M0010630G

SANMOTION

AC SERVO SYSTEMS

R

3E Model

TYPE S

Analog / Pulse Input Type

For Rotary Motor

Instruction Manual

SANYO DENKI

The seventh edition (G)

- Overall
  - Unify encoder names and add encoder code information.
    Single-turn absolute encoder (Encoder code: H)
    Battery backup absolute encoder (Encoder code: P)
    Battery-less absolute encoder (Encoder code: R)
    Wire-saving incremental encoder (Encoder code: S)
  - Resolver type battery-less absolute encoder (RA035) is added.

- p. 1-3
  - Description drawing of wiring change due to RS2 replacement is corrected.

- p. 1-12, 2-7
  - "PP031H" is added.

- p. 2-5, 5-105, 10-2, 10-5, 10-6
  - Symbols in drawing are changed to comply with JIS standards.

- p. 2-15
  - Calorific value of R1AA18750L is changed to 365 from 355.

- p. 4-32, 4-33
  - Below note is added.
    ✔ For MCCB, Noise filter, Magnetic contact, required current per axis is describing.

- p. 5-14
  - Section of "3) System parameters setting list related to motor encoder due to encoder types each" is added.

- p. 5-29, 5-36
  - "ID4C" is added.

- p. 5-29, 5-39
  - "ID70, 71, 73, 74 and 77" are added.

- p. 5-50
  - Setting ranges in general parameter GroupD are corrected as below.
    ID11: 00 to66 → 00 to 77
    ID31 to 36: 00 to 19, FF → 00 to 23, FF

- p. 5-106
  - Selection name in description is corrected as below.
    08: CMDINH_SB_SON ⇒ 08: CMDINH_SB_SON2

- p. 5-131
  - Items in ID11 are corrected as below.
    66 → 77, SYNERR→ HBLF

- p. 5-133
  - Items in ID31 to 36 are corrected as below.
    00 to 19 → 00 to 23
  - ID21, 22 and 23 are added to the table.

- p. 7-5
  - Regenerative power monitor display (monitor ID: 4C) is added.

- p. 8-7, 8-29
  - "Abnormality in external encoder main body: B0 to BF" is added.

- p. 8-41
  - Section "8.3.3 Correspondence table of EnDat Error message/alarm code" is added.

- p. 8-42
  - Note is added to clarify encoder clearing method.
  - Method of A6/Battery-less absolute encoder is changed as below.
    ･"Power-cycle" ･"Alarm reset" after "Encoder clear"

- p. 10-18
  - Period of confirmation of function operation is changed to "every 3 month" from "annually".

- p. 12-49
  - Section "12.6.7 Servo motor power cable" is added.

Safety Precautions

Please read this User Manual and its appendix carefully prior to installation, operation, maintenance or inspection and perform all tasks according to the instructions provided here. A good understanding of this equipment, its safety information as well as all Warnings / Cautions is also necessary before using.
Matters that require attention are ranked as “Danger” “Warning” and “Caution” in this document.

■ Warning Symbol

⚠**Danger**	Denotes immediate hazards that will probably cause severe bodily injury or death as a result of incorrect operation.
⚠**Warning**	Denotes immediate hazards which will probably cause severe bodily injury or death as a result of incorrect operation.
⚠**Caution**	Denotes hazards which could cause bodily injury and product or property damage as a result of incorrect operation.

⚠ Caution Even those hazards denoted by this symbol could lead to a serious accident. Make sure to strictly follow these safety precautions.

■ Prohibited, Mandatory Symbols

🚫	Indicates actions that must not be allowed to occur / prohibited actions.
❗	Indicates actions that must be carried out / mandatory actions.

Safety Precautions

■ Attention in use

⚠ Warning

- Do not use this device in explosive environment.
  Injury or fire could otherwise result.
- Do not perform any wiring, maintenance or inspection when the device is hot-wired. After switching the power off, wait at least 15 minutes before performing these tasks.
  Electric shock or damage could otherwise result.
- The protective ground terminal (⏚) should always be grounded to the unit or control board. The ground terminal of the motor should always be connected to the protective ground terminal (⏚) of the amplifier.
  Electric shock could otherwise result.
- Do not touch the inside of the amplifier.
  Electric shock could otherwise result.
- Do not damage the cable, do not apply unreasonable stress to it, do not place heavy items on it, and do not insert it in between objects.
  Electric shock could otherwise result.
- Do not touch the rotating part of the motor during operation.
  Bodily injury could otherwise result.

⚠ Caution

- Use the amplifier and motor together in the specified combination.
  Fire or damage to the device could otherwise result.
- Only technically qualified personnel should transport, install, wire, operate, or perform maintenance and inspection on this device.
  Electric shock, injury or fire could otherwise result.
- Do not expose the device to water, corrosive or flammable gases, or any flammable material.
  Fire or damage to the device could otherwise result.
- Be careful of the high temperatures generated by the amplifier/motor and the peripherals.
  Burn could otherwise result.
- Do not touch the radiation fin of the amplifier, the regenerative resistor, or the motor while the device is powered up, or immediately after switching the power off, as these parts generate excessive heat.
  Burn could otherwise result.
- In terms of designing safety systems using the Safe Torque Off function, personnel who have expertise of relevant safety standard are supposed to do that job with good understanding of this instruction manual.
  Injury or damage to the device could otherwise result.
- Please read the User Manual carefully before installation, operation, maintenance or inspection, and perform these tasks according to the instructions.
  Electric shock, injury or fire could otherwise result.
- Do not use the amplifier or the motor outside their specifications.
  Electric shock, injury or damage to the device could otherwise result.
- Regenerative resistor has instantaneous capacity. Contact our offices if the instantaneous regenerative power could be high as the result of high-inertia moment or high-velocity rotation.

■ Storage

🛇 Prohibited

- Do not store the device where it could be exposed to rain, water, toxic gases or other liquids.
  Damage to the device could otherwise result.

Mandatory

- Store the device where it is not exposed to direct sunlight, and within the specified temperature and humidity ranges {- 20°C to + 65°C, below 90% RH (non-condensing)}.
  Damage to the device could otherwise result.
- Please contact our office if the amplifier is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage, and could cause damage to the device.
  Damage to the device could otherwise result.
- Please contact our office if the amplifier is to be stored for a period of 3 years or longer.
  Confirmations such as bearings and the brakes are necessary.

■ Transportation

⚠ Caution

- When handling or moving this equipment, do not hold the device by the cables, the motor shaft or detector portion.
  Damage to the device or bodily injury could otherwise result.
- Keep in mind that it is dangerous at the time of conveyance if it falls and overturns.
  Bodily injury could otherwise result.

Mandatory

- Follow the directions written on the outside box. Excess stacking could result in collapse.
  Bodily injury could otherwise result.
- Use eyebolt of the motor only for transporting itself. Do not use for transportation of machinery combined with the motor.
  Damage to the device or bodily injury could otherwise result.

■ Installation

⚠ Caution

- ◆ Do not stand on the device or place heavy objects on top of it.
  Bodily injury could otherwise result.
- ◆ Make sure the mounting orientation is correct.
  Fire or damage to the device could otherwise result.
- ◆ Do not drop this device or subject it to excessive shock of any kind.
  Damage to the device could otherwise result.
- ◆ Do not obstruct the air intake and exhaust vents, and keep them free of debris and foreign matter.
  Fire could otherwise result.
- ◆ Consult the User Manual regarding the required distance inside the amplifier disposition.
  Fire or damage to the device could otherwise result.
- ◆ Open the box only after checking its top and bottom location.
  Bodily injury could otherwise result.
- ◆ Verify that the products correspond to the order sheet/packing list.
  Injury or damage could result.
- ◆ Take care of falling or overturning of the device during installation.
  Use eyebolts of the motor if supplied.
  Bodily injury could otherwise result.
- ◆ Install the device on a metal or other non-flammable support.
  Fire could otherwise result.
- ◆ Make the collision safety device strong enough to resist the maximum output of the system.
  Bodily injury could otherwise result.

■ Wiring

⚠ Caution

- Wiring connections must be secure.
  Bodily injury could otherwise result.
- Wiring should be completed based on the Wiring Diagram or the User Manual.
  Electric shock or fire could otherwise result.
- Wiring should follow electric equipment technical standards and indoor wiring regulations.
  An electrical short or fire could otherwise result.
- Do not connect a commercial power supply to the U, V or W terminals of the servo motor.
  Fire or damage to the device could otherwise result.
- Install a safety device such as a breaker to prevent external wiring short-circuits.
  Fire could otherwise result.
- Do not bind or band the power cable, input/output signal cable and/or encoder cable together or pass through the same duct or conduit.
  This action will cause faulty operation.
- Must add the surge absorbing diode if inductive load as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.
- Do not connect DC90V or AC power to the DC24V Brake of the servo motor. Also, do not connect AC400V to the AC200V Fan of the servo motor.
  An electrical short or fire could otherwise result.
- Please design a sequence that included braking delay time because the surge-absorbing component for the relay of holding brake of the servo motor gives braking delay time.
  Injury or load falling could otherwise result.

❗ Mandatory

- Install an external emergency stop circuit that can stop the device and cut off the power instantaneously. Install an external protective circuit to the amplifier to cut off the power from the main circuit in the case of an alarm.
  Motor runaway, bodily injury, burnout, fire and secondary damages could otherwise result.

■ Operation

⚠ Caution

- ◆ Do not perform extensive adjustments to the device as they may result in unstable operation.
  Bodily injury could otherwise result.
- ◆ Trial runs should be performed with the motor in a fixed position, separated from the mechanism. After verifying successful operation, install the motor on the mechanism.
  Bodily injury could otherwise result.
- ◆ The holding brake is not to be used as a safety stop for the mechanism. Install a safety stop device on the mechanism.
  Bodily injury could otherwise result.
- ◆ In the case of an alarm, first remove the cause of the alarm, and then verify safety. Next, reset the alarm and restart the device.
  Bodily injury could otherwise result.
- ◆ Check that input power supply voltage is keeping a specification range.
  Damage to the device could otherwise result.
- ◆ Avoid getting close to the device, as a momentary power outage could cause it to suddenly restart (although it is designed to be safe even in the case of a sudden restart).
  Bodily injury could otherwise result.
- ◆ Do not use motor or amplifier which is defective or failed and damaged by fire.
  Injury or fire could otherwise result.
- ◆ In the case of any irregular operation, stop the device immediately.
  Electric shock, injury or fire could otherwise result.
- ◆ When using the servo motor in vertical axis, provide safety devices to prevent falls during the work that will cause an alarm condition.
  Injury or damage could result.

Safety Precautions

Prohibited

- The built-in brake is intended to secure the motor; do not use it for regular control. Damage to the brake could otherwise result.
  Damage to the device could otherwise result.
- Keep the motor's encoder cables away from static electricity and high voltage.
  Damage to the device could otherwise result.
- Standard specification servo amplifiers have a dynamic brake resistor. Do not rotate the motor continuously from the outside when the amplifier is not powered on, because the dynamic brake resistor will heat up, and can be dangerous.
  Fire or burn could otherwise result.
- Absolutely do not apply voltage more than the spec to the amplifier because overvoltage will be cause of part failure.
  Damage to the device or bodily injury could otherwise result.
- Avoid frequent on and off power supply.
  Inner parts might get premature failure in case of repeating ON/OFF of power supply 30 times or more per day, otherwise 5 times or more per hour.

Mandatory

- Install an external emergency stop circuit that can stop the device and cut off the power instantaneously. Install an external protective circuit to the amplifier to cut off the power from the main circuit in the case of an alarm.
  Motor runaway, bodily injury, burnout, fire and secondary damages could otherwise result.
- There is no safeguard on the motor. Use an over-voltage safeguard, short-circuit breaker, overheating safeguard, and emergency stop to ensure safe operation.
  Injury or fire could otherwise result.
- Operate within the specified temperature and humidity range.
  Servo Amplifier
  Temperature 0°C to 55°C
  Humidity below 90% RH (non-condensing).
  Servo Motor
  Temperature 0°C to 40°C
  Humidity below 90% RH (non-condensing).}
  Burnout or damage to the device could otherwise result.

■ Maintenance･Inspection

⚠ Caution

- Some parts of the servo amplifier (electrolytic capacitor, cooling fan, lithium battery for encoder, fuse and relay kinds) can deteriorate with long-term use. Please contact our offices for replacements.
  Damage to the device could otherwise result.
- Do not touch or get close to the terminal while the device is powered up.
  Electric shock could otherwise result.
- Be careful during maintenance and inspection, as the body of the amplifier becomes hot.
  Burn could otherwise result.
- Please contact your distributor or sales office if repairs are necessary. Disassembly could render the device inoperative.
  Damage to the device could otherwise result.

⃠ Prohibited

- Do not overhaul the device.
  Fire or electric shock could otherwise result.
- Do not measure the insulation resistance and the pressure resistance.
  Damage to the device could otherwise result.
- Absolutely do not unplug the connector while the device is powered up because hot plug will give damaged by surge to component.
  Electric shock or damage could otherwise result.
- Do not remove the nameplate cover attached to the device.

■ Disposal

! Mandatory

- If the amplifier or the motor is no longer in use, it should be discarded as industrial waste.

Table of contents

1. Preface

2. Specifications

3. Installation

4. Wiring

Table of contents

5. Operation

6. Servo Tuning

Table of contents

7. Digital Operator

8. Maintenance

9. Dedicated function

10. Safe-Torque-Off function

11. Selection

12. Appendix

Table of contents

1

Preface

In this chapter, Introduction, Instruction manual, Illustration of system components, Model number structure and Part names of servo amplifier/motor are explained.

1. Preface

1.1 Introduction

1.1.1 Product overview

Thank you for purchasing the AC servo system, “SANMOTION R” 3E Model. This instruction manual describes important things to notice to ensure your safety, such as specifications, installation, wiring, operation, functions and maintenance of the system. Please make sure to read this instruction manual before use to operate this AC servo system correctly. After reading, please keep it handy to refer as needed.

The AC Servo amplifier “SANMOTION R” 3E Model is a consolidated power supply, single-axis type servo amplifier consisting of eight (8) models according to capacity.
This product is corresponded the Rotary Motor R series, and allows using an absolute encoder and incremental encoder as motor encoder. It is also allows using an incremental encoder and Heidenhain-made absolute encoder (Endat 2.2) as external encoder of full-closed system. Battery for the motor encoder is able to mount by battery holder (provided optionally). Battery holder is two types such as attaching to the amplifier and attaching to the encoder cable.
Outer shape and mounting dimensions and each connector is compatible with "SANMOTION R" ADVANCED MODEL. And, communication with setup software (in PC) is corresponding USB (Full speed).

1.1.2 Features of "SANMOTION R" 3E Model

"SANMOTION R" 3E Model is having concepts of "Evolved", "Eco-Efficient" and "Easy to use", as below.

(1) Evolved

■ Shortening of positioning settle time
Positioning settle time is shortened to 1/3 of previous model by higher response of velocity loop (2.2 kHz) and evolution of model following vibration suppression control.

■ Higher control accuracy
Control gain will be 1.2 times of previous model by equipping phase characteristic compensation function. Resist disturbance strongly, and realize high accurate process.

■ Shortening of tact time of process machinery
Tact time of process machinery is shortened drastically by real time switching function of trajectory control and positioning control.

■ Enhancing adaptive function
Adaptive notch filter that realize adaptive vibration suppression of machine vibration is equipped.
Realize stable operation by suppressing fluctuation and variation of machinery resonance frequency.

■ Safety performance improvement of Safe Torque Off
Improves Safety performance of Safe Torque Off by conforming of "SIL3/IEC 61508", "PL=e/ISO 13849-1". The product can use for the application which requires high safe performance.

(2) Eco-Efficient

■ Lower power consumption
Up to 10% loss reduction by equipping new generation power device. And decreasing waste of energy by controlling speed of fan that cools depending on load condition and environment temperature.

Especially standby power requirement (at servo off) is decreased 10% maximum, and fan noise decreased, also.

■ Power consumption visualization
Power consumption monitor function is equipped, so power consumption visualization of machine is available.
* Power consumption monitor function is available with R2 series, 200VAC motor written on this manual. The other motors cannot use that function.

(3) Easy to use

■ Easy startup
Easy startup is available by Virtual motor operation function that simulates operation of motor and amplifier without actual motion and Visualized functional parameter editor (in Setup software).

■ Easy servo tuning
Servo adjustment support function is enhanced by functions of setup software "SANMOTION motor setup", such as the auto selection function of optimum tuning mode by machine/load condition, the basic adjustment mode which allows maximum two parameters and the advanced adjustment mode for decided purpose.

■ Easy troubleshooting
Easy troubleshooting is available by the 1 ms each timestamp and the drive-recorder function which records operation state of motor and amplifier, and they will show trouble status later.

1.1.3 Cautions for replacement from "SANMOTION R" ADVANCED MODEL

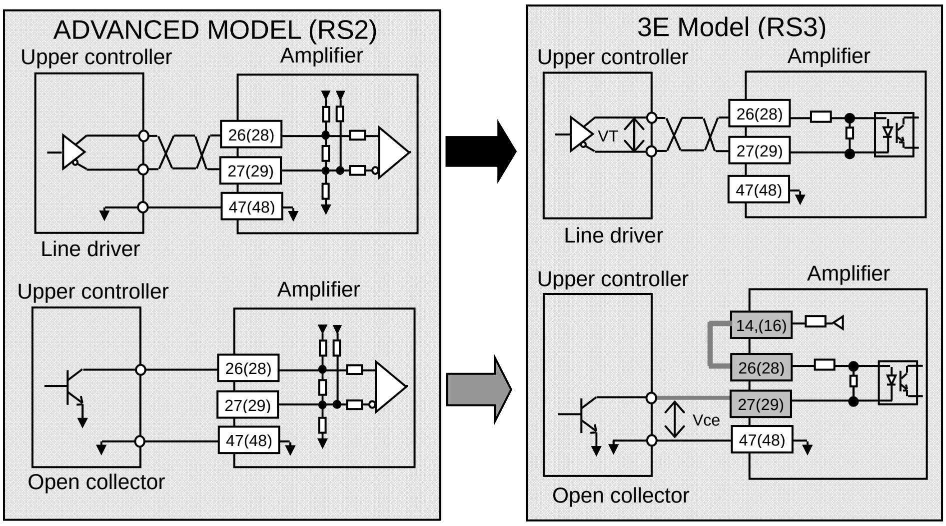
Please check contents below for replacement from "SANMOTION R" ADVANCED MODEL.

- Servo amplifier capacity
  The lineup under 100A are refining to 6 types (10A, 20A, 30A, 50A,75A,100A) from 4 types (15A, 30A, 50A,100A). Therefore relationship between servo amplifier capacity and combined motor has changed.
  See detail in "1.4.2 Servo amplifier model number".

- Command pulse input
  Command pulse input circuit has changed to photo coupler from line-receiver for applying to various type input. When upper controller uses differential output (line driver), allowable command pulse signal is having restriction. And, when open collector output is used, wiring change is needed. See detail below.

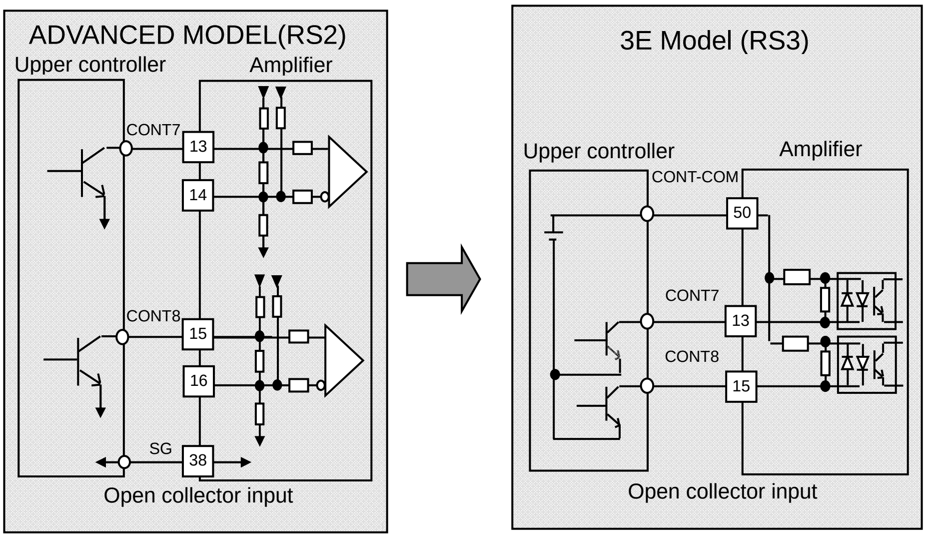
Pulse output circuit of upper controller	Wiring compatibility	Restriction condition
Differential output type (line driver)	Yes	Voltage difference of differential signal (VT): 2.5 to 3.8 V
Open collector output type	No (See drawing below)	Saturation voltage of transistor (V_{CE}): 1.5 V or less

* When used without condition above, it will be cause of error operation like pulse missing.



- General input 7,8 (CONT 7,8)
  General input 7,8 have changed to photo coupler from line receiver because all the circuit of general input (CONT 1 to 8) unifies to insulation type.
  Therefore line driver output cannot use to upper controller.
  And, when open collector output is used, wiring change is needed.

General output circuit of upper controller	Wiring compatibility	Remarks
Differential output type (line driver)	－	Please change to open collector type
Open collector output type	No (See drawing below)	Please wire like as for CONT 1 to 6.



- The setup software
  The setup software for AC servo amplifier “SANMOTION R” 3E Model is “SANMOTION MOTOR SETUP SOFTWARE”. “SANMOTION R ADVANCED MODEL SETUP SOFTWARE” is not able to use.
  Please download “SANMOTION MOTOR SETUP SOFTWARE” from our Website.
  And prepare commercial USB cable (Amplifier side is mini USB) as communication cable between the setup software and amplifier.

1.2 Instruction manual

This manual outlines the specifications, installation, wiring, operations, functions, maintenance, etc. of the AC servo amplifier “SANMOTION R” 3E Model as follows:

1.2.1 Contents

- Chapter 1 Preface
  Product outline, model number, names of components
- Chapter 2 Specifications
  Detailed specifications for Servo Motor, Servo Amplifier and Motor Encoder
- Chapter 3 Installation
  Explanation of installation procedure
- Chapter 4 Wiring
  Illustrations and explanations of wiring
- Chapter 5 Operation
  Explanation of operation sequence, test operations and parameters
- Chapter 6 Servo Tuning
  Explanation of servo adjustment as auto-tuning, manual tuning
- Chapter 7 Digital Operator
  Explanation of the LED display and use of the digital operator
- Chapter 8 Maintenance
  Explanation of troubleshooting when alarms occur and inspection
- Chapter 9 Dedicated function
  Explanation of full-closed control, tandem operation function and its how to use
- Chapter 10 Safe Torque Off function
  Explanation of Safe Torque Off function and its how to use
- Chapter 11 Selection
  Explanation of selection method for the servo motor and regenerative resistor capacity
- Chapter 12 Appendix
  Explanation of international standards, servo motor data sheets, dimensions and options

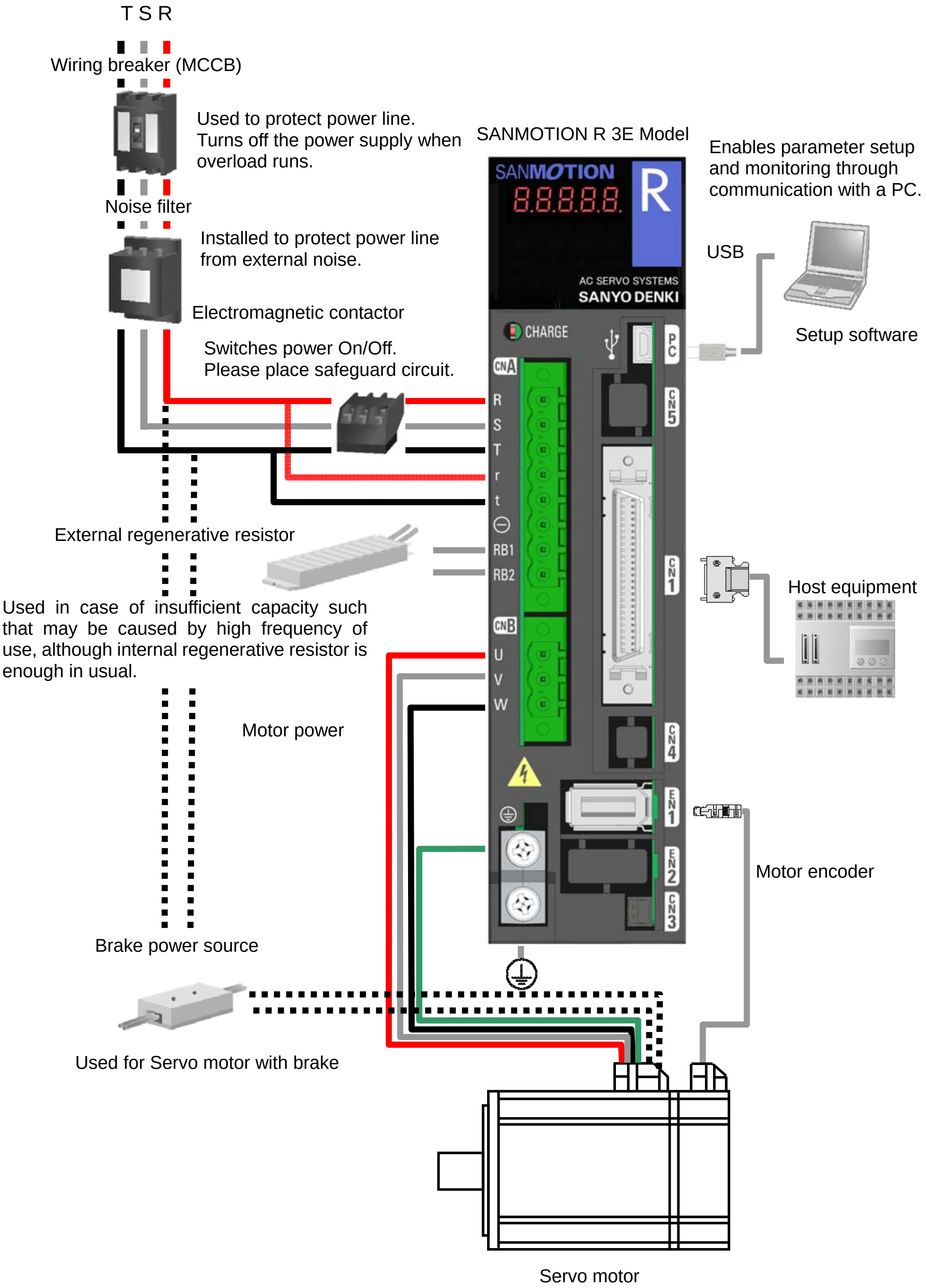
1.2.2 Precautions related to these instructions

In order to fully understand the functions of this product, please read this instruction manual thoroughly before using the product. After thoroughly reading the manual, keep it handy for reference.
Carefully and completely follow the safety instructions outlined in this manual.
Note that safety is not guaranteed for usage methods other than those specified in this manual or those methods intended for the original product.
Permission is granted to reproduce or omit a portion of the attached figures (as abstracts) for use.
The contents of this manual may be modified without prior notice as revisions or additions are created regarding the usage method of the product. Modifications are performed as per the revisions of this manual.
Although the manufacturer has taken all possible measures to ensure the veracity of the contents of this manual, should you notice any error or omission, please notify the nearest branch office or head office written in back cover.

Moreover, original text of this instruction manual is Japanese. Original text writing has priority if there is difference between original text and the other language writing.

1.3 Illustration of system components

- RS3☐01/02/03/05



Wiring breaker (MCCB): Used to protect power line. Turns off the power supply when overload runs.

Noise filter: Installed to protect power line from external noise.

Electromagnetic contactor: Switches power On/Off. Please place safeguard circuit.

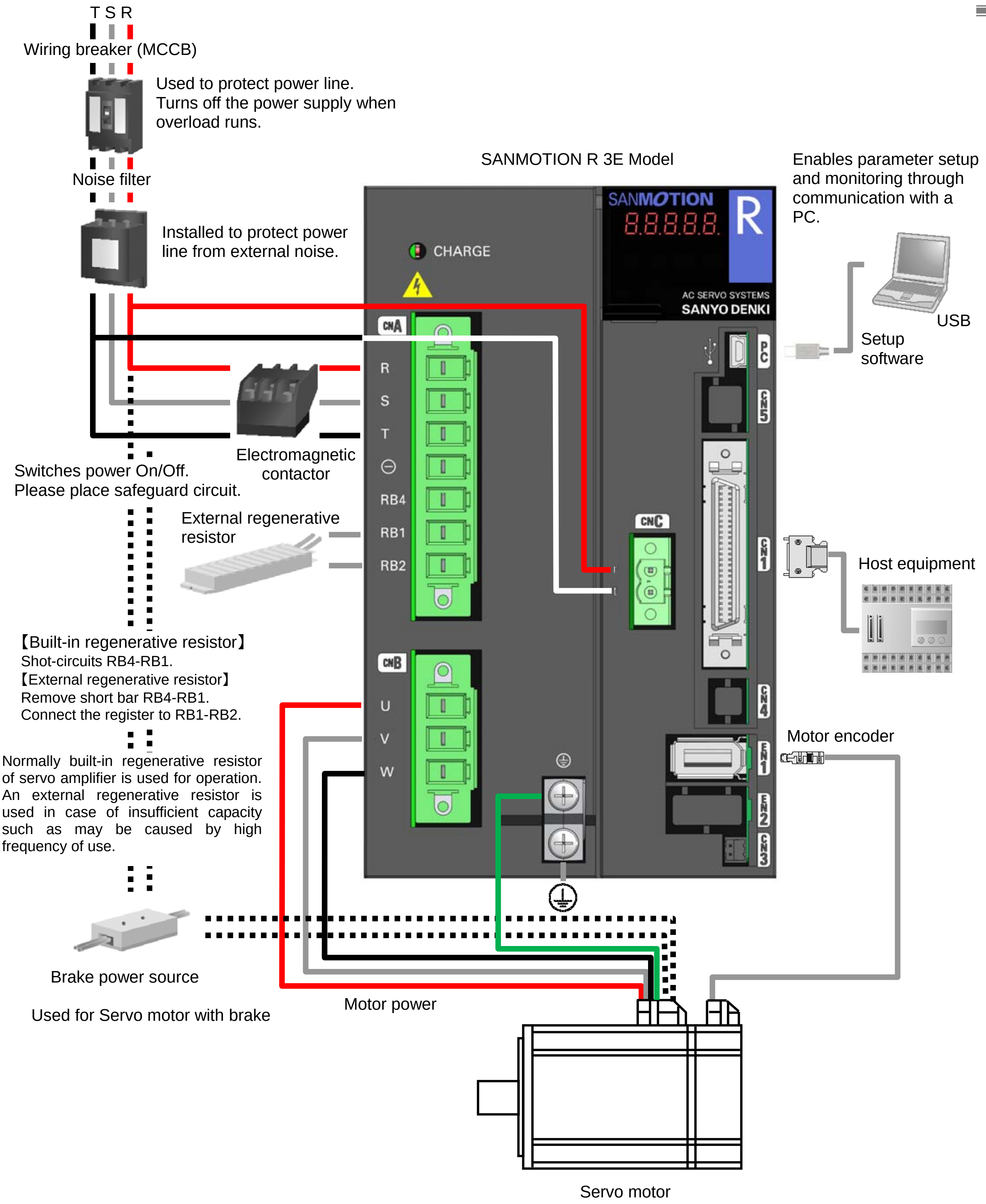
External regenerative resistor: Used in case of insufficient capacity such that may be caused by high frequency of use, although internal regenerative resistor is enough in usual.

Brake power source: Used for Servo motor with brake

Setup software: Enables parameter setup and monitoring through communication with a PC.

1.3 Illustration Of System Components

■ RS3A70



Used to protect power line. Turns off the power supply when overload runs.

Installed to protect power line from external noise.

Switches power On/Off.
Please place safeguard circuit.

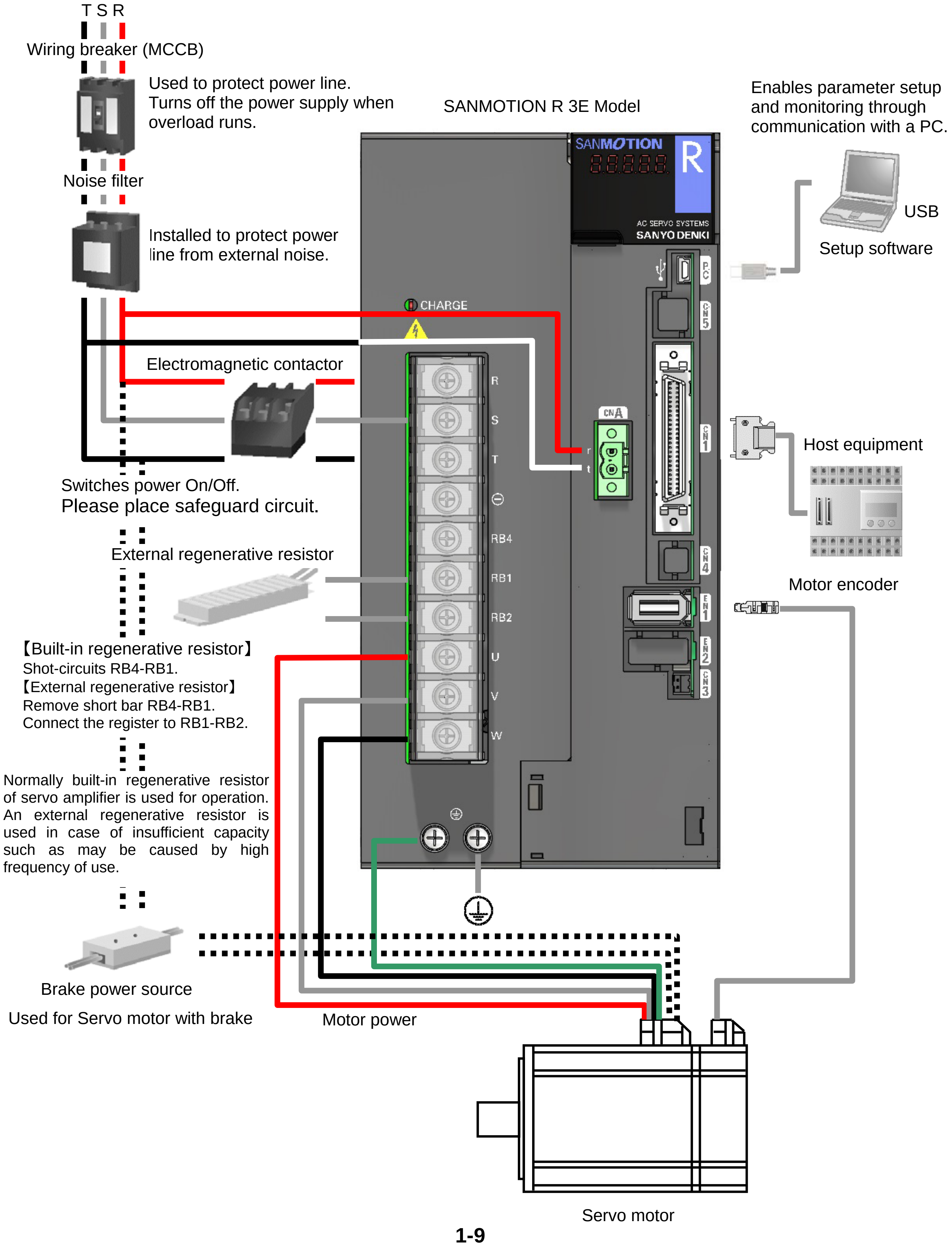
Enables parameter setup and monitoring through communication with a PC.

【Built-in regenerative resistor】
Shot-circuits RB4-RB1.
【External regenerative resistor】
Remove short bar RB4-RB1.
Connect the register to RB1-RB2.

Normally built-in regenerative resistor of servo amplifier is used for operation. An external regenerative resistor is used in case of insufficient capacity such as may be caused by high frequency of use.

Used for Servo motor with brake

- RS3A10/15



Used to protect power line.
Turns off the power supply when overload runs.

Installed to protect power line from external noise.

Enables parameter setup and monitoring through communication with a PC.

Switches power On/Off.
Please place safeguard circuit.

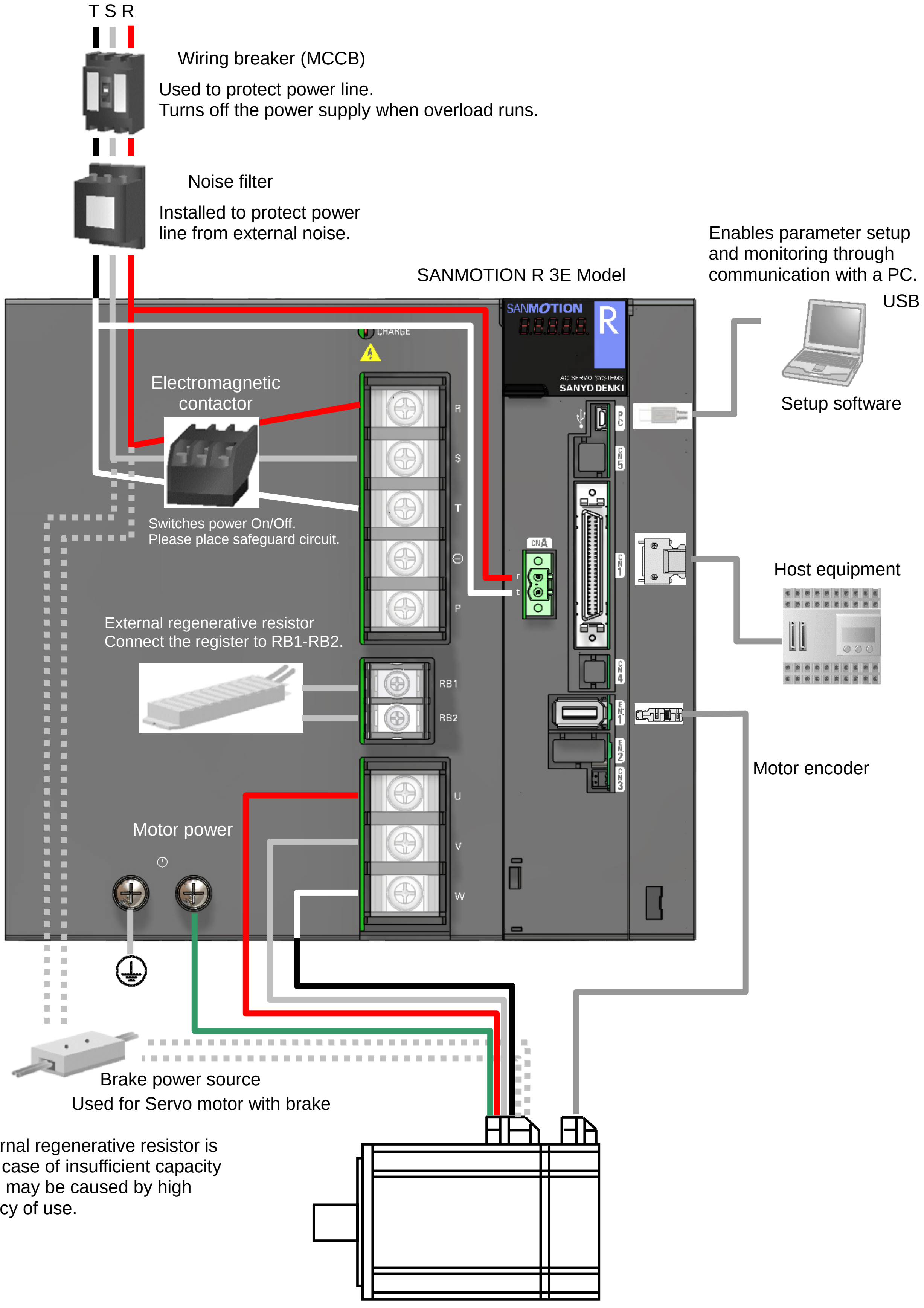
【Built-in regenerative resistor】
Shot-circuits RB4-RB1.
【External regenerative resistor】
Remove short bar RB4-RB1.
Connect the register to RB1-RB2.

Normally built-in regenerative resistor of servo amplifier is used for operation. An external regenerative resistor is used in case of insufficient capacity such as may be caused by high frequency of use.

Used for Servo motor with brake

1.3 Illustration Of System Components

■ RS3A30



Wiring breaker (MCCB)

Used to protect power line.
Turns off the power supply when overload runs.

Noise filter

Installed to protect power line from external noise.

SANMOTION R 3E Model

Enables parameter setup and monitoring through communication with a PC.

USB

Setup software

Electromagnetic contactor

Switches power On/Off.
Please place safeguard circuit.

Host equipment

External regenerative resistor
Connect the register to RB1-RB2.

Motor encoder

Motor power

Brake power source
Used for Servo motor with brake

An external regenerative resistor is used in case of insufficient capacity such as may be caused by high frequency of use.

Servo motor

1.4 Model number structure

1.4.1 Servo Motor Model Number

- R motor

R 2 AA ○○ ○○○ △ □ ◇ ○○ △ □

Servo motor series

R･･･R series

Servo motor type

1･･･R1 motor　2･･･R2 motor　5･･･R5 motor

Voltage

AA･･･AC200V　EA･･･AC100V

Flange dimensions

04･･･40mm　06･･･60mm　08･･･80mm
B8･･･86mm　10･･･100mm　13･･･130mm
18･･･180mm　22･･･220mm

Rated output

003･･･30W　005･･･50W　008･･･80W　010･･･100W
020･･･200W　040･･･400W　050･･･500/550W　075･･･750W
100･･･1.0kW　120･･･1.2kW　150･･･1.5kW　180･･･1.8kW
200･･･2.0kW　250･･･2.5kW　300･･･3.0kW　350･･･3.5kW
400･･･4.0kW　450･･･4.5kW　500･･･5.0kW　550･･･5.5kW
700･･･7.0kW　750･･･7.5kW　11K･･･11kW　15K･･･15kW

Maximum rotation speed

S･･･1000 min^{-1}　B･･･2000min^{-1}　R･･･2500min^{-1}
L･･･3000/4000min^{-1}　H･･･3000/3500min^{-1}　V･･･3000min^{-1}
D･･･4000/4500/5000min^{-1}　F･･･6000min^{-1}

Existence and spec for securing brake

X･･･No brake　B･･･With brake (DC90V)　C･･･With brake (DC24V)

Encoder type

H･･･Single-turn absolute encoder
P･･･Battery backup absolute encoder
R･･･Battery-less absolute encoder
W･･･Resolver type battery-less absolute encoder
S･･･Wire-saving incremental encoder

* See page 1-12, for kind of applicable motor encoder.

Specification identification

00･･･Standard

Additional specification

M･･･CE mark + UL supported　0･･･With decelerator without standards

Additional specification

for the motor with gear

Symbol	Reducer type	Reduction ratio
A	Planetary gear	1/3
B		1/5
C		1/9
D		1/15
E		1/33

Symbol	Reducer type	Reduction ratio
S	Backlash-less planetary gear	1/5
T		1/11
U		1/21
V		1/33

* Applicable to the flange size of 86mm or less.

◆ Absolute encoder (Standard)

Name (Code)	Motor model number Encoder code	Resolution per rotation	Multi turn amount	Transfer method
Single-turn absolute encoder (PA035S)	H	131072(17bit)	―	Half-duplex asynchronous 2.5Mbps
Battery backup absolute encoder (PA035C)	P	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps
Battery-less absolute encoder (HA035)	R	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps
Resolver type battery-less absolute encoder (RA035)	W	131072(17bit)	65536(16bit)	Half-duplex asynchronous 2.5Mbps

* Please contact us for the motor model number with the other absolute encoder except above.

◆ Incremental encoder (Standard)

Name (Code)	Motor model number Encoder code	Division number (Number of pulse)
Wire-saving incremental encoder (PP031H, PP031T, PP062)	S	8000(2000P/R)

* Please contact us for the motor model number with the other incremental encoder except above.

1.4.2 Servo Amplifier Model Number

RS3 △ ○○ A □ ◇ △ 0

Servo amplifier series

RS3･･･”SANMOTION R” 3E Model series

Input voltage

A･･･AC200V E･･･AC100V

Servo Amplifier capacity

01･･･10A 02･･･20A 03･･･30A 05･･･50A 07･･･75A
10･･･100A 15･･･150A 30･･･300A

* See page 1-14 for servo amplifier capacity and combination motor.

Servo Motor type

A･･･Rotary motor

Motor Encoder Type

	EN1 (for motor encoder only)	EN2 (for motor encoder or external encoder)
0	Absolute encoder	—
1	Absolute encoder	Absolute encoder
2	Absolute encoder	Incremental encoder
8	Incremental encoder	—
9	Incremental encoder	Absolute encoder
A	Incremental encoder	Incremental encoder

Interface type

A･･･Analog pulse control, sink type general output
B･･･Analog pulse control, source type general output

* See page 1-15 for the detail of sink and source type general output.

Option 1

A･･･With built-in regenerative resistance/ with DB resistance
L･･･Without built-in regenerative resistance/ with DB resistance

Option 2

	With Velocity/ Torque command input	Safe Torque Off function	Tandem operation function	Functional safety module
0	Available	None	None	None
2	Available	Available (without delay circuit)	Available	None
4	Available	Available (with delay circuit)	Available	None
C	Available	Available (without delay circuit)	Available	Available
E	Available	Available (with delay circuit)	Available	Available

* See "Instruction manual of SANMOTION R3E Model Safety, M0011778" for the functional safety module.

* Model numbers above are standard spec. Model number which is not listed spec in this manual will differ. Please contact us for the detail.

* Setup values of servo amplifier are "default values" at the time of shipment from our factory. Adjustments for System Parameters and General Parameters according to your equipment specifications, etc., as well as for Combination of Servo amplifier and Servo motor are necessary. Make certain to follow the appropriate set-up procedure to operate your system by referring to the following chapters:

- ◆ 5.1 Basic setting of the system
- ◆ 5.8 Parameter functions

* Motor encoder types, “0” or “8” are used exclusively for “Semi-closed” system and cannot be used for “Full-closed” systems.
However, the servo amplifier for the “Full-closed” system can be used for the “Semi-closed” system.

* Motor encoder type “2” is able to use for both of absolute encoder and incremental encoder, as motor encoder. Connect absolute encoder to EN1, and connect incremental encoder to EN2.

* See "10. Safe Torque Off function" for detail of Safe Torque Off function.

1.4 Model number structure

- ■ Servo amplifier capacity and combination motor (AC200V)
  *: Factory setting value of shortened model number

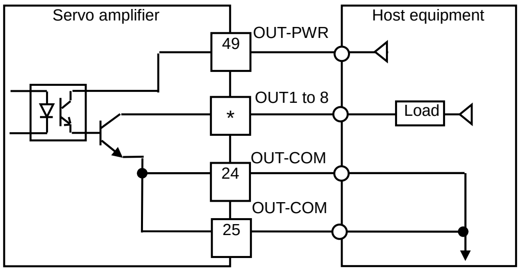
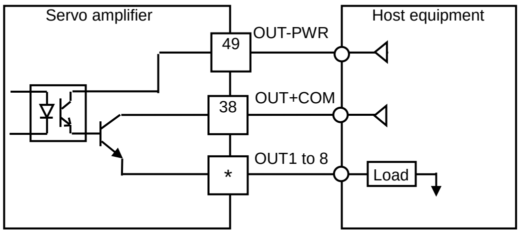
Input voltage	Servo amplifier model number	Servo motor model number
AC200V	RS3A01#	R2AA04003F*
		R2AA04005F
		R2AA04010F
		R2AA06010F
		R5AA06020H
	RS3A02#	R2AA06020F*
		R2AA06040F
		R2AA06040H
		R2AA08020F
		R2AA08040F
		R5AA06020F
		R5AA06040F
		R5AA06040H
	RS3A03#	R1AA10100H
		R1AA10150H
		R2AA08075F*
		R2AAB8100H
		R2AA10075F
		R2AA13050D
		R2AA13050H
		R2AA13120B
		R5AA08075D
		R5AA08075F
	RS3A05#	R1AA10100F
		R1AA10150F
		R1AA10200H
		R1AA10250H
		R2AAB8075F*
		R2AAB8100F
		R2AA10100F
		R2AA13120D
		R2AA13120L
		R2AA13180H
		R2AA13200L
	RS3A07#	R1AA10200F
		R1AA10250F
		R1AA13300H
		R2AA13180D*
		R2AA13200D
		R2AA18350V
AC200V	RS3A10#	R1AA13300F
		R1AA13400H
		R1AA13500H
		R2AA13180D
		R2AA13200D*
		R2AA18350L
	RS3A15#	R1AA13400F
		R1AA13500F
		R2AA18350D
		R2AA18450H
		R2AA18550R
		R2AA22500L
		R2AA22700S
	RS3A30#	R1AA18550H*
		R1AA18750L
		R1AA1811KR
		R1AA1815KB
		R2AA18550H
		R2AA18750H
		R2AA1811KR
		R2AA2211KB
		R2AA2215KB

* R2AA13180D and R2AA13200D are able to combine with either of RS3A07 or RS3A10.

- ■ Servo amplifier capacity and combination motor (AC100V)
  *: Factory setting value of shortened model number

Input voltage	Servo amplifier model number	Servo motor model number
AC100V	RS3E01#	R2EA04003F*
	RS3E02#	R2EA04005F*
		R2EA04008F
		R2EA06010F
	RS3E03#	R2EA06020F*

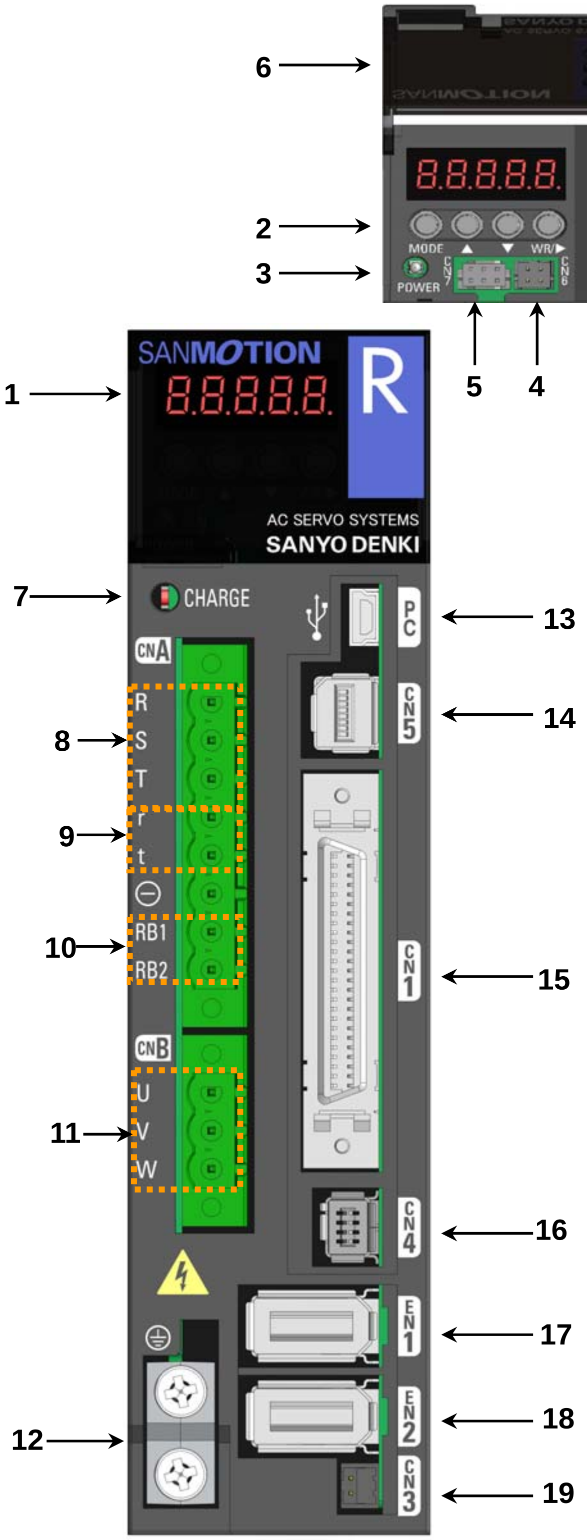
- Sink type general output, Source type general output

Interface type	General output circuit type	Output current	Circuit
A	Sink type general output	Current flows to output terminal from a load at output signal ON.	 * : 39 to 46
B	Source type general output	Current flows to a load from output terminal at output signal ON.	 * : 39 to 46

1.5 Part names

1.5.1 Servo amplifier

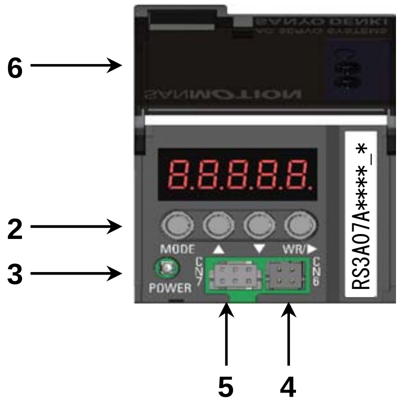
■ RS3☐01/ RS3☐02/ RS3☐03/ RS3☐05

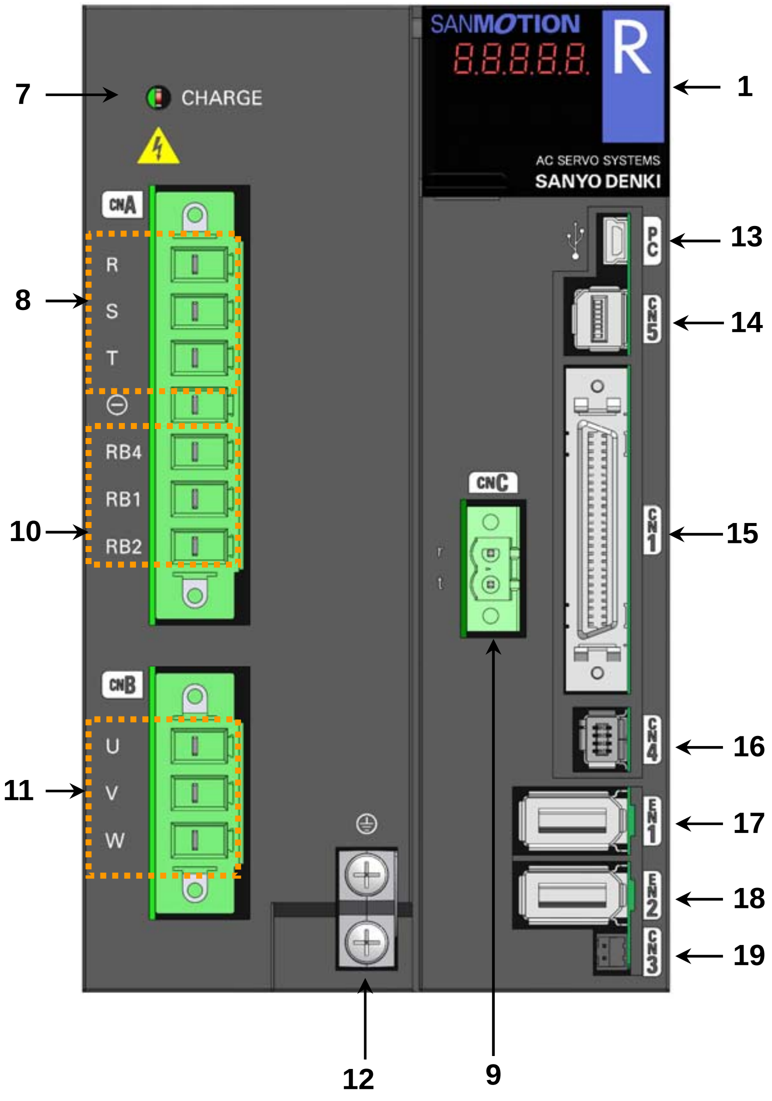


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input (CNA)/ For input terminal of main circuit power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal (CNA)/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal (CNB)/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4)/ *
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2)/ *
19	For battery connection (CN3)/ *

*: It may not have the connecter depending on the servo amplifier spec.

- ■ RS3A07



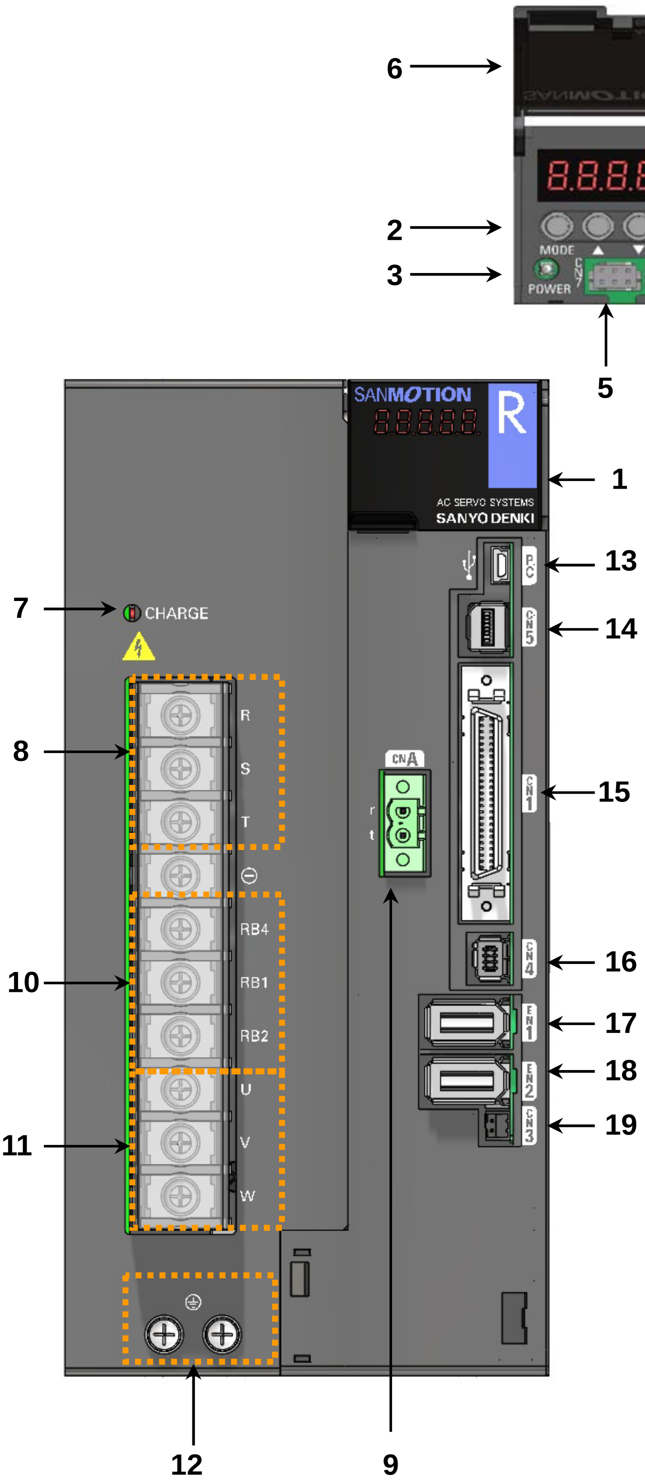


No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input terminal (CNA)/ For input terminal of control power
9	Control power input (CNC)/ For input terminal of control power
10	Regenerative resistor terminal (CNA)/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal (CNB)/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4) *
17	For motor encoder (EN1)
18	For motor encoder or external encoder (EN2) *
19	For battery connection (CN3) *

* It may not have the connecter depending on the servo amplifier spec.

1.5 Part names

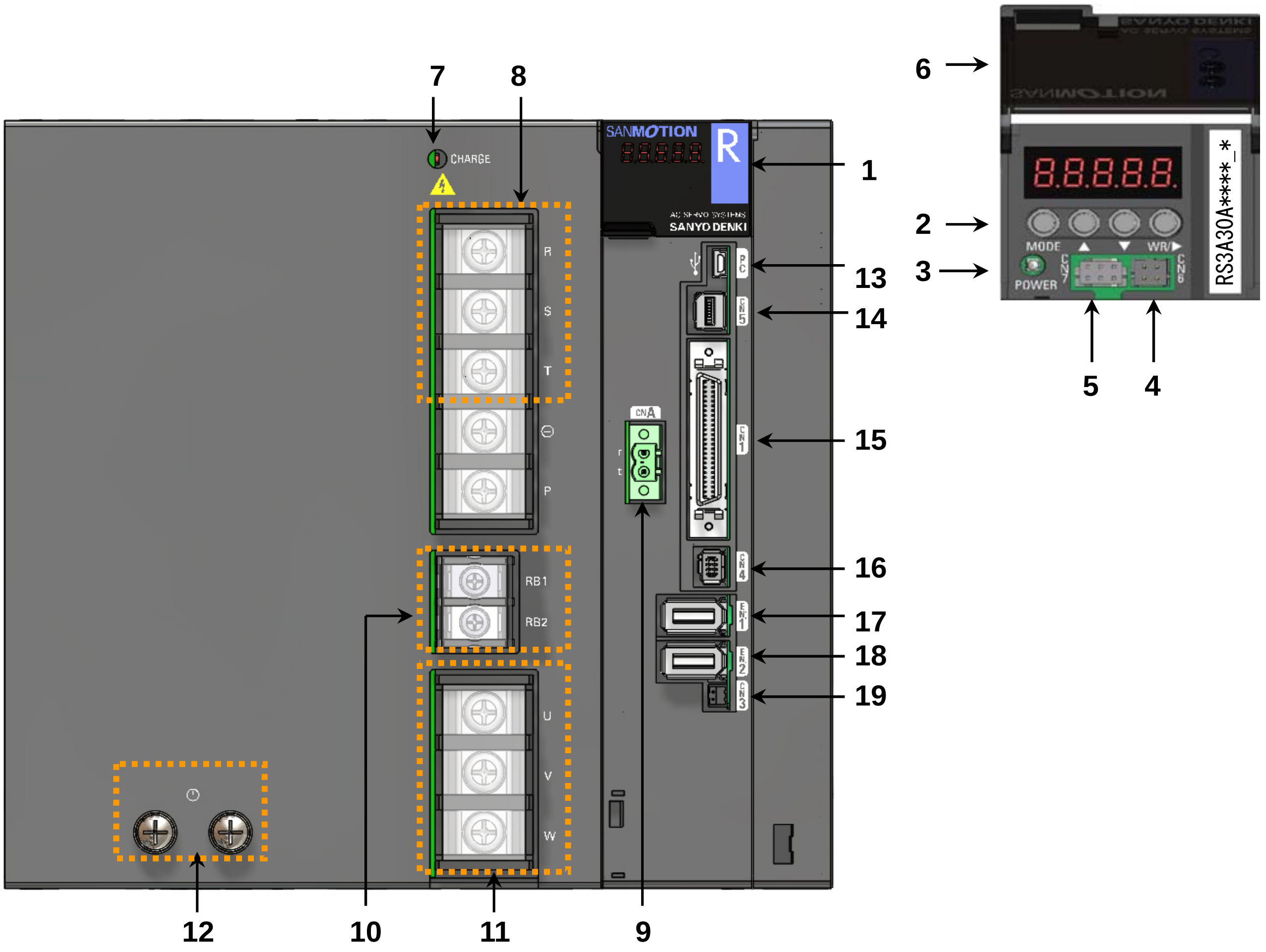
■ RS3A10/ RS3A15



No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.
8	Main circuit power input terminal/ For input terminal of control power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal/ Connect the resistor between RB1 and RB2. There are two kind of regenerative resistor, internal and external.
11	Motor power terminal/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) *
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4) *
17	For motor encoder (EN1)
18	For motor encoder or external encoder (EN2) *
19	For battery connection (CN3) *

* It may not have the connecter depending on the servo amplifier spec.

■ RS3A30



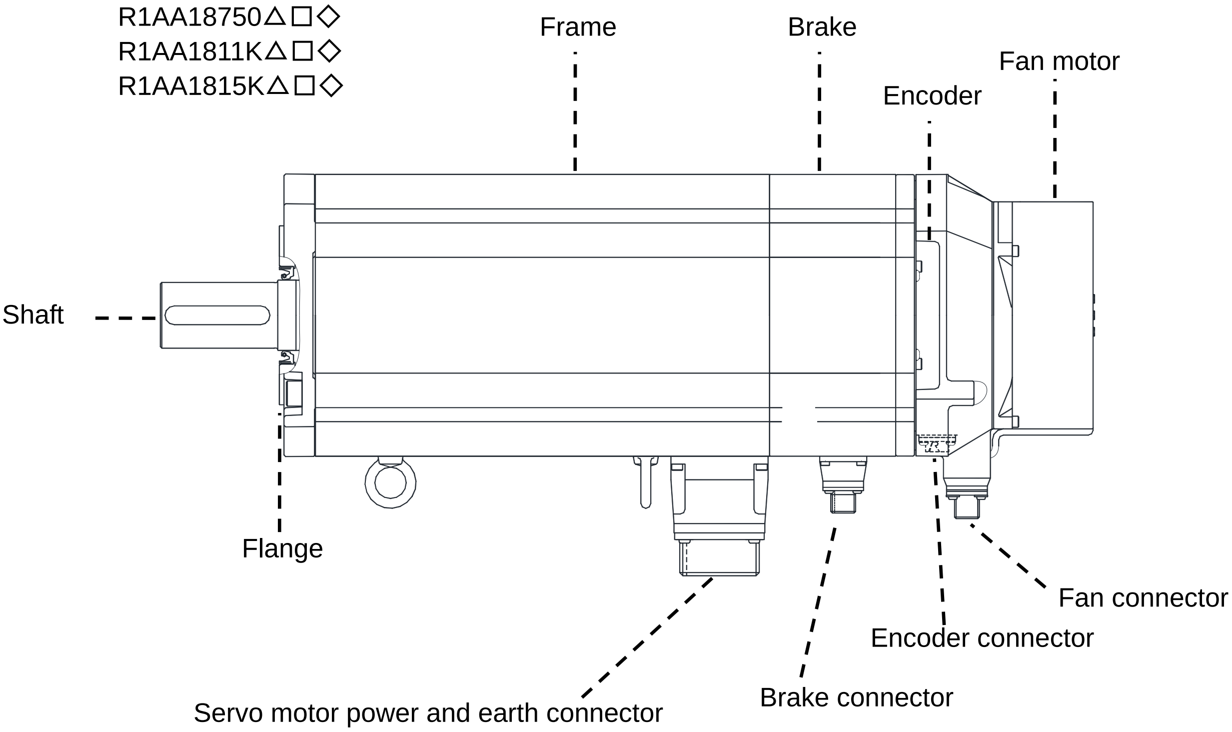
No.	Name/ Use
1	Digital operator display/ For servo amplifier status, alarm code and data display for parameter input
2	Digital operator key/ For parameter setting, test operation etc.
3	Control power status LED (Blue)/ Lighting on when control power inputted and control circuit is working.
4	Analog monitor connector (CN6)/ For measuring analog signal such as velocity or current with dedicated cable.
5	(CN7)/ For maintenance
6	Front panel cover/
7	Main circuit power LED (Red)/ Lighting on when main circuit power is ON. Continue lighting during internal capacitor has charge, even if power is OFF. Do not touch power terminal during lighting. There is a risk of electric shock.

No.	Name/ Use
8	Main circuit power input terminal/ For input terminal of main power
9	Control power input (CNA)/ For input terminal of control power
10	Regenerative resistor terminal/ Connect the external regenerative resistor between RB1 and RB2.
11	Motor power terminal/
12	Earth connecting terminal/
13	USB connector for PC communication (PC)/
14	For function expansion connector (CN5) ※
15	For I/O signal connector with host equipment (CN1)/
16	For safety features connector (CN4) ※
17	For motor encoder (EN1)/
18	For motor encoder or external encoder (EN2) ※
19	For battery connection（CN3）/ ※

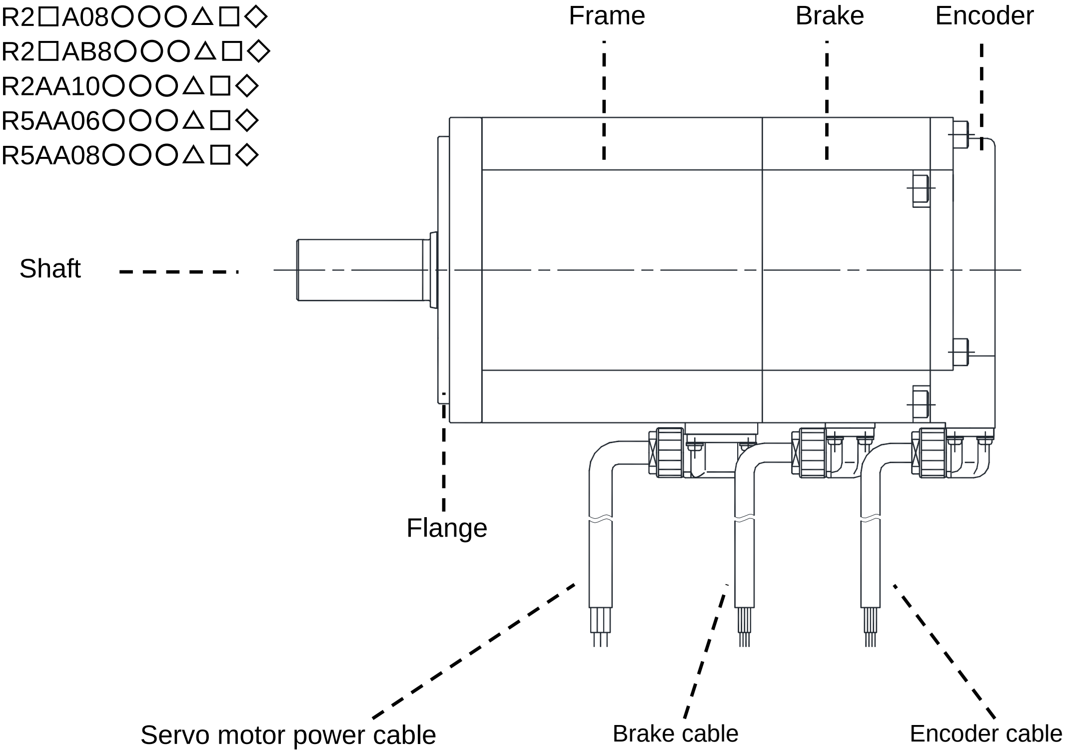
※ It may not have the connecter depending on the servo amplifier spec.

1.5.2 Servo motor

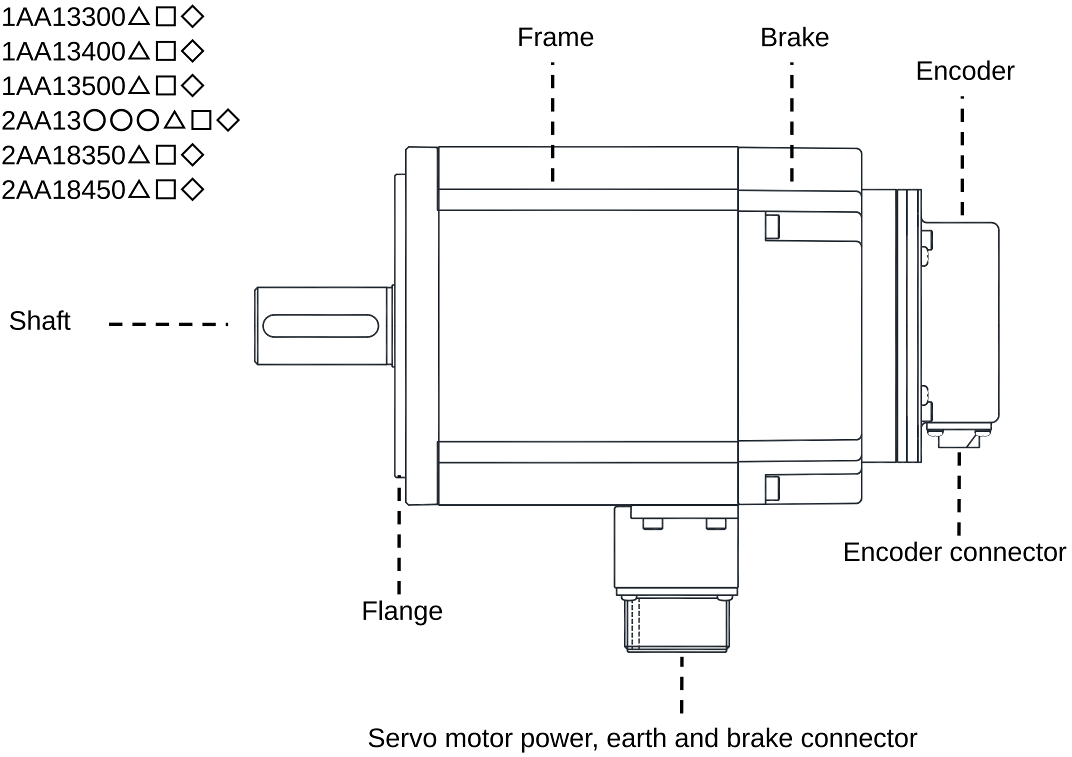
- R1 servo motor □180mm, 5.5kW to 15kW
  R1AA18550△□◇
  R1AA18750△□◇
  R1AA1811K△□◇
  R1AA1815K△□◇



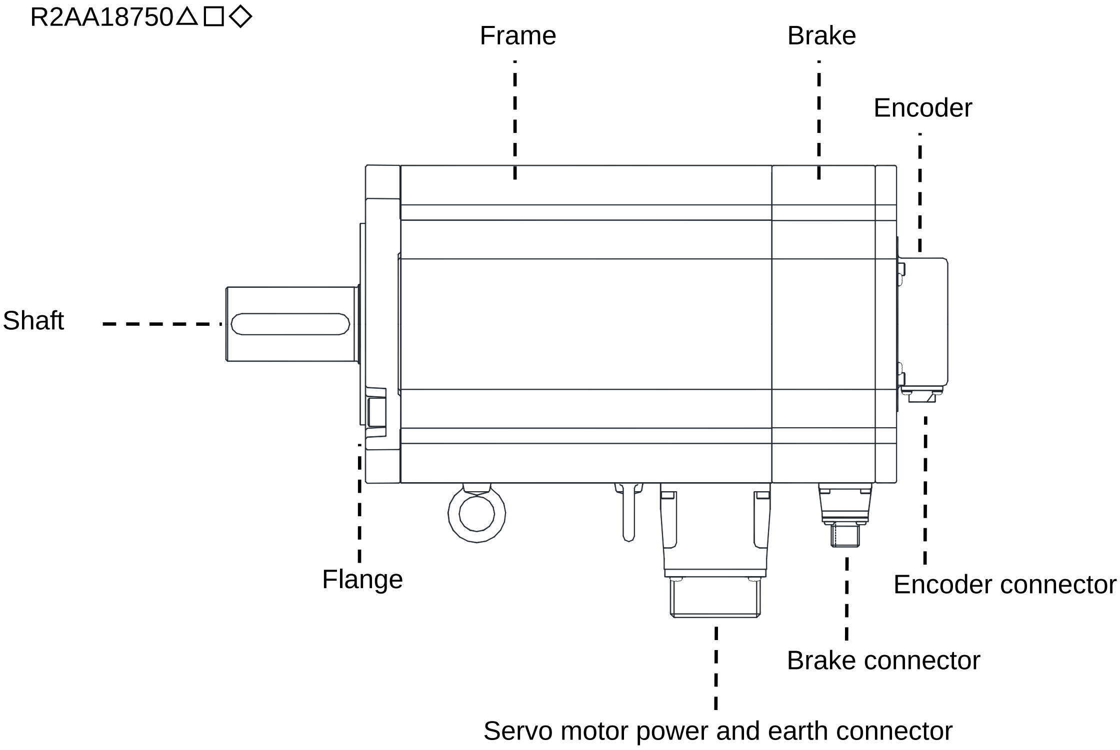
- R2,R5 servo motor □40mm to □100mm, 30W to 1.0kW
  R2□A04○○○△□◇
  R2□A06○○○△□◇
  R2□A08○○○△□◇
  R2□AB8○○○△□◇
  R2AA10○○○△□◇
  R5AA06○○○△□◇
  R5AA08○○○△□◇



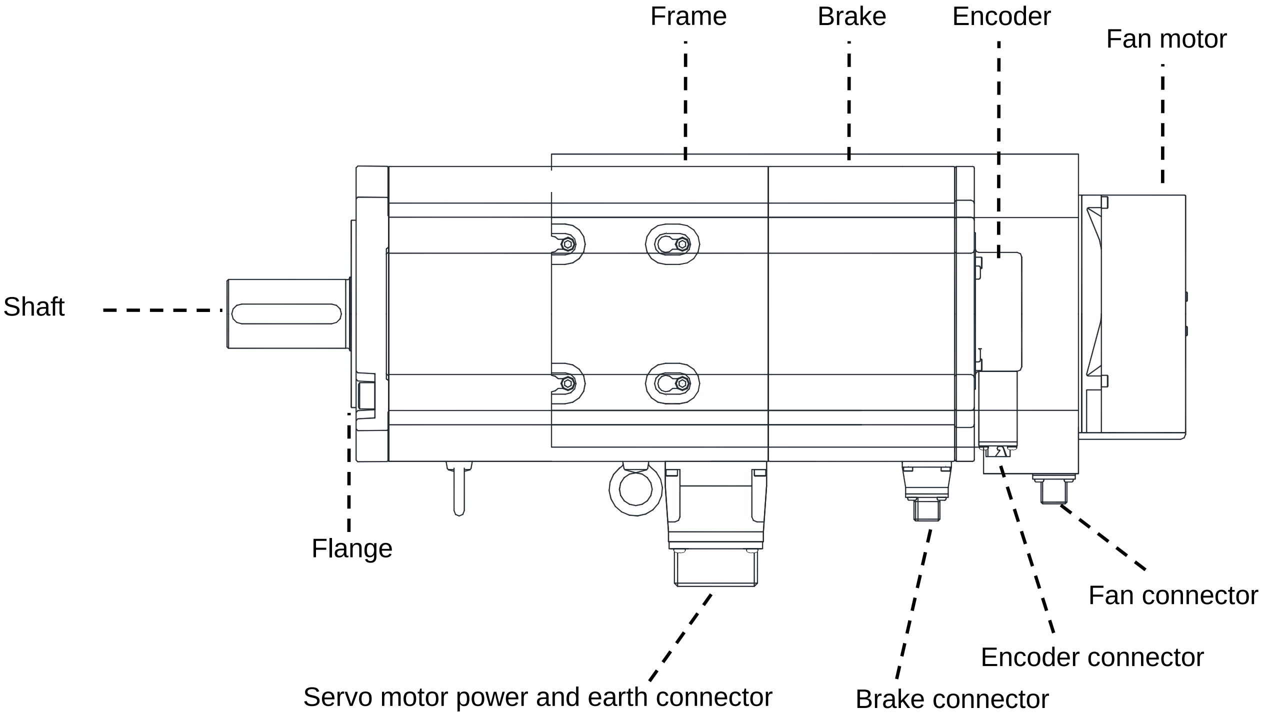
- R1 servo motor □100mm, 1.0kW to 2.5kW, □130mm, 3kW to 5kW
  R2 servo motor □130mm, 0.5kW to 2kW, □180mm, 3.5kW to 4.5kW
  - R1AA10100△□◇
  - R1AA10150△□◇
  - R1AA10200△□◇
  - R1AA10250△□◇
  - R1AA13300△□◇
  - R1AA13400△□◇
  - R1AA13500△□◇
  - R2AA13○○○△□◇
  - R2AA18350△□◇
  - R2AA18450△□◇



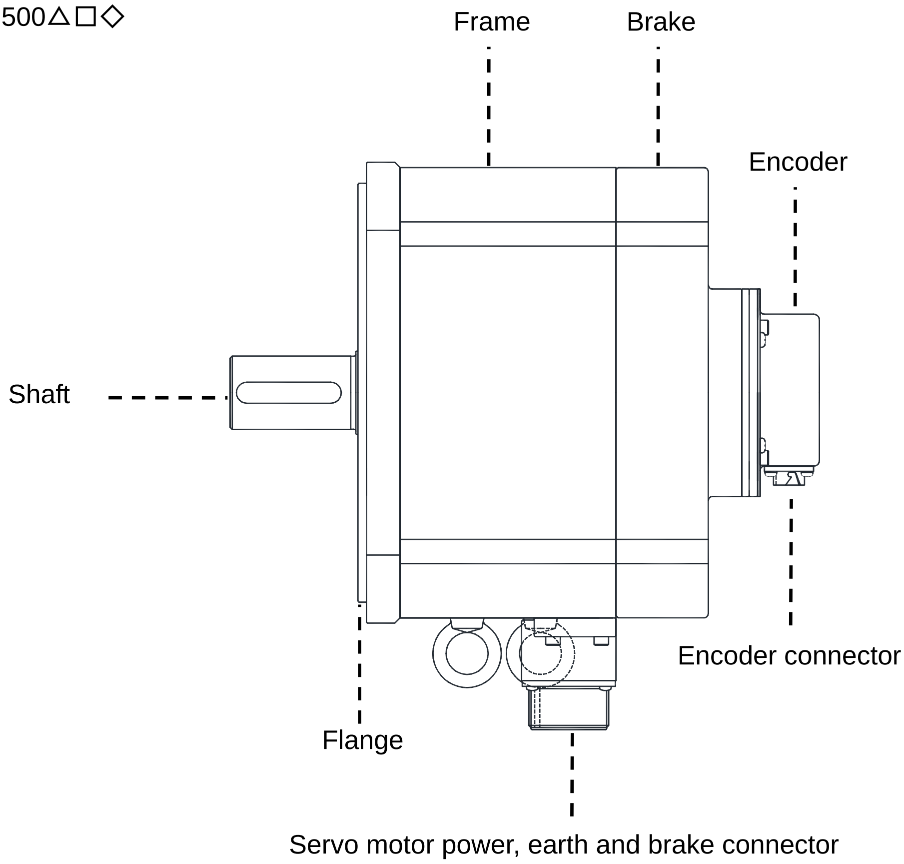
- R2 servo motor □180mm, 5.5kW to 7.5kW
  - R2AA18550△□◇
  - R2AA18750△□◇



- R2 servo motor □180mm, 11kW
  R2AA1811K△□◇

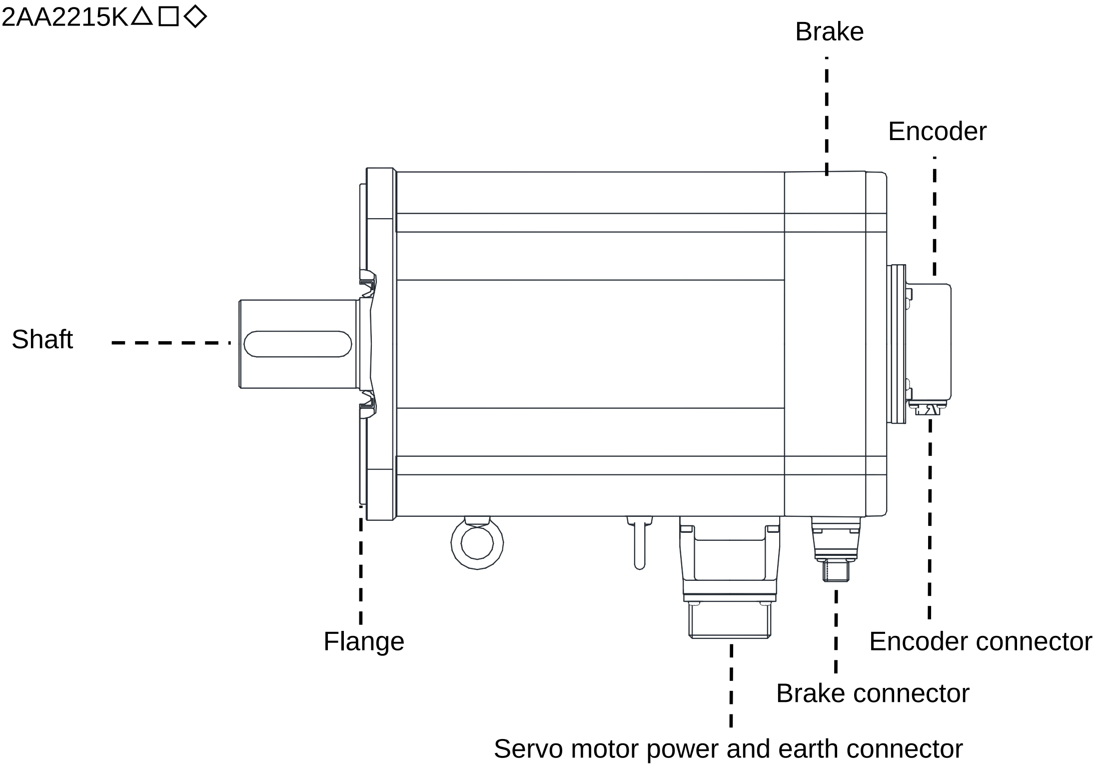


- R2 servo motor □220mm, 5kW
  R2AA22500△□◇



1. Preface

- ■ R2 servo motor □220mm, 7kW to 15kW
  R2AA22700△□◇
  R2AA2211K△□◇
  R2AA2215K△□◇



2

Specifications

In this chapter, specifications of servo amplifier, servo motor and regenerative resistor are explained.

2. Specifications

2.1 Servo motor

2.1.1 General specifications

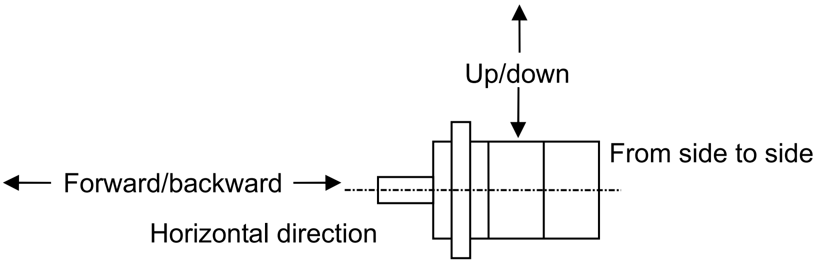
Series name	R1,R2,R5
Time rating	Continuous
Insulation classification	Type F
Voltage/Dielectric strength	AC1500V 1 minute
Insulation resistance	DC500V, greater than 10MΩ
Protection method	Totally Enclosed, Non-Ventilated Motor flange size 100 or less: IP65, 67 Motor flange size 130 or over: IP65 However, except for axial penetration part and cable tip part
Oil Sealing	Motor flange size 100 or less: No oil seal (but optionally available. Exceptionally, motor flange size 100 of R1 motor: With oil seal.) Motor flange size 130 or over: With oil seal
Ambient temperature	0 to +40°C
Storage temperature	-20 to +65°C
Ambient humidity	20 to 90% (without condensation)
Vibration classification	V15
Excitation method	Permanent magnet type
Installation method	Flange mount

2.1.2 Exterior dimensions/ specifications/ mass

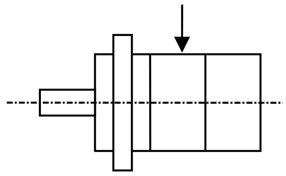
Refer to “12.3 Servo Motor Dimension”.
Refer to “12.4 Servo Motor Data Sheet”.

2.1.3 Mechanical specifications/ mechanical strength/ working accuracy

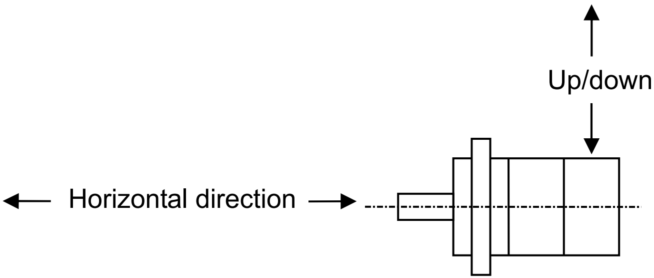
- Vibration resistance
  Install the servo motor horizontally (shown in the figure below), so when vibration occurs in any of three (3) directions (up/down, backward/forward, left/right) the motor will withstand vibration acceleration up to 24.5m/s2.
  Exceptionally for 100 and 130mm flange size R1 motor, 49m/s2 in rotating and 24.5m/s2 at stop.



- Vibration classification
  The vibration classification of the servo motor is V15 or less at maximum rotation speed for a single servo motor unit and is measured as indicated in the figure below.

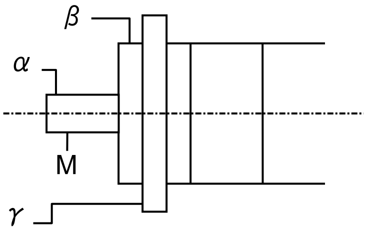


- Shock resistance
  Install the shaft of servo motor in a horizontal direction (shown in the figure below). This shaft should withstand shock acceleration up to 98m/s2 (when shock is applied in an upward/downward direction) for two (2) times. However, since a precision motor encoder is fixed to the counter-load side of the flange, any shock applied to the shaft may cause damage to the motor encoder. Therefore, try to avoid shock to the shaft under any circumstances.



- Mechanical strength
  The axis strength of the servo motor can withstand peak torque at stall.

- Working accuracy
  The following table shows the accuracy and precision of the servo motor output shaft (Total Indicator Reading) of the parts surrounding the shaft.

Items	T. I. R.	Reference Figure
Vibration of output shaft terminal: α	0.02	
Eccentricity of external diameter of flange on output shaft M: β	0.06(80 or less)	
	0.08(100 or over)	
Perpendicularity of flange face to output shaft M: γ	0.07(80 or less)	
	0.08(100 or over)	

* Figures in parentheses indicate square flange dimensions in millimeters.

2.1.4 Oil seal type

S-Type oil seal (as shown in the table below) is fixed to the output shaft of the servo motor. This oil seal is produced by NOK Corporation. Please contact us for replacement of this oil seal. Please contact us for oil seal replacement.

Servo motor model number	Oil seal type
R1AA10○○○□	Standard: Double Lip seal type
R1AA13○○○□	Standard: S-Type
R1AA18○○○□	Standard: S-Type
R2□A04○○○□	Standard: N/A, Optional: S-Type
R2□A06○○○□/R2□A□8○○○□	Standard: N/A, Optional: S-Type
R2□A10○○○□	Standard: N/A, Optional: S-Type
R2AA13○○○□/R2AA22500L	Standard: Double Lip seal type
R2AA18○○○□/R2AA22○○○□	Standard: S-Type
R5AA06○○○□	Standard: N/A, Optional: S-Type
R5AA08○○○□	Standard: N/A, Optional: S-Type

* Please contact us for specifications of the other model number above.

2.1.5 Holding brake

An optional Holding Brake is available for the servo motor. Since the primary use of this brake is for holding, it should never be used for braking, except in emergency situations.

- ■ Surge-absorbing element
  Must connect surge-absorbing element such as varistor or diode, to between holding brake terminals, for suppressing surge noise which occurs at holding brake excitation turn off. Please note, the braking delay time will differ depending on used servo motor and surge-absorbing element, as see table below.

- ■ Holding brake control
  Please control by using holding brake excitation signal from servo amplifier. In use of this signal, set suitable value to "Delay Time of Releasing Holding Brake(GroupB-ID04, BOFFDLY)" and "Delay Time of Engaging Holding Brake (GroupB-ID03, BONDLY)" by seeing the time in the table below as reference.
  In use of the signal from other device for holding brake excitation control, also refer the time in the table below.

  Release delay time is same for varistor and diode.

Servo motor model number		Static friction torque N・m	Release delay time msec	Braking delay time msec	
				Varistor	Diode
R1	R1AA10100□	9.3	100	30	140
	R1AA10150□				
	R1AA10200□				
	R1AA10250□				
	R1AA13300□	12	100	30	140
	R1AA13400□	16	150	50	300
	R1AA13500□				
	R1AA18550H	54.9	300	140	400
	R1AA18750L				
	R1AA1811KR	75			
	R1AA1815KB	120		60	600

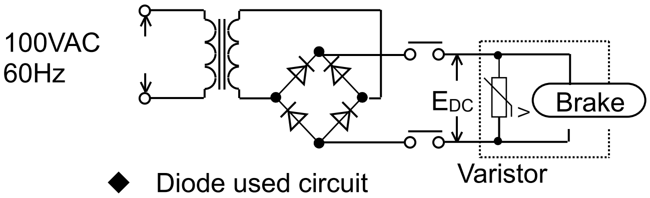
* Please contact us for specifications of the other model number above.

Servo motor model number		Static friction torque N・m	Release delay time msec	Braking delay time msec	
				Varistor	Diode
R2	R2AA04003F	0.32	25	15	100
	R2AA04005F				
	R2AA04010F				
	R2AA06010F	0.36	30	20	120
	R2AA06020F	1.37			
	R2AA06040☐	1.37			
	R2AA08020F	2.55	40		200
	R2AA08040F				
	R2AA08075F				
	R2AAB8075F	3.92			
	R2AAB8100☐				
	R2AA10075F				
	R2AA10100F				
	R2AA13050☐	3.50		30	120
	R2AA13120☐	9.0	100		130
	R2AA13180☐				
	R2AA13200☐	12.0			140
	R2AA18350☐	22.0	120	50	150
	R2AA18450H	32.0	150	60	250
	R2AA18550☐	42.0	150	60	250
	R2AA18750H	54.9	300	140	400
	R2AA1811KR	100	300	140	400
	R2AA22500L	42	150	60	250
	R2AA22700S	90	300	140	400
	R2AA2211KB				
	R2AA2215KB				
	R2EA04003F	0.32	25	15	100
	R2EA04005F				
	R2EA04008F				
	R2EA06010F	0.36	30	20	120
	R2EA06020F	1.37			
R5	R5AA06020☐				
	R5AA06040☐				
	R5AA08075☐	2.55	40		200

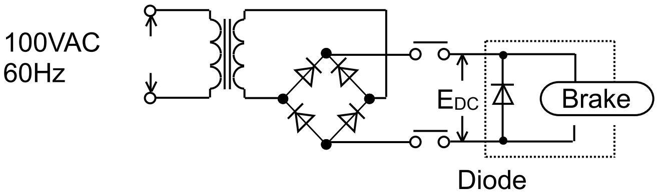
* Please contact us for specifications of the other model number above.

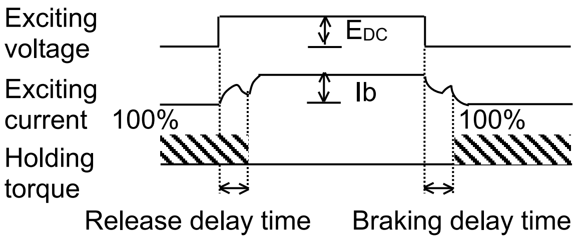
- Measurement of release delay time and braking delay time
  The value of release delay time and braking delay time are measured by the circuit below.

◆ Varistor used circuit



◆ Diode used circuit





2.1.6 Degree of decrease rating for R2AA motor, with oil seal and brake

In terms of servomotors with oil-seal and/or brake, the following de-rating ratio has to be applied to the torque characteristic in the continuous speed range.

Oil seal Brake	Without oil seal	With oil seal
With no brake	-	Degree of decrease rating 2
With brake	Degree of decrease rating 1	Degree of decrease rating 2

	R2AA04005F	R2AA04010F	R2AA06040□	R2AA08075F	R2EA04005F
Degree of decrease rating 1	-	90%	90%	-	-
Degree of decrease rating 1	90%	85%	80%	90%	90%

2.2 Motor encoder

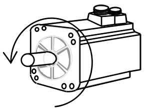
2.2.1 Absolute encoder

■ Absolute encoder specifications

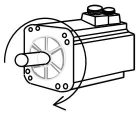
Name (code)	Motor model number encoder code	Resolution per rotation (Single turn)	Multi turn part amount (Multi turn)	Transfer method
Battery less absolute encoder (HA035)	R	131,072 (17bit) 1,048,576 (20bit) 8,388,608 (23bit)	65536 (16bit)	Half duplex asynchronous 2.5Mbps / 4Mbps
Single-turn absolute encoder (PA035S)	H	131,072 (17bit) 1,048,576 (20bit)	-	Half duplex asynchronous 2.5Mbps / 4Mbps
Battery backup absolute encoder (PA035C)	P	131,072 (17bit) 1,048,576 (20bit)	65536 (16bit)	Half duplex asynchronous 2.5Mbps / 4Mbps
Resolver type battery-less absolute encoder (RA035C)	W	131,072(17bit)	65536(16bit)	Half duplex asynchronous 2.5Mbps / 4Mbps

■ Relation between servo motor rotation direction and absolute position data (PS data)
See below the relation between servo motor rotation direction and absolute position data (PS data).

Servo motor rotation direction (Normal rotation) Position signal output (PS data): Increase



Servo motor rotation direction (Reverse rotation) Position signal output (PS data): Decrease



* Forward (normal) rotation is Counterclockwise (CCW) seeing from load side.
* PS data can be confirmed by “ID33, 34 ABSPS” in “5.5 Monitor function”.

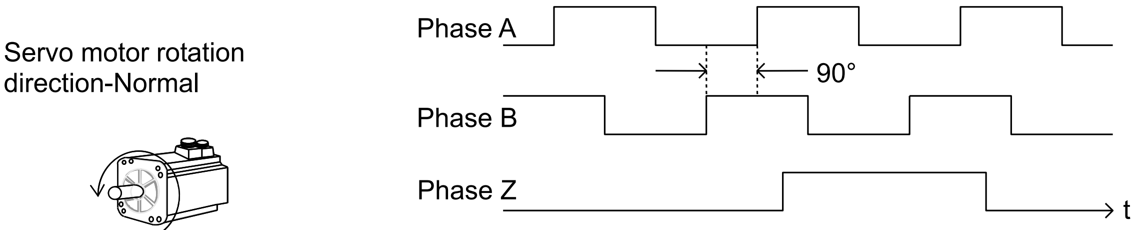
2.2.2 Incremental encoder specifications

■ Wire-saving incremental encoder

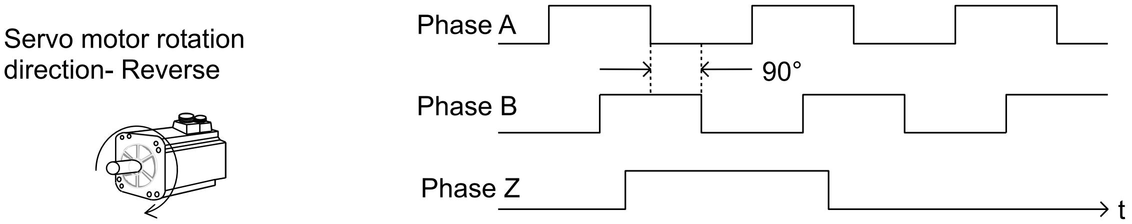
Model	Motor model number encoder code	Resolution	Conform to motor flange angle
PP031H PP031T	S	1000/2000/2048/4096/5000/6000/8192/10000 P/R	Greater than 40mm
PP062	S	1000/2000/2048/4096/5000/6000/8192/10000 P/R	Greater than 80mm

Model number example: R2-series, square type: 60mm, 200W-model R2AA06020FCS00

■ Servo motor rotation direction and encoder signal phase
Motor rotation direction and motor encoder signal phases are related as follows:



Phase B is 90° ahead of Phase A.



Phase B is 90° behind of Phase A.

* When Z-Phase is at high level, both Phases A and B cross the low level once every rotation.

2.2.3 Battery specification

Model: ER3VLY (produced by Toshiba Lifestyle Products & Services Corporation)
Voltage: 3.6V

2.3 Servo amplifier

2.3.1 General specifications

■ General specifications

Control function		Speed control/Torque control/Position control (Parameter changeover)							
Control system		IGBT: PWM control Sinusoidal drive							
Main Circuit Power Note 1)		Three-phase: AC200 to 240V+10,-15% , 50/60Hz±3Hz Single-phrase: AC200 to 240V+10,-15% , 50/60Hz±3Hz Note 2) Single-phrase: AC100 to 120V+10,-15% , 50/60Hz±3Hz Note 3)							
Control power Note 1)		Single-phrase: AC200 to 240V+10,-15% , 50/60Hz±3Hz Single-phrase: AC100 to 120V+10,-15% , 50/60Hz±3Hz Note 3)							
Environment		Ambient temperature	0 to 55℃						
		Storage temperature	-20 to +65℃						
		Operation/ Storage humidity	Below 90%RH (no condensation)						
		Elevation	Below 1000m						
		Vibration	$4.9m/s^2$						
		Shock	$19.6m/s^2$						
Structure		Built-in tray type power supply							
Servo amplifier model number		RS3#01A##A# RS3#01A##L#	RS3#02A##A# RS3#02A##L#	RS3#03A##A# RS3#03A##L#	RS3A05A##A# RS3A05A##L#	RS3A07A##A# RS3A07A##L#	RS3A10A##A# RS3A10A##L#	RS3A15A##A# RS3A15A##L#	RS3A30A##L#
External dimensions (H×W×D)		160×40×130	160×40×130	160×50×130	160×85×130	160×95×190	205(235) ×100×220	205(235) ×120×220	205(235) ×220×220
Weight (kg)	Without internal regenerative resistor	0.68	0.70	0.80	1.5	2.3	4.0	4.7	9.8
	With internal regenerative resistor	0.73	0.75	0.85	1.55	2.5	4.2	4.9	なし

Note 1) Power source voltage should be within the specified range AC200V Power input type:
Specified power supply range = AC170V to AC264V
AC100VPower input type: Specified power supply range = AC85V to AC132V
Note 2) AC200V-single-phase input type corresponds only to RS3☐01/RS3☐02/RS3☐03/ RS3☐05.
Note 3) AC100V-single-phase input type corresponds only to RS3☐01/ RS3☐02/RS3☐03.

■ Specifications

Speed control range	1: 5000 Note 4)
Frequency characteristics	2200Hz Note 5)
Allowable load inertia moment	10 times motor rotor inertia moment Note 6)

Note 4) Internal speed command
Note 5) In case of high-velocity sampling mode
Note 6) When the value exceeds the above allowable load inertia moment, please contact us.

■ Built-in functions

Protection functions	Over current, Current detection error, Overload, Regeneration error, Overheat error, External overheating, Over voltage, Main circuit power low voltage, Main circuit power supply open phase, Control power supply low voltage, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position, Position command pulse error, Built-in memory error, Parameter error, Cooling fan error	
Digital operator	Status display, Monitor display, Alarm display, Parameter setting, Test operation, Adjustment mode	
Dynamic brake circuit	Built -in	
Regeneration process circuit	Built -in	
Monitor	Speed monitor (VMON)	2.0V±10%(at 1000min^{-1})
	Torque (Thrust) (TCMON)	2.0V±10%(at 100%)

2.3.2 Input command, position signal output, general input, general output

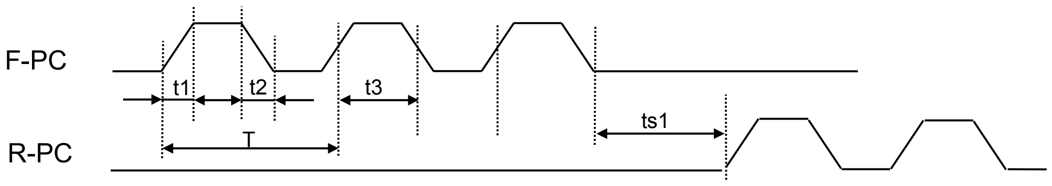
■ Input command

◆ Position command

Position command	Maximum input pulse frequency	4M Pulse/s (Reverse + Forward pulse, Code +Pulse) 1M Pulse/s (90°-phase difference two-phase pulse)
	Input pulse form	Forward + Reverse command pulse, Code + Pulse train command or 90°-phase difference two-phase pulse train command
	Electronic gear	N/D(N=1 to 2097152, D=1 to 2097152) However, 1/2097152 ≦ N/D ≦ 2097152

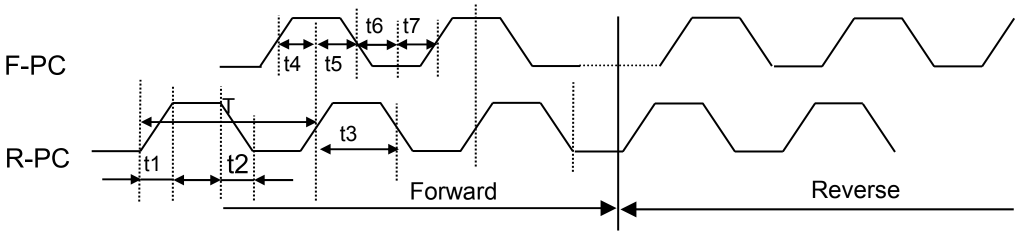
◆ Position command timing

Positive move pulse train + Negative move pulse train



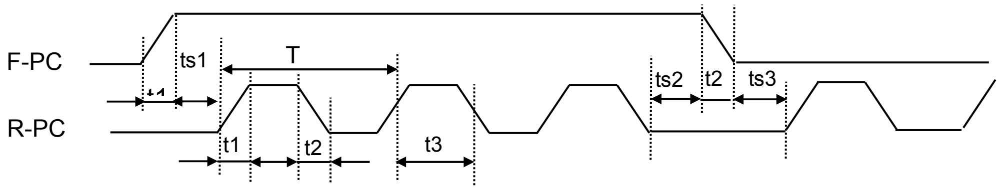
Stage up time (t1): ≦0.1μs	Stage down time (t2): ≦0.1μs
Duty[(t3/T)x100]: 50%	Change of pulse time: ts1 > 2μs

Pulse trains with 90°phase difference



Stage up time (t1): ≦0.1μs	Stage down time (t2): ≦0.1μs
Duty[(t3/T)x100]: 50%	
Minimum phase difference between pulse edges (t4, t5, t6, t7): >250nsec	

Code + Pulse train



Stage up time (t1): ≦0.1μs	Stage down time (t2): ≦0.1μs
Duty[(t3/T)x100]: 50%	Change of pulse time: ts1,ts2,ts3> 2μs

◆ Speed command

Speed command	Voltage command	DC±2.0V at 1000min-1 command, Plus command (forward) motor rotation Maximum input voltage ±10V
	Input impedance	Approximately10kΩ

◆ Torque command

Torque command	Voltage command	DC±2.0V at 100% torque, Plus command (forward) rotation Maximum input voltage ±10kΩ
	Input impedance	Approximately 10kΩ

- ■ Position signal output

Encoder output Pulse signal	N/32768(N=1～32767), 1/N(N=1～64) or 2/N(N=2～64)
Encoder output serial signal	Binary code output, decimal ASCII output

- ■ General input

Sequence input	Interactive photo coupler (sink, source connection): ×8 input
	Input power voltage range: DC5V±5% / DC12V~DC24V±10%, 100mA or over(DC24V)
	Servo ON, Alarm reset, Torque limit, Encoder clear, Forward rotation prohibit, Command prohibit, Reverse rotation prohibit, Command prohibit, External trip, Forced discharge, Emergency stop, Gain switching, Internal speed setting, etc. Refer to “Group9 Condition settings for enabling function (5-102)” for details.

- ■ General output [Sink type general output, Source type general output]

Sequence output	Open collector output: x 8 outputs
	Power supply for general output circuit (CN1-49,OUT-PWR): DC5V±5% / DC12V to DC24V±10%, 20mA or over
	Specification of Power supply for general output circuit ･DC5V±5% , Maximum current value 10mA (per 1 output) ･DC12V~DC15V±10% , Maximum current value 30mA (per 1 output) ･DC24V±10% , Maximum current value 50mA (per 1 output)
	Servo ready, Power ON, Servo ON, Holding brake timing, Torque limiting, Low speed, Velocity attainment, Matching speed, Zero speed, Command acceptable, Status of gain switch, Velocity loop proportional control status, Control mode switchover status, Forward OT, Reverse OT, Reverse OT, Warning, Alarm code (3bits), etc. Refer to “GroupA Settings for Generic Output Outputting Condition/Monitor Output selection/ Serial Communications (5-113)” for details.

2.3.3 Torque limit input

Torque limit input	DC±2.0V±15% (at rated torque) Input impedance: approximately 10kΩ

2.4 Power supply, calorific value

2.4.1 Main circuit power supply capacity, control power supply capacity

- AC200V Input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Rated main circuit power supply (kVA)	Control power supply (VA)
AC200V	RS3A01#	R2AA04003F	30	0.2	40
		R2AA04005F	50	0.2	
		R2AA04010F	100	0.3	
		R2AA06010F	100	0.3	
		R5AA06020H	200	0.6	
	RS3A02#	R2AA06020F	200	0.6	
		R2AA06040F	400	1.0	
		R2AA06040H	400	1.0	
		R2AA08020F	200	0.6	
		R2AA08040F	400	1.0	
		R5AA06020F	200	0.6	
		R5AA06040F	400	1.0	
		R5AA06040H	400	1.0	
	RS3A03#	R1AA10100H	1000	2.3	
		R1AA10150H	1500	3.0	
		R2AA08075F	750	1.6	
		R2AAB8100H	1000	2.0	
		R2AA10075F	750	1.7	
		R2AA13050D	550	1.2	
		R2AA13050H	550	1.2	
		R2AA13120B	1200	2.2	
		R5AA08075D	750	1.6	
		R5AA08075F	750	1.6	
	RS3A05#	R1AA10100F	1000	2.3	
		R1AA10150F	1500	3.0	
		R1AA10200H	2000	4.0	
		R1AA10250H	2500	5.0	
		R2AAB8075F	750	1.6	
		R2AAB8100F	1000	2.3	
		R2AA10100F	1000	2.3	
		R2AA13120D	1200	2.8	
		R2AA13120L	1200	2.8	
		R2AA13180H	1800	3.6	
		R2AA13200L	2000	4.0	
	RS3A07#	R1AA10200F	2000	4.0	
		R1AA10250F	2500	5.0	
		R1AA13300H	3000	6.0	
		R2AA13180D	1800	4.0	
		R2AA13200D	2000	4.0	
		R2AA18350V	3500	6.0	

* # = Optional alphabetical letter

* Values are of rated speed, torque ratings.

2.4 Power supply calorific value

■ AC200V input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply (kVA)	Control power supply (VA)
AC200V	RS3A10#	R1AA13300F	3000	6.0	40
		R1AA13400H	4000	6.7	
		R1AA13500H	5000	8.3	
		R2AA13180D	1800	4.0	
		R2AA13200D	2000	5.0	
		R2AA18350L	3500	6.0	
	RS3A15#	R1AA10200F	4000	6.7	
		R1AA10250F	5000	8.3	
		R2AA18350D	3500	7.0	
		R2AA18450H	4500	7.4	
		R2AA18550R	5500	8.4	
		R2AA22500L	5000	9.6	
		R2AA22700S	7000	12.2	
	RS3A30#	R1AA18550H	5500	9.3	
		R1AA18750L	7500	11.6	
		R1AA1811KR	11000	16.0	
		R1AA1815KB	15000	21.4	
		R2AA18550H	5500	9.3	
		R2AA18750H	7500	11.6	
		R2AA1811KR	11000	16.0	
		R2AA2211KB	11000	16.0	
		R2AA2215KB	15000	21.4	

■ AC100V Input

Input Voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Main circuit power supply (kVA)	Control power supply (VA)
AC100V	RS3E01#	R2EA04003F	30	0.2	40
	RS3E02#	R2EA04005F	50	0.2	
		R2EA04008F	80	0.4	
		R2EA06010F	100	0.5	
	RS3E03#	R2EA06020F	200	0.6	

* # = Optional alphabetical letter
* Values are of rated speed, torque ratings.

2.4.2 Inrush current, leakage current

- Inrush current

Input Voltage	Servo amplifier capacity	Control power (Maximum value between1ms after input)	Main circuit power (Maximum value between 1.2 seconds after input)
AC200V	RS3A01#	40A(0-P)	22A(0-P)
	RS3A02#		
	RS3A03#		
	RS3A05#		
	RS3A07#		17A(0-P)
	RS3A10#		
	RS3A15#		
	RS3A30#		
AC100V	RS3E01#	20A(0-P)	11A(0-P)
	RS3E02#		
	RS3E03#		

* # = Optional alphabetical letter
* Inrush current values above are at the condition of ordinary temperatures, 120VAC or 240VAC input.
* Using thermistor for inrush prevention circuit of control power supply. Inrush current which exceed value above might flow if power-cycled frequently in short time or ambient temperature is higher.

- Leakage current

Servo amplifier capacity	Electric leakage current per motor
RS3#01#	0.8 mA
RS3#02#	0.8 mA
RS3#03#	0.8 mA
RS3#05#	1.5 mA
RS3#07#	3.0mA
RS3#10#	3.0mA
RS3#15#	3.0mA
RS3#30#	3.0mA

* # = Optional alphabetical letter
* Leakage current value above is measured by leak checker which has set 700 Hz filter.
* While using two (2) or more motors, leakage current from each motor should be added.
* These values are applicable when a tough rubber sheath cable of 2M is used as a power line. In the case of a shorter or longer cable length, values of the above table should be selected as closely as possible.
* The machine should be grounded so that dangerous voltage does not occur at the main part of the machine, such as the operation panel, etc., during a period of emergency leakage current.
* Please use an earth leakage circuit breaker which is allowing high harmonics because normal earth leakage circuit breaker or earth leakage protection relay might malfunction by flow of a high harmonics leakage current of ground floating capacitance of servo motor winding, power cable or servo amplifier.

2.4.3 Calorific value

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC200V	RS3A01#	R2AA04003F	13
		R2AA04005F	14
		R2AA04010F	15
		R2AA06010F	15
		R5AA06020H	20
	RS3A02#	R2AA06020F	20
		R2AA06040F	31
		R2AA06040H	22
		R2AA08020F	20
		R2AA08040F	30
		R5AA06020F	20
		R5AA06040F	31
		R5AA06040H	22
	RS3A03#	R1AA10100H	45
		R1AA10150H	60
		R2AA08075F	43
		R2AAB8100H	45
		R2AA10075F	43
		R2AA13050D	44
		R2AA13050H	40
		R2AA13120B	50
		R5AA08075D	43
		R5AA08075F	43
	RS3A05#	R1AA10100F	60
		R1AA10150F	70
		R1AA10200H	70
		R1AA10250H	80
		R2AAB8075F	45
		R2AAB8100F	52
		R2AA10100F	50
		R2AA13120D	68
		R2AA13120L	60
		R2AA13180H	87
		R2AA13200L	87
	RS3A07#	R1AA10200F	100
		R1AA10250F	115
		R1AA13300H	120
		R2AA13180D	110
		R2AA13200D	100
		R2AA18350V	135

* # = Optional alphabetical letter

* Calorific values above are the condition of rated motor output operation. Calorific value of regenerative resistor is not included.

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC200V	RS3A10#	R1AA13300F	135
		R1AA13400H	157
		R1AA13500H	170
		R2AA13180D	110
		R2AA13200D	100
		R2AA18350L	148
	RS3A15#	R1AA13400F	157
		R1AA13500F	180
		R2AA18350D	148
		R2AA18450H	163
		R2AA18550R	213
		R2AA22500L	164
		R2AA22700S	235
	RS3A30#	R1AA18550H	315
		R1AA18750L	365
		R1AA1811KR	430
		R1AA1815KB	450
		R2AA18550H	315
		R2AA18750H	365
		R2AA1811KR	430
		R2AA2211KB	440
		R2AA2215KB	450

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC100V	RS3E01#	R2EA04003F	13
	RS3E02#	R2EA04005F	15
		R2EA04008F	16
		R2EA06010F	17
	RS3E03#	R2EA06020F	26

* # = Optional alphabetical letter

* Calorific values above are the condition of rated motor output operation. Calorific value of regenerative resistor is not included.

2.5 Operation pattern

2.5.1 Time of acceleration and deceleration, permitted repetition, loading precaution

The motor's acceleration time (ta), and deceleration time (tb) when under constant load is calculated using the following method:

- Acceleration time: $t_a=(J_M+J_L)\cdot(2\pi/60)\cdot\{(N_2-N_1)/(0.8\times T_P-T_L)\}$ [s]

- Deceleration time: $t_b=(J_M+J_L)\cdot(2\pi/60)\cdot[(N_2-N_1)/(0.8\times T_P+T_L)]$[s]

  - t_a: Acceleration time (s)
  - t_b: Deceleration time (s)
  - J_M: Motor inertia moment ($kg\cdot m^2$)
  - J_L: Load inertia moment ($kg\cdot m^2$)
  - N_1, N_2:Rotational speed of motor (min^{-1})
  - T_P: Instantaneous maximum stall torque ($N\cdot m$)
  - T_L: Load torque ($N\cdot m$)

* These expressions are for the rated speed values but exclude the viscous torque and friction of the motor.

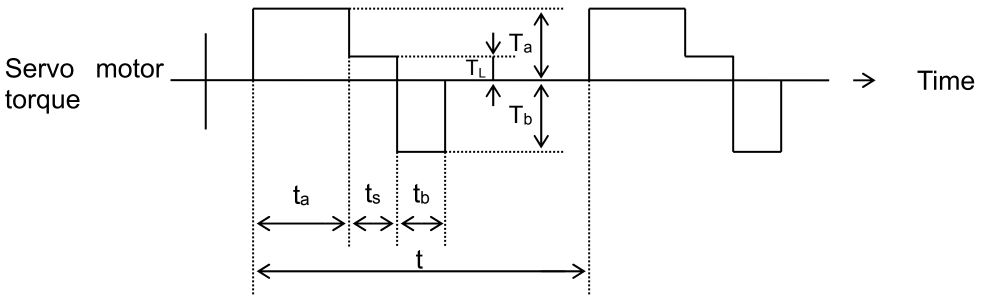
- Loading precaution
  There are separate limitations on repetitive operations for both the servo motor and servo amplifier, and the conditions of both must be met simultaneously.

- Frequency of permitted repetitions for the servo amplifier
  When Start/Stop sequences are repeated frequently, confirm in advance that the frequency of repetitions are within tolerance range. Allowed repetitions differ depending on the type, capacity, load inertia moment, accel/decel torque and motor rotation speed of the motor in use. If the load inertia moment = motor inertia moment X m-times, and when the permitted Start/Stop repetitions (up to the maximum rotation speed) exceed the following value, please contact us for assistance, as precise calculation of effective torque and regenerating power is critical.

$$\text{Frequency of repetitions} = \frac{20}{m+1} \text{ times / min}$$

- Frequency of permitted repetitions for the servo motor
  Permitted Start/Stop repetitions differ according to the motor usage conditions, such as load condition and operating time.

■ When the motor repeats continuous speed status and stop status
In operating status (shown below) the motor should be used at a frequency in which its effective torque is less than the rated torque TR.



◆ If the operating cycle is considered as "t", the usable range can be determined as follows:

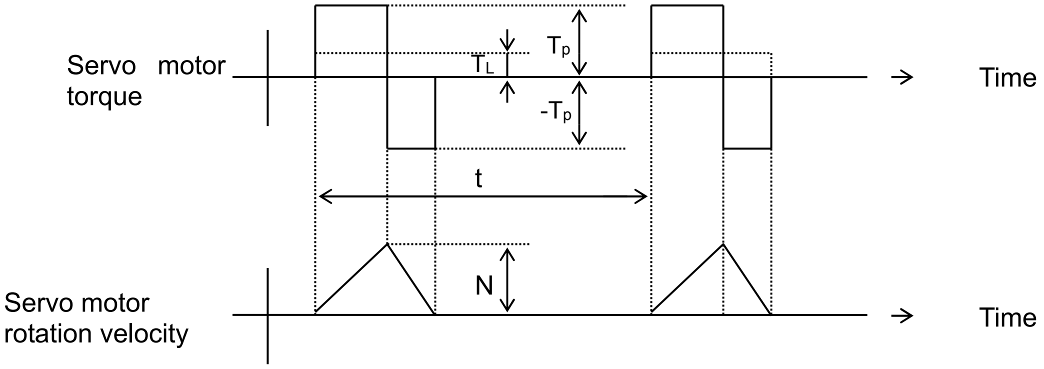
$$t \geqq \frac{T_a{}^2 t_a + T_L{}^2 t_s + T_b{}^2 t_b}{T_R{}^2} \text{ [s]}$$

Ta: Acceleration torque
Tb: Deceleration torque
TL: Load torque
Trms: Effective torque
TR: Rated torque
ts: constant speed time(s)

◆ When the cycle time (t) is predetermined Ta, Tb, ta, and tb appropriate in the above formula are required.

* When actually determining the system drive mode, it is recommended to calculate the load margin and suppress it to Trms< $0.8T_R$.

■ When the motor repeats acceleration, deceleration and stop status
In operating status (shown below) the value of permitted repetitions n (times/minutes) is found with the following equation:

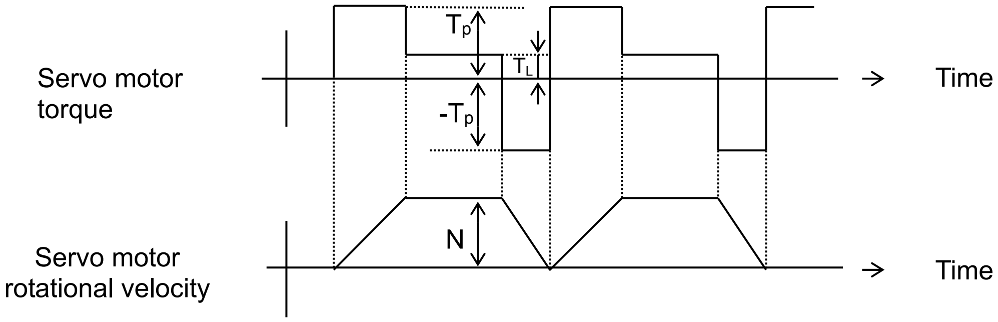


$$n = 2.86 \times 10^2 \times \frac{1}{N(J_M+J_L)} \times \frac{T_P{}^2 - T_L{}^2}{T_P{}^3} \times T_R{}^2 \quad \text{[times/ min]}$$

T_P: Peak Torque at stall (N・m)
T_R: Rated torque
N: Motor rotation speed (min^{-1})
J_M: Servo motor inertia moment (kg・m^2)
J_L: Load inertia moment (kg・m^2)

2.5 Operation pattern

■ When the motor repeats acceleration − constant speed operation − deceleration status
For the operating status shown below, the value of permitted repetitions n (times/min) is found in the following equation:



$$n = 2.86 \text{ x } 10^2 \text{ x } \frac{1}{N(J_M+J_L)} \text{ x } \frac{T_R^2 - T_L^2}{T_P} \quad \text{[times/ min]}$$

■ Negative load
Servo amplifier cannot perform continuous operation with a negative load from the servo motor. Please contact us when using the amplifier with a negative load.

Example

- Motor drive downward (when there is no center weight).
- Using like a generator, such as the wind-out spindle of a winder.

■ Load inertia moment (JL)
When the servo amplifier is used with a load inertia moment exceeding the allowable load inertia moment calculated in terms of the motor shaft, “main circuit power over voltage detection” or “regenerative error function” may be issued at the time of the operation.

- Reduce the torque limit
- Extend the acceleration and deceleration times (slow down)
- Reduce the maximum rotation speed
- Re-examine regenerative resistance

2.6 Position signal output

The amplifier outputs two (2) kinds of position signals: Serial signals and Pulse signals

2.6.1 Positions signals by serial signals

- Absolute position data of absolute encoder, "Encoder signal output (PS)", is output with the serial signal.

  "Encoder signal output (PS)" can be selected from among the two types below and "Motor encoder direct output".
  Select from the general parameters (Group ID07: Encoder Signal Output (PS) Format [PSOFORM]).

Selection value	00(03): Binary code output	01(04): ASCII decimal code output
Transmission method	Asynchronous	Asynchronous
Baud rate	9600bps	9600bps
Format	11bit	10bit
Transmission error check	1bit Even number parity	1bit Even number parity
Transfer time (Typ.)	9.2ms	16.7ms
Transfer period	Approximately 11ms	Approximately 40ms
Increase method	Increase during forward operation	Increase during forward operation

* "Encoder signal output (PS)" outputs from "CN1-9,10pin".
* Will be "Motor encoder direct output" when "02: Mot_Direct" is selected.
* "03, 04" are able to select only when Full-closed control is valid.
* Forward rotation is Counterclockwise (CCW) seeing from load side. Absolute value will change to minimum value (zero) when exceeding maximum value.
* Incremental encoder outputs “Actual position monitor value” through binary code regardless of the setting of (Group ID07: Encoder Signal Output (PS) Format [PSOFORM]).

2.6.2 Binary code output format and transfer period

■ Format

◆ Data format

11bit

1bit	5bit	3bit	1bit	1bit
Start bit	Data bit	Address bit	Parity bit	Stop bit

◆ Transfer format

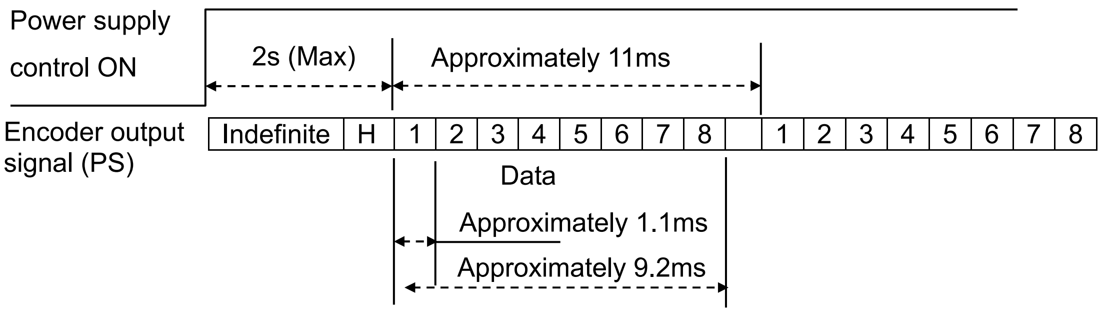
Data number	Start bit	Data bit					Address bit			Parity bit	Stop bit
･Data 1	0	D0 (LSB)	D1	D2	D3	D4	0	0	0	0/1	1
･Data 2	0	D5	D6	D7	D8	D9	1	0	0	0/1	1
･Data 3	0	D10	D11	D12	D13	D14	0	1	0	0/1	1
･Data 4	0	D15	D16	D17	D18	D19	1	1	0	0/1	1
･Data 5	0	0/D20	0/D21	0/D22	0/D23	0/D24	0	0	1	0/1	1
･Data 6	0	0/D25	0/D26	0/D27	0/D28	0/D29	1	0	1	0/1	1
･Data 7	0	0/D30	0/D31	0/D32 (MSB)	0/D33	0/D34	0	1	1	0/1	1
･Data 8	0	0/D35	0/D36	0/D37	0/D38 (MSB)	0	1	1	1	0/1	1

◆ Relation of the single/multi turn dividing number and the data position

Single turn	Multi turn	Data within 1 rotation	Data within multiple rotations
17bit	None	D0 to D16	-
17bit	16bit	D0 to D16	D17 to D32
20bit	16bit	D0 to D19	D20 to D35
23bit	16bit	D0 to D22	D23 to D38

* Unused data bit will be zero.

■ Transfer period



* The signal is indefinite for about 2 seconds after booting power and communication may not always begin from the first frame, even after 2 sec.

* If EnDAT is used in external encoder, it will unestablished 3sec from control power ON.

2.6.3 ASCII decimal code output format and transfer period

- ■ Format
  - ◆ Data format

10bit

1bit	7bit	1bit	1bit
Start bit	Data bit	Parity bit	Stop bit

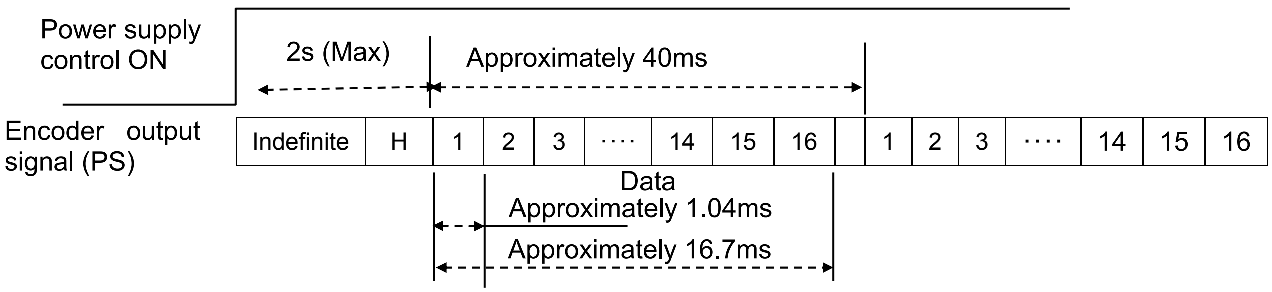
  - ◆ Transfer format

Data number	Start bit	D0	D1	D2	D3	D4	D5	D6	Parity bit	Stop bit
Data 1	0	Show position data ”P”							0/1	1
Data 2	0	Show multiple rotation data “+”							0/1	1
Data 3	0	Multiple rotation data “5th digit”							0/1	1
Data 4	0	Multiple rotation data “4th digit”							0/1	1
Data 5	0	Multiple rotation data “3rd digit”							0/1	1
Data 6	0	Multiple rotation data “2nd digit”							0/1	1
Data 7	0	Multiple rotation data “1st digit”							0/1	1
Data 8	0	Show comma ”,”							0/1	1
Data 9	0	1 rotation data “7thdigit“							0/1	1
Data 10	0	1 rotation data “6thdigit“							0/1	1
Data 11	0	1 rotation data “5thdigit“							0/1	1
Data 12	0	1 rotation data “4thdigit“							0/1	1
Data 13	0	1 rotation data “3rddigit“							0/1	1
Data 14	0	1 rotation data “2nddigit“							0/1	1
Data 15	0	1 rotation data “1st digit“							0/1	1
Data 16	0	Carriage return “CR“							0/1	1

  - ◆ Relation of the single/multi turn dividing number and the data position

Single turn	Multi turn	Data within 1 rotation	Data within multiple rotations
17bit	None	0000000 to 0131072	-
17bit	16bit	0000000 to 0131072	00000 to 65535
20bit	16bit	0000000 to 1048576	00000 to 65535
23bit	16bit	0000000 to 8388608	00000 to 65535

- ■ Transfer period



* The signal is indefinite for about 2 seconds after booting power and communication may not always begin from the first frame, even after 2 sec.

* If EnDAT is used in external encoder, it will unestablished 3sec from control power ON.

2.6.4 Position signal output from pulse signal

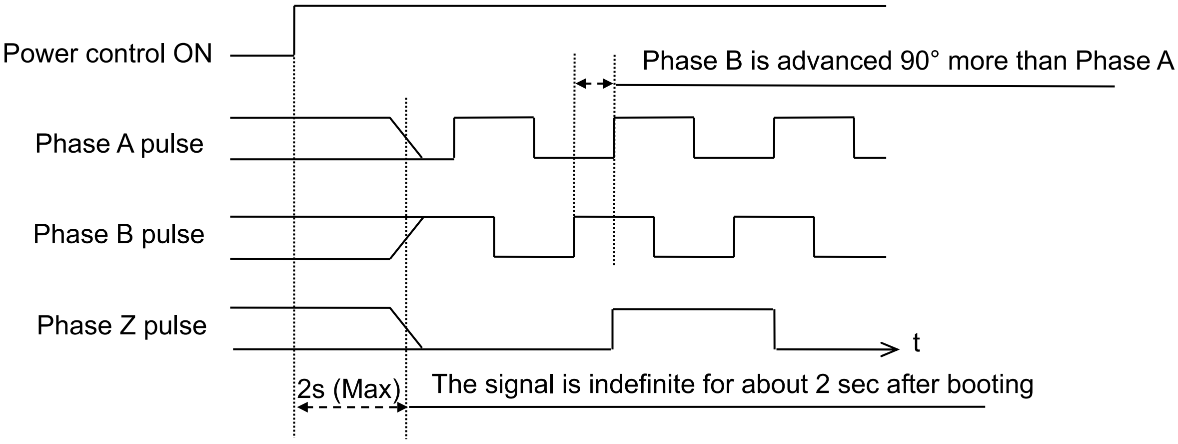
- ■ Servo amplifier outputs "90° -phase difference two-phase pulse (phase A, phase B) and original phase (phase Z)". Pulse output can change the division ratio by parameter.
  Set the general parameter "GroupC ID04 Encoder Output Pulse Division [ENRAT]".

* Output signal “A phase pulse output (AO/$\overline{\text{A0}}$)” outputs from “CN1-3 pin, 4 pin.”

* Output signal “B phase pulse output (BO/$\overline{\text{B0}}$)” outputs from “CN1-5 pin, 6 pin.”

* Output signal “Z phase output (ZO/$\overline{\text{ZO}}$)” outputs from “CN1-7 pin, 8 pin.” Also output from CN1-11 pin with open-collector.

- ■ Output signal under forward rotation



* Absolute encoder “positions signal output” delays about 224μs.

* Absolute encoder (Motor encoder) Phase Z output is once in 1-rotation (at every change of multiple rotations) based on positive edge of Phase A with the width of one pulse of Phase A. (does not determine the position relation of Phase Z or Phases A&B.

* When other than 1/1 is set as division ratio, Phase A and Phase B are divided but Phase Z is output with original pulse width.

* Absolute encoder can output the frequency up to 2Mpulse/sec (multiplied one).

* When EnDat is used in external encoder with full-closed control,
Phase Z is output every 8192 pulses (multiplied one) based on absolute position 0.

EnDat (angle encoder, rotary encoder)
Division ratio will be limited in such a way that a resolution becomes 32,768pulse/rev or more, if into the relation as follows: Single turn resolution x (1/N) < 32,768pulse/rev.

EnDat (linear encoder)
Use it in the range as follows: "231 x Resolution/((1/N)x4)" based on position 0.
(When it move to out of range from in a range and perform cycle power, phase Z output may misaligned.)

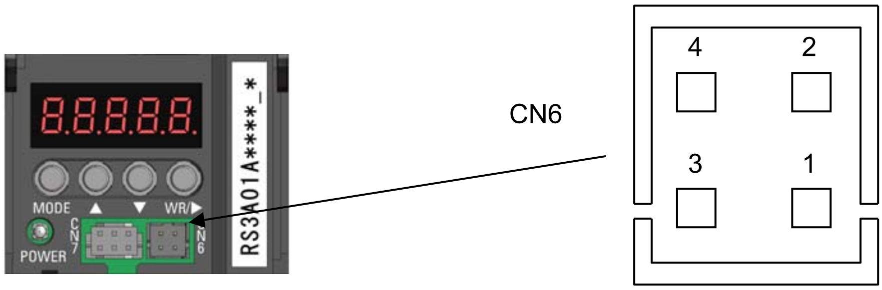
1/N: Selection value in the GroupC ID0C "External encoder output pulse division ratio selection".

It is indefinite between 3sec from control power establishment.

2.7 Specifications for analog monitor

2.7.1 Specifications for analog monitor

- Monitor output



Connector model number on board: DF11-4DP-2DSA(01)
Housing model number on receiving equipment: DF11-4DS-2C
Connector model number on receiving equipment: DF11-2428SCA

	General input/output connector CN1	CN6
Analog monitor output 1(MON1)	CN1-30	CN6-3
Analog monitor output 2(MON2)	Disabled	CN6-4
Digital monitor output (DMON)	Disabled	CN6-2
GND	CN1-31	CN6-1

2.7.2 Monitor for velocity, torque, and position deviation

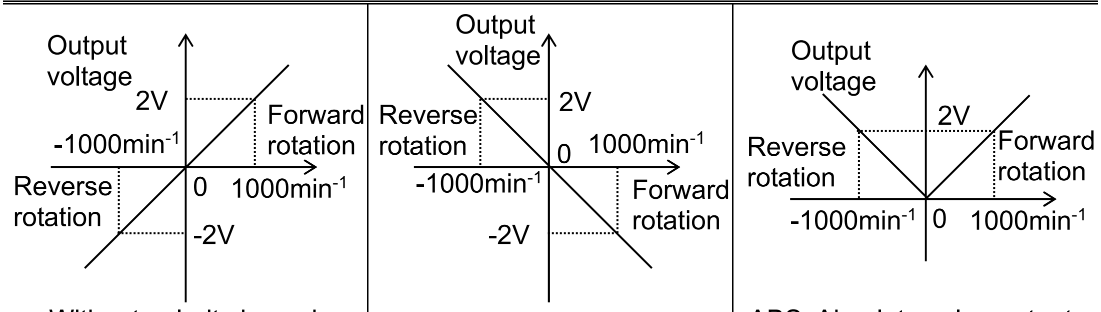
- ■ Electrical specifications
  - ◆ Output voltage range: DC±8V
  - ◆ Output resistance: 1kΩ
  - ◆ Load: less than 2mA

* Monitor output is indefinite at the time of power ON/OFF and may output DC12V+/- around 10%.

* Monitor output polarity can be selected from "+, Without polarity inversion", "-, With polarity inversion", "ABS, Absolute value output". Select from the GroupA ID13: Analog monitor output polarity [MONPOL].

■ Velocity command, velocity monitor

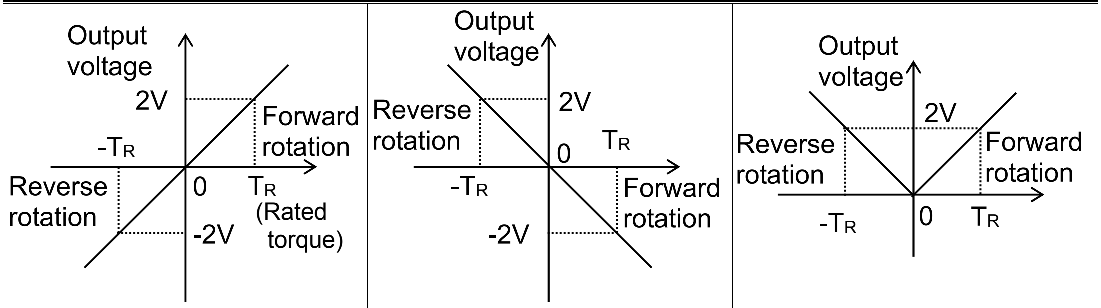
Speed command, speed monitor output



+, Without polarity inversion | -, With polarity inversion | ABS, Absolute value output

■ Torque command, torque monitor

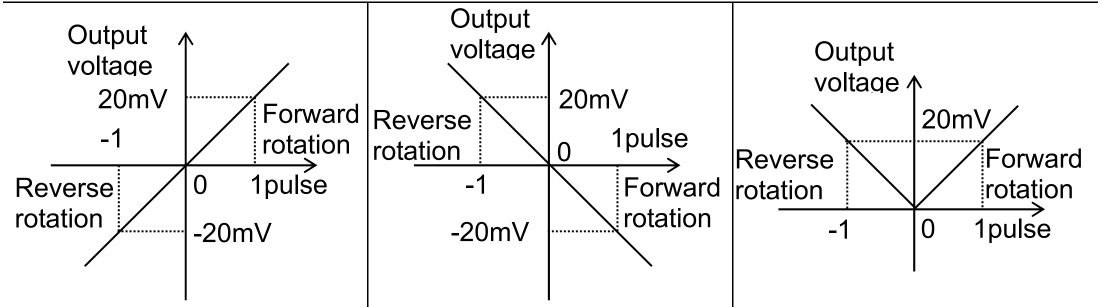
Torque command, torque monitor output



+, Without polarity inversion | -, With polarity inversion | ABS, Absolute value output

■ Position deviation monitor

Position deviation monitor output



+, Without polarity inversion | -, With polarity inversion | ABS, Absolute value output

2.8 Specifications for dynamic brake

2.8.1 Allowable frequency, instantaneous tolerance, decreasing the rotation angle of the dynamic brake

■ Allowable frequency of the dynamic brake
Less than 10 times per hour and 30 times per day at maximum speed within allowable load inertia moment.

■ Operation intervals
In basic terms, operation of the dynamic brake in six (6) minute intervals is acceptable. If the brake is to be operated more frequently, the motor speed must be reduced sufficiently.
Refer to the following expression to find a standard of operation:

$$\frac{\text{6 minutes}}{(\text{Rated rotation speed/maximum rotation speed in use})^2}$$

■ If/When load inertia moment (J_L) substantially exceeds allowable load inertia moment, abnormal heat can generate due to dynamic brake resistance. Take precautions against (Overheat alarm of the dynamic break) or (failure of dynamic brake resistance). Please consult us if such a situation is evident.

■ Instantaneous tolerance of dynamic brake

Servo amplifier model number	E_{RD} (J)
RS3#02A##A#/RS3#02A##L#	218
RS3#03A##A#/RS3#03A##L#	
RS3#05A##A#/RS3#05A##L#	912
RS3#07A##A#/RS3#07A##L#	2000
RS3#10A##A#/RS3#10A##L#	2450
RS3#15A##A#/RS3#15A##L#	
RS3#30A##L#	9384

* # = Optional number or alphabetical letter.
* RS3#01A does not have dynamic brake resistor. Shorting between motor phases as dynamic brake.

◆ The consumption of energy E_{RD} by dynamic brake resistance in one dynamic brake operation is as follows:

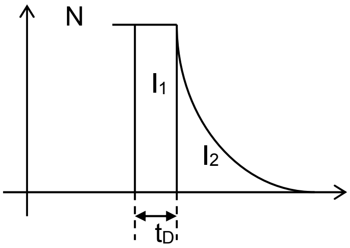
$$E_{RD}= \frac{2.5}{R\Phi+2.5} \times \left\{ \frac{1}{2} (J_M+J_L) \times \left[\frac{2\pi}{60} N \right]^2 - I \times T_L \right\}$$

$R\phi$: Servo motor phase winding resistance(Ω)
J_M: Inertia moment of servo motor (kg·m^2)
J_L: Load inertia moment (motor axis conversion)(kg·m$^{2)}$
N: Servo motor rotation speed in feed rate V(min^{-1})
I: Integrated stage-down rotation angle (rad)
T_L: Load torque (N·m)

2.8 Specifications for dynamic brake

- ■ Staging down the rotation angle using the dynamic brake is show as follows:

$$I=I_1+I_2=\frac{2\pi N \times t_D}{60}+(J_M+J_L) \times (\alpha N+\beta N^3)$$



J_M: Inertia of servo motor (kg·m^2)
J_L : Load inertia (motor axis conversion) (kg·m^2)
N : Servo motor rotation speed (min^{-1})
I_1 : Stage down rotation angle (rad) using amplifier internal process t_D
I_2 : Stage down rotation angle (rad) using dynamic brake operation
t_D :10×10^{-3}(s)

α ·β: See below.

Servo amplifier capacity	Servo motor model number	α	β	J_M(kg·m^2)
RS3A01	R2AA04003F	187	5.18×10^{-6}	0.0247×10^{-4}
	R2AA04005F	93.2	3.78×10^{-6}	0.0376×10^{-4}
	R2AA04010F	32.5	1.98×10^{-6}	0.0627×10^{-4}
	R2AA06010F	21.4	7.67×10^{-6}	0.117×10^{-4}
	R5AA06020H	11.7	3.76×10^{-6}	0.2×10^{-4}
RS3A02	R2AA06020F	14.5	2.46×10^{-6}	0.219×10^{-4}
	R2AA06040F	8.82	1.00×10^{-6}	0.412×10^{-4}
	R2AA06040H	5.47	1.61×10^{-6}	0.412×10^{-4}
	R2AA08020F	11.3	1.13×10^{-6}	0.52×10^{-4}
	R2AA08040F	6.91	4.25×10^{-6}	1.04×10^{-4}
	R5AA06020F	15.36	2.92×10^{-6}	0.2×10^{-4}
	R5AA06040F	10.11	1.55×10^{-6}	0.416×10^{-4}
	R5AA06040H	6.09	2.3×10^{-6}	0.416×10^{-4}
RS3A03	R1AA10100H	2.6	1.21×10^{-6}	1.4×10^{-4}
	R1AA10150H	1.31	6.87×10^{-7}	2.0×10^{-4}
	R2AA08075F	5.84	9.10×10^{-8}	1.82×10^{-4}
	R2AAB8100H	3.09	3.83×10^{-7}	2.38×10^{-4}
	R2AA10075F	6.04	1.2×10^{-6}	2.0×10^{-4}
	R2AA13050D	6.46	2.14×10^{-6}	3.1×10^{-4}
	R2AA13050H	4.37	3.55×10^{-6}	3.1×10^{-4}
	R2AA13120B	1.68	1.56×10^{-6}	6×10^{-4}
	R5AA08075D	4.67	1.67×10^{-6}	1.65×10^{-4}
	R5AA08075F	6.45	2.75×10^{-6}	1.65×10^{-4}
RS3A05	R1AA10100F	8.39	3.24×10^{-7}	1.4×10^{-4}
	R1AA10150F	4.21	1.82×10^{-7}	2.0×10^{-4}
	R1AA10200H	1.71	3.88×10^{-7}	2.3×10^{-4}
	R1AA10250H	1.26	2.80×10^{-7}	2.8×10^{-4}
	R2AAB8075F	6.55	4.16×10^{-7}	1.64×10^{-4}
	R2AAB8100F	5.46	2.08×10^{-7}	2.38×10^{-4}
	R2AA10100F	5.35	4.86×10^{-7}	3.5×10^{-4}
	R2AA13120D	4.06	6.45×10^{-7}	6.3×10^{-4}
	R2AA13120L	2.99	1.21×10^{-6}	6×10^{-4}
	R2AA13180H	2.17	4.66×10^{-7}	9.0×10^{-4}
	R2AA13200L	1.83	3.1×10^{-7}	12.2×10^{-4}

* The values for α, β are reached based on an assumed resistance value of the power line being 0Ω. Contact us when the combination with an amplifier is different than those shown above (invariably values are different).

Servo amplifier capacity	Servo motor model number	α	β	J_M(kg·m^2)
RS3A07	R1AA10200F	3.17	5.00×10^{-8}	2.3×10^{-4}
	R1AA10250F	2.15	4.70×10^{-8}	2.8×10^{-4}
	R1AA13300H	1.00	5.60×10^{-8}	7.0×10^{-4}
	R2AA13180D	2.12	1.23×10^{-7}	9.0×10^{-4}
	R2AA13200D	1.69	0.91×10^{-7}	12.2×10^{-4}
	R2AA18350V	3.23	2.5×10^{-8}	40×10^{-4}
RS3A10	R1AA13300F	3.08	4.20×10^{-8}	7.0×10^{-4}
	R1AA13400H	0.8	3.40×10^{-8}	8.8×10^{-4}
	R1AA13500H	0.57	3.00×10^{-8}	10.6×10^{-4}
	R2AA13180D	2.12	1.23×10^{-7}	9.0×10^{-4}
	R2AA13200D	1.69	0.91×10^{-7}	12.2×10^{-4}
	R2AA18350L	0.82	1.6×10^{-8}	40×10^{-4}
RS3A15	R1AA13400F	2.06	1.40×10^{-8}	8.8×10^{-4}
	R1AA13500F	1.88	9.00×10^{-9}	10.6×10^{-4}
	R2AA18350D	1.05	1.3×10^{-8}	40×10^{-4}
	R2AA18450H	0.67	1.2×10^{-8}	50×10^{-4}
	R2AA18550R	0.53	7×10^{-9}	68×10^{-4}
	R2AA22500L	0.8	0.41×10^{-7}	55×10^{-4}
	R2AA22700S	0.16	7×10^{-9}	136×10^{-4}
RS3A30	R1AA18550H	1.08	4×10^{-9}	33×10^{-4}
	R1AA18750L	0.67	2×10^{-9}	42×10^{-4}
	R1AA1811KR	0.41	2×10^{-9}	64×10^{-4}
	R1AA1815KB	0.26	2×10^{-9}	86×10^{-4}
	R2AA18550H	1.13	4×10^{-9}	68×10^{-4}
	R2AA18750H	0.72	2×10^{-9}	98×10^{-4}
	R2AA1811KR	0.51	3×10^{-9}	110×10^{-4}
	R2AA2211KB	0.42	1×10^{-9}	178×10^{-4}
	R2AA2215KB	0.35	1×10^{-9}	237×10^{-4}
RS3E01	R2EA04003F	187	5.18×10^{-6}	0.0247×10^{-4}
RS3E02	R2EA04005F	171	2.06×10^{-6}	0.0376×10^{-4}
	R2EA04008F	69.7	1.06×10^{-6}	0.0627×10^{-4}
	R2EA06010F	59.1	2.84×10^{-6}	0.117×10^{-4}
RS3E03	R2EA06020F	38.8	9.10×10^{-7}	0.219×10^{-4}

* The values for α, β are reached based on an assumed resistance value of the power line being 0Ω. Contact us when the combination with an amplifier is different than those shown above (invariably values are different).

2.9 Regeneration process

Allowable minimum values of Built-in/ external regenerative resistor and allowable regenerative power of regenerative circuit of servo amplifier are shown below. See "11.2 Selection of regenerative resistor" for selection method of regenerative resistor.

2.9.1 Minimum values of Built-in/ external regenerative resistor

Servo amplifier model	Built-in regenerative resistor	External regenerative resistor
RS3#01A##A#	50Ω	35Ω
RS3#02A##A#	50Ω	35Ω
RS3#03A##A#	50Ω	35Ω
RS3#05A##A#	17Ω	17Ω
RS3A07A##A#/RS3A07A##L#	10Ω	10Ω
RS3A10A##A#/RS3A10A##L#	10Ω	10Ω
RS3A15A##A#/RS3A15A##L#	6Ω	6Ω
RS3A30A##L#	without built-in regenerative resistor	2.5Ω

* “#” is optional number or alphabetical letter.

2.9.2 Allowable regenerative power

Servo amplifier model	Built-in regenerative resistor use [PRI]	External regenerative resistor use [PR0]
RS3#01A##A#/RS3#01A##L#	5W	125W
RS3#02A##A#/RS3#02A##L#	5W	125W
RS3#03A##A#/RS3#03A##L#	5W	125W
RS3#05A##A#/RS3#05A##L#	20W	250W
RS3A07A##A#/RS3A07A##L#	60W	500W
RS3A10A##A#/RS3A10A##L#	90W	500W
RS3A15A##A#/RS3A15A##L#	120W	500W
RS3A30A##L#	-	500W

* “#” is optional number or alphabetical letter.

3

Installation

In this chapter, installation of servo amplifier and servo motor are explained.

3. Installation

3.1 Servo amplifier

3.1.1 Precautions

When installing, please be sure to protect the following precautions.

■ Various precautions

The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.

Do not stand on, or put heavy items on the servo amplifier.

Operate the device within the specified environmental conditions.

Do not drop the device or subject it to excessive shock.

Make sure no screws or other conductive or flammable materials get inside the servo amplifier.

Do not obstruct the air intake and exhaust vents. The mounting direction should be observed strictly.

Please contact our office if the amplifier is to be stored for a period of 3 years or longer. The capacity of the electrolytic capacitors decreases during long-term storage.

Any damaged parts or the products which have damaged parts shall be repaired by returning it to our company immediately.

■ If enclosed in a cabinet

The temperature inside the cabinet might exceed the external temperature depending on the power consumption of the device and the size of the cabinet. Consider the cabinet size, cooling, and placement, and make sure the temperature around the servo amplifier does not exceed 55°C. For longevity and reliability purposes it is recommended to keep the temperature below 40°C.

■ If there is a vibration source nearby

Protect the servo amplifier from vibration by installing it on a base with a shock absorber.

■ If there is a heat generator nearby

If the ambient temperature might increase by convection or radiation, make sure the temperature near the servo amplifier does not exceed 55°C.

■ If corrosive gas is present

Long-term use may cause contact failure on the connectors and connecting parts. Never use the device where it may be exposed to corrosive gas.

■ If explosive or combustible gas is present

Never use the device where explosive or combustible gas is present.

The device’s relays and contactors, regenerative resistors and other parts can generate arc (spark) and can cause fire or explosion.

■ If dust or oil mist is present

The device cannot be used where dust or oil mist is present. If dust or oil mist accumulates on the device, it can cause insulation deterioration or leakage between the conductive parts, and damage the servo amplifier.

■ If a large noise source is present

If inductive noise enters the input signals or the power circuit, it can cause a malfunction. If there is a possibility of noise, inspect the line wiring and take appropriate noise prevention measures. A noise filter should be installed before the servo amplifier.

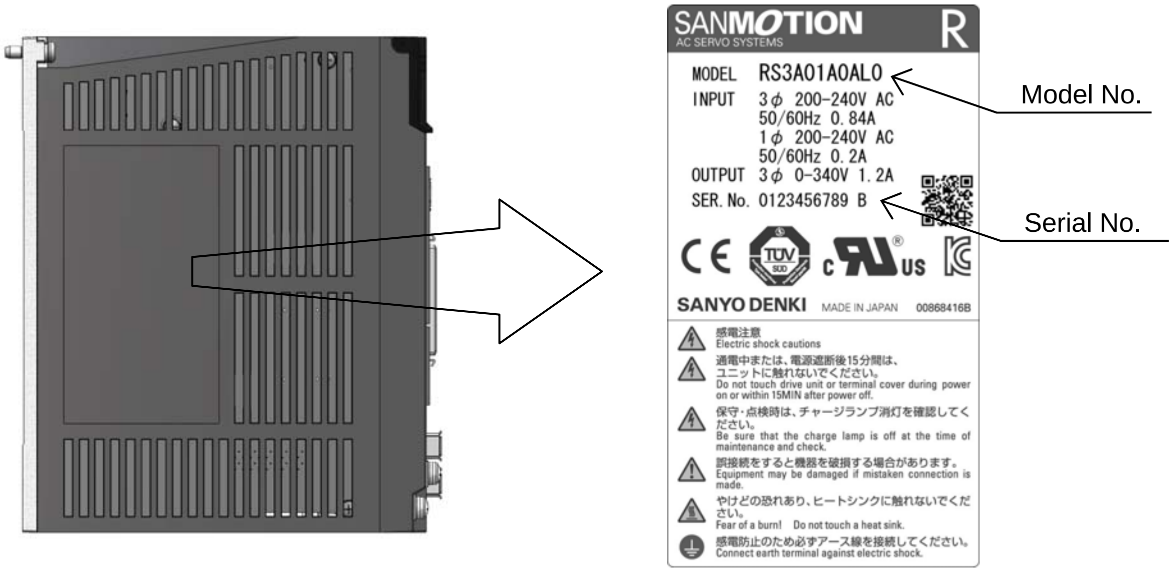
3.1.2 Unpacking

Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

- Verify that the model number of the servo motor or servo amplifier is the same as ordered. The model number is located on the main nameplate, following the word“MODEL”.
- Verify that there is no problem in the appearance of servo amplifier.
- Verify that there are no loose screws on the servo amplifier.

Servo amplifier

Servo amplifier main nameplate



MODEL RS3A01A0AL0
INPUT 3φ 200-240V AC
50/60Hz 0.84A
1φ 200-240V AC
50/60Hz 0.2A
OUTPUT 3φ 0-340V 1.2A
SER. No. 0123456789 B

感電注意
Electric shock cautions

通電中または、電源遮断後15分間は、ユニットに触れないでください。
Do not touch drive unit or terminal cover during power on or within 15MIN after power off.

保守・点検時は、チャージランプ消灯を確認してください。
Be sure that the charge lamp is off at the time of maintenance and check.

誤接続をすると機器を破損する場合があります。
Equipment may be damaged if mistaken connection is made.

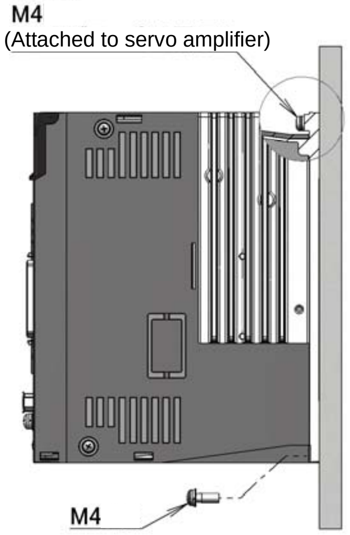
やけどの恐れあり、ヒートシンクに触れないでください。
Fear of a burn! Do not touch a heat sink.

感電防止のため必ずアース線を接続してください。
Connect earth terminal against electric shock.

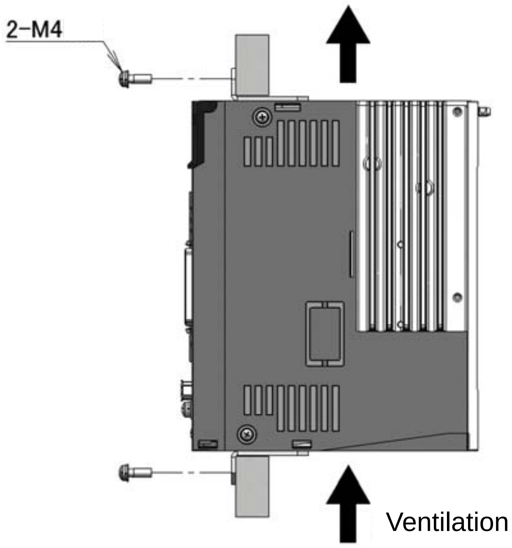
Interpretation of the serial number
Month (2-digit) + Year (2-digit) + Day (2-digit) + Serial number (4-digit) + Revision ("A" abbreviated)

3.1.3 Mounting direction and location

Rear-mounting



Front-mounting

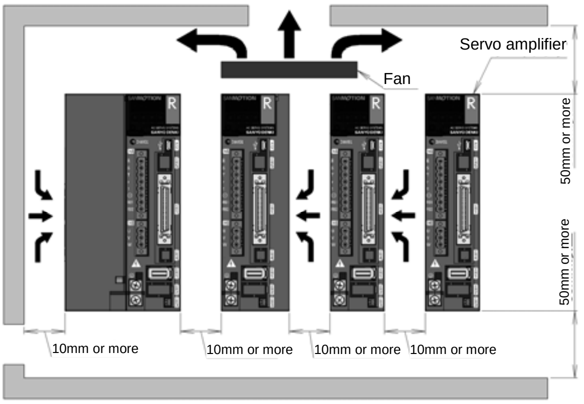


* For metal fittings of front mounting, see “12.6 Optional parts”.

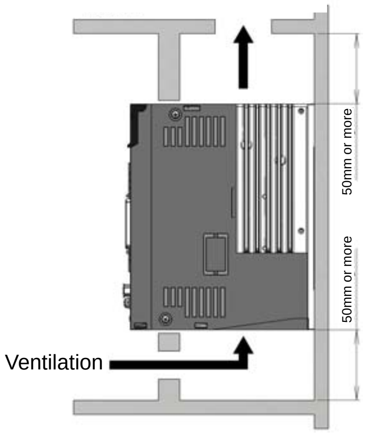
3.1.4 Arrangement within the cabinet

- ■ Leave at least 50 mm space above and below the servo amplifier to ensure unobstructed airflow from the inside of the servo amplifier and the radiator. If heat gets trapped around the servo amplifier, use a cooling fan to create airflow.
- ■ Make sure the temperature around the servo amplifier does not exceed 55°C. For longevity and reliability purposes it is recommended to keep the temperature below 40°C.
- ■ Leave at least 10 mm space on both sides of the servo amplifier to ensure unobstructed airflow from the heat sinks on the side and from the inside of the servo amplifier.
- ■ For RS3☐02･RS3☐03･RS3☐05, a cooling fan is attached at the side. Therefore, it is recommended that the servo amplifier be mounted in an arrangement as shown below.

Front view



Side view



* Arrangement above is order of RS3☐05, RS3☐03, RS3☐02 and RS3☐01 from left side.

3.2 Servo motor

3.2.1 Precautions

■ Various precautions

The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.
Do not stand on, or put heavy items on the servo amplifier.
Operate the device within the specified environmental conditions.
Do not drop the device or subject it to excessive shock.
The mounting instruction should be followed strictly.
Any damaged parts or the products which have damaged parts shall be repaired by returning it to our company immediately.
Please contact us for long-term period storage (for 3 years or more).

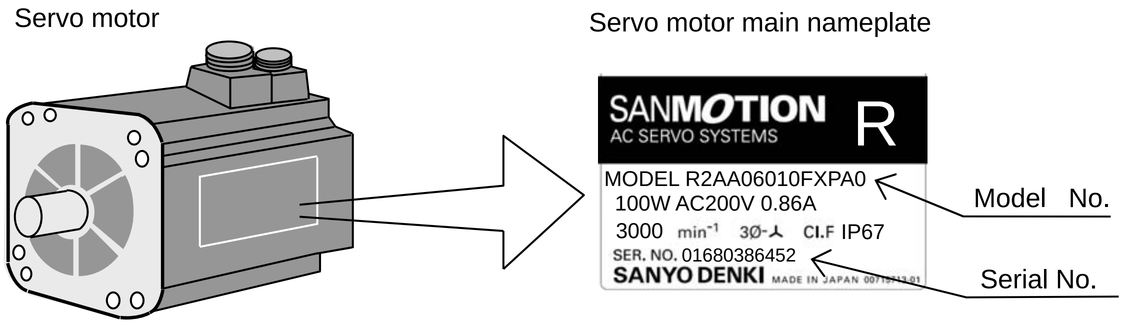
3.2.2 Unpacking

Verify the followings when the product arrives. If you find any discrepancy, contact your distributor or sales office.

■ Verify that the model number of the servo motor is the same as ordered.
The model number is located on the main nameplate, following the word “MODEL”.

■ Verify that there is no problem in the appearance of servo motor.

■ Verify that there are no loose screws on the servo motor.



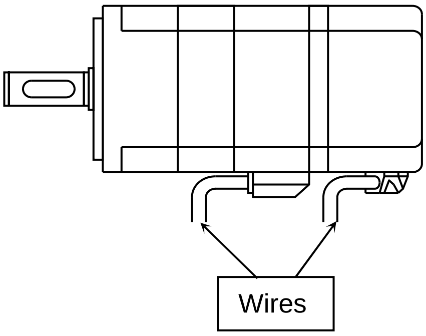
3.2.3 Installation

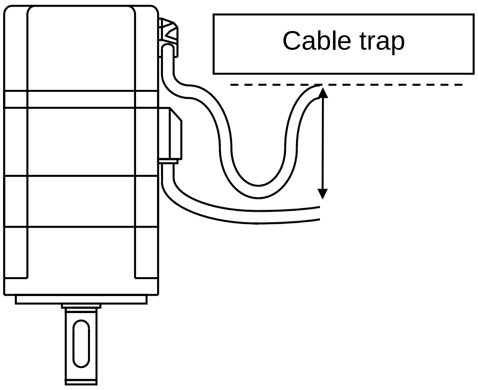
Please note the following regarding the installation location and mounting method.

<table>
<tr><td colspan="2">The servo motor is designed for indoor use. Make sure to Install it indoors.</td></tr>
<tr><td colspan="2">Do not use the device in locations where the oil seal lip is continuously exposed to oil, or where the device is exposed to large quantities of water, oil drops, or cutting fluid. The motor is designed to withstand only small amounts of moisture spray.</td></tr>
<tr><td>Ambient temperature: 0 to 40°C
Storage temperature: -20 to 65°C
Ambient humidity: 20 to 90%</td><td>Good ventilation, no corrosive or explosive gases present.
No dust or dirt accumulation in the environment.
Easy access for inspection and cleaning.</td></tr>
</table>

3.2.4 Mounting method

- Mounting in several orientations are acceptable as horizontal, or upper side/bottom side of the shaft end.
- If the output shaft is used in reduction devices that use grease, oil, or other lubricants, or in mechanisms exposed to liquids, the motor shaft should be installed in a perfectly horizontal or downward position. In some models, there is an oil-seal attached to the output shaft. If the shaft is facing upwards and the seal lip is continuously exposed to oil, oil can enter inside the motor and cause damage, as a result of wear and degradation of the oil seal. In such cases an oil seal should be used on the load-side as well. Contact your distributor or sales office if the device is to be used in such conditions.
- The motor connector and cable outlet should be installed facing downwards, as nearly vertical as possible.
- In vertical installation, create a cable trap to prevent oily water from getting into the motor.



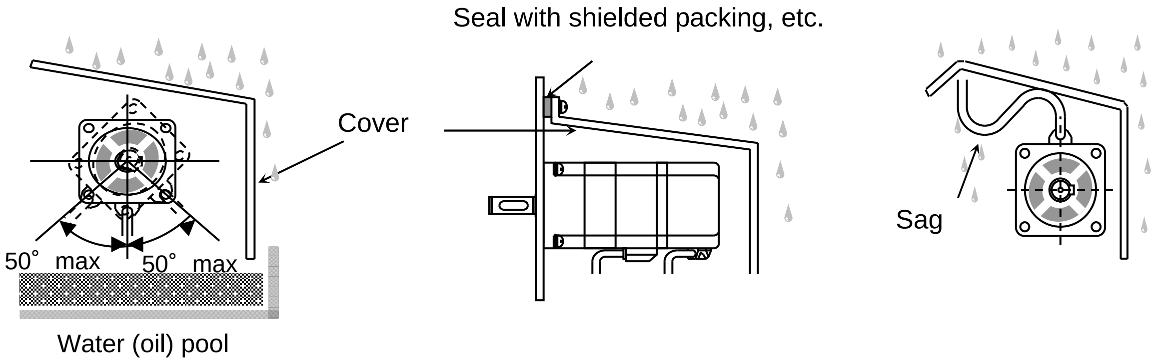


3.2.5 Waterproofing and dust proofing

- The protection inside the motor conforms to IEC standards (IEC34-5). However, such protection is suitable only for short-term use. For regular use, additional sealing measures are required. Be sure to handle the connector carefully, as damage to the exterior of the connector (painted surface) can reduce its waterproofing capability.
- The motor waterproofing is of IPX 7 class level, but still requires careful handling. If the motor is continuously wet, due to the respiratory effect of the motor, liquid might penetrate inside the motor.
- Install a protective cover to prevent corrosion of the coating and the sealing material, which can be caused by certain types of coolants (especially water soluble types).
- In case of a canon plug type motor, please use a waterproofed type plug.

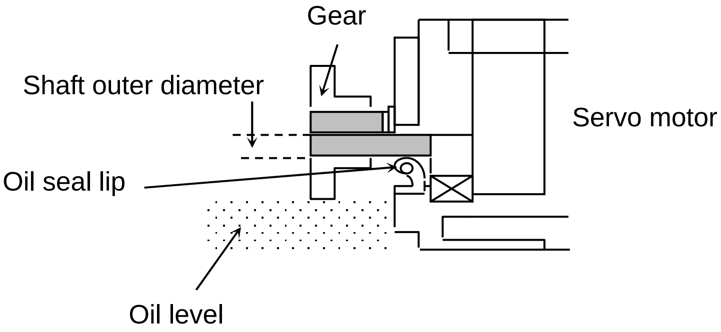
3.2.6 Protective cover installation

- Install a protective cover (as described below) for motors continuously subjected to liquids.
- Turn the connectors (lead outlets) downwards within the angle range shown in the picture below.
- Install the cover on the side where the water or oil would drip.
- Install the cover with slant (for runoff), to prevent water or oil from collecting.
- Make sure that the cable does not get soaked in water or oil.
- Create a sag in the cable outside the cover, to make sure water or oil does not penetrate to the motor.
- If it is not possible to install the connectors (lead outlets) facing downwards, create a sag in the cable to prevent water or oil from entering the motor.

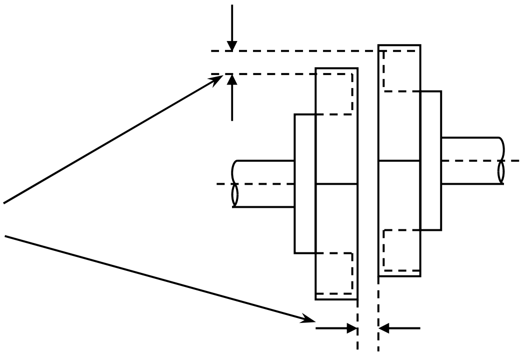


3.2.7 Gear installation and Integration with the target machinery

- The oil level of the gear box should be below the oil seal lip, for a slight spraying effect on the lip.
- Create a hole to prevent pressure build-up inside the gear box, as pressure can cause water or oil to penetrate the oil seal and enter inside the motor.
- If the motor is used with the shaft facing upwards, an oil seal should be used on the opposite side of the mechanism as well. In addition, install a drain to expel the water or oil that may penetrate through this oil seal.

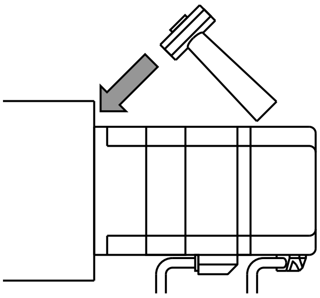


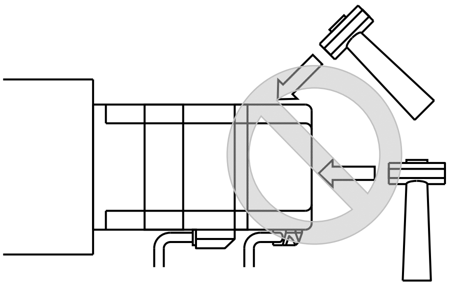
- Refer to the drawing below for correct centering of the motor shaft and the target machinery. Please note when using a rigid coupling that even a slight mistake in centering can damage the output shaft.



Measured at all 4 locations, the difference between the maximum and the minimum should not exceed 3/100mm.
(coupling rotates jointly)

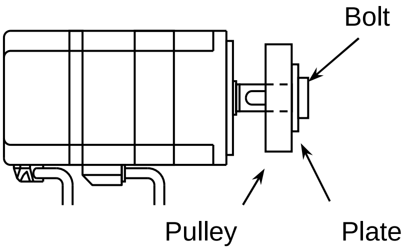
- Do not apply any shocks on the servo motor shaft because precision equipment, encoder is directly connected to it. If it is absolutely necessary to hit the motor for position adjustment or other reasons, use a rubber or plastic hammer and hit the front flange area.

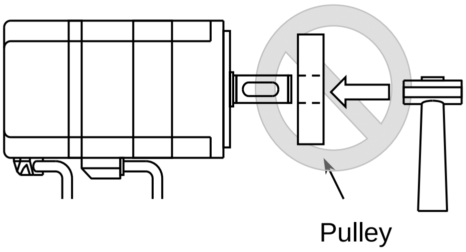




- For mounting to a machine, create accurate enough mounting holes for smooth coupling of the motor flange rabbet. The mounting surface should be flat, otherwise damage to the shaft or the load may occur.

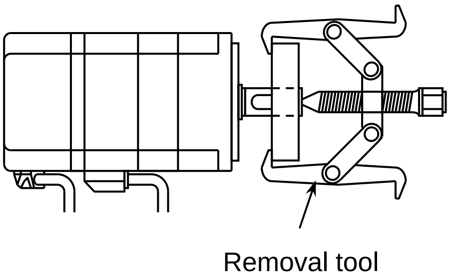
- Use the screw at the end of the shaft for installing parts such as the gear, pulley, or coupling, to avoid shock.

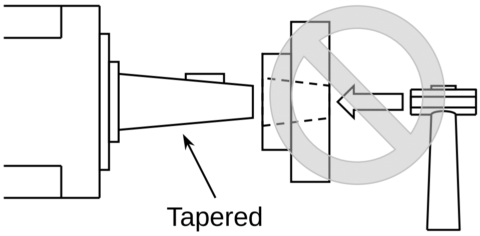




- Tapered servo motor shafts transmit the torque via the tapered surface. Make sure the key fits without rattling. The tapered surface contact should be no less than 70%.

- Use a special tool for removing the gear, pulley, etc.

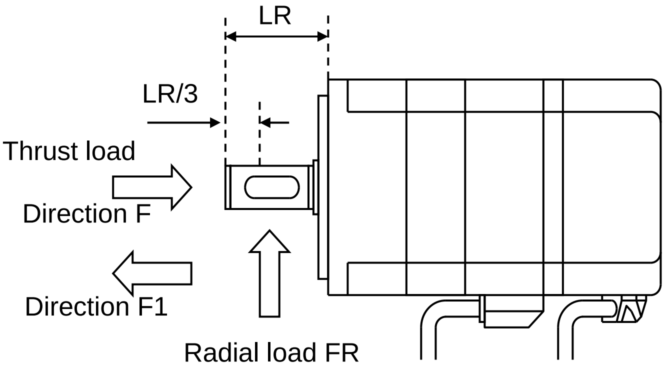




3.2.8 Allowable bearing load

- The table below shows the allowable bearing load of the servo motors. Do not apply excessive thrust load or radial load. In case of belt driving, make sure that the shaft converted value of belt tension does not exceed the allowable values shown below. The thrust load and radial load tolerance values assume individual application to the shaft.

The radial load tolerance value is the maximum load that can be applied at the point measured 1/3 of the distance from the tip of the output shaft.



	Servo motor model number	Assembly			Operation		
		Radial load (N)	Thrust load (N)		Radial load (N)	Thrust load (N)	
		FR	Direction F	Direction F1	FR	Direction F	Direction F1
R1	R1AA10100	980	290	290	690	290	290
	R1AA10150	980	290	290	690	290	290
	R1AA10200	980	290	290	690	290	290
	R1AA10250	980	290	290	690	290	290
	R1AA13300	2000	390	390	980	390	390
	R1AA13400	2000	390	390	980	390	390
	R1AA13500	2000	390	390	1200	390	390
	R1AA18550	3900	2000	2000	1800	590	590
	R1AA18750	3900	2000	2000	1800	590	590
	R1AA1811K	3900	2000	2000	1800	590	590
	R1AA1815K	3900	2000	2000	2700	1500	1500

	Servo motor model number	Assembly			Operation		
		Radial load (N)	Thrust load (N)		Radial load (N)	Thrust load (N)	
		FR	Direction F	Direction F1	FR	Direction F	Direction F1
R2	R2□A04003	98	78	78	49	29	29
	R2□A04005	150	98	98	98	29	29
	R2EA04008	150	98	98	98	29	29
	R2AA04010	150	98	98	98	29	29
	R2□A06010	150	98	98	98	29	29
	R2□A06020	390	200	200	200	68	68
	R2AA06040	390	200	200	250	68	68
	R2AA08020	390	200	200	200	98	98
	R2AA08040	390	200	200	250	98	98
	R2AA08075	590	390	390	340	200	200
	R2AAB8075	590	780	290	340	200	200
	R2AAB8100	590	780	290	340	200	200
	R2AA10075	590	780	290	340	200	200
	R2AA10100	590	780	290	340	200	200
	R2AA13050	980	1400	1400	640	490	490
	R2AA13120	1700	1900	1900	640	490	490
	R2AA13180	1700	1900	1900	640	490	490
	R2AA13200	1700	1900	1900	640	490	490
	R2AA18350	2300	1900	1900	1500	290	290
	R2AA18450	2300	1900	1900	1500	290	290
	R2AA18550	3900	2000	2000	1800	590	590
	R2AA18750	3900	2000	2000	1800	590	590
	R2AA1811K	3900	2000	2000	1800	590	590
	R2AA22500	2300	1900	1900	1500	490	490
	R2AA22700	3900	2000	2000	2500	1100	1100
	R2AA2211K	3900	2000	2000	2700	1500	1500
	R2AA2215K	3900	2000	2000	2700	1500	1500
R5	R5AA06020	390	200	200	200	68	68
	R5AA06040	390	200	200	250	68	68
	R5AA08075	390	390	390	340	200	200

3.2.9 Cable installation considerations

- Be careful not to apply excessive stress and damages onto cables.
- When installing cables in the place servo motor can move, take sufficient inflective radius so as not to apply excessive stress onto cables.
- Pass cables through the areas where cable insulators shall not be scratched by sharp cutting debris. Do not pass cables through the areas having possibility that machine corner scrapes against cables, or personnel/machines may tread on cables.
- Take measures such as clamp to machines so as not to apply flexion stress and own weight stress onto each connecting point of cables. When motor and cables need to be transferred with cableveyor (cable carrier), bending radius of cable shall be determined by referring required flexion life and wire type.
- Periodic replaceable structure for movable part of cable is recommended. Please contact us when you would like to use recommended cables for movable parts.

No Text on This Page.

4

Wiring

In this chapter, wiring between the servo amplifier, servo motor and peripherals are explained.

4. Wiring

4.1 Wiring for the terminal of high voltage and grounding

4.1.1 Part name and function

<table>
<tr><th>Terminal name</th><th>Connector marking</th><th colspan="2">Remarks</th></tr>
<tr><td rowspan="3">Main circuit power supply</td><td rowspan="3">R･T
or
R･S･T</td><td colspan="2">Single phase AC100 to 120V +10%, -15% 50/60Hz±3%</td></tr>
<tr><td colspan="2">Single phase AC200 to 240V +10%, -15% 50/60Hz±3%</td></tr>
<tr><td colspan="2">Three-phase AC200 to 240V +10%, -15% 50/60Hz±3%</td></tr>
<tr><td rowspan="2">Control power supply</td><td rowspan="2">r･t</td><td colspan="2">Single phase AC100 to 120V +10%, -15% 50/60Hz±3%</td></tr>
<tr><td colspan="2">Single phase AC200 to 240V +10%, -15% 50/60Hz±3%</td></tr>
<tr><td>Servo motor connector</td><td>U･V･W</td><td colspan="2">Connected with servo motor</td></tr>
<tr><td>Protective grounding terminal</td><td>⏚</td><td colspan="2">Connected with grounding wire of power supply and of servo motor.</td></tr>
<tr><td rowspan="2">Regeneration resistance connector</td><td rowspan="2">RB1･RB2
RB4</td><td>RS3□01
RS3□02
RS3□03
RS3A05
RS3A30</td><td>Connects regenerative resistance to terminal RB1 and RB2. Built-in regenerative resistor model has already connected at factory setting.
Connects external regenerative resistor to terminal RB1 and RB2 when regenerative performance is insufficient.
RB4 terminal is not equipped.</td></tr>
<tr><td>RS3A07
RS3A10
RS3A15</td><td>Built-in regenerative resistor model has short-bar between RB1 and RB4 at factory setting.
Connects external regenerative resistor to terminal RB1 and RB2 after removing the short-bar when regenerative performance is insufficient.</td></tr>
<tr><td>Maker maintenance</td><td>P･⊖</td><td colspan="2">For maker maintenance. Do not connect anything.</td></tr>
</table>

4.1.2 Wire

Electric wires for use in servo amplifier main circuit power are shown below.

■ Wire type

Kinds of wires		Conductor allowable temperature [°C]
Code	Name	
PVC	Common vinyl electric wire	—
IV	600V electric wire	60
HIV	Special heat-resistant vinyl wire	75

* The information in this table is based on rated armature current running through three bundled lead wires at ambient temperature of 40°C.
Use the electric wire beyond voltage resistance 600V.

* When wires are bundled or put into a wire-duct, such as a hardening vinyl pipe or a metallic conduit, take the allowable current reduction ratio into account.

* At high ambient temperature, service life of the wires becomes shorter by heat-related deterioration.
In this case, we recommend using heat-resistant vinyl wires (HIV).

4.1.3 Wire size - allowable current

AWG size	Nominal cross-sectional area [mm²]	Conductor resistance [Ω/km]	Allowable current over ambient temperature [A]		
			30°C	40°C	55°C
20	0.5	39.5	6.6	5.6	4.2
19	0.75	26.0	8.8	7.0	5.4
18	0.9	24.4	9.0	7.7	5.8
16	1.25	15.6	12.0	11.0	8.3
14	2.0	9.53	23.0	20.0	15.0
12	3.5	5.41	33.0	29.0	21.8
10	5.5	3.47	43.0	38.0	28.5
8	8.0	2.41	55.0	49.0	36.8
6	14.0	1.35	79.0	70.0	52.5

* This is reference value in the case of a special heat-resistant vinyl wire (HIV).
* Electric wire size and allowable current shows in case of a three electric wires bundled.
* Use wire at less than above-mentioned allowable current.

4.1.4 Recommended wire size

The recommendation electric wire size used for servo amplifiers and servo motors are shown below.

■ Input voltage 200V AC

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm^2	AWG No		mm^2	AWG No	mm^2	AWG No	mm^2	AWG No	mm^2	AWG No
R2AA04003F	0.5	20	RS3#01#	1.25	16	1.25	16	2.0	14	2.0	14
R2AA04005F											
R2AA04010F											
R2AA06010F											
R5AA06020H											
R2AA06020F	0.75	19	RS3#02#	2.0	14						
R2AA06040H											
R5AA06020F											
R5AA06040H											
R2AA08020F											
R2AA06040F											
R2AA08040F											
R5AA06040F											
R1AA10100H	0.75	19	RS3#03#								
R1AA10150H											
R2AA08075F											
R2AAB8100H											
R2AA10075F											
R2AA13050D											
R2AA13050H											
R2AA13120B											
R5AA08075D											
R5AA08075D											
R5AA08075F											
R1AA10100F	2.0	14	RS3A05#								
R1AA10150F											
R1AA10200H											
R1AA10250H											
R2AAB8075F											
R2AAB8100F											
R2AA10100F											
R2AA13120D											
R2AA13120L											
R2AA13180H											
R2AA13200L											
R1AA10200F	5.5	10	RS3A07#	5.5	10			3.5	12	5.5	10
R1AA10250F											
R1AA13300H											
R2AA13180D											
R2AA13200D											
R2AA18350V											

* Mark "#" shows optional number or alphabetical letter.

* The information in this table is based on rated armature current flowing through three bundled lead wires at ambient temperature of 40°C.

* When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.

* At high ambient temperature, service life of the wires becomes shorter by heat-related deterioration. In this case, we recommend using heat-resistant vinyl wires (HIV).

* Depending on the servo motor capacity, thinner electric wires than indicated in the above table can be used for the main circuit power terminal.

- ■ Continuing Input voltage 200V AC

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm²	AWG No		mm²	AWG No	mm²	AWG No	mm²	AWG No	mm²	AWG No
R1AA13300F	5.5	10	RS3A10#	5.5	10	1.25	16	5.5	10	5.5	10
R1AA13400H											
R1AA13500H											
R2AA13200D											
R2AA13180D											
R2AA18350L											
R1AA13400F	5.5	10	RS3A15#	8.0	8			8.0	8	8.0	8
R1AA13500F											
R2AA18350D											
R2AA18450H											
R2AA22500L											
R2AA18550R	8.0	8									
R2AA22700S	5.5	10									
R1AA18550H	14.0	6	RS3A30#	14.0	6			8.0	8	14.0	6
R1AA18750L											
R1AA1811KR											
R1AA1815KB											
R2AA18550H											
R2AA18750H											
R2AA1811KR											
R2AA2211KB											
R2AA2215KB											

- ■ Input voltage AC100V

Servo motor model No.	Motor power (U・V・W・⏚)		Combination servo amplifier	Main circuit power supply (R・S・T)		Control power supply		Regenerative resistance		⏚	
	mm²	AWG No		mm²	AWG No	mm²	AWG No	mm²	AWG No	mm²	AWG No
R2EA04003F	0.5	20	RS3#01#	1.25	16	1.25	16	1.25	16	2.0	14
R2EA04005F			RS3#02#								
R2EA04008F											
R2EA06010F											
R2EA06020F	0.75	19	RS3#03#	2.0	14			2.0	14		

- * Mark “#” shows optional number or alphabetical letter.
- * The information in this table is based on rated armature current flowing through three bundled lead wires at ambient temperature of 40°C.
- * When wires are bundled or put into a wire-duct, take the allowable current reduction ratio into account.
- * At high ambient temperature, service life of the wires becomes shorter by heat-related deterioration. In this case, we recommend using heat-resistant vinyl wires (HIV).
- * Depending on the servo motor capacity, thinner electric wires than indicated in the above table can be used for the main circuit power terminal.

4.1.5 Wiring for servo motor

- ■ Specifications for lead wires and pin assignment of R-series servo motor

Servo motor model number:
R2#A04***, R2#A06***, R2AA08***, R2AAB8***, R2AA10***, R5AA06***, R5AA08***

Lead color	Name	Remarks
Yellow	Brake	Power for brake (24V DC)
Yellow	Brake	Power for brake (GND of DC24V)
Red	U	Phase U
White	V	Phase V
Black	W	Phase W
Green/Yellow	⏚	Protective grounding terminal

* No polarity on terminal for brake power.
Please contact us for specifications for 90V DC power supply for brake.

* We recommend 1.25mm^2(AWG16)-wiring size of power supply for brake.

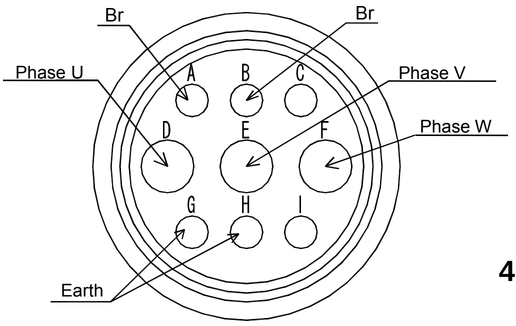
- ■ Specification and model number for canon plug of R-series servo motor (Products of Japan Aviation Electronics Industry, Ltd.)

Servo motor model number	Plug for powering and braking line (Cable clamp type) [Plug + clamp model number]		Plug for braking line (Cable clamp type) [Plug + clamp model number]	
	Straight	Angle	Straight	Angle
R1AA10100	N/MS3106B20-15S (N/MS3057-12A) 【MS06B20-15S-12】	N/MS3108B20-15S (N/MS3057-12A) 【MS08B20-15S-12】	Note 1)	Note 1)
R1AA10150				
R1AA10200				
R1AA10250				
R1AA13300	N/MS3106B24-11S (N/MS3057-16A) 【MS06B24-11S-16】	N/MS3108B24-11S (N/MS3057-16A) 【MS08B24-11S-16】		
R1AA13400				
R1AA13500				
R2AA13050				
R2AA13120				
R2AA13180				
R2AA13200				
R2AA18350				
R2AA18450				
R2AA22500				
R2AA22700			JL04V-6A10SL-3SE-EB-R (JL04-1012CK(05)-R) 【332706X1】	JL04V-8A10SL-3SE-EB-R (JL04-1012CK(05)-R) 【332707X1】
R1AA18550	N/MS3106B32-17S (N/MS3057-20A) 【MS06B32-17S-20】	N/MS3108B32-17S (N/MS3057-20A) 【MS08B32-17S-20】		
R1AA18750				
R1AA1811K				
R1AA1815K				
R2AA18550				
R2AA18750				
R2AA1811K				
R2AA2211K				
R2AA2215K				

Note1) Plug for braking line is used in common with powering line.

* Please contact us for waterproof type and TÜV-compliant products.
Please place your order by [plug + clamp model number], our exclusive model numbers.

- ■ Pin assignment of cannon plug



Canon plug for power line
(For N/MS3106 (8) B24-11S)
Pin assignment (Viewed from motor)

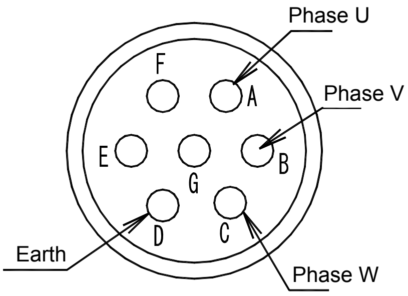
- Model number of fan plug for motor connection
  (Products of Japan Aviation Electronics Industry, Ltd.)

Servo motor model number	Plug model number for cooling fan (Cable clamp model number) [Plug + clamp model number]	Connector type	Disposition symbol of pins
			200V AC±10% Single-phase50/60Hz
All of R1 series, R2AA1811K	N/MS3106B10SL-4S (N/MS3057-4A) 【MS06B10SL-4S-4】	Straight	A, B
	N/MS3108B10SL-4S (N/MS3057-4A) 【MS08B10SL-4S-4】	Angle	A, B

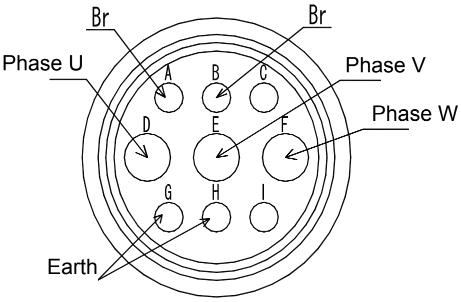
* No polarity.
Please place your order by [plug + clamp model number], our exclusive model numbers.

* For wire size of cooling fan, 1.25mm^2 (AWG16) is recommended.

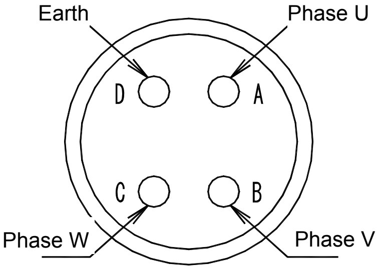
- Pin assignment of cannon plug
  Pin assignments are below, depending on model number for power, brake and cooling fan cable.



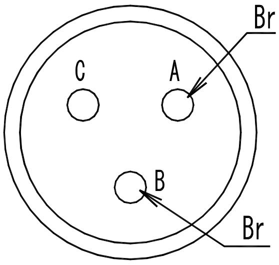
Canon plug for power line
(for N/MS3106(8)B20-15S)
Pin assignment (Viewed from motor)



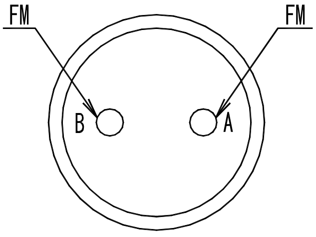
Canon plug for power line
(for N/MS3106(8)B24-11S)
Pin assignment (Viewed from motor)



Canon plug for power line
(for N/MS3106(8)B32-17S)
Pin assignment (Viewed from motor)



Canon plug for brake line
(for JL04V-6(8)A10SL-3SE-EB)
Pin assignment (Viewed from motor)

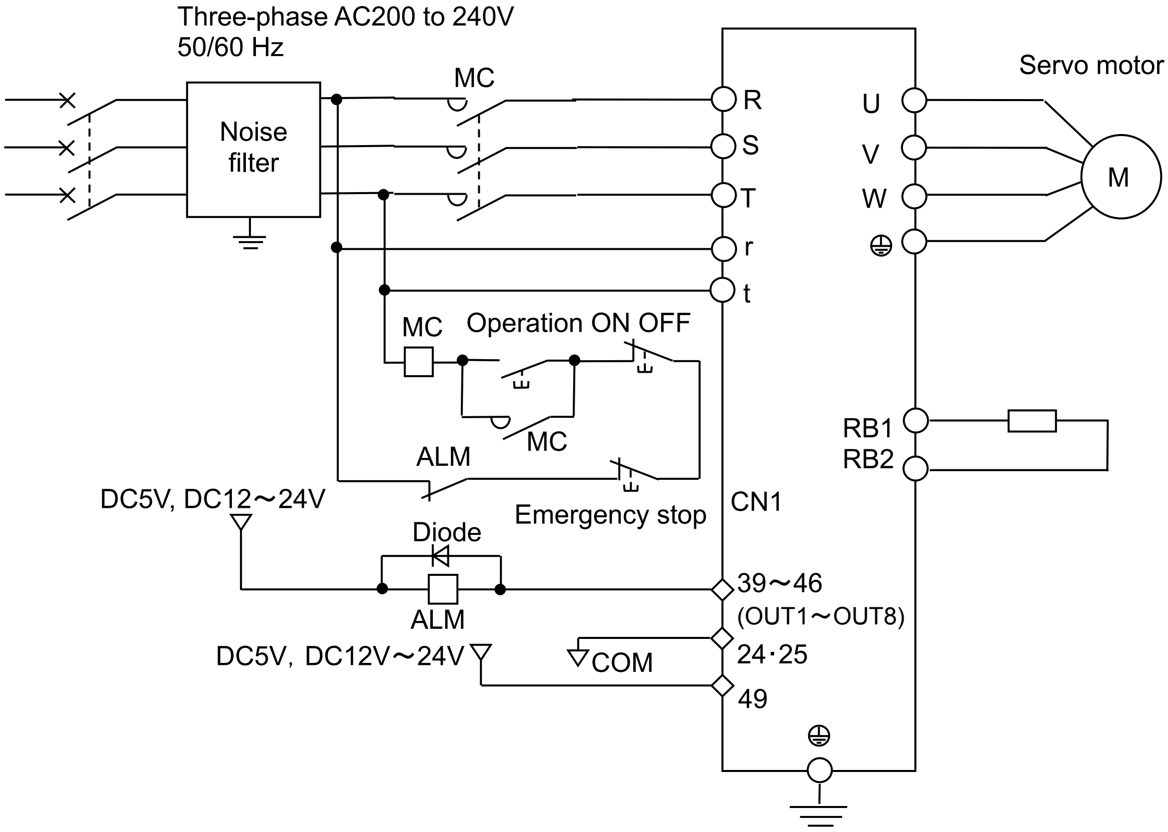


Canon plug for cooling fan
Pin assignment (Viewed from motor)

4.1.6 Example of wiring

Even if it turns off power supply, high-pressure voltage may remain in servo amplifier. Therefore, do not touch a power supply terminal for 15 minutes for the prevention from an electric shock. Completion of electric discharge turns off the CHARGE LED. Please perform connection check work after checking that the CHARGE LED goes dark.

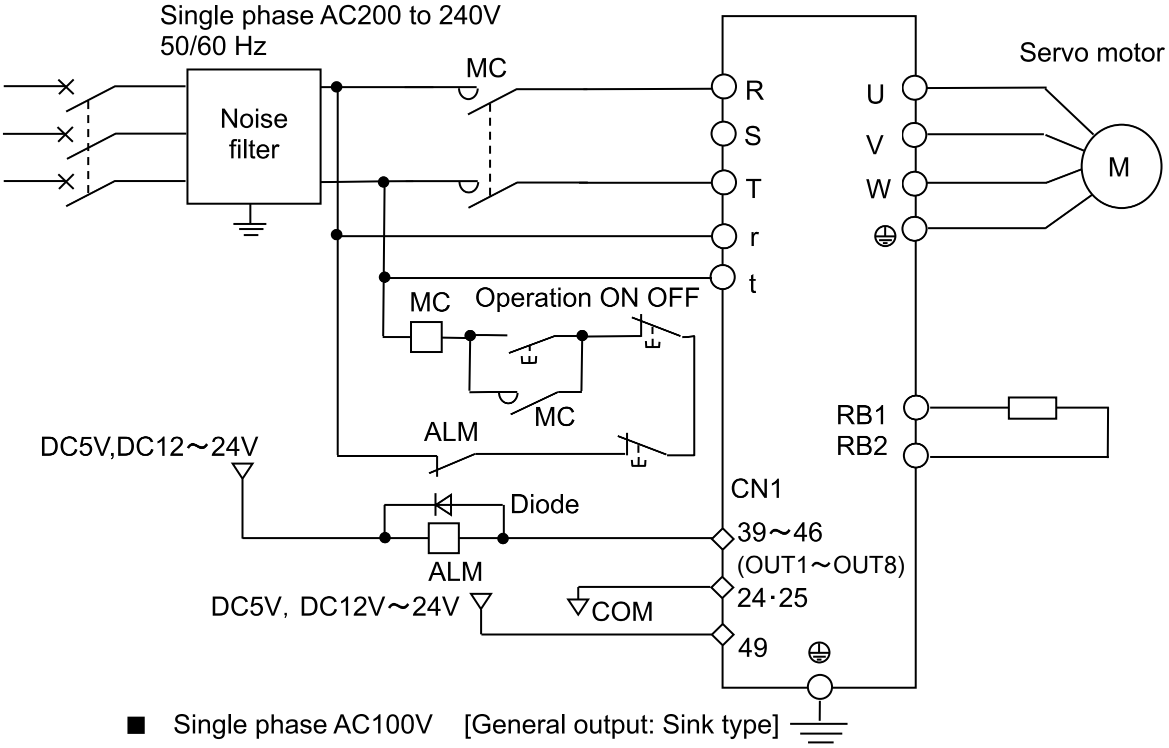
■ Three-phase AC200V [General output: Sink type]



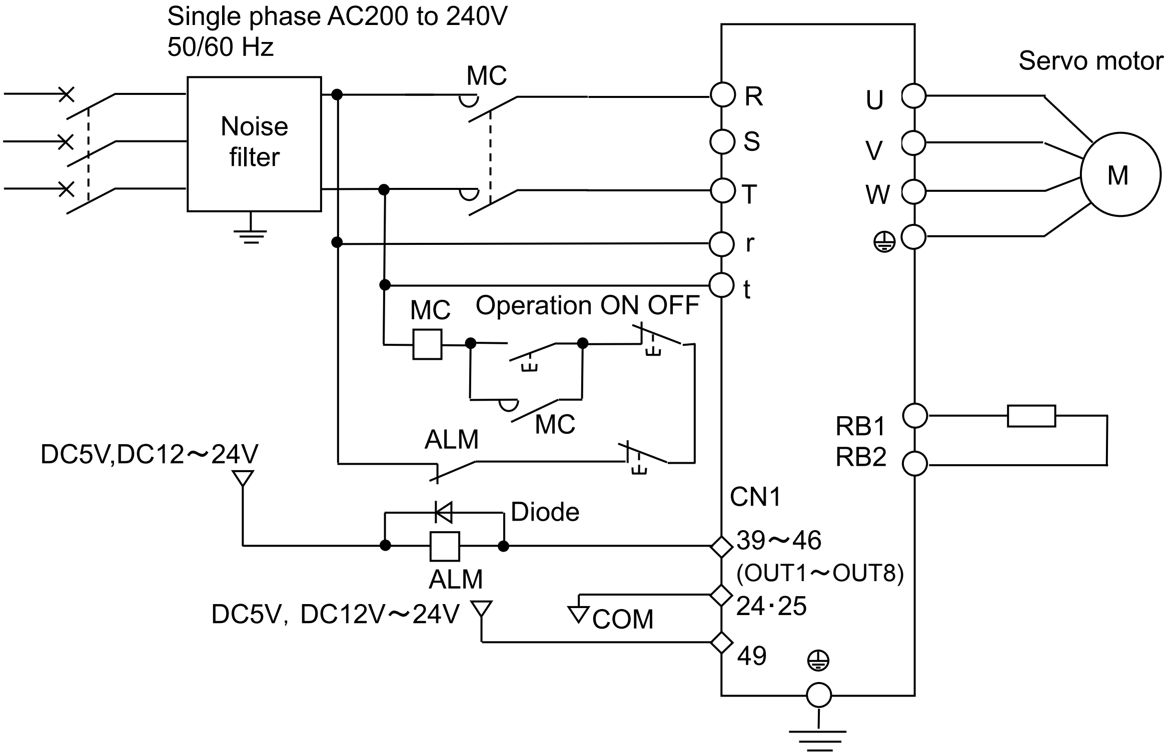
* For ALM contact of safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A "General output terminal output condition" (5-113).

* Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).
Please take care of polarity of the diode that will be cause of failure.

- Single phase AC200V [General output: Sink type]



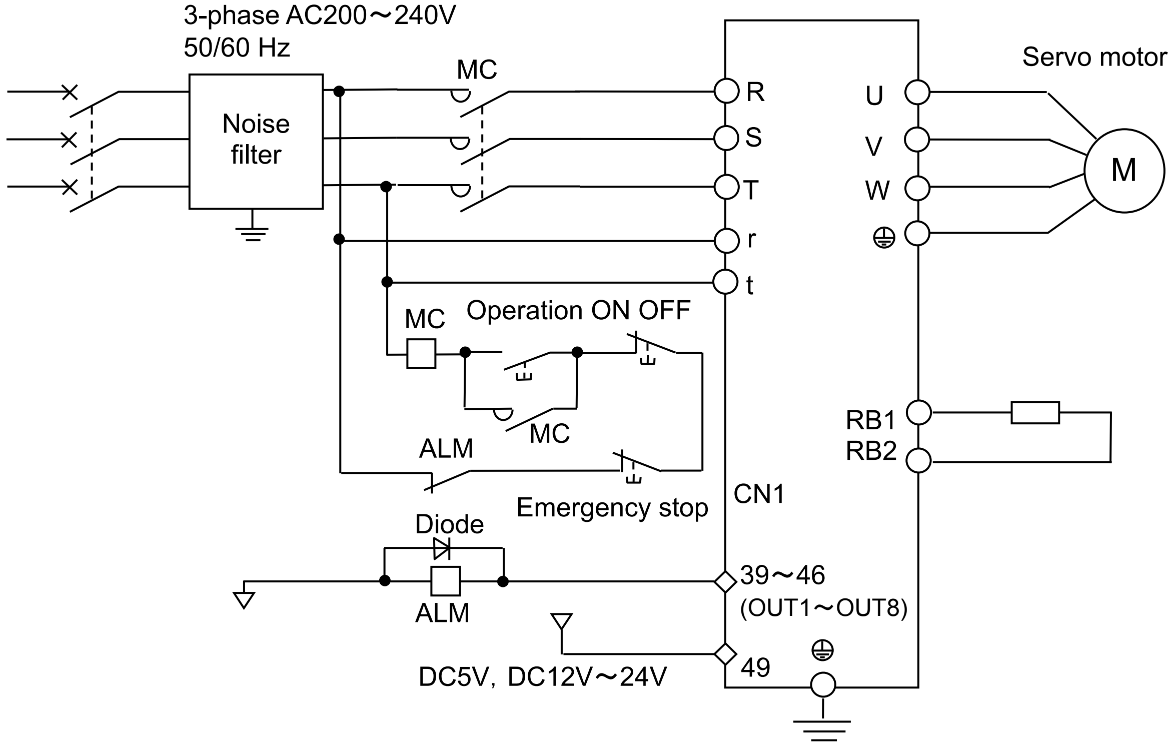
- Single phase AC100V [General output: Sink type]



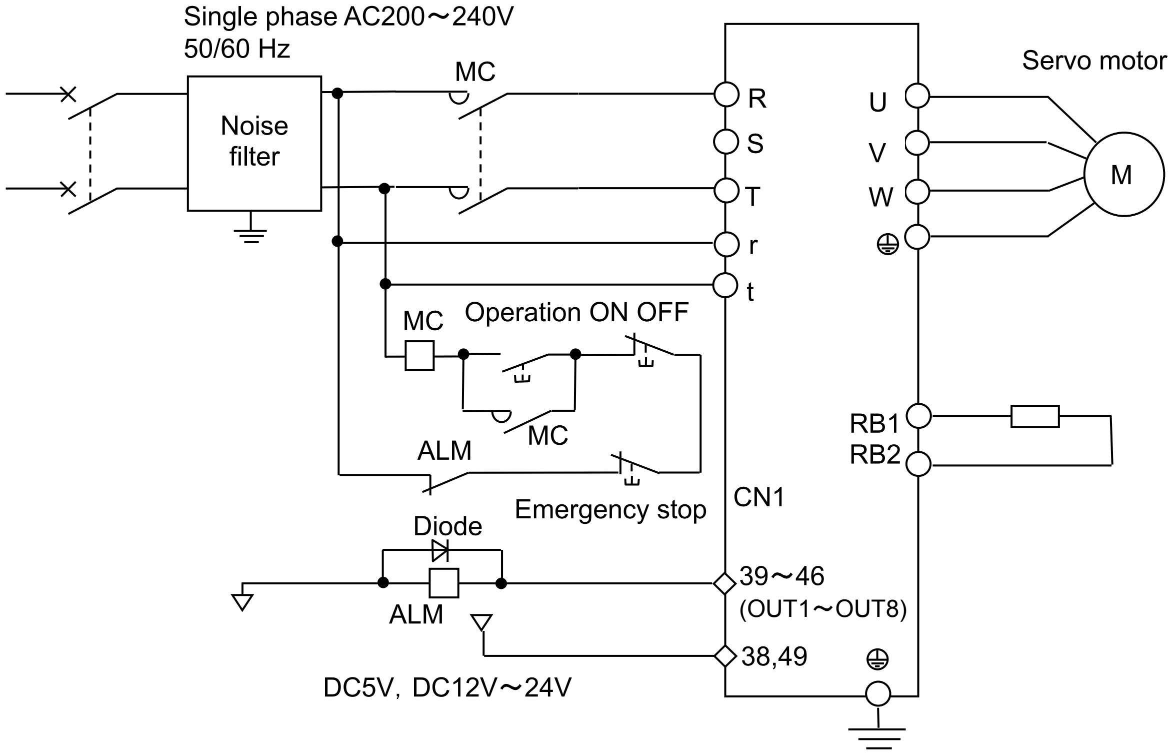
* For ALM contact of safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A “General output terminal output condition" (5-113).

* Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).
Please take care of polarity of the diode that will be cause of failure.

- ■ 3-phase AC200V [General output: Source type]



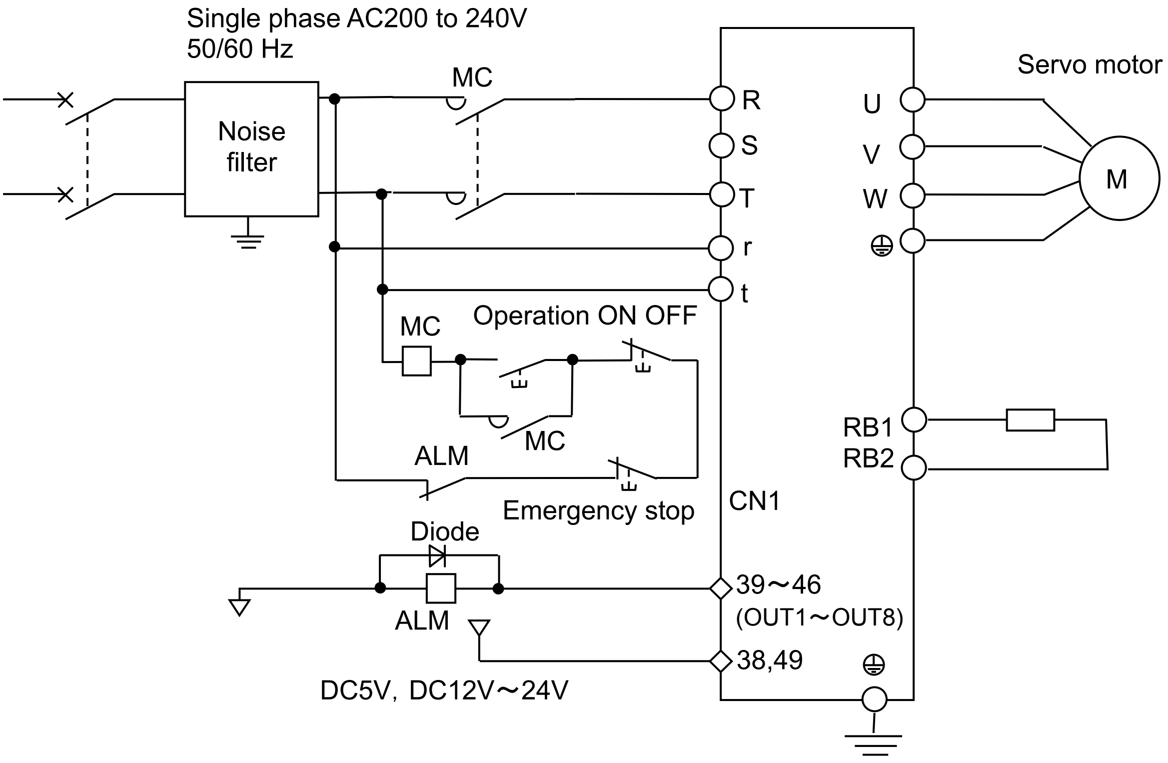
- ■ Single phase AC200V [General output: Source type]



* For ALM contact of safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A “General output terminal output condition" (5-113).

* Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).
Please take care of polarity of the diode that will be cause of failure.

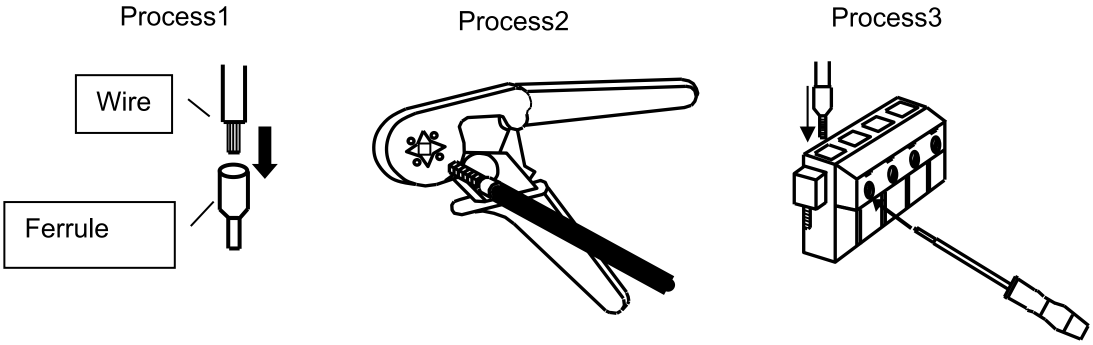
- ■ Single phase AC200V [General output: Source type]



- * For ALM contact of safety circuit, use one of the outputs from CN1- 39 to 46 (OUT1 to OUT8) as alarm signal by setting either During ALM status output ON or During ALM status output OFF at the selection setting of Group A “General output terminal output condition" (5-113).
- * Must add the surge absorbing diode to if inductive load as relay connect to CN1- 39 to 46 (OUT1 to OUT8).
  Please take care of polarity of the diode that will be cause of failure.

4.1.7 Crimping of wires

Insert the wire into ferrule, and use a special tool to crimp it in.
Insert the ferrule deep into the connector, and tighten it with a special minus screwdriver or something. The recommended torque is shown in the section 4.1.8.



■ Model number of recommended ferrules and crimping tools for various wire sizes (Manufactured by Phoenix Contact)

mm^2	AWG	Model number		
		1Pcs/Pkt	1000Pcs/Pkt	Taped components
0.75 mm^2	19	AI0.75-8GY	AI0.75-8GY-1000	AI0.75-8GY-B(1000Pcs/Pkt)
1.0 mm^2	18	AI1-8RD	AI1-8RD-1000	AI1-8RD-B(1000Pcs/Pkt)
1.5 mm^2	16	AI1.5-8BK	AI1.5-8BK-1000	AI1.5-8BK-B(1000Pcs/Pkt)
2.5 mm^2	14	AI2.5-8BU	AI2.5-8BU-1000	AI2.5-8BU-B(500Pcs/Pkt)
4.0mm^2	12	AI4-10GY Note1)	-	-
5.5mm^2	10	A6-10 Note1) Note2)	-	-

Note1) Use for CNA/CNB of RS3A07# only.
Note2) Without plastic sleeve.

- * GY: Gray, RD: Red, BK: Black, BU: Blue
- * Crimping tool model number: 0.14mm^2 to 10mm^2 : CRIMPFOX 10S

4.1.8 High voltage circuit terminal; tightening torque

Servo amplifier model number	Terminal marking		
	CNA	CNB	⏚
RS3#01#	[0.5 to 0.6 N·m]		[1.18 N·m] M4 (screw size)
RS3#02#			
RS3#03#			
RS3A05#			

Servo amplifier model number	Terminal marking			
	CNA	CNB	CNC	⏚
RS3A07#	Wire size 4mm^2 or less [0.5 to 0.6 N·m] Wire size 4mm^2 over [0.7 to 0.8 N·m]		[0.5 to 0.6 N·m]	[1.18 N·m] M4 (screw size)

Servo amplifier model number	Terminal marking											
	R	S	T	⊖	RB4	RB1	RB2	U	V	W	⏚	CNA
RS3A10#	[1.18 N·m] M4 (screw size)											[0.5 to 0.6 N·m]
RS3A15#												

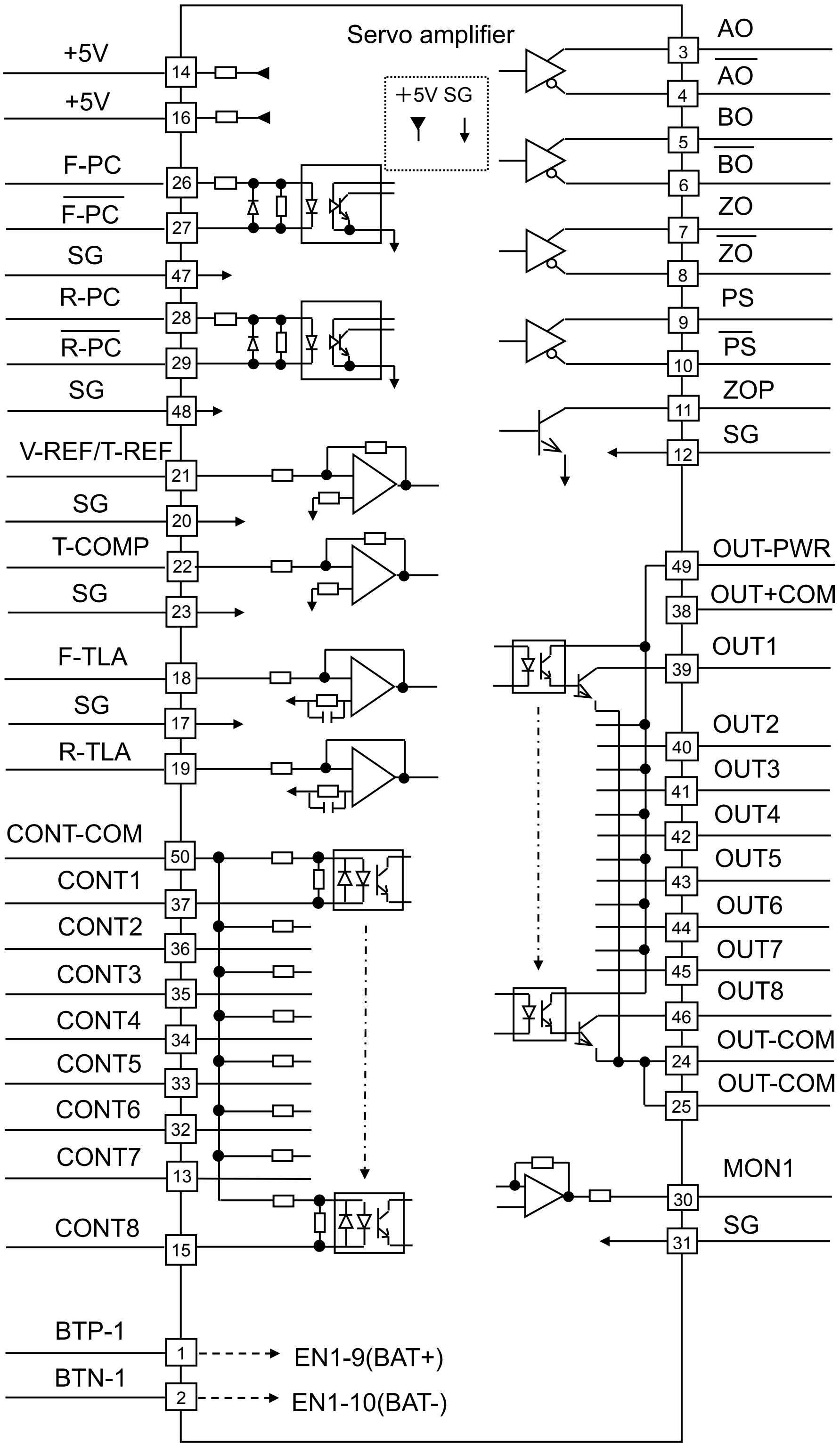
Servo amplifier model number	Terminal marking											
	R	S	T	⊖	P	U	V	W	⏚	RB1	RB2	CNA
RS3A30#	[3.73 N·m] M6 (screw size)									[1.18 N·m] M4 (screw size)		[0.5 to 0.6 N·m]

* “#” will be any number or alphabet.

4.2 Wiring with Host Unit

4.2.1 CN1 signal name and pin number (wiring with host unit)

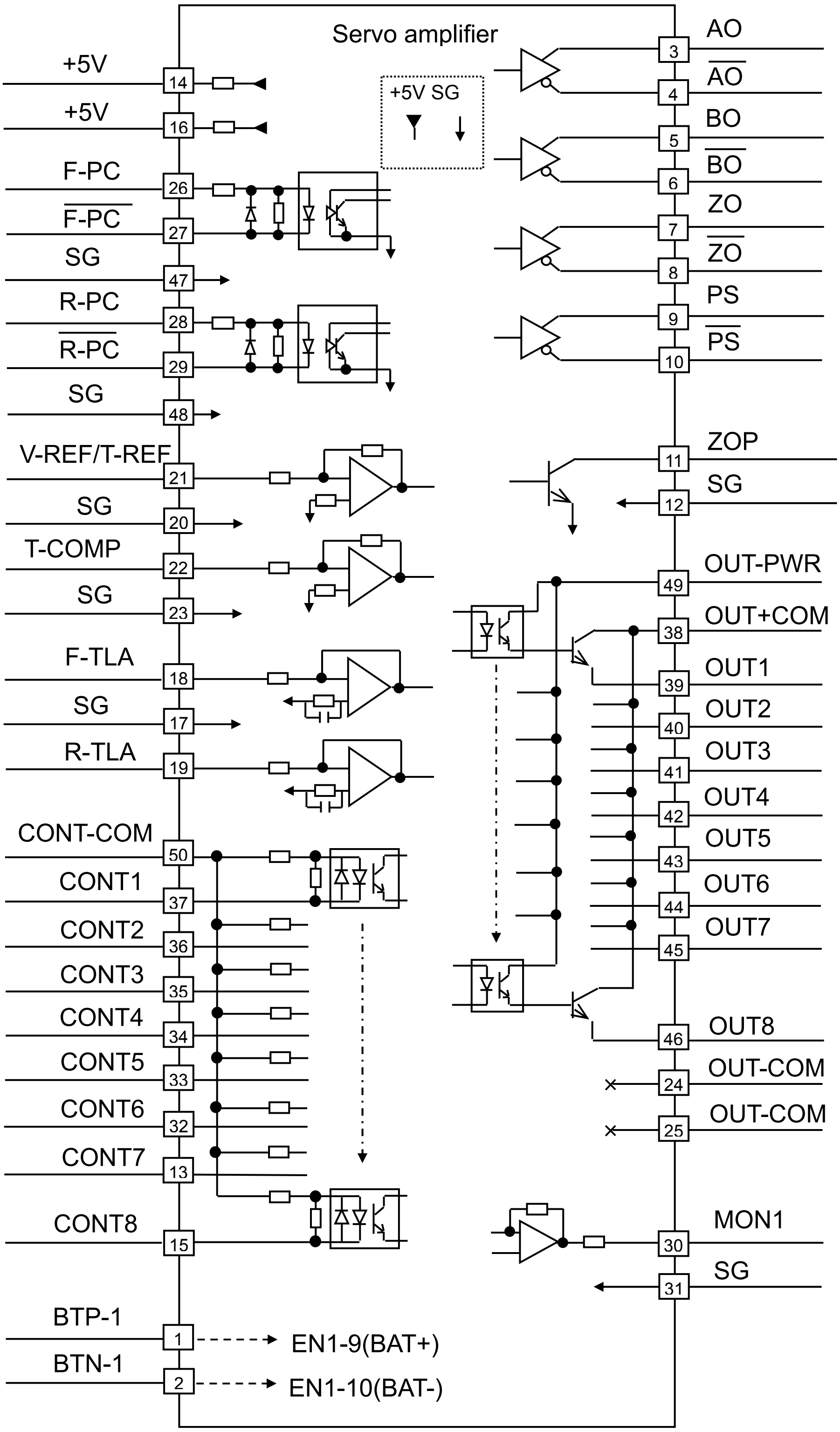
- CN1 terminal sequence [General output: Sink type output]



* Please check "1.1.3 Notes for replacement from SANMOTION R ADVANCED MODEL" for replacement from previous product (RS1, RS2).

* The wiring of CN1 use a twisted pair shield cable.

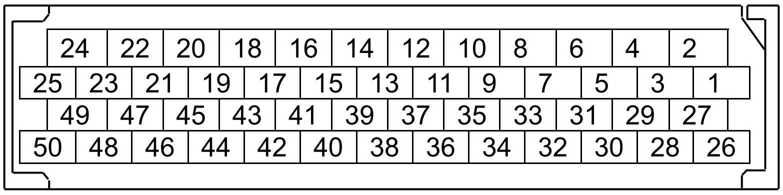
■ CN1 terminal sequence [General output: Source type output]



- * Please check "1.1.3 Notes for replacement from SANMOTION R ADVANCED MODEL" for replacement from previous product (RS1, RS2).
- * The wiring of CN1 use a twisted pair shield cable.
- * ZOP signal is sink type output even if general outputs are used as source type.

4.2.2 CN1 pin assignment

- CN1 10150-3000PE (Soldered side)



4.2.3 Signal name and its function

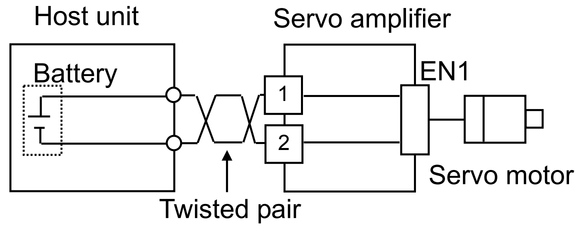
Terminal number	Signal name	Description
1	BTP-1	Battery plus
2	BTN-1	Battery minus
3	AO	A phase pulse output
4	$\overline{\text{AO}}$	/A phase pulse output
5	BO	B phase pulse output
6	$\overline{\text{BO}}$	/B phase pulse output
7	ZO	Z phase pulse output
8	$\overline{\text{ZO}}$	/Z phase pulse output
9	PS	Encoder signal output
10	$\overline{\text{PS}}$	/Encoder signal output
11	ZOP	Z phase pulse output
12	SG	Common for pins 3 to 11
17	SG	Common for pins 18, 19
18	F-TLA	Forward side torque limitation input
19	R-TLA	Reverse side torque limitation input
20	SG	Common for pin 21
21	V-REF	Velocity command input
	T-REF	Torque command input
22	T-COMP	Torque compensation input
23	SG	Common for pin 22
14	PC-PWR	Internal power for command pulse
16	PC-PWR	Internal power for command pulse
26	F-PC	Command pulse input
27	$\overline{\text{F-PC}}$	Command pulse input
28	R-PC	Command pulse input
29	$\overline{\text{R-PC}}$	Command pulse input
47	SG	Common for pins 26, 27
48	SG	Common for pins 28, 29

Terminal number	Signal name	Description
30	MON1	Analog monitor output
31	SG	Common for pin 30
15	CONT8	General input
13	CONT7	General input
32	CONT6	General input
33	CONT5	General input
34	CONT4	General input
35	CONT3	General input
36	CONT2	General input
37	CONT1	General input
50	CONT-COM	For general input power supply
39	OUT1	General output
40	OUT2	General output
41	OUT3	General output
42	OUT4	General output
43	OUT5	General output
44	OUT6	General output
45	OUT7	General output
46	OUT8	General output
49	OUT-PWR	Power supply for general output circuit
38 Note 1)	OUT+COM	Common for general output plus
24 Note 2)	OUT-COM	Common for general output minus
25 Note 2)	OUT-COM	Common for general output minus

Note 1) 38: OUT+COM will be NC in case of sink type, general output.
Note 2) 24 and 25: OUT-COM will be NC in case of source type, general output.

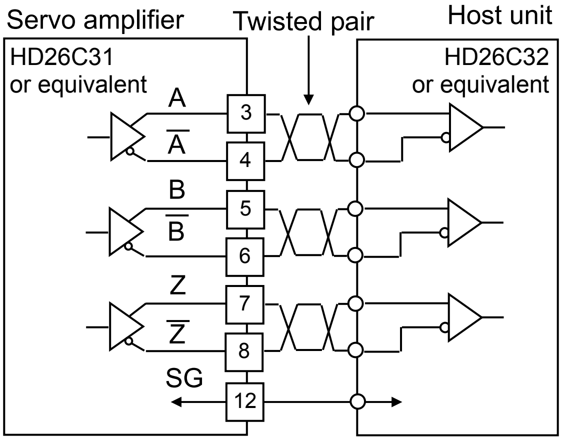
4.2.4 Terminal connection circuit

- Battery
  When using a Battery Backup Absolute Encoder (Encoder code: P), the battery for backup can be mounted in the host unit side, and it can connect via servo amplifier.

Terminal No.	Symbol	Name	Description
1	BTP-1	Battery plus	
2	BTN-1	Battery minus	

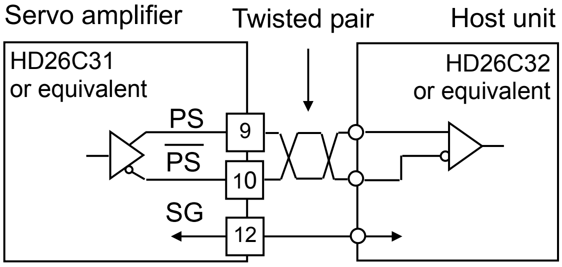
* Keep NC to these terminals if a battery connects to CN3.

- Encoder signal output: A, B, Z
  Outputting Signal: A, B and origin Z of motor or external encoder. Connect with a line receiver.

Terminal No.	Symbol	Name	Description
3	AO	A phase pulse output	
4	$\overline{\text{AO}}$	/A phase pulse output	
5	BO	B phase pulse output	
6	$\overline{\text{BO}}$	/B phase pulse output	
7	ZO	Z phase pulse output	
8	$\overline{\text{ZO}}$	/Z phase pulse output	
12	SG	Common for pins 3 to 11	

* Make sure to connect SG.

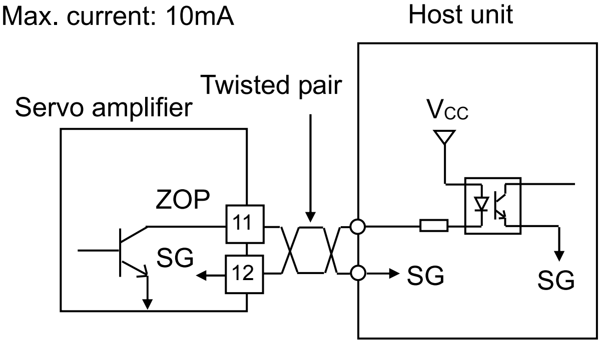
- Absolute encoder output: Absolute position data

Terminal No.	Symbol	Name	Description
9	PS	Encoder signal output	Absolute position data output signal of an absolute encoder 
10	$\overline{\text{PS}}$	Encoder signal output	
12	SG	Common for pins 3 to 11	

* Make sure to connect SG.

- Encoder signal output: Z phase pulse, open collector
  The origin Z phase pulse of a motor encoder is output by open collector.

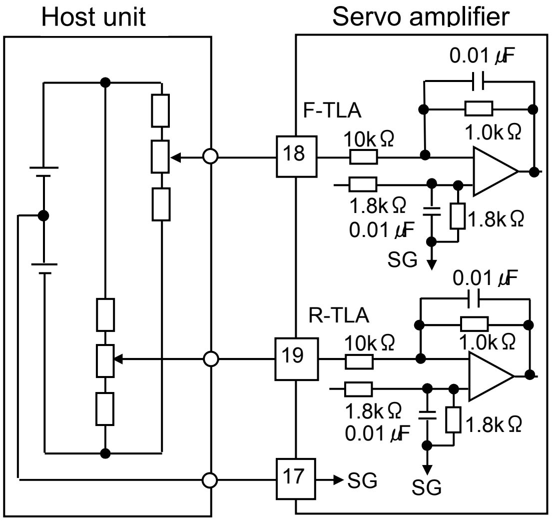
  - ◆ Sink type open collector output

Terminal No.	Symbol	Name	Description
11	ZOP	Z phase pulse output	[Circuit spec.] Max. voltage: DC30V Max. current: 10mA 
12	SG	Common for pins 3 to 11	

* Make sure to connect SG.

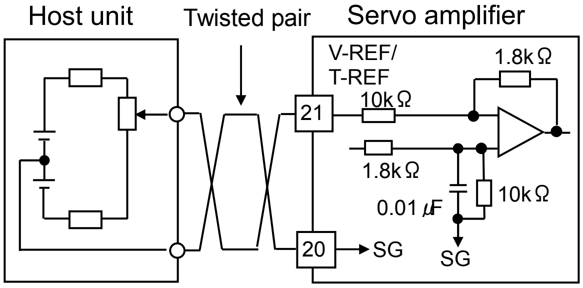
* Source type open collector output is not available.

- Torque limit input
  Forward and reverse side torque is restricted on external analog voltage.

Terminal No.	Symbol	Name	Description
18	F-TLA	Forward side torque limit input	[Circuit spec.] Input voltage range -10V to +10V Input impedance: about 10kΩ 
19	R-TLA	Reverse side torque limit input	
17	SG	Common for pins 18, 19	

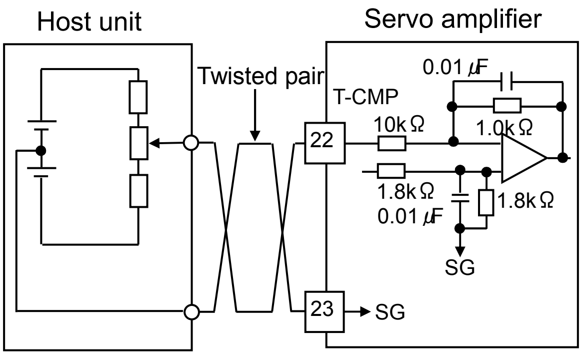
* Make sure to connect SG.

- Analog command input
  Inputting velocity addition command of position control, velocity command of velocity control and torque command of torque control, by analog voltage.

Terminal No.	Control type	Symbol	Name	Description
21	Position	V-REF	Velocity addition command input	[Circuit spec.] Max. allowable input voltage is ±10V. Input impedance is about 10kΩ 
	Velocity	V-REF	Velocity command input	
	Torque	T-REF	Torque command input	
20	Velocity, Torque	SG	Common for pins 21	

* Make sure to connect SG.

- Torque compensation input
  Inputting torque compensation value (position or velocity control only) by analog voltage.

Terminal No.	Symbol	Name	Description
22	T-COMP	Torque compensation input	[Circuit spec.] Max. allowable input voltage is ±10V. Input impedance is about 10kΩ 
23	SG	Common for pins 22	

* Make sure to connect SG.

- Command pulse input

  For inputting position command pulse of position control.

[Command pulse input type]

Command pulse input type is able to choose from 3 types below.

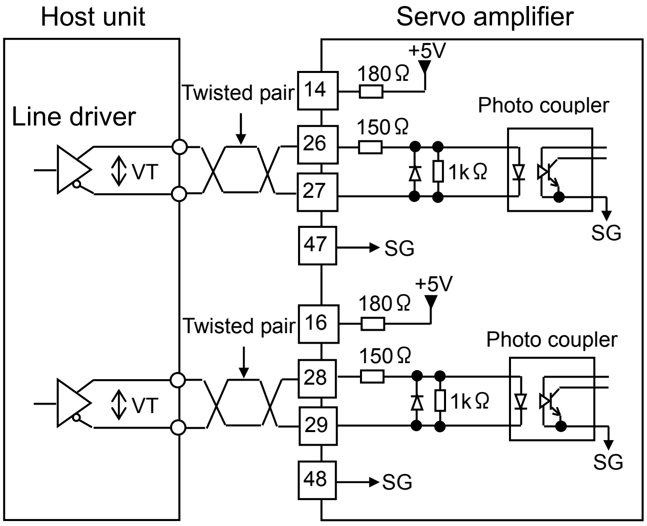
Command pulse input type	Maximum frequency of input pulse
Forward pulse and Reverse pulse	4 M Pulse/s
Pulse and Direction code	4 M Pulse/s
90 degree phase difference pulses	1 M Pulse/s

* When used in the Pulse and Direction code, connect the code to F-PC, and the pulse to R-PC. Refer the section 2.3.2, for detail of command pulse input.

[Command pulse output circuit]

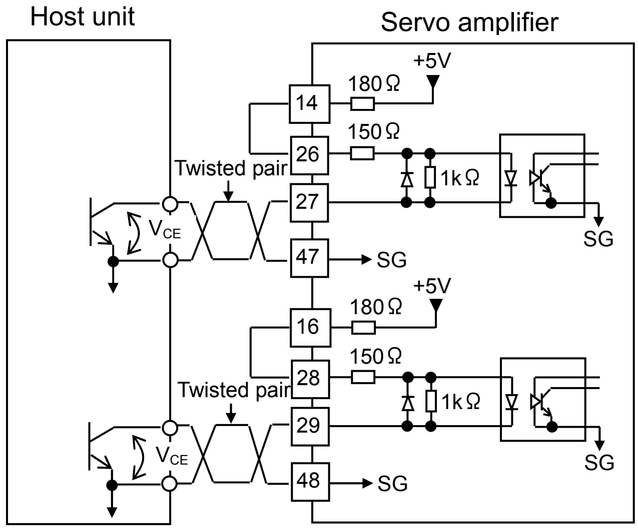
Command pulse which outputted from host unit is able to choose from 3 types, Differential line driver, Sink type open collector and Source type open collector.

◆ For Differential line driver

Terminal No.	Symbol	Name	Description
26	F-PC	Command pulse input	[Differential line driver spec.] Choose host unit side line driver which has differential output voltage(VT) range: 2.5 to 3.8 V. 
27	$\overline{\text{F-PC}}$	Command pulse input	
47	SG	Common for pins 26, 27	
28	R-PC	Command pulse input	
29	$\overline{\text{R-PC}}$	Command pulse input	
48	SG	Common for pins 28, 29	

* It will be cause of wrong operation by pulse missing or circuit failure when differential output voltage (VT) is less than 2.5V or more than 3.8V.

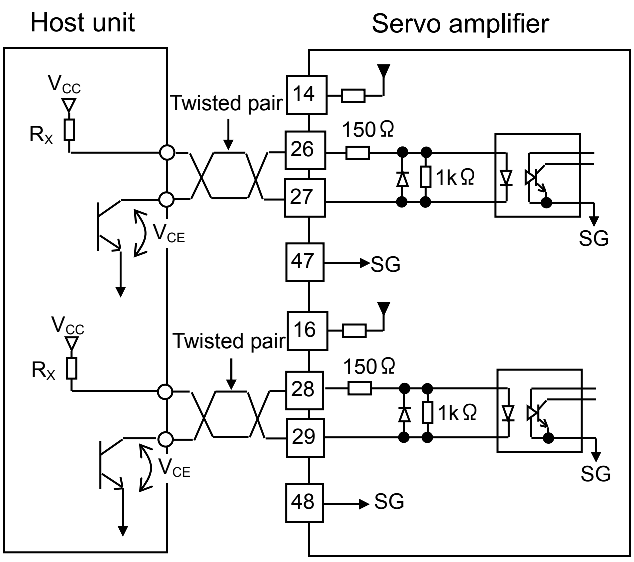
◆ For Sink type open collector (Internal +5V is used)

Terminal No.	Symbol	Name	Description
26	F-PC	Command pulse input	[Output transistor spec.] Choose host unit side transistor which has collector-emitter voltage (V_{CE}) range: less than 1.5V. 
27	$\overline{\text{F-PC}}$	Command pulse input	
14	PC-PWR	Internal power for command pulse	
47	SG	Common for pins 26, 27	
28	R-PC	Command pulse input	
29	$\overline{\text{R-PC}}$	Command pulse input	
16	PC-PWR	Internal power for command pulse	
48	SG	Common for pins 28, 29	

* It will be cause of wrong operation by pulse missing or circuit failure when collector-emitter voltage (V_{CE}) of a transistor in host unit is more than 1.5V.

* Make sure to connect SG.

◆ For Sink type open collector (External power is used)

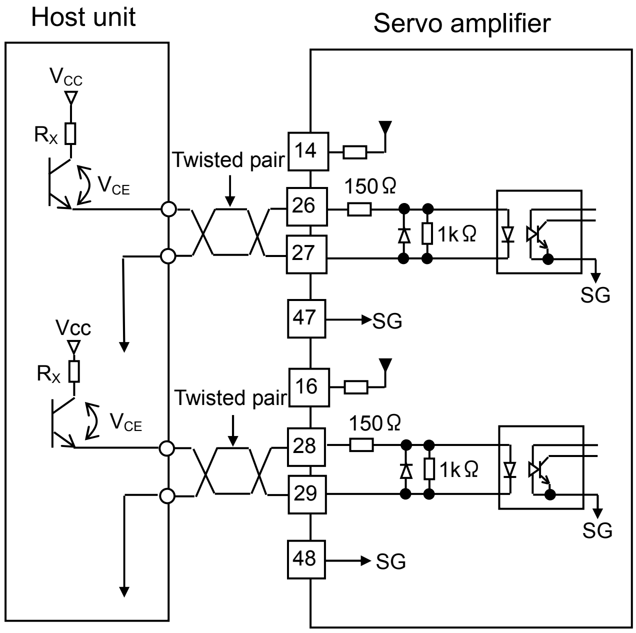
<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>26</td><td>F-PC</td><td>Command pulse input</td><td rowspan="6">[Pull up resistance spec.]
Choose pull up resistance (Rx) from table below with depending to power supply voltage (Vcc) to keep range of input current to servo amplifier: 3.8 to 15 mA.
<table>
<tr><th>External power(Vcc)</th><th>Pull up resistance (Rx)</th></tr>
<tr><td>5V±5%</td><td>100 to 180Ω</td></tr>
<tr><td>12V±5%</td><td>590 to 1.5kΩ</td></tr>
<tr><td>24V±5%</td><td>1.8k to 3.9kΩ</td></tr>
</table>
[Output transistor spec.]
Choose host unit side transistor which has collector-emitter voltage (VCE) range: less than 1.5V.


</td></tr>
<tr><td>27</td><td>$\overline{\text{F-PC}}$</td><td>Command pulse input</td></tr>
<tr><td>47</td><td>SG</td><td>Common for pins 26, 27</td></tr>
<tr><td>28</td><td>R-PC</td><td>Command pulse input</td></tr>
<tr><td>29</td><td>$\overline{\text{R-PC}}$</td><td>Command pulse input</td></tr>
<tr><td>48</td><td>SG</td><td>Common for pins 28, 29</td></tr>
</table>

* It will be cause of wrong operation by pulse missing or circuit failure when input current to servo amplifier is less than 3.8mA or more than 15mA.

* It will be cause of wrong operation by pulse missing or circuit failure when collector-emitter voltage (VCE) of a transistor in host unit is more than 1.5V.

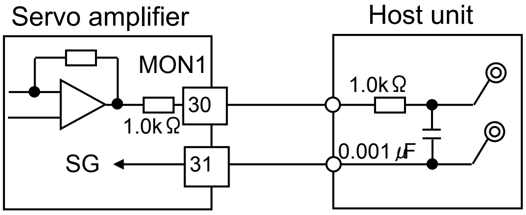
◆ For Source type open collector (External power only)

<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>26</td><td>F-PC</td><td>Command pulse input</td><td rowspan="6">[Pull up resistance spec.]
Choose pull up resistance (R_X) from table below with depending to power supply voltage (V_{CC}) to keep range of input current to servo amplifier: 3.8 to 15 mA
<table><tr><th>External power(V_{CC})</th><th>Pull up resistance (R_X)</th></tr><tr><td>5V±5%</td><td>100 to 180Ω</td></tr><tr><td>12V±5%</td><td>590 to 1.5kΩ</td></tr><tr><td>24±5%</td><td>1.8k to 3.9kΩ</td></tr></table>
[Output transistor spec.]
Choose host unit side transistor which has collector-emitter voltage (V_{CE}) range: less than 1.5V.
 </td></tr>
<tr><td>27</td><td>$\overline{\text{F-PC}}$</td><td>Command pulse input</td></tr>
<tr><td>47</td><td>SG</td><td>Common for pins 26, 27</td></tr>
<tr><td>28</td><td>R-PC</td><td>Command pulse input</td></tr>
<tr><td>29</td><td>$\overline{\text{R-PC}}$</td><td>Command pulse input</td></tr>
<tr><td>48</td><td>SG</td><td>Common for pins 28, 29</td></tr>
</table>

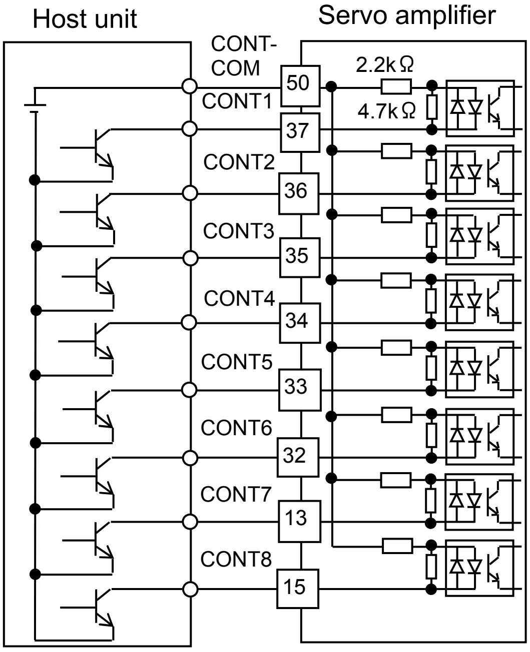
* It will be cause of wrong operation by pulse missing or circuit failure when input current to servo amplifier is less than 3.8mA or more than 15mA.

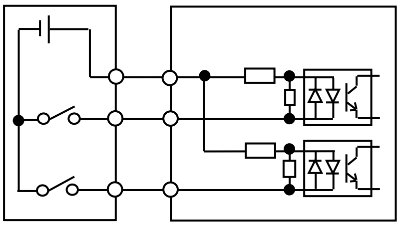
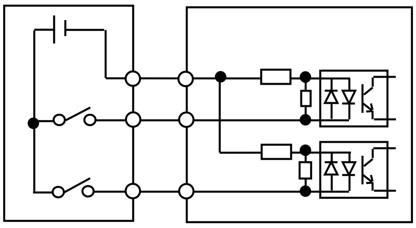
* It will be cause of wrong operation by pulse missing or circuit failure when collector-emitter voltage (V_{CE}) of a transistor in host unit is more than 1.5V.

- Analog monitor output
  Outputs the selection of analog monitor output 1.

Terminal No.	Symbol	Name	Description
30	MON1	Analog monitor output	[Circuit spec.] Load shall be less than 2mA. Output resistance shall be 1kΩ. Output voltage range shall be ±8V. 
31	SG	Common for pin 30	

- General input
  Inputting signals from relay switch, open collector type transistor (sink type, source type) output, etc.

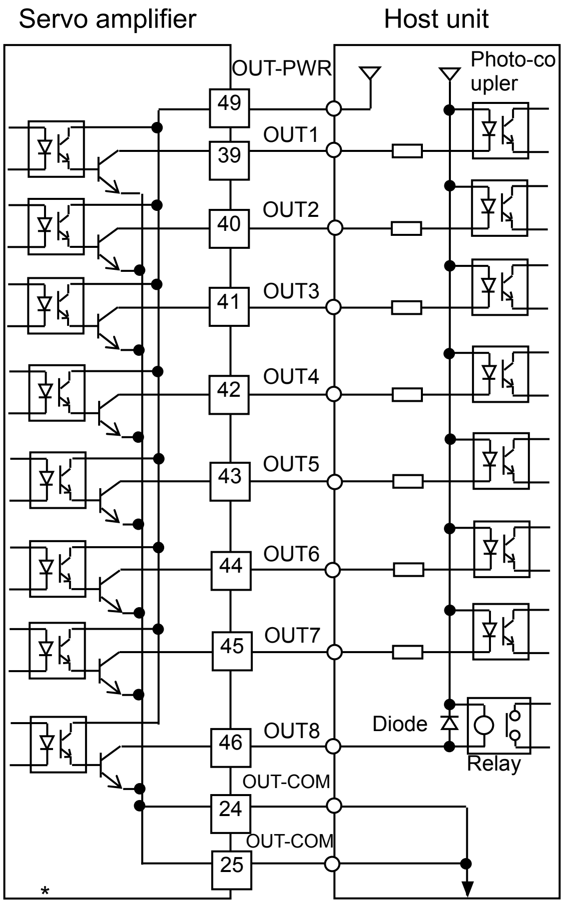
Terminal No.	Symbol	Name	Description
37	CONT1	General input	[External power supply spec.] Power supply voltage range: DC5V±5%, DC12V to DC24V±10% Current capacity: 100mA or more (at DC24V) [Sink type circuit example] 
36	CONT2	General input	
35	CONT3	General input	
34	CONT4	General input	
33	CONT5	General input	
32	CONT6	General input	
13	CONT7	General input	
15	CONT8	General input	
50	CONT-COM	For power supply to general input	

Sink type circuit	Source type circuit
	

- General output
  Driving electric loads like relay switch or photo-coupler.

  - For sink type
    These outputs pull current from electric load when output state is ON.

<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>39</td><td>OUT1</td><td>General output</td><td rowspan="9">[Internal power supply spec. for general output(OUT-PWR]
Power supply voltage range:
DC5V±5%, DC12V to DC24V±10%
Current capacity: 20mA or more

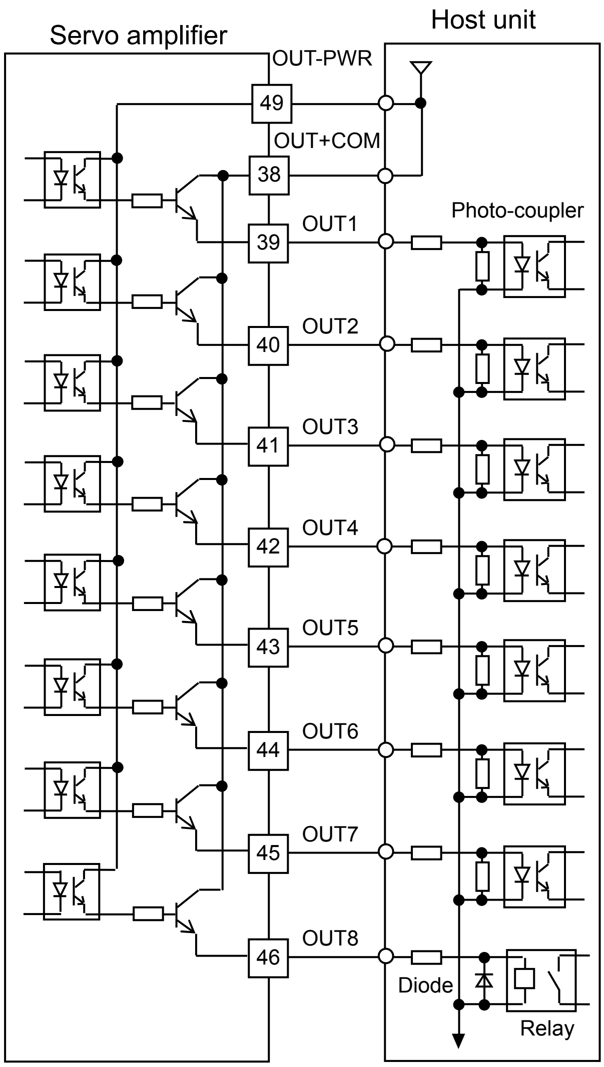
[General output (OUT-1 to OUT-8) spec.]
<table>
<tr><th>Power supply voltage range</th><th>Maximum output current (Each port)</th></tr>
<tr><td>DC5V±5%</td><td>10mA</td></tr>
<tr><td>DC12 to 15V±10%</td><td>30mA</td></tr>
<tr><td>DC24V±10%</td><td>50mA</td></tr>
</table>


</td></tr>
<tr><td>40</td><td>OUT2</td><td>General output</td></tr>
<tr><td>41</td><td>OUT3</td><td>General output</td></tr>
<tr><td>42</td><td>OUT4</td><td>General output</td></tr>
<tr><td>43</td><td>OUT5</td><td>General output</td></tr>
<tr><td>44</td><td>OUT6</td><td>General output</td></tr>
<tr><td>45</td><td>OUT7</td><td>General output</td></tr>
<tr><td>46</td><td>OUT8</td><td>General output</td></tr>
<tr><td>49</td><td>OUT-PWR</td><td>For power supply to general output</td></tr>
<tr><td>24</td><td>OUT-COM</td><td>Minus common for general output</td><td></td></tr>
<tr><td>25</td><td>OUT-COM</td><td>Minus common for general output</td><td></td></tr>
</table>

* Must add the surge absorbing diode if inductive load as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.

◆ For source type
These outputs flow current to electric load from terminal when output state is ON.

<table>
<tr><th>Terminal No.</th><th>Symbol</th><th>Name</th><th>Description</th></tr>
<tr><td>39</td><td>OUT1</td><td>General output</td><td rowspan="10">[Internal power supply spec. for general output(OUT-PWR]
Power supply voltage range:
DC5V±5%, DC12V to DC24V±10%
Current capacity: 20mA or more

[General output (OUT-1 to OUT-8) spec.]
<table>
<tr><th>Power supply voltage range</th><th>Maximum output current (Each port)</th></tr>
<tr><td>DC5V±5%</td><td>10mA</td></tr>
<tr><td>DC12 to 15V±10%</td><td>30mA</td></tr>
<tr><td>DC24V±10%</td><td>50mA</td></tr>
</table>

</td></tr>
<tr><td>40</td><td>OUT2</td><td>General output</td></tr>
<tr><td>41</td><td>OUT3</td><td>General output</td></tr>
<tr><td>42</td><td>OUT4</td><td>General output</td></tr>
<tr><td>43</td><td>OUT5</td><td>General output</td></tr>
<tr><td>44</td><td>OUT6</td><td>General output</td></tr>
<tr><td>45</td><td>OUT7</td><td>General output</td></tr>
<tr><td>46</td><td>OUT8</td><td>General output</td></tr>
<tr><td>49</td><td>OUT-PWR</td><td>For power supply to general output</td></tr>
<tr><td>38</td><td>COT+COM</td><td>Plus common for general output</td></tr>
</table>

* Must add the surge absorbing diode if inductive load as relay connect to the control signal output of the amplifier. Please take care of polarity of the diode that will be cause of failure.

4.3 Wiring for motor encoder

4.3.1 EN1, EN2 signal names and its pin numbers

■ Battery backup absolute encoder (Encoder code: P)

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (For lead wire type)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	Power supply common	
3	5V	-	NC Note 3)	-
4	SG	-	NC Note 3)	-
5	(NC)	-	NC Note 3)	-
6	(NC)	-	NC Note 3)	-
7	ES+	1 (Brown)	Serial data signal	Twisted pair
8	ES-	2 (Blue)		
9	BAT+	8 (Pink)	Battery	Twisted pair
10	BAT-	4 (Purple)		
Note 2)	Earth	7 (shielded)	Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect outer-shielded wires of encoder cable to metallic case (earth) of encoder connector (EN1) for servo amplifier Outer-shielded wire should connect to outer-shielded wire of encoder at the servomotor with leads, or connect up to the edge of cannon plug at the servo motor with cannon plug. This encoder does not connect outer-shields to somewhere inside of the servo motor equipped with this encoder.
Note 3) Do not connect anything to 3 to 6 pins.

■ Single-turn absolute encoder (Encoder code: H)

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (For lead wire type)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	Power supply common	
3	5V	-	NC Note 3)	-
4	SG	-	NC Note 3)	-
5	(NC)	-	NC Note 3)	-
6	(NC)	-	NC Note 3)	-
7	ES+	1 (Brown)	Serial data signal	Twisted pair
8	ES-	2 (Blue)		
9	(NC)	-	NC Note 3)	-
10	(NC)	-	NC Note 3)	-
Note 2)	Earth	7 (shielded)	Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect outer-shielded wires of encoder cable to metallic case (earth) of encoder connector (EN1). Outer-shielded wire should connect to outer-shielded wire of encoder at the servomotor with leads, or connect up to the edge of cannon plug at the servo motor with cannon plug. This encoder does not connect outer-shields to somewhere inside of the servo motor equipped with this encoder.
Note 3) Do not connect anything to 3 to 6, 9 and 10 pins.

- ■ Battery less absolute encoder (Encoder code: R)
- ■ Resolver type battery-less absolute encoder (Encoder code: W)

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (For lead wire type)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	Power supply common	
3	5V	-	NC Note 3)	-
4	SG	-	NC Note 3)	-
5	(NC)	-	NC Note 3)	-
6	(NC)	-	NC Note 3)	-
7	ES+	1 (Brown)	Serial data signal	Twisted pair
8	ES-	2 (Blue)		
9	(NC)	-	NC Note 3)	-
10	(NC)	-	NC Note 3)	-
Note 2)	Earth	7 (shielded)	Shield	-

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.

Note 2) Connect outer-shielded wires of encoder cable to metallic case (earth) of encoder connector (EN1) for servo amplifier and an earth of motor encoder.

Note 3) Do not connect anything to 3 to 6, 9 and 10 pins.

- ■ Wire-saving incremental encoder (Encoder code: S)

Servo Amplifier EN1, EN2 Terminal No.	Signal name	R-series Servo motor plug pin number (For lead wire type)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	Power supply common	
3	5V	-	NC Note 4)	-
4	SG	-	NC Note 4)	-
5	B	2 (Green)	Phase B pulse output	Twisted pair
6	/B	5 (Purple)		
7	A	1 (Blue)	Phase A pulse output	Twisted pair
8	/A	4 (Brown)		
9	Z	3 (White)	Phase Z pulse output	Twisted pair
10	/Z	6 (Yellow)		
Note 2)	Earth	7 (shielded)	Shield	-

Note 1) For amplifier model number "RS3****2***", EN2 is able to use as motor encoder input.

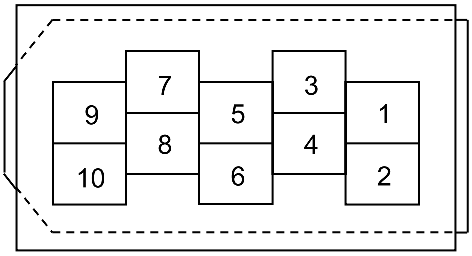
Note 2) Use an exterior covering shielded cable and perform twisted-pair wiring.

Note 3) Connect outer-shielded wires of encoder cable to metallic case (earth) of encoder connector (EN1 or EN2) and an earth of motor encoder.

Note 4) Do not connect anything to 3 and 4 pins.

4.3.2 EN1, EN2 pin assignment

- ■ EN1, EN2 36210-0100PL (soldered side)



* Wirings vary depending on encoders to be connected, so please carefully perform wiring.

- ■ Connector model number (3M Japan Limited)

	Model Number	Applicable wire size	Applicable cable diameter
Connector	36210-0100PL	AWG30 to AWG18	—
Shell kit	36310-3200-008	—	ϕ7 to ϕ9

4.3.3 Connector model number for motor encoder

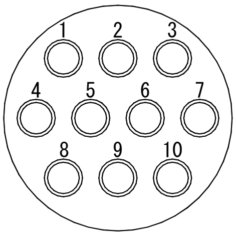
- R-series servo motor encoder
  Connector model numbers (Products of Japan Aviation Electronics Industry, Ltd.)

Motor model number	Motor encoder plug model number	Connector type	Applicable cable diameter
R2#A04003 R2#A04005 R2EA04008 R2#A04010 R2#A06010 R2#A06020 R2AA08020 R2AA06040 R2AA08040 R2AA08075 R2AAB8075 R2AAB8100 R2AA10075 R2AA10100 R5AA06020 R5AA06040 R5AA08075	(Lead wire type)	—	—
R1AA10100 R1AA10150 R1AA10200 R1AA10250 R1AA13300 R1AA13400 R1AA13500 R1AA18550 R1AA18750 R1AA1811K R1AA1815K R2AA13050 R2AA13120 R2AA13180 R2AA13200 R2AA18350 R2AA18450 R2AA18550 R2AA18750 R2AA1811K R2AA22500 R2AA22700 R2AA2211K R2AA2215K	JN2DS10SL1-R	Straight	ϕ5.7 to ϕ7.3
	JN2FS10SL1-R	Angle	
	JN2DS10SL2-R	Straight	ϕ6.5 to ϕ8.0
	JN2FS10SL2-R	Angle	
	JN2DS10SL3-R	Straight	ϕ3.5 to ϕ5.0
	JN2FS10SL3-R	Angle	

* ”#” will be any number or alphabet.

■ Contact model numbers (Products of Japan Aviation Electronics Industry, Ltd.)

Type	Model number	Qty	Applicable wire size
Manual crimping type	JN1-22-20S-R-PKG100	Note 1)	AWG20
	JN1-22-22S-PKG100	Note 1)	AWG21 to AWG25
	JN1-22-26S-PKG100	Note 1)	AWG26 to AWG28
Soldering type	JN1-22-22F-PKG100	Note 1)	AWG20 max.



R-series servo motor encoder canon plug pin assignment (Viewed from motor)

Note 1) At our site, order will be accepted from one piece.
At manufacturer site, order will be accepted 1 pack each (a hundred pieces are included).

4.3.4 Recommended encoder cable specification

Shielded cables with multiple twisted pairs

Cable Ratings	80°C 30V
Conductor resistance value	1Ω or less
Conductor size	AWG26 to AWG18
	SQ (mm$^{2)}$ 0.15 to 0.75

The conductor resistance value is recommended with the cable length actually used.

4.3.5 Encoder cable length

Maximum cable lengths by conductor sizes of power supply cable (5V, SG).

Conductor size		Conductor resistance Ω/km (20℃)	Length (m)
AWG	26	150 or less	5
	24	100 or less	10
	22	60 or less	15
	20	40 or less	25
	18	25 or less	40
SQ(mm^2)	0.15	150 or less	5
	0.2	100 or less	10
	0.3	65 or less	15
	0.5	40 or less	25
	0.75	28 or less	35

* The values above are for the case power supply (5V, SG) line is wired in a pair.
* Conductor resistance varies depending on conductor specifications.

4.4 Peripheral equipments

4.4.1 Power supply capacity and peripherals list

- AC200V input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC200V	RS3#01#	R2AA04003F	0.2	Model NF30 10A MITSUBISHI ELECTRIC	HF3030C-SZA SOSHIN ELECTRIC Co., Ltd.	S-N10 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R2AA04005F	0.2				
		R2AA04010F	0.3				
		R2AA06010F	0.3				
		R5AA06020H	0.6				
	RS3#02#	R2AA06020F	0.6				
		R2AA06040F	1.0				
		R2AA06040H	1.0				
		R2AA08020F	0.6				
		R2AA08040F	1.0				
		R5AA06020F	0.6				
		R5AA06040F	1.0				
		R5AA06040H	1.0				
	RS3#03#	R1AA10100H	2.3				
		R1AA10150H	3.0				
		R2AA08075F	1.6				
		R2AAB8100H	2.0				
		R2AA10075F	1.7				
		R2AA13050D	1.2				
		R2AA13050H	1.2				
		R2AA13120B	2.2				
		R5AA08075D	1.6				
		R5AA08075F	1.6				
	RS3A05#	R1AA10100F	2.3	Model NF30 5A MITSUBISHI ELECTRIC			
		R1AA10150F	3.0				
		R1AA10200H	4.0				
		R1AA10250H	5.0				
		R2AAB8075F	1.6				
		R2AAB8100F	2.3				
		R2AA10100F	2.3				
		R2AA13120D	2.8				
		R2AA13120L	2.8				
		R2AA13180H	3.6				
		R2AA13200L	4.0				
	RS3A07#	R1AA10200F	4.0	Model NF50 30A MITSUBISHI ELECTRIC		S-N18 MITSUBISHI ELECTRIC	
		R1AA10250F	5.0				
		R1AA13300H	6.0				
		R2AA13180D	4.0				
		R2AA13200D	4.0				
		R2AA18350V	6.0				

* ”#” will be any number or alphabet.

* Add surge absorber to power line input of servo amplifier if overvoltage like lightning surge may be given.

* For MCCB, Noise filter, Magnetic contact, required current per axis is describing.

■ AC200V input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded Case Circuit Breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC200V	RS3A10#	R1AA13300F	6.0	Model NF50 30A MITSUBISHI ELECTRIC	3SUPF-CH 40M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-N18 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R1AA13400H	6.7				
		R1AA13500H	8.3				
		R2AA13180D	4.0				
		R2AA13200D	5.0				
		R2AA18350L	6.0				
	RS3A15#	R1AA13400F	6.7	Model NF50 50A MITSUBISHI ELECTRIC		S-N35 MITSUBISHI ELECTRIC	
		R1AA13500F	8.3				
		R2AA18350D	7.0				
		R2AA18450H	7.4				
		R2AA18550R	8.4				
		R2AA22500L	9.6				
		R2AA22700S	12.2	Model NF100 75A MITSUBISHI ELECTRIC		S-N50 MITSUBISHI ELECTRIC	
	RS3A30#	R1AA18550H	9.3	Model NF100 100A MITSUBISHI ELECTRIC	3SUPF-CH 80M-F OKAYA ELECTRIC INDUSTRIES CO.,LTD.	S-N65 MITSUBISHI ELECTRIC	
		R1AA18750L	11.6				
		R1AA1811KR	16.0				
		R1AA1815KB	21.4				
		R2AA18550H	9.3				
		R2AA18750H	11.6				
		R2AA1811KR	16.0				
		R2AA2211KB	16.0				
		R2AA2215KB	21.4				

■ AC100V input

Input voltage	Servo amplifier model number	Servo motor model No.	Main circuit power supply rating (kVA)	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC100V	RS3#01# RS3#02#	R2EA04003F	0.2	Model NF30 10A MITSUBISHI ELECTRIC	HF3030C-SZA SOSHIN ELECTRIC Co., Ltd.	S-N10 MITSUBISHI ELECTRIC	LV275DI-U4 OKAYA ELECTRIC INDUSTRIES CO.,LTD.
		R2EA04005F	0.2				
		R2EA04008F	0.4				
		R2EA06010F	0.5				
	RS3#03#	R2EA06020F	0.8				

* ”#” will be any number or alphabet.

* Add surge absorber to power line input of servo amplifier if overvoltage like lightning surge may be given.

* For MCCB, Noise filter, Magnetic contact, required current per axis is describing.

5

Operation

In this chapter, each items for motor operations are explained.

5. Operation

5.1 Basic setting of the system

Basic settings of the system that needed to the operation are explained.

5.1.1 Specification check

Check the specification of servo amplifier through the setup software "SANMOTION MOTOR SETUP (hereinafter referred to as setup software)" or digital operator.

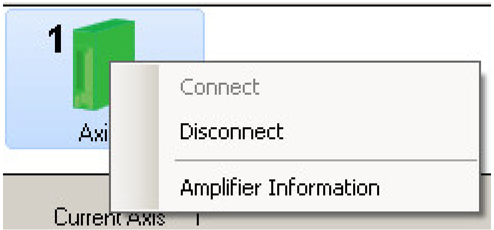
[Step 1: Check for the servo amplifier spec]

Check by 4 items below whether your product is fit to the target system spec.

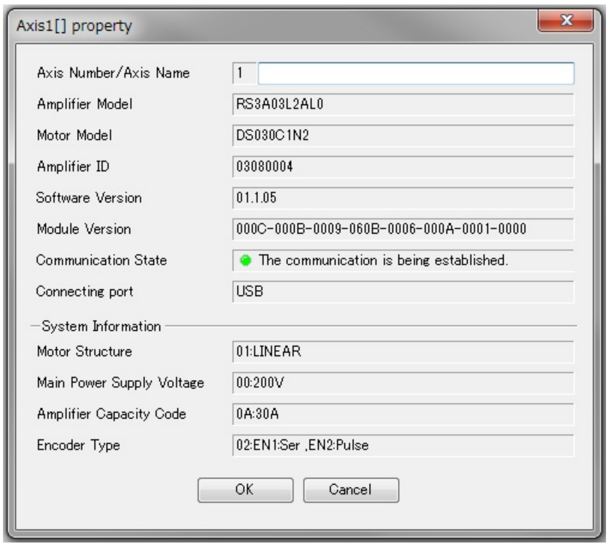
- ◆ Motor structure
- ◆ Main power supply voltage
- ◆ Amplifier capacity code
- ◆ Encoder type

1) Check by the setup software

- ■ Connect the servo amplifier by USB cable to a PC which installed setup software, and then turn on control power (r, t).
- ■ Run the setup software and start communication with the servo amplifier.
- ■ Select the target axis from upper side of main window, and then show the popup menu by right click.



- Property window for the axis will open when Amplifier information in the popup menu is selected.
  The codes of "Motor structure", "Main power supply voltage", "Amplifier capacity" and "Encoder type" are shown in System Information area. (See below)



Axis Number/Axis Name	1
Amplifier Model	RS3A03L2AL0
Motor Model	DS030C1N2
Amplifier ID	03080004
Software Version	01.1.05
Module Version	000C-000B-0009-060B-0006-000A-0001-0000
Communication State	● The communication is being established.
Connecting port	USB
System Information	
Motor Structure	01:LINEAR
Main Power Supply Voltage	00:200V
Amplifier Capacity Code	0A:30A
Encoder Type	02:EN1:Ser ,EN2:Pulse

- Check each item above by following description of step 2 or later.

✔ See the manual: M0010842 for detail of the setup software operation.

2) Check by the digital operator

- Use servo amplifier info code display function (InFo.1 to 3).

✔ See "7.4.7 How to check servo amplifier info code 1 to 3" for detail of the function use.

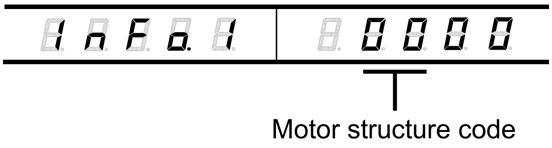
[Step 2: Check for motor structure]

This shows available motor structure with the servo amplifier. Please confirm that motor structure code is 00 (rotary motor).

motor structure code	Description
00	Rotary

1) By the setup software
   Motor structure code is shown in System Information area of Axis property window.

2) By the digital operator
   Motor structure code is shown at an upper byte of InFo.1.



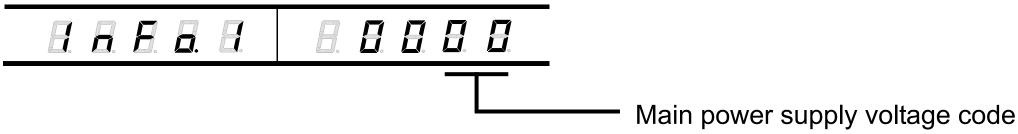
[Step 3: Check for main power supply voltage]

This shows applicable input voltage (into R/S/T terminals of CNA or terminal block) with the servo amplifier. Please confirm that main power supply voltage code is match to your system.

Main power supply voltage code	Description
00	200V AC
01	100V AC

1) By the setup software
   Main power supply voltage code is shown in System Information area of Axis property window.

2) By the digital operator
   Main power supply voltage code is shown at a lower byte of InFo.1.



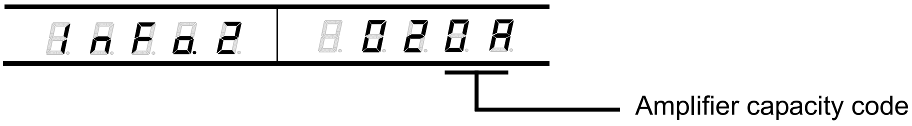
[Step 4: Check for amplifier capacity]

This shows servo amplifier capacity of output current.
Please confirm that the amplifier capacity code is match to combined motor.

Amplifier capacity code	Description	Servo amplifier model number
0D	10A	RS3#01A####
0B	20A	RS3#02A####
0A	30A	RS3#03A####
09	50A	RS3A05A####
08	75A	RS3A07A####
07	100A	RS3A10A####
06	150A	RS3A15A####
04	300A	RS3A30A####

1) By the setup software
   Amplifier capacity code is shown in System Information area of Axis property window.

2) By the digital operator
   Amplifier capacity code is shown at an lower byte of InFo.2.



[Step 5: Check for encoder type]

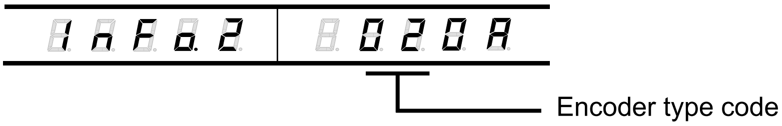
This shows the allowable encoder for the amplifier. Please confirm that combined motor encoder and external encoder you use are available.

Servo amplifier model number	Encoder type code	The motor encoder allowed by EN1	The external encoder allowed by EN2
RS3###A0##	00	Absolute encoder	N/A
RS3###A1##	01	Absolute encoder	Absolute encoder
RS3###A2##	02	Absolute encoder	Incremental encoder
RS3###A8##	08	Incremental encoder	N/A
RS3###A9##	09	Incremental encoder	Absolute encoder
RS3###AA##	0A	Incremental encoder	Incremental encoder

✔ In case of the code 02, incremental encoder is able to connect and use at EN2.

1) By the setup software
   Encoder type code is shown in System Information area of Axis property window.

2) By the digital operator
   Encoder type code is shown at an upper byte of InFo.2.



5.1.2 System parameters

System parameters decide basic specs and functions such as servo motor setting, selection of motor encoder, main power supply and control method.
See details of each parameter through page reference table below.

1) System parameter list

ID	Parameter name	Description	Page
00	Control cycle	Changing control cycle of velocity/torque control.	5-16
01	Main circuit power input type	Selecting input spec of main circuit power.	5-15
02	Virtual mode	Selecting mode of motor operation.	5-140
03	Regenerative resistor selection	Selecting regenerative resistor.	5-6, 5-15
04	Main power discharge selection	Selecting about electric discharge of main circuit power.	5-6, 5-15
06	Control mode selection	Selecting control mode.	5-16
07	Position control selection	Selecting position control method.	5-17
08	Amplifier communication function	Selecting the target of RS422 communication function (CN5 connector).	9-22
09	Motor parameter automatic set function selection	Selecting valid/invalid of motor parameter automatic set function.	5-8
0B	External regenerative resistor value	Setting regenerative resistor value.	5-15
10	Motor encoder input selection	Selecting connector of motor encoder to use.	5-11, 5-13
11	EN1 encoder type	Selecting encoder type of EN1 connection.	5-11, 5-13
12	EN2 encoder type	Selecting encoder type of EN2 connection.	5-13
13	EN1 absolute encoder baud rate selection	Selecting communication speed of absolute encoder of EN1 connection.	5-11
14	Battery backup absolute encoder function selection	Selecting function of battery backup absolute encoder.	5-12
15	Absolute encoder resolution	Selecting resolution of absolute encoder.	5-12
16	Absolute encoder multi turn count	Selecting multi turn count of absolute encoder.	5-12
17	Incremental encoder resolution	Selecting resolution of incremental encoder.	5-13
20	Position loop control, position loop encoder selection	Selecting encoder for position control.	9-7
21	EN2 absolute encoder baud rate selection	Selecting the communication speed of absolute encoder which connect to EN2.	9-8
22	External encoder resolution	Selecting resolution of external encoder.	9-9
24	Feedback pulse electronic gear ratio numerator	Setting the electronic gear ratio for converting a motor encoder resolution to an external encoder resolution.	9-11
25	Feedback pulse electronic gear ratio denominator		
26	External absolute encoder resolution	Setting the external absolute encoder resolution.	9-10

2) Factory setting value
Part of system parameters at factory setting are different depending on product model number.

RS3 △ ## A □ # ◇ #

Input power voltage
A･･･AC200V
E･･･AC100V

Option 1
A･･･With regenerative resistor/
With DB reisitor
L･･･Without regenerative resistor/
With DB reisitor

Encoder type

	EN1 (for motor encoder only)	EN2 (for motor encoder or external encoder)
0	Absolute encoder	—
1	Absolute encoder	Absolute encoder
2	Absolute encoder	Incremental encoder
8	Incremental encoder	—
9	Incremental encoder	Absolute encoder
A	Incremental encoder	Incremental encoder

✔ "#" will be any number or alphabet.
✔ Parameter backup function is able to save "system parameter", "general parameter" and "motor parameter" into the backup memory area in a servo amplifier, and the saved data can be restored when needed it.

■ The system parameter shared to all model number
The system parameters shown in below table are shared to all model number

ID	Parameter name	Common item
00	Control cycle	00:Standard_Sampling
02	Operation mode	00:Normal
06	Control mode selection	02:Position
07	Position control selection	00:Standard
10	Motor encoder input selection	00:EN1

■ Main circuit power input type
Set value of main circuit power input type depends on its voltage.

ID	Parameter name	Symbol at "△" part that shows input power voltage	
		A	E
01	Main circuit power input type	00:AC_3-phase	01:AC_Single-phase

■ Regenerative resistor selection
Set value of regenerative resistor selection depends on option 1.

ID	Parameter name	Symbol at "◇" part that shows option 1	
		A	L
03	Regenerative resistor selection	01:Built-in_R	00:Not_connect

■ Main circuit power electric discharge selection
Set value of main circuit power electric discharge selection depends on option 1.

ID	Parameter name	Symbol at "◇" part that shows option 1	
		A	L
04	Main circuit power electric discharge selection	01:Discharge	00:Not_Discharge

- System parameter related to encoder
  Set value of system parameter related to encoder depends on encoder type.

ID	Parameter name	Symbol at "☐" part that shows encoder type					
		0	1	2	8	9	A
09	Motor parameter automatic set function selection	00:Enabled			-		
11	EN1 encoder type	11:PA_C-ABS			80:Pulse		
12	EN2 encoder type	-	22:EnDat_ABS	82:Pulse_without_CS	-	22:EnDat_ABS	82:Pulse_without_CS
13	EN1 absolute encoder baud rate selection	02:2.5Mbps			-		
14	Battery backup absolute encoder function selection	00:Absolute_System			-		
15	Absolute encoder resolution	06:131,072_FMT			-		
16	Absolute encoder multi turn value	06:65,536_ROT			-		
17	Incremental encoder resolution	-		2,000	2000		
20	Position loop control, position loop encoder selection	-	01:External_Enc		-	01:External_Enc	
21	EN2 absolute encoder baud rate selection	-	01:2Mbps	-	-	01:2Mbps	-
22	External encoder resolution	-	-	2,000	-	-	2000
24	Feedback pulse electronic gear ratio numerator	-	1/1	1/1	-	1/1	1/1
25	Feedback pulse electronic gear ratio denominator						
26	External absolute encoder resolution	-	10,000	-	-	10000	-

✔ "-" in table means "not applicable for the product", so these parameters don't show at the setup software and the digital operator.

5.1.3 Servo motor setting

Combination servo motor can set by three ways below.

- Connected servo motor set automatically at power on. (Motor automatic set)
- Setting by the digital operator for the servo motor in use.
- Setting by the setup software for the servo motor in use.

- Servo motor setting availability
  Allowable setting method differs like as below table depending on the specs of servo motor and motor encoder.
  Please select applicable method for the product in use.

Servo motor	Motor encoder	Setting method		
		Motor automatic set	Setting by the digital operator	Setting by the setup software
Applicable motor	Absolute encoder	○	○	○
	Incremental encoder	×	○	○
Except above	Absolute encoder	×	×	○
	Incremental encoder	×	×	○

- ✔ ○: Available, ×: Not abailable
- ✔ For applicable motor, see next "Applicable motor list".
- ✔ Even if your servo motor or motor encoder is on the list, motor automatic set is disabled to some product by production date. In this case, please use the digital operator or the setup software to set the motor.

- Applicable motor list
  This is the list of servo motor model number and motor code that are able to set by the motor automatic set or the digital operator.

Combination servo amplifier	Servo motor model number	Motor code	Servo motor model number	Motor code	Servo motor model number	Motor code
RS3A01	R2AA04003F	0181	R2AA04005F	0182	R2AA04010F	0183
	R2AA06010F	0184	R5AA06020H	049D	—	—
RS3A02	R2AA06020F	0185	R2AA06040F	0186	R2AA06040H	0189
	R2AA08020F	018A	R2AA08040F	0188	R5AA06020F	049E
	R5AA06040F	02BB	R5AA06040H	049F	—	—
RS3A03	R1AA10100H	0515	R1AA10150H	0512	R2AA08075F	0187
	R2AAB8100H	0194	R2AA10075F	019F	R2AA13050D	018C
	R2AA13050H	018F	R2AA13120B	0191	R5AA08075D	02BA
	R5AA08075F	04A0	—	—	—	—
RS3A05	R1AA10100F	0516	R1AA10150F	04FA	R1AA10200H	0513
	R1AA10250H	0517	R2AAB8075F	01B1	R2AAB8100F	0193
	R2AA10100F	019E	R2AA13120D	018D	R2AA13120L	018E
	R2AA13180H	01B6	R2AA13200L	0192	—	—
RS3A07	R1AA10200F	050F	R1AA10250F	0518	R1AA13300H	0511
	R2AA13180D	04FB	R2AA13200D	04FC	R2AA18350V	04FD
RS3A10	R1AA13300F	0508	R1AA13400H	0519	R1AA13500H	050E
	R2AA13180D	011B	R2AA13200D	0190	R2AA18350L	011C
RS3A15	R1AA13400F	051A	R1AA13500F	051B	R2AA18350D	011D
	R2AA18450H	011E	R2AA18550R	01B8	R2AA22500L	0195
	R2AA22700S	0484	—	—	—	—

5. Operation

Combination servo amplifier	Servo motor model number	Motor code	Servo motor model number	Motor code	Servo motor model number	Motor code
RS3A30	R1AA18550H	0109	R1AA18750L	010F	R1AA1811KR	010D
	R1AA1815KB	010E	R2AA18550H	011F	R2AA18750H	01B9
	R2AA1811KR	0120	R2AA2211KB	0483	R2AA2215KB	0117
RS3E01	R2EA04003F	0197	―	―	―	―
RS3E02	R2EA04005F	0198	R2EA04008F	019D	R2EA06010F	019A
RS3E03	R2EA06020F	019B	―	―	―	―

1) How to use motor automatic set function

[Step 1: Connecting motor encoder]
Connect the motor encoder to servo amplifier, and then turn control power on.

[Step 2: Enabling the motor parameter automatic set function]
Check the system parameter ID09 through the setup software or the digital operator that is set to "00: Enabled" or not.

- ◆ Go Step 3, if "00: Enabled" is set to the system parameter ID09.
- ◆ If "01: Disabled" is set, change to "00: Enabled", and then power-cycle and go Step 3.

Group	ID	Name	Value	Description
System	09	Motor parameter automatic set function selection	00:Enabled	Motor automatic set function is available.

[Step 3: Checking alarm]
Check alarm of AL.EE(Motor Parameter Automatic Setting Error 1) and AL.EF(Motor Parameter Automatic Setting Error 2).
If these alarms are there, please follow the way below.

Alarm	Reason	Motor setting method
Motor Parameter Automatic Setting Error 1 (AL.EE)	Connected servo motor does not support to motor automatic set function.	Setting by the digital operator or the setup software.
Motor Parameter Automatic Setting Error 2 (AL.EF)	The servo amplifier does not support connected servo motor.	Setting by the setup software.
	Wrong combination of servo amplifier and servo motor.	Confirm model number of servo amplifier and servo motor, and then correct a combination.

[Step 4: Rechecking the motor set by automatic set]
Double check the motor through the setup software or the digital operator.

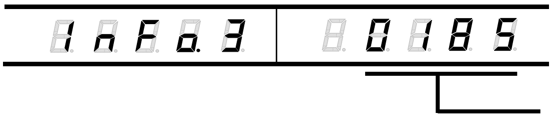
- ■ Check through the setup software
  Decided motor model number is shown in upper of each function window.

Amplifier/Motor Model RS3A02A2AL2 R2AA06040F

Decided motor model number

✔ See another manual: M0010842 for the setup software operation.

- ■ Check through the digital operator
  Decided servo motor code is shown at InFo.3 display.



Motor code

✔ See "7.4.7 How to check servo amplifier info code 1 to 3" to show the InFo.3 display.

2) How to set motor through the digital operator

[Step 1: Disabling motor automatic set function]

For setting by the digital operator, please check the system parameter ID09 that is set to "01: Disabled" or not. If "00: Enabled" is set, change to "01: Disabled", and then power-cycle and go Step 2.

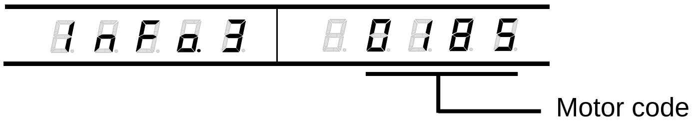
[Step 2: Selecting motor]

Set the motor code that will be used by following the steps of "7.18 How to set the motor code". Please have a control power-cycle after setting.

- ✔ For checking the motor code of servo motor, see "Applicable motor list (page 5-8)".
- ✔ For the servo motor which is not listed on Applicable motor list, please set by the setup software.

[Step 3: Rechecking the motor setting]

After power-cycling, please check whether motor code is correct through InFo.3 display.



- ✔ See "7.4.7 How to check servo amplifier info code 1 to 3" to show the InFo.3 display.

3) How to set motor through the setup software

[Step 1: Disabling motor automatic set function]

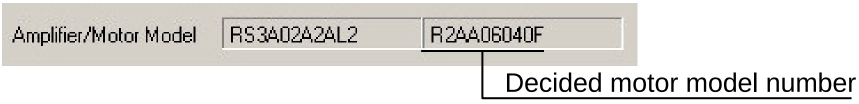
For setting by the Setup software, please check the system parameter ID09 that is set to "01: Disabled" or not. If "00: Enabled" is set, change to "01: Disabled", and then power-cycle and go Step 2.

[Step 2: Selecting motor]

Select the servo motor that will be used by following the steps of "4.2.3 How to set motor parameters - (B) When manually setting a motor", the setup software manual: M0010842.
Please have a control power-cycle after setting.

[Step 3: Rechecking the motor setting]

After power-cycling, please check whether motor model number is correct through the setup software, upper of each function window.



Amplifier/Motor Model RS3A02A2AL2 R2AA06040F

Decided motor model number

5.1.4 Motor encoder setting

The motor encoder that will be used is set. Available encoder differs by encoder type of the servo amplifier. Please set the system parameter concerned with motor encoder by following table reference below.

Target motor encoder	Applicable encoder type by servo amplifier model number				Reference
	RS3xxxx0xxx	RS3xxxx2xxx	RS3xxxx8xxx	RS3xxxxAxxx	
Absolute encoder	○	○	×	×	1)
Incremental encoder	×	○	○	○	2)

✔ ○: Combination available, ×: Combination not available

1) Absolute encoder (Applicable amplifier model number: RS3xxxx0xxx, RS3xxxx2xxx)

■ Motor encoder connector selection
Select the connector for connecting motor encoder. Must set "00: EN1".

Group	ID	Selection		Description
System	10	00	EN1	Uses EN1 for connecting motor encoder.
		01	EN2	Uses EN2 for connecting motor encoder.

✔ RS3xxxx0xxx allows "00:EN1" only.

■ EN1 encoder type
Select the encoder type that will be connected to EN1.
Please select absolute encoder type that will be used.

Group	ID	Selection		Description
System	11	10	PA S-ABS	Single-turn absolute encoder (Encoder code: H)
		11	PA C-ABS	Battery backup absolute encoder (Encoder code: P)
		12	RA C-ABS	Battery-less absolute encoder (Encoder code: R, W)

✔ It will be set automatically if motor automatic set function is effective.

■ EN1 absolute encoder baud rate selection
Select the baud rate of absolute encoder that will be used.

Group	ID	Selection		Description
System	13	02	2.5Mbps	2.5Mbps
		03	4Mbps	4Mbps

✔ It will be set automatically if motor automatic set function is effective.

- Battery backup absolute encoder function selection
  Select a use of battery backup absolute encoder as an absolute system with multi turn value or as an incremental system without multi turn value.
  - Must connect battery if use as an absolute system.
  - Battery is not necessary if use as an incremental system. As note, multi turn value does not back up.

Group	ID	Selection		Description
System	14	00	Absolute_System	Use as absolute system
		01	Incremental_System	Use as incremental system

- Absolute encoder resolution
  Select the resolution of single turn of motor.

Group	ID	Selection		Description	Selection		Description
System	15	00	2048_FMT	2048 division	07	262144_FMT	262144 division
		01	4096_FMT	4096 division	08	524288_FMT	524288 division
		02	8192_FMT	8192 division	09	1048576_FMT	1048576 division
		03	16384_FMT	16384 division	0A	2097152_FMT	2097152 division
		04	32768_FMT	32768 division	0B	4194304_FMT	4194304 division
		05	65536_FMT	65536 division	0C	8388608_FMT	8388608 division
		06	131072_FMT	131072 division			

✔ It will be set automatically if motor automatic set function is effective.

- Absolute encoder multi turn value
  Select the multi turn value of absolute encoder.

Group	ID	Selection		Description	Selection		Description
System	16	00	1_ROT	1 turn	07	131072_ROT	131072 turns
		01	2048_ROT	2048 turns	08	262144_ROT	262144 turns
		02	4096_ROT	4096 turns	09	524288_ROT	524288 turns
		03	8192_ROT	8192 turns	0A	1048576_ROT	1048576 turns
		04	16384_ROT	16384 turns	0B	2097152_ROT	2097152 turns
		05	32768_ROT	32768 turns	0C	4194304_ROT	4194304 turns
		06	65536_ROT	65536 turns			

✔ It will be set automatically if motor automatic set function is effective.

2) Incremental encoder
(Applicable amplifier model number: RS3xxxx2xxx, RS3xxxx8xxx, RS3xxxxAxxx)

■ Motor encoder connector selection
Select the connector for connecting motor encoder. Must set "00: EN1".
- ◆ Select "01:EN2" if "RS3xxxx2xxx" is used.
- ◆ Select "00:EN1" if "RS3xxxx8xxx or RS3xxxxAxxx" is used.

Group	ID	Selection		Description
System	10	00	EN1	Uses EN1 for connecting motor encoder.
		01	EN2	Uses EN2 for connecting motor encoder.

✔ RS3xxxx8xxx and RS3xxxxAxxx allow "00:EN1" only.

■ EN1 encoder type
Select the encoder type that will be connected to EN1.
Please select incremental encoder type that will be used.
- ◆ For RS3xxxx2xxx, select encoder type at "EN2 encoder type".
- ◆ For RS3xxxx8xxx and RS3xxxxAxxx, select encoder type at this parameter.

Group	ID	Selection		Description
System	11	80	Pulse	Wire-saving incremental encoder

■ EN2 encoder type
Select the encoder type that will be connected to EN2.
Please select incremental encoder type that will be used.
- ◆ For RS3xxxx2xxx, select encoder type at this parameter.
- ◆ For RS3xxxx8xxx and RS3xxxxAxxx, this parameter is not shown because it is not necessary.

Group	ID	Selection		Description
System	12	80	Pulse	Wire-saving incremental encoder

■ Incremental encoder resolution
Set the motor encoder resolution that will be used. Please set one-multiplied value.

Group	ID	Setting range	Unit
System	17	500 to 65,535 (one-multiplied)	P/R

3) System parameters setting list related to motor encoder due to encoder types each

ID	System paramer	Motor model number			
		RxxxxxxxxxxHxx	RxxxxxxxxxxPxx	RxxxxxxxxxxRxx	RxxxxxxxxxxSxx
10	Motor encoder input selection	00: EN1	00: EN1	00: EN1	00: EN1 or 01: EN2 Note 1)
11	EN1 encoder type	10: PA S-ABS	11: PA C-ABS	12: RA C-ABS	80: Pulse Note 2)
12	EN2 encoder type	Setting is just required for full-closed system use.			80:Pulse Note 2) Note 3)
13	EN1 absolute encoder baud rate selection	Set according to encoder spec in use.			Setting not required
14	Battery backup absolute encoder function selection	Setting not required	00: Absolute_System or 01: Incremental_System Note 4)	Setting not required	Setting not required
15	Absolute encoder resolution	Set according to encoder spec in use.			Setting not required
16	Absolute encoder multi turn count	Set according to encoder spec in use.			Setting not required
17	Incremental encoder resolution	Setting not required			Set according to encoder spec in use.

Note 1) Motor encoder input connector is able to select from EN1 or EN2 when servo amplifier model number is RS3□□□A2□□□ (eighth digit from left is "2").
Set "00：EN1" for a use of absolute encoder, "01：EN2" for a use of incremental encoder.

Note 2) Set "80:Pulse" to "EN1 encoder type" when servo amplifier model number is RS3□□□A8□□□ (eighth digit from left is "8").
Set "80:Pulse" to "EN2 encoder type", when servo amplifier model number is RS3□□□A2□□□ (eighth digit from left is "2") and "01:EN1" is set to the motor encoder input selection.

Note 3) It is not shown because the setting is not required when servo amplifier model number is RS3□□□A8□□□ (eighth digit from left is "8" or "A").

Note 4) For a use of battery backup absolute encoder as incremental system without multi-turn data, select "01:Incremental_System". In this case, battery connection is not required.

5.1.5 Main circuit power setting

Set the parameters about main circuit power.

■ Main circuit power input type selection
Set the type of power that will connect to main circuit power terminal (R/S/T of CNA or terminal block) of servo amplifier.

◆ For 200VAC, please select the type by power spec that will be used.
◆ For 100VAC, please select "01:AC_Single_phase".

Group	ID	Selection		Description
System	01	00	AC_3-phase	3-phase AC power is supplied to the main circuit.
		01	AC_Single-phase	Single-phase AC power is supplied to the main circuit.

✔ For single-phase 200VAC power, AL.63 (Main Power Supply phase loss) will occur if "00:AC_3-phase" is selected. So must select "01:AC_Single-phase".

■ Main power discharge selection
When cutting off the main power supply, select whether discharging or not a energy of DC bus capacitor through regenerative resistor.

Group	ID	Selection		Description
System	04	00	Not_Discharge	No discharge.
		01	Discharge	Will discharge.

✔ When regenerative resistor is not connected, discharge will be not occur even if "01:Discharge" is selected.

✔ When cut off the control power, discharge will be occur even if "00:Not_Discharge" is selected.

5.1.6 Regenerative resistor setting

Sets about a regenerative resistor.

■ Regenerative resistor selection
Select the regenerative resistor that will connect to the terminal (RB1/RB2 of CNA or terminal block) of servo amplifier.

Group	ID	Selection		Description
System	03	00	Not_Connect	No regenerative resistor connection.
		01	Built-in_R	Using internal regenerative resistor.
		02	External_R	Using external regenerative resistor.

■ External regenerative resistor value

Group	ID	Setting range	Unit
System	0B	1.0 to 100.0	ohm

✔ The value of regenerative resistor shall be set when selecting "02: External R (use external regenerative resistor)". This setting will invalid when selecting except "02: External R (use external regenerative resistor)".

✔ Accurate value is not able to calculate in the average power monitor, if wrong value is set to regenerative resistor.

5.1.7 Control method selection

Set the basic control method to use.

- Control cycle
  Select the control cycle of velocity control and torque control.
  Velocity control type response frequency is able to set high by setting "01:High-freq_Sampling".
  Please select "00:Standard_Sampling", normally.

Group	ID	Selection		Description
System	00	00	Standard_Sampling	Doing standard sampling mode.
		01	High-freq_Sampling	Doing high frequency sampling mode.

When "01:High-freq_Sampling" is selected, the functions in table below can not use.
When high frequency sampling is used, must use the parameter setting value of table below to the limiting functions.

Limiting functions	Parameter for limiting function			
	Group	ID	Name	Selection
Model-following (vibration suppression) control	System	07	Position control selection	00:Standard
Full closed control	System	20	Position loop control, position loop encoder selection	00:Motor_Enc

✔ When used in full-closed system, select "00:Standard_sampling" (Standard sampling mode).

- Control mode selection
  Sets the control mode of the servo system.

Group	ID	Selection		Type	Description
System	06	00	Torque	Torque control type	Control the motor torque. Operate by analog voltage as torque command from a host unit.
		01	Velocity	Velocity control type	Control the motor speed. Operate by the analog voltage as velocity command from a host unit, or by the internal velocity command that set in the servo amplifier.
		02	Position	Position control type	Control the motor position. Operate by pulse type position command from a host unit.
		03	Velo-Torq	Velocity / Torque control switching type	Operate with switching velocity control and torque control. The switching condition is set to the control mode switching function at Group9, ID10.
		04	Posi-Torq	Position / Torque control switching type	Operate with switching position control and torque control. The switching condition is set to the control mode switching function at Group9, ID10.
		05	Posi-Velo	Position / Velocity control switching type	Operate with switching position control and velocity control. The switching condition is set to the control mode switching function at Group9, ID10.

- Position control selection
  Select the type of position control.

Group	ID	Selection		Type
System	07	00	Standard	Standard position control
		01	Model1	Model-following control
		02	Model2	Model-following vibration suppression control
		03	Model3	Model-following / standard position control switching
		04	Model4	Model-following vibration suppression / standard position control switching

✔ When "01:High-freq_Sampling" (Control cycle:High speed sampling mode) is set to System parameter, ID00, only "00:Standard" (Standard position control) is effective for this parameter.

5.2 Test operation

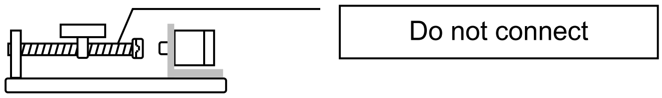
5.2.1 Check of installation and wiring

Check the installation and wiring of servo motor.

[Step 1: installation]

- Set the servo amplifier and motor by following "3. Installation".

- Do not connect servo motor shaft to any mechanism, keep free from a load.



[Step 2: Wiring/Connection --> Turn power on]

- Please wire the servo amplifier, motor and host unit by following "4. Wiring".
  As note, do not connect CN1 to the amplifier.

- Supply power. Check that the display of upper of servo amplifier front face does not show alarm code. If alarm code is shown, please take corrective action by following "8.3 Trouble shooting when alarm activated".

- If "≡" is not shown at 7-segment LED even if main power turns on, please take corrective action by following " 8.1 Trouble shooting".

- "Absolute encoder Internal Error 1 (AL.A1)" may blink when turning power on at the first time with servoamplifier and servo motor that has battery backup absolute encoder.
  The reason why alarm occurs is the data loss of absolute position in encoder by running out of battery.

5.2.2 Check of operation

[Step 1: JOG operation]

- Run the JOG operation without connection of a load to servo motor shaft.

- Check whether the servo motor shaft is able to rotate to positive and negative direction.

  - ◆ How to operate through the setup software
    Select JOG operation at the menu of Test Operation. See the manual: M0010842, "7.1 JOG operation" for detail of the setup software operation.

  - ◆ How to operate through the digital operator
    See "7.10 Velocity-controlled JOG Operation" for detail of the digital operator operation.

5.2.3 Check of I/O signal

Do the I/O signal setting, and then operation check by command from host controller.

[Step 1: Input signal setting]

- Select the function to be used from parameter Group9, and then set it to CONT1 to CONT8. Factory settings are written in table below.

Input signal	CN1 pin number	Factory settings	
		The function in general parameter Group9	Setting value
CONT1	37	Servo-ON Function	02:CONT1_ON
CONT2	36	Velocity Loop Proportional Control Switching Function	04:CONT2_ON
CONT3	35	Encoder Clear Function	06:CONT3_ON
CONT4	34	Deviation Clear Function	08:CONT4_ON
CONT5	33	Negative Over Travel Function	0B:CONT5_OFF
CONT6	32	Positive Over Travel Function	0D:CONT6_OFF
CONT7	13	Torque Limit Function	0E:CONT7_ON
CONT8	15	Alarm Reset Function	10:CONT8_ON

[Step 2: Output signal setting]

- Select the function to be used from parameter GroupA, and then set it to OUT1 to OUT8. Factory settings are written in table below.

Output signal	CN1 pin number	Factory settings
OUT1	39	18:INP_ON
OUT 2	40	0C:TLC_ON
OUT 3	41	02:S-RDY_ON
OUT 4	42	0A:MBR-ON_ON
OUT 5	43	33:ALM5_OFF
OUT 6	44	35:ALM6_OFF
OUT 7	45	37:ALM7_OFF
OUT 8	46	39:ALM_OFF

[Step 3: Double check of I/O signal setting]

- Through monitor function, check that the I/O signal that has set works correctly. See "5.5 Monitor function" for detail of the monitor.

  - ◆ How to check through the setup software
    Select Monitor function at the menu and check.

  - ◆ How to check through the digital operator
    See "7.16 Monitor display" for detail of the digital operator operation.

[Step 4: Input servo ON signal]

Input servo ON signal. Confirm that the servo motor is excited and the digital operator display on the servo amplifier front is drawing the character “8”.

- ■ When the digital operator shows as below, it means over travel status.
  In case of no use of over travel function, set "00:Always_Disable" to parameter Group9 ID00, ID01.

	Positive direction over-travel status. Positive direction over-travel has occured at position/velocity control.
	Negative direction over-travel status. Negative direction over-travel has occured at position/velocity control.

[Step 5: Inputting the command]

- ■ Inputting the command suitable for the control mode in use, by host unit. (see in system parameter ID06)
  - ◆ “Position control mode”····Position command pulse
  - ◆ “Velocity control mode”····Analog voltage
  - ◆ “Torque control mode” ····Analog voltage

✔ When operating by torque control without load, motor might rotate up to high speed. Please avoid risk watching a velocity or position by host unit.

- ■ Confirm that the shaft of the servo motor rotates to commanded direction.

- ■ If servo motor shaft does not rotate even if host unit gives command, please confirm command reception by monitor function.

Control mode	Input command type	Monitor		
		ID	Name	Description
Position control	Position command pulse	30	Position command pulse frequency monitor 1	Frequency of inputted command pulse is displayed.
Velocity control	Analog velocity command	31	Analog velocity command/Analog torque command input voltage monitor	Voltage of inputted command is displayed.
Torque control	Analog torque command			

- ■ If the servo amplifier does not receive the command from the upper device, the value displayed on the monitor does not change.
  Any of these cases could be the result of wrong wiring. Please double check the wiring.

- ■ Give command after receiving command acceptance permission signal from servo amplifier.
  See “5.4 Operation sequence” for the details.

[Step 5: Power shut off]

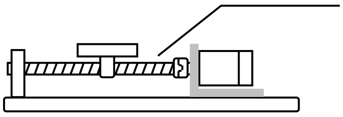
- ■ Turn off the servo-on signal. Then turn off the power supply.

5.2.4 Check of device operation

Connect the servo motor shaft with the machine and check the operation.

[Step 1: Connection to the machine]

- Connect the servo motor shaft with the machine and check the operation.



Connect the servo motor shaft to the machine

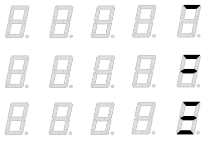
- Input the command (low speed); check the operation direction, distance, emergency stop and over-travel (F-OT･R-OT) to make sure they are operating properly.
- Prepare to stop soon in the event of something abnormal operation.

[Step 2: Operation]

- Input the command for the actual operation and start the machine.
- At the time of shipment, Auto-tuning (auto-adjustment for servo gain and filter, etc.) is valid. If there is nothing wrong with operation and the characteristic, manual tuning is not necessary. See "6. Servo tuning" for the Servo Tuning.

5.3 Servo amplifier status display

5.3.1 Normal display

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is on.	1
	Main circuit power supply established. Main power supply (R, S and T) is established, but operation preparation completion signal is off.	2
	Safe torque off working status. Main circuit power supply (R, S and T) is established and either safe torque off input 1 or 2 is “off”. “ --> -->  ” are shown sequentially.	2
	Operation setup is completed. Main power supply (R, S and T) is established and operation setup completion signal is on.	3
	Servo is on. Continue drawing of character "8", sequentially.	4

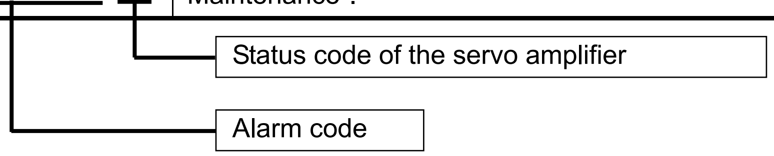
Marking	Description
	Positive direction over-travel status. Positive direction over-travel has occured at position/velocity control.
	Negative direction over-travel status. Negative direction over-travel has occured at position/velocity control.

✔ See "7.4.3 Warning status display" about display of warning status.

5.3.2 Alarm display

When an alarm occurs, the display shows the alarm code and the status code of the Servo amplifier.

Marking	Description
	When an alarm occurs, take corrective actions as instructed in "8. Maintenance".

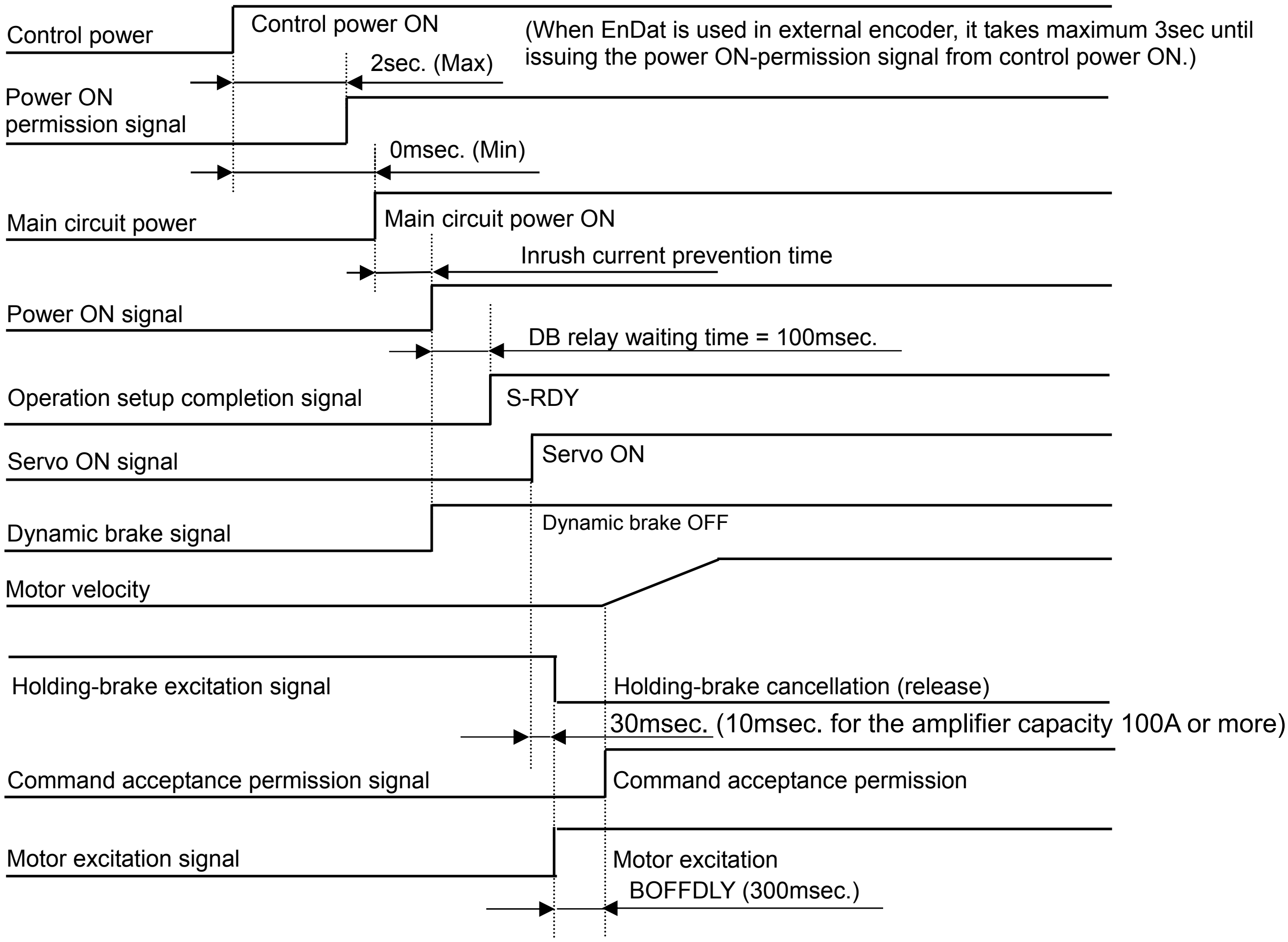


Code	Status	
1	Power OFF status	(P-OFF)
2	Power ON status	(P-ON)
3	Servo ready status	(S-RDY)
4	Servo ON status	(S-ON)
5	Servo OFF and stop status	(S-OFF)
6	Emergency stop status	(EMR)
F	Initial status	

5.4 Operation sequence

5.4.1 The operation sequence with factory setting from "turn power on" to "turn power off"

Power ON --> Servo ON



- ✔ Turn on power to an external encoder at same time or before of a servo amplifier control power.
- ✔ The frequency of the power ON/OFF of the servo amplifier shall be 5 times/hour or less and 30 times/day or less. Please set 10 minutes or more to power ON/OFF interval.
- ✔ See below for inrush current suppression time and servo amplifier capacity.

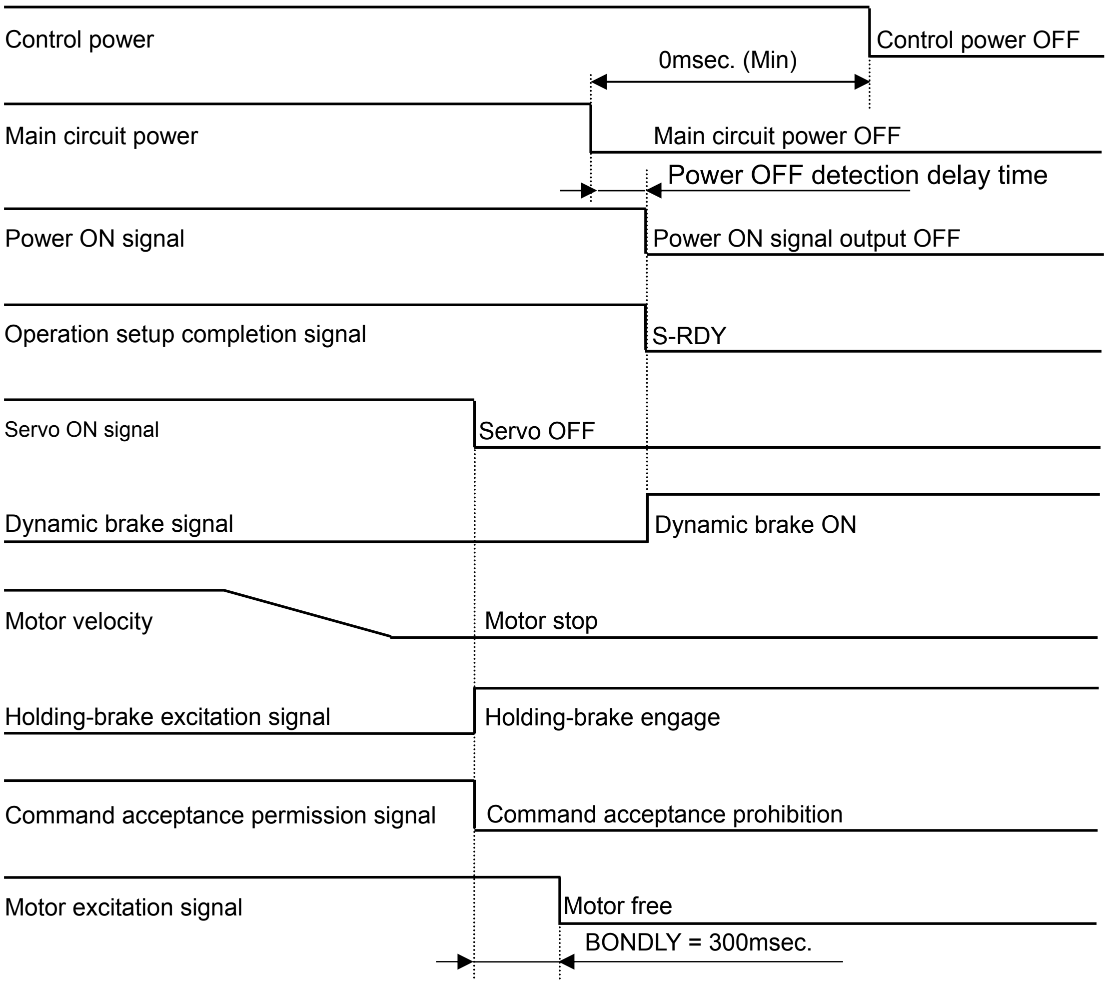
■ 200 VAC input model

Servo amplifier capacity	Inrush current suppression time	
	3-phase	Single-phase
RS3A01#	900 [ms]	1800 [ms]
RS3A02#	900 [ms]	1800 [ms]
RS3A03#	900 [ms]	1800 [ms]
RS3A05#	900 [ms]	1800 [ms]
RS3A07#	1200 [ms]	---
RS3A10#	1200 [ms]	---
RS3A15#	1200 [ms]	---
RS3A30#	1200 [ms]	---

■ 100 VAC input model

Servo amplifier capacity	Inrush current suppression time
RS3E01#	900 [ms]
RS3E02#	900 [ms]
RS3E03#	900 [ms]

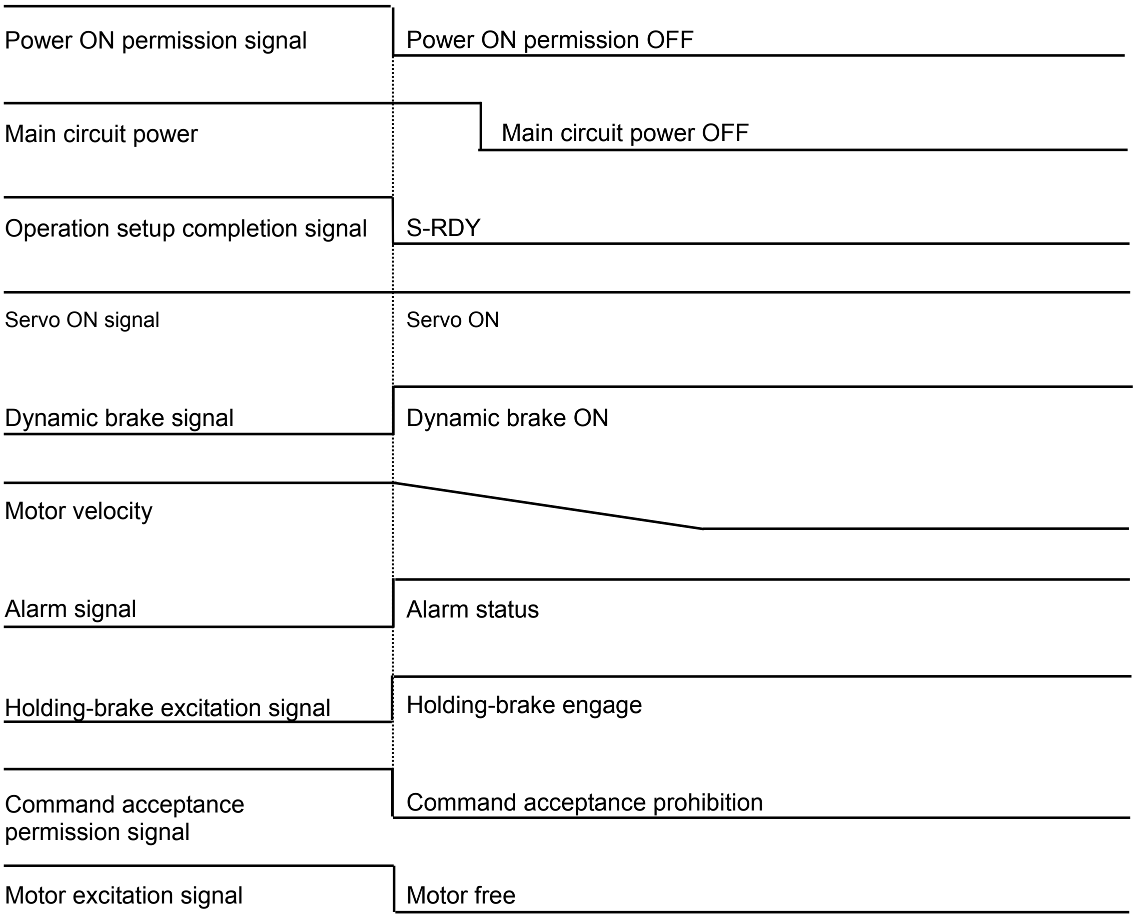
Servo OFF --> Power OFF



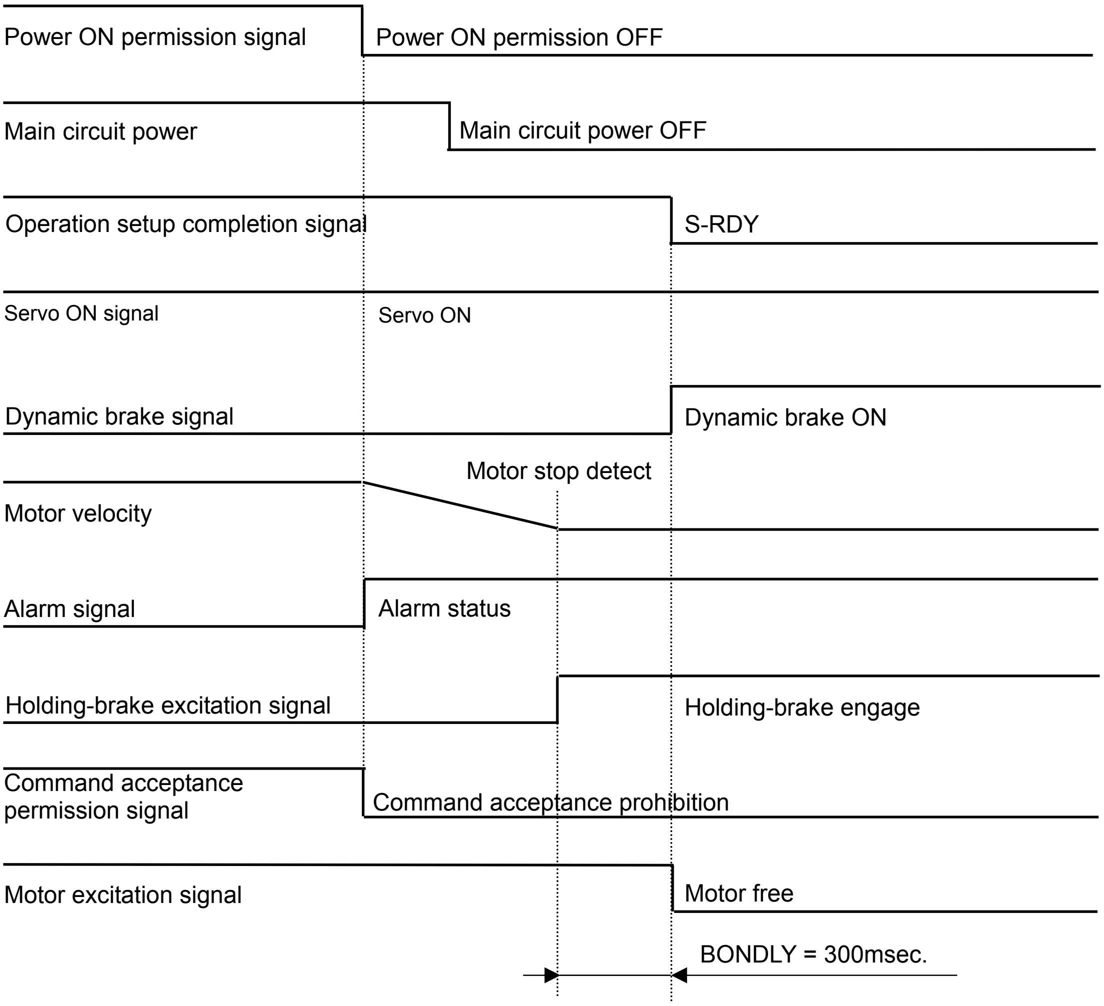
5.4.2 Stop sequence at alarm

When an alarm occurs, the servo motor is stopped by either dynamic brake or servo brake. Which brake is to be used is depending on alarm. See "8.2 List of warning and alarm".

Stop by dynamic brake at alarm



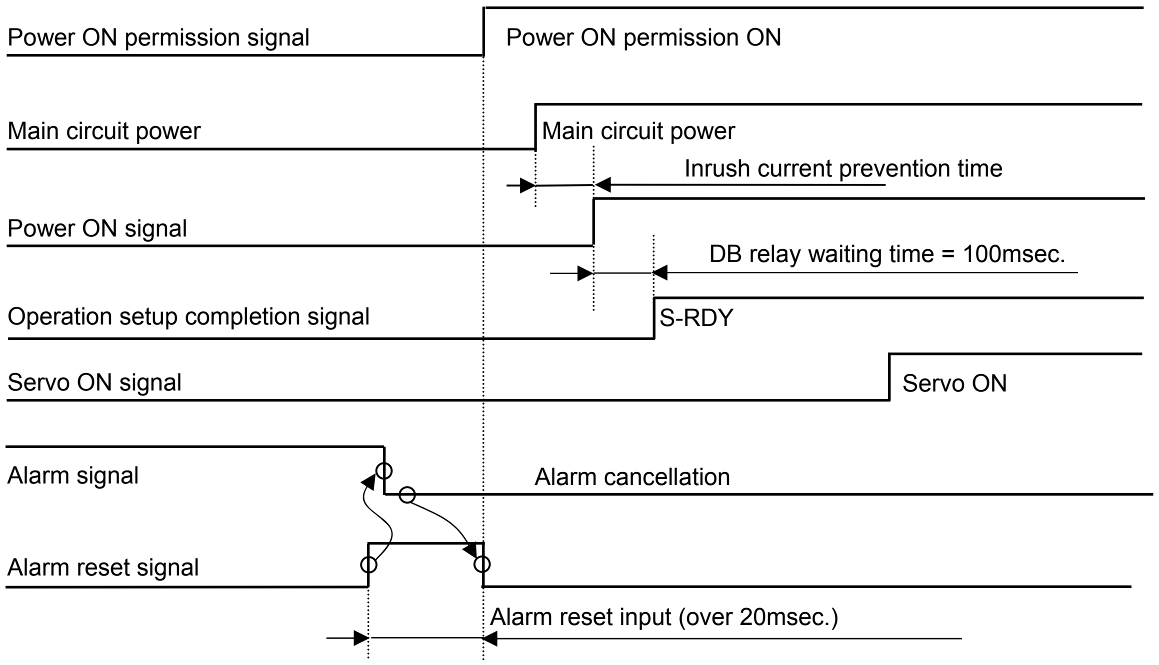
Stop by servo brake at alarm



- ✔ The above sequence is the one when protective circuit is installed. Install a protective circuit seeing "4.1.6 Wiring example".

5.4.3 Sequence of alarm reset

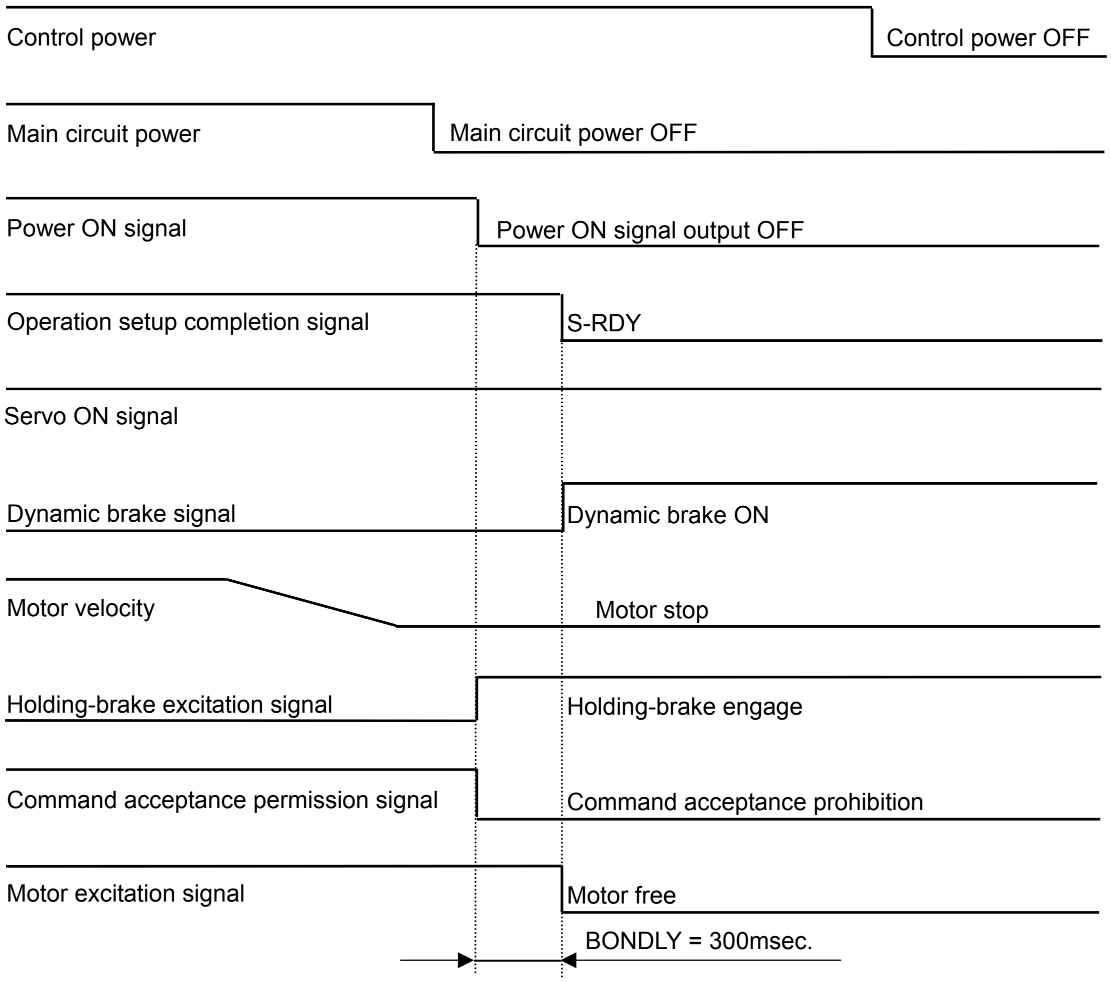
Inputting alarm reset signal from general input signal can reset alarms.



- ✔ Some alarms cannot be reset unless the power is reset (control power is turned OFF and ON again), or encoder is cleared.
  See "8.2 List of warning and alarm".
- ✔ Turn the alarm reset signal off after checking if the alarm signal is cleared. The alarm signal cannot be cleared when the alarm condition is continued, therefore, set a timeout period of 20ms or more to clear “alarm reset signal”.
  Also, it is necessary to input the time of 20msec or more when the alarm reset signal is input without checking for the alarm signal output.

5.4.4 Sequence when power is turned OFF during operation (During servo ON)

Stop by servo brake



- ✔ This is the sequence when "00: SERVO-BRAKE" is selected at GroupB ID02 "Emergency Stop Operation".

5.5 Monitor function

5.5.1 Monitor list

ID	Symbol	Name		Unit
00	STATUS	Servo amplifier status monitor		---
01	WARNING1	Warning status 1 monitor		---
02	WARNING2	Warning status 2 monitor		---
03	WARNING3	Warning status 3 monitor		---
04	WARNING4	Warning status 4 monitor		---
05	CONT8-1	General Purpose Input CONT8 to 1 monitor		---
06	OUT8-1	General Purpose Output OUT8 to 1 monitor		---
07	INC-E MON	Incremental encoder signal monitor		---
10	APMON	Present position monitor (Motor encoder)	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
11			Digital operator: Displays lower data	Pulse
12	CPMON	Command position monitor	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
13			Digital operator: Displays lower data	Pulse
14	PMON	Position deviation monitor		Pulse
15	VMON	Velocity monitor		min^{-1}
16	VCMON	Velocity command monitor		min^{-1}
17	TMON	Torque monitor		%
18	TCMON	Torque command monitor		%
19	ACCMON	Acceleration monitor		rad/s^{2}
1A	MTLMON-EST	Load Torque monitor (Estimate value)		%
30	FMON1	Position command pulse frequency monitor		k Pulse/s
31	VC/TC-IN	Analog velocity command/Analog torque command input voltage monitor		mV
32	MTCOMP	Analog torque addition command input voltage monitor		mV
33	ABSPS	Absolute encoder PS data monitor	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
34			Digital operator: Displays lower data	Pulse
35	MMOENCF	Motor Encoder frequency monitor		kPulse/s
36	CSU	U-phase electric angle monitor		degree
40	RegP	Regenerative resistor operation percentage monitor		%
41	TRMS	Effective torque monitor		%
42	ETRMS	Effective torque monitor (Estimated value)		%
44	VBUS	Vbus monitor		V
45	ENTMP	Encoder temperature monitor		degreeC
46	MATEMP	Amplifier temperature monitor		degreeC
47	RUNTIM	Amplifier Operation Time		h:mm:ss.ms
4A	MAVEPOW1	Average electric power monitor		W
4B	MAVEPOW2	Average electric power monitor		kW
4C	RegPOW	Regenerative power monitor		W
50	JRAT MON	Load Inertia Moment Ratio monitor		%
51	MKP MON	Model Control Gain monitor		1/s
52	KP MON	Position Loop Proportional Gain monitor		1/s
53	TPI MON	Position Loop Integral Time Constant monitor		ms
54	KVP MON	Velocity Loop Proportional Gain monitor		Hz
55	TVI MON	Velocity Loop Integral Time Constant monitor		ms
56	TCFIL MON	Torque Command Filter monitor		Hz
58	ADNFE MON	Frequency monitor E for adaptive notch filter		Hz
60	DFERR-MON	Dual position error monitor		Pulse
61	EX-APMON	Present position monitor (External encoder)	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
62			Digital operator: Displays lower data	Pulse
63	EX-ABSPS	External absolute encoder PS data monitor	Digital operator: Displays upper data	$\times 2^{32}$ Pulse
64			Digital operator: Displays lower data	Pulse
65	MEXENCF	Ext. Encoder frequency monitor		kPulse/s
66	SYNERR	Axes-sync error monitor		Pulse
70	RSRLYLF	Remaining life of relay for an inrush current prevention		%
71	DBRLYLF	Remaining life of relay for a dynamic brake		%
73	MOTE-ERRAT	Error rate of motor encoder communication		---
74	EXTE-ERRAT	Error rate of external encoder communication		---
77	HBLF	Remaining life of a holding brake		%

5.5.2 Descriptions of each monitor

ID	Description
00	Servo amplifier status monitor [STATUS]

Code	Status	
1	Power OFF state	(P-OFF)
2	Power ON state	(P-ON)
3	Servo ready state	(S-RDY)
4	Servo ON state	(S-ON)
5	Servo OFF and stop status	(S-OFF)
6	Emergency stop state	(EMR)
11	Alarm and power OFF state	(ALARM_P-OFF)
12	Alarm and power ON state	(ALARM_P-ON)
16	Alarm and emergency stop state	(ALARM_EMR)
22	Gate off and power-on state	(GATE OFF_P-ON)

ID	Description
01	Warning status 1 monitor [WARNING1]

- ■ Displays warning status. "1" or "ON" shows that the warning is active.

Bit	3	2	1	0
Function	Regenerative overload	Overload	---	Servo amplifier temperature

Bit	7	6	5	4
Function	Excessive deviation	Control power decrease	Velocity command under limit	Torque command under limit

ID	Description
02	Warning status 2 monitor [WARNING2]

- ■ Displays warning status. "1" or "ON" shows that the warning is active.

Bit	3	2	1	0
Function	Negative direction Over-travel	Positive direction Over-travel	---	Main circuit power being charged

Bit	7	6	5	4
Function	---	Absolute encoder warning	---	---

ID	Description
03	Warning status 3 monitor [WARNING3]

- ■ Displays warning status. "1" or "ON" shows that the warning is active.

Bit	3	2	1	0
Function	Adaptive notch filter E frequency	---	Dual position error excess	Axes-sync error excess

Bit	7	6	5	4
Function	---	---	External encoder warning	---

ID	Description
04	Warning status 4 monitor [WARNING4]

- ■ Displays warning status. "1" or "ON" shows that the warning is active.

Bit	3	2	1	0
Function	---	---	---	---

Bit	7	6	5	4
Function	---	---	---	---

ID	Description
05	General input CONT8 to 1 monitor [CONT8-1]

■ Displays generic input terminal status. It will be in a photo coupler excitation state by "1" or "ON".

Bit	3	2	1	0
Function	CONT4	CONT3	CONT2	CONT1

Bit	7	6	5	4
Function	CONT8	CONT7	CONT6	CONT5

ID	Description
06	General output OUT8 to 1 monitor [OUT8-1]

■ Displays generic output terminal status. It will be in a photo coupler excitation state by "1" or "ON".

Bit	3	2	1	0
Function	OUT4	OUT3	OUT2	OUT1

Bit	7	6	5	4
Function	OUT8	OUT7	OUT6	OUT5

ID	Description
07	Incremental encoder signal monitor [INC-E MON]

■ Displays incremental encoder signal status. "1" or "ON" shows an incoming signal level “H” state.

Bit	3	2	1	0
Function	---	EN1 encoder Z-phase signal	EN1 encoder B-phase signal	EN1 encoder A-phase signal

Bit	7	6	5	4
Function	---	EN2 encoder Z-phase signal	EN2 encoder B-phase signal	EN2 encoder A-phase signal

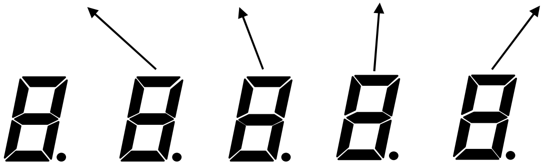
See tables below because display format of ID01 to 07 is different at the setup software and the digital operator.

■ Display of the setup software

Bit	7	6	5	4	3	2	1	0
0 or 1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0/1

■ Display of the Digital operator

Bit	7	6	5	4	3	2	1	0
ON								
OFF								
-	LED4		LED3		LED2		LED1	



Digital operator at the front of servo amplifier

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>10
11</td><td>
Actual position monitor (Motor encoder) [APMON]
■ Displays the current position of the motor encoder that has the origin as the position at the time the control power was turned ON.
As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed.
◆ Setup software displays the data to ID10.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays the data to ID10, ID11 by hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>10</td><td>Bit63 to Bit32</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>×2^{32} Pulse</td></tr>
<tr><td>11</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
<tr><td>12
13</td><td>
Command position monitor [CPMON]
■ Displays the current position of the pulse command that has the origin as the position at the time the control power was turned ON.
As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed.
◆ Setup software displays the data to ID12.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays the data to ID12, ID13 by hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>12</td><td>Bit63 to Bit32</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>×2^{32} Pulse</td></tr>
<tr><td>13</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
<tr><td>14</td><td>
Position deviation monitor [PMON]
■ Displays the position deviation value.
◆ Setup software displays values in decimal notation.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays values in hexadecimal notation.
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>14</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td rowspan="2">15</td><td>Velocity monitor [VMON]</td></tr>
<tr><td>

- Displays the rotation speed of the servo motor.
  - Setup software displays values in decimal notation.

<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>min^{-1}</td></tr>
</table>

  - Digital operator displays values in hexadecimal notation.

<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>15</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>min^{-1}</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">16</td><td>Velocity command monitor [VCMON]</td></tr>
<tr><td>

- Displays the velocity command value.
  - Setup software displays values in decimal notation.

<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>min^{-1}</td></tr>
</table>

  - Digital operator displays values in hexadecimal notation.

<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>16</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>min^{-1}</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">17</td><td>Torque monitor [TMON]</td></tr>
<tr><td>

- Displays the output torque of servo motor.

<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-499.9 to 499.9</td><td>%</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">18</td><td>Torque command monitor [TCMON]</td></tr>
<tr><td>

- Displays the torque command value.

<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-499.9 to 499.9</td><td>%</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">19</td><td>Acceleration monitor [ACCMON]</td></tr>
<tr><td>

- Displays the servo motor acceleration.
  - Setup software displays values in decimal notation.

<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>rad/s^2</td></tr>
</table>

  - Digital operator displays values in hexadecimal notation.

<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>19</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>rad/s^2</td></tr>
</table>

</td></tr>
</table>

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>1A</td><td>Load Torque monitor (Estimate value) [MTLMON-EST]
■ Displays the estimated value of load torque.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-499.9 to 499.9</td><td>%</td></tr>
</table>
</td></tr>
<tr><td>30</td><td>Position command pulse frequency monitor [FMON1]
■ Displays the entered command pulse frequency.
◆ Setup software displays values in decimal notation.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>kPulse/s</td></tr>
</table>
◆ Digital operator displays values in hexadecimal notation.
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>30</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>kPulse/s</td></tr>
</table>
</td></tr>
<tr><td>31</td><td>Analog velocity command/Analog torque command input voltage monitor [VC/TC-IN]
■ Displays the entered command voltage.
◆ Displays with mV unit at the setup software.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-12000 to 12000</td><td>mV</td></tr>
</table>
◆ Displays with 10mV unit at the digital operator.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-1200 to 1200</td><td>x10mV</td></tr>
</table>
</td></tr>
<tr><td>32</td><td>Analog torque addition command input voltage monitor [MTCOMP]
■ Displays the entered command voltage.
◆ Displays with mV unit at the setup software.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-12000 to 12000</td><td>mV</td></tr>
</table>
◆ Displays with 10mV unit at the digital operator.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-1200 to 1200</td><td>x10mV</td></tr>
</table>
</td></tr>
<tr><td>33
34</td><td>Absolute encoder PS data monitor (motor encoder) [ABSPS]
■ Displays position data of absolute encoder.
◆ Setup software displays the data to ID33.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to FFFFFFFFFFFFFFFF</td><td>Pulse</td></tr>
</table>
(Actual display range varies depending on the encoder specifications.)
◆ Digital operator displays the data to ID33, ID34 by hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>33</td><td>Bit63 to Bit32</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>34</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
</table>

ID	Description
35	Motor Encoder frequency monitor [MMOENCF] ■ Displays the motor encoder frequency of incremental encoder. ◆ Setup software displays values in decimal notation. Display range: -2147483648 to 2147483647 / Unit: kPulse/s ◆ Digital operator displays values in hexadecimal notation. ID: 35 / Data range: Bit31 to Bit0 / Display range: H.8000 L.0000 to H.7FFF L.FFFF / Unit: kPulse/s
36	U-phase electric angle monitor [CSU] ■ Displays U-phase electric angle. Always displayed except when encoder errors. Display range: 0 to 359 / Unit: deg
40	Regenerative resistor operation percentage monitor [RegP] ■ Displays the working ratio of regenerative resistor. Display range: 0.00 to 99.99 / Unit: %
41	Effective torque monitor [TRMS] ■ Displays effective torque. Depending on the operation pattern, it may take some hours to become stable. Display range: 0 to 499 / Unit: %
42	Effective torque monitor (Estimated value) [ETRMS] ■ Displays the effective torque estimation value. Estimates from short time operation. This can be confirmed shortly if the same operation pattern is repeated. Display range: 0 to 499 / Unit: %
44	Vbus monitor [VBUS] ■ Displays the dc value at main circuit. Display range: 0 to 1000 / Unit: V
45	Encoder temperature monitor [ENTMP] ■ Displays internal temperature of encoder. Display range: -40 to 127 / Unit: degree C ✔ Not shown with incremental encoder.

✔ Please use following conversion to convert "Effective torque monitor" or "Effective torque monitor (Estimated value)" to Motor Operating Rate Monitor which used for RS1 amplifier.

Motor Operating Rate Monitor [%] = (Effective torque monitor display value [%] / 100)^2 x 100

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td rowspan="2">46</td><td>Amplifier temperature monitor [MATEMP]</td></tr>
<tr><td>■ Displays internal temperature of servo amplifier.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-15 to 150</td><td>degree C</td></tr></table>
◆ Internal temperature of servo amplifier is the point near to power device.</td></tr>
<tr><td rowspan="2">47</td><td>Amplifier Operation Time [RUNTIM]</td></tr>
<tr><td>■ Displays the total time of control power ON.
<table><tr><th>Display format</th></tr><tr><td>Hour (h) : Minute (mm) : Second (ss) . Millisecond (ms)</td></tr></table>
◆ See "7.3 Setting and display range" for the digital operator display.</td></tr>
<tr><td rowspan="2">4A</td><td>Average electric power monitor
[MAVEPOW1]</td></tr>
<tr><td>■ Average electric power monitor shows a measurement result every 1 minute.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-999,999.9 to 999,999.9</td><td>[W]</td></tr></table>
◆ Refer to "7.3 Setting and display range" for the display of the digital operator.
✔ Not shown with the motor except standard spec R series.
✔ When 3-phase 200V AC is used to the 200V AC input type, accuracy will be ±25% (at the accel/decel operation with 100% effective torque).
✔ When single-phase 200V AC is used to the 200V AC input type, accuracy will be ±30% (at the accel/decel operation with 100% effective torque).
✔ For the 100V AC input type, accuracy will be ±30% (at the accel/decel operation with 100% effective torque).
(Accuracy may be worse when it is used at the instantaneous area of Velocity-torque characteristics.)</td></tr>
<tr><td rowspan="2">4B</td><td>Average electric power monitor
[MAVEPOW2]</td></tr>
<tr><td>■ Average electric power monitor shows a measurement result every 1 minute.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-999.9 to 999.9</td><td>[kW]</td></tr></table>
✔ Not shown with the motor except R series.
✔ When 3-phase 200V AC is used to the 200V AC input type, accuracy will be ±25% (at the accel/decel operation with 100% effective torque).
✔ When single-phase 200V AC is used to the 200V AC input type, accuracy will be ±30% (at the accel/decel operation with 100% effective torque).
✔ For the 100V AC input type, accuracy will be ±30% (at the accel/decel operation with 100% effective torque).
(Accuracy may be worse when it is used at the instantaneous area of Velocity-torque characteristics.)</td></tr>
<tr><td rowspan="2">4C</td><td>Regenerative power monitor
[RegPOW]</td></tr>
<tr><td>■ Displays the consumption power of regenerative resistor.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 4294967.295</td><td>W</td></tr></table></td></tr>
</table>

ID	Description
50	Load inertia moment ratio monitor [JRAT MON] ■ Displays the present load inertia moment ratio. Value can check when using gain switching and auto-tuning function.
51	Model Control Gain monitor [MKP MON] ■ Displays the present Model Control Gain. Value can check when using gain switching and auto-tuning function.
52	Position Loop Proportional Gain monitor [KP MON] ■ Displays the present Position Loop Proportional Gain. Value can check when using gain switching and auto-tuning function.
53	Position Loop Integral Time Constant monitor [TPI MON] ■ Displays the present Position Loop Integral Time Constant. Value can check when using gain switchinga function.
54	Velocity Loop Proportional Gain monitor [KVP MON] ■ Displays the present Velocity Loop Proportional Gain. Value can check when using gain switching and auto-tuning function.
55	Velocity Loop Integral Time Constant monitor [TVI MON] ■ Displays the present Velocity Loop Integral Time Constant. Value can check when using gain switching and auto-tuning function.
56	Torque Command Filter monitor [TCFIL MON] ■ Displays the present Torque Command Filter. Value can check when using gain switching and auto-tuning function.
58	Frequency monitor E for adaptive notch filter [ADNFE MON] ■ Displays the adaptive notch filter frequency. Display range: 100 to 1000,4000 / Unit: Hz
60	Dual position error monitor [DFERR-MON] ■ Displays the difference of current position between an external encoder and a motor encoder of after feedback pulse electronic gear. This value can check in use of full-closed control. ◆ Setup software displays values in decimal notation. Display range: -2147483648 to 2147483647 / Unit: Pulse ◆ Digital operator displays values in hexadecimal notation. ID: 60 / Data range: Bit31 to Bit0 / Display range: H.8000 L.0000 to H.7FFF L.FFFF / Unit: Pulse

ID 58:

Display range	Unit
100 to 1000,4000	Hz

ID 60, setup software:

Display range	Unit
-2147483648 to 2147483647	Pulse

ID 60, digital operator:

ID	Data range	Display range	Unit
60	Bit31 to Bit0	H.8000 L.0000 to H.7FFF L.FFFF	Pulse

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>61
62</td><td>
Present position monitor (External encoder) [EX-APMON]
■ Displays the current position of the external encoder that has the origin as the position at the time the control power was turned ON.
As this is a free run counter, if the current position exceeds the displayed range, the maximum reverse polarity value will be displayed.
◆ Setup software displays the data to ID61.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-9223372036854775808 to 9223372036854775807</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays the data to ID61, ID62 by hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>61</td><td>Bit63 to Bit32</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>62</td><td>Bit31 to Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
<tr><td>63
64</td><td>
External absolute encoder PS data monitor [EX-ABSPS]
■ Displays position data of external absolute encoder.
◆ Setup software displays the data to ID63.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>0 to FFFFFFFFFFFFFFFF</td><td>Pulse</td></tr>
</table>
(Actual display range varies depending on the encoder specifications.)
◆ Digital operator displays the data to ID63, ID64 by hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>63</td><td>Bit63 ～ Bit32</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>64</td><td>Bit31 ～ Bit0</td><td>H.0000 L.0000 to H.FFFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
<tr><td>65</td><td>
Ext. Encoder frequency monitor [MEXENCF]
■ Displays the external encoder frequency of incremental encoder.
◆ Setup software displays values in decimal notation.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>kPulse/s</td></tr>
</table>
◆ Digital operator displays values in hexadecimal notation (32-bit data).
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>65</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>kPulse/s</td></tr>
</table>
</td></tr>
<tr><td>66</td><td>
Axes-sync error monitor [SYNERR]
■ Displays position deviation error between own axis and counterpart axis.
◆ Setup software displays values in decimal notation.
<table>
<tr><th>Display range</th><th>Unit</th></tr>
<tr><td>-2147483648 to 2147483647</td><td>Pulse</td></tr>
</table>
◆ Digital operator displays values in hexadecimal notation.
<table>
<tr><th>ID</th><th>Data range</th><th>Display range</th><th>Unit</th></tr>
<tr><td>66</td><td>Bit31 to Bit0</td><td>H.8000 L.0000 to H.7FFF L.FFFF</td><td>Pulse</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td>70</td><td>Remaining life of relay for an inrush current prevention [RSRLYLF]
■ Displays the remaining life of relay for an inrush current prevention.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 100.00</td><td>%</td></tr></table></td></tr>
<tr><td>71</td><td>Remaining life of relay for a dynamic brake [DBRLYLF]
■ Displays the remaining life of relay for a dynamic brake.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 100.00</td><td>%</td></tr></table></td></tr>
<tr><td>73</td><td>Error rate of motor encoder communication [MOTE-ERRAT]
■ Displays the error rate of motor encoder communication.
It shows error count ratio against communication count per second.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0.000000 to 1.000000</td><td>-</td></tr></table></td></tr>
<tr><td>74</td><td>Error rate of external encoder communication [EXTE-ERRAT]
■ Displays the Error rate of external encoder communication.
It shows error count ratio against communication count per second.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0.000000 to 1.000000</td><td>-</td></tr></table></td></tr>
<tr><td>77</td><td>Remaining life of a holding brake [HBLF]
■ Displays the remaining life of a holding brake.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 100.00</td><td>%</td></tr></table>
✔ Displays just when the servo motor with holding brake is used.
✔ It doesn't display if combining the servo motor which is not support this function.</td></tr>
</table>

5.6 Analog monitor and digital monitor

All signals and internal status of the servo amplifier can be monitored by using the dedicated Monitor Box and cable. See "12.6 Optional parts" for the details of monitor box and dedicated cable.
Analog monitor output 1 is output also from “CN1-pin30”.

- Selection of output signal
  Selecting and changing the output signal to be used from the parameters list below.

General parameters GroupA ID10	DMON: Digital Monitor Output Signal Selection
General parameters GroupA ID11	Analog Monitor Selection for Output 1
General parameters GroupA ID12	Analog Monitor Selection for Output 2

5.7 Setting parameters

5.7.1 Parameters list

Below is the parameters list that classified to each Group and put in ID order. “System parameters”, “General parameters” and “Motor parameters” are retained in the servo amplifier by running the parameter back-up function, and they can reload as needed.
See another manual: M0010842 for the setup software operation.

■ General parameters group list

Group	Classification of the parameters in the group
Group0	Auto-tuning settings
Group1	Basic control parameter settings
Group2	FF (feed forward) vibration suppression control/ Notch filter/ Disturbance observer settings
Group3	Model following control settings
Group4	Gain switching control/ Vibration suppression frequency switching settings
Group5	Higher settling control settings
Group8	Control system settings
Group9	Function enabling condition settings
GroupA	General output terminal output condition/ Monitor output selection
GroupB	Sequence/alarm related settings
GroupC	Encoder related settings
GroupD	Support function related settings

✔ Parameters vary depending on the servo amplifier to be used.
✔ Setup software does not display invalid parameters.
The Digital Operator cannot change the setting value.

■ General parameters Group0 "Auto-tuning settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	TUNMODE	Tuning Mode	M,P,V,T	00:AutoTun	—	00 to 02
01	ATCHA	Auto-Tuning Characteristic	M,P,V,T	00:Positioning1	—	00 to 06
02	ATRES	Auto-Tuning Response	M,P,V,T	5	—	1 to 40
03	ATSAVE	Auto-Tuning Automatic Parameter Saving	M,P,V,T	00:Auto_Saving	—	00 to 01
04	ATCSEL	Auto-Tuning characteristic compatible mode	M,P,V,T	00:Disable	—	00 to 01
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	M,P,V,T	50.0	%	10.0 to 100.0
20	ASUPTC	Auto-FF Vibration Suppression Frequency Tuning Torque Command	M,P	25.0	%	10.0 to 100.0
21	ASUPFC	Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value	M,P	5.0	%	0.0 to 50.0
34	ADNFE	Adaptive notch filter function E	M,P,V	00:Adp_Filter Disable	—	00 to 01
35	ADNFUE	Adaptive notch filter frequency upper limit E	M,P,V	1000	Hz	100 to 1000
36	ADNFLE	Adaptive notch filter frequency lower limit E	M,P,V	100	Hz	100 to 1000
37	ADNSVE	Adaptive notch filter E auto saving	M,P,V	00:Auto_Saving	—	00 to 01

✔ M = Model following control type, P = Position control type, V = Velocity control type,
T = Torque control type

■ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	PCSMT	Position Command Smoothing Constant	M,P	0.0	ms	0.0 to 500.0
01	PCFIL	Position Command Filter	M,P	0.0	ms	0.0 to 2000.0
02	KP1	Position Loop Proportional Gain 1	M,P	30	1/s	1 to 3000
03	TPI1	Position Loop Integral Time Constant 1	M,P	1000.0	ms	0.3 to 1000.0
04	PLPHLK	Position loop phase lead compensation gain	M,P	0	%	0 to 100
05	PLPHLF	Position loop phase lead compensation frequency	M,P	500	Hz	10 to 4000
06	FFGN	Velocity Feed Forward Gain	P	0	%	0 to 100
07	FFFIL	Velocity Feed Forward Filter	P	4000	Hz	1 to 4000
08	TRCPGN	Higher Tracking Control Position Compensation Gain	M ※ ,P	0	%	0 to 100
10	VCFIL	Velocity Command Filter	M,P,V	4000	Hz	1 to 4000
11	VDFIL	Velocity Detection Filter	M,P,V	1500	Hz	1 to 4000
12	KVP1	Velocity Loop Proportional Gain 1	M,P,V	50	Hz	1 to 2000
13	TVI1	Velocity Loop Integral Time Constant 1	M,P,V	20.0	ms	0.3 to 1000.0
14	JRAT1	Load Inertia Moment Ratio 1	M,P,V	100	%	0 to 15000
15	VLPHLK	Velocity loop phase lead compensation gain	M,P,V	0	%	0 to 100
16	VLPHLF	Velocity loop phase lead compensation frequency	M,P,V	500	Hz	10 to 4000
17	HKVIK	High order integral control gain	M,P,V	0	%	0 to 100
18	HKVIF	High order integral control frequency	M,P,V	500	Hz	10 to 4000
19	TFFK	Torque feedforward gain	P,V	0	%	0 to 100
1A	TFFAVE	Torque feedforward averaging	P,V	01:4timesAverage	—	00 to 01
1B	TFFOUT	Torque feedforward output selection	P,V	00:Before_Filter	—	00 to 01
1C	AFBK	Acceleration Feedback Gain	M,P,V	0.0	%	-100.0 to 100.0
1D	AFBFIL	Acceleration Feedback Filter	M,P,V	500	Hz	1 to 4000
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	P,V	0	%	0 to 100
20	TCFIL1	Torque Command Filter 1	M,P,V,T	600	Hz	1 to 4000
21	TCFILOR	Torque Command Filter Order	M,P,V,T	2	Order	1 to 3
30	DFBCG	Dual position feedback gain	M,P	0	%	0 to 100
31	DFBFIL	Dual position feedback filter	M,P	0.0	ms	0.0 to 2000.0
80	KSCPGN	Axes-sync compensation proportional gain	P	0	%	0 to 1000
81	TSCIGN	Axes-sync compensation integral time constant	P	1000.0	ms	0.5 to 1000.0
82	SCFIL	Axes-sync compensation filter	P	0.0	ms	0.0 to 1000.0

✔ M = Model following control type, P = Position control type, V = Velocity control type,
T = Torque control type

*: It can not use when "03:Model1/Standard" or "04:Model2/Standard" are selected to the system parameter ID07.

- General parameters Group2 "FF (Feed forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	SUPFRQA1	FF Vibration Suppression Frequency A1	M,P	500.0	Hz	1.0 to 500.0
01	SUPLVA	FF Vibration Suppression Level Selection A	M,P	00	-	00 to 03
02	SUPFRQB1	FF Vibration Suppression Frequency B1	M,P	500.0	Hz	1.0 to 500.0
03	SUPCRB	FF Vibration Suppression Level Selection B	M,P	00	-	00 to 01
10	VCNFIL	Velocity Command Notch Filter	M,P,V	1000	Hz	50 to 1000
20	TCNFILA	Torque Command Notch Filter A	M,P,V,T	4000	Hz	100 to 4000
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement	M,P,V,T	0	-	0 to 2
22	TCNFILB	Torque Command Notch Filter B	M,P,V,T	4000	Hz	100 to 4000
23	TCNFDB	TCNFILB, Depth Selection	M,P,V,T	0	-	0 to 15
24	TCNFILC	Torque Command Notch Filter C	M,P,V,T	4000	Hz	100 to 4000
25	TCNFDC	TCNFILC, Depth Selection	M,P,V,T	0	-	0 to 15
26	TCNFILD	Torque Command Notch Filter D	M,P,V,T	4000	Hz	100 to 4000
27	TCNFDD	TCNFILD, Depth Selection	M,P,V,T	0	-	0 to 15
28	TCNFILE	Torque Command Notch Filter E	M,P,V,T	4000	Hz	100 to 4000
29	TCNFDE	TCNFILE, Depth Selection	M,P,V,T	0	-	0 to 15
30	OBCHA	Observer Characteristic	M,P,V	00:Low	-	00 to 02
31	OBG	Observer Compensation Gain	M,P,V	0	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	M,P,V	50	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	M,P,V	4000	Hz	100 to 4000
40	STV	Effective velocity for compensating stick-slip behavior	M,P,V,T	10.0	min^{-1}	0.1 to 128.0
41	STHLD	Retention time for compensating stick-slip behavior	M,P,V,T	20	ms	1 to 500
42	STTVI	Velocity loop integral time constant for stick-slip behavior compensation	M,P,V,T	3.0	ms	0.3 to 1000
50	CPVSFQ	CP vibration suppression control frequency	P,V	100.0	Hz	10.0 to 100.0
51	CPVSLV	CP vibration suppression control level	P,V	00	-	00 to 03
52	CPVSCR	CP vibration suppression control characteristics selection	P,V	01	-	00 to 02
60	FBHPLS	Minor vibration suppression pulse compensation value	M,P,V,T	1	Pulse	1 to 100
61	FBHTIM	Minor vibration suppression pulse compensation frequency	M,P,V,T	1	times	1 to 100

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- ■ General parameters Group3 "Model following control settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	KM1	Model Control Gain 1	M	30	1/s	1 to 3000
01	MZETA	Model control damping coefficient	M	100	%	0 to 100
02	MFFGN	Model velocity feedforward gain	M	0	%	0 to 100
03	MTFFD	Model velocity feedforward differential time constant	M	0.00	ms	0.00 to 10.00
04	MFFFIL	Model velocity feedforward filter	M	4000	Hz	1 to 4000
05	OSSFIL	Overshoot Suppression Filter	M	1500	Hz	1 to 4000
06	ANRFRQ1	Model Control Antiresonance Frequency 1	M	80.0	Hz	10.0 to 80.0
07	RESFRQ1	Model Control Resonance Frequency 1	M	80.0	Hz	10.0 to 80.0

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- ■ General parameters Group4 "Gain switching control/ Vibration suppression frequency switching settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	KM2	Model Control Gain 2	M	30	1/s	1 to 3000
01	KP2	Position Loop Proportional Gain 2	M,P	30	1/s	1 to 3000
02	TPI2	Position Loop Integral Time Constant 2	M,P	1000.0	ms	0.3 to 1000.0
03	KVP2	Velocity Loop Proportional Gain 2	M,P,V	50	Hz	1 to 2000
04	TVI2	Velocity Loop Integral Time Constant 2	M,P,V	20.0	ms	0.3 to 1000.0
05	JRAT2	Load Inertia Moment Ratio 2	M,P,V	100	%	0 to 15000
06	TCFIL2	Torque Command Filter 2	M,P,V,T	600	Hz	1 to 4000
10	KM3	Model Control Gain 3	M	30	1/s	1 to 3000
11	KP3	Position Loop Proportional Gain 3	M,P	30	1/s	1 to 3000
12	TPI3	Position Loop Integral Time Constant 3	M,P	1000.0	ms	0.3 to 1000.0
13	KVP3	Velocity Loop Proportional Gain 3	M,P,V	50	Hz	1 to 2000
14	TVI3	Velocity Loop Integral Time Constant 3	M,P,V	20.0	ms	0.3 to 1000.0
15	JRAT3	Load Inertia Moment Ratio 3	M,P,V	100	%	0 to 15000
16	TCFIL3	Torque Command Filter 3	M,P,V,T	600	Hz	1 to 4000
20	KM4	Model Control Gain 4	M	30	1/s	1 to 3000
21	KP4	Position Loop Proportional Gain 4	M,P	30	1/s	1 to 3000
22	TPI4	Position Loop Integral Time Constant 4	M,P	1000.0	ms	0.3 to 1000.0
23	KVP4	Velocity Loop Proportional Gain 4	M,P,V	50	Hz	1 to 2000
24	TVI4	Velocity Loop Integral Time Constant 4	M,P,V	20.0	ms	0.3 to 1000.0
25	JRAT4	Load Inertia Moment Ratio 4	M,P,V	100	%	0 to 15000
26	TCFIL4	Torque Command Filter 4	M,P,V,T	600	Hz	1 to 4000
30	GCFIL	Gain Switching Filter	M,P,V	0	ms	0 to 100
40	SUPFRQA2	FF Vibration Suppression Frequency A2	M,P	500.0	Hz	1.0 to 500.0
41	SUPFRQA3	FF Vibration Suppression Frequency A3	M,P	500.0	Hz	1.0 to 500.0
42	SUPFRQA4	FF Vibration Suppression Frequency A4	M,P	500.0	Hz	1.0 to 500.0
43	SUPFRQB2	FF Vibration Suppression Frequency B2	M,P	500.0	Hz	1.0 to 500.0
44	SUPFRQB3	FF Vibration Suppression Frequency B3	M,P	500.0	Hz	1.0 to 500.0
45	SUPFRQB4	FF Vibration Suppression Frequency B4	M,P	500.0	Hz	1.0 to 500.0
50	ANRFRQ2	Model Control Antiresonance Frequency 2	M	80.0	Hz	10.0 to 80.0
51	RESFRQ2	Model Control Resonance Frequency 2	M	80.0	Hz	10.0 to 80.0
52	ANRFRQ3	Model Control Antiresonance Frequency 3	M	80.0	Hz	10.0 to 80.0
53	RESFRQ3	Model Control Resonance Frequency 3	M	80.0	Hz	10.0 to 80.0
54	ANRFRQ4	Model Control Antiresonance Frequency 4	M	80.0	Hz	10.0 to 80.0
55	RESFRQ4	Model Control Resonance Frequency 4	M	80.0	Hz	10.0 to 80.0

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- ■ General parameters Group5 "High settling control settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	CVFIL	Command Velocity Low-pass Filter	P	1000	Hz	1 to 4000
01	CVTH	Command Velocity Threshold	P	20	min^{-1}	0 to 65535
02	ACCCO	Acceleration Compensation	P	0	×50 Pulse	-9999 to 9999
03	DECCO	Deceleration Compensation	P	0	×50 Pulse	-9999 to 9999

✔ P = Position control type

■ General parameters Group8 "Control system settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	CMDPOL	Position, Velocity, Torque Command Input Polarity	M,P,V,T	00:PC+_VC+_TC+	—	00 to 07
01	VC/TC-DW	Analog Velocity, Torque Command Input Dead Band Width	P,V,T	0.0	mV	0.0 to 6553.5
10	PMOD	Position Command Pulse Selection	M,P	00:F-PC_R-PC	—	00 to 02
11	PCPPOL	Position Command Pulse Count Polarity	M,P	00:Type1	—	00 to 03
12	PCPFIL	Position Command Pulse Digital Filter	M,P	00:850ns	—	00 to 07
13	B-GER1	Electronic Gear 1 Numerator	M,P	1	—	1 to 2097152
14	A-GER1	Electronic Gear 1 Denominator	M,P	1	—	1 to 2097152
15	B-GER2	Electronic Gear 2 Numerator	M,P	1	—	1 to 2097152
16	A-GER2	Electronic Gear 2 Denominator	M,P	1	—	1 to 2097152
17	EDGEPOS	Positioning Methods	M,P	00:Pulse_Interval	—	00 to 01
18	PDEVMON	In-Position Signal/ Position Deviation Monitor	P	00:After_Filter	—	00 to 01
19	CLR	Deviation Clear Selection	M,P	00:Type1	—	00 to 03
1A	PCDLY	Time to judge position command distribution completion	M,P	0.0	ms	0.0 to 1000.0
20	VC1	Preset Velocity Command 1	V	100	min^{-1}	0 to 32767
21	VC2	Preset Velocity Command 2	V	200	min^{-1}	0 to 32767
22	VC3	Preset Velocity Command 3	V	300	min^{-1}	0 to 32767
23	VC4	Preset Velocity Command 4	V	400	min^{-1}	0 to 32767
24	VC5	Preset Velocity Command 5	V	500	min^{-1}	0 to 32767
25	VC6	Preset Velocity Command 6	V	600	min^{-1}	0 to 32767
26	VC7	Preset Velocity Command 7	V	700	min^{-1}	0 to 32767
27	VCOMSEL	Velocity Compensation Command Input Selection	P	02:V-COMP	—	01 to 02
28	V-COMP	Preset Velocity Compensation Command	P	0	min^{-1}	-9999 to 9999
29	VCGN	Analog Velocity (Compensation) Command Scaling	P,V	500	min^{-1}/V	0 to 4000
2A	EX-VCFIL	External Velocity Command Filter	P,V	4000	Hz	1 to 4000
2B	TVCACC	Velocity Command Acceleration Time Constant	V	0	ms	0 to 16000
2C	TVCDEC	Velocity Command Deceleration Time Constant	V	0	ms	0 to 16000
2D	VCLM	Velocity Limit Command	P,V	65535	min^{-1}	1 to 65535
30	TCOMSEL	Torque Compensation Command Input Selection	P,V	02:T-COMP	—	01 to 02
31	T-COMP1	Preset Torque Compensation Command 1	P,V	0.0	%	-500.0 to 500.0
32	T-COMP2	Preset Torque Compensation Command 2	P,V	0.0	%	-500.0 to 500.0
33	TCGN	Analog Torque Command Scaling	T	50.0	%/V	0.0 to 500.0
34	T-COMPGN	Analog Torque Compensation Command Scaling	P,V	50.0	%/V	0.0 to 500.0
35	EX-TCFIL	External Torque Command Filter	P,V,T	4000	Hz	1 to 4000
36	TLSEL	Torque Limit Input Selection	M,P,V,T	00:TCLM	—	00 to 02
37	TCLM-F	Forward Direction Internal Torque Limit Value	M,P,V,T	100.0	%	10.0 to 500.0
38	TCLM-R	Reverse Direction Internal Torque Limit Value	M,P,V,T	100.0	%	10.0 to 500.0
39	SQTCLM	Sequence Operation Torque Limit Value	M,P,V,T	120.0	%	10.0 to 500.0
3A	CPETLSEL	Selection of Torque Limit Input Under Voltage Sag	M,P,V,T	00:No_Limit	—	00 to 03
3B	TASEL	Torque Attainment function select	M,P,V,T	00:TA/TR	—	00 to 01
3C	TA	Torque attainment setting	M,P,V,T	100.0	%	0.0 to 500.0
3D	TLMREST	The amounts of torque limit value restoration when power restored.	M,P,V,T	10.0	%	0.0 to 500.0
3E	BDLY_TCMP	Torque compensation command at holding brake operation cancellation delay	M,P,V	0.0	%	-100.0 to 100.0
40	NEAR	Near Range	M,P	500	Pulse	1 to 2147483647
41	INP	In-Position Window	M,P	100	Pulse	1 to 2147483647
42	ZV	Speed Zero Range	M,P,V,T	50	min^{-1}	50 to 500
43	LOWV	Low Speed Range	M,P,V,T	50	min^{-1}	0 to 65535
44	VA	Speed Attainment Setting (High Speed Range)	M,P,V,T	1000	min^{-1}	0 to 65535
45	VCMPUS	Speed Matching Unit Selection	M,P,V	00:min^{-1}	—	00 to 01
46	VCMP	Speed Matching Range	M,P,V	50	min^{-1}	0 to 65535
47	VCMPR	Speed Matching Range Ratio	M,P,V	5.0	%	0.0 to 100.0
80	SYNCDIR	Polarity selection of axes-sync compensation input	P	00:Not_Reversed	—	00 to 01

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- ■ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Control mode	Default value	Setting range
00	F-OT	Positive Over Travel Function	M,P,V,T	0D:CONT6_OFF	00 to 29
01	R-OT	Negative Over Travel Function	M,P,V,T	0B:CONT5_OFF	00 to 29
02	AL-RST	Alarm Reset Function	M,P,V,T	10:CONT8_ON	00 to 29
03	ECLR	Encoder Clear Function	M,P,V,T	06:CONT3_ON	00 to 29
04	CLR	Deviation Clear Function	M,P	08:CONT4_ON	00 to 29
05	S-ON	Servo-ON Function	M,P,V,T	02:CONT1_ON	00 to 29
10	MS	Control Mode Switching Function	P,V,T	00:Always_Disable	00 to 29
11	INH/Z-STP	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function	M,P,V	00:Always_Disable	00 to 29
12	GERS	Electronic Gear Switching Function	M,P	00:Always_Disable	00 to 29
13	GC1	Gain Switching Condition 1	M,P,V,T	00:Always_Disable	00 to 29
14	GC2	Gain Switching Condition 2	M,P,V,T	00:Always_Disable	00 to 29
15	SUPFSELA1	FF Vibration Suppression Frequency Select Input A1	M,P	00:Always_Disable	00 to 29
16	SUPFSELA2	FF Vibration Suppression Frequency Select Input A2	M,P	00:Always_Disable	00 to 29
17	SUPFSELB1	FF Vibration Suppression Frequency Select Input B1	M,P	00:Always_Disable	00 to 29
18	SUPFSELB2	FF Vibration Suppression Frequency Select Input B2	M,P	00:Always_Disable	00 to 29
19	PLPCON	Position Loop Proportional Control Switching Function	P	01:Always_Enable	00 to 29
1A	MODEL	Model following (vibration suppression) control/ standard position control switching function	M	00:Always_Disable	00 to 11
1B	MDLFSEL1	Model Vibration Suppression Frequency Select Input 1	M	00:Always_Disable	00 to 29
1C	MDLFSEL2	Model Vibration Suppression Frequency Select Input 2	M	00:Always_Disable	00 to 29
20	SP1	Preset Velocity Command Select Input 1	V	00:Always_Disable	00 to 29
21	SP2	Preset Velocity Command Select Input 2	V	00:Always_Disable	00 to 29
22	SP3	Preset Velocity Command Select Input 3	V	00:Always_Disable	00 to 29
23	DIR	Preset Velocity Command Operation Direction Select Input	V	00:Always_Disable	00 to 29
24	RUN	Preset Velocity Command Operation Start Signal Input	V	00:Always_Disable	00 to 29
25	RUN-F	Preset Velocity Command Positive (direction) Move Start Signal Input	V	00:Always_Disable	00 to 29
26	RUN-R	Preset Velocity Command Negative (direction) Move Start Signal Input	V	00:Always_Disable	00 to 29
27	VLPCON	Velocity Loop Proportional Control Switching Function	P,V	04:CONT2_ON	00 to 29
28	V-COMPS	Velocity Compensation Function	P	00:Always_Disable	00 to 29
30	T-COMPS1	Torque Compensation Function 1	P,V	00:Always_Disable	00 to 29
31	T-COMPS2	Torque Compensation Function 2	P,V	00:Always_Disable	00 to 29
32	TL	Torque Limit Function	M,P,V,T	0E:CONT7_ON	00 to 29
33	OBS	Disturbance Observer Function	M,P,V	00:Always_Disable	00 to 29
34	STC	Stick-slip behavior compensation function	M,P,V,T	00:Always_Disable	00 to 29
35	FBHYST	Minor vibration (oscillation) suppression function	M,P,V,T	00:Always_Disable	00 to 29
40	EXT-E	External Trip Input Function	M,P,V,T	00:Always_Disable	00 to 29
41	EMR	Emergency Stop Function	M,P,V,T	00:Always_Disable	00 to 29
80	SYNCEN	Axes-sync compensation function	P	00:Always_Disable	00 to 11
81	SYNPCNEN	Axes-sync compensation proportional control switching function	P	00:Always_Disable	00 to 29

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

■ General parameters GroupA "General output terminal output condition/ Monitor output selection"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	OUT1	General Output 1	M,P,V,T	18:INP_ON	—	00 to 81
01	OUT2	General Output 2	M,P,V,T	0C:TLC_ON	—	00 to 81
02	OUT3	General Output 3	M,P,V,T	02:S-RDY_ON	—	00 to 81
03	OUT4	General Output 4	M,P,V,T	0A:MBR-ON_ON	—	00 to 81
04	OUT5	General Output 5	M,P,V,T	33:ALM5_OFF	—	00 to 81
05	OUT6	General Output 6	M,P,V,T	35:ALM6_OFF	—	00 to 81
06	OUT7	General Output 7	M,P,V,T	37:ALM7_OFF	—	00 to 81
07	OUT8	General Output 8	M,P,V,T	39:ALM_OFF	—	00 to 81
10	DMON	Digital Monitor Output Signal Selection	M,P,V,T	00:Always_OFF	—	00 to 81
11	MON1	Analog Monitor Select Output 1	M,P,V,T	05:VMON_2mV/min^{-1}	—	00 to 36
12	MON2	Analog Monitor Select Output 2	M,P,V,T	02:TCMON_2V/TR	—	00 to 36
13	MONPOL	Analog Monitor Output Polarity	M,P,V,T	00:MON1+_MON2+	—	00 to 08

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- General parameters GroupB "Sequence/Alarm related settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	DBOPE	Servo-OFF stop behavior	M,P,V,T	04:SB_Free	—	00 to 07
01	ACTOT	Over-Travel Action	M,P,V,T	00:CMDINH_ SB_SON	—	00 to 08
02	ACTEMR	Emergency Stop Operation	M,P,V	00:SERVO-BRAKE	—	00 to 02
03	BONDLY	Delay Time of Engaging Holding Brake (Holding Brake Holding Delay Time)	M,P,V,T	300	ms	0 to 1000
04	BOFFDLY	Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)	M,P,V,T	300	ms	0 to 1000
05	BONBGN	Brake Operation Beginning Time	M,P,V,T	10000	ms	0 to 65535
06	PFDDLY	Power Failure Detection Delay Time	M,P,V,T	32	ms	20 to 1000
07	INTTIM	Initial timeout wait time	M,P,V,T	00:Disabled	—	00 to 07
10	OFWLV	Excessive Deviation Warning Level	M,P	2147483647	Pulse	1 to 2147483647
11	OFLV	Deviation Counter Overflow Value	M,P	5000000	Pulse	1 to 2147483647
12	OLWLV	Overload Warning Level	M,P,V,T	90	%	20 to 100
13	VFBALM	Velocity Feedback Alarm (ALM_C3) Detection	M,P,V,T	01:Enabled	—	00 to 01
14	VCALM	Velocity Control Alarm (ALM_C2) Detection	M,P,V,T	00:Disabled	—	00 to 01
15	SOFDEC	Deceleration Time Constant at Servo off Stopping	M,P,V,T	0	ms	0 to 16000
16	EMRDEC	Deceleration Time Constant at Emergency Stopping	M,P,V,T	0	ms	0 to 16000
17	SONFALL	External command effectivity selection at holding brake operation cancellation delay time	M,P,V	00:Disabled	—	00 to 01
18	SOFFFALL	External command effectivity selection at holding brake operation delay time	M,P,V	00:Disabled	—	00 to 01
19	DFOFWLV	Dual position error warning level	M,P	2147483647	Pulse	0 to 2147483647
1A	DFOFLV	Dual position error excess value	M,P	5000000	Pulse	0 to 2147483647
80	PSDEVW	Axes-sync error warning level	P	2147483647	Pulse	1 to 2147483647
81	PSDEVA	Axes-sync error excess value	P	5000000	Pulse	1 to 2147483647

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- General parameters GroupC "Encoder related settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	ENFIL	Motor Incremental Encoder Digital Filter	M,P,V,T	01:220ns	—	00 to 07
01	EX-ENFIL	External Incremental Encoder Digital Filter	M,P,V,T	01:220ns	—	00 to 07
02	EX-ENPOL	External Encoder Polarity Selection	M,P,V,T	00:Type1	—	00 to 07
03	PULOUTSEL	Encoder Output Pulse Divide Selection	M,P,V,T	00:Motor_Enc	—	00 to 01
04	ENRAT	Encoder Output Pulse Division	M,P,V,T	1/1	—	1/32768 to 1/1
05	PULOUTPOL	Encoder Output Pulse Divide Polarity	M,P,V,T	00:Type1	—	00 to 03
06	PULOUTRES	Encoder Output Pulse Divide Resolution Selection	M,P,V,T	00:32768P/R	—	00 to 01
07	PSOFORM	Encoder Signal Output (PS) Format	M,P,V,T	00:MOT_Binary	—	00 to 04
08	ECLRFUNC	Encoder Clear Function Selection	M,P,V,T	00:Status_ MultiTurn	—	00 to 01
0B	EX-SENPOL	External Absolute Encoder polarity selection	M,P,V,T	00:Standard	—	00 to 01
0C	EX-PULDIV	External encoder output pulse divide ratio selection	M,P,V,T	00:1/4(R)_1/4(L)	—	00 to 0B
10	DE1MSKLVL	Broken wire mask level at Encoder connector 1	M,P,V,T	0	kHz	0 to 65535
11	DE3MSKLVL	Broken wire mask level at Encoder connector 2	M,P,V,T	0	kHz	0 to 65535

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- General parameters GroupD "Support function related settings"

ID	Symbol	Name	Control mode	Default value	Unit	Setting range
00	JOGVC	JOG Velocity Command	M,P,V,T	50	min^{-1}	0 to 32767
02	TSTTCLM	Support function torque limit value	M,P,V,T	120.0	%	10.0 to 500.0
10	COMAXIS	Serial Communication Axis Number	M,P,V,T	01:#1	—	01 to 0F
11	MONDISP	Monitor Display Selection	M,P,V,T	00:STATUS	—	00 to 77
20	SAMPDIV	Drec. sampling rate	M,P,V,T	20	—	0 to 65535
21	SAMPNUM	Drec. sampling mode	M,P,V,T	00:256point	—	00 to 02
22	TRGCHSEL	Drec. Trigger Channel	M,P,V,T	83:DIGITAL_4	—	00 to 83
23	TRGEDGSEL	Drec. Trigger Slope	M,P,V,T	00:POS_EDGE	—	00 to 02
24	TRGHPOS	Drec. Trigger Horizontal Position	M,P,V,T	80	%	0 to 100
25	TRGLVL	Drec. Trigger Level	M,P,V,T	1	—	-9223372036854775808 to 9223372036854775807
31	CH1SEL	Drec. Analog CH1 selection	M,P,V,T	08:PCMDF1	—	00 to 23, FF
32	CH2SEL	Drec. Analog CH2 selection	M,P,V,T	01:VCMON	—	00 to 23, FF
33	CH3SEL	Drec. Analog CH3 selection	M,P,V,T	03:TCMON	—	00 to 23, FF
34	CH4SEL	Drec. Analog CH4 selection	M,P,V,T	15:VBUS	—	00 to 23, FF
35	CH5SEL	Drec. Analog CH5 selection	M,P,V,T	05:POSITION	—	00 to 23, FF
36	CH6SEL	Drec. Analog CH6 selection	M,P,V,T	00:VMON	—	00 to 23, FF
37	DCH1SEL	Drec. Digital CH1 selection	M,P,V,T	16:SRDY	—	00 to 20, FF
38	DCH2SEL	Drec. Digital CH2 selection	M,P,V,T	15:SACT	—	00 to 20, FF
39	DCH3SEL	Drec. Digital CH3 selection	M,P,V,T	1B:WRG-DF	—	00 to 20, FF
3A	DCH4SEL	Drec. Digital CH4 selection	M,P,V,T	1C:ALM	—	00 to 20, FF

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

- Basic parameters

ID	Symbol	Name	Control mode	Remarks	
00	COMAXIS	Serial Communication Axis Number	M,P,V,T	This is common with GroupD ID11	
01	TUNMODE	Tuning Mode	M,P,V,T	This is common with Group0 ID00	
02	ATRES	Auto-Tuning Response	M,P,V,T	This is common with Group0 ID02	
03	PCSMT	Position Command Smoothing Constant	M,P	This is common with Group1 ID00	
04	PCFIL	Position Command Filter	M,P	This is common with Group1 ID01	
05	B-GER1	Electronic Gear 1 Numerator	M,P	This is common with Group8 ID13	
06	A-GER1	Electronic Gear 1 Denominator	M,P	This is common with Group8 ID14	
07	INP	In-Position Window	M,P	This is common with Group8 ID41	
08	F-OT	Positive Over Travel Function	M,P,V,T	This is common with Group9 ID00	
09	R-OT	Negative Over Travel Function	M,P,V,T	This is common with Group9 ID01	
0A	AL-RST	Alarm Reset Function	M,P,V,T	This is common with Group9 ID02	
0B	ECLR	Encoder Clear Function	M,P,V,T	This is common with Group9 ID03	
0C	CLR	Deviation Clear Function	M,P	This is common with Group9 ID04	
0D	S-ON	Servo-ON Function	M,P,V,T	This is common with Group9 ID05	
0E	TL	Torque Limit Function	M,P,V,T	This is common with Group9 ID32	
0F	JOGVC	JOG Velocity Command	M,P,V,T	This is common with GroupD ID00	
10	ENRAT	Encoder output frequency pulse dividing	M,P,V,T	This is common with GroupC ID04	
11		Offset Adjustment of Velocity/Torque Command	P,V,T	Setting range	-9999 to 9999
12		Offset Adjustment of Analog Torque Compensation Command	P,V	Setting range	-9999 to 9999

✔ “Basic parameters” is able to set by the Digital operator.

✔ M = Model following control type, P = Position control type, V = Velocity control type, T = Torque control type

5.8 Parameter functions

Each parameter function is explained below.

■ Group0 "Auto-tuning settings"

ID	Contents	Setting range	Unit	Default
00	Tuning mode [TUNMODE]	00 to 02	-	00:AutoTun

■ Set the validity/ invalidity of Auto-tuning and Load inertia moment rate estimation.

Selection		Contents
00	AutoTun	Automatic Tuning
01	AutoTun_JRAT-Fix	Automatic Tuning (JRAT Manual Setting)
02	ManualTun	Manual Tuning

◆ Under the following operating conditions, Load inertia rate is not estimated properly: at low velocity, at low acceleration and at low acceleration/deceleration torque.
In these cases, please set “Automatic Tuning (JRAT Manual Setting)” and set proper value to JRAT 1.

◆ In addition, under the following machine operating conditions, Load inertia rate is not estimated properly: machine with large disturbance torque, with big backlash and with a machine in which movable parts vibrate.
In these cases, set at “Automatic Tuning (JRAT Manual Setting)” and set proper value to JRAT1.

✔ When “Model following vibration suppression control” is set to “ID07 Position Control Selection“ of system parameter, set “02: Manual tuning”.

－Group0－

ID	Contents			
01	Auto-Tuning Characteristic [ATCHA]	Setting range	Unit	Default
		00 to 06	-	00:Positioning1

■ Set the suitable parameters for each control method.

Selection		Contents
00	Positioning1	Positioning Control 1 (General Purpose)
01	Positioning2	Positioning Control 2 (High Response)
02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)
03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)
05	Trajectory1	Trajectory Control 1
06	Trajectory2	Trajectory Control 2 (KP,FFGN Manual Setting)

- ◆ “Positioning Control 1”
  - Select for general purpose positioning.
  - Use this parameter at Velocity control mode or Torque control mode.
  - Can be used for an axis which affected by gravity or external forces.
- ◆ “Positioning Control 2”
  - Use this parameter at Position control mode.
  - Can be suppressed overshoot at positioning use, it will shorten positioning settling time.
  - Can be used for an axis which affected by gravity or external forces.
- ◆ “Positioning Control 3”
  - Select for the purpose of manual tuning of FFGN.
- ◆ “Positioning Control 4”
  - Select this mode when the machine movement is in horizontal axis and receives no impacts from external force.
  - Positioning-settling time may shorten compared to “Positioning Control 2”.
  - Use this parameter at Position control mode.
  - Do not use for an axis which affected by gravity or external forces.
  - This parameter may give shock to the application.
- ◆ “Positioning Control 5”
  - Select for the purpose of manual tuning of FFGN when the machine movement is in horizontal axis and receives no impacts from external force.
  - Positioning-settling time may shorten compared to “Positioning Control 3”.
  - This parameter may give shock to the application.

- ◆ “Trajectory Control 1”
  - This is the setting for tracking a position command from host unit as machining.
  - Use this parameter at Position control mode.
  - Can be used for an axis which affected by gravity or external forces.
  - Select this parameter for single axis or asynchronous use.
  - Select "Trajectory Control 2" when cooperating with other axes.
  - The positioning characteristics will change when the “Position Loop Gain” is altered with fluctuation of the estimated inertia moment. If you want to avoid this change, please adopt “Trajectory Control 2” or use manual tuning.
- ◆ “Trajectory Control 2”
  - This is the setting for syncing a response of each axis position loop as cooperation with the other axes.
  - Use this parameter at Position control mode.
  - Can be used for an axis which affected by gravity or external forces.

✔ When "Trajectory control" is used, do not set "Model following vibration suppression control" to “ID07 Position Control Selection”. By setting "Model following vibration suppression control", trajectory will get deviation.

ID	Contents	Setting range	Unit	Default
02	Auto-Tuning Response [ATRES]	1 to 40	-	5

- ■ Sets the Auto-Tuning Response.
  - ◆ The larger the set value, the higher the response.
  - ◆ Caution, if the response is set too high, the machine may oscillate.
  - ◆ Make the setting suited to rigidity of the device.
- ■ In case of following, set value will be 30 even if 31 to 40 are set.
  - ◆ When "00: Positioning1" is set to Group0 ID01 Auto-Tuning Characteristic [ATCHA].
  - ◆ When "01: Enable" is set to Group0 ID04 Auto-Tuning characteristic compatible mode [ATCSEL].

ID	Contents	Setting range	Unit	Default
03	Auto-Tuning Automatic Parameter Saving [ATSAVE]	00 to 01	-	00:Auto_Saving

- ■ Select if the automatic parameter saving function is valid to save the Load inertia moment ratio estimated by the servo amplifier Auto-tuning function in the Group1 ID14 Load Inertia Moment Ratio 1 [JRAT1].
  - ◆ This setting is valid when Group0 ID00 Tuning Mode is at "00: AutoTun Auto-tuning".
  - ◆ Automatic save is done in every 30 minutes.

Selection		Contents
00	Auto_Saving	Automatically Saves in JRAT1
01	No_Saving	Automatic Saving is Invalid

ID	Contents	Setting range	Unit	Default
04	Auto-Tuning characteristic compatible mode [ATCSEL]	00 to 01	-	00:Disable

- ■ Set "01: Enable Valid (RS2 compatible)" to set auto-tuning characteristic compatible with RS1/RS2 amplifier. In this case, gain set value will be 30 even if 31 to 40 are set.

Selection		Contents
00	Disable	Invalid
01	Enable	Valid (RS2 compatible)

ID	Contents	Setting range	Unit	Default
10	Auto-Notch Filter Tuning Torque Command [ANFILTC]	10.0 to 100.0	%	50.0

- ■ Sets the torque value for excite the mechanical system during operation under "Auto-Notch Filter Tuning".
  - ✔ Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.

ID	Contents	Setting range	Unit	Default
20	Auto-FF Vibration Suppression Frequency Tuning Torque Command [ASUPTC]	10.0 to 100.0	%	25.0

- ■ Sets the torque value for excite the mechanical system during operation under "Auto-FF Vibration Suppression Frequency Tuning".
  - ✔ Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.

ID	Contents	Setting range	Unit	Default
21	Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value [ASUPFC]	0.0 to 50.0	%	5.0

- ■ Sets the friction torque compensation added to the motor torque to excite the mechanical system at the time of Auto-FF Vibration Suppression Frequency Tuning.
  - ◆ By setting this value close to actual friction torque, Auto-FF vibration suppression frequency tuning will be more accurate.
  - ✔ When the set value is low, there may be cases that the vibration frequency of the mechanical system cannot be detected, or the wrong value is detected. Raise the value until the detected value settles.

－Group0－

ID	Contents	Setting range	Unit	Default
34	Adaptive notch filter function E [ADNFE]	00 to 01	-	00: Adp_Filter Disable

- ■ This is the parameter which selects function of torque command notch filter E.
  By setting "01: Adp_Filter Enable Adaptation at all times", notch filter E will be adjusted to mechanical resonant frequency.
  When adaptive notch filter function is valid, Group2 ID29 will be fixed to 0. Group2 ID28 will work as initial value of adaptive notch filter.

Selection		Contents
00	Adp_Filter Disable	Adaptation invalid (TCNFILE manual setting)
01	Adp_Filter Enable	Adaptation at all times

ID	Contents	Setting range	Unit	Default
35	Adaptive notch filter frequency upper limit E [ADNFUE]	100 to 1000	Hz	1000

- ■ Sets adaptive notch filter frequency upper limit.
  Sets upper limit of mechanical variation.
  Please set higher value than ADNFLE.

ID	Contents	Setting range	Unit	Default
36	Adaptive notch filter frequency lower limit E [ADNFLE]	100 to 1000	Hz	100

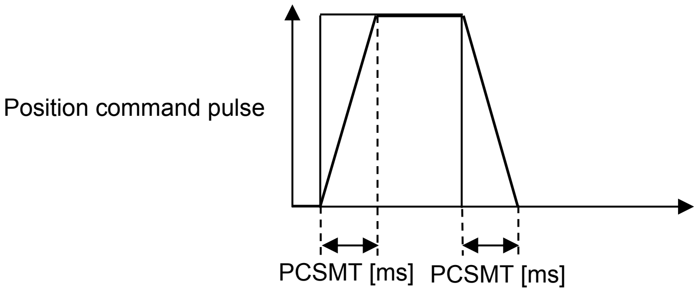
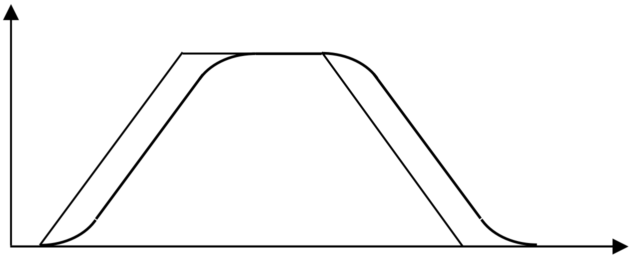
- ■ Sets adaptive notch filter frequency lower limit.
  Sets lower limit of mechanical variation.
  Please set lower value than ADNFUE.

ID	Contents	Setting range	Unit	Default
37	Adaptive notch filter E auto saving [ADNSVE]	00 to 01	-	00:Auto_Saving

- ■ Selects valid/invalid of the function that saves mechanical resonant frequency automatically which is estimated by the servo amplifier to torque command notch filter E set value.
  - ◆ This setting is valid when "01: Adp_Filter_Enable" is set to Group0 ID34.
  - ◆ Estimation result is automatically saved in torque command notch filter E in every 30 minutes.

Selection		Contents
00	Auto_Saving	Save automatically
01	No_Saving	Without save

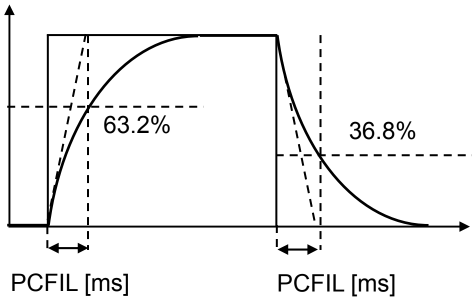
■ Group1 "Basic control parameter settings"

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td rowspan="2">Position Command Smoothing Constant
[PCSMT]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0.0 to 500.0</td><td>ms</td><td>0.0</td></tr>
<tr><td colspan="4">■ This is the moving-average filter which makes smooth the position command pulse.
◆ Sets time constants.
◆ Applies ramp to the step form position command pulse.
◆ Applies S curve to the ramp form position command pulse.
◆ Smoothes the position command pulse when the electronic gear ratio is greater or the position command pulse is coarse. (This may decrease the operating noise from servo motor.)
◆ Set the value 0.3 ms or more.
◆ When the set value is “0.0 to 0.2 ms”, this filter is invalid.
◆ Set in increments of 0.5ms. (Under the set value “0.4ms and less”, there may be cases where the set value cannot be applied to the operation.)
● Position command pulse applied as step form

● Position command pulse applied as ramp form
</td></tr>
</table>

－Group1－

ID	Contents	Setting range	Unit	Default
01	Position Command Filter [PCFIL]	0.0 to 2000.0	ms	0.0

- This primary low-pass filter suppresses any sudden change of the position control pulse.
  Sets time constants.
  - This parameter setting is valid when the value of Group1 ID08 Higher Tracking Control Position Compensation Gain is set at 0%.
  - When Higher Tracking Control Position Compensation Gain is 0%, and this value is set at 0.0ms, the filter becomes invalid.
  - This filter can suppress overshoot caused by the rise of the feed forward compensation gain.



ID	Contents	Setting range	Unit	Default
02	Position Loop Proportional Gain 1 [KP1]	1 to 3000	1/s	30

- Proportional gain for position controller.
  - Automatically overwrite by Auto-tuning result saving.
  - When Auto-tuning function is valid, this setting value is not applied.
  - When Gain switching function is valid, this setting value is applied by selecting gain 1.
  - When Gain switching function is invalid, this setting value is applied.

ID	Contents	Setting range	Unit	Default
03	Position Loop Integral Time Constant 1 [TPI1]	0.3 to 1000.0	ms	1000.0

- Integral time constant for position controller.
  This setting is valid when the Position Loop Proportional Control Switching Function is invalid.
  - Integral term is invalid (proportional control) at the setting value 1000.0ms.
  - When Gain switching function is valid, this setting value is applied by selecting gain 1.
  - When Gain switching function is invalid, this setting value is applied.

ID	Contents	Setting range	Unit	Default
04	Position loop phase lead compensation gain [PLPHLK]	0 to 100	%	0

- Sets the phase improving value of Position loop phase lead compensation.
  - For position loop, adds the function that shifts phase on phase lead compensation frequency (PLPHLF) as 17deg by 50% and 35deg by 100%. Pay attention for gain increment after PLPHLF.
  - This parameter will be disabled when 0% is set.

ID	Contents	Setting range	Unit	Default
05	Position loop phase lead compensation frequency [PLPHLF]	10 to 4000	Hz	500

- Sets the frequency that is wanted to improve the phase of position loop.
  - Set value will limit 1,000Hz even if 1,000Hz or more is set.
  - This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally.
    - ✔ Please stop servo motor if change this value.

ID	Contents	Setting range	Unit	Default
06	Velocity Feed Forward Gain [FFGN]	0 to 100	%	0

- ■ Sets the feed forward compensation gain to position control system.
- ■ When "Model following control" is enabling, model velocity feed forward gain will be enabled and this parameter value will be disabled.
  - ◆ This parameter will be valid when "Higher Tracking Control Position Compensation Gain" is set to 0%.
  - ◆ Automatically overwrite by Auto-tuning result saving.
  - ◆ The setting value is not applied when using the Auto-Tuning Characteristics listed below.

Positioning1	Positioning Control 1 (General Purpose)
Positioning2	Positioning Control 2 (High Response)
Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
Trajectory1	Trajectory Control 1

ID	Contents	Setting range	Unit	Default
07	Velocity Feed Forward Filter [FFFIL]	1 to 4000	Hz	4000

- ■ This is primary low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency.
- ■ When "Model following control" is enabling, model velocity feed forward will be enabled and this parameter value will be disabled.

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid

ID	Contents	Setting range	Unit	Default
08	Higher Tracking Control Position Compensation Gain [TRCPGN]	0 to 100	%	0

- ■ Adjusts command tracking performance of position control system.
  The larger value can raise command tracking performance higher.
  - ◆ When set the value except 0%, "Position command filter" and "Velocity Feed forward gain" are set automatically in the servo amplifier.
  - ◆ Automatically overwrite by Auto-tuning result saving.
  - ◆ When Auto-tuning function is valid, this setting value not applied.

ID	Contents	Setting range	Unit	Default
10	Velocity Command Filter [VCFIL]	1 to 4000	Hz	4000

- ■ This is primary low-pass filter to suppress sudden change of velocity command.
  Sets the cutoff frequency.
  Use External Velocity Command Filter when eliminating Analog velocity command noise.
  - ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	1 to 3999Hz	Set value valid
		4000Hz	Filter invalid

－Group1－

ID	Contents	Setting range	Unit	Default
11	Velocity Feedback Filter [VDFIL]	1 to 4000	Hz	1500

- ■ This is primary low-pass filter to eliminate ripples caused by encoder pulse included in the velocity control system feedback. Sets the cutoff frequency.
  - ◆ When the encoder resolution is low, lowering the setting value and suppressing the ripples may suppress motor drive noise. In addition, when the encoder resolution is high, raising the setting value may improve the response of the velocity control system. For general use, set at the Standard value.
  - ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	1 to 3999Hz	Set value valid
		4000Hz	Filter invalid

ID	Contents	Setting range	Unit	Default
12	Velocity Loop Proportional Gain 1 [KVP1]	1 to 2000	Hz	50

- ■ Proportional gain of velocity controller.
  When Load Inertia Moment Ratio 1 is same as the actual load inertia moment, this setting value response is performed.
  - ◆ Automatically overwrite by Auto-tuning result saving.
  - ◆ When Auto-tuning function is valid, this setting value is not applied.
  - ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
  - ◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.

ID	Contents	Setting range	Unit	Default
13	Velocity Loop Integral Time Constant 1 [TVI1]	0.3 to 1000.0	ms	20.0

- ■ Integral time constant of velocity controller.
  This setting value is valid when Velocity Loop Proportional Control Switching Function is invalid.
  - ◆ Integral term is invalid (proportional control) with the setting value of 1000.0ms.
  - ◆ Automatically overwrite by Auto-tuning result saving.
  - ◆ When Auto-tuning function is valid, this setting value is not applied.
  - ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
  - ◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.

ID	Contents			
14	Load Inertia Moment Ratio 1 [JRAT1]	Setting range	Unit	Default
		0 to 15000	%	100

- ■ Sets the inertia moment of the loading device to the servo motor inertia moment.
  - ◆ Setting value=J_L/J_M × 100%
    - ● J_L : Load inertia moment
    - ● J_M : Motor inertia moment
  - ◆ Automatically overwrite by Auto-tuning result saving.
  - ◆ If this value matches the actual mechanical system, setting value of KVP will be the response frequency of the velocity control system.
  - ◆ When Auto-Tuning Automatic Parameter Saving function is valid, this parameter is overwriting with an estimated result.
  - ◆ When Auto-tuning Function is valid, this value is not applied.
  - ◆ Use between the range of 100 to 3000% when driven with Model following vibration suppression control.
  - ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
  - ◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.

ID				
15	Velocity loop phase lead compensation gain [VLPHLK]	Setting range	Unit	Default
		0 to 100	%	0

- ■ Sets the phase improving value of Velocity loop phase lead compensation.
  - ◆ For velocity loop, adds the function that shifts phase on phase lead compensation frequency as 17deg by 50% and 35deg by 100%. Pay attention for gain increment after VLPHLF.
  - ◆ This parameter will be disabled when 0% is set.

ID				
16	Velocity loop phase lead compensation frequency [VLPHLF]	Setting range	Unit	Default
		10 to 4000	Hz	500

- ■ Sets the frequency that is wanted to improve the phase of velocity loop.
  - ◆ This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally.
  - ✔ Please stop servo motor if change this value.

Control cycle		Setting value	Compensation frequency
00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid
		1001 to 4000Hz	1000Hz
01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid
		2001 to 4000Hz	2000Hz

ID				
17	High order integral control gain [HKVIK]	Setting range	Unit	Default
		0 to 100	%	0

- ■ Sets the phase improving value of Velocity loop phase lead compensation.
  - ◆ The larger value can change shorter velocity loop integral time constant.
  - ◆ This parameter will be disabled when 0% is set.

ID				
18	High order integral control frequency [HKVIF]	Setting range	Unit	Default
		10 to 4000	Hz	500

- ■ Sets when velocity loop integral time constant wants to be shorter. Sets the frequency that is wanted to improve the phase.
  - ✔ This parameter can set in 1 Hz unit, but it will be rounded down to the 10 Hz internally.
  - ✔ Please stop servo motor if change this value.

Control cycle		Setting value	Compensation frequency
00	Standard_Sampling Standard sampling mode	1 to 1000Hz	Set value valid
		1001 to 4000Hz	1000Hz
01	High-freq_Sampling Hi-speed sampling mode	1 to 2000Hz	Set value valid
		2001 to 4000Hz	2000Hz

－Group1－

ID	Contents			
19	Torque Feed Forward Gain [TFFK]	Setting range 0 to 100	Unit %	Default 0
	■ Sets feed forward compensation gain to velocity control system. ◆ The setting value is not applied when "Position control selection " is "Model following control".			
1A	Torque feedforward averaging [TFFAVE]	Setting range 00 to 01	Unit -	Default 01: 4timesAverage
	■ Selects the average count of torque feedforward compensation.			
1B	Torque feedforward output selection [TFFOUT]	Setting range 00 to 01	Unit -	Default 00:Before_filter
	■ Select the point that is to be added torque feed forward compensation.			

1A selection table:

Selection		Contents
00	2timesAverage	2 times
01	4timesAverage	4 times

1B selection table:

Selection		Contents
00	Before_filter	Before torque command filter
01	After_filter	After torque command filter

ID	Contents			
1C	Acceleration Feedback Gain [AFBK]	Setting range -100.0 to 100.0	Unit %	Default 0.0
	■ Sets acceleration feedback compensation gain to make the velocity loop stable. Multiply this gain with the detected acceleration to compensate torque command. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value not applied. ◆ If the value is too large, the motor may oscillate. Sets within range ±15.0% for general use.			
1D	Acceleration Feedback Filter [AFBFIL]	Setting range 1 to 4000	Unit Hz	Default 500
	■ This is primary low-pass filter to eliminate ripples caused by encoder pulse included in acceleration feedback compensation. Sets the cutoff frequency. ◆ Lower this setting value when the encoder resolution is low. ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.			
1E	Higher Tracking Control Velocity Compensation Gain [TRCVGN]	Setting range 0 to 100	Unit %	Default 0
	■ Adjusts command tracking performance of velocity control system. ◆ The larger value can raise command tracking performance higher. ◆ When using Velocity Loop Proportional Control Switching Function, set 0%. ◆ When synchronizing with other axes, set 0%. ◆ When corresponding with Q series servo amplifier, set 100%. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value not applied. ◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".			

ID 1D control cycle table:

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling Standard sampling mode	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling Hi-speed sampling mode	1 to 3999Hz	Set value valid
		4000Hz	Filter invalid

－Group1－

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">20</td><td rowspan="2">Torque Command Filter 1
[TCFIL1]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>600</td></tr>
<tr><td colspan="4">■ This is Low-pass filter to eliminate high frequency component included in the torque command. Sets cutoff frequency.
◆ Automatically overwrite by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, this setting value is applied by selecting gain 1.
◆ While system analysis function is active, this value is applied even if Auto-tuning is valid.
◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
(Torque command filter cannot be disabled)
<table>
<tr><th colspan="2">Control cycle</th><th>Setting value</th><th>Cutoff frequency</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard sampling mode</td><td>1 to 1999Hz</td><td>Set value valid</td></tr>
<tr><td>2000 to 4000Hz</td><td>2000Hz</td></tr>
<tr><td>01</td><td>High-freq_Sampling
Hi-speed sampling mode</td><td>1 to 4000Hz</td><td>Set value valid</td></tr>
</table>

Use within 1 to 1,000Hz with Model following control.
Use within 100 to 1,000Hz with Model following vibration suppression control.</td></tr>
<tr><td rowspan="3">21</td><td rowspan="2">Torque Command Filter Order
[TCFILOR]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>1 to 3</td><td>Order</td><td>2</td></tr>
<tr><td colspan="4">■ Sets order of the torque command filter.
The order will be fixed with the set value even if the cut off frequency of torque command filter is changed by Gain switching.</td></tr>
</table>

ID	Contents	Setting range	Unit	Default
30	Dual position feedback gain [DFBCG]	0 to 100	%	0
	■ Sets the dual position feedback compensation gain. The larger value, the higher influence of the dual position feedback compensation. ◆ Become Invalid the dual position feedback gain compensation function when 0% is set.			
31	Dual position feedback filter [DFBFIL]	0.0 to 2000.0	ms	0.0
	■ Sets a band of the dual position feedback gain compensation. At transient responsiveness, the larger value, the nearer to a semi-closed control. ◆ Become Invalid the dual position feedback gain compensation function when 0% is set.			
80	Axes-sync compensation proportional gain [KSCPGN]	0 to 1000	%	0
	■ Sets a rate of the axes-sync compensation value. ◆ When 100% is set, adds the axes-sync compensation pulse value to the position deviation without change. ◆ Vibration might occur if set value is too large.			
81	Axes-sync compensation integral time constant [TSCIGN]	0.5 to 1000.0	ms	1000.0
	■ Sets an integral time constant for the axes-sync compensation. ◆ This set value will be valid when axes-sync compensation proportional control function is invalid. ◆ Integral term will be invalid (proportional control) when 1000.0ms is set.			
82	Axes-sync compensation filter [SCFIL]	0.0 to 1000.0	ms	0.0
	■ Primary low pass filter that suppress sudden variation of axes-sync compensation value. ◆ Filter will be invalid when 0.0ms is set.			

- Group2 "FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Contents

00

FF Vibration Suppression Frequency A1 [SUPFRQA1]	Setting range	Unit	Default
	1.0 to 500.0	0.1Hz	500.0

- Sets the frequency of the machine vibration to be suppressed by FF vibration suppressor function.
  Please stop servo motor if change this value.
  This parameter will be overwritten by executing Auto-FF Vibration Suppression Frequency Tuning.
  - ◆ Tuning result will be saved to this parameter automatically.
  - ◆ This setting value works when "FF Vibration Suppression Frequency Select Input A1" is enabled.
  - ◆ Do not use while synchronizing with other axis such as controlling XY table trajectory for cutting operation.

Setting range	Unit and process inside servo amplifier
1.0 to 9.9Hz	Valid by 0.1Hz
10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5
100.0 to 499.9Hz	Valid by 5Hz and drop less than 5
500.0Hz	FF vibration suppression control is invalid

✔ FF vibration suppression control will be invalid during this parameter change, and servo motor will rotate until rest of internal position command of FF vibration suppression control has outputted.

✔ If FF vibration suppression frequency is changed, the time which will be valid of changed value varies depending on the frequency before change.

The frequency before change	The time which will be valid of changed value
5.0Hz or more	1 sec.
3.0Hz	3 sec.
1.0Hz	7 sec.

01

FF Vibration Suppression Level Selection A [SUPLVA]	Setting range	Unit	Default
	00 to 03	—	00

- Sets the FF vibration suppression control effect level.
  - ◆ Please stop servo motor if change this value.
  - ◆ The delay for position command will be improved by enlarging this parameter value but vibration suppression effects become weak.
  - ◆ FF vibration suppressor frequency switching function does not affect this.

02

FF Vibration Suppression Frequency B1 [SUPFRQB1]	Setting range	Unit	Default
	1.0 to 500.0	0.1Hz	500.0

- See FF Vibration Suppression Frequency A1.

  ✔ It is not set automatically by Auto-FF Vibration Suppression Frequency Tuning.

03

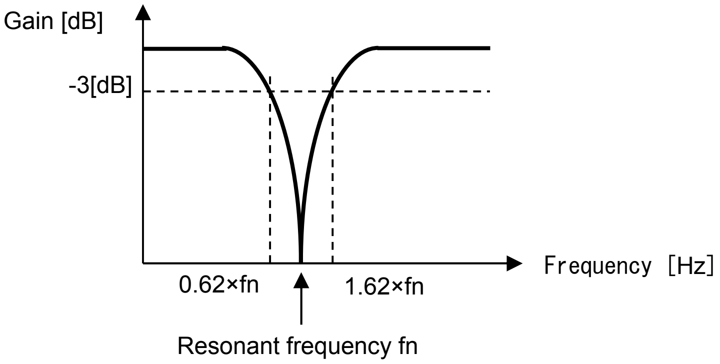
FF Vibration Suppression Level Selection B [SUPCRB]	Setting range	Unit	Default
	00 to 01	—	00

- Vibration suppression frequency range will be narrow at set frequency when 01 is set.

ID	Contents			
10	Velocity Command Notch Filter [VCNFIL]	Setting range 50 to 1000	Unit Hz	Default 1000

- ■ This is notch filter to eliminate frequency element arbitrarily set from velocity command. Sets the resonant frequency.
  - ◆ When sympathetic vibration occurs in velocity control system, the gain will be able to raise by setting the resonance frequency.
  - ◆ Do not use while synchronizing with other axis such as controlling XY table trajectory for cutting operation.
  - ◆ Invalid setting value varies depending on the setting of the system parameter ID00 Control Cycle. This parameter can set in 1 Hz unit, but the units listed below are applied internally.

Control cycle		Setting value	Unit and process inside servo amplifier
00	Standard_Sampling Standard sampling mode	50 to 99Hz	Valid by 1Hz
		100 to 499Hz	Valid by 5Hz and drop less than 5
		500 to 1000Hz	Filter invalid
01	High-freq_Sampling Hi-speed sampling mode	50 to 199Hz	Valid by 1Hz
		200 to 999Hz	Valid by 10Hz and drop less than 10
		1000Hz	Filter invalid



－Group2－

ID	Contents			
20	Torque Command Notch Filter A [TCNFILA]	Setting range	Unit	Default
		100 to 4000	Hz	4000

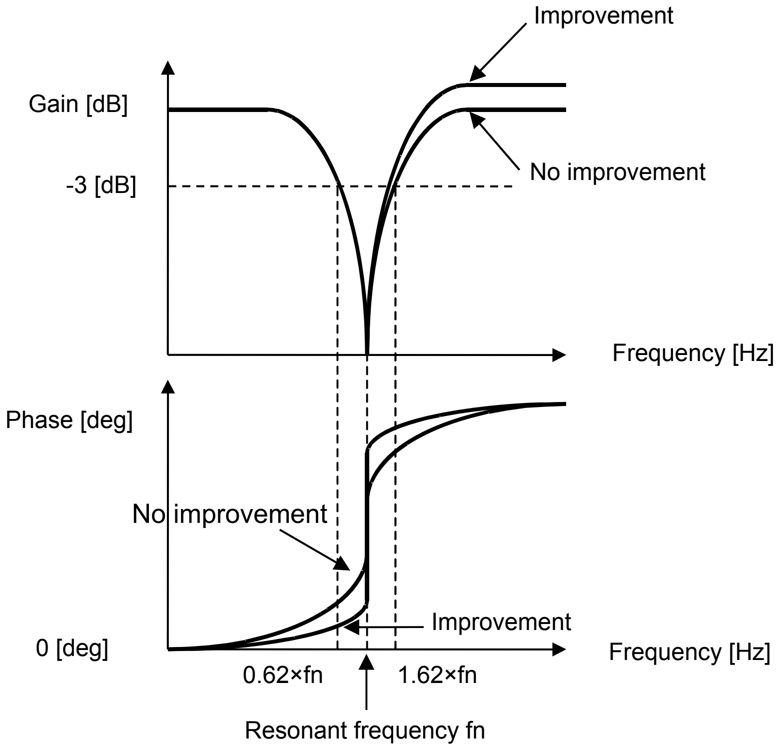
- ■ This is notch filter to eliminate sympathetic vibration element included in torque command. Sets the resonant frequency.
  - ◆ Invalid setting value varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Unit and process inside servo amplifier
00	Standard_Sampling Standard sampling mode	100 to 1999Hz	Valid by 1Hz
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling Hi-speed sampling mode	100 to 3999Hz	Valid by 1Hz
		4000Hz	Filter invalid

This parameter is automatically saved by executing Notch filter tuning.

ID	Contents			
21	TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]	Setting range	Unit	Default
		00 to 02	-	00

- ■ Improves phase delay at lower frequency than resonant frequency of the Torque Command Notch Filter A.
  - ◆ The larger the value is, the greater the improvement.
  - ◆ Characteristic is same as the standard notch filter when the setting value is 0.
  - ◆ Caution, other than the setting value 0, higher frequencies than the resonant frequency will be amplified.



ID	Contents	Setting range	Unit	Default
22	Torque Command Notch Filter B [TCNFILB]	100 to 4000	Hz	4000
24	Torque Command Notch Filter C [TCNFILC]	100 to 4000	Hz	4000
26	Torque Command Notch Filter D [TCNFILD]	100 to 4000	Hz	4000
28	Torque Command Notch Filter E [TCNFILE]	100 to 4000	Hz	4000

■ This is notch filter to eliminate sympathetic vibration element included in torque command. Sets the resonant frequency.

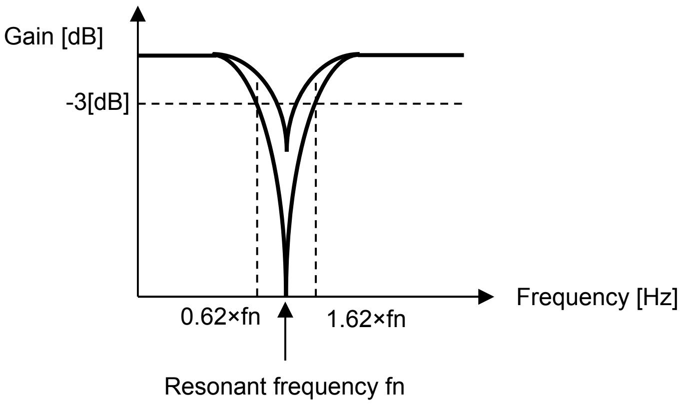
◆ Invalid "Torque command notch filter" setting value varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Unit and process inside servo amplifier
00	Standard_Sampling	100 to 1999Hz	Valid by 1Hz
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	100 to 3999Hz	Valid by 1Hz
		4000Hz	Filter invalid

◆ The value set to Torque Command Notch Filter E will be valid when “00: Adp_Filter Disable Adaptation invalid” is set to Group0 ID34 “Adaptive notch filter function E”.

ID	Contents	Setting range	Unit	Default
23	TCNFILB, Depth Selection [TCNFDB]	0 to 15	-	0
25	TCNFILC, Depth Selection [TCNFDC]	0 to 15	-	0
27	TCNFILD, Depth Selection [TCNFDD]	0 to 15	-	0
29	TCNFILE, Depth Selection [TCNFDE]	0 to 15	-	0

■ Parameters to set the depth of each Torque Command Notch Filter (TCNFILB to E). The larger the value is, the shallower the depth.



◆ The value set to TCNFILE, Depth Selection will be valid when “00: Adp_Filter Disable Adaptation invalid” is set to Group0 ID34 “Adaptive notch filter function E”.

－Group2－

ID	Contents

30

Observer Characteristic [OBCHA]	Setting range	Unit	Default
	00 to 02	—	00:Low

- ■ Selects frequency characteristic of the disturbance observer.

Selection		Contents
00	Low	For Low Frequency
01	Middle	For Middle Frequency
02	High	For High Frequency

- ◆ Select “00: Low, Low Frequency Disturbance Observer Suppressor” for Load torque monitor (estimate value).
- ◆ Select 02: High, High Frequency Disturbance Observer Suppressor, when the encoder resolution is over 1048576P/R.

31

Observer Compensation Gain [OBG]	Setting range	Unit	Default
	0 to 100	%	0

- ■ This is Compensation gain for Disturbance Observer.
  The larger the value is, the higher the suppression performance. However, if the value is too large, oscillation may sometimes occur.

32

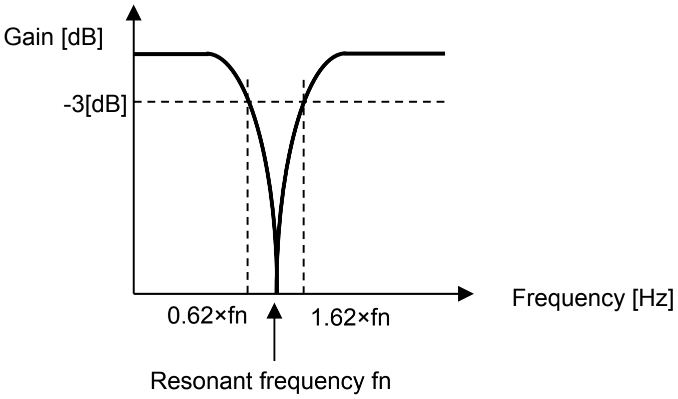
Observer Output Low-pass Filter [OBLPF]	Setting range	Unit	Default
	1 to 4000	Hz	50

- ■ This is primary low-pass filter to eliminate high frequency elements included in the observer compensation.
  Sets the cutoff frequency.
  - ◆ The larger the value is, the faster the response of disturbance observer suppression. However, it may cause a louder driving sound depending on the ripple components included in disturbance observer output.
  - ◆ Filter is invalid at the setting value more than 2,000Hz.
  - ◆ Filter is invalid when observer characteristic is set to “01: Middle, For Middle Frequency”, or “02: High, For High Frequency”.

ID	Contents	Setting range	Unit	Default
33	Observer Output Notch Filter [OBNFIL]	100 to 4000	Hz	4000

- ■ This is notch filter to eliminate arbitrarily selected frequency from observer compensation.
  Sets the resonant frequency.
  When resonance appears in disturbance observer output, such as sympathetic vibration with the mechanical system, this notch filter sometimes suppresses the vibration.
  - ◆ This parameter can set in 1 Hz unit, but the units listed below are applied internally.

Setting value	Unit and process inside servo amplifier
100 to 1999Hz	Valid by 10Hz and drop less than 10
2000 to 4000Hz	Filter invalid



ID	Contents	Setting range	Unit	Default
40	Effective velocity for compensating stick-slip behavior [STV]	0.1 to 128.0	min^{-1}	10.0

- ■ Sets the velocity at which stick-slip behavior compensatory function works.
  - ◆ Stick-slip behavior compensatory function works when the velocity command inside of servo amplifier is the set value or less.
  - ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.

ID	Contents	Setting range	Unit	Default
41	Retention time for compensating stick-slip behavior [STHLD]	1 to 500	ms	20

- ■ Sets the time to retain stick-slip behavior compensation.
  - ◆ Stick-slip behavior compensation continues till the above set time elapses even if the velocity command inside of servo amplifier exceeds the effective velocity for compensating stick-slip behavior.
  - ◆ Increase the value of the time if velocity loop responsiveness is low.
  - ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.

ID	Contents	Setting range	Unit	Default
42	Velocity loop integral time constant for stick-slip behavior compensation [STTVI]	0.3 to 1000	ms	3.0

- ■ Sets the Velocity loop integral time constant for stick-slip behavior compensation.
  - ◆ The above set value applies to velocity loop integral time constant while stick-slip behavior compensation is being performed.
  - ◆ This velocity loop integral time constant for stick-slip behavior compensation sets smaller velocity loop integral time constant values than the ones normally used. If you set the value larger than the above, stick-slip behavior compensation doesn't work.
  - ◆ Stick-slip behavior compensation doesn't work when velocity loop is in proportional control. Please carefully set the effective condition of "Velocity loop proportional control switching function" (Group9 ID27) when applying P-PI control switching to velocity control system.
  - ◆ Stick-slip behavior compensation is effective when the valid condition of stick-slip behavior compensatory function (Group9 ID34) is satisfied.

－Group2－

ID	Contents			
50	CP vibration suppression control frequency [CPVSFQ]	Setting range	Unit	Default
		10.0 to 100.0	0.1Hz	100.0
	■ Sets the vibration frequency of Machine stand. ◆ The filter will invalid if set value is 100.0 Hz or more. ◆ This function will valid if in conditions below. ・In case of standard position control. ・In case of "Model-following / standard position control switching (Model 3)" is set and Standard position control is valid. ・In case of "Model-following vibration suppression / standard position control switching (Model 4)" is set and Standard position control is valid. ✔ Please stop servo motor if change this value.			
51	CP vibration suppression control level [CPVSLV]	Setting range	Unit	Default
		00 to 03	-	00
	■ This is the parameter which sets impact of CP vibration suppression control. ◆ The larger value can be impact of CP vibration suppression control big. ✔ Please stop servo motor if change this value.			
52	CP vibration suppression control characteristics selection [CPVSCR]	Setting range	Unit	Default
		00 to 02	-	01
	■ Sets the effective frequency range of CP vibration suppression control. ◆ The larger value will be narrower the effective frequency range of CP vibration suppression control. ✔ Please stop servo motor if change this value.			
60	Minor vibration suppression pulse compensation value [FBHPLS]	Setting range	Unit	Default
		1 to 100	Pulse	1
	■ Sets the compensation amount of Minor vibration suppression function for velocity feedback. Unit of set value is 1 pulse of encoder. ✔ Sets by multiple of FBHTIM. If not multiple of FBHTIM, the actual Minor vibration suppression pulse compensation frequency will have deviation with FBHTIM.			
61	Minor vibration suppression pulse compensation frequency [FBHTIM]	Setting range	Unit	Default
		1 to 100	times	1
	■ Sets the number of Minor vibration suppression. ✔ This value will be valid if Minor vibration suppression function is valid.			

- Group3 "Model following control settings"

ID	Contents			
00	Model Control Gain 1	Setting range	Unit	Default
	[KM1]	1 to 3000	1/s	30
	■ Proportional gain for model position controller. ◆ Use within the range of 15 to 315 (1/s) if operate with Model-following vibration suppression control. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied. ◆ When Gain switching function is valid, this setting value is applied by selecting gain 1. ◆ Please stop servo motor if change this value.			
01	Model control damping coefficient	Setting range	Unit	Default
	[MZETA]	0 to 100	%	100
	■ This is parameter which changes velocity proportional gain of Model following control. ◆ The parameter value will be ζ=0.866 by the set value 0% and ζ=1.0 by 100%.			
02	Model velocity feedforward gain	Setting range	Unit	Default
	[MFFGN]	0 to 100	%	0
	■ This is FF compensation gain for Model position control system. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied.			
03	Model velocity feedforward differential time constant	Setting range	Unit	Default
	[MTFFD]	0.00 to 10.00	ms	0.00
	■ This is the parameter which improves command-following capability of Model position control system. The function is invalid when set value is 0.00msec.			
04	Model velocity feedforward filter	Setting range	Unit	Default
	[MFFFIL]	1 to 4000	Hz	4000
	■ This is primary low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency. ◆ The function is Invalid at 1,000Hz or more.			

- ✔ Please stop the servo motor when Gain switching function is acting.
- ✔ Please stop the servo motor if Model vibration suppression frequency switching is used.
- ✔ When alarm "Model Following Vibration Suppression Control Error (AL.C5)" occurs while working, please make accel/ decel gently by reducing "Model control gain (KM)" or changing operation pattern.
- ✔ Model Following Vibration Suppression Control function does not work at JOG operation.

－Group3－

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">05</td><td rowspan="2">Overshoot Suppression Filter
[OSSFIL]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>1500</td></tr>
<tr><td colspan="4">■ Filter to suppress overshoot with Model following control or Model following vibration suppression control.
Sets cutoff frequency.
◆ Lower the setting value when overshoot on position deviation occurs.
◆ Filter is invalid at the setting value of 2,000Hz or more.</td></tr>
<tr><td rowspan="3">06</td><td rowspan="2">Model Control Antiresonance Frequency 1
[ANRFRQ1]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td colspan="4">■ Sets the antiresonance frequency of the mechanical model in Model following vibration suppression control.
Actual measurement antiresonance frequency value of the mechanical system is able to set by using System Analysis function of the setup software.
◆ This value does not apply with “Model following control”.
◆ Vibration suppression control is invalid if larger value than "Model Control Resonance Frequency" has set.
◆ Please stop servo motor if change this value.</td></tr>
<tr><td rowspan="3">07</td><td rowspan="2">Model Control Resonance Frequency 1
[RESFRQ1]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td colspan="4">■ Sets the resonance frequency of the mechanical model in Model-following vibration suppression control.
Actual measurement resonance frequency value of the mechanical system is able to set by using System Analysis function of the setup software.
◆ This value does not apply with “Model following control”.
◆ Vibration suppression control is invalid if smaller value than "Model Control Antiresonance Frequency" has set, or if 80 Hz is set.
◆ Please stop servo motor if change this value.</td></tr>
</table>

- ✔ Please stop the servo motor when Gain switching function is acting.
- ✔ Please stop the servo motor if Model vibration suppression frequency switching is used.
- ✔ When alarm "Model Following Vibration Suppression Control Error (AL.C5)" occurs while working, please make accel/ decel gently by reducing "Model control gain (KM)" or changing operation pattern.
- ✔ Model Following Vibration Suppression Control function does not work at JOG operation.

- ■ Group4 "Gain switching control/ vibration suppression frequency switching settings"

ID	Contents			
00	Model Control Gain 2	Setting range	Unit	Default
	[KM2]	1 to 3000	1/s	30
10	Model Control Gain 3	Setting range	Unit	Default
	[KM3]	1 to 3000	1/s	30
20	Model Control Gain 4	Setting range	Unit	Default
	[KM4]	1 to 3000	1/s	30
	■ Proportional gain for Model position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Please stop servo motor if change this value.			
01	Position Loop Proportional Gain 2	Setting range	Unit	Default
	[KP2]	1 to 3000	1/s	30
11	Position Loop Proportional Gain 3	Setting range	Unit	Default
	[KP3]	1 to 3000	1/s	30
21	Position Loop Proportional Gain 4	Setting range	Unit	Default
	[KP4]	1 to 3000	1/s	30
	■ Proportional gain for Position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving.			
02	Position Loop Integral Time Constant 2	Setting range	Unit	Default
	[TPI2]	0.3 to 1000.0	ms	1000.0
12	Position Loop Integral Time Constant 3	Setting range	Unit	Default
	[TPI3]	0.3 to 1000.0	ms	1000.0
22	Position Loop Integral Time Constant 4	Setting range	Unit	Default
	[TPI4]	0.3 to 1000.0	ms	1000.0
	■ Integral time constant for Position controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ Integral term will be invalid (Proportional control) at 1,000.0 ms. ◆ This setting will be valid if Position loop proportional control switching function is invalid.			
03	Velocity Loop Proportional Gain 2	Setting range	Unit	Default
	[KVP2]	1 to 2000	Hz	50
13	Velocity Loop Proportional Gain 3	Setting range	Unit	Default
	[KVP3]	1 to 2000	Hz	50
23	Velocity Loop Proportional Gain 4	Setting range	Unit	Default
	[KVP4]	1 to 2000	Hz	50
	■ Proportional gain for Velocity controller which is selected in the Gain switching function 1 or 2. ◆ This parameter is excepted from Auto-tuning result saving. ◆ This value will be response frequency if corresponding Load inertia moment ratio (JRAT2, JRAT3 and JRAT4) matches actual Load inertia moment ratio.			

—Group4—

ID	Contents			
04	Velocity Loop Integral Time Constant 2	Setting range	Unit	Default
	[TVI2]	0.3 to 1000.0	ms	20.0
14	Velocity Loop Integral Time Constant 3	Setting range	Unit	Default
	[TVI3]	0.3 to 1000.0	ms	20.0
24	Velocity Loop Integral Time Constant 4	Setting range	Unit	Default
	[TVI4]	0.3 to 1000.0	ms	20.0

- ■ Integral time constant for Velocity controller which is selected in the Gain switching function 1 or 2.
  - ◆ This parameter is excepted from Auto-tuning result saving.
  - ◆ This setting is valid when Velocity Loop Proportional Control Switching Function is invalid.
  - ◆ Integral term will be invalid (Proportional control) at 1,000.0 ms.

ID	Contents			
05	Load Inertia Moment Ratio 2	Setting range	Unit	Default
	[JRAT2]	0 to 15000	%	100
15	Load Inertia Moment Ratio 3	Setting range	Unit	Default
	[JRAT3]	0 to 15000	%	100
25	Load Inertia Moment Ratio 4	Setting range	Unit	Default
	[JRAT4]	0 to 15000	%	100

- ■ Load inertia ratio for rotor inertia of servo motor which is selected in the Gain switching function 1 or 2.
  - ◆ If this value matches the actual mechanical system, the corresponding value of Velocity Loop Proportional Gain (KVP2, KVP3, or KVP4) will be response frequency of the velocity control system.
  - ◆ This parameter is excepted from Auto-tuning result saving.
  - ◆ Setting value=$J_L/J_M \times 100\%$
    - ● J_L: Load inertia moment
    - ● J_M: Motor inertia moment

ID	Contents			
06	Torque Command Filter 2	Setting range	Unit	Default
	[TCFIL2]	1 to 4000	Hz	600
16	Torque Command Filter 3	Setting range	Unit	Default
	[TCFIL3]	1 to 4000	Hz	600
26	Torque Command Filter 4	Setting range	Unit	Default
	[TCFIL4]	1 to 4000	Hz	600

- ■ This is low-pass filter to eliminate high frequency component in torque command which is selected in the Gain switching function 1 or 2. Sets the cutoff frequency.
  - ◆ This parameter is excepted from Auto-tuning result saving.
  - ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.
    (Torque command filter cannot be disabled)

Control cycle		Setting value	Cutoff frequency
00	Standard_Sampling Standard sampling mode	1 to 2000Hz	Set value valid
		2001 to 4000Hz	2000Hz
01	High-freq_Sampling Hi-speed sampling mode	1 to 4000Hz	Set value valid

ID	Contents	Setting range	Unit	Default
30	Gain Switching Filter [GCFIL]	0 to 100	ms	0

- ■ This is primary Low-pass filter which makes gain change gently at Gain switching. Sets time constant.
  - ◆ When the mechanical system is shocked by the change of gain resulted from gain switching, making a gentle gain change will soften the shock.
  - ◆ The larger the value, the gentler the gain changes.

ID	Contents	Setting range	Unit	Default
40	FF Vibration Suppression Frequency A2 [SUPFRQA2]	1.0 to 500.0	Hz	500.0
41	FF Vibration Suppression Frequency A3 [SUPFRQA3]	1.0 to 500.0	Hz	500.0
42	FF Vibration Suppression Frequency A4 [SUPFRQA4]	1.0 to 500.0	Hz	500.0

- ■ Sets the mechanical vibration frequency which is wanted to suppress by FF vibration suppression function. Selects in FF vibration suppression frequency selection 1 or 2.
  - ◆ Please stop servo motor if change this value.
  - ◆ This parameter is excepted from Auto-tuning result saving.
  - ◆ This parameter can set in 0.1 Hz unit, but the units listed below are applied internally.

Setting range	Unit and process inside servo amplifier
1.0 to 9.9Hz	Valid by 0.1Hz
10.0 to 99.9Hz	Valid by 0.5Hz and drop less than 0.5
100.0 to 499.9Hz	Valid by 5Hz and drop less than 5
500.0Hz	FF vibration suppression control is invalid

- ✔ FF vibration suppression control will be invalid when this parameter is changed. After outputting rest of internal position command, FF vibration suppression control will be valid with the frequency changed after.
- ✔ The time which will be valid of changed value varies depending on the frequency before change as follows.

The frequency before change	The time which will be valid of changed value
5.0Hz or more	1 sec.
3.0Hz	3 sec.
1.0Hz	7 sec.

ID	Contents	Setting range	Unit	Default
43	FF Vibration Suppression Frequency B2 [SUPFRQB2]	1.0 to 500.0	Hz	500.0
44	FF Vibration Suppression Frequency B3 [SUPFRQB3]	1.0 to 500.0	Hz	500.0
45	FF Vibration Suppression Frequency B4 [SUPFRQB4]	1.0 to 500.0	Hz	500.0

- ■ See FF Vibration Suppression Frequency A2 to A4. Selects these in FF Vibration Suppression Frequency Select Input B1/ B2.

－Group4－

ID	Contents	Setting range	Unit	Default
50	Model Control Antiresonance Frequency 2 [ANRFRQ2]	10.0 to 80.0	Hz	80.0
52	Model Control Antiresonance Frequency 3 [ANRFRQ3]	10.0 to 80.0	Hz	80.0
54	Model Control Antiresonance Frequency 4 [ANRFRQ4]	10.0 to 80.0	Hz	80.0

■ Sets the antiresonance frequency of the mechanical device at Model-following vibration suppression control. Selects in Model Vibration Suppression Frequency Select Input 1 or 2.

- ◆ This value does not apply with Model following control.
- ◆ Vibration suppression control is invalid if larger value than "Model Control Resonance Frequency" has set.
- ◆ Setting by using “system analysis” function cannot be performed.
- ◆ Please stop servo motor if change this value.

ID	Contents	Setting range	Unit	Default
51	Model Control Resonance Frequency 2 [RESFRQ2]	10.0 to 80.0	Hz	80.0
53	Model Control Resonance Frequency 3 [RESFRQ3]	10.0 to 80.0	Hz	80.0
55	Model Control Resonance Frequency 4 [RESFRQ4]	10.0 to 80.0	Hz	80.0

■ Sets the resonance frequency of the mechanical device at Model-following vibration suppression control. Selects in Model Vibration Suppression Frequency Select Input 1 or 2.

- ◆ This value does not apply with Model following control.
- ◆ Vibration suppression control is invalid if smaller value than "Model Control Antiresonance Frequency" has set, or if 80 Hz is set.
- ◆ Setting by using “system analysis” function cannot be performed.
- ◆ Please stop servo motor if change this value.

■ Group5 " Fast-settling control settings"

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td rowspan="2">Command Velocity Low-pass Filter
[CVFIL]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>1000</td></tr>
<tr><td colspan="4">■ This is primary low-pass filter to eliminate high frequency component such as ripples included in the velocity (command velocity) calculated from position command pulse inside of fast-settling control.
◆ Lower this setting value when the encoder resolution is low.
◆ Filter is invalid at the setting value of 2,000Hz or more.</td></tr>
<tr><td rowspan="3">01</td><td rowspan="2">Command Velocity Threshold
[CVTH]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0 to 65535</td><td>min^{-1}</td><td>20</td></tr>
<tr><td colspan="4">■ Sets the velocity threshold value that activates fast-settling control compensation (Acceleration Compensation and Deceleration Compensation).
◆ Acceleration Compensation or Deceleration Compensation will be done when velocity (command velocity) calculated from the position command pulse is larger than this value.</td></tr>
<tr><td rowspan="3">02</td><td rowspan="2">Acceleration Compensation
[ACCCO]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>-9999 to 9999</td><td>×50 Pulse</td><td>0</td></tr>
<tr><td colspan="4">■ Sets the Acceleration Compensation value in fast-settling control.
◆ Sets in units of position deviation pulse (In case of incremental encoder, four-multiplied to encoder resolution is it).
◆ Compensation will be done to a position deviation.
◆ The larger the setting value, the greater the compensation value.
◆ The larger the acceleration value calculated from position command pulse, compensation value increases.
◆ The larger the Load inertia moment, the greater the compensation value is.
◆ Position deviation decreases by fast-settling control.
◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".</td></tr>
<tr><td rowspan="3">03</td><td rowspan="2">Deceleration Compensation
[DECCO]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>-9999 to 9999</td><td>×50 Pulse</td><td>0</td></tr>
<tr><td colspan="4">■ Sets the Deceleration Compensation value in fast-settling control.
◆ Sets in units of position deviation pulse (In case of incremental encoder, four-multiplied to encoder resolution is it).
◆ Compensation will be done to a position deviation.
◆ The larger the setting value, the greater the compensation value.
◆ The larger the acceleration value calculated from position command pulse, compensation value increases.
◆ The larger the Load inertia moment, the greater the compensation value is.
◆ Position deviation decreases by fast-settling control.
◆ The setting value is invalid with "Model following control" or "Model following vibration suppression control".</td></tr>
</table>

■ Group8 "Control system settings"

ID	Contents			
00	Position, Velocity, Torque Command Input Polarity [CMDPOL]	Setting range	Unit	Default
		00 to 07	-	00:PC+_VC+_TC+

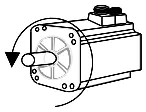
■ Selects the combination of each command polarity for position command pulse, Analog velocity command and Analog torque command input from the list below.

- ◆ Rotating direction of the servo motor can be reversed without changing the command wiring.
- ◆ Rotating direction which depends on the selection value will be shown below in case positive (+) polarity command is given.

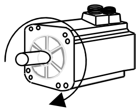
Selection		Polarity	Position Command Pulse (PCMD)	Analog Velocity Command (VCMD)	Analog Torque Command (TCMD)
00	PC+_VC+_TC+	+	Forward	Forward	Forward
01	PC+_VC+_TC-	+	Forward	Forward	Reverse
02	PC+_VC-_TC+	+	Forward	Reverse	Forward
03	PC+_VC-_TC-	+	Forward	Reverse	Reverse
04	PC-_VC+_TC+	+	Reverse	Forward	Forward
05	PC-_VC+_TC-	+	Reverse	Forward	Reverse
06	PC-_VC-_TC+	+	Reverse	Reverse	Forward
07	PC-_VC-_TC-	+	Reverse	Reverse	Reverse

◆ Command input polarity is at standard setting value “00: PC+_VC+_TC+”

Forward rotation (CCW)
with (+) polarity command

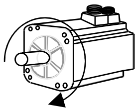


Reverse rotation (CW)
with (-) polarity command

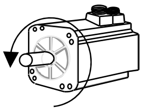


◆ Command input polarity change “07:PC-_VC-_TC-“

Reverse rotation (CW)
with (+) polarity command

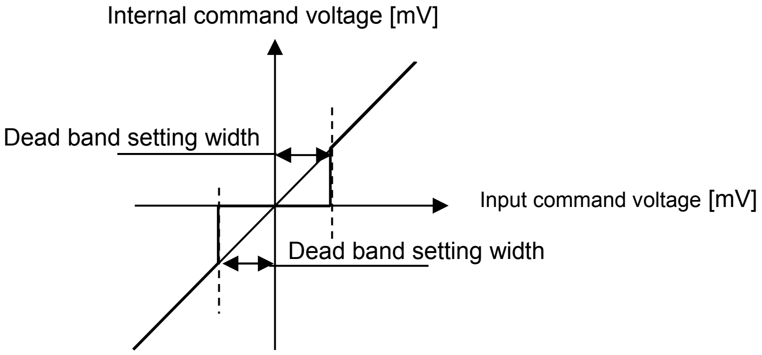


Forward rotation (CCW)
with (-) polarity command



ID	Contents			
01	Analog Velocity/Torque Command Input Dead Band Width [VC/TC-DW]	Setting range	Unit	Default
		0.0 to 6553.5	mV	0.0

- ■ Sets the voltage as dead band for Analog velocity command input and Analog torque command input.
  - ◆ Command voltage within the dead band setting range is treated as 0V at internal of servo amplifier.
  - ◆ It improves influences as noise and drift for Analog velocity command input and Analog torque command input.



ID	Contents			
10	Position Command Pulse Selection [PMOD] “Power cycle for control after setting”	Setting range	Unit	Default
		00 to 02	-	00: F-PC_R-PC

- ■ Sets the Position control command pulse type.
  - ◆ Select from below to match with the upper device specifications.

Selection		Contents
00	F-PC_R-PC	Forward Rotation (Positive) Pulse + Reverse Rotation (Negative) Pulse
01	PC-A_PC-B	Two-phase Pulse Train of 90°-Phase Difference
02	SIGN_PULS	Code + Pulse Train

- ◆ Connect position command pulse to CN1 pin listed below.

Forward rotation	Reverse rotation
Forward pulse (F-PC): CN1-26	Reverse pulse (R-PC): CN1-28
Forward pulse ($\overline{\text{F-PC}}$): CN1-27	Reverse pulse ($\overline{\text{R-PC}}$): CN1-29
Forward pulse SG: CN1-47	Reverse pulse SG: CN1-48

- ◆ These output types of the upper device are allowed: Line driver output and Open collector output. Be sure to connect SG.

－Group8－

ID	Contents
11	Position Command Pulse Count Polarity [PCPPOL] “Power cycle for control after setting”

Setting range	Unit	Default
00 to 03	-	00:Type1

- ■ Selects the Position Command Pulse Count Polarity from the list below.
  - ◆ Select according to host equipment.

Selection		Contents
00	Type1	F-PC: Not inverted. R-PC: Not inverted.
01	Type2	F-PC: Inverted. R-PC: Not inverted.
02	Type3	F-PC: Not inverted. R-PC: Inverted.
03	Type4	F-PC: Inverted. R-PC: Inverted.

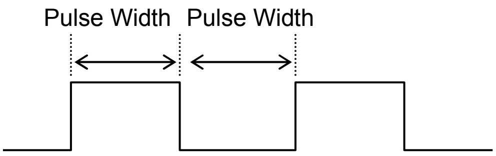
ID	Contents
12	Position Command Pulse Digital Filter [PCPFIL]

Setting range	Unit	Default
00 to 07	-	00:850ns

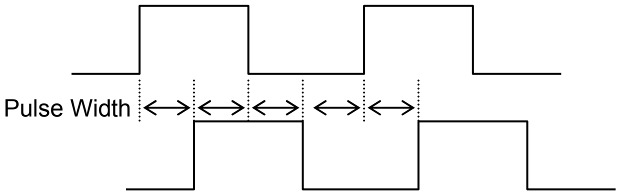
- ■ This is filter to eliminate noise elements included in the Position command pulse.
  - ◆ Select from below depending on pulse command condition.

Selection		Contents
00	850nsec.	Minimum Pulse Width =850nsec.
01	250nsec.	Minimum Pulse Width =250nsec.
02	500nsec.	Minimum Pulse Width =500nsec.
03	1.8μsec.	Minimum Pulse Width =1.8μsec.
04	3.6μsec.	Minimum Pulse Width =3.6μsec.
05	7.2μsec.	Minimum Pulse Width =7.2μsec.
06	200nsec.	Minimum Pulse Width =200nsec.
07	125nsec.	Minimum Pulse Width =125nsec.

Forward/Reverse Rotation pulse train method
or Code + Pulse train method



90°-Phase difference pulse method



- ■ When the Position command pulse width becomes less that the setting values of the Digital filter, the status may become Alarm Code D2 (Position command pulse frequency error 1).
  Set Digital filter setting value smaller than that of Pulse width at maximum command frequency.

- ■ Refer to "2.3.2 Input command, Position signal output, General input, General output" for the specification of the command pulse.

ID	Contents			
13	Electronic Gear 1 Numerator [B-GER1]	Setting range	Unit	Default
		1 to 2097152	-	1
14	Electronic Gear 1 Denominator [A-GER1]	Setting range	Unit	Default
		1 to 2097152	-	1
15	Electronic Gear 2 Numerator [B-GER2]	Setting range	Unit	Default
		1 to 2097152	-	1
16	Electronic Gear 2 Denominator [A-GER2]	Setting range	Unit	Default
		1 to 2097152	-	1

■ Sets the Electronic gear ratio to position command pulse.

- ◆ Two settings for Electronic gear ratio are available. Set gear 1 or gear 2 by switching.
  - ✔ Switching of Electronic gear ratio should done at state without position command input.
- ◆ If the position command pulse is the same, by switching the Electronic gear, rotating velocity and distance are changed.

$$f1 \longrightarrow \boxed{\begin{array}{c} \dfrac{\text{B (1 to 2097152)}}{\text{A (1 to 2097152)}} \\ 1/2^{21} \leqq \text{B/A} \leqq 2^{21} \end{array}} \longrightarrow f2\ (f2 = f1 \times B/A)$$

■ Example 1. Changing the unit of Position command pulse on the feed shaft with ball screw.
Use absolute encoder which has 131072[P/R] resolutions, decide the position of the lead 10[mm] ball screw. To calculate by 1 μm unit, use the calculation formula below and calculate the Electronic gear ratio numerator and denominator.

◆ Encoder position resolution = $\dfrac{131072[\text{P/R}]}{10 \times 10^{-3}\ [\text{m}]}$ = 13107200[P/m]

◆ Position resolution of upper controller = 1000000[P/m]

● Electronic gear ratio = $\dfrac{13107200[\text{P/m}]}{1000000[\text{P/m}]} = \dfrac{131072}{10000} = \dfrac{8192}{625}$

Thus, Electronic gear numerator = 8192, Electronic gear denominator = 625 are gotten.
(Setting value of numerator = 131072, denominator = 10000 are fine because they are within the setting range of Electronic gear.)

－Group8－

■ Example 2. In case of that the encoder resolution is changed by the motor exchange.
To change a servo motor with 2000[P/R] incremental encoder, to a servo motor with 8576[P/R] absolute encoder without changing upper controller position resolution. Use the calculation formula below and calculate Electronic gear numerator and denominator.

◆ Resolution before the motor exchange = 2000[P/R]×4 = 8000[P/R]
(At an incremental encoder, the position control resolution is 4-multiplied to the encoder resolution)

● Electronic gear ratio = $\dfrac{1048576[\text{P/m}]}{8000[\text{P/m}]} = \dfrac{16384}{125}$

Thus, Electronic gear numerator = 16384, Electronic gear denominator = 125 are gotten.
(Setting value of numerator = 1048576, denominator = 8000 are fine because they are within the setting range of Electronic gear.)
(If the Electronic gear value has set at the motor before exchanging, multiply the value of the Electronic gear ratio given here.)

■ Example 3. To avoid the constraint of Position command pulse frequency.
In case you operate a servo motor which has 131072 [P/R] resolution absolute encoder at 6000 [min^{-1}] using a controller having maximum frequency of 600 [kpps] (six hundred thousand pulse per sec.), use the following formula to get the value of the numerator and the denominator of the electric gearing.

◆ Position command pulse frequency at the encoder resolution
= 131072[P/R]×6000[min^{-1}]/60 = 13107.2[kpps]

● Electronic gear ratio = $\dfrac{13107.2\ [\text{kpps}]}{600[\text{kpps}]} = \dfrac{8192}{375}$

Thus, Electronic gear numerator = 8192, Electronic gear denominator = 375 are gotten.
(Setting value of numerator = 131072, denominator = 6000 are fine because they are within the setting range of Electronic gear.)
By setting this Electronic gear numerator and denominator, the motor rotation velocity is 6000[min^{-1}], when the Position command pulse frequency is 600[kpps].

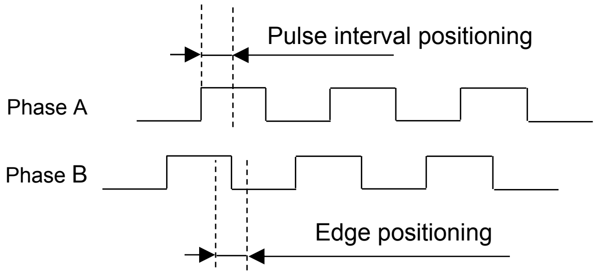
ID	Contents

17

Positioning Methods [EDGEPOS] “Power cycle for control after setting”	Setting range	Unit	Default
	00 to 01	-	00:Pulse_Interval

- ■ Selects the Encoder pulse positioning.
  - ◆ Positioning accuracy may improved by selecting Edge positioning when the encoder resolution is coarse. However, this may cause the driving sound of the mechanical system to increase as this edge is always the center of vibration.
  - ◆ Select standard value in usual operation.

Selection		Contents
00	Pulse_Interval	Specify Pulse Interval
01	Pulse_Edge	Specify Pulse Edge

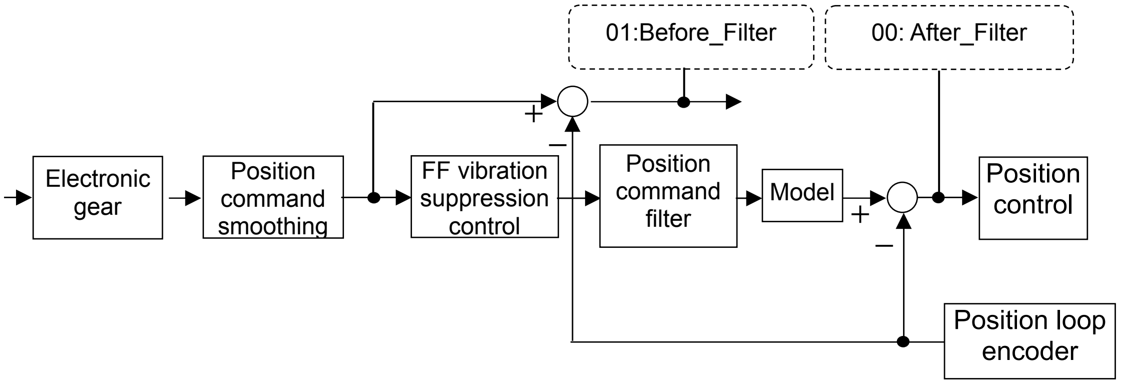


18

In-Position Signal/ Position Deviation Monitor [PDEVMON]	Setting range	Unit	Default
	00 to 01	-	00:After_Filter

- ■ Selects in-position signal (INP) and Position deviation monitor output before or after passing through the Position Command Filter.
  - ◆ For "00: After_Filter", use the Position deviation value of the Position controller.
  - ◆ For "01: Before_Filter", use the Position deviation value based on Position command before FF vibration suppression control.
  - ◆ This parameter works as "01: Before_Filter" even if the other value is selected when "01: Model 1 Model Following Control" or "02: Model 2 Model Following Vibration Suppression Control" is set to the system parameter ID07 Position Control Selection.

Selection		Contents
00	After_Filter	Compare Position command value with Feedback value after passing through the filter.
01	Before_Filter	Compare Position command value with Feedback value before passing through the filter.



－Group8－

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="9">19</td><td rowspan="2">Deviation Clear Selection
[CLR]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>00 to 03</td><td>-</td><td>00:Type1</td></tr>
<tr><td colspan="4">■ Sets whether a position deviation will be cleared or not during servo OFF, and how to treat deviation clear signal.
◆ Selects operation during servo OFF. Deviation cleared/ Deviation not cleared
◆ Selects deviation clear signal treatment. Level detection/ Edge detection
◆ Select proper setting corresponding to above combination from the list below.</td></tr>
<tr><td colspan="2">Selection</td><td colspan="2">Contents</td></tr>
<tr><td>00</td><td>Type1</td><td>At servo OFF → Deviation cleared
Clear input = Level detection</td><td>Deviation clear is continuing during servo OFF.
Deviation clear is continuing during Clear input is ON.</td></tr>
<tr><td>01</td><td>Type2</td><td>At servo OFF → Deviation cleared
Clear input = Edge detection</td><td>At the edge of OFF to ON of Deviation clear input, Deviation clear is executed.</td></tr>
<tr><td>02</td><td>Type3</td><td>At servo OFF → Deviation not cleared
Clear input = Level detection</td><td>During servo OFF, Deviation clear is not executed.
(After servo ON, the motor might operate suddenly.)</td></tr>
<tr><td>03</td><td>Type4</td><td>At servo OFF → Deviation not cleared
Clear input = Edge detection</td><td>During servo OFF, Deviation clear is not executed.
(After servo ON, the motor might operate suddenly.)</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td rowspan="3">1A</td><td rowspan="2">Time to judge position command distribution completion
[PCDLY]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0.0 to 1000.0</td><td>ms</td><td>0.0</td></tr>
<tr><td colspan="4">■ Sets the time till judging position command distribution completion.
◆ Distribution completion is judged if command position does not change (means previous and present command position are same) even if spending this setting time.
◆ State will change to "during position command distribution" instantly with no matter to this setting time, when new position command is input during count of position command distribution completion.</td></tr>
</table>

ID	Contents			
20	Preset Velocity Command 1 [VC1]	Setting range	Unit	Default
		0 to 32767	min^{-1}	100
21	Preset Velocity Command 2 [VC2]	Setting range	Unit	Default
		0 to 32767	min^{-1}	200
22	Preset Velocity Command 3 [VC3]	Setting range	Unit	Default
		0 to 32767	min^{-1}	300
23	Preset Velocity Command 4 [VC4]	Setting range	Unit	Default
		0 to 32767	min^{-1}	400
24	Preset Velocity Command 5 [VC5]	Setting range	Unit	Default
		0 to 32767	min^{-1}	500
25	Preset Velocity Command 6 [VC6]	Setting range	Unit	Default
		0 to 32767	min^{-1}	600
26	Preset Velocity Command 7 [VC7]	Setting range	Unit	Default
		0 to 32767	min^{-1}	700

■ Sets Velocity command for internal velocity operation.

- ◆ Preset velocities are able to set upto seven.
- ◆ Use the following General parameters Group9 ID20-26 to activate the Preset velocities.

ID	Symbol	Contents
20	SP1	Preset Velocity Command Select Input 1
21	SP2	Preset Velocity Command Select Input 2
22	SP3	Preset Velocity Command Select Input 3
23	DIR	Preset Velocity Command Operation Direction Select Input
24	RUN	Preset Velocity Command Operation Start Signal Input
25	RUN-F	Preset Velocity Command Positive (direction) Move Start Signal Input
26	RUN-R	Preset Velocity Command Negative (direction) Move Start Signal Input

◆ Select Preset velocity command by Preset velocity selection.

	VC1	VC2	VC3	VC4	VC5	VC6	VC7	Analog velocity command
SP3	0	0	0	1	1	1	1	0
SP2	0	1	1	0	0	1	1	0
SP1	1	0	1	0	1	0	1	0

0=OFF, 1=ON
Example: VC2 is valid when SP1=OFF, SP2=ON, SP3=OFF

◆ Drives the servo motor

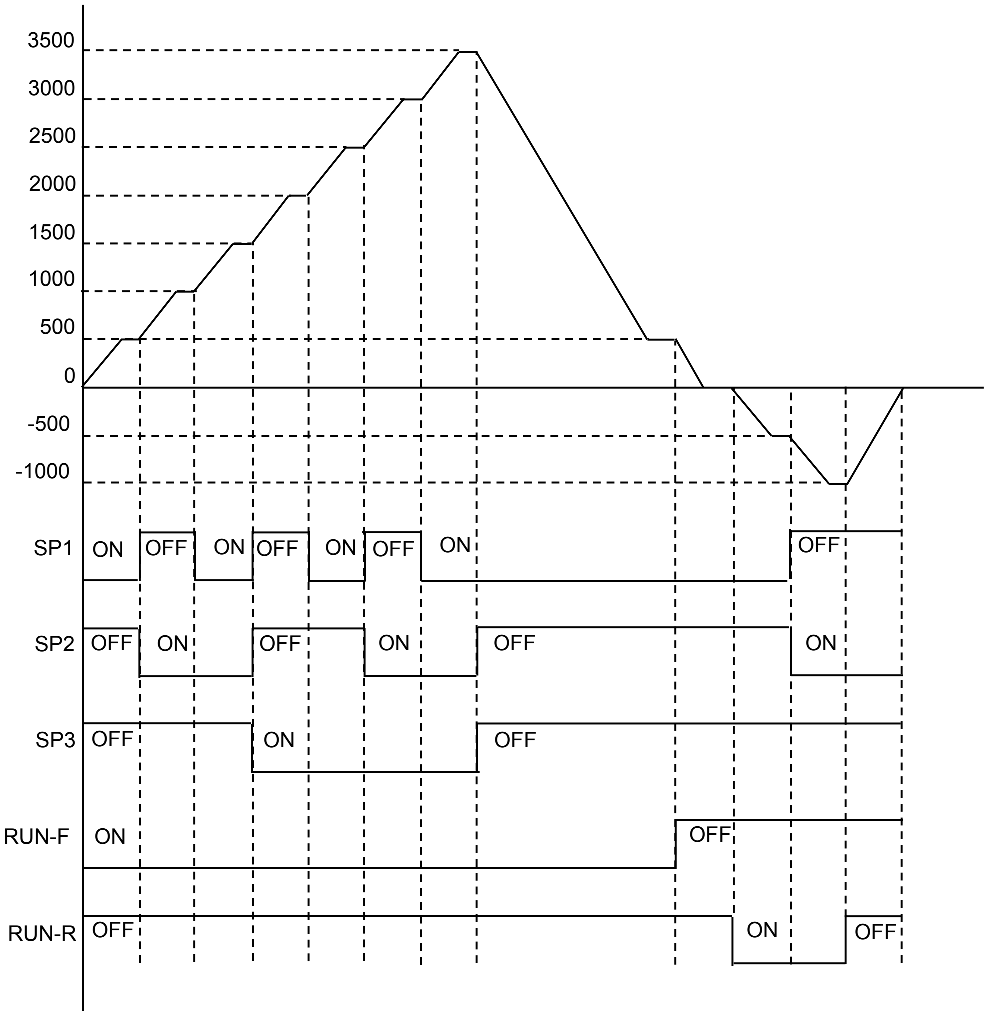
RUN: Preset Velocity Command Operation Start Signal Input	ON	Servo motor rotates forward
DIR: Preset Velocity Command Operation Direction Select Input	OFF	
RUN: Preset Velocity Command Operation Start Signal Input	ON	Servo motor rotates reverse
DIR: Preset Velocity Command Operation Direction Select Input	ON	

RUN-F: Preset Velocity Command Positive (direction) Move Start Signal Input	ON	Servo motor rotates forward
RUN-R: Preset Velocity Command Negative (direction) Move Start Signal Input	ON	Servo motor rotates reverse

－Group8－

ID	Contents
	■ Examples of setting and operation pattern at Preset Velocity Command Operation

VC1 Preset Velocity Command 1	500[min^{-1}]
VC2 Preset Velocity Command 2	1000[min^{-1}]
VC3 Preset Velocity Command 3	1500[min^{-1}]
VC4 Preset Velocity Command 4	2000[min^{-1}]
VC5 Preset Velocity Command 5	2500[min^{-1}]
VC6 Preset Velocity Command 6	3000[min^{-1}]
VC7 Preset Velocity Command 7	3500[min^{-1}]



◆ To change the Preset velocity using external contact input, set them so that SP1, SP2 and SP3 are changed at the same timing.

◆ When RUN-F and RUN-R are ON at the same time, it is treated as Velocity command 0.

ID	Contents	Setting range	Unit	Default
27	Velocity Compensation Command Input Selection [VCOMSEL]	01 to 02	-	02:V-COMP

- ■ Selects Velocity compensation command input.

Selection		Contents
01	Analog_Input	Analog velocity compensation command value is used when velocity compensation function is valid.
02	V-COMP	Preset velocity compensation command is used when velocity compensation function is valid.

ID	Contents	Setting range	Unit	Default
28	Preset Velocity Compensation Command [V-COMP]	-9999 to 9999	min^{-1}	0

- ■ Sets the Velocity if the velocity compensation command is used as fixed value in Velocity Compensation Function.

ID	Contents	Setting range	Unit	Default
29	Analog Velocity (Compensation) Command Scaling [VCGN]	0 to 4000	min^{-1}/V	500

- ■ Sets Analog Velocity (Compensation) Command scaling.
  - ◆ Sets the velocity value per 1 volt of Analog velocity (compensation) command input signal.

ID	Contents	Setting range	Unit	Default
2A	External Velocity Command Filter [EX-VCFIL]	1 to 4000	Hz	4000

- ■ This is primary low-pass filter to eliminate noise component from Analog velocity (compensation) command.
  - ◆ Sets cutoff frequency.
  - ◆ This filter also works with Preset velocity command.
  - ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	1 to 3999Hz	Set value valid
		4000Hz	Filter invalid

－Group8－

ID	Contents
	■ About Velocity Compensation Function Velocity Compensation Function is a Feed forward function for the Velocity control system. There are two settings for the Velocity compensation command input function: Preset velocity compensation command and Analog velocity compensation command. Use preset velocity compensation command to keep the Velocity compensation command fixed. Analog velocity compensation command is used when setting the Velocity compensation command input value from upper device.

◆ Sets preset velocity compensation command value

Group	ID	Symbol	Contents
8	28	V-COMP	Preset Velocity Compensation Command

◆ Selects velocity compensation command input method

Group	ID	Symbol	Contents
8	27	VCOMSEL	Velocity Compensation Command Input Selection

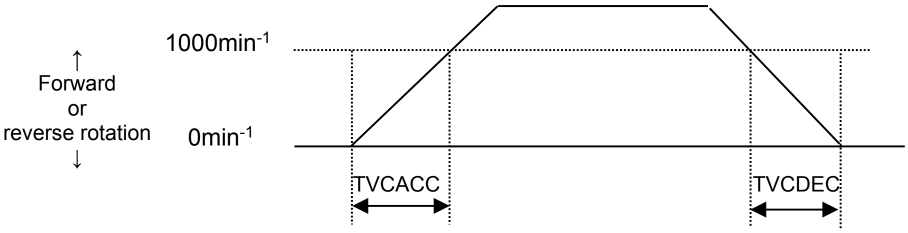
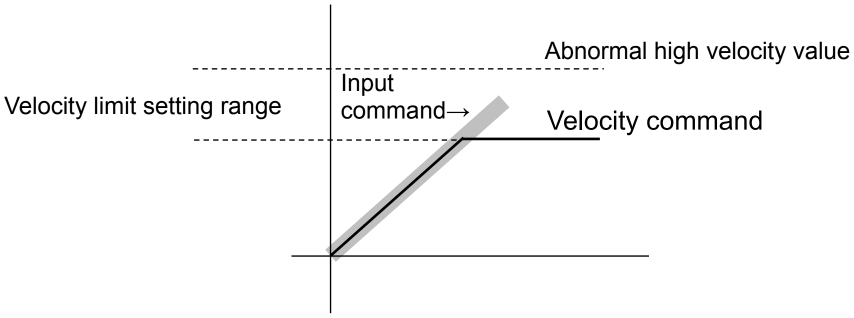
◆ Selects and sets the condition to set Velocity Compensation Function valid

Group	ID	Symbol	Contents
9	28	VCOMPS	Velocity Compensation Function

◆ Sets Analog velocity compensation scaling

Group	ID	Symbol	Contents
8	29	VCGN	Analog Velocity Command Scaling

◆ Input for Analog velocity compensation command is shared with Analog velocity command/Analog torque command Input.
CN1-21: Input Voltage range -10V to +10V

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="2">2B</td><td rowspan="2">Velocity Command Acceleration Time Constant
[TVCACC]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0～16000</td><td>ms</td><td>0</td></tr>
<tr><td rowspan="2">2C</td><td rowspan="2">Velocity Command Deceleration Time Constant
[TVCDEC]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
<tr><td></td><td colspan="4">■ These are parameters to restrict Acceleration and Deceleration commands of the Analog velocity command input, Preset velocity command, Analog velocity compensation input, Preset compensation, and JOG operation.
Acceleration: 0 min^{-1} --> forward, reverse rotation
Deceleration: forward, reverse rotation --> 0 min^{-1}
Sets the acceleration, deceleration per 1000 min^{-1}.
■ These parameters can give accel/decel to a step type velocity command input.
 </td></tr>
<tr><td rowspan="3">2D</td><td rowspan="2">Velocity Limit Command
[VCLM]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>1 to 65535</td><td>min^{-1}</td><td>65535</td></tr>
<tr><td colspan="4">■ Set to restrict Velocity command.
◆ Sets the maximum value of Velocity command.
◆ Restricts Velocity command at the setting range with position control mode or Velocity control mode.
◆ If the setting value is 50000 or more, Velocity command limit will be set to 1.1 times of maximum speed of the combination motor.
Set this parameter to limit motor rotational velocity to the value lower than 1.1 times the maximum rotational velocity. Use the standard value for normal use.
 </td></tr>
</table>

－Group8－

ID	Contents	Setting range	Unit	Default
30	Torque Compensation Command Input Selection [TCOMSEL]	01 to 02	-	02:T-COMP

- ■ Select Torque compensation command input from the list below.

Selection		Contents
01	Analog_Input	Analog torque compensation command value is used when torque compensation function is valid.
02	T-COMP	Preset torque compensation command 1, 2 are used when torque compensation function is valid.

ID	Contents	Setting range	Unit	Default
31	Preset Torque Compensation Command 1 [T-COMP1]	-500.0 to +500.0	%	0.0

- ■ This is parameter for using torque compensation command with fixed value if T-COMPS1 is activated.
  - ◆ This value will be added to the Torque command When Torque Compensation Command Input Selection is set at 02: T-COMP.

ID	Contents	Setting range	Unit	Default
32	Preset Torque Compensation Command 2 [T-COMP2]	-500.0 to +500.0	%	0.0

- ■ This is parameter for using torque compensation command with fixed value if T-COMPS2 is activated.
  - ◆ This value will be added to the Torque command When Torque Compensation Command Input Selection is set at 02: T-COMP.

ID	Contents	Setting range	Unit	Default
33	Analog Torque Command Scaling [TCGN]	0.0 to 500.0	%/V	50.0

- ■ Sets Analog Torque Command Scaling.
  - ◆ Sets the torque value per 1 volt of Analog torque command input signal.

ID	Contents	Setting range	Unit	Default
34	Analog Torque Compensation Command Scaling [T-COMPGN]	0.0 to 500.0	%/V	50.0

- ■ Sets Analog Torque Compensation Command Scaling.
  - ◆ Sets the torque value per 1 volt of Analog torque compensation command input signal.

ID	Contents	Setting range	Unit	Default
35	External Torque Command Filter [EX-TCFIL]	1 to 4000	Hz	4000

- ■ This is primary Low-pass filter to eliminate noise component from Analog torque (compensation) command.
  - ◆ Sets Cutoff frequency.
  - ◆ Setting range varies depending on the setting of the system parameter ID00 Control Cycle.

Control cycle		Setting value	Valid/ Invalid
00	Standard_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling	1 to 1999Hz	Set value valid
		2000 to 4000Hz	Filter invalid

ID	Contents

■ About Torque Compensation Function

The Torque Compensation Function is a feed forward function for the Torque control system.
There are two settings for Torque compensation command input function:
Preset torque compensation command and Analog torque compensation command.
Use preset torque compensation command to keep the Torque compensation command fixed.
Analog torque compensation command is used when setting the Torque compensation command input value from upper device.

◆ Sets Preset Torque Compensation Command Value

Group	ID	Symbol	Contents
8	31	T-COMP1	Preset Torque Compensation Command 1
8	32	T-COMP2	Preset Torque Compensation Command 2

◆ Selects Torque Compensation Command Input Method.

Group	ID	Symbol	Contents
8	30	TCOMSEL	Torque Compensation Command Input Selection

◆ Sets the condition of Torque Compensation Function being Valid

Group	ID	Symbol	Contents
9	30	T-COMPS1	Torque Compensation Function 1
9	31	T-COMPS2	Torque Compensation Function 2

◆ Sets Analog Torque Compensation Command Scaling

Group	ID	Symbol	Contents
8	34	T-COMPGN	Analog Torque Compensation Command Scaling

◆ Analog torque compensation command input
CN1-22: Input Voltage range -10V to +10V

36

Torque Limit Input Selection [TLSEL]	Setting range	Unit	Default
	00 to 02	-	00:TCLM

■ Selects input system to limit Torque command limit function from listed below.

Selection		Contents	
00	TCLM	Use internal torque limit value Forward side/TCLM-F Reverse side/TCLM-R	Forward side (forward direction): Limited at Forward Direction Internal Torque Limit Value. Reverse side (reverse direction): Limited at Reverse Direction Internal Torque Limit Value.
01	Analog_1	Use external torque limit input Forward side/F-TLA Reverse side/R-TLA	Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to R-TLA.
02	Analog_2	Use external torque limit input Forward side/F-TLA Reverse side/F-TLA	Forward side (forward direction): Limited at the voltage input to F-TLA. Reverse side (reverse direction): Limited at the voltage input to F-TLA.

－Group8－

ID	Contents	Setting range	Unit	Default
37	Forward Direction Internal Torque Limit Value [TCLM-F]	10.0 to 500.0	%	100.0
38	Reverse Direction Internal Torque Limit Value [TCLM-R]	10.0 to 500.0	%	100.0

■ Limits the Torque output at this setting value when Preset torque limit value is valid.

- ◆ Limits the torque by the ratio for the torque rating (100.0%= torque rating)
- ◆ When the Torque Limit Function (TL) is valid, the torque output is limited by the Preset torque limit setting value appropriate to the polarity of the Torque command.
- ◆ When the following conditions are set, the torque output is limited by a rate of "Peak armature current at stall (IP) / Rated armature current (IR)".
  - In case of exceeding Peak torque at stall (Tp) of combination motor.
  - In case of setting of exceeding a rate of "Peak armature current at stall (IP) / Rated armature current (IR)".

■ About Torque limit function

There are two input systems of restricting Torque function:
Preset torque limit and External torque limit.

◆ To use preset torque limit

- Restricts the maximum output torque by using preset torque limit.

Group	ID	Symbol	Contents
8	36	TLSEL	Torque Limit Input Selection

Selection		Contents
00	TCLM	Use preset torque limit value Forward side/TCLM-F Reverse side/TCLM-R

- Sets torque limit value.

Group	ID	Symbol	Contents
8	37	TCLM-F	Forward Direction Internal Torque Limit Value
8	38	TCLM-R	Reverse Direction Internal Torque Limit Value

- Sets torque limit function ON

Group	ID	Symbol	Contents
9	32	TL	Torque Limit Function

Selects to set the Torque function being valid.
While the Torque limit function is valid, restricts torque.

✔ When setting, be cautious about acceleration/deceleration time. If the setting value is too small, enough Acceleration/Deceleration torque can not get, and normal operation can not get.

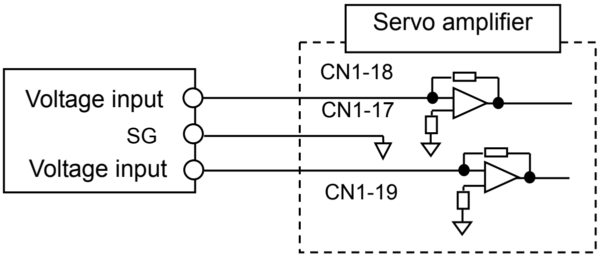
✔ Set at: Preset torque limit value > Acceleration/Deceleration torque.

✔ Preset torque limit can set individually to Forward and Reverse direction.

ID	Contents
	◆ To use External torque limit

- Restricts forward and reverse rotation torque by inputting External analog voltage to CN1.

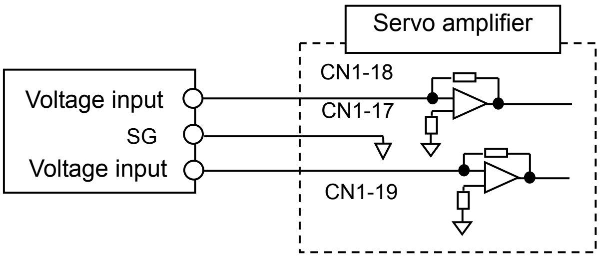
✔ Forward side torque limit input (F-TLA): CN1-18 input voltage range -10V to +10V
✔ Reverse side torque limit input (R-TLA): CN1-19 input voltage range -10V to +10V



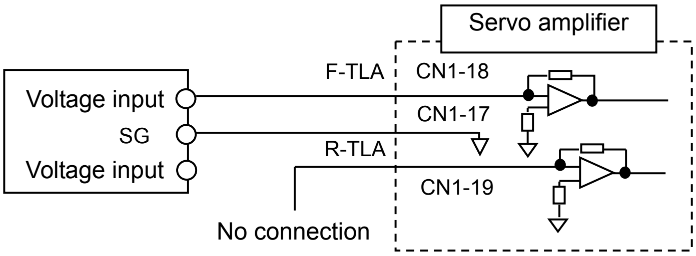
- Input signal specification has two ways.

Group	ID	Symbol	Contents
8	36	TLSEL	Torque Limit Input Selection

Selection		Contents
00	Analog_1	Use external torque limit input Forward side/ F-TLA Reverse side/ R-TLA

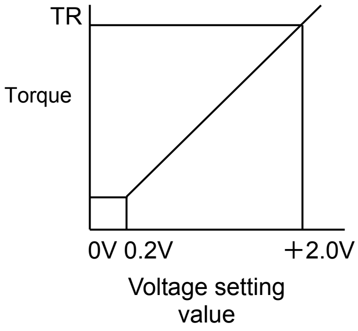


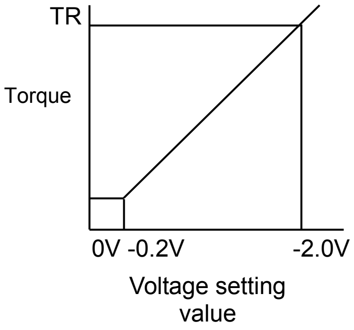
Selection		Contents
00	Analog_2	Use external torque limit input Forward side/ F-TLA Reverse side/ F-TLA



ID	Contents

◆ Inputs the voltage corresponding to the Torque limit.





- Enables the Torque limit function

Group	ID	Symbol	Contents
9	32	TL	Torque Limit Function

- Selects the condition to enable the Torque limit function.
- Restricts torque while Torque limit function is valid.

39

Sequence Operation Torque Limit Value [SQTCLM]	Setting range	Unit	Default
	10.0 to 500.0	%	120.0

■ Limits the output torque at sequence operation.

◆ Sets the limiting torque by the ratio of rated output torque. (100.0%=rated torque)

◆ When the following conditions are set, the torque output is limited by a rate of "Peak armature current at stall (IP) / Rated armature current (IR)".
- In case of exceeding Peak torque at stall (Tp) of combination motor.
- In case of setting of exceeding a rate of "Peak armature current at stall (IP) / Rated armature current (IR)".

◆ This parameter corresponds to JOG Operation, Over-Travel Action, Holding brake stand-by time, and Servo brake action.

3A

Selection of Torque Limit Input Under Voltage Sag [CPETLSEL]	Setting range	Unit	Default
	00 to 03	-	00:No_Limit

■ Selects the input system of Torque command limit function at voltage sag from list below.

Selection		Contents	
00	No_Limit	No torque limit	
01	Analog_1	Use external torque limit input Forward side/ F-TLA Reverse side/ R-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at R-TLA.
02	Analog_2	Use external torque limit input Forward side/ F-TLA Reverse side/ F-TLA	Forward (forward direction): Limit with voltage input at F-LTA. Reverse (reverse direction): Limit with voltage input at F-TLA.
03	SQTCLM	Use torque limit with sequence operation	Limit torque with Sequence Operation Torque Limit Value.

✔ At 00: No_Limit of list above, Limits the torque by following Group8 ID36 if Group9 ID32 is enabled.

ID	Contents

3B

Torque Attainment select [TASEL]	Setting range	Unit	Default
	00 to 01	-	00

- ■ To select a setting rate type of attaining torque

Selection		Contents
00	TA/TR	Sets the rate against rated torque. (Rated torque is 100%)
01	TA/TCLM	Sets the rate against Torque limit value.

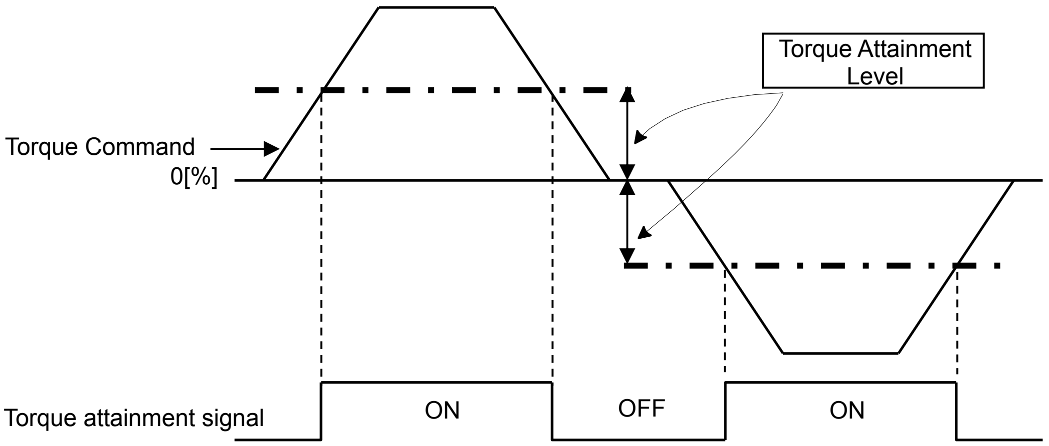
3C

Torque Attainment Setting [TA]	Setting range	Unit	Default
	0.0 to 500.0	%	100.0

■ Sets the rate of Torque attainment.
Target data of the ratio set in this parameter varies depending on Group8 3B "Torque attainment function selection".

◆ ["Torque attainment function selection": 00]

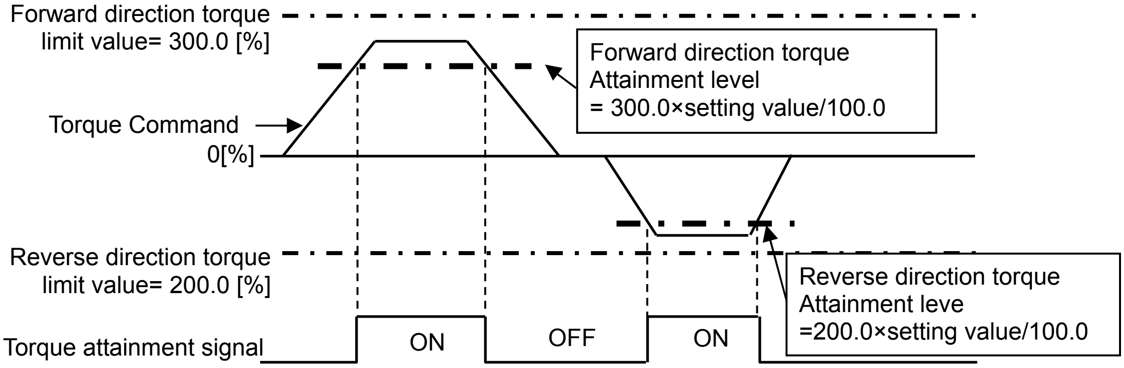
- ● Sets the rate against rated torque: 100%.
  Therefore, once the commanded torque exceeds the setting value, Torque attainment signal is output.



◆ ["Torque attainment function selection": 01]

- ● Sets the rate against Torque limit value.
  The level of attaining torque is calculated from the following formula.
  Torque attainment level = Torque limit value x setting value / 100.0 [%]

  Therefore, once the commanded torque exceeds the level of attaining torque that is calculated from the above formula, torque attainment signal is output.
  Even if the setting value is set more than 100.0 [%], that is limited to 100.0[%].
  If forward direction and reverse direction torque limit value are different, torque attainment level will be setup based on values of each of limited torque.



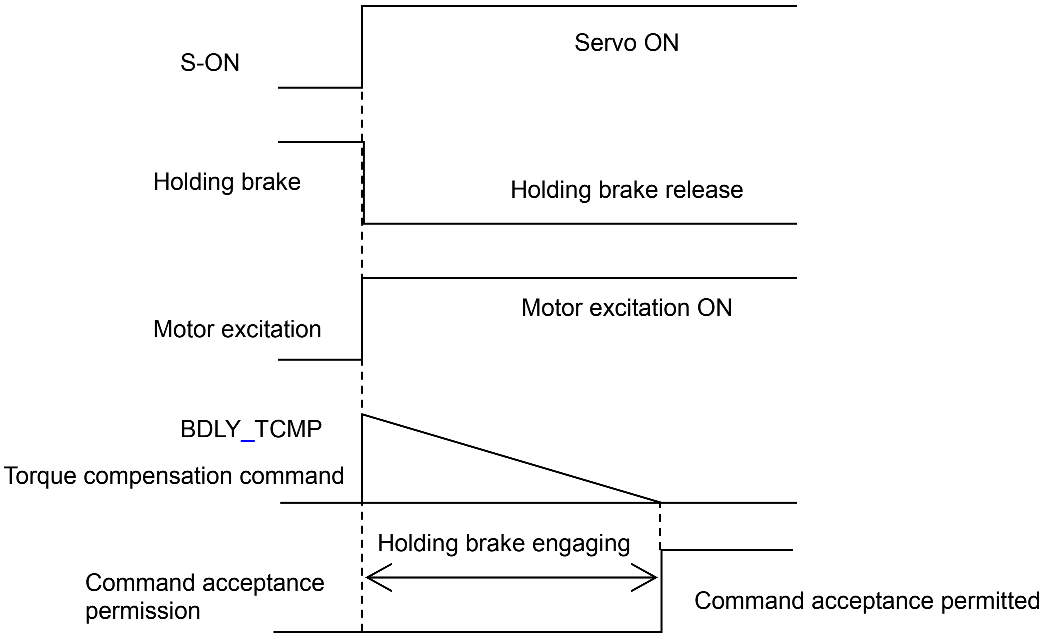
－Group8－

ID	Contents	Setting range	Unit	Default
3D	The amounts of torque limit value restoration when power restored [TLMREST]	0.0 to 500.0	%	10.0

- ■ Sets the torque-recovering value per 1ms which is used to normal torque from limited torque of power supply drop.
  - ◆ Sets the ratio to rated torque. (100.0% = rated torque)
  - ◆ When setting “0.0%”, operate as 10.0%.

ID	Contents	Setting range	Unit	Default
3E	Torque compensation command at holding brake operation cancellation delay [BDLY_TCMP]	-100 to 100	%	0.0

- ■ Sets the Torque compensation command at holding-brake operation cancellation delay to avoid self weight fall at the time of servo OFF to ON.
  - ◆ Self weight fall at servo ON is able to suppress by setting the torque compensation value which is correspond to gravity load or external load.
  - ◆ Torque compensation command will be linear-interpolated as to be zero after spending the time of GroupB ID04 "Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)".



ID	Contents	Setting range	Unit	Default
40	Near Range [NEAR]	1 to 2147483647	Pulse	500

- ■ Sets the output range of near range (near in-position) signal.
  - ◆ Outputs the Near range signal if the Position deviation counter is lower than this set value.
  - ◆ Sets at the encoder pulse resolution without relation to Electronic gear ratio. (Not the Position command pulse resolution.)

- ■ Generally, near range signal is used as auxiliary of In-position signal. For example, by setting this value larger than the range of In-position, the upper device receives the NEAR signal before the In-position signal (INP), and then necessary action can smoothly be accomplished when In-position completed.

  - ◆ Sets Near Range signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Purpose output*

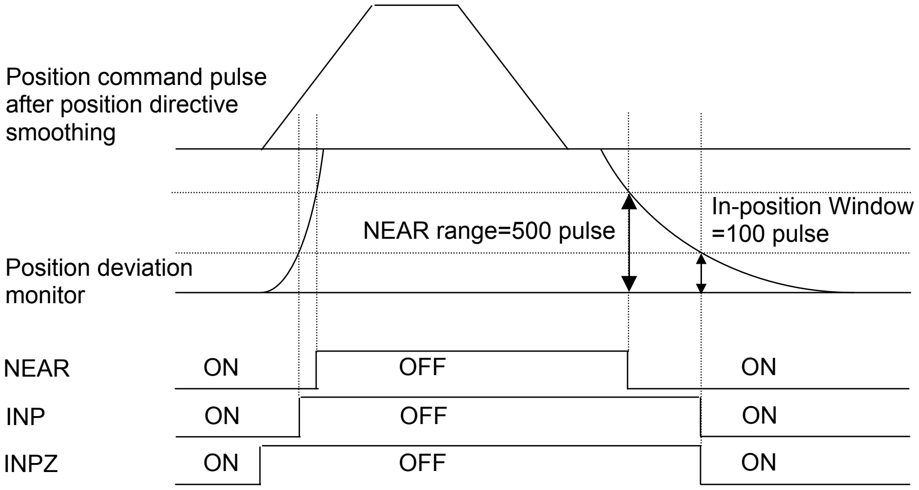
Selection		Contents
1A	NEAR_ON	Near Range Status, Output ON
1B	NEAR _OFF	Near Range Status, Output OFF

ID	Contents	Setting range	Unit	Default
41	In-Position Window [INP]	1 to 2147483647	Pulse	100

- ■ Sets output range of In-Position signal.
  - ◆ Outputs the positioning completion signal when position deviation counter value is this setting value or less.
  - ◆ Sets at the encoder pulse resolution without relation to Electronic gear ratio. (Not the Position command pulse resolution.)
  - ◆ In-Position completion signal will output from selected output terminal if the position deviation of a servo motor changes to less than this setting value.
  - ◆ Sets In-Position signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Purpose output*

Selection		Contents
18	INP_ON	In-Position Status,Output ON
19	INP_OFF	In-Position Status,Output OFF



- ◆ INPZ is a state signal turned on when the position directive pulse after position directive smoothing is 0 and a position deviation counter value is below setting of the completion range of positioning.

－Group8－

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">42</td><td rowspan="2">Speed Zero Range
[ZV]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>50 to 500</td><td>min^{-1}</td><td>50</td></tr>
<tr><td colspan="4">

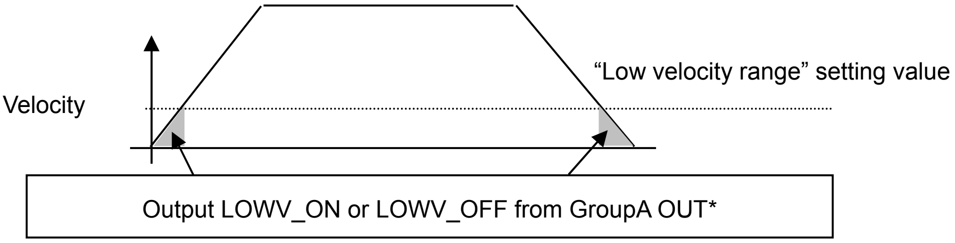
■ Setting value for detecting Zero-speed status (motor stop).

◆ When the speed becomes lower than this value, Zero-speed status is out.

</td></tr>
<tr><td rowspan="3">43</td><td rowspan="2">Low Speed Range
[LOWV]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0 to 65535</td><td>min^{-1}</td><td>50</td></tr>
<tr><td colspan="4">

■ Parameter for setting Low speed output range.

◆ When the speed is lower than this value, Low speed status is output.



◆ Automatically overwrite by Auto-tuning result saving.

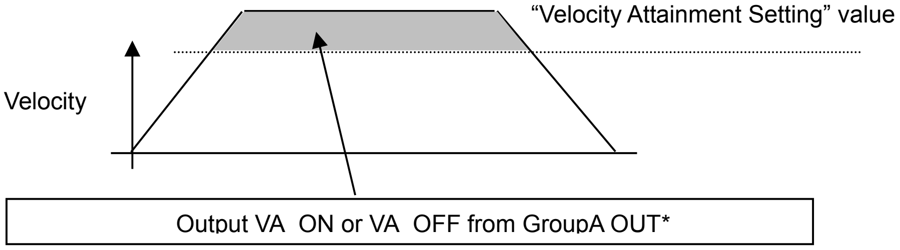
◆ When Auto-tuning function is valid, this setting value is not applied.

</td></tr>
<tr><td rowspan="3">44</td><td rowspan="2">Speed Attainment Setting (High Speed Range)
[VA]</td><td>Setting range</td><td>Unit</td><td>Default</td></tr>
<tr><td>0 to 65535</td><td>min^{-1}</td><td>1000</td></tr>
<tr><td colspan="4">

■ Parameters for setting speed attainment output range.

◆ When the speed exceeds this setting value, Speed attainment is output.

◆ When the operation is switched to torque control mode by using control mode switching function, in other words, when enabling “control model switching function (MS)” after setting ”03:Velo-Torq” or “04:Posi-Torq” of system parameter ID06 ”control mode selection”,simplified velocity limitation is controlled by this parameter. However, this method can not control with constant speed because a torque is forced to be zero when Motor speed exceeds this setting value. Avoid the use of such status to continue.



</td></tr>
</table>

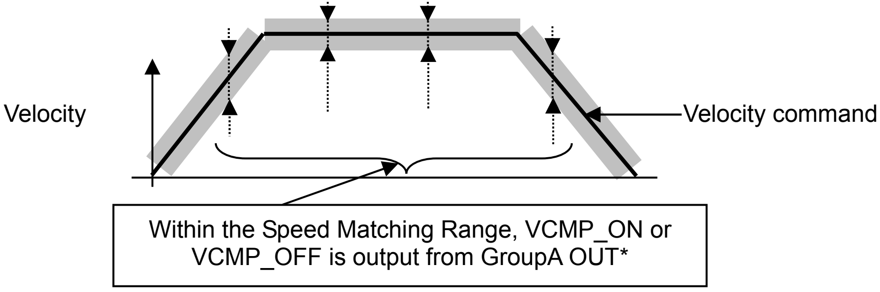
ID	Contents	Setting range	Unit	Default
45	Speed Matching Unit Selection [VCMPUS] “Power cycle for control after setting”	00 to 01	—	00:min^{-1}

- ■ Selects Speed Matching Unit setting method.

Selection		Contents
00	min^{-1}	Sets by [min^{-1}] unit. Uses the setting value of ID46 [VCMP] Speed Matching Range
01	Percent	Sets the ratio to velocity command by [%] unit. Uses the setting value of ID47 [VCMPR] Speed Matching Range Ratio.

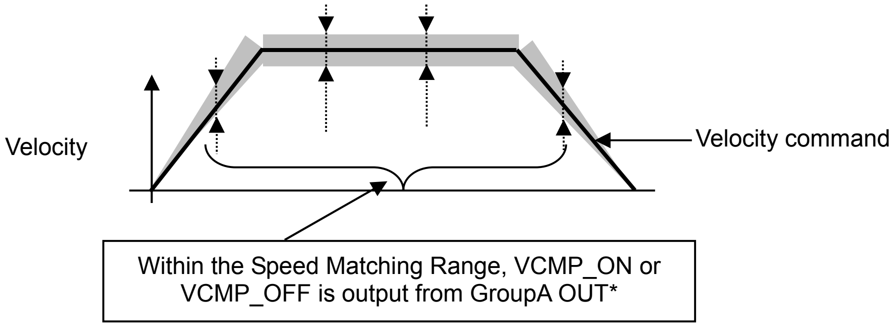
ID	Contents	Setting range	Unit	Default
46	Speed Matching Range [VCMP]	0 to 65535	min^{-1}	50

- ■ Sets the range regarded as Speed matching by the [min^{-1}] unit.
  - ◆ Use this setting value when ID45 [VCMPUS] Speed Matching Unit Selection is ”00:min^{-1}”.
  - ◆ Velocity matching is output when the Velocity deviation (difference between the velocity command and actual velocity) is within this setting range.



ID	Contents	Setting range	Unit	Default
47	Speed Matching Range Ratio [VCMPR]	0.0 to 100.0	%	5.0

- ■ Sets the range regarded as Speed matching ratio to Velocity command by the [%] unit.
  - ◆ This setting is used when “01: Percent” is set to ID45 ”[VCMPUS] Speed Matching Unit Selection”.
  - ◆ The value that multiplied the velocity command by this setting value is a Speed matching range.
  - ◆ Speed matching is outputted when a velocity deviation (difference of commanded velocity and real one) is in this setting range.
  - ◆ When this value is less than 1[min^{-1}], the Speed matching range is treated as 1[min^{-1}].



−Group8−

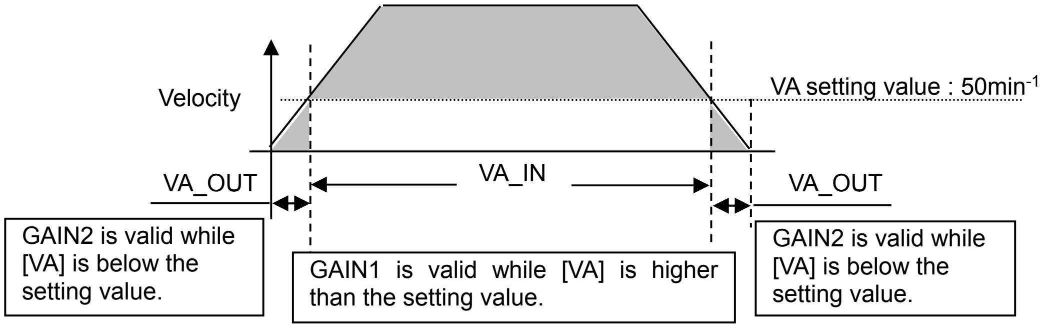
ID	Contents
	■ By combining with Group9 "Condition Settings for Enabling Functions", ID42 to ID47 will make the functions of Group9 valid.

Selection		Contents
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value).
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value).
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value)
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value)

✔ Speed Matched Range is depending on “Group8 ID45 to ID47” setting.

◆ Example: The servo amplifier sets the GAIN1 and GAIN2 switching without using input signal from the host unit.

- Sets 15: VA_OUT to Group9 ID13 Gain Switching Condition 1 [GC1].
- Sets 00: Always_Disable to Group9 ID14 Gain Switching Condition 2 [GC2].
- Sets 50min^{-1} (arbitrary value) to Group8 ID44 Speed Attainment
- (High Speed setting) [VA].



ID	Polarity selection of axes-sync compensation input [SYNCDIR]	Setting range	Unit	Default
80		00 to 01	-	00: Not_Reversed

■ Fit a polarity of position deviation each other.

◆ Set "01: Reversed" to one axis if rotation directions of combination axes are different.

Selection		Contents
00	Not_Reversed	Without reversing
01	Reversed	With reversing

■ General parameters Group9 "Function enabling condition settings"

ID	Name	Setting range	Default value	Functions-enabled input time
00	Positive Over Travel Function [F-OT]	00 to 29	0D:CONT6_OFF	20ms
01	Negative Over Travel Function [R-OT]	00 to 29	0B:CONT5_OFF	20ms
02	Alarm Reset Function [AL-RST]	00 to 29	10:CONT8_ON	20ms
03	Encoder Clear Function [ECLR]	00 to 29	06:CONT3_ON	200ms
04	Deviation Clear Function [CLR]	00 to 29	08:CONT4_ON	2ms
05	Servo-ON Function [S-ON]	00 to 29	02:CONT1_ON	20ms
10	Control Mode Switching Function [MS]	00 to 29	00:Always_Disable	5ms
11	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function [INH/Z-STP]	00 to 29	00:Always_Disable	20ms
12	Electronic Gear Switching Function [GERS]	00 to 29	00:Always_Disable	20ms
13	Gain Switching Condition 1 [GC1]	00 to 29	00:Always_Disable	2ms
14	Gain Switching Condition 2 [GC2]	00 to 29	00:Always_Disable	2ms
15	FF Vibration Suppressor Frequency Select Input A1 [SUPFSELA1]	00 to 29	00:Always_Disable	20ms
16	FF Vibration Suppressor Frequency Select Input A2 [SUPFSELA2]	00 to 29	00:Always_Disable	20ms
17	FF Vibration Suppressor Frequency Select Input B1 [SUPFSELB1]	00 to 29	00:Always_Disable	20ms
18	FF Vibration Suppressor Frequency Select Input B2 [SUPFSELB2]	00 to 29	00:Always_Disable	20ms
19	Position Loop Proportional Control Switching Function [PLPCON]	00 to 29	01:Always_Enable	20ms
1A	Model following (vibration suppression) control/ standard position control switching function [MODEL]	00 to 11	00:Always_Disable	2ms
1B	Model Vibration Suppressor Frequency Select Input 1 [MDLFSEL1]	00 to 29	00:Always_Disable	20ms
1C	Model Vibration Suppressor Frequency Select Input 2 [MDLFSEL2]	00 to 29	00:Always_Disable	20ms
20	Preset Velocity Command Select Input 1 [SP1]	00 to 29	00:Always_Disable	20ms
21	Preset Velocity Command Select Input 2 [SP2]	00 to 29	00:Always_Disable	20ms
22	Preset Velocity Command Select Input 3 [SP3]	00 to 29	00:Always_Disable	20ms
23	Preset Velocity Command Input Direction of Movement [DIR]	00 to 29	00:Always_Disable	20ms
24	Preset Velocity Command Operation Start Signal Input [RUN]	00 to 29	00:Always_Disable	20ms
25	Preset Velocity Command Positive (direction) Move Start Signal Input [RUN-F]	00 to 29	00:Always_Disable	20ms
26	Preset Velocity Command Negative (direction) Move Start Signal Input [RUN-F]	00 to 29	00:Always_Disable	20ms
27	Velocity Loop Proportional Control Switching Function [VLPCON]	00 to 29	04:CONT2_ON	2ms
28	Velocity Compensation Function [V-COMPS]	00 to 29	00:Always_Disable	2ms
30	Torque Compensation Function 1 [T-COMPS1]	00 to 29	00:Always_Disable	2ms
31	Torque Compensation Function 2 [T-COMPS2]	00 to 29	00:Always_Disable	2ms
32	Torque Limit Function [TL]	00 to 29	0E:CONT7_ON	20ms
33	Disturbance Observer Function [OBS]	00 to 29	00:Always_Disable	20ms
34	Compensatory function for stick-slip behavior [STC]	00 to 29	00:Always_Disable	20ms
35	Minor vibration (oscillation) suppression function [FBHYST]	00 to 29	00:Always_Disable	20ms
40	External Trip Input Function [EXT-E]	00 to 29	00:Always_Disable	20ms
41	Emergency Stop Function [EMR]	00 to 29	00:Always_Disable	20ms
80	Axes-sync compensation function [SYNCEN]	00 to 11	00:Always_Disable	20ms
81	Axes-sync compensation proportional control switching function [SYNPCNEN]	00 to 29	00:Always_Disable	20ms

Group9 List of selection contents

■ Keeping the function always valid or invalid

Selection		Contents
00	Always_Disable	Function is always invalid
01	Always_Enable	Function is always valid

■ Using function with the generic input signals

Selection		Contents
02	CONT1_ON	Function is valid when generic input, CONT1, is ON
03	CONT1_OFF	Function is valid when generic input, CONT1, is OFF
04	CONT2_ON	Function is valid when generic input, CONT2, is ON
05	CONT2_OFF	Function is valid when generic input, CONT2, is OFF
06	CONT3_ON	Function is valid when generic input, CONT3, is ON
07	CONT3_OFF	Function is valid when generic input, CONT3, is OFF
08	CONT4_ON	Function is valid when generic input, CONT4, is ON
09	CONT4_OFF	Function is valid when generic input, CONT4, is OFF
0A	CONT5_ON	Function is valid when generic input, CONT5, is ON
0B	CONT5_OFF	Function is valid when generic input, CONT5, is OFF
0C	CONT6_ON	Function is valid when generic input, CONT6, is ON
0D	CONT6_OFF	Function is valid when generic input, CONT6, is OFF
0E	CONT7_ON	Function is valid when generic input, CONT7, is ON
0F	CONT7_OFF	Function is valid when generic input, CONT7, is OFF
10	CONT8_ON	Function is valid when generic input, CONT8, is ON
11	CONT8_OFF	Function is valid when generic input, CONT8, is OFF

■ Activating the functions conditioning the rotational speed of servomotor

Selection		Contents
12	LOWV_IN	Function is valid while in low speed status (speed is lower than the LOWV Setting Value).
13	LOWV_OUT	Function is valid while not in low speed status (speed is lower than the LOWV Setting Value).
14	VA_IN	Function is valid while in speed attainment status (speed is higher than the VA Setting Value).
15	VA_OUT	Function is valid while not in speed attainment status (speed is higher than the VA Setting Value).
16	VCMP_IN	Function is valid while in speed matching status (within command-actual velocity consistent range).
17	VCMP_OUT	Function is valid while not in speed matching status (within command-actual velocity consistent range).
18	ZV_IN	Function is valid while in zero speed status (speed is lower than the ZV Setting Value).
19	ZV_OUT	Function is valid while not in zero speed status (speed is lower than the ZV Setting Value).

■ Activating the functions using the positioning signals

Selection		Contents
20	NEAR_IN	Function is valid while in Near range status
21	NEAR_OUT	Function is valid while not in Near range status
1A	INP_IN	Function is valid while in In-Position status (position deviation < INP)
1B	INP_OUT	Function is valid while not in In-Position status (position deviation < INP)
26	INPZ_IN	Function is valid while in Position command 0 and In-Position status (position deviation < INP)
27	INPZ_OUT	Function is valid while not in Position command 0 and In-Position status (position deviation < INP)
28	TRJCMP_IN	Function is valid while in Position command distribution completion (including delay time)
29	TRJCMP_OUT	Function is valid while not in Position command distribution completion (including delay time)

■ Activating the functions using the torque / speed limit

Selection		Contents
1C	TLC_IN	Function is valid while in torque limit status
1D	TLC_OUT	Function is valid while not in torque limit status
1E	VLC_IN	Function is valid while in velocity limit status
1F	VLC_OUT	Function is valid while not in velocity limit status

■ Activating the functions by the rotating direction or zero-speed state of servo motor

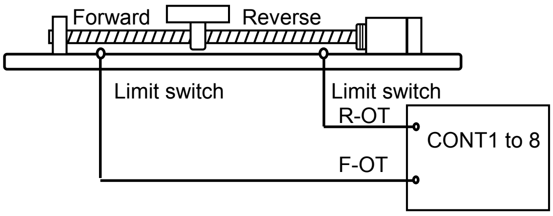
Selection		Contents
22	VMON_>_+LV	Function is valid while rotation direction is forward (VMON>+LOWV)
23	VMON_<=_+LV	Function is valid while rotation direction is not forward (VMON≦+LOWV)
24	VMON_<_-LV	Function is valid while rotation direction is reverse (VMON<-LOWV)
25	VMON_>=_-LV	Function is valid while rotation direction is not reverse (VMON≧-LOWV)

－Group9－

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">00
01</td><td>Forward Over-Travel Function [F-OT]
Reverse Over-Travel Function [R-OT]</td></tr>
<tr><td>

■ The over travel function uses limit switch to prevent damage to the unit. This function forcedly stops the unit when the movement range of the moving part is exceeded.

◆ Allocating over-travel input signal to CONT1 to CONT8.



◆ To use over-travel function, select the operating conditions of “position command input, servo motor stop operation and servo-on signal” when over-travel occurs.

<table>
<tr><th>Group</th><th>ID</th><th>Symbol</th><th>Contents</th></tr>
<tr><td>B</td><td>01</td><td>ACTOT</td><td>Over-Travel operation</td></tr>
</table>

</td></tr>
</table>

00
01

Selection		Contents
00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking (with peak torque) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Torque command for OT side is limited by the sequence torque limit.)
01	CMDINH_DB_SON	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
02	CMDINH_Free_SON	Command input is disabled, and motor is free-running when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
03	CMDINH_SB_SOFF	Command input is disabled, and motor is stopped by servo-braking when OT occurs. Servo is turned off after motor stops. (Torque command for both side is limited by the sequence torque limit.)
04	CMDINH_DB_SOFF	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned off after motor stops.
05	CMDINH_Free_SOFF	Command input is disabled, and motor is free-running when OT occurs. Servo is turned off after motor stops.
06	CMDACK_VCLM=0	Velocity limit command for the direction on which OT occured becomes zero when OT occurs.
08	CMDINH_SB_SON2	Command input is disabled, and motor is stopped by servo-brake operation (with sequence torque limit) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Torque command for both side is limited by the sequence torque limit.)

- ◆ Torque limit value differs depending on selection code, when stopping a servo motor by servo-brake.

  00: Peak torque
  03, 08: Sequence torque limit
- ◆ For the velocityt control mode, select from 00 to 05 or 08.
- ◆ For the torque control mode, operates as follows:
  - ● For 00 to 02 or 08, keeps servo-on state with torque command limitation by sequence torque limit.
  - ● For 03 or 04, shift to servo-off state and stop with dynamic brake. Also keeps servo-off state after motor stop.
  - ● For 05, shift to servo-off state and becobe freerun operation. Also keeps servo-off state after motor stop.
  - ◆ “Stop motor by servo-braking” when OT occurs.
    When selecting [08:_CMDINH_SB_SON2], torque value when servo-brake is working can be set by sequence operation torque limit value.

Group	ID	Symbol	Contents
8	39	SQTCLM	Sequence operation torque limit value

－Group9－

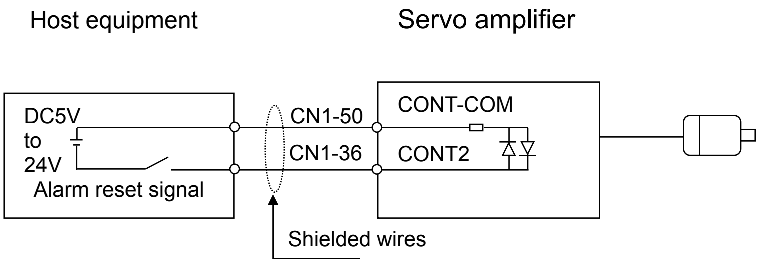
<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">02</td><td>Alarm reset function
[AL-RST]</td></tr>
<tr><td>

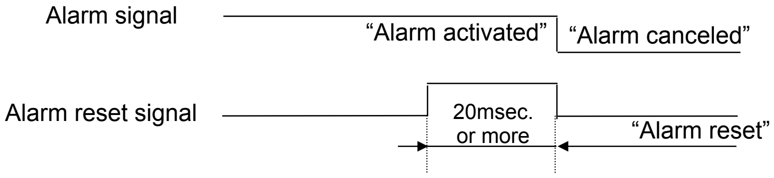
■ This function enables inputting alarm reset signal from host equipment. Alarm is cleared by enabling alarm reset function (AL-RST).

◆ Allocating conditions to enable alarm reset function. When AL-RST signal enabled, this function clears alarms.

✔ Please note that the alarms which needs control power-cycle for alarm reset are not able to clear by alarm reset signal.

◆ The wiring is as follows when enabling conditions allocation is set to CONT2.
Logic can be changed by selecting options of enabling conditions allocation.



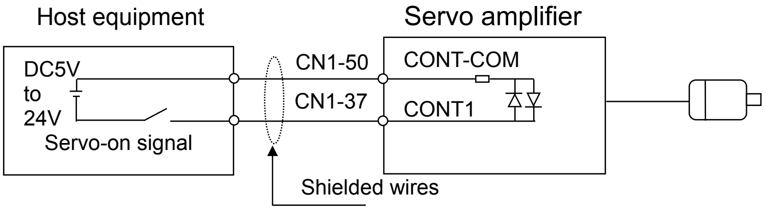


</td></tr>
<tr><td rowspan="2">05</td><td>Servo-on function [S-ON]
[S-ON]</td></tr>
<tr><td>

■ This function is to input servo-on signal from host equipment. Enabling servo-on function (SON) can put servo motor into current-applied state.

◆ Allocating conditions to enable servo-on function. When SON signal is enabled, the servo motor will be into current-applied state.

◆ The wiring is as follows when enabling conditions allocation is set to CONT1. Logic can be changed by selecting options of enabling conditions allocation.



</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">10</td><td>Control mode switching function
[MS]</td></tr>
<tr><td>
■ 2 types of control mode can be switched and used.
The control mode combination is selected by system parameter and can be switched with control mode switching function.
◆ Selecting control modes from system parameters ID06.
<table>
<tr><th>ID</th><th>Name</th><th>Setting range</th></tr>
<tr><td>06</td><td>Control mode</td><td>6 methods</td></tr>
</table>
<table>
<tr><th>Setting</th><th>Contents</th></tr>
<tr><td>03: Velo—Torq</td><td>Velocity control - torque control switching type</td></tr>
<tr><td>04: Posi—Torq</td><td>Position control - torque control switching type</td></tr>
<tr><td>05: Posi—Velo</td><td>Position control - velocity control switching type</td></tr>
</table>
✔ After setting changed --> The setting is enabled by re-turning on control power supply.

◆ Allocating conditions to enable control mode switching function. When MS signal is valid, control mode is switched.

◆ When using control mode switching type, “Auto-notch frequency tuning”, “Auto-vibration suppression frequency tuning”, and “JOG-operation” may not be used. Please use “Auto-notch frequency tuning”, “Auto-vibration suppression frequency tuning,” and “JOG-operation” after changing control mode to primary side (turning off “input signal”).
</td></tr>
<tr><td rowspan="2">11</td><td>Position command pulse inhibiting function･velocity-zero stop function
[INH/Z-STP]</td></tr>
<tr><td>
■ When operating in position control mode, you use position command pulse inhibiting function (INHIBIT function), when in velocity control mode, you use velocity-zero stop function.

◆ Enabling the function during servo motor operation inhibits input command, and then servo motor stops with the state servo motor being excited.
✔ When operating in position control mode, input pulse is not counted inside of the servo amplifier even if position command pulse is input.

◆ Allocating conditions to enable position command pulse inhibiting function/ velocity-zero stop function. This functions when INH/Z-STP signal is enabled.
</td></tr>
<tr><td rowspan="2">13
14</td><td>Gain switching condition 1 [GC1]
Gain switching condition 2 [GC2]</td></tr>
<tr><td>
■ 4 types of gain can be used by switching them.

◆ Allocating conditions to enable gain switching condition. You can switch GAIN 1 to 4 by combination of GC1 and GC2 setting.
<table>
<tr><td>GC1 : Gain switching condition 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>GC2 : Gain switching condition 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Gain becoming valid</td><td>GAIN1</td><td>GAIN2</td><td>GAIN3</td><td>GAIN4</td></tr>
</table>
</td></tr>
</table>

－Group9－

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">15
16</td><td>FF vibration suppression frequency selecting input A1 [SUPFSELA1]
FF vibration suppression frequency selecting input A2 [SUPFSELA2]</td></tr>
<tr><td>

■ 4 types of FF vibration suppression frequency can be used by switching them.

◆ Allocating conditions to enable FF vibration suppression frequency selecting input. You can switch FF vibration suppression frequency A1 to A4 by combination of SUPFSELA1 and SUPFSELA2 setting.

<table>
<tr><td>SUPFSELA1: FF vibration suppression frequency selecting input A1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>SUPFSELA2: FF vibration suppression frequency selecting input A2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Vibration suppression becoming valid</td><td>FF vibration suppression frequency A1
Group 2
ID00</td><td>FF vibration suppression frequency A2
Group 4
ID40</td><td>FF vibration suppression frequency A3
Group 4
ID41</td><td>FF vibration suppression frequency A4
Group 4
ID42</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">17
18</td><td>FF vibration suppression frequency selecting input B1 [SUPFSELB1]
FF vibration suppression frequency selecting input B2 [SUPFSELB2]</td></tr>
<tr><td>

■ 4 types of FF vibration suppression frequency can be used by switching them.

◆ Allocating conditions to enable FF vibration suppression frequency selecting input. You can switch FF vibration suppression frequency B1 to B4 by combination of SUPFSELB1 and SUPFSELB2 setting.

<table>
<tr><td>SUPFSELB1: FF vibration suppression frequency selecting input B1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>SUPFSELB2: FF vibration suppression frequency selecting input B2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Vibration suppression becoming valid</td><td>FF vibration suppression frequency B1
Group 2
ID02</td><td>FF vibration suppression frequency B2
Group 4
ID43</td><td>FF vibration suppression frequency B3
Group 4
ID44</td><td>FF vibration suppression frequency B4
Group 4
ID45</td></tr>
</table>

</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>19</td><td>Position loop proportional control switching function
[PLPCON]
■ You can switch between position loop PI control and P control. Enabling position loop proportional control switching function (PLPCON) enable switching.
◆ Allocating conditions to enable position loop proportional control switching function. When PLPCON signal enabled, the control is switched to proportional control.
● PI control (proportional･integral control)･･Position loop proportional gain (KP)/ integral time constant (TPI)
● P control (proportional control)･･････ Position loop proportional gain (KP)
✔ In the standard setting, position loop integral time constant (TPI) is 1000.0ms, so integration function is disabled.
◆ Automatically overwrite by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.</td></tr>
<tr><td>1A</td><td>Model following (vibration suppression) control/ standard position control switching function
[MODEL]
■ Enabling Model following (vibration suppression) control.
◆ This setting value is valid only when Control mode selection is "03: Velocity / Torque control switching type" or "04: Position / Torque control switching type".
✔ Valid condition is limited to 00 to 11.
✔ Do not perform switching of the model following (vibration suppression) control and the standard position control, during servo motor operation. Alarm (Model Following Vibration Suppression Control Error (AL.C5)) may occur.</td></tr>
<tr><td>1B
1C</td><td>Model vibration suppression frequency selecting input 1 [MDLFSEL1]
Model vibration suppression frequency selecting input 2 [MDLFSEL2]
■ 4 types of model vibration suppression frequency can be used by switching them.
◆ Allocating conditions to enable model control antiresonant frequency selecting input. You can switch model control antiresonant frequency 1 to 4/ model control antiresonant frequency 1 to 4 by combination of MDLFSEL1 with MDLFSEL2.
<table>
<tr><td>MDLFSEL1: Model vibration suppression frequency selecting input 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>MDLFSEL2: Model vibration suppression frequency selecting input 2</td><td>Invalid</td><td>Invalid</td><td>Valid</td><td>Valid</td></tr>
<tr><td></td><td>↓</td><td>↓</td><td>↓</td><td>↓</td></tr>
<tr><td>Vibration suppression frequency becoming valid</td><td>Model control antiresonant frequency 1
Group 3 ID06
Model control resonant frequency 1
Group 3 ID07</td><td>Model control antiresonant frequency 2
Group 4 ID50
Model control resonant frequency 2
Group 4 ID51</td><td>Model control antiresonant frequency 3
Group 4 ID52
Model control resonant frequency 3
Group 4 ID53</td><td>Model control antiresonant frequency 4
Group 4 ID54
Model control resonant frequency 4
Group 4 ID55</td></tr>
</table></td></tr>
</table>

－Group9－

ID	Contents
27	Velocity loop proportional control switching function [VLPCON] ■ You can switch between velocity loop PI control and P control. ◆ Enabling velocity loop proportional control switching function (VLPCON) enables switching. ◆ Allocating conditions to enable velocity loop proportional control switching function. When VLPCON signal is enabled, the control is switched to proportional control. ● PI control (proportional･integral control)･･Velocity loop proportional gain (KVP)/ integral time constant (TVI) ● P control (proportional control)･･････ Velocity loop proportional gain (KVP) ✔ Switching to proportional control decreases servo gain, and servo system becomes easy to stable. ✔ In the default setting, the velocity loop integral time constant (TVI) is 1000.0ms, so the integral function is invalid. ◆ Automatically overwrite by Auto-tuning result saving. ◆ When Auto-tuning function is valid, this setting value is not applied.
34	Stick-slip behavior compensation function [STC] ■ This enables stick motion compensation function in quadrant to compensate trajectory error occurred due to quadrant switching, for use in applications for arc-shape or curved surface process, such as NC machining equipments. ◆ The conditions for enabling compensatory function for stick-slip behavior are assigned. The compensatory function for stick-slip behavior becomes enabled If the STC signal is valid.
35	Minor vibration suppression function [FBHYST] ■ Minor vibration suppression function to suppress mechanical system-induced vibration caused by encoder pulse modulation is enabled when motor stops. ◆ The conditions for enabling minor vibration suppression function are assigned. The minor vibration suppression function becomes enabled If the FBHYST signal is valid.
40	External trip input function [EXT-E] ■ Contact input such as external thermal device can be taken in servo amplifier, and then output as an alarm (AL.55). ◆ Allocating conditions to enable external trip function. When EXT-E signal is enabled, this becomes alarm (AL.55).
41	Emergency stop function [EMR] ■ This can urgently stop servo motor by taking unit emergency signal into servo amplifier. ◆ Allocating conditions to enable unit emergency signal. When EMR signal is enabled, motor urgently stops.

ID	Contents
80	Axes-sync compensation function [SYNCEN]
	■ Tandem operation function will work when "01: Tandem" is set to system parameter ID08 "Amplifier communication function", and this parameter is valid. ✔ Valid condition is limited to 00 to 11.
81	Axes-sync compensation proportional control switching function [SYNPCNEN]
	■ Able to switch PI control and P control, in the axes-sync compensation function. ◆ Able to switch when this parameter (SYNPCNEN) is valid. ◆ Assign conditions of becoming valid the axes-sync compensation proportional control switching function. Change to proportional control when SYNPCNEN signal is valid. ● PI (Proportional-Integral) control Axes-sync compensation proportional gain (KSCPGN), Axes-sync compensation integral time constant (TSCIGN) ● P (Proportional) control Axes-sync compensation proportional gain (KSCPGN) ✔ Servo system will ease to stable when changing to proportional control by reducing axes-sync compensation value. ✔ In the default setting, the axes-sync compensation integral time constant (TSCIGN) is 1000.0ms, so the integral function is invalid.

- GroupA "General output terminal output condition/ Monitor output selection"

ID	Contents	Setting range	Unit	Default value
00	General Purpose Output 1 [OUT1]	00 to 81	-	18:INP_ON
01	General Purpose Output 2 [OUT2]	00 to 81	-	OC:TLC_ON
02	General Purpose Output 3 [OUT3]	00 to 81	-	02:S-RDY_ON
03	General Purpose Output 4 [OUT4]	00 to 81	-	0A:MBR-ON_ON
04	General Purpose Output 5 [OUT5]	00 to 81	-	33:ALM5_OFF
05	General Purpose Output 6 [OUT6]	00 to 81	-	35:ALM6_OFF
06	General Purpose Output 7 [OUT7]	00 to 81	-	37:ALM7_OFF
07	General Purpose Output 8 [OUT8]	00 to 81	-	39:ALM_OFF
10	Digital Monitor Output Signal Selection [DMON]	00 to 81	-	00:Always_OFF
	■ Selects output signal for Output digital monitor. ◆ The logic is reversed with the Digital monitor. ◆ Output voltage is approximately 5V when OFF, and 0V when ON.			

- Selection Contents list for General Purpose Output OUT1 to General Purpose Output OUT8 /Digital monitor output selection

◆ Fix Output to either selection.

01:Always_ON	00:Always_OFF

◆ When Generic input signal status is to be Output

General Input, CONT1 is ON	3A:CONT1_ON	3B:CONT1_OFF
General Input, CONT2 is ON	3C:CONT2_ON	3D:CONT2_OFF
General Input, CONT3 is ON	3E:CONT3_ON	3F:CONT3_OFF
General Input, CONT4 is ON	40:CONT4_ON	41:CONT4_OFF
General Input, CONT5 is ON	42:CONT5_ON	43:CONT5_OFF
General Input, CONT6 is ON	44:CONT6_ON	45:CONT6_OFF
General Input, CONT7 is ON	46:CONT7_ON	47:CONT7_OFF
General Input, CONT8 is ON	48:CONT8_ON	49:CONT8_OFF

◆ When Servo amplifier Preset status is to be output.

While Servo Ready Complete	02:S-RDY_ON	03:S-RDY_OFF
While Power Supply ON	04:P-ON_ON	05:P-ON_OFF
While Power Supply ON Permission	06:A-RDY_ON	07:A-RDY_OFF
While Motor Excitation	08:S-ON_ON	09:S-ON_OFF
While Holding Brake Excitation Signal Output	0A:MBR-ON_ON	0B:MBR-ON_OFF
While Torque Limiting	0C:TLC_ON	0D:TLC_OFF
While Velocity Limiting	0E:VLC_ON	0F:VLC_OFF
While Low Speed Status	10:LOWV_ON	11:LOWV_OFF
While Speed Attainment Status	12:VA_ON	13:VA_OFF
While Speed Matching Status	14:VCMP_ON	15:VCMP_OFF
While Speed Zero Status	16:ZV_ON	17:ZV_OFF
While Command Acceptance Permission Status	1C:CMD-ACK_ON	1D:CMD-ACK_OFF
While Gain Switching Status	1E:GC-ACK_ON	1F:GC-ACK_OFF
While Velocity Loop Proportional Control Switching Status	20:PCON-ACK_ON	21:PCON-ACK_OFF
While Electronic Gear Switching Status	22:GERS-ACK_ON	23:GERS-ACK_OFF
While Control Mode Switching Status	24:MS-ACK_ON	25:MS-ACK_OFF
While Forward Over-Travel Status	26:F-OT_ON	27:F-OT_OFF
While Reverse Over-travel Status	28:R-OT_ON	29:R-OT_OFF
While Main Circuit Power Supply Charging	4A:CHARGE_ON	4B:CHARGE_OFF
While Dynamic Braking	4C:DB_OFF	4D:DB_ON
While Torque Attainment Status	5E:TA_ON	5F:TA_OFF
While Model control/ Model vibration suppression control Status	68:MODLCH_ON	69:MODLCH_OFF
While Velocity command zero status	6A:VCZV_ON	6B:VCZV_OFF

- When Positioning signal is to be output

While In-Position Status	18:INP_ON	19:INP_OFF
While Near Range Status	1A:NEAR_ON	1B:NEAR_OFF
While In-Position with Position Command 0 Status	5A:INPZ_ON	5B:INPZ_OFF
While position command distribution completion status	60:TRJCMP_ON	61: TRJCMP_OFF

- When Warning signal is to be output

While Position Deviation Excess Warning Status	2A:WNG-OFW_ON	2B:WNG-OFW_OFF
While Overload Warning Status	2C:WNG-OLW_ON	2D:WNG-OLW_OFF
While Regenerative Overload Warning Status	2E:WNG-ROLW_ON	2F:WNG-ROLW_OFF
While Encoder Warning status	30:WNG-BAT_ON	31:WNG-BAT_OFF
While Voltage Sag Warning Status	5C:PEWNG_ON	5D:PEWNG_OFF
While dual position error excess warning status	66:DFWNG_ON	67:DFWNG_OFF
While adaptive notch filter E frequency warning status	6E:ANFEWNG_ON	6F:ANFEWNG_OFF
While axes-sync error warning status	80:SYNCEWNG_ON	81:SYNCEWNG_OFF

- When Alarm signals are to be output

Alarm Code Bit 5	32:ALM5_ON	33:ALM5_OFF
Alarm Code Bit 6	34:ALM6_ON	35:ALM6_OFF
Alarm Code Bit 7	36:ALM7_ON	37:ALM7_OFF
While Alarm Status	38:ALM_ON	39:ALM_OFF

- When PY compatible alarm signals are to be output

PY Compatible Alarm Code 1	50:PYALM1_ON	51:PYALM1_OFF
PY Compatible Alarm Code 2	52:PYALM2_ON	53:PYALM2_OFF
PY Compatible Alarm Code 4	54:PYALM4_ON	55:PYALM4_OFF
PY Compatible Alarm Code 8	56:PYALM8_ON	57:PYALM8_OFF

✔ "Torque limiting" is performed at "before torque limit filter" and "after torque command filter/torque FF compensation", by equipping the torque FF compensation function. "While Torque Limiting" is output when either condition is established. Therefore, confirm each state of the torque command monitor and the torque command monitor (before filter), for "Torque limiting".

－GroupA－

ID	Contents	Setting range	Unit	Default value
11	Analog Monitor Select Output 1 [MON1]	00 to 36	-	05:VMON_2mV/min^{-1}
12	Analog Monitor Select Output 2 [MON2]	00 to 36	-	02:TCMON_2V/TR

■ Selects output signals to output to Analog monitor 1 and 2 from the list below.

00:RESERVE	Monitor mode for manufacturer only	-
01:TMON_2V/TR	Torque Monitor	2V/Rated torque
02:TCMON_2V/TR	Torque Command Monitor	2V/Rated torque
03:VMON_0.2mV/ min^{-1}	Velocity Monitor	0.2mV/min^{-1}
04:VMON_1mV/ min^{-1}	Velocity Monitor	1mV/min^{-1}
05:VMON_2mV/ min^{-1}	Velocity Monitor	2mV/min^{-1}
06:VMON_3mV/ min^{-1}	Velocity Monitor	3mV/min^{-1}
07:VCMON_0.2mV/ min^{-1}	Velocity Command Monitor	0.2mV/min^{-1}
08:VCMON_1mV/ min^{-1}	Velocity Command Monitor	1mV/min^{-1}
09:VCMON_2mV/ min^{-1}	Velocity Command Monitor	2mV/min^{-1}
0A:VCMON_3mV/ min^{-1}	Velocity Command Monitor	3mV/min^{-1}
0B:PMON_0.01mV/P	Position Deviation Counter Monitor	0.01mV/Pulse
0C:PMON_0.1mV/P	Position Deviation Counter Monitor	0.1mV/Pulse
0D:PMON_1mV/P	Position Deviation Counter Monitor	1mV/Pulse
0E:PMON_10mV/P	Position Deviation Counter Monitor	10mV/Pulse
0F:PMON_20mV/P	Position Deviation Counter Monitor	20mV/Pulse
10:PMON_50mV/P	Position Deviation Counter Monitor	50mV/Pulse
11:FMON1_2mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	2mV/kPulse/s
12:FMON1_10mV/kP/s	Position Command Pulse Frequency Monitor 1 (Position Command Pulse Input Frequency)	10mV/kPulse/s
13:FMON2_0.05mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	0.05mV/kPulse/s
14:FMON2_0.5mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	0.5mV/kPulse/s
15:FMON2_2mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	2mV/kPulse/s
16:FMON2_10mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Controller)	10mV/kPulse/s
17:TLMON_EST_2V/TR	Load Torque Monitor (Estimated Value)	2V/Rated torque
18:Sine-U	U Phase Electronic Angle Sine	8Vpeak
19:ACMON_0.01mV/rad/s^2	Acceleration monitor	0.01mV/rad/s^2

1A:ACMON_0.1mV/rad/s^2	Acceleration monitor	0.1mV/rad/s^2
1B:ACMON_1mV/rad/s^2	Acceleration monitor	1mV/rad/s^2
1C:ACMON_10mV/rad/s^2	Acceleration monitor	10mV/rad/s^2
1D: VBUS_ 1V/DC100V	Bus voltage monitor	1V/DC100V
1E: VBUS_ 1V/DC10V	Bus voltage monitor	1V/DC10V
1F:DFERR_10mV/P	Dual position error monitor	10mV/Pulse
20:DFERR_0.1mV/P	Dual position error monitor	0.1mV/Pulse
21:SYNERR_10mV/P	Axes-sync error monitor	10mV/Pulse
22:SYNERR_0.1mV/P	Axes-sync error monitor	0.1mV/Pulse
23:OLRAT_0.5V/%	Overload detection temperature reach rate monitor	0.5V/%
24:FMON1_0.01mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.01mV/kPulse/s
25:FMON1_0.05mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.05mV/kPulse/s
26:FMON1_0.5mV/kP/s	Position command pulse frequency monitor 1 (Position command pulse input frequency)	0.5mV/kPulse/s
27:FMON2_0.01mV/kP/s	Position command pulse frequency monitor 2 (Position command pulse input frequency)	0.01mV/kPulse/s
28:MAVEPOW_1V/10W	Average power monitor	1V/ 10W
29:MAVEPOW _1V/100W	Average power monitor	1V/ 100W
2A:MAVEPOW _1V/1kW	Average power monitor	1V/ 1kW
2B:MAVEPOW _1V/10kW	Average power monitor	1V/ 10kW
2C:MAVEPOW _1V/100kW	Average power monitor	1V/ 100kW
2D:TMON2_2V/TR	Torque Command Monitor (before filter)	2V/Rated torque
34:JRAT_10mV/%	Load inertia moment ratio monitor	10mV/%
35:JRAT_5mV/%	Load inertia moment ratio monitor	5mV/%
36:JRAT_0.5mV/%	Load inertia moment ratio monitor	0.5mV/%

◆ Position command pulse frequency monitor 1 monitors Position command pulse before the Electronic gear.

◆ Position command pulse frequency monitor 2 monitors Position command pulse after passing through the Electronic gear and Position command smoothing.

✔ Position command pulse frequency monitor 1, 2 will be generated in pulse-state when the position command pulse is 10 kHz or less. When converting it to position command frequency, use it after averaging.

◆ The following low-pass filters are placed into torque monitor, acceleration monitor, and load torque monitor.

Torque monitor	250Hz
Velocity monitor	250Hz
Load torque monitor	50Hz

◆ Torque Command Monitor (before filter) outputs the state before filter, so torque command is shown with ripple. However, motor is driven by the torque command after filter. Therefore, it differs from motor behavior.

－GroupA－

ID	Contents			
13	Analog Monitor Output Polarity [MONPOL]	Setting range	Unit	Default value
		00 to 08	-	00:MON1+_MON2+

■ Selects Output polarity of Analog monitor output, MON1and MON2 from below.

◆ For both MON1 and MON2, set from any of the followings:
+ No Polarity Rotation, - Polarity Rotation, ABS Absolute Value Output

Selection	Contents
00:MON1+_MON2+	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage.
01:MON1-_MON2+	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage.
02:MON1+_MON2-	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
03:MON1-_MON2-	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
04:MON1ABS_MON2+	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
05:MON1ABS_MON2-	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage.
06:MON1+_MON2ABS	MON1: Output positive voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.
07:MON1-_MON2ABS	MON1: Output negative voltage at Forward (Positive) Rotation. Output positive/negative voltage. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.
08:MON1ABS_MON2ABS	MON1: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation. MON2: Output positive voltage at Forward (Positive) and Reverse (Negative) Rotation.

■ GroupB "Sequence/Alarm related settings"

ID	Contents	Setting range	Unit	Default value
00	Servo-OFF stop behavior [DBOPE]	00 to 07	-	04:SB_Free

■ Sets the stop behavior when state changed to servo OFF from servo ON, and the dynamic brake operation during servo OFF.

Selection		Contents
00	Free_Free	Free run works, at servo OFF. Motor gets free state, after motor stop.
01	Free_DB	Free run works, at servo OFF. Dynamic brake works, after motor stop.
02	DB_Free	Dynamic brake works, at servo OFF. Motor gets free state, after motor stop.
03	DB_DB	Dynamic brake works, at servo OFF. Dynamic brake works, after motor stop.
04	SB_Free	Servo brake works, at servo OFF. Motor gets free state, after motor stop.
05	SB_DB	Servo brake works, at servo OFF. Dynamic brake works, after motor stop.
06	Dec_Free	Stop after deceleration, at servo OFF. Motor gets free state, after motor stop.
07	Dec_DB	Stop after deceleration, at servo OFF. Dynamic brake works, after motor stop.

◆ Set the deceleration time constant of decelerate stop, into GroupB ID15.

✔ Motor stops by the action which set in GroupB ID02 "Emergency Stop Operation" if Main circuit power is shut down, and dynamic brake will work after stop. However if "Main Circuit Under-voltage" or "BONBGN passing" are detected during stopping, motor stops by dynamic brake operation.

－GroupB－

ID	Contents	Setting range	Unit	Default value
01	Over-Travel Action [ACTOT]	00 to 08	-	00:CMDINH_SB_SON

■ Selects operations at over-travel action.

Selection		Contents
00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking (with peak torque) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Torque command for OT side is limited by the sequence torque limit.)
01	CMDINH_DB_SON	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
02	CMDINH_Free_SON	Command input is disabled, and motor is free-running when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
03	CMDINH_SB_SOFF	Command input is disabled, and motor is stopped by servo-braking when OT occurs. Servo is turned off after motor stops. (Torque command for both side is limited by the sequence torque limit.)
04	CMDINH_DB_SOFF	Command input is disabled, and motor is stopped by dynamic-braking when OT occurs. Servo is turned off after motor stops.
05	CMDINH_Free_SOFF	Command input is disabled, and motor is free-running when OT occurs. Servo is turned off after motor stops.
06	CMDACK_VCLM=0	Velocity limit command for the direction on which OT occured becomes zero when OT occurs.
08	CMDINH_SB_SON2	Command input is disabled, and motor is stopped by servo-brake operation (with sequence torque limit) when OT occurs. Servo is turned on after motor stops. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0) (Torque command for both side is limited by the sequence torque limit.)

- ◆ Torque limit value differs depending on selection code, when stopping a servo motor by servo-brake.
  00: Peak torque
  03, 08: Sequence torque limit
- ◆ For the velocityt control mode, select from 00 to 05 or 08.
- ◆ For the torque control mode, operates as follows:
  - ● For 00 to 02 or 08, keeps servo-on state with torque command limitation by sequence torque limit.
  - ● For 03 or 04, shift to servo-off state and stop with dynamic brake. Also keeps servo-off state after motor stop.
  - ● For 05, shift to servo-off state and becobe freerun operation. Also keeps servo-off state after motor stop.

－GroupB－

ID	Contents	Setting range	Unit	Default value
02	Emergency Stop Operation [ACTEMR]	00 to 02	-	00:SERVO-BRAKE

- ■ Sets operation at Emergency Stop
  - ◆ Selects operation at the time of emergency stop.
    In case of vertical axis use, please use it with default setting (00: SERVO-BRAKE).

Selection		Contents
00	SERVO-BRAKE	Stops servo motor by operating servo brake at Emergency stop.
01	DYNAMIC-BRAKE	Stops servo motor by operating dynamic brake at Emergency stop.
02	DEC-STOP	Stops servo motor after deceleration at Emergency stop.

  - ◆ Under Torque control mode, dynamic brake stops servo motor regardless of the setting value.
  - ◆ If the alarm that has DB in "Detection operations" at 8.2.2 Alarm list occurs, and no Safe Torque Off function (servo amplifier model number option 2 is 0), stops servo motor by dynamic brake regardless of this setting.
  - ◆ Sets the deceleration time constant of deceleration stop at GroupB ID16.

    ✔ Forced stop operation means “emergency stop function enabled”, “main circuit power shutoff“, ”alarm activated” and “safe-torque-off operation”.

ID	Contents	Setting range	Unit	Default value
03	Delay Time of Engaging Holding Brake (Holding Brake Holding Delay time) [BONDLY]	0 to 1000	ms	300

- ■ Sets the holding-brake-activation delay time from when power distribution to holding brake stopped till when holding torque generated.
  - ◆ While shifting from servo ON to servo OFF, during the setting time, Excitation command 0 is given to servo motor. (Even when servo is turned OFF, power is supplied to the motor until the setting time is over).
    By this, until Holding brake functions, servo motor generates Holding torque.
  - ◆ Setting unit is 4ms. When the setting value is 0ms, after servo OFF, command is invalid (command 0) for approximately 4ms.
  - ◆ At the setting, GroupB ID00 [DBOPR] Servo-OFF stop behavior, when servo brake is ON at servo OFF, (04 SB_Free or 05 SB_DB), this is valid.
    (This function is invalid in Dynamic brake operation and Free-run operation.)

ID	Contents	Setting range	Unit	Default value
04	Delay Time of Releasing Holding Brake (Holding Brake Releasing Delay time) [BOFFDLY]	0 to 1000	ms	300

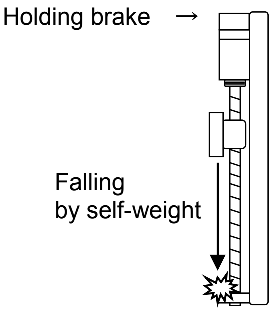
- ■ Sets the holding-brake-release delay time from when power distribution to holding brake started till when holding torque disappeared.
  - ◆ While shifting from servo OFF to servo ON, during the setting time, Excitation command 0 is given to servo motor. (Even when servo is turned ON, command is not accepted until the setting time is complete.)
    Therefore, until Holding brake is released, servo motor does not operate.
  - ◆ Setting unit is 4ms. When the setting value is 0ms, after servo ON, command is invalid (command 0) for approximately 4ms.

ID	Contents	Setting range	Unit	Default value
05	Brake Operation Beginning Time [BONBGN]	0 to 65535	ms	10000

- ■ Sets permissible time from servo OFF until servo motor stop.
  - ◆ While shifting servo ON to servo OFF, even after the selected time passed and the servo motor does not stop. Servo motor is forced to stop with Holding brake and Dynamic brake.
  - ◆ When the servo motor stops this setting does not function.
  - ◆ When servo motor does not stop after servo OFF at gravity axis, set this parameter.
  - ◆ When forced to stop by holding brake, the Holding brake may possibly be broken.
    Be cautious about device specifications and sequence when using this function.

■ About Holding Brake

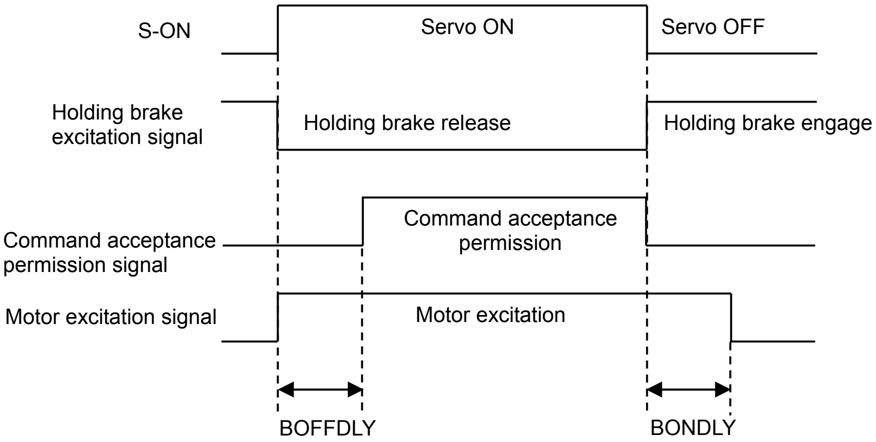
Servo motor with Holding brake function is usually used with an axis that is always affected by gravity and external forces in order to avoid movable parts falling off from its position when main circuit power is OFF, or servo OFF.
Holding brake is to support the movable parts against gravity and other external force when at rest.
Do not use it to stop a moving machine.



◆ Setting for Holding brake excitation signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Output*

Selection		Contents
0A	MBR-ON_ON	While Holding brake excitation signal output, output ON.
0B	MBR-ON_OFF	While Holding brake excitation signal output, output OFF.



ID | Contents

06

Power Failure Detection Delay Time	Setting range	Unit	Default value
[PFDDLY] “Power cycle for control after setting”	20 to 1000	ms	32

■ Sets the delay time from Control power OFF to Control power error detection.
The larger value makes the detection of Instantaneous stop slower.
(Control power holding time:
200V ac input type: about 100msec
100V ac input type: about 80msec
Larger set value will only result in slower detections of errors. In case of power failure of Internal logic circuit, operation is same as when Control power is turned ON again. In case of energy shortage of Main circuit power, other errors such as Main circuit power loss may be detected.)
In this setting, actual detection delay time varies by -12ms to +6ms.

07

Initial timeout wait time	Setting range	Unit	Default value
[INTTIM] “Power cycle for control after setting”	00 to 07	-	00:Disabled

■ Selects the time till initialization completion.

Selection		Contents
00	Disabled	Without wait time
01	1000ms	Insert 1000ms wait
02	1400ms	Insert 1400ms wait
03	1800ms	Insert 1800ms wait
04	2000ms	Insert 2000ms wait
05	3000ms	Insert 3000ms wait
06	5000ms	Insert 5000ms wait
07	10000ms	Insert 10000ms wait

10

Excessive Deviation Warning Level	Setting range	Unit	Default value
[OFWLV]	1 to 2147483647	Pulse	2147483647

■ Sets Warning output level before Excessive position deviation alarm is output.
- ◆ Sets at Encoder pulse resolution regardless of Electronic gear.
  - ✔ It will be limited to 1073741823 [Pulse] if the value is set exceeding 1073741823[Pulse].

11

Deviation Counter Overflow Value	Setting range	Unit	Default value
[OFLV]	1 to 2147483647	Pulse	5000000

■ Sets Position deviation value regarded as Excessive position deviation alarm.
- ◆ Sets at Encoder pulse resolution regardless of Electronic gear.
  - ✔ It will be limited to 1073741823 [Pulse] if the value is set exceeding 1073741823[Pulse].

12

Overload Warning Level	Setting range	Unit	Default value
[OLWLV] “Power cycle for control after setting”	20 to 100	%	90

■ Sets the Warning output level before Overload alarm output.
- ◆ The possible level to be set is from 20%-99%, assuming that the Overload Warning Level is 100%. When set to 100%, Overload warning and Overload alarm are output at one time.
- ◆ Overload detection is assumed and set as 75%, of a rated load when Control power is turned ON (hot start). Therefore, Overload warning may be output when Control power is turned ON.

13

Velocity Feedback Alarm (ALM_C3) Detection	Setting range	Unit	Default value
[VFBALM]	00 to 01	-	01:Enabled

■ Selects Valid/Invalid Velocity feedback error detection.

Selection		Contents
00	Disabled	Invalid
01	Enabled	Valid

－GroupB－

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>14</td><td>
<table>
<tr><td rowspan="2">Velocity Control Alarm (ALM_C2) Detection [VCALM]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Disabled</td></tr>
</table>
■ Selects Valid/Invalid Velocity control error detection.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Disabled</td><td>Invalid</td></tr>
<tr><td>01</td><td>Enabled</td><td>Valid</td></tr>
</table>
In such an operation pattern as causing a servo motor overshoot to the command, Velocity control error may be detected by mistake. For this, set this parameter to invalid.
</td></tr>
<tr><td>15</td><td>
<table>
<tr><td rowspan="2">Deceleration Time Constant at Servo off Stopping [SOFDEC]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
</table>
■ This is the parameter which sets the deceleration time constant in case of servo OFF during servo motor rotation.
Sets deceleration time per 1000 min^{-1}.
Will be valid when 06 or 07 is set to GroupB ID00.
</td></tr>
<tr><td>16</td><td>
<table>
<tr><td rowspan="2">Deceleration Time Constant at Emergency Stopping [EMRDEC]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
</table>
■ This is the parameter which sets the deceleration time constant in case of Emergency stop (Status of "emergency stop function enabled", "main circuit power shutoff", "alarm activated" and "safe-torque-off operation") during servo motor rotation.
Sets deceleration time per 1000 min^{-1}.
Will be valid when 02 is set to GroupB ID02.
◆ Operation will shift to dynamic brake stop sequence when main circuit power falls lower or safe torque-off time has passed during deceleration stop.
</td></tr>
<tr><td>17</td><td>
<table>
<tr><td rowspan="2">External command effectivity selection at holding brake operation cancellation delay time [SONFALL]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Disabled</td></tr>
</table>
■ Selects valid/invalid of external position/velocity command during the holding-brake-release delay time.
Self weight fall can suppress at servo ON by setting of position/velocity command that corresponded to gravity load or external load.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Disabled</td><td>Invalid</td></tr>
<tr><td>01</td><td>Enabled</td><td>Valid</td></tr>
</table>
◆ As notes, when the command that exceeds gravity load or external load is given, servo motor will rotate and it may cause of holding-brake failure.
</td></tr>
<tr><td>18</td><td>
<table>
<tr><td rowspan="2">External command effectivity selection at holding brake operation delay time [SOFFFALL]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Disabled</td></tr>
</table>
■ Selects valid/invalid of external position/velocity command during the holding-brake-activation delay time.
Self weight fall can suppress at servo OFF by setting of position/velocity command that corresponded to gravity load or external load.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Disabled</td><td>Invalid</td></tr>
<tr><td>01</td><td>Enabled</td><td>Valid</td></tr>
</table>
◆ As notes, when the command that exceeds gravity load or external load is given, servo motor will rotate and it may cause of holding-brake failure.
</td></tr>
</table>

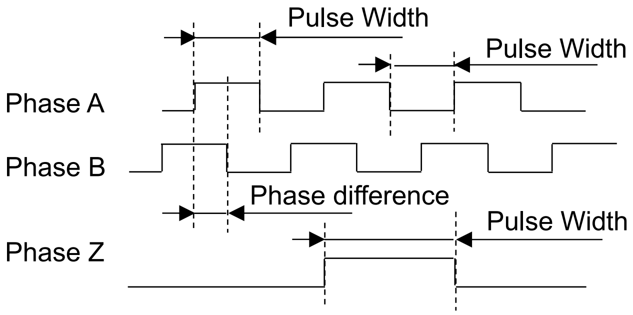
<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">19</td><td rowspan="2">Dual position error warning level
[DFOFWLV]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 2147483647</td><td>Pulse</td><td>2147483647</td></tr>
<tr><td colspan="4">■ Warning is output when current position difference between external encoder and motor encoder exceeds this value. Using as warning output before the Dual position error excess alarm occurs.
✔ Sets 4 multiples of external encoder resolution as standards.
✔ Dual position error excess alarm does not detect when set value is 0.</td></tr>
<tr><td rowspan="3">1A</td><td rowspan="2">Dual position error excess value
[DFOFLV]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 2147483647</td><td>Pulse</td><td>5000000</td></tr>
<tr><td colspan="4">■ Outputs the dual position error excess alarm when current position difference between external encoder and motor encoder exceeds this value.
✔ Sets 4 multiples of external encoder resolution as standards.
✔ Dual position error excess alarm does not detect when set value is 0.</td></tr>
<tr><td rowspan="3">80</td><td rowspan="2">Axes-sync error warning level
[PSDEVW]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>2147483647</td></tr>
<tr><td colspan="4">■ Warning occurs when position deviation error between own axis and counterpart axis exceeds this set value.
Uses as warning output before outputting the axes-sync error excess alarm.</td></tr>
<tr><td rowspan="3">81</td><td rowspan="2">Axes-sync error excess value
[PSDEVA]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>5000000</td></tr>
<tr><td colspan="4">■ Will be the axes-sync error excess when position deviation error between own axis and counterpart axis exceeds this set value.</td></tr>
</table>

■ GroupC "Encoder related settings"

ID	Contents	Setting range	Unit	Default value
00	Motor Incremental Encoder Digital Filter [ENFIL]	00 to 07	-	01:220ns

■ This parameter is settable only when using incremental encoder.
Sets Digital filter to motor Incremental Encoder.
Pulse lower than the set value is eliminated as noise when noise superposition occurs in encoder signals. Consider Encoder resolution and Maximum rotation velocity of the servo motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.

Selection		Contents
00	110nsec	Minimum Pulse Width =110nsec (Minimum pulse Phase Difference = 37.5nsec)
01	220nsec	Minimum Pulse Width = 220nsec
02	440nsec	Minimum Pulse Width = 440nsec
03	880nsec	Minimum Pulse Width = 880nsec
04	75nsec	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)
05	150nsec	Minimum Pulse Width = 150nsec
06	300nsec	Minimum Pulse Width = 300nsec
07	600nsec	Minimum Pulse Width = 600nsec



ID	Contents	Setting range	Unit	Default value
01	External Incremental Encoder Digital Filter [EX-ENFIL]	00 to 07	-	01:220ns

■ This parameter is settable only when using fully closed control function.
Sets Digital filter to External Incremental Encoder.
Pulse lower than the set value is eliminated as noise when noise superposition occurred in encoder signals. Consider Encoder resolution and Maximum rotation velocity of the servo motor in operation when selecting value. Set the value roughly less than 1/4 of the Encoder pulse width at Maximum rotation velocity.

Selection		Contents
00	110nsec	Minimum Pulse Width =110nsec (Minimum pulse Phase Difference = 37.5nsec)
01	220nsec	Minimum Pulse Width = 220nsec
02	440nsec	Minimum Pulse Width = 440nsec
03	880nsec	Minimum Pulse Width = 880nsec
04	75nsec	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)
05	150nsec	Minimum Pulse Width = 150nsec
06	300nsec	Minimum Pulse Width = 300nsec
07	600nsec	Minimum Pulse Width = 600nsec

ID	Contents			
02	External Encoder Polarity Selection [EX-ENPOL] "Power cycle for control after setting"	Setting range 00 to 07	Unit -	Default value 00:Type1

■ This parameter is settable only when using fully closed control function.

◆ Select External encoder signal polarity.

Selection		Contents		
00	Type1	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed
01	Type2	EX-Z/Not Reversed	EX-B/ Not Reversed	EX-A/ Reversed
02	Type3	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Not Reversed
03	Type4	EX-Z/Not Reversed	EX-B/ Reversed	EX-A/ Reversed
04	Type5	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Not Reversed
05	Type6	EX-Z/Reversed	EX-B/ Not Reversed	EX-A/ Reversed
06	Type7	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Not Reversed
07	Type8	EX-Z/Reversed	EX-B/ Reversed	EX-A/ Reversed

ID	Contents			
03	Encoder Output Pulse Divide Selection [PULOUTSEL] "Power cycle for control after setting"	Setting range 00 to 01	Unit -	Default value 00:Motor_Enc.

■ Sets Encoder output pulse division signal.
Select Motor encoder or External encoder to load Encoder pulse to upper device.

Selection		
00	Motor_Enc	Motor Encoder
01	External_Enc	External Encoder

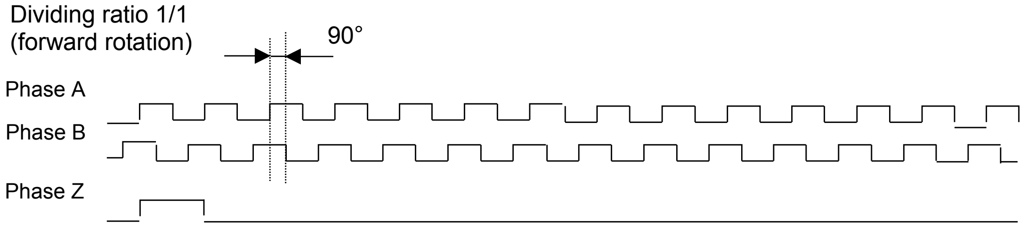
✔ When "00:Motor_Enc" is selected in the system parameter ID20 "Position loop control, position loop encoder selection", motor encoder side is output regardless with the set value.

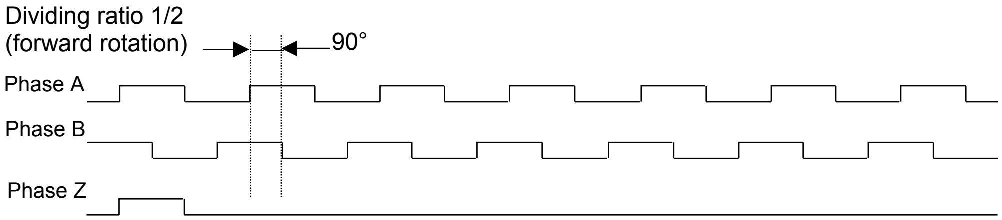
－GroupC－

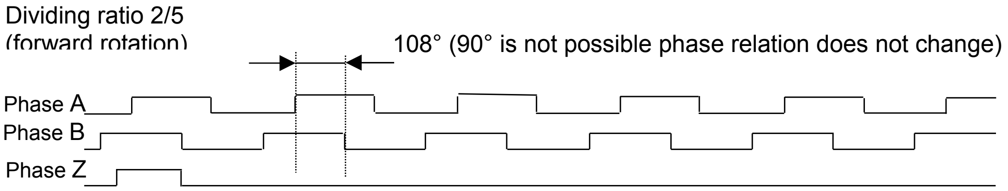
ID	Contents
04	Encoder Output Pulse Division [ENRAT]

Parameter	Setting range	Unit	Default value
Encoder Output Pulse Division [ENRAT]	1/1 to 1/64 2/3 to 2/64 1/32768 to 32767/32768	-	1/1

- ■ Sets ratio of Encoder output pulse division.
  - ◆ When the numerator of the dividing ratio is 1, setting range of the denominator is 1 (not divide), 2-64 or 32768.
  - ◆ When the numerator of the dividing ratio is 2, setting range of the denominator is 3-64 or 32768.
  - ◆ When the denominator of the dividing ratio is 32768, setting range of the numerator is 1-32767.
  - ◆ Z phase output is not divided.
  - ◆ After Control power ON, for 2s at maximum, the ratio is unstable.







ID	Contents
05	Encoder Output Pulse Divide Polarity [PULOUTPOL]

Parameter	Setting range	Unit	Default value
Encoder Output Pulse Divide Polarity [PULOUTPOL]	00 to 03	-	00:Type1

- ■ Sets division polarity of Encoder output pulse.

Selection		Contents
00	Type1	A Phase Signal/Not Reversed Z Phase Signal Logic/High Active
01	Type2	A Phase Signal/Reversed Z Phase Signal Logic/High Active
02	Type3	A Phase Signal/Not Reversed Z Phase Signal Logic/Low Active
03	Type4	A Phase Signal/Reversed Z Phase Signal Logic/Low Active

ID	Contents	Setting range	Unit	Default value
06	Encoder Output Pulse Divide Resolution Selection [PULOUTRES] “Power cycle for control after setting”	00 to 01	-	00:32768P/R

- ■ This parameter is settable only when using absolute encoder.
  - ◆ Sets resolution of Encoder output pulse divide.
  - ◆ Set at 8192P/R to make the Output pulse same as that of RS1 series servo amplifier.
  - ◆ Set at 8192P/R when Output pulse frequency exceeds the specification of the upper controller.
  - ◆ Set at 8192P/R when using servomotor at motor revolution speed of over 4000min^{-1}.
  - ◆ Outputs divided pulse by setting resolution to ID04 Encoder output divide.

Selection		Contents
00	32768P/R	32768 Pulse per 1 Motor Rotation
01	8192P/R	8192 Pulse per 1 Motor Rotation

ID	Contents	Setting range	Unit	Default value
07	Encoder Signal Output(PS) Format [PSOFORM] “Power cycle for control after setting”	00 to 04	-	00:MOT_Binary

- ■ Sets signal format of Encoder signal output (PS).

Selection		Contents
00	MOT_Binary	Encoder Binary Code Output
01	MOT_ASCII	Motor Encoder Decimal ASCII Code Output
02	MOT_Direct	Motor Encoder Signal Direct Output
03	EXT_Binary	External Encoder Binary Code Output
04	EXT_Direct	External Encoder Signal Direct Output

- ◆ The dedicated receiving circuit is needed if “02: Mot_Direct” is selected.
- ◆ “03: EXT_Binary” and “04: EXT_Direct” are able to select when Full-closed control valid.

ID	Contents	Setting range	Unit	Default value
08	Encoder Clear Function Selection [ECLRFUNC]	00 to 01	-	00:Status_MultiTurn

- ■ This parameter is settable only when using absolute encoder.
  - ◆ This is effective when using battery backup absolute encoder (Encoder code: P) and battery-less absolute encoder (Encoder code: R, W).
  - ◆ When using single-turn absolute encoder (Encoder code: H) for incremental system, “clear only encoder status” is set even if “00: Status_MultiTurn” is selected.
  - ◆ For the case an absolute encoder with multi-turn is used, clearing the encoder cannot clear the single turn part of the absolute encoder

Selection		Contents
00	Status_MultiTurn	Clear Encoder Status (Alarm and Warning) and Multi Turn Data
01	Status	Clear Only Encoder Status (Alarm and Warning)

－GroupC－

ID	Contents

0B

External absolute encoder polarity selection [EX-SENPOL] “Power cycle for control after setting”	Setting range	Unit	Default value
	00 to 01	-	00:Standard

- ■ Selects the count polarity of external encoder against motor rotation direction.
  - ◆ Select the polarity to match between the increment/decrement of monitor of ID61/62 (EX-APMON) and the ID10/11 (APMON).
    It becomes valid after control power cycle.
  - ◆ It is valid when an absolute encoder is used as external encoder.

Selection		Contents
00	Standard	Inverts not an encoder operation direction.
01	Reversed	Inverts an encoder operation direction.

0C

External encoder output pulse divide ratio selection [EX-PULDIV] “Power cycle for control after setting”	Setting range	Unit	Default value
	00 to 0B	-	00: 1/4(R)_1/4(L)

- ■ Selects the external encoder output pulse divide ratio when an absolute encoder is used as external encoder.
  - ◆ Selects the external encoder output pulse divide ratio (1/N) when EnDat is used to external encoder.
  - ◆ When the external encoder is angle encoder or rotary encoder, select from the range of 1/4(R) to 1/8192(R).
  - ◆ When the external encoder is linear encoder, select from the range of 1/4(L) to 1/2000(L).

Selection		Contents
00	1/4(R)_1/4(L)	Outputs by following calculation according to encoder type.
01	1/8(R)_1/20(L)	For angle encoder or rotary encoder, outputs the pulse as follows: "Single turn resolution" x (1/N). (Use 1/4(R) to 1/8192(R)) For linear encoder, outputs the pulse as follows: "Resolution" / (1/N). (Use 1/4(L) to 1/2000(L))
02	1/16(R)_1/40(L)	
03	1/32(R)_1/80(L)	
04	1/64(R)_1/120(L)	
05	1/128(R)_1/160(L)	
06	1/256(R)_1/200(L)	
07	1/512(R)_1/400(L)	
08	1/1024(R)_1/800(L)	
09	1/2048(R)_1/1200(L)	
0A	1/4096(R)_1/1600(L)	
0B	1/8192(R)_1/2000(L)	

✔ Output is available up to the frequency of 2Mpulse/sec (multiply 1).
Select the divide ratio in the range less than the frequency above.

EnDat (Angle encoder, Rotary encoder)
Divide ratio is limited to be 32768 pulse/rev or more when ""Single turn resolution" x (1/N) < 32768 pulse/rev." is established.

EnDat (Linear encoder)
Use in the range as follows: 2^{31} x Resolution / ((1/N)x4), based on zero position.
(Z-phase output position might shift if a power cycle is performed after moving to out of the range.)

－GroupC－

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Broken wire mask level at Encoder connector 1
[DE1MSKLVL]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 65535</td><td>kHz</td><td>0</td></tr>
<tr><td colspan="4">■ Sets the encoder pulse frequency (1-multiplied) which masks the detection of "Encoder Connector Disconnection 1 (AL.81)" if the motor encoder is incremental encoder and connect to encoder connector 1 (EN1).
◆ For high resolution incremental encoder, "Encoder Connector Disconnection 1 (AL.81)" might detect at high frequency range depending on its specs. In that case, please change this setting value.
◆ "Encoder Connector Disconnection 1 (AL.81)" does not detect while encoder frequency exceeds this setting value.
◆ "Encoder Connector Disconnection 1 (AL.81)" is detected at all frequency if 0 [kHz] is set.</td></tr>
<tr><td rowspan="3">11</td><td rowspan="2">Broken wire mask level at Encoder connector 2
[DE3MSKLVL]</td><td>Setting range</td><td>Unit</td><td>Default value</td></tr>
<tr><td>0 to 65535</td><td>kHz</td><td>0</td></tr>
<tr><td colspan="4">■ Sets the encoder pulse frequency (1-multiplied) which masks the detection of "Encoder Connector Disconnection 2 (AL.83)" if the encoder is incremental encoder or external encoder and connect to encoder connector 2 (EN2).
◆ For high resolution incremental encoder, "Encoder Connector Disconnection 2 (AL.83)" might detected at high frequency range depending on its specs. In that case, please change this setting value.
◆ "Encoder Connector Disconnection 2 (AL.83)" does not detect while encoder frequency exceeds this setting value.
◆ "Encoder Connector Disconnection 2 (AL.83)" is detected at all frequency if 0 [kHz] is set.</td></tr>
</table>

- GroupD "Supporting function related settings"

ID	Contents			
00	JOG velocity command [JOGVC]	Setting range	Unit	Default value
		0 to 32767	min^{-1}	50
	■ Sets the velocity command value for JOG operation. ◆ This value will be initial setting value of JOG velocity command in the Setup software.			
02	Support function torque limit [TSTTCLM]	Setting range	Unit	Default value
		10.0 to 500.0	%	120.0
	■ Sets the limit value of torque command at the support function (JOG, positioning and homing) operation. ◆ This value will be initial setting value of torque command limit for the support function operation in the Setup software.			
10	Serial Communication Axis Number [COMAXIS] “Power cycle for control after setting”	Setting range	Unit	Default value
		01 to 0F	-	01:#1
	■ Selects axis number when communicating with the setup software. ◆ Please set different number for each axis when multi axes are connecting at once because the setup software identifies servo amplifiers by this number.			
11	Monitor Display Selection [MONDISP]	Setting range	Unit	Default value
		00 to 77	-	00:STATUS
	■ Selects the contents of status display of the digital operator.			

ID 10 selection table:

Selection		Selection		Selection		Selection		Selection	
01	#1	04	#4	07	#7	0A	#A	0D	#D
02	#2	05	#5	08	#8	0B	#B	0E	#E
03	#3	06	#6	09	#9	0C	#C	0F	#F

ID 11 selection table:

Selection		Contents
00	STATUS	Shows the status of servo amplifier. See "5.3 Servo amplifier status display" for details.
01 to 77	WARNING1 to HBLF	Selects the monitor data showing at monitor function. See "5.5 Monitor function" for details.

ID	Contents	Setting range	Unit	Default value
20	Drec. sampling rate [SAMPDIV]	0 to 65535	-	20

- ■ Sets the sampling rate of the Drive recorder.
  - ◆ Minimum sampling rate (Ts) is fixed to 112 μs.
  - ◆ Sampling timing (T) is shown by T=Ts*n, and this parameter sets "n".
  - ◆ Drive recorder will stop if 0 is set.

ID	Contents	Setting range	Unit	Default value
21	Drec. sampling mode [SAMPNUM]	00 to 02	-	00:256point

- ■ Selects total data points per channel that will record by the Drive recorder.
  - ◆ Recordable channel numbers will limit if larger data point is selected.

Selection		Maximum recordable channel at once
00	256point	6 channels
01	512point	3 channels
02	1024point	1 channel

ID	Contents	Setting range	Unit	Default value
22	Drec. Trigger Channel [TRGCHSEL]	00 to 83	-	83:DIGITAL_4

- ■ Selects the channel for trigger on the Drive recorder.
  - ◆ Digital ch. and analog ch. can set.

Selection		Setting value	Selection		Setting value
00	ANALOG_1	Analog CH1	05	ANALOG_6	Analog CH6
01	ANALOG_2	Analog CH2	80	DIGITAL_1	Digital CH1
02	ANALOG_3	Analog CH3	81	DIGITAL_2	Digital CH2
03	ANALOG_4	Analog CH4	82	DIGITAL_3	Digital CH3
04	ANALOG_5	Analog CH5	83	DIGITAL_4	Digital CH4

ID	Contents	Setting range	Unit	Default value
23	Drec. Trigger Slope [TRGEDGSEL]	00 to 02	-	00:POS_EDGE

- ■ Sets the trigger edge condition on the Drive recorder.

Selection		Setting value
00	POS_EDGE	↑ edge
01	NEG_EDGE	↓ edge
02	BOTH_EDGE	↑ edge or ↓ edge

ID	Contents	Setting range	Unit	Default value
24	Drec. Trigger Horizontal Position [TRGHPOS]	0 to 100	%	80

- ■ Sets the horizontal position of trigger on the Drive recorder.
  - ◆ Set the rate of the total sampling time and the trigger position from sampling start by [0 -100%].

ID	Contents	Setting range	Unit	Default value
25	Drec. Trigger Level [TRGLVL]	-9223372036854775808 to 9223372036854775807	-	1

- ■ Set the trigger level on the Drive recorder.
  - ◆ Shows by hexadecimal (32 bit data) at ID25 and ID26 of the Digital operator.

ID	Data range	Display range
25	Bit63 to Bit32	H.8000 L.0000 to H.7FFF L.FFFF
26	Bit31 to Bit0	H.0000 L.0000 to H.FFFF L.FFFF

－GroupD－

ID	Contents	Setting range	Unit	Default value
31	Drec. Analog CH1 selection [CH1SEL]	00 to 23, FF	-	08:PCMDF1
32	Drec. Analog CH2 selection [CH2SEL]	00 to 23, FF	-	01:VCMON
33	Drec. Analog CH3 selection [CH3SEL]	00 to 23, FF	-	03:TCMON
34	Drec. Analog CH4 selection [CH4SEL]	00 to 23, FF	-	15:VBUS
35	Drec. Analog CH5 selection [CH5SEL]	00 to 23, FF	-	05:POSITION
36	Drec. Analog CH6 selection [CH6SEL]	00 to 23, FF	-	00:VMON

■ Selects the data which is measured as Analog channel on the Drive recorder.

- ◆ The datas below will need 2 ch data capacity when it set.
  - ● Present position monitor (Motor encoder/ External encoder)
  - ● Command position monitor
  - ● PS data monitor (Motor encoder/ External encoder)
- ✔ For example, ch.2 setting will invalid if encoder PS data is set to ch.1.
  Above channels will be invalid if sampling point: 1024 is selected.
- ◆ Do not set FF because it is for Manufacturer only.

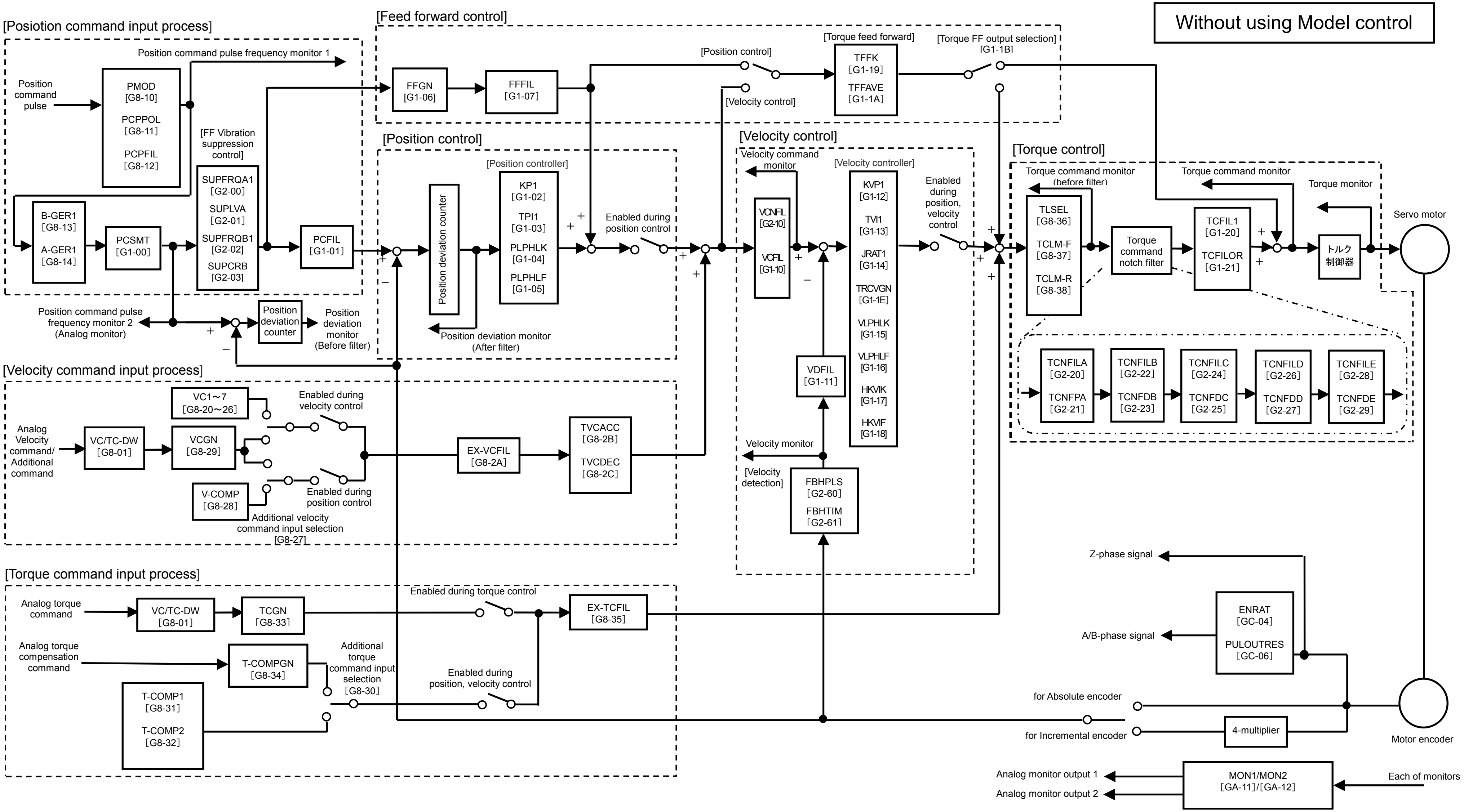
ID		Setting value	ID		Setting value
00	VMON	Velocity monitor	0F	JRAT	Load Inertia Moment Ratio monitor
01	VCMON	Velocity command monitor	10	MTL-EST	Load Torque monitor (Estimate value)
02	TMON	Torque monitor	11	SINEU	U-phase electric angle monitor
03	TCMON	Torque command monitor	12	DFERR	Dual position error monitor
04	PMON	Position deviation monitor	13	ACCMON	Acceleration monitor
05	POSITION	Present position monitor (Motor encoder)	14	ENTEMP	Encoder temperature monitor
06	POSITION-EXT	Present position monitor (External encoder)	15	VBUS	Main circuit bus voltage monitor
07	PCMDSUM	Command position integration value	16	OLRAT	Reaching rate of OL detection level of motor temperature rise estimation value
08	PCMDF1	Position command pulse frequency monitor 1	17	MAVEPOW1	Average power monitor
09	PCMDF2	Position command pulse frequency monitor 2	18	TCMON2	Torque command filter (before filter)
0A	PS_MOT	Absolute encoder PS data monitor (Motor encoder)	19	SYNERR	Axes-sync error monitor
0B	PS_EXT	Absolute encoder PS data monitor (External encoder)	21	RegPOW	Regenerative power monitor
0C	RegR	Regenerative resistor operation percentage monitor	22	MOTE-ERRAT	Error rate of motor encoder communication
0D	TRMS	Effective torque monitor	23	EXTE-ERRAT	Error rate of external encoder communication
0E	ETRMS	Effective torque monitor (Estimated value)	FF	RESERVE	Monitor mode, for manufacturer only

ID	Contents			
37	Drec. Digital CH1 selection	Setting range	Unit	Default value
	[DCH1SEL]	00 to 20, FF	-	16:SRDY
38	Drec. Digital CH2 selection	Setting range	Unit	Default value
	[DCH2SEL]	00 to 20, FF	-	15:SACT
39	Drec. Digital CH3 selection	Setting range	Unit	Default value
	[DCH3SEL]	00 to 20, FF	-	1B:WRG-OL
3A	Drec. Digital CH4 selection	Setting range	Unit	Default value
	[DCH4SEL]	00 to 20, FF	-	1C:ALM

- ■ Selects the data which is measured as Digital channel on the Drive recorder.
  - ◆ Do not set FF because it is for Manufacturer only.

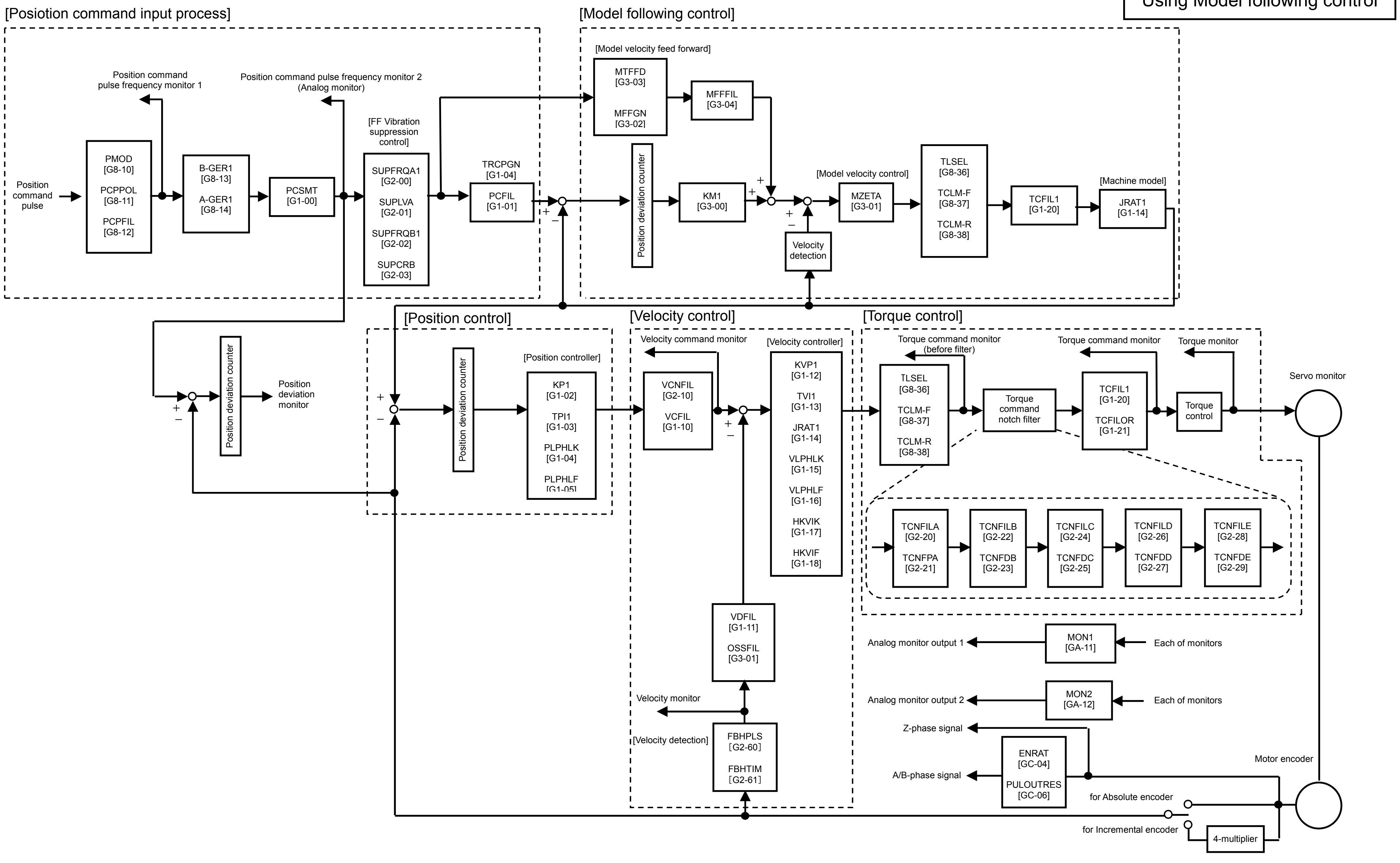
ID		Setting value	ID		Setting value
00	GIN1	General input 1	10	INP	While In-Position Status
01	GIN2	General input 2	11	NEAR	While Near Range Status
02	GIN3	General input 3	12	VCMP	While Speed Matching Status
03	GIN4	General input 4	13	TLIM	While Torque Limiting
04	GIN5	General input 5	14	VLIM	While Velocity Limiting
05	GIN6	General input 6	15	SACT	While Motor Excitation
06	GIN7	General input 7	16	SRDY	While Servo Ready Status
07	GIN8	General input 8	17	CMD-ACK	While Command Acceptance Permission Status
08	GOUT1	General output 1	18	PCON-ACK	While Velocity Loop Proportional Control Switching Status
09	GOUT2	General output 2	19	GC-ACK	While Electronic Gear Switching Status
0A	GOUT3	General output 3	1A	WRG-OVF	While Excessive Deviation Warning Status
0B	GOUT4	General output 4	1B	WRG-OL	While Overload Warning Status
0C	GOUT5	General output 5	1C	ALM	While Alarm Status
0D	GOUT6	General output 6	1D	WRG-DF	While dual position error excess warning
0E	GOUT7	General output 7	1E	TRJCMP	While position command distribution completion status (Delay time included)
0F	GOUT8	General output 8	20	WRG-SY	While Axes-sync Error Excess Warning
			FF	RESERVE	Monitor mode, for manufacturer only

5.9 Control block diagram

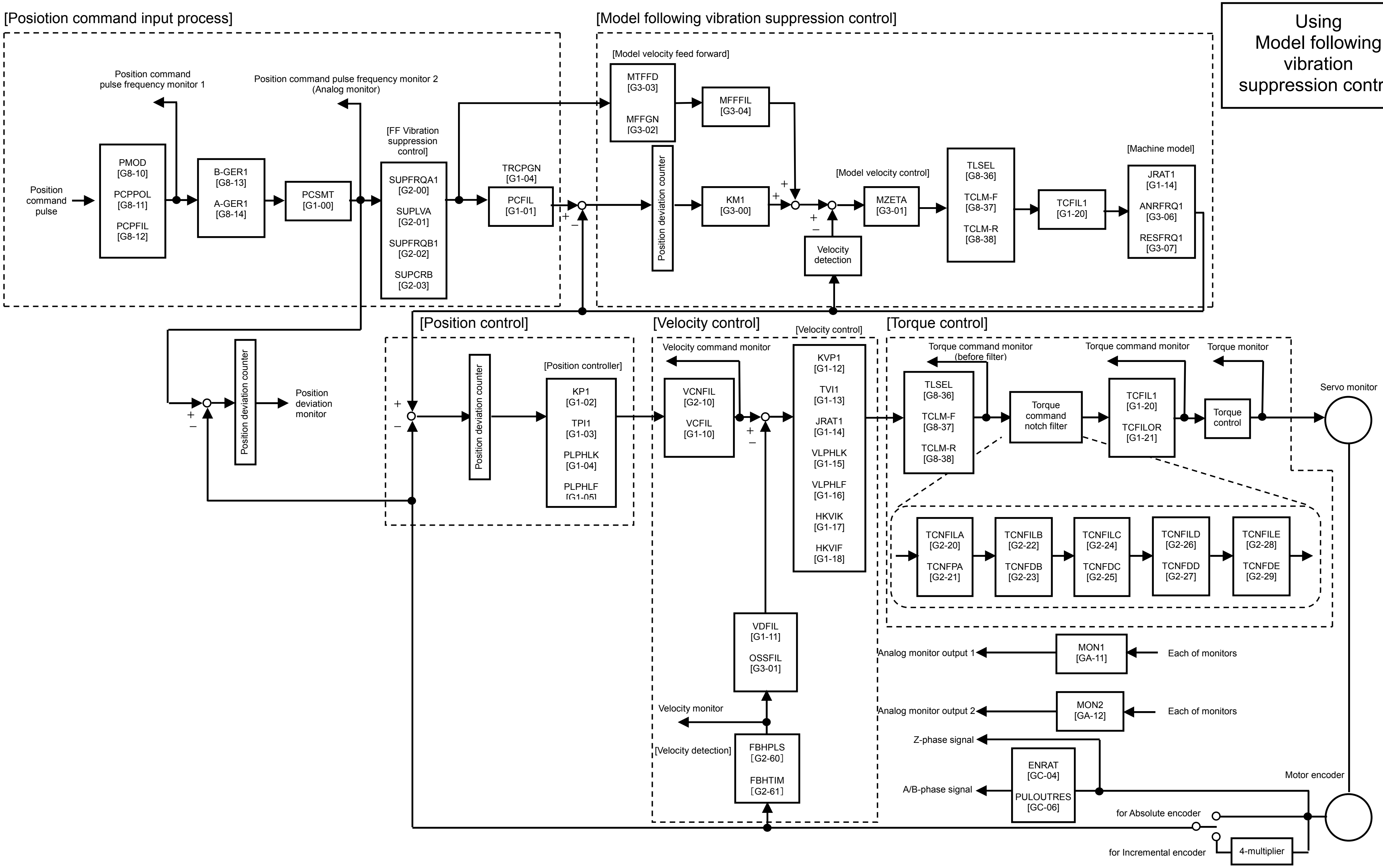


5.9 Control block diagram

Using Model following control



Using
Model following
vibration
suppression control



5.10 SEMI F47 supporting function

This function limits motor current when it detects voltage sag warning due to instantaneous power failure (when voltage dropped to 135 - 152VAC).
This function is provided to support acquiring "SEMI F47 Standard" that is requisite for semiconductor equipments.
Combined with Power Failure Detection Delay Time [GroupB ID16], it prevents motor stop with alarm when in instantaneous power failure and enables to continue operation.

5.10.1 Parameter setting

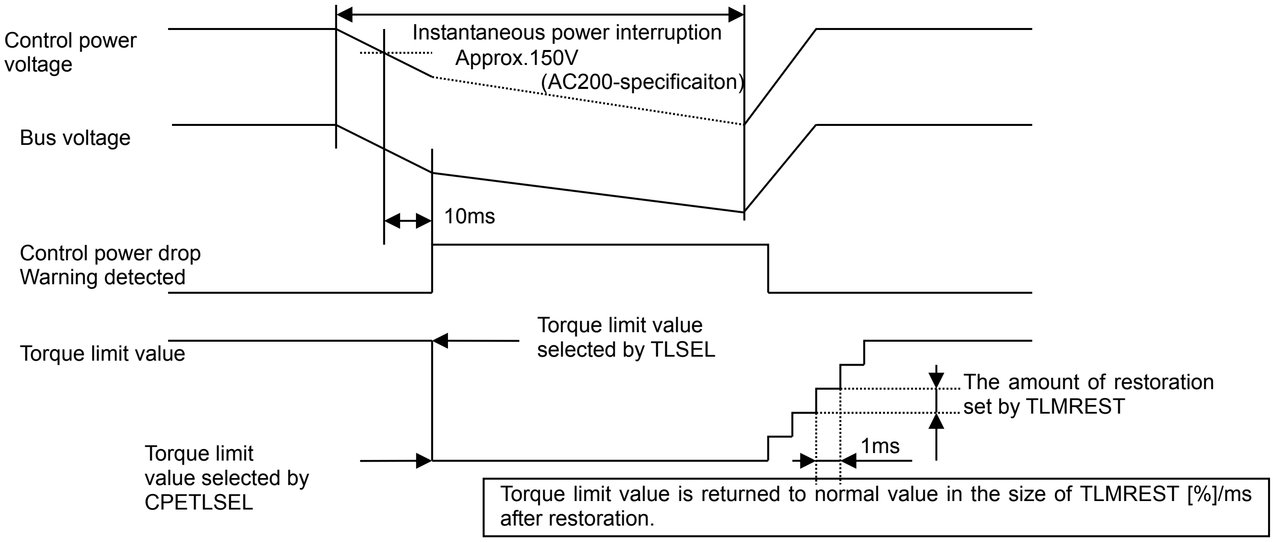
- General parameters Group8 "Control system"

ID	Symbol	Name	Default value	Unit	Setting range
3A	CPETLSEL	Torque limit input selection during power drop	00	-	00 to 03
3D	TLMREST	The amounts of torque limit value restoration when power restored	0.0	%	0.0 to 500.0

✔ TLMREST works as 10% if 0.0% is set.

5.10.2 Operational sequence

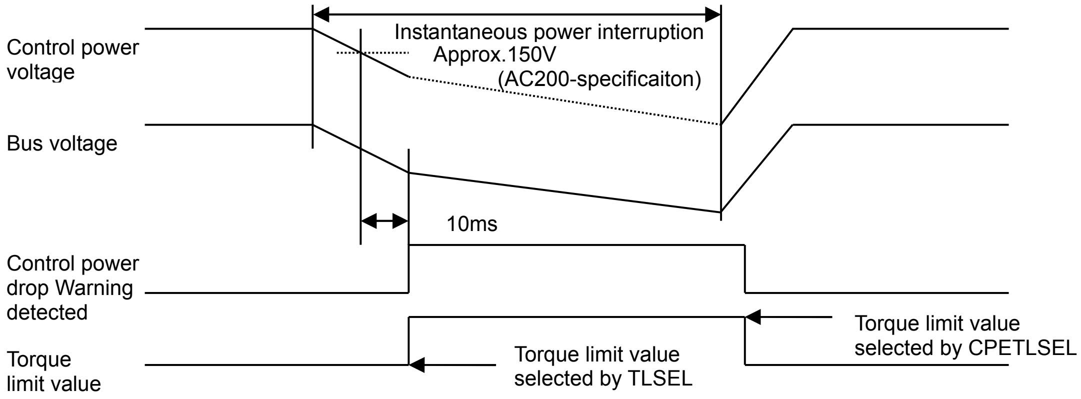
This shows the operational sequence from detecting warning of low control power voltage to restoration of control power voltage.



Torque limit value is returned to normal value in the size of TLMREST [%]/ms after restoration.

5.10.3 Notes

Set torque limit value under voltage sag warning smaller than that of normal operation.
Even if the torque limit value of voltage sag is greater than that of normal operation, it limits the torque at the set value when in voltage sag. After power restoration, the limiting value goes back to that of normal operation.



5.11 Virtual motor operation function

This is the function which simulates servo motor behavior and servo amplifier status at internal of the servo amplifier. This function is able to check a sequence with output signal and check a wiring with upper controller, without actual motor operation. Thus, safer and faster start-up of a system is available by this function.
As note, servo motor and encoder connection is not necessary for this function use.

5.11.1 Setting

Sets the system parameter below for this function use.

ID	Contents
02	Operation mode selection ■ Selects the operation mode. Selection / Contents: 00 Normal — Normal operation mode 01 Virtual1 — Virtual operation mode (virtual P_ON valid) 02 Virtual2 — Virtual operation mode (virtual P_ON invalid) ✔ “Power cycle for control after setting” ■ Operation mode action ◆ 01:Virtual1 Virtual operation mode (virtual P_ON valid) In this mode, servo motor operation can simulate by control power supply only. Automatically change state to main power ON, after control power supplied. ◆ 02:Virtual2 Virtual operation mode (virtual P_ON invalid) In this mode, servo motor operation can simulate after main circuit power supplied. Main circuit power supply is necessary, after control power supplied.

5.11.2 Restrictions

There are restrictions below for this function.

■ Load model for virtual motor operation is rigid body sysytem by load inertia moment.

Item	Conditions
Load torque	0 [N･m]
Load inertia moment	Load inertia moment ratio × Servo motor inertia moment
Mechanical stiffness	Rigid body

✔ Load inertia moment ratio is used from Group1 ID14.
The value set by the parameter below is used depending on gain switching condition if gain switching function is used.

Selection	Used Load inertia moment ratio		
	Group	ID	Name
1	1	14	Load inertia moment ratio 1
2	4	05	Load inertia moment ratio 2
3	4	15	Load inertia moment ratio 3
4	4	25	Load inertia moment ratio 4

■ Encoder position data does not backuped. Position data is zero when power is on.

■ Multi-turn part of encoder position data does not clear even if encoder clear function is executed.

■ Detection of alarm and warning for encoder does not work.

■ In use of incremental encoder, output pulse resolution will be 8192 [P/R] regardless of the encoder resolution setting.
Dividing is available for this resolution by the setting of GroupC ID04 Encoder Output Pulse Division.

■ U-phase electric angle monitor might show wrong value if incremental encoder is used.

■ Position, velocity and torque of servo motor is simulated to response of control system against virtual motor operation load model.

■ Action of servo motor and load model is stop at servo OFF. Free-run operation at servo OFF can not simulate.

■ When "01: Virtual" is set to Operation mode selection, main circuit power is supplied virtually, and regard as supplying rated power. As note, Alarm and regenerative operation for main power can not simulate.

■ Dynamic brake does not work. Stop operation by servo OFF or dynamic brake of emergency stop can not simulate. However, the signal of While Dynamic Braking is output from general purpose output.

■ When external encoder is absolute encoder (EnDat), it works as angle encoder (resolution 28bit).

5.11.3 Digital operator display

Digital operator display will change during virtual motor operation.

Display	Description
	Alphabet "t" shows at second LED from right, during virtual motor operation. The other LEDs show same as normal status display. In case except status display mode, also the same as normal.

5.11.4 Operating precautions

- Holding-brake release signal outputs same as normal operation even if virtual motor operation is executed. At vertical axis use, avoid holding-brake release as follows: Cancel the allocation of holding-brake release signal for general output. Shut off the holding-brake power. etc.

6

Servo Tuning

In this chapter, tuning of servo amplifier are explained.

6. Servo Tuning

6.1 Servo tuning functions and basic adjustment procedure

To operate the servo motor (and machine) using the servo amplifier, adjustments of the servo gain and its control system is necessary. Generally, the higher setting value of the servo gain increases the machine response. However, if the servo gain is too high, in a lower rigidity machine, vibration may result and the machine response will not increase. The servo gain and its control system need to be appropriately adjusted according to the operating servo motor and the mechanical system, and this adjustment method is called Servo tuning.
Following is an explanation of the Servo tuning procedure:

6.1.1 Servo tuning functions

- Adaptive notch filter function
  Realizing vibration suppression operation of machine vibration by estimating resonant frequency of machine system during servo motor operation and making feedback it to the control system.

- Automatic Tuning function
  - Automatic Tuning
    Servo amplifier estimates load inertia moment ratio during operation, and then automatically adjusts servo gain and filter frequency on a real-time basis. This is the most basic tuning method.

  - Automatic Tuning [JRAT Manual Setting]
    The servo amplifier does not estimate the Load inertia moment ratio. Servo gain and filter frequency are adjusted automatically corresponding to the load inertia moment ratio and the responses that are already set. This method is used when the Load inertia moment ratio could not be estimated correctly with auto-tuning.

- Manual Tuning
  Set all parameters, such as Load inertia moment ratio, servo gain, filter frequency, etc. manually. This method is used when characteristics during auto-tuning are insufficient.

- The function of making servo gain higher
  - Velocity loop phase lead compensation
    This is the function which compensate phase delay of velocity control system, to get higher velocity loop proportional gain.

  - Position loop phase lead compensation
    This is the function which compensate phase delay of position control system, to get higher position loop proportional gain.

  - Torque feed forward compensation
    This is the function which improve response for the command of control system by applying feed forward compensation to torque control system.

- Model following control
  Model following control is a control method that ensures a higher response by composing a model control system including the mechanical system in a servo amplifier to operate the actual servo motor in order to follow the model control system.

- Auto notch filter tuning function
  Notch filter is able to suppress high frequency resonance depends on a mechanical system coupling or stiffness. "Auto notch filter tuning" is able to search mechanical system resonant frequency easily by rotating servo motor in a short time.

- Vibration suppression function
  - Model-following vibration suppression
    Positioning settle time and response of machine are able to improve by using model control system to suppress machine stand vibration.

  - Auto FF Vibration Suppression Frequency Tuning, FF vibration suppression control
    FF Vibration Suppression control is able to suppress low frequency resonance like machine end vibration. "Auto FF Vibration Suppression Frequency Tuning" is able to set FF Vibration Suppression Frequency easily by rotating servo motor in a short time.

  - CP vibration suppression control
    This function is suppressing machine stand vibration though at the CP (Continuous Path) control like cutting work of machine tool.

  - Minor vibration suppression
    This function is suppressing minor vibration against velocity feedback during servo motor stop.

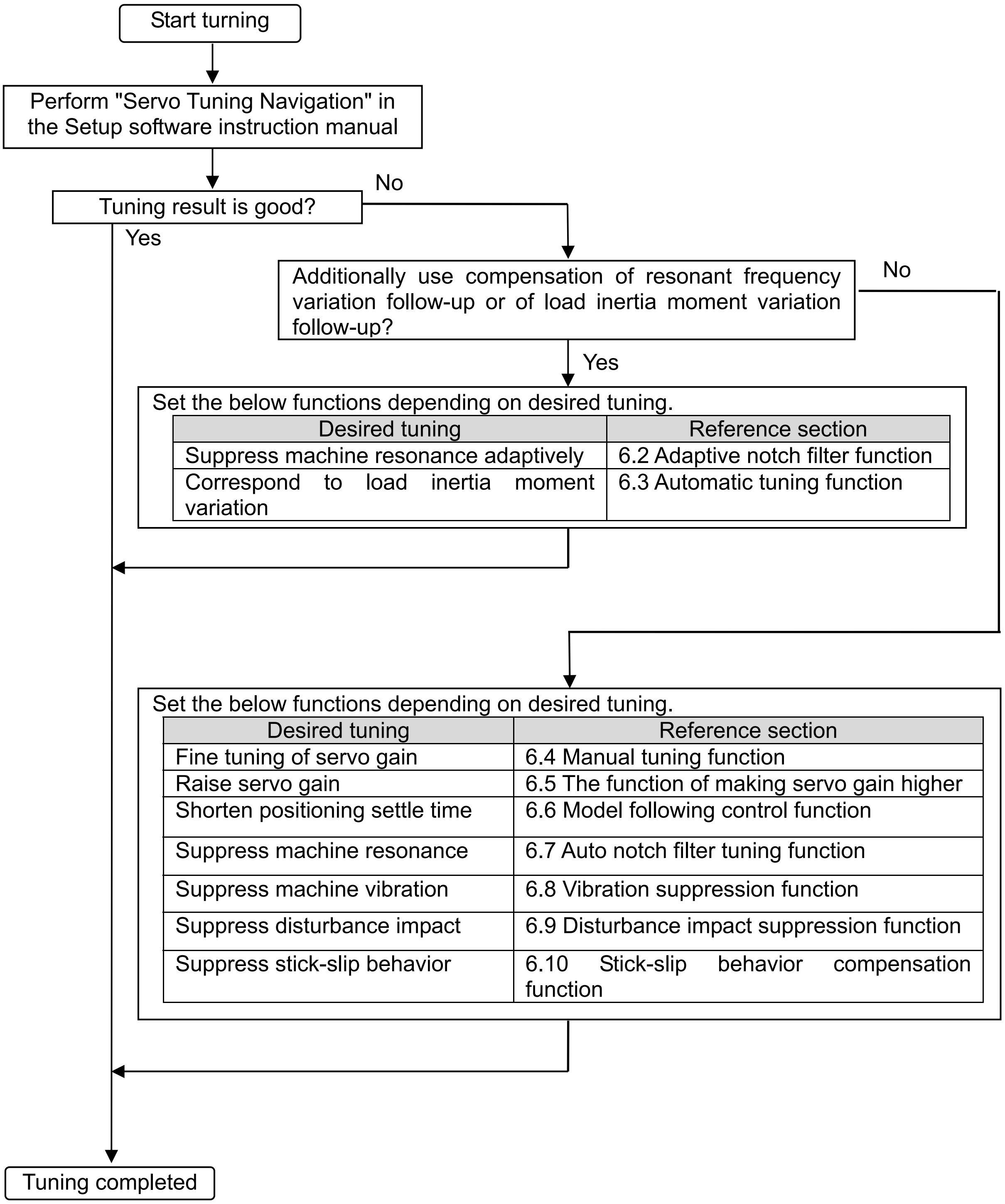
- Disturbance impact suppression function
  - High order integral control
    Uses when desired to suppress disturbance impact into control system, by decreasing the velocity loop integral time constant. This function compensates phase delay against feedback of velocity integral control system.

  - Disturbance observer function
    This function is suppressing impact of load torque by estimating the load torque internally and adding compensation against load torque to a torque command, if external load torque is applied to a servo motor.

- Stick-slip behavior compensation function
  This function is suppressing stick-slip behavior occurring by machine system friction etc.

6.1.2 Tuning method selection procedure

The selection procedure is displayed in the following chart:



Set the below functions depending on desired tuning.

Desired tuning	Reference section
Suppress machine resonance adaptively	6.2 Adaptive notch filter function
Correspond to load inertia moment variation	6.3 Automatic tuning function

Set the below functions depending on desired tuning.

Desired tuning	Reference section
Fine tuning of servo gain	6.4 Manual tuning function
Raise servo gain	6.5 The function of making servo gain higher
Shorten positioning settle time	6.6 Model following control function
Suppress machine resonance	6.7 Auto notch filter tuning function
Suppress machine vibration	6.8 Vibration suppression function
Suppress disturbance impact	6.9 Disturbance impact suppression function
Suppress stick-slip behavior	6.10 Stick-slip behavior compensation function

✔ Combinations of some functions are not allowed.

6.2 Adaptive notch filter function

Vibration suppression operation which adapt to frequency variation of mechanical vibration is realized by estimating mechanical resonant frequency in motor operation and reflecting to the control system.
It can suppress dispersion and variation of mechanical resonance frequency.

■ How to use

- ◆ Check a resonant frequency of mechanical system. (For use of the system analysis, see "10.3 System analysis" in setup software instruction manual: M0010842.)
- ◆ Set the value which have margin and consider dispersion and variation of mechanical resonance frequency from system analysis result, into "Adaptive notch filter frequency upper limit E", "Adaptive notch filter frequency lower limit E", Group0 ID35, 36. Adaptive notch filter will work between upper/lower limit which set.
- ◆ This function will be valid when "01_Adp_Filter_Enable" is set to "Group0 ID34: Adaptive notch filter function E [ADNFE]".
- ◆ Adaptive notch filter starts an operation with getting the value of "Group2 ID28: Torque Command Notch Filter E [TCNFILE]" as the initial value.
- ◆ Tuning result of Adaptive notch filter is saved to "Torque Command Notch Filter E [TCNFILE]" every 30 minutes automatically.
- ◆ Set "01_No_Saving" to "Group0 ID37: Adaptive notch filter E auto saving [ADNSVE]" if auto-save is not desired.

✔ This function is not able to estimate resonant frequency at below conditions.
(Corrective action: Adaptive notch filter is not able to use, so use notch filter with fixed value.)

- ◆ Resonance frequency is 3 times or less of “velocity loop proportional gain [KVP]".
- ◆ Resonance amplitude is small, or there is no impact of resonance to motor speed caused by low “velocity loop proportional gain [KVP]".
- ◆ Mechanical system has multiple resonance frequency.
- ◆ Position command resolution is low.
(Corrective action: Set "Group1 ID00: Position Command Smoothing Constant [PCSMT]".)

✔ This function cannot use with the tandem operation.

6.3 Auto-tuning function

6.3.1 Selection of tuning method

- ■ Parameter list
  Using parameters below for auto-tuning mode.

◆ Tuning mode

Group	ID	Selection		Contents
0	00	00	AutoTun	Auto-tuning
		01	AutoTun_JRAT-Fix	Auto-tuning [JRAT manual setting]
		02	ManualTun	Manual Tuning

◆ Auto-Tuning characteristic

Group	ID	Selection		Contents
0	01	00	Positioning1	Positioning Control 1 (General Purpose)
		01	Positioning2	Positioning Control 2 (High Response)
		02	Positioning3	Positioning Control 3 (High Response, FFGN Manual Setting)
		03	Positioning4	Positioning Control 4 (High Response, Horizontal Axis Limited)
		04	Positioning5	Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)
		05	Trajectory1	Trajectory Control 1
		06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

◆ Auto-Tuning Response

Group	ID	Setting range	Unit
0	02	1 to 40	—

◆ Auto-Tuning Automatic Parameter Saving

Group	ID	Selection		Contents
0	03	00	Auto_Saving	Automatically Saves in JRAT1
		01	No_Saving	Automatic Saving is Invalid

◆ Auto-Tuning characteristic compatible mode

Group	ID	Selection		Contents
0	04	00	Disable	Invalid
		01	Enable	Valid (RS2 Compatible)

- ■ Explanation for each parameter
  Details of each parameter are shown below.

  - ◆ General Parameter Group0 Auto-Tuning

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">00</td><td>Tuning Mode [TUNMODE]</td></tr>
<tr><td>
<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>00: AutoTun</td><td>Auto-Tuning</td></tr>
</table>

◆ Servo amplifier estimates Load inertia moment ratio of the machine or equipment during real time and automatically tunes the servo gain.
◆ Parameters which is tuned automatically by servo amplifier, is vary depends on selection of Group0 ID00 "Auto-Tuning Characteristic [ATCHA]".
◆ Servo amplifier estimates the Load inertia moment ratio at the time of acceleration/deceleration. Therefore, for operations only with excessively long acceleration/deceleration time constants or with only low torque in low velocity, this mode cannot be used. Also, for operations with high disturbance torque or with major mechanical clearance, this mode cannot be used. Use in [01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting].

<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>01: AutoTun_JRAT-Fix</td><td>Auto-Tuning [JRAT manual setting]</td></tr>
</table>

◆ Based on Group1 ID14 "Load inertia moment ratio 1 [JRAT1], which has to be set, the servo amplifier automatically tunes to the best servo gain.
◆ Parameters for the servo amplifier to automatically tune will vary depending on "Auto-Tuning characteristic [ATCHA]”.

<table>
<tr><th>Selection</th><th>Contents</th></tr>
<tr><td>02: ManualTun</td><td>Manual Tuning</td></tr>
</table>

◆ This mode is used in order to adjust the servo gain to the machine or equipment to ensure maximum response as well as when characteristics in auto-tuning are insufficient.

</td></tr>
</table>

ID	Contents
01	Auto-Tuning Characteristic [ATCHA]

- ■ Auto-Tuning Characteristic to fit the mechanical requirements and movements are provided. Parameters that can be adjusted vary depending on each auto-tuning characteristic. Select the parameters based on the situation.
- ■ [Positioning control (Positioning)]
  Positioning control is a control method used to reach the servo motor quickly to target a position from the present position by disregarding the trajectory between the positions. Select this mode when positioning PTP (point to point) is necessary.
- ■ [Trajectory control (Trajectory)]
  Trajectory control is a method used to move the servo motor to the target position from the present position while considering the trajectory between the positions. Select this mode when the Position command corresponding trajectory control is needed such as in processing work.

Selection		Contents
00	Positioning1	Positioning Control 1 (General Purpose)

- ◆ Select for general positioning purposes.
- ◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

Selection		Contents
01	Positioning2	Positioning Control 2 (High Response)

- ◆ Select for high response positioning.
- ◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

Selection		Contents
02	Positioning3	Positioning control 3 (High Response, FFGN Manual Setting)

- ◆ Select this mode to adjust Group1 ID06 "Velocity Feed Forward Gain [FFGN]" manually.
- ◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	06	FFGN	Velocity Feed Forward Gain

- ◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
3	02	MFFGN	Model velocity feed forward gain

Selection		Contents
03	Positioning4	Positioning control 4 (High Response, Horizontal Axis Limited)

- ◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources.
- ◆ Positioning time may be shortened compared to “Positioning Control 2”.
- ◆ Parameters shown in table at section 6.3.2 cannot be adjusted manually.

ID	Contents
01	Auto-Tuning Characteristic [ATCHA]

Selection		Contents
04	Positioning5	Positioning control 5 (for high response, horizontal axis only, FFGN manual setting)

- ◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources and when you want to adjust Group1 id06 "Velocity Feed Forward Gain [FFGN]" manually.
- ◆ Positioning time may be shortened compared to “Positioning control 3”.
- ◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	06	FFGN	Velocity Feed Forward Gain

- ◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
3	02	MFFGN	Model velocity feed forward gain

Selection		Contents
05	Trajectory1	Trajectory Control 1

- ◆ Select this mode for single axis use. The response of each axis can be different.
- ◆ Parameters shown in table 6.3.2 cannot be adjusted manually.

Selection		Contents
06	Trajectory2	Trajectory Control 2 (KP, FFGN Manual Setting)

- ◆ Select this mode when you need equal responses from multiple axes, respectively. Adjust Group1 ID02 "Position Loop Proportional Gain 1 [KP1]”, Group1 ID06 “Velocity Feed Forward Gain [FFGN]".
- ◆ The following parameter is able to adjust manually, if not use model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	02	KP1	Position Loop Proportional Gain 1
1	06	FFGN	Velocity Feed Forward Gain

- ◆ The following parameter is able to adjust manually, if using model following (vibration suppression) control:

Group	ID	Symbol	Contents
1	02	KP1	Position Loop Proportional Gain 1
3	02	MFFGN	Model velocity feed forward gain

ID	Contents
02	Auto-Tuning Response [ATRES] ■ Set this parameter when "00: Auto Tun" or "01: AutoTun_JRAT-Fix" in Group0 ID00 are used. ■ As the setting value rises, the response increases. Set the value suitable for equipment rigidity. ■ This does not function when "02: ManualTun" of the Tuning mode is selected.
03	Auto-Tuning Automatic Parameter Saving [ATSAVE] ■ "Load inertia moment ratio" obtained from the result of auto-tuning is automatically saved in Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]" every 30 minutes. ■ The select value is effective when auto-tuning is used. This does not function when "01: AutoTun_JRAT-Fix" of the Tuning mode is selected.

6.3.2 Automatically adjusted parameters in auto-tuning

These parameters will not reflect on servo motor movements by changing or overriding those values.
However, some of them can be adjusted manually depending on selected Group0 ID00 "Tuning mode [TUNMODE]" and Group0 ID01 "Auto-Tuning Characteristic [ATCHA].

■ At the standard position control, below parameters are adjusted automatically.

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
06	FFGN	Velocity Feed Forward Gain	Note 1), Note 2)
08	TRCPGN	Higher Tracking Control Position Compensation Gain	
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Remarks
43	LOWV	Low Speed Range	Note 4)

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function

Note 1) Manual setting is available on "06: Trajectory Control 2 (KP,FFGN Manual Setting)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 2) Manual setting is available on "02: Positioning Control 3 (High Response, FFGN Manual Setting)" or "04: Positioning Control 5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

Note 3) Manual setting is available on "01: Positioning Control 2 (High Response)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 4) Manual setting is available on "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

- ■ At the model following control, below parameters are adjusted automatically.

◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Remarks
02	KP1	Position Loop Proportional Gain 1	Note 1)
08	TRCPGN	Higher Tracking Control Position Compensation Gain	
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 3)
1C	AFBK	Acceleration Feedback Gain	
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
20	TCFIL1	Torque Command Filter 1	

◆ General parameters Group3 "Model following control settings"

ID	Symbol	Name	Remarks
00	KM1	Model Control Gain 1	
02	MFFGN	Model velocity feed forward gain	Note 1), Note 2)

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Remarks
43	LOWV	Low Speed Range	Note 4)

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function

Note 1) Manual setting is available on "06: Trajectory2 (KP,FFGN Manual Setting)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 2) Manual setting is available on "00: Positioning1 (General Purpose)", "02: Positioning3 (High Response, FFGN Manual Setting)" or "04: Positioning5 (High Response, Horizontal Axis Limited, FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

Note 3) Manual setting is available on "01: Positioning2 (High Response)" is selected at the Auto-Tuning Characteristic [ATCHA].

Note 4) Manual setting is available on "00: Positioning1 (General Purpose)", "01: Positioning2 (High Response)", "02: Positioning3 (High Response, FFGN Manual Setting)", "05: Trajectory1" or "06: Trajectory2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

6.3.3 Adjustable main parameters during auto-tuning

- The following main parameters are adjustable during auto-tuning:

  - General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name
00	PCSMT	Position Command Smoothing Constant
01	PCFIL	Position Command Filter
07	FFFIL	Velocity Feed Forward Filter
10	VCFIL	Velocity Command Filter
11	VDFIL	Velocity Feedback Filter
19	TFFK	Torque Feed Forward Gain
1A	TFFAVE	Torque feed forward averaging
1B	TFFOUT	Torque Feed Forward output selection
21	TCFILOR	Torque Command Filter Order
30	DFBCG	Dual position feedback gain
31	DFBFIL	Dual position feedback filter

  - General parameters Group2 "FF vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name
00	SUPFRQA1	FF Vibration Suppression Frequency A1
01	SUPLVA	FF Vibration Suppression Level Selection A
02	SUPFRQB1	FF Vibration Suppression Frequency B1
03	SUPCRB	FF Vibration Suppression Level Selection B
10	VCNFIL	Velocity Command Notch Filter
20	TCNFILA	Torque Command Notch Filter A
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement
22	TCNFILB	Torque Command Notch Filter B
23	TCNFDB	TCNFILB, Depth Selection
24	TCNFILC	Torque Command Notch Filter C
25	TCNFDC	TCNFILC, Depth Selection
26	TCNFILD	Torque Command Notch Filter D
27	TCNFDD	TCNFILD, Depth Selection
28	TCNFILE	Torque Command Notch Filter E
29	TCNFDE	TCNFILE, Depth Selection
50	CPVSFQ	CP vibration suppression control frequency
51	CPVSLV	CP vibration suppression control level
52	CPVSSH	CP vibration suppression control characteristics selection
60	FBHPLS	Minor vibration suppression pulse compensation value
61	FBHTIM	Minor vibration suppression pulse compensation frequency

  - General parameters Group4 “Gain switching control/Vibration suppression frequency switching settings”

ID	Symbol	Name
40	SUPFRQA2	FF Vibration Suppression Frequency A2
41	SUPFRQA3	FF Vibration Suppression Frequency A3
42	SUPFRQA4	FF Vibration Suppression Frequency A4
43	SUPFRQB2	FF Vibration Suppression Frequency B2
44	SUPFRQB3	FF Vibration Suppression Frequency B3
45	SUPFRQB4	FF Vibration Suppression Frequency B4

- ◆ General parameters Group5 “High setting control setting”

ID	Symbol	Name
00	CVFIL	Command Velocity Low-pass Filter
01	CVTH	Command Velocity Threshold
02	ACCCO	Acceleration Compensation
03	DECCO	Deceleration Compensation

6.3.4 Unavailable functions during auto-tuning

- ■ The following functions CANNOT be used during auto-tuning:

- ◆ General parameters Group9 “Function enabling condition settings”

ID	Symbol	Name
13	GC1	Gain Switching Condition 1
14	GC2	Gain Switching Condition 2
19	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function
33	OBS	Disturbance Observer Function
80	SYNCEN	Axes-sync compensation function
81	SYNPCNEN	Axes-sync compensation proportional control switching function

✔ "Disturbance Observer" is not able to use together with Auto-Tuning. If desired to use Auto-Tuning, make Group9 ID33 "Disturbance Observer Function [OBS]" invalid.

✔ SYNCEN and SYNPCNEN are able to use when "01: AutoTun_JRAT-Fix" is set to Group0 ID00 "Tuning mode". If "00: AutoTun" is set, disable Group9 ID80 [SYNCEN] and Group9 ID81 [SYNPCNEN].

- ◆ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name
08	TRCPGN	Higher Tracking Control Position Compensation Gain
1C	AFBK	Acceleration Feedback Gain
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain

- ◆ General parameters Group8 "Control system settings"

ID	Symbol	Name
43	LOWV	Low Speed Range

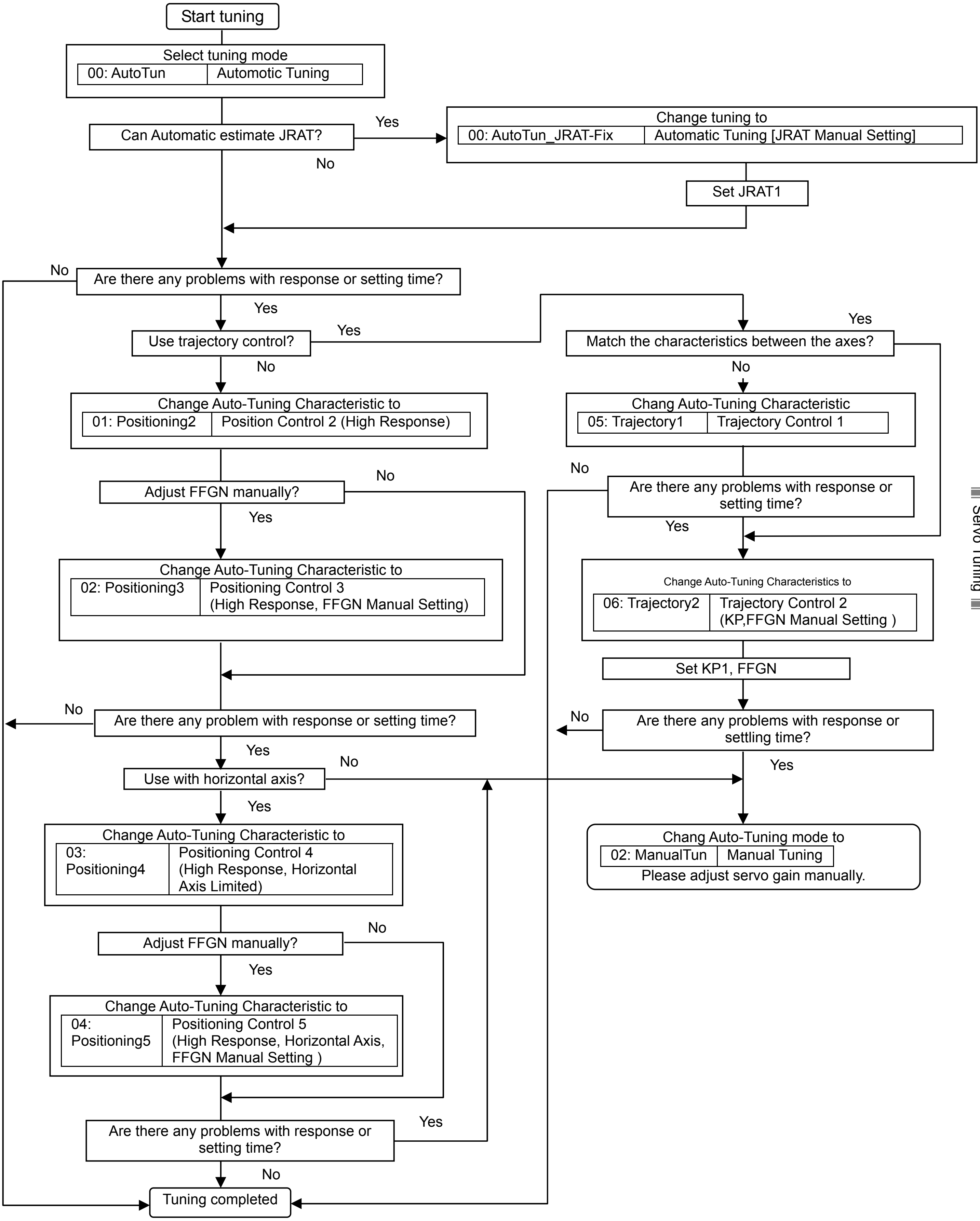
✔ "Low Speed Range [LOWV]" is able to use when "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

- ◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name
06	ANRFRQ1	Model Control Anti-resonance Frequency 1
07	RESFRQ1	Model Control Resonance Frequency 1

✔ “Model following control” is able to use when "01: AutoTun_JRAT-Fix" is set to Group0 ID00 "Tuning mode". If "00: AutoTun" is set, select"00: Standard" or "01: Model1" to sytem parameter ID07 "Position control selection".

6.3.5 Auto-tuning characteristic selection



6.3.6 Adjustment method for auto-tuning

Auto-tuning is a function where the servo amplifier automatically tunes to the best servo gain in real time.

Procedure 1	■ Select "00: AutoTun Auto-Tuning" at Group0 ID00 "Tuning mode [TUNMODE]" to estimate load inertia moment ratio by servo amplifier on a real-time basis, and then automatically adjust servo gain. Select "01:AutoTun_JRAT-Fix Automatic Tuning (JRAT Manual Setting)" to automatically adjust optimum servo gain based on manually set value of Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]".
Procedure 2	■ After setting "Tuning mode [TUNMODE]", select Group0 ID00 "Auto-Tuning Characteristic [ATCHA]" for the machine or equipment.
Procedure 3	■ Next, boot the servo motor and adjust Group0 ID02 "Auto-Tuning Response [ATRES]" according to equipment rigidity. ◆ Set "Auto-Tuning Response [ATRES]" at a low value initially and allow the machine to work about 10 times or more by commanding from upper controller. ◆ When response is low and the positioning settling time is slow, after machine movement, try to improve the response and settling times by increasing "Auto-Tuning Response [ATRES]" gradually. ◆ If increasing the response has caused the machine to get vibration, lower the value of the "Auto-Tuning Response [ATRES]" slightly. ✔ If the machine has not developed vibration, enable the Vibration suppression by setting the Notch filter and /or FF Vibration suppression frequency. Set the filter frequency to suppress mechanical vibration by using "6.7 Auto notch filter tuning function" and/or "6.8.2 Auto FF Vibration Suppression Frequency Tuning". ✔ Tuning methods are the same in "01:AutoTun_JRAT-Fix Automatic Tuning (JRAT Manual Setting)".

6.3.7 Monitoring servo gain adjustment parameters

Parameters automatically adjusted when using auto-tuning can be monitored with the Digital Operator and the Setup software. Refer to "7. Digital operator" for use of the Digital Operator.

ID	Symbol	Name	Unit
50	JRAT MON	Load Inertia Moment Ratio monitor	%
51	MKP MON	Model Control Gain monitor	1/s
52	KP MON	Position Loop Proportional Gain monitor	1/s
54	KVP MON	Velocity Loop Proportional Gain monitor	Hz
55	TVI MON	Velocity Loop Integral Time Constant monitor	ms
56	TCFIL MON	Torque Command Filter monitor	Hz

6.3.8 Manual tuning method using auto-tuning results

Result of auto-tuning can be stored in block and used to perform auto-tuning.
Refer to "7. Digital operator" for use of the Digital Operator.
For the Setup software, perform "Auto-tuning >> Auto-tuning result saving".

■ Saving parameters

◆ General parameters Group1 “Basic control parameter setting”

ID	Symbol	Name	Unit
02	KP1	Position Loop Proportional Gain 1	1/s
06	FFGN	Velocity Feed Forward Gain	%
08	TRCPGN	Higher Tracking Control Position Compensation Gain	%
12	KVP1	Velocity Loop Proportional Gain 1	Hz
13	TVI1	Velocity Loop Integral Time Constant 1	ms
14	JRAT1	Load Inertia Moment Ratio 1	%
1C	AFBK	Acceleration Feedback Gain	%
1E	TRCVGN	Higher Tracking Control Velocity Compensation Gain	%
20	TCFIL1	Torque Command Filter 1	Hz

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit
00	KM1	Model Control Gain 1	1/s
02	MFFGN	Model velocity feed forward gain	%

◆ General parameters Group8 "Control system settings"

ID	Symbol	Name	Unit
43	LOWV	Low Speed Range	min^{-1}

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit
19	PLPCON	Position Loop Proportional Control Switching Function	–
27	VLPCON	Velocity Loop Proportional Control Switching Function	–

6.4 Manual tuning function

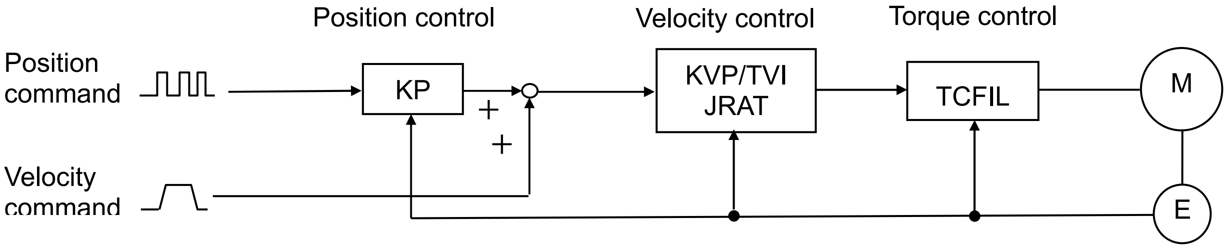
All gain is adjustable manually using manual tuning mode when characteristics in auto-tuning are insufficient. Select "02: ManualTun Manual Tuning" at Group0 ID00 "Tuning mode [TUNMODE]".

- ■ Setting parameters
  - ◆ General parameters Group0 ID00 “Tuning Mode [TUNMODE]”

Selection		Contents
02	ManualTun	Manual Tuning

6.4.1 Servo system configuration and servo adjustment parameters

The servo system is consist from "Position, Velocity and Torque control", and the control system response should be "Position control < Velocity control < Torque control". If this structure is compromised, the system will be unstable and it might result in low response, vibration or oscillation.



See below explanation for each servo parameter

■ Group1 ID00 "Position Command Smoothing Constant [PCSMT]"
This moving low-pass filter smoothes the position command pulse. Sets time constants. The position command pulse will become smoother by setting this parameter when the electronic gear ratio is high or position command pulse is coarse.

■ Group1 ID01 "Position Command Filter [PCFIL]"
When the position command resolution is low, set this parameter to suppress the ripples contained in the position command. A larger value of this parameter will cause a greater ripple suppressing effect; however, delay will be increased.

◆ When Group1 ID1E "Higher Tracking Control Position Compensation Gain [TRCPGN]" is set to other than 0%, this parameter is automatically set.

■ Group1 ID02 "Position Loop Proportional Gain 1 [KP1]"
Sets the response of Position control. Set this to: KP1 [1/S]=KVP1 [Hz]/4・2π as a rough indication.

■ Group1 ID06 "Velocity Feed Forward Gain [FFGN]"
The tracking effect of position command can be improved by increasing this gain. Under positioning control, set this to approximately 30-40% as the standard.

◆ When Group1 ID1E "Higher Tracking Control Position Compensation Gain [TRCPGN]" is set to other than 0%, this parameter is automatically set.

■ Group1 ID07 "Velocity Feed Forward Filter [FFFIL]"
When position command resolution is low, set this parameter to suppress ripples.

■ Group1 ID08 "Higher Tracking Control Position Compensation Gain [TRCPGN]"
When the tracking effect needs to be improved under high resolution of position command, increase this parameter after adjustment of Higher Tracking Control Velocity Compensation Gain.

■ Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]"
Set the value as high as possible in stable range that machine system does not vibrate and oscillate. If Group1 ID14 "Load Inertia Moment Ratio 1 [JRAT1]" is properly set, the set value as "Velocity Loop Proportional Gain 1 [KVP1]" becomes velocity control responsive band.

■ Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]"
Set this to: TVI1 [ms] = 1000/(KVP1 [Hz]), as a rough indication.

■ Group1 ID14 "Load inertia moment ratio 1 [JRAT1]"
Set this value to the calculation shown below:

$$\text{JRAT}= \frac{\text{Motor axis converted load inertia moment (JL)}}{\text{Servo motor rotor inertia moment (JM)}} \times 100\%$$

■ Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]"
Tracking effect can be improved by increasing compensation gain.
Adjust this to shorten the position setting time.

◆ Set the value of "Load Inertia Moment Ratio 1 [JRAT1]" properly to use this function.

◆ Set 0% when you use Group9 ID27 "Velocity Loop Proportional Control Switching Function [VLPCON]” during operation.

◆ Set at 100% to equal Q-series servo amplifier.

■ Group1 ID20 “Torque Command Filter 1 [TCFIL1]"
When rigidity of the mechanical device is high, set this value high and the "Velocity Loop Proportional Gain1 [KVP1]" can also be set higher. When the rigidity of the mechanical device is low, set this value low and resonance in the high frequency zone as well as abnormal sound can be suppressed. For normal usage, set this below 1200Hz.

6.4.2 Basic manual tuning method for velocity control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.
- Set value of Group 1 ID13 "Velocity Loop Integral Time Constant 1[TVI1]" by referring to "TVI1 [ms] = 1000/ KVP1 [Hz]", as a rough indication.
  - When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient, (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.4.3 Basic manual tuning method for position control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration increases, lower the value.
- Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring to "TVI1 [ms] = 1000/ KVP1 [Hz]", as a rough indication.
- Set value of Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" by referring to "KP1 [1/s] = KVP1 [Hz]/ 4・2π", as a rough indication. When vibration occurs, lower the value.
  - When you cannot increase the gain because of mechanical resonance, etc., and the response is insufficient (after using the Torque notch filter and/or FF vibration suppression frequency to suppress resonance) try the procedure again.

6.5 The function of making servo gain higher

There are explanations of the function for improving response, for position/ velocity/ torque control system each.

6.5.1 Velocity loop phase lead compensation

This is the function to compensate phase delay of Velocity control system, and helps Group1 ID12 "Velocity loop proportional gain 1 [KVP1]" change higher.
Use this when "Velocity loop proportional gain 1 [KVP1]" is not able to increase because there is no gain margin, phase margin.

■ How to use

◆ Please get a frequency characteristic of machine. (In case use of the System Analysis, see "10.3 System Analysis" in M0010842.)

◆ Set 3 times of "Velocity Loop Proportional Gain 1 [KVP1]" to Group1 ID16 "Velocity loop phase lead compensation frequency [VLPHLF]", and set near 30% to Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]", and then confirm increase of phase margin at higher frequency.

◆ Group1 ID15 "Velocity loop phase lead compensation gain [VLPHLK]" is able to increase up to the value of allowed phase margin at higher frequency.

◆ "Velocity Loop Proportional Gain 1 [KVP1]" is able to increase up to the value of allowed phase margin at around of "Velocity Loop Proportional Gain 1 [KVP1]".

■ Velocity loop phase lead compensation gain
Sets the compensation value of Velocity loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
15	VLPHLK	Velocity loop phase lead compensation gain	%	0 to 100

✔ This function will be disabled when 0% is set.

■ Velocity loop phase lead compensation frequency
Sets the frequency of Velocity loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
16	VLPHLF	Velocity loop phase lead compensation frequency	Hz	10 to 4000

✔ Up to 1000Hz setting is valid at normal sampling mode.
✔ Up to 2000Hz setting is valid at high rate sampling mode.

6.5.2 Position loop phase lead compensation

This is the function to compensate phase delay of Position control system, and helps Group1 ID02 "Velocity Loop Proportional Gain 1 [KVP1]" change higher.
Use when "Velocity Loop Proportional Gain 1 [KVP1]" is not able to change higher by overshoot occurring.

■ How to use

- ◆ Set 4 times of "Position Loop Proportional Gain 1 [KP1]" (KP1 [1/s]/2π×4 [Hz]) to Group1 ID05 "Position loop phase lead compensation frequency [PLPHLF]", and set near 30% to Group1 ID04 "Position loop phase lead compensation gain [PLPHLK]", and operate a servo motor.

- ◆ Increase "Position loop phase lead compensation gain [PLPHLK]" up to eliminating overshoot.

- ◆ Able to increase "Position Loop Proportional Gain 1 [KP1]" up to the value that allowed overshoot.

■ Position loop phase lead compensation gain
Sets the compensation value of Position loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
04	PLPHLK	Position loop phase lead compensation gain	%	0 to 100

✔ This function will be disabled when 0% is set.

■ Position loop phase lead compensation frequency
Sets the compensation frequency of Position loop phase lead compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
05	PLPHLF	Position loop phase lead compensation frequency	Hz	10 to 4000

✔ Up to 1000Hz setting is valid at normal sampling mode.

6.5.3 Torque feed forward compensation

There is explanation of function which improving response against a command of control system and applying feed forward compensation to the torque control system. Use when response is not good against command during circular machining etc.

■ How to use

◆ Improve response by increasing Group1 ID19 "Torque feed forward gain [TFFK]", at condition of setting value except 0% to Group1 ID06 "Feed Forward Gain [FFGN]".

◆ When there is no Improvement even if increasing "Torque feed forward gain [TFFK]", please change value of Group1 ID1A "Torque feed forward averaging [TFFAVE]" or Group1 ID1B "Torque feed forward output selection [TFFOUT]", and then confirm impact.

■ Torque Feed Forward Gain
Sets the compensation value of Torque-Feed Forward.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
19	TFFK	Torque feed forward gain	%	0 to 100

✔ This function will be disabled when 0% is set.
✔ Able to use at the position control type and velocity control type.
✔ At the position control type, this function will be disabled when 0% is set to Group1 ID06 "Feed Forward Gain [FFGN]".
✔ This function will be disabled at torque control type.
✔ This function will be disabled at model following (vibration suppression) control.
✔ Able to use the function along with the auto-tuning, except when "00: Positioning1 Positioning Control 1 (General Purpose)" is set to Gropu0 ID01 "Auto-Tuning Characteristic [ATCHA]".

■ Torque feed forward gain averaging
Selects the average count of torque feed forward compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
1A	TFFAVE	Torque feed forward gain averaging	-	00 to 01

Selection		Contents
00	2timesAverage	2 times
01	4timesAverage	4 times

■ Torque feed forward output selection
Select the point that is to be added torque feed forward compensation.

◆ General parameters Group1 “Basic Control parameter settings”

ID	Symbol	Name	Unit	Setting range
1B	TFFOUT	Torque feed forward output selection	-	00 to 01

Selection		Contents
00	Before_Filter	Before torque command filter
01	After_Filter	After torque command filter

6.6 Model following control function

Model following control is a method used to obtain a higher response. Model control systems include mechanical devices in a servo amplifier and drive a servo motor in order to track the Model control system.
Select "02: Position Position control type" at the system parameter ID06 "Control mode selection", and "01: Model1 Model-following control" at the system parameter ID07 "Position control selection".

■ How to use

- ◆ See "6.3.6 Adjustment method for auto-tuning" when using this function together with the auto-tuning.
- ◆ See "6.6.1 Manual tuning method for model following control" when setting the parameter manually without the auto-tuning.
- ◆ See "6.6.3 Model velocity feed forward differential compensation", for command-following improvement after the auto-tuning or the manual tuning.

■ Setting parameters

◆ System parameters

<table>
<tr><th>ID</th><th>Content</th></tr>
<tr><td rowspan="2">06</td><td>Control Mode Selection</td></tr>
<tr><td><table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>02</td><td>Position</td><td>Position control type</td></tr></table></td></tr>
<tr><td rowspan="2">07</td><td>Position Control Selection</td></tr>
<tr><td><table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>01</td><td>Model1</td><td>Model following control</td></tr></table></td></tr>
</table>

✔ Model following control cannot be used when in velocity control type or torque control type.

✔ Model following control can be used with auto-tuning at the same time.

✔ Model following control can be used with full-closed control at the same time.

6.6 Model following control function

6.6.1 Manual tuning method for model following control

- Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high a value as possible within the range that mechanical system stably works without any oscillation. If vibration occurs, lower the value.

- Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring “TVI1 [ms] = 1000/ KVP1 [Hz]”, as a rough indication.

- Set value of Group1 ID12 "Position Loop Proportional Gain 1 [KP1]" by referring to “KP1 [1/s] = KVP1 [Hz]/ 4･2π”, as a rough indication.

- Set value of Group3 ID03 "Model control gain 1 [KM1]" by referring to “KM1 ≒KP1”, as a rough indication. When vibration occurs, lower the set value.

- When responsiveness is low, change the value of "Model control gain 1 [KM1]" to the value approximately 1.1 to 1.2 times the value.

  - When the gain cannot rise because of mechanical vibration, etc., and the response time is insufficient, use Torque notch filter and/or FF Vibration suppression frequency to suppress resonance and attempt it again.

- Adjustable parameters in Model following control
  In addition to the parameters in Standard position control, the following parameters are also adjustable:

  - General Parameters Group3 “Model following control settings”

ID	Symbol	Name
00	KM1	Model Control Gain 1
01	MZETA	Model control damping coefficient
05	OSSFIL	Overshoot Suppression Filter

  - Model Control Gain 1 [KM1]
    Proportional gain fro Model following control position controller.
    Adjust this to: KM1 ≒ KP1, as a rough indication.

  - Model control damping coefficient [MZETR]
    This is parameter which changes velocity proportional gain of Model following control.
    The parameter value will be ζ=0.866 by 0% and ζ=1.0 by 100%.

  - Overshoot Suppression Filter [OSSFIL]
    Set cutoff frequency of overshoot suppression filter in Model following control.
    If overshoot occurs, lower the setting value. When overshoot occurs on position deviation, lower the set value.

6.6.2 Switching of the Feedback control and the Model-following (vibration suppression) control

Explains the function which switches standard position control, model-following control and model-following vibration suppression control, on real-time.
Select "02: Position Position control type" at the system parameter ID06 "Control mode selection", and select "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching" at the system parameter ID07 "Position control selection".

■ How to use

◆ The function is valid when condition that is selected in Group9 ID1A "Model following (vibration suppression) control/ standard position control switching function" is satisfied.

◆ "Model following (vibration suppression) control/ standard position control switching function" supports "00: Always_Disable", "01: Always_Enable" and "General input signal (CONT1 to CONT8)".

■ Setting parameters

◆ System parameters

<table>
<tr><th>ID</th><th>Content</th></tr>
<tr><td rowspan="2">06</td><td>Control Mode Selection</td></tr>
<tr><td><table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>02</td><td>Position</td><td>Position control type</td></tr></table></td></tr>
<tr><td rowspan="2">07</td><td>Position Control Selection</td></tr>
<tr><td><table><tr><th colspan="2">Select value</th><th>Content</th></tr><tr><td>03</td><td>Model3</td><td>Model-following / standard position control switching</td></tr><tr><td>04</td><td>Model4</td><td>Model-following vibration suppression / standard position control switching</td></tr></table></td></tr>
</table>

✔ Model following control cannot be used when in velocity control type or torque control type.
✔ Model following control can be used with auto-tuning at the same time.
✔ Model following control / Model-following vibration suppression control can be used with full-closed control at the same time.

■ Model following (vibration suppression) control/ standard position control switching function
Sets the valid condition for Model-following (vibration suppression) control.

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
1A	MODEL	Model following (vibration suppression) control/ standard position control switching function	-	00 to 11

✔ Control mode will be Model-following (vibration suppression) control when this function is valid.
✔ This setting value is valid only when Control mode selection is "03: Model3 Model-following / standard position control switching" or "04: Model4 Model-following vibration suppression / standard position control switching".
✔ Do not perform switching of the model following (vibration suppression) control and the standard position control, during servo motor operation. Alarm (Model Following Vibration Suppression Control Error (AL.C5)) may occur.

6.6.3 Model velocity feed forward differential compensation

This is the function to improve command response of model control system by differential compensation for feed forward of model control system.

■ How to use

◆ Able to improve a command-following by increasing Group3 ID02 "Model velocity feed forward gain [MFFGN]", at the model following control mode and the model following vibration suppression control mode.

◆ Able to improve more a command-following by increasing Group3 ID03 "Model velocity feed forward differential time constant [MTFFD]".

■ Model velocity feed forward gain
Sets the compensation value of Model velocity feed forward.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
02	MFFGN	Model velocity feed forward gain	%	0 to 100

✔ This function will be disabled when 0% is set.

■ Model velocity feed forward differential time constant
Sets the time constant of Model velocity feed forward differential compensation.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
03	MTFFD	Model velocity feed forward differential time constant	ms	0.00 to 10.00

✔ This function will be disabled when 0.00ms is set.

✔ This function will be enabled when the value except 0% is set to "Model velocity feed forward gain [MFFGN]".

■ Model velocity feed forward filter
Sets the cutoff frequency of Model velocity feed forward filter.

◆ General parameters Group3 “Model following control”

ID	Symbol	Name	Unit	Setting range
04	MFFFIL	Model velocity feed forward filter	Hz	1 to 4000

✔ The function is Invalid at 1,000Hz or more.

6.7 Auto notch filter tuning function

Notch filter is able to suppress high frequency resonance depends on a mechanical system coupling or stiffness. "Auto notch filter tuning" is able to search mechanical system resonant frequency easily by rotating servo motor in a short time.

■ How to use

- ◆ Able to operate from "Auto-tuning mode" in the Setup Software or the Digital Operator.
- ◆ The tuning results are saved automatically in Group2 ID20 “Torque Command Notch Filter A [TCNFILA]”.
- ◆ When resonance of the device does not stop even after using Automatic Tuning of notch filter, there may be two or more resonance points. In this case, inquire about the resonance frequency using the system analysis function and insert Notch filter B, C, D (Manual setting) to suppress each resonance. If resonance is still not suppressed, there is a possibility that Group0 ID02 "Auto-tuning response [ATRES]" or Group1 ID12 "Velocity loop proportional gain 1 [KVP1]" is too high. Lower the "Auto-tuning response [ATRES]" or "Velocity loop proportional gain 1 [KVP1]".

✔ Torque command notch filter function can be used together with Auto-tuning at the same time.

✔ Holding torque falls while auto notch filter is running. Do not use as a gravity axis.

■ Torque command value for auto notch filter tuning
Setting the Torque command value to the servo motor at the time of auto notch filter tuning :

- ◆ General parameters Group0 “Auto-Tuning settings”

ID	Symbol	Name	Unit	Setting range
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	%	10.0 to 100.0

✔ As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

■ Automatically saving parameters with Automatic tuning of notch filter

- ◆ General parameters Group2
  “FF vibration suppression control / Notch filter Disturbance observer settings”

ID	Symbol	Name	Unit	Setting range
20	TCNFILA	Torque Command Notch Filter A	Hz	100 to 4000

✔ The above parameter is saved automatically with auto notch filter tuning.

- ■ Adaptive notch filter function E
  Selects the valid/invalid of the Adaptive notch filter.
  - ◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
34	ADNFE	Adaptive notch filter function E	-	00 to 01

Select value		Content
00	Adp_Filter Disable	Adaptation invalid (TCNFILE manual setting)
01	Adp_Filter Enable	Adaptation at all times

✔ When adaptive notch filter function is valid, Group2 ID29 "TCNFILE, Depth Selection" will be fixed to 0.

- ■ Adaptive notch filter frequency upper limit E
  Sets the upper limit value of adaptive notch filter frequency.
  - ◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
35	ADNFUE	Adaptive notch filter frequency upper limit E	Hz	100 to 1000

✔ Sets the upper limit value of adaptive notch filter frequency for mechanical dispersion.
✔ Please set higher value than ADNFLE.

- ■ Adaptive notch filter frequency lower limit E
  Sets the lower limit value of adaptive notch filter frequency.
  - ◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
36	ADNFLE	Adaptive notch filter frequency lower limit E	Hz	100 to 1000

✔ Sets the lower limit value of adaptive notch filter frequency for mechanical dispersion.
✔ Please set lower value than ADNFLE.

- ■ Adaptive notch filter E auto saving
  Selects valid/invalid of the function that saves mechanical resonant frequency automatically.
  - ◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
37	ADNSVE	Adaptive notch filter E auto saving	-	00 to 01

Select value		Content
00	Auto_Saving	Automatically Saves
01	No_Saving	Automatic Saving is Invalid

6.8 Vibration suppression function

6.8.1 Model following vibration suppression control

When you use the servo motor to drive tables on a machine stand, the stand itself may vibrate as a reciprocal reactor of the motor.
When the machine stand vibrates, the vibration may cause a reaction with the Positioning stabilizing time of the table working on the stand.
Model following vibration suppression control suppresses this type of machine stand vibration and improves Position stabilization time and response.

■ How to use

◆ First, select “01: Model1 model following control” at the system parameter ID07 "Position control selection”, and then perform auto-tuning to adjust the machine to optimum servo gain. Refer to "6.3.6 Adjustment method for auto-tuning" for instructions on tuning.

◆ When servo gain tuning is completed, switch Group0 ID00 “Tuning mode” to “02: ManualTun manual tuning“ after performing auto tuning result saving function.

◆ Set “02: Model2 model following vibration suppression control” at the "Position control selection”, and then set mechanical anti-resonance frequency and resonance frequency. When anti-resonance frequency and resonance frequency are already known, set the values. If anti-resonance frequency and resonance frequency are not known, you can set by measuring anti-resonance frequency and resonance frequency by system analysis.

- When you measure the anti-resonance and resonance frequencies using System analysis, set the "Frequency range selection" in the low range. If you set the range in a high range, the ant-resonance and resonance frequencies in suppressible ranges created by the Model following vibration suppression control may not be measured.
  1 - 125Hz for "Frequency range selection" is recommended.
  (For use of the system analysis, see "10.3 System analysis" in another document: M0010842.)

- When the mass of the servo motor is smaller than the machine stand mass, the anti-resonance and resonance frequencies may not be measured in system analysis. And, system analysis cannot use during tandem operation. In this case, obtain the vibration frequency (Model anti-resonance frequency) by calculating the machine vibration period of the vibrating point at positioning and its reciprocal and set the model resonance frequency 1.05-1.2 times the anti-resonance frequency.

◆ Set value of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" as high as possible within the range that mechanical system can stably work without any oscillation. If vibration occurs, lower the set value.

◆ Set value of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" by referring to “TVI1 [ms] = 1000/KVP1 [Hz]”, as a rough indication.

◆ Set value of Group1 ID02 "Position Loop Proportional Gain 1 [KP1] by referring to “KP1 [1/s] = KVP1 [Hz]/ 4・2π”, as a rough indication.

◆ Set value of Group3 ID00 "Model Control Gain 1 [KM1]" by referring to “KM1 ≒KP1”, as a rough indication.
If vibration increases, lower the value.

- ◆ When responsiveness is low, change the value of "Model control gain 1 [KM1]" to the value approximately 1.1 to 1.2 times the value.

- ◆ Depending on the mechanical system, there may be two or more frequency vibrations aside from anti-resonance and resonance frequencies that have already been set. In this case, the vibration can be suppressed using FF vibration suppression controls together. Set the vibration frequency to Group02 ID00 "FF vibration suppression frequency A1 [SUPFRQA1]" by calculating the frequency from the vibration period.

- ◆ In case you cannot increase the gain because of mechanical resonance, etc., and response is insufficient, use Torque command notch filter and FF vibration suppression frequency to suppress the resonance, and then try again.

✔ Auto-tuning function is able to use only "Auto-tuning [JRAT manual setting]".

✔ Full-closed control is able to use in Model-following vibration suppression control, also.

✔ Model following (vibration suppression) control cannot be used when in Velocity control type or Torque control type.

■ Setting parameters

◆ General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15 to 315
01	MZETA	Model control damping coefficient	%	0 to 100
05	OSSFIL	Overshoot Suppression Filter	Hz	1 to 4000
06	ANRFRQ1	Model Control Anti-resonance Frequency 1	Hz	10.0 to 80.0
07	RESFRQ1	Model Control Resonance Frequency 1	Hz	10.0 to 80.0

✔ Do not change the setting value when the servo motor is running.

■ Model Control Gain 1 [KM1]
This is the proportional gain of the Model following controlling position controller and set response for Model control system. Adjust by referring to “KM1 ≒KP1”, as a rough indication.

■ Model control damping coefficient [MZETA]
This is parameter which changes velocity proportional gain of Model following control.
The parameter value will be ζ≒0.866 by 0% and ζ≒1.0 by 100%.

■ Overshoot Suppression Filter [OSSFIL]
This parameter is to set the cutoff frequency of the Overshoot suppression filter in Model following vibration suppression control. When overshoot occurs on position deviation, lower the set value.

■ Model Control Anti-resonance Frequency 1 [ANRFRQ1]
This is to set the Anti-resonance frequency of the machine using Model following vibration suppression control.
When the value is set higher than Model Control Resonance Frequency, vibration suppression control will be invalid.

■ Model Control Resonance Frequency 1 [RESFRQ1]
This is to set the Resonance frequency of the machine model using Model following vibration suppression control.
Vibration suppression control will be invalid at 80.0Hz.

- Parameter setting range for model following vibration suppression control
  Setting ranges for the following parameters are restricted:

  - General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Unit	Setting range
14	JRAT1	Load Inertia Moment Ratio 1	%	100 to 3000
20	TCFIL1	Torque Command Filter 1	Hz	100 to 1000

  - General parameters Group3 “Model following control settings”

ID	Symbol	Name	Unit	Setting range
00	KM1	Model Control Gain 1	1/s	15 to 315

6.8.2 Auto FF Vibration Suppression Frequency Tuning

FF Vibration Suppression control is able to suppress low frequency resonance like machine end vibration. "Auto FF Vibration Suppression Frequency Tuning" is able to set FF Vibration Suppression Frequency easily by rotating servo motor in a short time.

■ How to use

◆ Able to operate from "Auto-tuning mode" in the Setup Software or the Digital Operator. For use of the setup software, see "9.2 Auto FF Vibration Suppression Frequency Tuning" in another document: M0010842. For use of the digital operator, see "7.7 Auto FF vibration suppression frequency tuning".

◆ The tuning result is automatically saved in Group2 ID00 "FF vibration suppression frequency A1 [SUPFREQA1]".

◆ FF vibration suppression frequency is obtained by executing auto-tuning of vibration suppression frequency or by calculating vibration frequency from the mechanical vibration period at the time of positioning, and it is able to set.

✔ When the vibration is not able to suppress by setting of FF vibration suppression frequency, there is a possibility that Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" or Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" may be too high. In this case, lower "Position Loop Proportional Gain 1 [KP1]" or "Velocity Loop Proportional Gain 1 [KVP1]".

✔ When used together with Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]", vibration suppression effect may be improved.

✔ FF vibration suppression control function can be used with auto-tuning at the same time.

✔ Holding torque falls while Auto FF Vibration Suppression Frequency tuning is executing. Do not use as gravity axis.

■ Torque command value of Auto FF vibration suppression frequency tuning
Sets torque command value giving to servo motor at the time of performing the Auto FF vibration suppression frequency tuning

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
20	ASUPTC	Auto-FF Vibration Suppression Frequency Tuning Torque Command	%	10.0 to 100.0

✔ As the value increases so does tuning accuracy. However, machine movement will increase as well. Please monitor it closely.

■ Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value
Sets additional frictional torque compensation amount when Auto FF Vibration Suppression Frequency Tuning is executed. By setting the value close to the actual friction torque, the accuracy of Auto FF Vibration Suppression Frequency Tuning can be improved.

◆ General parameters Group0 “Auto-Tuning”

ID	Symbol	Name	Unit	Setting range
21	ASUPFC	Auto-FF Vibration Suppression Frequency Tuning Friction Compensation Value	%	0.0 to 50.0

- ■ The parameter saved automatically by the Auto FF Vibration Suppression Frequency Tuning
  - ◆ General parameters Group2 "FF (Feed forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
00	SUPFRQA1	FF Vibration Suppression Frequency A1	Hz	1.0 to 500.0

6.8.3 FF vibration suppression control

FF vibration suppression control can be used as a method of suppressing the vibration of the mechanical tip.
There are two kinds of FF vibration suppression controls which have different characteristics.

Name	Adjustable characteristics
FF vibration suppression control A	Vibration suppression effect
FF vibration suppression control B	Responsiveness of position control

- ■ How to use
  - ◆ Find out vibration frequencies of machine. (For use of the system analysis, see "10.3 System analysis" in another document: M0010842.)
  - ◆ In case of having a single vibration frequency, use either FF vibration suppression control A or B. (The vibration frequency will be set to FF vibration suppression control A (Group2 ID00 "FF vibration suppression frequency A1 [SUPFRQA1]") by performing "Auto FF vibration suppression frequency tuning".)
  - ◆ In case of having 2 vibration frequencies, use FF vibration suppression control A ("FF vibration suppression frequency A1 [SUPFRQA1]") with lower frequency, and use B (Group2 ID00 "FF vibration suppression frequency B1 [SUPFRQB1]") with higher frequency.

✔ When the vibration is not able to suppress the vibration of the mechanical tip by procedure above, there is a possibility that Group1 ID02 "Position Loop Proportional Gain 1 [KP1]" or Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" may be too high. In this case, lower "Position Loop Proportional Gain 1 [KP1]" or "Velocity Loop Proportional Gain 1 [KVP1]".

- ■ Setting parameter
  - ◆ General parameters Group2
    “FF vibration suppression control / Notch filter Disturbance observer settings”

ID	Symbol	Name	Unit	Setting range
00	SUPFRQA1	FF Vibration Suppression Frequency A1	Hz	1.0～500.0
01	SUPLVA	FF Vibration Suppression Level Selection A	—	00～03
02	SUPFRQB1	FF Vibration Suppression Frequency B1	Hz	1.0～500.0
03	SUPCRB	FF Vibration Suppression Level Selection B	—	00～01

✔ Do not change the setting value when the servo motor is running.

- ■ General parameters Group4 "Gain switching control/ Vibration suppression frequency switching settings"

ID	Symbol	Name
40	SUPFRQA2	FF Vibration Suppression Frequency A2
41	SUPFRQA3	FF Vibration Suppression Frequency A3
42	SUPFRQA4	FF Vibration Suppression Frequency A4
43	SUPFRQB2	FF Vibration Suppression Frequency B2
44	SUPFRQB3	FF Vibration Suppression Frequency B3
45	SUPFRQB4	FF Vibration Suppression Frequency B4

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
15	SUPFSELA1	FF Vibration Suppression Frequency Select Input A1	-	00 to 29
16	SUPFSELA2	FF Vibration Suppression Frequency Select Input A2	-	00 to 29
17	SUPFSELB1	FF Vibration Suppression Frequency Select Input B1	-	00 to 29
18	SUPFSELB2	FF Vibration Suppression Frequency Select Input B2	-	00 to 29

✔ When the vibration suppression frequency is changed, FF vibration suppression control will be invalid and servo motor will rotate till outputting a rest of position command pulse in the FF vibration suppression function.

✔ Do not change the vibration suppression frequency when the servo motor is running.

6.8.4 CP vibration suppression control

This is the function which suppress a vibration of machine stand, even if perform CP control like as during machine cutting.

■ How to use

◆ If a vibration occur by low rigidity of machine, calculate and find out vibration frequency from position deviation monitor, and set it to Group2 ID50 "CP vibration suppression control frequency [CPVSFQ]".

◆ If effect of CP vibration suppression is weak, it is able to make strong by increasing value of Group2 ID51 "CP vibration suppression control level [CPVSLV]".

■ CP vibration suppression control frequency
Sets the vibration frequency of Machine stand.

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
50	CPVSFQ	CP vibration suppression control frequency	Hz	10.0 to 100.0

✔ Please stop servo motor when setting this value.
✔ This function will be valid when performing at standard position control mode.

■ CP vibration suppression control level
This is the parameter which sets impact of CP vibration suppression control.

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
51	CPVSLV	CP vibration suppression control level	-	00 to 03

✔ Effect of CP vibration control will be larger when increasing this value.
✔ Please stop servo motor when selecting this value.

■ CP vibration suppression control characteristics selection
Sets the effective frequency range of CP vibration suppression control.

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
52	CPVSSH	CP vibration suppression control characteristics selection	-	00 to 03

✔ Frequency range of CP vibration control will be narrow when increasing this value.
✔ Please stop servo motor when selecting this value.

6.8.5 Minor vibration suppression

Explains the function which suppresses a minor vibration against velocity feedback during servo motor stop.

■ How to use

- ◆ The function is valid when condition that is selected in Group9 ID35 "Minor vibration suppression function" is filled.
  Example: Always valid when "01: Always_Enable" is selected.
- ◆ If minor vibration is there in velocity feedback at conditions of servo ON and servo motor stopping, activate FBHYST and set FBHPLS, FBHTIM.
- ◆ Set FBHPLS as multiple of FBHTIM as follows. If not multiple of FBHTIM, the actual Minor vibration suppression pulse compensation frequency will have deviation with FBHTIM.
- ◆ Sample combinations of Minor vibration suppression pulse compensation value and Minor vibration suppression pulse compensation frequency

Minor vibration suppression pulse compensation value	Minor vibration suppression pulse compensation frequency
10	1
10	10
50	1
50	10
50	50

■ Minor vibration suppression function
Select the condition which will be valid/invalid of this function.

◆ General parameters Group9 "Function enabling condition settings"

ID	Symbol	Name	Unit	Setting range
35	FBHYST	Minor vibration suppression function	-	00 to 29

■ Minor vibration suppression pulse compensation value
Sets the compensation amount of Minor vibration suppression function for velocity feedback.

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
60	FBHPLS	Minor vibration suppression pulse compensation value	pulse	1 to 100

✔ Sets by multiple of FBHTIM.

■ Minor vibration suppression pulse compensation frequency
Sets the number of Minor vibration suppression.

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
61	FBHTIM	Minor vibration suppression pulse compensation frequency	times	1 to 100

✔ The larger the set value, longer the minor vibration suppression period.
✔ Set the value which is smaller than FBHPLS.

6.9 Disturbance impact suppression function

When a force is given to a servo motor externally, bad impact might be given to the control system. Follows are explaining the function of suppressing disturbance impact.

6.9.1 High order integral control

Use for suppression of disturbance impact for control system by decreasing Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" more. This is the function to compensate phase delay of Velocity integral control system feedback. Use when oscillation or overshoot occurs by decreasing "Velocity Loop Integral Time Constant 1 [TVI1]".

■ How to use

- ◆ Set 1 or 2 times of Group1 ID12 "Velocity Loop Proportional Gain 1 [KVP1]" to Group1 ID18 "High order integral control frequency [HKVIF]".
- ◆ Set 30% to Group1 ID17 "High order integral control gain [HKVIK]", and then confirm the things that phase margin near to "Velocity Loop Proportional Gain 1 [KVP1]" became large.
- ◆ "High order integral control gain [HKVIK]" is able to increase up to phase margin will be allowed value at high frequency range.
- ◆ "Velocity Loop Integral Time Constant 1 [TVI1]" is able to decrease till phase margin will be allowed value at near of "Velocity Loop Proportional Gain 1 [KVP1]".

✔ High order integral control cannot use along with higher tracking control. For use of High order integral control, set 0% to Group1 ID1E "Higher Tracking Control Velocity Compensation Gain [TRCVGN]".

■ High order integral control gain

◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
17	HKVIK	High order integral control gain	%	0 to 100

✔ This function will be disabled when 0% is set.

■ High order integral control frequency

◆ General parameters Group1 "Basic control parameter settings"

ID	Symbol	Name	Unit	Setting range
18	HKVIF	High order integral control frequency	Hz	10 to 4000

✔ Up to 1000Hz setting is valid at normal sampling mode.
✔ Up to 2000Hz setting is valid at high rate sampling mode.

6.9.2 Disturbance Observer Function

The Disturbance Observer is a function to suppress the influence of external load torque by estimating the load torque inside the servo amplifier and adding the load torque compensation to the torque command.

■ How to use

◆ The function will be valid when the condition which is selected at Group9 ID33 "Disturbance Observer Function" is filled.
Example: The function will be always valid when "01: Always_Enable" is selected.

◆ Select appropriate observer characteristic depending on disturbance frequency which is desired to suppress.

◆ Increase the value of Group2 ID31 "Observer Compensation Gain [OBG]" by little, and do not start from large value. Disturbance suppression characteristic will improve by increasing "Observer Compensation Gain [OBG]". However, oscillation might occur by too large of set value. Please use in range of no oscillation.

◆ Group2 ID32 "Observer Output Low-pass Filter [OBLPF]" is able to improve observer characteristic by setting frequency higher at high encoder resolution or low load inertia moment ratio etc.

◆ Use "Observer Output Notch Filter" to suppress vibration when resonance is changed at high frequency range.

■ Parameters for using the Disturbance Observer

◆ Group9 “Functions enabling conditions settings”

ID	Symbol	Name	Setting range
33	OBS	Disturbance Observer Function	00 to 29

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
30	OBCHA	Observer Characteristic	—	00 to 02
31	OBG	Observer Compensation Gain	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	Hz	100 to 4000

◆ Disturbance observer characteristics are prepared as "00_Low: Low frequency disturbance suppression", "01_Middle: Mid-frequency disturbance suppression" and "02_High: High frequency disturbance suppression".

Frequency	Selection		Description
10 to 40 Hz	00	Low	Low frequency disturbance suppression
40 to 80 Hz	01	Middle	Mid-frequency disturbance suppression
80 to 200 Hz	02	High	High frequency disturbance suppression

✔ Disturbance Observer cannot be used with Auto-tuning at the same time.

✔ Use “02_High for High frequency disturbance suppression” when encoder resolution is above 1048576 division.

✔ Torque command might have variation if switches a valid/ invalid of Group9 ID33 "Disturbance Observer Function [OBS]" when cutoff frequency of OBLPF is set higher.

6.10 Stick-slip behavior compensation function

Explains the compensation function of stick-slip behavior which occurs by machine system friction etc.

■ How to use

◆ The function will be valid when the condition which is selected at Group9 ID34 "Stick-slip behavior compensation function" is filled.
Example: The function will be always valid when "01: Always_Enable" is selected.

◆ Set 70% of Group1 ID13 "Velocity Loop Integral Time Constant 1 [TVI1]" to Group1 ID42 "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]", and then confirm the things that stick-slip behavior has reduced.

◆ "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]" is able to decrease when oscillation does not occur. Increase "Velocity loop integral time constant for stick-slip behavior compensation [STTVI]" up to the value which has margin against oscillation, when oscillation occurs.

■ Parameters for using the stick-slip behavior compensation function.

◆ Group9 “Functions enabling conditions settings”

ID	Symbol	Name	Unit	Setting range
34	STC	Stick-slip behavior compensation function	-	00 to 29

◆ General parameters Group2
"FF (Feed Forward) vibration suppression control/ Notch filter/ Disturbance observer settings"

ID	Symbol	Name	Unit	Setting range
40	STV	Effective velocity for compensating stick-slip behavior	min^{-1}	0.1 to 128.0
41	STHLD	Retention time for compensating stick-slip behavior	ms	1 to 500
42	STTVI	Velocity loop integral time constant for stick-slip behavior compensation	ms	0.3 to 1000.0

◆ Effective velocity for compensating stick-slip behavior [STV]
Stick-slip behavior compensation will work when internal velocity command of servo amplifier is below of this value.

◆ Retention time for compensating stick-slip behavior [STHLD]
Stick-slip behavior compensation will be kept till over the set time, when internal velocity command of servo amplifier exceeds STV. Increase this value when response of velocity control is low.

◆ Velocity loop integral time constant for stick-slip behavior compensation [STTVI]
This set value will apply to velocity integral control system while stick-slip behavior compensation is performing.

7

Digital Operator

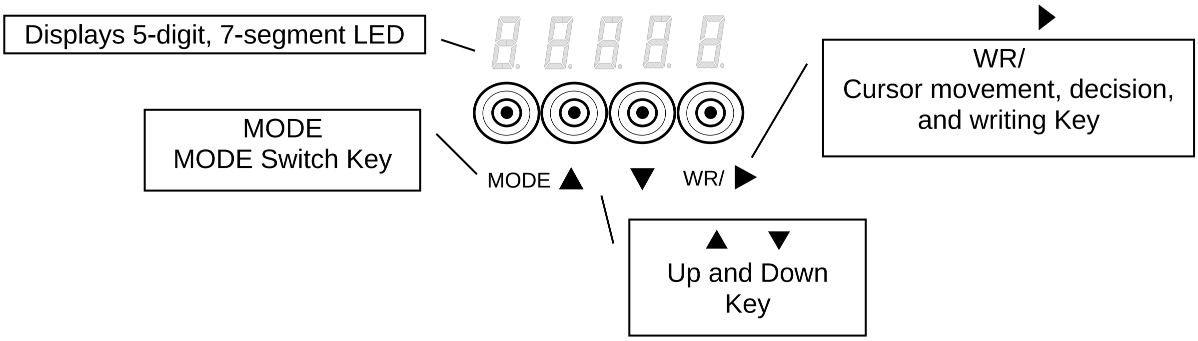
In this chapter, details of the Digital operator are explained.

7. Digital Operator

7.1 Digital Operator names and functions

It is possible to change or set the parameters and to confirm the status display, monitor display, test operation and alarm history with the built-in digital operator.

- Names



◆ Functions

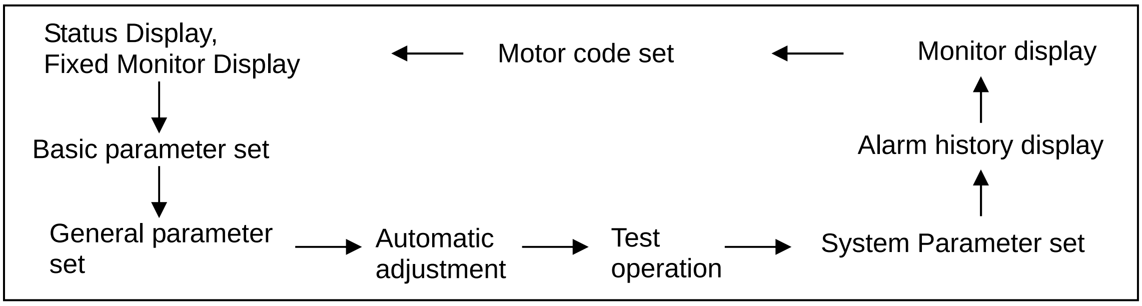
Displayed marks	Functions	Input time
WR	To input selections and write edited data.	More than 1 second
MODE	Changes the Mode.	Less than 1 second
▶	Cursor Key Changes the cursor position when editing	Less than 1 second
▲ ▼	Up/ Down key. Changes the numeric value.	Less than 1 second
7 segment LED	Displays monitor value or parameter setting value in five digits.	–

7.2 Modes

It is possible to display the status, to change or set the parameters, to automatically set the notch filter, to change servo motor, and to confirm test operation, alarm history and monitor display with the built-in digital operator.

7.2.1 Changing modes

Change in the mode presses the "MODE key." The mode switches in order of the following figure.



7.2.2 Mode contents

<table>
<tr><th>Mode</th><th>Contents</th></tr>
<tr><td>Status Display</td><td>■ Displays the establishment of control or main power supply, Servo ON, over-travel, warning and alarm status.</td></tr>
<tr><td>Basic parameter
bA 00</td><td>■ Parameters necessary for test operations by JOG and auto-tuning. Can be set at general parameter mode.</td></tr>
<tr><td>General parameter
Gr0.00</td><td>■ Settings can be made suitable for machines and equipment.
Parameters for adjusting servo gain can be changed.
Classified into 12 groups according to the functions.
<table>
<tr><th>Group</th><th>Description of Group</th></tr>
<tr><td>Group0</td><td>Settings of automatic tuning.</td></tr>
<tr><td>Group1</td><td>Settings of basic control parameters.</td></tr>
<tr><td>Group2</td><td>Settings of damping control/notch filter/disturbance observer.</td></tr>
<tr><td>Group3</td><td>Settings of model following control.</td></tr>
<tr><td>Group4</td><td>Settings of gain switching control/damping frequency switching.</td></tr>
<tr><td>Group5</td><td>To set high setting control.</td></tr>
<tr><td>Group8</td><td>Settings of control system.</td></tr>
<tr><td>Group9</td><td>Settings of various functional effective conditions.</td></tr>
<tr><td>GroupA</td><td>Setting of general output terminal output condition / monitor output selection</td></tr>
<tr><td>GroupB</td><td>Setting related to sequence / alarm.</td></tr>
<tr><td>GroupC</td><td>Settings related to encoder.</td></tr>
<tr><td>GroupD</td><td>Settings related to supporting function.</td></tr>
</table></td></tr>
<tr><td>Automatic adjustment
Au 00</td><td>■ Enables Adjustment for Torque Command Notch Filter A, Vibration Suppression frequency 1 and Offset of Analog Velocity/Torque/Torque Addition Command.</td></tr>
<tr><td>Test operation
Ad 00</td><td>■ JOG operation, encoder clear, auto tuning result writing and motor origin search are available.</td></tr>
<tr><td>System parameter
Sy 00</td><td>■ Sets the parameters related to servo amplifier - motor encoder.</td></tr>
<tr><td>Alarm history
ALH 1</td><td>■ Displays the latest 15 alarm events.</td></tr>
<tr><td>Monitor
ob 00</td><td>■ Displays the servo amplifier status such as Velocity, Velocity Command, Torque, Torque command, Position Deviation and Servo Adjustment Gain when using auto-tuning.</td></tr>
<tr><td>Motor code set
CoSEt</td><td>■ Sets the motor cord corresponding to servo motor, and changes the servo motor to be used.</td></tr>
</table>

7.3 Setting and display range

Digital operator displays data becomes the following form.

■ Data of 0 to +65535

Symbol	Digital operator display	Range of a digit display	
Plus	0	Position of 1 display	0 to 9
Plus	10	Position of 10 display	10 to 99
Plus	100	Position of 100 display	100 to 999
Plus	1000	Position of 1000 display	1000 to 9999
Plus	10000	Position of 10000 display	10000 to 99999

■ Data of -9999 to +9999

Symbol	Digital operator display	Range of a digit display	
Plus	0	Position of 1 display	0 to 9
Plus	10	Position of 10 display	10 to 99
Plus	100	Position of 100 display	100 to 999
Plus	9999	Position of 1000 display	1000 to 9999
Minus	-9999	Position of 10000 display	1000 to 9999

✔ Left end – expresses minus.

■ Data of 0 to +4199999999

Symbol	Digital operator display	Range of a digit display	
Plus	_ 1000	Low position of 1 to 1000 display	0 to 9999
Plus	= 1000	Middle position of 10000 to 10000000 display	0 to 9999
Plus	≡ 41	High position of 100000000 to 1000000000 display	0 to 41

✔ Left end LED expresses low position, middle position, and high position.
Press and hold MODE for 1 sec or more to switch.

■ Hexadecimal data

Data size	Digital operator display	Range of a digit display
1 byte	F0	00 to FF
2 byte	F000	0000 to FFFF
4 byte Low	L. F000	0000 to FFFF (Bit15 to Bit0) display
4 byte High	H. F000	0000 to FFFF (Bit31 to Bit16) display

■ Example display of decimal point data

First position of a decimal point	100.0
Second position of a decimal point	10.00

■ The data of servo amplifier operating time

Digits of the data	Digital operator display	Range of a digit display
Digits of millisec unit	999	0 to 999
Digits of sec unit	_ 59	0 to 59
Digits of minute unit	= 59	0 to 59
Lower 4 digits of hour unit	≡ 9999	0 to 9999
Upper 4 digits of hour unit	≡. 9999	0 to 9999

✔ Left end LED expresses digits of the data. Press and hold MODE for 1 sec or more to switch.

■ Average power monitor display (Monitor ID: 4A)
Display range of average power is automatically changed depending on the value, to indicate optimum range.
When average power exceed 1000W, "H" is indicated to highest digit and unit is changed to [kW].
Also, decimal point moves a position depending on average power.

Average power range		Example display	Unit
-999999.9 W	< Average power ≦-99950.0 W	H -999	kW
-99950.0 W	< Average power ≦-9995.0 W	H -99.9	kW
-9995.0 W	< Average power ≦-1000.0 W	H -9.99	kW
-999.9 W	≦ Average power ≦+999.9 W	-99.99 99.99	W
1000.0 W	≦ Average power <+9995.0 W	H 9.99	kW
9995.0 W	≦ Average power <+99950.0 W	H 99.9	kW
99950.0 W	≦ Average power <+999999.9 W	H 999	kW

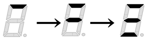
- ■ Regenerative power monitor display (Monitor ID: 4C)
  Display range of regenerative power is automatically changed depending on the value, to indicate optimum range.

Regenerative power range					Example display	Unit
0.000 W	≦	Regenerative power	≦	99.999 W	99.999	W
100.000 W	≦	Regenerative power	＜	999.995 W	999.99	W
999.995 W	≦	Regenerative power	＜	9,999.950 W	9999.9	W
9,999.950 W	≦	Regenerative power			99999	W

7.4 Status display mode

In this mode, the state of servo amplifier and the display of the alarm number when alarm occurring can be checked. In addition to these, reset of alarm, the software version check of servo amplifier, and setup of a password can be performed at the time of an alarm number display.

7.4.1 Status display mode

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is ON.	1
	Main circuit power supply established. Main power supply (R, S, and T) is established, but operation preparation completion signal is OFF.	2
	Safe Torque Off working status. Main circuit power supply (R, S, and T) is established and either safe torque off input 1 or 2 is “OFF”. “” are shown sequentially.	2
	Operation preparation completion signal established. Main power supply (R, S, T) is established and operation preparation completion signal is ON.	3
	Servo is ON. Rotates after displaying the character“8”.	4

7.4.2 Over-travel status display

Marking	Description
	Over-travel status at normal rotation. Forward rotation is in ‘Over-Travel’ status in position and speed control type.
	Over-travel status at reverse rotation. Reverse rotation is in ‘Over-Travel’ status in position and speed control type.

7.4.3 Status display of warning

Marking	Description
	Encoder system warning status Occurred warning below ■ Battery voltage sag
	Load system warning status Occurred one of warnings below ■ Regeneration overload ■ Overload ■ Servo amplifier internal temperature
	Power system warning status Occurred warning below ■ Battery voltage sag
	Control system warning status Occurred one of warnings below ■ Restricting torque command ■ Restricting velocity command ■ Excessive position deviation ■ Dual position error excess ■ Sync error excess ■ Adaptive notch filter E frequency

- ✔ Descriptions of each warning are shown at "8.2.1 Warning List".
- ✔ Confirm occurring warning by the digital operator referring "7.16 Monitor display" or by warning information of the setup software. For operation of the setup software, see another document: M0010842.

7.4.4 Alarm code and servo amplifier status code when alarm occurs

Marking	Description
AL.85.F	Please take a measure according to the contents of "Maintenance" when alarm occurs.

Status code

Alarm code

7.4.5 Alarm reset when alarm activated

Alarm can be reset from the digital operator. However, the alarm that needs to perform power supply reset cannot be reset from the digital operator. About the alarm that performs power supply reset, can check by [8.2 Warning and Alarm List]

Step	Displayed Character, number, code	Input button				How to operate
1	AL.55.4					Make the state where the alarm number is displayed.
2		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE for more than 1 second.
3	ALrSt					Display changes as the left.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	.r.u.n..					Display changes as the left for 2 seconds.
6	≡					When the cause of alarm is removed, the state of servo amplifier is displayed.

7.4.6 How to check the software version of servo amplifier

The software version of servo amplifier can be checked from the digital operator.

Step	Displayed Character, number, code	Input button				How to operate
1	≡					Make the state of servo amplifier, or the state where alarm is displayed.
2		○ MODE	○ ▲	● ▼	○ WR/▶	Push the subtraction button for more than 1 second.
3	CPu.no					Display changes as the left.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	8.8.8.8.8.					The present software version is displayed.
6		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once.
7	CPu.no					Display changes as the left.
8		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once.
9	≡					Returns to Process 1.

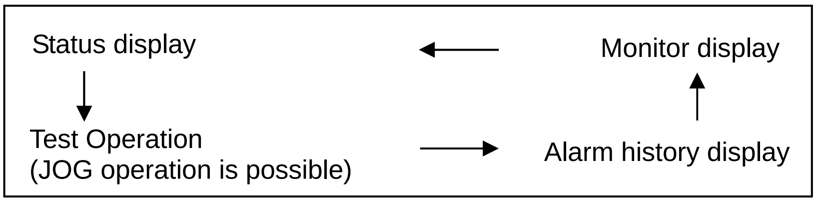
7.4.7 How to check the servo amplifier information 1 to 3

Step	Displayed Character, number code	Input button				How to operate
1	≡					Make the state of servo amplifier, or the state where alarm is displayed.
2		○ MODE	○ ▲	● ▼	○ WR/▶	Push the subtraction button for more than 1 second.
3	CPu.no					Display changes as the left.
4		○ MODE	● ▲	● ▼	○ WR/▶	Push addition and subtraction button.
5	InFo.1 InFo.2 InFo.3					Display changes as the left.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7						The selected information is displayed.
8		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once.
9	InFo.1 InFo.2 InFo.3					Returns to Process 5.
10		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once.
11	≡					Returns to Process 1.

✔ The contents of display information 1, information 2, and information 3 are described to “5.1.1 Specification check”.

7.4.8 How to set pass ward

The function that can be used by setting up a password from digital operator can be restricted, and change of a parameter etc. can be forbidden. The function and the setting method can be used is the following.



Step	Displayed character, number, code	Input button				How to operate
1	≡					Make the state of servo amplifier, or the state where alarm is displayed.
2		○ MODE	● ▲	○ ▼	○ WR/▶	Push addition button for more than 1 second.
3	-PAS-					Display switches as the left and the whole display blinks. When setup of the password has ended, display does not blink.
4	0000	○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5						Display changes as the left and right end LED blinks.
6	1234	○ MODE	● ▲	● ▼	● WR/▶	Display arbitrary numerical values with addition and subtraction and the cursor button. 0000 and FFFF cannot be set up.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
8	1234					Display blinks 3 times, and setup will be completed if blink stops.
9		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once.
10						Returns to process 1.
11	≡					Password will become effective if power supply is turned on again.

7.4.9 How to cancel password

Step	Displayed character, number, code	Input button				How to operate
3	- P A S -					Display switches as the left and the whole display lights up. Password is not set up when the display is blinking.
4	0 0 0 0	○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5						Display switches as the left and right end LED blinks.
6	1 2 3 4	○ MODE	● ▲	● ▼	● WR/▶	Set up password is displayed with addition and subtraction and the cursor button.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
8	1 2 3 4					Display blinks 3 times, and cancel will be completed if blink stops.
9		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE once. Then returns to Process 1.
10						After cancel does not need to turn on power supply again.

7.5 Editing parameters

The parameter inside servo amplifier can be changed into a setup put together with equipment and the machine of usage in fundamental parameter edit mode, general parameter edit mode, and system-parameter edit mode.
Here, the setting method is explained to an example for fundamental parameter edit mode.

7.5.1 Basic parameters, editing system parameters

Step	Displayed character, number, code	Input button				How to operate
1	bA	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	bA 00					Display changes as left, and right end LED blinks.
3	bA 10	○ MODE	● ▲	● ▼	● WR/▶	Display ID of the parameter changed with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	0E					The data set up is displayed.
6	0A	○ MODE	● ▲	● ▼	● WR/▶	Display a value to set up with addition and subtraction and the cursor button.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
8	0A					Setup is completion when blink stops, after a display blinks 3 times. When the set-up value is outside a setting range, setting of Process 5 is display without a display blinking 3 times.
9		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
10	bA 10					Display switches ad the left. When you set other parameters continuously, repeat from Process 3.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
12	Gr					Changes to the left display.

5	non	When reservation parameter cannot be set, the left is displayed in Process 5.

✔ When operating in system parameter editing mode, the displayed character in step 1 shall be "SY."

7.5.2 Editing general parameters

For example, method of changing Group9 ID01 “Negative Over Travel Function [R-OT]” from “0B” to ”00“ is as follows. Also, see next example for GroupC ID04 “Encoder Output Pulse Division [ENRAT]”.

Step	Displayed character, number, code	Input button				How to operate
1	G r	● MODE	○ ▲	○ ▼	○ WR/▶	Hold down MODE until the figure left is displayed.
2	G r 0. 0 0					Display changes as left, and right end LED blinks.
3	G r 9. 0 1	○ MODE	● ▲	● ▼	● WR/▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4	G r 9. 0 1	○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
5	0 b					“0b” is displayed.
6	0 0	○ MODE	● ▲	● ▼	● WR/▶	Set figure “00” by addition/ subtraction, cursor button.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
8		● MODE	○ ▲	○ ▼	○ WR/▶	Press MODE.
9	G r 9. 0 1					Display to be switched to the display left.

Editing general parameter GroupC ID04 “Encoder Output Pulse Division [ENRAT]”
For example, method to change from 1/1 to 2/64 is as follows.

Step	Displayed character, number, code	Input button				How to operate
1	G r	● MODE	○ ▲	○ ▼	○ WR/▶	Hold down MODE until the figure left is displayed.
2	G r 0. 0 0					Display changes as left, and right end LED blinks.
3	G r C. 0 4	○ MODE	● ▲	● ▼	● WR/▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4	G r C. 0 4	○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
5	G r n u.					“Gr nu” is displayed.
6	G r d E	● MODE	○ ▲	○ ▼	○ WR/▶	Hold down MODE for over a second to change the display to Gr dE. “nu” stands for numerator, “dE” stands for denominator. Hold down MODE for over a second to switch between “nu” and “dE.” Set “Gr dE (denominator)” first.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
8	1					Display to be switched, and then rightmost LED flashes. When setting dE first, holding down WR displays the denominator. The display left shows “1” as dE is set first. When you set nu first, holding down WR displays numerator.
9	6 4	○ MODE	● ▲	● ▼	● WR/▶	Set figure “64” (denominator) by addition/ subtraction, cursor button.
10		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.

Step	Displayed character, number, code	Input button				How to operate
11	64					When display flashes 3 times, and then the flashing stops, the setting of denominator is completed. If the set value is out of the setting range, the set value in the step 6 is displayed without flashing 3 times. When the numerator is “1,” “1 to 64” or “32768” is settable as the denominator.
12		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
13	GrC.04					“GrC.04” is displayed.
14		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
15	Gr nu.	● MODE	○ ▲	○ ▼	○ WR/▶	“Gr nu” is displayed.
16		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
17	1					Display to be switched, and then rightmost LED flashes. The set data are displayed. The display left shows “1” as nu is set first.
18	2	○ MODE	● ▲	● ▼	● WR/▶	Display the figure “2 (numerator)” you want to set by addition/ subtraction, cursor button.
19		○ MODE	○ ▲	○ ▼	● WR/▶	Hold down WR for over a second.
20	2					When display flashes 3 times, and then the flashing stops, the setting is completed. If the set value is out of the setting range, the set value in the step 13 is displayed without flashing 3 times.
21	GrC.04	● MODE	○ ▲	○ ▼	○ WR/▶	Press MODE.
22						Display to be switched to the display left.

✔ There are three setting ranges of pulse frequency dividing, “1/1 to 1/64,” “2/3 to 2/64,” and “1/32768 to 32767/32768.”
If you set the figure out of the ranges, the figure is not displayed, the figure before the setting flashes.
When setting numerator, the figure of denominator is applicable to the figure presently established.
For example, to change from 1/1 to 2/64, you need to set the denominator first, as the numerator is already fixed to “1,” and “2/1” is out of the ranges.

✔ “nu” stands for numerator, “dE” stands for denominator.

7.6 How to tune automatic notch frequency

Step	Displayed character, number, code	Input button				How to operate
1	A u	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	A u 0 0					Display changes and right end LED blinks.
3	A u 0 0	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	n o t C H					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	2					The character of 8 is drawn and servo is on.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	. r. u. n. .					A display change as the left and it performs.
10	8					Changes to the display of the left after a normal end.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
12	n o t C H					Servo is off and changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	A L. d F. 4					Completes and changes to the left display.

- ■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
A d	Changes to the left display.
MODE is pushed in Process 5.	
A u 0 0	Changes to the left display and return to Process 2.
MODE is pushed in Process 7.	
n o t C H	Changes to the left display and return to Process 5.
Mode is pushed again.	
A L. d F. 4	Complete and changes to the left display.
MODE is pushed in Process 9.	
A L. d F. 4	Complete and changes to the left display.

- ■ Error is displayed when cannot end normally.

E r r	Changes to the left display.
Will end, if MODE is pushed.	
A L. d F. 4	Complete to the left display.

7.7 Auto FF vibration suppression frequency tuning

Step	Displayed character, number, code	Input button				How to operate
1	A u	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	A u 0 0					Display changes and right end LED blinks.
3	A u 0 1	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	S u P r					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	8					The character of 8 is drawn and servo is on.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	. r. u. n. .					A display change as the left and it performs.
10	8					Changes to the display of the left after a normal end.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
12	S u P r					Servo is off and changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	A L. d F. 4					Completes and changes to the left diaplay.

■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
A d	Changes to the left display.
MODE is pushed in Process 5.	
A u 0 1	Changes to the left display and return to Process 2.
MODE is pushed in Process 7.	
S u P r	Changes to the left display and return to Process 5.
MODE is pushed again.	
A L. d F. 4	Complete and changes to the left display.
MODE is pushed in Process 9.	
A L. d F. 4	Complete and changes to the left display.

■ Error is displayed when cannot end normally.

E r r	Changes to the left display.
Will end, if MODE is pushed.	
A L. d F. 4	Completes and changes to the left display.

7.8 Offset adjustment of velocity/ torque command

■ Method of auto offset

Step	Displayed character, number, code	Input button				How to operate
1	Au	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	Au 00					Display changes and right end LED blinks.
3	Au 02	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	Cd oF					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	Auto					Changes to the left display.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	.r.u.n..					A display change as the left and it performs.
10	Cd oF					Changes to the display of the left after a normal end.
	Err					Error is displayed when cannot end normally.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE and finish.
12	Au 02					Changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	Ad					Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are the same as auto offset.						
7	Auto					Changes to the left display.
8		○ MODE	○ ▲	● ▼	○ WR/▶	Push subtraction button.
9	HAnd					Changes to the left display.
10		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
11	- 4					The data setup is displayed.
12		○ MODE	● ▲	● ▼	○ WR/▶	Adjust offset value with the addition-and-subtraction button.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	Cd oF					Changes to the left display.
15		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE and finish.
16	Au 02					Changes to the left display.
17		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
18	Ad					Changes to the left display.

7.9 Offset adjustment of analog torque compensation command

■ Method of auto offset

Step	Displayed character, number, code	Input button				How to operate
1	Au	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	Au 00					Display changes and right end LED blinks.
3	Au 03	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	AddoF					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	Auto					Changes to the left display.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	. r. u. n. .					A display change as the left and it performs.
10	AddoF					Changes to the display of the left after a normal end.
	Err					Error is displayed when cannot end normally.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE and finish.
12	Au 03					Changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	Ad					Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are same as auto offset.						
7	Auto					Changes to the left display.
8		○ MODE	○ ▲	● ▼	○ WR/▶	Push subtraction button.
9	HAnd					Changes to the left display.
10		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
11	- 4					The data set up is displayed.
12		○ MODE	● ▲	● ▼	○ WR/▶	Adjust offset value with an addition-and-subtraction button.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	AddoF					Changes to the left display.
15		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE and finish.
16	Au 03					Changes to the left display.
17		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
18	Ad					Changes to the left display.

7.10 Velocity-controlled JOG Operation

Step	Displayed character, number, code	Input button				How to operate
1	Ad	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	Ad 00					Display changes and right end LED blinks.
3	Ad 00	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	JoG					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	8					The character of 8 is drawn and servo is on.
8	8	○ MODE	● ▲	○ ▼	○ WR/▶	If it continues pushing an addition button, a motor shaft will rotate in the CCW direction. Will stop when an addition button is detached.
9	8	○ MODE	○ ▲	● ▼	○ WR/▶	If it continues pushing an addition button, a motor shaft will rotate in the CW direction. Will stop when a subtraction button is detached.
10		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
11	JoG					Servo is off and it changes to the left display.
12		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
13	AL.dF.4					Completes and changes to the left display.

■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
SY	Changes to the left display and shifts to system parameter.
MODE is pushed in Process 5.	
Ad 00	Changes to the left display and returns to step 2.
MODE is pushed in Process 7.	
JoG	Changes to the left display and returns to step 5.
Mode is pushed again.	
AL.dF.4	Completes and changes to the left display.

■ Display below is state of over travel.

⊣	Positive direction over-travel status. Positive direction over-travel has occurred at position/velocity control.
⊢	Negative direction over-travel status. Negative direction over-travel has occurred at position/velocity control.

✔ Over-travel functions are set at general parameter Group9 ID00 “Positive Over Travel Function[F-OT]”, ID01 “Negative Over Travel Function [R-OT]”.
See detail in "5.8 Parameter functions", Group9 "Function enabling condition settings".

7.11 Encoder Clear

Step	Displayed character, number, code	Input button				How to operate
1	Ad	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2						Display changes and right end LED blinks.
3	Ad 00	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4	Ad 01	○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	EnCLr					Changes to the left display.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	.r.u.n..					A display change as the left and it performs.
10	EnCLr					Changes to the display of the left after a normal end.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
12	Ad 01					Changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	SY					Changes to the left display.

7.12 Automatic tuning result writing

Step	Displayed character, number, code	Input button				How to operate
1	Ad	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	Ad 00					Display changes and right end LED blinks.
3	Ad 02	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	turSt					Changes to the left display.
8		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
9	.r.u.n..					A display change as the left and it performs.
10	turSt					Changes to the display of the left after a normal end.
11		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
12	Ad 02					Changes to the left display.
13		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
14	SY					Changes to the left display.

7.13 Motor origin search

Step	Displayed character, number, code	Input button				How to operate
1	Ad	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	Ad 00					Display changes and right end LED blinks.
3	Ad 03	○ MODE	● ▲	● ▼	● WR/▶	Make as the left display with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	orGPo					Changes to the left display.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	8					The character of 8 is drawn and servo is on.
8	.r.u.n.	○ MODE	● ▲	● ▼	○ WR/▶	Origin search starts to CCW when pushing addition button 1 sec or more, to CW when pushing subtraction button 1 sec or more. Display changes as the left at origin search starting.
9	orGPo					A display change as the left and it performs.
10						Changes to the display of the left after a normal end.
11	AL.dF.4	● MODE	○ ▲	○ ▼	○ WR/▶	Completes and changes to the left display.

- ■ For stopping during operation, please push the MODE button.

MODE is pushed in Process 2.	
SY	Changes to the left display and shifts to system parameter.
MODE is pushed in Process 5.	
Ad 00	Changes to the left display and returns to step 2.
MODE is pushed in Process 7.	
orGPo	Changes to the left display and returns to step 5.
Mode is pushed again.	
AL.dF.4	Completes and changes to the left display.

- ■ Display below is state of over travel.

⊣	Positive direction over-travel status. Positive direction over-travel has occurred at position/velocity control.
⊢	Negative direction over-travel status. Negative direction over-travel has occurred at position/velocity control.

✔ Over-travel functions are set at general parameter Group9 ID00 “Positive Over Travel Function[F-OT]”, ID01 “Negative Over Travel Function [R-OT]”.
See detail in "5.8 Parameter functions", Group9 "Function enabling condition settings".

7.14 Alarm history display

Step	Displayed character, number, code	Input button				How to operate
1	A L H	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	A L H 1					Display changes and right end LED blinks.
3	A L H 3	○ MODE	● ▲	● ▼	○ WR/▶	Display the number of an alarm history to check with an addition-and-subtraction button. The history of 15 times past before can be displayed.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	A L. 8 5. 0					The alarm of 3 times ago is displayed.
6		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
7	8 0 2					The passed time of alarm generating is displayed. Digits of milisec unit.
8		● MODE	○ ▲	○ ▼	○ WR/▶	Press and hold MODE for more than 1 second.
9	_ 2 9					The passed time of alarm generating is displayed. Digits of sec unit.
10		● MODE	○ ▲	○ ▼	○ WR/▶	Press and hold MODE for more than 1 second.
11	= 1					The passed time of alarm generating is displayed. Digits of minute unit
12		● MODE	○ ▲	○ ▼	○ WR/▶	Press and hold MODE for more than 1 second.
13	≡ 0					The passed time of alarm generating is displayed. Lower 4 digits of hour unit
14		● MODE	○ ▲	○ ▼	○ WR/▶	Press and hold MODE for more than 1 second.
15	≡ 0					The passed time of alarm generating is displayed. Upper 4 digits of hour unit
16		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
17	A L. 8 5. F					Returns to Process 5.
18		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
19	A L H 3					Returns to Process 3.
20	o b					Changes to the left display.

7.15 How to clear alarm history

Step	Displayed character, number, code	Input button				How to operate
1	ALH	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	ALH 1					Display changes and right end LED blinks.
3	ALH.CL	○ MODE	● ▲	● ▼	○ WR/▶	Display the left with the addition-and-subtraction button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	rdy					Changes to the left display and it blinks.
7		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
8	.r.u.n..					A display change as the left and it performs.
9	ALH 1					Changes to the display of the left after a normal end.
10		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
11	ob					Changes to the left display.

7.16 Monitor display

Step	Displayed character, number, code	Input button				How to operate
1	ob	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	ob 00					Display changes and right end LED blinks.
3	ob 08	○ MODE	● ▲	● ▼	● WR/▶	Display ID of the monitor with addition and subtraction and the cursor button.
4		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
5	0.3					The data is displayed.
6		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
7	ob 08					Changes to the left display. When you monitor other data continuously, repeat from Process 3.
8		● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE.
9	Co					Changes to the left display.

Note)	non	When it is a monitor that cannot be displayed, the left is displayed in Process 5.

✔ See "5.5.1 Monitor list" for ID of monitor items.

7.17 Fixed monitor display

The display shows monitoring value in 2 seconds after powering up.
It shows monitoring value set at Group D ID11 “Monitor Display Selection [MONDISP]” in status display mode.
“Monitor” to be displayed is the same as parameter ID in monitor display mode, but in the setting value “00 STATUS servo amplifier status monitor”, the display will be different from the code display in the monitor mode and will show the amplifier status in the status display mode
(- or Ξ).
In the state of alarm occurring, requiring safety function input, requiring motor magnetic pole detection or detecting the poles, the monitor display prioritize these status over the fixed display.

7.18 Motor code-setting of servo motor used

Step	Displayed character, number, code	Input button				How to operate
1	Co	● MODE	○ ▲	○ ▼	○ WR/▶	Push MODE until it displays the left.
2	CoSEt					Display changes and right end LED blinks.
3		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
4	3001	○ MODE	● ▲	● ▼	● WR/▶	Display the motor cord of the servo motor used with addition and subtraction and the cursor button.
5		○ MODE	○ ▲	○ ▼	● WR/▶	Push WR for more than 1 second.
6	. r. u. n. .					A display changes as the left and it performs.
7	oFF					Changes to the display of the left after a normal end.
8						Turn on the power supply again.

Note)	non	The servomotor that cannot be combined or used displays the left in Process 5. In this display, please set up by “Setup Software”.

✔ Check the Applicable motor list at "5.1.3 Servo motor setting" about applicable servo motor and motor code.

8

Maintenance

In this chapter, trouble shooting, inspection and service parts are explained.

8. Maintenance

8.1 Trouble shooting

When troubles occurred without any alarm displayed, check and take corrective actions for them by referring to the description below. When alarm occurs, take corrective measures referring to “8.3 Trouble shooting when alarm is activated “.

■ “≡“ does not blink in 7-segment LED even if main power is ON.

Investigation	Assumed causes and corrective actions
Check the voltage at the power input terminal.	■ If voltage is low, check the power supply. ■ Check that wires and screws are fastened properly.
Red “CHARGE“ LED goes out.	■ Internal power circuit of servo amplifier is defective, so replace the servo amplifier.
Over-travel status. Emergency Stop status.	■ Stop the input of Over-travel or the input of Emergency Stop. ■ Check of “Functions enabling condition settings “.
Safe Torque Off working status	■ Turn on /HWGOFF1 and /HWGOFF2 inputs.

■ The motor does not rotate although 7-segment LED is drawing a character “8 “.

Investigation	Assumed causes and corrective actions
Check a inputting command by using digital operator monitor. Page16: Velocity command monitor Page18: Torque command monitor Page30: Position command pulse frequency monitor	■ Inputting a command if the monitor value is zero.
Check the servo motor is locked or not.	■ Check that the power line of a servo motor is connected.
Check if torque limit is input.	■ When torque restriction is inputted, a servo motor cannot output the torque beyond the load torque. ■ Check of “Functions enabling condition settings “
Check the deviation clear input status.	■ Stop the input of deviation clear if the signal is in. ■ Check of “Functions enabling condition settings “
Check the encoder clear input status.	■ Stop the input of encoder clear if the signal is in. ■ Check of “Functions enabling condition settings “

* When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

- Servo motor operation is unstable or lower speed than the specified velocity command.

Investigation	Assumed causes and corrective actions
Check the status of proportional control input signal.	■ Stop the input of proportional control if the signal is in. ■ Check of "Functions enabling condition settings "
Check the status of torque limit input signal.	■ Stop the input of torque limit if the signal is in. ■ Check of "Functions enabling condition settings "

- Servo motor rotates only moment, and stops.

Investigation	Assumed causes and corrective actions
Check the servo motor power line.	■ Some of the servo motor power line is not connected.
Check a setup of combination motor.	■ Change the settings and turn ON the power again.
Check a setup of encoder resolution. (in System parameter)	

* When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

- Servo motor runs away.

Investigation	Assumed causes and corrective actions
Check the servo motor power line.	■ Phase order of servo motor power line is wrong.
Check the wiring of encoder cable.	■ Wiring of the encoder is incorrect.

* When performing the work for correction and investigation processing about wiring, be sure to intercept power supply.

- Servo motor is vibrating.

Investigation	Assumed causes and corrective actions
Check that motor is vibrating over 200Hz.	■ Reduce the loop gain speed, or set the torque command low-pass filter / torque command notch filter.

- Occurs over shoot/ under shoot when starting / stopping.

Assumed causes and corrective actions
■ Adjust the auto tuning "response ". ■ Reduce the velocity loop gain. ■ Increase the velocity integral time constant. ■ Loose the slope of acceleration / deceleration command. ■ Use position command low-pass filter

- Abnormal sound occurs

Investigation	Assumed causes and corrective actions
Check whether there is any problem in mechanical attachment.	■ Observe by operating servo motor by stand alone. ■ Check that the coupling does not have core shift or unbalance.
Operate at a low speed and check whether abnormal sound has periodicity.	■ Confirm that the twisted pair and shield processing of motor encoder signal line are correct. ■ Confirm that the wiring for motor encoder line and servo motor power line are not installed in the same duct. ■ Confirm that the power supply voltage is sufficient.

- The multi-turn part of the absolute encoder cannot be cleared by clearing the encoder although the absolute encoder that has multi-turn is used.

Investigation	Assumed causes and corrective actions
Check the setting value of system parameter.	■ Check that the set value of the system parameter ID11 ”EN1 encoder type” is “11: PA_C-ABS” or ”12: RA_C-ABS”.

8.2 List of warning and alarm

Names, contents and stopping operation of warning/ alarm, and alarm-reset methods are listed below.

8.2.1 Warning List

	Name	Contents
Load system	Overload Warning	■ When the effective torque exceeds the Overload Warning Level
	Regeneration Overload Warning	■ In case of overload of regenerative resistance
	Amplifier Temperature Warning	■ Ambient temperature of the amplifier is out of range of the operation temperature
Power supply system	Control power voltage sag warning	■ Voltage of control power is below AC152V (AC200V input type), or AC76V (AC100V input type).
External input system	Forward over travel	■ While entering forward over travel
	Reverse over travel	■ While entering reverse over travel
Encoder system	Absolute encoder warning	■ Battery voltage is below 3.2 V (typ.) (with battery backup) ■ State of detecting LED deterioration (battery-less)
	External absolute encoder warning	■ While occurring the external absolute encoder (EnDat) warning
Control system	Restricting torque command	■ While restricting the torque command by torque restriction value
	Restricting velocity command	■ While restricting the velocity command by velocity restriction value
	Excessive position deviation	■ While position deviation exceeds warning setting value.
	Dual position error excess	■ The difference between servo motor position and load position is exceeding the warning set value.
	Adaptive notch filter E frequency warning	■ Estimated frequency of the adaptive notch filter E is out of setting range.
	Axes-sync error excess	■ While position deviation error between own axis and counterpart axis exceeds warning setting value.

8.2.2 Alarm list

Operation at detecting: “DB“ performs the slowdown stop of the servo motor by dynamic brake operation at the alarm generating.
Operation at detecting: “SB“ performs the slowdown stop of the servo motor with sequence current limiting value.
When dynamic brake is selected by Emergency Stop Operation selection, the servo motor is decelerating stopped for the dynamic brake operation regardless of the operation when detecting it. (However, it stops in free servo brake operation at the time of alarm 53H (DB resistor overheating) detection.)

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Abnormality related to drive	21	0	0	1	0	0	0	1	Main Circuit Power Device Error (Over current)	■ Over current of drive module ■ Abnormality in drive power supply ■ Overheating of drive module	DB	Yes
	22				0	0	0	1	Current Detection Error 0	■ Abnormality of electric current detection value	DB	Yes
	23				0	0	0	1	Current Detection Error 1	■ Abnormality of Electric current detection circuit	DB	Yes
	24				0	0	0	1	Current Detection Error 2	■ Abnormality in communication with Electric current detection circuit	DB	Yes
	25				1	1	1	0	Safe Torque Off Error 1	■ Logic unmatched in safe torque off input	DB	No
	26				1	1	1	0	Safe Torque Off Error 2	■ Failure of safe torque off circuit	DB	No
	27				0	0	0	1	Fan stop	■ Speed reduction of fan	DB	No
Abnormality related to load	41	0	1	0	0	0	1	0	Overload 1	■ Excessive effective torque	SB	Yes
	42				0	0	1	0	Overload 2	■ Stall over load	DB	Yes
	43				0	1	0	1	Regenerative Overload	■ Regeneration load ratio exorbitance	DB	Yes
	45				0	0	1	0	Average continuous over speed	■ Over speed in average rotational speed	SB	Yes
	52				0	0	1	1	RS Overheat	■ Detection of in-rush prevention resistance overheating	SB	Yes
	53				0	0	1	1	Dynamic Brake Resistance Overheat	■ Overheating detection of dynamic brake resistor	SB	Yes
	54				0	1	0	1	Internal Regenerative Resister Overheat	■ Overheating detection of Internal regenerative resistor	DB	Yes
	55				0	0	1	1	External Error	■ Overheating detection of External regenerative resistor	DB	Yes
	56				0	0	1	1	Main Circuit Power Device Overheat	■ Overheating detection of Drive module	DB	Yes
Abnormality in power supply	61	0	1	1	0	1	0	1	Over-voltage	■ DC Excess voltage of main circuit	DB	Yes
	62				1	0	0	1	Main Circuit Under-voltage Note1)	■ DC Main circuit low voltage	DB	Yes
	63				1	0	1	0	Main Power Supply Fail Phase Note1)	■ 1 phase of the 3 phase main circuit power supply disconnected	SB	Yes
	68				0	1	0	1	Main circuit voltage detection error	■ Failure of VBUS detection circuit	DB	No
	71				0	1	1	1	Control Power Supply Under-voltage Note2)	■ Control power supply low voltage	DB	Yes Note 3)
	72				0	1	1	1	Control Circuit Under-voltage 1	■ Under voltage of ±12V	SB	Yes
	73				0	1	1	1	Control Circuit Under-voltage 2	■ Under voltage of +5V	DB	No

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Abnormality related to encoder wiring	81	1	0	0	1	0	0	0	Encoder Connector 1 Disconnection	■ Incremental encoder (A, B, Z) signal line break ■ Power supply break	DB	No
	83				1	0	0	0	Encoder Connector 2 Disconnection Note 7)	■ Incremental encoder (A, B, Z) signal line break ■ Power supply break	DB	No/Yes
	84				1	0	0	0	Absolute encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	No
	85				1	0	0	0	Encoder Initial Process Error	■ Failed to read CS data of Incremental encoder ■ Abnormality in initial process of Absolute encoder	—	No
	87				1	0	0	0	CS Signal Disconnection	■ CS signal line break	DB	No
	88				1	0	0	0	External Absolute Encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	No
	89				1	0	0	0	External Encoder Initial Process Error	■ Abnormality in initial process of absolute encoder	-	No
	8D				1	0	0	0	External encoder (EnDat) combination error	■ External encoder (EnDat) is out of applicable range.	-	No
Abnormality in encoder main body	A0	1	0	1	1	0	0	0	Absolute Encoder Internal Error 0	■ Encoder failure	DB	No
	A1				1	0	0	0	Absolute Encoder Internal Error 1	■ Encoder internal error	DB	Note 4)
	A2				1	0	0	0	Absolute Encoder Internal Error 2	■ Encoder internal error	DB	Note 4)
	A3				1	0	0	0	Absolute Encoder Internal Error 3	■ Encoder internal error	DB	Note 4)
	A4				1	0	0	0	Absolute Encoder Internal Error 4	■ Encoder internal error	DB	Note 4)
	A5				1	0	0	0	Absolute Encoder Internal Error 5	■ Encoder internal error	DB	Note 4)
	A6				1	0	0	0	Absolute Encoder Internal Error 6	■ Encoder internal error	DB	Note 4)
	A9				1	0	0	0	Absolute Encoder Internal Error 9	■ Encoder internal error	DB	Note 4)
	AA				1	0	0	0	Absolute Encoder Internal Error 10	■ Encoder internal error	DB	Note 4)
	AC				1	0	0	0	Absolute Encoder Internal Error 12	■ Encoder internal error	DB	Note 4)
	AD				1	0	0	0	Absolute Encoder Internal Error 13	■ Encoder internal error	DB	Note 4)
	AF				1	0	0	0	Absolute Encoder Internal Error 15	■ Encoder internal error	DB	Note 4)

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
External abnormality in encoder main body	B0	1	0	1	1	0	0	0	External Absolute Encoder Internal Error 0	■ Encoder failure	DB	No
	B1				1	0	0	0	External Absolute Encoder Internal Error 1	■ Encoder internal error	DB	Note 4)
	B2				1	0	0	0	External Absolute Encoder Internal Error 2	■ Encoder internal error	DB	Note 4)
	B3				1	0	0	0	External Absolute Encoder Internal Error 3	■ Encoder internal error	DB	Note 4)
	B4				1	0	0	0	External Absolute Encoder Internal Error 4	■ Encoder internal error	DB	Note 4)
	B5				1	0	0	0	External Absolute Encoder Internal Error 5	■ Encoder internal error	DB	Note 4)
	B6				1	0	0	0	External Absolute Encoder Internal Error 6	■ Encoder internal error	DB	Note 4)
	B7				1	0	0	0	External Absolute Encoder Internal Error 7	■ Encoder internal error	DB	Note 4)
	B8				1	0	0	0	External Absolute Encoder Internal Error 8	■ Encoder internal error	DB	Note 4)
	B9				1	0	0	0	External Absolute Encoder Internal Error 9	■ Encoder internal error	DB	Note 4)
	BA				1	0	0	0	External Absolute Encoder Internal Error 10	■ Encoder internal error	DB	Note 4)
	BB				1	0	0	0	External Absolute Encoder Internal Error 11	■ Encoder internal error	DB	Note 4)
	BC				1	0	0	0	External Absolute Encoder Internal Error 12	■ Encoder internal error	DB	Note 4)
	BD				1	0	0	0	External Absolute Encoder Internal Error 13	■ Encoder internal error	DB	Note 4)
	BE				1	0	0	0	External Absolute Encoder Internal Error 14	■ Encoder internal error	DB	Note 4)
	BF				1	0	0	0	External Absolute Encoder Internal Error 15	■ Encoder internal error	DB	Note 4)

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm reset
	Display	3bits output			PY compatible code							
		Bit7	Bit6	Bit5	ALM8	ALM4	ALM2	ALM1				
Control system abnormality	C1	1	1	0	0	1	1	0	Over-speed	■ Motor rotation speed reaches 120 % of the highest speed limit.	DB	Yes
	C2				1	1	0	0	Velocity Control Error	■ Torque command and acceleration direction are not matching.	DB	Yes
	C3				1	1	0	0	Velocity Feedback Error	■ Servo motor power disconnection Note 5)	DB	Yes
	C5				1	1	0	0	Model tracking vibration suppression control error	■ Operation pattern is not mach with model tracking vibration suppression control.	DB	Yes
	D1				1	1	0	1	Excessive Position Deviation	■ Position Deviation exceeds setup value.	DB	Yes
	D2				1	1	0	1	Faulty Position Command Pulse Frequency 1	■ Frequency of entered position command pulse is excessive	SB	Yes
	D3				1	1	0	1	Faulty Position Command Pulse Frequency 2	■ Position command frequency after electronic gear is high.	SB	Yes
	D4				1	1	0	1	Axes-sync error excess	■ Position deviation error between own axis and counterpart axis exceeds setting value.	DB	Yes
	D5				1	1	0	1	Dual position error excess	■ The difference of servo motor position and load position exceeds the setting value.	DB	Yes
	D6				1	1	0	1	Dual position error feedback error	■ The motor encoder frequency after feedback electronic gear is too high.	DB	Yes
	D7				1	1	0	1	Amplifier communication error	■ Amplifier communication error during axes-sync operation	DB	No
	DF				1	1	0	1	Test Run Close Note6)	■ Detection in ‘Test mode end’ status	DB	Yes
Control system/Memory system abnormality	E1	1	1	1	1	1	1	1	Memory Error 1	■ Abnormality of amplifier with built-in EEPROM	DB	No
	E2				1	1	1	1	Memory Error 2	■ Error in check sum of EEPROM (entire area)	—	No
	E3				1	1	1	1	CPU error 1	■ Access error in CPU built in RAM	—	No
	E4				1	1	1	1	CPU error 2	■ Checksum error of FLASH memory with built in CPU	—	No
	E5				1	1	1	1	System Parameter Error 1	■ System parameter is outside a setting range.	—	No
	E6				1	1	1	1	System Parameter Error 2	■ The combination of a system parameter is abnormal.	—	No
	E7				1	1	1	1	Motor Parameter Error	■ Setup of a motor parameter is abnormal.	—	No
	E8				1	1	1	1	Control circuit error 1	■ Access abnormality in CPU to ASIC	—	No
	E9				1	1	1	1	Control circuit error 2	■ Abnormalities of control circuit.	—	No
	EA				1	1	1	1	Memory Error 3	■ Abnormality of FLASH memory in servo amplifier.	SB	No
	EB				1	1	1	1	Control circuit error 3	■ Abnormalities of control circuit.	—	No
	EE				1	1	1	1	Motor Parameter Automatic Setting Error 1	■ Motor parameter automatic setting function cannot be performed.	—	No
	EF				1	1	1	1	Motor Parameter Automatic Setting Error 2	■ The result of motor parameter automatic setting is abnormal.	—	No
	F1				1	1	1	1	Task Process Error	■ Error in interruption process of CPU	DB	No
	F2				1	1	1	1	Initial Process Time-Out	■ Initial process does not end within initial process time	—	No
	F3				1	1	1	1	CPU error 3	■ Abnormality of CPU setting	—	No

Note 1) When the main power voltage increases or decreases gradually or is suspended, main circuit low voltage or main power failed phase may be detected.

Note 2) Control power supply under-voltage or servo ready OFF is detected during instantaneous break of 1.5 to 2 cycles. Detection of control power supply under-voltage and servo ready OFF can be delayed by setting larger value of Group B ID16 ”Power Failure Detection Delay Time [PFDDLY]”.

Note 3) When moment cutting of a control power source is long, it regards in power supply interception and re-input, and does not leave detected control power supply under-voltage to an alarm history. (If cutting exceeds 1 second at the moment, it will be certainly judged as power supply interception.)

Note 4) Due to abnormality in encoder main body, encoder clear may sometimes be needed. “An encoder clear and the alarm reset method“ change with motor encoders in use. Please refer to “8.4 Encoder clear and the alarm reset method. “

Note 5) When there is a rapid motor slow down simultaneous with servo ON, there is a possibility that a break in the motor’s power line cannot be detected.

Note 6) Alarm that occurs in ‘Test mode end’ status is not recorded in the alarm history.

Note 7) When encoder connector EN2 is used as motor encoder input, "Alarm reset" is "No". When encoder connector EN2 is used as external encoder input, "Alarm reset" is "Yes".

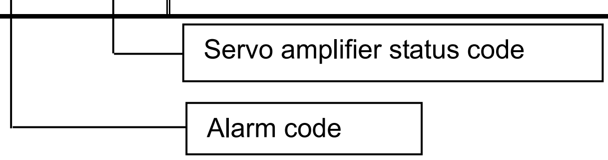
Note 8) For the servo amplifier with functional safety module, all alarms are treated as diagnosis function, so Safe Torque Off function is performed simultaneously with alarm occurring. That is reason why Safe Torque Off state continues after alarm resetting. To start operation again, turn off the servo ON input and return to servo ready state.

8.3 Trouble shooting when alarm activated

8.3.1 Alarm display

When an alarm occurs, the display shows the alarm code and the servo amplifier status code.

Display	Description
	Take appropriate action based on "8.3.2 Corrective action for alarm".

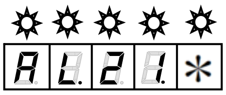


- Status code

Code	Status	
1	Power OFF status	(P-OFF)
2	Power ON status	(P-ON)
3	Servo ready status	(S-RDY)
4	Servo ON status	(S-ON)
5	Servo OFF status	(S-OFF)
6	Emergency stop status	(EMR)
F	Initial status	

8.3.2 Corrective action for alarm

- Alarm code 21 (Main Circuit Power Device Error)

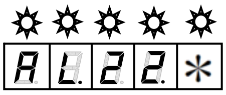


Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at input of servo ON.	✔	✔	✔	
Issued while starting and stopping the servo motor.	✔	✔	✔	
Issued after operation for some time.	✔	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Short circuit is there at U/V/W-phases of amplifier, or wiring between amplifier and motor. Otherwise, U/V/W-phases are grounded to the earth.	■ Check the wiring conditions and correct it if improper.
2	■ Short circuit or earth fault in U/V/W phases on servo motor side.	■ Replace the servo motor.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Overheating detection of the main circuit power device functioned. (50A or more of models only)	■ Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet.

■ Alarm code 22 (Current Detection Error 0)

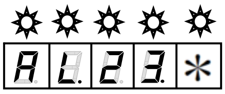


Status at the time of alarm	Cause	
	1	2
Issued at input of servo ON.	✔	✔

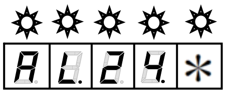
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Servo amplifier and motor are not combined properly.	■ Check that the servo motor is fit to the motor code, if not, change motor correctly.

■ Alarm code 23 (Current Detection Error 1)



■ Alarm code 24 (Current Detection Error 2)

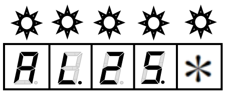


Status at the time of alarm	Cause	
	1	2
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm code 25 (Safe Torque Off error 1)

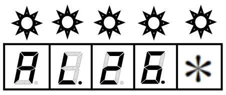


Status at the time of alarm	Cause	
	1	2
Occurred in about 10 sec. after control power turned on.	✔	✔
Occurred during operation.	✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Discrepancy of the input logic level between /HWGOFF1 and /HWGOFF2.	■ Match the input logic level of /HWGOFF1 and /HWGOFF2. ■ Check the wiring of both the HWGOFF1 and /HWGOFF2 signals, and correct the wiring if needed. ■ After switching the logic level of either /HWGOFF1 or /HWGOFF2 signal, make sure to switch the logic of the other signal also within 10 seconds.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm code 26 (Safe Torque Off error 2)

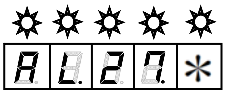


Status at the time of alarm	Cause	
	1	2
Occurred when control power is turned on.	✔	✔
Occurred during the operation.		✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Check grounding of the amplifier. ■ Take care of noise by adding ferrite core etc.

■ Alarm code 27 (Fan stop)

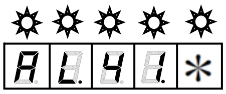


Status at the time of alarm	Cause	
	1	2
Occurred during the operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ The end of fan life.	■ Replace the cooling fan.

- Alarm code 41 (Overload 1)



Status at the time of alarm	Cause								
	1	2	3	4	5	6	7	8	9
Issued at input of servo ON.	✓	✓							✓
After command input, issued without rotating the motor.		✓			✓	✓	✓		✓
After command input, brief motor rotation			✓	✓	✓		✓	✓	

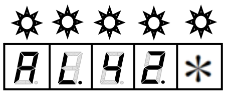
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
3	■ Effective torque exceeds the rated torque.	■ Monitor the load status using the monitor function ID41 Effective torque monitor [TRMS]", and check if effective torque exceeds the rated value. Or, calculate the motor effective torque from load conditions and operation conditions. If the effective torque is excessive, check the operation or load condition, or replace to the capacity of the large motor.
4	■ Defect in servo motor and servo amplifier combination.	■ Check if the motor in use matches with the recommended type, and replace if it is improper.
5	■ Holding brake of servo motor has not released.	■ Check that the wiring and voltage of the holding brake are correct; if not, correct it. If the above are OK, replace the servo motor.
6	■ Wiring of U/V/W −phase between servo amplifier and motor is wrong.	■ Check the wiring conditions and correct it if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / motor is disconnected.	■ Check the wiring conditions and correct it if improper.
8	■ Application collided to something.	■ Check the operating conditions and limit switch.
9	■ Motor encoder resolution setting does not match with the servo motor.	■ Set correct value depending on actual motor encoder to the System parameter ID15 "Absolute encoder resolution" or the System parameter ID17 "Incremental encoder resolution".

* In case of the alarm caused by conditions in #3 (above), there is a risk of burning out the servo motor if OFF and ON of control power supply is repeated. Wait for longer than 30 min for cooling purposes after power shut OFF, and resume operations.

8.3 Trouble shooting when alarm activated

- ■ Alarm code 42 (Overload 2)

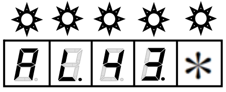


Status at the time of alarm	Cause										
	1	2	3	4	5	6	7	8	9	10	11
Issued at input of servo ON.	✓	✓							✓		
After command input, issued without rotating the servo motor.		✓			✓	✓	✓		✓	✓	✓
After command input, brief motor rotation.			✓	✓	✓		✓	✓			

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
3	■ Rotation is less than $50min^{-1}$ and torque command exceeds approx. 2 times of rated torque.	■ Check if torque command exceeds approx. 2 times of the rated torque by the monitor function ID18 "Torque command monitor [TCMON]". If any of the conditions (load condition when motor stops, operation condition at low velocity, and static load condition) exceed twice of rated torque, review an operation or load condition. Or replace with larger sized servo motor.
4	■ Defect in servo motor and servo amplifier combination.	■ Check if the motor in use matches with the recommended type, and replace if it is improper.
5	■ Holding brake of servo motor has not released.	■ Check that the wiring and voltage of the holding brake are correct; if not, correct it. If the above are OK, replace the servo motor.
6	■ Wiring of U/V/W −phase between servo amplifier and motor is wrong.	■ Check the wiring conditions and correct it if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / motor is disconnected.	■ Check the wiring conditions and correct it if improper.
8	■ Application collided to something.	■ Check the operating conditions and limit switch.
9	■ Motor encoder resolution setting does not match with the servo motor.	■ Set correct value depending on actual motor encoder to the System parameter ID15 "Absolute encoder resolution" or the System parameter ID17 "Incremental encoder resolution".
10	■ Rotation directions of 2 axes are different, in the tandem operation.	■ Set "04: PC-_VC+_TC+" to Group8 ID00 "Position, Velocity, Torque Command Input Polarity". Change to "01: Reversed ", in Group8 ID00 "Position, Velocity, Torque Command Input Polarity".
11	■ Wiring of servo motor and encoder is wrong, in the tandem operation.	■ Check the wiring and fix if wrong.

- Alarm code 43 (Regenerative Overload)



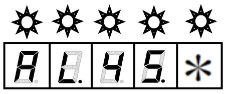
Status at the time of alarm	Cause							
	1	2	3	4	5	6	7	8
Issued when control power supply is turned ON.							✔	
Issued when main circuit power supply is turned ON.		✔	✔	✔		✔	✔	✔
Issued during operation.	✔			✔	✔		✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Exceeds a permitted value of the regenerative power at built-in regenerative resistance model. ■ Excessive load inertia moment, or tact time is short.	■ Check the load and operating conditions. ■ Change to external regenerative resistor. ■ Set to be the load inertia moment within the specified range. ■ Increase the deceleration time. ■ Increase the tact time.
2	■ Regenerative resistor is connected to the model without regenerative resistor.	■ Remove regenerative resistor.
3	■ Resistor wiring is wrong at built-in or external regenerative resistor model.	■ Check the wiring conditions and correct it if improper.
4	■ Regenerative resistor wire breaks.	■ For built-in regeneration resistor specifications, replace the servo amplifier. ■ For external regeneration resistor specifications, replace the regeneration resistor.
5	■ Resistance value of external regenerative resistor is excessive.	■ Replace to the resister that matching the specifications.
6	■ Input power supply voltage exceeds the specified range.	■ Check the input power supply voltage level.
7	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
8	■ External regenerative resistor does not connect although "02: External_R" is set in the system parameter ID03 "Regenerative resistor selection".	■ Connect external regenerative resistor. ■ Set "00: Not_connect" in the system parameter ID03 "Regenerative resistor selection".

* If the setting of system parameter ID03 “Regenerative Resistor Selection” is incorrect, regeneration overload is not detected properly, and the amplifier and surrounding circuit may be damaged or burnt.

- Alarm code 45 (Average continuous over speed)

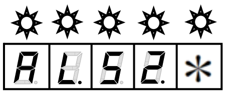


Status at the time of alarm	Cause
	1
Occurred during operation.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The average speed exceeds the maximum speed of continuous rotation speed range.	■ Review the operating conditions. ■ Resize the servo motor.

■ Alarm Code 52 (In-rush prevention resistance Overheat)

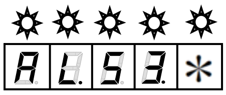


Status at the time of alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	✔		
Issued when main circuit power supply is turned ON.		✔	
Issued during operation.			✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Power turning ON is repeated too frequently.	■ Turn ON/OFF the power less frequently.
3	■ Ambient temperature is high.	■ Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet.

■ Alarm Code 53 (Dynamic Brake Resistor Overheat)

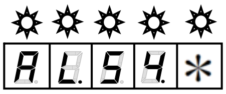


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON..	✔	
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Dynamic Brake operation is repeated too frequently.	■ Use the dynamic brake so as not to exceed the permissive frequency.

■ Alarm Code 54 (Built-in Regenerative Resistance Overheat)



Status at the time of alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	✔		✔
Issued during operation.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Regenerative power excessive.	■ Check the built-in regenerative resistor allowable power. ■ Check the operating conditions to keep that consumption power is below of allowable power. ■ Use an external regenerative resistor.
3	■ Resistor wiring is wrong at built-in regenerative resistor model.	■ Check the wiring conditions and correct it if improper.

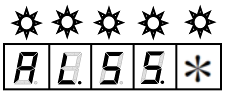
* When using a regenerative resistor built in the servo amplifier, make sure to set “01: Built-in_R“ at the system parameter ID03 “Regenerative Resistor Selection”. This setting decides enabled/disabled of the overheating protection detection treatment of the built-in regeneration resistance.

* Built-in regenerative resistance overheat does not detected when “02 External_R“ is selected. Therefore, there is a danger that built-in regenerative resistance will burn out or be damaged.

- Alarm Code 55 (External Error)

When host device or thermal output signal of external regenerative resistor are not connected

Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Validity condition for external trip function is set to ‘Valid’.	■ When not used, set "00:_Always_Disable” at Group9 ID40 "External Trip Input Function [EXT-E]".
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

When thermal signal of the external regenerative resistor is connected

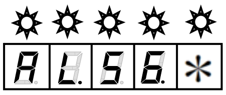
Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔		✔
Issued after operation for some time.		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Improper wiring of external regenerative resistance.	■ Check the wiring conditions and correct it if improper.
2	■ External regenerative resistor is operating.	■ Check the operating conditions. ■ Increase the capacity of the external regeneration resistor.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

* When output terminal of upper level device is connected, eliminate the alarm trigger of the host level device.

■ Alarm Code 56 (Main Circuit Power Device Overheat)

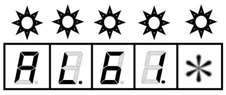


Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at input of servo ON.	✔	✔	✔	
Issued while starting and stopping the servo motor.	✔	✔	✔	
Issued after operation for some time.	✔	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ U/V/W-phase of amplifier is short circuited due to the wiring in amplifier and motor. Or, U/V/W-phases have earth fault.	■ Check the wiring conditions and correct it if improper.
2	■ Short circuit or earth fault of U/V/W phases, at servo motor side.	■ Replace the servo motor.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Ambient temperature is high.	■ Confirm temperature in cabinet (or ambient of the amplifier), then refine installation method of the servo amplifier and ventilation of the cabinet to keep 55℃ or lower of ambient temperature.

■ Alarm Code 61 (Over-Voltage)



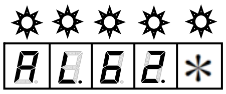
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔			
Issued when main circuit power supply is turned ON.	✔	✔		
Issued while starting and stopping the servo motor.		✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ The power supply voltage of main circuit is out of the specification.	■ Reduce the power supply voltage to within the specified range.
3	■ Excessive load inertia moment.	■ Reduce the load inertia moment to within the specified range.
4	■ Incorrect wiring of regenerative resistor. ■ Built-in regenerative circuit is not functioning.	■ Wire the regenerative resistor correctly. ■ Check the wiring and resistance value if using the external regenerative resistor. ■ Replace the servo amplifier if any abnormality occurs after countermeasure above.

8.3 Trouble shooting when alarm activated

■ Alarm Code 62 (Main Circuit Under-voltage)

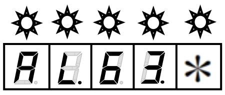


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when control power is turned ON.				✔	✔
Issued when main circuit power supply is turned ON.	✔	✔	✔		
Issued during operation.		✔	✔		

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Input power supply voltage is below the specified range.	■ Check the power supply and set it within the specified range.
2	■ Rectifier of main circuit is broken.	■ Replace the servo amplifier.
3	■ Input power supply voltage is reduced, or instantaneous power interruption is occurred.	■ Check the power supply, and confirm that there is no instantaneous power interruption or low voltage.
4	■ Low voltage outside of the specified range is supplied to the main circuit (R/S/T).	■ Check the main circuit voltage. Confirm that there is no external power supply to R/S/T when the main circuit is OFF.
5	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code 63 (Main Power Supply phase loss)

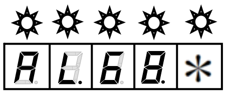


Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.		✔	
Issued when main circuit power supply is turned ON	✔	✔	✔
Issued during operation.	✔	✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ One of 3 phases (R/S/T) is not connected.	■ Check the wiring conditions and correct it if improper.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
3	■ Servo amplifier is not specified for single phase.	■ Change the system parameter ID01 " Main circuit power input type" to ”01：AC_Single-phase”.

■ Alarm Code 68 (Main circuit voltage detection error)

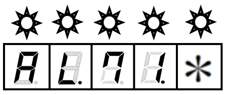


Status at the time of alarm	Cause
	1
Issued when control power is turned ON.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code 71 (Control Power Supply Under-voltage)

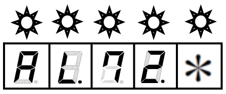


Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔	✔	
Issued during operation.	✔		✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Input power supply voltage is below the specified range.	■ Confirm that the power supply is set within the specified range.
3	■ Input power supply voltage is fluctuating or having phase loss.	■ Confirm power supply to avoid phase loss or voltage reduction.

■ Alarm Code 72 (Control Circuit voltage reduction 1)

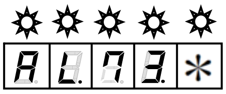


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector: CN1. Check the external circuit if alarm is not issued.

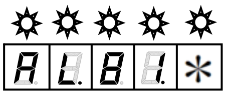
■ Alarm Code 73 (Control Circuit voltage reduction 2)

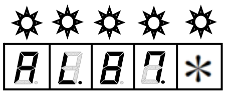


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector: CN1. Check the external circuit if alarm is not issued. ■ Restart the power supply after replacing the servo motor; if alarm is not issued, there is defect in internal circuit of motor encoder. Replace the servo motor.



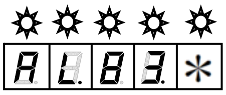


- ■ Alarm Code 81 (Encoder Connector 1 Disconnection)
- ■ Alarm Code 87 (CS Signal Disconnection)

Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔	✔	✔	✔
Issued during operation.	✔		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For motor encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the motor side is above 4.75 V, correct it if improper.
2	■ Servo amplifier and motor encoder are not combined properly.	■ Replace with servo motor equipped with proper encoder.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.



- ■ Alarm Code 83 (Encoder Connector 2 Disconnection)

[Use of EN1 with motor encoder in the semi-closed system]

Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Parameter setting is for full-closed system.	■ Change the system parameter ID20 to "00:Motor_Enc".
2	■ EN2 is selected as encoder connector. (In case of that the 8th digit of servo amplifier model number (encoder type) is "2".)	■ Change the system parameter ID10 to "00:EN1".

[Use of EN2 with motor encoder in the semi-closed system]

Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔	✔	✔	✔
Issued during operation.	✔		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For motor encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the motor side is above 4.75 V, correct it if improper.
2	■ Servo amplifier and motor encoder are not combined properly.	■ Replace with servo motor equipped with proper encoder.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.

[Use of EN2 with external encoder]

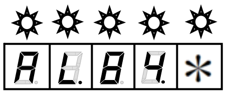
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔	✔	✔	✔
Issued during operation.	✔		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For external encoder wiring, ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the power supply voltage for the external encoder is above 4.75 V, and correct it if improper.
2	■ Turn-on timing of external encoder power is delayed.	■ Confirm that the power supply voltage for the external encoder soon after turning on control power, and bring forward the timing of turning on the power for external encoder if it is not established.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.

8.3 Trouble shooting when alarm activated

■ Alarm Code 84 (Absolute Encoder Communication Error)

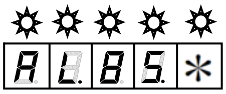


Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔	✔	✔
Issued during operation.		✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.
3	■ Motor encoder wiring has abnormalities.	■ Check the wiring conditions and correct it if improper.

■ Alarm Code 85 (Encoder Initial Process Error)

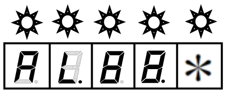


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when control power is turned ON.	✔	✔	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For motor encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the motor side is above 4.75 V, and correct it if improper.
2	■ Servo amplifier and motor encoder are not combined properly.	■ Replace with servo motor equipped with proper encoder.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
5	■ Initial position data could not be set because the number of rotations of the motor is more than 250 min^{-1} when power has been supplied.	■ Restart the power supply after motor is stopped. (Only when absolute encoder is used.)

■ Alarm Code 88 (External Absolute Encoder Communication Error)

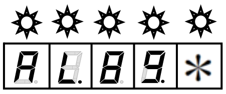


Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔	✔	✔	
Issued during operation.		✔		✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of external encoder.	■ Replace the external encoder.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.
3	■ External encoder wiring has abnormalities.	■ Check the wiring conditions and correct it if improper.
4	■ External encoder power supply voltage reduction.	■ Confirm that the external encoder power supply voltage is above 4.75 V, and correct it if improper.

■ Alarm Code 89 (External Encoder Initial Process Error)

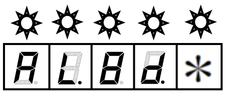


Status at the time of alarm	Cause			
	1	2	3	4
Issued during operation.	✔	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ For external encoder wiring: ◆ Improper wiring. ◆ Connector is removed. ◆ Loose connection. ◆ Encoder cable is too long. ◆ Encoder cable is too thin.	■ Check the wiring conditions and correct it if improper. ■ Confirm that the encoder power supply voltage at the motor side is above 4.75 V, and correct it if improper.
2	■ Turn-on timing of external encoder power is delayed.	■ Confirm that the power supply voltage for the external encoder soon after turning on control power, and bring forward the timing of turning on the power for external encoder if it is not established.
3	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
4	■ Defect in internal circuit of external encoder.	■ Replace the external encoder.

■ Alarm Code BD (External encoder (EnDat) combination error)

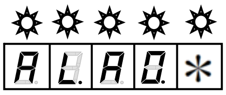


Status at the time of alarm	Cause
	1
Issued when control power is turned ON.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Combined external encoder is not apply to servo amplifier.	■ Replace to our recommended encoder. (Refer the section 9.1.3)

■ Alarm Code A0 (Absolute Encoder Internal Error 0)

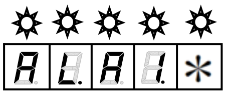


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm Code A1 (Absolute Encoder Internal Error 1)



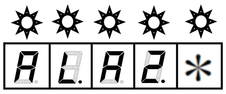
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔	✔		
Issued during operation.			✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Loose connection of battery cable.	■ Check the battery connector of encoder cable attachment.
2	■ Battery voltage reduction.	■ Check the voltage of battery.
3	■ Loose connection of encoder connector.	■ Check the wiring conditions and correct it if improper.
4	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.

* “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to "8.4 Encoder Clear and Alarm Reset Methods".

■ Alarm Code A2 (Absolute Encoder Internal Error 2)



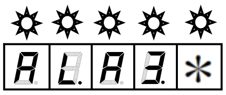
Status at the time of alarm	Cause		
	1	2	3
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Take care of noise by adding ferrite core etc.
3	■ Motor acceleration exceeds the permitted value.	■ Check the operation condition and increase the accel/decel time.

* “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to "8.4 Encoder Clear and Alarm Reset Methods".

■ Alarm Code A3 (Absolute Encoder Internal Error 3)



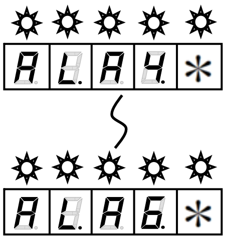
Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔		✔
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.	✔	✔	✔

◆ Corrective actions

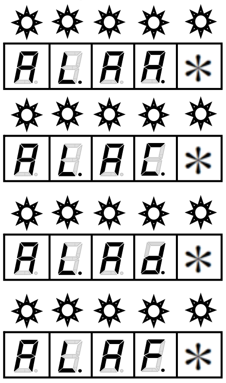
	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.
2	■ Malfunction due to noise	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.
3	■ Motor rotation speed exceeds the permitted velocity.	■ Check the operation condition and reduce the maximum rotation speed.

* “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to "8.4 Encoder Clear and Alarm Reset Methods".

- ■ Alarm Code A4 to A6 (Absolute Encoder Internal Error 4 to 6)



- ■ Alarm Code AA, AC, AD, AF (Absolute Encoder Internal Error 10, 12, 13, 15)



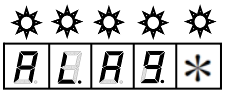
Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.
2	■ Malfunction due to noise	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.

* “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to "8.4 Encoder Clear and Alarm Reset Methods".

- ■ Alarm Code A9 (Absolute Encoder Internal Error 9)



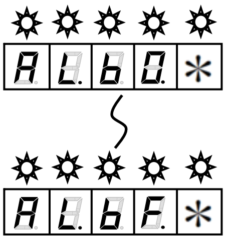
Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔	✔	
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again, if not corrected, replace the servo motor.
2	■ Servo motor is not generating heat, but encoder ambient temperature is too high.	■ Confirm that the cooling method keeps the motor encoder ambient temperature as below 80℃.
3	■ Servo motor is overheated.	■ Confirm the cooling procedure of the servo motor.

* “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to "8.4 Encoder Clear and Alarm Reset Methods".

■ Alarm Code B0 to BF (External absolute encoder Internal Error 0 to 15)

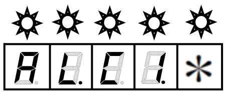


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of external encoder.	■ Turn ON the power supplies again, if not corrected, replace the external encoder.
2	■ Malfunction due to noise	■ Confirm proper grounding of the amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures to against noise.

- Alarm Code C1 (Over-speed)

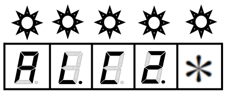


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when command is entered after Servo ON.	✔	✔			
Issued when the servo motor is started.			✔	✔	✔
Issued other than operating and starting the motor.		✔	✔		

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
3	■ Excessive overshoot while starting.	■ Adjust the servo parameters. ■ Loose the slope of acceleration / deceleration command. ■ Reduce the load inertia moment, or change motor capacity.
4	■ Wiring of U/V/W −phase between servo amplifier and motor is wrong.	■ Check the wiring conditions and correct it if improper.
5	■ Wiring of A and B phase of Incremental encoder is wrong.	■ Check the wiring conditions and correct it if improper.

- Alarm Code C2 (Velocity Control Error)



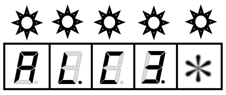
Status at the time of alarm	Cause			
	1	2	3	4
Issued while due to input of Servo ON.	✔		✔	
Issued when command has entered.	✔	✔	✔	
Issued while starting and stopping the servo motor.				✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Wiring of U/V/W −phase between servo amplifier and motor is wrong.	■ Check the wiring conditions and correct it if improper.
2	■ Wiring of A and B phase of Incremental encoder is wrong.	■ Check the wiring conditions and correct it if improper.
3	■ The servo motor is vibrating (oscillating).	■ Adjust the servo parameters so that servo motor will not vibrate (oscillate).
4	■ Excessive overshoot and undershoot.	■ Adjust the servo parameters to reduce overshoot and undershoot. ■ Loose the slope of acceleration / deceleration command. ■ Change Group B ID14 "Velocity Control Alarm (ALM_C2) Detection" to "00: Disabled".

* Velocity control error alarm is set to "00:Disabled" as default because the alarm may be detected if it is available in case of accel/decel with large load inertia or vertical application. If its detection is needed, consult our representatives.

- Alarm Code C3 (Velocity Feedback Error)

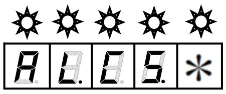


Status at the time of alarm	Cause		
	1	2	3
Issued when command has entered.	✔	✔	✔
Issued when control power is turned ON.		✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Motor is not rotating.	■ Check the wiring conditions of servo motor power line and correct it if improper. ■ Replace the servo motor.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
3	■ The servo motor is vibrating (oscillating).	■ Adjust the servo parameters so that servo motor will not vibrate (oscillate).

- Alarm Code C5 (Model Following Vibration Suppression Control Error)

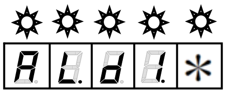


Status at the time of alarm	Cause			
	1	2	3	4
Issued when position command pulse is entered.	✔	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Setup of model control gain is high.	■ Lower model control gain.
2	■ The accel/decel time of a position command is short.	■ Loose the slope of acceleration / deceleration command.
3	■ Torque limiting value is low.	■ Enlarge a torque limit value, or disable a torque limitation.
4	■ Switched from the standard position control to the model following vibration suppression control.	■ Switch it at the state of servo motor stop.

* Other alarms are generated, and this alarm might be generated if a servo brake performs alarm reset during a slowdown.



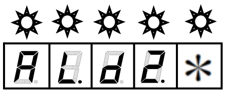
- ■ Alarm Code D1 (Excessive Position Deviation)

Status at the time of alarm	Cause													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Issued when control power is turned ON.												✓		
Issued when servo ON and while motor stopping.						✓							✓	
Issued immediately after entering the command.	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	
Issued during starting / stopping at high speed.	✓	✓					✓	✓	✓				✓	✓
Issued during the operations by lengthy command.		✓					✓	✓					✓	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Position command frequency is too high.	■ Correct the position command of the controller.
2	■ Excessive load inertia moment or low motor capacity.	■ Correct the load condition or increase the motor capacity.
3	■ Holding brake is not released.	■ Check the wiring conditions and correct it if improper. Replace the servo motor even brake is not released if brake is excited with proper voltage.
4	■ Application collided to something or locked mechanically.	■ Refine application system.
5	■ One or all phases of U/V/W -phase of the servo amplifier and motor has disconnected.	■ Check the wiring conditions and correct it if improper.
6	■ Motor is being rotated by an external force (Gravity, etc.) during stopping (positioning completion).	■ Check the load, or increase the servo motor capacity.
7	■ Valid torque limit command is entered by the controller, and its setting is too small. ■ Setting of a velocity limit command is too small. ■ Motor encoder pulse setting is not match with actual servo motor.	■ Enlarge a torque limit value, or disable a torque limitation. ■ Enlarge setting value of velocity limit command. ■ Sets a correct value to the system parameter ID15 "Absolute encoder resolution" or the system parameter ID17 "Incremental encoder resolution", for matching with servo motor encoder.
8	■ Settings of servo parameters (Position Loop Gain, etc.) are not appropriate.	■ Adjust the servo parameter settings (Raise the position loop gain, etc.).
9	■ Setting of a excessive position deviation is too small.	■ Set a value larger of GroupB ID11 "Deviation Counter Overflow Value".
10	■ Rotation directions of 2 axes are different, in the tandem operation.	■ Set "04: PC-_VC+_TC+" to Group8 ID00 "Position, Velocity, Torque Command Input Polarity". Change to "01: Reversed ", in Group8 ID00 "Position, Velocity, Torque Command Input Polarity".
11	■ Wiring of servo motor and encoder is wrong, in the tandem operation.	■ Check the wiring and fix if wrong.
12	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
13	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
14	■ Power supply voltage is low.	■ Check the power supply voltage.

■ Alarm Code D2 (Faulty Position Command Pulse Frequency 1)

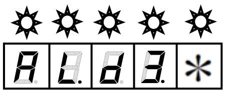


Status at the time of alarm	Cause
	1
Issued after entering position command pulse.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The command that exceeded digital filter setting for command pulse is entered.	■ Decrease the frequency of the command pulse. ■ Decrease minimum pulse width of digital filter setting in Group 8 ID12 "Position command pulse digital filter [PCPFIL]".

■ Alarm Code D3 (Faulty Position Command Pulse Frequency 2)

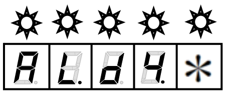


Status at the time of alarm	Cause	
	1	2
Issued after entering position command pulse.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Frequency of command pulse input is too high.	■ Reduce the frequency of command pulse input.
2	■ Setting value of electronic gear is excessive.	■ Decrease the electronic gear setting value in ID 13 to 16: Electric gear, Group 8 parameter.

■ Alarm Code D4 (Axes-sync error excess)



Status at the time of alarm	Cause				
	1	2	3	4	5
Issued immediately after entering the command.	✔	✔	✔	✔	✔
Issued during starting / stopping at high speed.	✔		✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Parameter settings of 2 axes are different.	■ Sets the parameters follow 9.2.5.
2	■ Same command is not entered to both axes.	■ Check the wiring and fix if wrong.
3	■ Axes-sync error set value is too small.	■ Increase setting of GroupB ID81 "Axes-sync error warning level".
4	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
5	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.

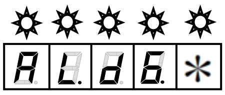
■ Alarm Code D5 (Dual position error excess)

Status at the time of alarm	Cause									
	1	2	3	4	5	6	7	8	9	10
Issued immediately after entering the command.	✔		✔	✔	✔		✔	✔	✔	✔
Issued during starting / stopping at high speed.	✔	✔					✔	✔	✔	✔
Issued during the operations by lengthy command.						✔				

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Servo motor and load (external encoder) are not connected mechanically. Or the connection is not rigid.	■ Review the mechanical connection status.
2	■ Servo parameters are not correct. (Position loop gain, Position feedback gain, etc)	■ Adjust the servo parameter according to "9.1.5.7 Dual position feedback compensation".
3	■ Motor encoder pulse setting does not match with the servo motor.	■ Fit to the motor encoder pulse number of the servo motor.
4	■ External encoder resolution does not match to servo motor encoder resolution after feedback electronic gear.	■ Review the system parameter ID22 "External encoder resolution", ID24/ 25 "Feedback electronic gear numerator/ denominator", according to "9.1.5.4 Feedback pulse setting".
5	■ The polarity of external encoder does not match to the motor encoder.	■ Check the wiring conditions of external encoder and correct it if improper. ■ Set the parameter GroupC ID02 "External Encoder Polarity Selection", according to "9.1.5.5 Rotation direction setting for servo motor ".
6	■ Rounded off a rest, at the setting of ID24/ 25 "Feedback electronic gear numerator/ denominator".	■ Invalid the alarm by setting 0 pulse to GroupB ID1A "Dual position error excess value".
7	■ Setting value of Dual position error excess error is too small.	■ Larger the setting of GroupB ID1A "Dual position error excess value".
8	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
9	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
10	■ Defect in internal circuit of external encoder.	■ Replace the external encoder.

■ Alarm Code D6 (Dual position error feedback error)



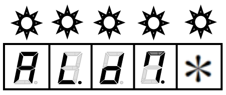
Status at the time of alarm	Cause		
	1	2	3
Issued after entering position command pulse.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Motor rotation speed is too high.	■ Lower a frequency of command pulse input.
2	■ Motor encoder pulse setting does not match with the servo motor.	■ Fit to the motor encoder pulse number of the servo motor.
3	■ Feedback electronic gear ratio is too large.	■ Review the setting value of system parameter ID24/ 25 "Feedback electronic gear numerator/ denominator".

* Maximum velocity of servo motor will be limited at the system which has larger motor encoder resolution and feedback electronic gear ratio.

■ Alarm Code D7 (Amplifier communication error)

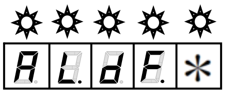


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when control power is turned ON.	✔	✔	✔	✔	
Issued during operation.					✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Wiring between amplifiers ◆ wrong wiring ◆ connector is unplugged ◆ connector has contact failure ◆ cable is too long	■ Check the wiring and fix if wrong. ■ Use our recommendation cables.
2	■ With tandem operation Tandem operation is not set to the parameter of counterpart axis.	■ Change to "01: Tandem operation" in counterpart axis system parameter ID08 "Amplifier communication function".
3	■ Without tandem operation Tandem operation is set to the parameter of own axis.	■ Change to "00: Invalid" in own axis system parameter ID08 "Amplifier communication function".
4	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
5	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm Code DF (Test mode has closed)

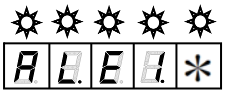


Status at the time of alarm	Cause
	1
Occurred after execution of test mode.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Normal operation.	■ Return to normal operation by alarm clear. (This is caution because test mode might have some deviation in control side after finish.)

■ Alarm Code E1 (Memory Error 1)

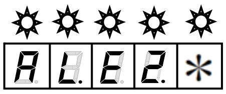


Status at the time of alarm	Cause
	1
Issued during display key operation or setup software operation.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E2 (Memory Error 2)

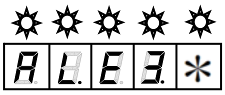


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

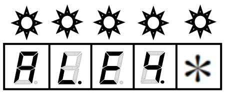
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Correct value did not read to CPU from EEPROM of servo amplifier.	■ Replace the servo amplifier.
2	■ Failed to write into the EEPROM during last power supply cutoff.	■ Replace the servo amplifier.

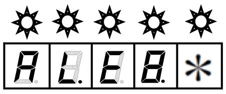
■ Alarm Code E3 (CPU error 1)



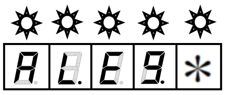
■ Alarm Code E4 (CPU error 2)



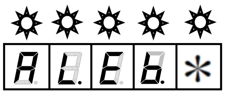
■ Alarm Code E8 (Control power circuit error 1)



■ Alarm Code E9 (Control power circuit error 2)



■ Alarm Code EB (Control power circuit error 3)

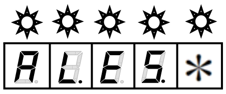


Status at the time of alarm	Cause
	1
Issued when control power is turned ON.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E5 (System Parameter Error 1)

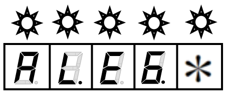


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The data out of setting range was given to system parameter.	■ Confirm the model number of the servo amplifier. Check and correct the setting value of system parameter. Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E6 (System Parameter Error 2)

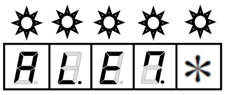


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Wrong combination of system parameter setting value and actual hardware. ■ Wrong combination of motor parameter and servo amplifier parameter. ■ Wrong combination between system parameters.	■ Confirm the model number of the servo amplifier. ■ Set a correct parameter applying to servo amplifier capacity. ■ Check and correct the setting value of system parameter. Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E7 (Motor Parameter Error)

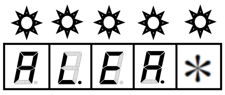


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Correct value did not read to CPU from non-volatile memory of servo amplifier.	■ If alarm recurs by control power cycle after re-setting the motor parameter, replace servo amplifier.
2	■ Failed to write into the non-volatile memory when changing motor parameter.	■ If alarm recurs by control power cycle after re-setting the motor parameter, replace servo amplifier.

■ Alarm Code EA (Memory Error 3)

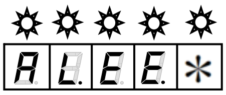


Status at the time of alarm	Cause
	1
Issued during display key operation or setup software operation.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code EE (Motor Parameter Automatic Setting Error 1)

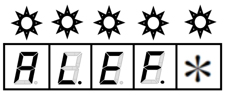


Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ The connected encoder is not supported by the servo amplifier.	■ Replace with the supported servo motor.
2	■ The connected encoder does not support a motor parameter automatic setting function.	■ Change the system parameter ID09 "Motor parameter automatic set function selection" to "01:Disabled". Then download a motor parameter from setup software.
3	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.

■ Alarm Code EF (Motor Parameter Automatic Setting Error 2)

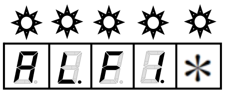


Status at the time of alarm	Cause		
	1	2	3
Issued when control power is turned ON.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Combination of servo amplifier and servo motor is wrong.	■ Please correct combination by checking the model number of servo amplifier and servo motor.
2	■ The connected encoder does not support a motor parameter automatic setting function.	■ Change ID09 of system parameter to “01:Disabled“. Then download a motor parameter from setup software.
3	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.

■ Alarm Code F1 (Task Process Error)

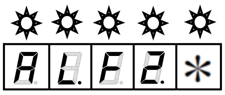


Status at the time of alarm	Cause
	1
Issued during operation.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code F2 (Initial Process Time-Out)

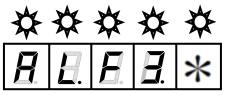


Status at the time of alarm	Cause	
	1	2
Issued when control power is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the amplifier. ■ Add ferrite core or similar countermeasures to against noise.

■ Alarm Code F3 (CPU error 3)



Status at the time of alarm	Cause
	1
Issued after firmware updating.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ CPU setting was wrong at firmware updating.	■ Correcting CPU setting of firmware updating tool.

8.3.3 Correspondence table for EnDat Error message and alarm code

EnDat Error message		RS3 Servo Amplifier	
Bit		Alarm Code	Priority
0	Light Source	B0	1
1	Signal amplitude	B1	2
2	Position	B2	3
3	Overvoltage	B3	4
4	Undervoltage	B4	5
5	Overcurrent	B5	6
6	Battery	B6	7
7	Currently not allocated Extension planned	B7	8
8		B8	9
9		B9	10
10		B10	11
11		B11	12
12		B12	13
13		B13	14
14		B14	15
15		B15	16

* "Error message" means Operation Status Word0 of EnDat.

* "Alarm Code" means the alarm code output from servo amplifier against applicable Error Message.

* "Priority" is given to alarm codes to be output when Error Messages are received simultaneously. Alarm Code output from servo amplifier is only one (which has higher priority) even if Error Messages are received multiple.

8.4 Encoder clear and alarm reset

Procedure of "encoder clear and alarm reset method" varies depending on motor encoder you use.
See table below and return to normal operation from alarm state. Please operate "alarm reset" after solving alarm cause.

Alarm reset method

Alarm code	Single-turn Absolute Encoder (Encoder code: H)	Battery Backup Absolute Encoder (Encoder code: P)	Battery-less Absolute Encoder (Encoder code: R)	Resolver Type Battery-less Absolute Encoder (Encoder code: W)
A1	–	・ “Alarm reset“ after “Encoder clear“	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
A2	–	–	–	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
A3	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
A4	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
A5	・ “Power-cycle”	・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
A6	・ Power-cycle	・ “Power-cycle”	・ Perform “Power-cycle”. Then perform "Alarm reset" after “Encoder clear“.	・ “Power-cycle”
A9	・ “Alarm reset“	・ “Power-cycle”	・ “Alarm reset“	・ "Alarm reset"
AA	–	–	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”
AC	–	–	–	・ “Power-cycle”
AD	–	–	–	・ “Power-cycle”
AF	–	–	・ “Alarm reset“ after “Encoder clear“ ・ “Power-cycle”	・ “Power-cycle”

* 7Multi-turn part of encoder position data will be cleared when "encoder clear" is performed. Adjust the relations between position data and machine coordinate system, and then perform operation.

* Encoder clear is able to perform by the method below.

1) Absolute encoder clearing function in "Test operation" mode of the setup software.
Refer another document M0010842 for how to operate the setup software.
2) Encoder Clear Function of servo amplifier
Encoder Clear Function is able to perform via a general input. Set a function valid condition to Group9 ID03 "Encoder Clear Function". Factory setting is "CONT3_ON: Function is valid when generic input, CONT3, is ON".

8.5 Inspection

For maintenance purposes, a daily inspection is typically sufficient. Upon inspection, refer to the following description.

Inspection target	Conditions			Items	Methods	Solution if abnormal
	Time	During operation	While stopping			
Servo motor	Daily	✔		Vibration	Check for excessive vibration than usual.	Contact dealer or sales office.
	Daily	✔		Sound	Check for abnormal sound than usual.	
	Periodic		✔	cleanliness	Check for dirt and dust.	Clean with cloth or air. Note 1)
	Yearly		✔	Measure a insulation resistance	Contact dealer or sales office.	
	5000 hours Note 2)		✔	Replacement of oil seal		
Servo amplifier	Periodic		✔	Cleaning	Check for dust accumulated in the accessories.	Clean with air. Note 1)
	Yearly		✔	Loose screws	Check for loose connections.	Fasten the screws properly.
Battery for Absolute encoder	Regularly Note 3)		✔	Battery voltage	Confirm that battery voltage is more than DC3.6V.	Replace the Battery.
Temperature	Periodic	✔		Measure temperature	Ambient temperature Motor frame temperature	Set the ambient temperature within the specified range. Check the load condition.

Note 1) Before cleaning, confirm that there is no oil content and/or moisture in compression air.

Note 2) This inspection and replacement period is when water- or oil-proof functions are required.

Note 3) The life expectancy of the battery is approximately 3 years at continuous backup of encoder. For replacement, a lithium battery (ER3V: 3.6V, 1000mAh) manufactured by Toshiba Lifestyle Products & Services Corporation is recommended.

8.6 Service parts

8.6.1 The parts requiring Inspection

Some parts have aging degradation.
Please request us an overhaul by referring to the periods below for preventive maintenance.

No.	Part name	Number of average replacement periods	Corrective measures / usage conditions
1	Aluminum electrolytic capacitor for smoothing main circuit	5 Years	Replacement with new part is necessary. Load ratio: 50% of rated output current of amplifier. Usage condition: Yearly average 40°C
2	Cooling Fan motor	5 Years	Replacement with new part is necessary. Usage condition: Yearly average 40°C
3	Lithium battery for absolute encoder [ER3VLY]	3 Years	Replacement with new part is necessary.
4	Aluminum electrolytic capacitor (other than capacitor for smoothing main circuit)	5 Years	Replacement with new part is necessary. Usage condition: Yearly average 40°C Annual total usage time is 4800 hours.
5	Fuse	10 Years	Replacement with new part is necessary.
6	Relays	(Power-cycle: a hundred thousand times)	Replacement with new part is necessary.

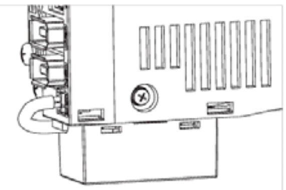
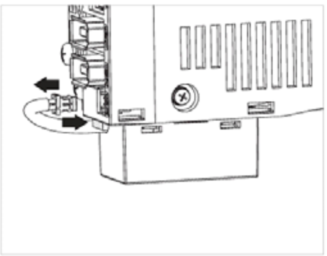
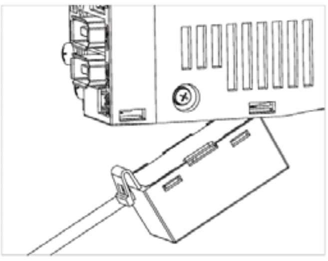
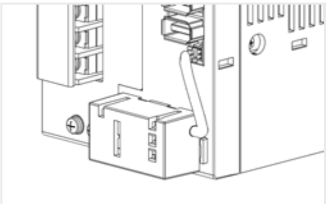
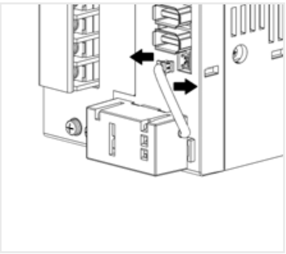
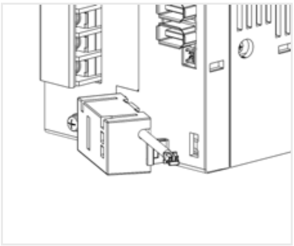
- ■ Capacitor for smoothing the main circuit, and relays
  - ◆ Inspection is needed if the servo amplifier has stored for more than 3 years. Contact the dealer or sales office.
  - ◆ It is necessary to replace the capacitor that is earlier than 5 years when it is used to exceed yearly average 40°C or exceed more than 50% of the rated output current of servo amplifier.
  - ◆ It is necessary to replace the capacitor or relays that are earlier than periods above where the main power-cycle is repeated more than 30 times per day or 5 times per hour. Capacity reduction or early failure of relays is considered.

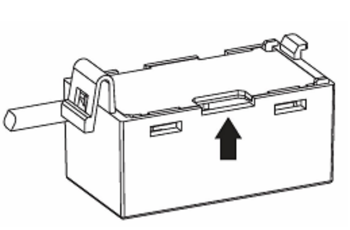
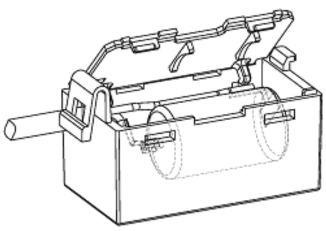
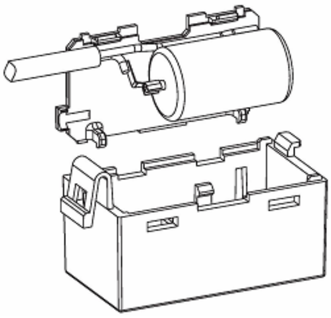
- Cooling Fan motor
  - The servo amplifier is designed corresponding to the pollution degree specified in EN61800-5-1 or IEC 664-1. It is not for dust proof or oil proof, so use it in an environment at Pollution Level 2 or less (i.e., Pollution Level 1, 2).
  - RS3 series servo amplifier models RS3□02, RS3□03, RS3A05, RS3A07, RS3A10, RS3A15 and RS3A30 have a built-in cooling fan; therefore be sure to maintain a space of 50mm on the upper and lower side of the amplifier for airflow.
    Installation in a narrow space may cause failure due to a static pressure reduction of the cooling fan and/or electronic parts degradation. Replacement is necessary if abnormal noise occurs or oil / dust are observed on the parts. Also, at an average temperature of 40°C year-round, the life expectancy is 5 years.
- Lithium battery for absolute encoder
  - The standard replacement period recommended by our company is the life expectancy of lithium battery based on normal usage conditions. However, if the motor is not used for a long period, the life of lithium battery is reduced. If the battery power is less than 3.6 V during inspection, replace it with new one.

8.6.2 Replacing battery for motor encoder

- Battery box attached to the servo amplifier

Process	Description
1	Turn ON the servo amplifier control power supply.
2	Prepare the replacement lithium battery. [Our model number: AL-00879511-01]
3	Detach the battery connector from servo amplifier.
4	Detach the battery box from servo amplifier.
5	Open the battery box.
6	Take out the old lithium battery and insert prepared new one to the battery box.
7	Close the battery box.
8	Attach the battery box to the bottom of servo amplifier.
9	Attach the connector in the right direction.

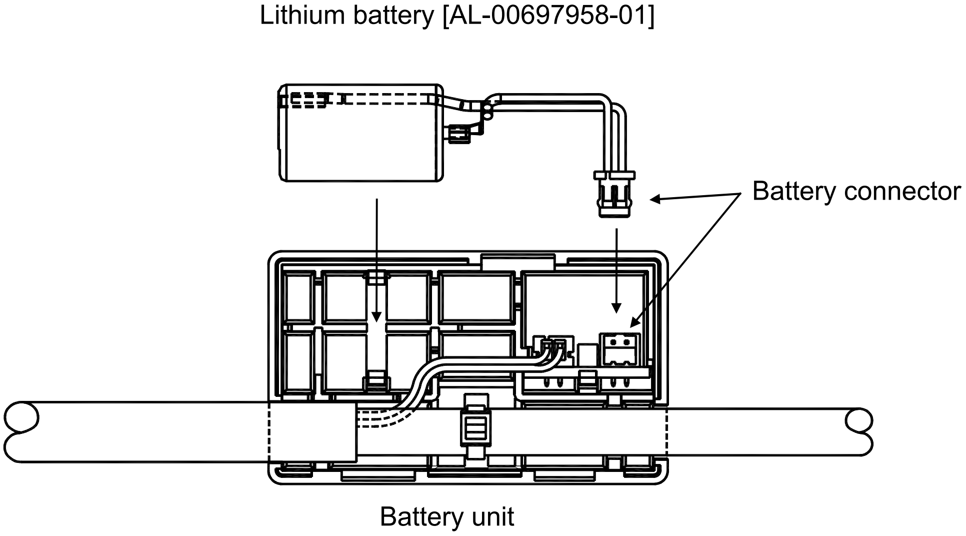
	Battery case position	Process 3 and 9	Process 4 and 8
RS3☐01 RS3☐02 RS3☐03 RS3A05 RS3A07	 Bottom of amplifier		
RS3A10 RS3A15 RS3A30	 Front of amplifier		

	Process 5 and 7	Process 6
Common	 	

* If the battery is replaced while the control power is OFF, multiple rotation counter (position data) of the motor encoder might be instable. When the amplifier control power is turned ON in this status, an alarm (AL_A1: Absolute Encoder Internal Error 1) might be issued. For this case, execute encoder clear and alarm reset to release the alarm status. Also, absolute encoder position data might be instable. So adjust the relations between a position data and a machine coordinate system to match, and then perform operation.

- ■ Battery unit attached to junction cable for motor encoder

Process	Description
1	Turn ON the servo amplifier control power supply.
2	Prepare the replacement lithium battery. [Our model number: AL-00697958-01]
3	Open the battery unit.
4	Detach the battery connector from the battery case.
5	Take out the old lithium battery and insert prepared new one to the battery case.
6	Attach the connector in the right direction.
7	Close the battery unit.



9

Dedicated function

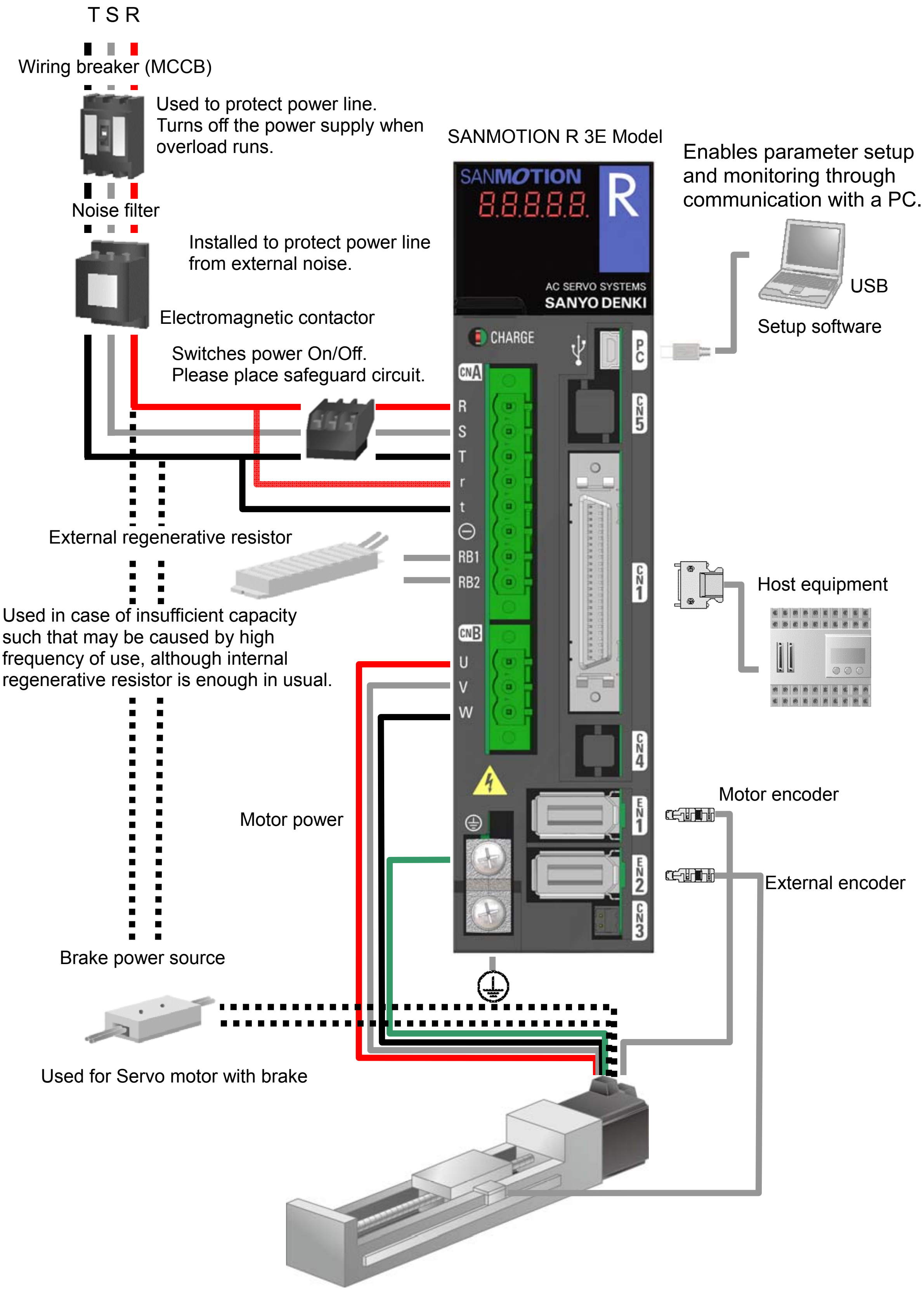
In this chapter, the things concerning dedicated function are explained.

9. Dedicated function

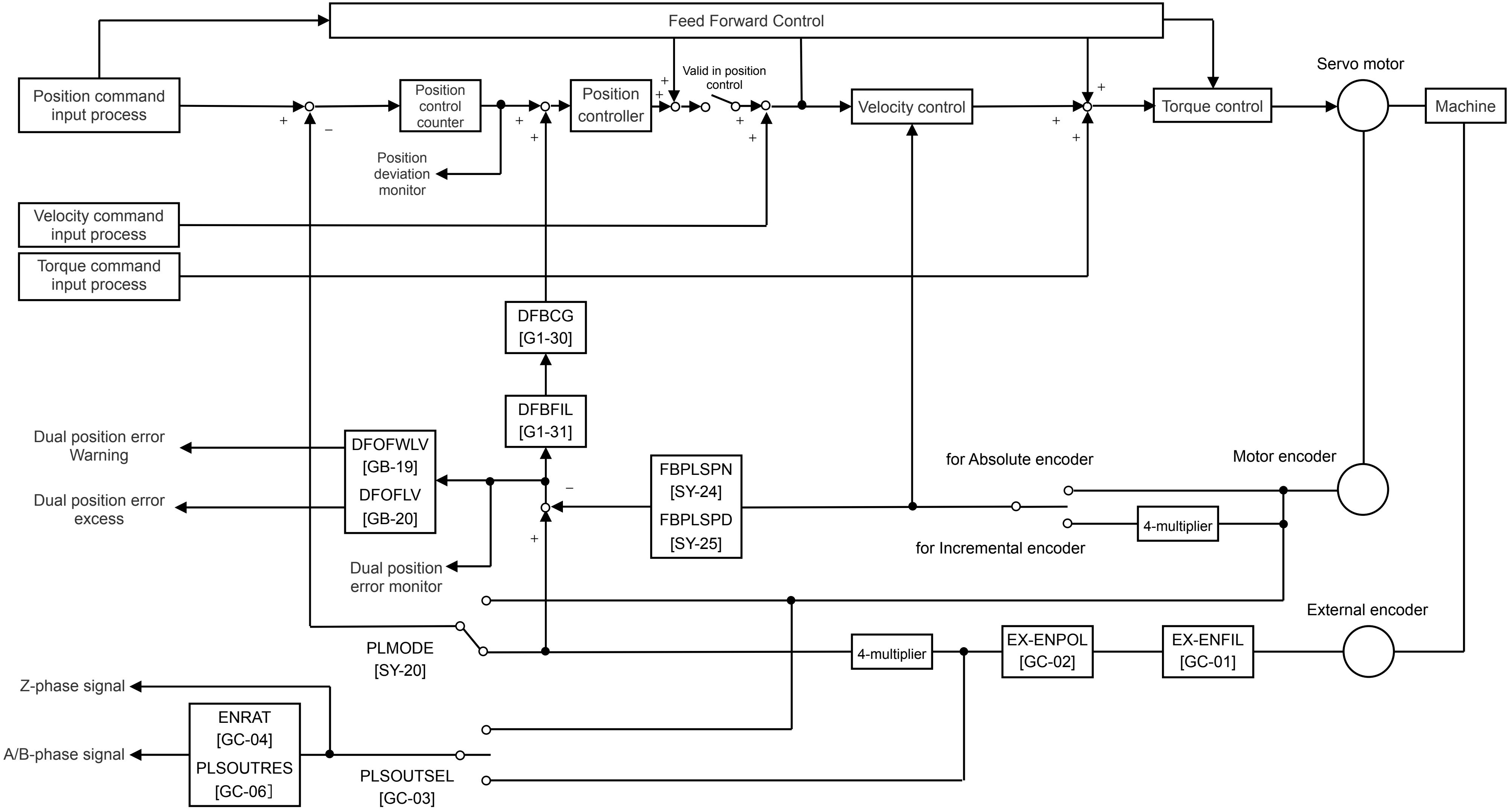
9.1 Full-closed system

9.1.1 Illustration of system components

■ RS3☐01/02/03/05



9.1.2 Internal block diagram



9.1.3 Combination encoder

Apply to the product below as external combination encoder.

■ Incremental encoder

Manufacturer	Series name	Output signal	Power supply	Minimum resolution
Renishaw plc	RGH22	RS422 compliant, 90 degree phase shift pulse train	5V±5%	0.1 to 5μm
HEIDENHAIN K.K.	LIDA400			0.05 to 1μm
	LIDA200			0.5 to 5μm

- ✓ Applicable output signal is RS422 compliant 90 degree phase shift pulse train only. (LIDA47, LIDA27)
  Analog sine wave output (LIDA48, LIDA28) and serial signal output are not applicable.
- ✓ For detail of linear encoder performance/spec/guarantee/mounting/etc, inquire to manufacturer of each linear encoder.
- ✓ Contact us if combine with the encoder except recommendation encoder above.

■ Absolute encoder
Only EnDat2.2 is apply to the interface.

Manufacturer	Type	Series name	Power supply	Resolution
HEIDENHAIN K.K.	Linear encoder	LIC4100	5V±5%	0.01μm 0.005μm 0.001μm
		LIC2100		0.1μm 0.05μm
		LC400		0.01μm 0.001μm
	Angle encoder	RCN2000		26,28bit
		RCN5000		26,28bit
		RCN8000		29bit
	Rotary encoder	ECN/ENQ1100		Single-turn resolution: 23bit Multi-turn total rotation number: —/12bit
		ECN/ENQ1300		Single-turn resolution: 25bit Multi-turn total rotation number: —/12bit

- ✓ This table is combination spec with our servo amplifier.
  It may differ from manufacturer spec.
- ✓ For detail of each encoder performance/spec/guarantee/mounting/etc,
  inquire to the encoder manufacturer.
- ✓ It is not applicable except EnDat2.2 interface (Ordering designation: EnDat22).
- ✓ Contact us if combine with the encoder except recommendation encoder above.
- ✓ It cannot use if the resolution which converted to motor single-turn exceeds 23 bit (8,388,608).

9.1.4 Wiring

Connect external encoder to EN2 when using as full-closed system. See "4.3 Wiring for motor encoder" for motor encoder wiring (EN1 connector).

9.1.4.1 Signal names and its pin numbers for external encoder (EN2)

- ■ Incremental encoder

EN2 Terminal No.	Signal name	Description	Remarks Note 1)
1	-	Note 3)	—
2	SG	Power supply common Note 4)	
3	-	Note 3)	—
4	SG	Power supply common Note 4)	
5	B	Phase B pulse output	Twisted pair
6	/B		
7	A	Phase A pulse output	Twisted pair
8	/A		
9	Z	Phase Z pulse output	Twisted pair
10	/Z		
Note 2)	Earth	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect exterior covering shielded cable to metal case of EN2 side, and to earth of external encoder side.
Note 3) Please prepare power supply for external encoder by yourself.
Do not connect power supply for external encoder to 1 and 3 pins.
Note 4) Power supply common shall be connected.

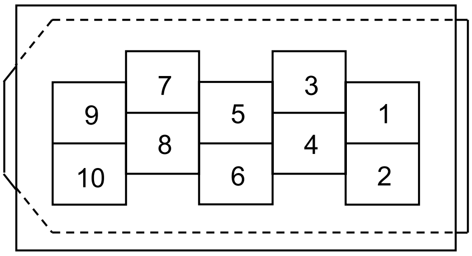
- ■ Absolute encoder (EnDat2.2)

EN2 Terminal No.	Signal name	Description	Remarks Note 1)
1	-	Note 3)	—
2	SG	Power supply common Note 4)	
3	-	Note 3)	—
4	SG	Power supply common Note 4)	
5	CLOCK+	Serial clock signal	Twisted pair
6	CLOCK-		
7	DATA+	Serial data signal	Twisted pair
8	DATA-		
9	—	—	—
10	—		
Note 2)	Earth	Shield	—

Note 1) Use an exterior covering shielded cable and perform twisted-pair wiring.
Note 2) Connect exterior covering shielded cable to metal case of EN2 side, and to earth of external encoder side.
Note 3) Please prepare power supply for external encoder by yourself.
Do not connect power supply for external encoder to 1 and 3 pins.
Note 4) Power supply common shall be connected.

9.1.4.2 EN2 pin assignment

- ■ EN2 36210-0100PL (soldered side)



- ■ Connector model number (3M Japan Limited)

	Model Number	Applicable wire size	Applicable cable diameter
Connector	36210-0100PL	AWG30 to AWG18	―

9.1.5 Basic setting of full-closed system

Explains basic setting of the system for full-closed system operation.

9.1.5.1 Specification confirmation

Confirm specifications of servo amplifier through the setup software or the digital operator.

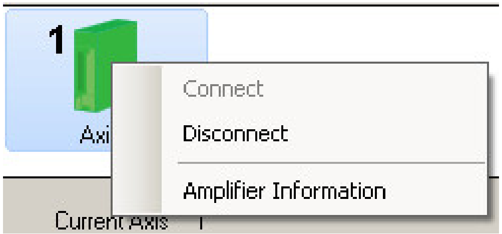
[Step 1: How to confirm specifications of servo amplifier]

Confirm that your servo amplifier is fit to full-closed system or not by the information below.

◆ Encoder type

1) Confirmation through the setup software

- ■ Connect the servo amplifier and PC (with USB cable) which installed the setup software, and then supply control power (to r and t terminal).
- ■ Run the setup software and start communication with the servo amplifier.
- ■ Select a desired axis from main window upper side axis icon, and then display popup menu (by right click).



[Step 2: Encoder type confirmation]

See below for allowable encoder of this servo amplifier. Please confirm that your external encoder is allowed.

Servo amplifier model number	Encoder type code	Motor encoder allowed by EN1	External encoder allowed by EN2
RS3###A1##	01	Absolute encoder	Absolute encoder
RS3###A2##	02	Absolute encoder	Incremental encoder
RS3###A9##	09	Incremental encoder	Absolute encoder
RS3###AA##	0A	Incremental encoder	Incremental encoder

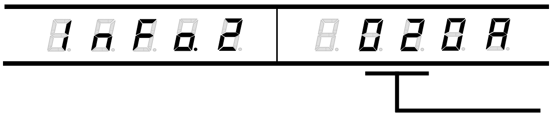
✔ Full-closed system is not allowed when encoder type code is the other of 01, 02, 09 or 0A.

1) Through the setup software

Encoder type code is shown in Control Circuit Type of System information.

2) Through the digital operator

Encoder type code is shown at an upper byte of InFo.2.



Control circuit type code

9.1.5.2 System parameter setting

Set the parameters as follows for use of full-closed control.

- Control cycle
  Select a control cycle of velocity control and torque control. "00: Standard_Sampling" shall be selected for use of full-closed control.

Group	ID	Selection		Description
System	00	00	Standard_Sampling	Standard sampling mode

- Control mode selection
  Selects the control mode. "02: Position" shall be selected for use of full-closed control.

Group	ID	Selection		Description
System	06	02	Position	Position control type

- Motor encoder connector selection
  Selects the connector used as motor encoder. "00: EN1" shall be selected for use of full-closed control.

Group	ID	Selection		Description
System	10	00	EN1	Uses EN1 for connecting motor encoder.

- Position loop control, position loop encoder selection
  Select the encoder for use of control method of position loop and position control. "01: External_Enc" shall be selected for use of full-closed control.

Group	ID	Selection		Description
System	20	01	External_Enc	Full-closed control/ External encoder

9.1.5.3 Full-closed encoder selection

■ EN2encoder type
Selects the external encoder type connected to EN2. Select depending on encoder type as below:
8th digit of servo amplifier model number is 1 or 9 (Absolute encoder): "22: EnDat_ABS"
8th digit of servo amplifier model number is 2 or A (Incremental encoder): "82: Pulse_without_CS"

Group	ID	Selection		Selection
System	12	22	EnDat_ABS	EnDat2.2
		80	Pulse	Wire-saving incremental encoder
		82	Pulse_without_CS	Incremental encoder (without CS)

■ EN2 absolute encoder baud rate selection
Set it when "22：EnDat_ABS" is selected to EN2.

Group	ID	Selection		Selection
System	21	01	2Mbps	2Mbps
		03	4Mbps	4Mbps

✔ Use with the initial setting (01:2Mbps), normally.

9.1.5.4 Feedback pulse setting

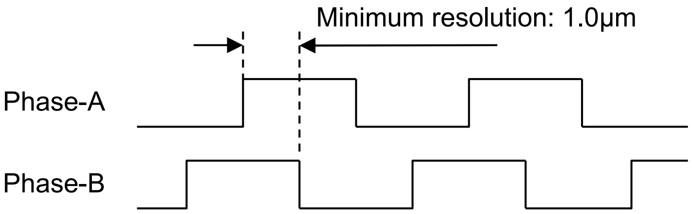
- External incremental encoder resolution
  Sets pulse amount (multiply 1) of external encoder per 1 turn of motor axis.
  Be valid after control power cycle.

Group	ID	Setting range	Unit
System	22	500 to 500,000 (multiplied 1)	P/R

◆ Setting sample

[Use condition]

- Move distance of work per 1 turn of motor axis: 10mm
- Minimum resolution of external encoder (multiplied 4): 1.0×10^{-3} mm (=1.0μm)



[Setting value]

Move distance of work per 1 turn of motor axis is 10mm, and Minimum resolution of external encoder is 1.0μm, so,

Pulse amount of external encoder per 1 turn of motor axis

$$= \frac{\text{Move distance of work per 1 turn of motor axis [mm]}}{\text{Minimum resolution of external encoder [mm]}}$$

$$= 10\text{mm} /(1.0 \times 10^{-3}\,\text{mm})$$
$$= 10000 \text{ P/R (multiplied 4)}$$

System parameter ID22 "External encoder resolution" is "multiplied 1" value (amount of phase-A or phase-B), so,

External encoder resolution = 10000/4 = 2500 P/R

set this value.

✔ Round off the value to the whole number.

9.1.5 Basic setting of full-closed system

- ■ External absolute encoder resolution (for absolute encoder)
  Sets the external encoder resolution per equal to motor single-turn.
  Be valid after control power cycle.

Group	ID	Setting range	Unit
System	26	2048 to 8388608	P/R

◆ Setting sample

[Use condition]

- ・ Move distance of work per 1 turn of motor axis: 10mm
- ・ Minimum resolution of external encoder (linear encoder): 0.01×10^{-3} mm (=0.01μm)

[Setting value]

Move distance of work per 1 turn of motor axis is 10mm, and Minimum resolution of external encoder is 1.0μm, so,

Pulse amount of external encoder per 1 turn of motor axis

$$= \frac{\text{Move distance of work per 1 turn of motor axis [mm]}}{\text{Minimum resolution of external encoder [mm]}}$$

$= 10\text{mm} / (0.01\times10^{-3}\ \text{mm})$

= 1000000P/R

◆ Setting sample

[Use condition]

- ・ Rotation of work per 1 turn of motor axis : 1/32 rotation
- ・ Resolution of external encoder (angle encoder): 26bit (67,108,864 division)

[Setting value]

Rotation of work per 1 turn of motor axis is 1/32 rotation, and Resolution of external encoder is 67,108,864 division, so,

Pulse amount of external encoder per 1 turn of motor axis
= Rotation of work per 1 turn of motor axis [rotation]
x Resolution of external encoder [division]
= (1/32 rotation) x (67,108,864 division)
= 2,097,152 P/R

✔ Round off the value to the whole number.

■ Feedback pulse electronic gear

Sets the electronic gear ratio for converting motor encoder resolution to external encoder resolution.

This parameter is used for calculation of dual position error (position error between motor encoder and external encoder).

Be valid after control power cycle.

Group	ID	Symbol	Name	Setting range	Unit
System	24	FBPLSPN	Numerator of feedback pulse electronic gear	1 to 2,097,152	Pulse
System	25	FBPLSPD	Denominator of feedback pulse electronic gear	1 to 2,097,152	Pulse

Relation equation of electronic gear ratio is follows.

$$\frac{\text{FBPLSPN [SY-24]}}{\text{FBPLSPD [SY-25]}} = \frac{\text{Feedback encoder pulse amount per 1 turn of motor}}{\text{Motor encoder resolution}}$$

✔ Multiplied 4 to encoder resolution, in case of incremental encoder.

◆ Setting sample 1 (Motor encoder is absolute encoder)

[Use condition]

- Move distance of work per 1 turn of motor axis: 10mm
- Minimum resolution of external encoder: 1.0×10^{-3}mm (=1.0μm)
- System parameter ID15 “Absolute encoder resolution”: 131072 division

[Setting value]

- FBPLSPN = 10mm/(1.0×10^{-3}) = 10000 Pulse
- FBPLSPD = Absolute encoder resolution = 131072 Pulse

◆ Setting sample 2 (Motor encoder is incremental encoder)

[Use condition]

- Move distance of work per 1 turn of motor axis: 10mm
- Minimum resolution of external encoder: 1.0×10^{-3}mm (=1.0μm)
- System parameter ID17 “Incremental encoder resolution”: 2000 P/R

[Setting value]

- FBPLSPN = 10mm/(1.0×10^{-3}) = 10000 = 10000 Pulse
- FBPLSPD = Incremental encoder resolution×4 = 2000×4 = 8000 Pulse

◆ Setting sample 3 (Motor encoder is absolute encoder)

[Use condition]

- Move distance of work per 1 turn of motor axis: 10/3 mm
  (Work moves 10 mm by 3 turns of motor.)
- Minimum resolution of external encoder: 1.0×10^{-3}mm (=1.0μm)
- System parameter ID15 “Absolute encoder resolution”: 131072 division

[Setting value]

- FBPLSPN = (10/3) /(1.0×10^{-3}) = 10000 / 3 = 3333 .333･･･ = 3333 Pulse
  Indivisible. So, set the value as follows in this case.

- FBPLSPN = 10/(1.0×10^{-3}) = 10000 Pulse
- FBPLSPD = Absolute encoder resolution×3 = 131072×3 = 393216 Pulse

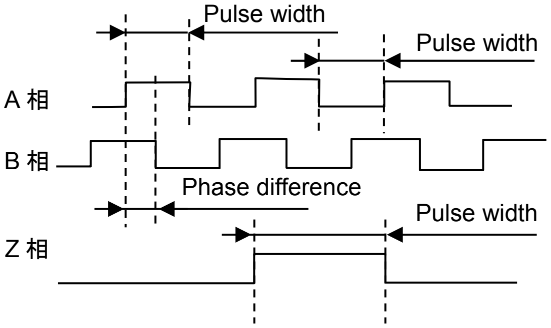
✔ When calculation values of FBPLSPN or FBPLSPD have decimal part, round off the value to the whole number. However, dual position error is not able to calculate accurate by round off, and it might detect “Dual position error excess (AL.D5).

So, in this case, set 0 to GroupB ID19 "Dual position error warning level" and GroupB ID1A "Dual position error excess value", for excepting warning and alarm detection.

9.1.5 Basic setting of full-closed system

■ External Encoder Digital Filter
Sets the digital filter for external encoder.
Even if noise is given to external incremental encoder, eliminate pulses below set value, as noise. Considering encoder resolution and maximum operation speed of servo motor, and set a quarter of maximum speed pulse width as a rough indication.

Group	ID	Selection		Description
C	01	00	110nsec	Minimum Pulse Width =110nsec (Minimum pulse Phase Difference = 37.5nsec)
		01	220nsec	Minimum Pulse Width = 220nsec
		02	440nsec	Minimum Pulse Width = 440nsec
		03	880nsec	Minimum Pulse Width = 880nsec
		04	75nsec	Minimum Pulse Width = 75nsec (Minimum pulse Phase Difference = 37.5nsec)
		05	150nsec	Minimum Pulse Width = 150nsec
		06	300nsec	Minimum Pulse Width = 300nsec
		07	600nsec	Minimum Pulse Width = 600nsec

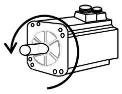
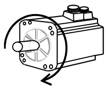
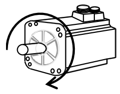
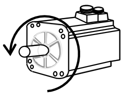


✔ Be valid when external incremental encoder is used.

9.1.5.5 Rotation direction setting for servo motor

At full-closed control, servo motor rotation direction is decided by command polarity and external incremental encoder polarity.

- Position, Velocity, Torque Command Input Polarity
  Selects command polarity of position command pulse.
  Rotation direction of servo motor is able to invert without changing command wiring.
  Be valid after control power cycle.

Group	ID	Selection		Position Command Pulse (PCMD) Plus	Position Command Pulse (PCMD) Minus
8	00	00	PC+_VC+_TC+	CCW rotation 	CW rotation 
		01	PC+_VC+_TC-		
		02	PC+_VC-_TC+		
		03	PC+_VC-_TC-		
		04	PC-_VC+_TC+	CW rotation 	CCW rotation 
		05	PC-_VC+_TC-		
		06	PC-_VC-_TC+		
		07	PC-_VC-_TC-		

- External Encoder Polarity Selection
  Selects signal polarity of external incremental encoder.
  Select polarity to get matching with increase/decrease of Monitor ID 61/62 "Present position monitor (External encoder) [EX-APMON]" and Monitor ID 10/11 "Present position monitor (Motor encoder) [APMON]".
  Be valid after control power cycle.

Group	ID	Selection		Description		
C	02	00	Type1	EX-Z /without inversion	EX-B /without inversion	EX-A /without inversion
		01	Type2	EX-Z /without inversion	EX-B /without inversion	EX-A /with inversion

✔ When count direction (increase/decrease) of external incremental encoder and motor encoder are not match, it might get runaway.

- External Absolute Encoder Polarity Selection
  Selects counting polarity of external absolute encoder.
  Select polarity to get matching with increase/decrease of Monitor ID 61/62 "Present position monitor (External encoder) [EX-APMON]" and Monitor ID 10/11 "Present position monitor (Motor encoder) [APMON]".
  Be valid after control power cycle.

Group	ID	Selection		Description
C	0B	00	Standard	Inverts not an encoder operation direction.
		01	Reversed	Inverts an encoder operation direction.

✔ It may become out of control if a counting direction (increase/decrease) of motor encoder and external absolute encoder are not matched.

9.1.5.6 Encoder output pulse signal setting

- Encoder Output Pulse Divide Selection
  Selects encoder output pulse divide signal.
  Select desired signal when upper controller requires encoder pulse signal.
  Be valid after control power cycle.

Group	ID	Selection		Description
C	03	00	Motor_Enc	Motor encoder
		01	External_Enc	External encoder

- External encoder output pulse divide ratio selection
  Selects the external encoder output pulse divide ratio (1/N) when EnDat is used to external encoder.
  When the external encoder is angle encoder or rotary encoder, select from the range of 1/4(R) to 1/8192(R).
  When the external encoder is linear encoder, select from the range of 1/4(L) to 1/2000(L).

Be valid after control power cycle.

Selection		Contents
00	1/4(R)_1/4(L)	Outputs by following calculation according to encoder type.
01	1/8(R)_1/20(L)	For angle encoder or rotary encoder, outputs the pulse as follows: "Single turn resolution" x (1/N). (Use 1/4(R) to 1/8192(R)) For linear encoder, outputs the pulse as follows: "Resolution" / (1/N). (Use 1/4(L) to 1/2000(L))
02	1/16(R)_1/40(L)	
03	1/32(R)_1/80(L)	
04	1/64(R)_1/120(L)	
05	1/128(R)_1/160(L)	
06	1/256(R)_1/200(L)	
07	1/512(R)_1/400(L)	
08	1/1024(R)_1/800(L)	
09	1/2048(R)_1/1200(L)	
0A	1/4096(R)_1/1600(L)	
0B	1/8192(R)_1/2000(L)	

✔ Output is available up to the frequency of 2Mpulse/sec (multiply 1).
Select the divide ratio in the range less than the frequency above.

EnDat (Angle encoder, Rotary encoder)
Divide ratio is limited to be 32768 pulse/rev or more when ""Single turn resolution" x (1/N) < 32768 pulse/rev." is established.

EnDat (Linear encoder)
Use in the range as follows: 231 x Resolution / ((1/N)x4), based on zero position.
(Z-phase output position might shift if a power cycle is performed after moving to out of the range.)

9.1.5.7 Dual position feedback compensation setting

Dual position feedback compensation performs full-closed control using along with external encoder feedback and motor encoder feedback, by setting dual position feedback filter. From above, it can use full-closed control at motor stop or constant rotation, and use semi-closed control at accel/decel, so accuracy of full-closed control and response of semi-closed control are able to go together.

- ■ Dual position feedback gain

Sets the ratio of semi-closed control (motor encoder feedback). Larger the value, higher the compensation impact.

Dual position feedback compensation function will be invalid when 0% is set.

Group	ID	Setting range	Unit
1	30	0 to 100	%

- ■ Dual position feedback filter

Sets the band of dual position feedback compensation. Larger the value, nearer responsiveness of transient response to semi-closed control.

Dual position feedback compensation function will be invalid when 0ms is set.

Group	ID	Setting range	Unit
1	31	0.0 to 2000.0	ms

- ■ How to use
  - ◆ Set 100% to "Dual position feedback gain", and set the value of "Dual position feedback filter" with referring calculation below as a rough indication.

    Dual position feedback filter [ms]=3÷KP [1/s]×1000
  - ◆ Increase position loop proportional gain until position deviation is getting vibration exceeding positioning completion range.
  - ◆ Increase Dual position feedback filter value up to the value that makes position deviation vibration stable.
  - ◆ When the vibration is not fit into positioning completion range, decrease position loop proportional gain and try adjustment again.

9.1.5.8 Alarm detection setting

Warning and alarm are able to output by detecting position difference between external encoder and motor encoder. It is able to avoid that continuous rotation of motor when abnormal issue is occurred like as external encoder signal does not change by something or change to opposite direction of motor encoder.

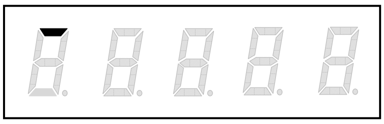
■ Dual position error warning level

Warning will be output when exceeding this setting value by difference between external encoder and current position of motor encoder which is applied feedback pulse electronic gear. Set the value of multiply 4 to external encoder resolution, as a base.

Dual position error warning does not output when 0 pulse is set.

Group	ID	Setting range	Unit
B	19	0 to 2147483647	Pulse

✔ Warning status is able to check on monitor display and front panel LED. Also, able to output from general output port.



■ Dual position error excess value

"Dual position error excess alarm (AL.D5)" will be output when exceeding this setting value by difference between external encoder and current position of motor encoder which is applied feedback pulse electronic gear. Set the value of multiply 4 to external encoder resolution, as a base.

Dual position error excess alarm does not detect when 0 pulse is set.

Group	ID	Setting range	Unit
B	1A	0 to 2147483647	Pulse

✔ Dual position error (difference between external encoder and current position of motor encoder) is able to check by Monitor ID60 "Dual position error monitor [DFERR-MON]".

✔ Dual position error will be cleared by the Deviation Clear.

9.1.5.9 External encoder signal output waiting function setting

If there is delay from supplying power to outputting encoder signal depending on external encoder specification, this function is able to delay boot time of servo amplifier along with encoder signal start time.

- Initial timeout waiting time
  Set the time of "from Supplying power to external encoder to Starting encoder signal output + α".

Group	ID	Selection	Description
B	0B	0	Invalid
		1	1000ms
		2	1400ms
		3	1800ms
		4	2000ms
		5	3000ms
		6	5000ms
		7	10000ms

- ✔ Supply power to external encoder at same timing for control power of servo amplifier or earlier.
- ✔ "Encoder Connector 2 Disconnection (AL.83)" will be output when setting value is shorter than the time from supplying power to outputting encoder signal.
- ✔ When EnDat is used to external encoder, it takes 1.3sec to start serial communication access from power establishment of external encoder. Therefore, 1.3sec or more is required to a booting time also when set value is 1 or 3.

9.1.6 Precautions

9.1.6.1 Power supply for external encoder

■ Please prepare power supply for external encoder by yourself.

✔ Power supply to external encoder shall be start at before or same timing of servo amplifier control power.

9.1.6.2 External encoder operation

■ Please check that external encoder has no problem before servo ON (exciting servo motor).

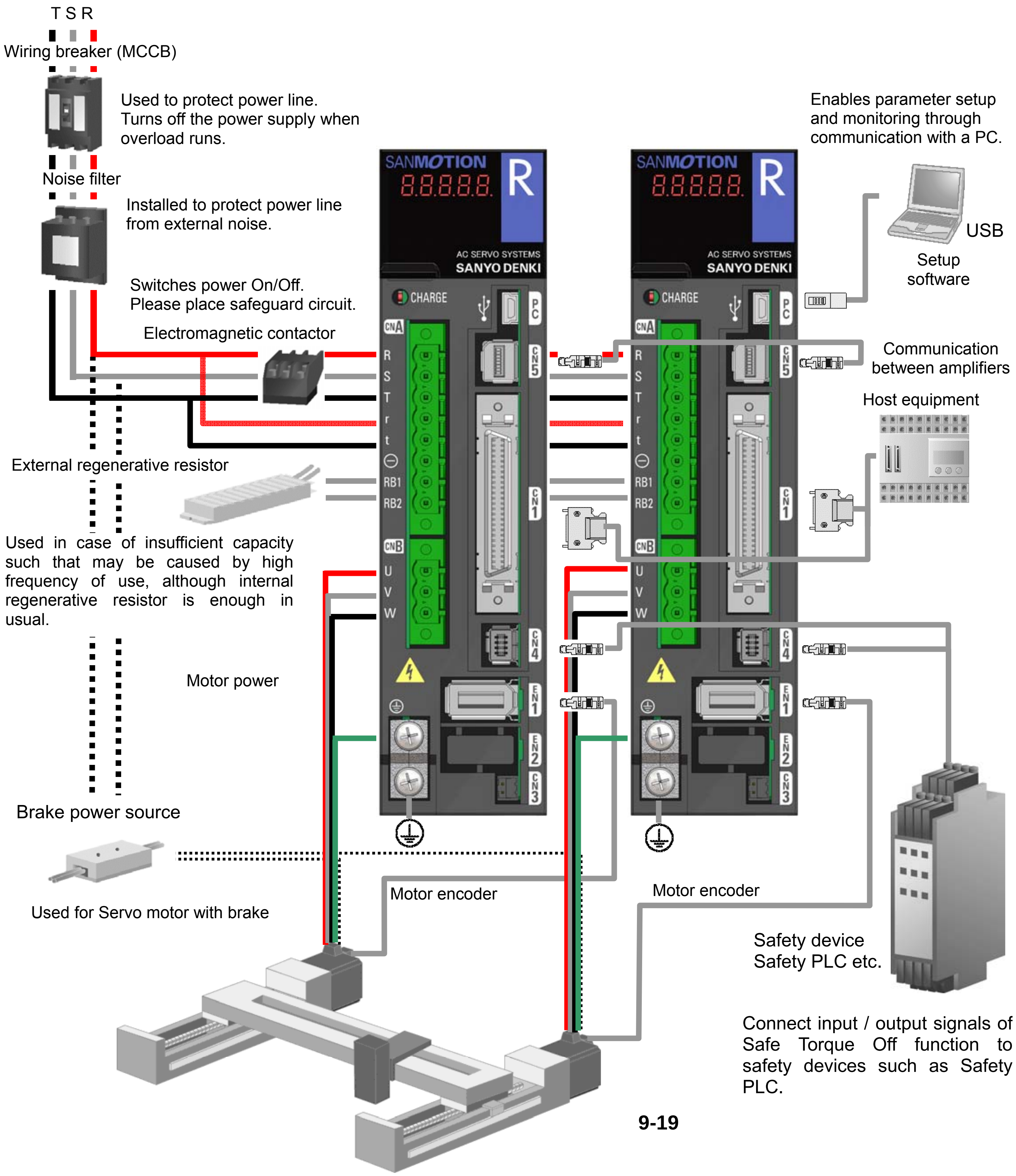
◆ When count directions (increase/decrease) of Monitor ID10/11 "Present position monitor (Motor encoder) [APMON]" and Monitor ID 61/62 "Present position monitor (External encoder) [EX-APMON]" are opposite, change GroupC ID02 "External Incremental Encoder Polarity Selection" or change GroupC ID0B "External Absolute Encoder Polarity Selection" to adjust a count direction (increase/decrease).

◆ When external encoder operation is removed
Use at the condition that external encoder is connecting mechanically.

9.2 Tandem operation

This is the function that operates 2 axes with checking position error each other and compensating difference, through local communication function built in the servo amplifier.

9.2.1 Illustration of system components



Wiring breaker (MCCB)

Used to protect power line.
Turns off the power supply when overload runs.

Noise filter

Installed to protect power line from external noise.

Switches power On/Off.
Please place safeguard circuit.

Electromagnetic contactor

External regenerative resistor

Used in case of insufficient capacity such that may be caused by high frequency of use, although internal regenerative resistor is enough in usual.

Motor power

Brake power source

Used for Servo motor with brake

Enables parameter setup and monitoring through communication with a PC.

Setup software

Communication between amplifiers

Host equipment

Motor encoder

Motor encoder

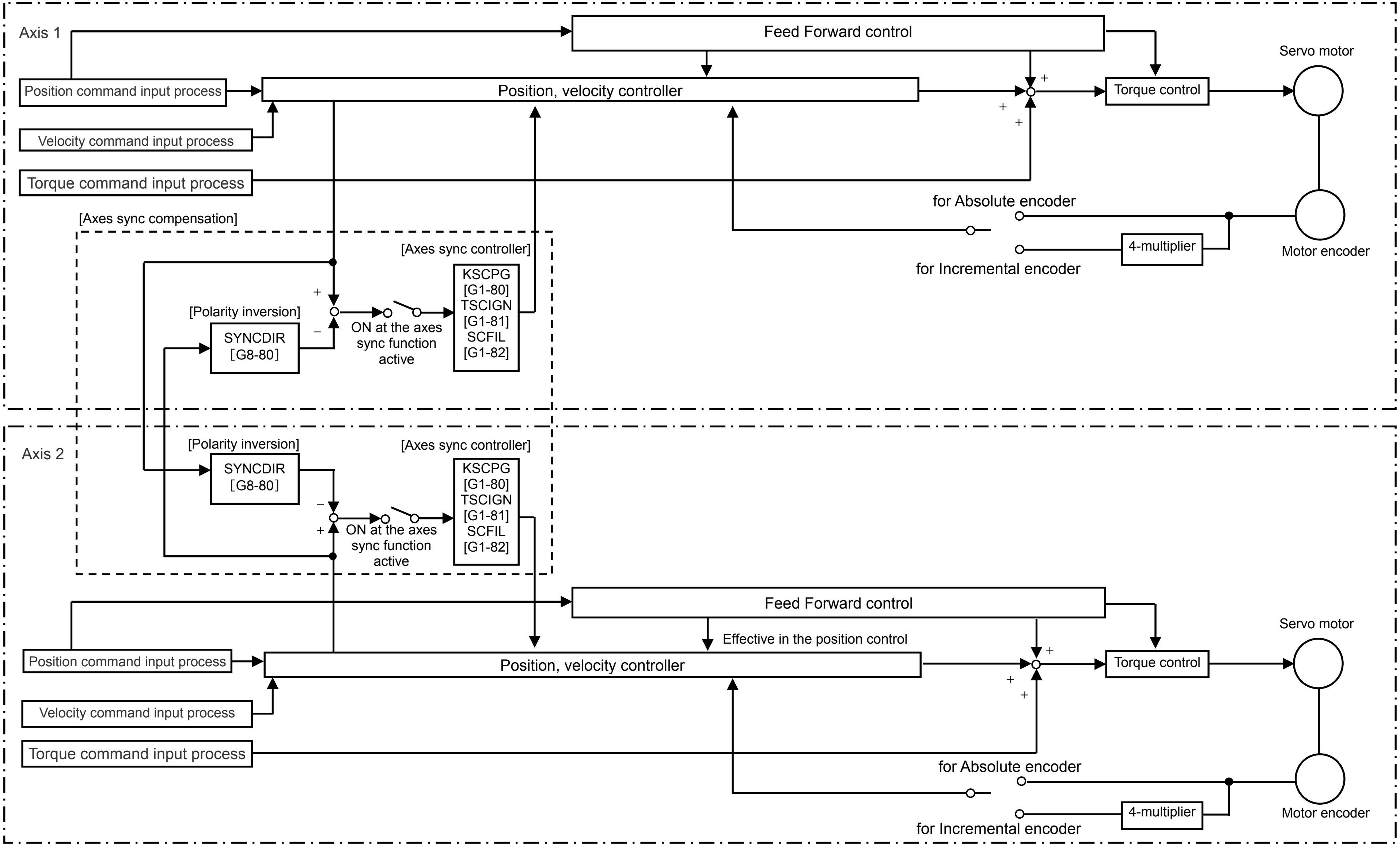
Safety device
Safety PLC etc.

Connect input / output signals of Safe Torque Off function to safety devices such as Safety PLC.

■ Precaution for system construction

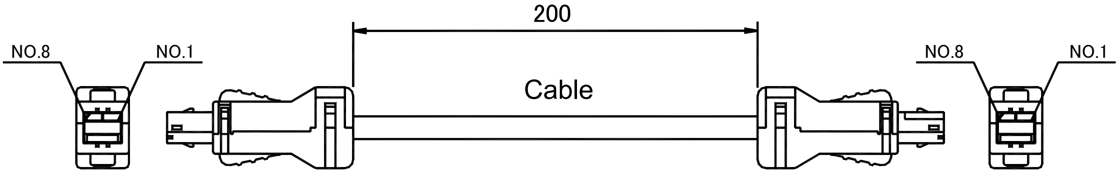
- ✔ Construct system as balance of machine system (load inertia moment, friction, load torque) will be same in 2 axes. When that balance differs in 2 axes, overload alarm might occur only in 1 axis.
- ✔ At the tandem operation, please use servo motors and amplifiers with a same model number, in 2 axes.
- ✔ Please place safeguard circuit that is able to stop both axes by single axis alarm (like as power supply breaker).
- ✔ When overtravel function is used, construct system as inputting an overtravel status to both axes with same timing, after sending individual overtravel signal to a host equipment.

9.2.2 Internal block diagram



9.2.3 Wiring

For use of the tandem operation, connect the communication cable to CN5.



- ✔ For use of the Safe Torque Off function, connect the wiring of CN4 (connector for safety device connection), between 2 axes.
- ✔ See "12.6.5 Communication cable between servo amplifiers" for detail of the communication cable.

9.2.4 Setting for the tandem operation function

For use of the Safe Torque Off function, set the parameters below.

- ■ Amplifier communication function selection
  Select use of the RS422 communication function (at CN5 connector).
  It will activate after power cycle for control.

Group	ID	Selection		Contents
System	08	01	Tandem	Uses as for the tandem operation.

- ✔ Select "01: Tandem" in both axes.
  If it is not selected at one side, "AL.D7(Amplifier communication error)" will occur.

- ■ Axes-sync compensation proportional gain
  Sets a rate of the axes-sync compensation value.
  When 100% is set, adds the axes-sync compensation pulse value to the position deviation without change.
  Vibration might occur if set value is too large.

Group	ID	Setting range	Default	Unit
1	80	0 to 300	0	%

- ■ Axes-sync compensation integral time constant
  Sets an integral time constant for the axes-sync compensation.
  This set value will be valid when axes-sync compensation proportional control function is invalid.
  Integral term will be invalid (proportional control) when 1000.0ms is set.

Group	ID	Setting range	Default	Unit
1	81	0.5 to 1000.0	1000.0	ms

- ■ Axes-sync compensation filter
  Primary low pass filter that suppress sudden variation of axes-sync compensation value.
  Filter will be invalid when 0.0ms is set.

Group	ID	Setting range	Default	Unit
1	82	0.0 to 1000.0	0.0	ms

- Polarity selection of axes-sync compensation input
  Fit a polarity of position deviation each other.
  Set "01: Reversed" to one axis if rotation directions of combination axes are different.

Group	ID	Setting range	Default	Contents
8	80	00:Not_reversed	00: Not_reversed	Without reversing
		01:Reversed		Reversing

- Axes-sync compensation function
  Selects an input condition to activate the axes-sync compensation function.
  Tandem operation function will work when "01: Tandem" is set to system parameter ID08 "Amplifier communication function", and this parameter is valid.

Group	ID	Setting range	Default	Unit
9	80	00 to 11	00	--

✔ See "Group9 Function enabling condition settings" in "5.8 Parameter functions", for detail of the selection.

- Axes-sync compensation proportional control switching function
  Selects an input condition to activate the axes-sync compensation proportional control switching function.

Group	ID	Setting range	Default	Unit
9	81	00 to 29	00	--

✔ See "Group9 Function enabling condition settings" in "5.8 Parameter functions", for detail of the selection.

9.2.5 How to use

- Tandem operation has the mutual compensating method and the Master-Slave method.
  - Mutual compensating method: This is the method that 2 axes are checking position error each other and compensating difference, through local communication function built in the servo amplifier. Use this method if same motion is required to both axes.

  - Master-Slave method: This is the method that one side (Slave) checks position deviation with the other side (Master) and compensates difference. Use this method if a follow-up motion against the Master axis is required to the Slave axis.

- For the mutual compensating method
  - If rotation directions of 2 axes are same, set all parameters same in 2 axes.

  - If rotation directions of 2 axes are different, set "04: PC-_VC+_TC+" to Group8 ID00 "Position, Velocity, Torque Command Input Polarity", at one axis. And, set "01: Reversed" to Group8 ID80 "Polarity selection of axes-sync compensation", at both axes. For the other parameters, set same parameters, at both axes.

  - Recommends parameters below, at adjustment starting.
    Axes-sync compensation proportional gain: 30%, Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms

  - Adjust the value of the axes-sync compensation proportional gain and the axes-sync compensation filter for minimizing deviation, with checking the axes-sync error monitor.

  - Make tune of servo gain. See "6. Servo tuning" for tuning procedure. However, some of functions are not able to use. See "9.2.7 Precautions" for the functions which are not able to use.

- For the Master-Slave method
  - When Master-Slave method is used, the axes-sync compensation function is set as invalid at Master axis, and set as valid at Slave axis.

  - If rotation directions of 2 axes are same, set same parameter to Group8 ID00 "Position, Velocity, Torque Command Input Polarity", in 2 axes. And, set " 00:Not_Reversed " to Group8 ID80 "Polarity selection of axes-sync compensation", at Slave axis.

  - If rotation directions of 2 axes are different, set "04: PC-_VC+_TC+" to Group8 ID00 "Position, Velocity, Torque Command Input Polarity" and set " 01:Reversed " to Group1 ID83 "Polarity selection of axes-sync compensation", at Slave axis.

  - Set Master side parameters as below.
    Axes-sync compensation proportional gain: 0% (equal to invalid), Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms

  - Slave side parameters are recommended as below.
    Axes-sync compensation proportional gain: 30%, Axes-sync compensation integral time constant: 1000ms (equal to invalid), Axes-sync compensation filter: 0.0ms

  - Adjust the value of the axes-sync compensation proportional gain, the axes-sync compensation integral time constant and the axes-sync compensation filter for minimizing deviation, with checking the axes-sync error monitor.

  - Make tune of servo gain. See "6. Servo tuning" for tuning procedure. However, some of functions are not able to use. See "9.2.7 Precautions" for the functions which are not able to use.

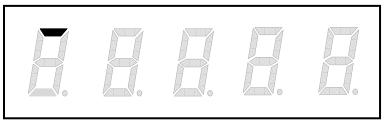
9.2.6 Error detection

Warnings or alarms are able to output by detecting position deviation error of own axis and counterpart axis. Avoids continuance of servo motor rotation if motions between 2 axes have gap by something cause.

- ■ Axes-sync error warning level
  Warning outputs when position deviation error between own axis and counterpart axis exceeds this set value.

Group	ID	Setting range	Unit
B	80	1 to 2147483647	Pulse

- ✔ Warning status is able to check by the monitor indication and the front LED.



- ■ Axes-sync error excess value
  Outputs the axes-sync error excess (alarm code: D4) when position deviation error between own axis and counterpart axis exceeds this set value.

Group	ID	Setting range	Unit
B	81	1 to 2147483647	Pulse

- ✔ Axes-sync error pulse is able to check by the monitor indication: ID66 Axes-sync error monitor.
- ✔ Axes-sync error pulse is able to reset by the position deviation clear.

9.2.7 Precaution

- ◆ At the tandem operation, different load inertia moment ratios cannot use in 2 axes. (Please set same load inertia moment ratio in 2 axes if using the value estimated by the load inertia moment ratio estimation.)

- ◆ Do not use functions below, in the tandem operation.
  - ✔ Adaptive notch filter function
  - ✔ Model control switching function
  - ✔ Model vibration suppression control switching function
  - ✔ Auto tuning function (Auto tuning [JRAT manual setting] is available)
  - ✔ Auto notch filter tuning function
  - ✔ Auto FF vibration suppression frequency tuning
  - ✔ CP vibration suppression control
  - ✔ Minor vibration suppression
  - ✔ Disturbance observer function
  - ✔ Gain switching function (In case of "always valid" and "operating by using general input signal", function is available.)
  - ✔ Full-closed function
  - ✔ System analysis function
  - ✔ Servo tuning navigation

- ◆ In use of mutual compensating method, please operate at same timing in 2 axes for active status control of each function which assigned to general input.

- ◆ When alarm is occurred, 2 axes might have position deviation.
  In that case, please adjust machine positions of 2 axes.

- ◆ For one side axis operation, disable Group9 ID80 "Axes-sync compensation function" and make counterpart axis servo off.
  - ✔ Avoid high speed operation. (Dynamic brake of counterpart axis might burn out.)

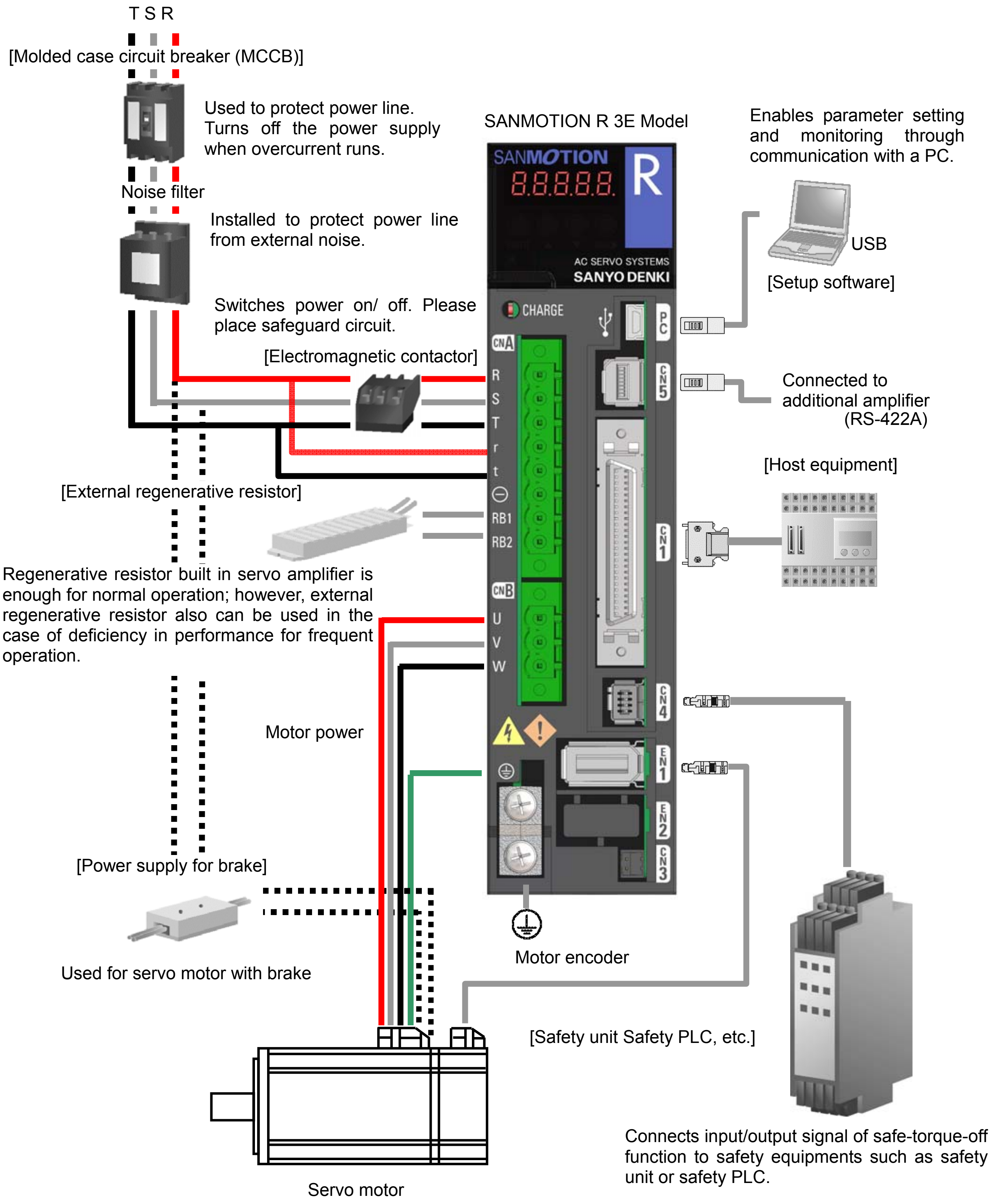
10

Safe-Torque-Off (STO) function

In this chapter, details of Safe-Torque-Off (STO) function are explained.

10. Safe Torque Off function

10.1 Illustration of system configuration



Used to protect power line. Turns off the power supply when overcurrent runs.

Installed to protect power line from external noise.

Switches power on/ off. Please place safeguard circuit.

Enables parameter setting and monitoring through communication with a PC.

Connected to additional amplifier (RS-422A)

Regenerative resistor built in servo amplifier is enough for normal operation; however, external regenerative resistor also can be used in the case of deficiency in performance for frequent operation.

Used for servo motor with brake

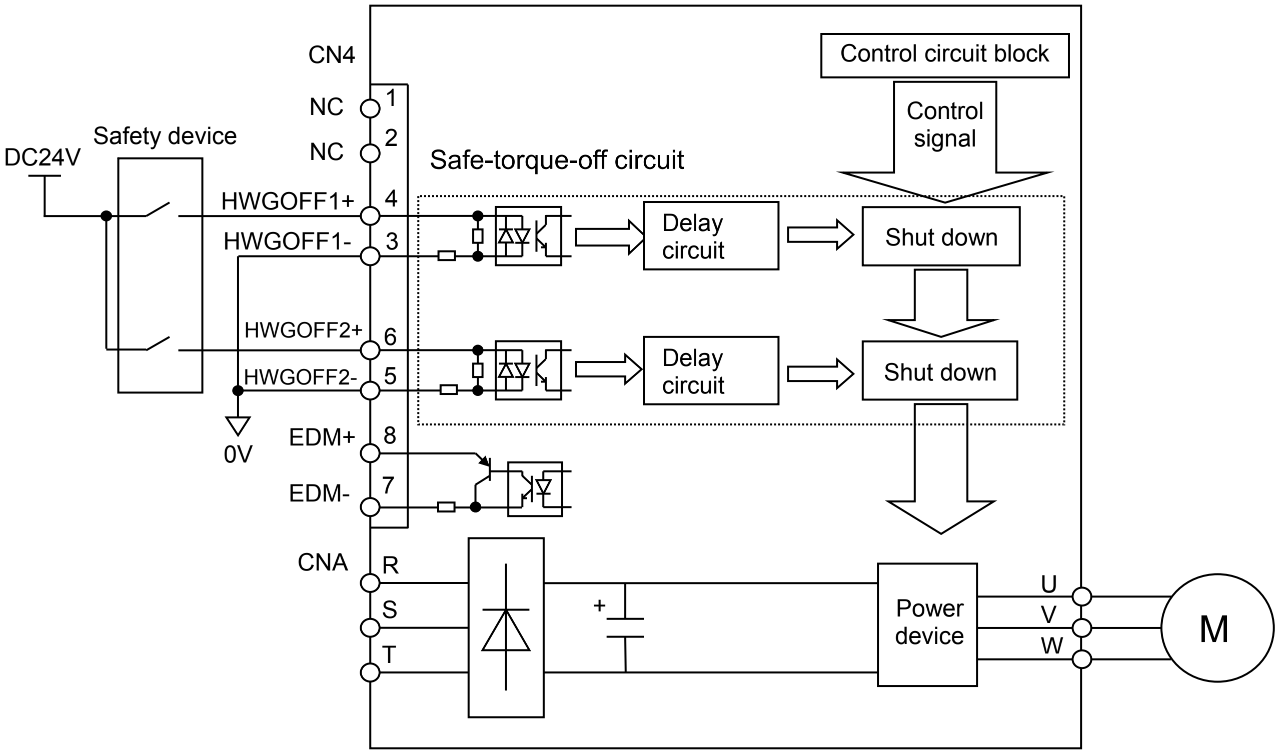
Connects input/output signal of safe-torque-off function to safety equipments such as safety unit or safety PLC.

10.2 Safe-Torque-Off function

Safe-torque-off function reduces injury risks and ensures the safety for those who work near moving parts of equipment. This function employs 2-channel input signal to block current to servo motor. Previously we ensure machine safety by blocking current to servo amplifier with use of electromagnetic contactor. This safe-torque-off function allows keeping machine safety without shutting down power supply even when you need to perform tasks such as machine maintenance in dangerous areas. Maintenance without shutting down power supply can help you improve your work efficiency.

10.2.1 Outline

This function stops current control signal of servo motor, which is generated control circuit, by any of each path connected to 2-channel safety input signals (HWGOFF1 and HWGOFF2), and then blocks current from power device to servo motor.



10.2.2 Standards conformity

This function meets the following safety functions, safety standards, and safety parameters.

Item	Standard
Safety functions	■ IEC61800-5-2, safe-torque-off (STO) / EN61800-5-2 ■ IEC60204, Stop Category 0 / EN60204
Safety Standards	■ IEC61508(2nd), SIL3, HFT=1, type B / EN61508 ■ IEC62061, SILCL3, HFT=1, type B / EN62061 ■ ISO13849-1:2006, Cat3, PL = e (When error detection performed by using EDM) / EN ISO 13849-1 / AC:2009 ■ ISO13849-1:2006, PL = c (When error detection not performed.) / EN ISO 13849-1 / AC:2009

✔ Probability of a dangerous Failure per Hour (PFH) of this function (Safe Torque Off circuit) achieves less than 25% of required level of SIL3 and 2% of required level of SIL2.

✔ To suffice ISO13849-1:2006, Cat3, PL=d, you need to design machine safety system so as to detect failure of STO circuit by surely using Error Detection Monitor (EDM).

✔ The Mean Time to Dangerous Failure (MTTFd) for this function is a hundred year. The Diagnostic Coverage (DC) for this function with use of Error Detection Monitor (EDM) is 92%.

✔ For another standards conformity of Safety Function and Safety Standard,
refer to Chapter 12.

✔ Please contact us if error detection by EDM is not used.

10.2.3 Risk assessment

This servo amplifier unit meets the requirements of the above functional safety standards. However, before activating this safety function, make sure to assess the risks associated with the overall equipment to ensure safety.

10.2.4 Residual risk

Even if this function activated, the following risks remain. Please ensure the safety is maintained even if these risks occur, by performing risk assessments.

■ When this function is activated while servo motor is running, the power supply to the motor is shut down, however, the motor continues to run a while because of inertia. Please make sure to design the safety system to prevent any danger until the motor stops completely.

■ When servo motor used in vertical axes, the motor rotates by gravity. Please be advised that preparing means for stopping such as mechanical brake at your end is needed. Moreover, please note that servo brake circuit of servo amplifier, dynamic brake circuit, holding brake excitation signal, and servo motor holding brake are not safety related devices.

■ If the power device malfunctions and causes inter-phase shorting, the servo motor may move within a range of up to 180 degrees in electrical angle and remain in the excited state. For your information, the travel distance of R motor in this occasion is as follows;
R-motor travel distance: 1/10 turns (rotation angle at the motor shaft).

■ Be sure to check if this function works properly when the machine is operated for the first time or servo amplifier is replaced. If the servo amplifier is incorrectly used due to miswiring of input / output signals, this function will not work properly, which may incur danger.

■ Even when this function is working, power supply to servo amplifier is not shut down. Be sure to shut down power supply before you perform maintenance or checkup of servo amplifier, in which you may be exposed to electric shock.

10.2.5 Delay circuit

We offer two paths, with or without delay circuit between safety input 1(HGWOFF1)/safety input 2 (HWGOFF2) input circuit and servo motor current control signal blocking circuit. When using in vertical axis, please use path with delay circuit to prevent motor shaft falling due to holding brake operation delay during safe torque off function operation.

Servo amplifier model number	Delay circuit (Max. delay time)
RS3#######2	No delay circuit (Max.20ms)
RS3#######4	With delay circuit (Max.700ms)

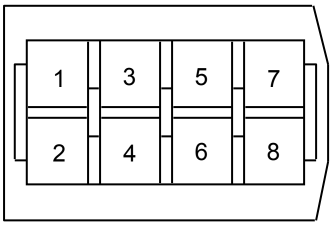
✔ Even the hardware without delay circuit, there are still max. 20ms of delay until the safe torque off function works due to the delay in the input circuit.

✔ Holding brake excitation signal and servo motor holding brake are not safety related parts.

10.3 Wiring

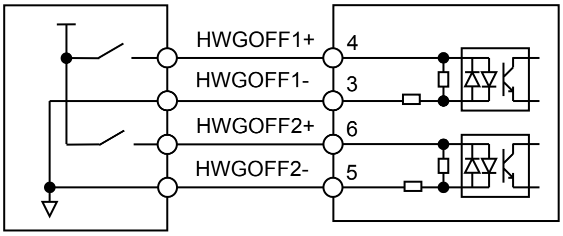
10.3.1 CN4 connector layout

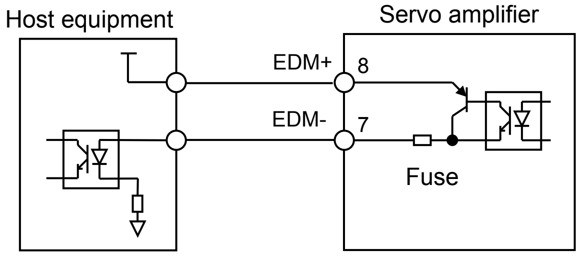
- CN4 2013595-3 (soldered side)



10.3.2 Connection diagram of CN4-terminals

Functions and connection circuit of each CN4-teminal are as shown below.

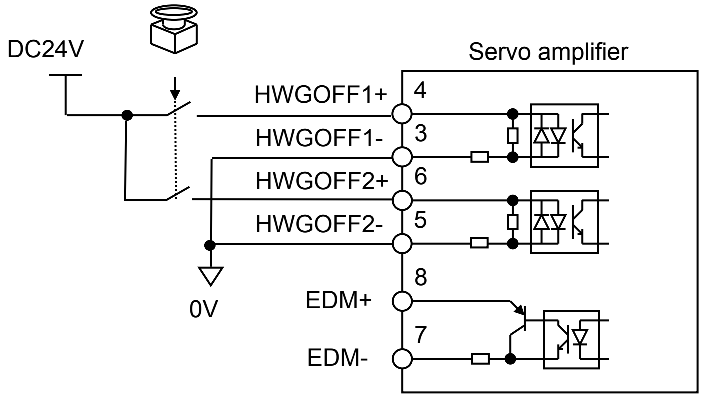
Signal	Terminal No.	Code	Description
	1		These are connecting terminals when the function is not used. Do not use these terminals.
	2		
Safety input 1	3	HWGOFF1-	This is an input signal to control safe-torque-off state. Connection circuit Connects to relay or transistor circuit of open collector. Power supply voltage range: DC24V±10% Internal impedance: 2.2kΩ Safety device Servo amplifier 
	4	HWGOFF1+	
Safety input 2	5	HWGOFF2-	
	6	HWGOFF2+	

Signal	Terminal No.	Code	Description
Error detection monitor	7	EDM-	This is a signal to monitor safe-torque-off functions faults. Connection circuit: Connects to photo coupler or relay circuit. Power supply voltage range (Uext): DC24V±10% Maximum current value: 50mA Output voltage: Uext-0.5 -Uext 
	8	EDM+	

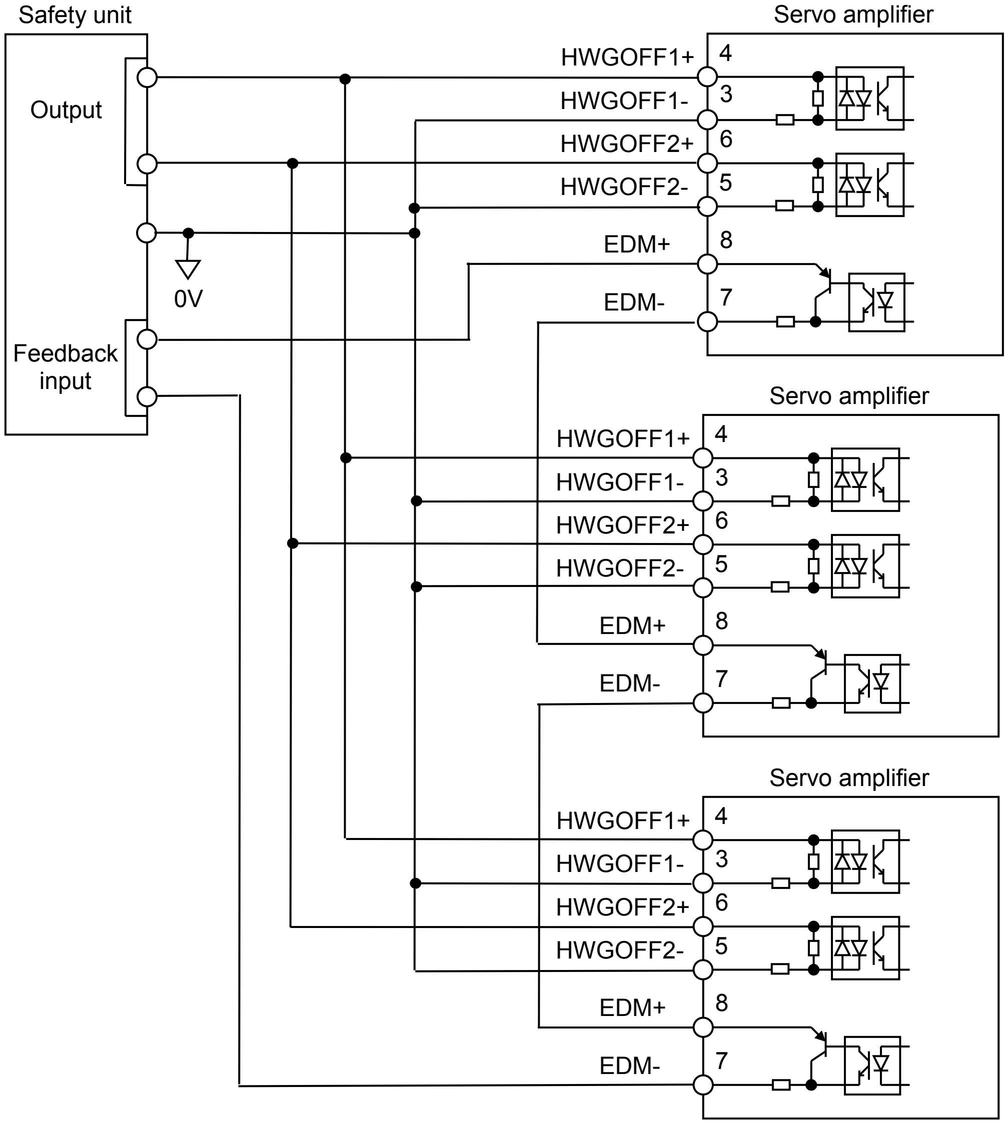
✔ When you do not use this function, connect terminal 1 and 3, 5, and also connect terminal 2 and 4, 6 (short-circuit). A connector for short-circuit, PN# AL-00718251-01, is available as an option.

10.3.3 Example of wiring

Example of wiring to safety switch (single servo amplifier connected)

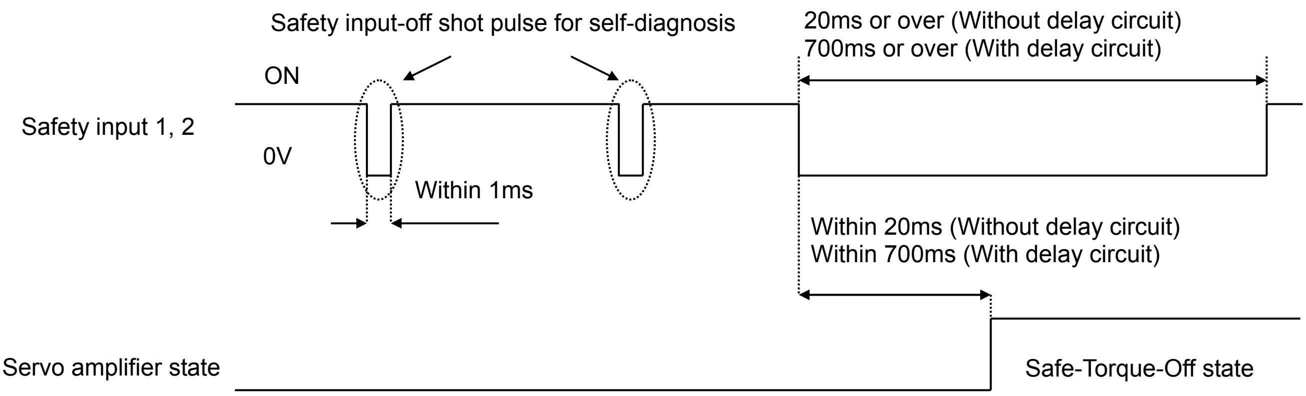


Example of wiring to safety unit (multiple-servo amplifier connected)



10.3.4 Safety input-off shot pulse for safety device self-diagnosis

When you connect safety device supplied with safety input-off shot pulse signal for self-diagnosis added to safety output signal, such as safety unit or safety sensor, use safety device whose safety input-off shot pulse signal is 1ms or less. Safe-torque-off function is not activated when the period of safety input signal (HWGOFF1, HWGOFF2)-OFF is 1ms or less.
In order to surely fulfill safe-torque-off function, turn off safety input signal for 20ms or more (without delay circuit) or 700ms or more (with delay circuit).



- ✔ Torque may turn off for a moment if the pulse of 1ms over to less than 8ms is input.

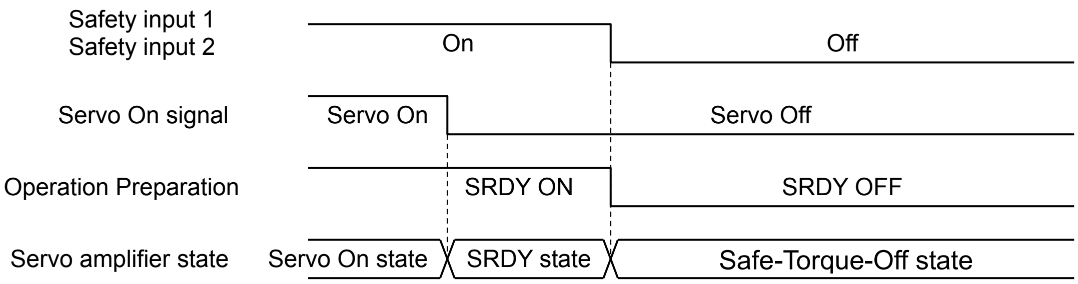
10.4 Safe-Torque-Off operation

10.4.1 Safe-torque-off state

When safety input 1(HWGOFF1) or safety input 2 (HWGOFF2) signal is off (as shown the table below), the state becomes safe-torque-off state.
In this state, servo-ready signal is turned off, and servo-on signal reception is prohibited.

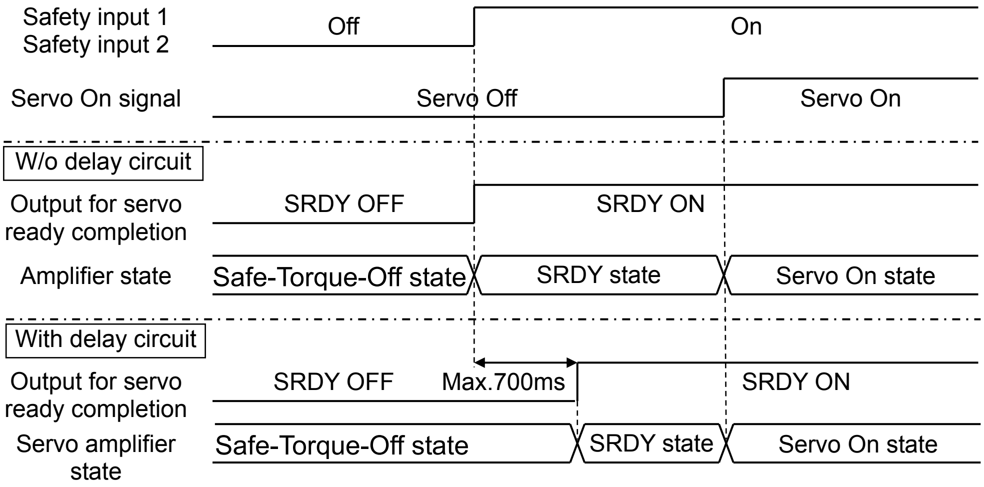
Signal	Input condition	Servo amplifier condition
Safety input 1 (HWGOFF1)	On	Normal state
	Off	Safe-torque-off state
Safety input 2 (HWGOFF2)	On	Normal state
	Off	Safe-torque-off state

- ✔ Off: Electric current will not flow (contact open).
- ✔ On: Electric current will flow (contact closed).

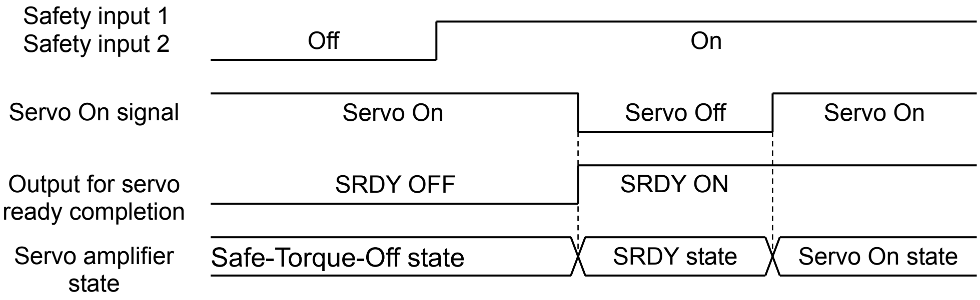


10.4.2 Restoration from safe-torque-off state

In the state servo-on signal is not input as described in 10.4.1, turning on safety input 1 or 2 activates SRDY state. Operation is restarted on inputting servo-on signal. (For delay circuit equipped hardware, it takes maximum 700ms to become SRDY state.)



In the state servo-on signal is input, safe-torque-off activated state remains even if safety input 1 or 2 is turned on. To restart operation, turn off servo-on signal to activate SRDY state, then input servo-on signal.

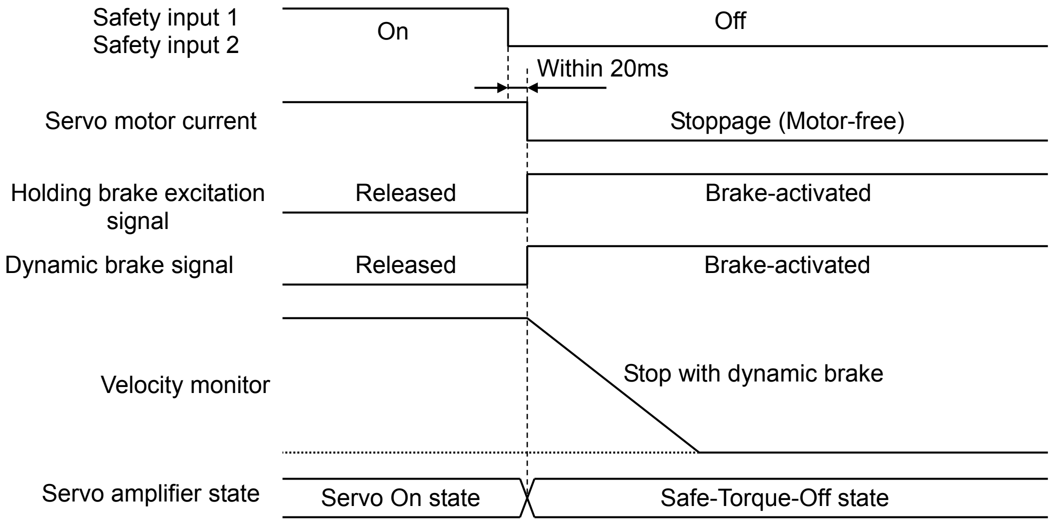


✔ Group9 ID05: Setting the Servo-ON Function parameter to "01: Always On" disables resets from the safe torque off state. Avoid this setting when using the safe torque off function.

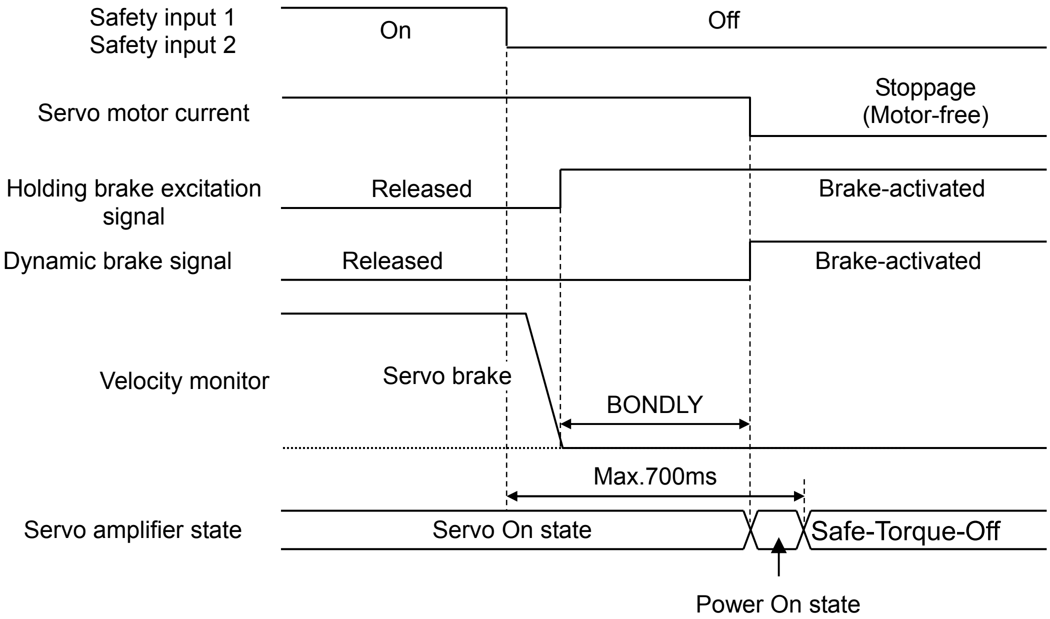
10.4.3 Safe-Torque-Off during servo motor running

Stoppage behavior varies depending on forced outage operation settings (ACTEMR Group B ID02).

- In case of setting "00: SERVO-BRAKE" at GroupB ID02 "Emergency Stop Operation [ACTEMR]".
  Stoppage behavior varies depending on amplifier model numbers.
  - RS3#######2 (without safe-torque-off delay circuit)
    Motor cannot stop with servo brake when safety input 1 or 2 is turned off because servo motor current is blocked. So motor shall be stopped with dynamic brake or holding brake.



◆ RS3#######4 (with safe-torque-off delay circuit)
Motor stops with servo brake when safety input 1 or 2 is turned off.



- ✔ When set value of GroupB ID03 “Holding brake activation delay time [BONDLY]” is more than safe-torque-off delay time (700ms max.), the state becomes motor-free after period of safe-torque-off delay time. Please note that recommended set value for BONDLY is less than 300ms.

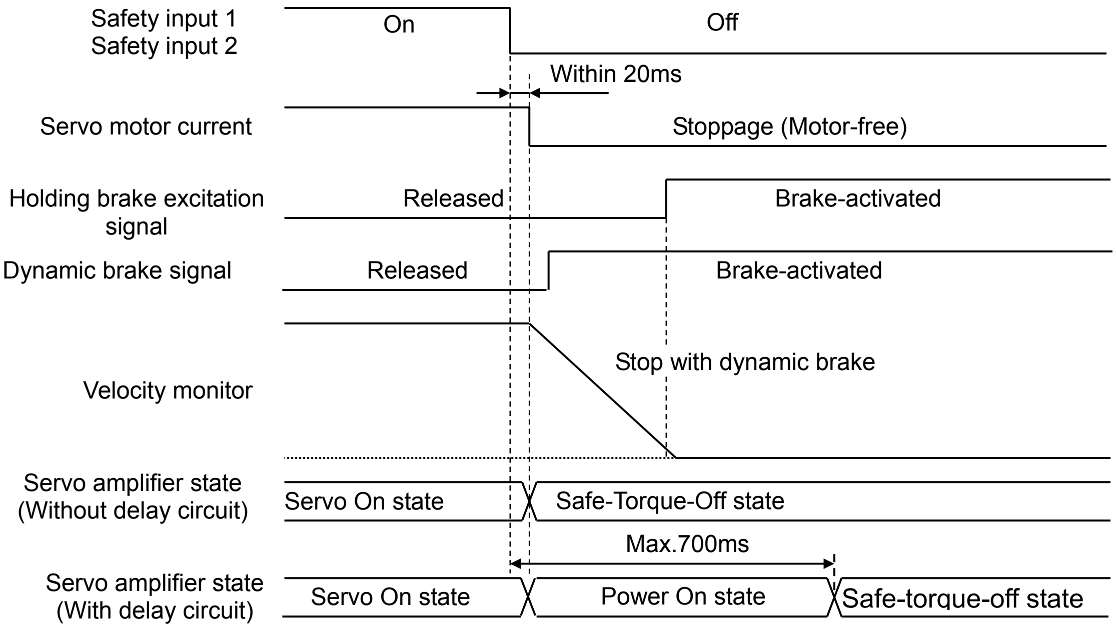
- ✔ Servo brake circuit, dynamic brake circuit, and holding brake excitation signal are not safety-related sections.

■ In case of setting "01: DYNAMIC-BRAKE" at GroupB ID02 "Emergency Stop Operation [ACTEMR]".

When safety input 1 or 2 is turned off, this setting blocks servo motor current, and then stops servo motor with dynamic brake after. Transition behavior to safe-torque-off state varies depending on amplifier model numbers.

◆ RS3#######2 (without safe-torque-off delay circuit)
Safety input is turned off and then the status comes to safe-torque-off state at the same time dynamic brake applied.

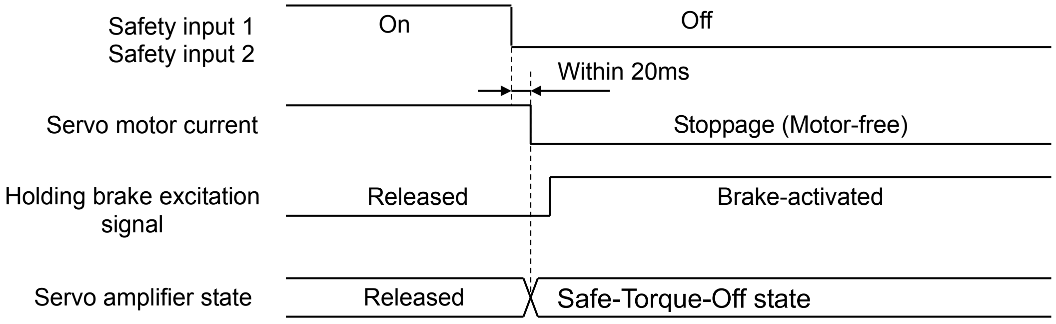
◆ RS3#######4 (with safe-torque-off delay circuit)
The state moves to safe-torque-off state after period of delay time (500ms max.) from turning off safety input. Dynamic brake is activated on turning off safety input.



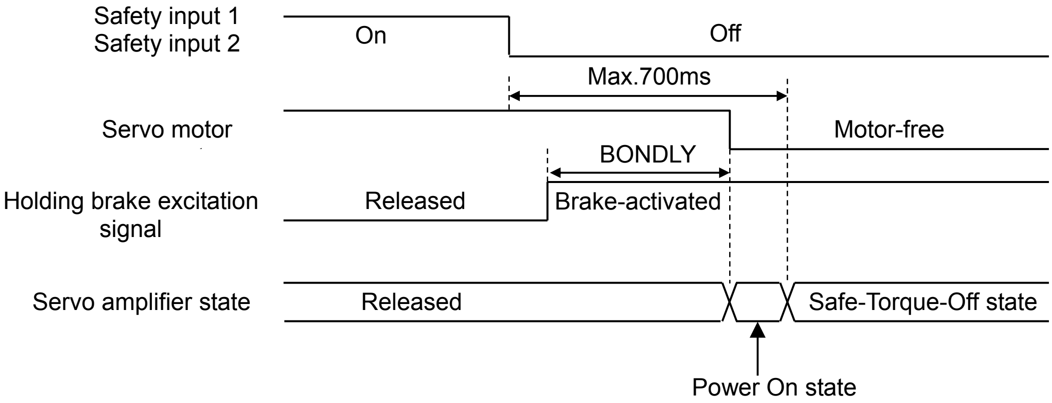
✔ Dynamic brake circuit and holding brake excitation signal are not safety-related sections.

10.4.4 Safe-Torque-Off during servo motor stoppage

When safety input 1 or safety input 2 is turned off, holding brake signal outputs brake-activated state, however this blocks servo motor current, so “holding brake activation delay time” becomes invalid. In line with this, servo motor may run by an external force during the period from the time holding brake signal activation state output to the time holding brake being activated.



When you use amplifier model number RS3#######4 (with safe-torque-off delay circuit), you can ensure the time to activate holding brake because of maximum 700ms of delay time by the time safe-torque-off function activated after safety input 1 or 2 is input.
Select amplifier model number RS3#######4 for use in gravity axes.



- ✔ Set GroupB ID03 “Holding brake activation delay time [BONDLY]” to the value less than 700ms.
- ✔ Set GroupB ID02 “Emergency Stop Operation [Emergency Stop Operation]” to "00: SERVO-BRAKE".

10.4.5 Deviation clear

When selecting 02:Type3 or 03:Type4 (not to clear deviations at servo-off state) on Group8 ID19 "Deviation Clear Selection [CLR]", please pay careful attention to the followings.
When safe-torque-off function activated under the condition that position command is input at the time of position control, position deviation accumulates and this causes alarm (excess position deviation: alarm D1) activated. Furthermore, when servo-on re-performed before alarm activated, servo motor moves by the accumulated partial position deviation. When you activated safe-torque-off function to avoid this state, stop position command and clear position deviation at the same time.
When selecting 00:Type1 or 01:Type2 (to clear deviation at servo-off state) on Group8 ID19 "Deviation Clear Selection [CLR]", position deviation is automatically cleared at servo-off.

10.4.6 Safety input signal failure detection

- Safe-Torque-Off malfunction 1 (Alarm 25)
  This alarm is activated when either safety input 1 or safety input 2 turned off, and after that the other is not turned off within 10 seconds. This allows detecting errors such as safety input signal disconnection.
  If internal circuits fail, the alarm is detected after 10 seconds. However it doesn’t affect the safety circuit.

- Safe-Torque-Off malfunction 2 (Alarm 26)
  This alarm is activated when detecting internal circuit errors by judging from safety input and internal status. This allows detecting errors occurred in the circuit that stops control signal from safety input to power module.

10.5 Error Detection Monitor (EDM)

10.5.1 Specifications

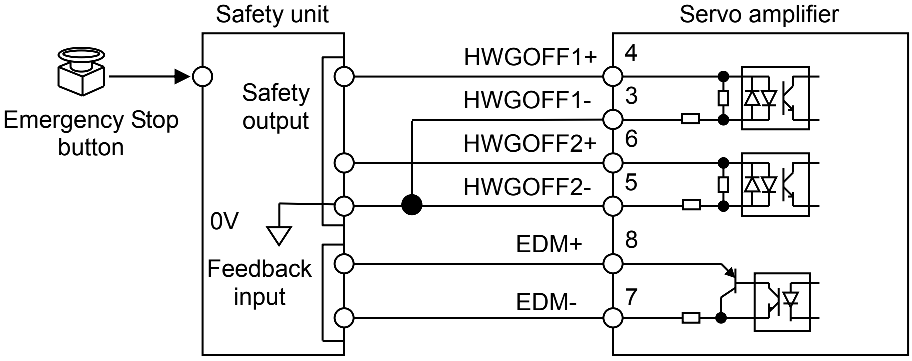
Error detection monitor (EDM) output is a signal to monitor wiring errors in safe-torque-off circuit or between safety equipment and safety input. The following table shows connections between safety input (HWGOFF1 and HWGOFF2) and error detection monitor (EDM) output.

Signal	State			
Safety input 1 (HWGOFF1)	On	On	Off	Off
Safety input 2 (HWGOFF2)	On	Off	On	Off
Error detection monitor (EDM)	Off	Off	Off	On

✔ If the above connections are not satisfied, the safe-torque-off circuit or EDM output circuit is malfunctioning.

10.5.2 Connection example

The following is connection example that allows activating safe-torque-off function on pressing emergency button by using safety unit.



Connect safety output signals of safety unit to safety input 1 (HWGOFF1) and safety input 2 (HWGOFF2) respectively, and then failure detection monitor output signal (EDM) from servo amplifier to feedback input of safety unit. Under normal conditions, pressing emergency stop button turns off both of safety inputs and on EDM output. Once emergency stop button is cancelled, feedback circuit of safety unit is reset and 2 safety inputs are turned on at the same time because EDM output is on. This allows restarting operation.

✔ In case such a malfunction occurs that EDM will not be turned on despite both the /HWGOFF1 and /HWGOFF2 being off, even if the emergency stop button is cancelled, the operation will not resume as the feedback circuit has not been reset yet. (The amplifier keeps safe-torque-off state).

10.5.3 Error detection method

EDM output will not on and EDM-signal remains off even if emergency stop button is pressed, in the case of an error such as either of safety input remains on inside of servo amplifier. In line with this, errors like this can be detected by developing system with use of safety unit enabling to detect any failures in the connections in the above table.

✔ In case you need to suffice requirement of ISO13849-1, PL=e, be sure to do testing of failure detection using EDM output once a month or more frequently.

✔ For discussions on connecting and operating the safety unit, please refer to the manual provided with your safety unit.

✔ The EDM signal is not a safety output. Do not use the EDM signal for any purpose other than malfunction monitoring.

10.6 Verification test

For use of the Safe Torque Off function, you must confirm that the safe torque off operations correctly during machine startup, servo amplifier replacement and test operation.
Even if it is not fit to the case above, strongly recommended that confirmation of function operation at least once every three months.

10.6.1 Preparation

Please perform test operation prior to performing verification test to verify no problems with servo amplifier and motor installation and wiring, and with servo amplifier and motor properly operate. Refer to “3. Installation” through “5.2 Test Operation” for installation, wiring, and test operation.

10.6.2 Confirmation procedure

Perform verification test for safe-torque-off in accordance with the follow the procedures:

Procedure 1. Supply control power and main circuit power.
Procedure 2. Turn on both safety input 1and 2.
Procedure 3. Input servo-on signal to excite servo motor.
Procedure 4. Turn off both safety input 1and 2.

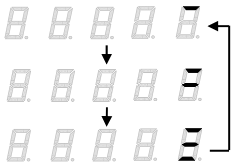
10.6.3 Acceptance criteria

In steps 2 to 4, verify the states listed below.

Procedure 1. In step 2, make sure that EDM output and LED indication are as follows:

Confirmation item	State
EDM output	Off
LED indication	

Procedure 2. In step 3, verify that servo motor is excited.
Procedure 3. In step 4, verify that EDM output and LED indication are as follows:
Also, verify that servo motor excitation is cancelled.

Confirmation item	State
EDM output	On
LED indication	

10.7 Safety precautions

Please thoroughly observe the following safety precautions to use safe-torque-off functions. Incorrect use of the functions can lead to personal injury or death.

- ✔ Safety system with safe-torque-off function shall be designed by the person with expertise of related safety standards and through understanding of the descriptions specified in this manual.
- ✔ Surely perform system risk assessment when you design safety system by using this function.
- ✔ When safe-torque-off function activated during servo motor running, power supply to servo motor is blocked but servo motor remains running through inertia. Please design your safety system so that no risks occur until servo motor comes to a complete stop.
- ✔ When used in vertical axes, servo motor runs by gravity. So please prepare means for stopping such as mechanical brake. Servo amplifier servo brake circuit, dynamic brake circuit, holding brake excitation signal, and servo motor holding brake are not safety-related sections.
- ✔ There is a possibility that servo motor runs in the range of maximum 180 electrical degree and servo motor-excited state continues, due to servo motor inter-phase short-circuit caused by power device failure. Please use this function only for usage you can judge that this behavior causes no risk conditions.
- ✔ Please perform verification test for this function at every machine start-up and servo amplifier replacement. Incorrect usage such as faulty wiring of input-output signals can lead to improper functioning and a risk condition.
- ✔ For the time of Safe Torque Off function working and the cause concerning information, recommended that recording as error log at user device.
- ✔ At inspection and maintenance for servo amplifier, strongly recommended that recording and storing a detail of inspection and maintenance.

11

Selection

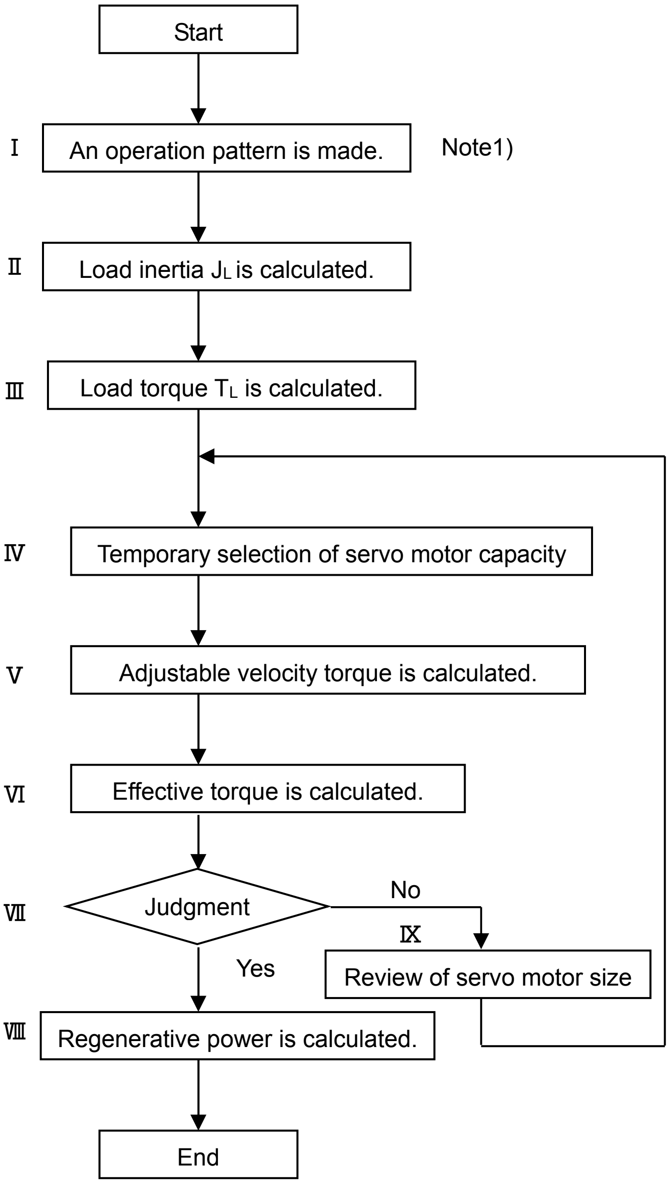
In this chapter, each kind of selections are explained.

11. Selection

11.1 Servo motor sizing

It is estimated that selection of servo motor capacity computes required servo motor capacity from machine specification (composition). In addition, since the capacity selection of a servo motor can download "the capacity selection software of a servo motor" for free from our company "website", please use it here. Here, the fundamental formula is described.

11.1.1 Flowchart of servo motor sizing



Ⅰ. Create operation pattern.

Ⅱ. Calculate load moment of inertia from a machine configuration.

Ⅲ. Calculate load torque from a machine configuration.

Ⅳ. Select the following motor:

・ Load moment of inertia (J_L) is 10 times or less of servo motor rotor moment of inertia (J_M).

・ The load torque (T_L) is 80% (T_R×0.8) of the motor rated torque or less.

$J_L \leqq J_M \times 10$

$T_L \leqq T_R \times 0.8$

Ⅴ. Calculate the required adjustable velocity torque from an operation pattern.

Ⅵ.Calculate the effective torque from a torque pattern.

Ⅶ.Judge whether the followings have been established. Adjustable velocity torque (T_a, T_b) is 80% (T_p×0.8) or less of the peak torque at stall (T_p) of servo motor

The effective torque (Trms) is 80% (T_R×0.8) or less of the rated torque (T_R) of servo motor

$T_a \leqq T_p \times 0.8$

$T_b \leqq T_p \times 0.8$

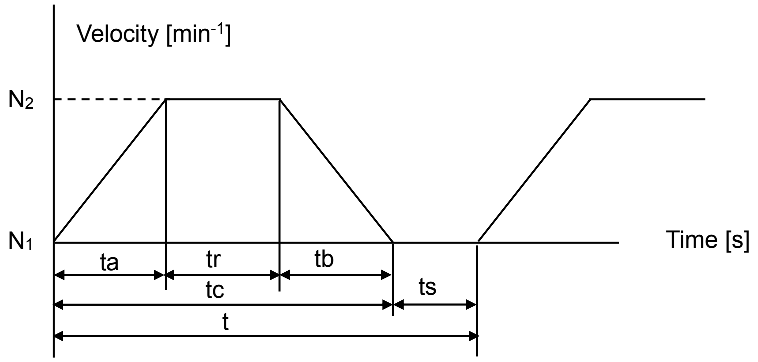
$Trms \leqq T_R \times 0.8$

Ⅷ. Calculate regeneration electric power, and if required, select an external regeneration resistor.

Ⅸ. Improve servo motor capacity, such as raising the capacity of a servo motor.

Note1) For making operation pattern, Must not exceed continuous maximum rotation speed by average rotation speed of motor.

11.1.2 Make an operation pattern



ta=Acceleration time
tb=Deceleration time
tr=Constant velocity time
ts=Stop time
t=1cycle

11.1.3 Calculate motor shaft conversion load moment of inertia (J_L)

- The inertia moment of a moving part.

$$J_L = \left(\frac{1}{G}\right)^2 \times \frac{\pi \times \rho \times D^4 \times L}{32} \quad [\mathrm{kg \cdot m^2}]$$

G: Reduction ratio
ρ Moving part specific gravity [kg/m^3]
D: Moving part diameter [m]
L: Moving part length [m]

- Work inertia moment

$$J_L = \left(\frac{1}{G}\right)^2 \times W \times \left(\frac{P}{2\pi}\right)^2 \quad [\mathrm{kg \cdot m^2}]$$

G: Reduction ratio
W: Moving part mass [kg]
P: In the case of a ball screw, is the lead of a ball screw [m]
In the case of a belt pulley, is an outside diameter of a pulley. [m]
($P=\pi D$)

11.1.4 Calculate motor shaft conversion load torque (T_L)

- Ball screw (in horizontal axis)

$$T_L= \frac{(F + \mu W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

- Ball screw (in vertical axis)

When motor drives upward

$$T_L= \frac{(F + (\mu+1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

When motor drives downward

$$T_L= \frac{(F + (\mu-1)W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

- When ball screw stops (in horizontal axis)

$$T_L= \frac{F}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

- When ball screw stops (in vertical axis)

$$T_L= \frac{(F+W)}{\eta} \times \frac{P}{2\pi} \times \frac{1}{G} \times 9.8 \quad [N \cdot m]$$

F: External force [kg]
η : Transmission efficiency
μ: Coefficient of friction
W: Moving part mass [kg]
P: Ball screw lead [m]
G: Reduction ratio

- Belt pulley (in vertical axis)

$$T_L= \frac{(F+\mu W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

- Belt pulley (in vertical axis)

Belt pulley (in vertical axis)

$$T_L= \frac{(F+(\mu+1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

When motor drives downward

$$T_L= \frac{(F+(\mu-1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

- When belt pulley stops (in horizontal axis)

$$T_L= \frac{F}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

- When belt pulley stops (in vertical axis)

$$T_L= \frac{(F+W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

F: External force [kg]
η : Transmission efficiency
μ: Coefficient of friction
W: Moving part mass [kg]
P: Diameter of a pulley [m]
G: Reduction ratio

11.1.5 Calculate acceleration torque (T_a)

$$T_a = \frac{2\pi (N_2-N_1) \times (J_L+J_M)}{60 \times ta} + T_L \quad [N \cdot m]$$

N_2: Servo motor rotation velocity after acceleration [min^{-1}]
N_1: Servo motor rotation velocity before acceleration [min^{-1}]
J_L: Load inertia moment [$kg \cdot m^2$]
J_M: Rotor inertia moment of servo motor [$kg \cdot m^2$]

11.1.6 Calculate deceleration torque (T_b)

$$T_b = \frac{2\pi (N_2-N_1) \times (J_L+J_M)}{60 \times tb} - T_L \quad [N \cdot m]$$

N_2: Servo motor rotation velocity before deceleration [min^{-1}]
N_1: Servo motor rotation velocity after deceleration [min^{-1}]
J_L: Load inertia moment [$kg \cdot m^2$]
J_M: Rotor inertia moment of servo motor [$kg \cdot m^2$]

11.1.7 Calculate effective torque (Trms)

$$Trms = \sqrt{\frac{(T_a^2 \times ta) + (T_L^2 \times tr) + (T_b^2 \times tb)}{t}} \quad [N \cdot m]$$

11.1.8 Judgment condition

- We consider the followings as the standard of the judgment.
  - Load torque load ratio $T_L \leqq T_R \times 0.8$ (Load torque is 80% or less of rated torque)
  - Acceleration torque load ratio $T_a \leqq T_P \times 0.8$ (Acceleration torque is 80% or less of peak torque at stall)
    * T_P: peak torque at stall
  - Deceleration torque load ratio $T_b \leqq T_P \times 0.8$ (Deceleration torque is 80% or less of peak torque at stall)
    * T_P: peak torque at stall
  - Effective torque load ratio $Trms \leqq T_R \times 0.8$ (The effective torque is 80% or less of rated torque)
  - Inertia moment ratio $J_L \leqq J_M \times 10$(Load moment of inertia is 10 times or less of the motor rotor moment of inertia)

In addition, the rise in heat of motor can be suppressed by taking the large degree of margin at torque load ratio. Moreover, when rotating a table mechanism slowly depending on inertia moment ratio, it may be able to control 10 or more times. We recommend you the check by the real machine.

11.2 Selection of regenerative resistor

Calculate "regeneration effective power (PM)," and determine the capacity of the regeneration resistance to be used. Judge whether usage of an internal regenerative register machine is possible by this calculation result.

11.2.1 How to find "regeneration effective power (PM)" of the horizontal axis drive by a formula

- Calculate regeneration energy.

$$EM = Ehb = \frac{1}{2} \times N \times 3 \times Ke\phi \times \frac{Tb}{KT} \times tb - \left[\frac{Tb}{KT}\right]^2 \times 3 \times R\phi \times tb$$

EM : EM: Regeneration energy during operations along horizontal axis [J]
Ehb : Regeneration energy during deceleration [J]
$Ke\phi$: Voltage constant per phase [Vrms/min^{-1}] (Motor constant)
KT : Torque constant [N･m/Arms] (Motor constant)
N : Motor rotation speed [min^{-1}]
$R\phi$: Phase resistance [Ω] (Motor constant)
tb : Deceleration time [s]
Tb : Torque during deceleration [N･m]

- Calculate "regeneration effective power" from regeneration energy.

$$PM = \frac{EM}{to}$$

PM : Effective regeneration power [W]
EM : Regeneration energy [J]
to :Cycle time [s]

11.2.2 How to find "regeneration effective power (PM)" of the vertical axis drive by a formula

- Calculate regeneration energy.

$$EM = EVUb + EVD + EVDb$$

$$= \frac{1}{2} \times N \times 3 \cdot Ke\phi \times \frac{TUb}{KT} \times tUb - \left[\frac{TUb}{KT}\right]^2 \times 3 \cdot R\phi \times tUb$$

$$+ N \times 3 \cdot Ke\phi \times \frac{TD}{KT} \times tD - \left[\frac{TD}{KT}\right]^2 \times 3 \cdot R\phi \times tD$$

$$+ \frac{1}{2} \times N \times 3 \cdot Ke\phi \times \frac{TDb}{KT} \times tDb - \left[\frac{TDb}{KT}\right]^2 \times 3 \cdot R\phi \times tDb$$

EM : Regeneration energy during operation in horizontal axis [J]
EVUb : Regeneration energy while motor drives upward during deceleration [J]
EVD : Regeneration energy while motor drives downward [J]
EVDb : Regeneration energy while motor drives downward during deceleration [J]
$Ke\phi$: Voltage constant per phase [Vrms/min^{-1}] (Motor constant)
KT : Torque constant [N・m/Arms] (Motor constant)
N : Motor rotational velocity [min^{-1}]
$R\phi$: Phase resistance [Ω] (Motor constant)
Tub : Torque while motor drives upward during deceleration [N・m]
tUb : Period of time motor drives upward during deceleration [s]
TD : Torque while motor drives downward [N・m]
tD : Period of time motor drives downward [s]
TDb : Torque while motor drives downward during deceleration [N・m]
tDb : Period of time motor drives downward during deceleration [s]

* When the calculation result of either of EVUb, EVD, or EVDb is negative, calculate EM by considering the value of those variabkes as 0.

- Calculate "regeneration effective power" from regeneration energy.

$$PM = \frac{EM}{to}$$

PM : Effective regeneration power [W]
EM : Regeneration energy during deceleration [J]
to : Cycle time [s]

11.2.3 Selection of regenerative resistor

Judge whether an internal regenerative resistor can be used from the calculation result. Moreover, when you cannot use it, determine the capacity of an external regeneration resistor.

■ Allowable power of an internal regenerative resistor
If the value of the regeneration effective power "PM" by the calculation result is below the value of [PRI] of the following table, an internal regenerative resistor can be used. Please use an external regenerative resistor at excepting conditions below.

Servo amplifier model number	Allowable regeneration resistance power to be used with an internal regenerative resistor [PRI]	Instantaneous capacity	Resistance value
RS3#01A##A#	Less than 5W	408J	50Ω
RS3#02A##A#	Less than 5W	408J	50Ω
RS3#03A##A#	Less than 5W	408J	50Ω
RS3A05A##A#	Less than 20W	743J	17Ω
RS3A07A##A#	Less than 60W	2300J	10Ω
RS3A10A##A#	Less than 90W	4400J	10Ω
RS3A15A##A#	Less than 120W	6400J	6Ω

■ Allowable power of an external regenerative resistor
When regeneration effective power "PM" becomes more than the allowable power of the amplifier internal regenerative resistor, the optional external regenerative resistor which is shown at "11.2.4" can be connected and operated. Allowable regenerative power and minimum resistance value of regenerative resistor are shown in below table.

Servo amplifier model number	Allowable regeneration resistance power to be used by an external regenerative resistor [PR0]	Allowable minimum resistance value of external regenerative resistor
RS3#01A##L#	Less than 125W	35Ω
RS3#02A##L#	Less than 125W	35Ω
RS3#03A##L#	Less than 125W	35Ω
RS3A05A##L#	Less than 250W	17Ω
RS3A07A##L#	Less than 500W	10Ω
RS3A10A##L#	Less than 500W	10Ω
RS3A15A##L#	Less than 500W	6Ω
RS3A30A##L#	Less than 500W	2.5Ω

* When regeneration effective power PM exceeds the maximum permitted power (PRO) of the external regeneration resistor, reconsider the acceleration constant, load inertia, etc.

11.2.4 Selection of external regenerative resistor

With the regeneration effective power "PM" found from calculation, choose the external regeneration resistor to be used from the following table.

Servo amplifier model number	[PM]	20W or less	30W or less	55W or less	60W or less	110W or less	125W or less
RS3#01A##L# RS3#02A##L# RS3#03A##L#	Resistor Sign	B×1	D×1	F×1	C×2	E×2	D×4
	Connection Number	Ⅲ	Ⅲ	Ⅲ	Ⅴ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	55W or less	125W or less	250W or less
RS3A05A##L#	Resistor Sign	G×1	H×1	I×2
	Connection Number	Ⅲ	Ⅲ	Ⅳ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A07A##L#	Resistor Sign	I×1	H×2	I×4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A10A##L#	Resistor Sign	I × 1	H × 2	I × 4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A15A##L#	Resistor Sign	J × 1	K × 2	J × 4
	Connection Number	Ⅲ	Ⅴ	Ⅵ

Servo amplifier model number	[PM]	125W or less	250W or less	500W or less
RS3A30A##L#	Resistor Sign	J × 1	L × 1	L × 2
	Connection Number	Ⅲ	Ⅲ	Ⅴ

* The resistor sign of an external regeneration resistor and the connection number correspond with the following page.

* The permissible effective power of external regenerative resistor is maximum 25% of the rated power under natural air cooling.

* The permissible effective power of external regenerative resistor is maximum 50% of the rated power under forced air cooling by fan.

11.2.5 Specification of external regenerative resistor

The resistor model name corresponds with the sign of the external regeneration resistor selected for the preceding clause.

Resistor Sign	Resistor Model Number	Rated power [PR]	Resistance Value	Thermostat Detection temperature (Contact specification)	Permissible Effective Power [PM]	Allowable instantaneous capacity [JI]	Mass
A	REGIST-080W100B	80W	100Ω	135°C±7°C (Switching contact b)	20W	35J	0.19kg
B	REGIST-080W50B	80W	50Ω		20W	35J	
C	REGIST-120W100B	120W	100Ω		30W	50J	0.24kg
D	REGIST-120W50B	120W	50Ω		30W	80J	
E	REGIST-220W100B	220W	100Ω		55W	90J	0.44kg
F	REGIST-220W50B	220W	50Ω		55W	125J	
G	REGIST-220W20B	220W	20Ω		55W	210J	
H	REGIST-500CW20B	500W	20Ω	100°C±5°C (Switching contact b)	125W	9700J	1.4kg
I	REGIST-500CW10B	500W	10Ω		125W	9300J	
J	REGIST-500CW7B	500W	7Ω		125W	7500J	
K	REGIST-500CW14B	500W	14Ω		125W	13000J	
L	REGIST-1000W6R7B	1000W	6.7Ω	140°C±5°C (Switching contact b)	250W	26000J	3.0kg

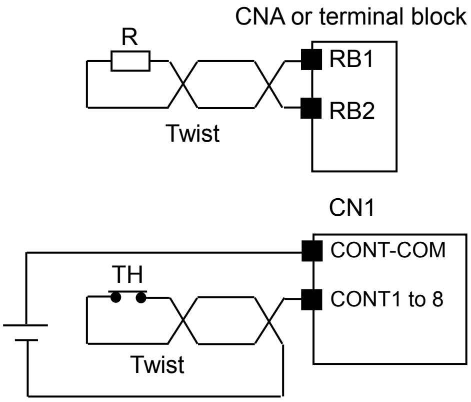
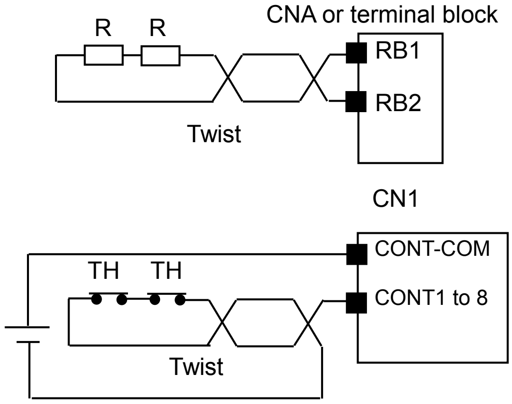
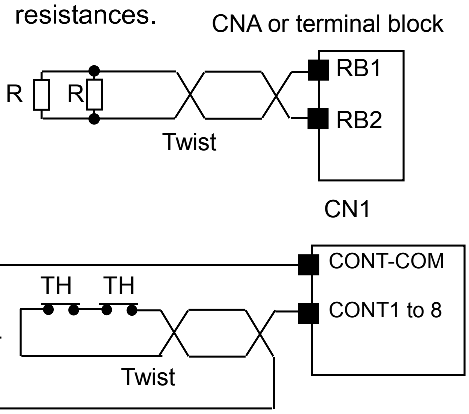
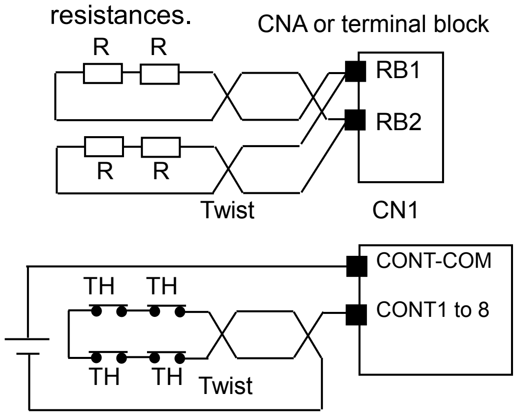
* See "12.7.6 Outline drawing of regenerative resistor" for external dimension of regenerative resistor.

* Permissible Effective Power value is at condition of natural air cooling.

11.2.6 Connection of regenerative resistor

The connection method of a resistor corresponds with the connection number of the external regeneration resistor selected by the 4) clause.

■ Connection of regenerative resistor

Connection Number Ⅲ	Connection Number Ⅳ
■ One resistance is connected.  Connect a thermostat to the general-purpose input of CN1.	■ Series connection about two resistances.  Connect a thermostat to the general-purpose input of CN1.
Connection Number Ⅴ	Connection Number Ⅵ
■ Parallel connection about two resistances.  Connect a thermostat to the general-purpose input of CN1.	■ Series/ parallel connection about four resistances.  Connect a thermostat to the general-purpose input of CN1.

* For amplifier: capacity 75A/100A/150A, mount an external regenerative resistor to terminals of RB1 and RB2 after removing short-bar between RB1 and RB4.

11.2.7 Thermostat connection of external regenerative resistor

Connect a thermostat to either of "the general-purpose inputs CONT1-CONT8". Depending on the connected general-purpose input signal terminal, please set Group9 ID40 "External Trip Input Function [EXT-E]".

- ■ Example: when connecting the thermostat to CONT6
  The external trip function will be valid when "0DH:CONT6_OFF" is set to Grop9 ID40 "External Trip Input Function" and CONT6 is turned off. Alarm AL.55 will be output from the servo amplifier when the thermostat of a generative resistor trips (the contact point comes off) because of heating. Refer to "4.2 Wiring with host unit for the wiring method".

11.2.8 Protection function of regenerative resistor

The regenerative resistor protection function is specified by parameter selections. Appropriate protection for regenerative resistor is applied by setting parameters according to the type of regenerative resistor to be connected. Set the appropriate parameters by following the instructions given below.

- ■ The two parameters requiring settings are given below.
  - ◆ System parameter ID03 “Regenerative resistor selection”
    - ● Must set "01: Built-in_R" when internal regenerative resistor is used.
    - ● Must set "02: External_R" when external regenerative resistor is used.
  - ◆ Group9 ID40 “External Trip Input Function”
    - ● When thermostat is connected to the servo amplifier, please set Group9 ID40 "External Trip Input Function [EXT-E]" depending on the connected general-purpose input signal terminal.

- ■ The protection functions are divided into three main types:
  - ◆ Protection for a short-time, high load factor (using built-in or external regenerative resistor):
  - ◆ An error is detected when the power absorption of regenerative resistor is extremely high over a short time period (100msec to 10 seconds). A ‘Regenerative Error’ alarm “AL.43” is issued when this error is detected.
  - ◆ Protection when allowable power absorption is exceeded for long time
    (using built-in regenerative resistor):
    An error is detected when the power absorption of the built-in regenerative resistor exceeds the allowable power absorption over a long time period (from a few seconds to a few minutes). An ’Internal Overheat’ alarm “AL.54” is issued when this error is detected.
  - ◆ Protection during thermostat operation of the external regenerative resistor:
    An error will be detected when External Trip Function works. An ’External Error’ alarm “AL.55” is issued when this error is detected.

11.2.9 Confirmation method of regeneration power PM in actual operation

Regeneration power PM can be easily confirmed in the digital operator or by R ADVANCED MODEL setup software.

- Digital operator: Monitor mode ID40 "Regenerative Resistor Operation Percentage monitor"
- Setup software: Monitor display ID40 "Regenerative Resistor Operation Percentage monitor"

* The monitor value of the regenerative resistor operation percentage shows the operating rate of regeneration circuit.

* The display range is 0.00% - 99.9%.

- The actual regeneration effective power PM can be calculated from this monitor value by following equation.
  - Input Supply Voltage: In case of AC200V specification

$$\text{Regeneration effective power [PM](W)} = \frac{400(V) \times 400(V)}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

  - Input Supply Voltage: In case of AC100V specification

$$\text{Regeneration effective power [PM](W)} = \frac{200(V) \times 200(V)}{\text{Regeneration resistance}(\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

- Calculation Example
  Input Supply Voltage: [AC200V Specification]
  Regeneration resistance value: 50Ω[Built-in Regenerative Resistor]
  Monitor Value (RegP): 0.12%

$$\text{Regeneration effective power [PM](W)} = \frac{400(V) \times 400(V)}{\text{Regeneration resistance}(\Omega)} \times \frac{0.12(\%)}{100(\%)} = 3.84 \quad (W)$$

* The regeneration power calculated from this monitor value continues to be the target until the end of operations. Regeneration power varies with the voltage fluctuation of the input power supply and changes across the ages of the servo amplifier and the loading device.

* Be sure to opt for selection of regeneration resistance based on the regeneration effective power "PM" found from calculation of a pattern of operation and regeneration power.

* Install the external regeneration resistor on equipment, and measure the temperature of the external regeneration resistor by the operating condition that the regeneration effective power “PM” becomes the maximum. Then do sufficient mounting check of alarm not being generated. In addition, it takes 1 to 2 hours until the temperature of the external regeneration resistor is saturated.

11.2.10 Precautions for external regenerative resistor use

- The place where corrosive gas has occurred, and when there is much dust, insulated degradation, corrosion, etc .may arise. There fore be careful of an attachment place.
- External regeneration resistor should be placed by keeping enough distance from the other parts so as not to be affected by the other parts-generated heat.
- Must wiring by twisted lines to external regenerative resistor. Wiring length keeps 5 m or less, and aims as short as it can.
- Wiring should keep no contact with regenerative resister, and using flame-retardant cable or giving flame-retardant by silicon tube.

12

Appendix

In this chapter, servo motor outline drawing and datasheet,
servo amplifier outline drawing and option parts are explained.

12.1 Standards Conformity

In our company, compatibility examinations of overseas standards are carried out in certificate authorities, and attestation markings are done based on the published certificate of attestation.

12.1.1 Standards Conformity

- This servo amplifier implements the standards examinations below.

Product model NO.	Applicable laws and Regulations		Standard code	Certificate authorities
	Class	Detailed class		
RS3#01A### # RS3#02A### # RS3#03A### # RS3#05A### # RS3#10A### # RS3#15A### # RS3#30A### #	UL/c-UL standards	---	UL508C	UL (Underwriters Laboratories inc.)
RS3#07A### #			UL61800-5-1	
RS3###A### **0** (Safe Torque Off function Unequipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1:2007/ EN61800-5-1:2007	TÜV (TÜV SÜD Japan, Ltd.)
	EMC	EMC under EMC Directive (2014/30/EU)	EN61000-6-2:2005 IEC61800-3:2004 (Note 1)/ EN61800-3:2004 A1:2012 (Note 1)	TÜV (TÜV SÜD Japan, Ltd.)
RS3###A### **2** RS3###A### **4** (Safe Torque Off function equipped model)	Electrical safety	Electrical safety under Low Voltage Directive (2014/35/EU)	IEC61800-5-1:2007/ EN61800-5-1:2007	TÜV (TÜV SÜD Japan, Ltd.) (Blue octagon)
	Mechanical safety	Machine safety under Machinery Directive (2006/42/EC)	IEC60204-1:2005/ EN60204-1:2006	
	Functional Safety	Generic Functional safety	IEC61508:2010/ EN61508:2010(SIL3)	
		Functional safety under Machinery Directive (2006/42/EC)	IEC62061/A1:2012/ EN62061/A1:2013 (SILCL3)	
		Functional safety under Machinery Directive (2006/42/EC)	EN ISO13849-1/ AC:2009(Cat.3, PL=e)	
		Functional safety for PDS under Machinery Directive (2006/42/EC)	IEC61800-5-2:2007/ EN61800-5-2:2007	
	EMC	EMC under EMC Directive(2014/30/EU)	IEC61800-3:2004 (Note 1)/ EN61800-3:2004 A1:2012 (Note 1)	
		Functional safety EMC for machine, factory automation application	IEC61326-3-1:2008/ EN61326-3-1:2008	
RS3###A### #	KC Mark		KN61000-6-2 KN61000-6-4	Ministry of Science, ICT & Future Planning

Note 1) Category of this standard is C2.

Warning: In a domestic environment, this product may cause radio interference, in which case supplementary mitigation measures may be required.

- ■ The servo motor implements the attestation examination to the following standards.

Standards	Standards code	Certificate authorities
UL standards	UL1004-1 UL1004-6 UL1446	UL (Underwriters Laboratories inc.)
EN Directive	EN60034-1 EN60034-5	TÜV (TÜV SÜD Japan, Ltd.)

- ✔ For products conforming to conformity standards, some specifications may differ from the standard product due to prerequisites necessary for obtaining approval. Contact us for more details.

12.1.2 Over-voltage Category, Protection Grade, Pollution Level

- ■ The "over-voltage category" of servo amplifier is "III" (EN61800-5-1). For the interface, use a DC power supply with reinforced and insulated input and outputs.

- ■ Make sure to install the servo amplifier in your control panel in an environment where the pollution level specified in EN61800-5-1 and IEC664 is no less than 2 (pollution level 1, 2). The protection grade of servo amplifiers are IP2X for 50A or less and IP1X for 100A or more. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc.

12.1.3 Connection and installation

Be careful of connection and installation as follows.

- ✔ Always ground the protective earth terminals of the servo amplifier to the power supply earth.

- ✔ When connecting grounding wire to the protective earth terminal, always connect one wire in one terminal; never connect jointly with multiple wires or terminals.

- ✔ When connecting the leakage stopper, make sure to connect the protective earth terminal to the power supply earth.

- ✔ Connect earthing wire by using a crimping terminal with insulated tube, so that the connected wire will not touch the neighboring terminals.

- ✔ For wire relays, use a fixed terminal block to connect wires; never connect wires directly.

- ✔ Connect an EMC filter to the input power supply of the unit.

- ✔ Use an EN/ IEC-standard compatible no-fuse Circuit breaker and electromagnetic contactor.

- ✔ Wiring for main circuit power shall be done as with the circuit shown in the section "4.1.6 Example of wiring", to break power at alarm.

12.1.4 UL File Number

The UL file number of servo amplifier and servo motor is as follows.
Can check from the website of UL. hiip://www.ul.com/database/

- ■ The UL file number of servo amplifier: E179775

- ■ The UL file number of servo motor: E179832

12.2 Compliance with EN Directives

We implement the conformity verification test of "Low Voltage Directive" and "an EMC command" in a certificate authority so that a user's CE Marking acquisition can be performed easily, and servo amplifier CE Marking is done based on the published certificate of attestation.

12.2.1 Conformity verification test

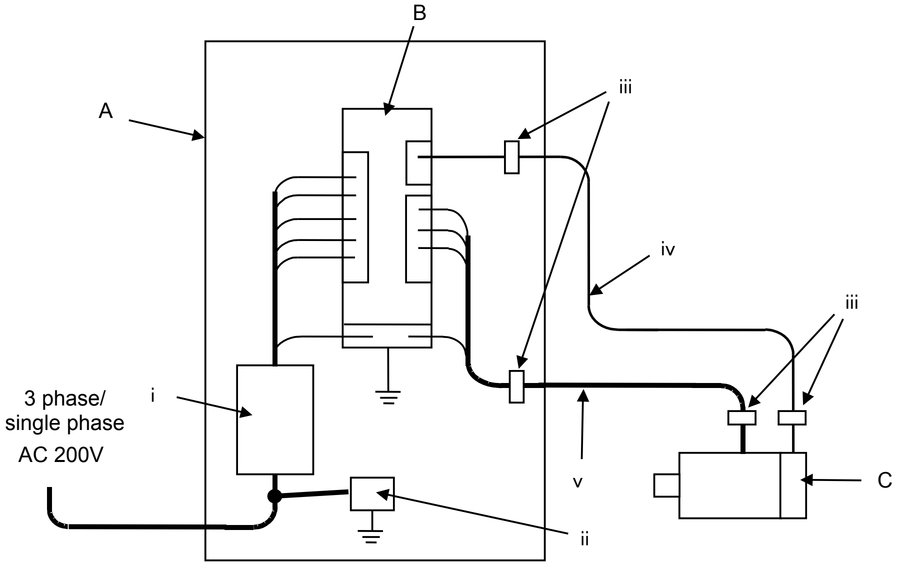
The following conformity verification tests are implemented.

Directive classification	Classification	Test	Test standard
Low voltage Directive (Servo amplifier)	—	—	EN61800-5-1
Low voltage Directive (Servo motor)	—	Rotating electrical machines-Part1: Rating and performance	EN60034-1
		Rotating electrical machines-Part5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)	EN60034-5
EMC Directive (Servo amplifier / servo motor)	Emission	Conducted emission	EN61800-3
		Radiated emission	EN61800-3
	Immunity	Electrostatic discharge immunity	EN61000-4-2
		Radiated electromagnetic field immunity	EN61000-4-3
		Electrical first transient/ burst immunity	EN61000-4-4
		Conducted disturbance immunity	EN61000-4-6
		Surge immunity	EN61000-4-5
		Voltage Dips & Interruptions immunity	EN61000-4-11
		Adjustable speed electrical power drive system	EN61800-3
		Safety of machinery	EN62061 (Annex E) Note 1)

Note 1) Standards applicable only to Safe Torque Off function equipped models.

12.2.2 EMC Installation Requirements

For the installation requirements, in our company the verification test is implemented by the following installations and measures methods, as machines and configurations differ depending on customers' needs. This servo amplifier has been authorized to display CE marking based on the recognition certificate issued by a certifying authority. Customers are instructed to perform the final conformity tests for all instruments and devices in use.



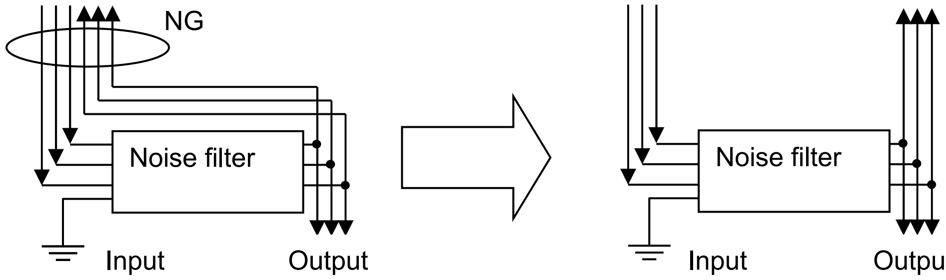
No.	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
i	Noise filter (Recommended prevention components)	RS3A01 to RS3A07: HF3030C-SZA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/rated current：Line-Line 480V AC / 30A RS3A10 to RS3A15: 3SUPF-CH40M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current：Line-Line 500V AC / 40A RS3A30: 3SUPF-CH80M-F: OKAYA ELECTRIC INDUSTRIES CO., LTD. Rated voltage/rated current：Line-Line 500V AC / 80A
ii	Surge-absorber (Recommended prevention components)	LV275DI-U4: OKAYA ELECTRIC INDUSTRIES CO.,LTD.
iii	Clamp grounding	-
iv	Encoder cable	Shield cable
v	Servo motor power cable	Shield cable

- ✔ Use metallic materials for the door and main body of control panel.
- ✔ Use EMI gasket so that there is zero clearance between the door and control panel. Install EMI gasket uniformly to the contact points between door and main body of control panel to confirm their conductivity.
- ✔ Ground the noise filter frame to the control panel.
- ✔ Use shield cables for motor power line and encoder cable. Clamp grounding of shield at the frame of control panel and equipment.
- ✔ Use conducting metal P-clip or U-clip to ground and clamp shielded wire, and fix it directly with metal screws. Do not ground by soldering electric wire to shielded wire.
- ✔ Wire servo amplifier at a short distance from the secondary side of noise filter, and wire the primary side and secondary side of noise filter separately.

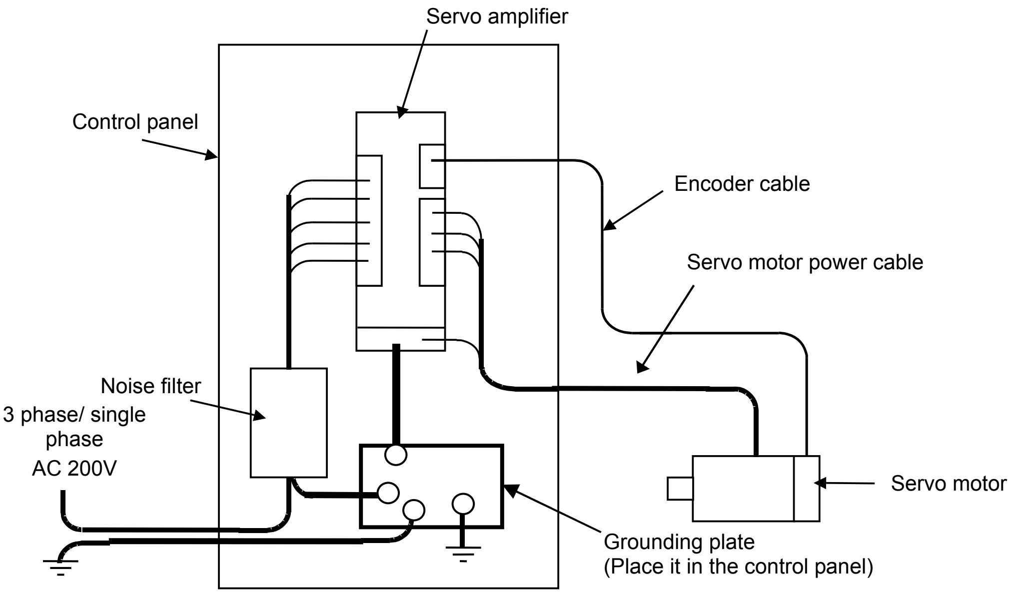
12.2.3 Precautions for noise filter connection

Precautions for noise filter mounting and wiring
See below precautions for mounting and wiring when noise filter is used.

- Do not bundle with input line and output line of noise filter. (Earth line also.)
  Avoid that go through a same duct. (It might reduce effect of filter, and noise might come around through that point.)



- Each of earth line shall be connected to grounding plate in a control panel by single-point.
  Also in case of multi axes construction in same control panel, grounding by single-point.



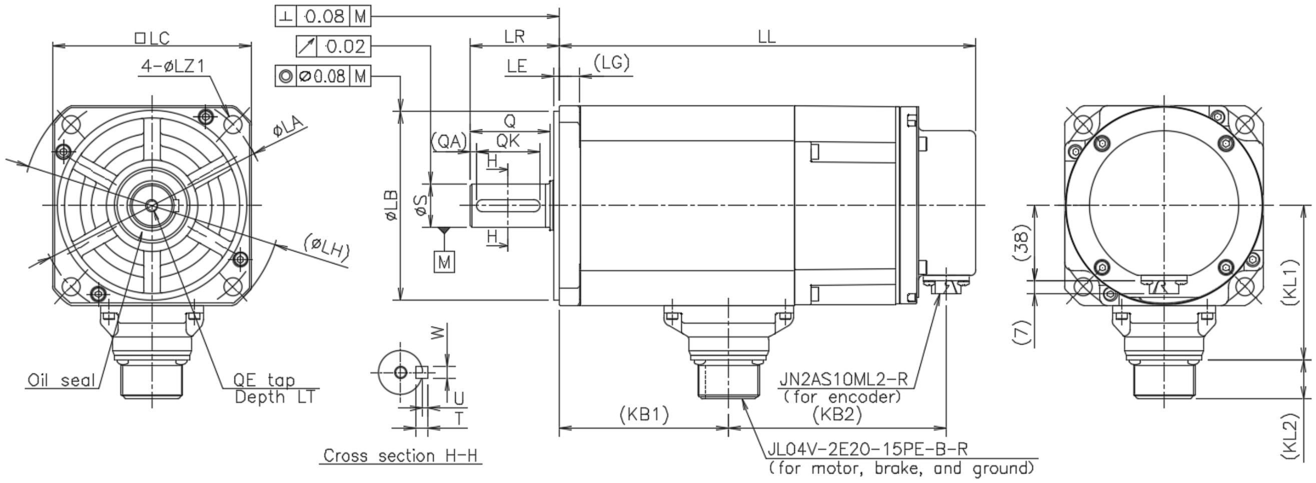
12.3 Servo motor dimensions

Below shows outline drawing and each dimensions of the motor with battery-less absolute encoder or single-turn absolute encoder.

- ✔ Each dimensions of the motor with battery backup encoder [PA035C] are same with the motor with single-turn absolute encoder.
- ✔ Contact us for each dimensions of the motor with resolver type battery-less absolute encoder [RA035C] or wire-saving incremental encoder.

12.3.1 R1 motor, flange size 100mm

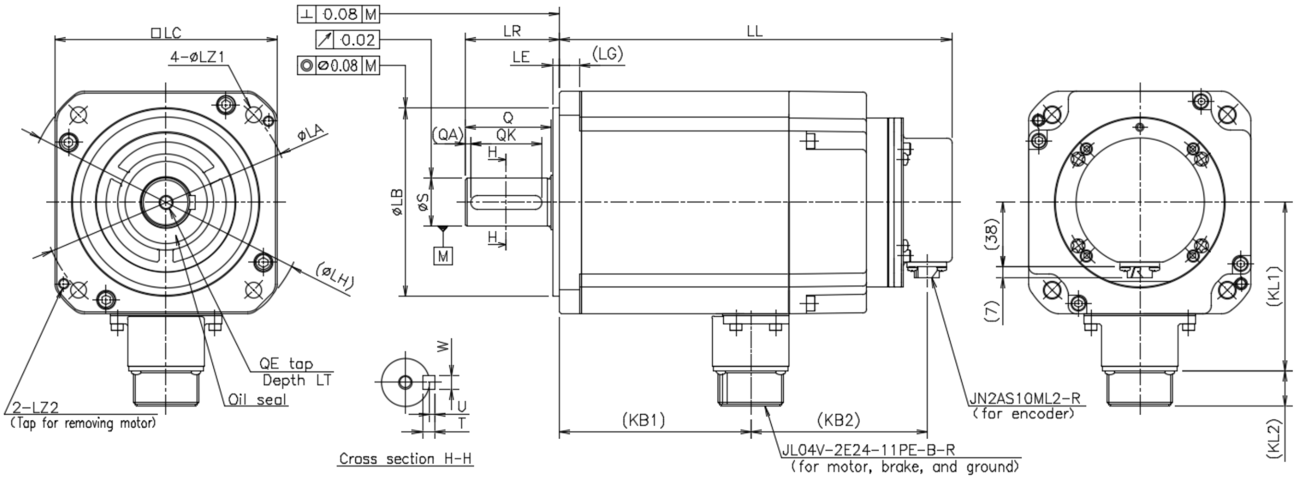
- ■ Battery-less absolute encoder (Encoder code: R)
- ■ Single-turn absolute encoder (encoder code: H)



	Without brake			With brake											
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1
R1AA10100△□◇	145	68	38	186	109	38	10	78	19	115	0 95 -0.035	3	130	100	9
R1AA10150△□◇	168			209											
R1AA10200△□◇	179			220											
R1AA10250△□◇	199			240											

12.3.2 R1 motor, flange size 130mm

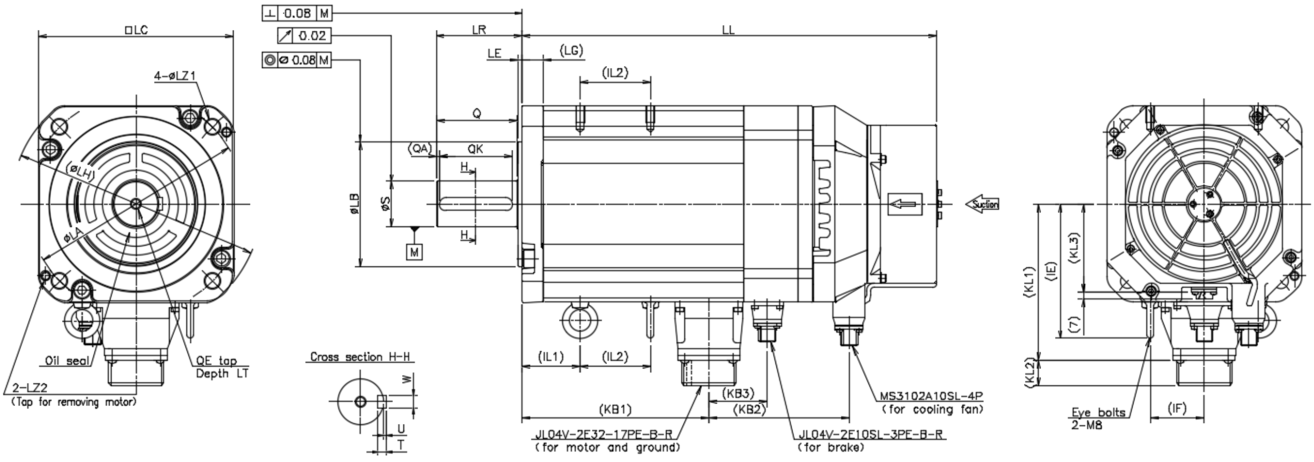
- Battery-less absolute encoder (Encoder code: R)
- Single-turn absolute encoder (encoder code: H)



Servo motor model number	Without brake			With brake														
	LL	KB2	KL3	LL	KB2	KL3	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1	LZ2
R1AA13300△□◇	184	57	38	230	103	38	12	98	21	145	$110_{-0.035}^{0}$	4	165	130	9	M6
R1AA13400△□◇	208			251	100											
R1AA13500△□◇	232			275												

12.3.3 R1 motor, flange size 180mm

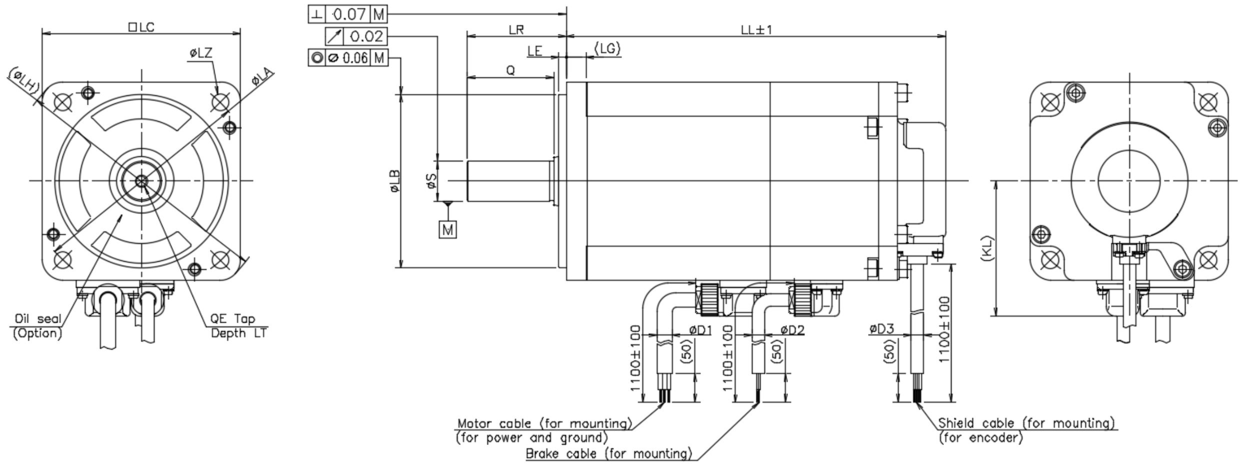
- Battery-less absolute encoder (Encoder code: R)
- Single-turn absolute encoder (encoder code: H)



Servo motor model number	Without brake				With brake														
	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1	LZ2
R1AA18550△□◇	333	80	-	81	383	130	54	81	19	143	23	200	$114.3_{-0.035}^{0}$	3	230	180	13.5	M8
R1AA18750△□◇	368				418													
R1AA1811K△□◇	438				517	158	79											
R1AA1815K△□◇	516				628	191	110											

12.3.4 R2 motor, flange size 40mm, 60mm, 80mm, 86mm, 100mm

■ Battery-less absolute encoder (Encoder code: R)



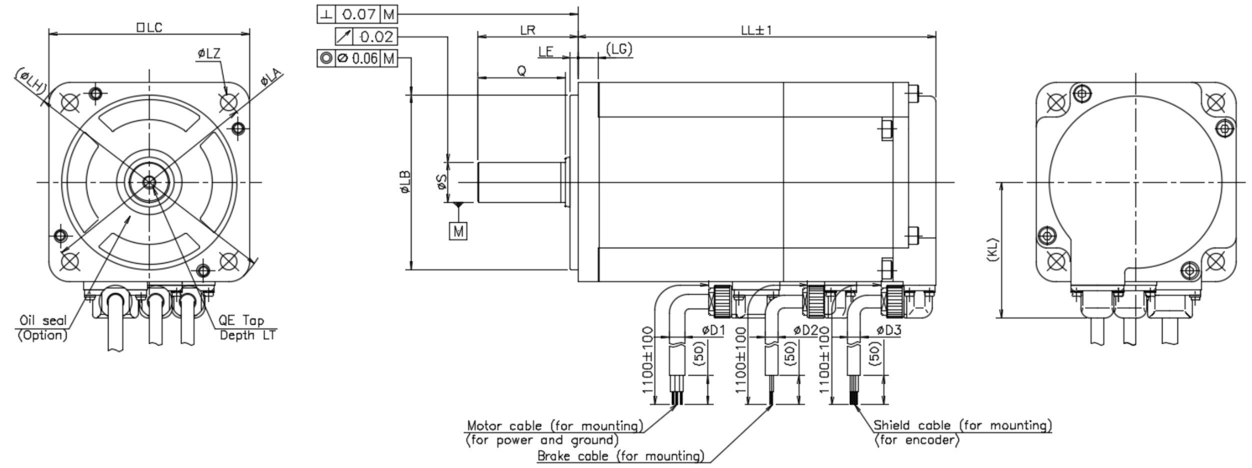
	Without Oil Seal		With Oil Seal	
	Without brake	With brake	Without brake	With brake
Servo motor model number	LL	LL	LL	LL
R2□A04003△□◇	62.5	98.5	67.5	103.5
R2□A04005△□◇	67.5	103.5	72.5	103.5
R2EA04008△□◇	83.0	119.0	88.0	124.0
R2AA04010△□◇				
R2□A06010△□◇	68.5	92.5	75.5	99.5
R2□A06020△□◇	79.5	107.5	86.5	114.5
R2AA08020△□◇	76.3	112.0	83.3	119.0
R2AA06040△□◇	105.5	133.5	112.5	140.5
R2AA08040△□◇	88.3	124.0	95.3	131.0
R2AA08075△□◇	117.3	153.0	124.3	160.0
R2AAB8075△□◇	123.1	149.0	123.1	149.0
R2AAB8100△□◇	145.8	171.8	145.8	171.8
R2AA10075△□◇	117.1	134.6	117.1	134.6
R2AA10100△□◇	134.1	151.6	134.1	151.6

Servo motor model number	LG	KL	LA	LB	LE	LH	LC	LZ	LR	S	Q	QE	LT	D1	D2	D3
R2□A04003△□◇	5	35.4	46	0 30-0.021	2.5	56	40	2-ϕ 4.5	25	0 6-0.008	20	–	–	6	5	5
R2□A04005△□◇										0 8-0.009						
R2EA04008△□◇																
R2AA04010△□◇																
R2□A06010△□◇	6	44.6	70	0 50-0.025	3	82	60	4-ϕ 5.5	25	0 8-0.009		–	–			
R2□A06020△□◇									30	0 14-0.011	25	M5	12			
R2AA08020△□◇	8	54.4	90	0 70-0.03		108	80	4-ϕ 6.6								
R2AA06040△□◇	6	44.6	70	0 50-0.025		82	60	4-ϕ 5.5								
R2AA08040△□◇	8	54.4	90	0 70-0.030	3	108	80	4-ϕ 6.6				M5	12			
R2AA08075△□◇									40	0 16-0.011	35					
R2AAB8075△□◇		59.4	100	0 80-0.03		115.5	86		35							
R2AAB8100△□◇											30					
R2AA10075△□◇	10	66.8	115	0 95-0.035	3	130	100	4-ϕ 9	45	0 22-0.013	40	M6	20			
R2AA10100△□◇																

✔ For motor requiring oil seal, the motor whole length differs.

✔ For motor without brake, no brake connector (or cable) attached.

- ■ Single-turn absolute encoder (encoder code: H)



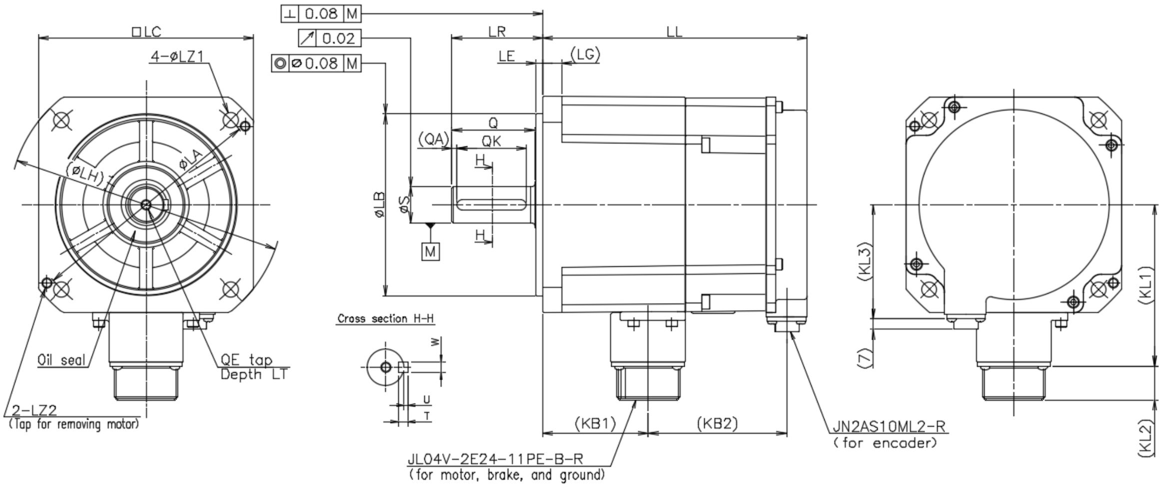
	Without Oil Seal		With Oil Seal	
	Without brake	With brake	Without brake	With brake
Servo motor model number	LL	LL	LL	LL
R2□A04003△□◇	51.5	87.5	56.5	92.5
R2□A04005△□◇	56.5	92.5	61.5	97.5
R2EA04008△□◇	72	108	77	113
R2AA04010△□◇				
R2□A06010△□◇	58.5	82.5	65.5	89.5
R2□A06020△□◇	69.5	97.5	76.5	104.5
R2AA08020△□◇	66.3	102	73.3	109
R2AA06040△□◇	95.5	123.5	102.5	130.5
R2AA08040△□◇	78.3	114	85.3	121
R2AA08075△□◇	107.3	143	114.3	150
R2AAB8075△□◇	114.3	140.2	114.3	140.2
R2AAB8100△□◇	137	163	137	163
R2AA10075△□◇	111.3	128.8	111.3	128.8
R2AA10100△□◇	128.3	145.8	128.3	145.8

Servo motor model number	LG	KL	LA	LB	LE	LH	LC	LZ	LR	S	Q	QE	LT	D1	D2	D3
R2□A04003△□◇	5	35.4	46	0 30-0.021	2.5	56	40	2-ϕ 4.5	25	0 6-0.008	20	–	–	6	5	5
R2□A04005△□◇										0 8-0.009						
R2EA04008△□◇																
R2AA04010△□◇																
R2□A06010△□◇	6	44.6	70	0 50-0.025	3	82	60	4-ϕ 5.5	25	0 8-0.009		–	–			
R2□A06020△□◇									30	0 14-0.011	25	M5	12			
R2AA08020△□◇	8	54.4	90	0 70-0.03		108	80	4-ϕ 6.6								
R2AA06040△□◇	6	44.6	70	0 50-0.025		82	60	4-ϕ 5.5								
R2AA08040△□◇	8	54.4	90	0 70-0.030	3	108	80	4-ϕ 6.6				M5	12			
R2AA08075△□◇									40	0 16-0.011	35					
R2AAB8075△□◇		59.4	100	0 80-0.03		115.5	86		35							
R2AAB8100△□◇											30					
R2AA10075△□◇	10	66.8	115	0 95-0.035	3	130	100	4-ϕ 9	45	0 22-0.013	40	M6	20			
R2AA10100△□◇																

- ✔ For motor requiring oil seal, the motor whole length differs.
- ✔ For motor without brake, no brake connector (or cable) attached.

12.3.5 R2 motor, flange size 130mm 0.5kW to 1.8kW

- ■ Battery-less absolute encoder (Encoder code: R)
- ■ Single-turn absolute encoder (encoder code: H)

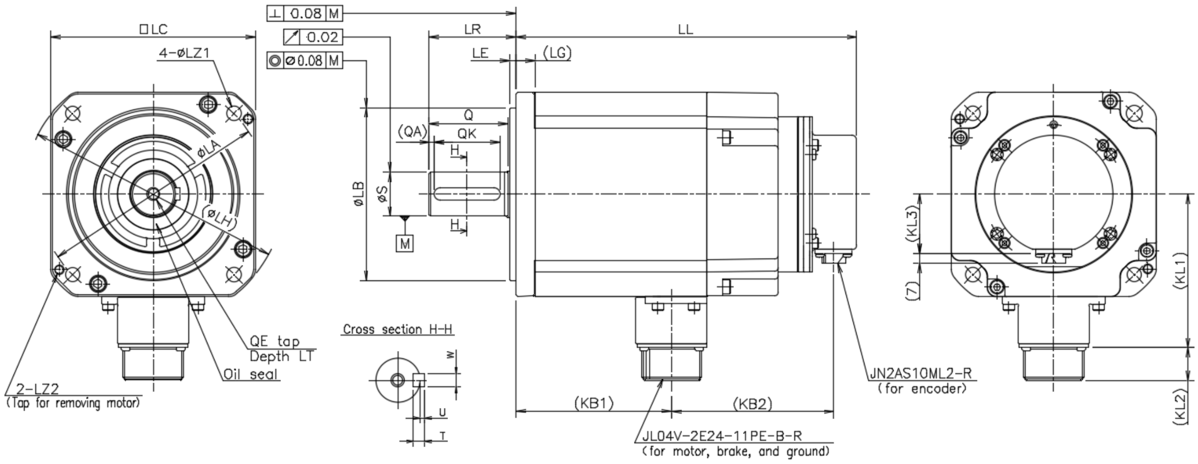


	Without brake			With brake		
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3
R2AA13050△□◇	103	44	69	139.5	81	69
R2AA13120△□◇	120.5			160	84	
R2AA13180△□◇	138			179	86	

Servo motor model number	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	QE	LT
R2AA13050△□◇	12	98	21	145	$110^{\ 0}_{-0.035}$	4	165	130	9	M6	55	$22^{\ 0}_{-0.013}$	50	3	42	$6^{\ 0}_{-0.030}$	6	2.5	46	M6	20
R2AA13120△□◇																			64		
R2AA13180△□◇																			81		

12.3.6 R2 motor, flange size 130mm 2kW

- ■ Battery-less absolute encoder (Encoder code: R)
- ■ Single-turn absolute encoder (encoder code: H)

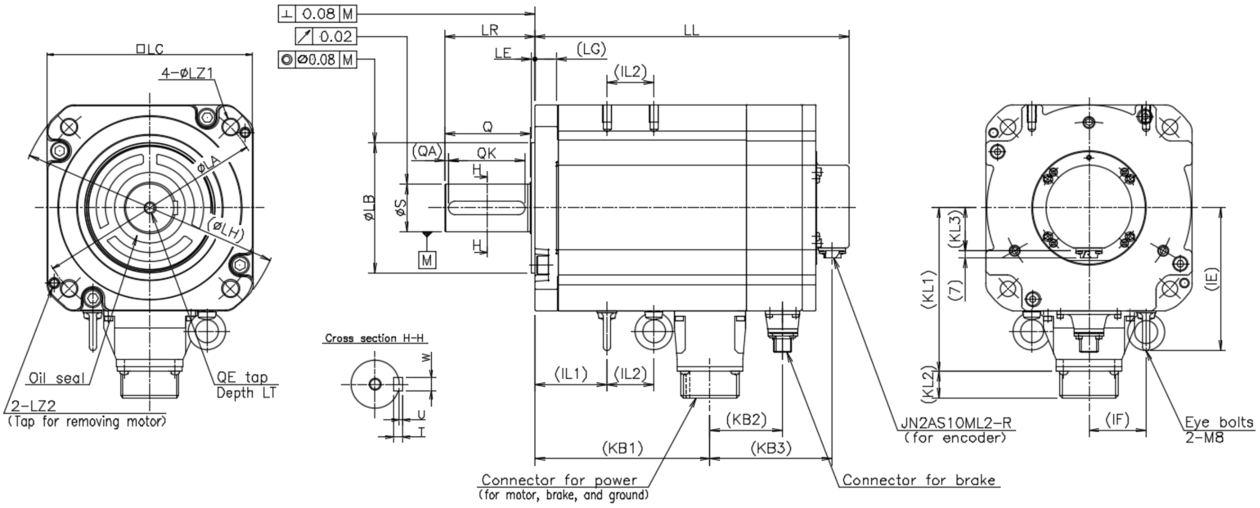


	Without brake			With brake		
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3
R2AA13200△□◇	171	57	38	216	103	38

Servo motor model number	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	QE	LT
R**2AA13200△□◇**	12	98	21	145	$110^{\ 0}_{-0.035}$	4	165	130	9	M6	55	$28^{\ 0}_{-0.013}$	50	3	42	$8^{\ 0}_{-0.036}$	7	3	99	M8	25

12.3.7 R2 motor, flange size 180mm 3.5kW to 7.5kW

■ Battery-less absolute encoder (Encoder code: R)



	Without brake				With brake													
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA	LB	LE	LH	W	T	U
R2AA18350△□◇	159	52	-	38	206	99	-	38	16	123	21	200	0 114.3 -0.035	3	230	0 10 -0.036	8	3
R2AA18450△□◇	176				223													
R2AA18550△□◇	228	59			274	107	64		19	144	22					0 12 -0.043		
R2AA18750△□◇	273				329	117	74											

Servo motor model number	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2	Connector model number for motor power	Connector model number for brake
R2AA18350△□◇	180	13.5	M8	65	0 35 -0.016	60	92	M8	25	123	50	47	20	JL04V-2E24-11PE-B-R	-
R2AA18450△□◇							109			123	50	57	20		①
R2AA18550△□◇				79	0 42 -0.016	75	153	M10				63	41	JL04V-2E32-17PE-B-R	JL04V-2E10SL-3PE-B-R
R2AA18750△□◇							198						86		

Note ① Brake cable is included in the connector for motor power.

■ Single-turn absolute encoder (encoder code: H)

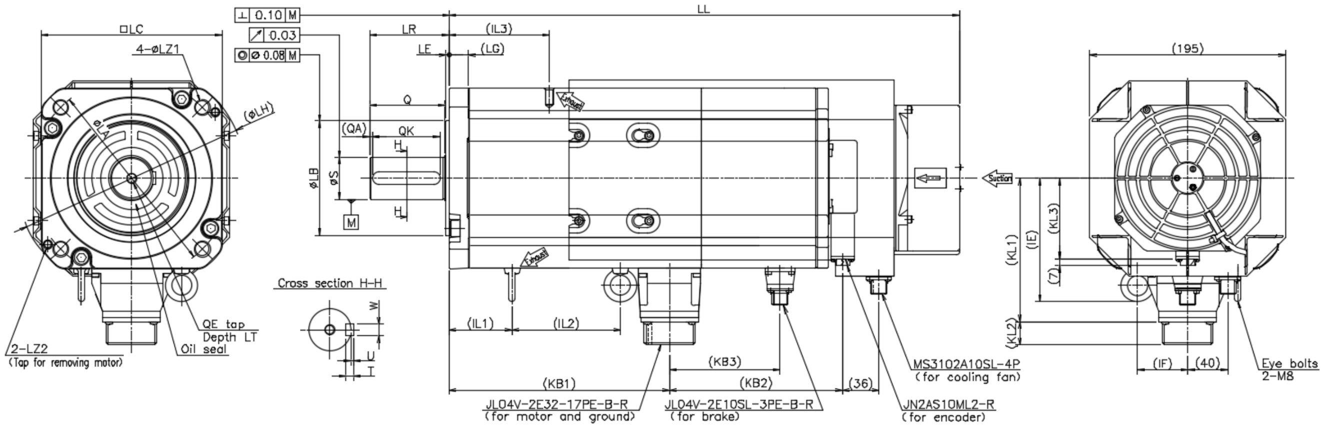
	Without brake				With brake													
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA	LB	LE	LH	W	T	U
R2AA18350△□◇	155	48	-	38	205	98	-	38	16	123	21	200	0 114.3 -0.035	3	230	0 10 -0.036	8	3
R2AA18450△□◇	172				222													
R2AA18550△□◇	228	59			274	107	64		19	144	22					0 12 -0.043		
R2AA18750△□◇	273				329	117	74											

Servo motor model number	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2	Connector model number for motor power	Connector model number for brake
R2AA18350△□◇	180	13.5	M8	65	0 35 -0.016	60	92	M8	25	123	50	47	20	JL04V-2E24-11PE-B-R	-
R2AA18450△□◇							109			123	50	57	20		①
R2AA18550△□◇				79	0 42 -0.016	75	153	M10				63	41	JL04V-2E32-17PE-B-R	JL04V-2E10SL-3PE-B-R
R2AA18750△□◇							198						86		

Note ① Brake cable is included in the connector for motor power.

12.3.8 R2 motor, flange size 180mm 11Kw

- ■ Battery-less absolute encoder (Encoder code: R)
- ■ Single-turn absolute encoder (encoder code: H)

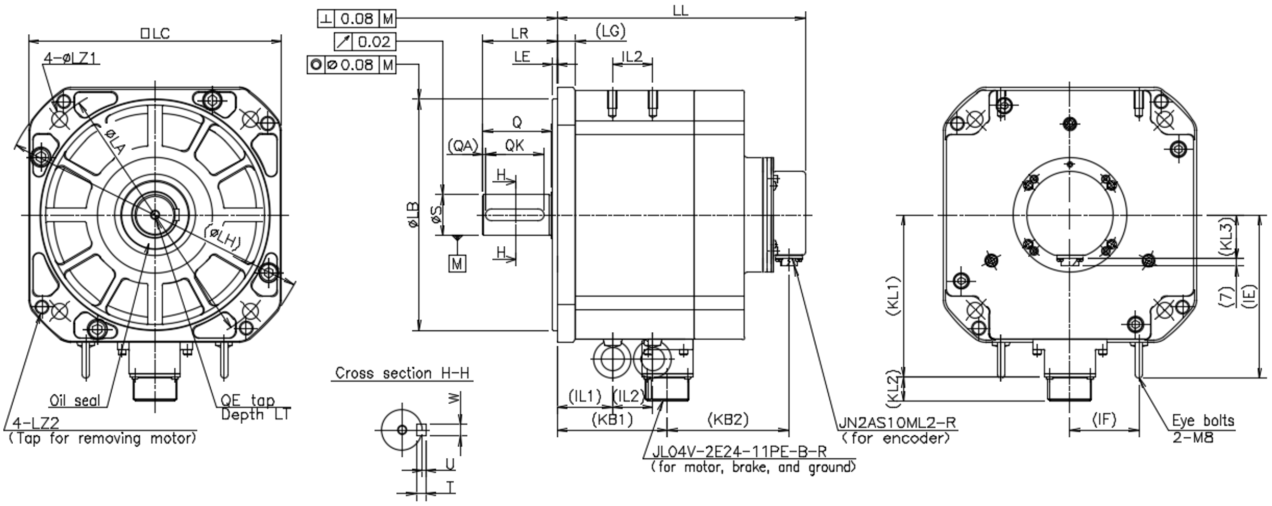


	Without brake				With brake			
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3
R2AA1811K△□◇	395	60	-	81	509	173	110	81

Servo motor model number	LG	KL1	KL2	LA	W	T	U	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2	IL3
R2AA1811K△□◇	19	143	23	200	0 12 -0.043	8	3	0 14.3 -0.035	3	230	180	13.5	M8	79	0 42 -0.016	75	220	M10	25	123	50	63	108	100

12.3.9 R2 motor, flange size 220mm 5kW

- ■ Battery-less absolute encoder (Encoder code: R)
- ■ Single-turn absolute encoder (encoder code: H)

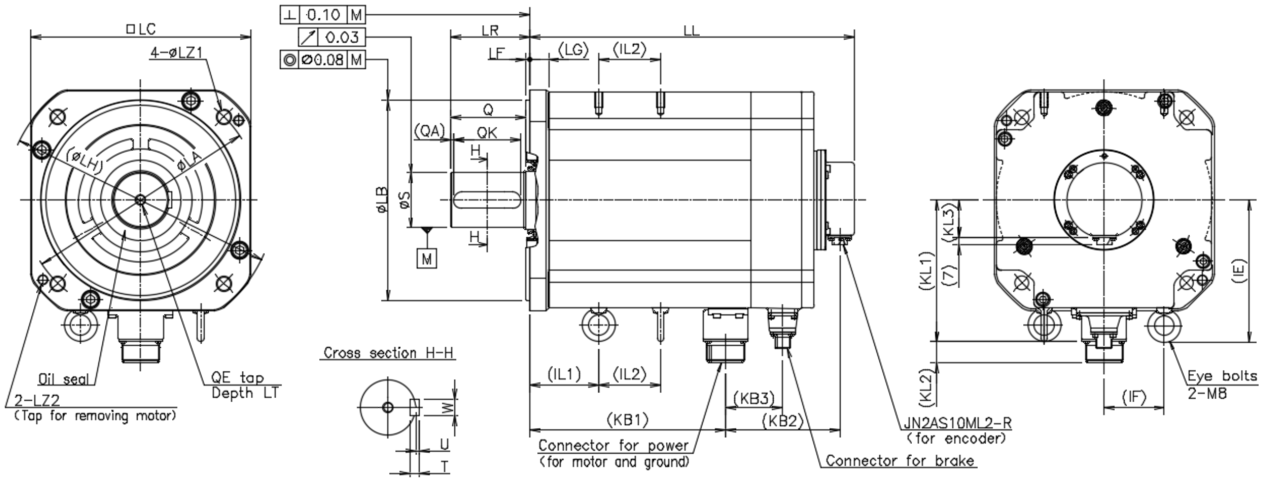


	Without brake			With brake		
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3
R2AA22500△□◇	163	52	38	216	106	38

Servo motor model number	LG	KL1	KL2	LA	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	W	T	U	IE	IF	IL1	IL2
R2AA22500△□◇	16	142	21	235	0 200 -0.046	4	270	220	13.5	M12	65	0 35 -0.016	60	96	M8	25	0 10 -0.036	8	3	142	60	48	35

12.3.10 R2 motor, flange size 220mm　7kW to 15kW

- Battery-less absolute encoder (Encoder code: R)
- Single-turn absolute encoder (encoder code: H)

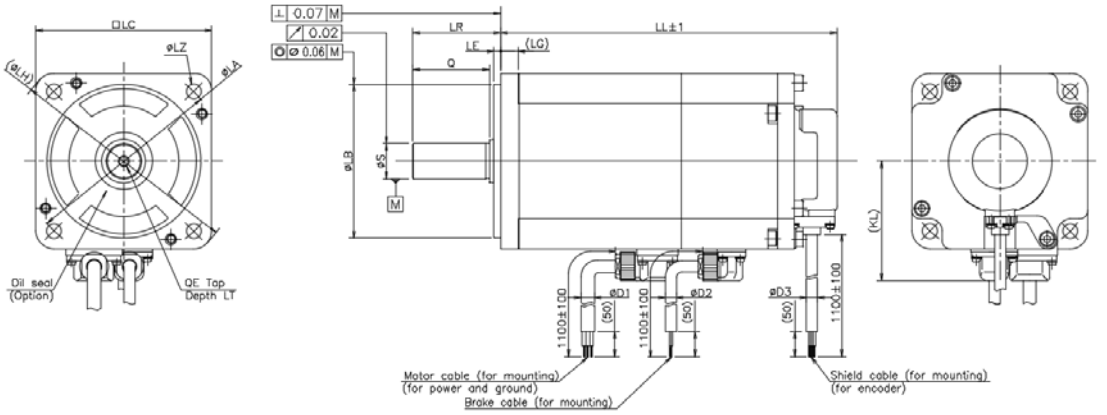


	Without brake		With brake															
Servo motor model number	LL	KB3	LL	KB3	KL1	KL2	KB1	IL2	LG	KL1	KL2	LA	LB	LE	LH	W	T	U
R2AA22700△□◇	265	-	325	57	141	21	196	62	19	141	21	235	0 200 -0.046	4	270	0 16 -0.043	10	4
R2AA2211K△□◇	304		364	66	162	22	226	101		16	22							
R2AA2215K△□◇	343		403				265	140										

Servo motor model number	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2	Connector model number for motor power	Connector model number for brake
R2AA22700△□◇	220	13.5	M10	79	0 55 -0.019	75	196	M10	25	142	60	69	62	JL04V-2E24-171E-B-R	JL04V-2E10SL-3PE-B-R
R2AA2211K△□◇							226						101	JL04V-2E32-17PE-B-R	
R2AA2215K△□◇							265						140		

12.3.11 R5 motor, flange size 60mm，80mm

- ■ Batteryless absolute encoder (Encoder code: R)



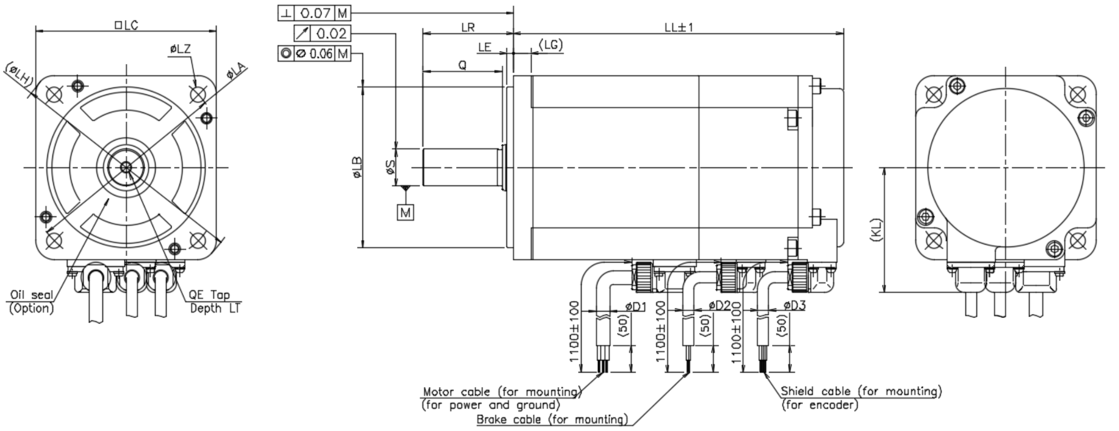
	Without Oil Seal		With Oil Seal	
	Without brake	With brake	Without brake	With brake
Servo motor model number	LL	LL	LL	LL
R5☐☐06020△☐◇	79.5	107.5	86.5	114.5
R5☐☐06040△☐◇	105.5	133.5	112.5	140.5
R5☐☐08075△☐◇	117.3	153.0	124.3	160.0

Servo motor model number	LG	KL	LA	LB	LE	LH	LC	LZ	LR	S	Q	QE	LT	D1	D2	D3
R5AA06020△☐◇	6	44.6	70	0 50-0.025	3	82	60	4-ϕ 5.5	30	0 14-0.011	25	M5	12	6	5	5
R5AA06040△☐◇																
R5AA08075△☐◇	8	54.4	90	0 70-0.03	3	108	80	4-ϕ 6.6	40	0 16-0.011	35					

✔ For motor requiring oil seal, the motor whole length differs.

✔ For motor without brake, no brake connector (or cable) attached.

- ■ Single-turn absolute encoder (encoder code: H)



	Without Oil Seal		With Oil Seal	
	Without brake	With brake	Without brake	With brake
Servo motor model number	LL	LL	LL	LL
R5AA06020△☐◇	72.5	100.5	79.5	107.5
R5AA06040△☐◇	98.5	126.5	105.5	133.5
R5AA08075△☐◇	110.3	146	117.3	153

Servo motor model number	LG	KL	LA	LB	LE	LH	LC	LZ	LR	S	Q	QE	LT	D1	D2	D3
R5AA06020△☐◇	6	44.6	70	0 50-0.025	3	82	60	4-ϕ 5.5	30	0 14-0.011	25	M5	12	6	5	5
R5AA06040△☐◇																
R5AA08075△☐◇	8	54.4	90	0 70-0.03	3	108	80	4-ϕ 6.6	40	0 16-0.011	35					

✔ For motor requiring oil seal, the motor whole length differs.

✔ For motor without brake, no brake connector (or cable) attached.

12.4 Servo motor data sheet

12.4.1 Characteristics table

- ■ Specification of R1 motor, AC200V

Servo motor model number R1AA			10100H	10150H	10100F	10150F	10200H	10250H
Amplifier size combined			RS3A03A	RS3A03A	RS3A05A	RS3A05A	RS3A05A	RS3A05A
*Rated output	P_R	kW	1.0	1.5	1.0	1.5	2.0	2.5
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	3000	3000	6000	6000	3000	3000
*Rated torque	T_R	N･m	3.2	4.8	3.2	4.8	6.37	7.97
*Continuous Torque at stall	T_S	N･m	3.2	4.9	3.2	4.9	6.37	7.97
*Peak Torque at stall	T_P	N･m	12.6	18.0	10.5	15.0	24.0	26.5
*Rated armature current	I_R	Arms	4.5	5.2	7.7	8.2	7.7	9.0
*Armature current at stall	I_S	Arms	3.8	3.8	7.4	7.7	6.8	7.2
*Peak armature current at stall	I_P	Arms	15.5	15.5	26.5	26.5	26.5	26.5
*Torque constant	K_T	N･m/ Arms	0.97	1.35	0.46	0.64	1.07	1.24
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	33.9	47.1	15.9	22.4	37.3	43.2
Phase resistance	R_ϕ	Ω	14	1.3	0.27	0.26	0.61	0.58
*Rated power rate	Q_R	kW/s	73	115	73	115	176	227
Moment of inertia	J_M	Kg･m^2(GD^2/4) x10^{-4}	1.4	2.0	1.4	2.0	2.3	2.8
Mass Note1)	WE	kg	3.8	5.0	3.8	5.0	5.7	6.7
Brake mass	W	kg	1.5	1.5	1.5	1.5	1.5	1.5
Aluminum plate		mm	t20 x 400	t20 x 400	t20 x 400	t20 x 400	t20 x 470	t20 x 470

Servo motor model number R1AA			10200F	10250F	13300H	13300F
Amplifier size combined			RS3A07A	RS3A07A	RS3A07A	RS3A10A
*Rated output	P_R	kW	2.0	2.5	3.0	3.0
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	6000	6000	3000	6000
*Rated torque	T_R	N･m	6.37	7.97	9.7	9.7
*Continuous Torque at stall	T_S	N･m	6.37	7.97	9.7	9.7
*Peak Torque at stall	T_P	N･m	20.0	24.0	34.8	29.0
*Rated armature current	I_R	Arms	13.9	14.8	14.7	17.5
*Armature current at stall	I_S	Arms	13.1	13.9	11.5	16.8
*Peak armature current at stall	I_P	Arms	45.5	45.5	45.5	55.0
*Torque constant	K_T	N･m/ Arms	0.51	0.62	0.92	0.63
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	17.9	21.8	32.0	21.8
Phase resistance	R_ϕ	Ω	0.15	0.17	0.18	0.08
*Rated power rate	Q_R	kW/s	176	227	134	134
Moment of inertia	J_M	Kg･m^2(GD^2/4) x10^{-4}	2.3	2.8	7.0	7.0
Mass Note1)	WE	kg	5.7	6.7	9.7	9.7
Brake mass	W	kg	1.5	1.5	2.1	2.1
Aluminum plate		mm	t20 x 470	t20 x 470	t20 x 470	t20 x 470

Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

12. Appendix

Servo motor model number R1AA			13400H	13500H	13400F	13500F
Amplifier size combined			RS3A10A	RS3A10A	RS3A15A	RS3A15A
*Rated output	P_R	kW	4.0	5.0	4.0	5.0
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	3000	3000	6000	6000
*Rated torque	T_R	N・m	12.8	16.0	12.8	16.0
*Continuous Torque at stall	T_S	N・m	12.8	16.0	12.8	16.0
*Peak Torque at stall	T_P	N・m	47.0	55.0	39.0	48.0
*Rated armature current	I_R	Arms	17.8	20.0	23.4	27.7
*Armature current at stall	I_S	Arms	15.5	14.1	22.5	26.6
*Peak armature current at stall	I_P	Arms	55.0	55.0	74.0	83.0
*Torque constant	K_T	N・m/ Arms	1.01	1.21	0.62	0.65
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	35.4	42.3	21.8	22.8
Phase resistance	R_ϕ	Ω	0.13	0.15	0.053	0.047
*Rated power rate	Q_R	kW/s	186	242	186	242
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	8.8	10.6	8.8	10.6
Mass Note1)	WE	kg	12.2	14.3	12.2	14.3
Brake mass	W	kg	2.5	2.5	2.5	2.5
Aluminum plate		mm	t20 x 470	t20 x 540	t20 x 470	t20 x 540

Servo motor model number R1AA			18550H	18750L	1811KR	1815KB
Amplifier size combined			RS3A30A	RS3A30A	RS3A30A	RS3A30A
*Rated output	P_R	kW	5.5	7.5	11	15
*Rated velocity	N_R	min^{-1}	1500	1500	1500	1500
*Maximum velocity	N_{max}	min^{-1}	3000	3000	2500	2000
*Rated torque	T_R	N・m	35	48	70	95.5
*Continuous Torque at stall	T_S	N・m	37	48	70	95.5
*Peak Torque at stall	T_P	N・m	110	135	195	230
*Rated armature current	I_R	Arms	46	49	55.0	60.0
*Armature current at stall	I_S	Arms	47	47	54.0	58.0
*Peak armature current at stall	I_P	Arms	155	155	155	155
*Torque constant	K_T	N・m/ Arms	0.86	1.09	1.4	1.77
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	30	38.1	48.7	61.6
Phase resistance	R_ϕ	Ω	0.029	0.031	0.033	0.033
*Rated power rate	Q_R	kW/s	370	550	770	1060
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	33	42	64	86
Mass Note1)	WE	kg	33	39	52	64
Brake mass	W	kg	2.8	4.5	7.1	8.9
Aluminum plate		mm	t20 x 540	t20 x 540	t30 x 610	t30 x 610

Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

12.4 Servo motor data sheet

■ Specification of R2 motor, AC200V

Servo motor model number R2AA			04003F	04005F	04010F	06010F	06020F	06040H	08020F
Amplifier size combined			RS3A01	RS3A01	RS3A01	RS3A01	RS3A02	RS3A02	RS3A02
*Rated output	P_R	kW	0.03	0.05	0.1	0.1	0.2	0.4	0.2
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	6000	6000	6000	6000	6000	3000	6000
*Rated torque	T_R	N・m	0.098	0.159	0.318	0.318	0.637	1.27	0.637
*Continuous Torque at stall	T_S	N・m	0.108	0.167	0.318	0.353	0.686	1.37	0.686
*Peak Torque at stall	T_P	N・m	0.37	0.59	1.18	1.13	2.2	4.8	2.2
*Rated armature current	I_R	Arms	0.51	0.67	0.81	0.86	1.5	1.7	1.5
*Armature current at stall	I_S	Arms	0.56	0.69	0.81	0.86	1.6	1.8	1.5
*Peak armature current at stall	I_P	Arms	2.15	2.8	3.3	3.5	5.6	7.1	4.8
*Torque constant	K_T	N・m/ Arms	0.201	0.246	0.424	0.375	0.476	0.816	0.516
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	7.0	8.6	14.8	13.1	16.6	28.5	18.0
Phase resistance	R_ϕ	Ω	12	9	9.3	4.8	2.7	3.3	2.3
*Rated power rate	Q_R	kW/s	3.9	6.7	16	8.6	19	39	8
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	0.028	0.0409	0.066	0.120	0.222	0.415	0.523
Mass Note1)	WE	kg	0.35	0.39	0.51	0.71	0.96	1.4	1.3
Brake mass	W	kg	0.27	0.27	0.27	0.34	0.39	0.39	0.89
Aluminum plate		mm	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250

Servo motor model number R2AA			06040F	08040F	08075F	B8075F	B8100H	B8100F	10075F
Amplifier size combined			RS3A02	RS3A02	RS3A03	RS3A05	RS3A03	RS3A05	RS3A03
*Rated output	P_R	kW	0.4	0.4	0.75	0.75	1.0	1.0	0.75
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	6000	6000	6000	6000	3000	6000	6000
*Rated torque	T_R	N・m	1.27	1.27	2.39	2.38	3.18	3.18	2.39
*Continuous Torque at stall	T_S	N・m	1.37	1.37	2.55	2.94	3.92	3.92	2.55
*Peak Torque at stall	T_P	N・m	4.8	4.4	8.5	11.0	11.6	14.3	8.6
*Rated armature current	I_R	Arms	2.8	2.6	4.6	4.7	4.6	6.0	4.4
*Armature current at stall	I_S	Arms	2.8	2.6	4.6	5.5	4.7	6.8	4.6
*Peak armature current at stall	I_P	Arms	10.8	8.9	15.5	23.7	15.5	25.7	14.0
*Torque constant	K_T	N・m/ Arms	0.524	0.559	0.559	0.547	0.825	0.582	0.582
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	18.3	19.5	19.5	19.1	28.8	20.3	20.3
Phase resistance	R_ϕ	Ω	1.36	0.93	0.4	0.62	0.85	0.44	0.69
*Rated power rate	Q_R	kW/s	39	16	31	35	42	42	29
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	0.415	1.043	1.823	1.643	2.383	2.383	2.003
Mass Note1)	WE	kg	1.4	1.7	2.7	2.9	3.6	3.6	3.3
Brake mass	W	kg	0.39	0.89	0.89	0.84	0.84	0.84	0.9
Aluminum plate		mm	t6 x 250	t6 x 250	t6 x 250	t12 x 305	t12 x 305	t12 x 305	t12 x 305

Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

Servo motor model number R2AA			10100F	13050H	13050D	13120B	13120D	13120L	13180H
Amplifier size combined			RS3A05	RS3A03	RS3A03	RS3A03	RS3A05	RS3A05	RS3A05
*Rated output	P_R	kW	1.0	0.55	0.55	1.2	1.2	1.2	1.8
*Rated velocity	N_R	min^{-1}	3000	2000	2000	2000	2000	2000	2000
*Maximum velocity	N_{max}	min^{-1}	6000	3500	5000	2000	5000	3000	3500
*Rated torque	T_R	N・m	3.18	2.6	2.6	5.7	5.7	5.7	8.6
*Continuous Torque at stall	T_S	N・m	3.92	3.0	2.6	6.0	6.0	6.0	10.0
*Peak Torque at stall	T_P	N・m	14.3	9.0	7.0	16.0	16.0	20.0	22.0
*Rated armature current	I_R	Arms	5.7	4.2	5.2	5.2	9.1	7.6	11.0
*Armature current at stall	I_S	Arms	6.8	4.6	5.2	5.2	9.3	8.4	11.8
*Peak armature current at stall	I_P	Arms	25.7	15.5	15.5	15.5	25.4	26.5	26.5
*Torque constant	K_T	N・m/ Arms	0.584	0.67	0.53	1.09	0.65	0.77	0.89
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	20.4	23.5	18.5	37.8	22.7	27.0	31.1
Phase resistance	R_ϕ	Ω	0.35	0.65	0.39	0.64	0.23	0.35	0.23
*Rated power rate	Q_R	kW/s	29	22	22	54	54	54	82
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	3.5	3.1	3.1	6.0	6.0	6.0	9.0
Mass Note1)	WE	kg	4.1	4.5	4.5	6.1	6.1	6.1	7.7
Brake mass	W	kg	0.9	1.3	1.3	1.5	1.5	1.5	1.5
Aluminum plate		mm	t12 x 305	t20 x 305	t20 x 305	t20 x 400	t20 x 400	t20 x 400	t20 x 470

Servo motor model number R2AA			13180D	13200L	13200D	18350V	18350L	18350D	18450H
Amplifier size combined			RS3A07/ RS3A10	RS3A05	RS3A07/ RS3A10	RS3A07	RS3A10	RS3A15	RS3A15
*Rated output	P_R	kW	1.8	2.0	2.0	3.5	3.5	3.5	4.5
*Rated velocity	N_R	min^{-1}	2000	2000	2000	2000	2000	2000	2000
*Maximum velocity	N_{max}	min^{-1}	5000	3000	5000	3000	3000	4000	3500
*Rated torque	T_R	N・m	8.6	9.5	9.5	17.0	17.0	17.0	21.5
*Continuous Torque at stall	T_S	N・m	10.0	12.0	12.0	20.0	22.0	22.0	30.0
*Peak Torque at stall	T_P	N・m	25.0	24.0	30.0	50.0	49.0	60.0	75.0
*Rated armature current	I_R	Arms	15.6	11.0	14.3	16.8	19.1	21.7	23.7
*Armature current at stall	I_S	Arms	17.3	12.0	17.5	17.8	23.7	27.0	31.7
*Peak armature current at stall	I_P	Arms	43.0	26.5	45.5	45.5	55.0	83.0	83.0
*Torque constant	K_T	N・m/ Arms	0.63	0.97	0.7	1.21	1.0	0.88	1.02
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	21.8	33.7	24.3	42.2	34.8	30.6	35.6
Phase resistance	R_ϕ	Ω	0.13	0.22	0.11	0.114	0.085	0.075	0.065
*Rated power rate	Q_R	kW/s	82	74	74	72	72	72	92
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	9.0	12.2	12.2	40	40	40	50
Mass Note1)	WE	kg	7.7	10.0	10.0	15.5	15.5	15.5	19.5
Brake mass	W	kg	1.5	2.0	1.5	2.4	2.4	2.4	2.8
Aluminum plate		mm	t20 x 470	t20 x 470	t20 x 470	t20 x 470	t20 x 470	t20 x 470	t20 x 470

Note1) Contains Battery-less absolute encoder (Encoder code: R).
Note2) It can combine with RS3A07 or RS3A10, but motor characteristics are same.

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

12.4 Servo motor data sheet

Servo motor model number R2AA			18550R	18550H	18750H	1811KR	22500L	22700S
Amplifier size combined			RS3A15	RS3A30	RS3A30	RS3A30	RS3A15	RS3A15
*Rated output	P_R	kW	4.5	5.5	7.5	11	5.0	7.0
*Rated velocity	N_R	min^{-1}	1500	1500	1500	1500	2000	1000
*Maximum velocity	N_{max}	min^{-1}	2500	3000	3000	2500	4000	1000
*Rated torque	T_R	N・m	35.0	35.0	48.0	70.0	24.0	67.0
*Continuous Torque at stall	T_S	N・m	37.3	37.5	54.9	80.0	32.0	70.0
*Peak Torque at stall	T_P	N・m	90.0	107.0	140.0	170.0	75.0	150.0
*Rated armature current	I_R	Arms	31.6	46.2	51.2	61.9	22.0	34.0
*Armature current at stall	I_S	Arms	32.9	48.0	56.8	66.0	34.0	34.0
*Peak armature current at stall	I_P	Arms	83.0	155.0	155.0	155.0	83.0	83.0
*Torque constant	K_T	N・m/ Arms	1.23	0.84	1.04	1.25	1.0	2.25
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	42.8	29.3	36.6	43.8	34.9	78.6
Phase resistance	R_ϕ	Ω	0.059	0.03	0.03	0.035	0.047	0.085
*Rated power rate	Q_R	kW/s	180	180	235	445	105	330
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	68	68	98	110	55	136
Mass Note1)	WE	kg	27.7	27.7	35.7	40	22.5	43
Brake mass	W	kg	2.8	2.8	4.5	8.9	5.5	7.8
Aluminum plate		mm	t20 x 540	t20 x 540	t20 x 540	t30 x 610	t20 x 540	t20 x 540

■ Specification of R2 motor, AC200V

Servo motor model number R2AA			2211KB	2215KB
Amplifier size combined			RS3A30	RS3A30
*Rated output	P_R	kW	11	15
*Rated velocity	N_R	min^{-1}	1500	1500
*Maximum velocity	N_{max}	min^{-1}	2000	2000
*Rated torque	T_R	N・m	70	95
*Continuous Torque at stall	T_S	N・m	80	95
*Peak Torque at stall	T_P	N・m	176	215
*Rated armature current	I_R	Arms	60	66
*Armature current at stall	I_S	Arms	66	66
*Peak armature current at stall	I_P	Arms	155	155
*Torque constant	K_T	N・m/ Arms	1.38	1.5
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	48.0	52.3
Phase resistance	R_ϕ	Ω	0.022	0.017
*Rated power rate	Q_R	kW/s	275	380
Moment of inertia	J_M	Kg・m^2(GD^2/4) x10^{-4}	178	237
Mass Note1)	WE	kg	55	62
Brake mass	W	kg	7.8	7.8
Aluminum plate		mm	t30 x 610	t30 x 610

Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

- ■ Specification of R2 motor, AC100V

Servo motor model number R2EA			04003F	04005F	04008F	06010F	06020F
Amplifier size combined			RS3E01	RS3E02	RS3E02	RS3E02	RS3E03
*Rated output	P_R	kW	0.03	0.05	0.08	0.1	0.2
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	6000	6000	6000	6000	6000
*Rated torque	T_R	N・m	0.098	0.159	0.255	0.318	0.637
*Continuous Torque at stall	T_S	N・m	0.108	0.167	0.255	0.318	0.686
*Peak Torque at stall	T_P	N・m	0.37	0.59	0.86	1.0	2.2
*Rated armature current	I_R	Arms	0.94	1.2	1.3	1.7	3.1
*Armature current at stall	I_S	Arms	1.0	1.3	1.3	1.7	3.2
*Peak armature current at stall	I_P	Arms	3.7	4.9	4.5	5.6	11.9
*Torque constant	K_T	N・m/ Arms	0.116	0.142	0.22	0.206	0.224
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	4.04	4.97	7.7	7.2	7.82
Phase resistance	R_ϕ	Ω	4.0	3.0	2.9	1.5	0.6
*Rated power rate	Q_R	kW/s	3.9	6.7	10	8.6	19
Moment of inertia	J_M	$Kg\cdot m^2(GD^2/4)$ $x10^{-4}$	0.028	0.0409	0.066	0.120	0.222
Mass Note1)	WE	kg	0.35	0.39	0.51	0.71	0.96
Brake mass	W	kg	0.27	0.27	0.27	0.34	0.39
Aluminum plate		mm	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250

Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

- ■ Specification of R5 motor, AC200V

Servo motor model number R5AA			06020H	06020F	06040H	06040F	08075D	08075F
Amplifier size combined			RS3A01	RS3A02	RS3A02	RS3A02	RS3A03	RS3A03
*Rated output	P_R	kW	0.2	0.2	0.4	0.4	0.75	0.75
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	3000	6000	3000	6000	5000	6000
*Rated torque	T_R	N・m	0.637	0.637	1.27	1.27	2.39	2.39
*Continuous Torque at stall	T_S	N・m	0.686	0.686	1.37	1.37	2.55	2.55
*Peak Torque at stall	T_P	N・m	2.2	2.2	4.8	4.8	8.5	7.5
*Rated armature current	I_R	Arms	1.1	1.5	1.8	2.8	3.9	4.5
*Armature current at stall	I_S	Arms	1.1	1.6	1.8	2.8	3.9	4.5
*Peak armature current at stall	I_P	Arms	4.2	5.7	7.0	10.8	14.4	15.5
*Torque constant	K_T	N・m/ Arms	0.649	0.476	0.836	0.525	0.763	0.607
Voltage constant for each phase	$K_{E\phi}$	mV/min^{-1}	21.7	16.1	27.0	17.3	23.2	18.9
Phase resistance	R_ϕ	Ω	4.8	2.7	3.3	1.36	0.78	0.51
*Rated power rate	Q_R	kW/s	20	20	39	39	35	35
Moment of inertia	J_M	$Kg\cdot m^2(GD^2/4)$ $x10^{-4}$	0.2	0.2	0.417	0.417	1.653	1.653
Mass Note1)	WE	kg	0.96	0.96	1.4	1.4	2.7	2.7
Brake mass	W	kg	0.39	0.39	0.39	0.39	0.9	0.9
Aluminum plate		mm	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250	t6 x 250

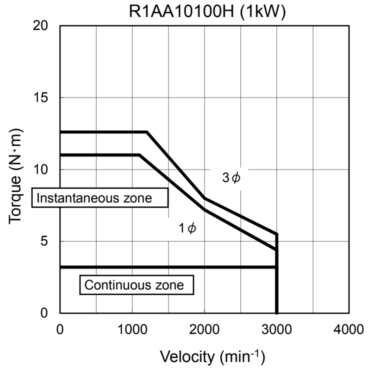
Note1) Contains Battery-less absolute encoder (Encoder code: R).

- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

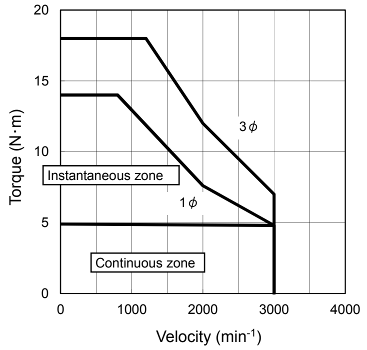
12.4.2 Velocity-torque characteristics

R1AA motor velocity-torque characteristics charts show the values when AC200V is used as input power supply. When power supply voltage is less than 200V, instantaneous zone decreases.

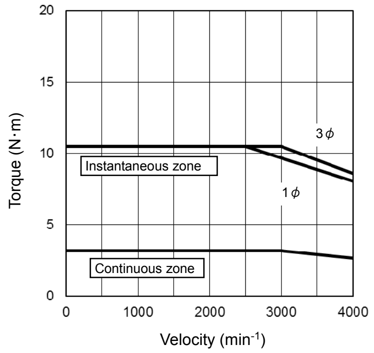
Velocity-torque characteristic
R1AA10100H (1kW)



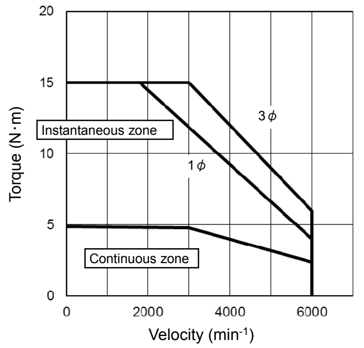
Velocity-torque characteristic
R1AA10150H (1.5kW)



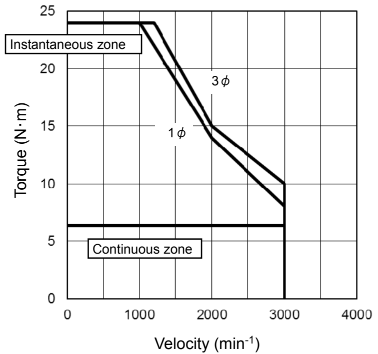
Velocity-torque characteristic
R1AA10100F (1kW)



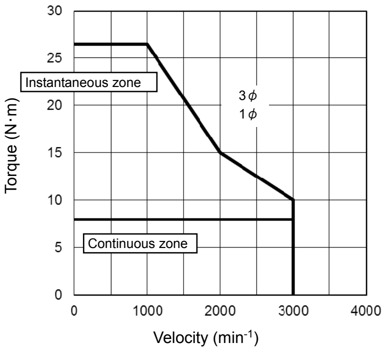
Velocity-torque characteristic
R1AA10150F (1.5kW)



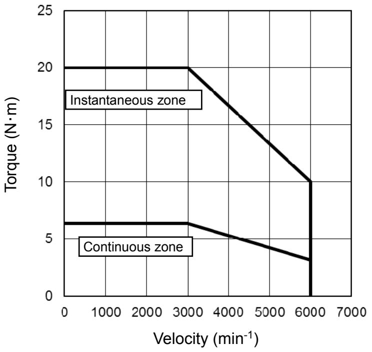
Velocity-torque characteristic
R1AA10200H (2kW)



Velocity-torque characteristic
R1AA10250H (2.5kW)

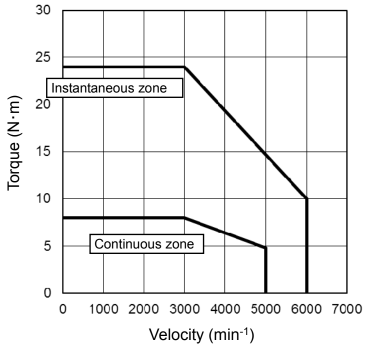


Velocity-torque characteristic
R1AA10200F (2kW)

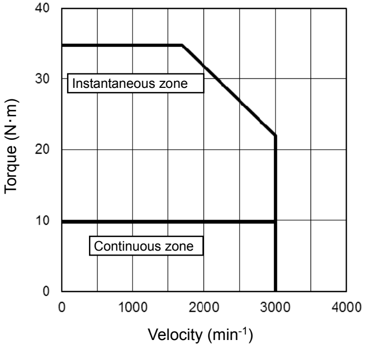


Note 1)

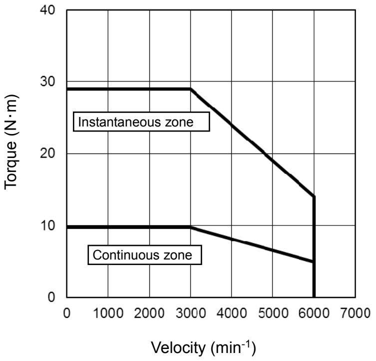
Velocity-torque characteristic
R1AA10250F (2.5kW)



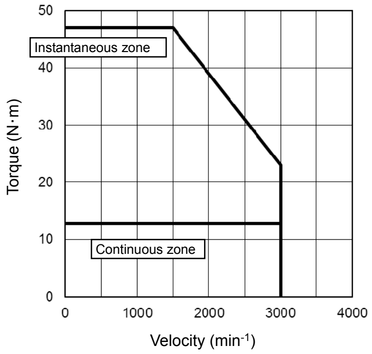
Velocity-torque characteristic
R1AA13300H (3kW)



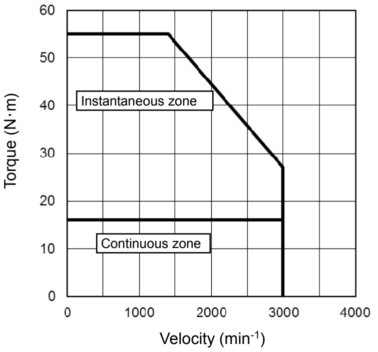
Velocity-torque characteristic
R1AA13300F (3kW)



Velocity-torque characteristic
R1AA13400H (4kW)

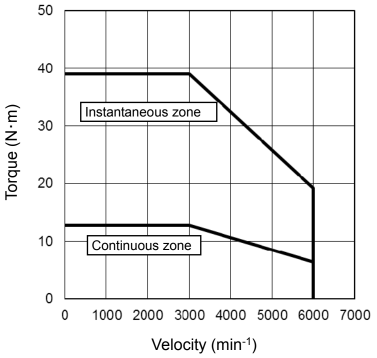


Velocity-torque characteristic
R1AA13500H (5kW)

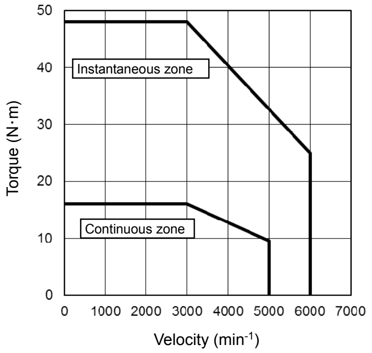


Note1) When you use motor (R1AA10250F, R1AA13500F, R1AA1811KR) whose maximum rotational velocity Nmax and maximum rotational velocity in the continuous zone are different, use the motor so that the motor average rotational velocity does not exceed maximum rotational velocity in the continuous zone.

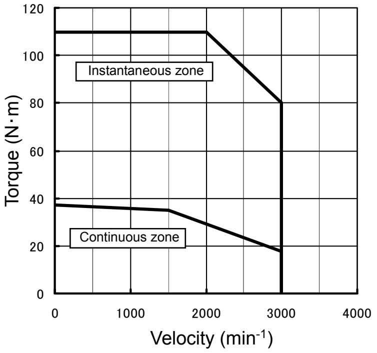
Velocity-torque characteristic
R1AA13400F (4kW)



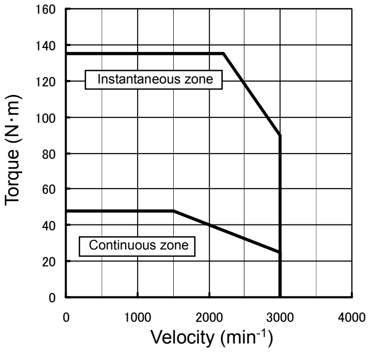
Note 1)
Velocity-torque characteristic
R1AA13500F (5kW)



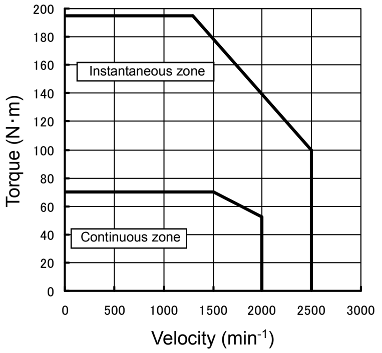
Velocity-torque characteristic
R1AA18550H (5.5kW)



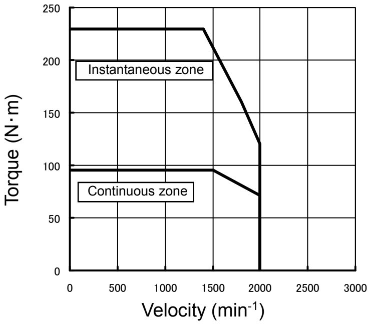
Velocity-torque characteristic
R1AA18550H (5.5kW)



Note 1)
Velocity-torque characteristic
R1AA1811KR (11kW)



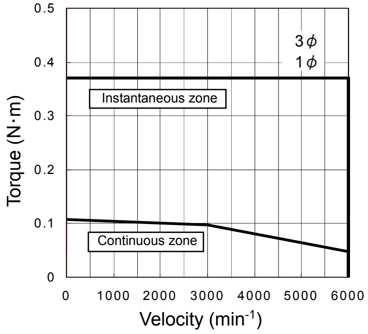
Velocity-torque characteristic
R1AA1815KB (15kW)



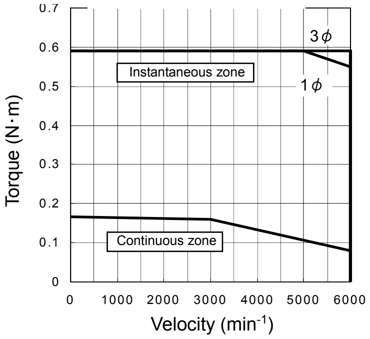
Note1) When you use motor (R1AA10250F, R1AA13500F, R1AA1811KR) whose maximum rotational velocity Nmax and maximum rotational velocity in the continuous zone are different, use the motor so that the motor average rotational velocity does not exceed maximum rotational velocity in the continuous zone.

R2AA motor velocity-torque characteristics charts show the values when AC200V 3-phase and single-phase are used as input power supply. When power supply voltage is less than 200V, instantaneous zone decreases.

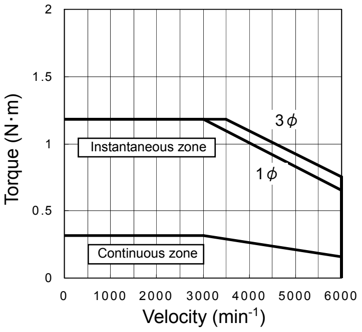
Velocity-torque characteristic
R2AA04003F (30W)



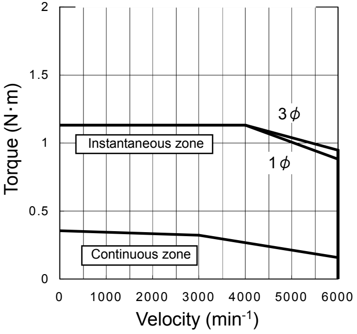
Velocity-torque characteristic
R2AA04005F (50W)



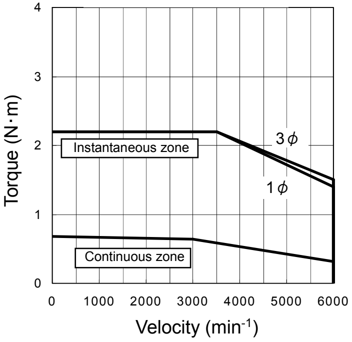
Velocity-torque characteristic
R2AA04010F (100W)



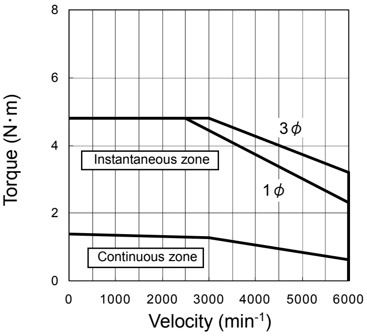
Velocity-torque characteristic
R2AA06010F (100W)



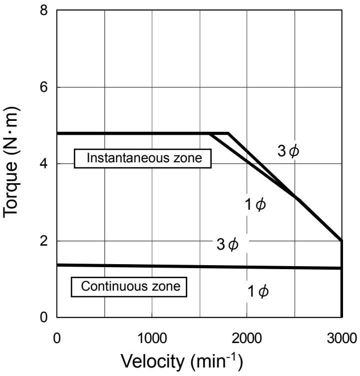
Velocity-torque characteristic
R2AA06020F (200W)



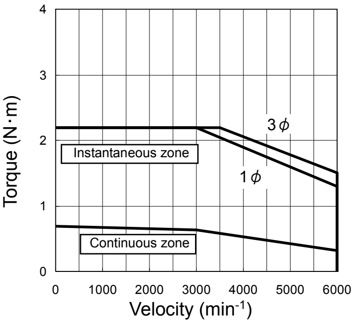
Velocity-torque characteristic
R2AA06040F (400W)



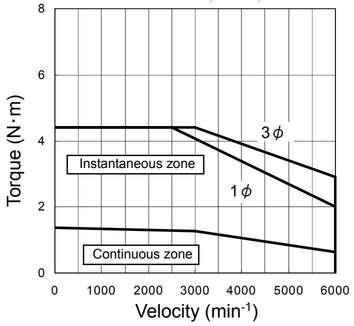
Velocity-torque characteristic
R2AA06040H (400W)



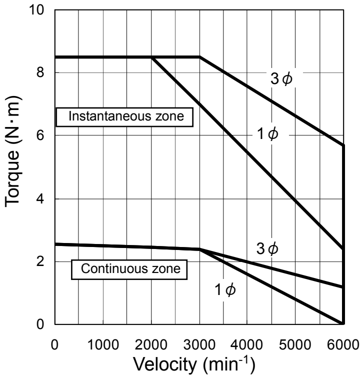
Velocity-torque characteristic
R2AA08020F (200W)



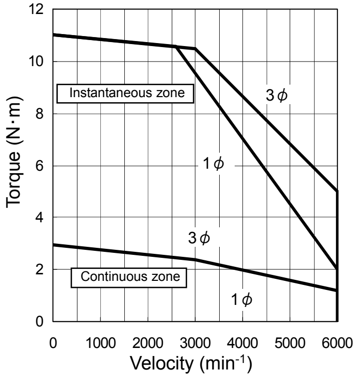
Velocity-torque characteristic
R2AA08040F (400W)



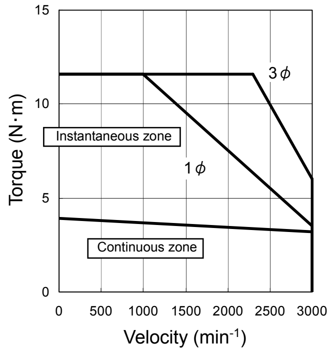
Velocity-torque characteristic
R2AA08075F (750W)



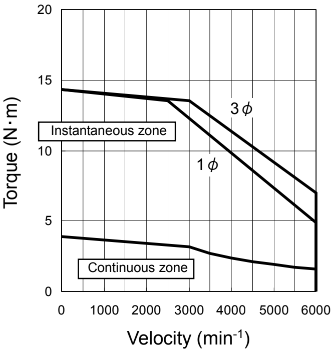
Velocity-torque characteristic
R2AAB8075F (750W)



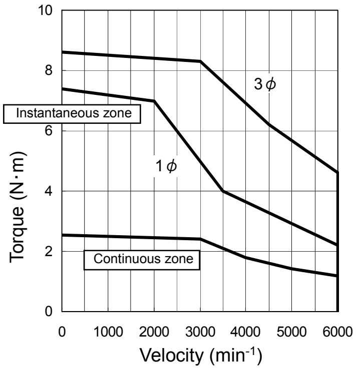
Velocity-torque characteristic
R2AAB8100H (1kW)



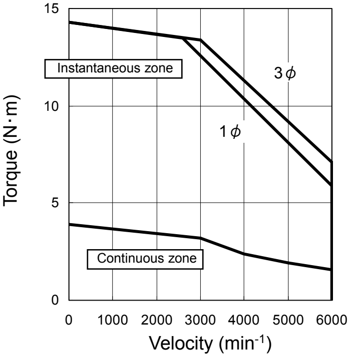
Velocity-torque characteristic
R2AAB8100F (1kW)



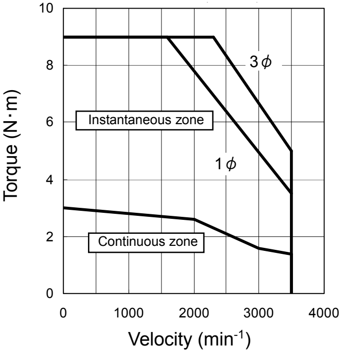
Velocity-torque characteristic
R2AA10075F (750W)



Velocity-torque characteristic
R2AA10100F (1kW)

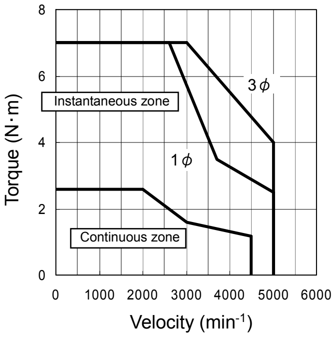


Velocity-torque characteristic
R2AA13050H (550W)

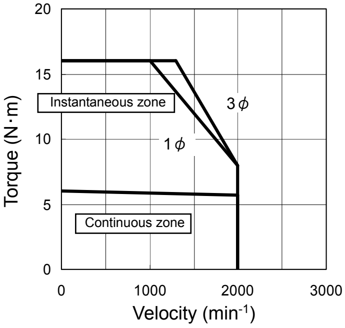


Note1)

Velocity-torque characteristic
R2AA13050D (550W)

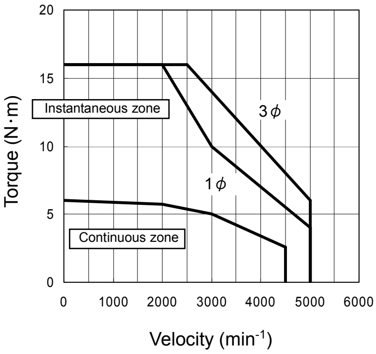


Velocity-torque characteristic
R2AA13120B (1.2kW)

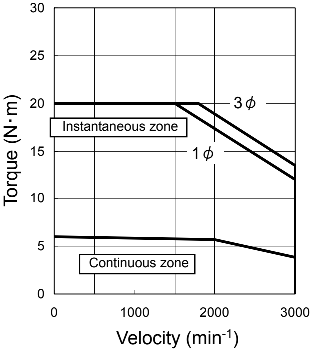


Note1)

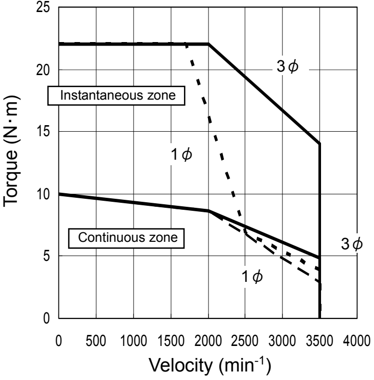
Velocity-torque characteristic
R2AA13120D (1.2kW)



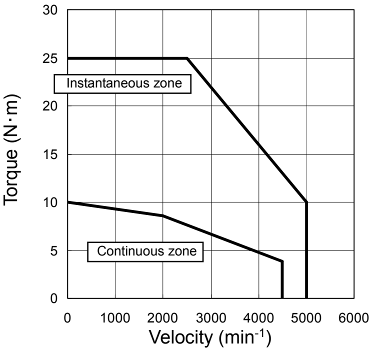
Velocity-torque characteristic
R2AA13120L (1.2kW)



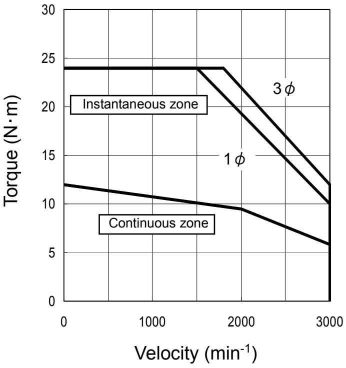
Velocity-torque characteristic
R2AA13180H (1.8kW)



Velocity-torque characteristic
R2AA13180D (1.8kW)

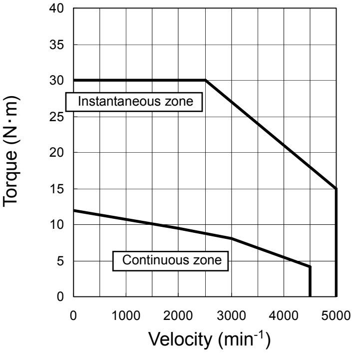


Velocity-torque characteristic
R2AA13200L (2kW)



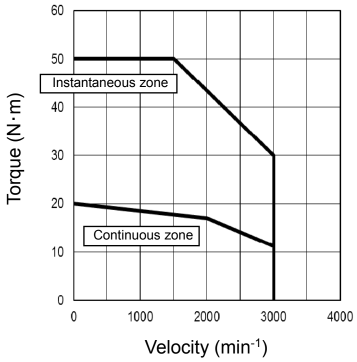
Note1)

Velocity-torque characteristic
R2AA13200D (2kW)

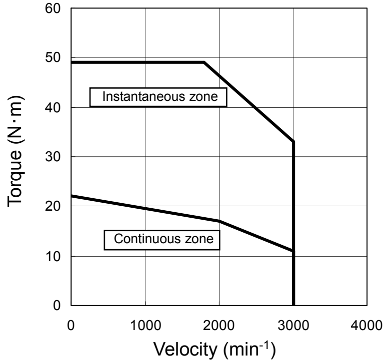


Note1) When you use motor (R2AA13050D, R2AA13120D, R2AA13180D, R2AA13200D, R2AA18450H, R2AA1811KR, R2AA22500L) whose maximum rotational velocity Nmax and maximum rotational velocity in the continuous zone are different, use the motor so that the motor average rotational velocity does not exceed maximum rotational velocity in the continuous zone.

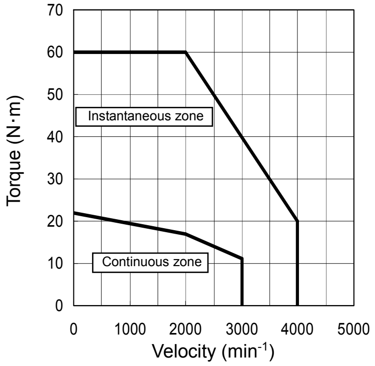
Velocity-torque characteristic
R2AA18350V（3.5kW）



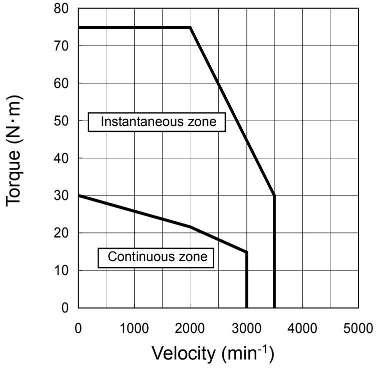
Velocity-torque characteristic
R2AA18350L (3.5kW)



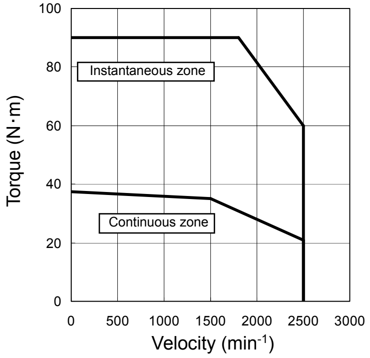
Velocity-torque characteristic
R2AA18350D (3.5kW)



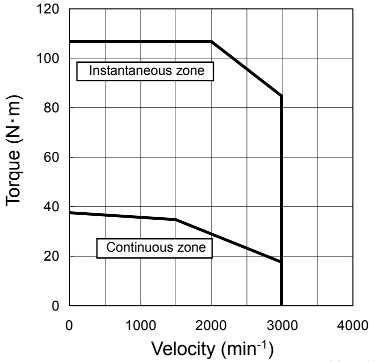
Velocity-torque characteristic
R2AA18450H (4.5kW)



Velocity-torque characteristic
R2AA18550R (5.5kW)

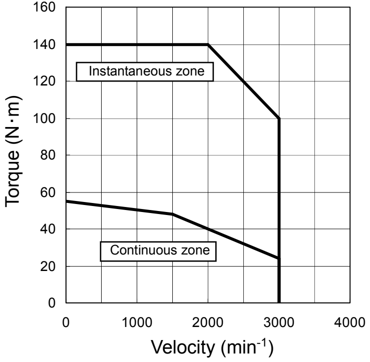


Velocity-torque characteristic
R2AA18550H (5.5kW)

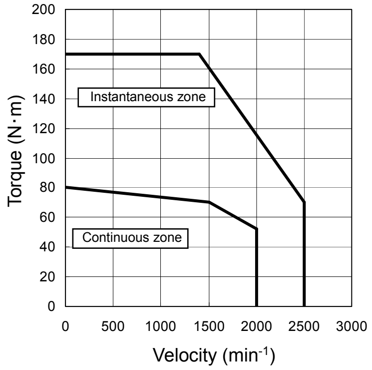


Note1)

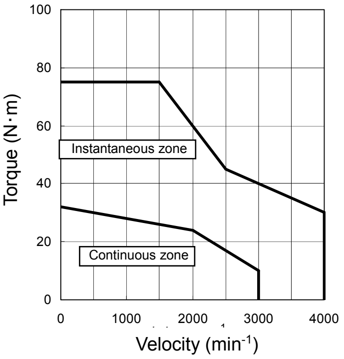
Velocity-torque characteristic
R2AA18750H (7.5kW)



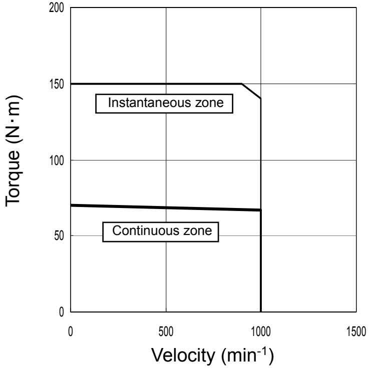
Velocity-torque characteristic
R2AA18750H (7.5kW)



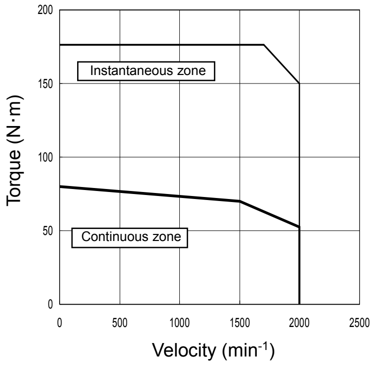
Velocity-torque characteristic
R2AA22500L (5kW)



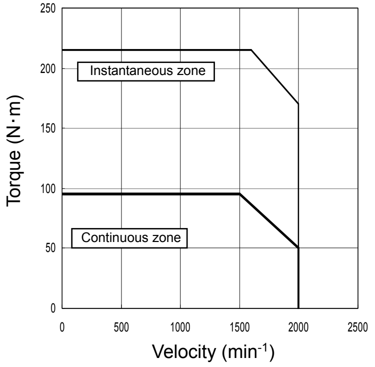
Velocity-torque characteristic
R2AA22700S (7kW)



Velocity-torque characteristic
R2AA2211KB (11kW)



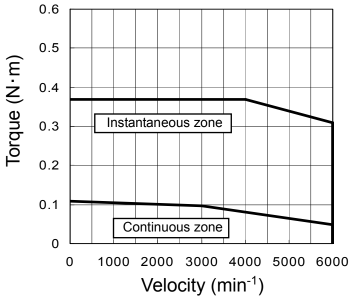
Velocity-torque characteristic
R2AA2215KB (15kW)



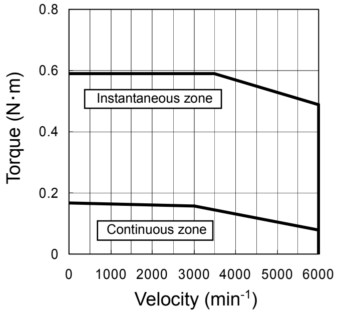
Note1) When you use motor (R2AA13050D, R2AA13120D, R2AA13180D, R2AA13200D, R2AA18450H, R2AA1811KR, R2AA22500L) whose maximum rotational velocity Nmax and maximum rotational velocity in the continuous zone are different, use the motor so that the motor average rotational velocity does not exceed maximum rotational velocity in the continuous zone.

R2EA Motor velocity-torque characteristics indicate the values when amplifier power supply is AC100V. Instantaneous zone decreases when amplifier power supply is below 100V.

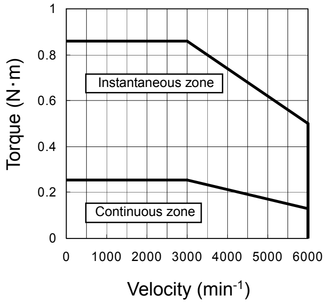
Velocity-torque characteristic
R2EA04003F (30W)



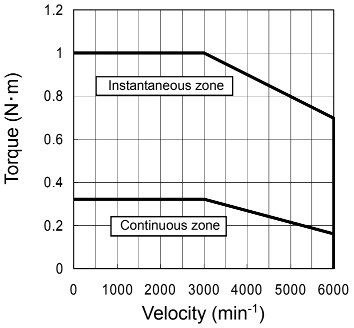
Velocity-torque characteristic
R2EA04005F (50W)



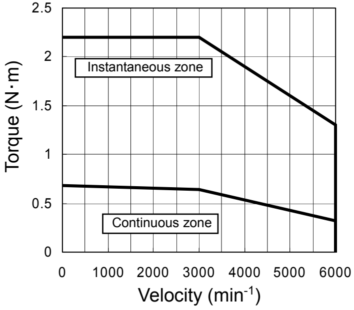
Velocity-torque characteristic
R2EA04008F (80W)



Velocity-torque characteristic
R2EA06010F (100W)



Velocity-torque characteristic
R2EA06020F (200W)



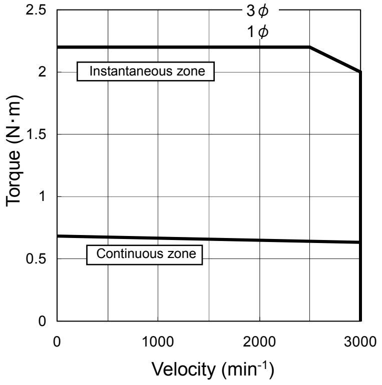
✔ For servo motor with oil-seal and/or brake, the following decrease-rating ratios have to be applied to the torque characteristic in the continuous velocity zone.

Oil Seal / Brake	Without Oil Seal	With Oil Seal
Without brake	—	Degree of decrease rating 2
With brake	Degree of decrease rating 1	Degree of decrease rating 2

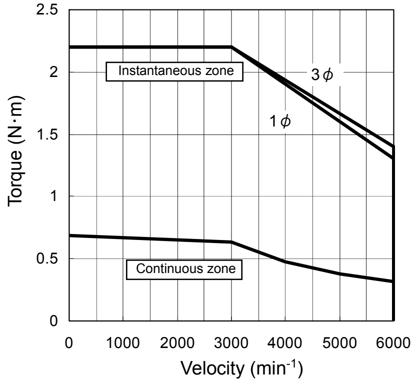
	R2AA04005F	R2AA04010F	R2AA06040□	R2AA08075F	R2EA04005F
Degree of decrease rating 1	—	90%	90%	—	—
Degree of decrease rating 2	90%	85%	80%	90%	90%

R5AA Motor velocity-torque characteristics indicate the values when amplifier power supply is AC200V. Instantaneous zone decreases when amplifier power supply is below 200V.

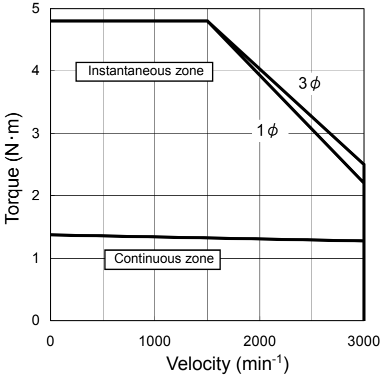
Velocity-torque characteristic
R5AA06020H (200W)



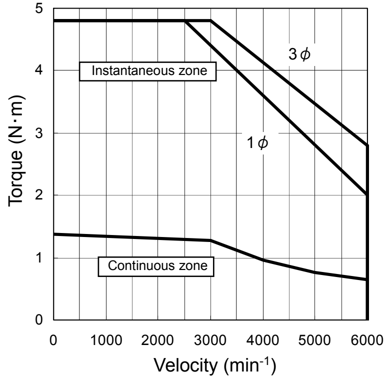
Velocity-torque characteristic
R5AA06020F (200W)



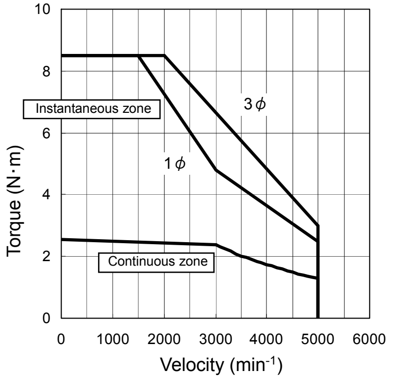
Velocity-torque characteristic
R5AA06040H (400W)



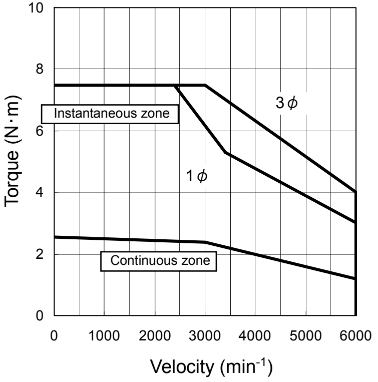
Velocity-torque characteristic
R5AA06040F (400W)



Velocity-torque characteristic
R5AA08075D (750W)



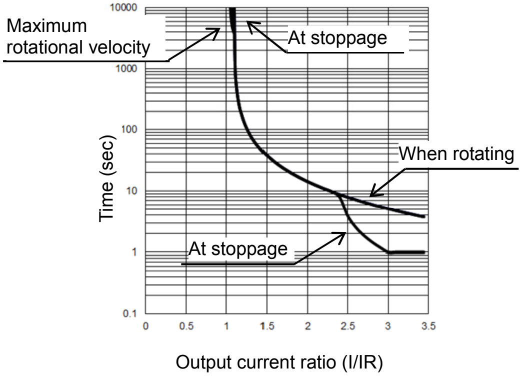
Velocity-torque characteristic
R5AA08075F (750W)



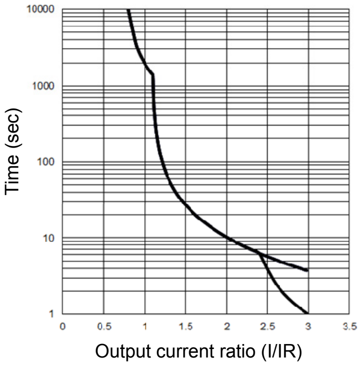
12.4.3 Overload characteristics

The following show overload characteristic of R1AA motor.

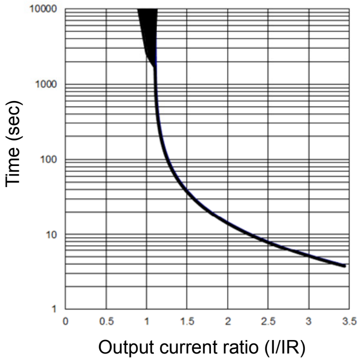
Overload characteristic
R1AA10100H (1kW)



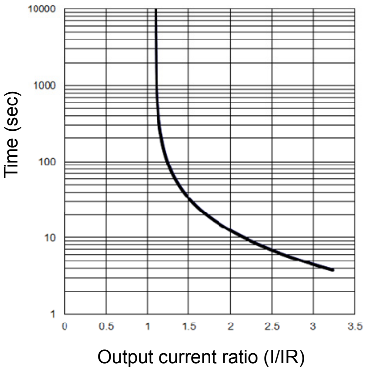
Overload characteristic
R1AA10150H (1.5kW)



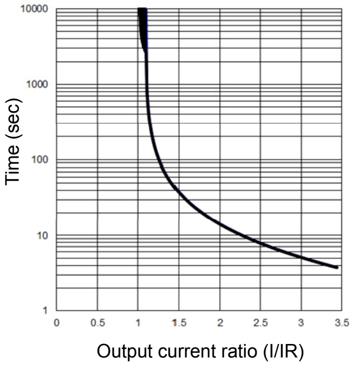
Overload characteristic
R1AA10100F (1kW)



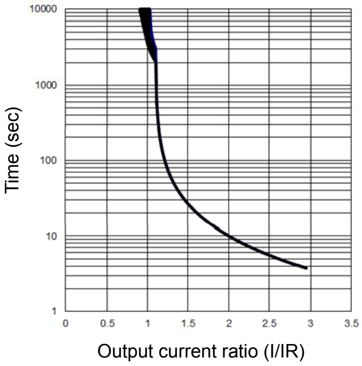
Overload characteristic
R1AA10150F (1.5kW)



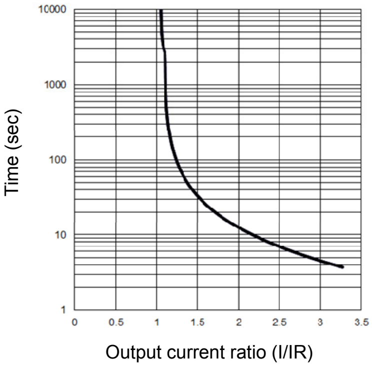
Overload characteristic
R1AA10200H (2kW)



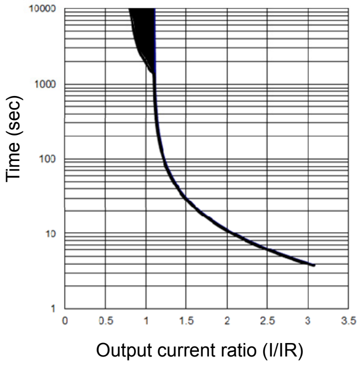
Overload characteristic
R1AA10250H (2.5kW)



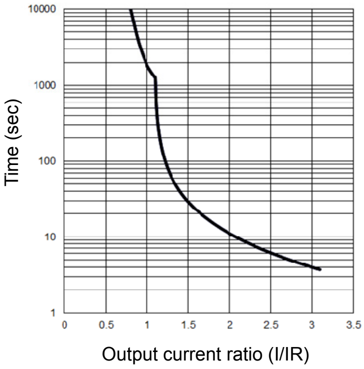
Overload characteristic
R1AA10200F (2kW)



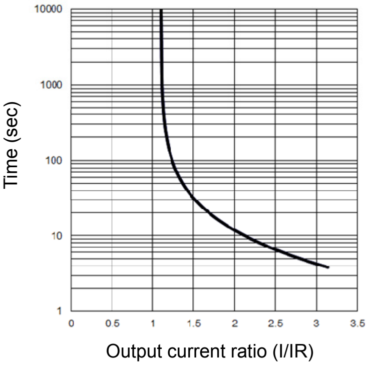
Overload characteristic
R1AA10250F (2.5kW)



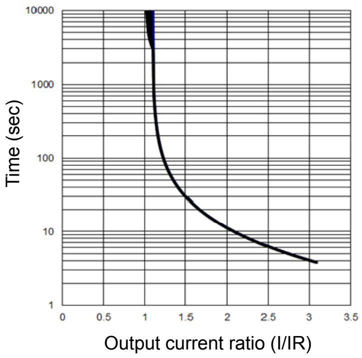
Overload characteristic
R1AA13300H (3kW)



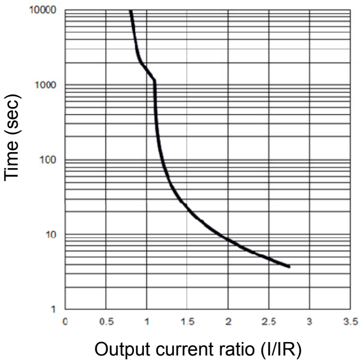
Overload characteristic
R1AA13300F (3kW)



Overload characteristic
R1AA13400H (4kW)

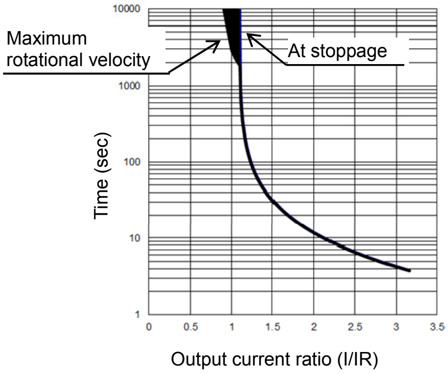


Overload characteristic
R1AA13500H (5kW)

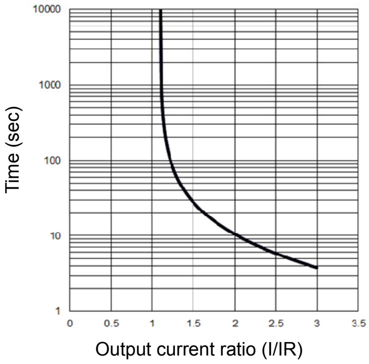


The following show overload characteristic of R1AA motor.

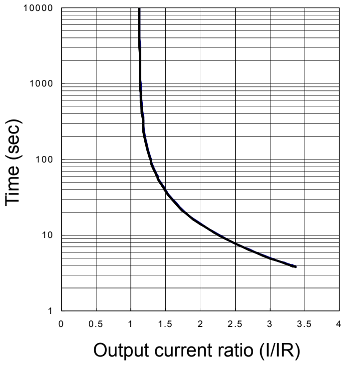
Overload characteristic
R1AA13400F (4kW)



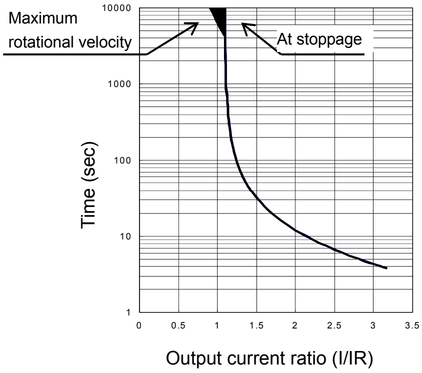
Overload characteristic
R1AA13500F (5kW)



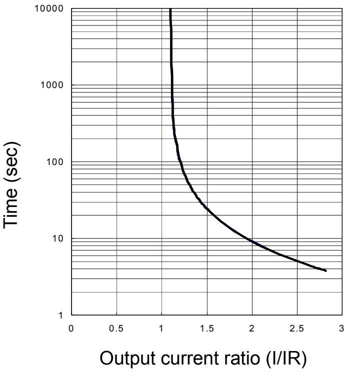
Overload characteristic
R1AA18550H (5.5kW)



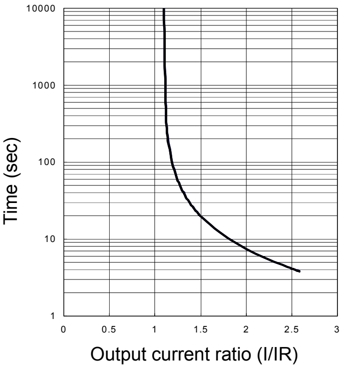
Overload characteristic
R1AA18750L (7.5kW)



Overload characteristic
R1AA1811KR (11kW)



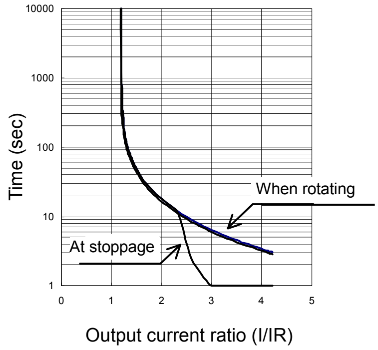
Overload characteristic
R1AA1815KB (15kW)



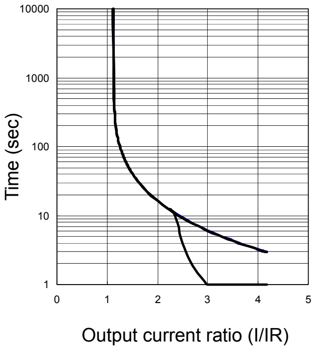
12. Appendix

The following show overload characteristic of R2AA motor.

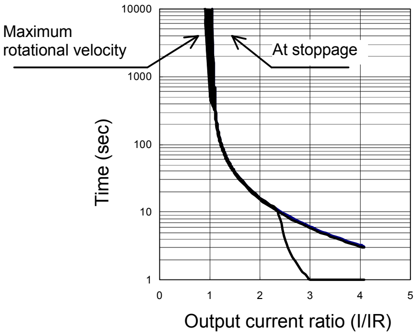
Overload characteristic
R2AA04003F (30W)



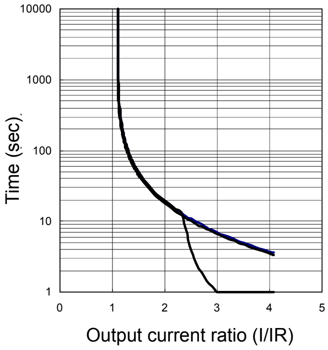
Overload characteristic
R2AA04005F (50W)



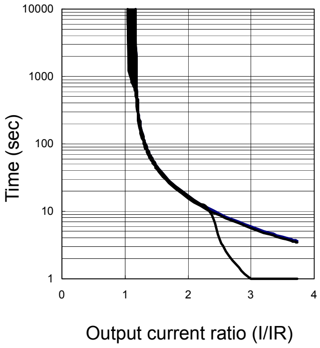
Overload characteristic
R2AA04010F (100W)



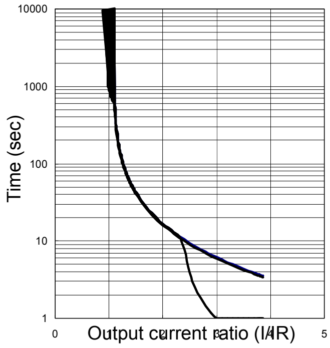
Overload characteristic
R2AA06010F (100W)



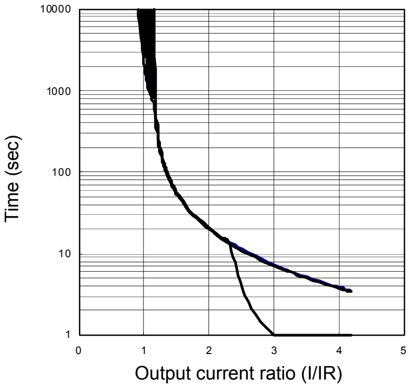
Overload characteristic
R2AA06020F (200W)



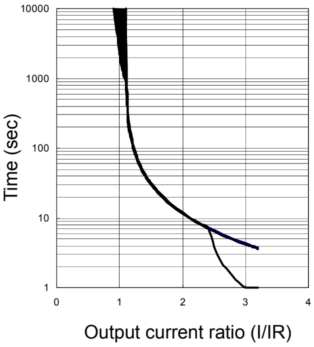
Overload characteristic
R2AA06040F (400W)



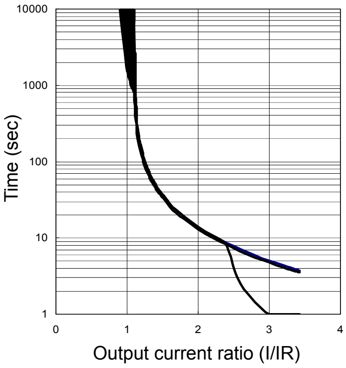
Overload characteristic
R2AA06040H (400W)



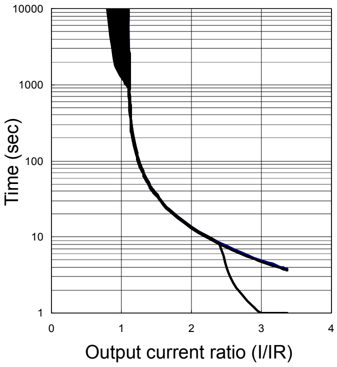
Overload characteristic
R2AA08020F (200W)



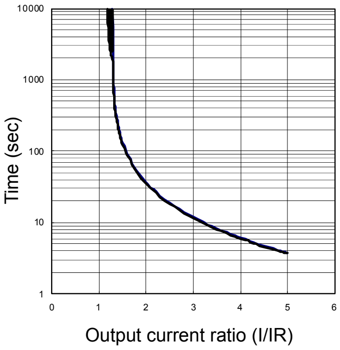
Overload characteristic
R2AA08040F (400W)



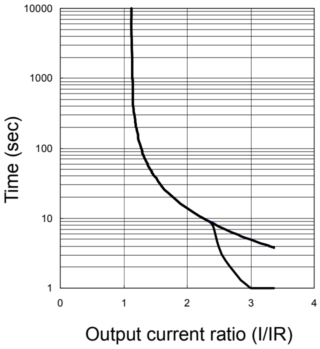
Overload characteristic
R2AA08075F (750W)



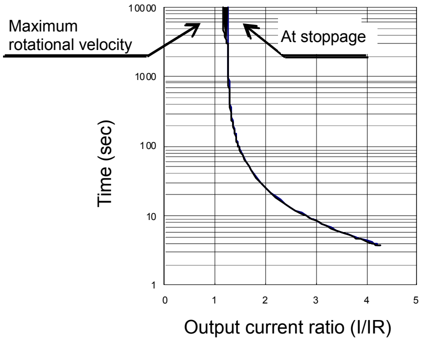
Overload characteristic
R2AAB8075F (750W)



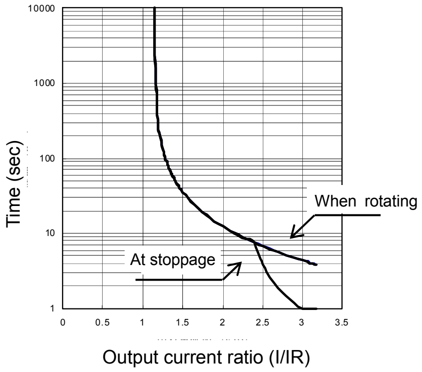
Overload characteristic
R2AAB8100H (1kW)



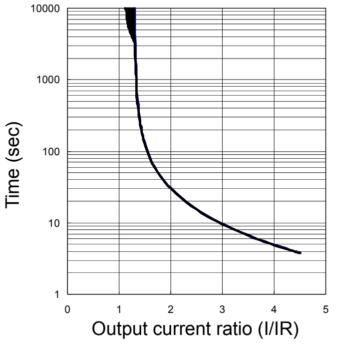
Overload characteristic
R2AAB8100F (1kW)



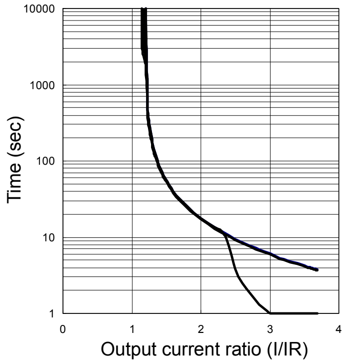
Overload characteristic
R2AA10075F (750W)



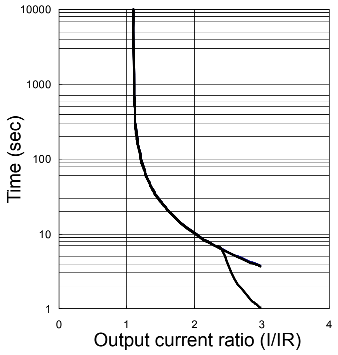
Overload characteristic
R2AA10100F (1kW)



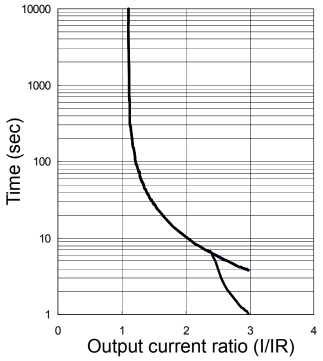
Overload characteristic
R2AA13050H (550W)



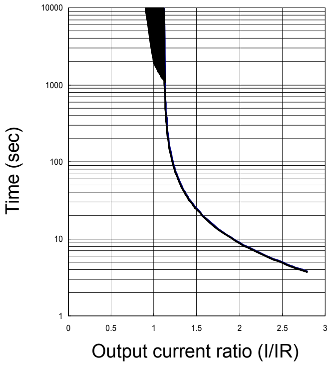
Overload characteristic
R2AA13050D (550W)



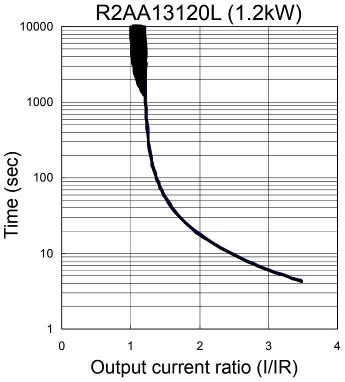
Overload characteristic
R2AA13120B (1.2kW)



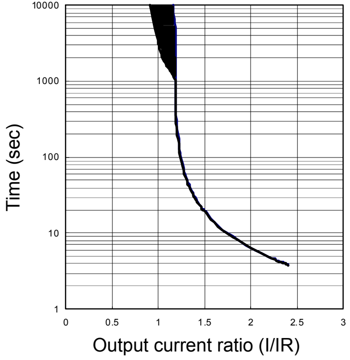
Overload characteristic
R2AA13120D (1.2kW)



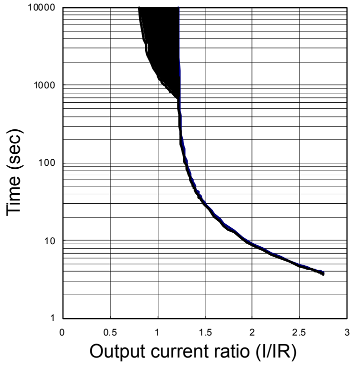
Overload characteristic
R2AA13120L (1.2kW)



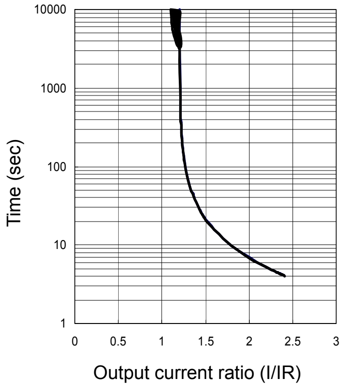
Overload characteristic
R2AA13180H (1.8kW)



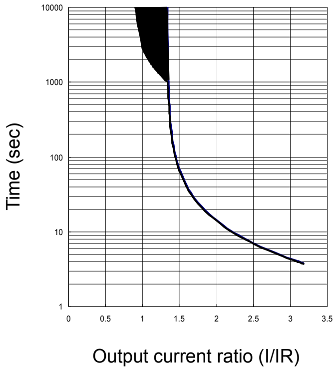
Overload characteristic
R2AA13180D (1.8kW)



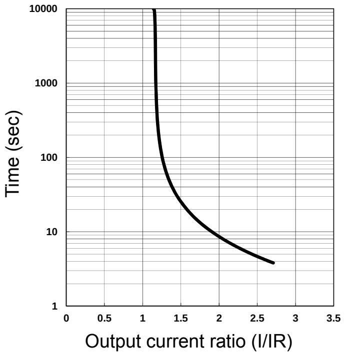
Overload characteristic
R2AA13200L (2kW)



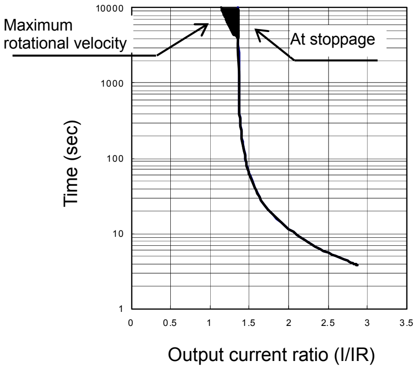
Overload characteristic
R2AA13200D (2kW)



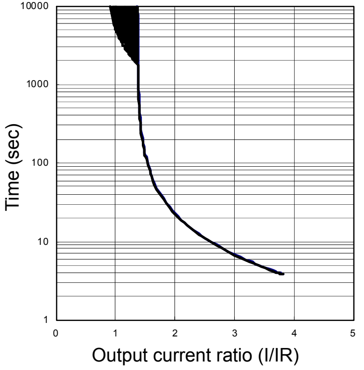
Overload characteristic
R2AA18350V (3.5kW)



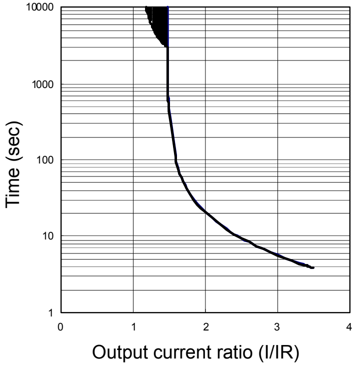
Overload characteristic
R2AA18350L (3.5kW)



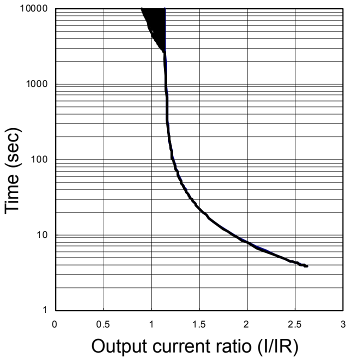
Overload characteristic
R2AA18350D (3.5kW)



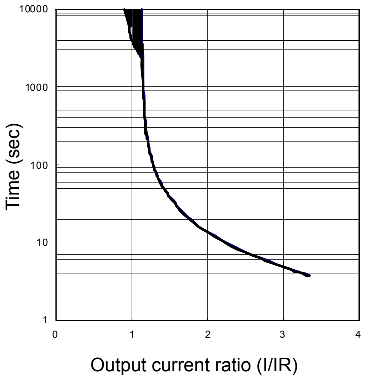
Overload characteristic
R2AA18450H (4.5kW)



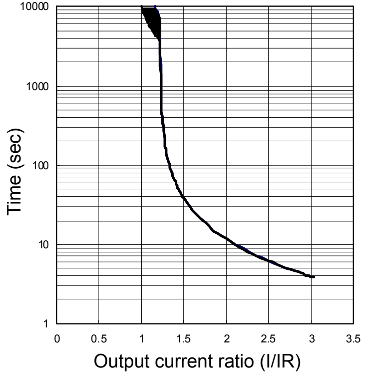
Overload characteristic
R2AA18550R (5.5kW)



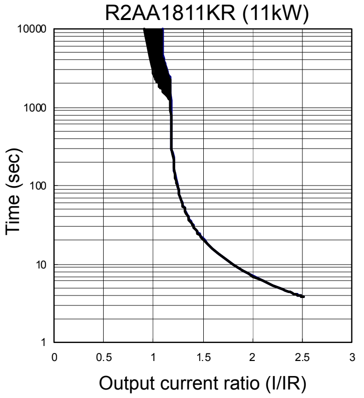
Overload characteristic
R2AA18550H (5.5kW)



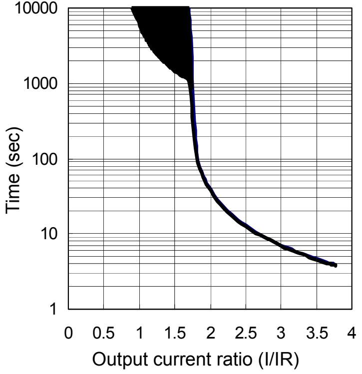
Overload characteristic
R2AA18750H (7.5kW)



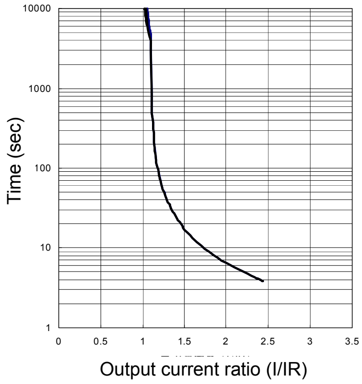
Overload characteristic
R2AA1811KR (11kW)



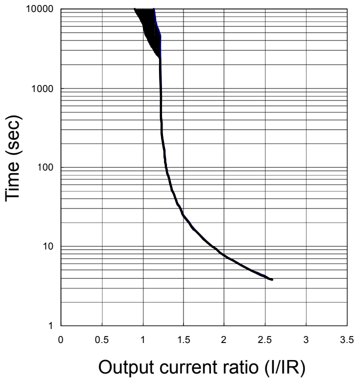
Overload characteristic
R2AA22500L (5kW)



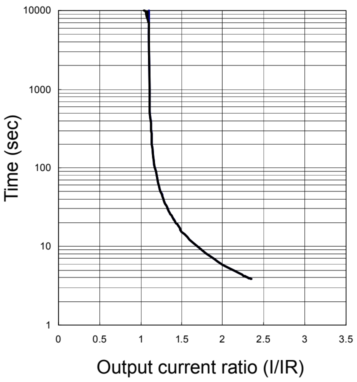
Overload characteristic
R2AA22700S (7kW)



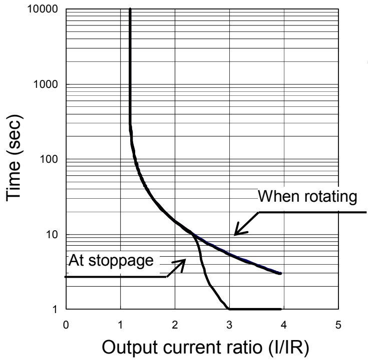
Overload characteristic
R2AA2211KB (11kW)

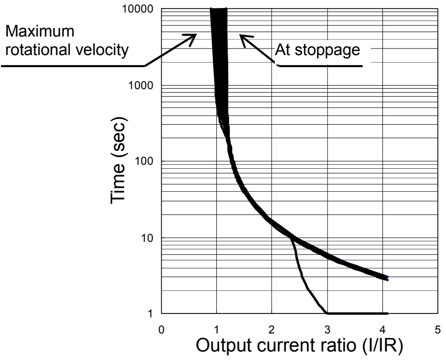


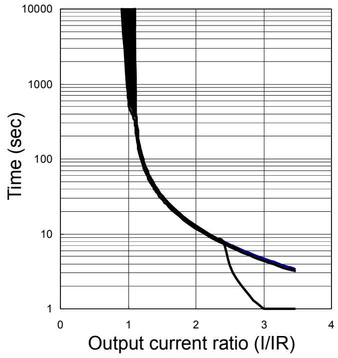
Overload characteristic
R2AA2215KB (15kW)

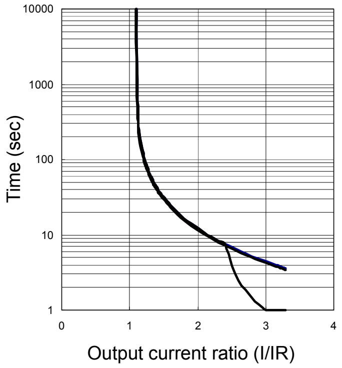


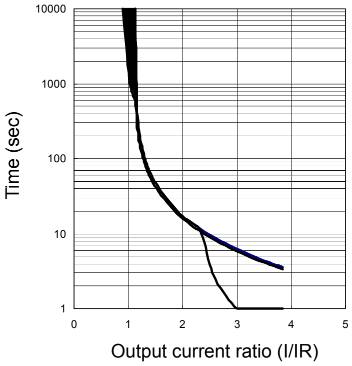
The following show overload characteristic of R2EA motor.


Overload characteristic
R2EA04003F (30W)

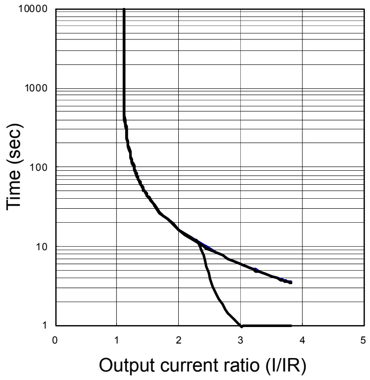

Overload characteristic
R2EA04005F (50W)

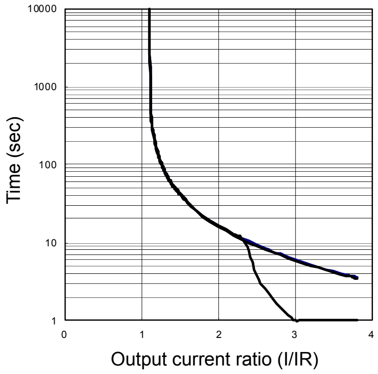

Overload characteristic
R2EA04008F (80W)

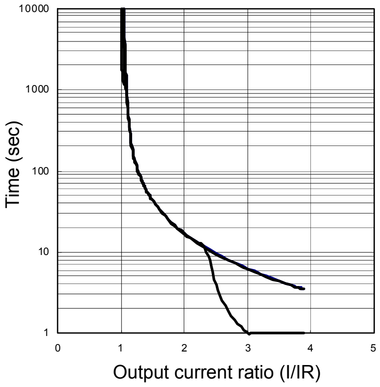

Overload characteristic
R2EA06010F (100W)

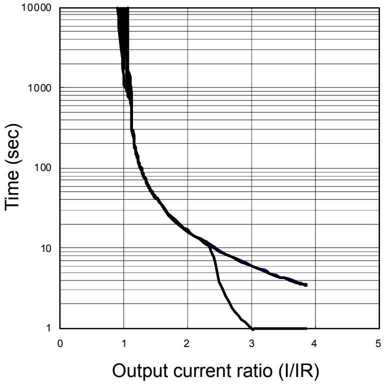

Overload characteristic
R2EA06020F (200W)

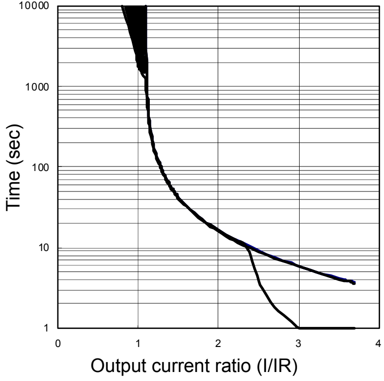
The following show overload characteristic of R5AA motor.

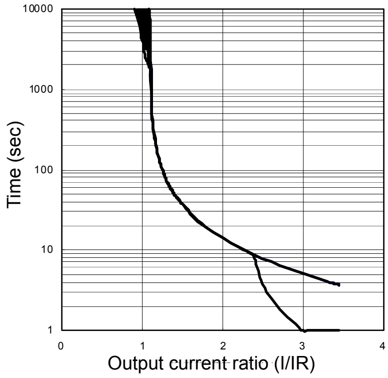

Overload characteristic
R5AA06020H (200W)


Overload characteristic
R5AA06020F (200W)


Overload characteristic
R5AA06040H (400W)

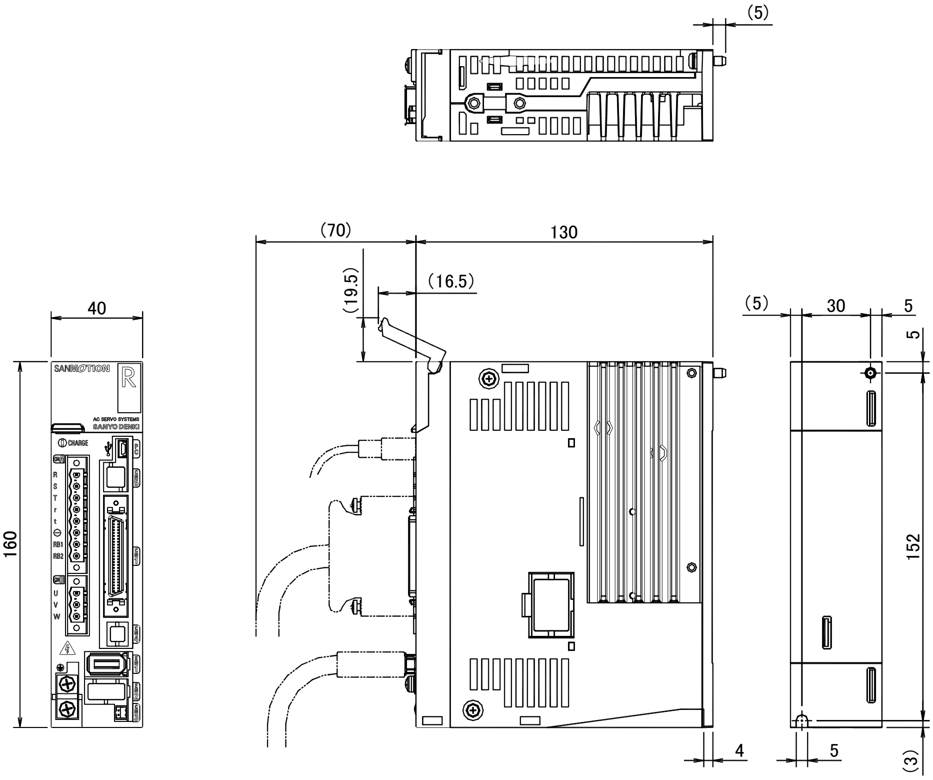

Overload characteristic
R5AA06040F (400W)


Overload characteristic
R5AA08075D (750W)

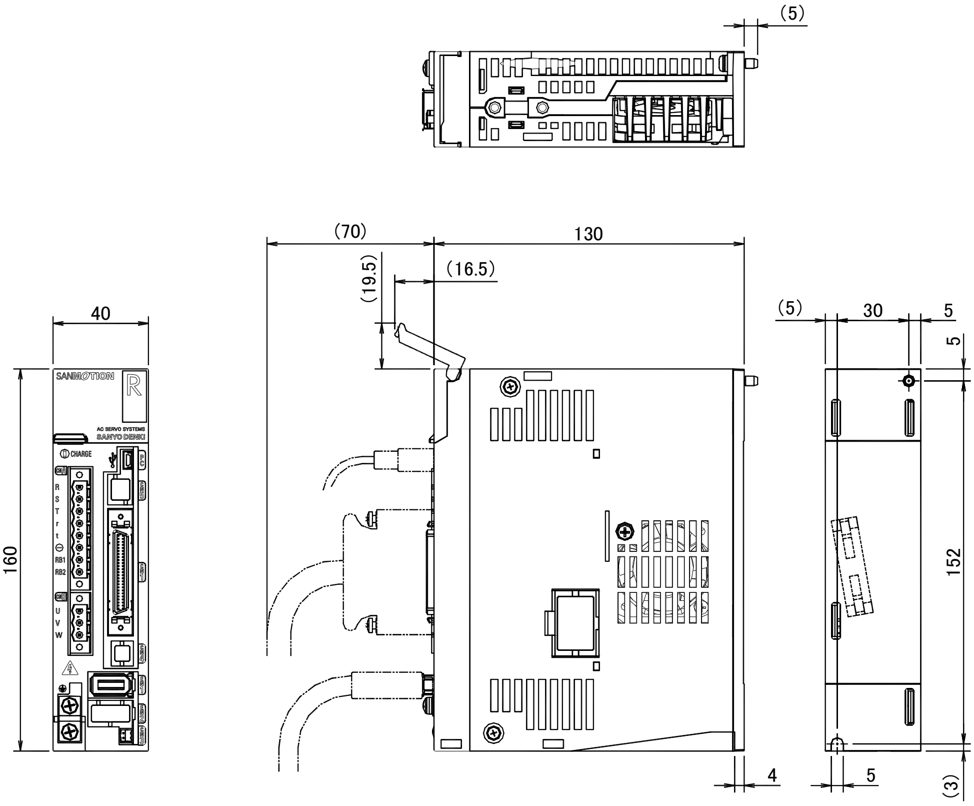

Overload characteristic
R5AA08075F (750W)

12.5 Servo amplifier dimensions

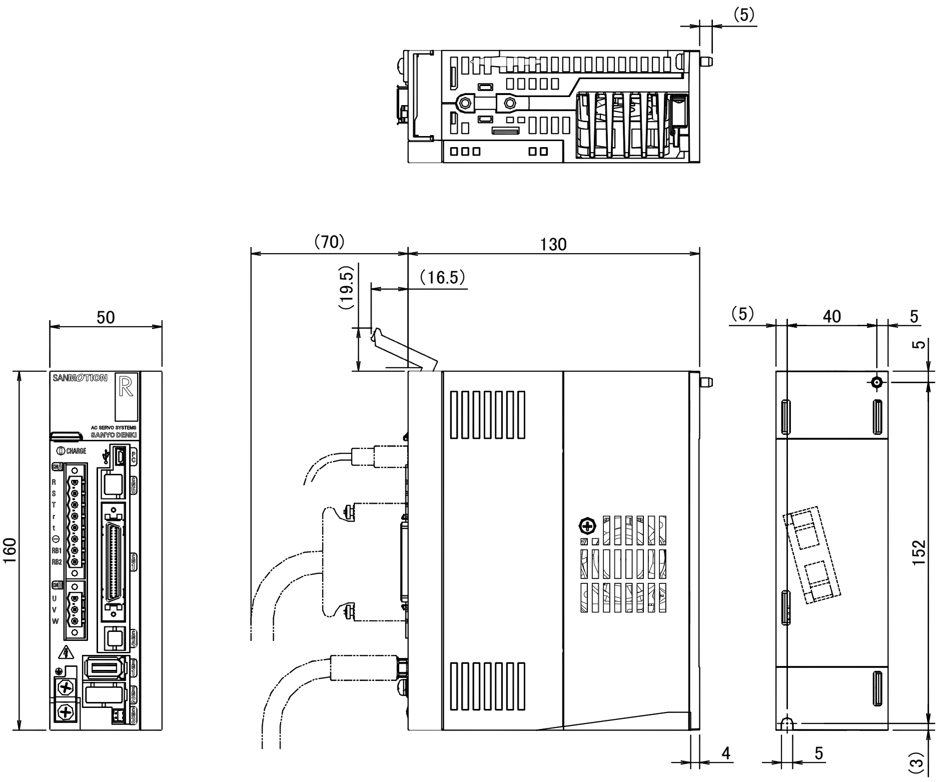
12.5.1 RS3☐01A☐☐L☐



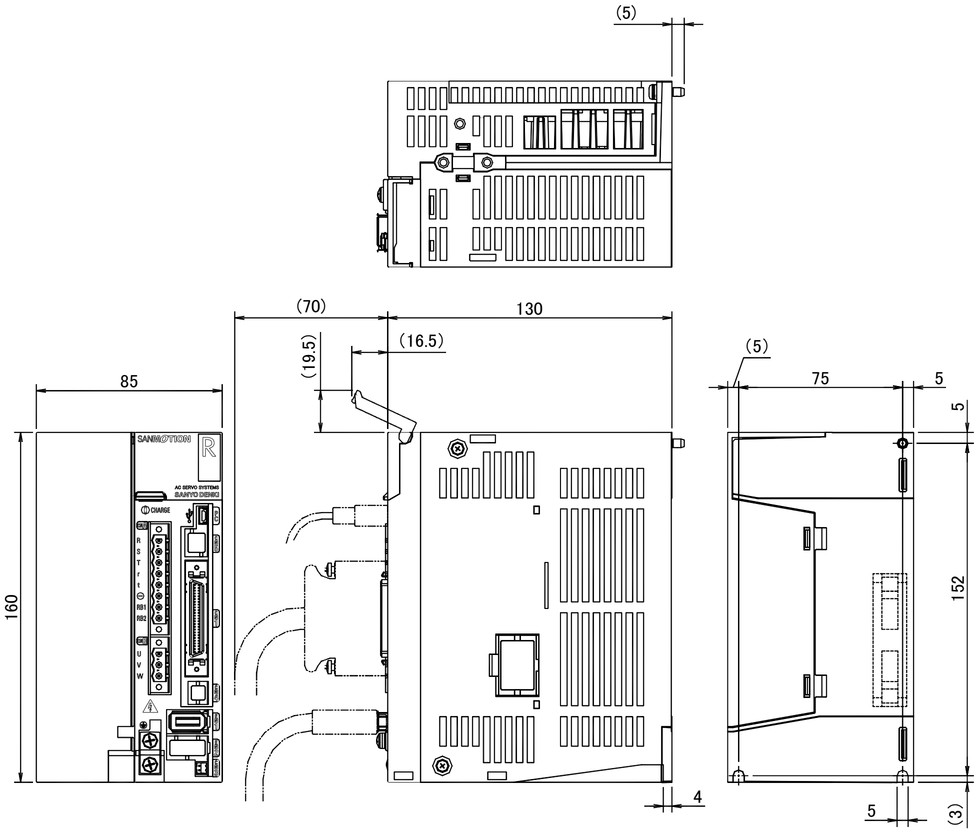
12.5.2 RS3☐02A☐☐L☐



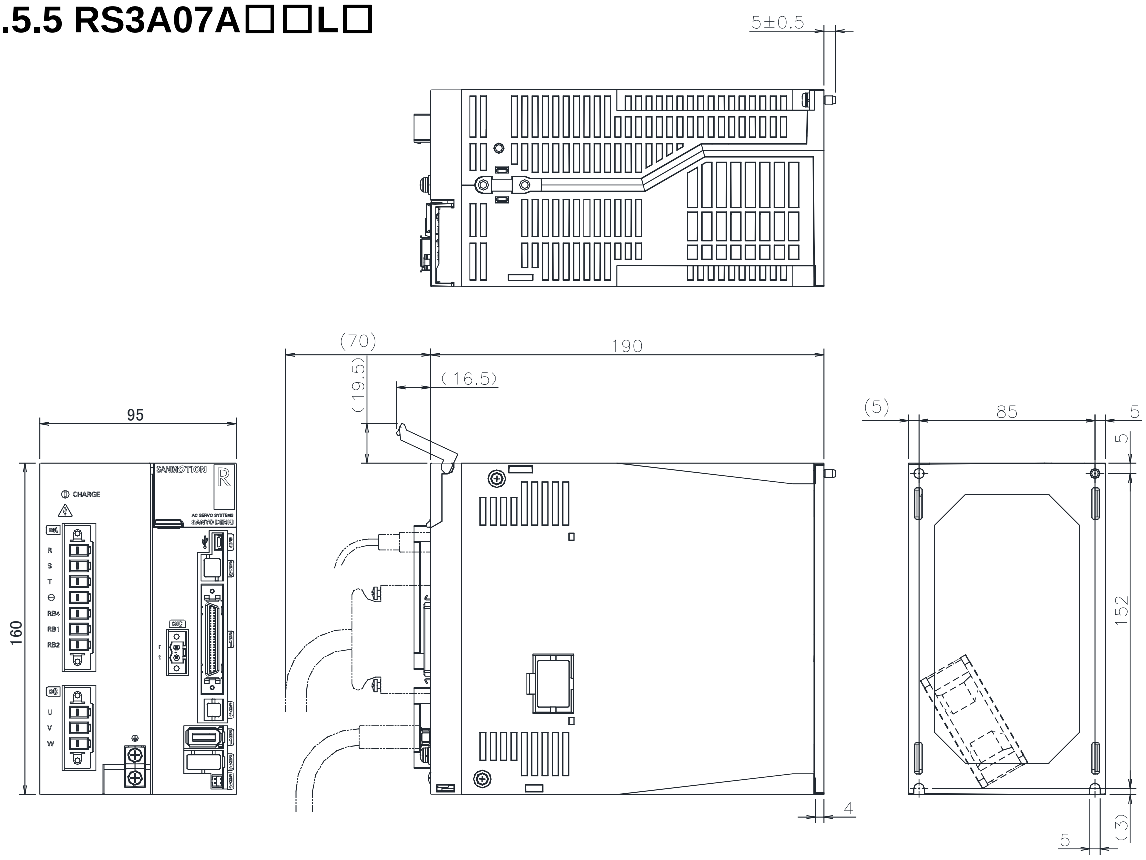
12.5.3 RS3□03A□□L□



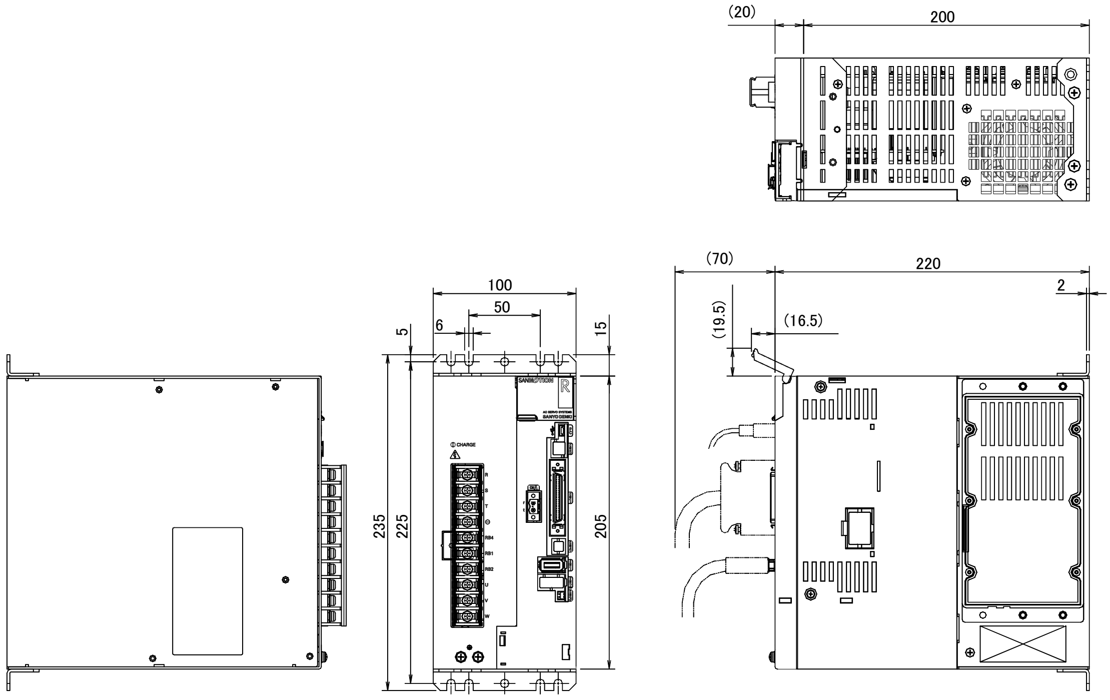
12.5.4 RS3A05A□□L□



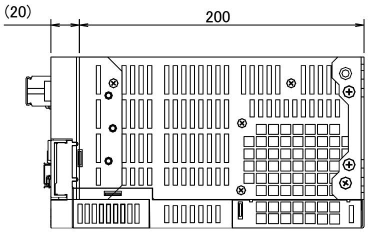
12.5.5 RS3A07A□□L□

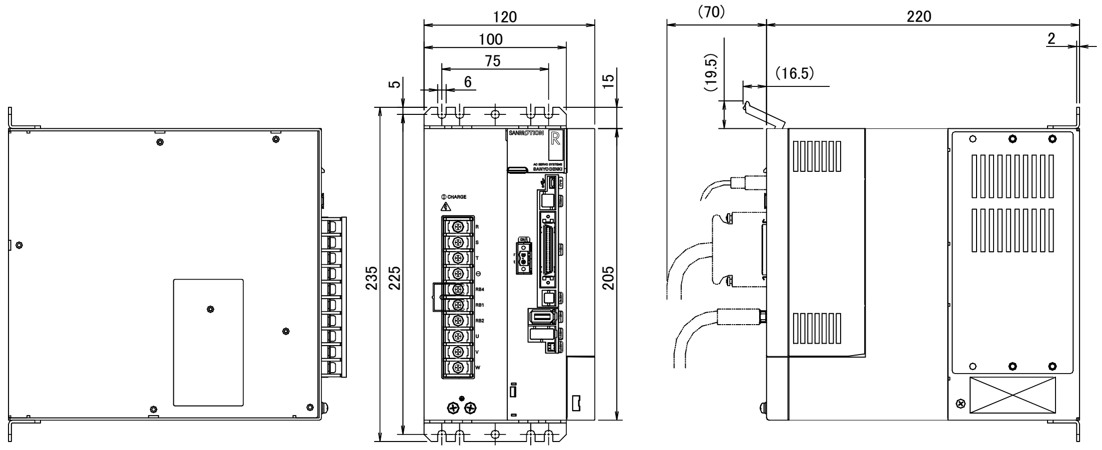


12.5.6 RS3A10A□□A□

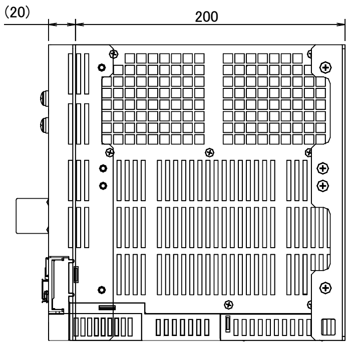


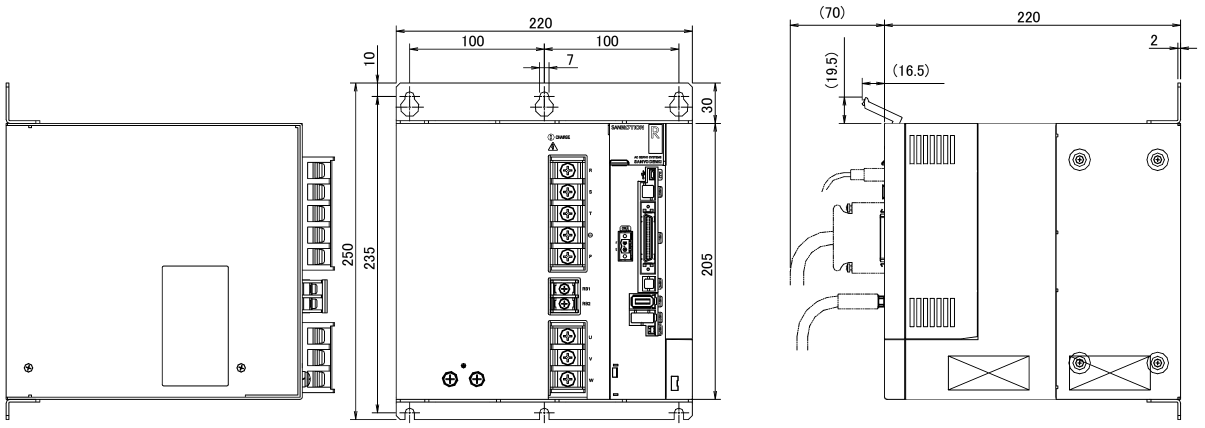
12.5.7 RS3A15A□□A□





12.5.8 RS3A30A□□L□





12.6 Optional parts

SANYO DENKI offers the following optional parts.

12.6.1 Connectors of servo amplifier

■ Model numbers of single connectors for RS3☐01, RS3☐02, RS3☐03 and RS3A05

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unit connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	For encoder connection	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	For input power supply, and regenerative resistance connection	AL-00686902-01	MSTBT2.5/8-STF-5.08L UB	Phoenix Contact Co. Ltd.
CNB	For servo motor connection	AL-Y0004079-01	MSTBT2.5/3-STF-5.08	
CN4 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3☐01, RS3☐02, RS3☐03, and RS3A05 (No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB	Standard	AL-00723282	RS3###A0#L0/RS3###A8#L0	No regenerative resistance
CN1,EN1,CNB	Standard	AL-00723284	RS3###A0#A0/RS3###A8#A0	With regenerative resistance
CN1,EN1,EN2, CNA,CNB	For fully-closed control system	AL-00723286	RS3###A1#L0/RS3###A2#L0/ RS3###A9#L0/RS3###AA#L0	No regenerative resistance
CN1,EN1,EN2, CNB		AL-00723288	RS3###A1#A0/RS3###A2#A0/ RS3###A9#A0/RS3###AA#A0	With regenerative resistance
CN1,EN1	Low voltage set	AL-00723290	RS3###A0##0/RS3###A8##0	-
CNA,CNB	High voltage set	AL-00696037	RS3###A##L#	No regenerative resistance

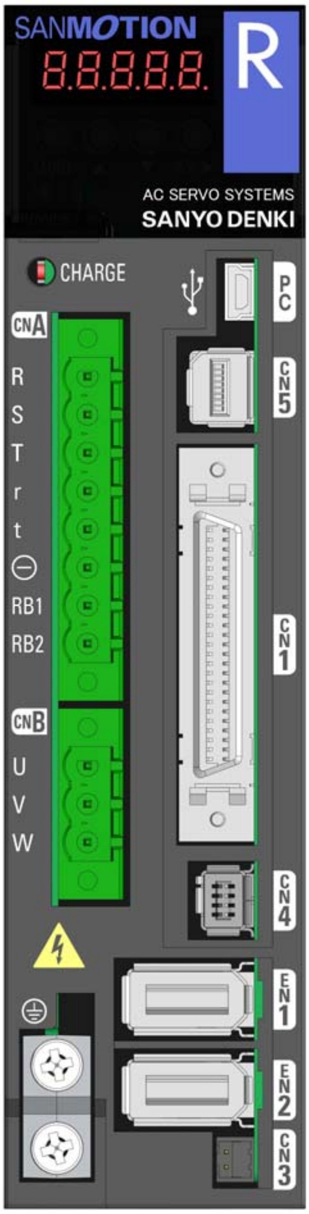
- ✔ Mark "#" shows arbitrary numerical values or alphabets.
- ✔ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

■ Model numbers of connector-kits for RS3☐01, S3☐02, RS3☐03, and RS3A05 (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB, CN4	Standard	AL-00723155	RS3###A0#L2(4)/RS3###A8#L2(4)	No regenerative resistance
CN1,EN1,CNB,CN4	Standard	AL-00723156	RS3###A0#A2(4)/RS3###A8#A2(4)	With regenerative resistance
CN1,EN1,EN2,CNA, CNB,CN4	For fully-closed control system	AL-00723157	RS3###A1#L2(4)/RS3###A2#L2(4)/ RS3###A9#L2(4)/RS3###AA#L2(4)	No regenerative resistance
CN1,EN1,EN2,CNB, CN4		AL-00723158	RS3###A1#A2(4)/RS3###A2#A2(4)/ RS3###A9#A2(4)/RS3###AA#A2(4)	With regenerative resistance
CN1,EN1,CN4	Low voltage set	AL-00723159	RS3###A0##2(4)/RS3###A8##2(4)	-

- ✔ Mark "#" shows arbitrary numerical values or alphabets.
- ✔ CN4 of the connecter kit is for connection with safety devices (for wiring), part number: AL-00718252-01.
- ✔ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

RS3□01, RS3□02, RS3□03, RS3A05



CNA
(For input power supply, and regenerative resistance connection)

CNB
(For servo motor connection)

CN1 (For host unit connection)

CN4
(For safety device connection)
Use only with Safe Torque Off equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external encoder connection)
Used for a part of semi-closed system or a full-closed control system

■ Model numbers of single connector for RS3☐07

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	For host unit connection	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	For encoder connection	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	For main circuit power supply, and regenerative resistance connection	AL-Y0011766-01	PC5/7-STF1-7.62	Phoenix Contact Co. Ltd.
CNB	For servo motor connection	AL-Y0011768-01	PC5/3-STF1-7.62	
CNC	For control power supply connection	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	
CN4 Note1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	For safety device connection (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3☐07 (No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB,CNC	Standard	AL-00946084	RS3A07A0#L0/RS3A07A8#L0	No regenerative resistance
CN1,EN1,CNB,CNC	Standard	AL-00946086	RS3A07A0#A0/RS3A07A8#A0	With regenerative resistance
CN1,EN1,EN2,CNA,CNB, CNC	For fully-closed control system	AL-00946088	RS3A07A1#L0/RS3A07A2#L0/ RS3A07A9#L0/RS3A07AA#L0	No regenerative resistance
CN1,EN1,EN2,CNB,CNC		AL-00946090	RS3A07A1#A0/RS3A07A2#A0/ RS3A07A9#A0/RS3A07AA#A0	With regenerative resistance
CN1,EN1	Low voltage set	AL-00723290	RS3###A0##0/RS3###A8##0	-
CNA,CNB,CNC	High voltage set	AL-00946092	RS3A07A##L#	No regenerative resistance
CNB,CNC	High voltage set	AL-00946094	RS3A07A##A#	With regenerative resistance

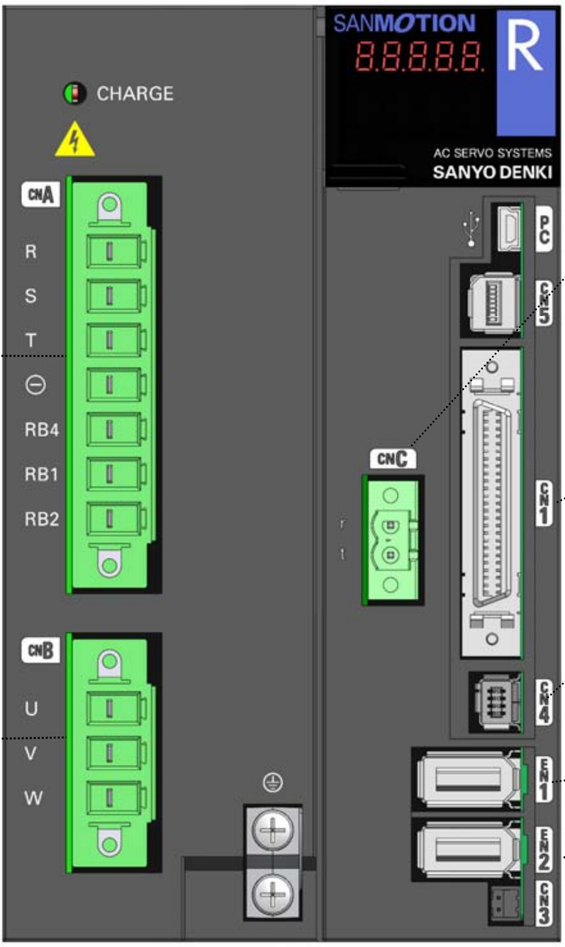
- ✔ Mark "#" shows arbitrary numerical values or alphabets.
- ✔ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

■ Model numbers of connector-kits for RS3☐07 (With Safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1,EN1,CNA,CNB, CNC,CN4	Standard	AL-00946096	RS3A07A0#L2(4)/RS3A07A8#L2(4)	No regenerative resistance
CN1,EN1,CNB,CNC, CN4	Standard	AL-00946098	RS3A07A0#A2(4)/RS3A07A8#A2(4)	With regenerative resistance
CN1,EN1,EN2,CNA, CNB,CNC,CN4	For fully-closed control system	AL-00946100	RS3A07A1#L2(4)/RS3A07A2#L2(4)/ RS3A07A9#L2(4)/RS3A07AA#L2(4)	No regenerative resistance
CN1,EN1,EN2,CNB, CNC,CN4		AL-00946102	RS3A07A1#A2(4)/RS3A07A2#A2(4)/ RS3A07A9#A2(4)/RS3A07AA#A2(4)	With regenerative resistance
CN1,EN1,CN4	Low voltage set	AL-00723159	RS3###A0##2(4)/RS3###A8##2(4)	-

- ✔ Mark "#" shows arbitrary numerical values or alphabets.
- ✔ CN4 of the connecter kit is for connection with safety devices (for wiring), part number: AL-00718252-01.
- ✔ For amplifier with regenerative resistor, the wire of the regenerative resistor is to be connected to CNA, so CNA is equipped with amplifier. So no optional provisions are offered.

RS3A07



CNA
(For main circuit power supply, and regenerative resistance connection)

CNB
(For servo motor connection)

CNC
(For control power supply connection)

CN1 (For host unit connection)

CN4
(For safety device connection)
Use only with Safe Torque Off equipped model.

EN1
(For motor encoder connection)

EN2
(For motor encoder or external encoder connection)
Used for a part of semi-closed system or a full-closed control system

■ Model numbers of single connectors for RS3A10, RS3A15, and RS3A30

Connector No.	Item	SANYO DENKI model No.	Manufacturer's model No.	Manufacturer
CN1	To connect host equipment	AL-00385594	10150-3000PE and 10350-52A0-008	3M Japan Limited
EN1,EN2	To connect encoder	AL-00632607	36210-0100PL and 36310-3200-008	
CNA	To input control power	AL-Y0005159-01	MSTBT2.5/2-STF-5.08	Phoenix Contact Co. Ltd.
CN4 Note1)	To connect safety device (For short-circuiting)	AL-00718251-01	2040978-1	Tyco Electronics Japan G.K.
CN4	To connect safety devices (For wiring)	AL-00718252-01	2013595-3	

Note1) If CN4 is unused (open), be sure to insert connecter for safety device (for short circuit) to CN4 of servo amplifier.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30
(No safe-torque-off function)

Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1,EN1,CNA	Standard	AL-00751448	RS3###A0##0/RS3###A8##0
CN1,EN1,EN2,CNA	For full-closed system	AL-00751450	RS3###A1##0/RS3###A2##0/ RS3###A9##0/RS3###AA##0
CN1,EN1	Low voltage set	AL-00723290	RS3###A0##0/RS3###A8##0

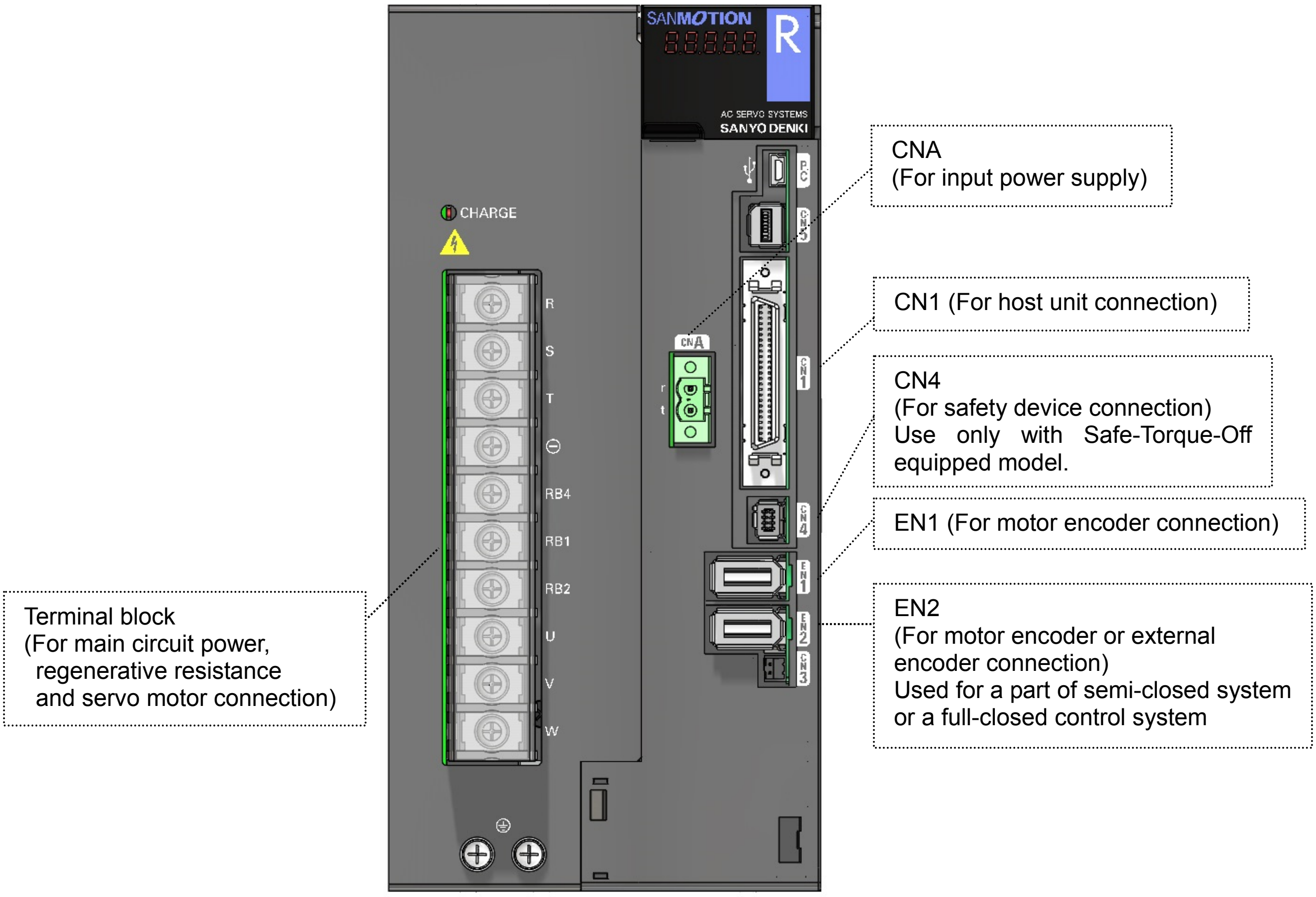
✔ Mark "#" shows arbitrary numerical values or alphabets.

■ Model numbers of connector-kits for RS3A10, RS3A15 and RS3A30
(With safe-torque-off function)

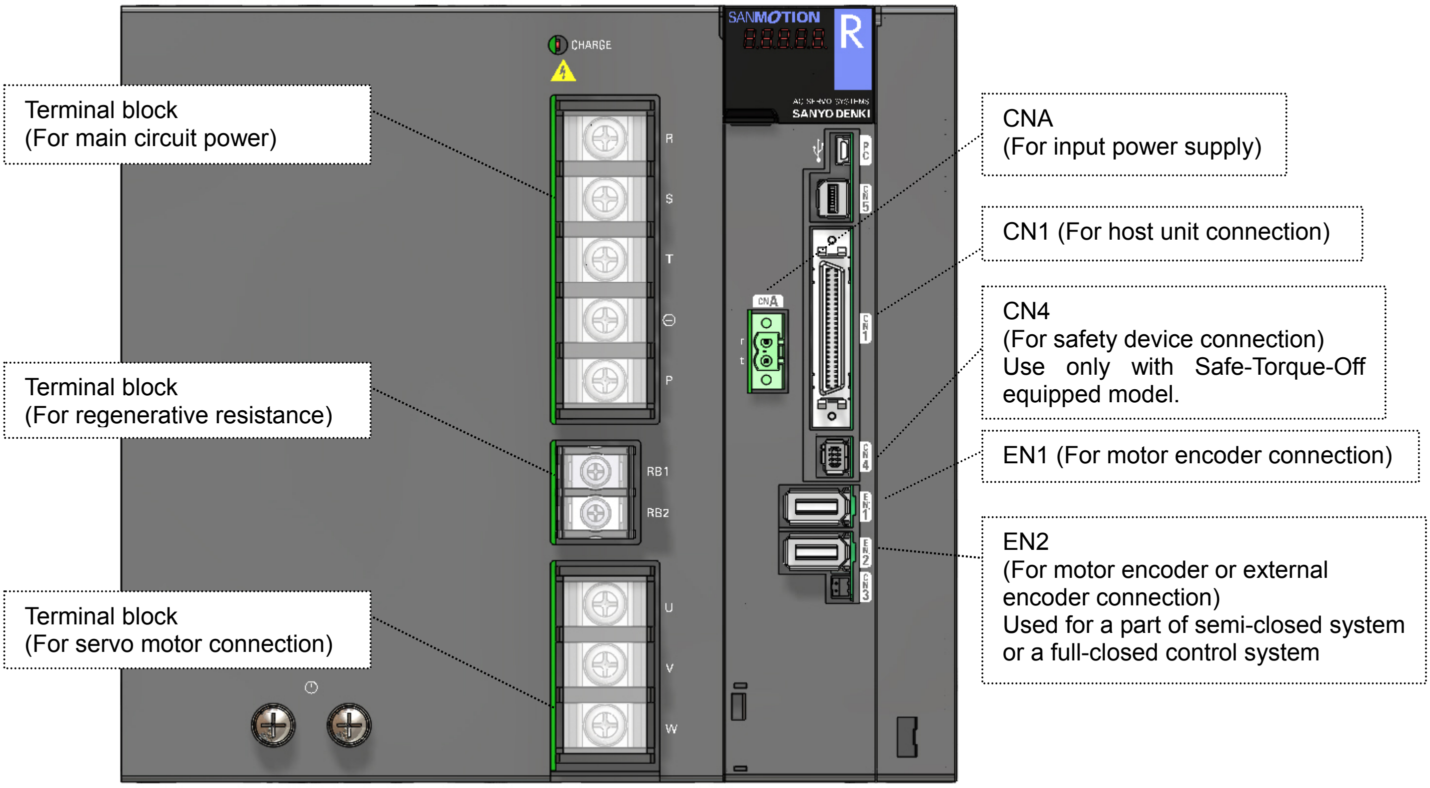
Connector No.	Item	SANYO DENKI model No.	Applicable servo amplifier model number
CN1,EN1,CNA,CN4	Standard	AL-00751452	RS3###A0##2(4)/RS3###A8##2(4)
CN1,EN1,EN2,CNA, CN4	For full-closed system	AL-00751454	RS3###A1##2(4)/RS3###A2##2(4)/ RS3###A9##2(4)/RS3###AA##2(4)
CN1,EN1,CN4	Low voltage set	AL-00723159	RS3###A0##2(4)/RS3###A8##2(4)

✔ Mark "#" shows arbitrary numerical values or alphabets.
✔ CN4 of the connecter kit is for connection with safety devices (for wiring), part number: AL-00718252-01.

RS3A10, RS3A15



RS3A30



12.6.2 Fixing bracket

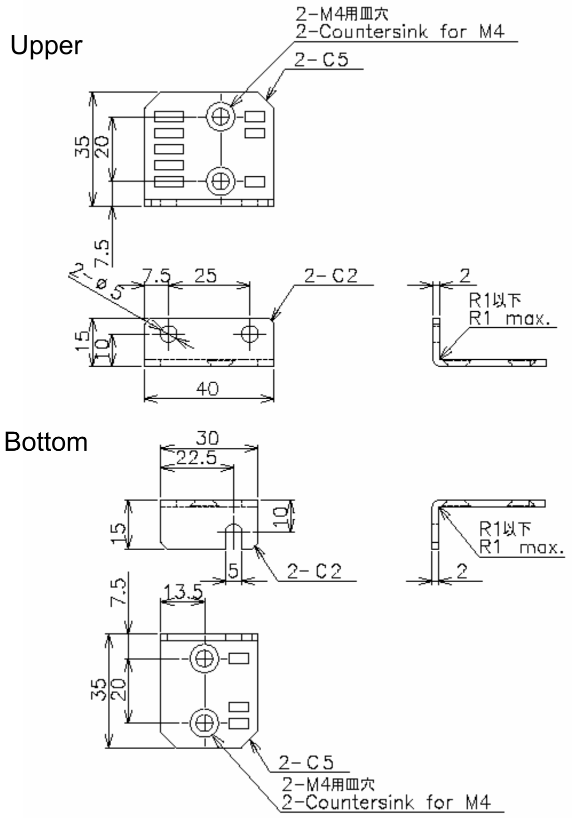
Fixing brackets for mounting servo amplifier front side are prepared.

- ■ List of fixing brackets for RS3☐01 to 30

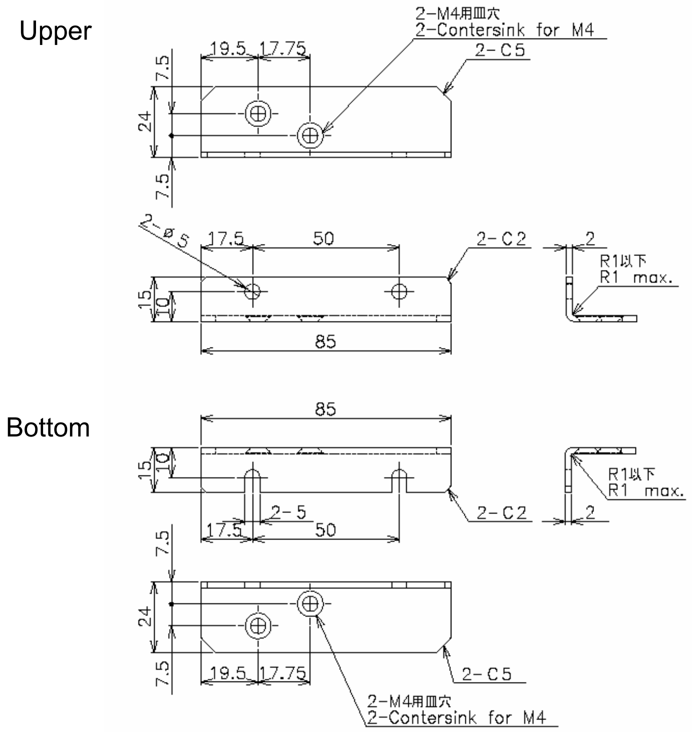
Servo amplifier model number	Bracket fixing position	Model number	Contents
RS3☐01,02,03	Front	AL-00880390-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS3A05,07	Front	AL-00880391-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS3A10,15 (Common)	Front	AL-00907039-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 6 ea
RS3A30	Front	AL-00907040-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 8 ea

These optional fixing brackets are processed trivalent chromium plating.
(Surface color: blue-silver/ different from body color.)

For RS3☐01, RS3☐02, RS3☐03
AL-00880390-01

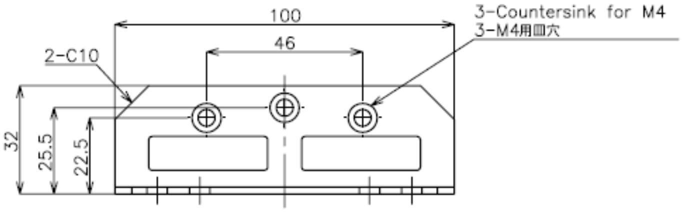


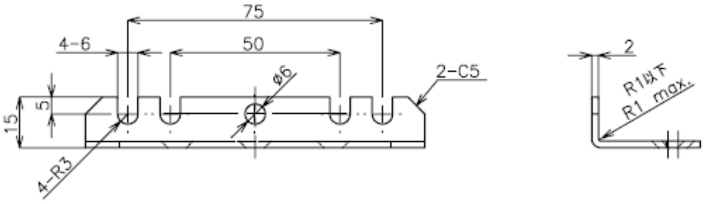
For RS3A05, 07
AL-00880391-01



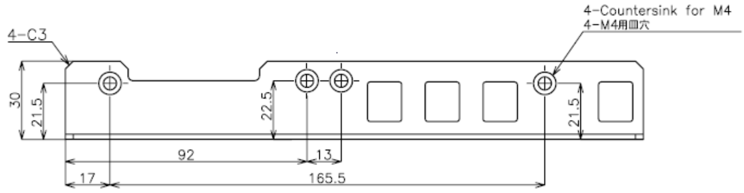
For RS3A10, RS3A15
AL-00907039-01

Common parts (Upper / Bottom)

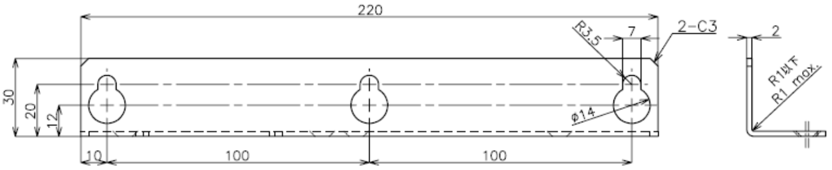


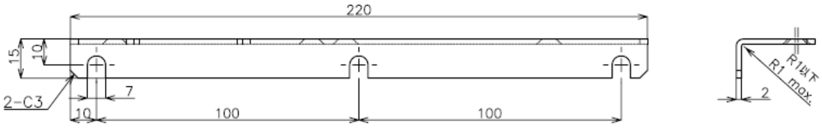


For RS3A30
AL-00907040-01

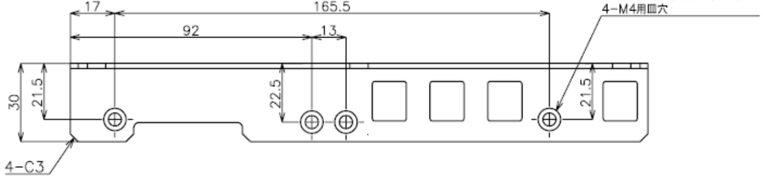


Upper





Bottom

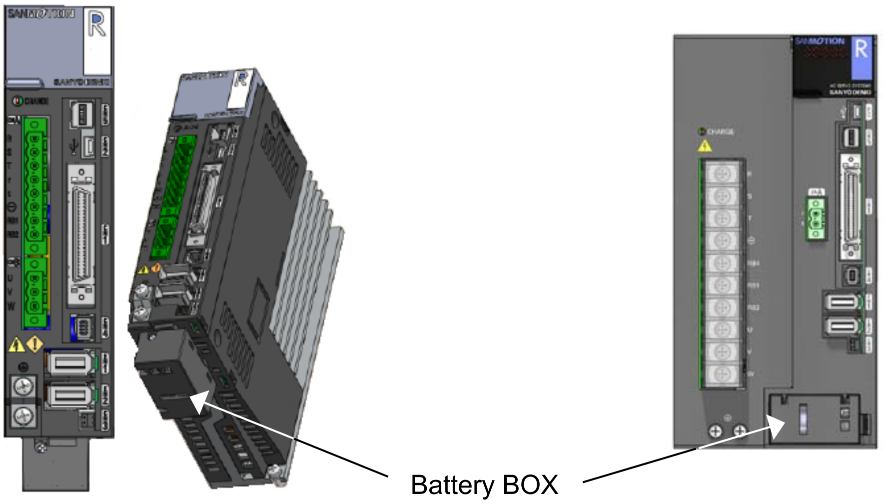


12.6.3 Battery backup absolute encoder (Encoder code: P) related items

Name	Details	SANYO DENKI model No.
Battery body for battery box (Lithium battery)	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation	AL-00879511-01
Battery BOX	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation With battery BOX	AL-00880402-01
Battery body for junction cable (Lithium battery)	Lithium battery: ER3VLY Toshiba Lifestyle Products & Services Corporation	AL-00697958-01
Battery trunk cable	—	AL-00697960-01 to -06
Battery trunk cable	—	AL-00731792-01

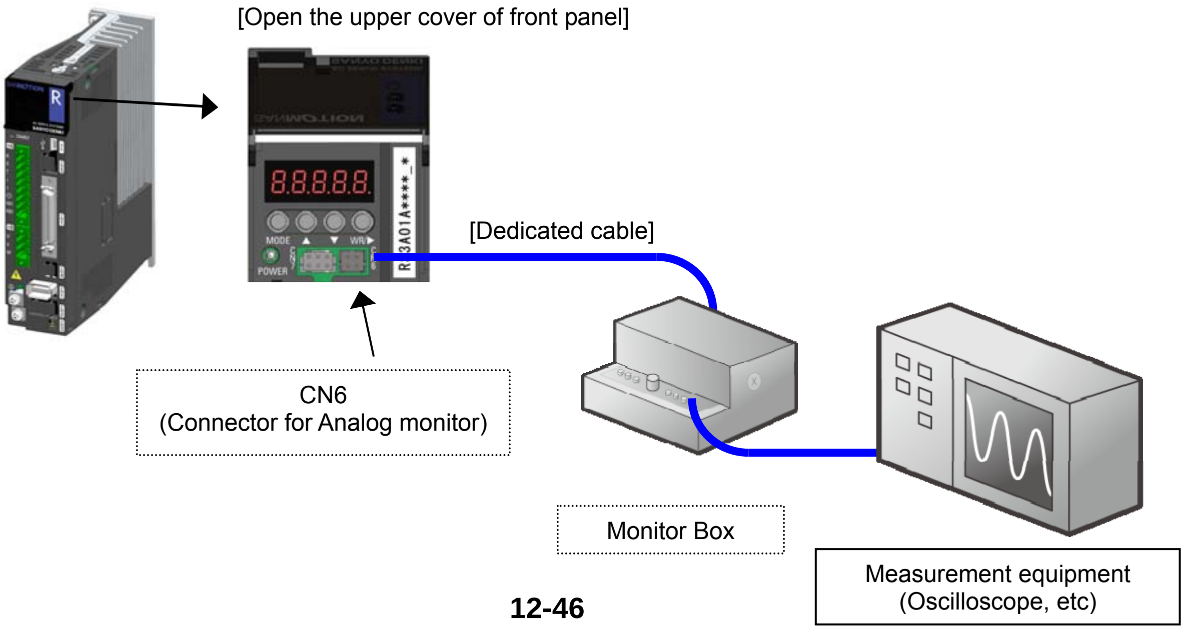
■ Battery BOX mounting position

RS3□01, RS3□02, RS3□03, RS3□05, RS3A07 RS3A10, RS3A15, RS3A30



12.6.4 Analog monitor related item

Name	Details	SANYO DENKI model No.
Monitor Box	Monitor box body 2 dedicated cables	Q-MON-3
Dedicated cable	1 dedicated cables	AL-00690525-01

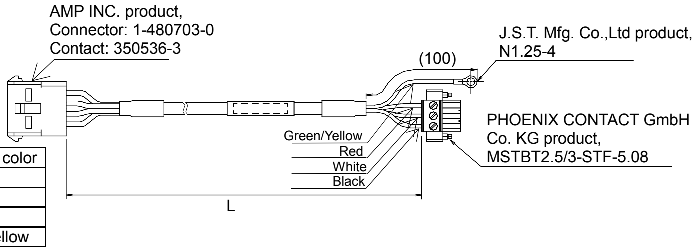


12.6.5 Communication cable of tandem operation between amplifiers

Name	Details	SANYO DENKI model No.
Communication cable between amplifiers (0.2m)	Servo amplifier(CN5) ⇔ Servo amplifier(CN5)	AL-00911582-01
Communication cable between amplifiers (3.0m)		AL-00911582-02

12.6.6 Junction cable for servo motor

Power cable



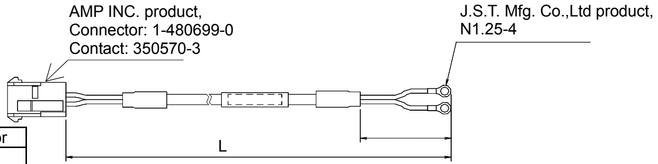
AMP INC. product,
Connector: 1-480703-0
Contact: 350536-3

J.S.T. Mfg. Co.,Ltd product,
N1.25-4

PHOENIX CONTACT GmbH
Co. KG product,
MSTBT2.5/3-STF-5.08

NO.	Lead wire color
1	Red
2	White
3	Black
4	Green/ Yellow

Brake cable

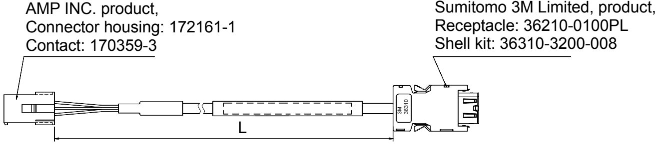


AMP INC. product,
Connector: 1-480699-0
Contact: 350570-3

J.S.T. Mfg. Co.,Ltd product,
N1.25-4

NO.	Lead wire color
1	White
2	Black

Encoder cable



AMP INC. product,
Connector housing: 172161-1
Contact: 170359-3

Sumitomo 3M Limited, product,
Receptacle: 36210-0100PL
Shell kit: 36310-3200-008

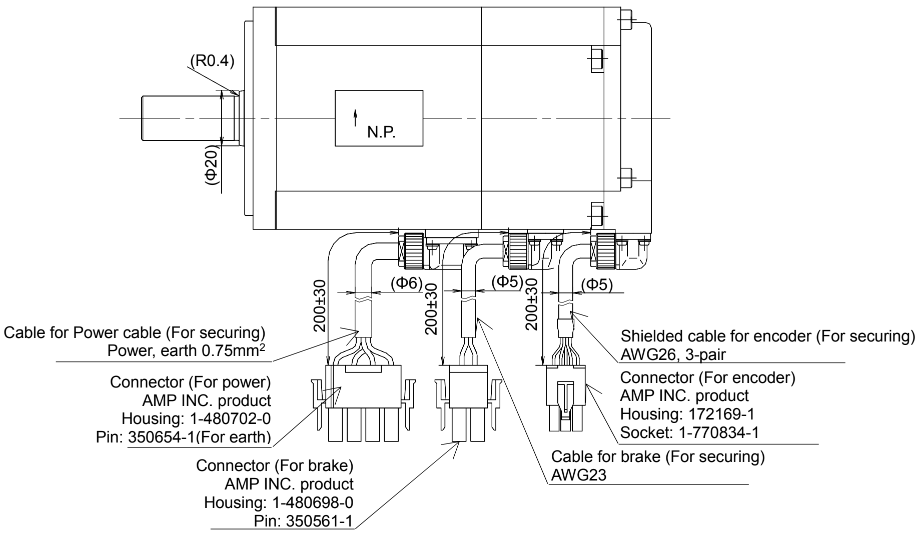
NO.	Lead wire color	Signal name
1	Black	0V
2	Red	+5V
3	Blown	ES+
4	Blue	ES-
5	Green	EBAT+
6	Purple	EBAT-
9	White/Black(Shielded)	Earth

NO.	Lead wire color	Signal name
1	Red	5V
2	Black	0V
7	Blown	ES+
8	Blue	ES-
9	Green	EBAT+
10	Purple	EBAT-

Model Number			Cable length : L(m)
Power cable	For brake	For encoder	
RS-CM4-01-R	RS-CB3-01-R	RS-CA4-01-R	1
RS-CM4-02-R	RS-CB3-02-R	RS-CA4-02-R	2
RS-CM4-03-R	RS-CB3-03-R	RS-CA4-03-R	3
RS-CM4-05-R	RS-CB3-05-R	RS-CA4-05-R	5
RS-CM4-10-R	RS-CB3-10-R	RS-CA4-10-R	10

Servo motor with connectors for junction cables, 200V

Rated output	Motor flange size	Holding brake	Model number	Remarks
30W	□40mm	–	R2AA04003FXPA0	
30W	□40mm	With holding brake (DC24V)	R2AA04003FCPA0	
50W	□40mm	–	R2AA04005FXPA0	
50W	□40mm	With holding brake (DC24V)	R2AA04005FCPA0	
100W	□40mm	–	R2AA04010FXPA0	
90W	□40mm	With holding brake (DC24V)	R2AA04010FCPA0	The rating decreases to 90%
100W	□60mm	–	R2AA06010FXPA0	
100W	□60mm	With holding brake (DC24V)	R2AA06010FCPA0	
200W	□60mm	–	R2AA06020FXPA0	
200W	□60mm	With holding brake (DC24V)	R2AA06020FCPA0	
400W	□60mm	–	R2AA06040FXPA0	
360W	□60mm	With holding brake (DC24V)	R2AA06040FCPA0	The rating decreases to 90%
750W	□80mm	–	R2AA08075FXPA0	
750W	□80mm	With holding brake (DC24V)	R2AA08075FCPA0	



12.6.7 Servo motor powe cable

- ■ Amplifier model number: RS3☐03A

Motor/amplifier option For power, AWG#19	Cable length: L (m)	Applicable motor
RS-CM4-01-R	1	R2AA06040F R2AA08075F
RS-CM4-02-R	2	
RS-CM4-03-R	3	
RS-CM4-05-R	5	
RS-CM4-10-R	10	

Item	Connector model number	Remarks
Motor side connector	Connector: 1-480703-0 Contact: 350536-3	Tyco Electronics Japan G.K.

Motor/amplifier option For brake, AWG#23	Cable length: L(m)	Applicable motor
RS-CB3-01-R	1	R2AA06040F R2AA08075F
RS-CB3-02-R	2	
RS-CB3-03-R	3	
RS-CB3-05-R	5	
RS-CB3-10-R	10	

Item	Connector model number	Remarks
Motor side connector	Connector: 1-480699-0 Contact: 350570-3	Tyco Electronics Japan G.K.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#16	For power and brake, AWG#16・AWG#20		
AL-00996451-01	AL-00996452-01	1	R1AA10100H R1AA10150H
AL-00996451-02	AL-00996452-02	2	
AL-00996451-03	AL-00996452-03	3	
AL-00996451-05	AL-00996452-05	5	
AL-00996451-10	AL-00996452-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#19	For power and brake, AWG#18		
AL-00937696-01	AL-00937697-01	1	R2AA13120B
AL-00937696-02	AL-00937697-02	2	
AL-00937696-03	AL-00937697-03	3	
AL-00937696-05	AL-00937697-05	5	
AL-00937696-10	AL-00937697-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

- ■ Amplifier model number: RS3☐05A

Model number		Cable length: L(m)	Applicable motor
For power, AWG#14	For power and brake, AWG#14・AWG#20		
AL-00937698-01	AL-00937699-01	1	R2AA13120D R2AA13120L R2AA13180H R2AA13200L
AL-00937698-02	AL-00937699-02	2	
AL-00937698-03	AL-00937699-03	3	
AL-00937698-05	AL-00937699-05	5	
AL-00937698-10	AL-00937699-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#12	For power and brake, AWG#12・AWG#20		
AL-00996453-01	AL-00996454-01	1	R1AA10100F R1AA10200H R1AA10250H
AL-00996453-02	AL-00996454-02	2	
AL-00996453-03	AL-00996454-03	3	
AL-00996453-05	AL-00996454-05	5	
AL-00996453-10	AL-00996454-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A20-15SE-EB-R Cable clamp: JL04-2022CK(14)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3☐07A

Model number		Cable length: L(m)	Applicable motor
For power, AWG#12	For power and brake, AWG#12・AWG#20		
AL-00962887-01	AL-00962895-01	1	R1AA10200F R1AA10250F
AL-00962887-02	AL-00962895-02	2	
AL-00962887-03	AL-00962895-03	3	
AL-00962887-05	AL-00962895-05	5	
AL-00962887-10	AL-00962895-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A20-15SE-EB-R Cable clamp: JL04-2022CK(14)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00996455-01	AL-00996456-01	1	R1AA13300H R2AA13180D R2AA13200D R2AA18350V
AL-00996455-02	AL-00996456-02	2	
AL-00996455-03	AL-00996456-03	3	
AL-00996455-05	AL-00996456-05	5	
AL-00996455-10	AL-00996456-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3☐10A

Model number		Cable length: L(m)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00918635-01	AL-00918636-01	1	R1AA13300F R2AA13180D R2AA13200D R2AA18350L
AL-00918635-02	AL-00918636-02	2	
AL-00918635-03	AL-00918636-03	3	
AL-00918635-05	AL-00918636-05	5	
AL-00918635-10	AL-00918636-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3☐15A

Model number		Cable length: L(m)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00918635-01	AL-00918636-01	1	R2AA18350D R2AA18450H
AL-00918635-02	AL-00918636-02	2	
AL-00918635-03	AL-00918636-03	3	
AL-00918635-05	AL-00918636-05	5	
AL-00918635-10	AL-00918636-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#10	For power and brake, AWG#10・AWG#20		
AL-00965257-01	AL-00965258-01	1	R2AA22500L
AL-00965257-02	AL-00965258-02	2	
AL-00965257-03	AL-00965258-03	3	
AL-00965257-05	AL-00965258-05	5	
AL-00965257-10	AL-00965258-10	10	

Item	Connector model number	Remarks
Motor side connector	Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R	Japan Aviation Electronics Industry, Ltd.

Model number		Cable length: L(m)	Applicable motor
For power, AWG#8	For brake, AWG#19		
AL-00965259-01	AL-00918630-01	1	R2AA22700S
AL-00965259-02	AL-00918630-02	2	
AL-00965259-03	AL-00918630-03	3	
AL-00965259-05	AL-00918630-05	5	
AL-00965259-10	AL-00918630-10	10	

Item	Connector model number	Remarks
Motor side connector	■ For power Straight plug: JL04V-6A24-11SE-EB-R Cable clamp: JL04-2428CK(17)-R ■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3☐15A (continued)

Model number		Cable length: L(m)	Applicable motor
For power, AWG#6	For brake, AWG#19		
AL-00968911-01	AL-00918630-01	1	R2AA18550R
AL-00968911-02	AL-00918630-02	2	
AL-00968911-03	AL-00918630-03	3	
AL-00968911-05	AL-00918630-05	5	
AL-00968911-10	AL-00918630-10	10	

Item	Connector model number	Remarks
Motor side connector	■ For power	
	Straight plug: JL04V-6A32-17SE-EB-R	Japan Aviation Electronics Industry, Ltd.
	Socket: N2KM2532	SANKEI MANUFACTURING CO. LTD.
	■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R	Japan Aviation Electronics Industry, Ltd.

■ Amplifier model number: RS3☐30A

Model number		Cable length: L(m)	Applicable motor
For power, AWG#6	ブレーキ用 AWG#19		
AL-00965260-01	AL-00918630-01	1	R2AA18550H R2AA18750H R2AA1811KR R2AA2211KB R2AA2215KB
AL-00965260-02	AL-00918630-02	2	
AL-00965260-03	AL-00918630-03	3	
AL-00965260-05	AL-00918630-05	5	
AL-00965260-10	AL-00918630-10	10	

Item	Connector model number	Remarks
Motor side connector	■ For power	
	Straight plug: JL04V-6A32-17SE-EB-R	Japan Aviation Electronics Industry, Ltd.
	Socket: N2KM2532	SANKEI MANUFACTURING CO. LTD.
	■ For brake Straight plug: JL04V-6A10SL-3SE-EB-R Cable clamp: JL04-1012CK(05)-R	Japan Aviation Electronics Industry, Ltd.

- For encoder

Model number	Cable length: L(m)	Applicable motor
RS-CA4-01-R	1	R2AA06040F R2AA08075F
RS-CA4-02-R	2	
RS-CA4-03-R	3	
RS-CA4-05-R	5	
RS-CA4-10-R	10	

Item	Connector model number	Remarks
Motor side connector	Housing: 172161-1 Contact: 170359-3	Tyco Electronics Japan G.K.
Amplifier side connector	Receptacle: 36210-0100PL Shell kit: 36310-3200-008	3M Japan Limited

Model number	Cable length: L(m)
AL-00937694-01	1
AL-00937694-02	2
AL-00937694-03	3
AL-00937694-05	5
AL-00937694-10	10

Item	Connector model number	Remarks
Motor side connector	Straight plug: JN2DS10SL2-R Contact: JN1-22-22F-PKG100	Japan Aviation Electronics Industry, Ltd.
Amplifier side connector	Receptacle: 36210-0100PL Shell kit: 36310-3200-008	3M Japan Limited

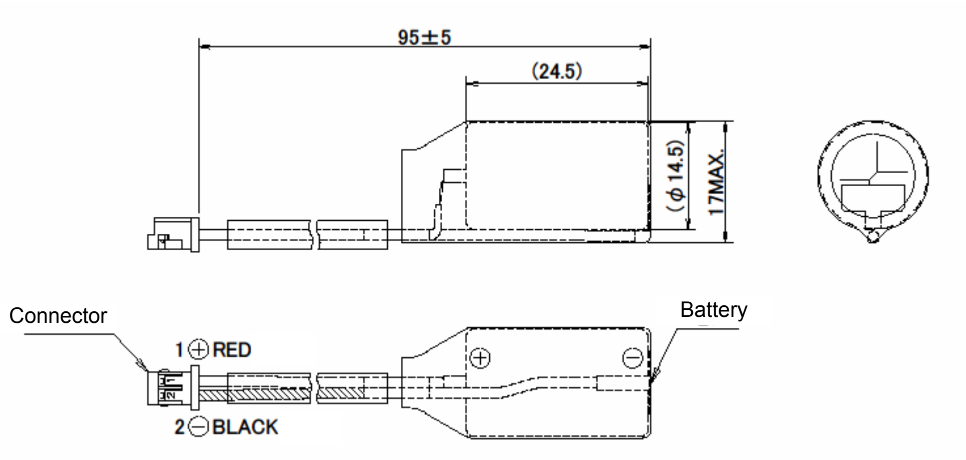
12.6.8 External regenerative resistor

Resistor Model Number	Rated power [PR]	Resistance value	Thermostat Detection temperature (Contact specification)	Mass
REGIST-080W100B	80W	100Ω	135°C±7°C (Switching contact b)	0.19kg
REGIST-080W50B	80W	50Ω		
REGIST-120W100B	120W	100Ω		0.24kg
REGIST-120W50B	120W	50Ω		
REGIST-220W100B	220W	100Ω		0.44kg
REGIST-220W50B	220W	50Ω		
REGIST-220W20B	220W	20Ω		
REGIST-500CW20B	500W	20Ω	100°C±5°C (Switching contact b)	1.4kg
REGIST-500CW10B	500W	10Ω		
REGIST-500CW7B	500W	7Ω		
REGIST-500CW14B	500W	14Ω		
REGIST-1000W6R7B	1000W	6.7Ω	140℃±5℃ (Switching contact b)	3.0kg

12.7 Optional parts dimensions

12.7.1 Battery peripherals dimensions

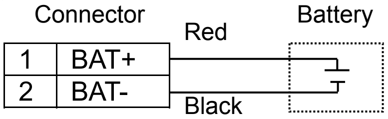
- ■ Battery body for battery box (Model No.: AL-00879511-01)



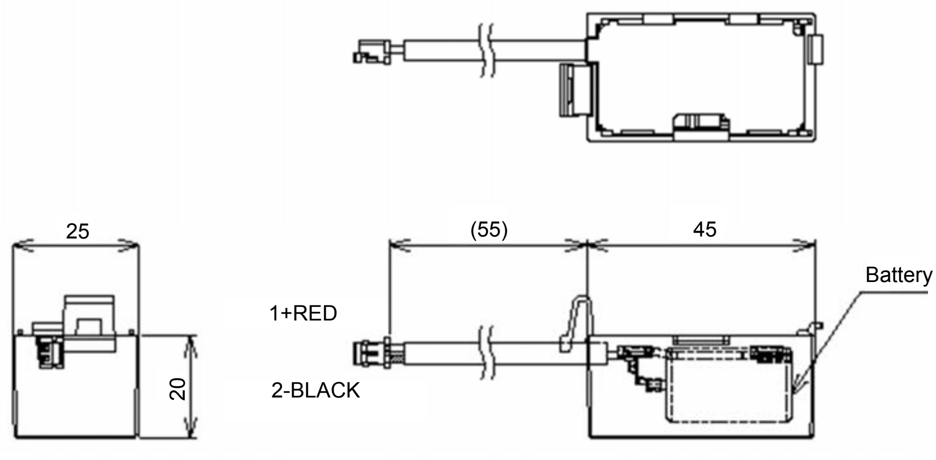
1. Battery and connector specifications

Lithium battery	Thionyl Chloride Lithium Battery ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium metal mass as standard: 0.31g
Connector	DF3-2S-2C; Socket Housing (HIROSE) DF3-2428SCFC; Contact (HIROSE)

2. Wiring diagram



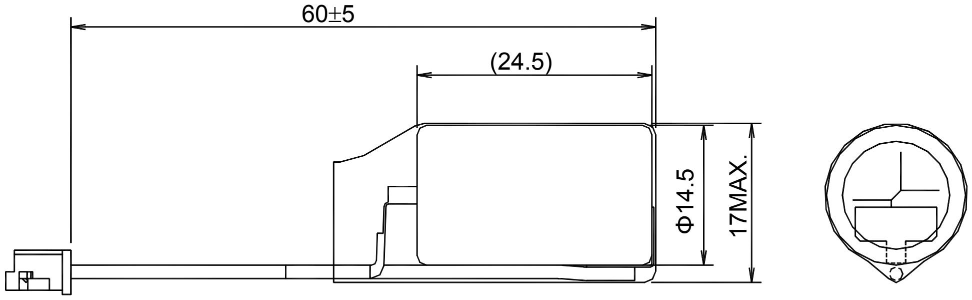
- ■ Battery BOX (Model No.:AL-00880402-01)

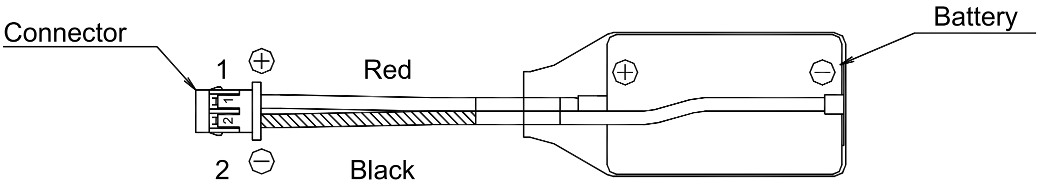


See "8.6.2 Replacing battery for motor encoder" for how to replace battery box.

12.7 Optional parts dimensions

- Battery body for junction cable (Model No.: AL-00697958-01)

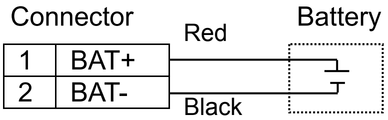




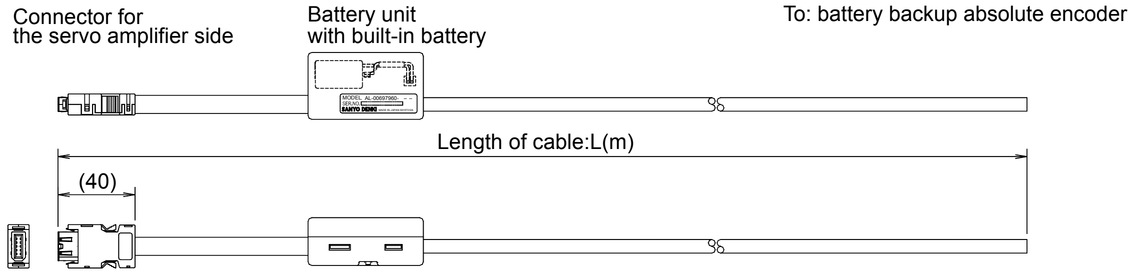
1. Battery and connector specifications

Lithium battery	Thionyl Chloride Lithium Battery ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium metal mass as standard: 0.31g
Connector	DF3-2S-2C; Socket Housing (HIROSE) DF3-2428SCFC; Contact (HIROSE)

2. Wiring diagram



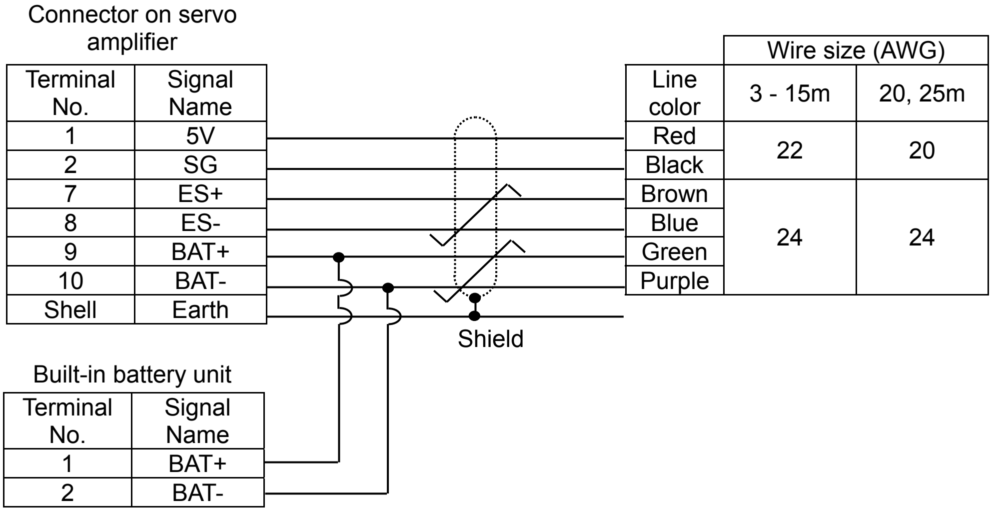
- ■ Battery trunk cable (Model No.: AL-00697960-☐☐)



Model Number	L[m]
AL-00697960-01	3
AL-00697960-02	5
AL-00697960-03	10
AL-00697960-04	15
AL-00697960-05	20
AL-00697960-06	25

1. Spec: Trunk cable for encoder with the connector in one end and the battery unit for moving part at mid-low speed *This shall not be designed for moving part at high speed.

2. Wiring spec



Connector on servo amplifier

Terminal No.	Signal Name
1	5V
2	SG
7	ES+
8	ES-
9	BAT+
10	BAT-
Shell	Earth

Built-in battery unit

Terminal No.	Signal Name
1	BAT+
2	BAT-

Line color	Wire size (AWG)	
	3 - 15m	20, 25m
Red	22	20
Black		
Brown	24	24
Blue		
Green		
Purple		

3. Specification for the connector and the battery unit

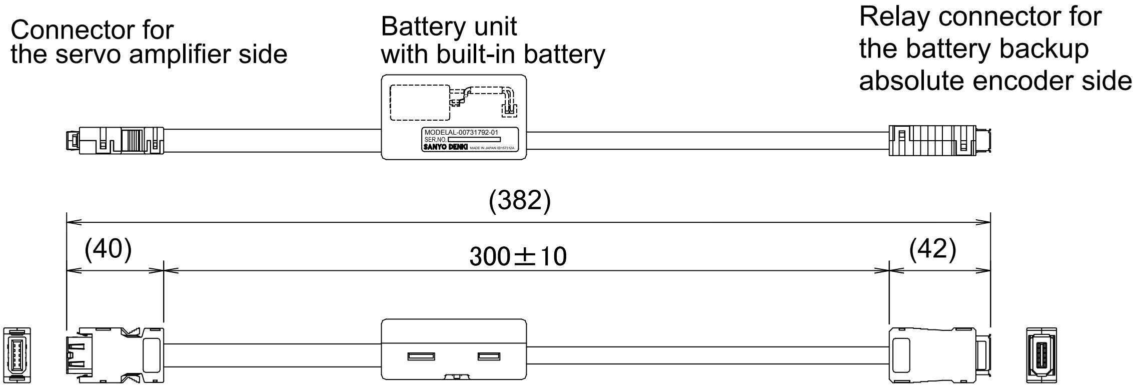
Connector for servo amplifier	36210-0100PL; Wiremount Receptacle (3M) 36310-3200-008; Shell Kit (3M)
Battery unit	Built-in battery; ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium-metal mass: 0.31g

4. Outline specification for cable

Robot cable for moving part at mid-low speed; UL-ORHV30-SB, Composite wire specification (Manufactured by OKANO ELECTRIC WIRE Co., Ltd.) High-density polyethylene insulated wire, Vinyl sheath, Braided shield addition.	
UL STYLE NO. 20276 (Ratings: 80°C, 30V)	
AL-00697960-01 - 04; 3 - 15m	AL-00697960-05, 06; 20,25m
22 AWG x 2C + 24 AWG x 2P Sheath thickness: 1.0mm Cable outer diameter: Φ7.1±0.5mm	20 AWG x 2C + 24 AWG x 2P Sheath thickness 1.0mm Cable outer diameter: Φ7.1±0.5mm
Respective wire specifications 24 AWG Conductor diameter: Φ0.65mm, Insulator thickness: 0.25mm, Insulator coat outer diameter:Φ1.15mm 22 AWG Conductor diameter: Φ0.77mm, Insulator thickness: 0.25mm, Insulator coat outer diameter: Φ1.27mm 20 AWG Conductor diameter: Φ0.95mm, Insulator thickness: 0.25mm, Insulator coat outer diameter: Φ1.45mm	

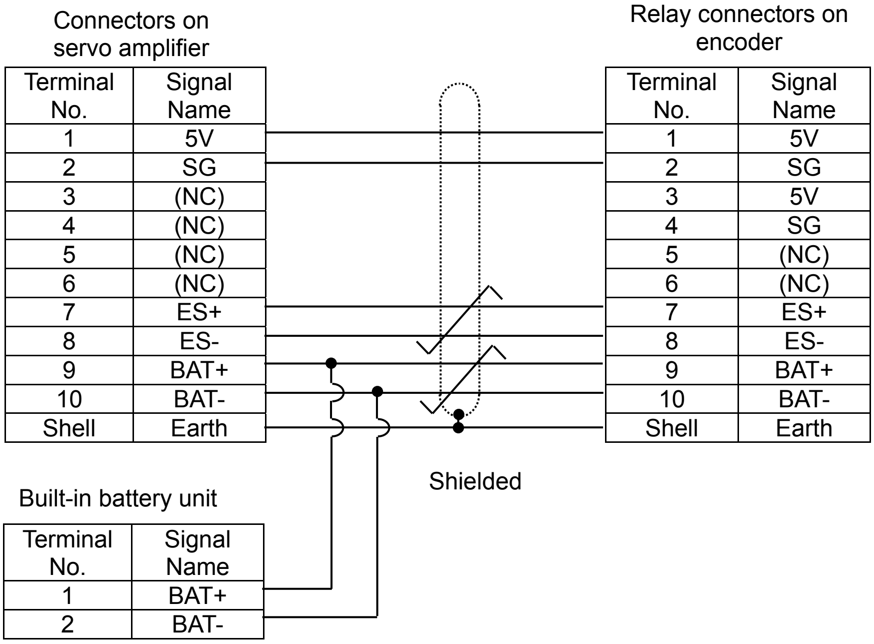
5. Battery model number for replacement: AL-00697958-01

- ■ Battery trunk cable (Model No.: AL-00731792-01)



1. Specification: Relay cable for encoder with the connector at both ends and the battery unit

2. Wiring spec



Connectors on servo amplifier

Terminal No.	Signal Name
1	5V
2	SG
3	(NC)
4	(NC)
5	(NC)
6	(NC)
7	ES+
8	ES-
9	BAT+
10	BAT-
Shell	Earth

Relay connectors on encoder

Terminal No.	Signal Name
1	5V
2	SG
3	5V
4	SG
5	(NC)
6	(NC)
7	ES+
8	ES-
9	BAT+
10	BAT-
Shell	Earth

Built-in battery unit

Terminal No.	Signal Name
1	BAT+
2	BAT-

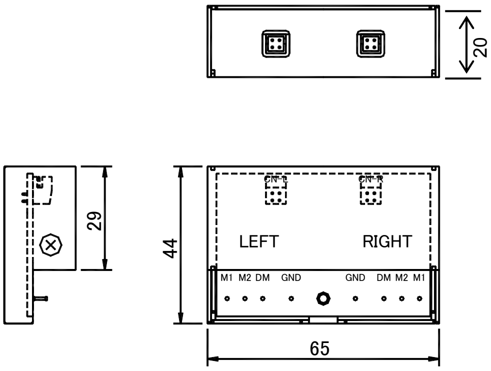
3. Specification for the connector and the battery unit

Connectors for servo amplifier	36210-0100PL; Wiremount Receptacle (3M) 36310-3200-008; Shell Kit (3M)
Trunk connectors for encoder	36110-3000FD; Wiremount Plug (3M) 36310-F200-008; Shell Kit (3M)
Battery unit	Built-in battery; ER3VLY (Toshiba Lifestyle Products & Services Corporation) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium-metal mass:0.31g

4. Battery model number or replacement: AL-00697958-01

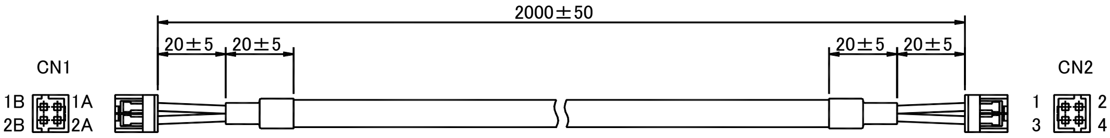
12.7.2 Monitor box outline drawing

- Monitor Box (Model No.: Q-MON-3



12.7.3 Dedicated Cable outline drawing

- Dedicated Cable (Model No.: AL-00690525-01)



Note 1) A pair of the dedicated cable shown above (model number: AL-00690525-01) are supplied with the Monitor Box (model number: Q-MON-3).

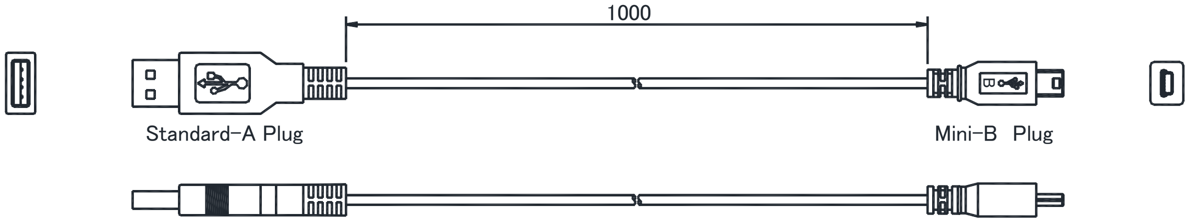
Terminal No. on CN1	Signal name	Terminal No. on CN2
1A	Analog monitor 1	3
1B	Analog monitor 2	4
2A	GND	1
2B	Digital monitor	2

CN1	Manufacturer model No.	Manufacturer
Connector	LY10-DC4BR	Japan Aviation Electronics Industry, Limited
Contact	LY10-C1-A1-1000	Japan Aviation Electronics Industry, Limited

CN2	Manufacturer model No.	Manufacturer
Connector	DF11-4DS-2C	HIROSE ELECTRIC CO., LTD.
Contact	DF11-2428SCA	HIROSE ELECTRIC CO., LTD.

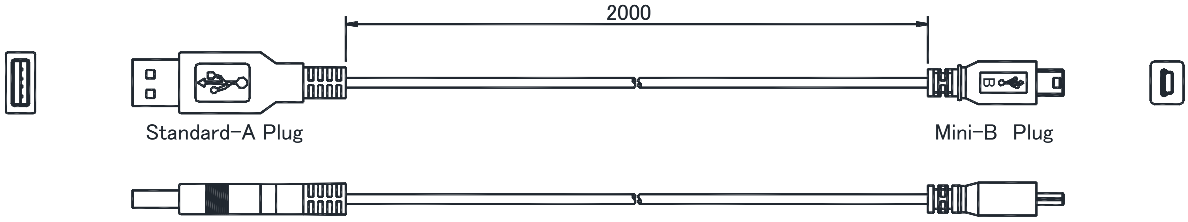
12.7.4 Outline drawing of USB communication cable

■ USB communication cable (1.0m) (Model number: AL-00896515-01)



✔ Appearance and spec may change without prior notice.

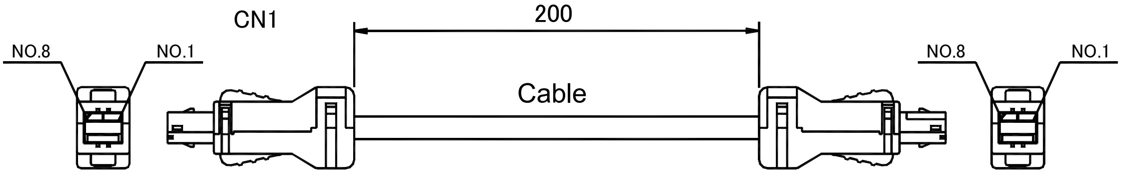
■ USB communication cable (2.0m) (Model number: AL-00896515-02)



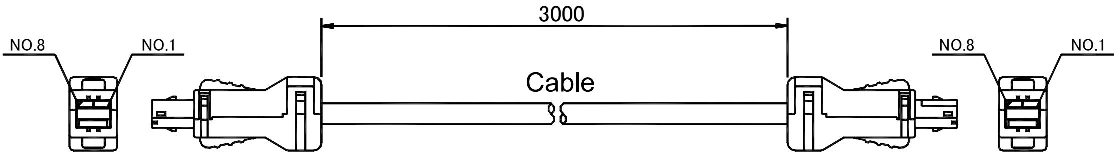
✔ Appearance and spec may change without prior notice.

12.7.5 Outline drawing of communication cable of tandem operation between amplifiers

■ Communication cable of tandem operation between amplifiers (0.2m) (Model number: AL-00911582-01)



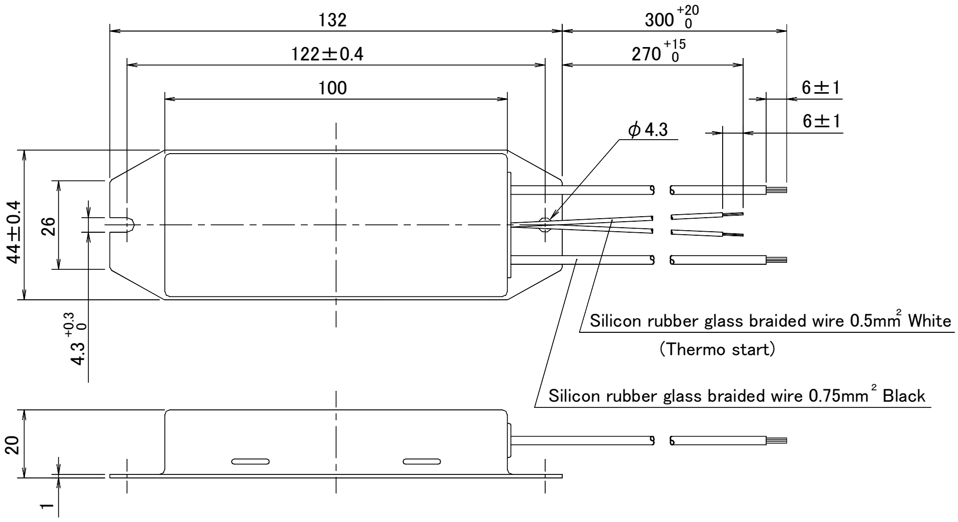
■ Communication cable of tandem operation between amplifiers (3.0m) (Model number: AL-00911582-02)



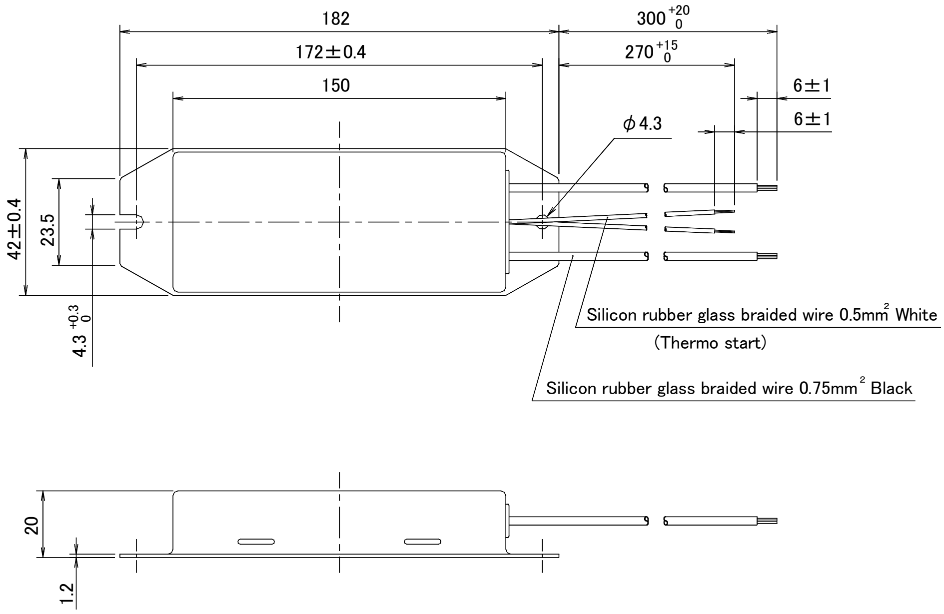
✔ As note, the wiring differs from the communication cable between amplifiers for R ADVANCED MODEL (Model number: AL-00695974-**).

12.7.6 Outline drawing of regenerative resistor

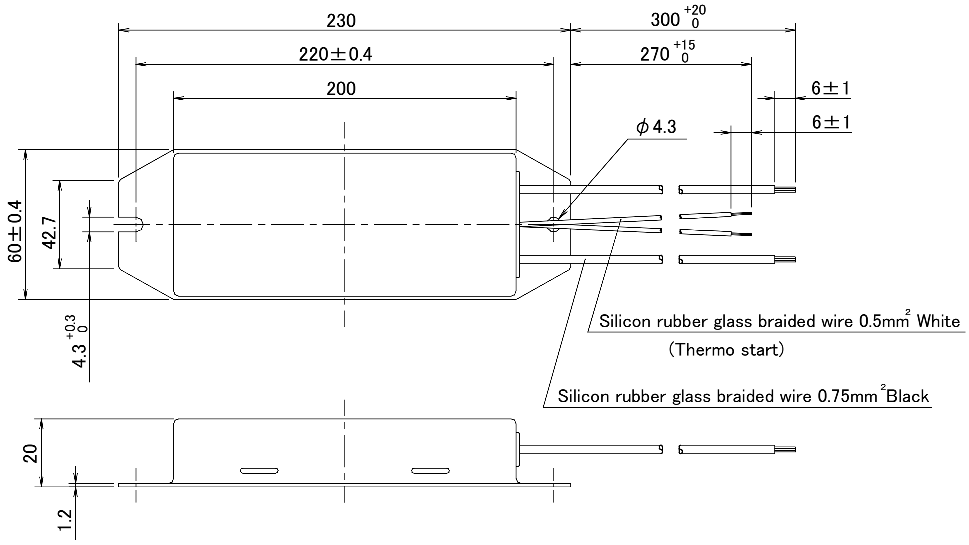
- ■ REGIST-080W



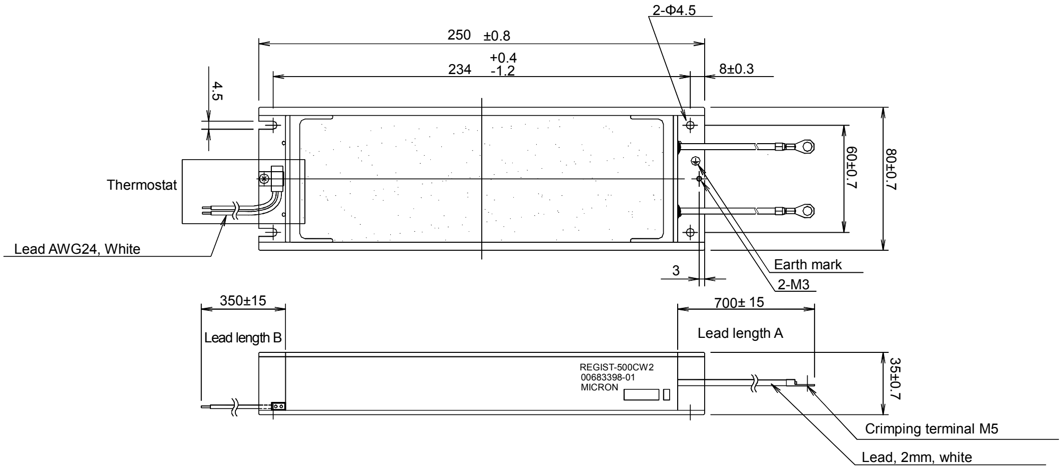
- ■ REGIST-120W



■ REGIST-220W

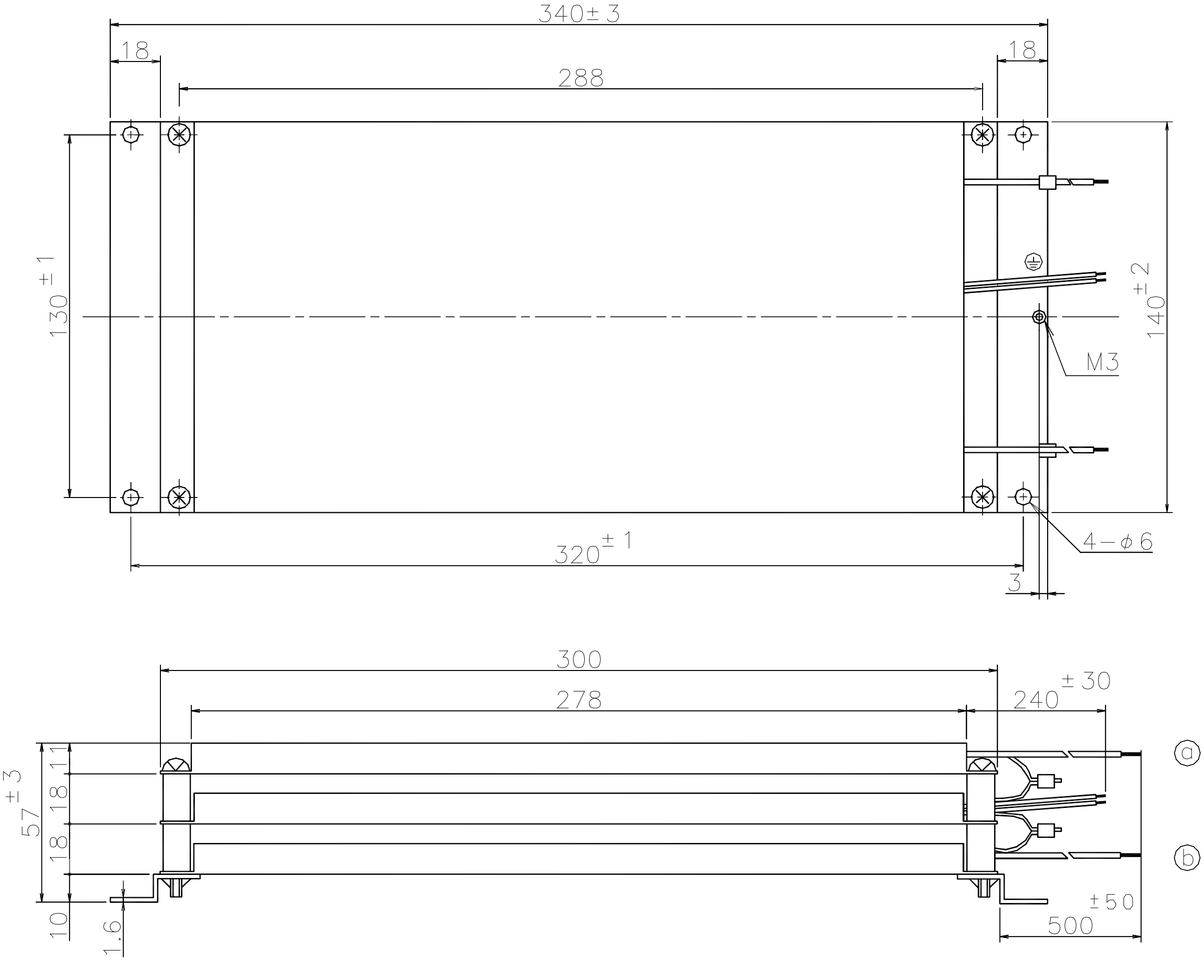


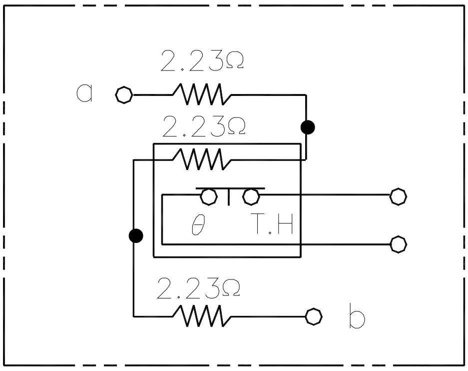
■ REGIST-500CW



12.7 Optional parts dimensions

- REGIST-1000W





Wiring diagram

Release	
Revision A	May. 2014
Revision B	Aug. 2014
Revision C	Jan. 2015
Revision D	May. 2016
Revision E	Nov. 2016
Revision F	Jul. 2017
Revision G	May. 2018

ECO PRODUCTS

■ECO PRODUCTS

Sanyo Denki's ECO PRODUCTS are designed with the concept of lessening impact on the environment in the process from product development to waste. The product units and packaging materials are designed for reduced environmental impact.
We have established our own assessment criteria on the environmental impacts applicable to all processes, ranging from design to manufacture.

■Precautions For Adoption

Failure to follow the precautions on the right may cause moderate injury and property damage, or in some circumstances, could lead to a serious accident.
Always follow all listed precautions.

⚠ Cautions

- ● Read the accompanying Instruction Manual carefully prior to using the product.
- ● If applying to medical devices and other equipment affecting people's lives please contact us beforehand and take appropriate safety measures.
- ● If applying to equipment that can have significant effects on society and the general public, please contact us beforehand.
- ● Do not use this product in an environment where vibration is present, such as in a moving vehicle or shipping vessel.
- ● Do not perform any retrofitting, re-engineering, or modification to this equipment.
- ● The Products presented in this Instruction Manual are meant to be used for general industrial applications. If using for special applications related to aviation and space, nuclear power, electric power, submarine repeaters, etc., please contact us beforehand.

* For any question or inquiry regarding the above, contact our Sales Department.

---

https://www.sanyodenki.com

SANYO DENKI CO., LTD. TEL: +81 3 5927 1020
3-33-1 Minami-Otsuka, Toshima-ku, Tokyo 170-8451, Japan

SANYO DENKI EUROPE SA. TEL: +33 1 48 63 26 61
P.A. Paris Nord Ⅱ, 48 Allée des Erables-VILLEPINTE, BP.57286, F-95958 ROISSY CDG Cedex, France

SANYO DENKI AMERICA, INC. TEL: +1 310 783 5400
468 Amapola Avenue Torrance, CA 90501, U.S.A.

SANYO DENKI SHANGHAI CO., LTD. TEL: +86 21 6235 1107
Room 2106-2110, Bldg A, Far East International Plaza, No.319, Xianxia Road, Shanghai, 200051, China

Beijing Branch TEL: +86 10 6522 2160
Room1222, Tower B, Beijing COFCO Plaza, No.8 Jianguomennei Dajie, Dong Cheng District, Beijing 100005 China

SANYO DENKI (H.K.) CO., LIMITED TEL: +852 2312 6250
Room 2305, 23/F, South Tower, Concordia Plaza, 1 Science Museum Rd., TST East, Kowloon, Hong Kong

SANYO DENKI TAIWAN CO., LTD. TEL: +886 2 2511 3938
N-711, 7F, Chia Hsin 2nd Bldg., No.96, Sec.2, Zhongshan N. Rd., Taipei 10449, Taiwan (R.O.C.)

SANYO DENKI SINGAPORE PTE.LTD. TEL: +65 6223 1071
988 Toa Payoh North, #04-08, Singapore 319002

Indonesia Representative Office TEL: + 62 21 252 3202
Summitmas II 4th Floor, Jl. Jend. Sudirman Kav.61-62, Jakarta 12190, Indonesia

SANYO DENKI GERMANY GmbH TEL: +49 6196 76113 0
Frankfurter Strasse 80-82, 65760 Eschborn, Germany

SANYO DENKI KOREA CO., LTD. TEL: +82 2 773 5623
15F, KDB Building, 372, Hangang-daero, Yongsan-gu, Seoul, 04323, Korea

Busan Branch TEL: +82 51 796 5151
8F, CJ Korea Express Bldg., 119, Daegyo-ro, Jung-gu, Busan, 48943, Korea

SANYO DENKI (Shenzhen) CO., LTD. TEL: +86 755 3337 3868
2F 02-11, Shenzhen International Chamber of Commerce Tower, No.168 Fuhua 3 Road, Futian District, Shenzhen, 518048 China

Tianjin Branch TEL: +86 22 2320 1186
Room AB 16th Floor TEDA Building, No. 256 Jie Fang Nan Road, Hexi District, Tianjin 300042 China

Chengdu Branch TEL: +86 28 8661 6901
Room2105B, Block A, Times Plaza, 2 Zongfu Road, Jinjiang District, Chengdu, 610016 China

SANYO DENKI (THAILAND) CO., LTD. TEL: +66 2261 8670
388 Exchange Tower, 25th Floor, Unit 2501-1, Sukhumvit Road, Klongtoey, Klongtoey, Bangkok 10110 Thailand

SANYO DENKI INDIA PRIVATE LIMITED TEL: +91 44 420 384 72
#14 (Old No.6/3), Avenue Road, Nungambakkam, Chennai - 600034, Tamil Nadu, India

---

Translated version of the original instructions