

FUJI SERVO SYSTEM

FALDIC-*W* Series

USER'S MANUAL





SAFETY INSTRUCTIONS

(1) Types and meanings of warnings

In all stages of the installation, operation, maintenance and check of this equipment, reference must be made to this manual and other related documents.

The correct understanding of the equipment, information about safety and other related instructions are essential for this system.

Cautionary indications DANGER and CAUTION are used in this manual to point out particular hazards and to highlight some unusual information which must be specially noted.









Warning	Meaning
 DANGER	If operation is incorrect, a dangerous situation may occur, resulting in death or serious injuries.
 CAUTION	If operation is incorrect, a dangerous situation may occur, resulting in minor to medium injuries or only physical damage to equipment.

An item described under Caution may result in a serious accident, depending on the situation. Both items indicate important procedures, and make sure to observe them.

After reading this manual, keep it in a place where an operator can access it at any time.

(2) Figures

Figures are used so that the meaning of the display may be understood at a glance.

Figure	Meaning	Figure	Meaning
	General notice for inhibition		Action of general operator
	No contact		Make sure to make grounding.
	No disassembly		Be careful of electric shock.
	Be careful of fire.		Be careful of high temperatures.

1. Precautions for operation



Danger



1. Never touch components inside the servo amplifier as you may receive an electric shock.



2. Make sure to ground the grounding terminals of the servo amplifier and the servomotor or you may receive an electric shock.



3. Perform wiring and inspection after waiting 5 minutes after shutting off the power or you may receive an electric shock.



4. Do not damage cables, subject them to undue stress, put any heavy object on them or pinch them as failure, damage or electric shock may result.



5. Do not touch the rotating part of the servomotor during operation as you may be injured.



Caution



1. Use the specified combination of the servomotor and the servo amplifier or fire or failure may occur.



2. Do not use the system in a place where it is exposed to water, a corrosive atmosphere or flammable gas atmosphere, or beside a flammable item as fire or failure may result.



3. Be careful as the temperature of the servo amplifier, servomotor and peripheral devices is high and may cause burns.



4. Do not touch the radiator of the servo amplifier, the regenerative resistor and the servomotor during power supply or soon after shutoff because they will be hot and may cause burns.



5. When the surface temperature of the servomotor exceeds 70°C for the final product during operation of the servomotor, affix a caution label indicating its high temperature.

2. Precautions for storage



Prohibited



1. Do not store the system in a place where it is exposed to rain or water drips or where there is a hazardous gas or liquid as failure may result.



2. Do not store the system directly on the ground if vibration is frequent as failure may result.



Compulsory



1. Store the system in a place where there is no direct sunlight and in the specified range of temperature/humidity (-20°C to 60°C, 10% to 90%RH or less, no condensation) or failure may result.



2. When the system is stored in installed condition
Cover the servomotor with a sheet to protect it from humidity, oil or water.
Apply rust preventive solution to the machined surfaces (shaft and flange surfaces) every 6 months.
To prevent bearings rusting, perform manual turning or 5 minute idling once a month.



3. If storage is to be for a long time, contact us.

3. Precautions for transportation



Caution



• Do not hold the cable or the motor shaft during transportation as failure or injuries may result.



Compulsory



1. Overloading of products may result in the collapse of piles. Observe the instructions.



2. Use the servomotor eyebolt only for transportation of the servomotor not for transportation of the machine as failure or injuries may result.

4. Precautions for installation



Caution



1. Do not ride on the servomotor or put a heavy object on the servomotor as failure, damage, electric shock or injuries may result.



2. Close the exhaust opening to prevent entry of foreign matter or fire or electric shock may result.



3. Make sure to observe the installation directions or fire or failure may result.



4. Maintain the specified distance between the main unit and the control panel or other devices or failure may result.



5. Do not subject to strong impact or failure may result.



Compulsory



1. The servomotor shaft thru-hole is not waterproofed or oil-proofed. Take necessary precautions for the machine to prevent entry of cutting oil into the servomotor or failure may result.



2. If the system is used in an environment where the servomotor is exposed to many water drips or oil drips, take precautions including a drip cover over the machine.

The servomotor itself can be subjected to a few splashes without serious consequences.

In an environment where there is much humidity or oil mist, perform wiring so that lead wires and connectors face downward or failure may result due to poor insulation or short-circuit.



3. Never modify the servomotor as a fire or failure may result.

5. Precautions for wiring



Caution



- Perform wiring correctly or a fire, failure, burns or injuries may result.



Prohibited



1. Never connect the commercial power supply (200V) to the U, V and W terminals of the servomotor or a fire or failure may result.



2. Do not connect a grounding wire (E) to the U, V and W terminals of the servomotor and do not connect U, V and W terminals in the wrong order or a fire or failure may result.



3. Never perform the withstanding voltage, megger and buzzer tests at the encoder terminal as the encoder may be damaged.
To perform the withstanding voltage, megger and buzzer tests at the U, V and W terminals of the servomotor, separate the connections from the servo amplifier before the test.



4. Do not connect the encoder terminals in the wrong order as the encoder and the servo amplifier may be damaged.



Compulsory



- Grounding is performed to prevent electric shock in an emergency.
Make sure to perform grounding for safety.

6. Precautions for operation



Caution



1. Extreme adjustment or changes may result in unstable operation and injuries may result.



2. During test operation, fix the servomotor and check operation of the servomotor with it separated from the machine before installing it in the machine or injuries may result.



3. The retention brake is not the stop system but for safety of the machine. Provide a stop system to ensure safety on the machine or failure or injuries may result.



4. If an alarm occurs, remove the cause and confirm safety. Reset the alarm and restart operation or injuries may result.



5. After instantaneous stop and recovery, the system may suddenly restart; do not approach the machine (design the machine so that human safety is ensured even after restart) or injuries may result.



6. Make sure that the power supply specification is correct or a fire, failure or injuries may result.



Prohibited



- The brake incorporated in the servomotor is for retention. Do not use it for normal braking or failure or injuries may result.



Compulsory



- Provide external emergency stop circuits so that the operation may be stopped immediately and that the power may be shut off or fire, failure, burns or injuries may result.

7. Precautions for maintenance and inspection



Prohibited



- Do not disassemble the system for repairs other than an expert engineer. If it is necessary to disassemble the motor, contact the shop you purchased or nearest sales office.

Descriptions given in this manual may be different from those of the product as a result of improvements of the product. Descriptions in this manual are subject to change without notice.

Values are indicated in SI units (third stage) in this manual. The units may be different from those indicated on the product (nameplate).

Illustration given in this manual may show the servo amplifier or servomotor of a specific capacity. Accordingly they may be different from the appearance of the product you have purchased.

Products introduced in this manual have not been designed or manufactured for such applications in a system or equipment that will affect human bodies or lives. Customers, who want to use the products introduced in this manual for special systems or devices such as for atomic-energy control, aerospace use, medical use, and traffic control, are requested to consult Fuji.

Customers are requested to prepare safety measures when they apply the products introduced in this manual to such systems or facilities that will affect human lives or cause severe damage to property if the products become faulty.

Introduction

This manual is the User's Manual for Fuji's FALDIC-W Series AC Servo System. The User's Manual comes in one volume and covers all handling procedures of the product.

The following document is included in the package of each device.

Device	Name of document	Document No.
Servo amplifier	Instruction Manual Fuji FALDIC-W Series AC Servo Amplifier (RYC□□□D (C, B) 3-△△△2)	INR-SI47-0853
Servomotor	Instruction Manual Fuji GYS/GYG Series AC Servomotor	ING-SI47-0863

The type designation of the product covered in this manual is shown below.

Device	Applicable type
Servo amplifier	RYC□□□D3-VVT2 RYC□□□C3-VVT2 RYC□□□B3-VVT2
Servomotor	GYS□□□DC2-*** GYG□□□CC2-*** GYG□□□BC2-***

- * "□" in the type designation indicates a decimal point or number.
- * "***" in the type designation indicates an alphabetic character or no mark.

For any uncertainties in the description of this manual or in the product itself, contact your dealer or Fuji's sales outlet.

Icons

In this manual, the following icons are used:



If the system is incorrectly operated by ignoring this mark, the optimum performance of FALDIC-W may not be shown, or such an operation or setting may result in an accident.



Useful reference items are given for operation or setting of the servo amplifier or the servomotor.



The page for reference is shown.

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1

OUTLINE

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1 OUTLINE

1.1 Items to be confirmed

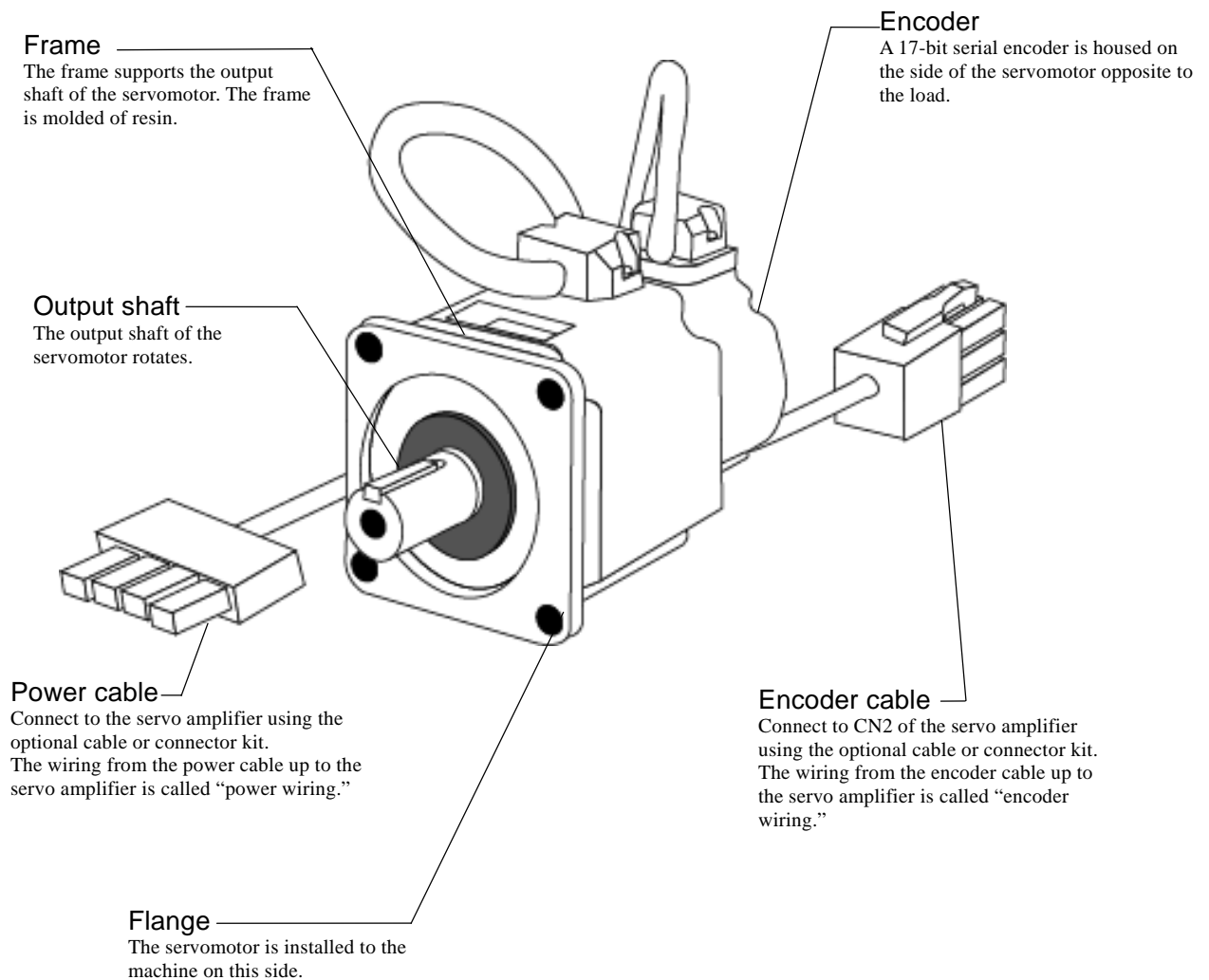
When the product (FALDIC-W Series) is delivered to you, unpack and check the following.

Items to be confirmed	Checking method	Check mark
Is the delivered FALDIC-W Series what you have ordered?	Check the “type” field in the motor and amplifier nameplates shown in the following pages.	
Is there any damage around the product?	Observe the appearance to check for broken parts.	
Check if the servomotor shaft rotates smoothly.	Turn by hand. If the shaft rotates smoothly, there is no problem. However, the shaft does not turn with servomotors equipped with a brake.	
Are any screws dislocated or loose?	Perform visual check.	

If any defects are found, contact your dealer or Fuji’s sales outlet (shown on the back cover of this manual) immediately.

1.2 Servomotor

■ Appearance of product (Example : GYS□□□DC2-T2□)



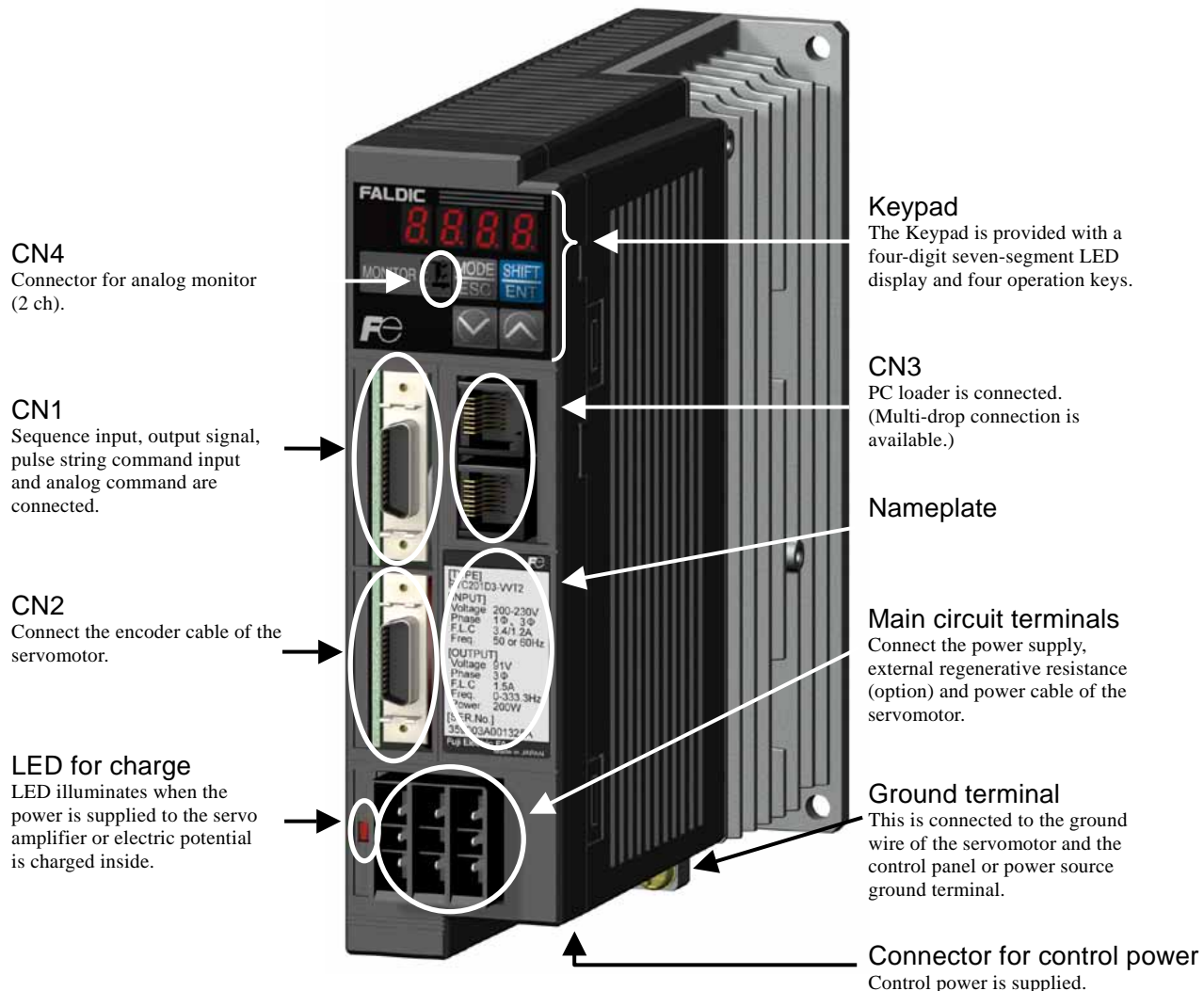
■ How the nameplate looks



1 OUTLINE

1.3 Servo amplifier

- Appearance of product (Example : RYC□□□D3-VVT2 (50W to 400W))

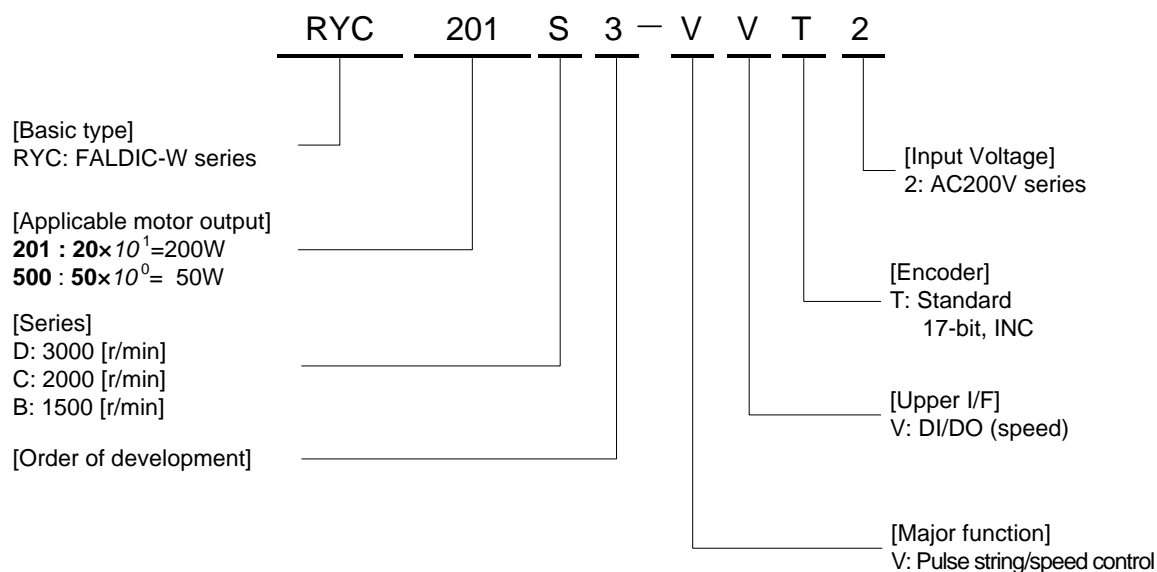


- How the nameplate looks

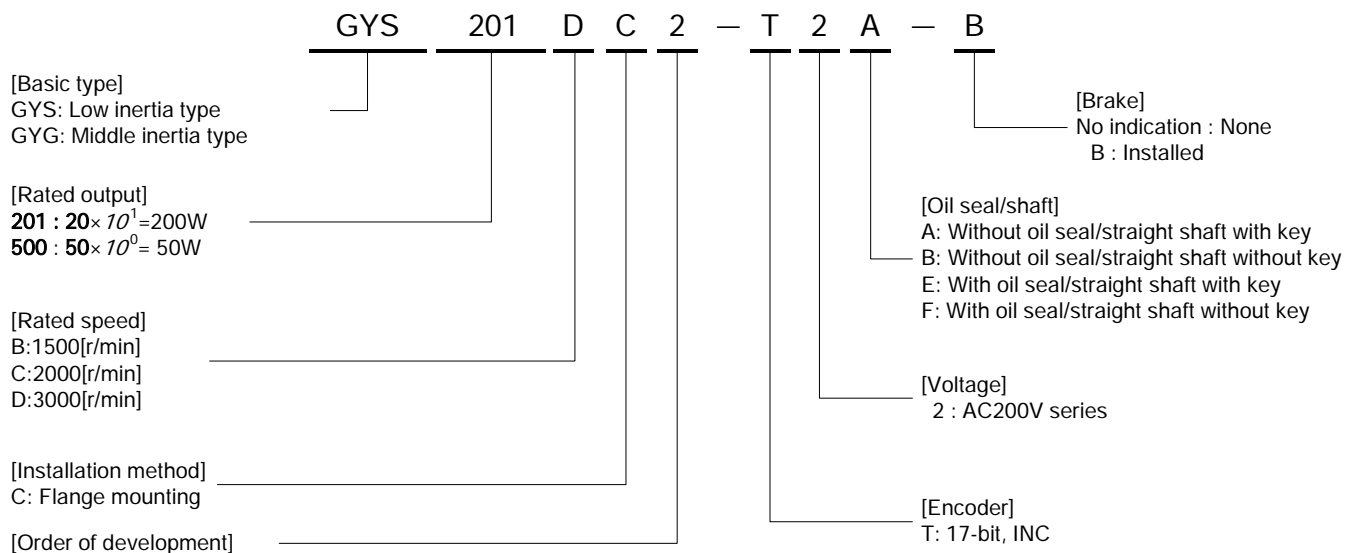
Amplifier type	→	[TYPE] RYC401S3-VVT2
Input voltage	→	[INPUT] Voltage 200-230V
No. of input phases	→	Phase 1 ϕ 3 ϕ
Maximum input current	→	F.L.C 3.4A/6.4A
Input frequency	→	Freq. 50 or 60Hz
Output voltage	→	[OUTPUT] Voltage 91V
No. of output phases	→	Phase 3 ϕ
Maximum output current	→	F.L.C 1.5A
Output frequency	→	Freq. 0-333.3Hz
Output capacity	→	Power 400W
Serial number	→	[SER. No] 02121333A001
		Fuji Electric FA Made in JAPAN

1.4 Explanation of Model Codes

<Servo amplifier>



<Servomotor>



2

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2 INSTALLATION

2.1 Servomotor

2.1.1 Storage temperature

Store the servomotor in the following environment when leaving it without energization.

Storage temperature : -20 to 60 °C

Storage humidity : 10 to 90% RH (no condensation allowed)

* To store the gear head without power supplied, store it in the following environment:

Storage temperature : -20 to 60 °C

Storage humidity : 10 to 90% RH (no condensation allowed)

2.1.2 Operating environment

Operate the servomotor in the following environment.

Operating temperature : -10 to 40 °C

Operating humidity : 10 to 90% RH (no condensation allowed)

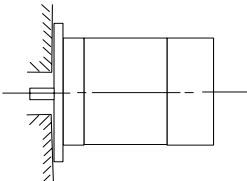
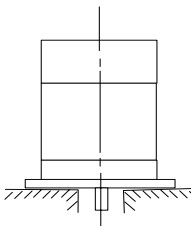
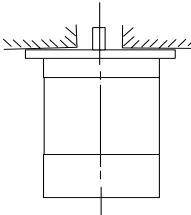
*Use the gear head in the following operating environment.

Operating temperature : 0 to 40 °C

Operating humidity : 10 to 90% RH (no condensation allowed)

2.1.3 Mounting

The servomotor can be mounted horizontally, downward or upward. The same rule applies to the servomotor equipped with a brake.

Flange-mounted		
IM B5(L51)	IM V1(L52)	IM V3(L53)
		

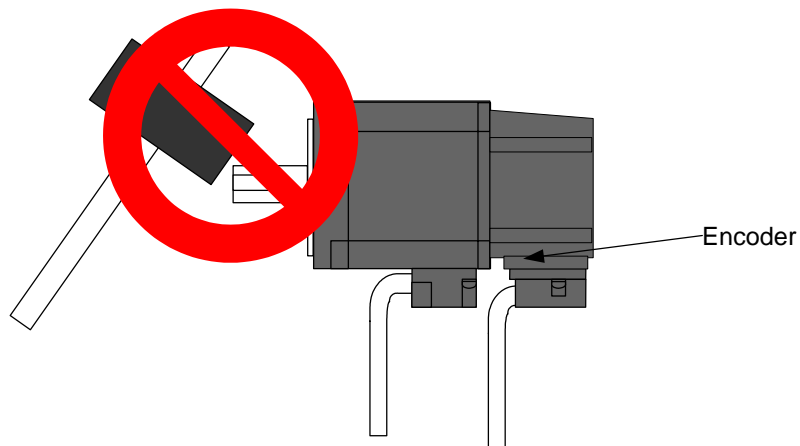
The symbol in the figure indicates the mounting method coded by JEM. Description in parentheses () indicates the former JEM code.



2.1.4 Handling

The servomotor is equipped with a built-in encoder. Do not hammer the output shaft of the servomotor because the encoder is a precision device.

Do not support the encoder to lift the servomotor during installation.

The encoder built in the servomotor has been aligned with the servomotor. If it is disassembled, the rated performance will not be obtained.



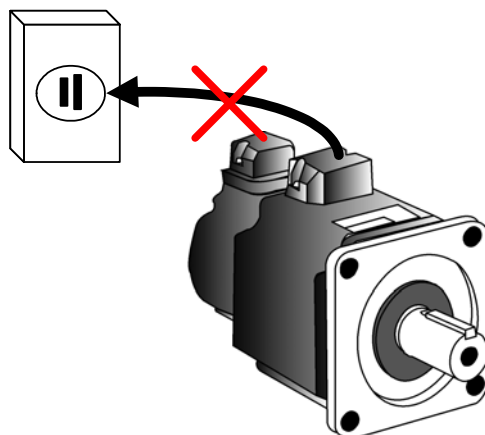
 CAUTION	
	<ul style="list-style-type: none"> ■ Never give shocks to the servomotor by hitting with a hammer etc. Otherwise the encoder will be broken, causing the servomotor to run away. ■ Do not disassemble the servomotor. If the servomotor is disassembled, the performance will deteriorate and the mechanical system may be broken.

2.1.5 Power supply to servomotor

Do not supply commercial power directly to the servomotor as the servomotor may be burned.

The servomotor cannot be used without connection to the corresponding amplifier.

For the connection method between the servomotor and servo amplifier, see chapter 3.



2 INSTALLATION

2.1.6 Cable stress

Do not apply bending or tensile stress to the cable.

■Precautions for applications with moving servomotor

- Design a system of an application with a moving servomotor so that the cables are free from forcible stress.
- Route the encoder cable and power cable in Cableveyor.
- Fix the encoder cable and power cable from the servomotor using cable clamps.
- Design the bending radius as large as possible.
- Do not allow bending stress or the weight of the cable itself to be exerted at cable connections.

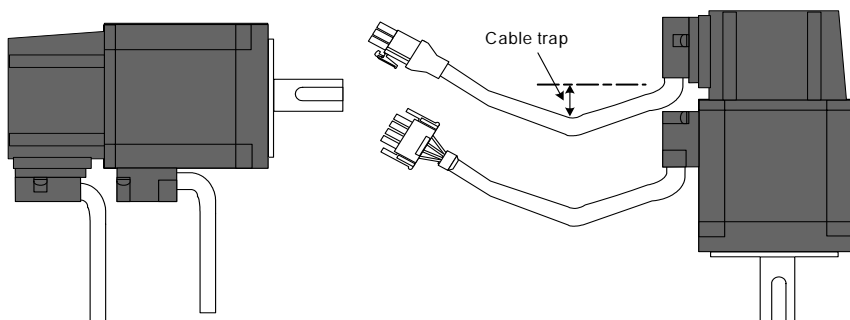
2.1.7 Protection against water and oil

① Measures taken to the motor are useful for protection against moderate amount of splashes.

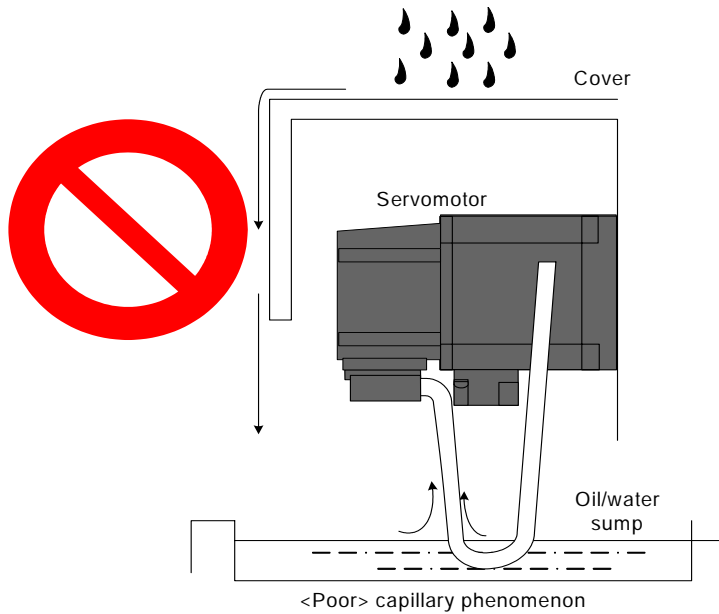
However, the shaft is not water-proof or oil resistant, and so take appropriate measures on the machine side to avoid entry of water and oil into the servomotor.

② In environments with significant water droplets, oil film or oil mist, provide covers over the machines.

③ When the servomotor is installed horizontally, route the power cable and the encoder cable downwards. Provide a cable trap when the servomotor is installed vertically or inclined.



- ④ Do not use the servomotor with the cable in contact with oil or water.



- ⑤ If the motor is exposed to splashes of oil such as cutting oil, some oil may adversely affect seal material, packing and cable.
- ⑥ The servomotor with an oil seal may produce a squeaking sound from the oil seal during operation, but this is not a problem as to functioning.
- ⑦ When the servomotor with oil seal is used in the axial direction, make sure that oil has not accumulated at the oil seal lip.

2 INSTALLATION

⑧ List of IP67 compatible connectors for GYG motor

■IP67 compatible connector type

Wiring area	Plug		Back shell		Cable clamp
	Straight	Angle	Straight	Angle	
Without brake for motor power wiring	CE05-6A18-10SD-B-BSS	CE05-8A18-10SD-B-BSA	—	—	CE3057-10A-x
With brake for motor power wiring	CE05-6A20-15SD-B-BSS	CE05-8A20-15SD-B-BSA	—	—	CE3057-12A-x
For encoder wiring	MS3106A20-29S (D190)		CE02-20BS-S	CE-20BA-S	CE3057-12A-x

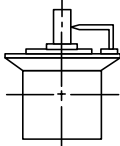
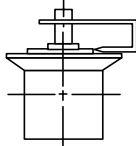
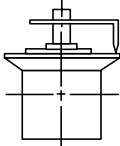
DDK Ltd.

2.1.8 Dimensional tolerances

The servomotor is assembled to the following accuracy.

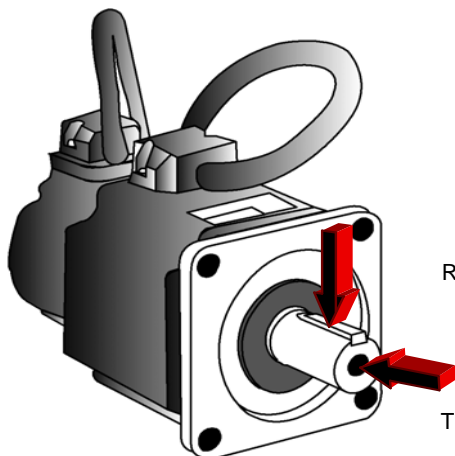
Unit: mm

Type of servomotor	Run-out at shaft end	Center deviation (Flange)	Perpendicularity of flange face (Flange)
GYS□□□DC2	≤ 0.02	≤ 0.06	≤ 0.08
GYG□□□△C2	≤ 0.02	≤ 0.06	≤ 0.08

Run-out at shaft end	Center deviation	Perpendicularity of flange face
		

2.1.9 Load

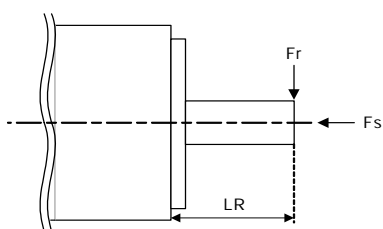
The radial load and thrust load exerted on the shaft end of the servomotor are as follows.



Radial load : Load exerted at right angles to motor shaft

Thrust load : Load exerted in parallel to motor shaft

	Type of servomotor	Allowable radial load F_r [N]	Allowable thrust load F_s [N]	LR [mm]
GYS 3000[r/min]	500DC2-T2A	127	19	25
	101DC2-T2A	127	19	25
	201DC2-T2A	264	58	30
	401DC2-T2A	264	58	30
	751DC2-T2A	676	147	40
GYG 2000[r/min]	501CC2-T2E	400	253	55
	751CC2-T2E	400	253	55
	102CC2-T2E	510	253	55
	152CC2-T2E	510	253	55
	202CC2-T2E	510	253	55
GYG 1500[r/min]	501BC2-T2E	449	253	58
	851BC2-T2E	449	253	58
	132BC2-T2E	575	253	58



2 INSTALLATION

2.2 Servo amplifier

2.2.1 Storage environment

Store the servo amplifier in the following environment when leaving it without energization.

Storage temperature : -20 to 85 °C

Storage humidity : 10 to 90% RH (no condensation allowed)

Storage area : Indoors with altitude of 1000 [m] or less

There shall be no dust, corrosive gas or direct sunlight.

Storage pressure : 70 - 106 [kPa]

Vibration/impact : 4.9 [m/s²]/19.6 [m/s²]

2.2.2 Operating environment

Operate the servomotor in the following environment.

The servo amplifier is not drip-proof and dust resistant.

Operating temperature : -10 to 55 °C

Operating humidity : 10 to 90% RH (no condensation allowed)

Operation area : Indoors with altitude of 1000 [m] or less

There shall be no dust, corrosive gas or direct sunlight.

Operation pressure : 70 - 106 [kPa]

Vibration/impact : 4.9 [m/s²]/19.6 [m/s²]

2.2.3 Mounting

- ① Mount the servo amplifier in the upright direction so that the “FALDIC” characters on the Keypad of the servo amplifier look horizontally.

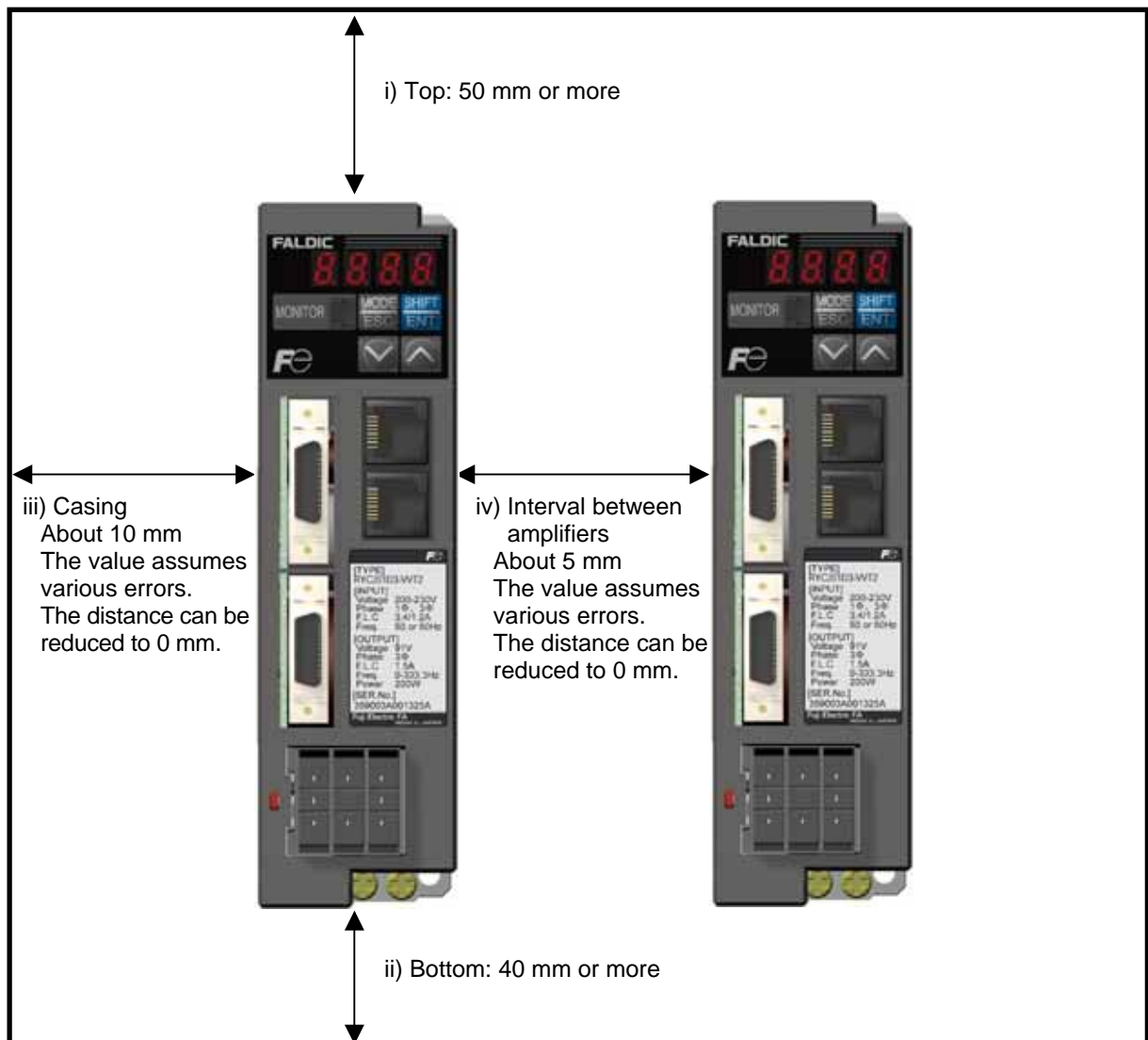


②The servo amplifier has the part that generates heat during operation.

To mount multiple servo amplifiers in the same panel, observe the following precautions.

- Mount side by side in principle. The RYC servo amplifier can be mounted closely. Use the amplifiers at 80% ED rating* if they are installed in contact with each other. There is no limitation in the operation frequency when amplifiers are mounted at 5 mm or larger intervals.
- Reserve 40 mm or a larger distance at the bottom of the servo amplifier.
- 50 mm or a larger distance is necessary above the servo amplifier for heat radiation.

* When the ambient temperature is 45 [°C] or less in close contact, the servo amplifier can be used at 100 [%ED].



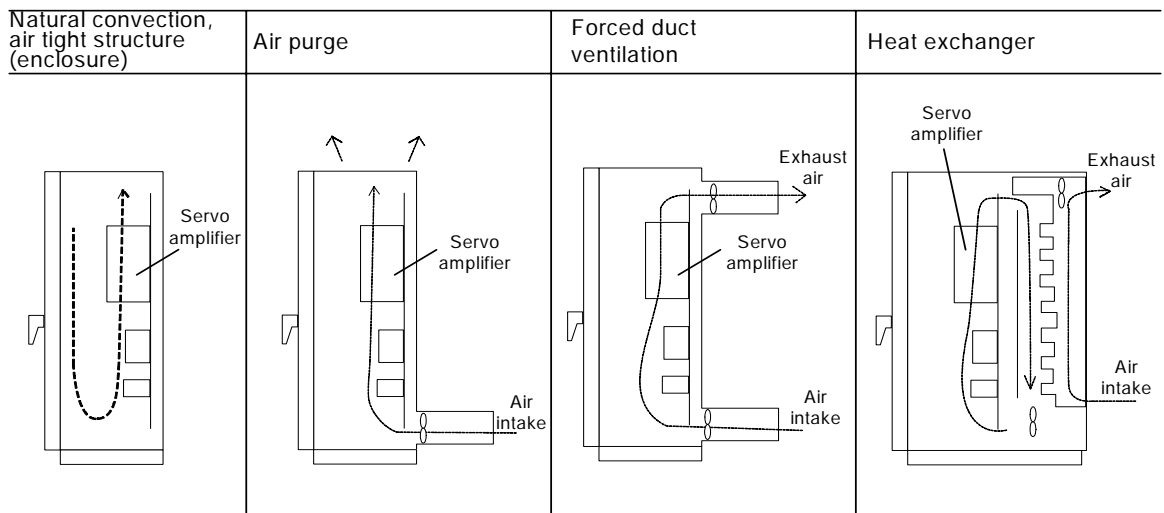
2 INSTALLATION

2.2.4 Handling

The servo amplifier consists of electronic parts including microprocessors. Do not operate in the following environment.

- Location near oil, steam or corrosive gas
- Location with much dust

Mount the servo amplifier in an airtight panel equipped with a forced ventilation fan when using it at places with much dust.



- Location where strong electrostatic or magnetic field exists
- Accommodation in the same panel together with high voltage (3 kV, 6 kV) equipment
- Sharing of the same power supply with the equipment which generates large noise
- Under standing vibration
- In vacuum
- In explosive atmosphere

2.2.5 Power supply to servo amplifier

Supply electric power to the servo amplifier in the specification range.

- Single-phase 200 V: 200 to 230 [VAC] (fluctuation: -10 to +10%)

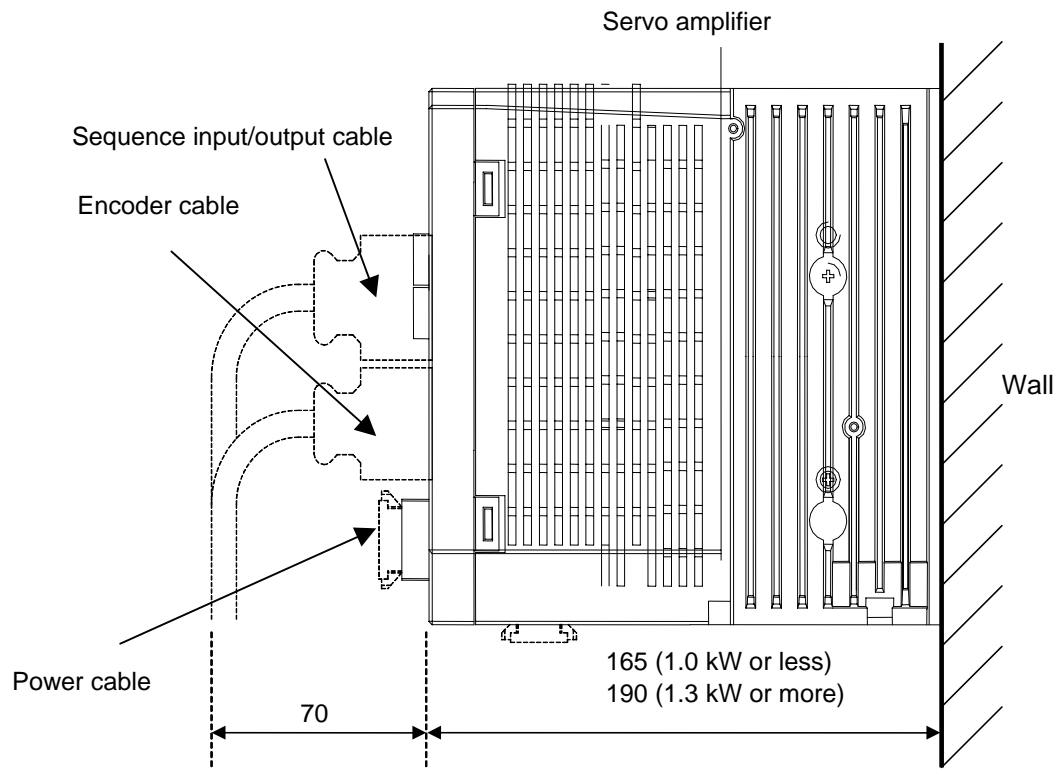
Servo amplifier capacity: 0.75 [kW] or less

- Three-phase 200 V: 200 to 230 [VAC] (fluctuation: -15 to +10%)

Servo amplifier capacity: 0.5 [kW] or more

2.2.6 Depth of amplifier

When the sequence input/output cable and the encoder cable are attached to the servo amplifier, secure a space of 70 [mm] or more at the front.



2 INSTALLATION

-MEMO-

3

WIRING

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3 WIRING

3.1 Configuration

The configuration of FALDIC-W Series is as follows.

(1) Servomotor (without brake)

Circuit breaker/Earth leakage circuit breaker

Circuit breaker/Earth leakage circuit breaker is installed in the primary circuit of the servo amplifier to avoid losses caused by shutdown or power-on or short-circuit current. The electromagnetic contactor may be installed between the circuit breaker and AC reactor.

AC reactor

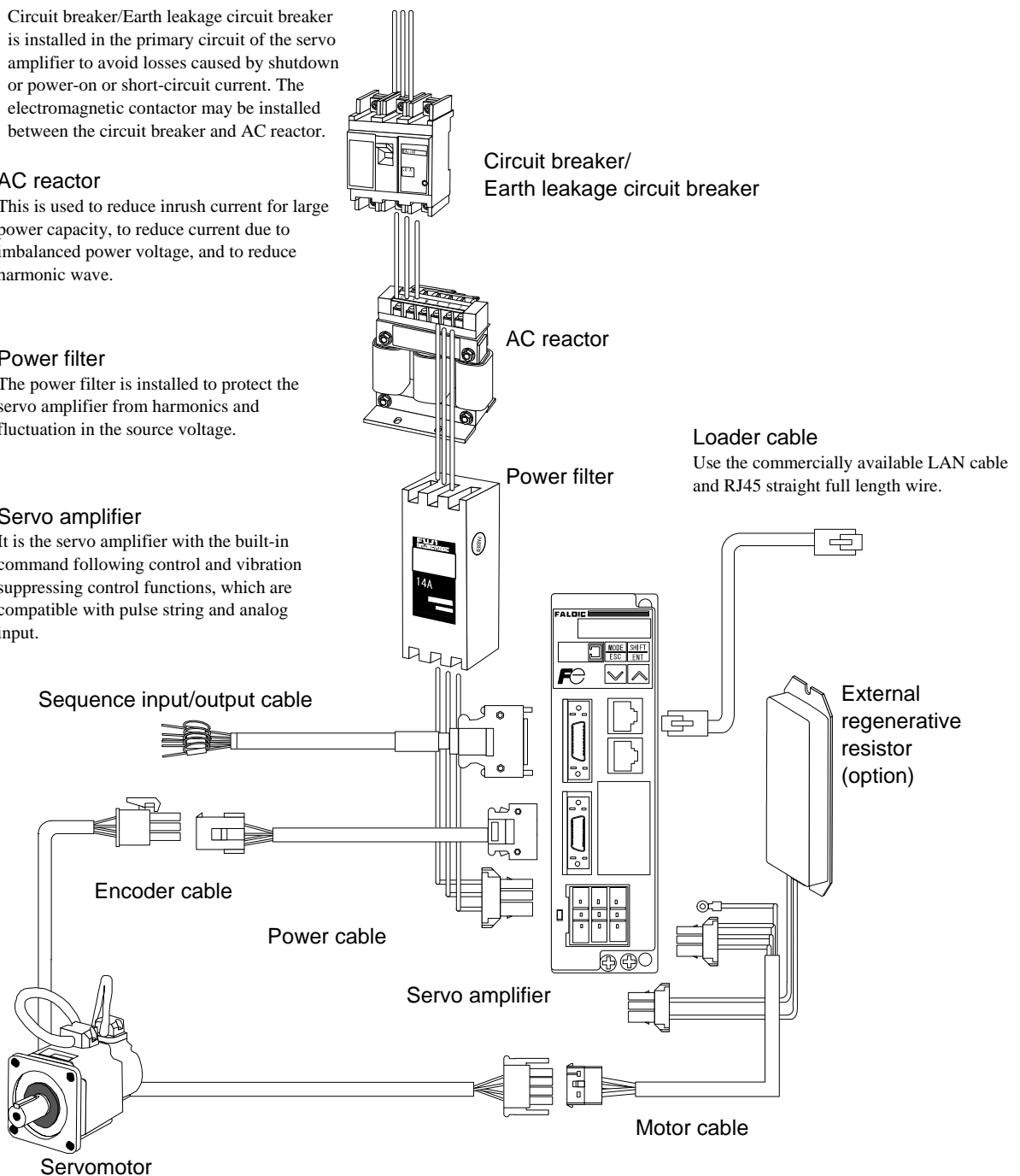
This is used to reduce inrush current for large power capacity, to reduce current due to imbalanced power voltage, and to reduce harmonic wave.

Power filter

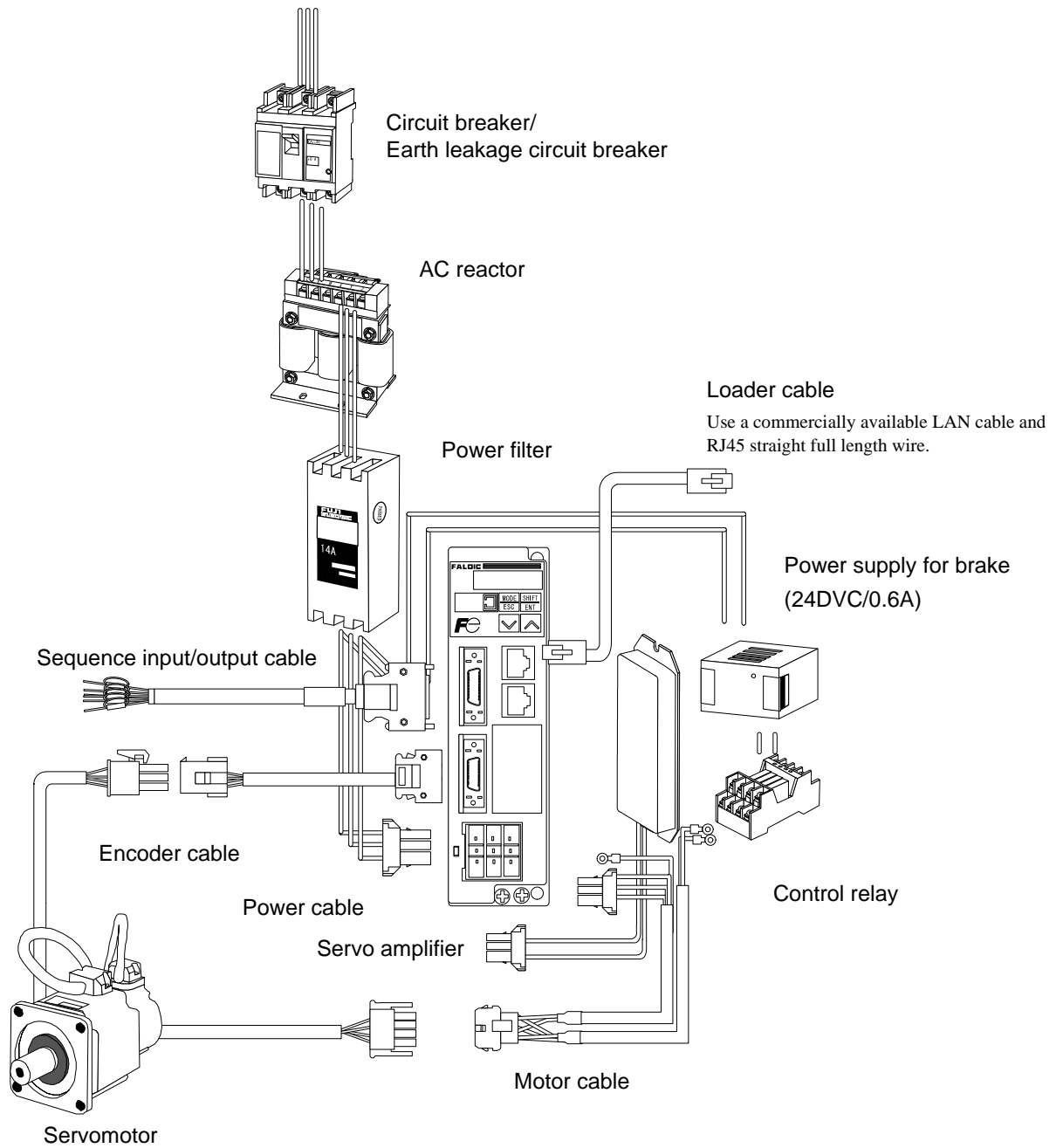
The power filter is installed to protect the servo amplifier from harmonics and fluctuation in the source voltage.

Servo amplifier

It is the servo amplifier with the built-in command following control and vibration suppressing control functions, which are compatible with pulse string and analog input.



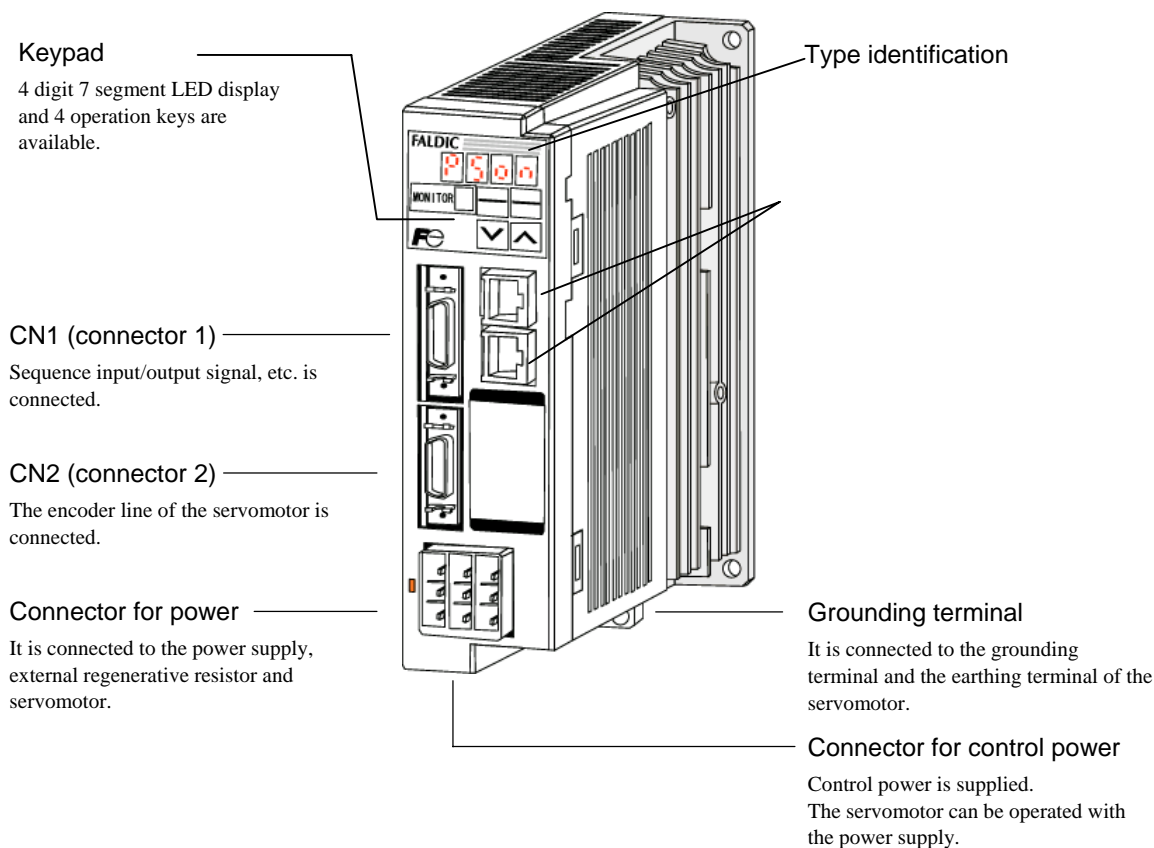
(2) Servomotor (with brake)



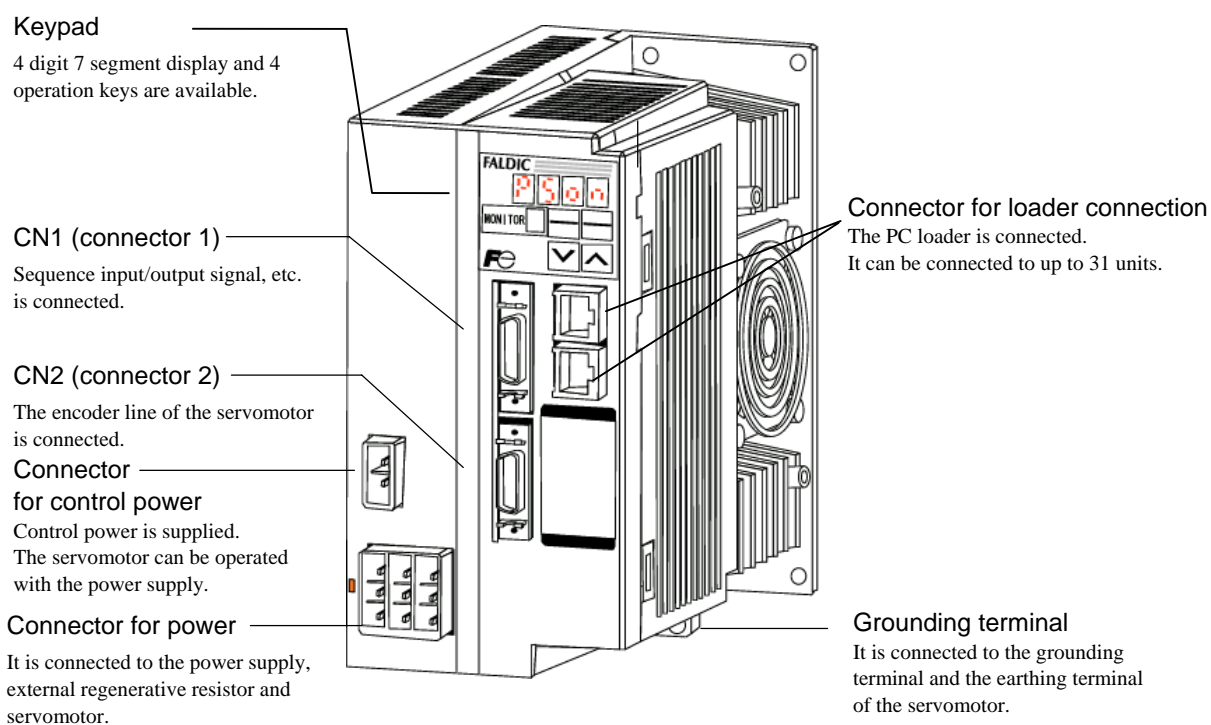
3 WIRING

3.2 Servo amplifier

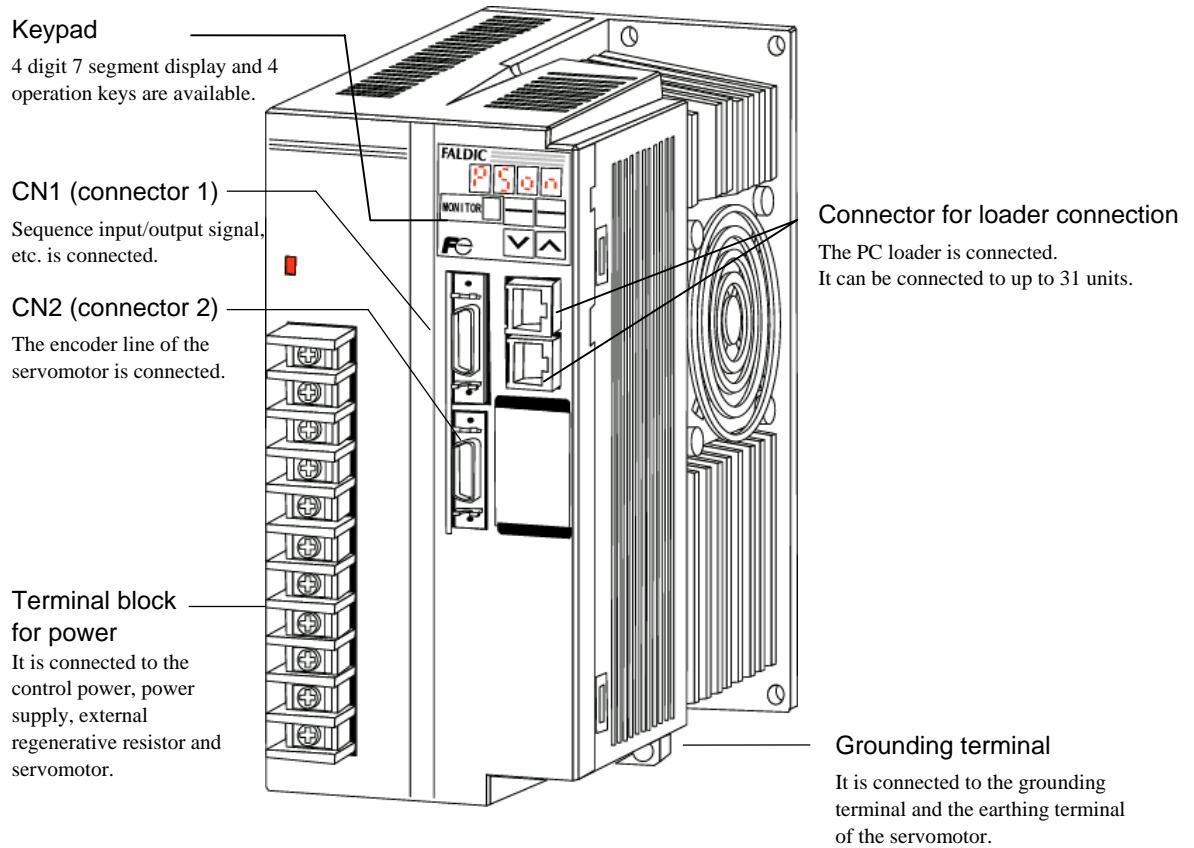
■ Frame 1



■ Frame 2



■ Frame 3



Outer frame	Rated rotation speed	Applicable motor output	Servo amplifier type
Frame 1	3000r/min	0.05kW	RYC500D3-VVT2
		0.1kW	RYC101D3-VVT2
		0.2kW	RYC201D3-VVT2
		0.4kW	RYC401D3-VVT2
Frame 2	3000r/min	0.75kW	RYC751D3-VVT2
		0.5kW	RYC501C3-VVT2
		0.75kW	RYC751C3-VVT2
		1kW	RYC102C3-VVT2
	2000r/min	0.5kW	RYC501B3-VVT2
		0.85kW	RYC851B3-VVT2
Frame 3	2000r/min	1.5kW	RYC152C3-VVT2
		2kW	RYC202C3-VVT2
	1500r/min	1.3kW	RYC132B3-VVT2

3 WIRING

3.2.1 Commercial power supply

Supply the commercial power in chapter 12 to the servo amplifier.

If the commercial power is directly supplied to the servomotor, the servomotor will be damaged.

- GYS type 0.4 kW or less (3000 r/min)

Supply the commercial power of single phase 200V to the servo amplifier. Connect it to L1 and L2 terminals.

Voltage: 200 to 230V, -10% to +10%

Frequency: 50/60 Hz

No. of phases: Single phase (Motor power source: L1, L2)/

Single phase (Control power source: sL1, sL2)

The voltage is reduced from 400V system. (Direct supply may damage the servomotor.)

- GYS type 0.75 kW (3000 r/min)
- GYG type 0.5 kW, 0.75 kW (2000 r/min)
- GYG type 0.5 kW (2000 r/min)

Supply commercial power of single phase 200V or 3 phase 200V to the servo amplifier.

Connect the power to L1 and L2 terminals for single phase and to L1, L2 and L3 terminals for 3 phase.

Voltage: Single phase 200 to 230V, to -10% to +10%, 3 phase 200V to 230V, -15% to +10%

Frequency: 50/60 Hz

No. of phases: Single phase (Motor power source: L1, L2),

3 phase (Motor power source: L1, L2, L3)/

Single phase (Control power source: sL1, sL2)

The voltage is reduced from 400V system. (Direct supply may damage the servomotor.)

- GYG type other than the above

Supply the commercial power of 3 phase 200V to the servo amplifier. Connect the power to L1, L2 and L3 terminals.

Voltage: 3 phase 200V to 230V, -15% to +10%

Frequency: 50/60 Hz

No. of phases: 3 phase (Motor power source: L1, L2, L3)/

Single phase (Control power source: sL1, sL2)

The voltage is reduced from 400V system. (Direct supply may damage the servomotor.)

3.2.2 Power supply capacity

The power supply capacity required for each servo amplifier is as follows. The same power supply capacity applies to the step-up or step-down transformer.

The specified power supply capacity is for the designated cable size and a wiring length of 20m. If the power supply capacity is 500 kVA or more, an AC reactor specified in Chapter 11 should be provided.

(Otherwise the contact of the electromagnetic contactor or the like may melt.)

Input power supply	Type of servo amplifier	Applicable motor example	Power supply capacity
Single phase 200 V (3000 r/min)	RYC500D3-VVT2	GYS500DC2-T2A	0.1kVA
	RYC101D3-VVT2	GYS101DC2-T2A	0.2kVA
	RYC201D3-VVT2	GYS201DC2-T2A	0.4kVA
	RYC401D3-VVT2	GYS401DC2-T2A	0.8kVA
Single phase 200 V (2000 r/min)	RYC501C3-VVT2	GYG501CC2-T2E	1kVA
	RYC751C3-VVT2	GYG751CC2-T2A	1.5kVA
Single phase 200 V (1500 r/min)	RYC501B3-VVT2	GYG501BC2-T2A	1kVA

Input power supply	Type of servo amplifier	Applicable motor example	Power supply capacity
3 phase 200 V (3000 r/min)	RYC751D3-VVT2	GYS751DC2-T2A	1.5kVA
3 phase 200 V (2000 r/min)	RYC501C3-VVT2	GYG501CC2-T2E	1kVA
	RYC751C3-VVT2	GYG751CC2-T2E	1.5kVA
	RYC103C3-VVT2	GYG102CC2-T2E	1.9kVA
	RYC152C3-VVT2	GYG152CC2-T2E	2.9kVA
	RYC202C3-VVT2	GYG202CC2-T2E	3.9kVA
3 phase 200 V (1500 r/min)	RYC510B3-VVT2	GYG501BC2-T2E	1kVA
	RYC851B3-VVT2	GYG851BC2-T2E	1.5kVA
	RYC152B3-VVT2	GYG132BC2-T2E	2.9kVA

3 WIRING

Action to prevent harmonic wave

The multipurpose inverter and the servo amplifier have been excluded from the “Guideline for prevention of harmonic waves in electric appliances and multipurpose products” from January 2004. The procedures to prevent harmonic waves of multipurpose inverters and servo amplifiers are revised from the previous guideline as follows:

All types of multipurpose inverters and servo amplifiers used by a specific user apply to the “Guideline for prevention of harmonic waves by users who receive power at high voltages or especially high voltages”. All users who are requested to apply the guideline should calculate the equivalent capacity or the harmonic wave runoff current according to the guideline. If the harmonic wave current exceeds the limit specified on the contract demand, appropriate action is required. (Refer to JEM-TR 201 and JEM-TR 225.)

Source: Japan Electrical Manufacturers’ Association

Note) The above description is only valid in Japan.

3.2.3 Motor power input/control power input

To connect the motor power input, control power input, external regenerative resistor and servomotor, use the connector or the terminal block.

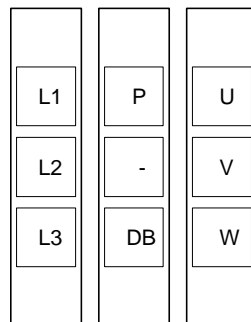
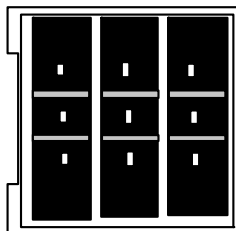
Since connectors do not accompany the servo amplifier, prepare a connector kit or the wiring cable.

Power wiring is as follows:

Power wiring	Servo amplifier type	Applicable motor type example
Connector	RYC500D3-VVT2	GYS500DC2-T2A
	RYC101D3-VVT2	GYS101DC2-T2A
	RYC201D3-VVT2	GYS201DC2-T2A
	RYC401D3-VVT2	GYS401DC2-T2A
	RYC751D3-VVT2	GYS751DC2-T2A
	RYC501C3-VVT2	GYG501CC2-T2E
	RYC751C3-VVT2	GYG751CC2-T2E
	RYC103C3-VVT2	GYG102CC2-T2E
Terminal block	RYC152C3-VVT2	GYG152CC2-T2E
	RYC202C3-VVT2	GYG202CC2-T2E
Connector	RYC510B3-VVT2	GYG501BC2-T2E
	RYC851B3-VVT2	GYG851BC2-T2E
Terminal block	RYC152B3-VVT2	GYG132BC2-T2E

■ Connector

• Connector for motor power



Cable compatible connector (Tyco Electronics AMP)

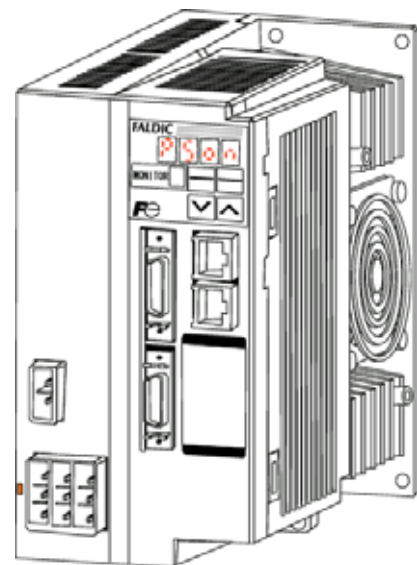
Receptacle housing : 1-178128-3 (L1, L2, L3)

1-178128-3 (P, DB)

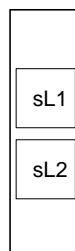
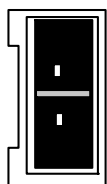
2-178128-3 (U, V, W)

Receptacle contact : 1-175218-5 (Common) * Loose type

1-175196-5 (Common) * Chain type



• Connector for control power



Cable compatible connector (Tyco Electronics AMP)

Receptacle housing : 1-178128-2 (sL1, sL2)

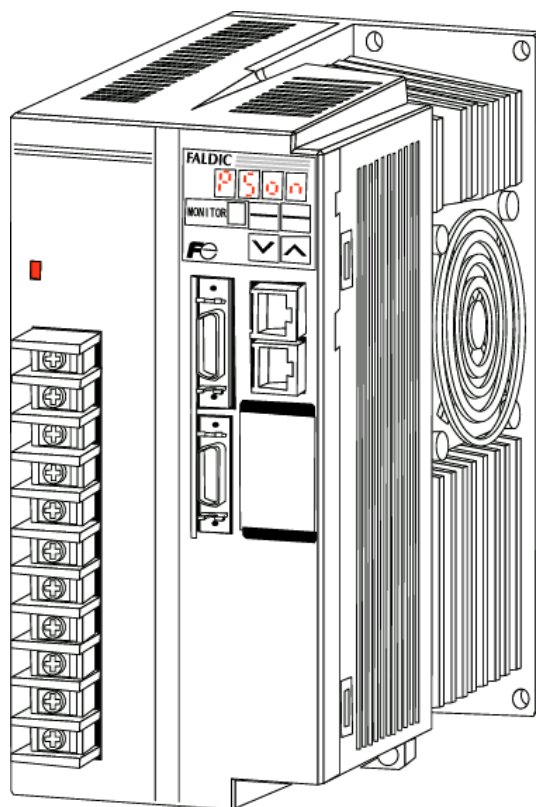
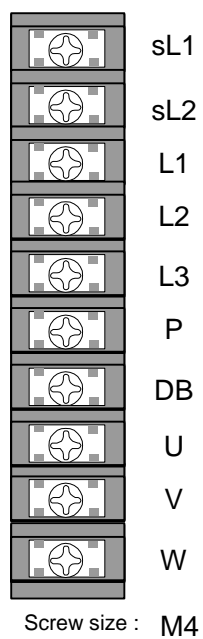
Receptacle contact : 1-175218-5 (Common) * Loose type

1-175196-5 (Common) * Chain type

Manual tool (standard type): 919802-1

3 WIRING

■ Terminal block



3.2.4 Sequence input/output (CN1)

Connect the signal cable of a host controller to connector 1 (CN1) of the servo amplifier.

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	OUT4	17	OUT3	5	CONT4	4	CONT3
16	OUT2	15	OUT1	3	CONT2	2	CONT1
14	M24			1	P24		

Compatible connector on cable side (By Sumitomo 3M)

Soldered plug : 10126-3000V

Shell kit : 10326-52A0-008

Terminal symbol	Pin No.	Name	Function and meaning
P24 M24	1 14	Power supply for sequence input/output	Power supply input for sequence input/output signals (+24VDC, 0.3A)
CONT1 CONT2 CONT3 CONT4 CONT5	2 3 4 5 6	Sequence input	Sequence input signals. The following signals are allocated by the factory settings. (+24VDC, 10 mA) CONT 1: Operation command (RUN) CONT 2: Reset (RST) CONT 3: (Not specified) CONT 4: (Not specified) CONT 5: (Not specified)
OUT1 OUT2 OUT3 OUT4	15 16 17 18	Sequence output	Sequence output signals. The following signals are allocated by the factory settings. (Max. +30VDC / 50mA) OUT 1: Ready [RDY] OUT 2: Positioning end [PSET] OUT 3: Alarm detection b-contact OUT 4: (Not specified)
PPI CA *CA CB *CB	19 7 8 20 21	Pulse string input	PPI: Power supply input for open collector (24 VDC +5%/-5%) CA, *CA, CB, *CB (max. input frequency: 1 MHz) CA, CB (max. input frequency: 200 kHz) The pulse string form can be chosen from command pulse and sign, forward/reverse rotation pulse, and two signals having 90-degree phase difference.
FFA *FFA FFB *FFB FFZ *FFZ FZ M5	9 10 11 12 23 24 25 26	Frequency dividing output	Frequency dividing output terminals. Two signals having 90-degree phase difference in proportion to the rotation of the servomotor are output. (Differential output) The FZ terminal is an open-collector output. (Max. +30VDC, 50mA) M5: Reference potential
Vref	22	Analog input	Input terminal of analog voltage. The speed command voltage for speed control and the torque command voltage for torque control are input. The standard potential is M5 terminal.

* Terminal M5 is not connected to terminal M24.

3 WIRING

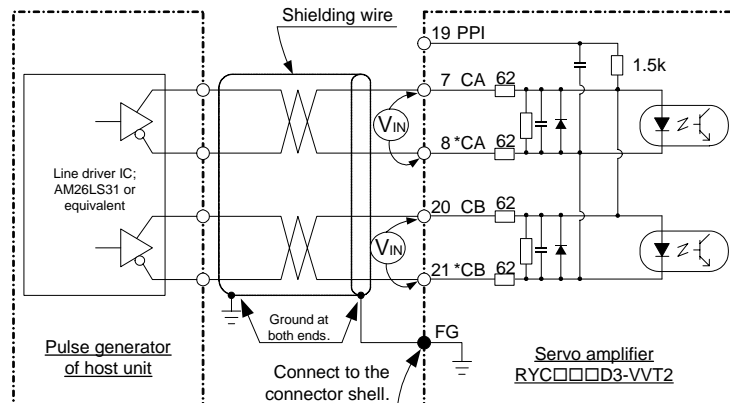
■ Interface circuit diagram

Signal name	Circuit
Sequence input <u>Interface specification</u> 24VDC/10mA (per point)	
Sequence output <u>Interface specification</u> 30VDC/50mA (max)	
Pulse string input <u>Interface specification</u> Differential input (line receiver)	
Pulse string output <u>Interface specification</u> Differential output (line driver)	
Pulse string output (Open collector) <u>Interface specification</u> 30VDC/50mA (max)	
Analog input <u>Interface specification</u> Input impedance 20kΩ	

■ Wiring example of pulse string input

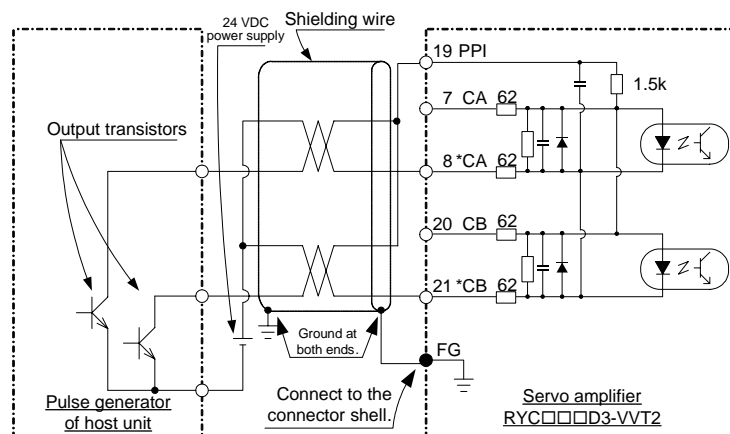
The pulse string input can be a 12 VDC input. In this case, the wiring method varies. Refer to the drawing in item (3) below.

① Differential output devices



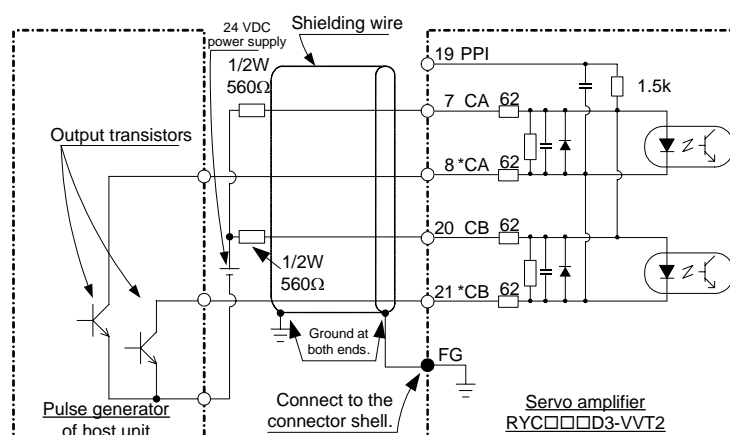
V_{IN} : The voltage amplitude between CA and *CA (between CB and *CB) must be between 2.8 and 3.7V.
(The servo amplifier may not accept the input pulse in other than the specified range.)

② Open collector output devices (24 VDC input)



24 VDC power supply: Contain the source voltage within the 24 VDC $\pm 5\%$ range. This circuit consumes a maximum 40 mA current. Prepare a power supply having a sufficient margin.

③ Open collector output devices (12 VDC input)



12 VDC power supply: Contain the source voltage within the 12 VDC $\pm 5\%$ range. This circuit consumes a maximum 40 mA current. Prepare a power supply having a sufficient margin.

3 WIRING

3.2.5 Encoder (CN2)

Connect the encoder signal of the servomotor to connector 2 (CN2) of the servo amplifier.

19	NC	20	FG	9	NC	10	NC
17	SIG+	18	SIG-	7	NC	8	NC
15	NC	16	NC	5	NC	6	NC
13	NC	14	NC	3	P5	4	P5
11	NC	12	NC	1	M5	2	M5

Cable compatible connector (by Sumitomo 3M Ltd.)

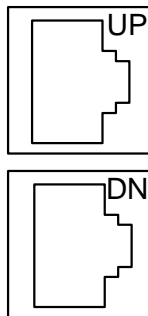
Solder plug : 10120-3000V

Shell kit : 10320-52A0-008

3.2.6 Loader (CN3)

Connect the PC to connector 3 (CN3) of the servo amplifier.

Use the signal converter and the commercially available LAN cable (CAT.5 straight full length wire) for connection. 31 servo amplifiers maximum can be connected.



UP Port

1	P5 (output)
2	M5
3	TXD
4	*RXD
5	RXD
6	*TXD
7	M5
8	P5 (output)

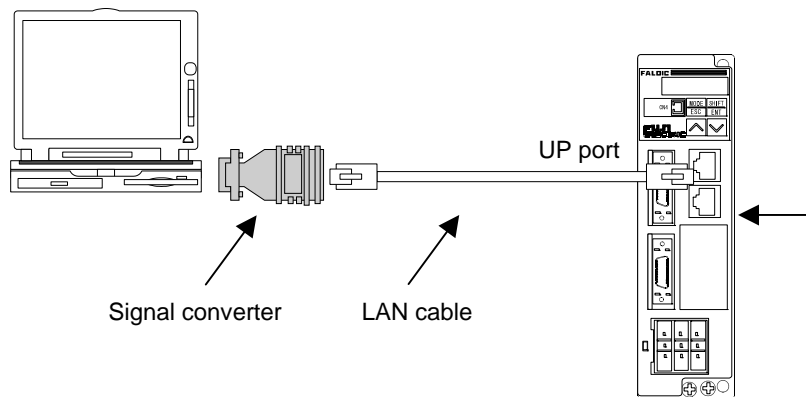
DN Port

1	NC
2	M5
3	TXD
4	*RXD
5	RXD
6	*TXD
7	M5
8	NC

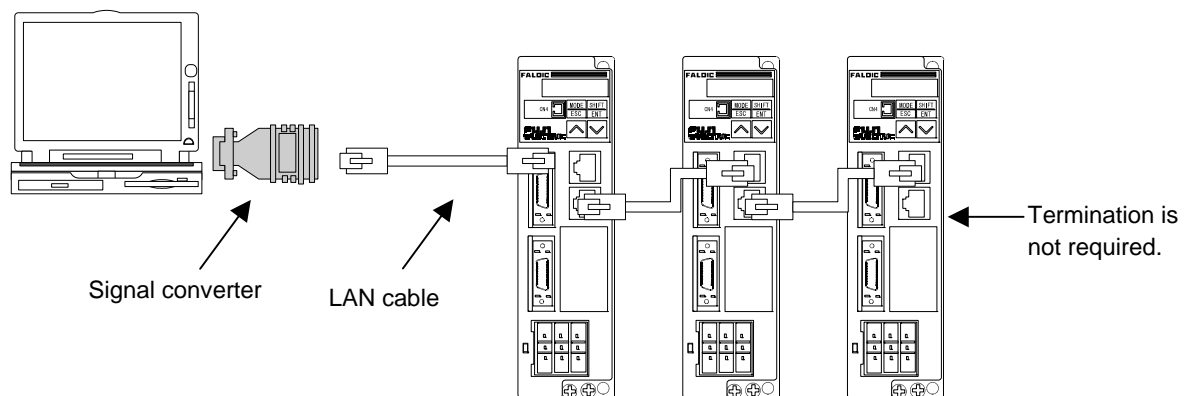
Cable compatible connector
(commercially available product)
RJ-45

Connect the PC to the DN port (lower) and the UP port of the next servo amplifier between the UP port (upper) and the servo amplifier. Final termination is not required.

■ For one servo amplifier



■ For connection to multiple servo amplifiers



3.2.7 Monitor pin (CN4)

Connect the measuring instrument to connector 4 (CN4) of the servo amplifier.

This monitor pin is not required for operation of the servo amplifier and is used for measurement of the servomotor speed waveform and the torque waveform.

CN4 is at the keypad.

Monitor

3	M5	4	M5
1	MON1	2	MON2

Cable compatible connector (by MOLEX)

Solder plug : 10126-3000V

The output of MON1 and MON2 terminals can be set with the standard parameters. The standard potential is M5 terminal.

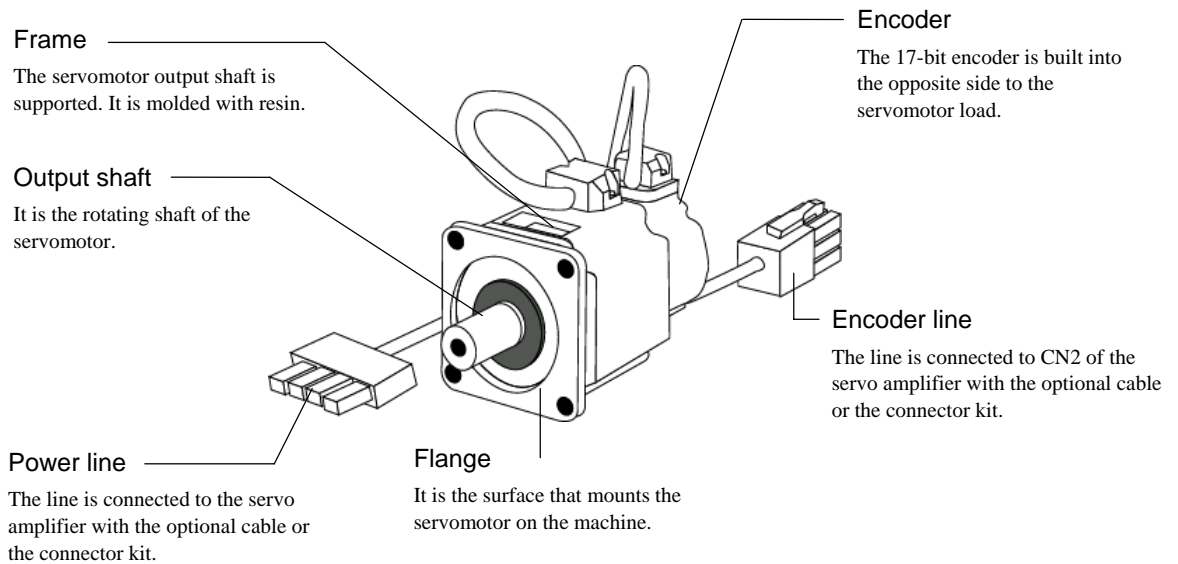
3 WIRING

3.3 Servomotor

■ GYS type 3000 r/min series

The encoder and the power line have lead wires (0.3 m) with connectors.

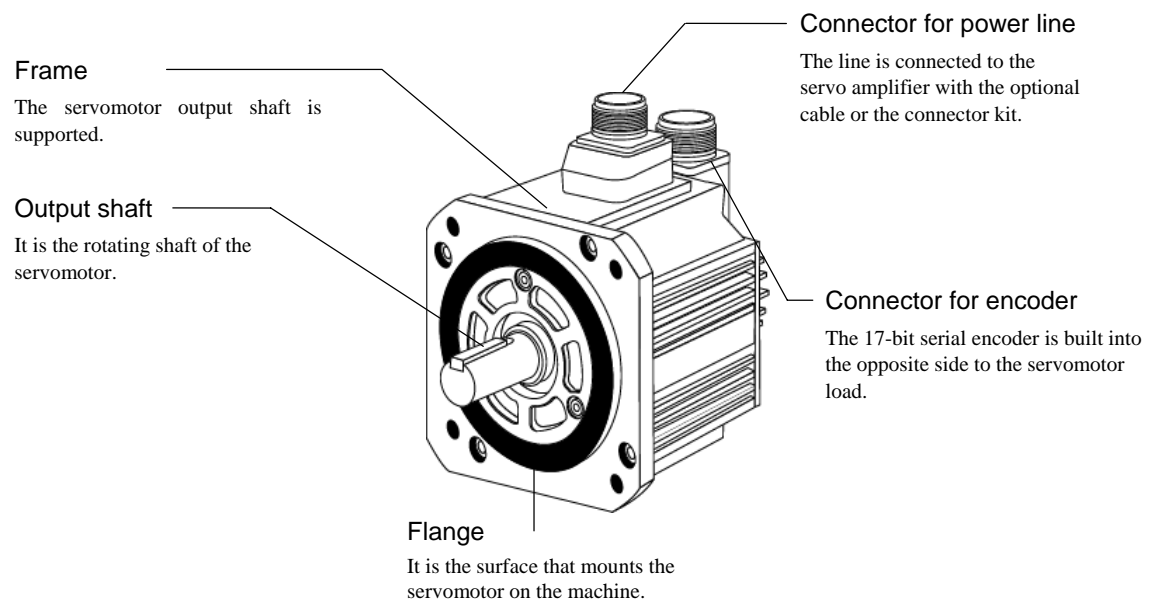
The protection grade is IP67 except for the shaft thru-hole and the connector.



■ GYG type 2000 and 1500 r/min series

Both the encoder and the power line are connected with canon connectors.

The protection grade is IP67 except for the shaft thru-hole.




* The appearance varies depending on the motor capacity.

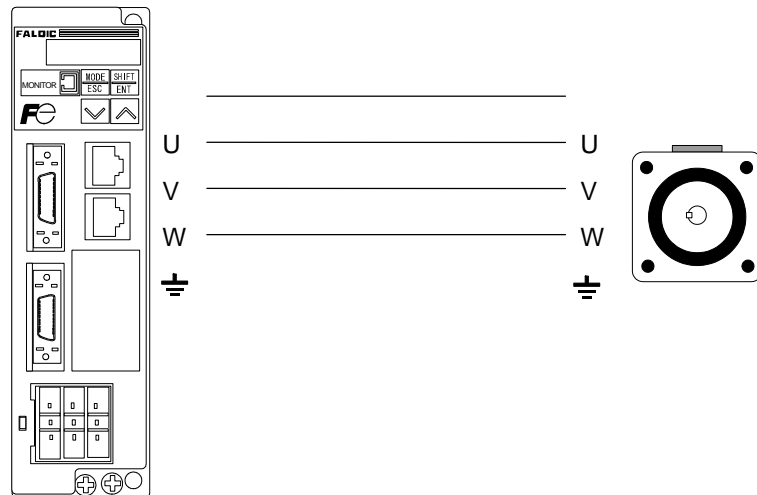
3.3.1 Servomotor

Connect the power cable of the servomotor to the U, V and W terminals of the servo amplifier while identifying the symbols.

Do not supply commercial power directly to the servomotor. Otherwise, the motor may be burned.

 CAUTION	<p>Do not supply commercial power to the servomotor. Otherwise, the motor may be burned.</p>
--	--

The direction of rotation of the servomotor cannot be changed by changing the sequence of the servomotor terminals. Change the parameter 4 setting to achieve this.



The wiring length between the servo amplifier and servomotor should be within 50 m long.

It is not permitted to perform ON/OFF of the wiring between the servo amplifier and servomotor using magnetic contactors. It is not permitted to turning ON/OFF multiple servomotors with a single servo amplifier.

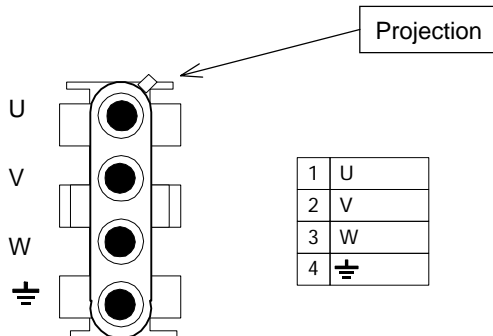
Furthermore, it is not permitted to connect the following equipment along the wiring between the servo amplifier and servomotor:

- Phase advancing capacitor
- Various reactors
- Noise filter
- Surge absorber

3 WIRING

■ GYS type 3000 r/min series

• Without brake



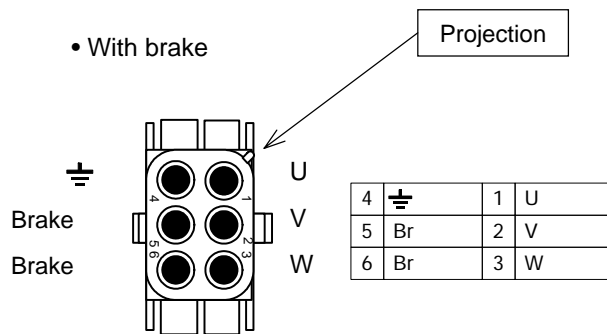
Motor power cable

(Viewed from contact inserting side)

1 cap housing
350780-1 type (Tyco Electronics AMP K.K)

4 contactors (socket)
350689-3 type (Tyco Electronics AMP K.K)

• With brake



Motor power cable

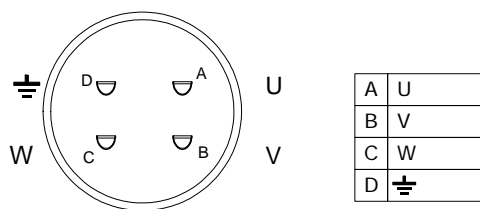
(Viewed from contact inserting side)

1 cap housing
350781-1 type (Tyco Electronics AMP K.K)

6 contactors (socket)
350689-3 type (Tyco Electronics AMP K.K)

■ GYG type 2000 and 1500 r/min series

• Without brake



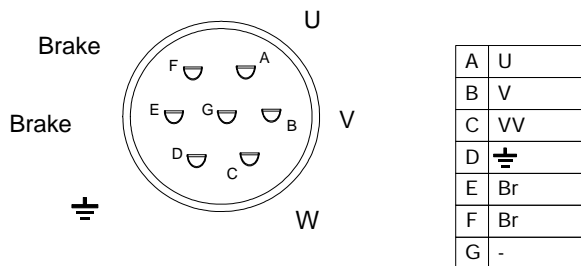
Motor power wiring

(Figure viewed from the plug wiring)

Connector type (L type plug)
MS3108B18-10S type (DDK Ltd.)

Cable clamp
MS3057-10A type type (DDK Ltd.)

- With brake



Motor power wiring

(Figure viewed from the plug wiring).

Note) G pin is vacant.

Connector type (L type plug)
MS3108B20-15P type (DDK Ltd.)

Cable clamp
MS3057-12A type (DDK Ltd.)

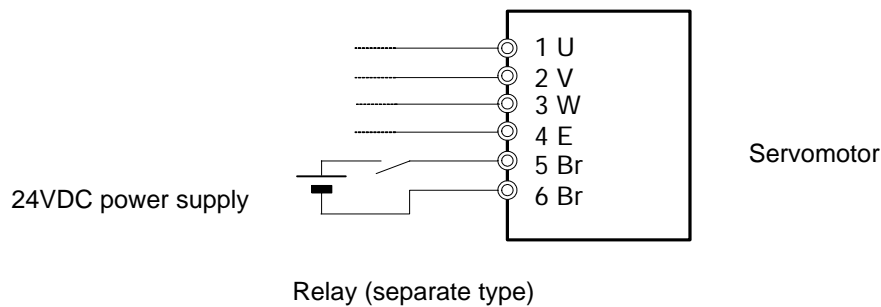
Refer to chapter 2 for straight plug and IP67 compatible connector.

3.3.2 Brake

The built-in motor brake is operated with the 24VDC power.

When 24VDC is applied, the brake is released. When the power is shut off, the brake is operated. The brake operation current is 0.6A or less. It is not directly operated with the sequence output signal of the servo amplifier. The brake power supply has no polarity.

Prepare the relay for rated current of 1A or more. The SSR output has polarity.



Separately prepare the 24VDC power source for the sequence from the 24VDC power source for the brake.

3 WIRING

3.4 Encoder

The 17-bit encoder is built into the opposite side to the servomotor load.

The encoder wire is connected to connector 2 (CN2) of the servo amplifier.

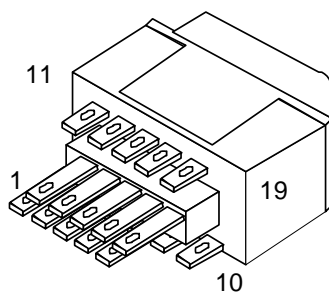
The encoder does not accompany connectors for wiring.

The optional cable with connectors at both ends and the connector kit are available.

The maximum length of the encoder is 50 m and it is restricted by the wiring cable.

■ All GYS models

Wiring on servo amplifier side



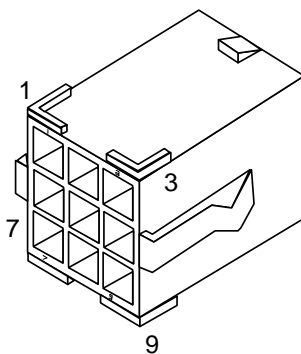
19 NC	20 FG	9 NC	10 NC
17 SIG+	18 SIG-	7 NC	8 NC
15 NC	16 NC	5 NC	6 NC
13 NC	14 NC	3 P5	4 P5
11 NC	12 NC	1 M5	2 M5

Cable compatible connector
(figure viewed
from connector wiring)

Solder plug : 10120-3000V
Shell kit : 10320-52A-008

* By Sumitomo 3M Ltd.

Wiring on servomotor side



1 NC	2 NC	3 FG
4 SIG+	5 SIG-	6 NC
7 P5	8 M5	9 NC

Cable compatible connector
(figure viewed
from terminal insertion)

Cap housing : 172161-1

Terminal socket :

Chain type 170361-1

Loose type 170365-1

* By Tyco Electronics AMP K.K

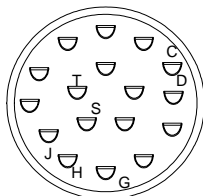
Dedicated crimp tool (manual)

755330-1

Dedicated pin terminal pulling tool

189727-1

■ All GYG models



H	P5
G	M5
C	+SIG
D	-SIG
J	SHIELD

Cable compatible connector
(figure viewed from wiring)

Connector type (L shaped plug)

Type: MS3108B20-29S

(DDK Ltd.)

Cable clamp

Type: MS3057-12A (DDK Ltd.)

• Wiring cable

Use the following cables if the optional encoder cable is not used.

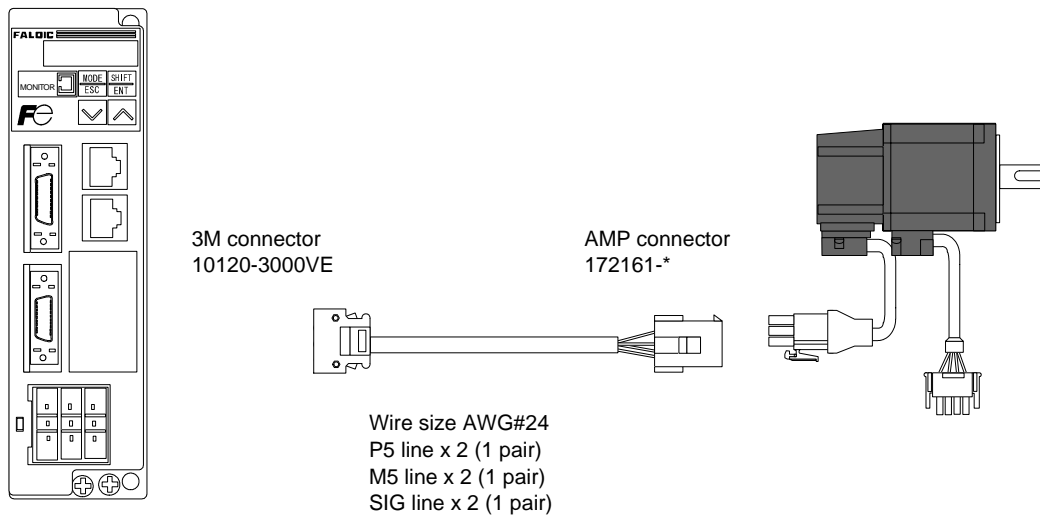
It is a normal twisted pair total shielded wire.

If the motor and the cable are not moving, it is not necessary to use a flexible cable.

■ Cross-link polyethylene insulated, vinyl sheath cable for robot travel (DAIDEN Co., Ltd.)

RMCV-SB-A (UL2464) AWG#24/3P (twisted-pair cable)

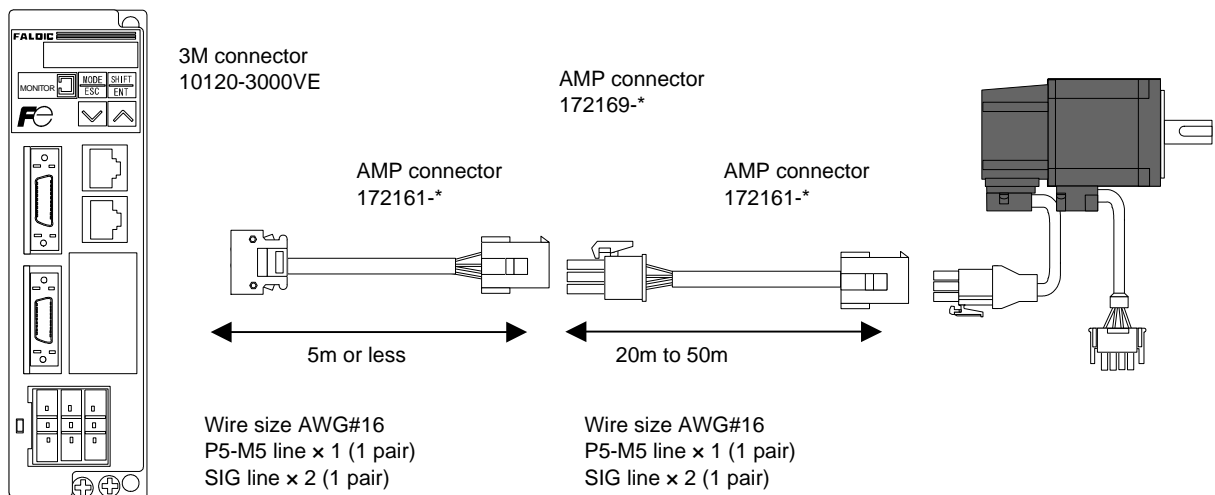
(Cable length: within 20m)



■ Cross-link polyethylene insulated, vinyl sheath cable for robot travel (DAIDEN Co., Ltd.)

RMCV-SB-A (UL2464) AWG#16/2P (twisted-pair cable)

(Wire length exceeds 20m and is 50m or less.)



3 WIRING

- Cable size

See the following table for conversion between AWG and mm sizes.

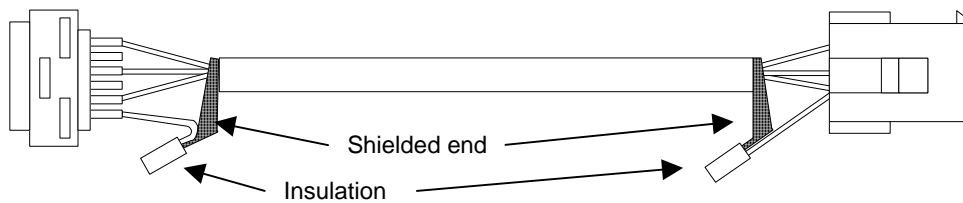
Gauge		SI unit		Inch unit	
A.W.G	mm ² conversion	Diameter [mm]	Sectional area [mm ²]	Diameter [mil]	Sectional area [CM]
16	1.25	1.291	1.309	50.82	2583
17		1.150	1.037	45.26	2048
18		1.024	0.8226	40.30	1624
19		0.9116	0.6529	35.89	1288
20		0.8118	0.5174	31.69	1021
21		0.7229	0.4105	28.46	810.0
22		0.6438	0.3256	25.35	642.6
23		0.5733	0.2581	22.57	509.4
24		0.5106	0.2047	20.10	404.0
25		0.4545	0.1623	17.90	320.4
26		0.4094	0.1288	15.94	254.1
27		0.3606	0.1021	14.20	201.6
28		0.3211	0.08097	12.64	159.8
29		0.2859	0.06425	11.26	126.8
30		0.2546	0.05097	10.03	100.6

■ Preparation method of encoder cable

- 1) Do not provide a relay terminal block between the servo amplifier and the servomotor.
- 2) Use a shielded wire.
- 3) Connect the end of the shielded wire to the connector pin.

For transmission between the servo amplifier and the encoder, high speed serial communication is used. To obtain reliability of the serial communication, it is important to shield the cable (connectors at both ends).

Perform shielding according to the procedure below:



3 WIRING

4) Allow for voltage drop of the cable.

The encoder consumes a current of approx. 200 mA.

When the wire resistance of the encoder is 1.59Ω or less, the encoder can be operated.

Considering the voltage drop of the cable, the relationship of the wire length (L) between the servo amplifier and the servomotor for the conductor resistance is as shown in formula ①.

$$\text{Wire length (L [m])} \leq \frac{1.59 [\Omega]}{\text{Conductor resistance } [\Omega/\text{km}]} \times 1000[\text{m}] \times \frac{1}{2^*} \dots\dots \text{Formula ①}$$

* The reason for the voltage drop is two wires of P5 and M5.

<Example>

When the wire resistance of AWG24 is 85.9 Ω/km (*1), with formula ①

$$\text{Wire length (L [m])} \leq \frac{1.59 [\Omega]}{85.9 [\Omega/\text{km}]} \times 1000[\text{m}] \times \frac{1}{2^*} = 9.25[\text{m}]$$

Therefore, Wire length (L [m]) ≤ 9.25 [m]

When the distance between the amplifier and the motor is 9.25 m or less, the encoder can be used. Determine the encoder wire length after checking the maximum conductor resistance (Ω/m) with your cable.

*1: For bridging wire AWG24 by Hitachi Cable, the maximum conductor resistance is 0.0859Ω/m.

3.5 Connection diagrams

Connection diagrams of the servo amplifier are shown here.

- (1) 3000 r/min series 0.05 kW - 0.4 kW
- (2) 3000 r/min series 0.75 kW
- (3) 2000 r/min series 0.5 kW - 0.75 kW
- (4) 2000 r/min series 1 kW - 2 kW
- (5) 1500 r/min series 0.5 kW
- (6) 1500 r/min series 0.85 kW - 1.3 kW

- The servomotor shows the wiring diagram of the motor with a brake.
The servomotor without a brake does not have No. 5 and 6 terminals or E, F and G terminals.

- Refer to Section 3.6 for the connection of other devices.

- The sequence input/output terminal initial values of the servo amplifier are as follows:

Settings before shipment from factory

CONT1: Servo ON	OUT1 terminal: Servo ready
CONT2: Alarm reset	OUT2 terminal: Positioning end
CONT3: (Not specified)	OUT3 terminal: Servo alarm (b contact)
CONT4: (Not specified)	OUT4 terminal: (Not specified)
CONT5: (Not specified)	

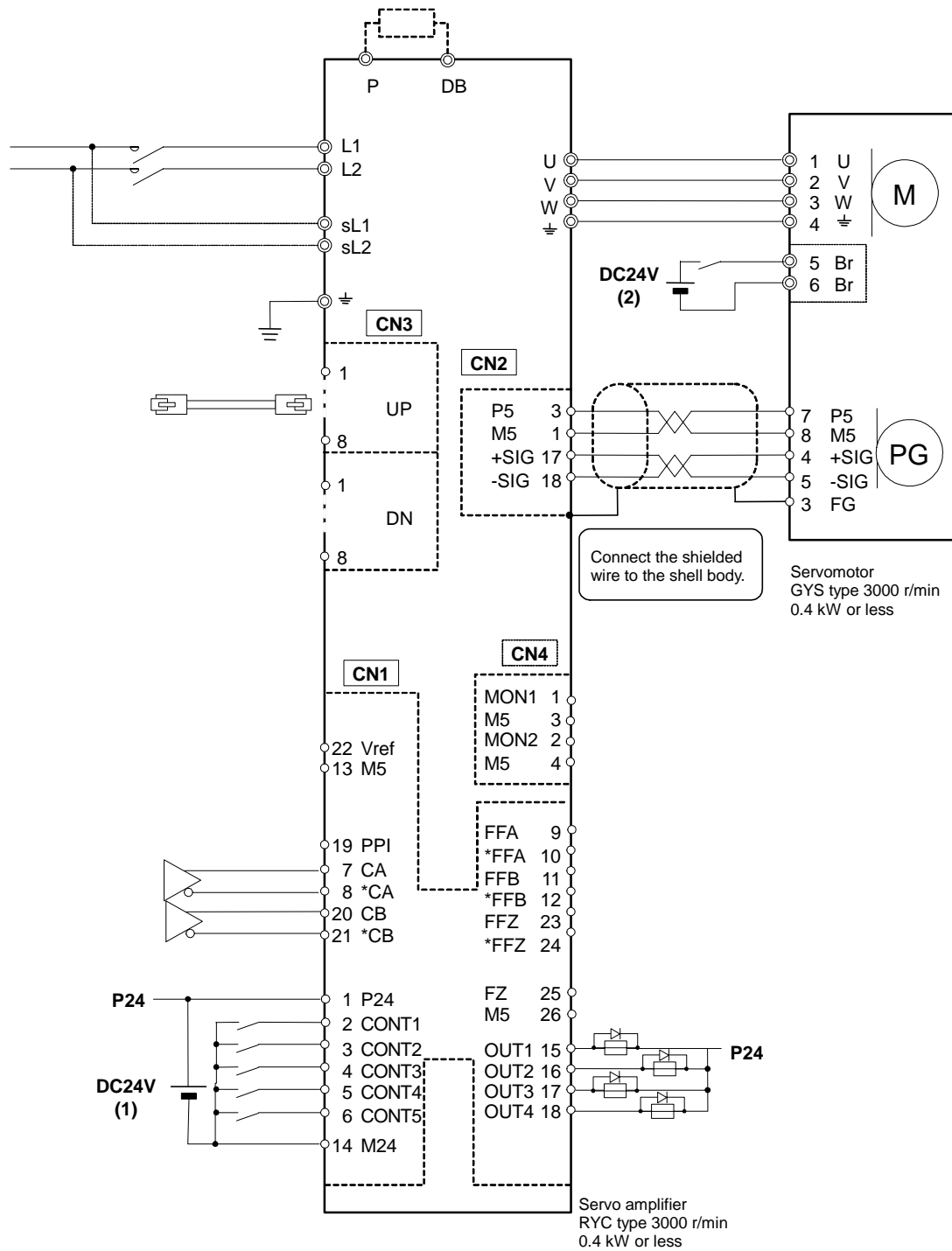
- Connector 4 (CN4) is not required for operation of the servomotor.
It is used for measurement of the servomotor speed waveform and the torque waveform using measuring instruments.
- The control power input terminal (sL1, sL2) is connected to perform parameter editing while the motor power is shut off. The servo amplifier is only operated with the motor power supply.
- Do not use the 24VDC power for both sequence input/output and the brake.
When the brake is released, the voltage may suddenly increase.
Also use a surge absorber.

3 WIRING

(1) 3000 r/m series 0.05 kW - 0.4 kW

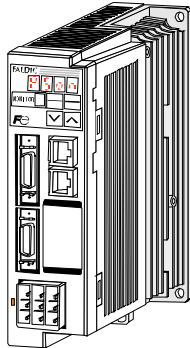
Input power supply : Single phase 200 - 230V

Motor power wiring : Connector

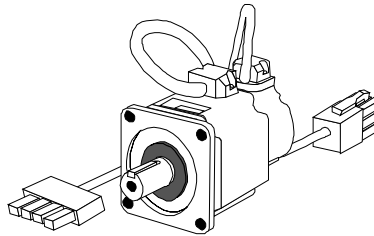


- RYC500D3-VVT2 (0.05kW) /RYC101D3-VVT2 (0.1kW) /RYC201D3-VVT2 (0.2kW)
/RYC401D3-VVT2 (0.4kW)

• Example of servo amplifier appearance



• Example of servomotor appearance



• Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-D
Motor power cable (5 m)	Without brake	WSC-M04P05-B
	With brake (*1)	WSC-M06P05-B

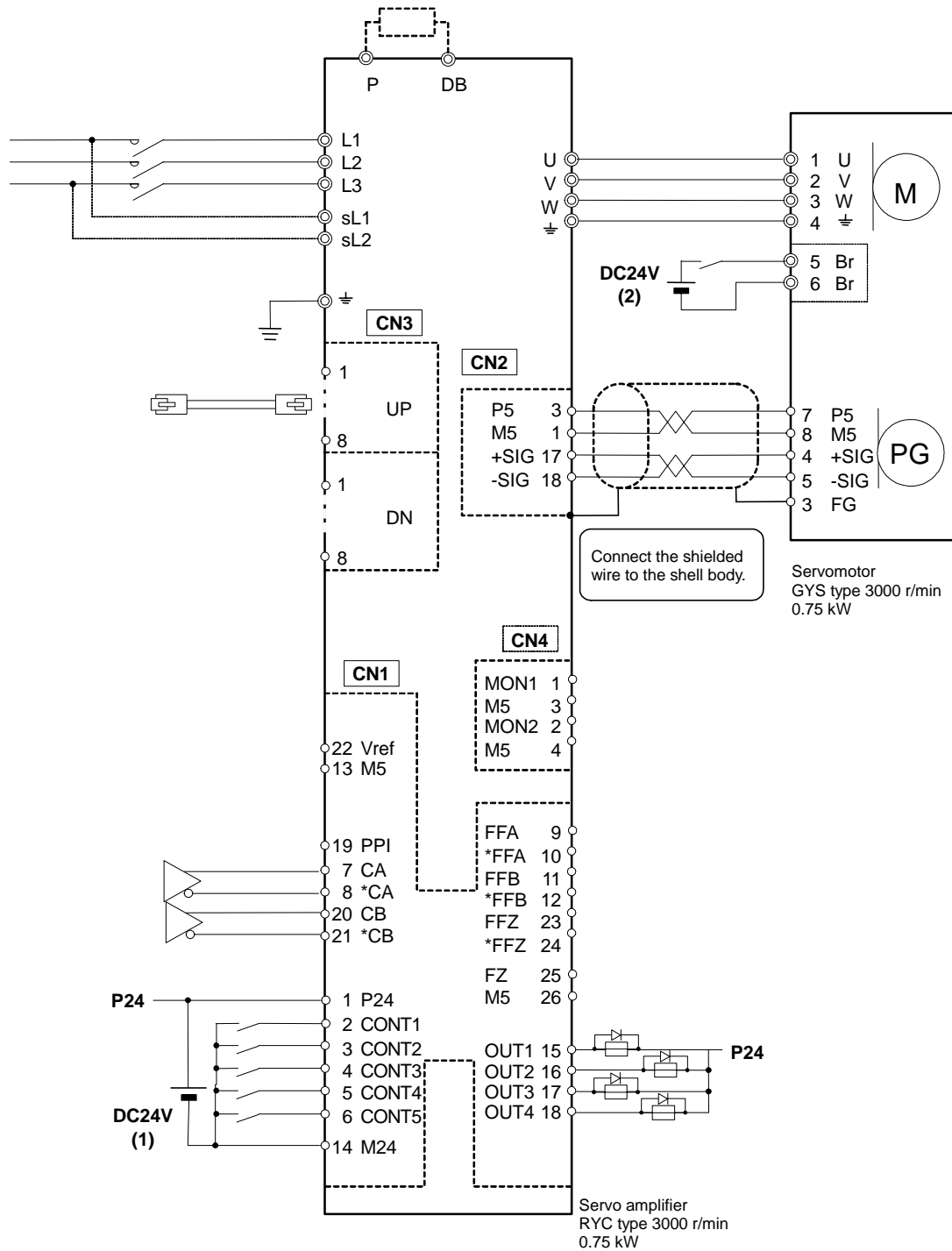
* 1) Prepare wires for the brake separately.

3 WIRING

(2) 3000 r/m series 0.75 kW

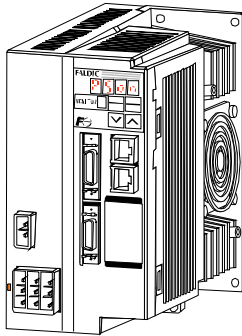
Input power supply : Single phase 200 - 230V or 3 phase 200 - 230V

Motor power wiring : Connector

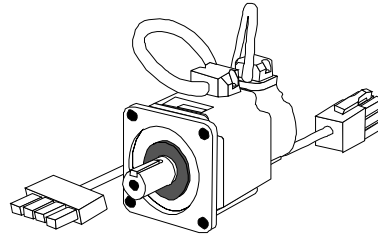


■ RYC751D3-VVT2 (0.75kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-D
Motor power cable (5 m)	Without brake	WSC-M04P05-B
	With brake (*1)	WSC-M06P05-B

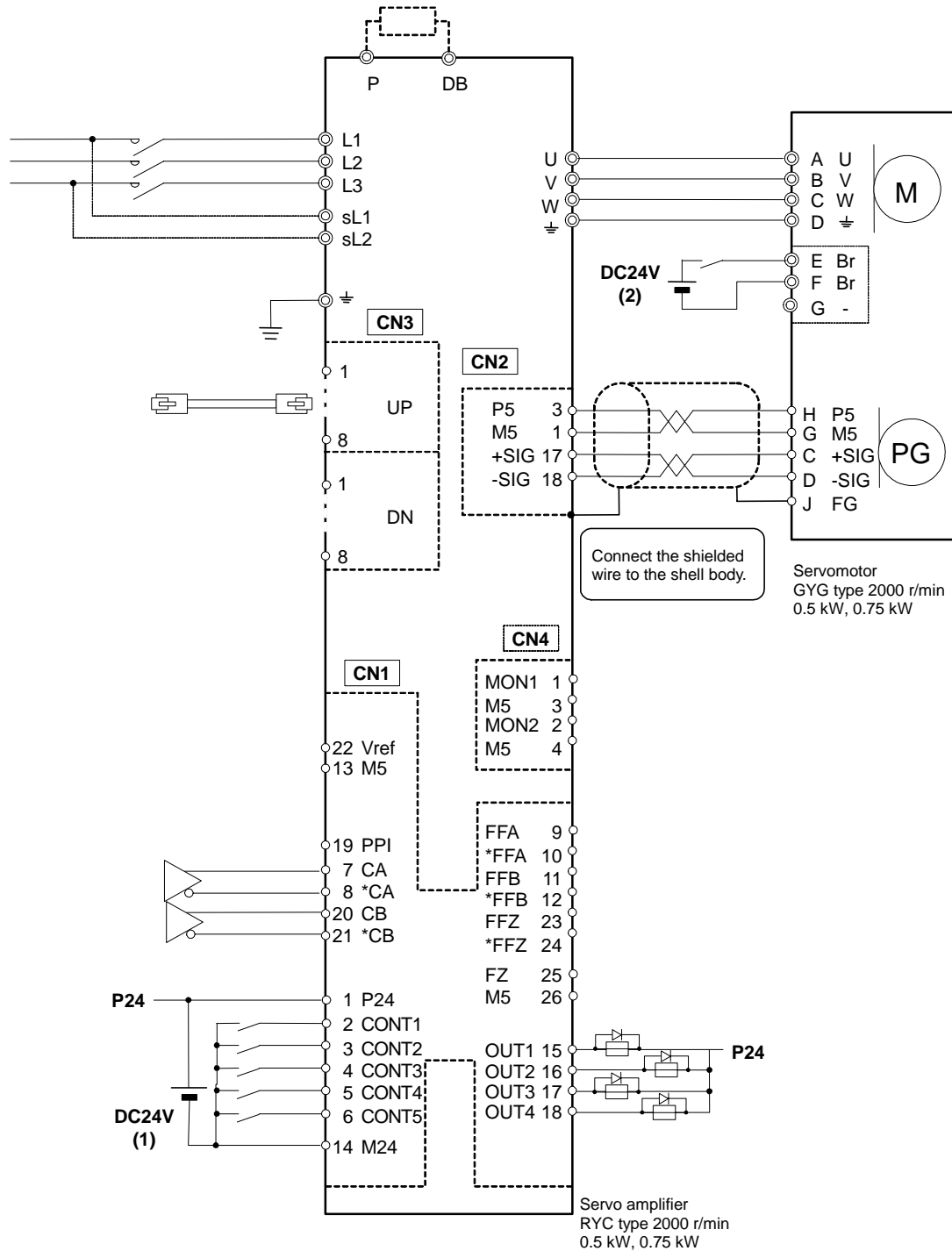
* 1) Prepare wires for the brake separately.

3 WIRING

(3) 2000 r/m series 0.5 kW - 0.75 kW

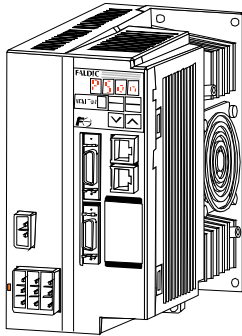
Input power supply : Single phase 200 - 230V or 3 phase 200 - 230V

Motor power wiring : Connector

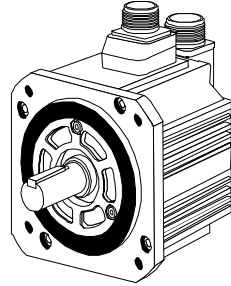


■ RYC501C3-VVT2 (0.5kW) /RYC751C3-VVT2 (0.75kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	WSC-M04P05-WD Connector kit : WSK-M04P-CA
	With brake (*1)	WSC-M04P05-WD Connector kit : WSK-M06P-CA

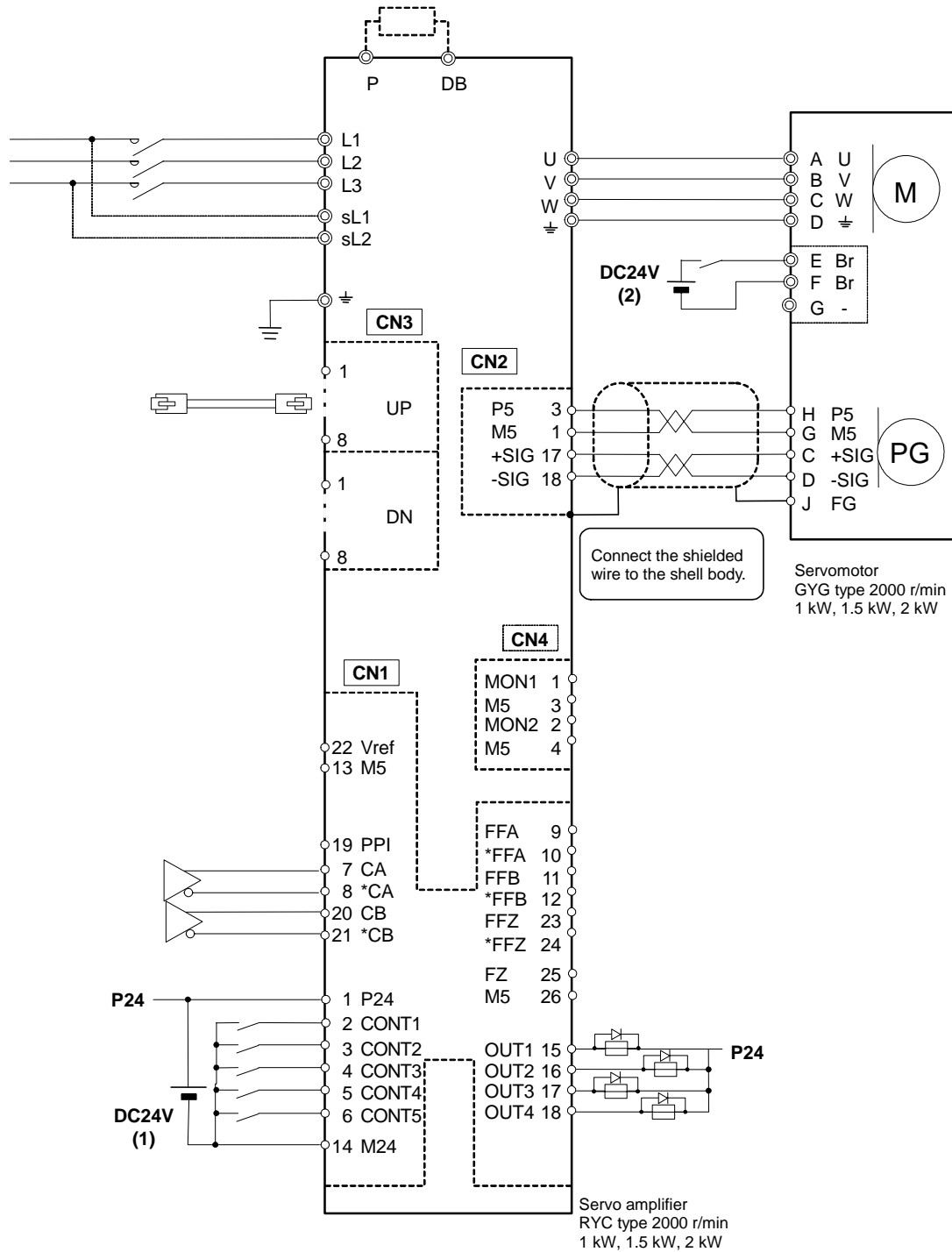
* 1) Prepare wires for the brake separately.

3 WIRING

(4) 2000 r/m series 1 kW - 2 kW

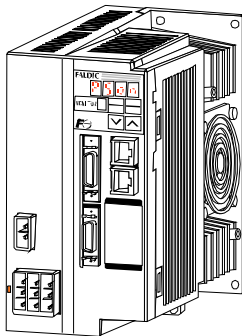
Input power supply : 3 phase 200 - 230V

Motor power wiring : Connector (1 kW), terminal block (1.5 kW, 2 kW)

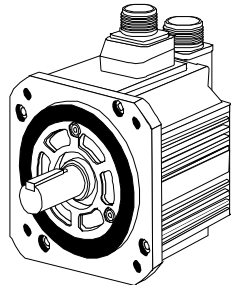


■ RYC102C3-VVT2 (1kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



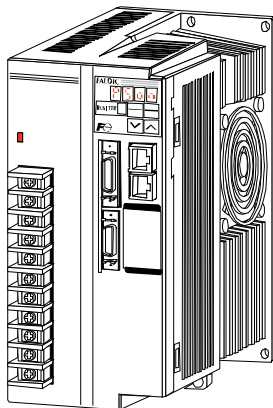
- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	WSC-M04P05-WD Connector kit : WSK-M04P-CA
	With brake (*1)	WSC-M04P05-WD Connector kit : WSK-M06P-CA

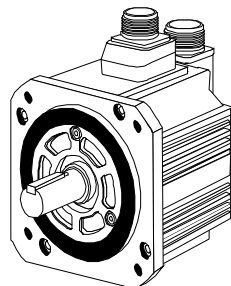
*1) Prepare wires for the brake separately.

■ RYC152C3-VVT2 (1.5kW) /RYC202C3-VVT2 (2kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		(Terminal block: M4)
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	- Connector kit : WSK-M04P-CA
	With brake (*1)	- Connector kit : WSK-M06P-CA

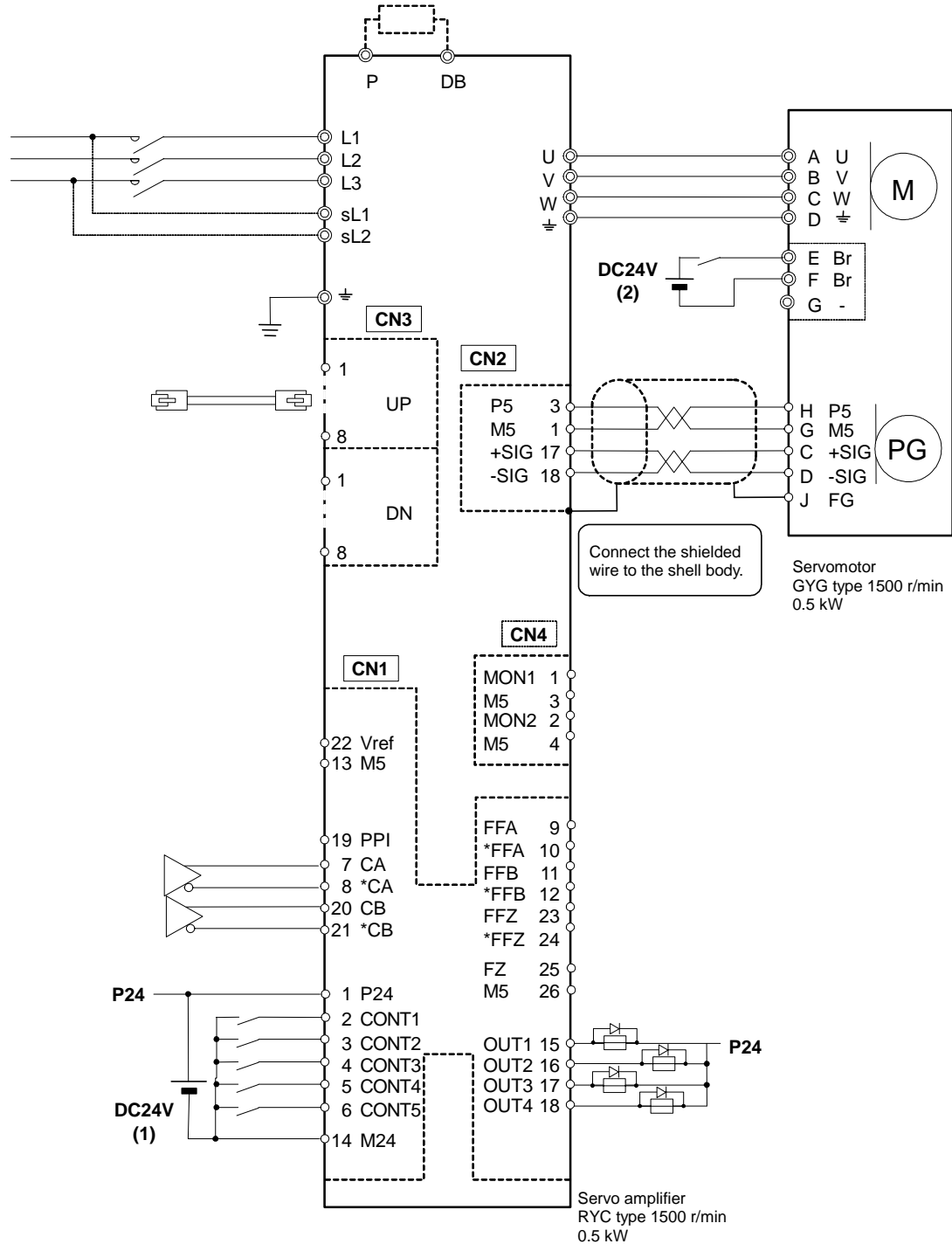
* 1) Prepare wires for the brake separately.

3 WIRING

(5) 1500 r/m series 0.5 kW

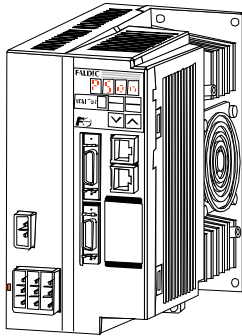
Input power supply : Single phase 200 - 230V or 3 phase 200 - 230V

Motor power wiring : Connector

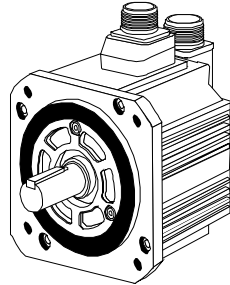


■ RYC501B3-VVT2 (0.5kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	WSC-M04P05-WD Connector kit : WSK-M04P-CA
	With brake (*1)	WSC-M04P05-WD Connector kit : WSK-M06P-CA

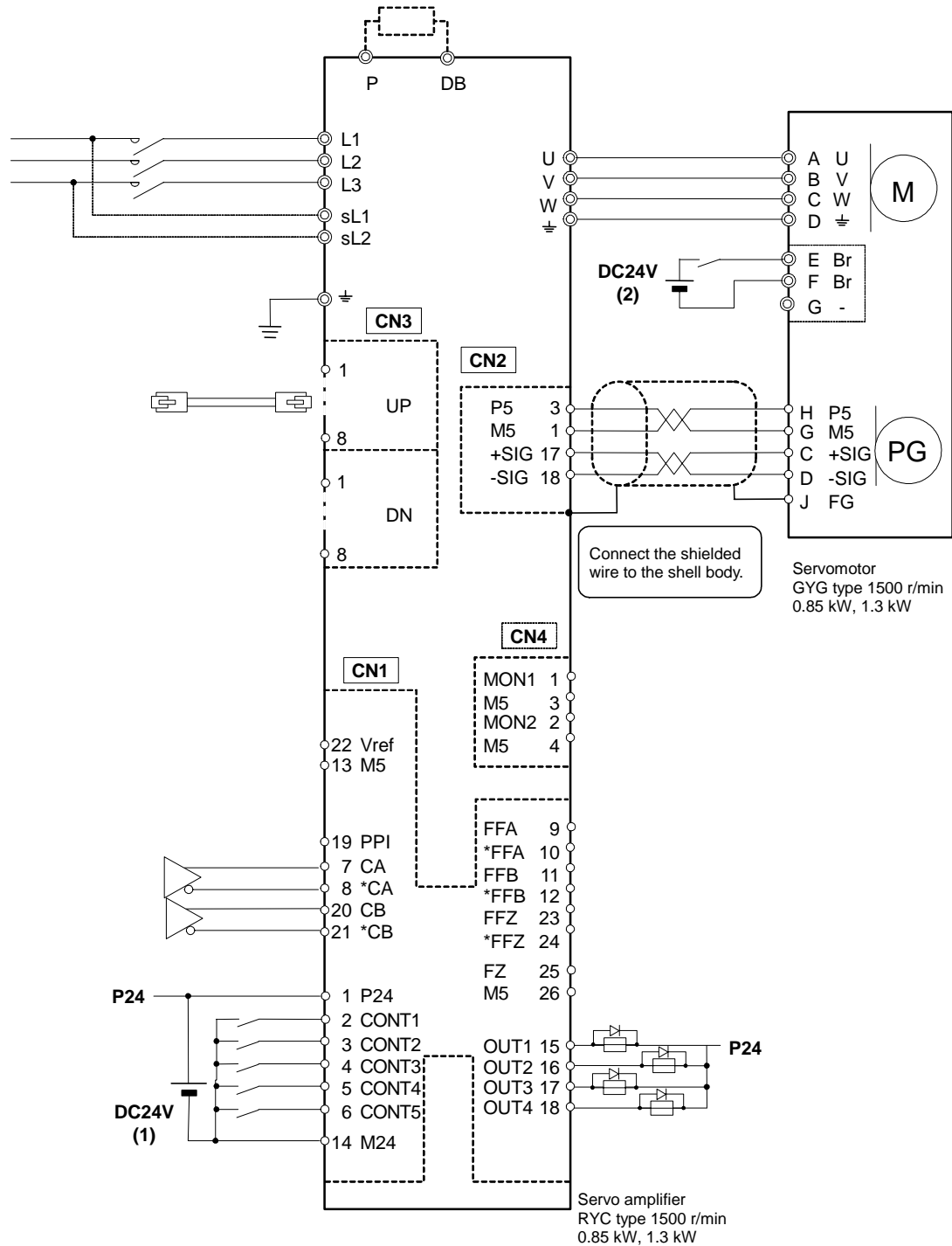
* 1) Prepare wires for the brake separately.

3 WIRING

(5) 1500 r/m series 0.85 kW - 1.3 kW

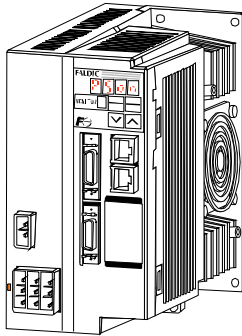
Input power supply : Single phase 200 - 230V

Motor power wiring : Connector (0.85 kW), terminal block (1.3 kW)

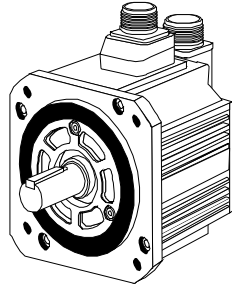


■ RYC851B3-VVT2 (0.85kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



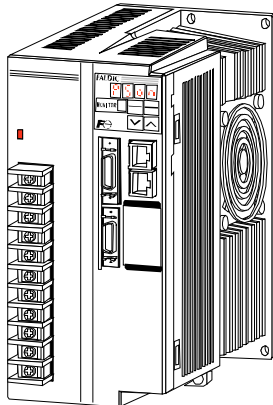
- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		WSC-S03P03-B
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	WSC-M04P05-WD Connector kit : WSK-M04P-CA
	With brake (*1)	WSC-M04P05-WD Connector kit : WSK-M06P-CA

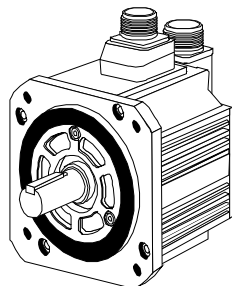
*1) Prepare wires for the brake separately.

■ RYC132B3-VVT2 (1.3kW)

- Example of servo amplifier appearance



- Example of servomotor appearance



- Optional cable

Description		Type
Sequence input/output cable		WSC-D26P03
Power wiring cable		(Terminal block: M4)
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	Without brake	- Connector kit : WSK-M04P-CA
	With brake (*1)	- Connector kit : WSK-M06P-CA

*1) Prepare wires for the brake separately.

3 WIRING

-MEMO-

3.6 Connection examples

Examples of connections to each device are described.

For products not specified in this manual, be sure to refer to the operation manual or user's manual of the corresponding equipment. The connection diagrams shown in this chapter are for reference only.

- Positioning module (NP1F-MP2)
- Positioning unit (QD75D type)
- Position control unit (NC113)

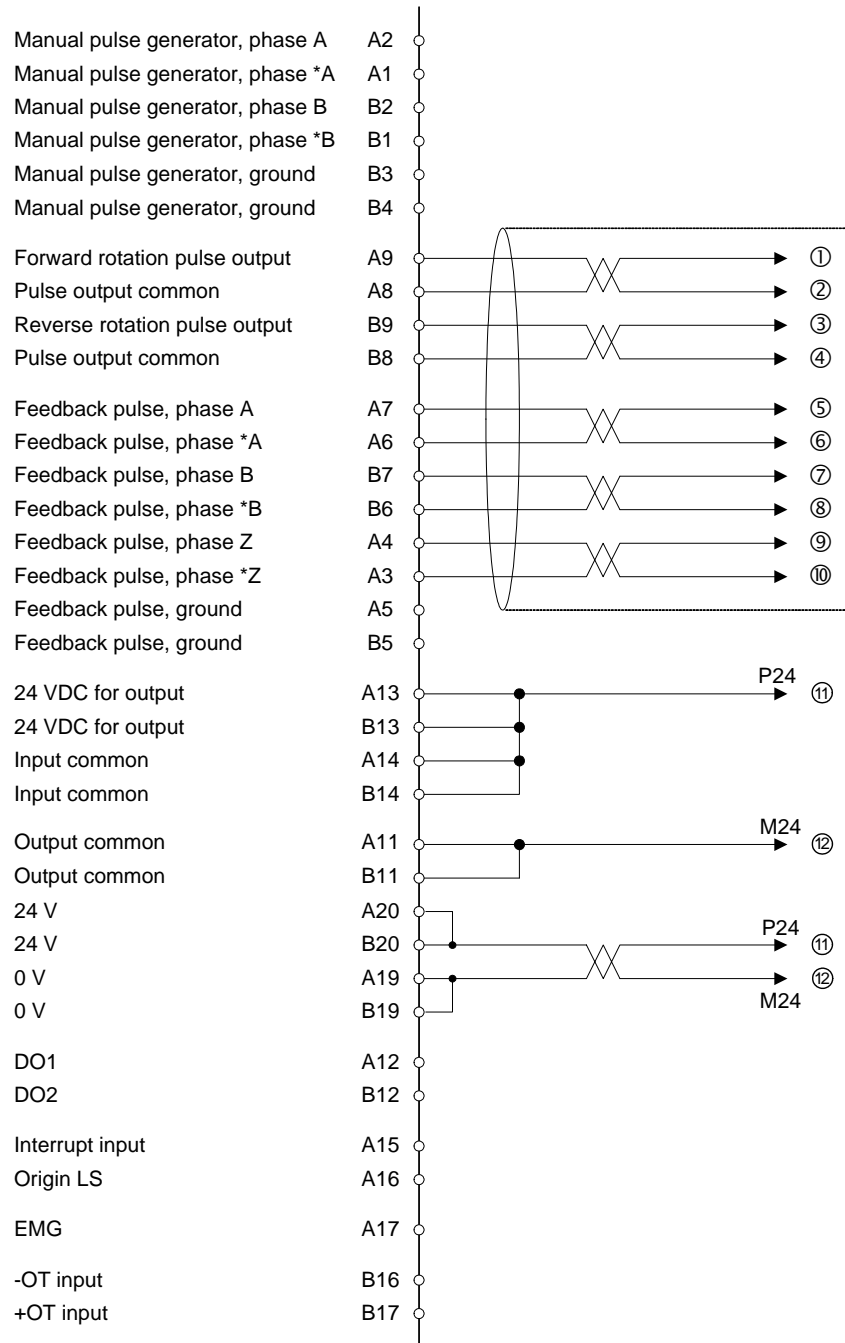
3 WIRING

■ Positioning module (NP1F-MP2)

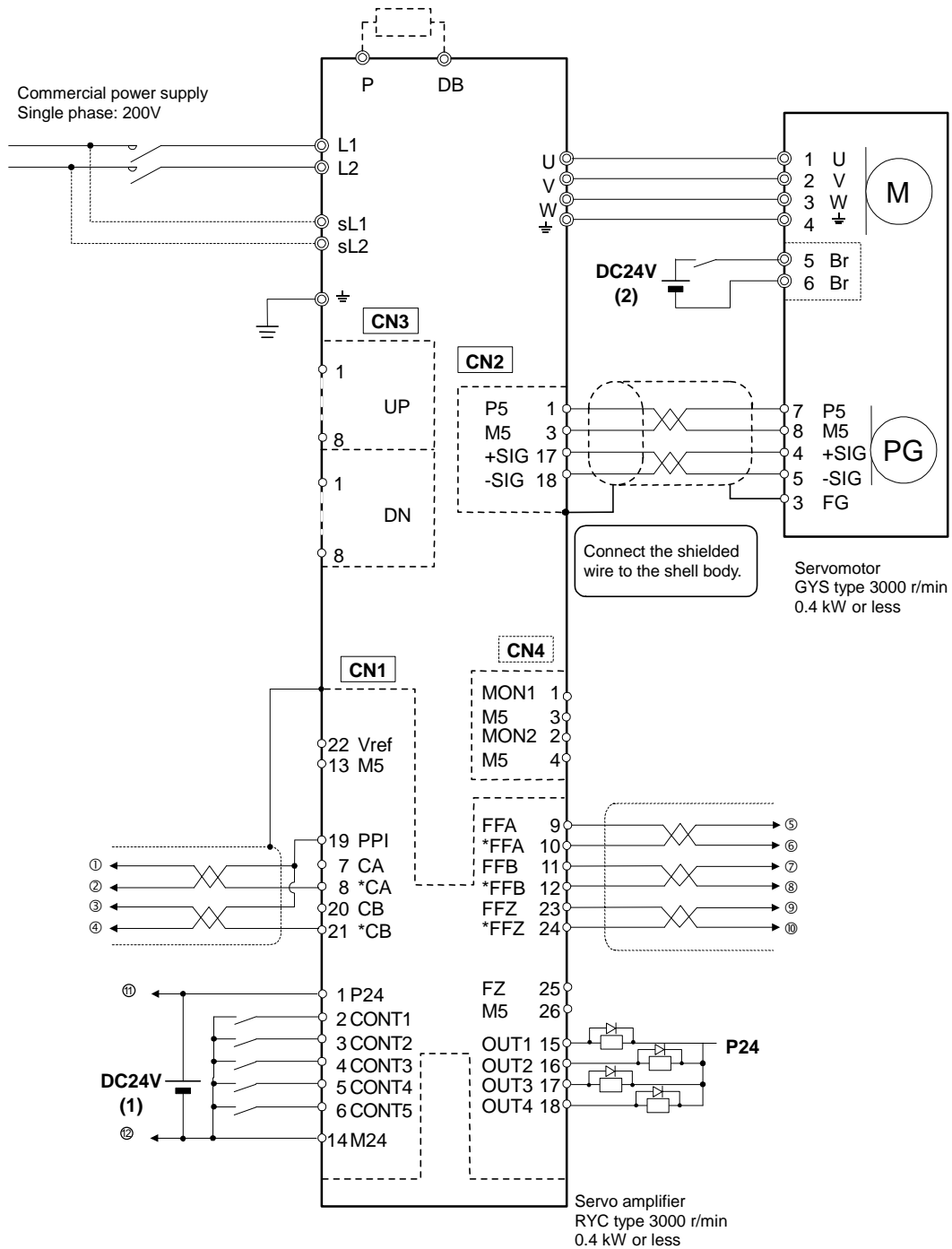
Example of connection with MICREX-SX series pulse-string output two-axis positioning module.

The control type is semi-closed loop with 500kHz maximum input frequency.

For the programmable logic controller, refer to the operation manual or user's manual.



Pulse string output positioning module (2-axis specification)
[NP1F-MP2]



3 WIRING

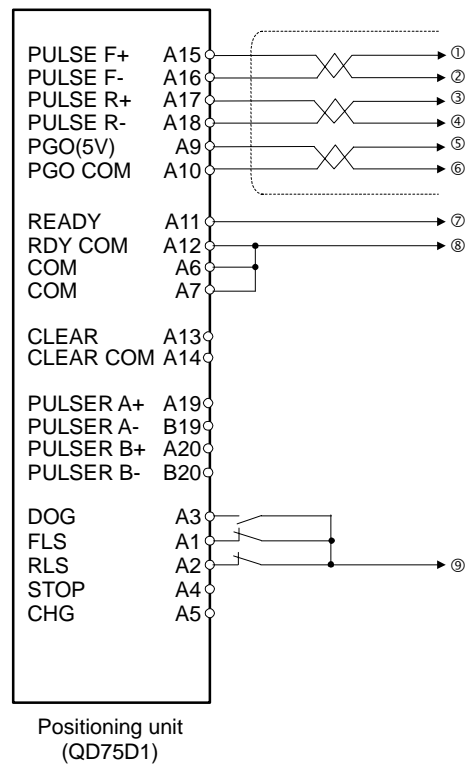
■ Positioning unit (QD75 type)

Example of connection with QD75D1 type positioning unit made by Mitsubishi Electric Co., Ltd.

Connections between the QD75D1 positioning unit and servo amplifier are shown.

For the programmable logic controller, refer to the operation manual or user's manual of the equipment.

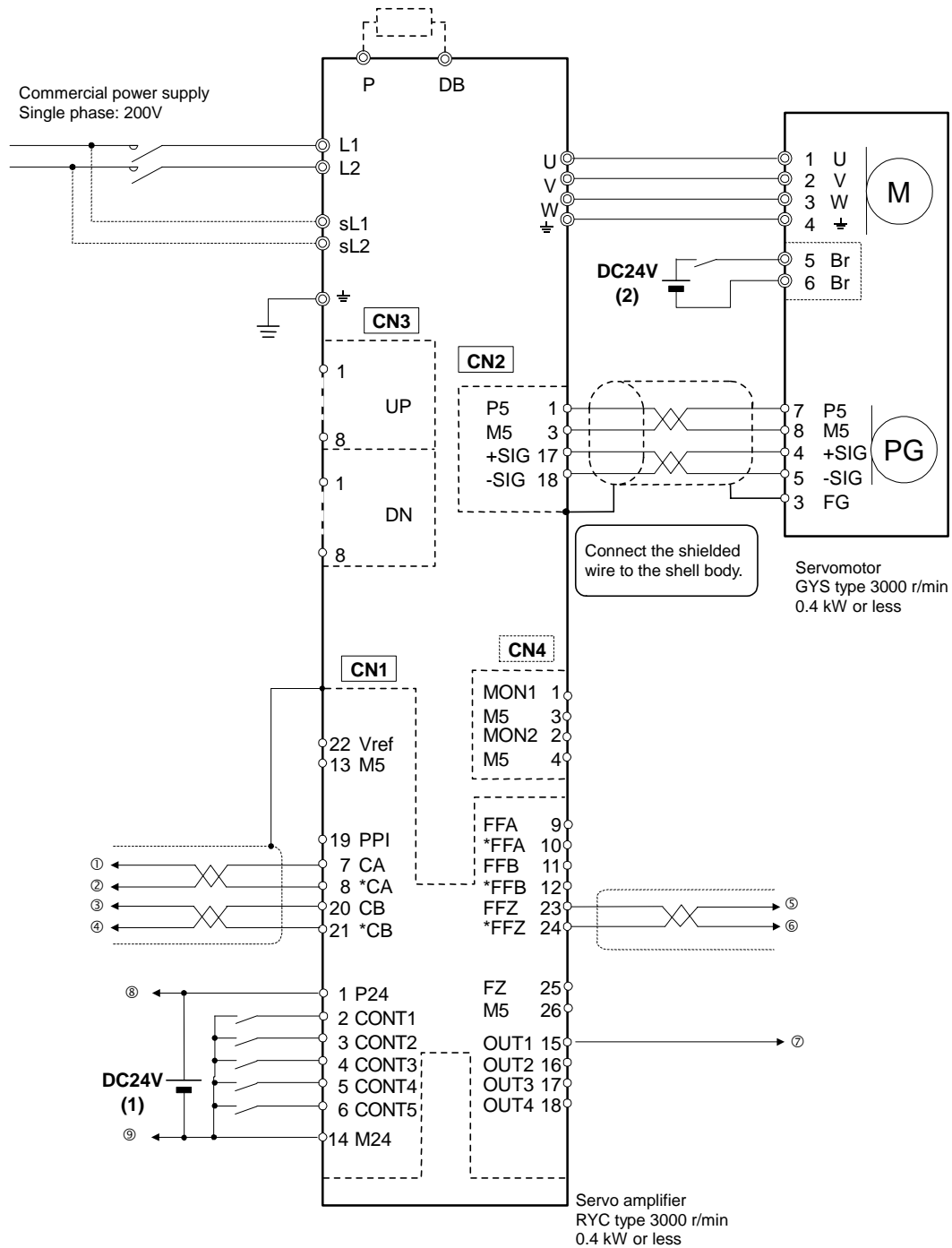
The connection diagram shown in this chapter is only for reference.



*1: Connect the shielded wires to the connector shells of CN1 and CN2. The connector shells are connected to grounding wires.

*2: Terminals vary depending on the capacity.

*3: The terminal symbol is different for 1.0 kW or more.



3 WIRING

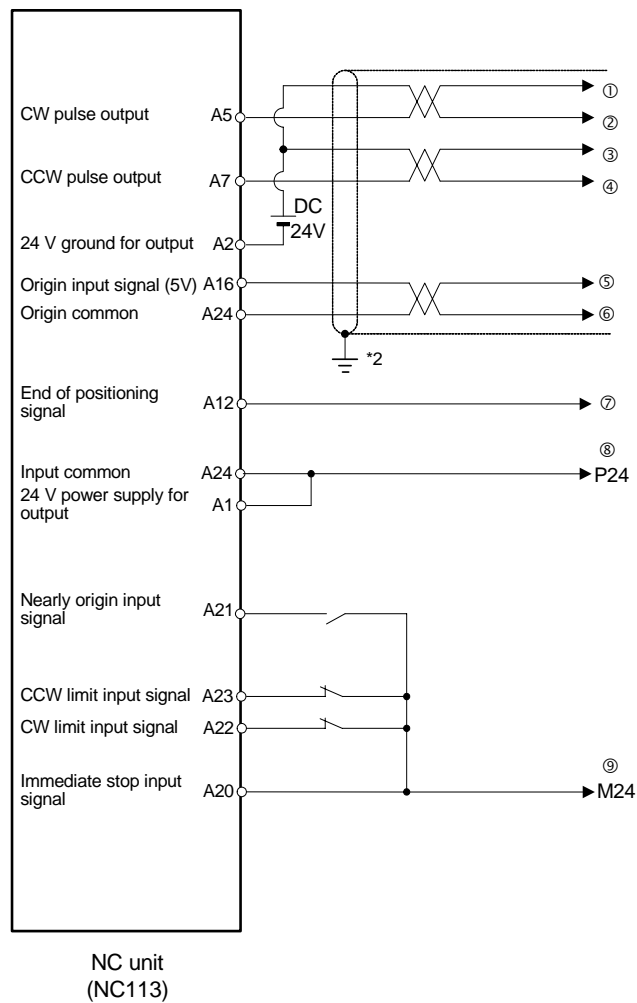
■ Position control unit (C200HW-NC113 type)

Example of connection with C200HW-NC113 position control unit made by Omron Corp.

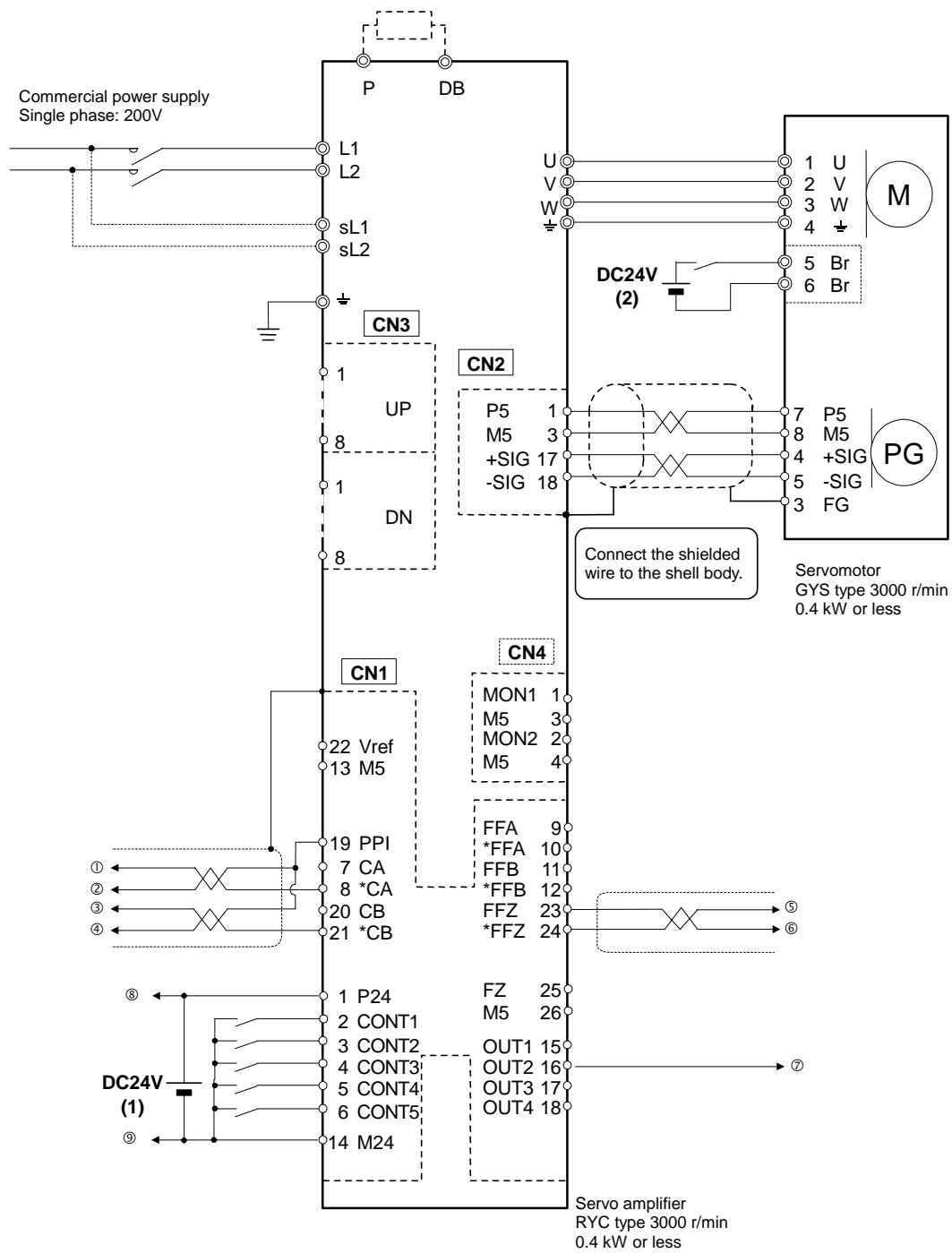
Only connections between the C200HW-NC113 position control unit and servo amplifier are shown.

For the programmable logic controller, refer to the operation manual or user's manual of the equipment.

The connection diagram shown in this chapter is only for reference.



*2 Ground the shielded wire at both ends. (Connect the wire to the connector shell for the amplifier and to the FG (grounding) for the pulse generator.)



3 WIRING

-MEMO-

4

TEST OPERATION

4.1	Check items for power supply	4- 2
4.2	Test operation in three stages	4- 3
4.2.1	First stage	4- 4
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4.2.2.1	Common for all control (position/speed/torque) modes	4- 6
4.2.2.2	Position control mode	4- 7
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4.2.3	Third stage	4-13
4.3	Brake timing output	4-14
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4.3.2	Timing chart	4-14
4.4	Return to origin	4-15

4 TEST OPERATION

4.1 Check items for power supply

When the power is supplied to the servo amplifier for the first time, check the following.

The largest cause of faulty operation of the servomotor is a simple wiring error. Make sure to check the following points before power supply.

■ Check items before power supply for the first time

Items to be checked	Check
Is the correct power source connected to the servo amplifier power input?	
Is the servomotor power connector correctly connected?	
Is the encoder connector (CN2) correctly connected?	
Is the sequence input/output connector (CN1) correctly connected?	
Is the regenerative resistor correctly connected? *1	
Is the brake wiring correctly connected? *2	
Are the servo amplifier and the servomotor securely grounded?	
Are the CN1 and CN2 shield wires securely grounded?	
Are cables exposed to undue force or are they extremely sharply bent?	
Are signal wires or power cables short-circuited due to dust or metal powder?	
Are screws loose in the servomotor mounting area or in the machine?	

*1) Check it only when the regenerative resistor is connected.

*2) Check it only when a motor with a brake is used.

When all checks above are completed, supply the power to the servo amplifier.

■ Check items when power is supplied for the first time

Items to be checked	Check
Is the display on the keypad correct?	
Are I/O signals correct (in particular, forced stop, \pm OT signals)?	

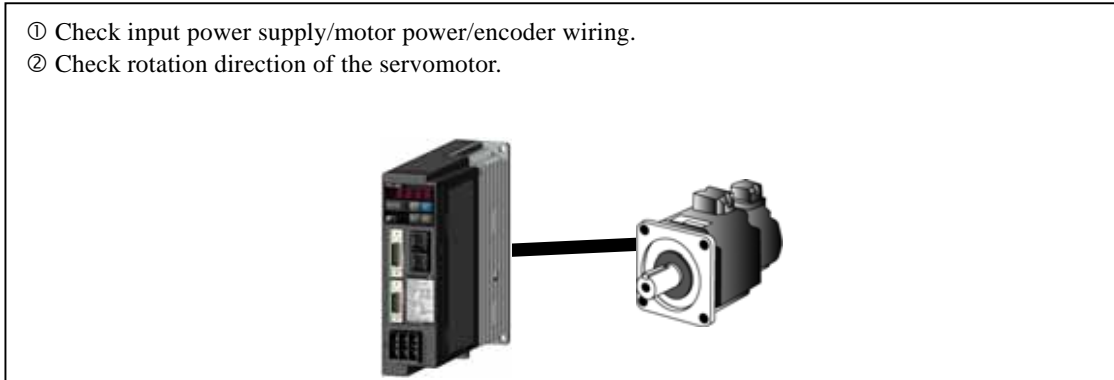
4.2 Test operation in three stages

Perform test operation in the following three stages.

■First stage

Perform test operation with the servomotor and the servo amplifier.

- ① Check input power supply/motor power/encoder wiring.
- ② Check rotation direction of the servomotor.

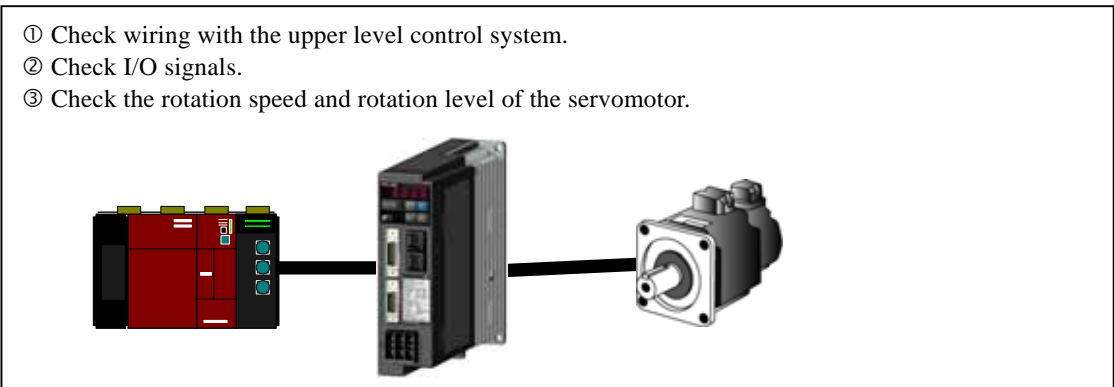


To proceed to the 2nd stage, make sure to turn off the power before starting work.

■Second stage

Connect the upper level control system to the servo amplifier and perform test operation with the command from the upper level control system.

- ① Check wiring with the upper level control system.
- ② Check I/O signals.
- ③ Check the rotation speed and rotation level of the servomotor.

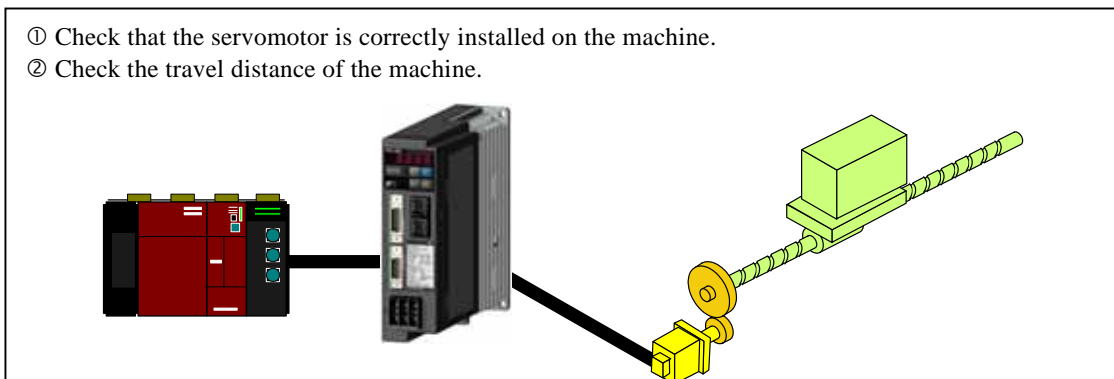


To proceed to the 3rd stage, make sure to turn off the power before starting work.

■3rd stage

Connect the upper level control system to the servo amplifier and mount the servomotor on the machine. Then, perform test operation.

- ① Check that the servomotor is correctly installed on the machine.
- ② Check the travel distance of the machine.



4 TEST OPERATION

4.2.1 First stage

Connect the servo amplifier and servomotor to perform test operation. Refer to Chapter 3 for the wiring method.

Perform test operation of the servomotor output shaft without connecting to the machine.

Check the following items in the first stage.

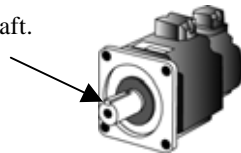
<Check>

- (1) Check the power supply wiring of the servo amplifier (L1, L2 and L3).
- (2) Check the servomotor power cables (U, V and W) and encoder cable.
- (3) Check if the servo amplifier and servomotor function correctly.
- (4) Check parameter #4 (rotation direction switching/phase switching for rotation in CCW direction)

■ Test operation procedure

- (1) Fix the servomotor so that it will not fall.

Mount nothing on the motor shaft.



Fix securely.

- (2) Referring to Chapter 3, connect cables to the servo amplifier and the servomotor.

* In the first instance, the test operation is performed in individual unit. Do not connect CN1.

- (3) After checking items listed under "Check items before power supply for the first time" on page 4-2, supply the power.

- i) Check LED for charge.
- ii) Check touch panel display.

i) Check the charge LED.
Red LED lights up in the normal state.



ii) Check the touch panel indication.

When correct	
When faulty	Alarm detection (letters are blinking)

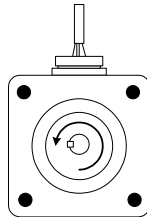
* If an alarm is detected, turn the power off, check wiring, and refer to Chapter 9.

(4) Perform test operation from the keypad and the PC loader.

Use the keypad to turn the servomotor. Check that the servomotor turns in the correct direction.

Basic setting parameter #04

No.	Name	Setting range	Initial value	Change
04	Rotation direction switching/phase switching for rotation in CCW direction	0 : Positive direction forward rotation (CCW)/B phase advance 1 : Positive direction reverse rotation (CW)/B phase advance 2 : Positive direction forward rotation (CCW)/A phase advance 3 : Positive direction reverse rotation (CW)/A phase advance	0	Power



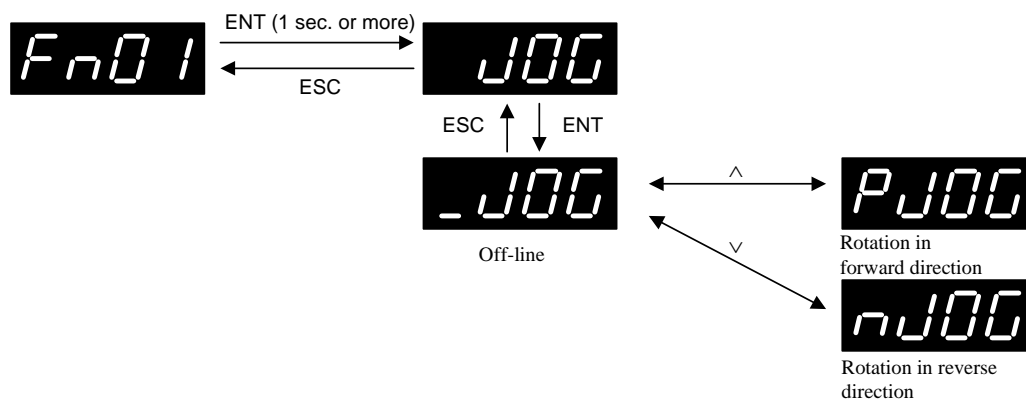
Forward rotation (CCW)

If no fault is found in the first stage, go to the second stage.

Test operation at keypad

Use the MODE key to start the test operation mode.

The servomotor rotates while the key on the keypad is held down. The servomotor rotates at the speed specified at parameter #31 with the acceleration and deceleration time specified at parameter #35/36.



* The servomotor rotates while the ^ or v key is held down.

No.	Name	Setting range	Initial value	Change
31	Manual feed speed 1 (and test operation)	0.1 to maximum rotation speed [r/min] (in 0.1 increments)	100.0	Always
35	Acceleration time (and test operation)	0.000 to 9.999 sec. (in 0.001 increments)	0.100	Always
36	Deceleration time (and test operation)	0.000 to 9.999 sec. (in 0.001 increments)	0.100	Always

4 TEST OPERATION

4.2.2 Second stage

Connect the upper level control system to the servo amplifier and perform test operation with the command from the upper level control system. Refer to Chapter 3 for wiring. Perform test operation without connecting the servomotor output shaft to the machine.

4.2.2.1 Common for all control (position/speed/torque) modes

In the 2nd stage, check the following items.

Then, check parameters for each control mode.

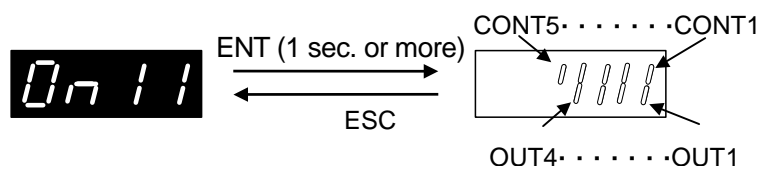
<Check>

- (1) Check wiring of signal wires between the servo amplifier and the upper level control systems
- (2) Check I/O signals

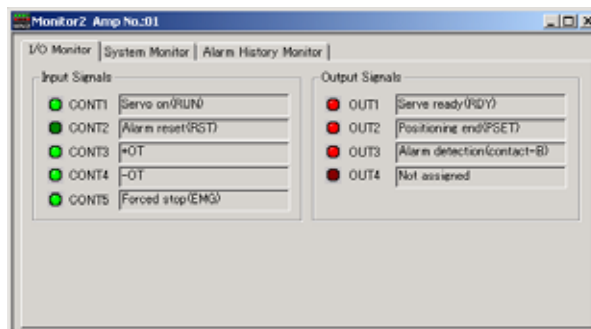
■ Test operation procedures

- (1) According to wiring in Chapter 3, connect the servo amplifier (CN1) to the upper control system.
- (2) Check I/O signals from the keypad or the PC loader.
In particular, check forced stop (EMG), \pm overtravel (\pm OT) and brake timing which are protective functions. Check that the servo amplifier is recognizing each signal.

I/O check from keypad



I/O check from PC loader



4.2.2.2 Position control mode

Set parameters for the pulse command from the upper level control systems.

<Check>

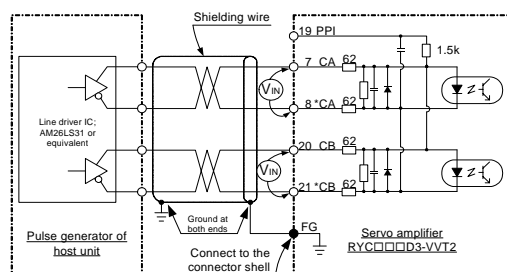
- (1) Check the pulse output circuit and the wire of the upper level control system.
- (2) Check parameters of the servo amplifier.

■Test operation procedures

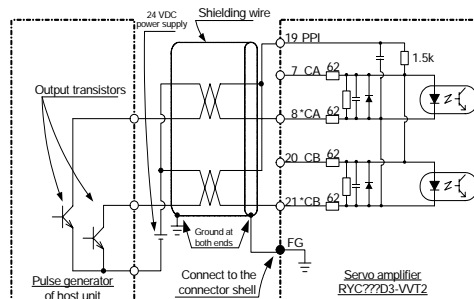
- (1) Wiring varies when the pulse output circuit * of the upper level control system is ① Differential output or ② Open collector output. Check the output circuit and the wiring.

* Refer to the operation manual on the upper level control system.

① Connection method for differential output



② Connection method for open collector output Example) For DC24V input



Note Refer to Chapter 3 for wiring.

- (2) Supply the power and check the pulse output from the upper level control system, settings of the command pulse compensation α/β (electronic gear) and the control mode (Parameters: #1 to 4, 9).

No.	Name	Setting range	Initial value	Change
01	Command pulse correction α	1 to 32767 (in 1 increments)	16	Always
02	Command pulse correction β	1 to 32767 (in 1 increments)	1	Always
03	Pulse string input form	0 : Command pulse and command sign 1 : Forward or reverse rotation pulse 2 : Two signals with 90-degree phase difference	1	Power
09	Control mode switching	0: Position, 1: Speed, 2: Torque, 3: Position \leftrightarrow Speed, 4: Position \leftrightarrow Torque, 5: Speed \leftrightarrow Torque	0	Power

4 TEST OPERATION

- (3) Turn ON the operation command (RUN) and make the system ready for rotation. Then output a pulse from the upper level control system to operate the motor. At this time, check the rotation speed, the movement in the rotation direction and the rotation direction of the motor.

① Check rotation speed

Check the touch panel monitor (On01).

② Calculation method of motor rotation speed from input frequency

$$\text{Rotation speed [r/min]} = \text{Input frequency [Hz]} \times \frac{60}{131072} \times \frac{\text{Command pulse compensation } \alpha}{\text{Command pulse compensation } \beta}$$

③ Calculation method of feed speed from motor rotation speed

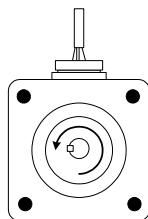
$$\text{Feed speed [mm/s]} = \frac{\text{Rotation speed [r/min]}}{60} \times \text{Movement per rotation [mm]}$$

④ Check method of movement

Check the current feedback position of the touch panel. (This value indicates the servomotor rotation in unit after pulse compensation.)

Check that the value of the current command position is the same as the value of the current feedback position.

⑤ Check rotation direction



Forward direction (CCW)

- (4) When the items above are checked, turn OFF the operation command (RUN) and shutoff the power supply.

Now, the 2nd stage test operation in the position control mode is completed.

■Troubleshooting

The motor does not rotate.

<Check>

- Check wiring with the upper level control system.
- Check with the keypad of the servo amplifier that the servomotor is ready for rotation.
- Check that the upper level control system is correctly giving pulses.
- Check the input cumulative pulses.

Items to be checked	Description of check	Check
1. Which is the circuit for the pulse string output of the upper level control system?	1 : Open collector output 2 : Line driver output	
2. Is connection of the pulse string input correct?	Check "Wiring" in Chapter 3.	
3. Which is the pulse string output of the upper level control system?	0 : Command pulse/command symbol 1 : Forward rotation pulse/reverse rotation pulse 2 : 90 degree phase difference 2 signal	
4. Are the pulse string output in "3" and the reference value of parameter #3 (pulse string output) correct?	Reference value of parameter #3	
5. Are the setting of parameters #1 and #2 (command pulse compensation α , β) correct?	Reference values of parameters #1 and #2	
6. Is the reference value of parameter #9 (control mode switching) "0: Position control"?	Setting value of parameter #9	
7. Is the rotation direction according to the command?	Setting value of parameter #4	
8. Is the rotation speed according to the command?	Check the keypad.	
9. Is the number of output pulses from the upper level control system equal to the number of the command cumulative pulses of the servo amplifier?	Check the keypad.	

4 TEST OPERATION


4.2.2.3 Speed/torque control mode

Set parameters for the analog command from the upper level control system.

<Check>

- (1) Check wiring of the analog input.
- (2) Check parameters of the servo amplifier.

■ Test operation procedures

- (1) Check that the analog output from the upper level control system is correctly wired to the analog input terminal (Vref) of the servo amplifier.
 Refer to Chapter 3.

- (2) Supply the power and check the control mode and the analog command gain (Parameters: #9, 70).

No.	Description	Setting range	Initial value	Change
09	Control mode switching *	0: Position, 1: Speed, 2: Torque, 3: Position↔Speed, 4: Position↔Torque, 5: Speed↔Torque	0	Power
70	Analog command gain	±0.10 to ±1.50 (in 0.01 increments)	1.00	Always

* When the control mode is set to "1: Speed control," the Vref terminal is the speed command terminal. When it is set to "2: Torque control," the terminal is the torque command terminal.

- (3) Turn ON the operation command (RUN) and make the system ready for rotation. Then output an analog command from the upper level control system to operate the motor. * At this time, check the rotation direction.

* During torque control, the motor rotation speed is not controlled. If test operation is performed without a load, the rotation speed increases up to the maximum rotation speed. Make sure to set the maximum rotation speed of parameter #34 to a low value, which is safe as the maximum rotation speed. (Example: 50 [r/min])

① Check rotation speed

Check the touch panel monitor.

② Calculation method for motor rotation speed from analog command voltage (speed control)

$$\text{Rotation speed [r/min]}^* = \frac{\text{Maximum rotation speed [r/min]}}{10 \text{ [V]}} \times \text{Parameter \#70} \times \text{Analog command voltage [V]}$$

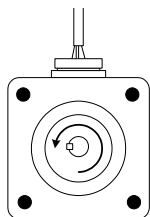
* The rotation speed does not exceed the maximum rotation speed.

③ Calculation method of torque command from analog command voltage (speed control)

$$\text{Torque command [\%]}^* = \frac{\text{Maximum torque [\%]}}{9 \text{ [V]}} \times \text{Parameter \#70} \times \text{Analog command voltage [V]}$$

* The torque command does not exceed the maximum torque.

④ Check rotation direction



Forward direction (CCW)

- (4) When the items above are checked, turn OFF the operation command (RUN) and shutoff the power supply.

Now, the 2nd stage test operation in the speed/torque control mode is completed.

4 TEST OPERATION

■ Troubleshooting

(1) Motor does not rotate.

<Check>

- Check wiring with the upper level control system.
- Check with the keypad of the servo amplifier if the servomotor is ready for rotation.
- Check that the upper level control system is correctly giving the analog voltage.
- Check with the keypad if the servo amplifier is receiving the analog voltage.

(2) The motor rotates when the analog voltage command is "0V".

<Check>

- Adjust the analog command offset (parameter #71).
- Use the zero clamp function (parameter #39).

4.2.3 Third stage

Mount the servo amplifier to the host controller and mount the servomotor to the machine to perform test operation. The test operation should be conducted in the final operation state.

Check the following items in the second stage.

<Check>

- (1) Installation of servomotor to mechanical system
- (2) Check I/O signals.
- (3) Check movement of the machine.

■ Test operation procedure

- (1) Referring to section 2.1 “Servomotor,” mount the servomotor to the machine securely. (Mount securely without play or deflection.)
- (2) Check I/O signals checked in 4.2.2 “2nd stage.”
In particular, check forced stop (EMG), \pm overtravel (\pm OT) and brake timing which are protective functions. Check that the servo amplifier is recognizing each signal and is performing protective functions.
- (3) Check that the command movement matches the actual movement of the machine.
- (4) According to description in Chapter 6 “Adjustment of servo,” adjust the parameters of the servo amplifier.

If no fault is found in the third stage, the test operation is complete.

4 TEST OPERATION

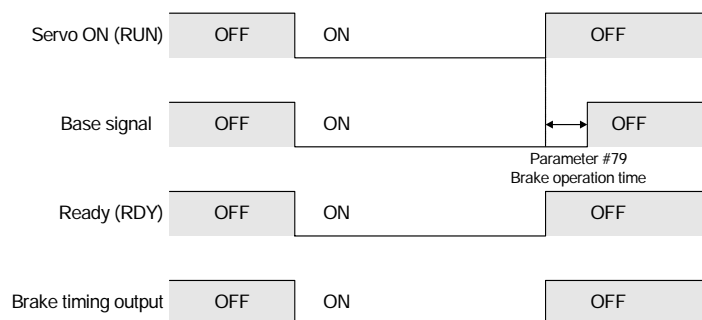
4.3 Brake timing output

4.3.1 Notes

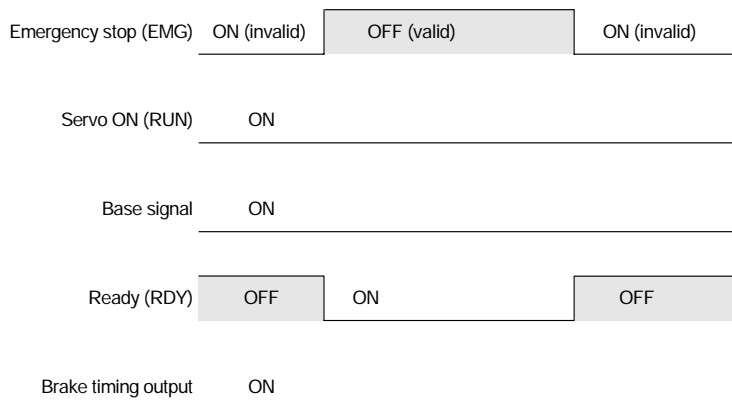
- (1) Brake is only used for "retention." Do not use it for braking.
- (2) Do not use the 24V power supply for the sequence input/output signal.
Prepare the brake power source separately.
- (3) When the brake is turned ON/OFF using the brake timing output, make sure to turn OFF the servo ON (RUN) signal and shut off the power supply.

4.3.2 Timing chart

(1) ON/OFF of servo ON (RUN) signal



(2) ON/OFF of emergency stop (EMG) signal



(3) Alarm occurrence

Alarm	Not detected	Detected
Alarm detection (a contact)	OFF	ON
Base signal	ON	OFF
Ready (RDY)	ON	OFF
Brake timing output	ON	OFF

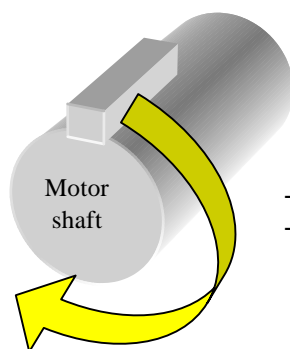
4.4 Return to origin

When a FALDIC-W series system returns to the origin, input the return-to-origin pattern from the upper level control system.

When the Z phase of the servomotor is detected to return to the origin immediately after the power supply, turn the motor 372° or more at a speed of 100 [r/min]. If this condition is not satisfied, the Z phase cannot be correctly detected.

<Notes for return to origin by detecting Z phase immediately after power supply>

- Rotation speed: 100 r/min or less
- Rotation angle: 372° or more (equivalent to approximately 1.04 rotations) at motor output shaft.



Turn the motor shaft by 372° .
The speed is 100 r/min or less.

4 TEST OPERATION

-MEMO-

5

PARAMETERS

5.1	Parameter configuration	5- 2
5.1.1	Parameter editing through keypad panel operation	5- 2
5.1.2	Parameter editing through PC loader	5- 3
5.2	List of parameters	5- 4
5.3	Explanation of parameter	5- 9

5 PARAMETERS

5.1 Parameter configuration

Various parameters are used to set up the mechanical system and adjust the characteristics and accuracy of servo.

The parameters are saved in the electrically erasable programmable read-only memory (EEPROM) and are not lost even when the power is turned off.

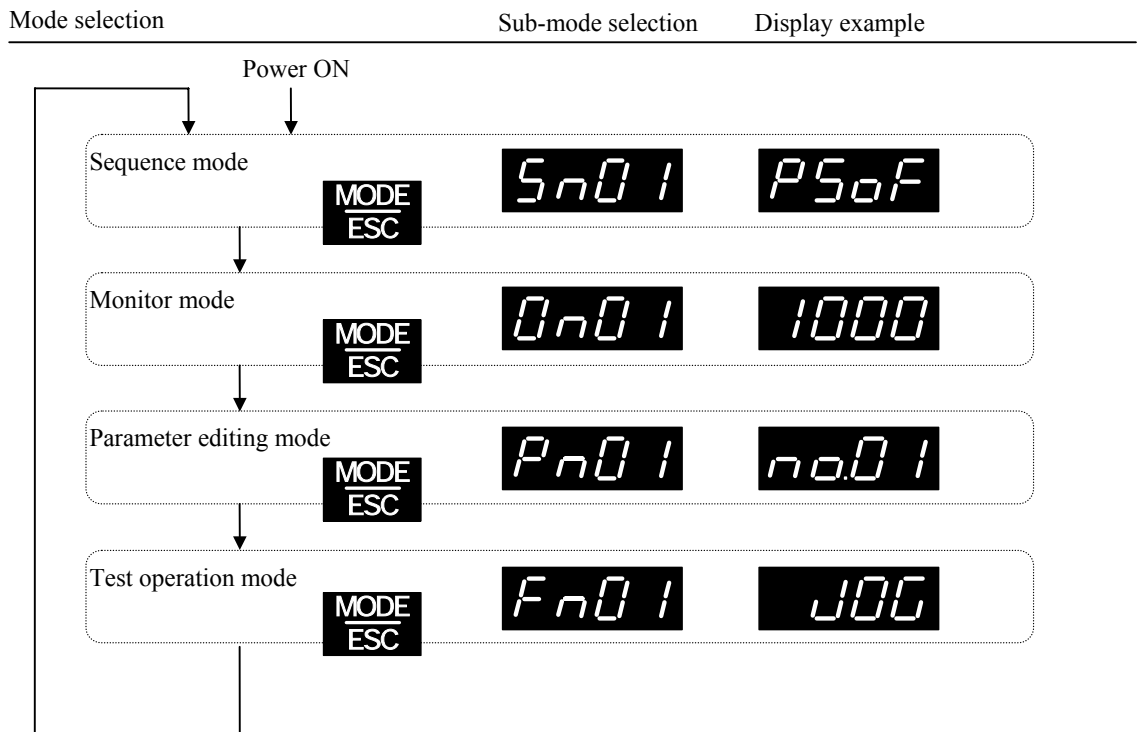
Parameters marked “Power” in the “Change” field in the parameter list become valid after the power supply is turned off and on again. (Check that the keypad panel (7-segment LED display) is unlit when the power is turned off.)

■ Parameter editing method

There are two parameter editing methods: through keypad panel operation and through PC loader operation.

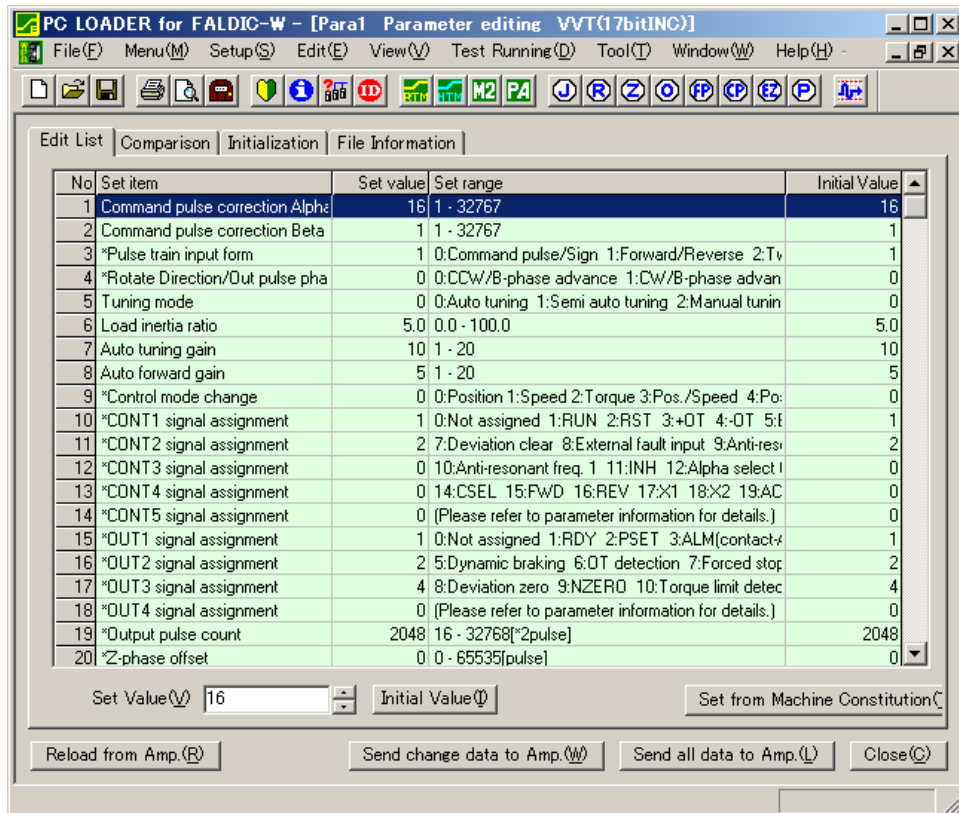
5.1.1 Parameter editing through keypad operation

Press the **MODE** **ESC** key to select the parameter editing mode and press the **▼** or **▲** key to select the desired parameter number.



5.1.2 Parameter editing through PC loader

Use the PC loader to edit parameters.



5 PARAMETERS

5.2 List of parameters

■Parameter list (1)

No.	Name	Control mode			Reference page
		Position	Speed	Torque	
01	Command pulse compensation α	O	-	-	5-9
02	Command pulse compensation β				
03	Pulse string input type	O	-	-	5-11
04	Rotation direction switching/output pulse phase switching	O	O	O	5-13
05	Tuning mode	O	O	-	5-14
06	Load inertia ratio	O	O	-	5-15
07	Auto tuning gain	O	O	-	5-16
08	Auto forward gain	O	-	-	5-17
09	Control mode switching	O	O	O	5-18
10	CONT 1 signal allocation	O	O	O	5-20
11	CONT 2 signal allocation				
12	CONT 3 signal allocation				
13	CONT 4 signal allocation				
14	CONT 5 signal allocation				
15	OUT 1 signal allocation	O	O	O	5-42
16	OUT 2 signal allocation				
17	OUT 3 signal allocation				
18	OUT 4 signal allocation				
19	No. of output pulses	O	O	O	5-53
20	Z phase offset	O	O	O	5-54
21	Zero deviation width	O	-	-	5-55
22	Deviation limit width	O	-	-	5-56
23	Zero speed width	O	O	O	5-56
24	Positioning end judgment time	O	-	-	5-57
25	Maximum current limit value	O	O	O	5-57
26	Alarm detection for undervoltage	O	O	O	5-58
27	Operation for undervoltage	-	O	-	5-58
28	For adjustment by manufacturer	-	-	-	5-59
29	Parameter write-protection	O	O	O	5-59
30	Initial display of the keypad	O	O	O	5-60
31	Manual feed speed 1 (and test operation)	O	O	-	5-61
32	Manual feed speed 2	O	O	-	
33	Manual feed speed 3	O	O	-	
34	Maximum rotating speed	O	O	O	5-61
35	Acceleration time 1 (and test operation)	O	O	-	5-62
36	Deceleration time 1 (and test operation)	O	O	-	
37	Acceleration time 2	O	O	-	
38	Deceleration time 2	O	O	-	
39	Zero clamp level	O	O		5-63
40	Position controller gain 1	O	-	-	5-66
41	Speed response 1	O	O	-	
42	Speed controller integration time 1	O	O	-	
43	S-curve time constant	O	O	-	5-68
44	Feed forward gain	O	-	-	5-68
45	Feed forward filter time constant	O	-	-	5-66
46	Torque filter time constant	O	O	-	
47	Speed setting filter	O	O	-	5-69
48	Gain switching factor	O	O	-	5-70
49	Gain switching level	O	O	-	
50	Gain switching time constant	O	O	-	

■Parameter list (2)

No.	Name	Control mode			Reference page
		Position	Speed	Torque	
51	Position controller gain 2	0	-	-	5-70
52	Speed response 2	0	0	-	
53	Speed controller integration time 2	0	0	-	
54	Torque setting filter	-	-	0	5-71
55	Command follow-up control selection	0	-	-	5-71
56	Notch filter 1 frequency	0	0	-	5-72
57	Notch filter 1 damping				
58	Notch filter 2 frequency				
59	Notch filter 2 damping				
60	Anti-resonance frequency 0	0	-	-	5-73
61	Anti-resonance frequency 1				
62	Anti-resonance frequency 2				
63	Anti-resonance frequency 3				
64 to 69	Not used	-	-	-	-
70	Analog command gain	0	0	0	5-74
71	Analog command offset				
72	Motion sequence selection for dynamic brake unit connection	0	0	0	5-76
73	Brake operation time	0	0	0	5-76
74	CONT normally ON 1	0	0	0	5-77
75	CONT normally ON 2				
76	CONT normally ON 3				
77	CONT normally ON 4				
78	Command pulse compensation α 1	0	-	-	5-78
79	Command pulse compensation α 2				
80	Command pulse compensation α 3				
81	Parameter storage in RAM	0	0	0	5-78
82	Station number	0	0	0	5-79
83	Baud rate				
84	Easy tuning: Travel setting	0	0	0	5-79
85	Easy tuning: Speed setting				
86	Easy tuning: Timer setting				
87	Monitor 1 signal allocation	0	0	0	5-80
88	Monitor 2 signal allocation				
89	Monitor 1 scale				
90	Monitor 1 offset				
91	Monitor 2 scale				
92	Monitor 2 offset				
93	Not used	-	-	-	-
94	For adjustment by manufacturer	-	-	-	-
95	For adjustment by manufacturer	-	-	-	5-82
96	For adjustment by manufacturer				
97	For adjustment by manufacturer				
98 to 99	Not used	-	-	-	-

5 PARAMETERS

■FALDIC-W parameter list (1)

No.	Name	Setting range	Initial value	Change
01	Command pulse compensation α	1 - 32767 (increments of 1)	16	Always
02	Command pulse compensation β	1 - 32767 (increments of 1)	1	Always
03	Pulse string input type	0: Command pulse/command symbol 1: Forward/reverse rotation pulse 2: 90 degree phase difference 2 signal	1	Power
04	Rotation direction switching/output pulse phase switching	0: Positive direction forward rotation (CCW)/B phase advance 1: Positive direction reverse rotation (CW)/B phase advance 2: Positive direction forward rotation (CCW)/A phase advance 3: Positive direction reverse rotation (CW)/A phase advance	0	Power
05	Tuning mode	0: Auto tuning 1: Semi-auto tuning 2: Manual tuning	0	Always
06	Load inertia ratio	GY type: 0.0 - 100.0 times (increments of 0.1) GYG type: 0.0 - 30.0 times (increments of 0.1)	5.0 (1.0)	Always
07	Auto tuning gain	1 - 20 (increments of 1)	10	Always
08	Auto forward gain	1 - 20 (increments of 1)	5	Always
09	Control mode switching	0: Position 1: Speed 2: Torque 3: Position \leftrightarrow Speed 4: Position \leftrightarrow Torque 5: Speed \leftrightarrow Torque	0	Power
10	CONT 1 signal allocation	0 - 21 (increments of 1) <div> 0: Not specified 1: Servo ON [RUN] 2: Reset [RST] 3: +OT 4: -OT 5: Emergency stop [EMG] 6: P motion 7: Deviation clear 8: External regenerative resistor 9: Anti-resonance frequency overheating selection 0 10: Anti-resonance frequency 11: Command pulse inhibition selection 1 13: Command pulse α selection 1 12: Command pulse α selection 0 15: Manual forward rotation 14: Control mode switching [FWD] 16: Manual reverse rotation [REV] 17: Multistep speed 1 [x1] 18: Multistep speed 2 [x2] 19: Acceleration/deceleration time 20: Current limiting regulator ON selection 21: Coasting [BX] </div>	1[RUN]	Power
11	CONT 2 signal allocation		2[RST]	Power
12	CONT 3 signal allocation		0	Power
13	CONT 4 signal allocation		0	Power
14	CONT 5 signal allocation		0	Power
15	OUT 1 signal allocation	0 - 10 (increments of 1)	1[RDY]	Power
16	OUT 2 signal allocation	<div> 0: Not specified 1: Ready [RDY] 2: Positioning end [PSET] 3: Alarm detection: a contact 4: Alarm detection: b contact 5: Dynamic braking 6: OT detection 7: Forced stop detection 8: Zero deviation 9: Zero speed 10: Current limit detection 11: Brake timing </div>	2[PSET]	Power
17	OUT 3 signal allocation		4[ALMb]	Power
18	OUT 4 signal allocation		0	Power
19	No. of output pulses	16 - 32768 [pulse] (increments of 1)	2048	Power
20	Z phase offset	0 - 65535 [x2 pulse] (increments of 1)	0	Power
21	Zero deviation width	1 - 2000 [pulse] (increments of 1)	400	Always
22	Deviation limit width	10 - 65535 [x100 pulse] (increments of 1)	20000	Always
23	Zero speed width	10 - Maximum rotation speed [r/min] (increments of 1)	50	Always
24	Positioning end judgment time	0.000 - 1.000 sec (increments of 0.001)	0.000	Always
25	Maximum current limit value	0 - 300% (increments of 1)	300	Always
26	Alarm detection for undervoltage	0: Not detected, 1: Detected	1	Power
27	Operation for undervoltage	0: Sudden deceleration and stop, 1: Coasting	0	Power
28	For adjustment by manufacturer	-	-	-
29	Parameter write-protection	0: Rewritable, 1: Write protected	0	Always
30	Initial display of the keypad	0 - 20 (increments of 1)	0	Power

* Values in () are the initial values of the GYG motor.

■FALDIC-W parameter list (2)

No.	Name	Setting range	Initial value	Change
31	Manual feed speed 1 (and test operation)	0.1 - Maximum rotation speed [r/min] (increments of 0.1)	100.0	Always
32	Manual feed speed 2	0.1 - Maximum rotation speed [r/min] (increments of 0.1)	500.0	Always
33	Manual feed speed 3	0.1 - Maximum rotation speed [r/min] (increments of 0.1)	1000.0	Always
34	Maximum rotation speed	0.1 - Maximum rotation speed [r/min] (increments of 0.1)	5000.0 (3000.0)	Always
35	Acceleration time 1 (and test operation)	0.000 - 9.999 sec. (increments of 0.001)	0.100	Always
36	Deceleration time 1 (and test operation)	0.000 - 9.999 sec. (increments of 0.001)	0.100	Always
37	Acceleration time 2	0.000 - 9.999 sec. (increments of 0.001)	0.500	Always
38	Deceleration time 2	0.000 - 9.999 sec. (increments of 0.001)	0.500	Always
39	Zero clamp level	0.0 - 500.0[r/min] (increments of 0.1)	0.0	Always
40	Position controller gain 1	1 - 1000[rad/sec] (increments of 1)	*1	Always
41	Speed response 1	1 - 1000[Hz] (increments of 1)	*1	Always
42	Speed controller integration time 1	1.0 - 1000.0[msec] (increments of 0.1)	*1	Always
43	S-curve time constant	0.0 - 100.0[msec] (increments of 0.1)	2.0	Always
44	Feed forward gain	0.000 - 1.500 (increments of 0.001)	0.000	Always
45	Feed forward filter time constant	0.0 - 250.0[msec] (increments of 0.1)	*1	Always
46	Torque filter time constant	0.00 - 20.00[msec] (increments of 0.01)	*1	Always
47	Speed setting filter	0.00 - 20.00[msec] (increments of 0.01)	0.00	Always
48	Gain switching factor	0: Position deviation (×10), 1: Feedback speed, 2: Command speed	1	Always
49	Gain switching level	1 - 1000 (increments of 1)	50	Always
50	Gain switching time constant	0 - 100[msec] (increments of 1)	10	Always
51	Position controller gain 2	30 - 200% (increments of 1)	100	Always
52	Speed response 2	30 - 200% (increments of 1)	100	Always
53	Speed controller integration time 2	30 - 200% (increments of 1)	100	Always
54	Torque setting filter	0.000 - 9.999[sec] (increments of 0.001)	0.000	Always
55	Command follow-up control selection	0: None, 1: Command follow-up control, 2: Command follow-up control (compensated for while stopped)	0	Power
56	Notch filter 1 frequency	10 - 200[×10Hz] (increments of 1)	200	Always
57	Notch filter 1 damping	0 - 40[dB] (increments of 1)	0	Always
58	Notch filter 2 frequency	10 - 200[×10Hz] (increments of 1)	200	Always
59	Notch filter 2 damping	0 - 40[dB] (increments of 1)	0	Always
60	Anti-resonance frequency 0	5.0 - 200.0[Hz] (increments of 0.1)	200.0	Always
61	Anti-resonance frequency 1	5.0 - 200.0[Hz] (increments of 0.1)	200.0	Always
62	Anti-resonance frequency 2	5.0 - 200.0[Hz] (increments of 0.1)	200.0	Always
63	Anti-resonance frequency 3	5.0 - 200.0[Hz] (increments of 0.1)	200.0	Always

* Values in () are the initial values of the GYG motor.

*1. Indicates the value immediately after parameter initialization is executed. The value is automatically updated if "auto tuning" or "semi-auto tuning" is selected with parameter #5.

5 PARAMETERS

■FALDIC-W parameter list (3)

No.	Name	Setting range	Initial value	Change
64 to 69	Not used	-	0	-
70	Analog command gain	$\pm 0.10 - \pm 1.50$ (increments of 0.01)	1.00	Always
71	Analog command offset	-2000 - +2000	(Set before shipment)	Always
72	Operation sequence selection for dynamic brake unit connection	0: DB invalid for OT detection/RUN = DB invalid for OFF 1: DB valid for OT detection/RUN = DB invalid for OFF 2: DB invalid for OT detection/RUN = DB valid for OFF 3: DB valid for OT detection/RUN = DB valid for OFF	0	Powre
73	Brake operation time	0.00 - 9.99 [sec] (increments of 0.01) Base shutoff delay time at RUN = OFF	0.00	Always
74	CONT normally valid 1	0 - 21	0	Powre
75	CONT normally valid 2		0	Powre
76	CONT normally valid 3		0	Powre
77	CONT normally valid 4		0	Powre
78	Command pulse compensation $\alpha 1$	1 - 32767 (increments of 1)	1	Always
79	Command pulse compensation $\alpha 2$		1	Always
80	Command pulse compensation $\alpha 3$		1	Always
81	Parameter storage in RAM	0: Not specified, 1 - 99 (increments of 1)	0	Powre
82	Station number	1 - 31	1	Powre
83	Baud rate	0: 38400 [bps], 1: 19200 [bps], 3: 9600 [bps]	0	Powre
84	Easy tuning: Travel setting	0.5 - 200.0 [rev] (increments of 0.1)	2.0	Always
85	Easy tuning: Speed setting	10.0 - Maximum rotation speed [r/min] (increments of 0.1)	500.0	Always
86	Easy tuning: Timer setting	0.01 - 5.00[sec] (increments of 0.01)	0.50	Always
87	Monitor 1 signal allocation	1: Speed command, 2: Speed feedback, 3: Torque command, 4: Position deviation, 5: Position deviation (extension), 6: Pulse frequency	2	Always
88	Monitor 2 signal allocation		3	Always
89	Monitor 1 scale	$\pm 2.0 - \pm 100.0[V]$ (increments of 0.1)	7.0	Always
90	Monitor 1 offset	-50 - +50 (increments of 1)	0	Always
91	Monitor 2 scale	$\pm 2.0 - \pm 100.0[V]$ (increments of 0.1)	6.0	Always
92	Monitor 2 offset	-50 - +50 (increments of 1)	0	Always
93	Not used	-	0	-
94	For adjustment by manufacturer	-	Adjustment value	-
95	For adjustment by manufacturer	-	Adjustment value	-
96	For adjustment by manufacturer	-	Adjustment value	-
97	For adjustment by manufacturer	-	Adjustment value	-
98 to 99	Not used	-	0	-

5.3 Explanation of parameter

The parameters are described in the order of the parameter number.

Pn01 / no.01 - no.02

Parameter #01 and #02

No.	Name	Setting range	Initial value	Change
01	Command pulse correction α	1 to 32767 (in 1 increments)	16	Always
02	Command pulse correction β	1 to 32767 (in 1 increments)	1	Always

* It is only valid for position control.

These parameters are used to convert the travel distance per each command pulse into a unit quantity that is used by the electronic gear.

Calculate in the following equation.

■ Calculation formula for command pulse correction α and β

$$\frac{(\text{Mechanical system travel distance per revolution of servomotor})}{(131072 \text{ pulses/rotation})} \times \frac{(\text{Command pulse correction } \alpha)}{(\text{Command pulse correction } \beta)} = (\text{Unit quantity})^*$$

* "Unit quantity" is a value such as "1," "0.1," "0.01," and "0.001."

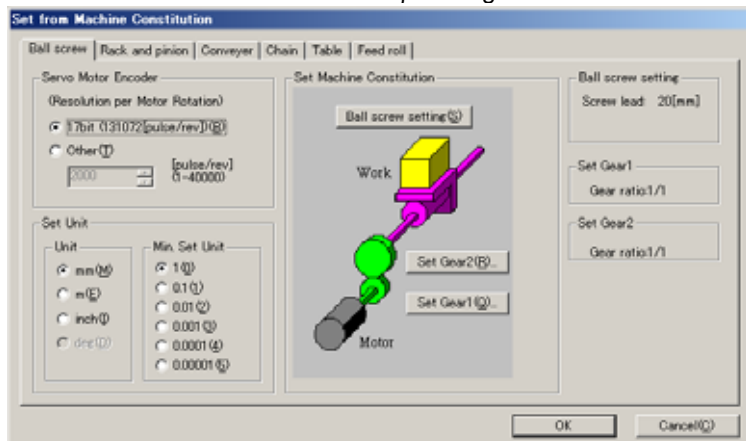
$$\frac{(\text{Command pulse correction } \alpha)}{(\text{Command pulse correction } \beta)} = \frac{(131072 \text{ pulses/rotation})}{(\text{Mechanical system travel distance per revolution of servomotor})} \times (\text{Unit quantity})$$

Reduce the fraction so that command pulse correction α and β become integers within 32767.

■ Setting from PC loader

Use the “ α and β setting from mechanical configuration” button in the parameter editing screen of the PC loader to automatically specify command pulse correction values α and β .

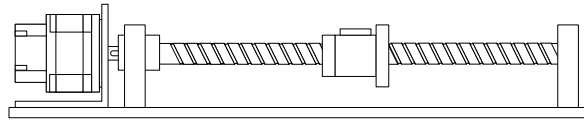
< α / β setting screen >



← Data are automatically set by simply entering the machine specifications. Because settings are given for each component of the machine, entry is simply.

5 PARAMETERS

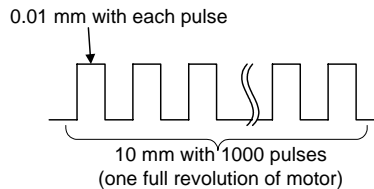
To couple 10-mm-lead screw to the output shaft of the servomotor with a setting unit of 1/100



$$\frac{\text{(Mechanical system travel distance per revolution of servomotor)}}{(131072 \text{ pulses/rotation})} \times \frac{\text{(Command pulse correction } \alpha \text{)}}{\text{(Command pulse correction } \beta \text{)}} = \text{(Unit quantity)}$$

$$\frac{10 \text{ mm}}{(131072 \text{ pulses/rotation})} \times \frac{\text{(Command pulse correction } \alpha \text{)}}{\text{(Command pulse correction } \beta \text{)}} = 1/100$$

Hence command pulse correction α becomes “16384” and command pulse correction β becomes “125.” With the above settings, the mechanical system travel distance per each pulse in the pulse string becomes 0.01 mm.



The pi (π) included in the mechanical system travel distance per each revolution of the servomotor can be approximated with “355 / 113.”

The number of output pulses has nothing to do with command pulse correction. According to the setting of parameter #19, two signals with phase-B-advanced 90-degree phase difference are output when the motor shaft rotates in the forward direction.

Pn01 / no.03

Parameter #03

No.	Name	Setting range	Initial value	Change
03	Pulse string input form	0: Command pulse / command sign, 1: Forward / reverse rotation pulse, 2: Two signals with 90-degree phase difference	1	Power

* It is only valid for position control.

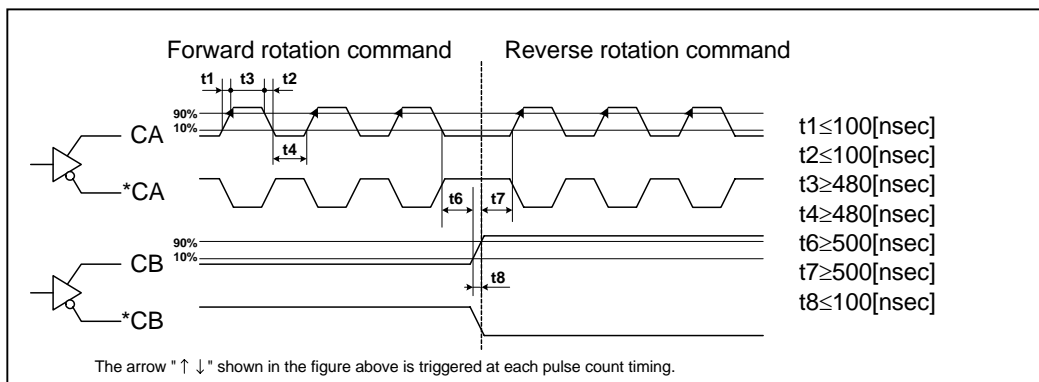
The form of the signal added to the pulse string input terminal can be selected.

The form of pulse strings added to the [CA], [*CA], [CB] and [*CB] pulse string input terminals of the servo amplifier can be specified. The maximum input frequency is 1.0MHz.

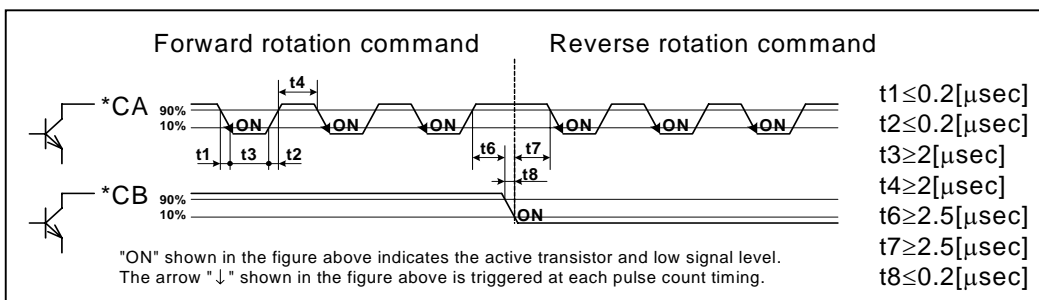
■ Command pulse/command sign (Setting of parameter 03: 0)

The rotation amount is indicated with the command pulse while the direction of rotation is indicated with the command sign.

• Differential input



• Open collector input

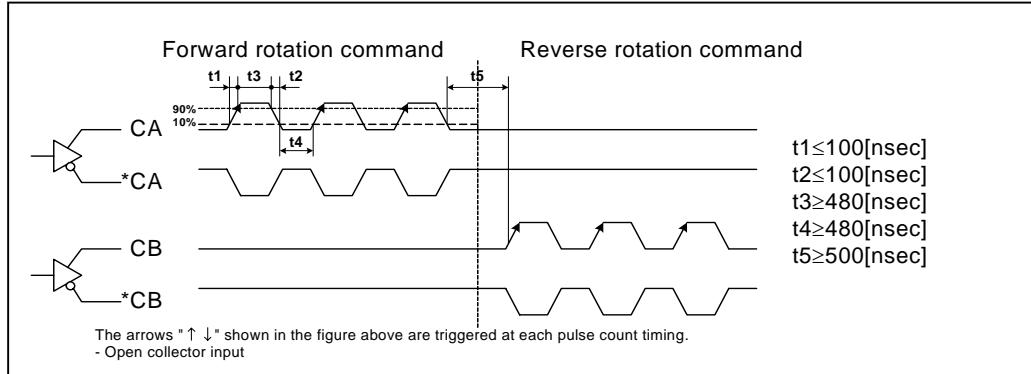


5 PARAMETERS

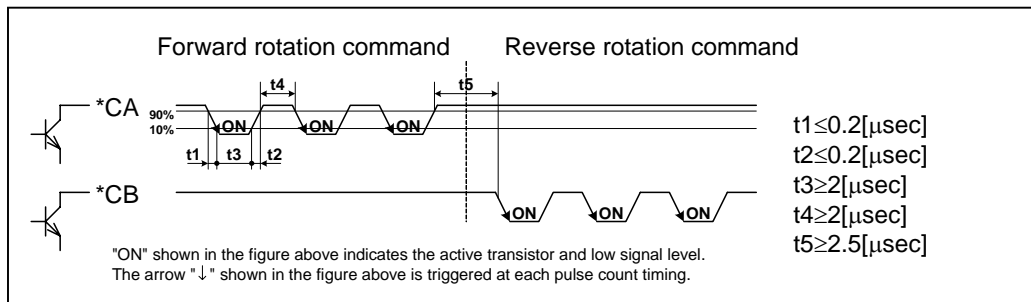
■ Forward / reverse rotation pulse (Setting of parameter 03: 1)

The forward rotation pulse indicates the rotation amount in the positive direction, while the reverse pulse indicates that in the reverse direction.

• Differential input



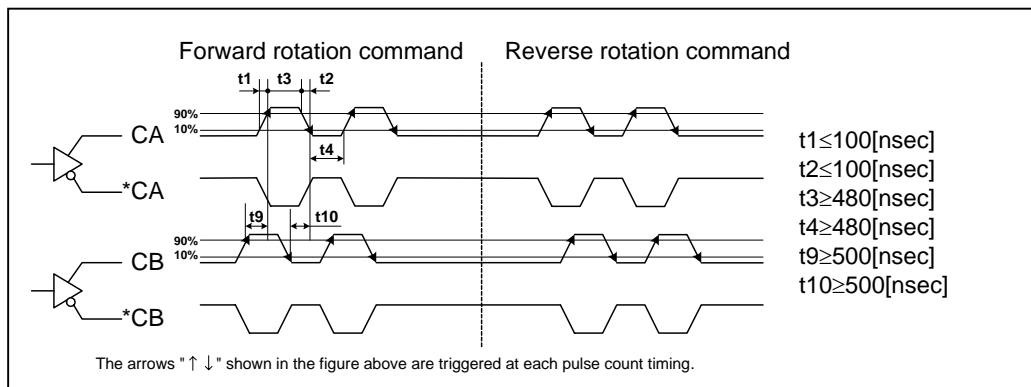
• Open collector input



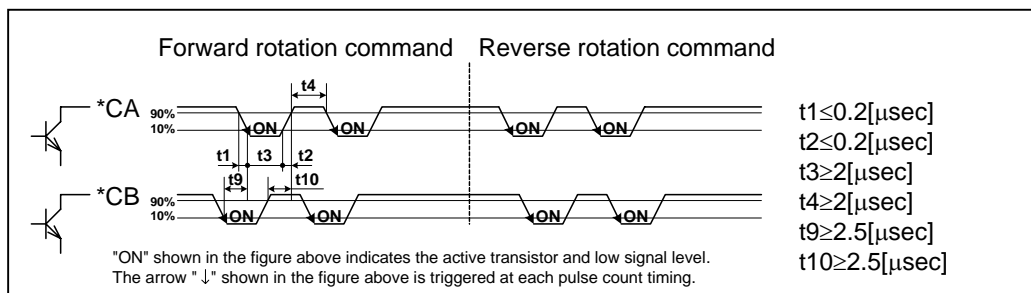
■ Two signals with 90-degree phase difference (Setting of parameter 03: 2)

The phase-A and phase-B signals indicate the direction of rotation and rotation amount, respectively. Each edge in the phase-A or phase-B signal corresponds to one pulse.

• Differential input



• Open collector input



Pn01 / no.04

Parameter #04

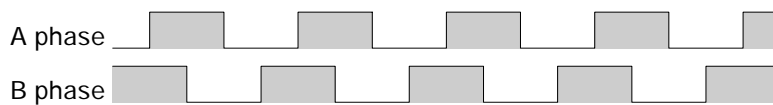
No.	Name	Setting range	Initial value	Change
04	Rotation direction switching/output pulse switching for rotation in CCW direction	0: Positive direction forward rotation (CCW)/B phase advance 1: Positive direction reverse rotation (CW)/B phase advance 2: Positive direction forward rotation (CCW)/A phase advance 3: Positive direction reverse rotation (CW)/A phase advance	0	Power

Set the servomotor rotation direction and the output pulse phase to the direction the machine is moving.

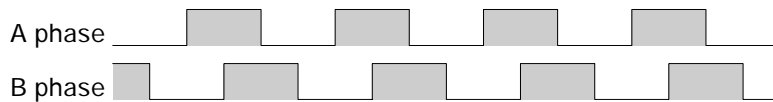
The rotation direction when the forward rotation pulse and the command signal are the H level or the 90 degree phase difference 2 signal with input of B phase advance pulse string is the positive direction.

To switch the output pulse phase, select the phase when the servomotor is rotating counterclockwise (CCW).

- When the reference value is 0 or 1

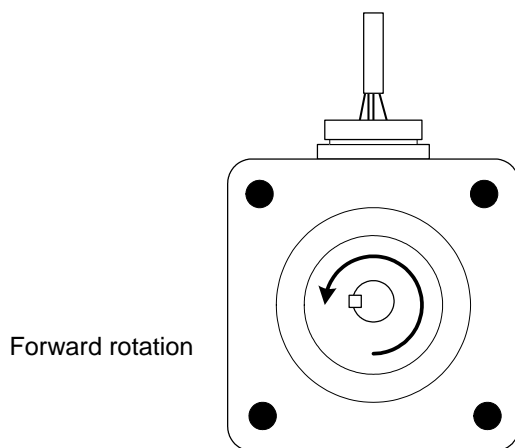


- When the reference value is 2 or 3



■ Forward/reverse rotation

Counterclockwise rotation (CCW) when the servomotor output shaft is viewed from the front is forward rotation. Clockwise rotation (CW) is reverse rotation.



5 PARAMETERS

Pn01 / no.05

Parameter #05

No.	Name	Setting range	Initial value	Change
05	Tuning mode	0: Auto tuning, 1: Semi-auto tuning, 2: Manual tuning	0	Always

* It is valid for position control and speed control.

Select the tuning method of the servo amplifier.

■ Auto tuning (Setting of basic setting parameter 05: 0)

This is the factory setting of the servo amplifier.

The inertia ratio of the machine is always assumed inside the amplifier in this mode to automatically set the optimum gain.

Set 0 for easy tuning.

■ Semi-auto tuning (Setting of parameter 05: 1)

Use this mode when the inertia ratio of the machine cannot be assumed correctly inside the amplifier.

■ Manual tuning (Setting of parameter 05: 2)

Use this option when adjustment fails in the auto tuning and semi-auto tuning modes.

Parameters that must be set or those automatically adjusted in each tuning mode are as follows.

No.	Name	Tuning mode		
		0: Auto	1: Semi-auto	2: Manual
06	Load inertia ratio	-	O	O
07	Auto tuning gain	O	O	×
40	Position controller gain 1	-	-	O
41	Speed response 1	-	-	O
42	Speed controller integration time 1	-	-	O
45	Feed forward filter time constant	-	-	O
46	Torque filter time constant	-	-	O

* O : Parameter that must be set

- : Parameter that may not be set (The value is automatically calculated inside the amplifier and the result is reflected on the parameter.)

× : The parameter has no effect even if it is set.

Refer to Chapter 6 for detailed description of tuning.

Pn01 / no.06

Parameter #06

No.	Name	Setting range	Initial value	Change
06	Load initial ratio	GYS motor: 0.0 - 100.0 times (in 0.1 increments) GYG motor: 0.0 - 30.0 times (in 0.1 increments)	5.0 (1.0)	Always

* It is valid for position control and speed control.

Values in () are the initial values of the GYG motor.

Specify the moment of inertia of the load (moment of inertia of load converted to motor shaft) exerted on the motor shaft in the mechanical system, in the ratio to the moment of inertia of the motor.

$$\text{Load inertial ratio} = \frac{\text{(Moment of inertia of load converted to motor shaft)}}{\text{(Moment of inertia of motor)}}$$

This parameter must be specified in some tuning modes (basic parameter 05).

No.	Name	Tuning mode		
		0: Auto	1: Semi-auto	2: Manual
06	Load inertia ratio	Automatically refreshed at every 10 minutes	0	0

0:Parameter that must be set

■ How to specify the load inertia ratio

There are the following two setting methods.

1) Setting the value monitored at the keypad panel

Use monitor mode **0n12** at the keypad panel to monitor.

Use the monitored value as a setting.

* If the value fluctuates, set the average value.

If fluctuation is considerable and the maximum-to-minimum ratio exceeds two, use the setting method described below.

2) Setting the calculated value

Calculate the load inertial moment and specify the result.

The calculation formula for obtaining the moment of inertia is described in appendix.

* Capacity selection software can be used for automatic calculation.

The capacity selection software can be downloaded free of charge from Fuji Electric's home page.

<http://www.fujielectric.co.jp/fcs/eng/>

5 PARAMETERS

Pn01 / no.07

Parameter #07

No.	Name	Setting range	Initial value	Change
07	Auto tuning gain	1 to 20 (in 1 increments)	10	Always

* It is valid for position control and speed control.

Specify the response of the servomotor used in the auto tuning or semi-auto tuning mode.

Specify a larger value to reduce the command follow-up time and positioning setting time, but too large a value cause the motor to vibrate.

* There is no need to set the parameter in the manual tuning mode.

■ Setting method

There are two setting methods

1) Setting parameter using PC loader and keypad panel (parameter setting mode)

After the parameter is established, the setting content is updated.

2) Setting through auto tuning gain setting from keypad panel (in test operation mode)

The setting is updated at real time when the value is changed.



Press the or key to update the setting at real time.

■ Approximate measure for setting

Configuration of machine	Auto tuning gain (approximate)
Large transfer machine	1 to 6
Arm robot	5 to 10
Belt drive	7 to 13
Ball screw mechanism	10 to 15
Inserting, mounting or bonding machine	13 to 20

* If the gain cannot be increased up to the value specified as an approximate measure, there may be mechanical resonance. Use a notch filter to suppress mechanical resonance. → Refer to page 5-72.

Pn01 / no.08

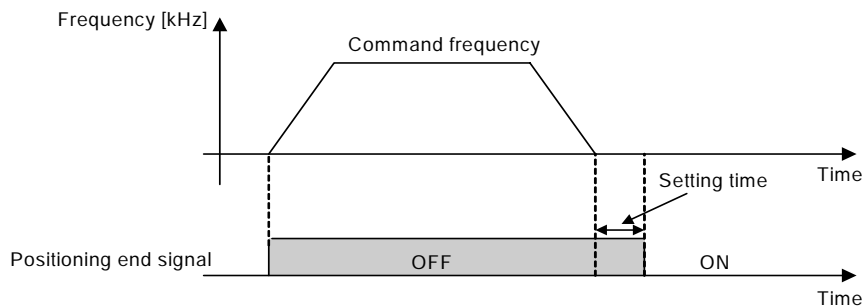
Parameter #08

No.	Name	Setting range	Initial value	Change
08	Auto forward gain	1 - 20 (in 1 increments)	5	Always

* It is only valid for position control.

This reduces the positioning setting time for auto/semi-auto tuning.

The larger this value is, the shorter the positioning setting time is. It is effective to reduce the tact time.



With adjustment of the auto forward gain, the following parameters are automatically adjusted.

No.	Name	Setting range	Initial value	Change
45	Feed forward filter time constant	0.0 - 250.0 [msec] (in 0.1 increments)	Initial value	Always

* Precautions for adjustment of auto forward gain

- 1) Make adjustment after adjustment of the auto tuning gain (standard parameter # 7).
- 2) Minimize the command pulse compensation (guideline value below).

$$\frac{\text{Command pulse compensation } \alpha \text{ (parameter \# 1)}}{\text{Command pulse compensation } \beta \text{ (parameter \# 2)}} \leq 30$$

<When the parameters below are set, the auto forward gain is invalid.>

- The tuning (parameter # 5) reference value is "2 (manual)".
- The command following control selection (parameter # 55) reference value is "1" or "2".

Parameter #55

No.	Name	Setting range	Initial value	Change
55	Command following control selection	0: None, 1: Command following control, 2: Command following control (compensated during stop)	0	Power

5 PARAMETERS

Pn01 / no.09

Parameter #09

No.	Name	Setting range	Initial value	Change
09	Control mode switching	0: Position, 2: Torque, 4: Position⇔Torque, 5: Speed⇔Torque 1: Speed 3: Position⇔Speed	0	Power

The RYC-VVT control function is of 3 types.

- Position control

Rotation of the servomotor output shaft is controlled (pulse string input).

- Speed control

The rotation speed of the servomotor output shaft is controlled.

- Torque control

Torque of the servomotor output shaft is controlled.

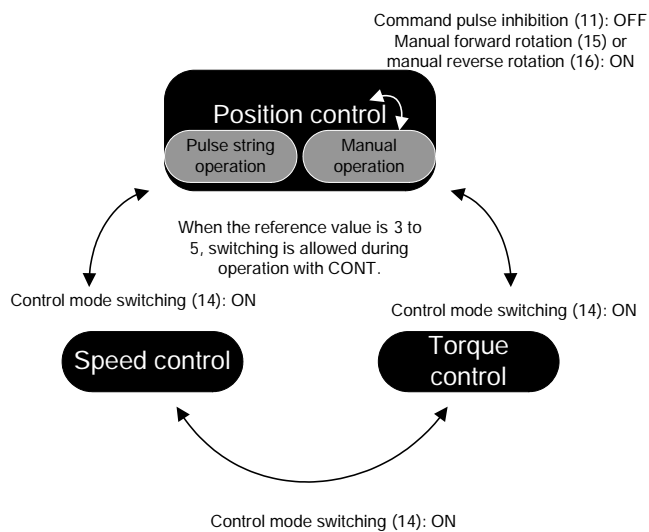
■ Switching method to each control mode

With parameter 09, whether the control mode is fixed or the control mode is switched by CONT signal allocation control mode switching (14) can be selected.

Position⇔Speed, Position⇔Torque and Speed⇔Torque can be switched at any time.

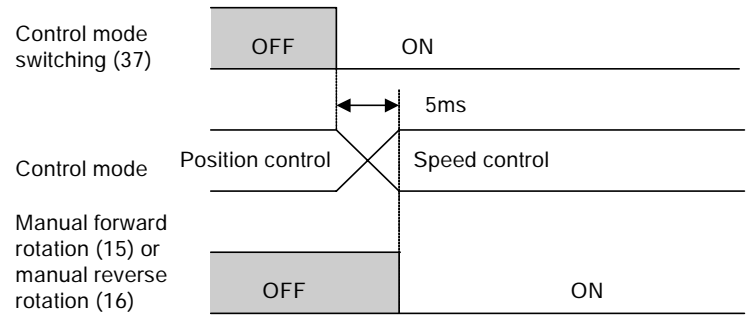
Basic setting parameter 09

Parameter reference value	Control mode	
	Control mode switching = OFF	Control mode switching = ON
0	Position control (fixed)	
1	Speed control (fixed)	
2	Torque control (fixed)	
3	Position control	Speed control
4	Position control	Torque control
5	Speed control	Torque control



■ Transition time to each control mode

The transition time to each control mode is 5 [ms].
Enter the switch signal and enter the following command 5 [ms] later.
Ex.) Position control → Switching to speed control



■ Position control

It is applicable to the pulse string operation, multistep speed operation (3rd speed) and analog speed command input operation. When command pulse inhibition (27) is ON, it is inhibited.

■ Speed control

It is applicable to the multistep speed operation (3rd speed) and analog speed command input operation.

■ Torque control

It is applicable to the analog torque command input operation.

5 PARAMETERS

Parameters are described in the order of the parameter number.

Pn01 / no.10 - no.14

Parameters #10 through #14

No.	Name	Setting range	Initial value	Change
10	CONT 1 signal allocation	0 to 21 (in 1 increments) 0: Not specified 2: Reset [RST] 4: - overtravel 6: P-action 8: External regenerative resistor overheat 10: Anti-resonance frequency selection 1 12: Command pulse α selection 0 14: Control mode switching 16: Manual reverse rotation [REV] 18: Multistep speed 2 [x2] 20: Current limiting regulator ON 1: Servo ON (RUN) 3: + overtravel 5: Emergency stop [EMG] 7: Deviation clearance 9: Anti-resonance frequency selection 0 11: Command pulse inhibition 13: Command pulse α selection 1 15: Manual forward rotation [FWD] 17: Multistep speed 1 [x1] 19: Acceleration/deceleration time selection 21: Coasting [BX]	1 [RUN]	Power
11	CONT 2 signal allocation		2 [RST]	Power
12	CONT 3 signal allocation		0	Power
13	CONT 4 signal allocation		0	Power
14	CONT 5 signal allocation		0	Power

Pn01 / no.15 - no.18

Parameters #15 and #18

No.	Name	Setting range	Initial value	Change
15	OUT 1 signal allocation	0 to 11 (in 1 increments) 0: Not specified 2: Positioning end [PSET] 4: Alarm detection: b-contact 6: Overtravel detection 8: Zero deviation 10: Current limit detection 1: Ready [RDY] 3: Alarm detection: a-contact 5: Dynamic brake 7: Forced stop detection 9: Zero speed 11: Brake timing	1 [RDY]	Power
16	OUT 2 signal allocation		2 [PSET]	Power
17	OUT 3 signal allocation		4 [ALMb]	Power
18	OUT 4 signal allocation		0	Power

The following functions can be assigned to sequence input/output terminals.

■CONT signal allocation number

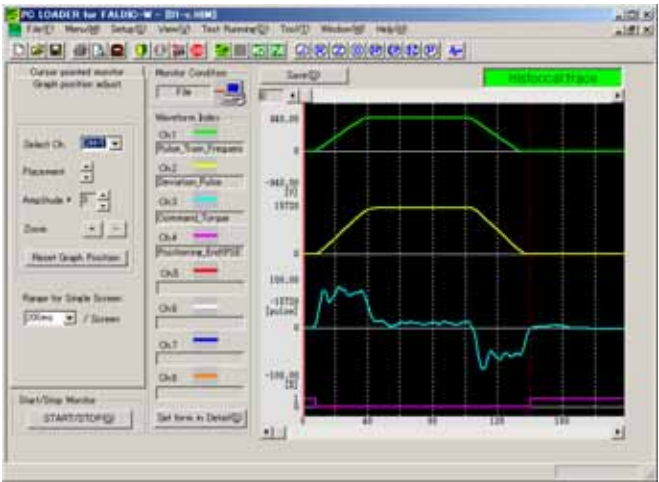
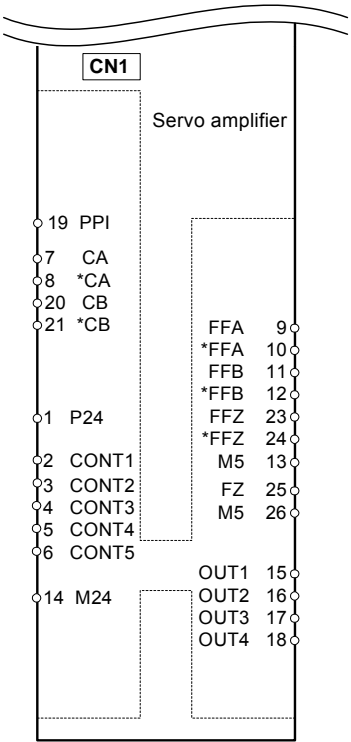
Setting	Name	Page
0	Not specified	-
1	Servo ON [RUN]	5-22
2	Reset [RST]	5-23
3	+ overtravel [+OT]	5-24
4	- overtravel [-OT]	
5	Forced stop [EMG]	5-26
6	P-action	5-28
7	Deviation clearance	5-29
8	External regenerative resistor overheat	5-30
9	Anti-resonance frequency selection 0	5-31
10	Anti-resonance frequency selection 1	
11	Command pulse inhibition	5-32
12	Command pulse α selection 0	5-34
13	Command pulse α selection 1	
14	Control mode switching	5-35
15	Manual forward rotation [FWD]	5-36
16	Manual reverse rotation [REV]	
17	Multistep speed 1 [x1]	5-38
18	Multistep speed 2 [x2]	
19	Acceleration/deceleration time selection	5-39
20	Current limiting regulator ON	5-40
21	Coasting [BX]	5-41

■OUT signal allocation number

Setting	Name	Page
0	Not specified	-
1	Ready	5-42
2	Positioning end	5-43
3	Alarm detection: a-contact	5-46
4	Alarm detection: b-contact	
5	Dynamic brake	5-47
6	Overtravel detection	5-24
7	Forced stop detection	5-26
8	Zero deviation	5-48
9	Zero speed	5-49
10	Current limit detection	5-40
11	Brake timing	5-50

- Each sequence input/output signal can be monitored in the trace screen of the PC loader.

Terminal allocation of connector 1 (CN1) of servo amplifier and trace screen of PC loader



5 PARAMETERS

(1) Servo on [RUN]

This signal makes the servomotor ready to rotate.

Sequence input signal	Operation command [RUN]... Assigned to CONT 1 with factory setting
------------------------------	--

■ Function

The servomotor is ready to rotate while the servo on [RUN] signal remains active.

The servomotor does not rotate if motor power is supplied but the servo on signal is turned off.

If the signal is turned off during rotation, the servomotor decelerates at its maximum performance and, after the stopping point (with rotation speed being within the zero speed width specified at parameter #21), the servomotor coasts to stop.

There is no retaining torque after the servomotor is stopped.

When the servo on [RUN] remains inactive, all rotation commands are ignored.

The servomotor is ready to rotate when the servo on [RUN] is active without alarm detection with active + overtravel, - overtravel and forced stop [EMG] signals.

If the servo on [RUN] signal is active and other signals are turned off, the servomotor is stopped.

■ Parameter setting

To assign the servo on [RUN] signal to a sequence input terminal, specify the corresponding value ("1") to the system setting parameter.

If the signal is not assigned to sequence input terminals, the signal is assumed to be active at any time.

■ Reference

For the forced stop signal, refer to page 5-26.

(2) Reset [RST]

Alarm detection of the servo amplifier is reset.

Sequence input signal

Reset [RST] ... Assigned to CONT 2 with factory setting

■ Function

The sequence input signal resets the alarm detected at the servo amplifier.

Alarm detection is reset upon the activating edge of the reset [RST] signal.

■ Alarm that can be reset by alarm reset

Indication	Description
OC1	Overcurrent 1
OC2	Overcurrent 2
OS	Overspeed
HU	Overvoltage
rH2	Regenerative transistor overheat
EC	Encoder communication alarm
OL	Overload
LU	Undervoltage
rH1	Regenerative resistance overheat
OF	Deviation limit
AH	Amplifier overheat

■ Alarm that is reset by rebooting

Indication	Description
Et	Encoder trouble
Ct	Control power alarm
dE	Memory alarm
Cnt	CONT duplication

■ Parameter setting

To assign the reset [RST] signal to a sequence input terminal, specify the corresponding value ("2") to the parameter.

If this signal is not assigned to the sequence input terminals, the signal is assumed to be inactive at any time.

■ Reference

Alarm detection can be reset in any of the following methods.

- 1) Activating edge of reset [RST] sequence input signal
- 2) ENT key operation upon alarm reset [**Fn04**] in test operation mode
- 3) Simultaneous depression of ^ and v keys upon alarm detection [**Sn02**] (for more than 1 second)
- 4) Power off and on

The alarm history can be initialized through ENT key operation at alarm history initialization [**Fn05**] in the test operation mode.

5 PARAMETERS

(3) Overtravel and overtravel detection

Movement of the machine can be forcibly stopped upon a signal from a limit switch or the like.

Sequence input/output signal

Overtravel / overtravel detection

■ Function

+OT (3)/-OT (4)

These are input signals from limit switches for the prevention of overtravel (OT) at the end of the moving stroke of the machine.

When the input signal is turned off, the servomotor decelerates to stop at its maximum performance while ignoring the rotation command in the detected direction. Only pulse string inputs in the direction opposite to the detecting direction and manual feed (forward/reverse rotation command) in the test operation mode are executed. (b-contact)

If over-travel is detected, the position deviation is cleared.

■ Parameter setting

To assign the +OT signal to a sequence input terminal, specify the corresponding value ("3") to the parameter. For -OT signal, specify "4."

These signals are assumed to be active at any time if they are not assigned to the sequence input terminals.

To assign OT detection to a sequence output terminal, specify the corresponding value ("6") to the system setting parameter.

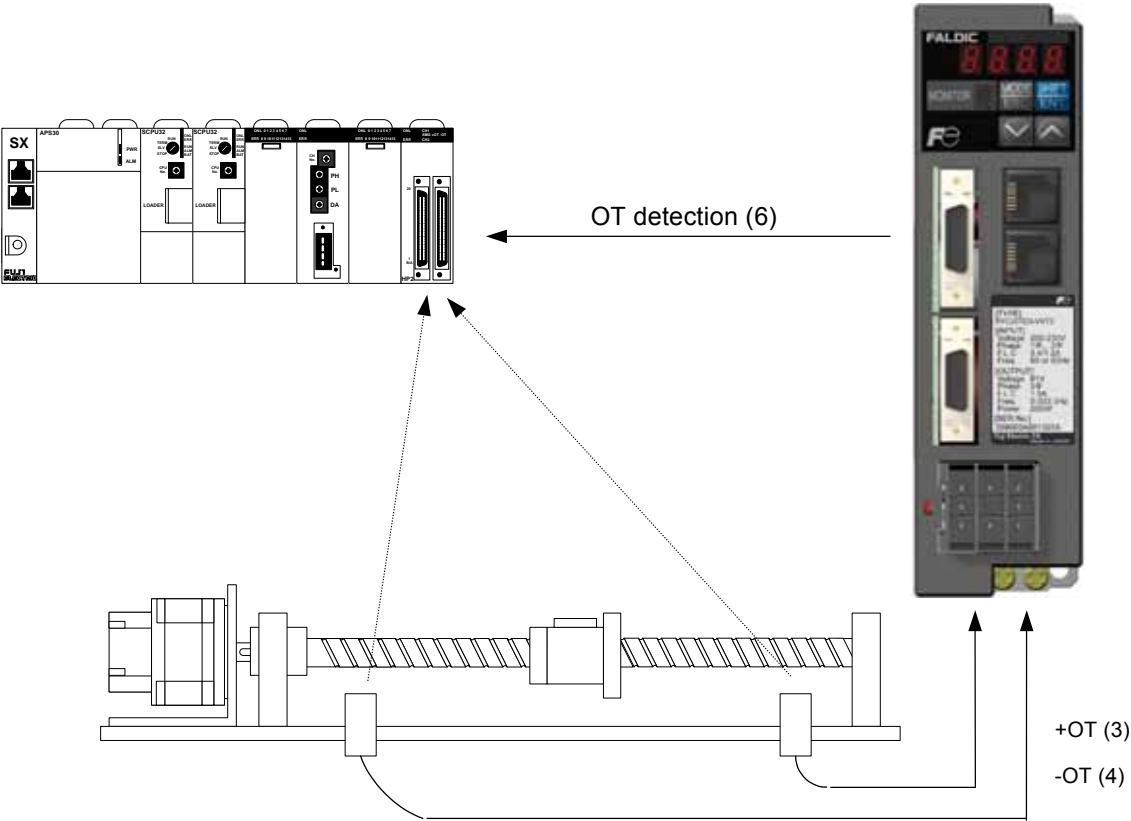
■ Reference

(1) Detecting direction

The +OT signal is detected while the servomotor rotates in the positive direction. The positive direction is the direction specified in basic setting parameter #4. The servomotor is not stopped even if the +OT signal is detected during rotation in the negative direction.

(2) OT detection (6)

This sequence output signal is turned on when +OT (3) or -OT (4) sequence input is turned off.



5 PARAMETERS

(4) Forced stop and forced stop detection

This signal supplied at the sequence input terminal stops the servomotor forcibly.

Sequence input/output signal	Forced stop/forced stop detection
------------------------------	-----------------------------------

■ Function

(1) Forced stop (Valid for position control/speed control)

The servomotor is forcibly stopped (with a b-contact) while the forced stop (5) signal is turned off.

This signal is valid in all control states and it is executed at the highest priority. Because safety and detection speeds are generally important for forced stop (5), the signal is directly connected to the servo amplifier.

Usually a self-locking pushbutton switch (command switch) on the operation panel is connected.

If forced stop is detected, the position deviation is cleared.

(2) Forced stop detection

When the forced stop (5) signal is turned off, the forced stop detection (7) signal is turned on to notify external devices of the event.

■ Parameter setting

To assign forced stop to a sequence input terminal, specify the corresponding value ("5") to the parameter.

If this signal is not assigned to the sequence input terminals, the signal is assumed to be active at any time.

When detection of forced stop is allocated to the sequence output terminal, set value (7) applicable to the parameter.

■ Reference

(1) Ready [RDY]

Assign the forced stop (5) signal to a sequence input terminal to turn on the ready [RDY] signal upon activation of the servo on [RUN] and forced stop signals, readying the output shaft of the servomotor to rotate.

(2) State of forced stop

If forced stop (5) is inactive and servo on [RUN] is active, the servomotor is stopped with the zero speed command state.

Activate forced stop to ready the servomotor for operation.

Deactivate the servo on [RUN] signal to coast to stop.

(3) Rotation command

While the forced stop signal remains inactive, all rotation commands are ignored.

5 PARAMETERS

(5) P-action

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

Sequence input signal	P-action
-----------------------	----------

■ Function

Activate this signal while the servo on [RUN] signal is active with the motor shaft being mechanically locked.

If P-action is activated during rotation of the servomotor, position control becomes unstable. Do not activate the signal while the servomotor rotates.

■ Parameter setting

To assign P-action to a sequence input terminal, specify the corresponding value ("6") to the parameter. The signal is assumed to be inactive at any time if it is not assigned to the sequence input terminals



If the brake is handled with servo locked, an overload alarm ("OL") is detected. This is because the servo performs PI control to generate a torque and restore the original position even upon small deviation. Therefore activate P-action without fail, using an external signal, when the brake is applied.

(6) Deviation clearance

Difference (position deviation) between the command position and feedback position is reduced to zero.

Sequence input signal	Deviation clearance
<div>■ Function</div> <p>While this signal remains active, the difference (position deviation) between the command position and feedback position is reduced to zero. The feedback position is made the command position.</p> <div>.....</div>	
<div>■ Parameter setting</div> <p>To assign deviation clearance to a sequence input terminal, specify the corresponding value (“7”) to the parameter.</p> <div>.....</div>	
<div>■ Reference</div> <p>While the deviation clearance signal is activated, all rotation commands are ignored.</p> <p>If the deviation clearance signal is turned on during rotation of the servomotor, pulse command, manual forward rotation [FWD] of the test operation mode and other commands are ignored, to cause the servomotor to be stopped.</p> <p>Deviation accumulated at a stopper can be zeroed to avoid movement caused by the offsetting of deviation upon a released load.</p> <div>.....</div>	

5 PARAMETERS

(7) Regenerative resistor overheat

Connect the thermistor signal of the external regenerative resistor (option) to this signal. When this signal is OFF with the regenerative resistor overheating alarm, the servomotor is forcibly stopped.

Sequence input signal	Regenerative resistor overheat
-----------------------	--------------------------------

■ Function

The servomotor is forcibly stopped (with a b-contact) while the regenerative resistor overheat signal is inactive.

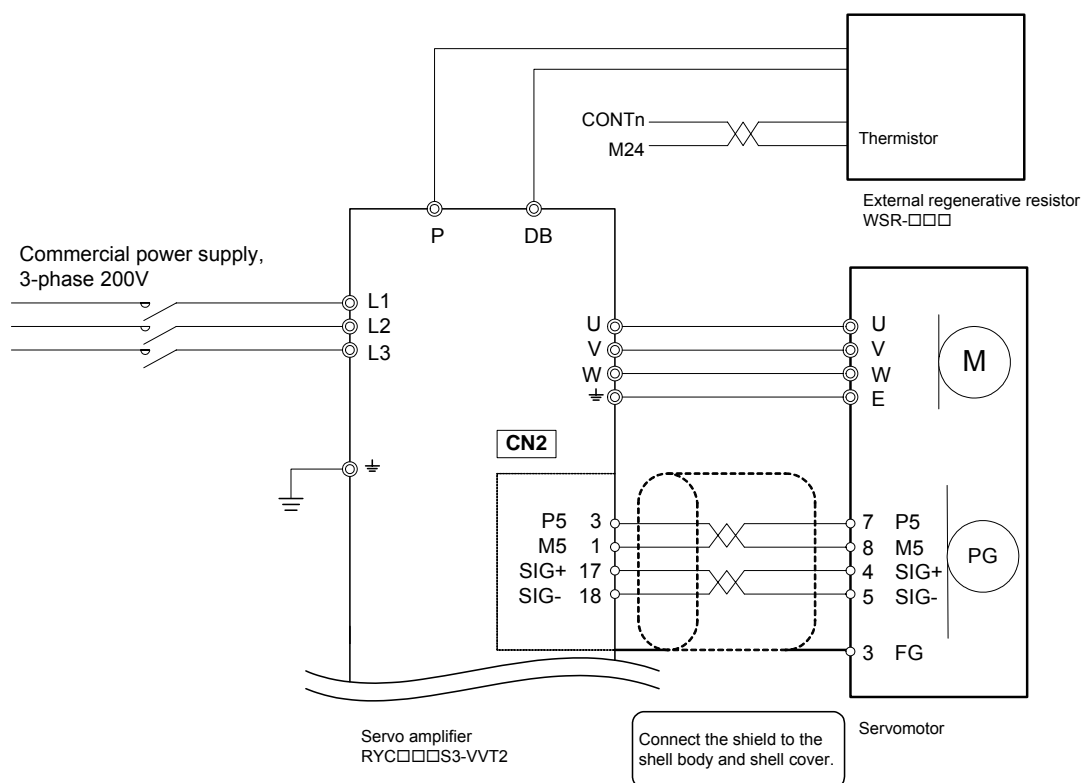
If this signal is deactivated during rotation, the servomotor decelerates by its maximum performance to stop (within the zero speed width (parameter #23)), and then it coasts to stop.

No holding torque generates after the servomotor is stopped.

■ Parameter setting

To assign regenerative resistor overheat to a sequence input terminal, specify the corresponding value ("8") to the parameter.

The signal is assumed to be active at any time if it is not assigned to the sequence input terminals.



(8) Anti-resonance frequency selection 0/1

Set any of the four anti-resonance frequencies.

Sequence input signal	Anti-resonance frequency selection 0/1
-----------------------	--

■ Function

Select any of the four anti-resonance frequencies by setting two ON/OFF bits.

Anti-resonance frequency selection 1	Anti-resonance frequency selection 0	Anti-resonance frequency
OFF	OFF	Parameter #60*
OFF	ON	Parameter #61
ON	OFF	Parameter #62
ON	ON	Parameter #63

* The signal is assumed to be inactive at any time if it is not assigned to sequence input signals.

In this case, parameter #60 (anti-resonance frequency 0) becomes always valid.

To make anti-resonance frequencies invalid, set the anti-resonance frequency at 200.0Hz (factory shipment value).

■ Parameter setting

To assign anti-resonance frequency 0 or 1 to a sequence input terminal, specify the corresponding value ("9") or ("10") to the parameter.

■ Reference

For details of the anti-resonance frequency, refer to Chapter 7.

5 PARAMETERS

(9) Command pulse inhibition

Pulse string input ON/OFF for position control is selected.

Sequence input signal

Command pulse inhibition

■ Function

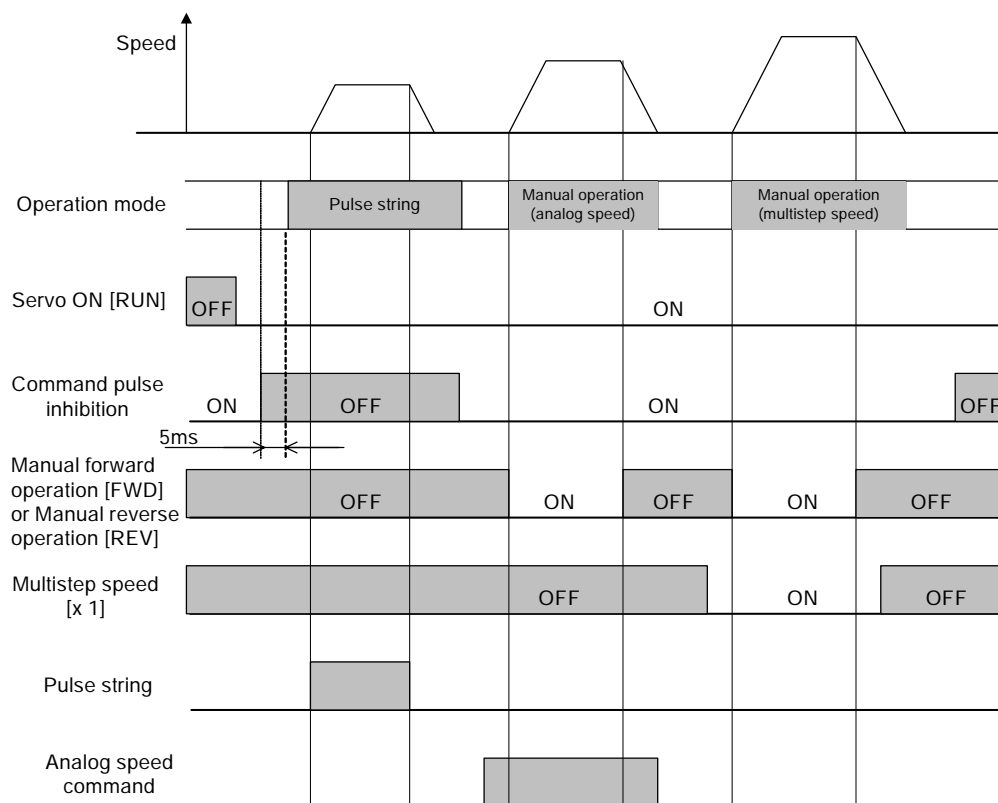
While the command pulse inhibition signal (11) is ON, manual operation of the servo amplifier is valid. It is used for manual forward operation [FWD] (15) or manual reverse operation [REV] (16) during position control. Switching between the pulse string operation and the manual operation is performed.

* When this signal is not allocated to the sequence input signal, it is considered to normally be OFF. Therefore, when servo ON [RUN] (1) is turned ON, the pulse string input is always ON.

■ Parameter setting

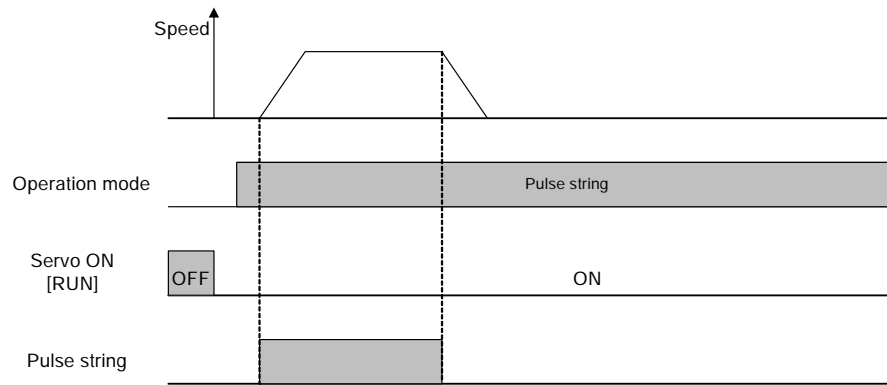
To allocate the command pulse inhibition to the sequence input terminal, set value (11) applicable to the parameter.

■ For pulse string operation and manual operation



■ When only pulse string operation is performed

Allocation of the command pulse inhibition (11) is not required as shown below:



5 PARAMETERS

(10) Command pulse compensation α selection 0/1

Multiplying power of the machine movement is changed.

Sequence input signal	Command pulse compensation α selection 0/1
-----------------------	---

■ Function

By switching the command pulse compensation $\alpha 0$ (12) or command pulse compensation $\alpha 1$ (13), either one of 4 command pulse compensation values is selected.

■ Command pulse compensation

Command pulse compensation α selection 1	Command pulse compensation α selection 0	Pulse compensation value
OFF	OFF	Parameter #1
OFF	ON	Parameter #78
ON	OFF	Parameter #79
ON	ON	Parameter #80

■ Parameter setting

To allocate the command pulse compensation $\alpha 0$ or command pulse compensation $\alpha 1$ to the sequence input terminal, set value (12) or (13) applicable to the parameter.

(11) Control mode switching

Control mode is switched.

Sequence input signal	Control mode switching
-----------------------	------------------------

■ Function

With ON/OFF of control mode switching (14), the control mode is switched.

Control mode switching is only valid when 3, 4 and 5 are set for parameter #09.

■ Control mode (parameter #09)

Parameter #09

Parameter reference value	Control mode switching	Control mode	
		Control mode switching = OFF	Control mode switching = ON
0	Invalid	Position control (fixed)	
1	Invalid	Speed control (fixed)	
2	Invalid	Torque control (fixed)	
3	Valid	Position control	Speed control
4	Valid	Position control	Torque control
5	Valid	Speed control	Torque control

■ Parameter setting

To allocate the control mode switching to the sequence input terminal, set value (14) applicable to the parameter.

■ Reference

Refer to parameter #09 for details of the control mode.

5 PARAMETERS

(12) Forward rotation command [FWD]/Reverse rotation command [REV]

It is the signal to rotate the servomotor.

Sequence input signal

Forward rotation command [FWD]/Reverse rotation command [REV]

■ Function

While the forward rotation command [FWD] (reverse rotation command [REV]) is ON, the servomotor rotates in the positive (negative) direction. When it is ON, acceleration starts. When it is OFF, deceleration starts.

(1) Speed control

The motor rotates at the voltage of the analog speed command input [Vref] terminal and at the speed selected from multistep speed [X1] and [X2].

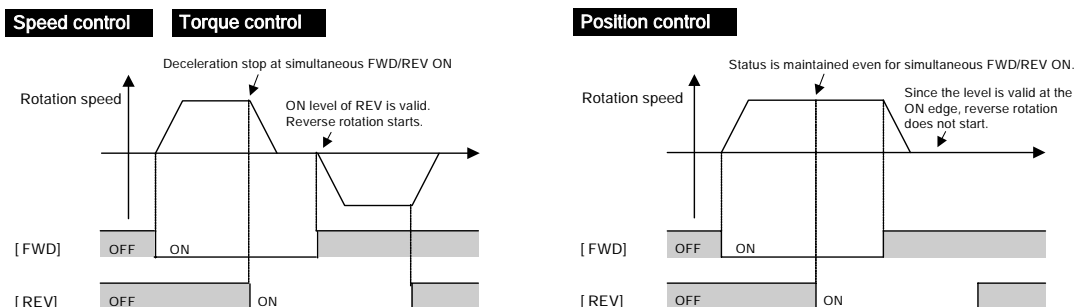
(2) Position control

It is the same as speed control. The motor starts rotation when the forward rotation command [FWD] (reverse rotation command [REV]) is at the ON edge. If other [REV] or [FWD] signal is ON during rotation, it is ignored.

(3) Torque control

Torque is output from the servomotor shaft according to the torque command voltage.

Control mode	FWD/REV signal	Simultaneous FWD/REV ON
Speed control	ON level	Deceleration stop
Position control	ON edge	Motion immediately before simultaneous ON is maintained.
Torque control	ON level	Deceleration stop



■ Parameter setting

To allocate the forward rotation command [FWD] signal to the sequence input terminal, set value (15) applicable to the parameter. ((16) for the reverse rotation command.)

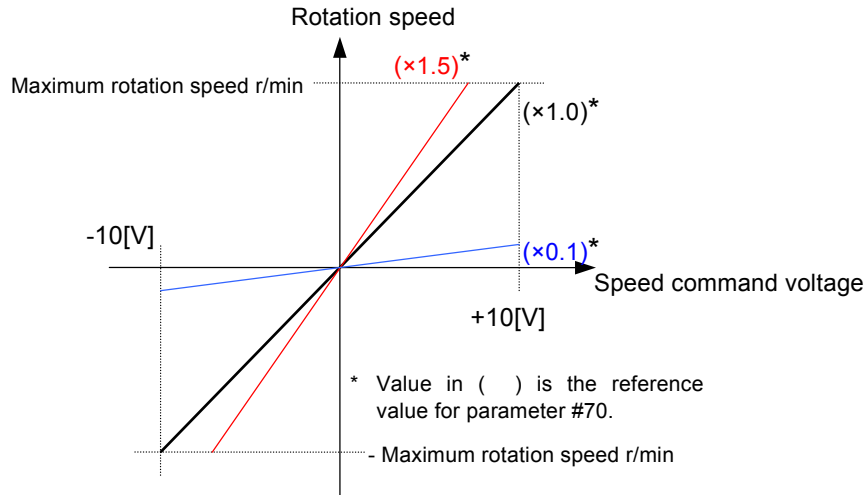
When this signal is not allocated to the sequence input terminal, it is considered to normally be OFF.

■ Reference

(1) Gain of analog speed command input [Vref] terminal (for speed command)

The motor shipped from the factory rotates at the maximum rotation speed [r/min] (Note 1) of the motor in the forward rotation direction for the speed command voltage of + 10 [V].

When parameter #70 is set, the rotation speed ratio for the speed command voltage can be changed. When the reference value for parameter #70 is 0.1, the rotation speed can be (Maximum rotation speed x 0.1) [r/min] for the speed command voltage of +10 [V].

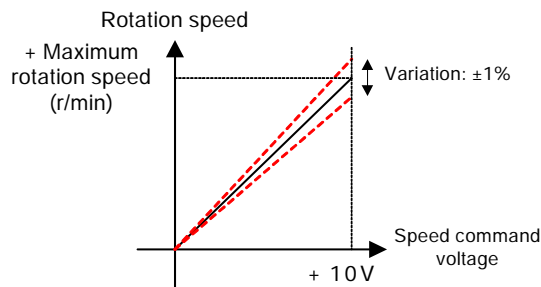


Note 1) The actual rotation speed of the motor has a tolerance of ± 10 [V]/ \pm Maximum rotation speed $\pm 1\%$ [r/min] due to variation of individual servo amplifiers and servomotors.

To make a fine adjustment of the rotation speed, adjust parameter #70 above.

GYS motor $\pm 10\text{V} / \pm 5000 \pm 1\%$ [r/min]

GYG motor $\pm 10\text{V} / \pm 3000 \pm 1\%$ [r/min]



(2) Resolution of analog speed command input voltage

The analog speed command input voltage [Vref] terminal has a resolution of 14 bits in full scale.

5 PARAMETERS

(13) Multistep speed 1 [X1]/2 [X2]

The setting speed for manual operation is selected.

Sequence input signal	Multistep speed 1 [X1]/2 [X2]
-----------------------	-------------------------------

■ Function

By switching of multistep speed 1 [X1]/2 [X2] signal, either one of 4 command pulse compensation values is selected.

Selection of multistep speed

X2	X1	Rotation speed
OFF	OFF	Analog speed command input [Vref] terminal
OFF	ON	Standard parameter #31
ON	OFF	Standard parameter #32
ON	ON	Standard parameter #33

(1) Speed control

The motor rotates at the voltage of the analog speed command input [Vref] terminal and at the speed selected in multistep speed [X1] and [X2].

(2) Position control

It is the same as speed control.

■ Parameter setting

To allocate the multistep speed 1 [X1] and 2 [X2] to the sequence input terminal, set value (17) or (18) applicable to the parameter.

(14) Acceleration/deceleration time selection

Acceleration/deceleration time in manual operation is selected.

Sequence input signal	Acceleration/deceleration time selection
-----------------------	--

■ Function

By switching the acceleration/deceleration time selection signals, either one of 2 acceleration/deceleration times is selected.

The acceleration time and the deceleration time of the servomotor are determined according to parameters #35 to 38. The acceleration time can be set separate from the deceleration time.

The acceleration time is not dependent on the rotation direction, and is on parameter #35 (#37). Parameters #35 and 37 can be switched with the acceleration/deceleration time selection signal.

Acceleration/deceleration time

Acceleration/ deceleration selection	Acceleration time	Deceleration time
OFF	Parameter 35	Parameter 36
ON	Parameter 37	Parameter 38

■ Parameter setting

To allocate the acceleration/deceleration time selection signal to the sequence input terminal, set value (19) applicable to the parameter. When this signal is not allocated to the sequence input terminal, it is considered to normally be OFF.

5 PARAMETERS

(15) Current limit valid/current limit detection

The maximum output torque of the servomotor can be limited.

Sequence input/output signal

Current limit valid/current limit detection

■ Function

(1) Current limit valid

While the current limit valid (20) signal is ON, the output torque of the servomotor can be limited. The torque limit value can be set in the range from 0 to 300 at the increments of 1 [%] to parameter #25. The maximum output torque is set as 100[%] rated torque.

Current limit is always valid for all control types.

When the output torque is limited during acceleration or deceleration, the acceleration/deceleration time in parameter setting may not be observed.

(2) Current limit detection

This signal is ON while the output torque of the servomotor has reached the torque limit value.

The output of current limit detection (10) is valid for all control types.

■ Parameter setting

To allocate the current limit valid signal to the sequence input terminal, set value (20) applicable to the parameter.

When the current limit valid (20) signal is not allocated to the sequence input terminal, the reference value for parameter 25 is always valid.

To allocate the current limit detection signal to the sequence input terminal, set value (10) applicable to the parameter.

(16) Coasting [BX]

The servomotor is forcibly set to coasting.

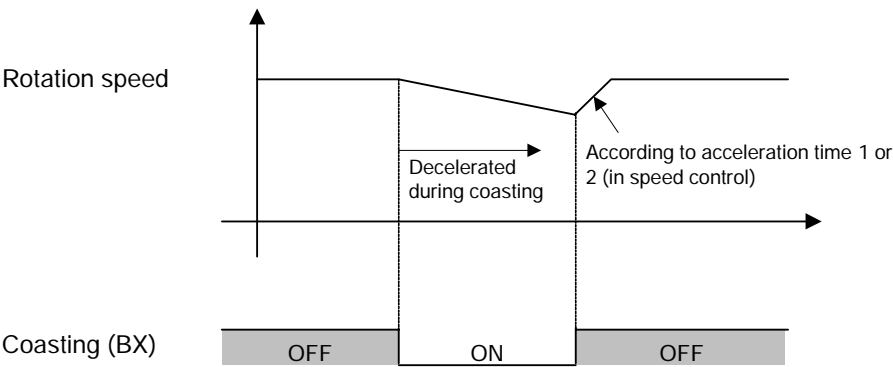
Sequence input signal	Coasting [BX]
-----------------------	---------------

■ Function

While the coasting (BX) signal is ON, the servo amplifier output is shutoff and the servomotor is coasting. The output shaft of the servomotor is decelerated (accelerated) with the load torque. The coasting signal is valid for all control status (position control, speed control and torque control).

It is safe that this signal is not used for moving the machine in the vertical direction.

While the signal is ON during position control, the servomotor is coasting. When positioning control is performed with the pulse string, the number of output pulses on the upper level controller does not match the rotation of the servomotor. During speed control and torque control, the servomotor is coasting as is. If the coasting signal is turned OFF during deceleration, the command speed or the command torque is output.



■ Parameter setting

To allocate the coasting signal to the sequence input terminal, set value (21) applicable to the parameter.

■ Reference

Coasting is a valid signal by priority in all control modes.

5 PARAMETERS

(17) Ready [RDY]

The signal is activated when the motor is ready to rotate.

Sequence output signal

Ready [RDY]...Assigned to OUT 1 with shipment setting

■ Function

The signal is activated when the following conditions are satisfied:

- 1) Servo ON [RUN] (1) signal ON
- 2) Active forced stop [EMG] (5) signal*
- 3) Inactive alarm detection: a-contact (3) signal (Or active alarm detection: b-contact (4) signal)
- 4) Active external regenerative resistor overheat (8) signal*
- 5) Source voltage above 150V
- 6) Coasting [BX] (21) signal OFF

* Conditions 2) and 4) are ignored if the corresponding signal is not assigned to the CONT terminals.

The host controller recognizes the ready [RDY] signal to check if the servomotor is ready to rotate.

■ Parameter setting

To allocate the ready [RDY] signal to the sequence input terminal, set value (1) applicable to the parameter.

(18) Positioning end [PSET]

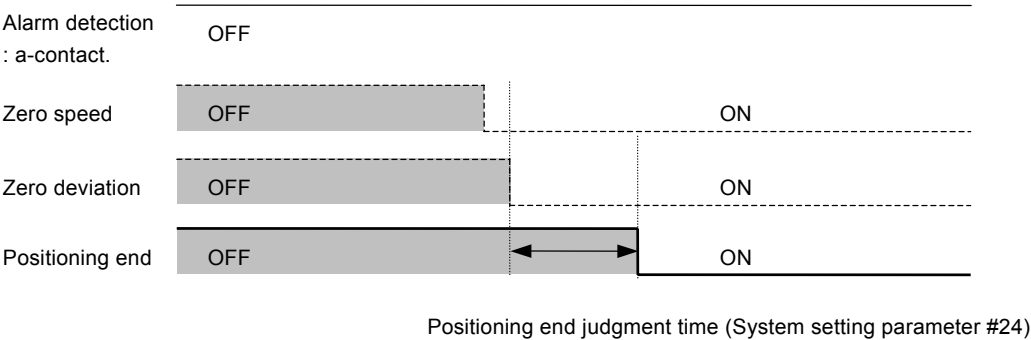
Use the signal to check that the positioning action has been completed.

Sequence output signal	Positioning end [PSET]...Assigned to OUT 2 with shipment setting
------------------------	--

■ Function

The signal is active when the following conditions are satisfied.

- 1) There is no alarm.
- 2) The rotation speed is within the zero speed width specified at parameter #23.
- 3) The deviation amount is within zero deviation width specified at parameter #21.
- 4) The above conditions remain arranged for the positioning end judgment time specified at parameter #24.



■ Parameter setting

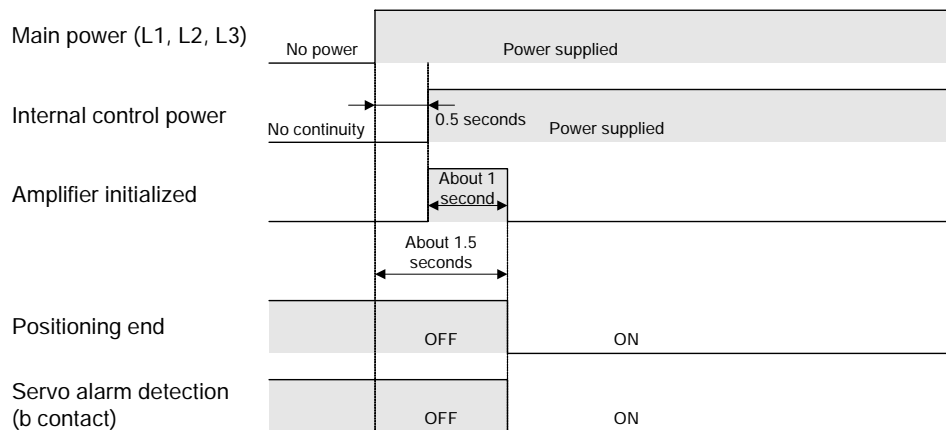
To allocate the positioning end [PSET] signal to the sequence input terminal, set value (2) applicable to the parameter.

5 PARAMETERS

■ Reference

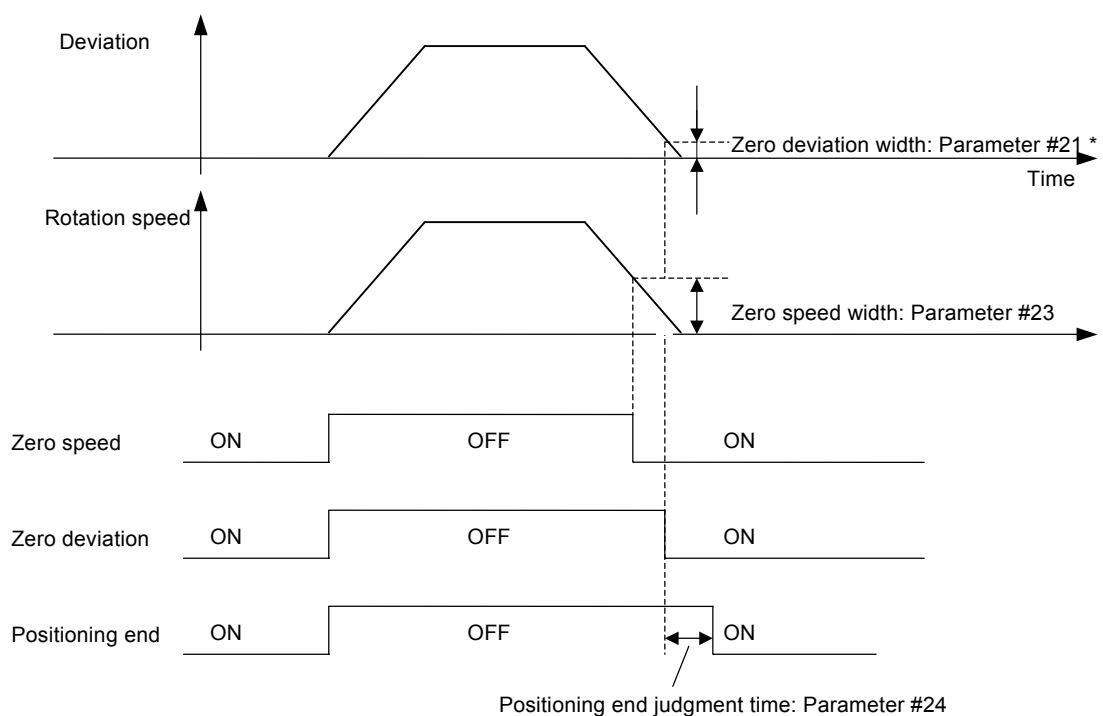
(1) When the power is supplied

It takes about 1.5 seconds from the power supply to defined position control of the servo amplifier. The positioning end signal is ON 1.5 seconds after the power is supplied.



(2) Position control

When the difference (deviation) between the command position (pulse string input) and the feedback position is zero deviation width (parameter 21) or less and the rotation speed is zero speed width (parameter 23) or less, the signal is ON.



* The unit uses encoder pulses (131072 pulses).

For details, refer to page 5-55.

(3) Positioning end (PSET) output for alarm detection

Positioning end (PSET) for alarm detection

Factor	Deceleration method	Positioning end signal	Remark
Servo ON [RUN] OFF	Forced zero speed - Base OFF	ON during stop	Ready [RDY] signal OFF
Forced stop [EMG] OFF	Forced zero speed	OFF	ON when forced stop is reset.
+OT, -OT detection	Forced zero speed - Servo lock	ON during stop	Rotation is available with pulse string, forward rotation command and reverse rotation command.
Alarm detection (minor failure)	Forced zero speed - Base OFF	OFF when alarm is detected.	ON when alarm is reset.
Alarm detection (major failure)	Base OFF	OFF when alarm is detected.	ON when alarm is reset.

Note) Minor failure - Deviation limit (OF), regenerative resistor overheating (rH1), amplifier overheating (AH), undervoltage (Lv)

Major failure - Failure detection other than minor failure

Forced zero speed - Decelerated at the maximum capacity of the servomotor.

Base OFF - No drive power on the servomotor (coasting).

5 PARAMETERS

(19) Alarm detection: a-contact (b-contact)

The servo amplifier detects the action (alarm) of protection function to activate (deactivate)* the signal.

Sequence output signal	Alarm detection: a-contact
	Alarm detection: b-contact ... Assigned to OUT 3 with shipment setting

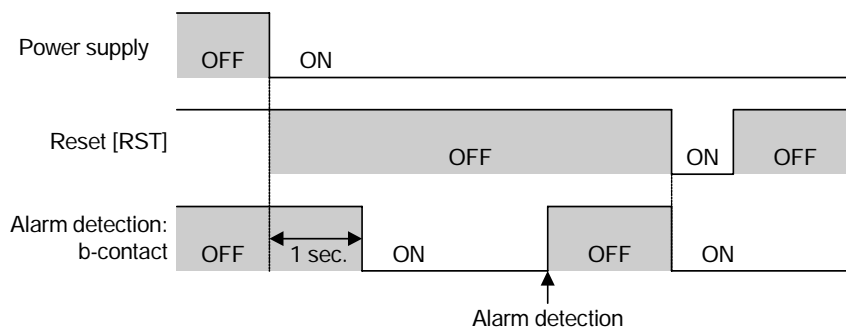
■ Function

The signal is activated (deactivated*) and is held at the servo amplifier when the servo amplifier detects an alarm. After the cause of the alarm is removed, the signal is deactivated (activated*) upon the activating edge of the reset signal [RST] so that operation is resumed.

The host controller recognizes the alarm detection signal to check for an alarm.

* Description in parentheses () is for b-contact alarm detection.

<Precaution for usage of b-contact alarm detection>



Make sure that the signal is inactive for about one second after the power is turned on.

■ Parameter setting

To assign a- or b-contact alarm detection to the sequence output terminal, specify the corresponding value ("3" or "4") to the parameter.

(20) Dynamic brake

This signal is ON when the servo amplifier detects a specific alarm *.

Sequence output signal	Dynamic brake
------------------------	---------------

■ Function

This signal is ON when the servo amplifier detects a specific alarm * that cannot drive the servomotor, and the signal is maintained until input of the alarm reset signal.

When the dynamic brake is applied, three phases of the synchronous motor are short-circuited to generate power. After the output shaft of the servomotor is stopped, no braking force generates.

The output terminal of the dynamic brake is +30VDC, 50mA. Because the electromagnetic contact cannot be driven directly, use a general relay or solid-state contactor (SSC).

■ Parameter setting

To assign the dynamic brake to the sequence output terminal, specify the corresponding value ("5") to the parameter.

■ Reference

• Specific alarm

The motion changes to coasting at the same time the alarm is detected.

Indication	Description
OC1	Overcurrent 1
OC2	Overcurrent 2
OS	Overspeed
HO	Overvoltage
Et	Encoder trouble
Ct	Control power alarm
dE	Memory alarm
rH2	Regenerative transistor overheat
EC	Encoder communication alarm
Cnt	CONT duplication
OL	Overload

* At occurrence of the alarm, only overload motion is decelerated at the maximum capacity. When the signal stops, the servomotor is coasting.

5 PARAMETERS

(21) Zero deviation

This can confirm that the servomotor has almost reached the command position.

Sequence output signal	Zero deviation
------------------------	----------------

■ Function

The signal is ON when the difference (position deviation) between the current command position and the current feedback position is within the reference value for parameter #21.

The zero deviation signal is valid at the position control mode.

The signal is always ON in control status (torque control, etc.) other than the position control.
Reference value level for parameter #21 is not related to positioning accuracy.

■ Parameter setting

To allocate the zero deviation signal to the sequence input terminal, set value (8) applicable to the parameter.

(22) Zero speed

This signal is ON when the rotation speed of the servomotor is almost 0 (zero).

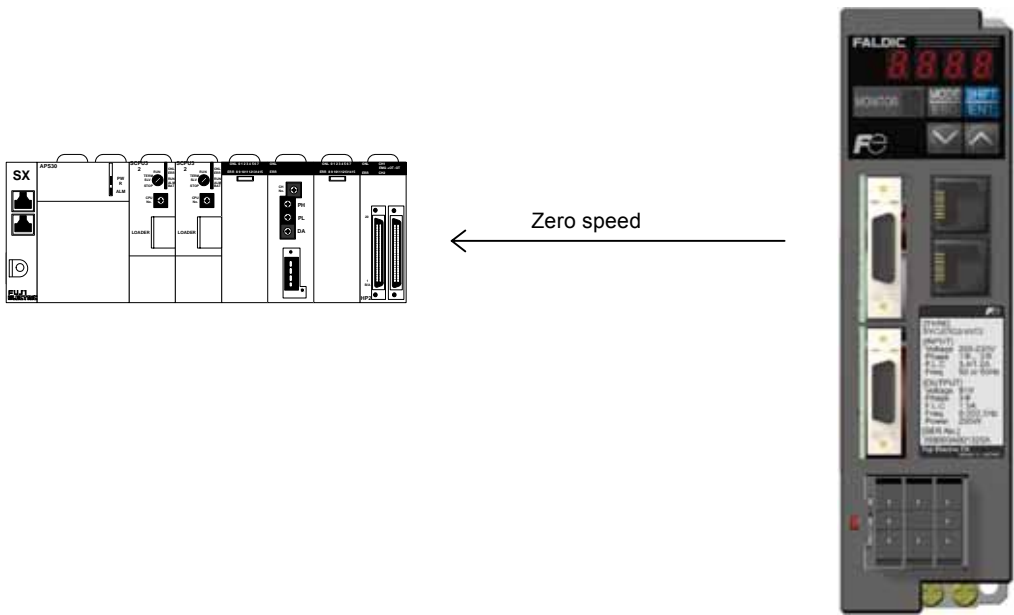
Sequence output signal	Zero speed
------------------------	------------

■ Function

This signal is ON when the actual rotation speed of the servomotor is reference value or less for parameter #23.

■ Parameter setting

To allocate the zero speed signal to the sequence input terminal, set value (9) applicable to the parameter.



5 PARAMETERS

(23) Brake timing

This is the timing signal to automatically turn the servomotor brake ON/OFF.

Sequence output signal	Brake timing
------------------------	--------------

■ Function

The timing signal that automatically excites/releases the servomotor brake is output according to the rotation command for the servo amplifier.

■ Parameter setting

To allocate the brake timing output signal to the sequence input terminal, set value (11) applicable to the parameter.

When this signal is not allocated to the sequence input terminal, it is considered to normally be OFF.

■ Reference

(1) Brake timing

The procedures to set the brake timing signal to the sequence output terminal are as follows:

1) Setting of sequence output terminal

Set value (11) applicable to brake timing to either one of parameters #15 to 18. If [11] is set to #15, the OUT1 terminal is the brake timing output.

2) Brake operation time

Set the operation time of the external brake to parameter #73.

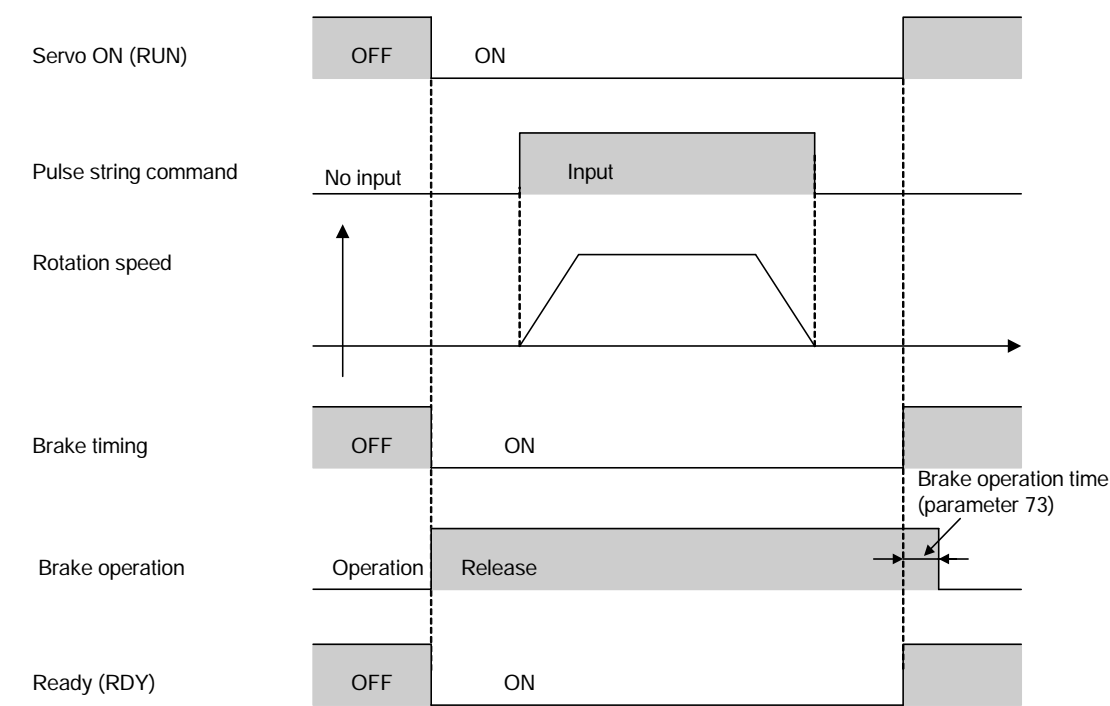
Add the scan time of programmable logic controller and the response time of external relay, electromagnetic contactor and brake to this value.

Brake operation time: Time setting from output OFF of the servo amplifier to actual operation of the external brake

Parameter #73

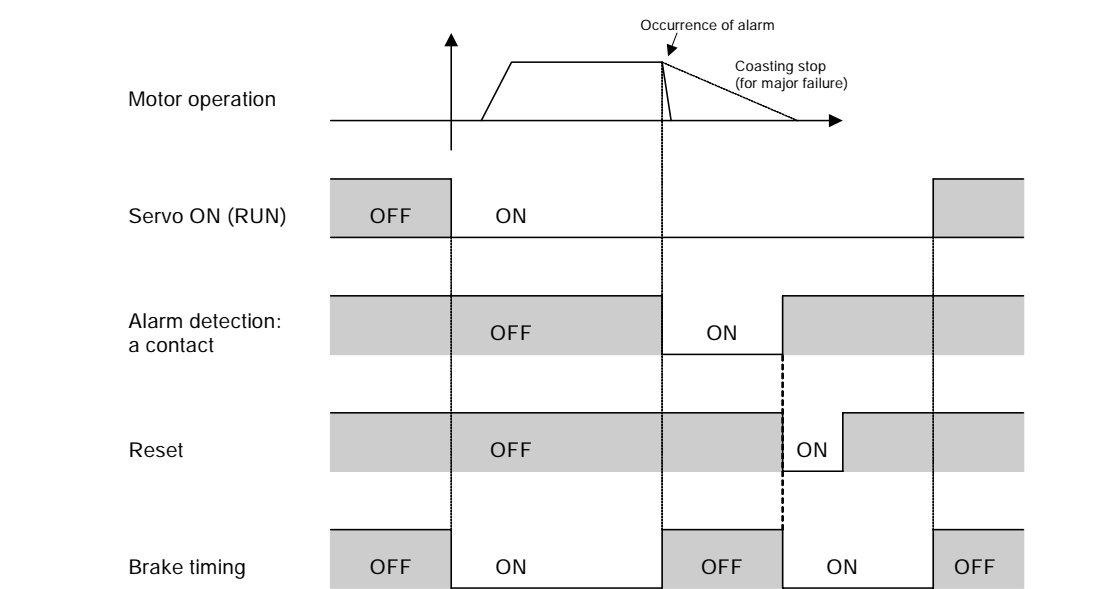
No.	Description	Setting range	Initial value	Change
73	Brake operation time	0.01 - 9.99 sec. (in 0.01 increments)	0.00	Always

(2) Brake timing chart



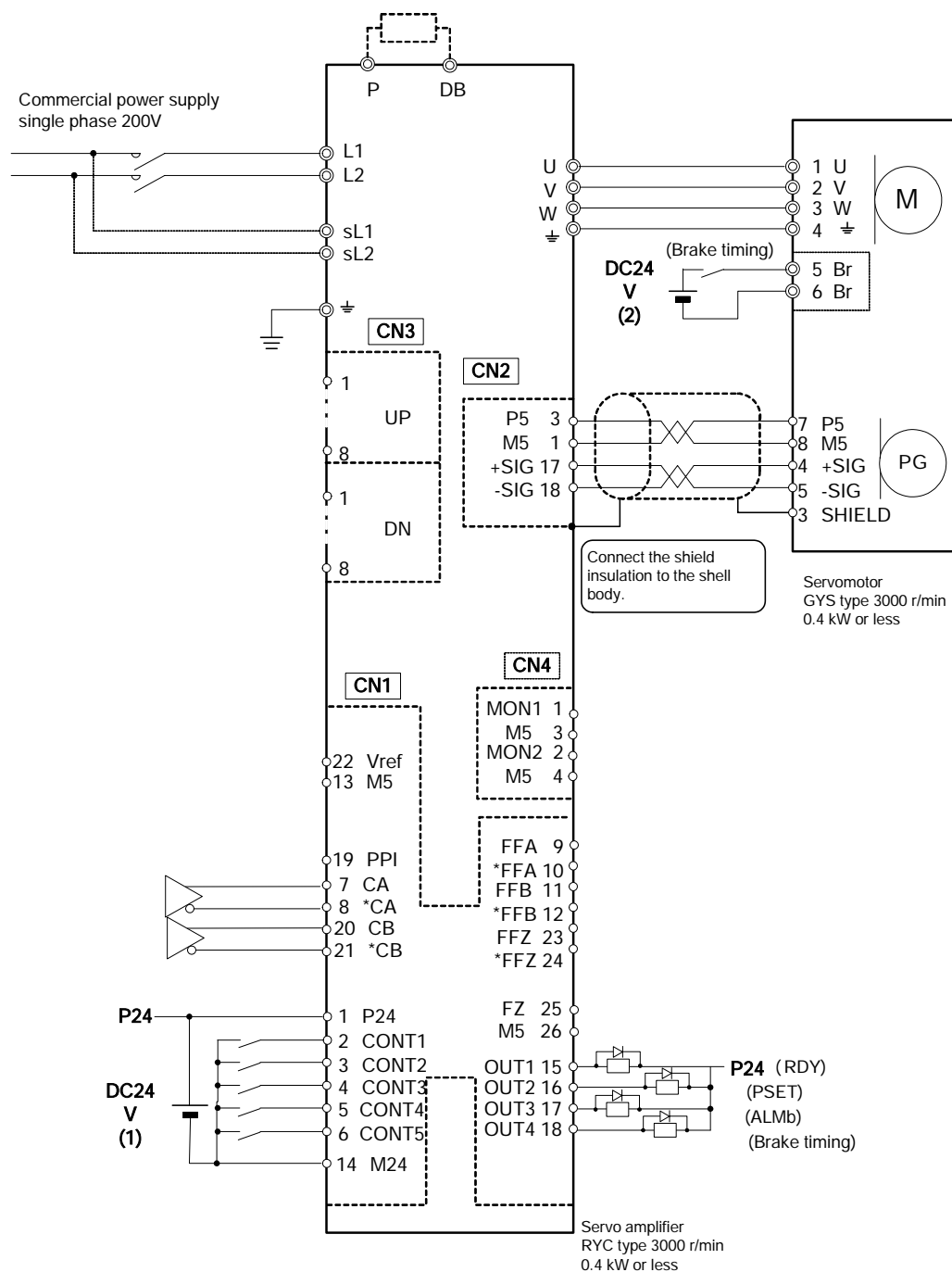
(3) Timing chart for alarm detection

If an alarm is detected, the brake is immediately activated without waiting for stoppage.
The brake is used for retention. Operation of the brake during rotation may shorten the life of the brake.
Avoid repeated operation.



5 PARAMETERS

■ Connection example of brake timing signal (0.4 [kW] or less)



- * Prepare DC24V separately for the sequence input/output power source (1) and the motor brake power source (2).
- * Set 11 (brake timing) to parameter #18 (CONT4 allocation).

Pn01 / no. 19

Parameter #19

No.	Name	Setting range	Initial value	Change
19	Output pulse count	16 to 32768 [pulse] (in 1 increments)	2048	Power

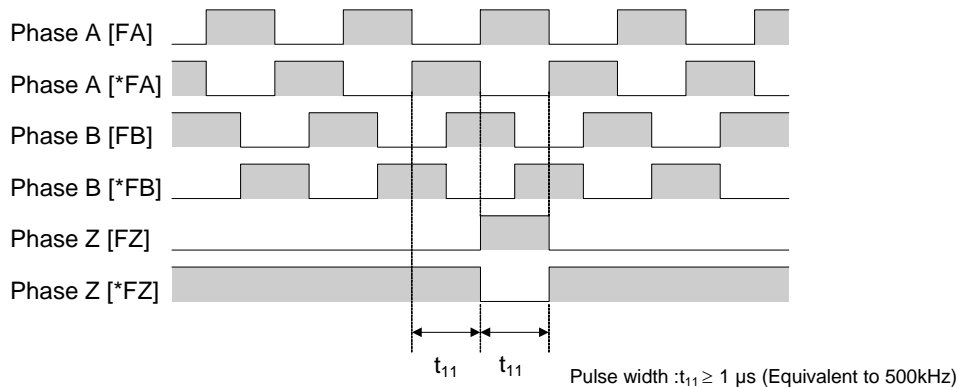
Specify the number of pulses output per each revolution of the servomotor.

The output form is two signals having 90-degree phase difference.

When the servomotor output shaft is rotating forward, B phase advance signal is output. By setting the rotation direction switching (parameter #4), the phase sequence can be changed.

- When the parameter #4 reference value is 1 or 2, the signal is B phase advance for counterclockwise rotation.
- When the parameter #4 reference value is 1 or 2, the signal is A phase advance for counterclockwise rotation.

The number of pulses output from the frequency dividing output terminals ([FA], [*FA], [FB], [*FB] and [*FZ] terminals) of the servo amplifier can be specified.



The phase-A and phase-B signals are 50% duty.

A single pulse of the phase-Z signal is output in each revolution. The output width depends on the number of output pulses.

The phase-A and phase-Z signals are synchronized with each other.

Use about 500kHz output frequency. There is no limit in the output frequency of the servo amplifier.

There is no relationship between the position of the output shaft of the servomotor and the phase-Z signal.



Hint

Number of output pulses during rotation at 5000 [r/min] with an output pulse count setting of 3000

$$\frac{3000[\text{pulse/rev}]}{60} \times 5000[\text{r/min}] = 250000[\text{Hz}]$$

The number of output pulses exceeds 2.7 [MHz] with maximum 32768 [pulses/rev] and 5000 [r/min].

5 PARAMETERS

Pr01 / no.20

Parameter #20

No.	Name	Setting range	Initial value	Change
20	Phase-Z offset	0 to 65535[×2 pulses] (in 1 increments)	0	Power

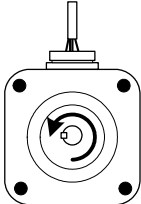
Specify the parameter to change the output position of the phase-Z signal.

There is a counterclockwise delay in the output position of the phase-Z signal by the number of pulses specified in parameter #20.

This parameter has no relations with the direction of rotation switch (parameter #4).

$$\frac{(\text{Phase-Z offset} [\times 2 \text{ pulses}])}{131072 \text{ pulses/rev}} = Z [\text{rev}]$$

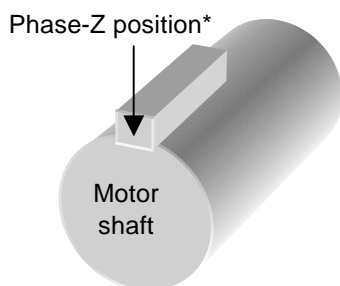
Counter clockwise



There is a counterclockwise delay in the output position of the phase-Z signal by Z revolutions.

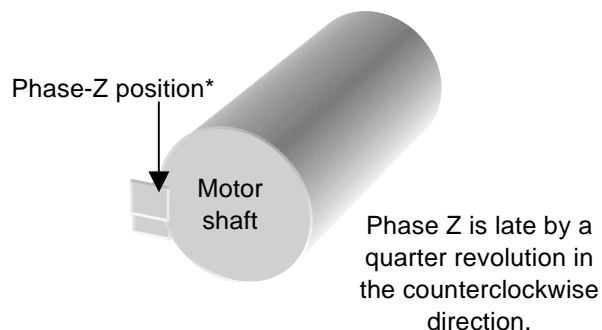
■ Output position of phase-Z signal

• When the phase-Z offset is “0”



• When phase-Z offset is “16384”


$$\frac{16384 \times 2 \text{ pulses}}{131072 \text{ pulses/rev}} = \frac{1}{4} [\text{rev}]$$



*The position of the key is not phase Z. The position of the key is assumed to be phase Z for explanation.

■ Reference

Adjustment of the phase-Z position can be made in the test operation mode of the keypad panel so that the current position becomes the position where the phase-Z signal is issued.

 Refer to page 8-24.

Precaution for detection of phase-Z signal for origin returning action

When the rotation speed is 100 [r/min] or less and the motor shaft rotation angle is advanced (released) 372°(machine angle) from the home position return limit switch (home position LS), perform the home position return operation.
If the angle is not released 372° or more, the motor may rotate another one turn when the home position return is completed.

Pn01 / no.21

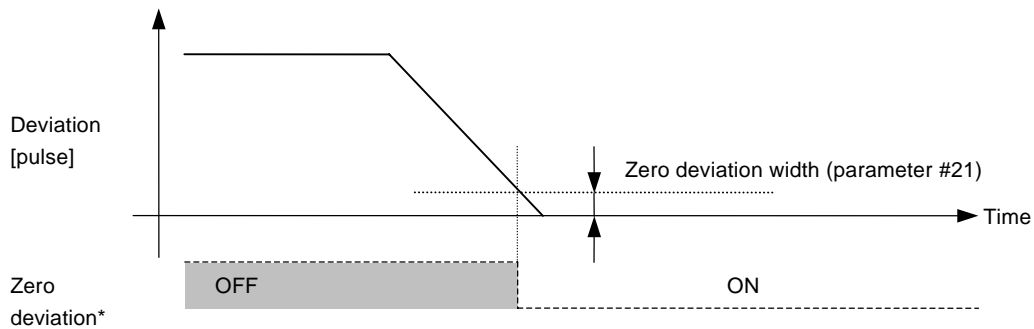
Parameter #21

No.	Name	Setting range	Initial value	Change
21	Zero deviation width	1 to 20000 [pulse] (in 1 increments)	400	Always

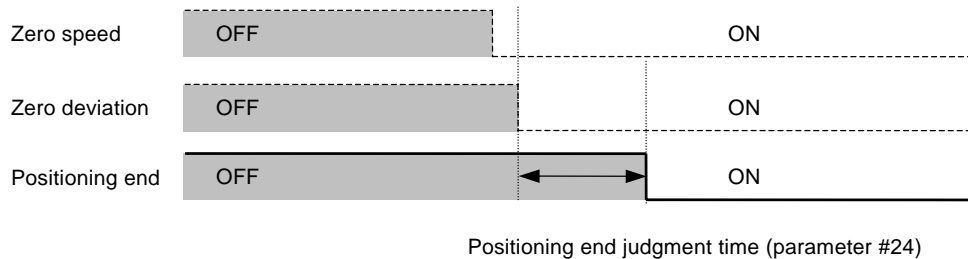
* It is only valid for position control.

Specify the width of the zone where the zero deviation signal is activated* in the number of encoder pulses.

The unit is equivalent to the number of encoder feedback pulses (not command pulses).



If both the zero deviation signal (parameter #21) and zero speed signal (parameter #23) remain active in the positioning end judgment time specified in parameter #24, the positioning end signal is activated.



When the precision of ± 10 [μm] is desired for a machine with ball screw fastening and the lead of 10 [mm].

$$\frac{131072[\text{pulse/rev}]}{\text{Movement per rotation [m]}} \times (\text{Required precision [m]}) = \text{Zero deviation width [pulse]}$$

$$\frac{131072[\text{pulse/rev}]}{10 \times 10^{-3} [\text{m}]} \times (10 \times 10^{-6} [\text{m}]) = 131.072 \approx 131 [\text{pulse}]$$

Set [131] to zero deviation width (parameter #21).

5 PARAMETERS

Pn01 / no.22

Parameter #22

No.	Name	Setting range	Initial value	Change
22	Deviation limit width	10 to 65535 [$\times 100$ pulse] (in 1 increments)	20000	Always

* It is only valid for position control.

Specify the number of pulses for detecting the deviation limit (for alarm detection) in the number of encoder feedback pulses (not command pulses).

The initial setting is "20000," so that deviation is detected at 2000000 pulses.

With the initial setting, deviation is detected if the difference between the command position and feedback position is equivalent to about 15.2 revolutions of the servomotor shaft.

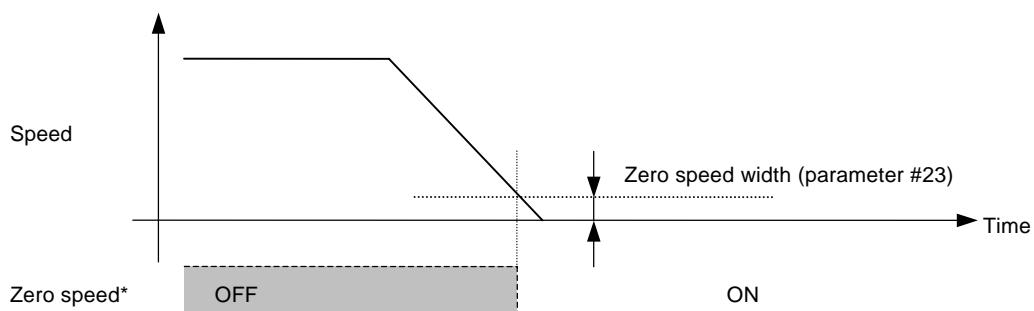
The deviation limit width is provided for alarm detection.

Pn01 / no.23

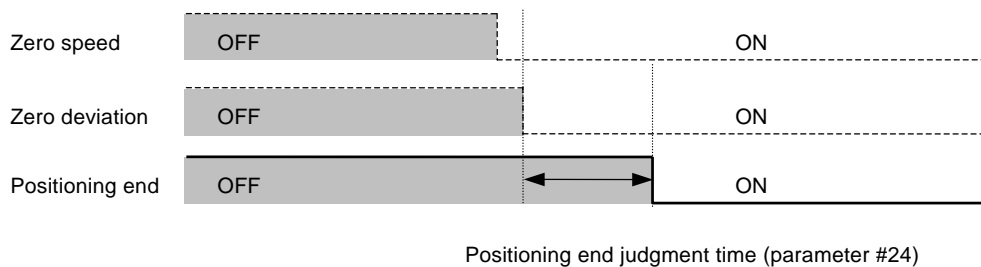
Parameter #23

No.	Name	Setting range	Initial value	Change
23	Zero speed width	10 to 5000 [r/min] (in 1 increments)	50	Always

Use the parameter to judge if the servomotor is stopped. Specify the width where the zero speed signal is activated*.



If the zero deviation signal (parameter #21) and zero speed signal (parameter #23) remain active in the positioning completion judgment time specified in parameter #24, the positioning end signal is activated.



Pn01 / no.24

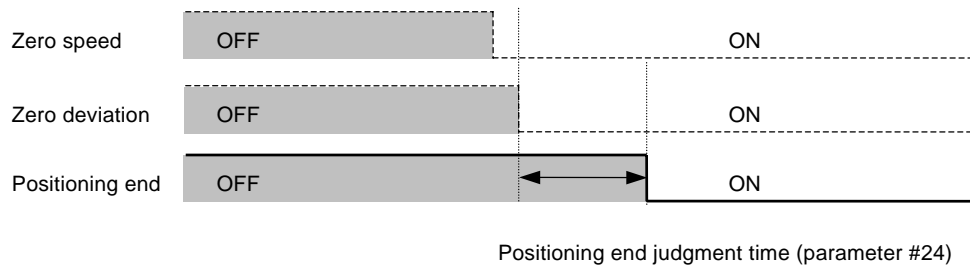
Parameter #24

No.	Name	Setting range	Initial value	Change
24	Positioning end judgment time	0.000 to 1.000 sec. (in 0.001 increments)	0.000	Always

* It is only valid for position control.

Specify the time for judgment of the end of positioning.

If the zero deviation signal (parameter #21) and zero speed signal (parameter #23) remain active in the positioning end judgment time (parameter #24), the positioning end signal is activated.



Pn01 / no.25

Parameter #25

No.	Name	Setting range	Initial value	Change
25	Max. current limit	0 to 300 % (in 1 increments)	300	Always

Specify the output torque limit of the servomotor.

This setting is specified as shown in the table below according to the sequence input signal torque limit (20) setting.

Allocation of current limit signal		Description of operation
No		Normally ON (parameter #25 reference value)
Yes	OFF	Maximum torque
	ON	ON (parameter #25 reference value)

5 PARAMETERS

Pn01 / no.26

Parameter #26

No.	Name	Setting range	Initial value	Change
26	Undervoltage alarm detection	0: No detection, 1: Detection	1	Power

Specify whether or not alarm detection is made upon detection of undervoltage in the power supply under active servo on [RUN].

Pn01 / no.27

Parameter #27

No.	Name	Setting range	Initial value	Change
27	Operation for undervoltage	0: Sudden deceleration and stop 1: Coasting	0	Power

* It is only valid for speed control.

While the servo on (RUN) signal is ON, the servomotor operation is specified for detection of undervoltage of the power supply.

Parameter #27

Setting range	Operation for detection of undervoltage
0: Sudden deceleration and stop	The system decelerates and stops at the maximum capacity of the servo amplifier.
1: Coasting	The system decelerates (accelerates) with the load torque for coasting.

Pn01 / no.28

Parameter #28

No.	Name	Setting range	Initial value	Change
28	For adjustment by manufacturer	-	Adjustment value	-

This parameter is for adjustment by manufacturer. Do not change it.

Pn01 / no.29

Parameter #29

No.	Name	Setting range	Initial value	Change
29	Parameter write-protection	0: Write-enable, 1: Write-protected	0	Always

Parameter editing is prohibited.

Even if write-protection is selected with parameter #29, parameter #29 can be edited.

5 PARAMETERS

Pn01 / no.30

Parameter #30

No.	Name	Setting range	Initial value	Change
30	Initial display of the keypad	0 to 20 (in 1 increments)	0	Power

Specify the initial display of the keypad immediately after the power is supplied.

Parameter #30

Setting	Description	Display
0	Operation mode	Sn01
1	Current alarm	Sn02
2	Alarm history	Sn03
3	Station No. setting	Sn04

Setting	Description	Display
4	Feedback speed	0n01
5	Command speed	0n02
6	Average torque	0n03
7	Current feedback position	0n04
8	Current command position	0n05
9	Position deviation	0n06
10	Feedback cumulative pulse	0n07
11	Command cumulative pulse	0n08
12	Peak torque	0n09
13	Input voltage	0n10
14	Input/output signal	0n11
15	Load inertia ratio	0n12
16	OL thermal value	0n13
17	Regenerative resistor thermal value	0n14
18	Pulse string input frequency	0n15
19	DC link voltage (maximum value)	0n16
20	DC link voltage (minimum value)	0n17

Refer to Chapter 8 Keypad for details of each display.

Pn01 / no.31 - no.33

Parameters #31 to 33

No.	Name	Setting range	Initial value	Change
31	Manual feed speed 1 (and test operation)	0.1 - (Maximum rotation speed) [r/min] (in 0.1 increments)	100.0	Always
32	Manual feed speed 2	0.1 - (Maximum rotation speed) [r/min] (in 0.1 increments)	500.0	Always
33	Manual feed speed 3	0.1 - (Maximum rotation speed) [r/min] (in 0.1 increments)	1000.0	Always

* It is valid for position control and speed control.

The rotation speed of the forward rotation command [FWD] (reverse rotation command [REV]) signal can be specified.

ON/OFF combination of X1 and X2 signals can change the rotation speed.

The rotation speed can be changed during operation of the servomotor. It is not related to the parameter sequence and the degree of the reference value.

Selection of multistep speed

X2	X1	Rotation speed
OFF	OFF	Analog speed command input [Vref] terminal
OFF	ON	Standard parameter #31
ON	OFF	Standard parameter #32
ON	ON	Standard parameter #33

Pn01 / no.34

Parameter #34

No.	Name	Setting range	Initial value	Change
34	Maximum rotation speed	0.1 - (Maximum rotation speed) [r/min] (in 0.1 increments)	5000.0 (3000.0)	Always

* Value in () is the initial value of the GYG motor.

Set the upper limit of the servomotor rotation speed specified with the parameter and the analog speed command input.

During torque control, the difference between the reference value and the actual rotation speed of the servomotor is about 100 [r/min].

(It is because speed control is not performed.)

The setting of the maximum rotation speed is not valid for position control of the pulse string input.

* The initial value of the GYS motor is 5000.0 [r/min].

* The initial value of the GYG motor is 3000.0 [r/min].

5 PARAMETERS

Pn01 / no.35 - no.38

Parameters #35 to 38

No.	Name	Setting range	Initial value	Change
35	Acceleration time 1	0.000 - 9.999 sec. (in 0.001 increments)	0.100	Always
36	Deceleration time 1	0.000 - 9.999 sec. (in 0.001 increments)	0.100	Always
37	Acceleration time 2	0.000 - 9.999 sec. (in 0.001 increments)	0.500	Always
38	Deceleration time 2	0.000 - 9.999 sec. (in 0.001 increments)	0.500	Always

* It is valid for position control and speed control.

Acceleration/deceleration time of the servomotor can be set.

It is valid for all acceleration/deceleration during speed control and position control (excluding the pulse string input).

The time setting is from 0 (zero) to 2000 [r/min].

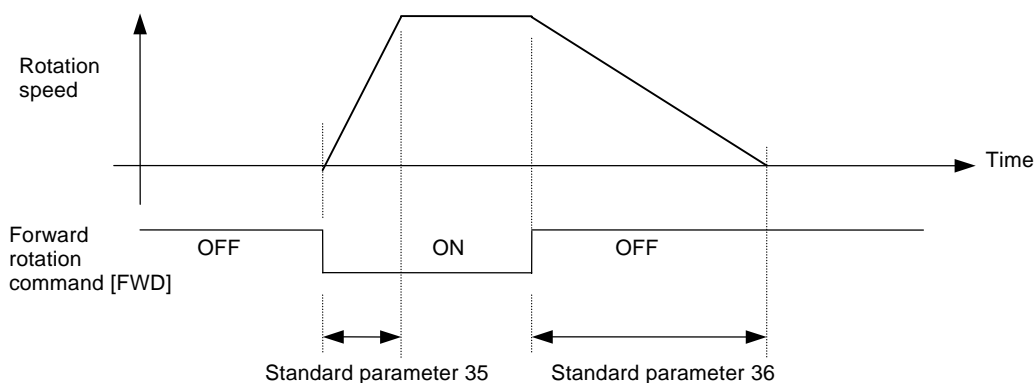
Acceleration time 2 and deceleration time 2 are valid while the acceleration/deceleration time selection signal is ON. ON/OFF of the acceleration/deceleration time selection is always ON. The acceleration time/deceleration time is changed in a similar manner.

The acceleration/deceleration time selection signal is the control allocation signal of the parameter.

External selection of acceleration/deceleration time

Acceleration/deceleration time selection (19)	Acceleration time	Deceleration time
OFF	Parameter 35	Parameter 36
ON	Parameter 37	Parameter 38

Acceleration time 1 can be set separate to deceleration time 1. Only the deceleration time can be increased. Deceleration time can be used depending on load including movement of a carrier.



When the analog speed command voltage is output with the upper level control unit and the feedback from the dividing output of the servo amplifier is used for position control, set the acceleration time and the deceleration time to 0.000 sec.

Pn01 / no.39

Parameter #39

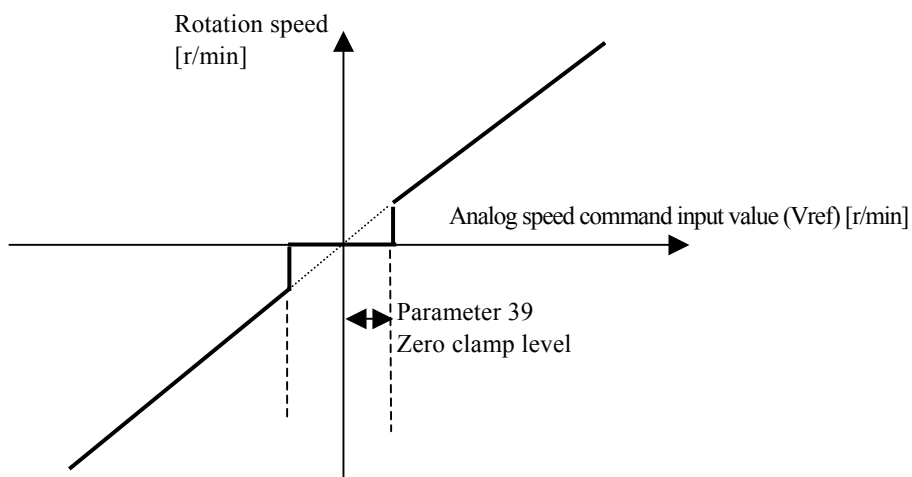
No.	Name	Setting range	Initial value	Change
39	Zero clamp level	0.0 - 500.0 [r/min] (in 0.1 increments)	0.0	Always

* It is valid for position control and speed control.

This sets the rotation speed of the servomotor in zero clamp.

When the analog speed command of position control and speed control is input, this signal is valid.

When the speed command value of the analog speed command input (Vref) terminal is zero clamp level or less, the rotation speed is zero clamped. Drift of the analog speed command input value is prevented near zero.



Note For analog voltage around the reference value, the command may fluctuate between "zero" and "reference value," resulting in an unstable motor shaft.

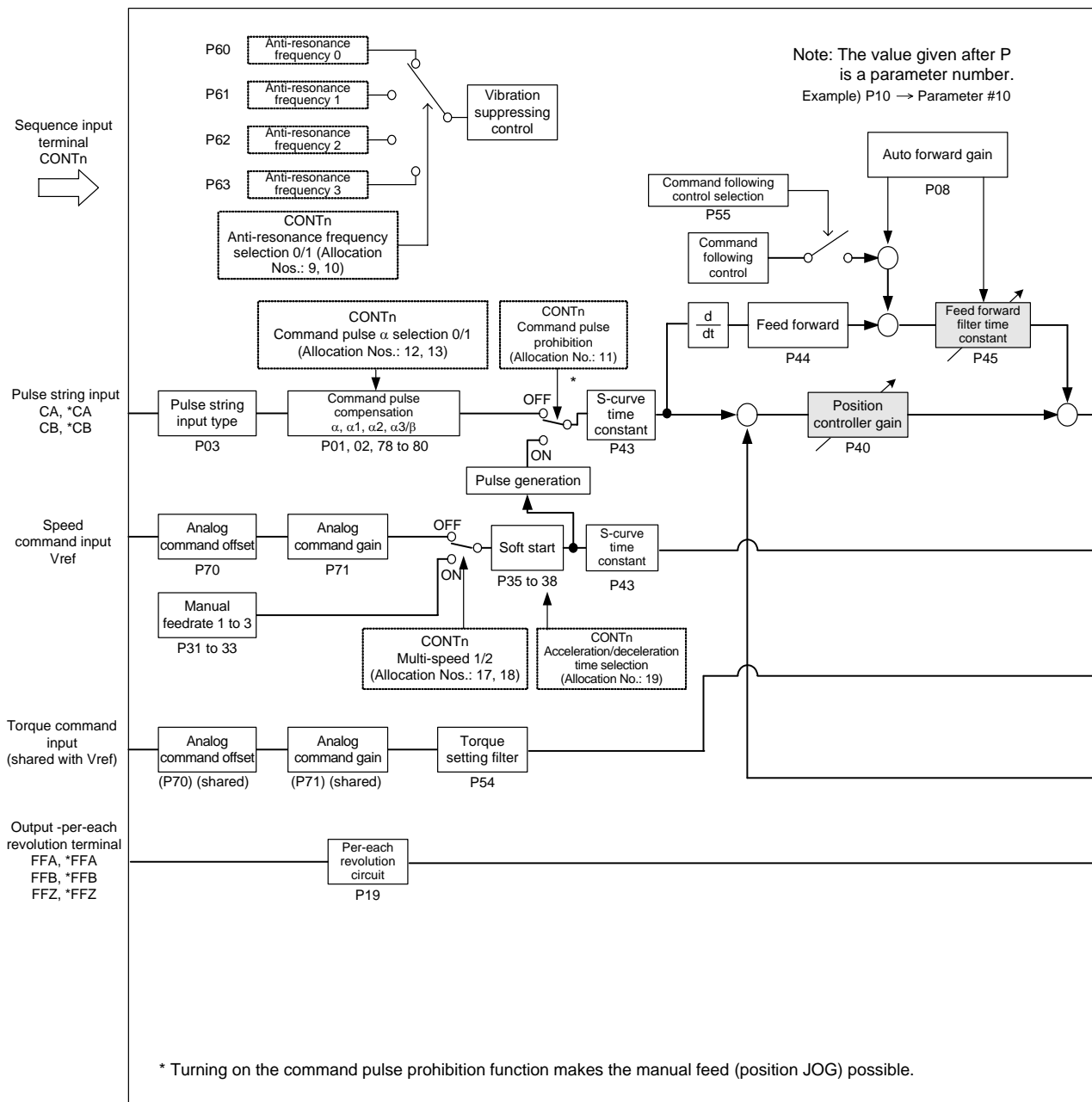
5 PARAMETERS

Control system settings

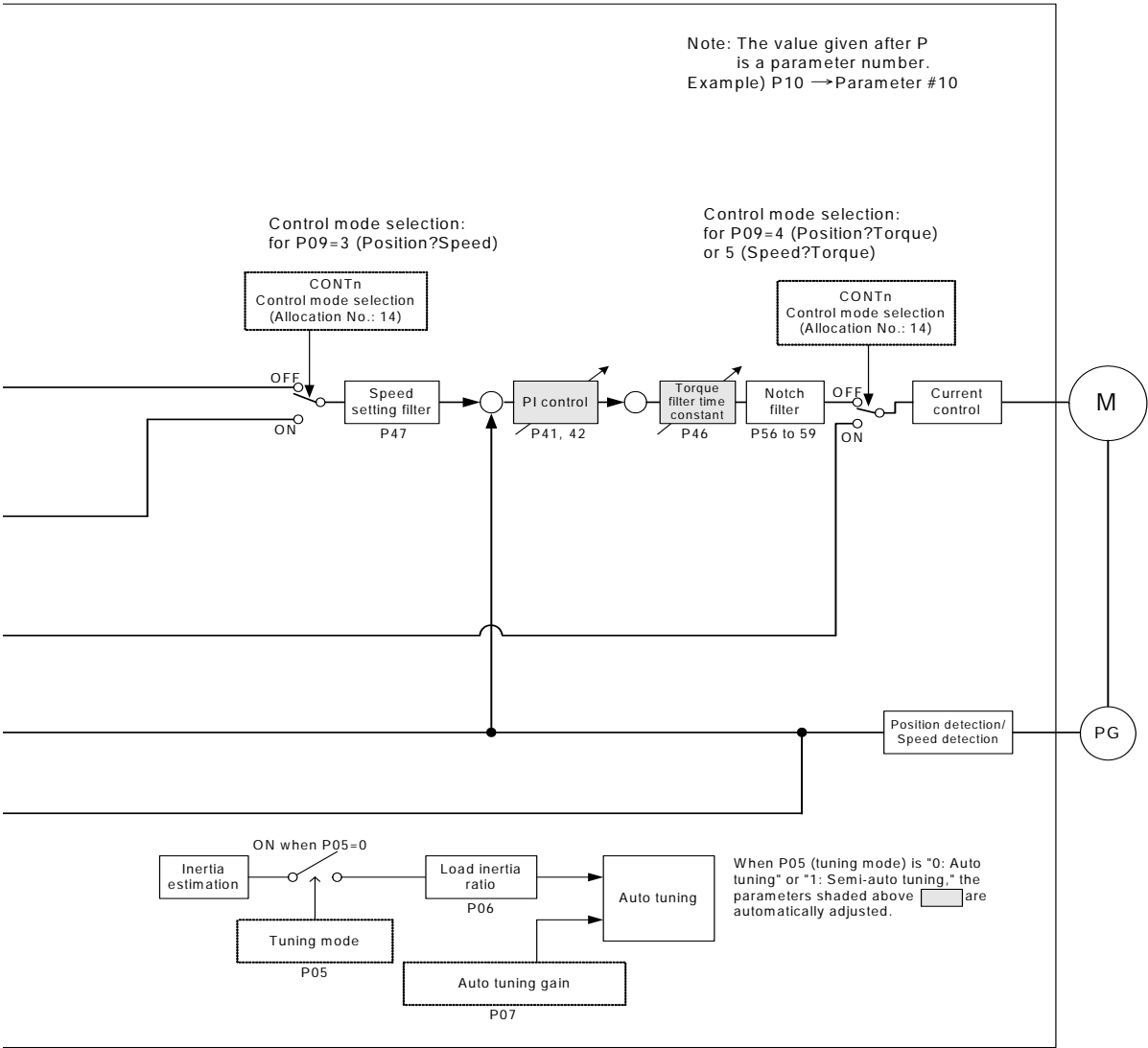
Control system setting parameters are described in the order of the parameter number.

Control block diagram

The control block diagram of FALDIC-W Series is shown.



Note: The value given after P
is a parameter number.
Example) P10 →Parameter #10



5 PARAMETERS

Pn01 / no.40 - no.42

Parameters #40 through #42

No.	Name	Setting range	Initial value	Change
40	Position controller gain 1	1 to 1000 [rad/sec] (in 1 increments)	77	Always
41	Speed response 1	1 to 1000 [Hz] (in 1 increments)	57	Always
42	Speed controller integration time 1	1.0 to 1000.0 [msec] (in 0.1 increments)	25.9	Always

* The initial value is for the GYS motor.

Pn01 / no.45 - no.46

Parameters #45 and #46

No.	Name	Setting range	Initial value	Change
45	Feed forward filter time constant	0.0 to 250.0 [msec] (in 0.1 increments)	12.9	Always
46	Torque filter time constant	0.00 to 20.00 [msec] (in 0.01 increments)	0.31	Always

* The initial value is for the GYS motor.

* It is valid for position control and speed control.

No. 40 and No. 45 are only valid for position control.

These parameters are automatically updated when “auto tuning” or “semi-auto tuning” is selected at basic setting parameter #5.

Specify them when “manual tuning” is selected.

No.	Name	Tuning mode		
		0: Auto	1: Semi-auto	2: Manual
06	Load inertia ratio	-	O	O
07	Auto tuning gain	O	O	X
40	Position controller gain 1	-	-	O
41	Speed response 1	-	-	O
42	Speed controller integration time 1	-	-	O
45	Feed forward filter time constant	-	-	O
46	Torque filter time constant	-	-	O

* O : Parameter which must be set

- : Parameter which may not be set (The value is automatically calculated inside the amplifier and the result is reflected on the parameter.)

X : The parameter has no effect even if it is set.

■ Position controller gain 1 (Parameter 40)

This parameter determines the response of the position control loop. A larger setting improves the response to the position command, while too large a setting is likely to generate overshoot.

■ Speed response 1 (Parameter 41)

This parameter determines the response of the speed control loop. A larger setting improves the response of the servomotor, while too large a setting may cause the mechanical system to vibrate.

■ Speed controller integration time 1 (Parameter 42)

This parameter determines the response of the speed control loop. A smaller setting improves the response of the servomotor, while too small a setting may cause the mechanical system to vibrate.

■ Feed forward filter time constant (Parameter 45)

This parameter filters feed forward action of the position control loop.
A smaller setting improves the response while it may cause torque shock.

■ Torque filter time constant (Parameter 46)

This parameter filters the torque command.
A larger setting suppresses resonance of the machine while stability in the control may be undermined.

5 PARAMETERS

Pn01 / no.43

Parameter #43

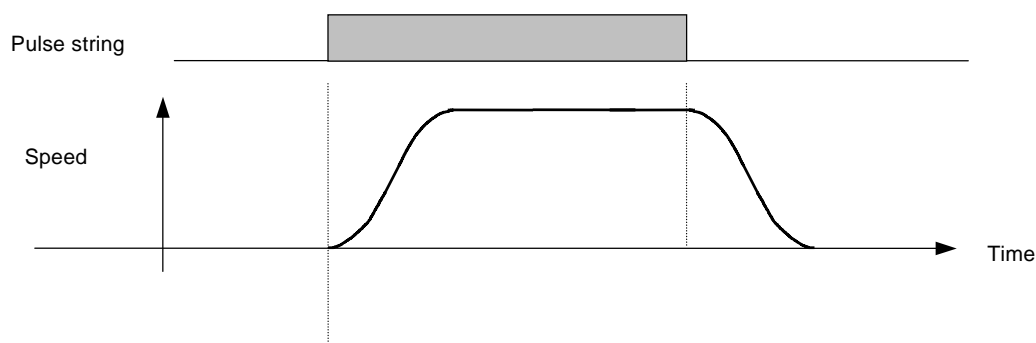
No.	Name	Setting range	Initial value	Change
43	S-curve time constant	0.0 to 100.0 [msec] (in 0.1 increments)	2.0	Always

* It is valid for position control and speed control.

The servomotor can be accelerated or decelerated moderately in the S-curve pattern.

If the pulse string input is given at a constant frequency, the servomotor accelerates or decelerates at the time constant of the set time.

Smooth acceleration and deceleration are obtained even if the host controller does not allow linear acceleration.



* Specify the parameter without fail if the dumping control function (parameters #60 through #63) are used.



Refer to section 7.1 "Vibration control."

Pn01 / no.44

Parameter #44

No.	Name	Setting range	Initial value	Change
44	Feed forward gain	0.000 to 1.500 (in 0.001 increments)	0.000	Always

* It is only valid for position control.

This parameter functions if parameter #60 (command following control selection) is set at "0 (none)." Specify the parameter in a poorly rigid machine or a mechanical system having a large load inertia ratio, to increase the response.

Specify a value between 0.100 and 0.500 to obtain a preferable result. A larger setting reduces position deviation (difference between position command and feedback position), resulting in a better response.

To perform synchronous operation between two axes, set "1.000."

Pn01 / no.47

Parameter #47

No.	Name	Setting range	Initial value	Change
47	Speed setting filter	0.00 to 20.00 [msec] (in 0.01 increments)	0.00	Always

* It is valid for position control and speed control.

Specify the parameter to filter the speed command.

* No change is necessary in principle.

5 PARAMETERS

Pn01 / no.48 - no.53

Parameters #48 through #53

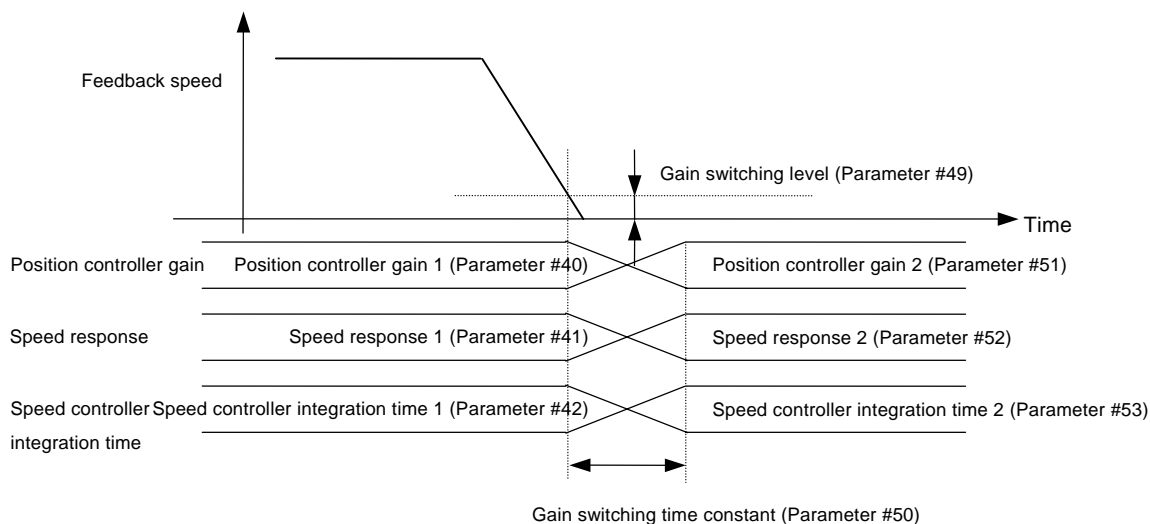
No.	Name	Setting range	Initial value	Change
48	Gain switching factor	0: Position deviation (x 10), 1: Feedback speed, 2: Command speed	1	Always
49	Gain switching level	1 to 1000 (in 1 increments)	50	Always
50	Gain switching time constant	0 to 100 [msec] (in 1 increments)	10	Always
51	Position controller gain 2	30 to 200 % (in 1 increments)	100	Always
52	Speed response 2	30 to 200 % (in 1 increments)	100	Always
53	Speed controller integration time 2	30 to 200 % (in 1 increments)	100	Always

* It is valid for position control and speed control.

Only No. 51 is valid for position control.

The gain at the time of stopping is switched from the first gain (parameters #40 to #42) to the second gain (parameters #51 to #53).

Gain switching reduces the noise and vibration at the time of stopping.



The settings of the second gain (parameters #51 to #53) are given in the ratio (%) to the first gain.

Example: When speed response 1 (parameter #41) is 100Hz

“100%” of speed response 2 (parameter #52) means 100Hz.

“80%” of speed response 2 (parameter #52) means 80Hz.

* The same rule applies to position controller gain 2 (parameter #51) and speed controller integration time 2 (parameter #53).

Pn01 / no.54

Parameter #54

No.	Name	Setting range	Initial value	Change
54	Torque setting filter	0.000 - 9.999 [sec] (in 0.001 increments)	0.000	Always

* It is only valid for torque control.

With this parameter, the input voltage of the analog torque command input [Vref] terminal can be filtered.

Pn01 / no.55

Parameter #55

No.	Name	Setting range	Initial value	Change
55	Command following control selection	0: None, 1: Command following control, 2: Command following control (with correction on stop)	0	Power

* It is only valid for position control.

Use the parameter to select the command following control mode where the mechanical system follows the command without delay to the pulse command.



Refer to section 7.2 "Command following control."

5 PARAMETERS

Pr01 / no.56 - no.59

Parameters #56 through #59

No.	Name	Setting range	Initial value	Change
56	Notch filter 1 frequency	10 to 200 [x 100 Hz] (in 1 increments)	200	Always
57	Notch filter 1 damping amount	0 to 40 [dB] (in 1 increments)	0	Always
58	Notch filter 2 frequency	10 to 200 [x 10Hz] (in 1 increments)	200	Always
59	Notch filter 2 damping amount	0 to 40 [dB] (in 1 increments)	0	Always

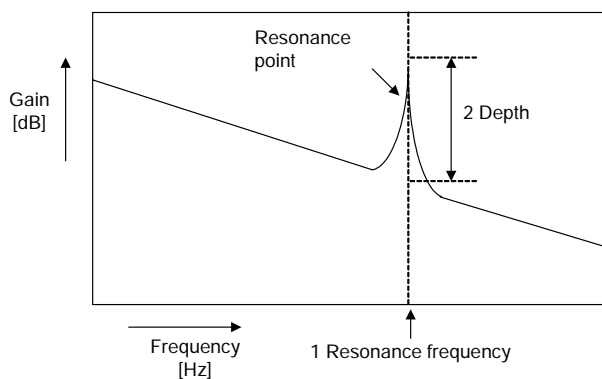
* It is valid for position control and speed control.

Specify to suppress resonance of the mechanical system.

Resonance can be suppressed at up to two points.

■ Notch filter setting method

- Use the servo analysis function of the PC loader (option) to determine the resonance point of the machine.

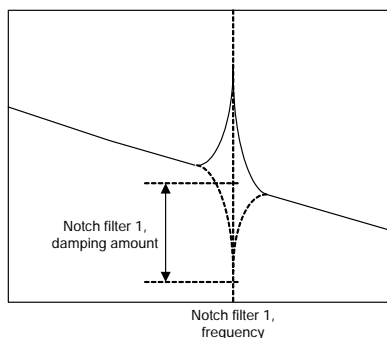


- Specify the resonance frequency and damping amount of the resonance point of the machine in parameters.

1 Resonance frequency → Parameter #56 (Notch filter 1 frequency)

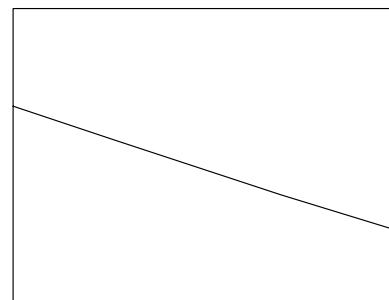
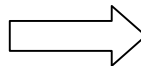
2 Depth → Parameter #57 (Notch filter 1 damping amount)*

* Too deep a damping amount may undermine stability of the control. Avoid setting too large a value.



The notch filter functions at the resonance point as shown in the figure above.

Use the servo analysis function again.



The resonance point is eliminated due to the notch filter.

Pn01 / no.60 - no.63


Parameters #60 through #63

No.	Name	Setting range	Initial value	Change
60	Anti-resonance frequency 0	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
61	Anti-resonance frequency 1	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
62	Anti-resonance frequency 2	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
63	Anti-resonance frequency 3	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always

* It is only valid for position control.

Use these parameters to specify anti-resonance frequencies and suppress vibration of the workpiece (vibration suppressing control).

The vibration suppressing control function becomes invalid with 200.0Hz (factory setting).

 Refer to section 7.1 "Vibration suppressing control."

Pn01 / no.64 - no.69

Parameters #64 through #69

No.	Name	Setting range	Initial value	Change
64 to 69	Not used	-	0	-

These parameters are not used.

5 PARAMETERS

Pn01 / no.70 - no.71

Parameters #70 and 71

No.	Name	Setting range	Initial value	Change
70	Analog command gain	$\pm 0.10 - \pm 1.5$ (in 0.01 increments)	1.0	Always
71	Analog command offset	-2000 - +2000	(Set before shipment)	Always

Gain and offset of the analog speed command input [Vref] can be adjusted.

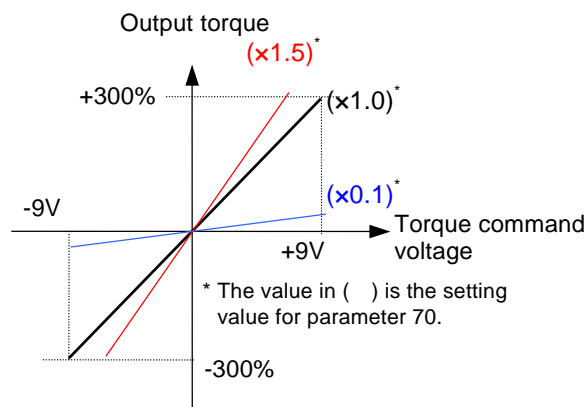
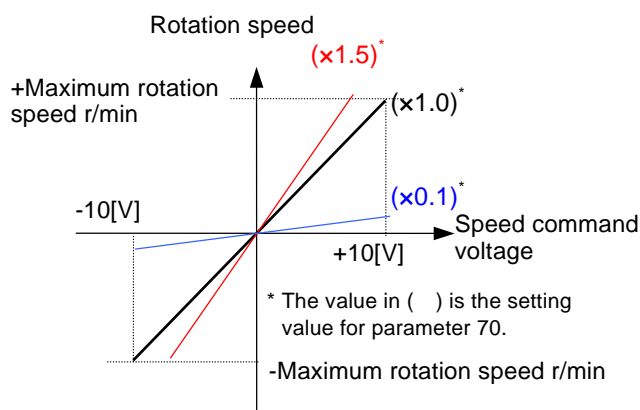
■ Analog command gain

The gain can be set in the range from ± 0.10 to ± 1.50 in increments of 0.01.

By adding the negative sign, the rotation direction will be reverse.

1) Speed control (speed command voltage)

2) Torque control (torque command voltage)



*) Relationship of rotation speed by speed command voltage and analog command gain.
(GYS motor)

Analog command gain		Rotation speed [r/min]			
		1.5	1.0	0.5	0.1
Speed command voltage	10V	5000	5000	2500	500
	9V		4500	2250	450
	8V		4000	2000	400
	7V		3500	1750	350
	6V	4500	3000	1500	300
	5V	3750	2500	1250	250
	4V	3000	2000	1000	200
	3V	2250	1500	750	150
	2V	1500	1000	500	100
	1V	750	500	250	50

*) Relationship of output torque by torque command voltage and analog command gain.

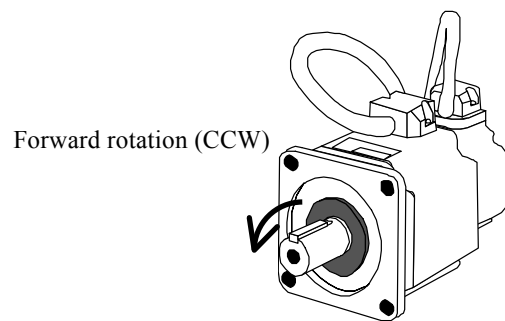
Analog command gain		Output torque [%]			
		1.5	1.0	0.5	0.1
Torque command voltage	9V	300	300	150	30
	8V		267	133	27
	7V		233	117	23
	6V		200	100	20
	5V	250	167	83	17
	4V	200	133	67	13
	3V	150	100	50	10
	2V	100	67	33	6.7
	1V	50	33	17	3.3

*) The relationship between the speed command voltage and the rotation direction is shown below (upon shipment from factory).

Speed command voltage	Rotation command	Rotation direction	Rotation speed [r/min]
+6.0V	FWD	CCW	3000
	REV	CW	
+1.0V	FWD	CCW	500
	REV	CW	
0V	FWD	-	0
	REV	-	
-5.0V	FWD	CW	2500
	REV	CCW	

*) The relationship between the torque command voltage and the rotation direction is shown below (upon shipment from factory).

Torque command voltage	Rotation command	Rotation direction	Output torque
+6.0V	FWD	CCW	200%
	REV	CW	
+1.5V	FWD	CCW	50%
	REV	CW	
0V	FWD	-	0%
	REV	-	
-4.5V	FWD	CW	150%
	REV	CCW	



■ Analog command offset

It is set in the range from -2000 to 2000 in increments of 1.

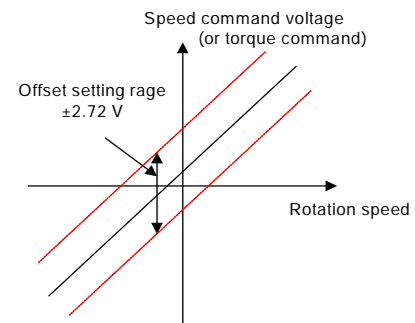
Increment [1] is equivalent to [1.36 mV].

The setting range is from [-2.72V] to [2.72V].

The reference value set at factory before shipment is registered as the initial value.

Automatic offset adjustment is available in test operation mode of the keypad. **F07**

The value after adjustment is incorporated to parameter No. 70.



■ Resolution during speed control (speed command voltage)

14 bit resolution is available in full scale (-11.22 to +11.22 [V]). When the maximum rotation speed is 5000 [r/min] and 10V (speed command voltage), the resolution is $(-5000 \text{ to } +5000) \text{ [r/min]} / 214 \times 11.22 / 10 = 0.67 \text{ [r/min]}$. (For GYS motor)

■ Resolution during torque control (torque command voltage)

14 bit resolution is available in full scale (-11.22 to +11.22 [V]). When the maximum torque is 300% and 9V (torque command voltage), the resolution is $(-300 \text{ to } +300) \% / 214 \times 11.22 / 9 = 0.046\%$ (rated torque 100%).

5 PARAMETERS

Pn01 / no.72

Parameter #72

No.	Name	Setting range	Initial value	Change
72	Operation sequence selection for dynamic brake unit connection	0: DB invalid for OT detection/RUN = DB invalid for OFF 1: DB valid for OT detection/RUN = DB invalid for OFF 2: DB invalid for OT detection/RUN = DB valid for OFF 3: DB valid for OT detection/RUN = DB valid for OFF	0	Power

It is set when the optional dynamic brake unit (soon to be released) is connected.

Pn01 / no.73

Parameter #73

No.	Name	Setting range	Initial value	Change
73	Brake operation time	0.00 - 9.99 [sec] (in 0.01 increments) Base shutoff delay time at RUN = OFF	0.00	Always

Set the operation time of the external brake.

Set the time from the servo ON (RUN) signal OFF of the servo amplifier to the base OFF status.



For detailed timing chart, refer to “4.4 Brake timing”.

Pn01 / no. 74 - no. 77

Parameters #74 to 77

No.	Name	Setting range	Initial value	Change
74	CONT normally ON 1	0 - 21 (in 1 increments)	0	Power
75	CONT normally ON 2	0 - 21 (in 1 increments)	0	Power
76	CONT normally ON 3	0 - 21 (in 1 increments)	0	Power
77	CONT normally ON 4	0 - 21 (in 1 increments)	0	Power

Any sequence input signal can always be ON.

Signals available for allocation are as follows:

1: Servo ON (RUN)

Operation command is normally ON.

11: Command pulse inhibition (INH)

Command pulse is normally inhibited.

This is set when only manual operation is performed during position control.

(It is not set for pulse string.)

15: Manual forward rotation command (FWD),

14: Manual reverse rotation command (REV)

It is normally ON during speed/torque control.

It is not normally ON during position control.

■ Recognition method of FWD/REV signal

Speed/torque control : Level

Position control : Edge

17: Multistep speed selection 1 (X1), 18: Multistep speed selection 2 (X2)

Specific multistep speed is ON.



When this parameter is allocated to either one of control parameters #74 to 77, it is normally ON. Signals that allow the status to be normally ON are 4.

5 PARAMETERS

Pr01 / no.78 - no.80

Parameters #78 to 80

No.	Name	Setting range	Initial value	Change
78	Command pulse compensation α 1	1 - 32767 (in 1 increments)	1	Always
79	Command pulse compensation α 2	1 - 32767 (in 1 increments)	1	Always
80	Command pulse compensation α 3	1 - 32767 (in 1 increments)	1	Always

* It is only valid for position control.

With “Command pulse compensation α selection 0” and “Command pulse compensation α selection 1” allocated by the sequence signal, the value of the command pulse compensation α is changed.

Command pulse compensation α selection 1	Command pulse compensation α selection 0	Command pulse compensation α
OFF	OFF	Parameter #1
OFF	ON	Parameter #78
ON	OFF	Parameter #79
ON	ON	Parameter # 80

Pr01 / no.81

Parameter #81

No.	Name	Setting range	Initial value	Change
81	Parameter storage in RAM	0: Not specified, 1 - 99 (in 1 increments)	0	Power

Parameter settings are stored in EEPROM (electronically rewritable EPROM) for data storage during power shutoff.

* The maximum assured count of rewriting in EEPROM is 100,000 times.

With storage of parameters in RAM, data can be infinitely rewritten.

Specify the number of RAM storage to parameter #81.

The initial value is set for the parameter stored in RAM when the power is supplied.

List of parameters storable in RAM

No.	Description of parameter	No.	Description of parameter
1	Command pulse compensation α	37	Acceleration time 2
2	Command pulse compensation β	38	Deceleration time 2
25	Maximum current limit value	60	Anti-resonance frequency 1
31	Manual feed speed 1	61	Anti-resonance frequency 2
32	Manual feed speed 2	62	Anti-resonance frequency 3
33	Manual feed speed 3	63	Anti-resonance frequency 4
34	Maximum rotation speed	78	Command pulse compensation α 1
35	Acceleration time 1	79	Command pulse compensation α 2
36	Deceleration time 1	80	Command pulse compensation α 3

Pn01 / no.82 - no.83

Parameters #82 and 83

No.	Name	Setting range	Initial value	Change
82	Station No.	1 - 31 (in 1 increments)	1	Power
83	Baud rate	0 : 38400 [bps] , 1 : 19200 [bps] , 2 : 9600 [bps]	0	Power

■ Station No.

The station number of the servo amplifier is specified from 1 to 31 with the RS485 communication cable.

■ Baud rate


The baud rate is set with the RS485 communication cable.

Pn01 / no.84 - no.86

Parameters #84 to 86

No.	Name	Setting range	Initial value	Change
84	Easy tuning: Travel setting	0.5 - 200.0 [rev] (in 0.1 increments)	2.0	Always
85	Easy tuning: Speed setting	10.0 - Maximum rotation speed [r/min] (in 0.1 increments)	500.0	Always
86	Easy tuning: Timer setting	0.01 - 5.00 [sec] (in 0.01 increments)	0.50	Always

The parameters are set for easy tuning.

 Refer to Chapter 6.

5 PARAMETERS

Pn01 / no.87 - no.92

Parameters #87 to 92

No.	Name	Setting range	Initial value	Change
87	Monitor 1 signal allocation	1: Speed command, 2: Speed feedback, 3: Torque command, 4: Position deviation, 5: Position deviation (extension), 6: Pulse frequency	2	Always
88	Monitor 2 signal allocation	1: Speed command, 2: Speed feedback, 3: Torque command, 4: Position deviation, 5: Position deviation (extension), 6: Pulse frequency	3	Always
89	Monitor 1 scale	$\pm 2.0 - \pm 100.0$ [V] (in 0.1 increments)	7.0	Always
90	Monitor 1 offset	- 50 - +50 (in 1 increments)	0	Always
91	Monitor 2 scale	$\pm 2.0 - \pm 100.0$ [V] (in 0.1 increments)	6.0	Always
92	Monitor 2 offset	- 50 - +50 (in 1 increments)	0	Always

* ± 11.0 [V] or more is not output for monitor output.

Monitor 1 or monitor 2 terminal output can be selected.

Output description of monitor 1 [MON1] and monitor 2 [MON2] terminals can be selected.

All output types are common for position control, speed control and torque control.

■ Monitor 1/monitor 2 signal allocation

Details output to monitor 1 [MON1] and monitor 2 [MON2] terminals are set.

Parameters #87, 88/Monitor allocation

Output type	Details
1: Speed command	Speed command to the servomotor recognized by the servo amplifier.
2: Speed feedback	Actual rotation speed of the servomotor.
3: Torque command	Torque command to the servomotor recognized by the servo amplifier.
4: Position deviation	Difference (deviation) between position command and position feedback.
5: Position deviation (extension)	Difference (deviation) between position command and position feedback.
6: Pulse string frequency	Pulse string frequency input to the pulse string input terminal.

■ Monitor 1/monitor 2 scale

Full scale output to monitor 1 [MON1] and monitor 2 [MON2] terminals is set.

#89, 91/Monitor scale

Output type	Monitor scale
1: Speed command	Output voltage for the maximum rotation speed.
2: Speed feedback	Output voltage for the maximum rotation speed.
3: Torque command	Output voltage for the maximum torque.
4: Position deviation	Output voltage for 8192 pulses.
5: Position deviation (extension)	Output voltage for 512 pulses.
6: Pulse string frequency	Output voltage for 1 MHz.

When negative sign is specified, polarity of the output voltage can be changed.

The settings to 100.0 [V] can be made, but voltage more than 11.0 [V] cannot be output.

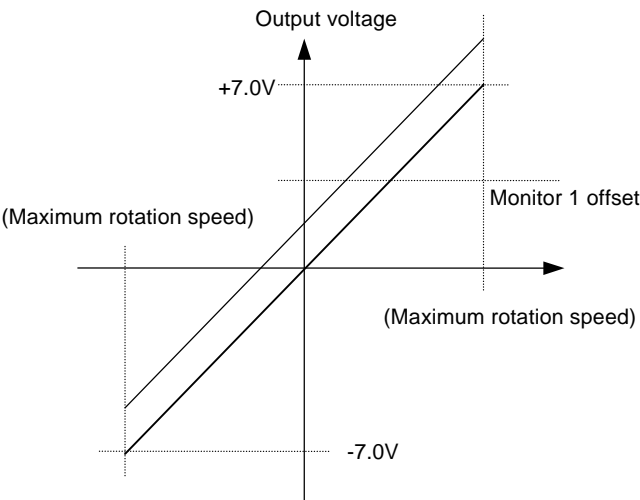
■ Monitor 1/monitor 2 offset

The offset voltage of monitor 1 [MON1] and monitor 2 [MON2] terminals can be adjusted.

The setting range is -50 - 0 - 50 in increments of 1. The setting value has no unit.

■ Monitor 1 output type (speed feedback)

Monitor 1 terminal (both anticipated values)



When the negative sign is specified by monitor 1 scale, polarity of the output voltage is reversed.

■ Resolution of monitor 1/monitor 2 output

The resolution is 12 bit (4096) in full scale (-12.5 to +12.5).

The resolution is (-12.5 to +12.5) [V]/212 = 6.1 [mV].

* The maximum/minimum output is ±11.0 [V] and the calculation of the resolution is ±12.5 [V].

Pn01 / no.93

Parameters #93

No.	Name	Setting range	Initial value	Change
93	Not used	-	0	-

These parameters are not used.

5 PARAMETERS

Pn01 / no.94 - no.97

Parameters #94 to 97

No.	Name	Setting range	Initial value	Change
94	For adjustment by manufacturer	-	Adjusted value	-
95	For adjustment by manufacturer	-	Adjusted value	-
96	For adjustment by manufacturer	-	Adjusted value	-
97	For adjustment by manufacturer	-	Adjusted value	-

The parameters are for adjustment by manufacturer. Do not change them.

Pn01 / no.98 - no.99

Parameters #98 and 99

No.	Name	Setting range	Initial value	Change
98 to 99	Not used	-	0	-

These parameters are not used.

6

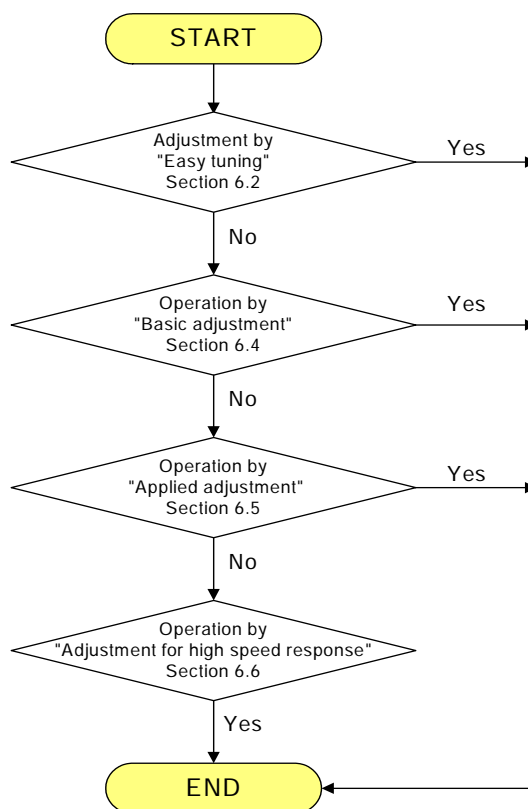
ADJUSTMENT OF SERVO

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6 ADJUSTMENT OF SERVO

6.1 Adjustment procedures

The servomotor must be tuned so that it reliably obeys commands sent from the host controller. Perform tuning with the procedures below:



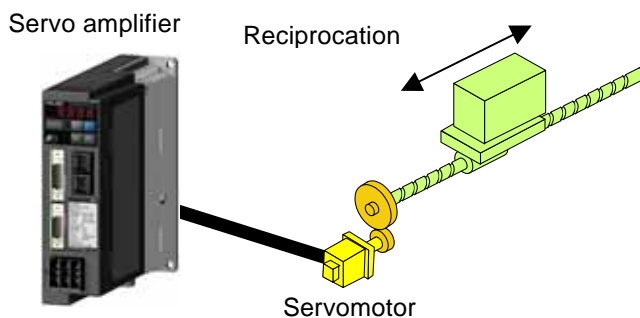
6.2 Easy tuning

6.2.1 What is "Easy tuning"

If the system is not connected to the upper level control system, the system automatically reciprocates for automatic tuning.

Even when the program of the upper level control system is not completed, the motor can be operated in advance and tuning can also be performed. This contributes to a reduction of the setup time.

<Only the amplifier and the motor allow reciprocation and tuning.>

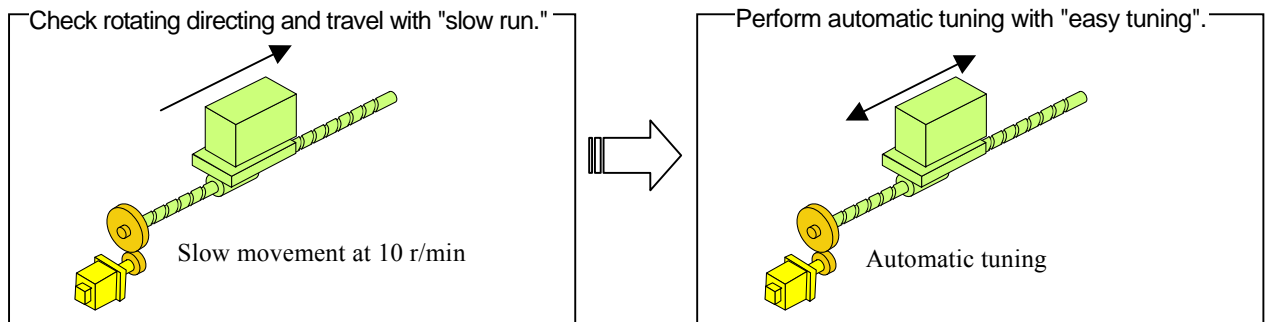


6.2.2 Operation pattern of easy tuning

Easy tuning has 2 operation patterns, which can be operated with keypad/PC loader.

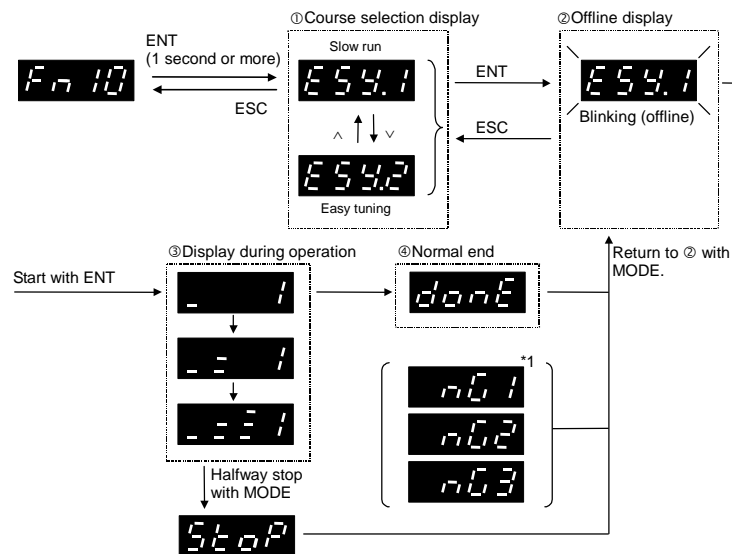
- 1) Slow runOne reciprocal movement at 10 r/min (fixed).
Rotation direction and travel are checked.
- 2) Easy tuning25 reciprocal movements.
During this time, automatic tuning is performed.

After checking rotating directing and travel with "slow run," perform "easy tuning."



Tips

Easy tuning operation method on the keypad



6 ADJUSTMENT OF SERVO

6.2.3 Cautions for easy tuning

During easy tuning, the system is automatically operated with the function of the servo amplifier. Be careful as to safety.

If the motor oscillates and an adverse effect on the machine is expected, allocate the servo ON (RUN) signal or the emergency stop (EMG) signal to the CONT signal. Perform easy tuning with these signals ON. If an error occurs during operation, turn OFF any of the signals immediately.

If the machine may be damaged due to overtravel, allocate \pm overtravel signal (\pm OT) to the CONT signal and provide the overtravel sensors at both ends of the movable travel before easy tuning.

6.2.4 Description of operation

Two operation patterns of easy tuning are described.

(1) Slow run

<Start conditions>

Conditions to start slow run are shown below. Required conditions are marked with "O" If the conditions below are not satisfied, the system cannot be started. ("NG1" is displayed.)

Power supply to main circuit	Not alarm status	Not \pm OT or EMG status	BX signal is OFF	Auto tuning status ^{*1}	Auto gain reference value at start	Parameter rewritable ^{*2}
O	O	O	O	O	*3	O

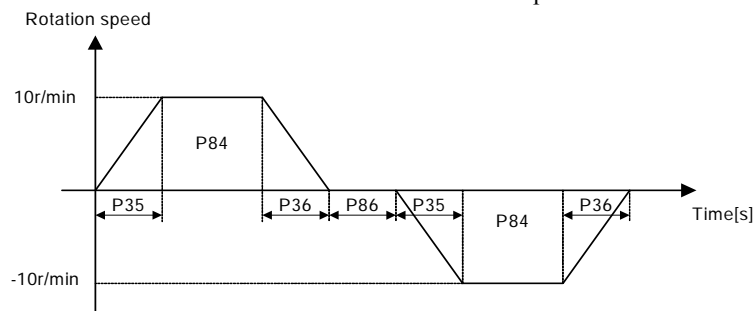
*1) When parameter No. 5 (tuning mode) is 0 (auto tuning) (The system cannot be started with other settings.)

*2) When parameter No. 29 (parameter write protected) is 0 (rewritable)

*3) When parameter No. 7 (auto tuning gain) is 4 or less, the system automatically starts from 5. When the parameter is 16 or more, it starts from 15.

<Operation pattern>

The operation pattern is as follows. "POO" in the table means the parameter number.



Travel distance	No. of operations	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction *	
						Forward	Return
P84	1 reciprocal movement	P35	P36	10r/min	P86	CCW	CW

* When P4 (rotating direction switching) is 0

<Description of tuning>

Tuning is not basically performed during slow run.

If the machine has a tendency to resonate, the auto tuning gain (hereinafter referred to as auto gain) is automatically reduced. At this time, the notch filter (page 56 to page 59) is automatically adjusted.

<Description of operation end>

There are 3 patterns for operation end; normal end, halfway stop (only performed by operator) and NG end. Each case is described.

Normal end	Halfway stop by stop operation	NG end	
		Error occurrence	Occurrence of machine resonance when auto gain is 4 or less
If machine resonance occurs, the notch filter is automatically adjusted and the auto gain is automatically reduced.	Returns to auto gain at the start of operation.	Returns to auto gain at the start of operation.	Automatically changes to auto gain that stops resonance.

6 ADJUSTMENT OF SERVO

(2) Easy tuning

<Start conditions>

Conditions to start easy tuning are shown below. Required conditions are marked with "○" If the conditions below are not satisfied, the system cannot be started. ("NG1" is displayed.)

Power supply to main circuit	Not alarm status	Not ±OT or EMG status	BX signal is OFF.	Auto tuning status ^{*1}	Auto gain reference value at start	Parameter rewritable ^{*2}
○	○	○	○	○	*3	○

*1) When parameter No. 5 (tuning mode) is 0 (auto tuning) (The system cannot be started with other settings.)

*2) When parameter No. 29 (parameter write protected) is 0 (rewritable)

*3) When parameter No. 7 (auto tuning gain) is 4 or less, the system automatically starts from 5. When the parameter is 16 or more, it starts from 15.

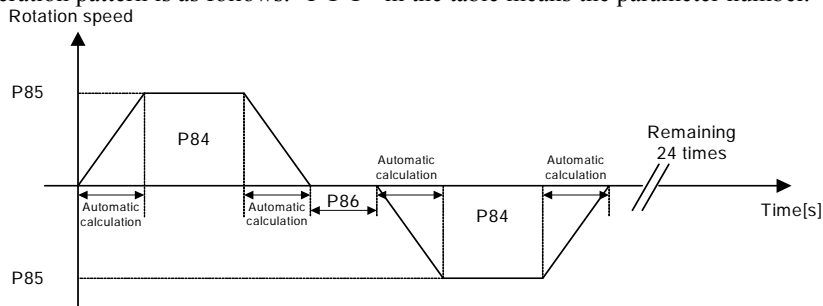
Tips

If the machine has any of the following problems, easy tuning may not function properly.

- Machine with low rigidity and high tendency to vibrate
- Machine with large backlash
- Machine with large viscous friction
- Machine that can only move in one direction (no reciprocal movement)
- Machine with very low rotation speed (Ex.: 100 r/min or less)
- Machine with large load inertia ratio (GYS motor: 30 times or more, GYG motor: 5 times or more)
- Machine with large fluctuations of load inertia

<Operation pattern>

The operation pattern is as follows. "POO" in the table means the parameter number.



Travel distance	No. of operations	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction ^{*1}	
						Forward	Return
P84	25 reciprocal movements	Automatic calculation ^{*2}	Automatic calculation ^{*2}	P85	P86	CCW	CW

*1) When P4 (rotation direction switching) is 0

*2) The automatically calculated value can be checked with the PC loader.

<Description of tuning>

During easy tuning, 25 reciprocal movements are performed. During this operation, automatic tuning (auto gain in the range from 5 to 15) is performed.

<Description of operation end>

There are 3 patterns for operation end; normal end, halfway stop (only performed by the operator) and NG end. Each case is described.

Normal end	Halfway stop by stop operation	NG end	
		Error occurrence	Machine resonance occurs even when auto gain is 4 or less
Auto gain (range from 5 to 15) is automatically and finally adjusted.	Returns to auto gain at start of operation.	Returns to auto gain at start of operation.	Automatically changes to auto gain that stops resonance.

6.2.5 Factor of NG display

Factors when NG is displayed during easy tuning are described (common for each mode).

<Cause of NG1 display>

- (1) Parameter No. 29 (parameter write protect) is "1: Write protect."
- (2) \pm OT, EMG or external regenerative resistor overheating is detected.
- (3) Parameter No. 5 (tuning mode) is not "0: Auto tuning."
- (4) Power is not supplied to the main circuit.

<Cause of NG2 display>

- (1) \pm OT, EMG or external regenerative resistor overheating is detected halfway. (Coasting signal is ignored.)
- (2) RUN signal is turned OFF. (RUN: Started with ON.)

<Cause of NG3>

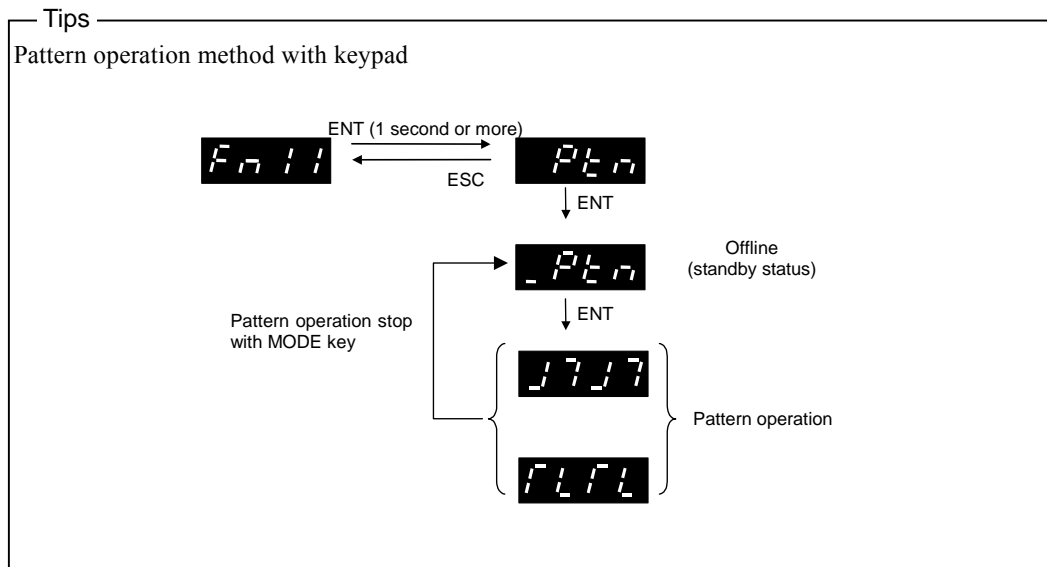
- (1) Auto tuning gain is 4 or less and the motor is oscillating.

6 ADJUSTMENT OF SERVO

6.3 Pattern operation

6.3.1 What is pattern operation?

If the system is not connected to the upper level control system, the system automatically performs reciprocation for automatic tuning. The operation continues until the system is stopped by an operator. This operation is used to confirm the effective torque (keypad: On13). (Tuning is not performed during pattern operation.)



6.3.2 Description of operation

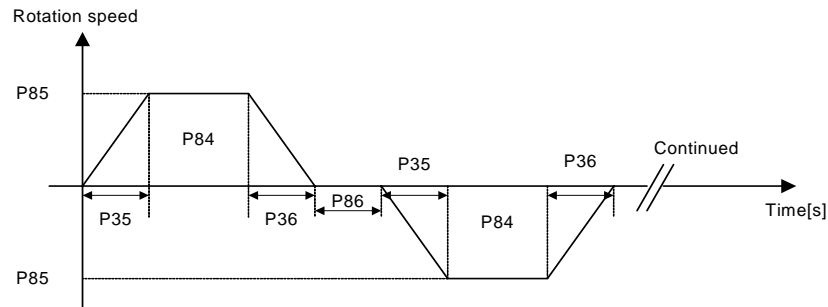
<Start conditions>

Conditions to start pattern operation are shown below. Required conditions are marked with "○". If the conditions below are not satisfied, the system cannot be started. ("NG1" is displayed.)

Power supply to main circuit	Not alarm status	BX signal is OFF.	Not ±OT or EMG status
○	○	○	○

<Operation pattern>

The operation pattern is as follows. "POO" in the table means the parameter number.



Travel distance	No. of operations	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction *	
						Forward	Return
P84	Continued	P35	P36	P85	P86	CCW	CW

*1) When P4 (rotation direction switching) is 0

<Description of tuning>

During pattern operation, tuning is not performed.

<Stop method of pattern operation>

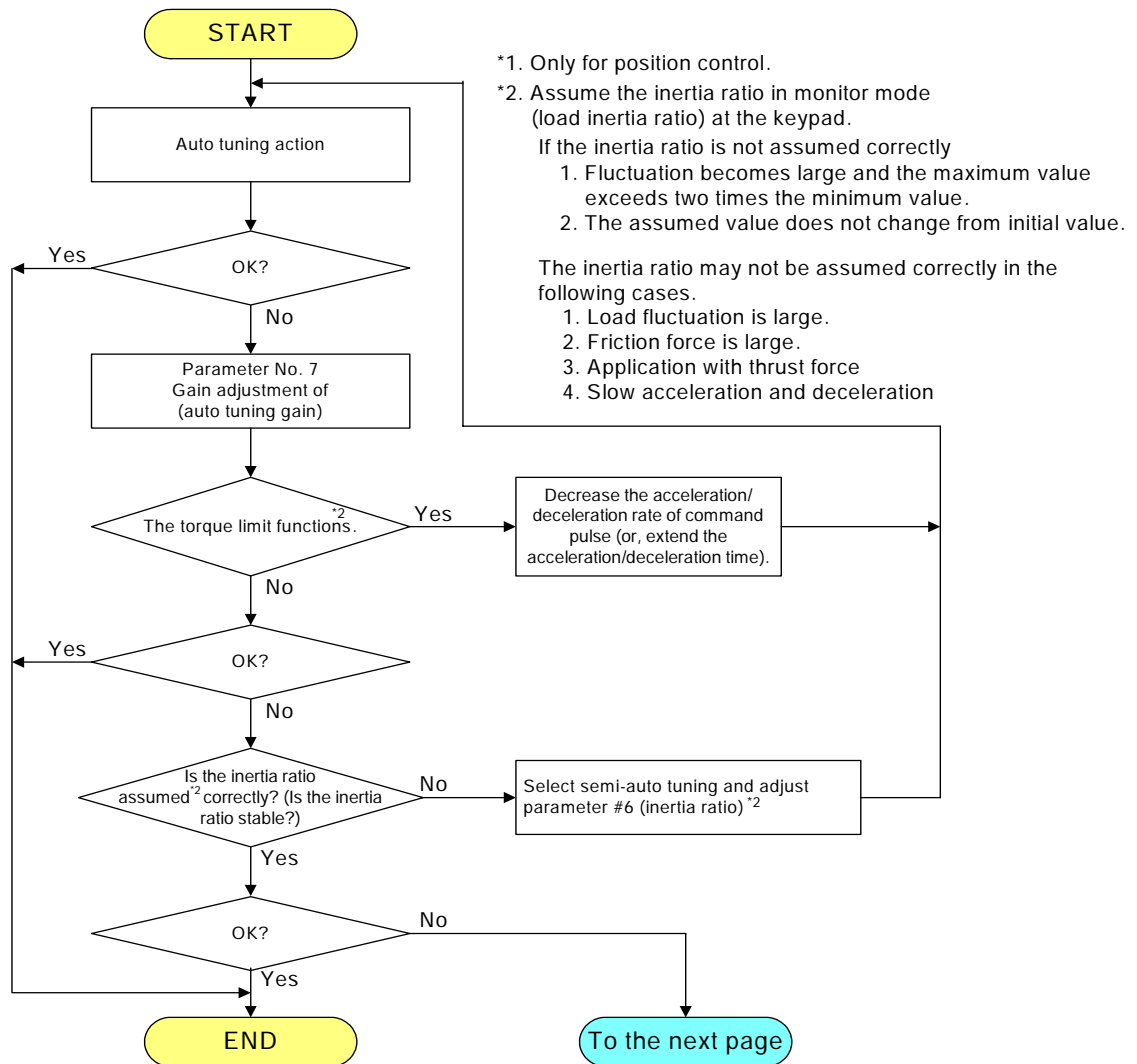
The method to stop pattern operation is stoppage of the system by an operator or occurrence of an error*.

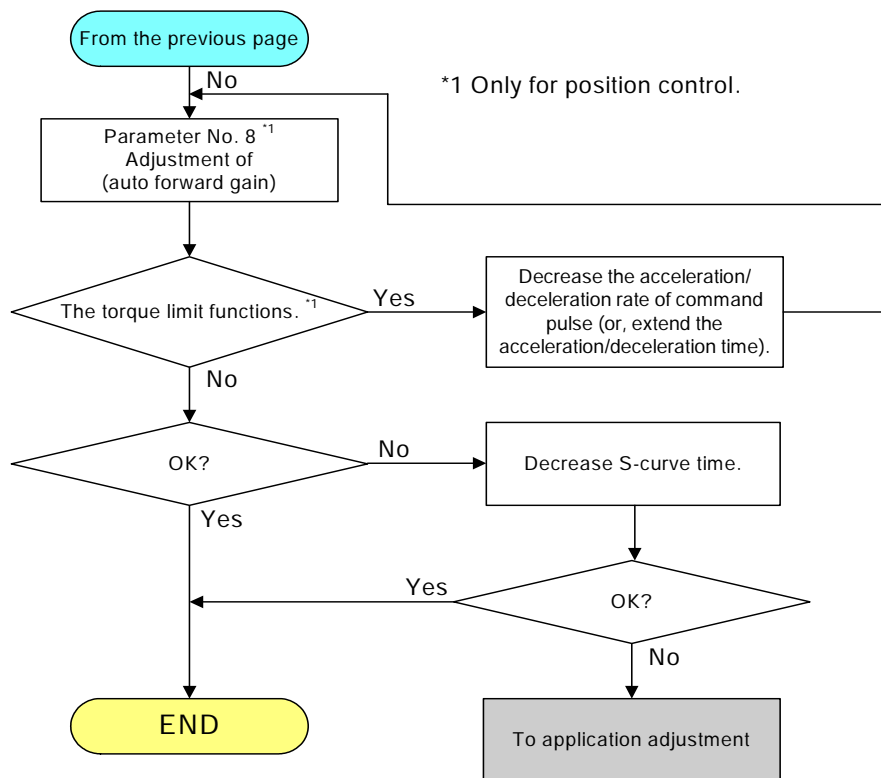
* Occurrence of an error means ① Detection of \pm OT, EMG or external regenerative resistor overheating halfway, ② Detection of BX (coasting signal) ON halfway and ③ RUN signal OFF halfway.

6 ADJUSTMENT OF SERVO

6.4 Basic adjustment

The tuning method includes three types: auto tuning, semi-auto tuning and manual tuning (parameter #5). Be sure to operate the servomotor in the auto tuning mode (factory setting) for the first time when operating it.





Set the zero deviation width (parameter No. 21) referring to the description below:

Ex.) When precision of $\pm 10 \mu\text{m}$ is desired on a machine with ball screw fastening and 10 mm lead.

$$\frac{131072[\text{pulse/rev}]}{\text{Movement per rotation [m]}} \times (\text{Required precision [m]}) = \text{Zero deviation width [pulse]}$$

$$\frac{131072[\text{pulse/rev}]}{10 \times 10^{-3} [\text{m}]} \times (10 \times 10^{-6} [\text{m}]) = 131.072 \approx 131 [\text{pulse}]$$

Set "131" for zero deviation width (parameter No. 21).

6 ADJUSTMENT OF SERVO

■ Parameters automatically adjusted in the auto or semi-auto tuning mode

No.	Name	Tuning mode	
		0: Auto	1: Semi-auto
06	Load inertia ratio	- (Updated every 10 minutes)	O(*1)
07	Auto tuning gain	O	O
40	Position controller gain 1	- (Always updated)	- (Fixed)
41	Speed response 1	- (Always updated)	- (Fixed)
42	Speed controller integration time 1	- (Always updated)	- (Fixed)
45	Feed forward filter time constant	- (Always updated)	- (Fixed)
46	Torque filter time constant	- (Always updated)	- (Fixed)

*1) This parameter is automatically set when "Auto" is changed to "Semi-auto."

O : Item specified manually.

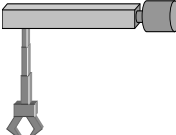
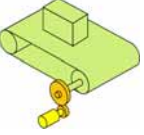
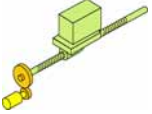
- : Item specified automatically.

- Parameters automatically updated in the auto tuning mode are updated at real time.

- In the semi-auto tuning mode, automatically updated parameters are fixed once they are set*.

* Parameters are automatically set when parameter #6 (load inertia ratio) or parameter #7 (auto tuning gain) is changed.

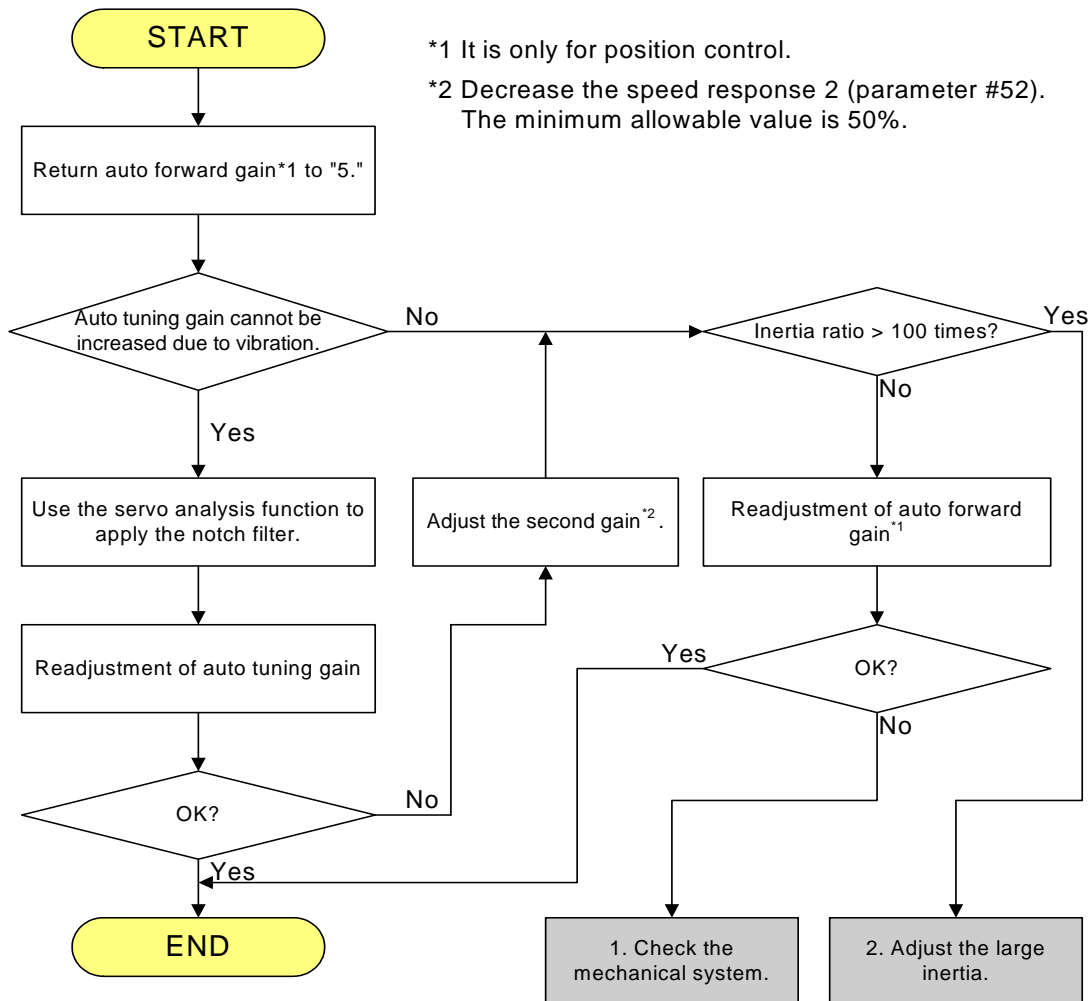
■ Approximate measure for auto tuning gain (parameter #7) setting

Mechanical configuration	Auto tuning gain (Approximate measure)
Large transportation machine	1 to 6
 Arm robot	5 to 10
 Belt drive	7 to 13
 Ball screw mechanism	10 to 15
Inserting, mounting or bonding machine	13 to 20

A larger auto tuning gain reduces the response time while vibration is likely to be generated.

6.5 Application adjustment

Use this adjustment method when adjustment is not satisfactory after the procedure described in section 6.4 "Basic adjustment" or if the servomotor vibrates and the auto tuning gain (parameter #7) cannot be increased sufficiently.



1. Check the mechanical system.

Check the mechanical system for the following problems.

- i) Large backlash
- ii) Deflection of belt

6 ADJUSTMENT OF SERVO

2. Adjust the large inertia.

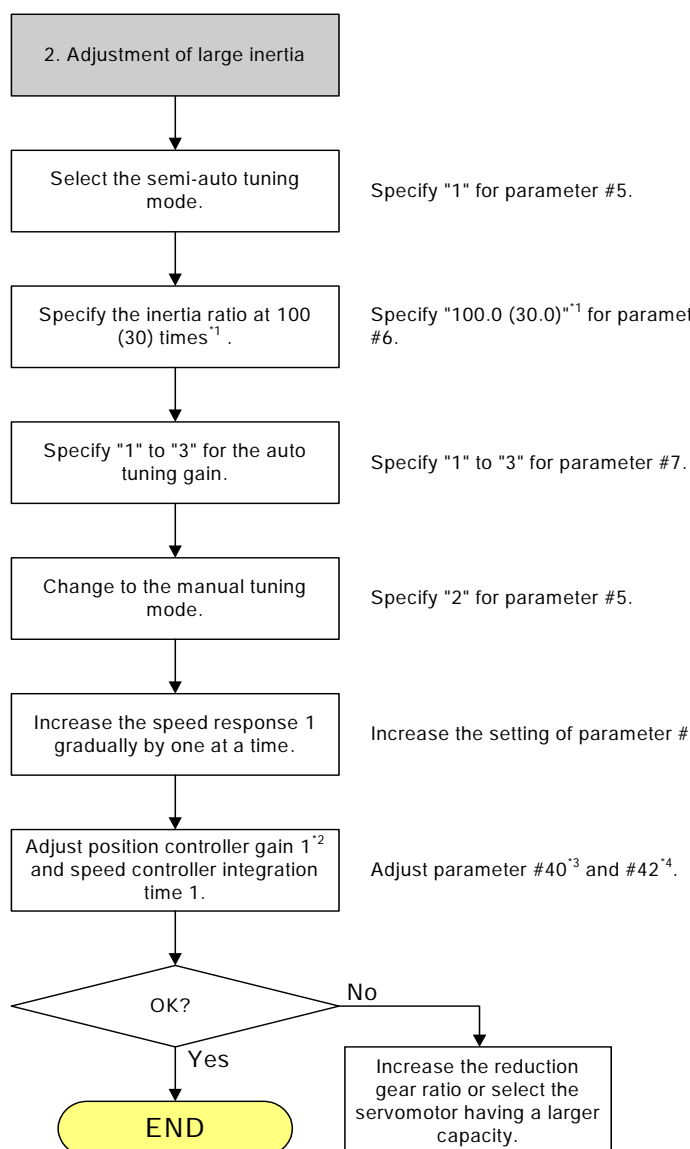
Note) In principle, the load inertia ratio should be used at GYS: 100 times or less and GYG: 30 times or less.

■ How to check if the load inertia ratio exceeds 100 times (or 30 times)^{*1}

i) Use capacity selection software to automatically calculate the load inertia.

ii) Use monitor mode 09 (load inertia ratio) at the Keypad to assume.

(The displayed value is up to 99 (30) times^{*1}. If "80 (20)"^{*1} or a larger value is displayed, the ratio may be larger than 100 (30) times^{*1}.)



^{*1} Values in () are the values when the GYG motor is used.

^{*2} It is only for position control.

^{*3} Approximate measure for parameter #40
Make adjustment so that the following equation stands.

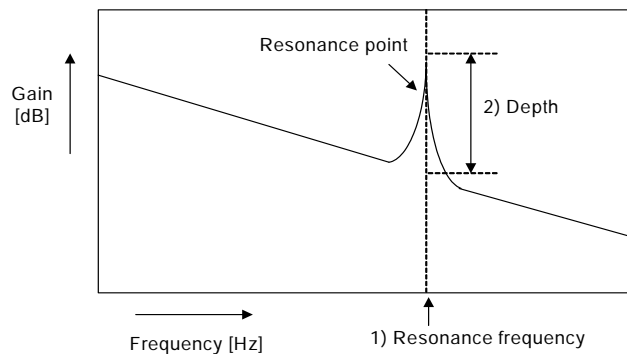
$$(\text{Parameter \#40}) < (\text{Parameter \#41}) \times \frac{100 (30)^{*1}}{(\text{Actual inertia ratio})}$$

^{*4} Approximate measure for parameter #42
Make adjustment so that the following equation stands.

$$(\text{Parameter \#42}) = \frac{2000}{(\text{Parameter \#40})}$$

■ How to set the notch filter (parameters #56 through #59)

i) Use the servo analysis function of the optional PC loader to locate the resonance point of the machine.

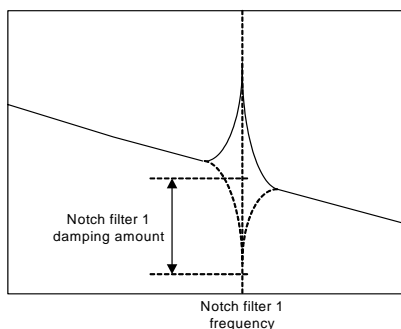


ii) Set the resonance frequency and damping amount at the resonance point of the machine in parameters.

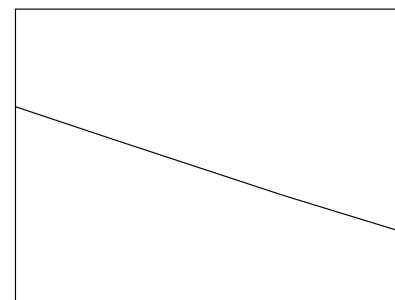
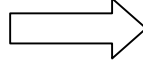
1) Resonance frequency → Parameter #56 (Notch filter 1 frequency)

2) Depth → Parameter #57 (Notch filter 1 damping amount)*

* If the damping amount is too large, stability of the control system may be undermined. Avoid specifying too large a value.



Activate the servo analysis function again.



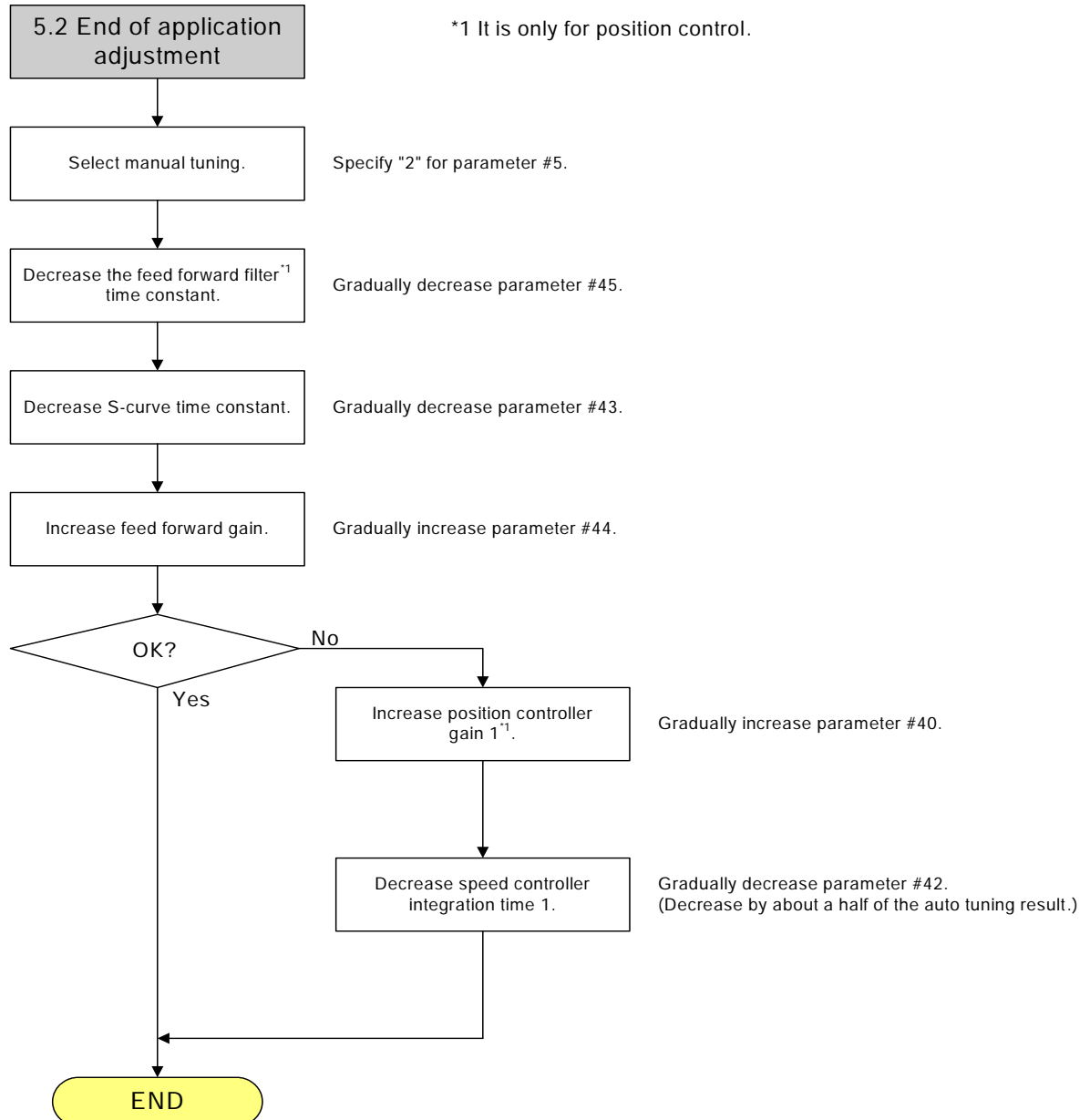
The notch filter is applied at the resonance point as shown in the figure above.

6 ADJUSTMENT OF SERVO

6.6 Adjustment requiring high speed response

Use this method to obtain quicker response than that obtained after adjustment specified in section 6.5 “Application adjustment.” (However, do not use the method described here if “adjustment of large inertia” has been made.)

While measuring the operation time and output timing of the positioning end signal by using historical trace of the PC loader, make adjustment as follows.

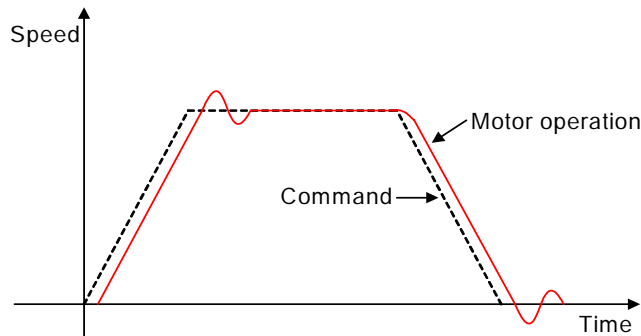


Note 1: Adjust the gain so as not to generate mechanical vibration or torque fluctuation.

Note 2: If the machine rigidity is low, vibration can be minimized by gradually increasing S-curve time constant (parameter No. 43).

6.7 Overshoot adjustment (only for position control)

This is the procedure applied when adjustment is performed while observing waveform on a PC loader and the following overshoot is detected on the waveform of motor's actual operation.



If overshoot is displayed as above, confirm the following:

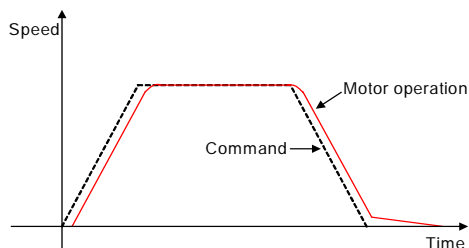
1. Does torque limitation work?
 - Make necessary adjustments so that the value may be less than the torque limit.
 - ① Lower acceleration/deceleration rate.
 - ② Lower load moment of inertia.
 - ③ Raise deceleration ratio or capacity.
2. Isn't the setting of load-to-inertia ratio (parameter No.6) too small?
 - Confirm the load-to-inertia ratio.
 - ① Confirm it on the keypad monitor.
 - ② Calculate it automatically by our company's capacity selection software.
3. Isn't "position controller gain 1 (parameter No.40)" greater than "speed response 1 (parameter No.41)" ?
 - Adjust parameters so that "position controller gain 1 (parameter No.40)" is greater than or equal to "speed response 1 (standard parameter No.41)"
4. Isn't the setting of feed forward gain (parameter No.44) too high?
 - Lower feed forward gain a little bit at a time.
5. Isn't the setting of speed controller integration time 1 (parameter No.42) too low?
 - Raise speed controller integration time 1 a little bit at time.
6. Isn't the setting of S-curve time (parameter No.43) too low?
 - Raise S-curve time a little bit at a time.

6 ADJUSTMENT OF SERVO

6.8 Adjustment for shortening stabilization time (only for position control)

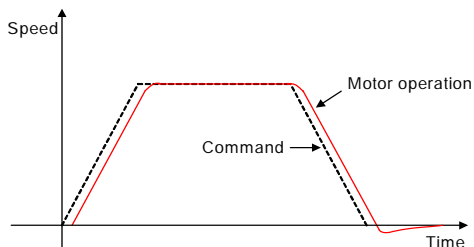
This is the adjustment procedure applied when adjustment is performed while observing waveform on a PC loader and the waveform of the motor's actual operation is as if leaving traces like below.

6.8.1 In the case of under-run:



- ① Lower S-curve time (parameter No.43).
- ② Increase auto forward gain (parameter No. 8). ^{*1}
- ③ Raise feed forward gain (parameter No.44).
- ④ Lower load-to-inertia ratio (parameter No.6). ^{*2}
(Apply a value within $\pm 10\%$ to the change volume as a measure.)

6.8.2 In the case of over-run:



- ① Raise S-curve time (parameter No.43).
- ② Decrease auto forward gain (parameter No. 8). ^{*1}
- ③ Lower feed forward gain (parameter No.44).
- ④ Raise load-to-inertia ratio (parameter No.6). ^{*2}
(Apply a value within $\pm 10\%$ to the change volume as a measure.)

*1) This is not valid when the tuning method is manual.

*2) This is not valid when the tuning method is auto (valid for semi-auto).

6.9 Standard values for adjustment parameters

The parameters for adjusting servo gain have the following standard values.

No.	Name	Standard value
40	Position controller gain 1	Position controller gain 1 (parameter No.40) \leq Speed response 1
41	Speed response 1	Speed response 1 (parameter No.41) $\leq \frac{500}{1+\text{Load-to-inertia ratio (parameter No.6)}}$
42	Speed controller integration time 1	Speed controller integration time 1 (parameter No.42) $= \frac{2000}{\text{Speed response 1 (parameter No.41)}}$
45	Feed forward filter time constant	Feed forward filter time constant (parameter No.45) $= \frac{1000}{\text{Position controller gain 1 (parameter No.40)}}$
46	Torque filter time constant	$0.2 \leq \text{Torque filter time constant (parameter No.46)} \leq 1.0$

6 ADJUSTMENT OF SERVO

-MEMO-

7

SPECIAL ADJUSTMENT

7.1	Vibration suppressing control	7- 2
7.1.1	What is vibration suppressing control?	7- 2
7.1.2	Parameter setting method	7- 4
7.2	Command following control	7- 9
7.2.1	What is command following control?	7- 9
7.2.2	Parameter setting method	7-10

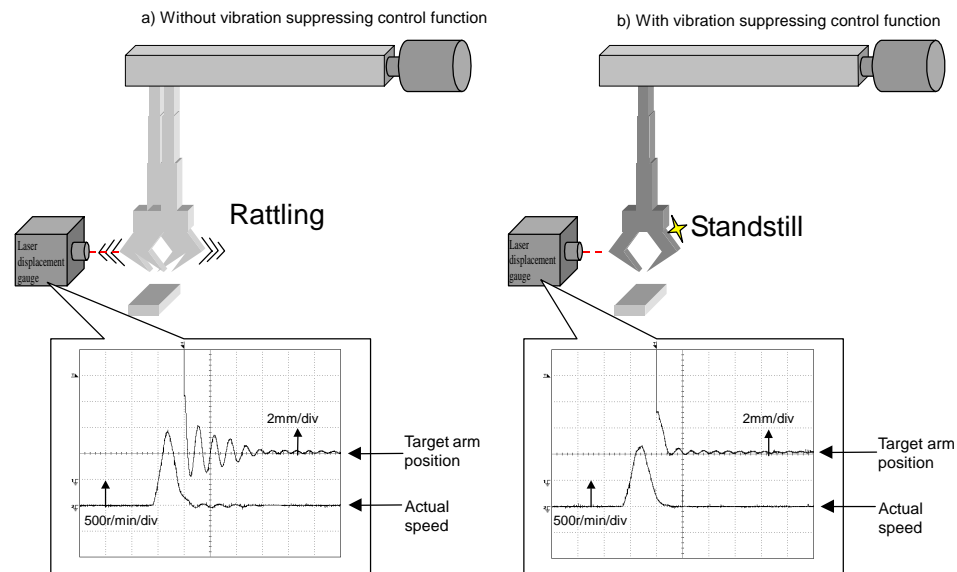
7 SPECIAL ADJUSTMENT

7.1 Vibration suppressing control

7.1.1 What is vibration suppressing control?

(1) Purpose of vibration suppressing control

In the spring structure of a robot arm or a transfer unit, a part end vibrates when the motor is suddenly accelerated or decelerated. The vibration suppressing control function prevents vibration of parts in such a system and performs positioning with high tact.

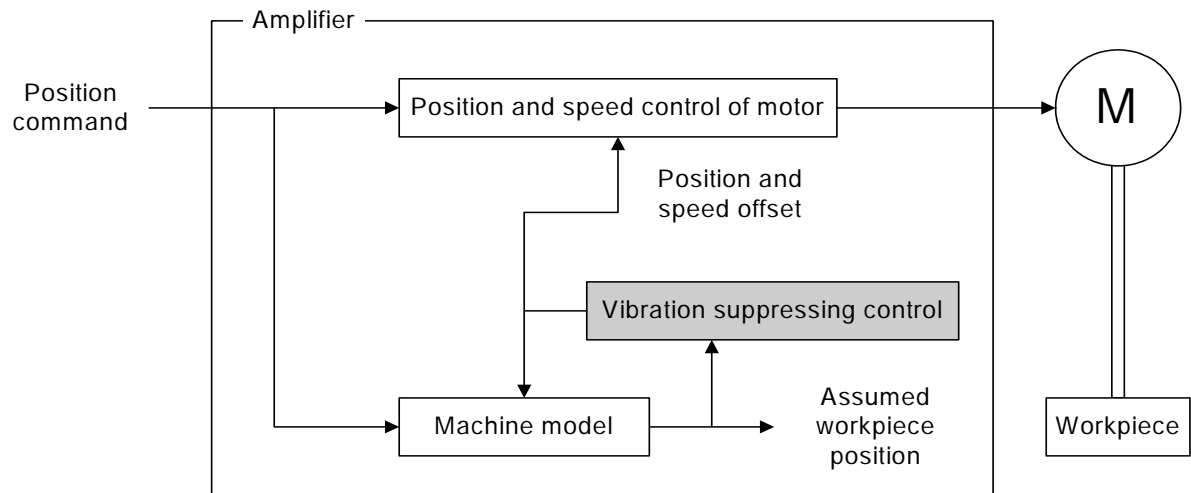


Not only vibration of parts is reduced, but also vibration of the overall unit is reduced.

- Without vibration suppressing control unit The maximum torque is generated when the motor is accelerated/decelerated. The entire machine may vibrate due to impact during acceleration/deceleration.
- With vibration suppressing control unit Torque during acceleration/deceleration of the motor is controlled. Impact during acceleration/deceleration is reduced and vibration of the entire machine may be controlled even on a machine with a relatively weak rigidity.

(2) Principle of vibration suppressing control

The amplifier incorporates a machine mode land controls dumping so that the vibration at the assumed workpiece position of the model is eliminated. The controlled variable thus obtained is added to the position and speed of the motor as an offset to suppress vibration at the actual workpiece position.



(3) Machine characteristics and conditions valid for vibration suppressing control

Applicable machine characteristics and conditions

- Vibration occurs at the end of the arm due to shocks during travel and stop of robot arm or the like.
- The machine itself vibrates due to the shock caused by movement or stopping of a part of the machine.
- Vibration frequency is between 5 and 100Hz.

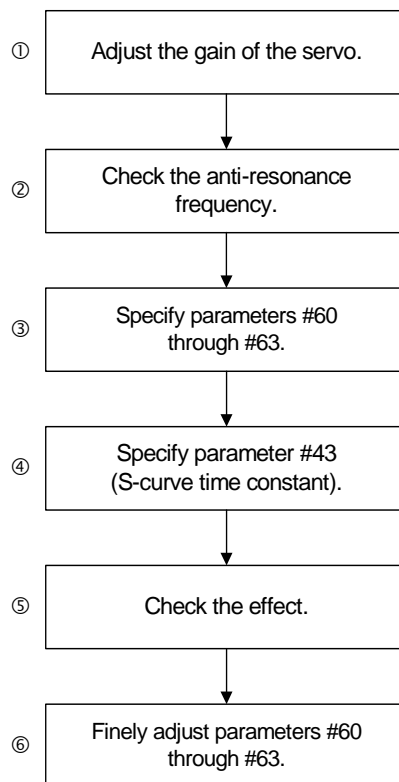
Non-applicable machine characteristics and conditions

- Vibration generates continuously without relations to movement or stopping.
- Vibration synchronized to the rotation of the motor or machine generates.
- The vibration frequency is smaller than 5Hz or larger than 100Hz.
- The moving time is within the vibration period.
- There is backlash in mechanical connections located up to the vibrating mechanism.
- (Command pulse compensation α / Command pulse compensation β) > 50
- Command pulse string frequency ≤ 20 kHz

7 SPECIAL ADJUSTMENT

7.1.2 Parameter setting method

■ Adjustment flow chart



① Adjust the gain of the servo.

To achieve smooth a stop (elimination of overshoot, etc.) with the servomotor while ignoring vibration at end of the machine, adjust the servo gain according to the adjustment procedure in chapter 6.

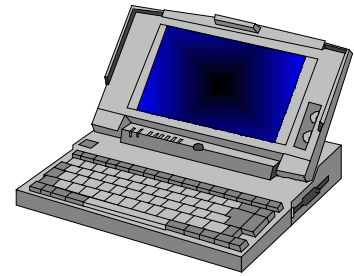


Note

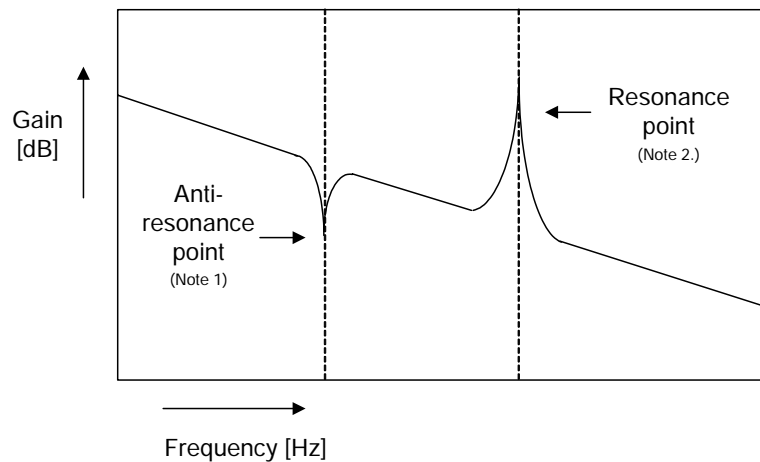
If parameters related to the gain are adjusted after specifying the anti-resonance frequency, the anti-resonance frequency must be specified again.
Be sure that the gain must be adjusted first.

② Check the anti-resonance frequency.

<When PC loader is used>



Use the servo analysis function to check the anti-resonance point.



Note 1 : The servo analysis function may fail to detect the anti-resonance point in the following machine configuration.

- ① Machines with much friction
- ② Reduction gear, ball screw mechanism and other machines having relatively large mechanical losses

Note 2 : Use the notch filter for the resonance point.

Resonance point and anti-resonance point

There are resonance point and anti-resonance point for the vibration of the machine.

The “resonance point” and “anti-resonance point” are machine characteristics viewed from the motor.

“Resonance point”	The end of the arm does not vibrate but the motor vibrates at the frequency.
“Anti-resonance point”	The motor shaft does not vibrate but the end of the arm vibrates at the frequency.

Generally speaking the anti-resonance frequency is smaller than the resonance frequency.

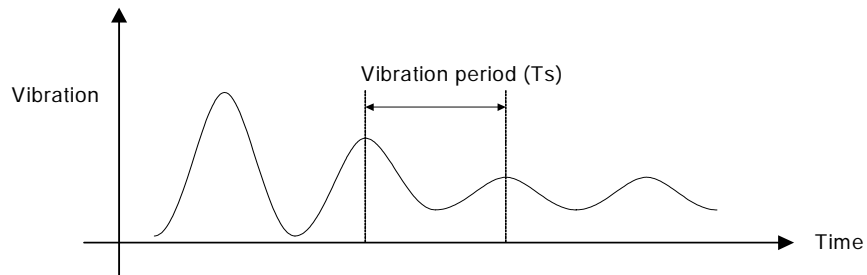
7 SPECIAL ADJUSTMENT

<When PC loader is not used>

There are two checking methods.

If vibration frequency can be measured using a laser displacement gauge or the like, follow checking method i). In other cases, follow checking method ii).

i) Measure vibration of the end of the arm directly using a laser displacement gauge or the like.



$$\text{Anti-resonance frequency} = \frac{1}{T_s} \quad [\text{Hz}]$$

ii) While reducing the settings of parameters #60 through #63 gradually from 200.0Hz (maximum value), visually check vibration to find the best value.

③ Setting parameters #60 through #63

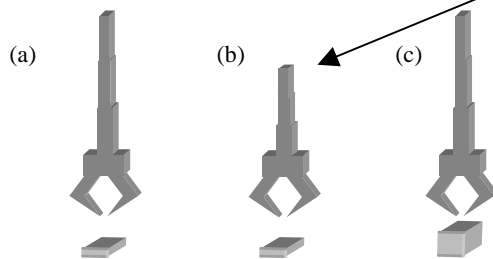
Specify the anti-resonance frequency obtained in step 2, to any of parameters #60 through #63*.

No.	Name	Setting range	Initial value	Change
60	Anti-resonance frequency 0	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
61	Anti-resonance frequency 1	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
62	Anti-resonance frequency 2	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always
63	Anti-resonance frequency 3	5.0 to 200.0 [Hz] (in 0.1 increments)	200.0	Always

* Up to four points can be specified.

With ON/OFF combination of “Anti-resonance frequency selection 0” and “Anti-resonance frequency selection 1” of CONT input signal, setting for 4 points is allowed.

The anti-resonance point may vary according to the arm length and the weight of the load.



The anti-resonance frequency may vary according to conditions a, b and c.

In this case, allocate this function to the CONT input signal and change the setting of the anti-resonance frequency for operation.

Anti-resonance frequency selection 1	Anti-resonance frequency selection 0	Anti-resonance frequency
OFF	OFF	Parameter #60*
OFF	ON	Parameter #61
ON	OFF	Parameter #62
ON	ON	Parameter #63

* These signals are assumed to be inactive at any time if they are not assigned to the sequence input signals.

In this case, parameter #60 (anti-resonance frequency 0) is always valid.

To make anti-resonance frequency invalid, set the anti-resonance frequency at 200.0Hz.

Change the setting during stoppage because otherwise shocks may generate.

7 SPECIAL ADJUSTMENT

④ Specify parameter #43 (S-curve time constant).

To achieve the effect of dumping control, specify parameter #43 (S-curve time constant).

The approximate measure of the setting is as follows.

No.	Name	Setting range	Initial value	Change
43	S-curve time constant	0.0 to 100.0 [msec] (in 0.1 increments)	0.0	Always

Parameters #60 through #63 (Anti-resonance frequency)	Parameter #43 (S-curve time constant) (Approximate measure)	
	$1 \leq \alpha/\beta^* \leq 8$	$8 < \alpha/\beta^* \leq 50$
< 10 Hz	10 msec	20 msec
10 Hz to 20 Hz	5 msec	10 msec
> 20 Hz	2 or 3 msec	5 msec

$$* \quad \frac{\alpha}{\beta} = \frac{\text{Command pulse compensation } \alpha \text{ (parameter \#1)}}{\text{Command pulse compensation } \beta \text{ (parameter \#2)}}$$

⑤ Check the effect.

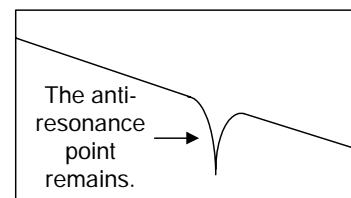
There are three checking methods.

i) Check the vibration of the end of the arm using a laser displacement gauge or a similar measuring instrument.

ii) Take the high-speed motion picture of the end of the arm to check for vibration.

iii) Visually check.

NOTE



The anti-resonance frequency is not reflected on the servo analysis function even if one is set.

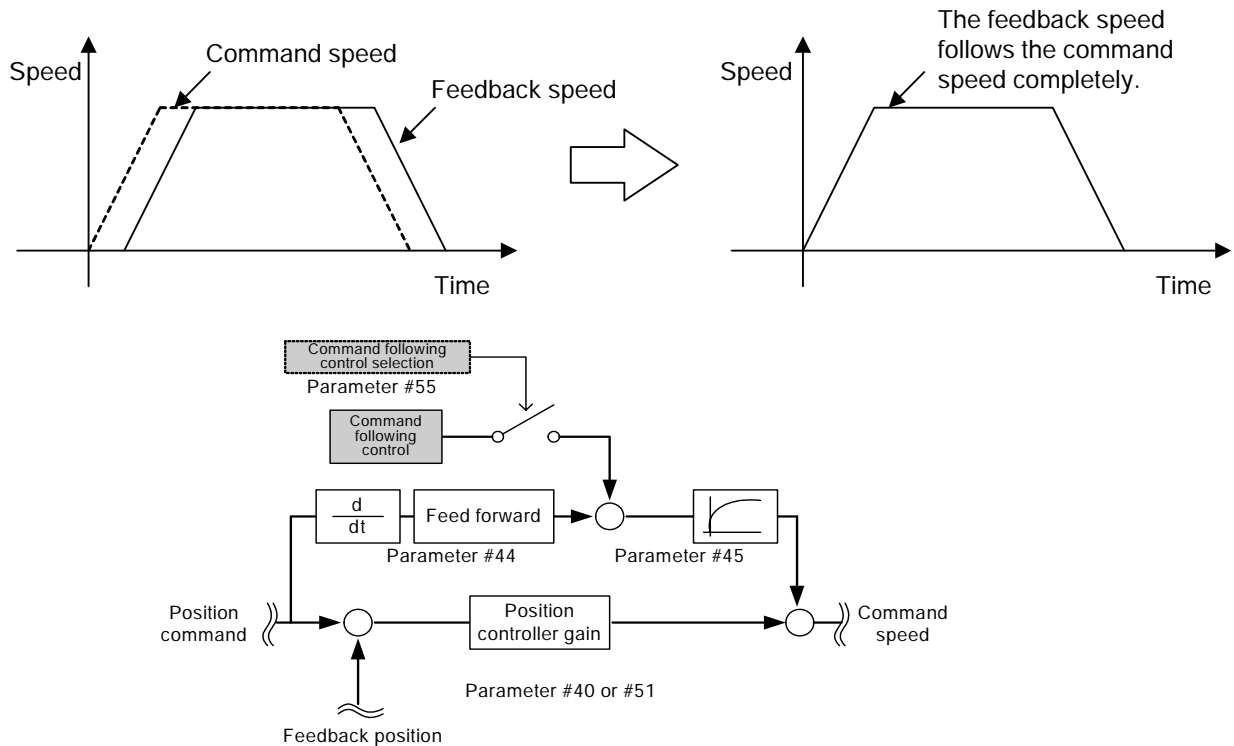
⑥ Finely adjust parameters #60 through #63.

While checking the effect of dumping control, finely adjust the setting (approximate measure: in 0.1 or 0.2 increments).

7.2 Command following control

7.2.1 What is command following control?

In the command following control mode, movement follows the command pulse string completely with almost zero position deviation.



■ Mechanical system realizing command following control

Use “command following control” for the mechanical system satisfying all the following conditions.

- (1) Highly rigid machine
- (2) Pulse commands sent from the host controller are linear or in an S-curve to assure smooth acceleration and deceleration.
- (3) The pulse frequency updating period of the host controller is within several milliseconds.
- (4) Load inertia ratio (parameter #6) ≤ 10.0

As a guideline, set the parameters to suit the following conditions.

- (5) Position controller gain 1 (parameter #40) \times S-curve time constant (parameter #43) ≤ 1000.0
- (6)
$$\frac{\text{Command pulse compensation } \alpha \text{ (parameter \#1)}}{\text{Command pulse compensation } \beta \text{ (parameter \#2)}} \leq 30$$

If command following control is used for a system not satisfying all of the above conditions, mechanical vibration may generate.

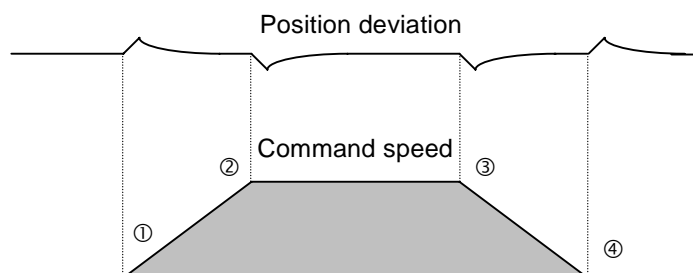
7 SPECIAL ADJUSTMENT

7.2.2 Parameter setting method

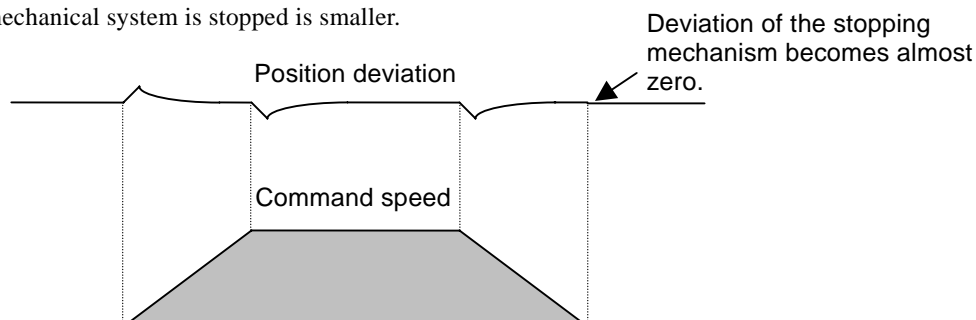
No.	Name	Setting range	Initial value	Change
55	Command following control selection	0: None, 1: Command following control, 2: Command following control (with correction on stop)	0	Power

The command following control includes two variations: with no correction on stop (setting: 1) and with correction on stop (setting: 2).

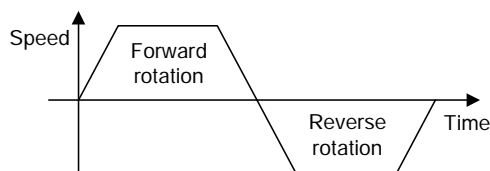
Position deviation generates in both methods when the acceleration changes (at ①, ②, ③, and ④).



In case “with correction on stop (setting: 2),” position deviation caused by the acceleration change when the mechanical system is stopped is smaller.



Select “no correction on stop (setting: 1)” for operation patterns where changes from forward to reverse rotation continue.



* In the command following control mode, specify “10” or a larger value for the auto tuning gain (parameter #7).

8

KEYPAD

8.1	Display.....	8- 2
8.1.1	Mode.....	8- 2
8.1.2	Operation key	8- 3
8.1.3	Mode select.....	8- 3
8.2	Function list	8- 4
8.3	Sequence monitor mode	8- 6
8.4	Monitor mode.....	8-10
8.5	Parameter editing mode	8-16
8.6	Test running mode.....	8-20

8 KEYPAD

8.1 Display



The servo amplifier is provided with a Keypad.

It has a display section of four 7-segment LED digits and four operation keys.

Figures and letters are displayed on the display section.

(See the left figure.)

*The Keypad cannot be removed.

8.1.1 Mode

The Keypad operation can be classified into four modes:

Sequence monitor mode Indicates the servo amplifier status.

Monitor mode..... Monitors the servomotor speed and the input/output signal status.

Parameter edit mode..... Edits the parameter setting.

Test running mode..... Operates the servomotor with the keypad operation.

List of 7-segment indications

0	1	2	3	4	5	6	7	8	9	-
A	b	C	d	E	F	G	H	I	J	L
n	O	o	P	r	S	t	U, V	u, v	y	

8.1.2 Operation key

- MODE
ESC

Changes the mode (MODE).
Cancels the selected mode (ESC).
- SHIFT
ENT

Shifts to the less significant digit (SHIFT).
Stores the mode and figure (ENT).
Press more than 1 sec to store the data.
- ▼

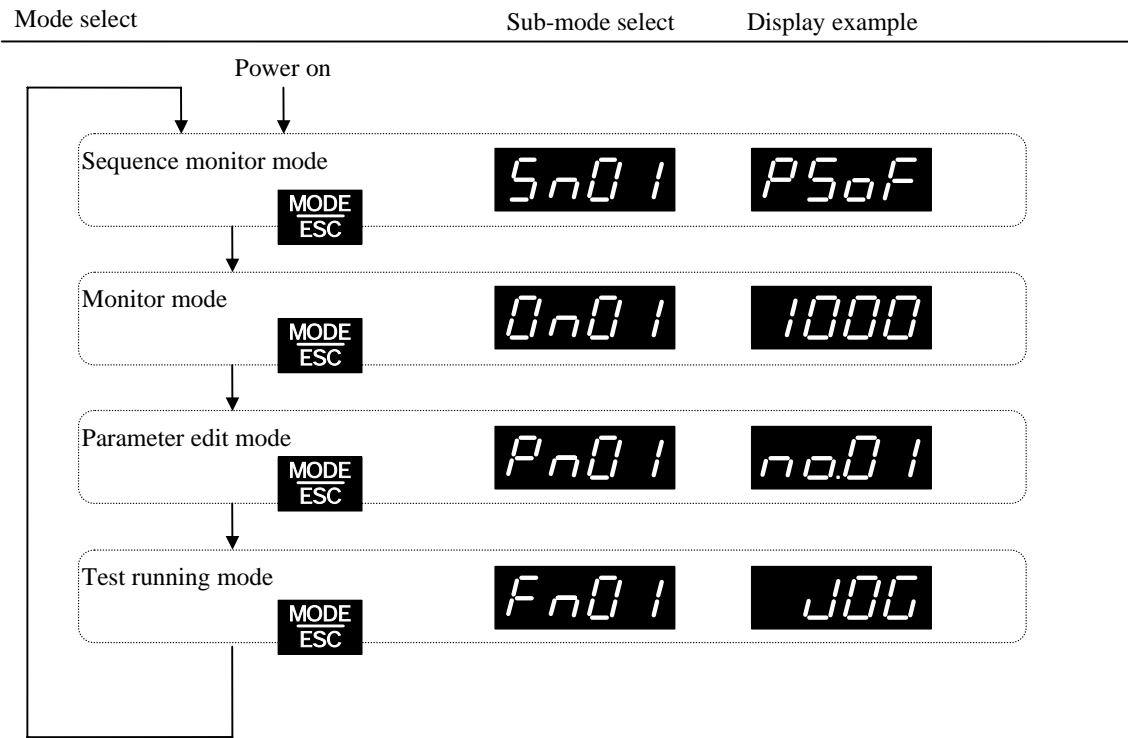
Selects the sub-mode.
Decreases the figure (-1).
- ▲

Selects the sub-mode.
Increases the figure (+1).

SHIFT ENT When this key is pressed, the upper 4 digits are replaced with the lower 4 digits.

8.1.3 Mode select










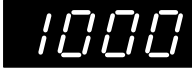







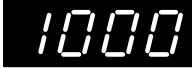

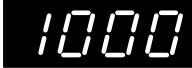



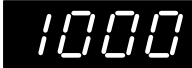



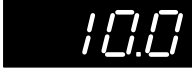
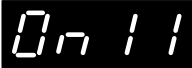







Each mode can be selected by the [MODE] key.






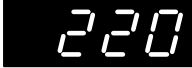


























8 KEYPAD

8.2 Function list

In parameter edit mode and positioning data edit mode, the reference values can be changed.

Mode	Sub-mode	Sub-mode select	Display and setting example
Sequence monitor mode	Sequence mode		
	Current alarm		
	Alarm history		
	Station No. display		
Monitor mode	Feedback speed		
	Command speed		
	Average torque		
	Current feedback speed		
	Current command speed		
	Position deviation		
	Feedback cumulative pulse		
	Command cumulative pulse		
	Peak torque		
	Input voltage		
	Input/output signal		
	Load inertia ratio		
	OL thermal value		
	Regenerative resistor thermal value		

Mode	Sub-mode	Sub-mode select	Display and setting example
Monitor mode	Pulse string input frequency		
	DC link voltage (maximum value)		
	DC link voltage (minimum value)		
Parameter editing mode	Parameter editing		
Test running mode	Manual feed		
	Position reset		
	Cumulative pulse clear		
	Alarm reset		
	Alarm history initialization		
	Parameter initialization		
	Auto offset adjustment		
	Phase-Z position adjustment		
	Auto tuning gain		
	Easy tuning		
	Pattern operation		

8 KEYPAD

8.3 Sequence monitor mode

In the sequence monitor mode, the servo amplifier's current status and the alarm detection history can be displayed.

Press the “MODE” key to display [*SnOn*] and then press the “ENT” key for more than 1 sec.

Sn01 : Sequence mode

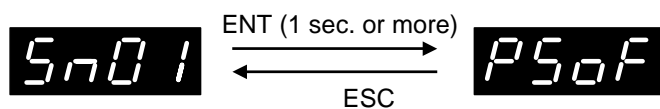
Sn02 : Current alarm

Sn03 : Alarm history

Sn04 : Station display

(1) Sequence mode

Output signal status and operation status of the servo amplifier are displayed.



Indication	Control mode	Name	Description
<i>PS0F</i>	Position control	Servo OFF	Base OFF status. The servomotor does not have drive force. It is in coasting state. (See Figure above.)
<i>PSon</i>		Servo ON	The servomotor is ready for rotation.
<i>PPIn</i>		Pulse string operation	The servomotor can rotate and pulse string inputs are valid.
<i>PJOG</i>		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
<i>PPot</i>		+OT	The amplifier has detected an overtravel signal in positive direction and stops.
<i>Pnot</i>		-OT	The amplifier has detected an overtravel signal in negative direction and stops.
<i>Pn0</i>		Zero speed stop	The amplifier has received a forced stop signal and stops with the speed zero.
<i>PLu</i>		In LV	This is displayed when undervoltage is detected.
<i>nS0F</i>	Speed control	Servo OFF	In base-off condition. The servomotor does not have driving force and is coasting to stop.
<i>nSon</i>		Servo ON	The servomotor is ready for rotation.
<i>nJOG</i>		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
<i>nPot</i>		+OT	The amplifier has detected an overtravel signal in positive direction and stops.
<i>nnot</i>		-OT	The amplifier has detected an overtravel signal in negative direction and stops.
<i>nn0</i>		Zero speed stop	The amplifier has received a forced stop signal and stops with the speed zero.
<i>nLu</i>		In LV	This is displayed when undervoltage is detected.
<i>tS0F</i>	Torque control	Servo OFF	In base-off condition. The servomotor does not have driving force and is coasting to stop.
<i>tSon</i>		Servo ON	The servomotor is ready for rotation.
<i>tJOG</i>		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
<i>tLu</i>		In LV	This is displayed when undervoltage is detected.



When the power is supplied to the servo amplifier, sequence of the sequence monitor mode is displayed.

The type of indication at power on can be changed by system parameter 30 setting.

Setting	Initial display	
0		Sequence mode
1		Current alarm
2		Alarm history
3		Station display

Setting	Initial display	
4		Feedback speed
5		Command speed
6		Average torque
7		Current feedback speed
8		Current command speed
9		Position deviation
10		Feedback cumulative pulse
11		Command cumulative pulse
12		Peak torque
13		Input voltage
14		Input/output signal
15		Load inertia ratio
16		OL thermal value
17		Regenerative resistor thermal value
18		Pulse string input frequency
19		DC link voltage (maximum value)
20		DC link voltage (minimum value)

8 KEYPAD

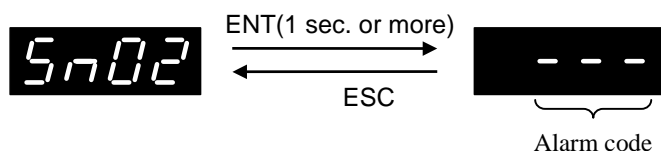
(2) Current Alarm

The contents of current alarm can be displayed with codes.

* The code is blinking during alarm detection. When the alarm is reset, the display becomes **---**.

The history can be displayed by [**5n03**].

When an alarm is detected, the following indication will appear automatically.



Priority	Indication	Description
1	OC 1	Overcurrent 1
2	OC 2	Overcurrent 2
3	OS	Overspeed
4	HV	Overvoltage
5	Et	Encoder trouble
6	Ct	Control power alarm
7	dE	Memory alarm
8	rH2	Regenerative transistor overheat
9	EC	Encoder communication alarm
10	Ent	CONT duplication
11	OL	Overload
12	LV	Undervoltage

Priority	Indication	Description
13	rH 1	Regenerative resistor overheat
14	DF	Deviation limit
15	AH	Amplifier overheat



The alarm codes are indicated automatically.

When an alarm is detected, the blinking occurs faster (intervals of 0.5 sec.) than normal (intervals of 1 sec.).

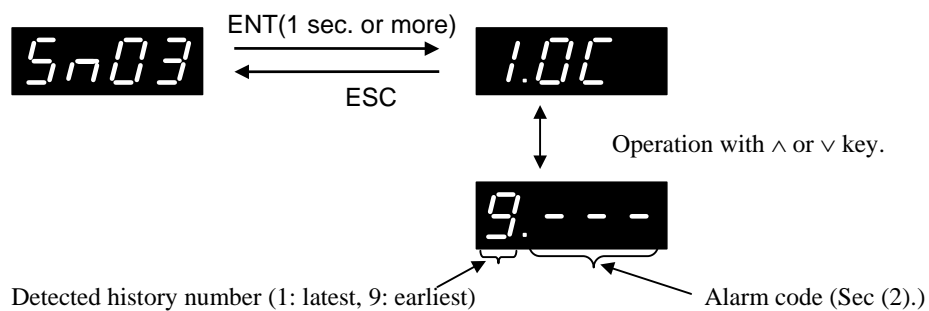
The reset of alarm detection can be carried out in the test operation mode.

Press the \wedge and \vee keys simultaneously for one second or more while alarm detection is indicated to reset the alarm detection.

When the alarm is reset, the display becomes **---**.

(3) Alarm history

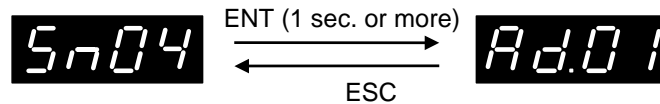
The latest nine times of alarm detection history can be indicated. The indication can be scrolled by the \wedge and \vee keys.



Hint The alarm history can be deleted in the test operation mode [`Fn05`].

(4) Station display

The station number set for the servo amplifier is displayed.



8 KEYPAD

8.4 Monitor mode

In monitor mode, the rotation speed of the servomotor and the input pulse cumulative value are displayed.

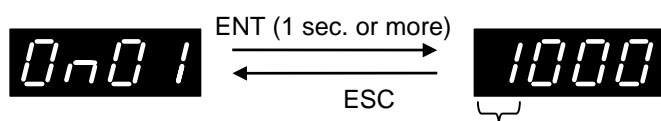
Press the MODE key to display [0n0n] and press the ENT key (for 1 sec or more) to display the content.

0n01: Feedback speed	0n08: Command cumulative pulse	0n15: Pulse string input frequency
0n02: Command speed	0n09: Peak torque	0n16: DC link voltage (maximum value)
0n03: Average torque	0n10: Input voltage	0n17: DC link voltage (minimum value)
0n04: Current feedback speed	0n11: Input/output signal	
0n05: Current command speed	0n12: Load inertia ratio	
0n06: Position deviation	0n13: OL thermal value	
0n07: Feedback cumulative pulse	0n14: Regenerative resistor thermal value	

(1) Feedback speed No. of displayed digits: 4 digits with sign

The servomotor's current speed. Even if the servomotor is driven by the load (mechanical system), the correct speed will be indicated.

The display is increments of 1 [r/min] and the negative sign is given for reverse rotation (clockwise when viewed from the motor shaft).



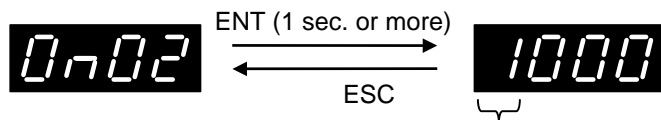
* During reverse rotation, the first digit ("1" for the example above) and "-" are displayed alternately.

Ex.) Alternately displayed

(2) Command speed..... No. of displayed digits: 4 digits with sign

It is the speed command to current servomotor. The command speed includes speed command voltage, multistep speed and pulse string, etc.

The display is in increments of 1 [r/min] and the negative sign is given for reverse rotation (clockwise when viewed from the motor shaft).

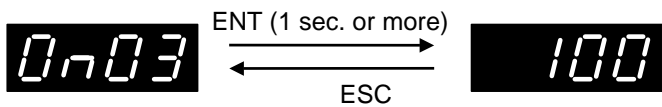


* During reverse rotation, the first digit ("1" for the example above) and "-" are displayed alternately.

Ex.) Alternately displayed

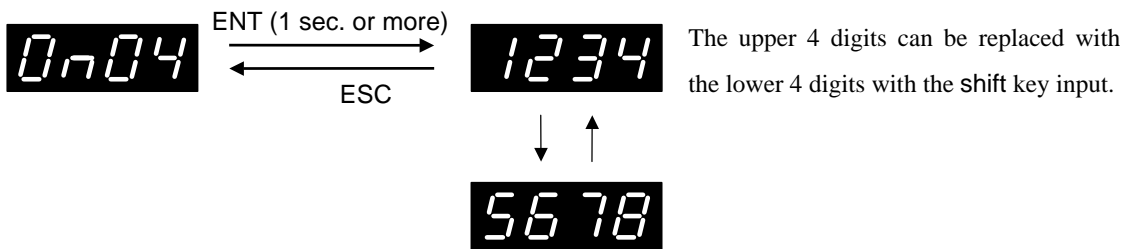
(3) Average torque.....No. of displayed digits: 3 digits with sign

Average torque value of which the command is given from the servo amplifier to the servomotor. The rated torque is displayed as 100%. The display range is from 0% to the (maximum torque) in increments of 1%. When the average torque is negative, a negative sign is added to the first digit.



(4) Current feedback positionNo. of displayed digits: 8 digits with sign

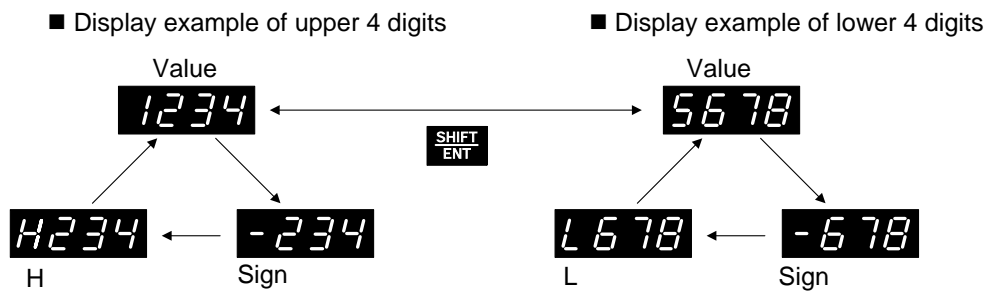
Rotation of the servomotor is displayed. The display is the rotation of the motor shaft encoder. (The 17 bit serial encoder has 131072 pulses/rotation.)



<Display of 8 digits with sign>

On display, the upper 4 digits can be replaced with the lower 4 digits and the negative sign is displayed. The leftmost digit of the upper 4 digits is displayed in the order of "Value," "Sign (negative sign only)" and "H (or L) *."

* H indicates the upper 4 digits and L indicates the lower 4 digits.



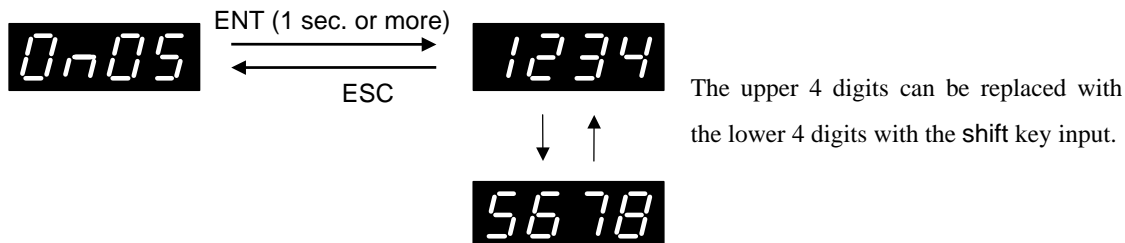
Hint When the rotation direction is switched with parameter No. 4, the display value increases in the increase direction of the current position.
After the maximum positive value of 99,999,999, counting is started increasing from 0 again.
After the maximum negative value of -99,999,999, counting is started decreased from 0 again.
Therefore, counting starts from 0 for each ±100,000,000.
The display is correct even when the value is transferred from load (machine).

8 KEYPAD

(5) Current command positionNo. of displayed digits: 8 digits with sign

The position of the servomotor controlled by the servo amplifier is displayed. (The pulse compensation is not considered.)

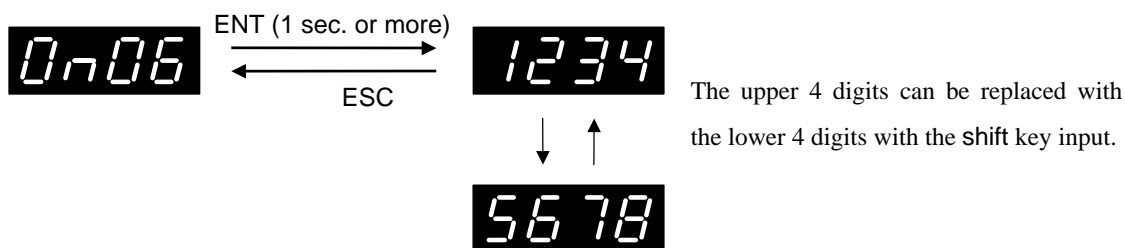
When the system reaches the target position and the value is transferred from load (machine) after turning OFF the operation command, the correct position is not displayed. For display, refer to "(4) Current feedback position."



(6) Position deviationNo. of displayed digits: 8 digits with sign

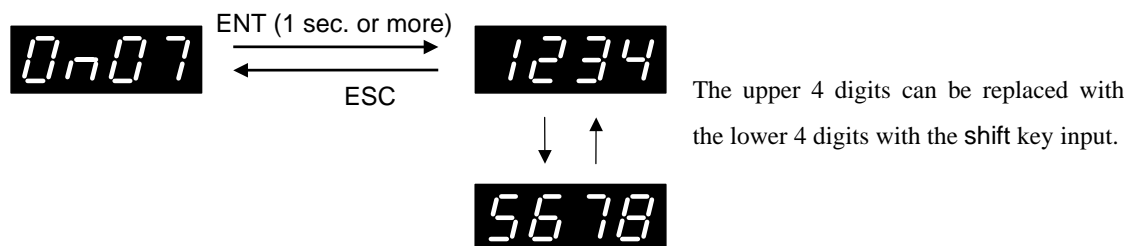
Difference between the command position and the feedback position is displayed. The deviation is the conversion value to the pulse of the encoder.

For display, refer to "(4) Current feedback position."



(7) Feedback cumulative pulseNo. of displayed digits: 8 digits with sign

The rotation cumulative pulse of the servomotor can be displayed with the encoder pulse (1 rotation: 131072 pulses). Rotation in the reverse direction decreases the cumulative value. Even when the value is transferred from load (machine), the correct value is displayed. For display, refer to "(4) Current feedback position."

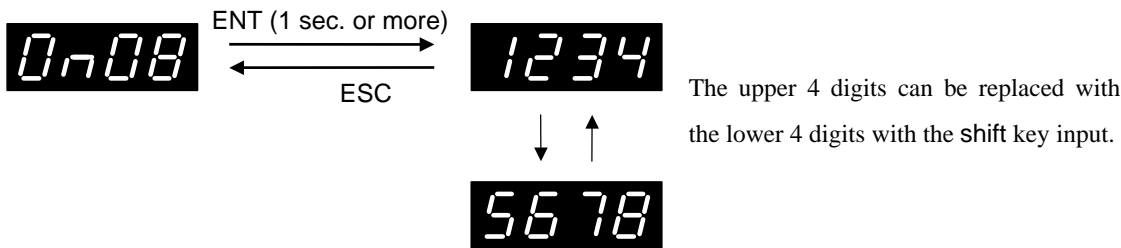


Hint When the \wedge key is pressed for 1 second or more and released, the feedback cumulative pulse can be cleared.

(8) Command cumulative pulseNo. of displayed digits: 8 digits with sign

The number of pulse strings input to the pulse string input terminal is displayed. With forward rotation pulse input, the cumulative value is increased. With reverse rotation pulse input, the cumulative value is decreased. Each edge is counted as a 90 degree phase difference 2 signal (multiplication of 4). The count value is increased with B phase advance.

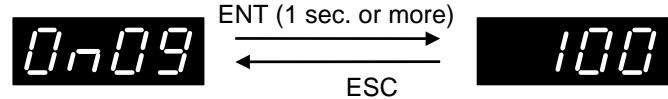
For display, refer to "(4) Current feedback position."



Hint When the \wedge key is pressed for 1 second or more and released, the feedback cumulative pulse can be cleared.

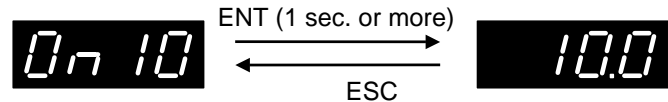
(9) Peak torque.....No. of displayed digits: 3 digits with sign

It is the peak torque value of the servomotor every 2 seconds. The rated torque is displayed as 100%. The value is displayed in the range from 0% to the (maximum torque) in increments of 1%. When the torque command is negative, the negative sign is given to the first digit.



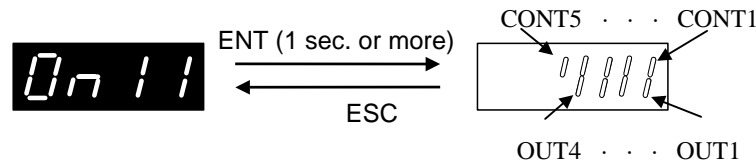
(10) Input voltage.....No. of displayed digits: 3 digits with sign

Input voltage of the analog input terminal [Vref] is displayed in increments of 0.1V. Negative sign indicates a negative (-) voltage. The display range is -12.0V to 12.0V.



(11) Input/output signal

ON/OFF of the sequence input/output signal to the servo amplifier is displayed. When the input signal is ON, the corresponding LED illuminates.

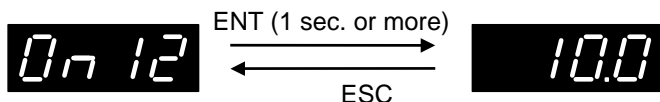


8 KEYPAD

(12) Load inertia ratio.....No. of displayed digits: 3 digits without sign

Regardless of the tuning mode selection for parameter No. 5, the load inertia ratio recognized by the servo amplifier is displayed. The value is displayed with multiplication (increments of 0.1) of the servomotor inertia moment. The display range is a multiplication of 1.0 to 99.9.

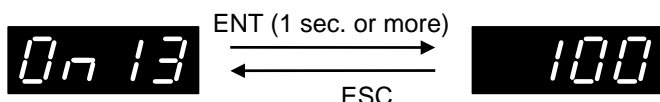
$$(\text{Load inertia ratio}) = \frac{(\text{Load inertia moment recognized by servo amplifier})}{(\text{Inertia moment of servomotor})}$$



(13) OL thermal valueNo. of displayed digits: 3 digits without sign

The load ratio when the load alarm level is 100 is displayed. When the value is 100, an overload alarm occurs. The minimum unit is 1%.

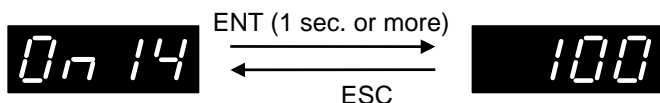
The display range is 0% to 100%.



(14) Regenerative resistance thermal value..... No. of displayed digits: 4 digits without sign

The regenerative load ratio is indicated, assuming the regenerative resistance overheat alarm level as 100. When the value reaches 100, a regenerative resistance overheat alarm is issued. The minimum unit is 1%.

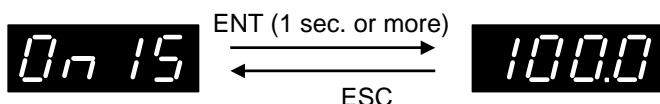
The display range is 0% to 100%.



(15) Pulse string frequency.....No. of displayed digits: 4 digits with sign

The pulse string frequency added to the pulse string input terminal is displayed. The minimum unit is 0.1 [kHz].

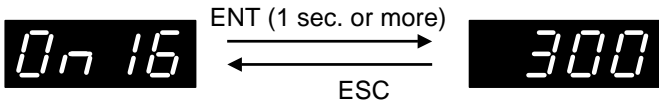
The display range is -999.9 kHz to 999.9 kHz.



(16) DC link voltage (maximum value) No. of displayed digits: 3 digits without sign

DC link voltage (maximum value) of the servo amplifier every 2 seconds is displayed.

The display range is 0V to 500V.

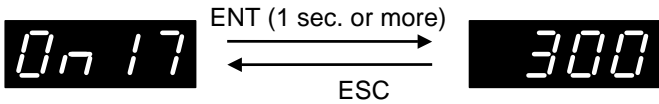


Hint If the DC link voltage (maximum value) exceeds 385V during operation, an external regenerative resistor is required. The detection level of "HV" (overvoltage) is 420V.

(17) DC link voltage (minimum value) No. of displayed digits: 3 digits without sign

DC link voltage (minimum value) of the servo amplifier every 2 seconds is displayed.

The display range is 0V to 500V.



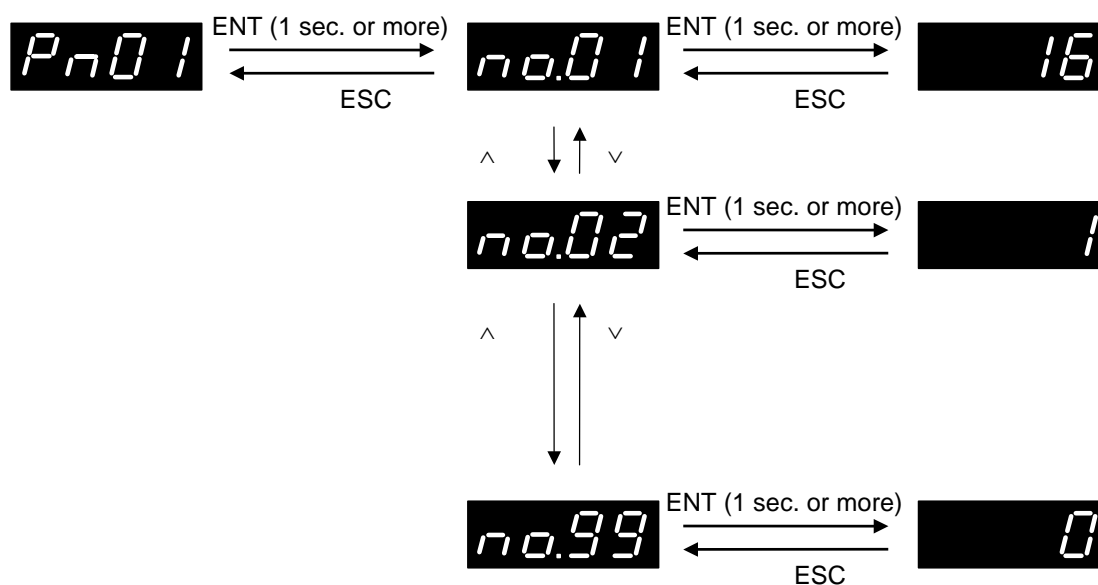
Hint The detection level of "LV" (undervoltage) is 210V.

8 KEYPAD

8.5 Parameter editing mode

In the parameter editing mode, parameters can be edited.

Display [*Pn01*] with the MODE key and select parameter editing with the ENT key (1 sec. or more) input. After selecting parameter input, select the parameter number for editing with the \wedge or \vee key. With the ENT key input, the details can be edited.



(1) Indication and editing

The indication and editing methods for parameter are as follows.

- Value indication

<Parameter of 3 digits or less without sign>

The value of 3 digits or less without sign is displayed as is.

07

The example on the left indicates that there are 2 digits for value settings.

To indicate the digit of value, zero suppress is not performed other than for the digits for setting.

<Parameter of 3 digits or less with sign>

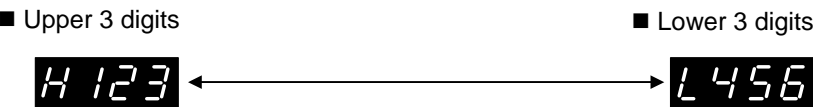
The value of 3 digits or less with sign has a sign to the left and the value is displayed in the remaining digit as is.

- 100

<Parameter of 4 to 5 digits or less without sign>

"H" is displayed at the left end for the upper 3 digits.

"L" is displayed at the left end for the lower 3 digits.

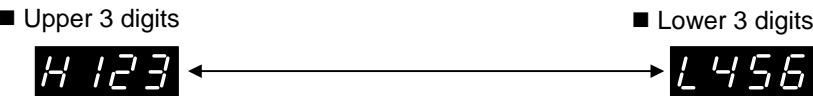


<Parameter of 4 to 5 digits with sign>

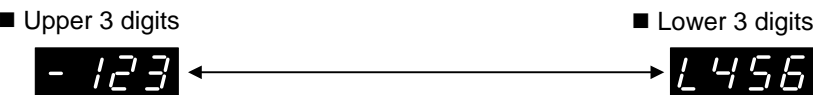
For the upper 3 digits, "H" is displayed at the left end for positive value and "-" is displayed for negative value.

For the lower 3 digits, "L" is displayed at the left end.

- For positive value



- For negative value



8 KEYPAD

- Editing a Value

When a parameter is read, the last digit (right end digit) is blinking. (For parameter with H and L, H details are displayed.) The blinking digit can be edited. (It blinks at an interval of approx. 1 sec.)

Press the \wedge or \vee key changes the value.

When 9 is increased to 0, the upper digits are not changed.

On the other hand, when 0 is decreased to 9, the upper digits are not changed.



Increase the value of "9" for the third digit by one with the \wedge key.



When the third digit is increased to "0", the upper digits are not changed.

Shift the digit for editing in sequence with the SHIFT key. The sequence for shifting is ① to ③ as shown below

- H (upper 4 digits)



① ② ③

- L (lower 4 digits)



④ ⑤ ⑥

- Storing the value

Press and hold the ENT key for 1 sec or more to store the value. All digits blink three times simultaneously. The stored value remains as it is. (The stored value blinks at about 0.5 second intervals.)

When the ESC key is input, the screen returns to the parameter number selection screen.

- Value beyond the specified range

When the number of digits is effective, a value outside the setting range can be input.

Ex.) For parameter No. 1, 0 to 99999 can be input (Setting range: 1 to 32767).

The value outside the setting range cannot be used as the parameter. (NG is displayed.)

- Editing example
Change the manual feed speed of 3 in parameter No. 33 to 1.0.

Keying	Indication	Remarks
		The action mode in the sequence mode is displayed.
		Returns to mode selection.
		Select the parameter mode.
(1 sec. or more)		Display the parameter number.
		Select parameter No. 33.
(1 sec. or more)		Settings of No. 33 are displayed. The first digit of H (upper 3 digits) is blinking. (Upper 2 digits of initial value 1000.0 are displayed.)
		Decrease the value to 0.
		Display L (lower 4 digits).
		Shift to the editing digit.
		Change the value to "1."
(1 sec. or more)		Define the changed value.
		The stored value remains as it is.

8 KEYPAD

8.6 Test running mode

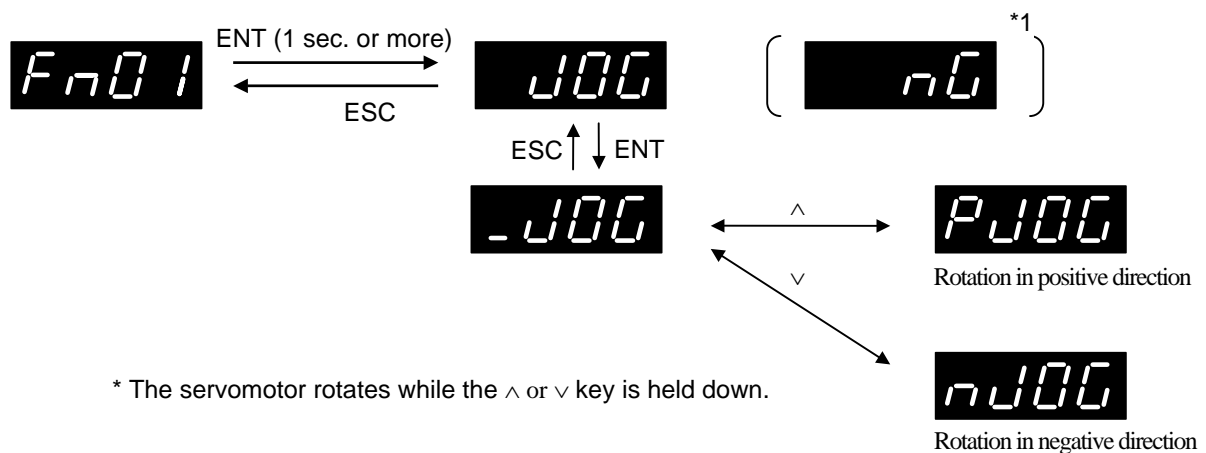
In the test running mode, keying on the Keypad can rotate the servomotor or reset various settings.

Press the MODE key to display [*F n 0 n*] and hold down the ENT key for at least 1 second to execute test running.

<i>F n 0 1</i> : Manual feed	<i>F n 0 5</i> : Alarm history initialization	<i>F n 0 9</i> : Auto tuning gain
<i>F n 0 2</i> : Position reset	<i>F n 0 6</i> : Parameter initialization	<i>F n 1 0</i> : Easy tuning
<i>F n 0 3</i> : Cumulative pulse clear	<i>F n 0 7</i> : Auto offset adjustment	<i>F n 1 1</i> : Pattern operation
<i>F n 0 4</i> : Alarm reset	<i>F n 0 8</i> : Phase-Z position adjustment	

(1) Manual feed

The servomotor rotates while a key on the Keypad is pressed. The servomotor speed is as per the setting of parameter #1.



While the servomotor is rotating with the sequence input/output signal, [NG] is displayed.

*1) Cause of NG display

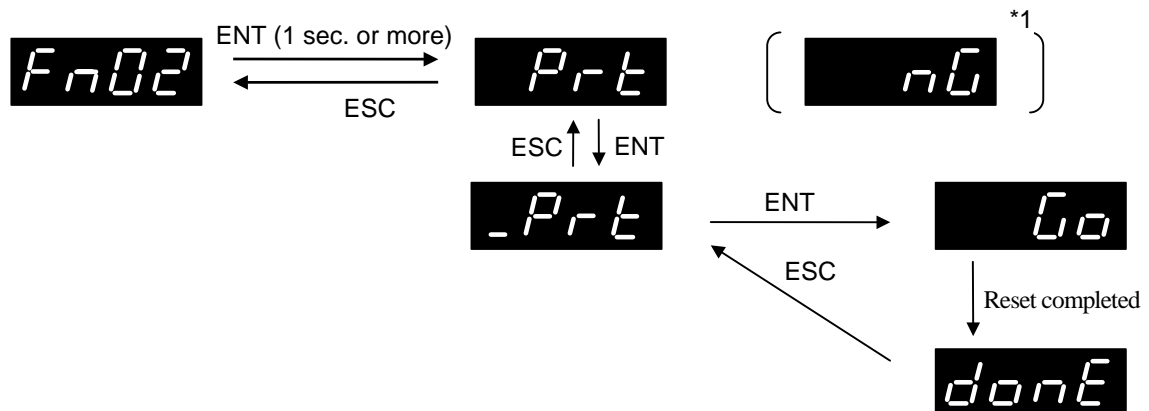
- RUN signal and FWD/REV signal are ON.
- Motor is rotating.



Forced stop, external regenerative resistor overheat, ±OT and coasting signals are valid during test operation. If test operation is faulty, check the signals above.

(2) Position reset

Reset (0) the current command position and the current feedback position of the servomotor.

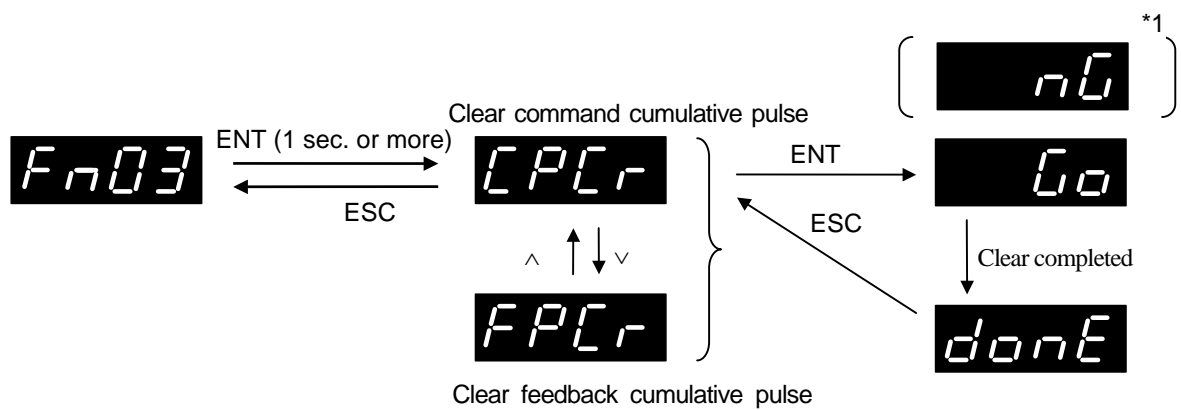


*1) Cause of NG display

- RUN signal and FWD/REV signal are ON.
- Motor is rotating.

(3) Cumulative pulse clear

The command cumulative pulse and the feedback cumulative pulse of the servo amplifier are cleared.



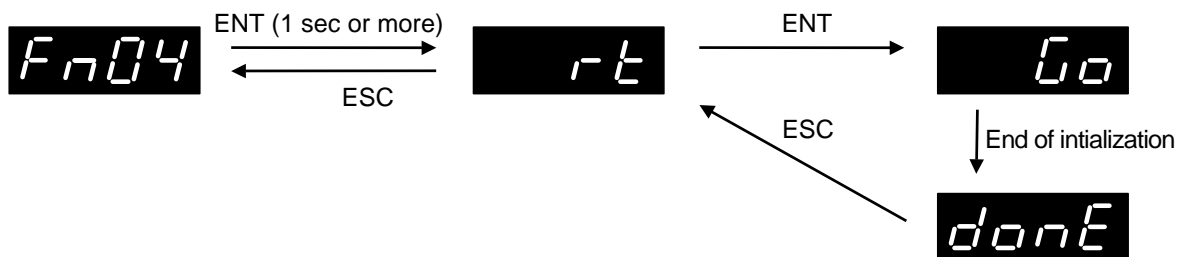
*1) Cause of NG display

- RUN signal and FWD/REV signal are ON.
- Motor is rotating.

8 KEYPAD

(4) Alarm reset

Resets the alarm detected by the servo amplifier.



* Some alarms cannot be reset with the alarm reset. For these alarms, supply the power again to reset the alarms.

■ Alarms that can be reset with the alarm reset

Indication	Description
OC1	Overcurrent 1
OC2	Overcurrent 2
OS	Overspeed
Hu	Overvoltage
rH2	Regenerative transistor overheat
EC	Encoder communication alarm
OL	Overload
Lu	Undervoltage
rH1	Regenerative resistor overheat
DF	Deviation limit
AH	Amplifier overheat

■ Alarms that are reset with the re-supply of power

Indication	Description
Et	Encoder trouble
Ct	Control power alarm
dE	Memory alarm
Cnt	CONT duplication

(5) Alarm history initialization

Deletes the alarm detection log recorded in the servo amplifier. The alarm detection history (alarm history) can be monitored in sequence mode [**Fn05**].

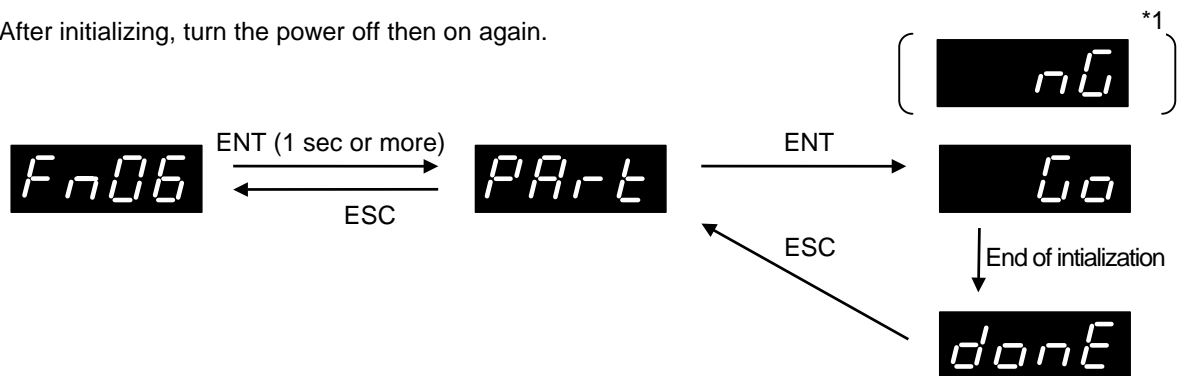


* The alarm history is retained even when the power is turned off.

(6) Parameter initialization

Initializes the parameters.

* After initializing, turn the power off then on again.



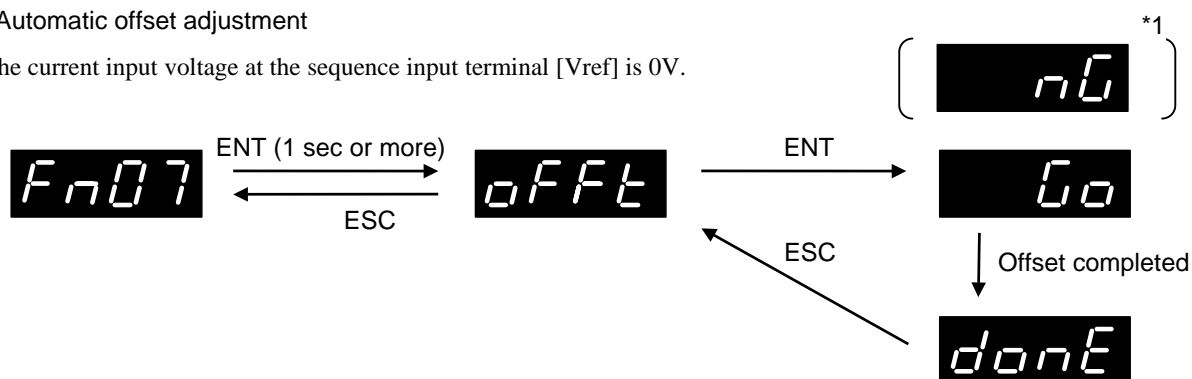
*1) Cause of NG display

- RUN signal is ON.
- Write-protection selected at parameter #29 (write-protection of parameters)

8 KEYPAD

(7) Automatic offset adjustment

The current input voltage at the sequence input terminal [Vref] is 0V.



When all X1 and X2 terminals of the multistep speed selection are OFF with FWD (REV) signal, the servomotor output shaft rotates according to the analog speed command voltage.

When the speed command voltage is decreased to 0V, the output shaft of the servomotor may rotate at a very low speed.

→ If required, use the "zero clamp function."

The adjusting procedure of the offset voltage is as follows:

- ① Apply voltage of 0V to the [Vref] terminal. The operation command may be given or not given at your discretion.
- ② Select [Fn07] on the keypad. When the ENT key is input, the offset is automatically adjusted.
- ③ Turn ON the operation command [RUN] signal and make sure that the output shaft of the servomotor does not rotate.

*1) Cause of NG display

- Write-protection selected at parameter #29 (write-protection of parameters)



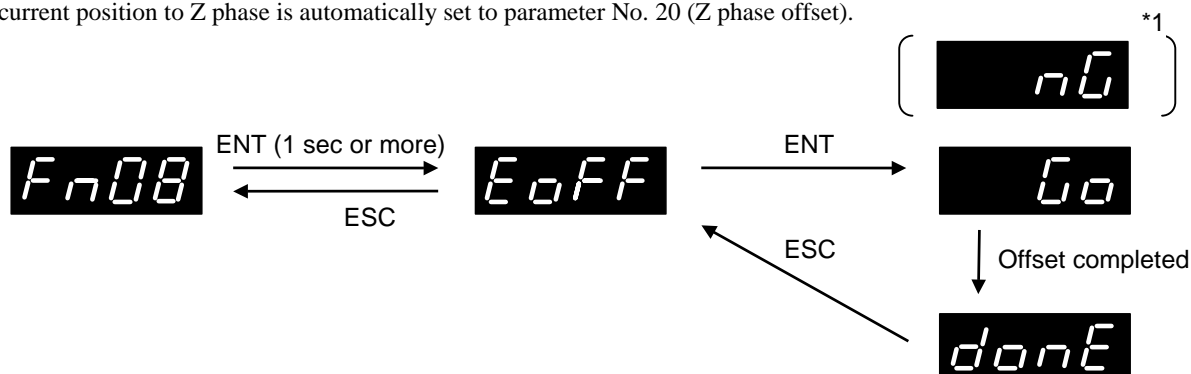
Hint

- The adjusted results are stored in parameter No. 71.
- With changes of the servo amplifier environments, offset adjustment may be required again.

When the servo amplifier is controlled with the upper level controller using the speed command voltage and the dividing output (feedback), do not select this adjustment.

(8) Phase-Z position adjustment

Defines the current position as the phase-Z position. With Z phase position adjustment, the distance from the current position to Z phase is automatically set to parameter No. 20 (Z phase offset).



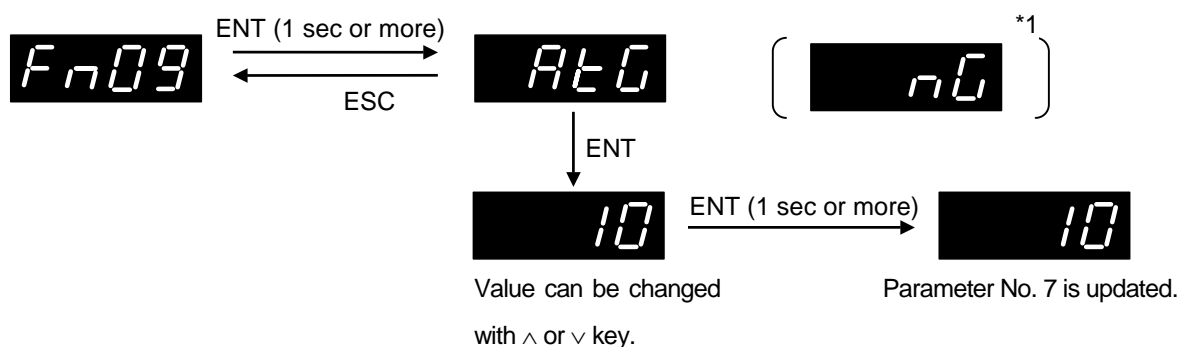
*1) Cause of NG display

- Write-protection selected at parameter #29 (write-protection of parameters)
- Encoder origin (phase-Z) establishment failure (immediately after power-on)
→ Turn the motor shaft at least twice to establish the phase-Z origin.

(9) Auto tuning gain setting

Parameter #7 (auto tuning gain) is refreshed at real time.

Unlike the other parameters, an increase or decrease is reflected on the data immediately (parameter #7 is not updated. However, parameter #7 is updated when the ENT key is pressed).



*1) Cause of NG display

- Write-protection selected at parameter #29 (write-protection of parameters)

8 KEYPAD

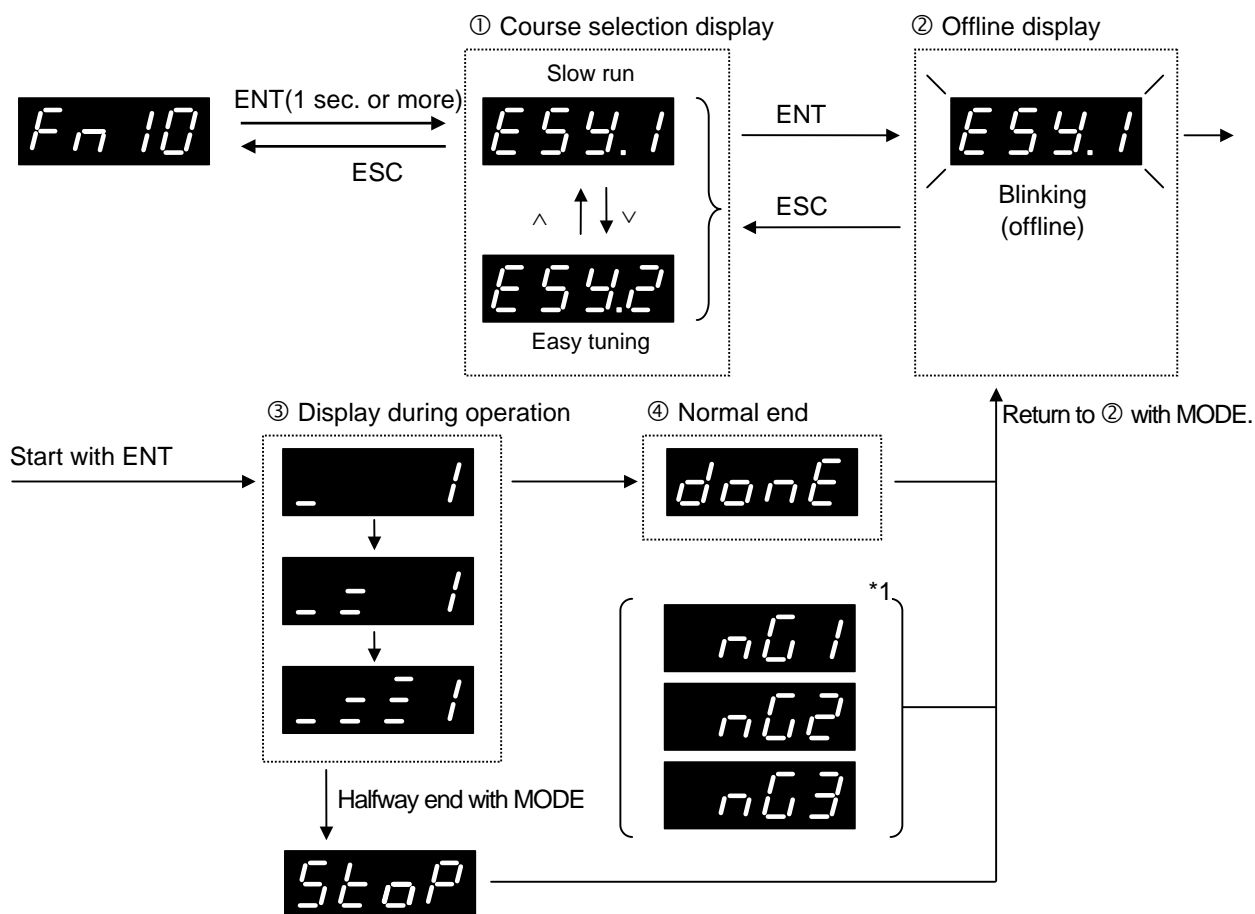
(10) Easy tuning

The servomotor is automatically started and the auto tuning gain is automatically adjusted.

If wires are not connected to the upper level control systems, the optimum adjustment can be made according to the machine.

There are two operation patterns; slow run and easy tuning. For details, refer to Chapter 6.

Course name	Travel distance	Operation count	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction	
							Forward	Return
Slow run	No. 84	1 reciprocal movement	No. 35	No. 36	10r/min	No. 86	CCW	CW
Easy tuning	No. 84	25 reciprocal movements	Automatic calculation	Automatic calculation	No. 85	No. 86	CCW	CW



*1) If NG is displayed, remove the cause. Then, press the MODE key to return to ② Offline status.

<Cause of NG1 display>

- Parameter No. 29 (parameter write protect) is "1: Write protect."
- \pm OT, EMG or external regenerative resistor overheating is detected.
- Parameter No. 5 (tuning mode) is not "0: Auto tuning."
- Power is not supplied to the main circuit.

<Cause of NG2 display>

- \pm OT, EMG or external regenerative resistor overheating is detected halfway. (Coasting signal is ignored.)
- RUN signal is turned OFF.

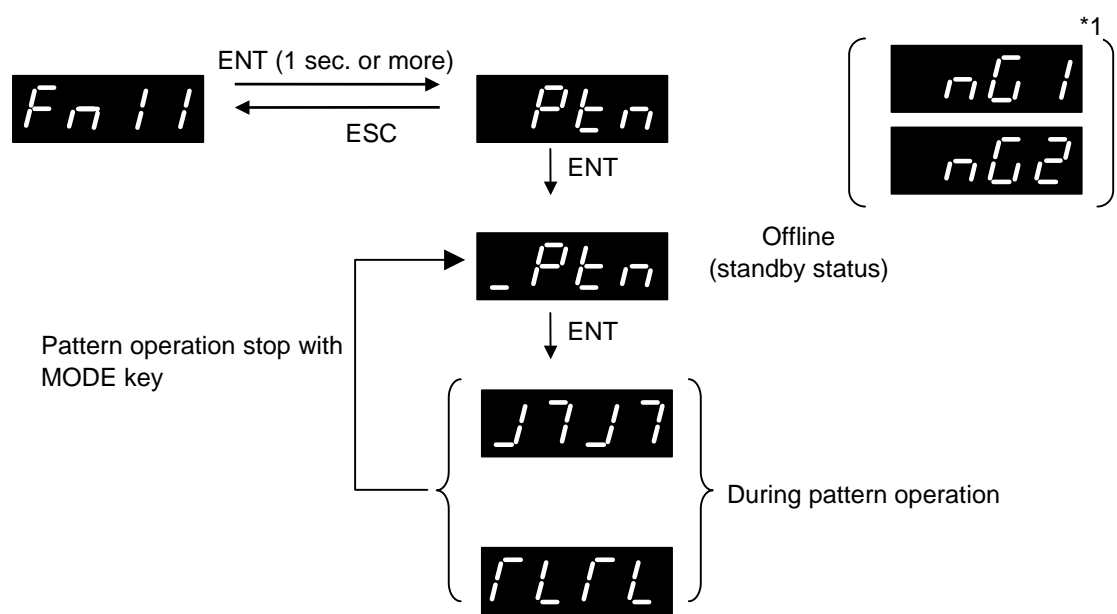
<Cause of NG3>

- Auto tuning gain is 4 or less and the motor is oscillating.

(11) Pattern operation

The servomotor is continuously operated. When this is started, reciprocal operation is continued until operation is stopped. If wires are not connected to the upper level control system, continuous operation can be performed. This operation is used to confirm the actual torque.

Course name	Travel distance	Operation count	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction	
							Forward	Return
Pattern operation	No. 84	Infinite	No. 35	No. 36	No. 85	No. 86	CCW	CW



*1) If NG is displayed, remove the cause. Then, press the MODE key to return to Offline status.

<Cause of NG1 display>

- ±OT, EMG or external regenerative resistor overheating is detected.
- Power is not supplied to the main circuit.

<Cause of NG2 display>

- ±OT, EMG or external regenerative resistor overheating is detected halfway. (Coasting signal is ignored.)
- RUN signal is turned OFF.

8 KEYPAD

-MEMO-

9

INSPECTION AND MAINTENANCE

9.1	Inspection	9- 2
9.2	Memory back-up	9- 3
9.3	Alarm indication	9- 4
9.4	Expected service life and discharge	9-19
9.5	Part replacement	9-20

9 INSPECTION AND MAINTENANCE

9.1 Inspection

The servo amplifier (RYC type) consists of electronic parts and requires no routine inspection. The servomotor is of a synchronous type (brushless) and has no part that requires routine maintenance. Though both the servo amplifier and servomotor are maintenance-free, perform periodic inspection to avoid possible accidents and keep reliability of the equipment.



DANGER

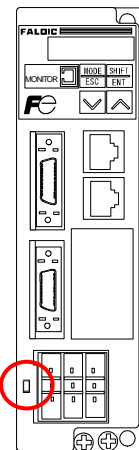
- Prior to inspection, turn off power and wait for at least five minutes. Otherwise, there is a risk of electric shock.
- Do not touch the servo amplifier when the commercial power is supplied. If attempted, there is a risk of electric shock.

Inspection items are as follows.

Inspection item

Device	Descriptio
Servomotor	Misalignment of mechanical coupling Direct exposure to water, steam or oil Abnormal vibration
Servo amplifier	Loose screws of terminal block and fastening parts Excessive accumulation of dust Foreign odor, damage due to heat, breakage or external deformation Cable-wire discontinuation

Before checking electrical wirings, turn off the power and wait for 5 minutes and then check that the [CHARGE] LED is off on the keypad.



CAUTION

- Do not perform megger test on the PC-board or terminal block of servo amplifier. If attempted, the servo amplifier and the encoder housed in the servomotor may be broken.

9.2 Memory back-up

(1) Memory back-up

An electrically erasable programmable read-only memory (EEPROM) is used for retaining the parameters and alarm detection history after turning off power supply.

Each area can be initialized by turning off the servo amplifier operation command [RUN] (while motor is de-energized).

① Initialization of parameter

To initialize, select the initialization of parameter in the test running mode and press the ENT key.



* After the initialization, be sure to turn on power again.

The initialization is not allowed if rewrite is inhibited by parameter #29.

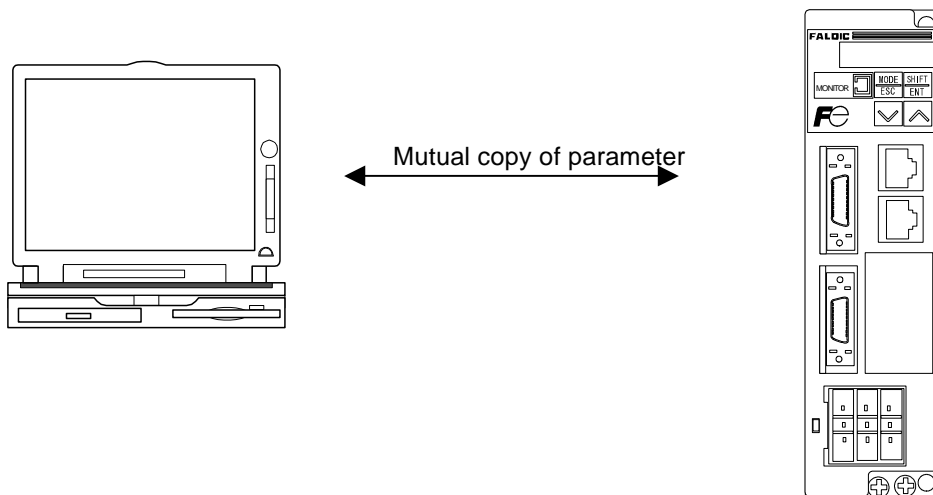
The initialization is impossible while the motor is energized with the [RUN] signal on.

② Initialization of alarm detection history

The alarm detection history is held at all times. It can be initialized by the initialization [Fn05] of history in the test running mode of the keypad.

(2) Copying the parameter

Use of the PC loader can copy the setting contents of servo amplifier to the loader or, reverse, the loader contents can be transferred to the servo amplifier.



9 INSPECTION AND MAINTENANCE

9.3 Alarm indication

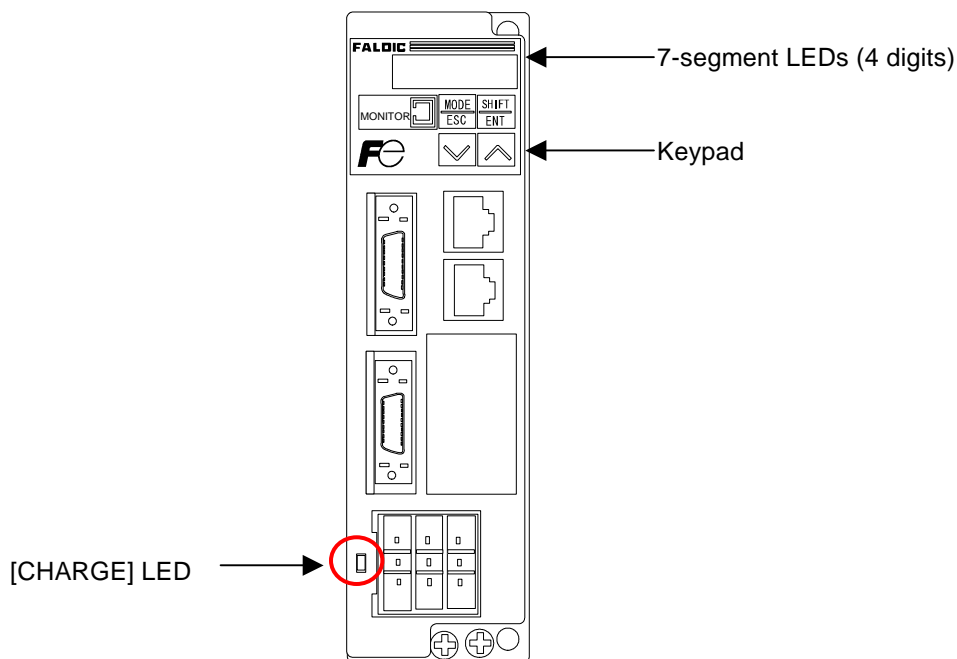
The fault diagnosis is explained in three sections below.

- (1) Initial status
- (2) When error (failure) is not displayed
- (3) Faults with alarm indication and remedy

(1) Initial status

When the commercial power is supplied to the servo amplifier, the 7 segment of the keypad displays the value set by parameter # 30

The LED at the front of the servo amplifier for [CHARGE] illuminates.



When the 7 segment does not illuminate after the power is supplied, the servo amplifier may be damaged. Please contact us.

(2) When error (failure) is not displayed

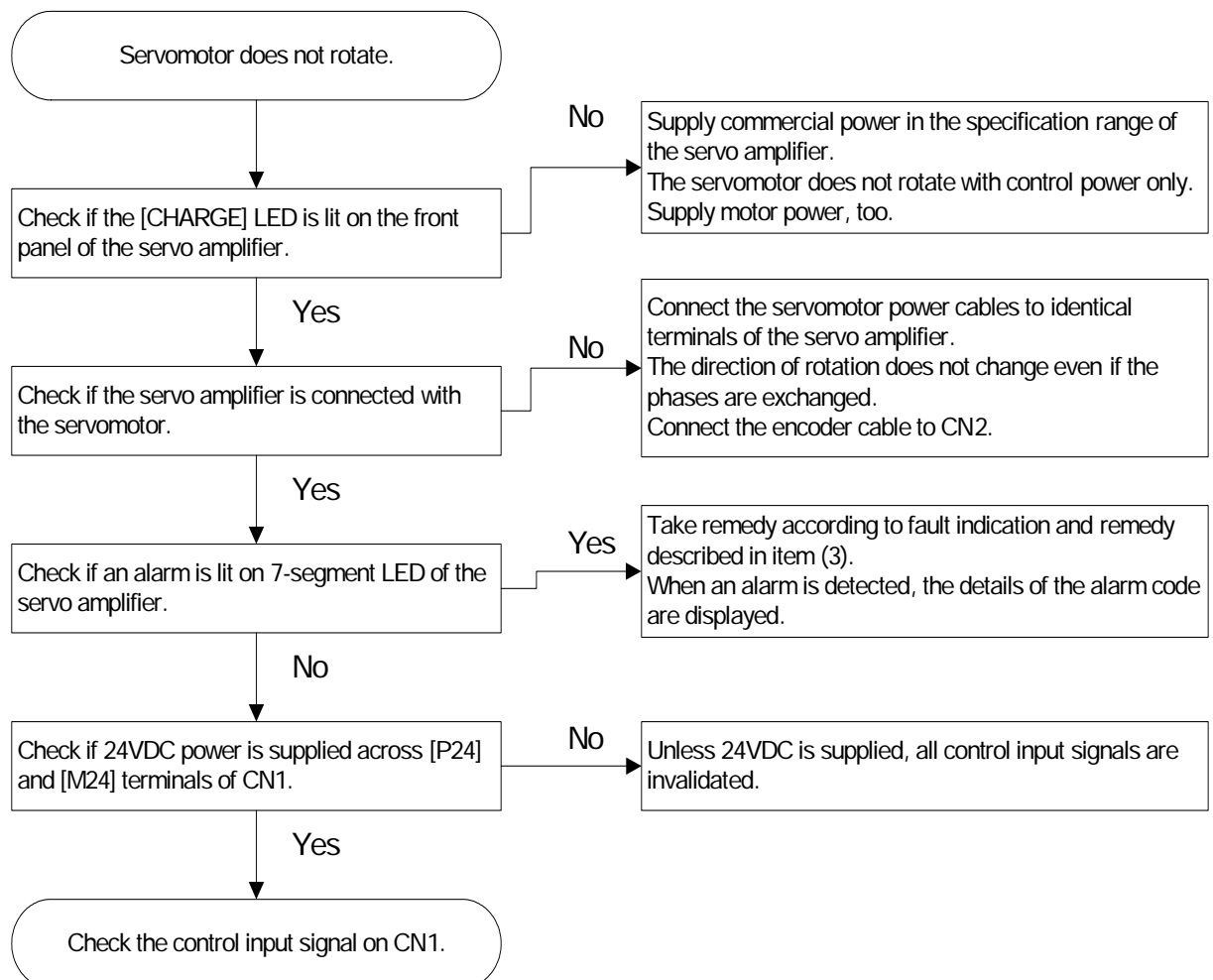
This type of failure is described by classification into the following three types:

- ① Servomotor does not rotate.
- ② Servomotor hunting
- ③ Positioning accuracy is poor.

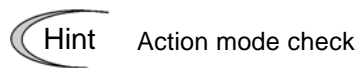
If correct operation is not obtained after troubleshooting, contact us.

If an alarm is indicated at the keypad of the servo amplifier, refer to item (3).

① Servomotor does not rotate.

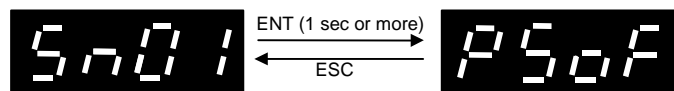


9 INSPECTION AND MAINTENANCE



Action mode check

Check the state of the servo amplifier.



Indication (1st digit)	Sequence
	Position control
	Speed control
	Torque control

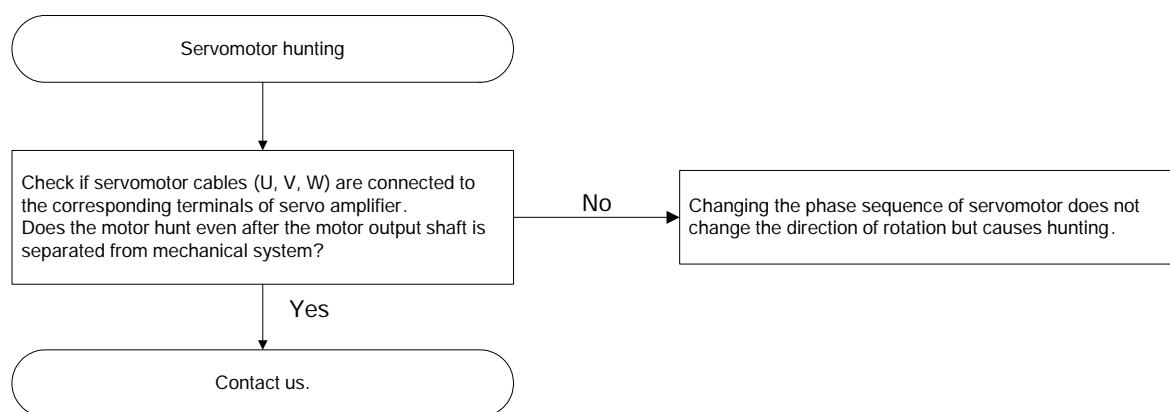
Indication (2 to 4 digits)	Sequence
	Base off. Servomotor has no drive force. Coasting.
	Waiting for command with the servo ON.
	The servomotor is ready to rotate. Pulse string input is effective.
	The servomotor is ready to rotate by manual operation (test running).
	Stopped under detection of positive overtravel signal.
	Stopped under detection of negative overtravel signal.
	Stopped at zero speed upon forced stop signal input.
	Undervoltage is detected.

- ② Servomotor hunting (Servomotor shaft alternates forward and reverse rotation repeatedly at a short interval.)

For the servo amplifier, the auto tuning function is made active by factory setting.

The auto tuning function is valid for most machines. It may not function correctly depending on the machine configuration.

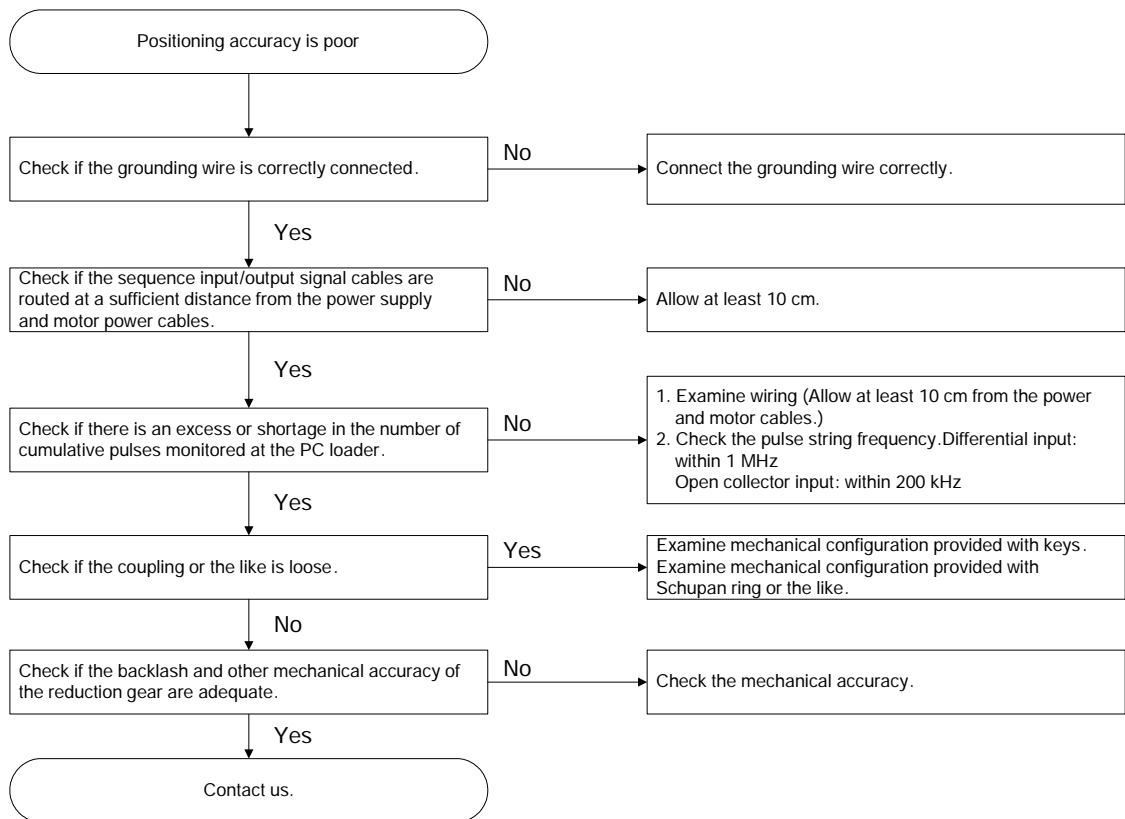
If hunting occurs without connection to the output shaft of the servomotor, check the following items.



If hunting occurs with a machine connected to the output shaft of the servomotor, refer to chapter 6.

9 INSPECTION AND MAINTENANCE

③ Poor positioning accuracy



(3) Details of alarm detection

When an alarm is detected, the alarm code is automatically displayed blinking on the keypad of the servo amplifier.

If multiple alarms are detected simultaneously, the alarm code with a higher priority blinks. See the table below for the priority order.

Priority	Indication	Description
1	OC 1	Overcurrent 1
2	OC 2	Overcurrent 2
3	OS	Overspeed
4	HV	Overvoltage
5	Et	Encoder trouble
6	Ct	Control power alarm
7	dE	Memory alarm
8	rH2	Regenerative transistor overheat
9	EC	Encoder communication alarm
10	Cont	CONT duplication
11	OL	Overload
12	LV	Undervoltage
13	rH1	Regenerative resistor overheat
14	DF	Deviation limit
15	AH	Amplifier overheat

The 7 segment of the keypad blinks at intervals of approx. 0.5 sec.

(4) Operation for alarm detection

The servomotor decelerates and stops upon detection of an alarm. The operation varies depending on the detection.

<Action upon alarm>

- Coasting to stop upon detection

Indication	Description	Page
OC 1	Overcurrent 1	9-11
OC 2	Overcurrent 2	9-11
OS	Overspeed	9-11
HV	Overvoltage	9-12
Et	Encoder trouble	9-12
Ct	Control power alarm	9-13
dE	Memory alarm	9-13
rH2	Regenerative transistor overheat	9-14
EC	Encoder communication alarm	9-14
Cont	CONT duplication	9-15

- The servomotor decelerates at the maximum torque and coasts after stopping.

Indication	Description	Page
OL	Overload	9-15
LV	Undervoltage	9-16
rH1	Regenerative resistor overheat	9-16
DF	Deviation limit	9-17
AH	Amplifier overheat	9-17

9 INSPECTION AND MAINTENANCE



An alarm is automatically displayed if detected.

When this is displayed, the alarm can be reset with the sequence input signal (reset).

The alarm detection of encoder error, control power error, memory error and CONT duplication cannot be reset with the sequence input signal.

In this case, shut off the power and make sure that the display of the keypad goes off. Then, re-supply the power.

Alarm detection can be reset in the test running mode [**FN04**] also.

1. Overcurrent

[Display]



[Details of detection]

The output current of the main circuit transistor exceeded the specified value.

[Factor and action]

Factors for overcurrent	Actions
Grounding wire is not connected.	Connect the grounding wire.
Output wire of the motor is wrong.	Connect wires to the servo amplifier and the servomotor by checking the phase sequence.
Output wire of the motor is short-circuited between phases.	Check the resistance values between U-V, V-W and W-U.
Output wire of the motor is short-circuited with the grounding.	Check the resistance value with the grounding wire.

The power wire to the servomotor may have a ground fault or short-circuit.

The resistance with the ground wire is usually several MΩ or more. The resistance value between coils is balanced.

2. Overspeed

[Display]



[Details of detection]

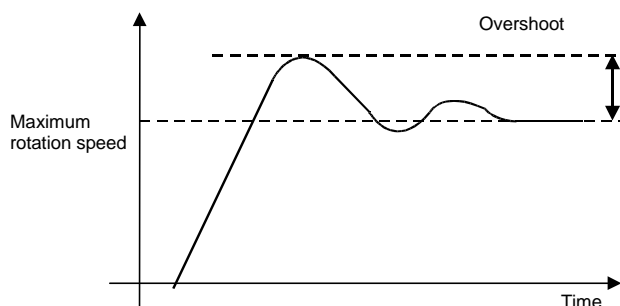
The rotation speed of the servomotor exceeded 1.1 times the maximum speed.

[Factor and action]

Factors for regenerative resistor overheating	Actions
Output wire of the motor is wrong.	Connect wires to the servo amplifier and the servomotor by checking the phase sequence.
The rotation speed is overshooting.	Increase acceleration time 1 (parameter # 35).
	Increase the S-curve time constant (parameter # 43).
	Increase the operation speed response (parameter # 41).

The motor rotation speed may be overshooting.

Check the speed waveform during acceleration with the PC loader.



9 INSPECTION AND MAINTENANCE

3. Overvoltage

[Display]



[Details of detection]

The DC link voltage inside the servo amplifier is larger than the limit value.

[Factor and action]

Factors for overvoltage	Actions
Power voltage is high (immediately after power supply).	Check the power voltage.
The external regenerative resistor is not connected.	Connect the external regenerative resistor. Check for wiring (disconnection) of the external regenerative resistor.
The regenerative transistor is damaged.	Replace the servo amplifier.

With the monitor mode on the keypad, the internal DC link voltage can be checked.

0n 16 : DC link voltage (maximum value), **0n 17** : DC link voltage (minimum value)

When overvoltage is approx. 420V, it is detected with the monitor above.

4. Encoder trouble

[Display]

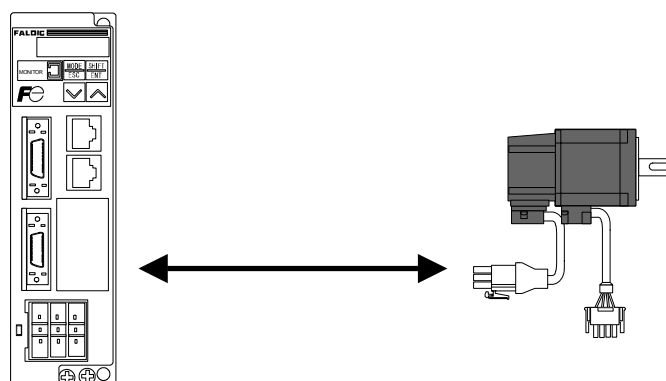


[Details of detection]

The encoder inside the servo amplifier may be damaged.

[Factor and action]

Factors for encoder error	Actions
Encoder is damaged.	Replace the servomotor.
Encoder is vibrating.	Reduce the operating speed response (parameter # 41) and check the condition.



An alarm is detected with the self-diagnosis result of the CPU in the encoder.

In this case, communication is performed between the servo amplifier and the servomotor.

5. Control power alarm

[Display]



[Details of detection]

The internal control power of the servo amplifier is faulty.
The servo amplifier may be broken.

[Factor and action]

Factors for control power error	Actions
The servo amplifier is damaged.	Replace the servo amplifier.

If this alarm is detected, contact us.

6. Memory alarm

[Display]



[Details of detection]

The parameter contents stored in EEPROM in the servo amplifier are damaged.

[Factor and action]

Factors for memory error	Actions
Memory contents are damaged.	Initialize the parameter and check the condition.
Memory is damaged.	Replace the servo amplifier.

If a memory error has occurred, initialize the parameter.

If a memory error is still detected even after initialization, replacement of the servo amplifier is required.

9 INSPECTION AND MAINTENANCE

7. Regenerative transistor overheat

[Display]



[Details of detection]

The regenerative transistor on the servo amplifier has overheated.

[Factor and action]

Factors for regenerative transistor overheating	Actions
Power voltage is high (immediately after power supply)	Check the power voltage.
Regenerative power cannot be consumed.	Increase the deceleration time and reduce the regenerative frequency.
	Reduce the rotation speed.

8. Encoder communication alarm

[Display]



[Details of detection]

Communication between the encoder on the servomotor and the servo amplifier is not performed.

[Factor and action]

Factors for encoder communication error	Actions
Encoder communication is interrupted.	When the optional cable is not used, check the wire specification.
	Check for disconnection of the wire.
	Place a ferrite core on the encoder wire and check the condition.

The encoder wire of the servomotor may be disconnected or cut.

The servo amplifier and the encoder are performing serial communication. Use the optional cable or the specified wire for the encoder cable.

Since the encoder wire has a voltage amplitude of approx. +5V, do not place the wire around a strong magnetic field or strong electric field. Keep the encoder wire separate from the servo amplifier unit, inverter and electromagnetic contactor (100 mm or more).

9. CONT input duplication

[Display]



[Details of detection]

Allocation of the sequence input terminal for the servo amplifier is duplicated.

[Factor and action]

Factors for sequence input duplication	Actions
The same input signals are allocated to multiple terminals.	Do not give the same numbers for parameters # 10 to 14. (Duplicate allocation is allowed only for forced stop.)

10. Overload

[Display]



[Details of detection]

The output torque effective value (command value) of the servo amplifier exceeded the allowable value of the combined servomotor.
(It is detected with the electronic thermal relay built into the servo amplifier.)

[Factor and action]

Factors for overload	Actions
The servomotor does not mechanically rotate.	Connect wires to the servo amplifier and the servomotor by checking the phase sequence.
	Make sure that the brake is not working.
Machine load is large compared to the motor capacity.	Review the capacity using the load ratio at a constant speed.
	If the rotation speed is low, review the deceleration ratio. If this error is detected during stoppage of the lifting machine, stop the machine with a brake.
Acceleration/deceleration frequency is high.	If this error does not occur by reduction of the operation frequency, review the capacity.
The servo amplifier is damaged.	Replace the servo amplifier.

If this alarm occurs at a constant speed or during stoppage, it is necessary to review the motor capacity.
When the operation frequency is high, reduce the operation frequency. If the alarm is not detected, the cause may be that acceleration/deceleration frequency is high.
In either case, check the OL thermal relay value with the monitor mode of the servo amplifier keypad.

9 INSPECTION AND MAINTENANCE

11. Undervoltage

[Display]



[Details of detection]

The power supply to the servo amplifier is lower than the minimum voltage of the specification range.

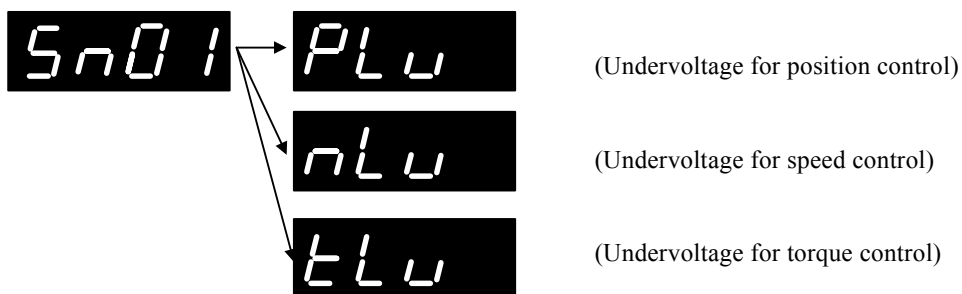
[Factor and action]

Factors for undervoltage	Actions
The power voltage was reduced.	Check the power supply environment. This alarm is only detected when parameter 26 is set to 1.

The power supply voltage may be reduced due to instantaneous power failure. Or the power supply capacity may be insufficient.

If the power supply environment is poor, detection of undervoltage can be ignored by setting parameter # 27. In this case, if coasting is selected from the setting of parameter # 26, operation can be continued with instantaneous power failure.

Undervoltage can be checked with the display on the keypad.



The DC link voltage can be checked with the monitor mode of the keypad.

If undervoltage is detected, it is approx. 210V of the DC link voltage.

12. Regenerative resistor overheat

[Display]



[Details of detection]

Heat of the regenerative resistor connected to the servo amplifier exceeded the upper limit.

[Factor and action]

Factors for regenerative resistor overheating	Actions
Power voltage is high (immediately after power supply)	Check the power voltage.
Regenerative power cannot be consumed.	Make the deceleration time longer. Reduce the regenerative frequency. Reduce the rotation speed.

13. Deviation limit

[Display]



[Details of detection]

Deviation (difference between the current command position and the current feedback position) exceeded the deviation limit width of parameter # 22.

[Factor and action]

Factors for deviation limit	Actions
The servomotor does not mechanically rotate.	Connect wires to the servo amplifier and the servomotor by checking the phase sequence. Make sure that the brake is not working.
Torque cannot be output.	Increase parameter # 25.
The deviation limit width is small.	Increase parameter # 22.
Acceleration is slow.	If "P motion" is set to be effective in the sequence input, cancel it. Adjust the gain according to chapter 6.
The pulse string frequency is quickly increased.	Perform soft start.

The initial value of standard parameter # 22 is 20000 ($\times 100$) pulses.

When the deviation exceeds 2000000 pulses, alarm for deviation limit is detected. With the normal operation method of the servo amplifier, the deviation becomes larger in proportion to the rotation speed.

One rotation of the motor shaft is 131072 pulses. When deviation has become equivalent to approx. 15 rotations of the motor shaft, the deviation limit is detected.

If the deviation limit is detected when the operation command [RUN] is ON, a different power wire of the servomotor may be used.

14. Amplifier overheat

[Display]



[Details of detection]

The cooling fin temperature of the servo amplifier exceeded approx. 100°C.

[Factor and action]

Factors for amplifier overheat	Actions
Ambient temperature exceeded 55°C.	Use the system in an ambient temperature of 55°C or less. To extend the life of the capacitor in the servo amplifier, it is recommended that the operation be 40°C or less.
Regenerative power cannot be consumed.	Make the deceleration time longer.

Use the servo amplifier at the ambient temperature of +55°C or less. The life of the large capacity capacitor in the servo amplifier is greatly affected by the ambient temperature.

9 INSPECTION AND MAINTENANCE

Items to specify when faulty

If an alarm appears, remedy it by referring to Chapter 9.

If the alarm is ignored and reset without knowledge about the cause of the alarm to continue operation, damage will be caused to the servo amplifier and servomotor.

When contacting us, specify the following items.

(1) Data on rating plate

Type of servo amplifier and servomotor

→ Example. RYC201D3-VVT2

(2) Device configuration

Connected external resistor

→ Example. Connect the external regenerative resistor.

(3) Outline of mechanical equipment system driven by motor

→ Example. Ball-screw feed, vertical drive, reduction speed ratio 1/2

(4) Description of fault

① Running duration (years). Was the motor operated normally even once?

② Frequency of alarm occurrence, conditions

→ Example. When a certain device operates, the motor stops.

③ Alarm display contents

④ Is the alarm reproducible?

⑤ When does the alarm occur, during acceleration, during rotation at a constant speed, or during deceleration?

⑥ Is there any difference between forward rotation and reverse rotation?

⑦ Does the alarm occur under particular conditions?

→ Example. When [RUN] signal has been turned on.

→ Example. When a table has advanced to a particular position.

⑧ If you have the machine or the servo amplifier with the same specifications, does the alarm occur even after the amplifier or the machine is replaced?

9.4 Expected service life and discharge

(1) Expected service life

The servomotor and servo amplifier are susceptible to aging under regular operating conditions.

Contact our service section for replacement of parts. Customers are not to disassemble or repair the unit themselves.

① Servomotor

The bearing life of the servomotor varies depending on the operation conditions.

If abnormal noise or vibration is found during inspection, it is necessary to replace the bearing.

② Brake built in servomotor

The brake built into the servomotor is the non-exciting operation type brake for retention.

It cannot be used for braking.

Use the brake only for retention of the servomotor stopped status.

③ Large capacity capacitor built in servo amplifier

The servo amplifier incorporates large capacity capacitors.

Contact us when replacement with new one is required.

(2) Discharge

① Servomotor

It can be discharged as a general industrial waste.

② Servo amplifier

It can be discharged as a general industrial waste.

9.5 Part replacement

The guideline for part replacement is as follows. The actual replacement period greatly varies depending on the operation environment and conditions.

■ Servo amplifier

Part name	Standard replacement time (years)
Main circuit capacitor	73,000 hours (10 years)
Aluminum electrolytic capacitor	73,000 hours (10 years)
Cooling fan	30,000 hours (3 years)

■ Servomotor

Part name	Standard replacement time (years)
Bearing	20,000 to 30,000 hours (3 to 5 years)
Oil seal	5,000 hours
Encoder	30,000 hours (3 years)

Operating conditions

- Ambient temperature: Annual average 30°C/year
- Load ratio: 80% or less
- Operation rate: 20 hours or less/day

10

CHARACTERISTICS

10.1	Timing chart	10- 2
10.1.1	Power ON	10- 2
10.1.2	Response time of sequence input signal	10- 2
10.1.3	Switching to each control mode	10- 3
10.1.4	Alarm detection/alarm reset	10- 3
10.2	Overload characteristics	10- 4
10.2.1	GYS motor	10- 4
10.2.2	GYG motor	10- 5
10.3	Power supply capacity and generation loss	10- 6
10.4	Inrush current	10- 6

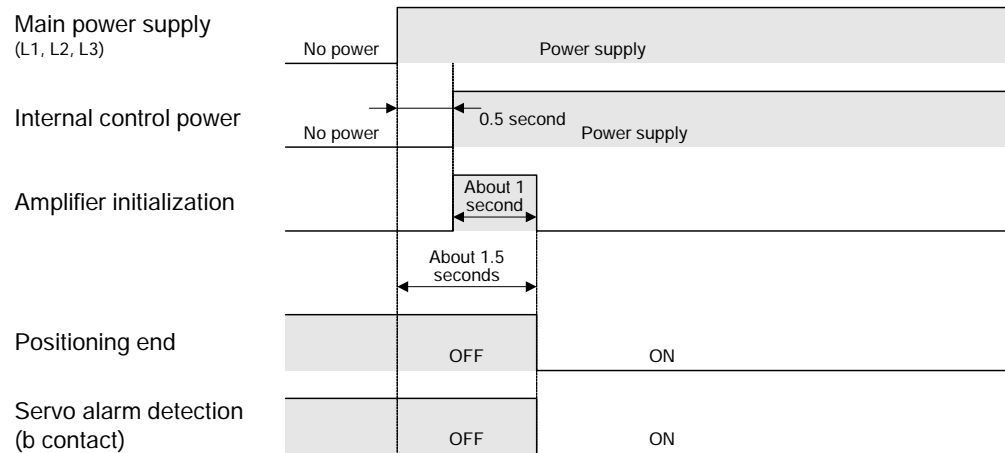
10 CHARACTERISTICS

10.1 Timing chart

10.1.1 Power ON

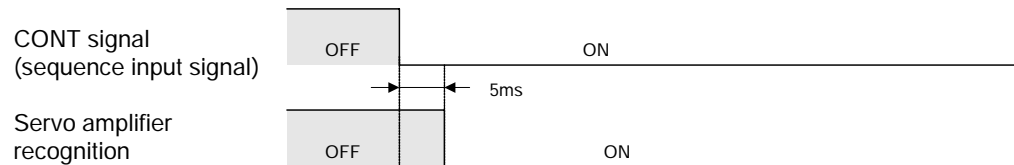
It takes “about 1.5 seconds” from power ON to effective status of various signals.

If a sequence signal is input during this time, it is not recognized by the servo amplifier.

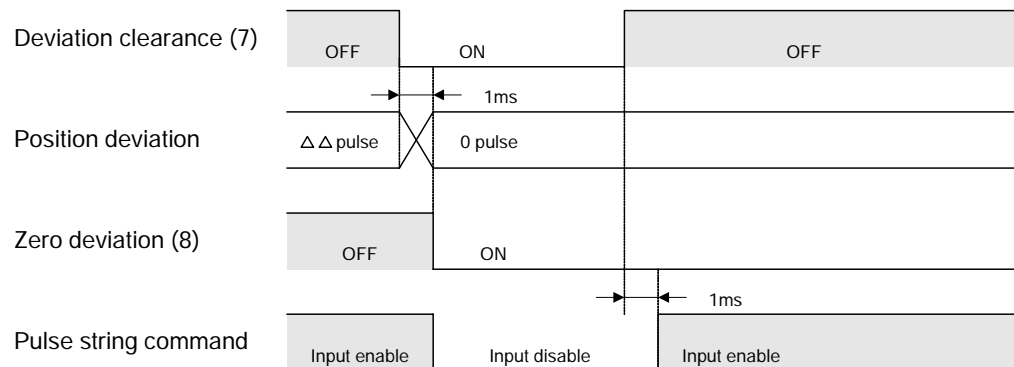


10.1.2 Response time of sequence input signal

The response time from input of sequence signal to recognition in the servo amplifier is “5 ms”*. Keep the ON width of the sequence input signal to 5 ms or more.



* Only the deviation clearance signal is recognized for 1 ms. For details, refer to the following. Keep the ON width of the deviation clearance signal to 1 ms or more.

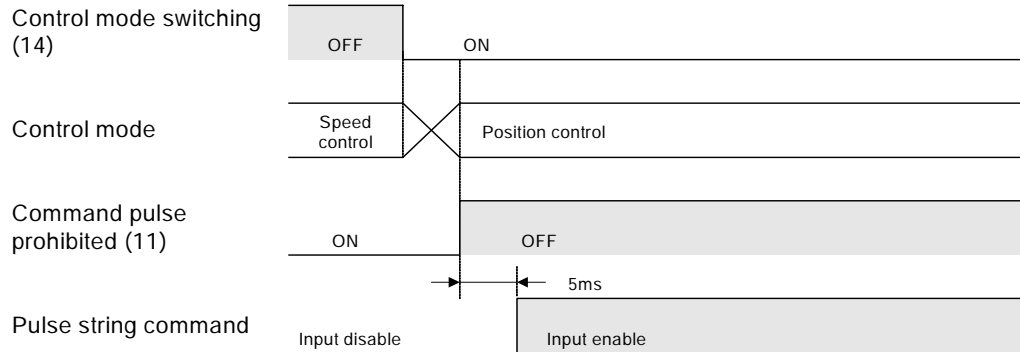


10.1.3 Switching to each control mode

The transition time to each control mode is 5 ms.

Input the following commands 5 ms or more after input the switching signal.

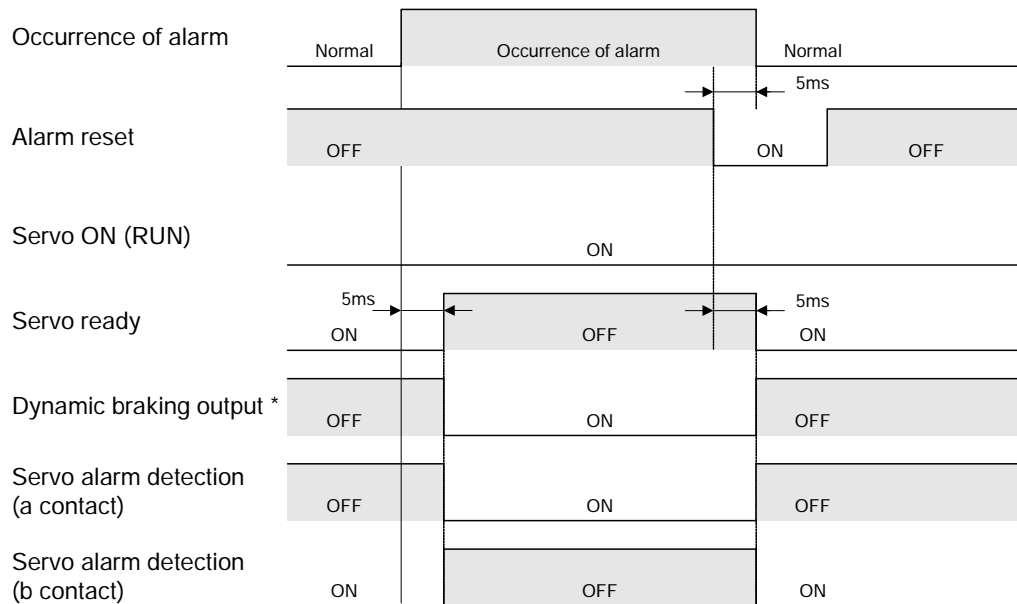
Example) Switching from speed control to position control



10.1.4 Alarm detection/alarm reset

It takes about 5 ms from occurrence of alarm to detection of alarm.

It takes about 5 ms from input of the alarm reset signal to actual reset of alarm.



*) For the alarm of the dynamic braking output, refer to "Dynamic braking output" in chapter 5.

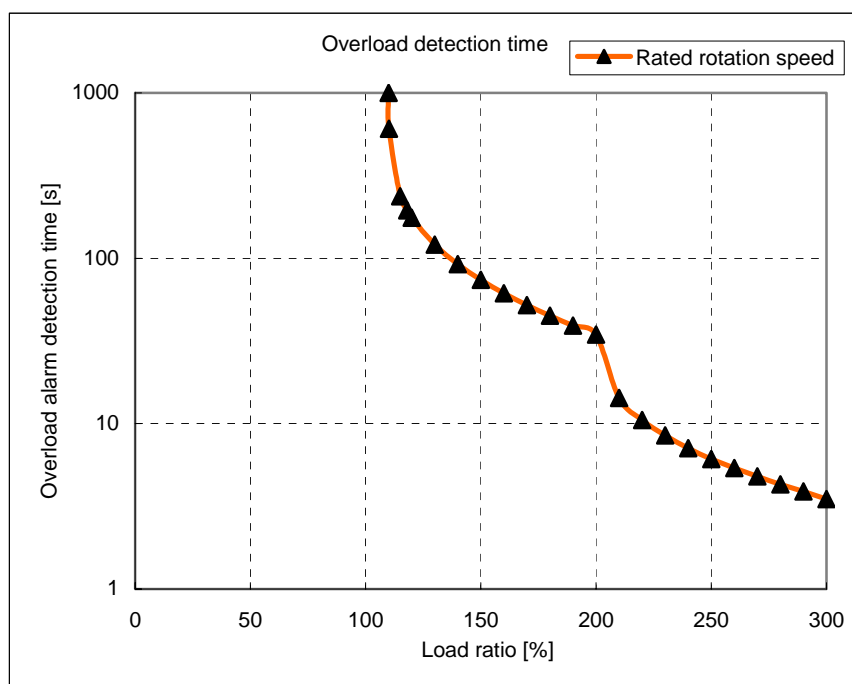
10 CHARACTERISTICS

10.2 Overload characteristics

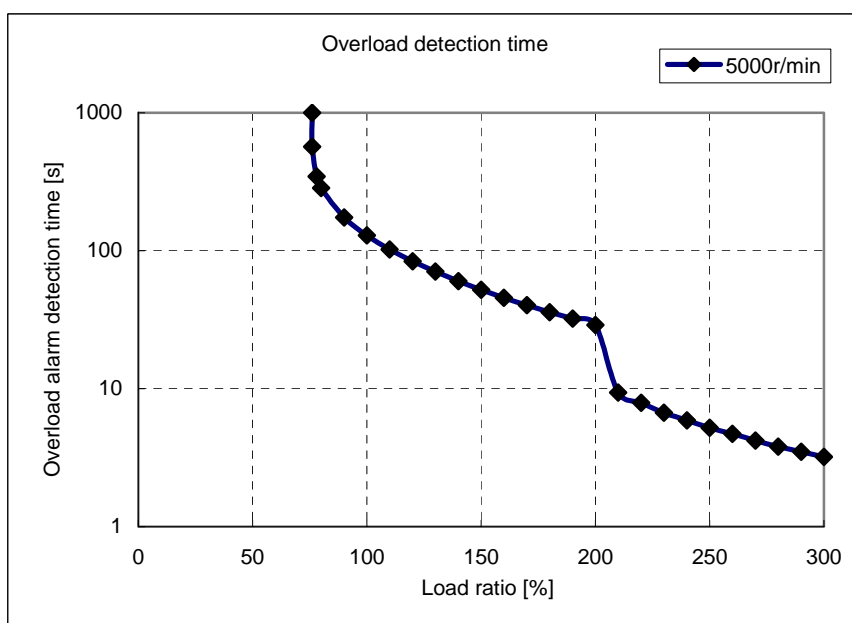
Characteristics of detection time and load ratio until the overload alarm occurs are shown for each rotation speed.

10.2.1 GYS motor

(1) Operation at rated rotation speed (3000 r/min)

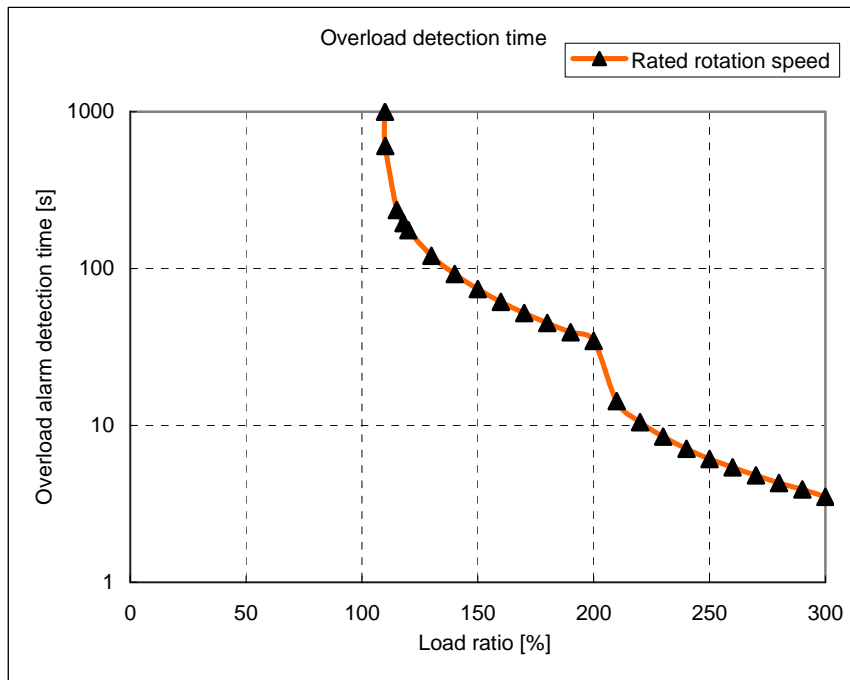


(2) Operation at maximum rotation speed (5000 r/min)

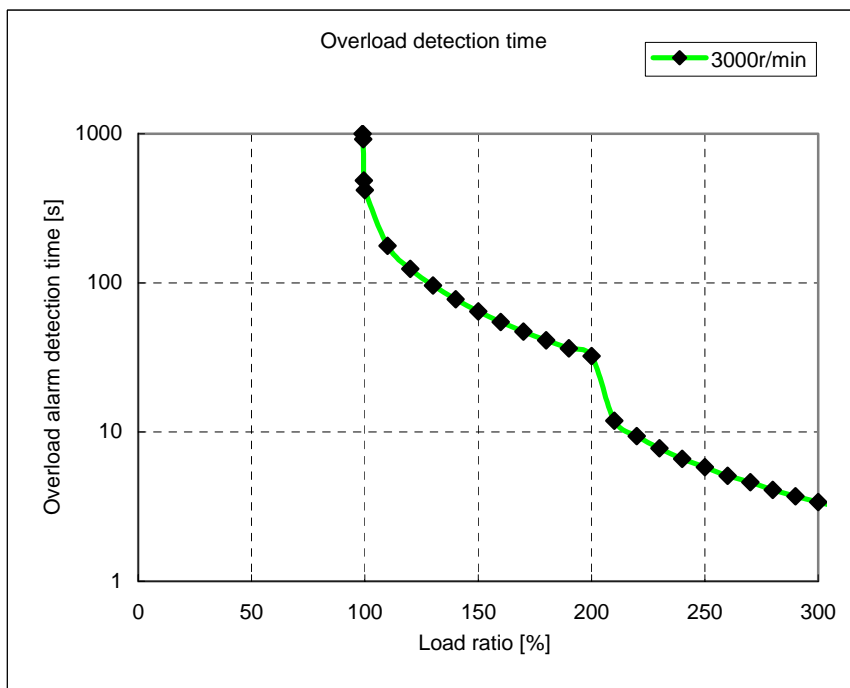


10.2.2 GYG motor

(1) Operation at rated rotation speed (2000 r/min & 1500 r/min)

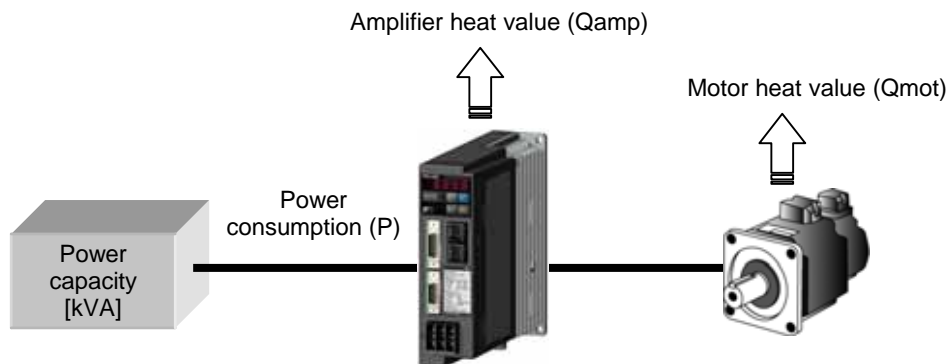


(2) Operation at maximum rotation speed (3000 r/min)



10 CHARACTERISTICS

10.3 Power supply capacity and generation loss



Rated rotation speed	Servo amplifier type	Servomotor type	Capacity [kW]	Power supply capacity [kVA]	Power consumption (P) [kW]	Amplifier heat value (Qamp) [kW]	Motor heat value (Qmot) [kW]
3000 [r/min]	RYC500T3-VVT2	GYS500DC2-T2A	0.05	0.1	0.074	0.018	0.006
	RYC101T3-VVT2	GYS101DC2-T2A	0.1	0.2	0.13	0.021	0.011
	RYC201T3-VVT2	GYS201DC2-T2A	0.2	0.4	0.25	0.027	0.022
	RYC401T3-VVT2	GYS401DC2-T2A	0.4	0.8	0.48	0.038	0.044
2000 [r/min]	RYC751T3-VVT2	GYS751DC2-T2A	0.75	1.5	0.89	0.059	0.083
	RYC501C3-VVT2	GYG501CC1-T2B	0.5	1.0	0.60	0.044	0.056
	RYC751C3-VVT2	GYG751CC1-T2B	0.75	1.5	0.89	0.059	0.083
	RYC102C3-VVT2	GYG102CC1-T2B	1.0	2.0	1.2	0.073	0.11
	RYC152C3-VVT2	GYG152CC1-T2B	1.5	2.9	1.8	0.103	0.17
1500 [r/min]	RYC202C3-VVT2	GYG202BC1-T2B	2.0	3.9	2.4	0.13	0.22
	RYC501B3-VVT2	GYG501BC1-T2B	0.5	1.0	0.60	0.044	0.056
	RYC851B3-VVT2	GYG851BC1-T2B	0.85	1.7	1.0	0.065	0.94
	RYC132B3-VVT2	GYG132BC1-T2B	1.3	2.6	1.5	0.091	0.14

10.4 Inrush current

Inrush current value to the servo amplifier is shown.

Rated rotation speed	Servo amplifier type	Servomotor type	Capacity [kW]	Inrush current [A]
3000 [r/min]	RYC500D3-VVT2	GYS500DC2-T2A	0.05	9.1
	RYC101D3-VVT2	GYS101DC2-T2A	0.1	9.1
	RYC201D3-VVT2	GYS201DC2-T2A	0.2	9.1
	RYC401D3-VVT2	GYS401DC2-T2A	0.4	9.1
	RYC751D3-VVT2	GYS751DC2-T2A	0.75	35.7
2000 [r/min]	RYC501C3-VVT2	GYG501CC1-T2B	0.5	35.7
	RYC751C3-VVT2	GYG751CC1-T2B	0.75	35.7
	RYC102C3-VVT2	GYG102CC1-T2B	1.0	35.7
	RYC152C3-VVT2	GYG152CC1-T2B	1.5	43.5
	RYC202C3-VVT2	GYG202CC1-T2B	2.0	43.5
1500 [r/min]	RYC501B3-VVT2	GYG501BC1-T2B	0.5	35.7
	RYC851B3-VVT2	GYG851BC1-T2B	0.85	35.7
	RYC132B3-VVT2	GYG132BC1-T2B	1.3	43.5

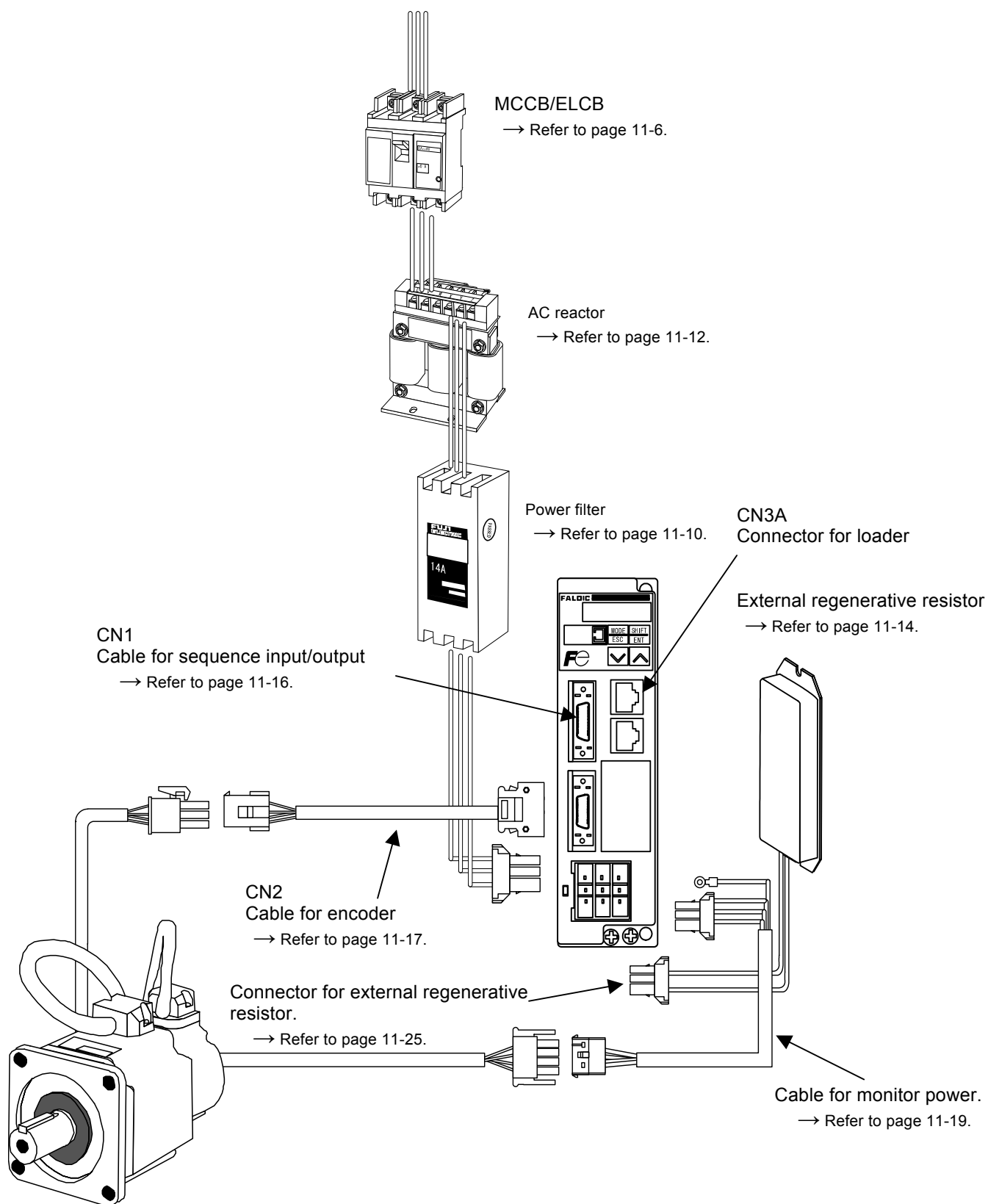
11

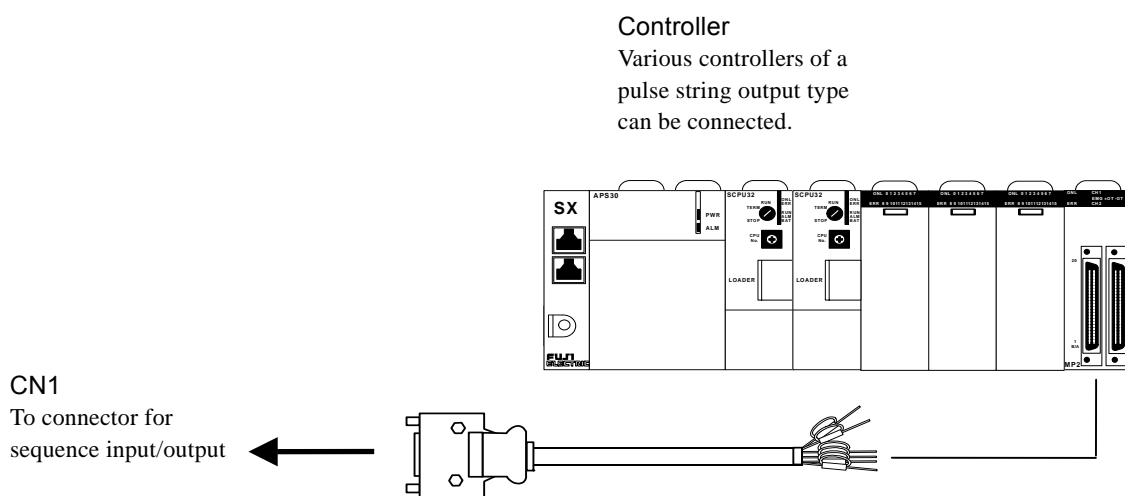
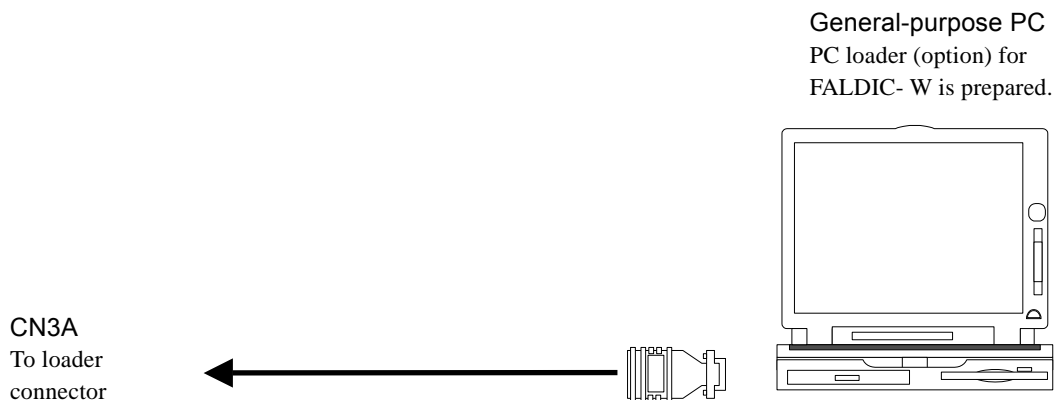
PERIPHERAL DEVICE

11.1	Cable size	11- 4
11.1.1	Main circuit terminal	11- 5
11.1.2	Control input/output	11- 5
11.1.3	Encoder cable.....	11- 5
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11.2	MCCB/ELCB	11- 6
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11 PERIPHERAL DEVICE

■ Configuration of system with peripheral devices





Optional cable

Cable for connection between devices (cable for sequence input/output)
Connector kit is also available.

* This is a schematic diagram for connections. The relative size of each device (external dimensions) is not correct.

No wiring connector comes with the servo amplifier or servomotor. Order optional cables
and connector kits separately.

11 PERIPHERAL DEVICE

11.1 Cable size

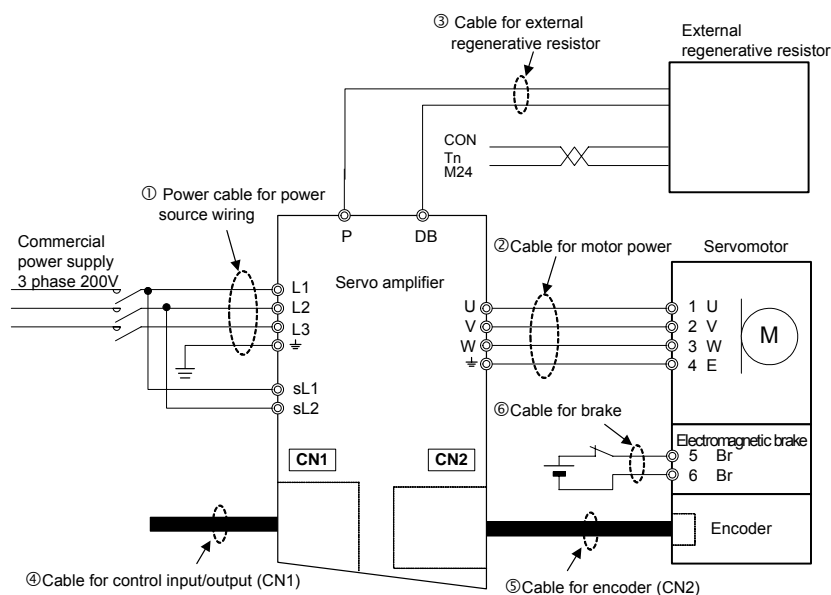
The electric circuits inside the control panel can be divided into the main circuit and control circuit. Cables used for general circuits except for those of encoder wiring of the servomotor are as follows.

- 600V class, poly-vinyl insulated cable (JIS C 3307: IV)
Used for main circuit. The cable cannot be twisted.
- Poly-vinyl insulated cable for electric appliances (JIS C 3316: KIV)
Can be used for all circuits; superior in flexibility.
- 600V class, cross-link polyethylene insulated cable (JCS 360 (standard of the Japanese Electric Wire & Cable Maker's Association): FSCL)
Used for main circuit. The cable size is smaller than the 600V-class poly-vinyl cable and superior in flexibility.
Example: Furukawa Electric's Baudrex
- Twisted shielded cable for electronic devices and electric appliances
Used for control circuit. Cables are prone to radio noise and inductive noise even in the panel and therefore shielded cables should be used.
Example: Furukawa Electric's Beemex S Shielded Cable XEBV or XEWV

The encoder cable for the servomotor is a composite 2C (cable) 2P (pair) shielded cable housing cables of different sizes.

- Cross-link polyethylene poly-vinyl insulated cable for robot travel (twisted pair type) (DAIDEN Co., Ltd.)
RMCV-SB-A (UL2464) AWG#24/3P (twisted pair type)
(Wire length: 20 m or less)
RMCV-SB-A (UL2464) AWG#16/2P (twisted pair type)
(Wire length: 50 m or less)

■ Recommended wire size



11.1.1 Main circuit terminal (Page 11-4: ①, ②, ③)

Motor	Input voltage	Rotation speed [r/min]	Capacity [kW]	Type	Recommended wire size [mm ²]							
					①Main circuit (L1, L2, L3) ②Motor power (U, V, W)			③External regenerative resistor (P, DB)			Control power supply (sL1, sL2)	
					60°C(IV)	75°C(HIV)	90°C(FSCL)	60°C(IV)	75°C(HIV)	90°C(FSCL)		
GYS	Single-phase 200V	3000	0.05	RYC500D3-WT2	0.75	0.75	0.75	0.75	0.75	0.75		
			0.1	RYC101D3-WT2								
			0.2	RYC201D3-WT2								
			0.4	RYC401D3-WT2								
GYG		2000	0.75	RYC751D3-WT2	1.25	0.75	1.25	0.75	0.75			
			0.5	RYC501C3-WT2								
			0.75	RYC751C3-WT2								
			0.5	RYC501B3-WT2								
GYS	3-phase 200V	3000	0.75	RYC751D3-WT2	1.25	0.75	0.75	0.75	0.75			
GYG		2000	0.5	RYC501C3-WT2								
			0.75	RYC751C3-WT2								
			1.0	RYC102C3-WT2								
			1.5	RYC152C3-WT2								
			2.0	RYC202C3-WT2								
			0.5	RYC501B3-WT2								
3000		0.85	RYC851B3-WT2	1.25						0.75	1.25	0.75
		1.3	RYC132B3-WT2	2.0						1.25	2.0	1.25

11.1.2 Control input/output (CN1) (Page 11-4: ④)

Digital input/output signals of max. 24VDC, 50mA current flow in the cables.

* Optional cable and connector kit are prepared (refer to section 11.8 "Option").

Servo amplifier type	Capacity [kW]	Cable size (CN1)
CN1 of VWT2 (end of type code)	-	AWG26 26-core shielded cable

11.1.3 Encoder cable (CN2) (Page 11-4: ⑤)

4-M bps serial communication is made through the cable. Use the following designated cable or optional cable (refer to section 11.8 "Option").

Servo amplifier type	Capacity [kW]	Cable size (CN2)
All models in RYC type	-	Cross-link polyethylene insulated, poly-vinyl sheath cable for robot travel RMCV-SB-A (UL2464) AWG#24/3P (twisted pair type) (Wire length: 20 m or less) RMCV-SB-A (UL2464) AWG#16/2P (twisted pair type) (Wire length: 50 m or less)

* Optional cable and connector kit are prepared (refer to section 11.8 "Option").

11.1.4 Motor brake (Page 11-4: ⑥)

Servo amplifier type	Capacity [kW]	Recommended wire size [mm ²]
All models in RYC type	-	0.75

11 PERIPHERAL DEVICE

11.2 MCCB/ELCB (molded case circuit breaker and earth leakage breaker)

MCCB (molded case circuit breaker) or ELCB (earth leakage breaker) is installed in the primary circuit of the power supply of the servo amplifier for turning power supply on/off and promptly cutting off a fault current such as short-circuit current.

The type for a single servo amplifier is described here.

The protective functions against overcurrent in the output circuit are built in the servo amplifier.

Types of molded case circuit breaker and earth leakage breaker.

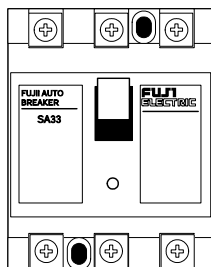
■ Single-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	MCCB	ELCB
3000[r/min]	RYC500D3-VVT2	0.05	EA33AC/3	EG33C/5
	RYC101D3-VVT2	0.1	EA33AC/5	
	RYC201D3-VVT2	0.2	EA33AC/10	EG33C/10
	RYC401D3-VVT2	0.4	EA53C/15	EG53C/15
	RYC751D3-VVT2	0.75		
2000[r/min]	RYC501C3-VVT2	0.5		
	RYC751C3-VVT2	0.75		
1500[r/min]	RYC501B3-VVT2	0.5		

■ 3-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	MCCB	ELCB
3000[r/min]	RYC751D3-VVT2	0.75	EA53C/15	EG53C/15
2000[r/min]	RYC501C3-VVT2	0.5	EA33AC/10	EG33C/10
	RYC751C3-VVT2	0.75	EA53C/15	EG53C/15
	RYC102C3-VVT2	1.0		
	RYC152C3-VVT2	1.5		
	RYC202C3-VVT2	2.0	EA53C/30	EG53C/30
1500[r/min]	RYC501B3-VVT2	0.5	EA33AC/10	EG33C/10
	RYC851B3-VVT2	0.85	EA53C/15	EG53C/15
	RYC132B3-VVT2	1.3		

<Appearance>



11.3 Magnetic contactor

Connect the electromagnetic contactor to isolate the servo amplifier by means of an external signal or to turn it on or off from a remote operation panel.

The types specified below turn on or off the primary circuit of a single servo amplifier of 500kVA or smaller power supply capacity and 20m or more wiring lengths with the designated cable size.

For power supply capacities exceeding 500kVA, connect an AC reactor.

Type of magnetic contactor

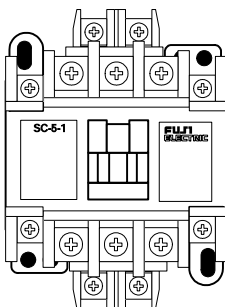
■Single-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	MC
3000[r/min]	RYC500D3-VVT2	0.05	SC-5-1 (19A)
	RYC101D3-VVT2	0.1	
	RYC201D3-VVT2	0.2	
	RYC401D3-VVT2	0.4	
	RYC751D3-VVT2	0.75	
2000[r/min]	RYC501C3-VVT2	0.5	
	RYC751C3-VVT2	0.75	
1500[r/min]	RYC501B3-VVT2	0.5	

■3-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	MC
3000[r/min]	RYC751D3-VVT2	0.75	SC-5-1 (19A)
2000[r/min]	RYC501C3-VVT2	0.5	
	RYC751C3-VVT2	0.75	
	RYC102C3-VVT2	1.0	
	RYC152C3-VVT2	1.5	
	RYC202C3-VVT2	2.0	
1500[r/min]	RYC501B3-VVT2	0.5	
	RYC851B3-VVT2	0.85	
	RYC132B3-VVT2	1.3	

<Appearance>



11 PERIPHERAL DEVICE

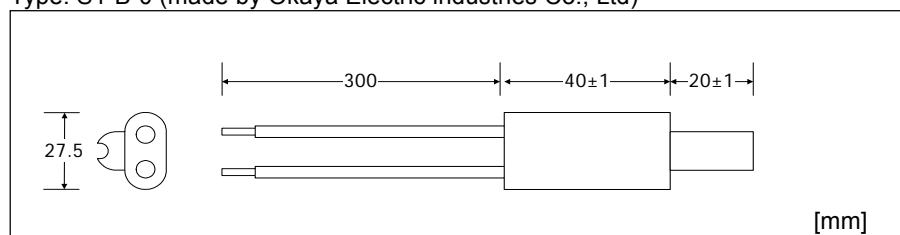
11.4 Surge absorber (surge suppressor, surge killer)

Shown below are recommended surge suppressors (for 250 [V] or less) to be installed on peripheral devices (magnetic contactor, solenoid valve, electromagnetic brake, etc.) of the servo amplifier.

DC equipment should be equipped with a diode for surge voltage suppression.

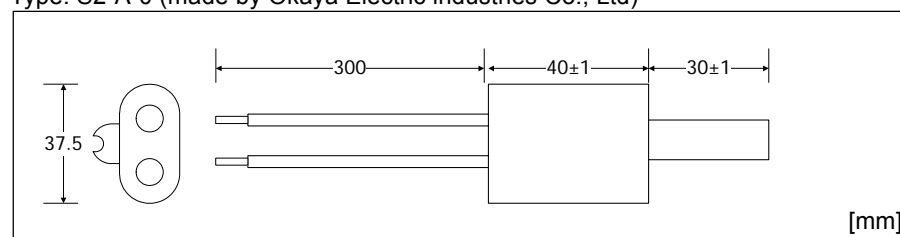
For control relay, etc.

Type: S1-B-0 (made by Okaya Electric industries Co., Ltd)



For electromagnetic contactor

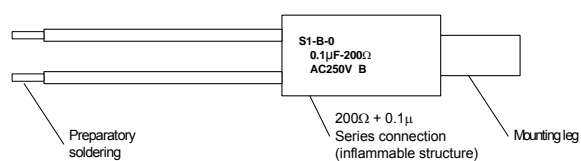
Type: S2-A-0 (made by Okaya Electric industries Co., Ltd)



* A non-inductive capacitor and non-inductive resistance are connected in series and sealed in epoxy resin.

S1-B-0: 200 Ω (1/2 W) + 0.1 μ F

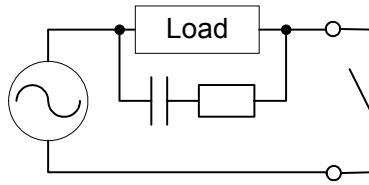
S2-A-0: 500 Ω (1/2 W) + 0.2 μ F



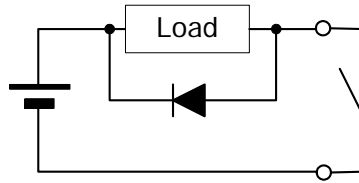
The purpose of the surge killer is suppression of surge voltage.

When an inductive load such as clutch and solenoid valve is turned off, several hundreds or thousands of volts of counter-electromotive force generates. The surge suppressor suppresses these surge voltages.

- Protection in AC circuit
C-R circuit
(Can be used for DC circuit.)



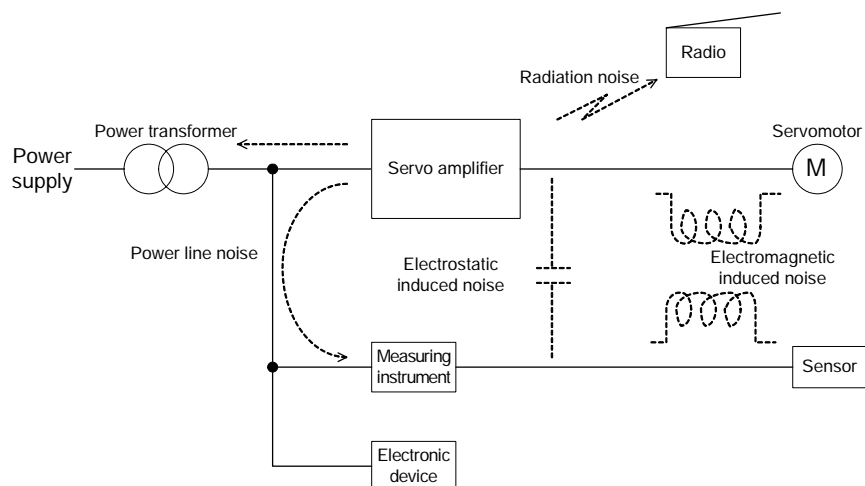
- Protection in DC circuit
Diode
(Be careful of orientation of the diode.)



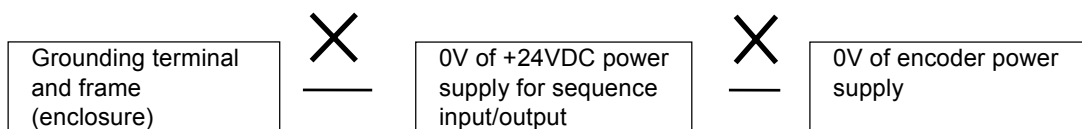
11 PERIPHERAL DEVICE

11.5 Power filter

In the servo amplifier, the pulse width modulation circuit performs high frequency switching similarly to general-purpose inverters. This causes power line noise, radiation noise from the amplifier and noise from the motor power cable, and these noises may have an adverse influence over external equipment. To prevent such an influence, the following methods are available.



- ① House the servo amplifier in a steel container (control cabinet) and ground the container. Avoid installation in a place close to the PC or measuring instruments.
- ② If the amplifier affects the equipment of which power is shared with the amplifier, incorporate the power filter in the primary circuit of the servo amplifier.
If the amplifier affects the equipment which gets its drive from different power source, install the transformer for radio noise prevention (TRAFY).
- ③ Use a metal conduit to house the cable extended from the servo amplifier to the servomotor, and ground the conduit (grounding at several points is possible).
- ④ Use a thick cable for grounding and make the cable as short as possible. Connect the grounding cable from the individual equipment directly to a copper bar (do not ground via any equipment).
- ⑤ Avoid mutual connection of the following signals.

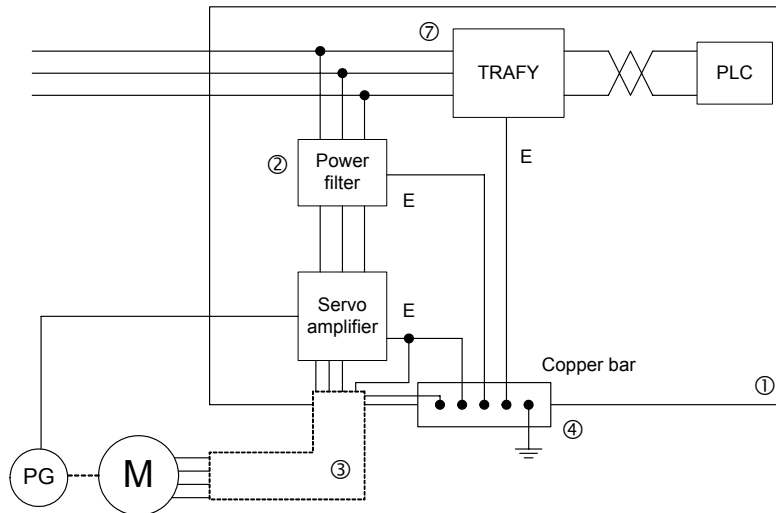


- ⑥ Avoid binding together the main circuit and control circuit or laying them in parallel.

Main circuit : Commercial power supply, motor power cable between servo amplifier and servomotor

Control circuit: +24VDC or +15VDC level signal cables, encoder cables of servomotor

- ⑦ Connect a transformer for radio noise prevention (TRAFY) to separate 100V power system devices (PLC, general-purpose PC, etc.) from the 200V power system.



Power filter type

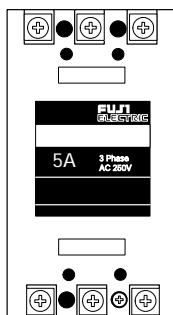
■Single-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	FHF
3000[r/min]	RYC500D3-VVT2	0.05	FHF-TA/5/250
	RYC101D3-VVT2	0.1	
	RYC201D3-VVT2	0.2	FHF-TA/10/250
	RYC401D3-VVT2	0.4	FHF-TA/20/250
	RYC751D3-VVT2	0.75	
2000[r/min]	RYC501C3-VVT2	0.5	
	RYC751C3-VVT2	0.75	
1500[r/min]	RYC501B3-VVT2	0.5	

■3-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	FHF
3000[r/min]	RYC751D3-VVT2	0.75	FHF-TA/20/250
2000[r/min]	RYC501C3-VVT2	0.5	FHF-TA/10/250
	RYC751C3-VVT2	0.75	FHF-TA/20/250
	RYC102C3-VVT2	1.0	
	RYC152C3-VVT2	1.5	
	RYC202C3-VVT2	2.0	
1500[r/min]	RYC501B3-VVT2	0.5	FHF-TA/10/250
	RYC851B3-VVT2	0.85	FHF-TA/20/250
	RYC132B3-VVT2	1.3	

<Appearance>



The power filter suppresses high-frequency voltage fluctuation caused by the servo amplifier on the commercial power supply. The filter functions both in the primary and secondary circuits, so that it protects the servo amplifier against high-frequency voltage fluctuation in the primary power supply.

11.6 AC reactor

Connect the AC reactor in the primary circuit of the servo amplifier in the following cases.

(1) Large power supply capacity

When the power supply capacity exceeds 500kVA, the input current of the servo amplifier becomes large at the time of power on, and there is a possibility where the rectifying diodes of the amplifier are damaged.
(Cable length of 20m with specified cable diameter size)

(2) Imbalance in power supply voltage

The current gathers in the phase of a higher voltage if there is imbalance among source voltage phases.
Connect an AC reactor if the power supply voltage imbalance rate is 3% or higher.

$$(\text{Imbalance rate of power supply voltage } [\%]) = \frac{((\text{Max. voltage } [V]) - (\text{Min. voltage } [V]))}{(\text{3-phase average voltage } [V])} \times 100$$

Connect the AC reactor to average the input current among phases. It also functions as a guard against power failure in the source voltage line.

(3) Suppression of harmonics

Higher harmonics current is generated because the servo amplifier is of a capacitor input type. The AC reactor suppresses voltage distortion in the power supply system to prevent troubles from occurring in the devices connected to the same power supply system. An imbalance in the source voltage increases harmonics.
Connect the AC reactor in the primary circuit of the servo amplifier. A smaller rated current capacity type generates heat, while the effect is small with a larger rated current capacity type.

AC reactor type

■ Single-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	AC reactor	Reactance [mH]
3000[r/min]	RYC500D3-VVT2	0.05	ACR2-0.4A	2.92
	RYC101D3-VVT2	0.1		
	RYC201D3-VVT2	0.2	ACR2-0.75A	1.57
	RYC401D3-VVT2	0.4	ACR2-1.5A	0.939
	RYC751D3-VVT2	0.75	ACR2-2.2A	0.679
2000[r/min]	RYC501C3-VVT2	0.5	ACR2-1.5A	0.939
	RYC751C3-VVT2	0.75	ACR2-2.2A	0.679
1500[r/min]	RYC501B3-VVT2	0.5	ACR2-1.5A	0.939

■ 3-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	AC reactor	Reactance [mH]
3000[r/min]	RYC751D3-VVT2	0.75	ACR2-1.5A	0.939
2000[r/min]	RYC501C3-VVT2	0.5	ACR2-0.75A	1.57
	RYC751C3-VVT2	0.75	ACR2-1.5A	0.939
	RYC102C3-VVT2	1.0	ACR2-2.2A	0.679
	RYC152C3-VVT2	1.5		
	RYC202C3-VVT2	2.0	ACR2-3.7A	0.406
1500[r/min]	RYC501B3-VVT2	0.5	ACR2-0.75A	1.57
	RYC851B3-VVT2	0.85	ACR2-1.5A	0.939
	RYC132B3-VVT2	1.3	ACR2-2.2A	0.679

■Action for reduction of harmonic waves

1. All types of servo amplifiers used by a specific user apply to the "Guideline for prevention of harmonic waves by users who receive power at high voltages or especially high voltages". Users who are requested for application of the guideline should calculate the equivalent capacity or the harmonic wave runoff current according to the guideline. If the harmonic wave current exceeds the limit specified on the contract demand, appropriate action is required.

(For details refer to JEM-TR 225.)

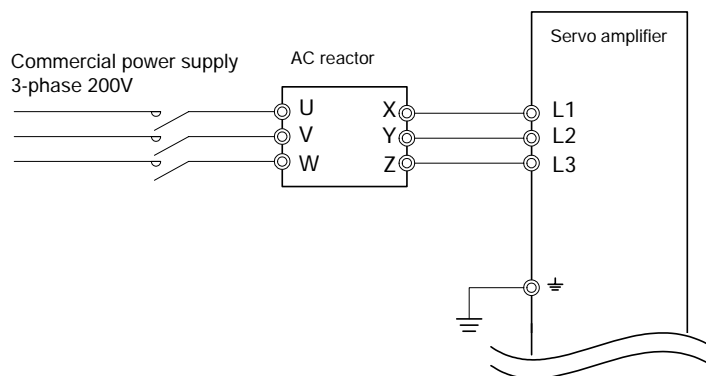
2. The servo amplifier has been excluded from the "Guideline for prevention of harmonic waves on electric appliances and multipurpose products" from January 2004.

JEMA has newly prepared the JEMA engineering documents to promote comprehensive action to reduce harmonic waves. It is recommended that users take actions to reduce harmonic waves in individual units as much as possible. (For details refer to JEM-TR 227.)

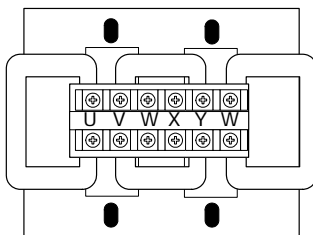
Source: Japan Electrical Manufacturers' Association

Connect to the servo amplifier an AC reactor or DC reactor specified in this manual.

If the applicable reactor is connected, the regulation values set forth in the guideline for harmonics suppression can be satisfied.



<Appearance>



The AC reactor aims at suppression of harmonics and protection of servo amplifier against imbalance in the voltage and power failure in the power supply line.

11 PERIPHERAL DEVICE

11.7 External regenerative resistor

The external regenerative resistor consumes the regenerative power from the servomotor.
When the lifting load and the operation frequency are high, an external regenerative resistor is used.

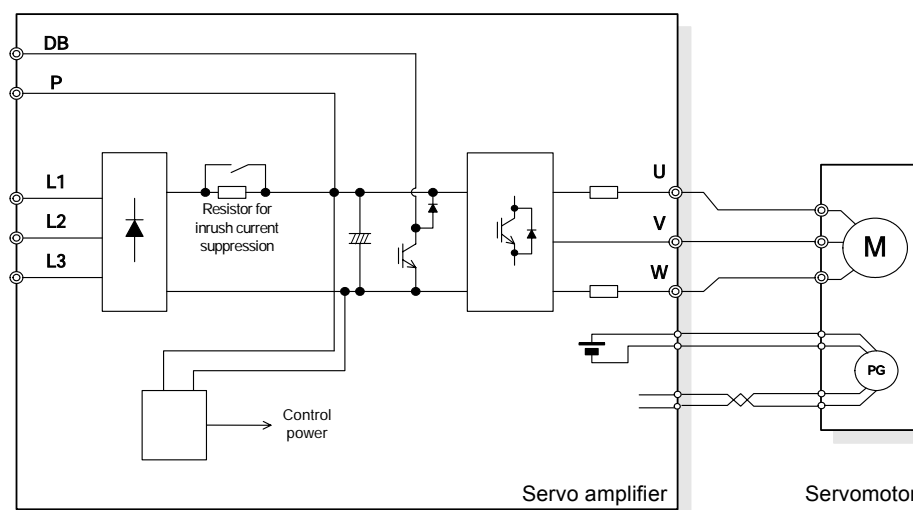
■Single-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	External regenerative resistor
3000[r/min]	RYC500D3-VVT2	0.05	WSR-401
	RYC101D3-VVT2	0.1	
	RYC201D3-VVT2	0.2	
	RYC401D3-VVT2	0.4	
	RYC751D3-VVT2	0.75	
2000[r/min]	RYC501C3-VVT2	0.5	WSR-152
	RYC751C3-VVT2	0.75	
1500[r/min]	RYC501B3-VVT2	0.5	

■3-phase 200V

Rated rotation speed	Servo amplifier type	Capacity [kW]	External regenerative resistor
3000[r/min]	RYC751D3-VVT2	0.75	WSR-152
2000[r/min]	RYC501C3-VVT2	0.5	
	RYC751C3-VVT2	0.75	
	RYC102C3-VVT2	1.0	
	RYC152C3-VVT2	1.5	
1500[r/min]	RYC202C3-VVT2	2.0	DB11-2
	RYC501B3-VVT2	0.5	WSR-152
	RYC851B3-VVT2	0.85	
	RYC132B3-VVT2	1.3	DB11-2

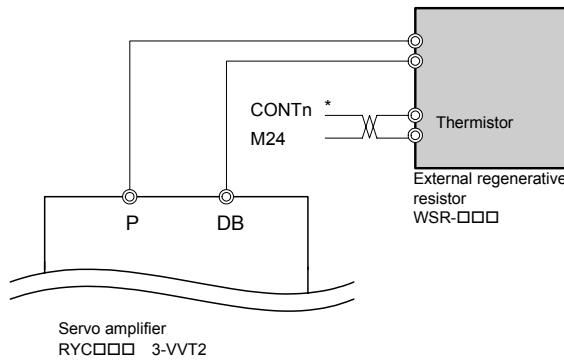
<Block diagram of main circuit>



When an external regenerative resistor is used, connection and parameter settings are required.

■ Connection of optional external regenerative resistor (WSR-401, WSR-152)

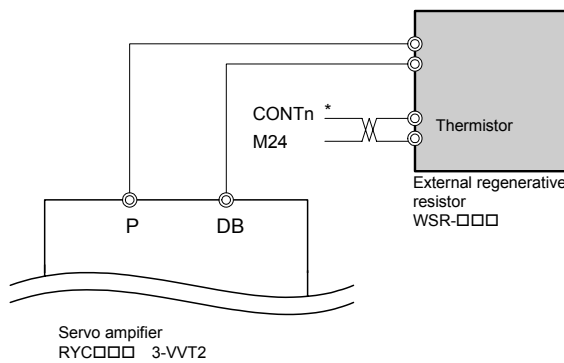
Connect the external regenerative resistor to the connector of the servo amplifier.
Use the connector for external regenerative resistor [type: WSK-R03P-B].



* Assign external regenerative resistor overheat ("8") to the CONT input terminal.

■ Connection of optional external regenerative resistor (DB11-2)

Connect the external regenerative resistor to the terminal block of the servo amplifier.



* Assign external regenerative resistor overheat ("8") to the CONT input terminal.

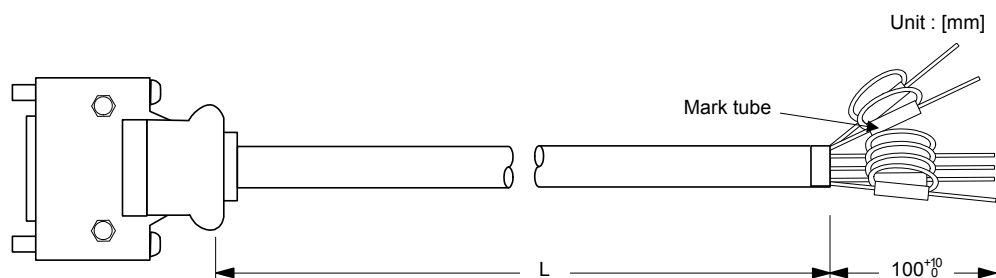
11 PERIPHERAL DEVICE

11.8 Option

Series : Optional cable for sequence input/output

Type : WSC-D26P03

Applicable to : All models (for CN1)



■ Connector

Connector 1

Plug	10126-3000V
Shell	10326-52A0-008

Made by Sumitomo 3M

■ Wire color

The colors of pins 14 and 15 change each other.
Be careful.

Connector 1	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
Mark tube	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
Wire color	Color		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
	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
Mark	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3

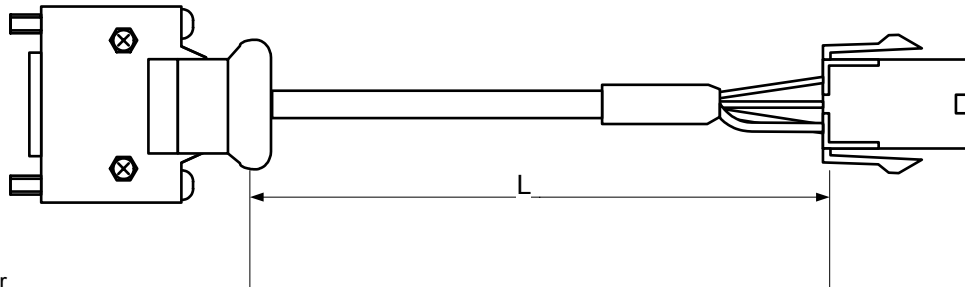
■ Length

Type	L [m]
WSC-D26P03	3.0 ^{+0.3} ₀

* For cables longer than 3m, contact us.

* The manufacturer of the connector is subject to change without notice.

Series : Optional cable for encoder wiring
 Type : WSC-P06P05-D to WSC-P06P20-D
 Applicable to : GYS type Full capacity (for CN2)



■Connector

Connector 1

Plug	10120-3000VE
Shell	10320-52A0-008

Made by Sumitomo 3M

Connector 2

Housing	172161-1
Cap	316455-1
Terminal ① signal side	170361-1
Terminal ② power supply side	170362-1

By Tyco Electronics AMP K.K.

■Wire color

Connector 1		N.C.	N.C.	20	17	18	N.C.	3	4	1	2	N.C.
Connector 2		1	2	3	4	5	6	7	8	9		
Wire color	①	-	-	Shielded	Red	Blue	-	White	Black	-		
	②	-	-		Sky blue	Sky blue /White	-	Red	Black	-		

The wire color is either
 ① or ②.
 Other terminals of
 connector 1 are
 vacant.

■Length

Type	L[m]
WSC-P06P05-D	5.0 ^{+0.5} ₀
WSC-P06P10-D	10.0 ^{+1.0} ₀
WSC-P06P20-D	20.0 ^{+2.0} ₀

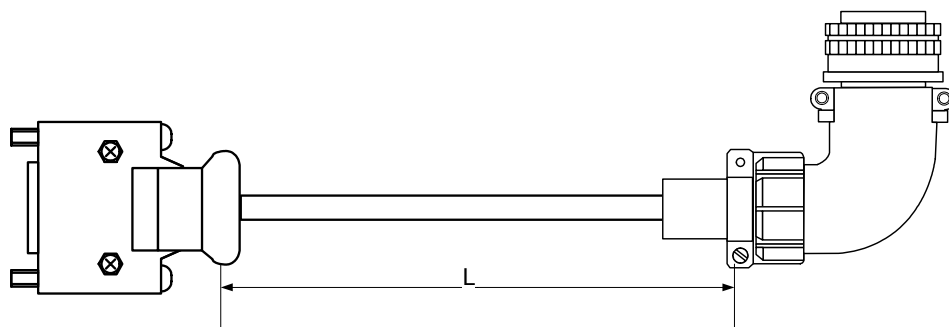
* The connector 1 and connector 2 types are different from those of the connector kit.

* The manufacturer of the connector is subject to change without notice.

* For cable lengths other than 5, 10 or 20m, contact us.

11 PERIPHERAL DEVICE

Series : Optional cable for encoder wiring
 Type : WSC-P06P05-CD to WSC-P06P20-CD
 Applicable to : GYG type Full capacity (for CN2)



■Connector

Connector 1

Plug	10120-3000VE
Shell	10320-52A0-008

Made by Sumitomo 3M

Connector 2

Connector	MS3108B20-29S
Cable clamp	MS3057-12A

By DDK Ltd.

■Wire color

Connector 1	N.C.	N.C.	20	17	18	N.C.	3	4	1	2	N.C.
Connector 2	N.C.	N.C.	J	C	D	N.C.	H		G		N.C.
Wire color	①	-	-	Red	Blue	-	White		Black	-	
	②	-	-	Sky blue / White	-	-	Red		Black	-	

The wire color is either ① or ②.
 Other terminals of connectors 1 and 2 are vacant.

■Length

Type	L [m]
WSC-P06P05-CD	5.0 ^{+0.5} ₀
WSC-P06P10-CD	10.0 ^{+1.0} ₀
WSC-P06P20-CD	20.0 ^{+2.0} ₀

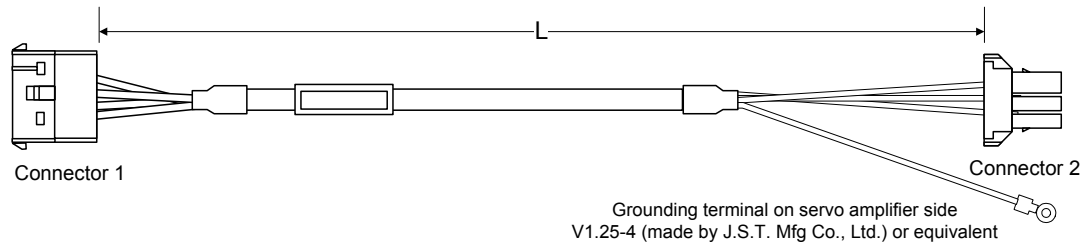
* The manufacturer of the connector is subject to change without notice.

* For cable lengths other than 5, 10 or 20m, contact us.

Series : Optional servomotor power cable for servomotors without brake

Type : WSC-M04P05-B to WSC-M04P20-B

Applicable to : GYS type Full capacity



■Connector

Connector 1

Cap housing	350780-1
Contact	350570-1

By Tyco Electronics AMP K.K.

Connector 2

Cap housing	2-178128-3
Contact	1-175218-5

By Tyco Electronics AMP K.K.

■Wire color

Connector 1	1	2	3	4
Mark	U	V	W	E
Wire color	Red	White	Black	Green / Yellow

Connector 2	1	2	3	Round terminal
Mark	U	V	W	E
Wire color	Red	White	Black	Green / Yellow

■Length

Type	L [m]
WSC-M04P05-B	5.0 $^{+0.5}_0$
WSC-M04P10-B	10.0 $^{+1.0}_0$
WSC-M04P20-B	20.0 $^{+2.0}_0$

* The manufacturer of the connector is subject to change without notice.

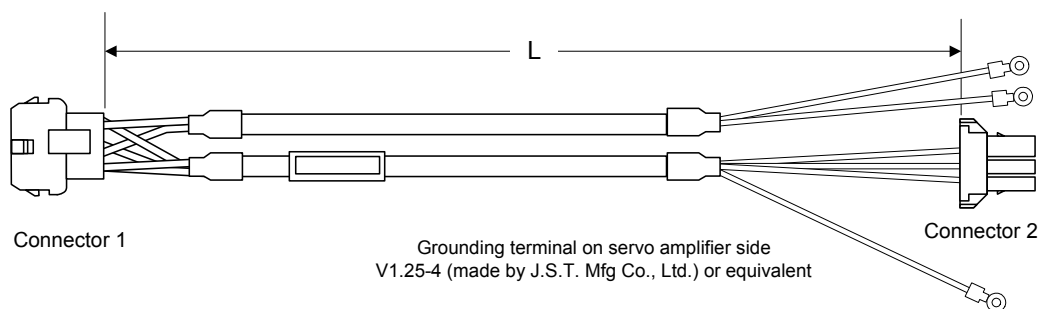
* For cable lengths other than 5, 10 or 20m, contact us.

11 PERIPHERAL DEVICE

Series : Optional servomotor power cable for servomotors with brake

Type : WSC-M06P05-B to WSC-M06P20-B

Applicable to : GYS type Full capacity (with brake)



■Connector

Connector 1

Cap housing	350781-1
Contact	350570-1

By Tyco Electronics AMP K.K.

Connector 2

Cap housing	2-178128-3
Contact	1-175218-5

By Tyco Electronics AMP K.K.

■Wire color

Connector 1	1	2	3	4	5	6
Mark	U	V	W	E		
Wire color	Red	White	Black	Green / Yellow	Red	Black

Connector 2	1	2	3	Round terminal
Mark	U	V	W	E
Wire color	Red	White	Black	Green / Yellow
				Red
				Black

■Length

Type	L [m]
WSC-M06P05-B	5.0 ^{+0.5} ₀
WSC-M06P10-B	10.0 ^{+1.0} ₀
WSC-M06P20-B	20.0 ^{+2.0} ₀

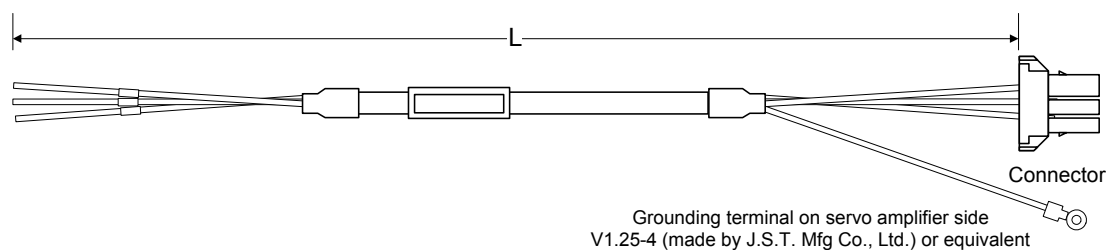
* For cable lengths other than 5, 10 or 20m, contact us.

* The manufacturer of the connector is subject to change without notice.

Series : Optional servomotor power cable for servomotors with brake

Type : WSC-M04P05-WD to WSC-M04P20-WD

Applicable to : GYG type 1.0 kW or less



■Connector

Connector 2

Cap housing	2-178128-3
Contact	1-175218-5

By Tyco Electronics AMP K.K.

■Wire color

Connector 2	1	2	3	Round terminal
Mark	U	V	W	E
Wire color	Red	White	Black	Green / Yellow

■Length

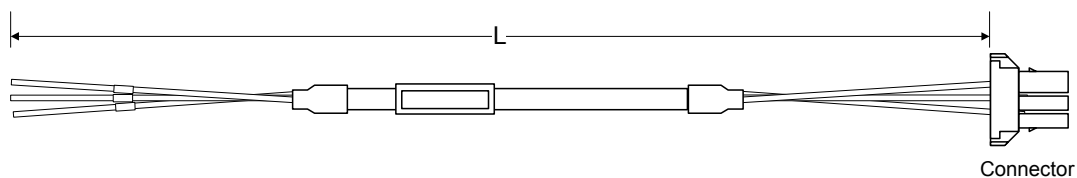
Type	L [m]
WSC-M04P05-WD	5.0 $^{+0.5}_0$
WSC-M04P10-WD	10.0 $^{+1.0}_0$
WSC-M04P20-WD	20.0 $^{+2.0}_0$

* For cable lengths other than 5, 10 or 20m, contact us.

* The manufacturer of the connector is subject to change without notice.

11 PERIPHERAL DEVICE

Series : Power cable
 Type : WSC-S03P03-B
 Applicable to : GYS type Full capacity
 GYG type 1.0 kW or less



■Connector

Connector

Cap housing	1-178128-3
Contact	1-175218-5

By Tyco Electronics AMP K.K.

■Wire color

Connector 1	1	2	3
Mark	L1	L2	L3
Wire color	Red	White	Black

■Length

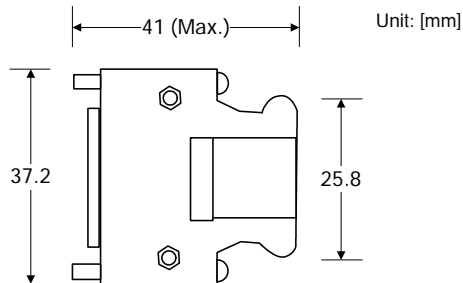
Type	L [m]
WSC-S03P03-B	3.0 $^{+0.3}_{0}$

* The manufacturer of connector is subject to change without notice.

Series : Connector kit for sequence input/output

Type : WSK-D26P

Applicable to : All models



Soldering plug	10126-3000VE
Shell kit	10326-52A0-008

Made by Sumitomo 3M

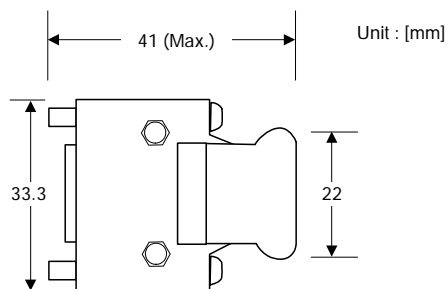
* The type of the connector kit is different from that of the optional cable.

* The manufacturer of the connector is subject to change without notice.

Series : Connector kit for encoder (on amplifier side)

Type : WSK-D20P

Applicable to : All models



Soldering plug	10120-3000VE
Shell kit	10320-52A0-008

Made by Sumitomo 3M

* The type of the connector kit is different from that of the optional cable.

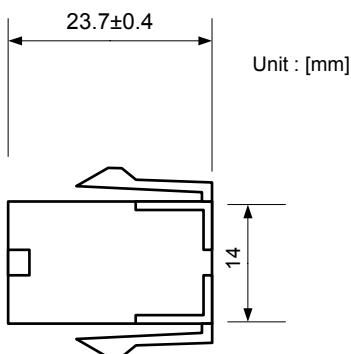
* The manufacturer of the connector is subject to change without notice.

11 PERIPHERAL DEVICE

Series : Connector kit for encoder (on motor side)

Type : WSK-P09P-D

Applicable to : GYS type Full capacity



Housing	172161-1
Cap	316455-1
Terminal ① signal side	170361-1
Terminal ② power supply side	170362-1

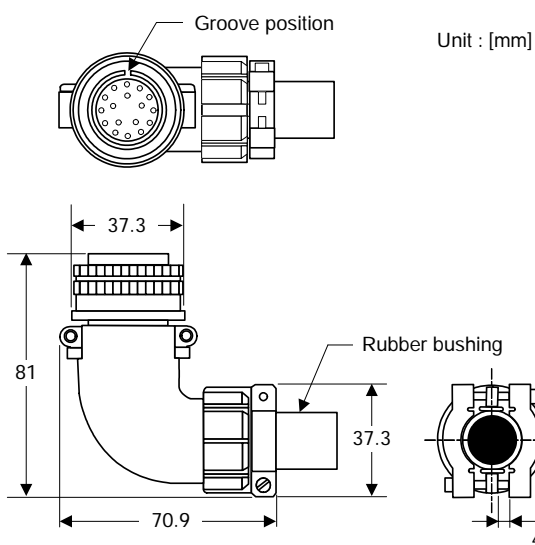
By Tyco Electronics AMP K.K.

- * The type of the connector is different from that of the optional cable.
- * The manufacturer of the connector is subject to change without notice.

Series : Connector kit for encoder (on motor side)

Type : WSK-P06P-C

Applicable to : GYG type Full capacity



Connector	MS3108B20-29S
Cable clamp	MS3057-12A

By DDK Ltd.

- * The type of the connector is different from that of the optional cable.
- * The connector type is not compatible with IP67. Refer to page 2-6 for compatible types.
- * The manufacturer of the connector is subject to change without notice.

Series : Connector kit for servomotor power cable (on amplifier side)

Type : WSK-M03P-B

Applicable to : GYS type Full capacity

GYG type 1.0 kW or less

Series : Connector kit for power cable (on amplifier side)

Type : WSK-S03P-B

Applicable to : GYS type Full capacity

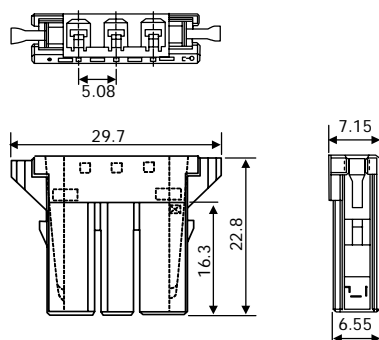
GYG type 1.0 kW or less

Series : Connector kit for external regenerative resistor (on amplifier side)

Type : WSK-R03P-B

Applicable to : GYS type Full capacity

GYG type 1.0 kW or less



Unit : [mm]

Connector kit for servomotor power cable WSK-M03P-B	Housing	2-178128-3
	Contact	1-175218-5
Connector kit for power cable WSK-S03P-B	Housing	1-178128-3
	Contact	1-175218-5
Connector kit for external regenerative resistor WSK-R03P-B	Housing	1-178128-3
	Contact	1-175218-5
	Keying plug	175855-1

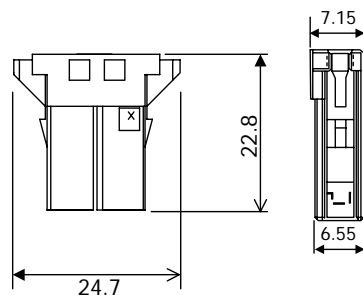
By Tyco Electronics AMP K.K.

Series : Connector kit for control power wiring (amplifier side)

Type : WSK-L02P-D

Applicable to : GYS type Full capacity

GYG type 1.0 kW or less

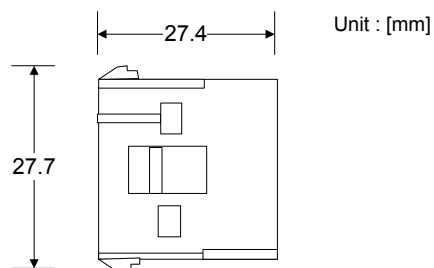


Connector kit for control power wiring WSK-L02P-D	Housing	1-178128-2
	Contact	1-175218-5

By Tyco Electronics AMP K.K.

11 PERIPHERAL DEVICE

Series : Connector kit for servomotor power cable
 Type : WSK-M04P
 Applicable to : GYS type Full capacity (without brake)

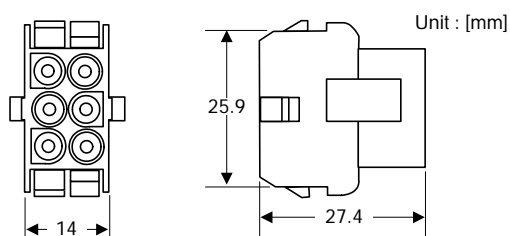


Cap	350780-1
Shell body clamp side	350570-1 or 350689-1

By Tyco Electronics AMP K.K.

* The manufacturer of the connector is subject to change without notice.

Series : Connector kit for servomotor power cable
 Type : WSK-M06P
 Applicable to : GYS type Full capacity (with brake)

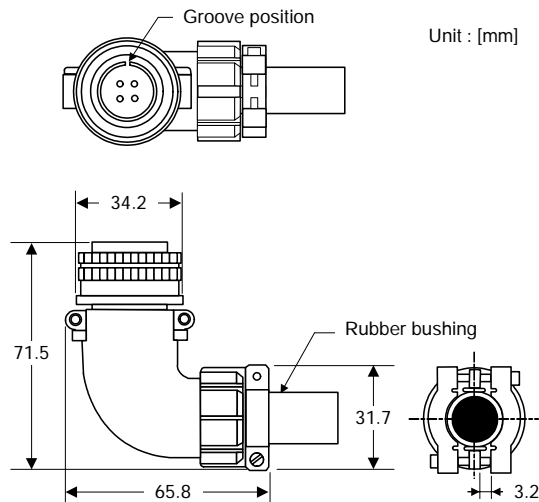


Cap housing	350781-1
Socket	350570-1

By Tyco Electronics AMP K.K.

* The manufacturer of the connector is subject to change without notice.

Series : Connector kit for servomotor power cable
 Type : WSK-M04P-CA
 Applicable to : GYG type Full capacity (without brake)

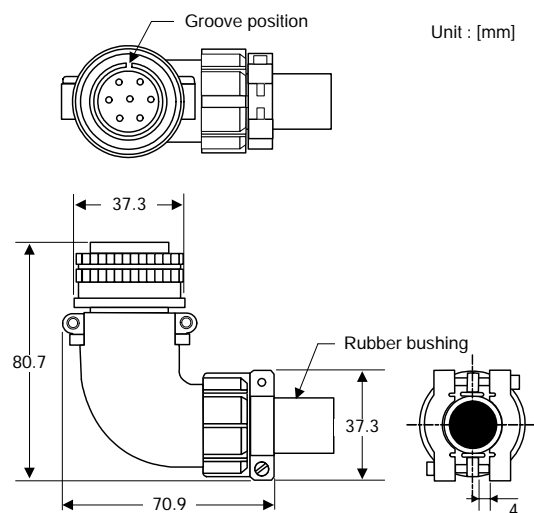


Connector	MS3108B18-10S
Cable clamp	MS3057-10A

By DDK Ltd.

- * The connector type is not compatible with IP67. Refer to page 2-6 for compatible types.
- * The manufacturer of the connector is subject to change without notice.

Series : Connector kit for servomotor power cable
 Type : WSK-M06P-CA
 Applicable to : GYG type Full capacity (without brake)



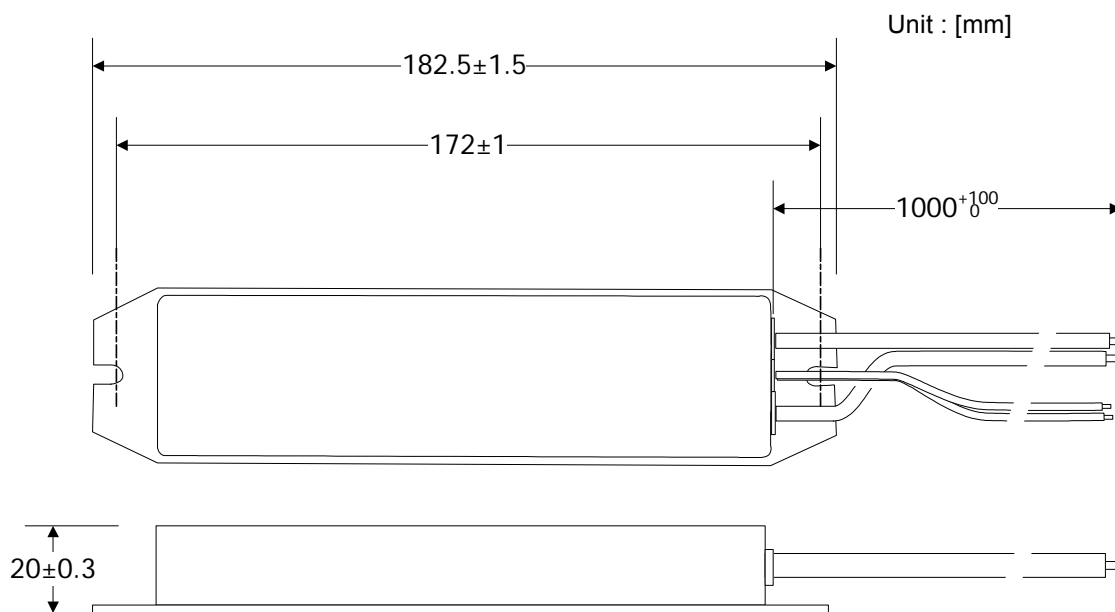
Connector	MS3108B20-15S
Cable clamp	MS3057-12A

By DDK Ltd.

- * The connector type is not compatible with IP67. Refer to page 2-6 for compatible types.
- * The manufacturer of the connector is subject to change without notice.

11 PERIPHERAL DEVICE

Series : External regenerative resistor
 Type : WSR-401
 Applicable to : RYC type ····· 0.4 kW or less



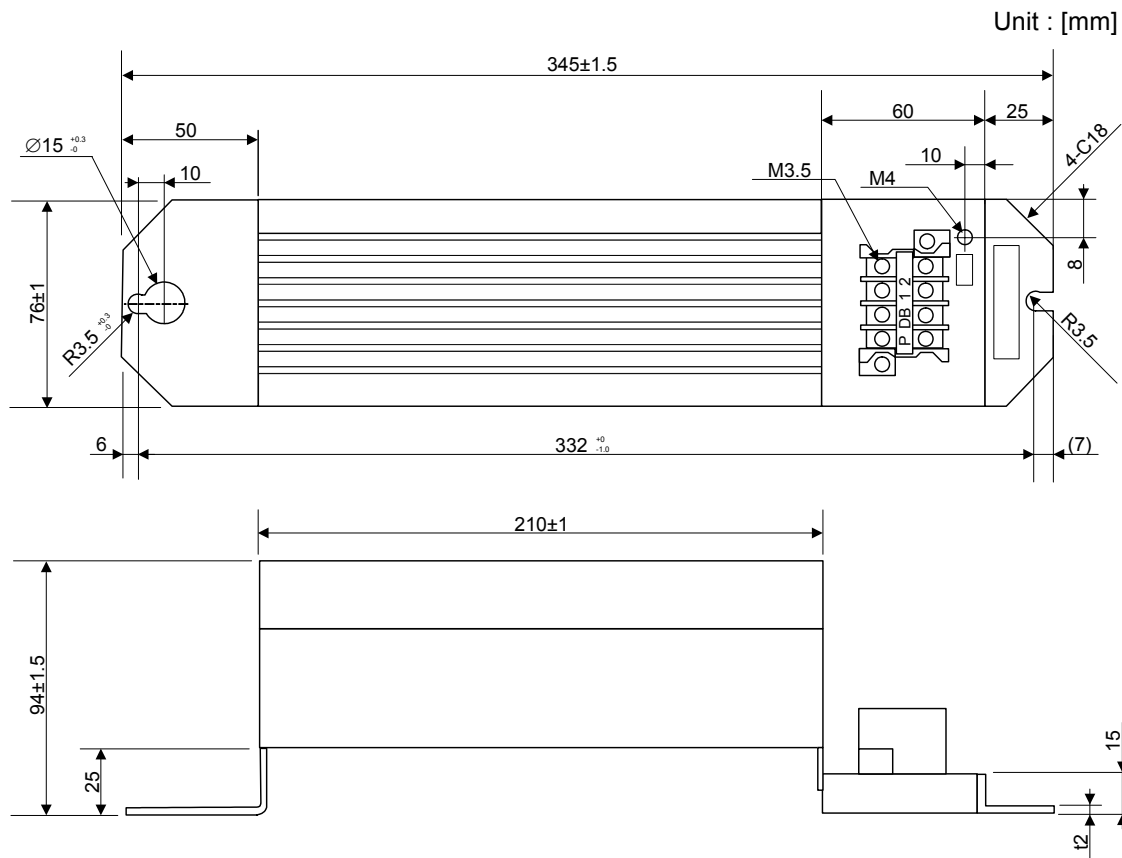
Item		Specification
Type		WSR-401
Resistor	Resistance	68 [Ω]
	Allowable power	17 [W] (Continuous)
Thermistor	Operating temperature	Open at 135 ± 5 °C
	Withstand voltage	1.5 kVAC for 1 minute
	Contact capacity	30 VDC, 0.1 A

The distance between the servo amplifier and external regenerative resistor must be within 10m.
 Do not place flammable objects near the external regenerative resistor because it generates heat.
 For connection of the external regenerative resistor, refer to section 11.7 “External regenerative resistor.”

Series : External regenerative resistor

Type : WSR-152

Applicable to : RYC type ····· 0.5 to 1.0kW



Item		Specification
Type		WSR-152
Resistor	Resistance	15 [Ω]
	Allowable power	50 [W] (Continuous)
Thermistor	Operating temperature	Open at 150 ± 10 °C
	Withstand voltage	2.5 kVAC for 1 minute
	Contact capacity	30 VDC, 0.1 A

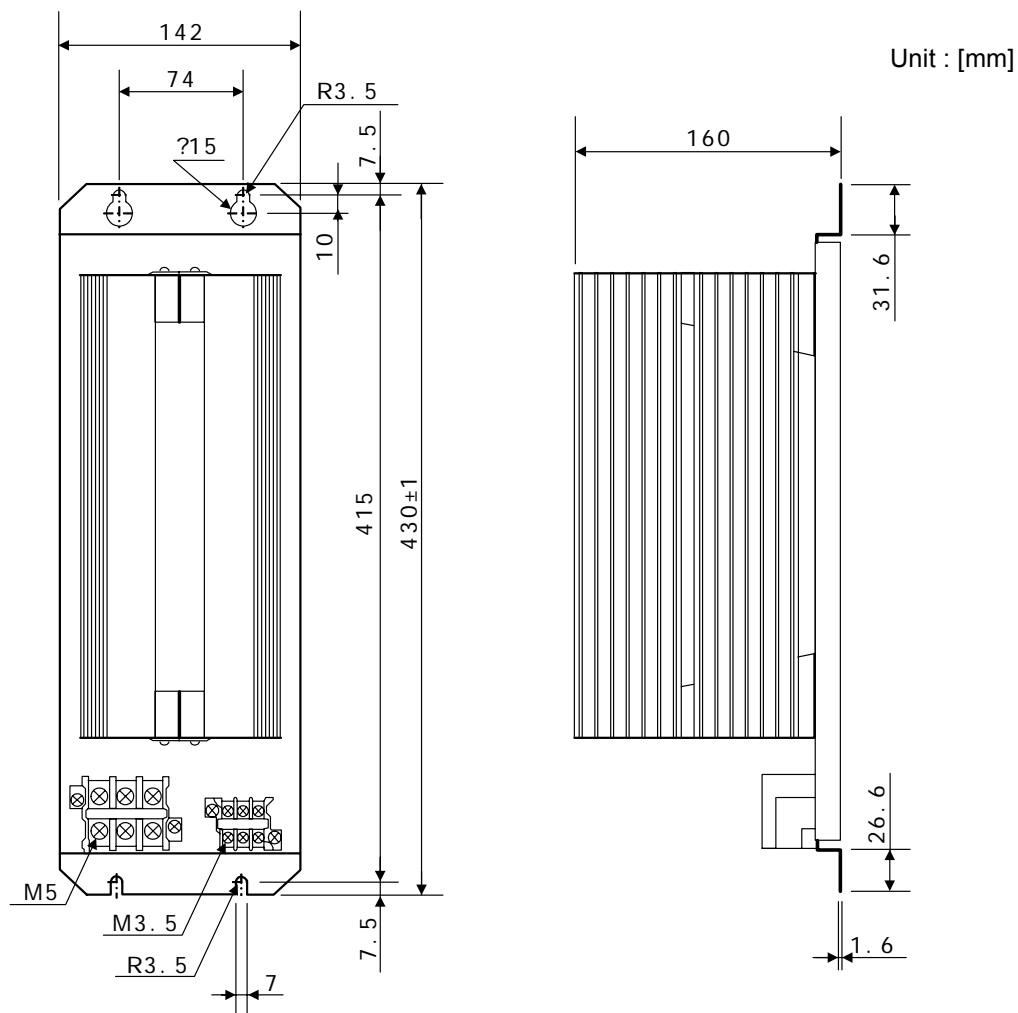
The distance between the servo amplifier and external regenerative resistor must be within 10m.

Do not place flammable objects near the external regenerative resistor because it generates heat.

For connection of the external regenerative resistor, refer to section 11-7 "External regenerative resistor."

11 PERIPHERAL DEVICE

Series : External regenerative resistor
 Type : DB11-2
 Applicable to : RYC type ····· 1.3 kW or more



Item		Specification
Type		DB11-2
Resistor	Resistance	10[Ω]
	Allowable power	260[W](Continuous)
Thermistor	Operating temperature	Open at 150±10°C
	Withstand voltage	2.5kVAC for 1 minute
	Contact capacity	120VAC/30VDC 0.1A

The distance between the servo amplifier and external regenerative resistor must be within 10m.

Do not place flammable objects near the external regenerative resistor because it generates heat.

For connection of the external regenerative resistor, refer to section 11.7 “External regenerative resistor.”

12

SPECIFICATIONS

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12 SPECIFICATIONS

12.1 List of servomotor specifications

12.1.1 Low inertia series (GYS motor) 3000r/min

● Standard specifications

Motor type	GYS500DC2-T2□	GYS101DC2-T2□	GYS201DC2-T2□	GYS401DC2-T2□	GYS751DC2-T2□
Rated output [kW]	0.05	0.1	0.2	0.4	0.75
Rated torque *1 [N·m]	0.159	0.318	0.637	1.27	2.39
Max. torque [N·m]	0.478	0.955	1.91	3.82	7.17
Rated speed [r/min]	3000				
Max. speed [r/min]	5000				
Moment of inertia [kg·m ²]	0.0192 × 10 ⁻⁴	0.0371 × 10 ⁻⁴	0.135 × 10 ⁻⁴	0.246 × 10 ⁻⁴	0.853 × 10 ⁻⁴
Rated current [A]	0.85	0.85	1.5	2.7	4.8
Max. current [A]	2.55	2.55	4.5	8.1	14.4
Insulation class	Class B				
Rating	Continuous rating				
Protective ventilation	Totally enclosed, self-cooling (IP 67) (except for shaft sealing and connectors)				
Terminal (Motor)	Cable 0.3 m (with connector)				
Terminal (Detector)	Cable 0.3 m (with connector)				
Overheat protection	None (Detection with servo amplifier)				
Mounting method	Flange IMB5 (L51) , IMV1 (L52) , IMV3 (L53)				
Shaft extension	Cylindrical shaft, with key				
Paint color	N1.5				
Detector	17-bit serial encoder				
Vibration	V5 or below				
Install location, altitude, Atmosphere	Indoors, altitude of 1000 m or less, place without corrosive gas, flammable gas, oil mist or dust				
Ambient temperatures and humidity	-10 to +40 °C, humidity: 90 % RH max. (free from condensation)				
Acceleration vibration, acceptable [m/s ²]	49				
Mass [kg]	0.45	0.55	1.2	1.8	3.4

● Motor with brake (*2)

Motor type	GYS500DC2-T2□-B	GYS101DC2-T2□-B	GYS201DC2-T2□-B	GYS401DC2-T2□-B	GYS751DC2-T2□-B
Rated output [kW]	0.05	0.1	0.2	0.4	0.75
Rated torque *1 [N·m]	0.159	0.318	0.637	1.27	2.39
Static friction torque [N·m]	0.34		1.27		2.45
Moment of inertia [kg·m ²]	0.0223 × 10 ⁻⁴	0.0402 × 10 ⁻⁴	0.335 × 10 ⁻⁴	0.446 × 10 ⁻⁴	1.203 × 10 ⁻⁴
Rated voltage [V]	DC24				
Attraction time [ms]	35		40		60
Release time [ms]	10		20		25
Power consumption [W]	6.1		7.3		8.5
Mass [kg]	0.6	0.7	1.7	2.3	4.2

*1) Rated torque is the value when operation is performed with the following aluminum heat sinks.

GYS500DC2-T2□ , GYS101DC2-T2□..... 200 × 200 × 6 [mm]

GYS201DC2-T2□ , GYS401DC2-T2□..... 250 × 250 × 6 [mm]

GYS751DC2-T2□..... 300 × 300 × 6 [mm]

*2) When the servomotor is operating at a low speed, a rattling noise may be heard from the brake lining. It is acceptable as to performance.

12.1.2 Middle inertia series (GYG motor) 2000r/min

● Standard specifications

Motor type	GYG501CC2-T2□	GYG751CC2-T2□	GYG102CC2-T2□	GYG152CC2-T2□	GYG202CC2-T2□
Rated output [kW]	0.5	0.75	1.0	1.5	2.0
Rated torque *1 [N·m]	2.39	3.58	4.77	7.16	9.55
Max. torque [N·m]	7.2	10.7	14.3	21.5	28.6
Rated speed [r/min]	2000				
Max. speed [r/min]	3000				
Moment of inertia [kg·m ²]	7.96×10^{-4}	11.55×10^{-4}	15.14×10^{-4}	22.33×10^{-4}	29.51×10^{-4}
Rated current [A]	3.5	5.2	6.4	10.0	12.3
Max. current [A]	10.5	15.6	19.2	30.0	36.9
Insulation class	Class F				
Rating	Continuous rating				
Protective ventilation	Totally enclosed, self-cooling (IP 67) (except for shaft sealing)				
Terminal (Motor)	Cannon connector				
Terminal (Detector)	Cannon connector				
Overheat protection	None (Detection with servo amplifier)				
Mounting method	Flange IMB5 (L51) , IMV1 (L52) , IMV3 (L53)				
Shaft extension	With straight shaft key, with oil seal				
Paint color	N1.5				
Detector	17-bit serial encoder				
Vibration	V5 or below				
Install location, altitude, Atmosphere	Indoors, altitude of 1000 m or less, place without corrosive gas, flammable gas, oil mist or dust				
Ambient temperatures and humidity	-10 to +40 °C, humidity: 90 % RH max. (free from condensation)				
Acceleration vibration, acceptable [m/s ²]	24.5				
Mass [kg]	5.3	6.4	7.5	9.8	12.0

● Motor with brake (*2)

Motor type	GYG501CC2-T2□-B	GYG751CC2-T2□-B	GYG102CC2-T2□-B	GYG152CC2-T2□-B	GYG202CC2-T2□-B
Rated output [kW]	0.5	0.75	1.0	1.5	2.0
Rated torque *1 [N·m]	2.39	3.58	4.77	7.16	9.55
Static friction torque [N·m]	17				
Moment of inertia [kg·m ²]	10×10^{-4}	13.6×10^{-4}	17.2×10^{-4}	24.4×10^{-4}	31.6×10^{-4}
Rated voltage [V]	DC24 ± 10%				
Attraction time [ms]	120				
Release time [ms]	30				
Power consumption [W]	14 (at 20°C)				
Mass [kg]	7.5	8.6	9.7	12.0	14.2

*1) Rated torque is the value when operation is performed with the following aluminum heat sinks.

GYG501CC2-T2□ , GYG751CC2-T2□ , GYG102CC2-T2□ 300 × 300 × 12 [mm]

GYG152CC2-T2□ , GYG202CC2-T2□ 400 × 400 × 12 [mm]

*2) When the servomotor is operating at a low speed, a rattling noise may be heard from the brake lining. It is acceptable as to performance.

12 SPECIFICATIONS

12.1.3 Middle inertia series (GYG motor) 1500r/min

● Standard specifications

Motor type	GYG501BC2-T2□	GYG851BC2-T2□	GYG132BC2-T2□
Rated output [kW]	0.5	0.85	1.3
Rated torque ^{*1} [N·m]	3.18	5.41	8.28
Rated speed [N·m]	9.50	16.2	24.8
Max. speed [r/min]	1500		
Max. torque [r/min]	3000		
Moment of inertia [kg·m ²]	11.55 × 10 ⁻⁴	15.15 × 10 ⁻⁴	24.8 × 10 ⁻⁴
Rated current [A]	4.7	7.3	11.5
Max. current [A]	14.1	21.9	34.5
Insulation class	Class F		
Rating	Continuous rating		
Protective ventilation	Totally enclosed, self-cooling (IP67) (except for shaft sealing)		
Terminal (Motor)	Cannon connector		
Terminal (Detector)	Cannon connector		
Overheat protection	None (Detection with servo amplifier)		
Mounting method	Flange IMB5 (L51) , IMV1 (L52) , IMV3 (L53)		
Shaft extension	With straight shaft key, with oil seal		
Paint color	N1.5		
Detector	17-bit serial encoder		
Vibration	V10 or below		
Install location, altitude, Atmosphere	Indoors, altitude of 1000 m or less, place without corrosive gas, flammable gas, oil mist or dust		
Ambient temperatures and humidity	-10 to +40 °C, humidity: 90 % RH max. (free from condensation)		
Acceleration vibration, acceptable [m/s ²]	24.5		
Mass [kg]	6.4	7.5	9.8

● Motor with brake ^{*2}

Motor type	GYG501BC2-T2□	GYG851BC2-T2□	GYG132BC2-T2□
Rated output [kW]	0.5	0.85	1.3
Rated torque ^{*1} [N·m]	3.18	5.41	8.28
Static friction torque [N·m]	17		
Moment of inertia [kg·m ²]		17.3 × 10 ⁻⁴	24.5 × 10 ⁻⁴
Rated voltage [V]	DC24±10%		
Attraction time [ms]	120		
Release time [ms]	30		
Power consumption [W]			
Mass [kg]	8.6	9.7	12.0

*1) Rated torque is the value when operation is performed with the following aluminum heat sinks.

GYG501BC2-T2□ , GYG851BC2-T2□ 300 × 300 × 12 [mm]

GYG132BC2-T2□ 400 × 400 × 12 [mm]

*2) When the servomotor is operating at a low speed, a rattling noise may be heard from the brake lining. It is acceptable as to performance.

12.2 Servo amplifier basic specification

12.2.1 GYS motor (3000r/min) compatible servo amplifier

Amplifier type		RYC500D3-VVT2	RYC101D3-VVT2	RYC201D3-VVT2	RYC401D3-VVT2	RYC751D3-VVT2	
Applicable motor output [kW]		0.05	0.1	0.2	0.4	0.75	
External frame No.		Frame 1				Frame 2	
Power supply	Main power	No. of phases	Single phase				Single phase/3 phase
		Voltage	AC200 to 230V, -15% to +10% (Single phase: -10% to +10%)				
		Frequency	50/60Hz				
	Control power	No. of phases	Single phase				
		Voltage	AC200 to 230V -10% to +10%				
Frequency		50/60Hz					
Control type		IGBT PWM sine wave operation					
Carrier frequency		10kHz					
Feedback		17 bit serial encoder (incremental)					
Speed fluctuation rate		±1 [r/min] or less: Load fluctuation 0 to 100%					
		±1 [r/min] or less: Load fluctuation -10% to +10%					
		±0.2% or less: Temperature fluctuation 25°C ±10%, Rated rotation speed standard (input of analog voltage)					
Speed control accuracy		1:5000 (rated load)					
Recommended load inertia moment		100 times or less for speed control of the servomotor and 30 times or less for position control.					
Overload resistance		300%/about 3 seconds					
Control function	Control type	Position control, speed control and torque control (switched with sequence input signal)					
	Position control	Pulse string					
	Speed control	Analog voltage command or internal multistep (3 step) command					
	Torque control	Analog voltage command					
	Accessory function	Brake timing output, Z phase offset, speed command zero clamp function, vibration control, command follow-up control, notch filter, etc.					
Position management	17 bit serial encoder	Dedicated to INC. The current position is lost when the power is shut off.					
Accessory function	Braking	Regenerative braking and regenerative resistance can be externally added to the DC link circuit.					
	Protection	Overcurrent (OC1, OC2), overspeed (OS), overvoltage (HV), encoder error (Et), control power error (Ct), memory error (dE), regenerative transistor overheating (rH2), encoder communication error (EC), CONT duplication (Cnt), overload (OL), undervoltage (Lv), regenerative resistor overheating (rH1), deviation limit (OF), amplifier overheating (AH)					
	Display and setting	CHARGE - Power supplied (red), 7-segment LED 4 digits and 4 operation keys					
Operating environment	Installation	Indoors, altitude of 1000 m or less, without dust, corrosive gas or direct sunlight Compatibility with European standard : Pollution Degree=2 Over Voltage Category = III					
	Ambient temperature and humidity	-10 to +55°C, 10 to 90%RH (no condensation)					
	Resistance to vibration and impact	4.9m/s ² {0.5G} · 19.6m/s ² {2G}					
Applicable standards		In accordance with UL/cUL (UL508c), in accordance with CE marking (low voltage directive EN50178)					
Weight [kg]		1.0				1.5	

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12.2.2 GYG motor (2000r/min) compatible servo amplifier

Amplifier type			RYC501C3-VVT2	RYC751C3-VVT2	RYC102C3-VVT2	RYC152C3-VVT2	RYC202C3-VVT2
Applicable motor output [kW]			0.5	0.75	1.0	1.5	2.0
External frame No.			Frame 2			Frame 3	
Power supply	Main power	No. of phases	Single phase/3 phase			3 phase	
		Voltage	AC200 to 230V, -15% to +10% (Single phase: -10% to +10%)				
		Frequency	50/60Hz				
	Control power	No. of phases	Single phase				
		Voltage	AC200 to 230V -10% to +10%				
		Frequency	50 to 60Hz				
Control type			IGBT PWM sine wave operation				
Carrier frequency			10kHz				
Feedback			17 bit serial encoder (incremental)				
Speed fluctuation rate			±1 [r/min] or less: Load fluctuation 0 to 100%				
			±1 [r/min] or less: Load fluctuation -10% to +10%				
			±0.2% or less: Temperature fluctuation 25°C ±10%, Rated rotation speed standard (input of analog voltage)				
Speed control accuracy			1:5000 (rated load)				
Recommended load inertia moment			30 times or less for speed control of the servomotor and 10 times or less for position control.				
Overload resistance			300%/about 3 seconds				
Control function	Control type		Position control, speed control and torque control (switched with sequence input signal)				
	Position control		Pulse string				
	Speed control		Analog voltage command or internal multistep (3 step) command				
	Torque control		Analog voltage command				
	Accessory function		Brake timing output, Z phase offset, speed command zero clamp function, vibration control, command follow-up control, notch filter, etc.				
Position management	17 bit serial encoder		Dedicated to INC. The current position is lost when the power is shut off.				
Accessory function	Braking		Regenerative braking and regenerative resistance can be externally added to the DC link circuit.				
	Protection		Overcurrent (OC1, OC2), overspeed (OS), overvoltage (HV), encoder error (Et), control power error (Ct), memory error (dE), regenerative transistor overheating (rH2), encoder communication error (EC), CONT duplication (Cnt), overload (OL), undervoltage (Lv), regenerative resistor overheating (rH1), deviation limit (OF), amplifier overheating (AH)				
	Display and setting		CHARGE - Power supplied (red), 7-segment LED 4 digits and 4 operation keys				
Operating environment	Installation		Indoors, altitude of 1000 m or less, without dust, corrosive gas or direct sunlight Compatibility with European standard : Pollution Degree=2 Over Voltage Category = III				
	Ambient temperature and humidity		-10 to +55°C, 10 to 90%RH (no condensation)				
	Resistance to vibration and impact		4.9m/s ² {0.5G} · 19.6m/s ² {2G}				
Applicable standards			In accordance with UL/cUL (UL508c), in accordance with CE marking (low voltage directive EN50178)				
Weight [kg]			1.5			2.5	

12.2.3 GYG motor (1500r/min) compatible servo amplifier

Amplifier type		RYC501B3-VVT2		RYC851B3-VVT2	RYC132B3-VVT2
Applicable motor output [kW]		0.5		0.85	1.3
External frame No.		Frame 2			Frame 3
Power supply	Main power	No. of phases	Single phase/3 phase		3 phase
		Voltage	AC200 to 230V, -15% to +10% (Single phase: -10% to +10%)		
		Frequency	50/60Hz		
	Control power	No. of phases	Single phase		
		Voltage	AC200 to 230V -10% to +10%		
		Frequency	50/60Hz		
Control type		IGBT PWM sine wave operation			
Carrier frequency		10kHz			
Feedback		17 bit serial encoder (incremental)			
Speed fluctuation rate		±1 [r/min] or less: Load fluctuation 0 to 100%			
		±1 [r/min] or less: Load fluctuation -10% to +10%			
		±0.2% or less: Temperature fluctuation 25°C ±10%, Rated rotation speed standard (input of analog voltage)			
Speed control accuracy		1:5000 (rated load)			
Recommended load inertia moment		30 times or less for speed control of the servomotor and 10 times or less for position control.			
Overload resistance		300%/about 3 seconds			
Control function	Control type		Position control, speed control and torque control (switched with sequence input signal)		
	Position control		Pulse string		
	Speed control		Analog voltage command or internal multistep (3 step) command		
	Torque control		Analog voltage command		
	Accessory function		Brake timing output, Z phase offset, speed command zero clamp function, vibration control, command follow-up control, notch filter, etc.		
Position management	17 bit serial encoder		Dedicated to INC. The current position is lost when the power is shut off.		
Accessory function	Braking		Regenerative braking and regenerative resistance can be externally added to the DC link circuit.		
	Protection		Overcurrent (OC1, OC2), overspeed (OS), overvoltage (HV), encoder error (Et), control power error (Ct), memory error (dE), regenerative transistor overheating (rH2), encoder communication error (EC), CONT duplication (Cnt), overload (OL), undervoltage (Lv), regenerative resistor overheating (rH1), deviation limit (OF), amplifier overheating (AH)		
	Display and setting		CHARGE - Power supplied (red), 7-segment LED 4 digits and 4 operation keys		
Operating environment	Installation		Indoors, altitude of 1000 m or less, without dust, corrosive gas or direct sunlight Compatibility with European standard : Pollution Degree=2 Over Voltage Category = III		
	Ambient temperature and humidity		-10 to +55°C, 10 to 90%RH (no condensation)		
	Resistance to vibration and impact		4.9m/s ² {0.5G} · 19.6m/s ² {2G}		
Applicable standards		In accordance with UL/cUL (UL508c), in accordance with CE marking (low voltage directive EN50178)			
Weight [kg]		1.5			2.5

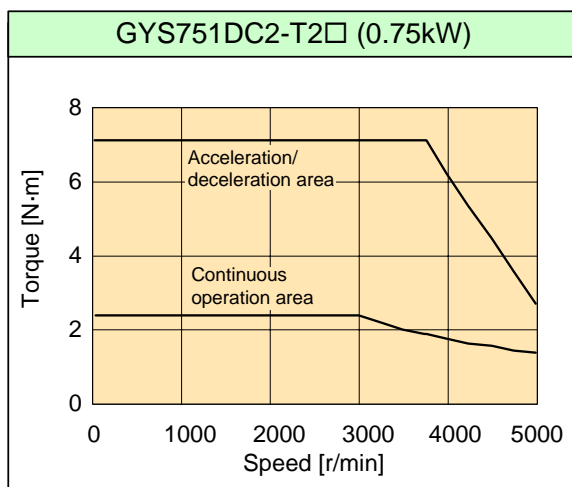
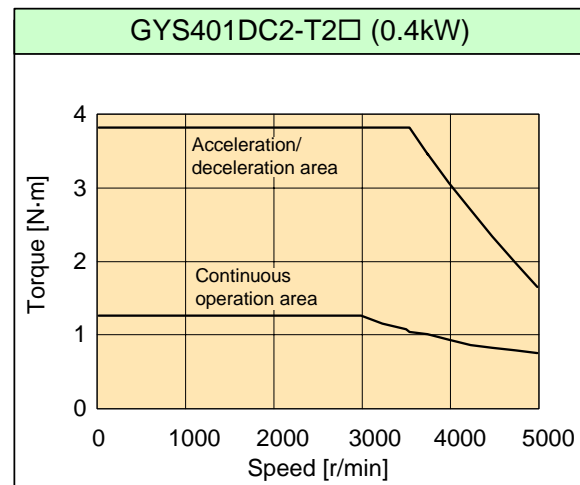
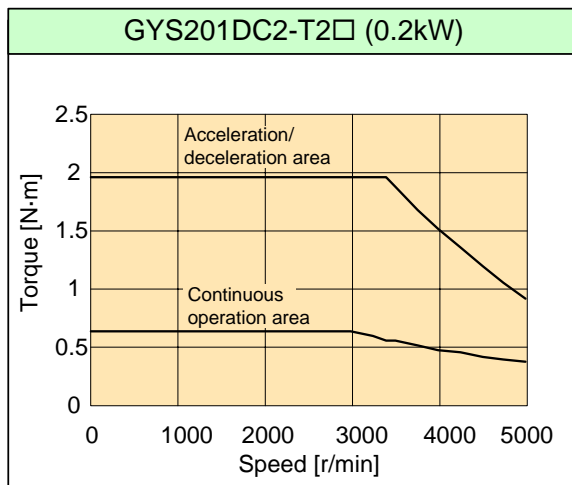
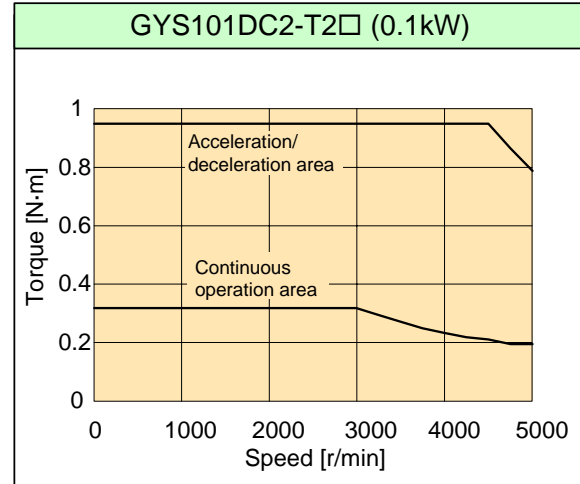
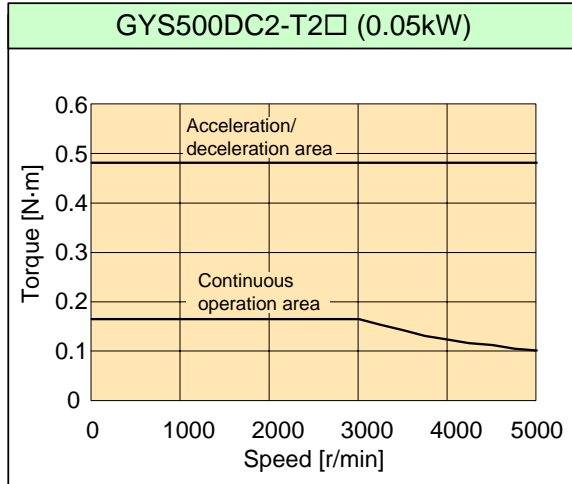
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12.2.4 Servo amplifier interface specification

Terminal name	Terminal symbol	Specification
Pulse string input	CA, *CA CB, *CB	<ul style="list-style-type: none"> Maximum input frequency: 1 MHz (differential input), 200 kHz (open collector) Pulse string type: Select the type from the following 3 types with a parameter. <ul style="list-style-type: none"> (1) Command pulse/command symbol, (2) Forward rotation pulse/reverse rotation pulse, (3) 90 degree phase difference 2 signal
	PPI	Operation power supply input for input of open collector (+ 24VDC)
Division output	FFA, *FFA FFB, *FFB	Maximum output frequency: 500 kHz (differential output) Output type: 90 degree phase difference 2 signal No. of output pulses: 16 to 32768 [pulse/rev]
	FFZ, *FFZ	Differential output, 1 [pulse/rev]
	FZ, M5	Open collector output, 1 [pulse/rev]
Analog input	Vref	Analog command input for speed and torque control Input voltage: $\pm 10V$ (input impedance 20 k Ω)
Power input for sequence signal	P24, M24	Power (24VDC) for sequence signal is externally supplied. Power supply specification: +24VDC/300 mA (externally supplied)
Sequence input signal	CONT1 to CONT5	+24VDC/10 mA (1 point) source input External sequence input terminal
Sequence output signal	OUT1 to OUT5	+30VDC/50 mA (maximum) sink output External sequence output terminal
Monitor output 1/2	MON1 MON2	Output for analog meter (both side movement/one side movement) (1) Speed command, (2) Feedback speed, (3) Torque command, (4) Position deviation, (5) Expansion of position deviation, (6) Pulse string input

12.3 Speed-torque characteristics

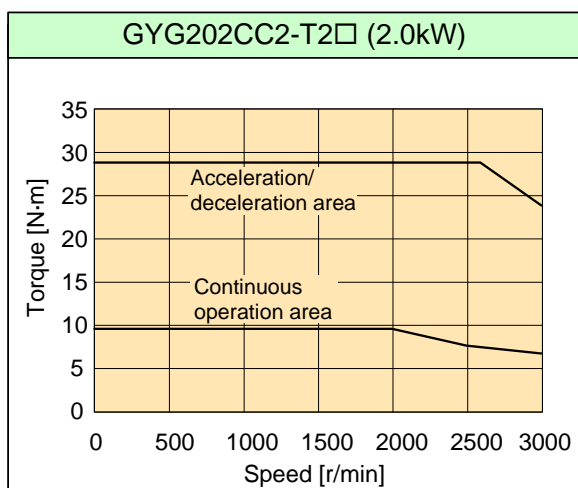
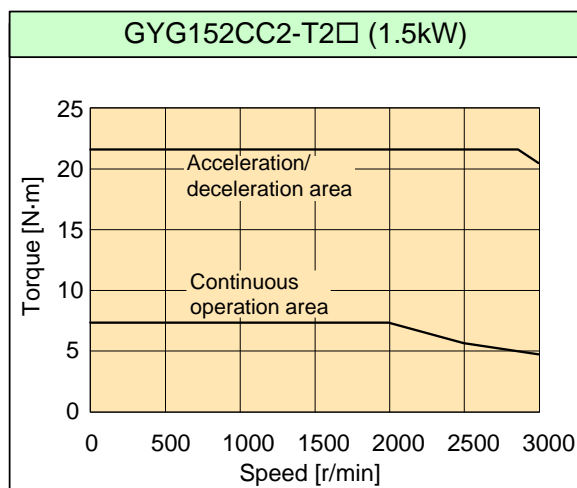
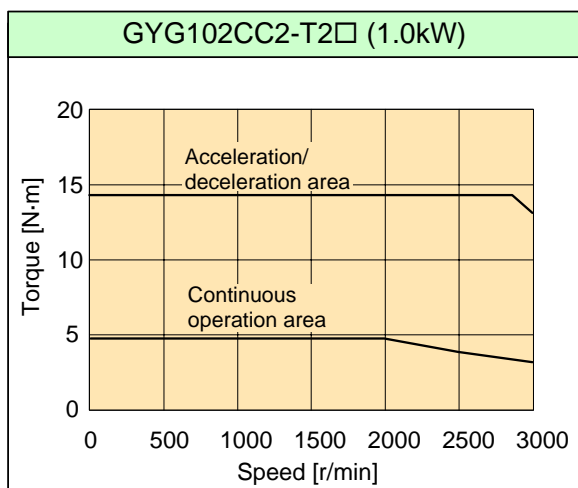
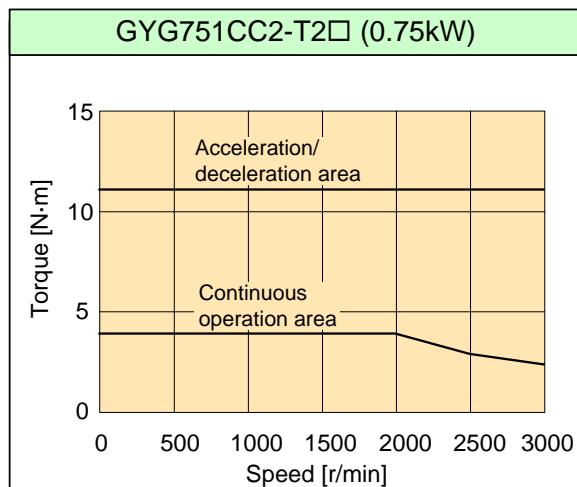
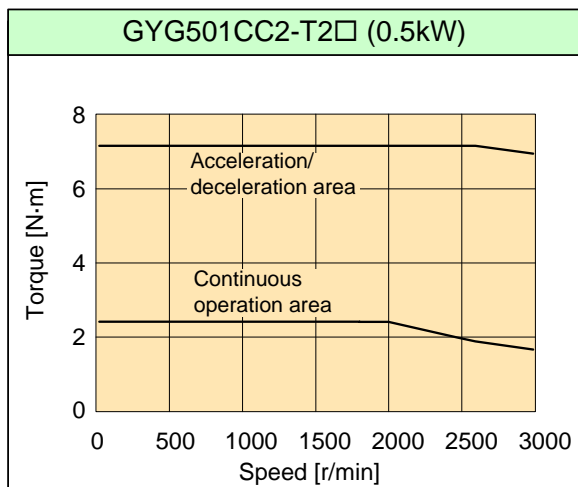
12.3.1 Low inertia series (GYS motor) 3000r/min



* The characteristics are indicated at 200V or more for 3 phase and at 230V or more for single phase.

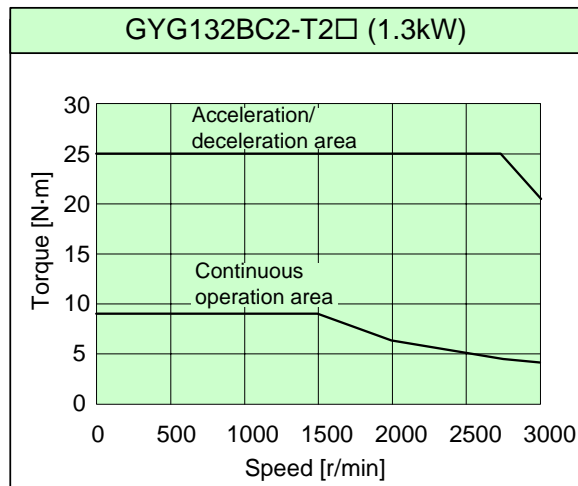
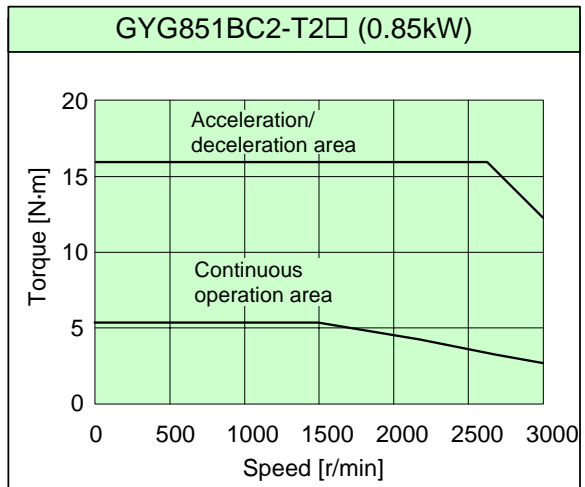
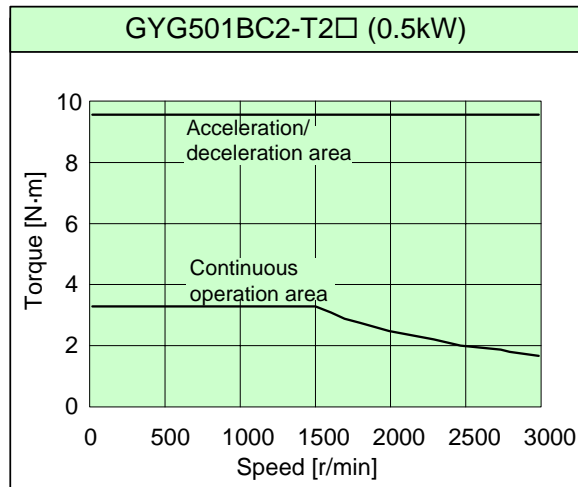
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12.3.2 Middle inertia series (GYG motor) 2000r/min



* The characteristics are indicated at 200V or more for 3 phase and at 230V or more for single phase.

12.3.3 Middle inertia series (GYG motor) 1500r/min



* The characteristics are indicated at 200V or more for 3 phase and at 230V or more for single phase.

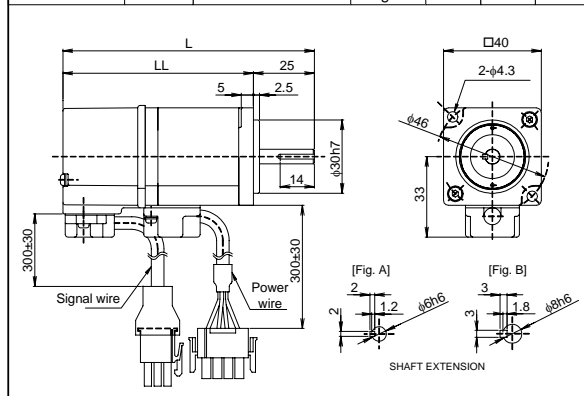
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12.4 External Dimension

12.4.1 Low inertia series (GYS motor) 3000r/min

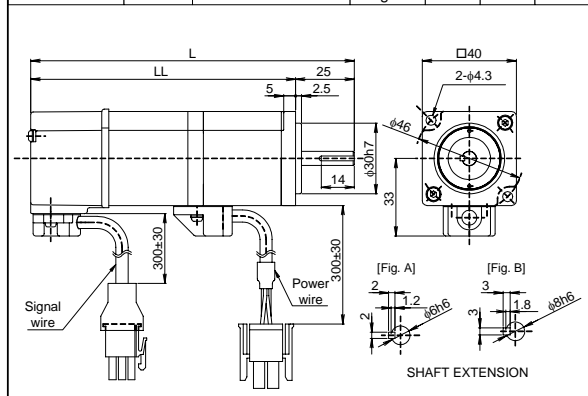
■Standard motor

Rated rotation speed	Rated output	Type	Shaft shape	Overall length (L)	Dimension (LL)	Weight [kg]
3000[r/min]	0.05kW	GYS500DC2-T2A	Fig. A	103	78	0.45
	0.1kW	GYS101DC2-T2A	Fig. B	121	96	0.55

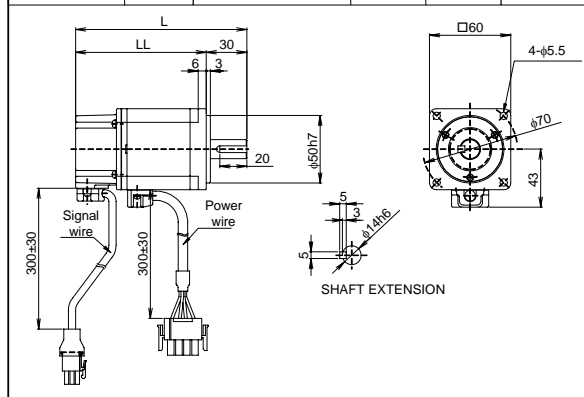


■Motor with brake

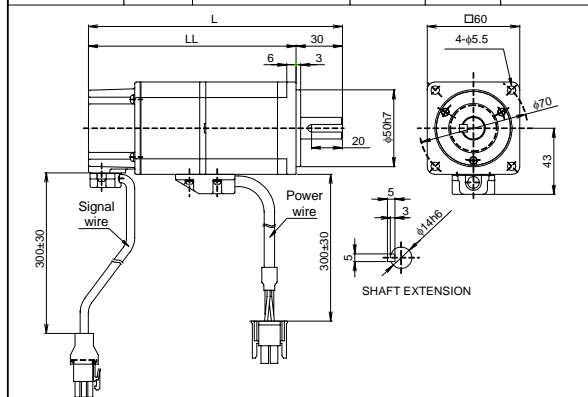
Rated rotation speed	Rated output	Type	Shaft shape	Overall length (L)	Dimension (LL)	Weight [kg]
3000[r/min]	0.05kW	GYS500DC2-T2A-B	Fig. A	137.5	112.5	0.6
	0.1kW	GYS101DC2-T2A-B	Fig. B	155.5	130.5	0.7



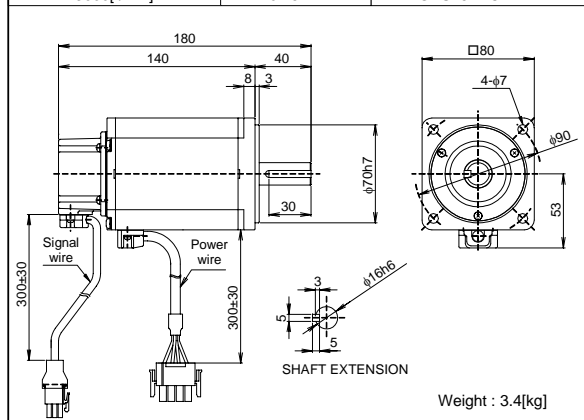
Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Weight [kg]
3000[r/min]	0.2kW	GYS201DC2-T2A	126.5	96.5	1.2
	0.4kW	GYS401DC2-T2A	154.5	124.5	1.8



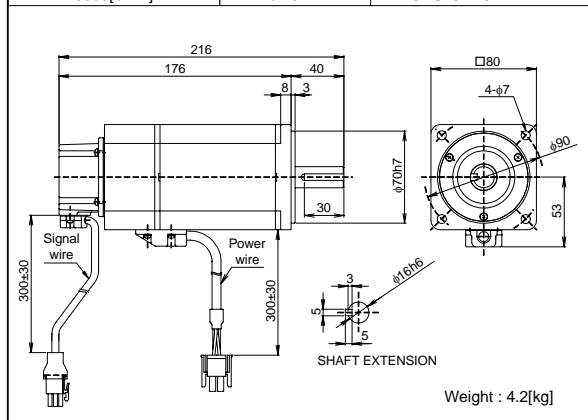
Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Weight [kg]
3000[r/min]	0.2kW	GYS201DC2-T2A-B	164.5	134.5	1.7
	0.4kW	GYS401DC2-T2A-B	192.5	162.5	2.3



Rated rotation speed	Rated output	Type
3000[r/min]	0.75kW	GYS751DC2-T2A

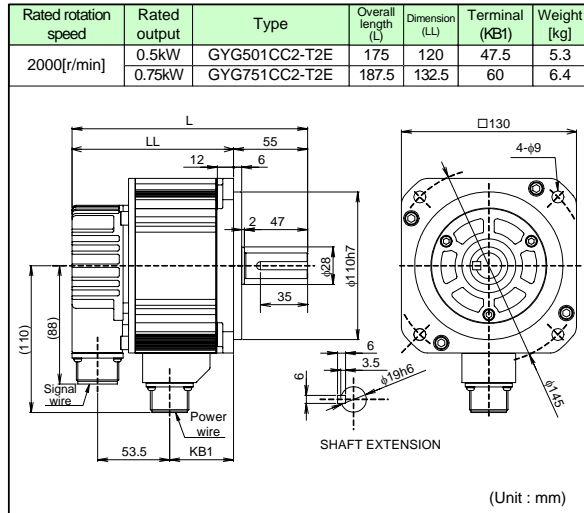


Rated rotation speed	Rated output	Type
3000[r/min]	0.75kW	GYS751DC2-T2A-B

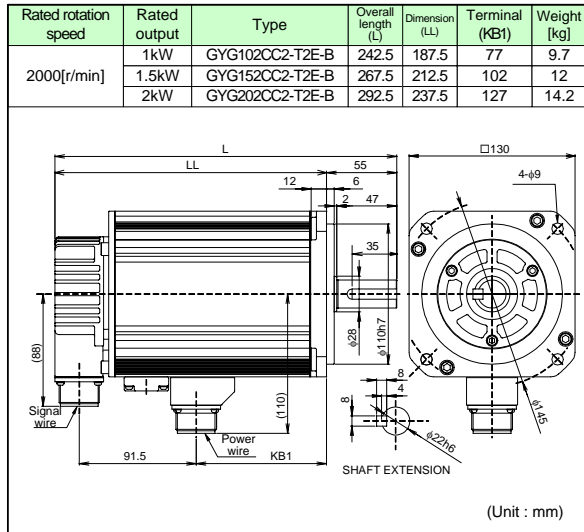
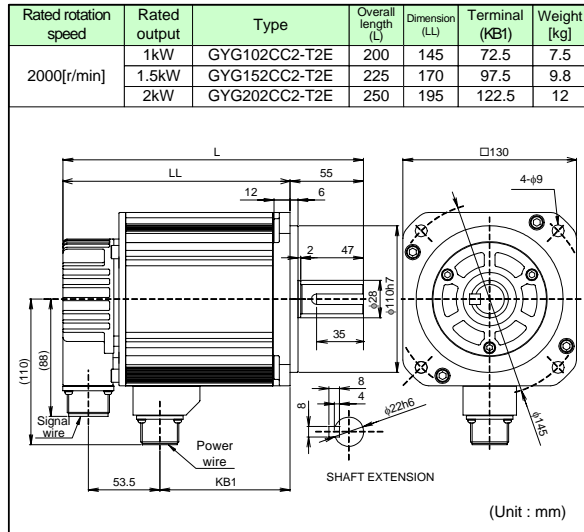
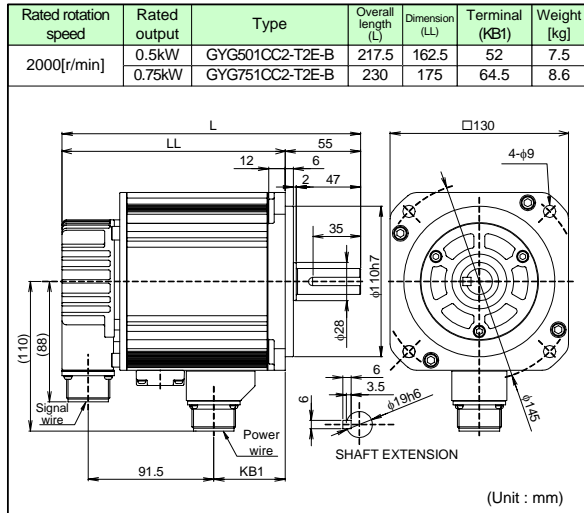


12.4.2 Middle inertia series (GYG motor) 2000r/min

■ Standard motor



■ Motor with brake

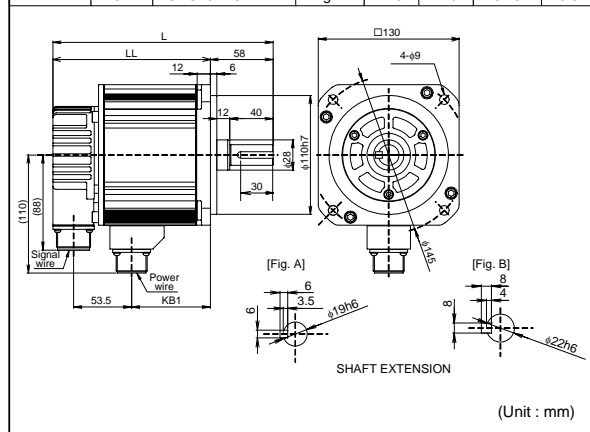


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12.4.3 Middle inertia series (GYG motor) 1500r/min

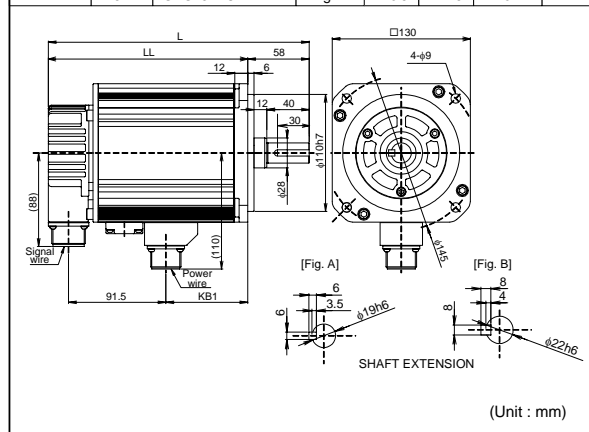
■ Standard motor

Rated rotation speed	Rated output	Type	Shaft shape	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
1500 [r/min]	0.5kW	GYG501BC2-T2E	Fig. A	190.5	132.5	60	6.4
	0.85kW	GYG851BC2-T2E	Fig. A	203	145	72.5	7.5
	1.3kW	GYG132BC2-T2E	Fig. B	228	170	97.5	9.8



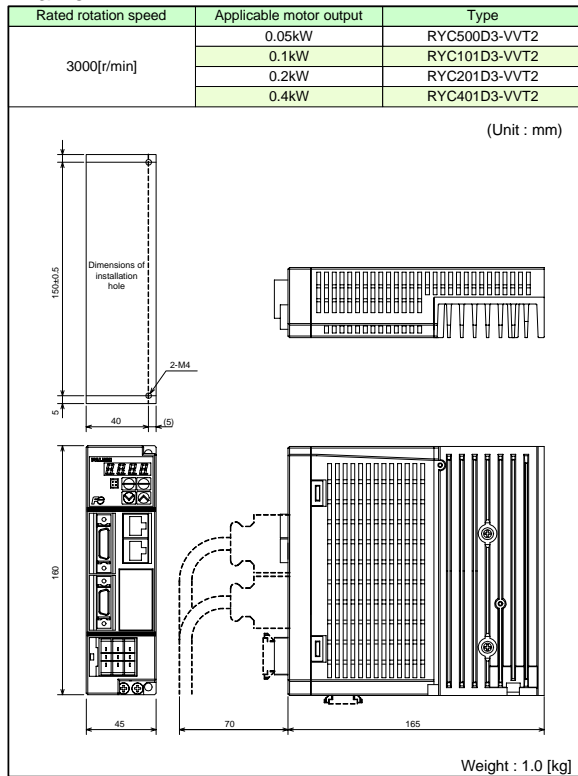
■ Motor with brake

Rated rotation speed	Rated output	Type	Shaft shape	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
1500 [r/min]	0.5kW	GYG501BC2-T2E-B	Fig. A	233	175	64.5	8.6
	0.85kW	GYG851BC2-T2E-B	Fig. A	245.5	187.5	77	9.7
	1.3kW	GYG132BC2-T2E-B	Fig. B	270.5	212.5	102	12

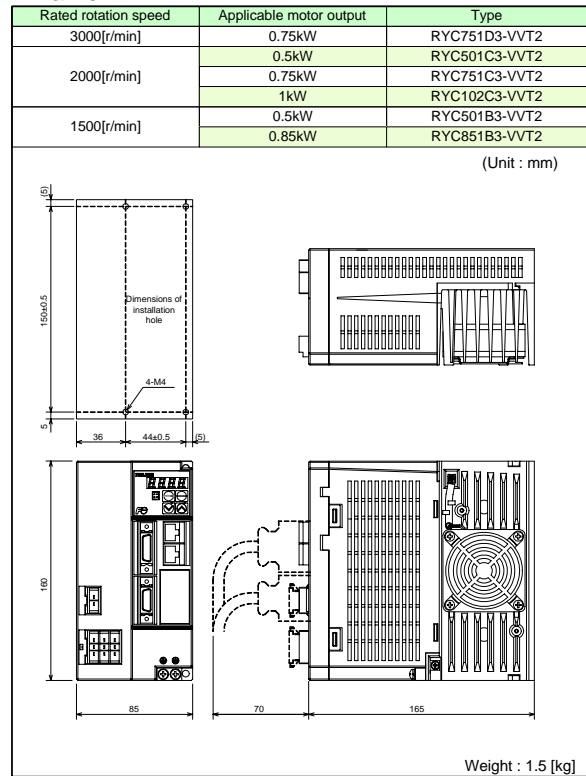


12.4.4 Servo amplifier

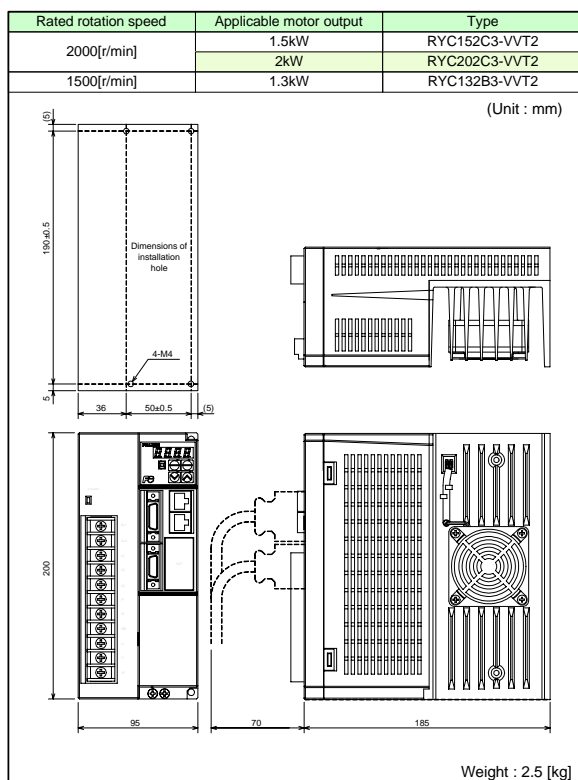
■Frame 1



■Frame 2



■Frame 3



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-MEMO-

13

RS485 COMMUNICATIONS

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13 RS485 COMMUNICATIONS

13.1 RS485 communication function

Details of the transmission command of the RYC□□□△3-VVT2 servo amplifier are described.

The RYC□□□△3-VVT2 servo amplifier can perform operation through the serial communication equivalent to the operation with the keypad (excluding a part of test operation mode).

13.1.1 Station number

The station number of the message is determined by the station number setting (parameter No. 82) of the servo amplifier.

After the parameter setting is changed, it is valid by turning the power OFF and ON again.

13.1.2 Sequence input terminal (CONT1 to CONT5) /sequence output terminal (OUT1 to OUT4)

The following signals are allocated to CONT1 to CONT5 terminals of connector 1 (CN1).
(Status at factory before shipment)

CN1	
Terminal symbol	Initial value
CONT1	Operation command [RUN]
CONT2	Alarm reset [RST]
CONT3	-
CONT4	-
CONT5	-

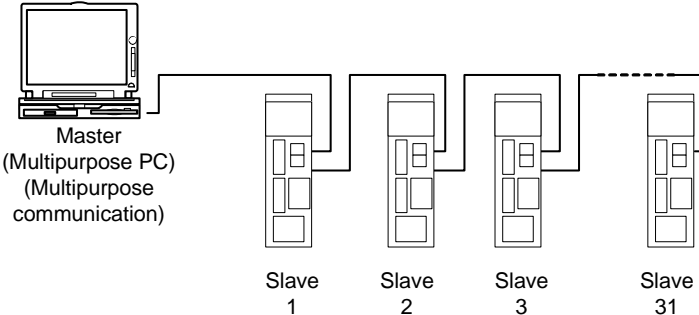
CN1	
Terminal symbol	Initial value
OUT1	Ready [RDY]
OUT2	Positioning end [PSET]
OUT3	Alarm detection b contact [ALMb]
OUT4	-

13.1.3 Response time

The operation command gives a response within approx. 5 ms. When rewriting parameters (maximum 4), the response is within approx. 20 ms.

13.1.4 Communication specifications

RS485 communication specifications

Item	Specification
Signal level	RS485
Synchronizing method	Asynchronous communication, TTY protocol
Communication method	4-wire type, half-duplex communication
Transmission speed	9600/19200/38400 bps (setting with parameter No. 83)
Transmission symbol	8 bits
Transmission configuration	Start bit: 1 bit Data bit: 8 bits Parity bit: 1 bit (even number) Stop bit: 1 bit
Transmission control	Transparent mode (There is no distinction by DLE character.)
Error control	Check sum
Transmission length	Reception: 128 bytes/Transmission: 128 bytes (maximum)
Communication type	<p>1: n communication ($1 \leq n \leq 31$)</p> <p>The servo amplifier functions as slave and only gives response for master commands. Communication between slaves is not performed.</p>  <p>Master (Multipurpose PC) (Multipurpose communication)</p> <p>Slave 1 Slave 2 Slave 3 Slave 31</p>
Station No.	1 to 31 (setting with parameter No. 82)
Connection cable	LAN cable (straight) or equivalent
Termination	Master: 100 [Ω] recommended, Slave: Not required.
Response time	Operation command: 5 ms or less Data (parameter) transmission: 20 ms or less

* When 8 bits are specified as data bit, a stop bit cannot be allocated on some software.

13 RS485 COMMUNICATIONS

13.1.5 Transmission protocol

■Transmission format

Transmission sequence	Description (All values are hexadecimal values.)	Transmission command (Upper level→Amplifier)	Reception command (Amplifier→Upper level)
①	START code	5 A	5 A
②	Data count	No. of data	No. of data
③	Fixed value for system	0 0	0 0
④	Processing status	F F	0 0
⑤	Connection method	7 B	7 B
⑥	Amplifier station No.	0 0 Fixed	0 0 Fixed
		01 (Station No.)	01 (Station No.)
⑦	Fixed value for system	1 1	1 1
		0 0	0 0
		F F	F F
		F F	F F
		F F	F F
		F F	F F
⑧	CMND	With command	With command
⑨	MODE	0 0	0 0
⑩	End information	0 0	0 0
⑪	Sequence number	0 1	0 1
⑫	Count for DATA area	No. of pieces of data in DATA area	No. of pieces of data in DATA area
⑬	Fixed value for system	0 0	0 0
⑭	DATA area	Memory type	Memory type
		Address (L)	Address (L)
		Address (M)	Address (M)
		Address (H)	Address (H)
		No. of read/write bytes	No. of read/write bytes
		0 0	0 0
		With command	STR1
			STR2
			With command
⑮	BCC	BCC calculation value	BCC calculation value

*1: The calculation range of BCC is ② to ⑭.

*2: The calculation range of data count is ④ to ⑮.

13.1.6 Description of transmission data

■Transmission code

Item	Description (hexadecimal)	Function
Start code	5AH (fixed)	Header code
Data count	XXH (variable)	Byte counter No. of bytes from processing status to BCC is set.
Fixed value for system	OOH (fixed) or XXH (fixed)	The value in the transmission format is set.
Processing status	00H or FFH	0xFF for request command. 0x00 for response command.
Connection method	7BH (fixed)	
Amplifier station No.	01H to 1FH (variable)	Station No. The station number to distinguish the servo amplifier is set. (1 to 31)
CMND	XXH (variable)	Command to the servo amplifier is specified.
MODE	OOH (fixed)	
End information	OOH (fixed)	
Sequence number	01H (fixed)	
Counter for DATA area	XXH (variable)	No. of bytes at DATA area is set.
DATA area	XXH (variable)	Values with each command are set.
BCC	XXH (variable)	Check sum 0x00 (Total sum of byte data from data counter to DATA area)

13 RS485 COMMUNICATIONS

13.1.7 Status information

■ Status information (ST1, ST2)

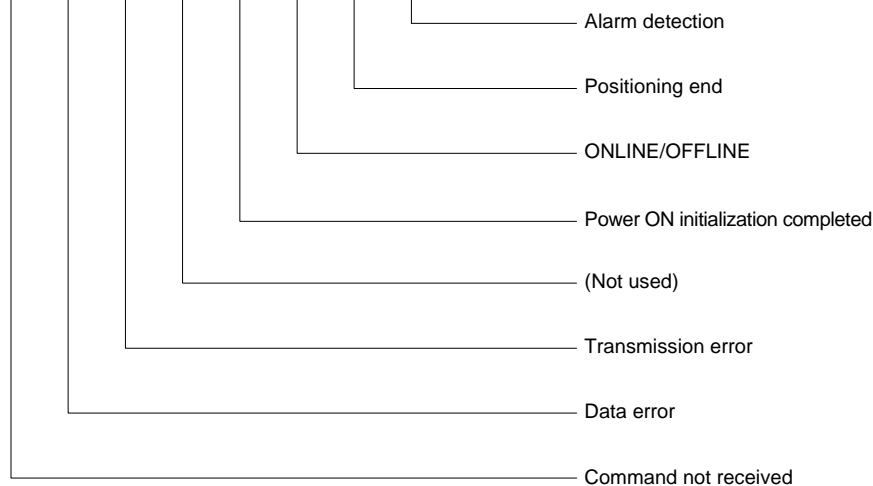
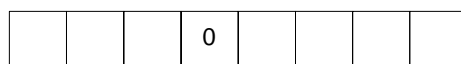
Code	Bit position	Function	Description
ST1	7	Command not received	0: Allowed, 1: Not allowed
	6	Data error	0: No, 1: Yes
	5	Transmission error	0: No, 1: Yes
	4	Not used	0: Fixed
	3	Power ON initialization completed	0: Initialization completed, 1: Initializing
	2	ONLINE/OFFLINE	0: ONLINE, 1: OFFLINE
	1	Positioning end	0: Operating, 1: Operation completed
	0	Alarm detection	0: No, 1: Yes
ST2	7 to 0	Not used	0: Not determined (area used by manufacturer)

Bit position

ST1

7

0



13.1.8 List of commands

■List of commands

No.	Function	CMND	DATA area			
			Memory type	Address (L)	Address (M)	Address (H)
Monitor						
01	Data read with multiple monitors	5 0 H	0 1 H	Monitor designated bit		0 0 H
Sequence monitor						
02	Sequence mode read	5 0 H	0 2 H	0 0 H	0 0 H	0 1 H
03	Sequence input/output signal read					0 2 H
04	Alarm history read					0 3 H
05	System status read					0 4 H
06	Current alarm read					0 7 H
Parameter edit						
07	Parameter read	5 0 H	0 3 H	Quantity (1 to 4)	Number (1 to 99)	0 0 H
08	Parameter write	5 1 H				0 1 H
Operation command						
09	Alarm reset	5 1 H	0 8 H	0 0 H	0 1 H	1 7 H
10	Alarm history initialization					2 3 H

13.2 Command transmission specification

The messages transmitted between the upper level system and the amplifier are classified into the following two messages:

- Request command: Message transmitted from the upper level system to the amplifier
 - Response command: Message transmitted from the amplifier to the upper level system
- Communication between amplifiers is not performed.

13.2.1 Communication start procedure

The amplifier does not give response for communication from the upper level system until internal initialization is completed after power supply. When the power is supplied, perform the following procedure before normal communication.

- ① After the power is supplied, wait for approx. 1.5 [s].
- ② Issue the "Status communication check" command from the upper level system and make sure that there is a response from the amplifier. At this time, check if "Power ON initialization completion (3rd bit)" is 0 (= OFF) with the "Status information (STR1)" in the response data. When this bit is 1 (= ON), it is under initialization.

13.2.2 Normal communication procedure

- ① The upper level system transmits the request command to the amplifier.
- ② After reception of the request command, the amplifier performs the requested command processing and transmits the response command.

The upper level system should confirm the response command before transmitting the next request command. The request commands should not be continuously transmitted without confirmation of the response command.

- ③ Other than the processing in ②, the amplifier is always waiting for commands from the upper level system.

<Procedure for error to improve reliability (Example)>

- ① Transmission error of physical or character level (detection by amplifier)

If a physical or character level (e.g. parity error) transmission error occurs during reception of the request command from the upper level system, the amplifier does not return the response command (no response).

If there is no response from the amplifier, the upper level system should send the same request command.

- The timer start timing for no response judgment time (timeout) is completion of the request command transmission.
- Set the timeout time as follows according to the transmission speed:

38400 [bps]	: 100 [ms] or more
19200 [bps]	: 200 [ms] or more
9600 [bps]	: 500 [ms] or more
- Several retry counts, depending on the application, are recommended.

② Transmission error of physical or character level (detection by upper level system)

If a physical or character level transmission error occurs during reception of the response command from the amplifier, it is recommended that the upper level system should send the same request command.

- Set the retransmission timing as follows after transmission error:

38400 [bps] : 100 [ms] or more

19200 [bps] : 200 [ms] or more

9600 [bps] : 500 [ms] or more

- Several retry counts, depending on the application, are recommended.

13.3 Protocol level error

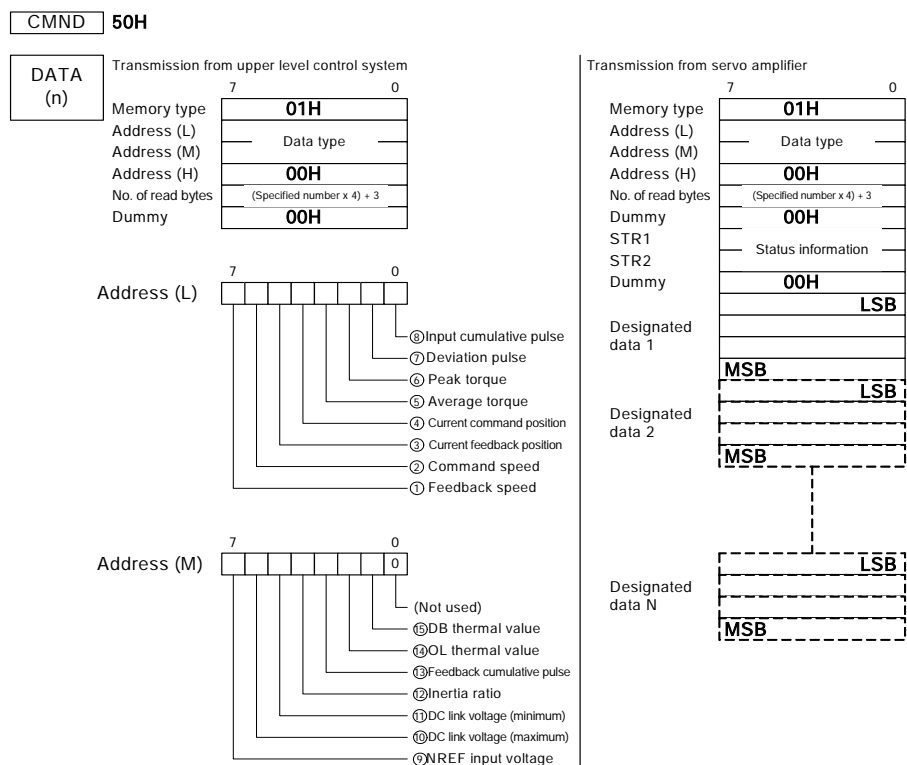
When the protocol is incorrect (data error), the amplifier does not perform the requested command processing. Error information is notified with "Status information (STR1)" in the response command. For details of STR1, refer to 13-1 (7) Data format details.

While the upper level application software is developed, it is recommended that error information is checked. Debug the protocol according to error information.

- Data error occurs when the request command data (header, BCC, setting range for parameter data, etc.) is incorrect. Modify the data details.
- Command not received occurs when the parameter is written with parameter write protect. Check the setting for parameter No. 29 "parameter write protect."
- Access to the memory in the amplifier is limited with LV (undervoltage). When a parameter is read/written or when an alarm history is read, the command may not be received. Check the power supply status.

13 RS485 COMMUNICATIONS

■ Multiple monitor data read



Transmit data that has 1 in address (L) and address (M) from the servo amplifier.

Maximum 6 data can be designated with priority number.

To obtain the current feedback position and the average torque, designate 28H to address (L).

Each piece of data is transmitted in the range of the table below with the 32 bit length fixed.

Monitor	Data (32 bit length binary fixed)	Maximum value	Priority
Feedback speed	3000 [r/min]/4000H, with \pm	Maximum rotation speed x 110%	1
Command speed			2
Current feedback position	1 [pulse]/1H, with \pm	-2147483648 or 2147483647	3
Current command position			4
Average torque	300 [%]/1 FFFH (rated torque 100%), with \pm	300 [%]	5
Peak torque			6
Deviation pulse	1 [pulse]/1H, with \pm	-2147483648 or 2147483647	7
Input cumulative pulse			8
NREF input voltage	11.2 [V]/2000H, with \pm	11.2 [V]	9
DC link voltage (maximum)	510 [V]/3FFH	510 [V]	10
DC link voltage (minimum)			11
Inertia ratio	1.00 multiplied/100H (1.0 multiplied load inertia at 100H)	100.00 [multiplied]	12
Feedback cumulative pulse	1 [pulse]/1H, with \pm	-2147483648 or 2147483647	13
OL thermal value	100 [%]/1000H, with \pm	100 [%] = Trip level	14
DB thermal value			15

13 RS485 COMMUNICATIONS

■ Sequence mode read

CMND

50H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	01H	
No. of read bytes	05H	
Dummy	00H	

Transmission from servo amplifier

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	01H	
No. of read bytes	05H	
Dummy	00H	
STR1	— Status information —	
STR2		
Control mode		
Operation mode		
Dummy	00H	

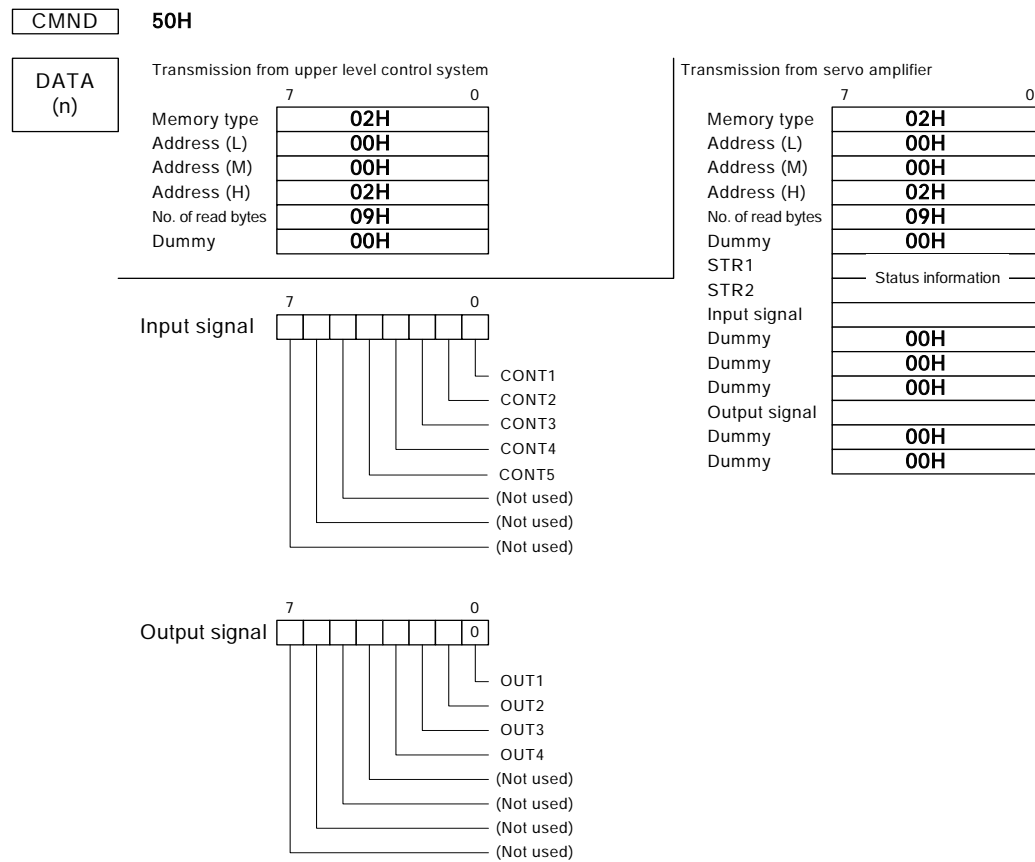
Control mode

Data	Control mode
00H	Position control
01H	Speed control
02H	Torque control

Operation mode

Data	Operation mode
00H	Servo OFF
01H	Servo ON
02H	Zero speed stop
03H	Manual operation (JOG)
04H	Pulse string (PIN)
05H	+OT
06H	-OT
07H	Undervoltage (LV)

■ Sequence input/output signal read



13 RS485 COMMUNICATIONS

■ Alarm history read

CMND

50H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	03H	
No. of read bytes	0BH	
Dummy	00H	

Transmission from servo amplifier

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	03H	
No. of read bytes	0BH	
Dummy	00H	
STR1	— Status information —	
STR2		
ALM01	Detection of description (latest)	
ALM02	Detection of description (one previous)	
ALM03	Detection of description (two previous)	
ALM04	Detection of description (three previous)	
ALM05	Detection of description (four previous)	
ALM06	Detection of description (five previous)	
ALM07	Detection of description (six previous)	
ALM08	Detection of description (seven previous)	
ALM09	Detection of description (eight previous)	

List of alarm codes

Code	Description
00H	(No detection)
01H	Overcurrent 1
02H	Overcurrent 2
03H	Overspeed
04H	Overvoltage
05H	Encoder error
06H	Control power error
08H	Memory error
0AH	Regenerative transistor overheating
0BH	Encoder communication error
0CH	CONT duplication
0DH	Overload
0EH	Undervoltage
0FH	Regenerative resistor overheating
10H	Deviation limit
11H	Amplifier overheating

13 RS485 COMMUNICATIONS

■ Current alarm history read

CMND

50H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	07H	
No. of read bytes	03H	
Dummy	00H	

Transmission from servo amplifier

	7	0
Memory type	02H	
Address (L)	00H	
Address (M)	00H	
Address (H)	07H	
No. of read bytes	03H	
Dummy	00H	
STR1	Status information	
STR2		
Current alarm		

List of alarm codes

Code	Description
00H	(No detection)
01H	Overcurrent 1
02H	Overcurrent 2
03H	Overspeed
04H	Overvoltage
05H	Encoder error
06H	Control power error
08H	Memory error
0AH	Regenerative transistor overheating
0BH	Encoder communication error
0CH	CONT duplication
0DH	Overload
0EH	Undervoltage
0FH	Regenerative resistor overheating
10H	Deviation limit
11H	Amplifier overheating

■ Parameter read

CMND 50H

DATA
(n)

Transmission from upper level control system

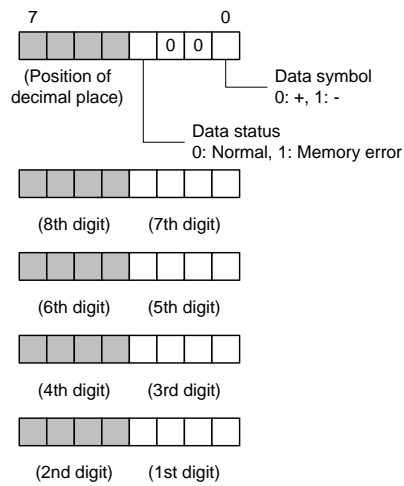
	7	0
Memory type	03H	
Address (L)	Quantity (01H to 04H)	
Address (M)	No. (01H to 99H)	
Address (H)	00H	
No. of read bytes	(Designated number x 5) + 2	
Dummy	00H	

* Address (M) is designated with BCD.
Ex.) No. 49→49H, No. 50→50H

Transmission from servo amplifier

	7	0
Memory type	03H	
Address (L)	Quantity (01H to 04H)	
Address (M)	Number (01H to 99H)	
Address (H)	00H	
No. of read bytes	(Designated number x 5) + 2	
Dummy	00H	
STR1	Status information	
STR2		
Parameter of designated number		
Parameter of designated number +1		
Parameter of designated number + designated quantity -1		

Parameter of designated number (5 bytes)



* The data is BCD 8 digits.

13 RS485 COMMUNICATIONS

■ Parameter write

CMND

50H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	03H	
Address (L)	Quantity (01H to 04H)	
Address (M)	Number (01H to 99H)	
Address (H)	01H	
No. of read bytes	(Written quantity x 5)	
Dummy	00H	
Parameter of designated number		
Parameter of designated number +1		

Parameter of designated number + designated quantity -1

* Address (M) is designated with BCD.
Ex.) No. 49?49H, No. 50?50H

Transmission from servo amplifier

	7	0
Memory type	03H	
Address (L)	Quantity (01H to 04H)	
Address (M)	Number (01H to 99H)	
Address (H)	01H	
No. of read bytes	(Written quantity x 5)	
Dummy	00H	
STR1	Status information	
STR2		

* When all data are normal, the designated quantity is written.
If an error is found, the subsequent data is not written.
Turn ON the 6th bit data error of STR1 and return the quantity actually written.

Parameter of designated number (5 bytes)

7					0
			0	0	0
(Position of decimal place)					
Data symbol 0: +, 1: -					
(8th digit)		(7th digit)			
(6th digit)		(5th digit)			
(4th digit)		(3rd digit)			
(2nd digit)		(1st digit)			

* The data is BCD 8 digits.

■ Alarm reset

CMND

51H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	08H	
Address (L)	00H	
Address (M)	01H	
Address (H)	17H	
No. of read bytes	00H	
Dummy	00H	

Transmission from servo amplifier

	7	0
Memory type	08H	
Address (L)	00H	
Address (M)	01H	
Address (H)	17H	
No. of read bytes	00H	
Dummy	00H	
STR1	Status information	
STR2		

■ Alarm history initialization

CMND

51H

DATA
(n)

Transmission from upper level control system

	7	0
Memory type	08H	
Address (L)	00H	
Address (M)	01H	
Address (H)	23H	
No. of read bytes	00H	
Dummy	00H	

Transmission from servo amplifier

	7	0
Memory type	08H	
Address (L)	00H	
Address (M)	01H	
Address (H)	23H	
No. of read bytes	00H	
Dummy	00H	
STR1	Status information	
STR2		

13 RS485 COMMUNICATIONS

- MEMO -

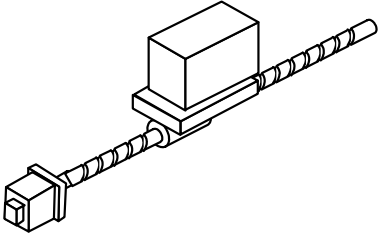
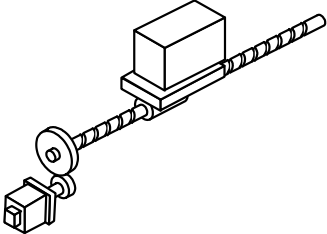
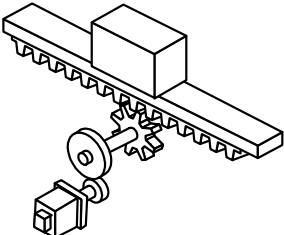
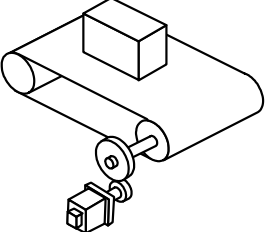
APPENDIXES

■ Calculation of capacity selection.....	A- 2
■ PC loader	A-17
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■ Calculation of capacity selection

(1) Machine type

The following types are available for machines that operate with the variable speed motor.

Mechanism	Feature
	Ball screw (direct link) Used for highly accurate positioning over short distance. The motor and the ball screw are only connected with the coupling, excluding any backlash.
	Ball screw (deceleration) With deceleration ratio, torque transferred to the machine is increased. Compensation for backlash of the gear is required.
	Rack and pinion Use for positioning over a relatively long distance (operation of carrier, etc.). Since the value of π is included for one rotation of the pinion, compensation for the value is required.
	Timing belt (conveyor) The degree of freedom in shape is larger than that of the chain. It is mainly used for light loads. Since the value of π is included for one rotation of the pulley, compensation for the value is required.

Pay attention to the following points when using the servo system on a machine.

① Deceleration ratio

To effectively use the servomotor power, use the motor at around the rated speed (maximum rotation speed). The continuous output torque at the maximum rotation speed is smaller than the rated torque.

② Preload torque

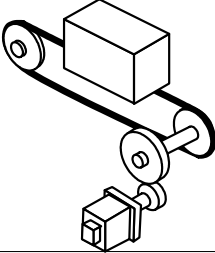
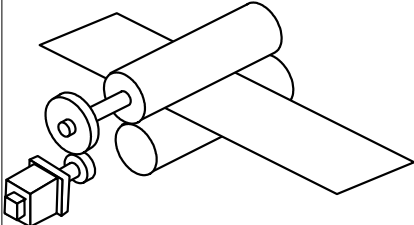
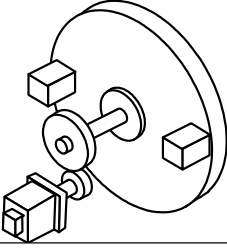
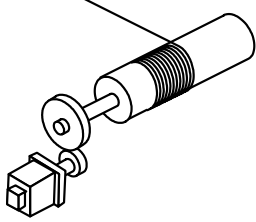
When preload is applied to the screw, rigidity increases but the load torque value also increases.

Refer to the ball screw specification for friction torque with preload.

③ Retention torque

In a lifting machine, the servomotor continues to output retention force during stoppage.

If time allows, it is recommended to use the retention brake.

Mechanism	Feature
	Chain drive Frequently used for transfer lines. Action to prevent extension of the chain is required. A relatively large deceleration ratio is used and the movement speed of the machine is slow.
	Feed roll A sheet (strip) of material is fed by pressing with rolls. Since the roll diameter is not strictly defined, there may be a dimensional error over a long distance. Compensation of the π value is required. If the system is suddenly accelerated, slippage occurs, resulting in a lack of feed amount.
	Table indexing Since the inertia moment of the table is large, a sufficient deceleration ratio is required. The rotation speed of the table is low and worm gears are often used.
	Shaft drive Since the inertia moment in a coil winding is large, sufficient deceleration is required. With constant surface speed control, review is required, including peripheral devices.

A APPENDIXES

<Reference>

Guideline of friction coefficient μ

Mechanism	Friction coefficient
Rail and steel wheel (carrier, 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
Polyacetal	1.43×10^3

Guideline value for machine efficiency η

Mechanism	Machine efficiency
Trapezoidal thread	0.5 to 0.8
Ball screw	0.9
Rack & pinion	0.8
Gear deceleration	0.8 to 0.95
Worm gear deceleration (start)	0.5 to 0.7
Worm gear deceleration (during operation)	0.6 to 0.8
Belt transfer	0.95
Chain transfer	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

(2) Calculation of capacity selection

Calculation of capacity selection is the calculation to find required servomotor capacity from the machine specification (configuration).

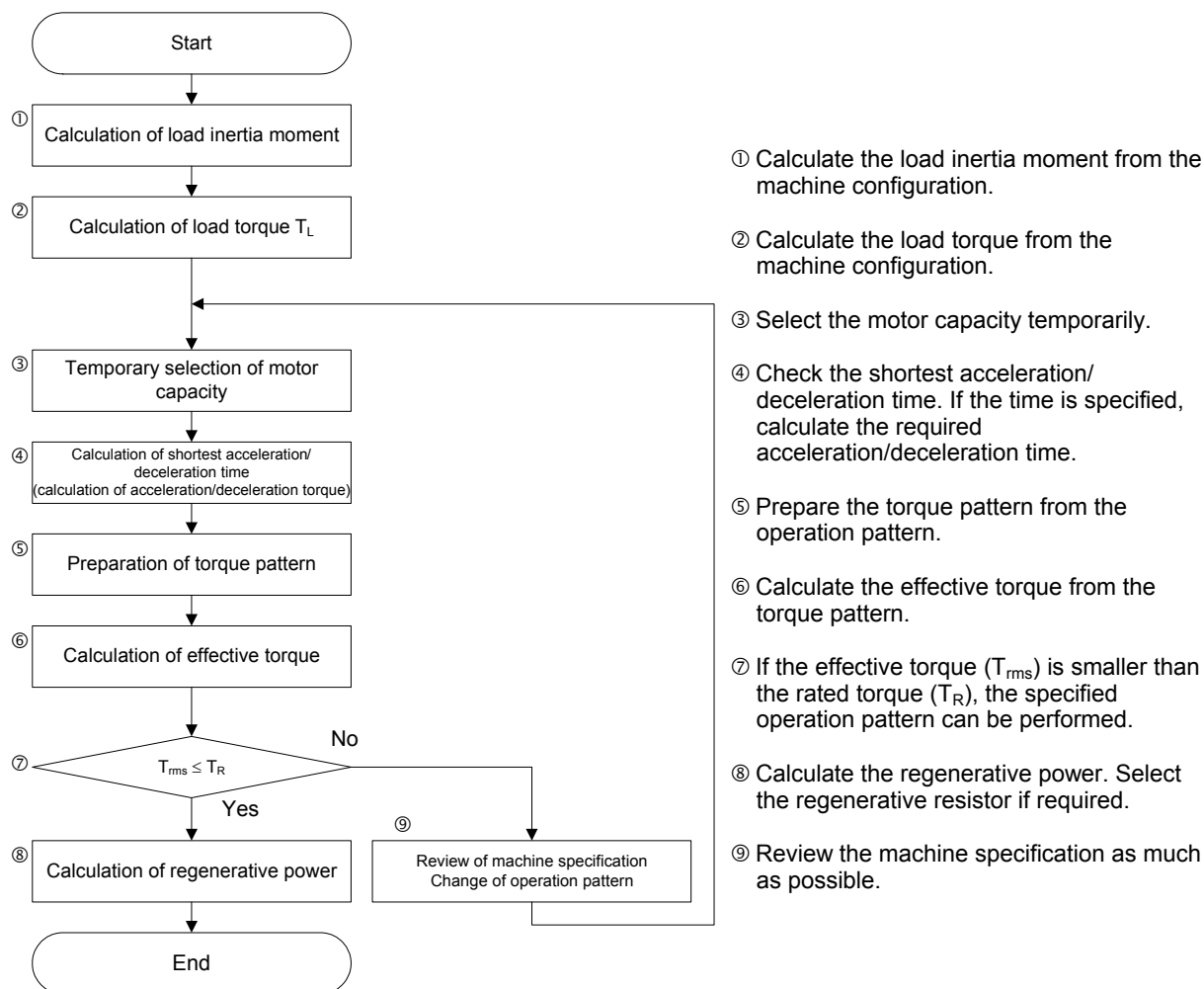
Items required for calculation of the capacity selection are as follows:

- Load inertia moment (machine inertia moment)
- Load torque (required torque to operate the machine)
- Acceleration/deceleration time
- Operation pattern

In general, the inertia moment and the load torque of a machine cannot be measured. An approximate value is calculated from the machine configuration.

The procedure for the capacity selection calculation is as follows:

Capacity selection flowchart



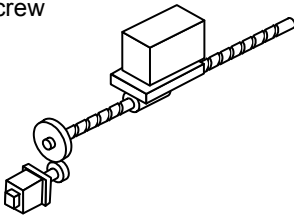
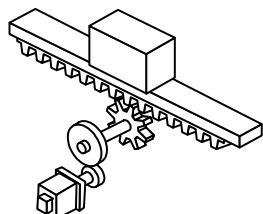
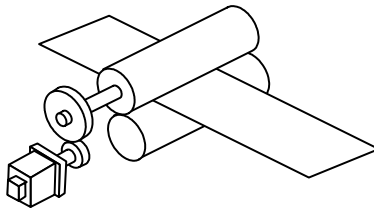
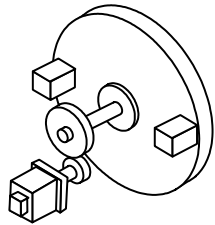
A APPENDIXES

<Calculation of moment of inertia>

• Shape

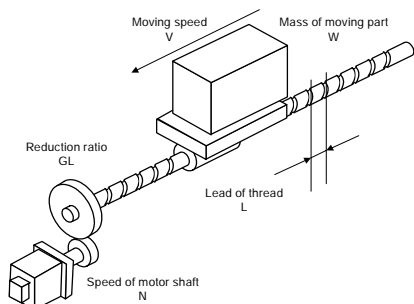
	$J_z = \frac{W}{8} \left(\frac{D}{10^3} \right)^2$ $= \frac{\pi \rho}{32} \left(\frac{L}{10^3} \right) \left(\frac{D}{10^3} \right)^4$ $J_x = J_y = \frac{W}{16} \left(\frac{D}{10^3} \right)^2 + \frac{W}{12} \left(\frac{L}{10^3} \right)^2$ $W = \frac{\pi \rho}{4} \left(\frac{L}{10^3} \right) \left(\frac{D}{10^3} \right)^2$
	$J_z = \frac{W}{8} \left[\left(\frac{D_2}{10^3} \right)^2 - \left(\frac{D_1}{10^3} \right)^2 \right]$ $= \frac{\pi \rho}{32} \left(\frac{L}{10^3} \right) \left[\left(\frac{D_2}{10^3} \right)^4 - \left(\frac{D_1}{10^3} \right)^4 \right]$ $J_x = J_y = \frac{W}{16} \left[\left(\frac{D_2}{10^3} \right)^2 - \left(\frac{D_1}{10^3} \right)^2 \right] + \frac{W}{12} \left(\frac{L}{10^3} \right)^2$ $W = \frac{\pi \rho}{4} \left(\frac{L}{10^3} \right) \left[\left(\frac{D_2}{10^3} \right)^2 - \left(\frac{D_1}{10^3} \right)^2 \right]$
	$J_z = \frac{W}{16} \left[\left(\frac{A}{10^3} \right)^2 + \left(\frac{B}{10^3} \right)^2 \right]$ $J_x = \frac{W}{16} \left(\frac{B}{10^3} \right)^2 + \frac{W}{12} \left(\frac{L}{10^3} \right)^2$ $J_y = \frac{W}{16} \left(\frac{A}{10^3} \right)^2 + \frac{W}{12} \left(\frac{L}{10^3} \right)^2$ $W = \frac{\pi \rho}{4} \left(\frac{A}{10^3} \right) \left(\frac{B}{10^3} \right) \left(\frac{L}{10^3} \right)$
	$J_x = \frac{W}{12} \left[\left(\frac{B}{10^3} \right)^2 + \left(\frac{L}{10^3} \right)^2 \right]$ $J_y = \frac{W}{12} \left[\left(\frac{L}{10^3} \right)^2 + \left(\frac{A}{10^3} \right)^2 \right]$ $J_z = \frac{W}{12} \left[\left(\frac{A}{10^3} \right)^2 + \left(\frac{B}{10^3} \right)^2 \right]$ $W = \rho \left(\frac{A}{10^3} \right) \left(\frac{B}{10^3} \right) \left(\frac{L}{10^3} \right)$
	$J_x = \frac{W_2}{12} \left[\left(\frac{B_2}{10^3} \right)^2 + \left(\frac{L}{10^3} \right)^2 \right] - \frac{W_1}{12} \left[\left(\frac{B_1}{10^3} \right)^2 + \left(\frac{L}{10^3} \right)^2 \right]$ $J_y = \frac{W_2}{12} \left[\left(\frac{A_2}{10^3} \right)^2 + \left(\frac{L}{10^3} \right)^2 \right] - \frac{W_1}{12} \left[\left(\frac{A_1}{10^3} \right)^2 + \left(\frac{L}{10^3} \right)^2 \right]$ $J_z = \frac{W_2}{12} \left[\left(\frac{A_2}{10^3} \right)^2 + \left(\frac{B_2}{10^3} \right)^2 \right] - \frac{W_1}{12} \left[\left(\frac{A_1}{10^3} \right)^2 + \left(\frac{B_1}{10^3} \right)^2 \right]$ $W = \rho \left[\left(\frac{A_2}{10^3} \right) \left(\frac{B_2}{10^3} \right) - \left(\frac{A_1}{10^3} \right) \left(\frac{B_1}{10^3} \right) \right] \left(\frac{L}{10^3} \right)$ $W_2 = \rho \left(\frac{A_2}{10^3} \right) \left(\frac{B_2}{10^3} \right) \left(\frac{L}{10^3} \right) \quad W_1 = \rho \left(\frac{A_1}{10^3} \right) \left(\frac{B_1}{10^3} \right) \left(\frac{L}{10^3} \right)$

• Conversion

<p>Ball-screw</p> 	$J_1 = W \left(\frac{1}{2\pi} \times \frac{BP}{10^3} \right)^2 \times GL^2$ <p> W : Mass of movable part [kg] BP : Lead of thread [mm] GL : Reduction ratio (no unit) </p>
<p>Rack and pinion, conveyor, chain drive</p> 	$J_1 = W \left(\frac{1}{2\pi} \times \frac{BP}{10^3} \right)^2 \times GL^2$ <p> W : Total mass of moving parts [kg] D : Diameter of pinion [mm] : Diameter of sprocket [mm] GL : Reduction ratio (no unit) </p>
<p>Feed roll</p> 	$J_3 = \frac{W}{4} \left(\frac{D}{10^3} \right)^2 \times GL^2$ <p> W : Total mass of moving parts [kg] D : Diameter of roll [mm] GL : Reduction ratio (no unit) </p>
<p>Rotor, table drive</p> 	<p>The moment of inertia can be obtained as a sum of each shape. Moment of inertia of an object placed at a distance from rotating shaft (J_4)</p> $J_4 = \left(J + W \left(\frac{L}{10^3} \right)^2 \right) \times GL^2$ <p> J : Moment of inertia around CG of body W : Mass of body [kg] L : Distance between body and rotating shaft [mm] GL : Reduction ratio (no unit) </p>

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<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 : Coefficient of friction

BP : Lead of thread [mm]

W, W_1 : Mass of moving part [kg]

W_2 : Mass of counter-weight [kg]

GL : Reduction ratio (no unit)

F : Thrust force [kg]

- When lifting vertically

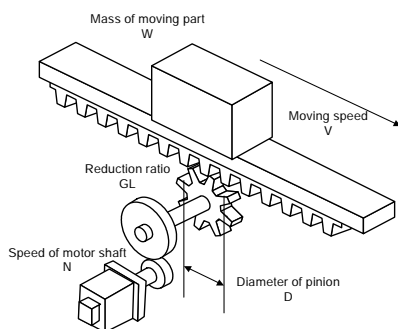
$$T_L = \frac{((\mu + 1) W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3} \right) \times GL$$

- When lowering vertically

$$T_L = \frac{((\mu - 1) W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3} \right) \times GL$$

- When stopping vertically

$$T_L = \frac{(W_1 - W_2) \times 9.81}{2\pi\eta} \left(\frac{BP}{10^3} \right) \times GL$$



Conveyor, rack and pinion

$$T_L = \frac{(\mu W + F) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3} \right) \times GL$$

μ : Coefficient of friction

D : Diameter [mm]

W, W_1 : Mass of moving part [kg]

W_2 : Mass of counter-weight [kg]

GL : Reduction ratio (no unit)

- When lifting vertically

$$T_L = \frac{((\mu + 1) W_1 - W_2) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3} \right) \times GL$$

- When lowering vertically

$$T_L = \frac{((\mu - 1) W_1 - W_2) \times 9.81}{\eta} \left(\frac{D}{2} \times \frac{1}{10^3} \right) \times GL$$

- When stopping 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 Calculation of load inertia moment (J_L)

Calculate the load inertia moment (GD^2) of the machine transferred to the motor shaft.

When the motor rotates, calculate the inertia moment of accompanying rotating (moving) parts and obtain the total sum.

② Calculation of load torque (T_L)

Calculate the load torque converted to the motor shaft.

③ Temporary selection of motor capacity

Select the motor capacity that satisfies the following two conditions:

■ Allowable load inertia moment

$J_L \leq J_M \times 100$ (30) Slow movement during speed control

$J_L \leq J_M \times 30$ (10) Positioning during position control

$J_L \leq J_M \times 10$ (-) Highly frequent positioning
(RUN/STOP every 0.5 seconds as a measure)

* The values in () are for use with the GYG motor.

■ Load torque

$T_L \leq T_R \times 0.9$ 0.9 is an example of safety factor.

④ Calculation of shortest acceleration/deceleration time

(calculation of acceleration/deceleration torque)

Check the shortest acceleration/deceleration time considering load conditions. If the acceleration/deceleration time is specified, calculate the acceleration/deceleration torque.

• Shortest acceleration/deceleration time $t_{AC} = \frac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60 (T_{AC} - T_L)}$

• Acceleration/deceleration torque $T_{AC} = \frac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60 (t_{AC})} + T_L$

t_{AC} : Acceleration/deceleration time [s]

J_M : Inertia moment of servomotor [kgm^2]

J_L : Load inertia moment of motor shaft conversion [kgm^2]

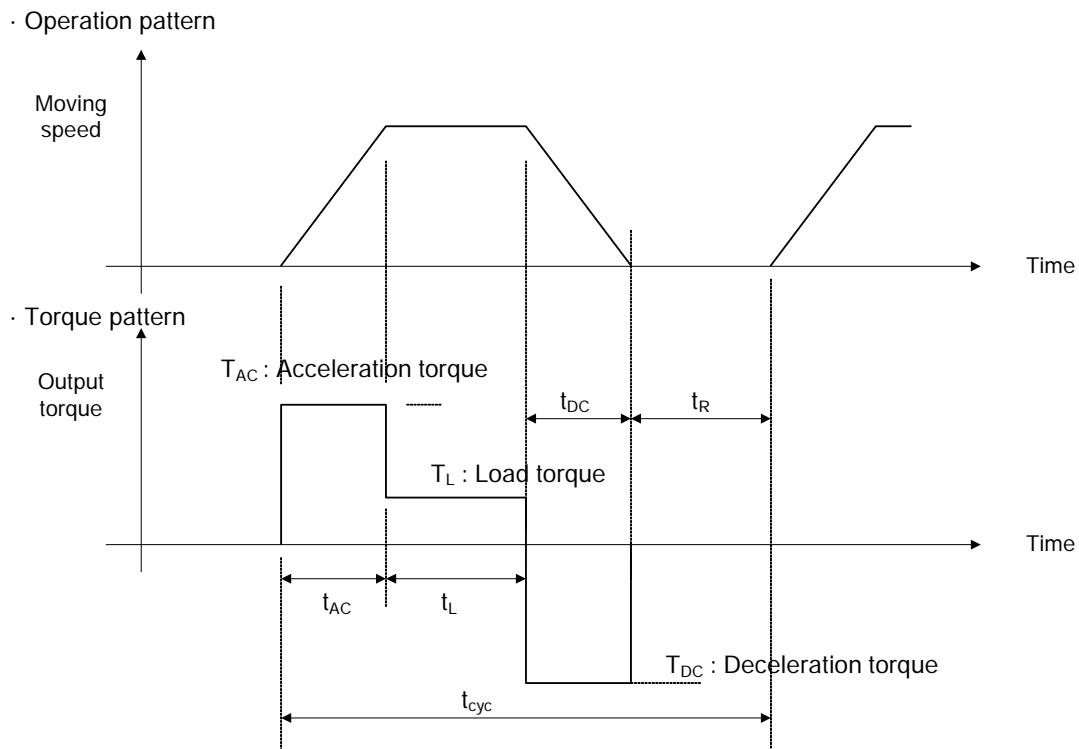
T_L : Load torque of motor shaft conversion [Nm]

T_{AC} : Acceleration/deceleration torque [Nm]

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⑤ Preparation of torque pattern

Prepare the output torque pattern from the operation pattern.



⑥ Calculation of effective torque (T_{rms})

Calculate the effective torque of operation pattern 1 cycle.

$$T_{rms} = \sqrt{\frac{(T_{AC}^2 \times t_{AC}) + (T_L^2 \times t_L) + (T_{DC}^2 \times t_{DC})}{t_{cyc}}}$$

The sum multiplied by the output from each output torque squared is divided by the time of 1 cycle and the square root of the value is obtained.

⑦ $T_{rms} \leq T_R$

When the effective torque is equal to or less than the rated torque, continuous operation is allowed with the specified operation pattern.

⑧ Calculation of regenerative power

In general, regenerative operation is performed in the following conditions:

Feed in horizontal direction : During deceleration

Feed in vertical direction : Feed during lowering at constant speed and during deceleration

Regenerative power during deceleration (P_1)

$$P_1[W] = (2\pi/60) \times T_{DC}[Nm] \times N_1[r/min] \times (1/2)$$

Feed during lowering at constant speed (P_2)

$$P_2[W] = (2\pi/60) \times T_{DC}[Nm] \times N_1[r/min]$$

Calculate average regenerative power (P) during operation pattern 1 cycle and make sure that the value is less than the regenerative resistance capacity. If it is more than the capacity, use the external regenerative resistor.

$$P[W] = \frac{(P_1[W] \times t_1[s] + P_2[W] \times t_2[s])}{t_{CYC}[s]}$$

⑨ Review of operation pattern/machine configuration

If T_{rms} is more than T_R , review the following points:

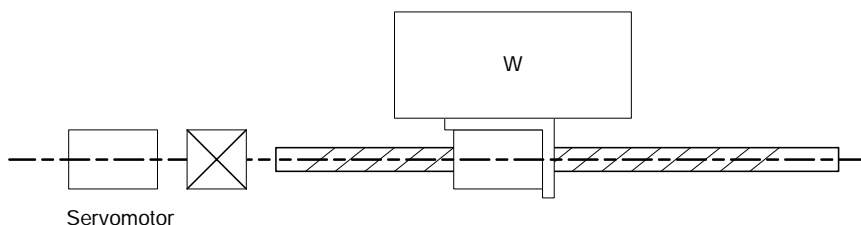
- Extend the acceleration/deceleration time in the range allowed.
- Extend the operation frequency (1 cycle time).
- If the rotation speed has an allowance, increase the deceleration ratio.
- Increase the motor capacity.
- If the stop time is long for a lifting machine, apply the brake mechanically.
- For highly frequent operation, increase the deceleration ratio and decrease the inertia moment as much as possible.

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(3) Calculation example of capacity selection

■ Machine configuration

Deceleration ratio 1/1 (direct link)



Thread pitch: 10 mm, Transfer weight: 20 kg, Thrust: 0 kg (None)

① Maximum moving speed (v)

Deceleration ratio 1/1 at motor rotation speed of 3000 [r/min]

$$v = (3000/60) \times 10 \times (1/1) = 500 \text{ [mm/s]}$$

② Load inertia moment converted to motor shaft (J_L)

- Temporarily determine screw (J_1) of $\Phi 20$ and length of 500 mm.

$$\begin{aligned} J_1 &= \frac{\pi \rho}{32} \left[\frac{L}{1000} \right] \left[\frac{D_1}{1000} \right]^4 \times GL^2 \\ &= \frac{\pi \times 7.85 \times 10^3}{32} \left[\frac{500}{1000} \right] \left[\frac{20}{1000} \right]^4 \times (1/1)^2 \\ &= 0.6 \times 10^{-4} \text{ [kg m}^2\text{]} \end{aligned}$$

- Temporarily determine transfer weight of 20 kg in movable area (J_2).

$$\begin{aligned} J_2 &= W \left[\frac{1}{2\pi} \frac{BP}{1000} \right]^2 \times (GL)^2 \\ &= 20 \left[\frac{1}{2\pi} \frac{10}{1000} \right]^2 \times (1/1)^2 \\ &= 0.5 \times 10^{-4} \text{ [kg m}^2\text{]} \end{aligned}$$

$$J_L = 1.1 \times 10^{-4} \text{ [kg m}^2\text{]}$$

③ Motor shaft conversion load torque (T_L)

Temporarily determine transfer weight of 20 kg, friction coefficient (μ) of 0.1 and machine efficiency (η) of 0.9.

$$\begin{aligned} T_L &= \frac{(\mu W + F) \times 9.81}{2\pi\eta} \left[\frac{BP}{1000} \right] \times GL \\ &= \frac{(0.1 \times 20 + 0) \times 9.81}{2\pi \times 0.9} \left[\frac{10}{1000} \right] \times (1/1) \\ &= 0.03 \text{ [Nm]} \end{aligned}$$

④ Capacity selection conditions

$$T_L \leq T_R \times 0.9$$

$$J_L \leq J_M \times 5 \quad (\text{Highly frequent feed})$$

$$T_L = 0.03 \text{ [Nm]}$$

$$J_L = 1.1 \times 10^{-4} \text{ [kg m}^2\text{]}$$

⑤ Temporary selection

From the capacity selection conditions, GYS201DC2-T2A (0.2 kW) is selected.

$$(J_M = 0.135 \times 10^{-4} \text{ [kgm}^2\text{]}, T_R = 0.637 \text{ [Nm]}, T_{AC} = 1.91 \text{ [Nm]})$$

⑥ Shortest acceleration/deceleration time (t_{AC})

$$\begin{aligned} t_{AC} &= \frac{(J_M + J_L) \times 2\pi \times N}{60 (T_{AC} - T_L)} \\ &= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 (1.91 - 0.03)} \\ &= 0.021 \text{ [s]} \end{aligned}$$

Acceleration/deceleration torque with acceleration/deceleration time of 0.05 sec.

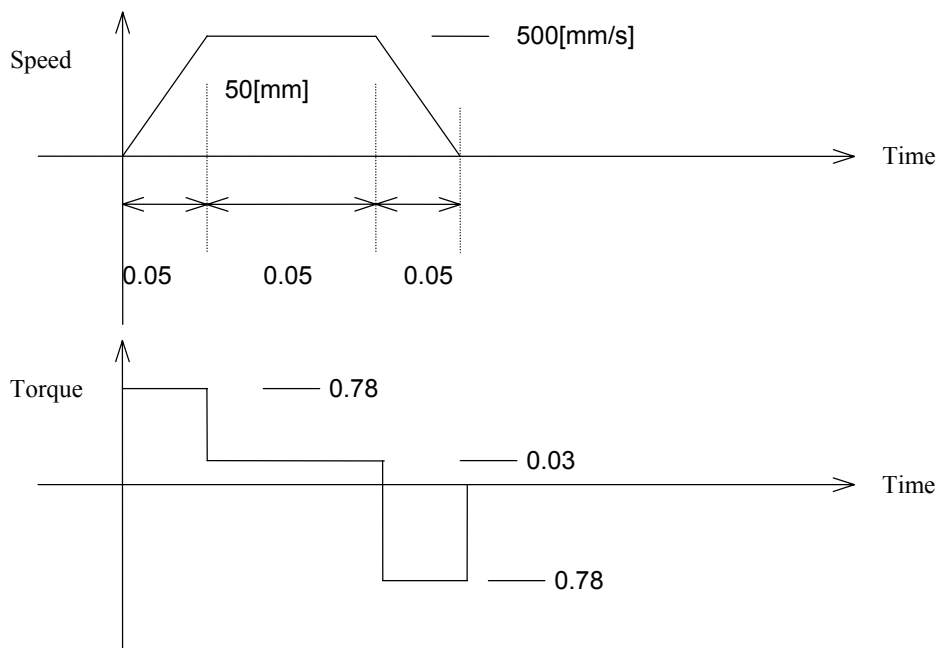
$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60 (t_{AC})} + T_L$$

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$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 \times 0.05} + 0.03$$

$$= 0.78 \text{ [Nm]}$$

⑦ Operation pattern



* Pattern for capacity selection. 0.5 sec. is temporarily determined for 1 cycle operation.

⑧ Effective torque (T_{rms})

It is the time average value of the output torque.

$$T_{rms} = \sqrt{\frac{T_{AC}^2 \times t_a + T_L^2 \times t_L + T_{DC}^2 \times t_d}{t_{cyc}}}$$

$$= \sqrt{\frac{(0.78^2 \times 0.05) \times 2 + (0.03^2 \times 0.05) \times 1}{0.5}}$$

$$= 0.25 \text{ [Nm]}$$

Since the rated torque of GYS201DC2-T2A type is 0.637 [Nm] or less, continuous operation is allowed for the specified pattern.

⑨ Selection result

Servomotor : GYS201DC2-T2A (0.2kW)

⑩ Regenerative power

Regenerative power is recovered during deceleration.

$$\begin{aligned} P_1[W] &= (2\pi/60) \times T \text{ [Nm]} \times N[r/min] \times (1/2) \\ &= (2\pi/60) \times 0.78 \times 3000 \times (1/2) \\ &\approx 123 \text{ [W]} \end{aligned}$$

Average regenerative power in 1 cycle operation

$$\begin{aligned} P &= (123 \times 0.05) / 0.5 \\ &\approx 12.3 \text{ [W]} \end{aligned}$$

The RYC201D3 type servo amplifier does not have a built-in regenerative resistor.

Review necessity for a regenerative resistor.

Step 1) Obtain energy (E_G) of the machine during deceleration.

$$\begin{aligned} E_G &= \frac{1}{2} (J_M + J_L) \cdot (2\pi N/60)^2 \\ &= \frac{1}{2} (0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times \left[\frac{2\pi \times 3000}{60} \right]^2 \\ &= 6.1 \text{ [J]} \end{aligned}$$

Step 2) Calculate energy (E_L) consumed by load torque.

$$\begin{aligned} E_L &= (2\pi/60) \times T_L \times N \times t_{DC} \times (1/2) \\ &= (2\pi/60) \times 0.03 \times 3000 \times 0.05 \times (1/2) \\ &= 0.24 \text{ [J]} \end{aligned}$$

Step 3) Calculate energy (E_M) consumed by coil of the servomotor.

$$\begin{aligned} E_M &= 3 \times (R \times I^2) \times t_{DC} \\ &= 3 \times R \times ((T_{DC}/T_R \times I_R)^2) \times t_{DC} \\ &= 3 \times 2.3 \times ((0.78/0.637 \times 1.5)^2) \times 0.05 \\ &= 1.2 \text{ [J]} \end{aligned}$$

* GYS201DC2-T2A type phase resistance: 2.3Ω

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* Phase resistance

■ 3000 r/min series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia moment(JL) $\times 10^{-4}$ [kg·m ²]	Capacitor capacity [μ F]
GYS	0.05	0.85	4.7	0.0192	660
	0.1	0.85	7.8	0.0371	660
	0.2	1.5	2.3	0.135	660
	0.4	2.7	1.1	0.246	660
	0.75	4.8	0.4	0.853	990

■ 2000 r/min series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia moment(JL) $\times 10^{-4}$ [kg·m ²]	Capacitor capacity [μ F]
GYG	0.5	3.5	0.7	7.96	990
	0.75	5.2	0.4	11.55	990
	1	6.4	0.3	15.14	990
	1.5	10	0.2	22.33	1880
	2.0	12.3	0.15	29.51	1880

■ 1500 r/min series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia moment(JL) $\times 10^{-4}$ [kg·m ²]	Capacitor capacity [μ F]
GYG	0.5	4.7	0.4	11.55	990
	0.85	7.3	0.3	15.15	990
	1.3	11.5	0.2	22.33	1880

Step 4) Calculate energy (E_s) that can be absorbed by the servo amplifier.

$$\begin{aligned}
 E_s &= \frac{1}{2} CV^2 \\
 &= \frac{1}{2} (660 \times 10^{-6}) \times (385^2 - (200 \times 2^{1/2})^2) \\
 &= 22.5[\text{J}]
 \end{aligned}$$

* DC link capacitor (RYC201) 660 μ F, power voltage 200V (effective value)

* Resistance for the capacitor of the servo amplifier with 0.2 kW or less is 660 μ F.

Energy that can be processed with machine, servo amplifier and servomotor is:

$$E_L + E_M + E_s = 0.24 + 1.2 + 22.5 \approx 24[\text{J}]$$

With $E_G = 6.1$ [J], the external regenerative resistor is not required.

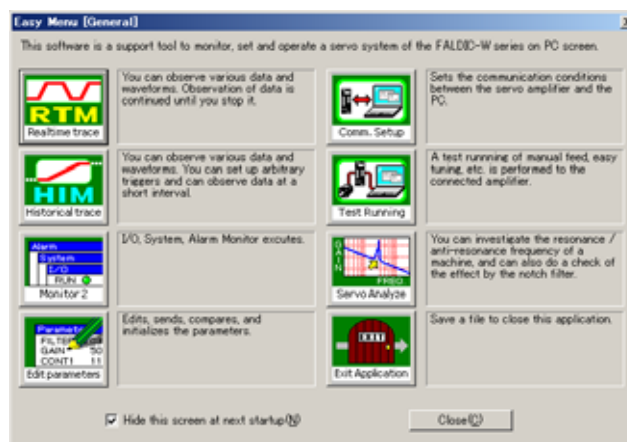
■ PC loader

PC loader software for FALDIC-W can be downloaded from our website below:

<http://www.fujielectric.co.jp/fcs/>

The following settings are available on the PC loader:

- (1) Real time tracing Speed or torque waveform can be continuously obtained.
- (2) Historical tracing Detailed waveform which is shorter than real time tracing can be obtained.
- (3) Monitor 2 I/O check, alarm history and system configuration can be monitored.
- (4) Parameter editing Parameters are edited, transferred, compared and initialized.
- (5) Communication settings ... Communication conditions between the servo amplifier and the PC are set.
- (6) Easy tuning Reciprocal operation of the servomotor is automatically performed with simple settings. The auto tuning gain suitable for the machine is adjusted.
- (7) Servo analyzing Resonance point/anti-resonance point of the machine is checked. Effects can also be checked with a notch filter.



Operating environment

- OS environment..... Windows 98SE, Windows NT4.0/WS (service pack 4 or later), Windows 2000, Windows ME, Windows XP
- CPU Pentium 133 MHz or higher is recommended.
- Memory environment..... 32 MB or better
- Display..... Display that has SVGA resolution of 800 × 600 or better, compatible with Windows
- Environment Hard disk drive space of 40MB bytes or larger (80MB bytes or larger is recommended.)

■ Parameter list

■ FALDIC-W parameter list (1)

No.	Name	Setting range	Setting	Change
01	Command pulse correction α	1 to 32767 (in 1 increments)		Always
02	Command pulse correction β	1 to 32767 (in 1 increments)		Always
03	Pulse string input form	0: Command pulse/command sign, 1: Forward/reverse rotation pulse, 2: Two signals with 90-degree phase difference		Power
04	Rotating direction switching/output pulse phase switching	0: Positive direction forward rotation (CCW)/B phase advance 1: Positive direction reverse rotation (CW)/B phase advance 2: Positive direction forward rotation (CCW)/A phase advance 3: Positive direction reverse rotation (CW)/A phase advance		Power
05	Tuning mode	0: Auto tuning, 1: Semi-auto tuning, 2: Manual tuning		Always
06	Load inertia ratio	GYS type: 0.0 to 100.0 times (in 0.1 increments) GYG type: 0.0 to 30.0 times (in 0.1 increments)		Always
07	Auto tuning gain	1 to 20 (in 1 increments)		Always
08	Auto forward gain	1 to 20 (in 1 increments)		Always
09	Control mode switching	0: Position 1: Speed 2: Torque 3: Position \leftrightarrow Speed 4: Position \leftrightarrow Torque 5: Speed \leftrightarrow Torque		Power
10	CONT 1 signal allocation	0 to 21 (in 1 increments)		Power
11	CONT 2 signal allocation	0: Not specified 1: Servo ON [RUN] 2: Reset [RST] 3: +OT 4: -OT 5: Emergency stop [EMG] 6: P motion 7: Deviation clear		Power
12	CONT 3 signal allocation	8: External regenerative resistor overheating 9: Anti-resonance frequency selection 0		Power
13	CONT 4 signal allocation	10: Anti-resonance frequency selection 1 11: Command pulse inhibition 12: Command pulse α selection 0 13: Command pulse α selection 1		Power
14	CONT 5 signal allocation	14: Control mode switching 15: Manual forward rotation [FWD] 16: Manual reverse rotation [REV] 17: Multistep speed 1 [x1] 18: Multistep speed 2 [x2] 19: Acceleration/deceleration time selection 20: Current limiting regulator ON 21: Coasting [BX]		Power
15	OUT 1 signal allocation	0 to 10 (in 1 increments)		Power
16	OUT 2 signal allocation	0: Not specified 1: Ready [RDY] 2: Positioning end [PSET] 3: Alarm detection: a contact 4: Alarm detection: b contact 5: Dynamic braking		Power
17	OUT 3 signal allocation	6: OT detection 7: Forced stop detection 8: Zero deviation 9: Zero speed 10: Current limit detection 11: Brake timing		Power
18	OUT 4 signal allocation			Power
19	Output pulse count	16 to 32768 [pulse] (in 1 increments)		Power
20	Phase-Z offset	0 to 65535 [$\times 2$ pulse] (in 1 increments)		Power
21	Zero deviation width	1 to 20000 [pulse] (in 1 increments)		Always
22	Deviation limit width	10 to 65535 [$\times 100$ pulse] (in 1 increments)		Always
23	Zero speed width	10 - Maximum rotation speed [r/min] (in 1 increments)		Always
24	Positioning end judgment time	0.000 to 1.000 sec. (in 0.001 increments)		Always
25	Max. current limit	0 to 300 % (in 1 increments)		Always

■ FALDIC-W parameter list (2)

No.	Name	Setting range	Setting	Change
26	Undervoltage alarm detection	0: No detection, 1: Detection		Power
27	Operation for undervoltage	0: Sudden deceleration and stop, 1: Coasting		Power
28	For adjustment by manufacturer	-		-
29	Parameter write-protection	0: Write-enable, 1: Write-protected		Always
30	Keypad initial display	0 to 20 (in 1 increments)		Power
31	Manual feed speed 1 (and test operation)	0.1 to Maximum rotation speed [r/min] (in 0.1 increments)		Always
32	Manual feed speed 2	0.1 to Maximum rotation speed [r/min] (in 0.1 increments)		Always
33	Manual feed speed 3	0.1 to Maximum rotation speed [r/min] (in 0.1 increments)		Always
34	Maximum rotation speed	0.1 to Maximum rotation speed [r/min] (in 0.1 increments)		Always
35	Acceleration time 1 (and test operation)	0.000 to 9.999 sec. (in 0.01 increments)		Always
36	Deceleration time 1 (and test operation)	0.000 to 9.999 sec. (in 0.01 increments)		Always
37	Acceleration time 2	0.000 to 9.999 sec. (in 0.01 increments)		Always
38	Deceleration time 2	0.000 to 9.999 sec. (in 0.01 increments)		Always
39	Zero clamp level	0.0 to 500.0 [r/min] (in 0.1 increments)		Always
40	Position adjustor gain 1	1 to 1000 [red/sec] (in 1 increments)		Always
41	Speed response 1	1 to 1000 [Hz] (in 1 increments)		Always
42	Speed adjustor integration time 1	1.0 to 1000.0 [msec] (in 0.1 increments)		Always
43	S-curve time constant	0.0 to 100.0 [msec] (in 0.1 increments)		Always
44	Feed forward gain	0.000 to 1.500 (in 0.001 increments)		Always
45	Feed forward filter time constant	0.0 to 250.0 [msec] (in 0.1 increments)		Always
46	Torque filter time constant	0.00 to 20.00 [msec] (in 0.01 increments)		Always
47	Speed setting filter	0.00 to 20.00 [msec] (in 0.01 increments)		Always
48	Gain switching factor	0: Position deviation (×10), 1: Feedback speed, 2: Command speed		Always
49	Gain switching level	1 to 1000 (in 1 increments)		Always
50	Gain switching time constant	0 to 100 [msec] (in 1 increments)		Always
51	Position adjustor gain 2	30 to 200 % (in 1 increments)		Always
52	Speed response 2	30 to 200 % (in 1 increments)		Always
53	Speed adjustor integration time 2	30 to 200 % (in 1 increments)		Always
54	Torque setting filter	0.000 to 9.999 [sec.] (in 0.001 increments)		Always
55	Command following control selection	0: None, 1: Command following control, 2: Command following control (with correction on stop)		Power
56	Notch filter 1 frequency	10 to 200 [×10Hz] (in 1 increments)		Always
57	Notch filter 1 damping amount	0 to 40 [dB] (in 1 increments)		Always
58	Notch filter 2 frequency	10 to 200 [×10 Hz] (in 1 increments)		Always
59	Notch filter 2 damping amount	0 to 40 [dB] (in 1 increments)		Always
60	Anti-resonance frequency 0	5.0 to 200.0 [Hz] (in 0.1 increments)		Always
61	Anti-resonance frequency 1	5.0 to 200.0 [Hz] (in 0.1 increments)		Always
62	Anti-resonance frequency 2	5.0 to 200.0 [Hz] (in 0.1 increments)		Always
63	Anti-resonance frequency 3	5.0 to 200.0 [Hz] (in 0.1 increments)		Always

A APPENDIXES

■ FALDIC-W parameter list (3)

No.	Name	Setting range	Setting	Change
64 to 69	Not used	-		-
70	Analog command gain	± 0.10 to ± 1.50 (in 0.01 increments)		Always
71	Analog command offset	-2000 to +2000		Always
72	Operation sequence selection for dynamic brake unit connection	0: DB invalid for OT detection/RUN = DB invalid for OFF 1: DB valid for OT detection/RUN = DB invalid for OFF 2: DB invalid for OT detection/RUN = DB valid for OFF 3: DB valid for OT detection/RUN = DB valid for OFF		Power
73	Brake operation time	0.00 to 9.99 [sec] (in 0.01 increments) Base shutoff delay time at RUN = OFF		Always
74	CONT normally valid 1	0 to 21		Power
75	CONT normally valid 2			Power
76	CONT normally valid 3			Power
77	CONT normally valid 4			Power
78	Command pulse compensation $\alpha 1$	1 to 32767 (in 1 increments)		Always
79	Command pulse compensation $\alpha 2$			Always
80	Command pulse compensation $\alpha 3$			Always
81	Parameter storage in RAM	0: Not specified, 1 to 99 (in 1 increments)		Power
82	Station number	1 to 31		Power
83	Baud rate	0 : 38400 [bps] , 1 : 19200 [bps] , 3 : 9600 [bps]		Power
84	Easy tuning: Travel setting	0.5 to 200.0 [rev] (in 0.1 increments)		Always
85	Easy tuning: Speed setting	10.0 to Maximum rotation speed [r/min] (in 0.1 increments)		Always
86	Easy tuning: Timer setting	0.01 to 5.00 [sec] (in 0.01 increments)		Always
87	Monitor 1 signal allocation	1: Speed command, 2: Speed feedback, 3: Torque command, 4: Position deviation, 5: Position deviation (extension), 6: Pulse frequency		Always
88	Monitor 2 signal allocation			Always
89	Monitor 1 scale	± 2.0 to ± 100.0 [V] (in 0.1 increments)		Always
90	Monitor 1 offset	-50 to +50 (in 1 increments)		Always
91	Monitor 2 scale	± 2.0 to ± 100.0 [V] (in 0.1 increments)		Always
92	Monitor 2 offset	-50 to +50 (in 1 increments)		Always
93	Not used	-		-
94	For adjustment by manufacturer	-		-
95	For adjustment by manufacturer	-		-
96	For adjustment by manufacturer	-		-
97	For adjustment by manufacturer	-		-
98 to 99	Not used	-		-

Inverter Value Engineering Center/Suzuka Factory has acquired the certification of environment management ISO14001 and quality management system ISO9001.



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