Fe *e-Front runners*

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:

Note 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.

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

The page for reference is shown.

CONTENTS

CONTENTS

1

OUTLINE

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□)

Frame
The frame supports the output shaft of the servomotor. The frame is molded of resin.

Encoder
A 17-bit serial encoder is housed on the side of the servomotor opposite to the load.

Output shaft
The output shaft of the servomotor rotates.

Power cable
Connect to the servo amplifier using the optional cable or connector kit.
The wiring from the power cable up to the servo amplifier is called "power wiring."

Encoder cable
Connect to CN2 of the servo amplifier using the optional cable or connector kit.
The wiring from the encoder cable up to the servo amplifier is called "encoder wiring."

Flange
The servomotor is installed to the machine on this side.

■ How the nameplate looks

Fe e-Front runners

Motor type → GYS201DC2-T2A
Serial No. → 000000I△△△   Japan

1 OUTLINE

1.3 Servo amplifier

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

CN4
Connector for analog monitor (2 ch).

CN1
Sequence input, output signal, pulse string command input and analog command are connected.

CN2
Connect the encoder cable of the servomotor.

LED for charge
LED illuminates when the power is supplied to the servo amplifier or electric potential is charged inside.

Keypad
The Keypad is provided with a four-digit seven-segment LED display and four operation keys.

CN3
PC loader is connected. (Multi-drop connection is available.)

Nameplate

Main circuit terminals
Connect the power supply, an external regenerative resistor (option), and the servomotor power cable.

Ground terminal
This is connected to the ground wire of the servomotor and the control panel or power source ground terminal.

Connector for control power
Control power is supplied.

■ How the nameplate looks

Amplifier type	[TYPE] RYC401S3-VVT2
	[INPUT]
Input voltage	Voltage 200-230V
No. of input phases phases	Phase 1φ 3φ
Maximum input current	F.L.C 3.4A/6.4A
Input frequency	Freq. 50 or 60Hz
	[OUTPUT]
Output voltage	Voltage 91V
No. of output phases	Phase 3φ
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>

RYC   201   S   3 — V   V   T   2

[Basic type]
RYC: FALDIC-W series

[Applicable motor output]
201 : 20×10^1=200W
500 : **50**×10^0= 50W

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

[Order of development]

[Input Voltage]
2: AC200V series

[Encoder]
T: Standard
    17-bit, INC

[Upper I/F]
V: DI/DO (speed)

[Major function]
V: Pulse string/speed control

<Servomotor>

GYS   201   D   C   2 — T   2   A — B

[Basic type]
GYS: Low inertia type
GYG: Middle inertia type

[Rated output]
201 : 20× 10^1=200W
500 : **50**× 10^0= 50W

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

[Installation method]
C: Flange mounting

[Order of development]

[Brake]
No indication : None
    B : Installed

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

[Voltage]
 2 : AC200V series

[Encoder]
T: 17-bit, INC

1 OUTLINE

-MEMO-

2

INSTALLATION

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)

*1) GYG182BC2-T2□, GYG292BC2-T2□: 0 to 40 [°C]

2.1.2 Operating environment

Operate the servomotor in the following environment.
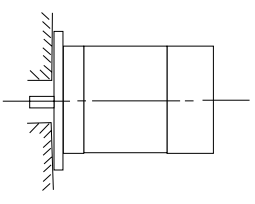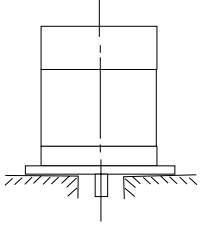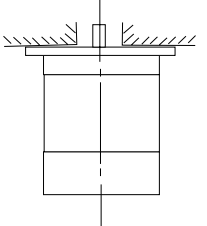
Operating temperature : -10 to 40 °C*

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

*1) GYG182BC2-T2□, GYG292BC2-T2□: 0 to 40 [°C]

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.

Encoder

⚠ CAUTION	
🚫	■ 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.
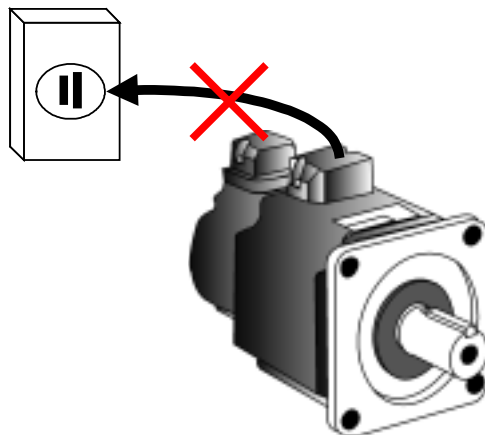
2 INSTALLATION

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

①Measures 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.

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

③When 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.

Cable trap
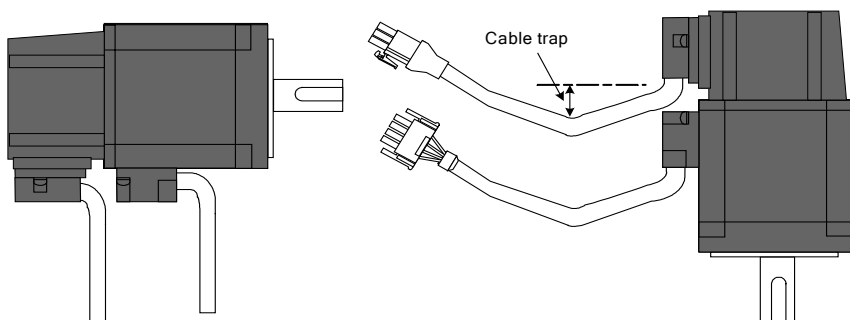
④ Do not use the servomotor while the cable is immersed in oil/water sump.

<Poor> capillary phenomenon
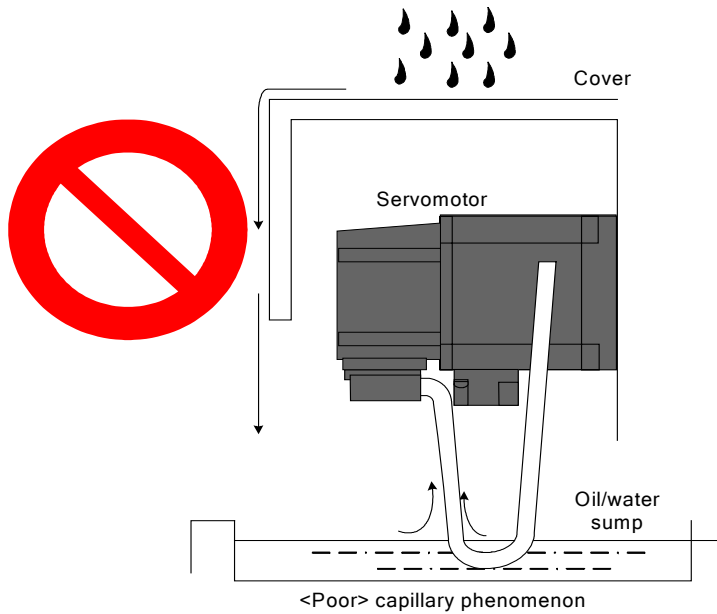
⑤ If the motor is exposed to splashes of oil such as cutting oil, some oil may adversely affect seal material, packing and cable.

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 type motor (for power cable of servomotor)

Applicable model: GYG type ····· 2000r/min Series: All capacities

1500r/min Series: 0.5kW/0.85kW/1.3kW

■IP 67-compatible connector type

Wiring site	Plug		Back shell		Cable clamp
	Straight	Angle	Straight	Angle	
For power cable of motor; without brake	CE05-6A18-10SD-B-BSS	CE05-8A18-10SD-B-BAS	—	—	CE3057-10A-x
For power cable of motor; with brake	CE05-6A20-15SD-B-BSS	CE05-8A20-15SD-B-BAS	—	—	CE3057-12A-x

Made by DDK Ltd.

⑨ List of IP65-compatible connectors for GYG type motor (for power cable of servomotor)

Applicable model: GYG type ····· 1500r/min Series: 1.8kW/2.9kW

■IP65-compatible connector type

Wiring site	Plug		Back shell		Cable clamp
	Straight	Angle	Straight	Angle	
For power cable of motor; with/without brake	CE05-6A24-11SGH-B-BSS	CE05-8A24-11SGH-B-BAS	—	—	CE3057-16A-x

Made by DDK Ltd.

⑩ List of IP67-compatible connectors for GYG type motor (for encoder cable)

Applicable model: GYG type ····· All models

■IP67-compatible connector type

Wiring site	Plug		Back shell		Cable clamp
	Straight	Angle	Straight	Angle	
For encoder cable	MS3106A20-29S(D190)		CE02-20BS-S	CE-20BA-S	CE3057-12A-x

Made by 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

*1) GYG182BC2-T2□, GYG292BC2-T2□: 0.08 or less

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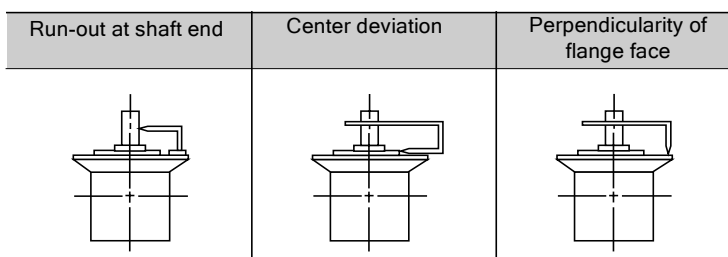
2.1.9 Load

The radial load and thrust load exerted on the shaft end of the servomotor are as follows.
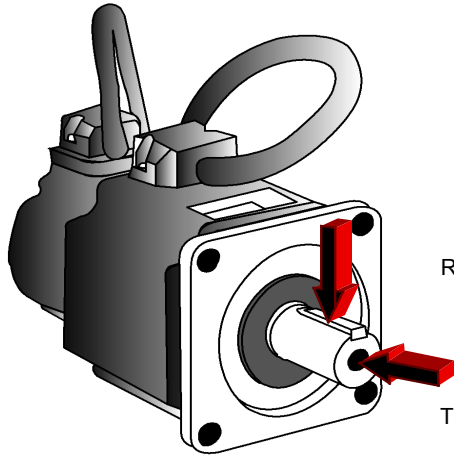
Radial load : Load exerted at right angles to motor shaft

Thrust load : Load exerted in parallel to motor shaft

Type of servomotor		Allowable radial load Fr[N]	Allowable thrust load Fs [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
	182BC2-T2G	1176	490	79
	292BC2-T2G	1470	490	79
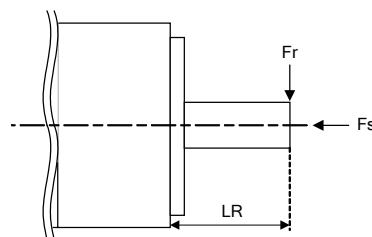
2 INSTALLATION

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].

i) Top: 50 mm or more

iii) Casing
About 10 mm
The value assumes various errors.
The distance can be reduced to 0 mm.

iv) Interval between amplifiers
About 5 mm
The value assumes various errors.
The distance can be reduced to 0 mm.

ii) Bottom: 40 mm or more
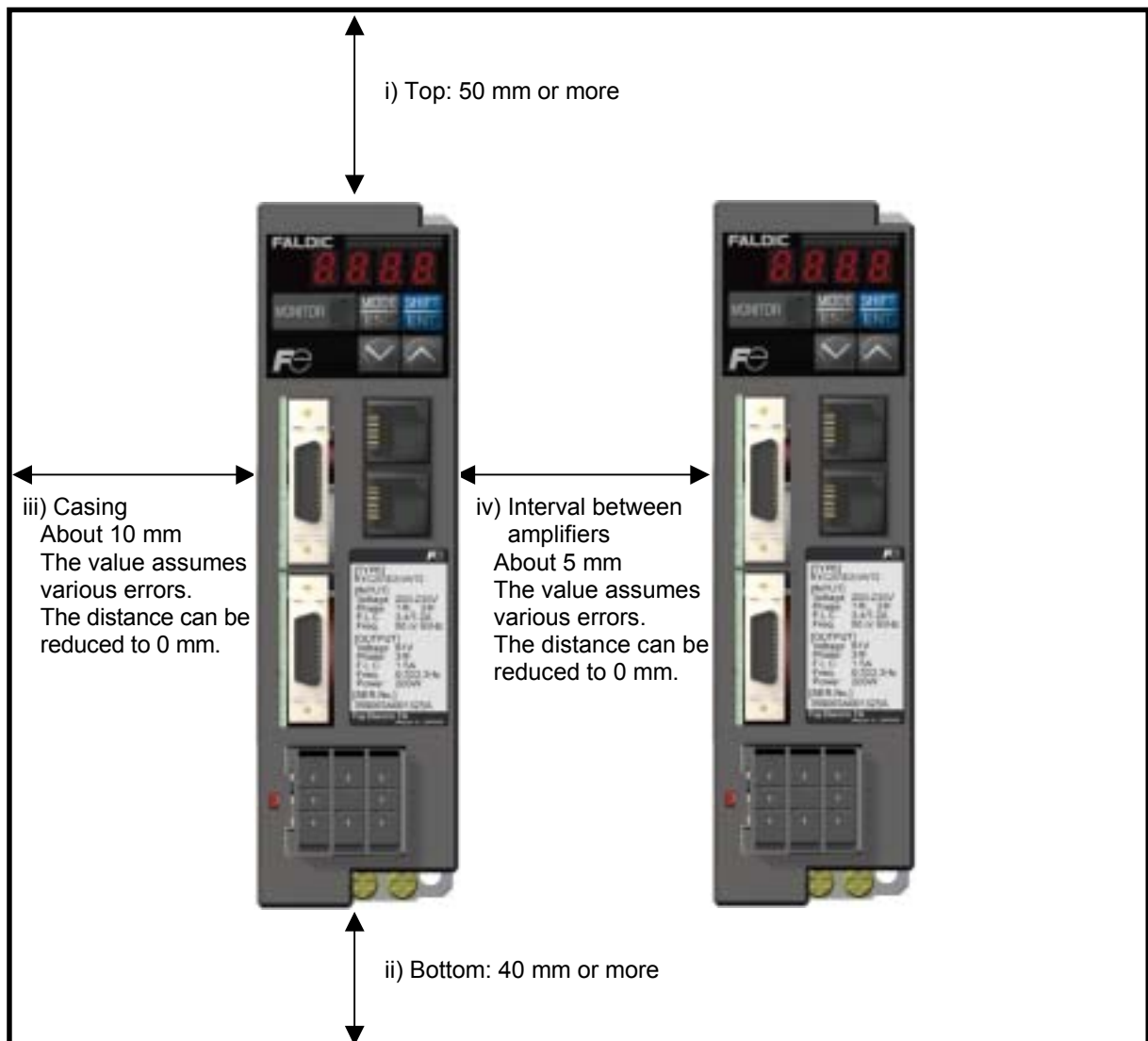
2 INSTALLATION

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.

Natural convection, air tight structure (enclosure)	Air purge	Forced duct ventilation	Heat exchanger
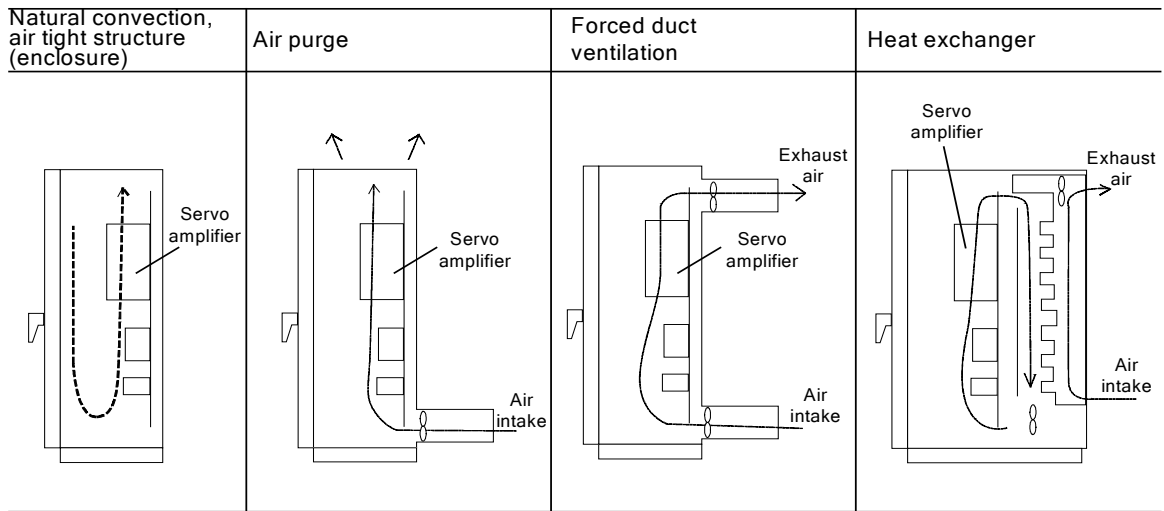
・ Location where strong electrostatic or magnetic field exists

・ 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.
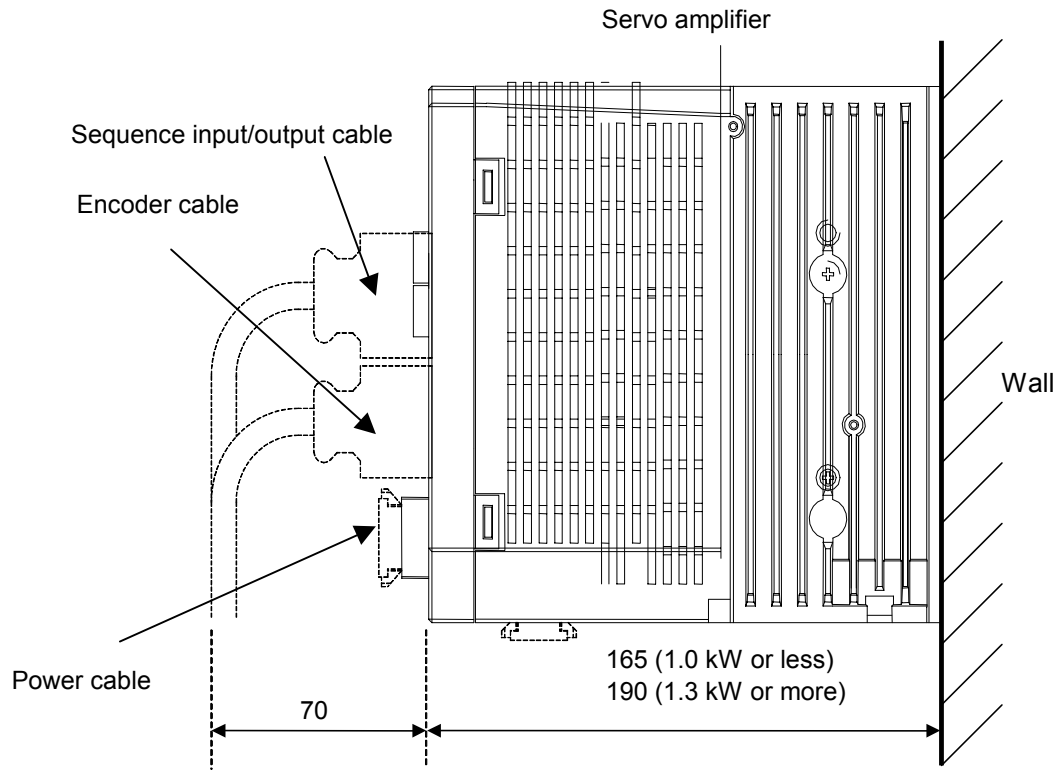
2 INSTALLATION

-MEMO-

3

WIRING

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.

Circuit breaker/
Earth leakage circuit breaker

AC reactor

Loader cable
Use the commercially available LAN cable
and RJ45 straight full length wire.

Power filter

Sequence input/output cable

External
regenerative
resistor
(option)

Encoder cable

Power cable

Servo amplifier

Motor cable

Servomotor

(2) Servomotor (with brake)

Circuit breaker/
Earth leakage circuit breaker

AC reactor

Loader cable

Use a commercially available LAN cable and
RJ45 straight full length wire.

Power filter

Power supply for brake
(24DVC/0.6A)

Sequence input/output cable

Encoder cable

Control relay

Power cable

Servo amplifier

Motor cable

Servomotor

3 WIRING

3.2 Servo amplifier

■ Frame 1

Keypad

4 digit 7 segment LED display and 4 operation keys are available.

Type identification

Connector for loader connection
The PC loader is connected.
It can be connected to up to 31 units.

CN1 (connector 1)

Sequence input/output signal, etc. is connected.

CN2 (connector 2)

The encoder line of the servomotor is connected.

Connector for power

It is connected to the power supply, external regenerative resistor and servomotor.

Grounding terminal

It is connected to the grounding terminal and the earthing terminal of the servomotor.

Connector for control power

Control power is supplied.
The servomotor can be operated with the power supply.

■ Frame 2

Keypad

4 digit 7 segment display and 4 operation keys are available.

Connector for loader connection
The PC loader is connected.
It can be connected to up to 31 units.

CN1 (connector 1)

Sequence input/output signal, etc. is connected.

CN2 (connector 2)

The encoder line of the servomotor is connected.

Connector
for control power

Control power is supplied.
The servomotor can be operated with the power supply.

Connector for power

It is connected to the power supply, external regenerative resistor and servomotor.

Grounding terminal

It is connected to the grounding terminal and the earthing terminal of the servomotor.

■ Frame 3

Keypad
4 digit 7 segment display and 4 operation keys are available.

CN1 (connector 1)
Sequence input/output signal, etc. is connected.

CN2 (connector 2)
The encoder line of the servomotor is connected.

Terminal block for power
It is connected to the control power, power supply, external regenerative resistor and servomotor.

Connector for loader connection
The PC loader is connected.
It can be connected to up to 31 units.

Grounding terminal
It is connected to the grounding terminal and the earthing terminal of the servomotor.

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
	2000r/min	0.5kW	RYC501C3-VVT2
		0.75kW	RYC751C3-VVT2
		1kW	RYC102C3-VVT2
	1500r/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
		1.8kW	RYC182B3-VVT2
		2.9kW	RYC292B3-VVT2

3 WIRING

3.2.1 Commercial power supply

Supply the commercial power described in Chapter 12 to the servo amplifier.

The power from a 400V series is supplied with the voltage stepped down.

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

1) Motor power supply

• Servo amplifier of 0.4kW or smaller

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

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

    Frequency: 50/60Hz

    Number of phases: Single phase (motor power supply, L1, L2)

Servo amplifier
RYC500D3−VVT2
RYC101D3−VVT2
RYC201D3−VVT2
RYC401D3−VVT2

(terminals: L1, L2, sL1, sL2)
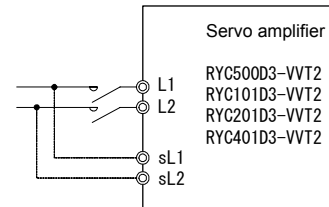
• Servo amplifier of 0.5kW or 0.75kW

Supply the single-phase 200V or three-phase 200V commercial power to the servo amplifier.

Connect the single-phase power to the L1 and L2 terminals, or the three-phase power to the L1, L2, and L3 terminals.

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

                Three-phase 200 to 230V, -15% to +10%

    Frequency: 50/60Hz

    Number of phases: Single phase (motor power supply, L1, L2)

                           Three phases (motor power supply: L1, L2, L3)

Servo amplifier
RYC751D3-VVT2
RYC501C3-VVT2
RYC751C3-VVT2
RYC501B3-VVT2

(terminals: L1, L2, sL1, sL2)

Servo amplifier
RYC751D3-VVT2
RYC501C3-VVT2
RYC751C3-VVT2
RYC501B3-VVT2

(terminals: L1, L2, L3, sL1, sL2)
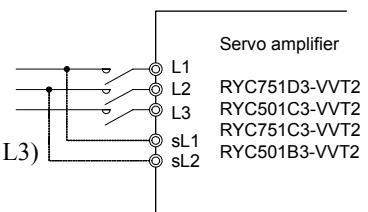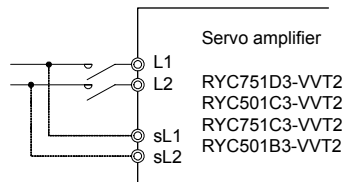
• Servo amplifier of 0.85kW or larger

Supply the three-phase 200V commercial power to the servo amplifier.

Connect it to the L1, L2, and L3 terminals.

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

    Frequency: 50/60Hz

    Number of phases: Three phases (motor power supply: L1, L2, L3)

Servo amplifier
RYC102C3-VVT2
RYC152C3-VVT2
RYC202C3-VVT2
RYC851B3-VVT2
RYC132B3-VVT2
RYC182B3-VVT2
RYC292B3-VVT2

(terminals: L1, L2, L3, sL1, sL2)
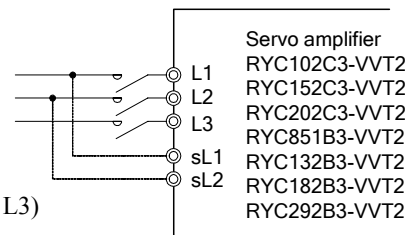
2) Control power supply (common to all models)

Supply the commercial power of single-phase 200V as the control power supply.

Connect it to the sL1 and sL2 terminals.

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

    Frequency: 50/60Hz

    Number of phases: Single phase (motor power supply, sL1, sL2)

Even if the control power is not used (unwired), the servo amplifier works properly if the motor power is supplied.

When the control power is used, the control circuit remains active even if the motor power is cut off for the purpose of safety in case of emergency. So, you can confirm the alarm status or the current position of the motor.

Note Precautions to be exercised when supplying the 230V power to the servo amplifier using the neutral point of the power supplied from the 400V series (Y-connection).

① Single-phase 200V series

To use the neutral point of the 400V series power supply to supply the 230V power to the motor power supply (L1, L2) and the control power supply (sL1, sL2), connect the same phase to each of them (Figure 1).

If a different phase is connected, the servo amplifier will be damaged (Figure 2).

Figure 1) Example of correct wiring

The control power and the motor power shall be connected to the same phases.
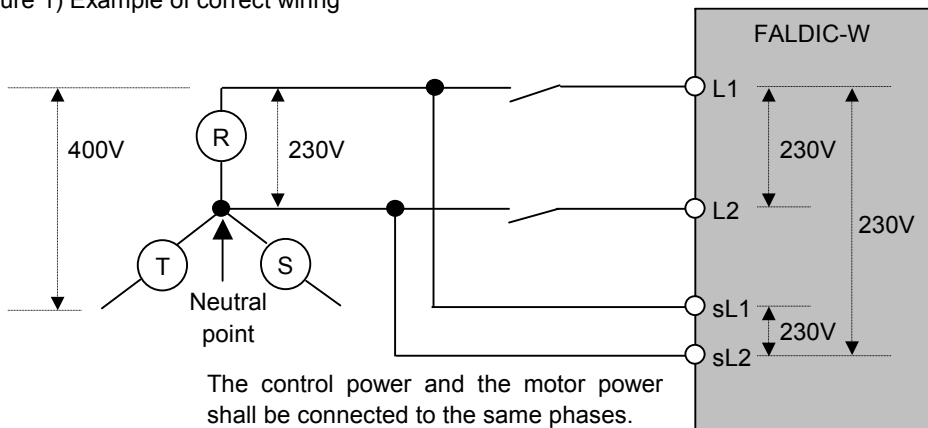
Figure 2) Example of incorrect wiring

If different phases are connected to the control power and the motor power, the 400V power will be applied to the servo amplifier, damaging the equipment.
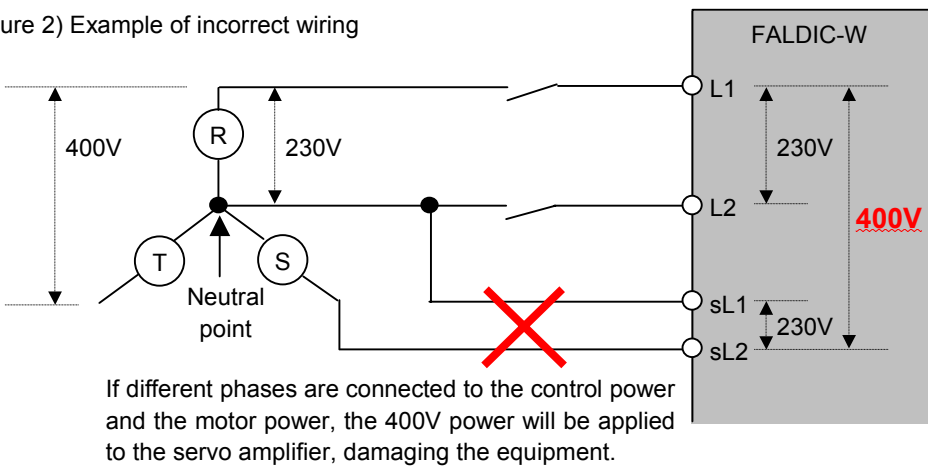
② Three-phase 200V series

Do not use the neutral point of the power from 400V series to supply the 230V power to the motor (L1, L2, L3). Failure to follow this instruction will cause damage to the servo amplifier.
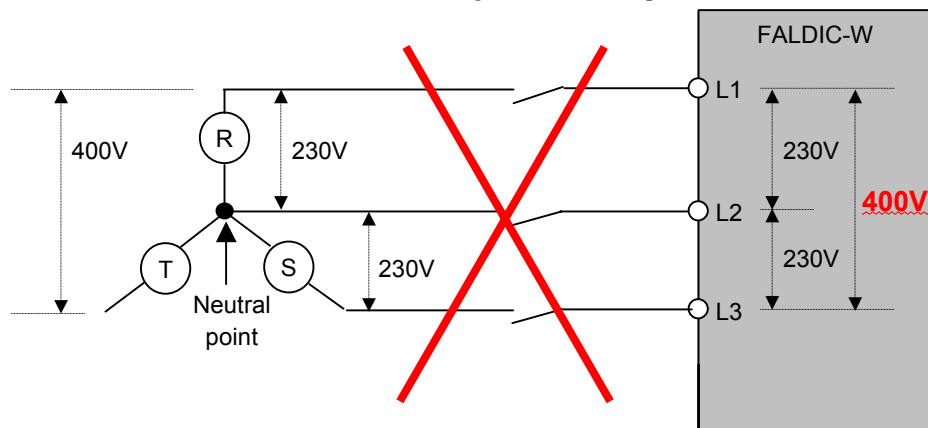
3 WIRING

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.)

• Motor power supply (L1, L2)

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-T2E	1.5kVA
Single phase 200 V (1500 r/min)	RYC501B3-VVT2	GYG501BC2-T2E	1kVA

• Motor power supply (L1, L2, L3)

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
	RYC102C3-VVT2	GYG102CC2-T2E	2.0kVA
	RYC152C3-VVT2	GYG152CC2-T2E	2.9kVA
	RYC202C3-VVT2	GYG202CC2-T2E	3.9kVA
3 phase 200 V (1500 r/min)	RYC501B3-VVT2	GYG501BC2-T2E	1kVA
	RYC851B3-VVT2	GYG851BC2-T2E	1.7kVA
	RYC132B3-VVT2	GYG132BC2-T2E	2.6kVA
	RYC182B3-VVT2	GYG182BC2-T2G	3.5kVA
	RYC292B3-VVT2	GYG292BC2-T2G	5.7kVA

• Control power supply (sL1, sL2)

Input power supply	Type of servo amplifier	Applicable motor example	Power supply capacity
Single-phase 200V	Common to all models		0.02kVA

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
	RYC102C3-VVT2	GYG102CC2-T2E
Terminal block	RYC152C3-VVT2	GYG152CC2-T2E
	RYC202C3-VVT2	GYG202CC2-T2E
Connector	RYC501B3-VVT2	GYG501BC2-T2E
	RYC851B3-VVT2	GYG851BC2-T2E
Terminal block	RYC132B3-VVT2	GYG132BC2-T2E
	RYC182B3-VVT2	GYG182BC2-T2G
	RYC292B3-VVT2	GYG292BC2-T2G

Servo amplifier of connector type
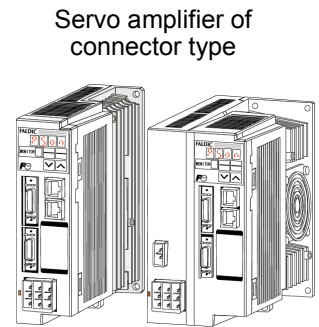
■ Connector

• Connector for motor power

L1	P	U
L2	-	V
L3	DB	W
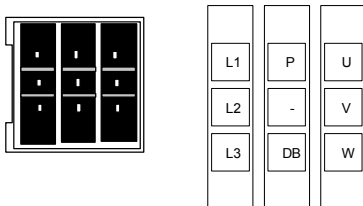
Cable compatible connector (Tyco Electronics AMP)

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

Keying plug: 175855-1 (P, DB)

• Connector for control power

| sL1 |
| sL2 |
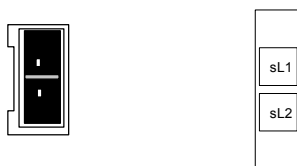
Cable compatible connector (Tyco Electronics AMP)

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

sL1	
sL2	
L1	
L2	
L3	
P	
N(-)	
DB	
U	
V	
W	

Screw size: M 4

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			13	M5		12	*FFB
24	*FFZ	25	FZ	11	FFB		10	*FFA
22	Vref	23	FFZ	9	FFA		8	*CA
20	CB	21	*CB	7	CA		6	CONT5
18	OUT4	19	PPI	5	CONT4		4	CONT3
16	OUT2	17	OUT3	3	CONT2		2	CONT1
14	M24	15	OUT1	1	P24			

Compatible connector on cable side (By Sumitomo 3M)

Soldered plug : 10126-3000VE

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) OUT1: Ready (RDY) OUT2: Positioning end (PSET) OUT3: Alarm detection: b-contact (ALMb) OUT4: (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 (For sink/source) Interface specification 24VDC/10mA (per point)	P24, 2.2k, (DC24V), DC24V, CONTn, Servo amplifier
Sequence output (For sink/source) Interface specification 30VDC/50mA (max)	OUTn, DC24V, (DC24V), M24, Servo amplifier
Pulse string input Interface specification Differential input (line receiver)	PPI, 1.5k, CA(CB), 62, *CA(*CB), 62, Servo amplifier
Pulse string output Interface specification Differential output (line driver)	(FFZ), (FFB), FFA, AM26LS31, *FFA, (*FFB), (*FFZ), Servo amplifier, M5, M5
Pulse string output (Open collector) Interface specification 30VDC/50mA (max)	FZ, 2SC2712, M5, Servo amplifier
Analog input Interface specification Input impedance 20kΩ	Vref, 22K, 220k, M5, M5, Servo amplifier

3-12

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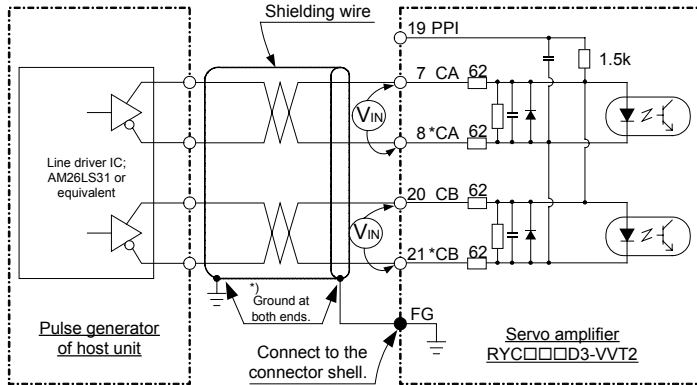
V_{IN}: The voltage amplitude between CA and *CA (between CB and *CB) must be between 2.8 and 3.7V.
(The servo amplifier may not accept the input pulse in other than the specified range.)

② Open collector output devices (24 VDC input)
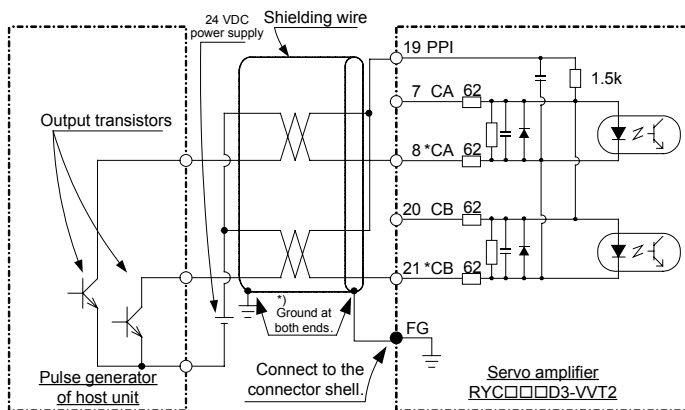
24 VDC power supply: Contain the source voltage within the 24 VDC ±5% range.
This circuit consumes a maximum 40 mA current. Prepare a power supply having a sufficient margin.

③ Open collector output devices (12 VDC input)
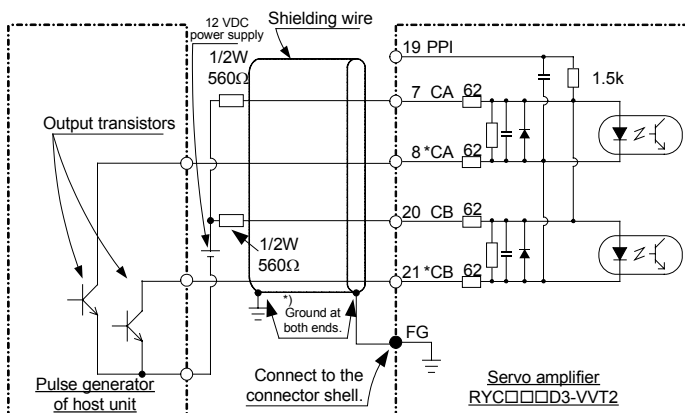
12 VDC power supply: Contain the source voltage within the 12 VDC ±5% range.
This circuit consumes a maximum 40 mA current. Prepare a power supply having a sufficient margin.

*) Ground the shielding wire at both ends with the host unit and the grounding terminal (FG) of the servo amplifier grounded at a single point within the panel. (It may be better to ground the shielding wire at either end when the host unit and the grounding terminal of the servo amplifier are not grounded at a single point.)

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

Cable compatible connector (by Sumitomo 3M Ltd.)

Solder plug　　: 10120-3000VE

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.
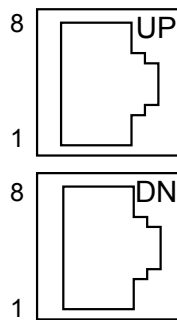
UP Port

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 UP port (upper) of a servo amplifier.

Then connect the DN port (lower) of the amplifier to the UP port of the next servo amplifier.

Final termination is not required.

• Terminal functions and interface

<Terminals functions>

Pin No.	Pin name	Function
3	TXD	Serial communication output (+)
6	*TXD	Serial communication output (-)
5	RXD	Serial communication input (+)
4	*RXD	Serial communication input (-)

<Interface>

Servo amplifier

3 TXD

6 *TXD

5 RXD

4 *RXD
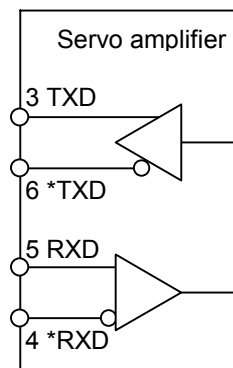
*Pay attention to the order of pin numbers

■ For one servo amplifier

UP port

Signal converter   LAN cable

Termination is not required.
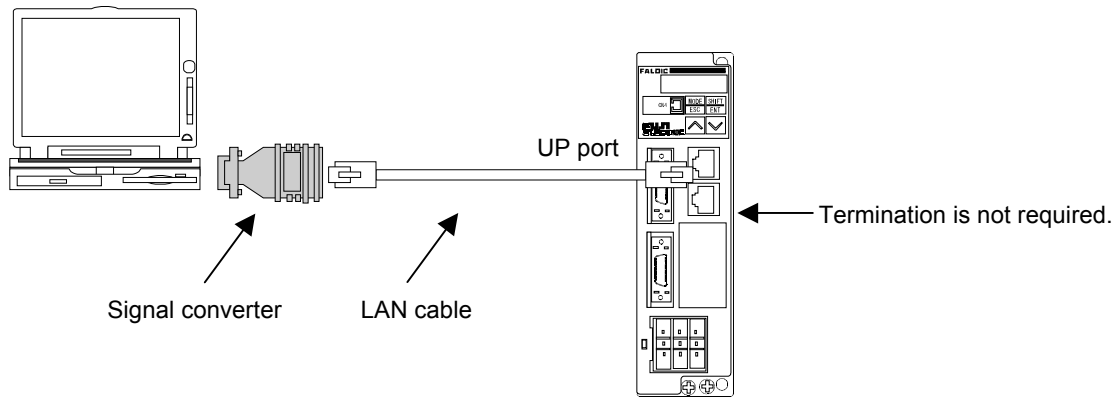
■ For connection to multiple servo amplifiers

Signal converter   LAN cable

Termination is not required.
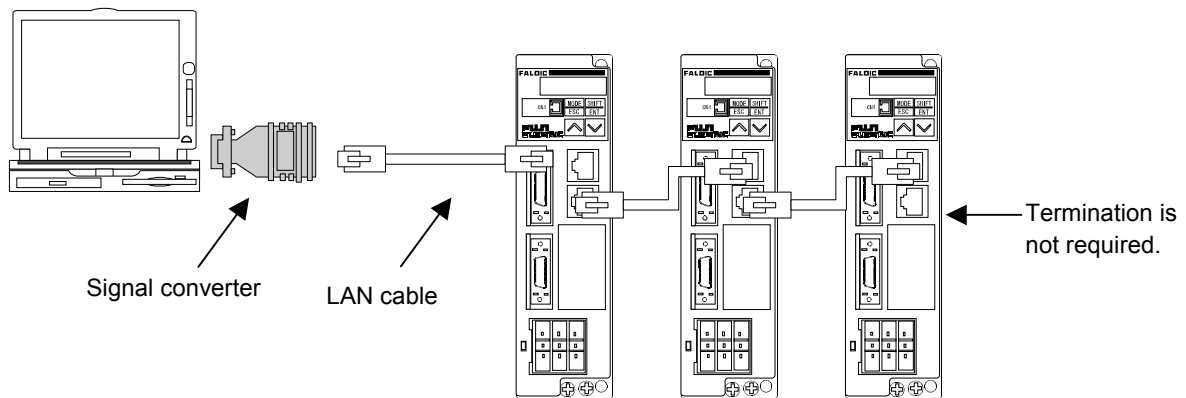
3.2.7   Monitor pin (CN4)

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 Hirose Electric)

Crimping socket: DF11-4DS-2C

Socket crimping terminal: DF11-2428SC

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.

Frame

The servomotor output shaft is supported. It is molded with resin.

Output shaft

It is the rotating shaft of the servomotor.

Power line

The line is connected to the servo amplifier with the optional cable or the connector kit.

Flange

It is the surface that mounts the servomotor on the machine.

Encoder

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

Encoder line

The line is connected to CN2 of the servo amplifier with the optional cable or the connector kit.

■ 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.

Frame

The servomotor output shaft is supported.

Output shaft

It is the rotating shaft of the servomotor.

Flange

It is the surface that mounts the servomotor on the machine.

Connector for power line

The line is connected to the servo amplifier with the optional cable or the connector kit.

Connector for encoder

The 17-bit serial encoder is built into the opposite side to the servomotor load.
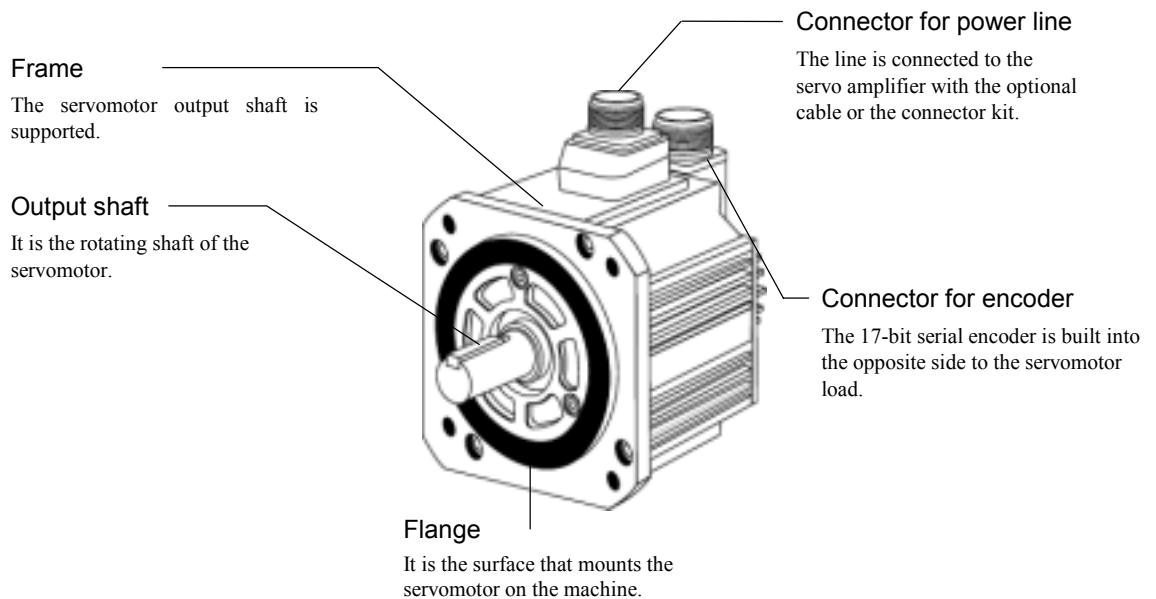
* The appearance varies depending on the motor capacity.

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

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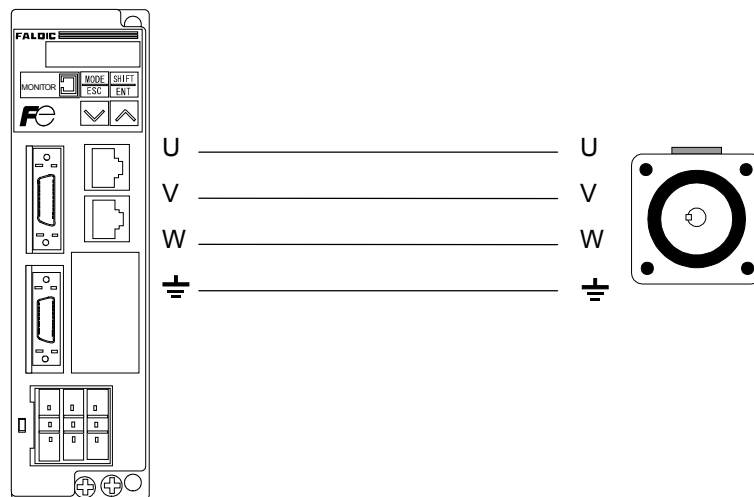
The wiring length between the servo amplifier and servomotor should be within 50 m long.

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

Projection

U
V
W
⏚

1	U
2	V
3	W
4	⏚
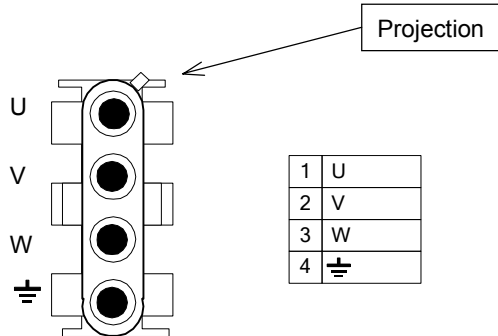
Motor power cable

(Viewed from contact inserting side)

1 cap
350780-1 type (Tyco Electronics AMP)

Contactors (socket)
350689-1 type (4 pieces) *Bulk
                       *Chain
350570-1 type (Tyco Electronics AMP)

  • With brake

Projection

⏚
Brake
Brake

U
V
W

4	⏚	1	U
5	Br	2	V
6	Br	3	W
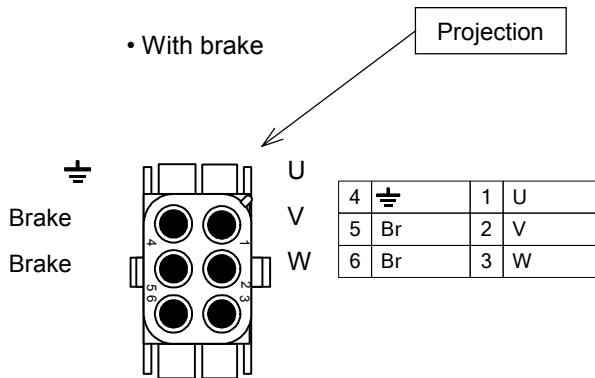
Motor power cable

(Viewed from contact inserting side)

1 cap
350781-1 type (Tyco Electronics AMP)

Contactors (socket)
350689-3 type (6 pieces) *Bulk
                       *Chain
350570-1 type (Tyco Electronics AMP)

■ GYG type 2000 and 1500 r/min series

  • Without brake

⏚
D A
W C B

Motor power wiring

(Figure viewed from the plug wiring)

U	A	U
	B	V
V	C	W
	D	⏚
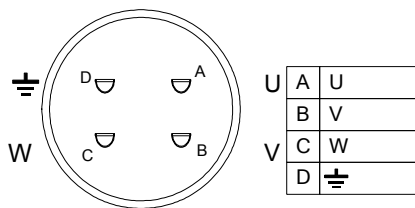
Connector type (L type plug)
MS3108B18-10S type (DDK Ltd.)

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

  • With brake

Brake
Brake
U
F A
E G B
D C
⏚
V
W

A	U
B	V
C	W
D	⏚
E	Br
F	Br
G	-
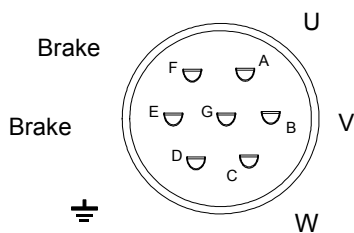
Motor power wiring

(Figure viewed from the plug wiring).

    Note) G pin is vacant.

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

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

■ GYG type 1500/min Series (1.8kW/2.9kW)

• Without brake
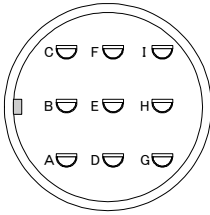
Power cable

(Appearance of wiring side of plug)

Connector type (L-shaped plug)
MS3108B24-11S type (DDK)

Cable clamp
MS3057-16A type (DDK)

A	—	D	U	G	⏚
B	—	E	V	H	—
C	—	F	W	I	—

• With brake
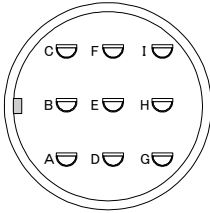
Power cable

(Appearance of wiring side of plug)

Connector type (L-shaped plug)
MS3108B24-11S type (DDK)

Cable clamp
MS3057-16A type (DDK)

A	Br	D	U	G	⏚
B	Br	E	V	H	—
C	—	F	W	I	—

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 $0.6A^{*1}$ 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 $1A^{*2}$ or more. The SSR output has polarity.

*1) GYG182BC2-T2_-B and GYG292BC2-T2_-B: 1.5A

*2) GYG182BC2-T2_-B and GYG292BC2-T2_-B: 3.0A

Servomotor

24VDC power supply

Relay (separate type)
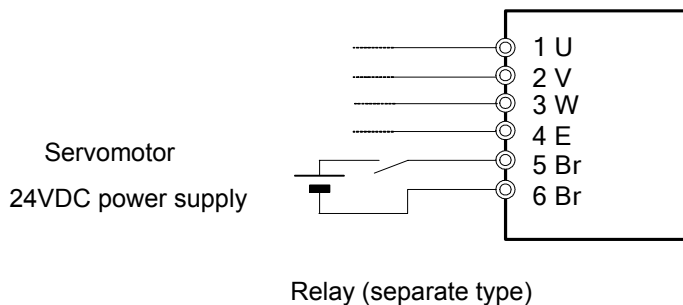
Separately prepare the 24VDC power source for the sequence from the 24VDC power source for the brake.

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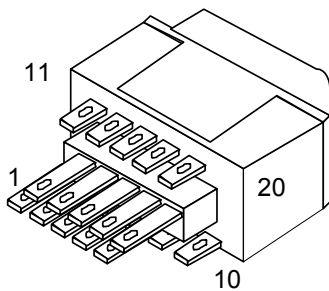
19	NC	20	FG	9	NC	10	NC
17	SIG+	18	SIG-	7	NC	8	NC
15	NC	16	NC	5	NC	6	NC
13	NC	14	NC	3	P5	4	P5
11	NC	12	NC	1	M5	2	M5

Cable compatible connector
(figure viewed
from connector wiring)

Solder plug : 10120-3000VE
Shell kit : 10320-52A0-008

* By Sumitomo 3M Ltd.

Wiring on servomotor side

1	2	3
NC	NC	FG
4	5	6
SIG+	SIG-	NC
7	8	9
P5	M5	NC
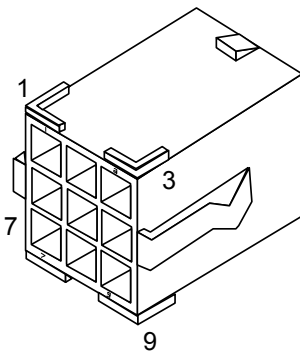
Cable compatible connector
(figure viewed
from terminal insertion)

Cap: 172161-9
Cap cover: 316455-1
Terminal socket :
170365-1 (SIG+, SIG-, FG) *Bulk
170366-1 (P5, M5) *Bulk
170361-1 (SIG+, SIG-, FG) *Chain
170362-1 (P5, M5) *Chain
* Made by Tyco Electronics AMP K.K.

Dedicated crimp tool (manual)
    755330-1
Dedicated pin terminal pulling tool
    189727-1

■ All GYG models
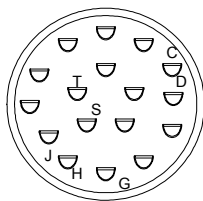
H	P5
G	M5
C	+SIG
D	-SIG
J	FG

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)
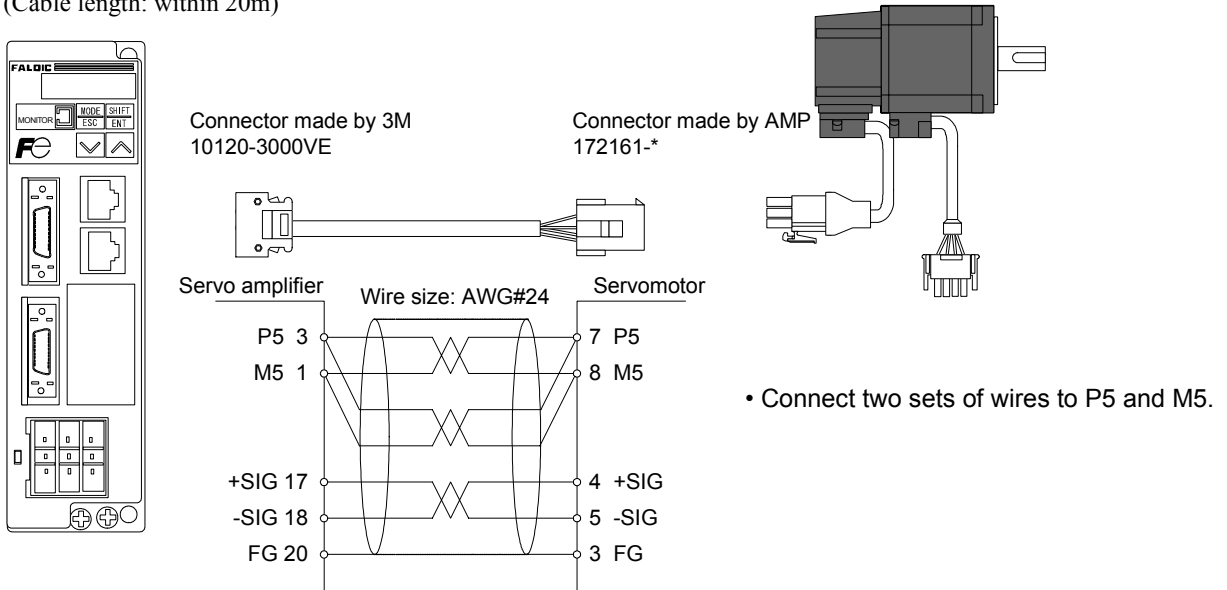
Connector made by 3M
10120-3000VE

Connector made by AMP
172161-*

Servo amplifier   Wire size: AWG#24   Servomotor

Servo amplifier		Servomotor
P5 3		7 P5
M5 1		8 M5
+SIG 17		4 +SIG
-SIG 18		5 -SIG
FG 20		3 FG

• Connect two sets of wires to P5 and M5.

■ 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.)

Connector made by 3M
10120-3000VE

Connector made by AMP
172169-*

Connector made by AMP
172161-*

Connector made by AMP
172161-*

5m or less   20m to 50m

Servo amplifier	Wire size: AWG#16			Wire size: AWG#16	Servomotor
P5 3	7 P5		P5 7	7 P5	
M5 1	8 M5		M5 8	8 M5	
+SIG 17	4 +SIG		+SIG 4	4 +SIG	
-SIG 18	5 -SIG		-SIG 5	5 -SIG	
FG 20	3 FG		FG 3	3 FG	
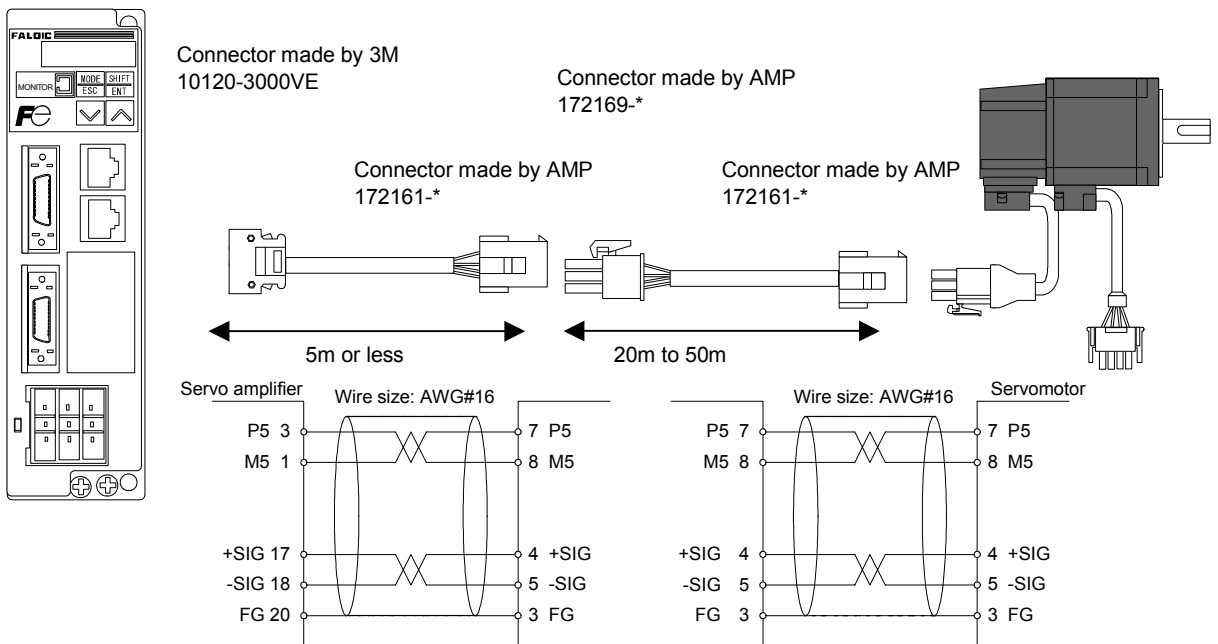
3 WIRING

• Cable size

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

Gauge		SI unit		Inch unit	
A.W.G	mm² conversion	Diameter [mm]	Sectional area [mm²]	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		0.4547	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:

Shielded end

Insulation
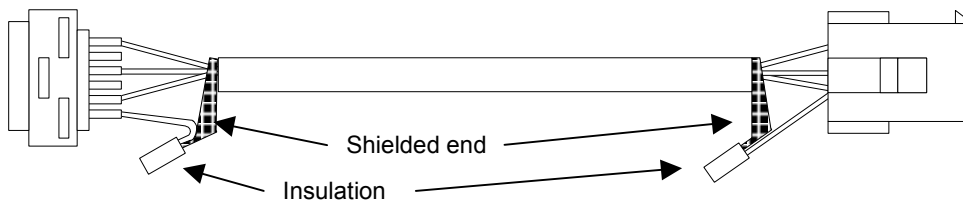
4) Connect the corresponding contactor to each encoder signal name.

Pin No.	Signal name	Contactor model
3	FG	170365-1
4	SIG+	170365-1
5	SIG-	170365-1
7	P5	170366-1
9	M5	170366-1

5) If the wiring is not more than 20 meters long, connect it as shown below.

① Use a twisted pair wire for each pair of a signal and a power supply.
② Connect two sets of wires to P5 and M5.
③ Connect the shielding wire to terminal #20 of the amplifier connector and to terminal #3 of the motor connector.

Cable model: RMCV-SB-A (UL2464)
Manufacturer: DAIDEN Co., Ltd.
Summary of specifications: AWG#24/3P (twisted-pair type)

Servo amplifier

P5 3
M5 1
②
①
+SIG 17
-SIG 18
FG 20
③

Servomotor

7 P5
8 M5
4 +SIG
5 -SIG
3 FG

Connector made by 3M
10120-3000VE

Connector made by AMP
172161-1
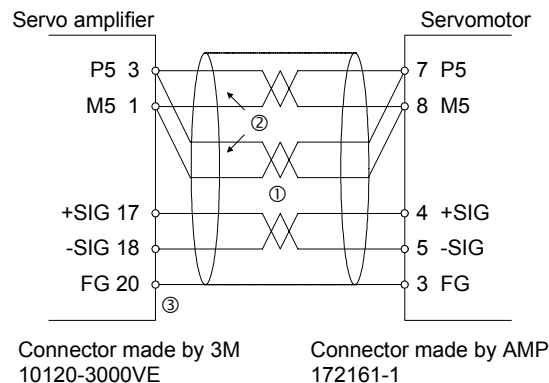
3 WIRING

6) 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.

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

* 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

(7) 1500 r/min series 1.8 kW, 2.9 kW

• 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
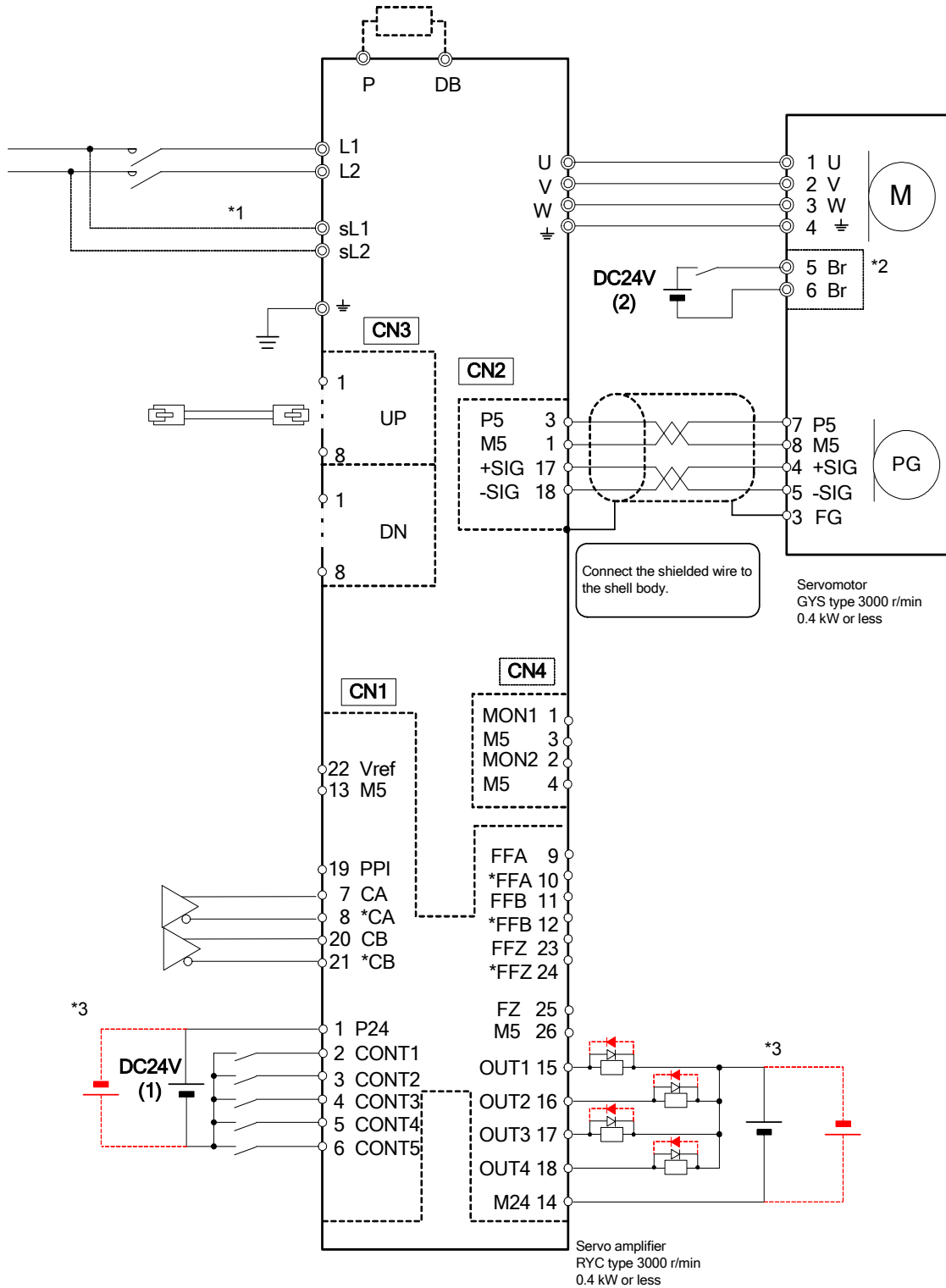
Motor power wiring : Connector

Connect the shielded wire to the shell body.

Servomotor
GYS type 3000 r/min
0.4 kW or less

Servo amplifier
RYC type 3000 r/min
0.4 kW or less

*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines.
Connect the noise suppressor diode, too, as shown with dotted lines.

■ 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
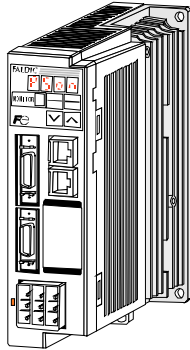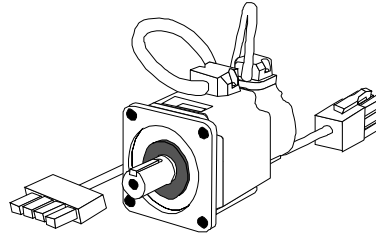
• Optional cable

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

Connect the shielded wire to the shell body.

Servomotor
GYS type 3000 r/min
0.75 kW

Servo amplifier
RYC type 3000 r/min
0.75 kW
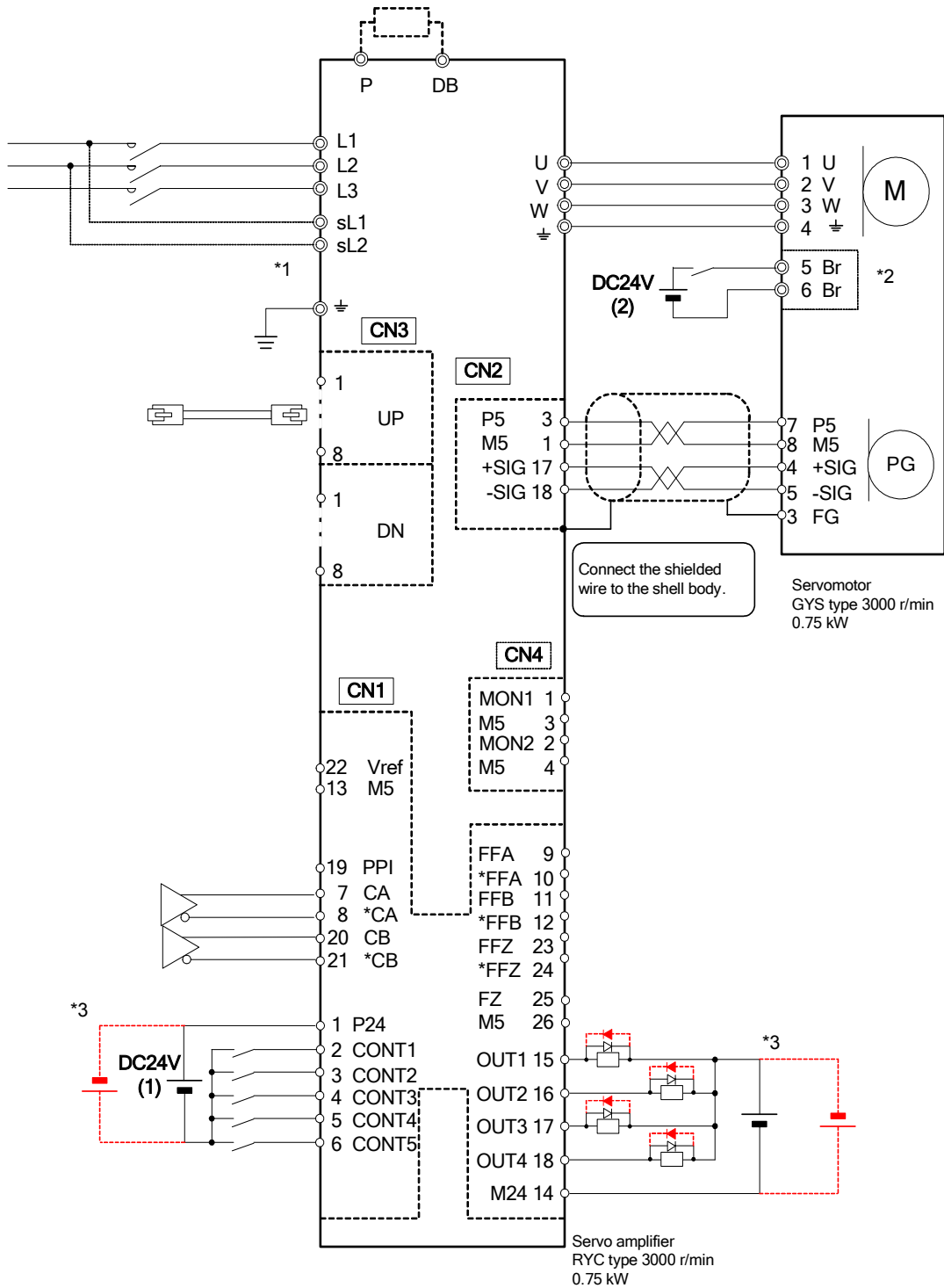
*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines.
Connect the noise suppressor diode, too, as shown with dotted lines.

■ RYC751D3-VVT2 (0.75kW)

• Example of servo amplifier appearance
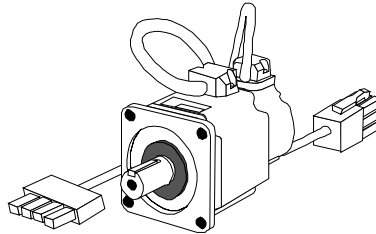
• Example of servomotor appearance

• 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
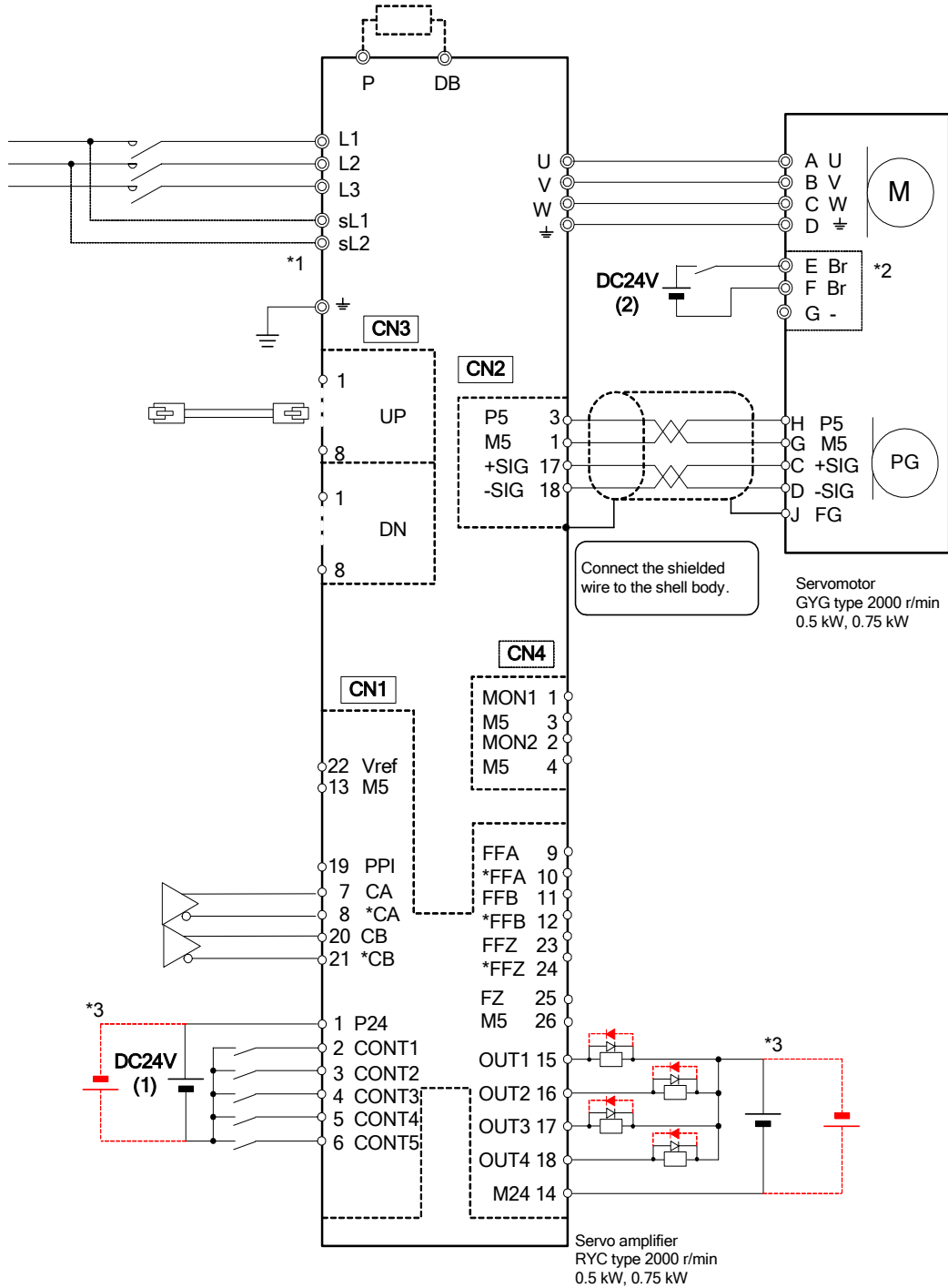
*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines.
Connect the noise suppressor diode, too, as shown with dotted lines.

■ 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)
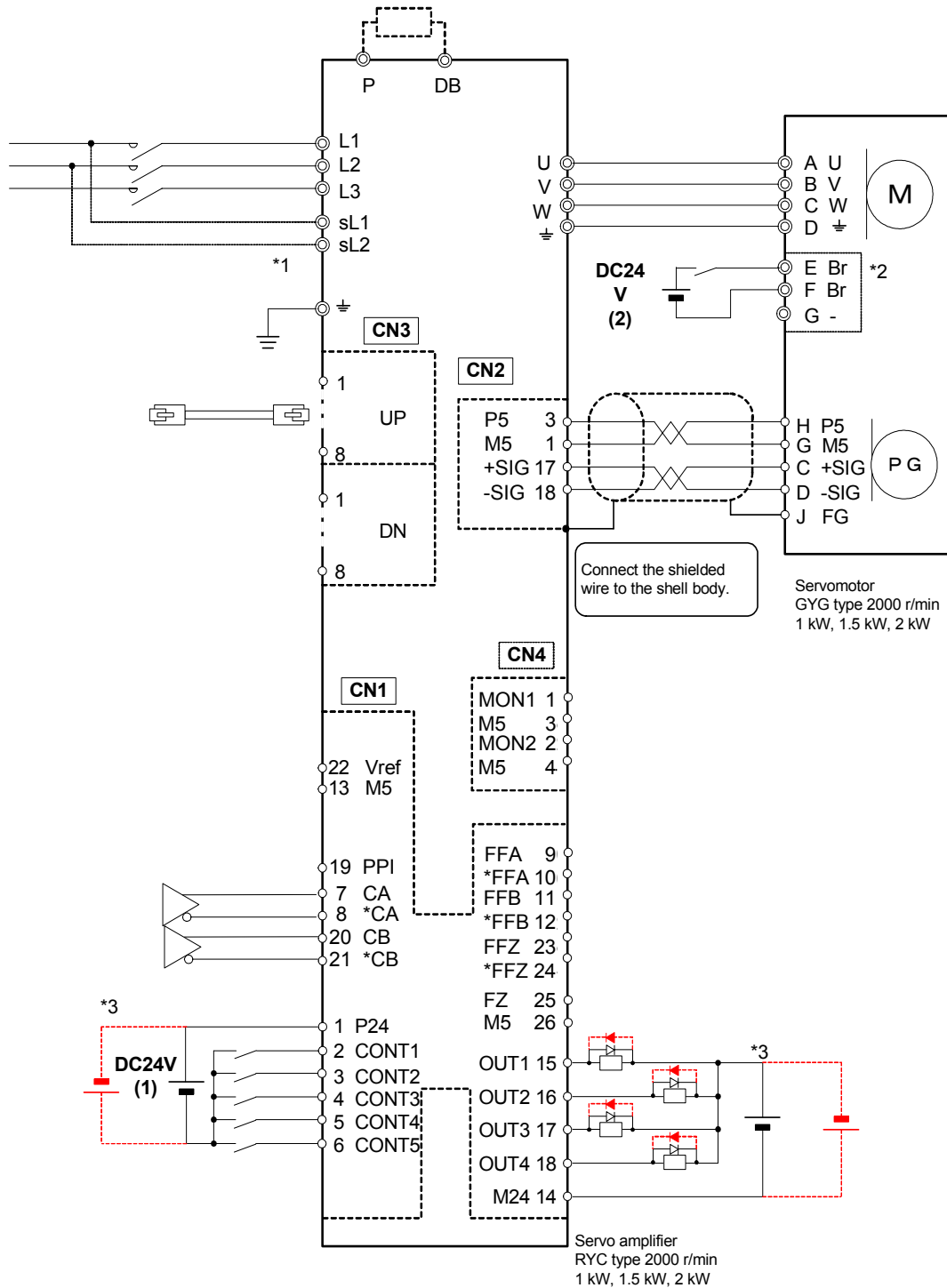
Connect the shielded wire to the shell body.

Servomotor
GYG type 2000 r/min
1 kW, 1.5 kW, 2 kW

Servo amplifier
RYC type 2000 r/min
1 kW, 1.5 kW, 2 kW

*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines.
Connect the noise suppressor diode, too, as shown with dotted lines.

■ 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
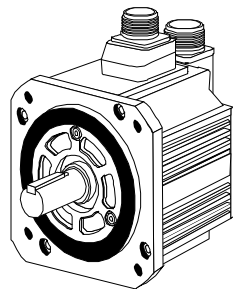
• Example of servomotor appearance

• 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

Servomotor
GYG type 1500 r/min
0.5 kW

Servo amplifier
RYC type 1500 r/min
0.5 kW

Connect the shielded wire to the shell body.
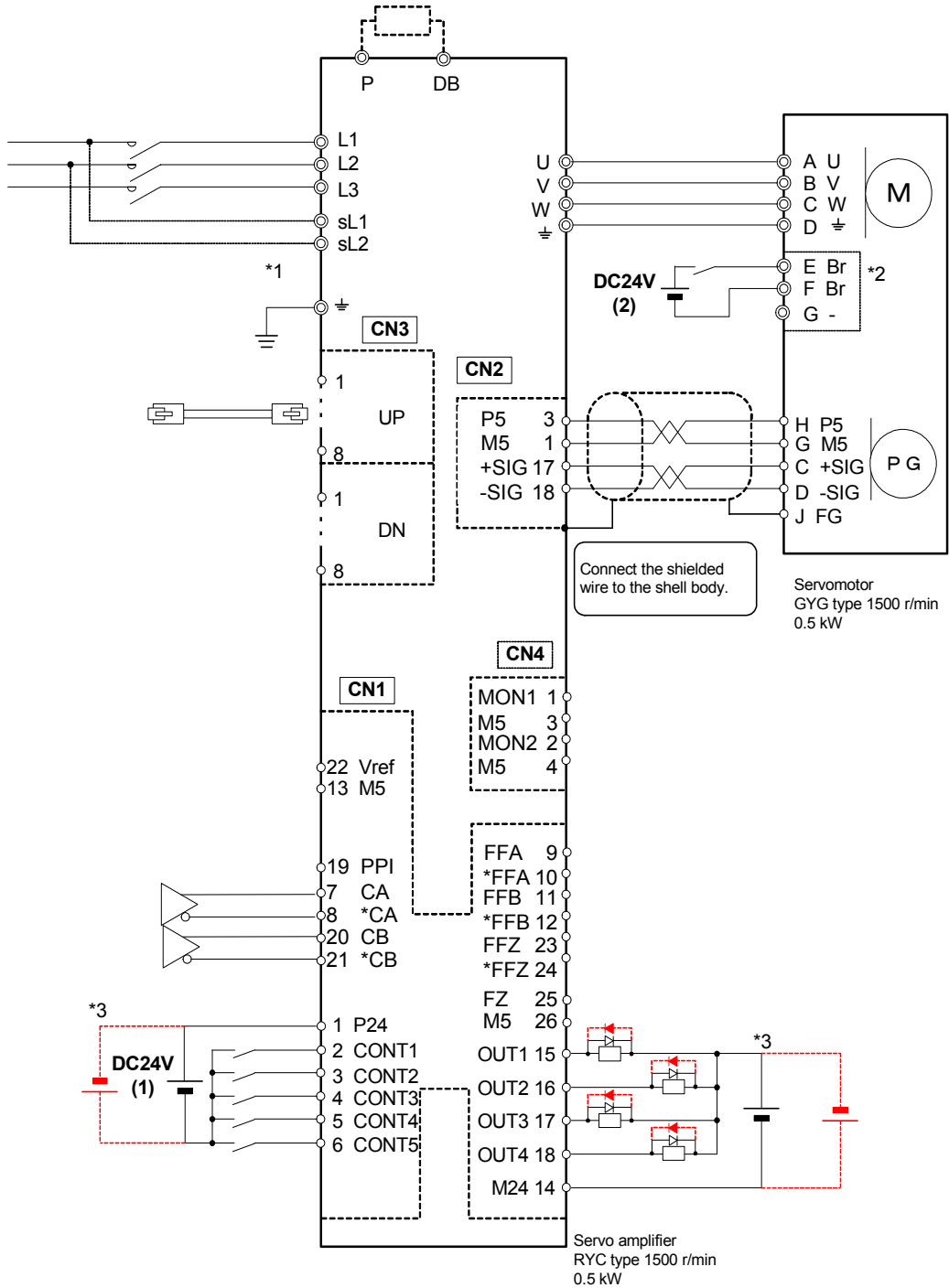
*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines. Connect the noise suppressor diode, too, as shown with dotted lines.

■ 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

(6) 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)
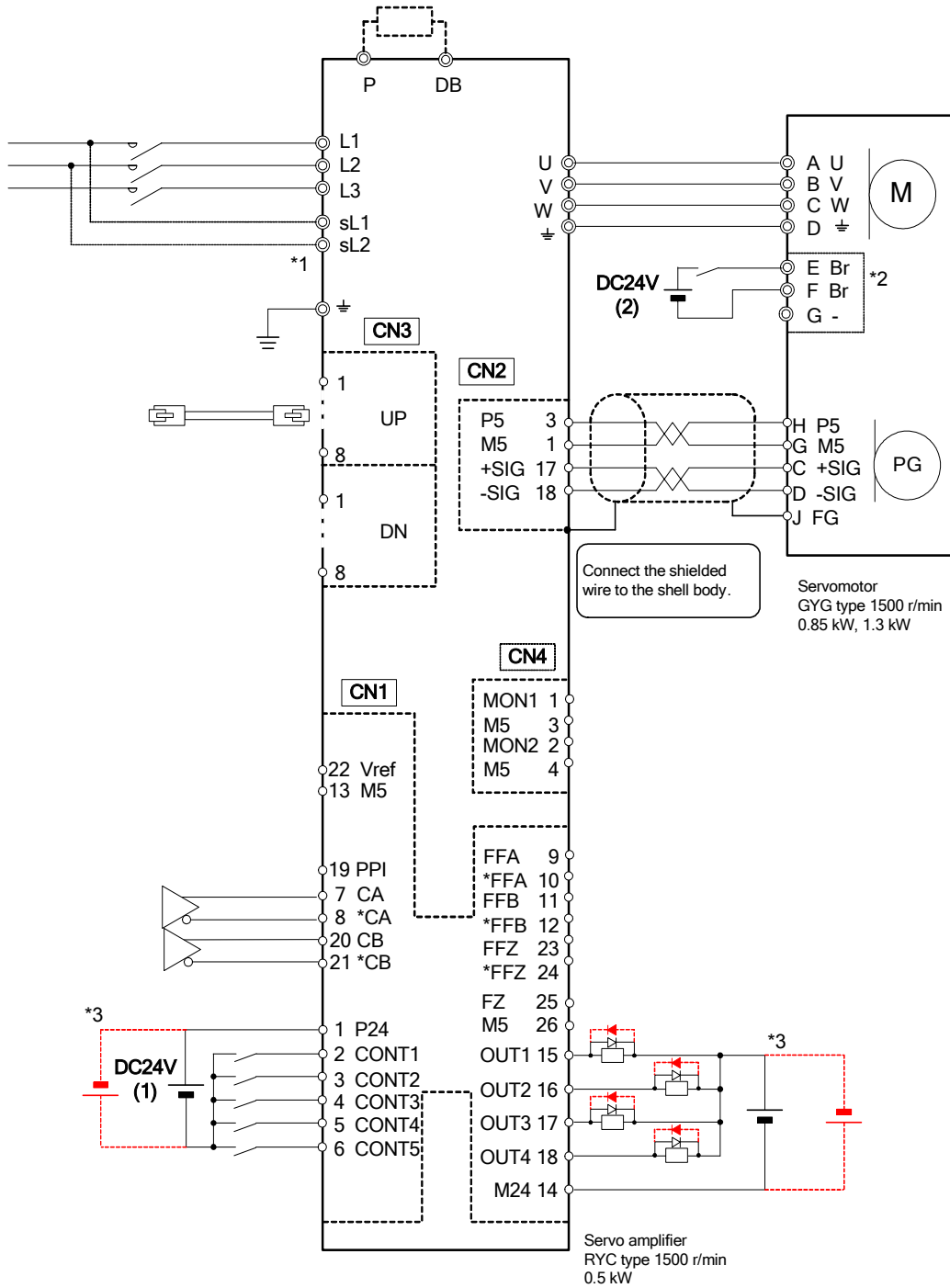
P   DB

L1
L2
L3
sL1
sL2
*1

⏚

CN3

1
UP
8
1
DN
8

U
V
W
⏚

DC24V
(2)

A U
B V
C W
D ⏚

E Br
F Br   *2
G -

M

CN2

P5   3
M5   1
+SIG 17
-SIG 18

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

PG

Connect the shielded
wire to the shell body.

Servomotor
GYG type 1500 r/min
0.85 kW, 1.3 kW

CN4

MON1 1
M5   3
MON2 2
M5   4

CN1

22 Vref
13 M5

19 PPI
7   CA
8   *CA
20 CB
21 *CB

FFA   9
*FFA 10
FFB   11
*FFB 12
FFZ   23
*FFZ 24
FZ   25
M5   26

*3

DC24V
(1)

1 P24
2 CONT1
3 CONT2
4 CONT3
5 CONT4
6 CONT5

OUT1 15
OUT2 16
OUT3 17
OUT4 18
M24   14

*3

Servo amplifier
RYC type 1500 r/min
0.5 kW

*1) For the precautions about the wiring of the control power supply, see page 3-7.

*2) This terminal is not provided for motors without a brake.

*3) For operation with source input/output, connect the 24VDC power as shown with dotted lines.
    Connect the noise suppressor diode, too, as shown with dotted lines.

■ 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
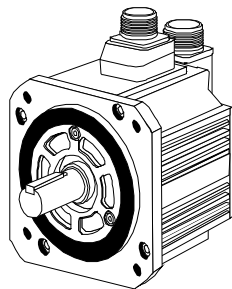
• Optional cable

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

(7) 1500 r/min series 1.8 kW, 2.9 kW

Input power supply : 3-phase 200 to 230V

Motor power wiring : Terminal block

Servomotor
GYG type 1500r/min
1.8kW,2.9kW

Connect the shield to the shell body.
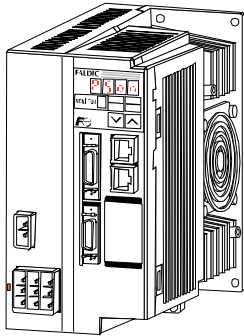
Servo amplifier
RYC type 1500 r/min
1.8 kW,2.9 kW
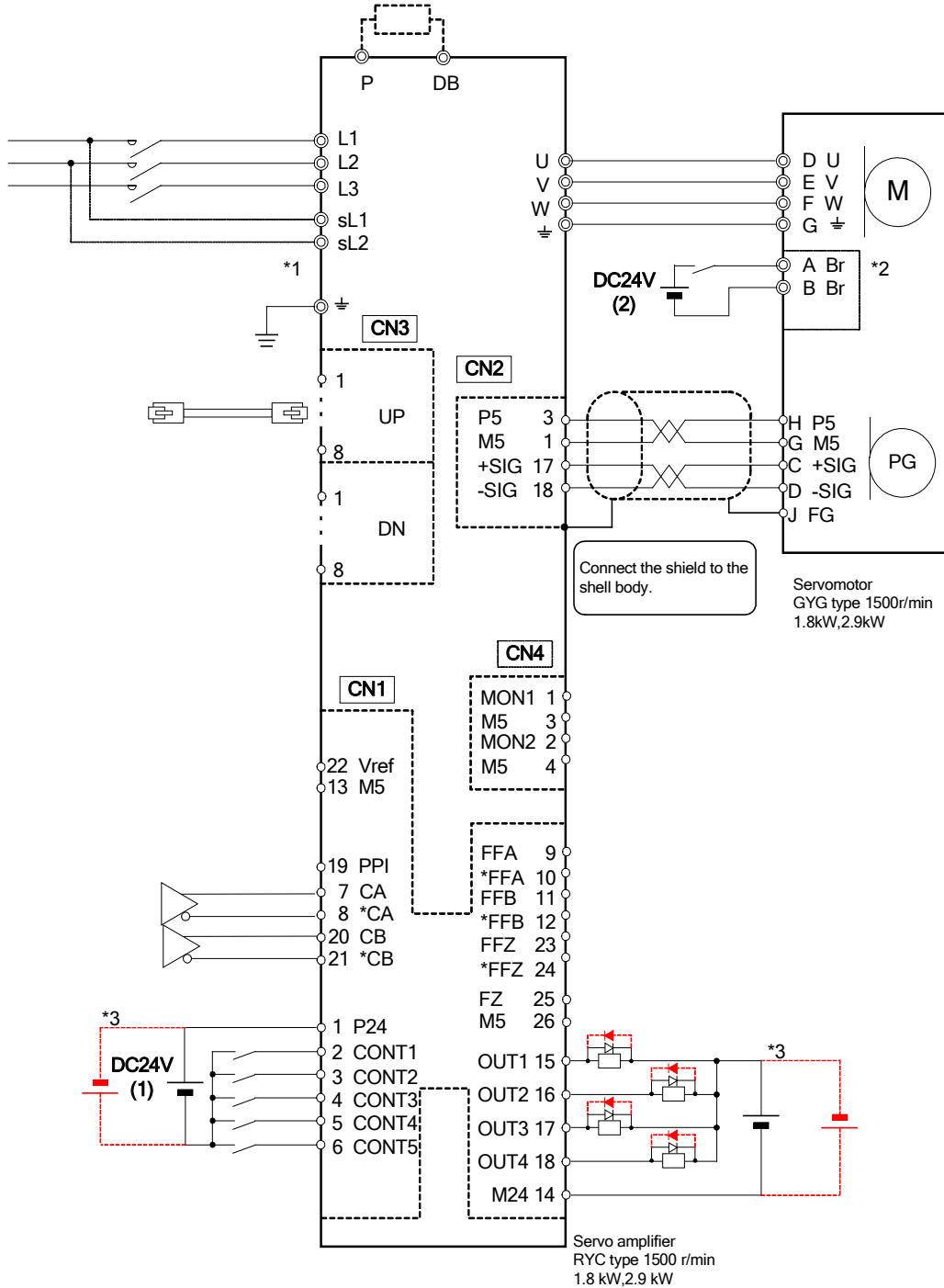
*1) For precautions on the wiring of the control power supply, refer to page 3-7.

*2) This terminal is provided also for motors without a brake, but the terminal is left unconnected.

*3) For operation with source input/output, connect the 24VDC power supply as shown with dotted lines.
Connect the noise suppressor diode, too, as shown with dotted lines

■ RYC182B3-VVT2（1.8 kW）

• Typical appearance of servo amplifier   • Typical appearance of servomotor
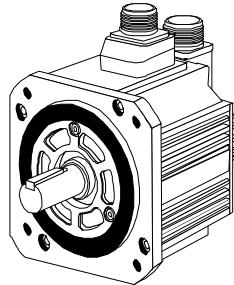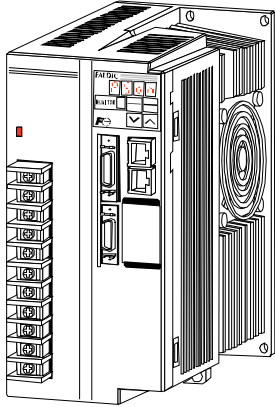
• Optional cable

Name		Type
Cable for sequence input/output		WSC-D26P03
Power cable		(Terminal block : M4)
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	With/Without brake (common)	- Connector kit : WSK-M09P-CC

■ RYC292B3-VVT2（2.9 kW）

• Typical appearance of servo amplifier   • Typical appearance of servomotor
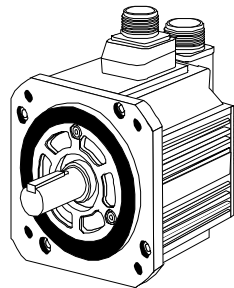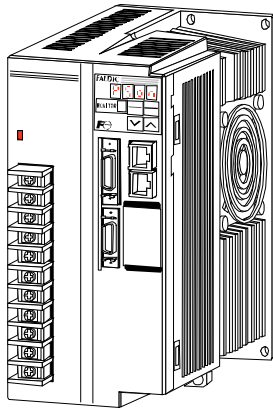
• Optional cable

Name		Type
Cable for sequence input/output		WSC-D26P03
Power cable		(Terminal block : M4)
Encoder cable (5 m)		WSC-P06P05-CD
Motor power cable (5 m)	With/Without brake (common)	- Connector kit : WSK-M09P-CC

3 WIRING

-MEMO-

WIRING **3**

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 200kHz maximum input frequency.
For the programmable logic controller, refer to the operation manual or user's manual.

Signal	Terminal
Manual pulse generator, phase A	A2
Manual pulse generator, phase *A	A1
Manual pulse generator, phase B	B2
Manual pulse generator, phase *B	B1
Manual pulse generator, ground	B3
Manual pulse generator, ground	B4
Forward rotation pulse output	A9
Pulse output common	A8
Reverse rotation pulse output	B9
Pulse output common	B8
Feedback pulse, phase A	A7
Feedback pulse, phase *A	A6
Feedback pulse, phase B	B7
Feedback pulse, phase *B	B6
Feedback pulse, phase Z	A4
Feedback pulse, phase *Z	A3
Feedback pulse, ground	A5
Feedback pulse, ground	B5
24 VDC for output	A13
24 VDC for output	B13
Input common	A14
Input common	B14
Output common	A11
Output common	B11
24 V	A20
24 V	B20
0 V	A19
0 V	B19
DO1	A12
DO2	B12
Interrupt input	A15
Origin LS	A16
EMG	A17
-OT input	B16
+OT input	B17

DC24V

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ *2

*1

P24 ⑪
M24 ⑫
P24 ⑪
M24 ⑫

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

*1) Ground the shielding wire at both ends with the host unit and the grounding terminal (FG) of the serve amplifier grounded at a single point within the panel. (It may be better to ground the shielding wire at either end when the host unit and the grounding terminal of the servo amplifier are not grounded at a single point.)

*2) The module can work without connecting these terminals.
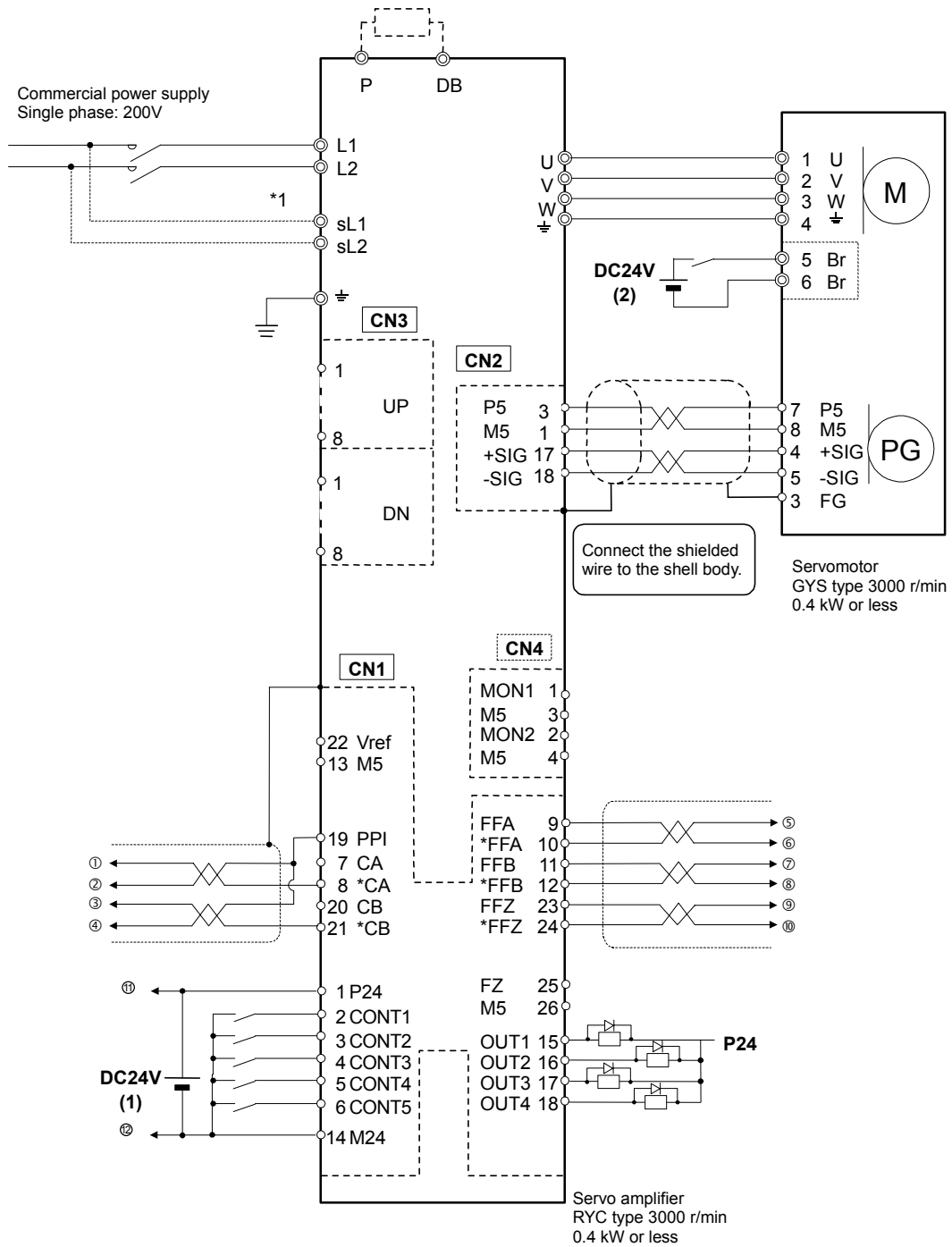
Commercial power supply
Single phase: 200V

*1) For the precautions about the wiring of the control power supply, see page 3-7.

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.

Positioning unit
(QD75D1)
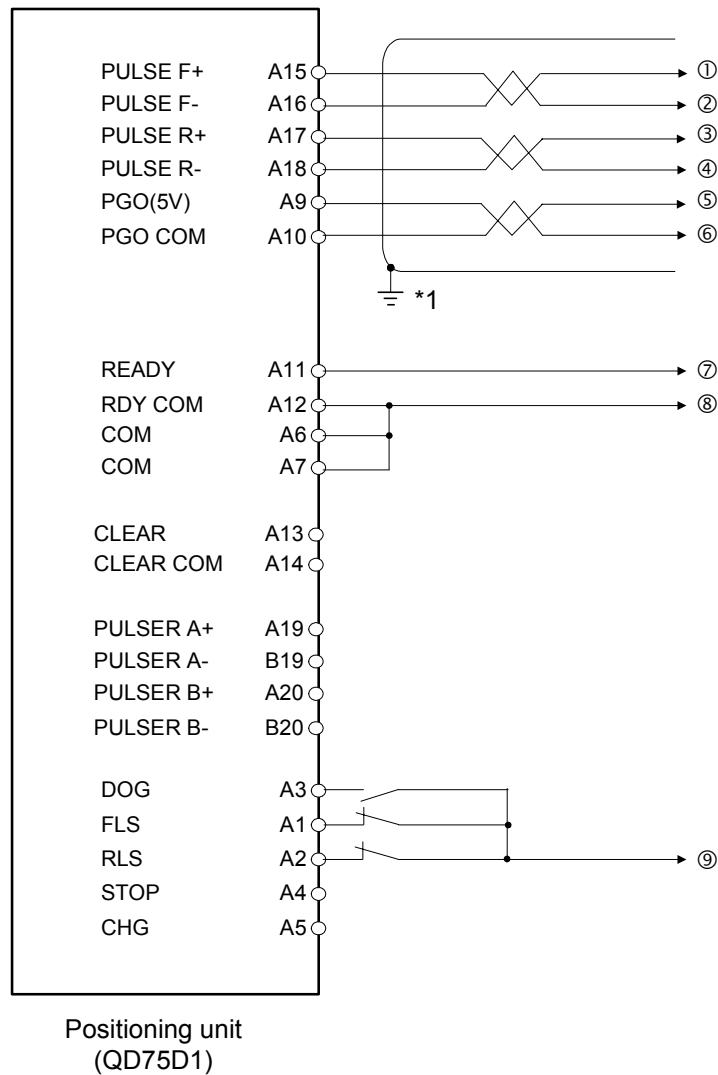
*1) Ground the shielding wire at both ends with the host unit and the grounding terminal (FG) of the serve amplifier grounded at a single point within the panel. (It may be better to ground the shielding wire at either end when the host unit and the grounding terminal of the servo amplifier are not grounded at a single point.)

*1) For the precautions about the wiring of the control power supply, see page 3-7.

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.

NC unit
(NC113)

*1) Ground the shielding wire at both ends with the host unit and the grounding terminal (FG) of the serve amplifier grounded at a single point within the panel. (It may be better to ground the shielding wire at either end when the host unit and the grounding terminal of the servo amplifier are not grounded at a single point.)

Commercial power supply
Single phase: 200V

P   DB

L1
L2
*1
sL1
sL2

CN3

CN2

DC24V
(2)

1 U
2 V
3 W
4 ⏚
5 Br
6 Br

U
V
W

M

1
8
1
8

UP

DN

P5   3
M5   1
+SIG 17
-SIG 18

7 P5
8 M5
4 +SIG
5 -SIG
3 FG

PG

Connect the shielded
wire to the shell body.

Servomotor
GYS type 3000 r/min
0.4 kW or less

CN1

CN4

MON1 1
M5   3
MON2 2
M5   4

22 Vref
13 M5

19 PPI
7 CA
8 *CA
20 CB
21 *CB

FFA   9
*FFA 10
FFB   11
*FFB 12
FFZ   23
*FFZ 24

①
②
③
④

⑤
⑥

1 P24
2 CONT1
3 CONT2
4 CONT3
5 CONT4
6 CONT5
14 M24

FZ   25
M5   26
OUT1 15
OUT2 16
OUT3 17
OUT4 18

⑧

DC24V
(1)

⑨

⑦

Servo amplifier
RYC type 3000 r/min
0.4 kW or less

*1) For the precautions about the wiring of the control power supply, see page 3-7.

3-47

3 WIRING

-MEMO-

4

TEST OPERATION

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, ±OT signals)?	
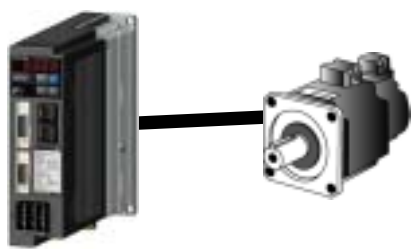
4.2 Test operation in three stages

Perform test operation in the following three stages.

■First stage

Perform test operation with the servomotor and the servo amplifier.

➀ Check input power supply/motor power/encoder wiring.
➁ Check rotation direction of the servomotor.

Note 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.

➀ Check wiring with the upper level control system.
➁ Check I/O signals.
➂ Check the rotation speed and rotation level of the servomotor.
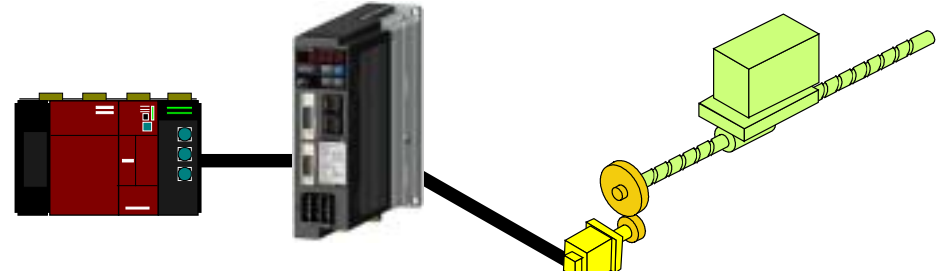
Note To proceed to the 3rd stage, make sure to turn off the power before starting work.

■3rd stage

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

➀ Check that the servomotor is correctly installed on the machine.
➁ 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.
(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.
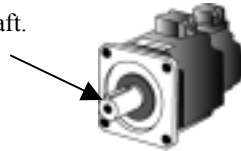
Fix securely.

(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.

ii) Check the touch panel indication.

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

When correct	*PSoF*
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.
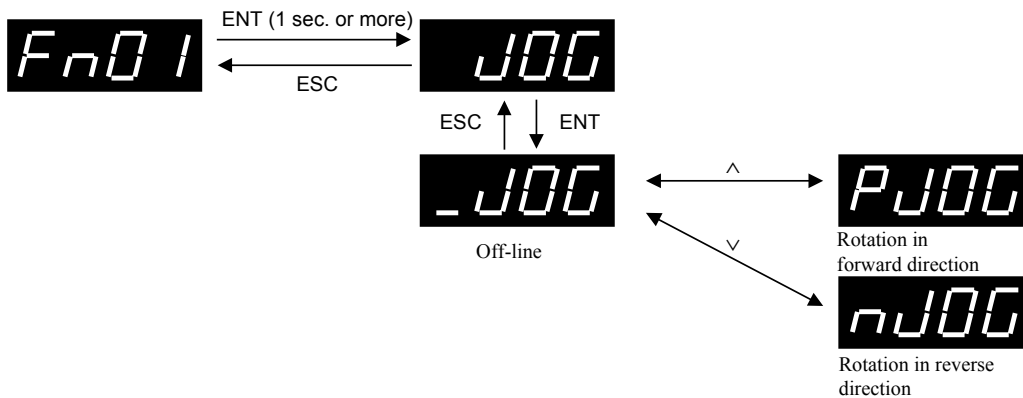
* The servomotor rotates while the ∧ or ∨ key is held down.

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), ±overtravel (±OT) and brake timing which are protective functions. Check that the servo amplifier is recognizing each signal.

I/O check from keypad
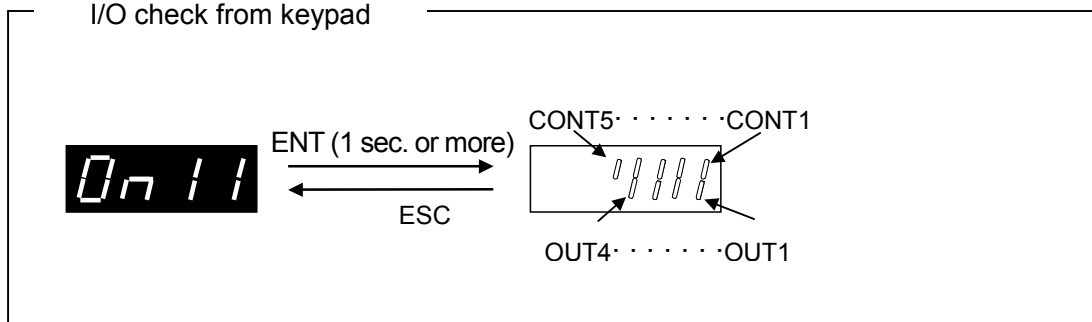
I/O check from PC loader
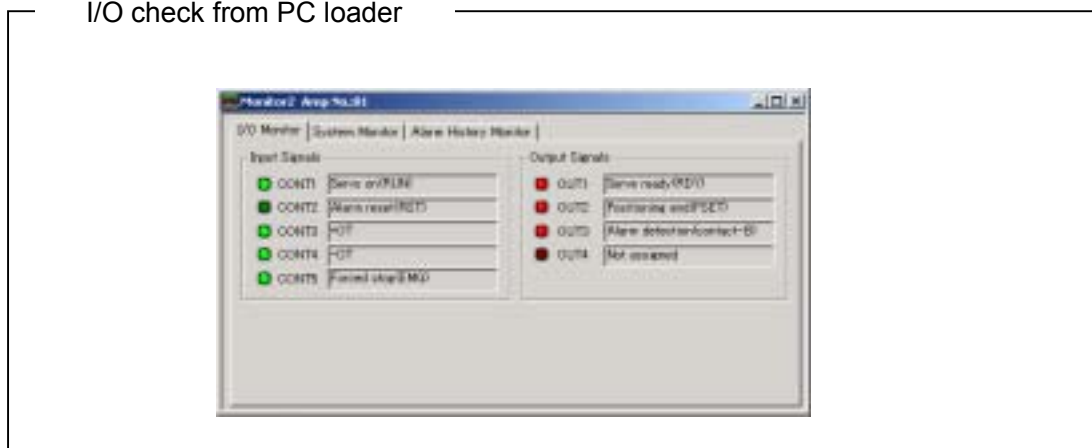
4.2.2.2 Position control mode

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

 (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
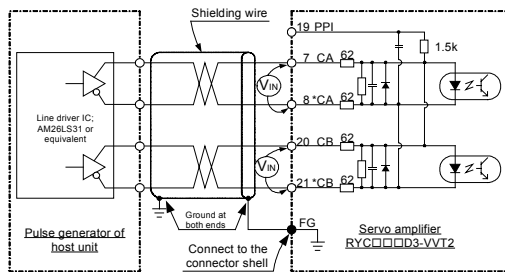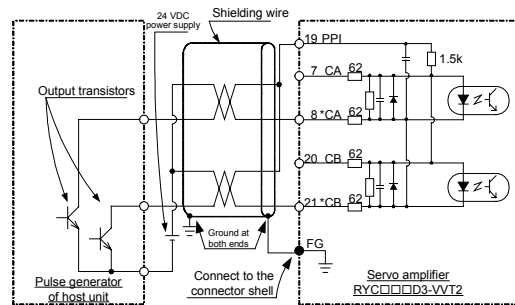
Note Refer to Chapter 3 for wiring.

 (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⇔Speed, 4: Position⇔Torque, 5: Speed⇔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 ─────────────────────────────────
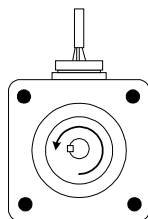
     Forward direction (CCW)

└──

(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.	

4.2.2.3   Speed/torque control mode

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

 (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) Allocate the manual forward (FWD) to the CONT3 signal of parameter #12, and manual reverse (REV) to the CONT4 signal of parameter #13. After the setting is completed, turn ON the power again.

 (4) Turn ON the run command (RUN) of the CONT1 signal and either manual forward (FWD) or manual reverse (REV) of the CONT3 signal. The servo amplifier is ready to run.

Servo ON (RUN)	OFF	ON		OFF
Manual forward (FWD)	OFF	ON	OFF	
Manual reverse (REV)		OFF	ON	OFF
Analog voltage (command)				
Rotation speed (under speed control)				
Output torque (under torque control)				
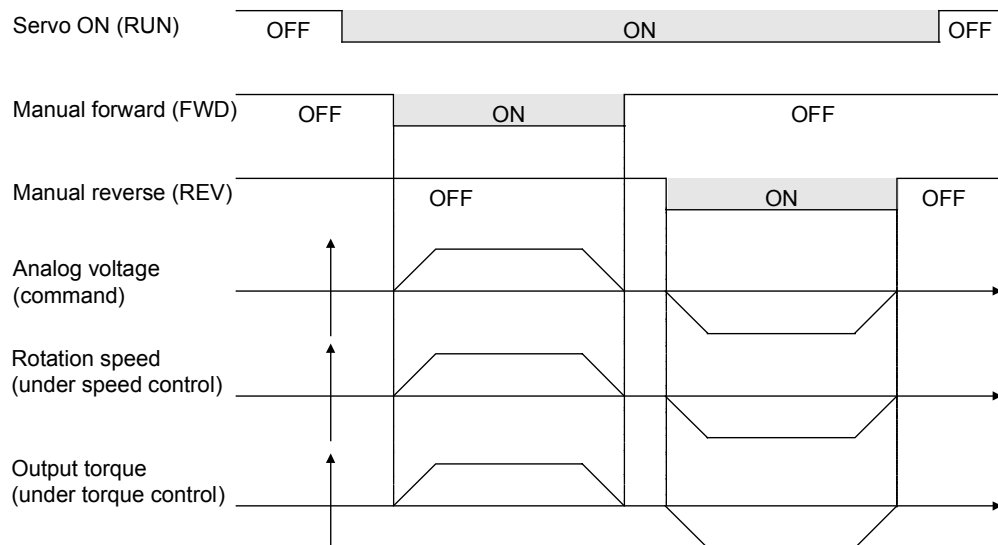
(5) Turn ON the operation command (RUN) and make the system ready for rotation. Then output an analog command from the upper level control system to operate the motor. * At this time, check the rotation direction.

> * 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)

$$\text{Rotation speed [r/min]}^* = \frac{\text{Maximum rotation speed [r/min]}}{10 \text{ [V]}} \times \text{Parameter \#70} \times \text{Analog command voltage [V]}$$
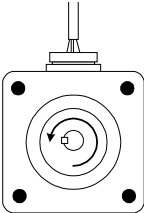
* The rotation speed does not exceed the maximum rotation speed.

---

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)

---

(6) 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 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".

- 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.
 (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), ±overtravel (±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

Servo ON (RUN)	OFF	ON		OFF
Base signal	OFF	ON		OFF

Parameter #73
Brake operation time

Ready (RDY)	OFF	ON	OFF

Brake timing output	OFF	ON	OFF
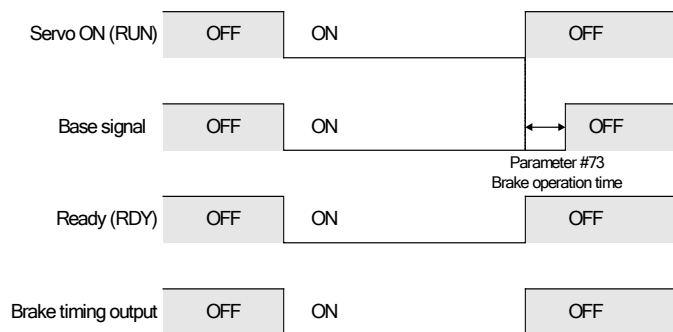
(2) ON/OFF of emergency stop (EMG) signal

Emergency stop (EMG)	ON (invalid)	OFF (valid)	ON (invalid)

Servo ON (RUN)	ON

Base signal	ON

Ready (RDY)	OFF	ON	OFF

Brake timing output	ON
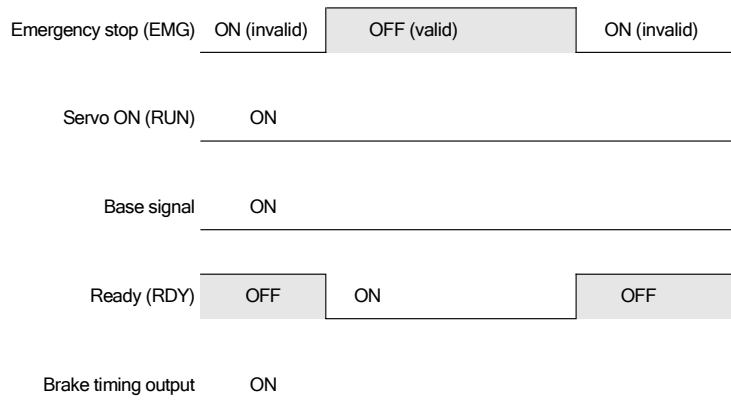
(3) Alarm occurrence

	Not detected	Detected
Alarm		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.
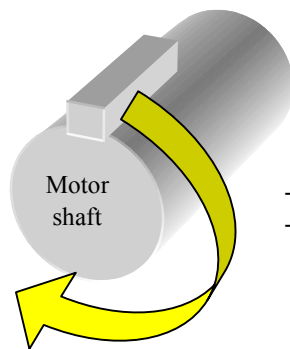
Motor shaft

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

4 TEST OPERATION

-MEMO-

5

PARAMETERS

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.

Mode selection		Sub-mode selection	Display example
Power ON			
Sequence mode	MODE/ESC	5n0 1	P5oF
Monitor mode	MODE/ESC	0n0 1	1000
Parameter editing mode	MODE/ESC	Pn0 1	no.0 1
Test operation mode	MODE/ESC	Fn0 1	J0G
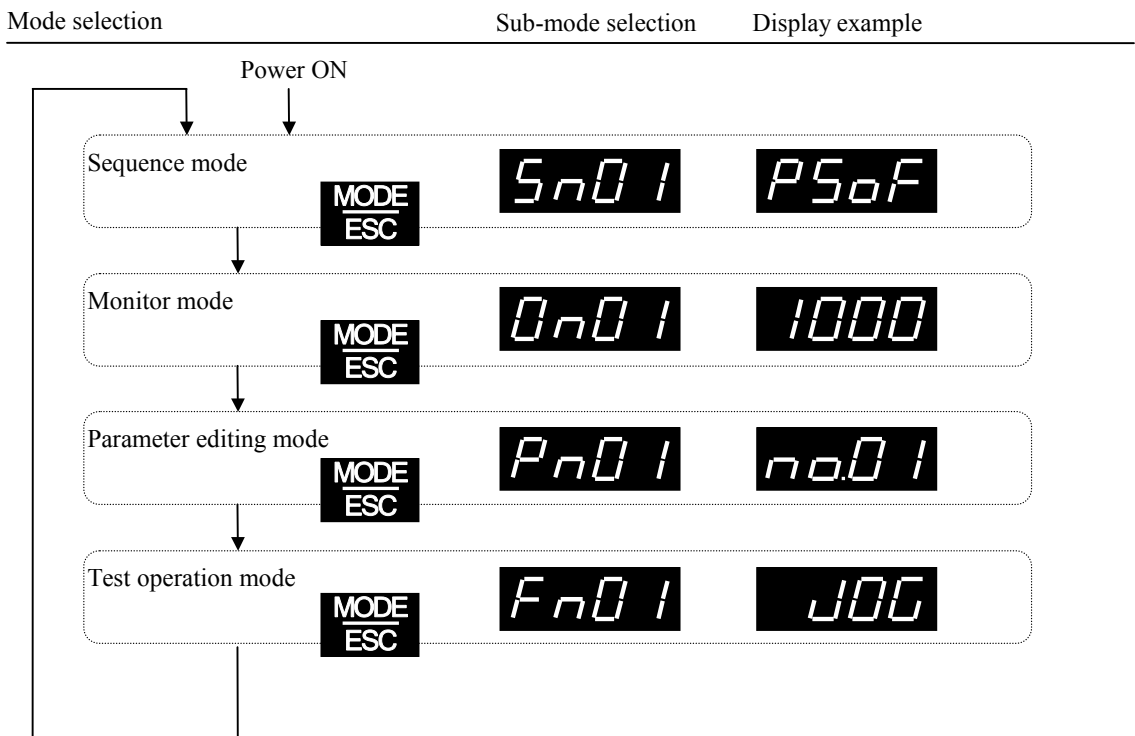
5.1.2　Parameter editing through PC loader

Use the PC loader to edit parameters.
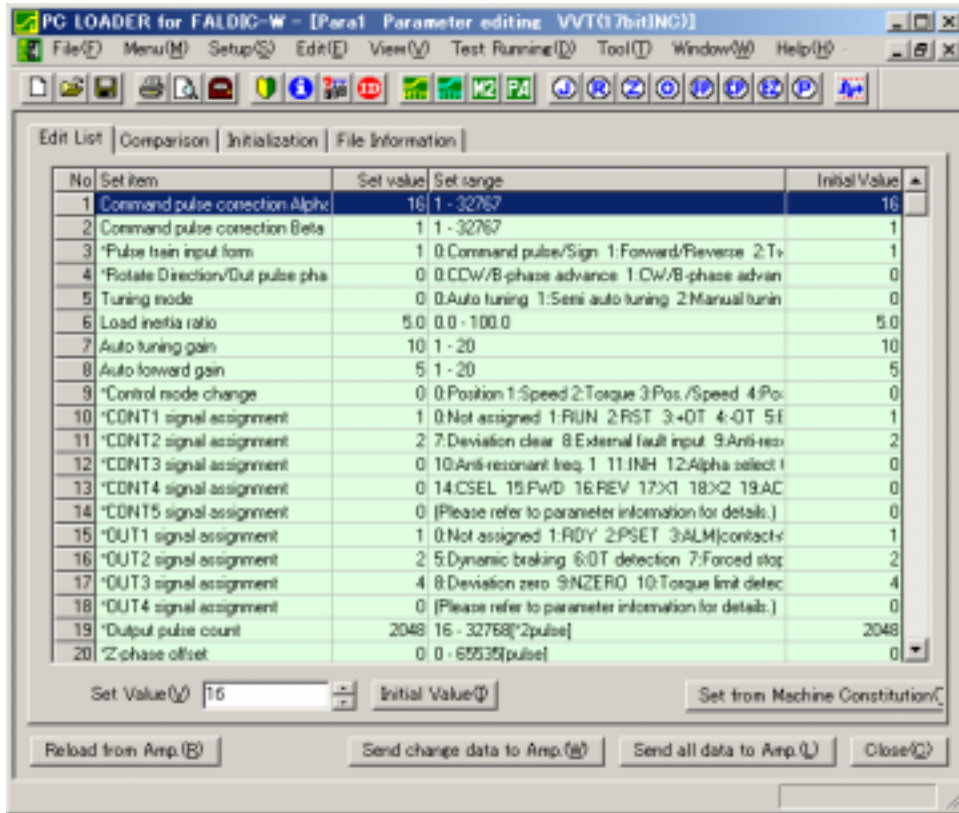
5 PARAMETERS

5.2 List of parameters

■Parameter list (1)

No.	Name	Control mode			Reference page
		Position	Speed	Torque	
01	Command pulse compensation ?	O	-	-	5-9
02	Command pulse compensation ?				
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	5-55
20	Z phase offset	O	O	O	5-56
21	Zero deviation width	O	-	-	5-57
22	Deviation limit width	O	-	-	5-58
23	Zero speed width	O	O	O	5-58
24	Positioning end judgment time	O	-	-	5-59
25	Maximum current limit value	O	O	O	5-59
26	Alarm detection for undervoltage	O	O	O	5-60
27	Operation for undervoltage	-	O	-	5-60
28	For adjustment by manufacturer	-	-	-	5-61
29	Parameter write-protection	O	O	O	5-61
30	Initial display of the keypad	O	O	O	5-62
31	Manual feed speed 1 (and test operation)	O	O	-	5-63
32	Manual feed speed 2	O	O	-	
33	Manual feed speed 3	O	O	-	
34	Maximum rotating speed	O	O	O	5-63
35	Acceleration time 1 (and test operation)	O	O	-	5-64
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		5-65
40	Position controller gain 1	O	-	-	5-68
41	Speed response 1	O	O	-	
42	Speed controller integration time 1	O	O	-	
43	S-curve time constant	O	O	-	5-70
44	Feed forward gain	O	-	-	5-70
45	Feed forward filter time constant	O	-	-	5-68
46	Torque filter time constant	O	O	-	
47	Speed setting filter	O	O	-	5-71
48	Gain switching factor	O	O	-	5-72
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	O	-	-	5-72
52	Speed response 2	O	O	-	
53	Speed controller integration time 2	O	O	-	
54	Torque setting filter	-	-	O	5-73
55	Command follow-up control selection	O	-	-	5-73
56	Notch filter 1 frequency	O	O	-	5-74
57	Notch filter 1 damping				
58	Notch filter 2 frequency				
59	Notch filter 2 damping				
60	Anti-resonance frequency 0	O	-	-	5-75
61	Anti-resonance frequency 1				
62	Anti-resonance frequency 2				
63	Anti-resonance frequency 3				
64 to 69	Not used	-	-	-	-
70	Analog command gain	O	O	O	5-76
71	Analog command offset				
72	Not used	-	-	-	-
73	Brake operation time	O	O	O	5-78
74	CONT normally ON 1	O	O	O	5-79
75	CONT normally ON 2				
76	CONT normally ON 3				
77	CONT normally ON 4				
78	Command pulse compensation α 1	O	-	-	5-80
79	Command pulse compensation α 2				
80	Command pulse compensation α 3				
81	Parameter storage in RAM	O	O	O	5-80
82	Station number	O	O	O	5-81
83	Baud rate				
84	Easy tuning: Travel setting	O	O	O	5-81
85	Easy tuning: Speed setting				
86	Easy tuning: Timer setting				
87	Monitor 1 signal allocation	O	O	O	5-82
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	-	-	-	5-84
95	For adjustment by manufacturer				
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	GYS 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⇔Speed 4: Position⇔Torque 5: Speed⇔Torque	0	Power
10	CONT 1 signal allocation	0 - 22 (increments of 1)	1[RUN]	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 / 8: External regenerative resistor overheating / 9: Anti-resonance frequency selection 0 / 10: Anti-resonance frequency selection 1 / 11: Command pulse inhibition / 12: Command pulse α selection 0 / 13: Command pulse α selection 1 / 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] / 22: For adjustment by manufacturer	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 - 13 (increments of 1)	1[RDY]	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 / 6: OT detection / 7: Forced stop detection / 8: Zero deviation / 9: Zero speed / 10: Current limit detection / 11: Brake timing / 12: For adjustment by manufacturer / 13: For adjustment by manufacturer	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 [×2 pulse] (increments of 1)	0	Power
21	Zero deviation width	1 - 2000 [pulse] (increments of 1)	400	Always
22	Deviation limit width	10 - 65535 [×100 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) 0 - 240% (increments of 1)[*1]	300 (240[*1])	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 - 21 (increments of 1)	0	Power

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

*1) Setting range/Default value of RYC182B3-VV** and RYC292B3-VV** types

■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)	*2	Always
41	Speed response 1	1 - 1000[Hz] (increments of 1)	*2	Always
42	Speed controller integration time 1	1.0 - 1000.0[msec] (increments of 0.1)	*2	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)	*2	Always
46	Torque filter time constant	0.00 - 20.00[msec] (increments of 0.01)	*2	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.

*2) 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	±0.10 - ±1.50 (increments of 0.01)	1.00	Always
71	Analog command offset	-2000 - +2000	(Set before shipment)	Always
72	Not used	-	0	-
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	Power
75	CONT normally valid 2	0 - 21	0	Power
76	CONT normally valid 3		0	Power
77	CONT normally valid 4		0	Power
78	Command pulse compensation α 1		1	Always
79	Command pulse compensation α 2	1 - 32767 (increments of 1)	1	Always
80	Command pulse compensation α 3		1	Always
81	Parameter storage in RAM	0: Not specified, 1 - 99 (increments of 1)	0	Power
82	Station number	1 - 31	1	Power
83	Baud rate	0: 38400 [bps], 1: 19200 [bps], 2: 9600 [bps]	0	Power
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	±2.0 - ±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	±2.0 - ±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.

$$\boxed{Pn01} \ / \ \boxed{no.01} - \boxed{no02}$$

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

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

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

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

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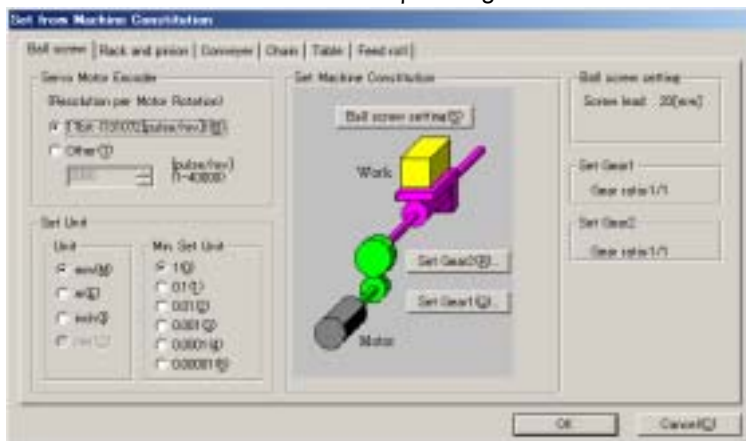
Data are automatically set by simply entering the machine specifications.
Because settings are given for each component of the machine, entry is simply.

5 PARAMETERS

To couple 10-mm-lead screw to the output shaft of the servomotor with a setting unit of 1/100
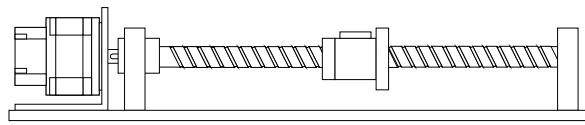
$$\frac{\text{(Mechanical system travel distance per revolution of servomotor)}}{\text{(131072 pulses/rotation)}} \times \frac{\text{(Command pulse correction } \alpha \text{)}}{\text{(Command pulse correction } \beta \text{)}} = \text{(Unit quantity)}$$

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

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.

0.01 mm with each pulse

10 mm with 1000 pulses
(one full revolution of motor)
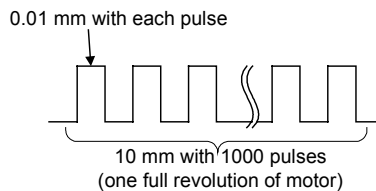
Hint · The pi (π) included in the mechanical system travel distance per each revolution of the servomotor can be approximated with "355 / 113."

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

$t1 \leq 100$[nsec]
$t2 \leq 100$[nsec]
$t3 \geq 480$[nsec]
$t4 \geq 480$[nsec]
$t6 \geq 500$[nsec]
$t7 \geq 500$[nsec]
$t8 \leq 100$[nsec]

The arrow " ↑ ↓ " shown in the figure above is triggered at each pulse count timing.

• Open collector input

$t1 \leq 0.2$[μsec]
$t2 \leq 0.2$[μsec]
$t3 \geq 2$[μsec]
$t4 \geq 2$[μsec]
$t6 \geq 2.5$[μsec]
$t7 \geq 2.5$[μsec]
$t8 \leq 0.2$[μsec]

"ON" shown in the figure above indicates the active transistor and low signal level.
The arrow " ↓ " shown in the figure above is triggered at each pulse count timing.
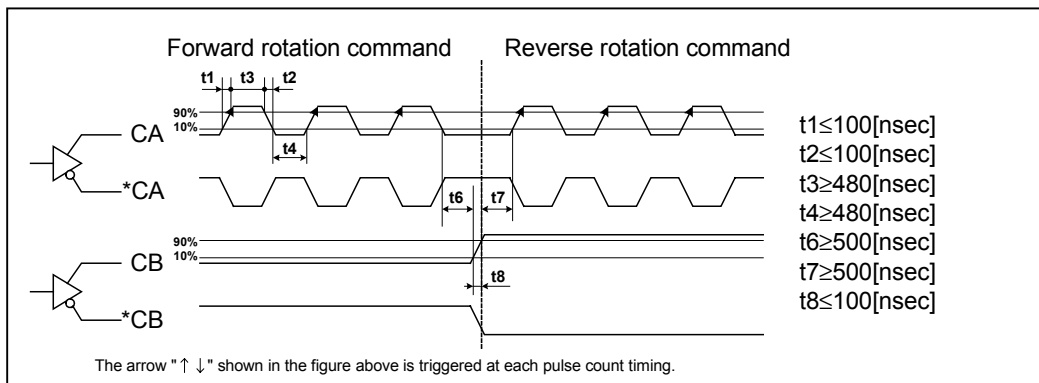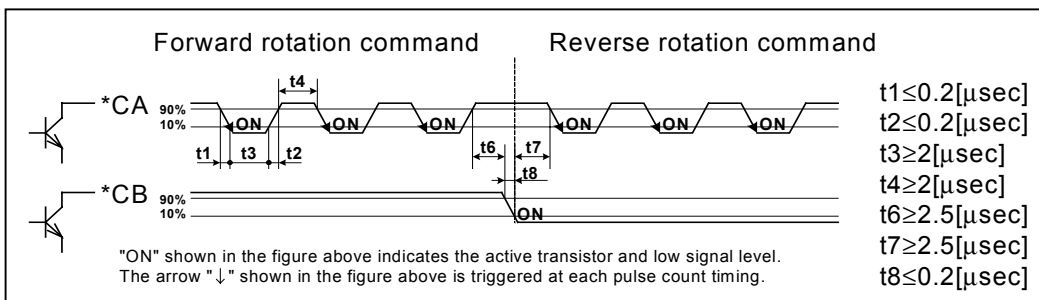
5 PARAMETERS

■ 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

t1≤100[nsec]
t2≤100[nsec]
t3≥480[nsec]
t4≥480[nsec]
t5≥500[nsec]

The arrows "↑ ↓" shown in the figure above are triggered at each pulse count timing.
- Open collector input

• Open collector input

t1≤0.2[μsec]
t2≤0.2[μsec]
t3≥2[μsec]
t4≥2[μsec]
t5≥2.5[μsec]

"ON" shown in the figure above indicates the active transistor and low signal level.
The arrow "↓" shown in the figure above is triggered at each pulse count timing.
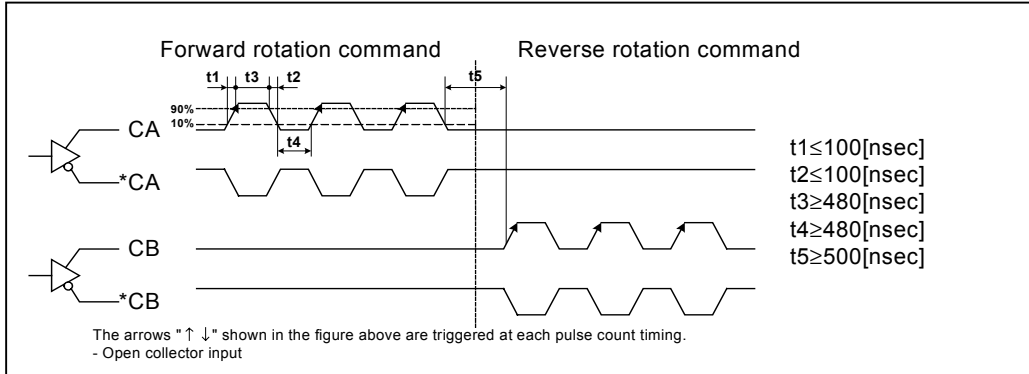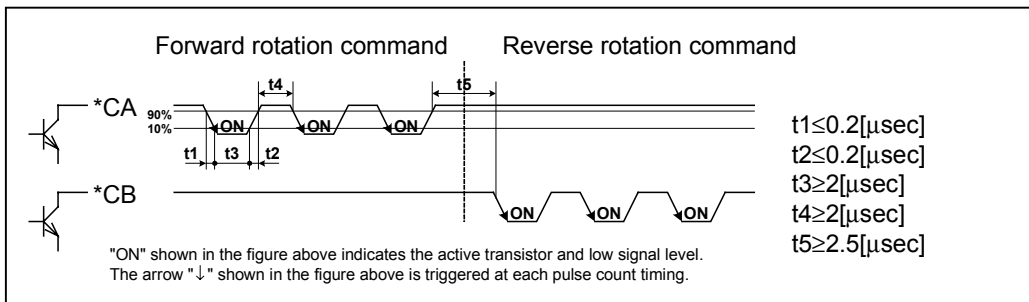
■ Two signals with 90-degree phase difference (Setting of parameter 03: 2)

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

t1≤100[nsec]
t2≤100[nsec]
t3≥480[nsec]
t4≥480[nsec]
t9≥500[nsec]
t10≥500[nsec]

The arrows "↑ ↓" shown in the figure above are triggered at each pulse count timing.

• Open collector input

t1≤0.2[μsec]
t2≤0.2[μsec]
t3≥2[μsec]
t4≥2[μsec]
t9≥2.5[μsec]
t10≥2.5[μsec]

"ON" shown in the figure above indicates the active transistor and low signal level.
The arrow "↓" shown in the figure above is triggered at each pulse count timing.
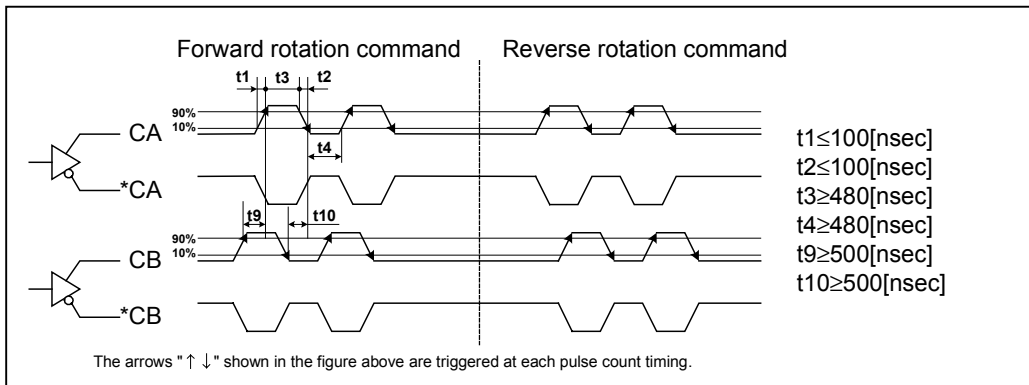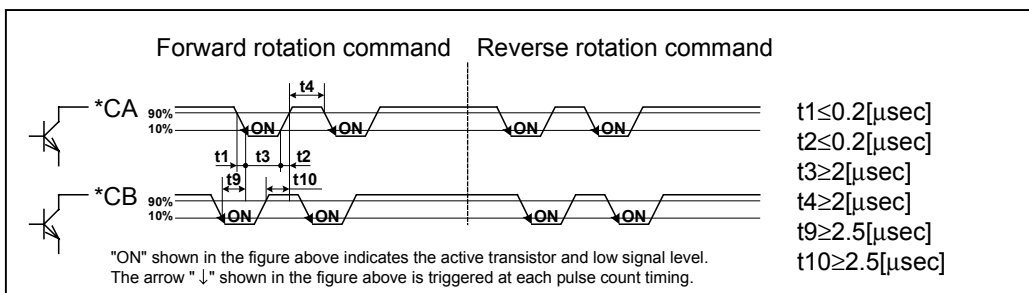
$Pn01$ / $no.04$

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

A phase

B phase
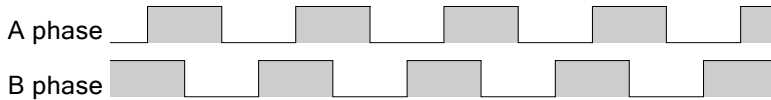
- When the reference value is 2 or 3

A phase

B phase
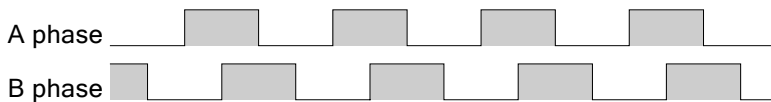
■ Forward/reverse rotation

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

Forward rotation
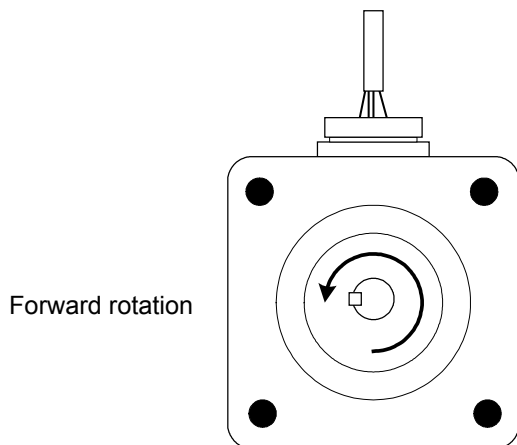
5 PARAMETERS

PnO1 / 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 inertia 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.

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

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	O	O

O: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 `On 12` 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

`PnD1` / `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.
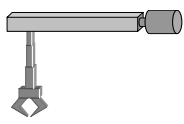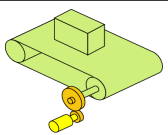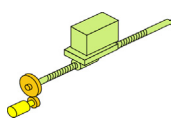
2) Setting through auto tuning gain setting from keypad panel (in test operation mode)
   The setting is updated at real time when the value is changed.

`Fn09` →(SHIFT ENT)→ `AtG` →(SHIFT ENT)→ `10`

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.
   → See page 5-74 (notch filter setting method) and page 6-12 (auto tuning).

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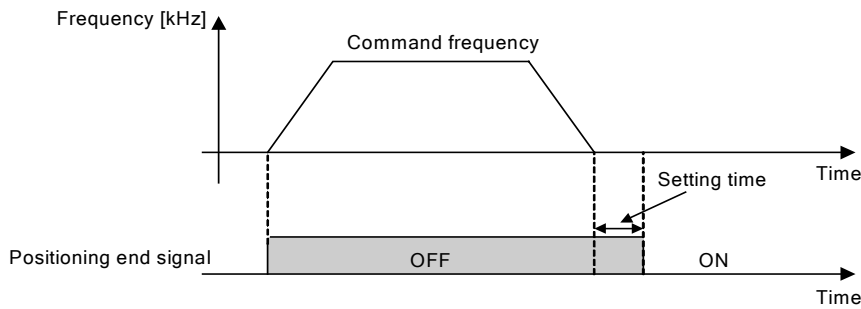
With adjustment of the auto forward gain, the following parameters are automatically adjusted.

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, 1: Speed 2: Torque, 3: Position⇔Speed 4: Position⇔Torque, 5: Speed⇔Torque	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

5-18
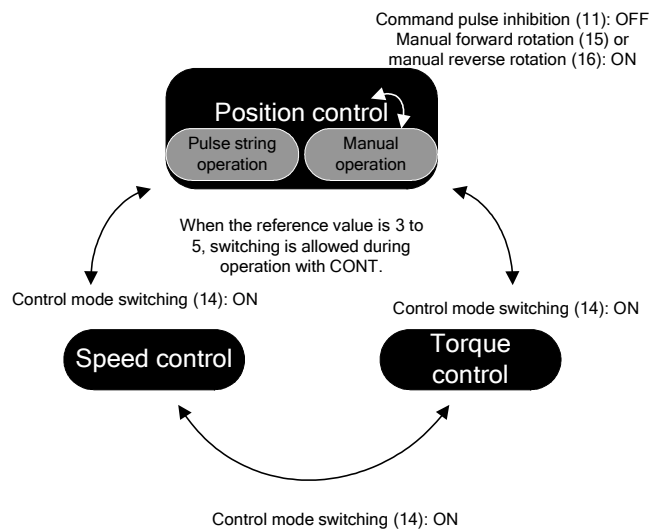
■ Transition time to each control mode

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
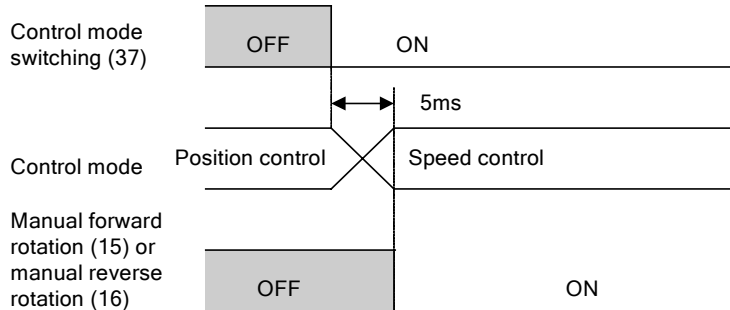
■ Position control

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 · 1: Servo ON (RUN) 2: Reset [RST] · 3: + overtravel 4: - overtravel · 5: Emergency stop [EMG] 6: P-action · 7: Deviation clearance 8: External regenerative resistor overheat · 9: Anti-resonance frequency selection 0 10: Anti-resonance frequency selection 1 · 11: Command pulse inhibition 13: Command pulse α selection 1 12: Command pulse α selection 0 · 15: Manual forward rotation [FWD] 14: Control mode switching · 17: Multistep speed 1 [x1] 16: Manual reverse rotation [REV] · 19: Acceleration/deceleration time selection 18: Multistep speed 2 [x2] 20: Current limiting regulator ON · 21: Coasting [BX] 22: For adjustment by manufacturer	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 · 1: Ready [RDY] 2: Positioning end [PSET] · 3: Alarm detection: a-contact 4: Alarm detection: b-contact · 5: Dynamic brake 6: Overtravel detection · 7: Forced stop detection 8: Zero deviation · 9: Zero speed 10: Current limit detection · 11: Brake timing 12: For adjustment by manufacturer · 13: For adjustment by manufacturer	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]	5-24
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	5-31
11	Command pulse inhibition	5-32
12	Command pulse α selection 0	5-34
13	Command pulse β selection 1	5-34
14	Control mode switching	5-35
15	Manual forward rotation [FWD]	5-36
16	Manual reverse rotation [REV]	5-36
17	Multistep speed 1 [x1]	5-38
18	Multistep speed 2 [x2]	5-38
19	Acceleration/deceleration time selection	5-39
20	Current limiting regulator ON	5-40
21	Coasting [BX]	5-41
22	For adjustment by manufacturer	-

■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	5-46
5	Dynamic brake	5-47
6	Overtravel detection	5-24
7	Forced stop detection	5-26
8	Zero deviation	5-50
9	Zero speed	5-51
10	Current limit detection	5-40
11	Brake timing	5-52
12	For adjustment by manufacturer	-
13	For adjustment by manufacturer	-

■ 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
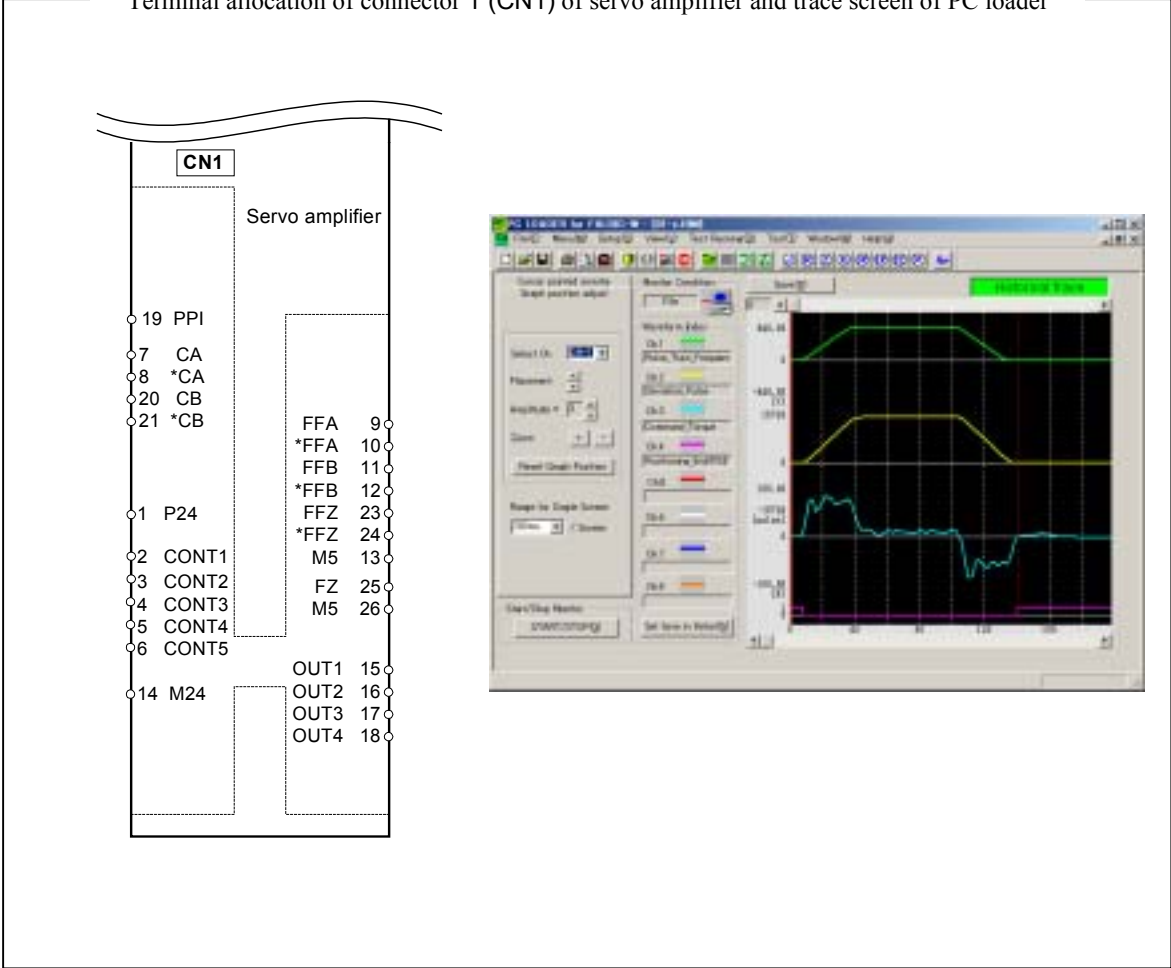
5 PARAMETERS

(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 ∨ 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.

OT detection (6)

+OT (3)

-OT (4)
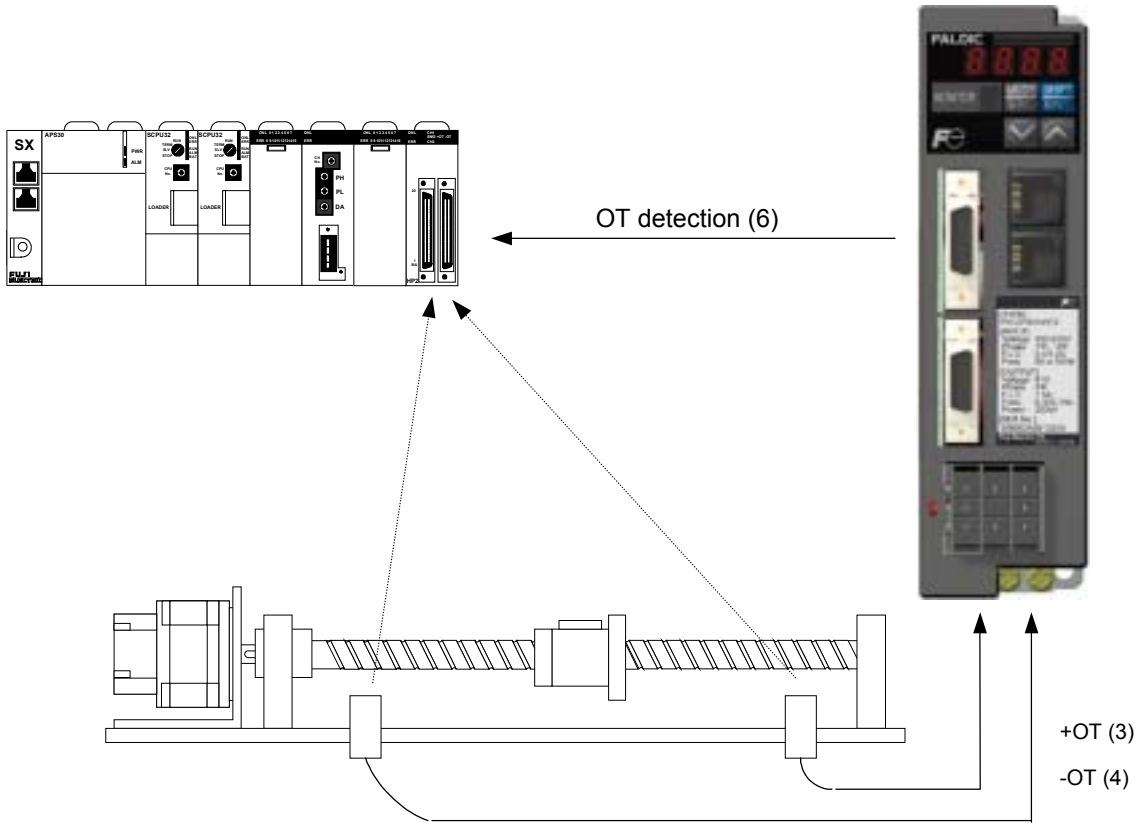
5 PARAMETERS

(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

> **Hint** — If the brake is handled with servo locked, an overload alarm ("$\boxed{\mathit{OL}}$") 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

■ Function

While this signal remains active, the difference (position devition) between the command position and feedback position is reduced to zero. The feedback position is made the command position.

■ Parameter setting

To assign deviation clearance to a sequence input terminal, specify the corresponding value ("7") to the parameter.

■ Reference

While the deviation clearance signal is activated, all rotation commands are ignored.
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.

Deviation accumulated at a stopper can be zeroed to avoid movement caused by the offsetting of deviation upon a released load.

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.
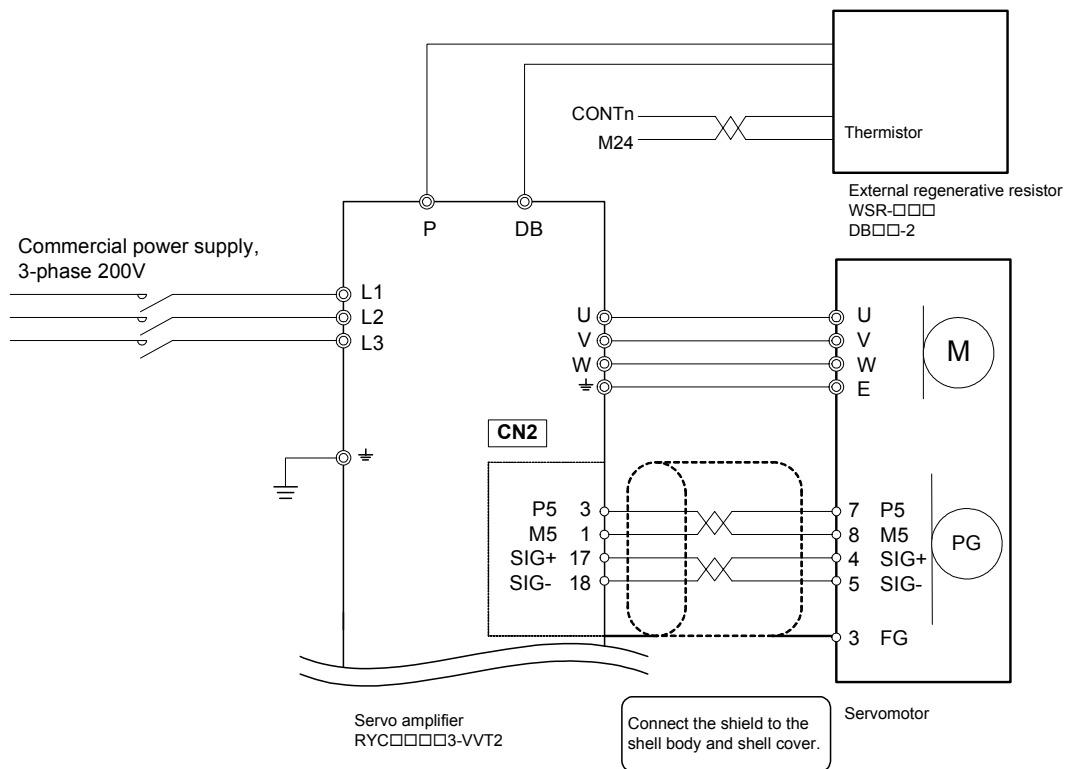
(8) Anti-resonance frequency selection 0/1

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
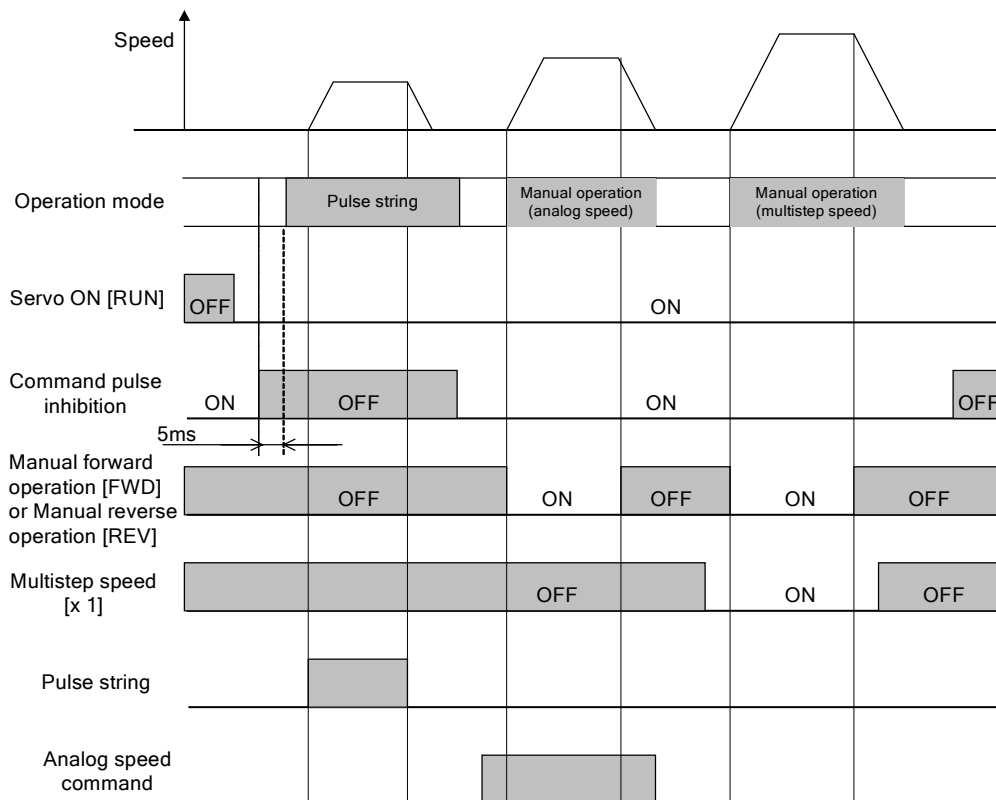
■ When only pulse string operation is performed

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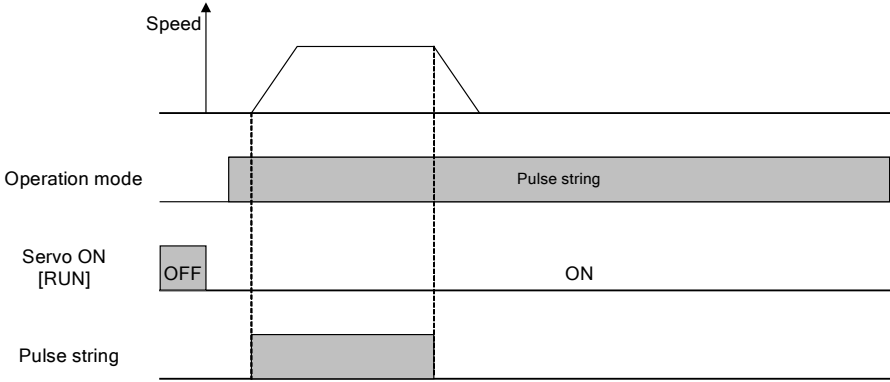
5 PARAMETERS

(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 α0 (12) or command pulse compensation α1 (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 α0 or command pulse compensation α1 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.

* Before starting manual operation, turn ON the "command pulse prohibited (11)" signal.

(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
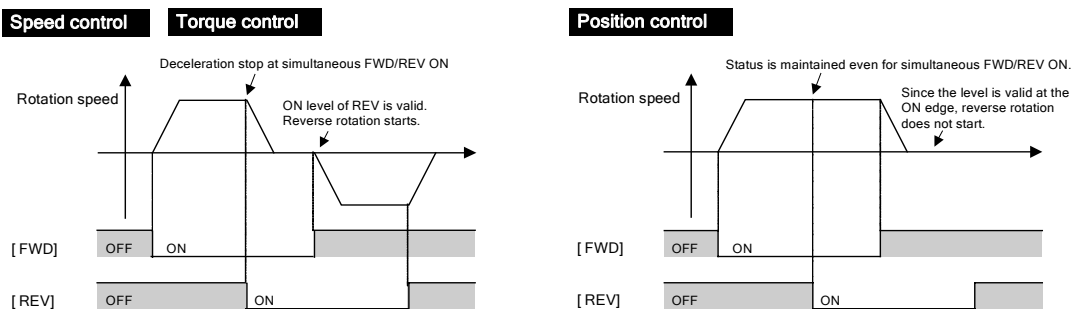
■ Parameter setting

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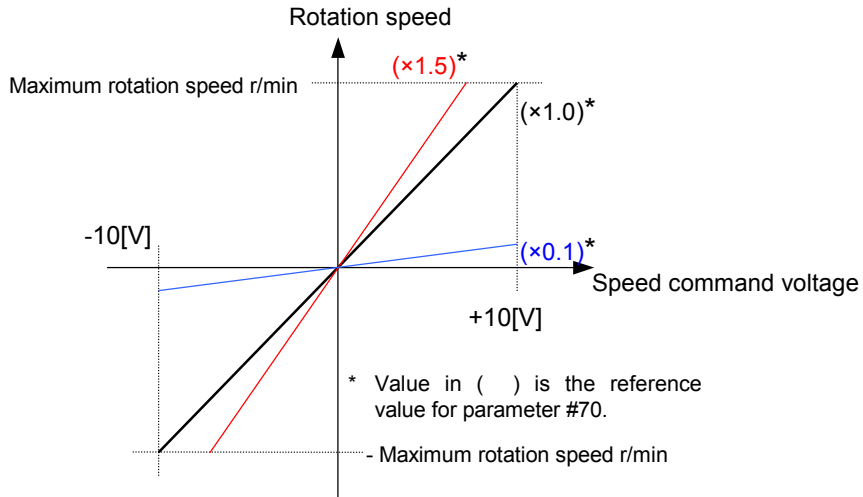
Note 1) The actual rotation speed of the motor has a tolerance of ±10 [V]/± Maximum rotation speed ±1% [r/min] due to variation of individual servo amplifiers and servomotors.

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

GYS motor	±10V / ±5000±1%[r/min]
GYG motor	±10V / ±3000±1%[r/min]
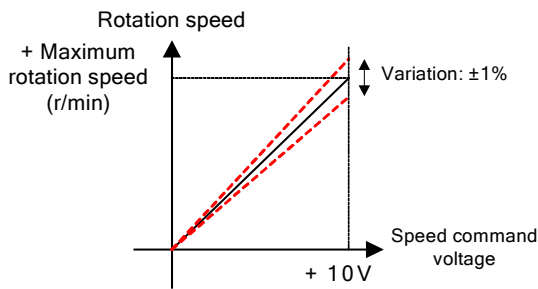
(2) Resolution of analog speed command input voltage

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 the multi-step speed 1 [X1]/2 [X2] signals, any of the four multi-step speeds will be selected.

Selection of multistep speed

X2	X1	Rotation speed
OFF	OFF	Analog speed command input [Vref] terminal
OFF	ON	Parameter #31
ON	OFF	Parameter #32
ON	ON	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.

* Before starting manual operation, turn ON the "command pulse prohibited (11)" signal.

■ 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[1] at the increments of 1 [%] to parameter #25. The maximum output torque is set as 100[%] rated torque.

[1]) With RYC182B3-VV** and RYC292B3-VV** types, 0 to 240

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.
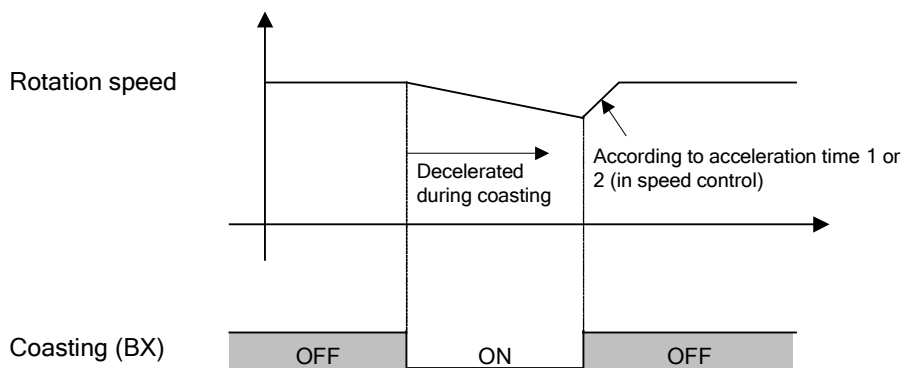
■ Parameter setting

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.

Positioning end judgment time (System setting parameter #24)
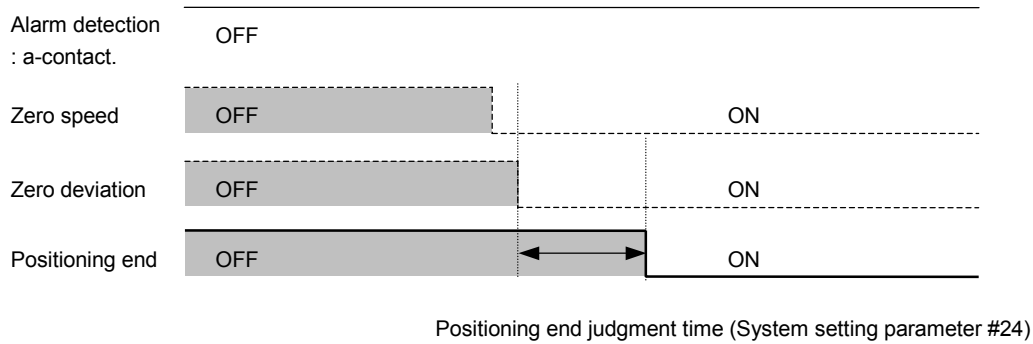
■ Parameter setting

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.

Main power (L1, L2, L3)	No power	Power supplied
Internal control power	No continuity	0.5 seconds Power supplied
Amplifier initialized		About 1 second
		About 1.5 seconds
Positioning end		OFF ON
Servo alarm detection (b contact)		OFF ON
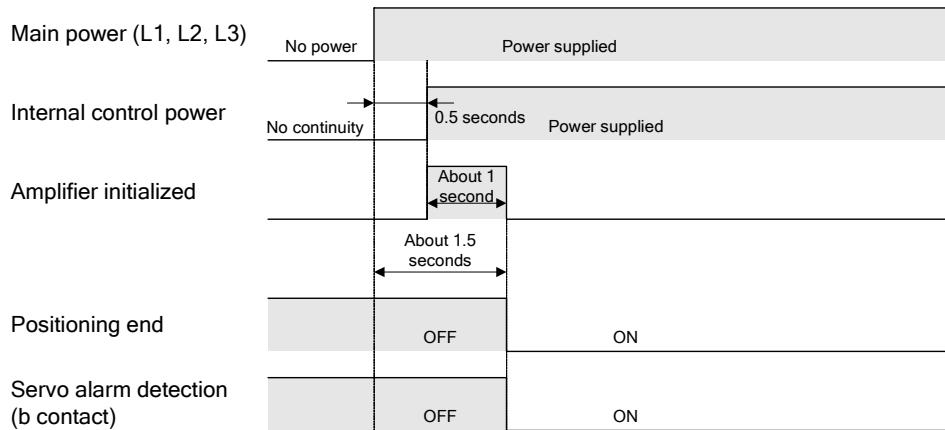
(2) Position control

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.

Deviation

Zero deviation width: Parameter #21 *

Time

Rotation speed

Zero speed width: Parameter #23

Zero speed	ON	OFF	ON
Zero deviation	ON	OFF	ON
Positioning end	ON	OFF	ON

Positioning end judgment time: Parameter #24
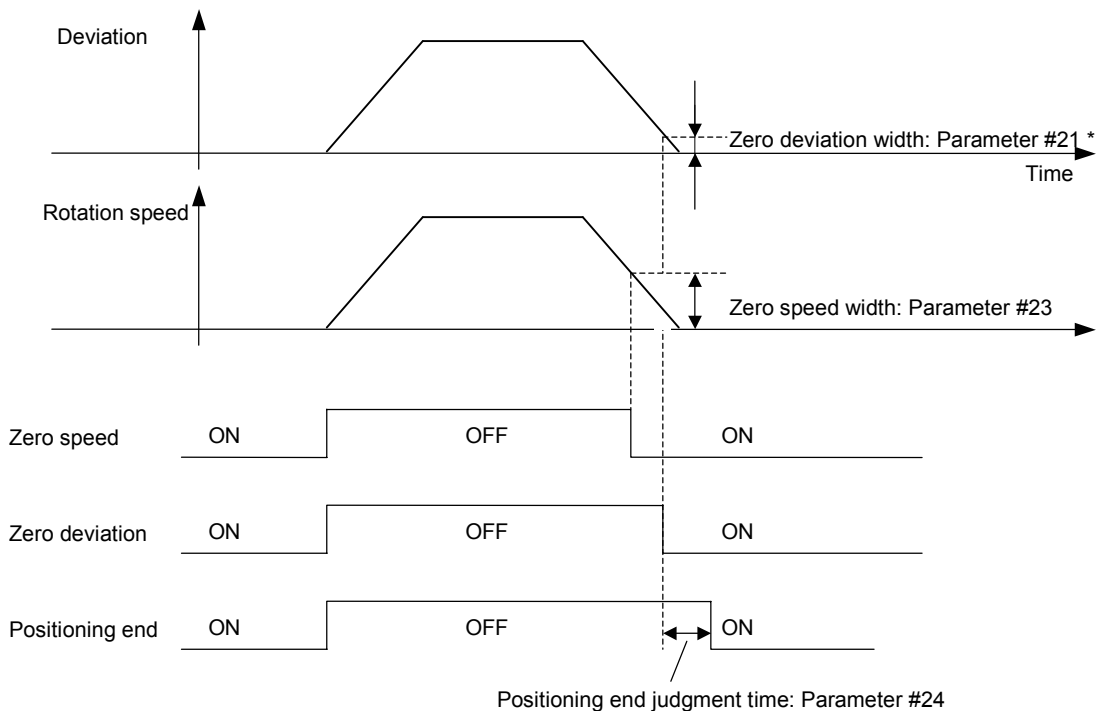
* The unit uses encoder pulses (131072 pulses).

(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 (desactivate)* 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>
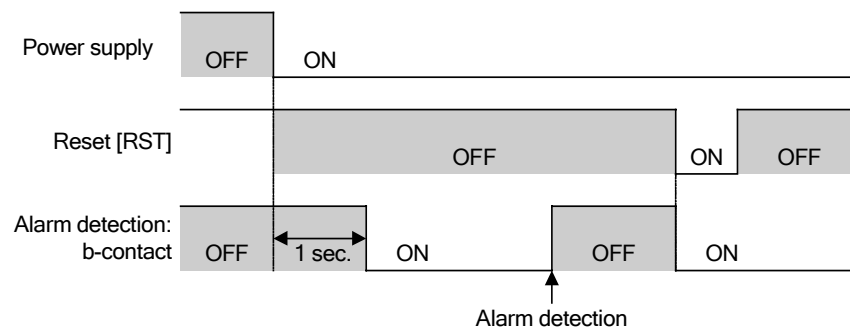
Make sure that the signal is inactive for about one second after the power is turned on.

■ 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
OC 1	Overcurrent 1
OC2	Overcurrent 2
OS	Overspeed
Hu	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

■ Dynamic braking connection diagram (1)

- Applied motor : GYS (3000 r/min) type ····· All capacities
  GYG (2000 r/min) type ····· 0.5 to 1.0 kW
  GYG (1500 r/min) type ····· 0.5 to 0.85 kW

- Connection diagram
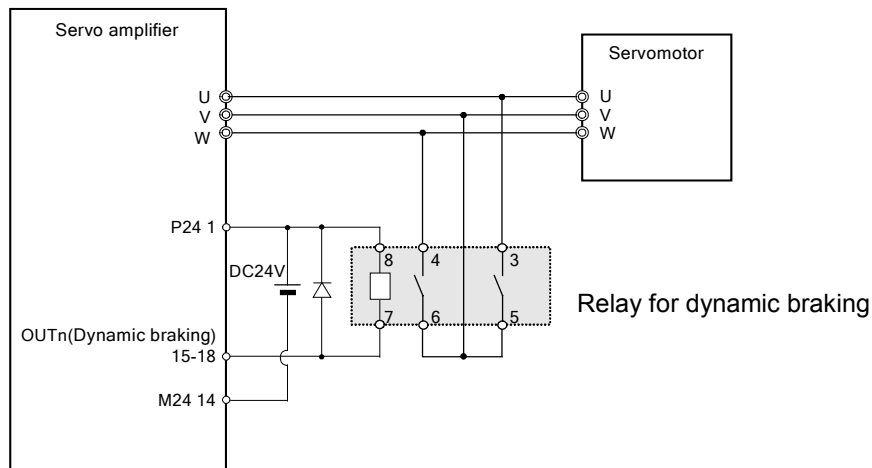
- Parts

  Use products satisfying the following specification for the dynamic braking circuit.

  1) Relay

Allowable contact current	: 25A or above
Current consumption of coil	: 50mA or less (Output capacity of output terminal: +30 [VDC] / 50 [mA])
Operating time	: 100ms or less

  * The recommended relay is specified below. (The connection diagram above supposes use of the following part.)

Relay type	: HH62P-DC24V (Made by Fuji Electric FA Components & Systems Co., Ltd.)
Socket type	: TP68X2 (Made by Fuji Electric FA Components & Systems Co., Ltd.)

- Operating conditions

Applicable inertia ratio	: 15 times or less (GYG102CC2-T2□)
	30 times or less (Motors other than the one specified above)
Operation frequency	: Once every 10 minutes

[Cautionary items]

1) The resistor becomes hot during dynamic braking operations. Do not leave flammable matters in the periphery. Otherwise fire may be caused.

2) Dynamic braking is for emergency stop. Do not use dynamic braking to stop the motor for regular purposes. Otherwise resistors and relays will deteriorate.

3) If dynamic braking is activated, leave at least 10 minutes before restarting. Otherwise resistors will deteriorate.

4) To operate at inertia ratios larger than that specified in operating conditions above, contact us.

■ Connection diagram of dynamic braking (2)

• Applied motor : GYG (2000 r/min) type ····· 1.5 to 2.0 kW

GYG (1500 r/min) type ····· 1.3 to 2.9 kW

• Connection diagram
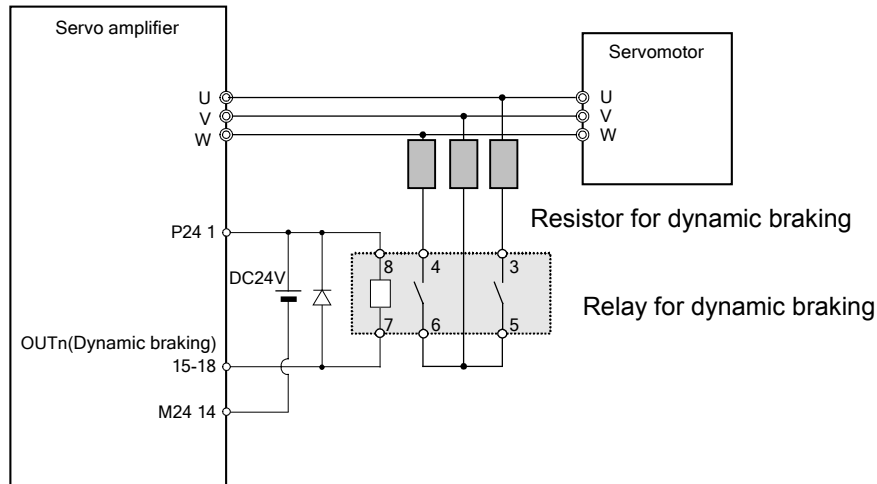
• Parts

Use products satisfying the following specification for the dynamic braking circuits.

1) Relay

Allowable contact current	: 25A or above
Current consumption of coil	: 50mA or less (Output capacity of output terminal: +30 [VDC] / 50 [mA])
Operating time	: 100ms or less

* The recommended relay is specified below. (The connection diagram above supposes use of the following part.)

Relay type	: HH62P-DC24V (Made by Fuji Electric FA Components & Systems Co., Ltd.)
Socket type	: TP68X2 (Made by Fuji Electric FA Components & Systems Co., Ltd.)

2) Resistor

Resistance (Ω)	: 5Ω to 8Ω
Capacity (W)	: 1400W or above (The short time (about 5s) overload capability must be the value specified on the left or over.)

* The short time overload capability of the resistor is defined in JIS-C-5202 to be measured while "you hold the resistor level and add ten times the rated power for five seconds."

In case of the resistor measured under the above condition, selection of a resistor having 140W or a larger rated capacity is assumed, while the definition of the short time overload may vary according to the resistor. Select one while referring to the detail specification of the resistor.

・Operating conditions

Applicable inertia ratio	: 15 times or less (GYG 182CC2-T2□, GYG292CC2-T2□)
	30 times or less (Motors other than the one specified above)
Operation frequency	: Once every 10 minutes

[Cautionary items]

1) The resistor becomes hot during dynamic braking operations. Do not leave flammable matters in the periphery. Otherwise fire may be caused.

2) Dynamic braking is for emergency stop. Do not use dynamic braking to stop the motor for regular purposes. Otherwise resistors and relays will deteriorate.

3) If dynamic braking is activated, leave at least 10 minutes before restarting. Otherwise resistors will deteriorate.

4) To operate at inertia ratios larger than that specified in operating conditions above, contact us.

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.
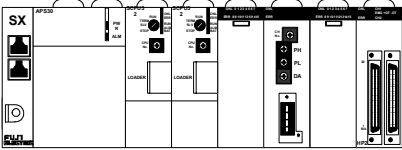
Zero speed

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 servo ON signal.

■ 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 at parameter #73. Add the scan time of the programmable logic controller (PLC), and the response time of the 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

Servo ON (RUN)	OFF	ON	
Pulse string command	No input	Input	
Rotation speed			
Brake timing	OFF	ON	
Brake operation	Operation	Release	
Ready (RDY)	OFF	ON	

Brake operation time (parameter 73)
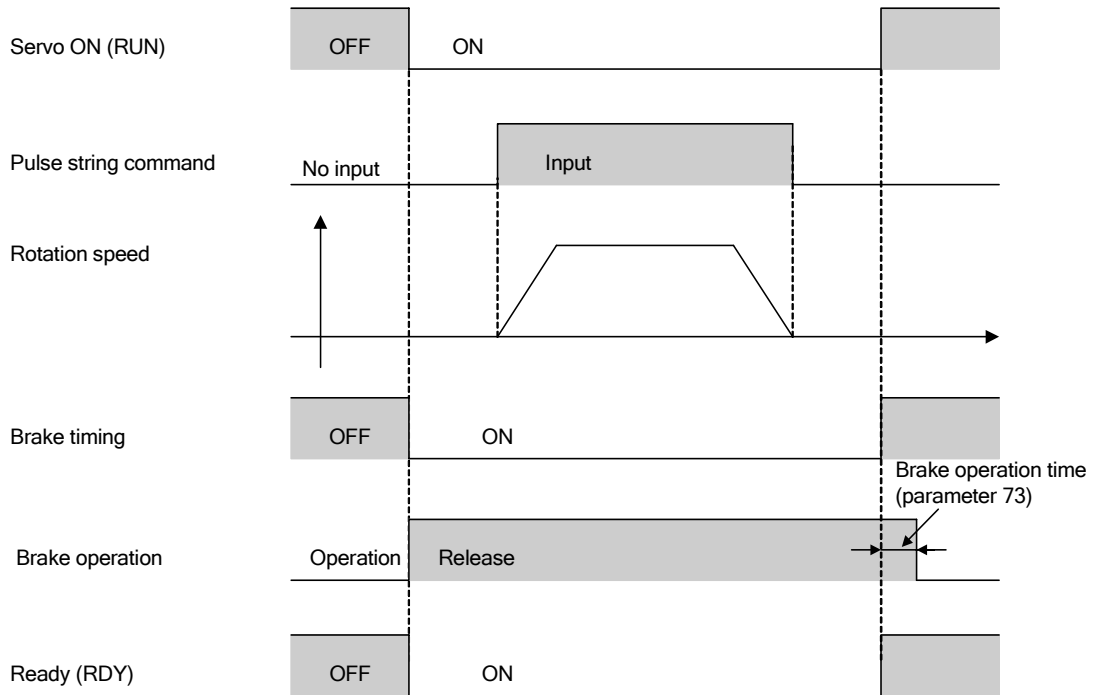
(3) Timing chart for alarm detection

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.

Occurrence of alarm

Coasting stop
(for major failure)

Motor operation					
Servo ON (RUN)	OFF	ON			
Alarm detection: a contact		OFF	ON		
Reset		OFF		ON	
Brake timing	OFF	ON	OFF	ON	OFF
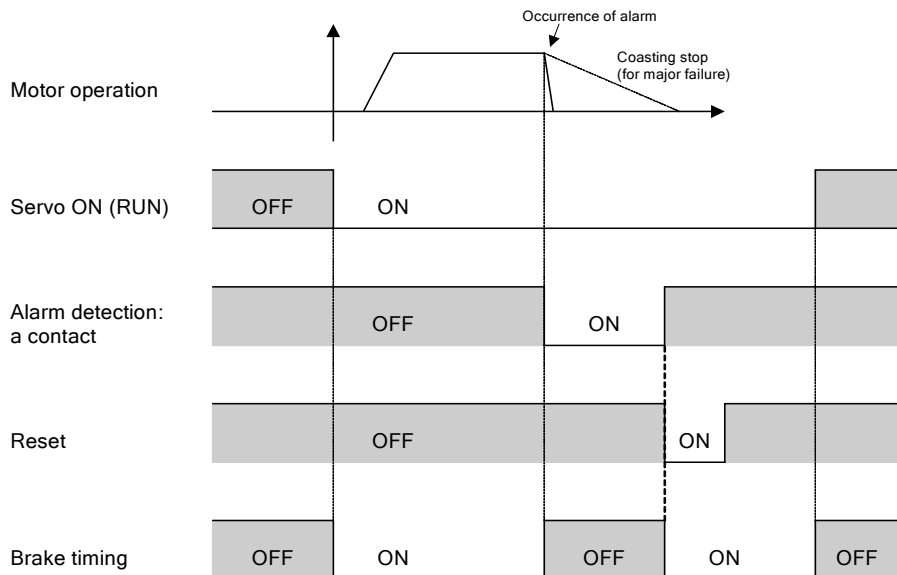
5 PARAMETERS

■ Connection example of brake timing signal (0.4 [kW] or less)
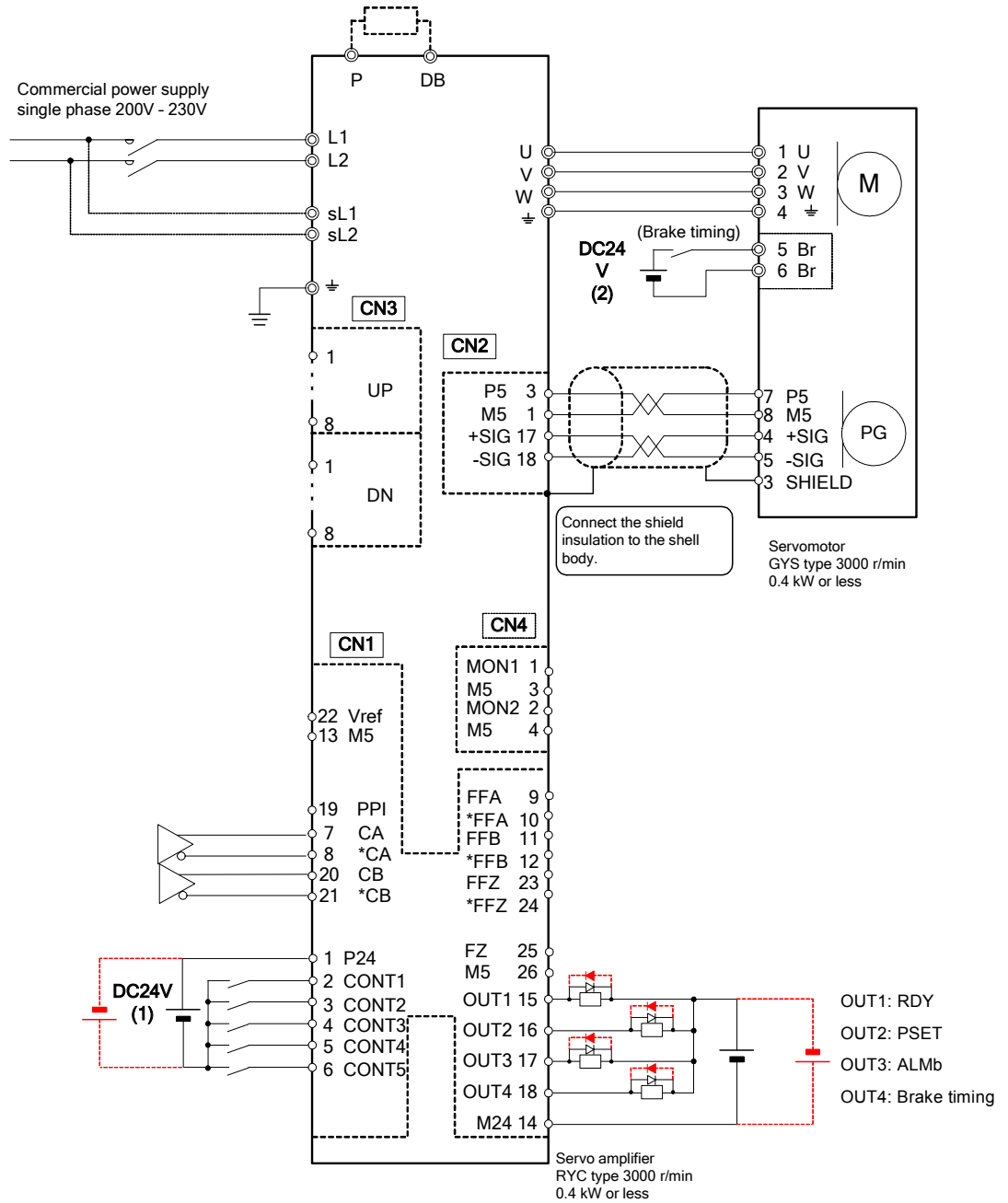
* Prepare DC24V separately for the sequence input/output power source (1) and the motor brake power source (2).
* Set 11 (brake timing) to parameter #18 (CONT4 allocation).

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.

Pulse width :$t_{11} \geq 1$ μs (Equivalent to 500kHz)
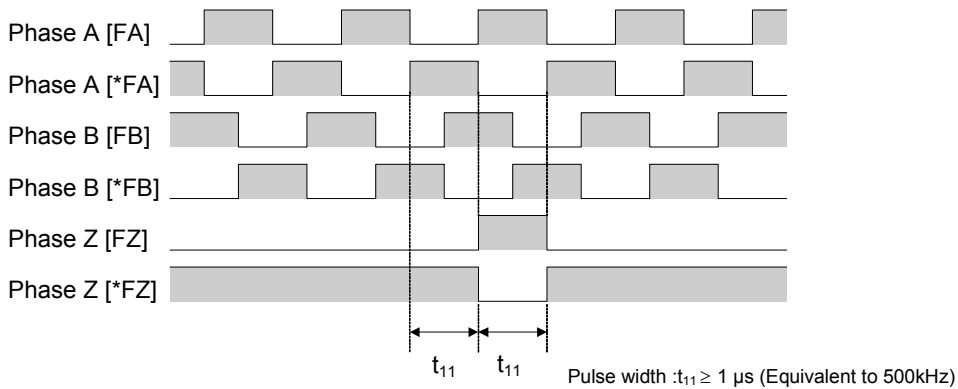
The phase-A and phase-B signals are 50% duty.

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

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

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

5 PARAMETERS

$Pn01$ / $no.20$

Parameter #20

No.	Name	Setting range	Initial value	Change
20	Phase-Z offset	0 to 65535[×2 pulses] (in 1 increments)	0	Power
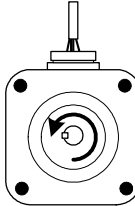
Specify the parameter to change the output position of the phase-Z signal.

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).

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

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"
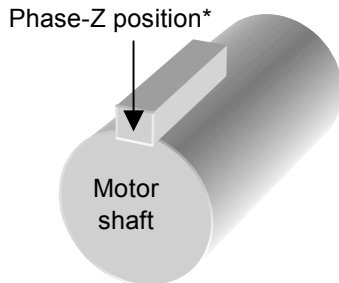
・When phase-Z offset is "16384"

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

Phase-Z position*

Motor shaft

Phase-Z position*

Motor shaft

Phase Z is late by a quarter revolution in the counterclockwise direction.
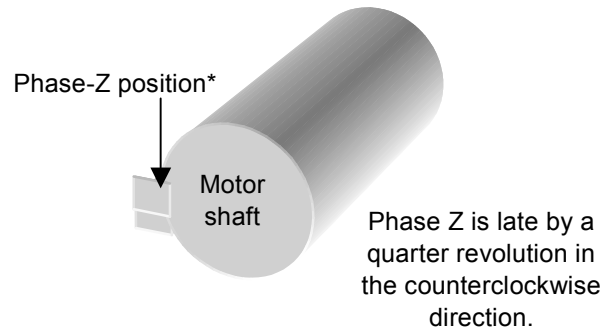
*The position of the key is not phase Z. The position of the key is assumed to be phase Z for explanation.

■ 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.

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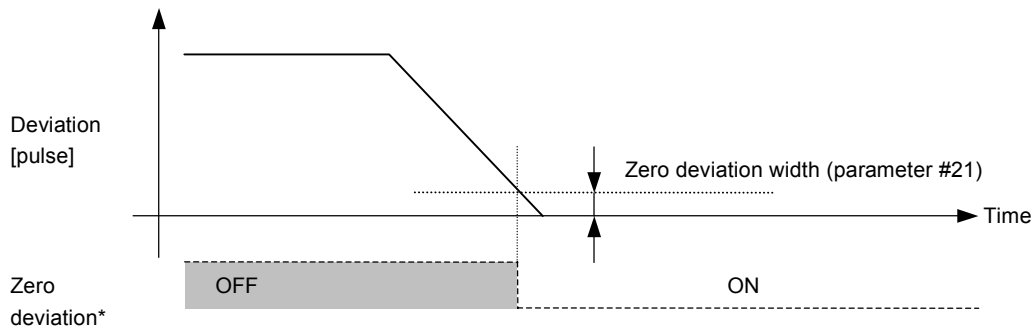
If both the zero deviation signal (parameter #21) and zero speed signal (parameter #23) remain active in the positioning end judgment time specified in parameter #24, the positioning end signal is activated.

Positioning end judgment time (parameter #24)
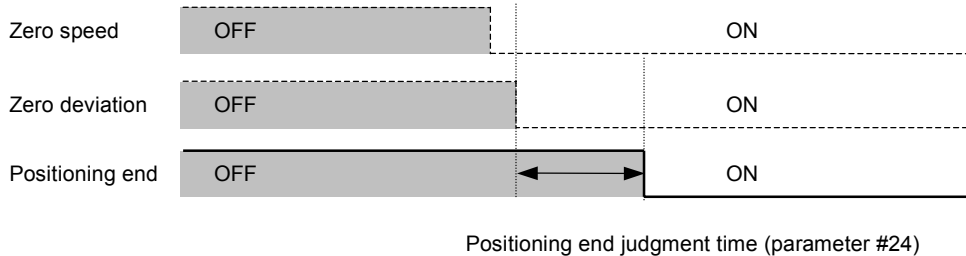
Hint   When the precision of ±10 [μm] is desired for a machine with ball screw fastening and the lead of 10 [mm].

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

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

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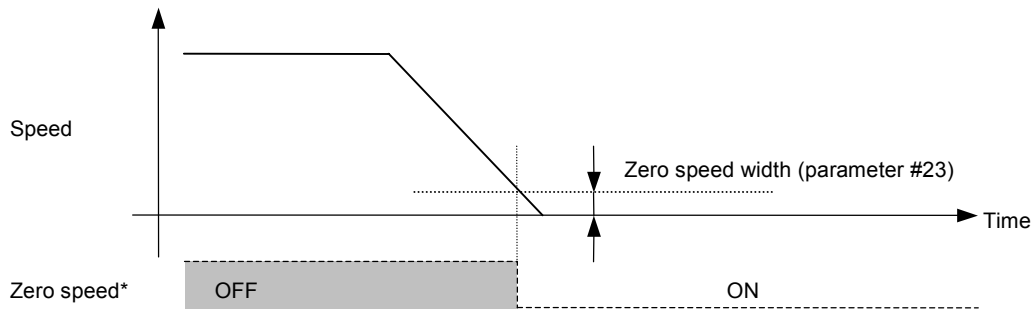
If the zero deviation signal (parameter #21) and zero speed signal (parameter #23) remain active in the positioning completion judgment time specified in parameter #24, the positioning end signal is activated.

Positioning end judgment time (parameter #24)
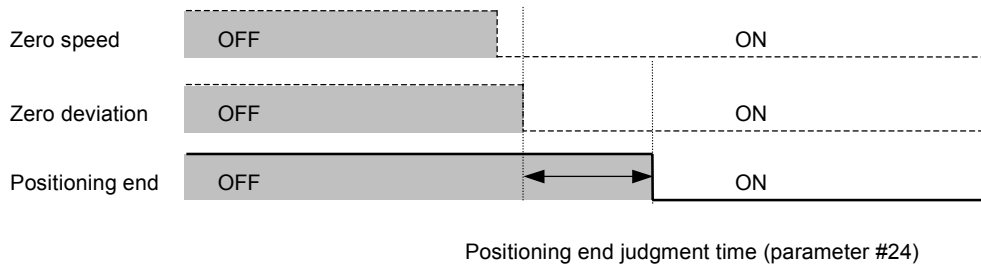
`PnO 1` / `no.24`

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.

Zero speed	OFF		ON
Zero deviation	OFF		ON
Positioning end	OFF	←→	ON

Positioning end judgment time (parameter #24)
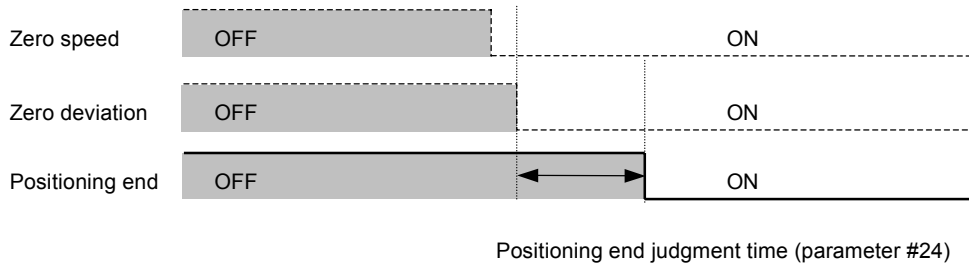
`PnO 1` / `no.25`

Parameter #25

No.	Name	Setting range	Initial value	Change
25	Max. current limit	0 to 300 % (in 1 increments) (0 to 240 % (in 1 increments)[*1]	300 (240[*1])	Always

*1) Setting range/Default value of RYC182B3-VV** and RYC292B3-VV** types

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.

`PnO1` / `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.

`PnO1` / `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 21 (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	`On01`
5	Command speed	`On02`
6	Average torque	`On03`
7	Current feedback position	`On04`
8	Current command position	`On05`
9	Position deviation	`On06`
10	Feedback cumulative pulse	`On07`
11	Command cumulative pulse	`On08`
12	Peak torque	`On09`
13	Input voltage	`On 10`
14	Input/output signal	`On 11`
15	Load inertia ratio	`On 12`
16	OL thermal value	`On 13`
17	Regenerative resistor thermal value	`On 14`
18	Pulse string input frequency	`On 15`
19	DC link voltage (maximum value)	`On 16`
20	DC link voltage (minimum value)	`On 17`
21	For adjustment by manufacturer	`On 18`

Refer to Chapter 8 Keypad for details of each display.

`PnO1` / `no.31` - `no33`

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

`PnO1` / `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.
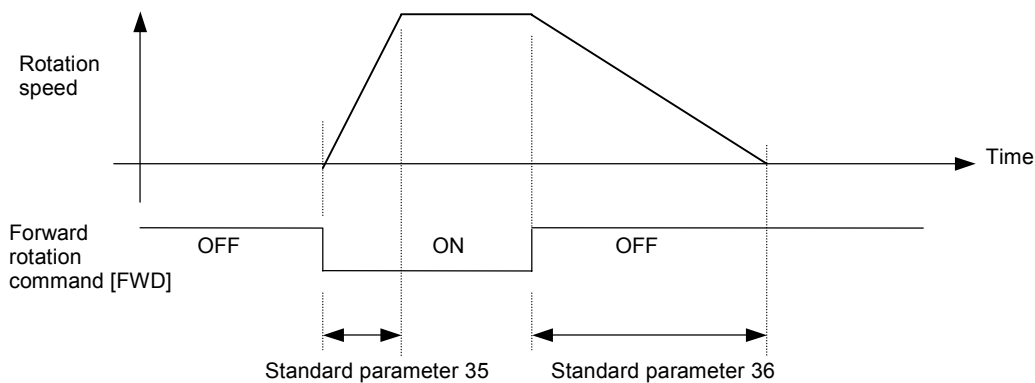
When the analog speed command voltage is output with the upper level control unit and the feedback from the dividing output of the servo amplifier is used for position control, set the acceleration time and the deceleration time to 0.000 sec.

`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.

Rotation speed
[r/min]

Analog speed command input value (Vref) [r/min]

Parameter 39
Zero clamp level
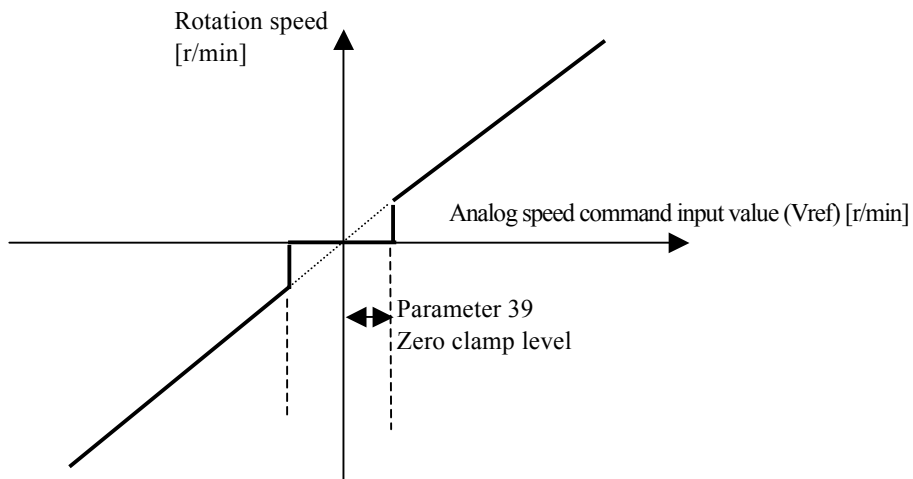
Note   For analog voltage around the reference value, the command may fluctuate between "zero" and "reference value," resulting in an unstable motor shaft.

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

* Turning on the command pulse prohibition function makes the manual feed (position JOG) possible.

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

Control mode selection:
for P09=3 (Position⇔Speed)

CONTn
Control mode selection
(Allocation No.: 14)

Control mode selection:
for P09=4 (Position⇔Torque)
or 5 (Speed⇔Torque)

CONTn
Control mode selection
(Allocation No.: 14)

OFF

ON

Speed
setting filter

P47

PI control

P41, 42

Torque
filter time
constant

P46

Notch
filter

P56 to 59

OFF

ON

Current
control

M

Position detection/
Speed detection

PG

ON when P05=0

Inertia
estimation

Load inertia
ratio

P06

Auto tuning

Tuning mode

P05

Auto tuning gain

P07

When P05 (tuning mode) is "0: Auto
tuning" or "1: Semi-auto tuning," the
parameters shaded above [ ] are
automatically adjusted.

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 load disturbance, while a too large 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 sets the feed forward filter for the position command and the tracking capability to the position command. The parameter is always valid regardless of the feed forward gain setting. A smaller setting improves the response but likely to 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

`PnO1` / `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.
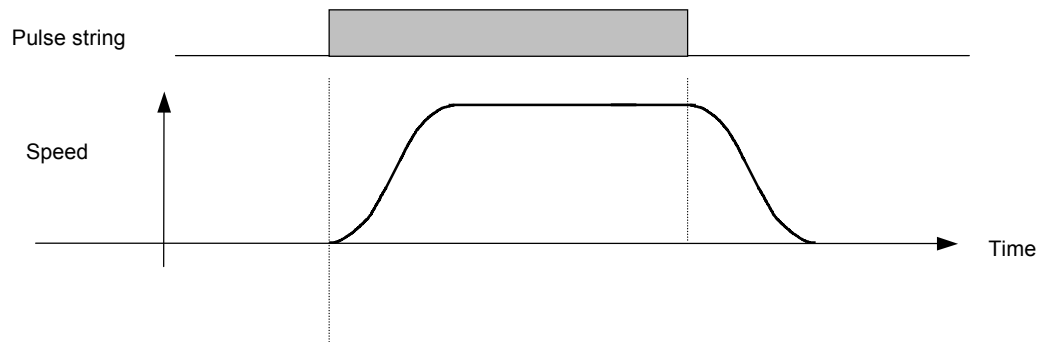
* Specify the parameter without fail if the dumping control function (parameters #60 through #63) are used.

📖 Refer to section 7.1 "Vibration control."

`PnO1` / `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."

`PnO1` / `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.

Gain switching time constant (Parameter #50)
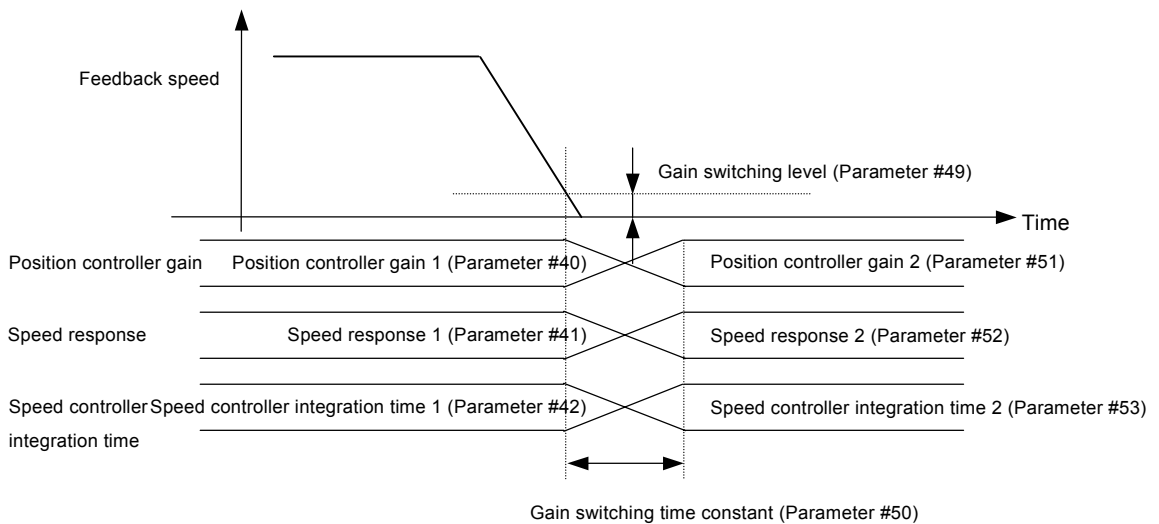
The settings of the second gain (parameters #51 to #53) are given in the ratio (%) to the first gain.

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

$Pn01$ / $no.56$ - $no.59$

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

i) Use the servo analysis function of the PC loader (option) to determine the resonance point of the machine.
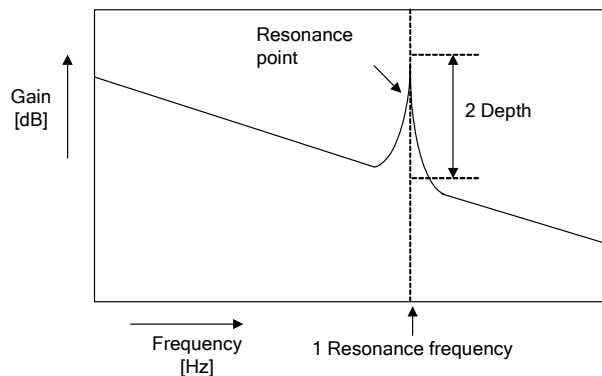
ii) Specify the resonance frequency and damping amount of the resonance point of the machine in parameters.

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.

Use the servo analysis function again.

The notch filter functions at the resonance point as shown in the figure above.
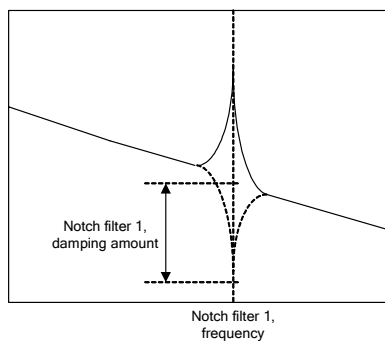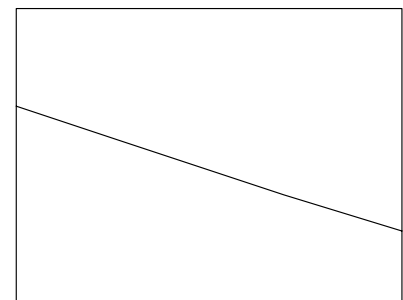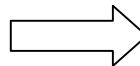
The resonance point is eliminated due to the notch filter.

`PnO1` / `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."

`PnO1` / `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	±0.10 - ±1.50 (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)
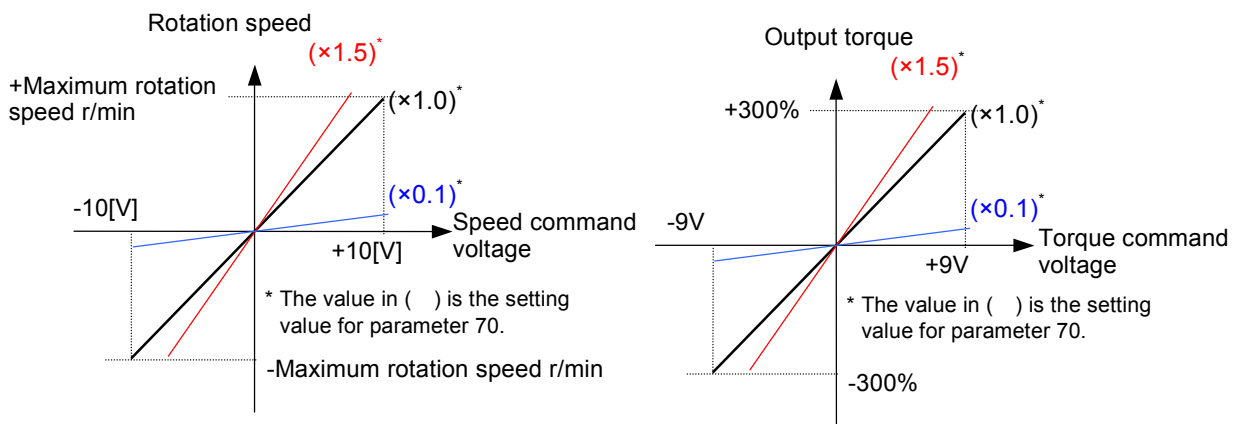
*) The relation between the speed command voltage and rotation speed by the analog command gain is as follows:
Rotation speed [r/min] = Maximum rotation speed [r/min] x Analog voltage x Analog command gain/10

*) The relation between the torque command voltage and the output torque by the analog command gain is as follows:
Output torque [%] = 300 [%] x Analog voltage x Analog command gain/9

*) 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	

Forward rotation (CCW)
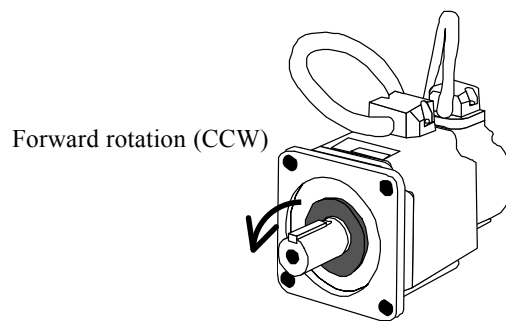
■ Analog command offset

It is set in the range from -2000 to 2000 in increments of 1.
Increment [1] is equivalent to [0.68 mV].
The setting range is from [-1.36V] to [1.36V].
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. `Fn07`
The value after adjustment is incorporated to parameter No. 70.

Speed command voltage
(or torque command)

Offset setting rage
±1.36 V
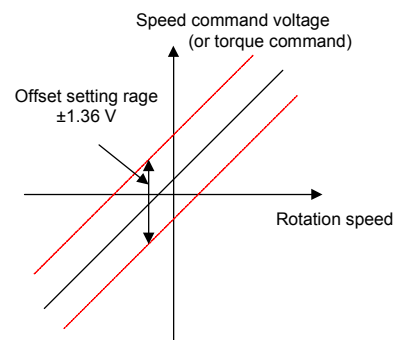
Rotation speed

Hint

■ 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 to +5000) [r/min]/2^{14} × 11.22/10 = 0.67 [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 to +300) % /2^{14} × 11.22/9 = 0.046% (rated torque 100%).

5 PARAMETERS

`Pn01` / `no.72`

Parameter #72

No.	Name	Setting range	Initial value	Change
72	Not used	-	0	-

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".

`PnO1` / `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.)

■ Recognition method of FWD/REV signal

15: Manual forward (FWD), 16: Manual reverse (REV)

Speed/torque control : Level

They are normally ON during speed/torque control

Position control : Edge

but are not normally ON during position control.

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

Specific multistep speed is ON.

Hint

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

`Pn01` / `no.78` - `no.80`

Parameters #78 to 80

No.	Name	Setting range	Initial value	Change
78	Command pulse compensation α1	1 - 32767 (in 1 increments)	1	Always
79	Command pulse compensation α2	1 - 32767 (in 1 increments)	1	Always
80	Command pulse compensation α3	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

`Pn01` / `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

`PnO1` / `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.

`PnO1` / `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

`PnO1` / `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	± 2.0 - ± 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	± 2.0 - ± 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 (initial value)

Output voltage
+7.0V
Monitor 1 offset
(Maximum rotation speed)
(Maximum rotation speed)
-7.0V
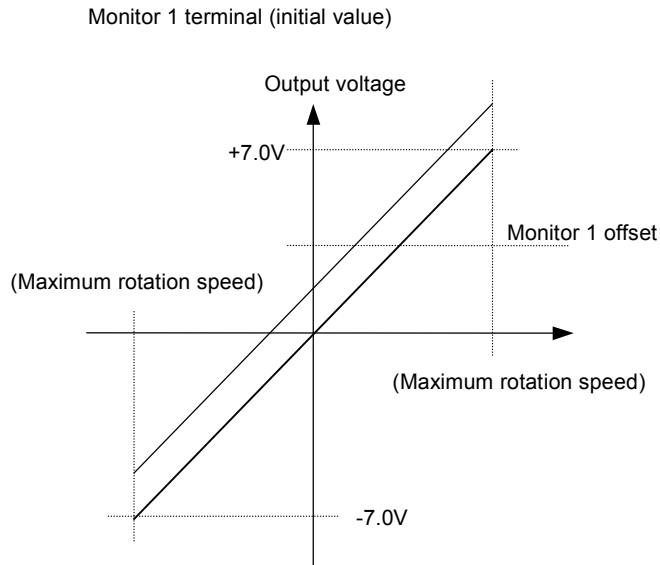
When the negative sign is specified by monitor 1 scale, polarity of the output voltage is reversed.

■ 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]/2^{12} = 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

PnO1 / 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.

PnO1 / 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

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:

```
                          ┌──────────────┐
                          │    START     │
                          └──────┬───────┘
                                 │
                          ╱──────┴───────╲
                         ╱  Adjustment by ╲        Yes
                        ⟨   "Easy tuning"  ⟩──────────────►
                         ╲   Section 6.2   ╱
                          ╲──────┬───────╱
                                 │ No
                          ╱──────┴───────╲
                         ╱  Operation by  ╲        Yes
                        ⟨ "Basic adjustment"⟩─────────────►
                         ╲   Section 6.4   ╱
                          ╲──────┬───────╱
                                 │ No
                          ╱──────┴───────╲
                         ╱  Operation by  ╲        Yes
                        ⟨"Applied adjustment"⟩────────────►
                         ╲   Section 6.5   ╱
                          ╲──────┬───────╱
                                 │ No
                    ╱────────────┴────────────╲
                   ╱      Operation by          ╲
                  ⟨ "Adjustment for high speed   ⟩
                   ╲  response" Section 6.6      ╱
                    ╲────────────┬────────────╱
                                 │ Yes
                          ┌──────┴───────┐
                          │     END      │◄────────────────
                          └──────────────┘
```
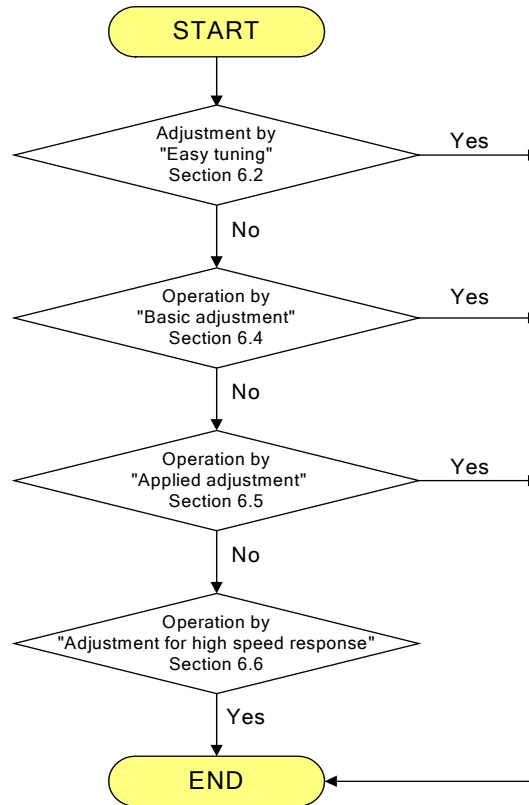
6.2   Easy tuning

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.>

Servo amplifier   Reciprocation

Servomotor
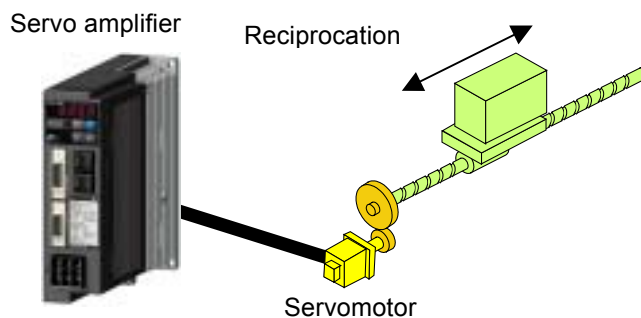
6.2.2   Operation pattern of easy tuning

Easy tuning has 2 operation patterns, which can be operated with keypad/PC loader.

1) Slow run · · · · · · · · · · · · · · · · ·   One reciprocal movement at 10 r/min (fixed).
Rotation direction and travel are checked.

2) Easy tuning · · · · · · · · · · · · · ·   25 reciprocal movements.
During this time, automatic tuning is performed.

After checking rotating directing and travel with "slow run," perform "easy tuning."

Check rotating directing and travel with "slow run."

Slow movement at 10 r/min

Perform automatic tuning with "easy tuning".
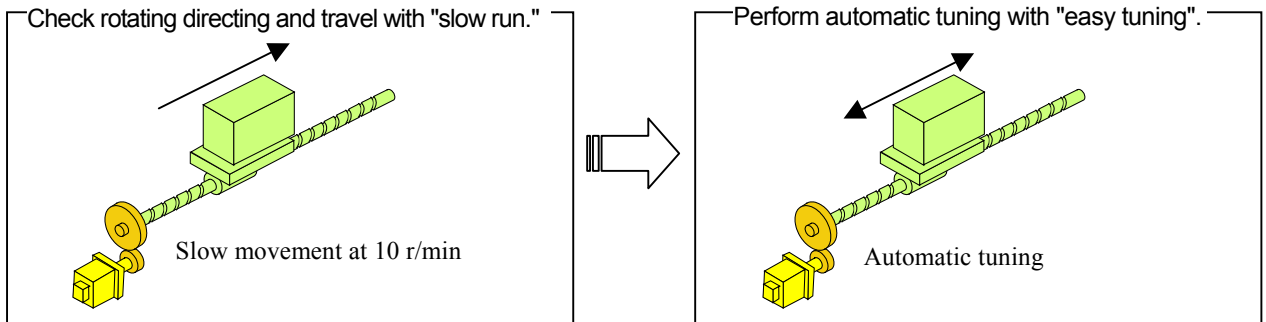
Automatic tuning

Tips

Easy tuning operation method on the keypad
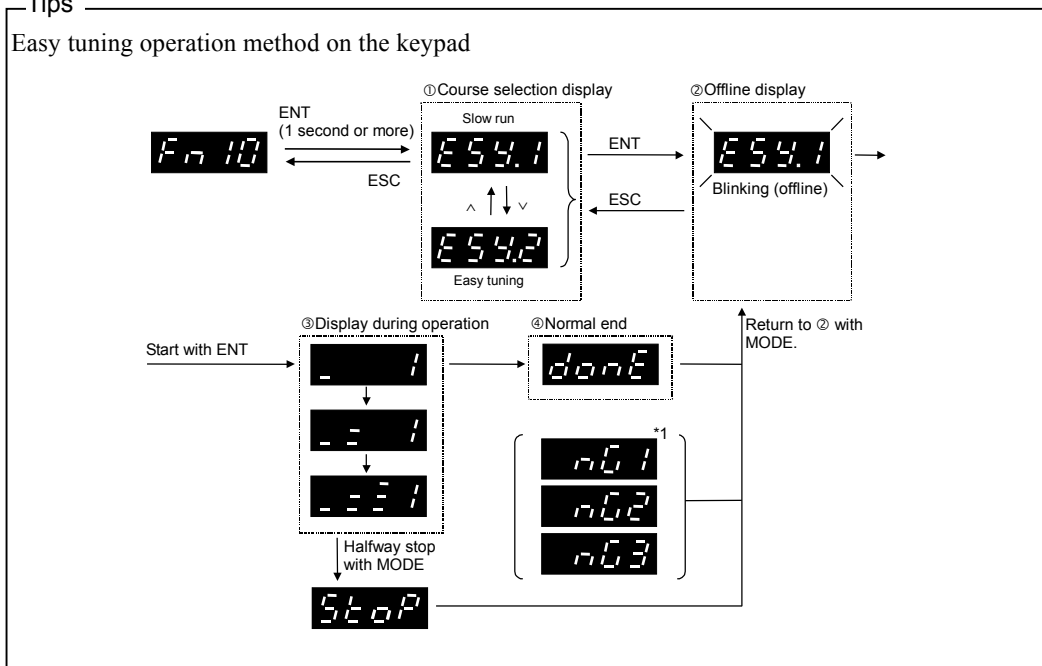
6 ADJUSTMENT OF SERVO

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 ±overtravel signal (±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 "○" 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.

<Operation pattern>

The operation pattern is as follows. "P○○" in the table means the parameter number.
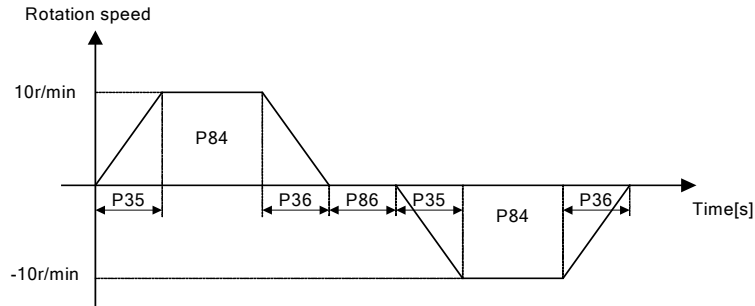
Travel distance	No. of operations	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction *	
						Forward	Return
P84	1 reciprocal movement	P35	P36	10r/min	P86	CCW	CW

* 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. "P○○" in the table means the parameter number.
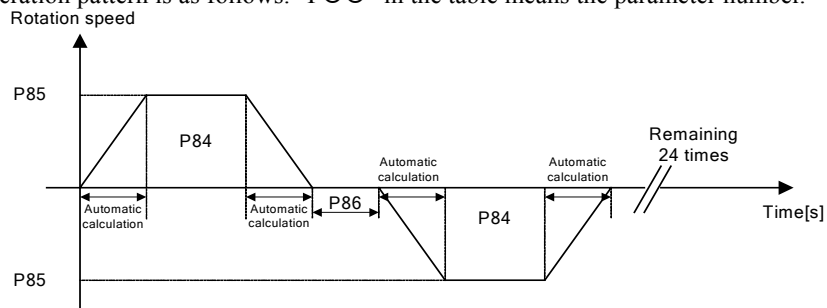
Travel distance	No. of operations	Acceleration time	Deceleration time	Rotation speed	Timer	Rotating direction [*1]	
						Forward	Return
P84	25 reciprocal movements	Automatic calculation [*2]	Automatic calculation [*2]	P85	P86	CCW	CW

*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) ±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) ±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.)

```
┌─ Tips ──────────────────────────────────────────────────────────┐
│ Pattern operation method with keypad                             │
│                                                                  │
│                    ENT (1 second or more)                        │
│         ┌──────┐  ─────────────────►  ┌──────┐                   │
│         │ Fn11 │  ◄─────────────────  │ Ptn  │                   │
│         └──────┘        ESC           └──────┘                   │
│                                          │ ENT                   │
│                                          ▼                       │
│                                       ┌──────┐    Offline        │
│                            ┌─────────►│ _Ptn │    (standby status)│
│                            │          └──────┘                   │
│                            │             │ ENT                   │
│     Pattern operation stop │             ▼                       │
│     with MODE key          │          ┌──────┐  ┐                │
│                            │          │ J7J7 │  │                │
│                            │          └──────┘  │                │
│                            └────────            ├ Pattern operation│
│                                       ┌──────┐  │                │
│                                       │ rLrL │  │                │
│                                       └──────┘  ┘                │
│                                                                  │
└──────────────────────────────────────────────────────────────────┘
```
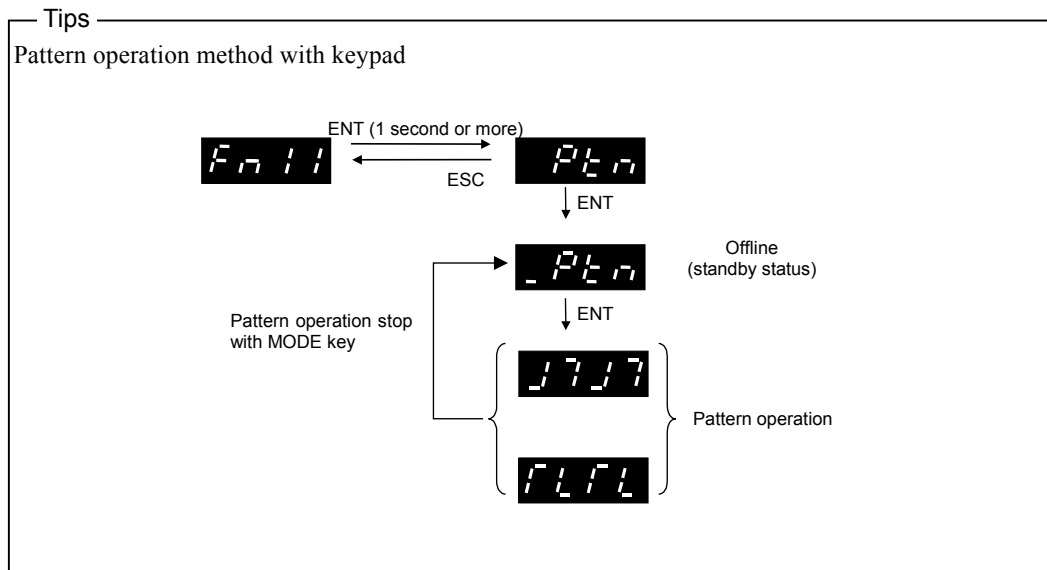
6.3.2   Description of operation

<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>

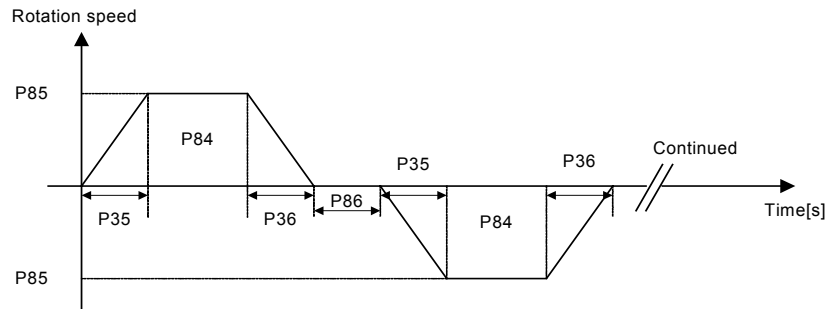The operation pattern is as follows. "P○○" in the table means the parameter number.

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.
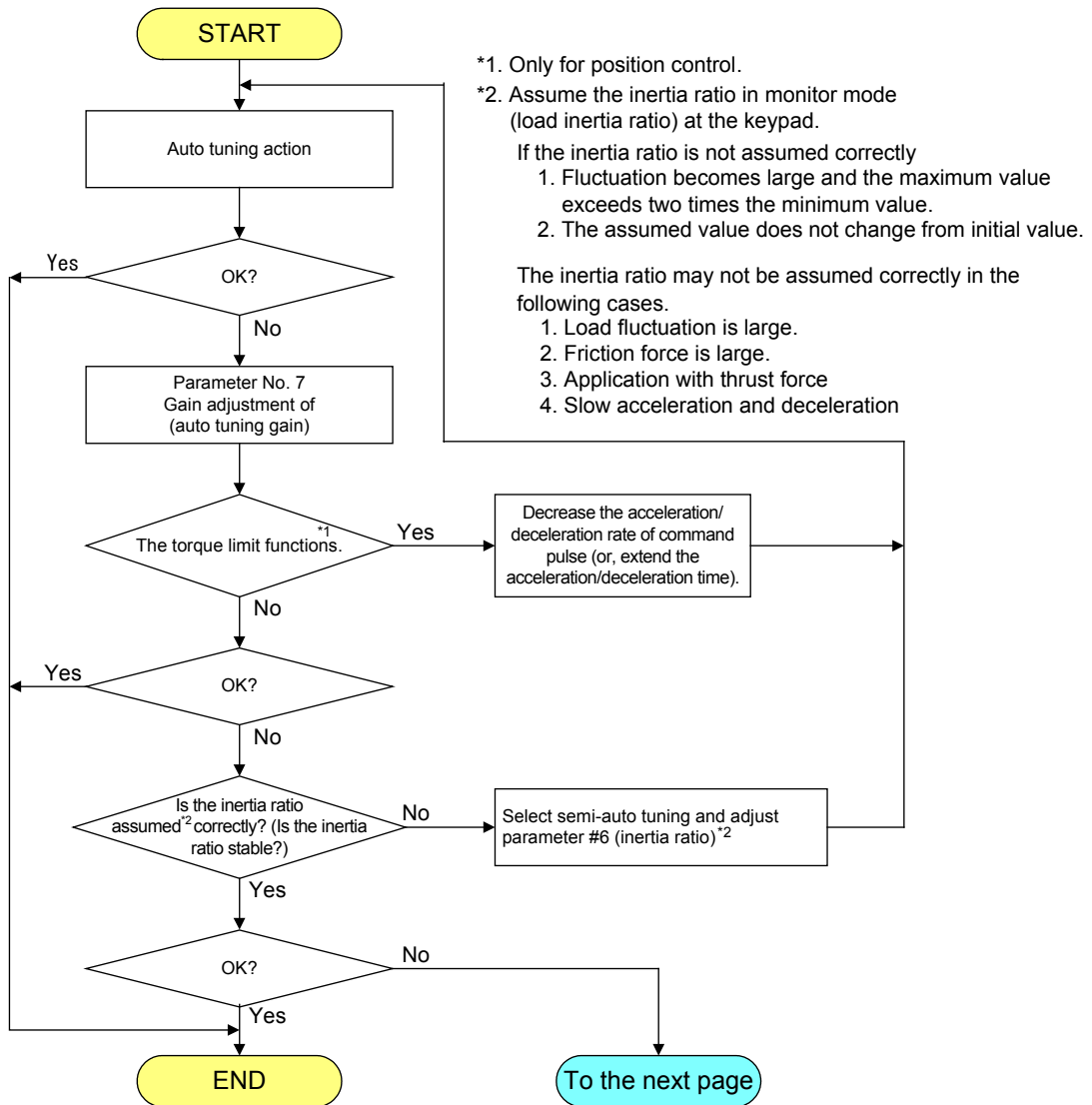
<Stop method of pattern operation>

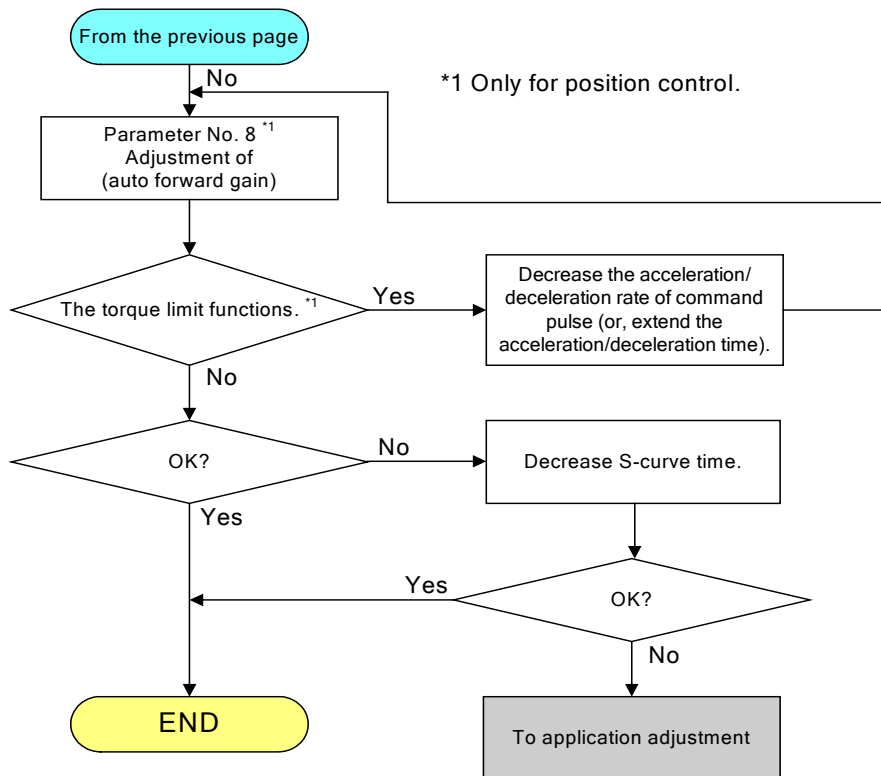The method to stop pattern operation is stoppage of the system by an operator or occurrence of an error*.

* Occurrence of an error means ① Detection of ±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.

*1. Only for position control.
*2. Assume the inertia ratio in monitor mode
   (load inertia ratio) at the keypad.

   If the inertia ratio is not assumed correctly
      1. Fluctuation becomes large and the maximum value
         exceeds two times the minimum value.
      2. The assumed value does not change from initial value.

   The inertia ratio may not be assumed correctly in the
   following cases.
      1. Load fluctuation is large.
      2. Friction force is large.
      3. Application with thrust force
      4. Slow acceleration and deceleration

Flowchart nodes:
- START
- Auto tuning action
- OK? — Yes → (loop to END path) / No ↓
- Parameter No. 7 Gain adjustment of (auto tuning gain)
- The torque limit functions.*1 — Yes → Decrease the acceleration/deceleration rate of command pulse (or, extend the acceleration/deceleration time). / No ↓
- OK? — Yes → / No ↓
- Is the inertia ratio assumed*2 correctly? (Is the inertia ratio stable?) — No → Select semi-auto tuning and adjust parameter #6 (inertia ratio)*2 / Yes ↓
- OK? — No → To the next page / Yes ↓
- END

From the previous page

*1 Only for position control.

No

Parameter No. 8 [*1]
Adjustment of
(auto forward gain)

The torque limit functions. [*1] — Yes → Decrease the acceleration/ deceleration rate of command pulse (or, extend the acceleration/deceleration time).

No

OK? — No → Decrease S-curve time.

Yes

OK? — Yes →

No

END

To application adjustment

Hint   Set the zero deviation width (parameter No. 21) referring to the description below:

Ex.) When precision of ±10 μm is desired on a machine with ball screw fastening and 10 mm lead.

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

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

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."
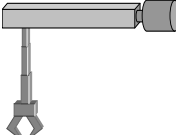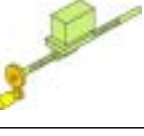O : Item specified manually.
- : Item specified automatically.

- 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.
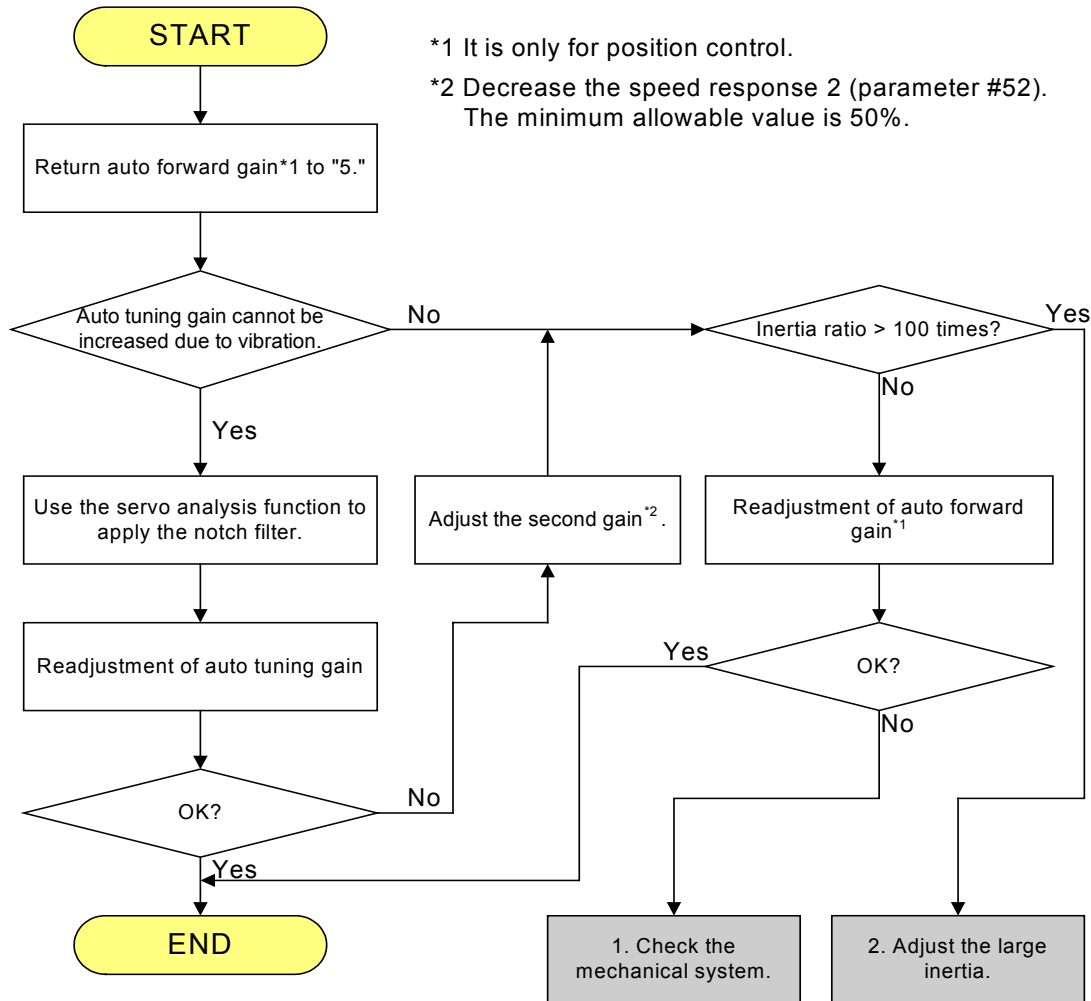
■ Approximate measure for auto tuning gain (parameter #7) setting

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.

```
                    ┌──────────────┐
                    │    START     │
                    └──────────────┘
                           │
                           ▼
          ┌──────────────────────────────┐        *1 It is only for position control.
          │ Return auto forward gain*1     │        *2 Decrease the speed response 2 (parameter #52).
          │ to "5."                        │           The minimum allowable value is 50%.
          └──────────────────────────────┘
                           │
                           ▼
              Auto tuning gain cannot be          No                    Inertia ratio > 100 times?      Yes
              increased due to vibration.  ───────────────►                                        ─────────►
                           │                                                       │ No
                           │ Yes                                                   ▼
                           ▼                                          ┌───────────────────────────┐
          ┌──────────────────────────────┐   ┌────────────────────┐  │ Readjustment of auto       │
          │ Use the servo analysis        │   │ Adjust the second   │  │ forward gain*1            │
          │ function to apply the notch    │   │ gain*2.            │  └───────────────────────────┘
          │ filter.                        │   └────────────────────┘              │
          └──────────────────────────────┘                                        ▼
                           │                                    Yes           OK?
                           ▼                              ◄──────────
          ┌──────────────────────────────┐                                        │ No
          │ Readjustment of auto tuning    │
          │ gain                           │
          └──────────────────────────────┘
                           │
                           ▼
                        OK?     ──── No
                           │ Yes
                           ▼
                    ┌──────────────┐
                    │     END      │
                    └──────────────┘

                              ┌────────────────────┐   ┌────────────────────┐
                              │ 1. Check the       │   │ 2. Adjust the large │
                              │ mechanical system. │   │ inertia.           │
                              └────────────────────┘   └────────────────────┘
```

*1 It is only for position control.

*2 Decrease the speed response 2 (parameter #52). The minimum allowable value is 50%.

1. Check the mechanical system.

Check the mechanical system for the following problems.

i) Large backlash

ii) Deflection of belt

6 ADJUSTMENT OF SERVO

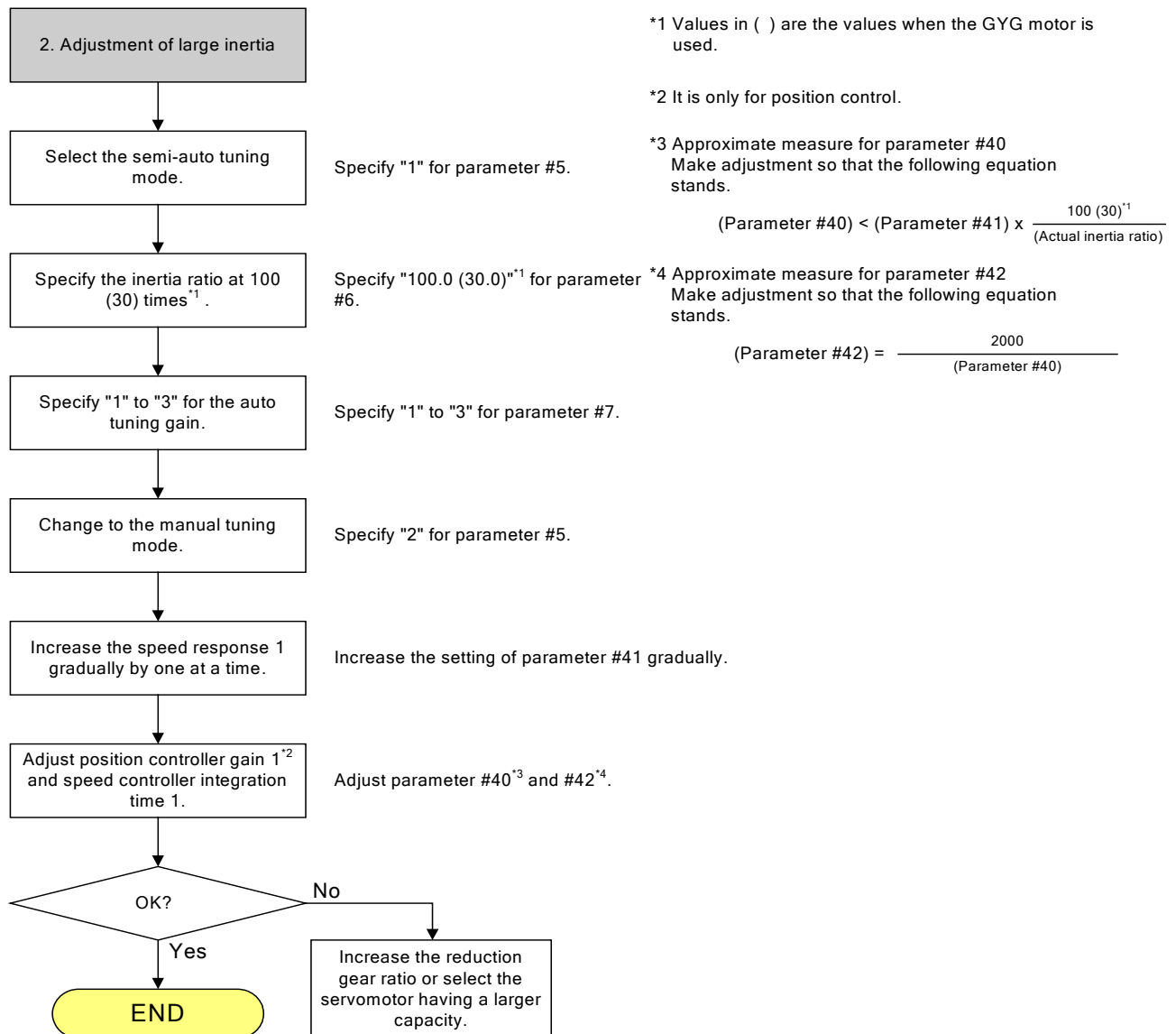<div style="border:1px solid">2. Adjust the large inertia.</div>

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].)

Flowchart	Description
2. Adjustment of large inertia	
Select the semi-auto tuning mode.	Specify "1" for parameter #5.
Specify the inertia ratio at 100 (30) times[1].	Specify "100.0 (30.0)"[1] for parameter #6.
Specify "1" to "3" for the auto tuning gain.	Specify "1" to "3" for parameter #7.
Change to the manual tuning mode.	Specify "2" for parameter #5.
Increase the speed response 1 gradually by one at a time.	Increase the setting of parameter #41 gradually.
Adjust position controller gain 1[2] and speed controller integration time 1.	Adjust parameter #40[3] and #42[4].
OK? → No → Increase the reduction gear ratio or select the servomotor having a larger capacity.	
Yes → END	

[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.
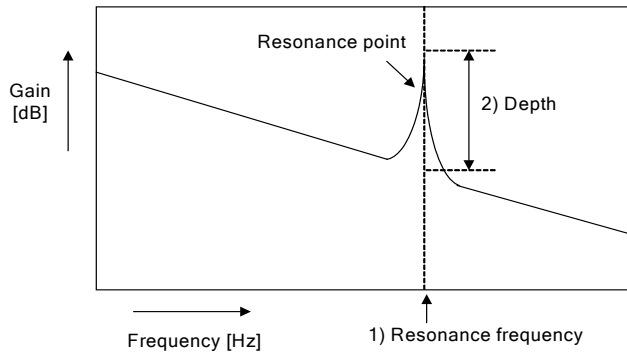
ii) Set the resonance frequency and damping amount at the resonance point of the machine in parameters.

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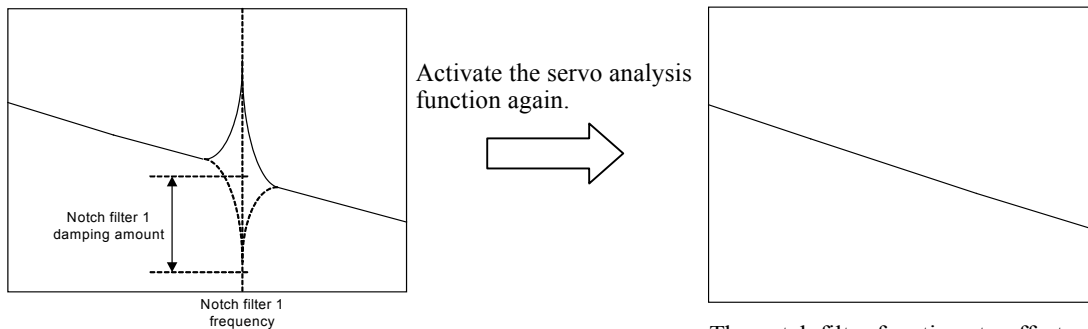
The notch filter is applied at the resonance point as shown in the figure above.

The notch filter functions to offset the resonance point.

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.
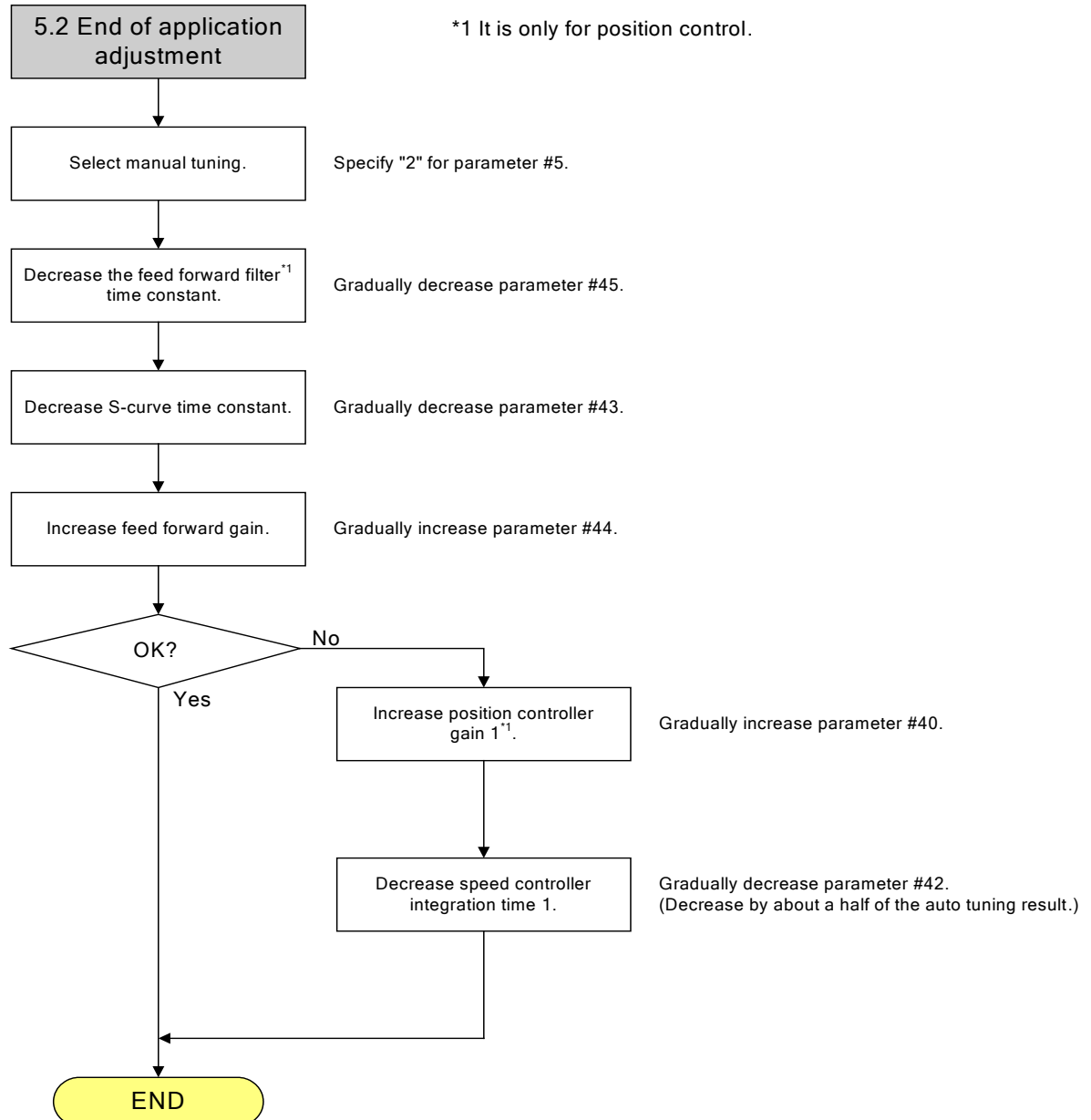
Note 1: Adjust the gain so as not to generate mechanical vibration or torque fluctuation.
Note 2: If the machine rigidity is low, vibration can be minimized by gradually increasing S-curve time constant (parameter No. 43).

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.
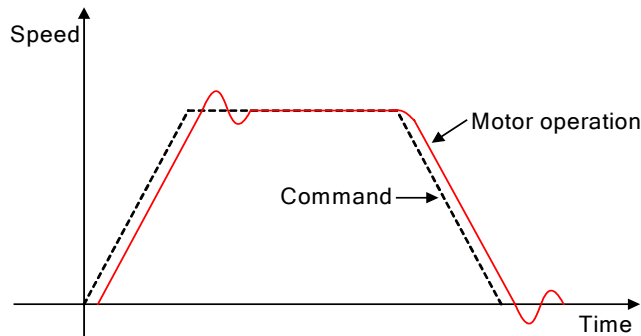
If overshoot is displayed as above, confirm the following:

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:
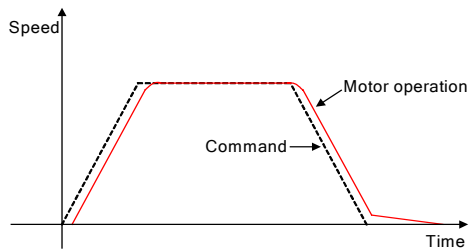
① Lower S-curve time (parameter No.43).

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 ±10% to the change volume as a measure.)

6.8.2 In the case of over-run:
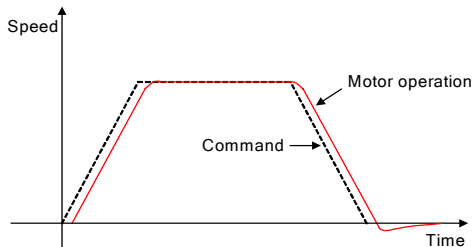
① Raise S-curve time (parameter No.43).

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 ±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) $\leq \dfrac{500}{1+\text{Load-to-inertia ratio (parameter No.6)}}$
42	Speed controller integration time 1	Speed controller integration time 1 (parameter No.42) $= \dfrac{2000}{\text{Speed response 1 (parameter No.41)}}$
45	Feed forward filter time constant	Feed forward filter time constant (parameter No.45) $= \dfrac{1000}{\text{Position controller gain 1 (parameter No.40)}}$
46	Torque filter time constant	$0.2 \leq$ Torque filter time constant (parameter No.46) ≤ 1.0

6 ADJUSTMENT OF SERVO

-MEMO-

7

SPECIAL ADJUSTMENT

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.
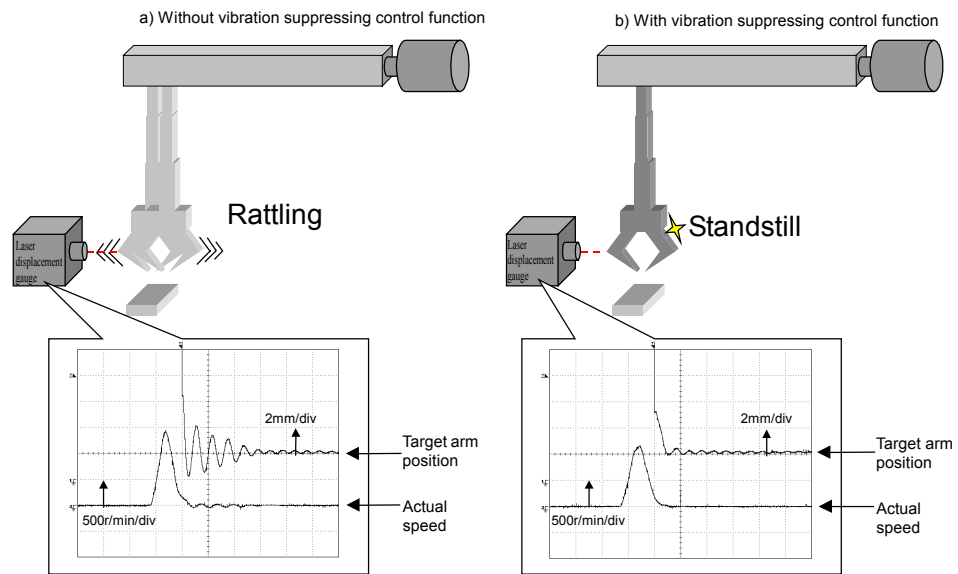
Not only vibration of parts is reduced, but also vibration of the overall unit is reduced.

• 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 redvibration suppressing controluced 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.
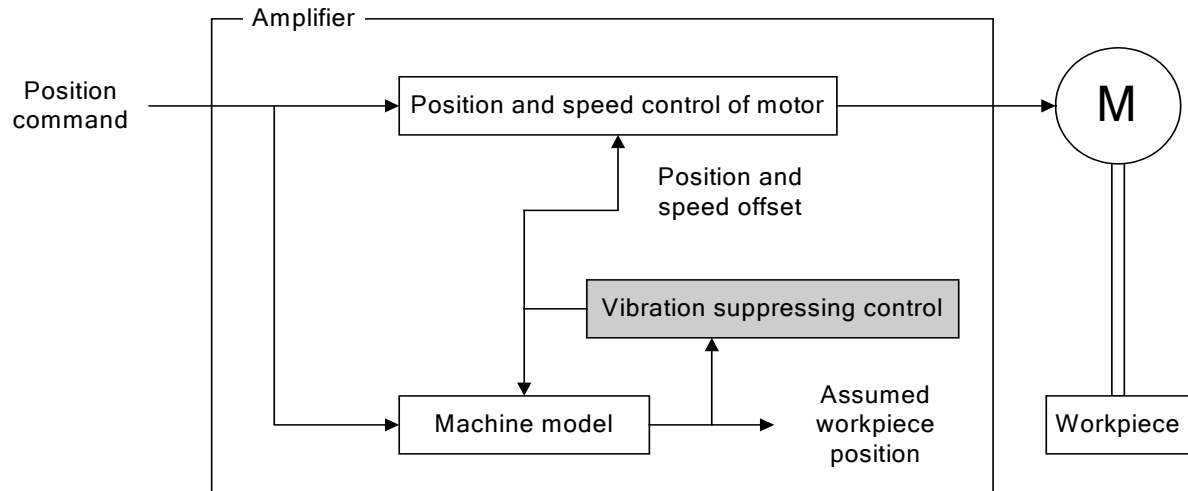
(3) Machine characteristics and conditions valid for vibration suppressing control

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. │
    └─────────────────────────────┘
                   │
                   ▼
②  ┌─────────────────────────────┐
    │ Check the anti-resonance     │
    │ frequency.                    │
    └─────────────────────────────┘
                   │
                   ▼
③  ┌─────────────────────────────┐
    │ Specify parameters #60        │
    │ through #63.                  │
    └─────────────────────────────┘
                   │
                   ▼
④  ┌─────────────────────────────┐
    │ Specify parameter #43         │
    │ (S-curve time constant).      │
    └─────────────────────────────┘
                   │
                   ▼
⑤  ┌─────────────────────────────┐
    │ Check the effect.             │
    └─────────────────────────────┘
                   │
                   ▼
⑥  ┌─────────────────────────────┐
    │ Finely adjust parameters #60  │
    │ through #63.                  │
    └─────────────────────────────┘
```
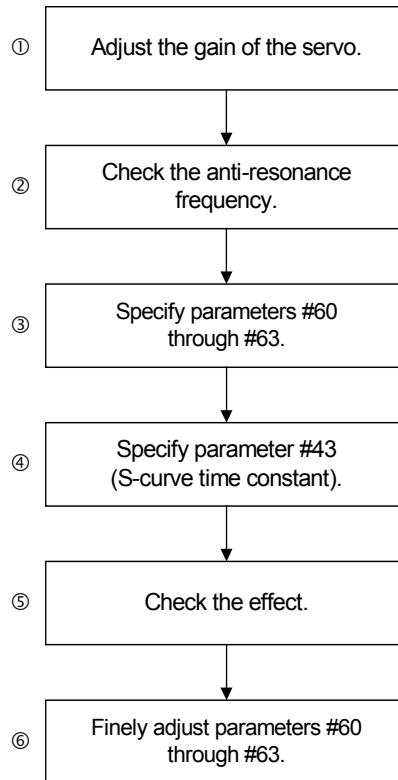
① Adjust the gain of the servo.

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>
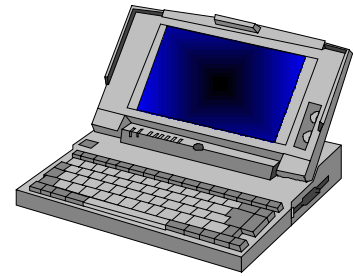
   Use the servo analysis function to check the anti-resonance point.
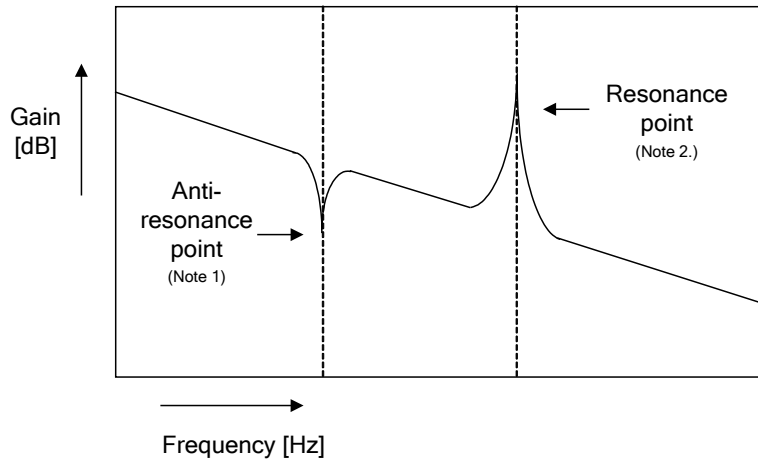
Note 1 : The servo analysis function may fail to detect the anti-resonance point in the following machine configuration.
   ① Machines with much friction
   ② Reduction gear, ball screw mechanism and other machines having relatively large mechanical losses

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.
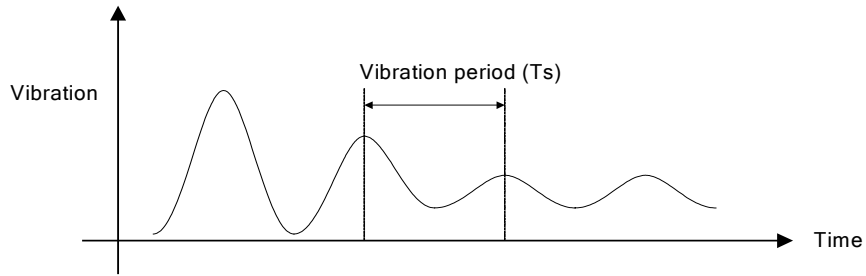
$$\text{Anti-resonance frequency} = \frac{1}{Ts} \quad [Hz]$$

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.

(a)   (b)   (c)
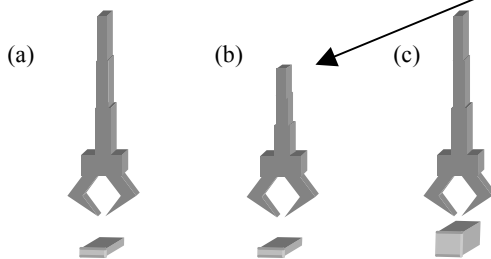
The anti-resonance frequency may vary according to conditions a, b and c.

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)	
	$1 \le \alpha/\beta^* \le 8$	$8 < \alpha/\beta^* \le 50$
< 10 Hz	10 msec	20 msec
10 Hz to 20 Hz	5 msec	10 msec
> 20 Hz	2 or 3 msec	5 msec
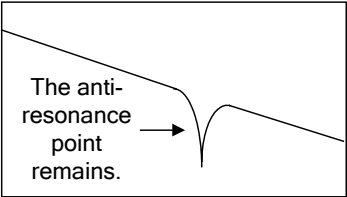
$$* \quad \frac{\alpha}{\beta} = \frac{\text{Command pulse compensation } \alpha \text{ (parameter #1)}}{\text{Command pulse compensation } \beta \text{ (parameter #2)}}$$

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 point remains.

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.
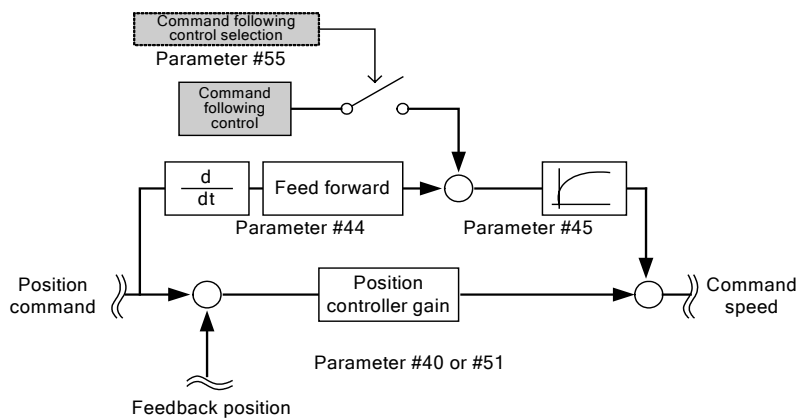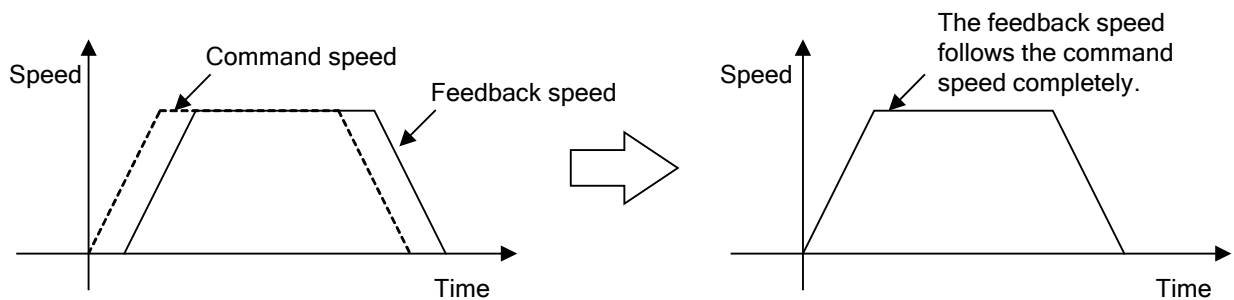
■ Mechanical system realizing command following control

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) × S-curve time constant (parameter #43) ≤ 1000.0

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

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).
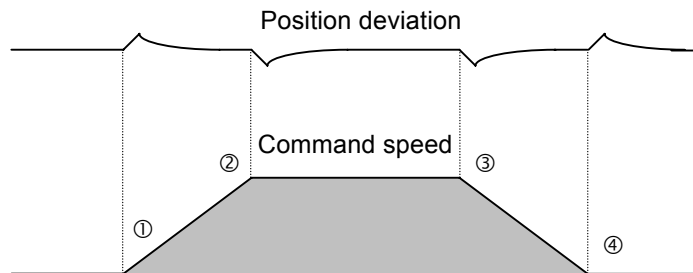
In case "with correction on stop (setting: 2)," position deviation caused by the acceleration change when the mechanical system is stopped is smaller.

Deviation of the stopping mechanism becomes almost zero.
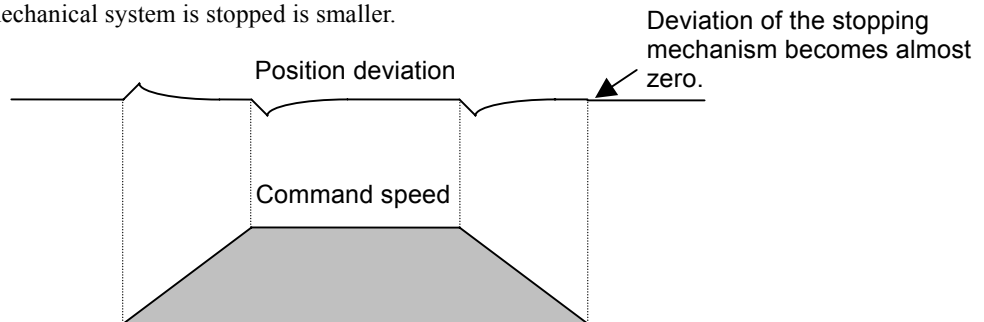
Select "no correction on stop (setting: 1)" for operation patterns where changes from forward to reverse rotation continue.
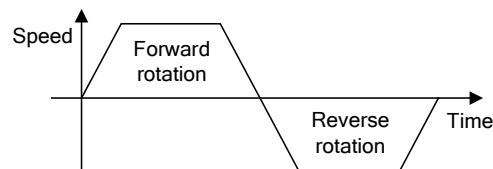
* In the command following control mode, specify "10" or a larger value for the auto tuning gain (parameter #7).

8

KEYPAD

8 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
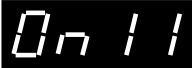
Each mode can be selected by the [MODE] key.

Mode select	Sub-mode select	Display example

Power on

Sequence monitor mode
MODE ESC → `Sn01` `PSoF`

Monitor mode
MODE ESC → `On01` `1000`

Parameter edit mode
MODE ESC → `Pn01` `no.01`

Test running mode
MODE ESC → `Fn01` `JOG`
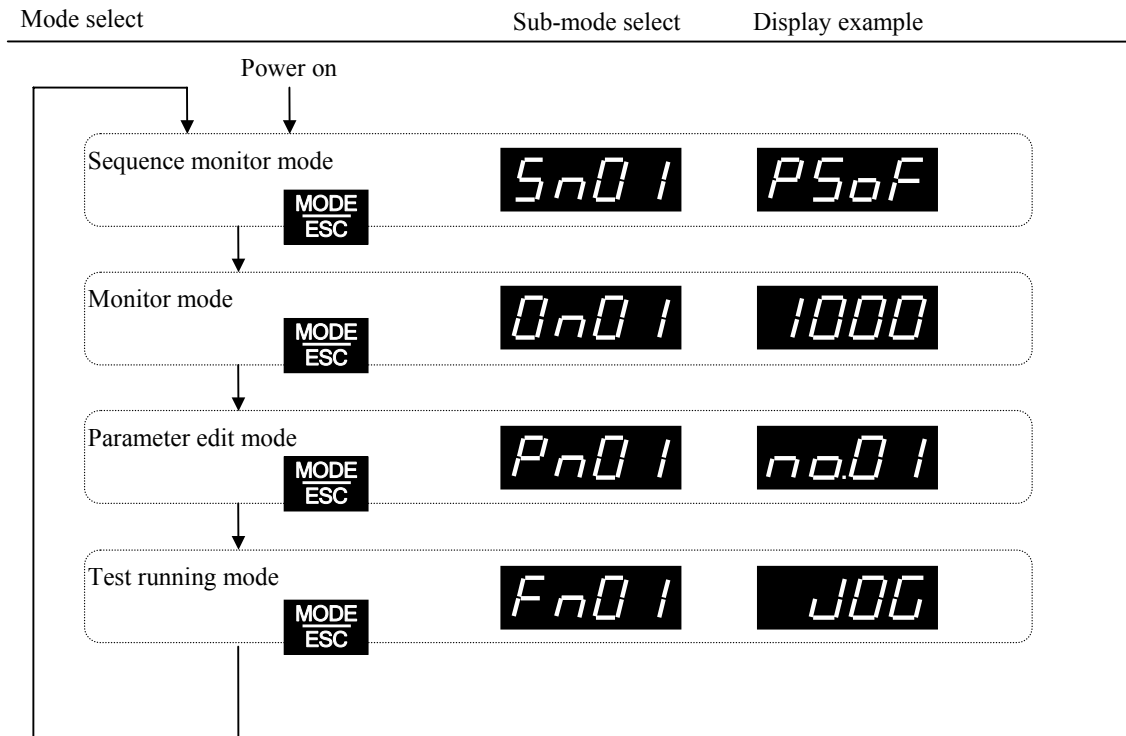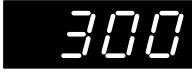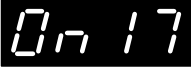
8 KEYPAD

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	Sn01	PSoF
	Current alarm	Sn02	OC
	Alarm history	Sn03	1.OL
	Station No. display	Sn04	Ad.01
Monitor mode	Feedback speed	On01	1000
	Command speed	On02	1000
	Average torque	On03	100
	Current feedback speed	On04	1000
	Current command speed	On05	1000
	Position deviation	On06	1000
	Feedback cumulative pulse	On07	1000
	Command cumulative pulse	On08	1000
	Peak torque	On09	100
	Input voltage	On10	10.0
	Input/output signal	On11	1111
	Load inertia ratio	On12	10.0
	OL thermal value	On13	100
	Regenerative resistor thermal value	On14	100

Mode	Sub-mode	Sub-mode select	Display and setting example
Monitor mode	Pulse string input frequency	`On 15`	`100.0`
	DC link voltage (maximum value)	`On 16`	`300`
	DC link voltage (minimum value)	`On 17`	`220`
	For adjustment by manufacturer	`On 18`	`C - - -`
Parameter editing mode	Parameter editing	`Pn01`	`no.01`
Test running mode	Manual feed	`Fn01`	`JOG`
	Position reset	`Fn02`	`Prt`
	Cumulative pulse clear	`Fn03`	`CPCr`
	Alarm reset	`Fn04`	`rt`
	Alarm history initialization	`Fn05`	`ALrt`
	Parameter initialization	`Fn06`	`PArt`
	Auto offset adjustment	`Fn07`	`oFFt`
	Phase-Z position adjustment	`Fn08`	`EoFF`
	Auto tuning gain	`Fn09`	`AtG`
	Easy tuning	`Fn10`	`ESY.1`
	Pattern operation	`Fn11`	`Ptn`

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.

𝑆𝑛𝑂1 : Sequence mode
𝑆𝑛𝑂2 : Current alarm
𝑆𝑛𝑂3 : Alarm history
𝑆𝑛𝑂4 : Station display

(1) Sequence mode

Output signal status and operation status of the servo amplifier are displayed.

𝑆𝑛𝑂1 ⟶ ENT (1 sec. or more) ⟶ 𝑃𝑆𝑜𝐹
⟵ ESC ⟵
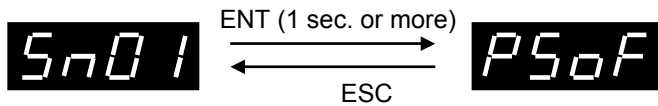
Indication	Control mode	Name	Description
PSoF	Position control	Servo OFF	Base OFF status. The servomotor does not have drive force. It is in coasting state. (See Figure above.)
PSon		Servo ON	The servomotor is ready for rotation.
PP In		Pulse string operation	The servomotor can rotate and pulse string inputs are valid.
PJOG		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
PPot		+OT	The amplifier has detected an overtravel signal in positive direction and stops.
Pnot		-OT	The amplifier has detected an overtravel signal in negative direction and stops.
Pn0		Zero speed stop	The amplifier has received a forced stop signal and stops with the speed zero.
PLu		In LV	This is displayed when undervoltage is detected.
nSoF	Speed control	Servo OFF	In base-off condition. The servomotor does not have driving force and is coasting to stop.
nSon		Servo ON	The servomotor is ready for rotation.
nJOG		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
nPot		+OT	The amplifier has detected an overtravel signal in positive direction and stops.
nnot		-OT	The amplifier has detected an overtravel signal in negative direction and stops.
nn0		Zero speed stop	The amplifier has received a forced stop signal and stops with the speed zero.
nLu		In LV	This is displayed when undervoltage is detected.
tSoF	Torque control	Servo OFF	In base-off condition. The servomotor does not have driving force and is coasting to stop.
tSon		Servo ON	The servomotor is ready for rotation.
tJOG		Manual operation	The servomotor is ready for rotation and is rotating by manual feed.
tLu		In LV	This is displayed when undervoltage is detected.

Hint 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	`Sn01`	Sequence mode
1	`Sn02`	Current alarm
2	`Sn03`	Alarm history
3	`Sn04`	Station display

Setting	Initial display	
4	`On01`	Feedback speed
5	`On02`	Command speed
6	`On03`	Average torque
7	`On04`	Current feedback speed
8	`On05`	Current command speed
9	`On06`	Position deviation
10	`On07`	Feedback cumulative pulse
11	`On08`	Command cumulative pulse
12	`On09`	Peak torque
13	`On 10`	Input voltage
14	`On 11`	Input/output signal
15	`On 12`	Load inertia ratio
16	`On 13`	OL thermal value
17	`On 14`	Regenerative resistor thermal value
18	`On 15`	Pulse string input frequency
19	`On 16`	DC link voltage (maximum value)
20	`On 17`	DC link voltage (minimum value)
21	`On 18`	For adjustment by manufacturer

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.

```
                ENT(1 sec. or more)
   5n02      ─────────────────►      - - -
             ◄─────────────────
                    ESC                  ╰──┬──╯
                                        Alarm code
```

Priority	Indication	Description		Priority	Indication	Description
1	OC 1	Overcurrent 1		13	rH 1	Regenerative resistor overheat
2	OC2	Overcurrent 2		14	OF	Deviation limit
3	OS	Overspeed		15	AH	Amplifier overheat
4	Hu	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	Cnt	CONT duplication				
11	OL	Overload				
12	Lu	Undervoltage				

Hint
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 ∧ and ∨ 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 ∧ and ∨ keys.

$$5\pi 03 \quad \xleftarrow[\text{ESC}]{\text{ENT(1 sec. or more)}} \quad l.0C$$

Operation with ∧ or ∨ key.

$$9.---$$

Detected history number (1: latest, 9: earliest)   Alarm code (Sec (2).)
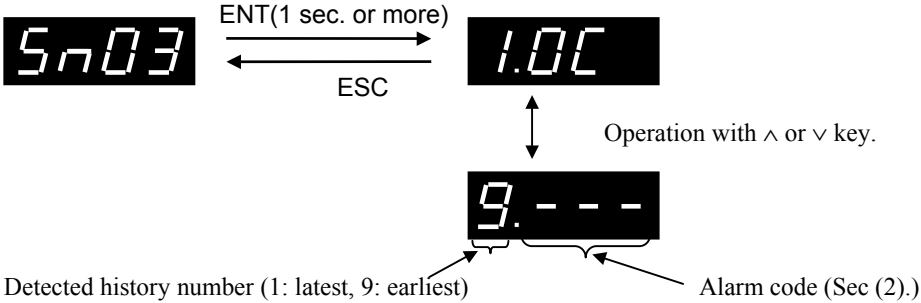
Hint · The alarm history can be deleted in the test operation mode [*Fn05*].

(4) Station display

The station number set for the servo amplifier is displayed.

$$5\pi 04 \quad \xleftarrow[\text{ESC}]{\text{ENT (1 sec. or more)}} \quad Ad.0 l$$
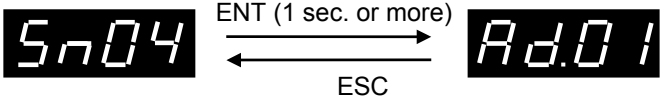
8 KEYPAD

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 [$OnOn$] and press the ENT key (for 1 sec or more) to display the content.

$On01$: Feedback speed $On08$: Command cumulative pulse $On15$: Pulse string input frequency

$On02$: Command speed $On09$: Peak torque $On16$: DC link voltage (maximum value)

$On03$: Average torque $On10$: Input voltage $On17$: DC link voltage (minimum value)

$On04$: Current feedback speed $On11$: Input/output signal $On18$: For adjustment by manufacturer

$On05$: Current command speed $On12$: Load inertia ratio

$On06$: Position deviation $On13$: OL thermal value

$On07$: Feedback cumulative pulse $On14$: 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.)
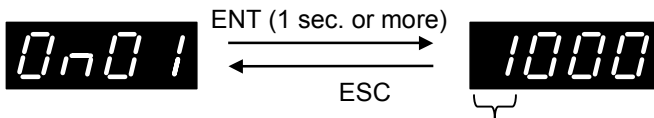
(2) Command speed ································· No. of displayed digits: 4 digits with sign

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.)
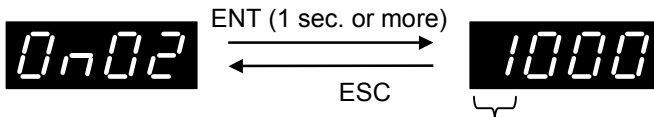
(3) Average torque · · · · · · · · · · · · · · · · No. of displayed digits: 3 digits with sign

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.

```
0n03  ←ENT (1 sec. or more)→  100
           ESC
```
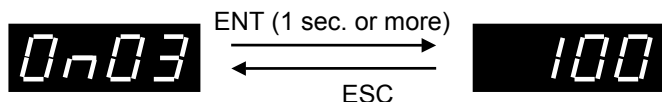
(4) Current feedback position · · · · · · · · No. of displayed digits: 8 digits with sign

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.)

```
0n04  ←ENT (1 sec. or more)→  1234
           ESC              ↓  ↑
                            5678
```

The upper 4 digits can be replaced with the lower 4 digits with the shift key input.

<Display of 8 digits with sign>
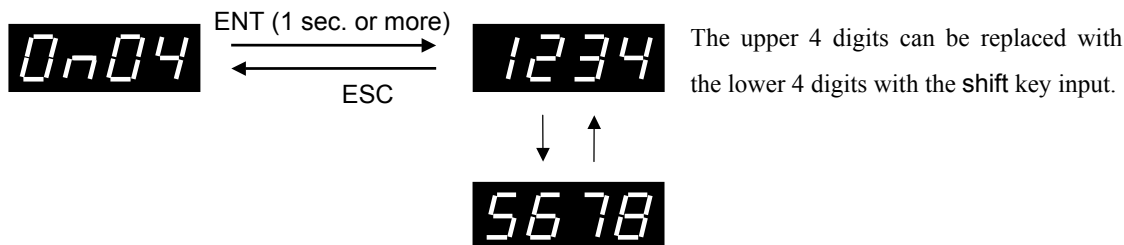
On display, the upper 4 digits can be replaced with the lower 4 digits and the negative sign is displayed. The leftmost digit of the upper 4 digits is displayed in the order of "Value," "Sign (negative sign only)" and "H (or L) *."

* H indicates the upper 4 digits and L indicates the lower 4 digits.

■ Display example of upper 4 digits   ■ Display example of lower 4 digits

Value   Value
```
1234  ←—— SHIFT/ENT ——→  5678
↗    ↘                    ↗    ↘
H234  ←  -234           L678  ←  -678
H       Sign            L        Sign
```
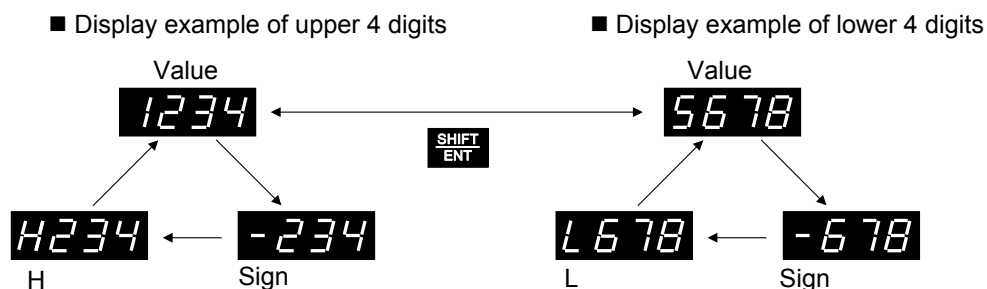
Hint When the rotation direction is switched with parameter No. 4, the display value increases in the increase direction of the current position.
After the maximum positive value of 99,999,999, counting is started increasing from 0 again.
After the maximum negative value of -99,999,999, counting is started 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).

(5) Current command position ············· No. 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."

```
On05
```
ENT (1 sec. or more)
→
ESC
```
1234
```
↓ ↑
```
5678
```

The upper 4 digits can be replaced with the lower 4 digits with the shift key input.
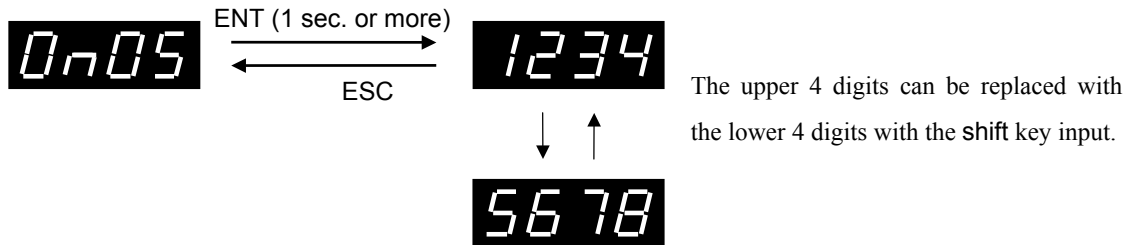
(6) Position deviation ·························· No. of displayed digits: 8 digits with sign

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."

```
On06
```
ENT (1 sec. or more)
→
ESC
```
1234
```
↓ ↑
```
5678
```

The upper 4 digits can be replaced with the lower 4 digits with the shift key input.
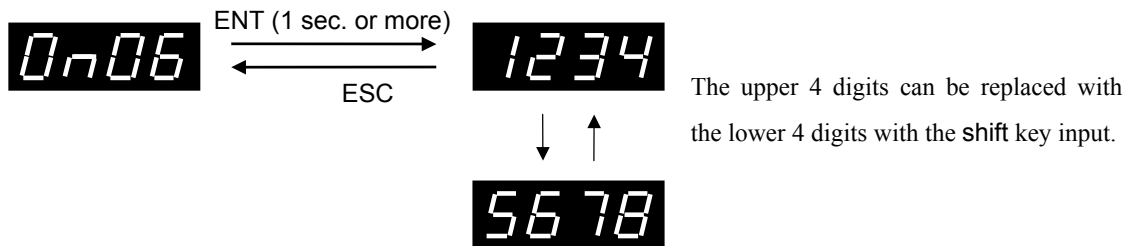
(7) Feedback cumulative pulse ······ No. of displayed digits: 8 digits with sign

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."
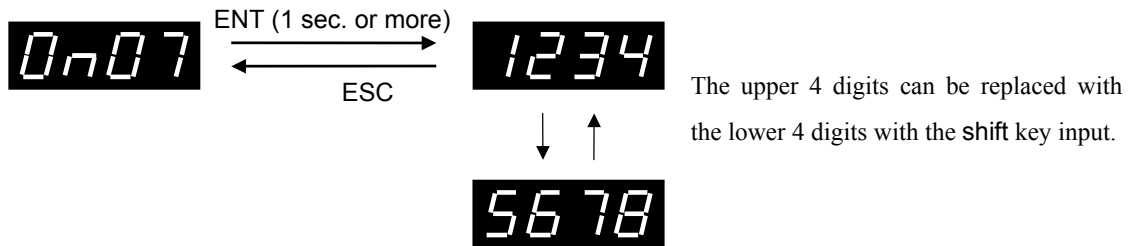
```
On07
```
ENT (1 sec. or more)
→
ESC
```
1234
```
↓ ↑
```
5678
```

The upper 4 digits can be replaced with the lower 4 digits with the shift key input.

Hint : When the ∧ key is pressed for 1 second or more and released, the feedback cumulative pulse can be cleared.

(8) Command cumulative pulse · · · · · · No. 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."
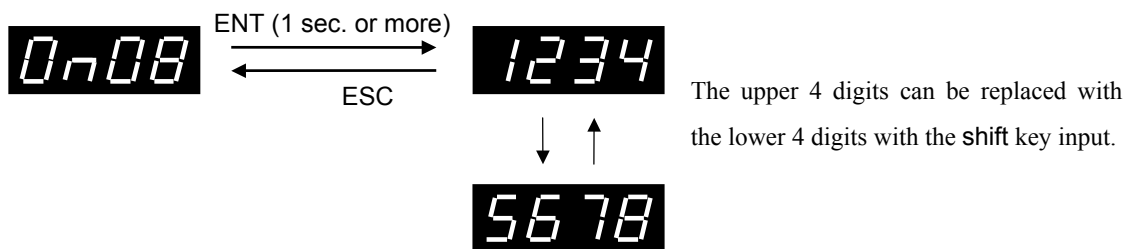
```
Ơn08   ENT (1 sec. or more)   1234
       ←——————————————→
              ESC
```
The upper 4 digits can be replaced with the lower 4 digits with the shift key input.

```
              5678
```

Hint: When the ∧ 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.

```
Ơn09   ENT (1 sec. or more)   100
       ←——————————————→
              ESC
```
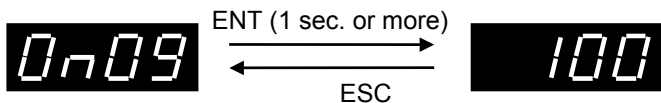
(10) Input voltage · · · · · · · · · · · · · · · · No. of displayed digits: 3 digits with sign

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.

```
Ơn 10   ENT (1 sec. or more)   10.0
        ←——————————————→
               ESC
```
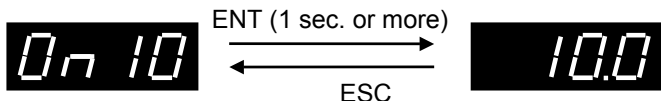
(11) Input/output signal

ON/OFF of the sequence input/output signal to the servo amplifier is displayed. When the input signal is ON, the corresponding LED illuminates.

```
Ơn 11   ENT (1 sec. or more)        CONT5 · · · CONT1
        ←——————————————→
               ESC                  OUT4 · · · OUT1
```
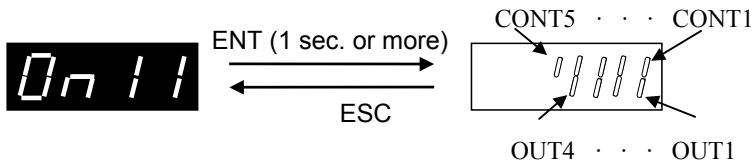
(12) Load inertia ratio · · · · · · · · · · · · No. of displayed digits: 3 digits without sign

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.

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

$$\boxed{On \ 12} \quad \xrightarrow{\text{ENT (1 sec. or more)}} \quad \xleftarrow{\text{ESC}} \quad \boxed{10.0}$$
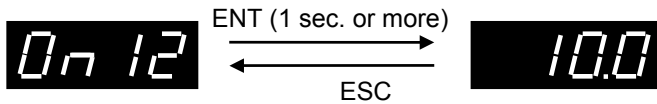
(13) OL thermal value · · · · · · · · · · · · No. of displayed digits: 3 digits without sign

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%.

$$\boxed{On \ 13} \quad \xrightarrow{\text{ENT (1 sec. or more)}} \quad \xleftarrow{\text{ESC}} \quad \boxed{100}$$
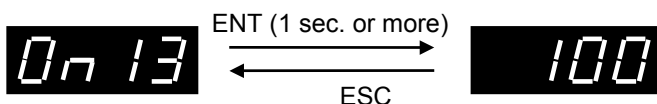
(14) Regenerative resistance thermal value · · · · · No. of displayed digits: 4 digits without sign

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%.

$$\boxed{On \ 14} \quad \xrightarrow{\text{ENT (1 sec. or more)}} \quad \xleftarrow{\text{ESC}} \quad \boxed{100}$$
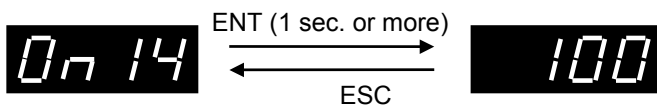
(15) Pulse string frequency · · · · · · · · No. of displayed digits: 4 digits with sign

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.

$$\boxed{On \ 15} \quad \xrightarrow{\text{ENT (1 sec. or more)}} \quad \xleftarrow{\text{ESC}} \quad \boxed{100.0}$$
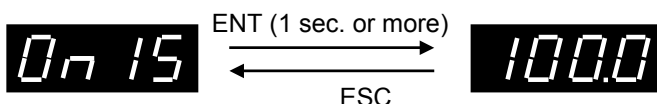
(16) DC link voltage (maximum value) ················· No. of displayed digits: 3 digits without sign

DC link voltage (maximum value) of the servo amplifier every 2 seconds is displayed.

The display range is 0V to 500V.

```
On 16            ENT (1 sec. or more)           300
        ←――――――――――――――――――→
                    ESC
```
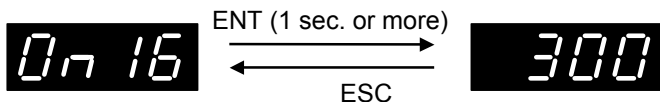
Hint If the DC link voltage (maximum value) exceeds 385V during operation, an external regenerative resistor is required. The detection level of "HV" (overvoltage) is 420V.

(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.

```
On 17            ENT (1 sec. or more)           300
        ←――――――――――――――――――→
                    ESC
```
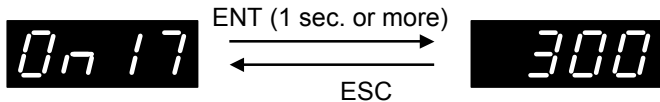
Hint The detection level of "LV" (undervoltage) is 210V.

(18) For adjustment by manufacturer ···················· Number of displaying digits: -

For adjustment by manufacturer.

```
On 18            ENT (1 sec. or more)          C - - -
        ←――――――――――――――――――→
                    ESC
```
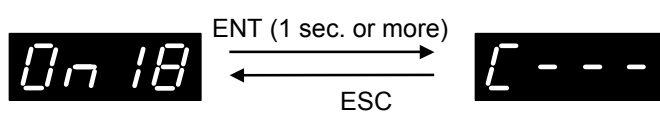
8 KEYPAD

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 ∧ or ∨ key. With the ENT key input, the details can be edited.
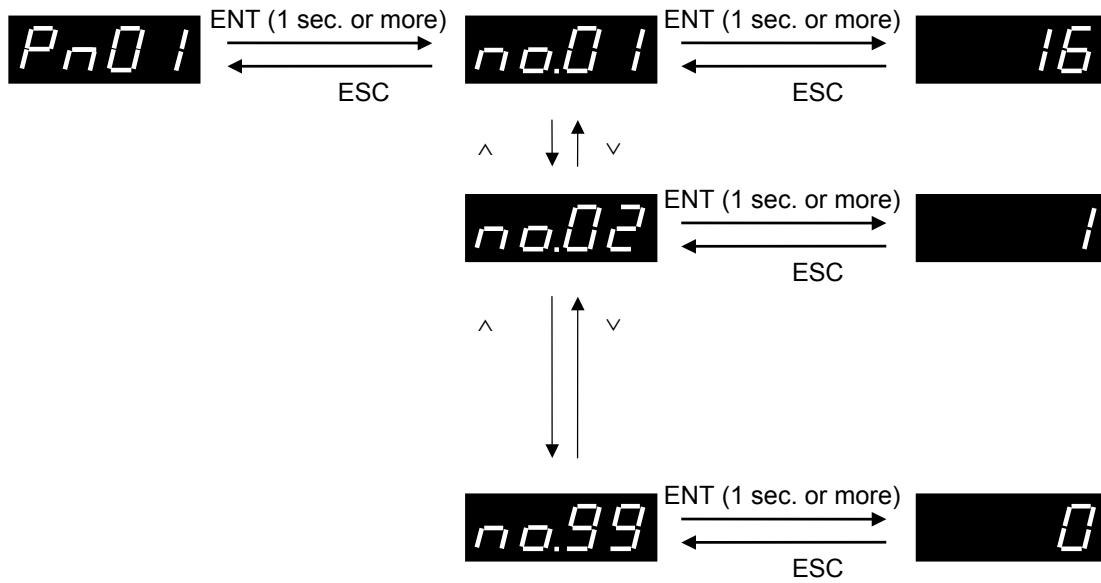
(1) Indication and editing

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.
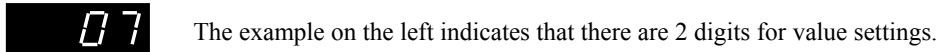
  To indicate the digit of value, zero suppress is not performed other than for the digits for setting.

  <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.

  ■ Upper 3 digits   ■ Lower 3 digits

  `H 123` ←――――――――――――――――――――――→ `L 456`

  <Parameter of 4 to 5 digits with sign>
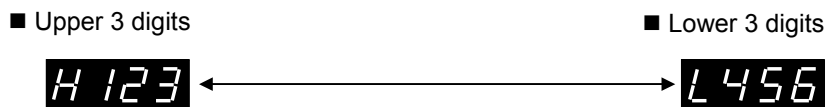
  For the upper 3 digits, "H" is displayed at the left end for positive value and "-" is displayed for negative value.

  For the lower 3 digits, "L" is displayed at the left end.

  • For positive value

  ■ Upper 3 digits   ■ Lower 3 digits

  `H 123` ←――――――――――――――――――――――→ `L 456`

  • For negative value

  ■ Upper 3 digits   ■ Lower 3 digits

  `- 123` ←――――――――――――――――――――――→ `L 456`
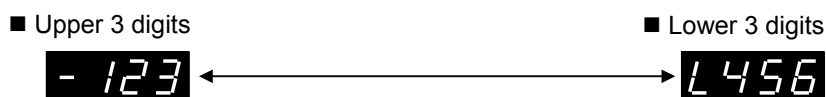
8 KEYPAD

• 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 ∧ or ∨ 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.

　　`2890`　　Increase the value of "9" for the third digit by one with the ∧ key.

　　↓

　　`2800`　　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)　　　　　　　　　　　　　• L (lower 4 digits)

　　`H 123`　←——————————→　`L 456`

　　　① ② ③　　　　　　　　　　　　　　　　　　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
	PSoF	The action mode in the sequence mode is displayed.
MODE/ESC	*Sn01*	Returns to mode selection.
MODE/ESC	*Pn01*	Select the parameter mode.
SHIFT/ENT (1 sec. or more)	*no.01*	Display the parameter number.
∧	*no.33*	Select parameter No. 33.
SHIFT/ENT (1 sec. or more)	*H 10* Blinking	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.)
∨	*H 00* Blinking	Decrease the value to 0.
SHIFT/ENT	*L 00.0* Blinking	Display L (lower 4 digits).
SHIFT/ENT	*L 00.0* Blinking	Shift to the editing digit.
∧	*L 01.0* Blinking	Change the value to "1."
SHIFT/ENT (1 sec. or more)	*L 01.0*	Define the changed value.
	L 01.0	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 [$FnOn$] and hold down the ENT key for at least 1 second to execute test running.

$FnO1$: Manual feed $FnO5$: Alarm history initialization $FnO9$: Auto tuning gain

$FnO2$: Position reset $FnO6$: Parameter initialization $Fn10$: Easy tuning

$FnO3$: Cumulative pulse clear $FnO7$: Auto offset adjustment $Fn11$: Pattern operation

$FnO4$: Alarm reset $FnO8$: 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 #31.

* The servomotor rotates while the ∧ or ∨ key is held down.

Rotation in positive direction
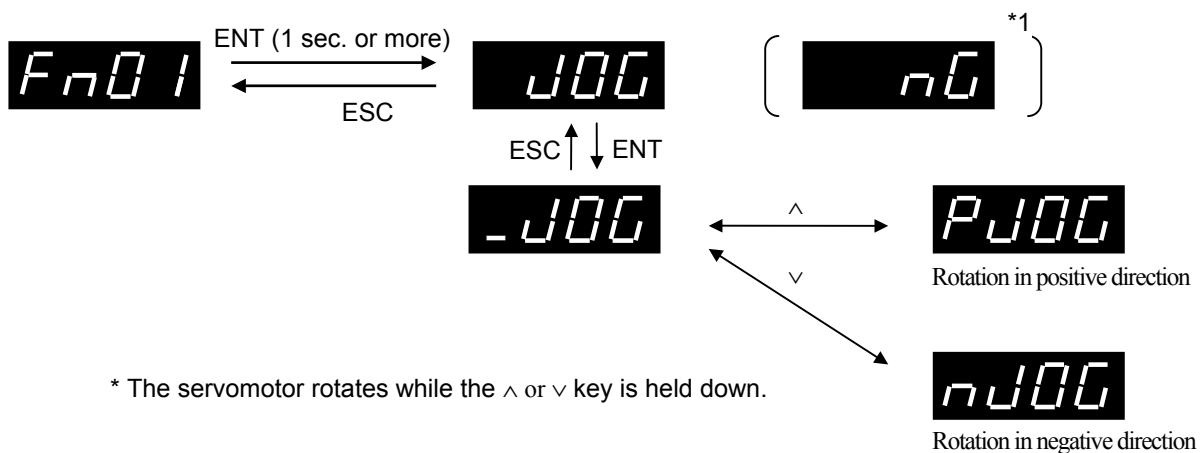
Rotation in negative direction

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.

Note   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.
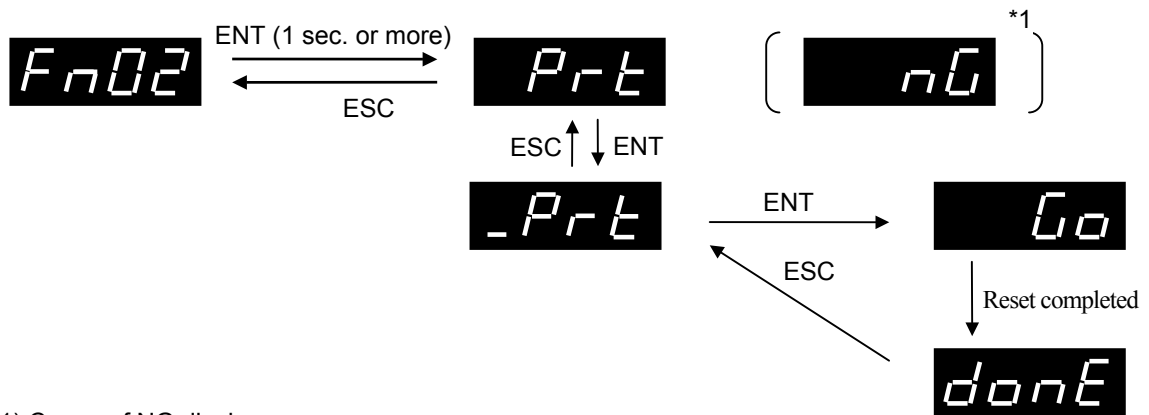
*1) Cause of NG display

• 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.

Clear feedback cumulative pulse
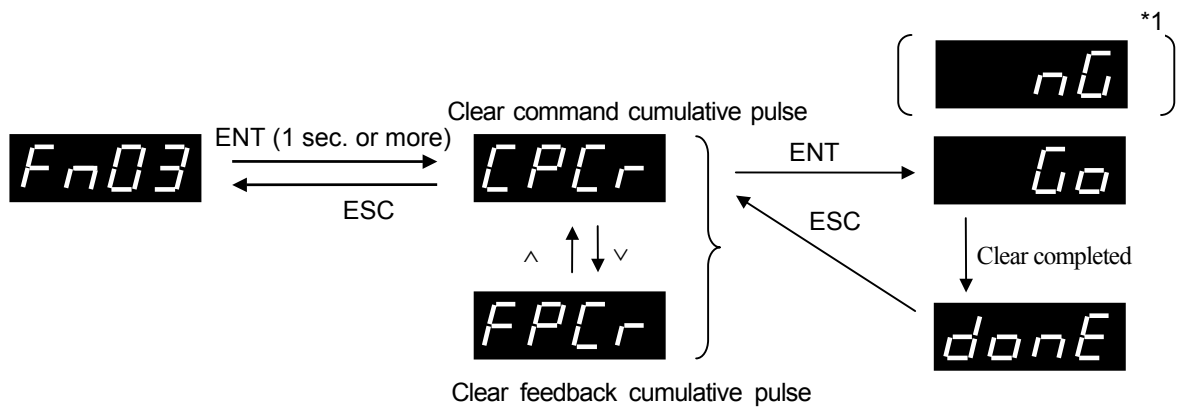
*1) Cause of NG display

• RUN signal and FWD/REV signal are ON.

• Motor is rotating.

8 KEYPAD

(4) Alarm reset

Resets the alarm detected by the servo amplifier.
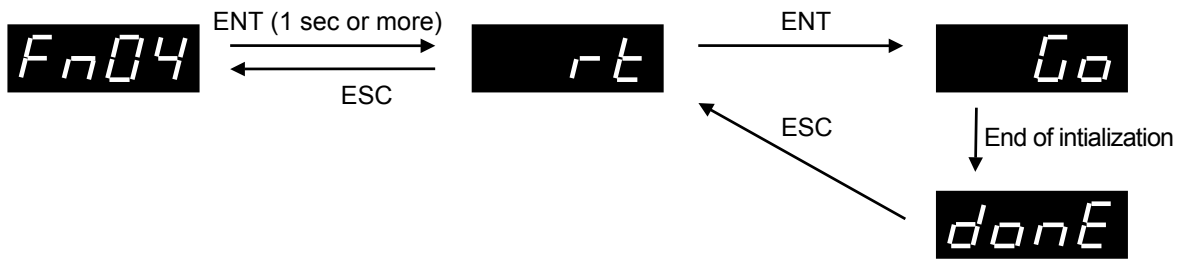
* Some alarms cannot be reset with the alarm reset. For these alarms, supply the power again to reset the alarms.

■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
OF	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 [$Fn04$].

* 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.
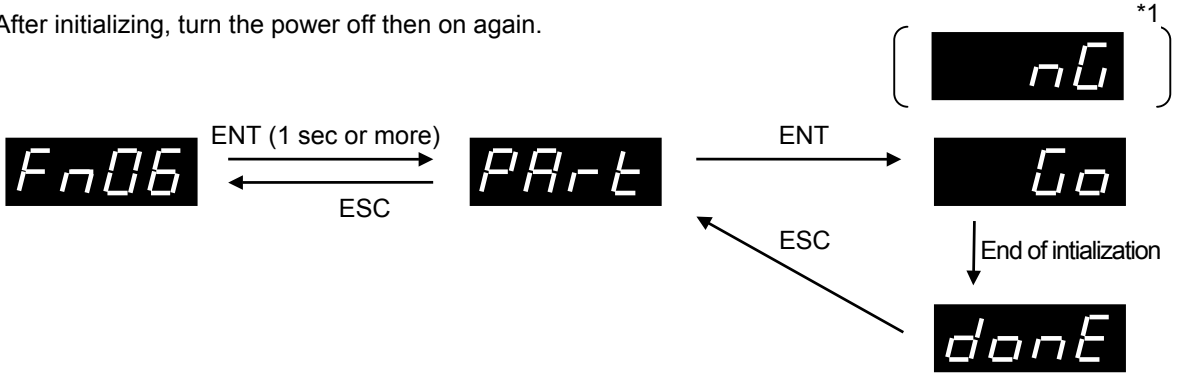
*1) Cause of NG display

• 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.
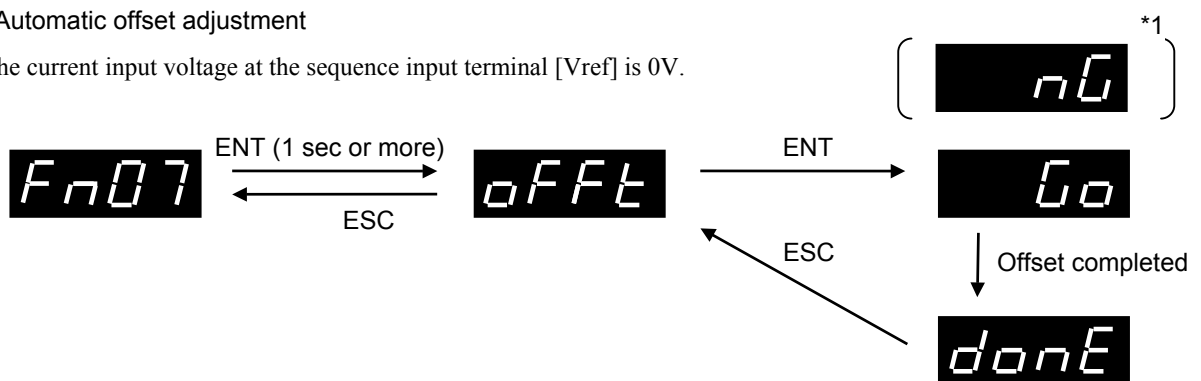
When all X1 and X2 terminals of the multistep speed selection are OFF with FWD (REV) signal, the servomotor output shaft rotates according to the analog speed command voltage.

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).
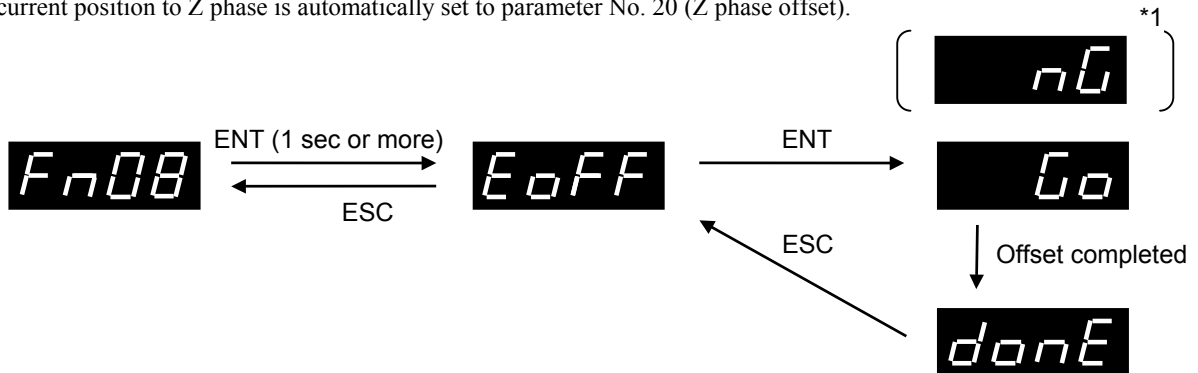
```
                                                                    *1
                                                        ┌─────────┐
                                                        │   nG    │
                        ENT (1 sec or more)      ENT    └─────────┘
  ┌────────┐  ────────────────────────►  ┌────────┐  ────────►  ┌────────┐
  │  Fn08  │  ◄────────────────────────  │  EoFF  │             │   Go   │
  └────────┘         ESC                  └────────┘             └────────┘
                                                ▲          ESC        │
                                                 ╲                    │ Offset completed
                                                  ╲                   ▼
                                                   ╲            ┌────────┐
                                                    ╲───────────│  donE  │
                                                                └────────┘
```

*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).
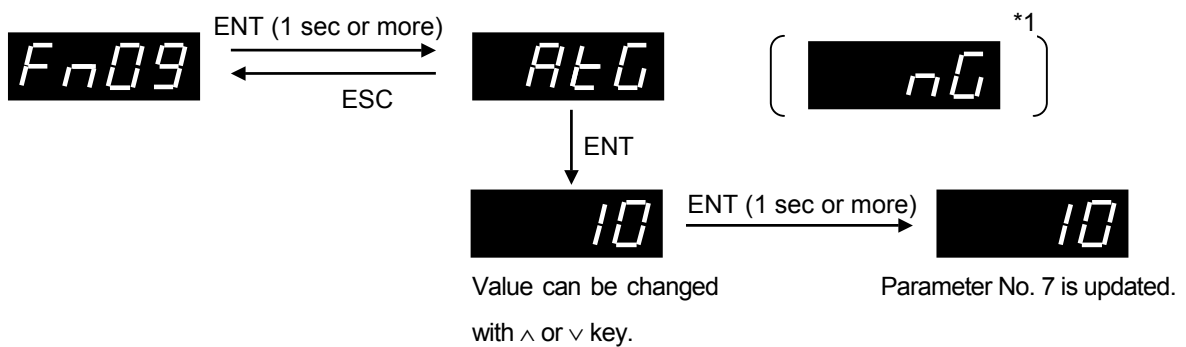
```
                        ENT (1 sec or more)                          *1
  ┌────────┐  ────────────────────────►  ┌────────┐          ┌─────────┐
  │  Fn09  │  ◄────────────────────────  │  AtG   │          │   nG    │
  └────────┘         ESC                  └────────┘          └─────────┘
                                                │ ENT
                                                ▼
                                          ┌────────┐  ENT (1 sec or more)  ┌────────┐
                                          │   10   │  ────────────────►    │   10   │
                                          └────────┘                       └────────┘
                                        Value can be changed        Parameter No. 7 is updated.
                                        with ∧ or ∨ key.
```

*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
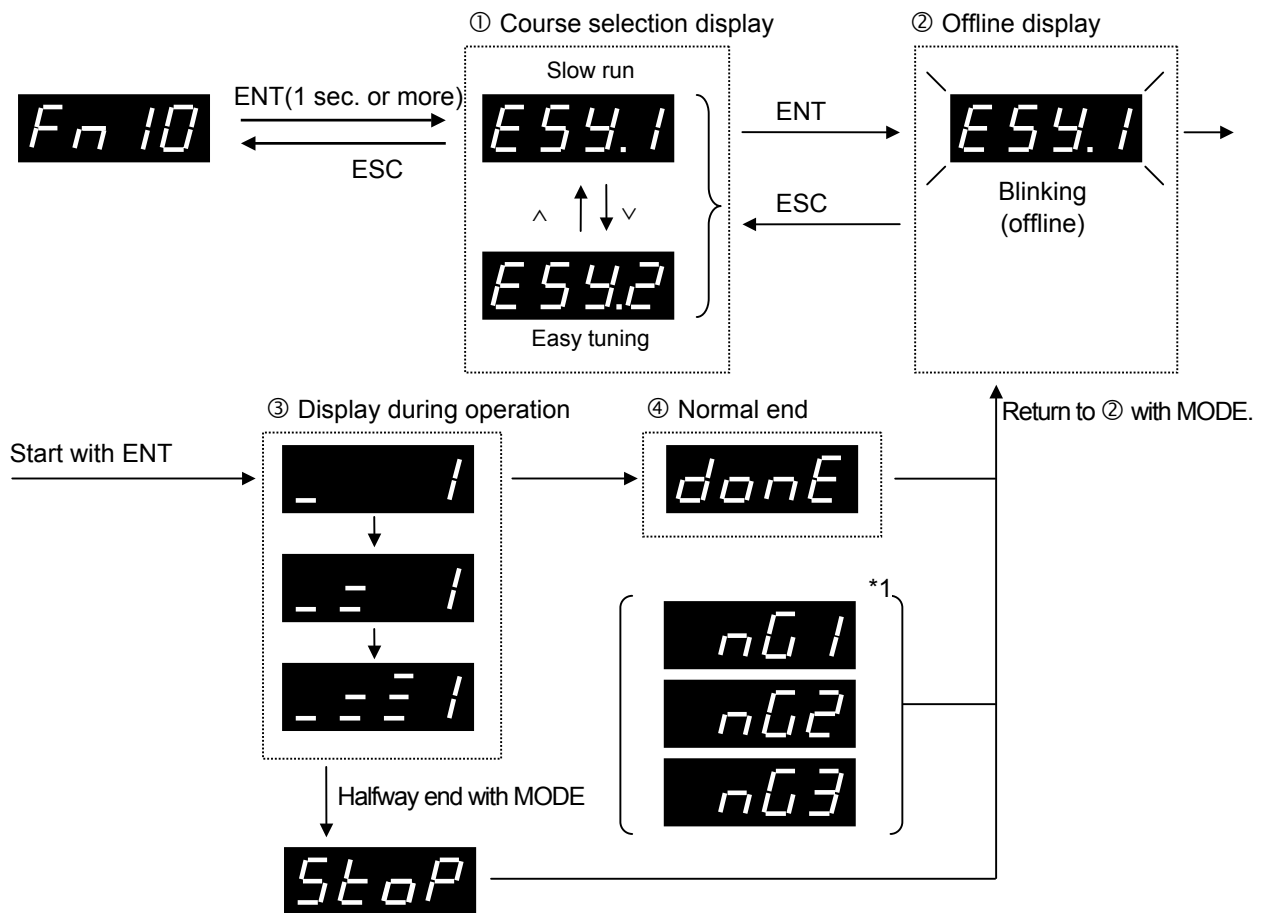
*1) If NG is displayed, remove the cause. Then, press the MODE key to return to ② Offline status.

<Cause of NG1 display>

- Parameter No. 29 (parameter write protect) is "1: Write protect."
- ±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>

- ±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
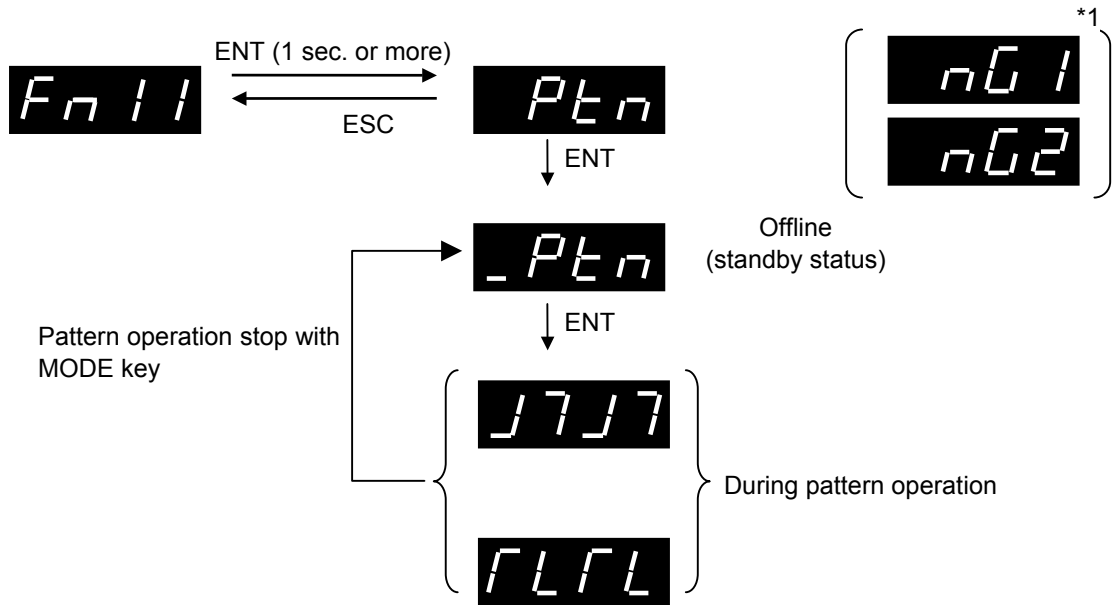
*1) If NG is displayed, remove the cause. Then, press the MODE key to return to Offline status.

  <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 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.
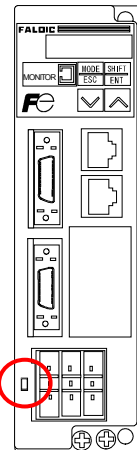
┌──┐
│   ⚠ CAUTION   │
├──┤
│ ■ Do not perform megger test on the PC-board or terminal block of servo │
│   amplifier. If attempted, the servo amplifier and the encoder housed in the │
│   servomotor may be broken.   │
└──┘

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.

`FnO6` → `PArt` → `Go` → `donE`

* 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 [`FnO5`] 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.

Mutual copy of parameter
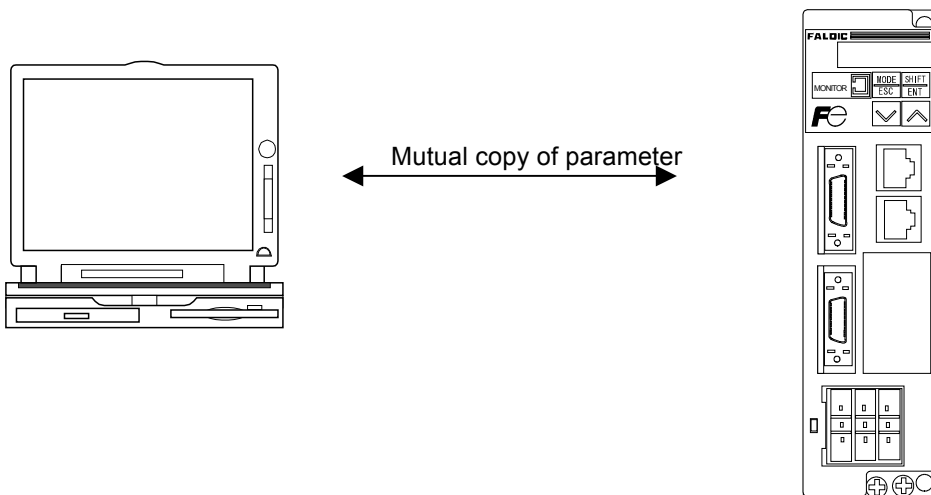
9 INSPECTION AND MAINTENANCE

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.
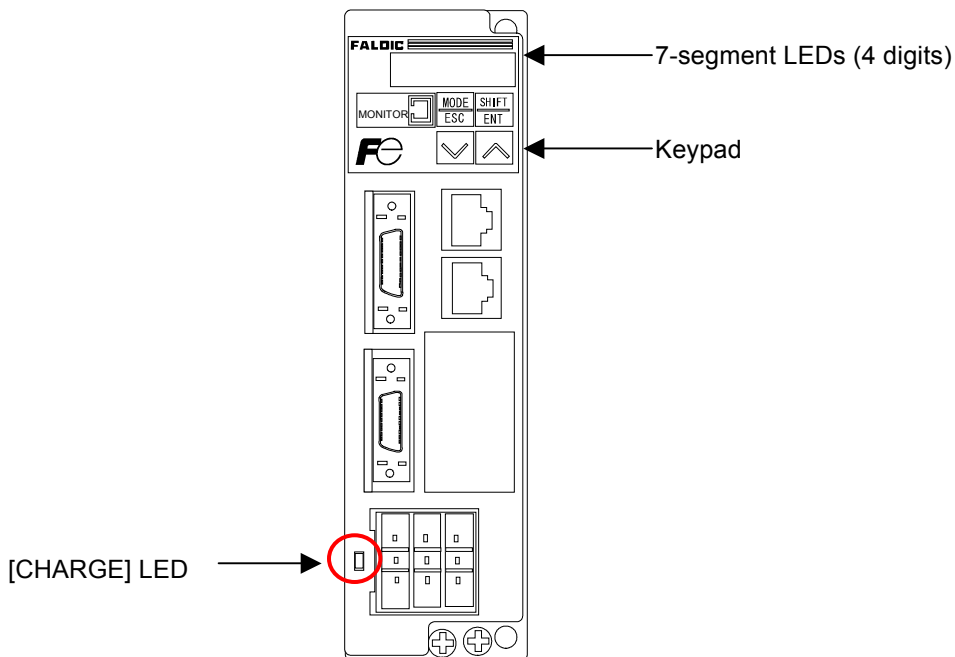
When the 7 segment does not illuminate after the power is supplied, the servo amplifier may be damaged. Please contact us.

(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.

```
        ┌─────────────────────────────────┐
        │    Servomotor does not rotate.  │
        └─────────────────────────────────┘
                        │
                        ▼
        ┌─────────────────────────────────┐   No   ┌──────────────────────────────────────┐
        │ Check if the [CHARGE] LED is lit │──────▶ │ Supply commercial power in the        │
        │ on the front panel of the servo  │        │ specification range of the servo      │
        │ amplifier.                       │        │ amplifier.                            │
        └─────────────────────────────────┘        │ The servomotor does not rotate with   │
                        │  Yes                       │ control power only.                    │
                        ▼                            │ Supply motor power, too.              │
                                                     └──────────────────────────────────────┘
        ┌─────────────────────────────────┐   No   ┌──────────────────────────────────────┐
        │ Check if the servo amplifier is  │──────▶ │ Connect the servomotor power cables   │
        │ connected with the servomotor.   │        │ to identical terminals of the servo   │
        └─────────────────────────────────┘        │ amplifier.                            │
                        │  Yes                       │ The direction of rotation does not    │
                        ▼                            │ change even if the phases are         │
                                                     │ exchanged.                            │
                                                     │ Connect the encoder cable to CN2.     │
                                                     └──────────────────────────────────────┘
        ┌─────────────────────────────────┐   Yes  ┌──────────────────────────────────────┐
        │ Check if an alarm is lit on      │──────▶ │ Take remedy according to fault        │
        │ 7-segment LED of the servo       │        │ indication and remedy described in    │
        │ amplifier.                       │        │ item (3).                             │
        └─────────────────────────────────┘        │ When an alarm is detected, the        │
                        │  No                        │ details of the alarm code are         │
                        ▼                            │ displayed.                            │
                                                     └──────────────────────────────────────┘
        ┌─────────────────────────────────┐   No   ┌──────────────────────────────────────┐
        │ Check if 24VDC power is supplied  │──────▶ │ Unless 24VDC is supplied, all control │
        │ across [P24] and [M24] terminals │        │ input signals are invalidated.        │
        │ of CN1.                          │        └──────────────────────────────────────┘
        └─────────────────────────────────┘
                        │  Yes
                        ▼
        ┌─────────────────────────────────┐
        │  Check the control input signal  │
        │  on CN1.                         │
        └─────────────────────────────────┘
```

9 INSPECTION AND MAINTENANCE

Hint   Action mode check

Check the state of the servo amplifier.

$$SnO1 \xrightarrow[\text{ESC}]{\text{ENT (1 sec or more)}} PSoF$$
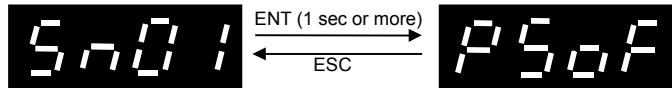
Indication (1st digit)	Sequence
P	Position control
n	Speed control
t	Torque control

Indication (2 to 4 digits)	Sequence
SoF	Base off. Servomotor has no drive force. Coasting.
Son	Waiting for command with the servo ON.
P In	The servomotor is ready to rotate. Pulse string input is effective.
JOG	The servomotor is ready to rotate by manual operation (test running).
Pot	Stopped under detection of positive overtravel signal.
not	Stopped under detection of negative overtravel signal.
nO	Stopped at zero speed upon forced stop signal input.
Lu	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.

```
        ┌────────────────────────────────────┐
        │         Servomotor hunting         │
        └────────────────────────────────────┘
                        │
                        ▼
 ┌──────────────────────────────────────────┐          ┌────────────────────────────────────────────┐
 │ Check if servomotor cables (U, V, W) are  │   No     │ Changing the phase sequence of servomotor does not │
 │ connected to the corresponding terminals  │─────────▶│ change the direction of rotation but causes hunting. │
 │ of servo amplifier.                       │          └────────────────────────────────────────────┘
 │ Does the motor hunt even after the motor  │
 │ output shaft is separated from mechanical │
 │ system?                                   │
 └──────────────────────────────────────────┘
                        │ Yes
                        ▼
        ┌────────────────────────────────────┐
        │            Contact us.             │
        └────────────────────────────────────┘
```
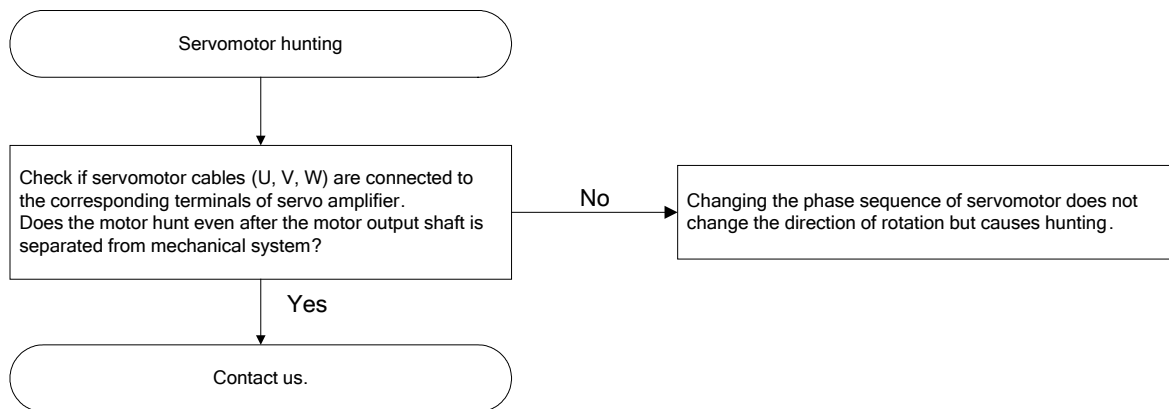
If hunting occurs with a machine connected to the output shaft of the servomotor, refer to chapter 6.

9 INSPECTION AND MAINTENANCE

③ Poor positioning accuracy

```
                    ╭─────────────────────────────╮
                    │  Positioning accuracy is poor │
                    ╰─────────────────────────────╯
                                   │
                                   ▼
        ┌────────────────────────────────────┐   No   ┌──────────────────────────────────┐
        │ Check if the grounding wire is       │───────▶│ Connect the grounding wire        │
        │ correctly connected.                 │        │ correctly.                        │
        └────────────────────────────────────┘        └──────────────────────────────────┘
                           │ Yes
                           ▼
        ┌────────────────────────────────────┐   No   ┌──────────────────────────────────┐
        │ Check if the sequence input/output   │───────▶│ Allow at least 10 cm.             │
        │ signal cables are routed at a         │        │                                   │
        │ sufficient distance from the power    │        └──────────────────────────────────┘
        │ supply and motor power cables.        │
        └────────────────────────────────────┘
                           │ Yes
                           ▼
        ┌────────────────────────────────────┐   No   ┌──────────────────────────────────────────┐
        │ Check if there is an excess or        │───────▶│ 1. Examine wiring (Allow at least 10 cm   │
        │ shortage in the number of cumulative  │        │    from the power and motor cables.)      │
        │ pulses monitored at the PC loader.    │        │ 2. Check the pulse string frequency.      │
        └────────────────────────────────────┘        │    Differential input: within 1 MHz       │
                           │ Yes                        │    Open collector input: within 200 kHz   │
                           ▼                            └──────────────────────────────────────────┘
        ┌────────────────────────────────────┐   Yes  ┌──────────────────────────────────────────┐
        │ Check if the coupling or the like is  │───────▶│ Examine mechanical configuration provided │
        │ loose.                                │        │ with keys.                                │
        └────────────────────────────────────┘        │ Examine mechanical configuration provided │
                           │ No                         │ with Schupan ring or the like.            │
                           ▼                            └──────────────────────────────────────────┘
        ┌────────────────────────────────────┐   No   ┌──────────────────────────────────┐
        │ Check if the backlash and other      │───────▶│ Check the mechanical accuracy.    │
        │ mechanical accuracy of the reduction  │        │                                   │
        │ gear are adequate.                    │        └──────────────────────────────────┘
        └────────────────────────────────────┘
                           │ Yes
                           ▼
                    ╭─────────────────────────────╮
                    │        Contact us.           │
                    ╰─────────────────────────────╯
```

(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	*OC2*	Overcurrent 2
3	*OS*	Overspeed
4	*Hu*	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	*Cnt*	CONT duplication
11	*OL*	Overload
12	*Lu*	Undervoltage
13	*rH 1*	Regenerative resistor overheat
14	*OF*	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
OC2	Overcurrent 2	9-11
OS	Overspeed	9-11
Hu	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
Cnt	CONT duplication	9-15

• The servomotor decelerates at the maximum torque and coasts after stopping.

Indication	Description	Page
OL	Overload	9-15
Lu	Undervoltage	9-16
rH 1	Regenerative resistor overheat	9-16
OF	Deviation limit	9-17
AH	Amplifier overheat	9-17

9 INSPECTION AND MAINTENANCE

Hint

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.

INSPECTION AND MAINTENANCE **9**

1. Overcurrent

[Display]   [Details of detection]

OC 1

OC2

The output current of the main circuit transistor exceeded the specified value.

[Factor and action]

Factors for overcurrent	Actions
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.
Grounding wire is not connected. (malfunction)	Connect the grounding wire.
The resistance value of the regenerative resistor is not proper.	Check the resistance value of the connected regenerative resistor.
The current is imbalanced due to the malfunction of the encoder.	Replace the servomotor.

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]

OS

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.
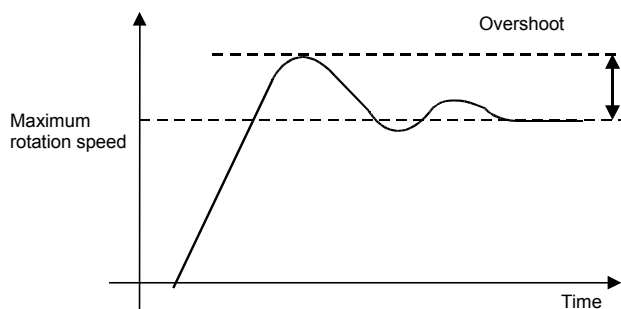
9 INSPECTION AND MAINTENANCE

3. Overvoltage

[Display]

```
Hu
```

[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.

`On 16` : DC link voltage (maximum value), `On 17` : DC link voltage (minimum value)

When overvoltage is approx. 420V, it is detected with the monitor above.

4. Encoder trouble

[Display]

```
Et
```

[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.
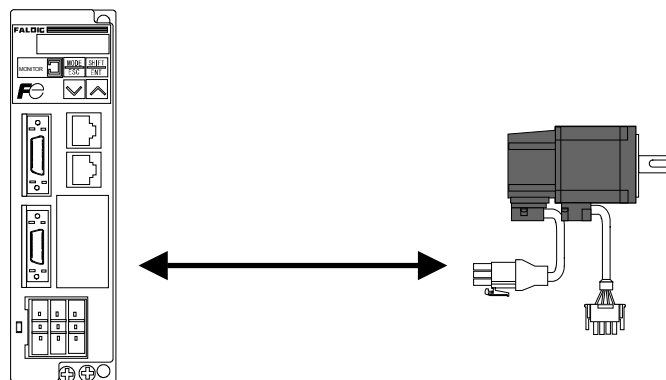
An alarm is detected with the self-diagnosis result of the CPU in the encoder.

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]

```
 rH2
```

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]

```
 EC
```

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]

```
Cnt
```
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]

```
OL
```
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.

(Undervoltage for position control)

(Undervoltage for speed control)

(Undervoltage for torque control)
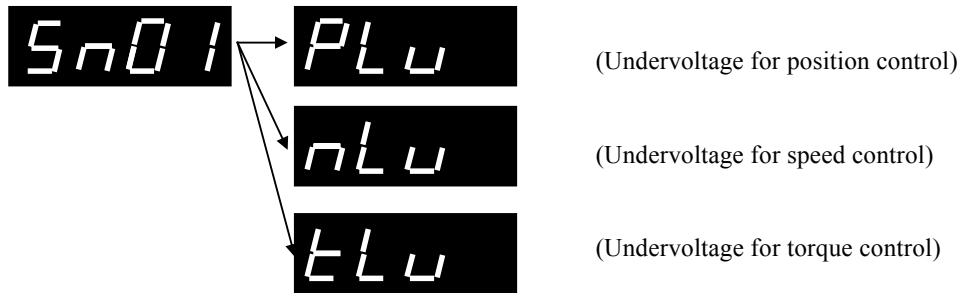
The DC link voltage can be checked with the monitor mode of the keypad.

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]

```
OF
```

[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 (× 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]

```
AH
```

[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 te 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 INSPECTION AND MAINTENANCE

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 CHARACTERISTICS

10.1 Timing chart

10.1.1 Power ON

(1) Operation only with the motor power supply (without using the control power supply) (recommended sequence)

① It takes about 1.5 seconds to complete the initialization of the servo amplifier after the motor power is turned ON.

② The completion of the initialization can be confirmed from the ON status of the servo alarm detection (b contact) signal.

③ The servo ON (RUN) signal is turned ON 0.4 second after the status of ② is confirmed.

④ The servo ready signal is turned ON, making the system ready to operate.

Motor power supply (L1, L2, L3)	No power supplied	Power supplied
Amplifier initialization		1.5 seconds
Servo alarm detection (b-contact)	OFF	ON
Servo ON (RUN)	OFF	0.4 second ON
Servo ready	OFF	ON
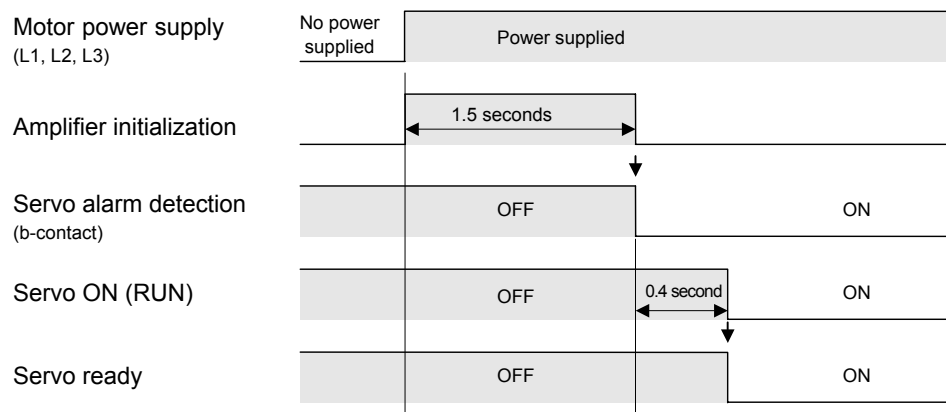
(2) Operation with the motor power supply and the control power supply (recommended sequence)

① It takes about 1.5 seconds to complete the initialization of the servo amplifier after the control power supply is turned ON.

② The completion of the initialization can be confirmed from the ON status of the servo alarm detection (b-contact) signal.

③ The servo ON (RUN) signal is turned ON 0.4 second after the status of ② is confirmed and the motor power supply is turned ON (*).

④ The servo ready signal is turned ON, making the system ready to operate.

Control power supply (sL1, sL2)	No power supplied	Power supplied
Motor power supply (L1, L2, L3)	No power supplied	Power supplied
Amplifier initialization		1.5 seconds
Servo alarm detection (b-contact)	OFF	ON
Servo ON (RUN)	OFF	0.4 second ON
Servo ready	OFF	ON
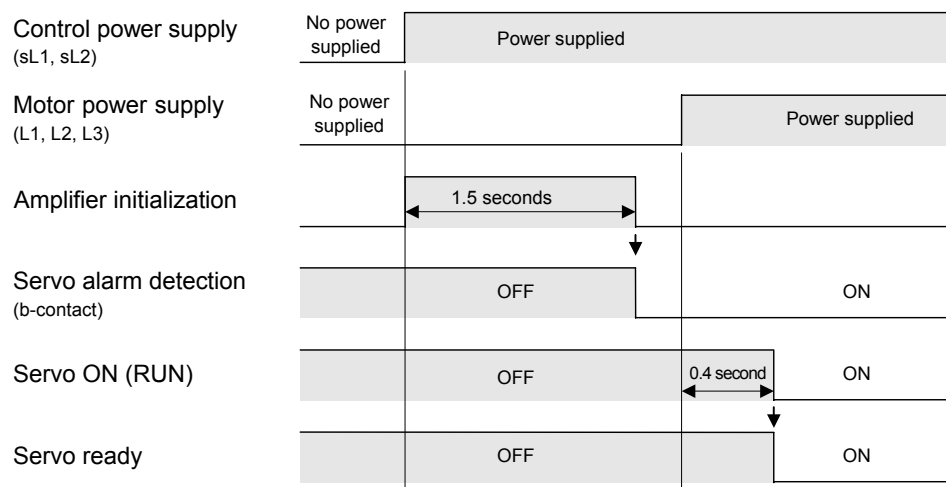
* The servo ON signal is turned ON only "when 0.4 second passes after the servo alarm detection (b-contact) signal and the motor power supply are both turned ON."

10.1.2 Response time of sequence input signals

The response time from the input of a sequence signal to its recognition inside the servo amplifier is "5ms."
Keep the sequence input signal ON for 5ms or longer.

| CONT signal (sequence input signal) | OFF | ON |
| Servo amplifier recognition | OFF | ON |

5ms
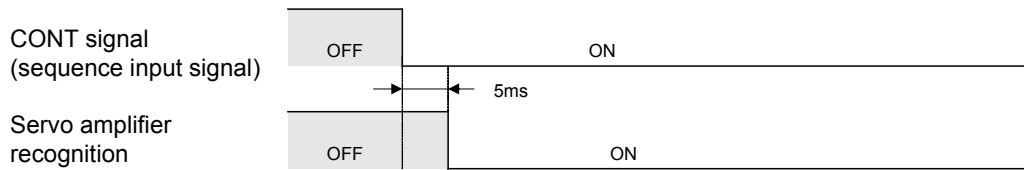
* Only the deviation clearance signal is recognized in 1ms. For details, see the figure below.

Keep the deviation clearance signal ON for 1ms or longer.

Deviation clearance (7)	OFF	ON	OFF
Position deviation	△△ pulse	0 pulse	
Zero deviation (8)	OFF	ON	
Pulse string command	Input enable	Input disable	Input enable

1ms

1ms
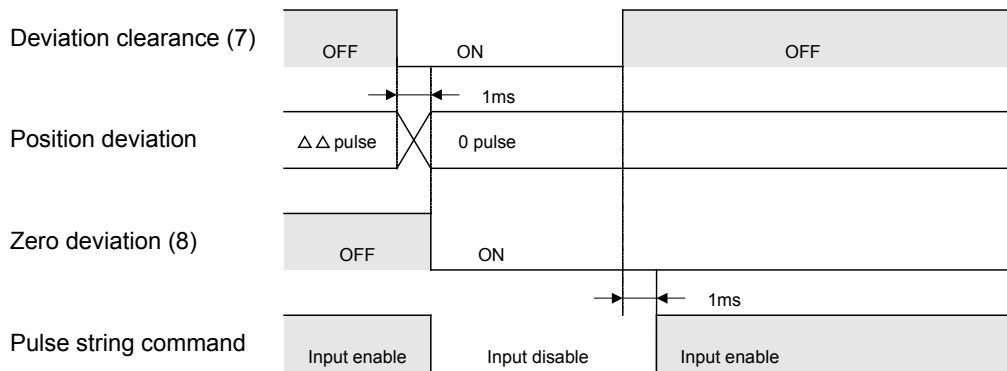
10 CHARACTERISTICS

10.1.3 Switching to each control mode

The transition time to each control mode is 5ms.

Input the following commands 5ms or more after the switching signal is input.

Example) Switching from speed control to position control

Control mode switching (14)	OFF	ON
Control mode	Speed control	Position control
Command pulse prohibited (11)	ON	OFF
Pulse string command	Input disable	Input enable

5ms
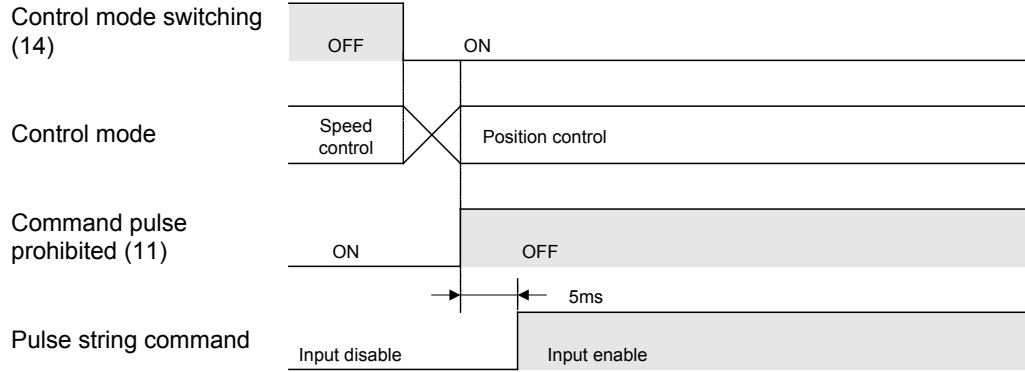
10.1.4 Alarm detection/reset

It takes about 5ms to output the alarm detection signal after an alarm occurs.

It takes about 5ms to actually reset an alarm after an alarm reset signal is input.

Occurrence of alarm	Normal	Occurrence of alarm	Normal
Alarm reset	OFF	ON	OFF
Servo ON (RUN)	ON		
Servo ready	ON	OFF	ON
Dynamic braking output *	OFF	ON	OFF
Servo alarm detection (a contact)	OFF	ON	OFF
Servo alarm detection (b contact)	ON	OFF	ON

5ms
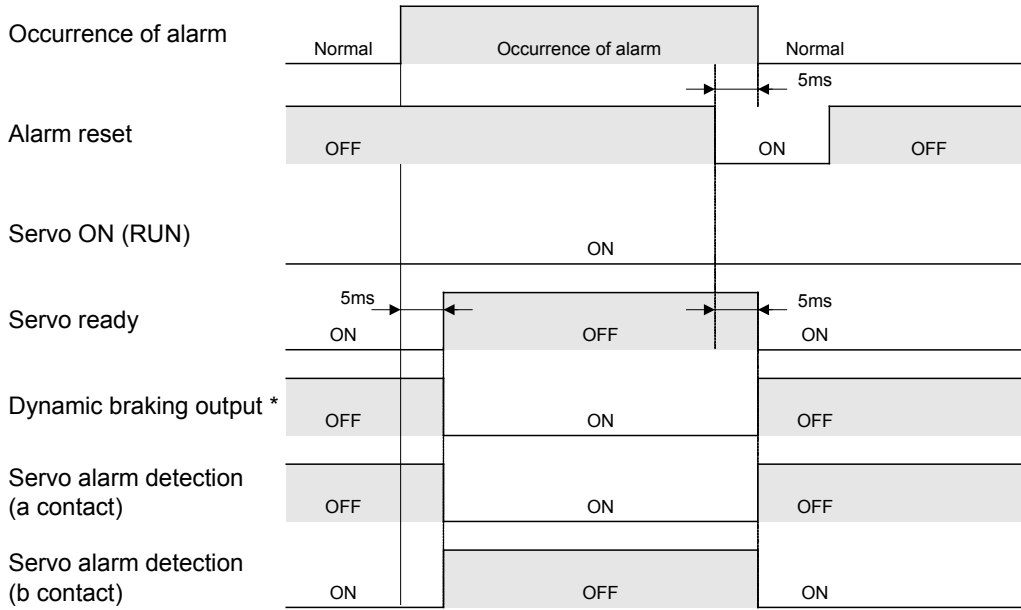
*) For the alarm of the dynamic braking output, refer to "Dynamic braking output" in chapter 5.

10.1.5 Returning to the hit-and-stop position regarded as the origin

(1) Method of returning to the origin in the position control mode

<Outline of operation>
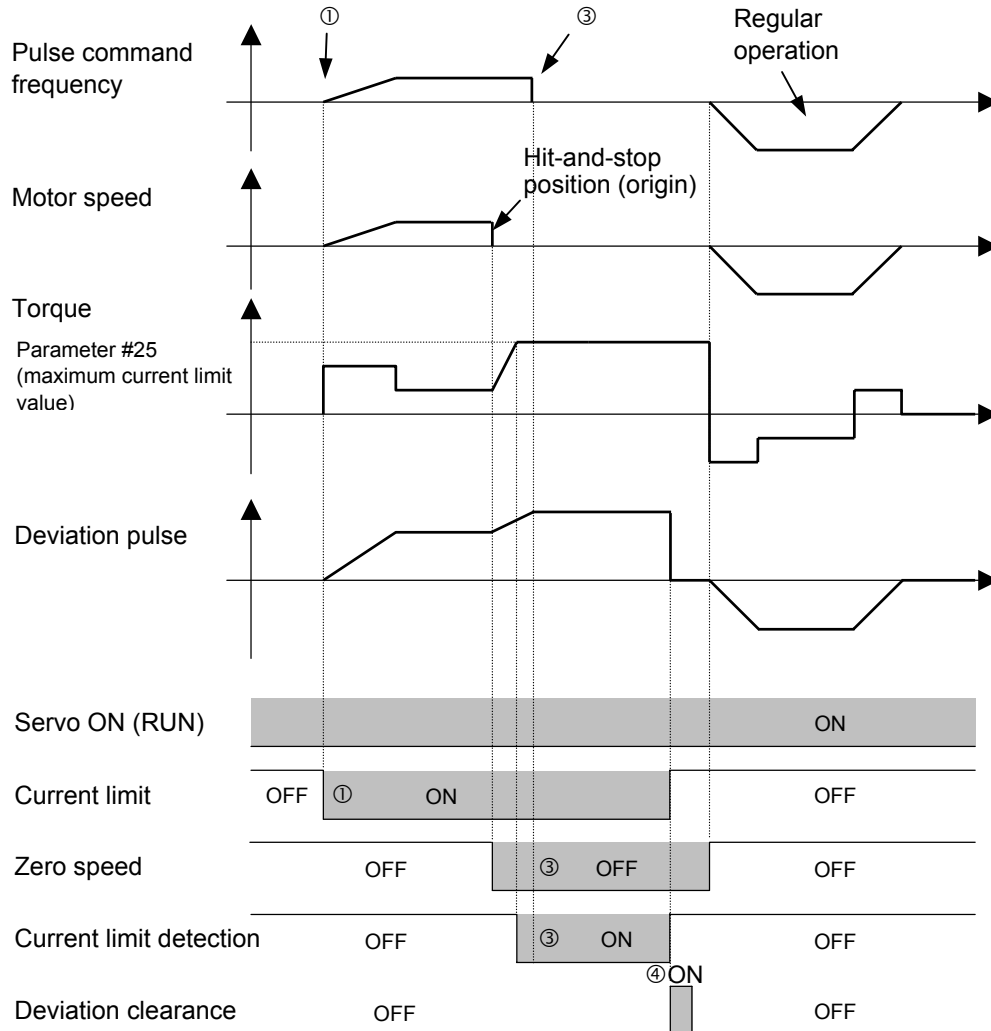
① A return to the origin begins at low speed. At the same time, the current limit signal is turned ON.

② The motor stops running after it reaches the hit-and-stop position, and the torque rises to the current limit level.

③ The pulse command frequency signal stops as soon as both the zero speed and current limit detection signals are detected (AND condition).

④ The deviation clearance signal is always turned ON before regular operation begins.

<Precautions>

• Keep the deviation clearance signal ON for 5ms or more.

• Set the maximum current limit value (parameter #25) at 90% or below.

• Set the deviation over width (parameter #22) at as large a value as possible if necessary.

10 CHARACTERISTICS

(2) Method of returning to the origin using the torque control mode
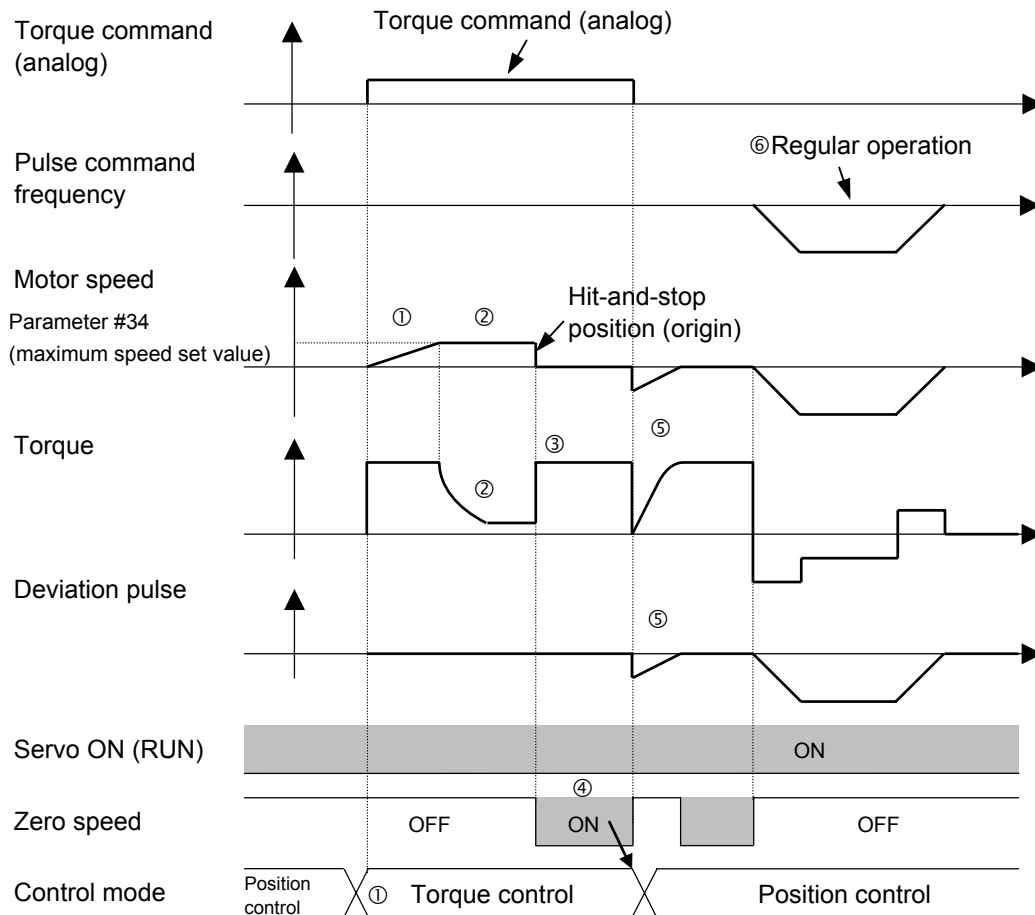
<Outline of operation>
① The control mode is switched to torque control, and a return to the origin begins at low speed.
② The torque decreases after the motor reaches the set maximum speed.
③ The motor stops running after it reaches the hit-and-stop position, and the torque rises to the command limit level.
④ After the zero speed signal is detected, the torque command (analog) signal stops, and the control mode is switched from torque control to position control.
⑤ Upon switching of the control mode to position control, the motor slightly returns due to reaction force. However, holding restarts because the position of the origin before the mode is switched is stored (the position of the origin remains unchanged).
⑥ It is confirmed that position control mode is active, and regular operation begins.

<Precautions>
• Set the maximum current limit value (parameter #25) at 90% or below.
• Set the deviation over width (parameter #22) at as large a value as possible if necessary.
• Set the maximum speed (parameter #34) at as small a value as possible if necessary.
  (The maximum speed setting becomes invalid in the position control of pulse string input.)

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)
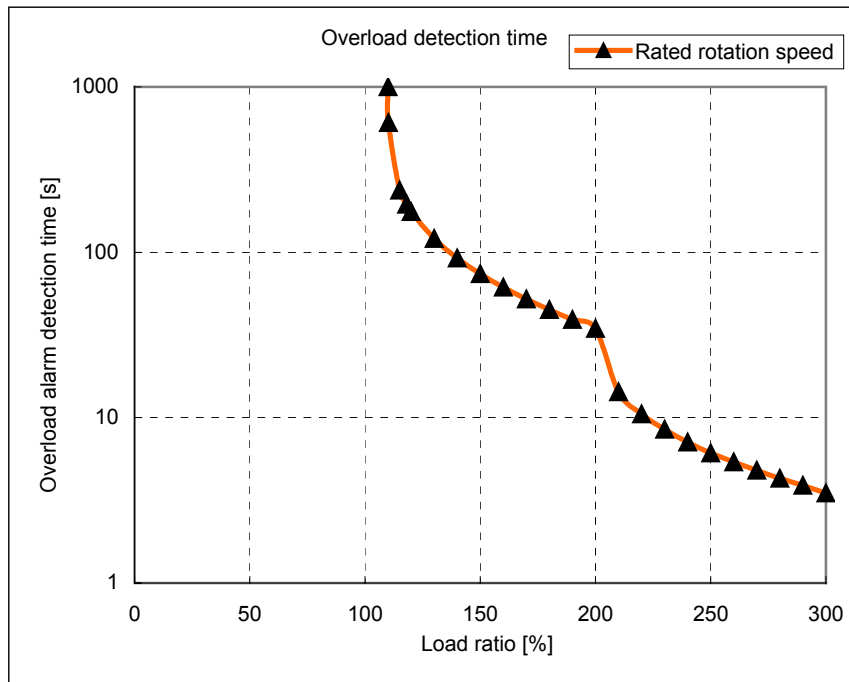
(2) Operation at maximum rotation speed (5000 r/min)
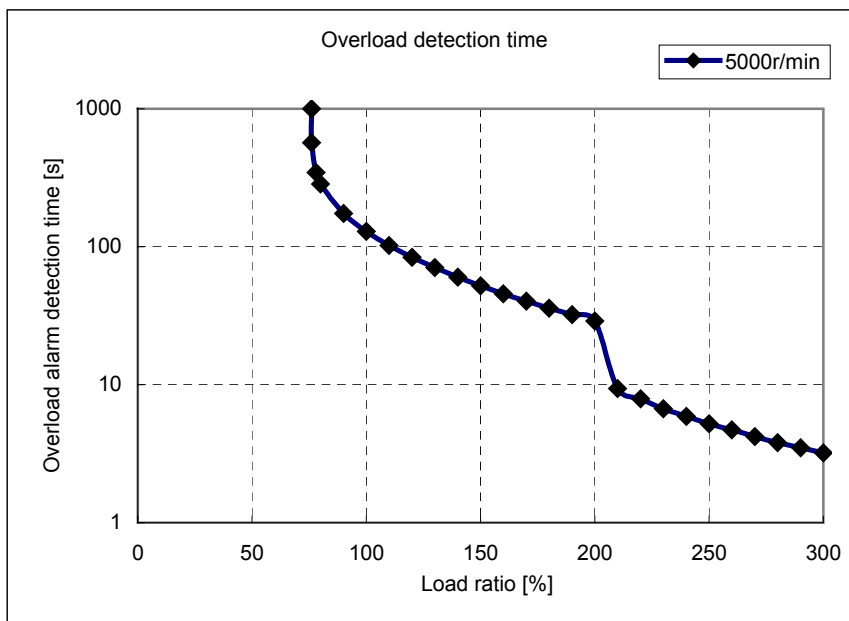
10 CHARACTERISTICS

10.2.2 GYG motor

(1) Operation at rated rotation speed (2000 r/min & 1500 r/min)*
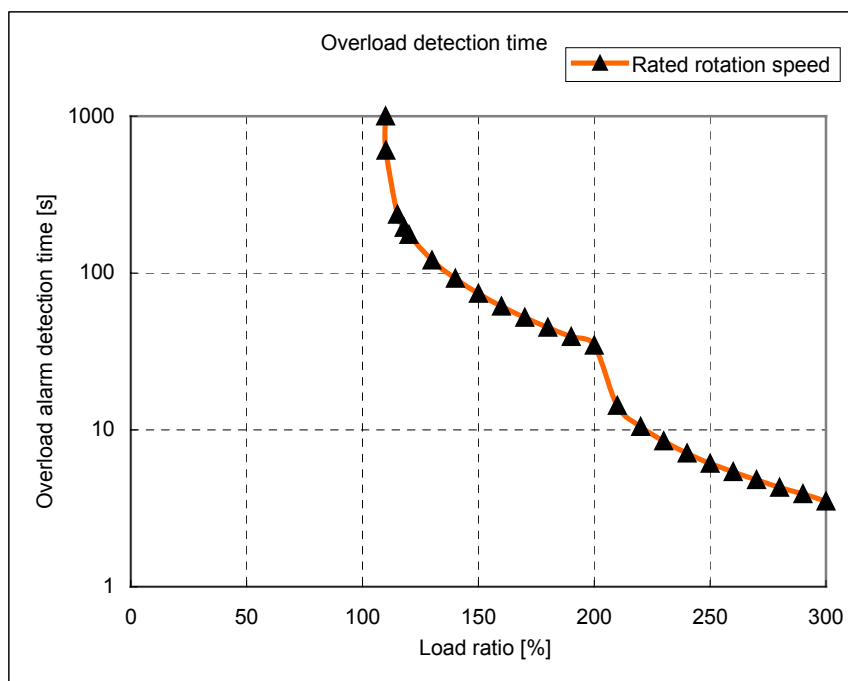
) The maximum load ratio of the GYG182BC2-T2 and GYG292BC2-T2* type motors is 240%.

(2) Operation at maximum rotation speed (3000 r/min)*
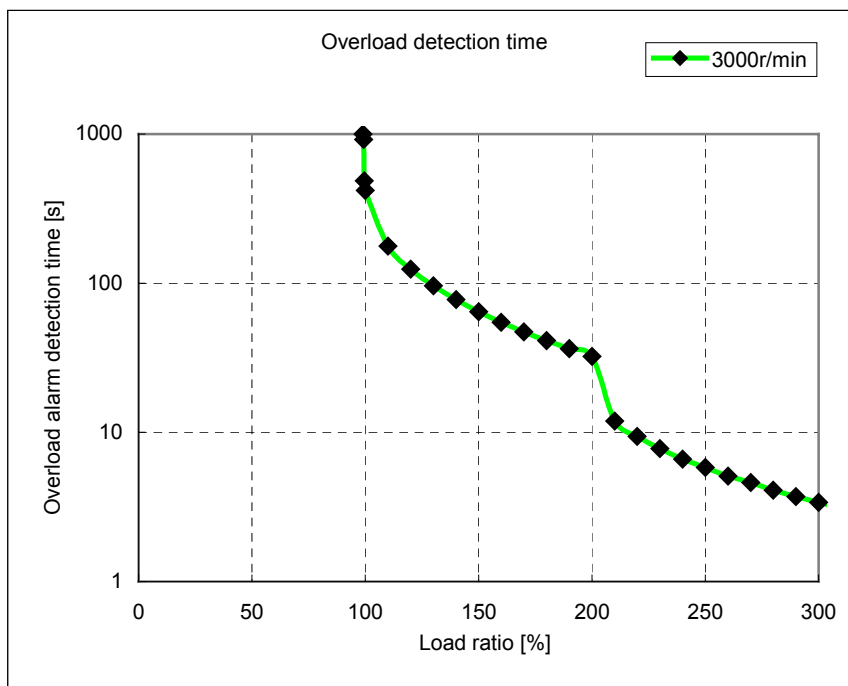
) The maximum load ratio of the GYG182BC2-T2 and GYG292BC2-T2* type motors is 240%.

10.3   Power supply capacity and generation loss

Amplifier heat value (Qamp)

Motor heat value (Qmot)

Power consumption (P)
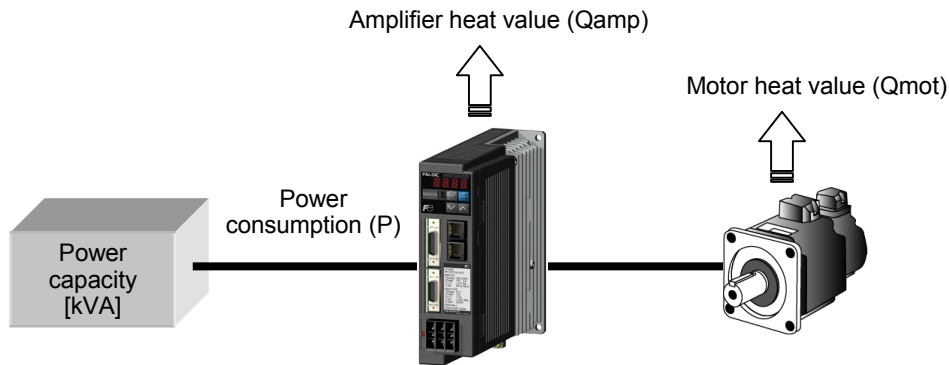
Power capacity [kVA]

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]	RYC500D3-VVT2	GYS500DC2-T2A	0.05	0.1	0.074	0.018	0.006
	RYC101D3-VVT2	GYS101DC2-T2A	0.1	0.2	0.13	0.021	0.011
	RYC201D3-VVT2	GYS201DC2-T2A	0.2	0.4	0.25	0.027	0.022
	RYC401D3-VVT2	GYS401DC2-T2A	0.4	0.8	0.48	0.038	0.044
	RYC751D3-VVT2	GYS751DC2-T2A	0.75	1.5	0.89	0.059	0.083
2000 [r/min]	RYC501C3-VVT2	GYG501CC2-T2E	0.5	1.0	0.60	0.044	0.056
	RYC751C3-VVT2	GYG751CC2-T2E	0.75	1.5	0.89	0.059	0.083
	RYC102C3-VVT2	GYG102CC2-T2E	1.0	2.0	1.2	0.073	0.11
	RYC152C3-VVT2	GYG152CC2-T2E	1.5	2.9	1.8	0.103	0.17
	RYC202C3-VVT2	GYG202BC2-T2E	2.0	3.9	2.4	0.13	0.22
1500 [r/min]	RYC501B3-VVT2	GYG501BC2-T2E	0.5	1.0	0.60	0.044	0.056
	RYC851B3-VVT2	GYG851BC2-T2E	0.85	1.7	1.0	0.065	0.94
	RYC132B3-VVT2	GYG132BC2-T2E	1.3	2.6	1.5	0.091	0.14
	RYC182B3-VVT2	GYG182BC2-T2G	1.8	3.5	2.1	0.120	0.20
	RYC292B3-VVT2	GYG292BC2-T2G	2.9	5.7	3.4	0.185	0.30

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	GYG501CC2-T2E	0.5	35.7
	RYC751C3-VVT2	GYG751CC2-T2E	0.75	35.7
	RYC102C3-VVT2	GYG102CC2-T2E	1.0	35.7
	RYC152C3-VVT2	GYG152CC2-T2E	1.5	43.5
	RYC202C3-VVT2	GYG202CC2-T2E	2.0	43.5
1500 [r/min]	RYC501B3-VVT2	GYG501BC2-T2E	0.5	35.7
	RYC851B3-VVT2	GYG851BC2-T2E	0.85	35.7
	RYC132B3-VVT2	GYG132BC2-T2E	1.3	43.5
	RYC182B3-VVT2	GYG182BC2-T2G	1.8	43.5
	RYC292B3-VVT2	GYG292BC2-T2G	2.9	43.5

10 CHARACTERISTICS

-MEMO-

11

PERIPHERAL DEVICE

11 PERIPHERAL DEVICE

■Configuration of system with peripheral devices

MCCB/ELCB
→ Refer to page 11-7.

AC reactor
→ Refer to page 11-12.

Power filter
→ Refer to page 11-10.

CN3A
Connector for loader

External regenerative resistor
→ Refer to page 11-14.

CN1
Cable for sequence input/output
→ Refer to page 11-16.

CN2
Cable for encoder
→ Refer to page 11-17.

Connector for external regenerative resistor.
→ Refer to page 11-25.

Cable for monitor power.
→ Refer to page 11-19.

General-purpose PC
PC loader (option) for
FALDIC- W is prepared.
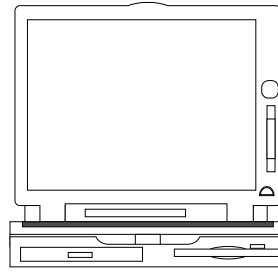
CN3A
To loader
connector

Controller
Various controllers of a
pulse string output type
can be connected.
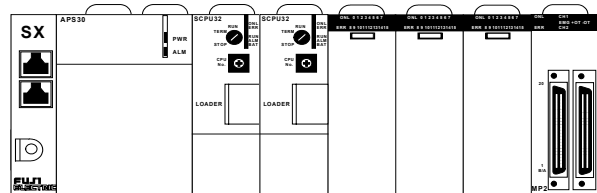
CN1
To connector for
sequence input/output
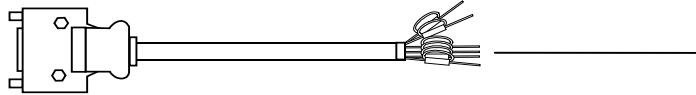
Optional cable
Cable for connection between devices (cable for sequence input/output)
Connector kit is also available.

* 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 PVC insulated cable (IV cable)
Used for circuits other than the control circuit. May not be used for control circuits because the cables may not be twisted. The maximum allowable temperature of the insulated cable is 60°C.

■ 600V class 2 PVC cable or 600V polyethylene insulated cable (HIV cable)
When compared with the IV cable, this type features potentially smaller cable sizes, superiority in flexibility and the maximum allowable temperature of the insulated cable as high as 75°C, and therefore this type is used for both main circuits and control circuits. However, short wiring distances and twisting are preconditions for the control circuit.

■ 600V cross-linked polyethylene insulated cable (FSLC cable)
Used mainly for main circuits and grounding circuits. When compared with IV and HIV cables, this type features potentially smaller cable sizes and superiority in flexibility. Because of these features, this type is used to meet reduced space requirements at high ambient temperatures (such as above 50°C) and improved moving efficiency. The maximum allowable temperature of the insulated cable is 90°C.
Example: Furukawa Electric's Boadlex

■ Twisted shielded cable for wiring inside electronic and electric appliances
Used for control circuits. Use this cable having a large shielding effect, for applications susceptible to or potentially susceptible to effects of radiant or induction noises. Accordingly it must be used even inside the panel for long wiring distances.
Example: Furukawa Electric's Beamex 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
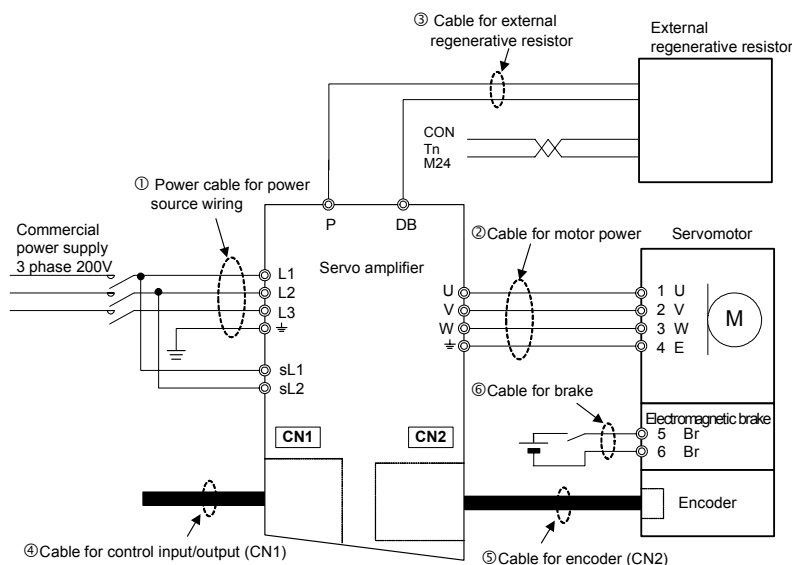
11.1.1 Main circuit terminal (Page 11-4: ①, ②, ③)

Motor	Input voltage	Speed [r/min]	Capacity [kW]	Type	Output current	Amplifier frame	Main circuit terminal size	Recommended cable size [mm²] ①Main circuit (L1, L2, L3) ②Motor power (U, V, W) 60°C(IV)	75°C(HIV)	90°C(FSCL)	③Regenerative resistor (P, DB) 60°C(IV)	75°C(HIV)	90°C(FSCL)	Control power supply (sL1, sL2) Common
GYS	Single-phase 200V	3000	0.05	RYC500D3-VVT2	0.85	1	Connector	0.75	0.75	0.75	0.75	0.75	0.75	0.75
			0.1	RYC101D3-VVT2	0.85									
			0.2	RYC201D3-VVT2	1.5									
			0.4	RYC401D3-VVT2	2.7									
			0.75	RYC751D3-VVT2	4.8									
GYG		2000	0.5	RYC501C3-VVT2	3.5	2	Connector							
			0.75	RYC751C3-VVT2	5.2									
		1500	0.5	RYC501B3-VVT2	4.7									
GYS	3-phase 200V	3000	0.75	RYC751D3-VVT2	4.8	2	Connector	0.75	0.75	0.75	0.75	0.75	0.75	0.75
GYG		2000	0.5	RYC501C3-VVT2	3.5	2	Connector	0.75			0.75			
			0.75	RYC751C3-VVT2	5.2									
			1.0	RYC102C3-VVT2	6.4									
			1.5	RYC152C3-VVT2	10	3	M4	1.25			1.25			
			2.0	RYC202C3-VVT2	12.3			2.0			2.0			
		1500	0.5	RYC501B3-VVT2	4.7	2	Connector	0.75			0.75			
			0.85	RYC851B3-VVT2	7.3									
			1.3	RYC132B3-VVT2	11.5	3	M4	2.0			2.0			
			1.8	RYC182B3-VVT2	17.8	3A	M4	3.5	2.0		3.5	2.0		
			2.9	RYC292B3-VVT2	23.6			5.5	3.5	2.0	5.5	3.5	2.0	

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 VVT2 (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 [mm²]
All models in RYC type	-	0.75

11 PERIPHERAL DEVICE

■How to calculate the input current of the servo amplifier

Calculate the input current of the servo amplifier for the selection of peripheral equipment in the following formulae.

<Formulae>

Input current (single-phase 200V) : Iin = (Po + Pi) / (Vac × 1.35 × ηamp × ηmot) × 1.27 × √3

Input current (3-phase 200V) : Iin = (Po + Pi) / (Vac × 1.35 × ηamp × ηmot) × 1.27

* ηamp (amplifier efficiency) (= 0.95) and ηmot (motor efficiency) (= 0.90) are common among all models.

■Single-phase 200V

Rated speed	Servo amplifier type	Capacity (Po) [W]	Input voltage (Vac) [V]	Internal power consumption (Pi) [W]	Input current (Iin) [A]	Input current for selection of peripheral equipment (Iin×1.5) [A]
3000[r/min]	RYC500D3-VVT2	50	170*	15	0.8	1.2
	RYC101D3-VVT2	100			1.3	2.0
	RYC201D3-VVT2	200			2.5	3.8
	RYC401D3-VVT2	400			4.7	7.1
	RYC751D3-VVT2	750			8.6	12.9
2000[r/min]	RYC501C3-VVT2	500			5.8	8.7
	RYC751C3-VVT2	750			8.6	12.9
1500[r/min]	RYC501B3-VVT2	500			5.8	8.7

■3-phase 200V

Rated speed	Servo amplifier type	Capacity (Po) [W]	Input voltage (Vac) [V]	Internal power consumption (Pi) [W]	Input current (Iin) [A]	Input current for selection of peripheral equipment (Iin×1.5) [A]
3000[r/min]	RYC751D3-VVT2	750	170*	15	5.0	7.5
2000[r/min]	RYC501C3-VVT2	500			3.4	5.1
	RYC751C3-VVT2	750			5.0	7.5
	RYC102C3-VVT2	1000			6.6	9.9
	RYC152C3-VVT2	1500			9.9	14.9
	RYC202C3-VVT2	2000			13.1	19.7
1500[r/min]	RYC501B3-VVT2	500			3.4	5.1
	RYC851B3-VVT2	850			5.6	8.4
	RYC132B3-VVT2	1300			8.6	12.9
	RYC182B3-VVT2	1800			11.8	17.7
	RYC292B3-VVT2	2900			18.9	28.4

* -15% of 200V

■Conditions of servo amplifier for selection of peripheral equipment

1. Selecting peripheral equipment for a single servo amplifier
   Use 1.5 times the input current (Iin) specified above, to compare.

2. Selecting peripheral equipment for multiple servo amplifiers
   Use 1.5 times the sum of input currents (Iin) of the multiple units, to compare.
   Example: In case of two 200W units and three 400W units
   Select peripheral equipment having I = { (2.5 × 2) + (4.7 × 3) } × 1.5 = 28.65 [A] or a larger rated current.

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 speed	Servo amplifier type	Capacity[kW]	MCCB	ELCB (Sensitivity current＝30mA)
3000[r/min]	RYC500D3-VVT2	0.05	EA32AC / 3	EG32AC / 3
	RYC101D3-VVT2	0.1		
	RYC201D3-VVT2	0.2	EA32AC / 5	EG32AC / 5
	RYC401D3-VVT2	0.4	EA32AC / 10	EG32AC / 10
	RYC751D3-VVT2	0.75	EA32AC / 15	EG32AC / 15
2000[r/min]	RYC501C3-VVT2	0.5	EA32AC / 10	EG32AC / 10
	RYC751C3-VVT2	0.75	EA32AC / 15	EG32AC / 15
1500[r/min]	RYC501B3-VVT2	0.5	EA32AC / 10	EG32AC / 10

■3-phase 200V

Rated speed	Servo amplifier type	Capacity[kW]	MCCB	ELCB (Sensitivity current＝30mA)
3000[r/min]	RYC751D3-VVT2	0.75	EA33AC / 10	EG33AC / 10
2000[r/min]	RYC501C3-VVT2	0.5	EA33AC / 10	EG33AC / 10
	RYC751C3-VVT2	0.75		
	RYC102C3-VVT2	1.0	EA33AC / 15	EG33AC / 15
	RYC152C3-VVT2	1.5	EA33AC / 20	EG33AC / 20
	RYC202C3-VVT2	2.0	EA33AC / 30	EG33AC / 30
1500[r/min]	RYC501B3-VVT2	0.5	EA33AC / 10	EG33AC / 10
	RYC851B3-VVT2	0.85		
	RYC132B3-VVT2	1.3	EA33AC / 15	EG33AC / 15
	RYC182B3-VVT2	1.8	EA33AC / 30	EG33AC / 30
	RYC292B3-VVT2	2.9		

<Appearance>
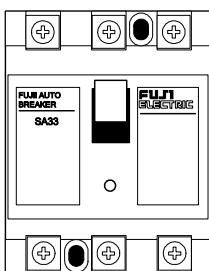
11 PERIPHERAL DEVICE

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 speed	Servo amplifier type	Capacity[kW]	MC
3000[r/min]	RYC500D3-VVT2	0.05	SC-03
	RYC101D3-VVT2	0.1	
	RYC201D3-VVT2	0.2	
	RYC401D3-VVT2	0.4	
	RYC751D3-VVT2	0.75	SC-0
2000[r/min]	RYC501C3-VVT2	0.5	SC-03
	RYC751C3-VVT2	0.75	SC-0
1500[r/min]	RYC501B3-VVT2	0.5	SC-03

■3-phase 200V

Rated speed	Servo amplifier type	Capacity[kW]	MC
3000[r/min]	RYC751D3-VVT2	0.75	SC-03
2000[r/min]	RYC501C3-VVT2	0.5	SC-03
	RYC751C3-VVT2	0.75	
	RYC102C3-VVT2	1.0	
	RYC152C3-VVT2	1.5	SC-4-1
	RYC202C3-VVT2	2.0	
1500[r/min]	RYC501B3-VVT2	0.5	SC-03
	RYC851B3-VVT2	0.85	
	RYC132B3-VVT2	1.3	SC-0
	RYC182B3-VVT2	1.8	SC-4-1
	RYC292B3-VVT2	2.9	SC-N1

<Appearance>
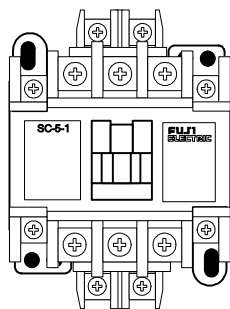
11.4   Surge absorber (surge suppressor, surge killer)

Shown below are recommended surge suppressors (for 250 [V] or less) to be installed on peripheral devices (magnetic contactor, solenoid value, 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)
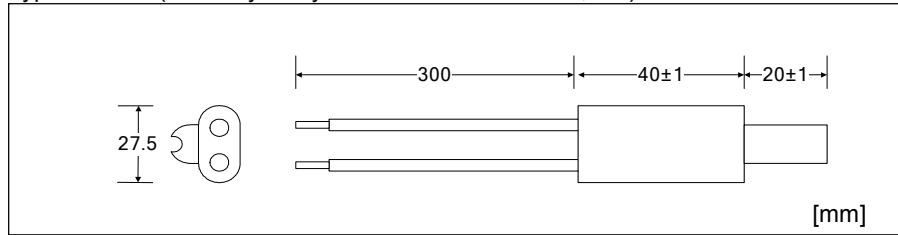
For electromagnetic contactor
Type: S2-A-0 (made by Okaya Electric industries Co., Ltd)
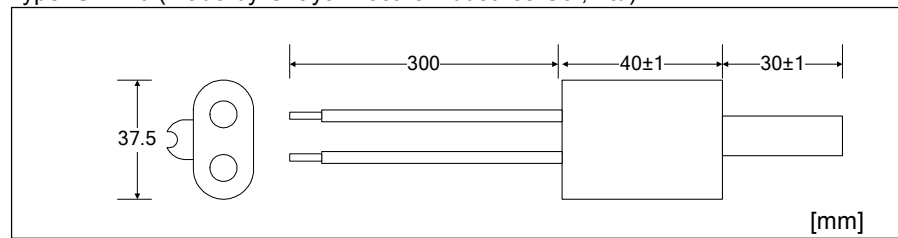
* A non-inductive capacitor and non-inductive resistance are connected in series and sealed in epoxy resin.
S1-B-0:200 Ω (1/2 W) + 0.1 μF
S2-A-0:500 Ω (1/2 W) + 0.2 μF
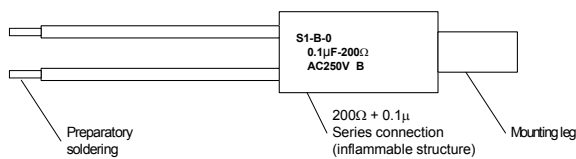
The purpose of the surge killer is suppression of surge voltage.

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.)
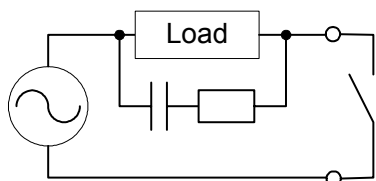
· Protection in DC circuit
   Diode
   (Be careful of orientation of the diode.)
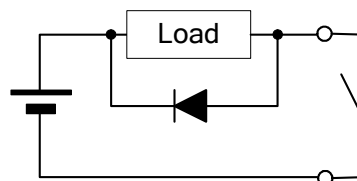
11 PERIPHERAL DEVICE

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.
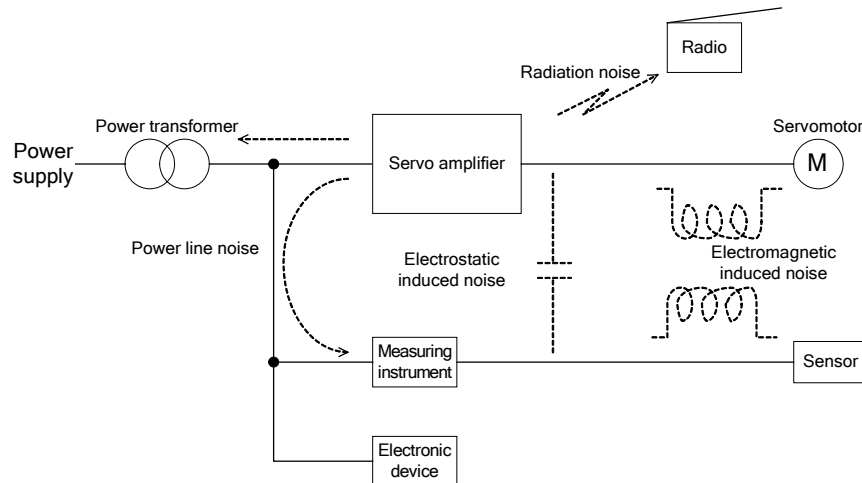
① House the servo amplifier in a steel container (control cabinet) and ground the container. Avoid installation in a place close to the PC or measuring instruments.

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.

Grounding terminal and frame (enclosure)	✕	0V of +24VDC power supply for sequence input/output	✕	0V of encoder power supply
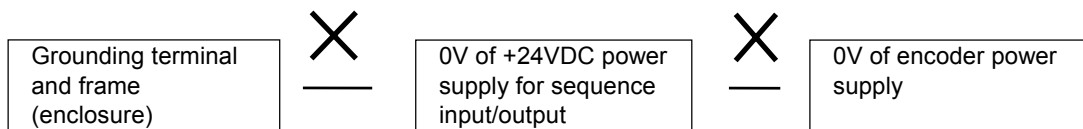
⑥ Avoid binding together the main circuit and control circuit or laying them in parallel.

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.
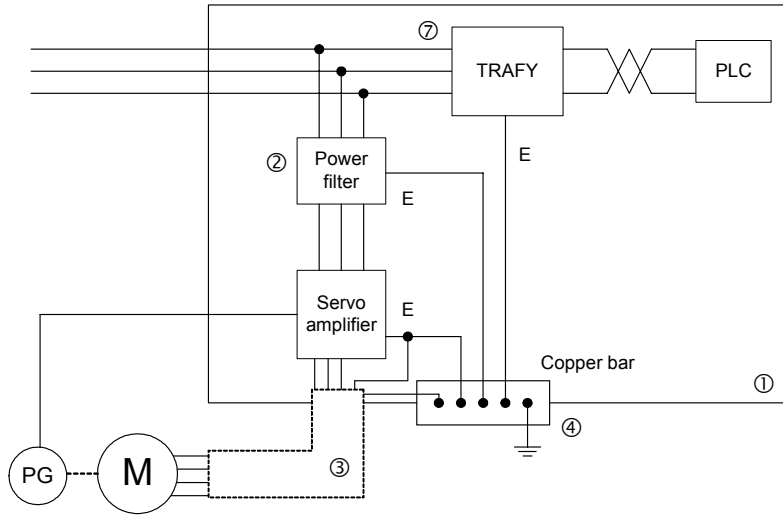
Power filter type

■Single-phase 200V

Rated speed	Servo amplifier type	Capacity[kW]	Power filter type
3000[r/min]	RYC500D3-VVT2	0.05	RNFTC06-20
	RYC101D3-VVT2	0.1	
	RYC201D3-VVT2	0.2	
	RYC401D3-VVT2	0.4	RNFTC10-20
	RYC751D3-VVT2	0.75	RNFTC20-20
2000[r/min]	RYC501C3-VVT2	0.5	RNFTC10-20
	RYC751C3-VVT2	0.75	RNFTC20-20
1500[r/min]	RYC501B3-VVT2	0.5	RNFTC10-20

■3-phase 200V

Rated speed	Servo amplifier type	Capacity[kW]	Power filter type
3000[r/min]	RYC751D3-VVT2	0.75	RNFTC10-20
2000[r/min]	RYC501C3-VVT2	0.5	RNFTC06-20
	RYC751C3-VVT2	0.75	RNFTC10-20
	RYC102C3-VVT2	1.0	
	RYC152C3-VVT2	1.5	RNFTC20-20
	RYC202C3-VVT2	2.0	
1500[r/min]	RYC501B3-VVT2	0.5	RNFTC06-20
	RYC851B3-VVT2	0.85	RNFTC10-20
	RYC132B3-VVT2	1.3	RNFTC20-20
	RYC182B3-VVT2	1.8	
	RYC292B3-VVT2	2.9	RNFTC30-20

<Appearance>
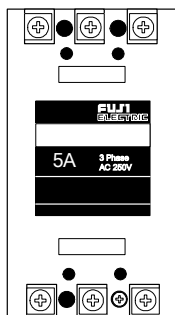
The power filter suppresses high-frequency voltage fluctuation caused by the servo amplifier on the commercial power supply. The filter functions both in the primary and secondary circuits, so that it protects the servo amplifier against high-frequency voltage fluctuation in the primary power supply.

11 PERIPHERAL DEVICE

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
	RYC182B3-VVT2	1.8	ACR2-3.7A	0.406
	RYC292B3-VVT2	2.9	ACR2-5.5A	0.279

■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>
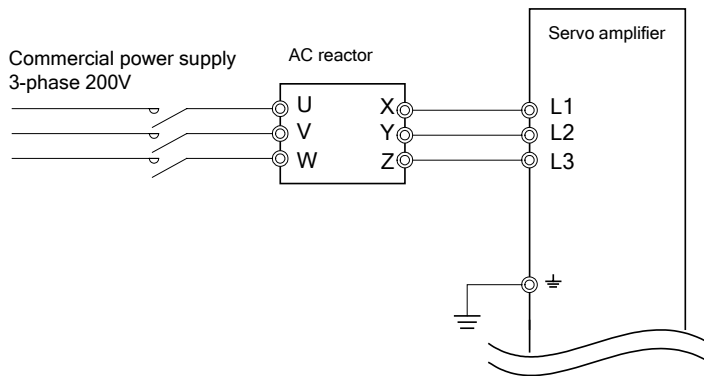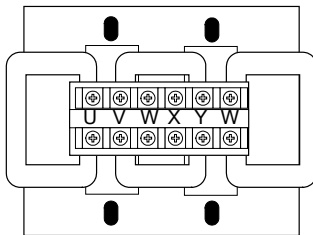
The AC reactor aims at suppression of harmonics and protection of servo amplifier against imbalance in the voltage and power failure in the power supply line.

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	WSR-152
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]	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	DB11-2
	RYC202C3-VVT2	2.0	
1500[r/min]	RYC501B3-VVT2	0.5	WSR-152
	RYC851B3-VVT2	0.85	
	RYC132B3-VVT2	1.3	DB11-2
	RYC182B3-VVT2	1.8	
	RYC292B3-VVT2	2.9	

<Block diagram of main circuit>
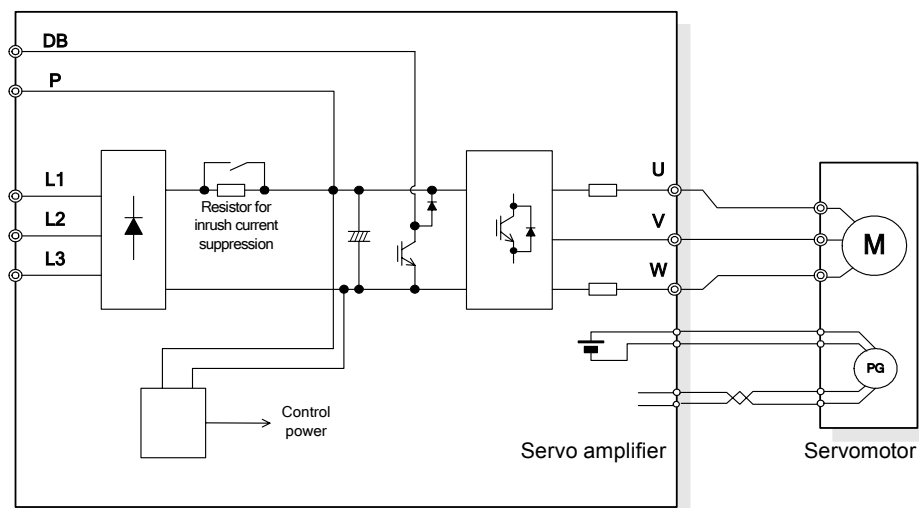
When an external regenerative resistor is used, connection and parameter settings are required.

■ 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].

CONTn *
M24
Thermistor
External regenerative
resistor
DB11-2

P   DB

Servo amplifier
RYC□□□△3-VVT2
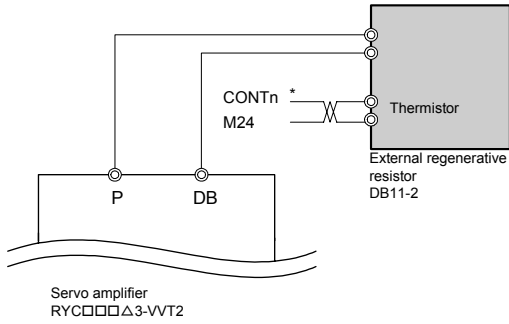
* Assign external regenerative resistor overheat ("8") to the CONT input terminal.

■ Connection of optional external regenerative resistor (DB11-2)

Connect the external regenerative resistor to the terminal block of the servo amplifier.

CONTn *
M24
Thermistor
External regenerative
resistor
DB11-2

P   DB

Servo ampifier
RYC□□□△3-VVT2
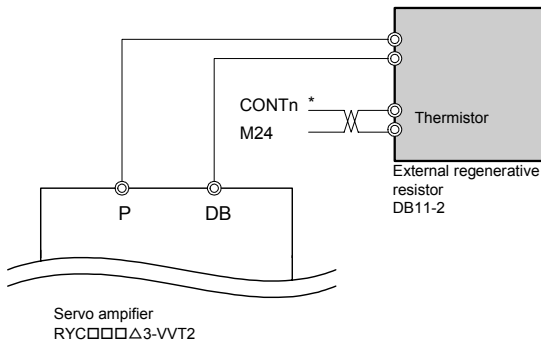
* Assign external regenerative resistor overheat ("8") to the CONT input terminal.

11 PERIPHERAL DEVICE

11.8 Option

Series   : Optional cable for sequence input/output

Type   : WSC-D26P03

Applicable to : All models (for CN1)

Unit : [mm]

Mark tube

L   100$^{+10}_{0}$
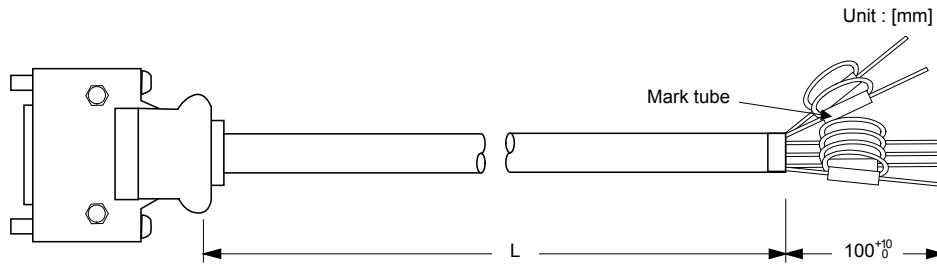
■ Connector

Connector 1

Plug	10126-3000VE
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
Color	Orange		Gray		White		Yellow		Pink		Orange		Gray		White		Yellow		Pink		Orange		Gray		White	
Mark	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 1	Black 1	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 2	Black 2	Red 3	Black 3	Red 3	Black 3	Red 3	Black 3

■ 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)
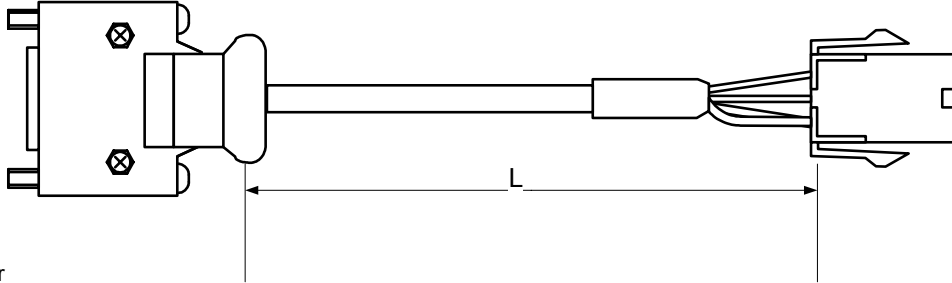
■Connector

Connector 1

Soldered plug	10120-3000VE
Shell kit	10320-52A0-008

Made by Sumitomo 3M

Connector 2

Cap	172161-9
Cap cover	316455-1
Socket (SIG+, SIG-, FG)	170365-1 (Bulk) 170361-1 (Chain)
Socket (P5, M5)	170366-1 (Bulk) 170362-1 (Chain)

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	-	-	Shielded	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)
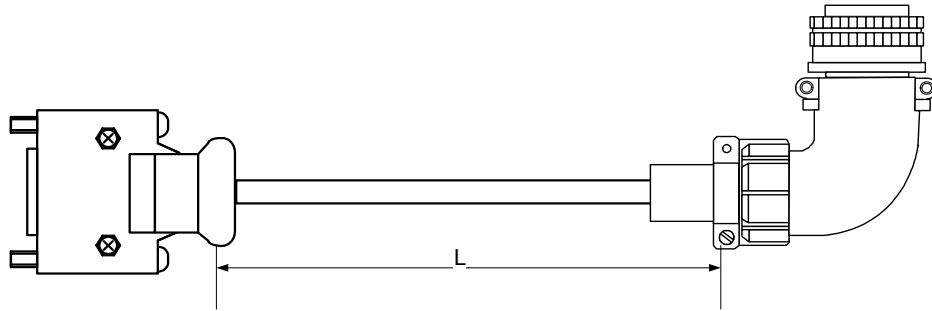
■Connector

Connector 1

Soldered plug	10120-3000VE
Shell kit	10320-52A0-008

Made by Sumitomo 3M

Connector 2

L-shaped plug	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	-	-	Shielded	Red	Blue	-	White		Black		-
	②	-	-	Shielded	Sky blue	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 1

Connector 2

Grounding terminal on servo amplifier side
V1.25-4 (made by J.S.T. Mfg Co., Ltd.) or equivalent
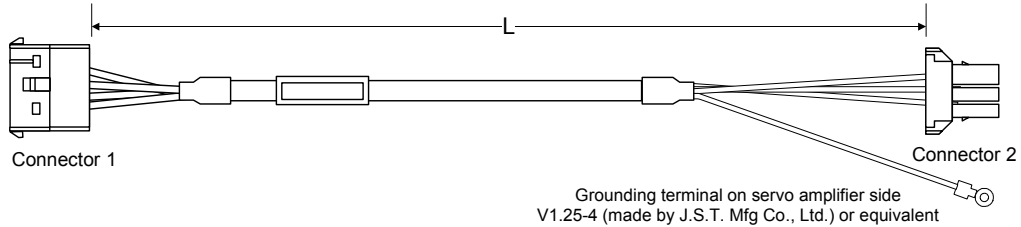
■Connector

Connector 1

Cap	350780-1
Socket	350689-1 (Bulk) 350570-1 (Chain)

By Tyco Electronics AMP K.K.

Connector 2

Receptacle housing	2-178128-3
Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)

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 1

Grounding terminal on servo amplifier side
V1.25-4 (made by J.S.T. Mfg Co., Ltd.) or equivalent
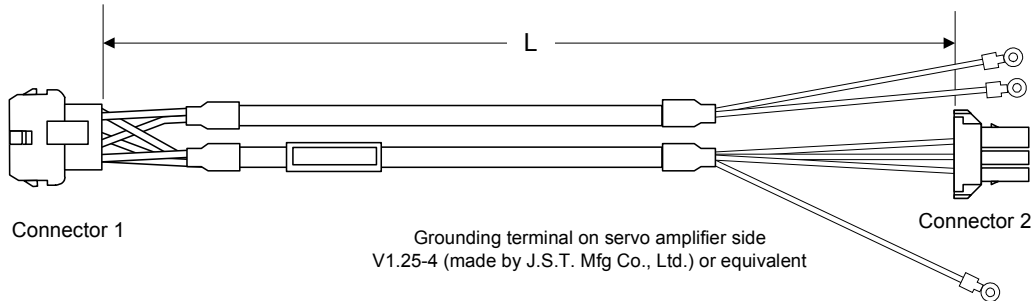
Connector 2

■Connector

Connector 1

Cap	350781-1
Socket	350689-1 (Bulk) 350570-1 (Chain)

By Tyco Electronics AMP K.K.

Connector 2

Receptacle housing	2-178128-3
Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)

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

Grounding terminal on servo amplifier side
V1.25-4 (made by J.S.T. Mfg Co., Ltd.) or equivalent
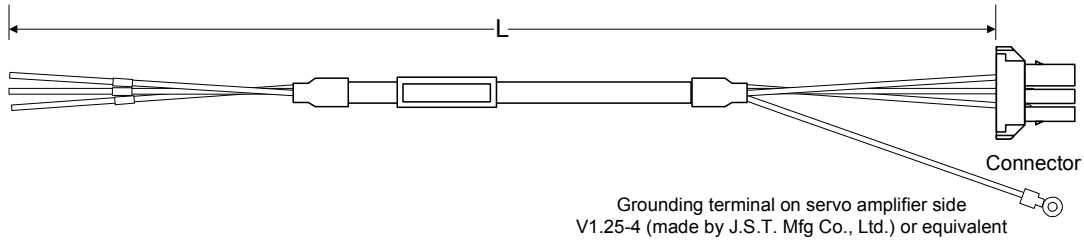
■Connector

Connector 2	
Receptacle housing	2-178128-3
Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)

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
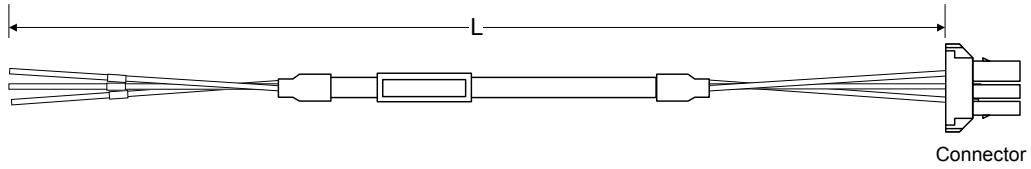
Connector

■Connector

Connector

Receptacle housing	1-178128-3
Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)

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

41 (Max.)   Unit: [mm]

37.2   25.8
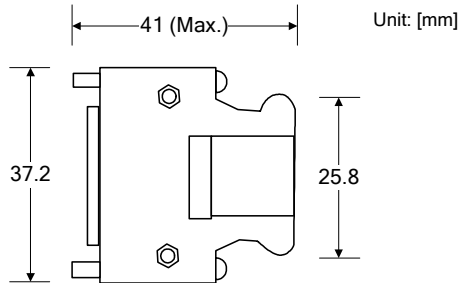
Soldered plug	10126-3000VE
Shell kit	10326-52A0-008

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

41 (Max.)   Unit : [mm]

33.3   22
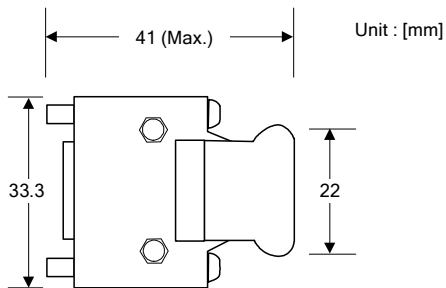
Soldering plug	10120-3000VE
Shell kit	10320-52A0-008

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
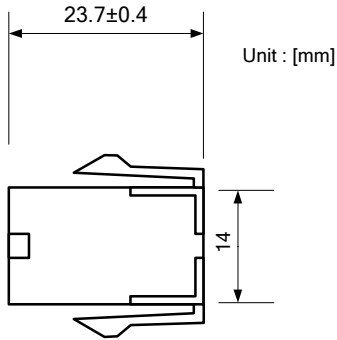
23.7±0.4

Unit : [mm]

14

Cap	172161-9
Cap cover	316455-1
Socket (SIG+, SIG-, FG)	170365-1 (Bulk) 170361-1 (Chain)
Socket (P5, M5)	170366-1 (Bulk) 170362-1 (Chain)

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

Groove position

Unit : [mm]

37.3

81

Rubber bushing

37.3

70.9

4
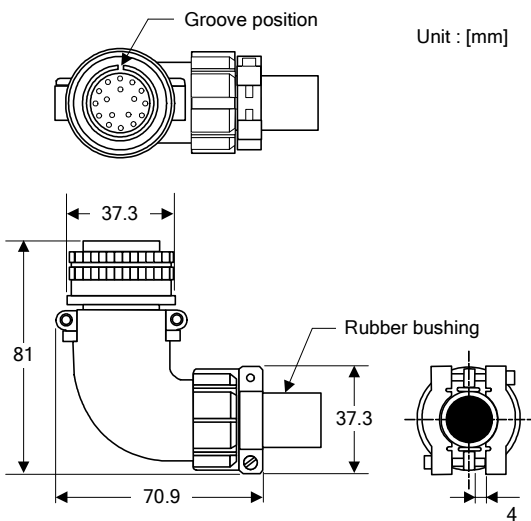
L-shaped plug	MS3108B20-29S
Cable clamp	MS3057-12A

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
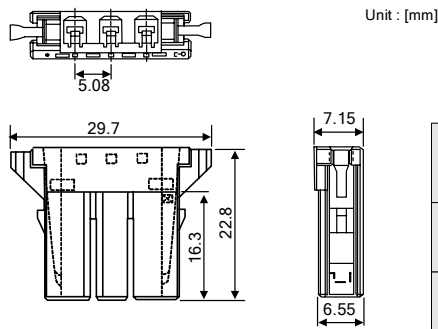
Unit : [mm]

Connector kit for servomotor power cable WSK-M03P-B	Receptacle housing	2-178128-3
	Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)
Connector kit for power cable WSK-S03P-B	Receptacle housing	1-178128-3
	Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)
Connector kit for external regenerative resistor WSK-R03P-B	Receptacle housing	1-178128-3
	Receptacle contact	1-175218-5 (Bulk) 1-175196-5 (Chain)
	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
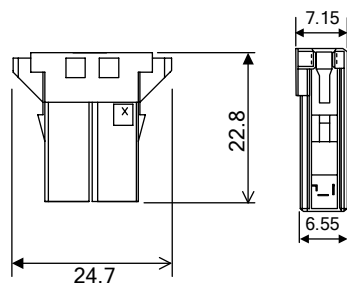
| Connector kit for control power wiring WSK-L02P-D | Receptacle housing | 1-178128-2 |
| | Receptacle contact | 1-175218-5 (Bulk) 1-175196-5 (Chain) |

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)

Unit : [mm]

27.4

27.7
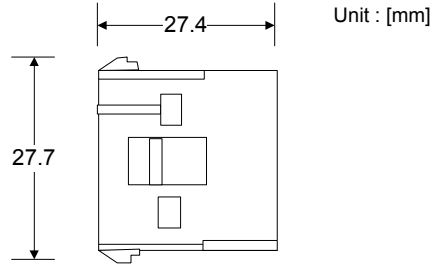
Cap	350780-1
Shell body clamp side	350570-1 or 350689-1

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)
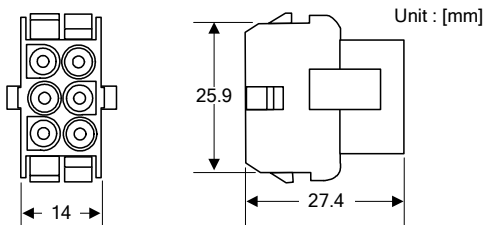
Unit : [mm]

25.9

14

27.4

Cap	350781-1
Socket	350689-1 (Bulk) 350570-1 (Chain)

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 ····· 2000 r/min Series: Full capacity (without brake)

1500 r/min Series: 0.5 kW/0.85 kW/1.3 kW (without brake)
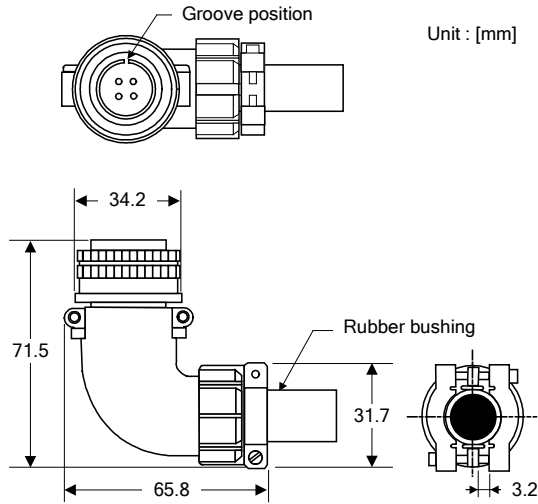
Groove position

Unit : [mm]

34.2

71.5

Rubber bushing

31.7

65.8

3.2

* 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.

L-shaped plug	MS3108B18-10S
Cable clamp	MS3057-10A

By DDK Ltd.

Series : Connector kit for servomotor power cable

Type : WSK-M06P-CA

Applicable to : GYG type ····· 2000 r/min Series: Full capacity (without brake)

1500 r/min Series: 0.5 kW/0.85 kW/1.3 kW (with brake)
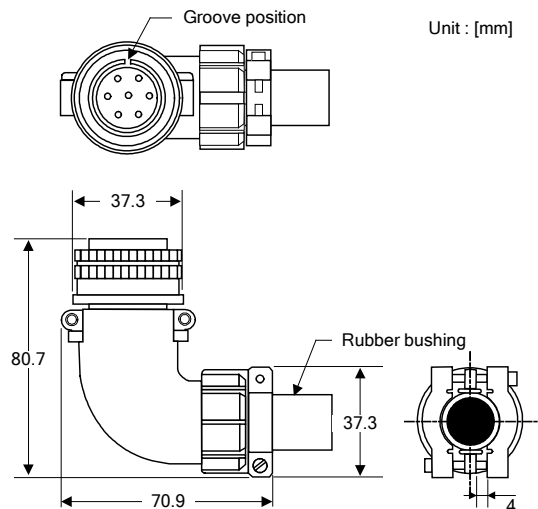
Groove position

Unit : [mm]

37.3

80.7

Rubber bushing

37.3

70.9

4

* 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.

L-shaped plug	MS3108B20-15S
Cable clamp	MS3057-12A

By DDK Ltd.

11 PERIPHERAL DEVICE

Series   : Connector kit for servomotor power cable

Type   : WSK-M09P-CC

Applicable to   : GYG type · · · · · 1500 r/min Series, 1.8 kW/2.9 kW (with/without brake)

Groove position

Unit : [mm]

43.7

88.6

Rubber bushing

42.9

72.6

4.8
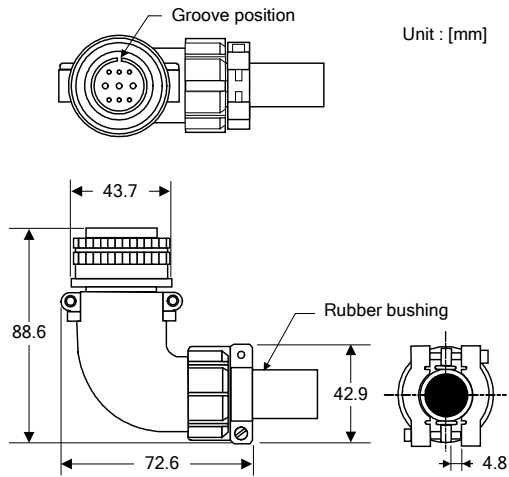
L-shaped plug	MS3108B24-11S
Cable clamp	MS3057-16A

Made by DDK Ltd.

* The connector type is not compatible with IP65.
  For compatible types, see page 2-6.
* The connector manufacturer is subject to change
  without previous notice.

Series : External regenerative resistor

Type : WSR-401

Applicable to : RYC type · · · · · 0.4 kW or less

Unit : [mm]

182.5±1.5

172±1

1000^{+100}_{0}

20±0.3

* Thickness of mounting plate is 1.2 mm.
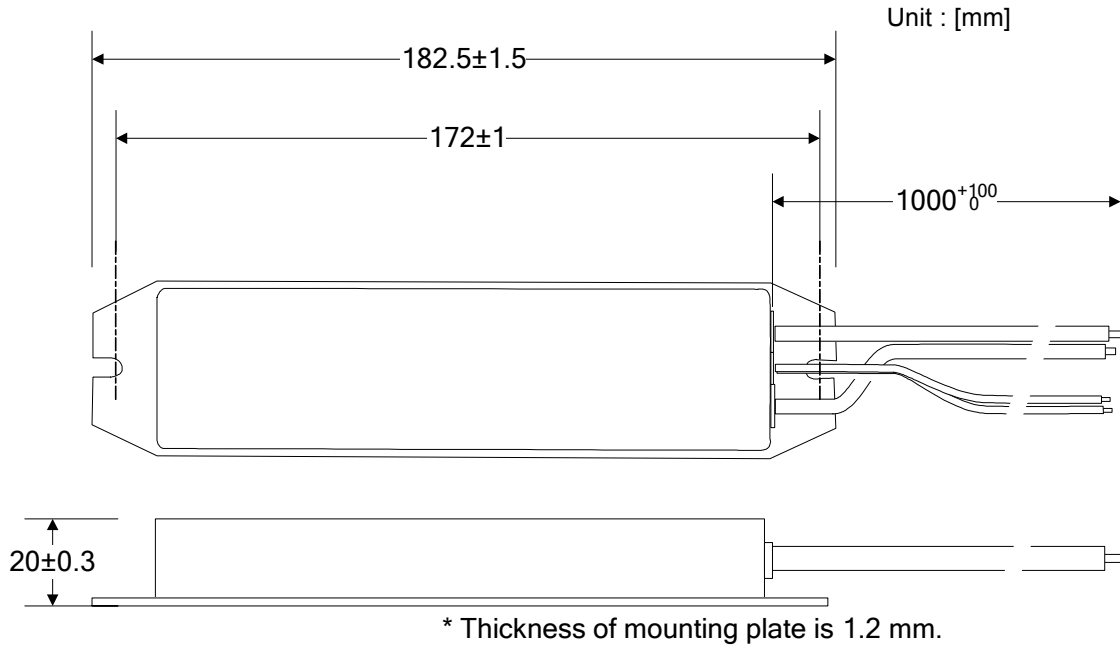
Item		Specification
Type		WSR-401
Resistor	Resistance	68 [Ω]
	Allowable power	17 [W] (Continuous)
Thermistor	Operating temperature	Open at 135 ± 5 °C
	Withstand voltage	1.5 kVAC for 1 minute
	Contact capacity	30 VDC, 0.1 A

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."

11 PERIPHERAL DEVICE

Series : External regenerative resistor

Type : WSR-152

Applicable to : RYC type · · · · · 0.5 to 1.0kW

Unit : [mm]
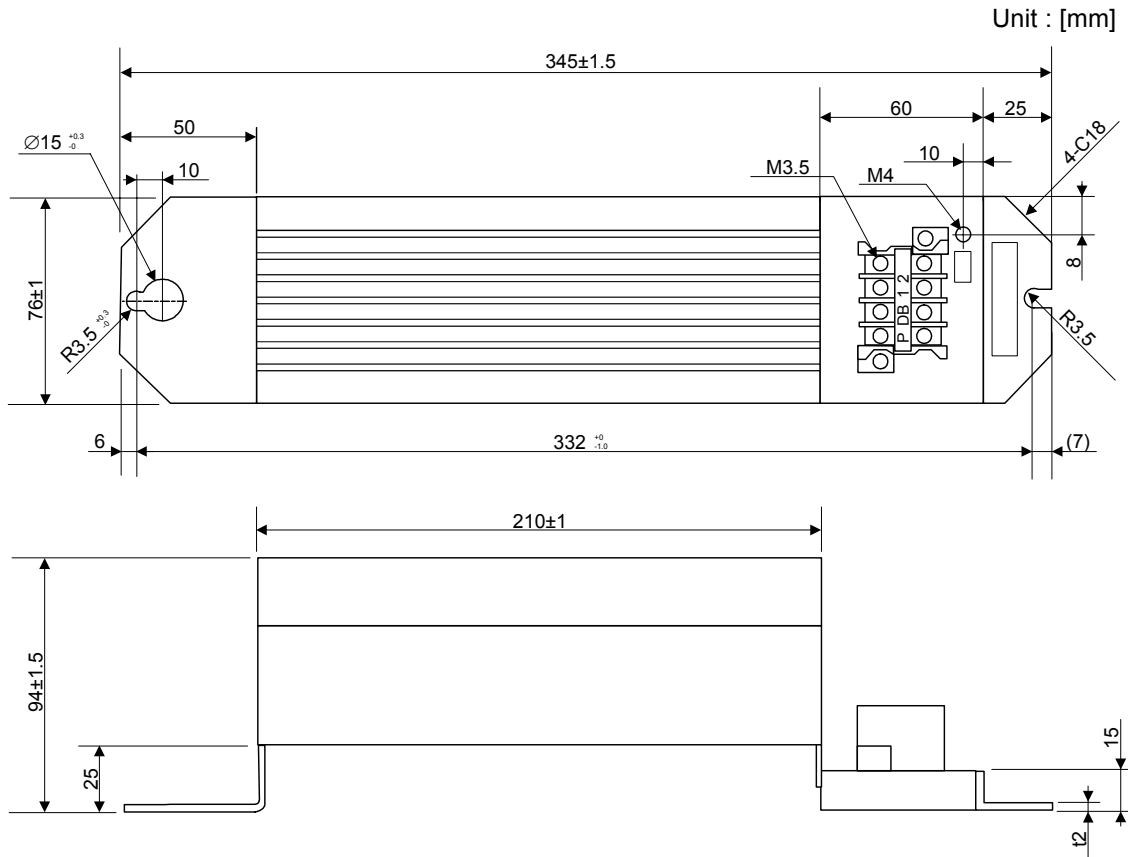
Item		Specification
Type		WSR-152
Resistor	Resistance	15 [Ω]
	Allowable power	50 [W] (Continuous)
Thermistor	Operating temperature	Open at 150 ± 10 °C
	Withstand voltage	2.5 kVAC for 1 minute
	Contact capacity	30 VDC, 0.1 A

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."

Series   : External regenerative resistor

Type   : DB11-2

Applicable to : RYC type · · · · · 1.3 kW or more
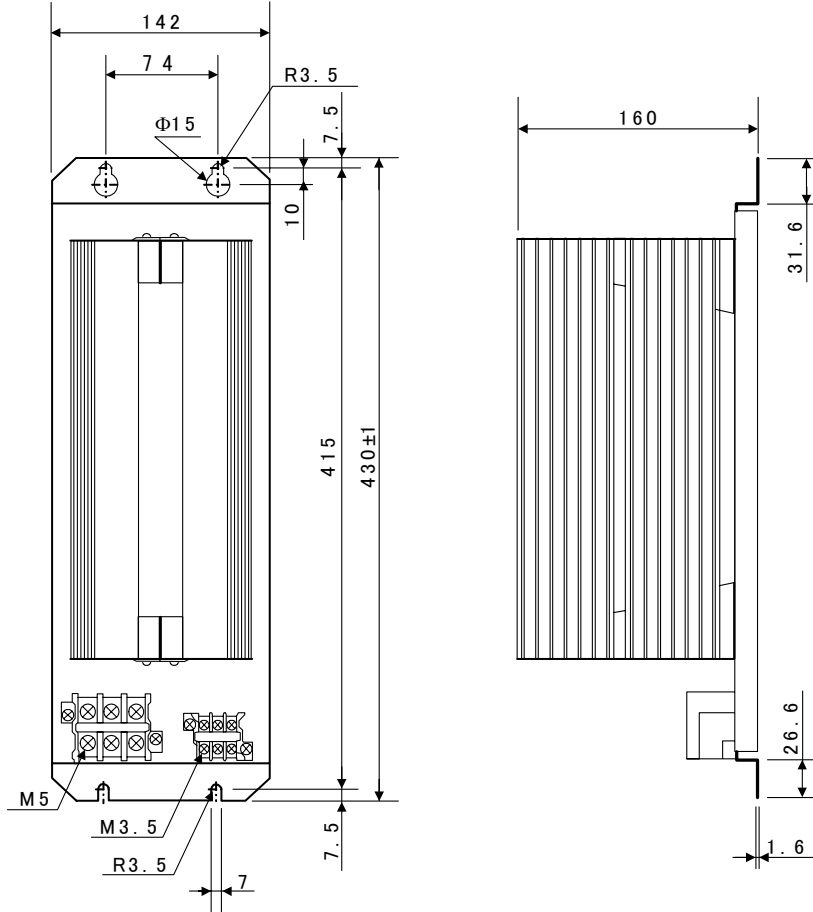
Unit : [mm]

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."

11 PERIPHERAL DEVICE

-MEMO-

12

SPECIFICATIONS

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 through part of shaft and connector)				
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 (Incremental)				
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 ± 10%				
Attraction time	[ms]	35		40		60
Release time	[ms]	10		20		25
Power consumption	[W]	6.1 (at 20 °C)		7.3 (at 20 °C)		8.5 (at 20 °C)
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·m²]	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 (Incremental)				
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/s²]	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				2.45
Moment of inertia	[kg·m²]	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□	GYG182BC2-T2□	GYG292BC2-T2□
Rated output	[kW]	0.5	0.85	1.3	1.8	2.9
Rated torque [1]	[N·m]	3.18	5.41	8.28	11.5	18.6
Rated speed	[N·m]	9.50	16.2	24.8	27.6	44.6
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}	29.5×10^{-4}	43.3×10^{-4}
Rated current	[A]	4.7	7.3	11.5	17.8	23.6
Max. current	[A]	14.1	21.9	34.5	42.7	56.6
Insulation class		Class F				
Rating		Continuous rating				
Protective ventilation		Totally enclosed, self-cooling (IP67) (except for shaft sealing)			Totally-enclosed self-cooled (IP65; except for through part of shaft)	
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			Straight shaft with key, tapped, with oil seal	
Paint color		N1.5				
Detector		17-bit serial encoder (Incremental)				
Vibration		V10 or below			V15 or less	
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)			0 to +40 °C, 90% RH or less (No condensation allowed)	
Acceleration vibration, acceptable [m/s^2]		24.5			19. 6	
Mass	[kg]	6.4	7.5	9.8	16.5	20.5

● Motor with brake [2]

Motor type		GYG501BC2-T2□-B	GYG851BC2-T2□-B	GYG132BC2-T2□-B	GYG182BC2-T2□-B	GYG292BC2-T2□-B
Rated output	[kW]	0.5	0.85	1.3	1.8	2.9
Rated torque [1]	[N·m]	3.18	5.41	8.28	11.5	18.6
Static friction torque	[N·m]	17			32	
Moment of inertia	[kg·m^2]	13.6×10^{-4}	17.3×10^{-4}	24.5×10^{-4}	42.3×10^{-4}	56.0×10^{-4}
Rated voltage	[V]	DC24±10%				
Attraction time	[ms]	120			170	
Release time	[ms]	30			50	
Power consumption	[W]	14 (at 20 ℃)			34.7 (at 20℃)	
Mass	[kg]	8.6	9.7	12.0	23.5	27.5

*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 -15 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℃ ±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		Incremental only. 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℃, 10 to 90%RH (no condensation)				
	Resistance to vibration and impact		4.9m/s² {0.5G} · 19.6m/s² {2G}				
Applicable standards			In accordance with UL/cUL (UL508c), in accordance with CE marking (low voltage directive EN50178)				
Weight [kg]			1.0				1.5

12 SPECIFICATIONS

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 -15 to +10%				
		Frequency	50 to 60Hz				
Control type			IGBT PWM sine wave operation				
Carrier frequency			10kHz			5kHz	
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℃ ±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		Incremental only. 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℃, 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	RYC152C3-VVT2	RYC202C3-VVT2
Applicable motor output [kW]			0.5	0.85	1.3	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 -15 to +10%				
		Frequency	50/60Hz				
Control type			IGBT PWM sine wave operation				
Carrier frequency			10kHz			5kHz	
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		Incremental only. 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/s² {0.5G} · 19.6m/s² {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 SPECIFICATIONS

12.2.4 Servo amplifier interface specification

Terminal name	Terminal symbol	Specification

Pulse string input	CA, *CA
	CB, *CB
		· 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.
		  (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: ±10V (input impedance 20 k?)
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, For sink and source output types
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
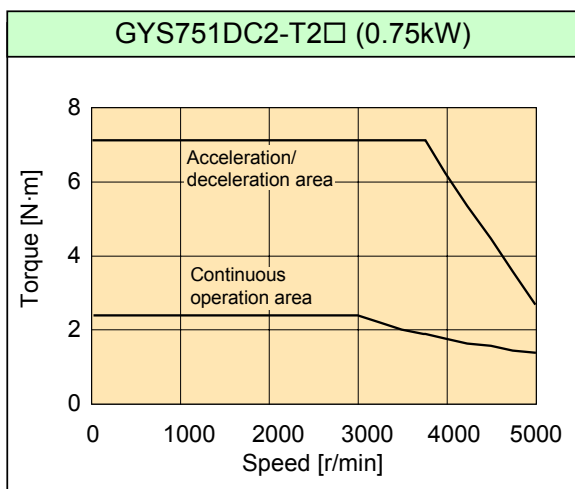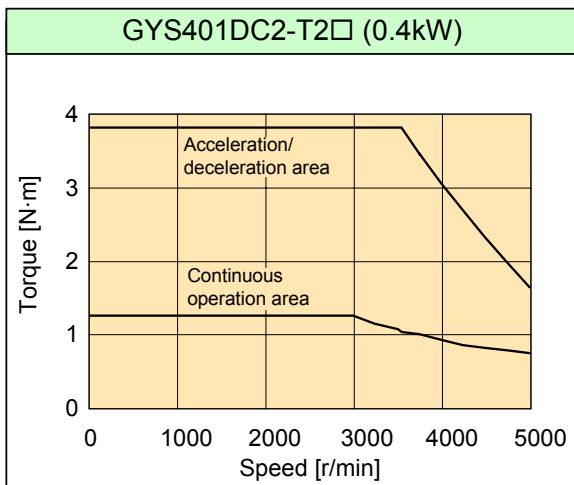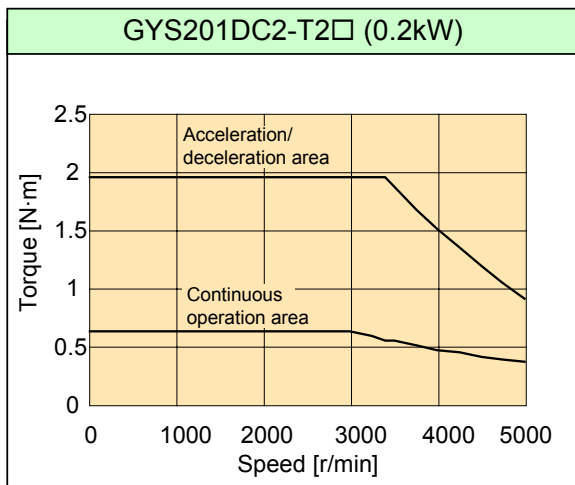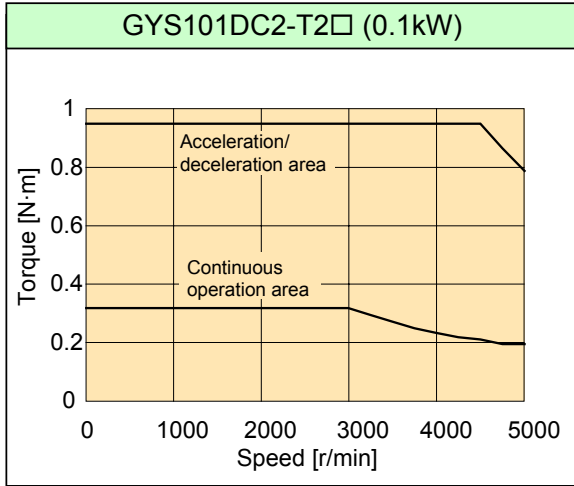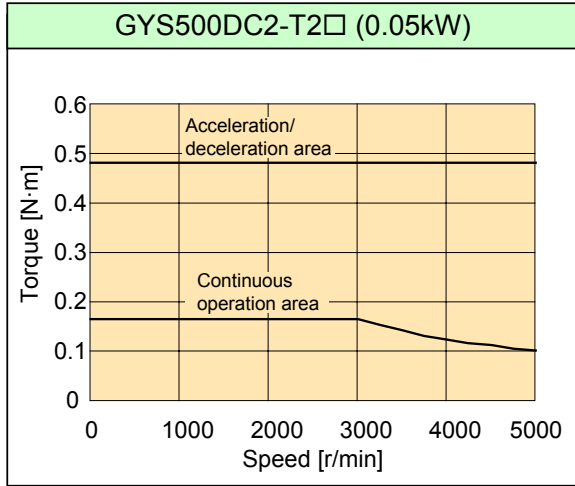
GYS500DC2-T2□ (0.05kW)

GYS101DC2-T2□ (0.1kW)

GYS201DC2-T2□ (0.2kW)

GYS401DC2-T2□ (0.4kW)

GYS751DC2-T2□ (0.75kW)

* The characteristics are indicated at 200V or more for 3 phase and at 230V or more for single phase.

12 SPECIFICATIONS

12.3.2 Middle inertia series (GYG motor) 2000r/min

GYG501CC2-T2☐ (0.5kW)

Torque [N·m] vs Speed [r/min]

- Acceleration/deceleration area
- Continuous operation area

GYG751CC2-T2☐ (0.75kW)

Torque [N·m] vs Speed [r/min]

- Acceleration/deceleration area
- Continuous operation area

GYG102CC2-T2☐ (1.0kW)

Torque [N·m] vs Speed [r/min]

- Acceleration/deceleration area
- Continuous operation area

GYG152CC2-T2☐ (1.5kW)

Torque [N·m] vs Speed [r/min]

- Acceleration/deceleration area
- Continuous operation area

GYG202CC2-T2☐ (2.0kW)

Torque [N·m] vs Speed [r/min]

- Acceleration/deceleration area
- Continuous operation area

* 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

GYG501BC2-T2□（0.5kW）

Torque [N·m] vs Speed [r/min]
- Acceleration/deceleration
- Continuous operation area

GYG851BC2-T2□（0.85kW）

Torque [N·m] vs Speed [r/min]
- Acceleration/deceleration
- Continuous operation area

GYG132BC2-T2□（1.3kW）

Torque [N·m] vs Speed [r/min]
- Acceleration/deceleration area
- Continuous operation area

GYG182BC2-T2□（1.8kW）

Torque [N·m] vs Speed [r/min]
- Acceleration/deceleration area
- Continuous operation area

GYG292BC2-T2□（2.9kW）

Torque [N·m] vs Speed [r/min]
- Acceleration/deceleration area
- Continuous operation area

* The characteristics are indicated at 200V or more for 3 phase and at 230V or more for single phase.

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
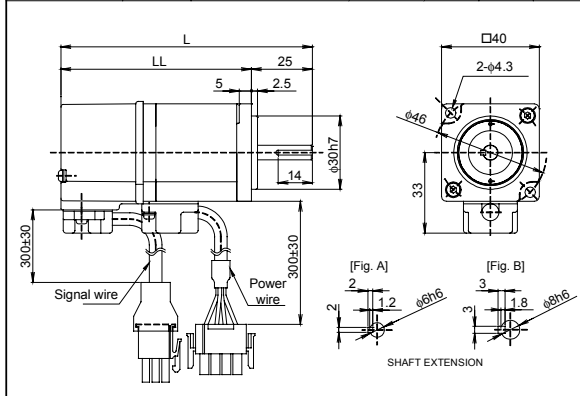
Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Weight [kg]
3000[r/min]	0.2kW	GYS201DC2-T2A	126.5	96.5	1.2
	0.4kW	GYS401DC2-T2A	154.5	124.5	1.8
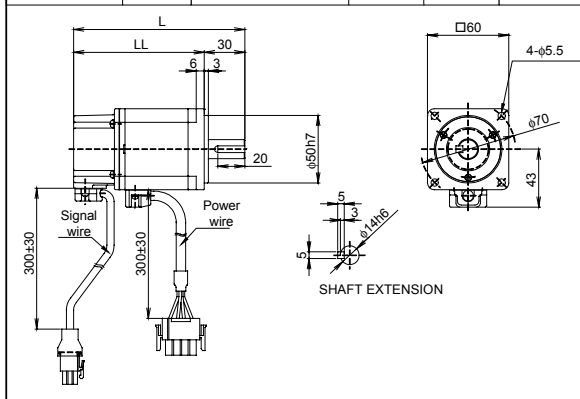
Rated rotation speed	Rated output	Type
3000[r/min]	0.75kW	GYS751DC2-T2A

Weight : 3.4[kg]

■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-B	164.5	134.5	1.7
	0.4kW	GYS401DC2-T2A-B	192.5	162.5	2.3
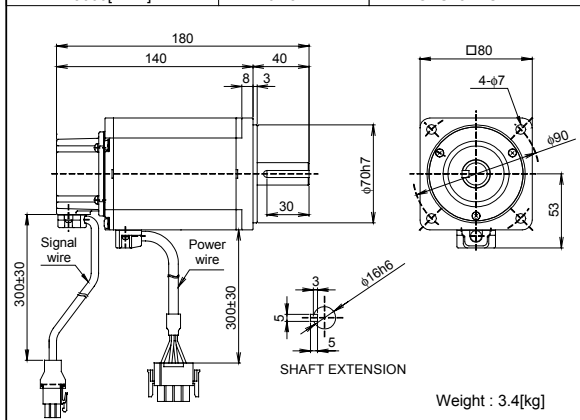
Rated rotation speed	Rated output	Type
3000[r/min]	0.75kW	GYS751DC2-T2A-B

Weight : 4.2[kg]
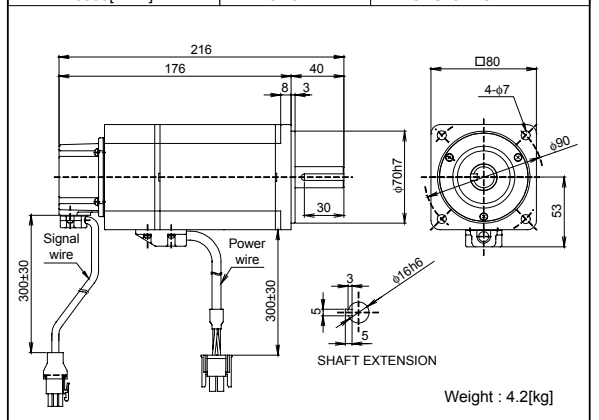
12.4.2 Middle inertia series (GYG motor) 2000r/min

■Standard motor

Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
2000[r/min]	0.5kW	GYG501CC2-T2E	175	120	47.5	5.3
	0.75kW	GYG751CC2-T2E	187.5	132.5	60	6.4
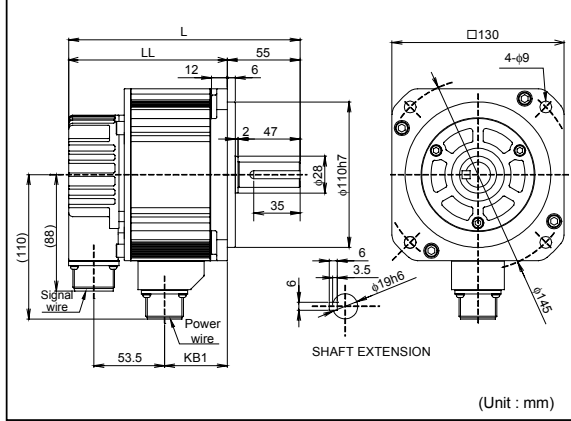
(Unit : mm)

■Motor with brake

Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
2000[r/min]	0.5kW	GYG501CC2-T2E-B	217.5	162.5	52	7.5
	0.75kW	GYG751CC2-T2E-B	230	175	64.5	8.6
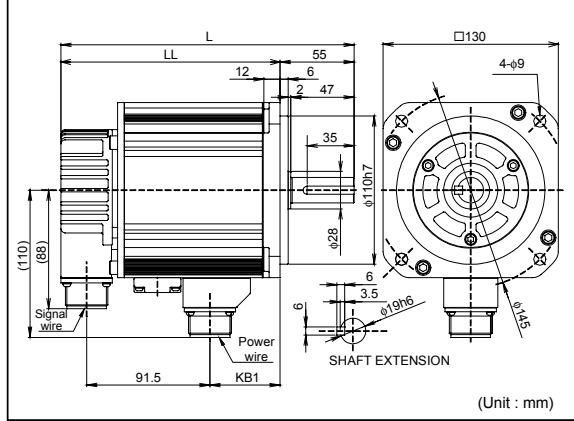
(Unit : mm)

Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
2000[r/min]	1kW	GYG102CC2-T2E	200	145	72.5	7.5
	1.5kW	GYG152CC2-T2E	225	170	97.5	9.8
	2kW	GYG202CC2-T2E	250	195	122.5	12
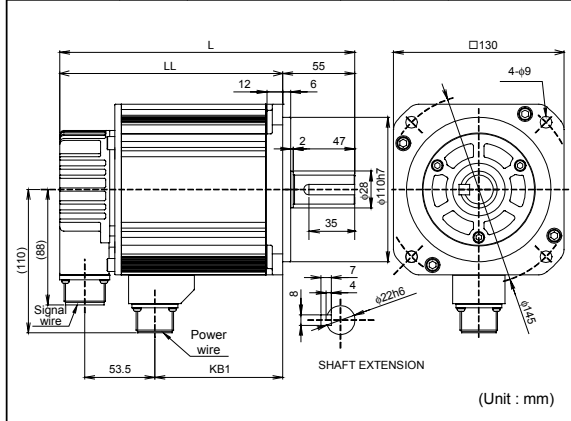
(Unit : mm)

Rated rotation speed	Rated output	Type	Overall length (L)	Dimension (LL)	Terminal (KB1)	Weight [kg]
2000[r/min]	1kW	GYG102CC2-T2E-B	242.5	187.5	77	9.7
	1.5kW	GYG152CC2-T2E-B	267.5	212.5	102	12
	2kW	GYG202CC2-T2E-B	292.5	237.5	127	14.2

(Unit : mm)
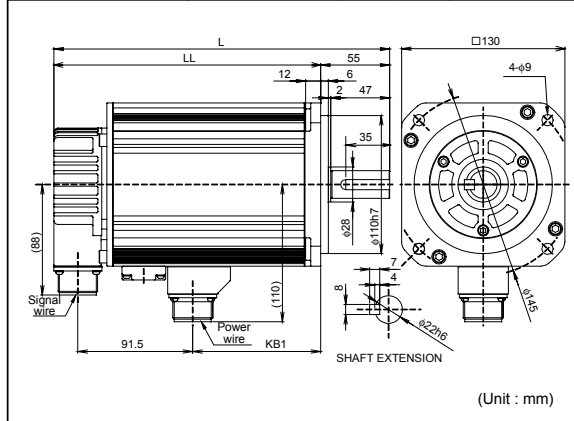
12.4.3 Middle inertia series (GYG motor) 1500r/min

■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
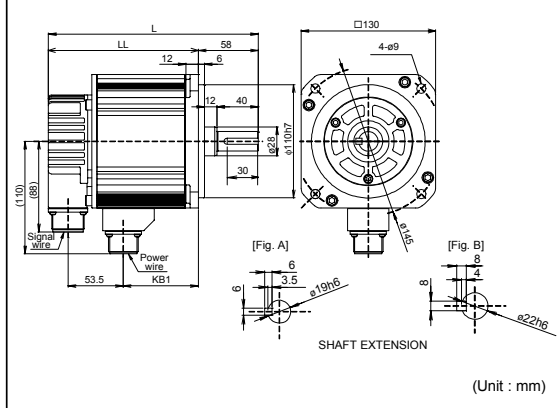
SHAFT EXTENSION

(Unit : mm)

■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
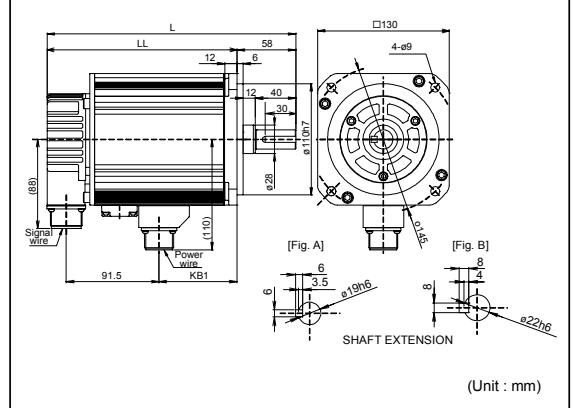
SHAFT EXTENSION

(Unit : mm)

Rated speed	Rated output	Type	Overall length (L)	Dimensions (LL)	Terminal section (KB1)	Mass [kg]
1500 [r/min]	1.8kW	GYG182BC2-T2G	270	191	85	16.5
	2.9kW	GYG292BC2-T2G	294	215	109	20.5
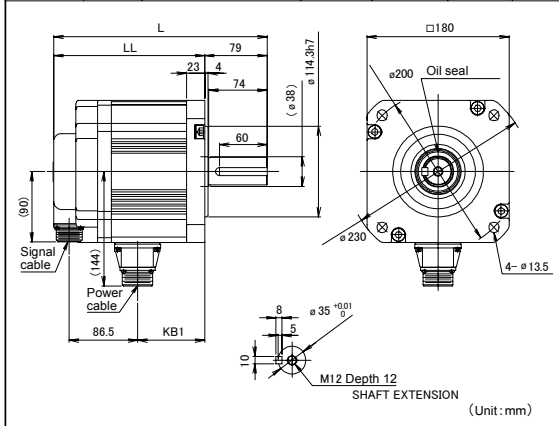
SHAFT EXTENSION

(Unit : mm)

Rated speed	Rated output	Type	Overall length (L)	Dimensions (LL)	Terminal section (KB1)	Mass [kg]
1500 [r/min]	1.8kW	GYG182BC2-T2G-B	319	240	107	23.5
	2.9kW	GYG292BC2-T2G-B	343	264	131	27.5

SHAFT EXTENSION
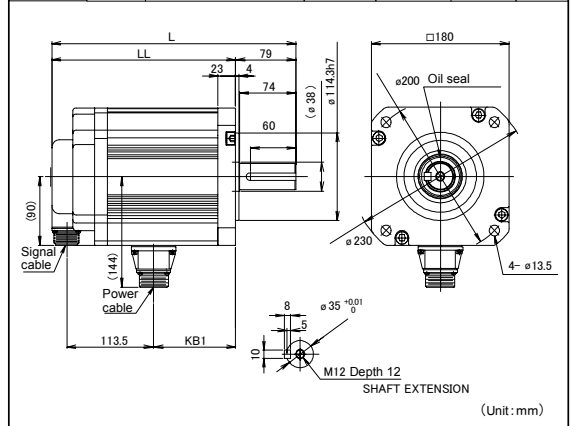
(Unit : mm)

12.4.4 Servo amplifier

■Frame 1

Rated rotation speed	Applicable motor output	Type
3000[r/min]	0.05kW	RYC500D3-VVT2
	0.1kW	RYC101D3-VVT2
	0.2kW	RYC201D3-VVT2
	0.4kW	RYC401D3-VVT2

(Unit : mm)

Weight : 1.0 [kg]

■Frame 2

Rated rotation speed	Applicable motor output	Type
3000[r/min]	0.75kW	RYC751D3-VVT2
2000[r/min]	0.5kW	RYC501C3-VVT2
	0.75kW	RYC751C3-VVT2
	1kW	RYC102C3-VVT2
1500[r/min]	0.5kW	RYC501B3-VVT2
	0.85kW	RYC851B3-VVT2

(Unit : mm)

Weight : 1.5 [kg]

■Frame 3

Rated rotation speed	Applicable motor output	Type
2000[r/min]	1.5kW	RYC152C3-VVT2
	2kW	RYC202C3-VVT2
1500[r/min]	1.3kW	RYC132B3-VVT2

(Unit : mm)

Weight : 2.5 [kg]

■Frame 3A

Rated rotation speed	Applied motor output	Type
1500[r/min]	1.8kW	RYC182B3-VVT2
	2.9kW	RYC292B3-VVT2

(Unit: mm)

Weight : 2.6 [kg]

12 SPECIFICATIONS

-MEMO-

13

RS485 COMMUNICATIONS

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 response time to operation commands and parameter writing (max. 4 pieces) is about 100 ms or less.

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	1: n communication (1 ≦ n ≦ 31) The servo amplifier functions as slave and only gives response for master commands. Communication between slaves is not performed. Master (Multipurpose PC) (Multipurpose communication) Slave 1 Slave 2 Slave 3 Slave 31
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: 100 ms or less Data (parameter) transmission: 100 ms or less

* When 8 bits are specified as data bit, a stop bit cannot be allocated on some software.

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
			0 1 (Station No.)	0 1 (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	Memory type
		Address (L)	Address (L)	Address (L)
		Address (M)	Address (M)	Address (M)
		Address (H)	Address (H)	Address (H)
		No. of read/write bytes	No. of read/write bytes	No. of read/write bytes
		0 0	0 0	0 0
		With command	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

| | | | 0 | | | | |

Alarm detection

Positioning end

ONLINE/OFFLINE

Power ON initialization completed

(Not used)

Transmission error

Data error

Command not received
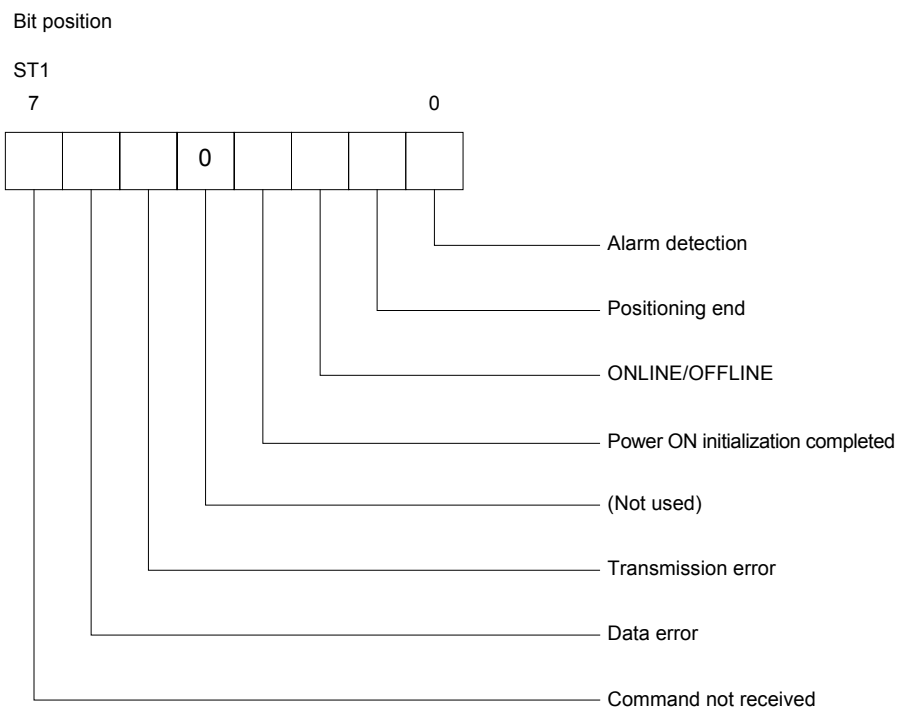
13.1.8　List of commands

■List of commands

No.	Function	CMND	DATA area			
			Memory type	Address (L)	Address (M)	Address (H)
Monitor						
01	Data read with multiple monitors	50H	01H	Monitor designated bit		00H
Sequence monitor						
02	Sequence mode read	50H	02H	00H	00H	01H
03	Sequence input/output signal read					02H
04	Alarm history read					03H
05	System status read					04H
06	Current alarm read					07H
Parameter edit						
07	Parameter read	50H	03H	Quantity (1 to 4)	Number (1 to 99)	00H
08	Parameter write	51H				01H
Operation command						
09	Alarm reset	51H	08H	00H	01H	17H
10	Alarm history initialization					23H

13 RS485 COMMUNICATIONS

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]	: 200 [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 recommended that the upper level system should send the same request command.

- Set the retransmission timing as follows after transmission error:

  38400 [bps]   : 200 [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 of 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.

■ Multiple monitor data read

CMND **50H**

DATA (n)

Transmission from upper level control system

	7	0
Memory type	**01H**	
Address (L)		
Address (M)	Data type	
Address (H)	**00H**	
No. of read bytes	(Specified number x 4) + 3	
Dummy	**00H**	

Address (L) (bits 7—0)

- ⑧ Input cumulative pulse
- ⑦ Deviation pulse
- ⑥ Peak torque
- ⑤ Average torque
- ④ Current command position
- ③ Current feedback position
- ② Command speed
- ① Feedback speed

Address (M) (bits 7—0)

- (Not used)
- ⑮ DB thermal value
- ⑭ OL thermal value
- ⑬ Feedback cumulative pulse
- ⑫ Inertia ratio
- ⑪ DC link voltage (minimum)
- ⑩ DC link voltage (maximum)
- ⑨ NREF input voltage

Transmission from servo amplifier

	7	0
Memory type	**01H**	
Address (L)		
Address (M)	Data type	
Address (H)	**00H**	
No. of read bytes	(Specified number x 4) + 3	
Dummy	**00H**	
STR1	Status information	
STR2		
Dummy	**00H**	
Designated data 1	LSB ... MSB	
Designated data 2	LSB ... MSB	
Designated data N	LSB ... MSB	

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 ±	Maximum rotation speed x 110%	1
Command speed			2
Current feedback position	1 [pulse]/1H, with ±	-2147483648 or 2147483647	3
Current command position			4
Average torque	300 [%]/1 FFFH (rated torque 100%), with ±	300 [%]	5
Peak torque			6
Deviation pulse	1 [pulse]/1H, with ±	-2147483648 or 2147483647	7
Input cumulative pulse			8
NREF input voltage	11.2 [V]/2000H, with ±	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 ±	-2147483648 or 2147483647	13
OL thermal value	100 [%]/1000H, with ±	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		
STR2	Status information	
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

CMND	50H

DATA (n)

Transmission from upper level control system

	7	0
Memory type	**02H**	
Address (L)	**00H**	
Address (M)	**00H**	
Address (H)	**02H**	
No. of read bytes	**09H**	
Dummy	**00H**	

Transmission from servo amplifier

	7	0
Memory type	**02H**	
Address (L)	**00H**	
Address (M)	**00H**	
Address (H)	**02H**	
No. of read bytes	**09H**	
Dummy	**00H**	
STR1	Status information	
STR2		
Input signal		
Dummy	**00H**	
Dummy	**00H**	
Dummy	**00H**	
Output signal		
Dummy	**00H**	
Dummy	**00H**	

Input signal   7   0

- CONT1
- CONT2
- CONT3
- CONT4
- CONT5
- (Not used)
- (Not used)
- (Not used)

Output signal   7   0

- OUT1
- OUT2
- OUT3
- OUT4
- (Not used)
- (Not used)
- (Not used)
- (Not used)
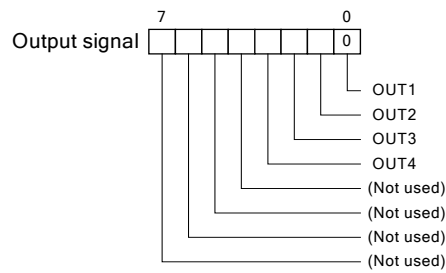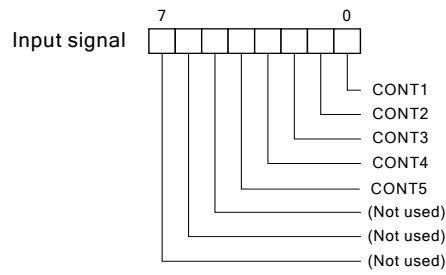
13RS485 COMMUNICATIONS

■ 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

■ System status read

CMND	**50H**

DATA (n)

Transmission from upper level control system

	7	0
Memory type	**02H**	
Address (L)	**00H**	
Address (M)	**00H**	
Address (H)	**04H**	
No. of read bytes	**11H**	
Dummy	**00H**	

Transmission from servo amplifier

	7	0
Memory type	**02H**	
Address (L)	**00H**	
Address (M)	**00H**	
Address (H)	**04H**	
No. of read bytes	**11H**	
Dummy	**00H**	
STR1	Status information	
STR2		
System 1		
System 2		
Model	**20H**	
Area used by manufacturer	No fixed	
ZNo.		
Area used by manufacturer	**No fixed (10byte)**	

System 1 — bits 7 to 0

Capacity

Code	Capacity [W]
01H	50
02H	100
03H	200
04H	400 or 500
05H	750 or 850
06H	1k
07H	1.3k or 1.5k
08H	2k

Input voltage

Code	Input voltage [V]
00H	200

System 2 — bits 7 to 0

Encoder

Code	Encoder
01H	17bit INC

Motor type

Code	Motor type
01H	3000[r/min]
02H	2000[r/min]
03H	1500[r/min]
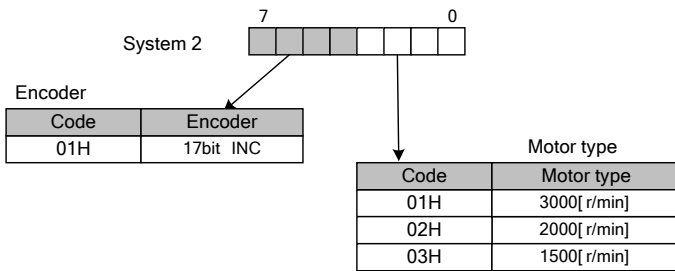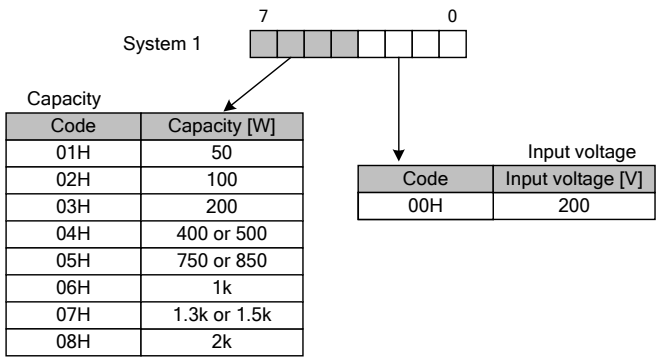
■ Current alarm history read

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		
STR2	Status information	

Parameter of designated number

Parameter of designated number +1

Parameter of designated number + designated quantity -1

Parameter of designated number (5 bytes)

7   0

(Position of decimal place)

Data symbol
0: +, 1: -

Data status
0: Normal, 1: Memory error

(8th digit)   (7th digit)

(6th digit)   (5th digit)

(4th digit)   (3rd digit)

(2nd digit)   (1st digit)
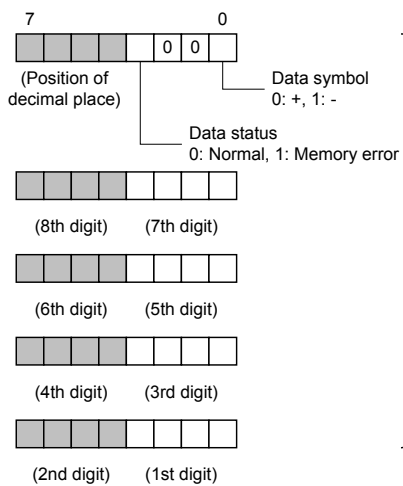
* The data is BCD 8 digits.

13 RS485 COMMUNICATIONS

■ Parameter write

CMND	**50H**

DATA (n)

Transmission from upper level control system
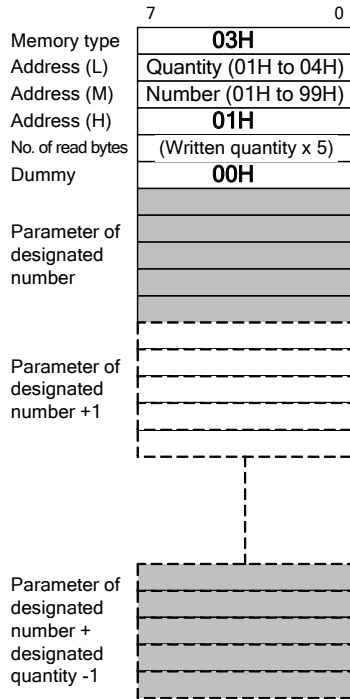
	7 0
Memory type	**03H**
Address (L)	Quantity (01H to 04H)
Address (M)	Number (01H to 99H)
Address (H)	**01H**
No. of read bytes	(Written quantity x 5)
Dummy	**00H**
Parameter of designated number	
Parameter of designated number +1	
Parameter of designated number + designated quantity -1	

* 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	
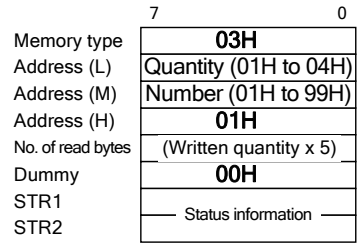
* When all data are normal, the designated quantity is written.
If an error is found, the subsequent data is not written.
Turn ON the 6th bit data error of STR1 and return the quantity actually written.

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)		
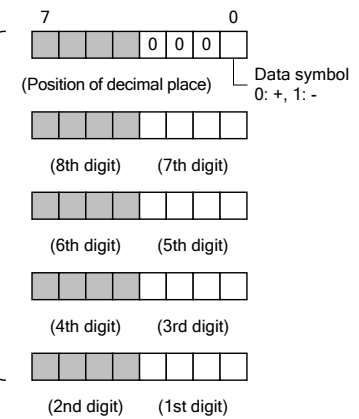
* The data is BCD 8 digits.

■ 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

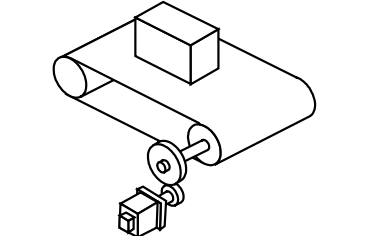|	7　　　　　　　　　0
Memory type	**08H**
Address (L)	**00H**
Address (M)	**01H**
Address (H)	**23H**
No. of read bytes	**00H**
Dummy	**00H**
STR1	Status information
STR2	

13 RS485 COMMUNICATIONS

- MEMO -
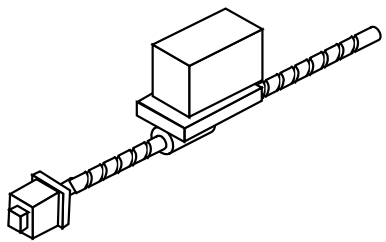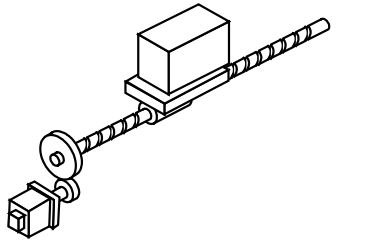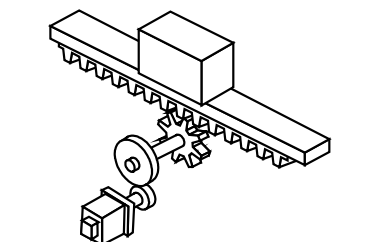
APPENDIXES

A APPENDIXES

■ 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.
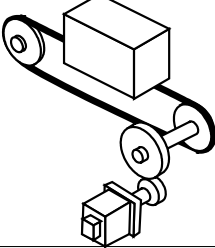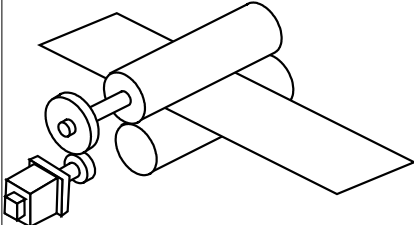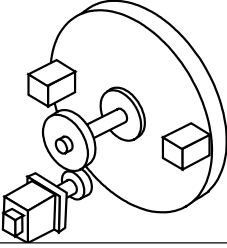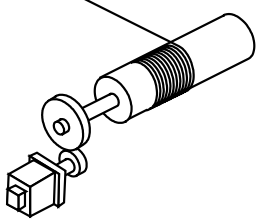
② Preload torque

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).
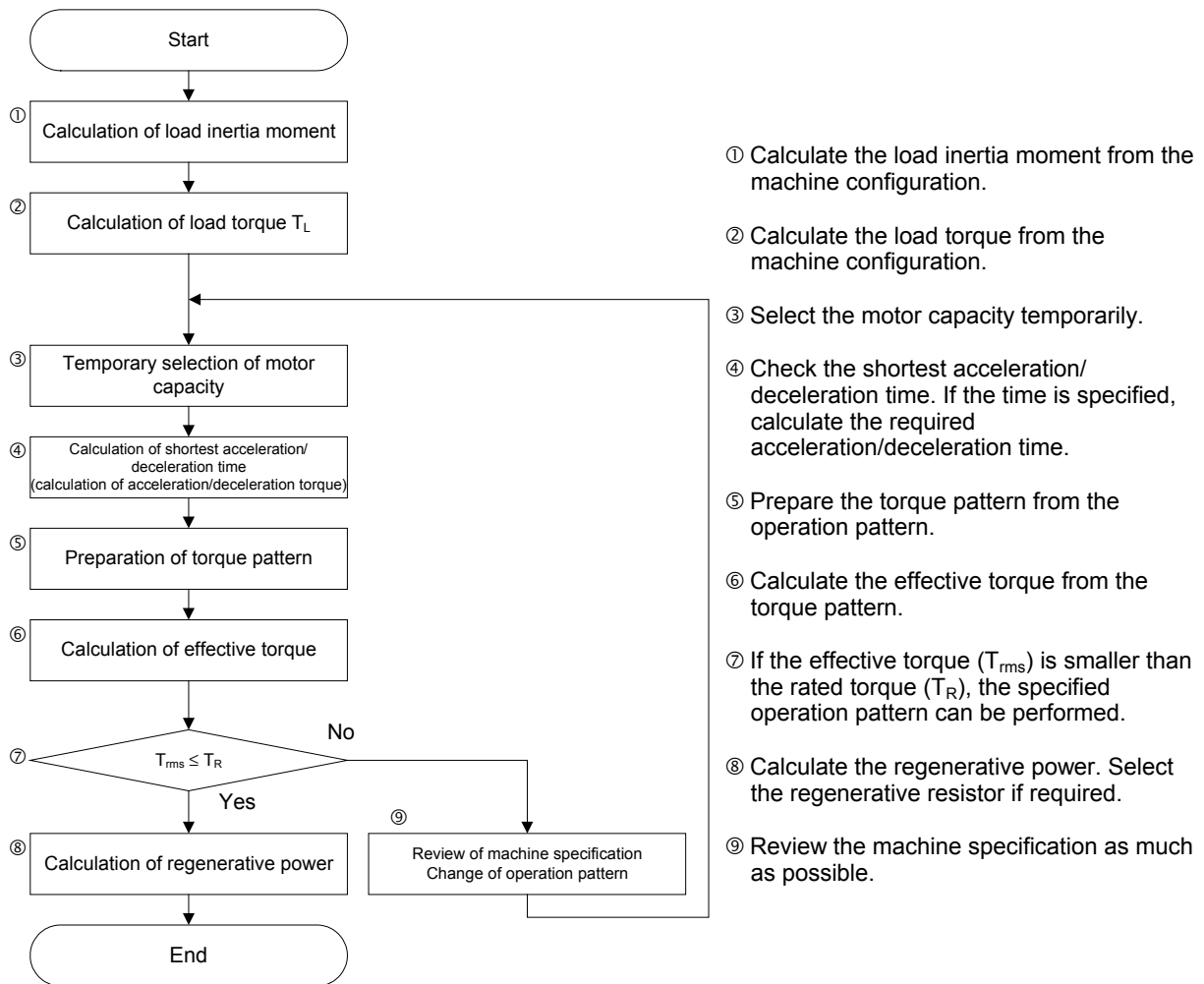
Items required for calculation of the capacity selection are as follows:

- 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

① Calculate the load inertia moment from the machine configuration.

② Calculate the load torque from the machine configuration.

③ Select the motor capacity temporarily.

④ Check the shortest acceleration/ deceleration time. If the time is specified, calculate the required acceleration/deceleration time.

⑤ Prepare the torque pattern from the operation pattern.

⑥ Calculate the effective torque from the torque pattern.

⑦ If the effective torque (T_{rms}) is smaller than the rated torque (T_R), the specified operation pattern can be performed.

⑧ Calculate the regenerative power. Select the regenerative resistor if required.

⑨ Review the machine specification as much as possible.

A APPENDIXES

<Calculation of moment of inertia>

• Shape

$$J_z = \frac{W}{8}\left(\frac{D}{10^3}\right)^2$$

$$= \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^4$$

$$J_x = J_y = \frac{W}{16}\left(\frac{D}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left(\frac{D}{10^3}\right)^2$$

$$J_z = \frac{W}{8}\left(\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right)$$

$$= \frac{\pi\rho}{32}\left(\frac{L}{10^3}\right)\left(\left(\frac{D_2}{10^3}\right)^4 - \left(\frac{D_1}{10^3}\right)^4\right)$$

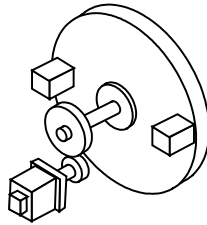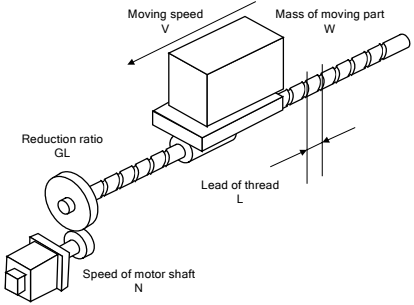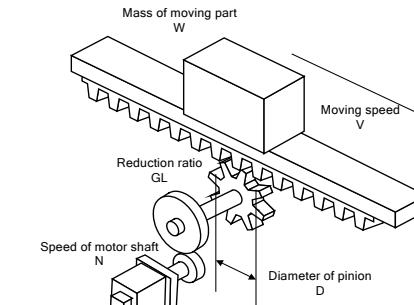$$J_x = J_y = \frac{W}{16}\left(\left(\frac{D_2}{10^3}\right)^2 + \left(\frac{D_1}{10^3}\right)^2\right) + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{L}{10^3}\right)\left(\left(\frac{D_2}{10^3}\right)^2 - \left(\frac{D_1}{10^3}\right)^2\right)$$

$$J_z = \frac{W}{16}\left(\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right)$$

$$J_x = \frac{W}{16}\left(\frac{B}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$J_y = \frac{W}{16}\left(\frac{A}{10^3}\right)^2 + \frac{W}{12}\left(\frac{L}{10^3}\right)^2$$

$$W = \frac{\pi\rho}{4}\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

$$J_x = \frac{W}{12}\left(\left(\frac{B}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right)$$

$$J_y = \frac{W}{12}\left(\left(\frac{L}{10^3}\right)^2 + \left(\frac{A}{10^3}\right)^2\right)$$

$$J_z = \frac{W}{12}\left(\left(\frac{A}{10^3}\right)^2 + \left(\frac{B}{10^3}\right)^2\right)$$

$$W = \rho\left(\frac{A}{10^3}\right)\left(\frac{B}{10^3}\right)\left(\frac{L}{10^3}\right)$$

$$J_x = \frac{W_2}{12}\left(\left(\frac{B_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right) - \frac{W_1}{12}\left(\left(\frac{B_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right)$$

$$J_y = \frac{W_2}{12}\left(\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right) - \frac{W_1}{12}\left(\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{L}{10^3}\right)^2\right)$$

$$J_z = \frac{W_2}{12}\left(\left(\frac{A_2}{10^3}\right)^2 + \left(\frac{B_2}{10^3}\right)^2\right) - \frac{W_1}{12}\left(\left(\frac{A_1}{10^3}\right)^2 + \left(\frac{B_1}{10^3}\right)^2\right)$$

$$W = \rho\left(\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right) - \left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\right)\left(\frac{L}{10^3}\right)$$

$$W_2 = \rho\left(\frac{A_2}{10^3}\right)\left(\frac{B_2}{10^3}\right)\left(\frac{L}{10^3}\right) \qquad W_1 = \rho\left(\frac{A_1}{10^3}\right)\left(\frac{B_1}{10^3}\right)\left(\frac{L}{10^3}\right)$$

• Conversion

Ball-screw

$$J_1 = W \left(\frac{1}{2\pi} \times \frac{BP}{10^3} \right)^2 \times GL^2$$

W : Mass of movable part [kg]
BP : Lead of thread [mm]
GL : Reduction ratio (no unit)

Rack and pinion, conveyor, chain drive

$$J_1 = \frac{W}{4} \left(\frac{D}{10^3} \right)^2 \times GL^2$$

W : Total mass of moving parts [kg]
D : Diameter of pinion [mm]
    : Diameter of sprocket [mm]
GL : Reduction ratio (no unit)

Feed roll

$$J_3 = \frac{W}{4} \left(\frac{D}{10^3} \right)^2 \times GL^2$$

W : Total mass of moving parts [kg]
D : Diameter of roll [mm]
GL : Reduction ratio (no unit)

Rotor, table drive

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)

$$J_4 = \left[J + W \left(\frac{L}{10^3} \right)^2 \right] \times GL^2$$

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)

A APPENDIXES

<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 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 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 $\quad t_{AC} = \dfrac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60 (T_{AC} - T_L)}$

• Acceleration/deceleration torque $\quad T_{AC} = \dfrac{(J_M + J_L) \times 2\pi \times (N_1 - N_0)}{60 (t_{AC})} + T_L$

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]

A APPENDIXES

⑤ Preparation of torque pattern

Prepare the output torque pattern from the operation pattern.

· Operation pattern
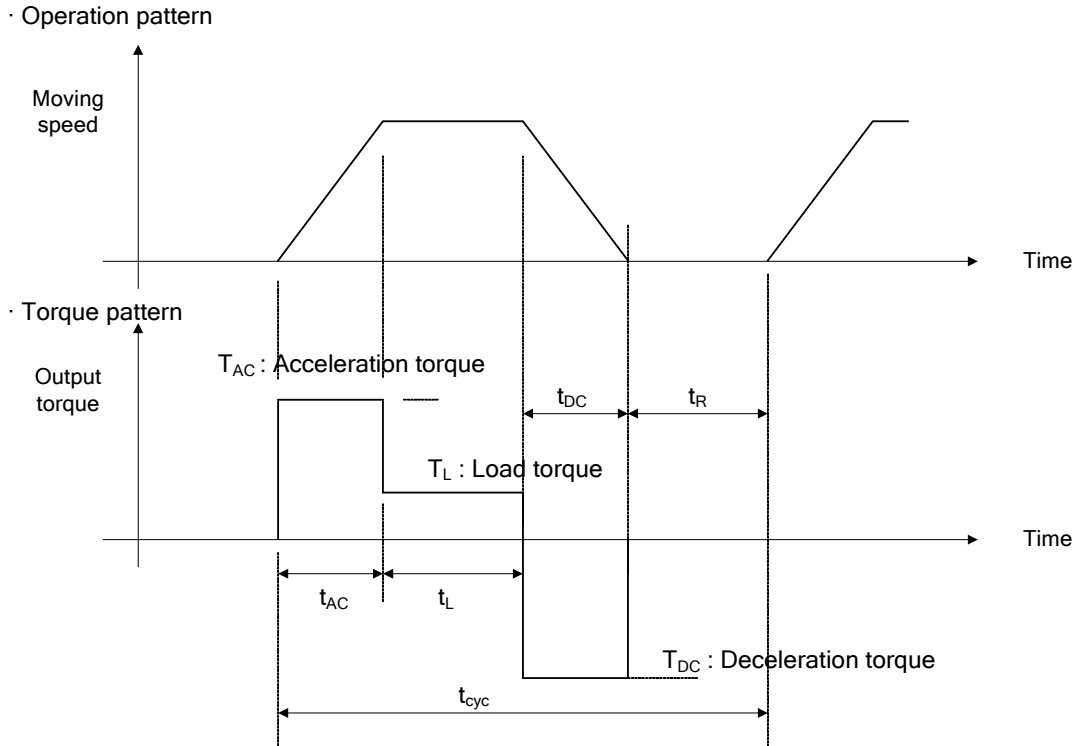
· Torque pattern

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.

A APPENDIXES

(3) Calculation example of capacity selection

■Machine configuration

Deceleration ratio 1/1 (direct link)

Servomotor
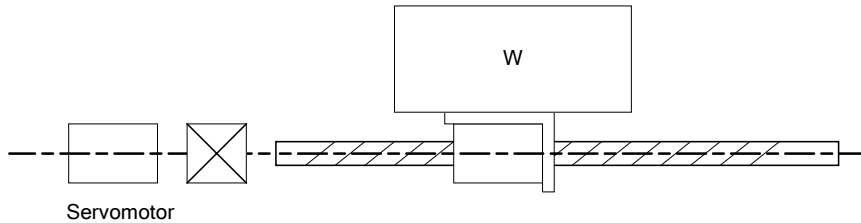
Thread pitch: 10 mm, Transfer weight: 20 kg, Thrust: 0 kg (None)

① Maximum moving speed (v)

Deceleration ratio 1/1 at motor rotation speed of 3000 [r/min]

$v = (3000/60) \times 10 \times (1/1) = 500$ [mm/s]

② Load inertia moment converted to motor shaft (J_L)

• Temporarily determine screw (J_1) of Φ20 and length of 500 mm.

$$J_1 = \frac{\pi \rho}{32} \left[\frac{L}{1000} \right] \left[\frac{D_1}{1000} \right]^4 \times GL^2$$

$$= \frac{\pi \times 7.85 \times 10^3}{32} \left[\frac{500}{1000} \right] \left[\frac{20}{1000} \right]^4 \times (1/1)^2$$

$$= 0.6 \times 10^{-4} \text{ [kg m}^2\text{]}$$

• Temporarily determine transfer weight of 20 kg in movable area (J_2).

$$J_2 = W \left[\frac{1}{2\pi} \frac{BP}{1000} \right]^2 \times (GL)^2$$

$$= 20 \left[\frac{1}{2\pi} \frac{10}{1000} \right]^2 \times (1/1)^2$$

$$= 0.5 \times 10^{-4} \text{ [kg m}^2\text{]}$$

$J_L =$ 　　　1.1×10^{-4} [kg m^2]

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**.

$$T_L = \frac{(\mu W + F) \times 9.81}{2\pi\eta} \left[\frac{BP}{1000} \right] \times GL$$

$$= \frac{(0.1 \times 20 + 0) \times 9.81}{2\pi \times 0.9} \left[\frac{10}{1000} \right] \times (1/1)$$

$$= 0.03 \text{ [Nm]}$$

④ Capacity selection conditions

$T_L \leq T_R \times 0.9$

$J_L \leq J_M \times 5$ 　(Highly frequent feed)

T_L 　$= 0.03$ [Nm]

J_L 　$= 1.1 \times 10^{-4}$ [kg m^2]

⑤ Temporary selection

From the capacity selection conditions, GYS201DC2-T2A (0.2 kW) is selected.

($J_M = 0.135 \times 10^{-4}$[kgm^2], $T_R = 0.637$[Nm], $T_{AC} = 1.91$[Nm])

⑥ Shortest acceleration/deceleration time (t_{AC})

$$t_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60 (T_{AC} - T_L)}$$

$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 (1.91 - 0.03)}$$

$$= 0.021 \text{ [s]}$$

Acceleration/deceleration torque with acceleration/deceleration time of **0.05** sec.

$$T_{AC} = \frac{(J_M + J_L) \times 2\pi \times N}{60 (t_{AC})} + T_L$$

A APPENDIXES

$$= \frac{(0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times 2\pi \times 3000}{60 \times 0.05} + 0.03$$

$$= 0.78 \text{ [Nm]}$$

⑦ Operation pattern
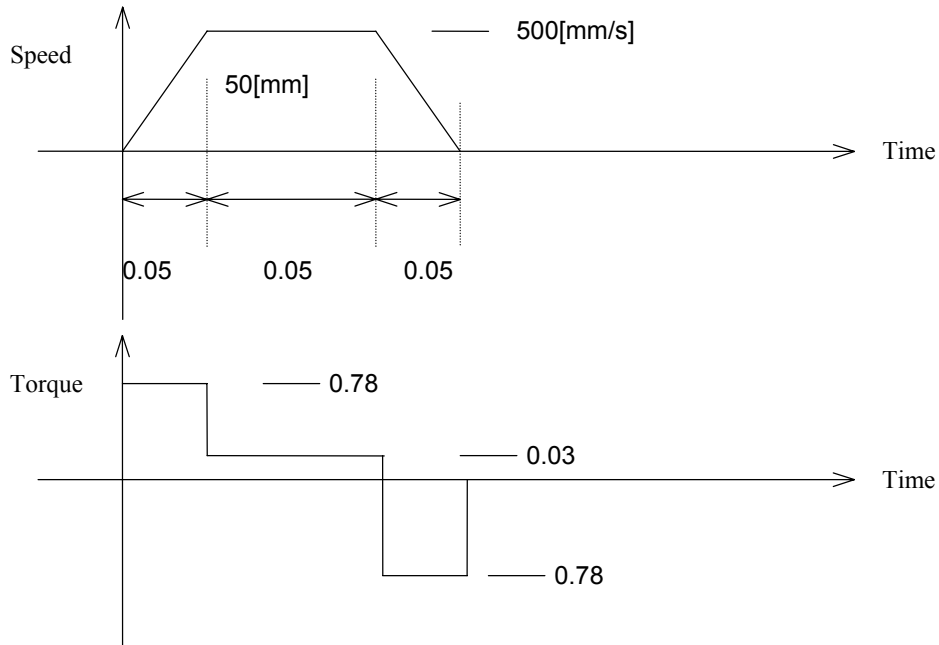
* Pattern for capacity selection. 0.5 sec. is temporarily determined for 1 cycle operation.

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.

　$P_1[W] = (2\pi/60) \times T [Nm] \times N[r/min] \times (1/2)$

　　　$= (2\pi/60) \times 0.78 \times 3000 \times (1/2)$

　　　$\approx 123 [W]$

　Average regenerative power in 1 cycle operation

　$P = (123 \times 0.05) / 0.5$

　　$\approx 12.3 [W]$

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.

$$E_G = \frac{1}{2} (J_M + J_L) \cdot (2\pi N/60)^2$$

$$= \frac{1}{2} (0.135 \times 10^{-4} + 1.1 \times 10^{-4}) \times \left[\frac{2\pi \times 3000}{60} \right]^2$$

　$= 6.1[J]$

Step 2) Calculate energy (E_L) consumed by load torque.

$E_L = (2\pi/60) \times T_L \times N \times t_{DC} \times (1/2)$

　$= (2\pi/60) \times 0.03 \times 3000 \times 0.05 \times (1/2)$

　$= 0.24[J]$

Step 3) Calculate energy (E_M) consumed by coil of the servomotor.

$E_M = 3 \times (R \times I^2) \times t_{DC}$

　$= 3 \times R \times ((T_{DC}/T_R \times I_R)^2) \times t_{DC}$

　$= 3 \times 2.3 \times ((0.78/0.637 \times 1.5)^2) \times 0.05$

　$= 1.2[J]$

　* GYS201DC2-T2A type phase resistance: 2.3Ω

A APPENDIXES

* Phase resistance

■ 3000 r/min series

Series	Capacity [kW]	Rated current [A]	Phase resistance [Ω]	Inertia moment(JL) ×10^{-4} [kg·m^2]	Capacitor capacity [μF]
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) ×10^{-4} [kg·m^2]	Capacitor capacity [μF]
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) ×10^{-4} [kg·m^2]	Capacitor capacity [μF]
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
	1.8	17.8	0.079	29.5	1880
	2.9	23.6	0.059	43.3	1880

Step 4) Calculate energy (E$_s$) that can be absorbed by the servo amplifier.

$$E_S = \frac{1}{2} C(V_{DB}^2 - V_{DC}^2)$$

$$= \frac{1}{2} (660 \times 10^{-6}) \times (385^2 - (200 \times \sqrt{2})^2)$$

$$= 22.5[J]$$

* DC link capacitor (RYC201) 660 μF, power voltage 200V (effective value)

* Resistance for the capacitor of the servo amplifier with 0.2 kW or less is 660 μF.

* V_{DB} = DB transistor ON level (385 [V]), V_{DC} = DC intermediate voltage (200 x $\sqrt{2}$ [V])

Energy that can be processed with machine, servo amplifier and servomotor is:

$E_L + E_M + E_S = 0.24 + 1.2 + 22.5 \approx 24[J]$

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.)
for installation

A APPENDIXES

■ Parameter list

■ FALDIC-W parameter list (1)

No.	Name	Setting range	Setting	Change
01	Command pulse correction ?	1 to 32767 (in 1 increments)		Always
02	Command pulse correction ß	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 ? Speed 4: Position ? Torque 5: Speed ? Torque		Power
10	CONT 1 signal allocation	0 to 22 (in 1 increments) 0: Not specified 1: Servo ON [RUN] 2: Reset [RST] 3: +OT		Power
11	CONT 2 signal allocation	4: -OT 5: Emergency stop [EMG] 6: P motion 7: Deviation clear 8: External regenerative resistor 9: Anti-resonance frequency overheating selection 0		Power
12	CONT 3 signal allocation	10: Anti-resonance frequency 11: Command pulse inhibition selection 1 13: Command pulse a selection 1 12: Command pulse a selection 0 15: Manual forward rotation [FWD]		Power
13	CONT 4 signal allocation	14: Control mode switching 17: Multistep speed 1 [x1] 16: Manual reverse rotation [REV] 19: Acceleration/deceleration 18: Multistep speed 2 [x2] time selection		Power
14	CONT 5 signal allocation	20: Current limiting regulator ON 21: Coasting [BX] 22: For adjustment by manufacturer		Power
15	OUT 1 signal allocation	0 to 13 (in 1 increments) 0: Not specified 1: Ready [RDY]		Power
16	OUT 2 signal allocation	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	12: For adjustment by 13: For adjustment by manufacturer manufacturer		Power
19	Output pulse count	16 to 32768 [pulse] (in 1 increments)		Power
20	Phase-Z offset	0 to 65535 [×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 [×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 Max. torque % (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	Not used	-		-
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			Power
75	CONT normally valid 2	0 to 21		Power
76	CONT normally valid 3			Power
77	CONT normally valid 4			Power
78	Command pulse compensation $\alpha 1$			Always
79	Command pulse compensation $\alpha 2$	1 to 32767 (in 1 increments)		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	-		-

Fuji Electric FA Components & Systems Co., Ltd.

Printed on 100% recycled paper

2006-10/CM