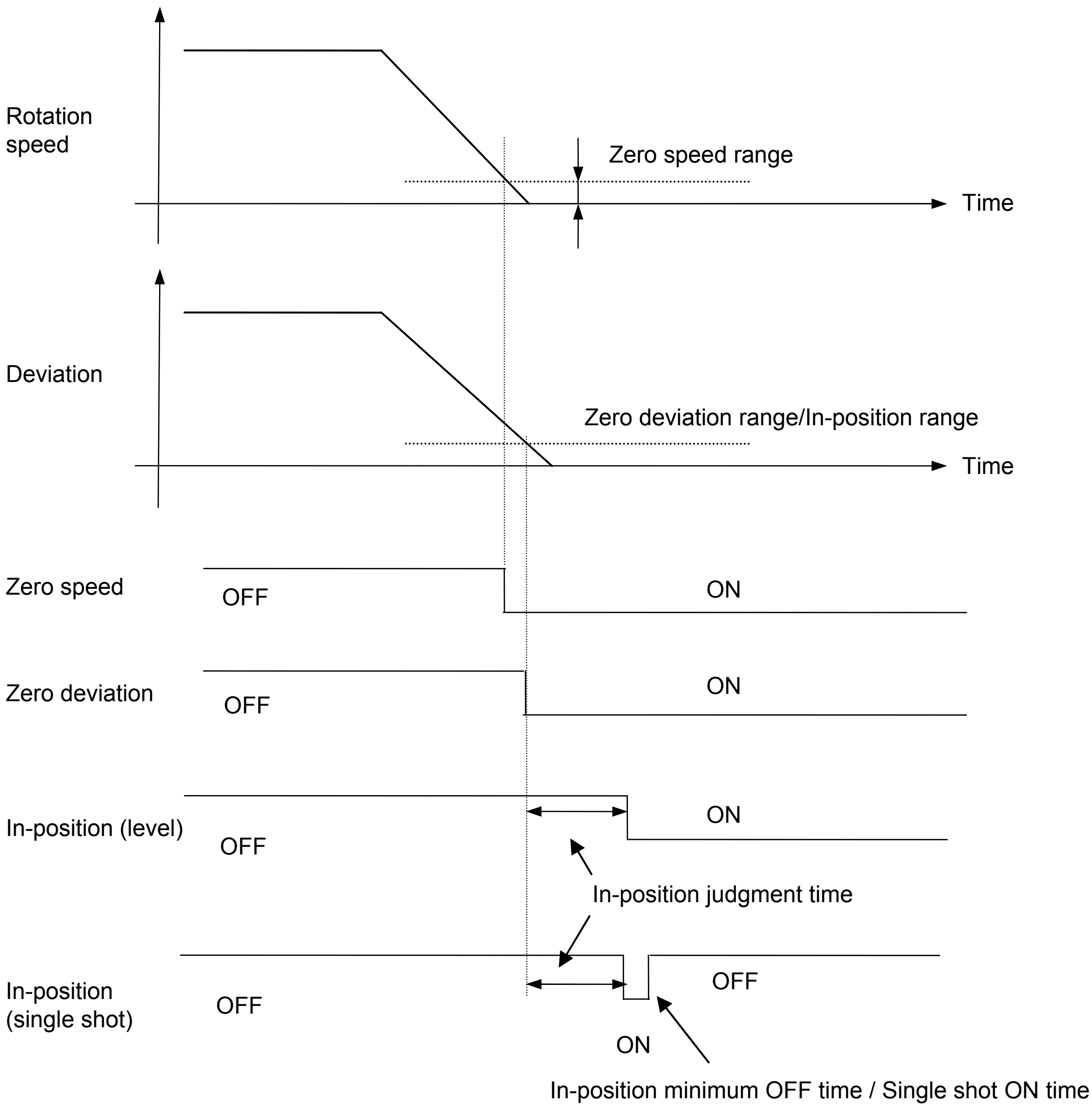
Enter the output format, minimum OFF time / Single shot ON time and judgment time of the in-position [INP] signal.
In-position output format: Select the format of the output signal (refer to the timing chart shown below).
In-position minimum OFF time / Single shot ON time: For the single shot output 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 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	

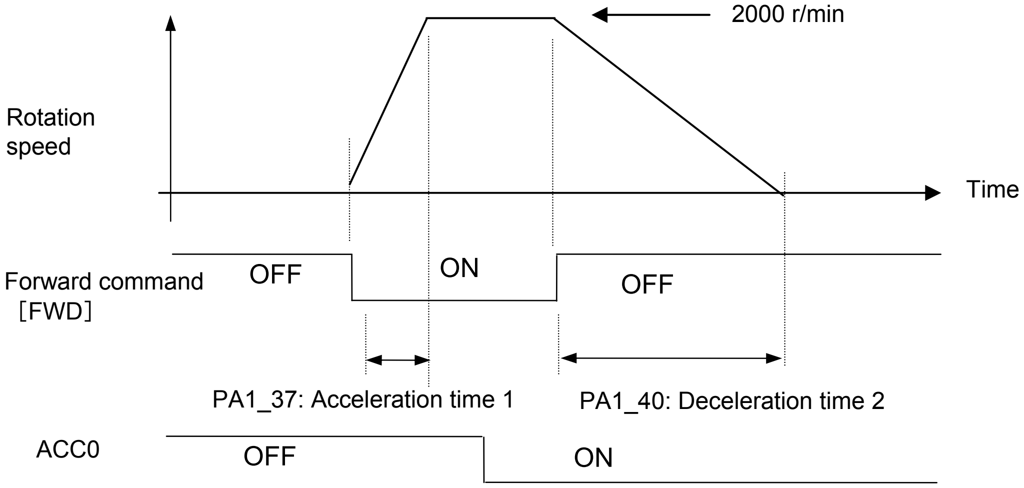
Specify the acceleration and deceleration of the servomotor with PA1_37 to _40 (acceleration/deceleration time).
The parameter is enabled for acceleration and deceleration motions under speed control and position control (automatic operation, homing and manual position control operation). Acceleration and deceleration follow these parameters during profile operation, too.
These parameters are disabled during pulse operation.
The acceleration/deceleration time setting indicates the time from 0 (zero) to 2000 r/min.

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.

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 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 command)	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 selection) set at "6" (extension mode).

4.3 Control Gain and Filter Setting Parameter

Note	Parameters marked "○" in the "Power" field is enabled after the power is turned off then turned on again. (Check that the display (7-segment display) on the servo amplifier is unlit when the 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	4.0	-	-	-	○	

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

4.3.2 Description of Each Parameter

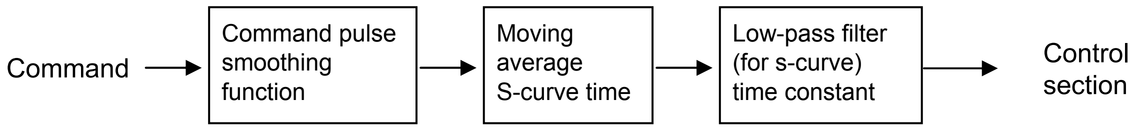
PA1_51 to 53 Command filter settings

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 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 10 (auto tuning), 11 (semi-auto tuning) or 15(shorter cycle time operation mode) 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 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 10 (auto tuning), 11 (semi-auto tuning) or 15(shorter cycle time operation mode).

PA1_55 to 57 Response to disturbance settings

No.	Name	Setting range	Default value	Change
55	Position loop gain 1	1 to 2000 [rad/s]	***	Always
56	Speed loop gain 1	1 to 2000 [Hz]	***	Always
57	Speed loop integration time constant	0.5 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 12 (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 to 20.00 [ms]	***	Always
60	Torque filter time constant for torque control	0.00 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	PA1_61=0:1 to 1000 [pulse] PA1_61=1,2:1 to 100 [r/min]	50	Always
63	Gain changing time constant	0 to 100 [ms]	1	Always
64	Position loop gain 2	30 to 200 [%]	100	Always
65	Speed loop gain 2	30 to 200 [%]	100	Always
66	Speed loop integration time constant 2	30 to 200 [%]	100	Always
67	Feed forward gain 2	30 to 200 [%]	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).

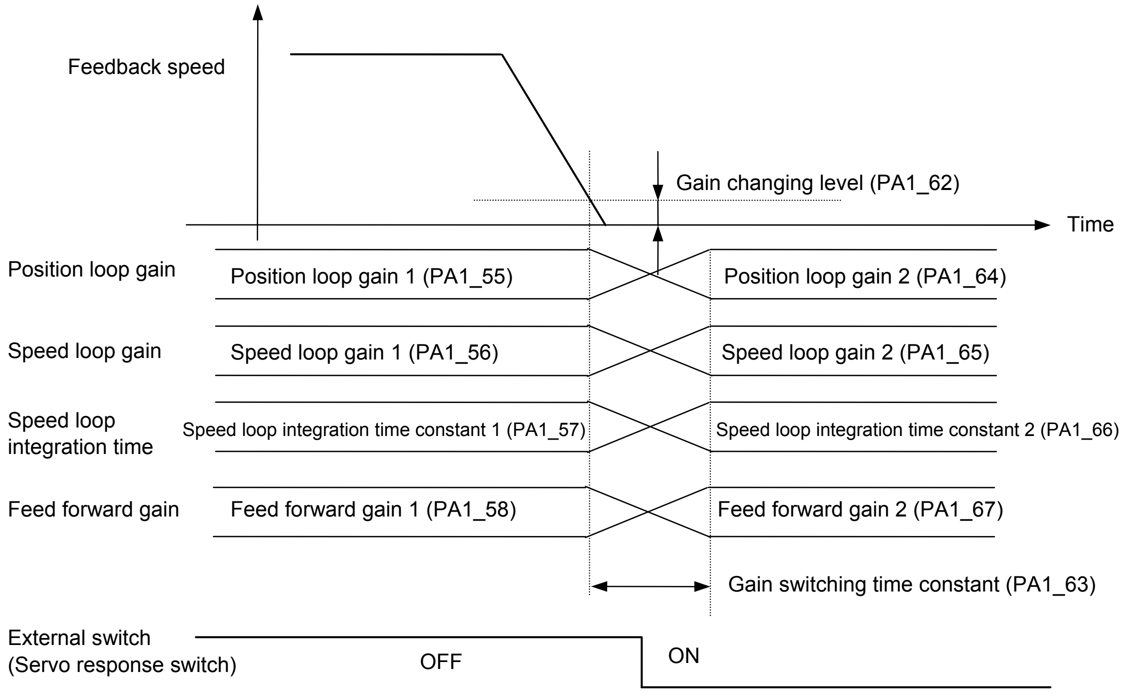
Noise and vibration during stoppage can be reduced through gain switching.

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.

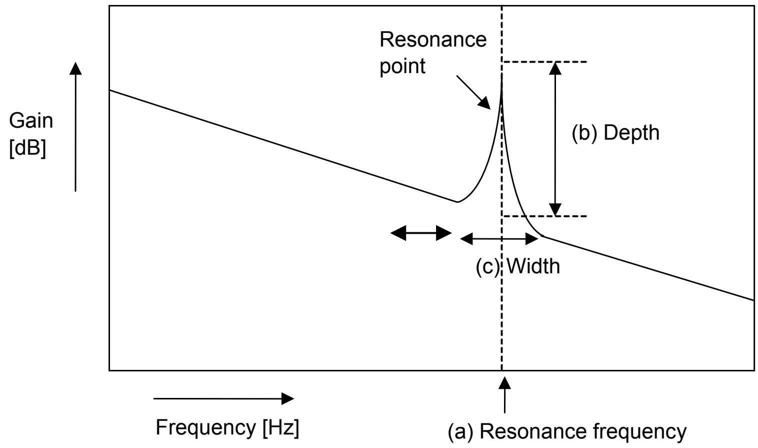
PA1_70 to 76 Notch filter settings

No.	Name	Setting range	Default value	Change
70	Automatic notch filter selection	0: Disable 1: Enable 2: Enable (notch filter 1 only)	1	Always
71	Notch filter 1, frequency	10 to 4000 [Hz]	4000	Always
72	Notch filter 1, attenuation	0 to 40 [dB]	0	Always
73	Notch filter 1, width	0 to 3	2	Always
74	Notch filter 2, frequency	10 to 4000 [Hz]	4000	Always
75	Notch filter 2, attenuation	0 to 40 [dB]	0	Always
76	Notch filter 2, width	0 to 3	2	Always

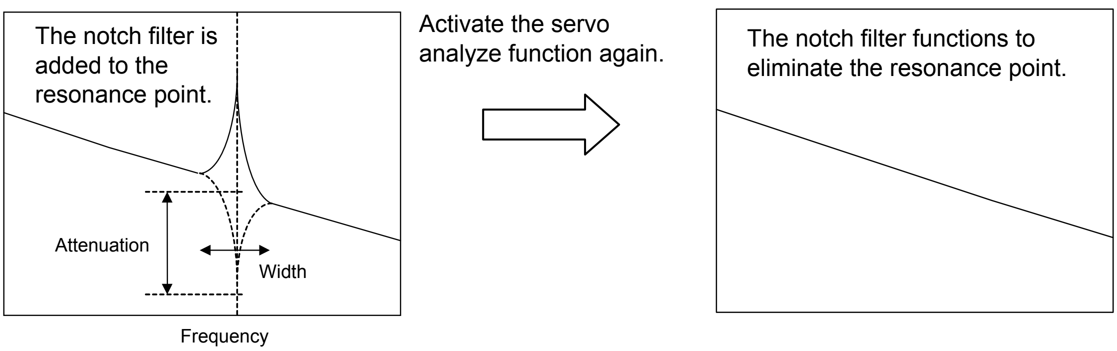
Specify to suppress resonance of the mechanical system. Up to two resonance points can be suppressed. Select 1 (enable) for automatic notch filter selection to adjust the notch filter automatically to the best value and suppress resonance.
Parameters automatically adjusted in this case include PA1_71 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 0 dB 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			

■ Setting the notch filter

Relation between automatic notch filter and manual notch filter

PA1_70 (automatic notch filter selection)	Notch filter 1	Notch filter 2
0	Manual	Manual
1	Auto	Auto
2	Auto	Manual

Notch filter setting at parameter change

PA1_70 (automatic notch filter selection)	Notch filter setting value	
	Notch filter 1	Notch filter 2
0 → 1	Cleared	Cleared
1 → 0	Remained	Remained
0 → 2	Cleared	Remained
1 → 2	Cleared	Remained
2 → 0	Remained	Remained
2 → 1	Cleared	Cleared

PA1_77 to 86 Vibration suppressing settings

No.	Name	Setting range	Default value	Change
77	Automatic vibration suppressing selection	0: Disable 1: Enable 2: Communications setting	0	Always
78	Vibration suppressing anti resonance frequency 0	1.0 to 300.0 [Hz]	300.0	Always
79	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 0	0 to 80 [%]	0	Always
80	Vibration suppressing anti resonance frequency 1	1.0 to 300.0 [Hz]	300.0	Always
81	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 1	0 to 80 [%]	0	Always
82	Vibration suppressing anti resonance frequency 2	1.0 to 300.0 [Hz]	300.0	Always
83	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 2	0 to 80 [%]	0	Always
84	Vibration suppressing anti resonance frequency 3	1.0 to 300.0 [Hz]	300.0	Always
85	Vibration suppressing workpiece inertia ratio (vibration suppressing resonance frequency) 3	0 to 80 [%]	0	Always
86	Vibration suppressing 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 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 1.5 s 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 following table.
The RS-485 communications setting is enabled if the parameter PA1_77 (automatic vibration suppressing selection) is set at 2 (communications 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 5.10 "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 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.
This function is not used when PA1_13 (tuning mode selection) is set to “14” (trace operationi 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 to 1000.0 [ms]	***	Always
89	Position loop integration limiter	0 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.

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	PI control
	OFF	P 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 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 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

<table>
<tr><th>No.</th><th>Name</th><th>Setting range</th><th>Default value</th><th>Change</th></tr>
<tr><td>94</td><td>Torque filter setting mode</td><td><table>
<tr><th>Setting value</th><th>PA1_59</th><th>PA1_87</th></tr>
<tr><td>0</td><td>Do not set automatically.</td><td>Set automatically.</td></tr>
<tr><td>1</td><td>Set automatically.</td><td>Set automatically.</td></tr>
<tr><td>2</td><td>Do not set automatically.</td><td>Do not set automatically.</td></tr>
<tr><td>3</td><td>Set automatically.</td><td>Do not set automatically.</td></tr>
</table></td><td>1</td><td>Always</td></tr>
</table>

This parameter is enabled under position and speed control.
Select either to set PA1_59 (torque filter time constant) and PA1_87 (model torque filter time constant) automaticall or not in other than the manual tuning mode.
Select “do not set automatically” to manually specify PA1_59 (torque filter time constant) and PA1_87 (model torque filter time constant) regardless of the setting of PA1_13 (tuning mode selection).
When “set automatically” is selected, the parameter is automatically adjusted in the amplifier in other than the manual tuning mode.
The setting of PA1_87 (model torque filter time constant) becomes invalid when PA1_13 (tuning mode selection) is set to “14” (trace operation motion).

PA1_95 Model torque calculation and speed observer selection

<table>
<tr><th>No.</th><th>Name</th><th>Setting range</th><th>Default value</th><th>Change</th></tr>
<tr><td>95</td><td>Model torque calculation and speed observer selection</td><td><table>
<tr><th>Setting</th><th>Model torque calculation</th><th>Speed observer</th></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></td><td>3</td><td>Always</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	4.0	Always

This parameter is enabled under torque control.
If the rotation speed exceeds the reference value of PA1_26 (maximum rotation speed (for 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 Automatic Operation Setting Parameter

Note	Parameters marked "○" in the "Power" field are enabled after the power is turned off then turned on again. (Check that the display (7-segment display) on the servo amplifier is unlit when the 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 detection during homing	0	○	○			
25	Software OT selection (PA1_01=1 to 6) / Positioning operation type (PA1_01=7)	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	○	○	-	-	
44	Positioning extended function	0	○	○	-	-	

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

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 to Max. rotation speed [r/min]	500.00	Always
07	Creep speed for homing	0.01 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 [units]	0	Always
10*	Homing direction after reference signal detection	0: Forward rotation 1: Reverse rotation	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 3: Encoder Z-phase	0	Power
13	Home position LS signal edge selection	0: Rising edge 1: Trailing edge	0	Power
14*	Home position shift unit amount	0 to 2000000000 [units]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation is desabled 1: Reverse rotation is enabled	0	Power
16	Home position after homing completion	-2000000000 to 2000000000 [units]	0	Always

No.	Name	Setting range	Default value	Change
17	Home position detection range	0: Always ON after homing completion 1 to 2000000000 [units]	0	Always
18	Deceleration time at OT during homing	0.0 to 99999.9 [ms]	100.0	Always
22	Detection time for contact-stopper	0 to 10000 [ms]	0	Always
23	Torque limit value for contact-stopper	0 to 100 [%]	0	Always
24	Selection of operation at OT during homing	0: Reverse rotation 1: Stop and cancel the homing	0	Power

*: Compulsory setting item

ALPHA5 smart 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.

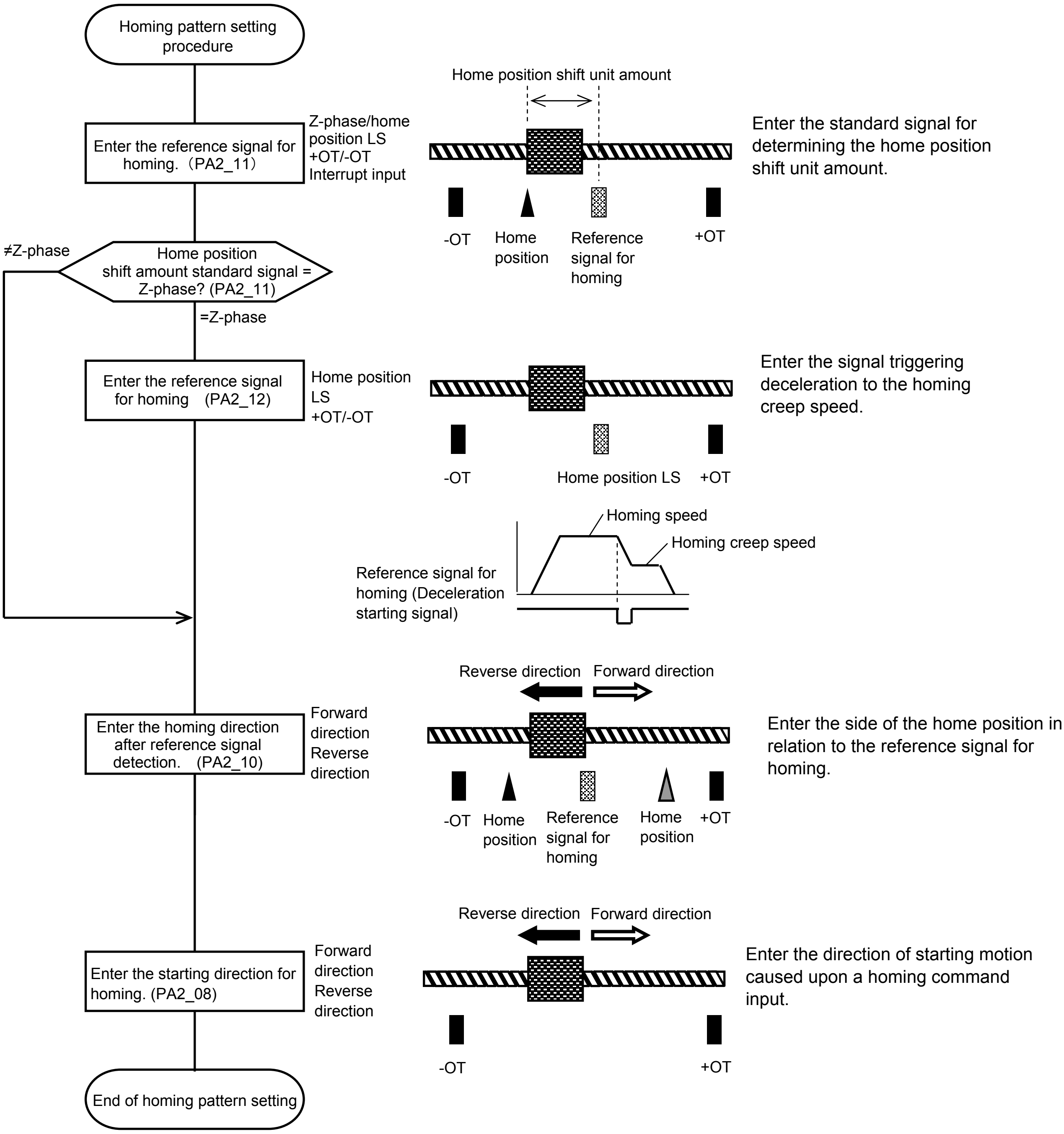
(2) Homing direction after reference signal detection
Select the side of the home position (forward or reverse rotation side) in relation to the reference signal for homing (Deceleration starting signal) and reference signal for shift operation.

(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 LS, +OT or -OT. When the encoder Z-phase is selected, It becomes the creep speed from the start of homing operation.

(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 4-49.

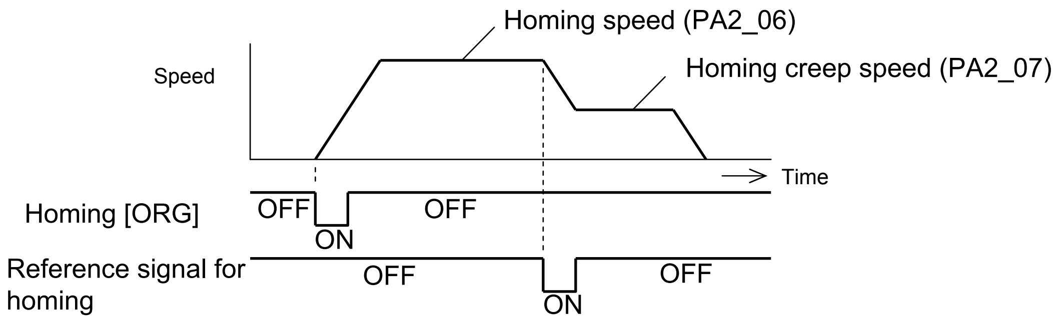
(2) Homing motion setting parameter

Parameters are combined to determine the homing motion.

PA2_06 Homing speed

No.	Name	Setting range	Default value	Change
06	Homing speed	0.01 to Max. rotation speed [r/min]	500.00	Always

Specify the homing speed.



PA2_07 Creep speed for homing

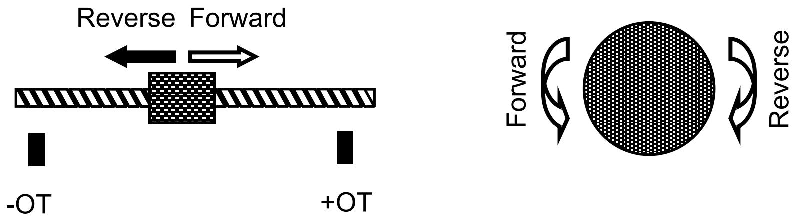
No.	Name	Setting range	Default value	Change
07	Creep speed for homing	0.01 to Max. rotation speed [r/min]	50.00	Always

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 4-64.

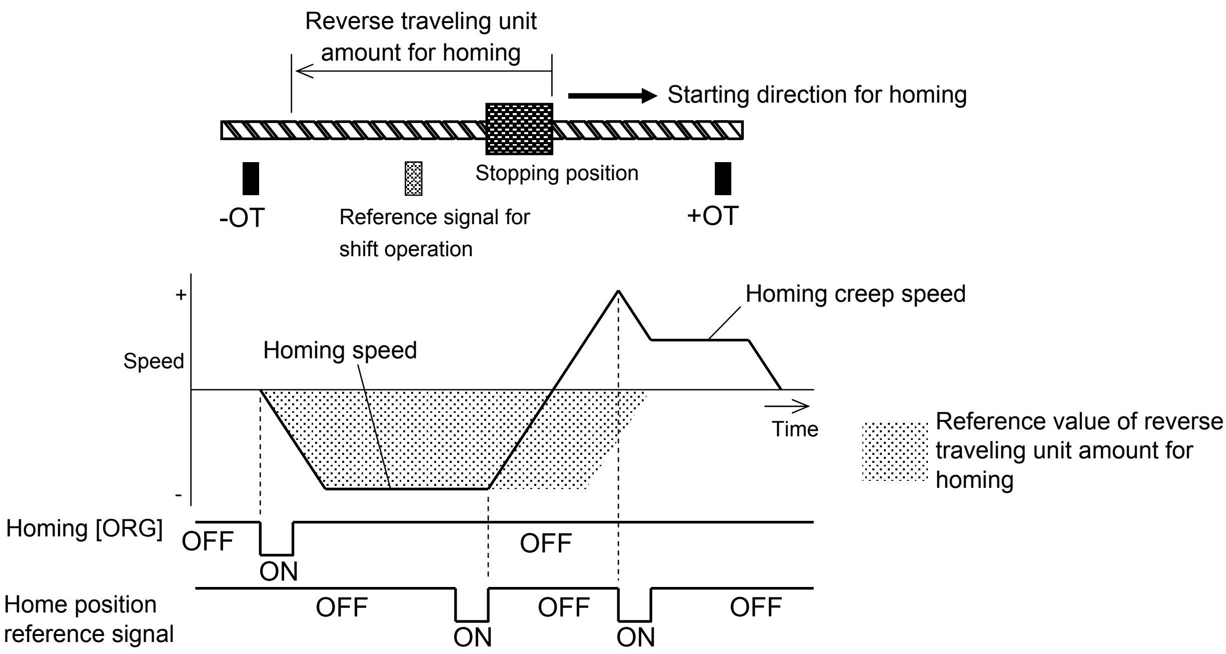
- Forward direction: direction of position increase Reverse direction: direction of position decrease
  The forward/reverse direction depends on parameter PA1_04 (rotation direction selection).

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 [units]	0	Always

<u>Not a compulsory item</u>

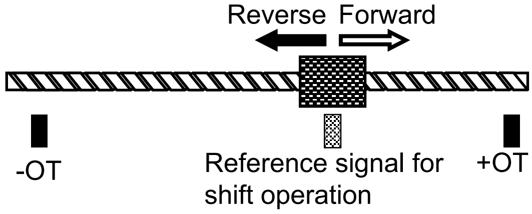
Specify the reverse traveling amount taken in the direction opposite to the starting direction for homing at the start of homing motion.
If a reference signal for homing (deceleration starting signal) or reference signal for shift operation is detected during reverse travel, movement toward the homing 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 rotation 1: Reverse rotation	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.

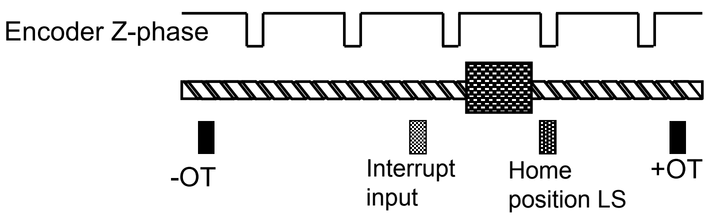


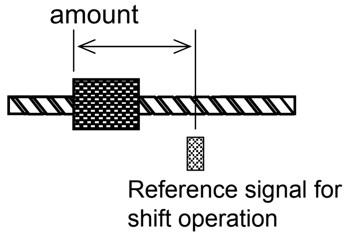
- If +OT or -OT is set as a reference signal for homing (deceleration starting signal), this parameter is disabled and the direction opposite to the one toward the specified OT signal is the homing direction after reference signal detection. If the encoder Z-phase is set as a reference signal for homing, this parameter is disabled and the direction follows Starting direction for homing.
  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 1 (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.



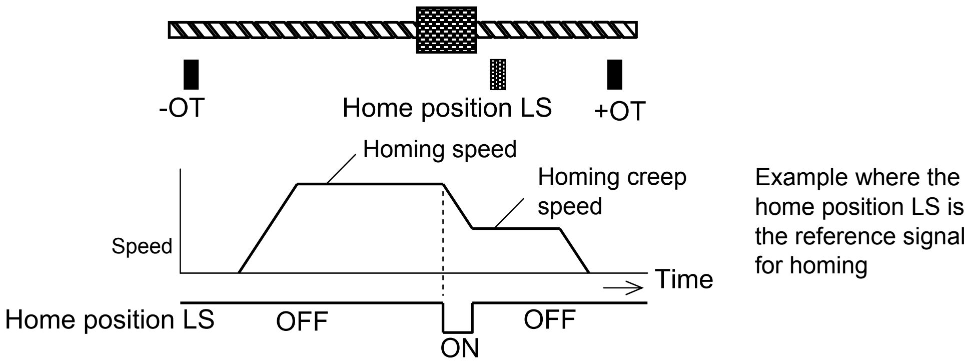


- If one among 0 (home position LS), 2 (+OT) and 3 (-OT) is selected, there is an error of ±250 pulses in the zero position at a creep speed for homing of 50 r/min.
- In the case of GYB motor, the Z phase of encoder will be detected right after the power is turned on.For homing operation, the motor should be kept over 372-degree at the speed of 100r/min.The Z phase can not be correctly detected if this condition is not satisfied.

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 3: Encoder Z-Phase	0	Power

If the encoder Z-phase is selected as a reference signal for shift operation, 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. If the encoder Z-phase is set as a reference signal for homing, the speed at the time of homing starting turns into the creep speed, and the first encoder Z-Phase after starting is a starting point of Home position shift unit amount.

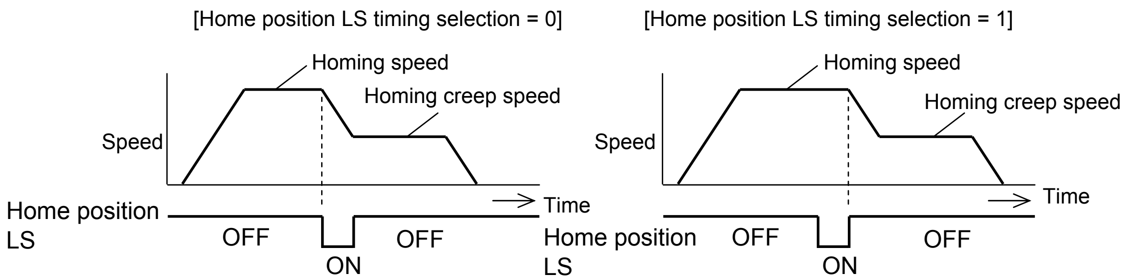


PA2_13 Home position LS signal edge selection

No.	Name	Setting range	Default value	Change
13	Home position LS signal edge selection	0: Rising edge 1: Trailing edge	0	Power

Not a compulsory item

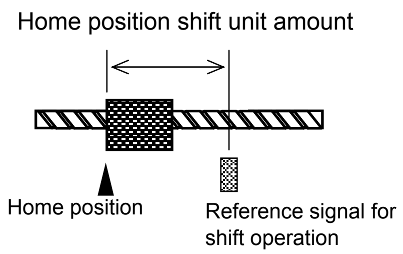
Specify the enabling timing of the home position LS signal if the home position LS is specified as a reference signal for shift operation reference signal for homing (Deceleration starting signal).



PA2_14 Home position shift unit amount

No.	Name	Setting range	Default value	Change
14	Home position shift unit amount	0 to 2000000000 [units]	1000	Always

Specify the distance (traveling amount) from the reference signal for shift operation to the home position.

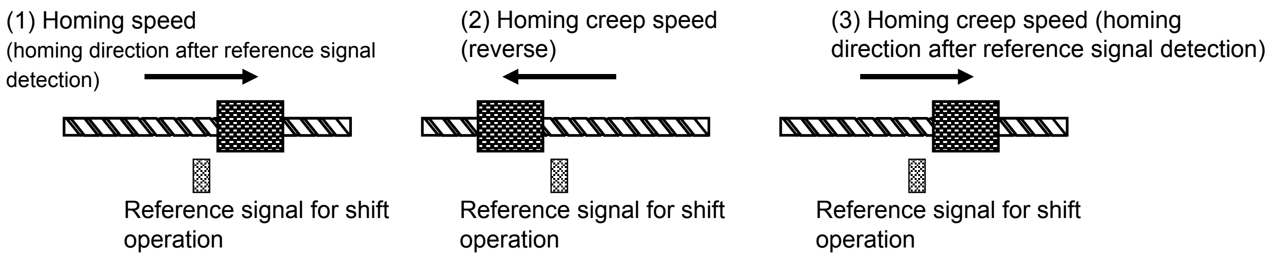


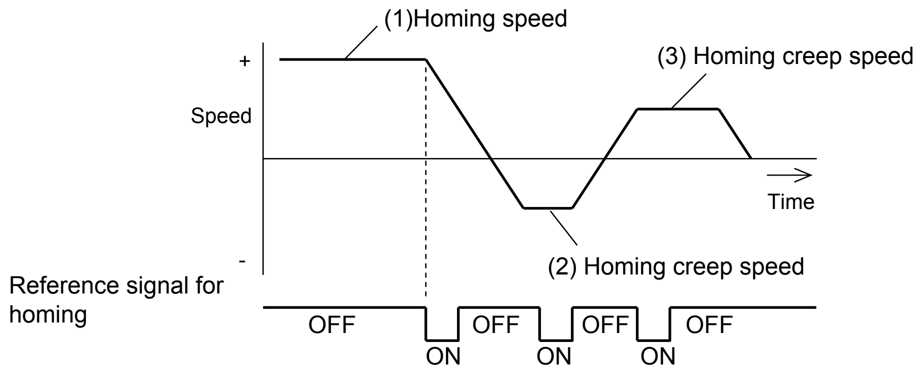
PA2_15 Deceleration operation for creep speed

No.	Name	Setting range	Default value	Change
15	Deceleration operation for creep speed	0: Reverse rotation is disabled 1: Reverse rotation is enabled	0	Power

Not a compulsory item

Specify 1 (reverse rotation is enabled) 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).



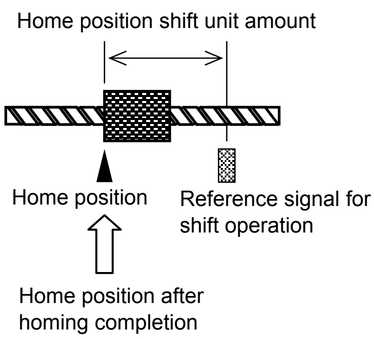


PA2_16 Home position after homing completion

No.	Name	Setting range	Default value	Change
16	Home position after homing completion	-2000000000 to 2000000000 [units]	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.

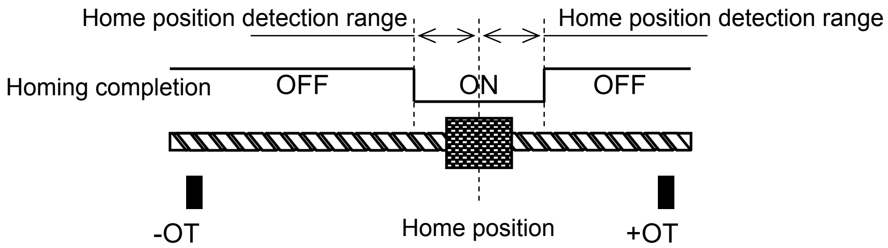


PA2_17 Home position detection range

No.	Name	Setting range	Default value	Change
17	Home position detection range	0: Always ON after homing completion 1 to 2000000000 [units]	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 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 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.)

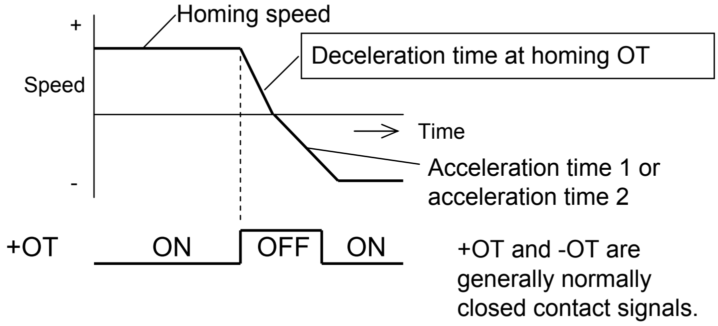
[Example of calculation of reference value]

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 /2000 r/min × Deceleration time at OT during homing /1000/60) × 1/2

Deceleration time at OT during homing = 1260.0 ms

- 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.



The acceleration time and deceleration time are based on 2000 r/min.

PA2_22 Detection time for contact-stopper
PA2_23 Torque limit for contact-stopper

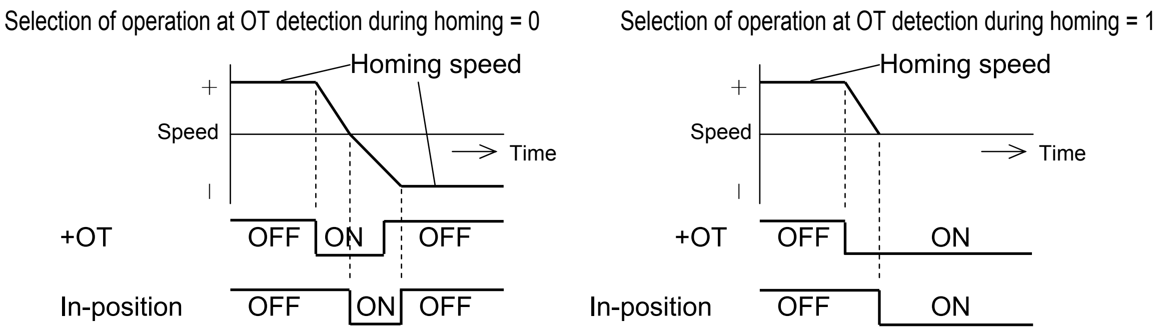
No.	Name	Setting range	Default value	Change
22	Detection time for contact-stopper	0 to 10000 [ms]	0	Always
23	Torque limit for contact-stopper	0 to 100 [%]	0	Always

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 detection time and the torque limit on contact with the stopper.
For details, refer to “(7) Homing Pattern Using the Stopper” on page 4-67.

PA2_24 Selection of operation at OT detection during homing

No.	Name	Setting range	Default value	Change
24	Selection of operation at OT during homing	0: Reverse rotation 1: Stop and cancel the homing	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 to 1048575 [pulses]: 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 4-14.

PA1_37 to 40 (acceleration times, deceleration times)

No.	Name	Setting range	Default value	Change
37	Acceleration time 1	0.0 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 to 2000 r/min.
For details, refer to "PA1_36 to 40 Acceleration time and deceleration time settings" on page 4-23.

PA2_60 (third torque limit)

No.	Name	Setting range	Default value	Change
60	Third torque limit	0 to 300 [%]	300	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 detection 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 4-77.

■ 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]

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 rotation	0	Power
09	Reverse traveling unit amount for homing	0 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	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	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation is disabled	0	Power
16	Home position after homing completion	0 [units]	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

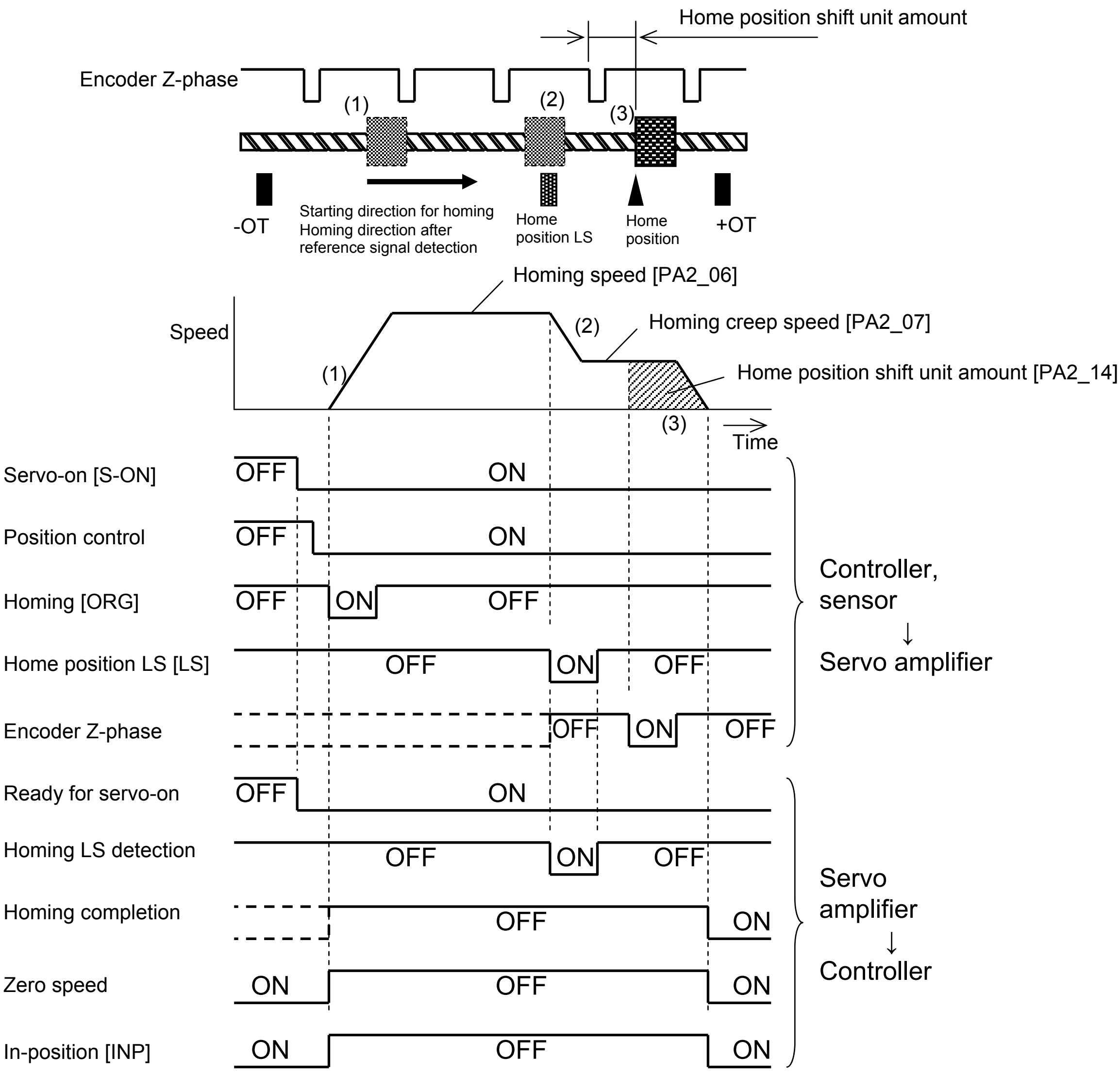
- To cancel homing upon detection of +OT or -OT, specify 1 (stop) to parameter PA2_24 (selection of operation at OT during homing).

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

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 rotation	0	Power
09	Reverse traveling unit amount for homing	0 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	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	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation is disabled	0	Power
16	Home position after homing completion	0 [units]	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.

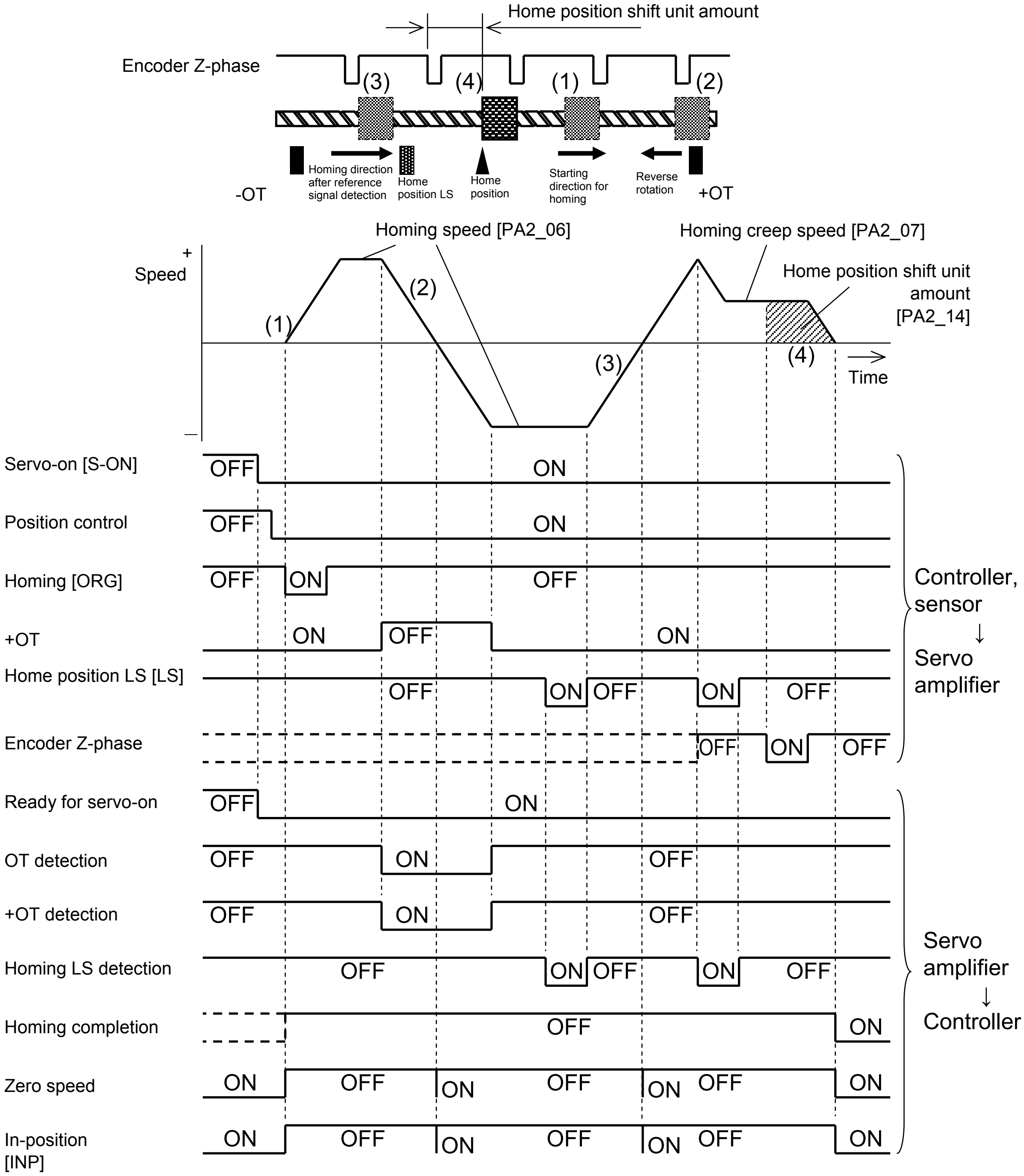
If OT is detected in the starting direction for homing during homing motion, the motion proceeds in the following procedure.

(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.

(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 rotation	0	Power
09	Reverse traveling unit amount for homing	20000 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	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	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation is disabled	0	Power
16	Home position after homing completion	0 [units]	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.

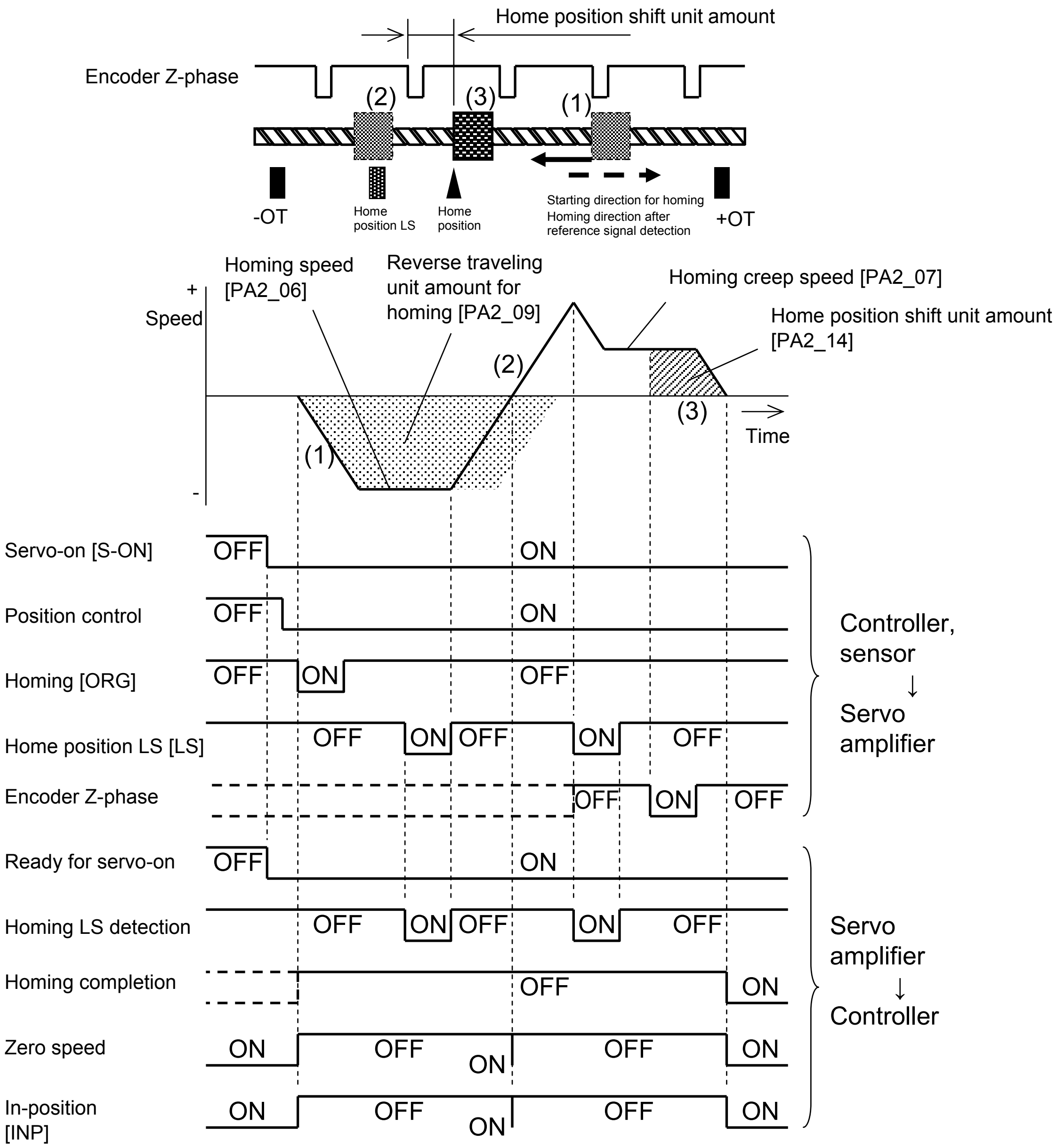
4

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.

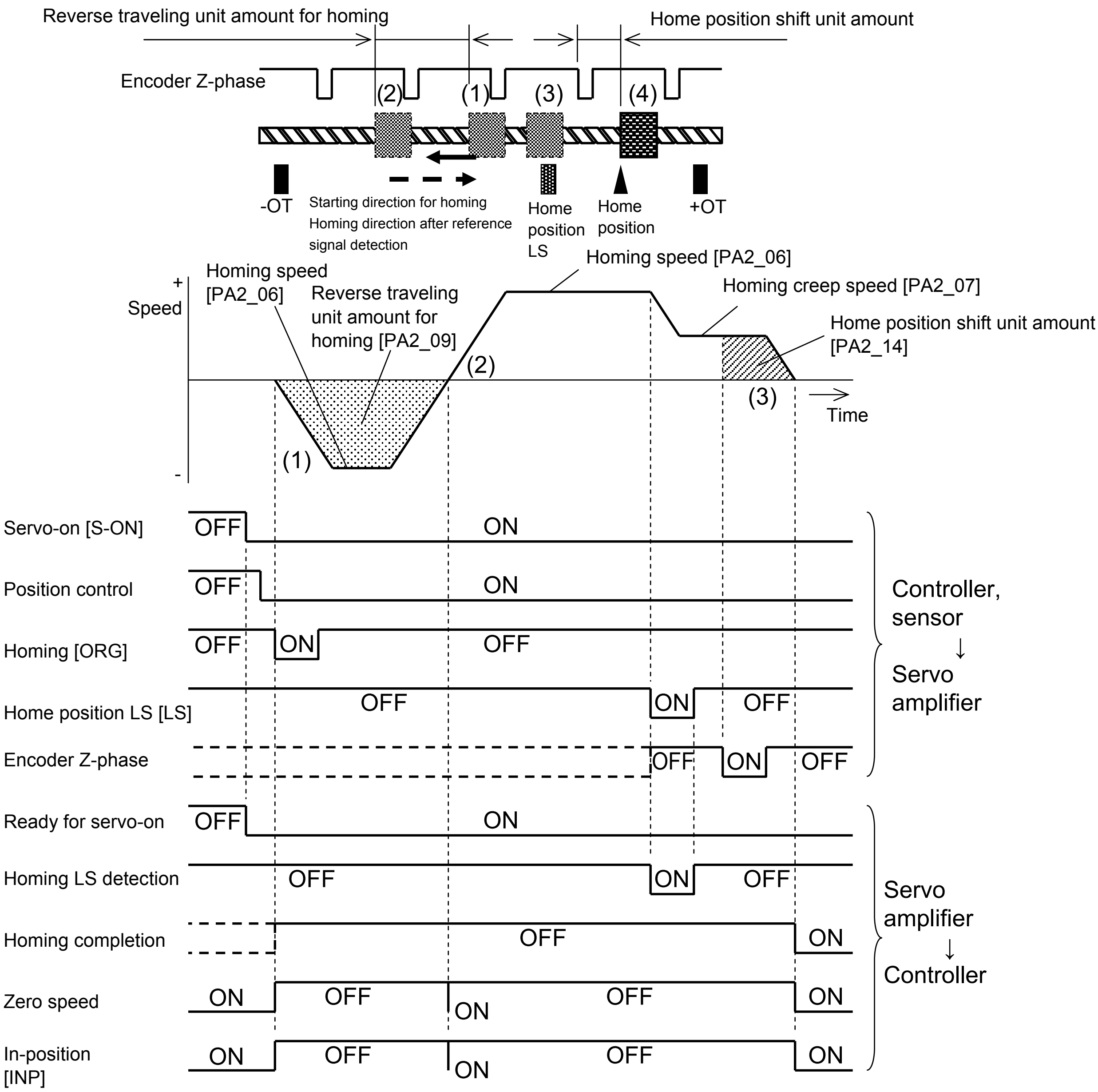
If the home position LS (PA2_12) is not found during travel from the homing starting position in the reverse traveling unit amount for homing (PA2_09), the motion continues in the starting direction for homing to search for the home position LS (PA2_12).

(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.

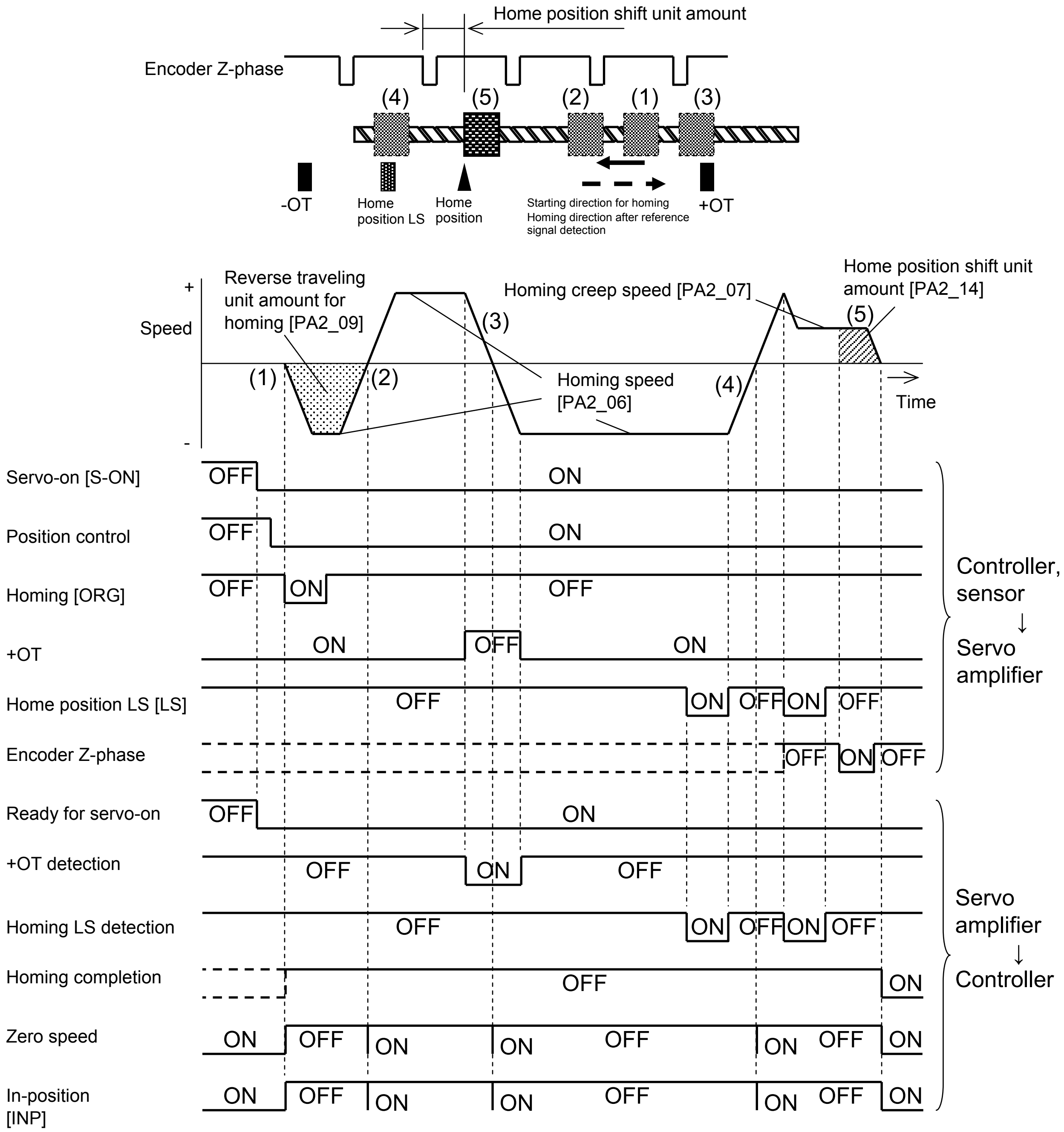
(1) The motion starts upon at the rising edge (OFF → ON) of homing [ORG] in the direction opposite to the starting direction for homing (PA2_08) at the homing speed (PA2_06).

(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) <u>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).</u>

(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.



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
Speed
+
-
Reverse traveling unit amount for homing [PA2_09]
Homing creep speed [PA2_07]
Home position shift unit amount [PA2_14]
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

(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 rotation	0	Power
09	Reverse traveling unit amount for homing	0 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	0	Power
11	Reference signal for shift operation	0: Home position LS	1	Power
13	Home position LS signal edge selection	0: Rising edge	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	1: Reverse rotation is enabled	0	Power
16	Home position after homing completion	0 [units]	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

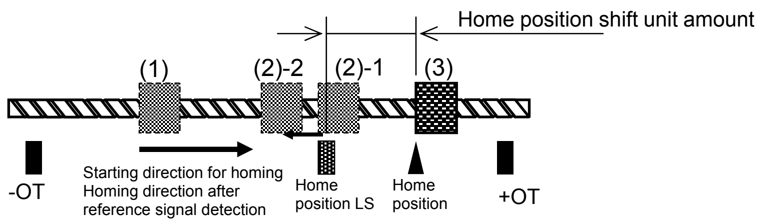
- Because rotation reverses in the direction opposite to the OT direction upon OT detection to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation, homing can be secured. The reverse rotation after OT detection follows (2) OT reference homing profile.

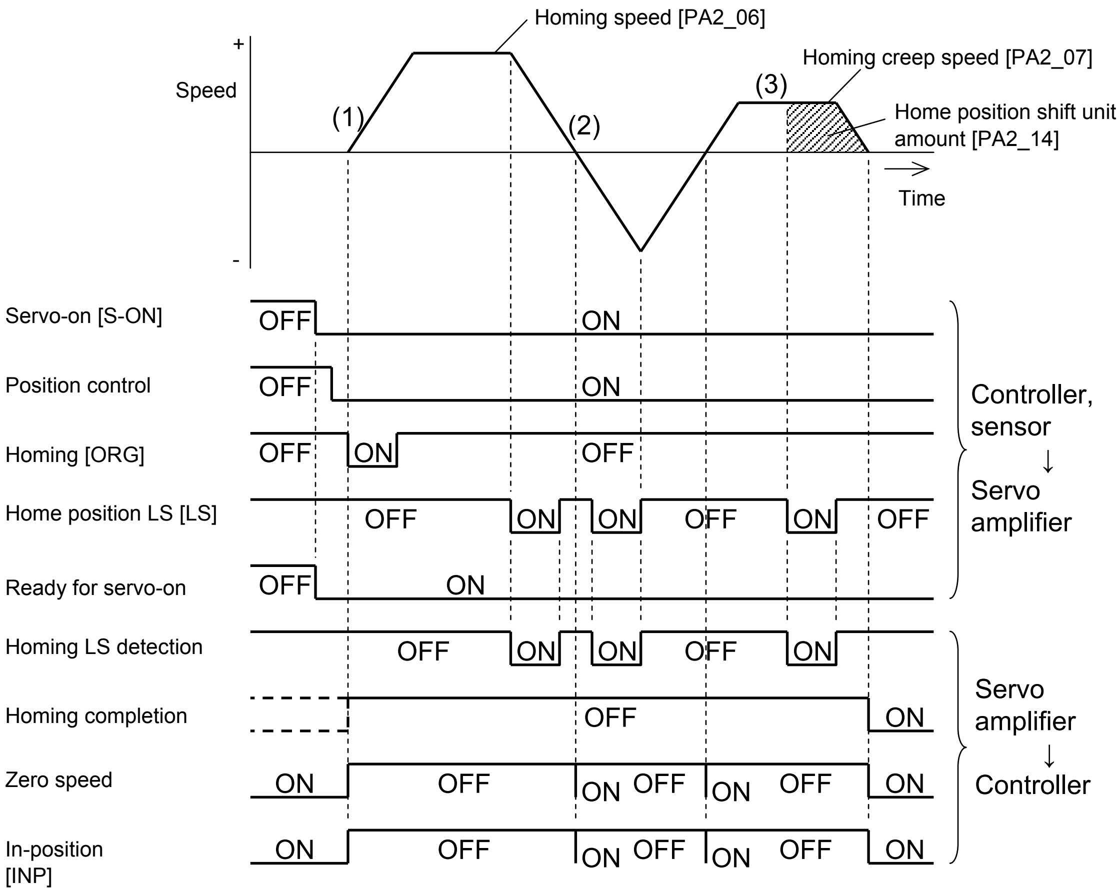
The motion proceeds in the following procedure.

(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.

4

(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	0: Reverse rotation	0	Power
09	Reverse traveling unit amount for homing	0 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	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	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	0: Reverse rotation is disabled	0	Power
16	Home position after homing completion	0 [units]	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

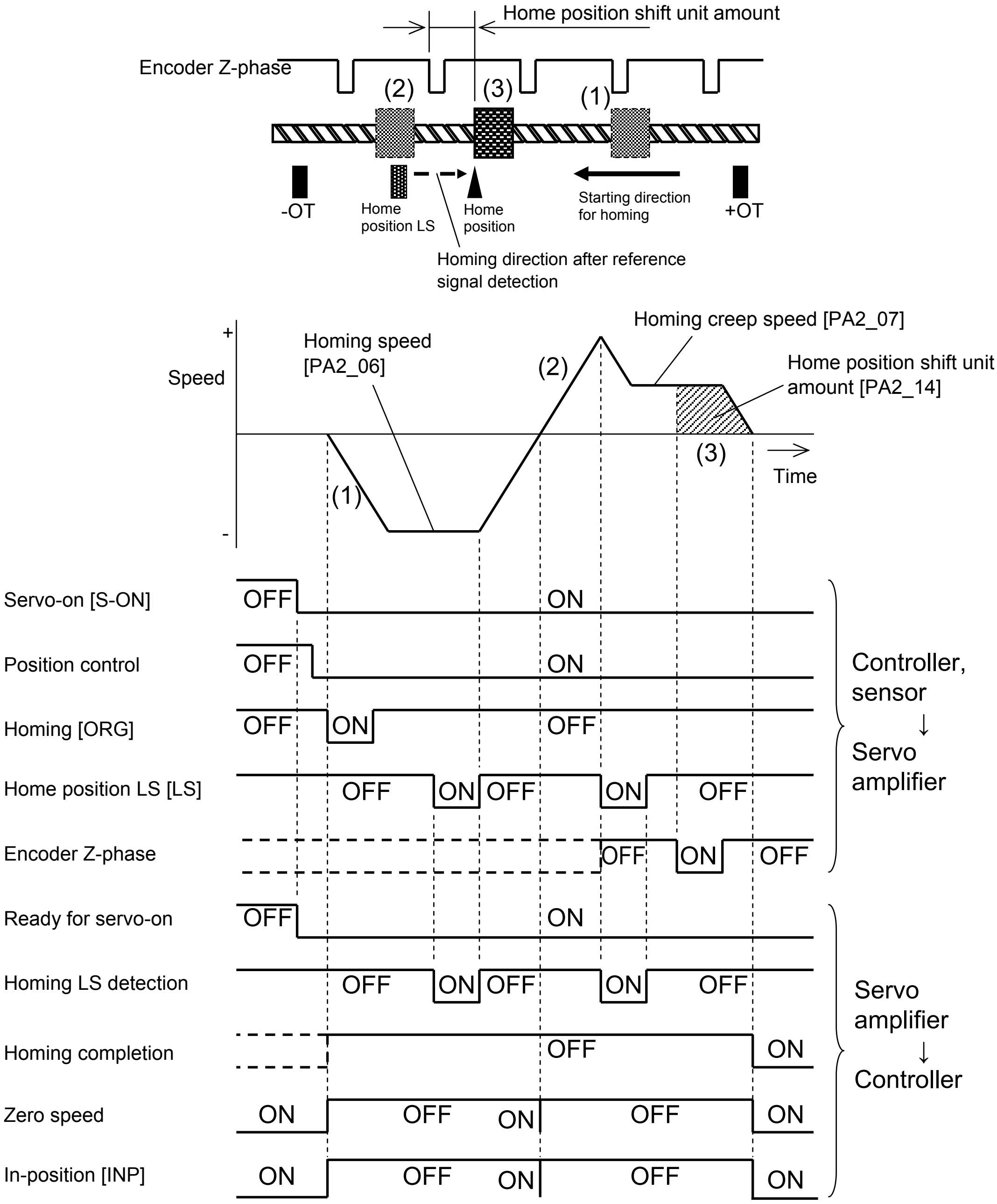
- Because rotation reverses in the direction opposite to the OT direction upon OT detection to detect the reference signal for homing (deceleration starting signal) and reference signal for shift operation, secure homing is realized. The reverse rotation after OT detection follows (2) OT reference homing 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.

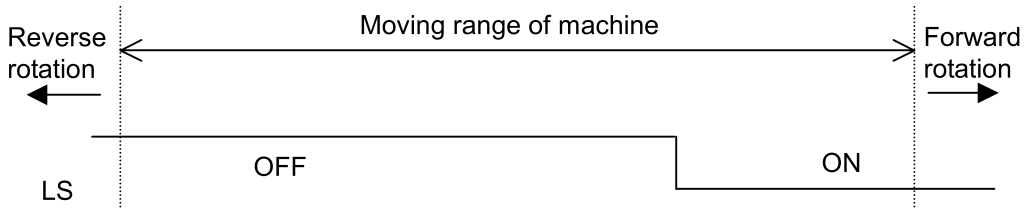


- At the rotation direction selection point with zero speed, zero speed and in-position [INP] are momentarily turned on. The signal change may fail to be sensed according to some scanning periods of the host controller.

(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 [units]	0	Always
10	Homing direction after reference signal detection	0: Forward rotation	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: Rising edge	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always
15	Deceleration operation for creep speed	1: Reverse rotation is enabled	0	Power
16	Home position after homing completion	0 [units]	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)

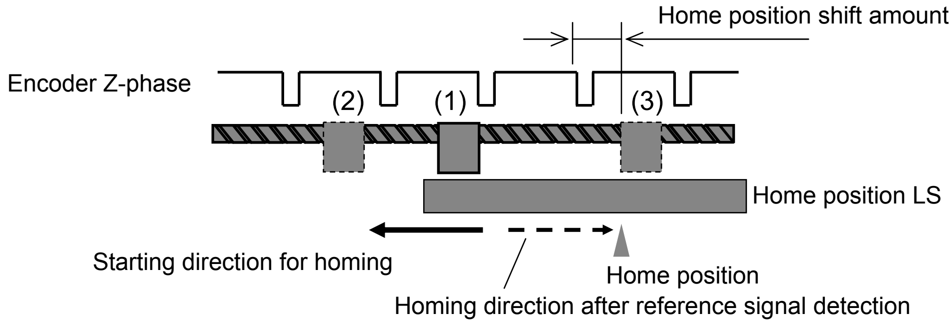
If PA2_08 = “2” and neither of the above conditions is satisfied, the starting direction for homing follows the setting of PA2_10 (homing direction after reference signal detection). If PA2_08 is set at “2,” PA2_09 (reverse traveling unit amount for homing) is internally handled as zero forcibly.

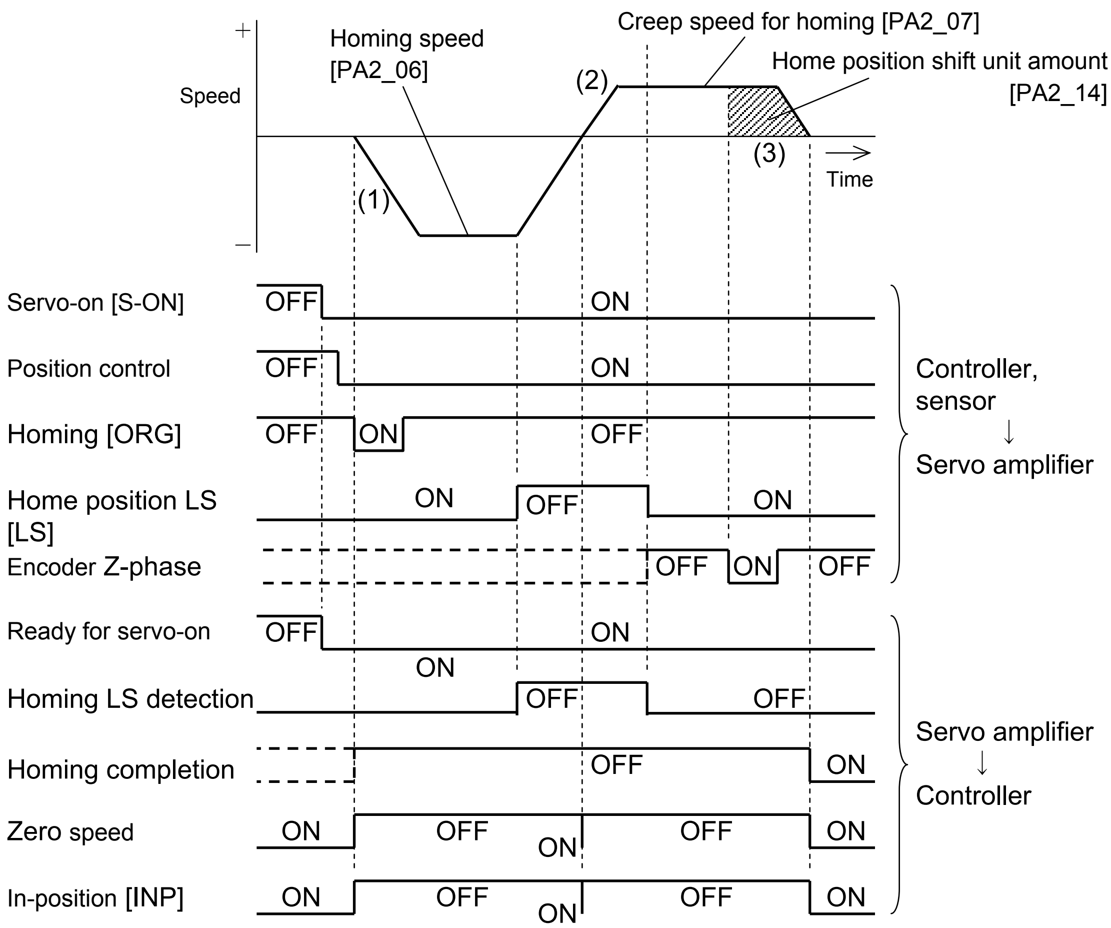
Operation proceeds in the following order.

(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.

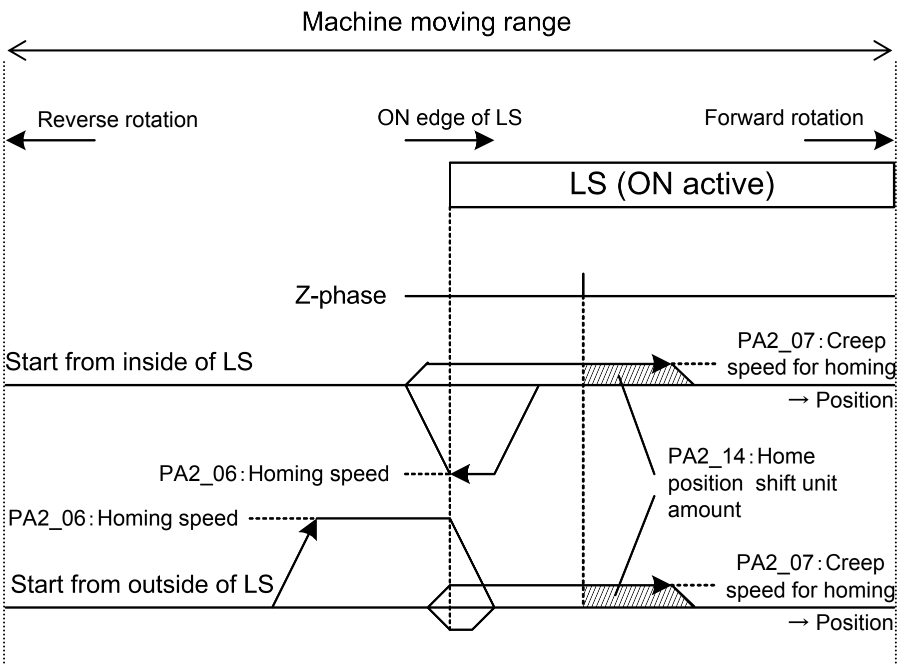




- Zero speed and in-position [INP] are temporarily turned on when the speed is reduced to zero at changeover of the direction of rotation. Signal transition may not be detected according to some scanning frequencies of the host controller.

- **[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.



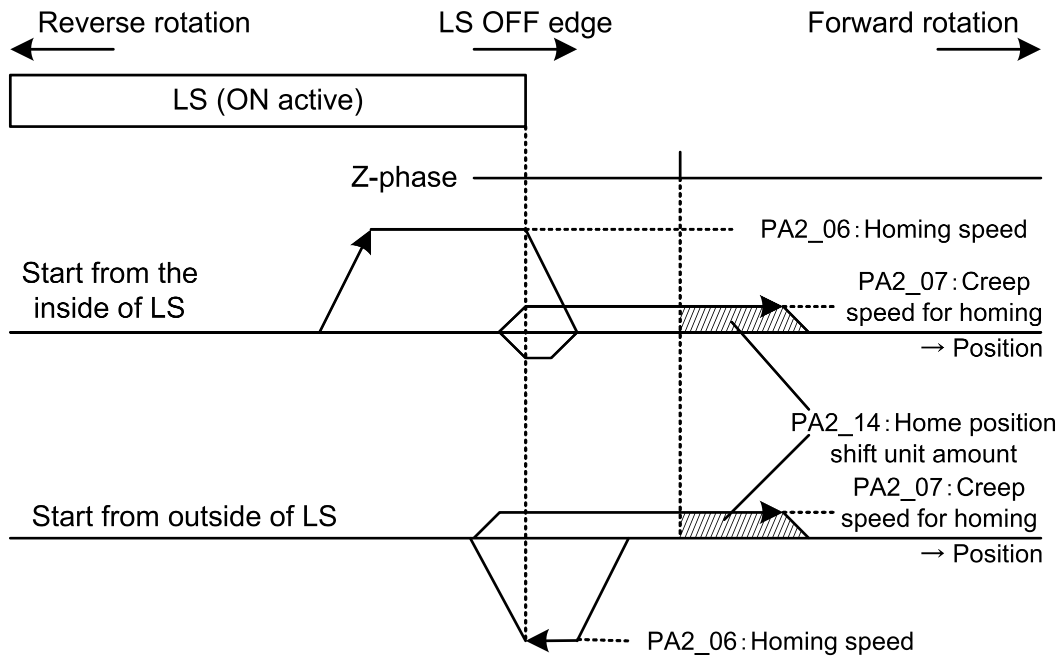
- Operation example at parameter setting change
  Operation examples after a parameter change necessitated due to the position, etc. of the home position LS (see Table a for the setting example) are shown in Figs. a to c.

Table a

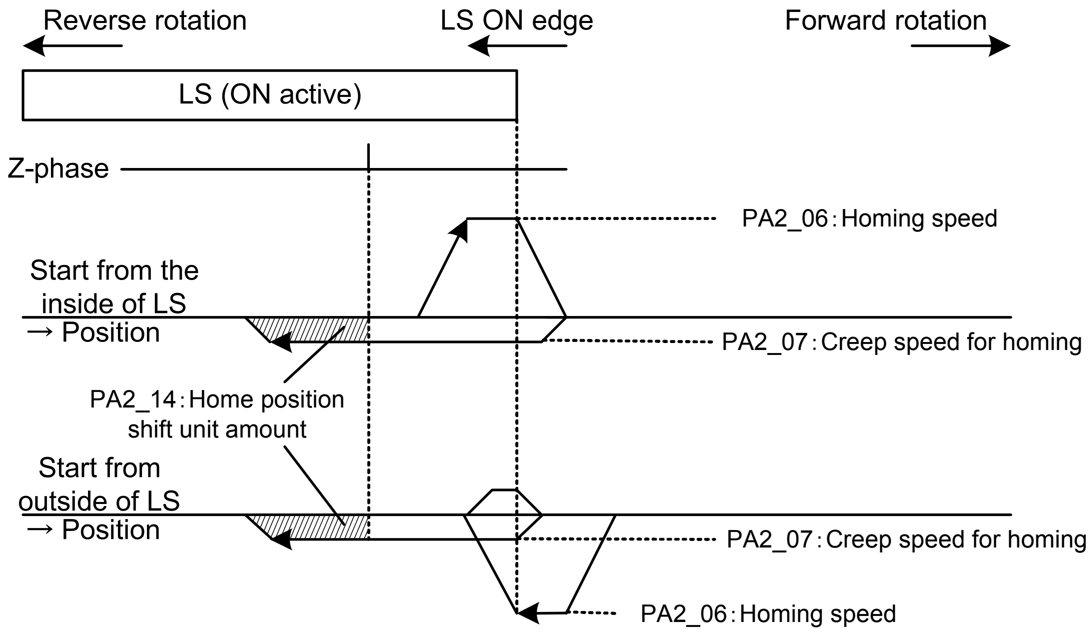
No.	Name	Setting example of Fig. a	Setting example of Fig. b	Setting example of Fig. c
PA2_08	Starting direction for homing	2:Condition judgment start		
PA2_10	Homing direction after reference signal detection	0:Forward rotation	1:Reverse rotation	
PA2_11	Reference signal for shift operation	1:Encoder Z-phase		
PA2_12	Reference signal for homing (Deceleration starting signal)	0:Home position LS		
PA2_13	Home position LS signal edge selection	1: Trailing edge	0: Rising edge	1: Trailing edge
PA2_15	Deceleration operation for creep speed	1:Reverse rotation is enabled		

Figs. a through c assume that the machine position is in the lateral direction.

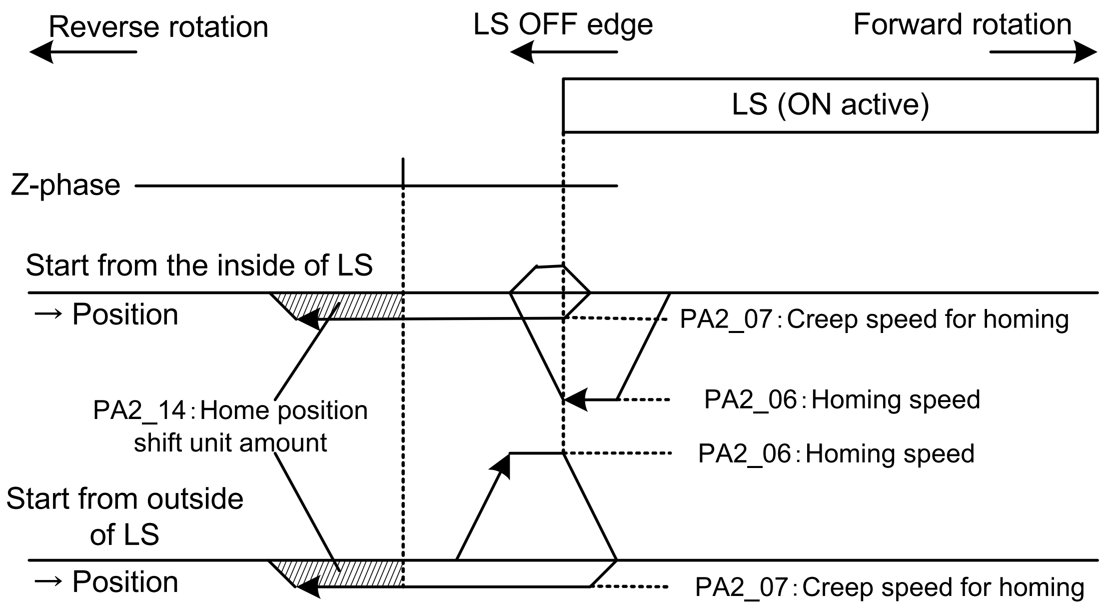
[Fig. a]



[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 encoder Z-phase as a referenece signal for homing

When it is a machine which cannot install sensors, such as LS, PA2_12: Reference signal for homing set as "Encoder Z-Phase".

[Parameter setting example]

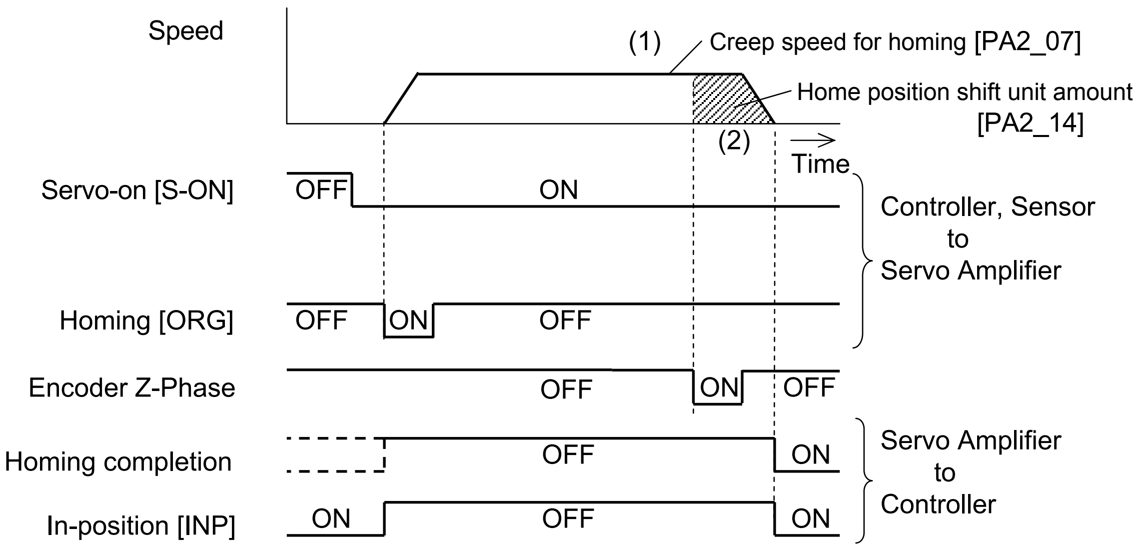
PA1_

No.	Name	Setting	Default value	Change
01	Control mode selection	0: Position	0	Power

PA2_

No.	Name	Setting	Default value	Change
07	Creep speed for homing	50.00 [r/min]	50.00	Always
08	Starting direction for homing	0: Forward rotation	0	Power
11	Reference signal for shift operation	1: Encoder Z-Phase	1	Power
12	Reference signal for homing	3: Encoder Z-Phase	0	Power
14	Home position shift unit amount	1000 [units]	1000	Always

- Timing chart
  - (1) When ORG signal is ON, the motor rotates with Creep speed for homing according to Starting direction for homing.
  - (2) If first encoder Z-Phase is detected, it moves by PA2_14: Homeing position shift unit amount.



- If PA2_12 is 3: Encoder Z-Phase, Reference signal for shift operation is always Encoder Z-Phaze even if PA2_11 is set as which value.
- When ±OT is detected at the start of homing, the motor does not rotate eve if PA2_24 is set as which value. And ±OT is detected during the homing operation, the motor is stopped.

(8) 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_

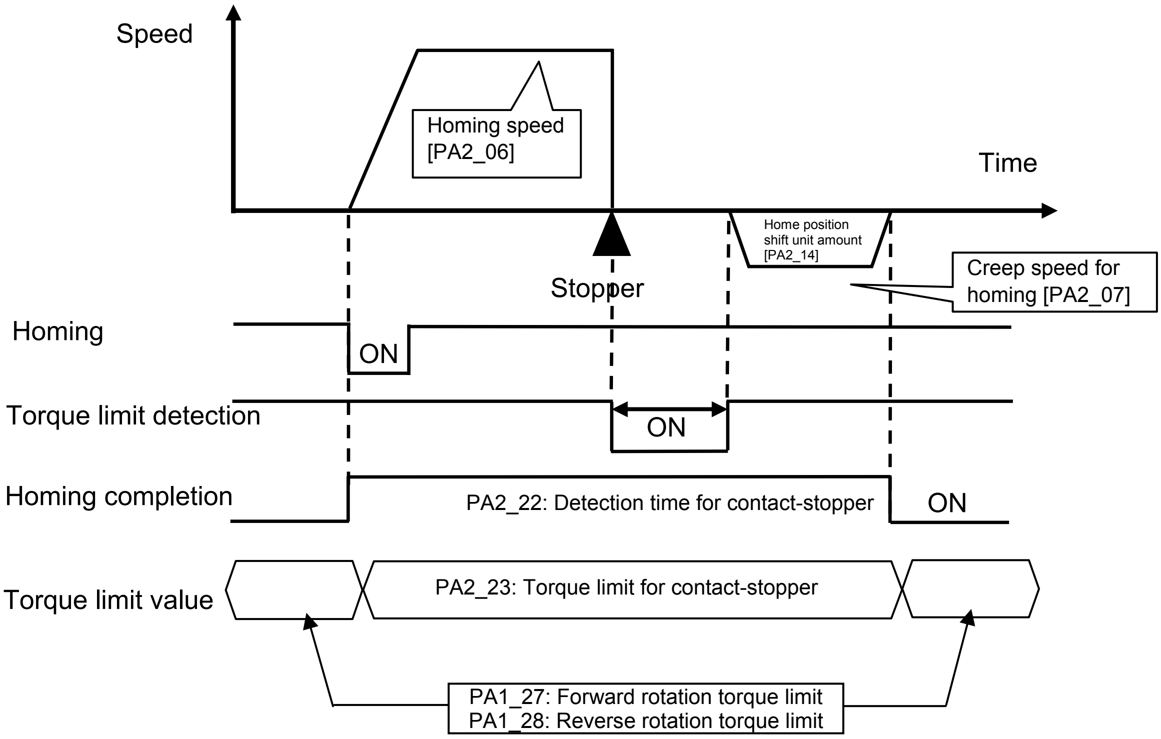
No.	Name	Setting	Default value	Change
06	Homing speed	500.00 [r/min]	500.00	Always
07	Creep speed for homing	50.00 [r/min]	50.00	Always
10	Homing direction after reference signal detection	0: Forward rotation	0	Power
11	Reference signal for shift operation	5: Stopper	1	Power
14	Home position shift unit amount	1000 [units]	1000	Always
16	Home position after homing completion	0 [units]	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 contact stop, and homing is finished there.

Timing chart



(1) The rising 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 [units]	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 [units]	100000	Always

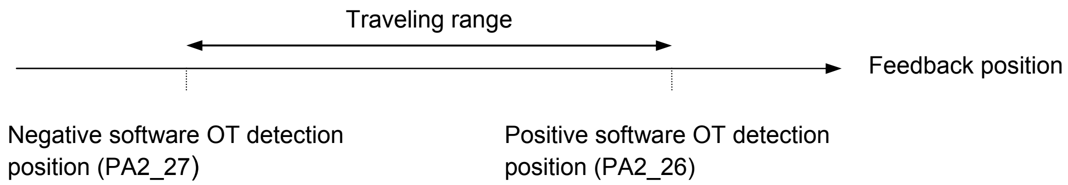
Specify to perform interrupt positioning.
Specify the traveling amount based on the position located at the timing of activation of an input signal ("interrupt input (49)" assigned to CONT signal).

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 1: Positioning start with zero position preset		
26	Positive software OT detection position	-2000000000 to 2000000000 [units]	2000000000	Always
27	Negative software OT detection position	-2000000000 to 2000000000 [units]	-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 positive software OT detection position is larger than negative software OT detection position.



(2) Position command format

Normal: Motion is conducted in the range from -2000000000 to 2000000000 units. Absolute/incremental positioning data designation and various position detection functions can be used.

1: Positioning start with zero position preset:	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 [units]	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."

4

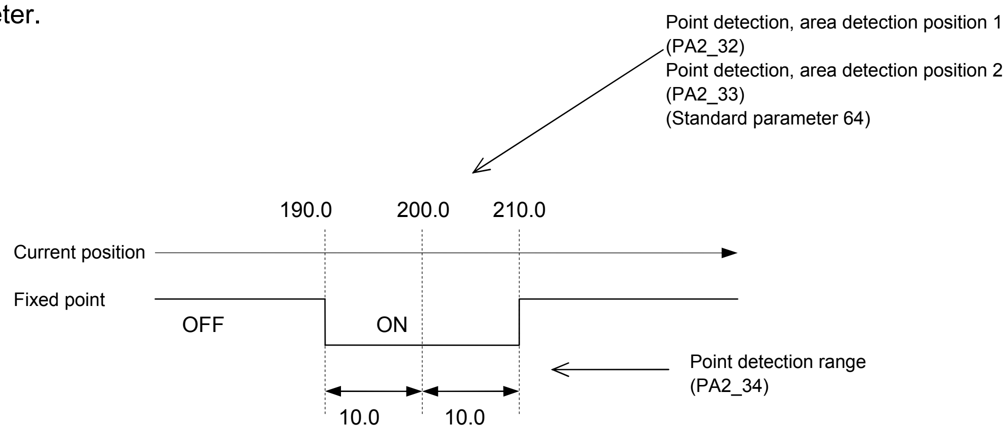
PA2_31 to 34 Point detection, area settings

No.	Name	Setting range	Default value	Change
31	Point detection, area detection	0: Point detection 1: ON for positive side 2: ON for negative side	0	Always
32	Point detection, area detection position 1	-2000000000 to 2000000000 units	0	Always
33	Point detection, area detection position 2	-2000000000 to 2000000000 units	0	Always
34	Point detection range	0 to 2000000000 units	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)

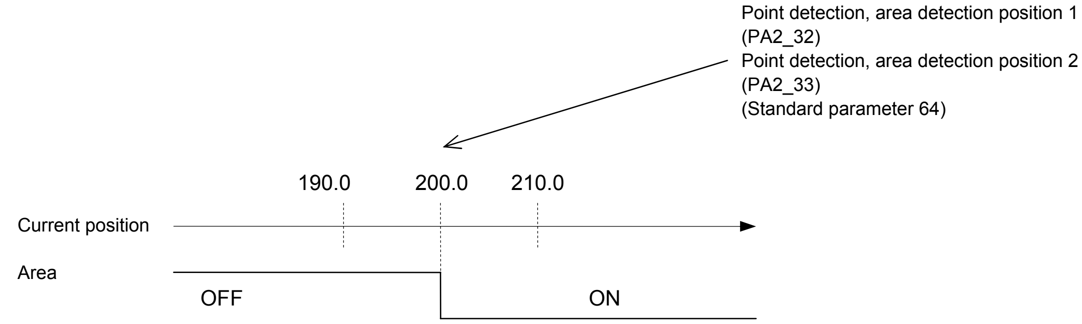
The signal is turned on if the current position is nearly the position specified in the standard parameter.



(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.

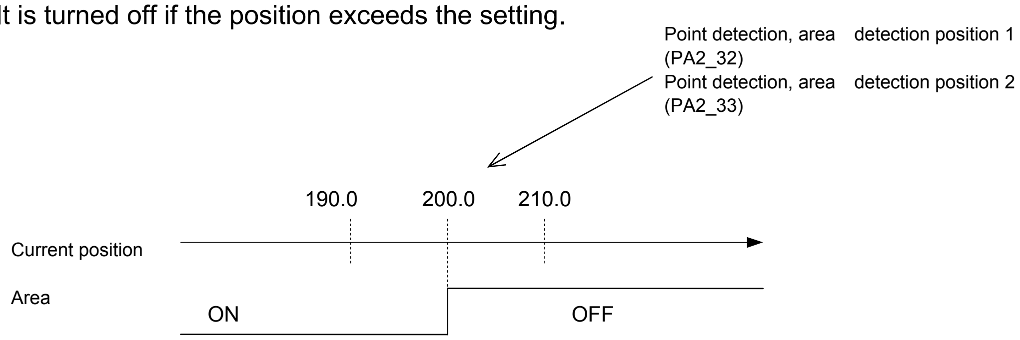
It is turned off if the position is less than the setting.



(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.



4

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 3: Immediate value data operation	0	Power

Select whether to enable the sequential start or not, and select the motion when AD0 through AD3 are inactive.

If “1” is selected and AD0 through AD3 are inactive, sequential start operation is conducted.

If “2” is selected and AD0 through AD3 are inactive, homing is conducted.

If "3" is selected and AD0 through AD3 are inactive, immediate value data operation 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 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”

PA2_44 Positioning extended function

No.	Name	Setting range	Default value	Change
44	Positioning extended function	0: Internal command completion 1: Internal feedback completion	0	Power

Select the condition for reversing in a case ”when the travel directions between two continuous motions are opposite” as the followings:

(a) In continuous operation by the immediate continuous command in immediate data operation

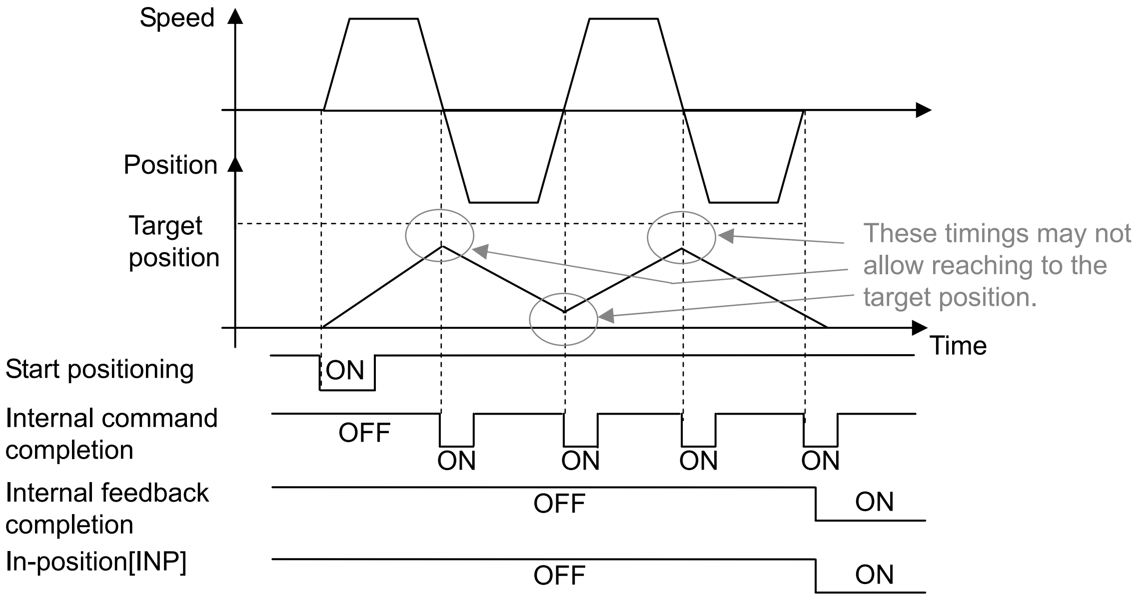
(b) In continuous operation with the step mode = CO (continuous) and the stop timer = “0” in positioning data operation

Setting value: 0 (Internal command completion.)

After the command in-position of each motion, next operation will be carried out continuously (in continuous operation) as shown in the chart below.

The current feedback position while continuous operation is carried out may not reach the target position due to delay of following behavior.

To approach the target position, adjust the tuning setting and increase the response.



Setting value: 1 (Internal feedback completion.)

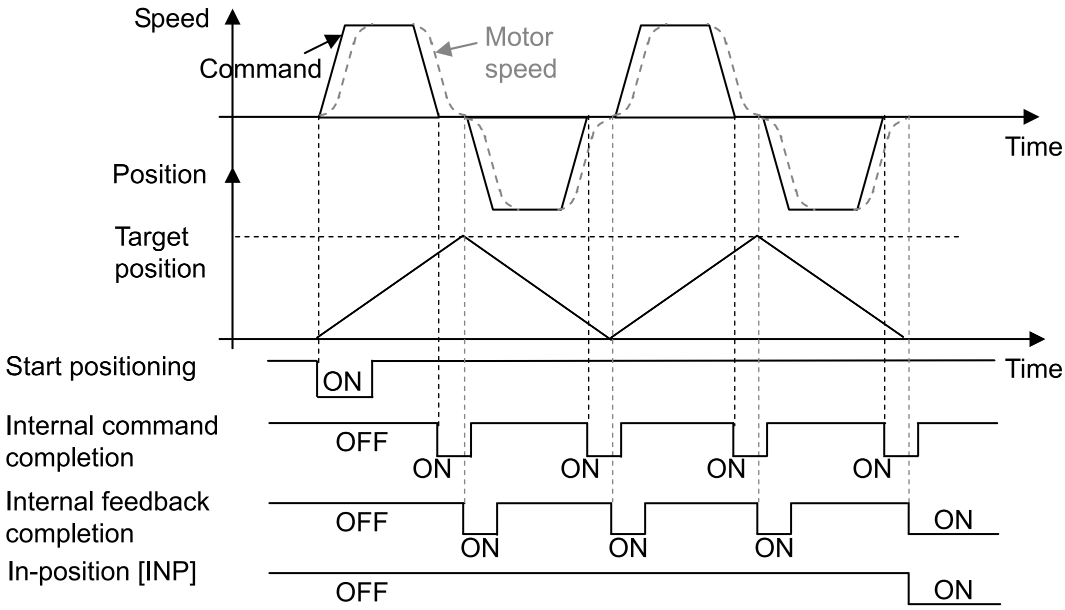
The operation will shift to the next motion continuously after each motion enters in-position conditions (*) as shown in the chart below.

The current feedback position while continuous operation is carried out will start the following motion to the target position after positioning is complete normally.

* Conditions for in-position is all of the following (a), (b) and (c).

(a) Internal command completion (b) The position deviation is within the deviation zero range (PA1_32) (c) The speed is within the zero speed range (PA1_30)

Moreover, the in-position [INP] signal is not output during continuous operation.



4

4.5 Extended Function Setting Parameter

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

4.5.1 List (PA2_□□)

No. PA2_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
51	Numerator 1 of electronic gear	1	–	○	–	–	
52	Numerator 2 of electronic gear						
53	Numerator 3 of electronic gear						
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	5	○	○	○	○	
63	Action sequence at main power shutoff	5	○	○	○	○	
64	Torque keeping time to holding brake	0.00	–	○	○	○	
65	Regenerative resistor selection	1	○	○	○	○	
66	Flying start at speed control	0	○	–	○	–	
67	Alarm detection at undervoltage	1	○	○	○	○	
68	Unused	0	–	–	–	–	
69	Deviation detection overflow value	15.0	–	○	–	–	
70	Overload warning value	50	–	○	○	○	
72	Station number for communications	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	–	○	–	–	
98	GY******2-T2*-* motor model setting	0	○	○	○	○	
99	Encoder selection	0	○	○	○	○	

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

4

4.5.2 Description of Each Parameter

PA2_51 to 53 Electronic gear ratio numerator 1, 2, 3

No.	Name	Setting range	Default value	Change
51	Numerator 1 of electronic gear	1 to 4194304	1	Always
52	Numerator 2 of electronic gear			
53	Numerator 3 of electronic gear			

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_06: 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

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.

4

PA2_56 Speed limit selection at torque control

No.	Name	Setting range	Default value	Change
56	Speed limit selection at torque control	0: Parameter (PA1_26) 1: As per multi-step speed selection inc. 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: As per CONT signal torque limit 0/1 1:TREF terminal voltage	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 terminal voltage	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)

CONT signal *		State of each limit	Enabled torque limit	
Torque limit 1	Torque limit 0	TL: TREF (analog torque limit)	CCW: Powering, CW: Regeneration	CW: Powering, CCW: Regeneration
OFF	OFF	No condition judgment	Forward rotation torque limit	Reverse rotation torque limit
OFF	ON	TL ≥ Forward/Reverse rotation torque limit	Forward rotation torque limit	Reverse rotation torque limit
		TL < Forward/reverse rotation torque limit	TL	TL
ON	OFF	Second torque limit ≥ Forward/Reverse rotation torque limit	Forward rotation torque limit	Reverse rotation torque limit
		Second torque limit < Forward/Reverse torque limit	Second torque limit	Second torque limit
ON	ON	TL ≥ Second torque limit	Second torque limit	Second torque limit
		TL < Second torque limit	TL	TL

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)

CONT signal *		State of each limit	Enabled torque limit	
Torque limit 1	Torque limit 0	TL: TREF (analog torque limit)	CW deceleration stop	CCW deceleration stop
OFF	OFF	Forward rotation torque limit ≥ Third torque limit	Third torque limit	Third torque limit
		Forward/Reverse rotation torque limit < Third torque limit	Forward rotation torque limit	Reverse rotation torque limit
OFF	ON	TL, forward/reverse torque limit ≥ Third torque limit	Third torque limit	Third torque limit
		TL, forward/reverse torque limit < Third torque limit	TL or forward rotation torque limit, whichever is less	TL or reverse rotation torque limit, whichever is less
ON	OFF	Second torque limit, forward/reverse rotation torque limit ≥ Third torque limit	Third torque limit	Third torque limit
		Second torque limit, forward/reverse rotation torque limit < Third torque limit	Second torque limit or forward rotation torque, whichever is less	Second torque limit or reverse rotation torque, whichever is less
ON	ON	TL, second torque limit ≥ Third torque limit	Third torque limit	Third torque limit
		TL, second torque limit < Third torque limit	TL or second torque limit, whichever is less	TL or second torque limit, whichever is less

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 (sequence input signal) turned off
- Sudden controlled stop caused by forced stop (sequence input signal) turned off
- Sudden controlled stop caused by ±OT (sequence input signal) turned off
- Controlled stop caused by minor failure alarm (If PA2_62 is 4 or 5)

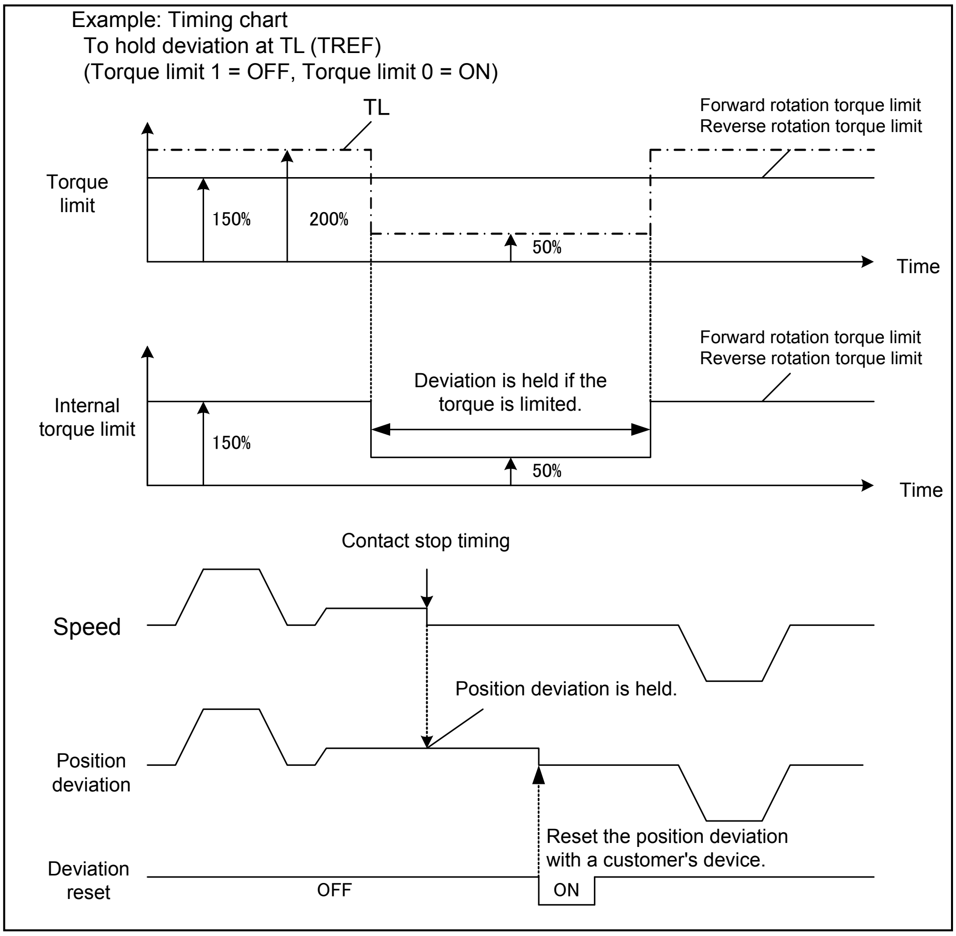
(5) Deviation holds selection at torque limit

This parameter is enabled under position control.
Position deviation is held with this function after a contact stop. Position deviation is held so that the position deviation count does not reach the limit at the contact stop.
The function is enabled under the following conditions. (If PA2_57 is 0)

CONT signal *		PA2_59 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 terminal voltage	TL
ON	OFF	1: Second torque limit	Second torque limit
		2: TREF terminal voltage	None
ON	ON	1: Second torque limit	Second torque limit
		2: TREF terminal voltage	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	3: Free-run at deceleration, free-run at stop 5: Emergency stop at deceleration /, free-run at stop	5	Power
62	Action sequence at alarm	3: Free-run at deceleration, free-run at stop 5: Emergency stop at deceleration / (*1), free-run at stop	5	Power
63	Action sequence at main power shutoff	3: Free-run at deceleration, free-run at stop 5: Emergency stop at deceleration /, free-run at stop	5	Power

(*1) Free-run causes deceleration upon major failure alarm.
Specify the deceleration and stopping states for each condition as shown in the previous table.

PA2_64 Torque keeping time to holding brake

No.	Name	Setting range	Default value	Change
64	Torque keeping time to holding brake	0.00 to 9.99 [s]	0.00	Always

Assign the "brake timing" signal to the output signal.
The reference value of this parameter indicates the delay taken from shutoff of servo-on (CONT input signal, function no.1) 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 Regenerative resistor selection

No.	Name	Setting range	Default value	Change
65	Regenerative resistor selection	0: None 1: Internal resistor 2: External resistor	1	Power

Select the regenerative resistor.
If the reference value is 1, the temperature of the regenerative resistor is calculated inside the amplifier and monitored as a regenerative thermal value. 100% indicates an overheated internal regenerative resistor (RH1).
To install an external regenerative 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 regenerative resistor overheat (function no.34).
Because of a normally closed contact, shutoff indicates an external regenerative resistor overheat (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.
The speed at the timing of 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 main power undervoltage.

PA2_69 Deviation detection overflow value

No.	Name	Setting range	Default value	Change
69	Deviation detection overflow value	0.1 to 100.0 [rev]	15.0	Always

Specify the value for detecting an "deviation overflow" 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

PA2_72 Station number

No.	Name	Setting range	Default value	Change
72	Station number	Station No.: 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] 3: 115200 [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

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: Regenerative 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. 46: Motor running time.	0	Power

Specify the data displayed on 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 display	0	Power

Select whether or not a warning sign is displayed on 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.

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 99: PA1_1 to 99 101 to 199: PA2_1 to 99 201 to 299: PA3_1 to 99	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 to 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 2: 17 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

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:

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)		

PA2_94 Response time (for Modbus)

PA2_95 Communications 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 Communications 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.

<u>The factory shipment setting is “0” (PC Loader protocol). To use Modbus RTU communications, do not fail to change to “1.”</u>

PA2_98 GY******2-T2*-* motor type setting

No.	Name	Setting range	Default value	Change
98	GY******2-T2*-* motor type setting	0:Not set 1:GYS500DC2-T2*-* 2:GYS101DC2-T2*-* 3:GYS201DC2-T2*-* 4:GYS401DC2-T2*-* 5:GYS751DC2-T2*-* 6:GYG501CC2-T2*-* 7:GYG751CC2-T2*-* 8:GYG102CC2-T2*-* 9:GYG152CC2-T2*-* 10:GYG202CC2-T2*-* 11:GYG501BC2-T2*-* 12:GYG851BC2-T2*-* 13:GYG132BC2-T2*-* 14:GYG182BC2-T2*-* 15:GYG292BC2-T2*-*	0	Power

Select the motor type to be connected when connected to a motor of FALDIC-W series.

Note	Make sure to connect the motor to which PA2_98 has been set. If a motor to which PA2_98 has not been set is connected, it may cause failure.

PA2_99 Encoder selection

No.	Name	Setting range	Default value	Change
99	Encoder selection	0: Automatic recognition（17～20bit） 1: 17bit　（FALDIC-W）	0	Power

Set the encoder type of the connected motor.

4

4.6 Input Terminal Function Setting Parameter

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

4.6.1 List (PA3_□□)

No. PA3_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
01	CONT1 signal assignment	Refer to the next page.	○	○	○	○	
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						
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	0					
27	CONT always ON 2	0					
28	CONT always ON 3	0					
29	CONT always ON 4	0					

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

4.6.2 Description of Each Parameter

PA3_01 to 05 CONT 1 to 5 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 next page.)	1	Power
02	CONT2 signal assignment		11	
03	CONT3 signal assignment		0	
04	CONT4 signal assignment		0	
05	CONT5 signal assignment		0	

PA3_09 to 24 (CONT9 to 24 signal assignment) can be set only by RS-485 communications.

4

(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 5).
Communication data setting is enabled from CONT9 through CONT24.
However, the setting of "48" (interrupt input enable) must be assigned to from CONT1 to 5.
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	49	Interrupt input
4	Start positioning [START]	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 regenerative 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	78	Broadcast cancel

The logic of the following signals differs between those assigned to hardware CONT signals (CONT1 to 5) and those to communications CONT signals (CONT9 to 24).
In "Chapter 2 Wiring" the signal logic is described with the case assigned to hardware CONT signals (CONT1 to 5).

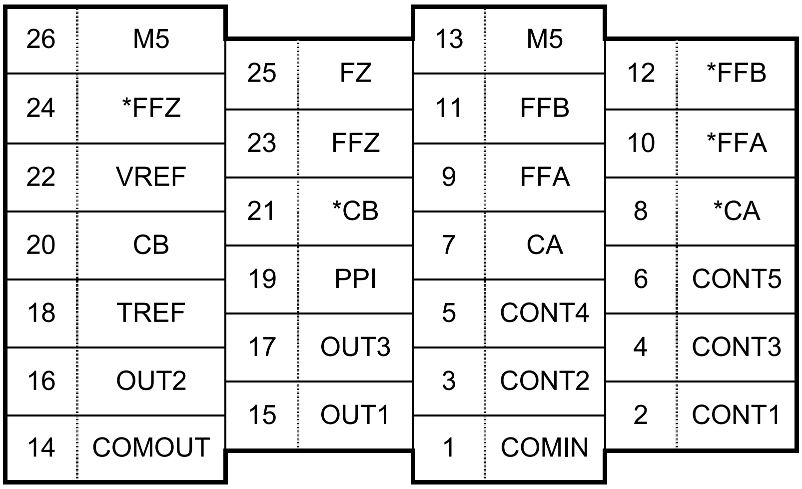
No.	Name	Signal logic	
		Hardware CONT signal: assigned to (CONT1 to 5)	Communications CONT signal: assigned to (CONT9 to 24)
7	+OT	N.C.	N.O.
8	-OT	N.C.	N.O.
10	Forced stop [EMG]	N.C.	N.O.
34	External regenerative resistor overheat	N.C.	N.O.

N.C.: Normally closed contact
N.O.: Normally open contact

(2) Connector pin layout

The pin layout of each signal is shown in the figure below.
Assign desired functions to signals CONT1 through CONT5.

CN1



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 78)	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.

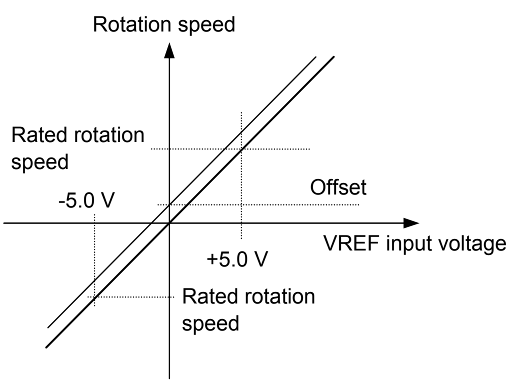
Functions that may not be specified with a normally closed signal include forced stop and external regenerative resistor overheat. (Functions that can be specified with a normally closed signal are +OT and -OT.)
For example, to turn forward command [FWD] always on, specify "2," which corresponds to the 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

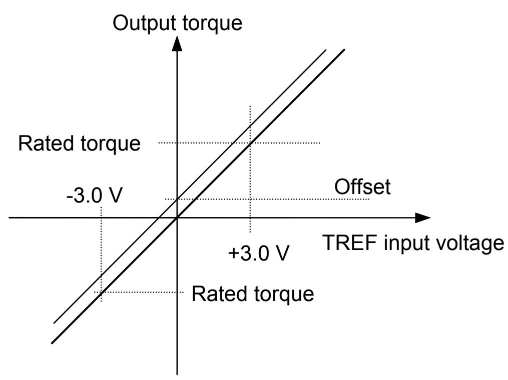
No.	Name	Setting range	Default value	Change
31	Speed command scale	±1.0 / to ±100.0 [V]/ Rated rotation speed	5.0	Always
32	Speed command offset	-2000 to 2000 [mV]	Shipment setting	Always
33	Torque command scale	±1.0 to ±10.0 [V]/ Torque command offset	3.0	Always
34	Torque command offset	-200×10 to 200 [×10 mV]	Shipment setting	Always

Specify the scale (gain) and offset of the analog input signal.

Speed command scale (default value)



Torque command scale (default value)



PA3_35 Zero clamp level

No.	Name	Setting range	Default value	Change
35	Zero clamp level	0 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

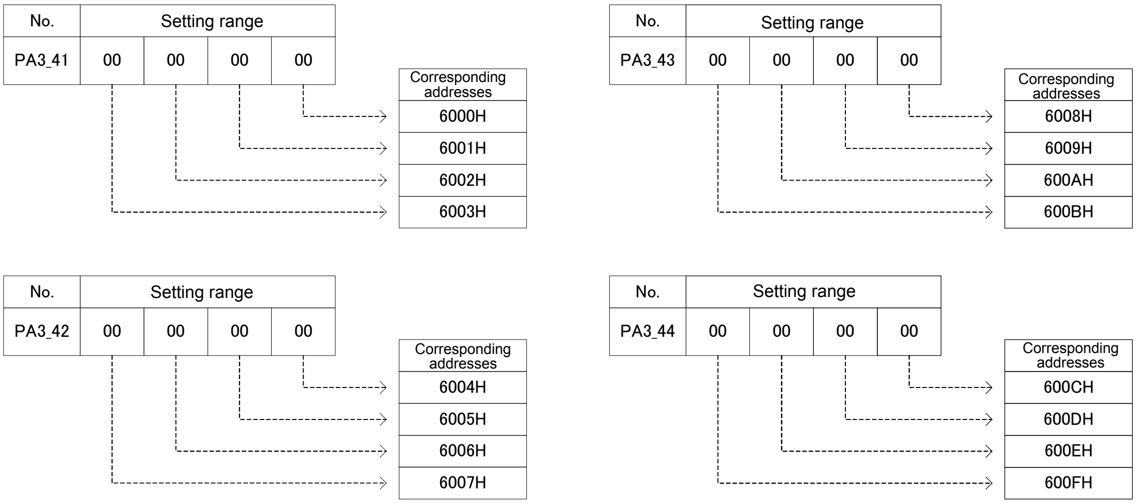
The gain can be finely adjusted in relation to the torque command.
The function is similar to that of PA3_39 (speed command fine adjustment gain).
[Example]
If TREF voltage is 3 V and PA3_40 is 1.0100, the torque command inside the servo amplifier is 3.03 V (3 × 1.0100).

PA3_41～44 Address free assignment 1 to 4 (for Modbus)

No.	Name	Setting range	Default value	Change
41	Address free assignment 1 (for Modbus)	00000000 to 99999999	00000000	Power
42	Address free assignment 2 (for Modbus)	00000000 to 99999999	00000000	Power
43	Address free assignment 3 (for Modbus)	00000000 to 99999999	00000000	Power
44	Address free assignment 4 (for Modbus)	00000000 to 99999999	00000000	Power

Parameter assignment corresponding address configuration and assignment No. details are as follows. Please note that the default value of 00000000 indicates the feedback speed.

■ Corresponding addresses:



These settings are valid only for addresses 6000H to 600FH.

- If function code (FC) 17H is used:
  Set as read and write data for parameters PA3_41 to PA3_42 (corresponding address area 6000H to 6007H), and as read data for parameters PA3_41 to PA3_44 (corresponding address area 6000H to 600FH).
  An exception code (02h) is returned if other than the above is set.
  If the same address is specified for both read data and write data, read out data is taken to be the same as write in data (value on this occasion).
  Set at least one item of read and write data. If less than this, an exception code (03h) is returned.
- If function code (FC) 03H is used:
  Set read data for parameters PA3_41 to PA3_44 (corresponding address area 6000H to 600FH).
  An exception code (02h) is returned if other than the above is set.
- If function code (FC) 10H is used:
  Set write data for parameters PA3_41 to PA3_42 (corresponding address area 6000H to 6007H).
  An exception code (02h) is returned if other than the above is set.

Refer to the following items in Chapter 13 for detailed settings.

3. Function codes (FC) ---------------FC 17h (Read out/write in various data)
4. Addresses ---------------------------Data addresses

4.7 Output Terminal Function Setting Parameter

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

4.7.1 List (PA3_□□)

4

No. PA3_	Name	Default value	Power	Control mode			Record of reference value
				Position	Speed	Torque	
51	OUT1 signal assignment	Refer to the next page.	○	○	○	○	
52	OUT2 signal assignment						
53	OUT3 signal assignment						
54	Unused						
55	Unused						
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 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 53 OUT 1 to 3 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 table on next page).	1	Power
52	OUT2 signal assignment		2	
53	OUT3 signal assignment		76	

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 3).
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	85	Interrupt positioning detection
22	Homing completion	45	Battery warning	91	CONTa through
23	Zero deviation	46	Life warning	92	CONTb through
24	Zero speed	60	MD0	93	CONTc through
25	Speed coincidence	61	MD1	94	CONTd through
26	Torque limit detection	62	MD2	95	CONTe through
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 OUT3.

CN1

26	M5	25	FZ	13	M5	12	*FFB
24	*FFZ	23	FFZ	11	FFB	10	*FFA
22	VREF	21	*CB	9	FFA	8	*CA
20	CB	19	PPI	7	CA	6	CONT5
18	TREF	17	OUT3	5	CONT4	4	CONT3
16	OUT2	15	OUT1	3	CONT2	2	CONT1
14	COMOUT			1	COMIN		

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/pulse]. 5: Position deviation 1/10 [units/pulse]. 6: Position deviation 1/100 [units/pulse]. 7: Command pulse frequency. 8: Speed deviation. 9: Motor current. 10: Effective torque. 11: DC link voltage. 12: OL thermal value. 13: Regenerative 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 to ±100.0 [V]	7.0	Always
84	Monitor 1 offset	-50 to 50	0	Always
85	Monitor 2 scale	±2.0 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

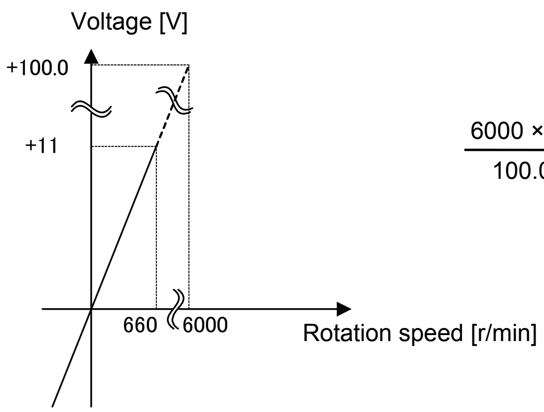
■ Monitor 1/2 signal assignment

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: Effective torque	Effective 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:Regenerative resistor thermal value	Load factor of regenerative resistor	Regenerative 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)



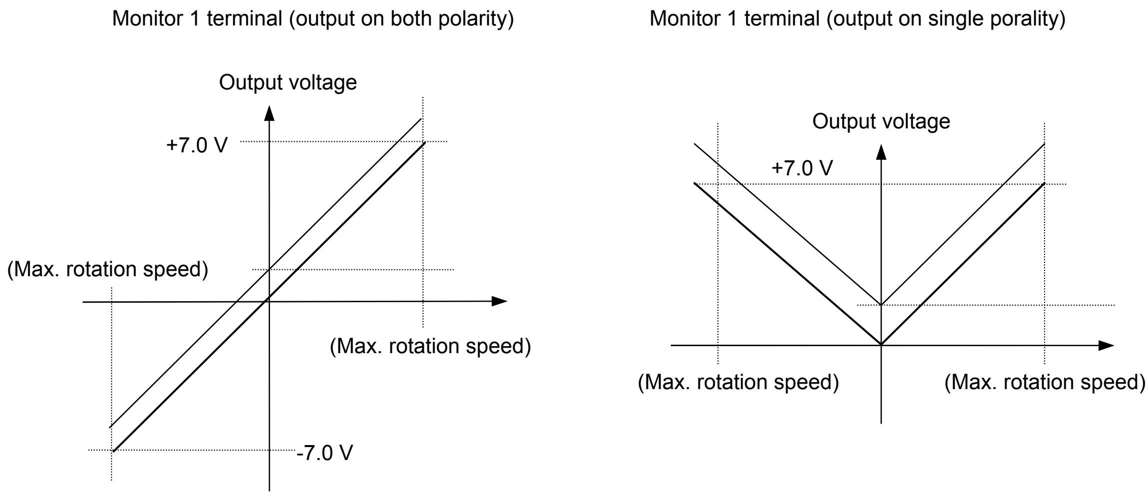
$$\frac{6000 \times 11}{100.0} = 660 \text{ r/min}$$

■ 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 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 output on both polarity or output on single polarity, scale and offset assigned to the monitor 1 [MON1] and monitor 2 [MON2] terminals.



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 [units]	0	Always
93	Range1 of position: Setting2	-2000000000 to 2000000000 [units]	0	Always
94	Range2 of position: Setting1	-2000000000 to 2000000000 [units]	0	Always
95	Range2 of position: Setting2	-2000000000 to 2000000000 [units]	0	Always

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.”

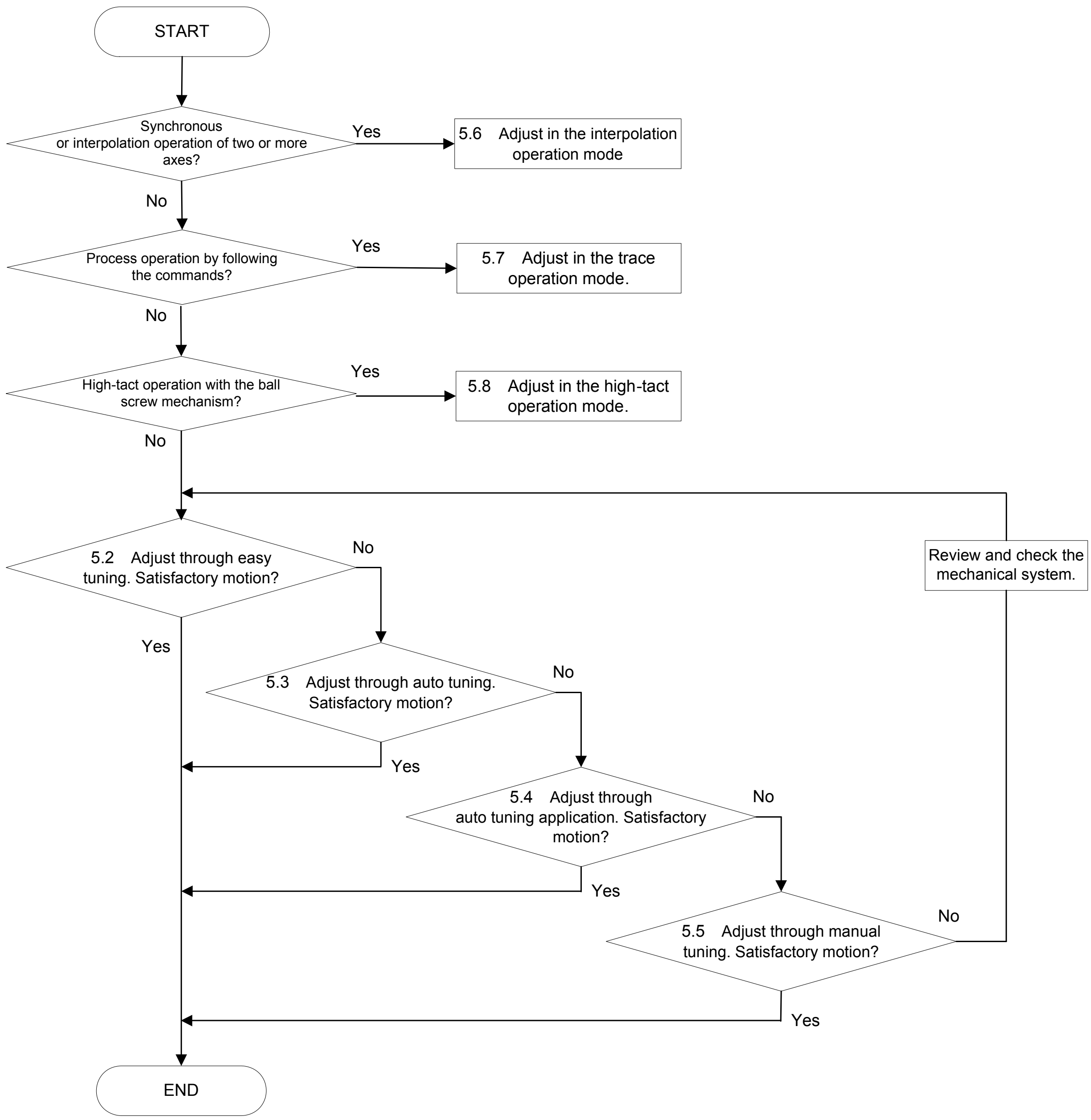
4

CHAPTER 5 SERVO ADJUSTMENT

5.1 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.

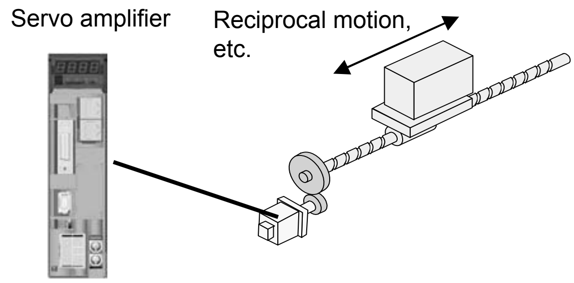
■ Using the tuning procedure and mode selection



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

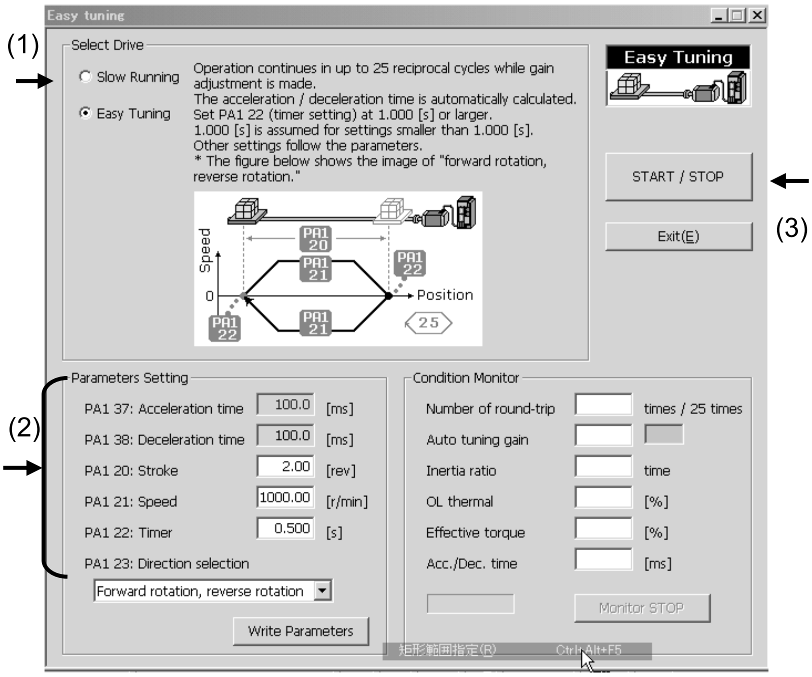
5.2.2 Easy Tuning Operation Profile

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

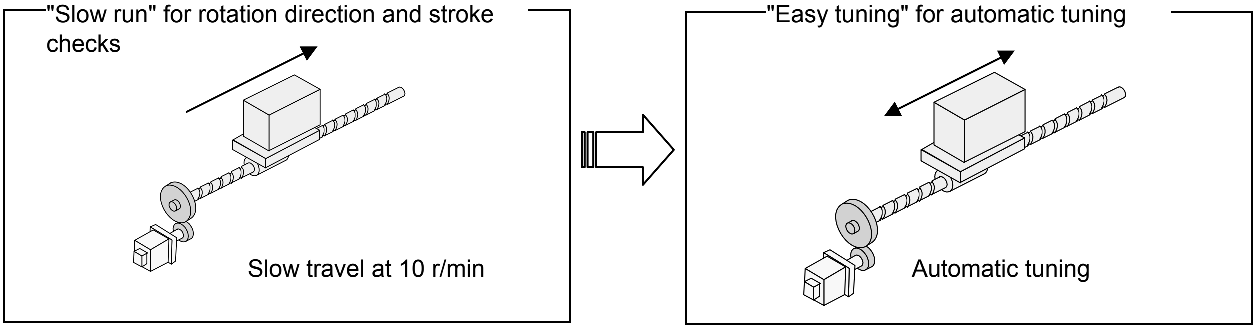
[1] Slow running
For machines with a linear driving system, follow the procedure below to perform slow running before performing easy tuning.
Turn the motor at 10 r/min (fixed) while checking the rotation direction and stroke.
Select "slow running" (1) on the PC Loader screen shown on the right and enter the "stroke setting" and "direction selection" parameters (2), and then press the "START/STOP" button (3).



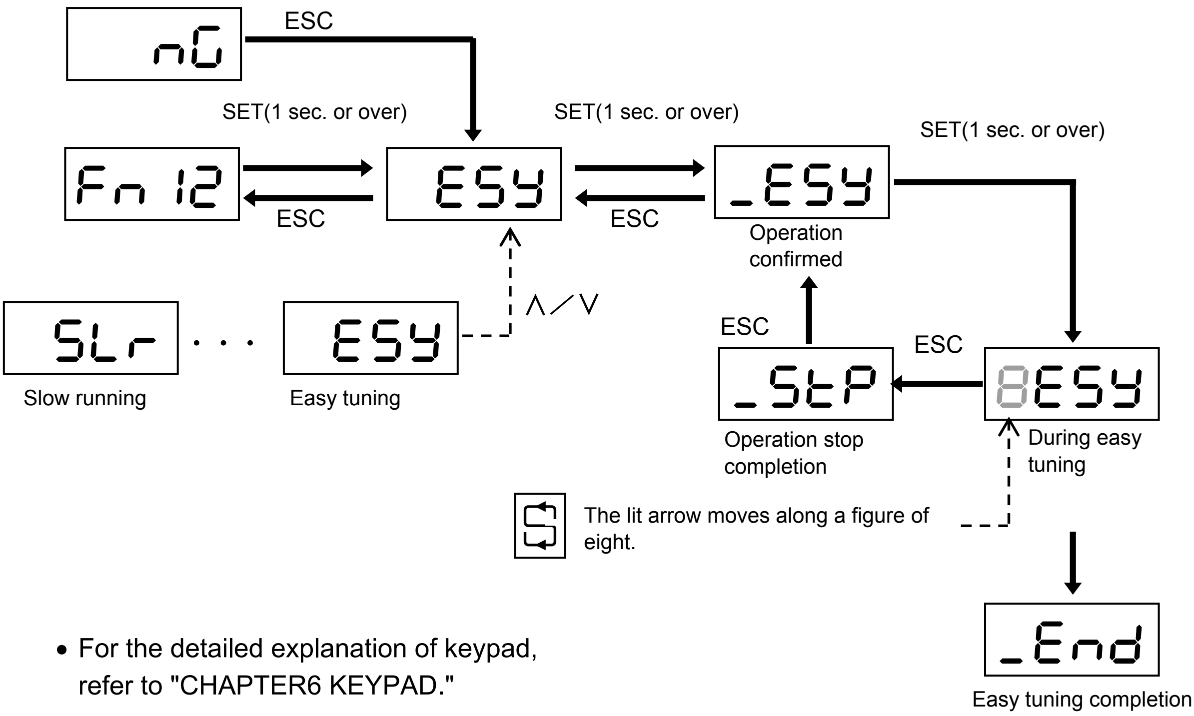
Hint	Slow running is unnecessary for machines with a rotary driving system.

[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.



■　To operate with keypad



- For the detailed explanation of keypad, refer to "CHAPTER6 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

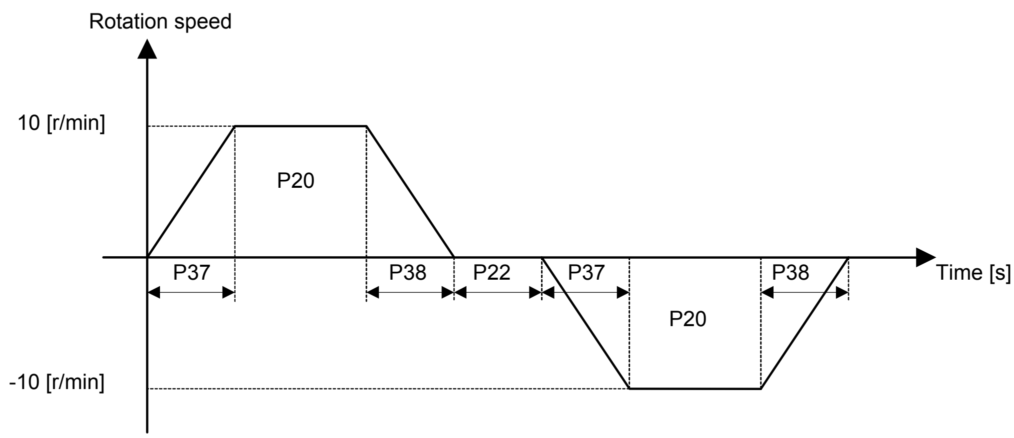
Conditions for starting slow running are indicated "○" in the table below.
Slow running does not start if the conditions shown below are not satisfied ("NG1" is indicated).
If none of conditions are satisfied during operation, operation is stopped ("NG2" is indicated).
The gain reference value at the 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 12 (manual tuning)
*2) PA2_74 (parameter write protection): 0 (write enable)

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 12 (manual tuning)
*2) PA2_74 (parameter write protection): 0 (write enable)

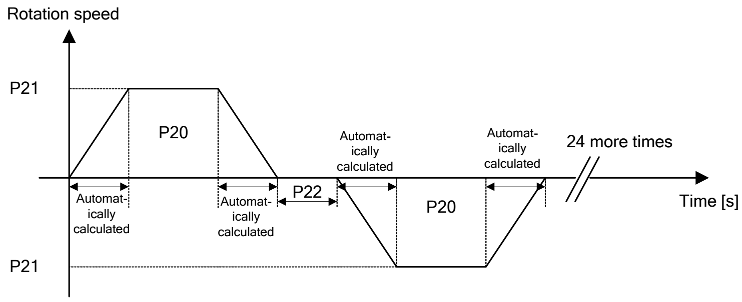
Hint

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/GYC motor (750 W or less) : 100 times or over
  GYS/GYC motor (1.0 kW or more) : 30 times or over
  GYG motor : 10 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).

5

Results of easy tuning

After easy tuning is normally finished, the gain and load inertia ratio automatically adjusted in tuning are reflected on parameters (the table below).

< The parameters set with easy-tuning >

No.: PA1_	Name
14	Load inertia ratio
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
88	Position loop integration time constant

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.
The gain is adjusted to the optimal value by adjusting the parameters PA1_15 (auto tuning gain 1) and PA1_16 (auto tuning gain 2) manually.

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 the range shown below.
  GYB/GYC/GYS motor (750 W or less) : 100 times or over
  GYC/GYS motor (1.0 kW or more) : 30 times or over
  GYG motor : 10 times or over
- 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

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	10: Auto tuning	11: 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

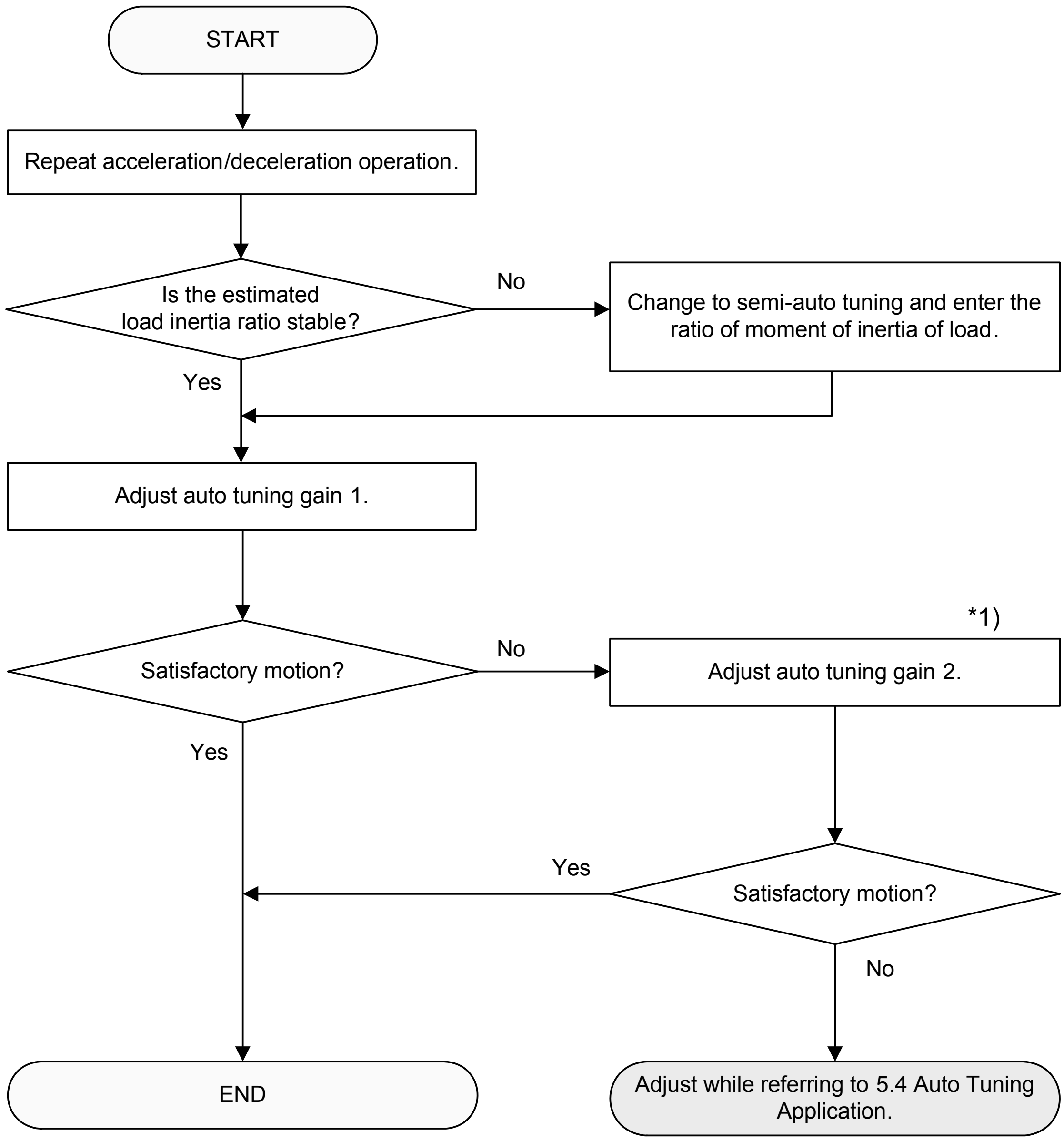
<Supplement> The parameters adjusted automatically by auto tuning

The parameters automatically adjusted by auto tuning are shown in the table below. The parameters to be adjusted automatically are different between PA1_15 (auto tuning gain 1) and PA1_16 (auto tuning gain 2).

No.	Name	Auto tuning gain 1 and 2	
		PA1_15	PA1_16
PA1_14	Load inertia ratio	Always updated when PA1_13 is set to 10 (auto)	
PA1_51	Moving average S-curve time	○	○
PA1_54	Position command response time constant	○	○
PA1_55	Position loop gain 1	○	×
PA1_56	Speed loop gain 1	○	×
PA1_57	Speed loop integration time constant 1	○	×
PA1_59	Torque filter time constant for position and speed contorol	○	×
PA1_87	Model torque filter time constant	○	×
PA1_88	Position loop integration time constant	○	×

○: the parameters adjusted automatically by auto tuning gain
×: the parameters not adjusted automatically even adjusted by auto tuning gain

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.

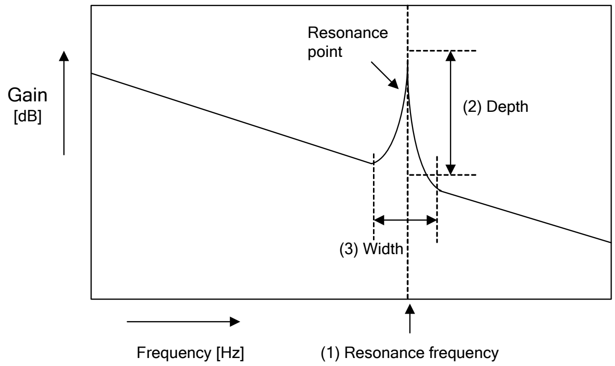
No.	Name	Approximate reference value	
PA1_13	Tuning mode selection	10: Auto tuning	11: Semi-auto tuning
PA1_14	Load inertia ratio	No need to enter (automatically updated)	Enter a stable estimated value (or average value).
PA1_15	Auto tuning gain 1	Refer to "5.3.3 Approximate Reference Value of Auto Tuning 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 (Not set automatically).	

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).

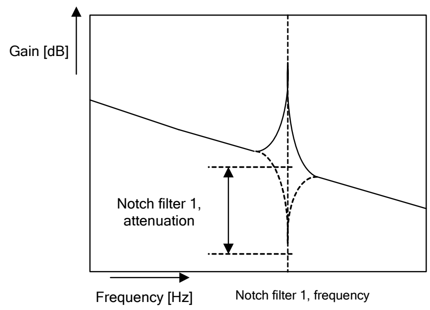
[2] Using the servo analyze function of the PC Loader, determine the mechanical resonance point.



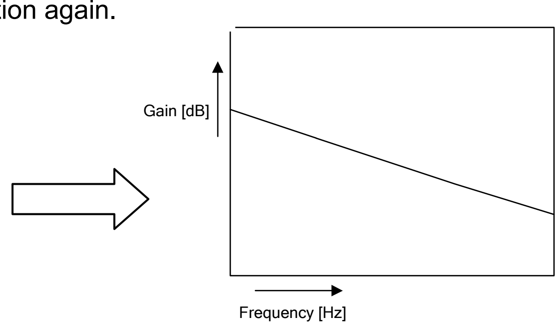
[3] Enter the resonance frequency of the mechanical resonance point and attenuation in parameters.

(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.

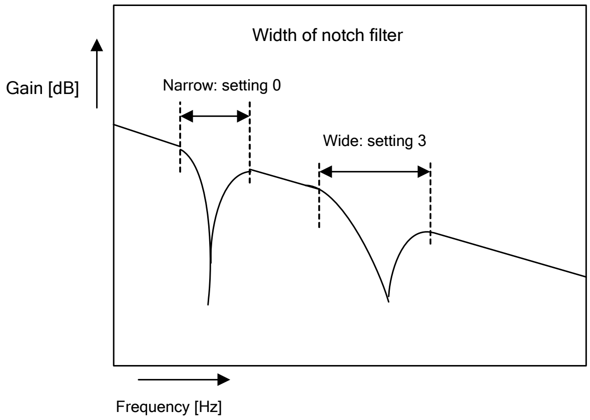


Use the servo analyze function again.



The notch filter is added to the resonance point as shown in the figure above.

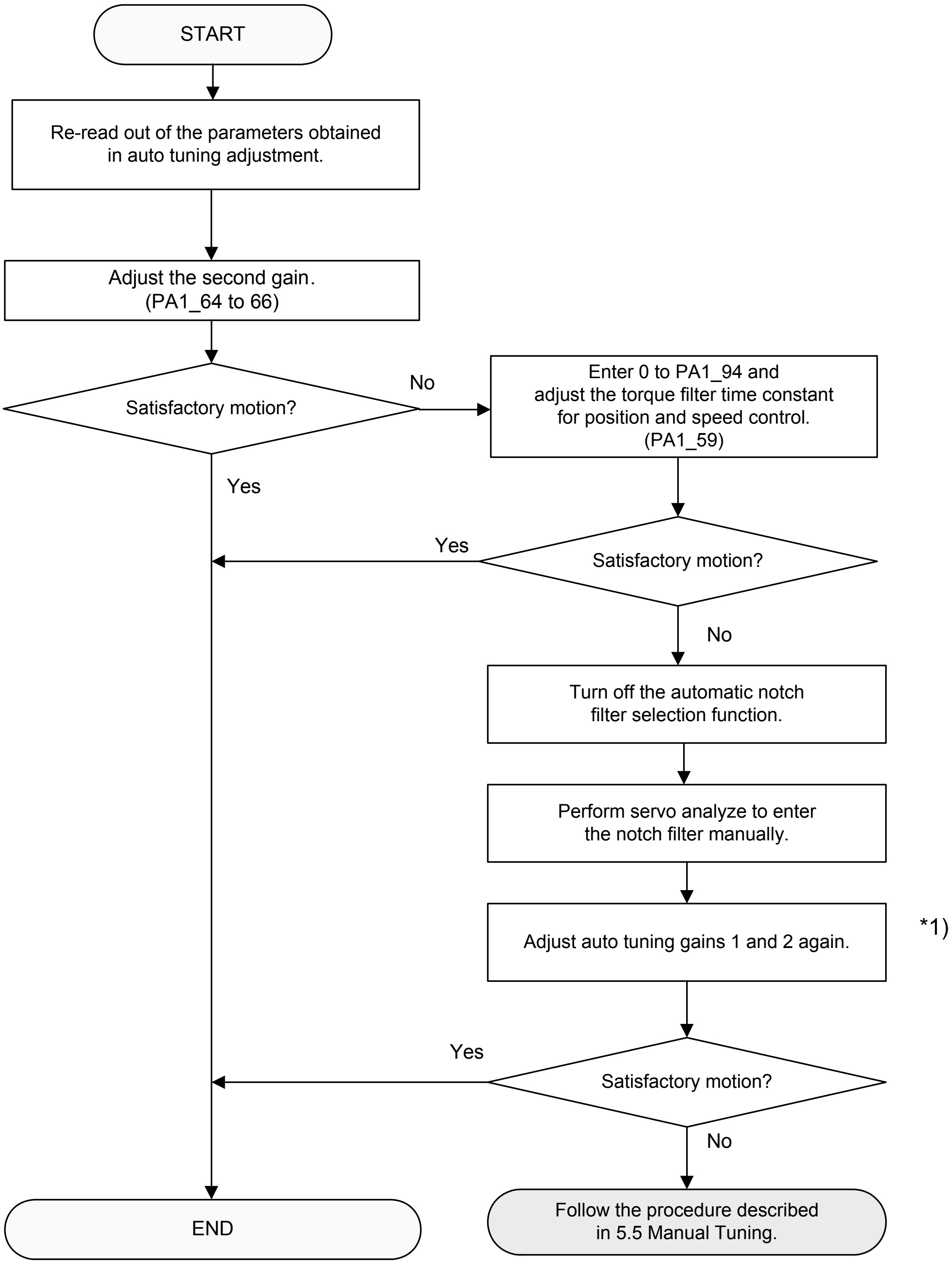
[4] Specify the width of the notch filter.
The width of the notch filter can be specified in four levels.
A large setting covers a wide frequency range.
A reference value of 2 is recommended in general.



The notch filter is added to eliminate the resonance point.

Hint	Use PA1_74 to 76 to add a notch filter to two resonance points simultaneously. By setting the parameter PA1_70 to "2", the notch filter 1 can be used as the automatic notch filter, and the notch filter 2 as the manual notch filter.

5.4.3 Adjustment Procedure with Auto Tuning Application



*1) Adjustment of auto tuning gain 2 is unnecessary under speed control.

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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 the range shown below.
  GYB/GYC/GYS motor (750 W or less) : 100 times or over
  GYC/GYS motor (1.0 kW or more) : 30 times or over
  GYG motor : 10 times or over
- The backlash of the mechanical system is not large and the belt is free from deflection.
- Auto tuning has been performed.

5.5.2 Parameters Used for Manual Tuning

Parameters used for gain adjustment are shown in the table in the next section.

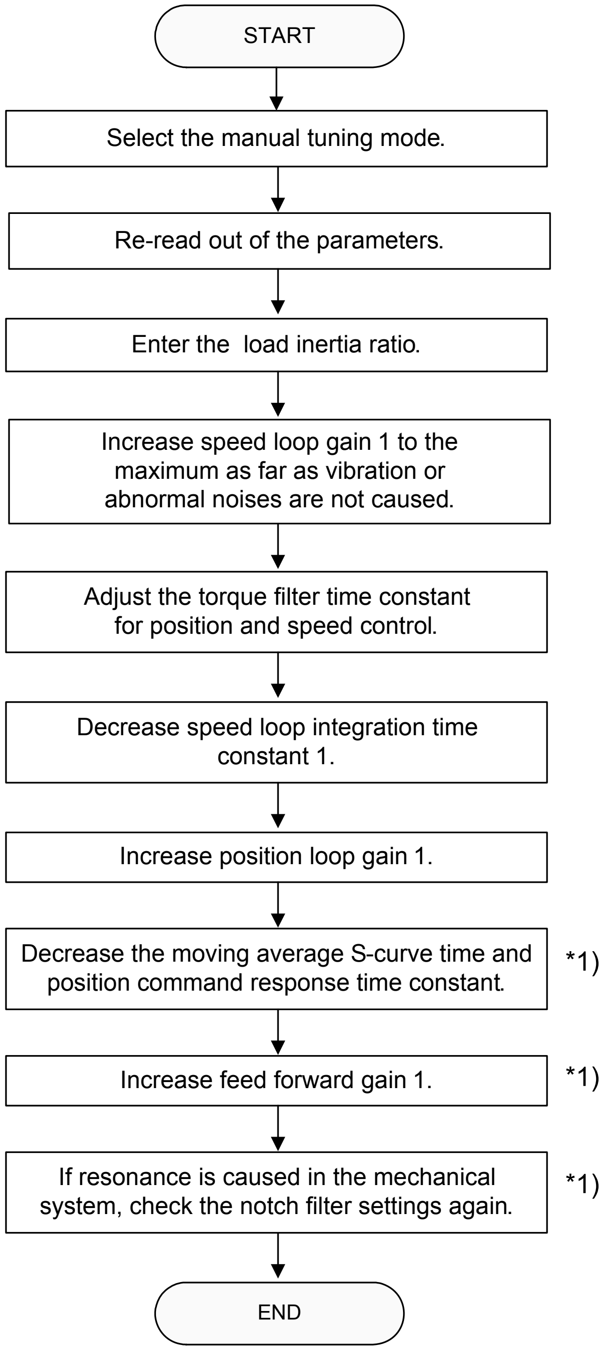
5.5.3 Approximate Gain Reference Value

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	12: Manual tuning	○	○
PA1_14	Load inertia ratio	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 ≥ 600/Kp1	○	-
PA1_55	Position loop gain 1	Kp1 ≤ Kv1 × (1 to 3)	○	-
PA1_56	Speed loop gain 1	Kv1 ≤ 2000/ (1+Jl)	○	○
PA1_57	Speed loop integration time constant 1	Ki1 ≥ 500/Kv1	○	○
PA1_58	Feed forward gain 1	Specify when necessary.	○	-
PA1_59	Torque filter time constant for position and speed control	0.1 ≤ Tt ≤ 1.0	○	○

Approximate values specified in the table on the previous page 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 adjustment procedure below. Parameters marked "-" in the speed control field in the table on the previous page need no adjustment.

5.5.4 Manual Tuning Adjustment Procedure



*1) Adjustment is unnecessary under speed control.

5.5.5 Individual Adjustment

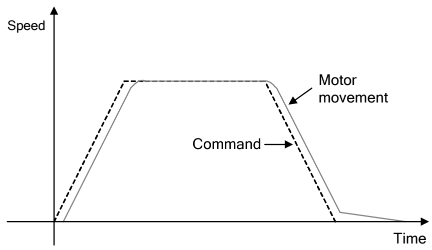
The adjustment method for the individual case is described (for position control).
The method varies according to the configuration of the mechanical system and other particulars.
Use the procedure as a basic adjustment procedure.
Before making adjustment, use historical trace of the PC Loader to measure 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).

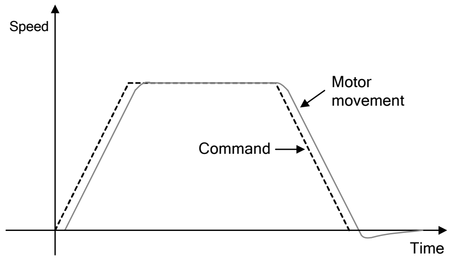
(Each change should be within ±10%.)



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 Operation Mode

Use the "interpolation operation 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 Operation 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.

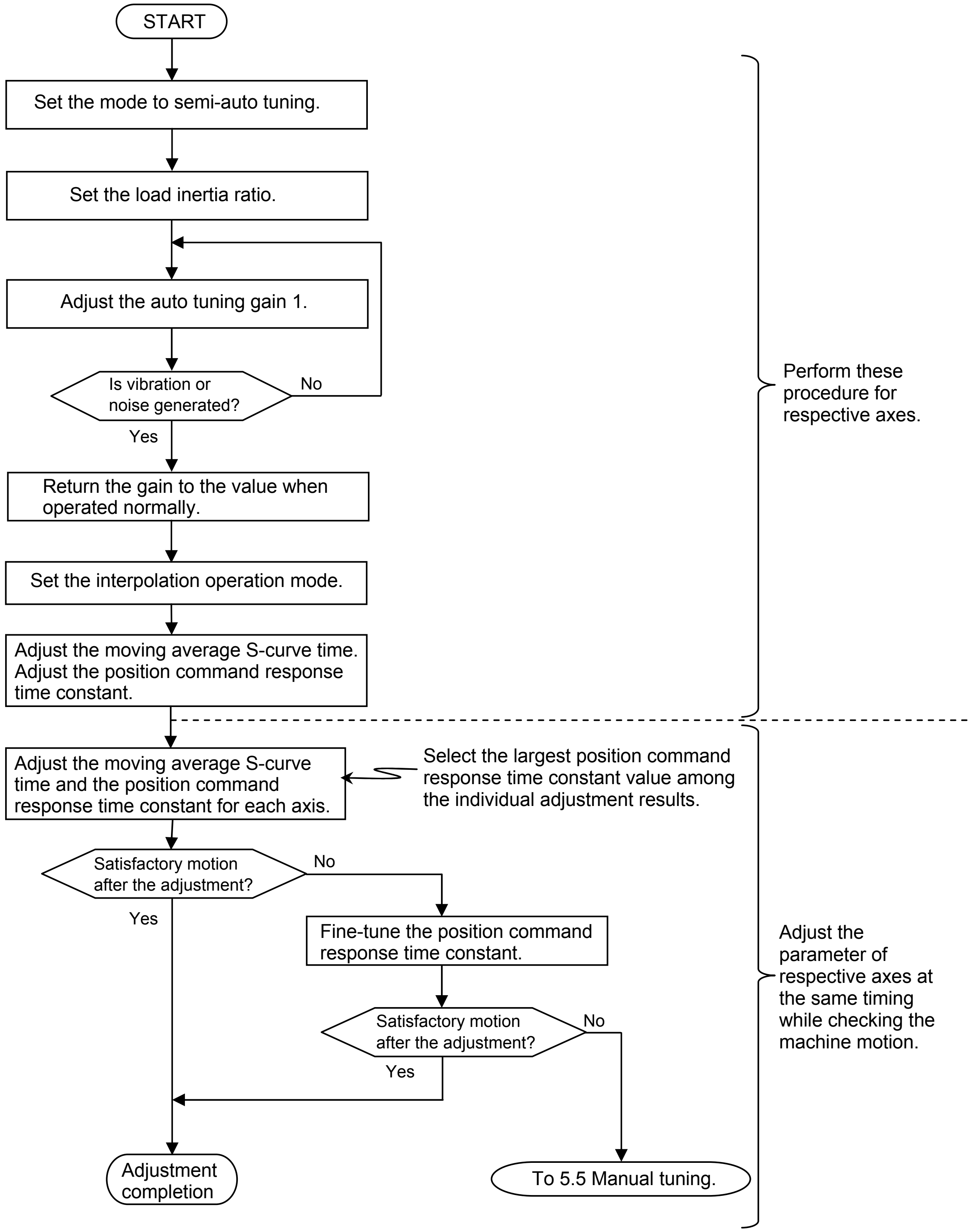
5.6.2 Parameters Used for Interpolation Operation Mode

Parameters used for gain adjustment are shown in the table below.

No.	Name	Approximate reference value
PA1_13	Tuning mode selection	13: Interpolation operation 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 adjustment parameters other than those in the table above are automatically adjusted. However, auto tuning gain 2 becomes disabled.

5.6.3 Adjustment Procedure in Interpolation Operation Mode



5.7 Trace Operation Mode

Use the trace operation mode to perform the process operation by following the commands, or to make the servomotor having two or more axes including X-Y tables operate so as to follow the command trace.

5.7.1 Conditions for Trace Operation Mode

Check the following conditions to perform adjustment.

- Keep consistency in the mechanical configuration and specifications of each axis to the largest extent (carrying weight, travel amount per motor rotation, etc.)
- The backlash of the mechanical system is not large and the belt is free from deflection.

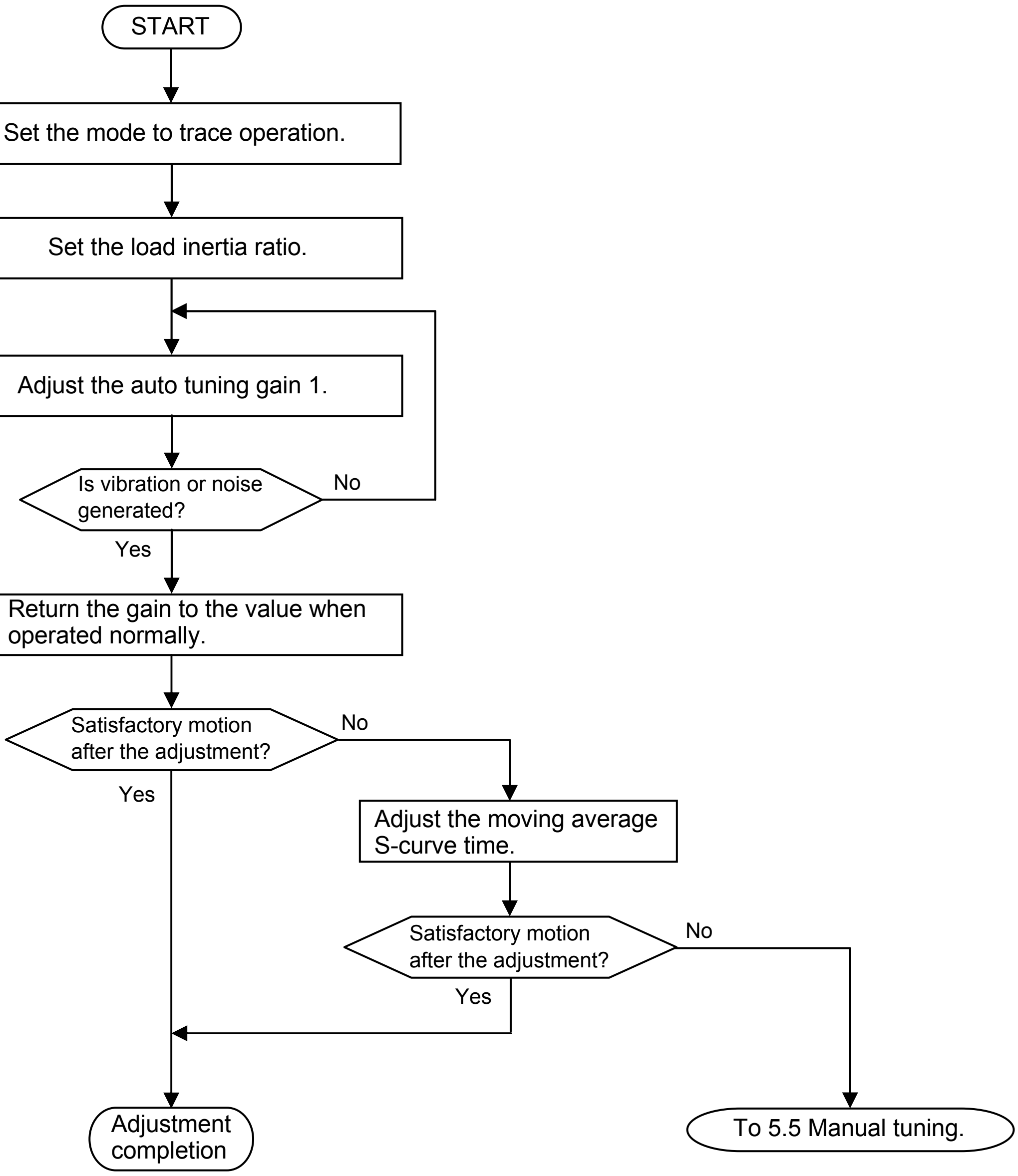
5.7.2 Parameters Used for Trace Operation Mode

The parameters used for gain adjustment are shown in the table below.

No.	Name	Approximate reference value
PA1_13	Tuning mode	14: Trace operation 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

The adjustment parameters other than those in the table above are automatically adjusted.
However, auto tuning gain 2 becomes disabled.

5.7.3 Adjustment Procedure in Trace Operation Mode



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5.8 Short cycle time Operation Mode

Use the short cycle time operation mode to perform high-tact operation with the ball screw drive, and when the semi-auto tuning adjustment has been executed with the ALPHA 5 series.

5.8.1 Conditions for Short cycle time Operation Mode

Check the following conditions to perform adjustment.
- The mechanical configuration should be relatively rigid.
- The backlash of the mechanical system is not large.

5.8.2 Parameters Used for Short cycle time Operation Mode

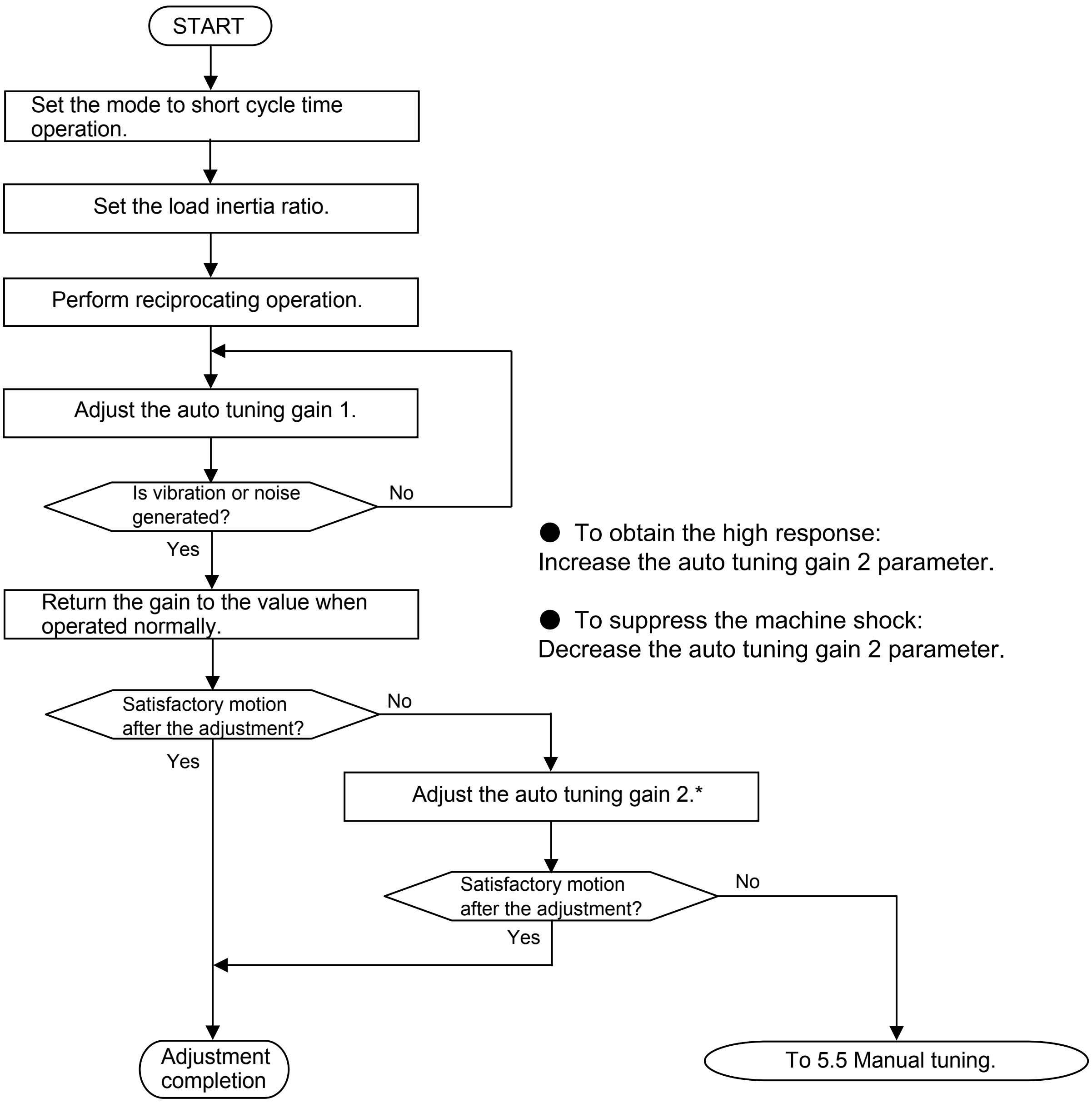
5

The parameters used for gain adjustment are shown in the table below.

No.	Name	Approximate reference value
PA1_13	Tuning mode	15: Short cycle time operation 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_16	Auto tuning gain 2	Set the parameter by following the flow chart in 5.8.3.

The adjustment parameters other than those in the table above are automatically adjusted.

5.8.3 Adjustment Procedure in Short cycle time Operation Mode



- To obtain the high response:
Increase the auto tuning gain 2 parameter.

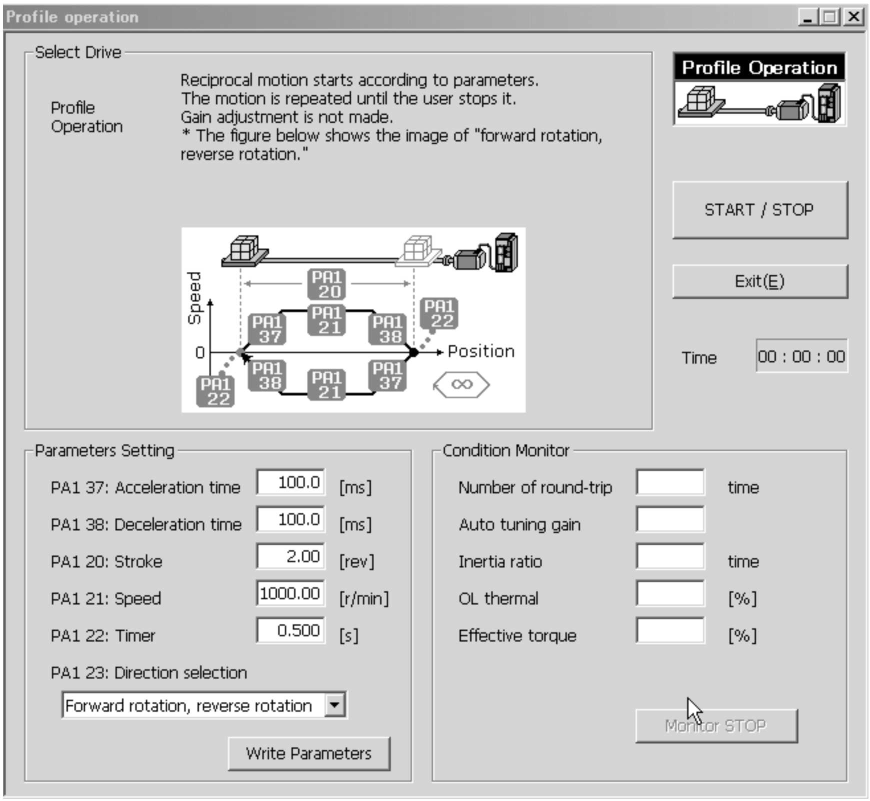
- To suppress the machine shock:
Decrease the auto tuning gain 2 parameter.

5.9 Profile Operation

5.9.1 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.

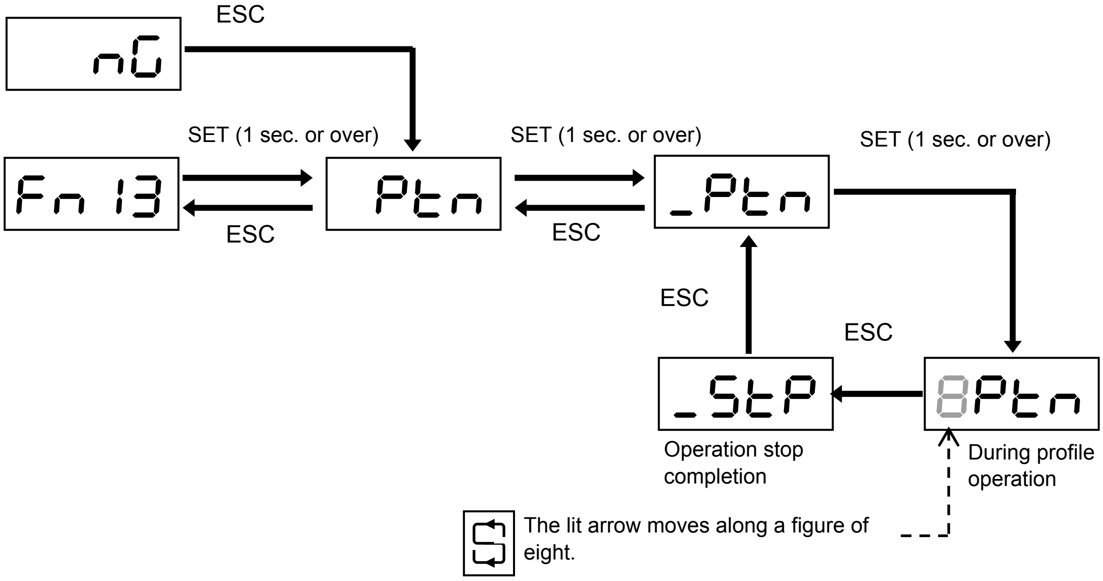
■ In case of operation at PC Loader



■ In case of operation at keypad

With this method, profile operation is performed at the keypad.

- For the detailed explanation of keypad, refer to "CHAPTER6 KEYPAD."



5.9.2 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).

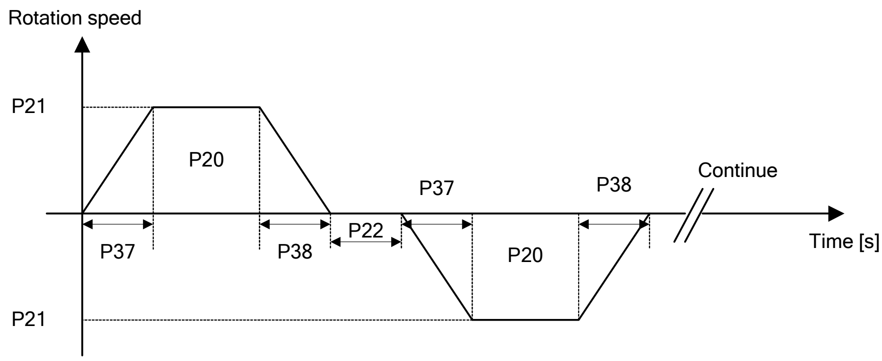
Operation is interrupted if any condition is dissatisfied during operation ("NG2" is indicated).

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 regenerative resistor overheat is detected in the middle.
- The free-run (BX) signal is turned on in the middle.
- The servo-on (S-ON) signal is turned off in the middle.

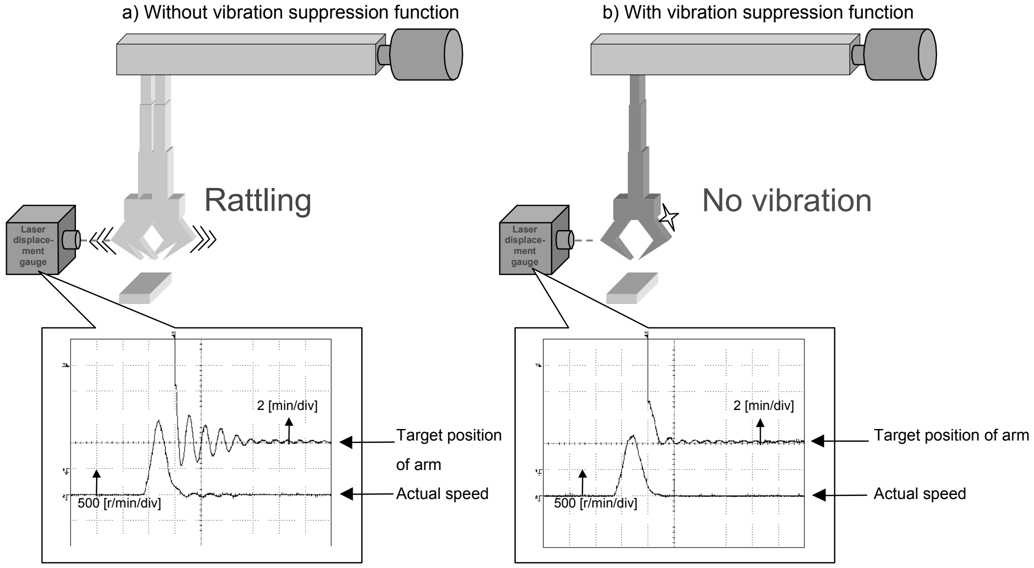
5

5.10 Special Adjustment (Vibration Suppression)

5.10.1 What is Vibration Suppression ?

■ Purpose of vibration suppression

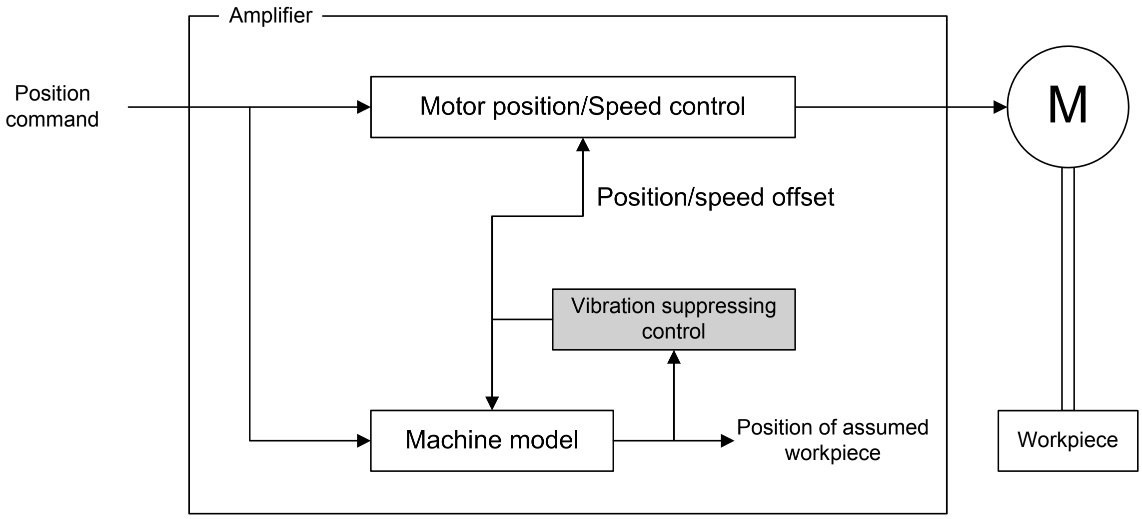
The end of the workpiece held in a structure having a spring characteristic such as the robot arm and transfer machine vibrates during quick acceleration or deceleration of the motor. The vibration suppression function aims at suppression of the workpiece and realization of positioning in a shorter cycle 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 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 frequency is equal to or less than 20 kHz

5.10.2 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

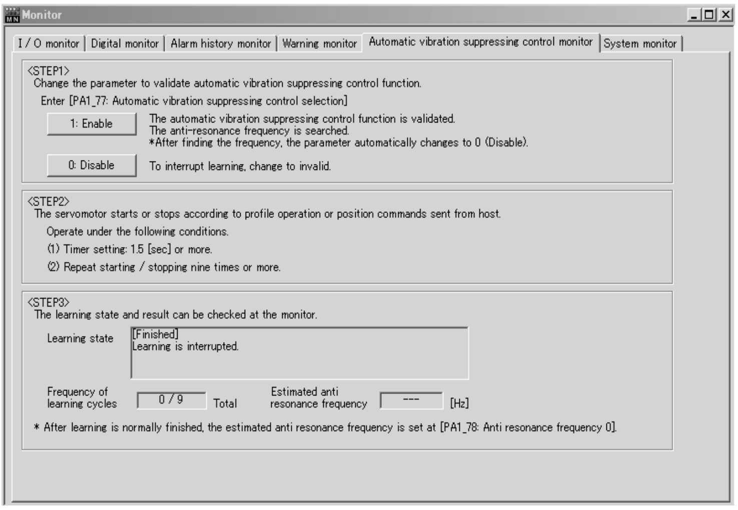
[1] Set PA1_77 (automatic vibration suppression selection) at 1 (enable).
[2] Perform profile operation or issue position commands from the host unit to start and stop the servomotor nine times.
[3] Set the dwell at 1.5 s or over.
[4] After operation is normally finished, the optimum value is automatically 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 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

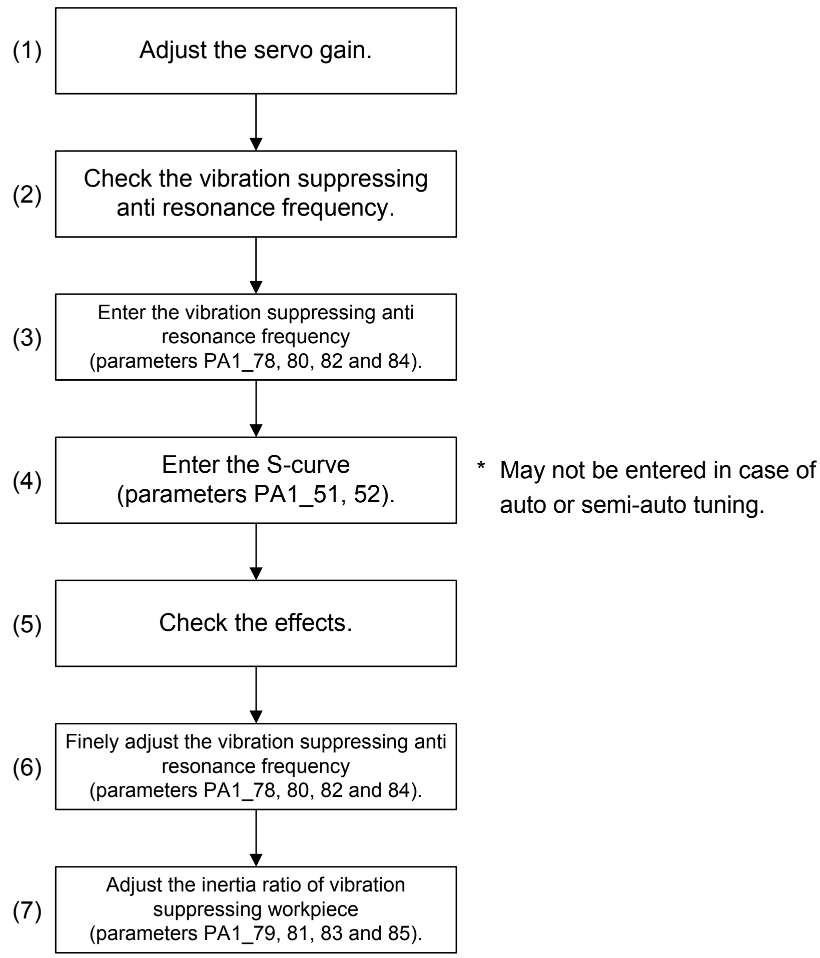
Use the monitor of the PC Loader to monitor the learning state of the automatic vibration suppression.



If no expected effect is obtained under automatic vibration suppression, refer to the following "5.10.3 Manual Adjustment of Vibration Suppression."

5.10.3 Manual Adjustment of Vibration Suppression

■ Adjustment flow chart



(1) Adjusting the servo gain

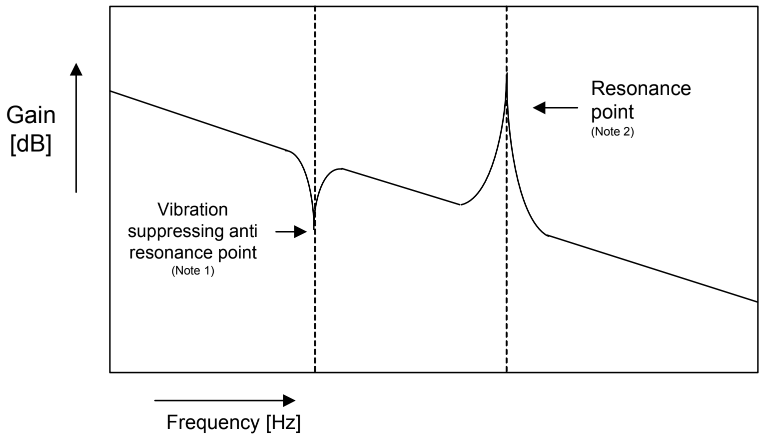
To ignore the vibration of the tip of the machine and reserve smooth stopping action of the servomotor free from overshoot, refer to the description given in sections 5.1 through 5.5 to adjust the servo gain.

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

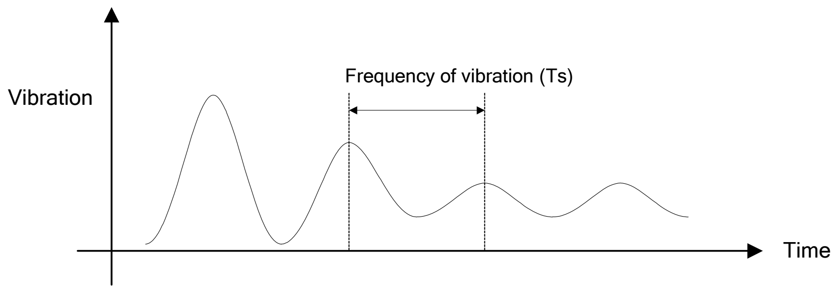
Note 2　Use the notch filter for the resonance point.

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.



$$\text{Vibration suppressing anti resonance frequency} = \frac{1}{Ts}\ [\text{Hz}]$$

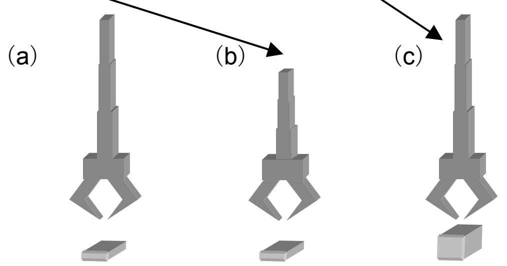
2) Starting at 300.0 Hz (maximum setting), decrease the reference values of parameters PA1_78, 80, 82 and 84 gradually while visually checking vibration, to find the best value.

(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]	300. 0	Always
PA1_80	Vibration suppressing anti resonance frequency 1	1.0 to 300.0 [Hz]	300. 0	Always
PA1_82	Vibration suppressing anti resonance frequency 2	1.0 to 300.0 [Hz]	300. 0	Always
PA1_84	Vibration suppressing anti resonance frequency 3	1.0 to 300.0 [Hz]	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*	0.2 to 500[× 0.125 ms]	20	Always
PA1_52	low-pass filter for S-curve time constant	0.0 to 1000.0[ms]	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 $\leq$ 50 (PG=18 bit) α / β *1 $\leq$ 200 (PG=20 bit)		50 < α / β *1 $\leq$ 250 (PG=18 bit) 200 < α / β *1 $\leq$ 1000 (PG=20 bit)	
	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)
< 10 Hz	80	10 ms	160	20 ms
10 Hz to 20 Hz	40	5 ms	80	10 ms
> 20 Hz	16 to 24	2 to 3 ms	40	5 ms

* 1 $\dfrac{\alpha}{\beta} = \dfrac{\text{PA1\_06 (numerator 0 of electronic gear)}}{\text{PA1\_07 (denominator of electronic gear)}}$

* 2 Cannot be set during auto or semi-auto tuning.

(5) Checking the effects

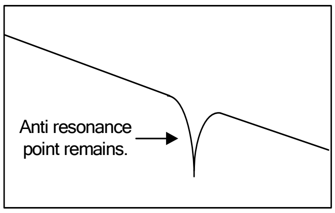
There are three checking methods.

(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.

Gain



Frequency

(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

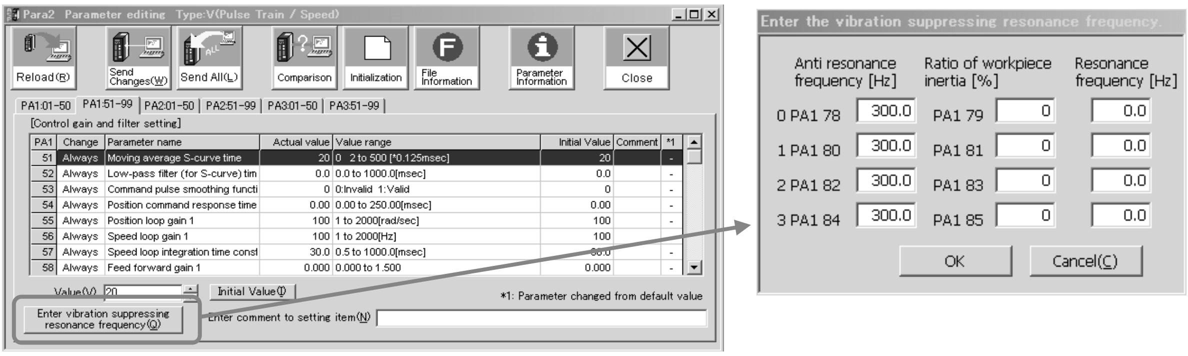
[1] Calculate the inertia of the vibrating point according to specifications of the machine.

$$\text{Vibration suppressing workpiece inertia ratio} = \frac{\text{Vibrating point inertia}}{\text{Entire load inertia}}$$

[2] Entering with the PC Loader

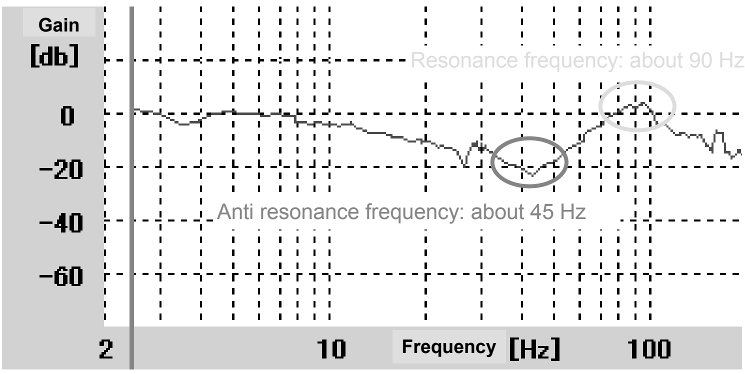
(1) Check the anti resonance frequency and resonance frequency by using the servo analyze function.

(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.

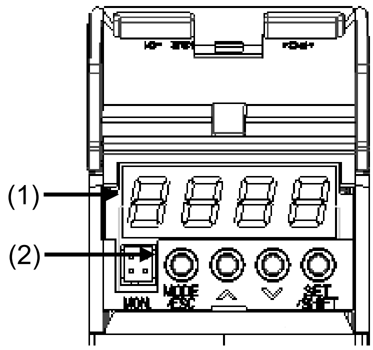
[Example of resonance frequency]



CHAPTER 6 KEYPAD

6.1 Display

The servo amplifier is equipped with a keypad (see the figure on the right).
The keypad is fixed.
The keypad is equipped with four-digit seven-segment LEDs (1), four keys (2) (lift the front cover).
Numbers and letters are displayed on the four-digit seven-segment LEDs.
Keys are [MODE/ESC], [∧], [∨], [SET/SHIFT] from the leftmost one.



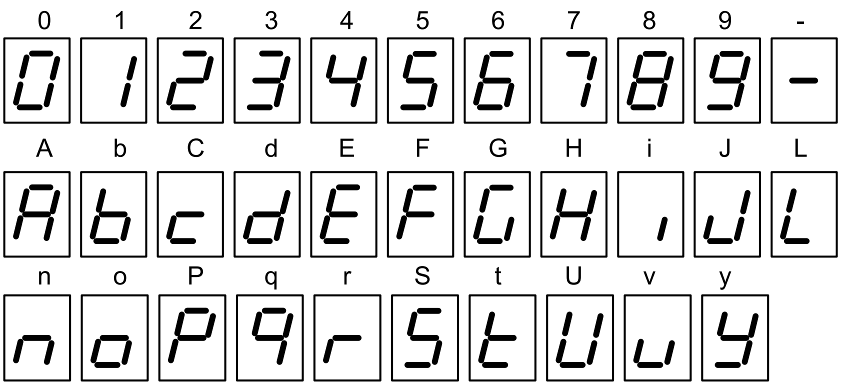
6.1.1 Mode

6

The keypad functions in seven modes.

- 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 number 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.

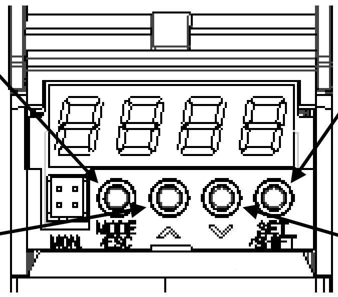
7-segment display



6.1.2 Key

[MODE/ESC]
・ The mode is switched (MODE).
・ The mode is deselected (ESC).

[∧]
The sub mode is selected.
The value increases by one (+1).



[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 decreases by one (-1).

- To show five or more digits, alternate the upper and lower four digits.
- To show nine or more digits, alternate the upper, middle and lower four digits sequentially.

6.1.3 Blinking Display

The keypad display blinks with some statuses.

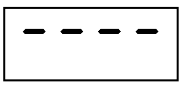
The table below shows the statuses and contents regarding blinking display.

Blink interval	Duration	Status	How to recover
0.5 sec cycle	Continuously	Alarm	Cycle the power or reset the alarm.
0.5 sec cycle	3 sec	Parameter being confirmed	-
Once every 2 sec	Continuously	During sequence test mode	Cycle the power, or cycle the power after changed to PA2_89 = 0.
Twice every 2 sec	Continuously	Cycle the power.*	Cycle the power.

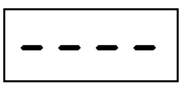
* When a parameter which becomes enabled after cycling the power is changed.

6.1.4 Displaying Upper/middle/lower Data

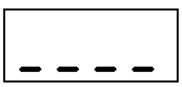
The display of the item described with  is shown with upper/middle/lower digits.



Blinks three times: upper digits



Blinks three times: middle digits

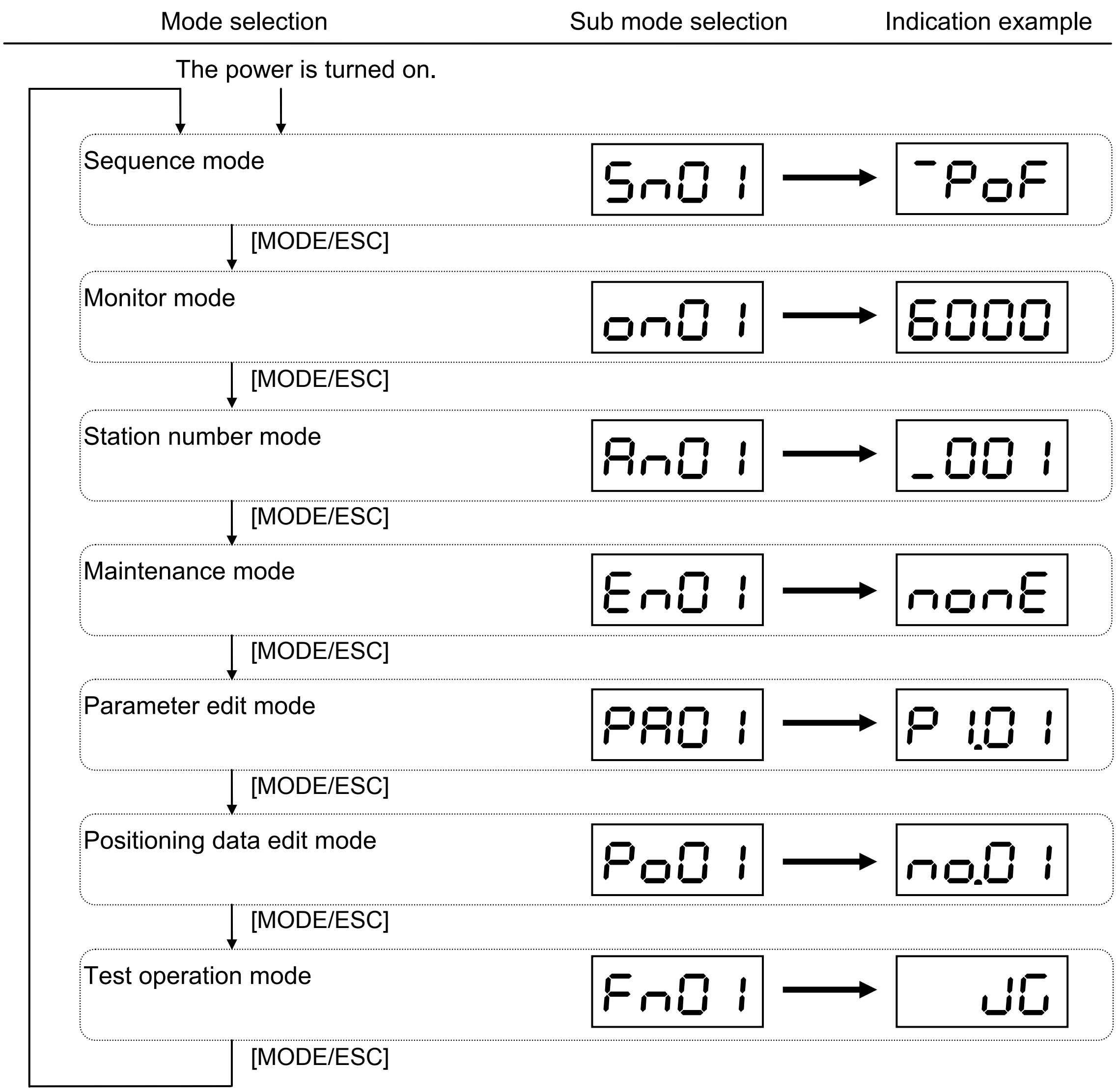


Blinks three times: lower digits

* With some items the middle digit display is not used.

6.1.5 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	Sn01	‾PoF
	Amplifier setting	Sn02	ud
	Motor setting	Sn03	S-7
Monitor mode	Feedback speed	on01	6000
	Command speed	on02	6000
	Command torque	on03	300
	Motor current	on04	300
	Peak torque	on05	300
	Effective torque	on06	300
	Feedback position	on07	99
	Command position	on08	09
	Position deviation	on09	00
	Command pulse frequency	on10	1
	Feedback cumulative pulse	on11	00
	Command cumulative pulse	on12	00
	LS-Z pulse	on13	104
	Load inertia ratio	on14	300.0
	DC link voltage (max.)	on15	300

Mode	Sub mode	Sub mode selection	Indication and entry example
Monitor mode	DC link voltage (min.)	on 16	300
	VREF input voltage	on 17	10.00
	TREF input voltage	on 18	10.00
	Input signals	on 19	ı ı
	Output signals	on20	ı ı
	OL thermal value	on21	001
	Regenerative resistor thermal value	on22	010
	Power (w)	on23	300
	Motor temperature	on24	020
	Overshoot unit amount	on25	00
	Settling time	on26	1
	Resonance frequency 1	on27	2000
	Resonance frequency 2	on28	2000
Station number mode	Station number display	An01	_031
Maintenance mode	Alarm at present	En01	nonE
	Alarm history	En02	no.01
	Warning at present	En03	0111

Mode	Sub mode	Sub mode selection	Indication and entry example
Maintenance mode	Total time-main power supply	En04	6
	Total time - control power supply	En05	
	Motor running time	En06	05.09
Parameter edit mode	Parameter page 1	PA01	P1.01
	Parameter page 2	PA02	P2.01
	Parameter page 3	PA03	P3.01
Positioning data edit mode			
	Positioning status	Pd_1	A.00.0
	Target position	Pd_2	-20
	Rotation speed	Pd_3	60
	Stand still timer	Pd_4	6
	M code	Pd_5	FF
	Acceleration time	Pd_6	99
	Deceleration time	Pd_7	99

6

Mode	Sub mode	Sub mode selection	Indication and entry example
Test operation mode	Manual operation	Fn01	JG
	Position preset	Fn02	PrSt
	Homing	Fn03	orG
	Automatic operation	Fn04	AUt
	Alarm reset	Fn05	AL.rt
	Alarm history initialization	Fn06	AL.in
	Parameter initialization	Fn07	PA.in
	Positioning data initialization	Fn08	Po.in
	Auto offset adjustment	Fn09	A.oFF
	Z-phase offset adjustment	Fn10	2.oFF
	Auto tuning gain	Fn11	At.tn
	Easy tuning	Fn12	SLr
	Profile operation	Fn13	Ptn
	Sequence test mode	Fn14	Sq.tS
	Teaching	Fn15	tEcH

6.3 Sequence Mode

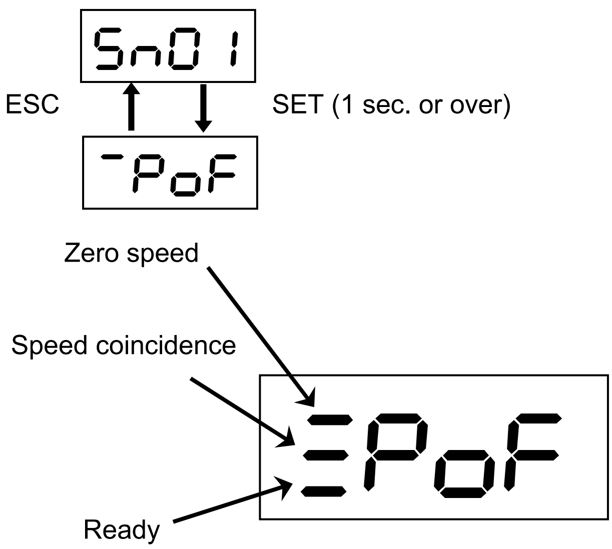
In the sequence mode, the state of the servo amplifier and amplifier setting are displayed.
Press the [MODE/ESC] key until [Sn01] is displayed, and press and hold the [SET/SHIFT] key for at least one second to show data.

Sn01 : Sequence mode
Sn02 : Amplifier setting
Sn03 : 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.



Display	Control mode	Name	Description
PoF	Position control	Servo off	The motor is not turned on. The servomotor has no driving force.
Pon		Servo on	The servomotor is ready to rotate.
PJG		Manual operation	Manual feed rotation state
PPi		Pulse operation	During pulse input operation
PAt		Automatic operation	Positioning is being executed.
Por		Homing	Homing is being executed.
Pi t		Interrupt positioning	Interrupt positioning is being executed.
Pot		+OT	The positive over-travel signal is being detected.
Pot		-OT	The negative over-travel signal is being detected. The display alternates between "P" and "-" .
Pn0		Zero speed stop	Stopped at zero speed due to forced stop signal
PLu		In LV	In undervoltage. For details, see the pages about undervoltage on page 7-10.
noF	Speed control	Servo off	The motor is not turned on. The servomotor has no driving force.
non		Servo on	The servomotor is ready to rotate.
nJG		Manual operation	Manual feed rotation state
not		+OT	The positive over-travel signal is being detected.
not		-OT	The negative over-travel signal is being detected. The display alternates between "n" and "-" .
nn0		Zero speed stop	Stopped at zero speed due to forced stop signal
nLu		In LV	In undervoltage. For details, see the pages about undervoltage on page 7-10.
toF	Torque control	Servo off	The motor is not turned on. The servomotor has no driving force.
ton		Servo on	The servomotor is ready to rotate.
tJG		Manual operation	Manual feed rotation state
tLu		In LV	In undervoltage. For details, see the pages about undervoltage on page 7-10.

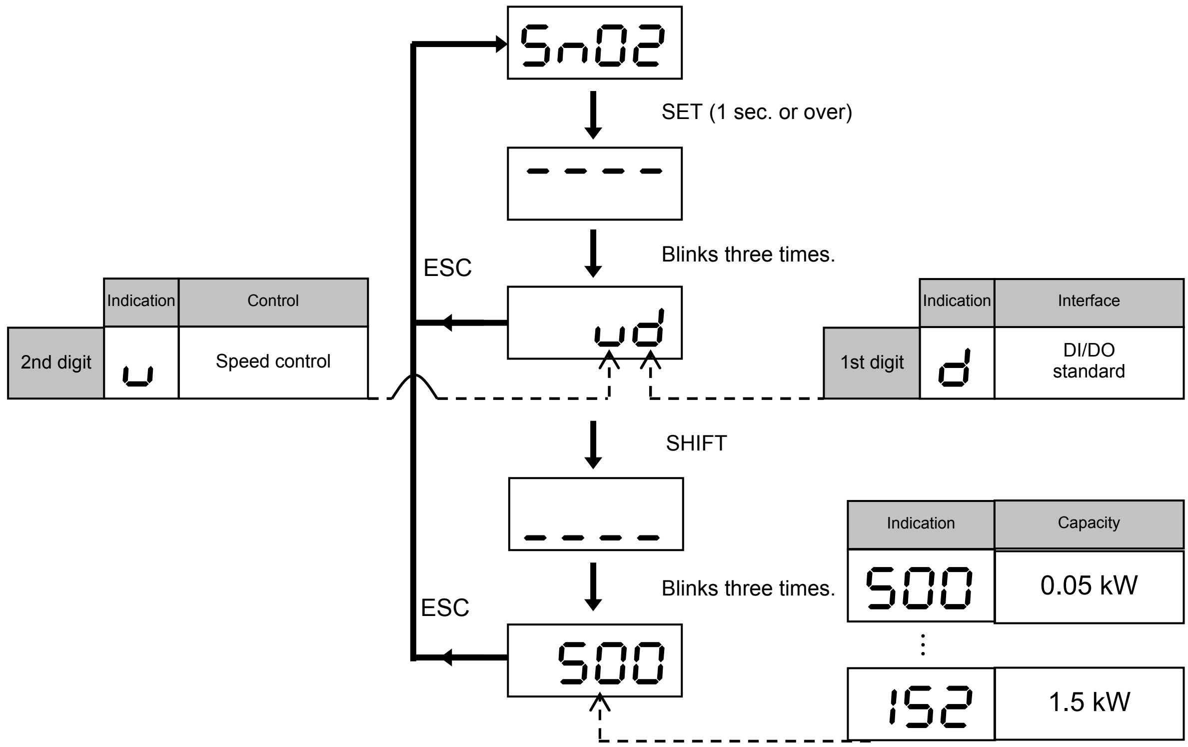
Hint	When the servo amplifier power is turned on, "sequence mode operation mode" is shown. The indication contents at power-on can be changed with parameter PA2_77.

Reference value	Initial display	
0	Sn01	Sequence mode
1	on01	Feedback speed
2	on02	Command speed
3	on03	Command torque
4	on04	Motor current
5	on05	Peak torque
6	on06	Effective torque
7	on07	Feedback position
8	on08	Command position
9	on09	Position deviation
10	on 10	Command pulse frequency
11	on 11	Feedback cumulative pulse
12	on 12	Command cumulative pulse
13	on 13	LS-Z pulse
14	on 14	Load inertia ratio
15	on 15	DC link voltage (max.)
16	on 16	DC link voltage (min.)
17	on 17	VREF input voltage
18	on 18	TREF input voltage

Reference value	Initial display	
19	on 19	Input signals
20	on20	Output signals
21	on21	OL thermal value
22	on22	Regenerative resistor thermal value
23	on23	Power (W)
24	on24	Motor temperature
25	on25	Overshoot unit amount
26	on26	Settling time
27	on27	Resonance frequency 1
28	On28	Resonance frequency 2
40	An01	Station number
41	En01	Alarm at present
42	En02	Alarm history
43	En03	Warning at present
44	En04	Total time-main power supply
46	En06	Motor running time

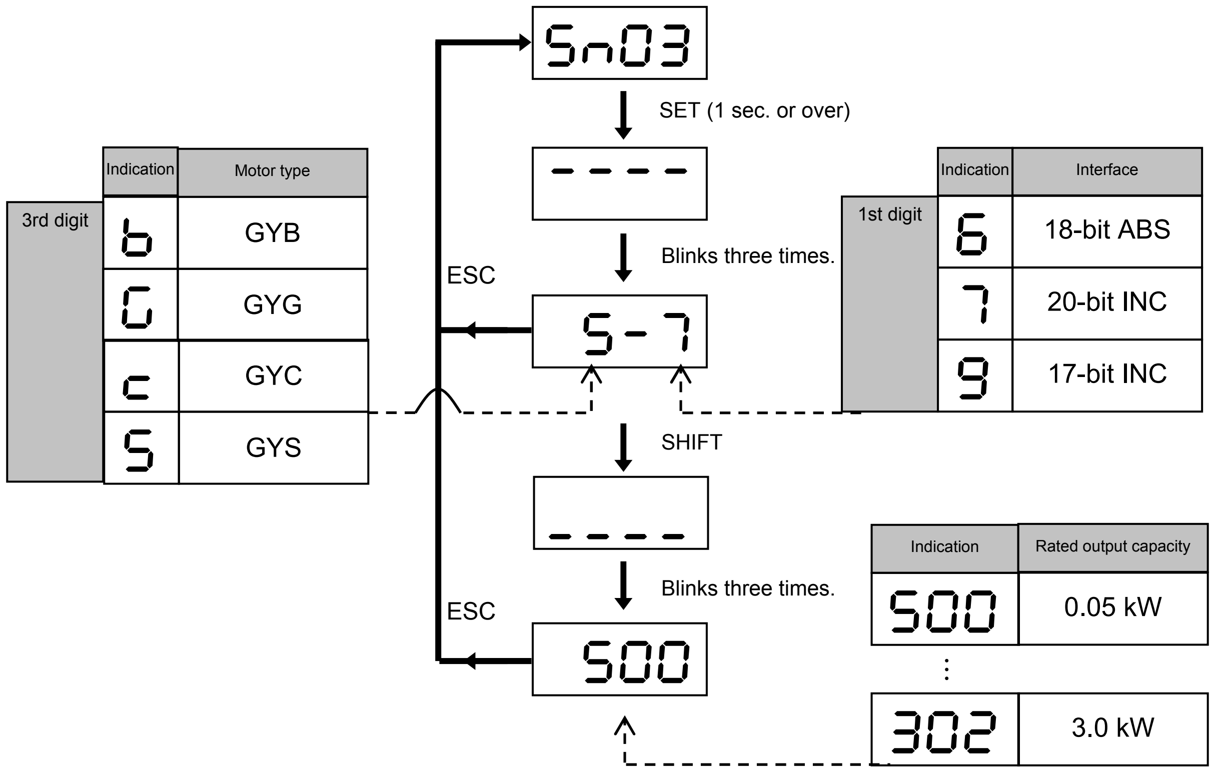
(2) Amplifier setting

The servo amplifier control function, interface format and capacity are displayed.



(3) Motor setting

The type of servomotor connected to the servo amplifier, capacity and encode type are displayed.

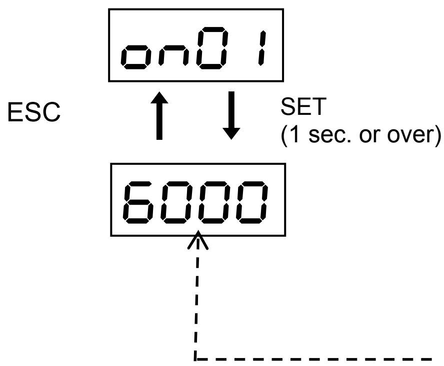


6.4 Monitor Mode

In the monitor mode, the servomotor rotation speed, cumulative input pulse and so on are displayed. Press the [MODE/ESC] key until [on01] is displayed, and press and hold the [SET/SHIFT] key for at least one second to display data.

on01	: Feedback speed	on11	: Feedback cumulative pulse	on21	: OL thermal value
on02	: Command speed	on12	: Command cumulative pulse	on22	: Regenerative resistor thermal value
on03	: Command torque	on13	: LS-Z pulse	on23	: Power (W)
on04	: Motor current	on14	: Load inertia ratio	on24	: Motor temperature
on05	: Peak torque	on15	: DC link voltage (max.)	on25	: Overshoot unit amount
on06	: Effective torque	on16	: DC link voltage (min.)	on26	: Settling time
on07	: Feedback position	on17	: VREF input voltage	on27	: Resonance frequency 1
on08	: Command position	on18	: TREF input voltage	on28	: Resonance frequency 2
on09	: Position deviation	on19	: Input signals		
on10	: Command pulse frequency	on20	: Output signals		

(1) Feedback speed (displayed digits: signed four digits)

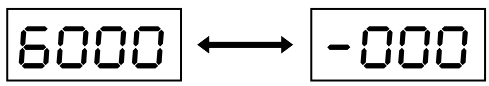


Current rotation speed of servomotor.

The correct value is displayed even if the load (mechanical system) rotates the motor.

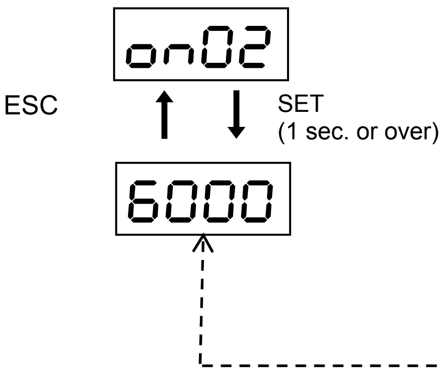
The speed is displayed in r/min and a negative sign is attached for reverse rotation (clockwise rotation when viewed against the motor shaft).

With a negative data



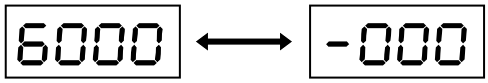
The figure and "-" symbol are displayed alternately.

(2)　Command speed (displayed digits: signed four digits)



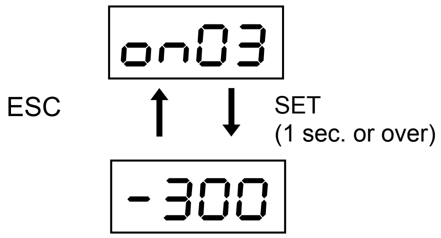
Current speed command issued to the servomotor. The command speed is given in a speed command voltage, multi-step speed, pulse or similar. The speed is displayed in r/min and a negative sign is attached for reverse rotation (clockwise rotation when viewed against the motor shaft).

With a negative data



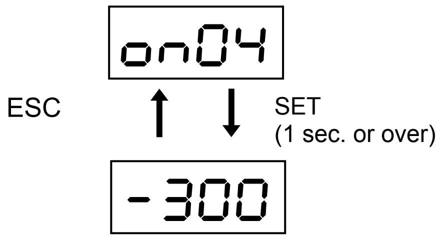
The figure and "-" symbol are displayed alternately.

(3)　Command torque (displayed digits: signed three digits)



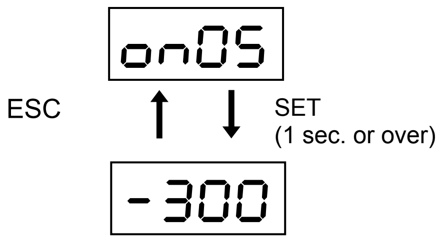
Average torque issued from the servo amplifier to the servomotor; the torque is displayed in percent to the rated torque. The range from 0% to the maximum torque is displayed in increments of 1. In case of a negative average torque, a negative sign is attached to the most significant digit.

(4)　Motor current (displayed digits: signed three digits)



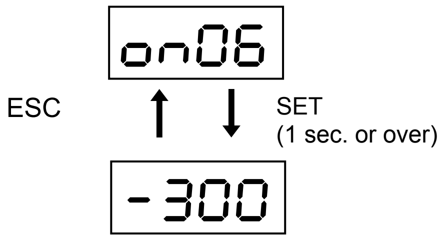
Current flowing through the servomotor; the current is displayed in percent to the rated current. The range from 0% to the maximum current is displayed in increments of 1. In case of a negative motor current, a negative sign is attached to the most significant digit.

(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)

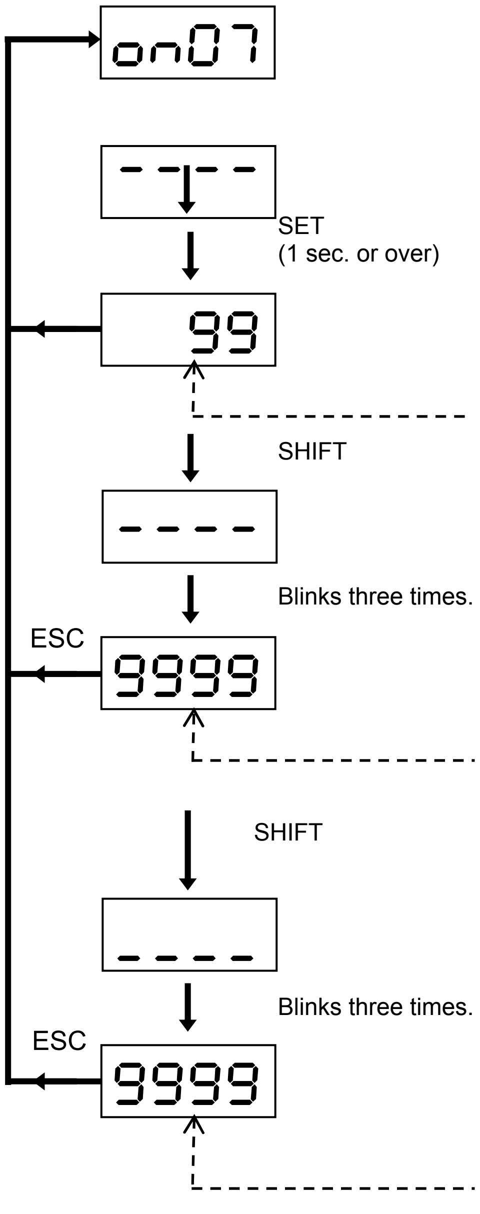


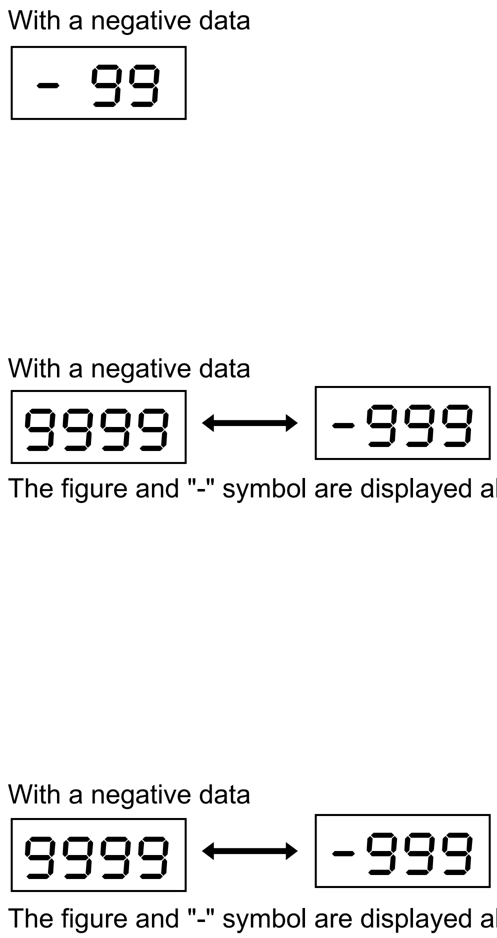
The load ratio of the servomotor; displayed in percent to the rated torque.

The range from 0% to the maximum torque is displayed in increments of 1.

(7) Feedback position (displayed digits: signed 10 digits)

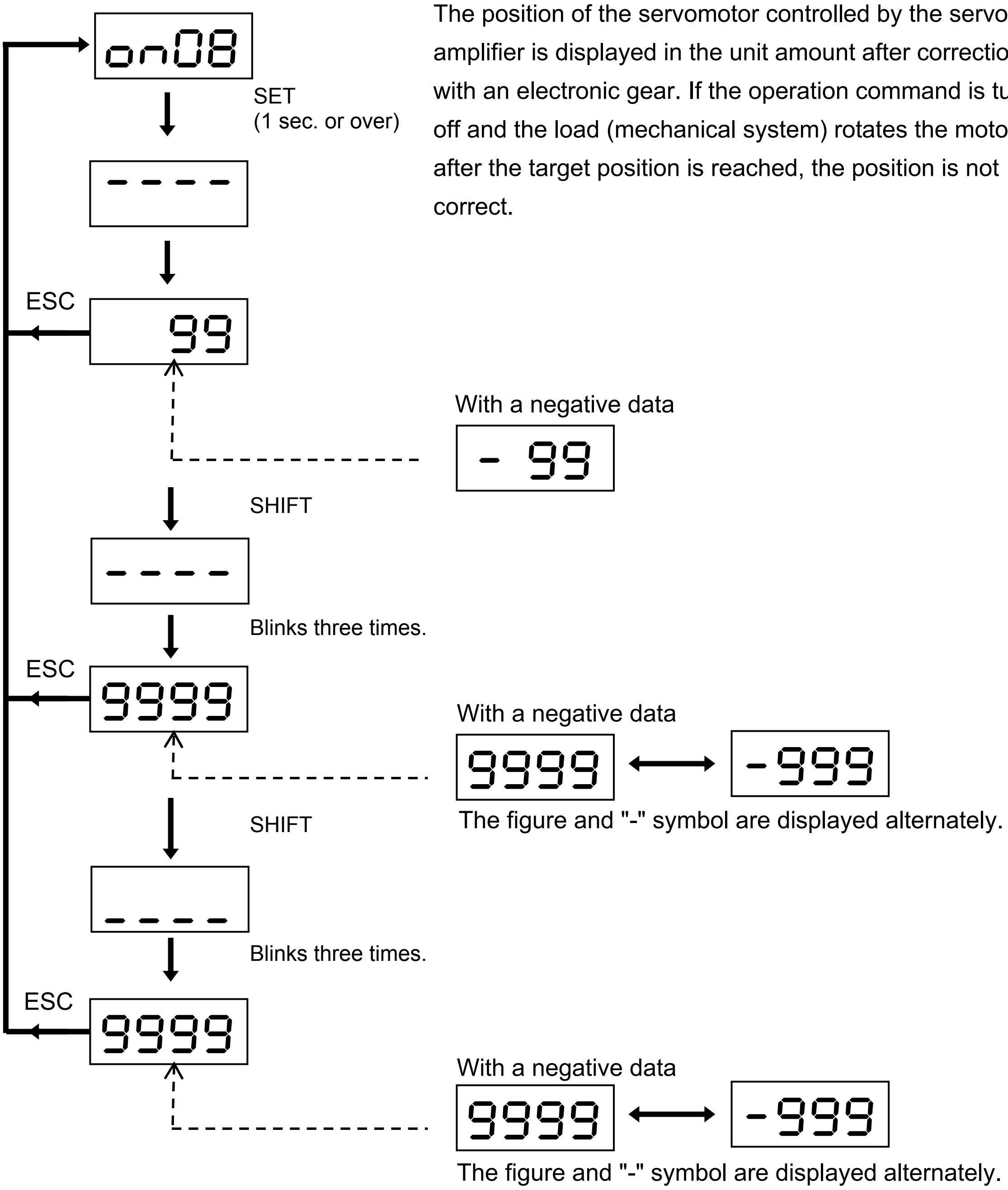
The rotation amount of the servomotor is displayed in the unit amount after correction with an electronic gear. If the electronic gear is unused, the data indicates the exact rotation amount of the motor shaft encoder (1048576 pulses/rev for the 20-bit serial encoder).





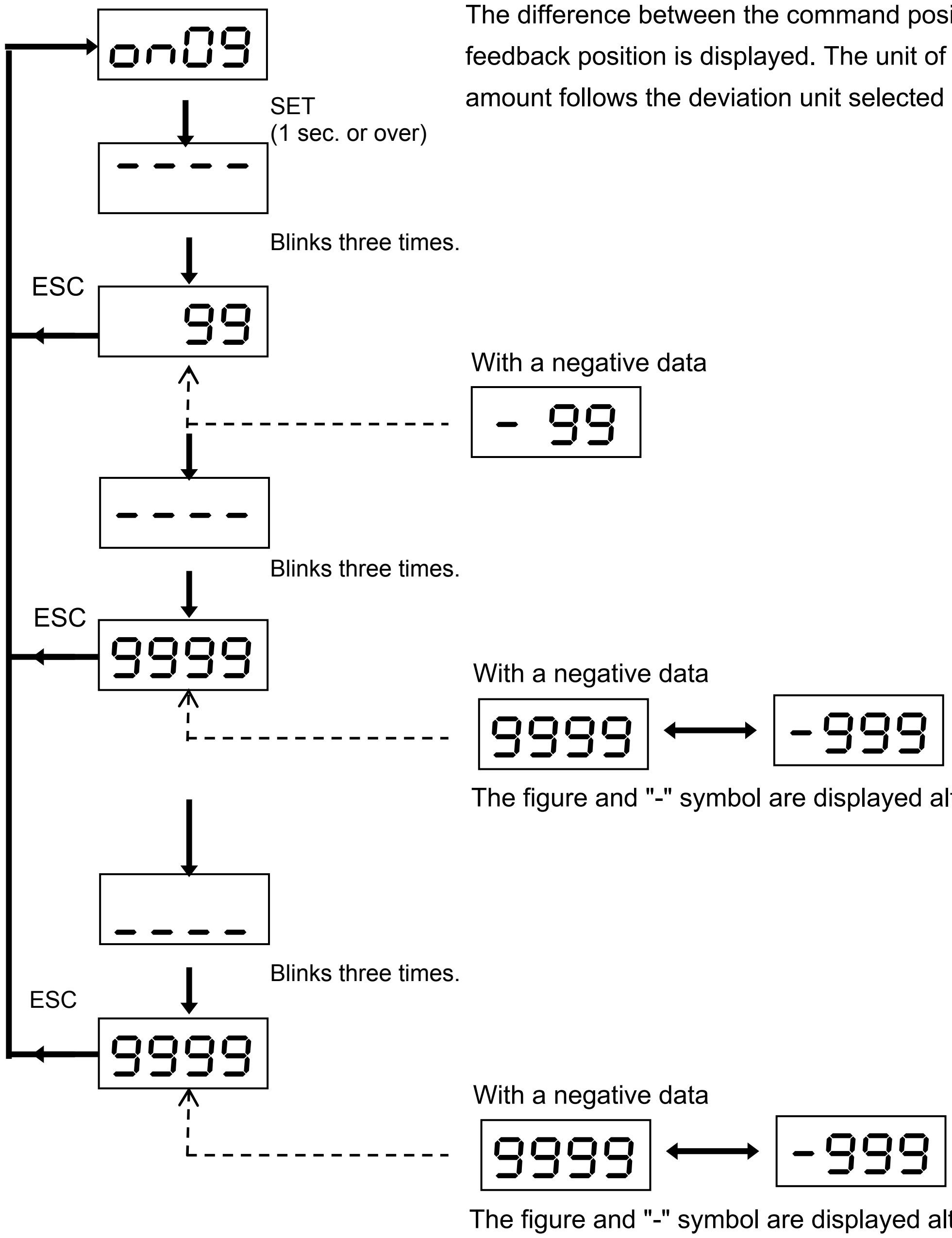
(8) Command position (displayed digits: signed 10 digits) U/L

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.



(9) Position deviation (displayed digits: signed 10 digits)

The difference between the command position and feedback position is displayed. The unit of deviation amount follows the deviation unit selected in PA1_31.



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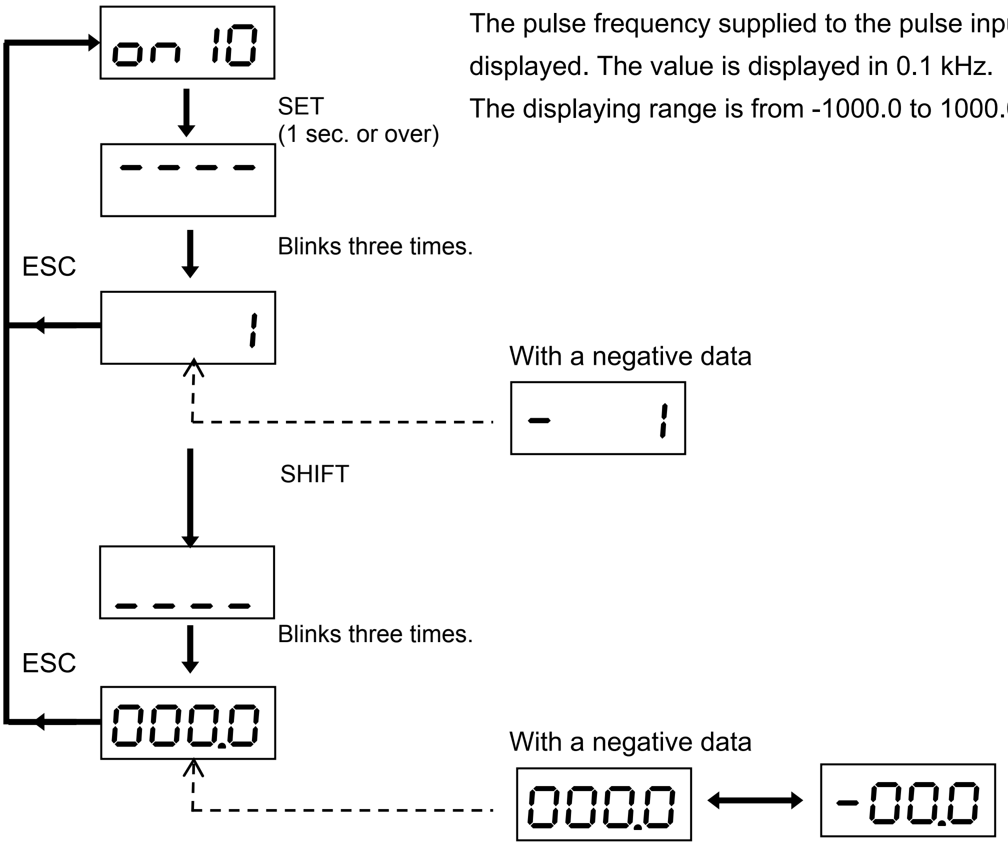
(10) Command pulse frequency (displayed digits: signed five digits)

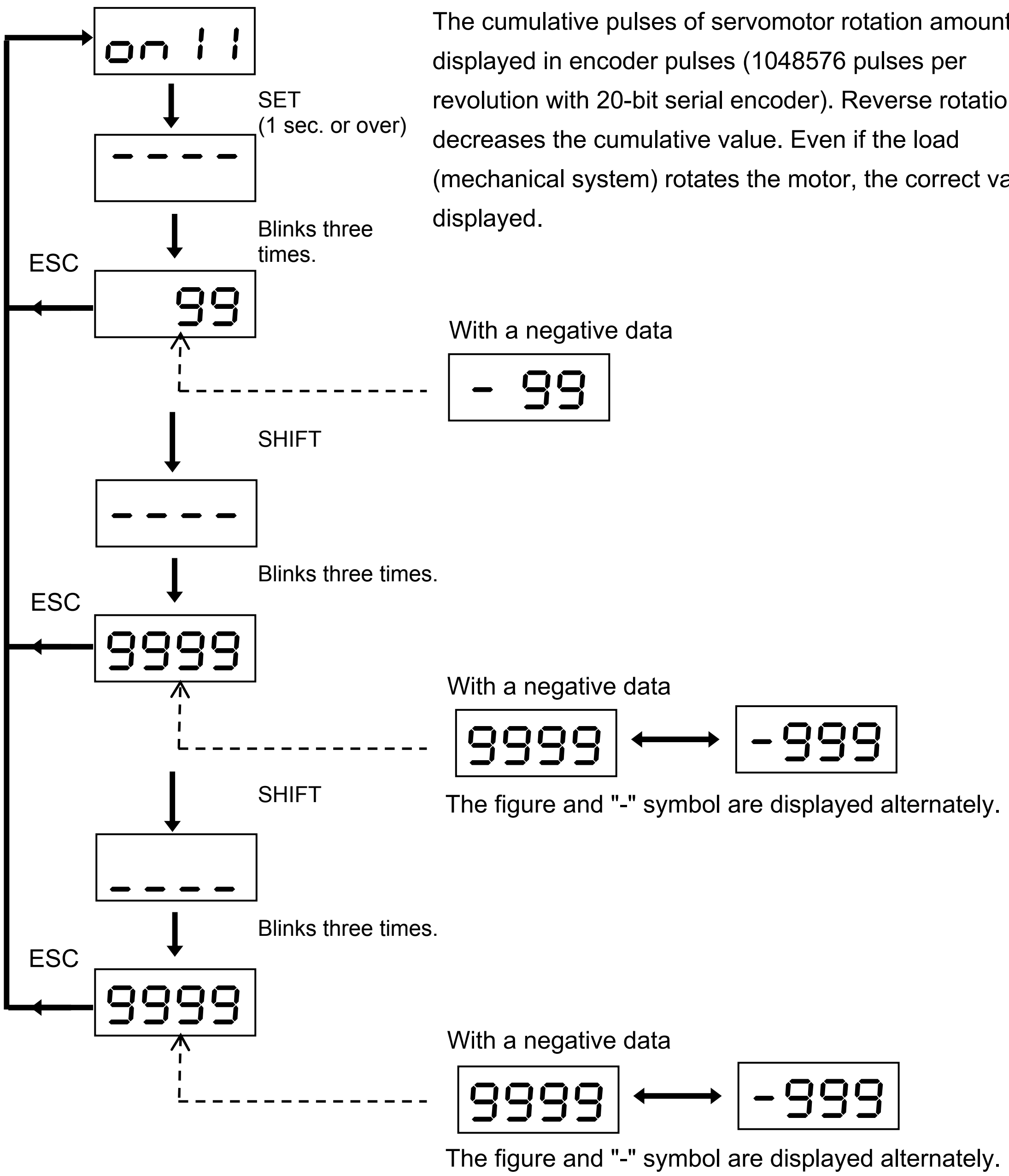
The pulse frequency supplied to the pulse input terminal is displayed. The value is displayed in 0.1 kHz.
The displaying range is from -1000.0 to 1000.0 kHz.



The figure and "-" symbol are displayed alternately.

(11) Feedback cumulative pulse (displayed digits: signed 10 digits)

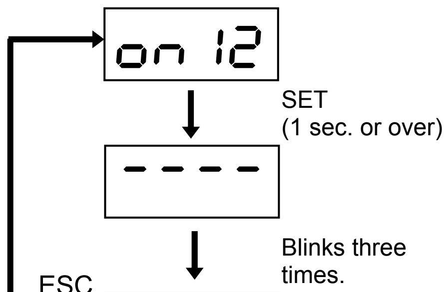
The cumulative pulses of servomotor rotation amount are displayed in encoder pulses (1048576 pulses per revolution with 20-bit serial encoder). Reverse rotation decreases the cumulative value. Even if the load (mechanical system) rotates the motor, the correct value is displayed.

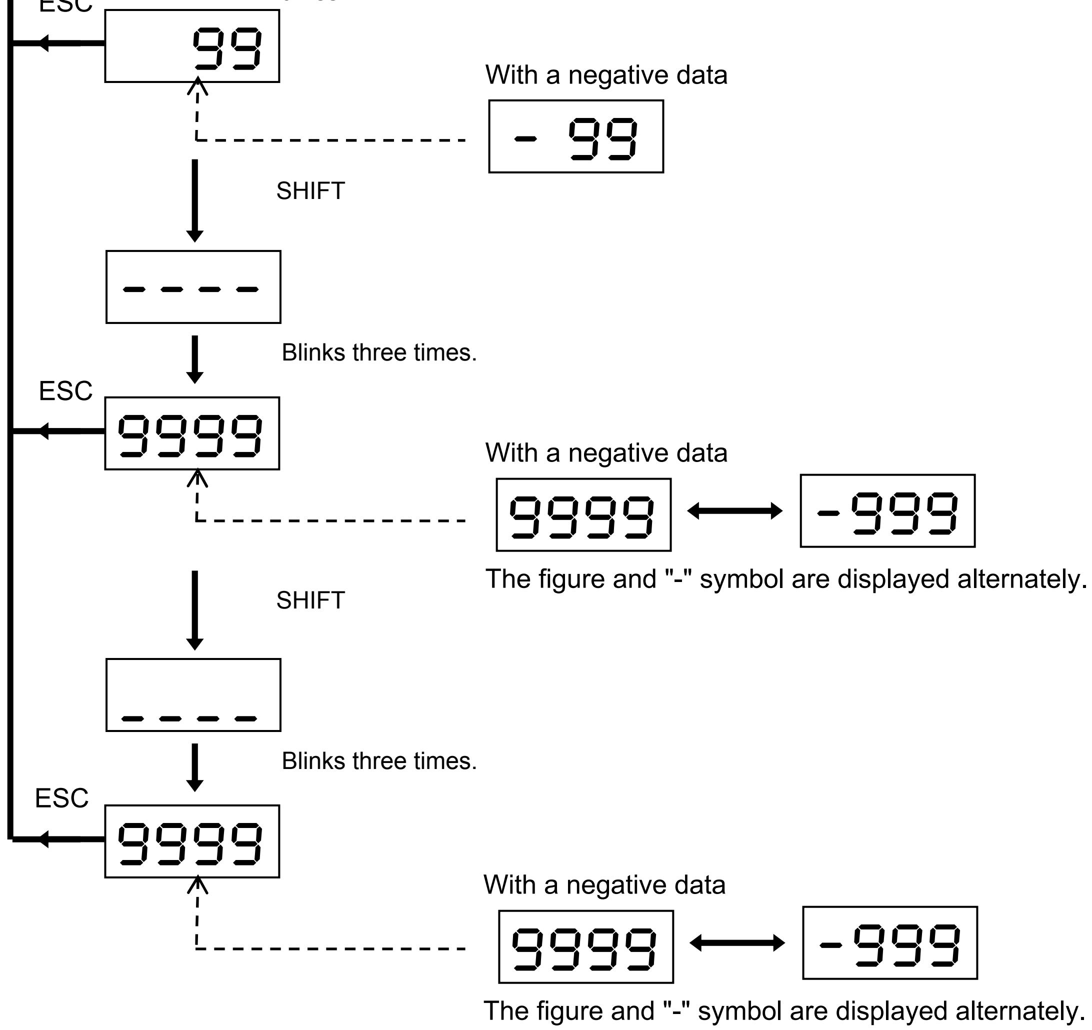


Hint	Press and hold the [∧] and [∨] keys simultaneously for at least one second to reset the feedback cumulative pulses.

(12) Command cumulative pulse (displayed digits: signed 10 digits)

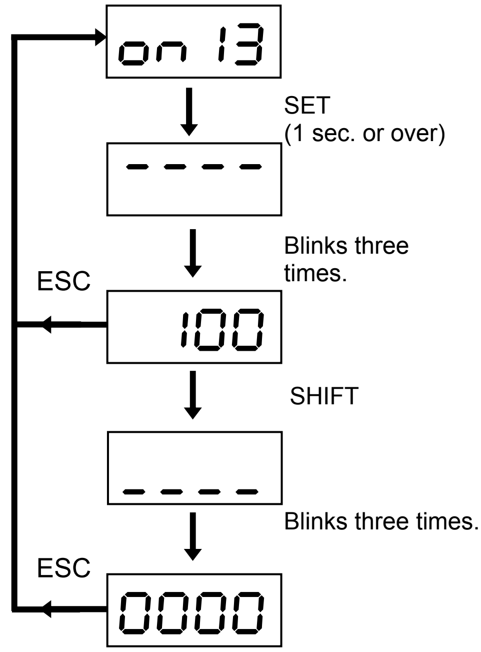
The number of pulses supplied to the pulse input terminal is displayed. The cumulative value increases upon forward direction pulses, while it decreases upon reverse direction pulses. With two signals at A/B phase pulse, each edge is counted (multiple of four). The count increases upon B-phase advance.





Hint	Press and hold the [∧] and [∨] keys simultaneously for at least one second to reset the feedback cumulative pulses.

(13) LS-Z pulse (displayed digits: unsigned seven digits) U/L

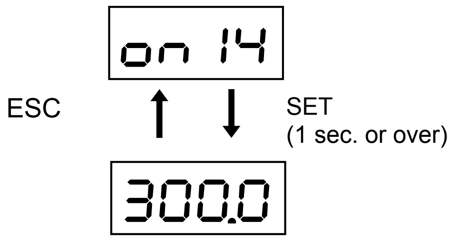


The number of pulses in a homing counted since the home position LS signal is turned off until the Z-phase of the encoder of the servomotor is detected is displayed. The indication is updated every time homing is performed. Because the value is in the homing direction, no negative sign is attached.

- Displayed only if the Z-phase is enabled.

6

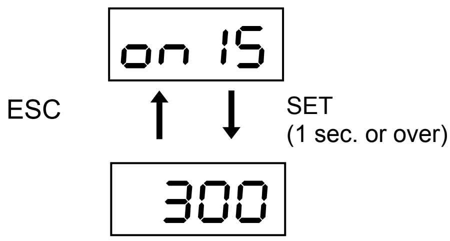
(14) Load inertia ratio (displayed digits: unsigned four digits)



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.

$$\text{(Load inertia ratio)} = \frac{\text{(Load inertia recognized by servo amplifier)}}{\text{(Inertia of servomotor itself)}}$$

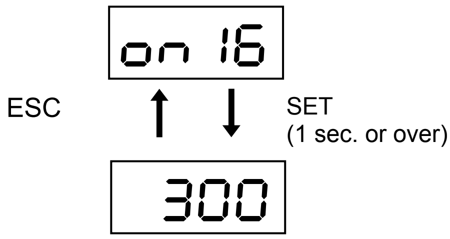
(15) DC link voltage (max.) (displayed digits: unsigned three digits)



The DC link voltage (max.) of the servo amplifier at every two seconds is displayed.
The displaying range is from 0 to 500 V.

Hint	If the DC link voltage (max.) exceeds 390 V during operation, an external regenerative resistor is necessary. "HV" (overvoltage) is detected at 420 V.

(16) DC link voltage (min.) (displayed digits: unsigned three digits)

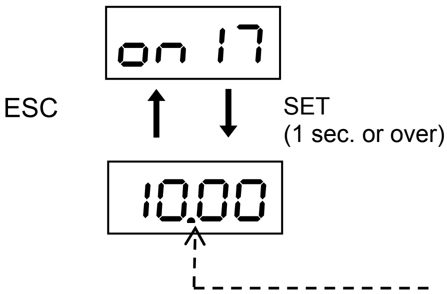


The DC link voltage (min.) of the servo amplifier at every two seconds is displayed.

The displaying range is from 0 to 500 V.

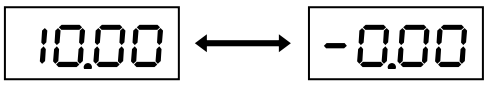
Hint	"LV" (under-voltage) is detected at 200 V.

(17) VREF input voltage (displayed digits: signed four digits)



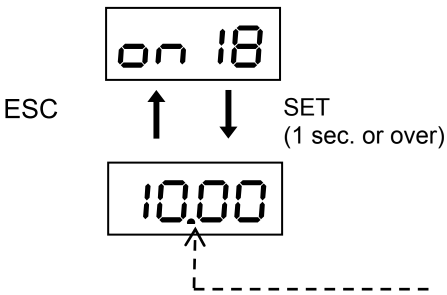
The input voltage of the analog input terminal [VREF] is displayed in 0.01 V. The negative sign indicates a negative voltage.

With a negative four-digit data



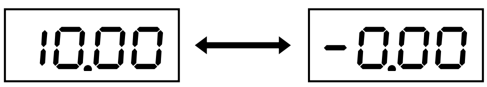
The figure and "-" symbol are displayed alternately.

(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.

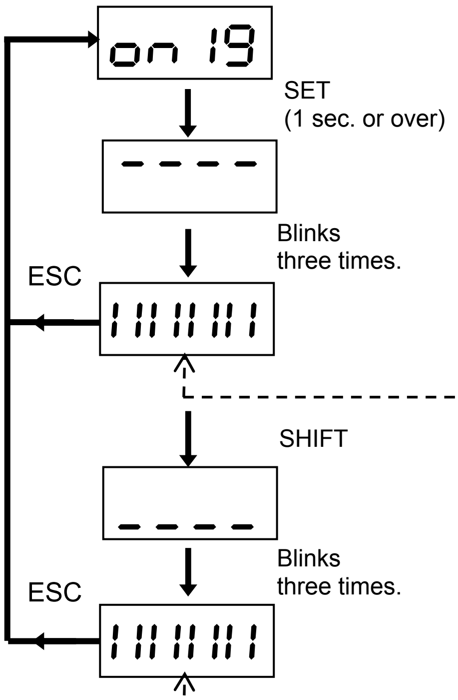
With a negative data

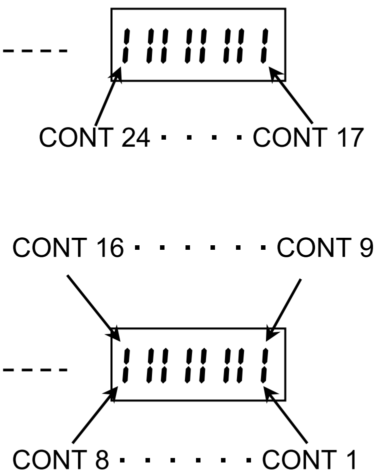


The figure and "-" symbol are displayed alternately.

(19) Input signals U/L

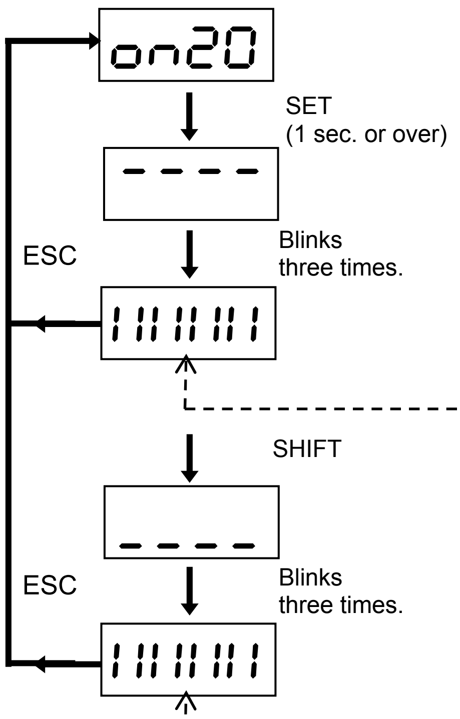
The ON/OFF status of sequence input signals supplied to the servo amplifier is displayed.
The corresponding LED lights up when the input signal is turned on.
While all the input signals are off, the display shows “nonE.

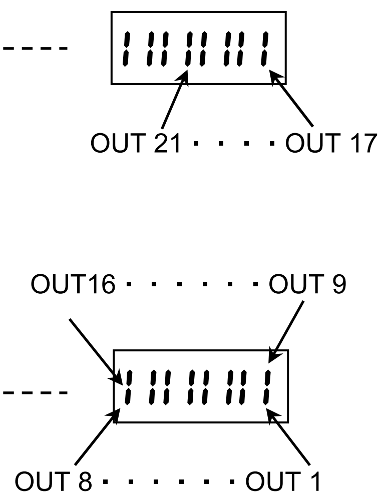




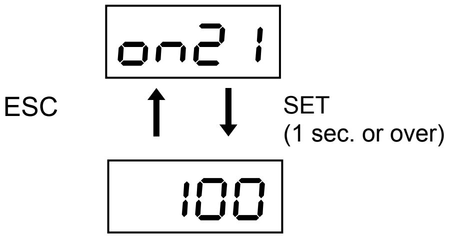
(20) Output signals U/L

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.
While all the output signals are off, the display shows “nonE.



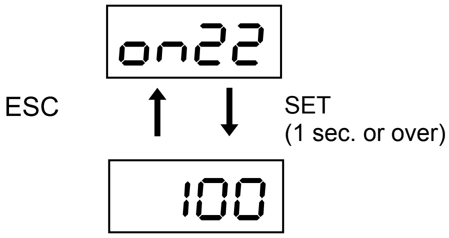


(21) OL thermal value (displayed digits: unsigned three digits)



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) Regenerative resistor thermal value (displayed digits: unsigned three digits)



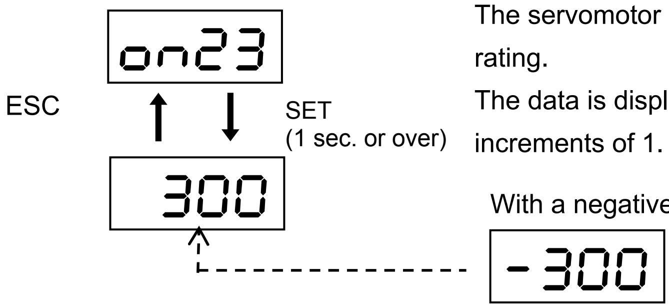
The regeneration load ratio to the regenerative resistor overheat alarm level is displayed in percent. A regenerative resistor overheat alarm is caused if this value is 100. The regeneration load ratio is calculated for amplifier frame no.2 or above if PA2_65 (regenerative resistor selection) is set at 1 (internal resistor).

The minimum increment is 1. The displaying range is from 0 to 100%.

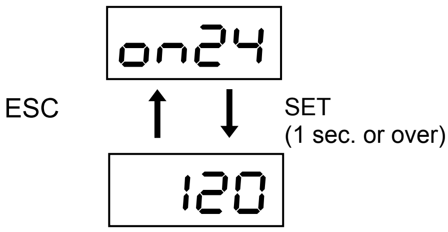
(23) Power (w) (displayed digits: signed three digits)

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.



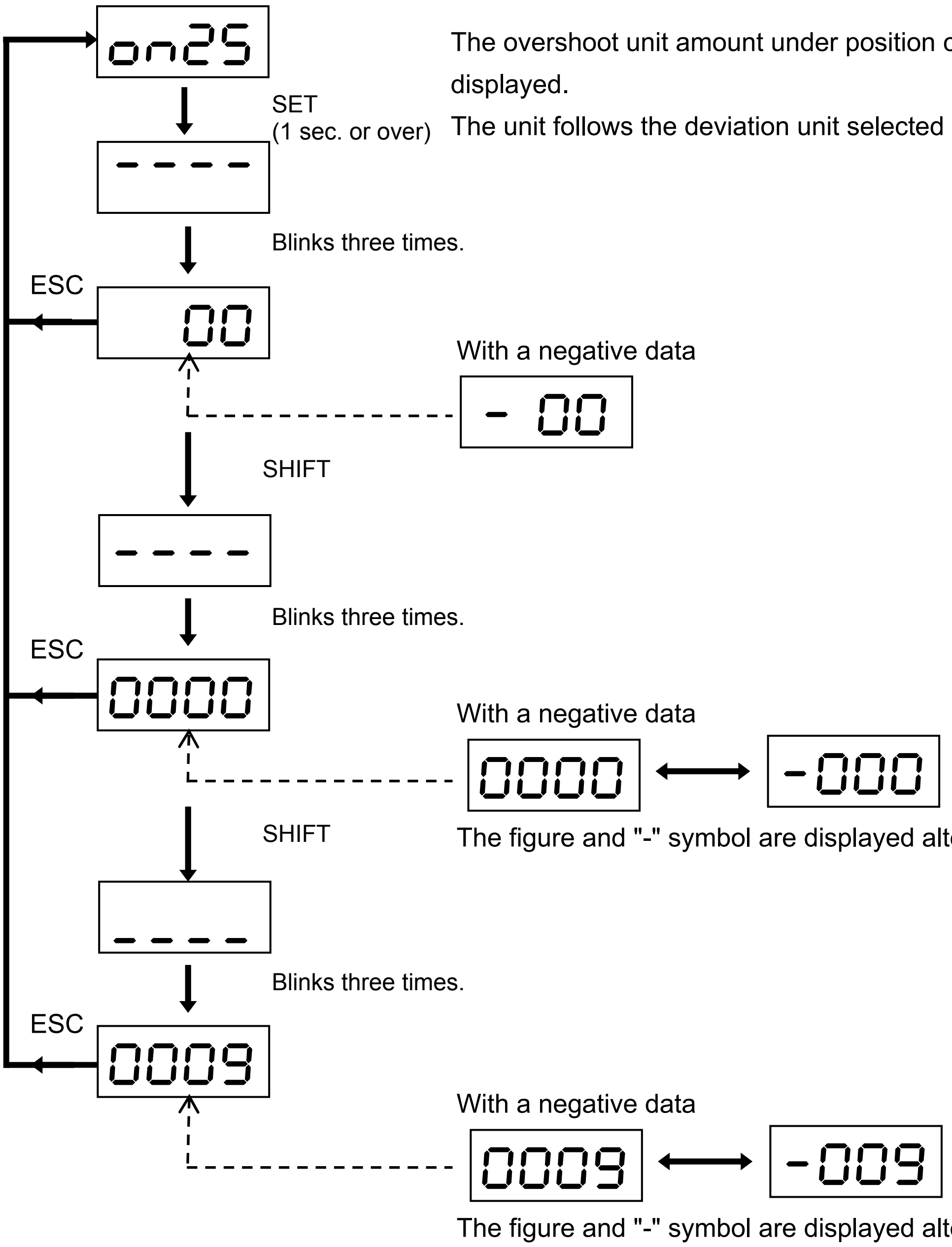
(24) Motor temperature (displayed digits: unsigned three digits)



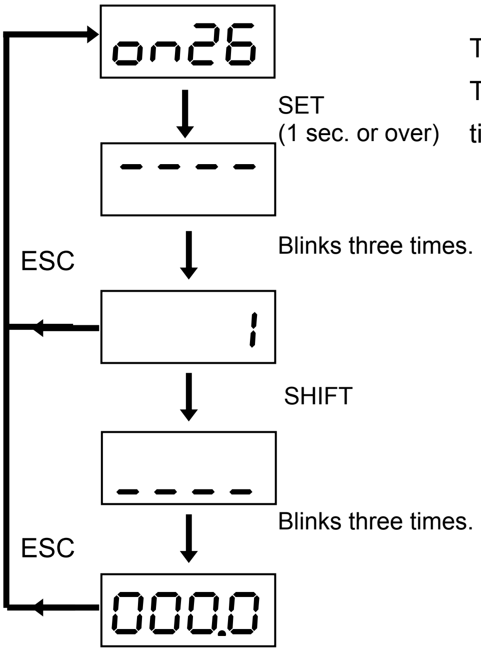
The servomotor temperature is displayed. The range from 0 to 120°C is displayed in increments of 1°C.

(25) Overshoot unit amount (displayed digits: signed 10 digits)

The overshoot unit amount under position control is displayed.
The unit follows the deviation unit selected in PA1_31.

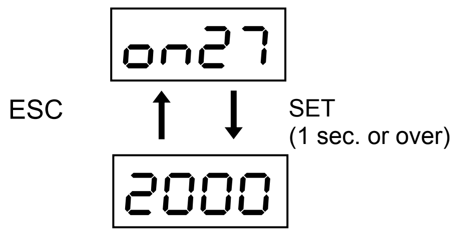


(26) Settling time (displayed digits: unsigned five digits)



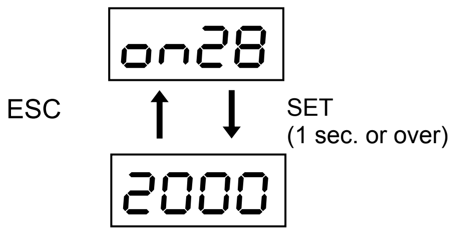
The settling time under position control is displayed.
The displaying range is from 0 to 1000.0 ms. If the settling time exceeds 1000.0 ms, "1000.0 is displayed.

(27) Resonance frequency 1 (displayed digits: unsigned four digits)



The resonance frequency recognized by the servo amplifier is displayed.
The displaying range is from 50 to 2000 Hz. If no resonance is detected, "4000" is displayed.

(28) Resonance frequency 2 (displayed digits: unsigned four digits)

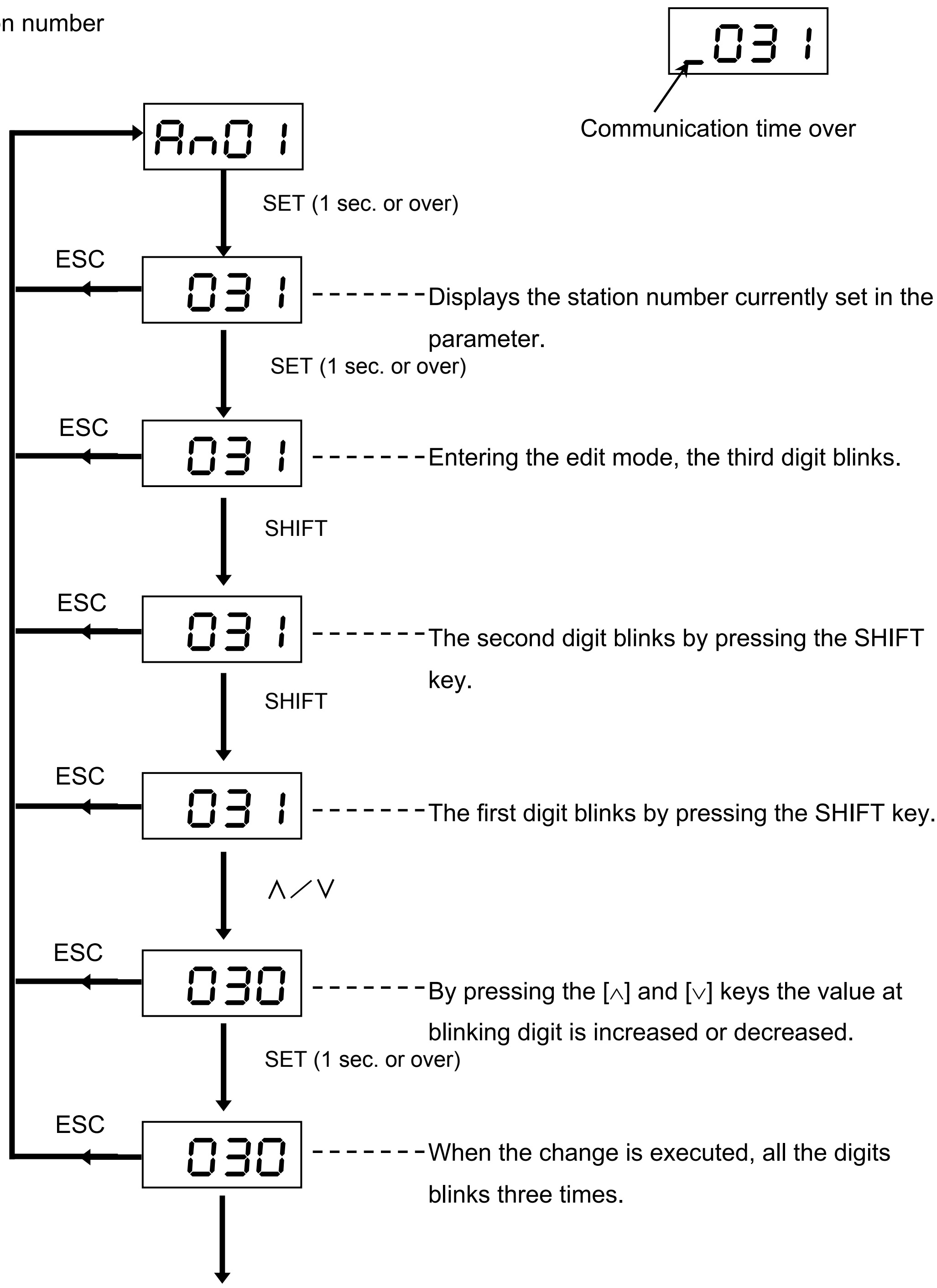


The resonance frequency recognized by the servo amplifier is displayed.
The displaying range is from 50 to 2000 Hz. If no resonance is detected, "4000" is displayed.

6.5 Station Number Mode

In the station number mode, the station number of the servo amplifier is displayed and a new station number can be entered.
Press the [MODE/ESC] key until [An01] is displayed, and press and hold the [SET/SHIFT] key for at least one second to display data.

An01: Station number



Turn the power off and on again to enable the new station number.

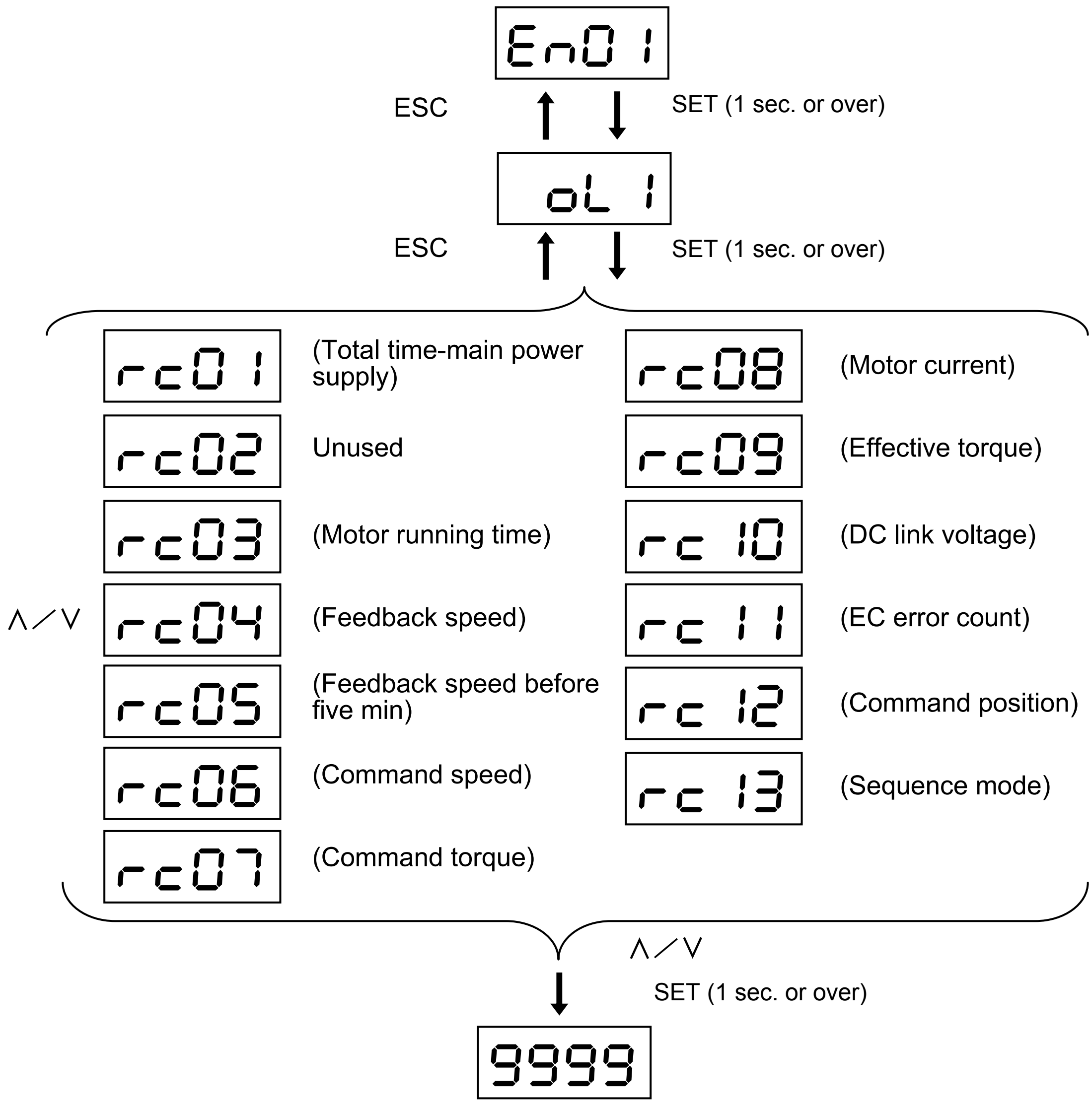
6.6 Maintenance Mode

In the maintenance mode, detected alarms, total time - main power supply and so on are displayed. Press the [MODE/ESC] key until [En01] is displayed and press and hold the [SET/SHIFT] key for at least one second to display data.

En01 : Alarm at present
En02 : Alarm history
En03 : Warning at present
En04 : Total time - main power supply
En06 : Motor running time

(1) Alarm at present
The alarm detected currently is displayed in a code.

- If the alarm reset is executed, the display will automatically return to the initial one.
After an alarm is detected, the following is displayed automatically. Supplementary data to the alarm can be displayed, too.



■ Alarm display

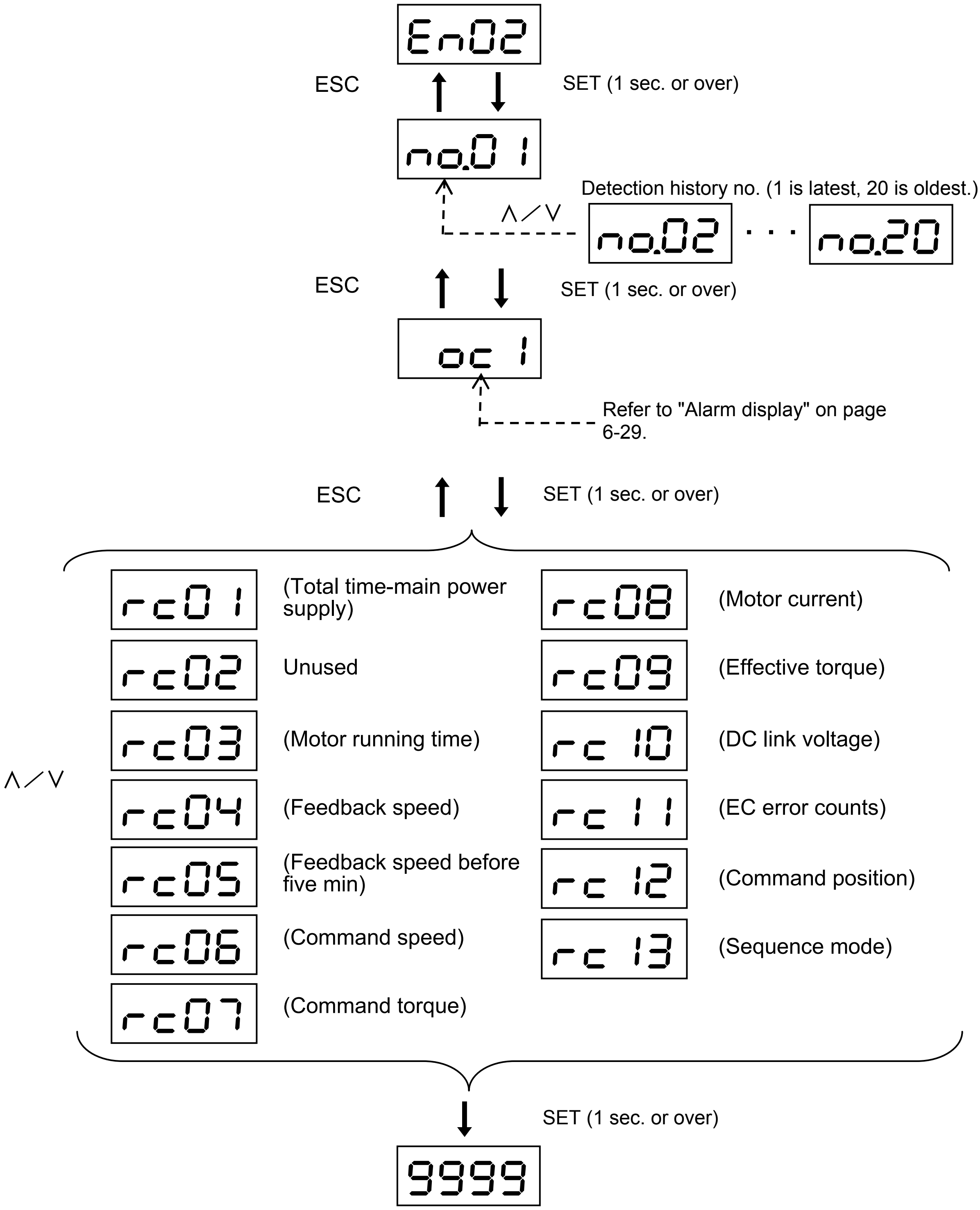
Order	display	Name
1	oc1	Overcurrent 1
2	oc2	Overcurrent 2
3	oS	Overspeed
4	Hu	Overvoltage
5	Et1	Encoder Trouble 1
6	Et2	Encoder Trouble 2
7	ct	Circuit Trouble
8	dE	Memory Error
9	Fb	Fuse Blown
10	cE	Motor Combination Error
11	tH	Breaking Transistor Overheat
12	Ec	Encoder Communication Error
13	ctE	CONT（Control signal）Error
14	oL1	Overload 1
15	oL2	Overload 2
16	rH4	Inrush Current Suppression Circuit Trouble
17	LuP	Main Power Undervoltage
18	rH1	Internal Breaking Resistor Overheat
19	rH2	External Breaking Resistor Overheat
20	rH3	Breaking Transistor Error
21	oF	Deviation Overflow
22	AH	Amplifier Overheat
23	EH	Encoder Overheat
24	dL1	Absolute Data Lost 1
25	dL2	Absolute Data Lost 2
26	dL3	Absolute Data Lost 3
27	AF	Multi-turn Data Over Flow
28	iE	Initial 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, display is restored to the initial display automatically.

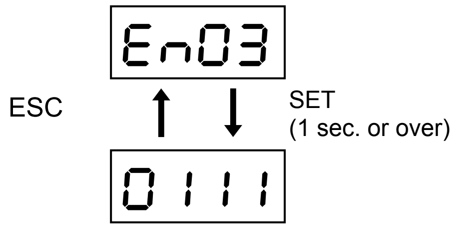
6

(2) Alarm history
Up to 20 past alarms can be displayed.
Press the [∧] or [∨] key to scroll in the history.



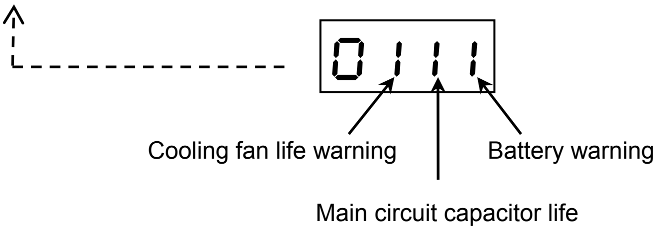
Hint	The history can be cleared in the test operation mode [Fn06].

(3) Warning at present

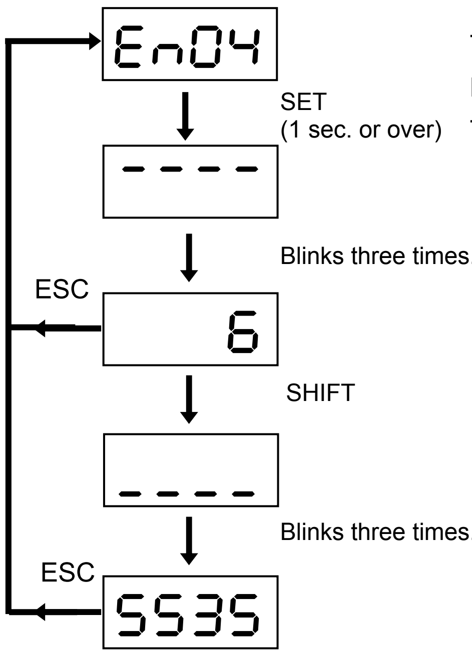


Warnings in the ABS battery, main circuit capacitors and cooling fan are displayed.

"0" indicates no warning, and "1" indicates a warning.



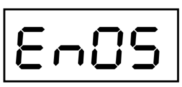
(4) Total time - main power supply U/L



The cumulative time of turning the main power (L1, L2 and L3) on is displayed.

The displaying range is from 0 to 65535 h.

(5) Total time -control power supply

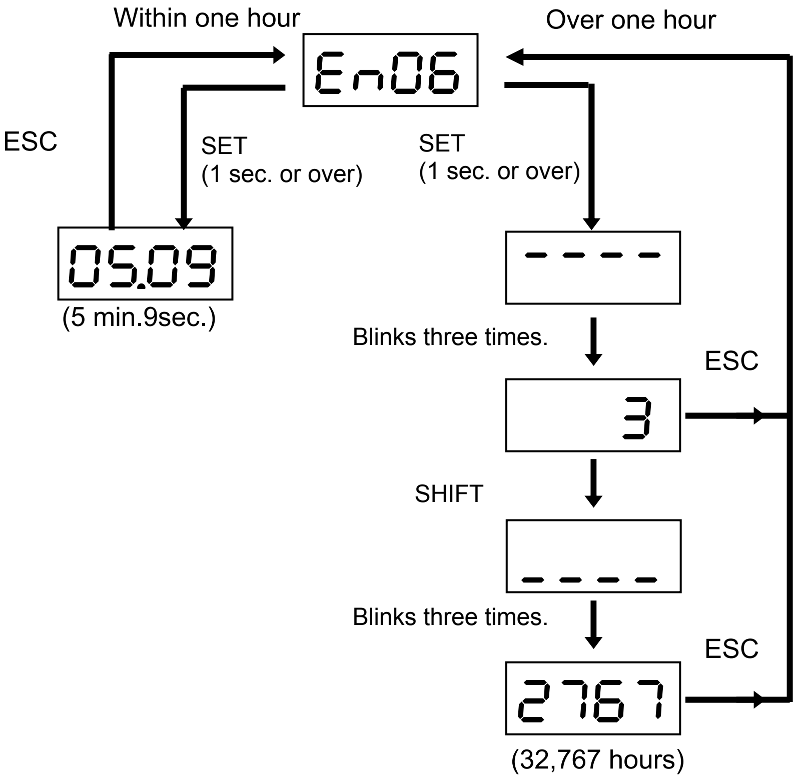


This function is unused.

6

(6) Motor running time 

The cumulative time of turning the servomotor on is displayed.
The displaying range is from 0 to 32767 h.



6.7 Parameter Edit Mode

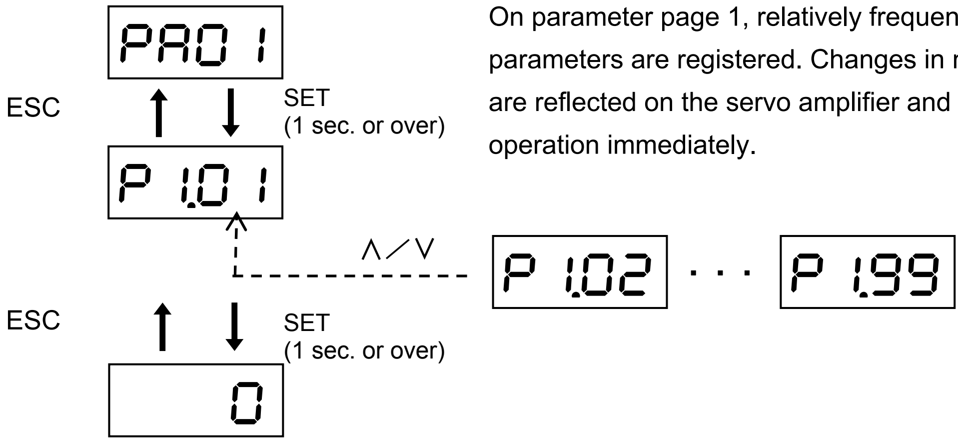
Parameters can be edited in the parameter edit mode.
Press the [MODE/ESC] key until [PA01] is displayed and press and hold the [SET/SHIFT] key for at least one second to select parameter editing.
After selecting parameter editing, press the [∧] or [∨] key to select the number of the desired parameter to be edited.

Press and hold the [SET/SHIFT] key for at least one second to edit the data.

PA01 : Parameter page 1
PA02 : Parameter page 2
PA03 : Parameter page 3

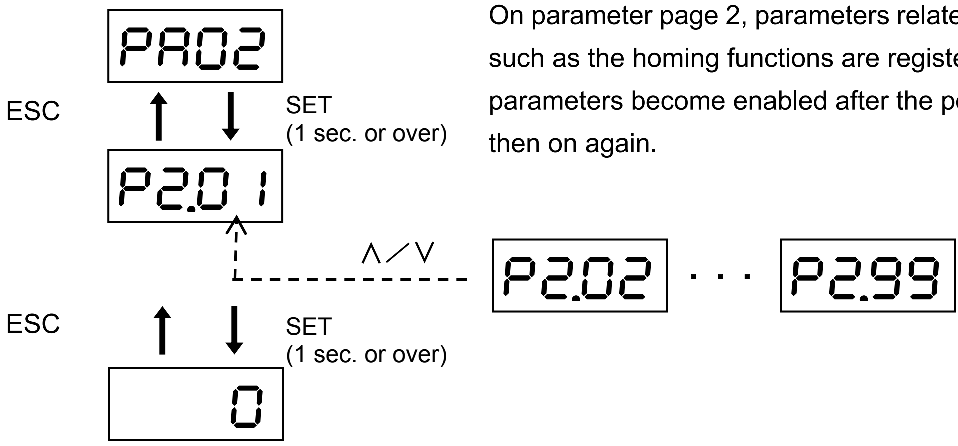
(1) Parameter page 1

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

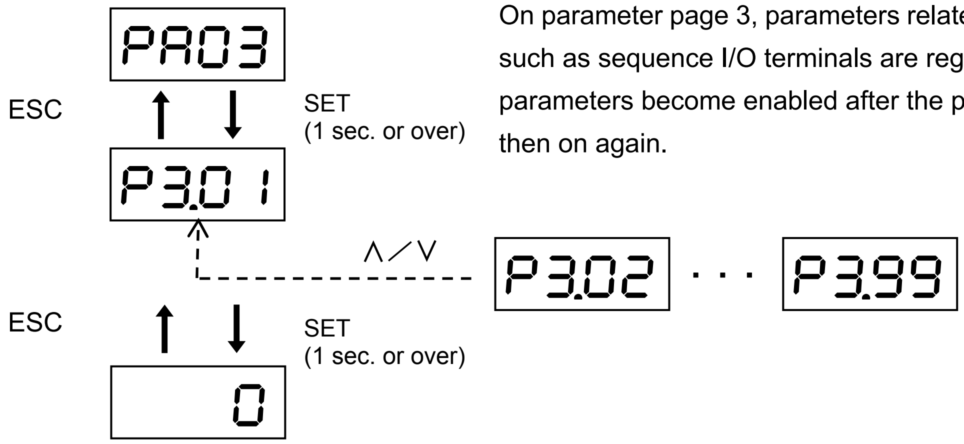
On parameter page 2, parameters related to system setting such as the homing functions are registered. Changes in parameters become enabled after the power is turned off then on again.



6

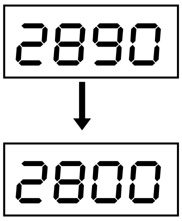
(3) Parameter page 3

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.



■ Value editing

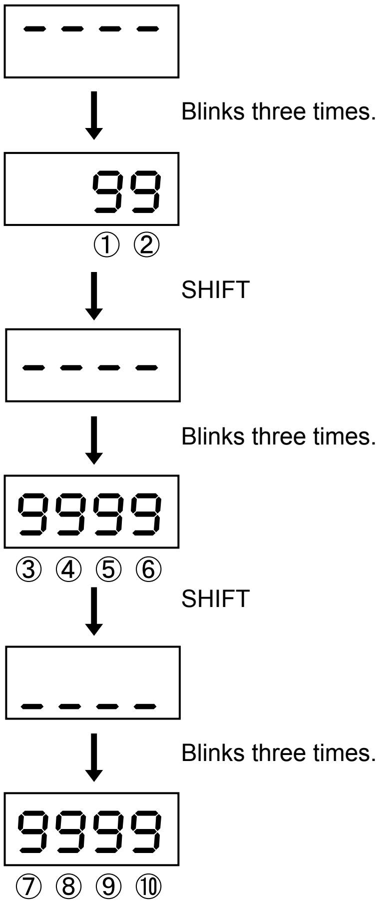
When a parameter is loaded, the uppermost (leftmost) digit blinks. (If the parameter has the upper/middle/lower-digit display, the uppermost detail is displayed.) The blinking digit can be edited (the digit blinks at about 1-second intervals). Press the [∧] or [∨] key to change the value. Even if "9" 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 digit shifts from 1 to 10 as shown below, and returns to 1 after 10.



Settling the value

Press and hold the [SET/SHIFT] key for at least one second to settle the value. All digits blink simultaneously. 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).

Blinking display

When parameters which become enabled after the power is cycled once, the keypad display blinks.

■ An example of editing operation

Change parameter PA1_7 (denominator of electronic gear) to100000.

Key operation	Display	Remarks
	‾PoF	An example of indication in sequence mode
[MODE]	Sn01	Return to mode selection.
[MODE]	PA01	Select the parameter editing mode.
[SET] (1 sec. or over)	P1.01	The parameter number is displayed.
[∧]	P1.07	Select parameter PA1_7.
[SET] (1 sec. or over)	- - - -	Blinks three times. The set detail (upper three digits) of PA1_7 is displayed next.
	000 Blink	The third digit of upper-digit display blinks.
[SET]	000 Blink	Shift to the desired editing digit.
[∧]	0 10 Blink	Increase the value to "1."
[SET]	0 10 Blink	Shift the target to the first digit.
[SET]	_ _ _ _	Blinks three times. The set detail lower four digits) of PA1_7 is displayed next.
	0001 Blink	The fourth digit of lower-digit display blinks.
[SET]	0001 Blink	Shift to the desired editing digit.

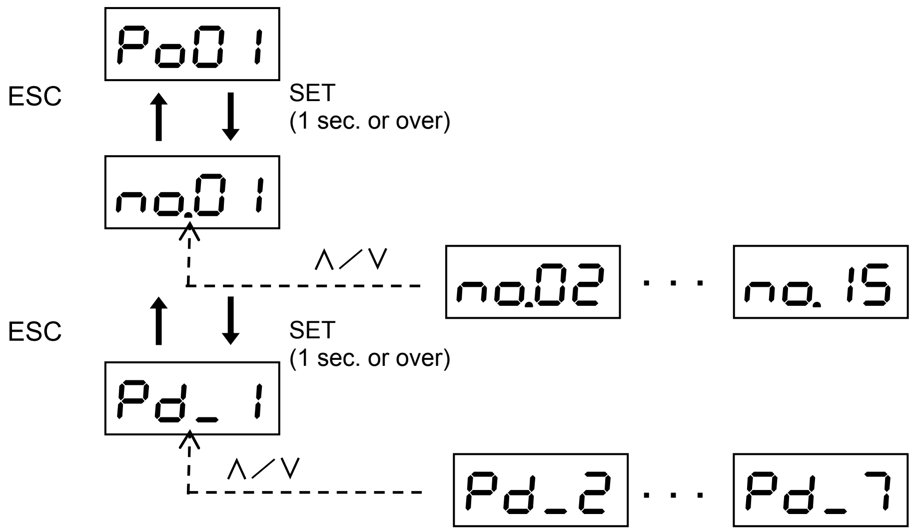
Key operation		Remarks
[∨]	0000 (Blink)	Change the value to "0."
[SET] (1 sec. or over)	0000	Settle the new value.
	0000	After being settled, the value remains.

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.

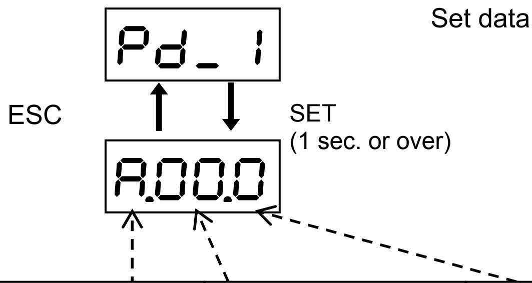
Pd_ 1 : Positioning status
Pd_2 : Target position
Pd_3 : Rotation speed
Pd_4 : Stand still timer
Pd_5 : M code
Pd_6 : Acceleration time
Pd_7 : Deceleration time

■ Procedure (common)



(1) Positioning status

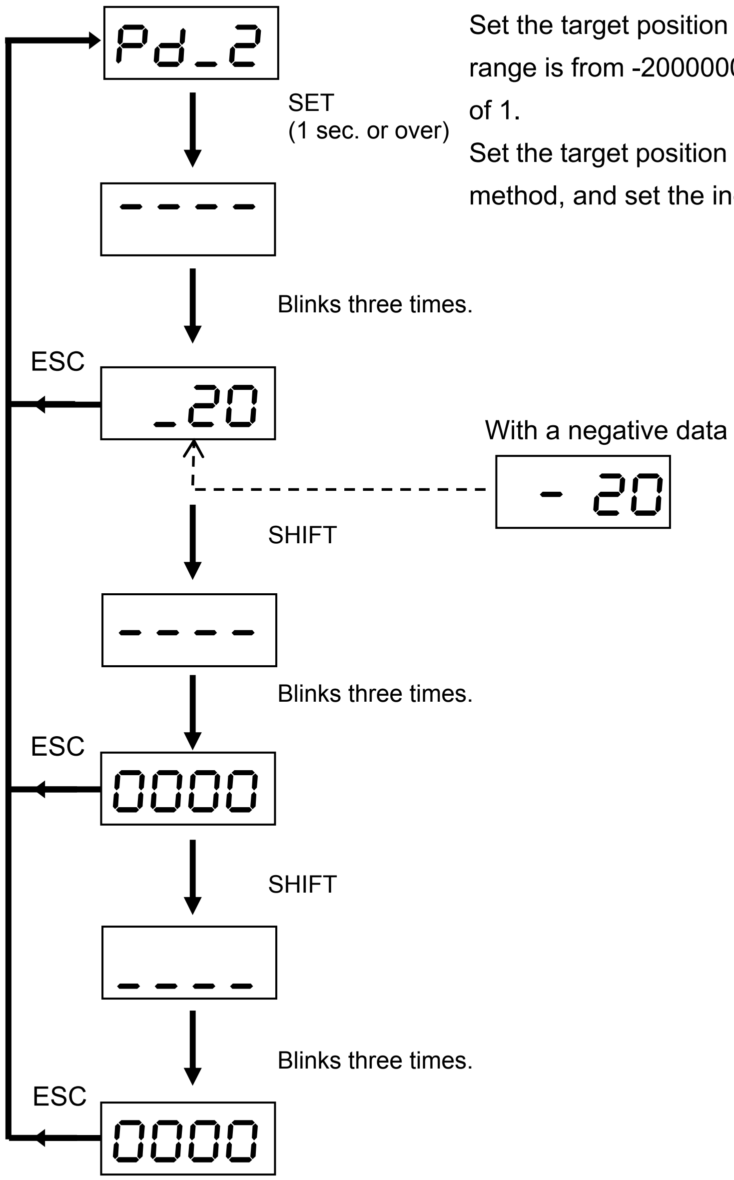
Set data relevant to the positioning data.



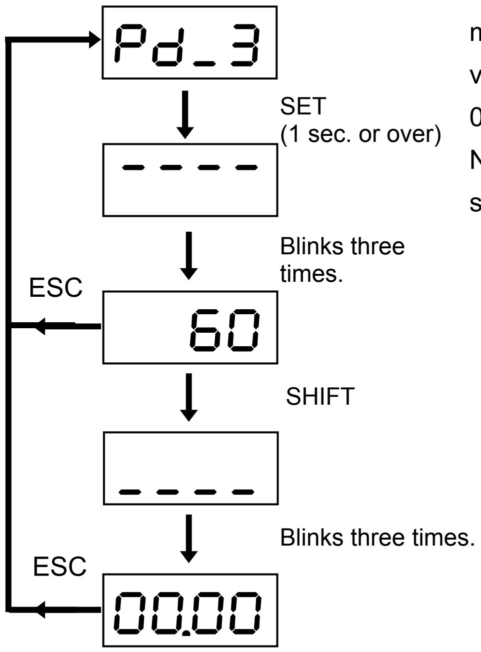
4th digit		2nd and 3rd digits		1st digit	
Indication	Command method	Indication	Step mode	Indication	M code setting
A	ABS	00	No designation	0	Disable
i	INC	co	Continuous	1	Output at startup
		cE	Cycle end	2	Output at completion

(2) Target position

Set the target position of the motor. The setting value range is from -2000000000 to 2000000000 in increments of 1.
Set the target position of the servomotor for ABS command method, and set the incremental value for INC.



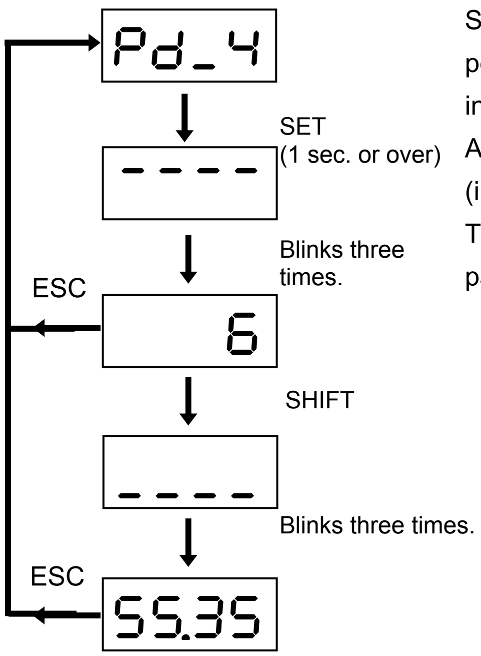
(3) Rotation speed



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 6000.00 r/min in increments of 0.01.

Note that the setting speed is not the machine travel speed.

(4) Stand still timer

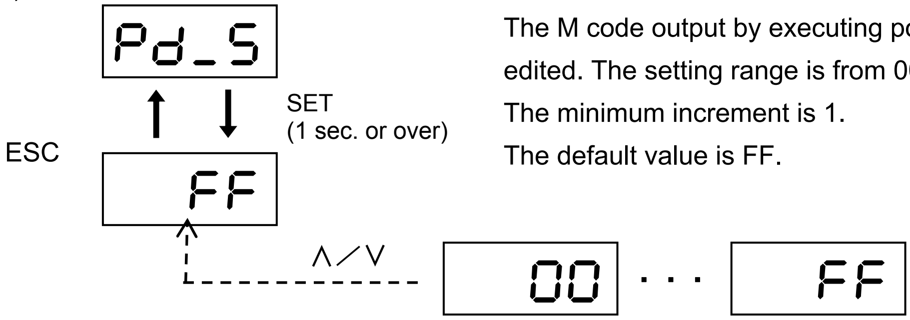


Set the stop time after the motor has reached the target position. The setting value range is from 0.00 to 655.35 s in increments of 0.01.

After the stop time has elapsed, the sequence output signal (in-position signal [INP]) turns on.

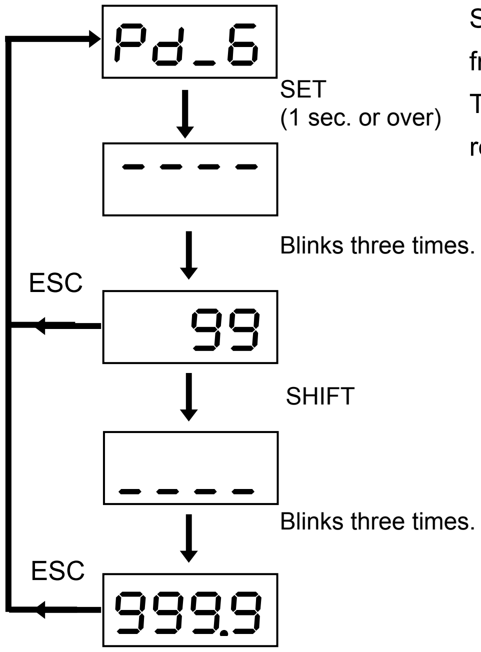
The decimal point position can be changed in the parameter PA2-42 (timer data decimal point position).

(5) M code



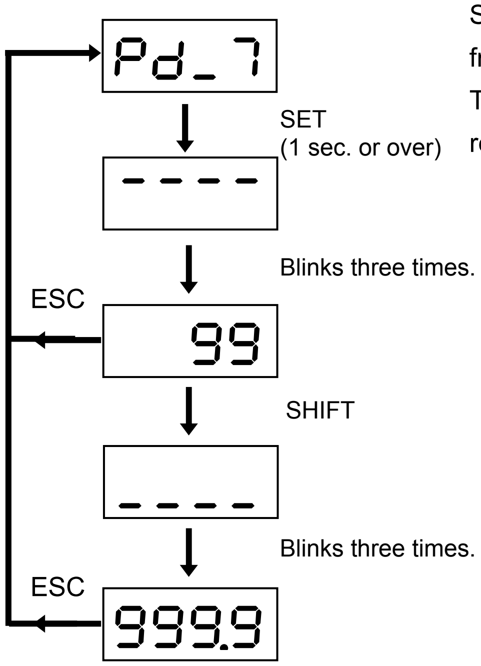
The M code output by executing positioning data can be edited. The setting range is from 00 to FF in hexadecimal. The minimum increment is 1.
The default value is FF.

(6) Acceleration time



Set the motor acceleration time. The setting value range is from 0.0 to 99999.9 ms in increments of 0.1.
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 to 99999.9 ms in increments of 0.1.
The setting value is the time until the motor rotation speed reaches 2000 r/min.

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 [Fn01] is displayed, and press and hold the [SET/SHIFT] key for at least one second to execute test operation.

Fn01 : Manual operation	Fn08 : Positioning data initialization
Fn02 : Position preset	Fn09 : Auto offset adjustment
Fn03 : Homing	Fn10 : Z-phase offset adjustment
Fn04 : Automatic operation	Fn11 : Auto tuning gain
Fn05 : Alarm reset	Fn12 : Easy tuning
Fn06 : Alarm history initialization	Fn13 : Profile operation
Fn07 : Parameter initialization	Fn14 : Sequence mode
	Fn15 : Teaching

■ NG display (common)

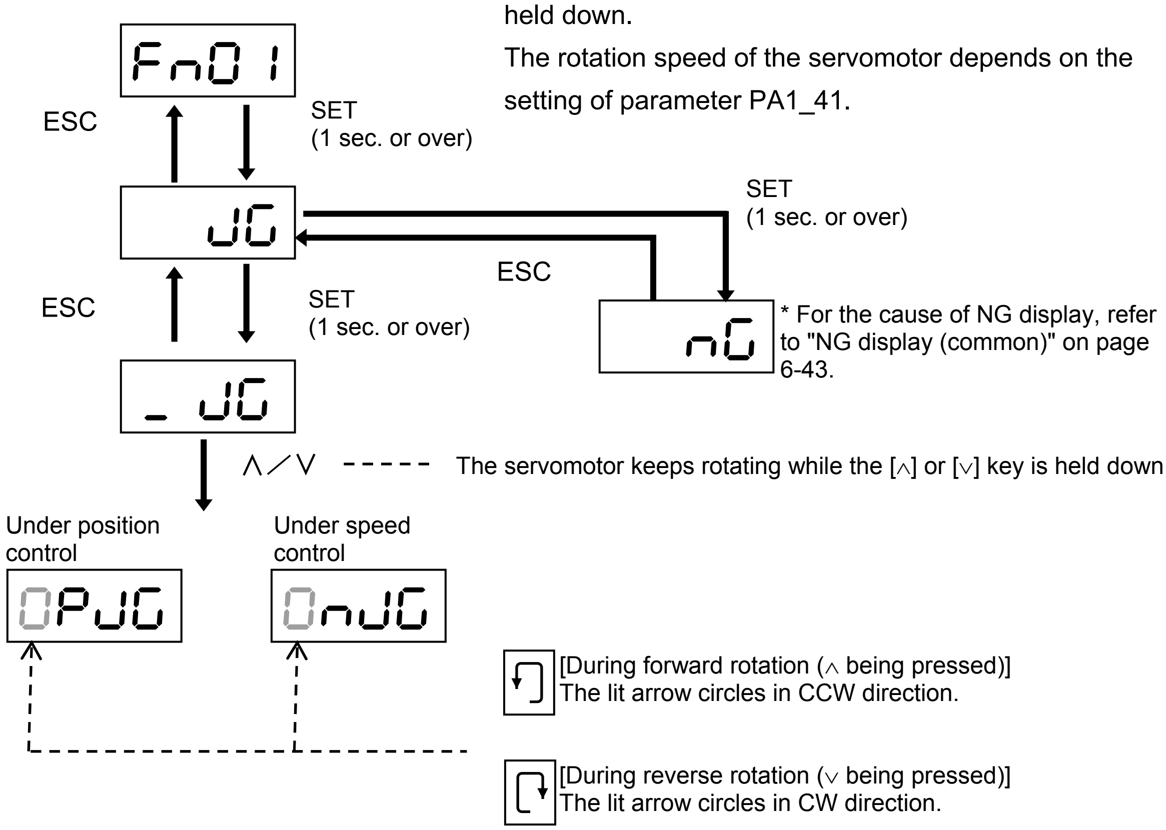
nG	nG 1

- Test run accompanying motor operation (Fn01, Fn03, Fn04, Fn12 and Fn13)
  If the motor operation is not available, the display indicates [NG].
  The signals of forced stop, ±OT, and free-run are effective during test run. Check these signals when [NG] is displayed.
- Test run accompanying parameter writing (Fn07, Fn09, Fn10, Fn11 and Fn12)
  If the parameter PA2_74 (parameter write protection) is set to "1" (write protect), the display indicates [NG]. Set PA2_74 to "0" (write enable) before performing test run. (*)
- Test run accompanying positioning data write (Fn08 and Fn15)
  If the parameter PA2_75 (positioning data write protection) is set to "1" (write protect), the display indicates [NG]. Set PA2_75 to "0" (write enable) before performing test run. (*)

(*) When the signal is turned off by assigning the edit permission command to the sequence input signal CONTn, both the parameter and the positioning data are not allowed to be rewritten. Perform the test run with the CONTn signal turned on.

(1) Manual operation

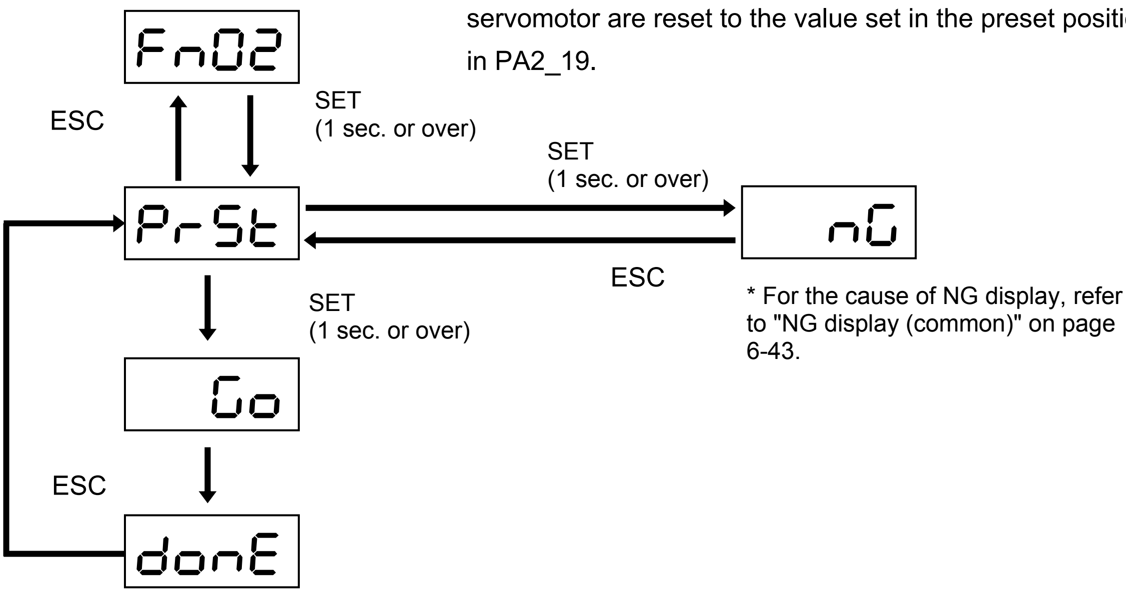
The servomotor rotates while the keypad key [∧] or [∨] is held down.
The rotation speed of the servomotor depends on the setting of parameter PA1_41.



Note	The forced stop, external regenerative 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

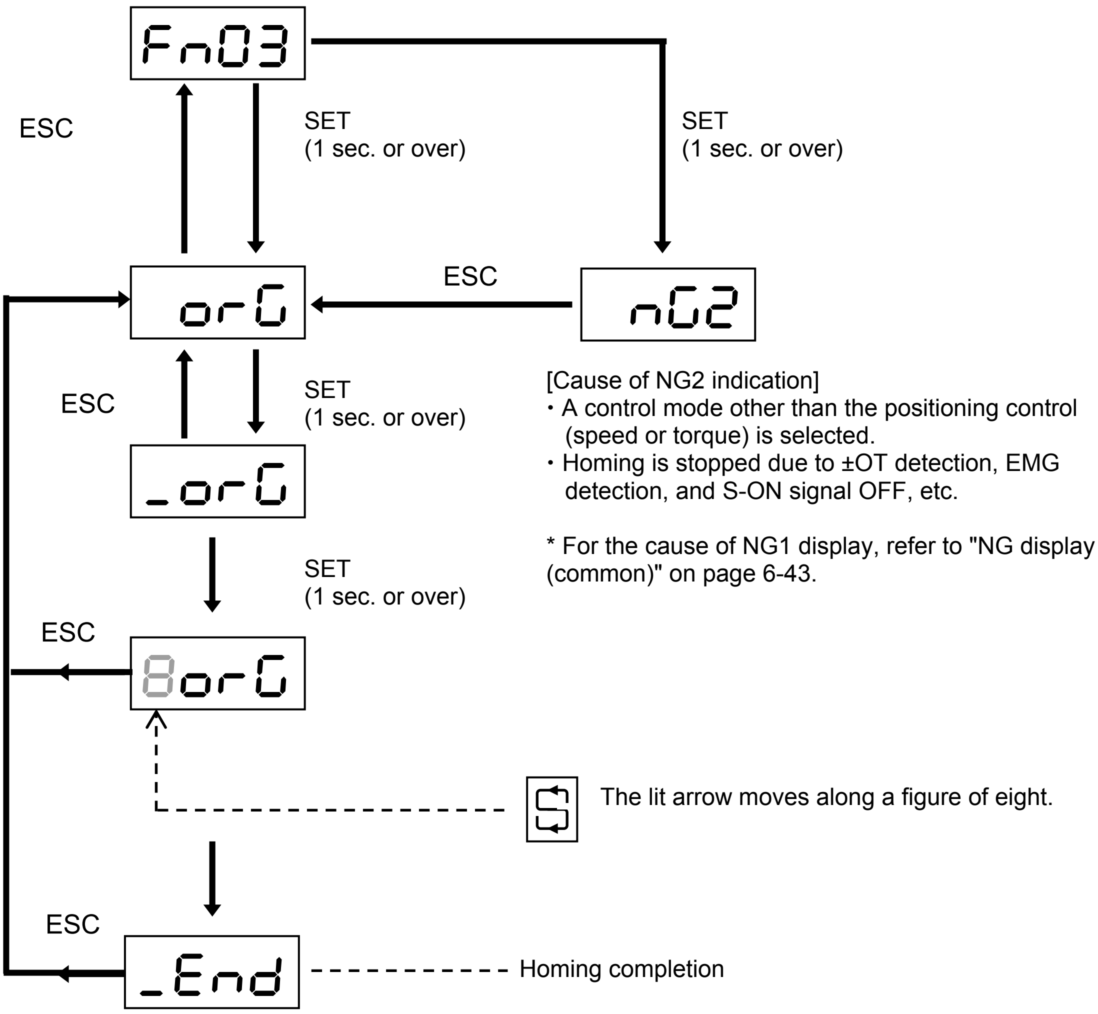
The command position and the feedback position of the servomotor are reset to the value set in the preset position in PA2_19.



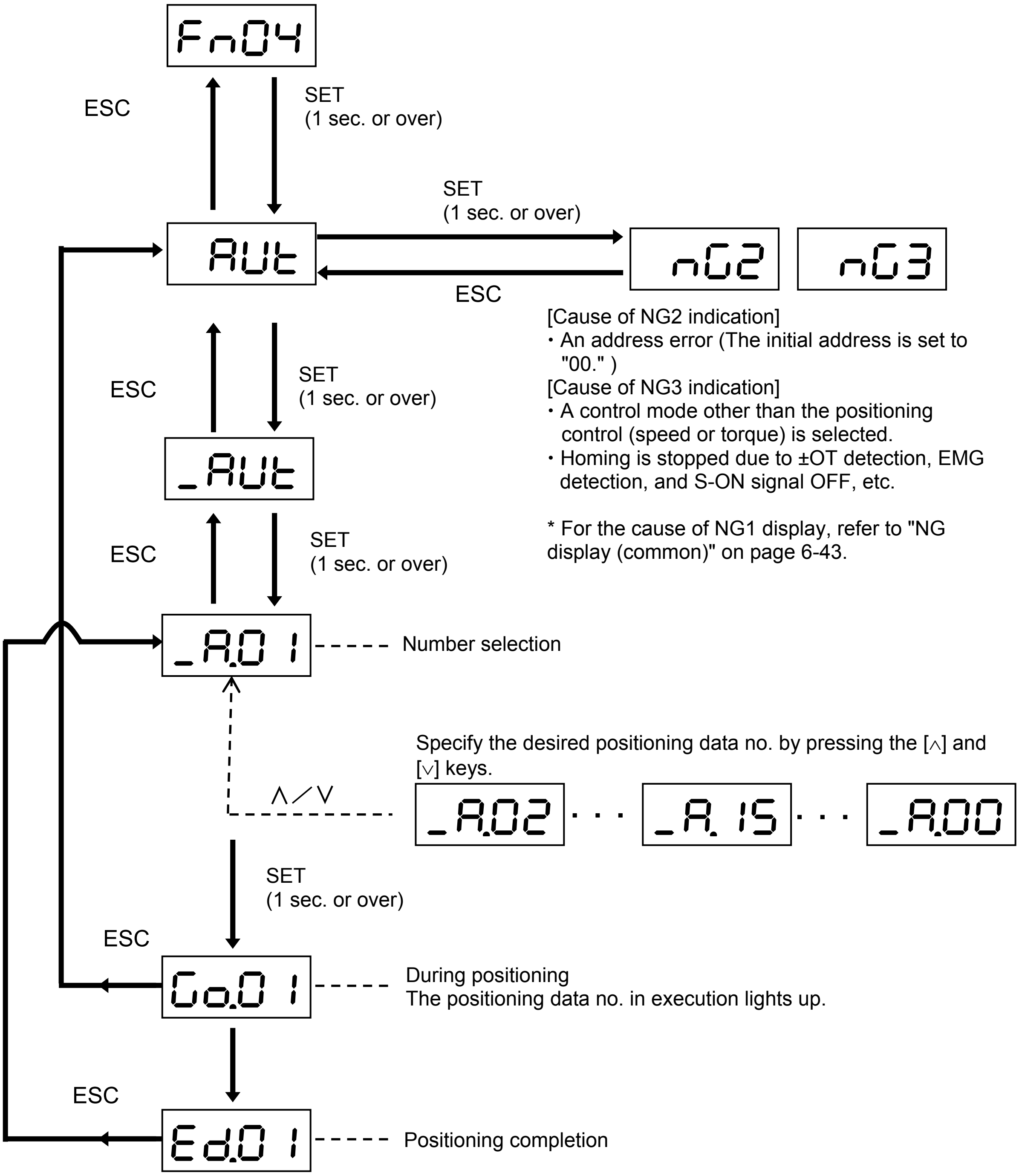
6

(3) Homing

Operate the keypad keys to perform homing. The homing profile follows the settings of parameters PA2_6 through PA2_18.



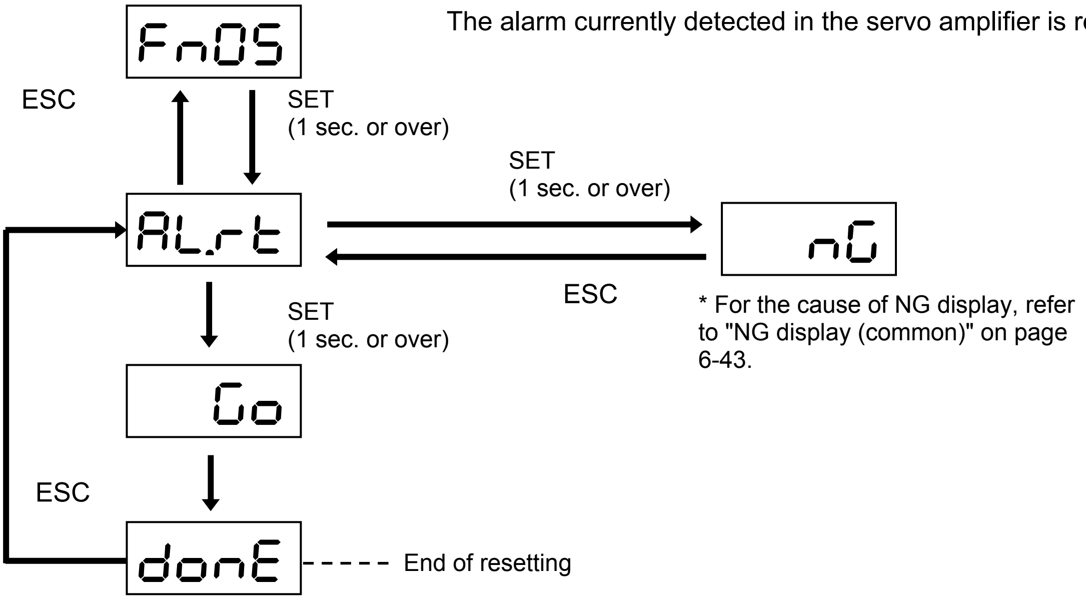
(4) Automatic operation
Operate the keypad keys to perform automatic operation.
Positioning is executed according to the registered positioning data 1 to 15.



Note	The forced stop, external regenerative 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

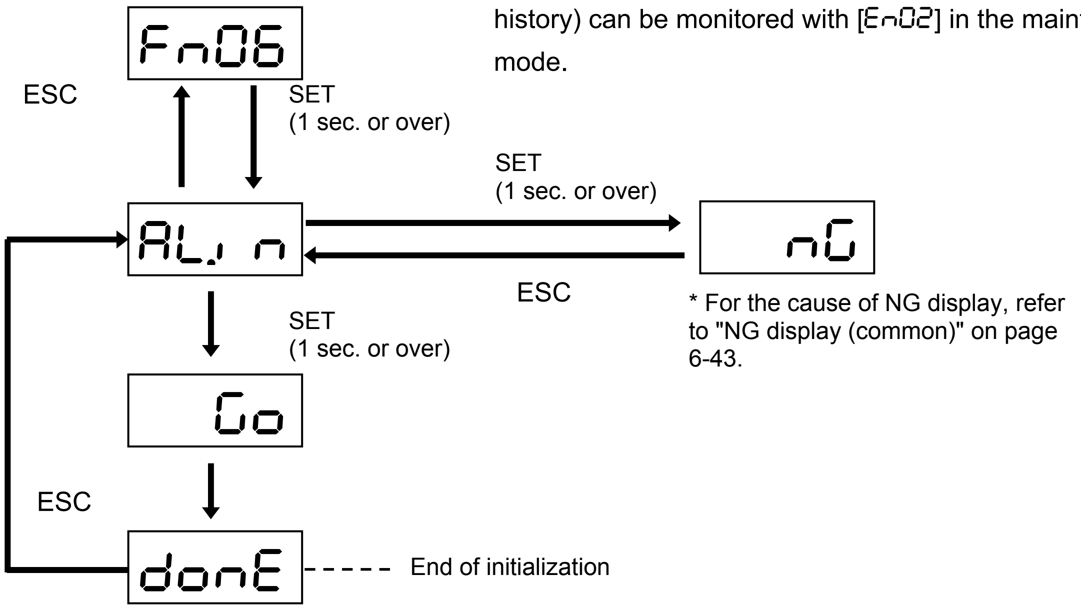
Display	Name
oc1	Overcurrent 1
oc2	Overcurrent 2
oS	Overspeed
Hu	Overvoltage
tH	Breaking Transistor Overheat
Ec	Encoder Communication Error
oL1	Overload 1
oL2	Overload 2
LuP	Main Power Undervoltage
rH1	Internal Breaking Resistor Overheat
rH2	External Breaking Resistor Overheat
oF	Deviation Overflow
AH	Amplifier Overheat
EH	Encoder Overheat

■ Alarms not removed through alarm resetting

Display	Name
Et1	Encoder Trouble 1
Et2	Encoder Trouble 2
ct	Circuit Trouble
cE	Motor Combination Error
tH	Breaking Transistor Overheat
ctE	CONT (Control signal) Error
rH3	Breaking Transistor Error
rH4	Inrush Current Suppression Circuit Trouble
dL1	Absolute Data Lost 1
dL2	Absolute Data Lost 2
dL3	Absolute Data Lost 3
AF	Absolute Data Over Flow
iE	Initial Error

(6) Alarm history initialization

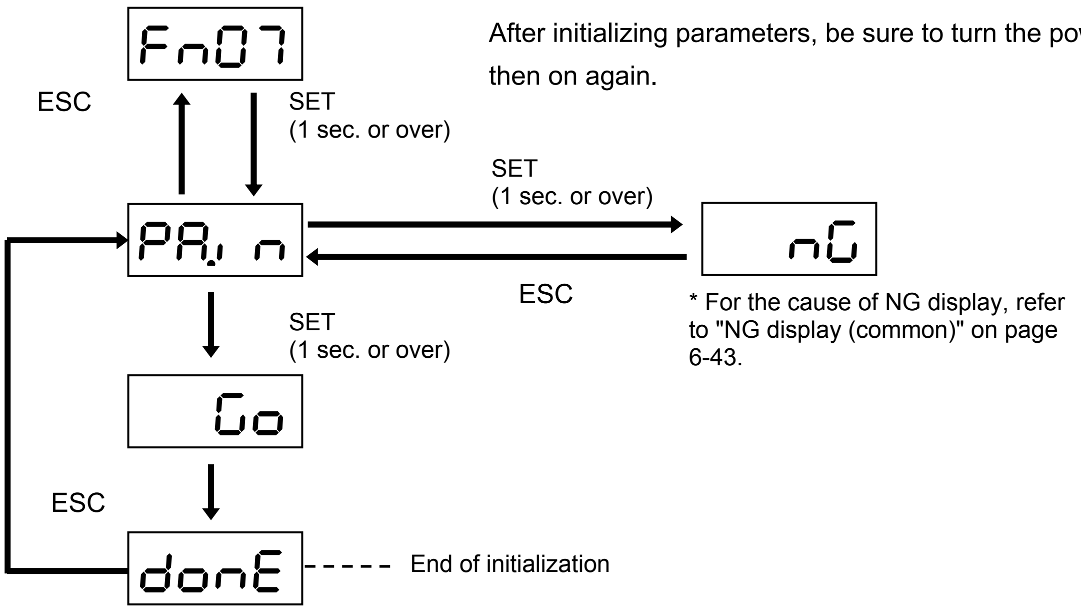
The history of detected alarms recorded in the servo amplifier is deleted. The alarm detection history (alarm history) can be monitored with [En02] in the maintenance mode.



・The alarm history is retained even after the power is turned off.

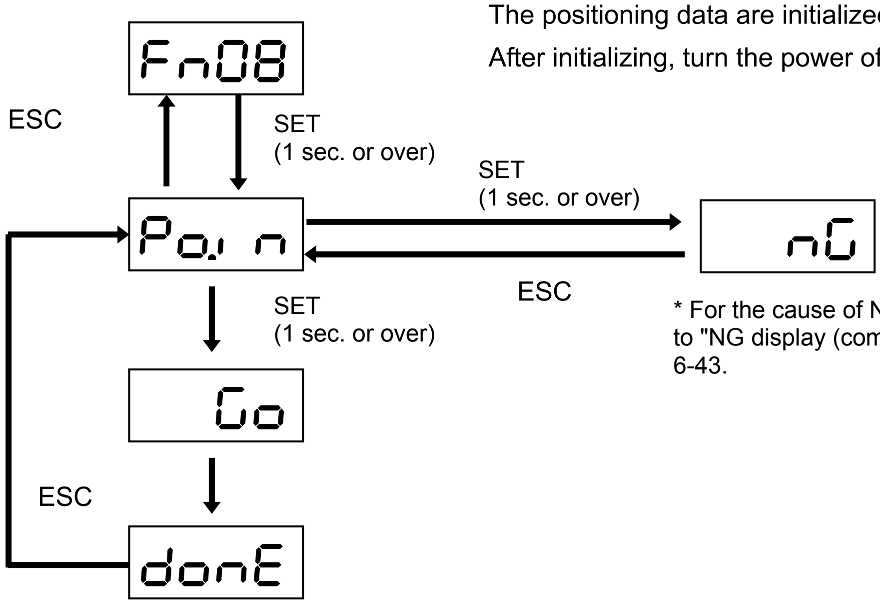
(7) Parameter initialization

Parameters are initialized.
After initializing parameters, be sure to turn the power off then on again.



(8) Positioning data initialization

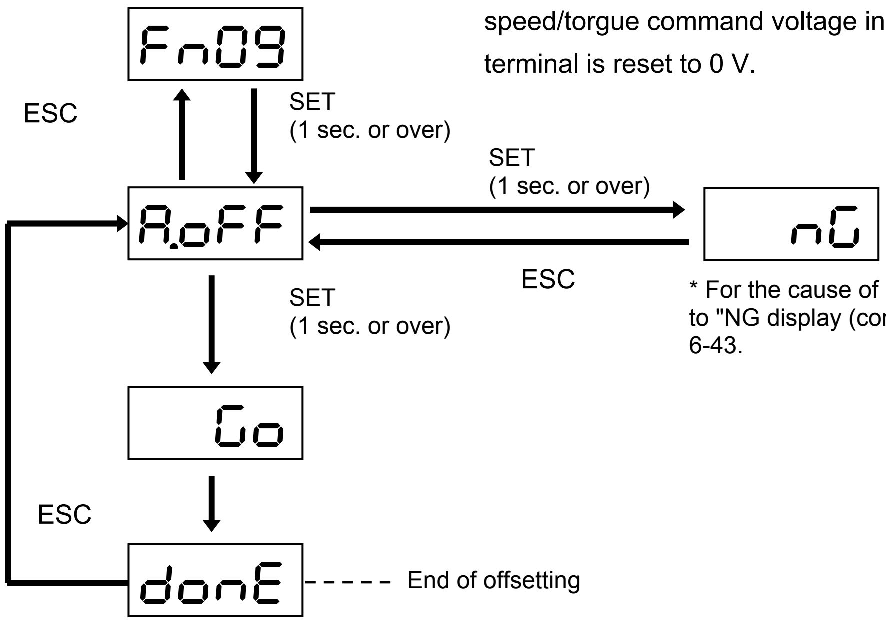
The positioning data are initialized.
After initializing, turn the power off then on again.



* For the cause of NG display, refer to "NG display (common)" on page 6-43.

(9) Auto offset adjustment

The current input voltage supplied at the analog speed/torgue command voltage input [VREF] / [TREF] terminal is reset to 0 V.



* For the cause of NG display, refer to "NG display (common)" on page 6-43.

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] and [TREF] terminals. The operation command can be given or not given.

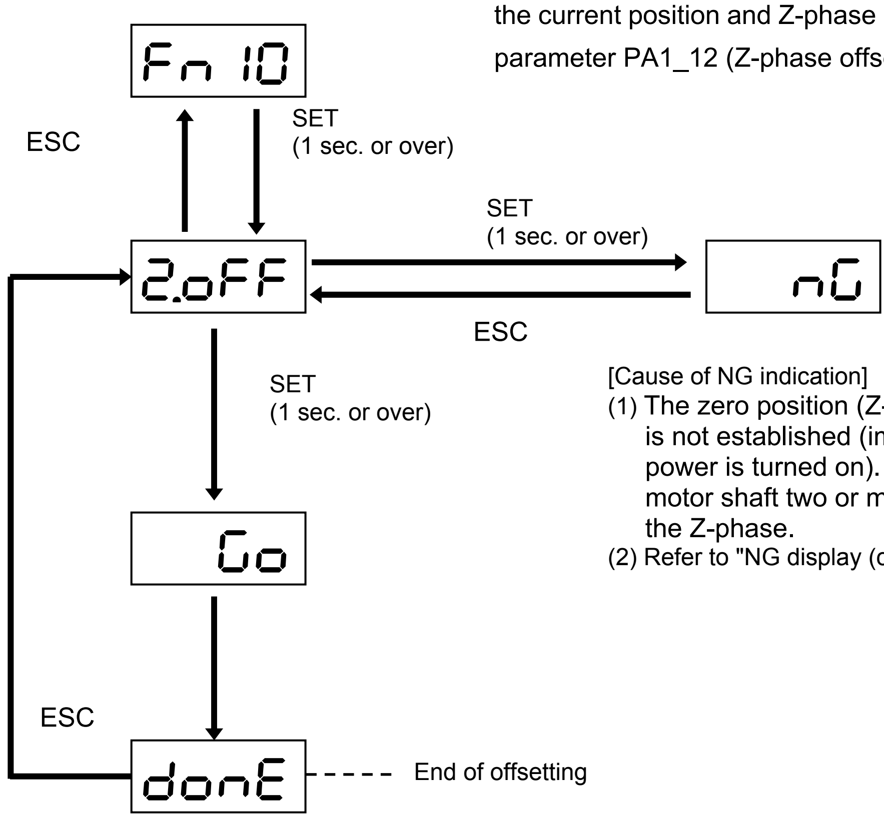
[2] Select [Fn09] at the keypad and press the [SET/SHIFT] key to automatically adjust the offset.

[3] Turn the operation command [S-ON] signal on and check that the output shaft of the servomotor does not rotate.

Hint	• Results of adjustment are stored in parameter PA3_32 and PA3_34. • 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 offset adjustment

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).



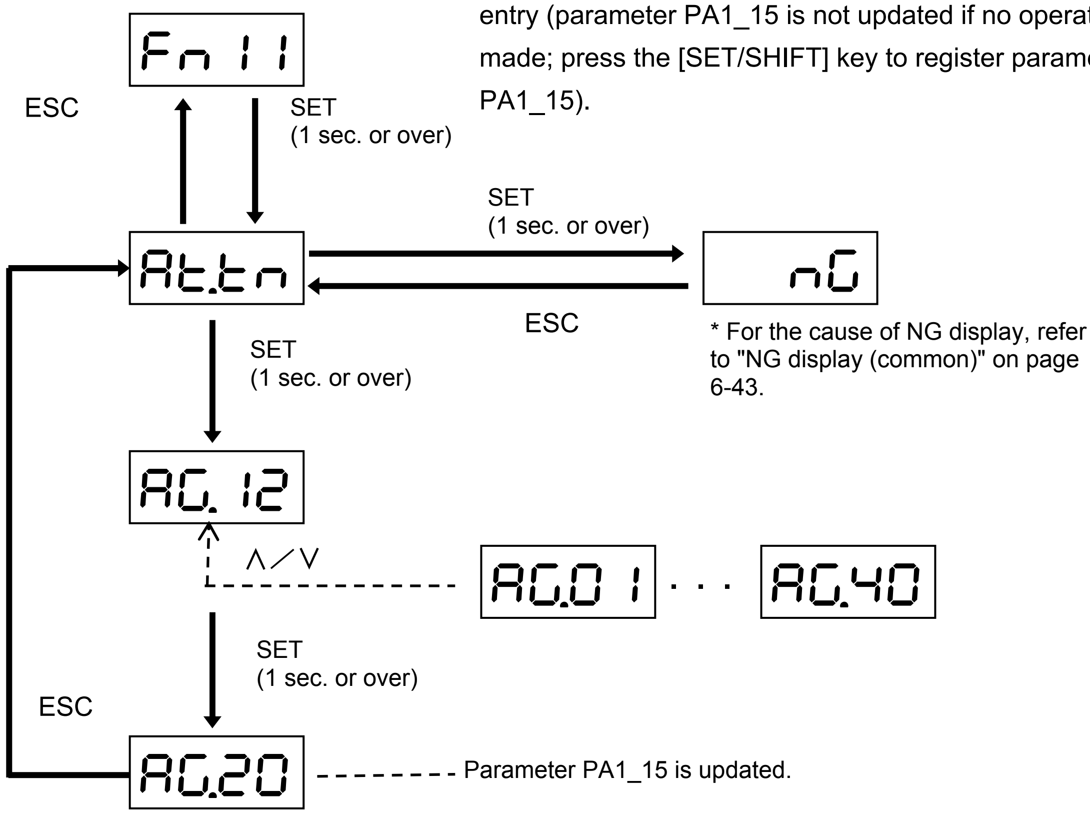
[Cause of NG indication]

(1) 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.

(2) Refer to "NG display (common)" on page 6-43.

(11) Auto tuning gain

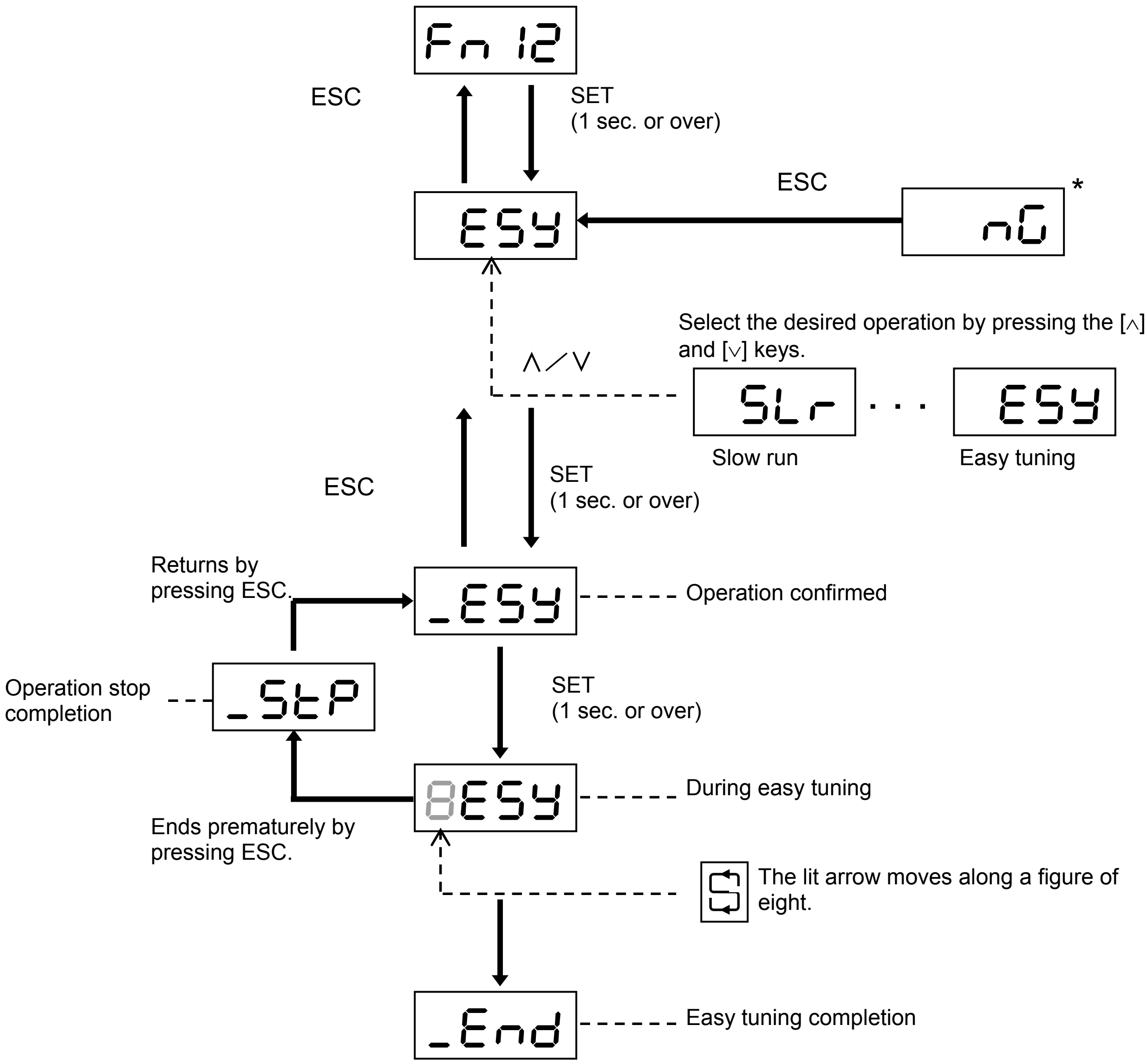
Parameter PA1_15 (auto tuning gain 1) is updated at real time.
The data is reflected at real time merely through increase/decrease of data, different from regular parameter entry (parameter PA1_15 is not updated if no operation is made; press the [SET/SHIFT] key to register parameter PA1_15).



(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_10	Once	PA1_37	PA1_38	10 r/min	PA1_22	PA1_23	
Easy tuning	PA1_20	Max. 50 times	Automatically calculated	Automatically calculated	PA1_21	PA1_22	PA1_23	



*[Cause of NG1 indication]

- The parameter PA1_13 (tuning mode) is set to "12" (manual).
- The parameter PA2_74 (parameter write protection) is set to "1" (write protect).
- Operation is disabled due to EMG detection or alarm detection.
- During motor rotation.

[Cause of NG2 indication]

- Operation is stopped due to ±OT detection, EMG detection, and S-ON signal OFF, etc.

[Cause of NG3 indication]

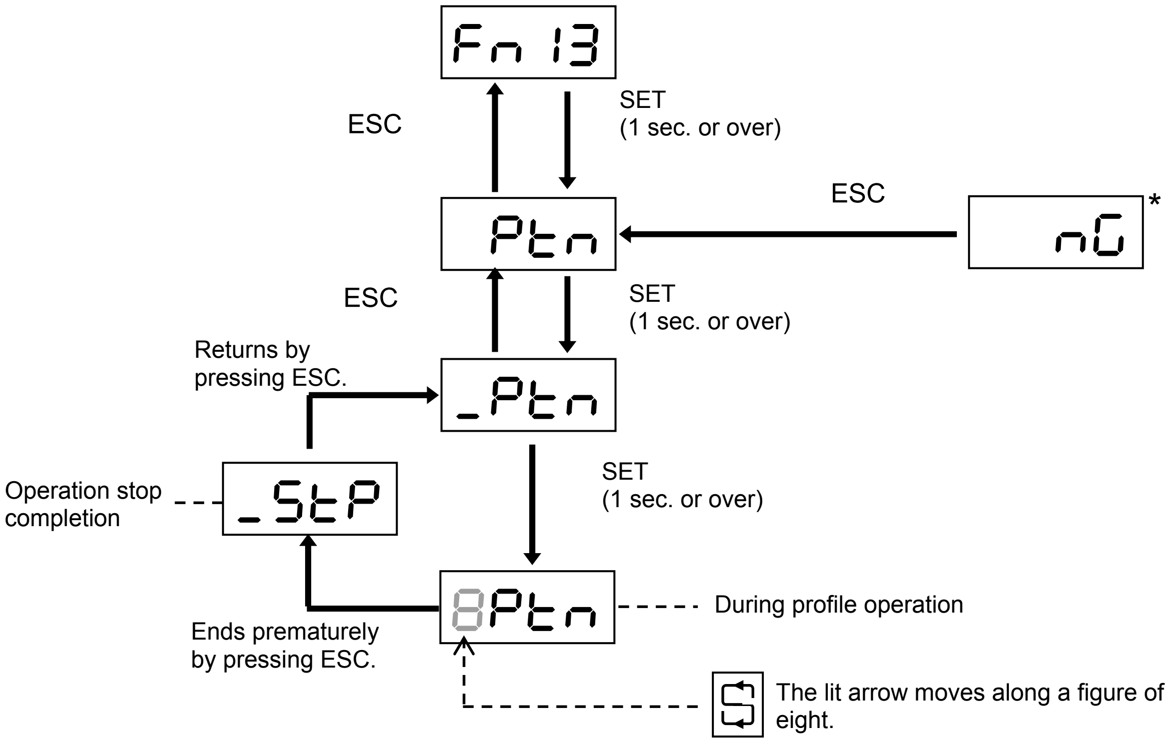
- The motor is oscillating even when the auto tuning gain is set to 4 or lower.

(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	



*[Cause of NG1 indication]

- Operation is disabled due to EMG detection or alarm detection.
- During motor rotation.

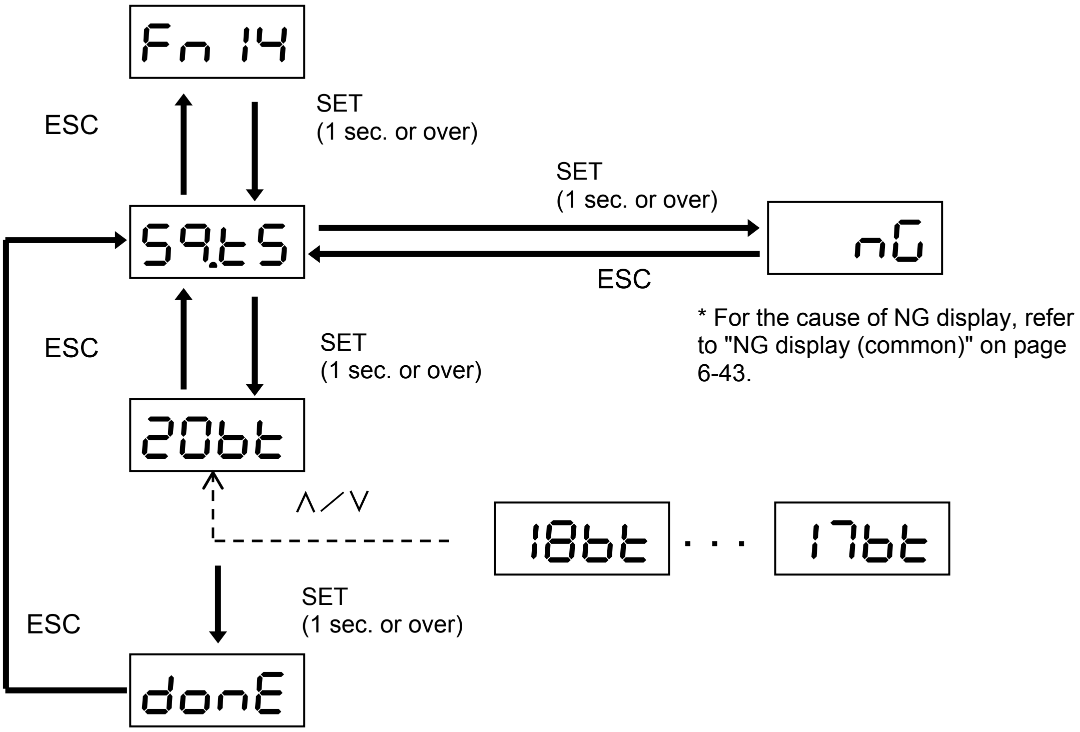
[Cause of NG2 indication]

- Operation is stopped due to ±OT detection, EMG detection, S-ON signal OFF, and alarm detection, etc.

6

(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.



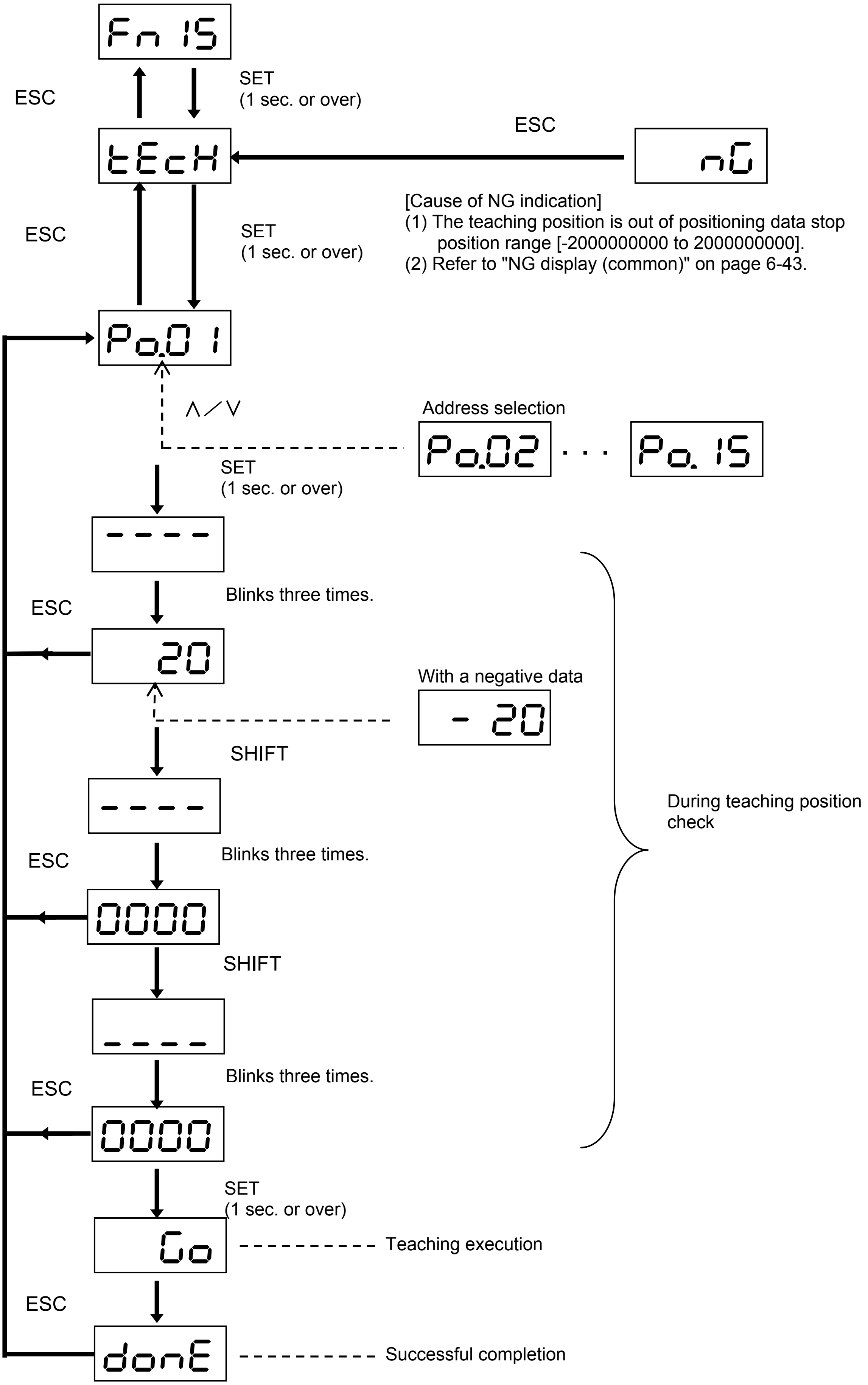
Hint	
Hint	• During the sequence test mode the 7-seg display (all the four digits) flashes with blinking with interval of several seconds. The display does not flash with blinking during key operation and data editing. • The sequence test mode is not finished even if another mode other than "Fn_014" 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

After operating the servomotor in the manual operation or pulse 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.



Fn 15
ESC
SET
(1 sec. or over)
tEcH
ESC
nG
[Cause of NG indication]
(1) The teaching position is out of positioning data stop position range [-2000000000 to 2000000000].
(2) Refer to "NG display (common)" on page 6-43.
ESC
SET
(1 sec. or over)
Po.01
∧／∨
Address selection
Po.02 . . . Po.15
SET
(1 sec. or over)

Blinks three times.
ESC
20
With a negative data
- 20
SHIFT

Blinks three times.
ESC
0000
SHIFT
____
Blinks three times.
ESC
0000
During teaching position check
SET
(1 sec. or over)
Go
Teaching execution
ESC
donE
Successful completion

6

6

7

CHAPTER 7 MAINTENANCE AND INSPECTION

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

There is a risk of electric shock.
- If the charge LED is off even though the power is turnd on, the fuse inside the servo amplifier may be blown. To check the fuse, wait five minutes or more after turning off the power.
  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.

7

■ 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. • There is no abnormal object mixing or abnormal sound or abnormal vibration in the fan,either there is no looseness in the bolt.

*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.

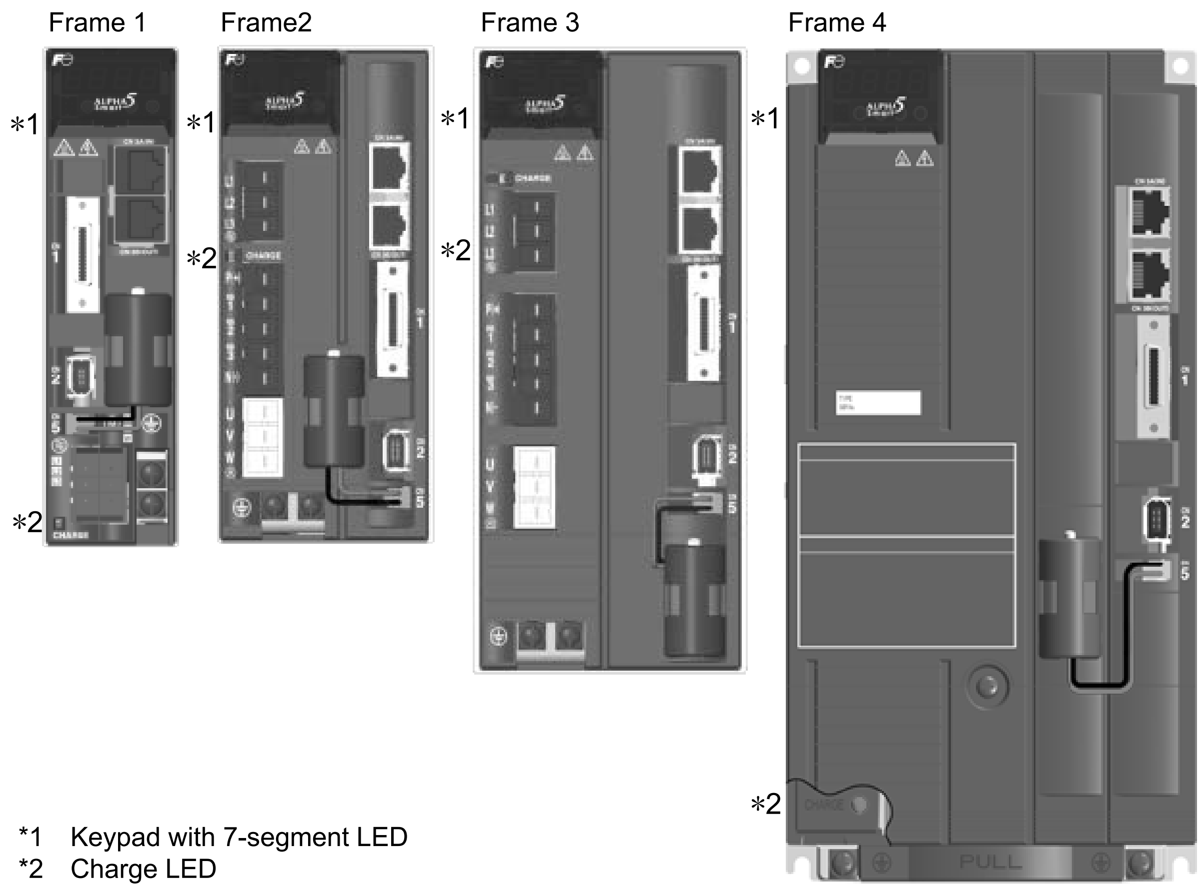
7.2 Status Display

7.2.1 Initial State

When the main circuit power (L1, L2 and L3) is supplied to the servo amplifier, the seven-segment LED of the keypad and the charge LED light up.

If nothing is displayed even though the power is supplied, contact us.

■ Front view of servo amplifier



*1 Keypad with 7-segment LED
*2 Charge LED

7.2.2 State at Alarm

In case of alarm, the servo amplifier will indicate alarm code on the key pad 7-segment LED.

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 display on the amplifier will show an alarm code as per the following table.

Order of description	display	Name	Type
1	oc1	Overcurrent 1	Major
2	oc2	Overcurrent 2	
3	oS	Overspeed	
4	Hv	Overvoltage	
5	Et1	Encoder Trouble 1	
6	Et2	Encoder Trouble 2	
7	ct	Circuit Trouble	
8	dE	Memory Error	
9	Fb	Fuse Blown	
10	cE	Motor Combination Error	
11	tH	Breaking Transistor Overheat	
12	Ec	Encoder Communication Error	
13	ctE	CONT（Control signal）Error	
14	oL1	Overload 1	
15	oL2	Overload 2	
16	rH4	Inrush Current Suppression Circuit Trouble	
17	LvP	Main Power Undervoltage	Minor
18	rH1	Internal Breaking Resistor Overheat	
19	rH2	External Breaking Resistor Overheat	
20	rH3	Breaking Transistor Error	
21	oF	Deviation Overflow	
22	AH	Amplifier Overheat	
23	EH	Encoder Overheat	
24	dL1	Absolute Data Lost 1	
25	dL2	Absolute Data Lost 2	
26	dL3	Absolute Data Lost 3	
27	AF	Multi-turn Data Over Flow	
28	iE	Initial Error	

To reset the alarm, perform one of the following methods.

- Turn the alarm reset (RST: sequence input signal) on temporarily and then turn it off.
- From the keypad, select the test operation mode [Fn05] and execute the 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 the alarm reset in the "monitor" command.
- After the alarm reset, the data specified with parameter "PA2_77 (initial display of the keypad)" is displayed.

■ Alarm reset

Some alarms cannot be cleared through alarm resetting. To remove the alarm that is not cleared through alarm resetting, remove the cause of the alarm following the method described in "7.3 Troubleshooting Method" after (or before) the power is turned off, and then reset the status by turning the power again.

Alarms cleared through alarm resetting

display	Name
oc1	Overcurrent 1
oc2	Overcurrent 2
oS	Overspeed
Hu	Overvoltage
tH	Breaking Transistor Overheat
Ec	Encoder Communication Error
oL1	Overload 1
oL2	Overload 2
LuP	Main Power Undervoltage
rH1	Internal Breaking Resistor Overheat
rH2	External Breaking Resistor Overheat
oF	Deviation Overflow
AH	Amplifier Overheat
EH	Encoder Overheat

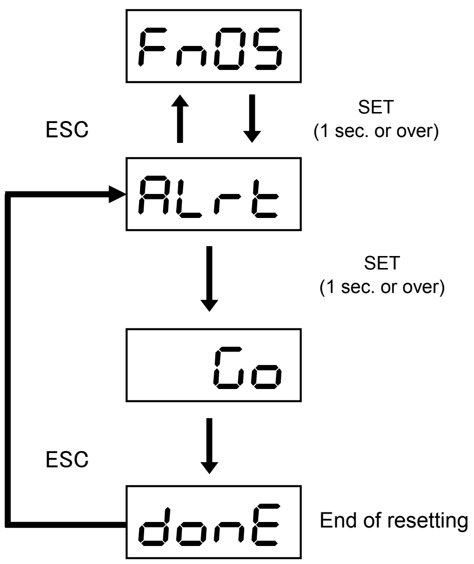
Alarms not cleared through alarm resetting

display	Name
Et1	Encoder Trouble 1
Et2	Encoder Trouble 2
ct	Circuit Trouble
dE	Memory Error
Fb	Fuse Blown
cE	Motor Combination Error
ctE	CONT（Control signal）Error
rH3	Breaking Transistor Error
rH4	Inrush Current Suppression Circuit Trouble
dL1	Absolute Data Lost 1*
dL2	Absolute Data Lost 2*
dL3	Absolute Data Lost 3*
AF	Multi-turn Data Over Flow*
iE	Initial Error

* The alarms dL1 to 3 and AF can be canceled by position preset.

Alarm reset at keypad

The alarm currently detected at the servo amplifier is reset.



7.3 Troubleshooting Method

1. Overcurrent

[Display]

oC1

oC2

[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 regenerative resistor	Replace with the regenerative resistor within the rating.
Current imbalance caused by an encoder fault	Replace the servomotor.
Unconnected grounding cable	Connect the grounding cable.

2. Overspeed

[Display]

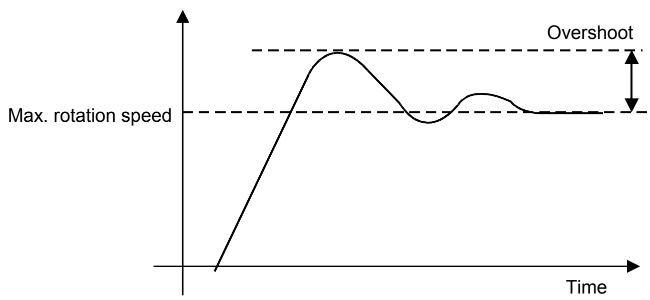
oS

[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_15 (auto tunimg gain 1). • Increase PA1_37 (acceleration time). • Increase PA1_52 (S-curve time constant).



3. Overvoltage

[Display]

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 regenerative resistor or wrong wiring	• Connect the external regenerative resistor. • Correct the wiring of the external regenerative resistor.
Broken regenerative transistor	Replace the servo amplifier.

The internal DC voltage can be checked in the monitor mode of the keypad.
[on15]: Internal DC link voltage (max. value)
Approximately over 420 V, overvoltage is detected.

4. Encoder Trouble

[Display]

Et1

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.

5. Circuit Trouble

[Display]

ct

[Description of detected alarm]

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.

6. Memory Error

[Display]

dE

[Description of detected alarm]

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. • If restoration is not obtained with the actions above, replace the servo amplifier.
The parameter overwriting frequency has exceeded 100,000 cycles.	Replace the servo amplifier. (Store the parameters which are overwritten frequently to PA2_80 to 85, parameter in RAM 1 to 6.)

7. Fuse Blown

[Display]

Fb

[Description of detected alarm]

The fuse in the servo amplifier main circuit is disconnected.

[Cause and remedy]

Cause	Remedy
The fuse is diconnected.	Replace the servo amplifier.

The main circuit fuse is used to prevent secondary disaster including fire.

Note	Customers are not allowed to replace the fuse. Contact us before turning on the power.

8. Motor Combination Error

[Display]

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.

For details, refer to “Combination between Servomotor and Servo Amplifier” in “CHAPTER 0 INTRODUCTION“.

9. Regenerative Resistor Overheat

[Display]

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.

10. Encoder Communication Error

[Display]

Ec

[Description of detected alarm]

Communications with the internal encoder of the servomotor fails.

[Cause and remedy]

Cause	Remedy
Error in encoder serial communications	• Check cables visually and through continuity check and correct faults. • Check for the broken wire in the encoder cable and correct if broken. • Insert ferrite cores.
Broken wire or poor contact	

The servo amplifier and encoder communicate through high speed serial communications. The encoder signal 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).

11. Cont (Control signal) Error

[Display]

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.

12. Overload

[Display]

oL 1

oL2

[Description of detected alarm]

- OL1: Alarm that detects failures such as a locked shaft instantaneously. (3 s/300%)
- OL2: The effective torque exceeds the allowable limit of the servomotor. (Detection at electronic thermal relay built in servo amplifier)

[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 the monitor mode of the keypad in both cases.

13. Main Power Undervoltage

[Display]

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.

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.

14. Internal Regenerative Resistor Overheat

[Display]

rH1

[Description of detected alarm]

The power consumption of the regenerative 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 regenerative resistor. • Install a counterweight.
The regenerative resistor is not connected.	Connect correctly. Set PA2_65 at 0 or 2.

Note: The internal regenerative resistor is possibly to get hot, so do not touch it.

15. External Regenerative Resistor Overheat

[Display]

rH2

[Description of detected alarm]

The external regenerative resistor overheat signal (normally closed contact signal) has worked (was open).

[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 regenerative resistor. • Install a counterweight.
Wrong wiring of external regenerative resistor overheat signal	Connect correctly.

7

16. Regenerative Transistor Error

[Display]

rH3

[Description of detected alarm]

The regeneration handling transistor built in the servo amplifier is damaged.

[Cause and remedy]

Cause	Remedy
The regenerative transistor is short circuited or damaged.	Turn the power off then on again. If the alarm persists, replace the servo amplifier.

Note	If the regenerative transistor is short circuited or damaged, fire may be caused. If the regenerative transistor fault alarm signal is output, turn the power off immediately.

17. Inrush Current Suppression Circuit Trouble

[Display]

rH4

[Description of detected alarm]

The circuit inside the servo amplifier which suppresses the inrush current generated at the power on may be broken.

[Cause and remedy]

Cause	Remedy
The servo amplifier is damaged.	Replace the servo amplifier.
The ambient temperature exceeds 55°C.	Keep the ambient temperature 55℃ or lower (40℃ or below is recommended).
	Move heat generating bodies near the servo amplifier as far away as possible.
The power is frequently supplied.	Reduce the frequency of turning the power on/off. (Reference: once a minute or less)

Note	If this alarm is detected even when the ambient temperature is below 55℃, replace the servo amplifier without attempting operating it.

18. Deviation Overflow

[Display]

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 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]

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.

Note	Effective torque may be exceeding 100% during operation. Check the effective torque using the keypad or PC loader so that it may not exceed 100%.

20. Encoder Overheat

[Display]

EH

[Description of detected alarm]

The encoder inside the servomotor is overheated exceeding the allowable temperature.

[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.

21. Absolute Data Lost

[Display]

dL1

dL2

dL3

[Description of detected alarm]

The absolute data of the encoder is lost.

- dL1: Battery voltage drop, broken encoder cable
- dL2: Multi-turn data fault in encoder
- dL3: Detection at power-on after an ET alarm

[Cause and remedy]

Cause	Remedy
dL1 alarm	• Check for the broken wire or wrong wiring in the encoder cable and correct. • Replace the battery. • A warning is displayed on the amplifier 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 cleared but the ET alarm persists. If the ET alarm is not cleared, replace the servomotor.

For details, refer to "CHAPTER 11 ABSOLUTE POSITION SYSTEM."

22. Multi-turn Data Over Flow

[Display]

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]

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.

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] RYH201F5-VV2
Device configuration	Host control unit, external regenerative resistor, etc. [Example] External regenerative 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

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 GYB, GYG, GYC and GYS 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.
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 display a warning on the 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 regenerative. Failure will be caused if the brake is used for regenerative, 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 display a warning on the 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.
By setting "1" to parameter PA2_78 (display transition at warning detection), a warning is displayed on the amplifier if the battery voltage becomes lower than the rated value.
Replace the battery soon while leaving the power turned on.
When the battery life becomes extremely short, a possibility for wrong wiring can be considered.

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

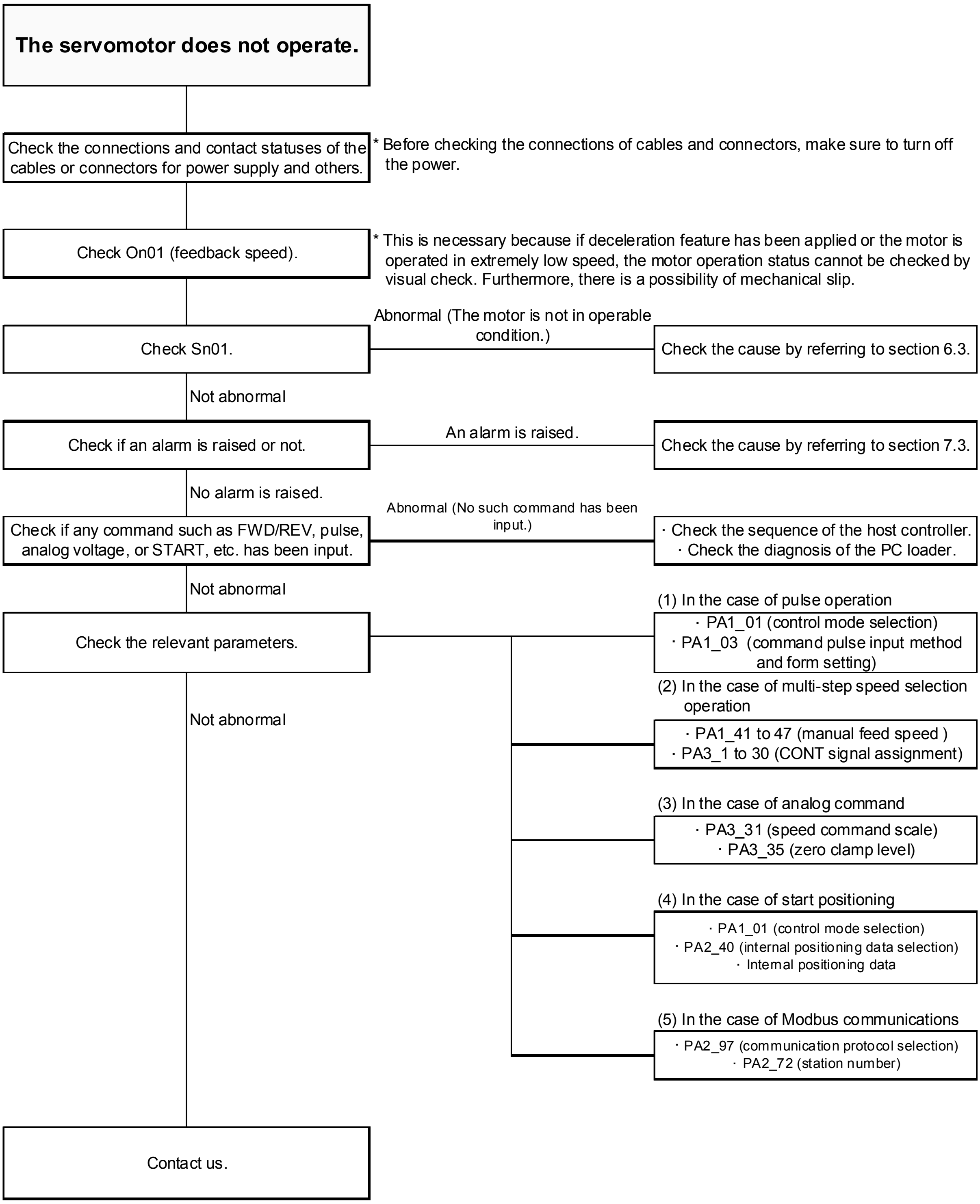
Part name	Standard service life	Method
Bearing	20,000 to 30,000 hours	Send the product back to us for repair.
Oil seal	5,000 hours	

■ 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

7.7 Troubleshooting



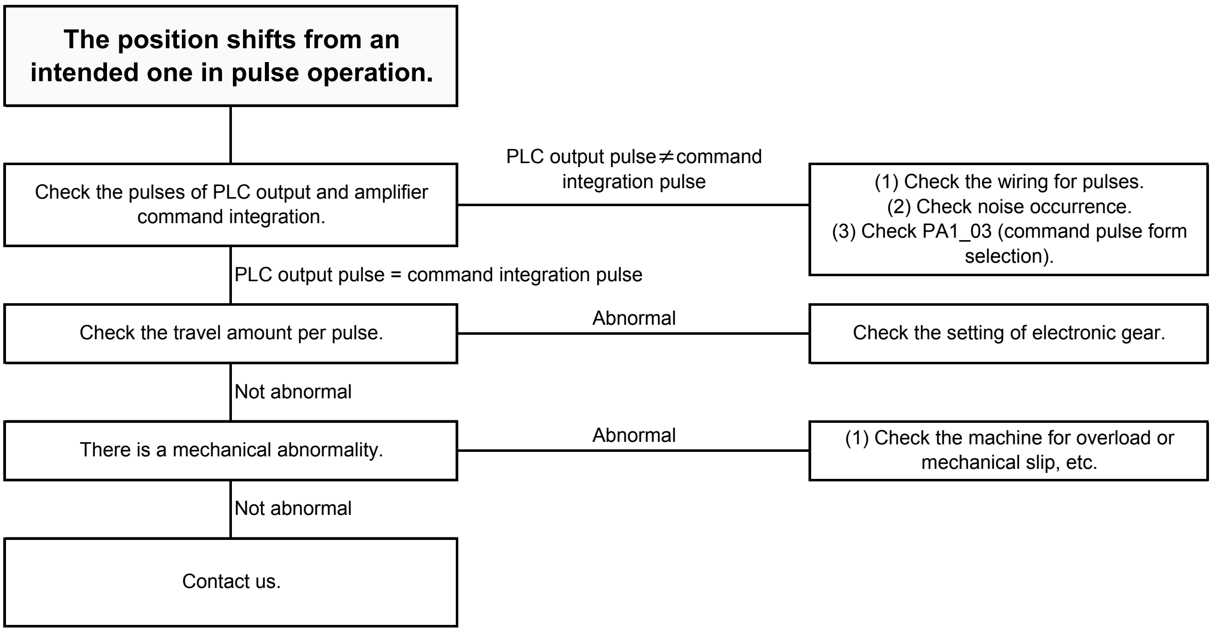
7

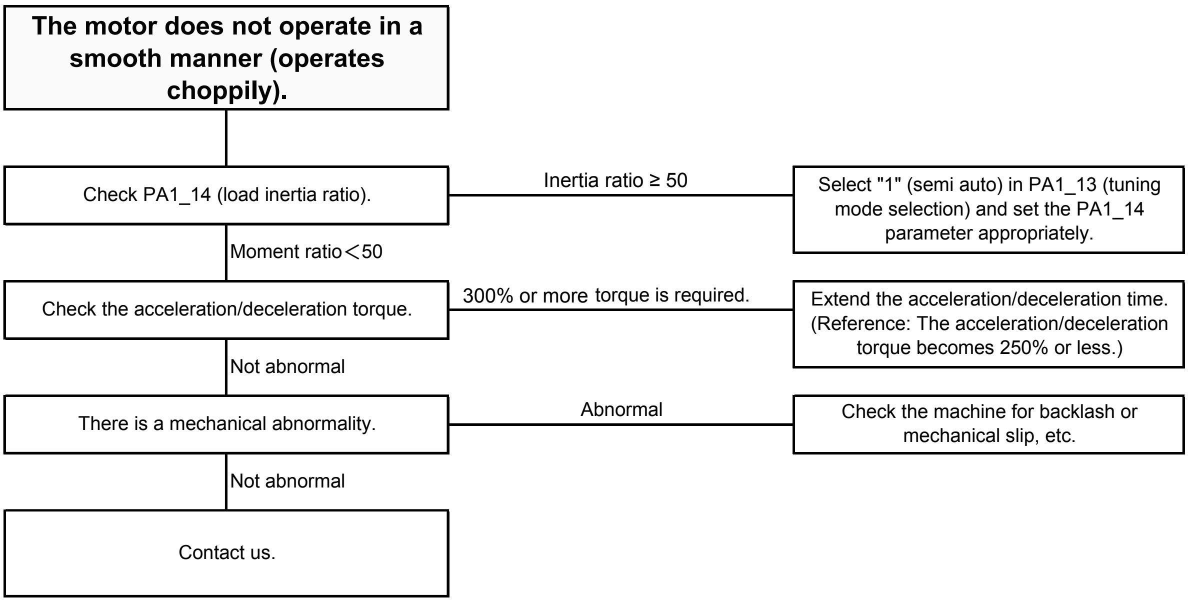
The servo motor has operated briefly and stopped.

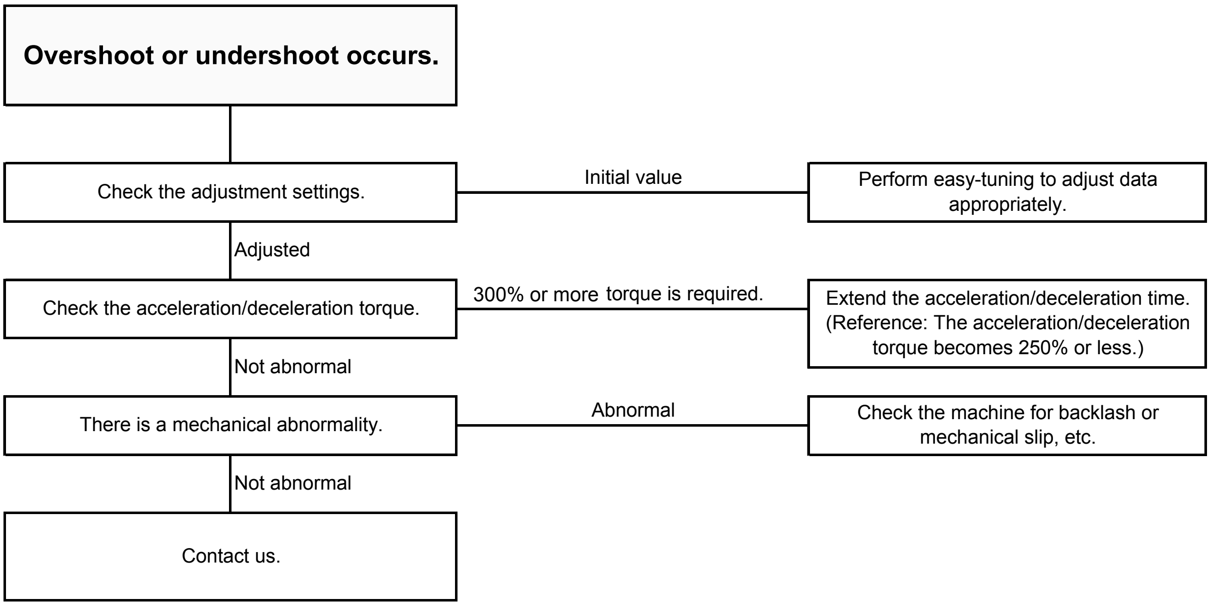
- Check if an alarm is raised or not.
  - An alarm is raised. → Check the cause by referring to section 7.3.
  - No alarm is raised.
- Check if the brake is released.
  - The brake is not released. → (1) Check the brake power. (2) Check the brake ON/OFF sequence.
  - The brake is released.
- There is a mechanical abnormality.
  - Abnormal → (1) Check the machine for the stroke end or mechanical slip, etc.
  - Not abnormal
- Contact us.

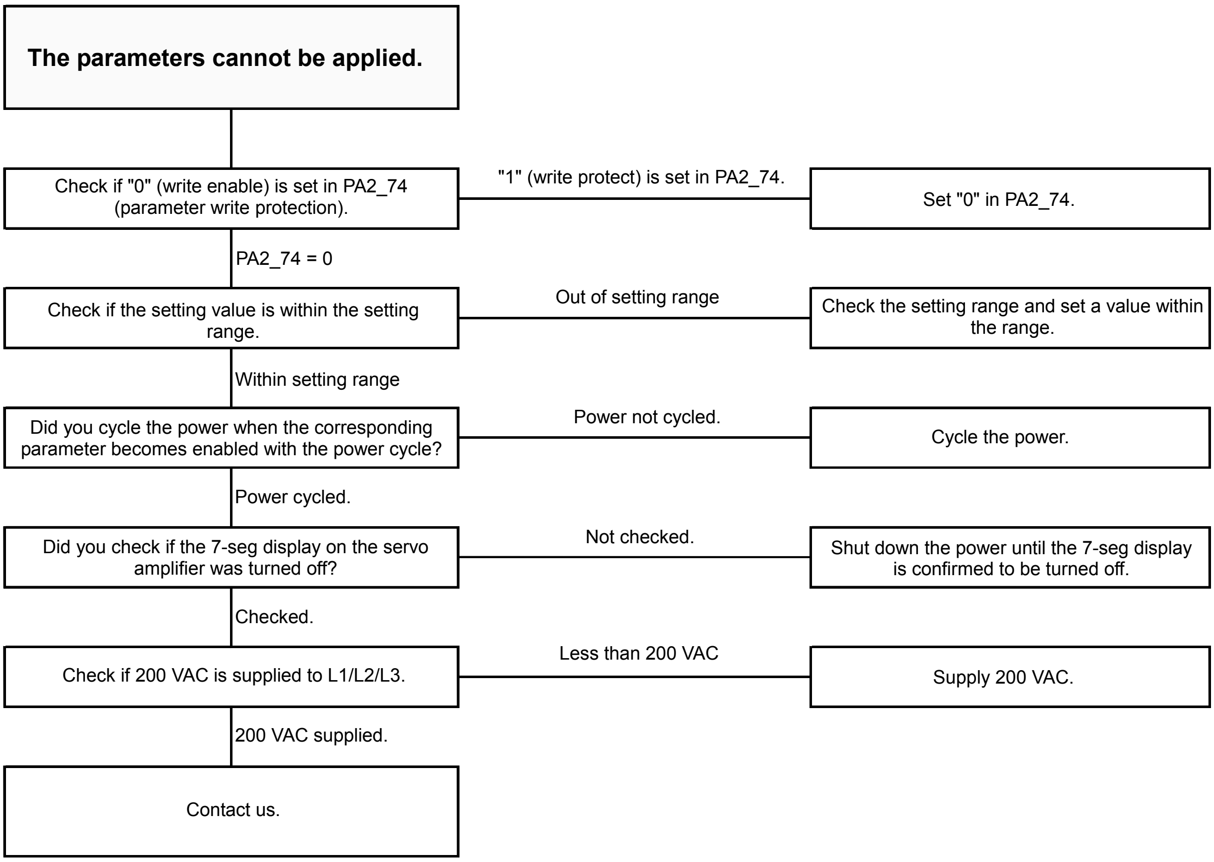
The motor issues unpleasant noise.

- Check if the motor is oscillating or not.
  - Oscillating → Reduce the PA1_15 (auto tuning gain 1) value.
  - Not oscillating
- Check if the brake is released.
  - The brake is not released. → (1) Check the brake power. (2) Check the brake ON/OFF sequence.
  - The brake is released.
- Check the wiring of power to the servomotor.
  - Abnormal → (1) Check the wiring of U/V/W. (2) Check if the wiring is connected to a wrong motor or not.
  - Not abnormal
- Check the wiring of the encoder cables.
  - Abnormal → (1) Check the encoder cables. (2) Check if the wiring is connected to a wrong motor or not.
  - Not abnormal
- There is a mechanical abnormality.
  - Abnormal → (1) Check the machine for the stroke end or mechanical slip, etc.
  - Not abnormal
- Contact us.


The position shifts from an intended one in pulse operation.
Check the pulses of PLC output and amplifier command integration.
PLC output pulse≠command integration pulse
(1) Check the wiring for pulses.
(2) Check noise occurrence.
(3) Check PA1_03 (command pulse form selection).
PLC output pulse = command integration pulse
Check the travel amount per pulse.
Abnormal
Check the setting of electronic gear.
Not abnormal
There is a mechanical abnormality.
Abnormal
(1) Check the machine for overload or mechanical slip, etc.
Not abnormal
Contact us.


The motor does not operate in a smooth manner (operates choppily).
Check PA1_14 (load inertia ratio).
Inertia ratio ≥ 50
Select "1" (semi auto) in PA1_13 (tuning mode selection) and set the PA1_14 parameter appropriately.
Moment ratio＜50
Check the acceleration/deceleration torque.
300% or more torque is required.
Extend the acceleration/deceleration time. (Reference: The acceleration/deceleration torque becomes 250% or less.)
Not abnormal
There is a mechanical abnormality.
Abnormal
Check the machine for backlash or mechanical slip, etc.
Not abnormal
Contact us.


Overshoot or undershoot occurs.
Check the adjustment settings.
Initial value
Perform easy-tuning to adjust data appropriately.
Adjusted
Check the acceleration/deceleration torque.
300% or more torque is required.
Extend the acceleration/deceleration time. (Reference: The acceleration/deceleration torque becomes 250% or less.)
Not abnormal
There is a mechanical abnormality.
Abnormal
Check the machine for backlash or mechanical slip, etc.
Not abnormal
Contact us.


The parameters cannot be applied.
Check if "0" (write enable) is set in PA2_74 (parameter write protection).
"1" (write protect) is set in PA2_74.
Set "0" in PA2_74.
PA2_74 = 0
Check if the setting value is within the setting range.
Out of setting range
Check the setting range and set a value within the range.
Within setting range
Did you cycle the power when the corresponding parameter becomes enabled with the power cycle?
Power not cycled.
Cycle the power.
Power cycled.
Did you check if the 7-seg display on the servo amplifier was turned off?
Not checked.
Shut down the power until the 7-seg display is confirmed to be turned off.
Checked.
Check if 200 VAC is supplied to L1/L2/L3.
Less than 200 VAC
Supply 200 VAC.
200 VAC supplied.
Contact us.

CHAPTER 8 SPECIFICATIONS

8.1 Specifications of Servomotor

8.1.1 GYB Motor

200 V series

■ Standard specifications

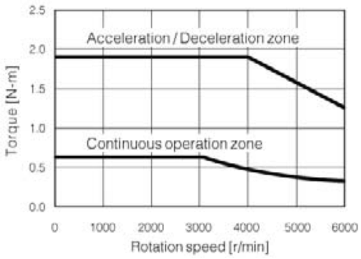
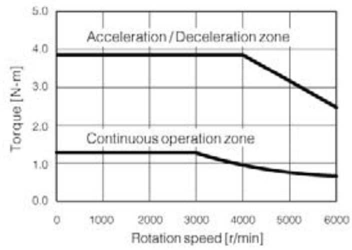
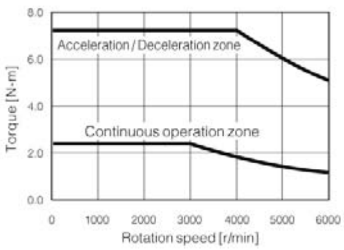
Motor type (-B) indicates the brake-incorporated type.	GYB201 D5-□□2 (-B)	GYB401 D5-□□2 (-B)	GYB751 D5-□□2 (-B)
Rated output [kW]	0.2	0.4	0.75
Rated torque [N · m]	0.637	1.27	2.39
Rated speed [r/min]	3000		
Max. speed [r/min]	6000*1		
Max. torque [N · m]	1.91	3.82	7.17
Inertia [kg · m²] ( ) indicates brake-incorporated type.	0.24×10^{-4} (0.29×10^{-4})	0.42×10^{-4} (0.46×10^{-4})	1.43×10^{-4} (1.61×10^{-4})
Rated current [A]	1.5	2.7	5.2
Max. current [A]	4.5	8.1	15.6
Winding insulation class	Class B		
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67, excluding the shaft-through)*2		
Terminals (motor)	0.3m cable		
Terminals (encoder)	0.3m cable		
Overheat protection	Not provided (The servo amplifier detects temperature.)		
Mounting method	By securing motor flange IMB5 (L51), IMV1 (L52), IMV3 (L53)		
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)		
Vibration level *3	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 (without condensation)		
Vibration resistance [m/s²]	49		
Mass [kg] ( ) indicates brake-incorporated type.	1.0 (1.5)	1.5 (2.1)	3.0 (3.9)
Compliance with standards	UL/cUL (UL508c) (Some models are in the process to be certified), CE marking (low power directive EN61800-5-1), RoHS directive.		

*1: The max. speed of 5000r/min can be reached by using it with Fuji's gear head
*2: Protection degree IP67 is initial value
*3: The vibration value is the property of flange type IMN1 (L52)

■ Brake specification (motor equipped with a brake)

Motor type	GYB201 D5-□□2-B	GYB401 D5-□□2-B	GYB751 D5-□□2-B
Static friction torque [N · m]	1.27		2.45
Rated DC voltage [V]	DC24±10%		
Attraction time [ms]	40		60
Release time [ms]	20		25
Power consumption [W]	7.2 (at 20 °C)		8.5 (at 20 °C)

■ Torque characteristics diagram (at 3-phase 200 [V] or single-phase 230 [V] source voltage)

<table>
<tr><td>GYB201D5-□□2　(0.2 kW)</td><td>GYB401D5-□□2　(0.4 kW)</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>GYB751D5-□□2　(0.75 kW)</td><td rowspan="2">These characteristics indicate typical values of each servomotor combined with the corresponding servo amplifier RYH series.
The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.
・Model GYB201D, 401D　: 250 × 250 × 6 mm
・Model GYB751D　: 300 × 300 × 6 mm</td></tr>
<tr><td>
</td></tr>
</table>

8.1.2 GYH Motor

■ Standard specifications

Motor type (-B) indicates the brake-incorporated type.	GYH102 C6-T□2 (-B)	GYH152 C6-T□2 (-B)	GYH202 C6-T□2 (-B)	GYH302 C6-T□2 (-B)	GYH402 C6-T□2 (-B)	GYH552 C6-T□2 (-B)	GYH702 C6-T□2 (-B)
Rated output [kW]	1.0	1.5	2.0	3.0	4.0	5.5	7.0
Rated torque [N · m]	4.77	7.16	9.55	14.32	19.10	26.26	33.42
Rated speed [r/min]	2000						
Max. speed [r/min]	2500						
Max. torque [N · m]	14.3	21.4	28.6	42.9	47.7	65.6	83.5
Inertia [kg · m²] ( ) indicates brake-incorporated type.	6.26×10^{-4} (6.96×10^{-4})	8.88×10^{-4} (9.58×10^{-4})	12.14×10^{-4} (12.84×10^{-4})	17.92×10^{-4} (18.62×10^{-4})	39.99×10^{-4} (40.80×10^{-4})	51.44×10^{-4} (52.31×10^{-4})	63.52×10^{-4} (67.36×10^{-4})
Rated current [A]	5.1	7.3	9	13.7	16	22.5	29
Max. current [A]	15.3	21.9	27	41.1	40.8	57.4	74.0
Winding insulation class	Class F						
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft-through)*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)						
Encoder	17-bit serial encoder (incremental)						
Vibration level	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	0 to +40°C (there should be no freezing), within 90% RH (without condensation)						
Vibration resistance [m/s²]	19.6						
Mass [kg] ( ) indicates brake-incorporated type.	6.5 (8.1)	8.1 (9.7)	10.2 (11.8)	13.9 (15.5)	19.5 (23.0)	26.2 (30.0)	30.0 (34.8)

*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.

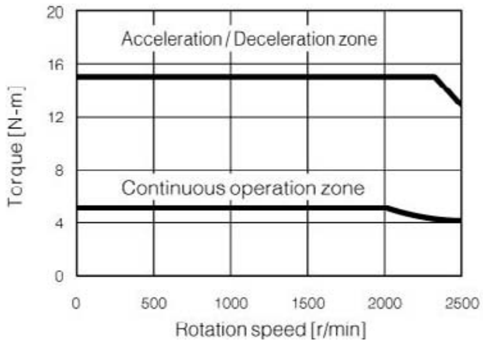
■ Brake specification (motor equipped with a brake)

Motor type	GYH102 C6-T□2 (-B)	GYH152 C6-T□2 (-B)	GYH202 C6-T□2 (-B)	GYH302 C6-T□2 (-B)	GYH402 C6-T□2 (-B)	GYH552 C6-T□2 (-B)	GYH702 C6-T□2 (-B)
Static friction torque [N · m]	20				30		50
Rated DC voltage [V]	DC24±10%				DC24±5%		
Attraction time [ms]	100				110		150
Release time [ms]	27				25		40
Power consumption [W]	19.5 (at 20°C)				23 (at 20°C)		27 (at 20°C)

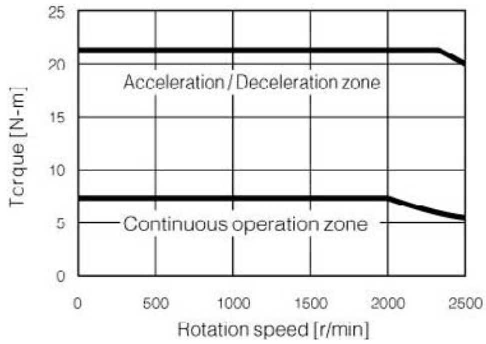
8

■ Torque characteristics diagrams (at 3-phase 200 [V] source voltage)

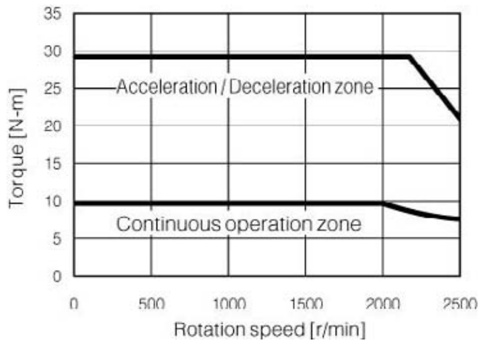
GYH102C6-T□2 (1.0kW)



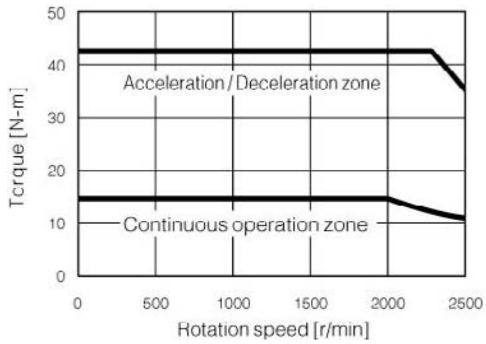
GYH152C6-T□2 (1.5kW)



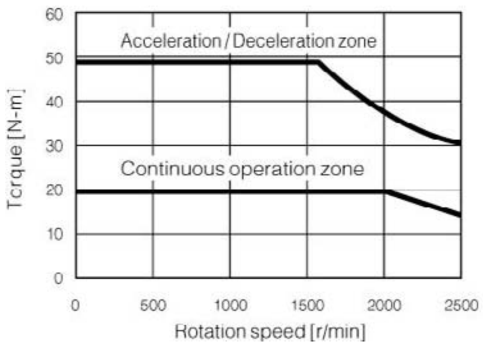
GYH202C6-T□2 (2.0kW)



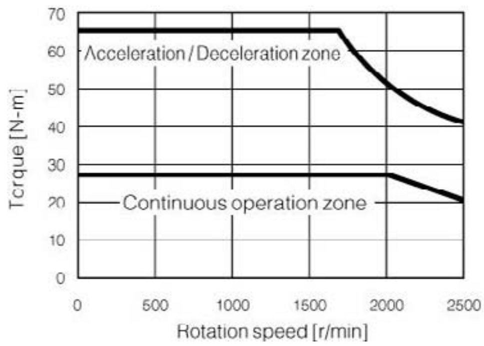
GYH302C6-T□2 (3.0kW)



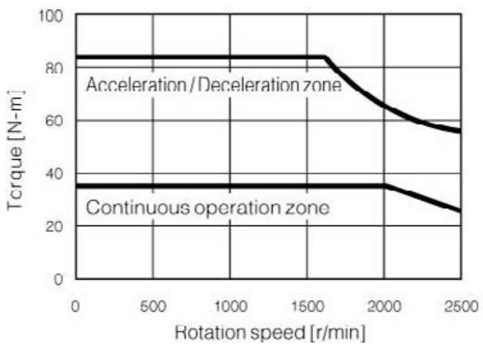
GYH402C6-T□2 (4.0kW)



GYH552C6-T□2 (5.5kW)



GYH702C6-T□2 (7.0kW)



These characteristics indicate typical values of each servomotor combined with the corresponding servo amplifier RYH series.
The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYH102, 152, 302 : 400 × 400 × 12 mm
- Model GYH402, 552, 702 : 600 × 600 × 25 mm

8.1.3 GYG Motor

■ 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)	GYG501B5 -□□2 (-B)	GYG851B5 -□□2 (-B)	GYG132B5 -□□2 (-B)
Rated output [kW]	0.5	0.75	1.0	1.5	2.0	0.5	0.85	1.3
Rated torque [N · m]	2.39	3.58	4.77	7.16	9.55	3.18	5.41	8.28
Rated speed [r/min]	2000					1500		
Max. speed [r/min]	3000							
Max. torque [N · m]	7.2	10.7	14.3	21.5	28.6	9.5	16.2	24.8
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})	11.55×10^{-4} (13.6×10^{-4})	15.15×10^{-4} (17.3×10^{-4})	22.33×10^{-4} (24.5×10^{-4})
Rated current [A]	3.5	5.2	6.4	10.0	12.3	4.7	7.3	11.5
Max. current [A]	10.5	15.6	19.2	30.0	36.9	14.1	21.9	34.5
Winding insulation class	Class F							
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft-through)*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)							
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)							
Vibration level *3	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 (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)	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							

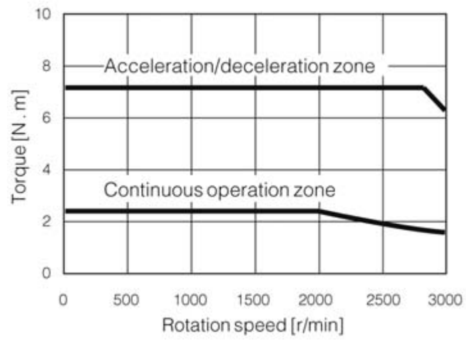
*1: The load inertia ratio to the inertia of servo motor. If the moment of load inertia ratio value exceeds the list value, please contact us.
*2: If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.
*3: The vibration value is the property of flange type IMN1(L52)

■ Brake specification (motor equipped with a brake)

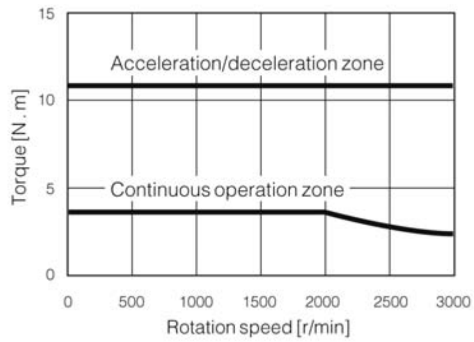
Motor type	GYG501C5 -□□2-B	GYG751C5 -□□2-B	GYG102C5 -□□2-B	GYG152C5 -□□2-B	GYG202C5 -□□2-B	GYG501B5 -□□2-B	GYG851B5 -□□2-B	GYG132B5 -□□2-B
Static friction torque [N · m]	17							
Rated DC voltage [V]	DC24±10%							
Attraction time [ms]	120							
Release time [ms]	30							
Power consumption [W]	12 (at 20 °C)							

■ Torque characteristics diagram (at 3-phase 200 V amplifier source voltage)

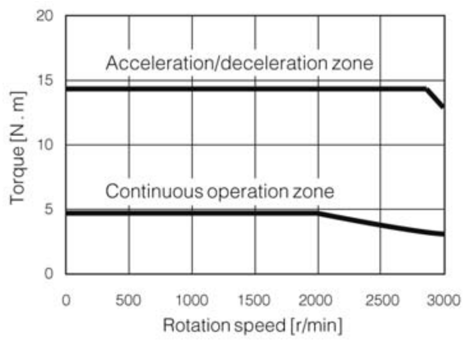
GYG501C5-□□2 (0.5 kW)



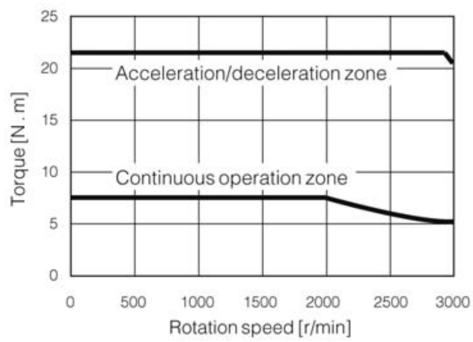
GYG751C5-□□2 (0.75 kW)



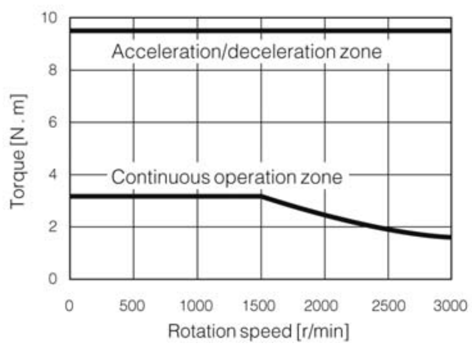
GYG102C5-□□2 (1.0 kW)



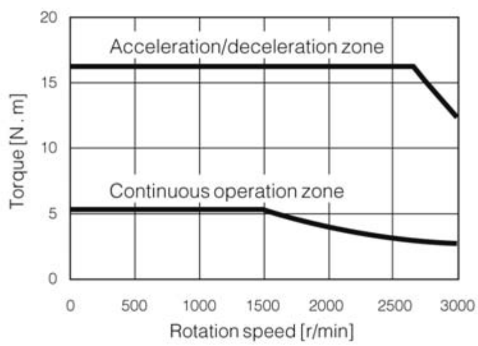
GYG152C5-□□2 (1.5 kW)



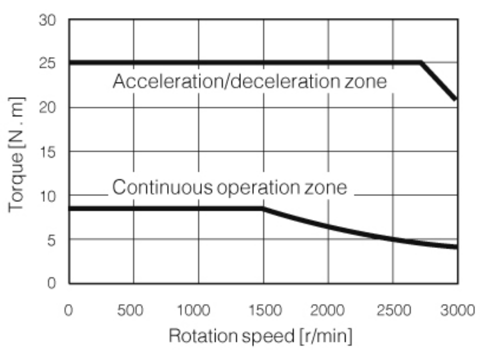
GYG501B5-□□2 (0.5 kW)



GYG851B5-□□2 (0.85 kW)



GYG132B5-□□2 (1.3 kW)



These characteristics indicate typical values of each servomotor combined with the corresponding 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 GYG152C : 400 × 400 × 12 mm
- Model GYG501B, 851B : 400 × 300 × 12 mm
- Model GYG132B : 400 × 400 × 12 mm

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8.1.4 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})
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		
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67. excluding the shaft-through and connectors)				Totally enclosed, self-cooled (IP 67. excluding the shaft-through) *2		
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)						
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)						
Vibration level *3	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 (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 If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protection degree.
*3 The vibration value is the property of flange type IMN1 (L52).

■ 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)		

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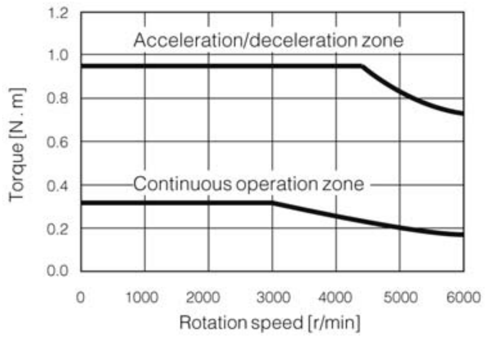
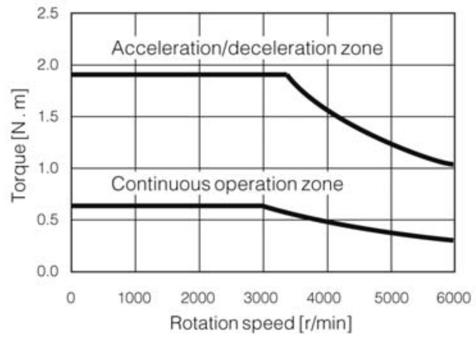
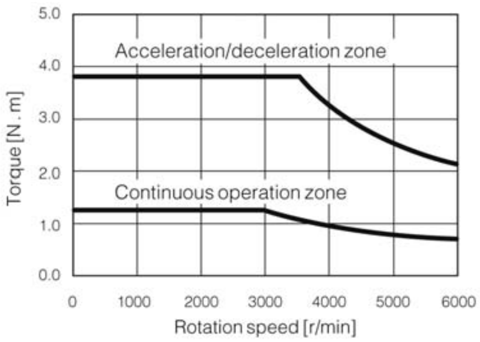
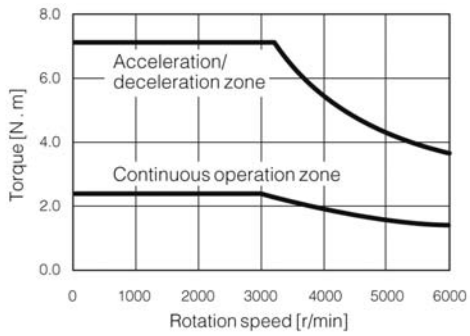
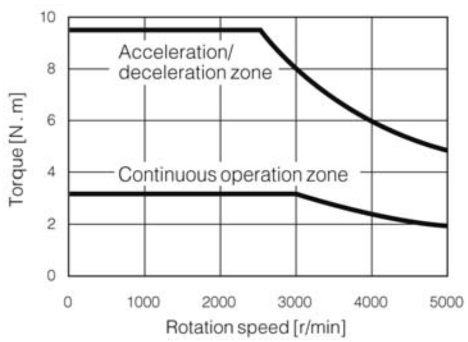
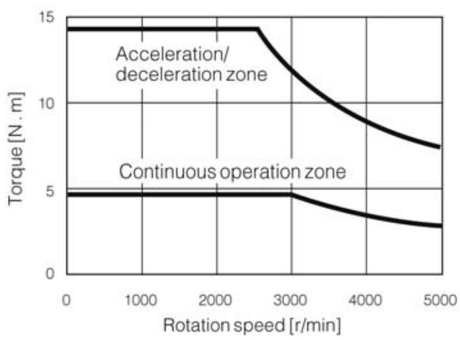
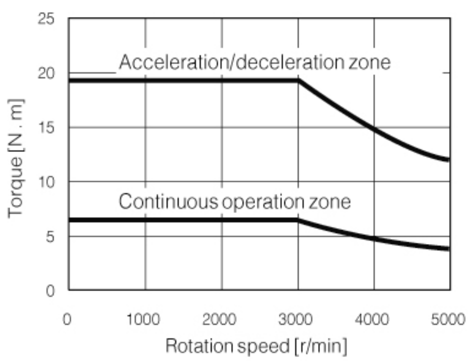
■ Torque characteristics diagram (at 3-phase 200 V or single-phase 230 V amplifier source voltage)

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 servo amplifier. The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

- Model GYC101D, 201D, 401D : 250 × 250 × 6 mm
- Model GYC751 : 300 × 300 × 6 mm
- Model GYC102D : 300 × 300 × 12 mm
- Model GYC152D, 202D : 400 × 400 × 12 mm

8.1.5 GYS Motor

200 V 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)	GYS102D5 -□□2 (-B)	GYS152D5 -□□2 (-B)	GYS202D5 -□□2 (-B)
Rated output [kW]	0.05	0.1	0.2	0.4	0.75	1.0	1.5	2.0
Rated torque [N · m]	0.159	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]	0.478	0.955	1.91	3.82	7.17	9.55	14.3	19.1
Inertia [kg · m^2] ( ) 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})	1.73×10^{-4} (2.03×10^{-4})	2.37×10^{-4} (2.67×10^{-4})	3.01×10^{-4} (3.31×10^{-4})
Rated current [A]	0.85	0.85	1.5	2.7	4.8	7.1	9.6	12.6
Max. current [A]	2.55	2.55	4.5	8.1	14.4	21.3	28.8	37.8
Winding insulation class	Class B					Class F		
Degree of enclosure protection	Totally enclosed, self-cooled (IP 67, excluding the shaft-through and connectors)					Totally enclosed, self-cooled (IP 67, excluding the shaft-through) *2		
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)							
Encoder	18-bit serial encoder (absolute/incremental), 20-bit serial encoder (incremental)							
Vibration level *3	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 (without condensation)							
Vibration resistance [m/s^2]	49					24.5		
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)	4.4 (5.9)	5.2 (6.8)	6.3 (7.9)
Compliance with standards	UL/cUL (UL1004), CE marking (EN60034-1, EN60034-5), RoHS directive							

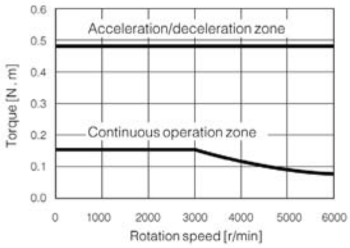
*1: The maximum rotation speed is 5000r/min when using the motor in combination with Fuji's gear head.
*2: If the motor is used in the environment rated to IP67 protection degree, use the wiring connector suitable for the protectio.
*3: The vibration value is the property of flange type IMN1(L52)

■ Brake specification (motor equipped with a brake)

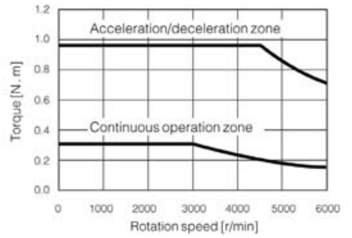
Motor type	GYS500D5 -□□2-B	GYS101D5 -□□2-B	GYS201D5 -□□2-B	GYS401D5 -□□2-B	GYS751D5 -□□2-B	GYS102D5 -□□2-B	GYS152D5 -□□2-B	GYS202D5 -□□2-B
Static friction torque [N · m]	0.34		1.27		2.45	6.86		
Rated DC voltage [V]	DC24±10%							
Attraction time [ms]	35		40		60	100		
Release time [ms]	10		20		25	40		
Power consumption [W]	6.1 (at 20 °C)		7.3 (at 20 °C)		8.5 (at 20 °C)	17.7 (at 20 °C)		

■ Torque characteristics diagram (at 3-phase 200 V or single-phase 230 V amplifier source voltage)

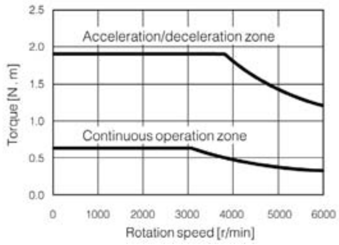
GYS500D5-□□2 (0.05 kW)



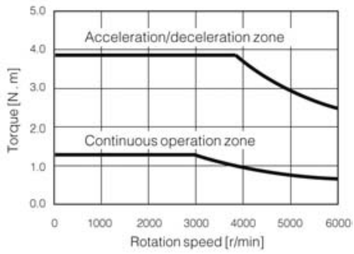
GYS101D5-□□2 (0.1 kW)



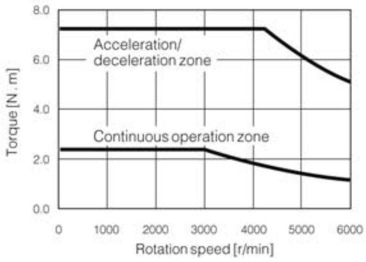
GYS201D5-□□2 (0.2 kW)



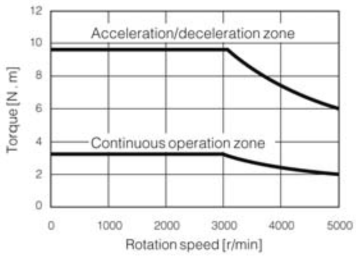
GYS401D5-□□2 (0.4 kW)



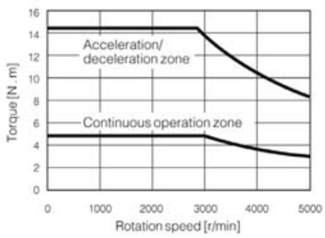
GYS751D5-□□2 (0.75 kW)



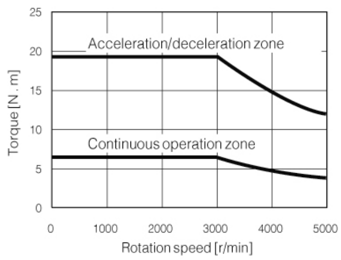
GYS102D5-□□2 (1.0 kW)



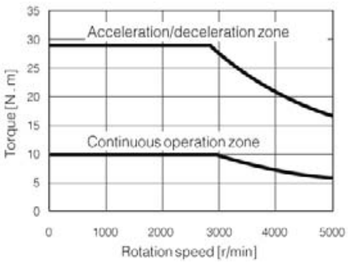
GYS152D5-□□2 (1.5 kW)



GYS202D5-□□2 (2.0 kW)



GYS302D5-□□2 (3.0 kW)



These characteristics indicate typical values of each servomotor combined with the corresponding servo amplifier. The rated torque indicates the value obtained when the servo amplifier is installed to the following aluminum heat sink.

・Model GYS500D, 101D : 200 × 200 × 6 mm
・Model GYS201D, 401D : 250 × 250 × 6 mm
・Model GYS751D : 300 × 300 × 6 mm
・Model GYS102D, 152D, 202D : 350 × 350 × 8 mm
・Model GYS302D : 400 × 400 × 12 mm

8.2 Specifications of Servo Amplifier

8.2.1 Common Specifications

Applicable motor rated speed		3000r/min									2000r/min					1500r/min		
Applicable motor output	[kW]	0.05	0.1	0.2	0.4	0.75	1.0	1.5	2.0	3.0	0.5	0.75	1.0	1.5	2.0	0.5	0.85	1.3
Amplifier type	RYH□□□F5-VV2	201			401	751	152		202	302	751		152		202	751	152	202
Outer frame number		1a			1b	2a	2b		3a	3b	2a		2b		3a	2a	2b	3a
Mass	[kg]	0.8				1.2	1.3		2.2		1.2		1.3		2.2	1.2	1.3	2.2
Protective construction / cooling		Open / natural cooling				Open / mechanical cooling												
Power supply	Phase	Single-phase, 3-phase					3-phase				Single-phase, 3-phase		3-phase			Single-phase, 3-phase	3-phase	
	Voltage / frequency	200 to 240VAC 50/60Hz																
	Allowable voltage fluctuation	3-phase : 170 to 264 VAC, Single-phase : 180 to 264 VAC																
Control system		Fully-digital sinusoidal PWM drive																
Max voltage for regenerative resistance [W]	Built-in resistor	–				20			30		20				30	20		30
	External resistor	17				50			260		50				260	50		260

Item		Specification
Feedback		INC 20bit/rev, ABS/INC 18bit/rev
Overload capability		300% / 3 sec.
Speed fluctuation ratio*	Load fluctuation	Within ± 0.01% (load fluctuation 0 to 100% at rated operation speed)
	Power supply fluctuation	0% (power supply fluctuation -10 to +10% at rated operation speed)
	Temperature fluctuation	Within ± 0.2% (25 ± 10°C at rated operation speed)
Capability and function VV type	Speed control	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	Closed loop control with position adjuster, electronic gear, output pulse setting, feed forward, homing, interrupt positioning, auto startup, etc.
	Torque control	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.
Protective function (Alarm display)		Over Current (oc1, oc2), Over Speed (oS), High Voltage (Hu), Encoder Trouble (Et1, Et2), Circuit Trouble (ct), Data Error (dE), Combination Error (cE), Resistor Tr Heat (tH), Encoder Communication Error (Ec), Cont (CONTrol signal) Error (ctE), Over Load (oL1, oL2), Power Low Voltage (LuP), Resistor Heat (rH1, rH2, rH3), Over Flow (oF), Amp Heat (AH), Encoder Heat (EH), Absolute Data Lost (dL1, dL2, dL3), Absolute Data Over Flow (AF), Initial Error (iE)
Operation and display section of main body(keypad)		4-digit alphanumeric display with 7-segment LED 4 operation switches (MODE, SET, UP and DOWN)
Working conditions	Installation place	Indoors at altitude ≤ 1000m, free from dust, corrosive gases and direct sunlight In case of compliance with CE marking: pollution degree 2, over voltage category III
	Temperature / humidity	-10 to 55°C/10 to 90%RH (without condensation)
	Vibration / shock resistance	Vibration resistance: 3mm: 2 to 9Hz or less, 9.8m/s²: 9 to 20Hz or less, 2m/s²: 20 to 55Hz or less, 1m/s²: 55 to 200Hz or less Shock resistance: 19.6m/s² (2G)
Standards		UL/cUL (UL508c), CE marking (low voltage directive EN61800-5-1), RoHS directive (Some of the models are in the process to be certisfied.)

*This value represents the average value of the speed fluctuation that is generated from load fluctuation, power supply fluctuation, and temperature fluctuation as the percentage to the rated rotation speed.

8

8.2.2 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)
		Fuji's original protocol Modbus-RTU
		9600/19200/38400/115200 bps, connection of max. 31 units

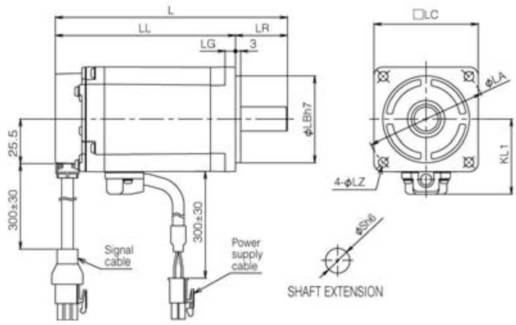
Terminal name	Symbol	Specifications
Pulse input	CA,*CA CB,*CB	Differential input: max. input frequency ≤ 1.0MHz Open collector input: max. input frequency ≤ 200kHz (in case of signals at 90-degree phase difference, the above relationship is true for the four-fold frequency.) Pulse format: Command pulse/Command 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 ± 5%)
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 CONT5	12VDC-10% to 24VDC+10% Current consumption 8mA (per contact; used at circuit voltage of 12 to 24VDC) Function of each signal depends on parameter setting Compatible with both sink and source input methods
	COMIN	Reference potential
Sequence output signal	OUT1 to OUT3	30VDC / 50mA (max.) Function of each signal depends on parameter setting Compatible with both sink and source output methods
	COMOUT	Reference potential
Analog voltage input (for speed and torque control)	VREF	Speed command voltage input Input range: from -10 to 0 to -10V, input impedance 20kΩ Resolution: 15 bits / ± full scale
	TREF	Torque command voltage input Input range: from -10 to 0 to +10V, input impedance 20kΩ Resolution: 14 bits / ± full scale
	M5	Reference potential (0V)

8

8.3 Dimensions of Servomotor

8.3.1 GYB Motor

(Unit mm)

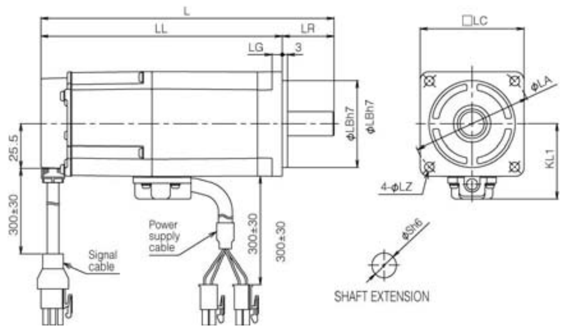


Rated speed [r/min]	Rated output [kW]	Model codes	L	LL	Flange dimensions							S	MASS [Kg]
					LR	LG	LB	KL1	LC	LA	LZ		
3000	0.2	GYB201D5-□B2	112	82	30	6	50	43	60	70	5.5	14	1.0
	0.4	GYB401D5-□B2	134	104	30	6	50	43	60	70	5.5	14	1.5
	0.75	GYB751D5-□B2	157	117	40	8	70	53	80	90	7	19	3.0

* See page 8-20 for the shaft extension specification of the motor with a key

8.3.2 GYB Motor (With a Brake)

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	L	LL	Flange dimensions							S	MASS [Kg]
					LR	LG	LB	KL1	LC	LA	LZ		
3000	0.2	GYB201D5-□B2-B	148	118	30	6	50	43	60	70	5.5	14	1.5
	0.4	GYB401D5-□B2-B	170	140	30	6	50	43	60	70	5.5	14	2.1
	0.75	GYB751D5-□B2-B	194.5	154.5	40	8	70	53	80	90	7	19	3.9

* See page 8-20 for the shaft extension specification of the motor with a key

8.3.3 GYH Motor

(Unit : mm)

Fig. A

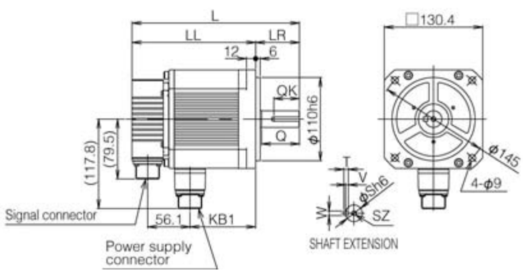
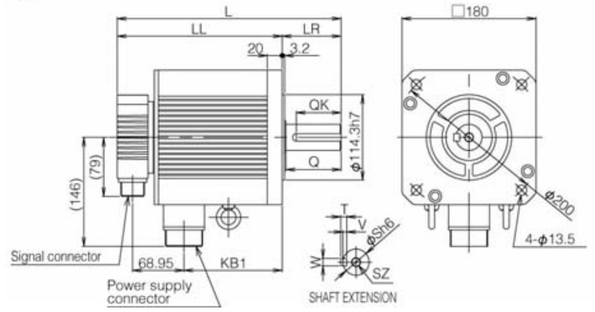


Fig. B



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions LR	Flange dimensions KB1	S	Q	QK	W	T	V	SZ	MASS [Kg]
2000	1.0	GYH102C6-TC2	A	221.8	163.8	58	87	22	50	35	6	6	3.5	M6 depth:15	6.5
	1.5	GYH152C6-TC2	A	241.8	183.8	58	107	22	50	35	6	6	3.5	M6 depth:15	8.1
	2.0	GYH202C6-TC2	A	271.8	213.8	58	137	22	50	35	6	6	3.5	M6 depth:15	10.2
	3.0	GYH302C6-TC2	A	321.8	263.8	58	187	22	50	35	6	6	3.5	M6 depth:15	13.9
	4.0	GYH402C6-TC2	B	332.8	253.4	79	163.75	35	74	60	10	8	5	M12 depth:24	19.5
	5.5	GYH552C6-TC2	B	361.4	282.4	79	192.75	35	74	60	10	8	5	M12 depth:24	26.2
	7.0	GYH702C6-TC2	B	409.4	296.4	113	206.75	42	108	90	12	8	5	M16 depth:32	30.0

8.3.4 GYH Motor (With a Brake)

8

(Unit : mm)

Fig. C

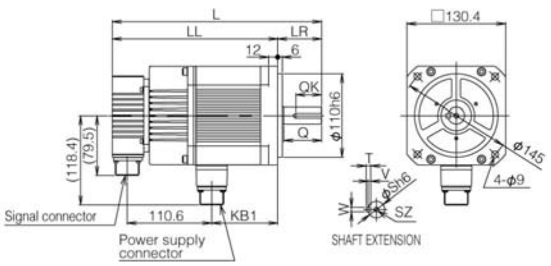
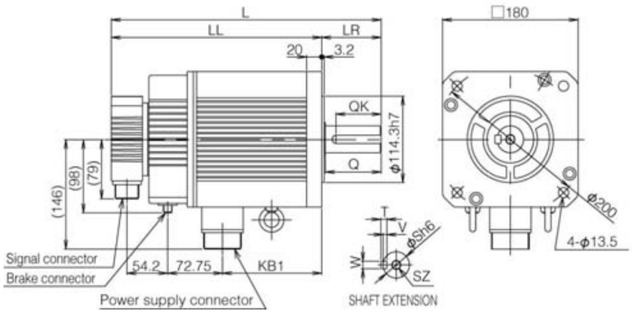


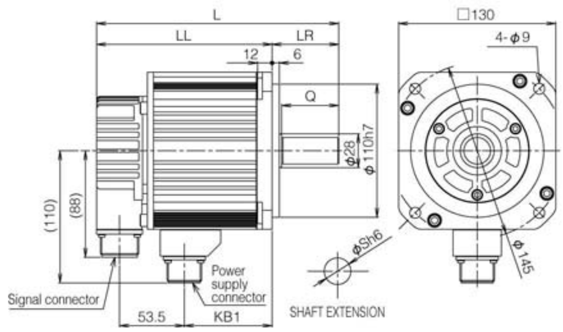
Fig. D



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions LR	Flange dimensions KB1	S	Q	QK	W	T	V	SZ	MASS [Kg]
2000	1.0	GYH102C6-TC2-B	C	276.3	218.3	58	87	22	50	35	6	6	3.5	M6 depth:15	8.1
	1.5	GYH152C6-TC2-B	C	296.3	238.3	58	107	22	50	35	6	6	3.5	M6 depth:15	9.7
	2.0	GYH202C6-TC2-B	C	326.3	268.3	58	137	22	50	35	6	6	3.5	M6 depth:15	11.8
	3.0	GYH302C6-TC2-B	C	376.3	318.3	58	187	22	50	35	6	6	3.5	M6 depth:15	15.5
	4.0	GYH402C6-TC2-B	D	390.4	311.4	79	163.75	35	74	60	10	8	5	M12 depth:24	23.0
	5.5	GYH552C6-TC2-B	D	419.4	340.4	79	192.75	35	74	60	10	8	5	M12 depth:24	30.0
	7.0	GYH702C6-TC2-B	D	467.4	354.4	113	206.75	42	108	90	12	8	5	M16 depth:32	34.8

8.3.5 GYG Motor

(Unit : mm)

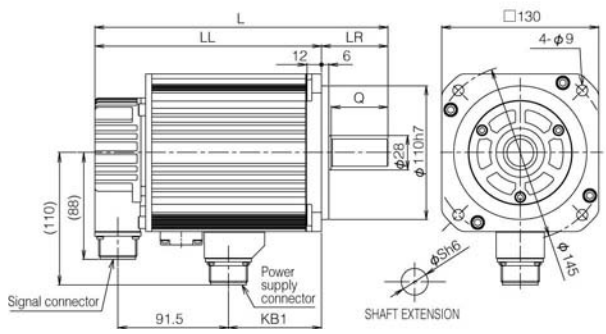


Rated speed [r/min]	Rated output [kW]	Model codes	L	LL	Flange dimensions		S	Q	MASS [Kg]
					LR	KB1			
2000	0.5	GYG501C5- □B2	175	120	55	47.5	19	47	5.3
	0.75	GYG751C5- □B2	187.5	132.5	55	60	19	47	6.4
	1.0	GYG102C5- □B2	200	145	55	72.5	22	47	7.5
	1.5	GYG152C5- □B2	225	170	55	97.5	22	47	9.8
	2.0	GYG202C5- □B2	250	195	55	122.5	22	47	12
1500	0.5	GYG501B5- □B2	190.5	132.5	58	60	19	40	6.4
	0.85	GYG851B5- □B2	203	145	58	72.5	19	40	7.5
	1.3	GYG132B5- □B2	228	170	58	97.5	22	40	9.8

* See page 8-20 for the shaft extension specification of the motor with a key

8.3.6 GYG Motor (With a Brake)

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	L	LL	Flange dimensions		S	Q	MASS [Kg]
					LR	KB1			
2000	0.5	GYG501C5- □B2-B	217.5	162.5	55	52	19	47	7.5
	0.75	GYG751C5- □B2-B	230	175	55	64.5	19	47	8.6
	1.0	GYG102C5- □B2-B	242.5	187.5	55	77	22	47	9.7
	1.5	GYG152C5- □B2-B	267.5	212.5	55	102	22	47	12
	2.0	GYG202C5- □B2-B	292.5	237.5	55	127	22	47	14.2
1500	0.5	GYG501B5- □B2-B	233	175	58	64.5	19	40	8.6
	0.85	GYG851B5- □B2-B	245.5	187.5	58	77	19	40	9.7
	1.3	GYG132B5- □B2-B	270.5	212.5	58	102	22	40	12

* See page 8-20 for the shaft extension specification of the motor with a key

8.3.7 GYC Motor

Fig.A

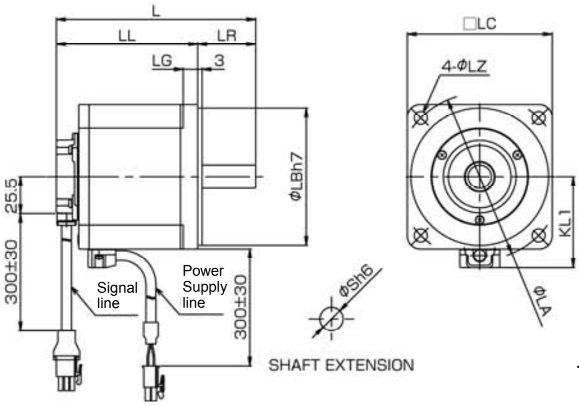
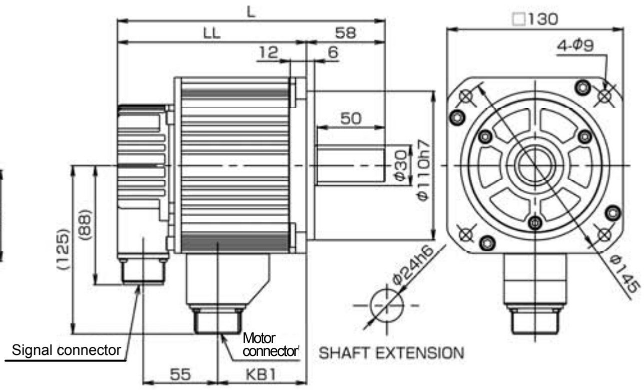


Fig.B

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions							S	MASS [Kg]
						LR	LG	LB	KL1	LC	LA	LZ		
3000	0.1	GYC101D5- □B2	A	81	56	25	6	50	43	60	70	5.5	8	0.75
	0.2	GYC201D5- □B2	A	93	63	30	8	70	53	80	90	7	14	1.3
	0.4	GYC401D5- □B2	A	108	78	30	8	70	53	80	90	7	14	1.9
	0.75	GYC751D5- □B2	A	137.5	97.5	40	10	95	63	100	115	9	16	3.5

* See page 8-20 for the shaft extension specification of the motor with a key

Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions	MASS [Kg]
						KB1	
3000	1.0	GYC102D5- □B2	B	197.5	139.5	65.5	5.7
	1.5	GYC152D5- □B2	B	212.5	154.5	80.5	7.0
	2.0	GYC202D5- □B2	B	227.5	169.5	95.5	8.2

* See page 8-20 for the shaft extension specification of the motor with a key

8

8.3.8 GYC Motor (With a Brake)

Fig.C

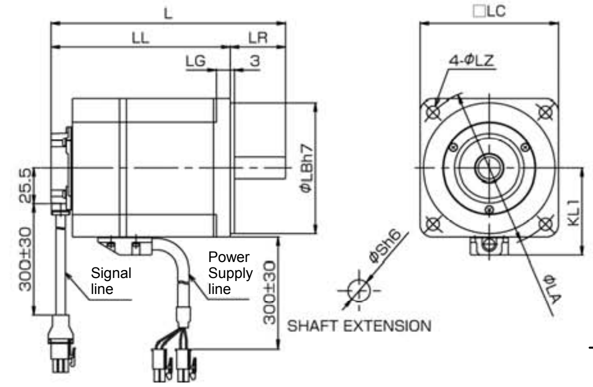
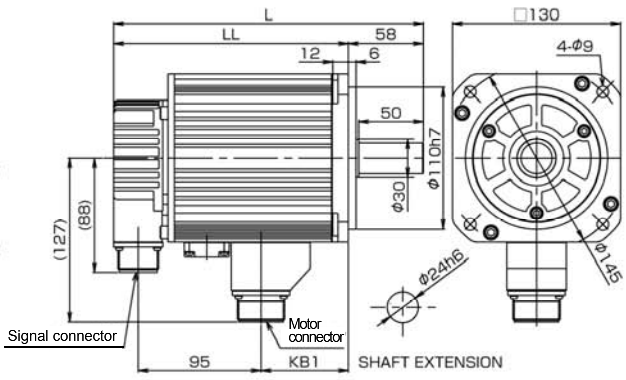


Fig.D

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions							S	MASS [Kg]
						LR	LG	LB	KL1	LC	LA	LZ		
3000	0.1	GYC101D5- □B2-B	C	108.5	83.5	25	6	50	43	60	70	5.5	8	1.0
	0.2	GYC201D5- □B2-B	C	124	94	30	8	70	53	80	90	7	14	1.9
	0.4	GYC401D5- □B2-B	C	139	109	30	8	70	53	80	90	7	14	2.6
	0.75	GYC751D5- □B2-B	C	169.5	129.5	40	10	95	63	100	115	9	16	4.3

* See page 8-20 for the shaft extension specification of the motor with a key

Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions	MASS [Kg]
						KB1	
3000	1.0	GYC102D5-□B2-B	D	239.5	181.5	67.5	8.0
	1.5	GYC152D5-□B2-B	D	254.5	196.5	82.5	9.8
	2.0	GYC202D5-□B2-B	D	269.5	211.5	97.5	11

* See page 8-20 for the shaft extension specification of the motor with a key

8.3.9 GYS Motor

Fig.A

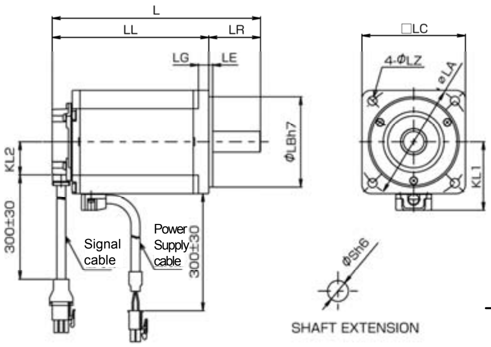
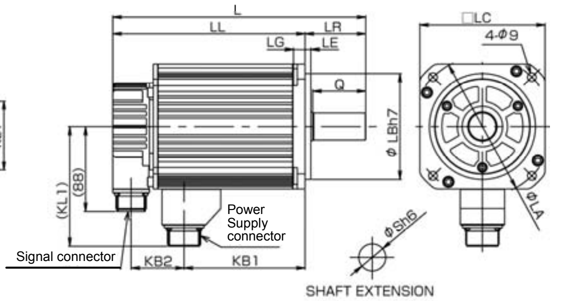


Fig.B

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions									S	MASS [Kg]
						LR	LG	LE	LB	KL1	KL2	LC	LA	LZ		
3000	0.05	GYS500D5-□B2	A	89	64	25	5	2.5	30	33	21	40	46	4.3	6	0.45
	0.1	GYS101D5-□B2	A	107	82	25	5	2.5	30	33	21	40	46	4.3	8	0.55
	0.2	GYS201D5-□B2	A	107.5	77.5	30	6	3	50	43	25.5	60	70	5.5	14	1.2
	0.4	GYS401D5-□B2	A	135.5	105.5	30	6	3	50	43	25.5	60	70	5.5	14	1.8
	0.75	GYS751D5-□B2	A	161	121	40	8	3	70	53	25.5	80	90	7	16	3.4

* See page 8-20 for the shaft extension specification of the motor with a key

Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions									S	Q	MASS [Kg]
						LR	LG	LE	LB	KB1	KB2	KL1	LC	LA			
3000	1.0	GYS102D5-□B2	B	198	153	45	10	3	95	77	57	95.5	100	115	24	40	4.4
	1.5	GYS152D5-□B2	B	220.5	175.5	45	10	3	95	99.5	57	95.5	100	115	24	40	5.2
	2.0	GYS202D5-□B2	B	243	198	45	10	3	95	122	57	95.5	100	115	24	40	6.3
	3.0	GYS302D5-□B2	B	262.5	199.5	63	12	6	110	125.5	55	125	130	145	28	55	11
	4.0	GYS402D5-□B2	B	292.5	229.5	63	12	6	110	155.5	55	125	130	145	28	55	13.5
	5.0	GYS502D5-□B2	B	322.5	259.5	63	12	6	110	185.5	55	125	130	145	28	55	16

* See page 8-20 for the shaft extension specification of the motor with a key

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8.3.10 GYS Motor (With a Brake)

Fig.C

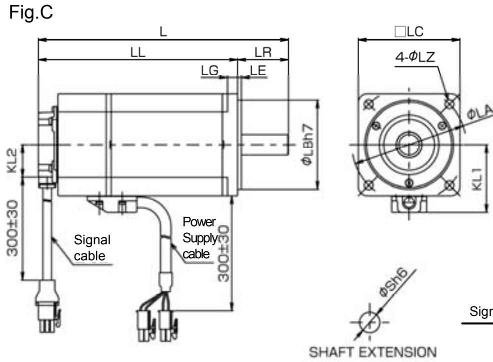
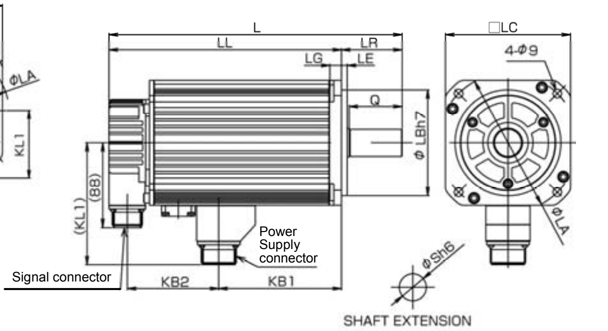


Fig.D

(Unit : mm)



Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions									S	MASS [Kg]
						LR	LG	LE	LB	KL1	KL2	LC	LA	LZ		
3000	0.05	GYS500D5-□B2-B	C	123.5	98.5	25	5	2.5	30	33	21	40	46	4.3	6	0.62
	0.1	GYS101D5-□B2-B	C	141.5	116.5	25	5	2.5	30	33	21	40	46	4.3	8	0.72
	0.2	GYS201D5-□B2-B	C	145.5	115.5	30	6	3	50	43	25.5	60	70	5.5	14	1.7
	0.4	GYS401D5-□B2-B	C	173.5	143.5	30	6	3	50	43	25.5	60	70	5.5	14	2.3
	0.75	GYS751D5-□B2-B	C	197	157	40	8	3	70	53	25.5	80	90	7	16	4.2

* See page 8-20 for the shaft extension specification of the motor with a key

Rated speed [r/min]	Rated output [kW]	Model codes	Fig	L	LL	Flange dimensions									S	Q	MASS [Kg]
						LR	LG	LE	LB	KB1	KB2	KL1	LC	LA			
3000	1.0	GYS102D5-□B2-B	D	239	194	45	10	3	95	79	96	96	100	115	24	40	5.9
	1.5	GYS152D5-□B2-B	D	261.5	216.5	45	10	3	95	101.5	96	96	100	115	24	40	6.8
	2.0	GYS202D5-□B2-B	D	284	239	45	10	3	95	124	96	96	100	115	24	40	7.9
	3.0	GYS302D5-□B2-B	D	304.5	241.5	63	12	6	110	127.5	95	127	130	145	28	55	13
	4.0	GYS402D5-□B2-B	D	334.5	271.5	63	12	6	110	157.5	95	127	130	145	28	55	15.5
	5.0	GYS502D5-□B2-B	D	364.5	301.5	63	12	6	110	187.5	95	127	130	145	28	55	18

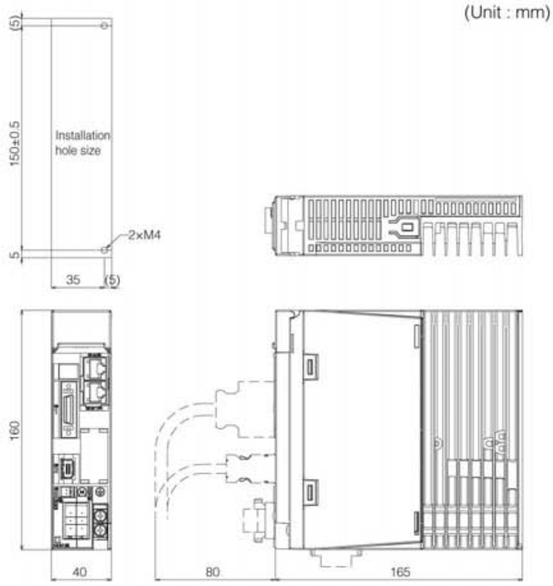
* See page 8-20 for the shaft extension specification of the motor with a key

8.4 Dimensions of Servo Amplifier

■Frame 1

Applicable motor output	Type
200W, 100W, 50W	RYH201F5-VV2
400W	RYH401F5-VV2

(Unit : mm)

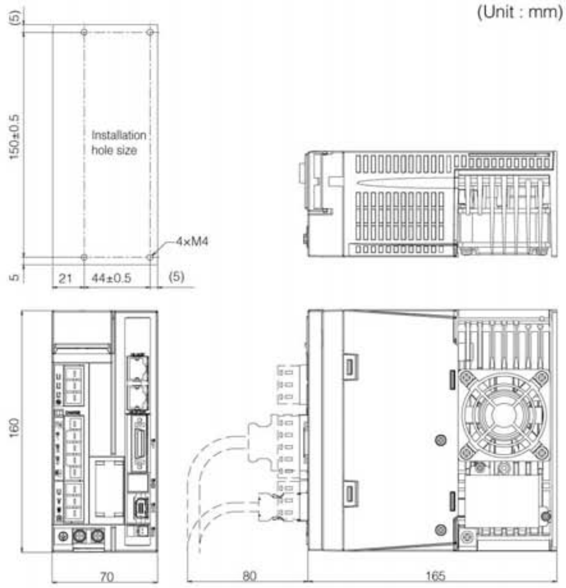


[Mass:0.8kg]

■Frame 2

Applicable motor output	Type
500W, 750W, 1.0kW(GYH)	RYH751F5-VV2
850W, 1.0kW, 1.5kW, 2.0kW(GYH)	RYH152F5-VV2

(Unit : mm)

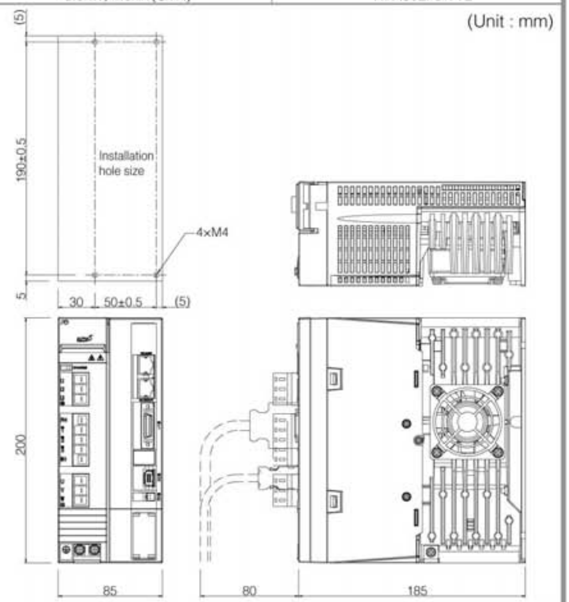


[Mass:1.3kg]

■Frame 3

Applicable motor output	Type
1.3kW, 2.0kW, 3.0kW(GYH)	RYH202F5-VV2
3.0kW, 4.0kW(GYH)	RYH302F5-VV2

(Unit : mm)

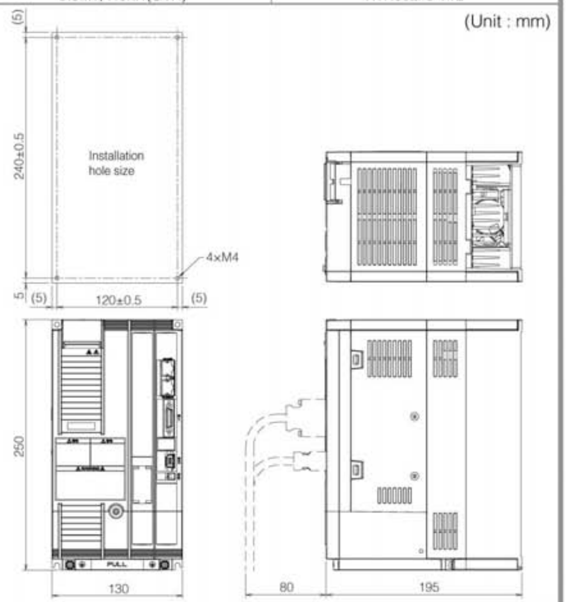


[Mass:2.2kg]

■Frame 4

Applicable motor output	Type
4.0kW, 5.5kW(GYH)	RYH402F5-VV2
5.0kW, 7.0kW(GYH)	RYH502F5-VV2

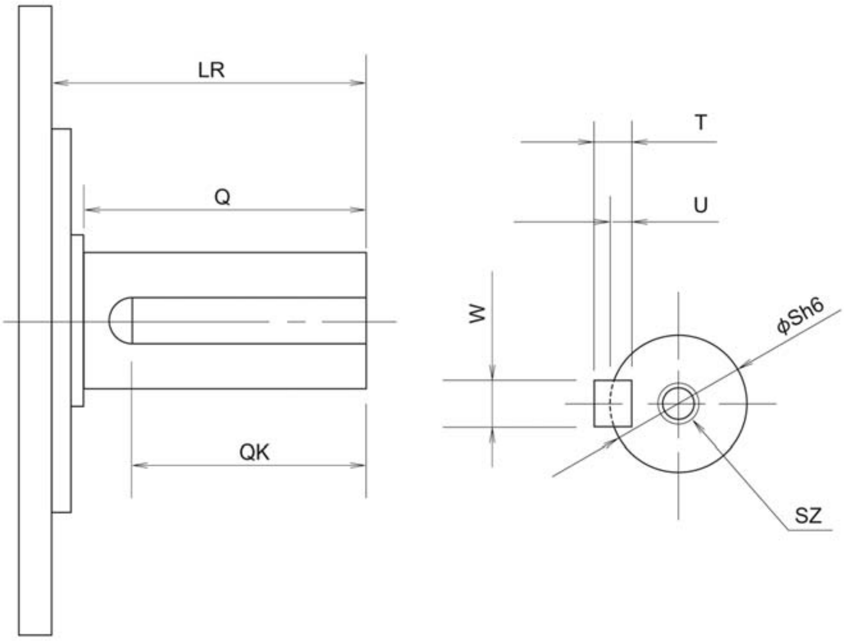
(Unit : mm)



[Mass:3.6kg]

8

8.5 Optional Specification of Shaft Extension [With a Key, Tapped]



8

Motor type	LR	Q	QK	S	T	U	W	SZ
GYB motor								
GYB201D5-□C2-□	30	–	14	14	5	3	5	M5 depth:8
GYB401D5-□C2-□								
GYB751D5-□C2-□	40	–	22	19	6	3.5	6	M6 depth:10
GYG motor 2000r/min								
GYG501C5-□C2-□	55	47	35	19	6	3.5	6	M6 depth:12
GYG751C5-□C2-□								
GYG102C5-□C2-□				22	7	4	8	M8 depth:16
GYG152C5-□C2-□								
GYG202C5-□C2-□								
GYG motor 1500r/min								
GYG501B5-□C2-□	58	40	30	19	6	3.5	6	M6 depth:12
GYG851B5-□C2-□								
GYG132B5-□C2-□				22	7	4	8	M8 depth:16
GYC motor								
GYC101D5-□A2-□*1	25	–	14	8	3	1.8	3	–
GYC201D5-□C2-□	30		16	14	5	3	5	M5 depth:8
GYC401D5-□C2-□								
GYC751D5-□C2-□	40		22	16				
GYC102D5-□C2-□	58	50	40	24	7	4	8	M8 depth:16
GYC152D5-□C2-□								
GYC202D5-□C2-□								
GYS motor								
GYS500D5-□A□-□*1	25	–	14	6	2	1.2	2	–
GYS101D5-□A□-□*1				8	3	1.8	3	–
GYS201D5-□C□-□	30		20	14	5	3	5	M5 depth:8
GYS401D5-□C□-□								
GYS751D5-□C2-□	40		30	16				
GYS102D5-□C2-□	45	40	32	24	7	4	8	M8 depth:16
GYS152D5-□C2-□								
GYS202D5-□C2-□								

*1 The shaft extension of the GYC and GYS motors of 0.1 kW or less is not tapped.

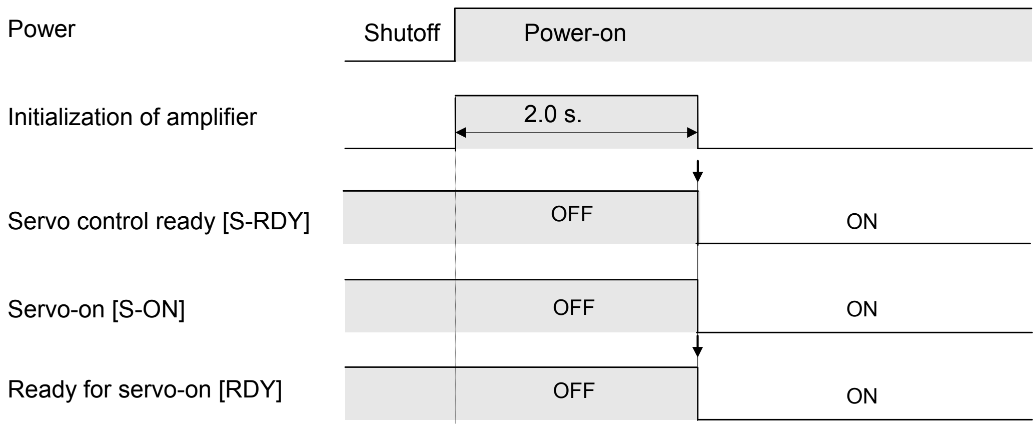
CHAPTER 9 CHARACTERISTICS

9.1 Timing Chart

9.1.1 Power-On Timing

■ When the power is turned on

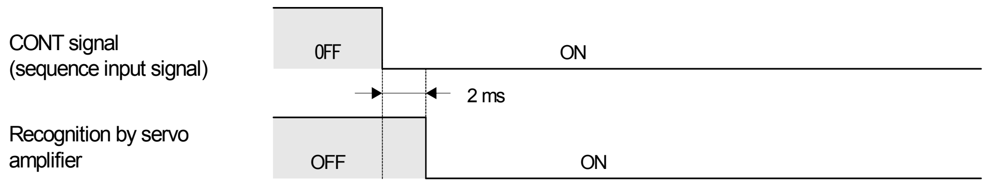
(1) After power-on, it takes about 2.0 seconds until initialization of the servo amplifier is finished.
(2) Completion of initialization is indicated by activation of servo control ready [S-RDY].
(3) After (2) is verified, the servo-on [S-ON] signal is turned on.
(4) After ready for servo-on [RDY] is turned on, the servo amplifier is ready to operate.



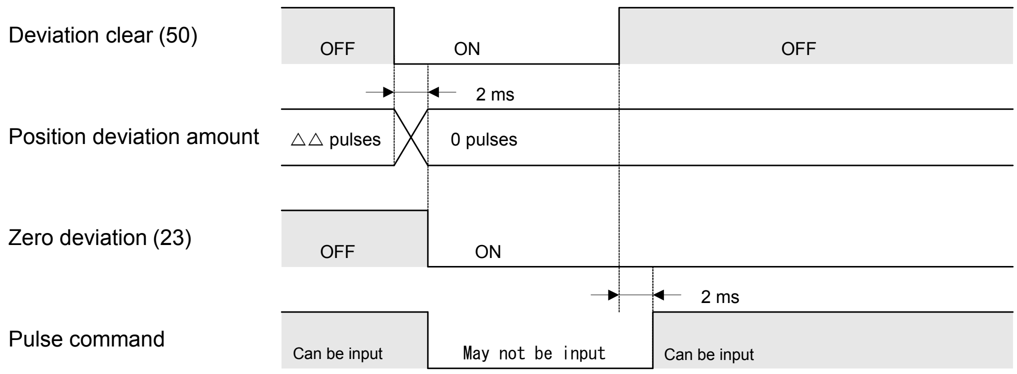
9.1.2 Each Signal Timing

■ 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

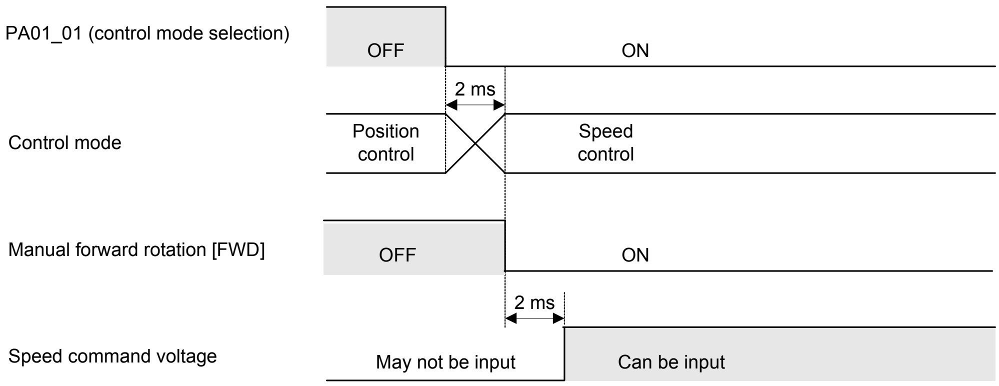


9.1.3 Control Mode Selection Timing

Transition time for each control mode is 2 ms.

After issuing a selection signal, wait for 2 ms or more before issuing next commands.

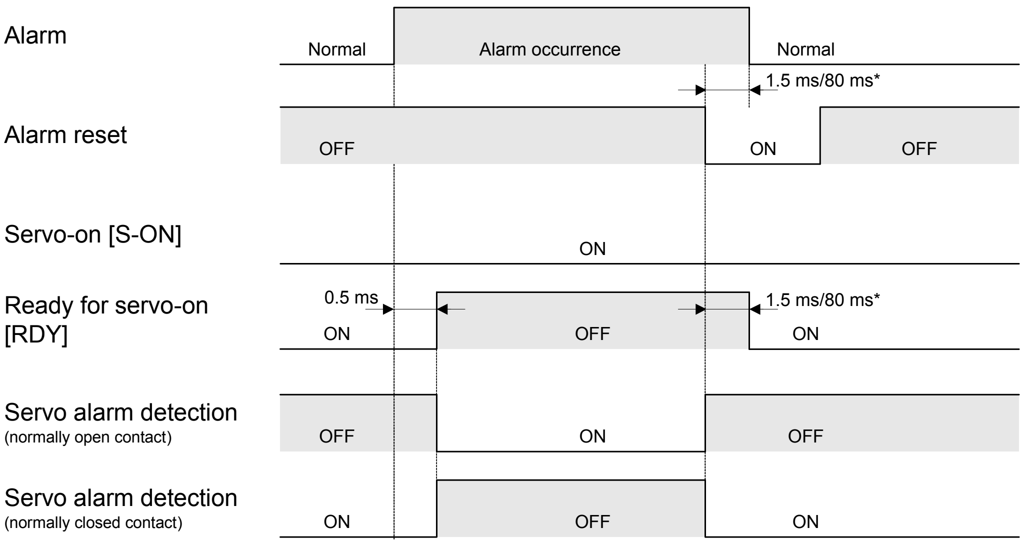
[Example] Switching from position control to speed control



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.

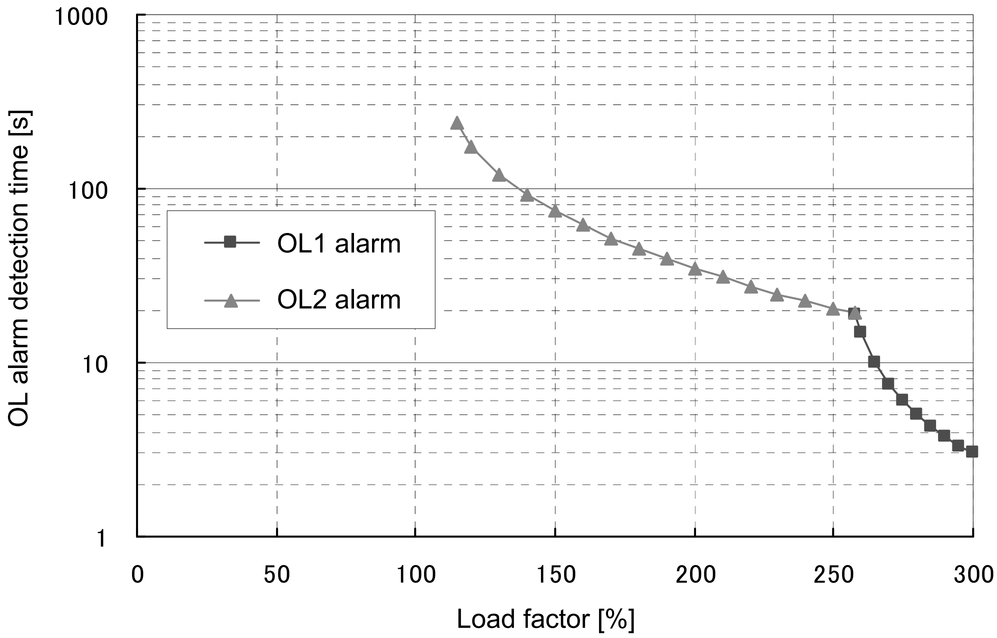


9.2 Overload Characteristic

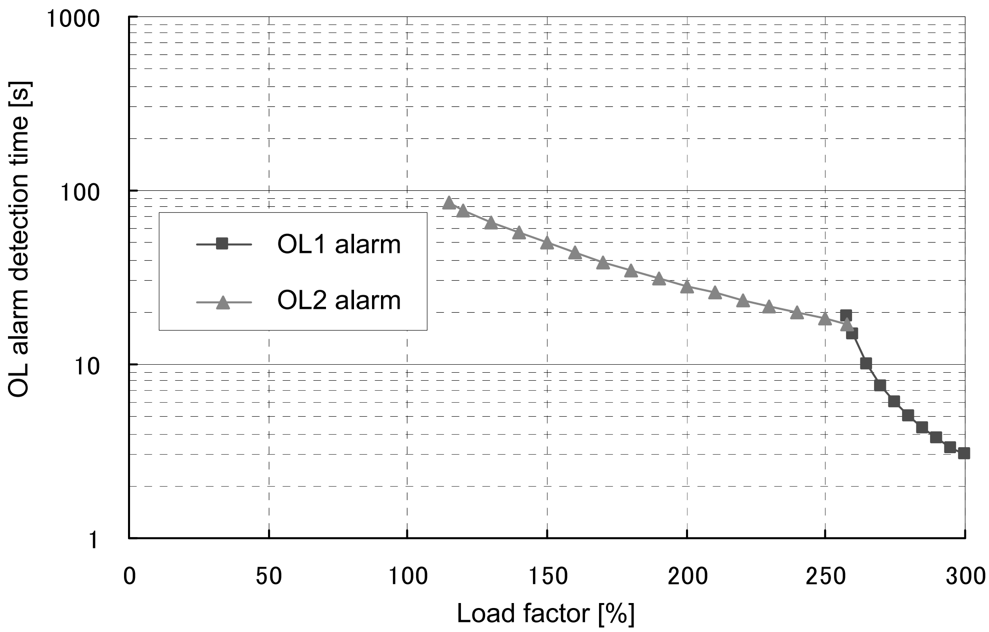
The detection time and load factor characteristics until an overload alarm (OL1/OL2) occurs are indicated by rotation speed.

9.2.1 GYB/GYC/GYS Motor

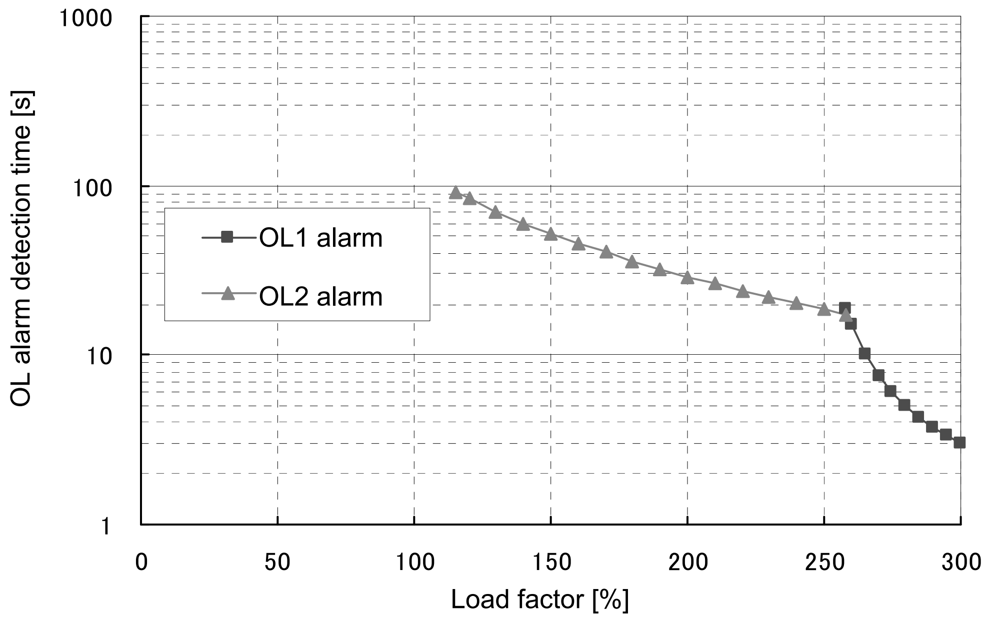
(1) In case of operation at rated rotation speed (3000 r/min)
Target capacity: all capacities* *Other than 0.4 kW



(2) In case of operation at maximum rotation speed (6000 r/min)
Target capacity: 0.05 kW to 0.75 kW* *Other than 0.4 kW

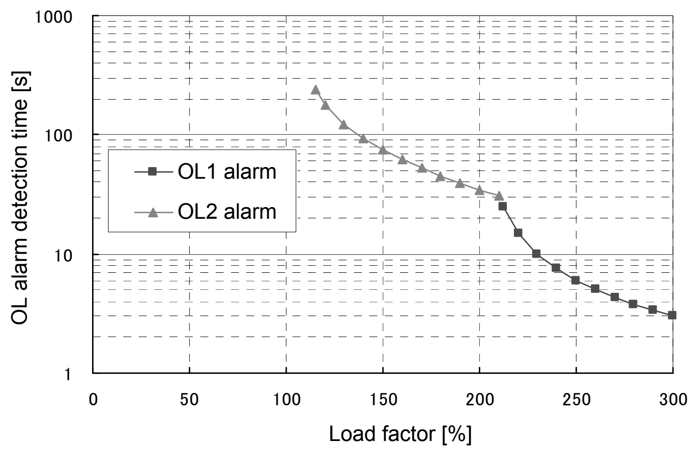


(3) In case of operation at max. rotation speed (5000 r/min)
Target capacity: 1.0 kW or more

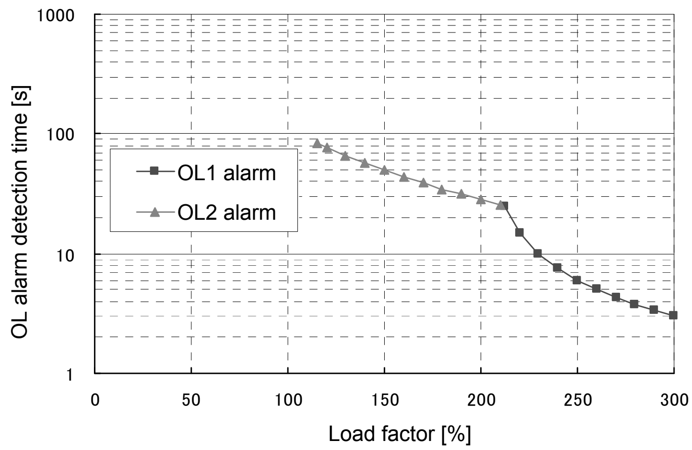


* Overload characteristics of 0.4 kW

・When operated with rated speed (3000 [r/min])



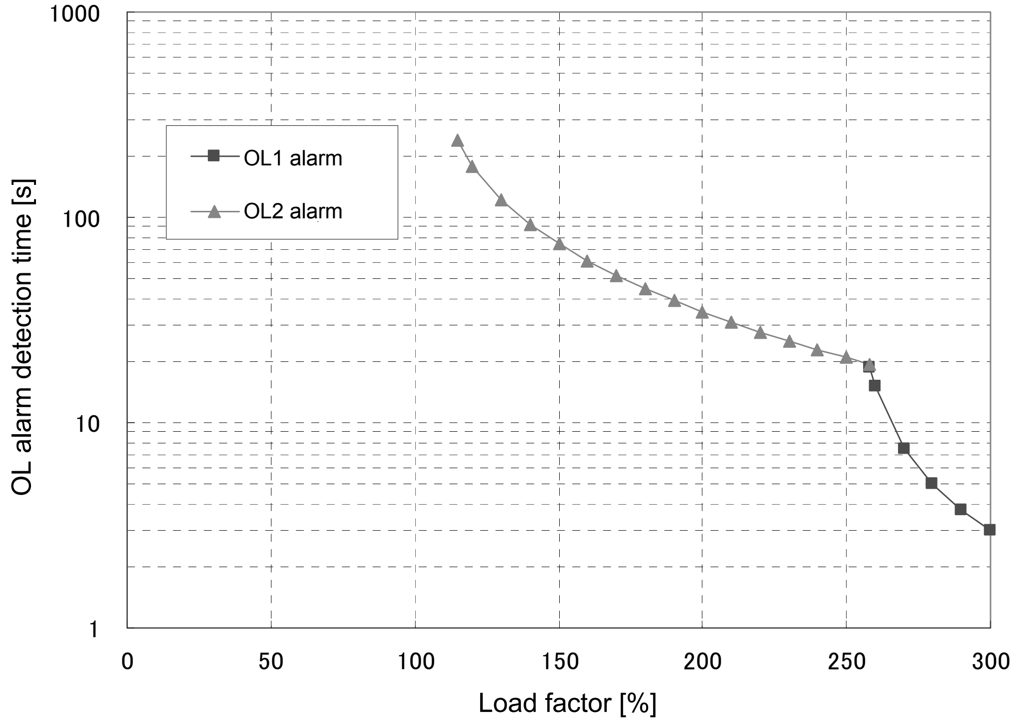
・When operated with max. speed (6000 [r/min])



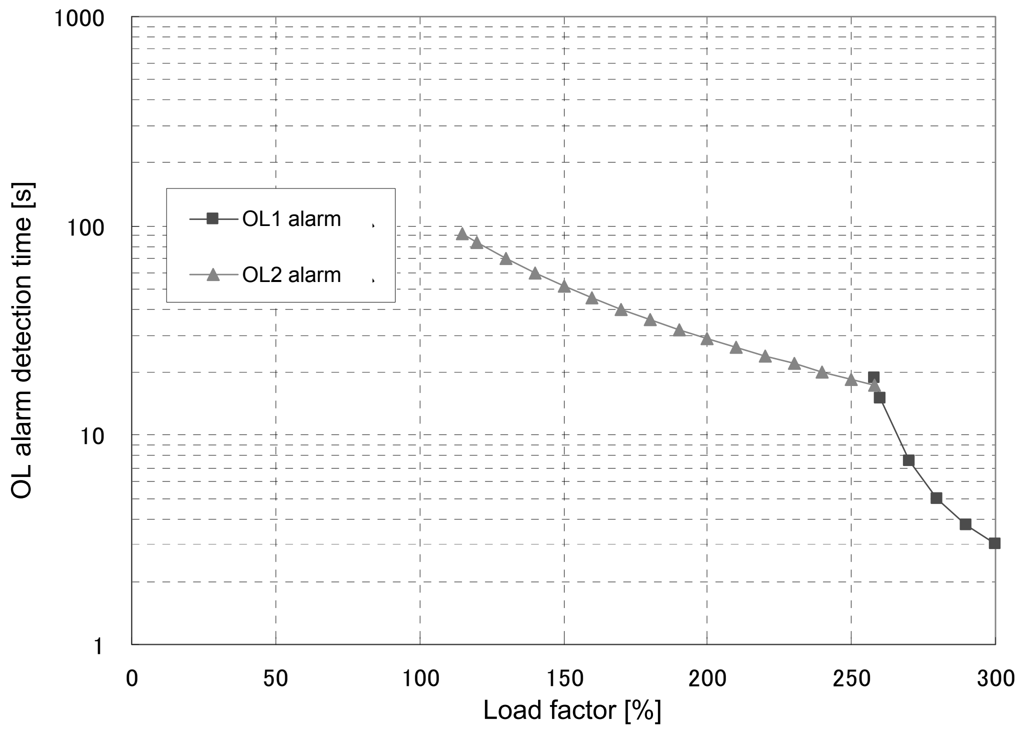
Note) The OL1 alarm detection time is 15 [r/min] or more. The alarm time will be detected in shorter time (0.25sec/300%) if the motor is stopped due to machine entanglement or other reasons resulting in overload.

9.2.2 GYH Motor

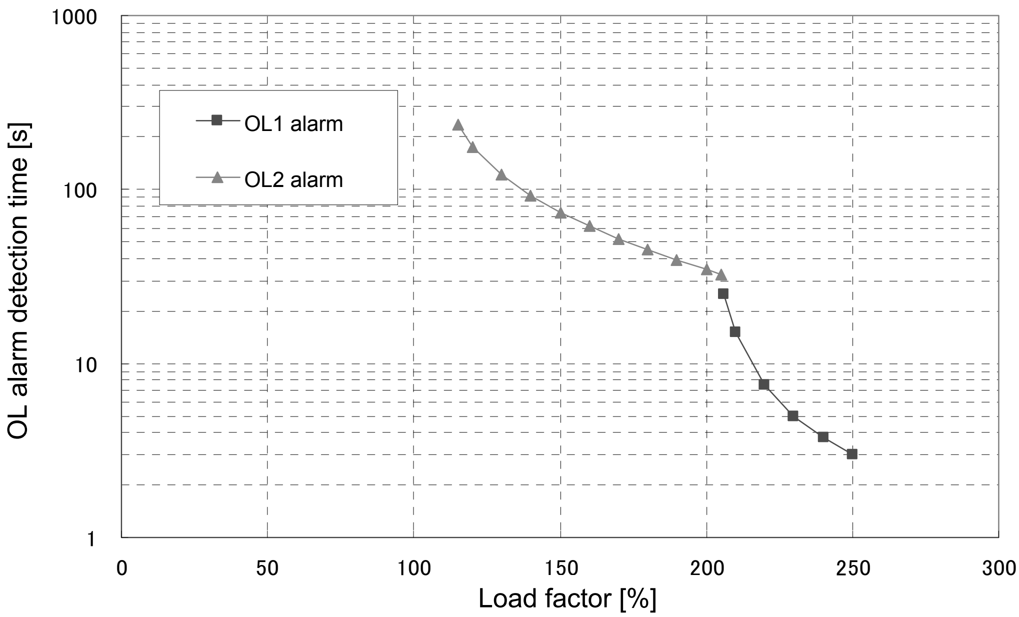
(1) In case of operation at rated rotation speed (2000 r/min)
Target capacity: 1.0 kW to 3.0 kW



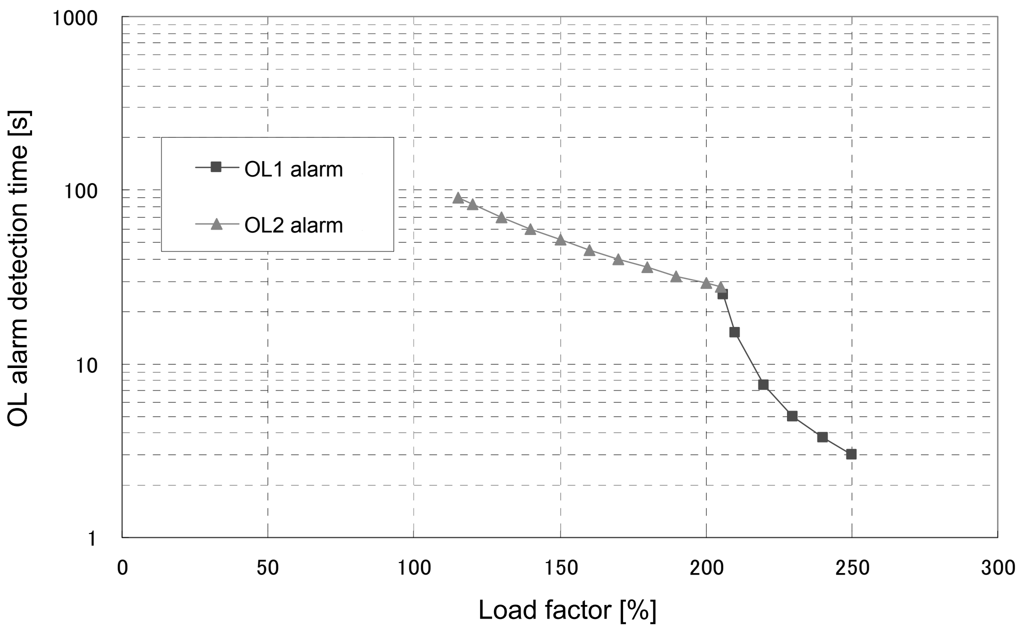
(2) In case of operation at max. rotation speed (2500 r/min)
Target capacity: 1.0 kW to 3.0 kW



(3) In case of operation at rated rotation speed (2000 r/min)
Target capacity: 4.0 kW to 7.0 kW

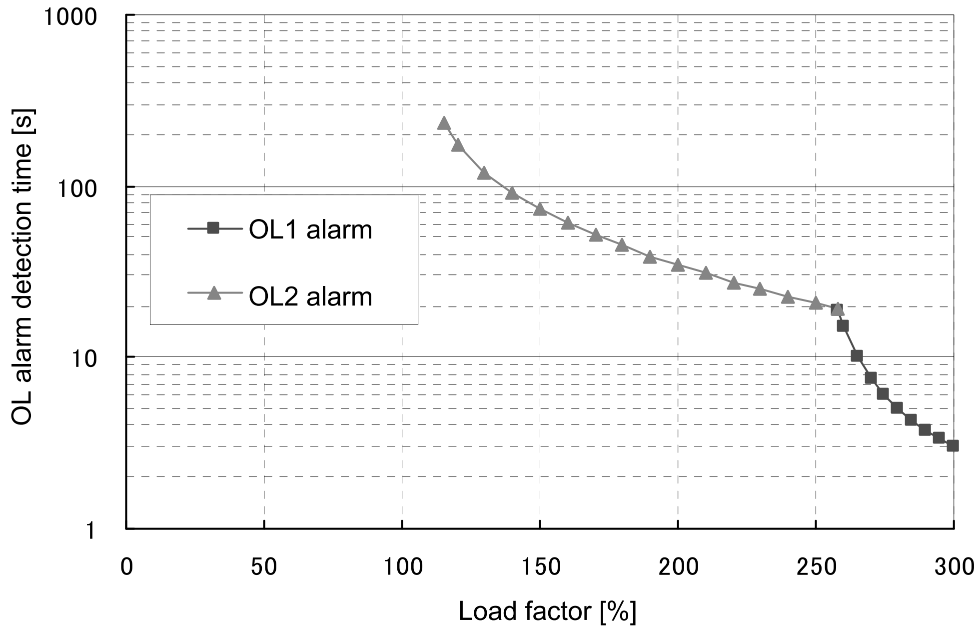


(4) In case of operation at max. rotation speed (2500 r/min)
Target capacity: 4.0 kW to 7.0 kW

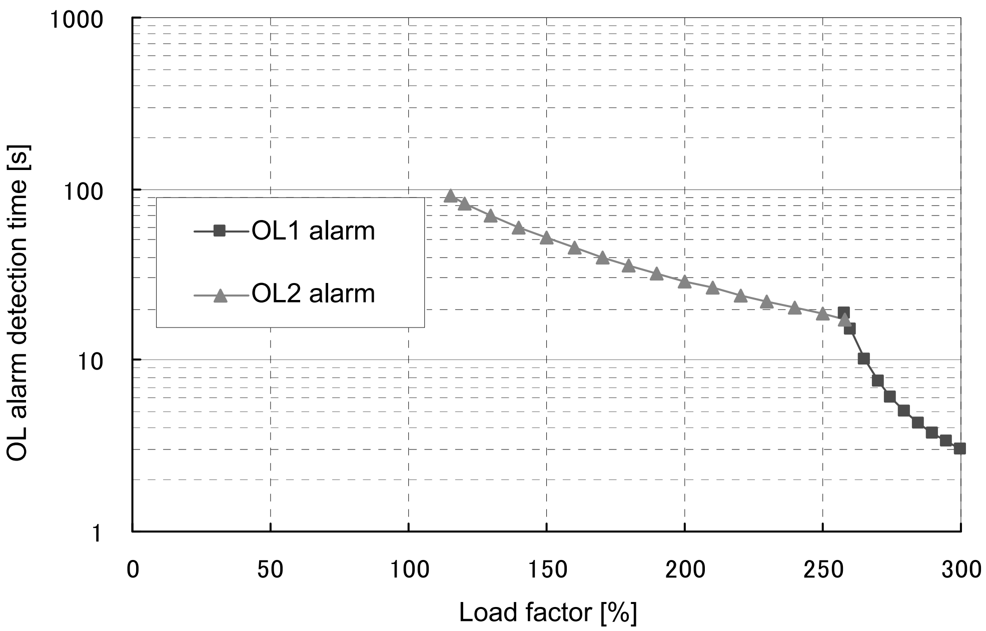


9.2.3 GYG Motor

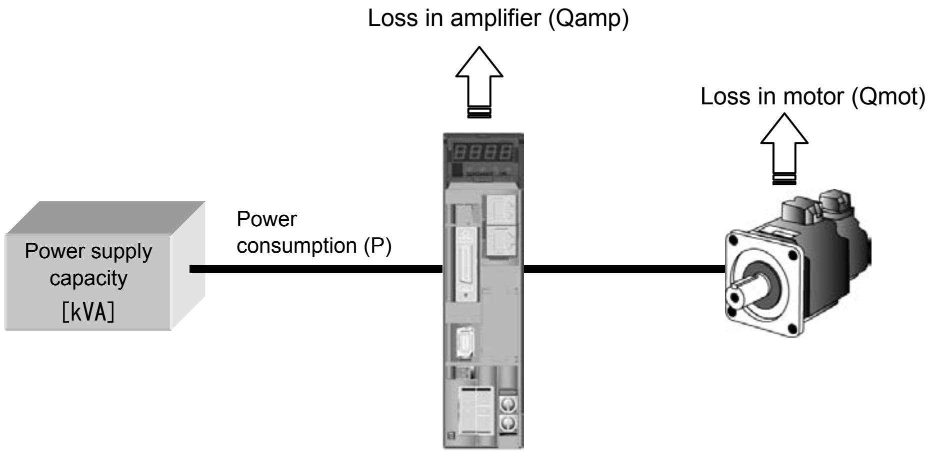
(1) In case of operation at rated rotation speed (1500/2000 r/min)



(2) In case of operation at max. rotation speed (3000 r/min)



9.3 Power Supply Capacity and Generated Loss



Rated rotation speed	Servo amplifier model	Servomotor model	Capacity [kW]	Power supply capacity [kVA]	Power consumption (P) [kW]	Loss in amplifier (Qamp) [kW]	Loss in motor (Qmot) [kW]
3000 [r/min]	RYH201F5-VV2	GY□500D5-□□2	0.05	0.1	0.074	0.018	0.006
		GY□101D5-□□2	0.1	0.2	0.13	0.021	0.011
		GY□201D5-□□2	0.2	0.4	0.25	0.027	0.022
	RYH401F5-VV2	GY□401D5-□□2	0.4	0.8	0.48	0.038	0.044
	RYH751F5-VV2	GY□751D5-□□2	0.75	1.5	0.89	0.059	0.083
	RYH152F5-VV2	GY□102D5-□□2	1.0	2.0	1.2	0.073	0.11
		GY□152D5-□□2	1.5	2.9	1.8	0.103	0.17
	RYH202F5-VV2	GY□202D5-□□2	2.0	3.9	2.4	0.13	0.22
	RYH302F5-VV2	GY□302D5-□□2	3.0	5.9	3.5	0.19	0.33
	RYH402F5-VV2	GY□402D5-□□2	4.0	7.8	4.7	0.25	0.44
	RYH502F5-VV2	GY□502D5-□□2	5.0	9.8	5.9	0.31	0.56
2000 [r/min]	RYH751F5-VV2	GY□501C5-□□2	0.5	1.0	0.6	0.044	0.056
		GY□751C5-□□2	0.75	1.5	0.89	0.059	0.083
		GYH102C6-□□2	1.0	2.0	1.2	0.073	0.11
	RYH152F5-VV2	GY□102C5-□□2	1.0	2.0	1.2	0.073	0.11
		GY□152C5-□□2	1.5	2.9	1.8	0.103	0.17
		GYH152C6-□□2	1.5	2.9	1.8	0.103	0.17
		GYH202C6-□□2	2.0	3.9	2.4	0.13	0.22
	RYH202F5-VV2	GY□202C5-□□2	2.0	3.9	2.4	0.13	0.22
		GYH302C6-□□2	3.0	5.9	3.5	0.19	0.33
	RYH302F5-VV2	GYH402C6-□□2	4.0	7.8	4.7	0.25	0.44
	RYH402F5-VV2	GYH552C6-□□2	5.5	10.7	6.4	0.34	0.61
	RYH502F5-VV2	GYH702C6-□□2	7.0	13.7	8.2	0.42	0.78
1500 [r/min]	RYH751F5-VV2	GY□501B5-□□2	0.5	1.0	0.6	0.044	0.056
	RYH152F5-VV2	GY□851B5-□□2	0.85	1.7	1.0	0.065	0.094
	RYH202F5-VV2	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.

Servo amplifier model	Inrush current [A]
RYH201F5-VV2	7.2
RYH401F5-VV2	
RYH751F5-VV2	
RYH152F5-VV2	
RYH202F5-VV2	23.5
RYH302F5-VV2	
RYH402F5-VV2	34.4
RYH502F5-VV2	

・The inrush current indicates the maximum peak current.

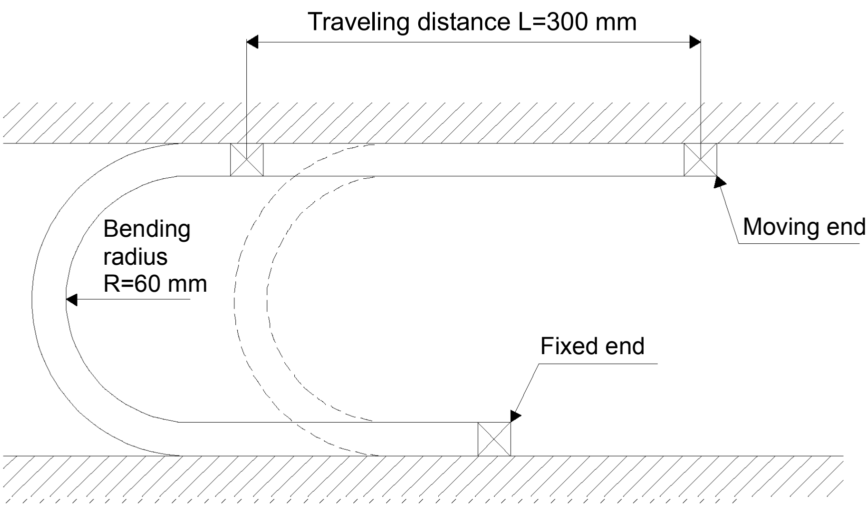
9.5 Bending Strength of Cable

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.

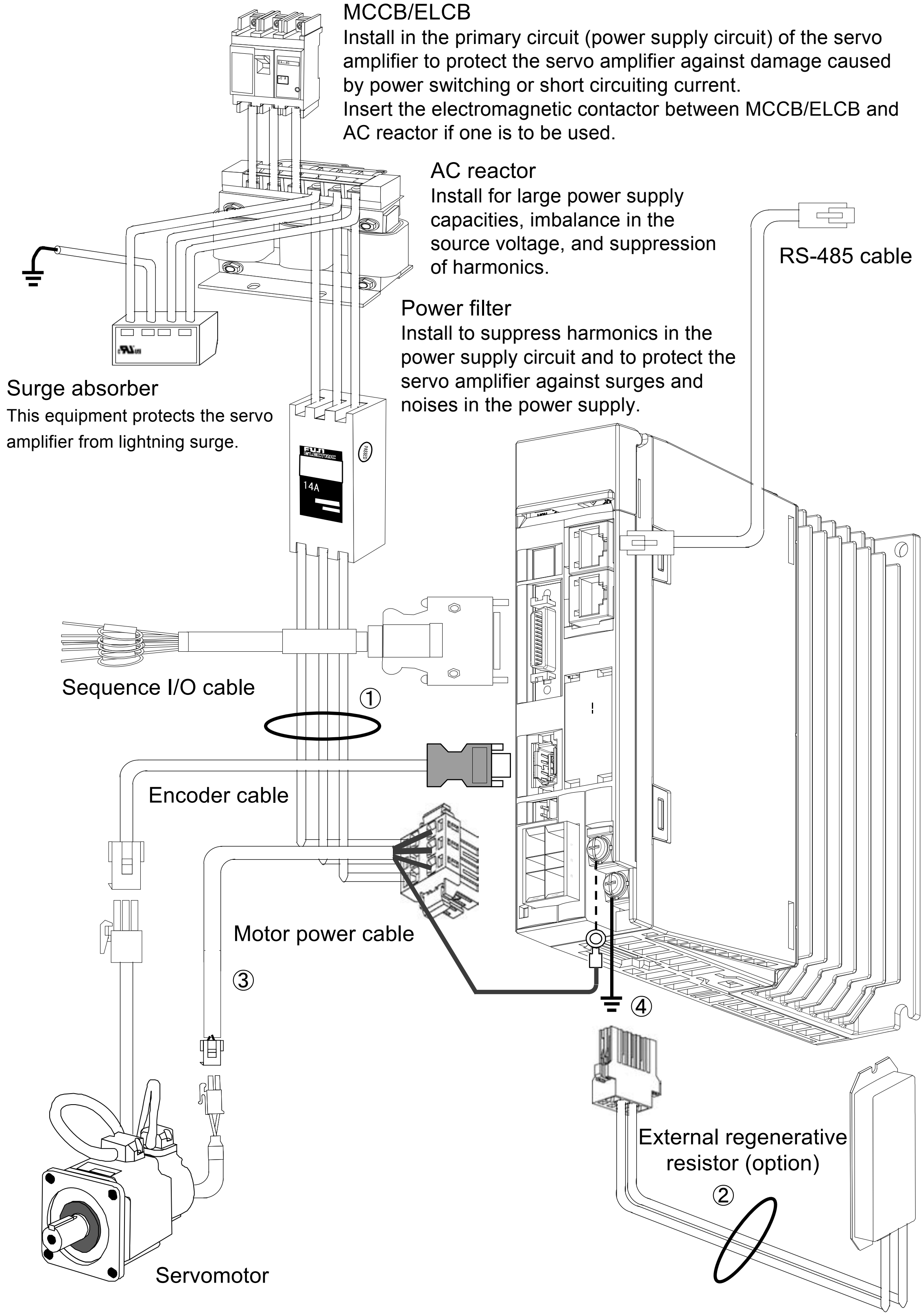


Note	The cable life depends largely on the handling method. The bending life is a reference value for the testing conditions specified above.

10

CHAPTER 10 PERIPHERAL EQUIPMENT

10.1 Overall Configuration of Peripheral Equipment



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

600 V class 2 vinyl cable, or 600 V 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.

600 V cross linked polyethylene insulated cable (CV 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)

10.2.1 Main Circuit Section Cable Size

The following cable sizes are recommended for parts (1), (2), (3) and (4) specified on page 10-2.

■ Single-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	Recommended cable size [mm^2]			
		(1) Power supply (L1,L2,L3) (3) Motor power (U,V,W) (4) Earthing (E)		(2) Regenerative resistor (RB1, RB2, RB3)	
		75[℃] (HIV)	90[℃] (CV)	75[℃] (HIV)	90[℃] (CV)
3000	0.05 to 0.75	1.25	0.75	1.25	0.75
2000	0.5				
	0.75				
1500	0.5				

■ 3-phase 200 V

<table>
<tr><th rowspan="3">Rated rotaion speed [r/min]</th><th rowspan="3">Capacity [kW]</th><th colspan="4">Recommended cable size [mm^2]</th></tr>
<tr><th colspan="2">(1) Power supply (L1,L2,L3)
(3) Motor power (U,V,W)
(4) Earthing (E)</th><th colspan="2">(2) Regenerative resistor
(RB1, RB2, RB3)</th></tr>
<tr><th>75 [°C]
(HIV)</th><th>90 [°C]
(CV)</th><th>75 [°C]
(HIV)</th><th>90 [°C]
(CV)</th></tr>
<tr><td rowspan="6">3000</td><td>0.05
to
1.0</td><td>1.25</td><td rowspan="3">0.75</td><td rowspan="14">1.25</td><td rowspan="14">1.25</td></tr>
<tr><td>1.5</td><td rowspan="3">2.0</td></tr>
<tr><td>2.0</td></tr>
<tr><td>3.0</td><td>1.25</td></tr>
<tr><td>4.0</td><td rowspan="2">3.5</td><td>2.0</td></tr>
<tr><td>5.0</td><td>3.5</td></tr>
<tr><td rowspan="7">2000</td><td>0.5
to
1.0</td><td>1.25</td><td rowspan="3">0.75</td></tr>
<tr><td>1.5</td><td rowspan="3">2.0</td></tr>
<tr><td>2.0</td></tr>
<tr><td>3.0</td><td>1.25</td></tr>
<tr><td>4.0</td><td>3.5</td><td>2.0</td></tr>
<tr><td>5.5</td><td>5.5</td><td>3.5</td></tr>
<tr><td>7.0</td><td>8.0</td><td>5.5</td></tr>
<tr><td>1500</td><td>0.5
to
1.3</td><td>1.25</td><td>0.75</td></tr>
</table>

10.2.2 Encoder 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 AWG#25/2P + AWG#23/2C or AWG#23/3P

(For 10 m or smaller wiring length)

RMCV-SB AWG#25/2P + AWG#17/2C or its equivalent

(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 200 V): Iin = (Po + Pi) / (Vac × 1.35 × ηamp × ηmot) × 1.27 × √3

Input current (3-phase 200 V): Iin = (Po + Pi) / (Vac × 1.35 × ηamp × ηmot) × 1.27

ηamp (amplifier efficiency) = 0.95 and ηmot (motor efficiency) = 0.90 are common among all models.

■ Single-phase 200 V

Rated rotation speed [r/min]	Capacity (Po) [kW]	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	0.05	180*	15	0.7	1.1
	0.1			1.3	2.0
	0.2			2.4	3.6
	0.4			4.7	7.1
	0.75			8.6	13.0
2000	0.5			5.8	8.7
	0.75			8.6	13.0
1500	0.5			5.8	8.7

* -10% of 200 V

■ 3-phase 200 V

Rated rotation speed [r/min]	Capacity (Po) [kW]	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	0.05	170*	15	0.4	0.6
	0.1			0.7	1.1
	0.2			1.4	2.1
	0.4			2.7	4.0
	0.75			5.0	7.4
	1.0			6.6	9.8
	1.5			9.8	14.7
	2.0			13.0	19.5
	3.0			19.5	29.3
	4.0			26.0	39.0
	5.0			32.5	48.7
2000	0.5			3.3	5.0
	0.75			5.0	7.4
	1.0			6.6	9.8
	1.5			9.8	14.7
	2.0			13.0	19.5
	3.0			19.5	29.3
	4.0			26.0	39.0
	5.5			35.7	53.5
	7.0			45.4	68.1
1500	0.5			3.3	5.0
	0.85			5.6	8.4
	1.3			8.5	12.8

* -15% of 200 V

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10.2.4 Conditions for Selecting Peripheral Equipment of Servo Amplifier

■ 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 200 V)

I = {(2.4 × 2) + (4.7 × 3)} × 1.5 = 28.35 A

Select peripheral equipment having 28.35 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.

Models of molded case circuit breaker and earth leakage breaker

- Single-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	MCCB	ELCB (Sensed current: 30 mA)
3000	0.05	BW32AAG-2P/3	EW32AAG-2P/3
	0.1		
	0.2	BW32AAG-2P/5	EW32AAG-2P/5
	0.4	BW32AAG-2P/10	EW32AAG-2P/10
	0.75	BW32AAG-2P/15	EW32AAG-2P/15
2000	0.5	BW32AAG-2P/10	EW32AAG-2P/10
	0.75	BW32AAG-2P/15	EW32AAG-2P/15
1500	0.5	BW32AAG-2P/10	EW32AAG-2P/10

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■ 3-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	MCCB	ELCB (Sensed current: 30 mA)
3000	0.05	BW32AAG-3P/3	EW32AAG-3P/3
	0.1		
	0.2		
	0.4	BW32AAG-3P/5	EW32AAG-3P/5
	0.75	BW32AAG-3P/10	EW32AAG-3P/10
	1.0	BW32AAG-3P/15	EW32AAG-3P/15
	1.5	BW32AAG-3P/20	EW32AAG-3P/20
	2.0	BW32AAG-3P/30	EW32AAG-3P/30
	3.0	BW32AAG-3P/40	EW32AAG-3P/40
	4.0	BW50AAG-3P/50	EW50AAG-3P/50
	5.0		
2000	0.5	BW32AAG-3P/10	EW32AAG-3P/10
	0.75		
	1.0	BW32AAG-3P/15	EW32AAG-3P/15
	1.5	BW32AAG-3P/20	EW32AAG-3P/20
	2.0	BW32AAG-3P/30	EW32AAG-3P/30
	3.0	BW50AAG-3P/40	EW50AAG-3P/40
	4.0	BW50AAG-3P/50	EW50AAG-3P/50
	5.5	BW100AAG-3P/60	EW100AAG-3P/60
	7.0	BW100AAG-3P/75	EW100AAG-3P/75
1500	0.5	BW32AAG-3P/10	EW32AAG-3P/10
	0.85		
	1.3	BW32AAG-3P/15	EW32AAG-3P/15

Made by Fuji Electric FA Components & Systems

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.

Models of electromagnetic contactor

■ Single-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	Magnetic contactor
3000	0.05	SC-03
	0.1	
	0.2	
	0.4	
	0.75	SC-0
2000	0.5	SC-03
	0.75	SC-0
1500	0.5	SC-03

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■ 3-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	Magnetic contactor
3000	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	0.5	SC-03
	0.75	
	1.0	
	1.5	SC-4-1
	2.0	
	3.0	SC-N1
	4.0	SC-N2
	5.5	
	7.0	SC-N2S
1500	0.5	SC-03
	0.85	
	1.3	SC-0

Made by Fuji Electric FA Components & Systems

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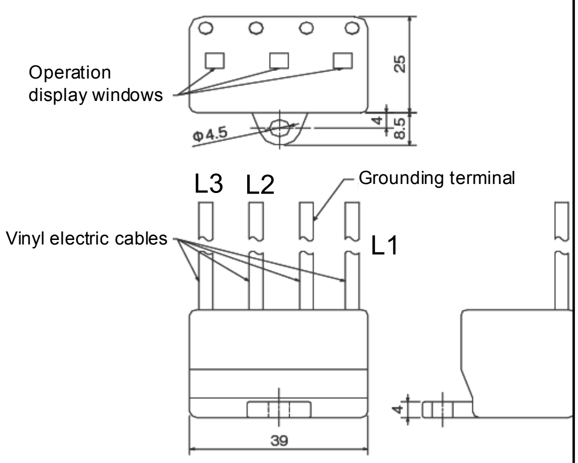
10.5 Surge Absorber

■ For protection from lightning surge

Install a surge absorber to protect servo system from the surge approaching from the power line (induced lightning surge).
Serge absorber absorbs lightning surge, preventing malfunction or damage of a servo system.

Recommendation [Soshin Electric product]
Single phase: LT-C12G801WS *
Three-phase: LT-C32G801WS
* The product for single phase has no L2 terminals.

<External dimensions>



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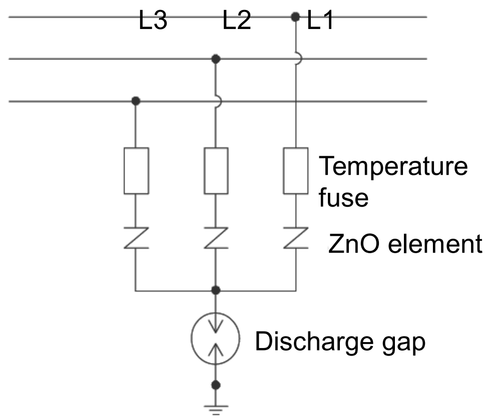
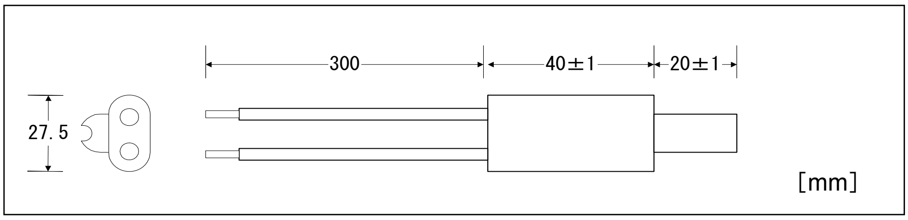


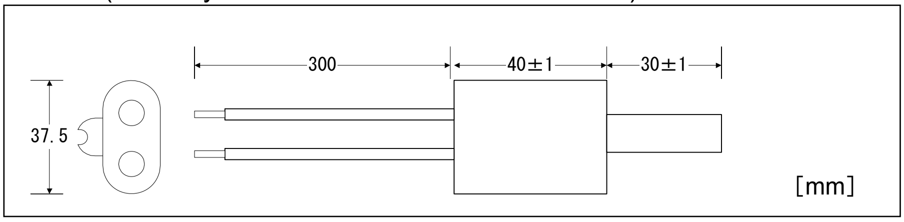
■ For protection from open/close surge of peripheral equipment

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.

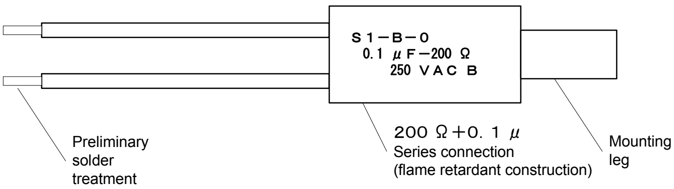
Control relay, etc.
Model: S1-B-0 (made by OKAYA ELECTRIC INDUSTRIES)



Electromagnetic contactor, etc.
Model: S2-A-0 (made by OKAYA ELECTRIC INDUSTRIES)



Applicable to 250 VAC or less voltages
A non-inductive capacitor and a non-inductive resistor are connected in series and filled in epoxy resin.
S1-B-0:200 Ω (1/2 W)+0.1 μF
S2-A-0:500 Ω (1/2 W)+0.2 μF

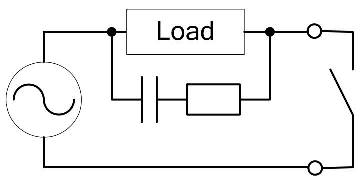


The purpose of the surge absorber is suppression of the surge voltage.

・Protection in AC circuit

C-R circuit

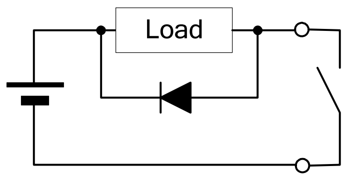
(Protection of the DC circuit is also provided.)



・Protection in DC circuit

Diode

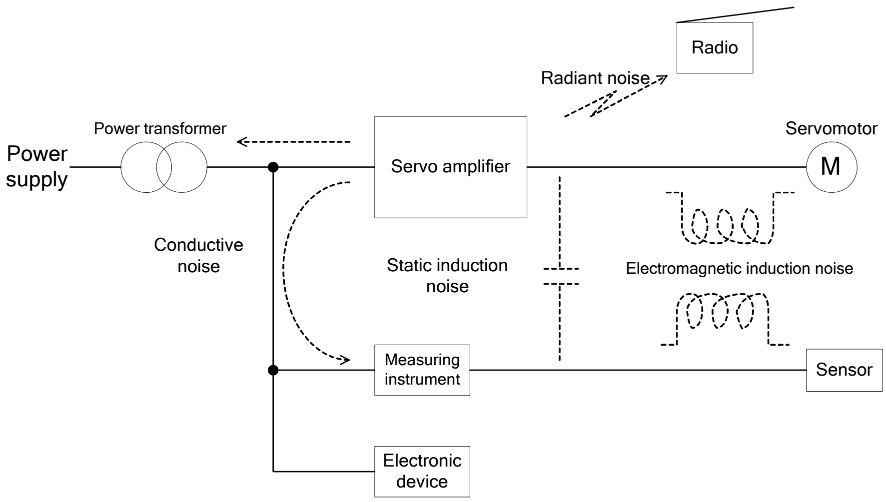
(Be aware of the orientation of the diode.)



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.



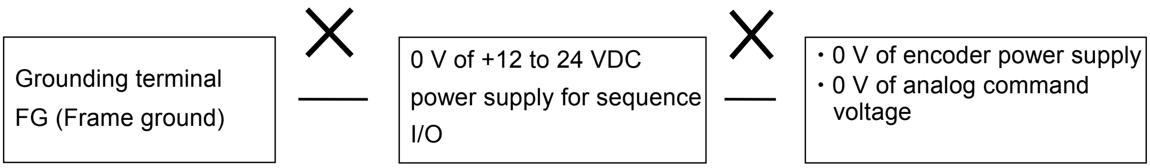
(1) House the servo amplifier in an iron (conductive) control panel and ground the control panel.
Do not install a PC or measuring instrument nearby.

(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).

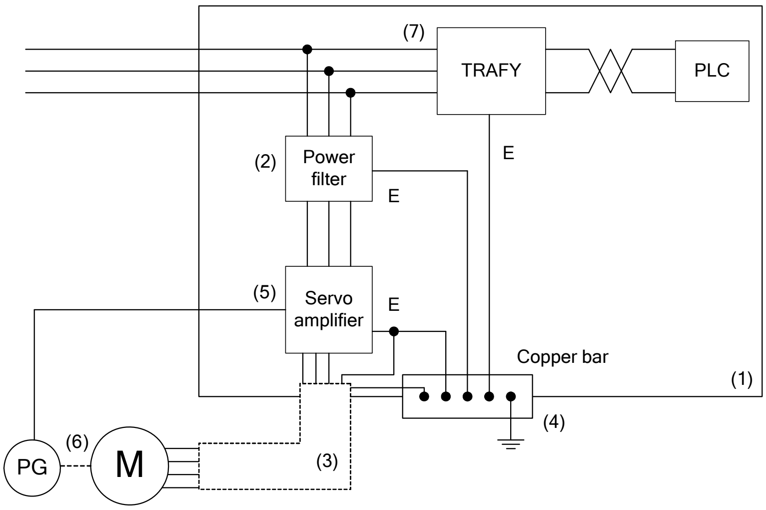
(4) Use a grounding cable as thick and short as possible.
Connect the grounding cable directly from the copper bar to individual device (do not use a jumper cable). A twisted or net cable has a larger effect.

(5) Never connect the following signals.



(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 VDC 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.

Models of power filter

■ In case of single-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	Power filter
3000	0.05	RNFTC06-20
	0.1	
	0.2	
	0.4	RNFTC10-20
	0.75	RNFTC20-20
2000	0.5	RNFTC10-20
	0.75	RNFTC20-20
1500	0.5	RNFTC10-20

Made by Fuji Electric Technica

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.

■ In case of 3-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	Power filter
3000	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	0.5	RNFTC06-20
	0.75	RNFTC10-20
	1.0	
	1.5	RNFTC20-20
	2.0	
	3.0	RNFTC30-20
	4.0	RNFTC50-20
	5.5	RNFMC60-20
	7.0	RNFMC75-20
1500	0.5	RNFTC06-20
	0.85	RNFTC10-20
	1.3	RNFTC20-20

Made by Fuji Electric Technica

10.7 AC Reactor

Connect an AC 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.

$$\text{(Ratio of power supply imbalance)} = \frac{\text{(Max. voltage [V]) - (Min. voltage [V])}}{\text{(Average voltage of threV])}} \times 100$$

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.

Model of AC reactor

■ Single-phase 200 V

Rated rotation speed [r/min]	Capacity [kW]	AC reactor
3000	0.05	ACR2-0.4 A
	0.1	
	0.2	ACR2-0.75 A
	0.4	ACR2-1.5 A
	0.75	ACR2-2.2 A
2000	0.5	ACR2-1.5 A
	0.75	ACR2-2.2 A
1500	0.5	ACR2-1.5 A

■ 3-phase 200 V

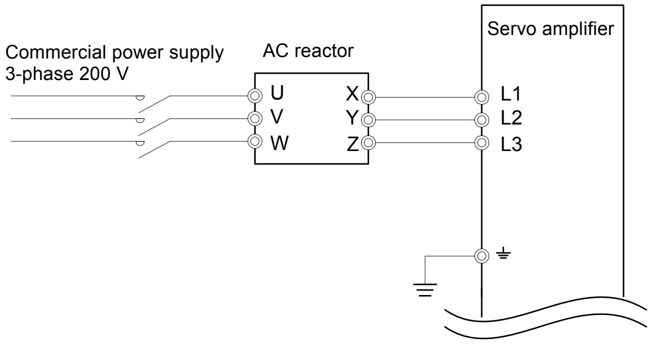
Rated rotation speed [r/min]	Capacity [kW]	AC reactor
3000	0.05	ACR2-0.4 A
	0.1	
	0.2	
	0.4	ACR2-0.75 A
	0.75	ACR2-1.5 A
	1.0	ACR2-2.2 A
	1.5	
	2.0	ACR2-3.7 A
	3.0	ACR2-5.5 A
	4.0	ACR2-7.5A
	5.0	ACR2-11A
2000	0.5	ACR2-0.75 A
	0.75	ACR2-1.5 A
	1.0	ACR2-2.2 A
	1.5	
	2.0	ACR2-3.7 A
	3.0	ACR2-5.5A
	4.0	ACR2-7.5A
	5.5	ACR2-11A
	7.0	ACR2-15A
1500	0.5	ACR2-0.75 A
	0.85	ACR2-1.5 A
	1.3	ACR2-2.2 A

■ 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 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

10

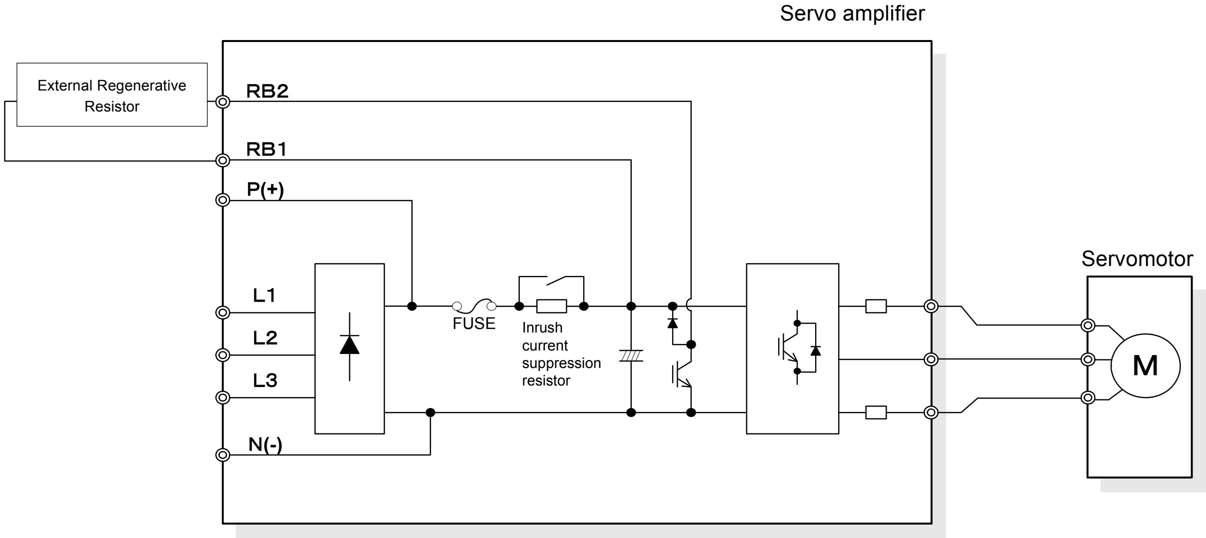
10.8 External Regenerative Resistor

The external regenerative resistor consumes regenerative power generated by the servomotor. Use an external regenerative resistor if the elevating load is large and the operation frequency is high.

Servo amplifier model	Built-in Regenerative resistor*	External Regenerative Resistor	Applicable resistance [Ω]
RYH201F5-VV2	-	WSR-401 (17W/68Ω)	39 to 180
RYH401F5-VV2	-		39 to 90
RYH751F5-VV2	20W/40Ω	WSR-152 (50W/15Ω)	13 to 47
RYH152F5-VV2	20W/15Ω		8.2 to 27
RYH202F5-VV2	45W/12Ω	DB11-2 (260W/10Ω)	8.2 to 20
RYH302F5-VV2			8.2 to 13
RYH402F5-VV2	60W/6Ω	DB22-2 (300W/5.8Ω)	3.9 to 8.2
RYH502F5-VV2			3.9 to 6.8

* The allowable wattage of the built-in regenerative resistor varies according to the ambient temperature.

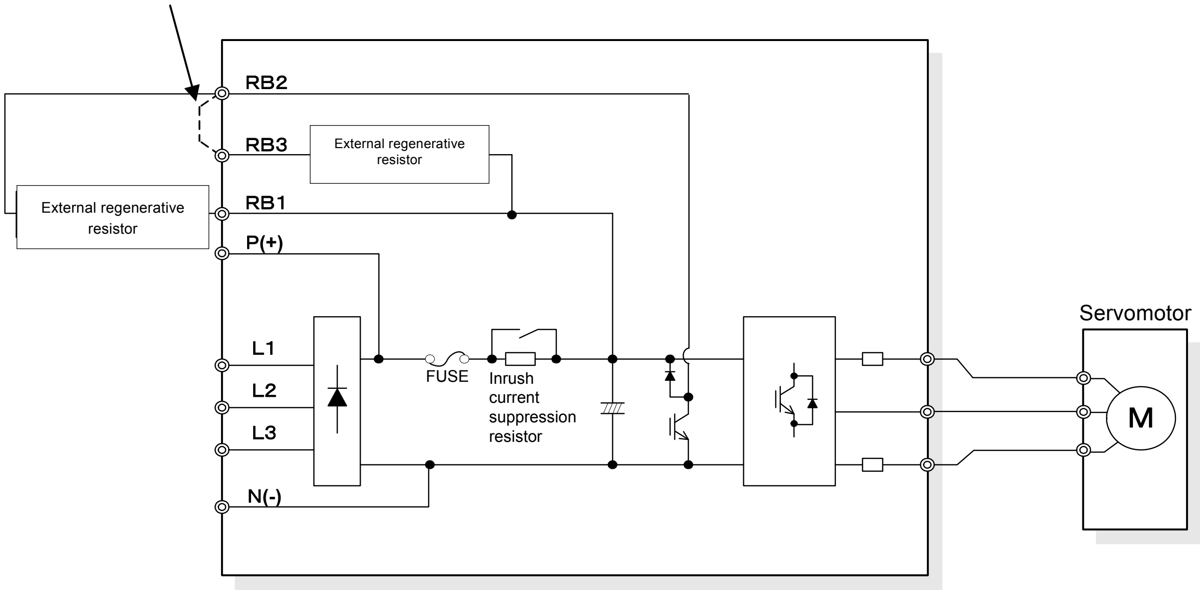
Block diagram of main circuit section (Frame 1)



Note	Use the external regenerative resistor in the designated set without fail. There is a risk of fire.

Block diagram of main circuit section (frame 2 or higher)

Always disconnect the jumper wire across RB2 to RB3 when connecting the external regenerative resistor.



Note	Use the external regenerative resistor in the designated set without fail. There is a risk of fire.

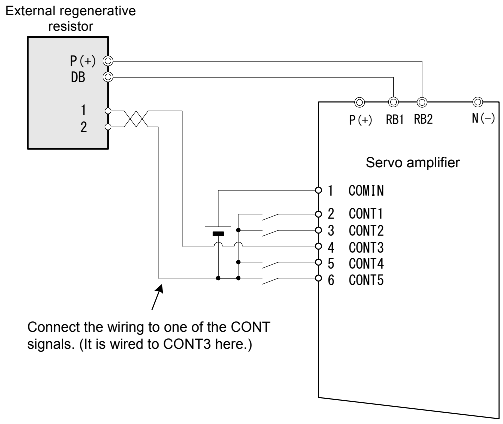
10

■ To connect the optional external regenerative resistor

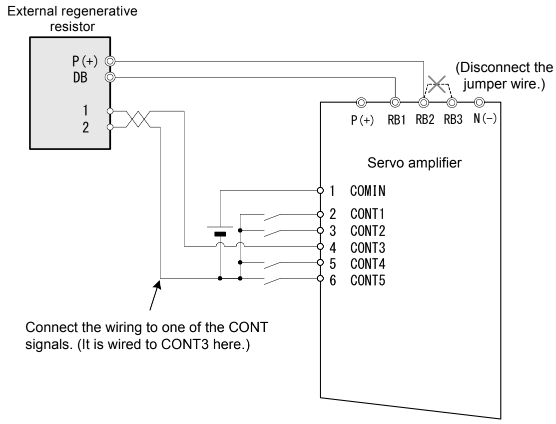
Perform the wiring and set the parameters shown below so that the servo system is shut off upon activation (the contact was open) of the thermistor built in the external regenerative resistor.

- Wiring of thermistor output of external regenerative resistor
  - Connect the wiring to one of the sequence inputs (CONT 1 to 5) of the servo amplifier.

Frame 1



Frame 2 or higher



- Parameter setting
  - Allocate "34"(external regenerative resistor overheat) to PA3_01 to 05 (allocation to the connected CONT signal).
  - Set PA2_65 (regenerative resistor selection) at "2" (external resistor).

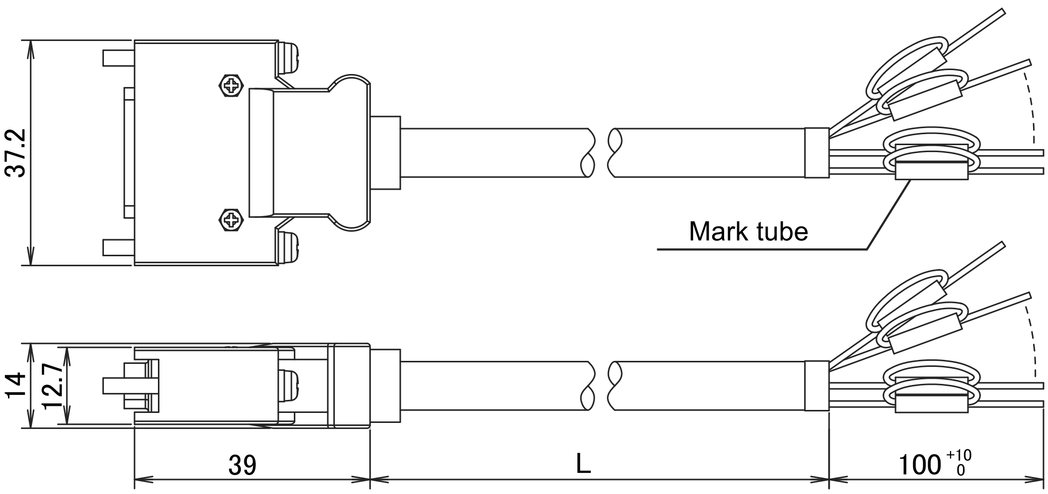
Note	* The external regenerative resistor will become excessively hot in the event of failure of the regenerative transistor, possibly causing fire.

10

10.9 Optional Equipment

Sequence I/O cable (Pulse form: Differential)

Model: WSC-D26P02 (Cable length: 2 m)
WSC-D26P03 (Cable length: 3 m)
Applicable range: All models (for CN1)



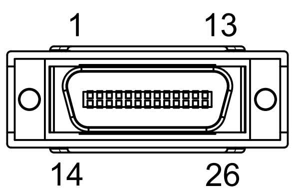
■Cable color

Pin no.	1	2	3	4	5	6	7	8	9	10	11	12	13	15	14	16	17	18	19	20	21	22	23	24	25	26
Insulator color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
Mark type	1		1		1		1		1		2		2		2		2		2		3		3		3	
Mark color	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black

■Length

Model	L[mm]	
WSC-D26P02	2000	+200 0
WSC-D26P03	3000	+300 0

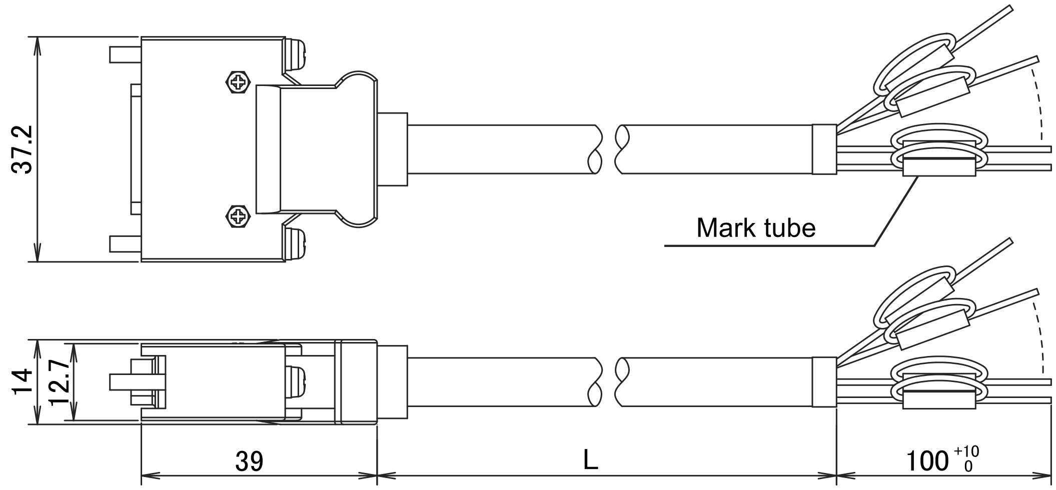
■Terminal layout



* Contact Fuji Electric if the cable of lengths other than above is necessary.
－The manufacturer of the connector is subject to change without notice.

Sequence I/O cable (Pulse form: Open collector)

Model: WSC-D26P02-F (Cable length: 2 m, Power supply: 24 VDC)
Applicable range: All models (for CN1)



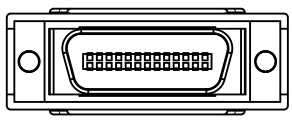
■Cable color

Pin no.	1	2	3	4	5	6	7	8	9	10	11	12	13	15	14	16	17	18	19	20	21	22	23	24	25	26
Insulator color	Orange		Gray		White		NC	Yellow	Pink		Orange		Gray		White		Yellow		Pink	NC	Orange		Gray		White	
Mark type	1		1		1			1	1		2		2		2		2		2		3		3		3	
Mark color	RED	Black	RED	Black	RED	Black		Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED		RED	Black	RED	Black	RED	Black

■Length

Model	L[mm]
WSC-D26P02-F	2000 +200 0

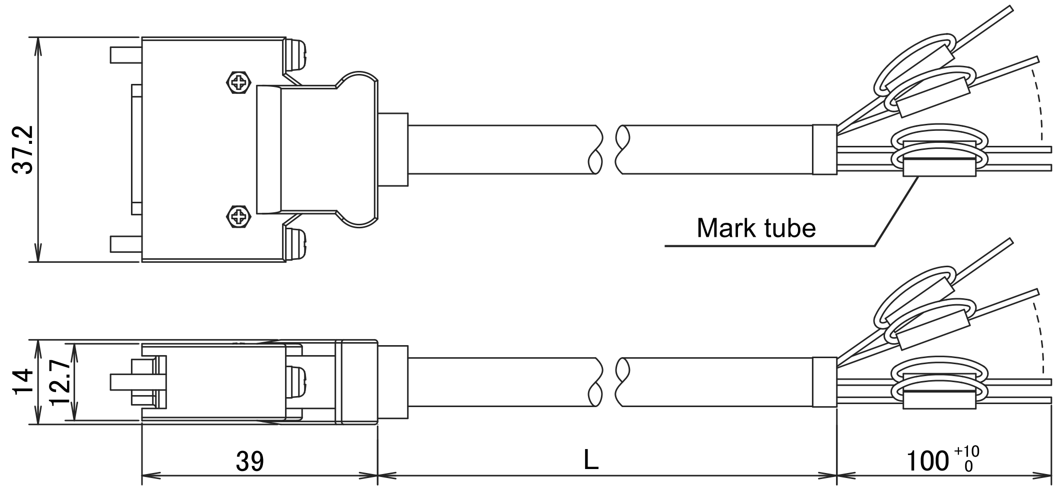
■Terminal layout



* Contact Fuji Electric if the cable of lengths other than above is necessary.
－The manufacturer of the connector is subject to change without notice.

Sequence I/O cable (Pulse form: Open collector)

Model: WSC-D26P02 (Cable length: 2 m, Power supply: other than 24 VDC)
Applicable range: All models (for CN1)



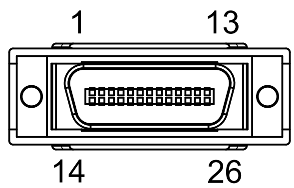
■Cable color

Pin no.	1	2	3	4	5	6	7	8	9	10	11	12	13	15	14	16	17	18	19	20	21	22	23	24	25	26
Insulator color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
Mark type	1		1		1		1		1		2		2		2		2		2		3		3		3	
Mark color	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black	RED	Black

■Length

Model	L[mm]	
WSC-D26P02	2000	+200 0

■Terminal layout

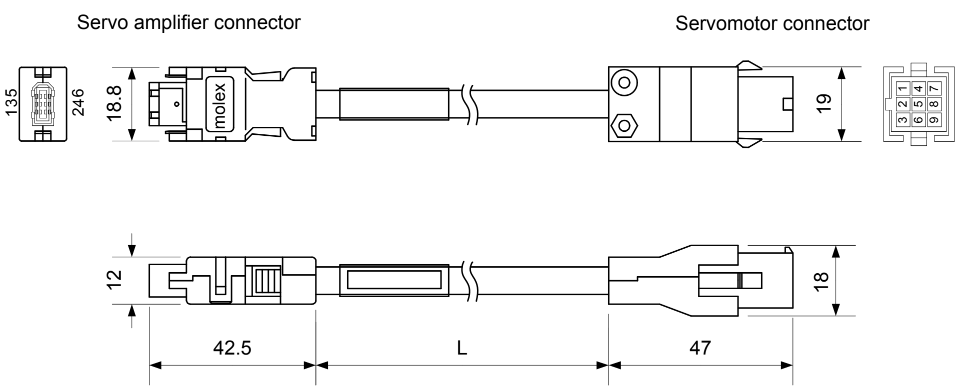


* Contact Fuji Electric if the cable of lengths other than above is necessary.
－The manufacturer of the connector is subject to change without notice.

Encoder cable (1)

Model: WSC-P06P02-E to WSC-P06P20-E

Applicable range: GYB／GYC／GYS 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	1-172161-9
Cap housing	316455-1
Socket（SIG+、SIG-、BAT+、BAT-）	170361-1（Chain）
Socket（P5、M5、FG）	171637-1（Chain）
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.

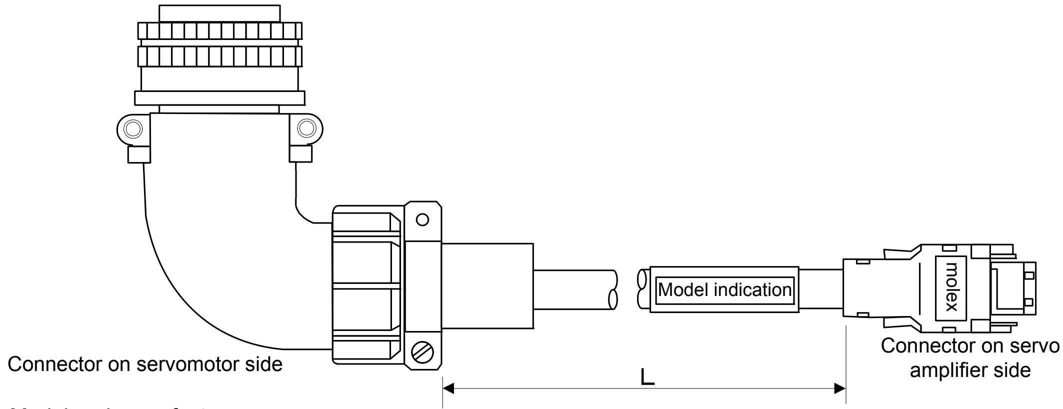
⚠ CAUTION

Do not join two or more encoder cables to extend the wiring distance.
Otherwise the voltage drop caused by connector contact resistance will cause sudden stoppage.

Encoder cable (2)

Model: WSC-P06P05-C to WSC-P06P20-C

Applicable range: GYG model ... 0.5 to 2.0 kW (for CN2)
GYC model ... 1.0 to 2.0 kW (for CN2)
GYS model ... 1.0 to 5.0 kW (for CN2)



■ Model and manufacturer

Connector on servomotor side

Connector	D/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.

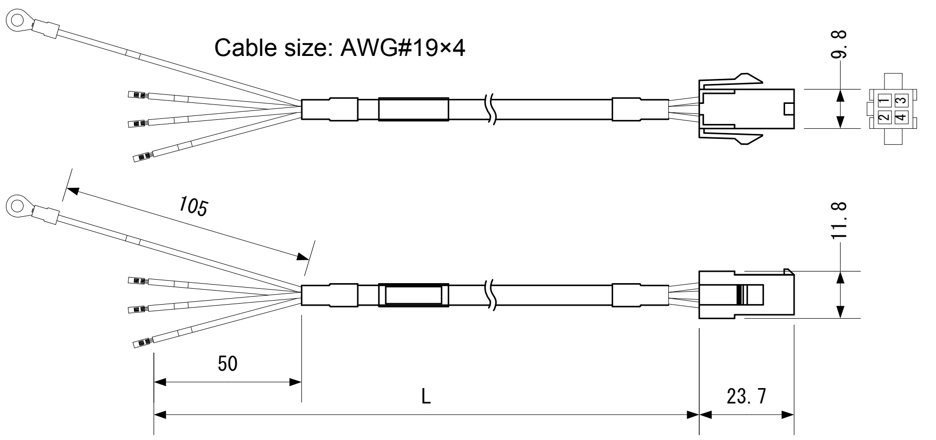
⚠ CAUTION

Do not join two or more encoder cables to extend the wiring distance.
Otherwise the voltage drop caused by connector contact resistance will cause sudden stoppage.

Motor power cable

Model: WSC-M04P02-E to WSC-M04P20-E

Applicable range: GYB／GYC／GYS model ... 0.75 kW or less (for CN2)



■ 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.

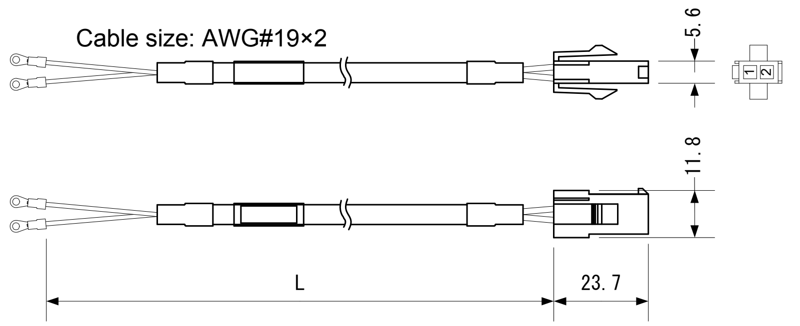
10

Brake cable

Model: WSC-M02P02-E to WSC-M02P20-E

Applicable range: GYB／GYC／GYS model ... 0.75 kW or less　(with brake)

Control device side　　　　Servomotor connector



■ 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.

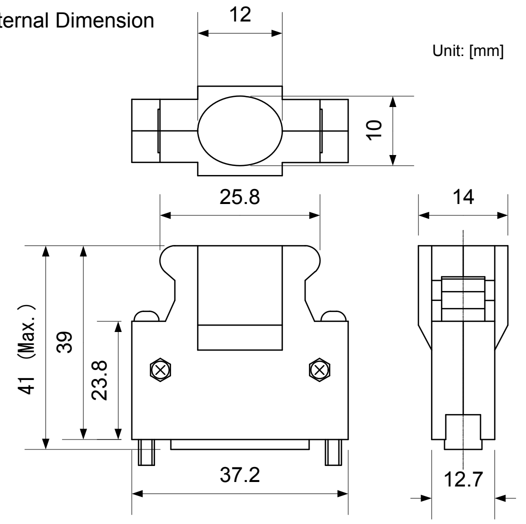
10

Sequence I/O connector kit

Model: WSK-D26P

Applicable range: All models

■ External Dimension

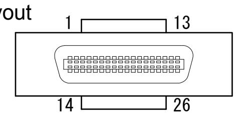


■ Model and manufacturer

Soldered plug	10126-3000VE
Shell kit	10326-52A0-008

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.

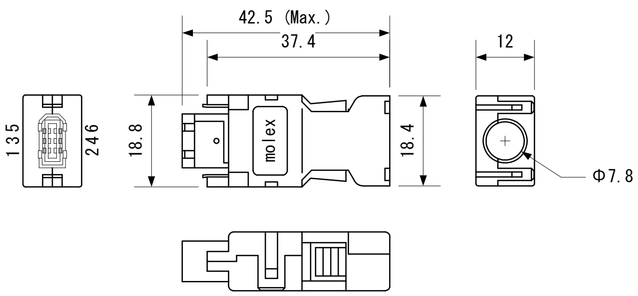
Encoder connector kit (Amplifier side)

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.

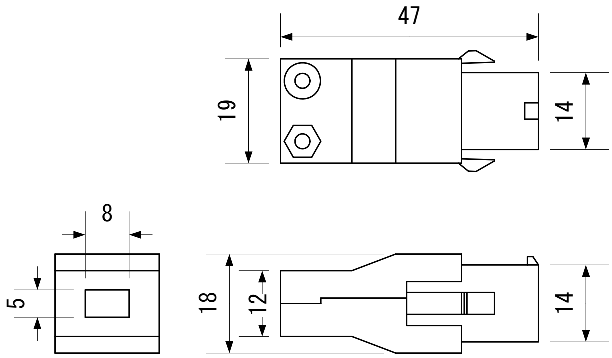
Encoder connector kit (Motor side)

Model: WSK-P09P-D

Applicable range: GYB／GYC／GYS model ... 0.75 kW or less

■ External Dimension

Unit: [mm]

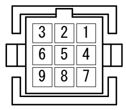


■ Model and manufacturer

Cap	1-172161-9
Cap cover	316455-1
Socket (SIG+,SIG-,BAT+,BAT-,FG)	170365-1(bulk) 170361-1(chain)
Socket (P5,M5)	170366-1(bulk) 170637-1(chain)
Screw（×2）	XPB M2.6×10
Nut（×2）	M2.6

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.

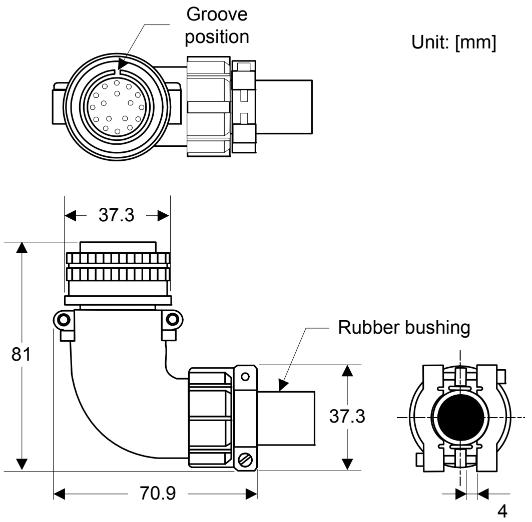
Encoder connector kit (Motor side)

Model: WSK-P06P-C

Applicable range: GYG model ... 0.5 to 2.0 kW
GYC model ... 1.0 to 2.0 kW
GYS model ... 1.0 to 5.0 kW

■ External dimension

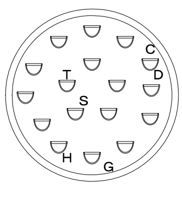
Unit: [mm]



■ Model and manufacturer

Connector	D/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.

Recommended connector kit (motor side) for GYH type motor encoder wiring

Applicable range：GYH type････1.0 to 7.0 kW

■Model and manufacturer

L-shaped clamp	MS3108B20-18S
Cable clamp	MS3057-12A

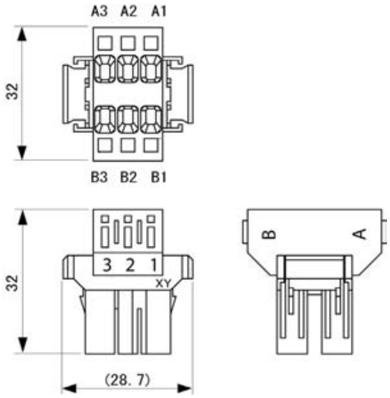
Made by Daiichi Denshi Kogyo

Power supply and motor power conncetor (Amplifier side)

Model: WSK-S06P-F

Applicable range: GYB／GYC／GYS model‥‥0.4 [kW]or less

■External Dimension



■Model and manufacturer

Connector	06JFAT-SAXYGG-F-KK
Open tool	J-FAT-OT

J.S.T. Mfg. Co., Ltd.

■Terminal layout

Symbol	Terminal
A1	L1
A2	L2
A3	L3

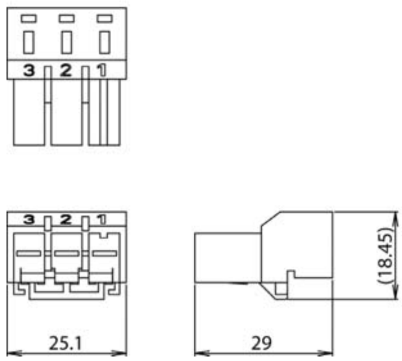
Symbol	Terminal
B1	U
B2	V
B3	W

Power supply conncetor (Amplifier side)

Model: WSK-S03P-F

Applicable range: GYB model‥‥0.75 kW
GYG model‥‥0.5 to 2.0 kW
GYC model‥‥0.75 to 2.0 kW
GYS model‥‥0.75 to 3.0 kW

■External Dimension



■Model and manufacturer

Connector	03JFAT-SAXGSA-L
Open tool	J-FAT-OT

J.S.T. Mfg. Co., Ltd.

■Terminal layout

Pin no.	1	2	3
Name	L1	L2	L3

Recommended RYH type (frame 3) /UL standard compatible power supply connector (amplifier side)

Applicable range: GYH type‥‥3.0 kW 4.0 kW
GYG type‥‥1.3 kW 2.0 kW
GYC type‥‥2.0 kW
GYS type‥‥2.0 kW 3.0 kW

■Model and manufacturer

Connector	03JFAT-SAXGFK-XL
Open tool	J-FAT-OT-EXL

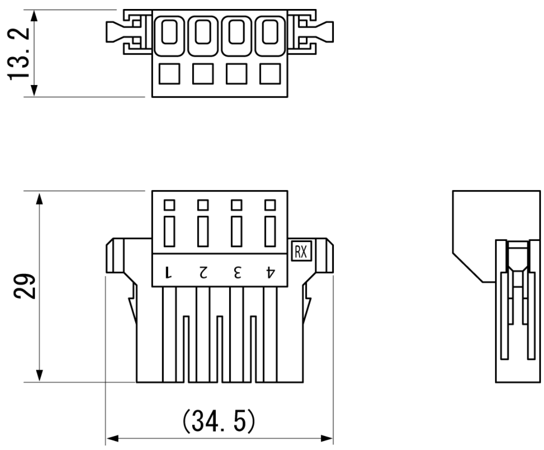
J.S.T. Mfg. Co., Ltd.

DC circuit connector (Amplifier side)

Model: WSK-R04P-F

Applicable range: GYB／GYC／GYS model····0.4 [kW]or less

■External Dimension



■Model and manufacturer

Connector	04JFAT-SBXGF-I
Open tool	J-FAT-OT

J.S.T. Mfg. Co., Ltd.

■Terminal layout

Pin no.	1	2	3	4
Name	P(+)	RB1	RB2	N(-)

DC circuit connector (Amplifier side) *Provided with amplifier.

Model: WSK-R05P-F

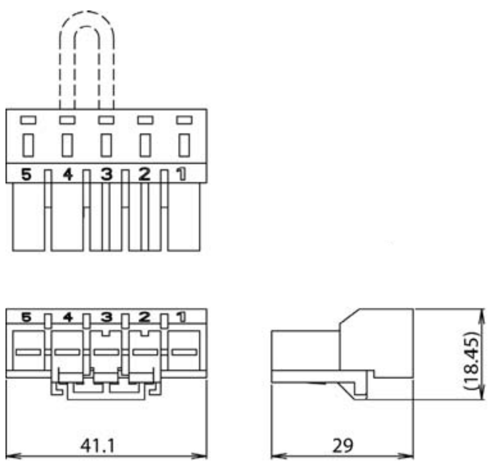
Applicable range: GYB model····0.75 kW

GYG model····0.5 to 2.0 kW

GYC model····0.75 to 2.0 kW

GYS model····0.75 to 3.0 kW

■External Dimension



■Model and manufacturer

Connector	05JFAT-SAXGSA-L
Open tool	J-FAT-OT

J.S.T. Mfg. Co., Ltd.

■Terminal layout

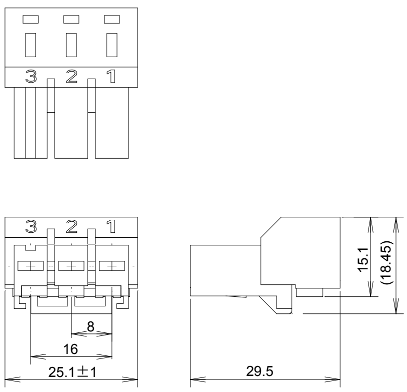
Pin no.	1	2	3	4	5
Name	P(+)	RB1	RB2	RB3	N(-)

Motor power connector (Amplifier side)

Model: WSK-M03P-F

Applicable range: GYB model・・・・0.75 kW
GYG model・・・・0.5 to 2.0 kW
GYC model・・・・0.75 to 2.0 kW
GYS model・・・・0.75 to 3.0 kW

■External Dimension



■Model and manufacturer

Connector	03JFAT-SAYGSA-L
Open tool	J-FAT-OT

J.S.T. Mfg. Co., Ltd.

■Terminal layout

Pin no.	1	2	3
Name	U	V	W

Recommended RYH type (frame 3) / UL standard compatible motor power connector (amplifier side)

Applicable range: GYH model・・・3.0[kW], 4.0[kW]
GYG model・・・1.3[kW], 2.0[kW]
GYC model・・・2.0[kW]
GYS model・・・2.0[kW], 3.0[kW]

■Model and manufacturer

Connector	03JFAT-SAYGFS-XL
Open tool	J-FAT-OT-EXL

J.S.T. Mfg. Co., Ltd.

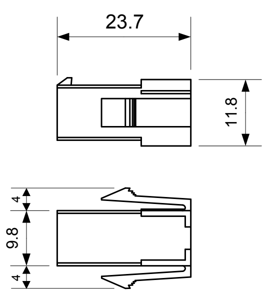
Motor power connector kit (Motor side)

Model: WSK-M04P-E

Applicable range: GYB／GYC／GYS model ... 0.75 kW or less

■External Dimension

Unit: [mm]

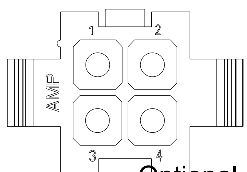


■Model and manufacturer

Cap housing	172159-1	
Socket	170362-1 (for 0.75 mm^2)	
	171637-1 (for 1.25 mm^2)	

Made by Tyco Electronics Amp K.K.

■Terminal layout



1 : U
2 : V
3 : W
4 : E

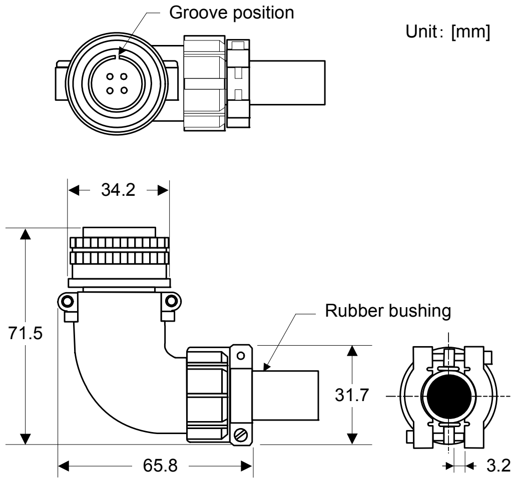
10

Motor power connector kit (Motor side)

Model: WSK-M04P-CA
Applicable range: GYG model・・・・0.5 to 2.0 kW
GYS model・・・・1.0 to 2.0 kW

■ External Dimension

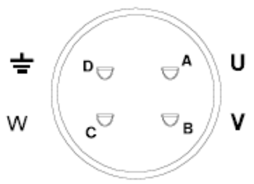
Unit: [mm]



■Model and manufacturer

Connector	MS3108B18-10S
Cable clamp	MS3057－10A

Made by Daiichi Denshi Kogyo



A	U
B	V
C	W
D	⏚

Recommended connector kit (motor side) for GYH type motor power wiring

Applicable range：GYH model・・・・1.0 to 3.0 kW

■Model and manufacturer

L-shaped clamp	MS3108B20-4S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo

Applicable range：GYH model・・・・4.0 to 7.0 kW

■Model and manufacturer

L-shaped clamp	MS3108B32-17S
Cable clamp	MS3057-20A

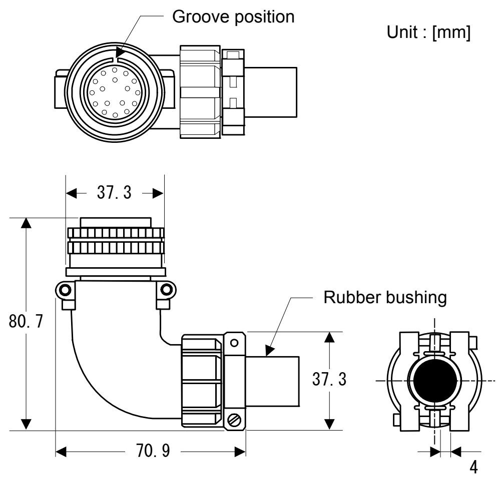
Made by Daiichi Denshi Kogyo

Motor power connector kit (Motor side : With brake)

Model: WSK-M06P-CA
Applicable range: GYH model・・・・1.0 to 3.0 kW (with brake)
GYG model・・・・0.5 to 2.0 kW (with brake)
GYS model・・・・1.0 to 2.0 kW (with brake)

■External Dimension

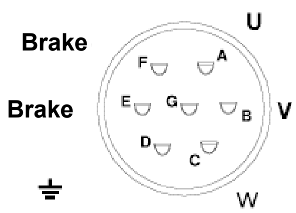
Unit : [mm]



■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	－

Recommended connector kit (motor side) for GYH type brake wiring

Applicable range：GYH model････4.0 to 7.0 kW

■Model and manufacturer

Straight clamp	MS3106A10SL-3S
Cable clamp	MS3057-4A

Made by Daiichi Denshi Kogyo

Motor power connector kit (Motor side)

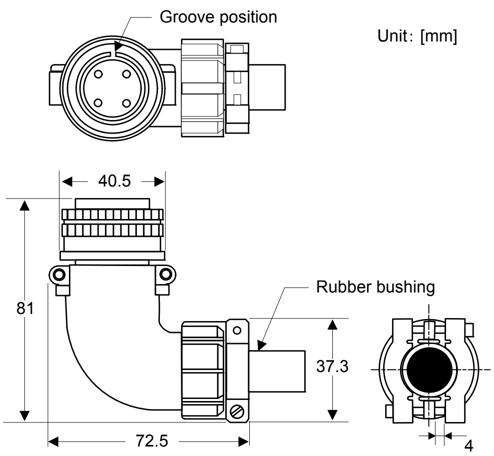
Model: WSK-M04P-CB

Applicable range: GYC model････0.5 to 2.0 kW

GYS model････3.0 kW

■ External Dimension

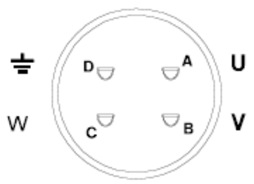
Unit: [mm]



■ Model and manufacturer

L-type clamp	MS3108B22-22S
Cable clamp	MS3057-12A

Made by Daiichi Denshi Kogyo



A	U
B	V
C	W
D	⏚

Motor power connector kit (Motor side : With brake)

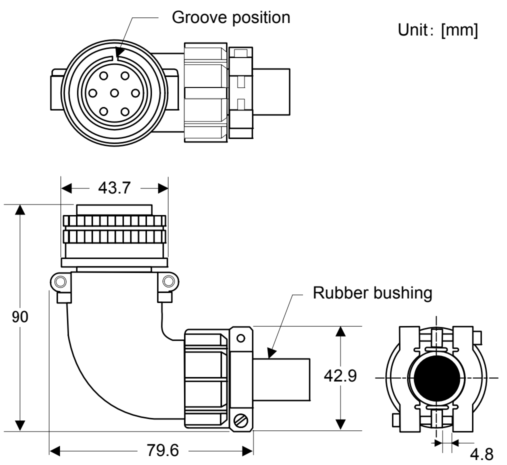
Model: WSK-M06P-CB

Applicable range: GYC model････0.5 to 2.0 kW (with brake)

GYS model････3.0 kW (with brake)

■ External Dimension

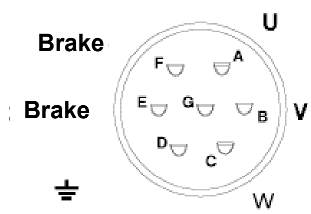
Unit: [mm]



■ Model and manufacturer

L-type clamp	MS3108B24-10S
Cable clamp	MS3057-16A

Made by Daiichi Denshi Kogyo



A	U
B	V
C	W
D	⏚
E	Br
F	Br
G	―

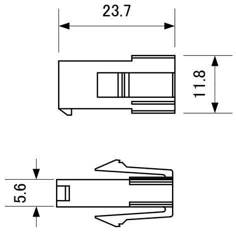
Brake connector kit (Motor side)

Model: WSK-M02P-E

Applicable range: GYB／GYC／GYS model･･･0.75 kW or less (with brake)

■ External Dimension

Unit: [mm]

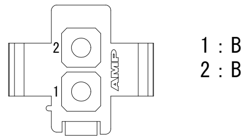


■ Model and manufacturer

Cap housing	172157-9
Socket	170362-1

Made by Tyco Electronics Amp K.K.

■ Terminal layout

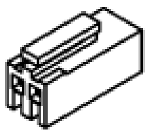


Battery (CN5)

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

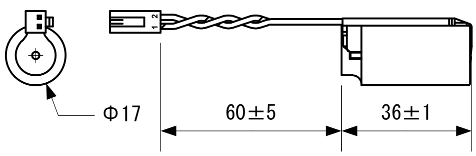
Japan Aviation Electronics Industry, Ltd.

Battery + Battery case

Model: WSB-SC

Applicable range: All models

■ Battery

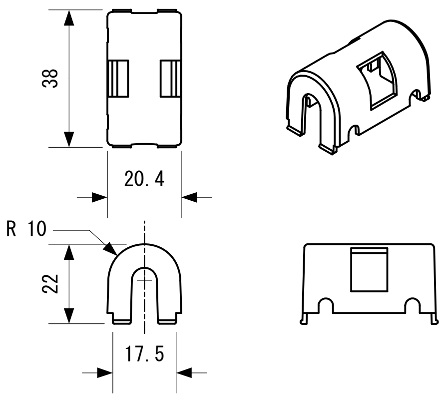


■ Model and manufacturer

Battery	ER1733WK41 1PP

Hitachi Maxell Ltd.

■ Battery case

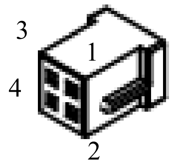


10

Monitor (CN4)

A measuring instrument or similar is connected to the connector 4 (CN4) 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(0 V)
2	MON2	4	M5(0 V)



■ Model and manufacturer

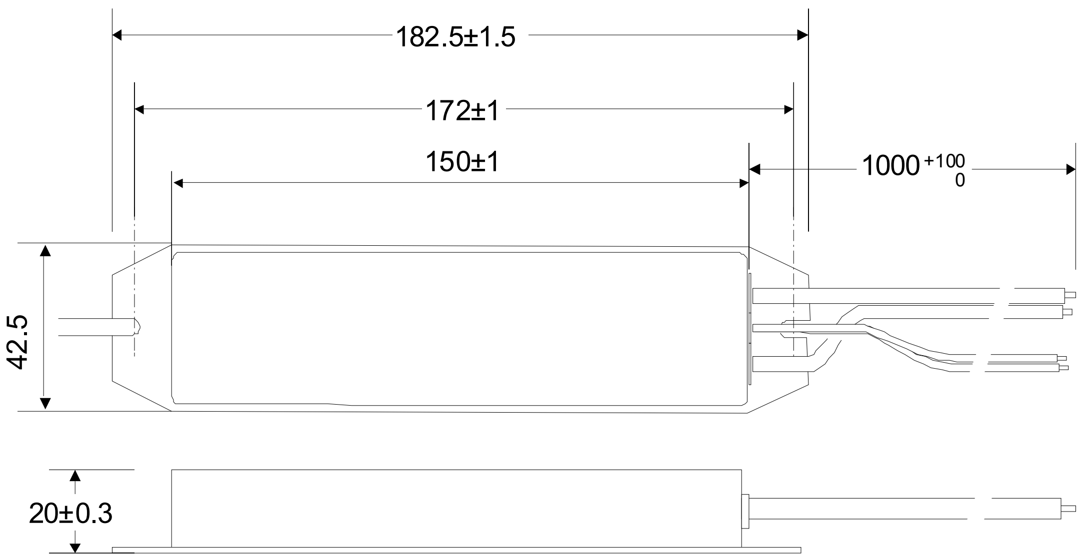
Crimp socket	DF11-4DS-2C
Crimp terminal	DF11-2428SC

Hirose Electric Co., Ltd.

External regenerative resistor (1)

Model: WSR-401

Applicable range: servo amplifier model: RYH201F5-VV2, RYH401F5-VV2



* Thickness of the installed section: 1.2 mm

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 1.5 kV AC
	Contact capacity	30 VDC 3 A

- Connect the regenerative resistor to the servo amplifier with a 10 m or shorter cable.
- The external regenerative resistor becomes hot. Keep flammable matters away from the external regenerative resistor.
- For connection of the external regenerative resistor, refer to "10.8 External Regenerative Resistor."

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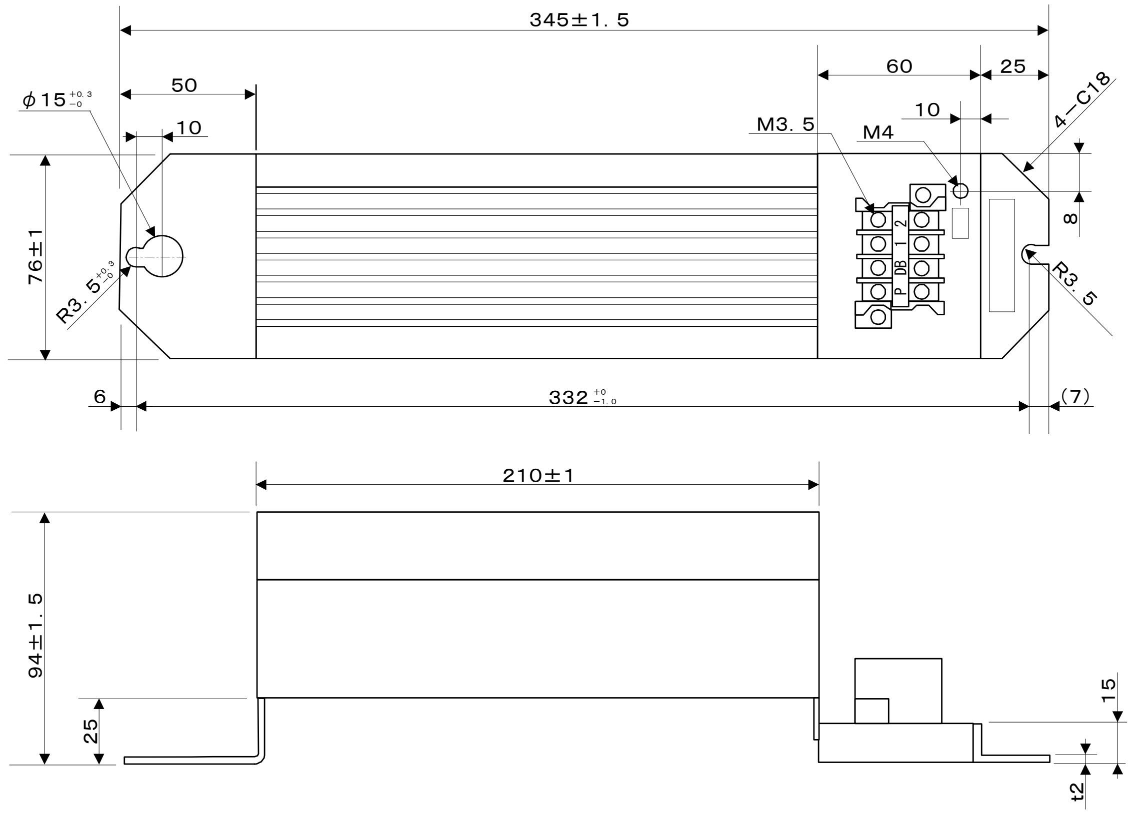
External regenerative resistor (2)

Model: WSR-152

Applicable range: servo amplifier model: RYH751F5-VV2、RYH152F5-VV2



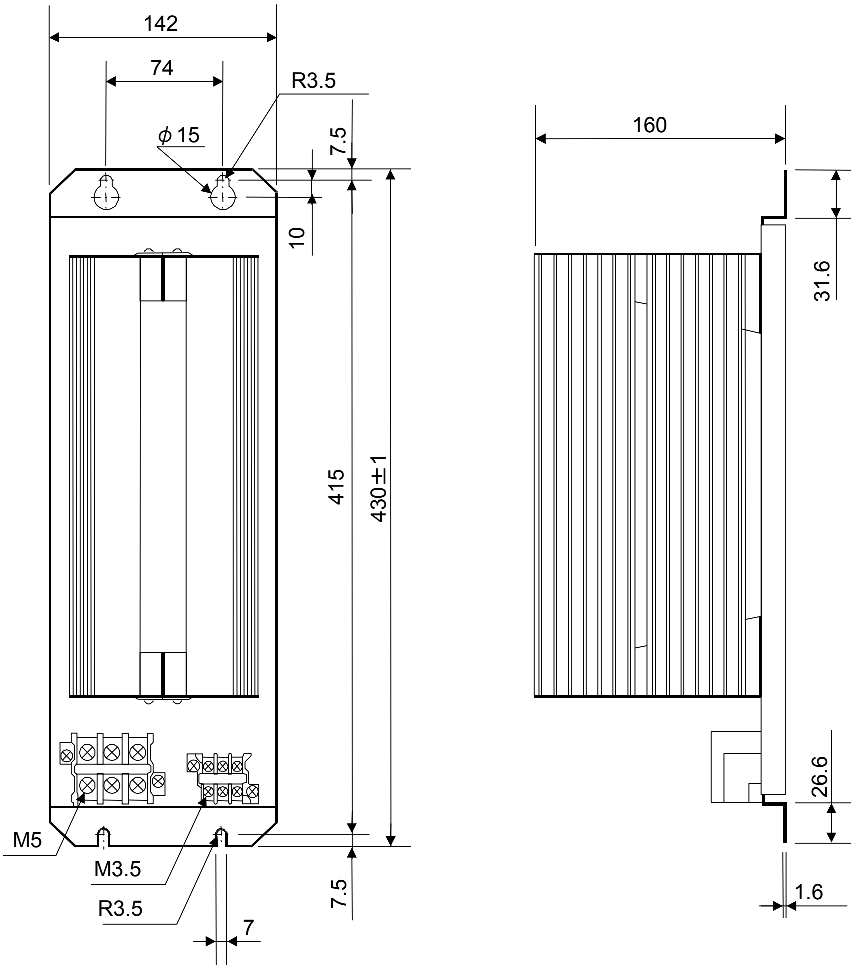
Item		Specifications
Model		WSR-152
Resistor	Resistance	15 Ω
	Allowable power	50 W（cont.）
Thermistor	Operating temperature	Open at 150 ±10°C
	Dielectric strength	For 1 minutes at 2.5 kV AC
	Contact capacity	30 VDC 3 A

- Connect the regenerative resistor to the servo amplifier with a 10 m or shorter cable.
- The external regenerative resistor becomes hot. Keep flammable matters away from the external regenerative resistor.
- For connection of the external regenerative resistor, refer to "10.8 External regenerative Resistor."

External regenerative resistor (3)

Model: DB11-2

Applicable range: servo amplifier model: RYH202F5-VV2、RYH302F5-VV2



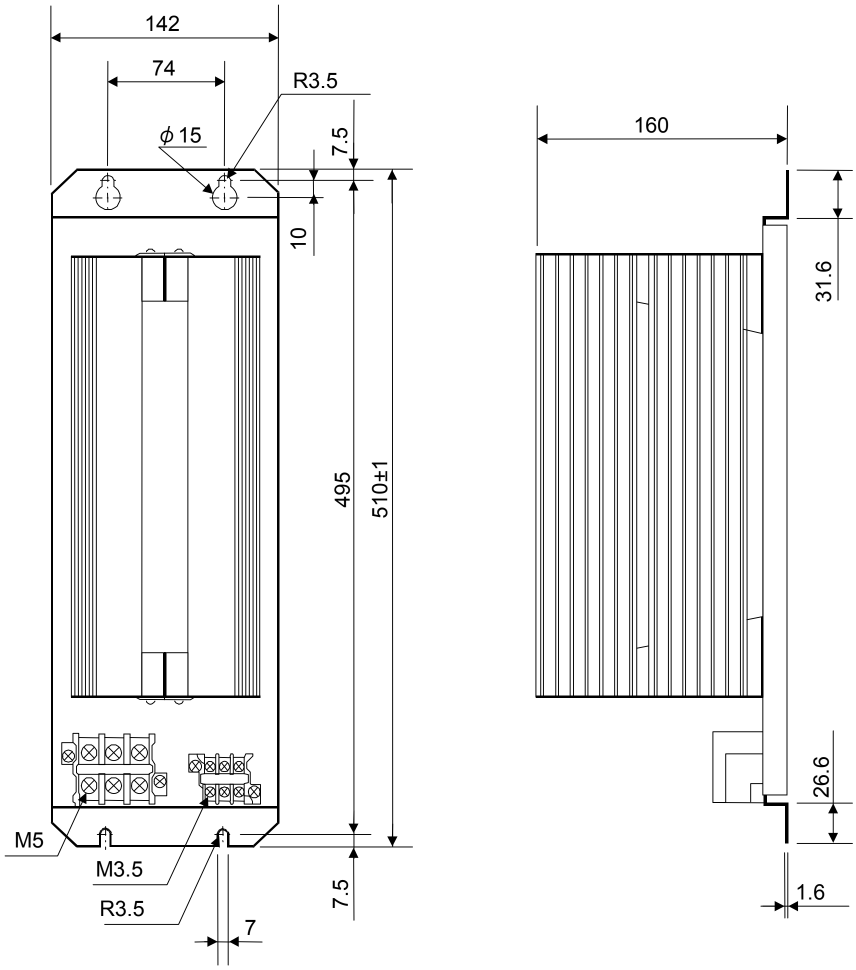
Item		Specifications
Model		DB11-2
Resistor	Resistance	10Ω
	Allowable power	260 W（cont.）
Thermistor	Operating temperature	Open at 150 ±10°C
	Dielectric strength	For 1 minutes at 2.5 kV AC
	Contact capacity	120 V AC /30 V DC 1A

- Connect the regenerative resistor to the servo amplifier with a 10 m or shorter cable.
- The external regenerative resistor becomes hot. Keep flammable matters away from the external regenerative resistor.
- For connection of the external regenerative resistor, refer to "10.8 External regenerative Resistor."

External regenerative resistor (4)

Model: DB22-2

Applicable range: servo amplifier model: RYH402F5-VV2,RYH502F5-VV2



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 2.5 kV AC
	Contact capacity	120 V AC /30 V DC 0.1 A

- Connect the regenerative resistor to the servo amplifier with a 10 m or shorter cable.
- The external regenerative resistor becomes hot. Keep flammable matters away from the external regenerative resistor.
- For connection of the external regenerative resistor, refer to "10.8 External regenerative Resistor."

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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

■ Marine or air transport of battery (lithium-metal battery)

The following precautions must be taken when you transport lithium-metal batteries in any of the conditions of the followings: individually, packaged with the devices, or mounted in devices.

1) When transporting lithium-metal batteries mounted in devices

When transporting the batteries together with a control panel or the like instrumented with five or more servo amplifiers into which the batteries are mounted, attach the label Fig. 1 below and submit the transportation documents.

2) When transporting lithium-metal batteries packaged with devices

It is necessary to attach the label Fig. 1 below and submit the transportation documents to issue the drop test certificate.

Furthermore, the allowable number of the batteries to be transported by air is the number required to operate the device plus two.

Fig.1 Label to be attached to the package outer surface

Size: 120 ×110 mm

For details contact us or Fuji Electric Systems representative.

■ 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.

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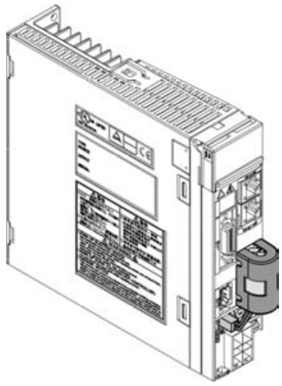
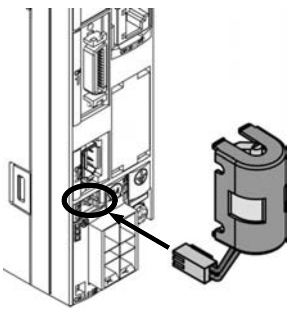
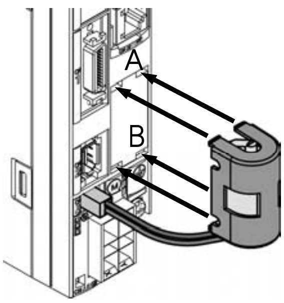
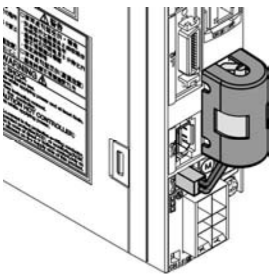
11.2 Battery Installation and Replacement Procedures

11.2.1 Battery Installation Procedure [Frame 1]

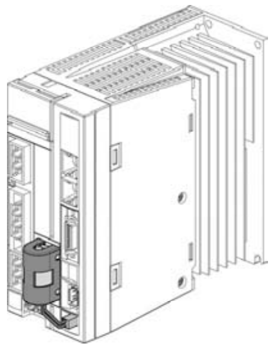
Install the battery with the following procedure.



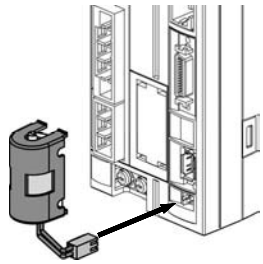
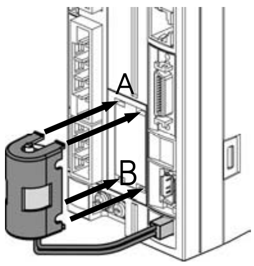
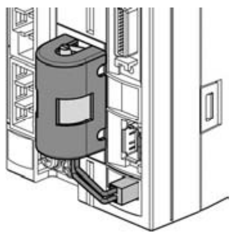
Appearance with the battery mounted

①		Put the battery in the battery case first. Connect the lead wire connector of the battery to CN5 on the front panel of the servo amplifier.
②		Fit the four tabs of the battery case into the mounting holes on the servo amplifier front face. Fit the tabs on A side first and then B side (or B side first and then A side) to fit the case in readily way.
③		Check the condition if the case is fitted securely. - Has the connector been inserted securely? - Have all of the four battery case tabs been fitted to the front face of the servo amplifier?

11.2.2 Battery Installation Procedure [Frame 2, 3 and 4]



Appearance with the battery mounted

①		Put the battery in the battery case first. Connect the lead wire connector of the battery to CN5 on the front panel of the servo amplifier.
②		Fit the four tabs of the battery case into the mounting holes on the servo amplifier front face. Fit the tabs on A side first and then B side (or B side first and then A side) to fit the case in readily way.
③		Check the condition if the case is fitted securely. - Has the connector been inserted securely? - Have all of the four battery case tabs been fitted to the front face of the servo amplifier?

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 power supplied when working. • Leave the encoder cable connected.

11.3 Starting Up Procedure

Follow the procedure below to start up the absolute position system.

[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 off then on again.

To make new parameters enabled, turn the power off then on again.

dL 1

[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].

11.4 Battery Warning

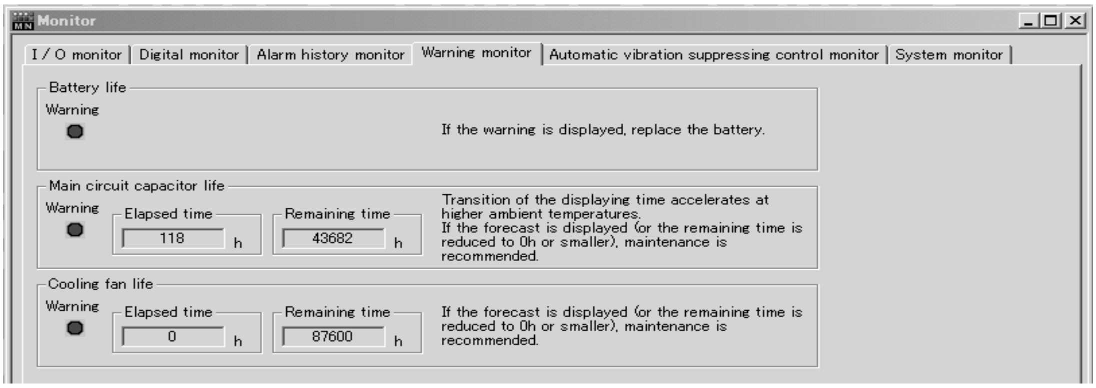
A battery warning is issued if the battery voltage is lower than the value preset in the servo amplifier. If this warning* is issued, replace the battery immediately.

* 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 three ways to check the battery warning.

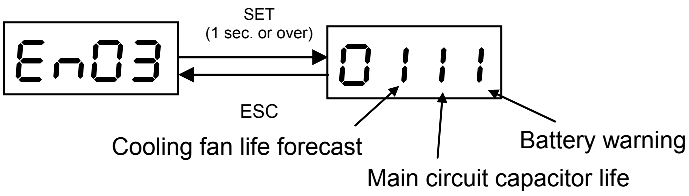
(1) OUT signal (assignment number: 45)

(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.



* Set PA2_78 (display transition at warning detection) at 1 (transition to warning display) to automatically show (3) at the keypad.

11.5 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.

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* 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.
* In the case of wrong wiring in encoder cable, the battery life possibly becomes extremely short.

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CHAPTER 12 POSITIONING DATA

12.1 Operation Modes

12.1.1 Operation Method

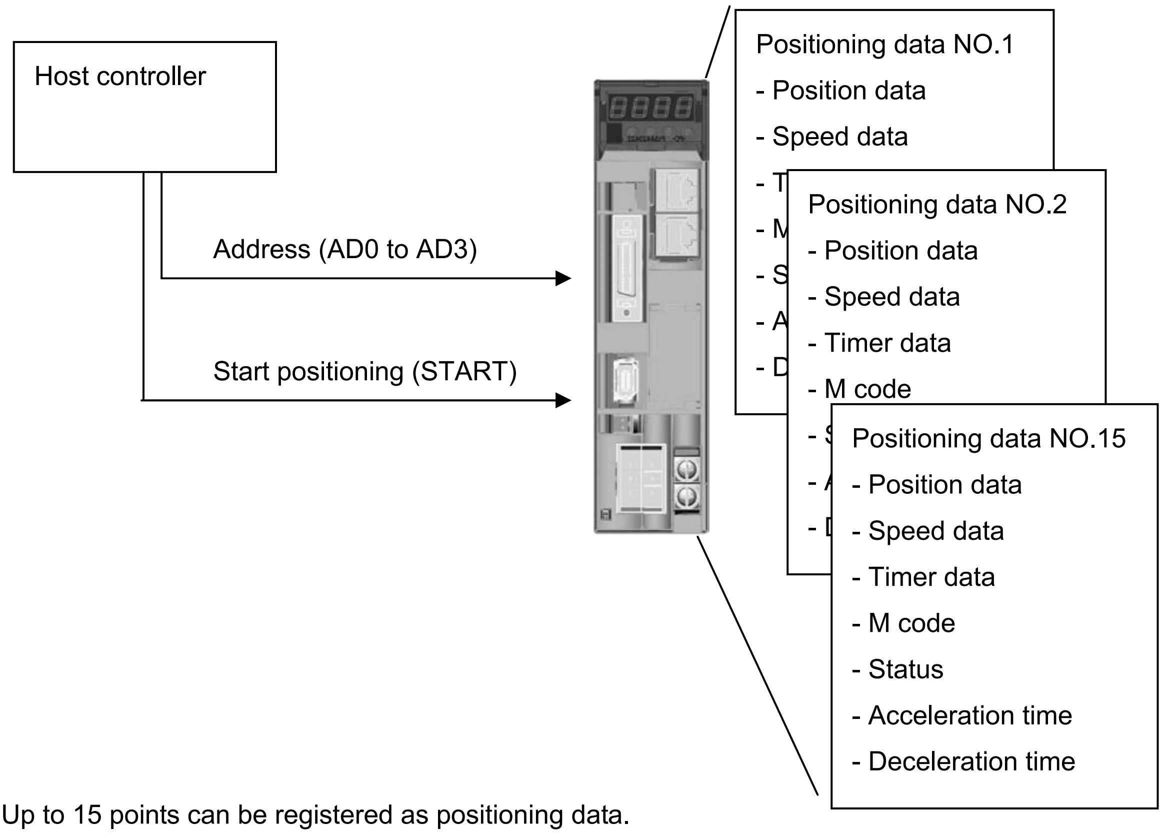
Positioning operation based on positioning data and immediate value data can be conducted with this servo amplifier.

(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)



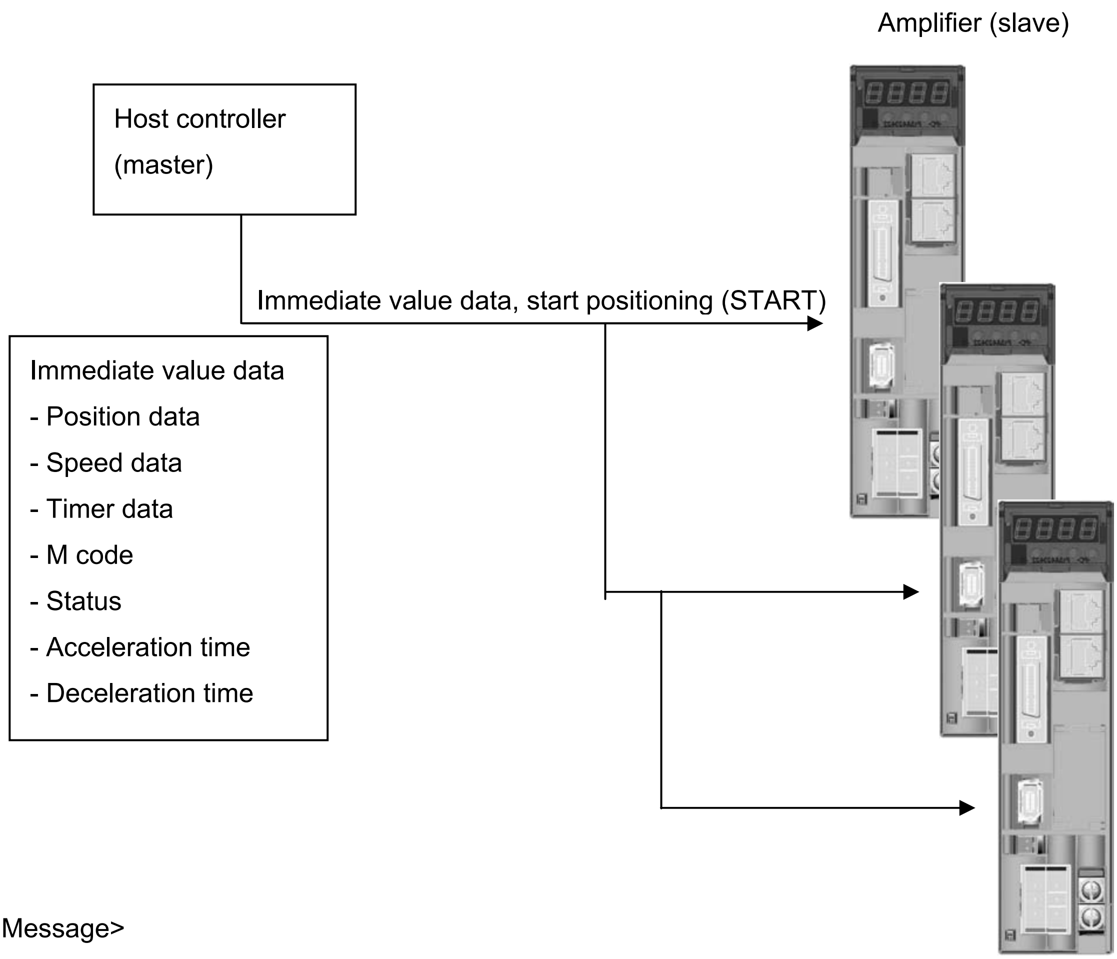
Up to 15 points can be registered as positioning data.

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_41: sequential start selection = 3 (immediate value data operation)
- 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
		3: Immediate value data operation					Immediate value data operation
			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
		3: Immediate value data operation					Immediate value data operation
			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 units	0
	Speed (rotation speed)	0.01 to max. rotation speed [r/min]	0.01
	Stand still timer	0.00 to 655.35 s or 0.000 to 65.535 s (Note 1)	0.00
	Acceleration time	0.0 to 99999.9 ms 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 to 99999.9 ms 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

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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).

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	16	Always
07	Denominator of electronic gear	1-4194304	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.

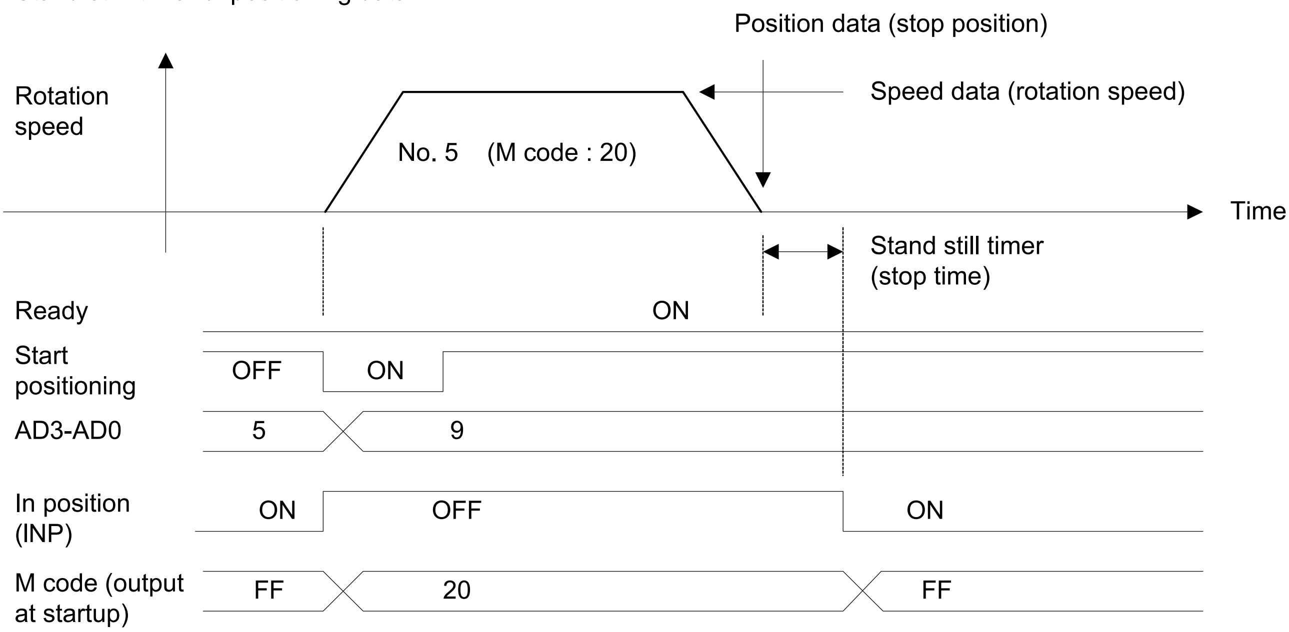
12.2.1.3 Stand still timer (stop time)

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.

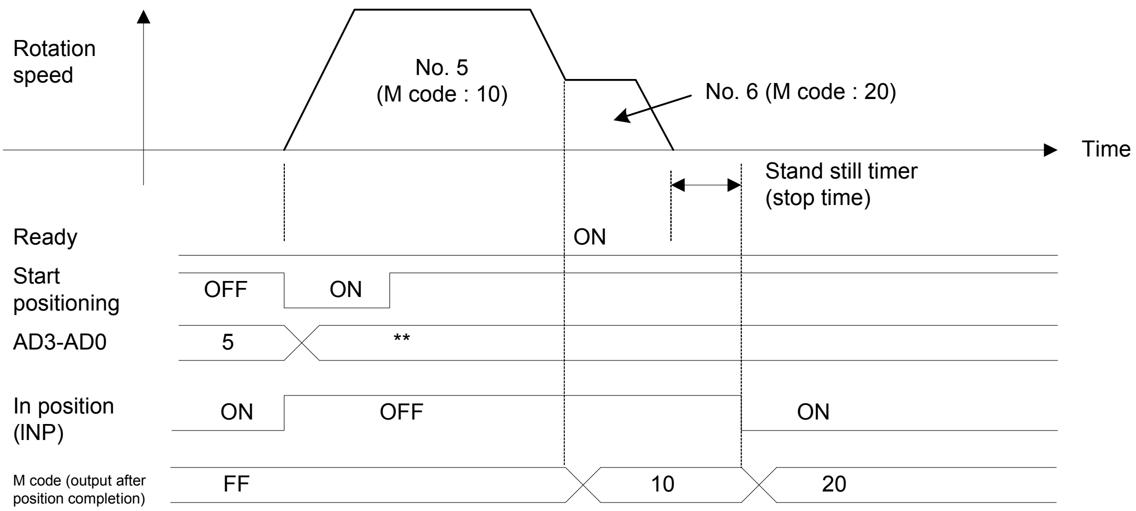
If data continuation is specified on positioning data 5, the motor moves according to positioning data 6.

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

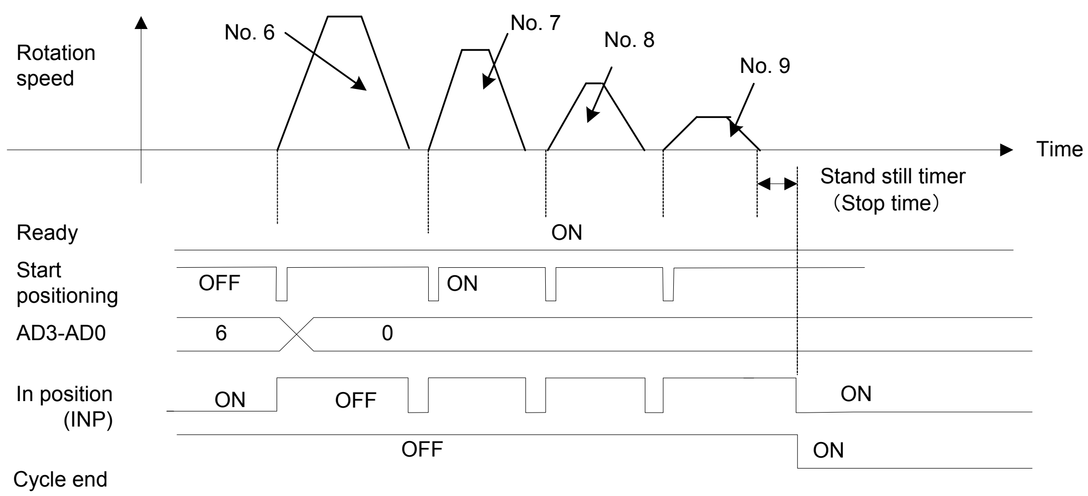
No.	Command style	Step mode	Stop position	Rotation speed	＊＊	＊＊
6	ABS	CO	0.00	0.00		
7	ABS	CO	5000.00	5000.00		
8	ABS	CO	5200.00	500.00		
9	ABS		5400.00	50.00		

■ 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).

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 units	0
Speed (rotation speed)	0.01 to max. rotation speed [r/min]	0.01
Acceleration time	0.0 to 99999.9 ms 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 to 99999.9 ms 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.

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.

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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
					3: Immediate value data operation	Immediate value data 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

■ 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
- Edit using the Servo Operator
- 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

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CHAPTER 13 RS-485 COMMUNICATIONS

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] 3･･･115200 [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 [s] (*)	0.00	Always
PA2_95	Communication time over	0.00 [s]: No detection 0.01 to 9.99 [s]	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 13-34 (response time) and 13-35 (communication time over).

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13.1.2 Communication Specifications

Item		Specifications	Remarks (PA is a parameter No.)
Communication	Electric I/F	RS-485	
	Communication speed	38400／19200／9600／115200 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	
	Cable length (recommneded)	Entire extended length: 100 m or less (up to 38400 bps) 40 m or less (115200 bps) Length between stations: 20 m or less	
	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)	1(01h): Read out coil data 3(03h): Read out various data 5(05h): Write in single coil data 8(08h): Maintenance (echo back) 15(0Fh): Write in coil data 16(10h): Write in various data 23(17h): Read out/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	Variable length	Max. 200 bytes
	Frame synchronization method	Timing synchronization	Frames are initialized if time data for three characters are absent.

It is recommended to use the RS-232C - RS-422 converter (model: NW0H-CNV) for the use of 1:1 communications between the master and the slave (servo amplifier). Do not use it for multiple unit connection.

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 six types of FC below are supported:

Category	FC	Function	Broadcasting
Data manipulation	03h (3)	Read out various data	Disabled
	10h (16)	Write in various data	Enabled
	17h (23)	Read out/write in various data	Enabled*
Coil data manipulation	01h (1)	Read out coil data	Disabled
	05h (5)	Write in single coil data	Enabled
	0Fh (15)	Write in coil data	Enabled
Maintenance	08h (8)	Echo back	Disabled

*Queries from master are accepted, and response messages are not returned.

■ 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)	* For the addresses, refer to the table 13-1.
	No. of registers	2 bytes	(H)	··· Specify the number of sets of data **n × 2**.
			(L)	* Specify **n × 10** on the positioning data.
CRC check		16 bits (2 bytes)	(L)	* The max number of positioning data is 9, and 45 for others.
			(H)	

(2) Response message from the 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
			(HL)	* The positioning data are 20 bytes per data.
			(LH)	* For the data format, refer to page 13-14 [Table 13-1].
			(LL)	* "0" is returned to nonexistent data.
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(3) Message examples

Monitor data: shows a message example to read out a feedback position.

<Query example>

Station No.		1 byte	01	When the amplifier station no. is "1".
FC		1 byte	03	
Information	Address	2 bytes	10	Specify **1006h** as the address of a feedback position.
			06	
	No. of registers	2 bytes	00	Specify **0002h** as the number of data 1×2.
			02	
CRC check		16 bits (2 bytes)	20	
			CA	

<Response message example>

Station No.		1 byte	01	
FC		1 byte	03	
Information	No. of data bytes	1 byte	04	1×4 = **04h**
	Data 1	4 bytes	00	**000186A0h** = 100000 units Data 1 will be **FFFE7960h** with -100000 units.
			01	
			86	
			A0	
CRC check		16 bits (2 bytes)	C9	
			EB	

■ FC 10h (Write of various data)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		**10h**
Information	Address	2 bytes	(H)	Specify the data address. * For the addresses, refer to the table 13-1.
			(L)	
	No. of registers	2 bytes	(H)	Specify the number of sets of data **n × 2**. * Specify **n × 10** on the positioning data. * The max number of parameters and positioning data is 9, and 45 for others.
			(L)	
	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 * The positioning data are 20 bytes per data. * For the data format, refer to the table 13-1.
			(HL)	
			(LH)	
			(LL)	
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

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(2) Response message from the amplifier

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** * The positioning data are **m × 10**. * Cannot write in to nonexistent data.
			(L)		
CRC check		16 bits (2 bytes)	(L)		
			(H)		

(3) Message examples

PA2_19: shows a message example to enter 200000 to a preset position.

<Query example>

Station No.		1 byte	**01**	When the amplifier station no. is "1".
FC		1 byte	**10**	
Information	Address	2 bytes	**41**	Specify **4112h** as the address of PA2_19.
			12	
	No. of registers	2 bytes	**00**	Specify **0002h** as the number of data 1×2.
			02	
	No. of data bytes	1 byte	**04**	1×4 = **04h**
	Data 1	4 bytes	**00**	Specify 200000 = **00030D40h**.
			03	Specify data 1 = **FFFCF2C0h** for -20000.
			0D	
			40	
CRC check		16 bits (2 bytes)	**BA**	
			49	

<Response message example>

Station No.		1 byte	**01**
FC		1 byte	**10**
Information	Address	2 bytes	**41**
			12
	No. of registers	2 bytes	**00**
			02
CRC check		16 bits (2 bytes)	**F5**
			F1

■ FC 01h (Read out coil data)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		··· **01h**
Information	Address	2 bytes	(H)	··· Specify the coil address. * For the addresses, refer to the table 13-4.
			(L)	
	No. of coil data	2 bytes	(H)	··· Specify the number of coils n. * Up to 16 pcs.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message form the amplifier

Station No.		1 byte		
FC		1 byte		··· **01h**
Information	No. of data bytes	1 byte		··· The value (N) obtained from n/8 and by rounding up decimal
	Data 1	1 byte	(8 bits)	··· n pcs data read out from a specified address. * 1 pcs = 1 bit (1 byte by 8 pcs) * Allocated from LSB in order.
	~	~		
	Data N	1 byte	(8 bits)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(3) Message examples

Shows a message example to read out ten pieces of coil data from OUT6 signal.

<Query example>

Station No.		1 byte	**01**	··· When the amplifier station no. is "1".
FC		1 byte	**01**	
Information	Address	2 bytes	**03**	··· Specify **0305h** as the OUT6 signal address.
			05	
	No. of coil data	2 bytes	**00**	··· Specify 10 = **000Ah** as the number of coils.
			0A	
CRC check		16 bits (2 bytes)	**AC**	
			48	

<Response message example>

Station No.		1 byte	**01**	
FC		1 byte	**01**	
Information	No. of data bytes	1 byte	**02**	··· The value obtained from 10 pcs/8 and by rounding up decimal
	Data 1	1 byte	**A5**	··· See below.
	Data 2	1 byte	**02**	
CRC check		16 bits (2 bytes)	**43**	
			6D	

Data are allocated from LSB in order starting from the smaller address.

The corresponding bit indicates ON with "1" and OFF with "0". The rest of bits are all fixed to "0."

Data1 (=A5h)	OUT13 1 (ON)	OUT12 0 (OFF)	OUT11 1 (ON)	OUT10 0 (OFF)	OUT9 0 (OFF)	OUT8 1 (ON)	OUT7 0 (OFF)	OUT6 1 (ON)
Data2 (=02h)	0	0	0	0	0	0	OUT15 1 (ON)	OUT14 0 (OFF)

■ FC 05h (Write in single coil data)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		. . . **05h**
Information	Address	2 bytes	(H)	. . . Specify the coil address. * For the addresses, refer to the table 13-4.
			(L)	
	Coil data	2 bytes	(H)	. . . Specify **000h** for OFF and **FF00h** for ON.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message form the amplifier

Station No.		1 byte		
FC		1 byte		. . . **05h**
Information	Address	2 bytes	(H)	. . . Specified address.
			(L)	
	Coil data	2 bytes	(H)	. . . Specified data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(3) Message examples

Shows a message example to write in ON to OUT9 signal.

<Query example>

Station No.		1 byte	**01**	. . . When the amplifier station no. is "1".
FC		1 byte	**05**	
Information	Address	2 bytes	**02**	. . . Specify **0208h** as the CONT9 signal address.
			08	
	No. of coil data	2 bytes	**FF**	. . . Specify ON = **FF00h**.
			00	
CRC check		16 bits (2 bytes)	**0C**	
			40	

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<Response message example>

Station No.		1 byte	**01**
FC		1 byte	**05**
Information	Address	2 bytes	**02**
			08
	No. of coil data	2 bytes	**FF**
			00
CRC check		16 bits (2 bytes)	**0C**
			40

■ FC 0Fh (Write in coil data)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		. . . **0Fh**
Information	Address	2 bytes	(H)	. . . Specify the coil address. * For the addresses, refer to the table 13-4.
			(L)	
	No. of coil data	2 bytes	(H)	. . . Specify the number of coils n. * Up to 16 pcs.
			(L)	
	No. of data bytes	1 byte		. . . The value (N) obtained from n/8 and by rounding up decimal
	Data 1	1 byte	(8 bits)	. . . n pcs of data read out from a specified address. * 1 pcs = 1 bit (1 byte by 8 pcs) * Allocated from LSB in order.
	~	~		
	Data N	1 byte	(8 bits)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from the amplifier

Station No.		1 byte		
FC		1 byte		. . . **05h**
Information	Address	2 bytes	(H)	. . . Specified address.
			(L)	
	No. of coil data	2 bytes	(H)	. . . The number of coils actually written in is m pcs. * Cannot write in to nonexistent coil data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

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(3) Message examples

Shows a message example to write in three pieces of coil data from CONT22 signal.

<Query example>

Station No.		1 byte	**01**	. . . When the amplifier station no. is "1".
FC		1 byte	**0F**	. . . **0Fh**
Information	Address	2 bytes	**02**	. . . Specify **0215h** as the CONT22 signal address.
			15	
	No. of coil data	2 bytes	**00**	. . . Specify 3 = **0003h** as the number of coils.
			03	
	No. of data bytes	1 byte	**01**	. . . The value obtained from 3 pcs/8 and by rounding up decimal
	Data 1	1 byte	**06**	. . . See below.
CRC check		16 bits (2 bytes)	**03**	
			74	

Data are allocated from LSB in order starting from the smaller address.

The corresponding bit indicates ON with "1" and OFF with "0". The rest of bits are all fixed to "0."

Data1 (=06h)	0	0	0	0	0	CONT24 1 (ON)	CONT23 1 (ON)	CONT22 0 (OFF)

<Response message example>

Station No.		1 byte	**01**
FC		1 byte	**0F**
Information	Address	2 bytes	**02**
			15
	No. of coil data	2 bytes	**00**
			03
CRC check		16 bits (2 bytes)	**05**
			B6

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■ FC 17h (Read out/write in various data)

Only addresses 6000H to 600FH are applicable.

An exception response (exception code: 02H) is returned if an address outside this range is specified.

(1) Query from the master

Field	Item	Size	Byte	Remarks
Station No.		1 byte		
FC		1 byte		· · · **17h**
Information	Read out start address	2 bytes	(H)	· · · Specifies the data address. * Addresses from **6000H to 600FH** can be set.
			(L)	
	No. of registers	2 bytes	(H)	· · · Specify the number of sets of data **n x 2**. * Up to setting range **1 to 16** for number of sets of data n
			(L)	
	Write in start address	2 byte	(H)	· · · Specify the data address. * Addresses from **6000H to 6007H** can be set.
			(L)	
	No. of registers	2 byte	(H)	· · · Specify the number of sets of data **n x 2**. * Up to setting range **1 to 8** for number of sets of data n
			(L)	
	No. of data bytes	1 byte		· · · **n x 4**
	Data 1	4 bytes	(HH)	· · · Write in data for n sets from the specified address * For the data format, refer to the format field (symbol) in table 4-1.
			(HL)	
			(LH)	
			(LL)	
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from slave

Field	Item	Size	Byte	Remarks
Station No.		1 byte		
FC		1 byte		· · · **17h**
Information	No. of data bytes	1 byte		· · · **n x 4**
	Data 1	4 bytes	(HH)	· · · Read out data for n sets from the specified Address ** Data read out range: **1 to 16**
			(HL)	
			(LH)	
			(LL)	
	~	~		
	Data n	4 bytes	(HH)	
			(HL)	
			(LH)	
			(LL)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

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(3) Message examples

Shows a message example to write in immediate speed, immediate acceleration time and communication CONT signal, and read out feedback speed, effective torque, and motor current. The write in start address is 6000H, and the read out start address is 6008H.

First, set parameter Nos. for the free assignment of addresses for parameters PA3_41 to PA3_44. After setting, reboot to enable the settings.

PA3_41: 007993292
PA3_42: 00000000 (default)

PA3_43: 00040500
PA3_44: Set 00000000 (default)

<Query example>

Station No.		1 byte	**01**	・ When the amplifier station no. is "**1**".
FC		1 byte	**17**	
Information	Read out start address	2 bytes	**60**	・・・ Specify the read out first address.
			08	
	No. of registers	2 bytes	**00**	・・・ Specify **0006h** as the number of data 3×2.
			06	
	Write in start address	2 bytes	**60**	・・・ Specify the write in first address.
			00	
	No. of registers	2 bytes	**00**	・・・ Specify **0006h** as the number of data 3×2.
			06	
	No. of data bytes	1 byte	**0C**	・・・ Specify 3×4 = **0Ch**.
	Data 1	4 byte	**00**	・・・ Specify immediate speed: **186A0h (1000 r/min)**.
			01	
			86	
			A0	
	Data 2	4 byte	**00**	・・・ Specify immediate acceleration time: **3E8h (100 ms)**.
			00	
			03	
			E8	
	Data 3	4 byte	**00**	・・・ Specify communication CONT signal: servo ON and FWD.
			00	
			00	
			03	
CRC check		16 bits (2 bytes)	**CC**	
			17	

<Response message example>

Station No.		1byte	01	
FC		1byte	17	
Information	No. of data bytes	1byte	0C	
	Data 1	4byte	00	・・・ Feedback speed: 1000 [r/min] (3E8h)
			00	
			03	
			E8	
	Data 2	4byte	00	・・・ Effective torque: 80 [%] (50h)
			00	
			00	
			50	
	Data 3	4byte	00	・・・ Motor current: 80 [%] (50h)
			00	
			00	
			50	
CRC check		16 bits (2 bytes)	19	
			5F	

■ FC 08h (Echo back maintenance)

(1) Query from the master

Station No.		1 byte		
FC		1 byte		・・・ **08h**
Information	Sub code	2 bytes	(H)	・・・ Specify **0000h** as the sub code of echo back.
			(L)	
	Data	2 bytes	(H)	・・・ Specify an arbitrary data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

(2) Response message from the amplifier

Station No.		1 byte		
FC		1 byte		・・・ **08h**
Information	Sub code	2 bytes	(H)	・・・ **0000h**
			(L)	
	Data	2 bytes	(H)	・・・ Echo back the specified data.
			(L)	
CRC check		16 bits (2 bytes)	(L)	
			(H)	

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4. Addresses

The addresses of various data are as follows:

■ Data addresses

[Table 13-1] Fixed data 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 [5-1]		0-FFFFh (0: OFF all)
	Communication OUT signal	0100	○	×	Refer to [5-1]		—
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	(Yes)	—
	Command position	1007	○	×	1h=1 unit	(Yes)	—
	Position deviation	1008	○	×	1h=1 (*1)	(Yes)	—
	Command pulse frequency	1009	○	×	1h=0.1 kHz	(No)	—
	Feedback cumulative pulses	100A	○	×	1h=1 pulse	(Yes)	—
	Cumulative 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	Regenerative 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 (*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 [5-1]	–
	Hardware OUT signal	2001	○	×	Refer to [5-1]	–
	Control mode	2100	○	×	Refer to [5-1]	–
	Sequence mode	2101	○	×	Refer to [5-1]	–
	Alarm at present	2200	○	×	Refer to [5-2]	–
	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 [5-3]	–
	Immediate value position	5101	○	○	1h=1 unit (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)

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Data type	Data name		Address (hex.)	Applicable FC		Format (with a sign)		Setting range (default value)
				03h	10h			
Positioning data (divided)	Data 1	Positioning status + M code	5200	○	○	Positioning status: Refer to [Table 5-5].	(No)	M code: 0-FFh (FFh)
		Stop timer	5201	○	○	1h=0.01sec *2	(No)	0.00-655.35 (0.00)
		Stop position	5202	○	○	1h=1 unit	(Yes)	0-±2000000000 (0)
		Rotation speed	5203	○	○	1h=0.01 r/min	(No)	0.01-Max. rotation speed (0.01)
		Acceleration time	5204	○	○	1h=0.1 ms	(No)	0.0-99999.9 (0.0)
		Deceleration time	5205	○	○			
	⋮	⋮	⋮	⋮	⋮			
	Data 15	Positioning status + M code	52E0	○	○	Positioning status: Refer to [Table 5-5].	(Yes)	M code: 0-FFh (FFh)
		Stop timer	52E1	○	○	1h=0.01sec *2	(No)	0.00-655.35 (0.00)
		Stop position	52E2	○	○	1h=1 unit	(Yes)	0-±2000000000 (0)
		Rotation speed	52E3	○	○	1h=0.01 r/min	(No)	0.01-Max. rotation speed (0.01)
		Acceleration time	52E4	○	○	1h=0.1 ms	(No)	0.0-99999.9 (0.0)
		Deceleration time	52E5	○	○			
Positioning data (Batch)	Positioning data 1-15		D000-D00E	○	○	Refer to [5-4].		—

(*1) By setting PA1_31 (selection of deviation unit), 0 and 1 are defined as unit amount and pulse, respectively.
(*2) By setting PA2_42 (stop timer decimal position), 0 represents 0.01 sec, and 1 represents 0.001 sec.

[Table 13-2] Free data address list

Data type	Data name	Address (hex.)	Applicable FC	Format (with a sign)	Setting range (default value)
Free assignment data	PA3_41 assignment	6000-6003	03h, 10h 17h (*)	Based on assigned parameters (*)	Based on assigned parameters (*)
	PA3_42 assignment	6004-6007			
	PA3_43 assignment	6008-600B			
	PA3_44 assignment	600C-600F			

(*) Refer to the "Table 13-3 Assigned parameter list" for details.

Refer to Chapter 4 for details on settings PA3_41 to 44.

[Table 13-3] Assigned parameter list ○ Supported X: Not supported

Data type	Assigned parameter No.	Name	FC：17H Read	FC：17H Write	FC：03H (Read)	FC：10H (Write)
Communication CONT/OUT signals	79	Communication CONT signal	○	○	○	○
	39	Communication OUT signal	○	×	○	×
Monitor	00	Feedback speed	○	×	○	×
	01	Command speed	○	×	○	×
	02	Command torque	○	×	○	×
	03	Peak current	○	×	○	×
	04	Motor current	○	×	○	×
	05	Effective torque	○	×	○	×
	06	Feedback position	○	×	○	×
	07	Command position	○	×	○	×
	08	Position deviation	○	×	○	×
	09	Command pulse frequency	○	×	○	×
	10	Feedback cumulative pulses	○	×	○	×
	11	Cumulative input pulses	○	×	○	×
	12	LS-Z pulse	○	×	○	×
	13	Load inertia ratio	○	×	○	×
	14	DC link voltage (max.)	○	×	○	×
	15	DC link voltage (min.)	○	×	○	×
	16	VREF input voltage	○	×	○	×
	17	TREF input voltage	○	×	○	×
	18	OL thermal value	○	×	○	×
	19	Regenerative resistor thermal value	○	×	○	×
	20	Power (W)	○	×	○	×
	21	Motor temperature	○	×	○	×
	22	Overshoot unit amount	○	×	○	×
	23	Settling time	○	×	○	×
	24	Resonance frequency 1	○	×	○	×

Data type	Assigned parameter No.	Name	FC：17H Read	FC：17H Write	FC：03H (Read)	FC：10H (Write)
Monitor	25	Resonance frequency 2	○	×	○	×
Sequence monitor	40	Hardware CONT signal	○	×	○	×
	41	Hardware OUT signal	○	×	○	×
	42	Control mode	○	×	○	×
	43	Sequence mode	○	×	○	×
	50	Alarm at present	○	×	○	×
	51-70	Alarm history 1-20	○	×	○	×
Various commands	82	Anti resonance frequency	○	○	○	○
	83	Workpiece inertia ratio	○	○	○	○
Immediate value data	90	Immediate value status	○	○	○	○
	91	Immediate value position	○	○	○	○
	92	Immediate value speed	○	○	○	○
	93	Immediate value acceleration time	○	○	○	○
	94	Immediate value deceleration time	○	○	○	○

Coil addresses

[Table 13-4] Coil address list

Coil type	Coil name	Address (hex.)	Applicable FC		
			01h	05h	0Fh
Communication CONT signal	CONT9 signal	0208	○	○	○
	CONT10 signal	0209			
	CONT11 signal	020A			
	CONT12 signal	020B			
	CONT13 signal	020C			
	CONT14 signal	020D			
	CONT15 signal	020E			
	CONT16 signal	020F			
	CONT17 signal	0210			
	CONT18 signal	0211			
	CONT19 signal	0212			
	CONT20 signal	0213			
	CONT21 signal	0214			
	CONT22 signal	0215			
	CONT23 signal	0216			
	CONT24 signal	0217			
Communication OUT signal	OUT6 signal	0305	○	×	×
	OUT7 signal	0306			
	OUT8 signal	0307			
	OUT9 signal	0308			
	OUT10 signal	0309			
	OUT11 signal	030A			
	OUT12 signal	030B			
	OUT13 signal	030C			
	OUT14 signal	030D			
	OUT15 signal	030E			
	OUT16 signal	030F			
	OUT17 signal	0310			
	OUT18 signal	0311			
	OUT19 signal	0312			
	OUT20 signal	0313			
	OUT21 signal	0314			
Hardware CONT signal	CONT1 signal	0400	○	×	×
	CONT2 signal	0401			
	CONT3 signal	0402			
	CONT4 signal	0403			
	CONT5 signal	0404			
Hardware OUT signal	OUT1 signal	0500	○	×	×
	OUT2 signal	0501			
	OUT3 signal	0502			

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■ Communication CONT/OUT signal

The CONT/OUT signal is divided into two types: the hardware signal (sequence I/O terminal) and the communications signal (Modbus communications) depending on the I/O form as shown in the table below. For the hardware CONT/OUT signals, refer to the page of the sequence monitor.

	Hardware signal	Communications signal
CONT signal	CONT1-5 (5 bits)	CONT9-24 (16 bits)
OUT signal	OUT1-3 (3 bits)	OUT6-21 (16 bits)

It is possible to write and read the CONT signals via RS-485 communications. In reading and writing, the same type of signals (5 to 16 bits) are handled in a batch data.
The following shows the signal arrangement in the data. The signal turns on with the corresponding bit “1” and off with bit “0”.

a) Communication CONT signal (CONT9 - 24)

Data	4bytes	00h							
		00h							
		CONT24	CONT23	CONT22	CONT21	CONT20	CONT19	CONT18	CONT17
		CONT16	CONT15	CONT14	CONT13	CONT12	CONT11	CONT10	CONT9

b) Communication OUT signal (OUT6 - 21)

Data	4bytes	00h							
		00h							
		OUT21	OUT20	OUT19	OUT18	OUT17	OUT16	OUT15	OUT14
		OUT13	OUT12	OUT11	OUT10	OUT9	OUT8	OUT7	OUT6

Relation with coil data manipulation

Manipulating CONT/OUT signals can be performed in the following two ways: a batch data operation (FC 03h, and 10h) by specifying data addresses and individual operation per bit (FC 01h, 05h, and 0Fh) by specifying each coil address. Among these, the signal statuses will follow the latest manipulation regardless of method of batch data operation or coil address specification for communication CONT signals 9 to 24 to which data can be written (FC 05h, 0Fh, and 10h).

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■ Sequence monitor

(1) Hardware CONT signal and hardware OUT signal

The CONT signal and the OUT signal of sequence I/O can be loaded.

a) Hardware CONT signal (CONT1 - 5)

Data	4bytes	00h							
		00h							
		00h							
		0	0	0	CONT5	CONT4	CONT3	CONT2	CONT1

b) Hardware OUT signal (OUT1 - 3)

Data	4bytes	00h							
		00h							
		00h							
		0	0	0	0	0	OUT3	OUT2	OUT1

(2) Control mode, Sequence mode, Alarm at present, Alarm history

Each piece of data in the control mode, sequence mode, alarm at present, and alarm history is the code data of 1 byte.

DATA	4bytes	00h
		00h
		00h
		Code

The content of the code varies depending on the data. For the detail, refer to the corresponding tables below.

Control mode

Code	Control mode
00h	Position control
01h	Speed control
02h	Torque control

Sequence mode

Code	Sequence mode
00h	Servo off
01h	Servo on
02h	Zero speed stop
03h	Manual feed (JOG)
04h	Pulse operation
05h	＋OT
06h	－OT
07h	In LV (under voltage)
08h	Positioning
09h	Homing
0Ah	Interrupt positioning

Alarms at present and alarm histories

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Code	Alarm	Symbol (*)	Code	Alarm	Symbol (*)
00h	None	---			
01h	Overcurrent 1	oc1	21h	Main Power Undervoltage	LvP
02h	Overcurrent 2	oc2	22h	Internal Breaking Resistor Overheat	rH1
03h	Overspeed	oS	23h	External Breaking Resistor Overheat	rH2
04h	—	—	24h	Breaking Transistor Error	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	Circuit Trouble	ct	28h	Absolute Data Lost 1	dL1
09h	Memory Error	dE	29h	Absolute Data Lost 2	dL2
0Ah	Fuse Blown	Fb	2Ah	Absolute Data Lost 3	dL3
0Bh	Motor Combination Error	cE	2Bh	Multi-turn Data Over Flow	AF
0Ch	Breaking Transistor Overheat	tH	2Ch	Initial Error	iE
0Dh	Encoder Communication Error	Ec	2Dh	—	—
0Eh	CONT (Control signal) Error	ctE			
0Fh	Overload 1	oL1			
10h	Overload 2	oL2			
11h	Inrush Current Suppression Circuit Trouble	rH4			

(*) Displayed on the amplifier.

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■ 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 13-5].
		Immediate value M code	1 byte	0-FFh (FFh)
		Not used	2 bytes	00h fixed

[Table 13-5] 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(batch)

Positioning data are 20 bytes long for each set, organized as follows:

	Configuration				Format, setting range (default value)
Data	20 bytes	Positioning status	1 byte		Refer to [Table 13-6].
		M code	1 byte		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
				(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.

[Table 13-6] 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: Data continuation (CO) 1,0: Cycle end (CEND) 1,1: Setup impossible		0,0
0	Command method	0: ABS	1: INC	1
Others	Not used	fixed to 0		0

■ Positioning data (divided)

Positioning data are 4 bytes long for each set. The positioning status, M code, and the stop timer are configured as follows. All other items are configured in the same way as positioning data (batch).

DATA	4bytes	00h
		00h
		Positioning status
		M code

DATA	4bytes	00h
		00h
		Stop timer (H)
		Stop timer (L)

5. 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.

Station No.	1 byte	
FC	1 byte	
Exceptional code	1 byte	
CRC check	16 bits (2 bytes)	(L)
		(H)

(1) 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
01h	81h
03h	83h
05h	85h
08h	88h
0Fh	8Fh
10h	90h
17h	97h

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(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 01h, 03h, 05h, 08h, 0Fh, and 10h, which are supported, is specified.
02h	Incorrect address (An incorrect address is specified) When FC 03h or 10h is specified ・An address not listed in [Table 13-1] data addresses list is specified. ・The address that is listed only for FC 03h in [Table 13-1] is specified for FC 10h. When FC 01h, 05h or 0Fh is specified ・An address not listed in [Table 13-4] coil data addresses list is specified. ・The address that is listed only for FC 01h in [Table 13-4] is specified for FC 05h or 0Fh. When FC 17h is specified · The write data specified address is other than 6000h to 6007h, and the read data specified address is other than 6000h to 600Fh. When corresponding address in 6000s is specified with FC 03h or 10h · The read data address specified with FC 03h is other than 6000h to 600Fh. · The write data address specified with FC 10h is other than 6000h to 6007h.
03h	Incorrect data (An abnormal value is specified in the information field.) When FC 03h or 10h is specified ・The following value is specified as the no. of registers: zero, odd number, or a value exceeding the maximum value. ・A value different from the no. of registers is specified to the no. of data bytes. ・A value out of range is specified to a write data. When FC 01h, 05h or 0Fh is specified ・The following value is specified as the no. of coil data: zero, or a value exceeding the maximum value. ・A value different from the no. of coil data is specified to the no. of data bytes. ・A value not specified as ON/OFF values is specified to a coil data in FC 05h. When address in 6000s is specified with FC 17h · The number of registers is 0 or an odd number, or a value that exceeds the maximum value is specified. · The value specified for the number of data bytes is in disagreement with the number of registers. · A value outside the following ranges is specified for read and write data. ・ The number of read data items exceeds 16. ・ The number of write data items exceeds 8.

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6. CRC-16

(1) Outline of CRC

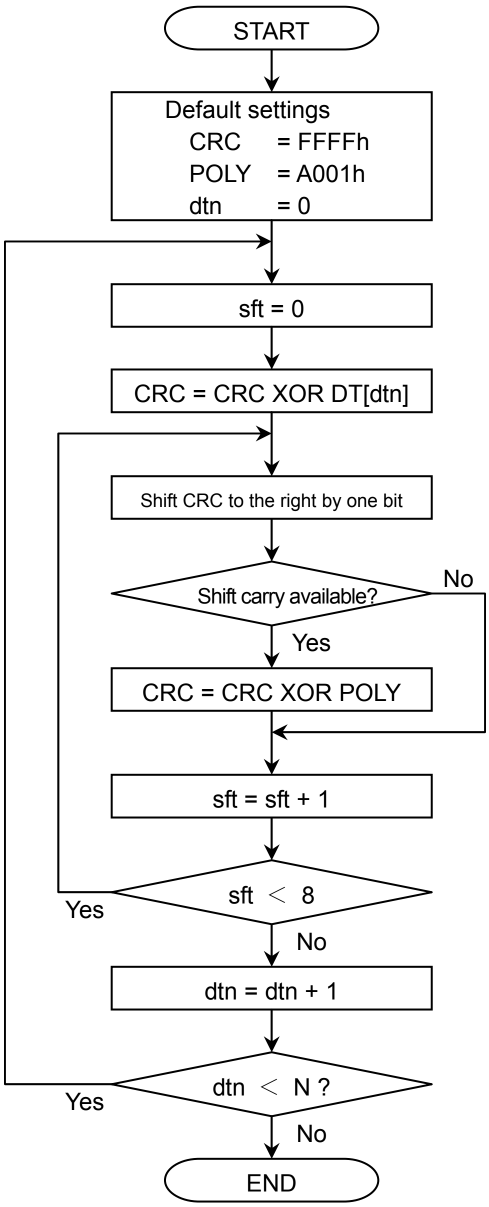
CRC (Cyclic Redundancy Check) is a system to check if communications data are correct.

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.

(3) CRC-16 calculation example

The [Table 13-7] is the result obtained from CRC-16 calculated according to its algorithm using the query to read parameters PA1_41 to 47 (7 pcs). The last data No.52: C651h will be added to the end of the frame in order of digits from lower to upper.

Station No.	FC	Address		No. of registers		CRC check	
01h	03h	40h	28h	00h	0Eh	51h	C6h

[Table 13-7] calculation examples

No.	Calculations	bit																Shift carry
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
1	**CRC** (initial value)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
2	**POLY** (initial value)	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	
3	**DT[0]** (station no.)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
4	**CRC** = No.1 XOR No.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	
5	Shift **CRC** by 2 bits to the right (until shift-carry occurs.)	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	**CRC** = No.5 XOR No.2	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	0	
7	Shift **CRC** by 2 bits to the right	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1
8	**CRC** = No.7 XOR No.2	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	
9	Shift **CRC** by 2 bits to the right	0	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1
10	**CRC** = No.9 XOR No.2	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	
11	Shift **CRC** by 2 bits to the right (Finished with **sht** =8.)	0	0	1	0	0	0	0	0	0	1	1	1	1	1	1	1	1
12	**CRC** = No.11 XOR No.2	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	
13	**DT[1]** (FC)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	
14	**CRC** = No.12 XOR No.13	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	
15	Shift **CRC** by 1 bit to the right	0	1	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1
16	**CRC** = No.15 XOR No.2	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	
17	Shift **CRC** by 1 bit to the right	0	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1
18	**CRC** = No.17 XOR No.2	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1	0	
19	Shift **CRC** by 2 bits to the right	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	1
20	**CRC** = No.19 XOR No.2	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	
21	Shift **CRC** by 2 bits to the right	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	1
22	**CRC** = No.21 XOR No.2	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	
23	Shift **CRC** by 2 bits to the right	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	
24	**DT[2]** (Address (H))	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
25	**CRC** = No.23 XOR No.24	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	
26	Shift **CRC** by 8 bits to the right	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	
27	**DT[3]** (Address (L))	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	
28	**CRC** = No.26 XOR No.27	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	
29	Shift **CRC** by 1 bit to the right	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
30	**CRC** = No.29 XOR No.2	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	
31	Shift **CRC** by 1 bit to the right	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1
32	**CRC** = No.31 XOR No.2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	
33	Shift **CRC** by 1 bit to the right	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1
34	**CRC** = No.33 XOR No.2	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	
35	Shift **CRC** by 5 bits to the right	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	
36	**DT[4]** (No. of registers (H))	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
37	**CRC** = No.35 XOR No.36	0	0	0	0	0	1	1	0	1	1	0	0	0	0	0	0	
38	Shift **CRC** by 7 bits to the right	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1
39	**CRC** = No.38 XOR No.2	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	
40	Shift **CRC** by 1 bit to the right	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	

No.	Calculations	bit																Shift carry
		15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
41	**DT[5]** (No. of registers (L))	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	
42	**CRC** = No.40 XOR No.41	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	
43	Shift **CRC** by 4 bits to the right	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1
44	**CRC** = No.43 XOR No.2	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1	
45	Shift **CRC** by 1 bit to the right	0	1	0	1	0	0	1	0	1	0	0	0	0	0	0	0	1
46	**CRC** = No.45 XOR No.2	1	1	1	1	0	0	1	0	1	0	0	0	0	0	0	1	
47	Shift **CRC** by 1 bit to the right	0	1	1	1	1	0	0	1	0	1	0	0	0	0	0	0	1
48	**CRC** = No.47 XOR No.2	1	1	0	1	1	0	0	1	0	1	0	0	0	0	0	1	
49	Shift **CRC** by 1 bit to the right	0	1	1	0	1	1	0	0	1	0	1	0	0	0	0	0	1
50	**CRC** = No.49 XOR No.2	1	1	0	0	1	1	0	0	1	0	1	0	0	0	0	1	
51	Shift **CRC** by 1 bit to the right	0	1	1	0	0	1	1	0	0	1	0	1	0	0	0	0	1
52	**CRC** = No.51 XOR No.2	**1**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**1**	

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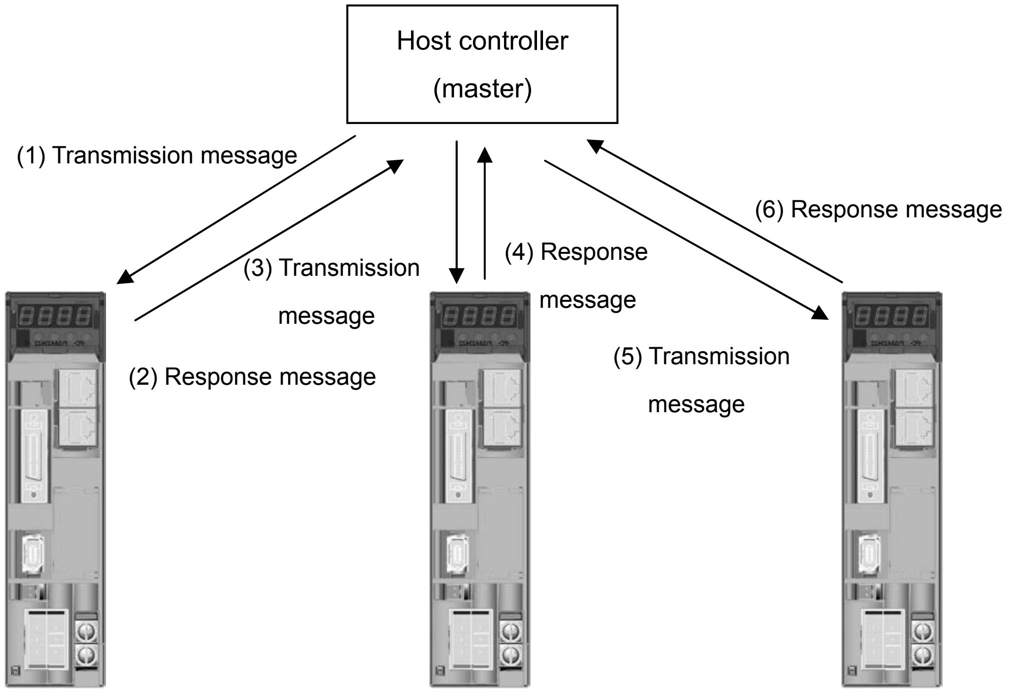
7. Communitacation methods

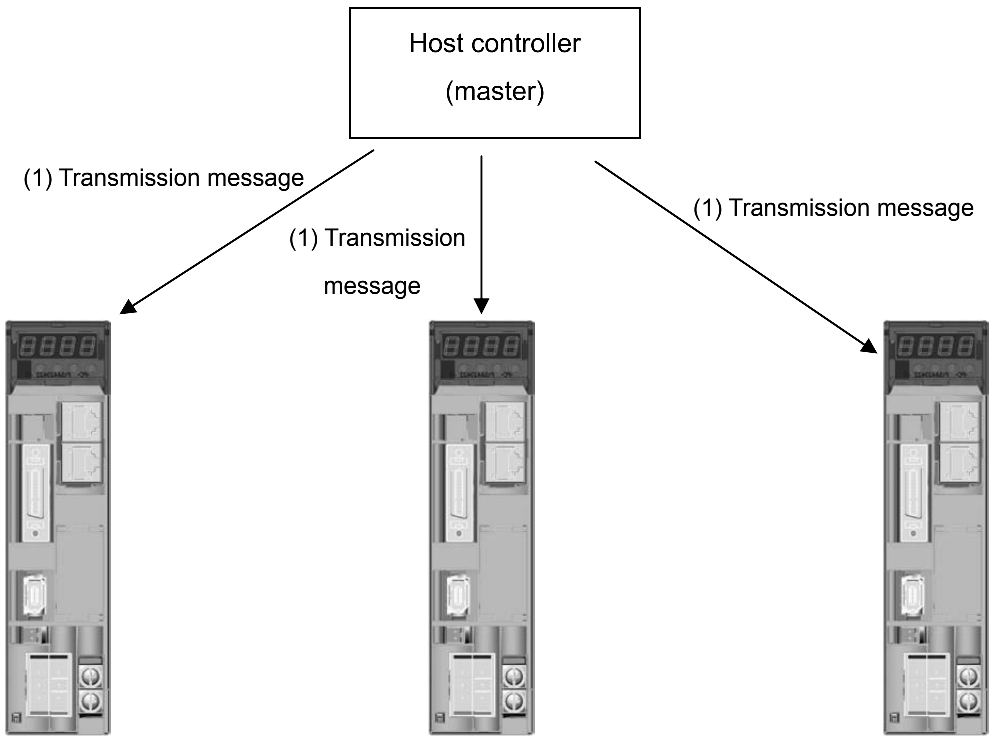
<Unicast method>

Messages are sent in the following order in this method: (1) → (2) → (3) → (4) → (5) → (6).



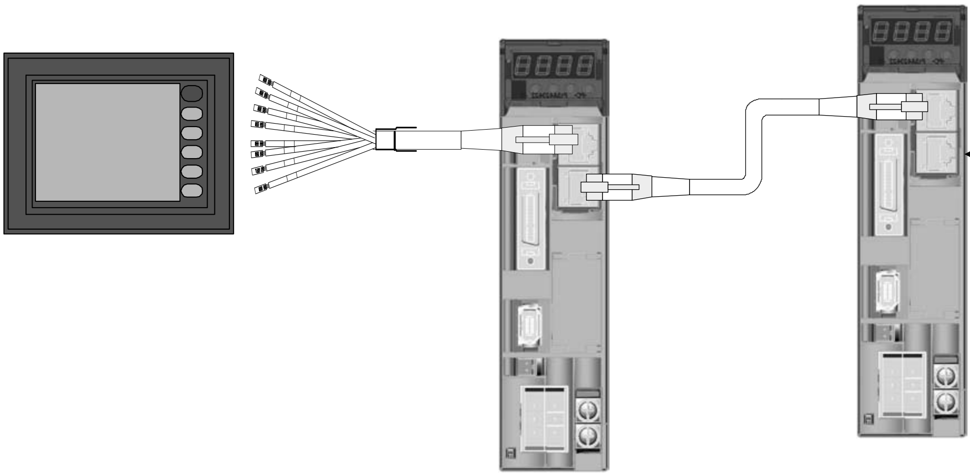
<Broadcasting method>

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)



No terminal resistor is needed.

In case of using Fuji's MONITOUCH

MONITOUCH　（MJ1/MJ2）

Signal name	Pin.NO
-RD/-SD	2
+RD/+SD	1
SG	5
FG	Shell

Smart　（CN3A）

Pin.NO	Signal name
8	P5
7	M5 (0 V)
6	*TXD
5	RXD
4	*RXD
3	TXD
2	M5 (0 V)
1	P5

RJ45 connector

・Connect between Smart and Smart with a commercial LAN cable (straight).

13.1.5 Communications Procedures

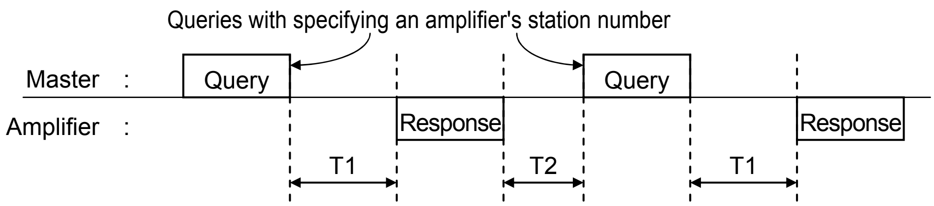
1. Start of communications

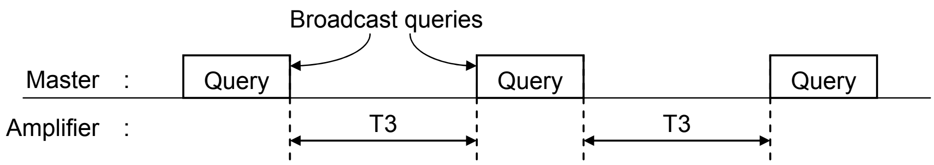
The amplifier cannot perform communications after the power supply is turned on until the internal initialization has been complete. When turning on the amplifier, perform the procedure below, and then start normal communications.

1. Turn on the power supply, and wait for approximately 1.5 s.
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>Other than 10h</td><td>-</td><td rowspan="2">115200 bps : 1.7 ms
38400 bps : 5 ms
19200 bps : 10 ms
9600 bps : 10 ms</td><td rowspan="3">115200 bps : 1.7 ms
38400 bps : 5 ms
19200 bps : 10 ms
9600 bps : 10 ms</td><td rowspan="3">Same as T1</td><td rowspan="2">100 ms</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>

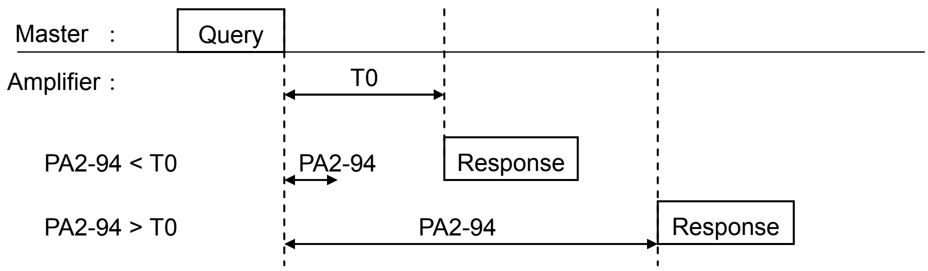
■ Response time

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 s is set on PA2_95 (communication time over).

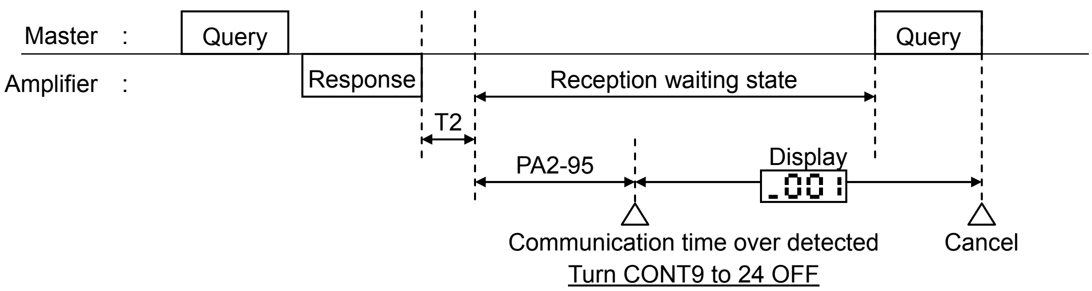
If an amplifier has been in the state of waiting for receiving a message over the time specified by PA2_95, a communication time over has occurred, and all the communication CONT signals (CONT9-24) operated by the Modbus communications are set off.

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   001
- Communication time over   _001

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 cleared, and it returns to the normal display.



If PA2_95 is set to 0.00 s, 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

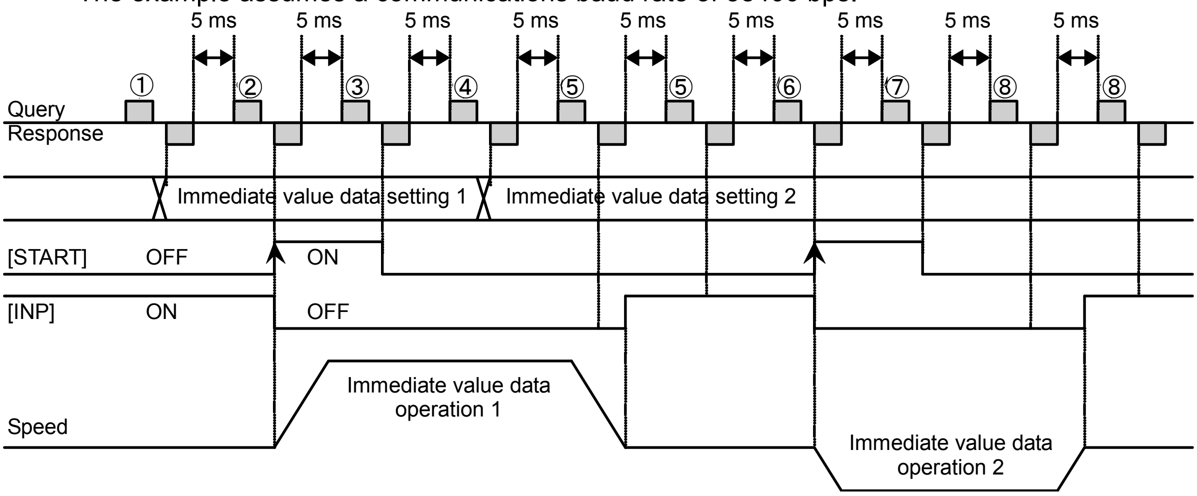
A Communications example for conducting positioning operation with immediate value data is described.

■ 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

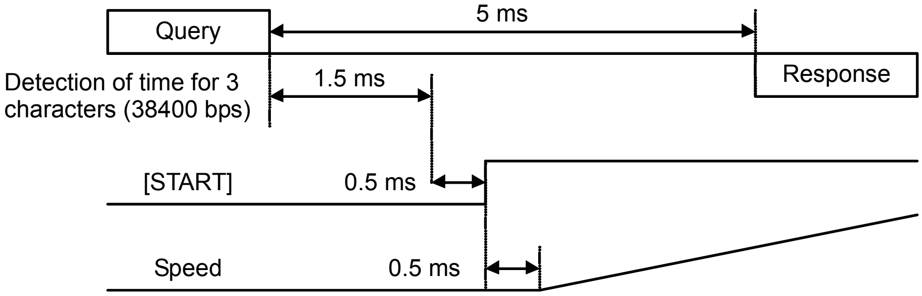
- Turn on [S-ON] assigned to CONT1 to arrange the operation state, and perform communications as shown below.
- The example assumes a communications baud rate of 38400 bps.



(1) Write immediate value data setting 1 as immediate value data.
Setting 1: Designation method = ABS. Immediate value position = 500000 units.
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.



(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 units.

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.

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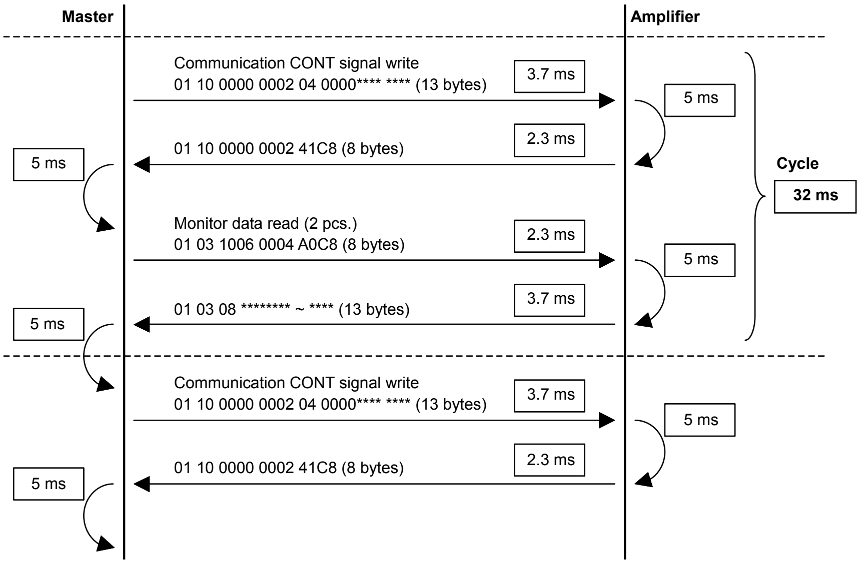
5-2. Monitoring cycle

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

13.2 PC Loader Communications

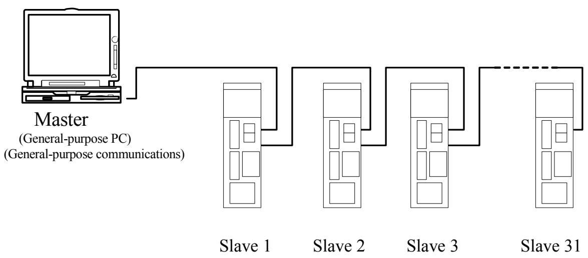
The transmission and reception commands of the RYH□□□F5-VV2 type servo amplifier are described in details in this section.
The RYH□□□F5-VV2 type servo amplifier is capable of reading data and writing parameters via serial communications.

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	9600/19200/38400/115200 bps (Set at parameter PA2_73.)
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	500 m
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 100 ms Data (parameter) transfer: Within 100 ms

* Some pieces of software do not allow eight data bits and a stop bit simultaneously.

It is recommended to use the RS-232C - RS-422 converter (model: NW0H-CNV) for the use of 1:1 communications between the master and the slave (servo amplifier). Do not use it for multiple unit connection.

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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

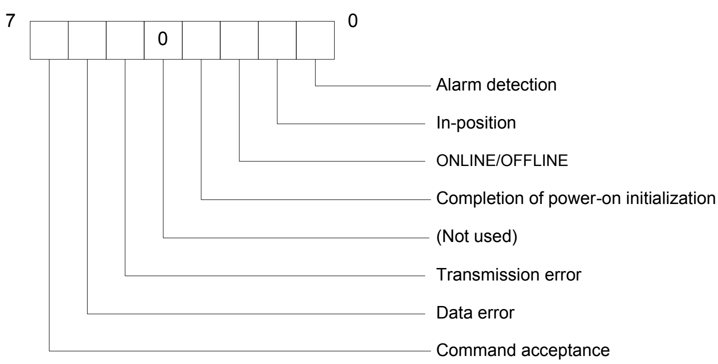
Item	Description (hex.)	Function
Start code	5Ah (Fixed)	Start code
Count of No. of pieces of data	XXh (Variable)	Byte counter Enter the number of bytes from the process status to BCC.
Fixed value used by system	00h (Fixed) or XXh (Fixed)	Enter the value specified in the transmission format table.
Process 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 read with multiple monitors	50h	01h	00h	00h	04h
Sequence monitor relations						
02	Sequence mode read	50h	02h	00h	00h	01h
03	System status read					04h
04	Alarm at present read					10h
05	Alarm history read					11h
06	Sequence I/O signal read					12h
Parameter editing relations						
07	PA1 parameter read	50h	21h	Quantity (1 to 15)	No. (1 to 99)	00h
08	PA1 parameter write	51h				01h
09	PA2 parameter read	50h	22h	Quantity (1 to 15)	No. (1 to 99)	00h
10	PA2 parameter write	51h				01h
11	PA3 parameter read	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:

- Transmission message: Message sent from host to amplifier
- Response message: 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 transmission message to the amplifier.
(2) When receiving a transmission message, the amplifier processes the transmission message and sends back a response message.
The host sends the next transmission message after checking the response message. Do not send the transmission message without checking the response message.
(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 transmission message sent from the host, the amplifier does not send back the response message (considered as nonresponse).
If there is no response from the amplifier, the host should send the same transmission message again.
- The timer for judging absence of response (time-out) is counted after transmission of the transmission message is finished.
- Time-out period shall be as below according to the transmission speed.

	Parameter interrupt command	Other commands
115200 bps:	250 ms or over	100 ms or over
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 message from an amplifier, the host should send the same transmission message again.
- Re-transmission should be performed after the following timing after the transmission error.

115200 bps:	50 ms or over
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 transmission message but it sends error data in "status data (STR1)" of the response message.

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 transmission message 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)

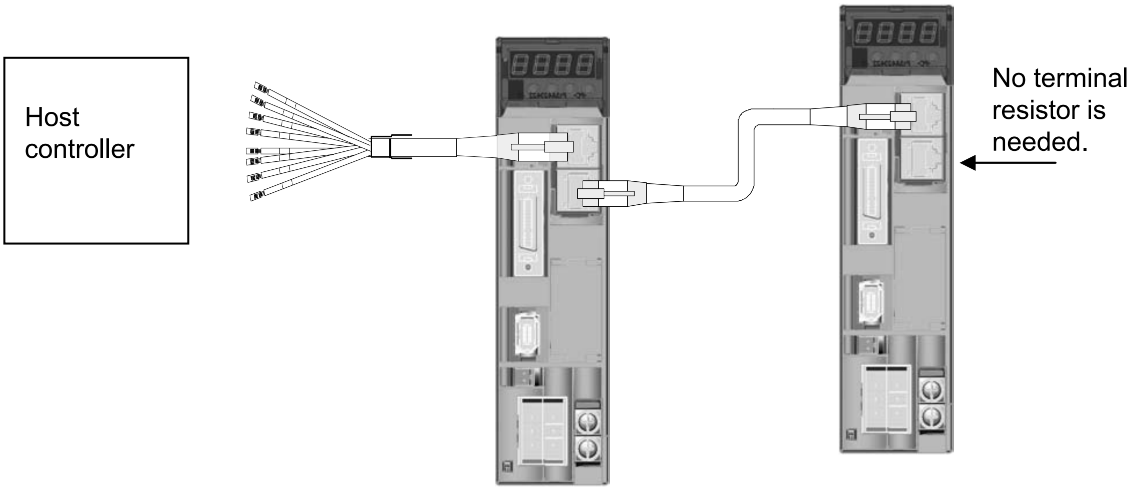
Connect to the host controller with marketed LAN cable.

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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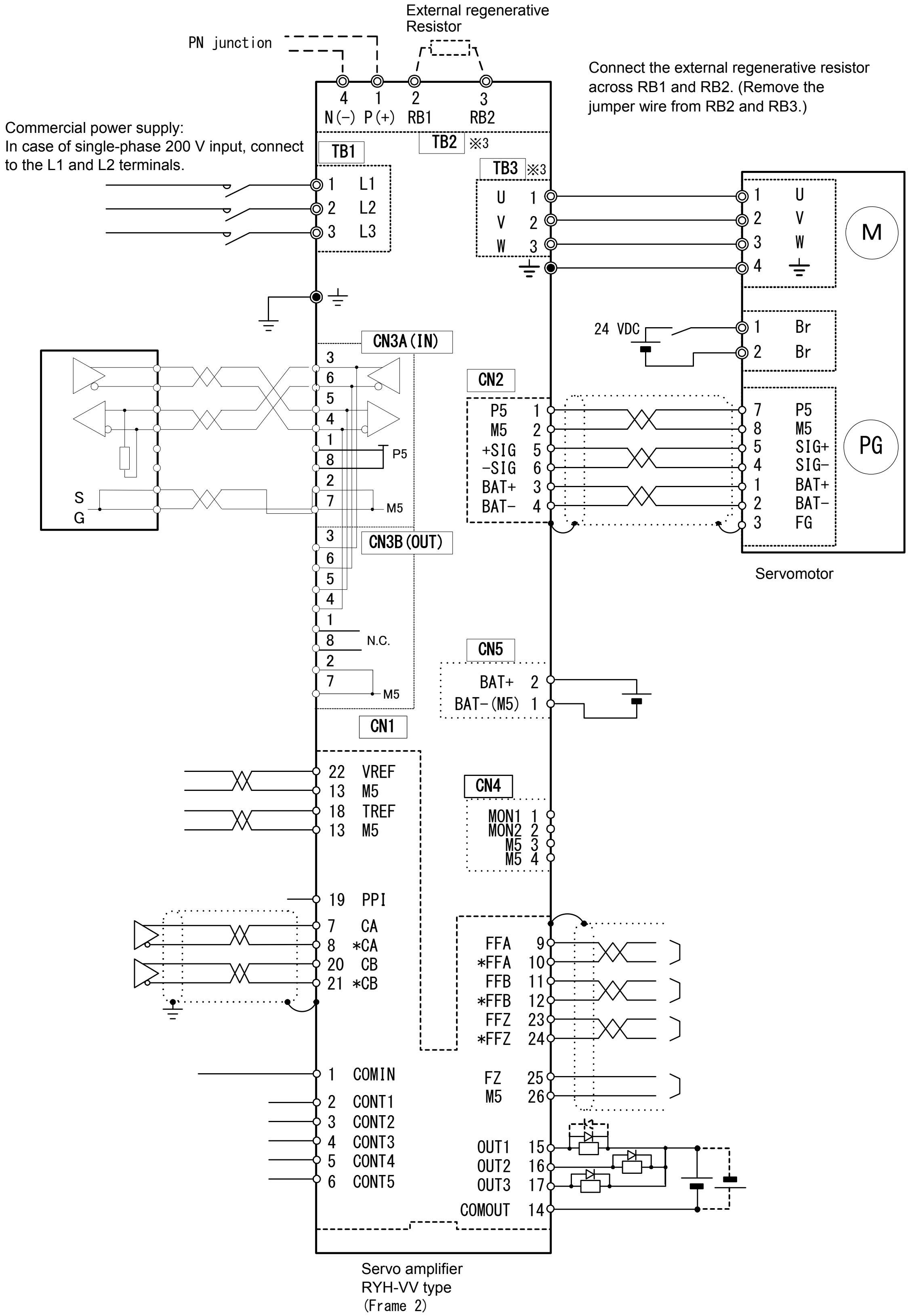
■ Standard connection diagram

Frame 1



13.2.12 Communications

■ 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
00h	No designation
01h	Feedback speed
02h	Command speed
03h	Command torque
04h	Peak torque
05h	Motor current
06h	Effective torque
07h	Feedback position
08h	Command position
09h	Position deviation
10h	Command Pulse frequency
11h	Feedback cumulative pulse
12h	Command cumulative pulse
13h	LS-Z pulse
14h	Load inertia ratio

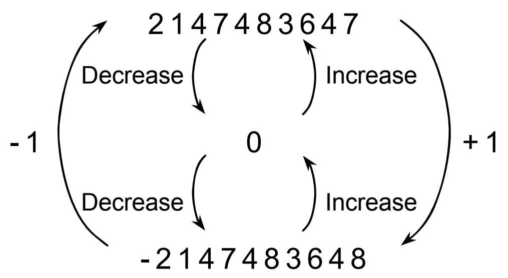
Code	Monitor name
15h	DC link voltage (max.)
16h	DC link voltage (min.)
17h	VREF input voltage
18h	TREF input voltage
19h	OL thermal value
20h	Regenerative resistor thermal value
21h	Power
22h	Motor temperature
23h	Overshoot unit amount
24h	Settling time
25h	Resonance frequency 1
26h	Resonance frequency 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
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 read

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.
Sequence 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 / Position command operation
05h	+OT
06h	-OT
07h	Under voltage
08h	Positioning
09h	Homing
0Ah	Interrupt positioning

■ System status read

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.
Smart identification	40h
For manufacturer	Reserved
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	18-bit ABS
07h	20-bit INC
09h	17-bit INC

■ Alarm at present read

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	—	—
05h	Hu	Overvoltage
06h	Et 1	Encoder Trouble 1
07h	Et 2	Encoder Trouble 2
08h	ct	Circuit Trouble
09h	dE	Memory Error
0Ah	Fd	Fuse Blown
0Bh	cE	Motor Combination Error
0Ch	t H	Breaking Transistor Overheat
0Dh	Ec	Encoder Communication Error
0Eh	ct E	CONT（Control signal）Error
0Fh	oL1	Overload 1
10h	oL2	Overload 2
11h	r H4	Inrush Current Suppression Circuit Trouble
21h	LuP	Main Power Undervoltage
22h	r H1	Internal Breaking Resistor Overheat
23h	r H2	External Breaking Resistor Overheat
24h	r H3	Breaking 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	I E	Initial Error

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■ Alarm history read

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	—	—
05h	Hu	Overvoltage
06h	Et 1	Encoder Trouble 1
07h	Et 2	Encoder Trouble 2
08h	ct	Circuit Trouble
09h	dE	Memory Error
0Ah	Fb	Fuse Blown
0Bh	cE	Motor Combination Error
0Ch	t H	Breaking Transistor Overheat
0Dh	Ec	Encoder Communication Error
0Eh	ct E	CONT（Control signal）Error
0Fh	oL1	Overload 1
10h	oL2	Overload 2
11h	r H4	Inrush Current Suppression Circuit Trouble
21h	LuP	Main Power Undervoltage
22h	r H1	Internal Breaking Resistor Overheat
23h	r H2	External Breaking Resistor Overheat
24h	r H3	Breaking 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	I E	Initial Error

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■ Sequence I/O signal read

CMND **50h**

DATA (n)

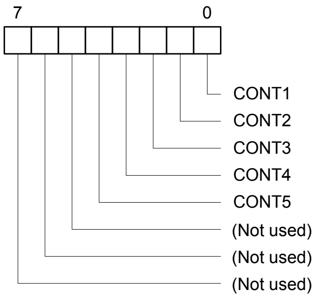
Sent from host controller

	7 … 0
Memory type	02h
Address (L)	00h
Address (M)	00h
Address (H)	12h
Number of loaded bytes	0Ah
Dummy	00h

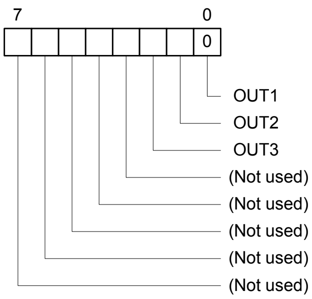
Sent from servo amplifier

	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



■ Parameter read

CMND **50h**

DATA (n)

Sent from host controller

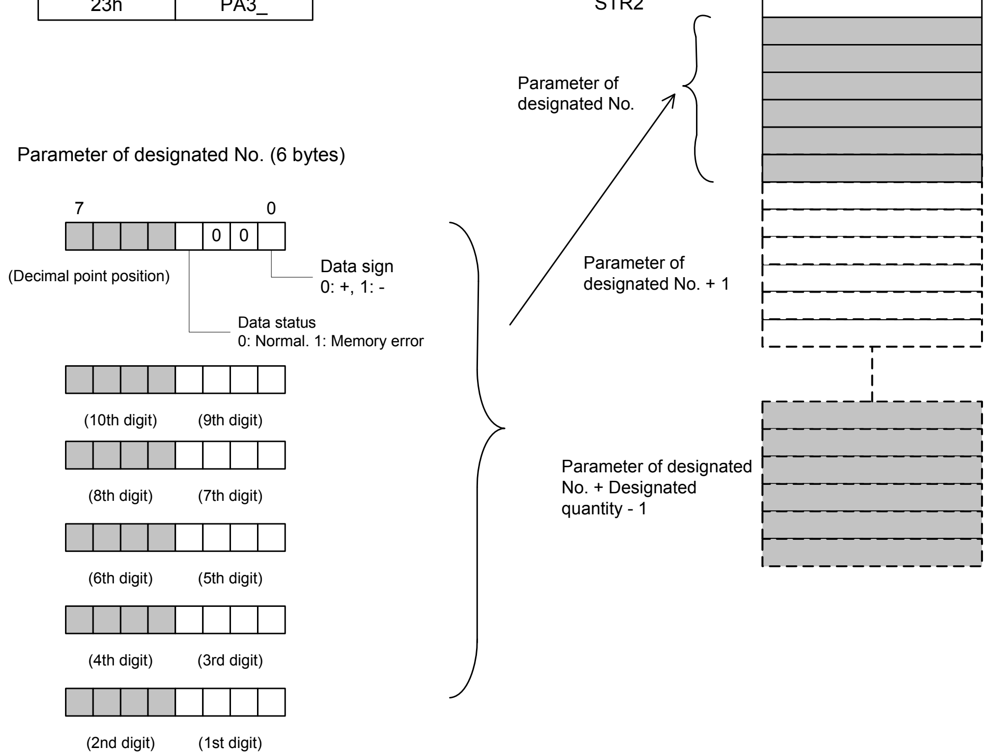
	7 0
Memory type	See the table below.
Address (L)	Quantity (01h to 15h)
Address (M)	No.(01h to 99h)
Address (H)	00h
Number of readed out bytes (L)	(Designated No. × 6) + 2
Number of readed out bytes (H)	00h

* 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	



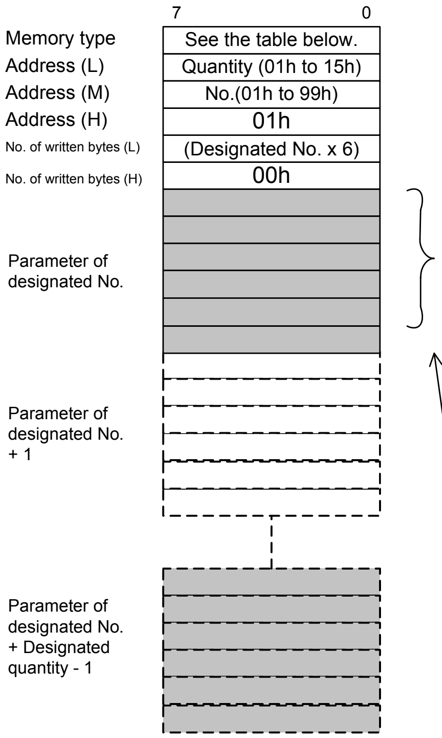
* The data is a 10-digit BCD.

■ Parameter write

CMND **51h**

DATA (n)

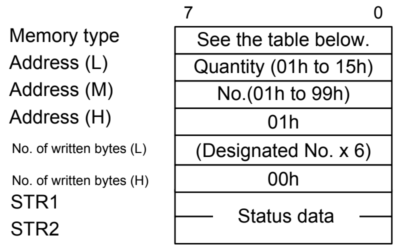
Sent from host controller



* Designate addresses (L) and (M) in a BCD.
Example: 49 → 49h, 50 → 50h

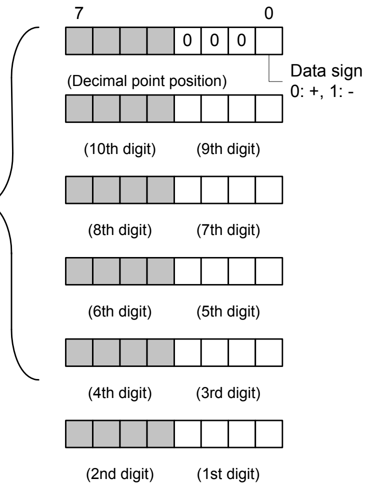
Memory type	Parameter
21h	PA1_
22h	PA2_
23h	PA3_

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	

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ALPHA5 Smart

14

CHAPTER 14 PC LOADER

14.1 Operating Environment

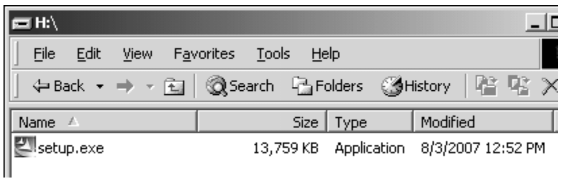
To run PC Loader, a PC having the following environment is necessary.

- 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)
  Windows Vista (Service Pack 1 or later)
  Windows 7
- CPU
  Pentium 133 MHz or faster (Windows 2000 Professional)
  Pentium 300 MHz or faster (Windows XP Professional, Windows XP Home Edition)
  Pentium 800 MHz or faster 32 bits (Windows Vista)
  Pentium 1GHz or faster 32 bits（Windows 7）
- Memory environment
  64 MB or more (Windows 2000 Professional)
  128 MB or more (Windows XP Professional, Windows XP Home Edition)
  512 MB or more (Windows Vista)
  1 GB or more（Windows 7）
- Display
  Windows-compatible display having XGA (1024 x 768 pixels) or better resolution
- Free space of hard disk
  100 MB minimum

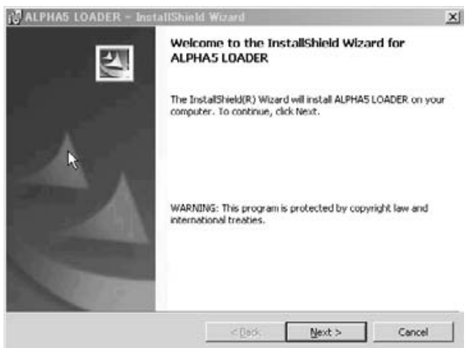
14.2 Installation Method

Before starting installation, exit from Message Manager (MM) (see page 14-4).

[1] Run the ALPHA5 Series PC Loader setup program.
Click setup-***.exe.



[2] The installation preparation screen is displayed.
Click "Next "



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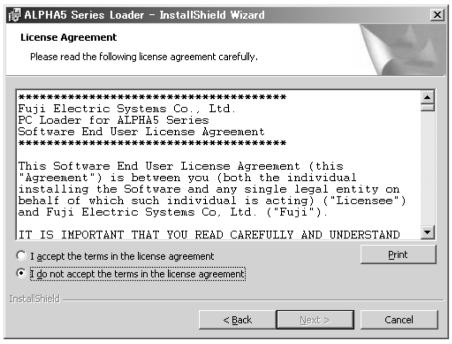
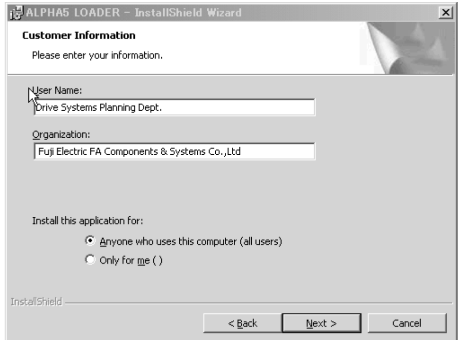
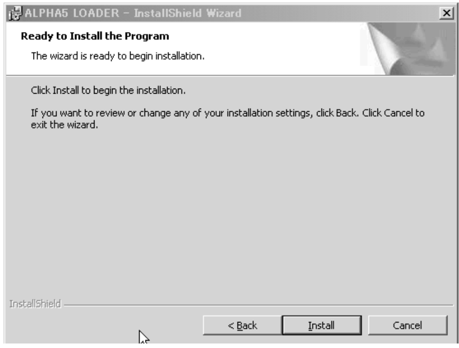
[3] The ALPHA5 Series PC Loader software license agreement is displayed.
Carefully read the license agreement.
To accept, click "I accept the terms in the license agreement " then "Next ."



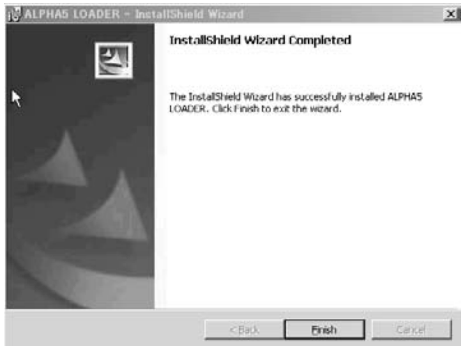
[4] Enter user information.
Enter the user name and the division you belong to.
Designate the user of the PC Loader.
After entering and selecting, click "Next ."



[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.



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Hint

The ALFHA5 Series PC Loader can apply to the following products.

[PC Loader]
(1) ALPHA5
(2) ALPHA5 Smart
(3) Servo operator

[Conversion tool]
(1) Parameter file conversion tool [FALDIC-α → ALPHA5]
(2) Positioning data file conversion tool [FALDIC-α → ALPHA5]
(3) Parameter file conversion tool [FALDIC-W → ALPHA5 Smart]

The description is given mainly for the PC Loader for ALFHA5 Smart from the next page.

■ 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 the ALPHA5 Series PC Loader is launched. Keep MM running during operation of the ALPHA5 Series 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 loader version of respective devices is old, the PC loader for the ALPHA5 Series will not be enabled. In such a case, terminate the MM and then launch the PC loader for the ALPHA5 Series.
If the ALPHA5 Series PC Loader is launched first, the PC Loader in the following list can be used.

Applicable device	Applicable model	Name and model of loader
Fuji's integral controller	MICREX-SX	SX Programmer Expert (D300winVer2) / NP4H-SEDBV2
		SX Programmer Expert (D300winVer3) / NP4H-SEDBV3
		SX Programmer Standard / NP4H-SWN
		SX communications middle ware / NP4N-MDLW
Fuji's inverter	FRENIC-Mini FRENIC-Eco	The FRENIC Loader
	FRENIC-Multi	FRENIC Loader
	FRENIC-MEGA	FRENIC Loader 3

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.

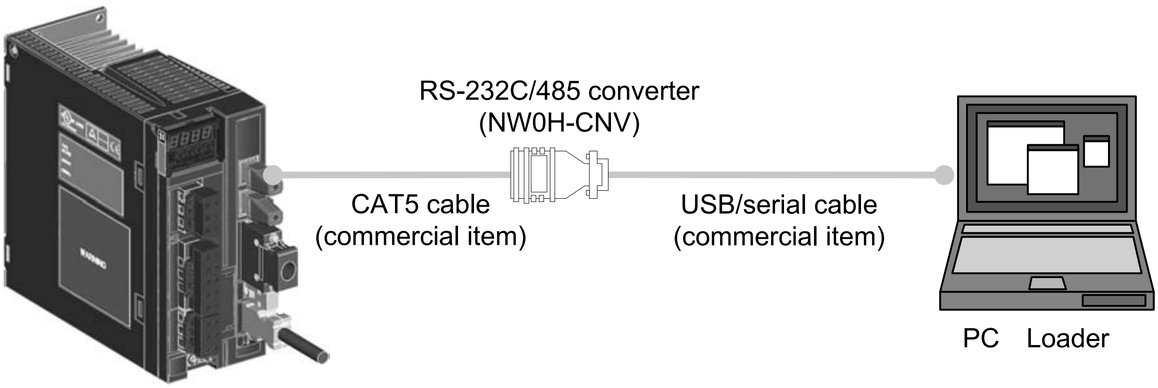
[3] MM is terminated and the  icon disappears from the task bar.

14.3 Communications Setting

Two methods are available to connect the servo amplifier to a PC.
The communications setting detail varies depending on the connection method. See the following description and set the communications appropriately.

1) When using the RS-232C/485 converter (NW0H-CNV)

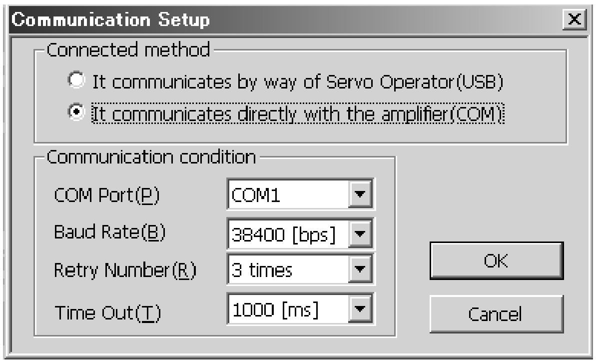
■ Wiring outline



■ Setting method

(1) Select "Comm. Setup" from Wizard Menu.

(2) Select "It communicates directly with the amplifier(COM)." in the Connection method item, and then click the OK button.



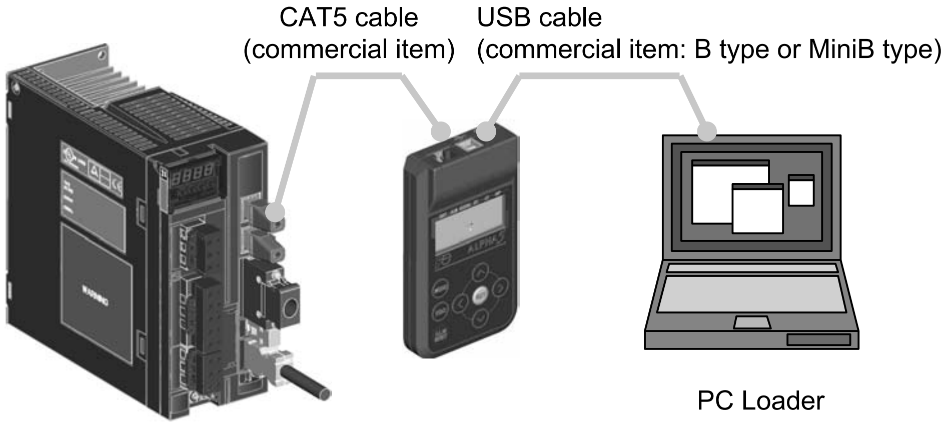
■ Notes

Set the same value between PA2_73 (communications baud rate) on the amplifier side and the communications baud rate as a communications condition.

No.	Parameter name	Setting range	Default value	Change
PA2_73	Communications baud rate	0･･･ 38400 [bps]、1･･･ 19200 [bps] 2･･･ 9600 [bps]、3･･･115200 [bps]	0	Power

2) When using the servo operator

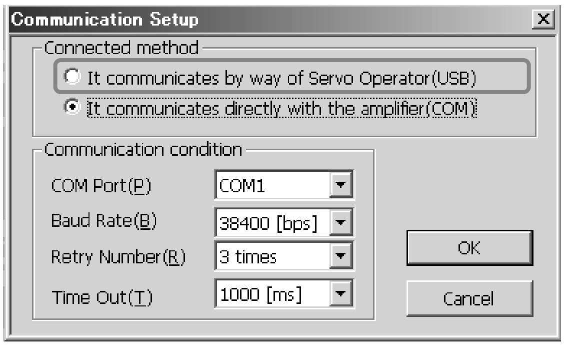
■ Wiring outline



■ Setting method

(1) Select "Comm. Setup" from Wizard Menu.

(2) Select "It communicates by way of servo operator(USB)." in the Connected method item, and then click the OK button.



■ Notes

Set the same value between PA2_73 (communications baud rate) on the amplifier side and the communications baud rate setting* on the servo operator side. (The initial value is 38400 bps for both.)

No.	Parameter name	Setting range	Default value	Change
PA2_73	Communications baud rate	0･･･ 38400 [bps]、1･･･ 19200 [bps] 2･･･ 9600 [bps]、3･･･115200 [bps]	0	Power

*) For the baud rate setting of the servo operator, refer to "Test Running " in the servo operator manual.

■ Procedure for USB hardware search wizard (when using the servo operator)

For Windows 7

[1] Select “Browse my computer for driver software (advanced) (R).”

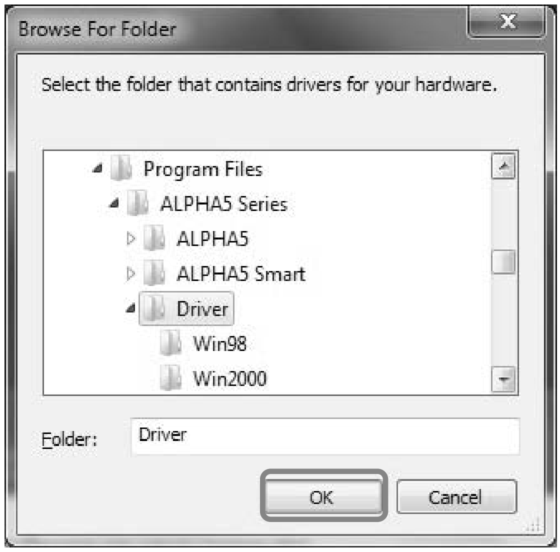
[2] Select the USB driver file.
Click the “Browse” button.

[3] Select the folder containing the driver file.

The USB driver is copied in the folder* where PC Loader is installed.
* Example of ALPHA5 Smart PC Loader

C: \Program Files\ALPHA5 Series\Driver

Select the folder and clock “OK.”



[4] The folder is designated.

Click “Next”.

[5] Install the driver.

The driver installation is started by clicking “Install this driver software anyway. “

[6] The file is copied and the completion screen is displayed.

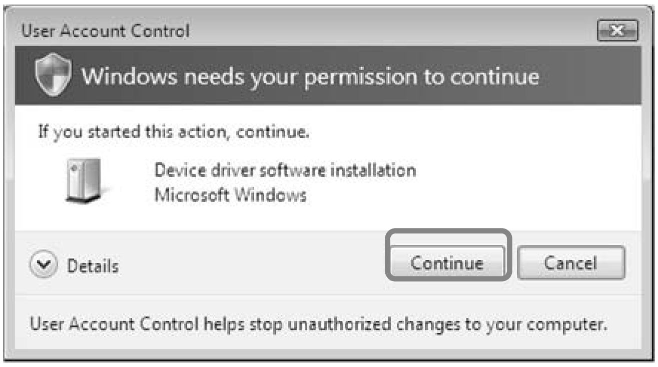
Click the “Close” button to exit from the driver installation.

For Windows Vista

[1] Using a USB cable, Connect the PC with the servo operator.
Install the USB driver.

Select "Install by searching the driver software (recommended) (L)."

[2] Select "Continue."



[3] Select "Browse my computer for driver software(advanced)(R)."

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[4] Select the USB driver file.
Click the "Browse" button.

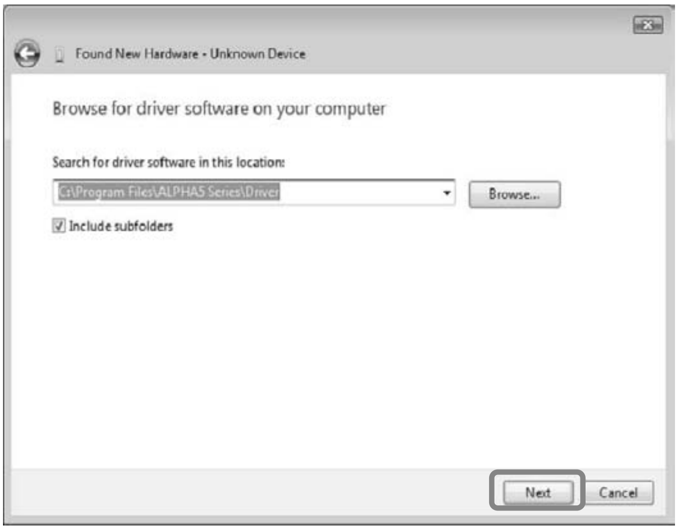
[5] Select the folder containing the driver file.

The USB driver is copied in the folder* where PC Loader is installed.
* Example of ALPHA5 Series PC Loader.
C:\Program Files\ALPHA5 Series \Driver

Select the folder and click "OK."

[6] The folder is designated.

Click "Next."



[7] Install the driver.

The driver installation is started by clicking "Install this driver software anyway."

[8] The file is copied and the completion screen is displayed.

Click the "Close" button to exit from the driver installation.

■ Procedure of USB hardware search wizard

For Windows XP

[1] Using a USB cable, connect the PC with the servo operator.
Install the 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.
* Example of ALPHA5 Series Looder
C: \Program Files\ALPHA5 Series\Driver

Select the folder and click "OK."

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[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 Series\Driver\Win2000

[6]　Select the SxUsb.sys file and click the "Open" button.

[7]　"Copy files from " is designated.
　　Click the "OK" button.

[8]　The file is copied and the completion screen is displayed.

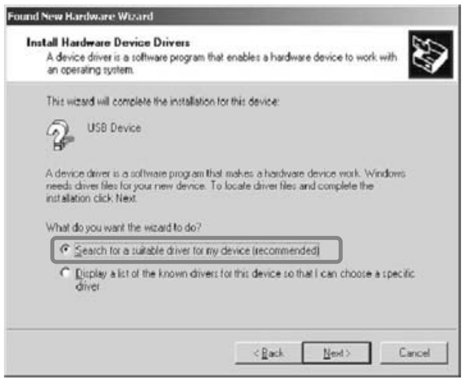
　　Click the "Finish" button to exit from driver installation.

<u>For Windows 2000</u>

[1] Using a USB cable, connect the PC with the servo operator.

Install the 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.
Example of ALPHA5 Series Loader
C: \Program Files\ALPHA5 Series\Driver

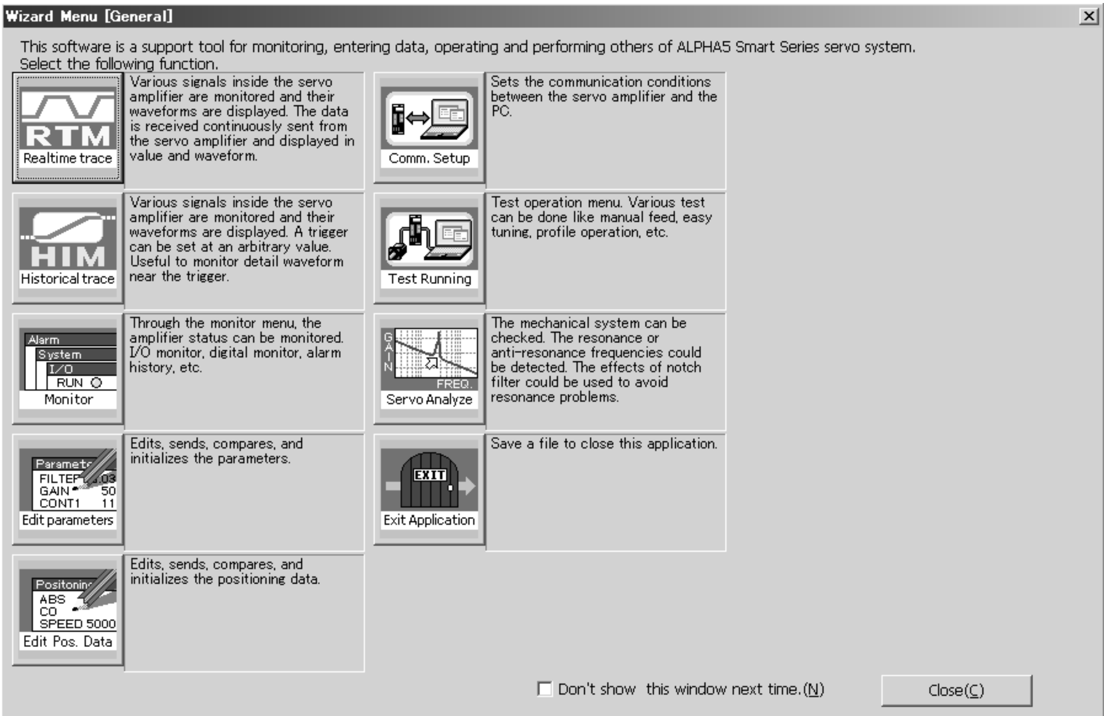
[5] Select the SxUsb.inf file and click "OK."

[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.

14.4 Function List

After the PC Loader is launched, the wizard Menu [General] shown below is displayed.

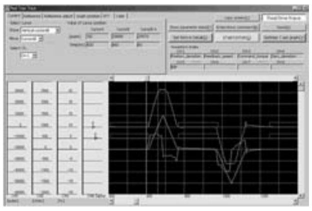
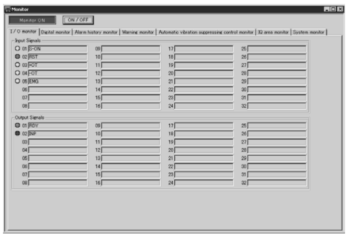
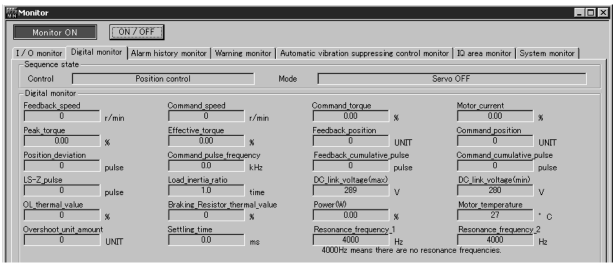
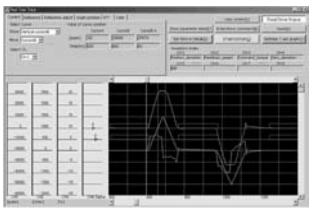


- Real time trace
  The speed, torque waveform and so on can be obtained easily with a single click.
- Historical trace
  Enter trigger settings to obtain waveforms in more details than those obtained with real time trace.
- Monitor
  Monitor [I/O check], [Various numerical data], [Alarm history], [Warning/Forecast monitor], [Automatic vibration suppressing monitor], or [System configuration].
- Edit Parameters
  Parameters can be edited, transferred, compared or initialized.
- Edit positioning data
  Positioning data can be edited, transferred, compared or initialized.
- Communication setup
  Set up communication conditions for the servo amplifier and the 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.

14.5 Use Method at Setting Up

When setting up the equipment, follow the procedure below for smoother work.

Step	Description	Items to be confirmed	Operation of PC Loader
[1]	Operate the discrete motor to check if the motor functions correctly.	・ Perform manual operation [JOG] to check if the motor operates according to commands.	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)
[2]	Connect with the host controller and perform motion to check if the sequence program functions correctly.	・ Perform I/O check. ・ If necessary, perform forced OUT signal output and forced pulse output.	Perform I/O monitor in the monitor mode to check. 
		・ Give commands from the host and check for motions.	Use digital monitor in the monitor mode to check the command pulse frequency and command cumulative pulses. 
[3]	Install the motor to the machine and operate to check if the mechanical equipment functions correctly.	・ Operate the motor in the final state to check for faults in the motion.	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)

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14.6 Detail Description of Function

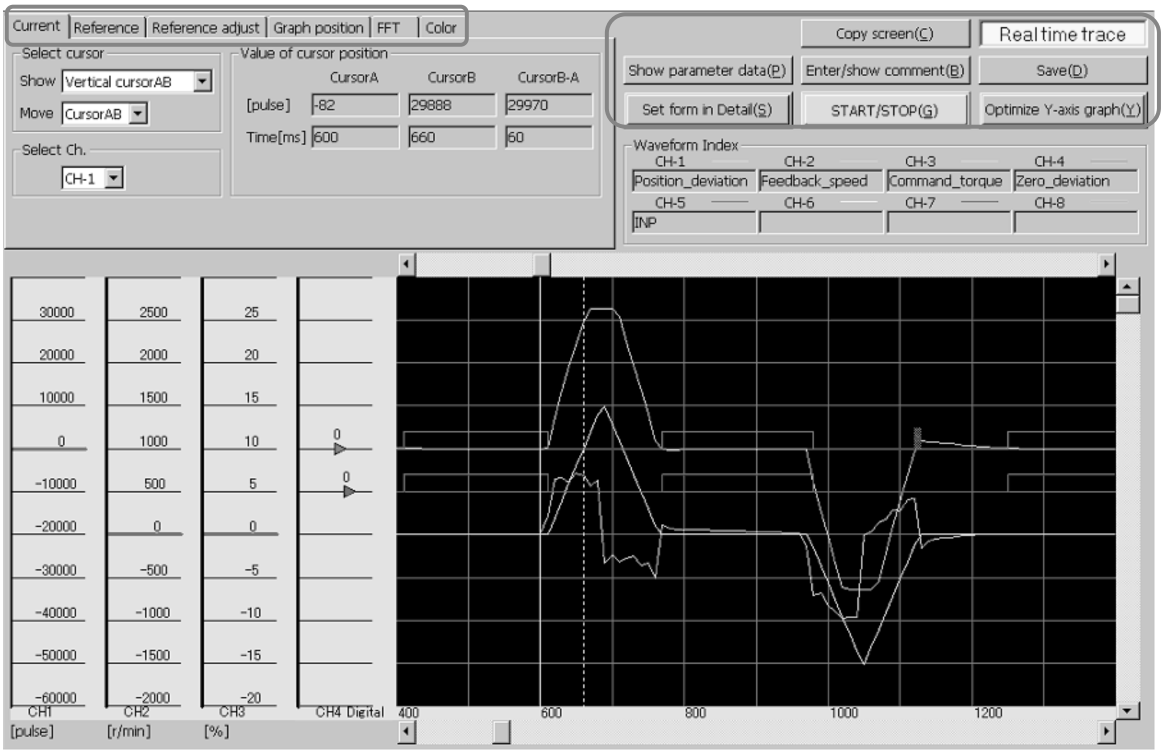
14.6.1 Real-Time Trace

Servomotor motion waveforms are drawn. Data of about 60,000 points can be acquired continuously. The trace is automatically terminated when the limit of 60,000 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

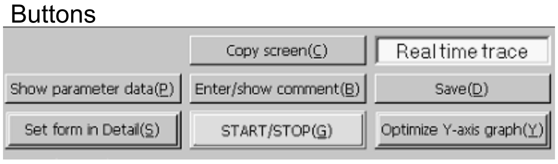
[Example of real time trace screen]



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.

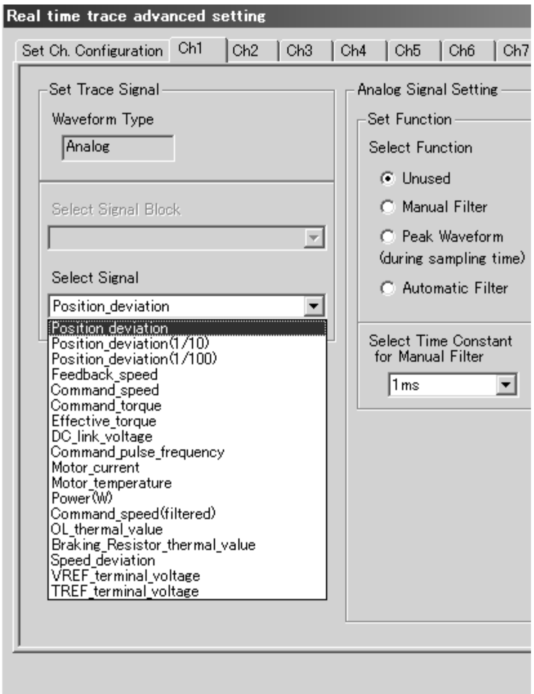
■ Waveform that can be acquired

Up to eight channels* of analog or digital signals can be acquired.

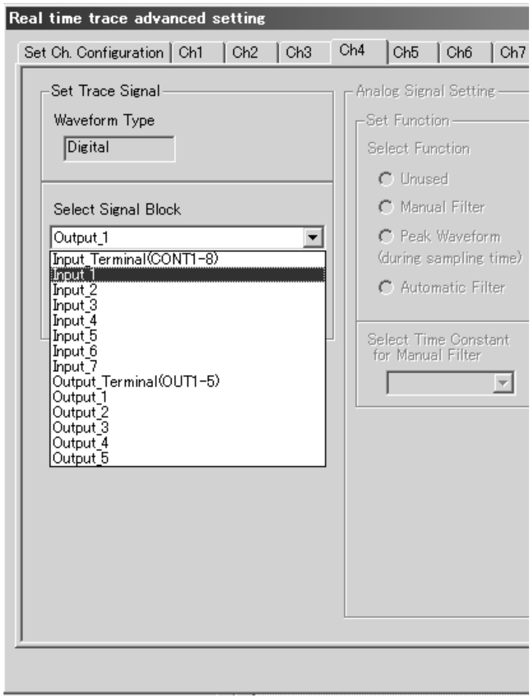
Waveforms that can be acquired are shown below. (All digital I/O signals can be traced.)

* 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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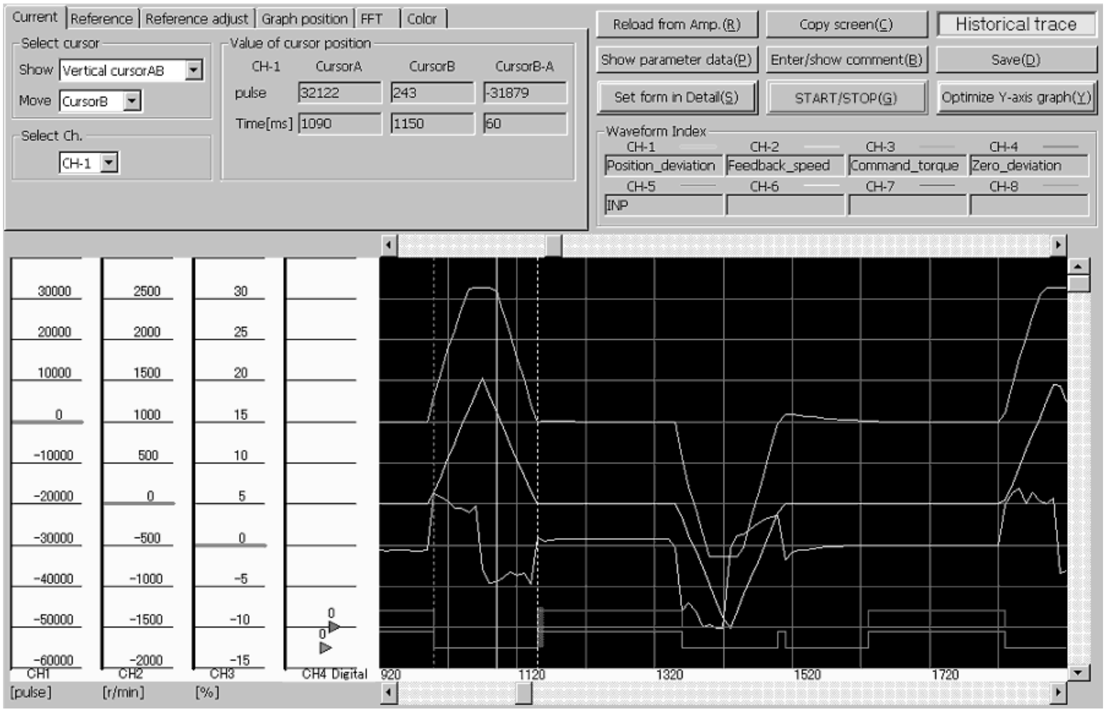
14.6.2 Historical Trace

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.

■ 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.

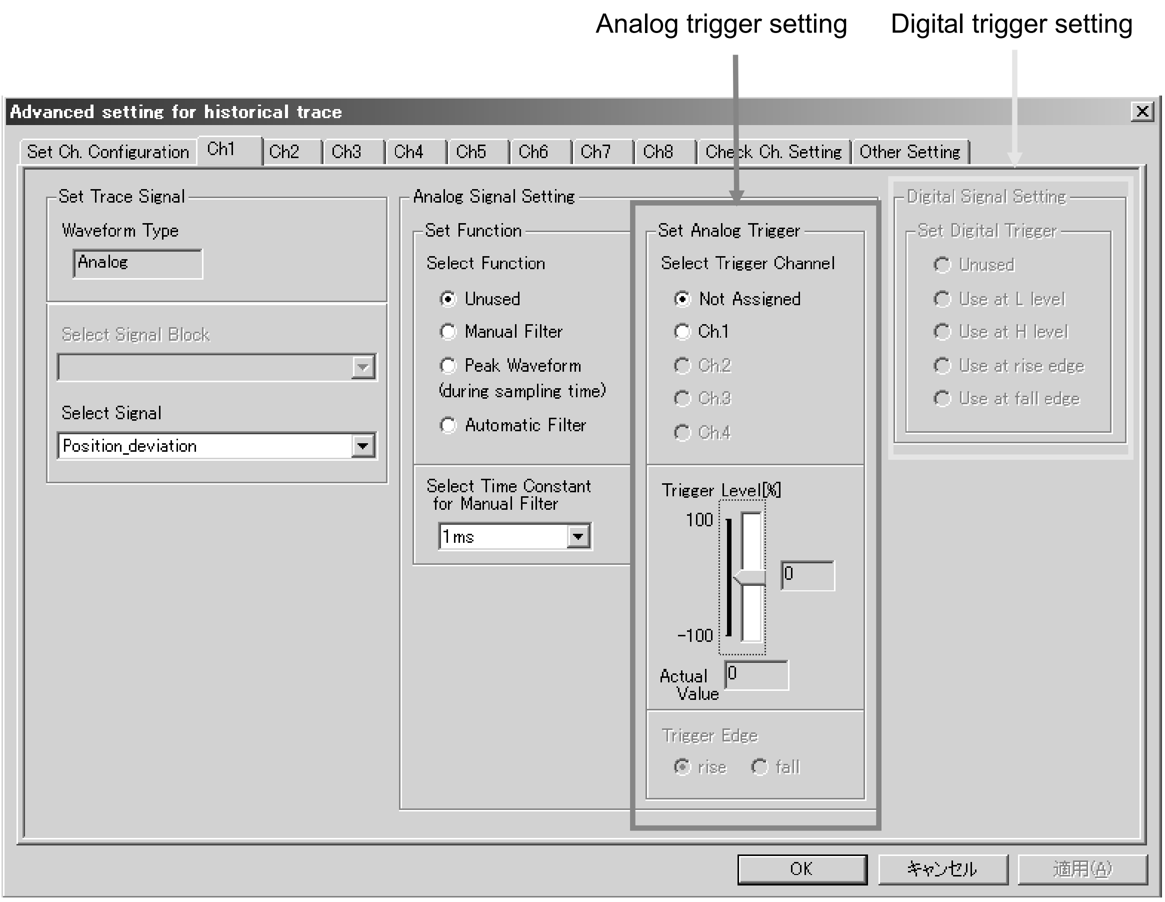
■ Waveform that can be acquired

Same as that of real time trace

■ Trigger setting

Both analog and digital waveforms can be used for the trigger setting*.

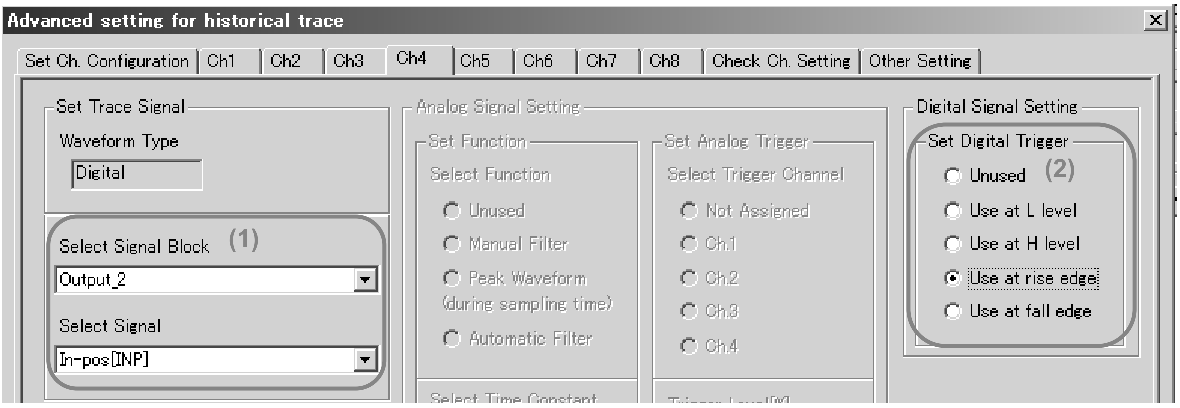
* The trigger setting is only for the single channel.

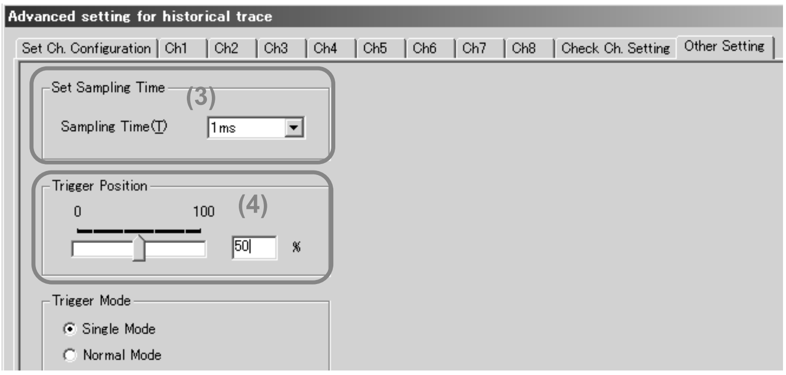


■ Example of setting method for measurement of waveform in stoppage

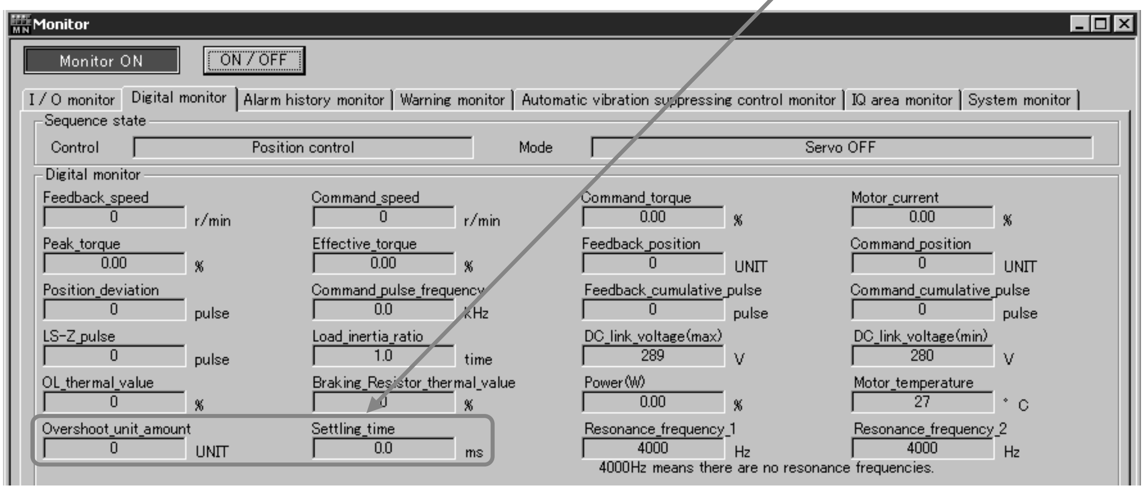
(1) 3 analog waveforms (command speed, position deviation and command torque)
1 digital waveform (in-position (INP))
(2) Select "Use at ↑ edge" as a digital trigger signal of the digital waveform (in-position (INP)).
(3) Set the sampling time at "1ms."
(4) Set the trace count from the trigger position at 20.

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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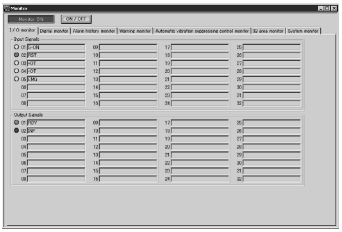
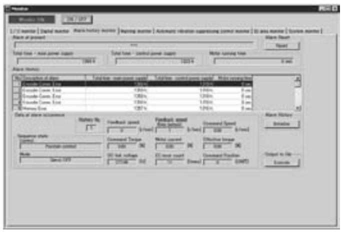
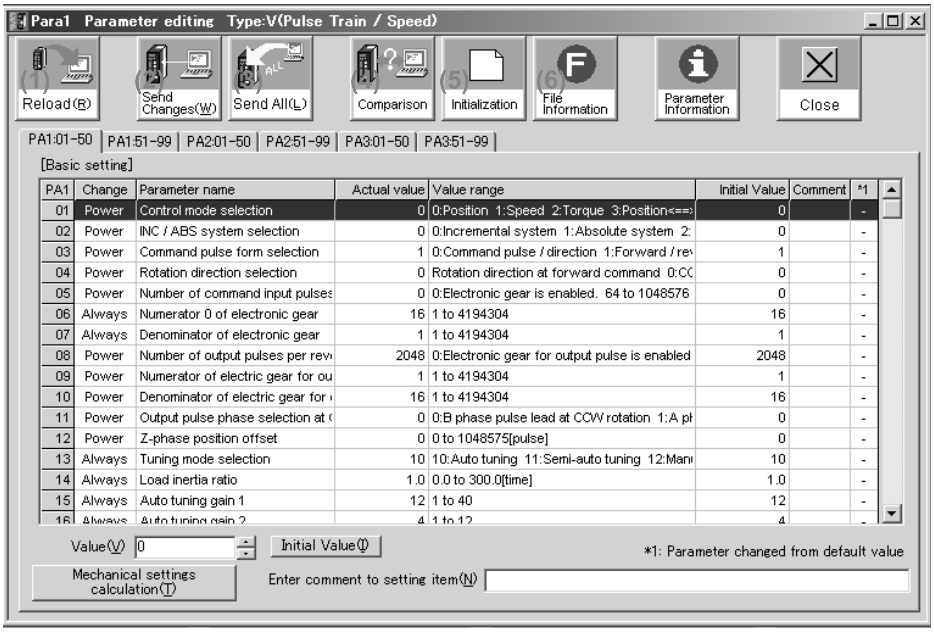
14.6.3 Monitor

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/ monitor	The warnings and forecasts indicated at the servo amplifier are displayed.	
Automatic vibration suppressing control monitor	The state of learning of automatic vibration suppressing is displayed.	
System monitor	The model of the connected servo amplifier and servomotor is displayed.	

14.6.4 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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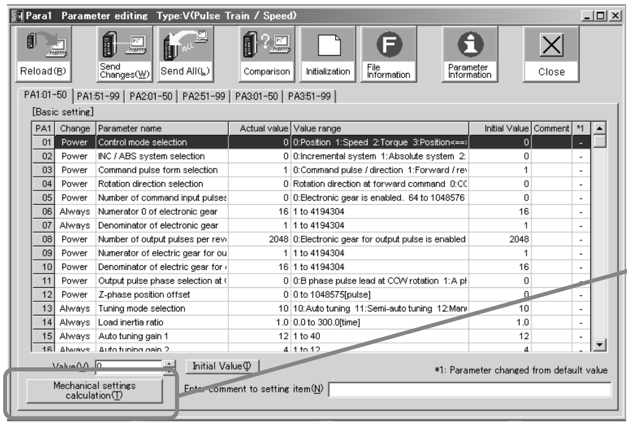
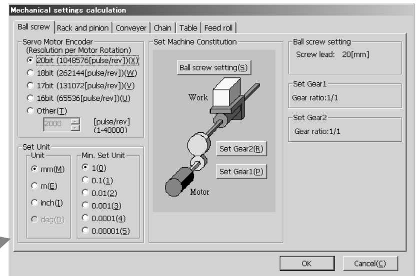
■ Automatic calculation of electronic gear

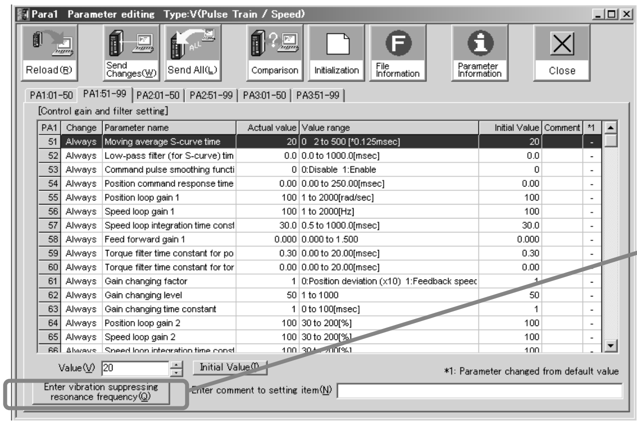
Press the "Mechanical settings calulation" button at [PA1: Basic setting] to open a special window. Enter specifications of each mechanical system to automatically calculate the electronic gear.

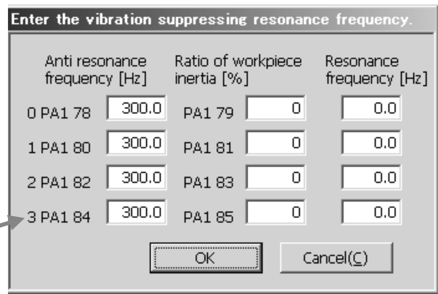




■ Automatic calculation of workpiece inertia ratio

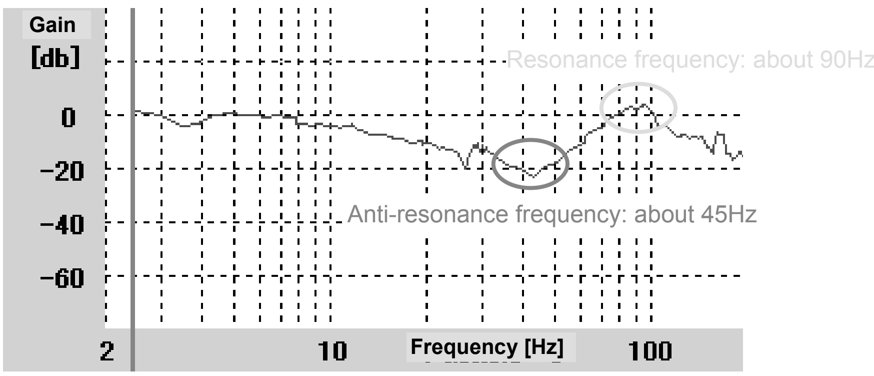
Press the "Enter vibration suppressing resonance frequency" at [PA1: Control gain and filter setting] and enter the anti resonance frequency and resonance frequency* to automatically calculate the workpiece inertia ratio.





* 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.

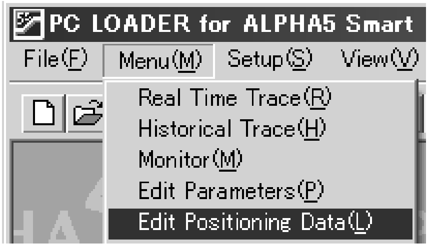
[Example of resonance frequency]

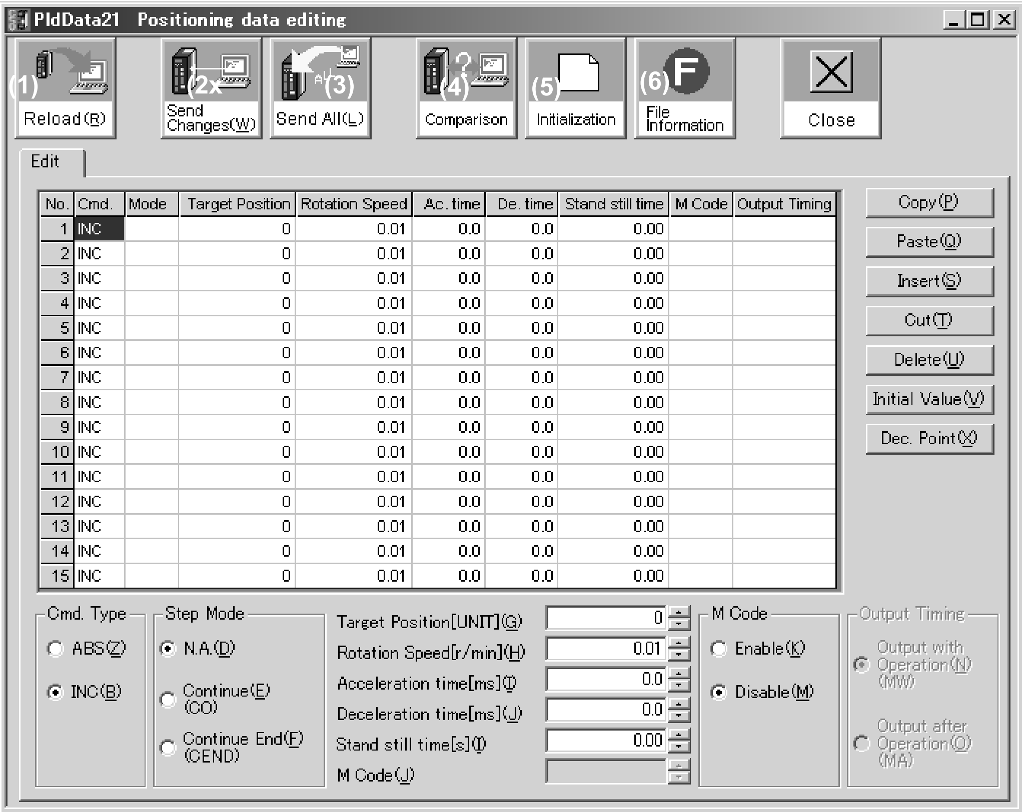


14.6.5 Positioning Data Editing

Positioning data are registered to the servo amplifier.

Launch the screen by selecting [Menu] →[Edit Positioning Data].





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 positioning data are compared with those of the connected servo amplifier or those having been saved in a file.

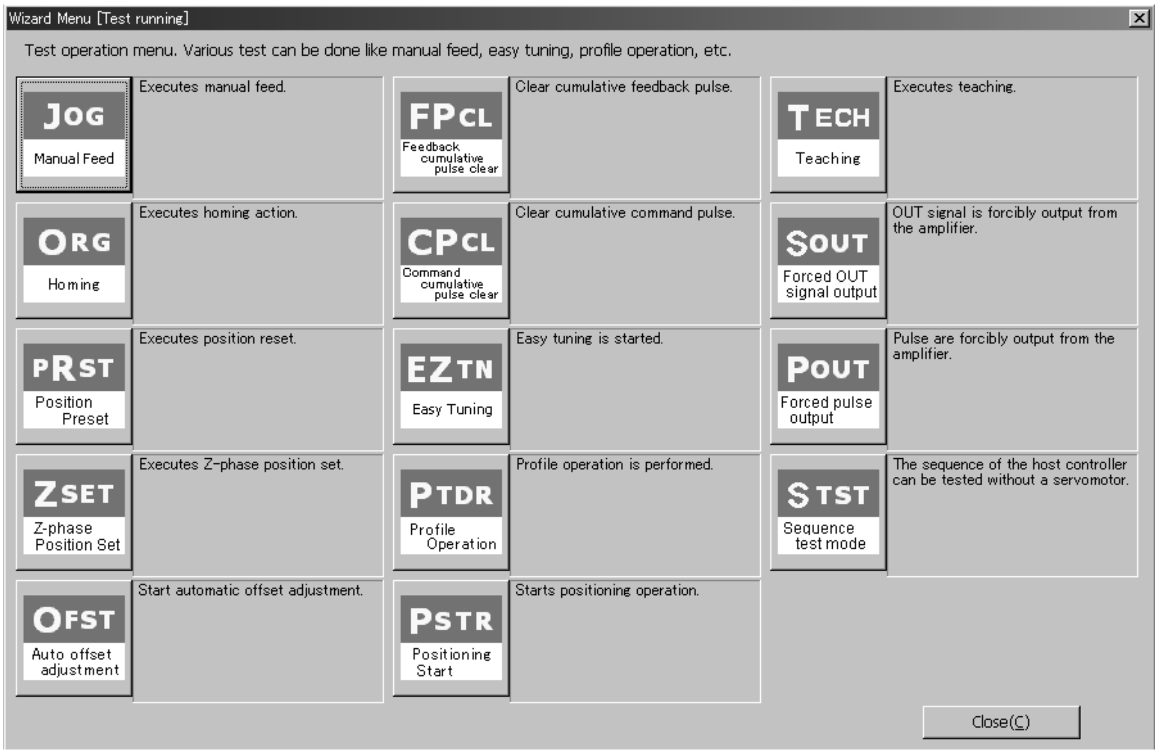
(5) Initialization
Currently edited positioning data or those of the connected servo amplifier* are reset to default values.

(6) File information
Data about currently edited positioning data 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.

14.6.6 Test Running

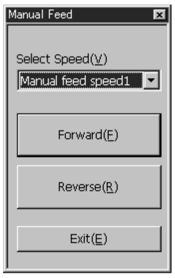
Disconnect the servo amplifier from the host to perform test running of the servomotor from the main body of the servo amplifier.
Use this function if the servomotor does not operate correctly according to host commands, if the motor fails to start or to check the direction of rotation.



*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.

■ Each test operation screen

(1) Manual feed

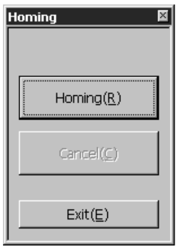


Select the speed (parameters PA1_41 through _47).

The motor rotates forward while the button is clicked on.

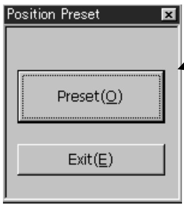
The motor reverses while the button is clicked on.

(2) Homing



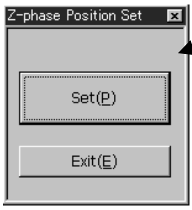
Press the "Homing" button to start the motor according to the setting of homing-related parameters PA2_06 through _14.
After the homing, the motion is finished.

(3) Position preset



Press the "Preset" button to change the current position to the one specified in parameter PA2_19 (preset position).

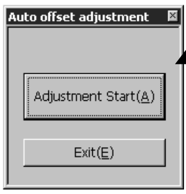
(4) Z-phase position set



Press the "Set" button to output the Z-phase at the current position and automatically change parameter PA1_12 (Z-phase position offset).
* "Z-phase position set" fails in the following cases.

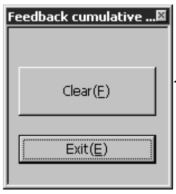
- PA2_74 (parameter write protection) is set at 1 (write protect).
- The zero position (Z-phase) of the encoder is not established.
  In this case, turn the motor shaft twice or more.

(5) Auto offset adjustment

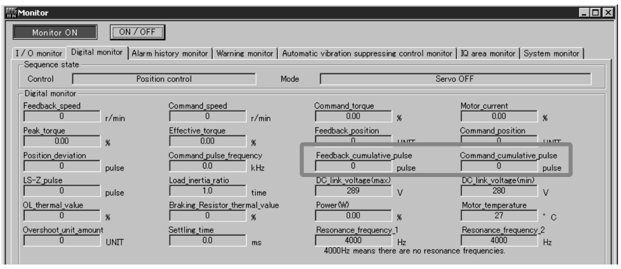


Press the "Adjustment Start" button to adjust the offset of the VREF and TREF analog input terminals and change parameters PA3_32 (speed command offset) and PA3_34 (torque command offset).
Auto offset adjustment is impossible if PA2_74 (parameter write protection) is set at 1 (write protect).

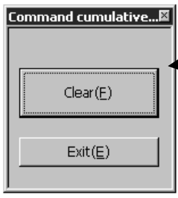
(6) Feedback cumulative pulse clear



Press the "Clear" button to reset the cumulative feedback pulse to "zero."



(7) Command cumulative pulse clear

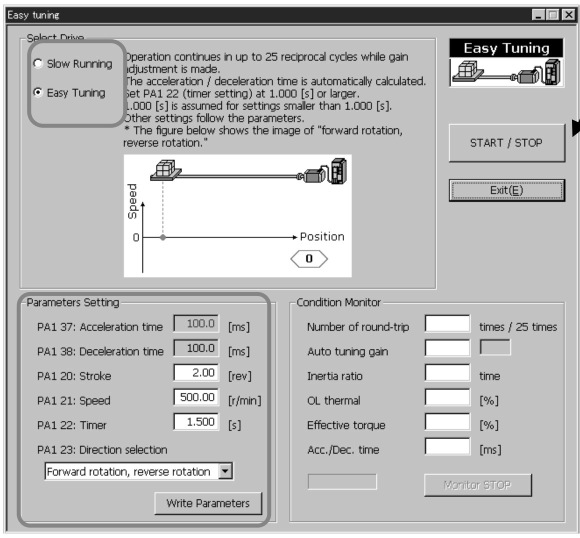


Press the "Clear" button to reset the command cumulative pulse to "zero."

(8) Easy tuning

(a)

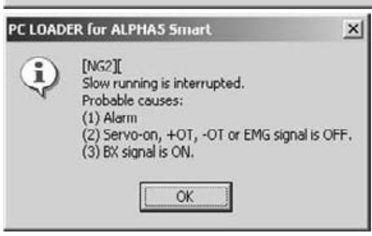
(b)

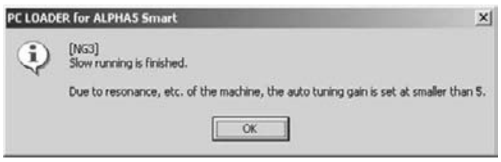


Press the "START/STOP" button to start one of motions (a).
Press the START/STOP button during the motion to stop immediately.

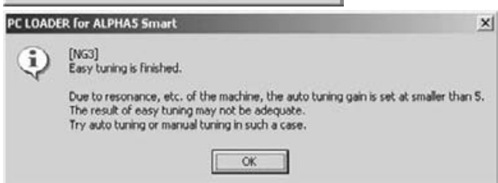
- Slow running
  A motion starts according to parameter settings (b).
  The speed is fixed at 10 r/min.
  The function is for the check of the traveling amount and direction.
- Easy tuning
  A motion starts according to parameter settings (b) while the auto tuning gain 1 is adjusted. However, the acceleration and deceleration time is automatically adjusted.

[Slow running fault screen]





[Easy tuning fault screen]



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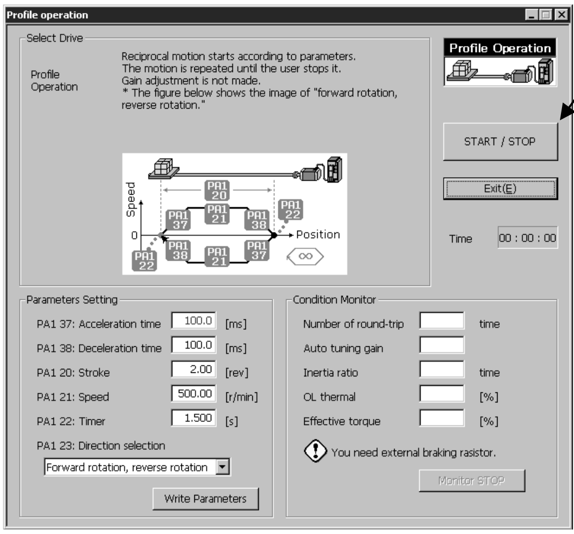
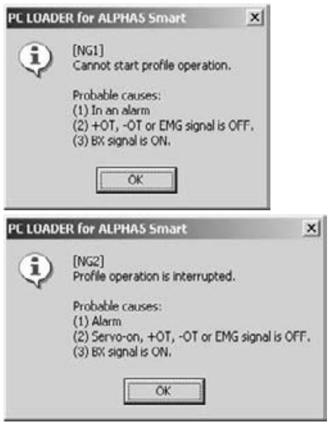
(9) Profile operation



Press the "START/STOP" button to start profile operation.
Press the "START/STOP" button during the motion to stop after the current cycle.

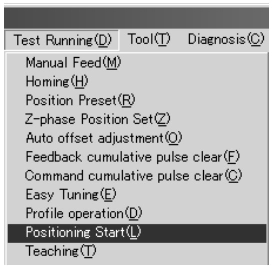
[Profile operation fault screen]



(10) Positioning start

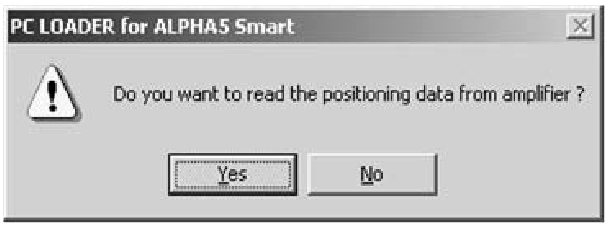
Launch the positioning start

by selecting [Test running] → [Positioning start].

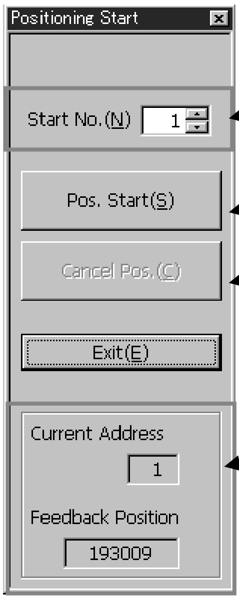


The following window appears with launching.

(The positioning data edit screen can be launched at the same time for checking the positioning data.)



14



Select the positioning data to be launched.

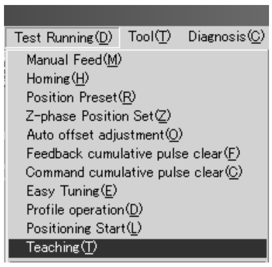
Pressing this button starts automatic operation with selected positioning data.

Positioning operation is canceled and stops if this button is pressed during operation.

Currently executed positioning data address and feedback current position are monitored.

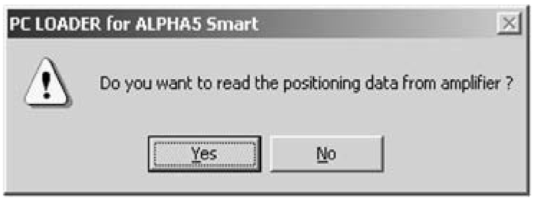
(11) Teaching

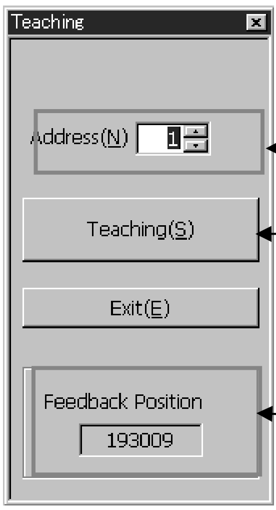
Launch the teaching by selecting [Test running] →[Teaching].



The following window appears with launching.

(The positioning data edit screen can be launched at the same time for checking the positioning data.)





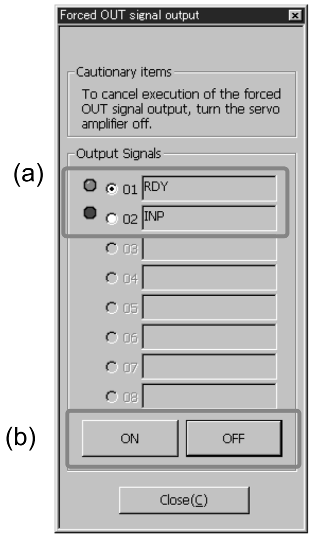
Select the positioning data to write data.

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.

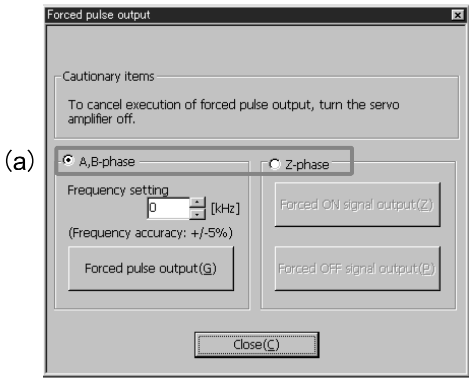
(12) Forced OUT signal output



Select the OUT signal output at (a) and select ON or OFF at (b).

To exit from this mode, turn the power off.

(13) Forced pulse output



Select the pulse signal to be output, at (a).

A,B-phase

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) Sequence test mode

Even if the servomotor is not connected, you can simulate servomotor connection state.

Use this function to efficiently debug host programs.

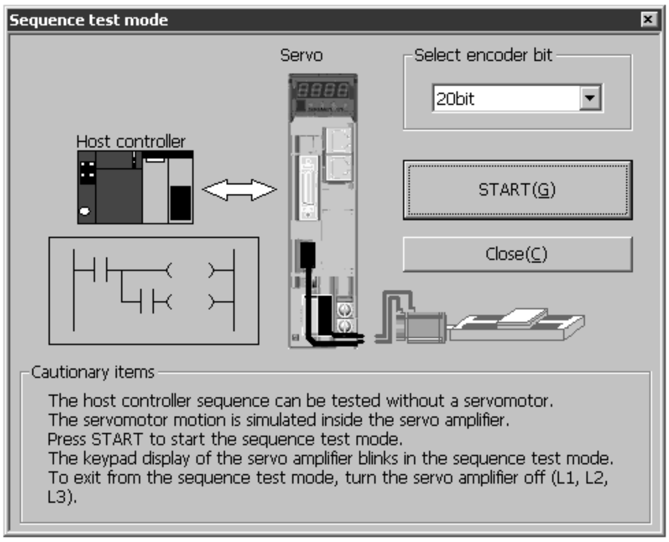
Notes

- 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 regenerative 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 keypad indication of the servo amplifier blinks.

Startup screen



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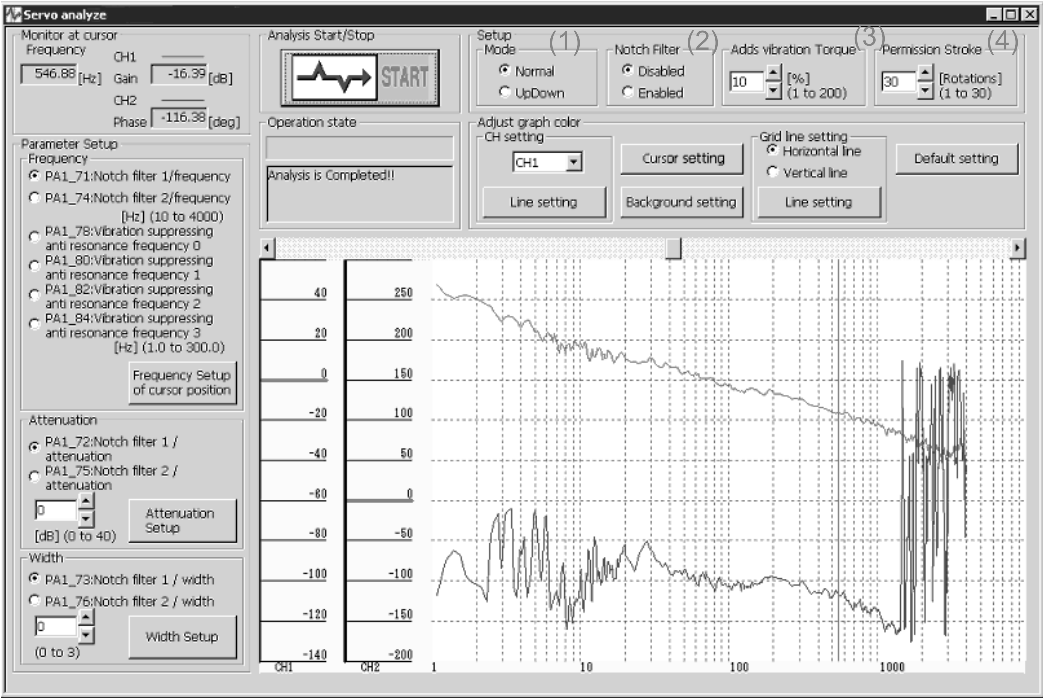
14.6.7 Servo Analyze

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.)



■ Each setting

(1) Mode
In case of horizontally driven equipment, select "Normal." In case of vertically driven equipment, select "UpDown."

(2) Notch filter
Select "Disable" to check mechanical characteristics such as the resonance point.
Select "Enable" to check effects of the notch filter.

(3) 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%).

(4) Permission stroke
An error is caused if the servomotor moves beyond this reference value. A travel of the rotation setting is not guaranteed.

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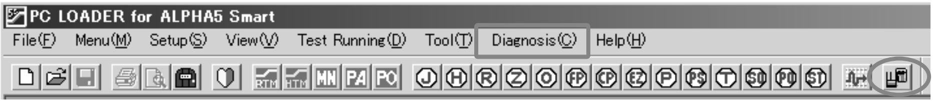
14.6.8 Diagnosis to be Made if the Servomotor Fails to Start

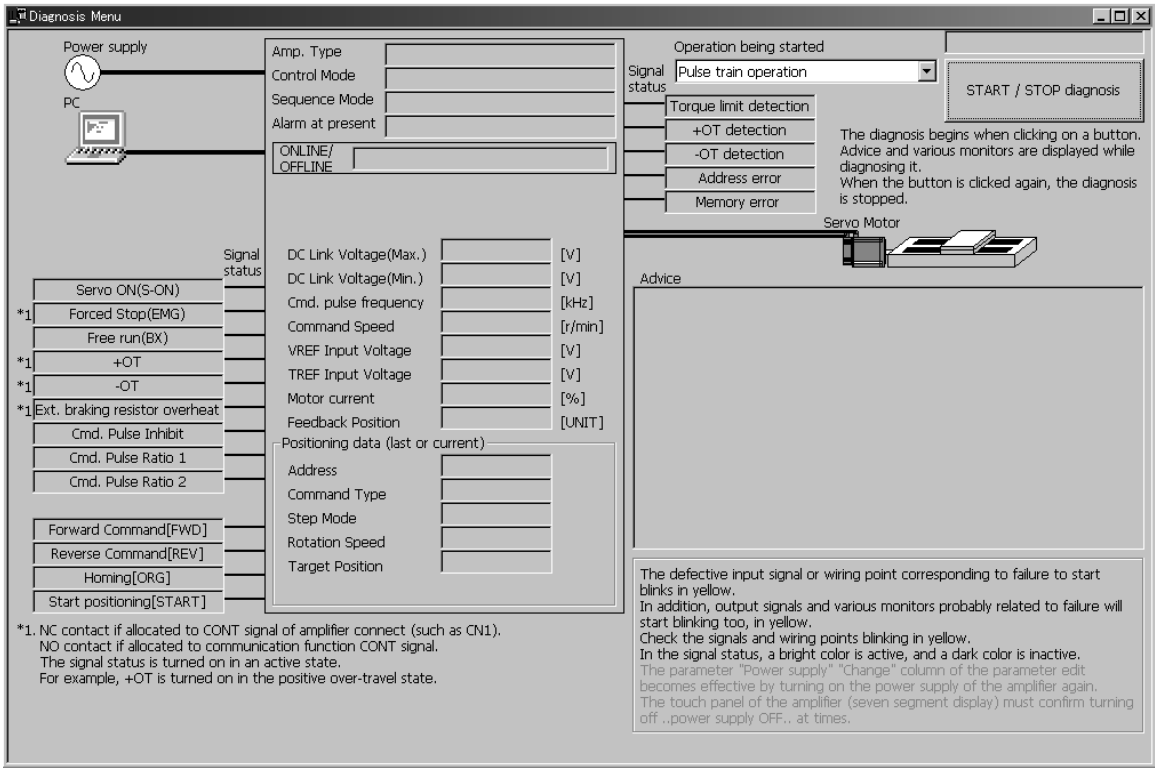
If the servomotor fails to start or unexpected message is shown, launch "Immobility diagnosis" to analyze probable causes at real time.

■ Starting method

Select [Diagnosis] → [Diagnosis Menu] from the menu or click the icon to start.

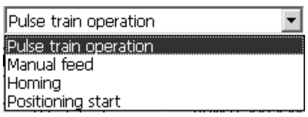


■ Reference screen



■ Operation method

Select from the list of "Operation being started" (1) in the screen above.



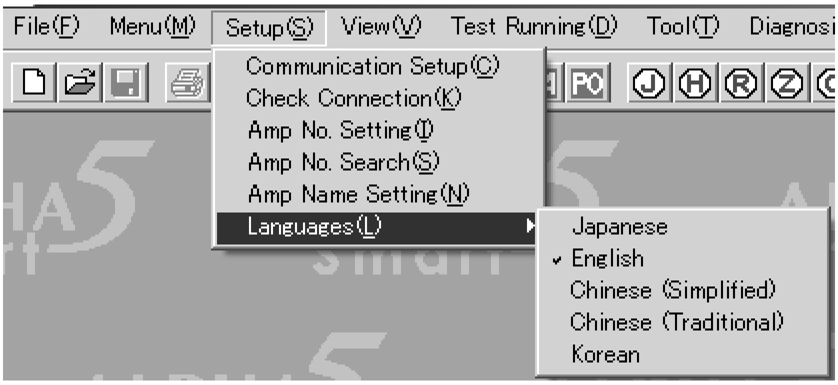
Press the "START/STOP Diagnosis" button to show the amplifier state and estimate the cause of immobility.

14.6.9 Language Selection

The PC Loader supports following languages: Japanese, English, Chinese (both simplified and traditional), and Korean.

■ Selecting procedure

Select the desired language by selecting [Setup] →[Languages] 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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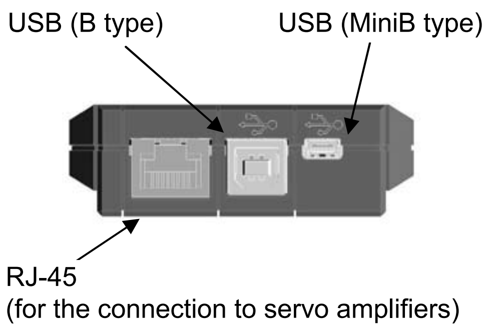
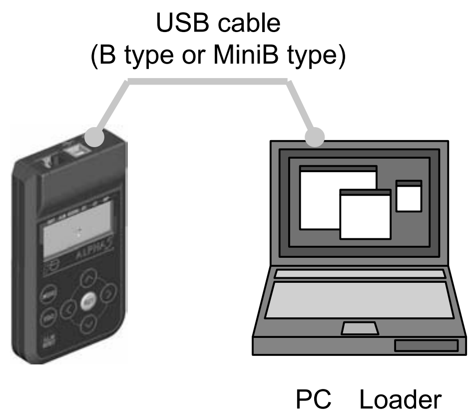
14.7 Servo Operator

14.7.1 Wiring

Use a USB cable (B type or MiniB type) for the connection between the PC and the servo operator.





14.7.2 PC Loader for Servo Operator

The series selection screen shown below appears when the PC loader for the ALPHA5 series is started.

Select the servo operator among selection items to start the PC loader for the servo operator.

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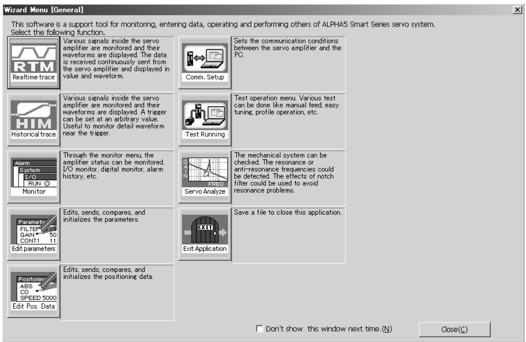
14.7.3 Wizard Menu

The Wizard Menu screen shown below appears when the PC loader for the ALPHA5 series is started.



- Monitor
  The alarm history stored in the servo operator memory can be monitored.
- Edit parameters
  Four parameters stored in the servo operator memory can be checked and edited.
  In addition, new parameters can be registered to the servo operator memory.
- Edit positioning data
  Two pieces of positioning data stored in the servo operator memory can be checked and edited.
  In addition, new positioning data can be registered to the servo operator memory.
- Communications setup
  The communications conditions between the servo operator and the PC can be set.

For the explanation of buttons on each screen, refer to the PC loader help.

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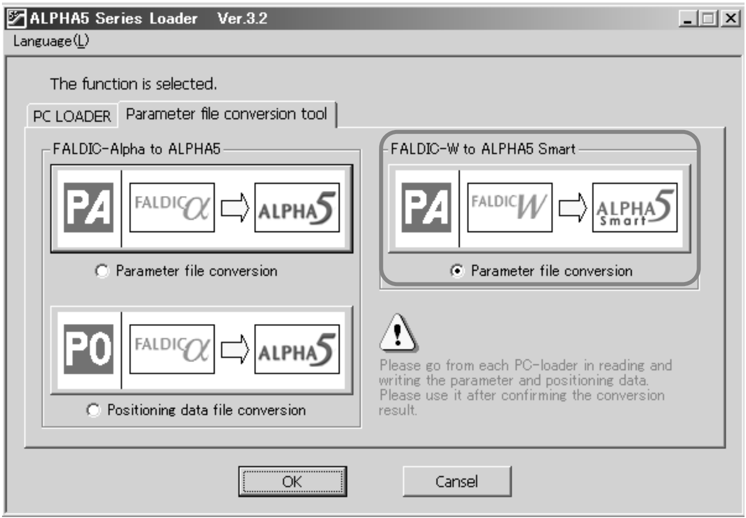
14.8 Parameter Conversion Tool

The parameter file conversion tools [FALDIC-α→ALPHA5] and [FALDIC-W → ALPHA5 Smart] convert the parameter files of FALDIC-α and W series to those of ALPHA5 and ALPHA5 Smart series respectively.

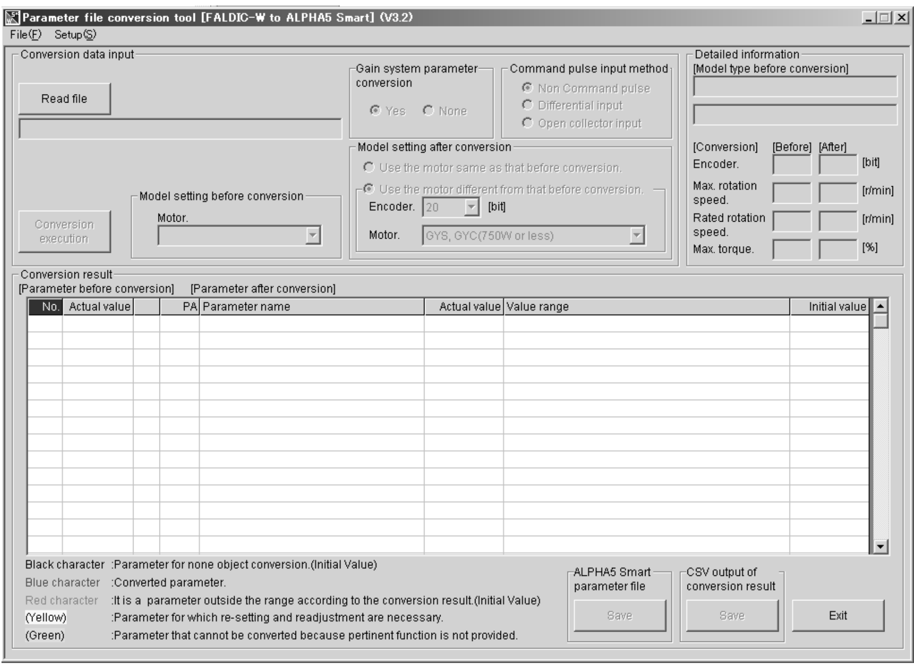
By setting the conversion conditions after loading the parameter file for FALDIC-α and W series, the files can be converted into and saved as the parameter file for ALPHA5 and ALPHA5 Smart series.

In addition, the standard parameter file and the system parameter file need to be stored with the PC loader of version 2.6 or higher in order to convert the FALDIC-α parameter file.



How to convert the file from the parameter file for FALDIC-W series to the one for ALPHA5 Smart series is explained on the next page.

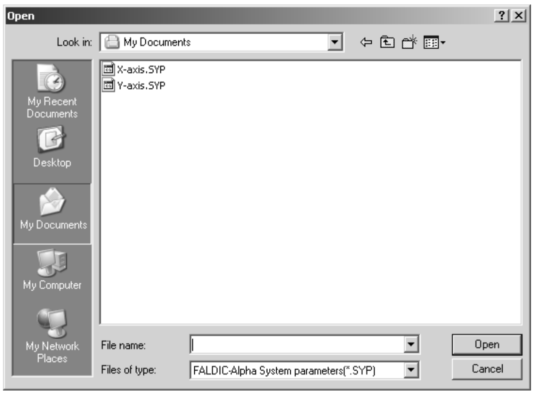
■ Reference screen



■ Operation method

Loading the parameter file

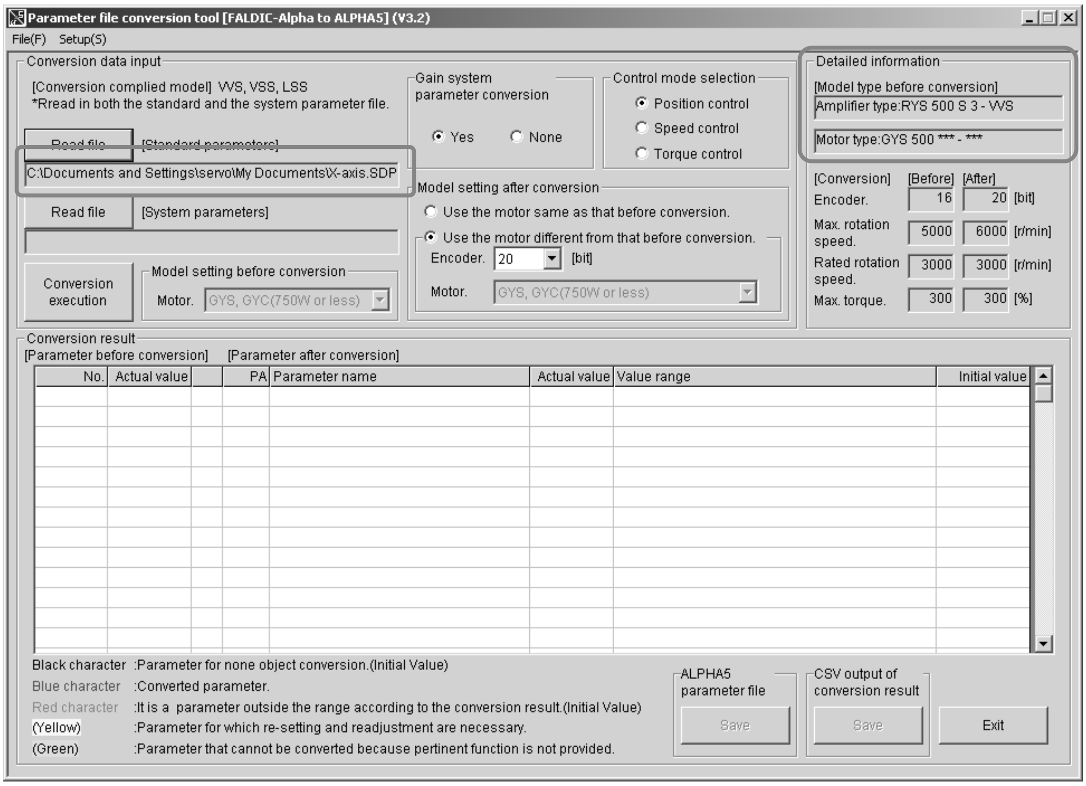
[1] Click “File Load” on the parameter file screen to display the window below.



Select the file to be converted and click “Open”.

[2] The file path name of the loaded parameter file is displayed.

In addition, the information regarding the file appears in the Detailed information part including [Model type before conversion].



Note	If the parameter file for an amplifier for optional item (Z No.) is selected, an error message appears.

Setting the conversion condition

[3] Model setting before conversion – Motor

When the parameter file with which the motor type information can be obtained is loaded, the motor model before conversion is automatically set.

If the parameter file with which the motor type information is not clear is loaded, set the motor model before conversion manually. In this case, select the motor model before conversion.

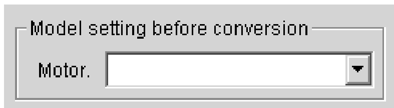
Hint

■ When the parameter file with which the motor type information can be obtained is loaded.

(The motor model is automatically set and the data cannot be changed.)

■ When the parameter file with which the motor type information is not clear is loaded

(Select the motor model.)

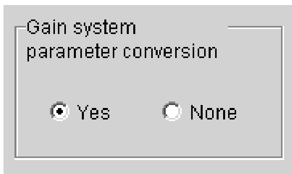


[4] Gain system parameter conversion

Select whether to convert the gain system parameter.

When "Yes" is selected for gain system parameter conversion, the gain system parameter is included in the conversion operation.

When "None" is selected, the gain system parameter is not converted.



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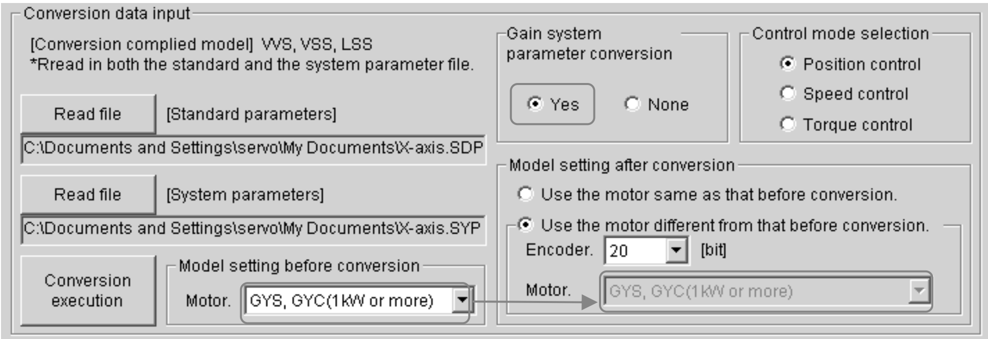
Hint

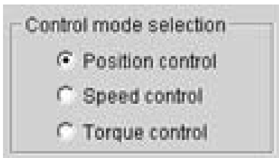
■ When "Yes" is selected with gain system parameter conversion, the motor models before conversion and after conversion are dealt as the same in gain system parameter conversion. Therefore, the data of motor model after conversion is set same as the motor model before conversion.

Motor setting before conversion	Motor setting after conversion	Remarks
GYS500DC2-T2*-*	GYS, GYC(750W or less)	
GYS101DC2-T2*-*		
GYS201DC2-T2*-*		
GYS401DC2-T2*-*		
GYS751DC2-T2*-*		
GYG501CC2-T2*-*	GYG(Rated rotation speed:2000r/min)	
GYG751CC2-T2*-*		
GYG102CC2-T2*-*		
GYG152CC2-T2*-*		
GYG202CC2-T2*-*		
GYG501BC2-T2*-*	GYG(Rated rotation speed:1500r/min)	
GYG851BC2-T2*-*		
GYG132BC2-T2*-*		
GYG182BC2-T2*-*	GYG182BC2-T2*-*	Encoder. :17bit
GYG292BC2-T2*-*	GYG292BC2-T2*-*	



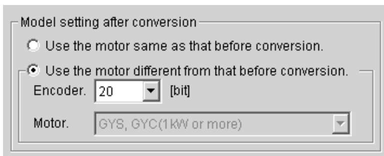
[5] Control mode selection

Select the command pulse input method to be used.



[6] Model setting after conversion

Select the motor model used after conversion.



Use the motor same as that before conversion:
Select this when the same motor is used after conversion.

Use the motor different from that before conversion:
Select this when a different motor is used after conversion.

Encoder: Select the encoder after conversion.

Motor: Select the motor model after conversion.

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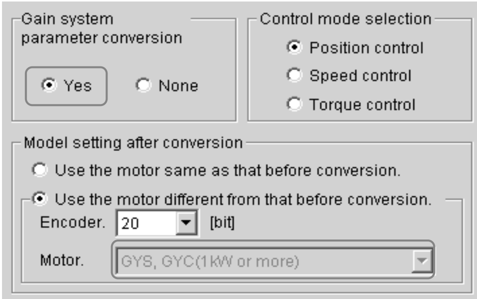
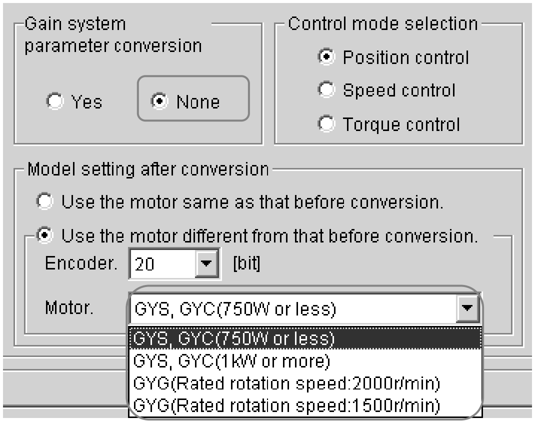
Hint

■ When “Use the motor different from that before conversion” is selected.

When “Yes” is selected at gain system parameter conversion, the motor model after conversion cannot be selected.

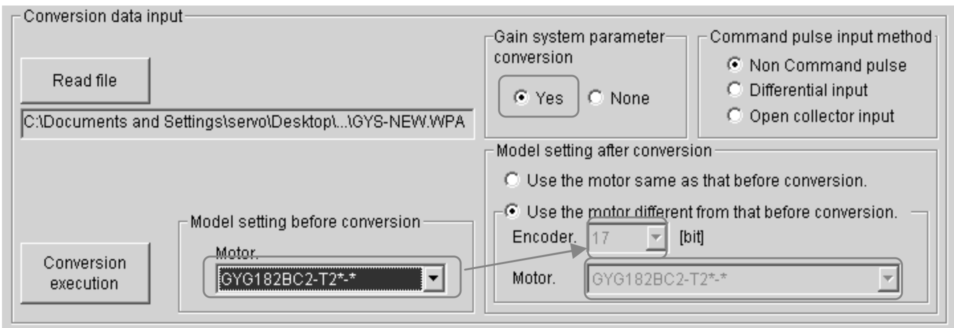


When “None” is selected at gain system parameter conversion, the motor model after conversion can be selected.



■ When “Yes” at gain system parameter conversion and “Use the motor different from that before conversion” are selected, with “GYG182BC2-T2*-*” or “GYG292BC2-T2*-*” selected as “motor model before conversion”.

“17 bit” appears for the encoder after conversion, restricting change of encoder. This is because the motors “GYG182BC2-T2*-*” and “GYG292BC2-T2*-*” are “17bit” type only.



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Conversion execution

[7] After the parameter file is loaded and the conversion condition setting is complete, click the “conversion execution”.

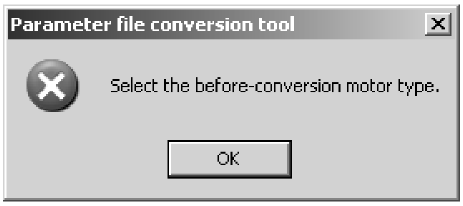
Hint

■ When an error message appears.

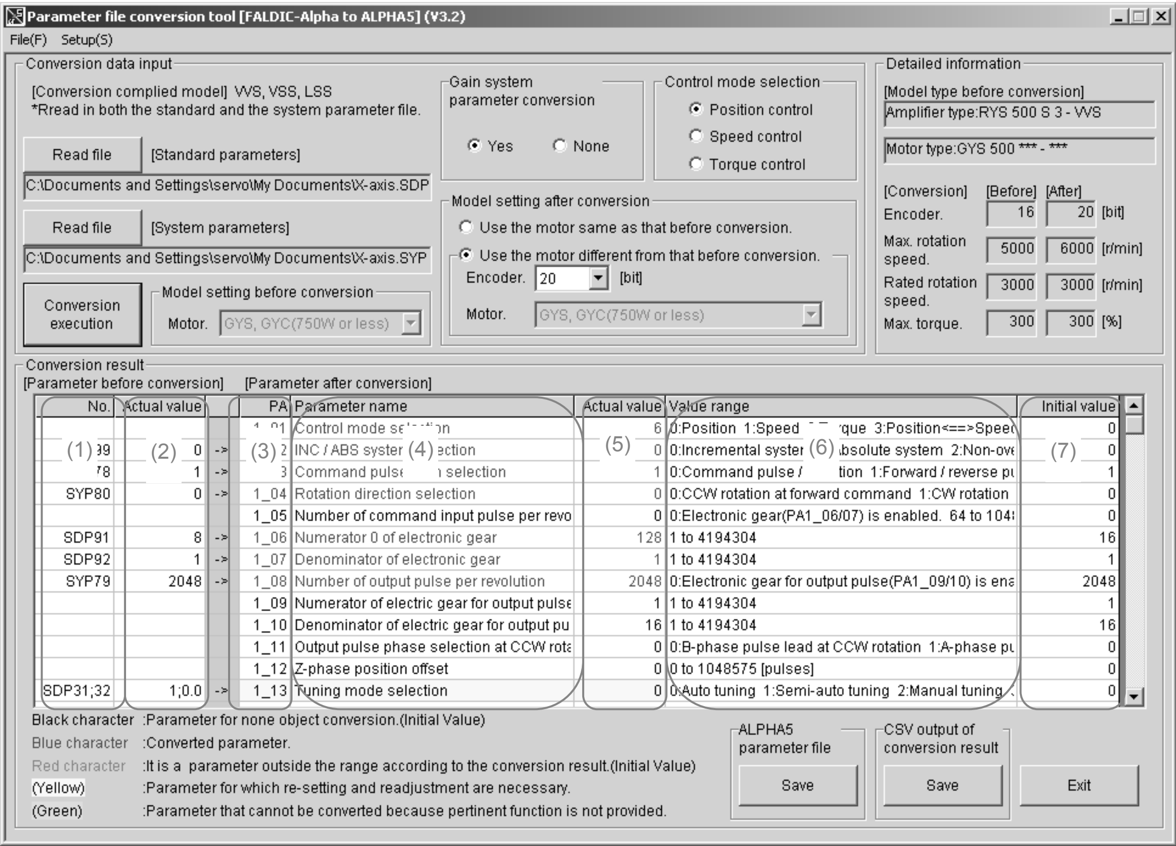
If the conversion conditions are insufficient, an error message appears.

Error item: Selection is not made in motor model before conversion.

Countermeasure: Select a model for motor model before conversion.



[7] When “conversion execution” is complete, the conversion result is displayed.



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Contents of the conversion result screen

The following contents are displayed on the conversion result screen.

Parameter before conversion	(1)	No.	FALDIC-W parameter nos.
	(2)	Setting value	Setting values of parameter file for FALDIC-W before conversion
Parameter after conversion	(3)	PA	ALPHA5 Smart parameter nos.
	(4)	Setting item	ALPHA5 Smart parameter names
	(5)	Setting value	ALPHA5 Smart setting values (result from conversion)
	(6)	Setting range	ALPHA5 Smart parameter setting range
	(7)	Initial value	ALPHA5 Smart parameter initial values

The conversion results of the parameter are color coded in (3)(4)(5) on the conversion result screen.

Display colors in (3)(4)(5)	Conversion results
Characters in black	Parameters not included in conversion work (default)
Characters in blue	Converted parameters
Characters in red	Parameters not included in the range as the result of conversion (default)
(Yellow)	Parameters that need to be set again or adjusted as appropriate.
(Green)	Parameters that cannot be converted due to lack of required functions

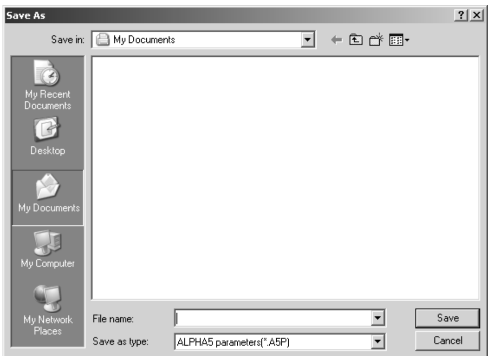
[8] Saving the conversion result

■ ALPHA5 Smart parameter file — Save

Save the conversion result into the ALPHA5 Smart parameter file.

Click the “Save” with ALPHA5 Smart parameter to display the window on the right.

Input the file name and click “Save”.



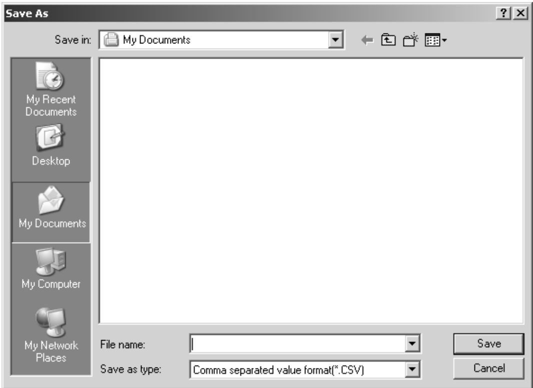
Note

- Make sure to check all the conversion results in the ALPHA5 Smart parameter file of conversion result and adjust accordingly before writing the data into the amplifier.
- To adjust the conversion result, use “parameter edit” in “ALPHA5 Smart LOADER”.
- After the conversion result have been checked and adjusted appropriately with ALPHA5 Smart LOADER, write the parameters into the amplifier by “Send all”.

■ Conversion result CSV output — Save

Save the conversion result in CSV format.

The window below appears when “Save” is clicked with conversion result CSV output.

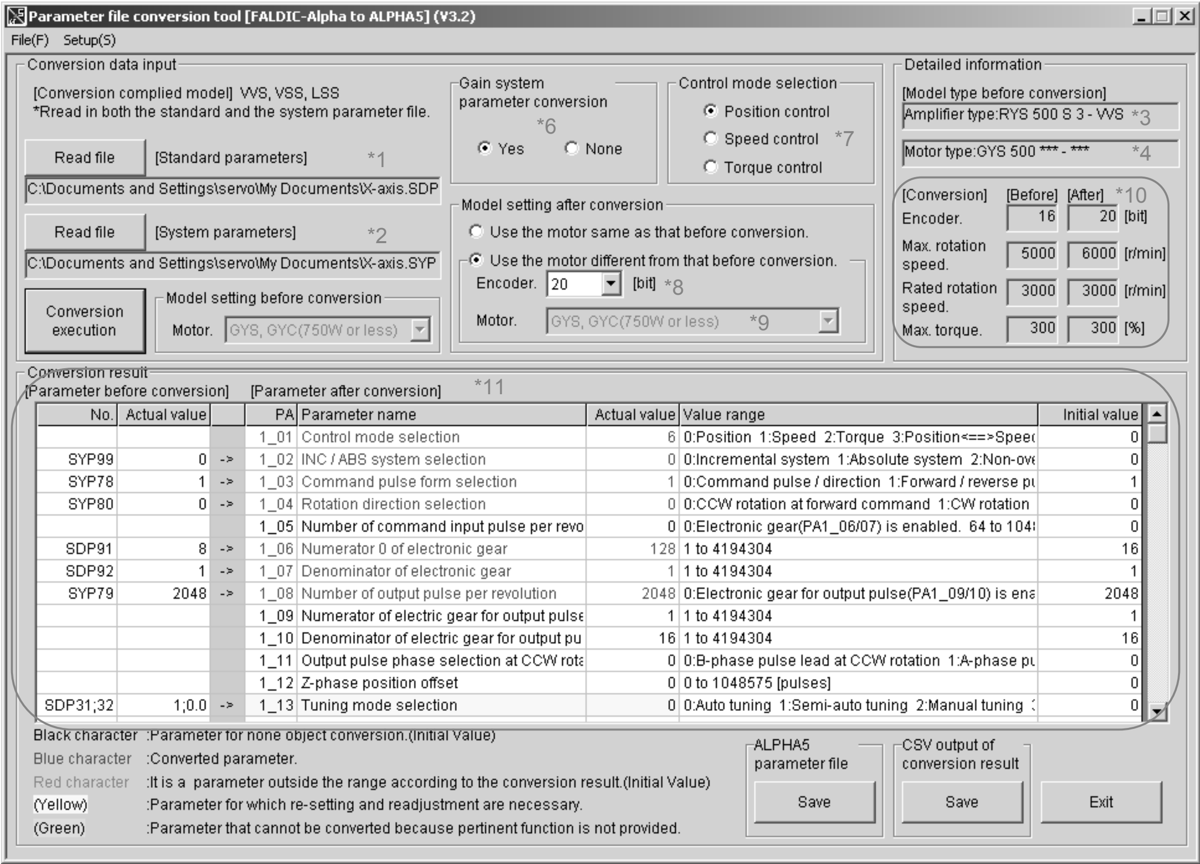


Input the file name and click “Save”.

Contents of the conversion result CSV output file

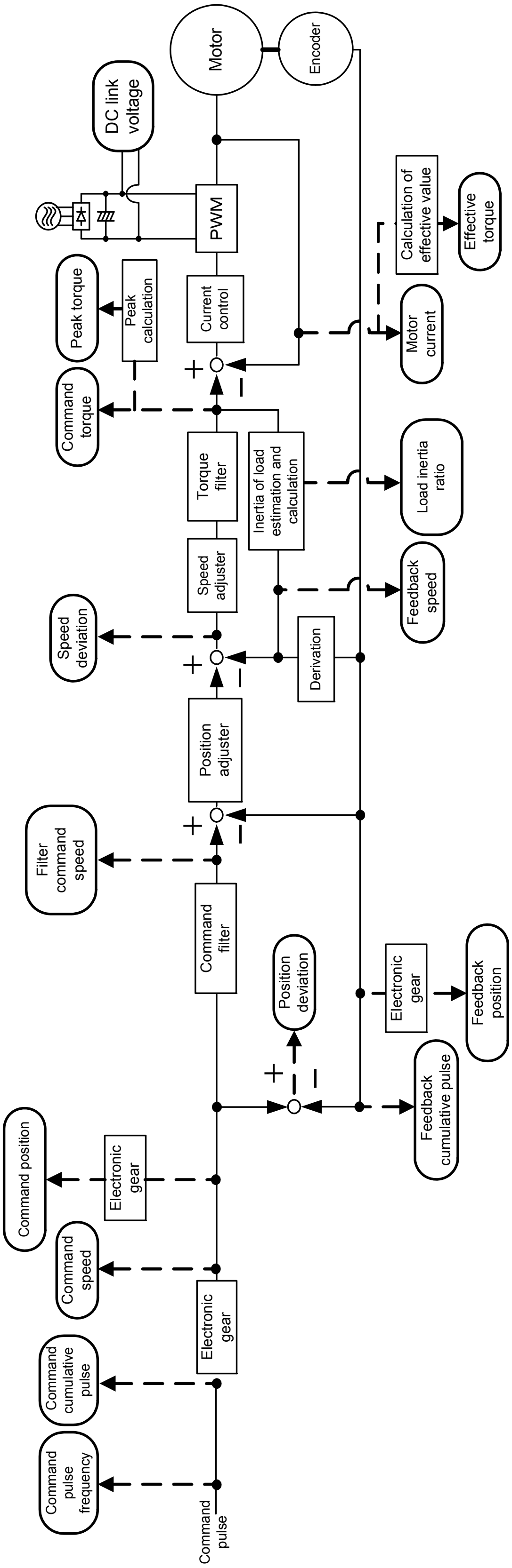
The data of the following contents are stored into the CSV file.

[File information before conversion]								
File name before conversion:								
SDP: C:\Documents and Settings\servo\My Documents\X-axis.SDP *1								
SYP: C:\Documents and Settings\servo\My Documents\X-axis.SYP *2								
Amplifier type:RYS 500 S 3 - VVS *3								
Motor type:GYS 500 *** - *** *4								
[Model setting before conversion]								
GYS. GYC(750W or less) *5								
[Gain system parameter conversion]								
Yes *6								
[Control mode selection]								
Position control	*7							
[Model setting after conversion]								
Encoder : 20 [bit] *8								
Motor : GYS. GYC(750W or less) *9								
[Conversion condition]								
	Before of conve	After of conversion						
Encoder	16	20						
Max. rotation speed	5000	6000	*10					
Rated rotation speed	3000	3000						
Max. torque	300	300						
[Conversion result]								
(None):Parameter for none object conversion.(Initial Value)								
*1:Converted parameter.								
*2:It is a parameter outside the range according to the conversion result.(Initial Value)								
*3:Parameter for which re-setting and readjustment are necessary.								
*4:Parameter that cannot be converted because pertinent function is not provided.								
				*11				
[Before of conversion]			[After of conversion]					
No.	Actual value		PA	Parameter name	Actual value	Value range	Initial value	Conversion result
			1_01	Control mode selection	6	0:Position 1:Speed 2:T	0	*1
SYP99	0	->	1_02	INC / ABS system selection	0	0:Incremental system 1	0	*1
SYP78	1	->	1_03	Command pulse form selection	1	0:Command pulse / dire	1	*1
SYP80	0	->	1_04	Rotation direction selection	0	0:CCW rotation at forw	0	*1
			1_05	Number of command input pulse	0	0:Electronic gear(PA1_	0	
SDP91	8	->	1_06	Numerator 0 of electronic gear	128	1 to 4194304	16	*1
SDP92	1	->	1_07	Denominator of electronic gear	1	1 to 4194304	1	*1
SYP79	2048	->	1_08	Number of output pulse per revol	2048	0:Electronic gear for ou	2048	*1
				.				
				.				
				.				


Parameter file conversion tool [FALDIC-Alpha to ALPHA5] (V3.2)
File(F) Setup(S)
Conversion data input
[Conversion complied model] VVS, VSS, LSS
*Rread in both the standard and the system parameter file.
Read file
[Standard parameters]
*1
C:\Documents and Settings\servo\My Documents\X-axis.SDP
Read file
[System parameters]
*2
C:\Documents and Settings\servo\My Documents\X-axis.SYP
Conversion execution
Model setting before conversion
Motor.
GYS, GYC(750W or less)
Gain system parameter conversion
*6
Yes
None
Control mode selection
Position control
Speed control
*7
Torque control
Model setting after conversion
Use the motor same as that before conversion.
Use the motor different from that before conversion.
Encoder.
20
[bit]
*8
Motor.
GYS, GYC(750W or less)
*9
Detailed information
[Model type before conversion]
Amplifier type:RYS 500 S 3 - VVS
*3
Motor type:GYS 500 *** - ***
*4
[Conversion] [Before] [After]
*10
Encoder. 16 20 [bit]
Max. rotation speed. 5000 6000 [r/min]
Rated rotation speed. 3000 3000 [r/min]
Max. torque. 300 300 [%]
Conversion result
[Parameter before conversion]
[Parameter after conversion]
*11
No. | Actual value | | PA | Parameter name | Actual value | Value range | Initial value
| | | 1_01 | Control mode selection | 6 | 0:Position 1:Speed 2:Torque 3:Position<==>Speed | 0
SYP99 | 0 | -> | 1_02 | INC / ABS system selection | 0 | 0:Incremental system 1:Absolute system 2:Non-ove | 0
SYP78 | 1 | -> | 1_03 | Command pulse form selection | 1 | 0:Command pulse / direction 1:Forward / reverse pu | 1
SYP80 | 0 | -> | 1_04 | Rotation direction selection | 0 | 0:CCW rotation at forward command 1:CW rotation | 0
| | | 1_05 | Number of command input pulse per revo | 0 | 0:Electronic gear(PA1_06/07) is enabled. 64 to 104 | 0
SDP91 | 8 | -> | 1_06 | Numerator 0 of electronic gear | 128 | 1 to 4194304 | 16
SDP92 | 1 | -> | 1_07 | Denominator of electronic gear | 1 | 1 to 4194304 | 1
SYP79 | 2048 | -> | 1_08 | Number of output pulse per revolution | 2048 | 0:Electronic gear for output pulse(PA1_09/10) is ena | 2048
| | | 1_09 | Numerator of electric gear for output pulse | 1 | 1 to 4194304 | 1
| | | 1_10 | Denominator of electric gear for output pu | 16 | 1 to 4194304 | 16
| | | 1_11 | Output pulse phase selection at CCW rota | 0 | 0:B-phase pulse lead at CCW rotation 1:A-phase pu | 0
| | | 1_12 | Z-phase position offset | 0 | 0 to 1048575 [pulses] | 0
SDP31;32 | 1;0.0 | -> | 1_13 | Tuning mode selection | 0 | 0:Auto tuning 1:Semi-auto tuning 2:Manual tuning | 0
Black character :Parameter for none object conversion.(Initial Value)
Blue character :Converted parameter.
Red character :It is a parameter outside the range according to the conversion result.(Initial Value)
(Yellow) :Parameter for which re-setting and readjustment are necessary.
(Green) :Parameter that cannot be converted because pertinent function is not provided.
ALPHA5 parameter file
Save
CSV output of conversion result
Save
Exit

CHAPTER 15 APPENDIXES

15.1 Status Indication Block Diagram



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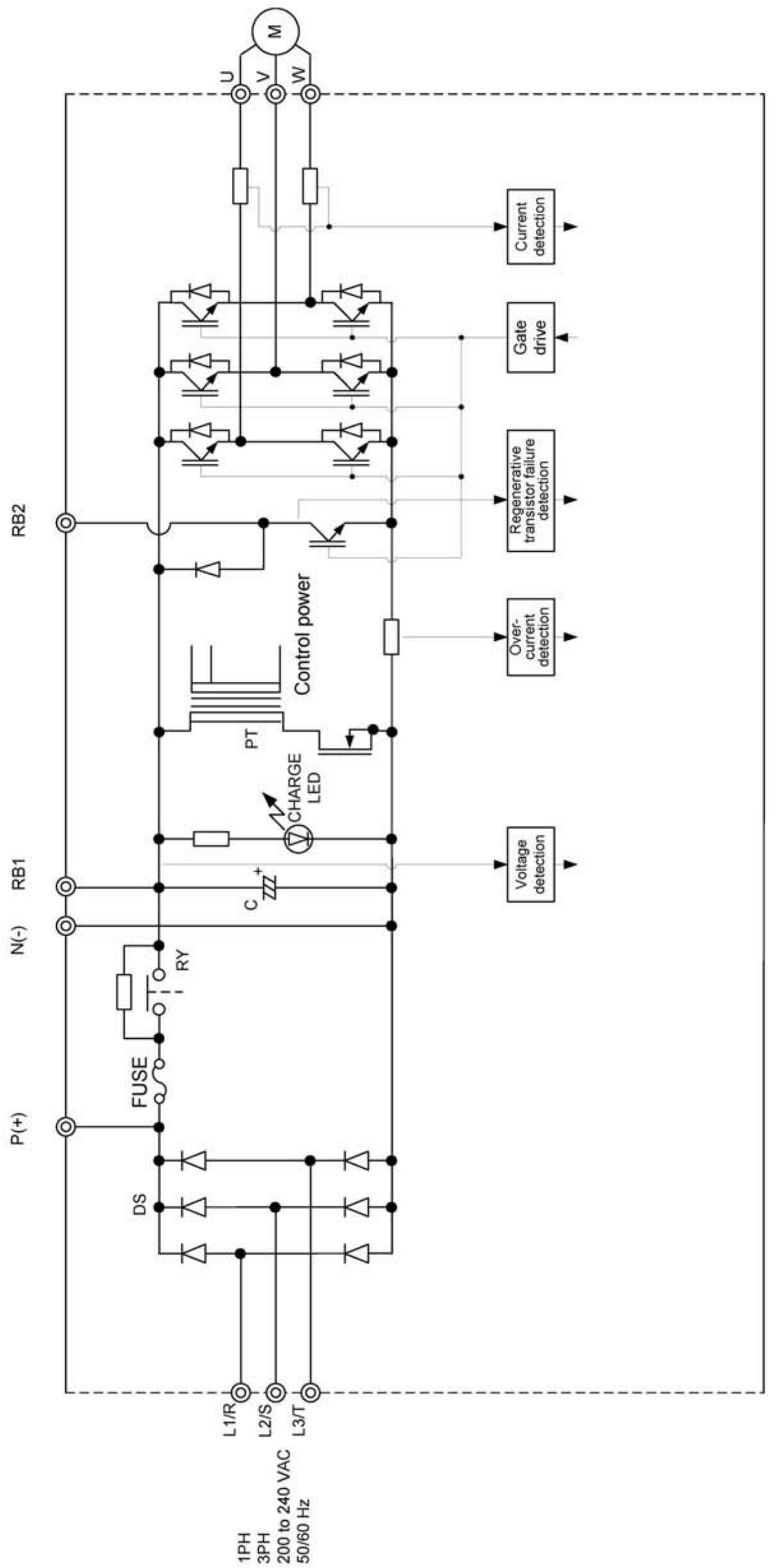
15.2 Main Circuit Block Diagram

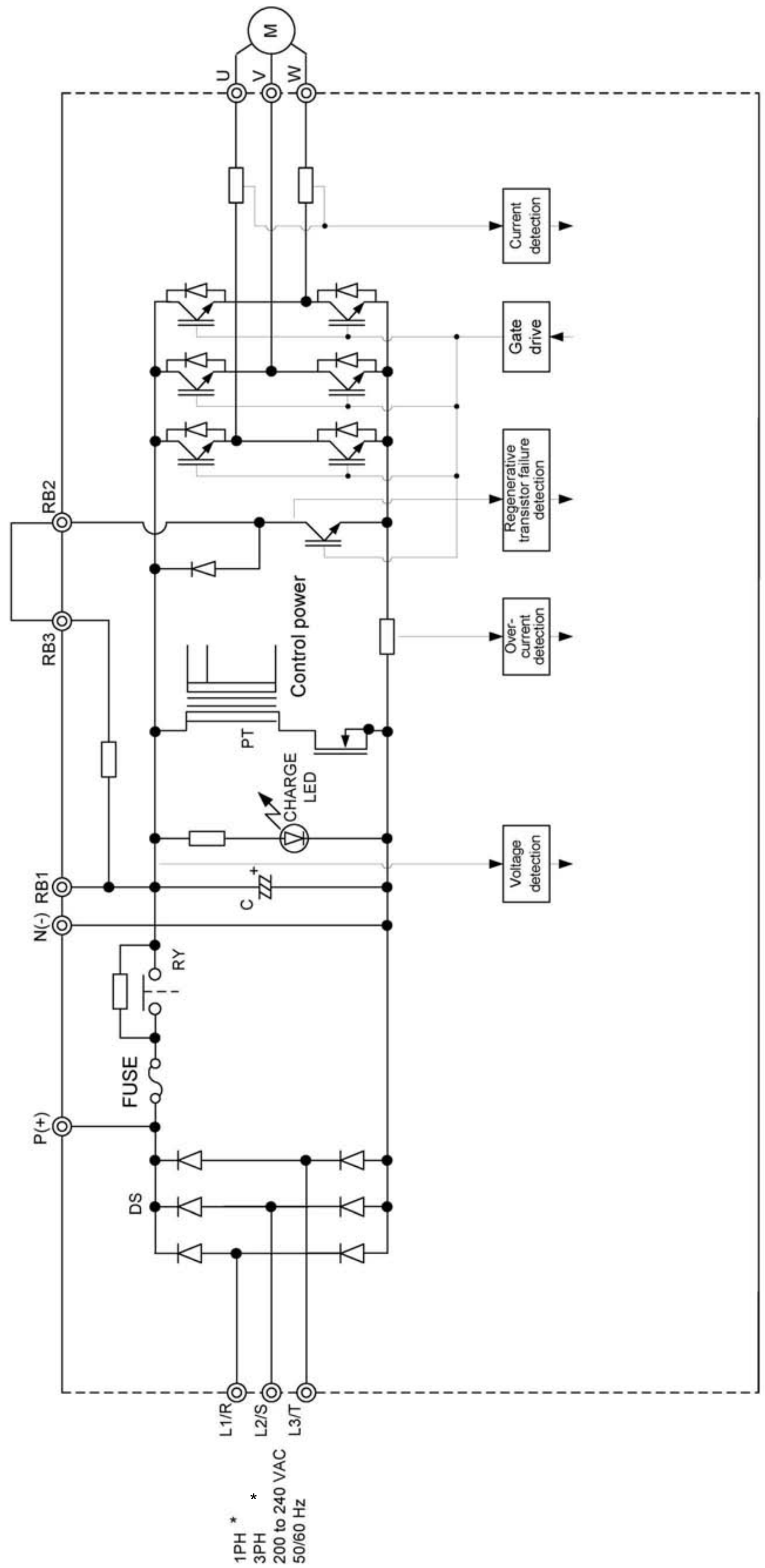
Applicable model

Frame1



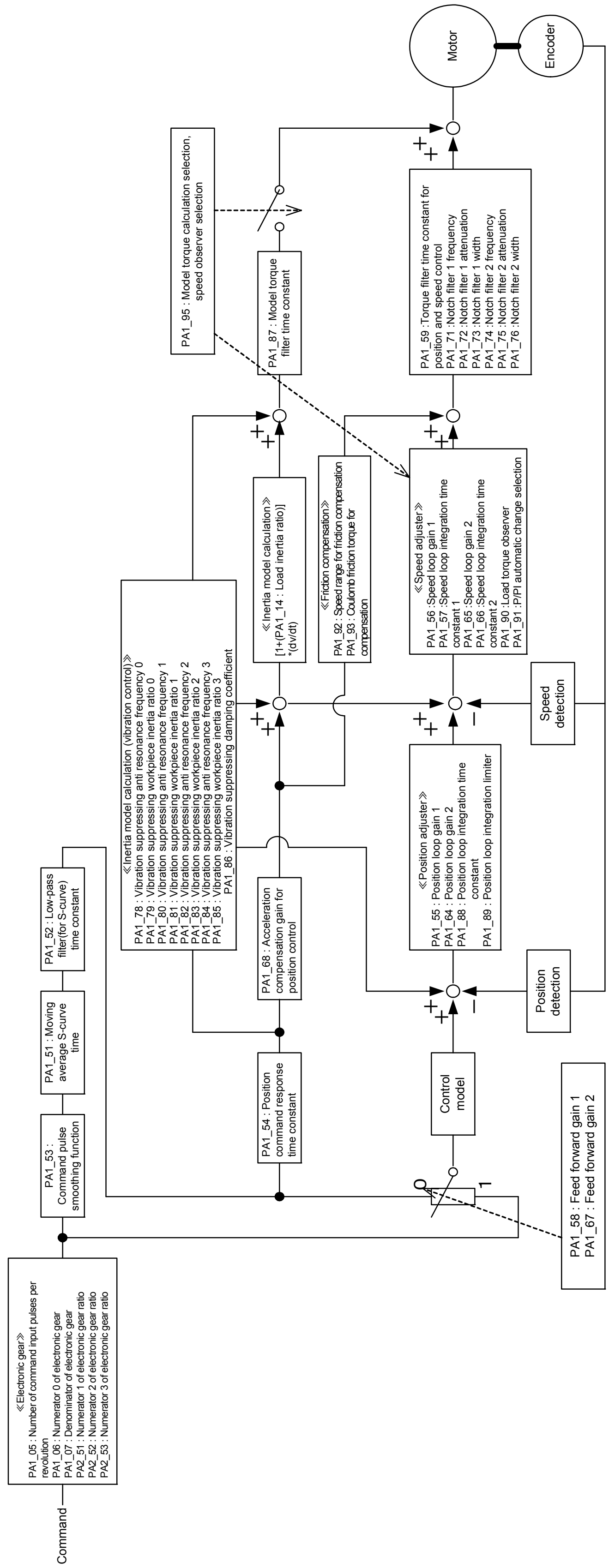
Applicable model

Frame2, Frame3, Frame4



* The 1Ph can be applied only to the frame 2a.

15.3 Control Block Diagram



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15.4 Parameter List

■ PA1_: Basic setting parameters

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
01	Control mode selection	○	○	○	○	
02	INC/ABS system selection	○	○	○	○	
03	Command pulse input method and 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 position 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 parameters

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 parameters

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	Deceleration time 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	Selection of operation at OT during homing	○	○	-	-	
25	Software OT selection (PA1_01=1 to 6) / positioning operation type (PA1_01=7)	○	○	○	-	
26	Positive software OT detection position	-	○	○	-	
27	Negative software OT detection position	-	○	○	-	
28	Positive limiter detection position	-	○	-	-	
29	Negative 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	○	○	-	-	
44	Positioning extended function	○	○	-	-	

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

■ PA2_: Extended function setting parameters

No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
51	Numerator 1 of electronic gear	-	○	-	-	
52	Numerator 2 of electronic gear					
53	Numerator 3 of electronic gear					
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	Regenerative resistor selection	○	○	○	○	
66	Flying start at speed control	○	-	○	-	
67	Alarm detection at undervoltage	○	○	○	○	
69	Deviation detection overflow value	-	○	-	-	
70	Overload warning value	-	○	○	○	
72	Station number for communications	○	○	○	○	
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					

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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	Communications time over time (for Modbus)	-	○	-	-	
97	Communications protocol selection	-	○	-	-	
98	GY******2-T2*-*Motor type setting	○	○	○	○	
99	Encoder selection	○	○	○	○	

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

■ PA3_: Input terminal function setting parameters

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	○	○	○	○	
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 clear overflow input form	○	○	-	-	
39	Speed command fine adjustment gain	-	○	○	○	
40	Torque command fine adjustment gain	-	○	○	○	
41	Address free assignment 1 (for Modbus)	○	○	○	○	
42	Address free assignment 2 (for Modbus)	○	○	○	○	
43	Address free assignment 3 (for Modbus)	○	○	○	○	
44	Address free assignment 4 (for Modbus)	○	○	○	○	

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■ PA3_: Output terminal function setting parameters

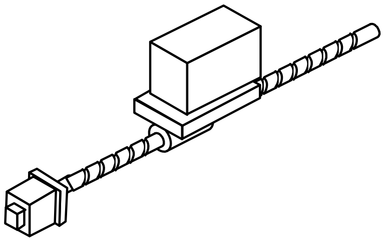
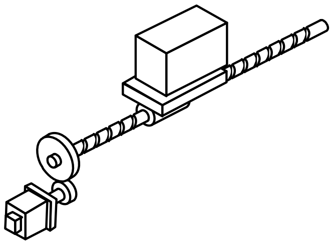
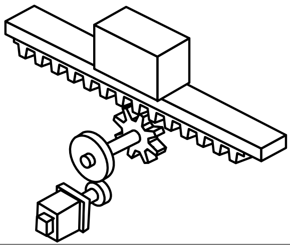
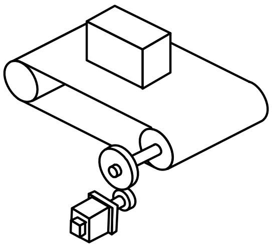
No.	Name	Power	Control mode			Record of reference value
			Position	Speed	Torque	
51	OUT1 signal assignment	○	○	○	○	
52	OUT2 signal assignment					
53	OUT3 signal assignment					
56	OUT6 signal assignment					
57	OUT7 signal assignment					
58	OUT8 signal assignment					
59	OUT9 signal assignment					
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 assignment	-	○	○	○	
82	Monitor 2 signal assignment	-	○	○	○	
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.

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.

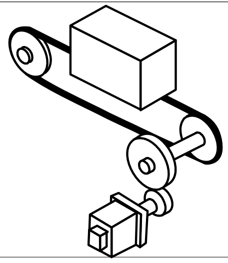
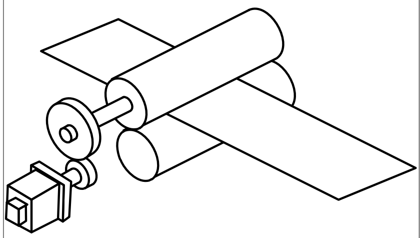
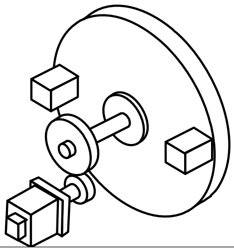
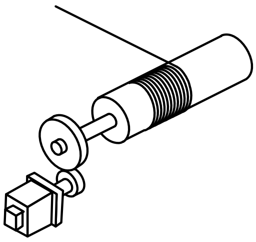
Mechanism	Features
	Ball screw (direct coupling) Used for a relatively short distance and accurate positioning. The motor is connected with the ball screw via a coupling and no play is included.
	Ball screw (geared) A reduction gear is included so that the torque transmitted to the mechanical system 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

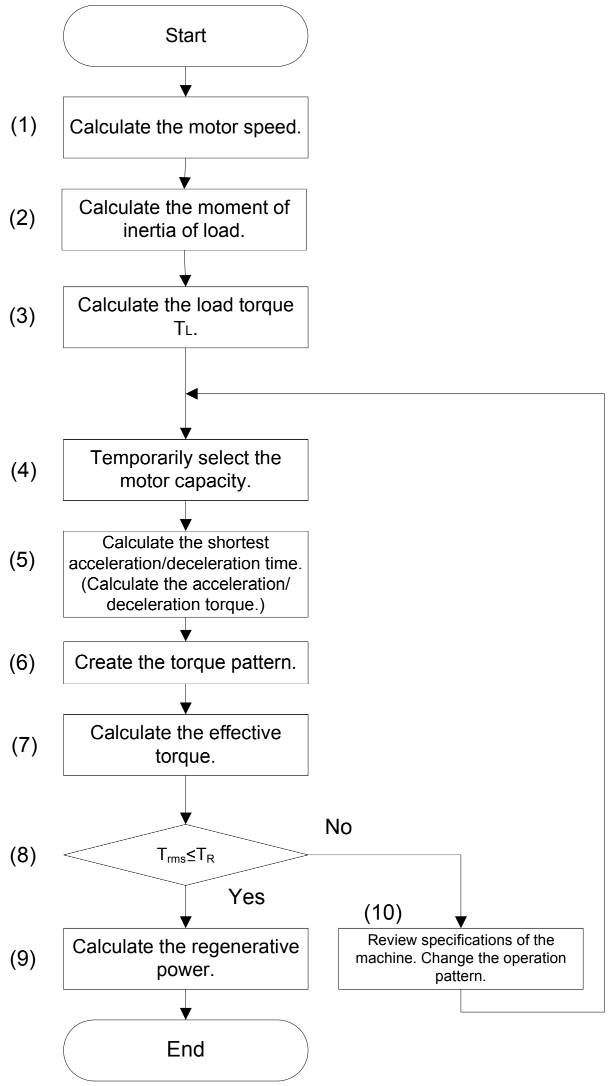
Perform capacity selection calculation to obtain the servomotor capacity necessary for machine specifications (configuration).
Items necessary for capacity selection calculation include the following.

- 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.

Follow the procedure below to perform capacity selection calculation.

Capacity selection flow chart



(1) Calculate the motor speed according to the configuration of the machine and the line speed.

(2) Calculate the load inertia according to the configuration of the machine.

(3) Calculate the load torque according to the configuration of the machine.

(4) Temporarily select the motor capacity.

(5) Check the shortest acceleration/ deceleration time. If the time is designated, calculate the necessary acceleration/deceleration torque.

(6) Create the torque pattern according to the operation pattern.

(7) Calculate the effective torque according to the torque pattern.

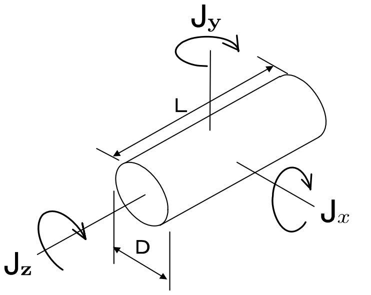
(8) If the effective torque (T_{rms}) is smaller than the rated torque (T_R), operation can be made with the designated operation pattern.

(9) Calculate the regenerative power and, if necessary, select the regenerative resistor.

(10) Review the specifications of the machine if possible.

■ Calculation of inertia

Shape

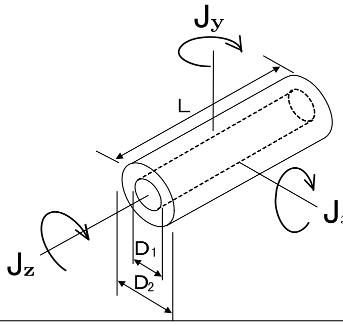


$$J_z = \frac{W}{8}\left(\frac{D}{10^3}\right)^2 = \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^4$$

$$J_x = J_y = \frac{W}{16}\left(\frac{D}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^2$$

W : [kg]
D : [mm]
L : [mm]
ρ : [kg/m^3]

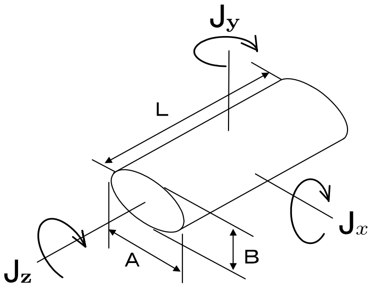


$$J_z = \frac{W}{8}\left\{\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right\} = \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left\{\left(\frac{D_2}{10^3}\right)^4 - \left(\frac{D_1}{10^3}\right)^4\right\}$$

$$J_x = J_y = \frac{W}{16}\left\{\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right\} + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left\{\left(\frac{D_2}{10^3}\right)^2 - \left(\frac{D_1}{10^3}\right)^2\right\}$$

W : [kg]
D : [mm]
L : [mm]
ρ : [kg/m^3]



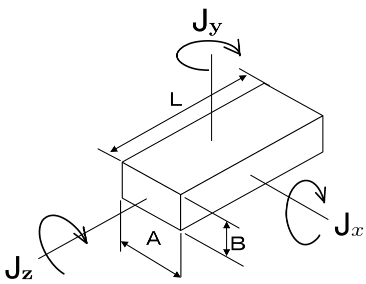
$$J_z = \frac{W}{16}\left\{\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right\}$$

$$J_x = \frac{W}{16}\left(\frac{B}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$J_y = \frac{W}{16}\left(\frac{A}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]



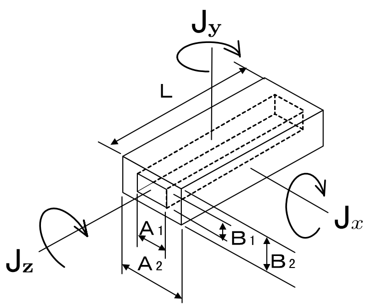
$$J_x = \frac{W}{12}\left\{\left(\frac{B}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_y = \frac{W}{12}\left\{\left(\frac{L}{10^3}\right)^2 + \left(\frac{A}{10^3}\right)^2\right\}$$

$$J_z = \frac{W}{12}\left\{\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right\}$$

$$W = \rho\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]



$$J_x = \frac{W_2}{12}\left\{\left(\frac{B_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{B_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_y = \frac{W_2}{12}\left\{\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right\}$$

$$J_z = \frac{W_2}{12}\left\{\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{B_2}{10^3}\right)^2\right\} - \frac{W_1}{12}\left\{\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{B_1}{10^3}\right)^2\right\}$$

$$W = \rho\left\{\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right) - \left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\right\}\left(\frac{L}{10^3}\right)$$

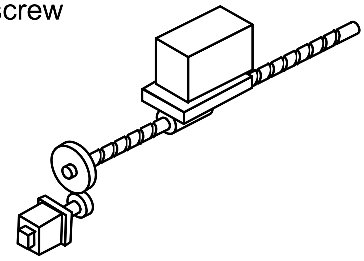
$$W_2 = \rho\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right)\left(\frac{L}{10^3}\right) \qquad W_1 = \rho\left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\left(\frac{L}{10^3}\right)$$

W :[kg]
L :[mm]
A : [mm]
B : [mm]
ρ : [kg/m^3]

15

Conversion

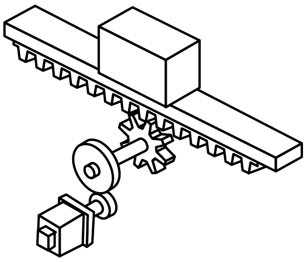
Ball screw



$$J_1 = W\left(\frac{1}{2\pi} \times \frac{BP}{10^3}\right)^2 \times GL^2$$

W: Total mass of moving parts [kg]
BP: Thread lead [mm]
GL: Reduction ratio (no unit)

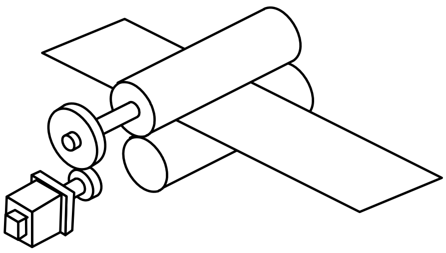
Rack & Pinion, conveyor and chain drive



$$J_2 = \frac{W}{4}\left(\frac{D}{10^3}\right)^2 \times GL^2$$

W: Total mass of moving parts [kg]
D: Diameter of pinion [mm]
Diameter of sprocket [mm]
GL: Reduction ratio (no unit)

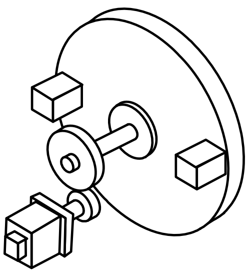
Feed roll



$$J_3 = \frac{W}{4}\left(\frac{D}{10^3}\right)^2 \times GL^2$$

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)

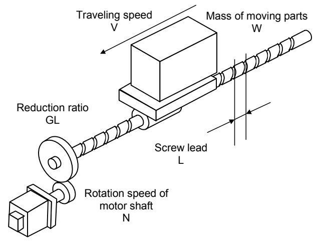
$$J_4 = \left(J + W\left(\frac{L}{10^3}\right)^2\right) \times GL^2$$

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)

15

■ 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)

$$T_L = \frac{((\mu + 1)W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

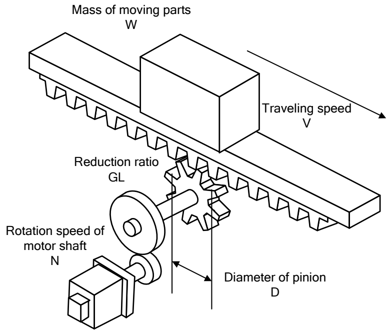
・Descending (vertically)

$$T_L = \frac{((\mu - 1)W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3}\right) \times GL$$

・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 motor speed (N)
Calculate the motor shaft speed according to the configuration of the machine and the line speed.

(2) Calculating the load inertia (J_L)
Calculate the inertia (GD^2) of the load of the mechanical system converted to the motor shaft.
Calculate the inertia of the parts rotating (moving) along with motor rotation, and obtain the sum of all.

(3) Calculating the load torque (T_L)
Calculate the load torque converted to the motor shaft.

(4) Temporarily select the motor capacity
Select the motor capacity satisfying the following two conditions.

- Allowable load inertia
  $J_L \leq J_M \times 100$ (30) ···················· In case of slow travel under speed control
  $J_L \leq J_M \times 30$ (10) ······················ In case of positioning under position control
  $J_L \leq J_M \times 10$ (-) ························ 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
  $T_L \leq T_R \times 0.9$ ··························· 0.9 indicates a typical margin of safety.

(5) 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 (Mechanical efficiency (η) : assuming 100%).

- Shortest acceleration/Deceleration time

$$t_{MIN} = \frac{(J_M + J_L) \times 2\pi \times (N)}{60\,(T_{MAX} - T_L)}$$

- Acceleration torque

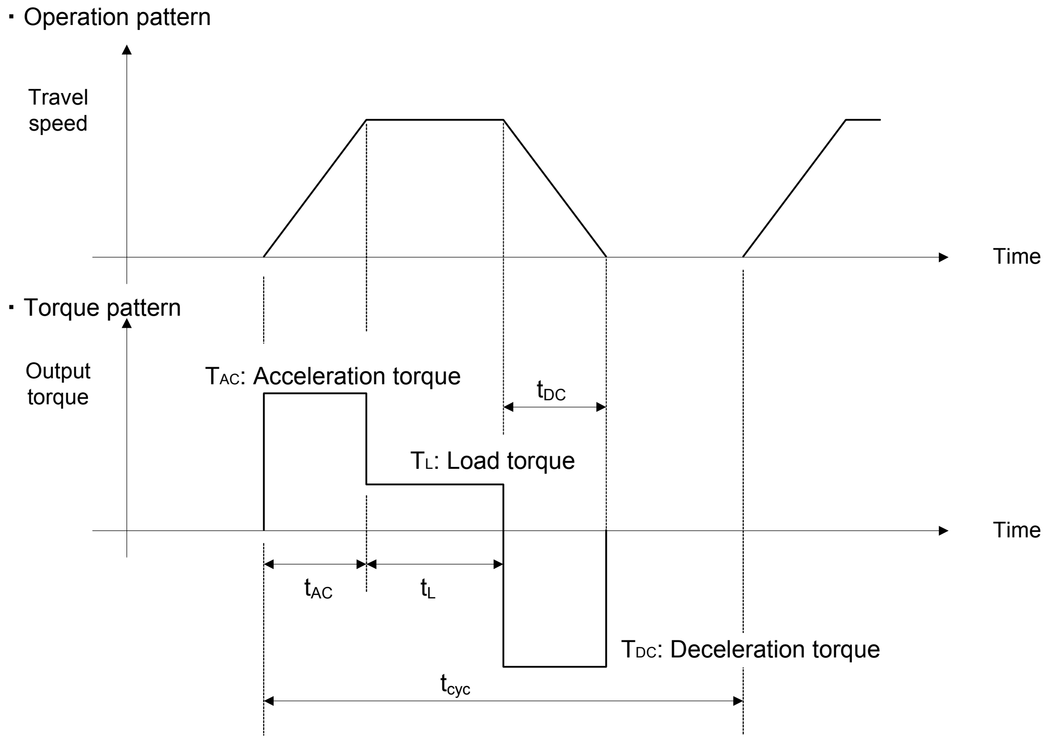
$$T_{AC} = T_L + \frac{(J_M + J_L) \times 2\pi \times (N)}{60(\,t_{AC}\,)}$$

- Deceleration torque

$$T_{DC} = T_L - \frac{(J_M + J_L) \times 2\pi \times (N)}{60(\,t_{DC}\,)}$$

where
t_{AC} : Acceleration time [s]
t_{DC} : Deceleration time[s]
J_M : Inertia of servomotor [kgm^2]
J_L : Inertia of load converted to motor shaft [kgm^2]
T_L : Load torque converted to motor shaft [Nm]
T_{AC} : Acceleration torque [Nm]
T_{DC} : Deceleration torque [Nm]
T_{MAX} : Max. torque [Nm]
N : Rotation speed [r/min]
t_{MIX} : Shortest acceleration/deceleration time [s]

(6) Creating the torque pattern
Create the pattern of the output torque according to the operation pattern.



(7) 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.

(8) $T_{rms} \leq T_R$
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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(9) Calculating the regenerative power

Regenerative operation is caused while the torque value is negative, in general as indicated below.
Horizontal feed: During deceleration
Vertical feed: During constant speed feed in the lowering cycle and during deceleration

Regenerative energy during deceleration (E_1)

$E_1[J] = (2\pi/60) \times T_{DC}[Nm] \times N[r/min] \times t_{DC} \times (1/2)$

Regenerative power during constant speed feed (E_2) ←Mainly in lowering cycle

$E_2[J] = (2\pi/60) \times T_L[Nm] \times N[r/min] \times t_L$

Accumulated energy on main circuit capacitor (E_3)

$E_3[J] = (1/2) \times C[F] \times V^2$

$= (1/2) \times C[F] \times \{390^2 - (200\sqrt{2})^2\}$

Regenerative power (P)

$P[W] = \{ | (E_1 + E_2) | - E_3\} / (t_{cyc})$

P≤0: No external regenerative resistor is necessary.

P>0: The external (internal) regenerative resistor is necessary.

T_{DC}	: Deceleration torque [Nm]
T_L	: Load torque [Nm]
t_{DC}	: Deceleration time [s]
t_L	: Constant speed time [s]
t_{cyc}	: Cycle time [s]
C	: Servo amplifier capacitor capacity [F] →See page 15-29.
V^2	: Regenerative transistor ON level^2 $- (200\sqrt{2})^2$ $= 390^2 - (200\sqrt{2})^2$

Calculate the average regenerative power (P) of each cycle of the operation pattern1 to check if P is within the regenerative resistor capacity. If it is not, an external regenerative resistor is necessary.

(10) Reviewing the operation pattern and mechanical configuration

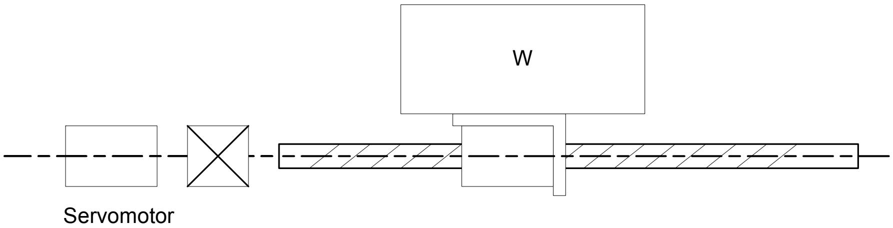
If T_{rms} exceeds T_R, review the following items.

- 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

15.5.3 Capacity Selection Calculation Example

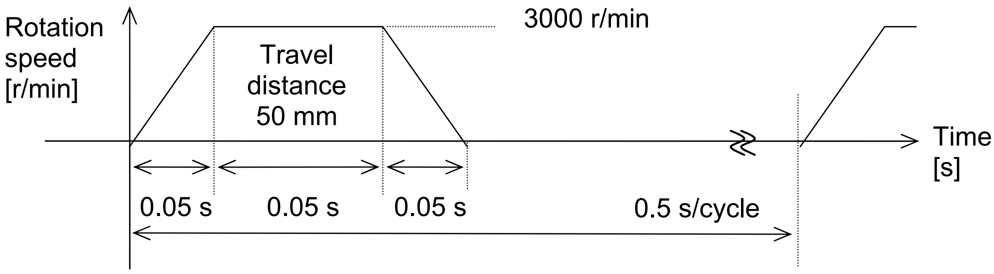
■ Mechanical configuration



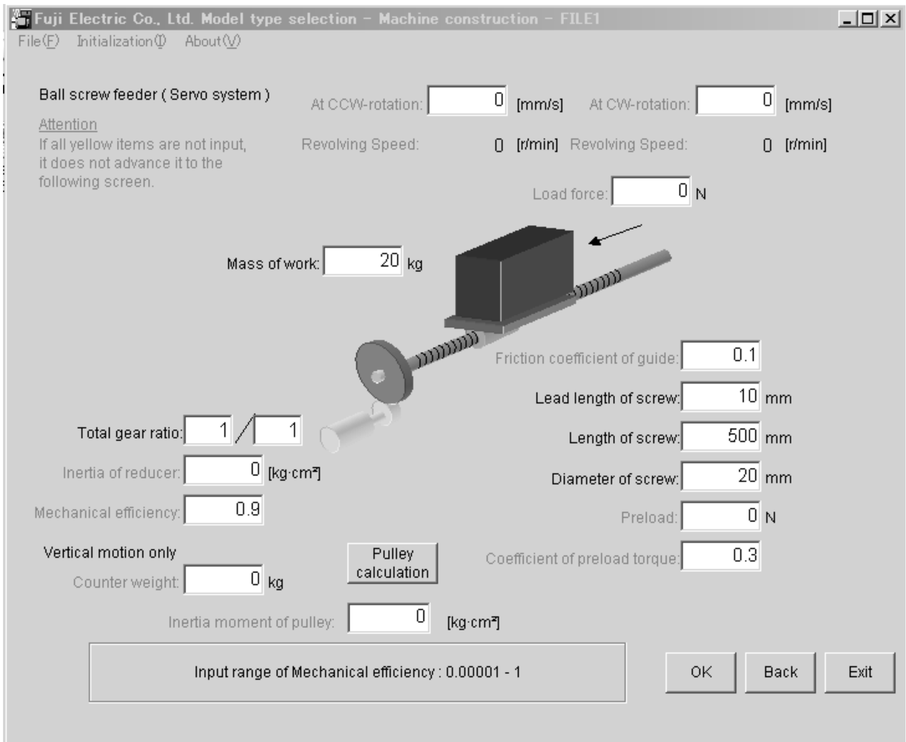
(15) Transfer weight [W] : 20 kg
(16) Deceleration ratio [GL] : 1／1
(17) Mechanical efficiency [η] : 0.9
(18) Load thrust [F] : 0 kg

(11) Friction factor [μ] : 0.1 N
(12) Screw lead [BP] : 10 mm
(13) Screw length [L] : 500 mm
(14) Screw dia. [D] : 20 mm

■ Operation profile



■ Capacity selection software



(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.

$$J_1 = \frac{\pi\rho}{32}\left[\frac{L}{1000}\right]\left[\frac{D_1}{1000}\right]^4 \times GL^2$$

$$= \frac{\pi \times 7.85 \times 10^3}{32}\left[\frac{500}{1000}\right]\left[\frac{20}{1000}\right]^4 \times (1/1)^2$$

$$= 0.6 \times 10^{-4}\ \mathrm{kg\ m^2}$$

- Moving parts (J_2) Suppose a transfer mass of 20 kg.

$$J_2 = W\left[\frac{1}{2\pi} \times \frac{BP}{1000}\right]^2 \times (GL)^2$$

$$= 20\left[\frac{1}{2\pi} \times \frac{10}{1000}\right]^2 \times (1/1)^2$$

$$= 0.5 \times 10^{-4}\ \mathrm{kg\ m^2}$$

$$J_L = J_1 + J_2 = 1.1 \times 10^{-4}\ \mathrm{kg\ m^2}$$

(3) Load torque converted to motor axis (T_L)
Suppose a transfer mass of 20 kg, friction coefficient (μ) of 0.1 and machine efficiency (η) of 0.9.

$$T_L = \frac{(\mu W + F) \times 9.81}{2\pi\eta}\left[\frac{BP}{1000}\right] \times GL$$

$$= \frac{(0.1 \times 20 + 0) \times 9.81}{2\pi \times 0.9}\left[\frac{10}{1000}\right] \times (1/1)$$

$$= 0.03\ \mathrm{Nm}$$

BP	: Screw lead [mm]
D	: Screw dia. [mm]
G_L	: Deceleration ratio
J_L	: Load inertia converted to motor shaft [kgm^2]
L	: Screw length [mm]
T_L	: Load torque converted to motor shaft [Nm]
W	: Transfer weight [kg]
μ	: Friction factor

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(4) Temporary selection

J_L	: Load inertia torque converted to motor shaft [kgm^2]
J_M	: Motor inertia [kgm^2]
T_{AC}	: Acceleration torque [Nm]
T_{DC}	: Deceleration torque [Nm]
T_L	: Load torque converted to motor shaft [Nm]
T_R	: Rated torque [Nm]

[Capacity selection condition]

①$T_L \leq T_R \times 0.9$

T_L = 0.03 Nm *P.15-26 (3)

②$J_L \leq J_M \times 10$ (Frequent feed)

$J_L = 1.1 \times 10^{-4}$ kg m^2 *P.15-26(2)

The motor that satisfies the capacity selection condition (1) and (2) is:

GYS201D5-HB2 (0.2 kW)

(T_R = 0.637 Nm, $J_M = 0.135 \times 10^{-4}$ kgm^2, T_{MAX} = 1.91 Nm)

(5) Shortest acceleration/deceleration time (t_{AC})

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60\,(T_{AC} - T_L)}$$

$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60\,(1.91 - 0.03)}$$

$$= 0.021 \text{ s}$$

Acceleration/Deceleration torque at an acceleration/Deceleration time of 0.05 seconds

(Mechanical efficiency (η) : assuming 100%)

[Acceleration torque]

$$T_{AC} = T_L + \frac{(J_M + J_L) \times 2\pi \times N}{60\,(t_{AC})}$$

$$= 0.03 + \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 \times 0.05}$$

$$= 0.81 \text{ Nm}$$

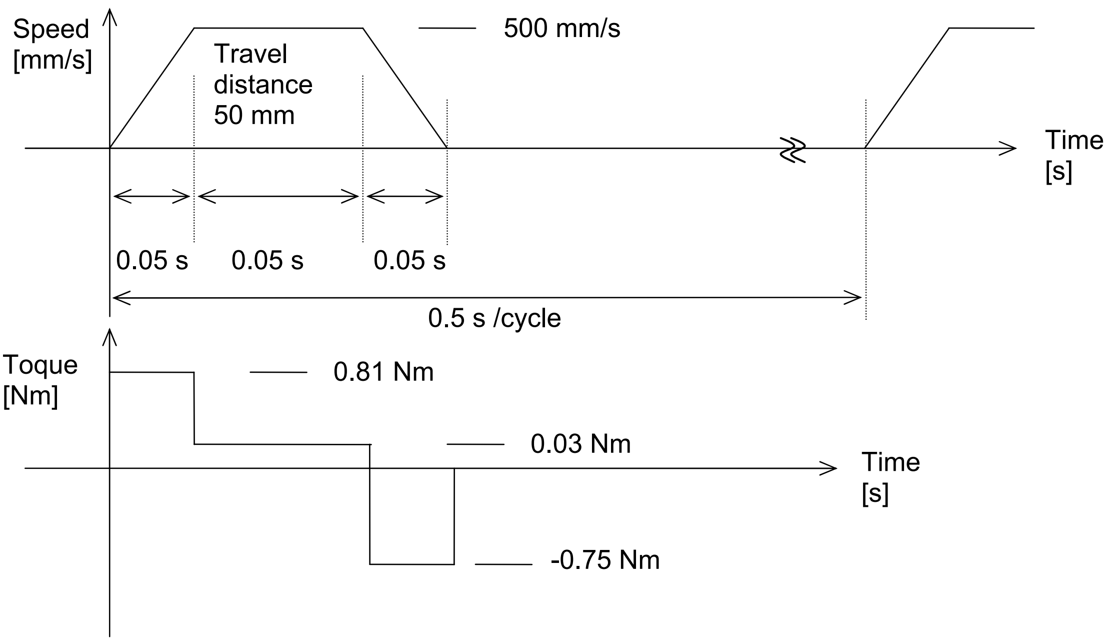
[Deceleration torque]

$$T_{DC} = T_L - \frac{(J_M + J_L) \times 2\pi \times N}{60\,(t_{DC})}$$

$$= 0.03 - \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 \times 0.05}$$

$$= -0.75 \text{ Nm}$$

(6) Operation profile



This profile is based on calculation selection. The operation cycle time supposes 0.5 s.

(7) Effective torque (T_{rms})

Time-average output torque

$$T_{rms} = \sqrt{\frac{(T_{AC}^2 \times t_{AC}) + (T_L^2 \times t_L) + (T_{DC}^2 \times t_{DC})}{t_{cyc}}}$$

$$= \sqrt{\frac{(0.81^2 \times 0.05) + (0.03^2 \times 0.05) + (-0.75^2 \times 0.05)}{0.5}}$$

$$= 0.35 \text{ Nm}$$

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.

T_{AC} : Acceleration torque [Nm]
T_{DC} : Deceleration torque [Nm]
T_L : Load torque converted to motor shaft [Nm]
t_{AC} : Acceleration time [s]
t_{DC} : Deceleration time [s]
t_L : Constant speed time [s]
t_{CYC} : Running hour per cycle [s]

(8) Result of selection

Servomotor: GYS201D5-HB2 (0.2 kW)

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(9) Regenerative power

Regenerative power is caused during deceleration.

$E_1[J] = (2\pi/60) \times T_{DC}$ [Nm] $\times$ N [r/min] $\times t_{DC} \times (1/2)$

$= (2\pi/60) \times -0.75 \times 3000 \times 0.05 \times (1/2)$

$\fallingdotseq$ -5.9 J

Accumulated energy on main circuit capacitor (E_2)

$E_2[J] = (1/2) \times C[F] \times V^2$

$= (1/2) \times (440 \times 10^{-6}) \times \{390^2 - (200\sqrt{2})^2\}$

= 15.8 J

Regenerative energy (P)

The capacitor for the servo amplifier of 0.2 kW or less has a capacity of 440 μF.

$P[W] = (| E_1 | - E_2) / (t_{cyc})$

$=(| -5.9 | - 15.8) / 0.5$

= -19.8 J

As P is equal to or less than 0, no external regenerative resistor is required since the regenerative energy can be processed in the servo amplifier.

■ Constants

■200 V series

Series	Capacity [kW]	Inertia 10^{-4}[kg·m^2]	Capacity of capacitor [μF]
GYB	0.2	0.24	440
	0.4	0.42	660
	0.75	1.43	1360
GYH	1.0	6.26	1360
	1.5	8.88	
	2.0	12.14	
	3.0	17.92	1800
	4.0	39.99	2400
	5.5	51.44	4000
	7.0	63.52	
GYG 2000 r/min	0.5	7.96	1360
	0.75	11.55	
	1.0	15.14	
	1.5	22.33	
	2.0	29.51	1800
GYG 1500 r/min	0.5	11.55	1360
	0.85	15.15	
	1.3	22.33	1800
GYC	0.1	0.0577	440
	0.2	0.213	
	0.4	0.408	660
	0.75	1.21	1360
	1.0	3.19	
	1.5	4.44	
	2.0	5.69	1800
GYS	0.05	0.0192	440
	0.1	0.0371	
	0.2	0.135	
	0.4	0.246	660
	0.75	0.853	1360
	1.0	1.73	
	1.5	2.37	
	2.0	3.01	1800
	3.0	8.32	2400
	4.0	10.8	4000
	5.0	12.8	

15.6 Replacement (from FALDIC-W)

15.6.1 Overview

This section describes the procedure of replacement to ALPHA5 Smart using the existing FALDIC-W series motor (hereafter called “W motor”).
Target W motors　GYS: 50 to 750 W, GYG (2000 r/min): 500 W to 2.0 kW, GYG (1500 r/min): 500 W, 850 W,1.3 kW

15.6.2 Combination with FALDIC-W Motor

The combinations between the FALDIC-W servo motor and the ALPHA5 Smart servo amplifier are as follows. Wiring fabrication is required when replacing the amplifier.

Combinations between the FALDIC-W motor and the ALPHA5 Smart amplifier

FALDIC-W series motor type		ALPHA5 Smart series Amplifier type	Frame no.	Encoder cable	Motor power cable
GYS	GYS500DC2-T2*	RYH201F5-VV2	1a	WSC-P06P□□-E (both ends connector)	M1 in the next table
	GYS101DC2-T2*				
	GYS201DC2-T2*				
	GYS401DC2-T2*	RYH401F5-VV2	1b		
	GYS751DC2-T2*	RYH751F5-VV2	2a		M2in the next table
GYG [2000r/min]	GYG501CC2-T2*	RYH751F5-VV2	2a	Must be fabricated.	M3 in the next table
	GYG751CC2-T2*				
	GYG102CC2-T2*	RYH152F5-VV2	2b		
	GYG152CC2-T2*				
	GYG202CC2-T2*	RYH202F5-VV2	3a		
GYG [1500r/min]	GYG501BC2-T2*	RYH751F5-VV2	2a	Must be fabricated.	M3 in the next table
	GYG851BC2-T2*	RYH152F5-VV2	2b		
	GYG132BC2-T2*	RYH202F5-VV2	3a		
	GYG182BC2-T2*	RYH302F5-VV2	3b		M4 in the next table
	GYG292BC2-T2*	RYH402F5-VV2	4a	Must be fabricated.	M5 in the next table

*: with oil seal/ shaft type　　□□: cable length

Motor power cable and brake cable

No.	Brake	Optional cable / connector kit type			Fabrication by the user
		Connector on the motor side	Cable	Connector on the amplifier side	
M1	None	WSC-M04P□□-B		Shared with the power supply connector.	Wire the motor power cable to the connector on the amplifier side.
	Provided	WSC-M06P□□-B			
M2	None	WSC-M04P□□-B		WSK-M03P-F	
	Provided	WSC-M06P□□-B			
M3	None	WSK-M04P-CA	Prepared by the user.	WSK-M03P-F	
	Provided	WSK-M06P-CA			
M4	Common to both None/ Provided	WSK-M09P-CC	Prepared by the user.	WSK-M03P-F	
M5				Not required	Wire the motor power cable to the amplifier terminal block.

□□: cable length

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15.6.3 Wiring between Motor and Amplifier

■ GYS motor (400 W or less)

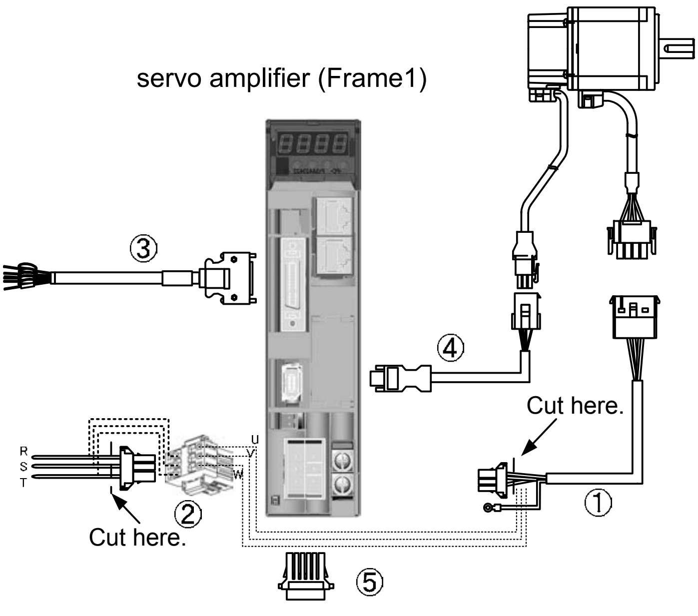
servo amplifier.

The table below shows the cables and the connectors for the GYS motor of 400 W or less and the

		Purchase	Type
(1)	Motor power cable	Existing item can be used.	-
	Motor power connector	To be purchased. (Shared with power supply connector.)	-
(2) Power supply connector		To be purchased.	WSK-S06P-F
(3) Sequence I/O cable		Existing item can be used.	-
(4) Encoder cable		To be purchased.	WSC-P06P□□-E
(5) DC circuit connector		To be purchased. (Not necessary if no external regenerative resistor is used.)	WSK-R04P-F

□□: cable length

■ Cable processing



Connection with a GYS motor (50 W to 400 W)

(1) Motor power cable
Cut the motor power cable connector part on the amplifier side, and then connect it to the motor output side of the power supply connector for ALPHA5 Smart.

(2) Power supply cable
Cut the power supply cable connector part for FALDIC-W, and then connect it to the power supply side of the power supply connector for ALPHA5 Smart.

(3) Sequence I/O cable
If the wiring of pulse is used with an open collector, be sure to cut the no. 7 pin (CA) and no.20 pin (CB) on the amplifier-side connector.

(4) Encoder cable
Purchase an encoder cable for ALPHA5 Smart. Or, exchange the amplifier-side connector of the existing encoder cable. (Exchange connector type: WSK-P06P-M)

(5) DC circuit connector
This connector is used to connect the external regenerative resistor. Connect this to the 2-3 terminal (RB1-RB2 terminal). This connector is not necessary if no external regenerative resistor is used.

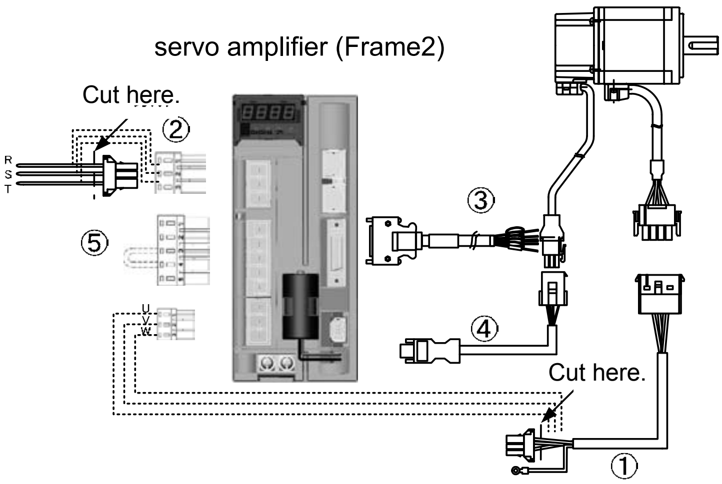
■ GYS motor (750 W)

The table below shows the cables and the connectors for the GYS motor of 750 W and the servo amplifier.

		Purchase	Type
(1)	Motor power cable	Existing item can be used.	-
	Motor power connector	To be purchased.	WSK-M03P-F
(2)	Power supply connector	To be purchased.	WSK-S03P-F
(3)	Sequence I/O cable	Existing item can be used.	-
(4)	Encoder cable	To be purchased.	WSC-P06P□□-E
(5)	DC circuit connector	Supplied with the amplifier.	WSK-R05P-F

□□: cable length

■ Cable processing



Connection with a GYS motor (750 W)

(1) Motor power cable
Cut the motor power cable connector part on the amplifier side, and then connect it to the motor power connector for ALPHA5 Smart.

(2) Power supply cable
Cut the power supply cable connector part for FALDIC-W, and then connect it to the power supply connector for ALPHA5 Smart.

(3) Sequence I/O cable
If the wiring of pulse is used with an open collector, be sure to cut the no. 7 pin (CA) and no.20 pin (CB) on the amplifier-side connector.

(4) Encoder cable
Purchase an encoder cable for ALPHA5 Smart. Or, exchange the amplifier-side connector of the existing encoder cable. (Exchange connector type: WSK-P06P-M)

(5) DC circuit connector
If an external regenerative resistor is used, disconnect the short-circuit wire at 3-4 terminal (RB2-RB3 terminal) and connect it to the 2-3 terminal (RB1-RB2 terminal).

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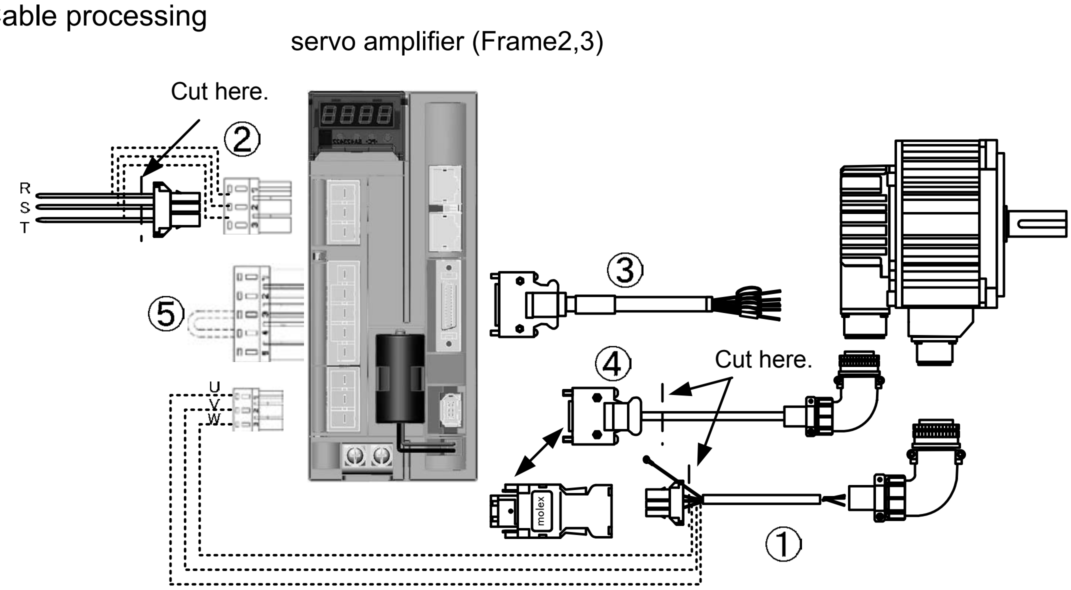
GYG motor

The table below shows the cables and the connectors for the GYG motor and the servo amplifier.

		Purchase	Type
(1)	Motor power cable	Existing item can be used.	-
	Motor power connector	To be purchased.	WSK-M03P-F
(2) Power supply connector		To be purchased.	WSK-S03P-F
(3) Sequence I/O cable		Existing item can be used.	-
(4) Encoder cable		Purchase the connector for the amplifier side only.	WSK-P06P-M
(6) DC circuit connector		Supplied with the amplifier.	WSK-R05P-F

□□: cable length

Cable processing



Connection with a GYG motor

(1) Motor power cable

Cut the amplifier-side connector part or the crimping terminal of the motor power cable, and then connect it to the motor power connector for ALPHA5 Smart.

(2) Power supply cable

Cut the connector part of the power supply cable for FALDIC-W, and then connect it to the power supply connector for ALPHA5 Smart.

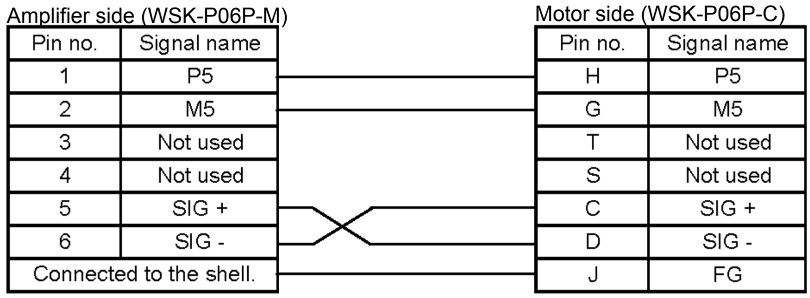
(3) Sequence I/O cable

If the wiring of pulse is used with an open collector, be sure to cut the no. 7 pin (CA) and no.20 pin (CB) on the amplifier-side connector.

(4) Encoder cable

Wiring processing is required. Exchange the Amplifier-side connector to the connector for ALPHA5 Smart (WSK-P06P-M). For wiring refer to the connector connecting diagram.

Connecting diagram between the amplifier-side and motor-side connectors



(5) DC circuit connector

If an external regenerative resistor is used, disconnect the short-circuit wire at 3-4 terminal (RB2-RB3 terminal) and connect it to the 2-3 terminal (RB1-RB2 terminal).

15.6.4 I/O Terminal (CN1)

The following tables show comparison of the CN1 terminal between the FALDIC-W amplifier and the ALPHA5 Smart amplifier. The terminal symbol differs only at the pin no. 18. Thus wiring must be changed there. If the amplifier is used without changing the wiring, the amplifier may be broken. Wiring change is not necessary with other pins.

Pin no.	Terminal symbol (FALDIC-W)	Terminal symbol (ALPHA5 Smart)
1	P24	COMIN
2	CONT1	CONT1
3	CONT2	CONT2
4	CONT3	CONT3
5	CONT4	CONT4
6	CONT5	CONT5
7	CA	CA
8	*CA	*CA
9	FFA	FFA
10	*FFA	*FFA
11	FFB	FFB
12	*FFB	*FFB
13	M5	M5

Pin no.	Terminal symbol (FALDIC-W)	Terminal symbol (ALPHA5 Smart)
14	M24	COMOUT
15	OUT1	OUT1
16	OUT2	OUT2
17	OUT3	OUT3
18	OUT4	TREF
19	PPI	PPI
20	CB	CB
21	*CB	*CB
22	Vref	VREF
23	FFZ	FFZ
24	*FFZ	*FFZ
25	FZ	FZ
26	M5	M5

15.6.5 Parameter Setting

The parameters are not divided into classification with FALDIC-W, but are divided with ALPHA5 Smart into classification of 1 to 3. If you are using the parameter files, use the parameter file conversion tool (ALPHA5 Series Loader Ver3.2 or later). This sub section explains major parameters.

Note	Before using the parameters. be sure to check the converted result with the parameter file conversion tool.

■ Parameters to be set

When used in combination with a W motor, set the Smart parameter PA2_99: encoder selection to 1: 17 bits. In addition, set the motor model with Smart parameter PA2-98. For the motor model and the setting value, see the table below. It is necessary to match the amplifier frame with the servo motor capacity for setting.

Setting value	Motor model
0	Not set (default)
1	GYS500DC2-T2*
2	GYS101DC2-T2*
3	GYS201DC2-T2*
4	GYS401DC2-T2*
5	GYS751DC2-T2*
6	GYG501CC2-T2*
7	GYG751CC2-T2*
8	GYG102CC2-T2*
9	GYG152CC2-T2*
10	GYG202CC2-T2*
11	GYG501BC2-T2*
12	GYG851BC2-T2*
13	GYG132BC2-T2*
14	GYG182BC2-T2*
15	GYG292BC2-T2*

*: with oil seal/shaft type

■ Command pulse signal setting

It is necessary to set the parameter depending on the command pulse input method (open collector input or differential input).

No.	Parameter	Setting value
PA1-03	Command pulse input method and form selection	0: Differential input, command pulse/direction 1: Differential input, forward/reverse pulse 2: Differential input, A/B phase pulse 10: Open collector input, command pulse/direction 11: Open collector input, forward/reverse pulse 12: Open collector input, A/B phase pulse

■ Parameter related to adjustment

Because the control block has been improved with ALPHA5 Smart, there are cases where uses are required to adjust the control parameters. For the adjustment detail, refer to “CHAPTER 5 SERVO ADJUSTMENT”.

■ Motor maximum speed setting

The maximum speed is 5000 r/min and 6000 r/min with the GYS motor for FALDIC-W series and the GYS motor (750 W or less) for ALPHA5 Smart series respectively. When using a W motor, the maximum speed that can be set is 5000 r/min. Although the initial value at PA1_25: maximum speed (for position and speed control) and PA1_26: maximum speed (for torque control) is 6000 r/min, the maximum speed is limited with the amplifier to the one corresponding to the motor.

15.7 Precautions on Functions

■ Monitor display of motor temperature

When combined with a W motor, the motor temperature is always output and displayed as 0 C° (for the following three items).

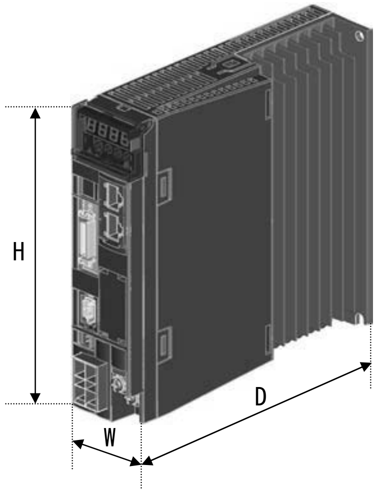
- Monitor 1 and 2(Motor temperature output on analog monitors MON1 and MON2)
- Touch panel (Motor temperature display in the monitor mode [on_24])
- PC loader (Motor temperature display in the digital monitor)

■ Z-phase with W series motor

When using the homing function immediately after the power is supplied, perform the operation following the conditions below if the reference signal for shift operation (PA2_11) has been set to 1: Encoder Z-phase.

- The speed must be 100 r/min or below.
- Rotate the motor by the angle of rotation of 372 degrees (approx. 1.04 turn) or over with the motor output shaft.

15.7.1 Dimension Comparison of Servo Amplifier



Applicable motor Rated speed	Capacity [kW]	FALDIC-W External dimension [mm]			ALPHA5 Smart External dimension [mm]		
		W	H	D	W	H	D
3000 [r/min]	0.05	45	160	165	40	160	165
	0.1	45	160	165	40	160	165
	0.2	45	160	165	40	160	165
	0.4	45	160	165	40	160	165
	0.75	85	160	165	70	160	165
2000 [r/min]	0.5	85	160	165	70	160	165
	0.75	85	160	165	70	160	165
	1	85	160	165	70	160	165
	1.5	95	200	185	70	160	165
	2.0	95	200	185	85	200	185
1500 [r/min]	0.5	85	160	165	70	160	165
	0.85	85	160	165	70	160	165
	1.3	95	200	185	85	200	185
	1.8	95	200	185	85	200	185
	2.9	95	200	185	130	250	195

15.8 Revision History

Date of printing	Index	Description of revision
June, 2010	None	First version
July, 2011	A	The command pulse connection method detail. The dimensions of the frame-2 servo amplifier. The company name.
October, 2011	B	Capacity expanded (up to 3 kW)
September, 2012	24C7-E-0016	Cover Design Statement Catalogue Index GYB type added
September, 2013	24C7-E-0016a	Modbus Function Code 17h added
May, 2014	24C7-E-0016b	Z-phase homing added Capacity expansion (GYH type added)
October, 2014	24C7-E-0016c	The pin name of the encoder connector was corrected.

15.9 Product Warranty

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalog, specifications or other materials will be as mentioned below.
In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this company.
Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

1. Free of Charge Warranty Period and Warranty Range

1-1 Free of charge warranty period

(1) The product warranty period is "1 year from the date of purchase" or 24 months from the manufacturing date imprinted on the name place, whichever date is earlier.
(2) However, in cases where the use environment, conditions of use, use frequency and times used, etc., have an effect on product life, this warranty period may not apply.
(3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date that repairs are completed."

1-2 Warranty range

(1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.

1) The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, operation manual, specifications or other relevant documents.
2) The breakdown was caused by the product other than the purchased or delivered Fuji's product.
3) The breakdown was caused by the product other than Fuji's product, such as the customer's equipment or software design, etc.
4) Concerning the Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or the results from using such a program.
5) The breakdown was caused by modifications or repairs affected by a party other than Fuji Electric.
6) The breakdown was caused by improper maintenance or replacement using consumables, etc. specified in the operation manual or catalog, etc.
7) The breakdown was caused by a chemical or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.
8) The product was not used in the manner the product was originally intended to be used.
9) The breakdown was caused by a reason which is not this company's responsibility, such as lightning or other disaster.

(2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.
(3) The upper limit for the warranty range shall be as specified in item (1) above and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

1-3. Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform the trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

2. Exclusion of Liability for Loss of Opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not be responsible for causing.

3. Repair Period after Production Stop, Spare Parts Supply Period (Holding Period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

4. Transfer Rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

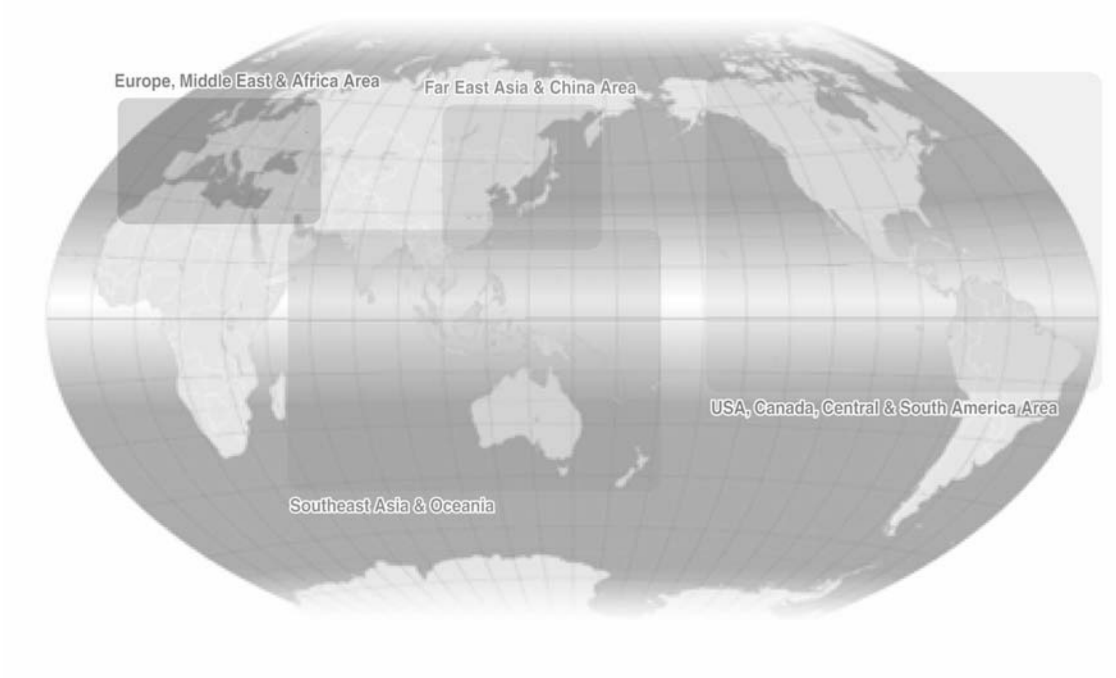
5. Service Contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

6. Applicable Scope of Service

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 for the detail separately.

15.10 Service Network



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⚠ SAFETY PRECAUTIONS

1. This catalog is intended for use in selecting required servo systems. Before actually using these products, carefully read their instruction manuals and understand their correct usage.
2. Products described in this catalog are neither designed nor manufactured for combined use with a system or equipment that will affect human lives.
   If you are considering using these products for special purposes, such as atomic energy control, aerospace, medical application, or traffic control, please consult our sales office.
3. If you use our product with equipment that is expected to cause serious injury or damage to your property in case of failure, be sure to take appropriate safety measures for the equipment.

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