M0008424J

SANMOTION

AC SERVO SYSTEMS

R ADVANCED MODEL

TYPE S

Analog / Pulse Input Type

For Rotary Motor

Instruction Manual

SANYO DENKI

Details of the change history

The sixth edition (J)

- Page 1-18
  2-3,-10,-12,-23
  3-8
  4-2,-4,-25,-27
  5-2
  12-8,-17,-24,-25,-33
  - Motor is deleted: R2AA22350L.

- 1-15,-18,-22
  2-1,-2,-3,-10,-12,-24
  3-8
  4-3,-4,-5,-25,-28
  5-2
  12-5,-14,-22,-30
  - R1 motors are added: R1AA18550H, R1AA18750L, R1AA1811KR, R1AA1815KB.

- 1-8,-11
  5-1,-3,-5,-12,-13,-14,-29
  6-21
  - Instruction manual numbering of the setup software has changed to M0010842.

- 5-32,-73
  - Group8 ID3E ”Torque Compensation Command in delay time of releasing holding brake [BDLY_TCMP]” is added.

- 5-34,-95
  - GroupB ID19 ”Power Off Detection Delay Time [POFFDLY]” is added.

- 5-34,-100
  - GroupC ID10,11 ” Mask Level of Encoder Connector 1, 2 Disconnection Alarm [DE1MSKLVL][DE3MSKLVL]” are added.

- 2-6,8-31,12-46,-50,-51,-52
  - Battery manufacturer name changed.
    TOSHIBA HOME APPLIANCES CORPORATION
    → Toshiba Lifestyle Products & Services Corporation

- 8-31,12-50,-51,-52
  - Battery model number is changed.
    ER3V → ER3VLY

Safety precautions Please fully observe

The following signs are used to indicate safety precaution in this instruction manual.

Please fully observe the precautions as important contents included in the descriptions.

■ Safety precautions and the signs

Safety precautions		Signs	
Danger	Indicates an imminently hazardous situation which, if incorrectly operated, will result in death or serious injury.	◇!	Danger, injury
		◇⚡	Electrical shock
Warning	Indicates a potentially hazardous situation that, if incorrectly operated, may result in minor or moderate injury, or property damage only. Even those hazardous indicated with this sign may lead to a serious accident.	⚠	Warning
		▲🔥	Fire
		▲♨	Burn injury
Prohibition	Indicates actions that must not be allowed.	⊘	Prohibition
		⊘	Disassembly prohibited
Mandatory	Indicates actions that must be carried out (mandatory actions).	●	Mandatory

■ Danger ◇!

Do not use the system in explosive atmospheres.	
◇!	Injuries and fire may occur.

Do not perform wiring, maintenance, and inspection with power distributed. Make sure to start performing any tasks surely 10 minutes or more after power shutdown.	
◇⚡	Electrical shock may occur.

Make sure to ground servo amplifier protective grounding terminal “ ⏚ ” to the machine or control cabinet. Make sure to ground servo motor grounding terminal to servo amplifier protective grounding terminal “⏚”.	
◇⚡	Electrical shock may occur.

Never touch inside of servo amplifier.	
◇⚡	Electrical shock may occur.

Only qualified personnel who have electrical knowledge should conduct maintenance and inspection.	
⚡	Electrical shock, injuries, and fire may occur.

Do not damage, apply excessive stresses, put heavy things on, and tuck down cables.	
⚡	Electrical shock may occur.

Perform wiring in accordance with wiring diagram and the instruction manual.	
⚡	Electrical shock and fire may occur.

Never approach or touch terminals and connectors while power is being distributed.	
⚡	Electrical shock may occur.

Never touch rotating part of servo motor during operation.	
⚠	Injuries may occur.

Never remove terminals and connectors while power is being distributed.	
⚡	Electrical shock may occur.

Only qualified personnel who have knowledge on safety system related standards should design safety system utilizing safe-torque-off function after thoroughly understanding descriptions in this instruction manual.	
⚠	Injuries and failures may occur.

■ Warning ⚠

Unpack after checking upside and downside.	
⚠	Injuries may occur.

Verify no discrepancies between the product you received and the product you ordered. Installing incorrect product can result in injuries and damages.	
⚠	Injuries and failures may occur.

Make sure to read the instruction manual and observe the instructions before inspection, operation, maintenance, and inspection.	
⚠	Electrical shock, injuries and fire may occur.

Do not use faulty, damaged, and burnt-out servo amplifier and servo motor.	
⚠	Injuries and fire may occur.

Please be aware that temperatures on servo amplifier, servo motor, and peripheral equipments become high.	
⚠	Fire may occur.

Do not use servo amplifier and servo motor outside the scope of the specification.	
⚠	Electrical shock, injuries and failures may occur.

Use the specified combination of servo amplifier and servo motor.	
⚠	This can result in fire and failures.

Do not perform measurement of insulation resistance and dielectric strength voltage.	
⚠	Failures may occur.

Correctly and properly perform wiring.	
⚠	Injuries may occur.

Do not put heavy things on, or climb on the system.	
⚠	Injuries may occur.

Make sure to observe the specified installation direction.	
⚠	This can result in fire and failures.

Do not apply high impacts.	
⚠	This can result in failures.

Never install the system in the area where it may be exposed to water, near corrosive/ flammable gaseous, or by combustible material.	
⚠	This can result in fire and failures.

Do not apply static electrical charge and high voltage to cable for servo motor encoder.	
⚠	This can result in failures.

Perform wiring in accordance with electrical installation technical standards and internal wiring standards.	
⚠	Burnout or fire may occur.

Do not block and let any foreign materials into inlet/outlet.	
⚠	Fire may occur.

Maintain the specified distances for layout inside of servo amplifier control cabinet.	
⚠	This can result in fire and failures.

It is very dangerous to carry the system, so carefully carry the system as not to fall and roll over. Use eyebolt if the servo motor you use equips it.	
⚠	Injuries may occur.

Install the system in incombustible material, such as metal.	
⚠	Fire may occur.

No protective equipments are supplied with servo motor. Protect the system with overcurrent protective device, earth leakage circuit breaker, overtemperature thermostat, and emergency stop equipment.	
⚠	Injuries and fire may occur.

Do not touch heat releasing fin and regenerative resistor of servo amplifier, and servo motor while power being distributed or after a while power is turned off, as the temperatures on them become high.	
⚠	Burn injuries may occur.

Stop operation immediately when any abnormality occurred.	
⚠	Electrical shock, injuries, and fire may occur.

Never make excessive adjustment change as operation becomes unstable.	
⚠	Injuries may occur.

Perform test operation by fixing servo motor with motor separated from mechanical systems, and then install the motor after performing the operation check.	
⚠	Injuries may occur.

Holding brake is not a stop device to secure mechanical safety. Install a stop device to ensure safety in mechanical system.	
⚠	Injuries may occur.

When alarm activated, eliminate the cause, secure the safety, reset the alarm, and then re-start operation.	
⚠	Injuries may occur.

Confirm that input power voltage is within the specification.	
⚠	This can result in failures.

Do not approach equipments after restoration from instantaneous interruption of service, as sudden re-start can occur.
(Design the machine so as to ensure safety even sudden re-start occurs.)

⚠ Injuries may occur.

Do not externally and continuously rotate servo motor during servo-off with standard speciation servo amplifier with dynamic brake, as the dynamic brake will generate heat and this will cause dangers.

⚠ Fire and burn injuries may occur.

Carefully perform maintenance and inspection as temperature on servo amplifier frame becomes high.

⚠ Burn injuries may occur.

Expected life of electrolytic capacitor inside of servo amplifier is 5 years at full-year average temperature 40°C. Replacing with new electrolytic capacitor at the above intervals as a guide is recommended for preventive maintenance. Please contact us.

⚠ This can result in failures.

Please contact us to repair. Disassembly can cause inoperative.

⚠ This can result in failures.

It is very dangerous to carry the system, so carefully carry the system as not to fall and roll over.

⚠ Injuries may occur.

Do not hold cables and servo motor shaft to carry the system.

⚠ Failures and injuries may occur.

Dispose driver and motor properly as general industrial wastes.

⚠

■ Prohibition 🛇

Do not store the system in the area where it may be exposed to rain and water drops, or toxic gasses or liquids exist.	
🛇	This can result in failures.

Brake built in servo motor is for holding, so do not use it for braking. Using the brake for braking will damage the brake.	
🛇	This can result in failures.

Do not perform overhaul.	
🛇	This can result in fire and electrical shock.

Do not remove nameplate.
🛇

■ Mandatory ❗

<table>
<tr><td colspan="2">Store the system within the specified temperature and humidity “-20° C to +65° C, 90%RH or less(no condensation)” away from direct sunlight.</td></tr>
<tr><td>❗</td><td>This can result in failures.</td></tr>
</table>

<table>
<tr><td colspan="2">For long-term storage of servo amplifier (over 3 years as a guide), please contact us. Long-term storage will reduce capacity of electrolytic capacitor, and this can result in failures.</td></tr>
<tr><td>❗</td><td>This can result in failures.</td></tr>
</table>

<table>
<tr><td colspan="2">Place emergency stop circuit outside the product so that operation can be stopped and power supply can be shut down instantaneously. Place a safeguard circuit outside servo amplifier so as to shut off main circuit power supply when alarm activated.</td></tr>
<tr><td>❗</td><td>Going out of control, injuries, burnout, fire, and secondary damages can occur.</td></tr>
</table>

<table>
<tr><td colspan="2">Please operate within the specified range of temperature and humidity.
Servo amplifier
Temperature: 0°C to 55°C
Humidity: 90%RH or less (No condensation)
Servo motor
Temperature: 0°C to 40°C
Humidity: 20 to 90%RH (No condensation)</td></tr>
<tr><td>❗</td><td>This can result in burnout and failures.</td></tr>
</table>

<table>
<tr><td colspan="2">Overloading of product can lead collapses, so observe the instructions indicated on original outer package, as injuries may occur.</td></tr>
<tr><td>❗</td><td>Injuries may occur.</td></tr>
</table>

<table>
<tr><td colspan="2">Use eyebolt of servo motor for carrying servo motor only. Do not use for carrying equipments.</td></tr>
<tr><td>❗</td><td>Injuries and failures may occur.</td></tr>
</table>

Table of contents

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1. Preface

1.1 Introduction

Thank you for purchasing our AC servo system ”SANMOTION R” ADVANCED MODEL. This instruction model describes specifications, installation, wiring, operation, functions, maintenance of the system, and important instructions to observe to ensure your safety. 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” ADVANCED MODEL is a consolidated power supply, single-shaft type servo amplifier consisting of six (6) models according to capacity. This improved model corresponds to the Rotary Motor R series, which enables it to utilize a serial encoder and pulse encoder for motor encoding. Furthermore, this product will correspond to an external pulse encoder for a fully-closed control system. Batteries for the motor encoder are mounted with an encoder cable; size has been reduced up to 15% by decreasing the power circuitry size with an estimate of up to 19% savings in energy by adapting a new generation power module as compared with earlier models. The input/output connector for the upper controller is currently compatible. In addition, PC connectors, encoder connectors and monitor connectors are available.

1) Differences between AC servo amplifier SANMOTION R (previous model) and this system

■ Reduced size
Consolidated CNA and CNB Adopted smaller connector for motor encoder.

■ Separated connector for Software Setup
Daisy chain connection became simpler by adding a connection port.

■ Increased response time
Increased the frequency of velocity response to 1200Hz (double the current ratio) enabling this product to correspond with higher functioning equipment.

■ Shortened the position settling time
Improved the throughput of your equipment by shortening the position settling time to one-half that of current products by using “model following vibration control” and “feed forward vibration control” simultaneously in addition to the rapid response and model following control.

■ Noise reduction
Using “model following vibration control” and “feed forward vibration control” the entire machinery system vibration is suppressed with an added bonus of cutbacks in energy expenditure.

■ Improved positioning resolution
The motor encoder resolution ability has increased and as a result positioning resolution has improved which increases the processing accuracy of your equipment.

■ Improved software setup functions
Improvement of operation trace function, ability to measure operational properties of the servo motor with virtually the same operability of an oscilloscope, which increases measurement efficiency of machinery properties. Additionally, the creation of a multi-window display allows the operator to change parameters by checking measurement data for servo tuning, allowing for improved tuning efficiency.

■ Alarm display function
With the addition of “status display function at the time of alarm” and “time-stamp function of alarm history” diagnosing the specific cause of an alarm has become easier, improving maintenance.

■ Parameter backup function
With the Parameter backup function, you can maintain system parameters, general parameters and motor parameters in a servo amplifier making parameter restoration available as the need arises.

■ Safe torque off function
By using hardware equipped with Safe Torque Off function that safely disables motor torque, you can easily incorporate safety functions to the machines.

1.2 Instruction manual

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

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 Adjustments
  Explanation of auto tuning, manual servo tuning, etc.
- Chapter 7 Digital Operator
  Explanation of the LED display and the digital operator
- Chapter 8 Maintenance
  Explanation of troubleshooting when alarms occur and inspection
- Chapter 9 Fully-closed control
  Explanation of Fully-closed control and how to use it
- Chapter 10 Safe-Torque-Off function
  Explanation of Safe-Torque-Off function and how to use it
- Chapter 11 Selection
  Explanation of selection method for the servo motor as well as regenerative resistance capacity
- Chapter 12 Appendix
  Explanation of international standards, servo motor data sheets and dimensions

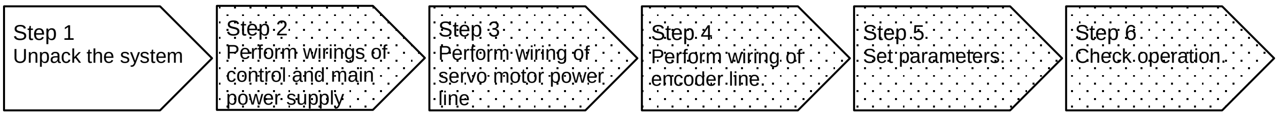
2) Precautions related to these instructions

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 your local sales office or the head office of your findings.

1.3 System introduction guide

This section describes system introduction flow from unpacking to operation check for customers using servo amplifier and servo motor for the first time.

Introduction flow



Step 1
Unpack the system

Step 2
Perform wirings of control and main power supply

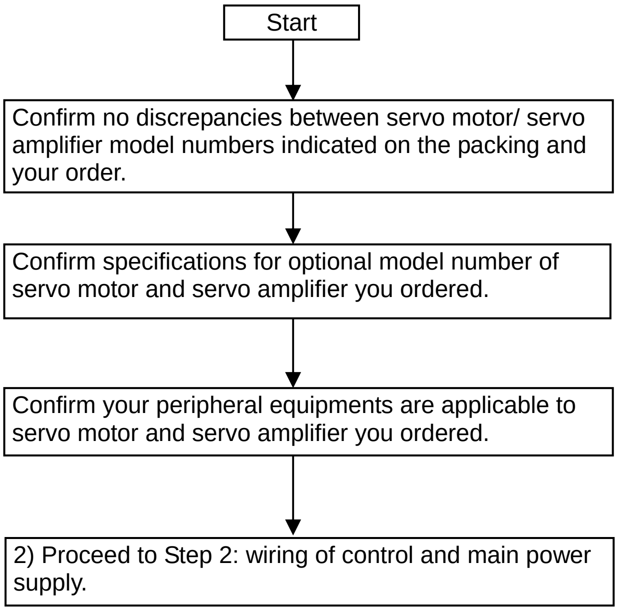
Step 3
Perform wiring of servo motor power line

Step 4
Perform wiring of encoder line.

Step 5
Set parameters.

Step 6
Check operation.

1) Step 1: Unpack the system



Start

Confirm no discrepancies between servo motor/ servo amplifier model numbers indicated on the packing and your order.

Confirm specifications for optional model number of servo motor and servo amplifier you ordered.

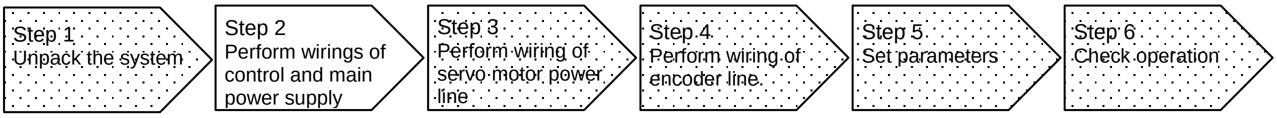
Confirm your peripheral equipments are applicable to servo motor and servo amplifier you ordered.

2) Proceed to Step 2: wiring of control and main power supply.

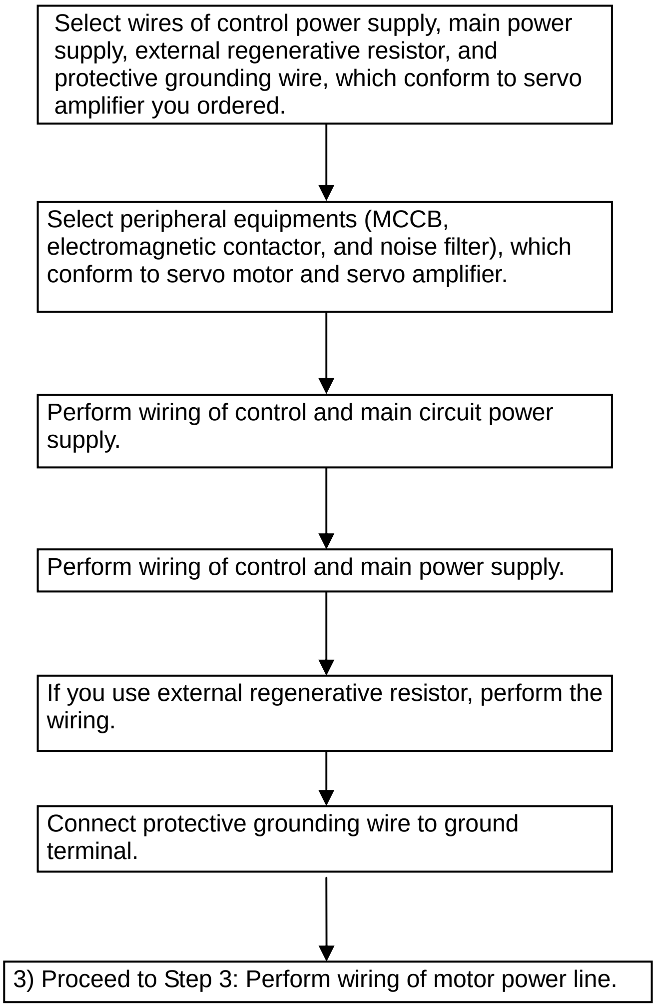
- ✔ Refer to “Unpacking (3-2), (3-4)” for the details.
- ✔ Refer to “Model number structure (1-15 to1-18), Optional items (12-41 to 12-47)” for the details.
- ✔ Refer to “System configuration (1-12 to1-14), Peripheral equipments (4-27)” for the details.

- ✔ If you found any abnormalities, please contact us.

Introduction flow



2) Step 2: Perform wirings of control and main power supply



- ✔ Refer to “Wiring for main circuit power supply, control power, regenerative resistance, servo motor, and protective grounding (4-1 to 4-11)” for the details.
- ✔ Refer to “ Example of wiring (4-7 to 4-10)” for the details.
- ✔ Refer to “Example of wiring (4-7 to 4-10)” for the details.
- ✔ Refer to “Crimping of wires in main circuit (4-11)” for the details.
- ✔ Refer to “Wiring for main circuit power supply, control power, regenerative resistance, servo motor, and protective grounding (4-1 to 4-11)” for the details.
- ✔ Refer to “Wiring for main circuit power supply, control power, regenerative resistance, servo motor, and protective grounding (4-1 to 4-11)” for the details.

Introduction flow

Step 1 Unpack the system

Step 2 Perform wirings of control and main power supply

Step 3 Perform wiring of servo motor power line

Step 4 Perform wiring of encoder line.

Step 5 Set parameters.

Step 6 Check operation

3) Step 3: Perform wiring of servo motor power line

Select wires of motor power line, which conform to servo motor you ordered.

✔ Refer to "Wiring for main circuit power supply, control power, regenerative resistance, servo motor, and protective grounding (4-1 to 4-11)" for the details.

Perform wiring of servo motor power line and grounding.

✔ Refer to "Wiring of servo motor (4-4 to 4-6)" for the details.

4) Proceed to Step 4: Perform wiring of encoder line

Introduction flow

Step 1
Unpack the system

Step 2
Perform wirings of control and main power supply

Step 3
Perform wiring of servo motor power line

Step 4
Perform wiring of encoder line.

Step 5
Set parameters.

Step 6
Check operation.

4) Step 4: Perform wiring of encoder line.

Select wiring method from "encoder type" indicated in servo motor model number you ordered.

✔ Refer to "Servo motor model number (1-15, 16)" for the details.

Taking motor model number: R2AA06020FXP00 for example, the encoder type is "P," so perform wiring of battery backup absolute encoder.

✔ Refer to "Wiring (4-23 to 4-26)" for the details.

Taking motor model number: R2AA06020FXH00 for example, the encoder type is "H," so perform wiring of absolute encoder for incremental system encoder.

✔ Refer to "Wiring (4-23 to 4-26)" for the details.

Taking motor model number: R2AA06020FXW00 for example, the encoder type is "W," so perform wiring of battery-less absolute encoder.

✔ Refer to "Wiring (4-23 to 4-26)" for the details.

Taking motor model number: R2AA06020FXS00 for example, the encoder type is "S," so perform wiring of pulse encoder.

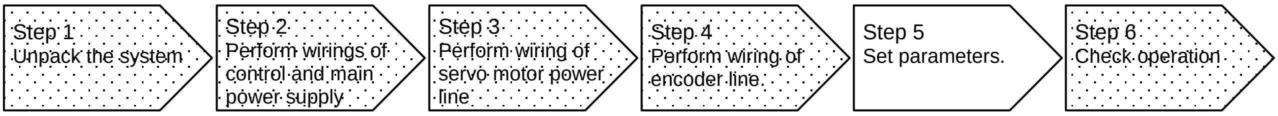
✔ Refer to "Wiring (4-23 to 4-26)" for the details.

When control power established LED (lights in blue) and main circuit power LED (lights in red during CHARGE) do not light even if control and main circuit power are turned on, review the wiring.

✔ Refer to "Part names (1-19 to 1-21)" for the details.

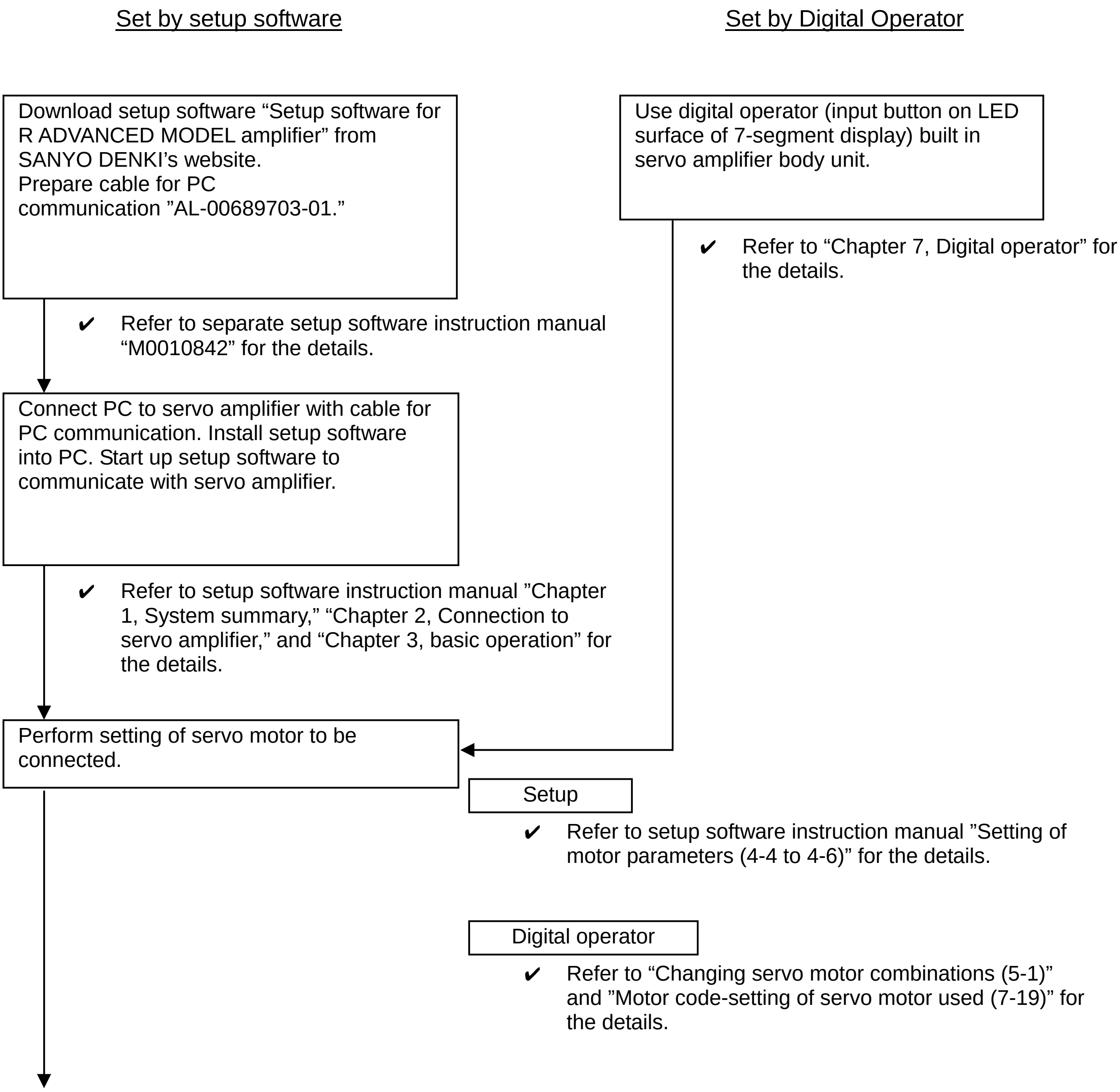
✔ Alarm "AL☐☐☐" can be indicated on digital operator display, as encoder is not set.

Introduction flow



5) Step 5: Set parameters

Parameters need to be properly set by using servo amplifier to drive servo motor. The setting can be performed by either setup software or digital operator.



Set by setup software

Set by Digital Operator

Download setup software “Setup software for R ADVANCED MODEL amplifier” from SANYO DENKI’s website.
Prepare cable for PC communication ”AL-00689703-01.”

✔ Refer to separate setup software instruction manual “M0010842” for the details.

Connect PC to servo amplifier with cable for PC communication. Install setup software into PC. Start up setup software to communicate with servo amplifier.

✔ Refer to setup software instruction manual ”Chapter 1, System summary,” “Chapter 2, Connection to servo amplifier,” and “Chapter 3, basic operation” for the details.

Use digital operator (input button on LED surface of 7-segment display) built in servo amplifier body unit.

✔ Refer to “Chapter 7, Digital operator” for the details.

Perform setting of servo motor to be connected.

Setup

✔ Refer to setup software instruction manual ”Setting of motor parameters (4-4 to 4-6)” for the details.

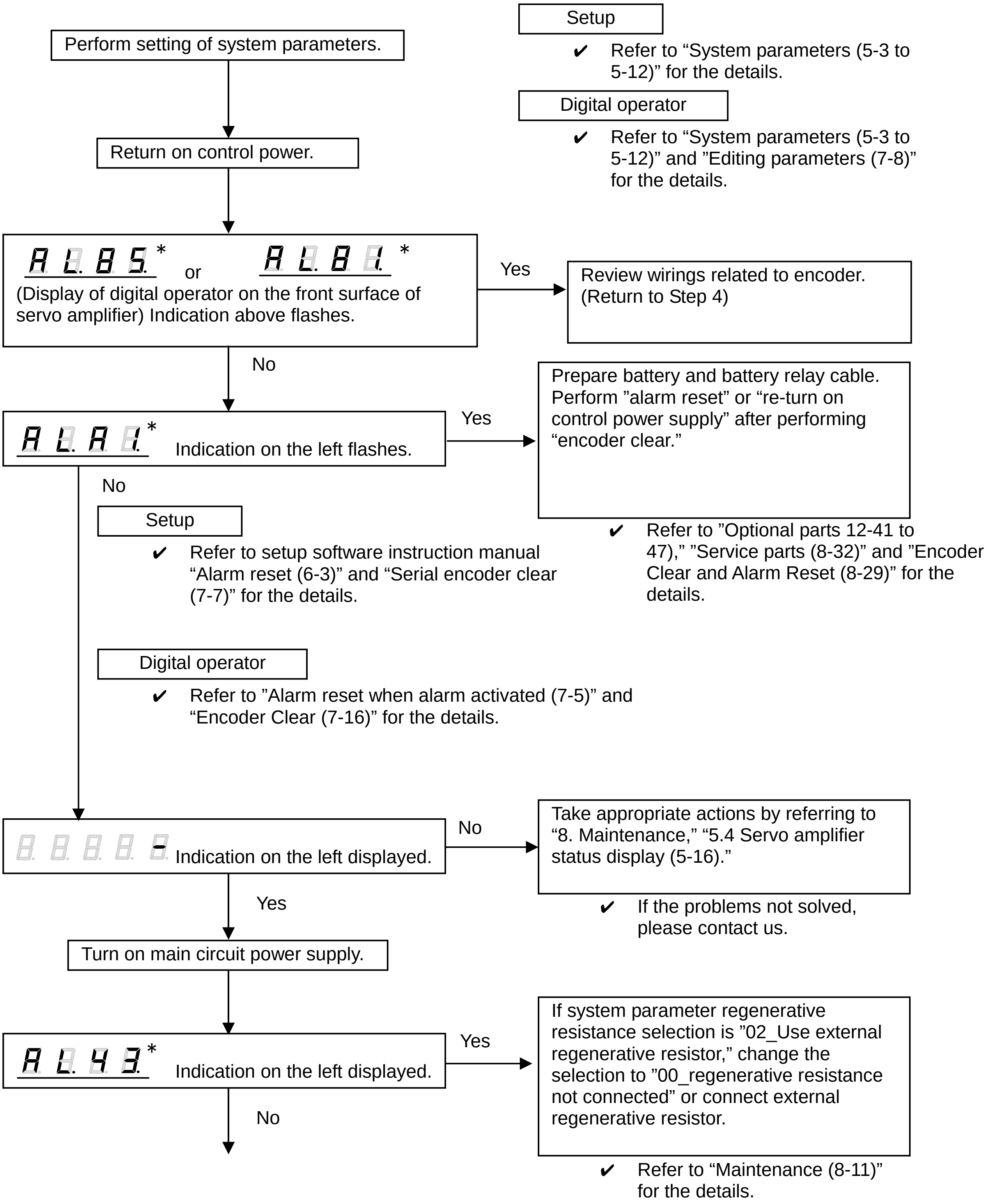
Digital operator

✔ Refer to “Changing servo motor combinations (5-1)” and ”Motor code-setting of servo motor used (7-19)” for the details.

Introduction flow

Step 1 Unpack the system → Step 2 Perform wirings of control and main power supply → Step 3 Perform wiring of servo motor power line → Step 4 Perform wiring of encoder line. → **Step 5 Set parameters.** → Step 6 Check operation

5) Step 5: Set parameters (Cont.)



Perform setting of system parameters.

Setup

- ✔ Refer to “System parameters (5-3 to 5-12)” for the details.

Digital operator

- ✔ Refer to “System parameters (5-3 to 5-12)” and ”Editing parameters (7-8)” for the details.

Return on control power.

AL.85.* or AL.81.* (Display of digital operator on the front surface of servo amplifier) Indication above flashes.

Yes: Review wirings related to encoder. (Return to Step 4)

No: AL.A1.* Indication on the left flashes.

Yes: Prepare battery and battery relay cable. Perform ”alarm reset” or “re-turn on control power supply” after performing “encoder clear.”

- ✔ Refer to ”Optional parts 12-41 to 47),” ”Service parts (8-32)” and ”Encoder Clear and Alarm Reset (8-29)” for the details.

No:

Setup

- ✔ Refer to setup software instruction manual “Alarm reset (6-3)” and “Serial encoder clear (7-7)” for the details.

Digital operator

- ✔ Refer to ”Alarm reset when alarm activated (7-5)” and “Encoder Clear (7-16)” for the details.

8.8.8.8.- Indication on the left displayed.

No: Take appropriate actions by referring to “8. Maintenance,” “5.4 Servo amplifier status display (5-16).”

- ✔ If the problems not solved, please contact us.

Yes: Turn on main circuit power supply.

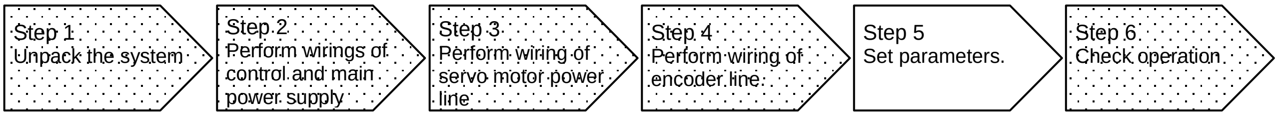
AL.43.* Indication on the left displayed.

Yes: If system parameter regenerative resistance selection is ”02_Use external regenerative resistor,” change the selection to ”00_regenerative resistance not connected” or connect external regenerative resistor.

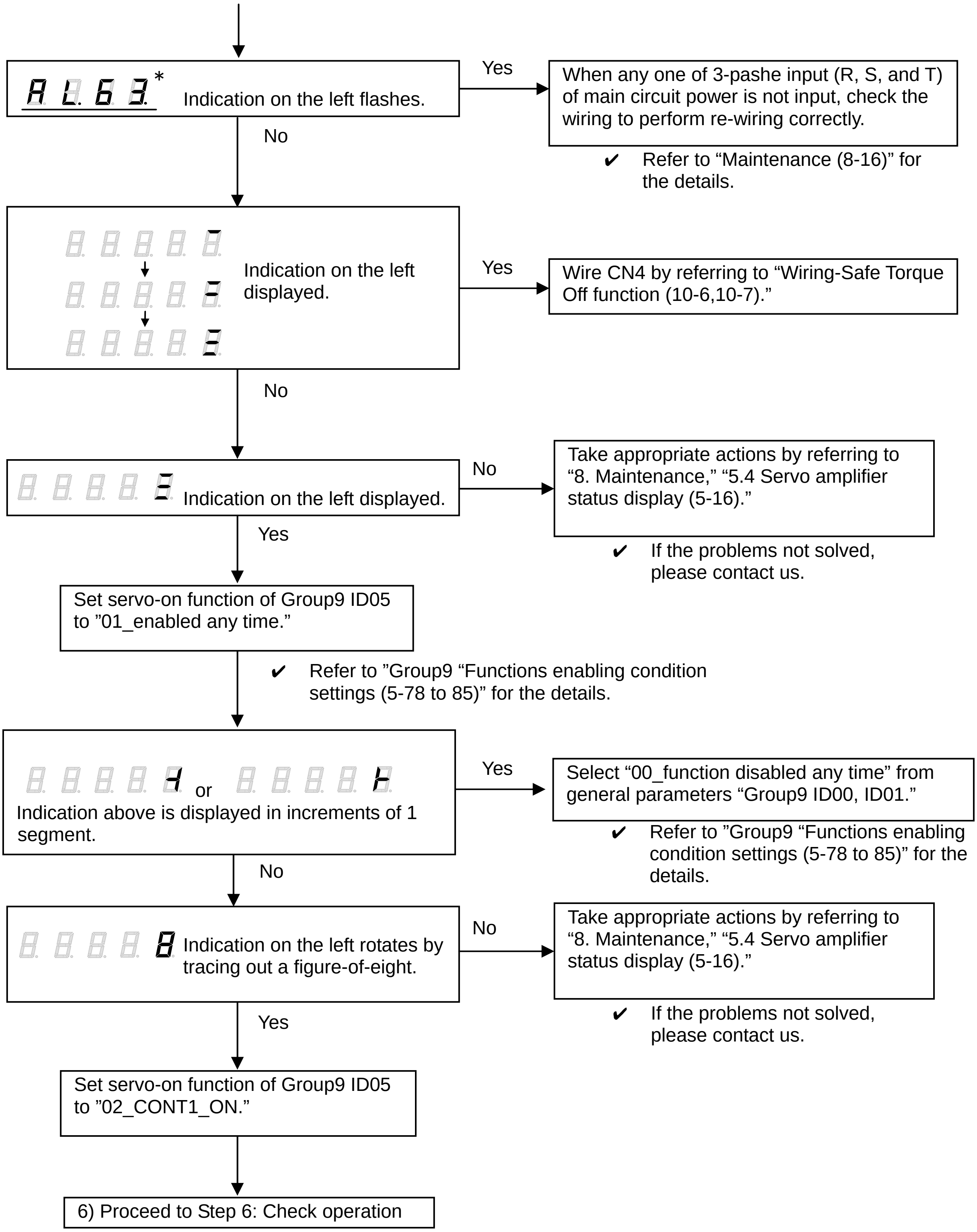
- ✔ Refer to “Maintenance (8-11)” for the details.

No

Introduction flow



5) Step 5: Set parameters (Cont.)



Indication on the left flashes.

When any one of 3-pashe input (R, S, and T) of main circuit power is not input, check the wiring to perform re-wiring correctly.

✔ Refer to “Maintenance (8-16)” for the details.

Indication on the left displayed.

Wire CN4 by referring to “Wiring-Safe Torque Off function (10-6,10-7).”

Indication on the left displayed.

Take appropriate actions by referring to “8. Maintenance,” “5.4 Servo amplifier status display (5-16).”

✔ If the problems not solved, please contact us.

Set servo-on function of Group9 ID05 to ”01_enabled any time.”

✔ Refer to ”Group9 “Functions enabling condition settings (5-78 to 85)” for the details.

Indication above is displayed in increments of 1 segment.

Select “00_function disabled any time” from general parameters “Group9 ID00, ID01.”

✔ Refer to ”Group9 “Functions enabling condition settings (5-78 to 85)” for the details.

Indication on the left rotates by tracing out a figure-of-eight.

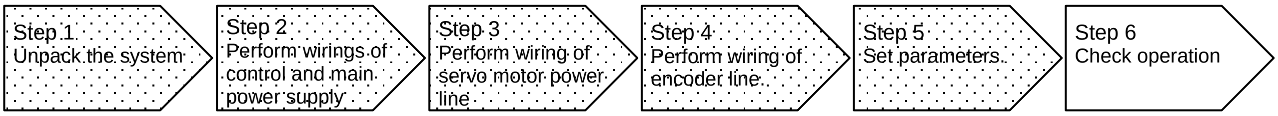
Take appropriate actions by referring to “8. Maintenance,” “5.4 Servo amplifier status display (5-16).”

✔ If the problems not solved, please contact us.

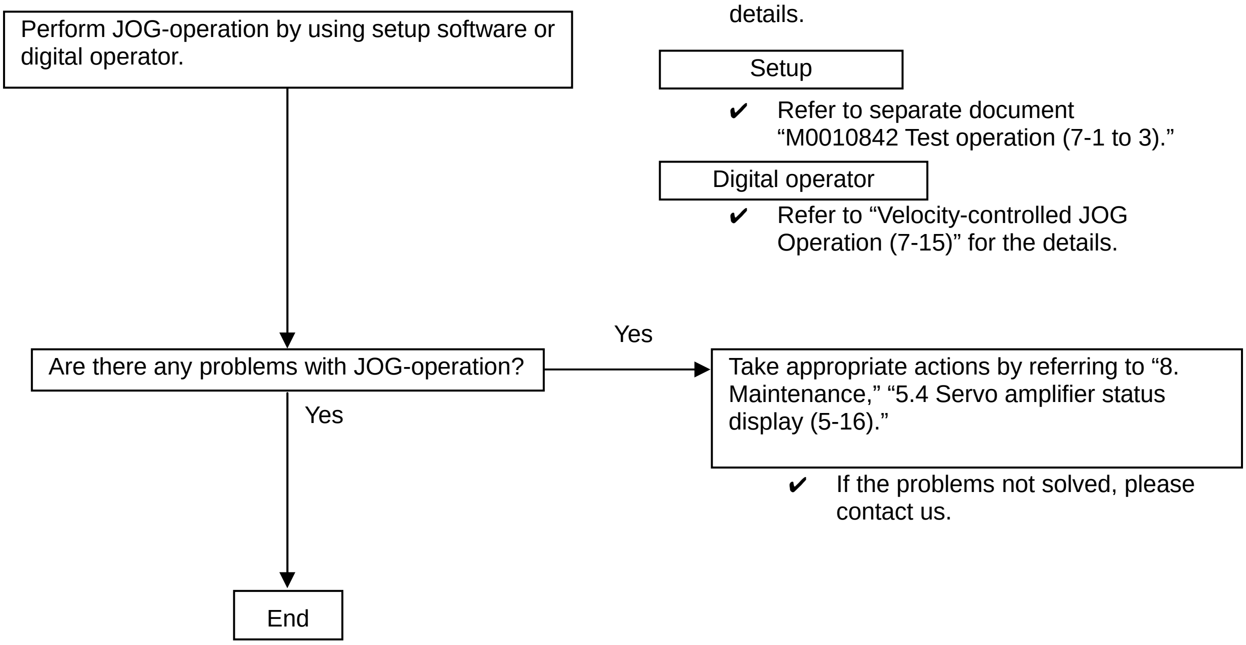
Set servo-on function of Group9 ID05 to ”02_CONT1_ON.”

6) Proceed to Step 6: Check operation

Introduction flow



6) Step 6: Check operation



- ✔ Refer to “Test Operation (5-13)” for the details.

Setup

- ✔ Refer to separate document “M0010842 Test operation (7-1 to 3).”

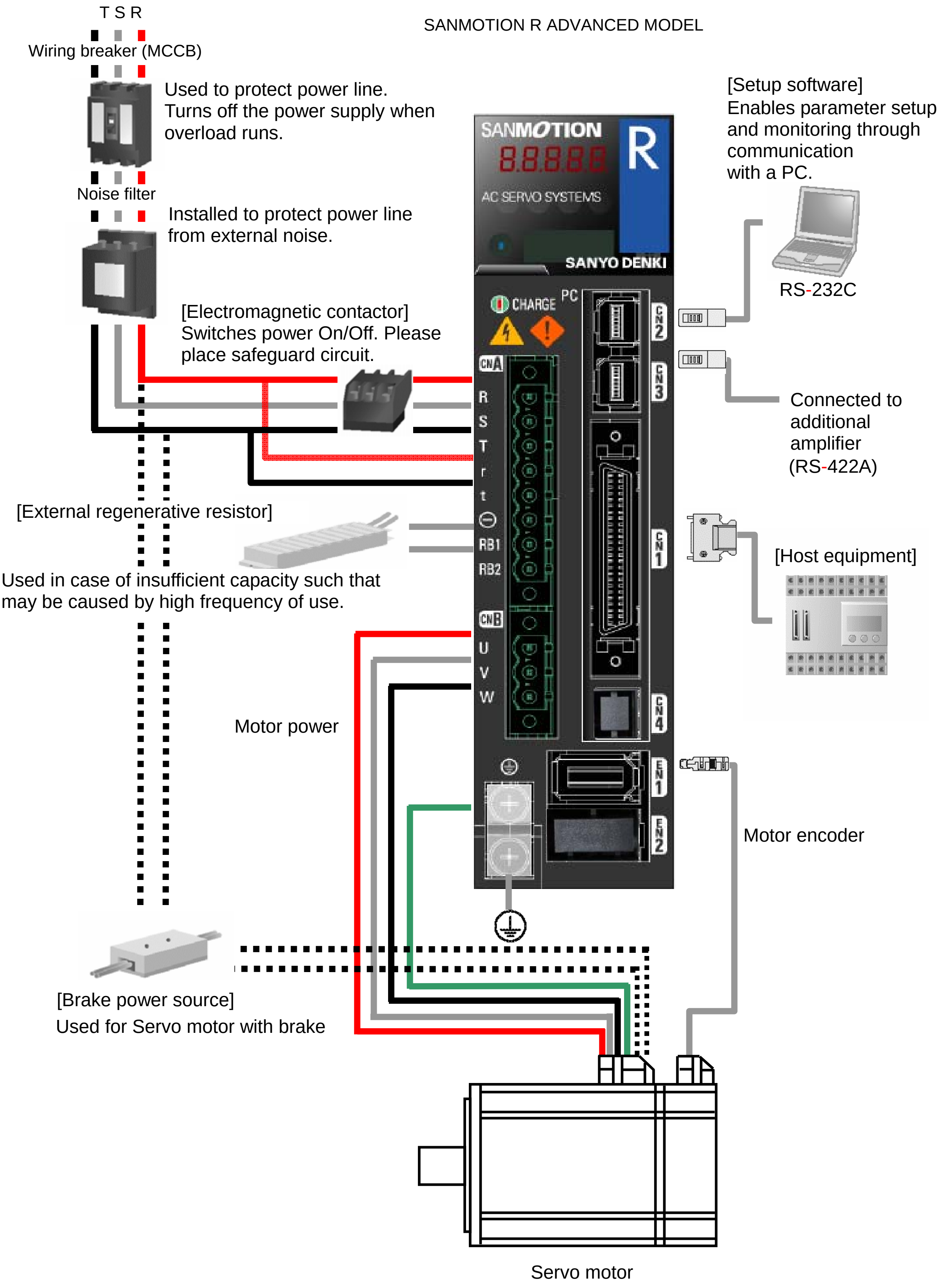
Digital operator

- ✔ Refer to “Velocity-controlled JOG Operation (7-15)” for the details.

- ✔ If the problems not solved, please contact us.

1.4 Illustration of system components

■ RS2☐01/RS2☐03/RS2☐05



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

Installed to protect power line from external noise.

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

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

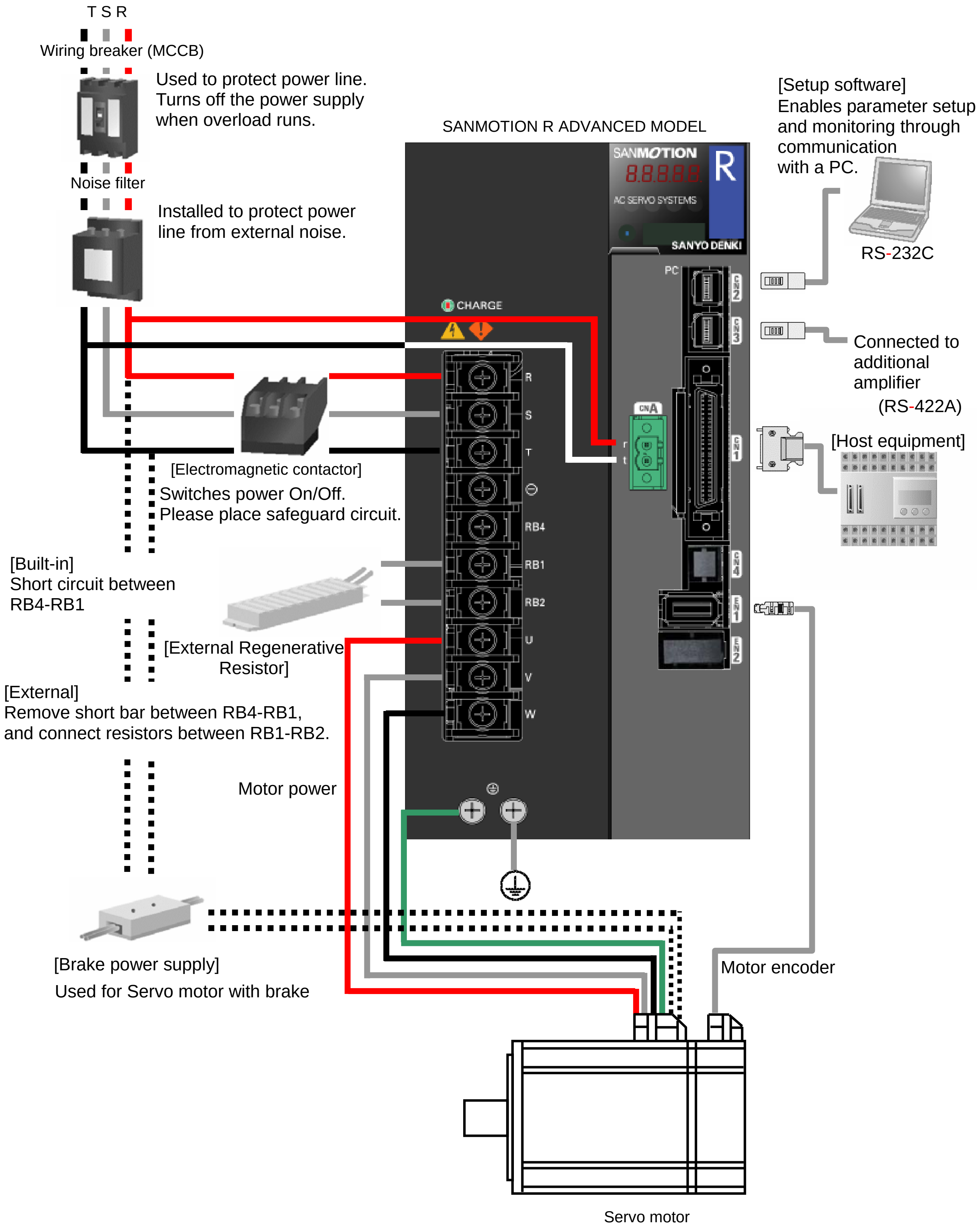
Connected to additional amplifier (RS-422A)

[External regenerative resistor]

Used in case of insufficient capacity such that may be caused by high frequency of use.

[Brake power source]
Used for Servo motor with brake

■ RS2□10/RS2□15



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

Installed to protect power line from external noise.

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

Connected to additional amplifier

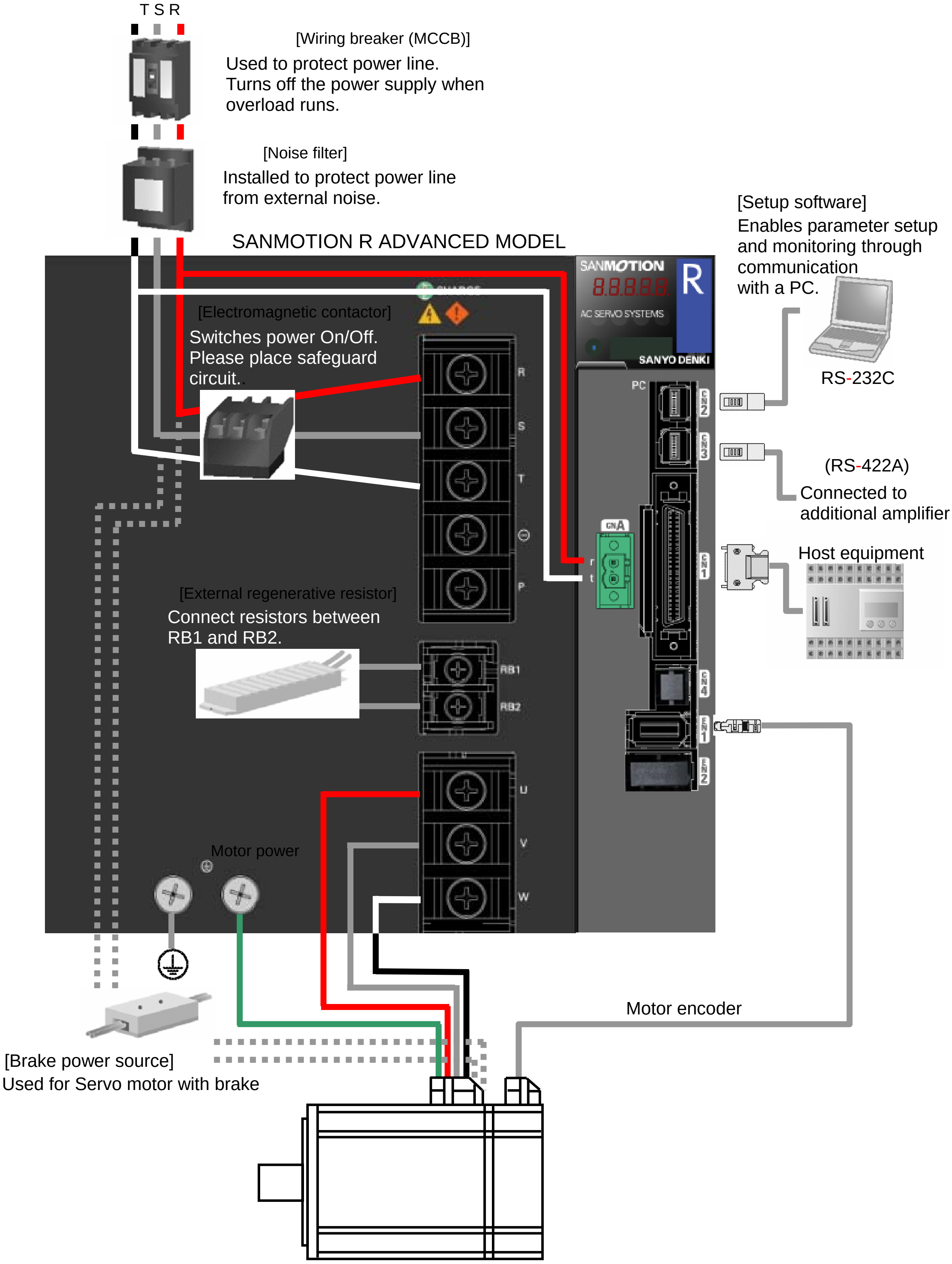
Switches power On/Off. Please place safeguard circuit.

[Built-in] Short circuit between RB4-RB1

[External] Remove short bar between RB4-RB1, and connect resistors between RB1-RB2.

Used for Servo motor with brake

■ RS2☐30



[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]
Connect resistors between RB1 and RB2.

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

Connected to additional amplifier

Host equipment

[Brake power source]
Used for Servo motor with brake

Servo motor

1.5 Model number structure

1) Servo Motor Model Number

R 2 AA 06 020 F C P 00 M A

■ Note 1)

Sign	Reducer type	Reduction ratio
A	Planet gear	1/3
B		1/5
C		1/9
D		1/15
E		1/25
S	Backlash-less planet gear	1/5
T		1/11
U		1/21
V		1/33

■ Additional specification identification

M・・・CE mark + UL supported

0・・・With decelerator without standards Note 1)

■ Specification identification

00・・・Standard

■ Encoder type

H・・・Absolute encoder for incremental system (PA035S)

P・・・Battery backup method absolute encoder (PA035C)

W・・・Batteryless absolute encoder (RA035C)

S・・・Wire-saving incremental encoder (PP031T, PP062)

■ Securing brake

X・・・No brake

B・・・(90V)Brake

C・・・(24V) Brake

■ Maximum rotation speed

S・・・・1000min^{-1} B・・・・2000min^{-1} R・・・・2500min^{-1}

L・・・・3000/4000min^{-1} H・・・・3000/3500min^{-1} D・・・・4000/4500/5000min^{-1}

F・・・・6000min^{-1}

■ Rated output

003・・・30W 020・・・200W 100・・・1kW 350・・・3.5kW 700・・・7kW

005・・・50W 040・・・400W 120・・・1.2kW 450・・・4.5kW 750・・・7.5kW

008・・・80W 050・・・500/550W 180・・・1.8kW 500・・・5kW 11K・・・11kW

010・・・100W 075・・・750W 200・・・2kW 550・・・5.5kW 15K・・・15kW

Decreasing rating may be needed for the model with oil seal and brake. Refer to page 12-26

■ Flange dimensions

04・・・・・・40mm 06・・・・・・60mm 08・・・・・・80mm

B8・・・・・・86mm 10・・・・・100mm 13・・・・・130mm

18・・・・・180mm 22・・・・・220mm

■ Voltage

AA・・・200V Motor

EA・・・100V Motor

■ Servo Motor type

1・・・R1-series Motor 2・・・R2-series Motor 5・・・R5-series motor

■ R Series

Note1) Applicable to the flange size of 86mm or less.

■ Motor Encoder Model Number

◆ Serial Encoder

Type	Resolution within 1 rotation	Resolution within multiple rotations	Name	Transmission format
PA035S	131072(17bits)	---	Absolute encoder for incremental system	Half-duplex asynchronous 2.5Mbps (standard)
PA035C	131072(17bits)	65536(16bits)	Battery backup method absolute encoder	Half-duplex asynchronous 2.5Mbps (standard)
RA035C	131072(17bits)	65536(16bits)	Batteryless absolute encoder	Half-duplex asynchronous 2.5Mbps (standard)

◆ Pulse Encoder

Model	Standard	Applicable range	Name
	Division number (Number of pulse)	Division number (Number of pulse)	
PP031T PP062	8000(2000P/R)	8192・20000・32768・40000 (2048・5000・8192・10000P/R)	Wire-saving incremental encoder

✔ Please contact our office about the combination with servo motor.

2) Servo motor model number

Q 1 AA 10 200 D C P 00 E

■ Additional specification identification
E･･･Supports mark CE
U･･･Supports UL
M･･･Supports mark CE and UL

■ Specification identification
00･･･Standard

■ Encoder type
S･･･Wire-saving incremental encoder (PP031T, PP062)
H･･･Absolute encoder for incremental system (PA035S)
P･･･Battery backup method absolute encoder (PA035C)
W･･･Batteryless absolute encoder (RA035C)

■ Securing brake
X･･･No brake B･･･(90V)Brake C･･･(24V) Brake

■ Maximum rotation speed
S････1000min^{-1} M････1500min^{-1}
B････2000min^{-1} V････2000min^{-1}
R････2500min^{-1} H････3000/3500min^{-1}
L････3000min^{-1} D････4500/5000min^{-1}

■ Rated output
100･･･1.0kW 300･･･3.0kW 500･･･5.0kW 11K･･･11kW
150･･･1.5kW 350･･･3.5kW 550･･･5.5kW 15K･･･15kW
200･･･2.0kW 400･･･4.0kW 700･･･7.0kW
250･･･2.5kW 450･･･4.5kW 750･･･7.5kW

■ Flange dimensions
10･････100mm 12･････120mm
13･････130mm 18･････180mm
22･････220mm

■ Servo Motor type
1･･･Low inertia 2･･･Medium Inertia 4･･･Low inertia (High-capacity)

■ Voltage
AA･･･200V Motor

■ Q Series

■ Motor encoder model number

◆ Serial encoder

Type	Resolution within 1 rotation	Resolution within multiple rotations	Name	Transmission format
PA035S	131072 (17bit)	---	Absolute encoder for incremental system	Half-duplex asynchronous 2.5Mbps (standard)
PA035C	131072 (17bit)	65536 (16bit)	Battery backup method absolute encoder	Half-duplex asynchronous 2.5Mbps (standard)
RA035C	131072 (17bit)	65536 (16bit)	Battery-less absolute encoder	Half-duplex asynchronous 2.5Mbps (standard)

◆ Pulse encoder

Model	Standard	Applicable range	Name
	Division number (Number of pulse)	Division number (Number of pulse)	
PP031T PP062	8000 (2000P/R)	8192･20000･32768･40000･65536･100000 (2048･5000･8192･10000･16384･25000P/R)	Wire-saving incremental encoder

✔ Please contact our office about the combination with servo motor.

3) Servo amplifier model number (11-digit abbreviated model number)

RS2 A 01 A 0 A A 0

■ Option 2

	Velocity/ Torque command input	Safe Torque Off function
0	Available	None
2	Available	Available (without delay circuit)
4	Available	Available (with delay circuit)

■ Option 1

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

■ Interface type

A····Analog pulse control, NPN (Sink) output
B····Analog pulse train, PNP (Source) output

PNP Generic output: PNP (Source) output:
It takes external 24VDC as common power supply and outputs 24VDC when generic output is ON.

■ Motor Encoder Type

	EN1 (Motor encoder)	EN2 (External pulse encoder)
0	Serial encoder	-
2	Serial encoder	Pulse encoder
8	Pulse encoder	-
A	Pulse encoder	Pulse encoder

■ Servo Motor type

A···Rotary motor

■ Servo Amplifier capacity

01····15A 03····30A
05····50A 10···100A
15···150A 30···300A

■ Input voltage

A····AC200V
E····AC100V

■ RS2 Series

✔ Setup values for the 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 pages:

◆ [Procedureto combine the servo motor (5-1)]
◆ [System parameters (5-3)]
◆ [Factory Default Setting Values (5-12)]
◆ [Setting parameters (5-29)]

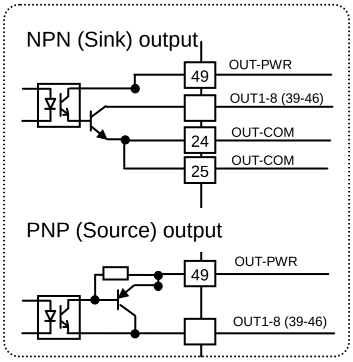
✔ For customers using the Servo amplifier for "Full-closed" system:
Motor encoder type: 2 or A model
Specify this model as your motor encoder

✔ 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.

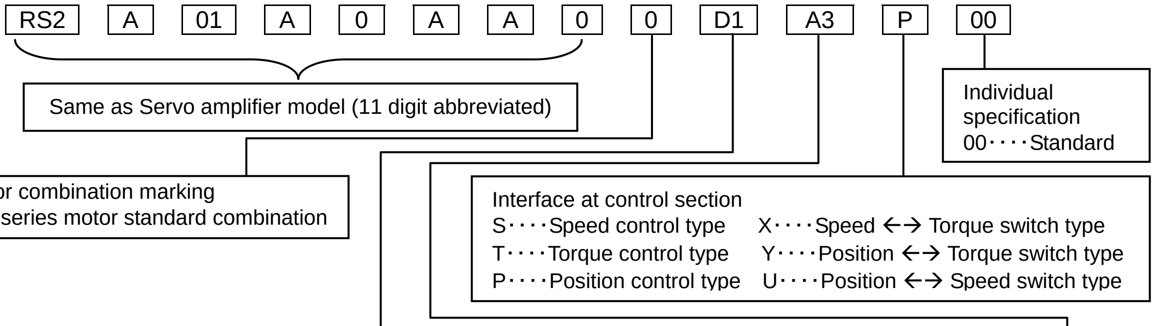
✔ See chapter 10 for Safe Torque Off function.

<u>NPN (Sink) output and PNP (Source) output</u>

NPN (Sink) output and PNP (Source) output are names of method of generic output circuit for the servo amplifiers. Besides the existing hardware with NPN (Sink) output, hardware equipped with PNP (Source) is added to the product lineup since Jun. 2009.
See the diagram on the right for the output circuit



4) Servo amplifier model number (19-digit full model number string)



Same as Servo amplifier model (11 digit abbreviated)

Servo motor combination marking
0････R, Q series motor standard combination

Individual specification
00････Standard

Interface at control section
S････Speed control type X････Speed <-> Torque switch type
T････Torque control type Y････Position <-> Torque switch type
P････Position control type U････Position <-> Speed switch type

List of motors used in combination with RS2

*: The shaded areas show set values at factory for abbreviated model numbers.

Specifications for use in AC200V					
RS2A01	Motor Code	RS2A03	Motor Code	RS2A05	Motor Code
RS2AA04003F*	D1	R2AA06040F*	D6	R2AAB8075F	EH
R2AA04005F	D2	R2AA08040F	D8	R2AAB8100F	DK
R2AA04010F	D3	R2AA08075F	D7	R2AA10100F	DX
R2AA06010F	D4	R2AAB8100H	DL	R2AA13120D*	DD
R2AA06020F	D5	R2AA10075F	DY	R2AA13120L	DE
R2AA06040H	D9	R2AA13050H	DF	R2AA13180H	EN
R2AA08020F	DA	R2AA13050D	DC	R2AA13200L	DJ
R5AA06020H	eW	R2AA13120B	DH	Q1AA10100D	37
R5AA06020F	eX	R5AA06040F	NU	Q1AA10150D	38
R5AA06040H	eY	R5AA08075D	NT	Q1AA12100D	3B
		R5AA08075F	eZ		

Specifications for use in AC200V					
RS2A10	Motor Code	RS2A15	Motor Code	RS2A30	Motor Code
R2AA13180D	9U	R2AA18350D	9W	R1AA18550H	99
R2AA13200D*	DG	R2AA18450H	9X	R1AA18750L	9F
R2AA18350L	9V	R2AA18550R	ER	R1AA1811KR	9D
Q1AA10200D	39	R2AA22500L	e4	R1AA1815KB	9E
Q1AA10250D	3A	R2AA22700S	3F	R2AA18550H	9Y
Q1AA12200D	3C	Q1AA13400D*	3F	R2AA18750H	ES
Q1AA12300D	3D	Q1AA13500D	3G	R2AA1811KR	9Z
Q1AA13300D	3E	Q1AA18450M	3H	R2AA2211KB	e3
Q2AA13200H	4J	Q2AA18350H	4L	R2AA2215KB	9P
Q2AA18200H	4K	Q2AA18450H	4M	Q1AA18750H	3J
		Q2AA18550R	4N	Q2AA18550H*	7M
		Q2AA22550B	4T	Q2AA18750L	7N
		Q2AA22700S	4U	Q2AA2211KV	7R
				Q2AA2215KV	7S
				Q4AA1811KB	A1
				Q4AA1815KB	A2

Specifications for use in AC100V			
RS2E01	Motor Code	RS2E03	Motor Code
R2EA04003F*	DP	R2EA06020F*	DU
R2EA04005F	DR		
R2EA04008F	DW		
R2EA06010F	DT		

Motor Encoder Code Type

Pulse encoder		
Encoder Code	Number of pulse	Name
01	2000 P/R	Wire-saving incremental encoder
02	6000 P/R	
B2	10000 P/R	

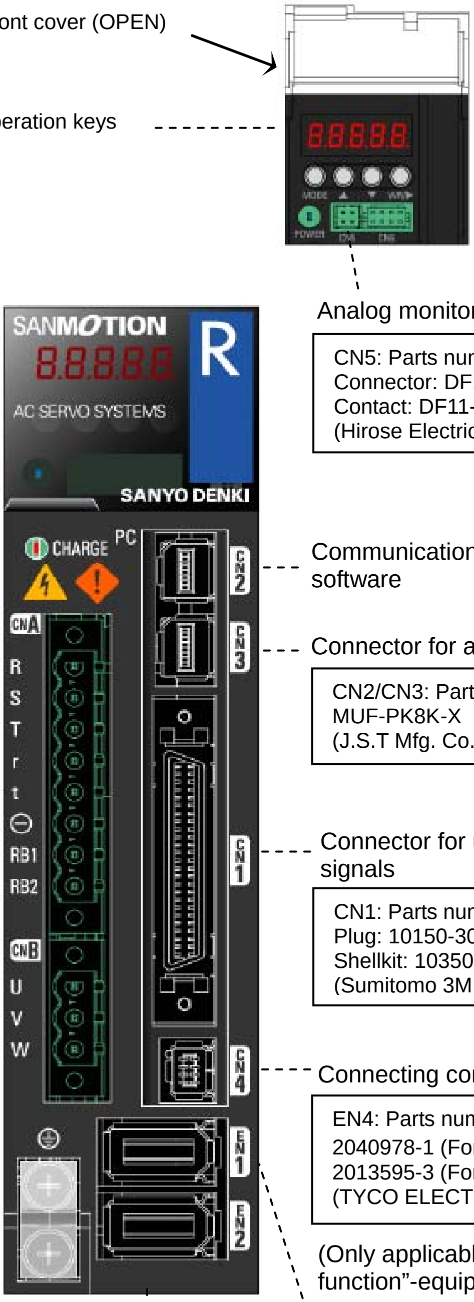
Serial encoder				
Encoder Code	Type	Resolution	Transmission rate	Name
AE	PA035S	17bit	2.5Mbps	Absolute encoder for incremental system
A3	PA035C	17bit	2.5Mbps	Battery backup method absolute encoder
A4		17bit	4.0Mbps	
A8	RA062C	17bit	2.5Mbps	Absolute encoder for incremental system
AA	RA035C	17bit	4.0Mbps	

✔ Please contact our office about the model number not shown in the above table.

1.6 Part names

1) Servo amplifier

■ RS2☐01/RS2☐03/RS2☐05



Inside the front cover (OPEN)

Digital Operator operation keys

Analog monitor connector

CN5: Parts number on plug
Connector: DF11-4DS-2C
Contact: DF11-2428SCA
(Hirose Electric Co., Ltd.)

5-digit 7-segment LED

Control power status LED (POWER-Blue)

Main circuit power LED (Red-CHARGE)

Communication connector of setup software

Connector for additional Servo amplifier

CN2/CN3: Parts number on plug
MUF-PK8K-X
(J.S.T Mfg. Co., Ltd.)

Main circuit power input
Control power input
Regenerative
resistor connector

CNA: Parts number on plug
MSTBT2.5/ 8-STF-5.08LUB
(Phoenix Contact)

Connector for upper device input/output signals

CN1: Parts number on plug
Plug: 10150-3000PE
Shellkit: 10350-52A0-008
(Sumitomo 3M Ltd.)

Servo motor connector

CNB: Parts number on plug
MSTBT2.5/3-STF-5.08
(Phoenix Contact)

Connecting connector for safety features

EN4: Parts number on plug
2040978-1 (For short-circuiting)
2013595-3 (For wiring)
(TYCO ELECTRONICS AMP.)

(Only applicable to “safe torque off function”-equipped products)

Protective ground terminal ⏚

Connecting connector for external pulse encoder

EN2: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

(Only applicable to fully closed control system)

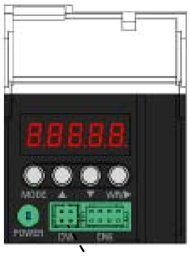
Connector for encoder signal

EN1: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

- RS2☐10/RS2☐15

Upper front cover-open

Digital Operator operation keys



Analog monitor connector

CN5: Parts number on plug
Connector: DF11-4DS-2C
Contact: DF11-2428SCA
(Hirose Electric Co., Ltd.)

5-digit 7-segment LED

Control power status LED
(POWER-Blue)

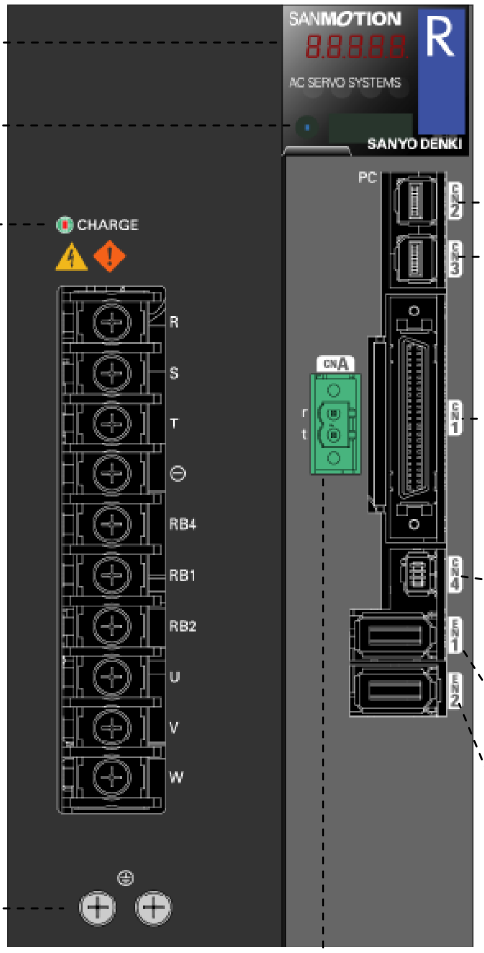
Main circuit power LED
(Red-CHARGE)

Main circuit power input

Regenerative
resistor terminal
block

Servo motor terminal
block

Protective ground terminal
⏚



Communication connector for setup software

Connector for additional Servo amplifier

CN2/CN3: Parts number on plug
MUF-PK8K-X
(J.S.T Mfg. Co., Ltd.)

Connector for host equipment input/output signals

CN1: Parts number on plug:
10150-3000PE
Shellkit: 10350-52A0-008
(Sumitomo 3M Ltd.)

Connecting connector for safety features

CN4: Parts number on plug
2040978-1 (For short-circuiting)
2013595-3 (For wiring)
(TYCO ELECTRONICS AMP)

(Only applicable to “safe torque off function”-equipped products)

Connector for encoder signal

EN1: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

Control power input connector

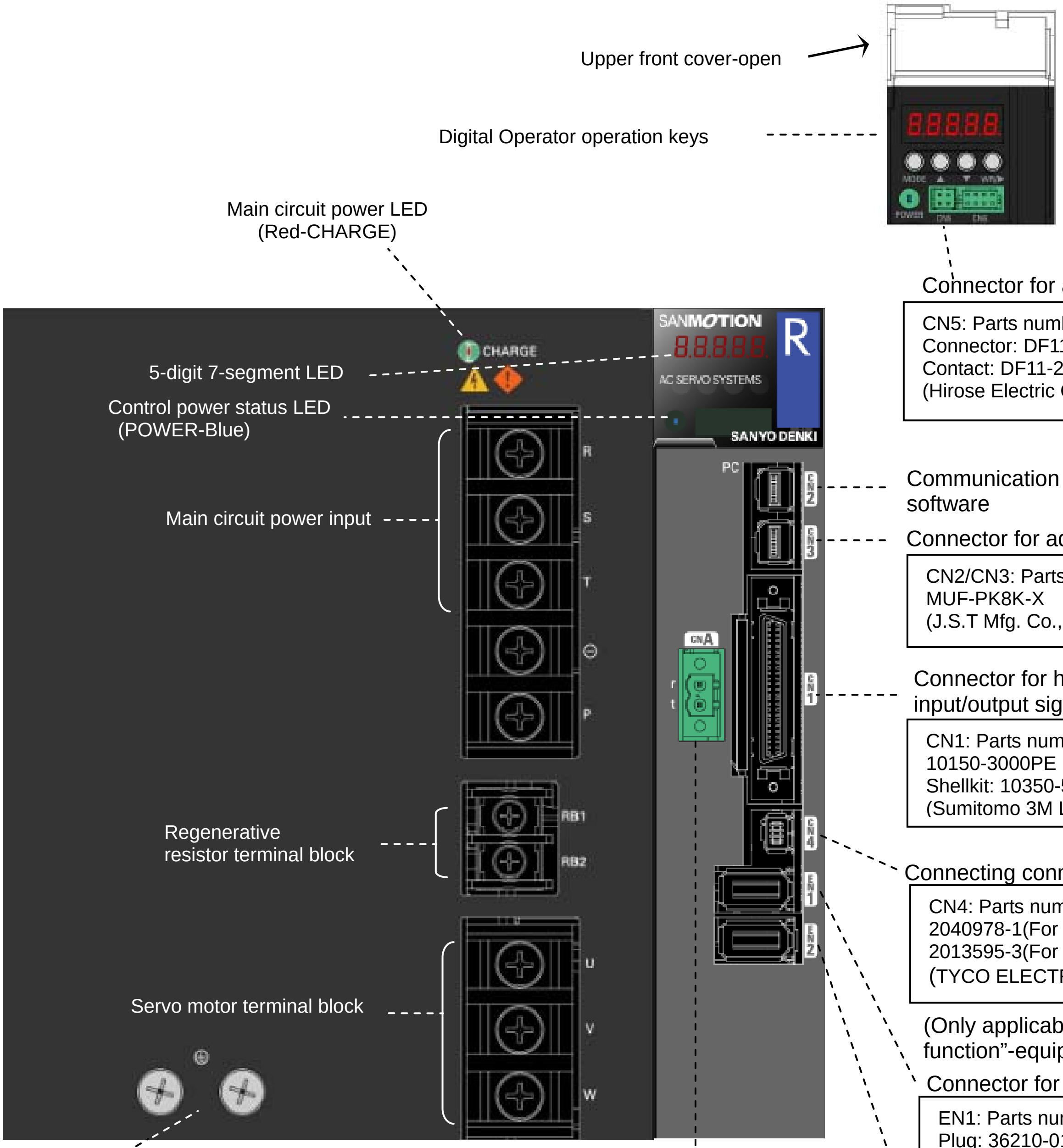
CNA: Parts number on plug
MSTBT2.5/2-STF-5.08
(Phoenix Contact)

Connecting connector for external pulse encoder

EN2: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

(Only applicable to fully closed control system)

■ RS2☐30



Upper front cover-open

Digital Operator operation keys

Main circuit power LED
(Red-CHARGE)

5-digit 7-segment LED

Control power status LED
(POWER-Blue)

Main circuit power input

Regenerative
resistor terminal block

Servo motor terminal block

Protective ground terminal ⏚

Control power input connector

CNA: Parts number on plug
MSTBT2.5/2-STF-5.08
(Phoenix Contact)

Connector for analog monitor

CN5: Parts number on plug
Connector: DF11-4DS-2C
Contact: DF11-2428SCA
(Hirose Electric Co., Ltd.)

Communication connector for setup software

Connector for additional Servo amplifier

CN2/CN3: Parts number on plug:
MUF-PK8K-X
(J.S.T Mfg. Co., Ltd.)

Connector for host equipment input/output signals

CN1: Parts number on plug:
10150-3000PE
Shellkit: 10350-52A0-008
(Sumitomo 3M Ltd.)

Connecting connector for safety features

CN4: Parts number on plug
2040978-1(For short-circuiting)
2013595-3(For wiring)
(TYCO ELECTRONICS AMP)

(Only applicable to “safe torque off function”-equipped products)

Connector for encoder signal

EN1: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

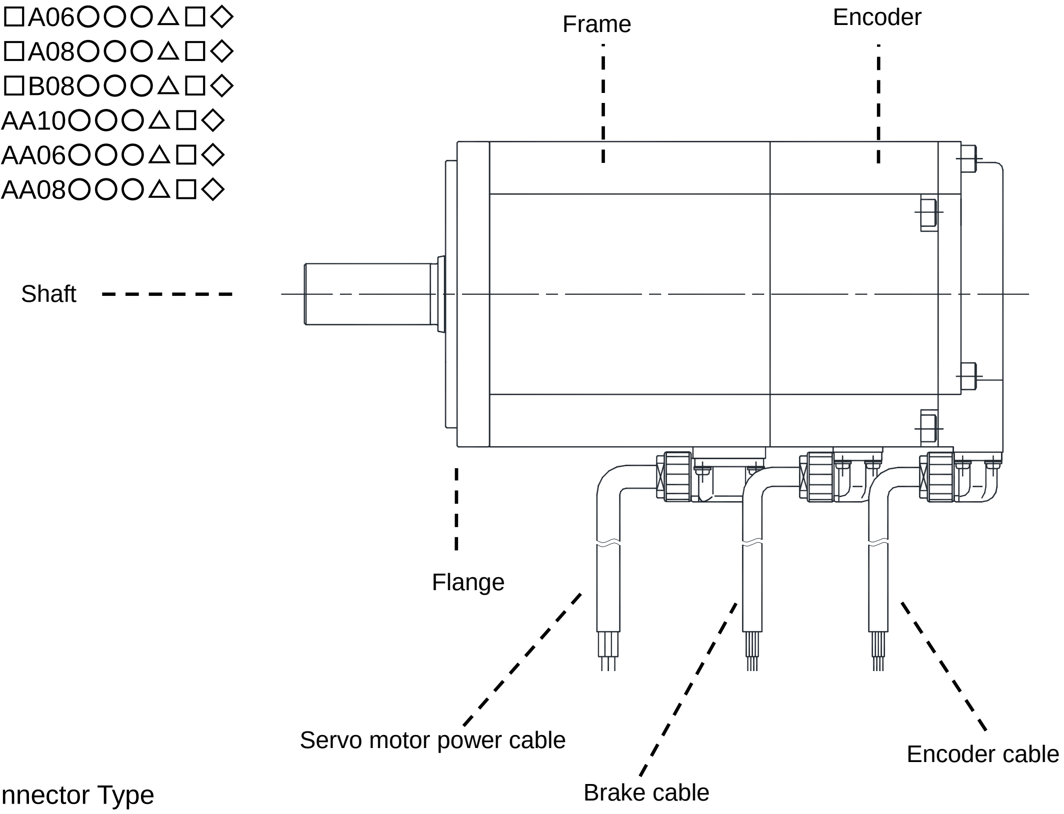
Connecting connector
for external pulse encoder

EN2: Parts number on plug
Plug: 36210-0100PL
Shellkit: 36310-3200-008
(Sumitomo 3M Ltd.)

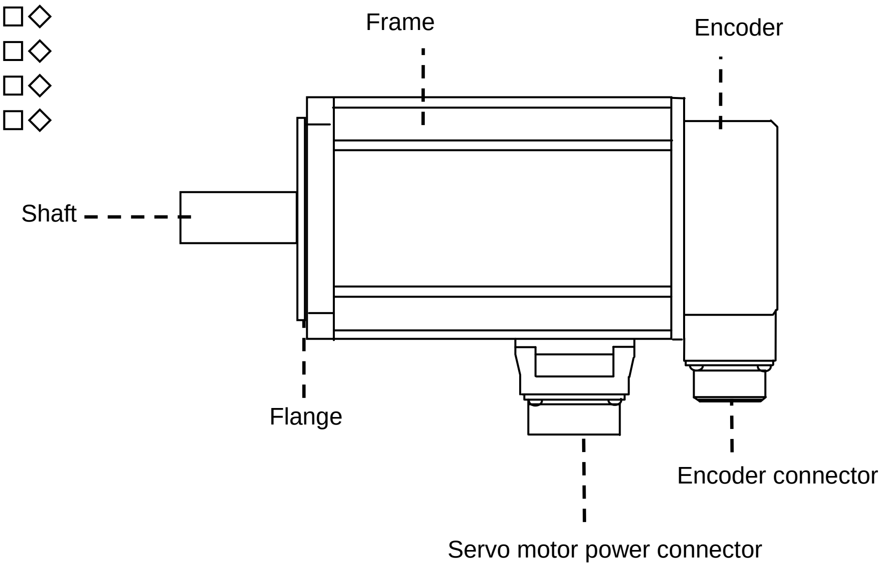
(Only applicable to fully closed control system)

2) Servo motor

- Lead wire type
  R2□A04○○○△□◇
  R2□A06○○○△□◇
  R2□A08○○○△□◇
  R2□B08○○○△□◇
  R2AA10○○○△□◇
  R5AA06○○○△□◇
  R5AA08○○○△□◇



- Connector Type
  R1AA18○○○△□◇
  R2AA13○○○△□◇
  R2AA18○○○△□◇
  R2AA22○○○△□◇
  Q1AA10○○○△□◇
  Q1AA12○○○△□◇
  Q1AA13○○○△□◇
  Q1AA18○○○△□◇
  Q2AA10○○○△□◇
  Q2AA13○○○△□◇
  Q2AA18○○○△□◇
  Q2AA22○○○△□◇
  Q4AA18○○○△□◇



2

2. Specifications

2.1 Servo motor

1) General specifications

Series name	R1, R2, R5,Q1, Q2, Q4
Time rating	Continuous
Insulation classification	Type F
Voltage/Dielectric strength	AC1500V 1 minute
Insulation resistance	DC500V, greater than 10MΩ
Protection method	Fully closed, Auto cooling Motor flange angle: 86 or less: IP67 Motor flange angle: 130 or over: IP65 However, except for axial penetration part and cable tip part
Oil Sealing	Motor flange angle: 86 or less: No oil seal (Optionally available) Motor flange angle: 100 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) Exterior dimensions/ specifications/ mass

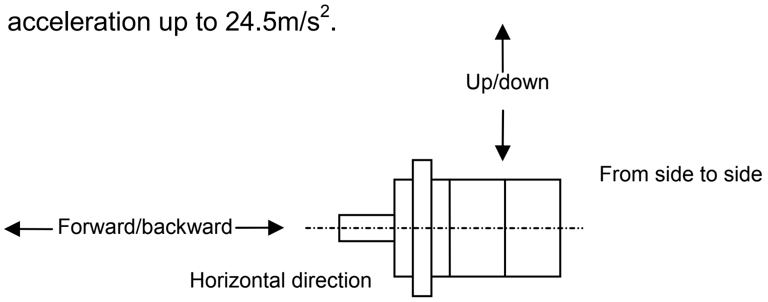
Refer to [Servo Motor Dimension (12-5)]

Refer to [Servo Motor Data Sheet (12-14)]

3) Mechanical specifications/ mechanical strength/ working accuracy

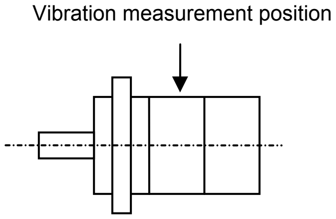
- Vibration resistance

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/s^2.



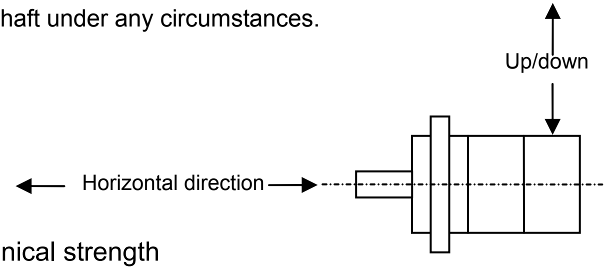
- Vibration classification

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/s^2 (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.

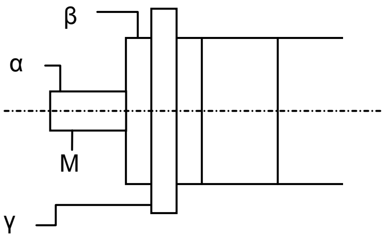


- **Mechanical strength**

  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	
	0.03 (220)	
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 (30 or over)	
	0.10 (220)	

✔ Figures in parentheses indicate square flange dimensions in millimeters.

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.

Servo motor model number	Oil seal type
R1AA18○○○□	Standard: S-Type
R2□A04○○○□	Standard: N/A Optional: G-Type
R2□A06○○○□/R2□A□8○○○□	Standard: N/A Optional: S-Type
R2□A10○○○□	Standard: N/A Optional: S-Type
R2□A13○○○□	Standard: Double Lip seal type
R2AA18○○○□	Standard: S-Type
R2□A22○○○□	Standard: Double Lip seal type
R5AA06○○○□	Standard: N/A Optional: S-Type
R5AA08○○○□	Standard: N/A Optional: S-Type
Q1□A10○○○□	Standard: S-Type
Q1□A12○○○□/ Q1□A13○○○□	Standard: S-Type
Q1□A18○○○□	Standard: S-Type
Q2□A13○○○□	Standard: S-Type
Q2□A18○○○□	Standard: S-Type
Q2□A22○○○□	Standard: S-Type
Q4□A18○○○□	Standard: S-Type

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.

Turn the brake excitation On or Off using the “holding brake timing signal output”. When using this signal, set the command for brake release time to 0min^{-1} for the servo amplifier.

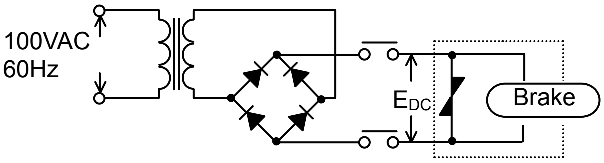
To externally control the holding brake, a response time (as in the table below) is required.

When using a motor with the brake, determine a time sequence that accounts for this delay.

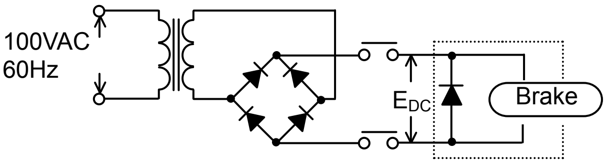
Servo motor model number		Static friction torque N・m	Release time ms	Braking delay time ms	
				Varistor	Diode
R1	R1AA18550H	54.9	300	140	400
	R1AA18750L				
	R1AA1811KR	75			
	R1AA1815KB	120		60	600
R2	R2AA04003F	0.32	25	15	100
	R2AA04005F	0.32			
	R2AA04010F	0.32			
	R2AA06010F	0.36	30	20	120
	R2AA06020F	1.37			
	R2AA08020F	2.55	40	20	200
	R2AA06040□	1.37	30	20	120
	R2AA08040F	2.55	40	20	200
	R2AA08075F	2.55			
	R2AAB8075F	3.92	40	20	200
	R2AAB8100□	3.92	40	20	200
	R2AAB8100F	3.92	40	20	200
	R2AA10075F	3.92	40	20	200
	R2AA10100F	3.92	40	20	200
	R2AA13050□	3.50	40	30	120
	R2AA13120□	9.0	100	30	130
	R2AA13180□	9.0	100	30	130
	R2AA13200□	12.0	100	30	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	0.32			
	R2EA04008F	0.32			
	R2EA06010F	0.36	30	20	120
	R2EA06020F	1.37			
R5	R5AA06020H	1.37	30	20	120
	R5AA06020F	1.37	30	20	120
	R5AA06040H	1.37	30	20	120
	R5AA06040F	1.37	30	20	120
	R5AA08075D	2.55	40	20	200
	R5AA08075F	2.55	40	20	200
Q1	Q1AA10100D	3.92	60	50	200
	Q1AA10150D	9.80	100	30	140
	Q1AA12100D	9.0	100	30	140
	Q1AA10200D	7.84	100	30	140
	Q1AA10250D	9.80	100	30	140
	Q1AA12200D	7.84	100	30	140
	Q1AA12300D	11.8	100	30	140
	Q1AA13400D	19.6	120	50	150
	Q1AA13500D	19.6			
	Q1AA18450M	32.0	150	40	250
	Q1AA18750H	54.9	300	140	400

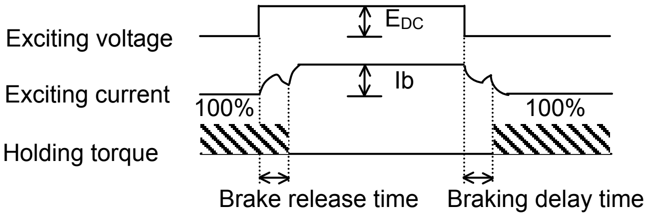
Servo motor model number		Static friction torque N・m	Release time ms	Braking delay time ms	
				Varistor	Diode
	Q2AA13200H	12.0	100	30	140
	Q2AA18200H	12.0	100	30	140
	Q2AA18350H	32.0	120	40	150
	Q2AA18450H	32.0	150	40	250
	Q2AA18550R	54.9	300	140	400
	Q2AA18550H				
	Q2AA18750L				
	Q2AA22550B	90.0	300	140	400
	Q2AA22700S	90.0	300	140	400
	Q2AA2211KV				
	Q2AA2215KV				

- ■ Brake operating time is measured in the following circuit:
  - ◆ Varistor used circuit



  - ◆ Diode used circuit





✔ Brake release time and Braking delay time refers to those times mentioned in the above table. The Brake release time is the same for both the varistor and diode.

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 2	90%	85%	80%	90%	90%

2.2 Motor encoder

1) Serial encoder specifications

- Absolute encoder for incremental system

Model	Resolution	Synchronization method	Transmission method	Baud rate
PA035S	131072 division (17bits)	Asynchronous	Half duplex serial communication	2.5Mbps

Model number example: R2-series, square type: 60mm, 200W-model R2AA06020FCH00

- Battery backup method absolute encoder

Model	Resolution	Multiple rotations	Synchronization method	Transmission method	Baud rate
PA035C	131072 division (17bits)	65536(16bits)	Asynchronous	Half duplex serial	2.5Mbps
	131072 division (17bits)	65536(16bits)	Asynchronous	Half duplex serial	4.0Mbps

Model number example: R2-series, square type: 60mm, 200W-model R2AA06020FCP00

- Battery-less absolute encoder

Model	Resolution	Multiple rotations	Synchronization method	Transmission method	Baud rate
RA035C	131072 division (17bits)	65536(16bits)	Asynchronous	Half duplex serial	2.5Mbps

Model number example: R2-series, square type: 60mm, 200W-model R2AA06020FCW00

2) Pulse encoder specifications

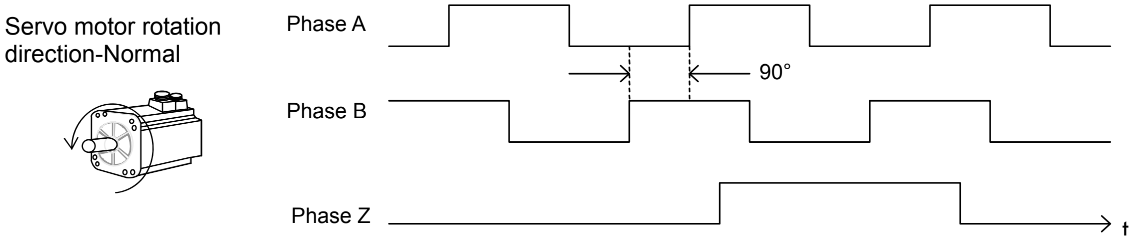
- Wire-saving incremental encoder

Model	Resolution	Conform to motor flange angle
PP031	1000/2000/2048/4096/5000/6000/8192/10000 P/R	Greater than 40mm
PP062	1000/2000/2048/4096/5000/6000/8192/10000 P/R	Greater than 80mm

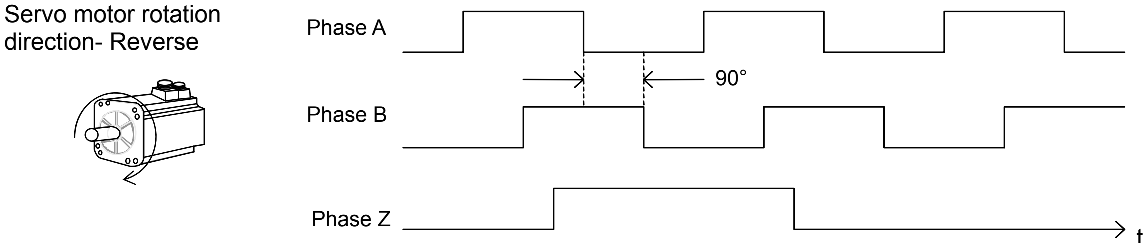
Model number example: R2-series, square type: 60mm, 200W-model R2AA06020FCS00

- Servo motor rotation direction and encoder signal pulses of pulse encoder

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



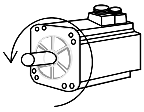
Phase B is behind Phase A 90°



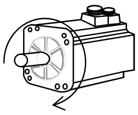
Phase B is behind Phase A 90°

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

- ■ Serial encoder
- ■ 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: the servo motor rotates in a counterclockwise direction from the load side
- ✔ PS data can be confirmed by “Monitor ID16, 17 ABSPS.”

3) Battery specification

Model: ER3VLY (produced by TOSHIBA LIFESTYLE PRODUCTS & SERVICES CORPORATION)

Voltage: 3.6V

2.3 Servo amplifier

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 230V+10, -15%, 50/60Hz±3Hz Single-phrase: AC200 to 230V+10, -15%, 50/60Hz±3Hz Note 2) Single-phase: AC100 to 115V+10, -15%, 50/60Hz±3Hz Note 3)					
Control power Note 1)		Single-phase: AC200 to 230V+10, -15%, 50/60Hz±3Hz Single-phase: AC100 to 115V+10, -15%, 50/60Hz±3Hz Note 3)					
Environment		Ambient temperature	0 to 55°C				
		Storage temperature	-20 to +65°C				
		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		RS2#01A##A#/ RS2#01A##L#	RS2#03A##A#/ RS2#03A##L#	RS2#05A##A#/ RS2#05A##L#	RS2A10A##A# RS2A10A##L#	RS2A15A##A# RS2A15A##L#	RS2A30A##L#
External dimensions (H×W×D)		160 x 40 x 130	160 x 50 x 130	160 x 85 x 130	205(235) x 100 x 220	205(235) x 120 x 220	205(235) x 220 x 220
Weight (kg)	Without internal regenerative resistor	0.75	0.9	1.65	4.8	5.1	9.6
	With internal regenerative resistor	0.8	0.95	1.7	5.0	5.3	N/A

Note 1) Power source voltage should be within the specified range AC200V Power input type: Specified power supply range = AC170V to AC253V
AC100VPower input type: Specified power supply range = AC85V to AC127V

Note 2) AC200V-single-phase input type corresponds only to RS2☐01/RS2☐03/RS2☐05.

Note 3) AC100V-single-phase input type corresponds only to, RS2☐01/RS2☐03

■ Performance

Speed control range	1: 5000 Note 4)
Frequency characteristics	1200Hz Note 5)
Allowable load inertia moment	10 times motor rotor inertia moment

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, Amplifier overheating, 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	
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%)

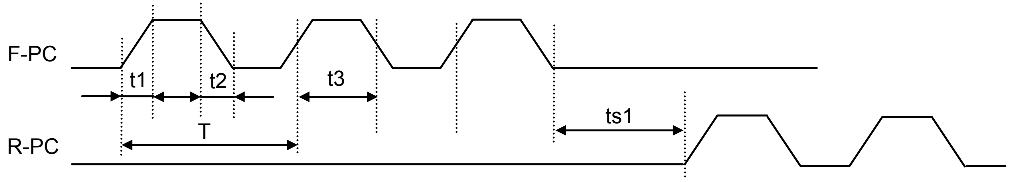
2) Input command, position signal output, general input, general output

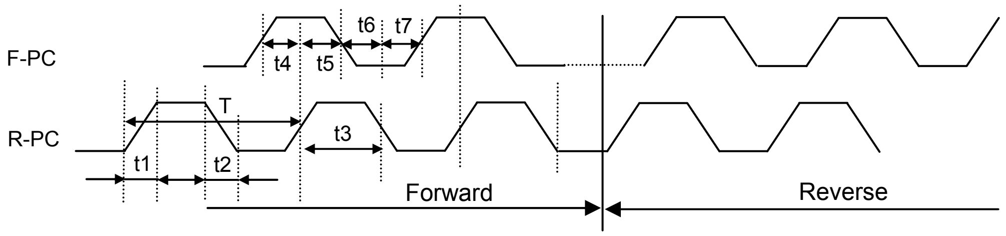
■ Input command

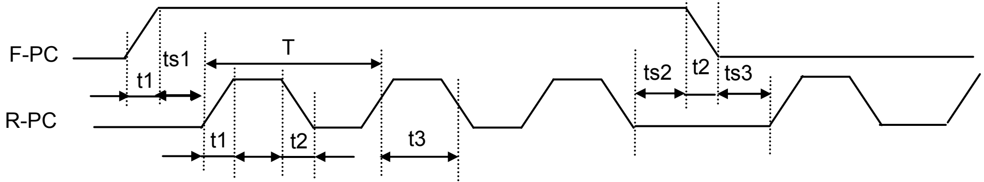
◆ Position command

Position command	Maximum input pulse frequency	5Mpps (Reverse + Forward pulse, Code +Pulse) 1.25Mpps (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±10V
	Input impedance	Approximately 10kΩ

■ Position signal output

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

■ General input

Sequence input	Interactive photo coupler (sink, source connection): ×6 input
	Line receiver: ×2 input
	Input power voltage range: DC5V±5% / DC12V to 24V±10%, 100mA or over (DC24V)
	Minimum current value: 100mA
	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 (5-78)] for all the functions and input time function-enabled.

■ General output [NPN output]

Sequence output	Open collector output: ×8 output
	External power supply voltage (OUT-PWR): DC5V±5% / DC12V to DC24V±10%, 20mA or over
	Circuit power for output signal: DC5V±5% / Maximum current value 10mA (per 1 output) Circuit power for output signal: DC12V to DC15V±10% / Maximum current value 30mA(per 1 output) Circuit power for output signal: DC24V to DC15V±10% / Maximum current value 50 mA (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 (5-86)]

■ General output [PNP output]

PNP

Sequence output	Open collector output: x 8 outputs
	External power supply (OUT-PWR): DC24V±10%, 20mA or over
	Regenerative power for output signals: DC24V±10%/ Maximum current value 50mA (per 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 (5-86)]

3) Torque limit input

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

2.4 Power supply, calorific value

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	RS2A01#	R2AA04003F	30	0.2	40
		R2AA04005F	50	0.2	
		R2AA04010F	100	0.3	
		R2AA06010F	100	0.3	
		R2AA06020F	200	0.6	
		R2AA06040H	400	1.0	
		R2AA08020F	200	0.6	
		R5AA06020H	200	0.6	
		R5AA06020F	200	0.6	
		R5AA06040H	400	1.0	
	RS2A03#	R2AA06040F	400	1.0	
		R2AA08040F	400	1.0	
		R2AA08075F	750	1.6	
		R2AAB8100H	1000	2.0	
		R2AA10075F	750	1.7	
		R2AA13050H	550	1.2	
		R2AA13050D	550	1.2	
		R2AA13120B	1200	2.2	
		R5AA06040F	400	1.0	
		R5AA08075D	750	1.6	
		R5AA08075F	750	1.6	
	RS2A05#	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	
		Q1AA10100D	1000	2.3	
		Q1AA10150D	1500	3.0	
		Q1AA12100D	1000	2.3	
	RS2A10#	R2AA13180D	1800	4.0	
		R2AA13200D	2000	5.0	
		R2AA18350L	3500	6.0	
		Q1AA10200D	2000	4.0	
		Q1AA10250D	2500	4.2	
		Q1AA12200D	2000	4.0	
		Q1AA12300D	3000	5.0	
		Q1AA13300D	3000	5.0	
		Q2AA13200H	2000	4.0	
		Q2AA18200H	2000	4.0	
	RS2A15#	R2AA18350D	3500	7.0	
		R2AA18450H	4500	7.4	
		R2AA18550R	5500	8.4	
		R2AA22500L	5000	9.6	
		R2AA22700S	7000	12.2	
		Q1AA13400D	4000	6.7	
		Q1AA13500D	5000	8.3	
		Q1AA18450M	4500	7.4	
		Q2AA18350H	3500	6.9	
		Q2AA18450H	4500	7.4	
		Q2AA18550R	5500	8.4	
		Q2AA22550B	5500	10.0	
		Q2AA22700S	7000	12.2	
	RS2A30#	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	

✔ # = Optional alphabetical letter

✔ Values are of rated speed, torque ratings.

- 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	RS2A30#	Q1AA18750H	7500	12.6	40
		Q2AA18550H	5500	10.0	
		Q2AA18750L	7500	12.6	
		Q2AA2211KV	11000	16.0	
		Q2AA2215KV	15000	21.4	
		Q4AA1811KB	11000	15.7	
		Q4AA1815KB	15000	21.4	

- AC100V Input

Input voltage	Servo amplifier capacity	Servo motor model number	Rated output (W)	Rated main circuit power supply(kVA)	Control power supply(VA)
AC100V	RS2E01#	R2EA04003F	30	0.2	40
		R2EA04005F	50	0.2	
		R2EA04008F	80	0.4	
		R2EA06010F	100	0.5	
	RS2E03#	R2EA06020F	200	0.6	

- ✔ # = Optional alphabetical letter
- ✔ Value are of rated speed, torque ratings

2) Incoming current, leakage current

- Incoming 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	RS2A01#	40A (0-P)	22A (0-P)
	RS2A03#		
	RS2A05#		
	RS2A10#		17A (O-P)
	RS2A15#		
	RS2A30#		
AC100V	RS2E01#	20A (0-P)	11A (0-P)
	RS2E03#		

- ✔ # = Optional alphabetical letter
- ✔ Using thermistor for incoming prevention circuit of control power supply. This is the maximum current value under normal temperature conditions when AC230V or AC115V is supplied.
- ✔ Incoming current value is the value when AC230V or AC115V is supplied.
- ✔ When the power is turned ON again immediately after disconnection, power supply disconnection is repeated for a short period of time, ambient temperature is high, or, the thermistor temperature rises, the incoming current exceeding the above table may pass.

- Leakage current

Servo amplifier capacity	Electric leakage current per motor
RS2#01#	0.8 mA
RS2#03#	0.8 mA
RS2#05#	1.5 mA
RS2A10#	3.0 mA
RS2A15#	3.0 mA
RS2A30#	3.0 mA

- ✔ # = Optional alphabetical letter
- ✔ 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.
- ✔ The value of leaked current is the measured value using ordinary leak checkers (Filter 700Hz). When electric leakage current of high frequency flows through the floating capacity of the motor winding, power cable or amplifier, malfunctions may occur in the short circuit breaker and protective relay in the power supply electric circuit. Use the inverter as an electricity leakage breaker to provide countermeasures for incorrect operations.

3) Calorific value

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC200V	RS2A01#	R2AA04003F	13
		R2AA04005F	14
		R2AA04010F	15
		R2AA06010F	15
		R2AA06020F	20
		R2AA06040H	22
		R2AA08020F	20
		R5AA06020H	20
		R5AA06020F	20
		R5AA06040H	22
	RS2A03#	R2AA06040F	31
		R2AA08040F	30
		R2AA08075F	43
		R2AAB8100H	45
		R2AA10075F	43
		R2AA13050H	40
		R2AA13050D	44
		R2AA13120B	50
		R5AA06040F	31
		R5AA08075D	43
		R5AA08075F	43
	RS2A05#	R2AAB8075F	45
		R2AAB8100F	52
		R2AA10100F	50
		R2AA13120D	68
		R2AA13120L	60
		R2AA13180H	87
		R2AA13200L	87
		Q1AA10100D	50
		Q1AA10150D	75
		Q1AA12100D	50
	RS2A10#	R2AA13180D	92
		R2AA13200D	100
		R2AA18350L	148
		Q1AA10200D	112
		Q1AA10250D	118
		Q1AA12200D	104
		Q1AA12300D	125
		Q1AA13300D	127
		Q2AA13200H	98
		Q2AA18200H	108
AC200V	RS2A15#	R2AA18350D	148
		R2AA18450H	163
		R2AA18550R	213
		R2AA22500L	164
		R2AA22700S	235
		Q1AA13400D	157
		Q1AA13500D	180
		Q1AA18450M	150
		Q2AA18350H	148
		Q2AA18450H	163
		Q2AA18550R	213
		Q2AA22550B	200
		Q2AA22700S	235
	RS2A30#	R1AA18550H	315
		R1AA18750L	365
		R1AA1811KR	430
		R1AA1815KB	450
		R2AA18550H	315
		R2AA18750H	365
		R2AA1811KR	430
		R2AA2211KB	440
		R2AA2215KB	450
		Q1AA18750H	380
		Q2AA18550H	315
		Q2AA18750L	365
		Q2AA2211KV	440
		Q2AA2215KV	450
		Q4AA1811KB	430
		Q4AA1815KB	450

Input voltage	Servo amplifier capacity	Servo motor model number	Servo amplifier total calorific value (W)
AC100V	RS2E01#	R2EA04003F	13
		R2EA04005F	15
		R2EA04008F	16
		R2EA06010F	17
	RS2E03#	R2EA06020F	26

- ✔ # = Optional alphabetical letter
- ✔ Generation of heat from regeneration resistance is not included in the numerical value of the above table. It is necessary to add it if needed.
- ✔ Strictly follow installation method (Installation Servo amplifier (3-1).)
- ✔ Values are rated speed and rated torque.

2.5 Operation pattern

1) Time of acceleration and deceleration, permitted repetition, loading precaution

The motor's acceleration time (t_a), and deceleration time (t_b) 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·m^2)
  - ◆ J_L : Load inertia moment (kg·m^2)
  - ◆ N1, N2 : Rotational speed of motor (min^{-1})
  - ◆ T_P : Instantaneous maximum stall torque (N·m)
  - ◆ T_L : Load torque (N·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, adjustable speed current value 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.

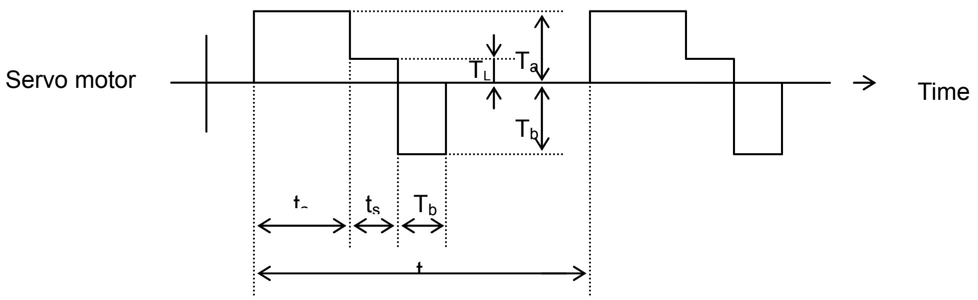
$$\text{Frequency of repetitions} = \frac{20}{m+1} \quad \text{times/ min}$$

- ■ 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 T_R.



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

$$t \geqq \frac{Ta^2\,ta + T_L^2\,t_s + Tb^2\,tb}{T_R^{\ 2}} \quad \text{[s]}$$

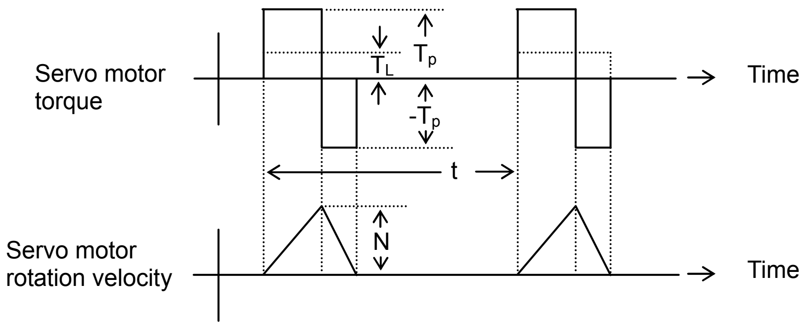
Ta: Acceleration torque
Tb: Deceleration torque
TL: Load torque
Trms: Effective torque
T_R: Rated torque
t_s: constant speed time(s)

◆ 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<0.9T_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:

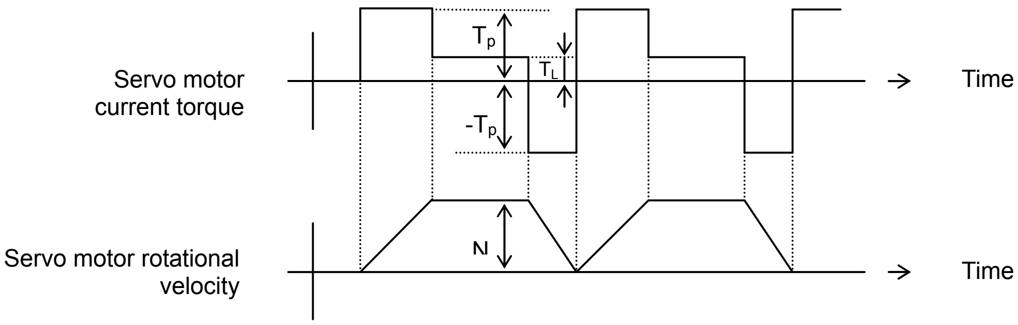


$$n=2.86\times10^2\times\frac{1}{N\,(J_M+J_L)}\times\frac{T_P^{2}-T_L^{2}}{T_P^{3}}\times T_R^{2} \qquad \text{[times/min]}$$

T_R: Rated torque

- 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:



$$n=2.86\times10^2\times\frac{1}{N\,(J_M+J_L)}\times\frac{T_R{}^2-T_L{}^2}{T_P}\quad[\text{times/ min}]$$

T_R: Rated torque

- 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.

  Examples:

  - 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 (J_L)
- 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

1) Positions signals by serial signals

■ The following serial encoders output absolute position data (encoder signal output -PS-) from the absolute encoder of the servo amplifier using serial signals.

Model	Encoder name	Resolution within 1 rotation	Resolution within multiple rotations
PA035S	Absolute encoder for incremental system	131072 (17bits)	-
PA035C	Absolute encoder with battery backup method	131072 (17bits)	65536 (16bits)
RA035C	Absolute encoder- battery-less	131072 (17bits)	65536 (16bits)

✔ Output signals (encoder signal output -PS-) are emitted from (Cn1-9 pin, 10 pin).

■ Encoder signal output-PS-format can be selected from among the two values. Select from the general parameters (Group ID07: Encoder Signal Output (PS) Format [PSOFORM]).

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

✔ Forward rotation is anti-clockwise rotation from the motor shaft axis. When absolute value increases to maximum, it becomes minimum value (0).

✔ Pulse encoder outputs “Actual position monitor value” through binary code regardless of the setting of (Group ID07: Encoder Signal Output (PS) Format [PSOFORM]).

2) Binary code output format and transfer period

■ Format

◆ Data format

11bits

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

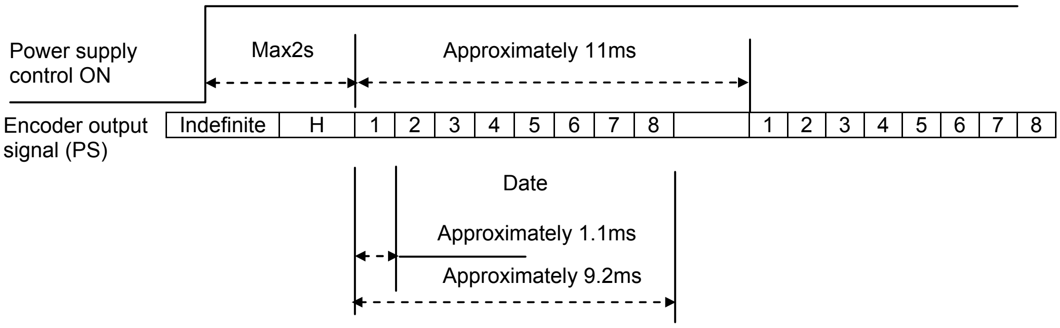
◆ Transfer format

	Start bit	Data bit					Address bit			Parity bit	Stop bit
･Data 1	0	D0	D1	D2	D3	D4	0	0	0	0/1	1
		(LSB)									
･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	0/D17	0/D18	0/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	0	0	0	1	1	0/1	1
				(MSB)							
･Data 8	0	0	0	0	0	0	1	1	1	0/1	1

◆ Data positions of absolute data for motor encoder

Motor encoder mode	Data within 1 rotation	Data within multiple rotations
PA035S	D0 to D16	-
PA035C	D0 to D16	D17 to D32
RA035C	D0 to D16	D17 to D32

■ 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 seconds.

3) ASCII decimal code output format and transfer period

■ Format

◆ Data format

10bits

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

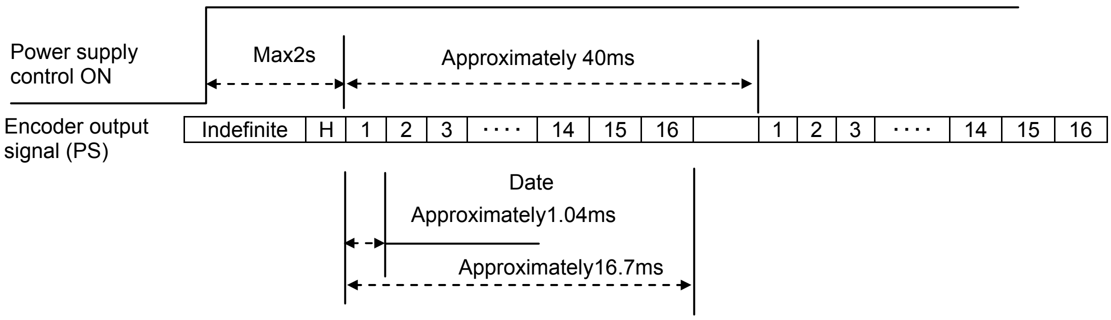
◆ Transfer format

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

◆ Absolute data of motor encoder

Motor encoder model	Absolute value within 1 rotation	Absolute value within multiple rotations
PA035S	00000 to 131071	-
PA035C	00000 to 131071	00000 to 65535
RA035C	00000 to 131071	00000 to 65536

■ 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 seconds.

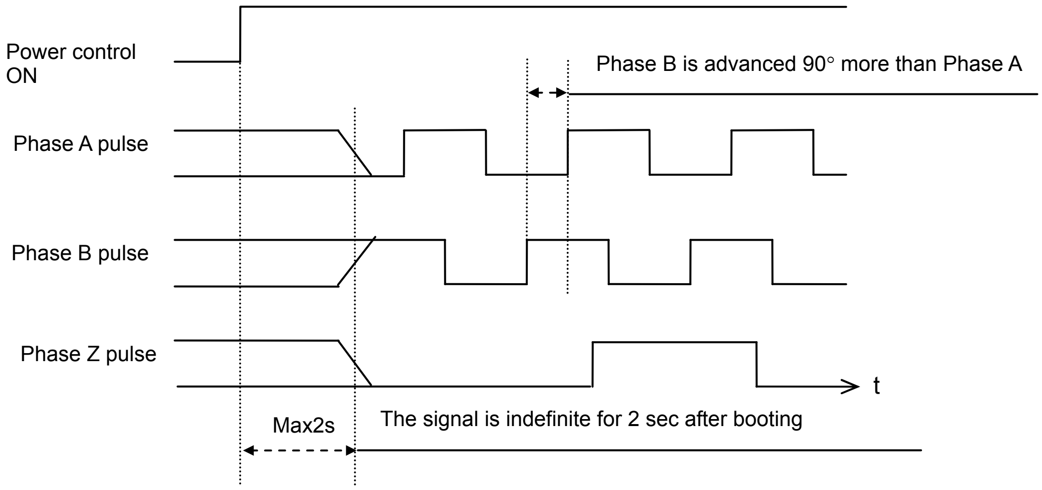
4) Position signal output from pulse signal

- ■ 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.”

- ✔ Output signal “A phase pulse output (A0/$\overline{A0}$)” outputs from “CN1-3 pin, 4 pin.”
- ✔ Output signal “B phase pulse output (B0/$\overline{BO}$)” outputs from “CN1-5 pin, 6 pin.”
- ✔ Output signal “Z phase output (Z0/$\overline{ZO}$)” outputs from “CN1-7 pin, 8 pin.”

- ■ Output signal under forward rotation

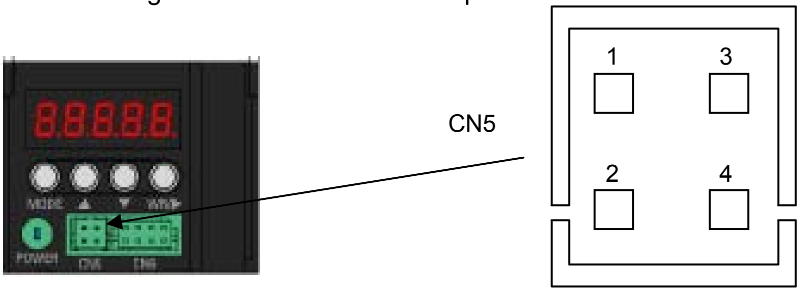


- ✔ Serial encoder “positions signal output” delays about 224μs.
- ✔ Serial encoder Phase Z output is once in 1-rotation (at every change of multiple rotations) based on loading or training edge of Phase A or Phase B with the width of one pulse of Phase A. (does not determine the position relation of 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.

2.7 Specifications for analog monitor

1) Monitor output

- Pin numbers and signal names for 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

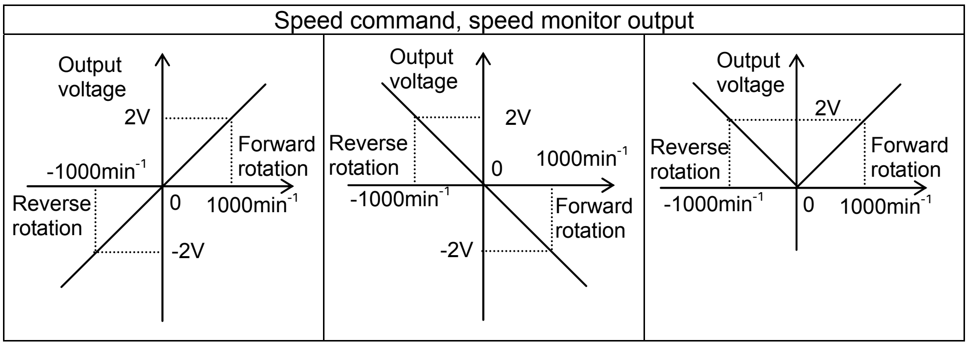
	General input/output connector CN1	CN5
Analog monitor output 1 (MON1)	CN1-30	CN5-3
Analog monitor output 2 (MON2)	Disabled	CN5-4
Digital monitor output (DMON)	Disabled	CN5-2
GND	CN1-31	CN5-1

Monitor for velocity, torque, and position deviation

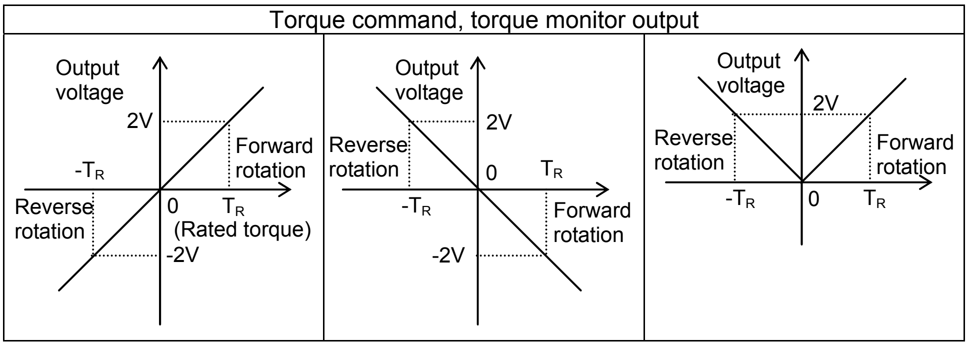
- Electrical specifications
  - Output voltage range: DC±8V
  - Output resistance: 1kΩ
  - Load: less than 2mA

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

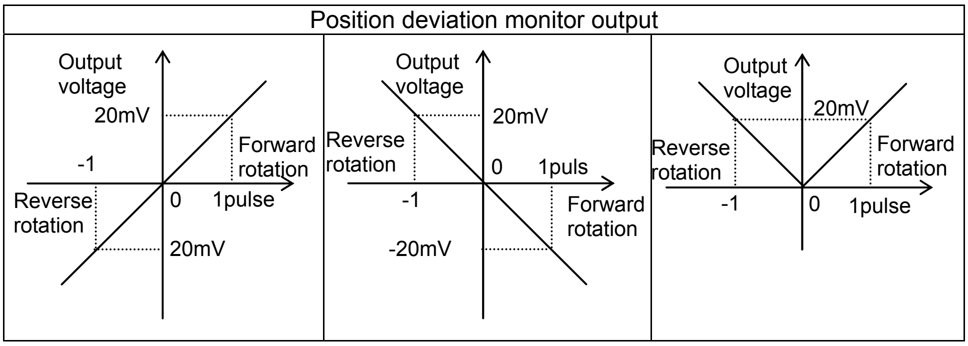
- Velocity command, velocity monitor



- Torque command, torque monitor



- Position deviation monitor



2.8 Specifications for dynamic brake

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

- Allowable frequency of the dynamic brake (main circuit power ON/OFF)

  Less than 10 times per hour and 50 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:

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

- 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)
RS2#01A##A#/RS2#01A##L#	360
RS2#03A##A#/RS2#03A##L#	360
RS2#05A##A#/RS2#05A##L#	1800
RS2#10A##A#/RS2#10A##L#	2450
RS2#15A##A#/RS2#15A##L#	2450
RS2#30A##L#	9384

✔ # = Optional number or alphabetical letter.

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

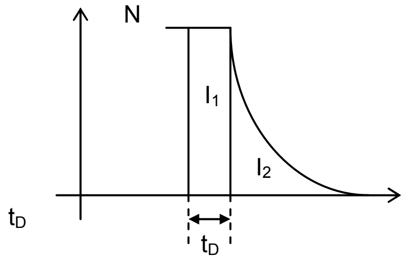
$$E_{RD}=\frac{2.5}{R\Phi+2.5}\times\left\{\frac{1}{2}(J_M+J_L)\times\left[\frac{2\pi}{60}N\right]^{2}-I\times T_L\right\}$$

- R_{Φ} : 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)

- 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
I_2 : Stage down rotation angle (rad) using dynamic brake operation
t_D : 10 × 10^{-3}(s)

α·β:

Servo amplifier apacity	Servo motor model number	α	β	JM(kg·m2)
RS2A01	R2AA04003F	227	4.29×10^{-6}	0.0247×10^{-4}
	R2AA04005F	119	2.96×10^{-6}	0.0376×10^{-4}
	R2AA04010F	41.2	1.56×10^{-6}	0.0627×10^{-4}
	R2AA06010F	32.6	5.04×10^{-6}	0.117×10^{-4}
	R2AA06020F	14.5	2.46×10^{-6}	0.219×10^{-4}
	R2AA06040H	5.47	1.61×10^{-6}	0.412×10^{-4}
	R2AA08020F	11.3	1.13×10^{-6}	0.52×10^{-4}
	R5AA06020H	11.7	3.76×10^{-6}	0.2×10^{-4}
	R5AA06020F	15.36	2.92×10^{-6}	0.2×10^{-4}
	R5AA06040H	6.09	2.3×10^{-6}	0.416×10^{-4}
RS2A03	R2AA06040F	8.82	1.00×10^{-6}	0.412×10^{-4}
	R2AA08040F	6.91	4.25×10^{-6}	1.04×10^{-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}
	R2AA13050H	4.37	3.55×10^{-6}	3.1×10^{-4}
	R2AA13050D	6.46	2.14×10^{-6}	3.1×10^{-4}
	R2AA13120B	1.68	1.56×10^{-6}	6×10^{-4}
	R5AA06040F	10.11	1.55×10^{-6}	0.416×10^{-4}
	R5AA08075D	4.67	1.67×10^{-6}	1.65×10^{-4}
	R5AA08075F	6.45	2.75×10^{-6}	1.65×10^{-4}
RS2A05	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}
	Q1AA10100D	5.84	4.47×10^{-7}	1.29×10^{-4}
	Q1AA10150D	3.51	4.01×10^{-7}	1.61×10^{-4}
	Q1AA12100D	5.05	4.14×10^{-7}	2.25×10^{-4}
RS2A10	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}
	Q1AA10200D	4.19	0.47×10^{-7}	2.15×10^{-4}
	Q1AA10250D	2.70	0.46×10^{-7}	2.65×10^{-4}
	Q1AA12200D	2.85	0.33×10^{-7}	4.37×10^{-4}
	Q1AA12300D	1.53	0.27×10^{-7}	6.40×10^{-4}
	Q1AA13300D	1.78	0.53×10^{-7}	4.92×10^{-4}
	Q2AA13200H	1.23	0.48×10^{-7}	12×10^{-4}
	Q2AA18200H	1.49	0.36×10^{-7}	20×10^{-4}

Servo amplifier capacity	Servo motor model number	α	β	J_M(kg·m^2)
RS2A15	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}
	Q1AA13400D	2.13	0.25×10^{-7}	6.43×10^{-4}
	Q1AA13500D	1.52	0.20×10^{-7}	8.47×10^{-4}
	Q1AA18450M	0.43	0.35×10^{-7}	27.5×10^{-4}
	Q2AA18350H	1.14	0.09×10^{-7}	38×10^{-4}
	Q2AA18450H	0.74	0.09×10^{-7}	55×10^{-4}
	Q2AA18550R	0.52	0.05×10^{-7}	72.65×10^{-4}
	Q2AA22550B	0.46	0.11×10^{-7}	95×10^{-4}
	Q2AA22700S	0.18	0.10×10^{-7}	185×10^{-4}
RS2A30	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}
	R1AA2215KB	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}
	R2AA2211KB	0.42	1×10^{-9}	178×10^{-4}
	Q1AA18750H	0.92	4.97×10^{-9}	52×10^{-4}
	Q2AA18550H	1.1	2.38×10^{-9}	73×10^{-4}
	Q2AA18750L	0.7	2.40×10^{-9}	95×10^{-4}
	Q2AA2211KV	0.46	2.58×10^{-9}	186×10^{-4}
	Q2AA2215KV	0.32	2.04×10^{-9}	255×10^{-4}
	Q4AA1811KB	0.38	2.27×10^{-9}	63×10^{-4}
	Q4AA1815KB	0.25	2.62×10^{-9}	85×10^{-4}
RS2E01	R2EA04003F	305	3.19×10^{-6}	0.0247×10^{-4}
	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}
RS2E03	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

The tables below are resistance value of the built-in regeneration resistor and regeneration resistance power that can be tolerated by the amplifier regeneration circuit.

Refer to [Capacity Selection of Regenerative Resistor (11-2)] for the selection method of regeneration resistance.

1) Resistance value of built-in regeneration resistor

Servo amplifier model	Resistance value of built-in resistor
RS2#01A##A#	50Ω
RS2#03A##A#	50Ω
RS2#05A##A#	17Ω
RS2A10A##A#	10Ω
RS2A15A##A#	6Ω

✔ “#” is optional number or alphabetical letter.

✔ Model number RS2A30A##L# has no regenerative unit, so please connect regenerative unit to the model.

■ Tolerable power of regeneration resistance

Servo amplifier model	Tolerable regeneration resistance power-built-in type [PRI]	Tolerable regeneration resistance power-external type [PR0]
RS2#01A##A#/RS2#01A##L#	5W	220W
RS2#03A##A#/RS2#03A##L#	5W	220W
RS2#05A##A#/RS2#05A##L#	20W	500W
RS2A10A##A#/RS2A10A##L#	90W	500W
RS2A15A##A#/RS2A15A##L#	120W	500W
RS2A30A##L#	-	500W

✔ “#” is optional number or alphabetical letter.

3

3. Installation

3.1 Installation

1) Servo amplifier

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, and 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 attachment 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 and parts with the mounting parts have been damaged shall be fixed by returning to our company immediately.

■ If enclosed in a cabinet

The temperature inside the cabinet can 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 may increase due to 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 contacts, regenerative resistors and other parts can 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

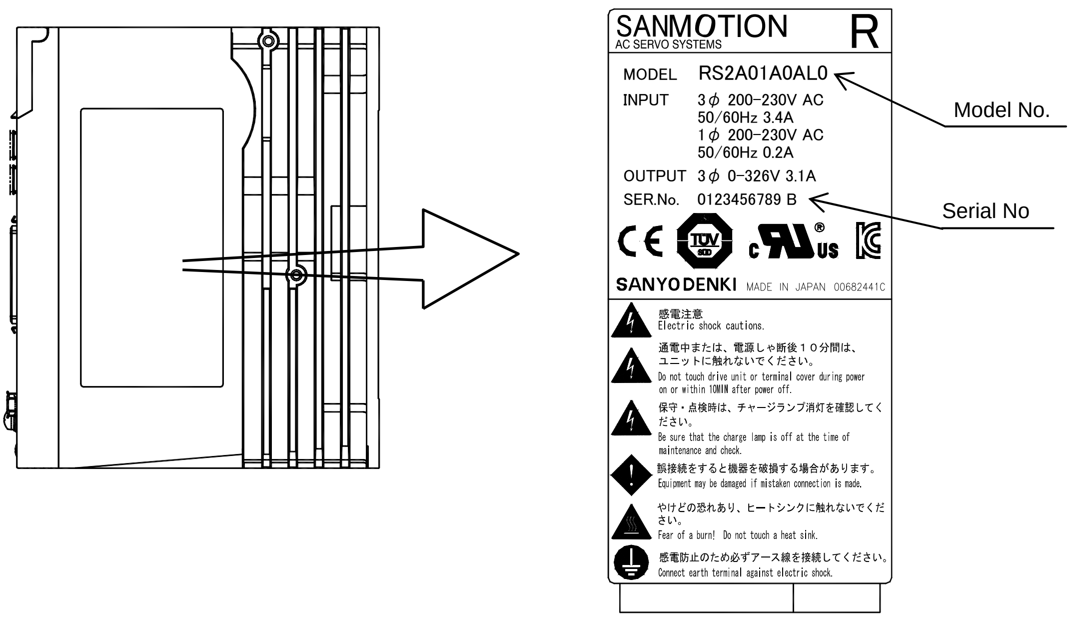
If inductive noise enters the input signals or the power circuit, it can cause a malfunction. If there is a possibility of noise, inspect the line wiring and take appropriate noise prevention measures. A noise filter should be installed to protect the servo amplifier.

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.

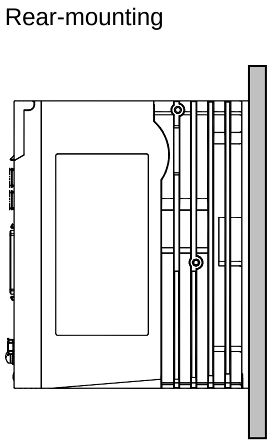


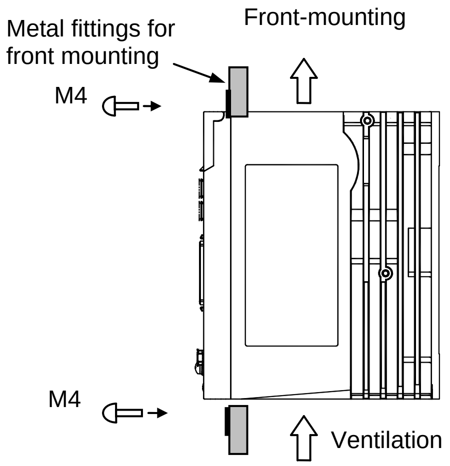
Servo amplifier

Servo amplifier main nameplate

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

3) Mounting direction and location



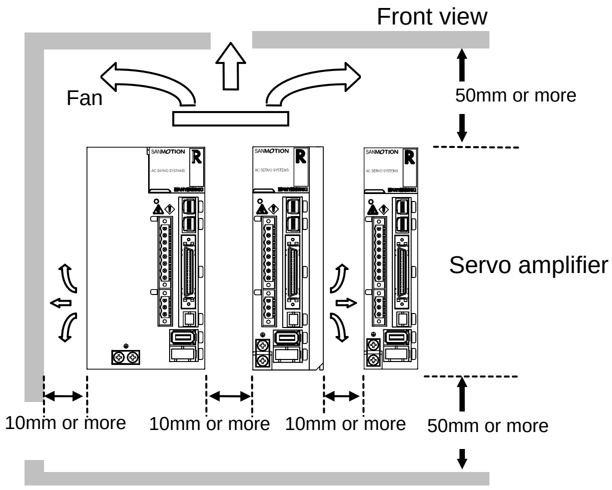


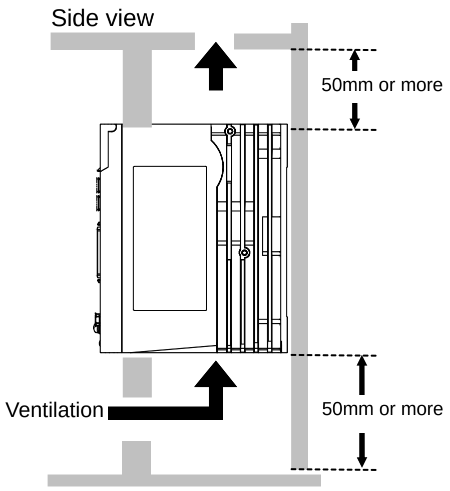
✔ Refer to optional parts, 12 Appendix, for metal fittings for front mounting.

4) Control arrangement within the machine

- ■ 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.
- ■ If the R-series servo amplifier is installed on its side, make sure that the ambient temperature does not exceed 50°C, and mount the back panel to a metal plate.

  RS2☐01, RS2☐03, and RS2☐05: recommended metal plate thickness is 2mm or more RS2☐10, RS2☐15, and RS2☐30: recommended metal plate thickness is 5mm or more
- ■ For RS2☐03･RS2☐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.





3.2 Servo motor

1) Precautions

- Various precautions

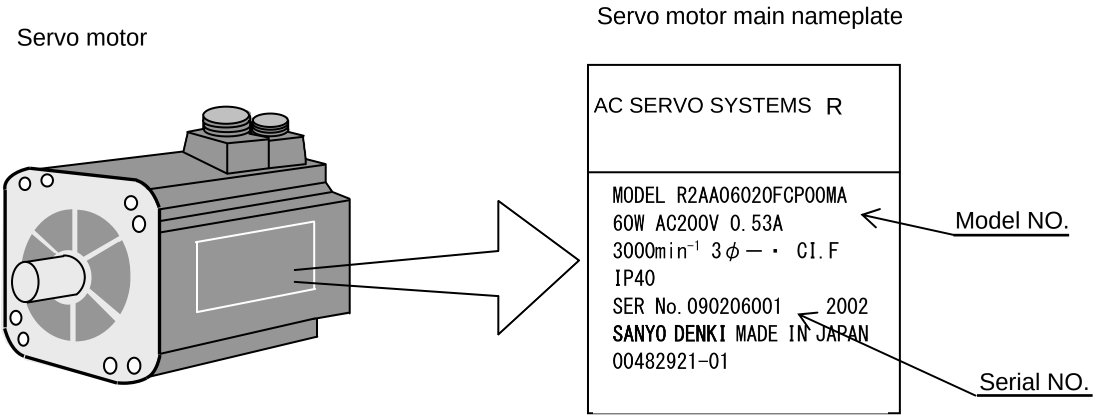
The device should be installed on non-flammable surfaces only. Installation on or near flammable materials can cause fire.
Do not stand, and put heavy items on the servo amplifier.
Operate the device within the specified environmental conditions.
Do not drop the device or subject it to excessive shock.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

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.



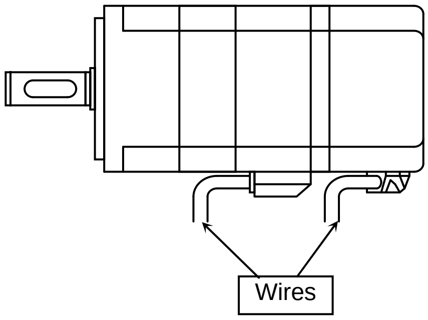
3) Installation

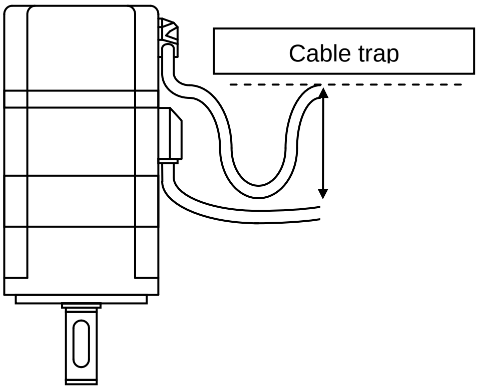
Please note the following regarding the installation location and mounting method for the servo motor.

The servo motor is designed for indoor use. Make sure to Install it indoors.	
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.	
Ambient temperature: 0 to 40°C Storage temperature: -20 to 65°C Ambient humidity: 20 to 90%	Good ventilation, no corrosive or explosive gases present. No dust or dirt accumulation in the environment. Easy access for inspection and cleaning.

4) Mounting method

- Mounting in several orientations - horizontal, or with the shaft on top or bottom- is acceptable.
- If the output shaft is used in reduction devices that use grease, oil, or other lubricants, or in mechanisms exposed to liquids, the motor 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.



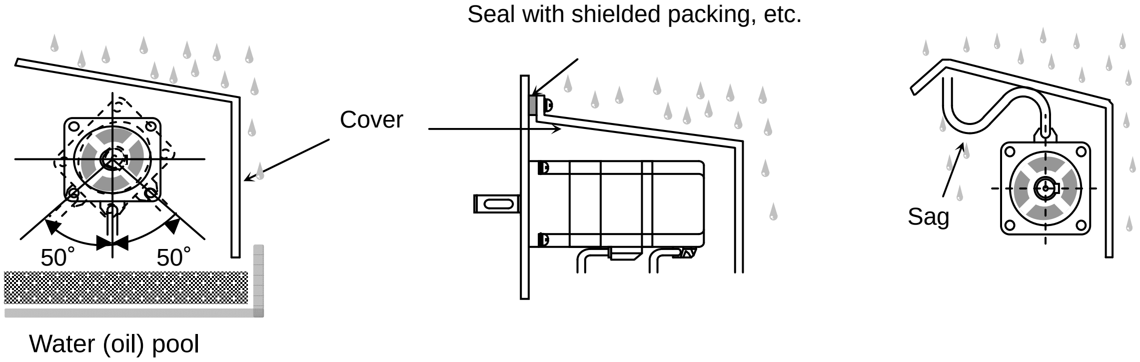


5) Waterproofing and dust proofing

- 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 may 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 the case of a canon plug type motor, use a waterproofed type plug.

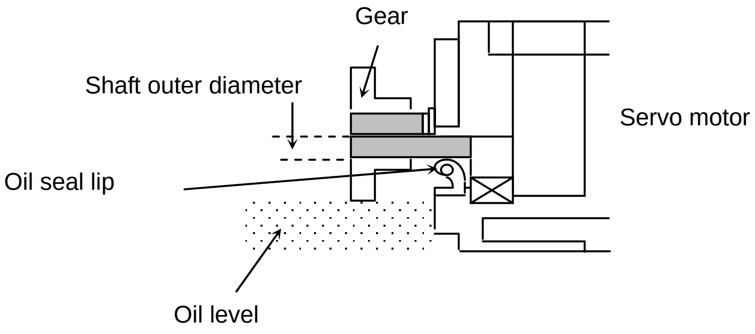
6) Protective cover installation

- 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 at an angle (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.

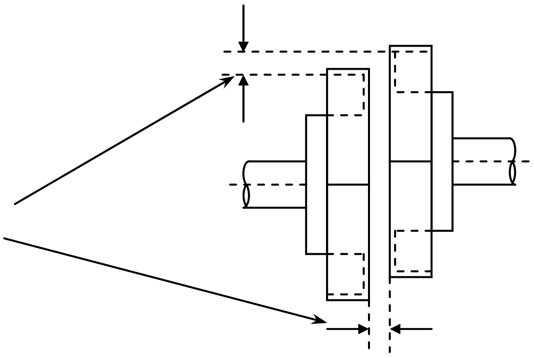


7) Gear installation and Integration with the target machinery

- 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.

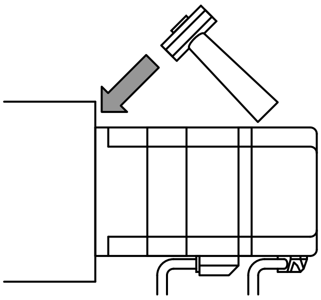


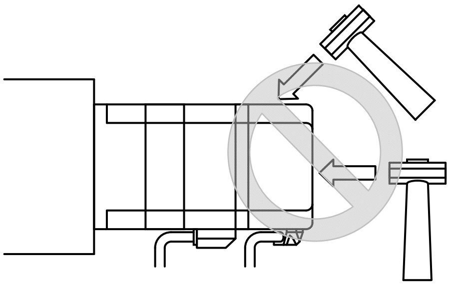
- Refer to the drawing below for correct centering of the motor shaft and the target machinery.
  Please note when using a rigid coupling that even a slight mistake in centering can damage the output shaft.



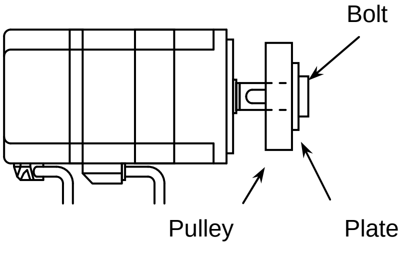
Measured at all 4 locations, the difference between the maximum and the minimum should not exceed 3/100mm
(coupling rotates jointly)

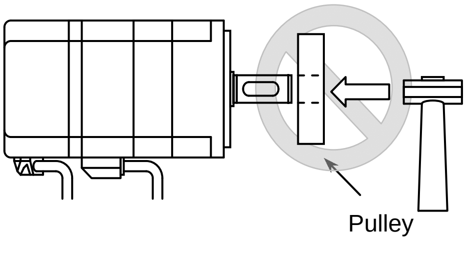
- Do not apply any impacts on the servo motor, as precision equipment, encoder, is directly connected to it.
  If it is absolutely necessary to hit the motor for position adjustment or other reasons, use a rubber or plastic hammer and hit the front flange area.





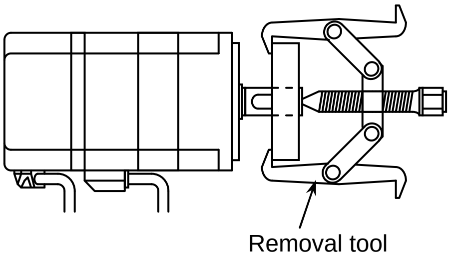
- If mounting to a machine, create enough mounting holes for smooth coupling of the motor flange rabbet. The mounting surface should be flat, otherwise damage to the shaft or the load may occur.
- Use the screw at the end of the shaft for installing parts such as the gear, pulley, or coupling, to avoid shock.

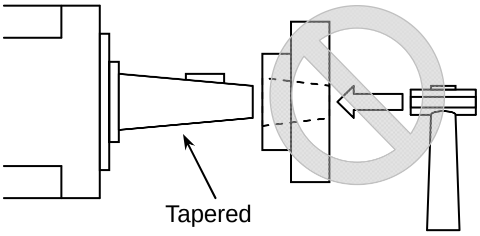




- Tapered servo motor shafts transmit the torque via the tapered surface. Make sure the key fits without rattling. The tapered surface contact should be no less than 70%.

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

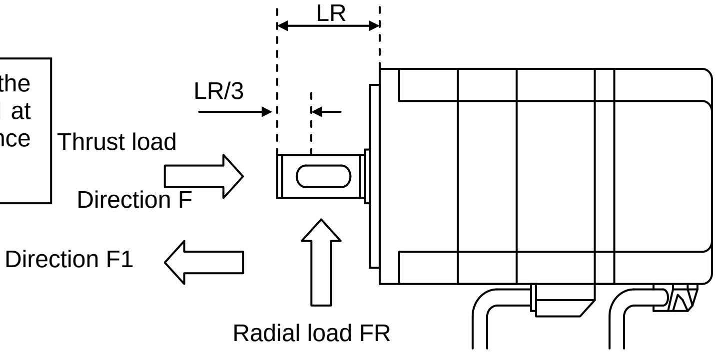




8) Allowable bearing load

- 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	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
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
	R2AA08020	390	200	200	200	98	98
	R2AA06040	390	200	200	250	68	68
	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

	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
R5	R5AA06020	390	200	200	200	68	68
	R5AA06040	390	200	200	250	68	68
	R5AA08075	590	390	390	340	200	200
Q1	Q1AA10100	980	290	290	690	290	290
	Q1AA10150	980	290	290	690	290	290
	Q1AA12100	980	290	290	690	290	290
	Q1AA10200	980	290	290	690	200	200
	Q1AA10250	980	290	290	690	200	200
	Q1AA12200	980	290	290	690	290	290
	Q1AA12300	980	290	290	690	290	290
	Q1AA13300	2000	390	390	980	390	390
	Q1AA13400	2000	390	390	1200	390	390
	Q1AA13500	2000	390	390	1200	390	390
	Q1AA18450	2300	1900	1900	1500	490	490
	Q1AA18750	3900	2000	2000	1800	590	590
Q2	Q2AA13200	1700	1300	1300	690	290	290
	Q2AA18200	2300	1900	1900	1500	490	490
	Q2AA18350	2300	1900	1900	1500	490	490
	Q2AA18450	2300	1900	1900	1500	490	490
	Q2AA18550	3900	2000	2000	1800	590	590
	Q2AA18750	3000	2000	2000	2000	1100	1100
	Q2AA22550	3900	2000	2000	1800	590	590
	Q2AA22700	3900	2000	2000	2500	1100	1100
	Q2AA2211K	3900	2000	2000	2700	1500	1500
	Q2AA2215K	3900	2000	2000	2300	1500	1500
Q4	Q4AA1811KB	3900	2000	2000	1800	590	590
	Q4AA1815KB	3900	2000	2000	2700	1500	1500

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 clamping 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.

4

4. Wiring

4.1 Wiring for main circuit power supply, control power, regenerative resistance, servo motor, and protective grounding

1) Part name and function

Terminal name	Connector marking	Remarks	
Main circuit power supply	R･T or R･S･T	Single phase AC100 to115V +10%,-15% 50/60Hz±3%	
		Single phase AC200 to 230V +10%,-15% 50/60Hz±3%	
		Three-phase AC200 to 230V +10%,-15% 50/60Hz±3%	
Control power supply	r･t	Single phase AC100 to 115V +10%,-15% 50/60Hz±3%	
		Single phase AC200 to 230V +10%,-15% 50/60Hz±3%	
Servo motor connector	U･V･W	Connected with servo motor	
Safeguard connector	⏚	Connected with grounding wire of power supply and of servo motor.	
Regeneration resistance connector	RB1･RB2 RB4	RS2☐01 RS2☐03 RS2☐05 RS2☐30	Connects regenerative resistance to terminal RB1 and RB. Built-in regenerative resistance is already connected at factory setting. Connects external regenerative resistance to terminal RB1 and RB when regenerative performance is insufficient. Terminal RB4 is not supplied.
		RS2☐10 RS2☐15	In the case of built-in regenerative resistance, terminal RB1 and RB4 are already short-circuited by short bar at factory setting. Remove short bar of terminal RB1 and RB4 (opened), to connect external regenerative resistance to terminal RB1 and RB4, when regenerative performance is insufficient.
Maker maintenance	⊖	For maker maintenance. Do not connect anything.	

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 proof-pressure 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 due to heat-related deterioration. In this case, we recommend using heat-resistant vinyl wires.

3) Wire diameter-allowable current

AWG sides	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).
- ✔ The diameter of an electric wire and allowable current in the case of doing the bundle line of the three electric wires are shown.
- ✔ Use it below by the above-mentioned allowable current.

4) Recommended wire diameter

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

■ Input voltage AC200V

Servo motor model No.	Motor power (U·V·W·⏚)		Servo amplifier to be combined	Main circuit power supply (R·S·T⏚)		Control power supply		Regeneration resistance		⏚	
	mm^2	AWG No		mm^2	AWG No	mm^2		AWG No		mm^2	AWG No
R2AA04003F	0.5	20	RS2#01#	1.25	16	1.25	M	1.25	16	2.0	14
R2AA04005F											
R2AA04010F											
R2AA06010F											
R2AA06020F	0.75	19									
R2AA06040H											
R2AA08020F											
R5AA06020H											
R5AA06020F											
R5AA06040H											
R2AA06040F	0.75	19	RS2#03#	2.0	14			2.0	14		
R2AA08040F											
R2AA08075F											
R2AAB8100H											
R2AA10075F											
R2AA13050D											
R2AA13050H											
R2AA13120B											
R5AA08075D											
R5AA06040F											
R5AA08075D											
R5AA08075F											
R2AAB8075F	2.0	14	RS2#05#	2.0	14						
R2AAB8100F											
R2AA10100F											
R2AA13120D											
R2AA13120L											
R2AA13180H											
R2AA13200L											
Q1AA10100D											
Q1AA10150D											
Q1AA12100D											

- ✔ 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 due to heat-related deterioration. In this case, use special heat-resistant vinyl wire (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.

■ Input voltage AC200V (cont.)

Servo motor model No.	Motor power (U·V·W·⏚)		Servo amplifier to be combined	Main circuit power supply (R·S·T·⏚)		Control power supply		Regeneration resistance		⏚	
	Mm^2	AWG No		mm^2	AWG No	mm^2		AWG No		mm^2	AWG No
R2AA13200D	5.5	10	RS2#10#	5.5	10	1.25	16	5.5	10	5.5	10
R2AA13180D											
R2AA18350L											
Q1AA10200D	3.5	12									
Q1AA10250D											
Q1AA12200D	5.5	10									
Q1AA12300D											
Q1AA13300D											
Q2AA13200H											
Q2AA18200H											
R2AA18350D	5.5	10	RS2#15#	8.0	8			8.0	8	8.0	8
R2AA18450H											
R2AA22500L	8.0	8									
R2AA18550R											
R2AA22700S											
Q1AA13400D	5.5	10									
Q1AA13500D											
Q1AA18450M											
Q2AA18350H											
Q2AA18450H											
Q2AA18550R	8.0	8									
Q2AA22550B											
Q2AA22700S											
R2AA18550H	14.0	6	RS2#30#	14.0	6			8.0	8	14.0	6
R2AA18750H											
R2AA1811KR											
R2AA2211KB											
R2AA2215KB											
R1AA18550H											
R1AA18750L											
R1AA1811KR											
R1AA1815KB											
Q1AA18750H											
Q2AA18550H											
Q2AA18750L											
Q2AA2211KV											
Q2AA2215KV											
Q4AA1811KB											
Q4AA1815KB											

■ Input voltage AC100V

Servo motor model No.	Motor power (U·V·W·⏚)		Servo amplifier to be combined	Main circuit power supply (R·S·T·⏚)		Control power supply	Regeneration resistance	⏚	
	mm^2	AWG No.		mm^2	AWG No.	mm^2	AWG No.	mm^2	AWG No.
R2EA04003F	0.5	#20	RS2#01#	1.25	#16	AWG16	AWG #16 1.25 mm^2	2.0	#14
R2EA04005F									
R2EA04008F									
R2EA06010F									
R2EA06020F	0.75	19	RS2#03#	2.0	#14		AWG #14 2.0 mm^2		

✔ 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 due to heat-related deterioration. In this case, use special heat-resistant vinyl wire (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.

5) Wiring of 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)
Yellow	Brake	Power for brake (24V)
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-power supply for brake.
- ✔ We recommend 1.25mm2(AWG16)-wiring diameter of power supply for brake.

■ Specifications for canon plug and power lines, model numbers of brake plug of R-series servo motor (Products of Japan Aviation Electronics Industry)

Servo motor model number	Plug for powering and braking line (Cable clamp) [Plug + clamp model number]		Plug for braking line (Cable clamp) [Plug + clamp model number]	
	Straight	Angle	Straight	Angle
R2AA13050	N/MS3106B24-11S (N/MS3057-16A) [MS06B24-11S-16]	N/MS3108B24-11S (N/MS3057-16A) [MS08B24-11S-16]	Note 1)	Note 1)
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]
R1AA18550H	N/MS3106B32-17S (N/MS3057-20A) [MS06B32-17S-20]	N/MS3108B32-17S (N/MS3057-20A) [MS08B32-17S-20]		
R1AA18750L				
R1AA1811KR				
R1AA1815KB				
R2AA18550				
R2AA18750				
R2AA1811K				
R2AA2211K				
R2AA2215K				

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

- ✔ Please contact us for waterproofing specifications and TÜV-compliant products. Please place your order by "plug + clamp model number," our exclusive model numbers.

- ■ Plug model number for power line and brake of Q-series servo motor (Products of Japan Aviation Electronics Industry, Limited)

Servo motor model number	Plug for power line (Cable clamp) [Plug + clamp model number]		Plug for power (Cable clamp) [Plug + clamp model number]		Remarks
	Straight	Angle	Straight	Angle	
Q1AA10100D	N/MS3106B20-15S (N/MS3057-12A) [MS06B20-15S-12]	N/MS3108B20-15S (N/MS3057-12A) [MS08B20-15S-12]	JL04V-6A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332706 x 1]	JL04V-8A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332707 x 1]	
Q1AA10150D					
Q1AA10200D					
Q1AA10250D					
Q1AA12100D	N/MS3106B24-11S (N/MS3057-16A) [MS06B24-11S-16]	N/MS3108B24-11S (N/MS3057-16A) [MS08B24-11S-16]	JL04V-6A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332706 x 1]	JL04V-8A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332707 x 1]	
Q1AA12200D					
Q1AA12300D					
Q1AA13300D			Note 1)	Note 1)	
Q1AA13400D					
Q1AA13500D					
Q1AA18450M					
Q1AA18750H	N/MS3106B32-17S (N/MS3057-20A) [MS06B32-17S-20]	N/MS3108B32-17S (N/MS3057-20A) [MS08B32-17S-20]	JL04V-6A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332706 x 1]	JL04V-8A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332707 x 1]	
Q2AA13200H	N/MS3106B24-11S (N/MS3057-16A) [MS06B24-11S-16]	N/MS3108B24-11S (N/MS3057-16A) [MS08B24-11S-16]	Note 1)	Note 1)	
Q2AA18200H					
Q2AA18350H					
Q2AA18450H					
Q2AA18550R	N/MS3106B32-17S (N/MS3057-20A) [MS06B32-17S-20]	N/MS3108B32-17S (N/MS3057-20A) [MS08B32-17S-20]	JL04V-6A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332706 x 1]	JL04V-8A10SL-3SE-EB-R (JL04-1012CK (05)-R) [332707 x 1]	
Q2AA18550H					
Q2AA18750L					
Q2AA22550B	N/MS3106B24-11S (N/MS3057-16A) [MS06B24-11S-16]	N/MS3108B24-11S (N/MS3057-16A) [MS08B24-11S-16]			
Q2AA22700S					
Q2AA2211KV	N/MS3106B32-17S (N/MS3057-20A) [MS06B32-17S-20]	N/MS3108B32-17S (N/MS3057-20A) [MS08B32-17S-20]			
Q2AA2215KV					
Q4AA1811KB					
Q4AA1815KB					

Note 1) TÜV-compliant, DC24V with brake model needs separate plug for brake. Plug for brake is used in common with the one for power line except for the above model.

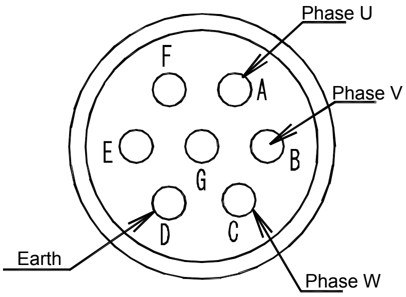
- ✔ Please contact us for waterproofing specifications and TÜV-compliant products. Please place your order by "plug + clamp model number," our exclusive model numbers.

- ■ Plug model numbers of cooling fan connected to motor (Products of Japan Aviation Electronics Industry)

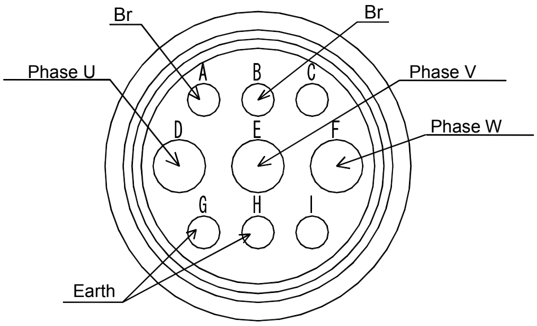
Servo motor model number	Plug model NO. of cooling fan (Cable clamp model NO.) [Plug + clamp model NO.]	Connector type	Pin assignment code
			AC200V±10% Single-phase 50/60Hz
All of R1 series, R2AA1811K, All of Q4-models	N/MS3106B10SL-4S (N/MS3057-4A) [MS06B10SL-4S-4]	Straight	A, B
	N/MS3108B10SL-4S (N/MS3057-4A) [MS08B10SL-4S-4]	Angle	A, B

- ✔ No polarity. Please place your order by "plug + clamp model number," our exclusive model numbers.
- ✔ We recommend 1.25mm^2(AWG16)-wiring diameter of cooling fan.

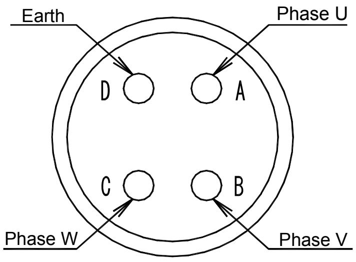
- Pin assignment of canon plug
  Pin assignment shall be any of the followings, depending on model numbers of plug for powering line, braking line, and cooling fan.



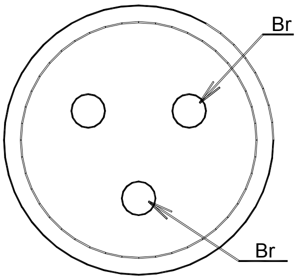
Q-series servo motor
Canon plug for power line
(For N/MS3106 (8) B20-15S)
Pin assignment (Viewed from motor)



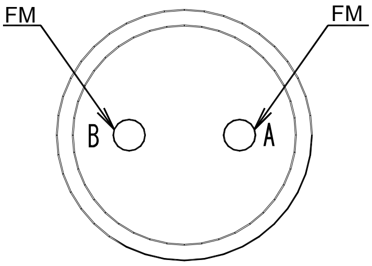
Q-series servo motor
Canon plug for power line
(For N/MS3106 (8) B24-11S)
Pin assignment (Viewed from motor)



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



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

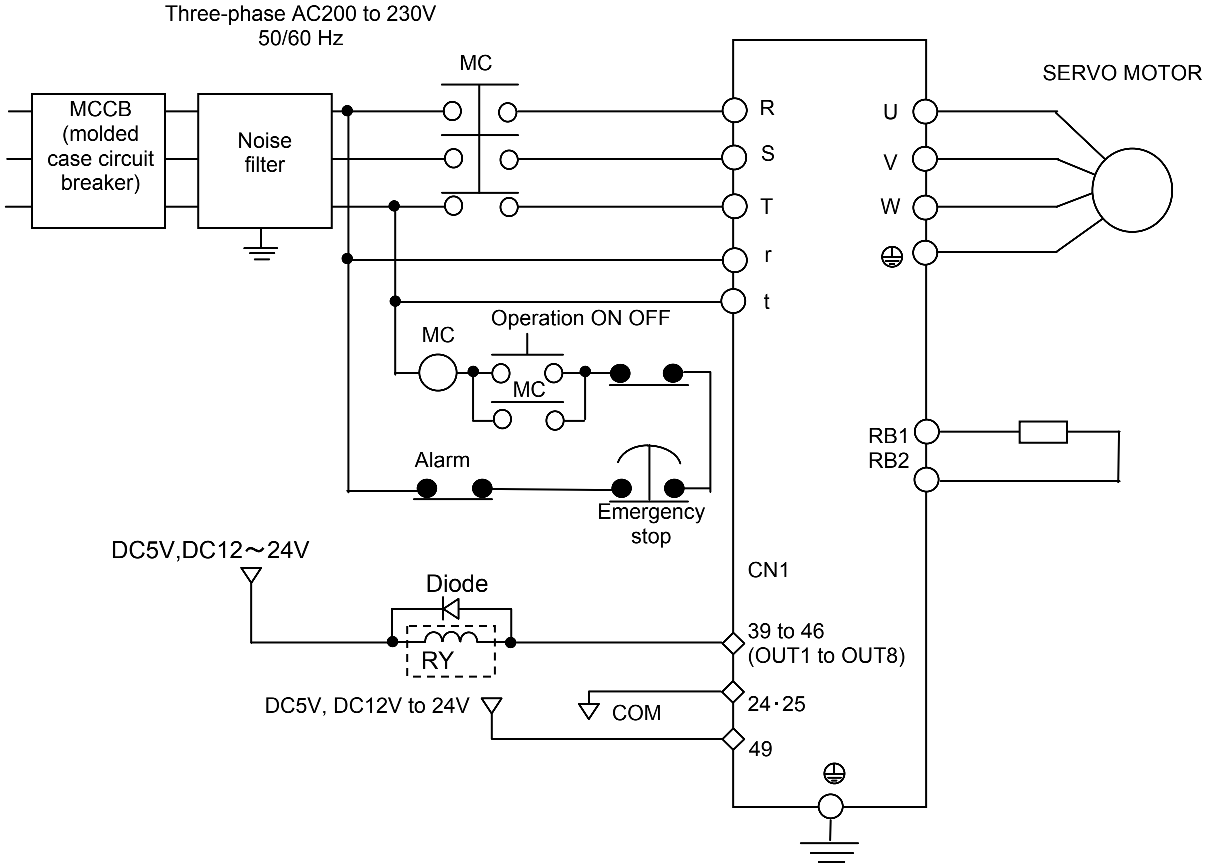


Q4-series servo motor
Plug for cooling fan
Pin assignment (viewed from motor)

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 5 minutes for the prevention from an electric shock. Completion of electric discharge turns off the lamp of CHARGE. Please perform connection check work after checking putting out lights.

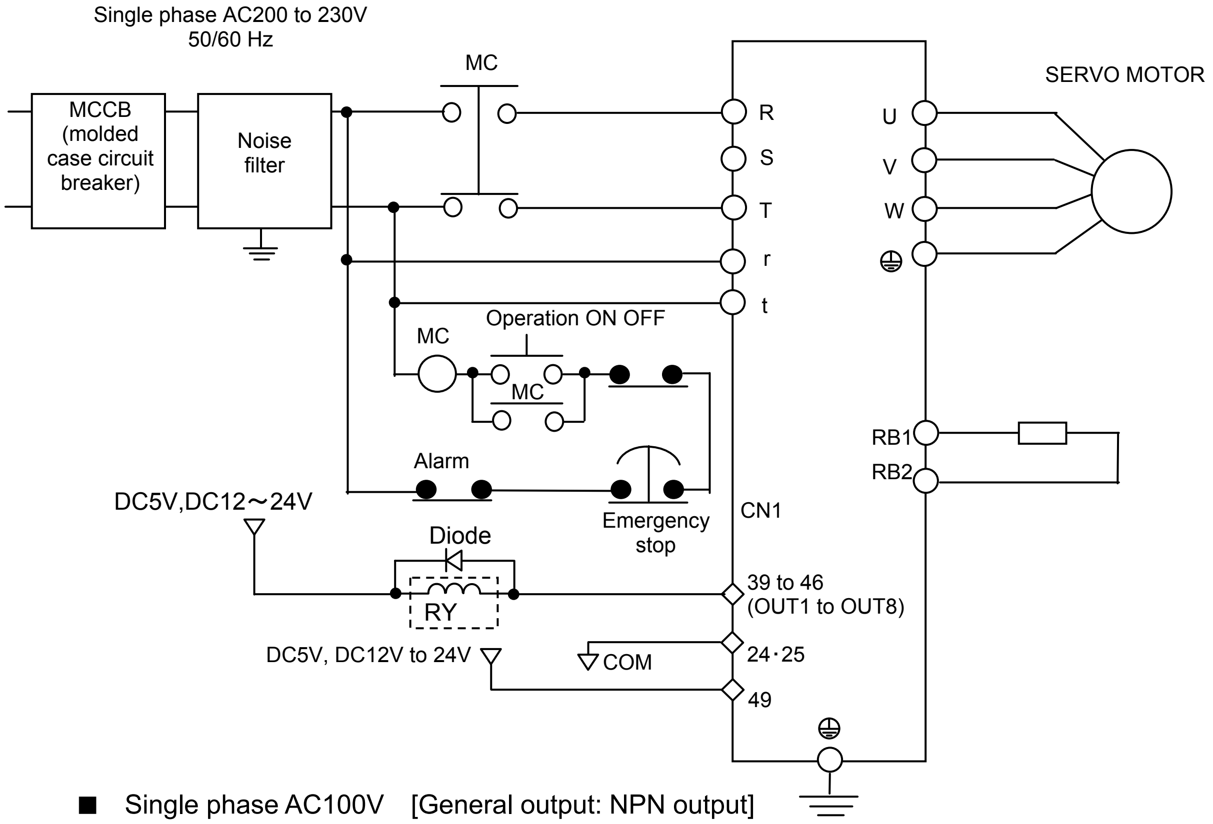
■ Three-phase AC200V [General output: NPN output]



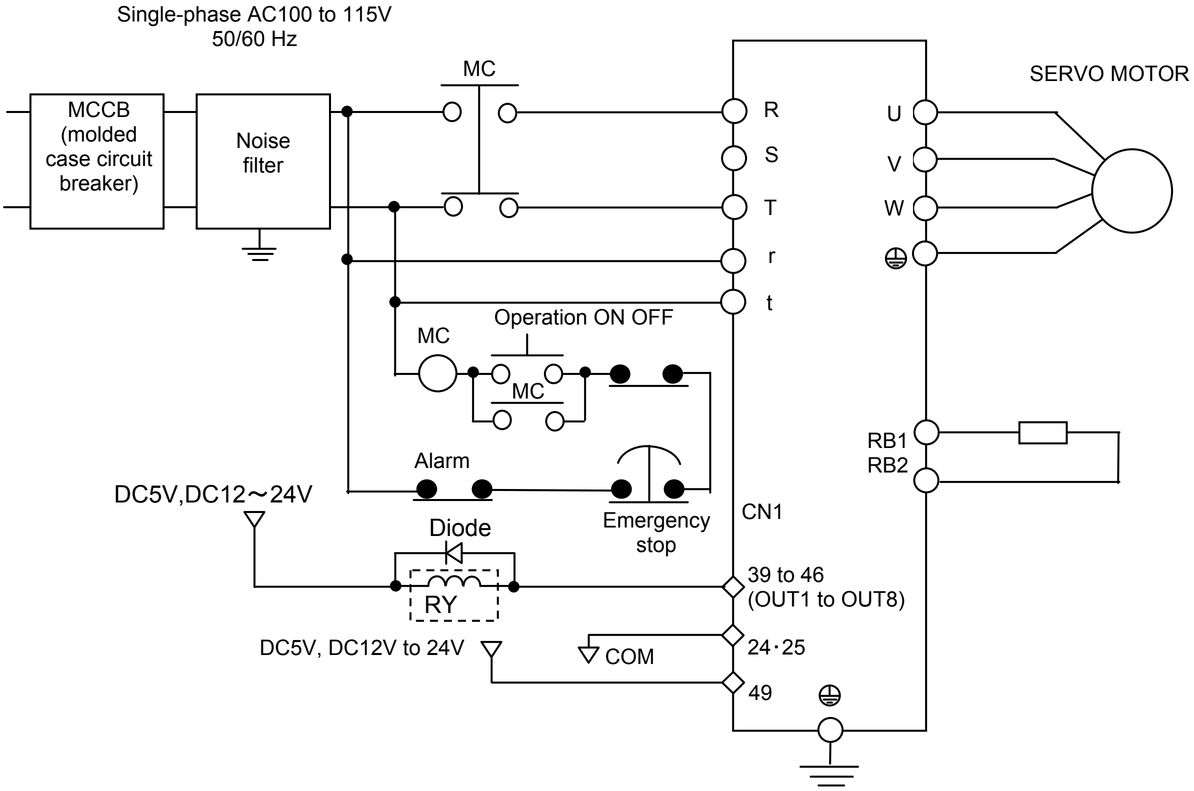
- ✔ Use one of the CN1 39 to 46(OUT1 to OUT8) outputs, and set either During ALM status output ON or During ALM status output OFF at the selection setting of “parameter group A.”

- ✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to output 39-46 on CN1 (OUT1 to OUT8).
  Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

■ Single phase AC200V [General output: NPN output]



■ Single phase AC100V [General output: NPN output]



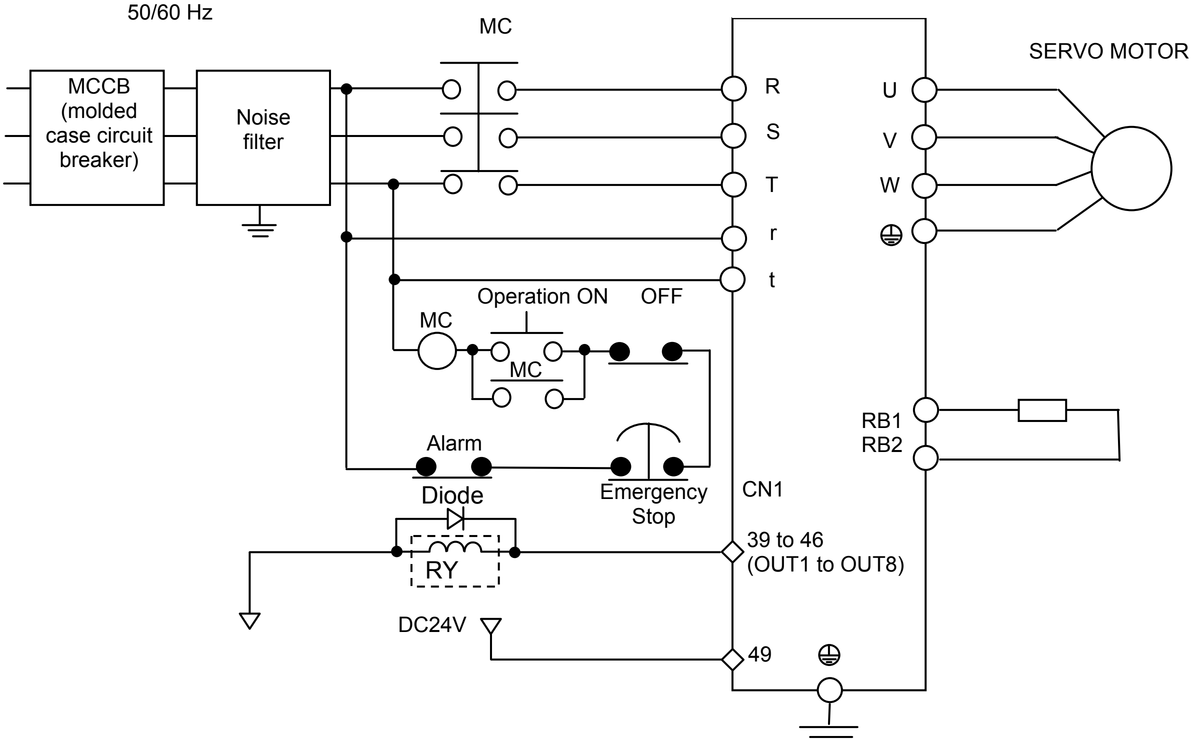
- ✔ Use one of the CN1 39 to 46(OUT1 to OUT8) outputs, and set either During ALM status output ON or During ALM status output OFF at the selection setting of “parameter group A.”

- ✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to output 39-46 on CN1 (OUT1 to OUT8).
  Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

■ 3-phase 200VAC [General output: PNP output]

PNP

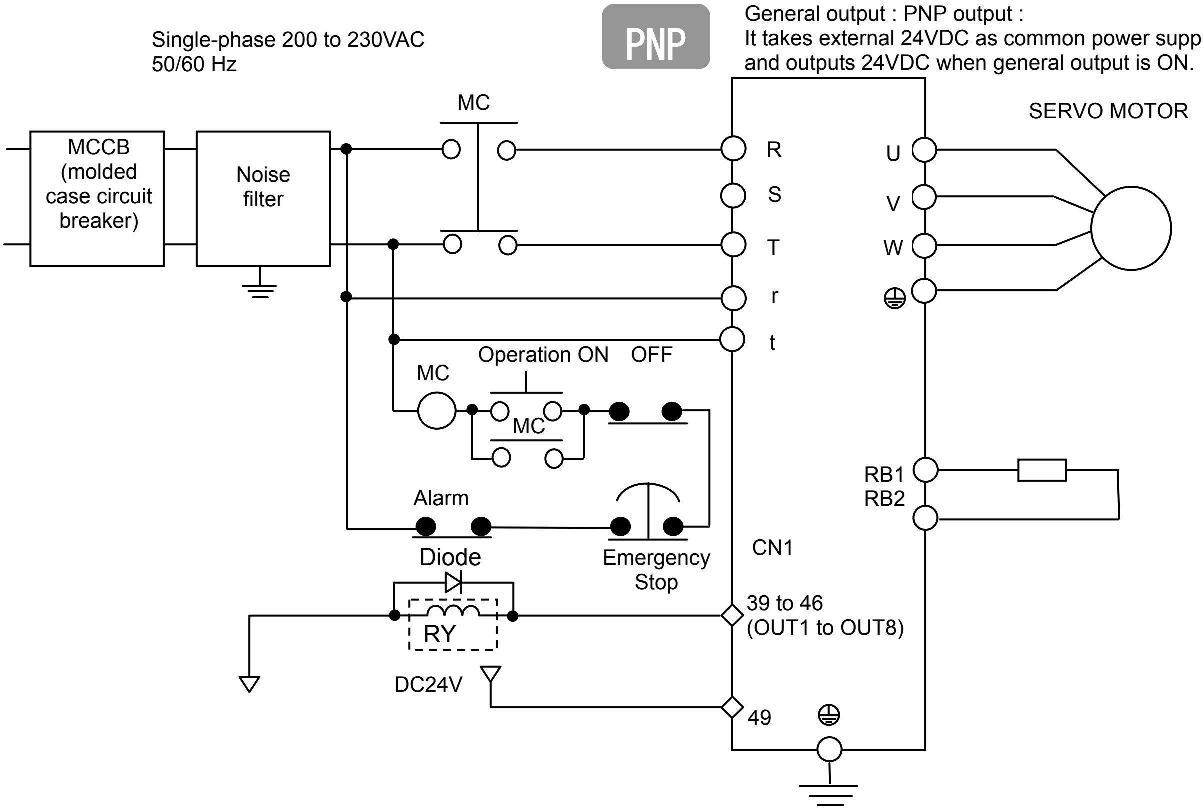
General output: PNP output:
It takes external 24VDC as common power supply and outputs 24VDC when general output is ON.



■ Single-phase AC200V [General output: PNP output]

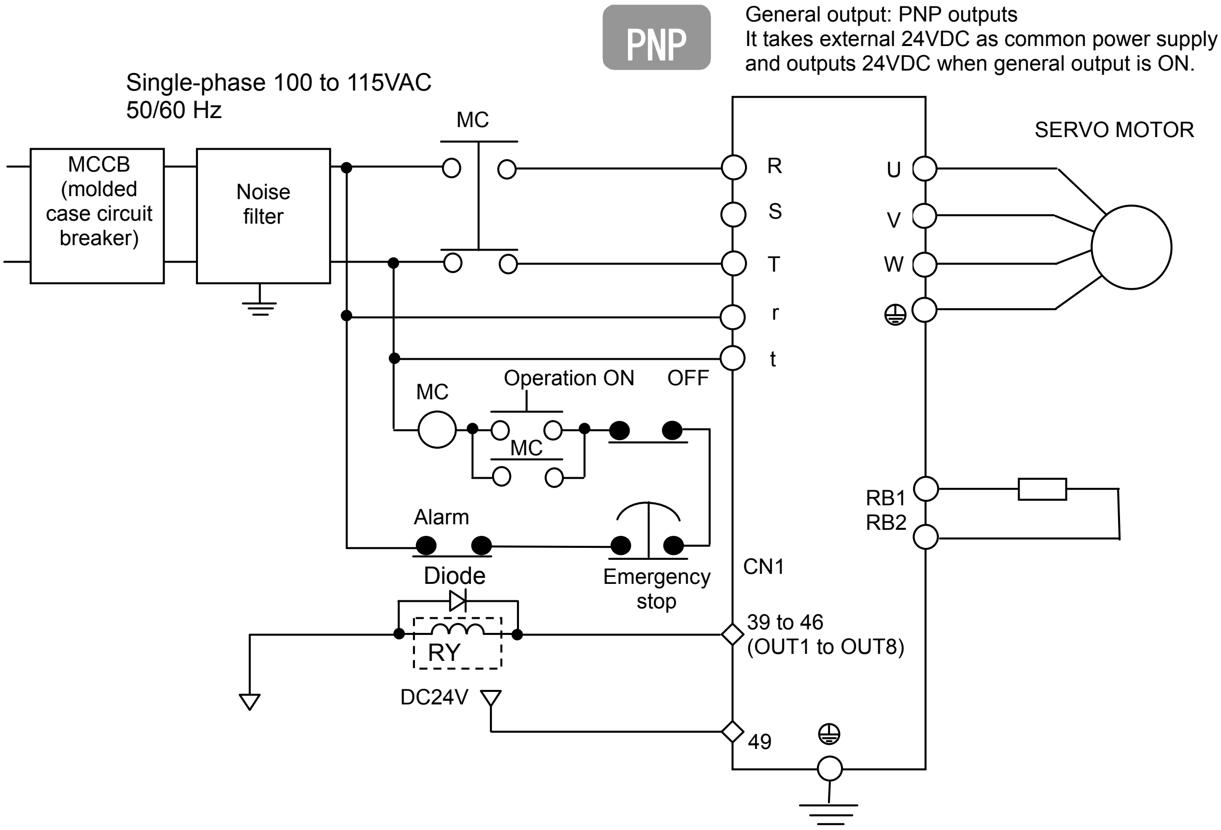
PNP

General output : PNP output :
It takes external 24VDC as common power supply and outputs 24VDC when general output is ON.



- ✔ Use one of the CN1 39 to 46(OUT1 to OUT8) outputs, and set either During ALM status output ON or During ALM status output OFF at the selection setting of "parameter group A."
- ✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to output 39-46 on CN1 (OUT1 to OUT8).
  Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

■ Single-phase 100VAC [General output: PNP output]



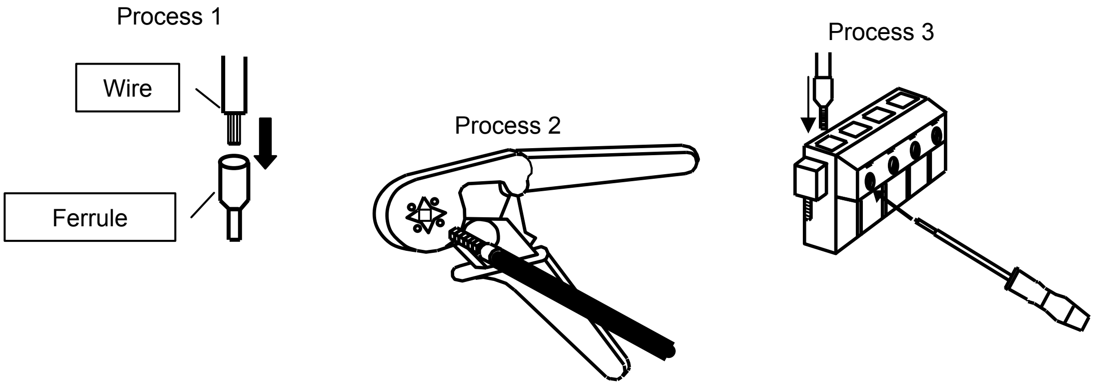
✔ Use one of the CN1 39 to 46(OUT1 to OUT8) outputs, and set either During ALM status output ON or During ALM status output OFF at the selection setting of “parameter group A.”

✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to output 39-46 on CN1 (OUT1 to OUT8).
Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

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 0.5 to 0.6 N･m.



■ Model number of recommended ferrules and crimping tools for various wire sizes

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)

- ✔ GY: Gray, RD: Red, BK: Black, BU: Blue
- ✔ Crimping tool model number: 0.25mm^2 to 6mm^2 : CRIMPFOX UD 6-4, 0.75mm^2 to 10mm^2: CRIMPFOX UD 10-4GY
- ✔ Manufactured by Phoenix Contact.

8) High voltage circuit terminal; tightening torque

Servo amplifier capacity	Terminal marking		
	CNA	CNB	⏚
RS2#01#	[0.5 to 0.6 N･m]		[1.18 N･m] M4 (screw size)
RS2#03#			
RS2#05#			

Servo amplifier size	Terminal code											
	R	S	T	⊖	RB4	RB1	RB2	U	V	W	⏚	CNA
RS2#10#	[1.18 N･m] M4 (screw size)											[0.5 to 0.6 N･m]
RS2#15#												

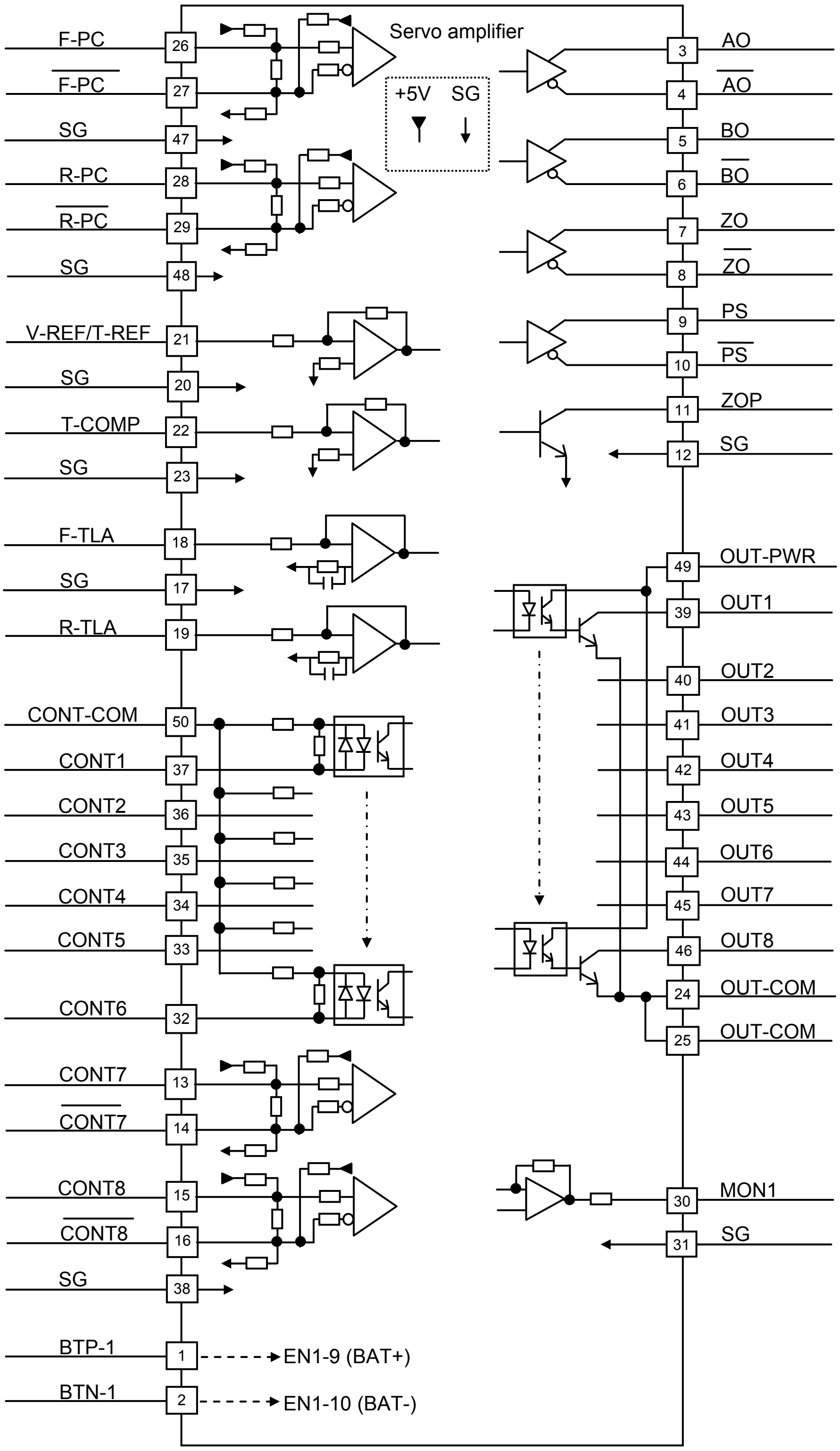
Servo amplifier size	Terminal code											
	R	S	T	⊖	P	U	V	W	⏚	RB1	RB2	CNA
RS2#30#	[3.73 N･m] M6 (screw size)									[1.18 N･m] M4-screw		[0.5 to 0.6 N･m]

- ✔ Mark “#” shows optional number or alphabetical letter.

4.2 Wiring with Host Unit

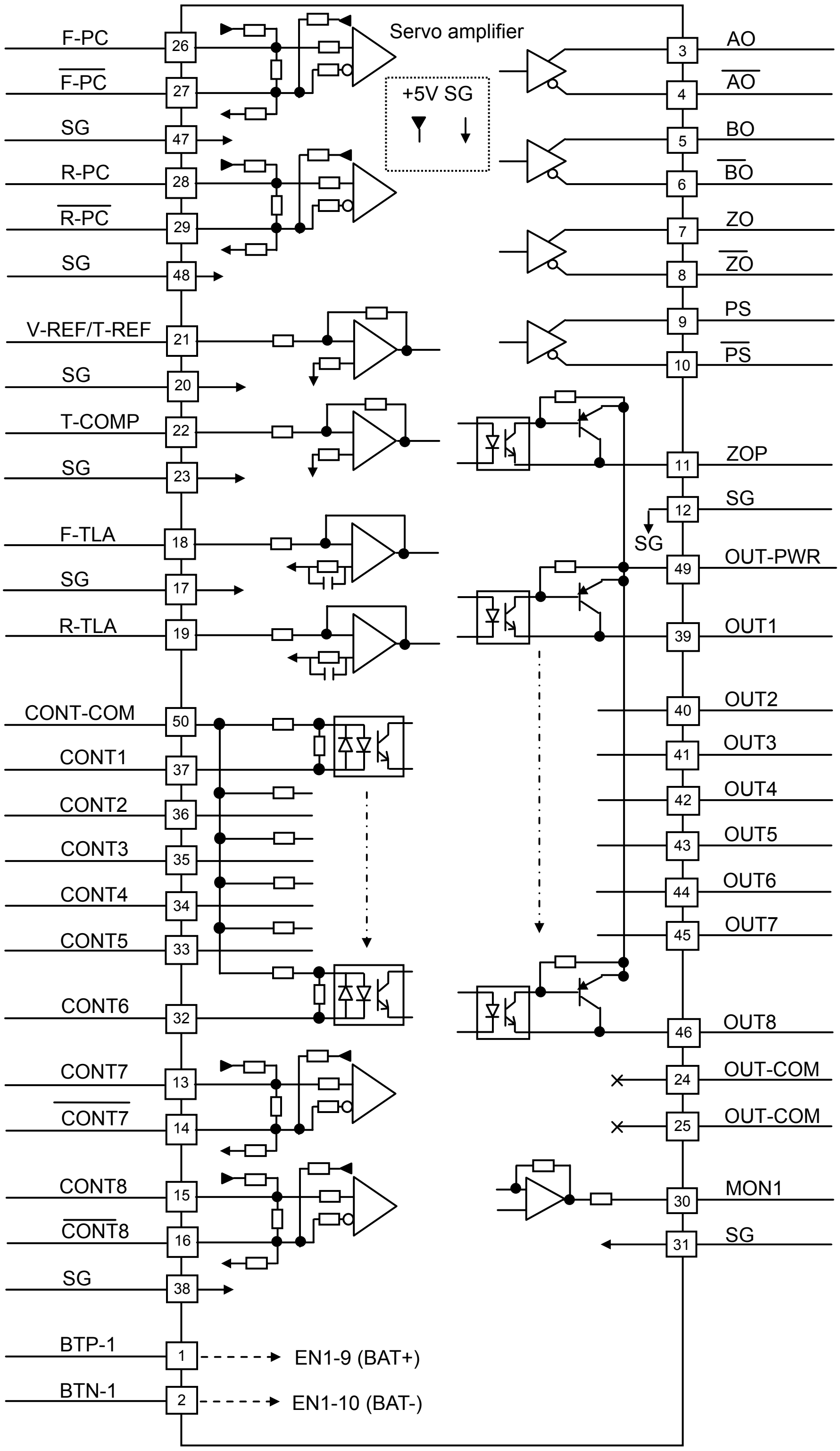
1) CN1 signal and pin number (wiring with host unit)

■ CN1 terminal sequence [General output: NPN output]



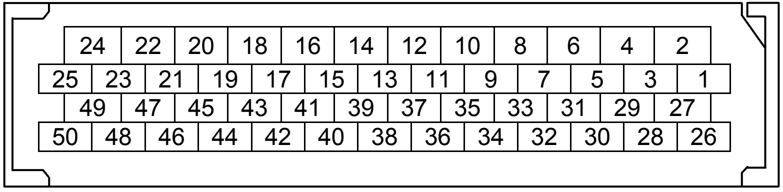
■ CN1 terminal sequence [General output: PNP output]

PNP General output: PNP output:
It takes external 24VDC as common power supply and outputs 24VDC when general output is ON.



2) CN1 connector disposition

- ■ CN1 10150-3000PE (Soldered side)



3) Signal name and its function

Terminal number	Signal name	Description
1	BTP-1	Battery plus
2	BTN-1	Battery minus
3	A0	A phase pulse output
4	$\overline{A0}$	/A phase pulse output
5	BO	B phase pulse output
6	$\overline{BO}$	/B phase pulse output
7	ZO	Z phase pulse output
8	$\overline{ZO}$	/Z phase pulse output
9	PS	Encoder signal output
10	$\overline{PS}$	/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
26	F-PC	Command pulse input
27	$\overline{F\text{-}PC}$	Command pulse input
28	R-PC	Command pulse input
29	$\overline{R\text{-}PC}$	Command pulse input
47	SG	Common for pins 26･27
48	SG	Common for pins 28･29

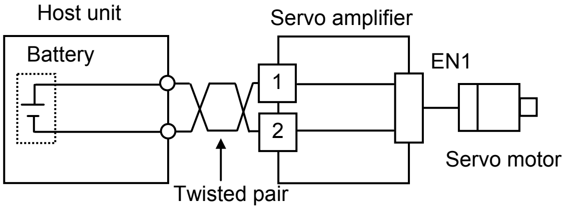
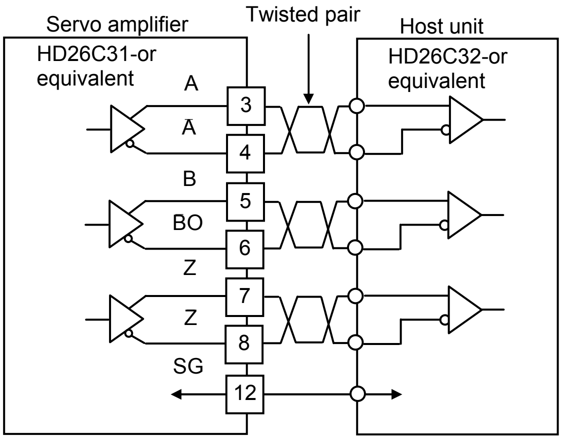
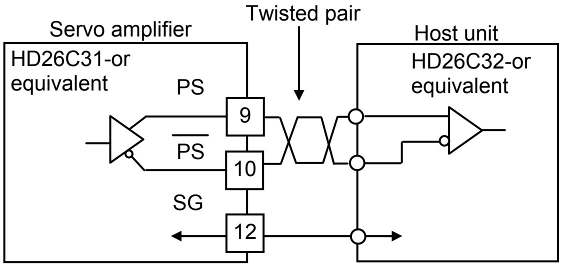
Terminal number	Signal name	Description
30	MON1	Analog monitor output
31	SG	Common for pin 30
13	CONT7	General input
14	$\overline{CONT7}$	General input
15	CONT8	General input
16	$\overline{CONT8}$	General input
38	SG	Common for pins 13 to 16
32	CONT6	General input
33	CONT5	General input
34	CONT4	General input
35	CONT3	General input
36	CONT2	General input
37	CONT1	General input
50	CONT-COM	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	General output power supply
24 Note 1)	OUT-COM*	General output Common/NC
25 Note 1)	OUT-COM*	General output Common/NC

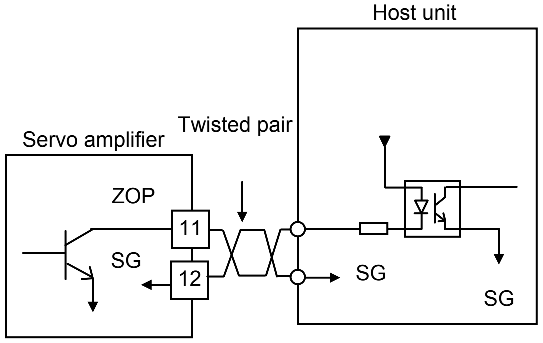
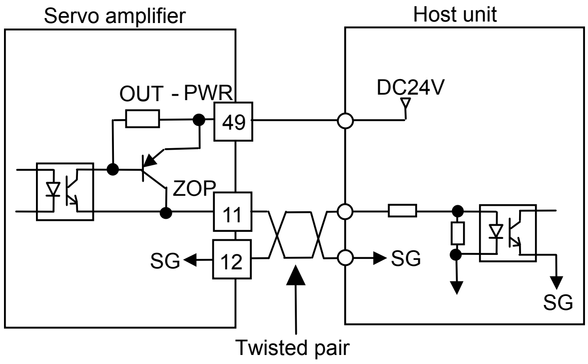
Note 1) 24: OUT-COM*, 25: OUT-COM*
It is NC under PNP output.

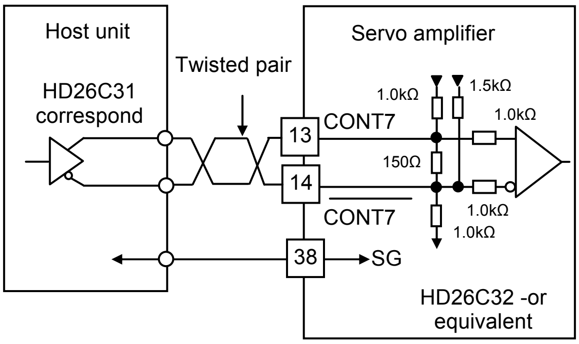
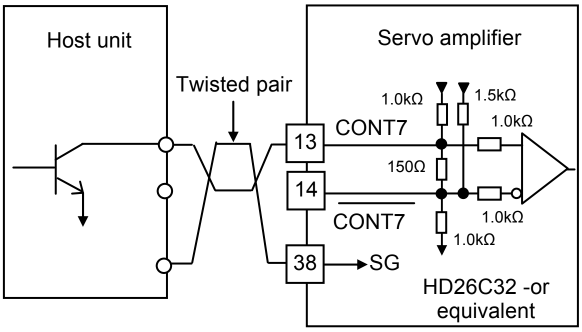
PNP

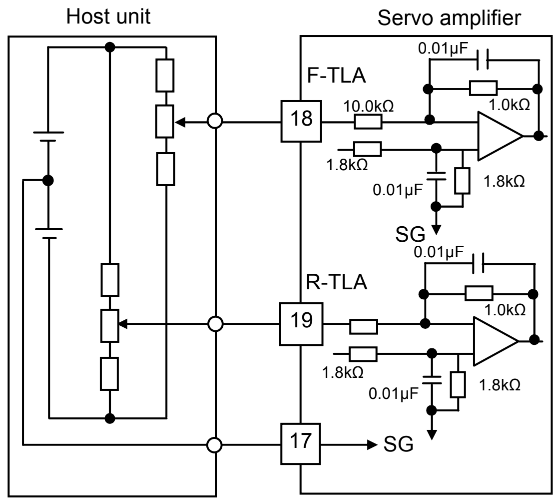
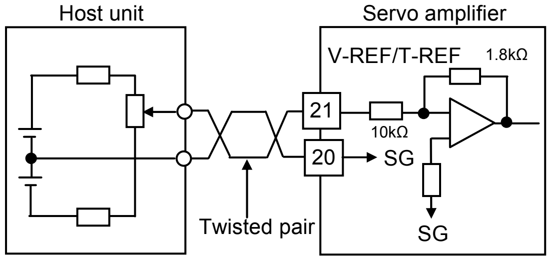
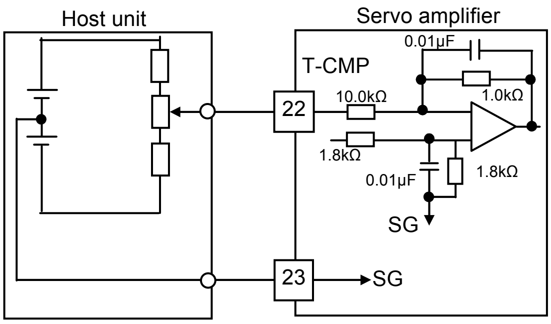
General output: PNP output:
It takes external 24VDC as common power supply and outputs 24VDC when general output is ON.

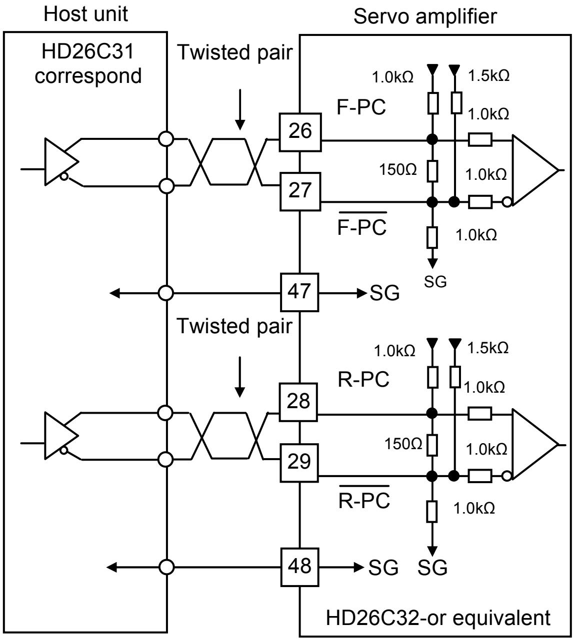
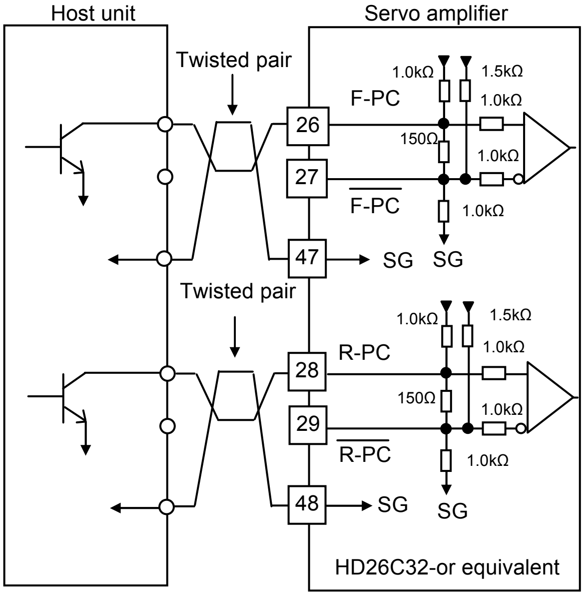
4) Terminal connection circuit

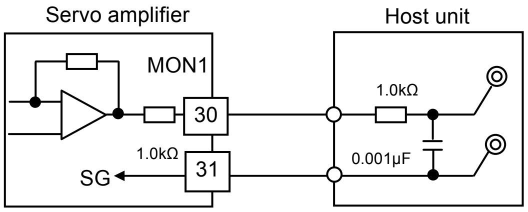
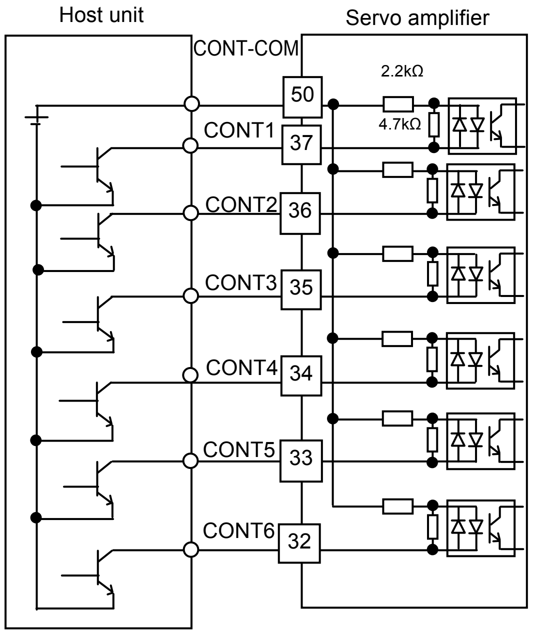
Terminal No.	Symbol	Name	Description
1	BTP-1	Battery plus	When using a Battery Backup Method Absolute Encoder, the battery for backup can be mounted in the host unit side, and it can connect via servo amplifier. When it mounts a battery between servo amplifier and a servo motor, it is not necessary to connect. 
2	BTN-1	Battery minus	
3	A0	A phase pulse output	The signal of A phase of a motor encoder, B phase pulse, and a starting point Z phase pulse is outputted. Connect with a line receiver.  Make sure to connect SG.
4	$\overline{\mathrm{A0}}$	/A phase pulse output	
5	BO	B phase pulse output	
6	$\overline{\mathrm{BO}}$	/B phase pulse output	
7	ZO	Z phase pulse output	
8	$\overline{\mathrm{ZO}}$	/Z phase pulse output	
9	PS	Encoder signal output	Absolute position data output signal of a serial encoder.  Make sure to connect SG.
10	$\overline{\mathrm{PS}}$	/Encoder signal output	

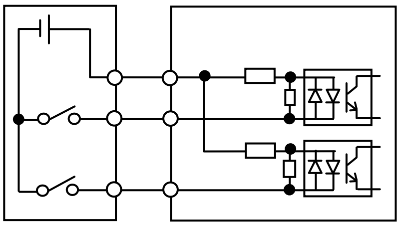
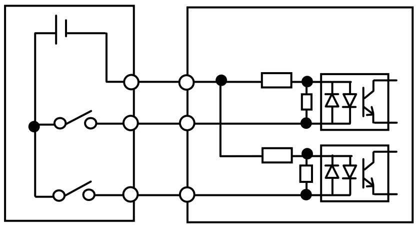
Terminal No.	Symbol	Name	Description
11	ZOP	Z phase pulse output	An open collector outputs the starting Point Z phase pulse of a motor encoder. [NPN output] Maximum voltage: DC30V Maximum current: 10mA  Be sure to connect SG. [PNP output] Max. Voltage: 24VDC Max. Current: 50mA PNP General output: PNP output: It takes external 24VDC as common power supply and outputs 24VDC when general output is ON. 

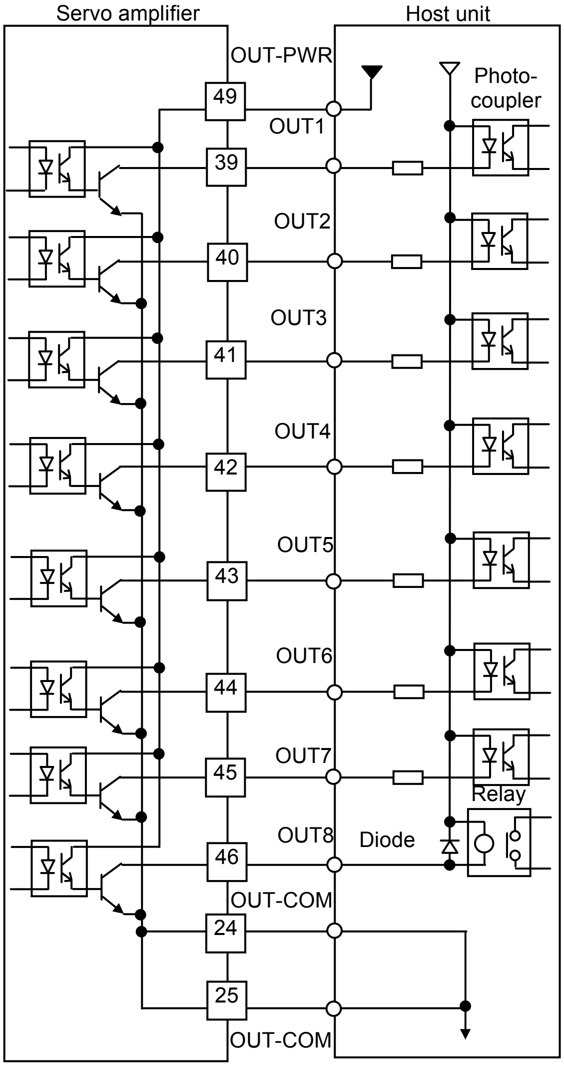
13	CONT7	General input	Receivable with a line receiver. General output signals can receive either a differential signal or an open collector signal. Differential output signal connection  Open collector signal output connection  Make sure to connect SG.
14	$\overline{\text{CONT7}}$	General input	
15	CONT8	General input	
16	$\overline{\text{CONT8}}$	General input	

Terminal No.	Symbol	Name	Description
18	F-TLA	Forward side torque limitation input	Forward and reverse side torque is restricted on external analog voltage. Forward side torque limitation input (F-TLA): CN1-18 Input voltage range -10V to +10V Reverse side torque limitation input (R-TLA): CN1-19 Input current range -10V to +10V Input impedance: about 10kΩ 
19	R-TLA	Reverse side torque limitation input	
21	V-REF	Velocity command input	Analog command input is either velocity command input or torque command input. Velocity command input → Velocity control type. Torque command input → Torque control type Input impedance is about 10kΩ. Maximum allowable input voltage is ±12V. 
	T-REF	Torque command input	
22	T-COMP	Torque compensation input	

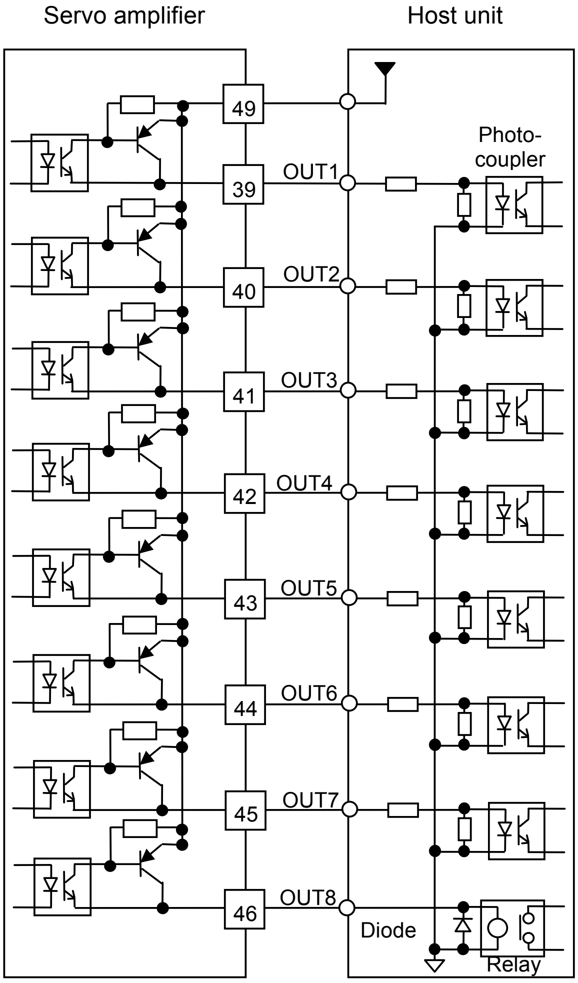
Terminal No.	Symbol	Name	Description
26	F-PC	Command pulse input	Command pulse input is a position command input. Velocity command input → Velocity control type. Three types of command input pulse. [Normal pulse + Reverse pulse] Maximum 5Mpps [Code + pulse train] Maximum 5Mpps [90°-phase difference two phase pulse train] Maximum 1.25Mpps Differential output signal connection  Be sure to connect SG. Open collector signal output connection 
27	$\overline{\text{F-PC}}$	Command pulse input	
28	R-PC	Command pulse input	
29	$\overline{\text{R-PC}}$	Command pulse input	

Terminal No.	Symbol	Name	Description
30	MON1	Analog monitor output	Outputs the selection of analog monitor output 1. Load shall be less than 2mA. Output resistance shall be 1kΩ. Output voltage range shall be ±8V. 
32	CONT6	General input	General input circuit is connected with the transistor circuit of a relay or an open collector. Power supply & voltage range: DC5V±5% / DC12V to DC24V±10% Minimum current: 100mA [Sink circuit example] 
33	CONT5	General input	
34	CONT4	General input	
35	CONT3	General input	
36	CONT2	General input	
37	CONT1	General input	
50	CONT-COM	General input power supply	

Sink circuit type	Source circuit type
	

Terminal No.	Symbol	Name	Description
39	OUT1	General output	General output circuit is connected with a photo-coupler or a relay circuit. [NPN output] OUT-PWR (outer power supply) specification Power supply & voltage range:DC5V ±5%, DC12V to 24V ±10% Minimum current: 20mA Specification of input circuit power Power supply voltage range: DC5V ±5% Power supply voltage range: DC12V to 15V ±10% Power supply voltage range: DC24V ±10% Maximum current:DC5V･･････････10mA Maximum current:DC12V to 15V････30mA Maximum current:DC24V･････････50mA **NPN**  Refer to the example of wiring for PNP to next page.
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	General output power supply	
24	OUT-COM	General output common	
25	OUT-COM	General output common	

✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to general (-purpose) output.
Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

Terminal No.	Symbol	Name	Description
			[PNP output] OUT-PWR (external power supply) specification Power supply voltage: 24VDC ±10% Current capacity: 20mA or over OUT-1 to OUT-8 (output circuit) power supply specification Power supply voltage: 24VDC ±10% Max. current: 24VDC ·········50mA PNP General output: PNP output: It takes external 24VDC as common power supply and outputs 24VDC when general output is ON. 

✔ Make sure to install diode as a surge absorber when connecting induction load, such as relay, to general (-purpose) output.
Please carefully install diode so as not to connect polarity of diode. Failure to do this causes servo amplifier malfunction.

4.3 Wiring

1) EN1 signal names and its pin numbers

■ Battery backup method absolute encoder

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	H	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	G	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	(NC)	-	-	Unconnected	-
6	(NC)	-	-	Unconnected	-
7	ES+	1 (Brown)	E	Serial data signal	Twisted pair
8	ES-	2 (Blue)	F		
9	BAT+	8 (Pink)	T	Battery	Twisted pair
10	BAT-	4 (Purple)	S		
Note 2)	Earth	7 (shielded)	J	Shield	-

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

Note 2) Connect outer-shielded wires of servo amplifier to metallic case (earth) of servo amplifier (EN1). For the case of servo motor with leads, the outer shielded wire of the servo motor shall be connected to shielded wires of leads, and for the motor with canon plug type, perform wiring very close to servo motor. Encoder is not connected to outer shields inside of the servo motor equipped with this encoder.

■ Absolute encoder for incremental system

Servo Amplifier EN1 Terminal No.	Signal name	R/Q-series Servo motor plug pin number (Specification for leads)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	Power supply common	
3	5V	-	Unconnected	-
4	SG	-	Unconnected	-
5	(NC)	-	Unconnected	-
6	(NC)	-	Unconnected	-
7	ES+	1 (Brown)	Serial data signal	Twisted pair
8	ES-	2 (Blue)		
9	(NC)	-	Unconnected	-
10	(NC)	-	Unconnected	-
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 servo amplifier to metallic case (earth) of servo amplifier (EN1). For the case of servo motor with leads, the outer shielded wire of the servo motor shall be connected to shielded wires of leads, and for the motor with canon plug type, perform wiring very close to servo motor. Encoder is not connected to outer shields inside of the servo motor equipped with this encoder.

■ Battery less absolute encoder

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	H	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	G	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	(NC)	-	-	Un connected	-
6	(NC)	-	-	Un connected	-
7	ES+	1 (Brown)	E	Serial data signal	Twisted pair
8	ES-	2 (Blue)	F		
9	(NC)	-	-	Un connected	-
10	(NC)	-	-	Un connected	-
Note 2)	Earth	7 (shielded)	J	Shield	-

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

Note 2) Connect with the metal casing (ground) by the side of EN1, and connect an exterior covering shield line to a ground by the motor encoder side.

■ Pulse encoder

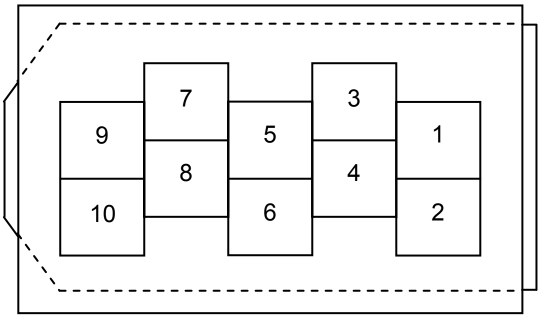
Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	J	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	N	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	B	2 (Green)	B	B-phase pulse output	Twisted pair
6	/B	5 (Purple)	E		
7	A	1 (Blue)	A	A-phase pulse output	Twisted pair
8	/A	4 (Brown)	D		
9	Z	3 (White)	F	Z-phase pulse output	Twisted pair
10	/Z	6 (Yellow)	G		
Note 2)	Earth	7 (shielded)	H	Shield	-

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

Note 2) Connect with the metal casing (ground) by the side of EN1, and connect an exterior covering shield line to a ground by the motor encoder side.

2) EN1 connector layout

■ EN1 36210-0100PL (soldered side)



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

■ Connector number (Sumitomo 3M Ltd.)

	Model Number	Application wire size	Application cable diameter
Connector	36210-0100PL	AWG30 to AWG18	-
Shellkit	36310-3200-008	-	Φ7 to Φ9

3) Connector model number for motor encoder

■ R-series and Q-series servo motor encoder (absolute encoder for incremental system)
Connector model numbers (Products of Japan Aviation Electronics Industry, Limited)

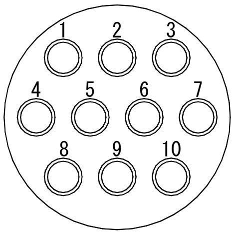
Motor model number	Motor encoder plug model number	Connector type	Applicable cable diameter
R2#A04003 R2#A04005 R2EA04008 R2#A04010 R2#A06010 R2#A06020 R2AA08020 R2AA06040 R2AA08040 R2AA08075 R2AAB8075 R2AAB8100 R2AA10075 R2AA10100 R5AA08075	(Specification for lead locating)	-	-
R1AA18550H R1AA18750L R1AA1811KR R1AA1815KB 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 toΦ8.0
	JN2FS10SL2-R	Angle	
	JN2DS10SL3-R	Straight	Φ3.5 toΦ5.0
	JN2FS10SL3-R	Angle	

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

■ Contact model numbers (Products of Japan Aviation Electronics Industry, Limit

Type	Model number	Qty	Applicable wire size
Manual crimping type	JN1-22-20S-R-PKG100	Note1	AWG20
	JN1-22-22S-PKG100	Note1	AWG21 to AWG25
	JN1-22-26S-PKG100	Note1	AWG26 to AWG28
Soldering type	JN1-22-22F-PKG100	Note1	AWG20 max.

Note1. Please be advised that one unit per order will be accepted to place order of contact. Minimum quantity of 100 units (1 pack) per order is requested to directly place order with contact manufacture.

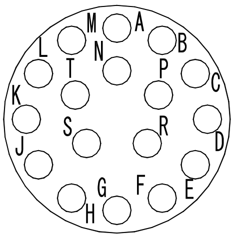


R-series servo motor encoder canon plug pin assignment (Viewed from motor)

■ Q-series servo motor encoder (Excluding absolute encoder for incremental system)
Connector model numbers (Products of Japan Aviation Electronics Industry, Limited)

Motor model number	Motor encoder plug model number (Cable clamp) [Plug + clamp model number]	Connector type	Remarks
All of model Q1, Q2, and Q4	N/MS3106B20-29S (N/MS3057-12A) [MS06B20-29S-12]	Straight	-
	N/MS3108B20-29S (N/MS3057-12A) [MS08B20-29S-12]	Angle	-

✔ Please contact us for waterproofing specifications and TÜV-compliant products. Please place your order by “plug + clamp model number, ” our exclusive model numbers.



Q-series servo motor
Canon plug for encoder
Pin assignment (Viewed from motor)

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 (mm2)	0.15 to 0.75

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

5) Encoder cable length

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

Conductor size		Conductor resistance Ω/km (20°C)	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

1) Power supply capacity and peripherals list

■ AC200V input

Input voltage	Servo amplifier capacity	Servo motor model No.	Main circuit power supply rating (kVA)	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC200V	RS2#01#	R2AA04003F	0.2	Model NF30 10A MITSUBISHI ELECTRIC	HF3030C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N10 MITSUBISHI ELECTRIC	LT-C32G801WS SOSHIN ELECTRIC Co., Ltd.
		R2AA04005F	0.2				
		R2AA04010F	0.3				
		R2AA06010F	0.3				
		R2AA06020F	0.6				
		R2AA06040H	1.0				
		R2AA08020F	0.6				
		R5AA06020H	0.6				
		R5AA06020F	0.6				
		R5AA06040H	1.0				
	RS2#03#	R2AA06040F	1.0				
		R2AA08040F	1.0				
		R2AA08075F	1.6				
		R2AAB8100H	2.0				
		R2AA10075F	1.7				
		R2AA13050H	1.2				
		R2AA13050D	1.2				
		R2AA13120B	2.2				
		R5AA06040F	1.0				
		R5AA08075D	1.6				
		R5AA08075F	1.6				
	RS2#05#	R2AAB8075F	1.6	Model NF30 15A MITSUBISHI ELECTRIC			
		R2AAB8100F	2.3				
		R2AA10100F	2.3				
		R2AA13120D	2.8				
		R2AA13120L	2.8				
		R2AA13180H	3.6				
		R2AA13200L	4.0				
		Q1AA10100D	2.3				
		Q1AA10150D	3.0				
		Q1AA12100D	2.3				
	RS2#10#	R2AA13180D	4.0	Model NF50 30A MITSUBISHI ELECTRIC		S-N18 MITSUBISHI ELECTRIC	
		R2AA13200D	5.0				
		R2AA18350L	6.0				
		Q1AA10200D	4.0				
		Q1AA10250D	4.2				
		Q1AA12200D	4.0				
		Q1AA12300D	5.0				
		Q1AA13300D	5.0				
		Q2AA13200H	4.0				
		Q2AA18200H	4.0				
	RS2#15#	R2AA18350D	7.0	Model NF50 50A MITSUBISHI ELECTRIC		S-N35 MITSUBISHI ELECTRIC	
		R2AA18450H	7.4				
		R2AA18550R	8.4				
		R2AA22500L	9.6				
		R2AA22700S	12.2	Model NF100 75A MITSUBISHI ELECTRIC	HF3050C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N50 MITSUBISHI ELECTRIC	
		Q1AA13400D	6.7	Model NF50 50A MITSUBISHI ELECTRIC	HF3030C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N35 MITSUBISHI ELECTRIC	
		Q1AA13500D	8.3				
		Q1AA18450M	7.4				
		Q2AA18350H	6.9				
		Q2AA18450H	7.4				
		Q2AA18550R	8.4				
		Q2AA22550B	10.0				
		Q2AA22700S	12.2	Model NF100 75A MITSUBISHI ELECTRIC	HF3050C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N50 MITSUBISHI ELECTRIC	

- ✔ Mark "#" is optional number or alphabetical letter.
- ✔ Please install surge absorber at the input part of servo amplifier when overvoltage such as lightning surge is applied to servo amplifier.

■ AC200V input

Input voltage	Servo amplifier capacity	Servo motor model No.	Main circuit power supply rating (kVA)	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC200V	RS2#30#	R1AA18550H	9.3	Model NF100 100A MITSUBISHI ELECTRIC	HF3080C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N65 MITSUBISHI ELECTRIC	LT-C32G801WS SOSHIN ELECTRIC Co., Ltd.
		R1AA18750L	11.6				
		R1AA1811KR	16.0				
		R1AA1815KB	21.4				
		R2AA18550H	9.3				
		R2AA18750H	11.6				
		R2AA1811KR	16.0				
		R2AA2211KB	16.0				
		R2AA2215KB	21.4				
		Q1AA18750H	12.6				
		Q2AA18550H	10.0				
		Q2AA18750L	12.6				
		Q2AA2211KV	16.0				
		Q2AA2215KV	21.4				
		Q4AA1811KB	15.7				
		Q4AA1815KB	21.4				

■ AC100V input

Input voltage	Servo amplifier capacity	Servo motor model No.	Main circuit power supply rating (KVA)	Molded case circuit breaker (MCCB)	Noise filter	Magnetic contact	Surge absorber
AC 100V	RS2#01#	R2EA04003F	0.2	NF30 Type 10A MITSUBISHI ELECTRIC	HF3030C-UQA SOSHIN ELECTRIC Co., Ltd.	S-N10 MITSUBISHI ELECTRIC	LT-C12G801WS SOSHIN ELECTRIC Co., Ltd.
		R2EA04005F	0.2				
		R2EA04008F	0.4				
		R2EA06010F	0.5				
	RS2#03#	R2EA06020F	0.8				

- ✔ Mark “#” is optional number or alphabetical letter.
- ✔ Please install surge absorber at the input part of servo amplifier when overvoltage such as lightning surge is applied to servo amplifier.

5

5. Operation

5.1 Changing servo motor combination

Combination of servo motor connected and servo amplifier you use can be change by using AC servo system supportive system "SANMOTION MOTOR SETUP (hereinafter referred to as setup software)" or “digital operator.” Pease refer to separate operating manual of setup software M0010842 or “Chapter 7, Digital Operator” for the details.

1) Confirmation and change of the setup software

Procedure	Item and contents
1	Confirmation of the servo motor model number
	■ Confirm the servo motor model number to be combined with the servo amplifier. Confirm that the model number (first 10 digits) of the servo motor to be used is the same as the model number found in the Combination Motor model number in the setup software. If the servo motor model number to be used is the same as the Combination Motor model number, there is no need to change the settings. If not, change the number to the correct servo motor model number. ■ Turn on control power (r, t) of servo amplifier to start up setup software. Opening System parameters tab of Parameters setting (P) shows 10-digit servo motor model number on the upper left side of the display with “Motor combined” and “Present set value” in the lead.
2	Alteration of the servo motor model number
	■ There are two ways to change the setting of the servo motor to be combined with the amplifier: Select from List and Automatic Setting. ◆ Turn on control power (r, t) of servo amplifier to start up setup software. ◆ Open System parameters tab of Parameters setting (P) and “Select motor from list (M)” of “Motor combined” to select file name (extension .mt1) of servo motor model number (leading 10-digit).
3	■ Reactivate the control power after changing the setting this will reset the setting.

2) Confirmation and change by the Digital Operator

Procedure	Item and contents
1	Confirmation of the servo motor model number

■ Confirm the servo motor model number setting at the servo amplifier.
The Digital Operator displays the Motor Code according to the servo motor model number. Confirm that the model number (first 10 digits) of the servo motor to be used is the same as the model number corresponding to the Motor Code shown below. If the Motor code corresponding to the model number of the servo motor to be used is the same as the Motor Codes below, there is no need to change the settings. If not, change the number to the correct servo motor model number.

Motor Code corresponding to servo motor model number

Servo amplifier size	Servo motor model number	Motor Code	Servo motor model number	Motor Code	Servo motor model number	Motor Code
RS2A01	R2AA04003F	0181	R2AA04005F	0182	R2AA04010F	0183
	R2AA06010F	0184	R2AA06020F	0185	R2AA06040H	0189
	R2AA08020F	018A	R5AA06020H	049D	R5AA06020F	049E
	R5AA06040H	049F				
RS2A03	R2AA06040F	0186	R2AA08040F	0188	R2AA08075F	0187
	R2AAB8100H	0194	R2AA10075F	019F	R2AA13050H	018F
	R2AA13050D	018C	R2AA13120B	0191	R5AA06040F	02BB
	R5AA08075D	02BA	R5AA08075F	04A0		
RS2A05	R2AAB8075F	01B1	R2AAB8100F	0193	R2AA10100F	019E
	R2AA13120D	018D	R2AA13120L	018E	R2AA13180H	01B6
	R2AA13200L	0192	Q1AA10100D	0047	Q1AA10150D	0048
	Q1AA12100D	004B				
RS2A10	R2AA13180D	011B	R2AA13200D	0190	R2AA18350L	011C
	Q1AA10200D	0049	Q1AA10250D	004A	Q1AA12200D	004C
	Q1AA12300D	004D	Q1AA13300D	004E		
RS2A15	R2AA18350D	011D	R2AA18450H	011E	R2AA18550R	01B8
	R2AA22500L	0195	R2AA22700S	0484	Q1AA13400D	004F
	Q1AA13500D	0050	Q1AA18450M	0051		
RS2A30	R1AA18750L	010F	R1AA1811KR	010D	R1AA1815KB	010E
	R2AA18550H	011F	R2AA18750H	01B9	R2AA1811KR	0120
	Q1AA18750H	0052	Q2AA18550H	00D5	R2AA2211KB	0483
	R2AA2215KB	0117				
RS2E01	R2EA04003F	0197	R2EA04005F	0198	R2EA04008F	019D
	R2EA06010F	019A				
RS2E03	R2EA06020F	019B				

◆ Verification method
Confirm the Motor Code corresponding to the servo motor model number from Information 3 (Motor Code). Refer to [Status Display Mode (7-4)] for operation.

Information 3	Motor code
InFo.3	0185

Procedure	Item and contents
2	Alteration of the servo motor model number

■ There are two ways to change the setting of the servo motor to be combined with the servo amplifier: Select from Motor code or Automatic Setting

◆ Select from Motor Codes
Refer to [Setting Motor Code of Servo Amplifier to Be Used (7-19)] for operation.

◆ “Automatic setting”
Refer to “section 7.13, Automatic Setting of Motor Parameter (page 7-17)” for operation procedure of digital operator.

Procedure	Item and contents
3	■ Reactivate the control power after changing the setting this will reset the setting.

- ✔ Servo motors corresponding to “selected from motor codes” vary depending on the software version of servo amplifier.
- ✔ For the motor which is not written in the list above, please set it through the setup software.

5.2 System parameters

1) Confirmation of specifications

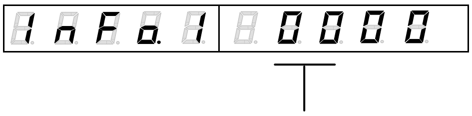
Confirm the specifications, the combination of the servo amplifier and the motor encoder, using either of the AC servo system support tools: setup software or Digital Operator.

<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td rowspan="2">1</td><td>Confirmation of servo amplifier specifications</td></tr>
<tr><td>■ Confirm that the specifications of the product purchased are the same as that of the machine being used. Also, confirm the following four (4) items with statements or codes.
◆ Motor structure
◆ Main circuit power supply voltage
◆ Amplifier capacity code
◆ Control board code

■ Confirm the statement contents and codes with the AC servo system support tools: Setup software or Digital Operator.

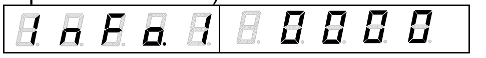
◆ Confirm with setup software.
Turn on control power (r, t) to start up setup software.
Opening System parameters tab of Parameters setting (P) shows “System information” in the upper right of the display. Confirm in accordance with procedure 2 and later. Refer to separate document M0010842 for setup software operation.

◆ Confirm with Digital Operator
Codes are shown at Information 1 (servo amplifier) and Information 2 (servo amplifier).
Refer to [Status Display Mode (7-4)] for Digital Operator operation.</td></tr>
<tr><td rowspan="2">2</td><td>Motor structure</td></tr>
<tr><td><table><tr><th>Code</th><th>Motor structure</th></tr><tr><td>00</td><td>Rotary</td></tr></table>
■ Confirm that Rotary is displayed at Motor Structure in setup software.

■ Confirm that the Motor Structure code is shown at Information 1 (servo amplifier) of Digital Operator.

Motor Structure code</td></tr>
</table>

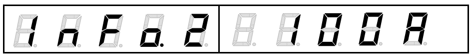
<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td rowspan="2">3</td><td>Main circuit power supply voltage</td></tr>
<tr><td>
<table>
<tr><th>Code</th><th>Main circuit power supply voltage display</th></tr>
<tr><td>00</td><td>200V</td></tr>
<tr><td>01</td><td>100V</td></tr>
</table>

- ■ Using setup software, confirm that voltage value of main circuit power connected to connector CNA or terminal block RST is displayed.
- ■ Using Digital Operator, confirm that codes of voltage value of main circuit power connected to connector CNA or terminal block RST is displayed on “information 1 (servo amplifier information).”



Main circuit power supply voltage code
</td></tr>
<tr><td rowspan="2">4</td><td>Amplifier capacity</td></tr>
<tr><td>
<table>
<tr><th>Code</th><th>Amplifier capacity</th><th>Servo amplifier model number</th></tr>
<tr><td>0C</td><td>15A</td><td>RS2#01A####</td></tr>
<tr><td>0A</td><td>30A</td><td>RS2#03A####</td></tr>
<tr><td>09</td><td>50A</td><td>RS2#05A####</td></tr>
<tr><td>07</td><td>100A</td><td>RS2#10A####</td></tr>
<tr><td>06</td><td>150A</td><td>RS2#15A####</td></tr>
<tr><td>04</td><td>300A</td><td>RS2#30A####</td></tr>
</table>

- ■ Confirm setup software displays the amplifier capacity of the servo amplifier model number that you use.
- ■ Confirm Digital Operator displays the code of the servo amplifier capacity you use at Information 2 (servo amplifier).

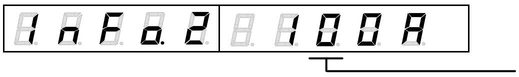


Amplifier capacity code
</td></tr>
<tr><td rowspan="2">5</td><td>Control board code</td></tr>
<tr><td>
<table>
<tr><th>Code</th><th>Motor encoder model connected to EN1</th><th>External encoder connected to EN2</th></tr>
<tr><td>#0</td><td>PA035S, PA035C, RA035C</td><td>Do not use</td></tr>
<tr><td>#2</td><td>PA035S, PA035C, RA035C</td><td>Pulse encoder</td></tr>
<tr><td>#8</td><td>PP031T, PP062</td><td>Do not use</td></tr>
<tr><td>#A</td><td>PP031T, PP062</td><td>Pulse encoder</td></tr>
</table>

- ■ Confirm the corresponding code from the motor encoder of the servo motor to be used (EN1 and EN2) is displayed.

<table>
<tr><th>Model</th><th>Name</th></tr>
<tr><td>PA035S</td><td>Absolute Encoder for Incremental System</td></tr>
<tr><td>PA035C</td><td>Battery Backup Method Absolute Encoder</td></tr>
<tr><td>RA035C</td><td>Battery-less Absolute Encoder</td></tr>
<tr><td>PP031T, PP062</td><td>Pulse Encoder</td></tr>
</table>

- ■ Confirm setup software displays the code.
- ■ Confirm Digital Operator displays Information 2 (servo Amplifier information).



Control board code
</td></tr>
</table>

2) System parameters list

System parameters list is shown below. Settings vary depending on the system used.

Please confirm 3), 4) and the following IDs for the proper settings.

ID	Contents
00	Control Cycle
01	Main Circuit Power Input Type
02	Regenerative Resistor Selection
04	Serial Encoder Function Selection
05	Serial Encoder Resolution
06	Backup Type Absolute Encoder Function Selection
07	Pulse Encoder Function Selection
08	Pulse Encoder Resolution
09	Control Mode Selection
0A	Position Control Selection
0B	Position Loop Control, Position Loop Encoder Selection
0C	External Pulse Encoder Resolution

3) Confirmation and settings of system parameters

Use the AC servo system support tools, setup software or digital operator, to set the specifications and correct combination of the servo amplifier and motor encoder. For operating instructions, see separate volume, M0010842, for setup software and [Digital Operator (7)] for the Digital Operator.

System Parameters Setting (servo amplifier)

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">00</td><td>Control Cycle</td></tr>
<tr><td>
■ Select the control cycle for Velocity control/ Torque control.
“High Frequency Sampling” enables increasing the frequency response of the velocity control system. Please set at “00: Standard_Sampling” for normal use.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Standard_Sampling</td><td>Standard Sampling</td></tr>
<tr><td>01</td><td>High-freq_Sampling</td><td>High Frequency Sampling</td></tr>
</table>
■ “High frequency sampling mode” is not available for the following conditions:
◆ System Parameters ID0A setting value of the “Position Control Selection”
<table>
<tr><th>Present setting value</th><th>Contents</th></tr>
<tr><td>01:Model1</td><td>Model Following Control</td></tr>
</table>
or
<table>
<tr><th>Present setting value</th><th>Contents</th></tr>
<tr><td>02:Model2</td><td>Model Following Vibration Suppressor Control</td></tr>
</table>
◆ System Parameters ID0B setting value of the “Position Loop Control, Position Loop Encoder Selection”
<table>
<tr><th>Present setting value</th><th>Contents</th></tr>
<tr><td>01: External_Enc</td><td>Fully-closed Control/ External Encoder</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">01</td><td>Main circuit power input type</td></tr>
<tr><td>
■ Set input type of main circuit power connected to CNA on servo amplifier or R, S, and T on terminal block.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>AC_3-phase</td><td>3 phase AC power is supplied to the main circuit</td></tr>
<tr><td>01</td><td>AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
■ Set according to the specifications of the main circuit power that is used as Follows:
◆ Connect to 3 phase AC power 200V
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00: AC_3-phase</td><td>3 phase AC power is supplied to the main circuit</td></tr>
</table>
◆ Connect to single phase AC power 200V.
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
◆ Connect AC 100V to R, T of CNA
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: AC_Single-phase</td><td>Single phase AC power is supplied to the main circuit</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">02</td><td>Regenerative resistor selection</td></tr>
<tr><td>
■ Set installation specification of regenerative resistor connected to CNA on servo amplifier or RB1 and RB2 on terminal block, or the condition that regenerative resistance is not connected.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Not_connect</td><td>Regenerative resistor is not connected</td></tr>
<tr><td>01</td><td>Built-in_R</td><td>Use built-in regenerative resistor</td></tr>
<tr><td>02</td><td>External_R</td><td>Use external regenerative resistor</td></tr>
</table>
■ Set to meet the flowing specifications:
◆ Regenerative resistor is not connected
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00: Not_connect</td><td>Regenerative resistor is not connected</td></tr>
</table>
◆ Use built-in regenerative resistor of the servo amplifier
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: Built-in_R</td><td>Use built-in regenerative resistor</td></tr>
</table>
◆ Use external regenerative resistor
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>02: External_R</td><td>Use external regenerative resistor</td></tr>
</table>
</td></tr>
</table>

ID	Contents
09	Control mode selection

■ Set the control mode of the servo amplifier used as follows:

Selection		Description
00	Torque	Torque Control Mode
01	Velocity	Velocity Control Mode
02	Position	Position Control Mode
03	Velo-Torq	Velocity - Torque Control Switch Mode
04	Posi-Torq	Position - Torque Control Switch Mode
05	Posi-Velo	Position - Velocity Control Switch Mode

■ Set to the host device specifications as follows:

◆ Servo amplifier used in “Position control mode”: host device input “Position command pulse” to servo amplifier.

Present setting value	Description
02: Position	Position Control Mode

◆ Servo amplifier used as in “Velocity control mode”: host device input “Analog voltage” or “built-in velocity command” to servo amplifier used.

Present setting value	Description
01: Velocity	Velocity Control Mode

◆ Servo amplifier used as “Torque control mode”; the host device inputs “Analog voltage” to servo amplifier.

Present setting value	Description
00: Torque	Torque Control Mode

◆ Servo amplifier used by switching “Velocity control mode” and “Torque control mode” of the “Control mode”.

Present setting value	Description
03: Velo - Torq	Velocity - Torque Control Switch Mode

◆ Servo amplifier is used by switching “Position control mode” and “Torque control mode” of “Control mode”.

Present setting value	Description
04: Posi - Torq	Position - Torque Control Switch Mode

◆ Servo amplifier used by switching “Position control mode” and “Velocity control mode” of “Control mode”.

Present setting value	Description
05: Posi – Velo	Position - Velocity Control Switch Mode

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">0A</td><td>Position control selection</td></tr>
<tr><td>
■ Select the function Position Control Mode.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard</td><td>Standard</td></tr>
<tr><td>01</td><td>Model1</td><td>Model Following Control</td></tr>
<tr><td>02</td><td>Model2</td><td>Model Following Vibration Suppress Control</td></tr>
</table>
■ Under the following parameter settings, ‘Model Flowing Control” and “Model Following Vibration Suppressor Control” are not valid.
◆ System parameter ID00 “Control Cycle” is set as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: High-freq_Sampling</td><td>High Frequency Sampling</td></tr>
</table>
◆ System parameter ID09 “Control Mode Selection” is not set as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>02:Position</td><td>Position Control Mode</td></tr>
</table>
■ If the parameter is set as below, the “Model Following Vibration Suppressor Control” is not valid.
◆ System parameter ID0B “Position Loop Control, Position Loop Encoder Selection” is set as below:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>01: External_Enc</td><td>Fully-closed Control/ External Encoder</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">0B</td><td>Position loop control, position loop encoder selection</td></tr>
<tr><td>
■ Select the encoder for “Position loop control system” and “Position loop control” for the servo amplifier under “Fully-closed control”.
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Motor_Enc</td><td>Semi-closed Control/ Motor Encoder</td></tr>
<tr><td>01</td><td>External_Enc</td><td>Fully-closed Control/ External Encoder</td></tr>
</table>
■ “Fully-closed control” is not chosen, no need to change. Confirm that the setting is as follows:
<table>
<tr><th>Present setting value</th><th>Description</th></tr>
<tr><td>00:Motor_Enc</td><td>Semi-closed Control/ Motor Encoder</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">0C</td><td>External pulse encoder resolution</td></tr>
<tr><td>
■ Sets resolution of the external pulse encoder under Fully-closed control. Sets the number of converted pulses for each rotation of the motor shaft.
<table>
<tr><th>Setting range</th><th>Unit</th></tr>
<tr><td>500 to 99999 (multiply by 1)</td><td>P/R</td></tr>
</table>
</td></tr>
</table>

4) Confirmation and settings of the system parameters (settings for motor encoder specification)

Set the motor encoder to be used. Setting items vary depending on the encoder. Parameters that need to be set are listed below. Please set the confirmed setting for each encoder in the following pages.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">04</td><td>Serial encoder function selection</td></tr>
<tr><td>■ Select the serial encoder function
<table>
<tr><th colspan="2">Selection</th><th colspan="2">Description</th></tr>
<tr><td>00</td><td>PA_S_2.5M</td><td>Absolute Encoder for Incremental System</td><td>2.5Mbps</td></tr>
<tr><td>01</td><td>PA_S_4M</td><td>Absolute Encoder for Incremental System</td><td>4.0Mbps</td></tr>
<tr><td>02</td><td>PA_C_2.5M</td><td>Battery Backup Method Absolute Encoder</td><td>2.5Mbps</td></tr>
<tr><td>03</td><td>PA_C_4M</td><td>Battery Backup Method Absolute Encoder</td><td>4.0Mbps</td></tr>
<tr><td>04</td><td>RA_C_2.5M</td><td>Battery-less Absolute Encoder</td><td>2.5Mbps</td></tr>
<tr><td>05</td><td>RA_C_4M</td><td>Battery-less Absolute Encoder</td><td>4.0Mbps</td></tr>
</table>
✔ When automatic motor parameter setting function (7-15) is executed, it is automatically updated.</td></tr>
<tr><td rowspan="2">05</td><td>Serial encoder resolution</td></tr>
<tr><td>■ Set the divisions per single (1) shaft rotation
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>2048_FMT</td><td>2048 divisions</td></tr>
<tr><td>01</td><td>4096_FMT</td><td>4096 divisions</td></tr>
<tr><td>02</td><td>8192_FMT</td><td>8192 divisions</td></tr>
<tr><td>03</td><td>16384_FMT</td><td>16384 divisions</td></tr>
<tr><td>04</td><td>32768_FMT</td><td>32768 divisions</td></tr>
<tr><td>05</td><td>65536_FMT</td><td>65536 divisions</td></tr>
</table>
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>06</td><td>131072_FMT</td><td>131072 divisions</td></tr>
<tr><td>07</td><td>262144_FMT</td><td>262144 divisions</td></tr>
<tr><td>08</td><td>524288_FMT</td><td>524288 divisions</td></tr>
<tr><td>09</td><td>1048576_FMT</td><td>1048576 divisions</td></tr>
<tr><td>0A</td><td>2097152_FMT</td><td>2097152 divisions</td></tr>
</table>
✔ When automatic motor parameter setting function (7-15) is executed, it is automatically updated.</td></tr>
<tr><td rowspan="2">06</td><td>Backup type absolute encoder function selection</td></tr>
<tr><td>■ Select the proper setting for the system
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Absolute_System</td><td>Absolute System</td></tr>
<tr><td>01</td><td>Incremental_System</td><td>Incremental System</td></tr>
</table>
✔ This is an exclusive setting for operation with battery-backup type absolute encoder connected. (Effective when either 02 or 03 is selected in the above ID04.)
Selecting 01 performs “encoder clear” at the time the power supply is turned on, and then clear “encoder status (error, warning)” and multi-turn data.</td></tr>
<tr><td rowspan="2">07</td><td>Pulse encoder function selection</td></tr>
<tr><td>■ Select the pulse encoder to be used
<table>
<tr><th colspan="2">Selection</th><th>Description</th></tr>
<tr><td>00</td><td>Standard</td><td>Wire-saving Incremental Encoder [Standard (4 pairs)]</td></tr>
<tr><td>01</td><td>7Pairs_INC-E</td><td>Incremental Encoder with CS Signal (7 pairs)</td></tr>
</table></td></tr>
<tr><td rowspan="2">08</td><td>Pulse encoder resolution</td></tr>
<tr><td>■ Set the pulse number per single (1) shaft rotation
<table>
<tr><th>Setting range</th><th>Unit</th></tr>
<tr><td>500 to 65535 (multiply by 1)</td><td>P/R</td></tr>
</table></td></tr>
</table>

■ The motor encoder to be used is “serial encoder” and “incremental system” will also be used

Motor encoder used for EN1	PA035S: Absolute encoder for incremental system
Motor encoder specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex asynchronous 2.5Mbps (standard)

■ Setting value for system parameter ID04 “Serial Encoder Function Selection”

Setting value	Description
00: PA_S_2.5M	Absolute Encoder for Incremental System 2.5Mbps

■ Setting value for system parameter ID05 “Serial Encoder Resolution”

Setting value	Description
06: 131072_FMT	131072 divisions

Motor encoder used for EN1	PA035C: Battery backup method absolute encoder
Motor encoder specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex asynchronous 2.5Mbps(standard)

■ Setting value for system parameter ID04 “Serial Encoder Function Selection”

Setting value	Description
02: PA_C_2.5M	Battery Backup Method Absolute Encoder 2.5Mbps

■ Setting value for system parameter ID05 “Serial Encoder Resolution”

Setting value	Description
06: 131072_FMT	131072 divisions

■ Setting value for system parameter ID06 “Backup Type Absolute Encoder Function Selection”

Setting value	Description
01: Incremental_System	Incremental System

✔ No need to connect backup battery.

✔ Setting varies depending on motor encoder you use.

■ The motor encoder to be used is “serial encoder” and “absolute system” will be used.

Motor encoder used for EN1	PA035C: Battery backup method absolute encoder
Motor encoder specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex asynchronous 2.5Mbps(standard)

■ Setting value for system parameter ID04 “Serial Encoder Function Selection”

Setting value	Description
02: PA_C_2.5M	Battery Backup Method Absolute Encoder 2.5Mbps

■ Setting value for system parameter ID05 “Serial Encoder Resolution”

Setting value	Description
06: 131072_FMT	131072 divisions

■ Setting value for system parameter ID06 “Backup Type Absolute Encoder Function Selection”

Setting value	Description
00: Absolute _System	Absolute System

Motor encoder used for EN1	RA035C: Batteryless absolute encoder RA062C: Batteryless absolute encoder
Motor encoder specification	Resolution per 1 rotation: 131072(17bits)
	Transmission method: Half-duplex asynchronous 2.5Mbps (standard)

■ Setting value for system parameter ID04 “Serial Encoder Function Selection”

Setting value	Description
04: RA_C_2.5M	Battery-less Absolute Encoder 2.5Mbps

■ Setting value for system parameter ID05 “Serial Encoder Resolution”

Setting value	Description
06: 131072_FMT	131072 divisions

■ The motor encoder to be used is “pulse encoder”

EN1: “PP031T,PP038,PP062” Connect pulse encoder

■ Setting value for system parameter ID07 “Pulse Encoder Function Selection”

Setting value	Description
00: Standard	Wire-saving Incremental Encoder [Standard (4 pairs)]

■ Setting value for system parameter ID08 “Pulse Encoder Resolution”

Setting range	Unit
500 to 65535(multiply by 1)	P/R

✔ Setting varies depending on motor encoder you use.

5) Factory default setting values

The following chart shows the default factory parameter settings.

■ Servo amplifier model number: RS2A○○A△#□#

ID	Name	Setting value
00	Control Cycle	00:_ Standard_Sampling
01	Main Circuit Power Input Type	00:_AC_3-Phase
02	Regenerative Resistor Selection	When □is A, 01: _Built-in_R When □is L, 02: _External_R
04	Serial Encoder Function Selection	When ○○ is 01, 03, or 05: 00:PA_S_2.5M When ○○ is 10,15, or 30: 02:PA_C_2.5M
05	Serial Encoder Resolution	06:131072_FMT
06	Function selection of battery backup absolute encoder	00:Absolute_System
09	Control Mode Selection	02:Position
0B	Position Loop Control, Position Loop Encoder Selection	When △ is 0, 00:Motor_Enc When △ is 2, 01:External_Enc

■ Servo amplifier model number: RS2A##A△#□#

ID	Name	Setting value
00	Control Cycle	00:_ Standard_Sampling
01	Main Circuit Power Input Type	00:_AC_3-Phase
02	Regenerative Resistor Selection	When □ is A, 01: _Built-in_R When □is L, 02: _External_R
07	Pulse Encoder Function Selection	00: Standard
08	Pulse Encoder Resolution	2000P/R
09	Control Mode Selection	02:Position
0B	Position Loop Control, Position Loop Encoder Selection	When △ is 8, 00:Motor_Enc When △ is A, 01:External_Enc

■ Servo amplifier model number: RS2E##A△#□#

ID	Name	Setting value
00	Control Cycle	00:_ Standard_Sampling
01	Main Circuit Power Input Type	01:_AC_Single-Phase
02	Regenerative Resistor Selection	When □ is A, 01: _Built-in_R When □ is L, 02: _External_R
04	Serial Encoder Function Selection	00:PA_S_2.5M
05	Serial Encoder Resolution	06:131072_FMT
06	Function selection of battery backup absolute encoder	00:Absolute_System
09	Control Mode Selection 02:Position	
0B	Position Loop Control, Position Loop Encoder Selection	When △ is 0, 00:Motor_Enc When △ is 2, 01:External_Enc

■ Servo amplifier model number: RS2E##A△#□#

ID	Name	Setting value
00	Control Cycle	00:_ Standard_Sampling
01	Main Circuit Power Input Type	01:_AC_Single-Phase
02	Regenerative Resistor Selection	When □ is A, 01: _Built-in_R When □ is L, 02: _External_R
07	Pulse Encoder Function Selection	00: Standard
08	Pulse Encoder Resolution	2000P/R
09	Control Mode Selection	02:Position
0B	Position Loop Control, Position Loop Encoder Selection	When △ is 8, 00:Motor_Enc When △ is A, 01:External_Enc

✔ Mark “# “ is an arbitrary number or letter.

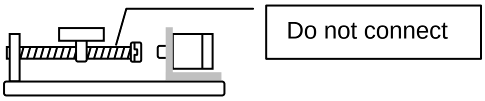
✔ By performing parameter backup function, you can save “System Parameters”, “General parameters” and “Motor Parameters” inside of servo amplifier for restoration if needed.

✔ For operating instructions, please refer to separate document M0010842 for setup software.

5.3 Test operation

1) Confirmation of installation and wiring

Confirm the installation and the wiring of the servo amplifier and the servo motor.

Procedure	Item and contents
1	Installation
	■ Install the servo amplifier and the servo motor by referring to [Installation (3)]. Do not connect the servo motor shaft to the machine to maintain the no load status. 
2	Wiring, connecting → Turning on the power supply
	■ Wire the power supply servo motor and upper device by referring to [Wiring (4)]. Do not connect CN1 to the servo amplifier. ■ Turn on the power supply. Confirm that there is no alarm code displayed at the upper center of the servo amplifier display. If there is one, follow the instructions in [Trouble shooting When Alarm Occurs (8-7). ■ Follow “Trouble shooting (8-1)” , if the 7 segment LED does not light “≡” when powered up. ■ Alarm A1 may flash when initially turning on the power supply after wiring servo amplifier and servo motor with battery-backup absolute encoder. This is for the following reasons: The back-up available time covered by battery has elapsed, this should make the absolute position inside of encoder unstable, and then the alarm should be output in line with the state.

2) Confirmation of movement

Perform JOG Operation by using the setup software or the digital operator.

Procedure	Item and contents
1	JOG Operation
	■ Do not connect the shaft of the servo motor into the machine to keep the status of no load, and perform JOG-operation. ■ Confirm that the servo motor rotates forward direction and backward direction ◆ Operating using setup software: Select JOG Operation from the Test Operation menu. For operating instructions, please see separate volume, M0010842, for setup software. ◆ Confirmation and settings using digital operator: For operating instructions, please see [Digital Operator (7)].

3) Confirmation of I/O signal

Settings for general I/O signals (CN1) are the defaults set at the time of shipment

Procedure	Item and contents

1

Confirmation of I/O signal

- ■ Allocate functions you use to CONT1 to CONT8 by selecting parameters from general parameters Group 9.

		Default setting value at shipment	
Input signal	CN1 pin number	Signal selected form 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	13,14	Torque Limit Function	0E:_CONT7_ON
CONT8	15,16	Alarm Reset Function	10:_CONT8_ON

2

Confirmation of output signals

- ■ Select the output signal from general parameters GroupA and allocate OUT1 to OUT 8.

		Default setting value at shipment			Default setting value at shipment
Output signal	CN1 Pin number	Setting value	Output signal	CN1 Pin number	Setting value
OUT1	39	18:_INP_ON	OUT5	43	33:_ALM5_OFF
OUT2	40	0C:_TLC_ON	OUT6	44	35:_ALM6_OFF
OUT3	41	02:_S-RDY_ON	OUT7	45	37:_ALM7_OFF
OUT4	42	0A:_MBR-ON_ON	OUT8	46	39:_ALM_OFF

3

Confirmation of I/O signal

- ■ Confirm that the I/O signal functions fine at the monitor.
  Refer to [Monitor Function (5-23)] for explanation.

  - ◆ Confirming with setup software
    Confirm from the menu monitor.
    For operating instructions of setup software, please see the separate volume M0010842.

  - ◆ Confirming with Digital Operator
    For operating instructions, please see [Digital Operator (7)].

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”.

  Display shown below indicates over travel status.

	Over-travel on forward rotation. Over travel on position and velocity control of forward rotation.
	Over-travel on reverse rotation. Over-travel on position and velocity control of reverse rotation.

- ■ Setting and changing the over-travel function can be done at the general parameters Group9 ID00, ID01.

<table>
<tr><th>Procedure</th><th colspan="2">Item and contents</th></tr>
<tr><td rowspan="2">5</td><td colspan="2">Command input</td></tr>
<tr><td colspan="2">■ Input the command suitable for the control mode in use
(setting value of “Control Mode Selection” of system parameter ID09).
◆ “Position control mode”・・・・Position command pulse
◆ “Velocity control mode”・・・・Analog voltage
◆ “Torque control mode” ・・・・Analog voltage

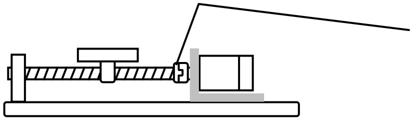
■ Confirm that the shaft of the servo motor rotates in the right direction.
■ If the shaft of the servo motor command input from the upper device does not rotate, confirm that the command is input at the monitor function.

◆ “Position control mode”・・・・Position command pulse
Monitor ID13
<table><tr><td>Position command pulse frequency monitor (FMON1)</td><td>Command pulse frequency being input is displayed.</td></tr></table>
◆ “Velocity control mode” “Torque control mode”・・・Analog voltage
Monitor ID12
<table><tr><td>Analog velocity command/
Analog torque command input voltage monitor (VC/TC-IN)</td><td>Command voltage being input is displayed.</td></tr></table>
■ 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 poor wiring: Confirm the wiring again.

■ Input command after receiving command reception enabling signal from servo amplifier.
Refer to “Operation sequence” for the details.</td></tr>
<tr><td>6</td><td>Power shut off</td><td>Turn o the servo-on signal. Then turn off the power supply.</td></tr>
</table>

4) Confirmation of device operation

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

<table>
<tr><th>Procedure</th><th>Item and contents</th></tr>
<tr><td rowspan="2">1</td><td>Connection to the machine</td></tr>
<tr><td>■ Connect the servo motor shaft to the machine.

Connect the servo motor shaft with 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.

■ Be sure to stop in the event of any abnormal operation.</td></tr>
<tr><td rowspan="2">2</td><td>Operation</td></tr>
<tr><td>■ Input the command for the actual operation and start the machine.

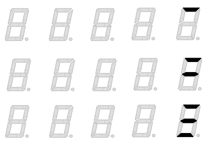
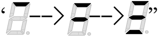
■ At the time of shipment, Auto-tuning (auto-adjustment for servo gain and filter, etc.) has been set and is valid. If there is nothing wrong with operation and the characteristic, manual tuning is not necessary. Refer to [Adjustments (6)] for the Servo Tuning.</td></tr>
</table>

5) Confirmation of safe torque off function

When using hardware equipped with safe torque off function, check if the function properly works by following “Confirmation Test (10-16)”.

5.4 Servo amplifier status display

1) Default display

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is on.	0
	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.	4
	Servo is on. Rotates after displaying the character “8.”	8

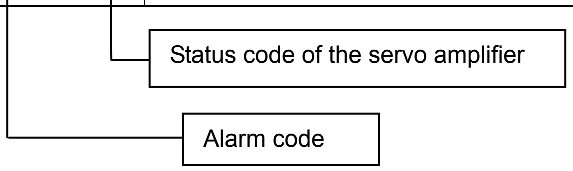
Marking	Description
	Over-travel status at normal rotation. Forward rotation is in ‘Over-travel’ status in position and speed control type.
	Over-travel status at reverse rotation. Reverse rotation is in ‘Over-travel’ status in position and speed control type.

Marking	Description
	Battery Warning status. Replace the battery.
	Regenerative overload warning status. If operation is kept on, alarm may go off.
	Overload Warning status. If operation is kept on, alarm may go off.

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 [Maintenance (8)].

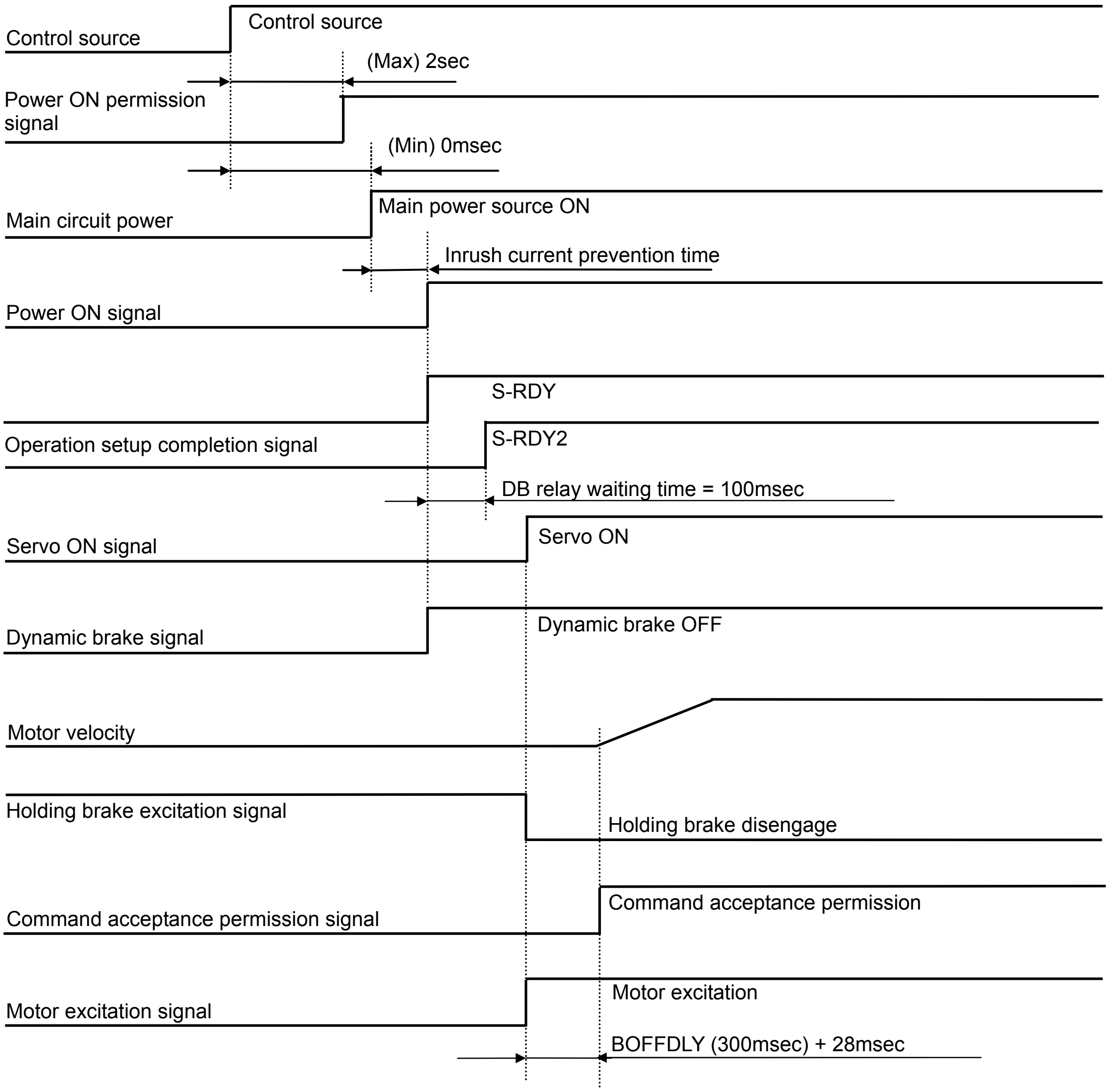


Code	Status	
0	Power ON status	(P-OFF)
2	Power OFF status	(P-ON)
4	Servo ready status	(S-RDY)
8	Servo ON status	(S-ON)
A	Emergency stop status	(EMR)
F	Initial status	

5.5 Operation sequence

1) Operation sequence from power turn on to power shut off at the standard shipment setting

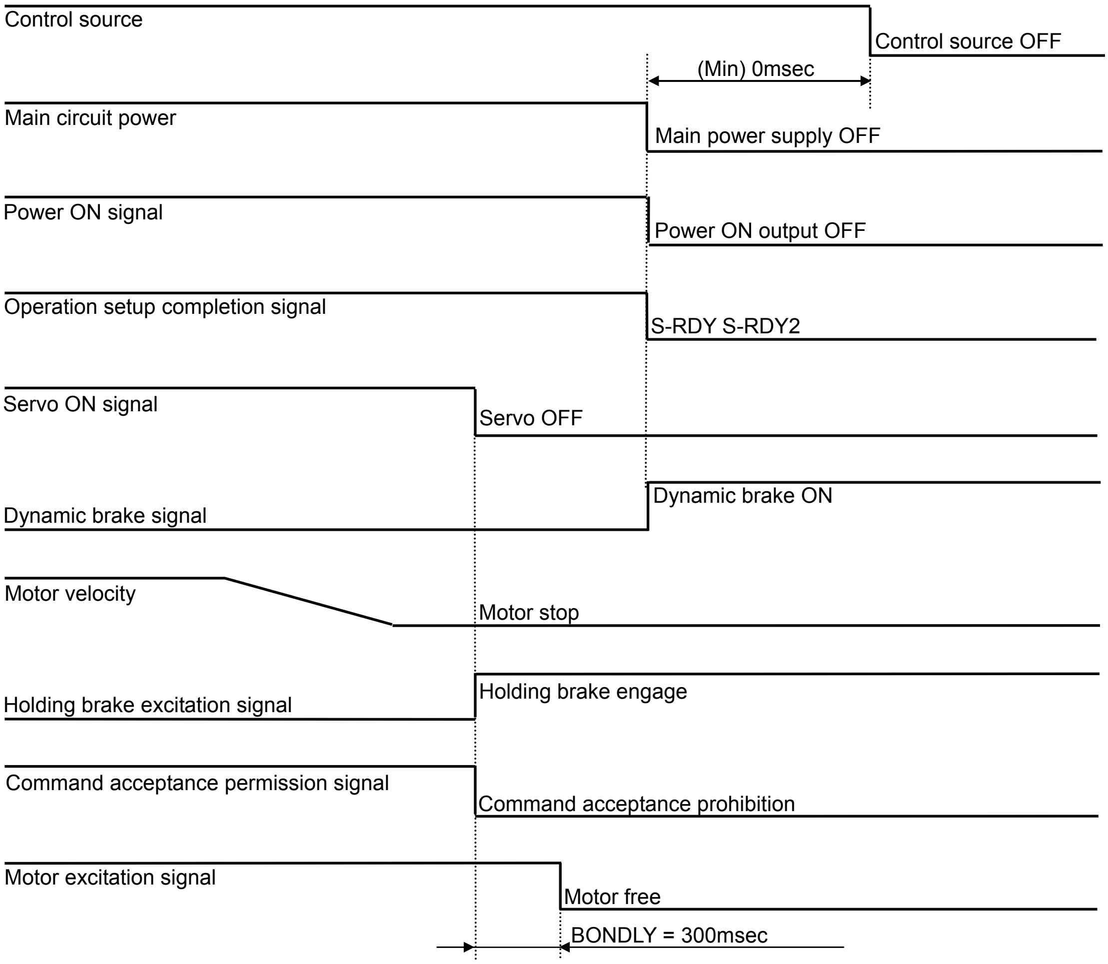
Power ON → Servo ON



- ✔ 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.
- ✔ Inrush current suppression times of each servo amplifier size are as follows.

Servo amplifier size	Inrush current suppression time
RS2#01#	900[ms]
RS2#03#	900[ms]
RS2A05#	900[ms]
RS2A10#	1400[ms]
RS2A15#	1400[ms]
RS2A30#	1900[ms]

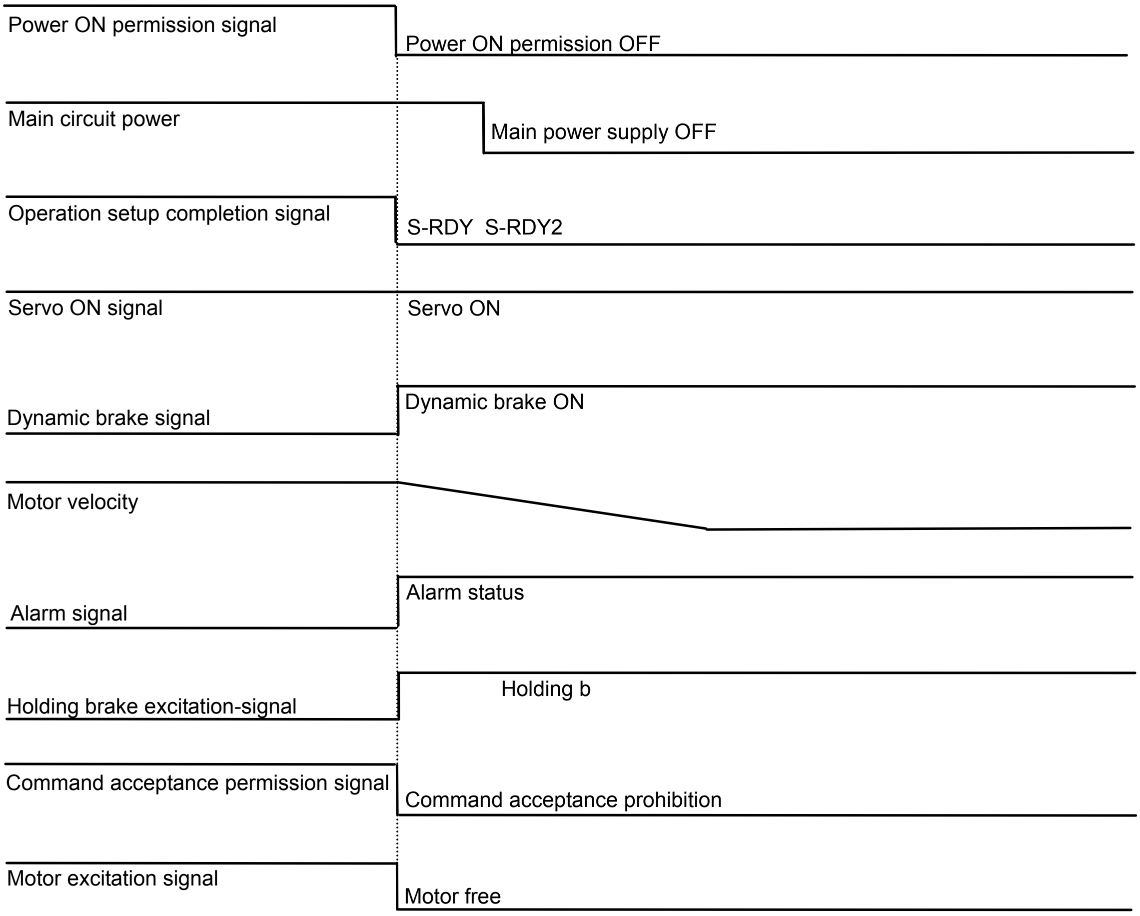
Servo OFF → Power OFF



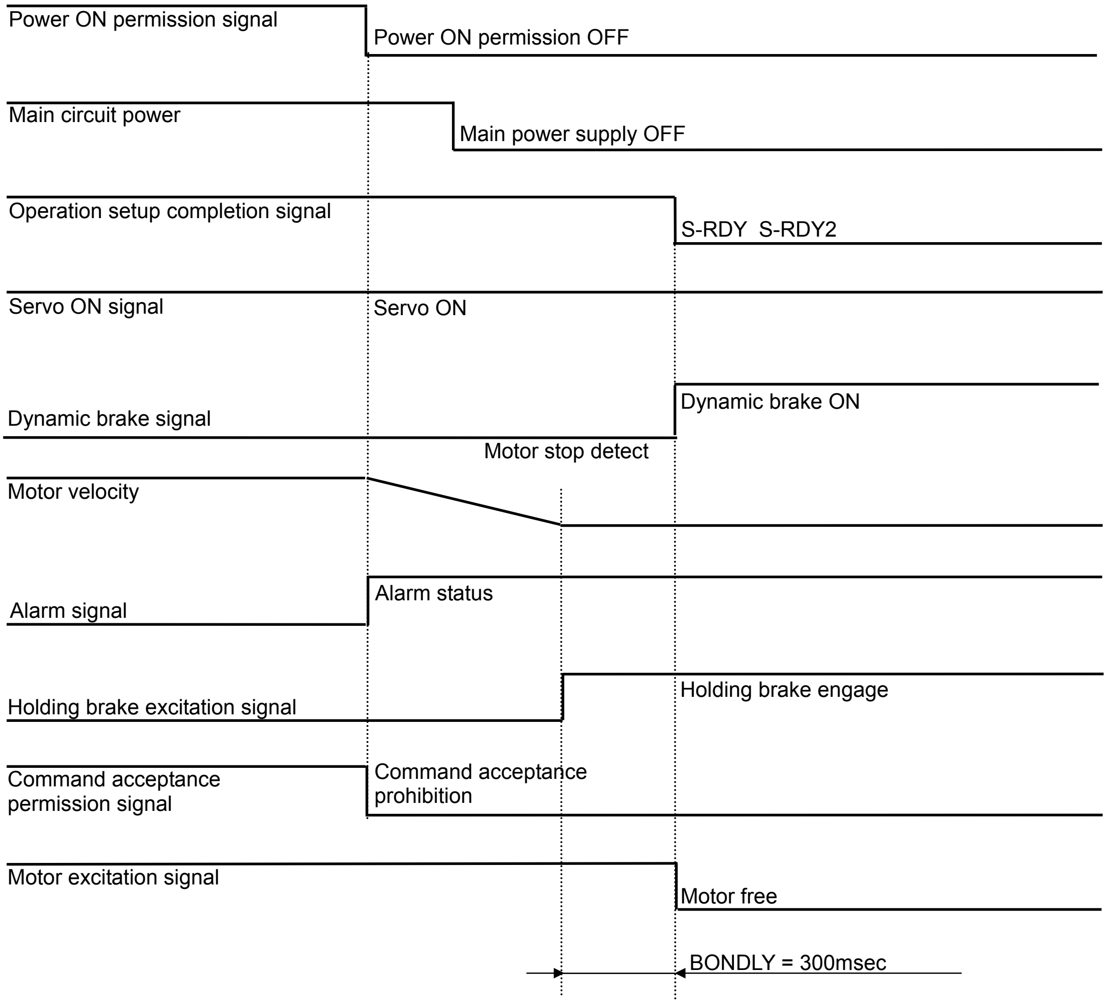
2) Stop sequence at alarm

When an alarm occurs, the servomotor is stopped by either dynamic brake or servo brake (zero-speed command). The alarm content dictates which brake to be used. Refer to [Warning and Alarm List (8-3)]

Stop by dynamic brake at alarm



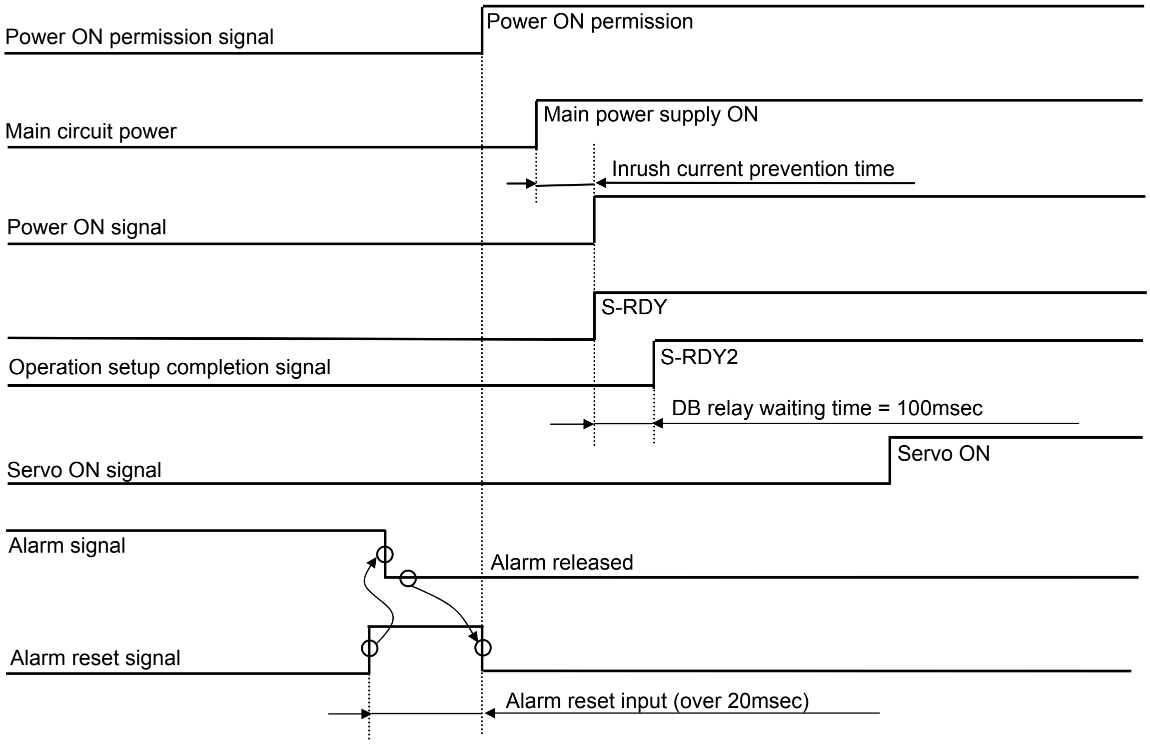
Stop by servo brake at alarm



- ✔ The above sequence is the one when protective circuit is installed. Install a protective circuit referring to [Wiring Example (4-7)]

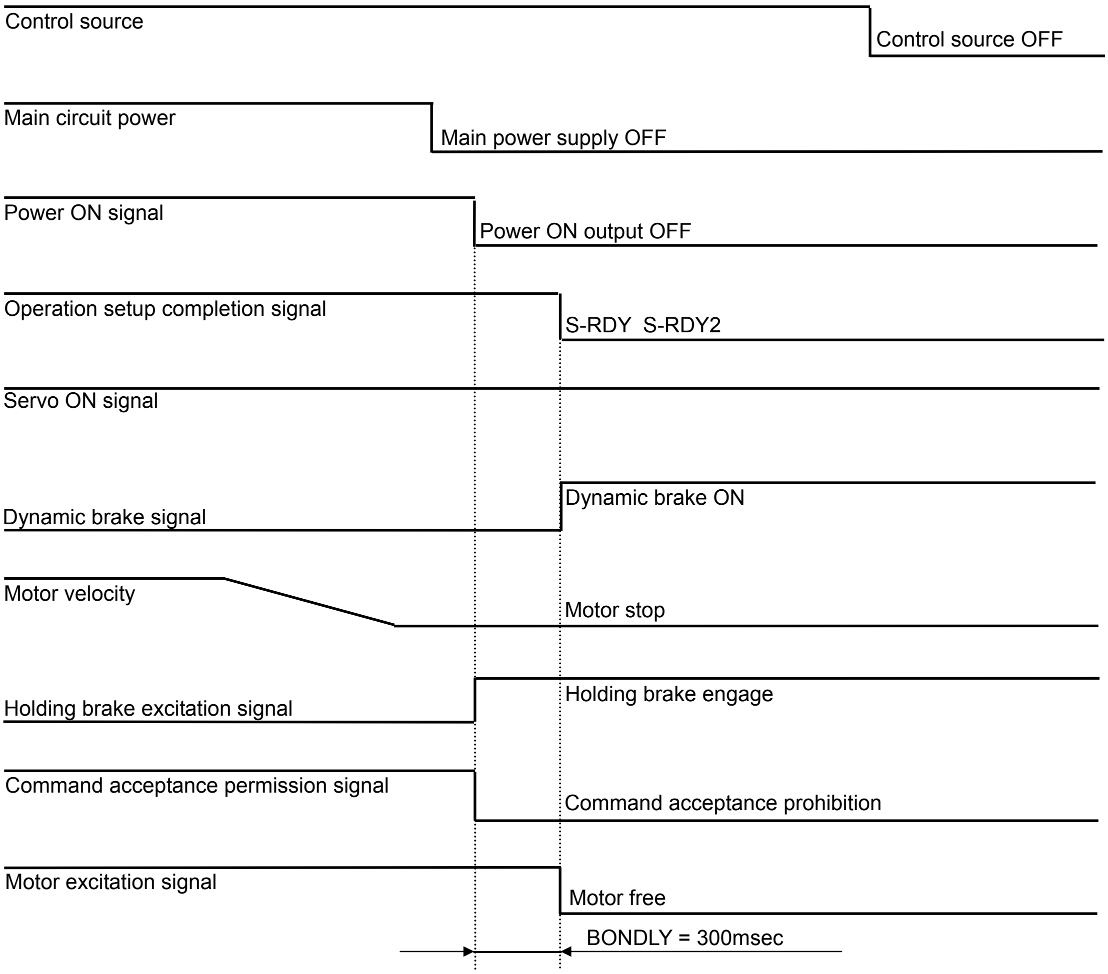
3) Sequence of alarm reset

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. Refer to [Warning and Alarm List (8-3)].
- ✔ Clear the alarm reset signal after checking if the alarm signal is cleared.
- ✔ The alarm signal cannot be cleared when the alarm condition continues, 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.

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



5.6 Monitor function

1) Monitor function

ID	Symbol	Name		Unit
00	STATUS	Servo amplifier status monitor		---
01	WARNING1	Warning status 1 monitor		---
02	WARNING2	Warning status 2 monitor		---
03	CONT8-1	General Purpose Input CONT8 to 1 monitor		---
04	OUT8-1	General Purpose Output OUT8 to 1 monitor		---
05	INC-E MON	Pulse encoder signal monitor		---
06	VMON	Velocity monitor		min^{-1}
07	VCMON	Velocity command monitor		min^{-1}
08	TMON	Torque monitor		%
09	TCMON	Torque command monitor		%
0A	PMON	Position deviation monitor		Pulse
0C	APMON	Present position monitor (Motor encoder)	Digital operator: Displays upper data	×2^{32} Pulse
0D			Digital operator: Displays lower data	Pulse
0E	EX-APMON	External present position monitor (External encoder)	Digital operator: Displays upper data	×2^{32} Pulse
0F			Digital operator: Displays lower data	Pulse
10	CPMON	Command position monitor	Digital operator: Displays upper data	×2^{32} Pulse
11			Digital operator: Displays lower data	Pulse
12	VC/TC-IN	Analog velocity command/Analog torque command input voltage monitor		mV
13	FMON1	Position command pulse frequency monitor		k Pulse/s
14	CSU	U-phase electric angle monitor		deg
16	ABSPS	Serial encoder PS data monitor	Digital operator: Displays upper data	×2^{32} Pulse
17			Digital operator: Displays lower data	Pulse
1A	RegP	Regenerative resistor operation percentage monitor		%
1B	TRMS	Effective torque monitor		%
1C	ETRMS	Effective torque monitor (Estimated value)		%
1D	JRAT MON	Load Inertia Moment Ratio monitor		%
1E	KP MON	Position Loop Proportional Gain monitor		1/s
1F	TPI MON	Position Loop Integral Time Constant monitor		ms
20	KVP MON	Velocity Loop Proportional Gain monitor		Hz
21	TVI MON	Velocity Loop Integral Time Constant monitor		ms
22	TCFIL MON	Torque Command Filter monitor		Hz
23	MKP MON	Model Control Gain monitor		1/s
24	MTLMON -EST	Load Torque monitor (Estimate value)		%
25	OPE-TIM	Amplifier operation time		×2 hour
26	ACCMON	Acceleration monitor		rad/s2

2) Description of monitor

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">00</td><td>Servo amplifier status monitor [STATUS]</td></tr>
<tr><td>
<table>
<tr><th>Code</th><th colspan="2">Status</th></tr>
<tr><td>0</td><td>Power OFF state</td><td>(P-OFF)</td></tr>
<tr><td>2</td><td>Power ON state</td><td>(P-ON)</td></tr>
<tr><td>4</td><td>Servo ready state</td><td>(S-RDY)</td></tr>
<tr><td>8</td><td>Servo ON state</td><td>(S-ON)</td></tr>
<tr><td>A</td><td>Emergency stop state</td><td>(EMR)</td></tr>
<tr><td>10</td><td>Alarm and power OFF state</td><td>(ALARM_P-OFF)</td></tr>
<tr><td>12</td><td>Alarm and power ON state</td><td>(ALARM_P-ON)</td></tr>
<tr><td>1A</td><td>Alarm and emergency stop state</td><td>(ALARM_EMR)</td></tr>
<tr><td>22</td><td>Gate off and power-on state</td><td>(GATE OFF_P-ON)</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">01</td><td>Warning status 1 monitor [WARNING1]</td></tr>
<tr><td>■ Displays warning status. Displays warning status under“1”or “ON”
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>Regenerative load</td><td>Overload</td><td>---</td><td>Temperature inside amplifier</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>Excessive deviation</td><td>---</td><td>Velocity controlled</td><td>Torque controlled</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">02</td><td>Warning status 2 monitor [WARNING2]</td></tr>
<tr><td>■ Displays warning status. Valid when“1”or“ON”.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>Reverse direction Over-travel</td><td>Forward direction Over-travel</td><td>---</td><td>Main circuit power being charged</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>Voltage sag</td><td>Low battery voltage</td><td>---</td><td>---</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">03</td><td>General Purpose Input CONT8 to 1 monitor [CONT8-1]</td></tr>
<tr><td>■ Displays generic input terminal status. It will be in a photo coupler exciting state by 1 or ON.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>CONT4</td><td>CONT3</td><td>CONT2</td><td>CONT1</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>CONT8</td><td>CONT7</td><td>CONT6</td><td>CONT5</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">04</td><td>General Purpose Output OUT8 to 1 monitor [OUT8-1]</td></tr>
<tr><td>■ Displays generic output terminal status. It will be in a photo coupler exciting state by 1 or ON.
<table>
<tr><td>Bit</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Function</td><td>OUT4</td><td>OUT3</td><td>OUT2</td><td>OUT1</td></tr>
</table>
<table>
<tr><td>Bit</td><td>7</td><td>6</td><td>5</td><td>4</td></tr>
<tr><td>Function</td><td>OUT8</td><td>OUT7</td><td>OUT6</td><td>OUT5</td></tr>
</table>
</td></tr>
</table>

ID	Contents
05	Pulse encoder signal monitor [INC-E MON]
	■ Displays pulse encoder signal status. 1 or ON shows an incoming signal level “H” state.

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

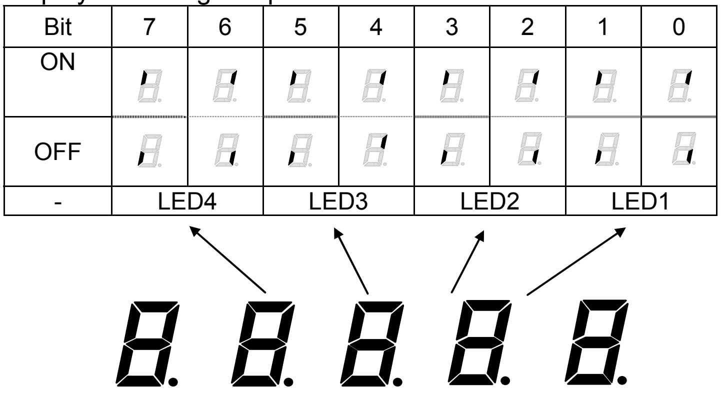
Bit	7	6	5	4
Function	---	External encoder Z-phase signal	External encoder B-phase signal	External encoder A-phase signal

Refer to the following charts for the display format of ID01 to 05 as setup software and Digital Operator have different indicators:

■ 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 the servo amplifier

ID	Contents
06	Velocity monitor [VMON]
	■ Displays the rotation speed of the servo motor.

Display range	Unit
-9999 to 9999	min^{-1}

ID	Contents
07	Velocity command monitor [VCMON]
	■ Displays the velocity command value.

Display range	Unit
-9999 to 9999	min-1

ID	Contents
08	Torque monitor [TMON]
	■ Displays the output torque.

Display range	Unit
-499.9 to 499.9	%

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">09</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">0A</td><td>Position deviation monitor [PMON]</td></tr>
<tr><td>

■ 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>0A</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">0C
0D</td><td>Actual position monitor (Motor encoder) [APMON]</td></tr>
<tr><td>

■ Displays the current position of the encoder motor (assuming that the position at the time the control power was turned ON is the original mode).
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 on ID0C.

<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 on ID0C, ID0D 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>0C</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>0D</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">0E
0F</td><td>External monitor (External encoder) [EX-APMON]</td></tr>
<tr><td>

■ Displays the current position of the external encoder
(assuming that the position at the time the control power was turned ON is the original mode).
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 on ID0E.

<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 on ID0E, ID0F 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>0E</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>0F</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">10
11</td><td>Command position monitor[CPMON]</td></tr>
<tr><td>

■ Displays the current position of the pulse command (assuming that the position at the time the control power was turned ON is the original mode). 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 on 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 on ID10, ID11 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>10</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>$\times 2^{32}$ Pulse</td></tr>
<tr><td>11</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr>
</table>

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

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td>12</td><td>Analog velocity command/Analog torque command input voltage monitor [VC/TC-IN]
■ Displays entered command voltage.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-12000 to 12000</td><td>mV</td></tr></table></td></tr>
<tr><td>13</td><td>Position command pulse frequency monitor [FMON1]
■ Displays entered command pulse frequency.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>-6000 to 6000</td><td>kPulse/s</td></tr></table></td></tr>
<tr><td>14</td><td>U-phase electric angle monitor [CSU]
■ Displays U-phase electric angle. Always displayed excluding encoder errors.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 359</td><td>deg</td></tr></table></td></tr>
<tr><td>16
17</td><td>Serial encoder PS data monitor [ABSPS]
■ Displays position data of serial encoder.
◆ Setup software displays the data on D16.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 1099511627775</td><td>Pulse</td></tr></table>
(Actual display range varies depending on the encoder specifications.)
◆ Digital operator displays the data on ID16, ID17 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>16</td><td>Bit63 to Bit32</td><td>H.FFFF to L.0000</td><td>$\times 2^{32}$ Pulse</td></tr><tr><td>17</td><td>Bit31 to Bit0</td><td>H.FFFF to L.0000</td><td>Pulse</td></tr></table></td></tr>
<tr><td>1A</td><td>Regenerative resistor operation percentage monitor [RegP]
■ Displays run rate of regenerative resistance.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0.00 to 99.9</td><td>%</td></tr></table></td></tr>
<tr><td>1B</td><td>Effective torque monitor [TRMS]
■ Displays effective torque. Depending on the operation pattern, it may take some hours to become stable.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 499</td><td>%</td></tr></table></td></tr>
<tr><td>1C</td><td>Effective torque monitor (Estimated value) [ETRMS]
■ Displays effective torque estimated value. Estimates from short time operation. This can be confirmed shortly if the same operation pattern is repeated.
<table><tr><th>Display range</th><th>Unit</th></tr><tr><td>0 to 499</td><td>%</td></tr></table></td></tr>
<tr><td>1D</td><td>Load inertia moment ratio monitor [JRAT MON]
■ Indicates present load inertia moment ratio.
You can check the value when using gain switching and auto-tuning function.</td></tr>
<tr><td>1E</td><td>Position loop proportional gain monitor [KP MON]
■ Indicates present position loop proportional gain.
You can check the value when using gain switching and auto-tuning function.</td></tr>
</table>

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">1D</td><td>Load Inertia Moment Ratio monitor [JRAT MON]</td></tr>
<tr><td>■ Displays actual Load Inertia Moment Ratio.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">1E</td><td>Position Loop Proportional Gain monitor [KP MON]</td></tr>
<tr><td>■ Displays actual Position Loop Proportional Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">1F</td><td>Position Loop Integral Time Constant monitor [TPI MON]</td></tr>
<tr><td>■ Displays actual Position Loop Integral Time Constant value.
Value can be confirmed when changing the gain function.</td></tr>
<tr><td rowspan="2">20</td><td>Velocity Loop Proportional Gain monitor [KVP MON]</td></tr>
<tr><td>■ Displays actual Velocity Loop Proportional Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">21</td><td>Velocity Loop Integral Time Constant monitor [TVI MON]</td></tr>
<tr><td>■ Displays actual Velocity Loop Integral Time Constant.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">22</td><td>Torque Command Filter monitor [TCFIL MON]</td></tr>
<tr><td>■ Displays actual Torque Command Filter.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">23</td><td>Model Control Gain monitor [MKP MON]</td></tr>
<tr><td>■ Displays actual Model Control Gain.
Value can be confirmed when changing gain and at Auto-tuning function.</td></tr>
<tr><td rowspan="2">24</td><td>Load Torque monitor (Estimate value) [MTLMON-EST]</td></tr>
<tr><td>■ Displays 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 rowspan="2">25</td><td>Amplifier operation time [OPE-TIM]</td></tr>
<tr><td>■ Is counted during period control power is being turned on. The time is displayed value x 2 hours.
<table>
<tr><th>Unit</th></tr>
<tr><td>×2 hour</td></tr>
</table></td></tr>
<tr><td rowspan="2">26</td><td>Acceleration monitor [ACCMON]</td></tr>
<tr><td>■ Indicates 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>26</td><td>Bit31 to Bit0</td><td>H.FFFF L.FFFF to H.0000 L.0000</td><td>rad/s^2</td></tr>
</table></td></tr>
</table>

✔ Conversion formula of “Effective torque monitor” and “Effective torque monitor (estimate value) is as follows:
Motor utilization monitor [%] = (Effective torque monitor display value [%]/100)^2×100

5.7 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. Refer to [Optional parts (12-39)] for the details of monitor box and dedicated cable. Analog monitor output 1 is also output from “CN1-pin30”.

■ Selection of output signal

Select and change 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	MON1: Analog Monitor Select Output 1
General parameters GroupA ID12	MON2: Analog Monitor Select Output 2

5.8 Setting parameters

1) Parameters list

Below is the parameters list. Groups in ID order are classified.” System parameters”, “General parameters” and “Motor parameters” are retained in the servo amplifier by keeping the parameter back-up function in effect for restoration of the parameter(s) as needed. For operating instructions, refer to separate volume, M0010842, for setup software.

■ General parameters group list

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

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

■ General parameters Group0 “Auto-tuning settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	TUNMODE	Tuning Mode	P,V,T	00:AutoTun	-	00 to 02
01	ATCHA	Auto-Tuning Characteristic	P,V,T	00:Positioning1	-	00 to 06
02	ATRES	Auto-Tuning Response	P,V,T	5	-	1 to 30
03	ATSAVE	Auto-Tuning Automatic Parameter Saving	P,V,T	00:Auto_Saving	-	00 to 01
10	ANFILTC	Auto-Notch Filter Tuning Torque Command	P,V,T	50.0	%	10.0 to 100.0
20	ASUPTC	Auto-FF Vibration Suppressor Frequency Tuning Torque Command	P,V,T	25.0	%	10.0 to 100.0
21	ASUPFC	Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value	P,V,T	5.0	%	0.0 to 50.0

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters Group1 “Basic control parameter settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	PCSMT	Position Command Smoothing Constant	P	0.0	ms	0.0 to 500.0
01	PCFIL	Position Command Filter	P	0.0	ms	0.0 to 2000.0
02	KP1	Position Loop Proportional Gain 1	P	30	1/s	1 to 3000
03	TPI1	Position Loop Integral Time Constant 1	P	1000.0	ms	0.3 to 1000.0
04	TRCPGN	Higher Tracking Control Position Compensation Gain	P	0	%	0 to 100
05	FFGN	Feed Forward Gain	P	0	%	0 to 100
06	FFFIL	Feed Forward Filter	P	4000	Hz	1 to 4000
10	VCFIL	Velocity Command Filter	P,V	4000	Hz	1 to 4000
11	VDFIL	Velocity Feedback Filter	P,V	1500	Hz	1 to 4000
12	KVP1	Velocity Loop Proportional Gain 1	P,V	50	Hz	1 to 2000
13	TVI1	Velocity Loop Integral Time Constant 1	P,V	20.0	ms	0.3 to 1000.0
14	JRAT1	Load Inertia Moment Ratio 1	P,V	100	%	0 to 15000
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain	P,V	0	%	0 to 100
16	AFBK	Acceleration Feedback Gain	P,V	0.0	%	-100.0 to 100.0
17	AFBFIL	Acceleration Feedback Filter	P,V	500	Hz	1 to 4000
20	TCFIL1	Torque Command Filter 1	P,V,T	600	Hz	1 to 4000
21	TCFILOR	Torque Command Filter Order	P,V,T	2	Order	1 to 3

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters Group2 “FF (Feed forward) vibration suppressor control/ Notch filter/ Disturbance observer settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppressor Frequency 1	P	500	Hz	5 to 500
01	SUPLV	FF Vibration Suppressor Level Selection	P	00	-	00 to 03
10	VCNFIL	Velocity Command Notch Filter	P,V	1000	Hz	50 to 1000
20	TCNFILA	Torque Command Notch Filter A	P,V,T	4000	Hz	100 to 4000
21	TCNFPA	TCNFILA, Low Frequency Phase Delay Improvement	P,V,T	00	-	00 to 02
22	TCNFILB	Torque Command Notch Filter B	P,V,T	4000	Hz	100 to 4000
23	TCNFDB	TCNFILB, Depth Selection	P,V,T	00	-	00 to 03
24	TCNFILC	Torque Command Notch Filter C	P,V,T	4000	Hz	100 to 4000
25	TCNFDC	TCNFILC, Depth Selection	P,V,T	00	-	00 to 03
26	TCNFILD	Torque Command Notch Filter D	P,V,T	4000	Hz	100 to 4000
27	TCNFDD	TCNFILD, Depth Selection	P,V,T	00	-	00 to 03
30	OBCHA	Observer Characteristic	P,V	00:Low	-	00 to 02
31	OBG	Observer Compensation Gain	P,V	0	%	0 to 100
32	OBLPF	Observer Output Low-pass Filter	P,V	50	Hz	1 to 4000
33	OBNFIL	Observer Output Notch Filter	P,V	4000	Hz	100 to 4000
40	STV	Effective velocity for compensating stick-slip behavior	P,V,T	10.0	min^{-1}	0.1～128.0
41	STHLD	Retention time for compensating stick-slip behavior	P,V,T	20	ms	1～500
42	STTVI	Velocity loop integral time constant for stick-slip behavior compensation	P,V,T	3.0	ms	0.3～1000

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters Group3 " Model following control settings"

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	KM1	Model Control Gain 1	P	30	1/s	1 to 3000
01	OSSFIL	Overshoot Suppressor Filter	P	1500	Hz	1 to 4000
02	ANRFRQ1	Model Control Antiresonance Frequency 1	P	80.0	Hz	10.0 to 80.0
03	RESFRQ1	Model Control Resonance Frequency 1	P	80.0	Hz	10.0 to 80.0

✔ P = Position control type V = Velocity control type T = Torque control type

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

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	KM2	Model Control Gain 2	P	30	1/s	1 to 3000
01	KP2	Position Loop Proportional Gain 2	P	30	1/s	1 to 3000
02	TPI2	Position Loop Integral Time Constant 2	P	1000.0	ms	0.3 to 1000.0
03	KVP2	Velocity Loop Proportional Gain 2	P,V	50	Hz	1 to 2000
04	TVI2	Velocity Loop Integral Time Constant 2	P,V	20.0	ms	0.3 to 1000.0
05	JRAT2	Load Inertia Moment Ratio 2	P,V	100	%	0 to 15000
06	TCFIL2	Torque Command Filter 2	P,V,T	600	Hz	1 to 4000
10	KM3	Model Control Gain 3	P	30	1/s	1 to 3000
11	KP3	Position Loop Proportional Gain 3	P	30	1/s	1 to 3000
12	TPI3	Position Loop Integral Time Constant 3	P	1000.0	ms	0.3 to 1000.0
13	KVP3	Velocity Loop Proportional Gain 3	P,V	50	Hz	1 to 2000
14	TVI3	Velocity Loop Integral Time Constant 3	P,V	20.0	ms	0.3 to 1000.0
15	JRAT3	Load Inertia Moment Ratio 3	P,V	100	%	0 to 15000
16	TCFIL3	Torque Command Filter 3	P,V,T	600	Hz	1 to 4000
20	KM4	Model Control Gain 4	P	30	1/s	1 to 3000
21	KP4	Position Loop Proportional Gain 4	P	30	1/s	1 to 3000
22	TPI4	Position Loop Integral Time Constant 4	P	1000.0	ms	0.3 to 1000.0
23	KVP4	Velocity Loop Proportional Gain 4	P,V	50	Hz	1 to 2000
24	TVI4	Velocity Loop Integral Time Constant 4	P,V	20.0	ms	0.3 to 1000.0
25	JRAT4	Load Inertia Moment Ratio 4	P,V	100	%	0 to 15000
26	TCFIL4	Torque Command Filter 4	P,V,T	600	Hz	1 to 4000
30	GCFIL	Gain Switching Filter	P,V	0	ms	0 to 100
40	SUPFRQ2	FF Vibration Suppressor Frequency 2	P	500	Hz	5 to 500
41	SUPFRQ3	FF Vibration Suppressor Frequency 3	P	500	Hz	5 to 500
42	SUPFRQ4	FF Vibration Suppressor Frequency 4	P	500	Hz	5 to 500
50	ANRFRQ2	Model Control Anti-resonance Frequency 2	P	80.0	Hz	10.0 to 80.0
51	RESFRQ2	Model Control Resonance Frequency 2	P	80.0	Hz	10.0 to 80.0
52	ANRFRQ3	Model Control Anti-resonance Frequency 3	P	80.0	Hz	10.0 to 80.0
53	RESFRQ3	Model Control Resonance Frequency 3	P	80.0	Hz	10.0 to 80.0
54	ANRFRQ4	Model Control Anti-resonance Frequency 4	P	80.0	Hz	10.0 to 80.0
55	RESFRQ4	Model Control Resonance Frequency 4	P	80.0	Hz	10.0 to 80.0

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters Group5 "High settling control settings"

ID	Symbol	Name	Control mode	Standard 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 V = Velocity control type T = Torque control type

■ General parameters Group8 “Control system settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	CMDPOL	Position, Velocity, Torque Command Input Polarity	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	P	00:F-PC_R-PC	-	00 to 02
11	PCPPOL	Position Command Pulse Count Polarity	P	00:Type1	-	00 to 03
12	PCPFIL	Position Command Pulse Digital Filter	P	00:834nsec	-	00 to 07
13	B-GER1	Electronic Gear 1 Numerator	P	1	-	1 to 2097152
14	A-GER1	Electronic Gear 1 Denominator	P	1	-	1 to 2097152
15	B-GER2	Electronic Gear 2 Numerator	P	1	-	1 to 2097152
16	A-GER2	Electronic Gear 2 Denominator	P	1	-	1 to 2097152
17	EDGEPOS	Positioning Methods	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	P	00:Type1	-	00 to 03
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	P,V,T	00:TCLM	-	00 to 02
37	TCLM-F	Forward Direction Internal Torque Limit Value	P,V,T	100.0	%	10.0 to 500.0
38	TCLM-R	Reverse Direction Internal Torque Limit Value	P,V,T	100.0	%	10.0 to 500.0
39	SQTCLM	Sequence Operation Torque Limit Value	P,V,T	120.0	%	10.0 to 500.0
3A	CPETLSEL	Selection of Torque Limit Input Under Voltage Sag	P,V,T	00:No_Limit	-	00 to 03
3B	TASEL	Torque Attainment select	P,V,T	00	-	00 to 01
3C	TA	Torque attainment	P,V,T	100.0	%	0.0 to 500.0
3D	TLMREST	The amount of torque limit value restoration when power restored.	P,V,T	10.0	%	0.0 to 500.0
3E	BDLY_TCMP	Torque Compensation Command in delay time of releasing holding brake	P,V	0.0	%	-100.0 to 100.0
40	NEAR	Near Range	P	500	Pulse	1 to 2147483647
41	INP	In-Position Window	P	100	Pulse	1 to 2147483647
42	ZV	Speed Zero Range	P,V,T	50	min^{-1}	50 to 500
43	LOWV	Low Speed Range	P,V,T	50	min^{-1}	0 to 65535
44	VA	Speed Attainment Setting (High Speed Range)	P,V,T	1000	min^{-1}	0 to 65535
45	VCMPUS	Speed Matching Unit Selection	P,V	00_min^{-1}	-	00 to 01
46	VCMP	Speed Matching Range	P,V	50	min^{-1}	0 to 65535
47	VCMPR	Speed Matching Range Ratio	P,V	5.0	%	0.0 to 100.0

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters Group9 “Function enabling condition settings”

ID	Symbol	Name	Control mode	Standard value	Setting range
00	F-OT	Positive Over Travel Function	P,V,T	0D:CONT6_OFF	00 to 27
01	R-OT	Negative Over Travel Function	P,V,T	0B:CONT5_OFF	00 to 27
02	AL-RST	Alarm Reset Function	P,V,T	10:CONT8_ON	00 to 27
03	ECLR	Encoder Clear Function	P,V,T	06:CONT3_ON	00 to 27
04	CLR	Deviation Clear Function	P	08:CONT4_ON	00 to 27
05	S-ON	Servo-ON Function	P,V,T	02:CONT1_ON	00 to 27
10	MS	Control Mode Switching Function	P,V,T	00:Always_Disable	00 to 27
11	INH/Z-STP	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function	P,V	00:Always_Disable	00 to 27
12	GERS	Electronic Gear Switching Function	P	00:Always_Disable	00 to 27
13	GC1	Gain Switching Condition 1	P,V,T	00:Always_Disable	00 to 27
14	GC2	Gain Switching Condition 2	P,V,T	00:Always_Disable	00 to 27
15	SUPFSEL1	FF Vibration Suppressor Frequency Select Input 1	P	00:Always_Disable	00 to 27
16	SUPFSEL2	FF Vibration Suppressor Frequency Select Input 2	P	00:Always_Disable	00 to 27
17	PLPCON	Position Loop Proportional Control Switching Function	P	01:Always_Enable	00 to 27
18	MDLFSEL1	Model Vibration Suppressor Frequency Select Input 1	P	00:Always_Disable	00 to 27
19	MDLFSEL2	Model Vibration Suppressor Frequency Select Input 2	P	00:Always_Disable	00 to 27
20	SP1	Preset Velocity Command Select Input 1	V	00:Always_Disable	00 to 27
21	SP2	Preset Velocity Command Select Input 2	V	00:Always_Disable	00 to 27
22	SP3	Preset Velocity Command Select Input 3	V	00:Always_Disable	00 to 27
23	DIR	Preset Velocity Command Input Direction of Movement	V	00:Always_Disable	00 to 27
24	RUN	Preset Velocity Command Operation Start Signal Input	V	00:Always_Disable	00 to 27
25	RUN-F	Preset Velocity Command Positive (direction) Move Start Signal Input	V	00:Always_Disable	00 to 27
26	RUN-R	Preset Velocity Command Negative (direction) Move Start Signal Input	V	00:Always_Disable	00 to 27
27	VLPCON	Velocity Loop Proportional Control Switching Function	P,V	04:CONT2_ON	00 to 27
28	V-COMPS	Velocity Compensation Function	P	00:Always_Disable	00 to 27
30	T-COMPS1	Torque Compensation Function 1	P,V	00:Always_Disable	00 to 27
31	T-COMPS2	Torque Compensation Function 2	P,V	00:Always_Disable	00 to 27
32	TL	Torque Limit Function	P,V,T	0E:CONT7_ON	00 to 27
33	OBS	Disturbance Observer Function	P,V	00:Always_Disable	00 to 27
34	STC	Compensatory function for stick-slip behavior	P,V,T	00:Always_Disable	00 to 27
35	FBHYST	Minor vibration (oscillation) suppression function	P,V,T	00:Always_Disable	00 to 27
40	EXT-E	External Trip Input Function	P,V,T	00:Always_Disable	00 to 27
41	DISCHARG	Main Power Discharge Function	P,V,T	01:Always_Enable	00 to 27
42	EMR	Emergency Stop Function	P,V,T	00:Always_Disable	00 to 27

■ General parameters GroupA “General output terminal output condition/ Monitor output selection/ Serial communication settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	OUT1	General Purpose Output 1	P,V,T	18:INP_ON	-	00 to 5F
01	OUT2	General Purpose Output 2	P,V,T	0C:TLC_ON	-	00 to 5F
02	OUT3	General Purpose Output 3	P,V,T	02:S-RDY_ON	-	00 to 5F
03	OUT4	General Purpose Output 4	P,V,T	0A:MBR-ON_ON	-	00 to 5F
04	OUT5	General Purpose Output 5	P,V,T	33:ALM5_OFF	-	00 to 5F
05	OUT6	General Purpose Output 6	P,V,T	35:ALM6_OFF	-	00 to 5F
06	OUT7	General Purpose Output 7	P,V,T	37:ALM7_OFF	-	00 to 5F
07	OUT8	General Purpose Output 8	P,V,T	39:ALM_OFF	-	00 to 5F
10	DMON	Digital Monitor Output Signal Selection	P,V,T	00:Always_OFF	-	00 to 5F
11	MON1	Analog Monitor Select Output 1	P,V,T	05:VMON_2mV/min^{-1}	-	00 to1C
12	MON2	Analog Monitor Select Output 2	P,V,T	02:TCMON_2V/TR	-	00 to1C
13	MONPOL	Analog Monitor Output Polarity	P,V,T	00:MON1+_MON2+	-	00 to 08
20	COMAXIS	Serial Communication Axis Number	P,V,T	01:#1	-	01 to 0F
21	COMBAUD	Serial Communication Baud Rate	P,V,T	05:38400bps	-	03 to 06
22	RSPWAIT	Latency to start sending response message	P,V,T	0	ms	0 to 500
30	MONDISP	Monitor Display Selection	P,V,T	00:STATUS	-	00 to 26

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters GroupB “Sequence/Alarms related settings”

ID	Symbol	Name	Control mode	Standard value	Unit	Setting range
00	JOGVC	JOG Velocity Command	P,V,T	50	min^{-1}	0 to 32767
10	DBOPE	Dynamic Brake Operation	P,V,T	04:SB_Free	-	00 to 05
11	ACTOT	Over-Travel Action	P,V,T	00:CMDINH_SB_SON	-	00 to 06
12	ACTEMR	Emergency Stop Operation	P,V	00:SERVO-BRAKE	-	00 to 01
13	BONDLY	Delay Time of Engaging Holding Brake (Holding Brake Holding Delay Time)	P,V,T	300	ms	0 to 1000
14	BOFFDLY	Delay Time of Releasing Holding Brake (Holding Brake Release Delay Time)	P,V,T	300	ms	0 to 1000
15	BONBGN	Brake Operation Beginning Time	P,V,T	10000	ms	0 to 65535
16	PFDDLY	Power Failure Detection Delay Time	P,V,T	32	ms	20 to 1000
19	POFFDLY	Power Off Detection Delay Time	P,V,T	0	ms	0 to 1000
20	OFWLV	Excessive Deviation Warning Level	P	2147483647	pulse	1 to 2147483647
21	OFLV	Deviation Counter Overflow Value	P	5000000	pulse	1 to 2147483647
22	OLWLV	Overload Warning Level	P,V,T	90	%	20 to 100
23	VFBALM	Velocity Feedback Alarm (ALM_C3) Detection	P,V,T	01:Enabled	-	00 to 01
24	VCALM	Velocity Control Alarm (ALM_C2) Detection	P,V,T	00:Disabled	-	00 to 01

✔ 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 Pulse Encoder Digital Filter	P,V,T	01:220nsec	-	00 to 07
01	EX-ENFIL	External Pulse Encoder Digital Filter	P,V,T	01:220nsec	-	00 to 07
02	EX-ENPOL	External Pulse Encoder Polarity Selection	P,V,T	00:Type1	-	00 to 07
03	PULOUTSEL	Encoder Output Pulse Divide Selection	P,V,T	00:Motor_Enc	-	00 to 01
04	ENRAT	Encoder Output Pulse Division	P,V,T	1/1	-	1/32768 to 1/1
05	PULOUTPOL	Encoder Output Pulse Divide Polarity	P,V,T	00:Type1	-	00 to 03
06	PULOUTRES	Encoder Output Pulse Divide Resolution Selection	P,V,T	00:32768P/R	-	00 to 01
07	PSOFORM	Encoder Signal Output (PS) Format	P,V,T	00:MOT_Binary	-	00 to 01
08	ECLRFUNC	Encoder Clear Function Selection	P,V,T	00:Status_ Multi Turn	-	00 to 01
10	DE1MSKLVL	Mask Level of Encoder Connector 1 Disconnection Alarm	P,V,T	0	kHz	0 to 10000
11	DE3MSKLVL	Mask Level of Encoder Connector 2 Disconnection Alarm	P,V,T	0	kHz	0 to 10000

✔ P = Position control type V = Velocity control type T = Torque control type

■ General parameters

ID	Symbol	Name	Control mode	Remarks
00	COMAXIS	Serial Communication Axis Number	P,V,T	This is common with GroupA ID20
01	COMBAUD	Serial Communication Baud Rate	P,V,T	This is common with GroupA ID21
02	TUNMODE	Tuning Mode	P,V,T	This is common with Group0 ID00
03	ATRES	Auto-Tuning Response	P,V,T	This is common with Group0 ID02
04	PCSMT	Position Command Smoothing Constant	P	This is common with Group1 ID00
05	PCFIL	Position Command Filter	P	This is common with Group1 ID01
06	B-GER1	Electronic Gear 1 Numerator	P	This is common with Group8 ID13
07	A-GER1	Electronic Gear 1 Denominator	P	This is common with Group8 ID14
08	INP	In-Position Window	P	This is common with Group8 ID41
09	F-OT	Positive Over Travel Function	P,V,T	This is common with Group9 ID00
0A	R-OT	Negative Over Travel Function	P,V,T	This is common with Group9 ID01
0B	AL-RST	Alarm Reset Function	P,V,T	This is common with Group9 ID02
0C	ECLR	Encoder Clear Function	P,V,T	This is common with Group9 ID03
0D	CLR	Deviation Clear Function	P	This is common with Group9 ID04
0E	S-ON	Servo-ON Function	P,V,T	This is common with Group9 ID05
0F	TL	Torque Limit Function	P,V,T	This is common with Group9 ID32
10	JOGVC	JOG Velocity Command	P,V,T	This is common with GroupB ID00
11	ENRAT	Encoder output frequency pulse dividing	P,V,T	This is common with GroupC ID04
12		Offset Adjustment of Velocity/Torque Command	P,V,T	Setting range -9999~9999
13		Offset Adjustment of Analog Torque Compensation Command	P,V	Setting range -9999~9999

✔ “General parameters” is operated from the Digital Operator.

✔ P = Position control type V = Velocity control type T = Torque control type

5.9 Parameter functions

Each parameter function is explained below.

■ Group0 “Auto-tuning settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td rowspan="2">Tuning Mode
[TUNMODE]</td><td>Setting range</td><td>Unit</td><td>Selection</td></tr>
<tr><td>00 to 02</td><td>-</td><td>00:AutoTun</td></tr>
<tr><td colspan="4">■ Set the validity, invalidity of Auto-tuning, and Load inertia moment rate estimation.
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>AutoTun</td><td>Automatic Tuning</td></tr><tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning (JRAT Manual Setting)</td></tr><tr><td>02</td><td>ManualTun</td><td>Manual Tuning</td></tr></table>
◆ Under the following operating conditions, Load inertia rate is not estimated properly: operation 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 at 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 at JRAT1.
✔ When “model following vibration suppression control” is set to “ID0A Position Control Selection“ of system parameter, set “02 manual tuning.”</td></tr>
</table>

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

■ Sets the Auto-Tuning Characteristic best fits to the servo system.

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”
- Used for general purpose positioning.
- Used for Velocity control mode or Torque control mode.
- Can be used for always affected by gravity and external forces.

◆ “Positioning Control 2”
- Used for Position control mode.
- If used for response positioning for shortened positioning time.
- Can be used for always affected by gravity and external forces.

◆ “Positioning Control 3”
- On the basis of “Positioning Control 2” to FFGN adjustment.

◆ “Positioning Control 4”
- Select this mode when the machine movement is in horizontal axis and receives no impacts from external force.
- Positioning time may be shortened compared to “Positioning Control 2.”
- Use this mode in “Position control mode.”
- Machines may receive any impacts.

◆ “Positioning Control 5”.
- On the basis of “Positioning Control 4” to FFGN adjustment.
- Do not used for always affected by gravity and external forces.
- The machine may receive impulse.

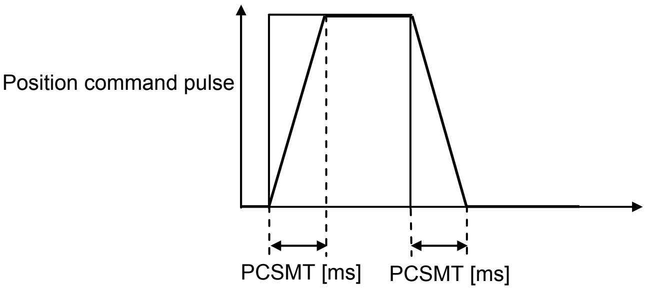
◆ “Trajectory Control 1”
- Used when following position command pulse and cutting behavior.
- Used for Position control mode.
- Can be used for always affected by gravity and external forces.
- Select this mode for single axis use. The response of each axis can be different.
- Used when cooperating with other axes, which used for “Trajectory Control 2”.
- The positioning characteristics will change when the “Position Loop Gain” is altered with fluctuation of the estimated inertia moment. Please adopt “Trajectory Control 2” or use manual tuning if you want to avoid this change.

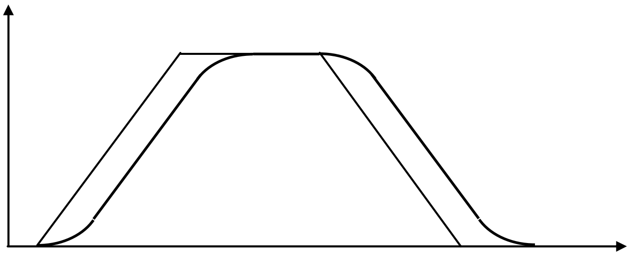
◆ “Trajectory Control 2”
- This setting is used to tune the response of each axis positioning loop in cooperation with the other axes.
- Used for Position control mode.
- Can be used for always affected by gravity and external forces.

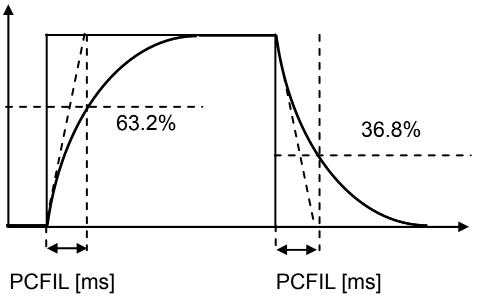
✔ When you use this mode for trajectory control, do not set “ID0A Position Control Selection” at Model following vibration suppressor control. In Model following vibration suppressor control, trajectory will be out of alignment.

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">02</td><td rowspan="2">Auto-Tuning Response
[ATRES]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 30</td><td>-</td><td>5</td></tr>
<tr><td colspan="4">■ 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 suitable for rigidity of the device.</td></tr>
<tr><td rowspan="3">03</td><td rowspan="2">Auto-Tuning Automatic Parameter Saving
[ATSAVE]</td><td>Setting range</td><td>unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Auto_Saving</td></tr>
<tr><td colspan="4">■ 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 (JRAT1) Load Inertia Moment Ratio 1.
◆ This setting is valid when Group0 ID00 Tuning Mode is at 00 AutoTun Auto-tuning
◆ The first automatic save is done after one (1) hour from the power input. Then automatic save is done in every two (2) hours.
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>Auto_Saving</td><td>Automatically Saves in JRAT1</td></tr>
<tr><td>01</td><td>No_Saving</td><td>Automatic Saving is Invalid</td></tr>
</table>
</td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Auto-Notch Filter Tuning Torque Command
[ANFILTC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 100.0</td><td>%</td><td>50.0</td></tr>
<tr><td colspan="4">■ Sets the torque value to 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.</td></tr>
<tr><td rowspan="3">20</td><td rowspan="2">Auto-FF Vibration Suppressor Frequency Tuning Torque Command [ASUPTC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 100.0</td><td>%</td><td>25.0</td></tr>
<tr><td colspan="4">■ Sets the torque value to excite the mechanical system during run time “Auto-FF Vibration Suppressor Frequency Tuning.”
✔ Larger value makes the tuning more accurate; however, note that it also makes the movement of the machine greater.</td></tr>
<tr><td rowspan="3">21</td><td rowspan="2">Auto-FF Vibration Suppressor Frequency Tuning Friction Compensation Value [ASUPFC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 50.0</td><td>%</td><td>5.0</td></tr>
<tr><td colspan="4">■ Sets the friction torque compensation added to the motor torque to excite the mechanical system at the time of Auto-FF Vibration Suppressor Frequency Tuning.
◆ Set this value close to actual friction torque, and vibration suppressor 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.</td></tr>
</table>

■ Group1 “Basic control parameter settings”

<table>
<tr><td>ID</td><td colspan="4">Contents</td></tr>
<tr><td rowspan="3">00</td><td rowspan="2">Position Command Smoothing Constant [PCSMT]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 500.0</td><td>ms</td><td>0.0</td></tr>
<tr><td colspan="4">■ This moving low-pass filter smoothes the position command pulse.
Sets time constants.
◆ Applies gradient to the step condition positioning pulse.
◆ Applies S curve to the lamp condition 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.)
◆ When the set value is “0.0ms to 0.2ms”, 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 with step condition applied


● Position command pulse with lamp condition applied.
</td></tr>
</table>

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">01</td><td rowspan="2">Position Command Filter
[PCFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 2000.0</td><td>ms</td><td>0.0</td></tr>
<tr><td colspan="4">■ This low-pass filter suppresses any sudden change of the position control pulse.
Sets time constants.
◆ This parameter setting is valid when the value of Group1ID04 Higher Tracking Control Position Compensation Gain is set at 0%.
◆ When Higher Tracking Control Position Compensation Gain is 0%, 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.
 </td></tr>
<tr><td rowspan="3">02</td><td rowspan="2">Position Loop Proportional Gain 1
[KP1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 3000</td><td>1/s</td><td>30</td></tr>
<tr><td colspan="4">■ Proportional gain for position controller.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Gain switching function is invalid, this setting value is applied.</td></tr>
<tr><td rowspan="3">03</td><td rowspan="2">Position Loop Integral Time Constant 1
[TPI1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.3 to 1000.0</td><td>ms</td><td>1000.0</td></tr>
<tr><td colspan="4">■ Integral time constant for position controller.
This setting is valid when the Position Loop Proportional Control Switching Function is invalid.
◆ Integral time is invalid (proportional control) at the setting value 1000.0ms.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Gain switching function is invalid, this setting value is applied.</td></tr>
<tr><td rowspan="3">04</td><td rowspan="2">Higher Tracking Control Position Compensation Gain
[TRCPGN]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 100</td><td>%</td><td>0</td></tr>
<tr><td colspan="4">■ Adjusts the performance of command tracking of the position control system.
The larger value can raise command tracking performance.
◆ When a value other than 0% is set, Position Command Filter and Feed Forward Gain are automatically set in the servo amplifier.
◆ When Auto-tuning function is valid, this setting value not applied.</td></tr>
</table>

ID	Contents	Setting range	Unit	Standard value
05	Feed Forward Gain [FFGN]	0 to 100	%	0

- Sets feed forward compensation gain to position control system.
  Model control system compensates for feed forward to Model following system when Position Control Selection is at Model following control.

  - ◆ Valid when Higher Tracking Control Position Compensation Gain is set at 0%.
  - ◆ 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	Standard value
06	Feed Forward Filter [FFFIL]	1 to 4000	Hz	4000

- First low-pass filter to eliminate pulsed ripple caused by the position command pulse included in the feed forward command. Sets the cutoff frequency.
  - ◆ Depending on the setting of the system parameter ID0A Position Control Selection, the point the filter becomes invalid causes the value to vary.

Position Control Selection		
00	Standard	More than 2000Hz
01	Model 1 Model Following Control	More than 1000Hz
02	Model 2 Model Flowing Vibration Suppress Control	More than 1000Hz

ID	Contents	Setting range	Unit	Standard value
10	Velocity Command Filter [VCFIL]	1 to 4000	Hz	4000

- First low-pass filter to suppress sudden change of velocity command.
  Use External Velocity Command Filter when eliminating Analog velocity command noise. Sets the 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 Standard Sampling	1 to 1999Hz	Valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	1 to 3999Hz	Valid
		4000Hz	Filter invalid

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">11</td><td rowspan="2">Velocity Feedback Filter
[VDFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>1500</td></tr>
<tr><td colspan="4">■ First 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 suppressor the ripples can 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.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Valid/Invalid</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 to 1999Hz</td><td>Valid</td></tr>
<tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>1 to 3999Hz</td><td>Valid</td></tr>
<tr><td>4000Hz</td><td>Filter invalid</td></tr>
</table></td></tr>
<tr><td rowspan="3">12</td><td rowspan="2">Velocity Loop Proportional Gain 1
[KVP1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 2000</td><td>Hz</td><td>50</td></tr>
<tr><td colspan="4">■ 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 saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When the Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.</td></tr>
<tr><td rowspan="3">13</td><td rowspan="2">Velocity Loop Integral Time Constant 1
[TVI1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.3 to 1000.0</td><td>ms</td><td>20.0</td></tr>
<tr><td colspan="4">■ 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 saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.</td></tr>
</table>

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">14</td><td rowspan="2">Load Inertia Moment Ratio 1
[JRAT1]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 15000</td><td>%</td><td>100</td></tr>
<tr><td colspan="4">■ Sets inertia moment of the loading device to the servo motor inertia moment.
◆ Setting value=$J_L/J_M \times 100\%$
● J_L: Load inertia moment
● J_M: Motor inertia moment
◆ Automatically saved by Auto-tuning result saving.
◆ If this value matches the actual mechanical system, setting value of KVP is the response frequency of the velocity control system.
◆ This parameter is saved with an estimated result when Auto-Tuning Automatic Parameter Saving function is valid. When Auto-tuning Function is valid, this value is not applied.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ Use between the range 100 to 3000% when driven with Model following vibration suppressor control.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.</td></tr>
<tr><td rowspan="3">15</td><td rowspan="2">Higher Tracking Control Velocity Compensation Gain
[TRCVGN]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 100</td><td>%</td><td>0</td></tr>
<tr><td colspan="4">■ 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%.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ The setting value is invalid with Model following control or Model following vibration suppressor control.</td></tr>
<tr><td rowspan="3">16</td><td rowspan="2">Acceleration Feedback Gain
[AFBK]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>-100.0 to 100.0</td><td>%</td><td>0.0</td></tr>
<tr><td colspan="4">■ Sets acceleration feedback compensation gain to make the velocity loop stable.
Multiply this gain with the detected acceleration to compensate torque command.
◆ When Auto-tuning function is valid, this setting value not applied.
◆ If the value is too large, the motor may oscillate. Set within range ±15.0% for general use.</td></tr>
<tr><td rowspan="3">17</td><td rowspan="2">Acceleration Feedback Filter
[AFBFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>500</td></tr>
<tr><td colspan="4">■ First 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.
<table>
<tr><th colspan="2">Control Cycle</th><th>Setting value</th><th>Valid/Invalid</th></tr>
<tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 to 1999Hz</td><td>Valid</td></tr>
<tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr>
<tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>1 to 3999Hz</td><td>Valid</td></tr>
<tr><td>4000Hz</td><td>Filter invalid</td></tr>
</table>
</td></tr>
</table>

<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>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>600</td></tr>
<tr><td colspan="4">■ Low-pass filter to eliminate high frequency component included in the torque command.
Sets cutoff frequency.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When Gain switching function is valid, select gain 1 and this setting value is applied.
◆ When Auto-tuning is valid, while system analysis function is active, this value is applied.
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</td><td>1 to 2000Hz</td><td>Setting value</td></tr>
<tr><td>2001 to 4000Hz</td><td>2000Hz</td></tr>
<tr><td>01</td><td>High-freq_Sampling
High Frequency Sampling</td><td>1 to 4000Hz</td><td>Setting value</td></tr>
</table>
Use within 1 to 1000Hz with Model following control.
Use within 100 to 1000Hz with Model following vibration suppressor 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>Standard value</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 is set within the setting range even if the cut off frequency of torque command filter is changed by Gain switching.</td></tr>
</table>

■ Group2 “FF (Feed Forward) vibration suppressor control/ Notch filter/ Disturbance observer settings”

ID	Contents	Setting range	Unit	Standard value
00	FF Vibration Suppressor Frequency 1 [SUPFRQ1]	5 to 500	Hz	500

- ■ Sets the frequency of the machine vibration to be suppressed by FF vibration suppressor function.
  - ◆ Change this while the servo motor is OFF.
  - ◆ Do not use while synchronizing with other axis such as controlling XY table trajectory for cutting operation.
  - ◆ Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are used.

Setting range	Unit value inside servo amplifier
5 to 99Hz	Valid by 1Hz
100 to 499Hz	Valid by 5Hz and drop less than 5
500Hz	FF vibration suppressor control is invalid

This parameter is automatically saved by executing FF vibration suppressor frequency tuning.
FF vibration suppressor frequency can be switched 2-4.

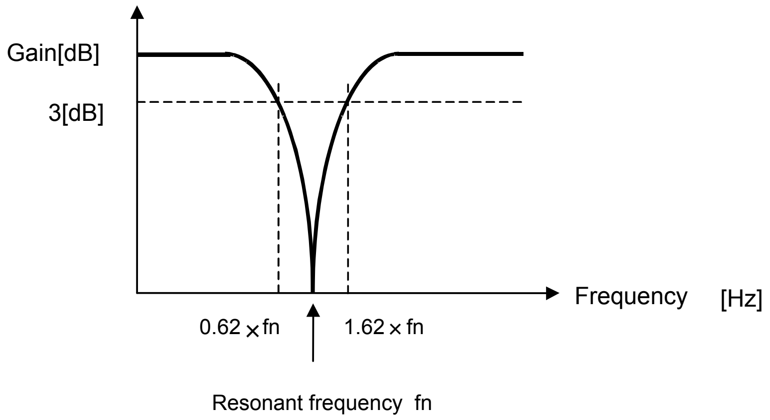
ID	Contents	Setting range	Unit	Standard value
01	FF Vibration Suppressor Level Selection [SUPLV]	00 to 03	-	00

- ■ Sets FF vibration suppressor control effect level.
  - ◆ Change while servo motor is OFF.
  - ◆ The smaller the value, the greater the effect will be.
  - ◆ FF vibration suppressor frequency switching function does not affect this.

ID	Contents	Setting range	Unit	Standard value
10	Velocity Command Notch Filter [VCNFIL]	50 to 1000	Hz	1000

- ■ 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 is raised by setting the resonance frequency.
  - ◆ Do not use while synchronizing with othER axis such as controlling XY table trajectory for cutting operation.
  - ◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle. Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.

Control Cycle		Setting value	Unit value inside servo amplifier
00	Standard_Sampling Standard Sampling	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 High Frequency Sampling	50 to 199Hz	Valid by 1Hz
		200 to 999Hz	Valid by 10Hz and drop less than 10
		1000Hz	Filter invalid



ID	Contents	Setting range	Unit	Standard value
20	Torque Command Notch Filter A [TCNFILA]	100 to 4000	Hz	4000

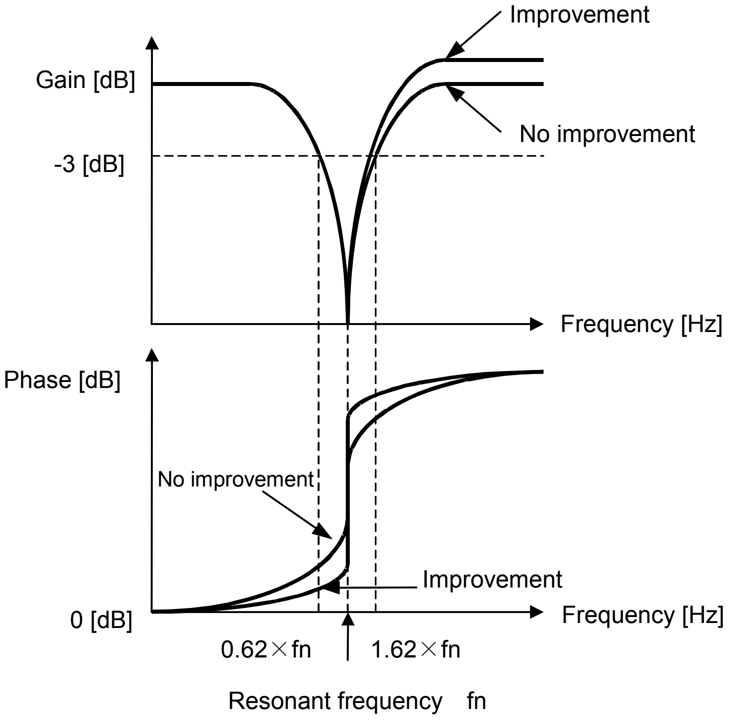
- ■ Notch filter to eliminate sympathetic vibration element included in torque command. Sets the resonant frequency.
  - ◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle. Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.

Control Cycle		Setting value	Unit value inside servo amplifier
00	Standard_Sampling Standard Sampling	100 to 1999Hz	Valid by 10Hz and drop less than 10
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	100 to 3999Hz	Valid by 10Hz and drop less than 10
		4000Hz	Filter invalid

This parameter is automatically saved by executing Notch filter tuning.

ID	Contents	Setting range	Unit	Standard value
21	TCNFILA, Low Frequency Phase Delay Improvement [TCNFPA]	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 at the setting value 0.
  - ◆ Caution, other than the setting value 0, higher frequencies than the middle frequency will be amplified.



ID	Contents	Setting range	Unit	Standard value
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

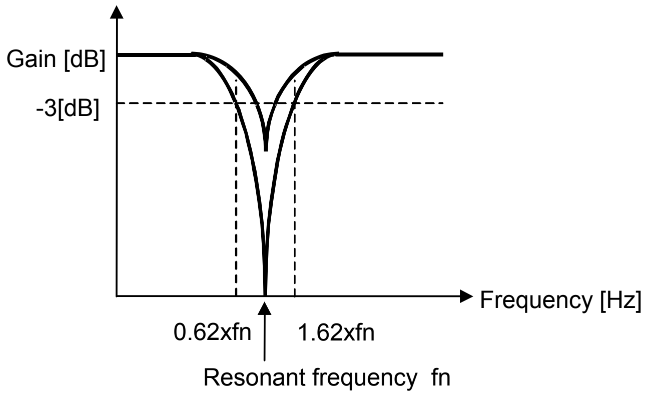
■ Notch filter to eliminate sympathetic vibration element included in torque command.
Sets the resonant frequency.

- ◆ Setting value varies depending on the setting of the system parameter ID00 Control Cycle. Setting value can be input by 1Hz unit; inside the servo amplifier, the units listed below are applied.

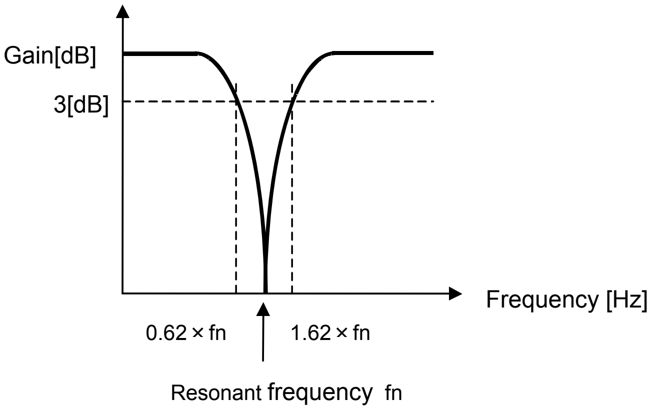
Control Cycle		Setting value	Unit value inside servo amplifier
00	Standard_Sampling Standard Sampling	100 to 1999Hz	Valid by 10Hz and drop less than 10
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	100 to 3999Hz	Valid by 10Hz and drop less than 10
		4000Hz	Filter invalid

ID	Contents	Setting range	Unit	Standard value
23	TCNFILB, Depth Selection [TCNFDB]	00 to 03	-	00
25	TCNFILC, Depth Selection [TCNFDC]	00 to 03	-	00
27	TCNFILD, Depth Selection [TCNFDD]	00 to 03	-	00

■ Parameters to set the depth of each Torque Command Notch Filter (TCNFILB toD). The larger the value is, the shallower the depth.



<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">30</td><td rowspan="2">Observer Characteristic
[OBCHA]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 02</td><td>-</td><td>00:Low</td></tr>
<tr><td colspan="4">■ Select frequency characteristic of the disturbance observer
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Low</td><td>For Low Frequency</td></tr><tr><td>01</td><td>Middle</td><td>For Middle Frequency</td></tr><tr><td>02</td><td>High</td><td>For High Frequency</td></tr></table>
◆ 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.</td></tr>
<tr><td rowspan="3">31</td><td rowspan="2">Observer Compensation Gain
[OBG]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 100</td><td>%</td><td>0</td></tr>
<tr><td colspan="4">■ 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.</td></tr>
<tr><td rowspan="3">32</td><td rowspan="2">Observer Output Low-pass Filter
[OBLPF]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>50</td></tr>
<tr><td colspan="4">■ First 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 2000Hz.
◆ Filter is invalid when observer characteristic is set to [01 Middle, For Middle Frequency], or [02 High, For High Frequency].</td></tr>
</table>

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">33</td><td rowspan="2">Observer Output Notch Filter
[OBNFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>100 to 4000</td><td>Hz</td><td>4000</td></tr>
<tr><td colspan="4">
■ 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.
◆ Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.
<table>
<tr><th>Setting value</th><th>Unit value inside servo amplifier</th></tr>
<tr><td>100 to 1999Hz</td><td>Valid by 10Hz and drop less than 10</td></tr>
<tr><td>2000 to 4000Hz</td><td>Filter invalid</td></tr>
</table>


</td></tr>
<tr><td rowspan="3">40</td><td rowspan="2">Effective velocity for compensating stick-slip behavior
[STV]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.1 to 128.0</td><td>min^{-1}</td><td>10.0</td></tr>
<tr><td colspan="4">
■ 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.
</td></tr>
<tr><td rowspan="3">41</td><td rowspan="2">Retention time for compensating stick-slip behavior
[STHLD]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 500</td><td>ms</td><td>20</td></tr>
<tr><td colspan="4">
■ 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 when 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.
</td></tr>
<tr><td rowspan="3">42</td><td rowspan="2">Velocity loop integral time constant for stick-slip behavior compensation
[STTVI]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.3 to1000</td><td>ms</td><td>3.0</td></tr>
<tr><td colspan="4">
■ Sets velocity loop integral time constant for stick-slip behavior compensation.
◆ The above set value applies to while stick-slip behavior compensation is being performed velocity loop integral time constant.
◆ 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-P 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.
</td></tr>
</table>

■ Group3 “Model following control settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td>Model Control Gain 1</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>[KM1]</td><td>1 to 3000</td><td>1/s</td><td>30</td></tr>
<tr><td colspan="4">■ Proportional gain for model position controller.
◆ Set within the range of 15 to 315 (1/s) when operating with Model following vibration suppressor control.
◆ Automatically saved by Auto-tuning result saving.
◆ When Auto-tuning function is valid, this setting value is not applied.
◆ When the Gain switching function is valid, select gain 1 and this setting value is applied.</td></tr>
<tr><td rowspan="3">01</td><td>Overshoot Suppressor Filter</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>[OSSFIL]</td><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 suppressor control.
Sets cutoff frequency.
◆ Lower the setting value when overshoot on position deviation occurs.
◆ Filter is invalid at the setting value more than 2000Hz.</td></tr>
<tr><td rowspan="3">02</td><td>Model Control Antiresonance Frequency 1</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>[ANRFRQ1]</td><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td colspan="4">■ Sets antiresonance frequency to the mechanical device with Model following vibration suppressor control.
Sets actual antiresonance frequency value of the mechanical system by using System Analysis function of the setup software.
◆ Setting value is invalid with following control.
◆ If the sitting value is over the Model Control Resonance Frequency, vibration suppressor control is invalid.
◆ Change value while the servo motor is OFF.</td></tr>
<tr><td rowspan="3">03</td><td>Model Control Resonance Frequency 1</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>[RESFRQ1]
Setting range</td><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td colspan="4">■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control.
Sets actual resonance frequency value of the mechanical system by using System Analysis function of the setup software.
◆ Setting value is invalid with Model following control.
◆ Vibration suppressor control becomes invalid at the setting value 80.0Hz.
◆ Change value while the servo motor is OFF.</td></tr>
</table>

- ✔ Turn the servo motor OFF when using gain switching function.
- ✔ Turn the servo motor OFF when using Model vibration suppressor frequency switching function.
- ✔ If alarm, ALC5 Model following vibration suppressor control abnormal, is issued during operation, lower the value of KM Model Control Gain, or Change the operation pattern so that acceleration and deceleration become moderate.
- ✔ Model following vibration suppressor control is invalid with JOG operation.

■ Group4 “Gain switching control/ vibration suppressor frequency switching settings”

ID	Contents			
00	Model Control Gain 2 [KM2]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
10	Model Control Gain 3 [KM3]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
20	Model Control Gain 4 [KM4]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
	■ Proportional gain for Model position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving.			
01	Position Loop Proportional Gain 2 [KP2]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
11	Position Loop Proportional Gain 3 [KP3]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
21	Position Loop Proportional Gain 4 [KP4]	Setting range	Unit	Standard value
		1 to 3000	1/s	30
	■ Proportional gain for position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving.			
02	Position Loop Integral Time Constant 2 [TPI2]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
12	Position Loop Integral Time Constant 3 [TPI3]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
22	Position Loop Integral Time Constant 4 [TPI4]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	1000.0
	■ Integral time constant for position controller. Select from gain switching function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ Integral term is valid (Proportional control) at the setting value 1000.0ms. ◆ This setting in valid when the Position Loop Proportional Control Switching Function is invalid.			
03	Velocity Loop Proportional Gain 2 [KVP2]	Setting range	Unit	Standard value
		Setting range	Unit	Standard value
13	Velocity Loop Proportional Gain 3 [KVP3]	Setting range	Unit	Standard value
		1 to 2000	Hz	50
23	Velocity Loop Proportional Gain 4 [KVP4]	Setting range	Unit	Standard value
		1 to 2000	Hz	50
	■ Proportional gain for velocity controller. Select from Gain Switching Function 1 or 2. ◆ This parameter is not covered by Auto-tuning result saving. ◆ When Load Inertia Moment Ratio (JRAT2, JRAT3, and JRAT4) are the same as actual load inertia moment, this setting value response is performed.			

ID	Contents			
04	Velocity Loop Integral Time Constant 2 [TVI2]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0
14	Velocity Loop Integral Time Constant 3 [TVI3]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0
24	Velocity Loop Integral Time Constant 4 [TVI4]	Setting range	Unit	Standard value
		0.3 to 1000.0	ms	20.0

- ■ Integral time constant for velocity controller. Select from gain switching function 1 and 2.
  - ◆ This parameter is not covered by Auto-tuning result saving.
  - ◆ This setting is valid when Velocity Loop Proportional Control Switching Function is invalid.
  - ◆ Integral time is invalid (proportional control) with the setting value 1000.0ms.

ID	Contents			
05	Load Inertia Moment Ratio 2 [JRAT2]	Setting range	Unit	Standard value
		0 to 15000	%	100
15	Load Inertia Moment Ratio 3 [JRAT3]	Setting range	Unit	Standard value
		0 to 15000	%	100
25	Load Inertia Moment Ratio 4 [JRAT4]	Setting range	Unit	Standard value
		0 to 15000	%	100

- ■ Sets Inertia moment of load device to the servo motor inertia moment. Select from Gain switching function 1 or 2.
  - ◆ If this value matches the actual mechanical system, the setting value corresponding to Velocity Loop Proportional Gain (KVP2, KVP3, and KVP4) is response frequency of the velocity control system.
  - ◆ This parameter is not covered by Auto-Tuning Automatic Parameter Saving function.
  - ◆ Setting value=J_L/J_M×100%
    - ● J_L: Load inertia moment
    - ● J_M: Motor inertia moment

ID	Contents			
06	Torque Command Filter 2 [TCFIL2]	Setting range	Unit	Standard value
		1 to 4000	Hz	600
16	Torque Command Filter 3 [TCFIL3]	Setting range	Unit	Standard value
		1 to 4000	%	600
26	Torque Command Filter 4 [TCFIL4]	Setting range	Unit	Standard value
		1 to 4000	%	600

- ■ Low-pass filter to eliminate high frequency element included in torque command. Select from gain switching function 1 or 2. Sets cutoff frequency.
  - ◆ This parameter is not covered by Auto-tuning result saving.
  - ◆ Setting range varies depending on the setting of system parameter ID00 Control Cycle. (Torque command filter cannot be disabled.)

Control Cycle		Setting value	Cutoff frequency
00	Standard_Sampling Standard Sampling	1 to 2000Hz	Setting value
		2001 to 4000Hz	2000Hz
01	High-freq_Sampling High Frequency Sampling	1 to 4000Hz	Setting value

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">30</td><td rowspan="2">Gain Switching Filter
[GCFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 100</td><td>ms</td><td>0</td></tr>
<tr><td colspan="4">■ Low-pass filter to change gain moderately when switching.
Sets time constant.
◆ When the mechanical system is shocked by the change of gain resulted from gain switching, making a moderate gain change will modify the shock.
◆ The larger the value, the gentler the gain changes.</td></tr>
<tr><td rowspan="2">40</td><td rowspan="2">FF Vibration Suppressor Frequency 2
[SUPFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td rowspan="2">41</td><td rowspan="2">FF Vibration Suppressor Frequency 3
[SUPFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td rowspan="2">42</td><td rowspan="2">FF Vibration Suppressor Frequency 4
[SUPFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>5 to 500</td><td>Hz</td><td>500</td></tr>
<tr><td></td><td colspan="4">■ Sets mechanical vibration frequency to be suppressed with this function. Select from FF vibration suppressor frequency selection 1 or 2.
◆ Change value while the servo motor is OFF.
◆ This parameter is not covered by Auto-tuning result saving.
◆ Setting value can be input by 1Hz; inside the servo amplifier, the units listed below are applied.
<table>
<tr><th>Setting range</th><th>Unit value inside servo amplifier</th></tr>
<tr><td>5 to 99Hz</td><td>Valid by 1Hz</td></tr>
<tr><td>100 to 499Hz</td><td>Valid by 5Hz and drop less than 5</td></tr>
<tr><td>500Hz</td><td>FF vibration suppressor invalid</td></tr>
</table></td></tr>
<tr><td rowspan="2">50</td><td rowspan="2">Model Control Antiresonance Frequency 2
[ANRFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">52</td><td rowspan="2">Model Control Antiresonance Frequency 3
[ANRFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">54</td><td rowspan="2">Model Control Antiresonance Frequency 4
[ANRFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td></td><td colspan="4">■ Sets antiresonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2.
◆ Setting value is invalid with Model following control.
◆ Vibration suppressor is invalid when it is set over the value of Model Control Resonance Frequency.
◆ This is not overwritten by System Analysis function.
◆ Setting by using “system analysis” function cannot be performed.
◆ Change value while the servo motor is OFF.</td></tr>
<tr><td rowspan="2">51</td><td rowspan="2">Model Control Resonance Frequency 2
[RESFRQ2]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">53</td><td rowspan="2">Model Control Resonance Frequency 3
[RESFRQ3]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td rowspan="2">55</td><td rowspan="2">Model Control Resonance Frequency 4
[RESFRQ4]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>10.0 to 80.0</td><td>Hz</td><td>80.0</td></tr>
<tr><td></td><td colspan="4">■ Sets resonance frequency of the mechanical device with Model following vibration suppressor control. Select from Model Vibration Suppressor Frequency Select Input 1 or 2.
◆ Setting value is invalid under Model following control.
◆ Vibration suppressor control becomes invalid at the setting value 80.0Hz.
◆ This is not overwritten by System Analysis function.
◆ Setting by using “system analysis” function cannot be performed.
◆ Change value while the servo motor is OFF.</td></tr>
</table>

■ Group5 “High setting 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>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>1000</td></tr>
<tr><td colspan="4">■ First low-pass filter to eliminate high frequency elements such as ripples included in the velocity (command velocity) calculated from position command pulse inside high setting control. Sets cutoff frequency.
◆ Lower the cutoff frequency when the encoder resolution is low.
◆ Filter is invalid at setting the value more then 2000Hz.</td></tr>
<tr><td rowspan="3">01</td><td rowspan="2">Command Velocity Threshold
[CVTH]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 65535</td><td>min^{-1}</td><td>20</td></tr>
<tr><td colspan="4">■ Sets velocity threshold value to make high setting control compensation (Acceleration Compensation and Deceleration Compensation) valid.
◆ Acceleration Compensation or Deceleration Compensation is done when velocity (command velocity) calculated from the position command pulse reaches 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>Standard value</td></tr>
<tr><td>-9999 to +9999</td><td>×50 Pulse</td><td>0</td></tr>
<tr><td colspan="4">■ Sets Acceleration Compensation value with high setting control.
◆ Sets in units of position deviation pulse (encoder resolution unit x4 with pulse encoder)
◆ Compensates to 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 with high setting control.
◆ The setting value is invalid with Model following control or Model following vibration suppressor control.</td></tr>
<tr><td rowspan="3">03</td><td rowspan="2">Deceleration Compensation
[DECCO]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>-9999 to +9999</td><td>×50 Pulse</td><td>0</td></tr>
<tr><td colspan="4">■ Sets Deceleration Compensation value with high setting control.
◆ Set in units of position deviation pulse (for pulse encoder, set in units of encoder resolution with 4-multiplied.)
◆ Compensation is performed for position deviation.
◆ The larger the set value, the more the amount of compensation.
◆ The larger the acceleration converted fro, position command, the more the amount of compensation.
◆ The larger load inertia moment, the more the amount of compensation.
◆ Position deviation decreases by high stabilization control.
◆ This setting value is not reflected in operation with “model following control” or “model following vibration suppression control.”</td></tr>
</table>

■ Group8 "Control system settings"

ID	Contents	Setting range	Unit	Standard value
00	Position, Velocity, Torque Command Input Polarity [CMDPOL]	00 to 07	-	00:PC+_VC+_TC+

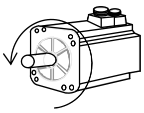
■ Select the combination of each command polarity for position command pulse, Analog velocity command and Analog torque command input from the list below.

- ◆ Rotating direction of the servo motor can be reversed without changing the command wiring.
- ◆ Rotating direction with positive (+) polarity command supply according to the setting value is shown below.

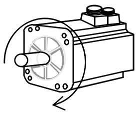
Selection		Polarity	Position Command Pulse (PCMD)	Analog Velocity Command (VCMD)	Analog Torque Command (TCMD)
00	PC+_VC+_TC+	+	Forward	Forward	Forward
01	PC+_VC+_TC-	+	Forward	Forward	Reverse
02	PC+_VC-_TC+	+	Forward	Reverse	Forward
03	PC+_VC-_TC-	+	Forward	Reverse	Reverse
04	PC-_VC+_TC+	+	Reverse	Forward	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 with (+) polarity command

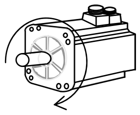


Reverse rotation with (-) polarity command

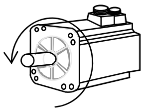


- ◆ Command input polarity change "07:PC-_VC-_TC-"

Reverse rotation with (+) polarity command



Forward rotation with (-) polarity command

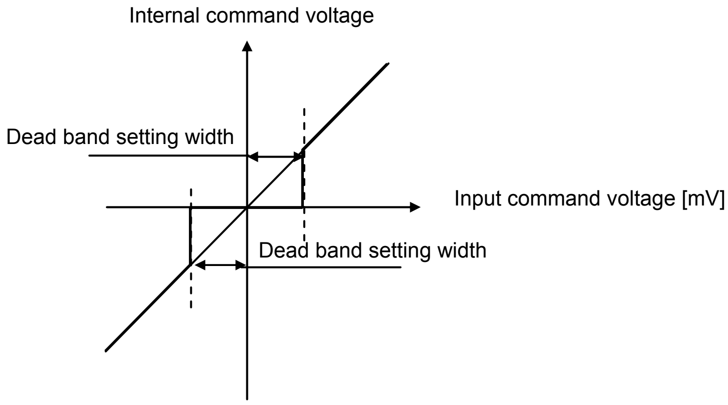


ID | Contents

01

Analog Velocity, Torque Command Input Dead Band Width [VC/TC-DW]	Setting range	Unit	Standard value
	0.0 to 6553.5	mV	0.0

- ■ Sets voltage of dead band of Analog velocity command input and Analog torque command input.
  - ◆ Command voltage is considered as 0V within the dead band setting range in servo amplifier.
  - ◆ It improves influences from Analog velocity command input and Analog torque command input noise and drift.



10

Position Command Pulse Selection [PMOD] Control power a reactivation after setting.	Setting range	Unit	Standard value
	00 to 02	-	00:F-PC_R-PC

- ■ Set 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 ($\overline{\text{F}}$-$\overline{\text{PC}}$): CN1-27	Reverse pulse ($\overline{\text{R}}$-$\overline{\text{PC}}$): CN1-29
Forward pulse SG: CN1-47	Reverse pulse SG: CN1-48

  - ◆ Capable of these output types of the upper devise: Line driver output and Open collector output. Be sure to connect SG.

ID	Contents	Setting range	Unit	Standard value
11	Position Command Pulse Count Polarity [PCPPOL] Control power a reactivation after setting.	00 to 03	-	00:Type1

- ■ Select 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	Setting range	Unit	Standard value
12	Position Command Pulse Digital Filter [PCPFIL]	00 to 07	-	00:834nsec

- ■ Filter to eliminate noise elements included in the Position command pulse.
  - ◆ Select from the following list:

Setting value		Contents
00	834nsec	Minimum Pulse Width = 834nsec
01	250nsec	Minimum Pulse Width = 250nsec
02	500nsec	Minimum Pulse Width = 500nsec
03	1.8usec	Minimum Pulse Width = 1.8µsec
04	3.6usec	Minimum Pulse Width = 3.6µsec
05	7.2usec	Minimum Pulse Width = 7.2µsec
06	125nsec	Minimum Pulse Width = 125nsec
07	83.4nsec	Minimum Pulse Width = 83.4nsec

- ■ When the Position command pulse width becomes less that the setting values of the Digital filter, the status becomes 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 [Input command, Position signal output, General input, General output (2-8)] for the specification of the command pulse.

ID	Contents			
13	Electronic Gear 1 Numerator [B-GER1]	Setting range	Unit	Standard value
		1 to 2097152	-	1
14	Electronic Gear 1 Denominator [A-GER1]	Setting range	Unit	Standard value
		1 to 2097152	-	1
15	Electronic Gear 2 Numerator [B-GER2]	Setting range	Unit	Standard value
		1 to 2097152	-	1
16	Electronic Gear 2 Denominator [A-GER2]	Setting range	Unit	Standard value
		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.
- ◆ If the position command pulse is the same, by switching the Electronic gear, rotating velocity and distance are changed.

$$f1 \longrightarrow \boxed{\begin{array}{c} \dfrac{B\ (1\ \text{to}\ 2097152)}{A(1\ \text{to}\ 2097152)} \\ 1/2^{21} \leqq B/A \leqq 2^{21} \end{array}} \longrightarrow f2\ (f2 = f1xB/A)$$

■ Example 1. Changing the Position command pulse the unit to the feed shaft with ball screw.
Use serial encoder, 131072[P/R], decide the position of the lead 10[mm] ball screw. To calculate by 1μm unit, use the calculation formula below and calculate the Electronic gear ratio numerator and denominator:

- ◆ Encoder position resolution = $\dfrac{131072[P/R]}{10 \times 10^{-3}\ [m]} = 13107200[P/m]$
- ◆ Position resolution of upper controller = 1000000[P/m]
  - ● Electronic gear ratio = $\dfrac{13107200[P/m]}{1000000[P/m]} = \dfrac{131072}{10000} = \dfrac{8192}{625}$

Thus, Electronic gear numerator = 8192, Electronic gear denominator = 625.
(Setting value of numerator = 131072, denominator = 10000 are fine as they are within the setting range of Electronic gear.)

- Example 2. When the encoder resolution is changed by the motor exchange.
  To change a servo motor with 2000[P/R] pulse encoder,to a servo motor with 8576[P/R] serial encoder without changing upper controller position resolution. Use the calculation formula below and calculate Electronic gear numerator and denominator.

  ◆ Resolution before the motor exchange = 2000×4[P/R] = 8000[P/R]
  (For a pulse encoder, multiply the encoder resolution by 4 for the position control resolution.)

  ● $\text{Electronic gear ratio} = \dfrac{1048576[\text{P/m}]}{8000[\text{P/m}]} = \dfrac{16384}{125}$

  Thus, Electronic gear numerator = 16384, Electronic gear denominator = 125.
  (Setting value of numerator = 1048576, denominator = 8000 are fine as they are within the setting range of Electronic gear.)
  (If the Electronic gear value is set at the motor exchanging, multiply the value by the Electronic gear ratio given here.)

- Example 3. To bypass the frequency constraint of Position command pulse.
  In case you operate a servomotor with 131072 [P/R] resolution of serial encoder at 6000 [min^{-1}] using a controller having maximum frequency of 600 [kpps] (600K pps), 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]

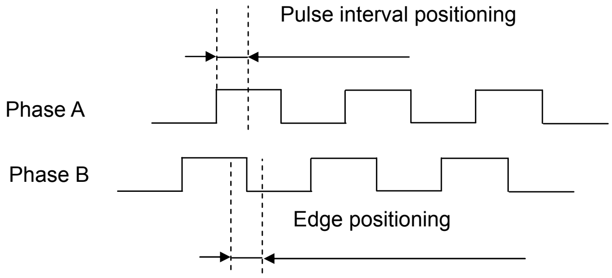
  ● $\text{Electronic gear ratio} = \dfrac{13107.2\ [\text{kpps}]}{600[\text{kpps}]} = \dfrac{8192}{375}$

  Thus, Electronic gear numerator = 8192, Electronic gear denominator = 375.
  (Setting value of numerator = 131072, denominator = 6000 are fine as they are within the setting range of Electronic gear.)
  By setting this Electronic gear numerator, denominator, the motor rotation velocity is 6000[min^{-1}] with the Position command pulse frequency 600[kpps].

ID	Contents			
17	Positioning Methods [EDGEPOS] Control power a reactivation after setting.	Setting range	Unit	Standard value
		00 to 01	-	00:Pulse_Interval

- ■ Select the Encoder pulse positioning.
  - ◆ Positioning accuracy is 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 for usual operation.

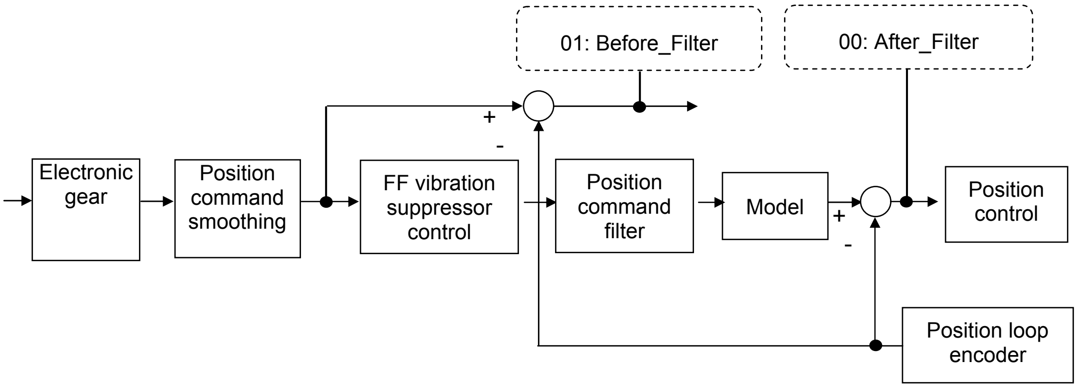
Selection		Contents
00	Pulse_Interval	Specify Pulse Interval
01	Pulse_Edge	Specify Pulse Edge



ID	Contents			
18	In-Position Signal/ Position Deviation Monitor [PDEVMON]	Setting range	Unit	Standard value
		00 to 01	-	00:After_Filter

- ■ Select in-position signal (INP) and Position deviation monitor output before and 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 suppressor control.
  - ◆ With system parameter ID0A Position Control Selection at 01 Model 1 Model Following Control, or 02 Model 2 Model Following Vibration Suppress Control, 01: Before_Filter always operates no matter the 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.



ID	Contents			
19	Deviation Clear Selection [CLR]	Setting range	Unit	Standard value
		00 to 03	-	00:Type1

■ Sets ON/OFF of position deviation clear during servo OFF, and deviation clear signal treatment.

- ◆ Selects operation during servo OFF. Deviation clear/ Deviation NOT clear
- ◆ Selects deviation signal treatment. Level detection /Edge detection
- ◆ Select proper setting corresponding to above combination from the list below.

Selection		Contents	
00	Type1	When Servo OFF → Clear Deviation Deviation Clear Input = Level Detection	During servo OFF, Deviation clear is always executed. While Deviation clear input is ON, Deviation clear is always executed.
01	Type2	When Servo OFF → Clear Deviation Deviation Clear Input = Edge Detection	At the edge of OFF→ON of Deviation clear input, Deviation clear is executed.
02	Type3	When Servo OFF → NOT Clear Deviation Deviation Clear Input = Level Detection	During servo OFF, Deviation clear is not executed. (After servo ON, the motor may operate suddenly.)
03	Type4	When Servo OFF → NOT Clear Deviation Deviation Clear Input = Edge Detection	During servo OFF, Deviation clear is not executed. (After servo ON, the motor may operate suddenly.)

ID	Contents			
20	Preset Velocity Command 1 [VC1]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	100
21	Preset Velocity Command 2 [VC1]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	200
22	Preset Velocity Command 3 [VC3]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	300
23	Preset Velocity Command 4 [VC4]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	400
24	Preset Velocity Command 5 [VC5]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	500
25	Preset Velocity Command 6 [VC6]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	600
26	Preset Velocity Command 7 [VC7]	Setting range	Unit	Standard value
		0 to 32767	min^{-1}	700

- ■ Sets Velocity command for internal velocity operation.
  - ◆ There are seven (7) ways to set preset velocity.
  - ◆ Use the following General parameters Group9 ID20-26 and the Preset velocity is Valid.

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 Input Direction of Movement
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 with 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

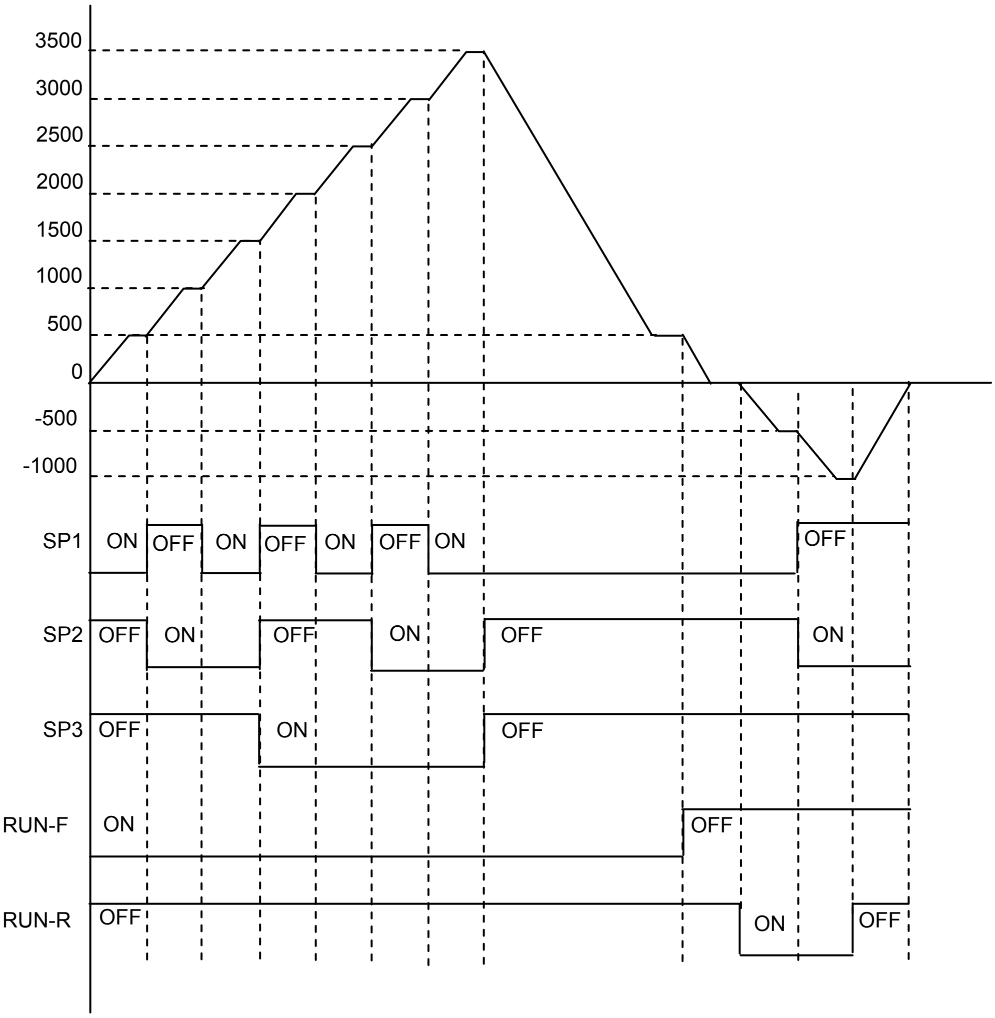
- ◆ Drives the servo motor

RUN: Preset Velocity Command Operation Start Signal Input	ON	Servo motor, forward rotation
DIR: Preset Velocity Command Input Direction of Movement	OFF	
RUN: Preset Velocity Command Operation Start Signal Input	ON	Servo motor, reverse rotation
DIR: Preset Velocity Command Input Direction of Movement	ON	

RUN-F: Preset Velocity Command Positive (direction) Move Start Signal Input	ON	Servo motor, forward rotation
RUN-R: Preset Velocity Command Negative (direction) Move Start Signal Input	ON	Servo motor, reverse rotation

- ■ Examples of setting and operation pattern at Preset Velocity Command Operation

VC1 Preset Velocity Command 1	500 [min^{-1}]
VC1 Preset Velocity Command 2	1000 [min^{-1}]
VC1 Preset Velocity Command 3	1500 [min^{-1}]
VC1 Preset Velocity Command 4	2000 [min^{-1}]
VC1 Preset Velocity Command 5	2500 [min^{-1}]
VC1 Preset Velocity Command 6	3000 [min^{-1}]
VC1 Preset Velocity Command 7	3500 [min^{-1}]



◆ To change the Preset velocity using external contact input, set it so that SP1 to SP3 change at the same time.

◆ When RUN-F and RUN-R are ON at the same time, it is treated as Velocity command 0.

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">27</td><td rowspan="2">Velocity Compensation Command Input Selection
[VCOMSEL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>01 to 02</td><td>-</td><td>02:V-COMP</td></tr>
<tr><td colspan="4">■ Select Velocity compensation command input.
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>01</td><td>Analog_Input</td><td>Analog velocity compensation command value is used when velocity compensation function is valid.</td></tr><tr><td>02</td><td>V-COMP</td><td>Preset velocity compensation command is used when velocity compensation function is valid.</td></tr></table></td></tr>
<tr><td rowspan="3">28</td><td rowspan="2">Preset Velocity Compensation Command
[V-COMP]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>-9999 to +9999</td><td>min^{-1}</td><td>0</td></tr>
<tr><td colspan="4">■ Sets the Velocity in a fixed compensation command value with Velocity Compensation Function.</td></tr>
<tr><td rowspan="3">29</td><td rowspan="2">Analog Velocity (Compensation) Command Scaling
[VCGN]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 4000</td><td>min^{-1}/V</td><td>500</td></tr>
<tr><td colspan="4">■ Sets Analog Velocity (Compensation) Command scaling.
◆ Sets the Velocity against analog velocity (compensation) command input signal 1 [V].</td></tr>
<tr><td rowspan="3">2A</td><td rowspan="2">External Velocity Command Filter
[EX-VCFIL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 4000</td><td>Hz</td><td>4000</td></tr>
<tr><td colspan="4">■ First low-pass filter to eliminate noise elements 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.
<table><tr><th colspan="2">Control Cycle</th><th>Setting Value</th><th>Filter Valid/invalid</th></tr><tr><td rowspan="2">00</td><td rowspan="2">Standard_Sampling
Standard Sampling</td><td>1 to 1999Hz</td><td>Valid</td></tr><tr><td>2000 to 4000Hz</td><td>Filter Invalid</td></tr><tr><td rowspan="2">01</td><td rowspan="2">High-freq_Sampling
High Frequency Sampling</td><td>1 to 3999Hz</td><td>Valid</td></tr><tr><td>4000Hz</td><td>Filter Invalid</td></tr></table></td></tr>
</table>

■ 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.

◆ Set preset velocity compensation command

Group	ID	Symbol	Contents
8	28	V-COMP	Preset Velocity Compensation Command

◆ Select velocity compensation command input method

Group	ID	Symbol	Contents
8	27	VCOMSEL	Velocity Compensation Command Input Selection

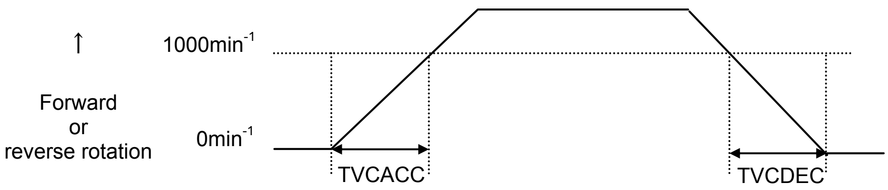
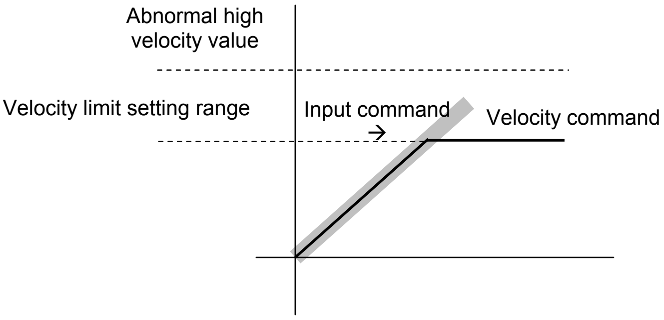
◆ Select and set the condition to set Velocity Compensation Function valid

Group	ID	Symbol	Contents
9	28	VCOMPS	Velocity Compensation Function

◆ Set Analog velocity compensation scaling

Group	ID	Symbol	Contents
8	29	VCGN	Analog Velocity Command Scaling

◆ Input is shared with Analog velocity command/Analog torque command Input when using Analog velocity compensation command.
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>Standard value</td></tr>
<tr><td>0 to 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>Standard value</td></tr>
<tr><td>0 to 16000</td><td>ms</td><td>0</td></tr>
<tr><td></td><td colspan="4">■ 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 acceleration, deceleration per 1000 min^{-1}.
■ With Velocity command acceleration, deceleration time constant, and Step input velocity, the command can be accelerated or decelerated.
 </td></tr>
<tr><td rowspan="3">2D</td><td rowspan="2">Velocity Limit Command
[VCLM]</td><td>Setting range</td><td>Unit</td><td>Standard value</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.
◆ At the setting value 50000 and over, Velocity command is restricted at maximum speed of the combined motor x 1.1.
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>

ID	Contents	Setting range	Unit	Standard value
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	When Torque compensation function in valid, Analog torque compensation command value is used.
02	T-COMP	When Torque compensation function in valid, Preset torque compensation command 1 or 2 is used.

ID	Contents	Setting range	Unit	Standard value
31	Preset Torque Compensation Command 1 [T-COMP1]	-500.0 to +500.0	%	0.0

- ■ Parameter for using Torque Compensation Function 1(T-COMPS1) at a fixed value.
  - ◆ When Torque Compensation Command Input Selection is set at 02: T-COMP, the value is added to the Torque command.

ID	Contents	Setting range	Unit	Standard value
32	Preset Torque Compensation Command 2 [T-COMP2]	-500.0 to +500.0	%	0.0

- ■ Parameter for using Torque Compensation Function 2 (T-COMPS2) at a fixed value.
  - ◆ When Torque Compensation Command Input Selection is set at 02: T-COMP, the value is added to the Torque command.

ID	Contents	Setting range	Unit	Standard value
33	Analog Torque Command Scaling [TCGN]	0.0 to 500.0	%/V	50.0

- ■ Parameter for setting Analog Torque Command Scaling.
  - ◆ Sets torque to Analog torque command input signal per 1V.

ID	Contents	Setting range	Unit	Standard value
34	Analog Torque Compensation Command Scaling [T-COMPGN]	0.0 to 500.0	%/V	50.0

- ■ Parameter for setting Analog Torque Compensation Command Scaling.
  - ◆ Sets torque to Analog torque compensation command input signal per 1V.

ID	Contents	Setting range	Unit	Standard value
35	External Torque Command Filter [EX-TCFIL]	1 to 4000	Hz	4000

- ■ First use the Low-pass filter to eliminate noise elements 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	Filter Valid/Invalid
00	Standard_Sampling Standard Sampling	1 to 1999Hz	Valid
		2000 to 4000Hz	Filter invalid
01	High-freq_Sampling High Frequency Sampling	1 to 3999Hz	Valid
		4000Hz	Filter invalid

- 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 at a fixed Torque compensation command value.
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 to set Torque Compensation Function 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

		Setting range	Unit	Standard value
36	Torque Limit Input Selection [TLSEL]	00 to 02	-	00:TCLM

- Select input system to limit Torque command limit function 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 (forward direction) side: Limited at the voltage input to F-TLA. Reverse (reverse direction) side: F- Limited at the voltage input to F-TLA.

ID	Contents			
37	Forward Direction Internal Torque Limit Value [TCLM-F]	Setting range	Unit	Standard value
		10.0 to 500.0	%	100.0
38	Reverse Direction Internal Torque Limit Value [TCLM-R]	Setting range	Unit	Standard value
		10.0 to 500.0	%	100.0

- Limits the Torque output at the 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 value is set exceeding the Maximum Instant Stall Torque (T_P) of the combining servo motor, it is limited by the Maximum Instant Stall Torque (T_P) of the combining servo motor.

- 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 sing preset torque limit.

Group	ID	Symbol	Contents
8	36	TLSEL	Torque Limit Input Selection

Setting value		
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 valid.
While the Torque limit function is valid, restricts torque.

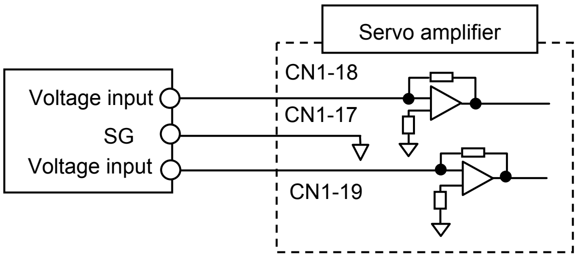
✔ When setting, be cautious about acceleration/deceleration time. If the setting value is too low, Acceleration/Deceleration torque is not sufficient for normal operation.

✔ Set at: Preset torque limit value > Acceleration/Deceleration torque.

✔ With Preset torque limit, Forward and Reverse setting values can be set independently.

◆ To use External torque limit

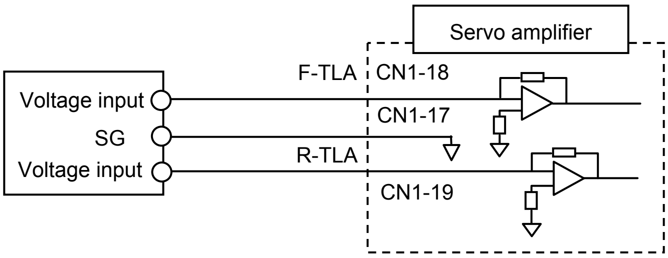
- Input External analog voltage from CN1 to restrict forward and reverse rotation torque.
  - ✔ Forward side torque limit input (F-TLA): CN1-18 input voltage range -10V to +10V
  - ✔ Reverse side torque limit input (R-TLA): CN1-19 input voltage range -10V to +10V



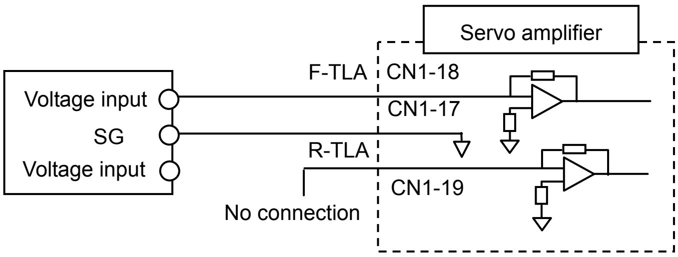
- Input voltage specification, Input signal specification is used two ways:

Group	ID	Symbol	Contents
8	36	TLSEL	Torque Limit Input Selection

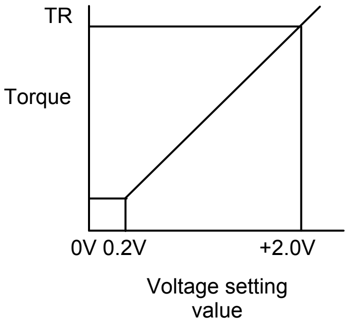
Selection		
01	Analog_1	Use external torque limit input Forward side /F-TLA Reverse side/R-TLA

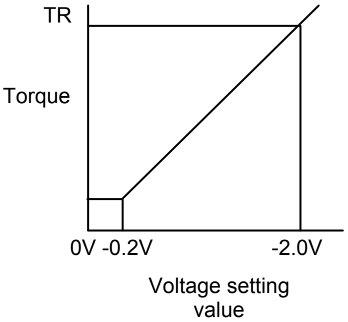


Selection		
02	Analog_2	Use external torque limit input Forward side /F-TLA Reverse side/R-TLA



◆ Input 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	Standard value
	10.0 to 500.0	%	120.0

■ Limits output torque at sequence operation.

◆ Sets the limiting torque by the ratio of rated output torque. (100.0%=rated torque)

◆ When the value is set exceeding the Maximum instant stall torque (T_P) of the combining servo motor, it is limited by the Maximum instant stall torque (T_P) of the combining servo motor.

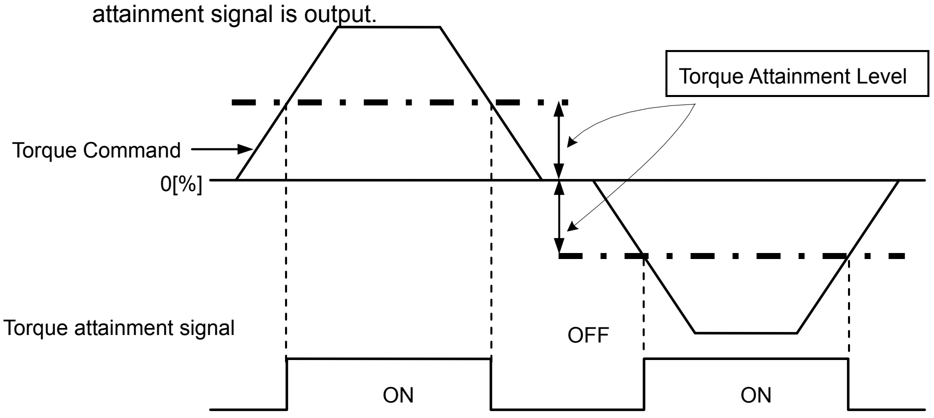
◆ During the sequence operation, Torque limit corresponds to JOG Operation, Over-Travel Action, Holding brake stand-by time, and Servo brake action.

3A

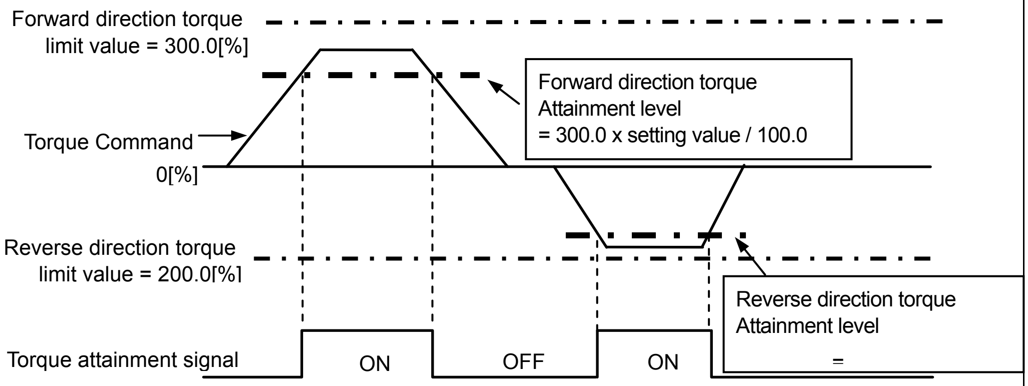
Selection of Torque Limit Input Under Voltage Sag [CPETLSEL]	Setting range	Unit	Standard value
	00 to 03	-	00:No_Limit

■ Select input system to limit Torque command limit function under voltage sag listed below:

Selection			Description
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.

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">3B</td><td rowspan="2">Torque Attainment select
[TASEL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00</td></tr>
<tr><td colspan="4">■ To select a setting rate type of attaining torque
<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>TA/TR</td><td>To set percentage of Rated torque
(Rated torque is 100%)</td></tr>
<tr><td>01</td><td>TA/TCLM</td><td>To set percentage of Torque limit value</td></tr>
</table>
</td></tr>
<tr><td rowspan="3">3C</td><td rowspan="2">Torque Attainment Setting
[TA]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 500.0</td><td>%</td><td>100.0</td></tr>
<tr><td colspan="4">■ To set the rate of Torque attainment
Target data of the ratio set in this parameter varies depending on torque attainment function selection [Group8-3B].
◆ [Torque Attainment select: 00]
● Set percentage of Rated torque (100.0%).
Therefore, once the commanded torque exceeds the setting value, Torque attainment signal is output.


◆ [Torque Attainment select: 01]
● Set percentage rate of 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 can be setup based on values of each of limited torque.


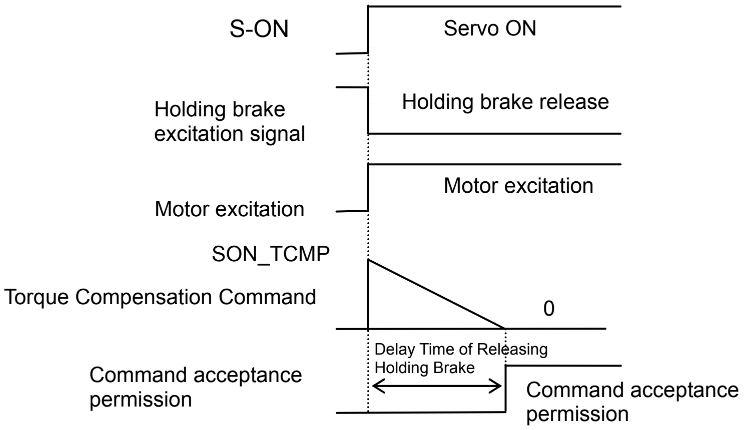
</td></tr>
</table>

ID	Contents	Setting range	Unit	Standard value
3D	Amount t of torque limit value restoration when power restored [TLMREST]	0.0 to 500.0	%	10.0

- ■ Sets the amount of restoration per 1ms when power restored from power supply drop, which can cancel torque limit value at power drop.
  - ◆ Sets the ratio to rated torque. (100.0% = rated torque)
  - ◆ When setting “0.0%,” operate as 10.0%.

ID	Contents	Setting range	Unit	Standard value
3E	Torque Compensation Command in delay time of releasing holding brake [BDLY_TCMP]	0.0	%	-100.0 to 100.0

- ■ This is to set torque addition command during the delay time up to cancel holding brake operation. This is for suppressing downward movement under own weight when changing servo-off to servo-on.
  - ◆ Setting torque addition value equivalent to the amount of gravitational loading ot external loading can suppress downward movement under own weight at servo-on setting.
  - ◆ Torque addition command works as linear interpolation so as to be 0[%] after a lapse of the delay time up to cancel holding brake operation (Group B, ID14).



ID	Contents	Setting range	Unit	Standard value
40	Near Range [NEAR]	1 to 2147483647	Pulse	500

- ■ Sets the output range of near range (near in-position) signal.
  - ◆ Outputs Near range signal when the Position deviation counter is set lower that this set value.
  - ◆ Sets at the resolution of the encoder pulse at any Electronic gear. (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, it can receive the NEAR signal before the upper device receives the In-position signal (INP), thus when In-position the necessary action can smoothly be accomplished.

  - ◆ Sets Near Range signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Purpose output*

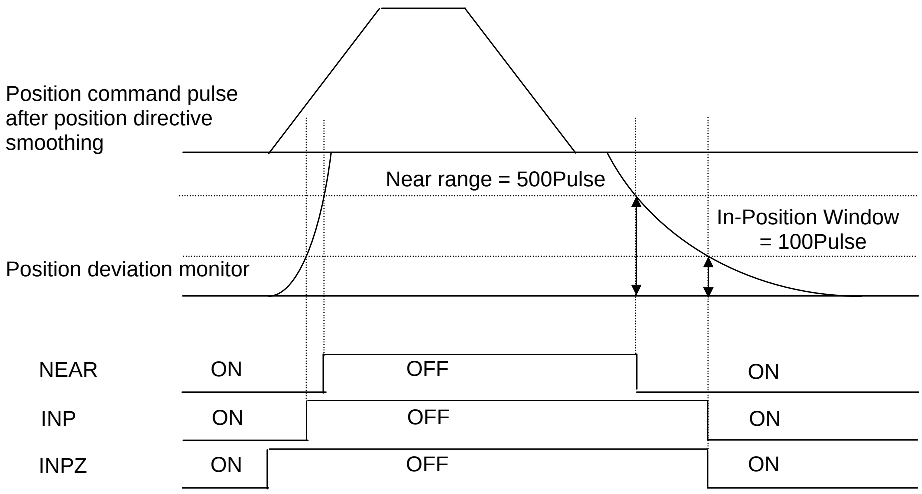
Selection		Contents
1A	NEAR_ON	Near Range Status, Output ON
1B	NEAR_OFF	Near Range Status, Output OFF

		Setting range	Unit	Standard value
41	In-Position Window [INP]	1 to 2147483647	Pulse	100

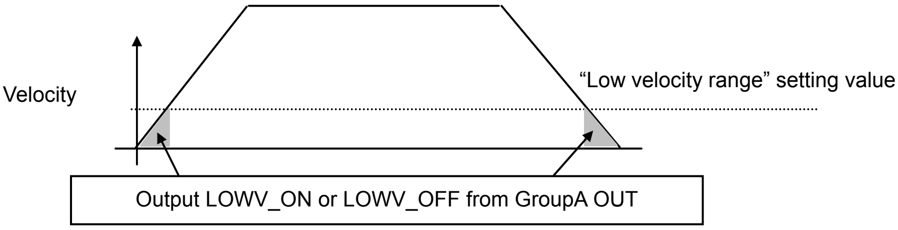
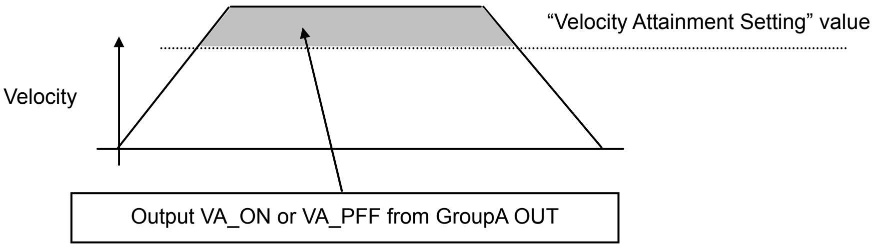
- ■ Sets output range of In-Position signal.
  - ◆ Outputs positioning completion signal when position deviation counter value is the setting value or less.
  - ◆ Sets based on the resolution of encoder pulse, regardless of any electronic gears. (This is not position command pulse resolution.)
  - ◆ Sets In-Position signal output

Group	ID	Symbol	Contents
A	0*	OUT*	Generic Purpose output*

Selection		Contents
1A	INP_ON	In-Position Status,Output ON
1B	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.

ID	Contents			
42	Speed Zero Range	Setting range	Unit	Standard value
	[ZV]	50 to 500	min^{-1}	50
	■ Setting value for detecting Zero-speed status (motor stop). ◆ When the speed becomes lower than this value, Zero-speed status is out.			
43	Low Speed Range	Setting range	Unit	Standard value
	[LOWV]	0 to 65535	min^{-1}	50
	■ Parameter for setting Low speed output range. ◆ When the speed is lower than this value, Low speed range is output.  ◆ When Auto-tuning function is valid, this setting value is not applied.			
44	Speed Attainment Setting (High Speed Range)	Setting range	Unit	Standard value
	[VA]	0 to 65535	min^{-1}	1000
	■ 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 ID09 "control mode selection",simple velocity limitation is controlled by this parameter. However, when Motor speed exceeds this setting value, as the velocity sets at zero, control of unstable velocity cannot be exercised. Avoid the use of such status to continue. 			

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">45</td><td rowspan="2">Speed Matching Unit Selection
[VCMPUS]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00_</td></tr>
<tr><td colspan="4">

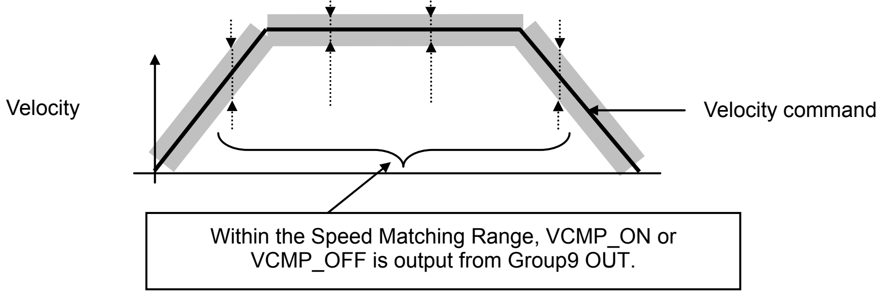
■ Selects Speed Matching Unit setting method.

<table>
<tr><th colspan="2">Selection</th><th>Contents</th></tr>
<tr><td>00</td><td>min^{-1}</td><td>Sets by unit[min^{-1}]
Uses the setting value of ID46 [VCMP] Speed Matching Range</td></tr>
<tr><td>01</td><td>Percent</td><td>Sets the ratio to velocity command by [%] unit
Uses the setting value of ID47 [VCMPR] Speed Matching Range Ratio</td></tr>
</table>

</td></tr>
<tr><td rowspan="3">46</td><td rowspan="2">Speed Matching Range
[VCMP]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 65535</td><td>min^{-1}</td><td>50</td></tr>
<tr><td colspan="4">

■ Sets the range regarded as Speed matching by the unit [min^{-1}].

- ◆ 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.

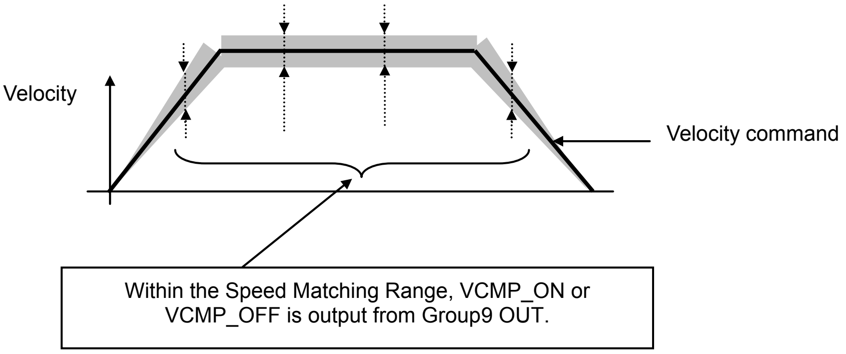


Within the Speed Matching Range, VCMP_ON or VCMP_OFF is output from Group9 OUT.

</td></tr>
<tr><td rowspan="3">47</td><td rowspan="2">Speed Matching Range Ratio
[VCMPR]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0.0 to 100.0</td><td>%</td><td>5.0</td></tr>
<tr><td colspan="4">

■ Sets the range regarded as Speed matching ratio to Velocity command by the unit [%].

- ◆ This setting is used when ID45 ”[VCMPUS] Speed Matching Unit Selection” is “01 Percent”
- ◆ Speed matching is outputted when a velocity deviation (difference of commanded velocity and real one) is in this setting range.
- ◆ The value that multiplied the velocity command by setting is a Speed matching range. When this value is less than 1[min^{-1}], the Speed matching range is treated as 1[min^{-1}].



Within the Speed Matching Range, VCMP_ON or VCMP_OFF is output from Group9 OUT.

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

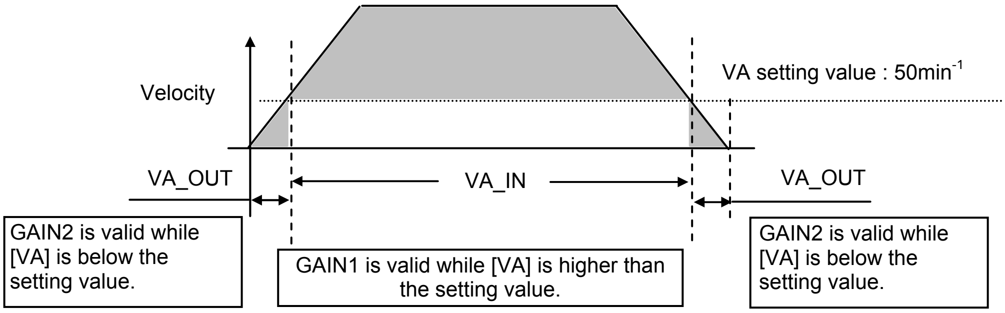
■ By combining with Group9, Condition Settings for Enabling Functions, the functions of Group9 are valid for ID42 to ID47.

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 based on “Group8 ID45, ID47” setup.

◆ Example: The servo amplifier sets the GAIN1 and GAIN2 switching without using input signal from the host unit.

- Set 15: VA_OUT to Group9 ID13 Gain Switching Condition 1 GC1.
- Set 00: Always_Disable to Group9 ID14 Gain Switching Condition 2 GC2.
- Set 50min^{-1} (arbitrary value) to Group8 ID44 Speed Attainment (High Speed setting) VA.



■ Group9 “Functions enabling condition settings”

ID	Contents	Setting range	Standard value	Functions-enabled input time
00	Positive Over Travel Function [F-OT]	00 to 27	OD:CONT6_OFF	20ms
01	Negative Over Travel Function [R-OT]	00 to 27	OB:CONT5_OFF	20ms
02	Alarm Reset Function [AL-RST]	00 to 27	10:CONT8_ON	20ms
03	Encoder Clear Function [ECLR]	00 to 27	O6:CONT3_ON	200ms
04	Deviation Clear Function [CLR]	00 to 27	O8:CONT4_ON	1ms
05	Servo-ON Function [S-ON]	00 to 27	O2:CONT1_ON	20ms
10	Control Mode Switching Function [MS]	00 to 27	00:Always_Disable	4ms
11	Position Command Pulse Inhibit Function, Velocity Command Zero Clamp Function [INH/Z-STP]	00 to 27	00:Always_Disable	20ms
12	Electronic Gear Switching Function [GERS]	00 to 27	00:Always_Disable	20ms
13	Gain Switching Condition 1 [GC1]	00 to 27	00:Always_Disable	1ms
14	Gain Switching Condition 2 [GC2]	00 to 27	00:Always_Disable	1ms
15	FF Vibration Suppressor Frequency Select Input 1 [SUPFSEL1]	00 to 27	00:Always_Disable	20ms
16	FF Vibration Suppressor Frequency Select Input 2 [SUPFSEL2]	00 to 27	00:Always_Disable	20ms
17	Position Loop Proportional Control Switching Function [PLPCON]	00 to 27	01:Always_Enable	20ms
18	Model Vibration Suppressor Frequency Select Input 1 [MDLFSEL1]	00 to 27	00:Always_Disable	20ms
19	Model Vibration Suppressor Frequency Select Input 2 [MDLFSEL2]	00 to 27	00:Always_Disable	20ms
20	Preset Velocity Command Select Input 1 [SP1]	00 to 27	00:Always_Disable	20ms
21	Preset Velocity Command Select Input 2 [SP2]	00 to 27	00:Always_Disable	20ms
22	Preset Velocity Command Select Input 3 [SP3]	00 to 27	00:Always_Disable	20ms
23	Preset Velocity Command Input Direction of Movement [DIR]	00 to 27	00:Always_Disable	20ms
24	Preset Velocity Command Operation Start Signal Input [RUN]	00 to 27	00:Always_Disable	20ms
25	Preset Velocity Command Positive (direction) Move Start Signal Input [RUN-F]	00 to 27	00:Always_Disable	20ms
26	Preset Velocity Command Negative (direction) Move Start Signal Input [RUN-F]	00 to 27	00:Always_Disable	20ms
27	Velocity Loop Proportional Control Switching Function [VLPCON]	00 to 27	O4:CONT2_ON	1ms
28	Velocity Compensation Function [V-COMPS]	00 to 27	00:Always_Disable	1ms
30	Torque Compensation Function 1 [T-COMPS1]	00 to 27	00:Always_Disable	1ms
31	Torque Compensation Function 2 [T-COMPS2]	00 to 27	00:Always_Disable	1ms
32	Torque Limit Function [TL]	00 to 27	OE: CONT7_ON	20ms
33	Disturbance Observer Function [OBS]	00 to 27	00:Always_Disable	20ms
34	Compensatory function for stick-slip behavior	00～27	00:Always_Disable	20ms
35	Minor vibration (oscillation) suppression function	00～27	00:Always_Disable	20ms
40	External Trip Input Function [EXT-E]	00 to 27	00:Always_Disable	20ms
41	Main Power Discharge Function [DISCHARG]	00 to 27	01:Always_Enable	20ms
42	Emergency Stop Function [EMR]	00 to 27	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 status
21	NEAR_OUT	Function is valid while not in Near 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 in Position command 0 and In-Position status (position deviation < INP)

■ 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

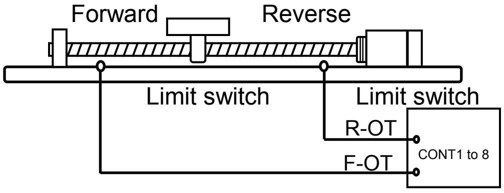
■ Activating the functions conditioning the rotating direction of servomotor or zero-speed state

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)

ID	Description
00 01	Forward Over-Travel Function [F-OT] Reverse Over-Travel Function [R-OT]

■ 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 travel function, select the operating conditions for "position command input, servo motor stop operation and servo-on signal" when over travel occurs.

Group	ID	Symbol	Description
B	11	ACTOT	Over travel operation

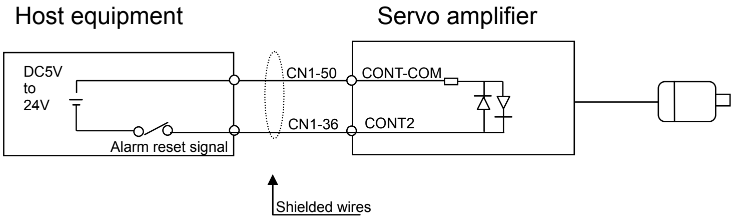
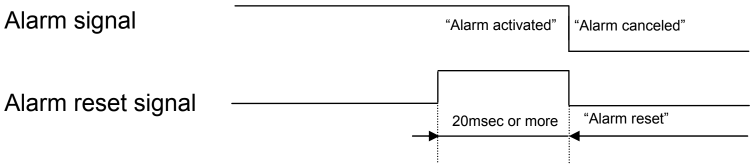
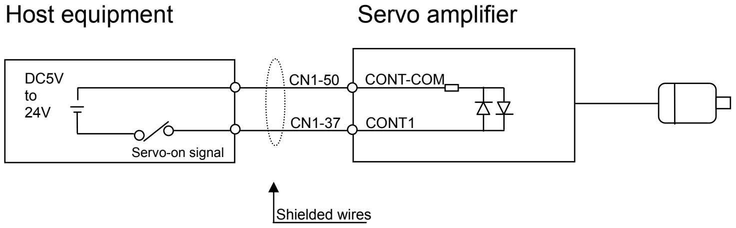
Selectable value		Contents
00	CMDINH_SB_SON	Command input is disabled, and motor is stopped by servo-braking when OT occurs. (Command from either positive or negative direction in which OT occurs, command disabled = velocity limit command = 0)
01	CMDINH_DB_SON	Command input is disabled, and motor is 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.
04	CMDINH_DB_SOFF	PC is inhibited and Dynamic-Braking is performed. After stops, S-OFF is operated 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 to the equipment on which OT occurs becomes zero when OT occurs.

◆ "Stop motor by servo-braking" when OT occurs

When selecting [00:_CMDINH_SB_SON] or [03:_CMDINH_SB_SOFF], torque value when servo-brake is working can be set by sequence operation torque limit value.

Group	ID	Symbol	Description
8	39	SQTCLM	Sequence operation torque limit value

✔ When setting the value over the maximum output torque (T_P) of servomotor combined, the torque is limited to the maximum output torque (T_P) of servomotor combined.

ID	Description
02	Alarm reset function [AL-RST] ■ 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 you can not clear the alarms that cannot be cleared unless control power supply is turned off once by alarm reset signal. ◆ The wiring when enabling conditions allocation is set to CONT2 is as follows. Logic can be changed by selecting options of enabling conditions allocation.  
05	Servo-on function [S-ON] ■ 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, this inputs servo motor into current-applied state. ◆ The wiring is as follows when setting the allocation of enabling condition to CONT1. The logic can be changed by selection of enabling condition allocation. 

<table>
<tr><th>ID</th><th>Description</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 to be combined is selected by system parameter and can be switched with control mode switch over function.

◆ Selecting control modes from system parameters ID09.

<table>
<tr><th>Page</th><th>Name</th><th>Setting range</th></tr>
<tr><td>08</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 - torque 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>

<table>
<tr><th>ID</th><th>Description</th></tr>
<tr><td rowspan="2">15
16</td><td>FF vibration suppression frequency selecting input 1 [SUPFSEL1]
FF vibration suppression frequency selecting input 2 [SUPFSEL2]</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 1 to 4 by combination of SUPFSEL1 and SUPFSEL2 setting.

<table>
<tr><td>SUPFSEL1: FF vibration suppression frequency selecting input 1</td><td>Invalid</td><td>Valid</td><td>Invalid</td><td>Valid</td></tr>
<tr><td>SUPFSEL2: FF 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 becoming valid</td><td>FF vibration suppression frequency 1 Group 2 ID00</td><td>FF vibration suppression frequency 2 Group 4 ID40</td><td>FF vibration suppression frequency 3 Group 4 ID41</td><td>FF vibration suppression frequency 4 Group 4 ID42</td></tr>
</table>

</td></tr>
<tr><td rowspan="2">17</td><td>Position loop proportional control switching function [PLPCON]</td></tr>
<tr><td>

■ 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.

◆ When Auto-tuning function is valid, this setting value is not applied.

</td></tr>
<tr><td rowspan="2">18
19</td><td>Model vibration suppression frequency selecting input 1 [MDLFSEL1]
Model vibration suppression frequency selecting input 2 [MDLFSEL2]</td></tr>
<tr><td>

■ 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 ID02
Model control resonant frequency 1 Group 3 ID03</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>

ID	Description
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 swathing. ◆ 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 (KP)/ integral time constant (TPI) ● P control (proportional control)･････ Velocity loop proportional gain (KP) ✔ Switching to proportional control decreases servo gain, and then servo system becomes stable. ✔ When setting velocity loop integral time constant (TVI) to 1000.0ms, the operation is in the state integration function is disabled (proportional control), so you do not need to use this function. ◆ When Auto-tuning function is valid, this setting value is not applied.
34	Compensatory function for stick-slip behavior [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 (oscillation) suppression function [FBHYST]
	■ Minor vibration suppression function to suppress mechanical system-induced vibration due to ±1-pulse width modulation of encoder 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 (AL55). ◆ Allocating conditions to enable external trip function. When EXT-E signal is enabled, this becomes alarm (AL55).
41	Forced discharge function [DISCHARG]
	■ This is to forcedly discharge the voltage charged in the capacitor for main circuit power supply inside of servo amplifier, when main circuit power supply is being turned off. Note that discharging cannot be performed when main circuit power supply is being turned on. ◆ Allocating conditions to enable forced discharge function. When DISCHARGE signal is enabled, capacitor is forcedly discharged.
42	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.

- ■ GroupA “General output terminal output condition/ Monitor output selection/ Serial communication settings”

ID	Contents	Setting range	Unit	Standard value
00	General Purpose Output 1 [OUT1]	00 to 5F	-	18:INP_ON
01	General Purpose Output 2 [OUT2]	00 to 5F	-	0C:TLC_ON
02	General Purpose Output 3 [OUT3]	00 to 5F	-	02:S-RDY_ON
03	General Purpose Output 4 [OUT4]	00 to 5F	-	0A:MBR-ON_ON
04	General Purpose Output 5 [OUT5]	00 to 5F	-	33:ALM5_OFF
05	General Purpose Output 6 [OUT6]	00 to 5F	-	35:ALM6_OFF
06	General Purpose Output 7 [OUT7]	00 to 5F	-	37:ALM7_OFF
07	General Purpose Output 8 [OUT8]	00 to 5F	-	39:ALM_OFF
10	Digital Monitor Output Signal Selection [DMON]	00 to 5F	-	00:Always_OFF
	■ Select 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 on either selection.

01:Always_ON	00:Always_OFF

◆ When Generic input signal status it 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
	58:S-RDY2_ON	59:S-RDY2_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

◆ 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

◆ When Warning signal is to be output

While Excessive Deviation 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 Battery Warning status	30:WNG-BAT_ON	31:WNG-BAT_OFF
While Under Voltage Sag Warning Status	5C:PEWNG_ON	5D:PEWNG_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

ID	Contents	Setting range	Unit	Standard value
11	Analog Monitor Select Output 1 [MON1]	00 to 1C	-	05:VMON_2mV/min^{-1}
12	Analog Monitor Select Output 2 [MON2]	00 to 1C	-	02:TCMON_2V/TR

■ Select output signals to output to Analog monitor 1 and 2 from the list below:

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 Control)	0.05mV/kPulse/s
14:FMON2_0.5mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	0.5mV/kPulse/s
15:FMON2_2mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	2mV/kPulse/s
16:FMON2_10mV/kP/s	Position Command Pulse Frequency Monitor 2 (Position Command Pulse Frequency for Position Control)	10mV/kPulse/s
17:TLMON_EST_2V/TR	Load Torque Monitor (Estimated Value)	2V/Rated torque
18:Sine-U	U Phase Electronic Angle Sin	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

- ◆ 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 10kHz 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 (force) monitor 250Hz
  Acceleration monitor 250Hz
  Load torque monitor 20Hz

ID	Contents			
13	Analog Monitor Output Polarity [MONPOL]	Setting range	Unit	Standard value
		00 to 08	-	00:MON1+_MON2+

- ■ Select Output polarity of Analog monitor output, MON1and MON2

  - ◆ 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.

ID	Contents	Setting range	Unit	Standard value
20	Serial Communication Axis Number [COMAXIS] Control power reactivation after setting	01 to 0F	-	01:#1

- ■ Select Axis number from below for Serial communication (RS-232C/RS-422A) with PC or upper controller:

  ◆ As this number identifies each servo amplifier, assign the different number so that the servo amplifiers connected to PC or host controller do not have the same number.

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	Contents	Setting range	Unit	Standard value
21	Serial Communication Baud Rate [COMBAUD] Control power reactivation after setting	03 to 06	-	05:38400bps

- ■ Select Communication speed (Baud rate) with PC or upper controller from below:

Selection	
03	9600bps
04	19200bps
05	38400bps
06	57600bps

ID	Contents	Setting range	Unit	Standard value
22	Latency to start sending response message	0 to 500	ms	0

- ■ When performing RS-422A-communication between controller and servo amplifier, a minimum latency to start sending response message can be set.
  - ◆Actual latency may vary to the extent of 0 to +3ms to this setting value.
    - ✔ Make sure to set “0” to communicate with setup software.

ID	Contents	Setting range	Unit	Standard value
30	Monitor Display Selection [MONDISP]	00 to 26	-	00:STATUS

- ■ Select status display on digital operator.

Selection		Description
00	STATUS	Displays status of servo amplifier. See “Servo Amplifier Status Display (5-16)” for more details.
01 to 25	WARNING1 to OPE-TIM	Select monitoring data to show on monitor function. See “Monitor function (5-23)” for more details.

■ GroupB “Sequence/Alarm related settings”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">00</td><td rowspan="2">JOG Velocity Command
[JOGVC]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 32767</td><td>min^{-1}</td><td>50</td></tr>
<tr><td colspan="4">■ Set velocity command value for JOG operation.
◆ This value is set as initial setting value for JOG Velocity Command for setup software.</td></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Dynamic Brake Operation
[DBOPE]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 05</td><td>-</td><td>04:SB_Free</td></tr>
<tr><td colspan="4">■ Select Dynamic Brake Operation when shifted from serve ON to servo OFF, and during servo OFF.
<table><tr><th colspan="2">Selection</th><th>Contents</th></tr><tr><td>00</td><td>Free_Free</td><td>When Servo OFF, Free-Run Operation
After Motor Stop, Motor-Free Operation</td></tr><tr><td>01</td><td>Free_DB</td><td>When Servo OFF, Free-Run Operation
After Motor Stop, Dynamic Brake Operation</td></tr><tr><td>02</td><td>DB_Free</td><td>When Servo OFF, Dynamic Brake Operation
After Motor Stop, Motor-Free Operation</td></tr><tr><td>03</td><td>DB_DB</td><td>When Servo OFF, Dynamic Brake Operation
After Motor Stop, Dynamic Brake Operation</td></tr><tr><td>04</td><td>SB_Free</td><td>When Servo OFF, Servo Brake Operation
After Motor Stop, Motor-Free Operation</td></tr><tr><td>05</td><td>SB_DB</td><td>When Servo OFF, Servo Brake Operation
After Motor Stop, Dynamic Brake Operation</td></tr></table>
✔ When the main circuit power supply is shut-off, the motor stops as configured at “GroupB ID12: Emergency Stop Operation [ACTEMER]” and goes with dynamic brake operation after the stopping.
Nevertheless, if it detects “Main circuit voltage sag” or “Passing BONBGN” in the process of the emergency stopping, it stops with dynamic brake operation.</td></tr>
</table>

ID	Contents	Setting range	Unit	Standard value
11	Over-Travel Action [ACTOT]	00 to 06	-	00:CMDINH_SB_SON

■ Select operations at over-travel action

Selection		Contents
00	CMDINH_SB_SON	When in Over-travel action, Command input is invalid and servo brake stops servo motor. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
01	CMDINH_DB_SON	When in Over-travel action, Command input is invalid and dynamic brake stops servo motor. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
02	CMDINH_Free_SON	When in Over-travel action, Command input is invalid and Free run is operated. After servo motor stops, servo is ON. (command at OT side = velocity limit command =0)
03	CMDINH_SB_SOFF	When in Over-travel action, Command input is invalid and servo brake stops servo motor. After servo motor stops, servo is OFF.
04	CMDINH_DB_SOFF	When in Over-travel action, Command input is invalid and dynamic brake stops servo motor. After servo motor stops, servo is OFF.
05	CMDINH_Free_SOFF	When in Over-travel action, Command input is invalid and Free run is operated. After servo motor stops, servo is OFF.
06	CMDACK_VCLM=0	When in Over-travel action, Command input to the Over -travel side is 0.

- ◆ Torque limit value to stop servo motor by servo brake is the setting value of sequence Torque limit.
- ◆ Select from 00-05 under Velocity control mode.
- ◆ Under Torque control mode, operations are as follows:
  - ● When selection is 00 -02, keeps servo ON status while limiting Torque command by sequence torque limit.
  - ● When selection is 03 –04, servo is OFF and Dynamic brake operates. After servo motor stop, servo OFF status is kept.
  - ● When selection is 05, servo is OFF and free-run is operated. After servo motor stops, servo-OFF status is kept.

ID	Contents	Setting range	Unit	Standard value
12	Emergency Stop Operation [ACTEMR]	00 to 01	-	00:SERVO-BRAKE

■ Sets operation at Emergency Stop

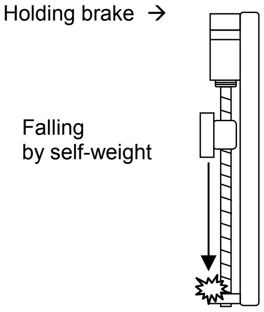
- ◆ From the following contents, select operation at the time of emergency stop (EMR, main power OFF). Besides, in usage by a vertical axis, please use it with standard setting 00: _SERVO-BRAKE).
- ◆

Selection		Contents
00	SERVO-BRAKE	At the time of EMR-input, main circuit power shutdown, alarm activated, or safe torque off operation, stop servo motor by operating servo brake, and then dynamic brake is activated after servo motor stopped.
01	DYNAMIC-BRAKE	At the time of EMR-input, main circuit power shutdown, alarm activated, or safe torque off operation, stop servo motor by operating dynamic brake, and the dynamic brake continues to be activated even after servo motor stopped.

- ◆ Under Torque control mode, dynamic brake stops servo motor regardless of the setting value.
- ◆ Alarm whose “stop operation” when alarm activated is DB, stops servo motor by dynamic brake regardless of this setting.
  - ✔ Forced stop operation means “emergency stop function enabled,” “main circuit power shutoff, “ ”alarm activated,” and “safe-torque-off operation.”

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">13</td><td rowspan="2">Delay Time of Engaging Holding Brake
(Holding Brake Holding Delay time)
[BONDLY]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 1000</td><td>ms</td><td>300</td></tr>
<tr><td colspan="4">■ Sets 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, Group8 ID10 [DBOPE] Dynamic Brake Operation, when servo brake is ON at servo OFF, (04 SB_Free or 05 SB_DB), it is valid.
(This function is invalid in Dynamic brake operation and Free-run operation.)</td></tr>
<tr><td rowspan="3">14</td><td rowspan="2">Delay Time of Releasing Holding Brake
(Holding Brake Releasing Delay time)
[BOFFDLY]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 1000</td><td>ms</td><td>300</td></tr>
<tr><td colspan="4">■ Sets 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.</td></tr>
<tr><td rowspan="3">15</td><td rowspan="2">Brake Operation Beginning Time
[BONBGN]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 65535</td><td>ms</td><td>10000</td></tr>
<tr><td colspan="4">■ 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.</td></tr>
</table>

■ About Holding Brake

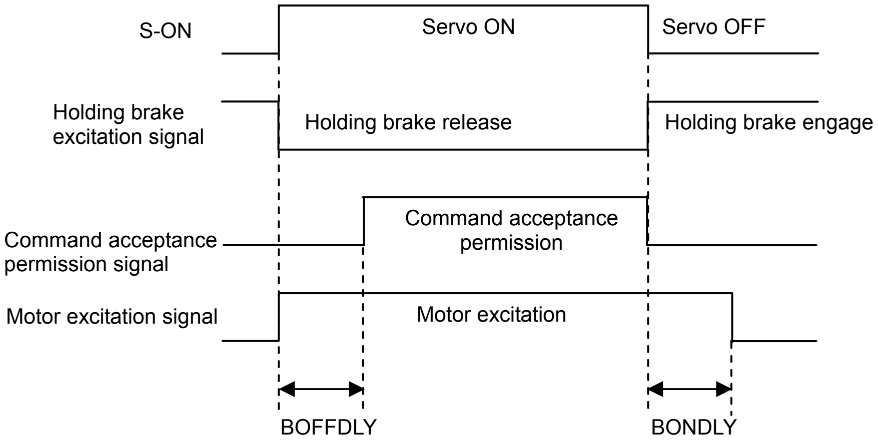


Servo motor with Holding brake function is usually used with an axis that is always affected by gravity and external forces in order to avoid movable parts falling off from its position when main circuit power is OFF, or servo OFF.
Holding brake is to support the movable parts against gravity and other 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.



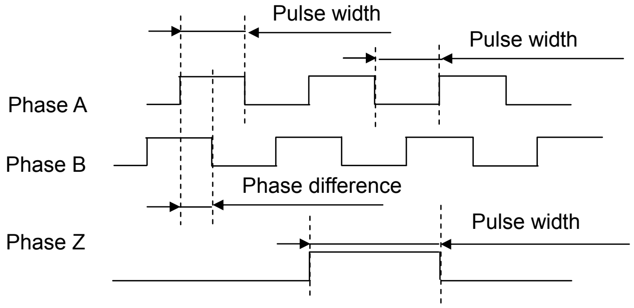
<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">16</td><td rowspan="2">Power Failure Detection Delay Time
[PFDDLY]
Control power reactivation after setting</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>20 to 1000</td><td>ms</td><td>32</td></tr>
<tr><td colspan="4">■ 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.</td></tr>
<tr><td rowspan="3">19</td><td rowspan="2">Power Off Detection Delay Time
[POFFDLY]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0</td><td>ms</td><td>0 to 1000</td></tr>
<tr><td colspan="4">■ This is to set the delay time that elapses before powering-off state detection after main circuit power supply disconnection.
◆ The powering-off state has been detected after a lapse of the delay time up to detect power failure (GroupB-16). With this parameter, powering-off detection can be controlled separately from control power supply failure detection.
◆ When the setting value is 0ms, powering-off state is detected after a lapse of the delay time up to detect power failure. (Backward Compatible)</td></tr>
<tr><td rowspan="3">20</td><td rowspan="2">Excessive Deviation Warning Level
[OFWLV]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>2147483647</td></tr>
<tr><td colspan="4">■ Sets Warning output level before Excessive position deviation alarm is output.
◆ Sets at Encoder pulse resolution regardless of Electronic gear.</td></tr>
<tr><td rowspan="3">21</td><td rowspan="2">Deviation Counter Overflow Value
[OFLV]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>1 to 2147483647</td><td>Pulse</td><td>5000000</td></tr>
<tr><td colspan="4">■ Sets Position deviation value regarded as Excessive position deviation alarm.
◆ Sets at Encoder pulse resolution regardless of Electronic gear.</td></tr>
<tr><td rowspan="3">22</td><td rowspan="2">Overload Warning Level
[OLWLV]
Control power reactivation after setting</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>20 to 100</td><td>%</td><td>90</td></tr>
<tr><td colspan="4">■ Sets 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.</td></tr>
<tr><td rowspan="3">23</td><td rowspan="2">Velocity Feedback Alarm (ALM_C3) Detection
[VFBALM]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>01:Enabled</td></tr>
<tr><td colspan="4">■ Selects Valid/Invalid Velocity feedback 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></td></tr>
<tr><td rowspan="3">24</td><td rowspan="2">Velocity Control Alarm (ALM_C2) Detection
[VCALM]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>00 to 01</td><td>-</td><td>00:Disabled</td></tr>
<tr><td colspan="4">■ 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>
</table>

- ■ GroupC “Encoder related settings”

ID	Contents	Setting range	Unit	Standard value
00	Motor Pulse Encoder Digital Filter [ENFIL]	00 to 07	-	01:220nsec

■ This parameter is settable only when using pulse encoder.
Sets Digital filter to motor Pulse 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	Standard value
01	External Pulse Encoder Digital Filter [EX-ENFIL]	00 to 07	-	01:220nsec

■ This parameter is settable only when using fully closed control function.
Sets Digital filter to External Pulse 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
05	150nsec	Minimum Pulse Width = 150nsec
06	300nsec	Minimum Pulse Width = 300nsec
07	600nsec	Minimum Pulse Width = 600nsec

ID	Contents			
02	External Pulse Encoder Polarity Selection [EX-ENPOL] Control power reactivation after setting	Setting range	Unit	Standard value
		00 to 07	-	00:Type1

■ This parameter is settable only when using fully closed control function.
- ◆ Select External pulse 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

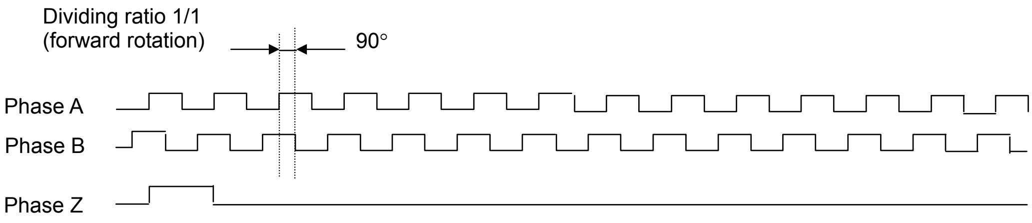
ID	Contents			
03	Encoder Output Pulse Divide Selection [PULOUTSEL] Control power reactivation after setting	Setting range	Unit	Standard value
		00 to 01	-	00:Motor_Enc.

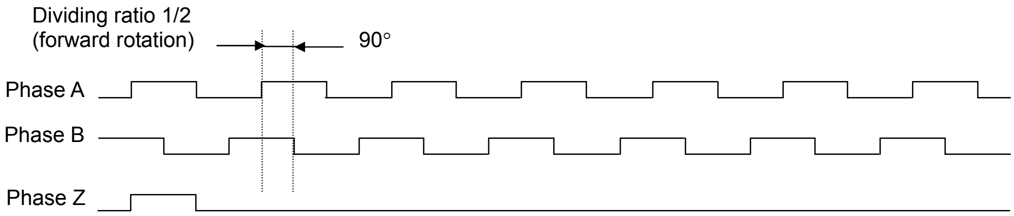
■ Sets Encoder output pulse division signal.
Select Motor encoder or External encoder to load Encoder pulse to upper device.

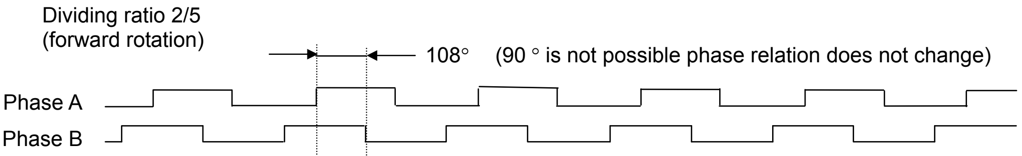
Selection		
00	Motor_Enc	Motor Encoder
01	External_Enc	External Encoder

ID	Contents	Setting range	Unit	Standard value
04	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	Setting range	Unit	Standard value
05	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	Standard value
06	Encoder Output Pulse Divide Resolution Selection [PULOUTRES] Control power reactivation after setting	00 to 01	-	00:32768P/R

■ This parameter is settable only when using serial 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	Standard value
07	Encoder Signal Output(PS) Format [PSOFORM] Control power reactivation after setting	00 to 01	-	00:MOT_Binary

■ Sets signal format of Encoder signal output (PS).

Selection		Contents
00	MOT_Binary	Motor Encoder Binary Code Output
01	MOT_ASCII	Motor Encoder Decimal ASCII Code Output

ID	Contents	Setting range	Unit	Standard value
08	Encoder Clear Function Selection [ECLRFUNC]	00 to 01	-	00:Status_MultiTurn

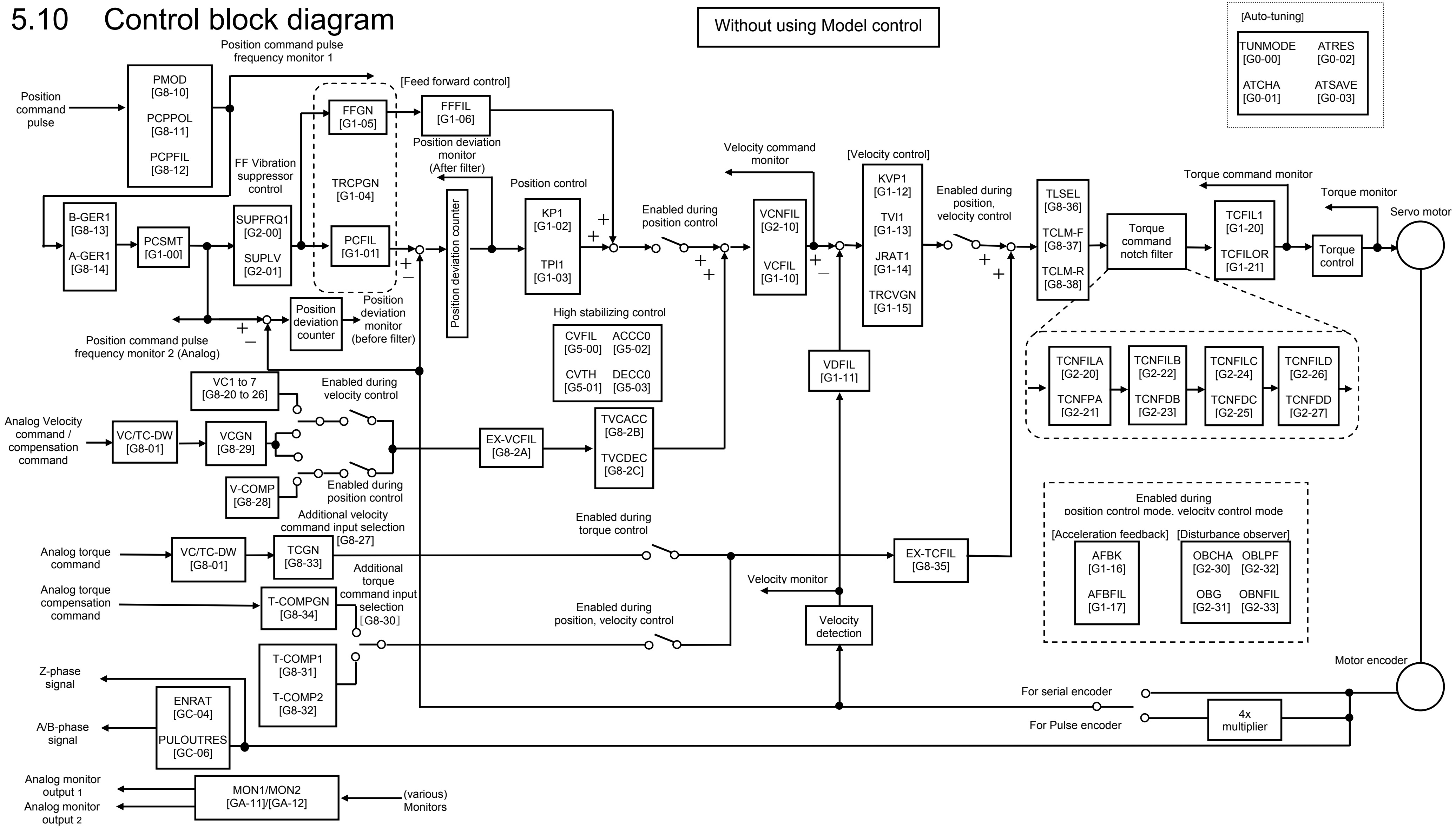
■ This parameter is settable only when using serial encoder.

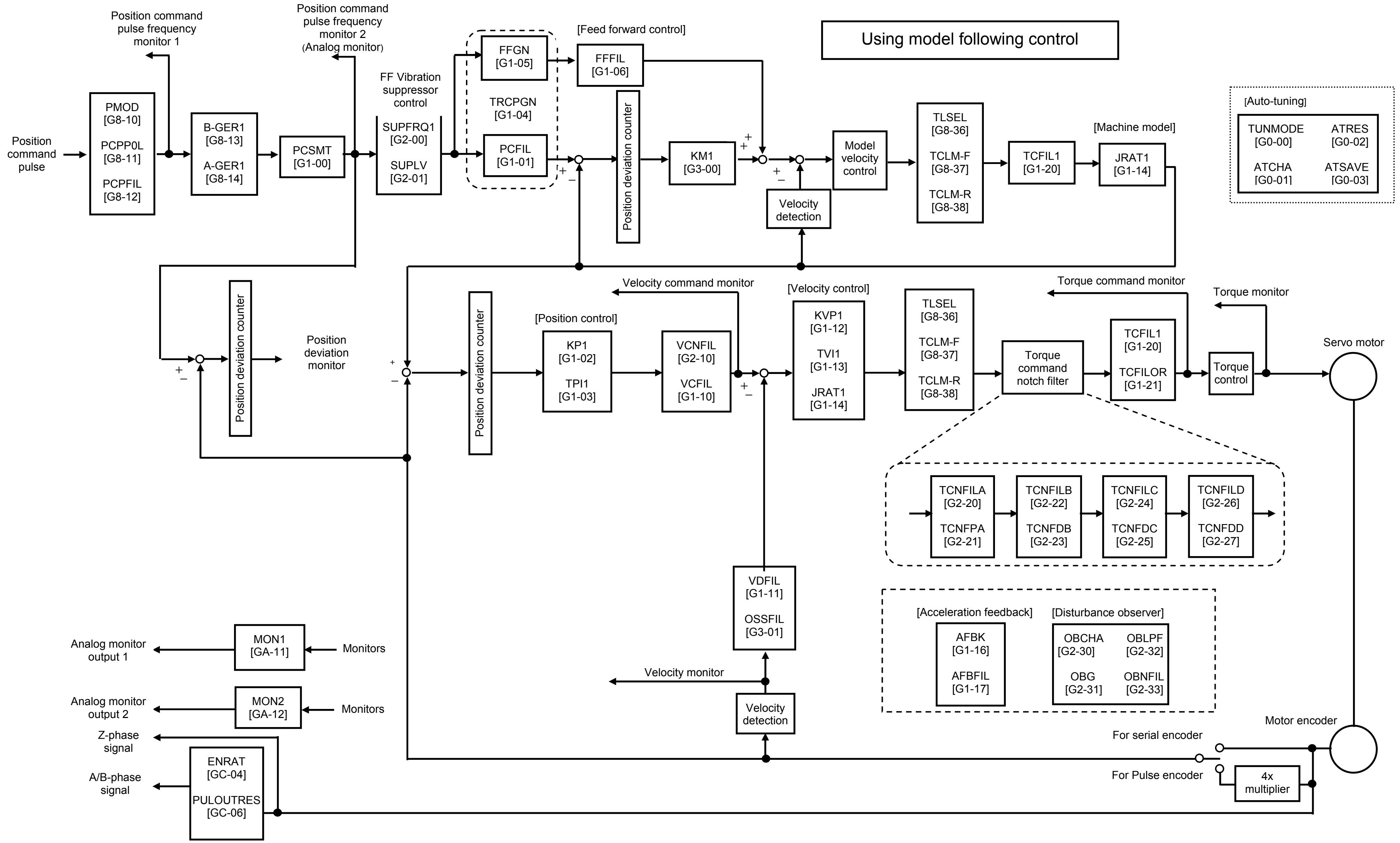
- This is effective when using battery backup absolute encoder and battery-less absolute encoder.
- When using absolute encoder for incremental system, “clear only encoder status” is set even if “00: Status_MultiTurn” is selected.
- For the case a serial encoder with multiple rotations is used, clearing the encoder cannot clear the single-rotation part of the serial encoder.

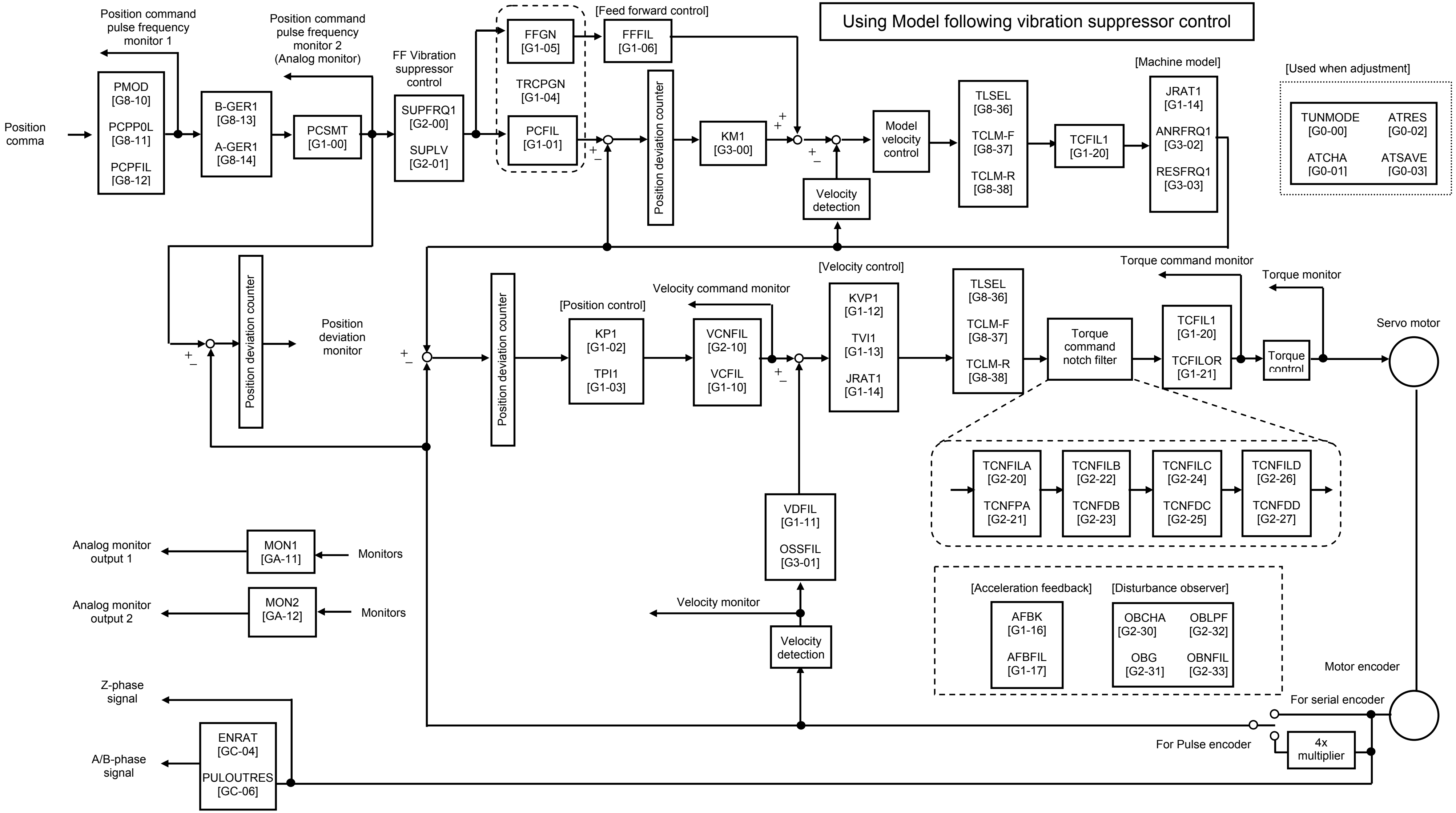
Selection		Contents
00	Status_MultiTurn	Clear Encoder Status (Alarm and Warning) and Multi Turn Data
01	Status	Clear Only Encoder Status (Alarm and Warning)

<table>
<tr><th>ID</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="3">10</td><td rowspan="2">Mask Level of Encoder Connector 1 Disconnection Alarm
[DE1MSKLVL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 10000</td><td>kHz</td><td>0</td></tr>
<tr><td colspan="4">■ This is to set encoder pulse frequency (1 multiplied) masking the detection of Encoder connector 1 disconnection alarm (Alarm code: 81).
◆ This is mainly for linear motors. When you use high-resolution encoder, the Encoder connector 1 disconnection alarm could be activated as the encoder pulse frequency increases, depending on specifications of encoder you use. In this case please change this value.
◆ Encoder connector 1 disconnection alarm is not detected while encoder frequency exceeds the set value.
◆ When you set to 0 [kHz], Encoder connector 1 disconnection alarm is detected at any frequency.</td></tr>
<tr><td rowspan="3">11</td><td rowspan="2">Mask Level of Encoder Connector 2 Disconnection Alarm
[DE3MSKLVL]</td><td>Setting range</td><td>Unit</td><td>Standard value</td></tr>
<tr><td>0 to 10000</td><td>kHz</td><td>0</td></tr>
<tr><td colspan="4">■ This is to set encoder pulse frequency (1 multiplied) masking the detection of Encoder connector 2 disconnection alarm (Alarm code: 83).
◆ When you use external high-resolution encoder for the purpose of fully-closed controlling, the Encoder connector 2 disconnection alarm could be activated as the encoder pulse frequency increases, depending on specifications of encoder you use. In this case please change this value.
◆ Encoder connector 2 disconnection alarm is not detected while encoder frequency exceeds the set value.
◆ When you set to 0 [kHz], Encoder connector 2 disconnection alarm is detected at any frequency.</td></tr>
</table>

5.10 Control block diagram




Using model following control
Position command pulse frequency monitor 1
Position command pulse frequency monitor 2 (Analog monitor)
FF Vibration suppressor control
[Feed forward control]
Position command pulse
PMOD [G8-10]
PCPP0L [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Model velocity control
Velocity detection
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
[Machine model]
JRAT1 [G1-14]
[Auto-tuning]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Position deviation counter
Position deviation monitor
Position deviation counter
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
Velocity command monitor
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
Torque command monitor
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque monitor
Torque control
Servo motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
[Acceleration feedback]
AFBK [G1-16]
AFBFIL [G1-17]
[Disturbance observer]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Analog monitor output 1
MON1 [GA-11]
Monitors
Analog monitor output 2
MON2 [GA-12]
Monitors
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]
Motor encoder
For serial encoder
For Pulse encoder
4x multiplier
+
−


Using Model following vibration suppressor control
Position comma
Position command pulse frequency monitor 1
PMOD [G8-10]
PCPP0L [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
Position command pulse frequency monitor 2 (Analog monitor)
PCSMT [G1-00]
FF Vibration suppressor control
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
[Feed forward control]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
+
+
+
−
+
−
Model velocity control
Velocity detection
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
[Machine model]
JRAT1 [G1-14]
ANRFRQ1 [G3-02]
RESFRQ1 [G3-03]
[Used when adjustment]
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
+
−
Position deviation counter
Position deviation monitor
+
−
Position deviation counter
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
Velocity command monitor
VCNFIL [G2-10]
VCFIL [G1-10]
+
−
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
Torque command monitor
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque monitor
Torque control
Servo motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
[Acceleration feedback]
AFBK [G1-16]
AFBFIL [G1-17]
[Disturbance observer]
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Analog monitor output 1
MON1 [GA-11]
Monitors
Analog monitor output 2
MON2 [GA-12]
Monitors
Motor encoder
For serial encoder
For Pulse encoder
4x multiplier
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTRES [GC-06]

5.11 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.

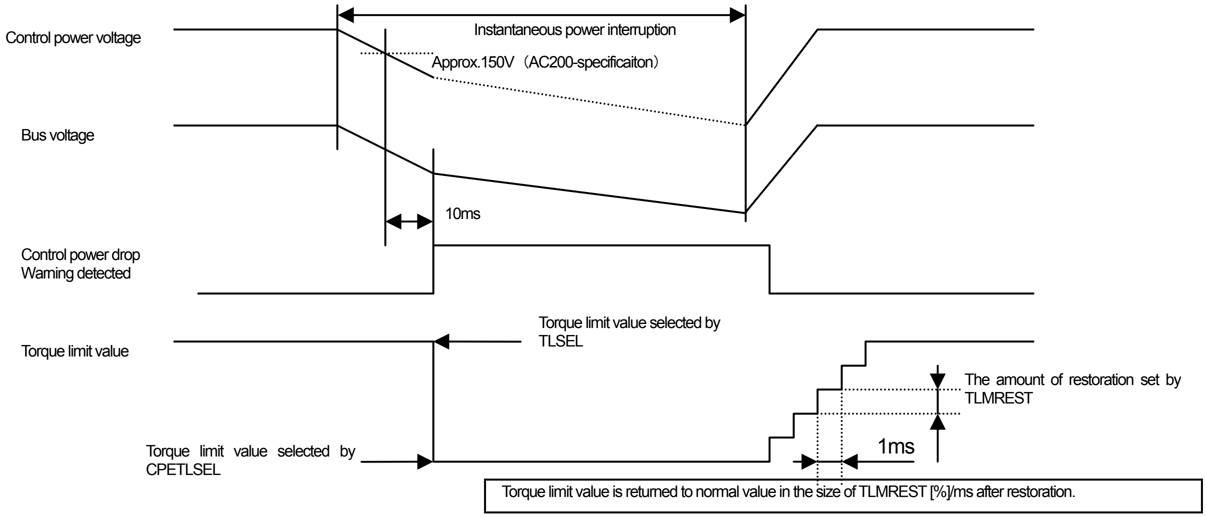
1) Parameter setting

General parameters Group8 "Control system"

ID	Symbol	Name	Standard setting 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

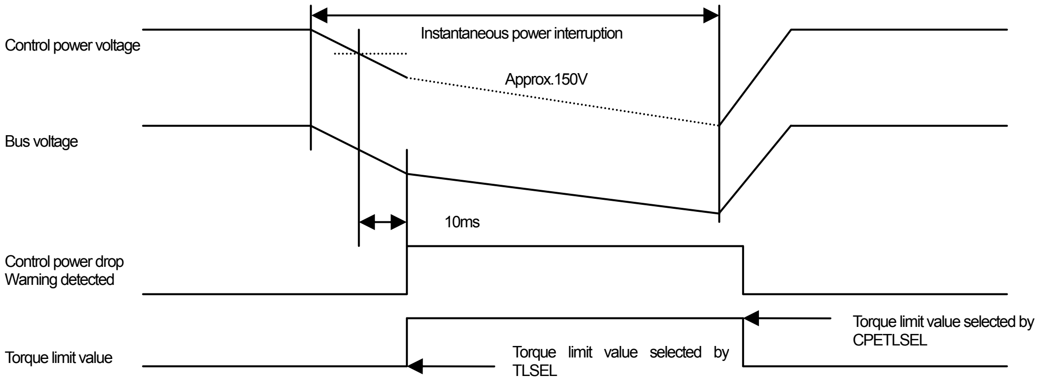
2) Operational sequence

This shows the operational sequence from detecting warning of low control power voltage to restoration of control power voltage.



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.



✔ This function is supposed to limit motor torque when in power failure and does not support all the load or operating conditions. Check if it properly works on the actual machines before the actual use.

6

6. Adjustments

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:

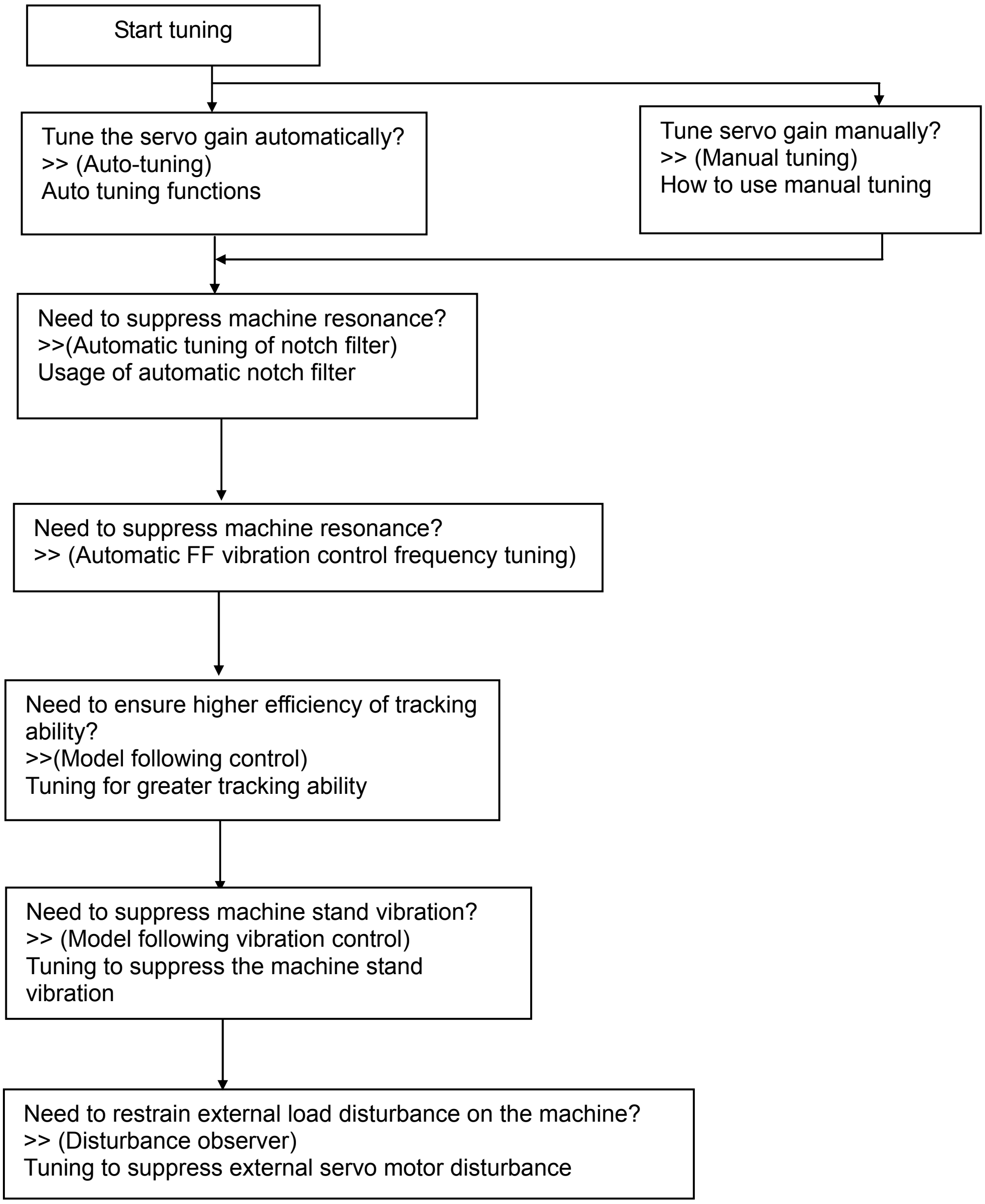
1) Servo tuning functions

- ■ Servo gain tuning procedure
  Servo gain tuning is performed as follows:
  - ◆ 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.
- ■ Vibration suppression of mechanical system
  - ◆ Automatic tuning of FF Vibration Suppression Frequency
    This is used to obtain the vibration frequency when FF vibration suppression control is initiated.
  - ◆ Automatic tuning of notch filter
    This method is used for suppressing high frequency resonance caused by coupling and/or rigidity of the mechanical system using a notch filter.

- **Model following control**
  Model following control is a control method that ensures a higher detection 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.
  - ◆ Model following control
    Use Model control system to ensure higher detection response.
  - ◆ Model following vibration suppression control
    Use the model control system to ensure a higher detection response by suppressing the machine stand vibration.

2) Tuning method selection procedure

The selection procedure is displayed in the following chart:



✔ Depending on the combination of these functions, use of more than two (2) methods jointly will invalidate the procedure.

6.2 Automatic tuning

1) Use the following parameters for automatic tuning

Explanation of Automatic tuning functions

- ■ Use the following parameters for Automatic tuning”
  (For explanation of parameters, see following pages)

◆ Group0 ID00 [Tuning Mode]

00:_AutoTun	Automatic Tuning
01:_AutoTun_JRAT-Fix	Automatic Tuning [JRAT manual setting]
02:_ManualTun	Manual Tuning

◆ Group0 ID01 [Auto-Tuning Characteristic]

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)

◆ Group0 ID02 [Auto-Tuning Response]

1 to 30	Automatic Tuning Response

◆ Group0 ID03 [Auto-Tuning Automatic Parameter Saving]

00:_Auto_Saving	Automatically Saves in JRAT1
01:_No_Saving	Automatic Saving is Invalid

■ Explanation for each parameter

ID	Contents
00	Tuning Mode [TUNMODE]
	<table><tr><th colspan="2">Selection</th><th>Meaning</th></tr><tr><td>00</td><td>AutoTun</td><td>Automatic 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 for the servo amplifier to automatically tune vary depending on selected auto-tuning characteristics. ◆ 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. [01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting] <table><tr><th colspan="2">Selection</th><th>Meaning</th></tr><tr><td>01</td><td>AutoTun_JRAT-Fix</td><td>Automatic Tuning [JRAT manual setting]</td></tr></table>◆ Based on the Load inertia moment ratio (JRAT1) [Group1 ID14], 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 the selected auto-tuning characteristics. <table><tr><th colspan="2">Selection</th><th>Meaning</th></tr><tr><td>02</td><td>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.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">01</td><td>Auto-Tuning Characteristic [ATCHA]</td></tr>
<tr><td>
■ Auto-Tuning Characteristic to fit the mechanical requirements and movements are provided. Parameters that can be adjusted vary depending on each auto-tuning characteristic. Set 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 point by 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.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>00</td><td>Positioning 1</td><td>Positioning Control 1(General Purpose)</td></tr>
</table>
◆ Select for general positioning purposes.
◆ Parameters shown in table 2 cannot be adjusted manually.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>01</td><td>Positioning 2</td><td>Positioning Control 2(High Response)</td></tr>
</table>
◆ Select for high response positioning.
◆ Parameters shown in table 2 cannot be adjusted manually.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>02</td><td>Positioning 3</td><td>Positioning control 3(High Response, FFGN Manual Setting)</td></tr>
</table>
◆ Select this mode to adjust FFGN manually.
◆ The following parameter adjustment is made manually:
General parameters GROUP1 [Basic control parameter settings]
<table>
<tr><th>ID</th><th>Symbol</th><th>Name</th></tr>
<tr><td>05</td><td>FFGN</td><td>Feed Forward Gain</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td rowspan="2">01</td><td>Auto-Tuning Characteristic [ATCHA]</td></tr>
<tr><td>
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>03</td><td>Positioning 4</td><td>Positioning control 4(High Response, Horizontal Axis Limited)</td></tr>
</table>
◆ 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 2 cannot be adjusted manually.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>04</td><td>Positioning 5</td><td>Positioning control 5 (for high response, horizontal axis only, FFGN manual setting)</td></tr>
</table>
◆ Select this mode when the machine movement is on a horizontal axis and receives no disturbing influence from external sources or when you want to adjust FFGN manually.
◆ Positioning time may be shortened compared to “Positioning control 2”.
◆ The following parameter adjustment is done manually.
General parameters GROUP1 [Basic Control Parameter Settings]
<table>
<tr><th>ID</th><th>Symbol</th><th>Name</th></tr>
<tr><td>05</td><td>FFGN</td><td>Feed Forward Gain</td></tr>
</table>
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>05</td><td>Trajectory1</td><td>Trajectory Control 1</td></tr>
</table>
◆ Select this mode for single axis use. The response of each axis can be different.
◆ Parameters shown in table 2 cannot be adjusted manually.
<table>
<tr><th colspan="2">Selection</th><th>Meaning</th></tr>
<tr><td>06</td><td>Trajectory2</td><td>Trajectory Control 2 (KP, FFGN Manual Setting)</td></tr>
</table>
◆ Select this mode when you need equal responses from multiple axes, respectively. Adjust KP, FFGN.
◆ The following parameter adjustment is done manually.
General parameters GROUP1 [Basic control parameter settings]
<table>
<tr><th>ID</th><th>Symbol</th><th>Name</th></tr>
<tr><td>02</td><td>KP1</td><td>Position Loop Proportional Gain 1</td></tr>
<tr><td>05</td><td>FFGN</td><td>Feed Forward Gain</td></tr>
</table>
</td></tr>
<tr><td rowspan="2">02</td><td>Auto-Tuning Response [ATRES]</td></tr>
<tr><td>■ Select this mode when Auto-tuning and Auto-tuning [JRAT manual setting] are used.
■ As the setting value rises, the response increases.
Set the value suitable for equipment rigidity.
■ This does not function for manual tuning.</td></tr>
<tr><td rowspan="2">03</td><td>Auto-Tuning Automatic Parameter Saving [ATSAVE]</td></tr>
<tr><td>■ Load inertia moment ratio obtained from the result of auto-tuning is automatically saved in parameter JRAT1 every two (2) hours.
■ The value is effective when auto-tuning is used.
This does not function for [JRAT manual setting].</td></tr>
</table>

2) Automatically adjusted parameters in auto-tuning

The following parameters are automatically adjusted at the time of auto-tuning. These parameters will not reflect on motor movements by changing or overriding those values. However, some of them can be adjusted manually depending on selected [Tuning Mode] and [Auto-Tuning Characteristic].

■ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Notes
02	KP1	Position Loop Proportional Gain 1	Note 1) 2)
05	FFGN	Feed Forward Gain	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)
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain	
1C	AFBK	Acceleration Feedback Gain	
20	TCFIL1	Torque Command Filter 1	

Note 1) Manual setting is available on Trajectory Control 2 (KP, FFGN Manual Setting).
Note 2) Manual setting is available on Positioning Control 3
(High Response, FFGN Manual Setting).
Manual setting is available on “Positioning Control 5”
(High Response, Horizontal Axis Limited, FFGN Manual Setting).
Note 3) Manual setting is available on auto-tuning [JRAT manual setting].

■ General parameters Group3 [Model following control settings]

ID	Symbol	Name
00	KM1	Model Control Gain 1

Note 4) This is valid when Model following control is used.

■ General parameters Group8 [Control system settings]

ID	Symbol	Name	Notes
43	LOWV	Low Speed Range	Note 5)

Note 5) 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].

■ General parameters Group9 [Function enabling condition settings]

ID	Symbol	Name
17	PLPCON	Position Loop Proportional Control Switching Function
27	VLPCON	Velocity Loop Proportional Control Switching Function

3) Adjustable parameters during auto-tuning

The following 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
06	FFFIL	Feed Forward Filter
10	VCFIL	Velocity Command Filter
11	VDFIL	Velocity Feedback Filter
21	TCFILOR	Torque Command Filter Order

■ General parameters Group2 [FF vibration suppression control/ Notch filter/ Disturbance observer settings]

ID	Symbol	Name
00	SUPFRQ1	FF Vibration Suppression Frequency 1
01	SUPLV	FF Vibration Suppression Level Selection
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

■ General parameters Group4 [Gain switching control/Vibration suppression frequency switching settings]

ID	Symbol	Name
40	SUPFRQ2	FF Vibration Suppression Frequency 2
41	SUPFRQ3	FF Vibration Suppression Frequency 3
42	SUPFRQ4	FF Vibration Suppression Frequency 4

■ 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

4) Unstable 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
17	PLPCON	Position Loop Proportional Control Switching Function
26	VLPCON	Velocity Loop Proportional Control Switching Function
33	OBS	Disturbance Observer Function

✔ [Disturbance observer] cannot be used together with auto-tuning at the same time.
Make Group9 ID33 [Disturbance observer] function invalid when auto-tuning is used.

■ General parameters Group1 [Basic control parameter setting]

ID	Symbol	Name
04	TRCPGN	Higher Tracking Control Position Compensation Gain
15	TRCVGN	Higher Tracking Control Velocity Compensation Gain
16	AFBK	Acceleration Feedback Gain

■ General parameters Group 8 [Control system settings]

ID	Symbol	Name
43	LOWV	Low Speed Range

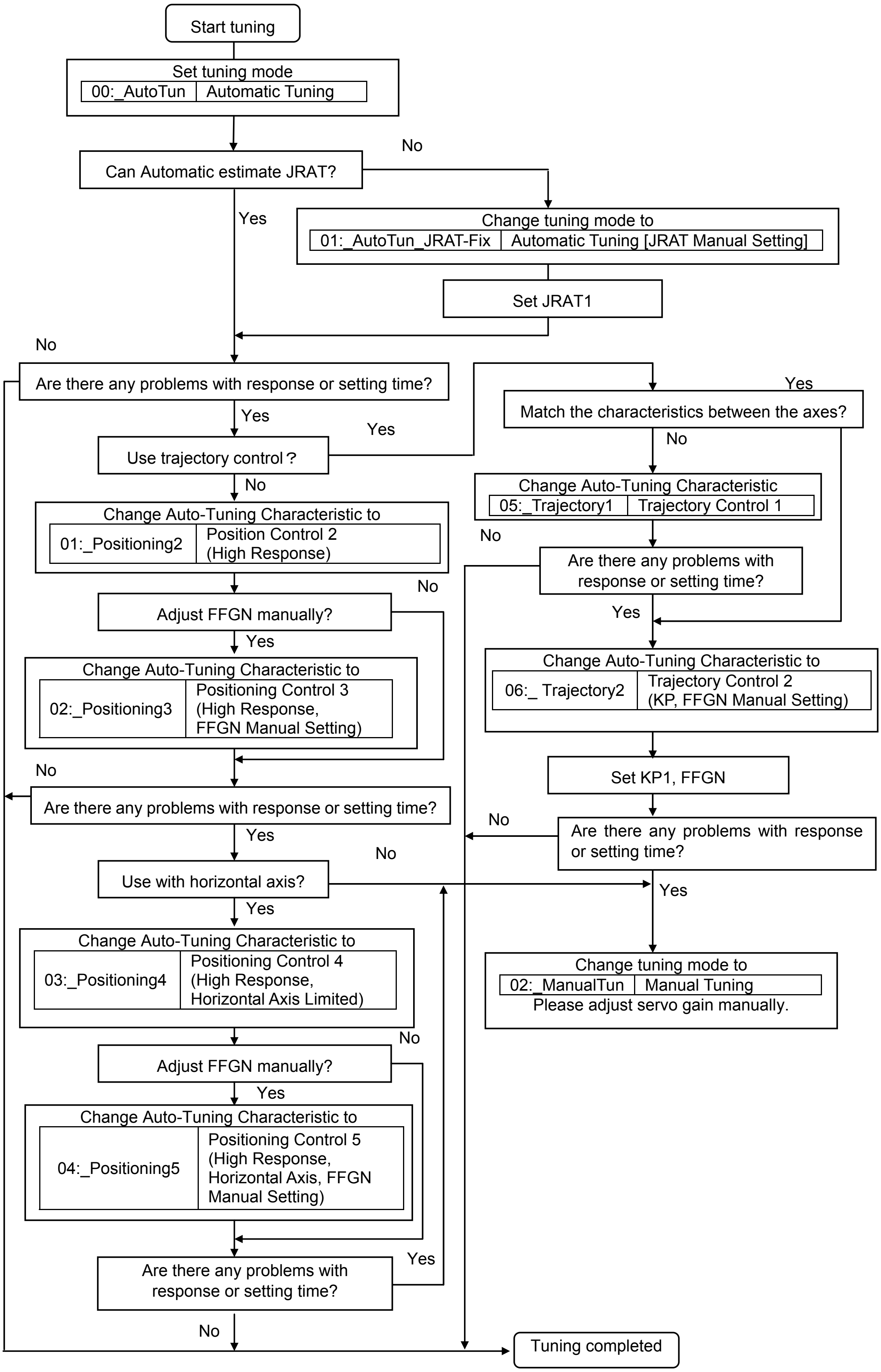
✔ Manual setting is available on "00: Positioning Control 1 (General Purpose)", "01: Positioning Control 2 (High Response)", "02: Positioning Control 3 (High Response, FFGN Manual Setting)", "05: Trajectory Control 1" or "06: Trajectory Control 2 (KP,FFGN Manual Setting)" are selected at the Auto-Tuning Characteristic [ATCHA].

■ General parameters Group 3 [Model following control settings]

ID	Symbol	Name
02	ANRFRQ1	Model Control Antiresonance Frequency 1
03	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".

5) Auto-tuning characteristic selection flowchart



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	■ Set “tuning mode” to “00:_AutoTun automatic tuning” to estimate load inertia moment ratio by servo amplifier on a real-time basis, and then automatically adjust servo gain. Set “auto-tuning mode” to 01:_AutoTun_JRAT-Fix Automatic Tuning [JRAT Manual Setting] to automatically adjust optimum servo gain based on manually set load inertia moment 1 ratio (JRAT1).
Procedure 2	■ After setting [Tuning Mode] select [Auto-Tuning Characteristic] for the machine or equipment.
Procedure 3	■ Next, boot the servo motor and adjust [Auto-Tuning Response] according to equipment rigidity. ◆ Set [Auto-Tuning Response] at a low value initially and allow the machine to work about 10 times or more by commanding higher-rank equipment. ◆ When response is low and the positioning setting time is slow, after machine movement, try to improve the response and positioning times by increasing [Auto-tuning] gradually. ◆ If increasing the response has caused the machine to develop vibration, lower the value of the [Auto-Tuning Response] 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 [Automatic tuning of notch filter] and/or [Automatic tuning of FF Vibration Suppression Frequency]. ✔ Tuning methods are the same in [01:_AutoTun_JRAT-Fix [JRAT Manual Setting].

7) Monitoring servo gain adjustment parameters

Parameters automatically adjusted when using auto-tuning can be monitored with Digital Operator, setup software. Refer to [Digital operator (7)] for use of Digital Operator.

ID	Symbol	Name	Unit
1D	JRAT MON	Load Inertia Moment Ratio monitor	%
1E	KP MON	Position Loop Proportional Gain monitor	1/s
20	KVP MON	Velocity Loop Proportional Gain monitor	Hz
21	TVI MON	Velocity Loop Integral Time Constant monitor	ms
22	TCFIL MON	Torque Command Filter monitor	Hz
23	MKP MON	Model Control Gain monitor	1/s

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 [Digital Operator (7)] for use of Digital Operator.

For Software Setup, use Auto-tuning >> Auto-tuning result saving.

■ Saving parameters

◆ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Unit
02	KP1	Position Loop Proportional Gain 1	1/s
12	KVP1	Velocity Loop Proportional Gain 1	Hz
13	TVI1	Velocity Loop Integral Time Constant 1	ms
14	JRAT1	Load Inertia Moment Ratio 1	%
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

6.3 Automatic tuning of notch filter

Automatic notch filter can suppress high frequency resonance resulting from coupling and rigidity from the device mechanism.
With short periods of operation of servo amplifier and servo motor, the mechanical resonance frequency can be found easily.

1) Operation method

- ■ Operate from Auto-tuning mode in Software Setup or Digital Operator.
- ■ The tuning results are saved automatically in [Group2 ID20: Torque Command Notch Filter A (TCNFILA)].
  - ✔ 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.
- ■ 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 auto-tuning response or gain control is too high. Lower the Auto-Tuning Response or control gain.

2) Setting parameters

■ Torque command value for notch filter tuning
Setting the Torque command value to the motor at the time of Automatic tuning of notch filter:

◆ General parameters Group0 [Auto-tuning settings]

ID	Symbol	Name	Unit	Setting range
10	ANFILTC	Automatic tuning of notch filter 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 Automatic tuning of notch filter

6.4 Automatic tuning of FF vibration suppression frequency

Set FF vibration suppression frequency to suppress low frequency vibration at the tip or body of the machine. Automatic tuning of FF Vibration suppression frequency simply enables the frequency tune in minimal motion cycle time between the servo amplifier and the servo motor.

1) Operation method

- ■ Operate from Auto-tuning mode in Software Setup or Digital Operator.
- ■ The tuning result is automatically saved in Group2 ID00: FF Vibration suppression frequency "[SUPFREQ1]."
- ■ 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.
  - ✔ When vibration does not stop with FF vibration suppression frequency, there is a possibility that the gain for control system may be too high. In this case, lower the control system gain.
  - ✔ When used together with Higher Tracking Control Velocity Compensation Gain, 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 Automatic tuning of FF Vibration Suppression Frequency is executing. Do not use as gravity axis.

2) Setting parameters

- ■ Torque command value of Auto-FF vibration suppression frequency
  Sets torque command value to servo motor at the time of Automatic tuning of FF Vibration Suppression Frequency execution.
  - ◆ General parameters Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
20	ASUPTC	Automatic tuning of FF Vibration Suppression Frequency 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.

- ■ Friction torque compensation amount during Automatic tuning of FF Vibration Suppression Frequency. Sets additional frictional torque compensation amount when Automatic tuning of FF Vibration Suppression Frequency is executed. By setting the value close to the actual friction torque, the accuracy of Automatic tuning of FF Vibration Suppression Frequency can be improved.
  - ◆ General parameters Group0 [Auto-tuning setup]

ID	Symbol	Name	Unit	Setting range
21	ASUPFC	Automatic tuning of FF Vibration Suppression Frequency Friction Compensation Value	%	0.0 to 50.0

- ■ Automatically saved parameter of Automatic tuning of FF Vibration Suppression Frequency.
  - ◆ General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppression Frequency 1	Hz	5 to 500

6.5 Using manual tuning

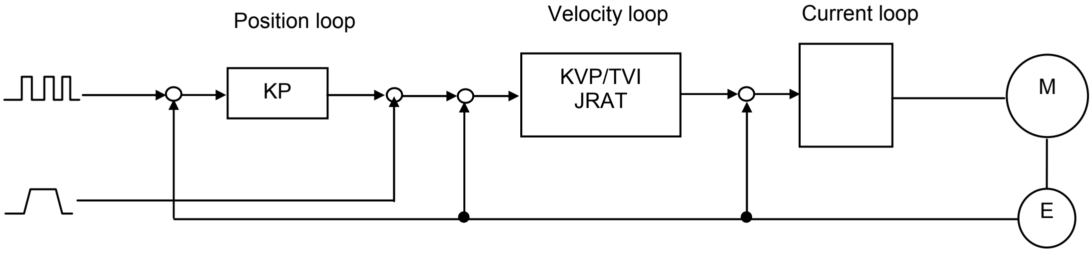
All gain is adjustable manually using manual tuning mode when characteristics in auto-tuning are insufficient. Sets tuning mode to “manual tuning.”

■ General parameters Group0 ID00 [Tuning Mode]

02:_ManualTun	Manual Tuning

1) Servo system configuration and servo adjustment parameters

The servo system consists of three (3) subsystems: Position loop, Velocity loop and Current loop. Higher response is required for internal loops. If this structure is compromised, it could result in instability, low response, vibration or oscillation.



Descriptions of each of servo parameters (Group 1) are shown below.

■ 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.

■ 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 Higher Tracking Control Position Compensation Gain is set to other than 0%, this parameter is automatically set.

■ Position Loop Proportional Gain (KP)
Sets the response of Position control.
Set this to: $KP_{[1/S]}=KVP_{[Hz]}/4\cdot 2\pi$

■ 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.

- 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 Higher Tracking Control Position Compensation Gain is set to other than 0%, this parameter is automatically set.
- Feed Forward Filter (FFFIL)
  When position command resolution is low, set this parameter to suppress ripples.
- Velocity Loop Proportional Gain (KVP)
  Sets responsiveness of velocity control. Set the value as high as possible in stable range that machine system does not vibrate and oscillate. If JRAT is properly set, the set value as KVP becomes velocity loop responsive range.
- Velocity Loop Integral Time Constant (TVI)
  Set this to: $TVI_{[ms]}=1000/(KVP_{[Hz]})$
- Load inertia moment ratio (JRAT)
  Set this value to the calculation shown below:

$$\text{JRAT}=\frac{\text{Motor axis converted load inertia moment } (J_L)}{\text{Motor inertia moment } (J_M)}\times 100\%$$

- 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 JRAT properly to use this function.
  - ✔ Set 0% when you use [Velocity Loop Proportional Control Switching Function (Group9 ID27)] during operation.
  - ✔ Set at 100% to equal Q-series servo amplifier.

- Torque Command Filter 1 (TCFIL1)
  When rigidity of the mechanical device is high, set this value high and the Velocit0 Loop Proportional Gain 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.

2) Basic manual tuning method for velocity control

- Set value of Velocity Loop Proportional Gain (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 Velocity Loop Integral Time Constant (TV1) by referring to “$\text{TVI}_{[ms]}$ =1000/ ($\text{KVP}_{[Hz]}$)” as a guide.
  - ✔ 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.

3) Basic manual tuning method for position control

- Set value of Velocity Loop Proportional Gain (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 Velocity Loop Integral Time Constant (TVI1) by referring to”$\text{TVI}_{[ms]}$ =1000/ ($\text{KVP}_{[Hz]}$)” as a guide.
- Set value of Position Loop Proportional Gain (KP1) by referring to “$\text{KP}_{[1/S]}= \text{KVP}_{[HZ]}/4\cdot 2\pi$” as a guide. 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.

6.6 Model following control

Model following control is a method used to obtain a higher response. Model control systems include mechanical devices in a servo amplifier and run a servo motor in order to track the Model control system.
Select [Position control form] in [Control mode]
Select [Model following control] in [Position control selection]

ID	Content
09	Control Mode Selection Select value / Content 02 Position / Position control form
0A	Position Control Selection Select value / Content 01 Model1 / Model following control

- ✔ Model following control cannot be used when in velocity control mode or torque control mode.
- ✔ Model following control can be used with auto-tuning at the same time.
- ✔ Model following control can be used with fully closed control at the same time.

1) Automatic tuning method for model following control

Model following control can be used with auto-tuning at the same time.
Follow the tuning procedure shown in [Adjustment method for auto-tuning].
Model Control Gain 1 is tuned in addition to tuning the parameter at Standard position control.

■ Automatically adjust parameters using Model following control auto-tuning.

◆ General parameters Group1 [Basic control parameter settings]

ID	Symbol	Name	Notes
02	KP1	Position Loop Proportional Gain 1	Note 1)
12	KVP1	Velocity Loop Proportional Gain 1	
13	TVI1	Velocity Loop Integral Time Constant 1	
14	JRAT1	Load Inertia Moment Ratio 1	Note 2)
20	TCFIL1	Torque Command Filter 1	

Note 1) Manual setting is available in Trajectory Control 2 [KP, FFGN manual setting]
Note 2) Manual setting is available in Automatic Tuning [JRAT Manual Setting]

◆ General parameters Group3 [Model following control settings]

ID	Symbol	Name	Notes
00	KM1	Model Control Gain 1	Note 3)

Note 3) KP1 setting value is set in Trajectory Control 2 [KP, FFGN Manual Setting]

- ✔ Parameters automatically adjusted by the servo amplifier vary according to selected Auto-Tuning Characteristic.

2) Manual tuning method for model following control

- Set value of Velocity Loop Proportional Gain (KVP1) as high a value as possible within the range that mechanical system stably works without any vibration or oscillation. If vibration occurs, lower the value.
- Set value of Velocity Loop Integral Time Constant (TVI1) by referring to "$TVI_{[ms]}=1000/(KVP_{[Hz]})$" as a guide.
- Set value of Position Loop Proportional Gain (KP1) by referring to "$KP_{[1/S]}=KVP_{[Hz]}/4 \cdot 2\pi$" as a guide.
- Set value of model control gain [KM1] by referring to "KM≒KP" as a guide.
  When vibration occurs, lower the set value.
- When responsiveness is low, change the value of model control gain [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	OSSFIL	Overshoot Suppression Filter

  - Model Control Gain 1 (KM1)
    Proportional gain fro Model following control position controller. Adjust this to: KM≒KP.
  - 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.

6.7 Tuning to suppress vibration

1) FF vibration suppression control

FF vibration suppression control can be used as a method of suppressing the vibration of the mechanical tip.

- ■ Adjust this gain by using the same basic tuning procedures from Position control.
- ■ When vibration rises on the machine tip during operation, use [Auto-FF vibration suppression frequency
  tuning] or calculate the vibration frequency from the vibration period and set the vibration frequency to
  [FF vibration suppression frequency (SUPFRQ1)].
  - ◆ General parameters Group2 [FF vibration suppression control/Notch filter/ Disturbance observer settings]

ID	Symbol	Name	Unit	Setting range
00	SUPFRQ1	FF Vibration Suppression Frequency 1	Hz	5 to 500

- ✔ If the machine tip vibration does not stop after taking the above steps, there is a possibility the gain for the control system could be too high. In this case, lower the Control system gain.
- ✔ Do not change the Setting value when the motor is running.

2) 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.

- ■ When you use Model following vibration suppression control, select Position control at Control Mode Selection and Model following vibration suppression control at Position Control Selection at System parameters.
  You can run the servo motor under the condition that the machine stand vibration is suppressed using Model control system.

ID	Contents
09	Control Mode Selection
	Select value: 02 Position — Contents: Position Control
0A	Position Control Selection
	Select value: 02 Model2 — Contents: Model Following Vibration Suppress Control

Select value		Contents
02	Position	Position Control

Select value		Contents
02	Model2	Model Following Vibration Suppress Control

- ✔ Do not use Auto-tuning with Model following vibration suppression control.
- ✔ Full-closed control cannot be used with Model following vibration suppression control.
- ✔ Model following vibration suppression control cannot be used when in Velocity control mode or Torque control mode.

- ■ Adjustable parameters in Model following vibration suppression control

◆ 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	OSSFIL	Overshoot Suppression Filter	Hz	1 to 4000
02	ANRFRQ1	Model Control Antiresonance Frequency 1	Hz	10.0 to 80.0
03	RESFRQ1	Model Control Resonance Frequency 1	Hz	10.0 to 80.0

◆ Model Control Gain 1 (KM1)
This is the proportional gain of the Model following controlling position controller and set response for Model control system.

◆ 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 Antiresonance 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.

✔ Do not change the setting value when the motor is running.

- ■ 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

3) Tuning methods

- ■ First, select “01: _Model_1 model following control” from “ID0A: position control selection” of system parameters, and then perform auto-tuning with “model following control” to adjust the machine to optimum servo gain. Refer to Auto-tuning method for model following control for instructions on tuning.
  - ✔ When the best servo gain for the machine has been selected, ignore this step.

- ■ When servo gain tuning is completed, switch “tuning mode” to “manual tuning“ after performing tuning result saving function.
- ■ Set “02: _Model_2 model following suppression control” of “ID0A: position control selection” of system parameter, 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.

  - ✔ Refer to Setup Software Instruction manual M0010842 for instructions on using 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.
  - ✔ When the mass of the drive motor is smaller than the machine stand mass, the anti-resonance and resonance frequencies may not be measured in system analysis. 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 Velocity Loop Proportional Gain (KVP1) as high as possible within the range that mechanical system can stably work without any vibration or oscillation. If vibration occurs, lower the set value.
- ■ Set value of Velocity Loop Integral Time Constant (TVI1) by referring to $TVI_{[ms]}=1000/(KVP_{[Hz]})$ as a guide.
- ■ Set value of Position Loop Proportional Gain (KP1) by referring to $KP_{[1/S]}=KVP_{[Hz]}/4 \cdot 2\pi$ as a guide.
- ■ Set value of Model Control Gain (KM1) by referring to KM≒KP. If vibration increases, lower the value as a guide.
- ■ When responsiveness is low, change the value of model control gain [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 1(SUPFRQ1)] 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.

6.8 Using disturbance observer function

The servo motor speed will fluctuate when an external force is applied to the operating machine, and it may affect the machine operation.
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. To use the Disturbance Observer, set [Group9 ID33: disturbance observer function [OBS] to [Functions enabled]. Adjust the observer related parameters in [Group2 ID30-33] and suppression or reject the disturbance.

■ Parameters for using the Disturbance Observer

◆ Group9 [Functions enabling conditions settings]

ID	Symbol	Contents	Setting range
33	OBS	Disturbance Observer Function	00 to 27

◆ General parameters Group2 [FF 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

■ Explanation of the parameters using the Disturbance Observer.

◆ There are three types of disturbance observer characteristics.
Select a proper type depending on disturbance frequency to be suppressed

Frequency	Type
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

◆ Gradually increase Observer Compensation Gain. (Do not set the value at the beginning.)
The higher the Observer Compensation Gain becomes, the more disturbance suppressing characteristics will improve. However, if the gain is excessively high, oscillation may result. Use this within a range that will not cause oscillation.

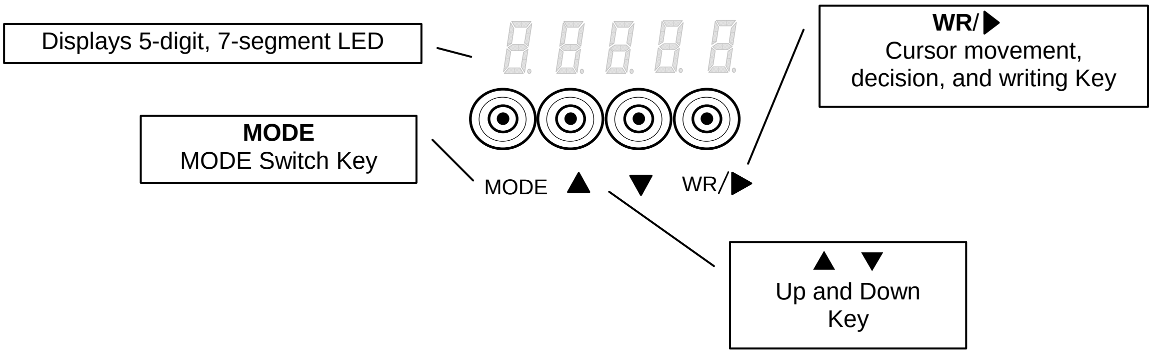
- ✔ Disturbance Observer cannot be used with Auto-tuning at the same time.
- ✔ Observer low-pass filter can be used when the encoder resolution is high or the Load inertia moment ratio is low. Observer characteristics can be improved by setting the frequency high.
- ✔ Use the Observer notch filter to suppress vibration in case the resonance in high frequency zones has changed.
- ✔ Use [02_High for High frequency disturbance suppression] when encoder resolution is above 1048576 division.

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

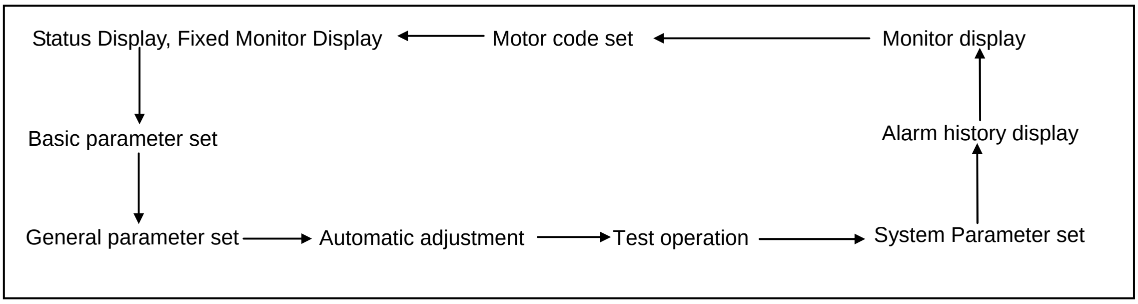
Displayed marks	Functions	Input time
WR	To input selections and write edited data.	More than 1second
MODE	Changes the Mode.	Less than 1 second
▶	Cursor Key. Changes the cursor position when editing.	Less than 1 second
▲ ▼	Up/Down key. Changes the numeric value.	Less than 1 second
7 segment LED	Displays 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.

1) Changing modes

Change in the mode presses the "MODE key." The mode switches in order of the following figure.



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
</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
</td><td>■ Settings can be made suitable for machines and equipment.
Parameters for adjusting servo gain can be changed.
Classified into 11 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 / serial communication</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>
</table>
</td></tr>
<tr><td>Automatic adjustment
</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
</td><td>■ Enables JOG operation, Alarm Reset, Automatic Tuning Result writing, Encoder Clear and Alarm History Clear.</td></tr>
<tr><td>System parameter
</td><td>■ Sets the parameters related to servo amplifier - motor encoder.</td></tr>
<tr><td>Alarm history
</td><td>■ Displays the latest 7 alarm events.</td></tr>
<tr><td>Monitor
</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
</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		Position of 1 display	0 to 9
Plus		Position of 10 display	10 to 99
Plus		Position of 100 display	100 to 999
Plus		Position of 1000 display	1000 to 9999
Plus		Position of 10000 display	10000 to 99999

■ Data of -9999 to +9999

Symbol	Digital operator display	Range of a digit display	
Plus		Position of 1 display	0 to 9
Plus		Position of 10 display	10 to 99
Plus		Position of 100 display	100 to 999
Plus		Position of 1000 display	1000 to 9999
Minus		Position of 1000 display	1000 to 9999

✔ Left end - expresses minus.

■ Data of 0 to +41999999999

Symbol	Digital operator display	Range of a digit display	
Plus		Low position of 1 to 1000 display	0 to 9999
Plus		Middle position of 10000 to 10000000 display	0 to 9999
Plus		High position of 100000000 to 10000000000 display	0 to 419

✔ 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		00 to FF
2 byte		0000 to FFFF
8 byte Low		0000 to FFFF (Bit31 to Bit0) display
8 byte High		0000 to FFFF (Bit63 to Bit32) display

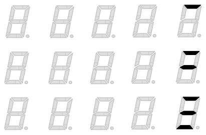
■ Example display of decimal point data

First position of a decimal point	
Second position of a decimal point	

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.

1) Servo amplifier status display

Marking	Description	Status code
	Control power supply established. Control power supply (r, t) is established and amplifier (RDY) is ON.	0
	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.	4
	Servo is ON. Rotates after displaying the character“8”.	8

2) Over-travel status display

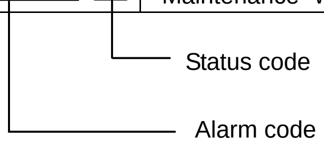
Marking	Description
	Over-travel status at normal rotation. Forward rotation is in ‘Over-Travel’ status in position and speed control type.
	Over-travel status at reverse rotation. Reverse rotation is in ‘Over-Travel’ status in position and speed control type.

3) Status display of battery warning, regenerative overload warning, and overload warning

Marking	Description
	Battery Warning status. Replace the battery.
	Regenerative overload Warning status. If operation is kept on, alarm may be issued.
	Overload Warning status If operation is kept on, alarm may be issued.

4) Alarm code and servo amplifier status code when alarm occurs

Marking	Description
	Please take a measure according to the contents of "Maintenance" when alarm occurs.



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 [Warning and Alarm List (8-3)]

Step	Displayed Character, number, code	Input button	How to operate
1			Make the state where the alarm number is displayed.
2		**MODE**	Push MODE for more than 1 second.
3			Display changes as the left.
4		**WR**	Push WR for more than 1 second.
5			Display changes as the left for 2 seconds.
6			When the cause of alarm is removed, the state of servo amplifier is displayed.

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		▼	Push the subtraction button for more than 1 second.
3			Display changes as the left.
4		**WR**	Push WR for more than 1 second.
5			The present software version is displayed.
6		**MODE**	Push MODE once.
7			Display changes as the left.
8		**MODE**	Push MODE once.
9			Returns to Process 1.

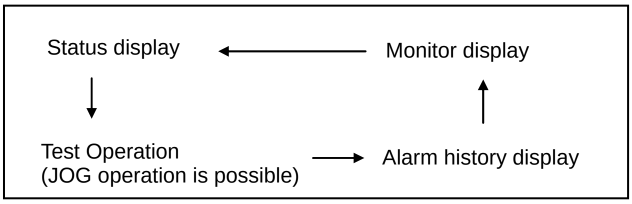
7) How to check Information 1, Information 2 (servo amplifier information), and Information 3 (Motor Code)

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		▼	Push the subtraction button for more than 1 second.
3	C P u. n o		Display changes as the left.
4		▲▼	Push addition and subtraction button.
5	I n F o. 1 I n F o. 2 I n F o. 3		Display changes as the left.
6		**WR**	Push WR for more than 1 second.
7			The selected information is displayed.
8		**MODE**	Push MODE once.
9	I n F o. 1 I n F o. 2 I n F o. 3		Returns to Process 5.
10		**MODE**	Push MODE once.
11			Returns to Process 1.

✔ The contents of display information 1, information 2, and information 3 are described to [Procedureto combine the servo motor (5-1)] and [System parameters (5-3)]

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		▲	Push addition button for more than 1 second.
3	- P A S -		Display switches as the left and the whole display blinks. When setup of the password has ended, display does not blink.
4	0 0 0 0	**WR**	Push WR for more than 1 second.
5			Display changes as the left and right end LED blinks.
6	1 2 3 4	▲▼ ▶	Display arbitrary numerical values with addition and subtraction and the cursor button. 0000 and FFFF cannot be set up.
7		**WR**	Push WR for more than 1 second.
8	1 2 3 4		Display blinks 3 times, and setup will be completed if blink stops.
9		**MODE**	Push MODE once.
10			Returns to Process 1.
11	≡		Password will become effective if power supply is turned on again.

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	**WR**	Push WR for more than 1 second.
5			Display switches as the left and right end LED blinks.
6	1 2 3 4	▲▼ ▶	Set up password is displayed with addition and subtraction and the cursor button.
7		**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**	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.

1) Basic parameters, editing system parameters

Step	Displayed character, number, code	Input button	How to operate
1	bA	**MODE**	Push MODE until it displays the left.
2	bA 00		Display changes and right end LED blinks.
3	bA 10	▲▼ ▶	Display ID of the parameter changed with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	0E		The data set up is displayed.
6	0A	▲▼ ▶	Display a value to set up with addition and subtraction and the cursor button.
7		**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 displayed without a display blinking 3 times.
9		**MODE**	Push MODE.
10	bA 10		Display switches as the left. When you set other parameters continuously, repeat from Process 3.
11		**MODE**	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.”

2) Editing general parameters

Editing method of general parameters other than Group C ID04 “Encoder Output Pulse Division”

For example, method to change Group9 ID01 “Negative Over Travel Function ”from “0B” to ”00“ is as follows.

Step	Letters, numerical values, and codes indicated	Input button	Description of operating procedure
1	Gr	**MODE**	Hold down MODE until the figure left is displayed.
2	Gr0.00		Display to be switched, and then rightmost LED flashes.
3	Gr9.01	▲▼ ▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4	Gr9.01	**WR**	Hold down WR for over a second.
5	0b		“0b” is displayed.
6	00	▲▼ ▶	Set figure “00” by addition/ subtraction, cursor button.
7		**WR**	Hold down WR for over a second.
8		**MODE**	Press MODE.
9	Gr9.01		Display to be switched to the display left.

Editing general parameter Group C ID04 “Encoder Output Pulse Division”

For example, method to change from 1/1 to 2/64 is as follows.

Step	Letters, numerical values, and codes indicated	Input button	Description of operating procedure
1	Gr	**MODE**	Hold down MODE until the figure left is displayed.
2	Gr0.00		Display to be switched, and then rightmost LED flashes.
3	GrC.04	▲▼ ▶	Display ID of parameter to be changed by addition/ subtraction, cursor button.
4	GrC.04	**WR**	Hold down WR for over a second.
5	Gr nu.		“Gr nu” is displayed.
6	Gr dE	**MODE**	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		**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	64	▲▼ ▶	Set figure “64” (denominator) by addition/ subtraction, cursor button.
10		**WR**	Hold down WR for over a second.
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**	Press MODE.

13			“GrC.04” is displayed.
14		**WR**	Hold down WR for over a second.
15		**MODE**	“Gr nu” is displayed.
16		**WR**	Hold down WR for over a second.
17			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		▲▼ ▶	Display the figure “2 (numerator)” you want to set by addition/ subtraction, cursor button.
19		**WR**	Hold down WR for over a second.
20			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		**MODE**	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**	Push MODE until it displays the left.
2	A u 0 0		Display changes and right end LED blinks.
3	A u 0 0	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	n o t C H		Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7	8		The character of 8 is drawn and servo is on.
8		**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**	Push MODE.
12	n o t C H		Servo is off and changes to the left display.
13		**MODE**	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	Completes and changes to the left display.
MODE is pushed in Process 9.	
A L. d F. 4	Completes 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	Changes to the left display.

7.7 How to tune automatic FF vibration suppression frequency

Step	Displayed character, number, code	Input button	How to operate
1	A u	**MODE**	Push MODE until it displays the left.
2	A u 0 0		Display changes and right end LED blinks.
3	A u 0 1	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	S u P r		Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7	8		The character of 8 is drawn and servo is on.
8		**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**	Push MODE.
12	S u P r		Servo is off and changes to the left display.
13		**MODE**	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 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	Completes and changes to the left display.
MODE is pushed in Process 9.	
A L. d F. 4	Completes and changes to the left display.

Error is displayed when cannot end normally.

- E r r -	Changes to the left display.
MODE	Push MODE.
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	A u	**MODE**	Push MODE until it displays the left.
2	A u 0 0		Display changes and right end LED blinks.
3	A u 0 2	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	C d o F		Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7	A u t o		Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9	. r. u. n. .		A display change as the left and it performs.
10	C d o F		Changes to the display of the left after a normal end.
	- E r r -		Error is displayed when cannot end normally.
11		**MODE**	Push MODE and finish.
12	A u 0 2		Changes to the left display.
13		**MODE**	Push MODE.
14	A d		Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are the same as auto offset.			
7	A u t o		Changes to the left display.
8		▼	Push subtraction button.
9	H A n d		Changes to the left display.
10		**WR**	Push WR for more than 1 second.
11	- 4		The data set up is displayed.
12		▲▼	Adjust offset value with the addition-and-subtraction button.
13		**MODE**	Push MODE.
14	C d o F		Changes to the left display.
15		**MODE**	Push MODE and finish.
16	A u 0 2		Changes to the left display.
17		**MODE**	Push MODE.
18	A d		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	A u	**MODE**	Push MODE until it displays the left.
2	A u 0 0		Display changes and right end LED blinks.
3	A u 0 3	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	A d d o F		Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7	A u t o		Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9	. r. u. n. .		A display change as the left and it performs.
10	A d d o F		Changes to the display of the left after a normal end.
	- E r r -		Error is displayed when cannot end normally.
11		**MODE**	Push MODE and finish.
12	A u 0 3		Changes to the left display.
13		**MODE**	Push MODE.
14	A d		Changes to the left display.

■ The method of manual offset

From Process 1 to 7 are the same as auto offset.			
7	A u t o		Changes to the left display.
8		▼	Push subtraction button.
9	H A n d		Changes to the left display.
10		**WR**	Push WR for more than 1 second.
11	- 4		The data set up is displayed.
12		▲▼	Adjust offset value with an addition-and-subtraction button.
13		**MODE**	Push MODE.
14	A d d o F		Changes to the left display.
15		**MODE**	Push MODE and finish.
16	A u 0 3		Changes to the left display.
17		**MODE**	Push MODE.
18	A d		Changes to the left display.

7.10 Velocity-controlled JOG Operation

Step	Displayed character, number, code	Input button	How to operate
1	A d	**MODE**	Push MODE until it displays the left.
2	A d 0 0		Display changes and right end LED blinks.
3	A d 0 0	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	J o G		Changes to the left display.
6		**WR**	Push WR for more than 1 second.
7	8		The character of 8 is drawn and servo is on.
8	8	▲	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	▼	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**	Push MODE.
11	J o G		Servo is off and it changes to the left display.
12		**MODE**	Push MODE.
13	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.	
S Y	Changes to the left display and shifts to system parameter.
MODE is pushed in Process 5.	
A d 0 0	Changes to the left display and returns to step 2.
MODE is pushed in Process 7.	
J o G	Changes to the left display and returns to step 5.
Mode is pushed again.	
A L. d F. 4	Completes and changes to the left display.

7.11 Encoder clear

Step	Displayed character, number, code	Input button	How to operate
1	Ad	**MODE**	Push MODE until it displays the left.
2	Ad 00		Display changes and right end LED blinks.
3	Ad 01	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	EnCLr		Changes to the left display.
8		**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**	Push MODE.
12	Ad 01		Changes to the left display.
13		**MODE**	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**	Push MODE until it displays the left.
2	Ad 00		Display changes and right end LED blinks.
3	Ad 02	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	turSL		Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9	. r. u. n. .		A display change as the left and it performs.
10	turSL		Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12	Ad 02		Changes to the left display.
13		**MODE**	Push MODE.
14	Sy		Changes to the left display.

7.13 Automatic setting of motor parameter

Step	Displayed character, number, code	Input button	How to operate
1	Ad	**MODE**	Push MODE until it displays the left.
2	Ad 00		Display changes and right end LED blinks.
3	Ad 03	▲▼ ▶	Make as the left display with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	PASEt		Changes to the left display.
8		**WR**	Push WR for more than 1 second.
9	.r.u.n..		A display change as the left and it performs.
10	PASEt		Changes to the display of the left after a normal end.
11		**MODE**	Push MODE.
12	oFF		Changes to the left display and it blinks.
13			Turn on the power supply again.

✔ When about 10 seconds pass in Process 10, it changes to the display of Process 12 compulsorily.

✔ Motor parameter auto-setting function cannot be used in the following cases:

・In alarm or servo-on state, while encoder clear being performed.
・Motor not applicable to auto-setting function is connected.
・Inappropriate combination of motor and amplifier(motor size, encoder baud rate, etc.)

7.14 Alarm history display

Step	Displayed Character, number, code	Input button	How to operate
1	ALH	**MODE**	Push MODE until it displays the left.
2	ALH 1		Display changes and right end LED blinks.
3	ALH 3	▲▼	Display the number of an alarm history to check with an addition-and-subtraction button. The history of 7 times past before can be displayed.
4		**WR**	Push WR for more than 1 second.
5	AL.85.0		The alarm of 3 times ago is displayed.
6		**WR**	Push WR for more than 1 second.
7	_ 1802		The passed time of alarm generating is displayed. Low-position digit.
8		**MODE**	Press and hold MODE for more than 1 second.
9	= 0		The passed time of alarm generating is displayed. Middle-position digit.
10		**MODE**	Press and hold MODE for more than 1 second.
11	≡ 0		The passed time of alarm generating is displayed. High-position digit.
12		**MODE**	Push MODE.
13	AL.85.0		Returns to Process 5.
14		**MODE**	Push MODE.
15	ALH 3		Returns to Process 3.
16	ob		Changes to the left display.

7.15 How to clear alarm history

Step	Displayed character, number, code	Input button	How to operate
1	AL H	**MODE**	Push MODE until it displays the left.
2	AL H 1		Display changes and right end LED blinks.
3	ALH.CL	▲▼	Display the left with the addition-and-subtraction button.
4		**WR**	Push WR for more than 1 second.
5	rdy		Changes to the left display and it blinks.
7		**WR**	Push WR for more than 1 second.
8	.r.u.n..		A display change as the left and it performs.
9	AL H 1		Changes to the display of the left after a normal end.
10		**MODE**	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**	Push MODE until it displays the left.
2	ob 00		Display changes and right end LED blinks.
3	ob 08	▲▼ ▶	Display ID of the monitor with addition and subtraction and the cursor button.
4		**WR**	Push WR for more than 1 second.
5	0.3		The data is displayed.
6		**MODE**	Push MODE.
7	ob 08		Changes to the left display. When you monitor other data continuously, repeat from Process 3.
8		**MODE**	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.

7.17 Fixed monitor display

The display shows monitoring value in a second after powering up.
It shows monitoring value set at [Group A ID30: 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 =).
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.
In case of setting “Group A ID30: Monitor Display Selection [MONDISP]” from SETUP software with the digital operator in “Status mode”, either reboot the hardware or push “MODE” button on the digital operator to show “Status mode” again.

7.18 Motor code-setting of servo motor used

Step	Displayed character, number, code	Input button	How to operate
1	Co	**MODE**	Push MODE until it displays the left.
2	CoSEt		Display changes and right end LED blinks.
3		**WR**	Push WR for more than 1 second.
4	3001	▲▼ ▶	Display the motor cord of the servo motor used with addition and subtraction and the cursor button.
5		**WR**	Push WR for more than 1 second.
6	. r. u. n. .		A display change 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."

8

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 "Trouble Shooting When Alarm Occurs ".

■ "≡" 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. ■ Stop the input of Emergency Stop. ■ Check of "Functions enabling condition settings "
Safe Torque Off working status	■ Turn on /HWGOFF1 and /HWGOFF2 inputs

■ 7-segment LED displays a rotating character "8 "(Servo ON status), but motor does not rotate.

Investigation	Assumed causes and corrective actions
Check the command is inputted or not by a digital operator's monitor. Page07: Velocity command monitor (VCMON) Page09: Torque command monitor (TCMON) Page13: Position command pulse frequency monitor (FMON1)	■ If the value of a monitor is zero, input a command.
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.	■ Since torque restrictions are inputted, a servo motor cannot output the torque beyond the load torque. ■ Check of "Functions enabling condition settings "
Enter deviation clear to check if process is continued.	■ Stop the input of deviation clear.
Enter encoder clear to check if process is continued.	■ Stop the input of encoder clear. ■ Check of "Functions enabling condition settings "

✔ When performing the work for correction processing, be sure to intercept power supply.

■ Rotations of servo motor are unstable and less than the specified velocity command.

Investigation	Assumed causes and corrective actions
Check if proportional control is entered.	■ Stop the input of proportional control. ■ Check of "Functions enabling condition settings "
Check if torque limit is input.	■ Quit inputting torque limit. ■ Check of "Functions enabling condition settings "

- Servo motor rotates only once, and stops.

Investigation	Assumed causes and corrective actions
Check motor power line.	■ The servo motor power line is not connected.
Check a setup of a combination motor.	■ Change the settings and turn ON the power again.
Check a setup of encoder resolution. (System parameter)	

✔ When performing the work for correction processing, be sure to intercept power supply.

- Servo motor hangs up.

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 processing, be sure to intercept power supply.

- Servo motor is vibrating.

Investigation	Assumed causes and corrective actions
Motor is vibrating with frequency above 200 Hz.	■ Reduce the loop gain speed. ■ Set the torque command low-pass filter and torque command notch filter.

- Occurs over shoot/ under shoot during starting / stopping.

Assumed causes and corrective actions
■ Adjust the auto tuning "response ". ■ Reduce the loop gain speed. ■ Increase the velocity integral time constant. ■ Simplify the acceleration and declaration command. ■ Use position command low-pass filter.

- Abnormal sound occurs

Investigation	Assumed causes and corrective actions
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 port. ■ Confirm that the power supply voltage is sufficient.
Check whether there is any problem in mechanical attachment.	■ Observe by operating one servo motor. ■ Pay attention while coupling and confirm that there is no core shift or unbalance.

- When a serial encoder with multiple rotations is used, the multiple-rotation part of the serial encoder cannot be cleared by clearing the encoder.

Investigation	Assumed causes and corrective actions
Check the set value of system parameter.	■ Check that the set value of the system parameter ID04 serial encoder function selection is any of the followings: 02: PA_C_2.5M/03: PA_C_4M/04: RA_C_2.5M/ 05: RA_C_4M

8.2 List of warning and alarm

Names and contents of warning/ alarm, and the stop operations when detected, and alarm-reset methods are listed below.

1) Warning List

	Warning Title	Warning Contents
Load system	Overload Warning	■ When the effective torque exceeds the Overload Warning Level
	Regenerated 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	Main circuit is charging	■ Voltage of main circuit is above DC 105 V
	Voltage sag warning	■ Control power goes 152VAC or less (with 200VAC hardware)
External input system	Forward over travel	■ While entering forward over travel
	Reverse over travel	■ While entering reverse over travel
Encoder system	Serial encoder Battery warning	■ Battery voltage is below 3.0 V
Control system	Restricting torque command	■ While restricting the torque command by torque restriction value
	Restricting speed command	■ While restricting the speed command by speed value.
	Excessive position deviation	■ In the state position deviation exceeds warning setting value.

2) Alarm List

Operation at detecting: “DB “ performs the slowdown stop of the servo motor in dynamic brake operation when 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 Clear
	Display	3 bits 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	V
	22				0	0	0	1	Current Detection Error 0	■ Abnormality of electric current detection value	DB	V
	23				0	0	0	1	Current Detection Error 1	■ Abnormality of Electric current detection circuit	DB	V
	24				0	0	0	1	Current Detection Error 2	■ Abnormality in communication with Electric current detection circuit	DB	V
	25				1	1	1	0	Safe Torque Off Error 1	■ Logic unmatched in safe torque off input	SB	“ “
	26				1	1	1	0	Safe Torque Off Error 2	■ Failure of safe torque off circuit	SB	“ “
Abnormality related to load	41	0	1	0	0	0	1	0	Overload 1	■ Excessive effective torque	SB	V
	42				0	0	1	0	Overload 2	■ Stall over load	DB	V
	43				0	1	0	1	Regenerative Overload	■ Regeneration load ratio exorbitance	DB	V
	45				0	0	1	0	Average continuous over speed	■ Over speed in average rotational speed	SB	V
	51				0	0	1	1	Servo Amplifier Temperature Error	■ Overheating detection of amplifier ambient temperature	SB	V
	52				0	0	1	1	RS Overheat	■ Detection of in-rush prevention resistance overheating	SB	V
	53				0	0	1	1	Dynamic Brake Resistance Overheat	■ Overheating detection of dynamic brake resistor	SB	V
	54				0	1	0	1	Internal Regenerative Resister Overheat	■ Overheating detection of Internal regeneration resistor	DB	V
	55				0	0	1	1	External Error	■ Overheating detection of External regeneration resistor	DB	V
	56				0	0	1	1	Main Circuit Power Device Overheat	■ Overheating detection of Drive module	DB	V
Abnormality in power supply	61	0	1	1	0	1	0	1	Over-voltage	■ DC Excess voltage of main circuit		
	62				1	0	0	1	Main Circuit Under-voltage Note1)	■ DC Main circuit low voltage	DB	V
	63				1	0	1	0	Main Power Supply Fail Phase Note1)	■ 1 phase of the 3 phase main circuit power supply disconnected	DB	V
	71				0	1	1	1	Control Power Supply Under-voltage Note2)	■ Control power supply low voltage	SB	V
	72				0	1	1	1	Control Circuit Under-voltage 1	■ Under voltage of ±12V	DB	V Note 3)
	73				0	1	1	1	Control Circuit Under-voltage 2	■ Under voltage of +5V	SB	V

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits 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	■ Pulse encoder (A, B, Z) signal line break ■ Power supply break	DB	“ “
	83				1	0	0	0	Encoder Connector 2 Disconnection	■ Breaking of full close Encoder (A, B, Z) signal line	DB	“ “
	84				1	0	0	0	Serial Encoder Communication Error	■ Encoder serial signal time out ■ Serial communication data error	DB	“ “
	85				1	0	0	0	Encoder Initial Process Error	■ Failed to read CS data of pulse encoder ■ Abnormality in initial process of serial encoder	—	“ “
	87				1	0	0	0	CS Signal Disconnection	■ CS signal line break	DB	“ “
Abnormality in encoder main body	A0	1	0	1	1	0	0	0	Serial Encoder Internal Error 0	■ Encoder failure	DB	“ “
	A1				1	0	0	0	Serial Encoder Internal Error 1	■ Multi-turn error	DB	Note 4)
	A2				1	0	0	0	Serial Encoder Internal Error 2	■ Accelerate error	DB	Note 4)
	A3				1	0	0	0	Serial Encoder Internal Error 3	■ Over-speed	DB	Note 4)
	A4				1	0	0	0	Serial Encoder Internal Error 4	■ Access error of Encoder internal EEPROM	DB	Note 4)
	A5				1	0	0	0	Serial Encoder Internal Error 5	■ 1 rotation coefficient incorrect	DB	Note 4)
	A6				1	0	0	0	Serial Encoder Internal Error 6	■ Multiple rotations coefficient incorrect	DB	Note 4)
	A9				1	0	0	0	Serial Encoder Internal Error 9	■ Servo motor built-in Encoder Overheating	DB	Note 4)
	AA				1	0	0	0	Serial Encoder Internal Error 10	■ Position data incorrect	DB	Note 4)
	AB				1	0	0	0	Serial Encoder Internal Error 11	■ Encoder incorrect	DB	Note 4)
	AC				1	0	0	0	Serial Encoder Internal Error 12	■ Error generation of multi-rotation data	DB	Note 4)
	AD				1	0	0	0	Serial Encoder Internal Error 13	■ Encoder internal EEPROM data is not set	DB	Note 4)
	AE				1	0	0	0	Serial Encoder Internal Error 14	■ Resolver Abnormality	DB	Note 4)
	AF				1	0	0	0	Serial Encoder Internal Error 15	■ Resolver disconnection	DB	Note 4)

	Alarm code								Alarm name	Alarm contents	Detection Operations	Alarm Clear
	Display	3 bits 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 is 120 % more than the highest speed limit	DB	V
	C2				1	1	0	0	Velocity Control Error	■ Torque command and acceleration direction are not matching.	DB	V
	C3				1	1	0	0	Velocity Feedback Error	■ Servo motor power disconnection Note 5)	DB	V
	C5				1	1	0	0	Model tracking vibration suppression control error	■ Machine cycle time is not mach with model tracking vibration suppression control.	DB	V
	D1				1	1	0	1	Excessive Position Deviation	■ Position Deviation exceeds setup value.	DB	V
	D2				1	1	0	1	Faulty Position Command Pulse Frequency 1	■ Frequency of entered position command pulse is excessive	SB	V
	D3				1	1	0	1	Faulty Position Command Pulse Frequency 2	■ Position command frequency after electronic gear is high.	SB	V
	DF				1	1	0	1	Test Run Close Note6)	■ Detection in ‘Test mode end’ status	DB	V
Control system/Memory system abnormality	E1	1	1	1	1	1	1	1	EEPROM Error	■ Abnormality of amplifier with built-in EEPROM	DB	“ “
	E2				1	1	1	1	EEPROM Check Sum Error	■ Error in check sum of EEPROM (entire area)	—	“ “
	E3				1	1	1	1	Memory Error 1	■ Access error in CPU built in RAM	—	“ “
	E4				1	1	1	1	Memory Error 2	■ Checksum error of FLASH memory with built in CPU	—	“ “
	E5				1	1	1	1	System Parameter Error 1	■ System parameter is outside a setting range.	—	“ “
	E6				1	1	1	1	System Parameter Error 2	■ The combination of a system parameter is abnormal.	—	“ “
	E7				1	1	1	1	Motor Parameter Error	■ Setup of a motor parameter is abnormal.	—	“ “
	E8				1	1	1	1	Abnormalities in CPU circumference circuit	■ Access abnormality in CPU to ASIC	—	“ “
	E9				1	1	1	1	System Code Error	■ Abnormalities of control circuit.	—	“ “
	EE				1	1	1	1	Motor Parameter Automatic Setting Error 1	■ Motor parameter automatic setting function cannot be performed.	—	“ “
	EF				1	1	1	1	Motor Parameter Automatic Setting Error 2	■ The result of motor parameter automatic setting is abnormal.	—	“ “
	F1				1	1	1	1	Task Process Error	■ Error in interruption process of CPU	DB	“ “
	F2				1	1	1	1	Initial Process Time-Out	■ Initial process does not end within initial process time	—	“ “

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 PFDDLY (GroupB ID16).

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.

8.3 Trouble shooting when alarm activated

1) Alarm display

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

Display	Description
AL.85 *	Take appropriate action based on 2) Corrective action for alarm.

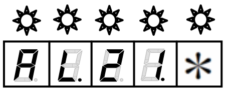
Status code of the servo amplifier

Alarm code

Code	Status	
0	Power ON status	(P-OFF)
2	Power OFF status	(P-ON)
4	Servo ready status	(S-RDY)
8	Servo ON status	(S-ON)
A	Emergency stop status	(EMR)
F	Initial status	

2) Corrective action for alarm

■ Alarm code 21 (Main Circuit Power Device Error)



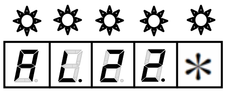
Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at input of servo ON.	✔	✔	✔	
Issued while starting and stopping the servo motor.	✔	✔	✔	
Issued after extended operating time.	✔	✔	✔	✔

◆ 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. Also, U/V/W-phases are grounded in the earth.	■ Check the wiring conditions and restore if improper.
2	■ Short circuit or 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.	■ For an amplifier equipped with a cooling fan motor, check that the cooling fan motor is running; if not, replace the servo amplifier. ■ Confirm that the temperature of the control panel (ambient temperature of the servo amplifier) does not exceed 55°C. If in excess of 55(C, check the installation method of the servo amplifier, and confirm that the cooling temperature of the control panel is set to below 55°C

■ Alarm code 22 (Current Detection Error 0)

Status at the time of alarm	Cause	
	1	2
Issued when servo is turned ON.	✔	✔



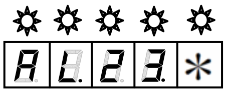
◆ Corrective actions

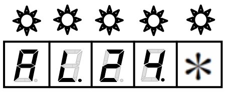
	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Servo amplifier and motor are not combined properly.	■ Confirm that the proper codes (per the specified Motor Codes) have been used for the servo motor; if not, replace the servo motor.

■ 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.	✔	✔



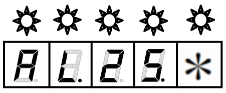


◆ Corrective actions

	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 against noise.

■ Alarm code 25 (Safe Torque Off error 1)

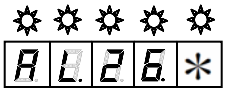
Status at the time of alarm	Cause	
	1	2
Occurred in about 10 sec. after control power turned on	✔	✔
Occurred during operation	✔	



◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Discrepancy of the input logic between /HWGOFF1 and /HWGOFF2	■ Match the input logic of /HWGOFF1 and /HWGOFF2. ■ Check the wiring of both the HWGOFF1 and /HWGOFF2 signals, and correct the wiring if needed. ■ After switching the logic 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)

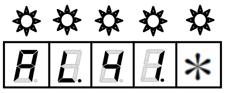


Status at the time of alarm	Cause	
	1	2
Occurred when control power is turned on.	✔	✔
Occurred during the operation.		✔

◆ 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 41 (Overload 1)

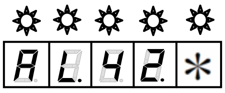


Status at the time of alarm	Cause								
	1	2	3	4	5	6	7	8	9
Issued at input of servo ON.	✔	✔							✔
After command input, issued without rotating the motor.		✔			✔	✔	✔		✔
After command input, brief motor rotation			✔	✔	✔		✔	✔	

◆ 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 motor usage ratio 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 operating or loading, or replace the capacity of the large motor.
4	■ Defect in servo motor-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 does not release.	■ Check that the wiring and voltage of the holding brake are acceptable; if not, repair. If the above are OK, replace the servo motor.
6	■ Wiring of U/V/W –phase between servo amplifier and motor do not match.	■ Check the wiring conditions and restore if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / motor is disconnected.	■ Check the wiring conditions and restore if improper.
8	■ Machines collided.	■ Check the operating conditions and limit switch.
9	■ Motor encoder pulse number setting does not match with the servo motor.	■ Match the encoder pulse number with the servo motor.

✔ During the alarm caused by conditions in #3 (above), if OFF→ON of power supply control is repeated, there is a risk of burning out the servo motor. Wait for longer than 30 min. for cooling purposes after power shut OFF, and resume operations.

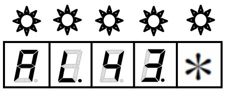


Alarm code 42 (Overload 2)

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 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-torque command monitor (TCMON). If any of the conditions (load condition when motor stops, operation condition at low velocity, and load condition) exceeds twice the rated torque, review operation or load condition. Or replace with larger sized servo motor.
4	■ Defect in servo motor-servo amplifier combination	■ Check the motor type setting and the motor in use are matching. If not, correct them.
5	■ Holding brake of servo motor does not release.	■ Check that wirings and voltage for holding brake are correct. If not, repair them. If they are appropriate, replace the servo motor.
6	■ Wiring of U/V/W –phase between servo amplifier and motor do not match.	■ Check the wiring conditions and restore if improper.
7	■ One or all connections of U/V/W -phase wiring of servo amplifier / motor is disconnected.	■ Check the wiring conditions and restore if improper.
8	■ Machines collided.	■ Check the operating conditions and limit switch.
9	■ Motor encoder pulse number setting does not match with the servo motor.	■ Match the encoder pulse number with the servo motor.



■ Alarm code 43 (Regenerative Overload)

Status at the time of alarm	Cause							
	1	2	3	4	5	6	7	8
Issued when power supply control is turned ON.							✔	
Issued when power supply of main circuit is turned ON.		✔	✔	✔		✔	✔	✔
Issued during operation.	✔			✔	✔		✔	

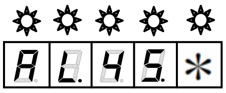
◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Exceeded permitted value of regenerating power in built-in regenerative resistance specifications. ■ Excessive load inertia moment, or tact time is short.	■ Check the load and operating conditions. ■ Use an external regeneration resistor. ■ Set the load inertia moment within the specified range. ■ Increase the deceleration time. ■ Increase the tact time.
2	■ Regenerative resistance wiring conflicts with built-in regenerative resistance specifications.	■ Check wiring and replace if incorrect.
3	■ Regenerative resistance wiring conflicts with external regeneration resistor specifications.	■ Check wiring and replace if incorrect.
4	■ Regeneration resistor is disconnected.	■ For built-in regeneration resistor specifications, replace the servo amplifier. ■ For external regeneration resistor specifications, replace the regeneration resistor.
5	■ Resistance value of external regeneration resistor is excessive.	■ Replace the current resistance value with a value 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	■ When external regenerative resistance is selected for system parameter ID02 and external regenerative resistance is not installed.	■ Install the external regenerative resistance. ■ Set to “Do not connect regenerative resistance “.

✔ If the setting of system parameter ID02 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)

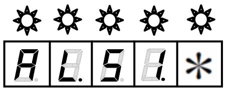
Status at the time of alarm	Cause
	1
Occurred during operation.	✔



◆ 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 51 (Amplifier Overheat)



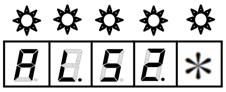
Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.	✔		✔	✔	
Issued during operation.	✔	✔	✔	✔	
Issued after emergency stop.					✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Regenerating power exceeded.	■ Check the operating conditions. ■ Use external regeneration resistor.
3	■ Regenerating power is within the specified range but ambient temperature of servo amplifier is out of specified range.	■ Confirm that the cooling method maintains the temperature of control board between 0 to 55°C.
4	■ Regenerating power is within the specified range but built-in cooling fan of servo amplifier is stopped.	■ For an amplifier equipped with a cooling fan motor, check that the cooling fan motor is running; if not, replace the servo amplifier.
5	■ Regeneration energy during emergency stop exceeded.	■ Change the servo amplifier. ■ Check the loading condition.

✔ Abnormalities are detected in the internal temperature of the amplifier regardless of its ambient temperature. When an amplifier temperature warning is issued, please be sure to check the cooling method of the control panel.

■ Alarm Code 52 (In-rush prevention resistance Overheat)



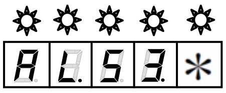
Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		
Issued when main circuit power supply is turned ON.		✔	
Issued during operation.			✔

◆ 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.	■ For an amplifier equipped with a cooling fan motor, check that the cooling fan motor is running; if not, replace the servo amplifier. ■ Check if the temperature inside the control board (servo amplifier ambient temperature) exceeds 55°C. If it does, review the servo amplifier installing method and cooling method of control board to make it below 55°C.

■ Alarm Code 53 (Dynamic Brake Resistor Overheat)

Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	
Issued during operation.	✔	✔

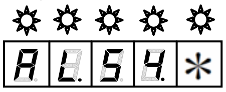


◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Dynamic Brake operation frequency exceeded.	■ 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 power supply control is turned ON.	✔		✔
Issued during operation.	✔	✔	✔



◆ Corrective actions

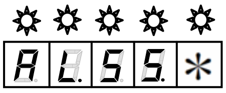
	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
2	■ Regenerating power excessive.	■ Check the built-in regenerative resistance absorption power ■ Check the operating conditions, so that regenerating power is within permitted absorption power. ■ Use an external regeneration resistor.
3	■ Improper wiring of built-in regeneration resistor.	■ Confirm improper condition and repair if necessary.

✔ When using a regeneration resistance built in the servo amplifier, make sure to set “built-in regeneration resistance“ at system parameter ID02 [Regenerative Resistor Selection]. This setting makes the judgment between enabled/disabled of the overheating protection detection treatment of the built-in regeneration resistance. When “No connected regenerative resistance or external regenerative resistance“is selected, overheating of built-in regenerative resistance is not detected. 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 power supply control 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.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ When thermal signal of the external regenerative resistor is connected

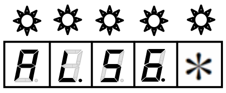
Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		✔
Issued after operation for some time.		✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Improper wiring of external regenerative resistance.	■ Check wiring and replace if necessary.
2	■ External regeneration 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)

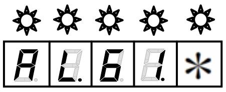


Status at the time of alarm	Cause			
	1	2	3	4
Issued when control power is turned ON.	✔		✔	✔
Issued at servo input.	✔	✔	✔	
Issued while starting and stopping the servo motor.	✔	✔	✔	
Issued after operation for some time.	✔	✔	✔	✔

◆ 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. Also, U/V/W-phases are grounded in the earth.	■ Check wiring and replace if necessary.
2	■ Short circuit or 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	■ Ambient temperature is high.	■ For an amplifier equipped with a cooling fan motor, check that the cooling fan motor is running; if not, replace the servo amplifier. ■ Confirm that the temperature of the control board (ambient temperature of the servo amplifier) does not exceed 55°C. If in excess of 55°C, check the installation method of the servo amplifier, and confirm that the cooling temperature of the control board is set to below 55°C.

■ Alarm Code 61 (Over-Voltage)

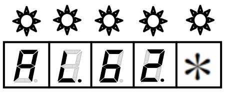


Status at the time of alarm	Cause			
	1	2	3	4
Issued when power supply control is turned ON.	✔			
Issued when power supply of main circuit is turned ON.	✔	✔		
Issued while starting and stopping the servo motor.		✔	✔	✔

◆ 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 for regeneration resistance. ■ Built-in regeneration circuit is not functioning.	■ Wire the regeneration resistance correctly. ■ While using the external regenerative resistance, check the wiring and resistance value. ■ Replace the servo amplifier if any abnormality occurs.

■ Alarm Code 62 (Main Circuit Under-voltage)

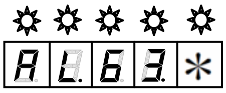


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.				✔	✔
Issued after power supply of main circuit is turned ON.	✔	✔	✔		
Issued during operation.		✔	✔		

◆ 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 and/or blinking.	■ Check the power supply and confirm that there is no blinking 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 Fail Phase)

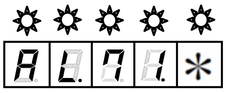


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.		✔	
Issued when power supply of main circuit is turned ON.	✔		✔
Issued during operation.	✔		
Alarm issued during single-phase power input selection.			✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ One out of 3 phases (R/S/T) is not inserted.	■ Check the wiring and repair if necessary.
2	■ Defect in internal circuit of Servo amplifier.	■ Replace the servo amplifier.
3	■ Servo amplifier is not specified for single phase.	■ Check the model number and delivery specifications of the servo amplifier and replace it with a servo amplifier for single-phase power supply. ■ Change ID01 of system parameter to “Single phase AC power is supplied to the main circuit “.

■ Alarm Code 71 (Control Power Supply Under-voltage)

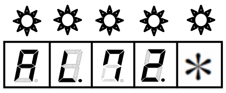


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔	✔	
Issued during operation.	✔		✔

◆ 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 blinking.	■ Confirm that the power supply is not going to neither blink nor reduce the power.

■ Alarm Code 72 (Control Circuit Under-voltage 1)

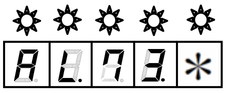


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of the servo amplifier.	■ Replace the servo amplifier.
2	■ Defect in external circuit.	■ Restart the power supply after removing the connector; if alarm is not issued, check the external circuit. ■ Restart the power supply after replacing the servo motor; if alarm is not issued, there is defect in internal circuit of motor encoder.

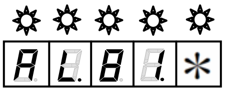
■ Alarm Code 73 (Control Circuit Under-voltage 2)

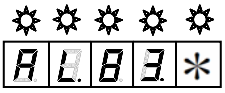


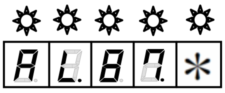
Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔

◆ 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; if alarm is not issued, check the external circuit.







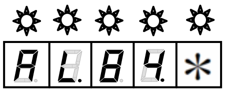
- Alarm Code 81 (Encoder Connector Disconnection 1)
- Alarm Code 83 (Encoder Connector Disconnection 2)
- Alarm Code 87 (CS Signal Disconnection)

Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when power supply control 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 wiring and replace if necessary. ■ Confirm that the encoder power supply voltage of the motor is above 4.75 V; increase it if below 4.75 V.
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	■ Parameter set to ‘Full-closed system’.	■ Change ID0B of system parameter to “Semi-close Control / Motor Encoder “ (Only with alarm code 83)

- Alarm Code 84 (Serial Encoder Communication Error)

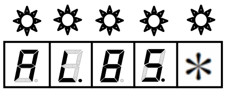


Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✓	✓	✓
Issued during operation.		✓	

◆ 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 against noise.
3	■ Motor encoder wiring has abnormalities.	■ Check wiring and replace if necessary.

■ Alarm Code 85 (Encoder Initial Process Error)

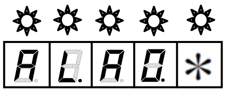


Status at the time of alarm	Cause				
	1	2	3	4	5
Issued when power supply control is turned ON.	✔	✔	✔	✔	✔

◆ 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 wiring and replace if necessary. ■ Confirm that the encoder power supply voltage of the motor is above 4.75 V; increase it if below 4.75 V.
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, as the number of rotations of the motor is more than 250 min -1 during power supply.	■ Restart the power supply after motor is stopped. (Only when PA035C and PA035S encoder is used.)

■ Alarm Code A0 (Serial Encoder Internal Error 0)

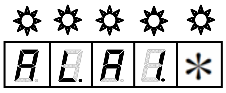


Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	✔
Issued during operation.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, 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 against noise.

■ Alarm Code A1 (Serial Encoder Internal Error 1)



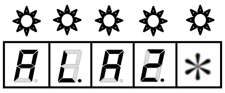
Status at the time of alarm	Cause			
	1	2	3	4
Issued when power supply control is turned ON.	✔	✔		
Issued during operation.			✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Loose connection of battery cable.	■ Check the battery connector of encoder cable attachment.
2	■ The fall of battery voltage.	■ Check the voltage of battery.
3	■ Loose connection of encoder connector.	■ Check wiring and replace if necessary.
4	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, replace the servo motor.

✔ “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to [Encoder Clear and Alarm Reset Methods (8-29)].

■ Alarm Code A2 (Serial Encoder Internal Error 2)



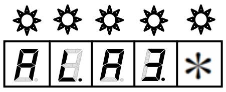
Status at the time of alarm	Cause		
	1	2	3
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, 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 against noise.
3	■ The acceleration of motor rotation exceeds the permitted acceleration.	■ Check the operation condition, and extend the acceleration and declaration time.

✔ “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to [Encoder Clear and Alarm Reset Methods (8-29)].

■ Alarm Code A3 (Serial Encoder Internal Error 3)



Status at the time of alarm	Cause		
	1	2	3
Issued when power supply control is turned ON.	✔		✔
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.	✔	✔	✔

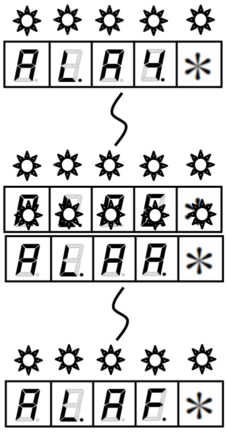
◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, replace the motor.
2	■ Malfunction due to noise.	■ Confirm proper grounding of the servo amplifier. ■ Check the shielding of the encoder cable. ■ Add ferrite core or similar countermeasures against noise.
3	■ Number of motor rotations exceeds the permitted velocity.	■ Check the operation condition and reduce the maximum number of rotations.

✔ “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to [Encoder Clear and Alarm Reset Methods (8-29)].

■ Alarm Code A4 to A6 (Serial Encoder Internal Error 4 to 6)

■ Alarm Code AA to AF (Serial Encoder Internal Error 10 to 15)



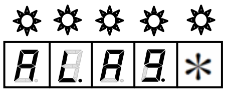
Status at the time of alarm	Cause	
	1	2
Issued when power supply control is turned ON.	✔	
Issued during operation.	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, 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 against noise.

✔ “Encoder clear and alarm reset methods“ vary depending on the motor encoder in use. Please refer to [Encoder Clear and Alarm Reset Methods (8-29)].

■ Alarm Code A9 (Serial Encoder Internal Error 9)



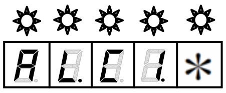
Status at the time of alarm	Cause		
	1	2	3
Issued when control power supply is turned ON.	✔	✔	
Issued while stopping the servo motor.	✔	✔	
Issued while rotating the servo motor.		✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of motor encoder.	■ Turn ON the power supplies again; if not restored, 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 below 80°C
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 [Encoder Clear and Alarm Reset Methods (8-29)].

■ Alarm Code C1 (Over-speed)

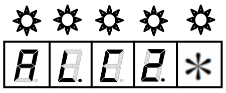


Status at the time of alarm	Cause			
	1	2	3	4
Issued when command is entered after Servo ON.	✔	✔		
Issued when the servo motor is started.			✔	✔
Issued other than operating and starting the motor.		✔	✔	

◆ 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. ■ Simplify the acceleration and declaration command pattern. ■ Reduce the load inertia moment.
4	■ Wiring of U/V/W -phase between servo amplifier and motor do not match.	■ Check the wiring and repair any irregularities.

■ Alarm Code C2 (Velocity Control Error)



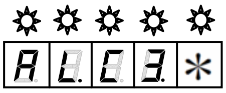
Status at the time of alarm	Cause			
	1	2	3	4
Issued while due to input of Servo ON.	✔		✔	
Issued if command is entered.	✔	✔	✔	
Issued while starting and stopping the servo motor.				✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Wiring of U/V/W -phase between servo amplifier and motor do not match.	■ Check the wiring and repair any irregularities.
2	■ Wiring of A/B -phase of pulse encoder do not match.	■ Check the wiring and repair any irregularities.
3	■ The servo motor is vibrating (oscillating).	■ Adjust the servo parameters so that servo motor will not vibrate (oscillate).
4	■ Excessive overshoot and undershoot.	■ Monitor speed with the analog monitor. ■ Adjust the servo parameters to reduce overshoot and undershoot. ■ Simplify the acceleration and declaration command pattern. ■ Mask the alarm.

✔ For the velocity control error alarm, an alarm may occur while starting and stopping when load inertia moment is excessive. For this reason, in the gravitational axis applications, “Do not detect“ is selected as the standard setting. If its detection is needed, consult our representatives.

■ Alarm Code C3 (Velocity Feedback Error)

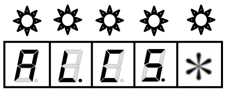


Status at the time of alarm	Cause		
	1	2	3
Issued when command is entered.	✔	✔	✔
Generated at the time of control input.		✔	

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Motor is not rotating.	■ Confirm that the power line is properly connected. ■ Replace the servo motor.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
3	■ The motor is vibrating (oscillating).	■ Adjust the servo parameter so that servo motor will not vibrate (oscillate).

■ Alarm Code C5 (Model Tracking Vibration Suppression, Control Error)

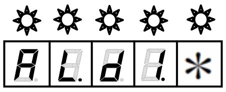


Status at the time of alarm	Cause		
	1	2	3
Issued after entering position command pulse.	✔	✔	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Setup of model control gain is high.	■ Lower model control gain.
2	■ The acceleration-and-deceleration time of a position command is short.	■ Simplify the acceleration and declaration command pattern.
3	■ Torque limiting value is low.	■ Enlarge a torque limiting value or repeal torque restrictions.

✔ Other alarms are generated, and this alarm may be generated if a servo brake performs alarm reset during a slowdown.



■ Alarm Code D1 (Following Error / Excessive Position Deviation)

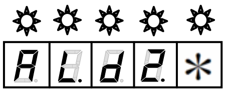
Status at the time of alarm	Cause											
	1	2	3	4	5	6	7	8	9	10	11	12
Issued when control power supply is turned ON.										✔		
Issued when servo ON is stopped.						✔					✔	
Issued immediately after entering the command.	✔	✔	✔	✔	✔		✔	✔	✔		✔	
Issued during starting or stopping at high speed.	✔	✔					✔	✔	✔		✔	✔
Issued during the operations by lengthy command.		✔					✔	✔			✔	

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Position command frequency is high or acceleration and declaration time is short.	■ 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 wiring and replace if necessary. If specified voltage is applied, replace the servo motor.
4	■ Servo motor is mechanically locked or machine is colliding.	■ Check the machinery system.
5	■ One or all phases of U/V/W -phase of the servo amplifier and motor has disconnected.	■ Check wiring and replace if necessary.
6	■ Motor is being rotated by an external force (Gravity, etc.) during stopping (positioning completion).	■ Check the load, and/or increase the servo motor capacity.
7	■ Valid torque limit command is entered by the controller, and the torque limit setting is too much reduced. ■ Setting of a Velocity Limit Command is too little. ■ Number of motor encoder pulses does not match with the servo motor.	■ Increase the torque limit value or disable the torque limit. ■ Enlarge setting of a Velocity Limit Command. ■ Match the number of servo motor encoder pulses.
8	■ Settings of servo parameters (Position Loop Gain, etc.) are not appropriate.	■ Check the servo parameter settings (Raise the position loop gain, etc.).
9	■ Excessive deviation setting value is much reduced.	■ Set a greater value for excessive deviation.
10	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.
11	■ Defect in internal circuit of motor encoder.	■ Replace the servo motor.
12	■ 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.	✔

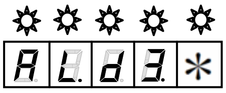


◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Command for the digital filter setting of the command pulse input is entered.	■ Decrease the frequency of the command pulse. ■ Increase the frequency of the digital filter.

■ Alarm Code D3 (Faulty Position Command Pulse Frequency 2)

Status at the time of alarm	Cause	
	1	2
Issued after entering position command pulse.	✔	✔

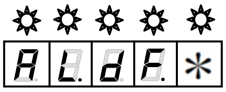


◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Frequency of command pulse input is excessive.	■ Reduce the frequency of command pulse input.
2	■ Setting value of electronic gear is excessive.	■ Decrease the electronic gear setting value.

■ Alarm Code DF (Test Run Close)

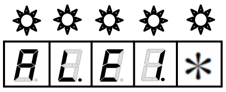
Status at the time of alarm	Cause
	1
Occurred after execution of test mode.	✔



◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Normal operation.	■ Clear the alarm and restore operation. (After completion of test mode, to confirm any deviation in the controller).

■ Alarm Code E1 (EEPROM Error)

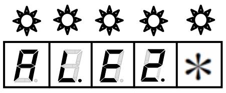


Status at the time of alarm	Cause
	1
Issued during display key operation or set up software operation.	✔

◆ Corrective actions

	Cause	Investigation and corrective actions
1	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

■ Alarm Code E2 (EEPROM Check Sum Error)



Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ Corrective actions

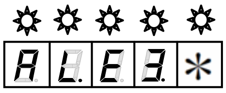
	Cause	Investigation and corrective actions
1	■ Correct value not read by CPU by EEPROM built-in servo amplifier.	■ Replace the servo amplifier.
2	■ Failed to write into the EEPROM during last power supply cutoff.	■ Replace the servo amplifier.

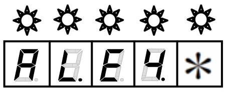
■ Alarm Code E3 (Memory Error 1)

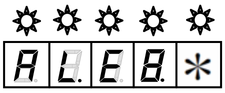
■ Alarm Code E4 (Memory Error 1)

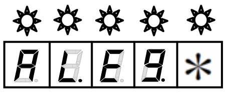
■ Alarm Code E8 (CPU Surrounding Circuit Error)

■ Alarm Code E9 (System Code Error)







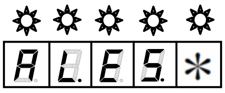


Status at the time of alarm	Cause
	1
Issued when control power supply is turned ON.	✔

◆ 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)

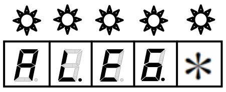


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Selected value is outside the specified range for a system parameter.	■ Confirm the model number of the servo amplifier. 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)



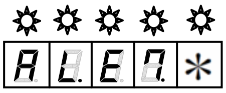
Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Selected values of system parameters and actual hardware do not match. ■ Improper assembly of system parameter settings.	■ Confirm the model number of the servo amplifier. ■ Turn ON the control power again and confirm that alarm is cleared.
2	■ Defect in internal circuit of servo amplifier.	■ Replace the servo amplifier.

✔ R5 series motor is able to use with the amplifier that is revision H or newer, and is up to 50 A output motor current model. Please note the alarm E6 will given by combination of the amplifier older than revision H with R5 series motor.

■ Alarm Code E7 (Motor Parameter Error)

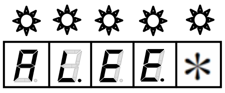


Status at the time of alarm	Cause	
	1	2
Issued when control power supply is turned ON.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Correct value not read by CPU by EEPROM built-in servo amplifier.	■ If control power supply is re-switched on and alarm recurs after re-setting a motor parameter, replace servo amplifier.
2	■ Failed to write into the EEPROM when changing motor parameter.	■ If power supply is re-switched on and alarm recurs after re-setting a motor parameter, replace servo amplifier.

■ Alarm Code EE (Motor Parameter Automatic Setting Error 1)

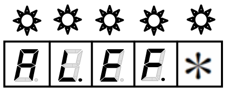


Status at the time of alarm	Cause		
	1	2	3
Issued after motor parameter automatic setting functional execution.	✔	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ The connected encoder does not support a motor parameter automatic setting function.	■ Replace with the supported servo motor.
2	■ The connected servo motor does not support a motor parameter automatic setting function.	■ Since the servo motor of usage cannot respond to this function, 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)



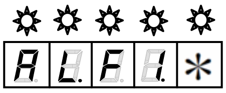
Status at the time of alarm	Cause	
	1	2
Issued after motor parameter automatic setting functional execution.	✔	✔

◆ Corrective actions

Cause		Investigation and corrective actions
1	■ Servo amplifier and motor are not combined properly.	■ Check the model number of servo amplifier and servo motor, and correct the combination.
2	■ 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.	✔

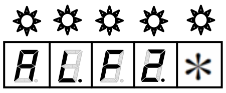


◆ Corrective actions

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 supply 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 servo amplifier. ■ Add ferrite core or similar countermeasures against noise.

8.4 Encoder clear and alarm reset

Procedure of “encoder clear and alarm reset method“ varies depending on motor encoder you use. Perform “encoder clear and alarm reset“ for motor encoder you use by referring to “2) Alarm code activated.“ Please operate “encoder clear and alarm reset“ in the state alarm cause is eliminated.

1) Types of motor encoder

- ■ Absolute Encoder for Incremental System

Type	Resolution	Synchronization system	Transmission method	Transmission speed
PA035S	131072divisions(17bits)	Asynchronous	Half duplex serial	2.5Mbps

- ■ Battery Backup Method Absolute Encoder

Type	Resolution	Multiple rotations	Synchronization system	Transmission method	Transmission speed
PA035C	131072 divisions (17bits)	65536(16bits)	Asynchronous	Half duplex serial	2.5Mbps
	131072 divisions (17bits)	65536(16bits)	Asynchronous	Half duplex serial	4.0Mbps

- ■ Battery-less Absolute Encoder

Type	Resolution	Multiple rotations	Synchronization system	Transmission method	Transmission speed
RA035C	131072 divisions (17bits)	65536(16bits)	Asynchronous	Half duplex serial	2.5Mbps

2) Occurring Alarm Code

- ■ Alarm Code A1 (Serial Encoder Internal Error 1)

  - ◆ The “Motor encoder “and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Alarm reset “after “Encoder clear“
PA035C	
RA035C	“Alarm reset “after “Encoder clear“ Or “Turn on the control power again“

- ■ Alarm Code A2 (Serial Encoder Internal Error 2)

  - ◆ The “Motor encoder“ and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Turn on the control power again“
PA035C	
RA035C	“Alarm reset“after “Encoder clear“ Or “Turn on the control power again“

- ■ Alarm Code A3 (Serial Encoder Internal Error 3)

  - ◆ The “Motor encoder“ and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Alarm reset “after “Encoder clear“ Or “Turn on the control power again “
PA035C	
RA035C	

- Alarm Code A4 (Serial Encoder Internal Error 4)

  - The “Motor encoder“ and the “Encoder clear and Alarm reset “ method in use.

Type	Method
PA035S	“Alarm reset “ after “Encoder clear “ Or “Turn on the control power again “
PA035C	
RA035C	

- Alarm Code A5 (Serial Encoder Internal Error 5)

  - The “Motor encoder“ and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Turn on the control power again “
PA035C	
RA035C	

- Alarm Code A6 (Serial Encoder Internal Error 6)

  - The “Motor encoder“ and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Turn on the control power again “
PA035C	
RA035C	

- Alarm Code A9 (Serial Encoder Internal Error 9)

  - The “Motor encoder“ and the “Encoder clear and Alarm reset“ method in use.

Type	Method
PA035S	“Alarm reset “
PA035C	
RA035C	

- Alarm Code AA to AF (Serial Encoder Internal Error 10 to 15)

  - The “Motor encoder “ and the “Encoder clear and Alarm reset “ method in use.

Type	Method
PA035S	“Turn on the control power again “
PA035C	
RA035C	

8.5 Inspection

For maintenance purposes, a daily inspection is typically sufficient.

Upon inspection, refer to the following description.

Inspection location	Testing conditions			Inspection Items	Inspection Methods	Solution if abnormal
	Time	During operation	While stopping			
Servo motor	Daily	✔		Vibration	Check for excessive vibration.	Contact dealer/sales office.
	Daily	✔		Sound	Check if there is no abnormal sound as compared to normal sound.	
	Periodic		✔	Cleanliness	Check for dirt and dust.	Clean with cloth or air. Note 1)
	Yearly		✔	Measure value of 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 serial 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) While cleaning with air, confirm that there is no oil content and/or moisture in the 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 2 years, when its power is OFF throughout the year. For replacement, a lithium battery (ER3VLY: 3.6V, 1000mAh) manufactured by TOSHIBA LIFESTYLE PRODUCTS & SERVICES CORPORATION. is recommended.

8.6 Service parts

1) Inspection parts

Parts can be agedly deteriorated. Perform periodic inspection for preventive maintenance.

No.	Part name	Number of average replacement years	Corrective measures / usage conditions
1	Condenser for smoothing main circuit	5 Years	Replacement with new part is necessary. Load ratio: 50% of rated output current of amplifier. Usage condition: Average temp. 40°C year-round.
2	Cooling Fan motor	5 Years	Replacement with new part is necessary. Usage condition: Average temp. 40°C year-round.
3	Lithium battery for serial encoder [ER3V]	3 Years	Replacement with new part is necessary.
4	Electrolysis condenser (other than condenser for smoothing main circuit)	5 Years	Replacement with new part is necessary. Usage condition: Average temp. 40°C year-round. Annual usage period is 4800 hours.
5	Fuse	10 Years	Replacement with new part is necessary.

■ Condenser for smoothing the main circuit

- ◆ If the servo amplifier is in use for more than 3 years, contact the dealer or sales office. The capacity of the condenser for smoothing the main circuit is reduces due to the frequency of motor output current and main circuit power ON/ OFF during usage, and it may cause damage.
- ◆ When the condenser is used with an average 40°C through out the year, and exceeds more than 50% of the rated output current of servo amplifier, it is necessary to replace the condenser with a new part every 5 years.
- ◆ When used in an application where the power turn ON/OFF is repeated more than 30 times a day, consult our representatives.

■ Cooling Fan motor

- ◆ The R-Series Amplifier is set corresponding to the degree of pollution specified in EN50178 or IEC 664-1. As it is not dust proof or oil proof, use it in an environment above Pollution Level 2 (i.e., Pollution Level 1,2).
- ◆ R-Series servo amplifiers models RS2□03, RS2□05, RS2□10, RS2□15, and RS2□30 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 damage due to a reduction in the static pressure of the cooling fan and/or degradation of electronic parts. Replacement is necessary if abnormal noise occurs, or oil or dust is observed on the parts. Also, at an average temperature of 40°C year-round, the life expectancy is 5 years.

■ Lithium battery for serial encoder

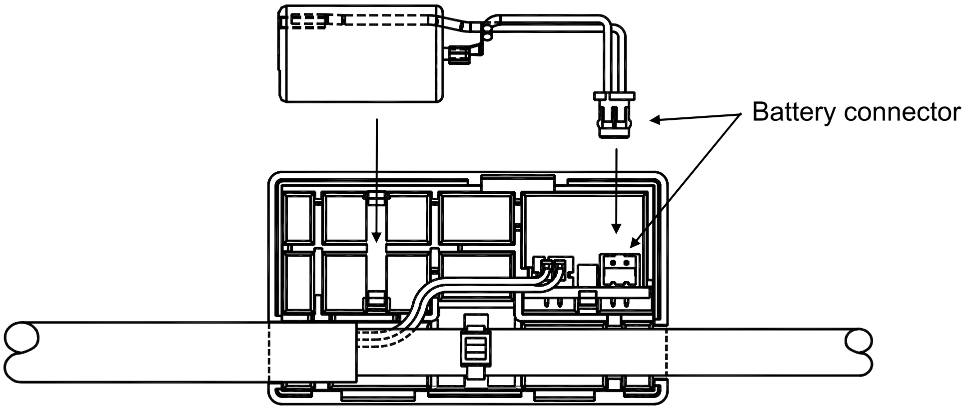
- ◆ The standard replacement period recommended by our company is the life expectancy of lithium battery based on normal usage conditions. However, if there is high frequency of turning the power ON/OFF, or the motor is not used for a long period, then the life of lithium battery is reduced. If the battery power is less than 3.6 V during inspection, replace it with new one.

■ SANYO DENKI-overhauled servo amplifier is shipped with the same parameters as the ones before overhauling, however, be sure to confirm the parameters before use.

2) Replacing battery 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 case.
4	Remove the battery connector.
5	Take out the used lithium battery and put in the new replacement one.
6	Attach the connector in the right direction.
7	Close the battery case.

Lithium battery [AL-00697958-01]



Battery case

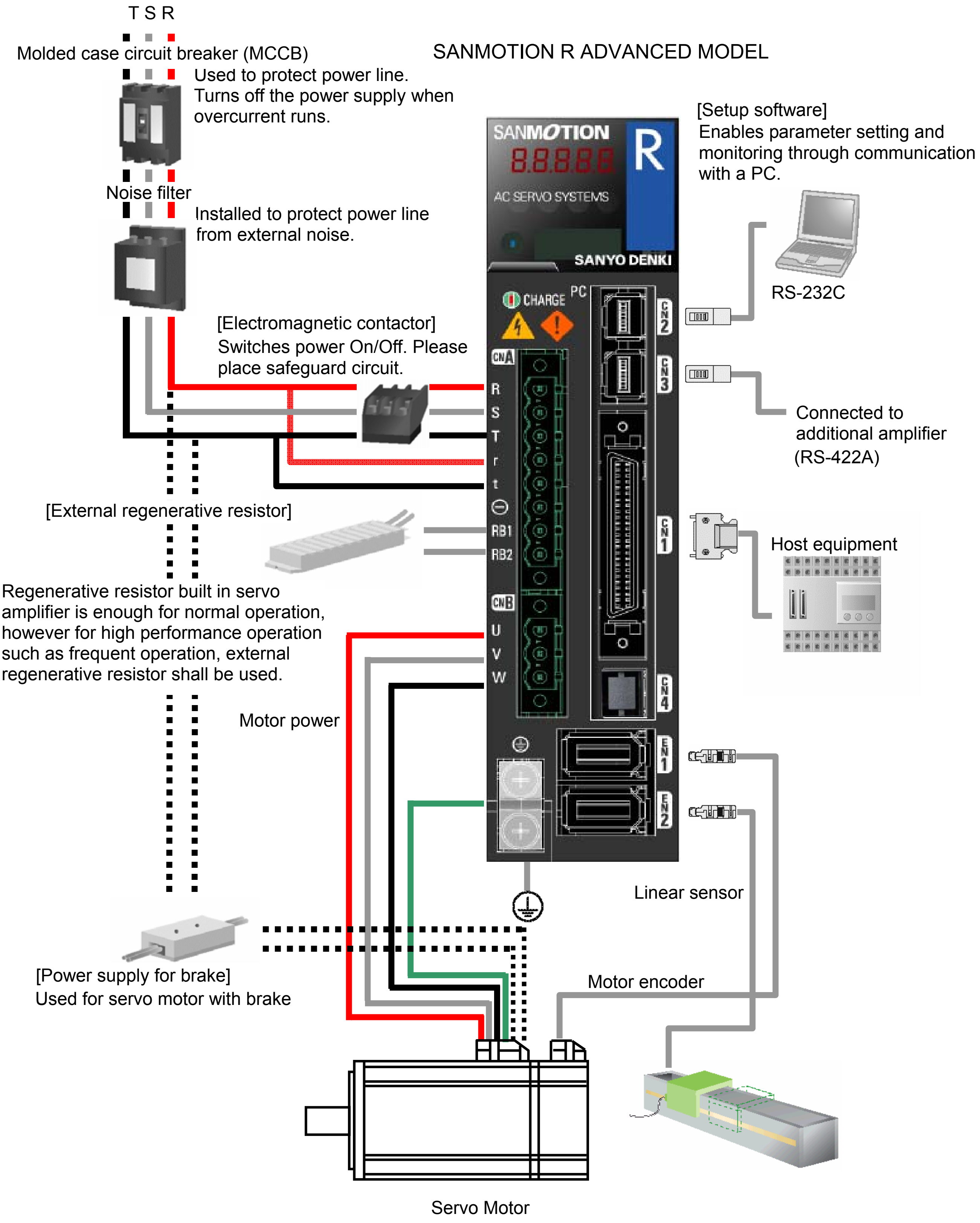
- ✔ If the battery is replaced while the control power is OFF, multiple rotation counter (position data) of the motor encoder may be instable. When the amplifier control power is turned ON in this status, an alarm (Serial Encoder Error) may be issued. For this, execute encoder clear and alarm reset to release the alarm status. Also, absolute encoder position data may be instable. Check and adjust the relations between position data and machine coordinate system.

9

9. Fully closed control

9.1 Illustration of system configuration

■ RS2☐01/RS2☐03/RS2☐05



SANMOTION R ADVANCED MODEL

Molded case circuit breaker (MCCB)
Used to protect power line.
Turns off the power supply when overcurrent runs.

Noise filter
Installed to protect power line from external noise.

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

[External regenerative resistor]

Regenerative resistor built in servo amplifier is enough for normal operation, however for high performance operation such as frequent operation, external regenerative resistor shall be used.

Motor power

[Power supply for brake]
Used for servo motor with brake

[Setup software]
Enables parameter setting and monitoring through communication with a PC.

Connected to additional amplifier (RS-422A)

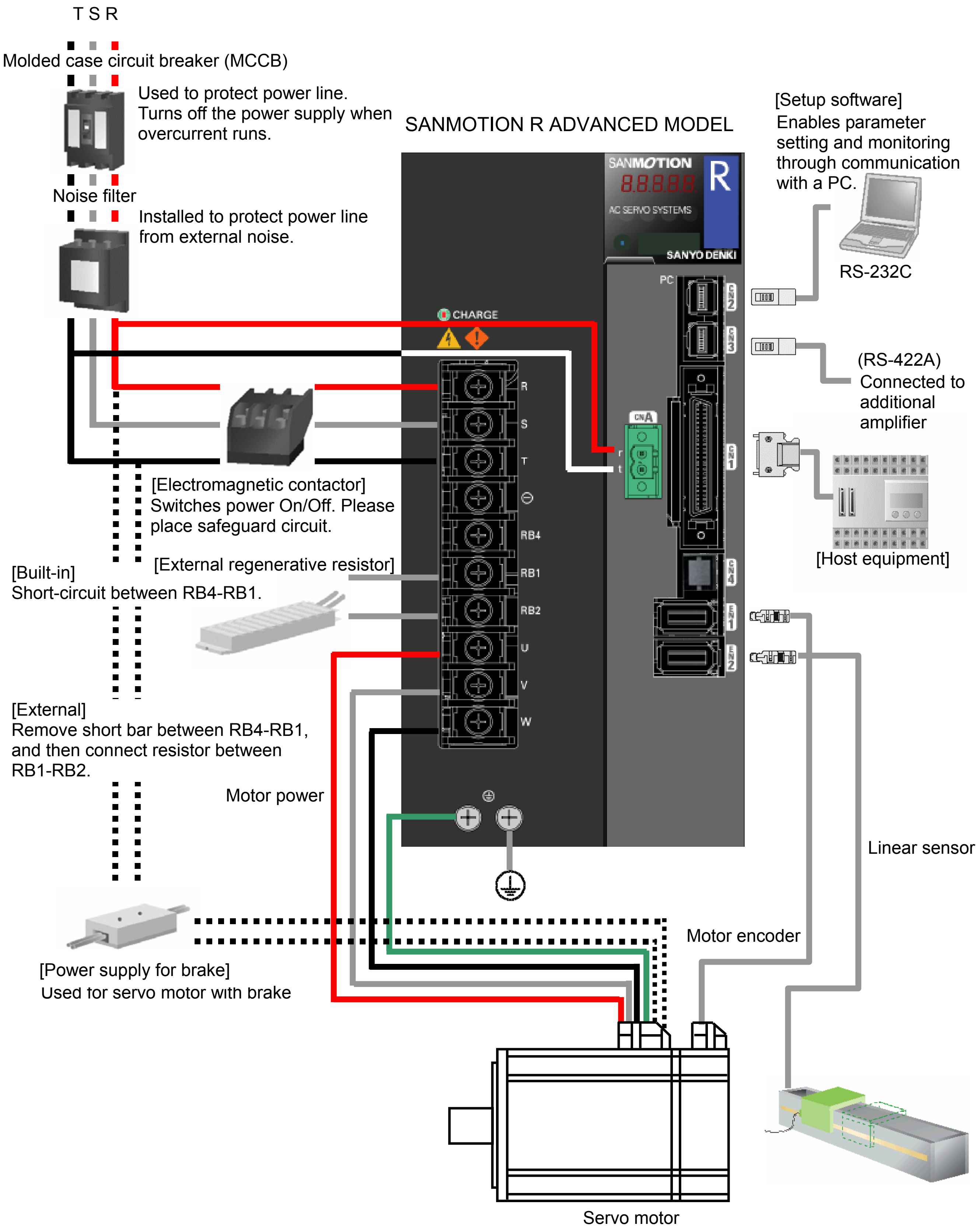
Host equipment

Linear sensor

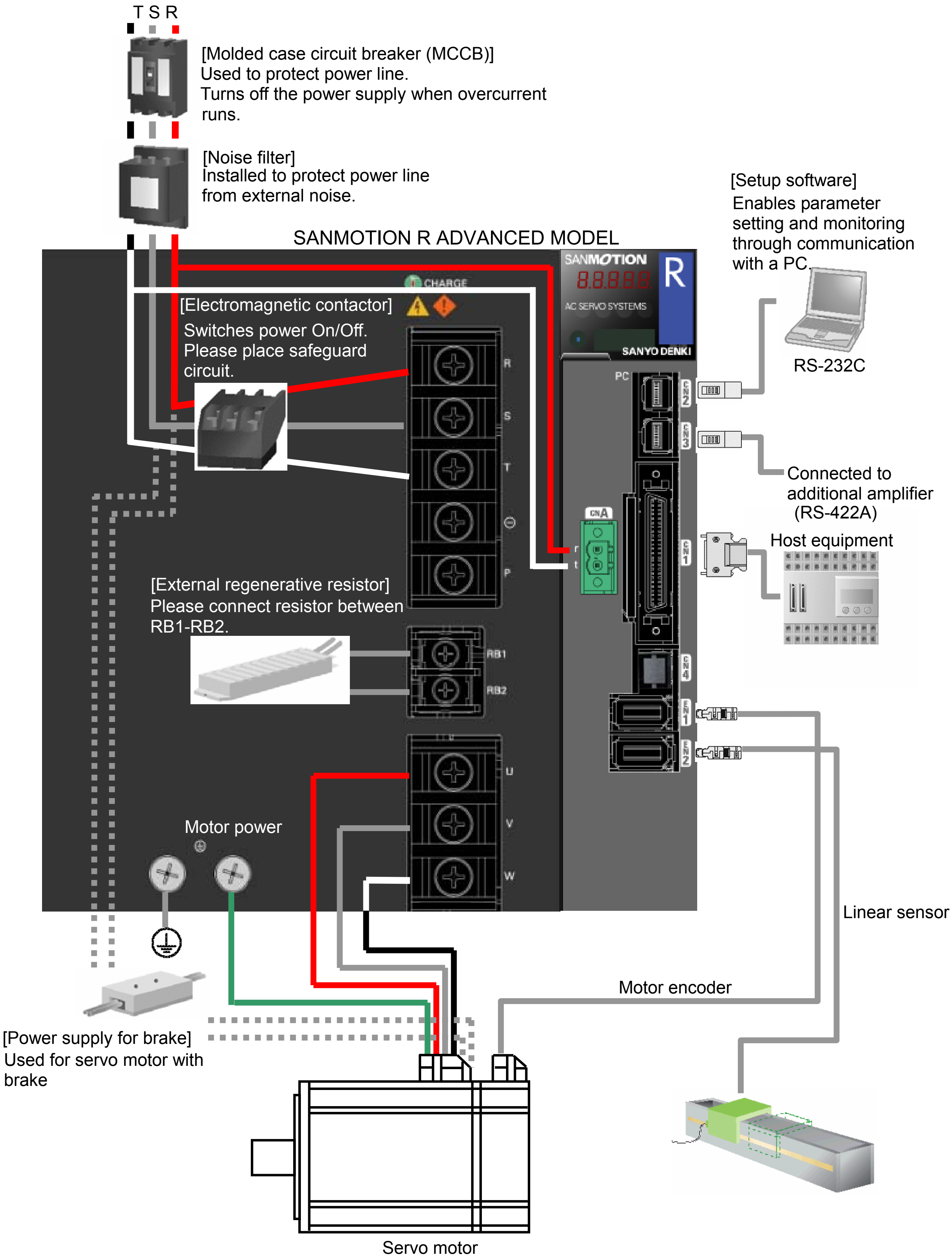
Motor encoder

Servo Motor

■ RS2□10/RS2□15


T S R
Molded case circuit breaker (MCCB)
Used to protect power line.
Turns off the power supply when overcurrent runs.
Noise filter
Installed to protect power line from external noise.
SANMOTION R ADVANCED MODEL
SANMOTION
AC SERVO SYSTEMS
SANYO DENKI
R
CHARGE
PC
CN2
CN3
CN1
CN4
EN1
EN2
CNA
r
t
R
S
T
⊖
RB4
RB1
RB2
U
V
W
[Setup software]
Enables parameter setting and monitoring through communication with a PC.
RS-232C
(RS-422A)
Connected to additional amplifier
[Host equipment]
[Electromagnetic contactor]
Switches power On/Off. Please place safeguard circuit.
[External regenerative resistor]
[Built-in]
Short-circuit between RB4-RB1.
[External]
Remove short bar between RB4-RB1, and then connect resistor between RB1-RB2.
Motor power
Linear sensor
Motor encoder
[Power supply for brake]
Used for servo motor with brake
Servo motor

- ■ RS2□30



[Molded case circuit breaker (MCCB)]
Used to protect power line.
Turns off the power supply when overcurrent runs.

[Noise filter]
Installed to protect power line from external noise.

[Setup software]
Enables parameter setting and monitoring through communication with a PC.

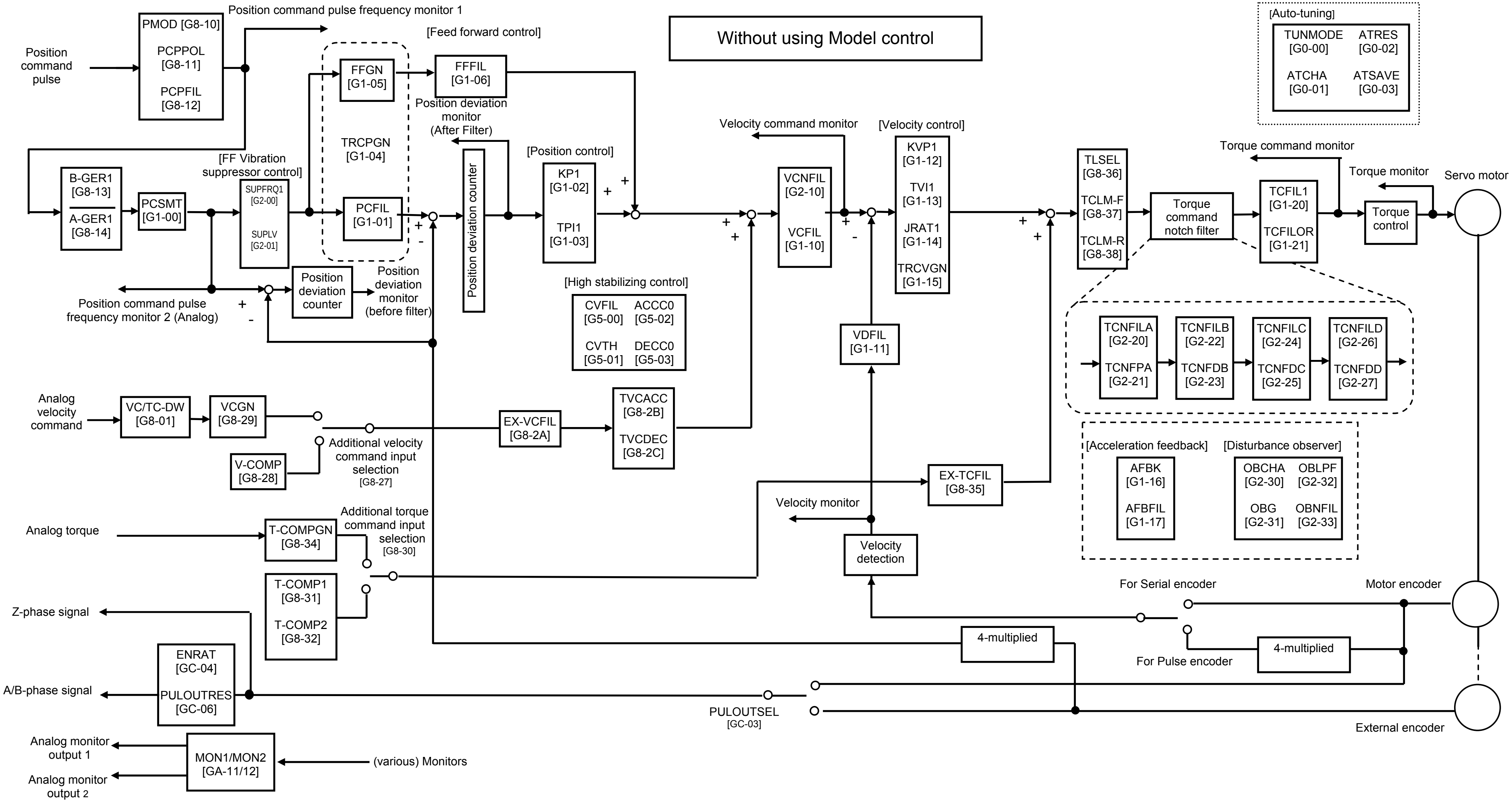
[Electromagnetic contactor]
Switches power On/Off.
Please place safeguard circuit.

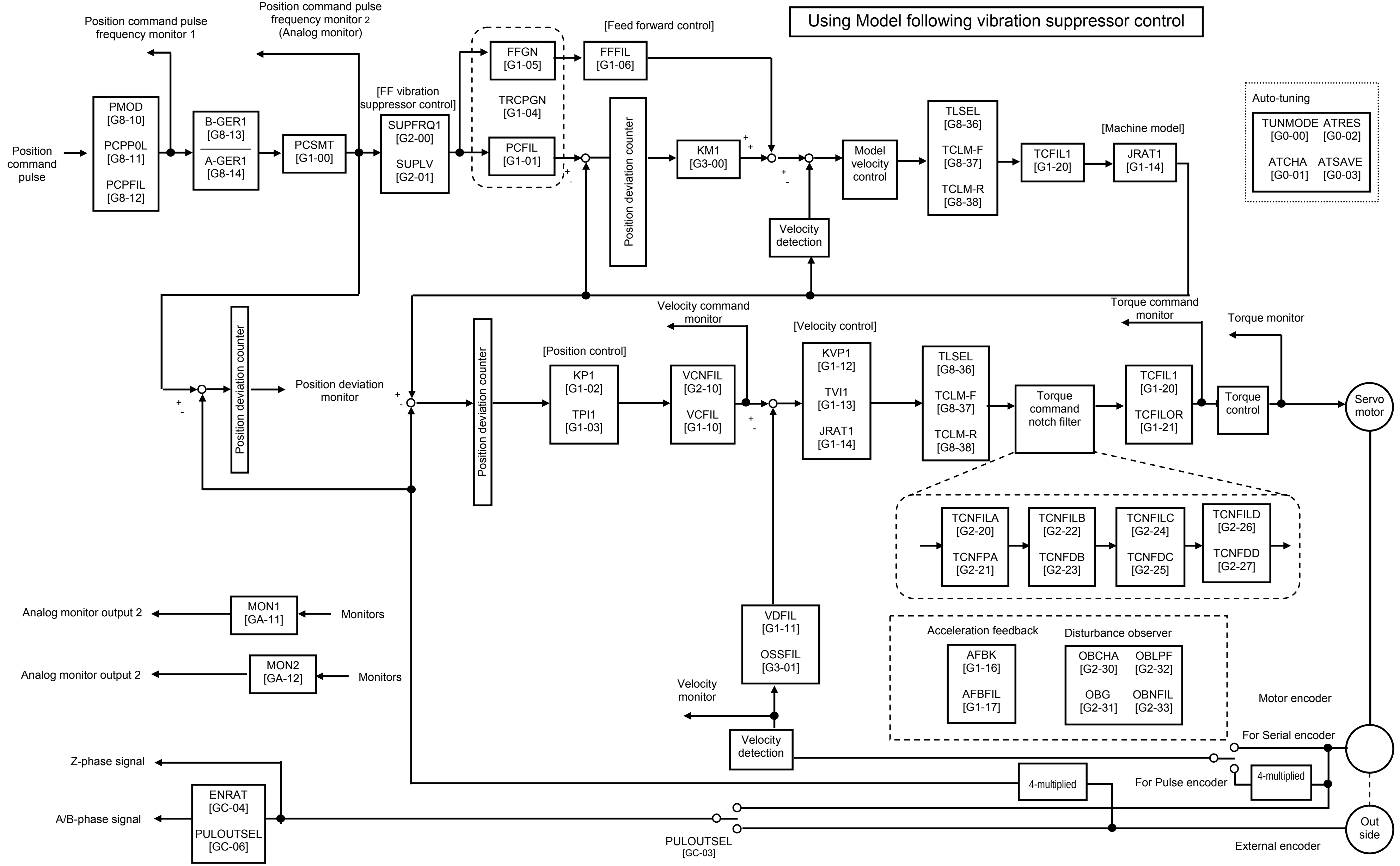
Connected to additional amplifier (RS-422A)

[External regenerative resistor]
Please connect resistor between RB1-RB2.

[Power supply for brake]
Used for servo motor with brake

9.2 Internal block diagram




Using Model following vibration suppressor control
Position command pulse frequency monitor 1
Position command pulse frequency monitor 2 (Analog monitor)
Position command pulse
PMOD [G8-10]
PCPP0L [G8-11]
PCPFIL [G8-12]
B-GER1 [G8-13]
A-GER1 [G8-14]
PCSMT [G1-00]
[FF vibration suppressor control]
SUPFRQ1 [G2-00]
SUPLV [G2-01]
FFGN [G1-05]
TRCPGN [G1-04]
PCFIL [G1-01]
[Feed forward control]
FFFIL [G1-06]
Position deviation counter
KM1 [G3-00]
Velocity detection
Model velocity control
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
TCFIL1 [G1-20]
[Machine model]
JRAT1 [G1-14]
Auto-tuning
TUNMODE [G0-00]
ATRES [G0-02]
ATCHA [G0-01]
ATSAVE [G0-03]
Position deviation counter
Position deviation monitor
Position deviation counter
[Position control]
KP1 [G1-02]
TPI1 [G1-03]
Velocity command monitor
VCNFIL [G2-10]
VCFIL [G1-10]
[Velocity control]
KVP1 [G1-12]
TVI1 [G1-13]
JRAT1 [G1-14]
TLSEL [G8-36]
TCLM-F [G8-37]
TCLM-R [G8-38]
Torque command notch filter
Torque command monitor
TCFIL1 [G1-20]
TCFILOR [G1-21]
Torque monitor
Torque control
Servo motor
TCNFILA [G2-20]
TCNFPA [G2-21]
TCNFILB [G2-22]
TCNFDB [G2-23]
TCNFILC [G2-24]
TCNFDC [G2-25]
TCNFILD [G2-26]
TCNFDD [G2-27]
Analog monitor output 2
MON1 [GA-11]
Monitors
Analog monitor output 2
MON2 [GA-12]
Monitors
VDFIL [G1-11]
OSSFIL [G3-01]
Velocity monitor
Velocity detection
Acceleration feedback
AFBK [G1-16]
AFBFIL [G1-17]
Disturbance observer
OBCHA [G2-30]
OBLPF [G2-32]
OBG [G2-31]
OBNFIL [G2-33]
Motor encoder
For Serial encoder
For Pulse encoder
4-multiplied
4-multiplied
Z-phase signal
A/B-phase signal
ENRAT [GC-04]
PULOUTSEL [GC-06]
PULOUTSEL [GC-03]
Out side
External encoder
+
-

9.3 Wiring

1) Signal names and pin numbers of EN1 and EN2

■ Battery backup method absolute encoder

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	H	Power supply	Twisted pair (Recommended)
2	SG	10 (Black)	G	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	(NC)	-	-	Unconnected	-
6	(NC)	-	-	Unconnected	-
7	ES+	1 (Brown)	E	Serial data signal	Twisted pair
8	ES-	2 (Blue)	F		
9	BAT+	8 (Pink)	T	Battery	Twisted pair
10	BAT-	4 (Purple)	S		
Note 2)	Earth	7 (shielded)	J	Shield	-

Note 1) Use twisted shielded pair cable.

Note 2) Connect jacketed shielded wires of servo amplifier to metallic case (grounding) of servo amplifier (EN1). When you use servo motor with leads, connect jacketed shielded wires on servo motor side (routed from servo amplifier) to shielded wires of leads, when you use canon plug type servo motor, wire jacketed shielded-wires close to servo motor. Shielded wires of servo motor equipped with this encoder do not connect to the encoder inside the servo motor.

■ Absolute encoder for incremental system

Servo Amplifier EN1 Terminal No.	Signal name	R/Q-series Servo motor Plug pin number (Specification for leads)	Description	Remarks Note 1)
1	5V	9 (Red)	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	Power supply common	
3	5V	-	Unconnected	-
4	SG	-	Unconnected	-
5	(NC)	-	Unconnected	-
6	(NC)	-	Unconnected	-
7	ES+	1 (Brown)	Serial data signal	Twisted pair
8	ES-	2 (Blue)		
9	(NC)	-	Unconnected	-
10	(NC)	-	Unconnected	-
Note 2)	Earth	7 (shielded)	Shield	-

Note 1) Use twisted shielded pair cable.

Note 2) Connect jacketed shielded wires of servo amplifier to metallic case (grounding) of servo amplifier (EN1). When you use servo motor with leads, connect jacketed shielded wires on servo motor side (routed from servo amplifier) to shielded wires of leads, when you use canon plug type servo motor, wire jacketed shielded-wires close to servo motor. Shielded wires of servo motor equipped with this encoder do not connect to the encoder inside the servo motor.

■ Battery-less absolute encoder

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	H	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	G	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	(NC)	-	-	Un connected	-
6	(NC)	-	-	Un connected	-
7	ES+	1 (Brown)	E	Serial data signal	Twisted pair
8	ES-	2 (Blue)	F		
9	(NC)	-	-	Un connected	-
10	(NC)	-	-	Un connected	-
Note 2)	Earth	7 (shielded)	J	Shield	-

Note 1) Use twisted shielded pair cable.
Note 2) Connect jacketed shielded wires to metallic case (grounding) of servo amplifier (EN1), and ground it to motor encoder.

■ Pulse encoder

Servo Amplifier EN1 Terminal No.	Signal name	R-series Servo motor plug pin number (Specification for leads)	Q-series Servo motor plug pin number	Description	Remarks Note 1)
1	5V	9 (Red)	J	Power supply	Twisted pair (Recommendation)
2	SG	10 (Black)	N	Power supply common	
3	5V	-	-	Unconnected	-
4	SG	-	-	Unconnected	-
5	B	2 (Green)	B	B-phase pulse output	Twisted pair
6	/B	5 (Purple)	E		
7	A	1 (Blue)	A	A-phase pulse output	Twisted pair
8	/A	4 (Brown)	D		
9	Z	3 (White)	F	Z-phase pulse output	Twisted pair
10	/Z	6 (Yellow)	G		
Note 2)	Earth	7 (shielded)	H	Shield	-

Note 1) Use twisted shielded pair cable.
Note 2) Connect jacketed shielded wires to metallic case (grounding) of servo amplifier (EN1), and ground it to motor encoder.

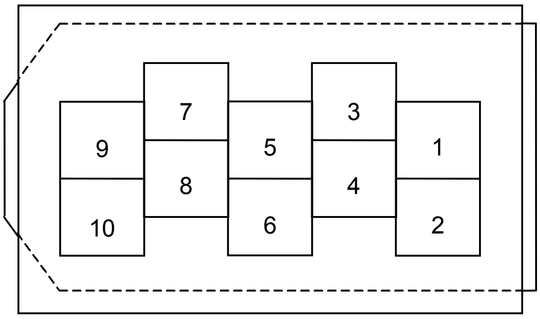
■ EN2 Wiring (External pulse encoder)

EN2 Terminal No.	Signal name	Description	Note 1)
1	5V	Note 3)	Twisted pair
2	SG	Common power source Note 4)	Twisted pair
3	5V	Note 3)	-
4	SG	Common power source Note 4)	
5	B	B-phase pulse output	Twisted pair
6	/B		
7	A	A-phase pulse output	Twisted pair
8	/A		
9	Z	Z-phase pulse output	Twisted pair
10	/Z		
Note 2)	Earth	Shield	-

Note 1) Use twisted shielded pair cable.
Note 2) Connect jacketed shielded wires to metallic case (earth) of EN2, and then ground it to external pulse encoder.
Note 3) Please be advised that power supply for external pulse encoder is user-prepared item.
Note 4) Please make sure to connect common power supply.

2) Connector layout of EN1 and EN2

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



9.4 Fully closed control related parameters

When using by fully closed control, please set a parameter as follows.

1) System parameters settings

The System parameters have the following restrictions when fully closed control is used for operation:
Fully closed control becomes valid when the Control mode is in [Positions control].
Fully closed operation is invalid with another Control mode except Positions control.
Only [Standard_Sampling] for the Control period, [Standard] and [Model following control] for Position control selection is valid.

<table>
<tr><th>ID</th><th>Contents</th></tr>
<tr><td rowspan="2">00</td><td>Control Cycle</td></tr>
<tr><td>■ Select Velocity control, Torque control period
Set below
<table>
<tr><th colspan="2">Selection Value</th><th>Contents</th></tr>
<tr><td>00</td><td>Standard_Sampling</td><td>Standard sampling mode</td></tr>
</table></td></tr>
<tr><td rowspan="2">09</td><td>Control Mode Selection</td></tr>
<tr><td>■ Setup Control mode to the servo amplifier being used
Set below
<table>
<tr><th colspan="2">Selection Value</th><th>Contents</th></tr>
<tr><td>02</td><td>Position</td><td>Position control</td></tr>
</table></td></tr>
<tr><td rowspan="2">0A</td><td>Position Control Selection</td></tr>
<tr><td>■ Select functions of Position control mode
Set below
<table>
<tr><th colspan="2">Selection Value</th><th>Contents</th></tr>
<tr><td>00</td><td>Standard</td><td>Standard</td></tr>
<tr><td>01</td><td>Model1</td><td>Model following control</td></tr>
</table></td></tr>
<tr><td rowspan="2">0B</td><td>Position Loop Control, Position Loop Encoder Selection</td></tr>
<tr><td>■ For the system [Fully closed control] is used. Select [Position loop control] method for the servo amplifier and select the encoder the servo amplifier is going to use for [Position loop control].
<table>
<tr><th colspan="2">Selection Value</th><th>Contents</th></tr>
<tr><td>00</td><td>Motor_Enc</td><td>Semi-closed control/Motor encoder</td></tr>
<tr><td>01</td><td>External_Enc</td><td>Fully closed control/External encoder</td></tr>
</table>
■ Confirm and set below.
<table>
<tr><th>Current set Value</th><th>Contents</th></tr>
<tr><td>01 : External_Enc</td><td>Fully closed control/External encoder</td></tr>
</table>
✔ Changes are not necessary for the system if [Fully closed control] is not used.</td></tr>
</table>

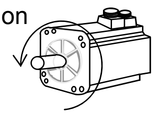
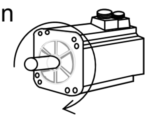
2) Rotational direction setting for the servo motor

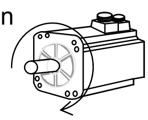
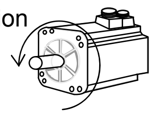
Rotation of the servo motor in Fully closed control is determined by Command polarity and External pulse encoder polarity.

Contents

“Group8 ID00”Position, Velocity, Torque Command Input Polarity

- ■ Select Command polarity of Position command pulse from the following:
  The rotation of the servo motor can is reversible without changing the command wiring.

Selection Value		Position command pulse positive (PCMD)	Position command pulse negative (PCMD)
00	PC+_VC+_TC+	CCW Rotation 	CW Rotation 
01	PC+_VC+_TC-		
02	PC+_VC-_TC+		
03	PC+_VC-_TC-		
ID : 0C/0D “APMON”		Current position monitor value increase	Current position monitor value decrease

Selection Value		Position command pulse positive (PCMD)	Position command pulse negative (PCMD)
04	PC-_VC+_TC+	CW Rotation 	CCW Rotation 
05	PC-_VC+_TC-		
06	PC-_VC-_TC+		
07	PC-_VC-_TC-		
ID : 0C/0D “APMON”		Current position monitor value decrease	Current position monitor value increase

“GroupC ID02”External Pulse Encoder Polarity Selection
[Control power reactivation after setting]

- ■ Setup Signal polarity of external pulse encoder

Selection Value		Contents		
00	Type1	EX-Z/No inversion	EX-B/ No inversion	EX-A/ No inversion
01	Type2	EX-Z/ No inversion	EX-B/ No inversion	EX-A/ Inversion

Set: [External pulse encoder signal polarity] as the increase and decrease of ID: OE/OF “EX-APMON” External position monitor (External encoder) becomes same as ID: OC/OC “AMPON” Current position monitor (Motor encoder).
This parameter becomes valid after inputting the Control power setting again.

3) Setting for external encoder resolution

System parameter ID0C External Pulse Encoder Resolution [Control power reactivation after setting]

- ■ Input the pulse number converted in 1 rotation of motor axis.

Setting range	Unit
500 to 99999(1 multiplier)	P/R

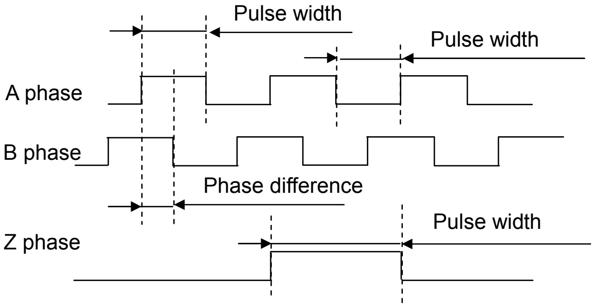
- ■ Example:
  - ◆ Minimum resolution of external pulse encoder used : 1.0μm
  - ◆ Work moving distance for single-turn of motor axis: 10mm
    Pulse number of external pulse encoder resolution converted into resolution/1mm is 1000P/mm.
    Pulse number converted to single-turn of motor is as follows, in consideration of that work moving distance for single-turn of motor axis is 10mm:
    10mm/ single-turn x 1000P/mm = 10000P/R (value 4-multiplired)
    (Set value is to be 1-multiplied, so set 10000/4 = 2500P/R.)
    - ✔ Please round the value off to the closest whole number.

4) Digital filter setting

"GroupC ID01" External Pulse Encoder Digital Filter

- Setting Digital filter of External pulse encoder
  When noise is superimposed on the External pulse encoder, the pulse below set value is removed as noise.
  Set this value by considering the resolution of the encoder and the maximum rotation speed of the servo motor.
  Set the value below ¼ to the Encoder pulse width under peak motor rotation speed as a standard.

Selection value		Contents
00	110nsec	Minimum pulse width=110nsec(Minimum 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 phase difference =37.5nsec)
05	150nsec	Minimum pulse width =150nsec
06	300nsec	Minimum pulse width =300nsec
07	600nsec	Minimum pulse width =600nsec



5) Encoder output pulse signals

"GroupC ID03" encoder output pulse divide selection [Control power reactivation after setting]

- Setting the Encoder output pulse division
  Select one of the encoders [Motor encoder] or [External encoder] to take [Encoder pulse signal] into the host equipment.

Selection value		
00	Motor_Enc	Motor encoder
01	External_Enc	External encoder

9.5 Remarks

1) Input power timing for external pulse encoder

- Please provide the power supply for the External pulse encoder on your own.
- Turn the power ON before or at the same time of inputting the Control power to the servo amplifier.
  If there is more than 1s delay from the Control power input, [Alarm of wire breaking of encoder connector 2 “ALM_83”] may occur.

2) Workings of external pulse encoder

- Servo motor can run out of control under the following conditions: So please check if no errors on external pulse encoder before servo-on excitation.

  - When counting direction of ”APMON: present position monitor (motor encoder)” and ”EX-APMON: present position monitor (external encoder)” are opposite (increase/ decrease). →Change “GroupC ID02” external pulse encoder polarity selection to match the counting directions (increase/ decrease).

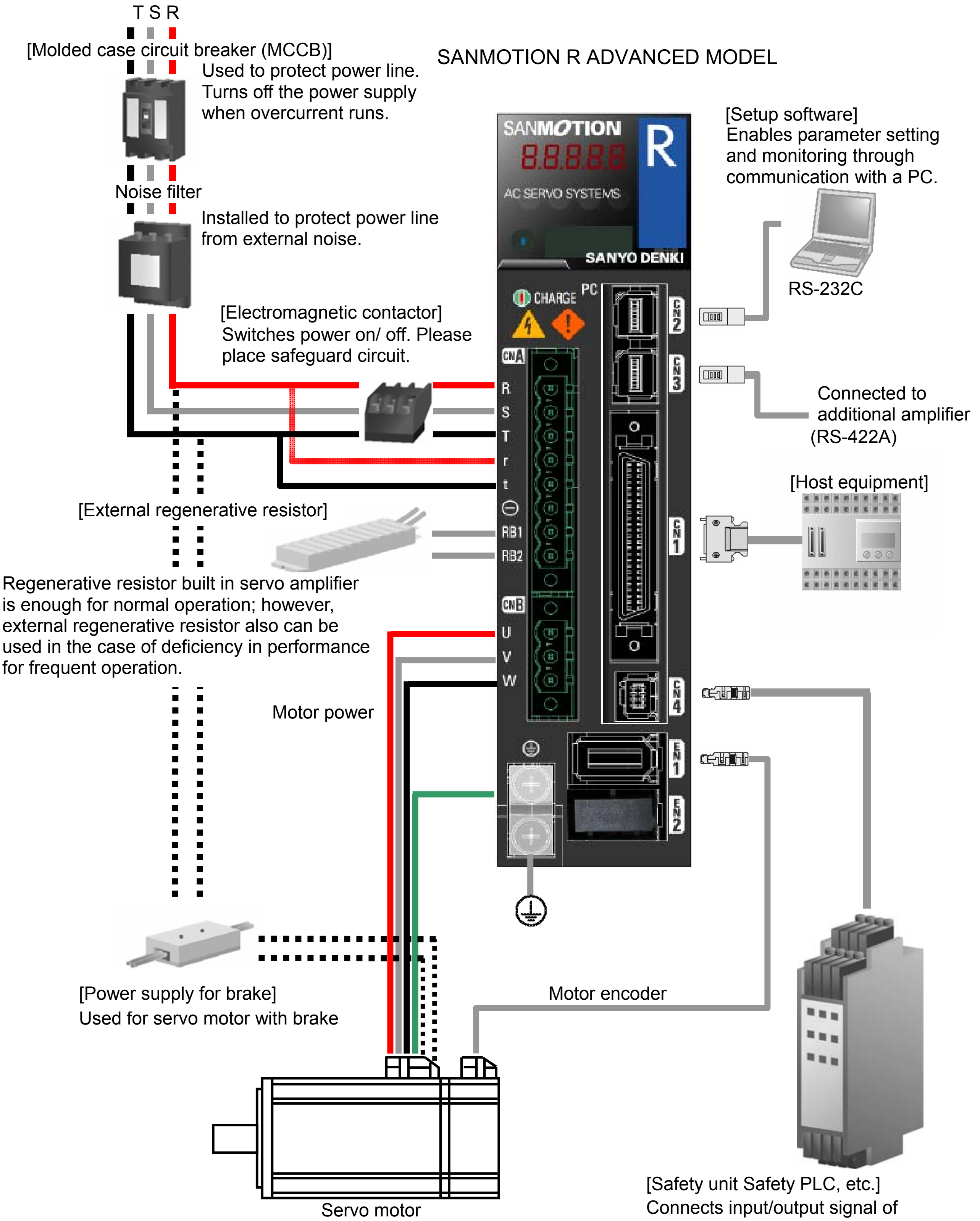
  - When external pulse encoder operation is disconnected.→ Please operate the system with external encoder connected mechanically.

10

10. Safe-Torque-Off (STO) function

10.1 Illustration of system configuration

■ RS2☐01/RS2☐03/RS2☐05



[Molded case circuit breaker (MCCB)]
Used to protect power line.
Turns off the power supply when overcurrent runs.

Noise filter
Installed to protect power line from external noise.

[Electromagnetic contactor]
Switches power on/ off. Please place safeguard circuit.

[External regenerative resistor]

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.

[Setup software]
Enables parameter setting and monitoring through communication with a PC.

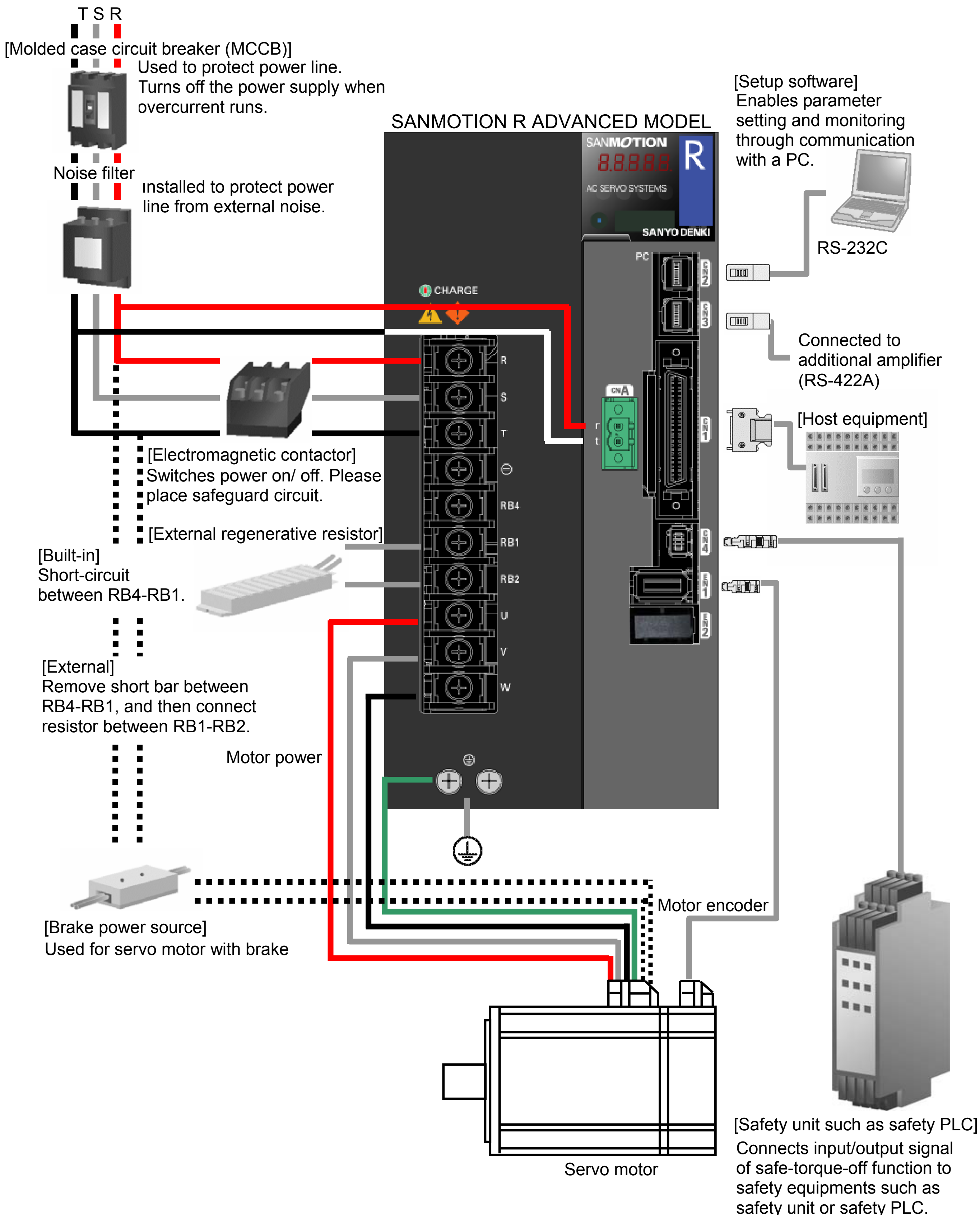
Connected to additional amplifier (RS-422A)

[Host equipment]

[Power supply for brake]
Used for servo motor with brake

[Safety unit Safety PLC, etc.]
Connects input/output signal of safe-torque-off function to safety equipments such as safety unit or safety PLC.

■ RS2☐10/RS2☐15



[Molded case circuit breaker (MCCB)]
Used to protect power line.
Turns off the power supply when overcurrent runs.

Noise filter
Installed to protect power line from external noise.

[Electromagnetic contactor]
Switches power on/ off. Please place safeguard circuit.

[External regenerative resistor]

[Built-in]
Short-circuit between RB4-RB1.

[External]
Remove short bar between RB4-RB1, and then connect resistor between RB1-RB2.

[Brake power source]
Used for servo motor with brake

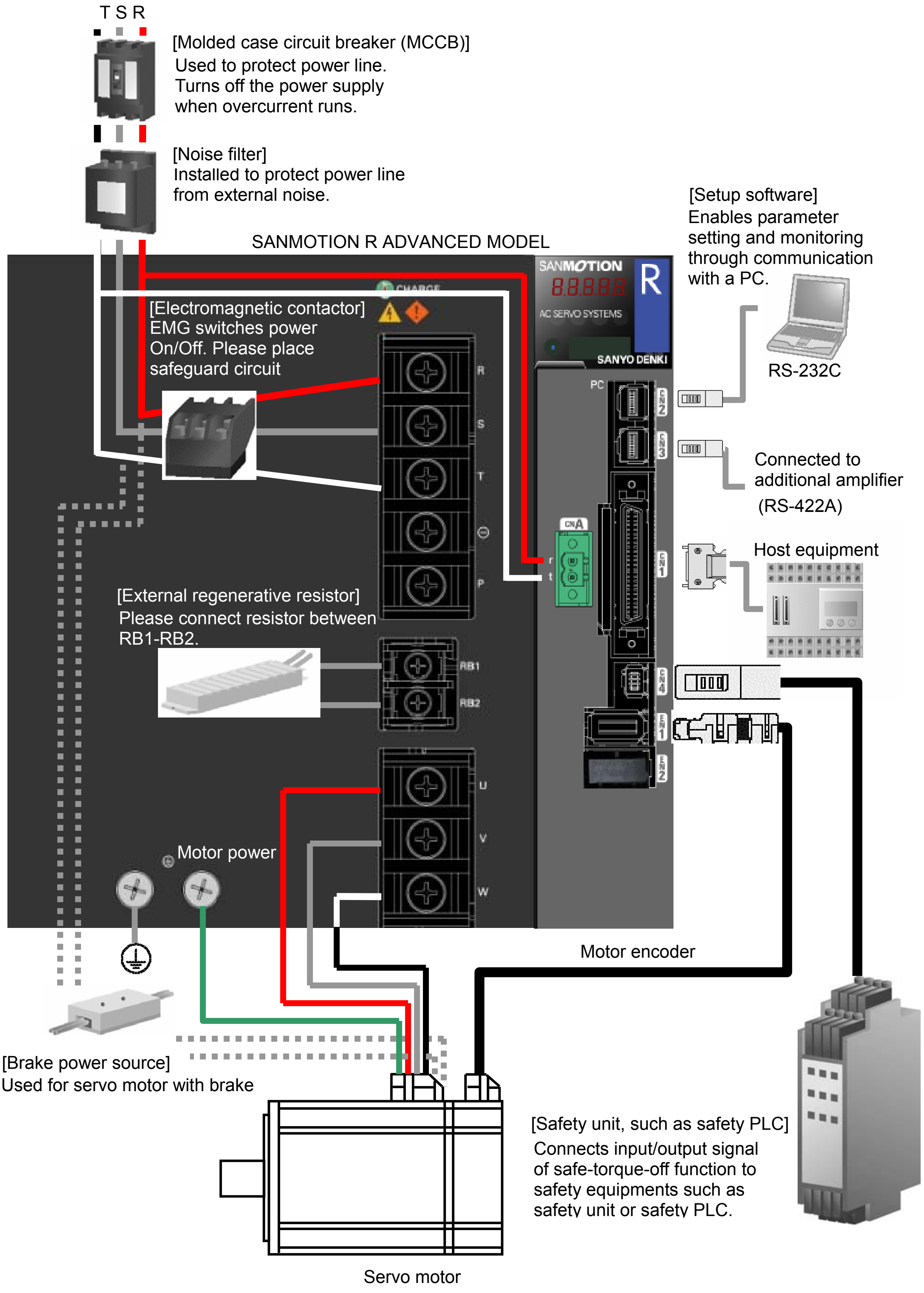
[Setup software]
Enables parameter setting and monitoring through communication with a PC.

Connected to additional amplifier (RS-422A)

[Host equipment]

[Safety unit such as safety PLC]
Connects input/output signal of safe-torque-off function to safety equipments such as safety unit or safety PLC.

■ RS2□30



[Molded case circuit breaker (MCCB)]
Used to protect power line.
Turns off the power supply
when overcurrent runs.

[Noise filter]
Installed to protect power line
from external noise.

[Setup software]
Enables parameter
setting and monitoring
through communication
with a PC.

[Electromagnetic contactor]
EMG switches power
On/Off. Please place
safeguard circuit

Connected to
additional amplifier
(RS-422A)

[External regenerative resistor]
Please connect resistor between
RB1-RB2.

[Brake power source]
Used for servo motor with brake

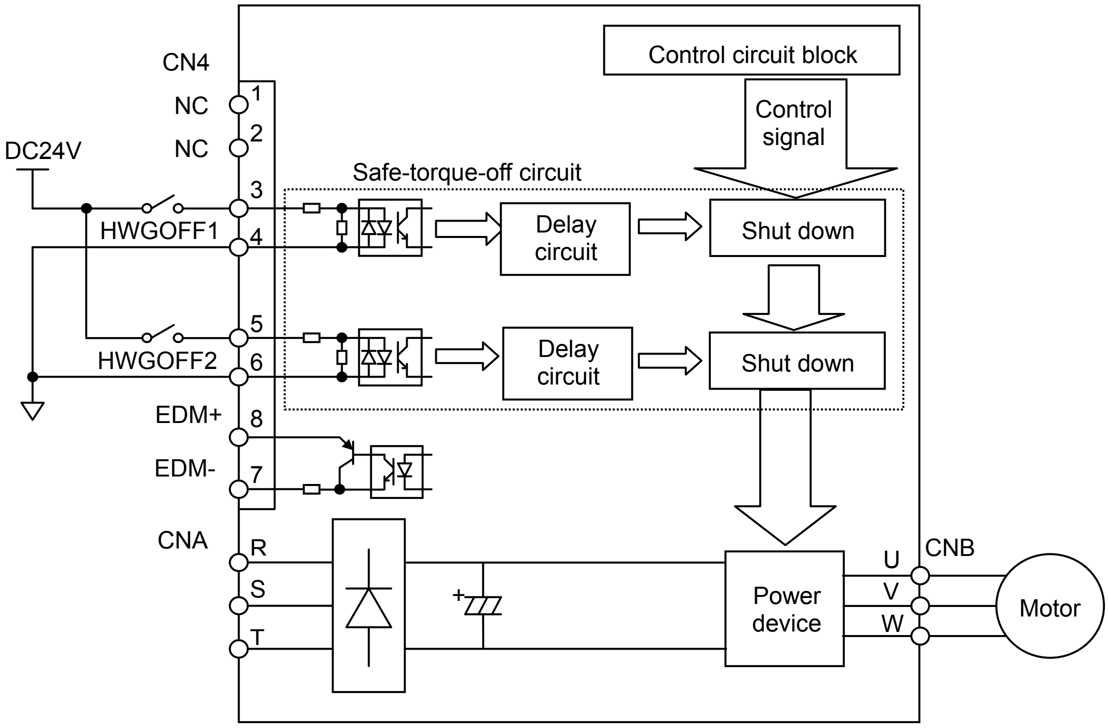
[Safety unit, such as safety PLC]
Connects input/output signal
of safe-torque-off function to
safety equipments such as
safety unit or safety PLC.

10.2 Safe-Torque-Off (STO) 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.

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.



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 ■ IEC60204, stop category 0
Safety Standards	■ IEC61508, SIL2 ■ IEC62061, SILCL2 ■ ISO13849-1, PL = d (When error detection performed by using EDM.) ■ ISO13849-1, PL = c (When error detection not performed.) ■ EN954-1, Cat.3

- ✔ PFH (Probability of a dangerous Failure per Hour) of this function (Safe Torque Off circuit) achieves less than 2% of required level of SIL2.
- ✔ To suffice ISO13849-1, 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 92.5%.

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.

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.

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.

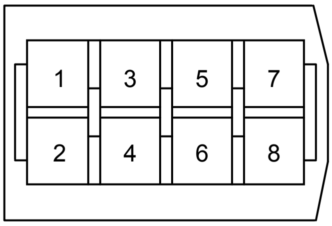
Servo amplifier model number	Delay circuit (Max. delay time)
RS2#######2	No delay circuit (20ms max.)
RS2#######4	With delay circuit (500ms max.)

- ✔ 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

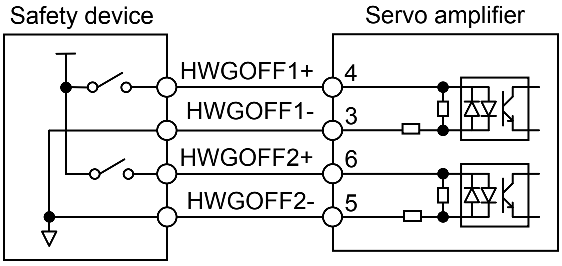
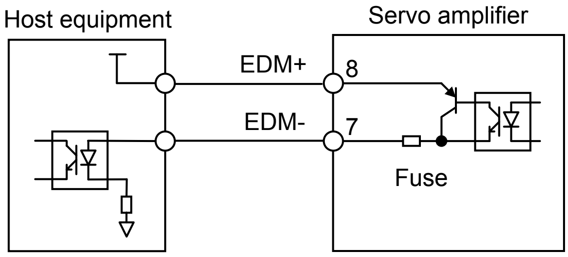
1) CN4 connector layout

■ CN4 2013595-3 (soldered side)



2) Connection diagram of CN4-terminals

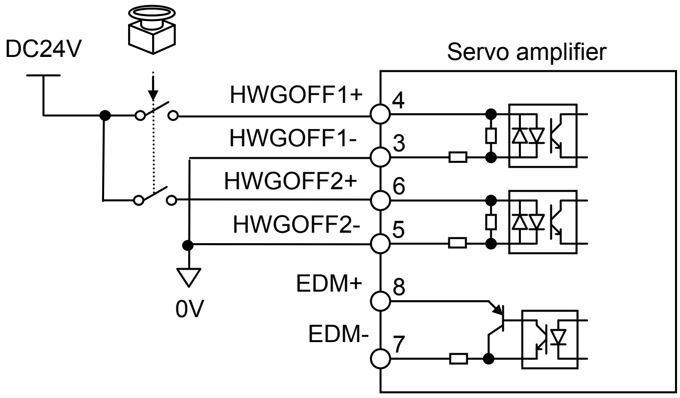
Functions and connection circuit of each CN4-teminal are as shown below.

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 
	4	HWGOFF1+	
Safety input 2	5	HWGOFF2-	
	6	HWGOFF2+	
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+	

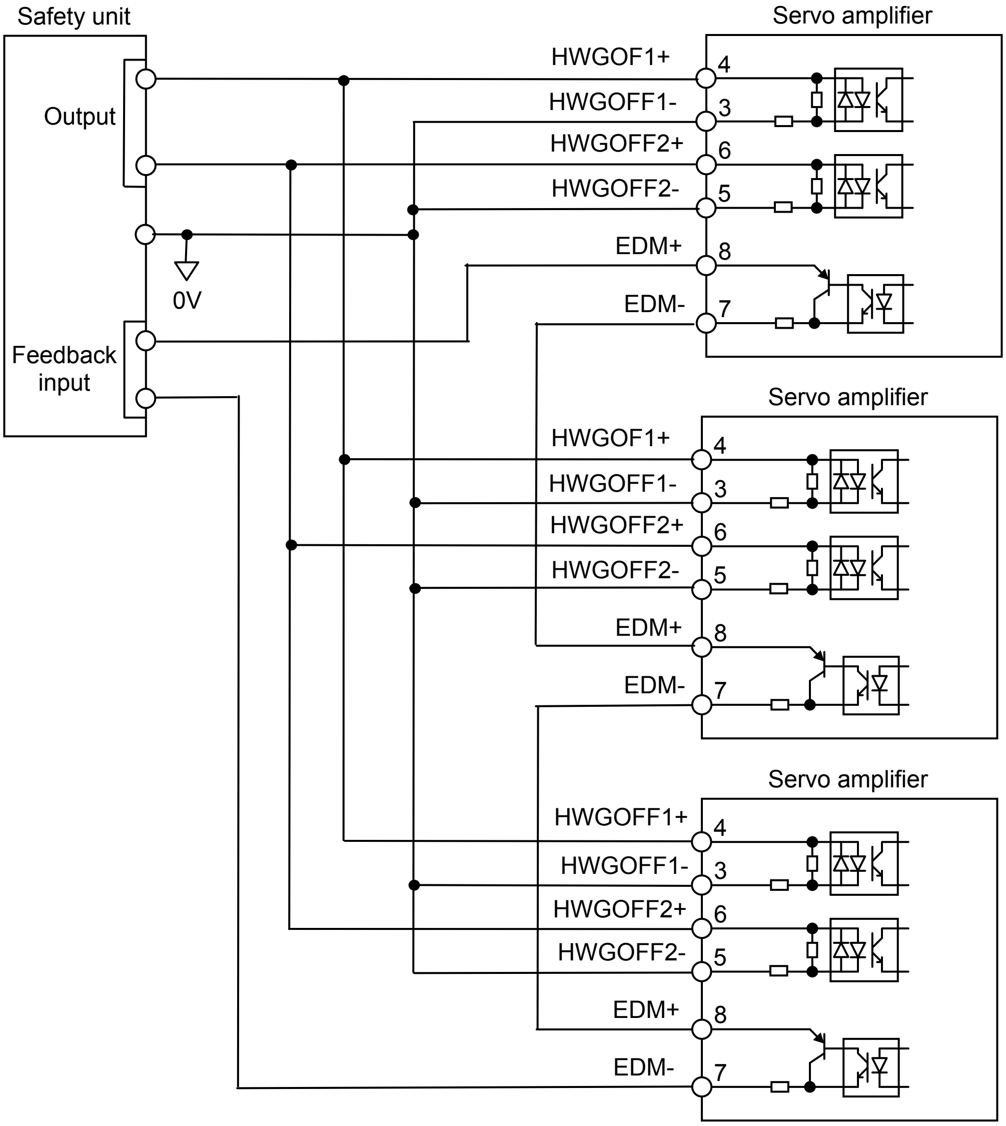
✔ When you do not use this function, connect terminal 1 and 3, 5, and also connect terminal 2 and 4, 6 (short-circuit). A connector for short-circuit, PN# AL-00718251-01, is available as an option.

3) Example of wiring

Example of wiring to safety switch (single servo amplifier connected)

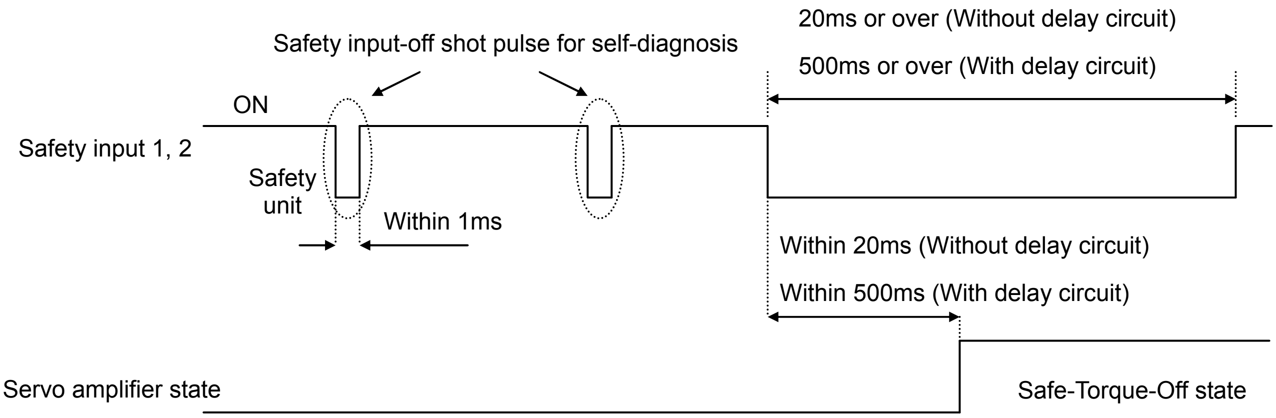


Example of wiring to safety unit (multiple-servo amplifier connected)



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 500ms or more (with delay circuit).



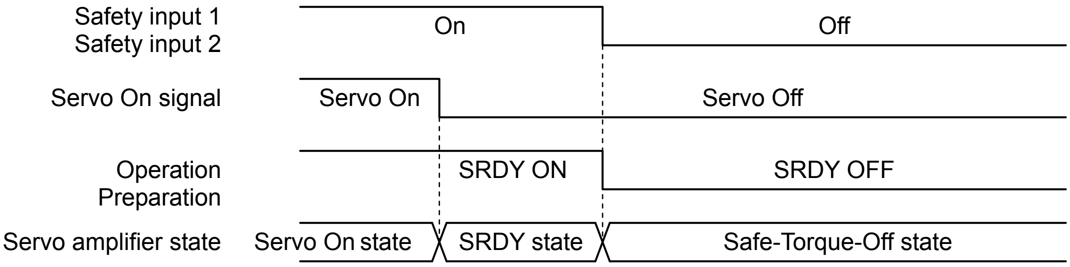
10.4 Safe-Torque-Off operation

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.

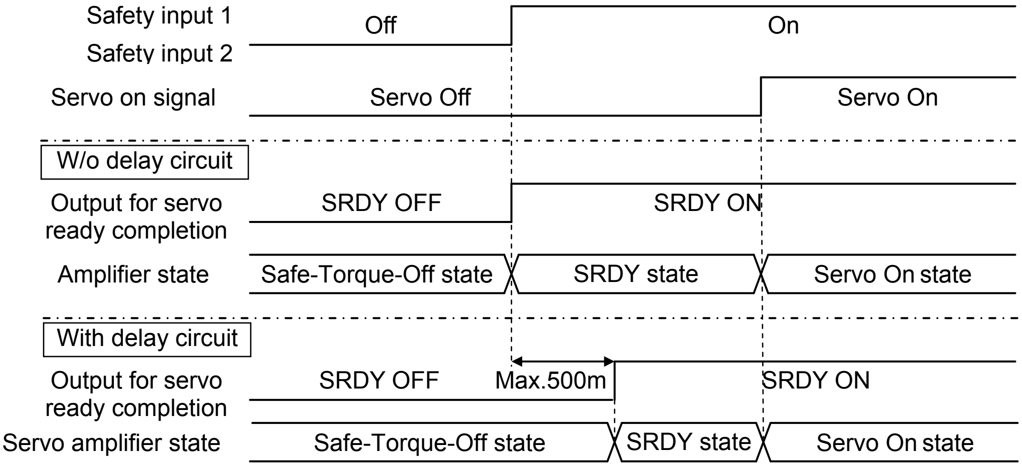
Signal	Input condition	Servo amplifier condition
Safety input 1 (HWGOFF1)	On	Normal state
	Off	Safe-torque-off state
Safety input 2 (HWGOFF2)	On	Normal state
	Off	Safe-torque-off state

- ✔ Off: Electric current will not flow (contact open).
- ✔ On: Electric current will flow (contact closed).

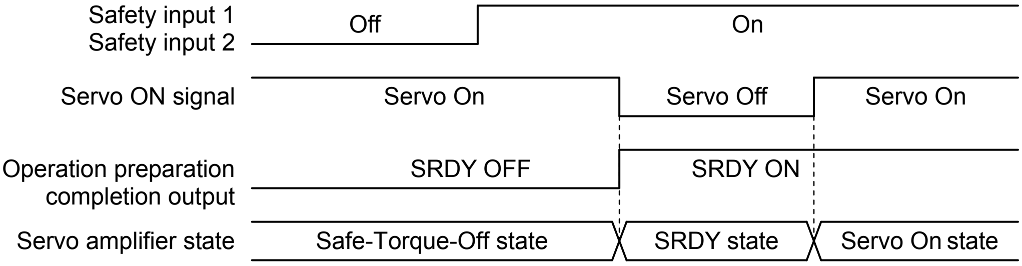


2) Restoration from safe-torque-off state

In the state servo-on signal is not input as described in 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 500ms 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 ID06: 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.

3) Safe-Torque-Off during servo motor running

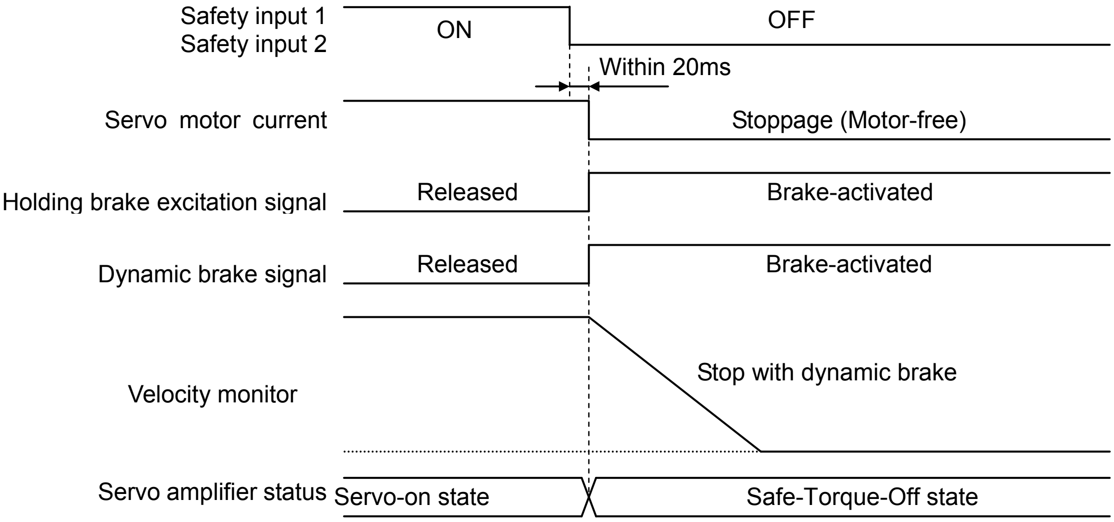
Stoppage behavior varies depending on forced outage operation settings (ACTEMR Group B ID12).

■ When set value is 00. (When motor stopped by servo brake)

Stoppage behavior varies depending on amplifier model numbers.

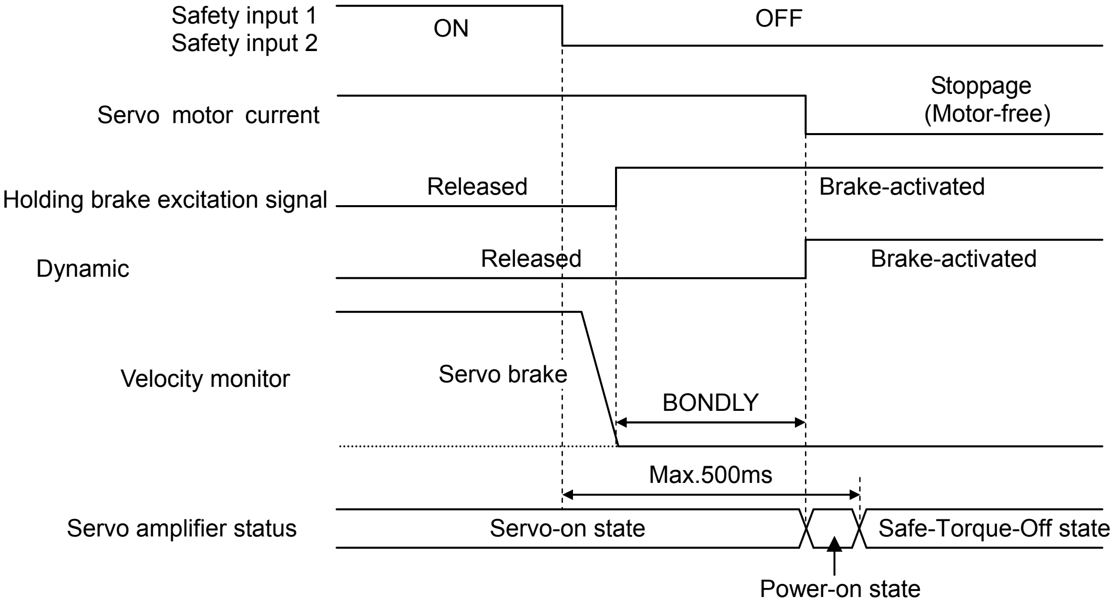
◆ RS2#######2 (without safe-torque-off delay circuit)

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.



◆ RS2#######4 (with safe-torque-off delay circuit)

Motor stops with servo brake when safety input 1 or 2 is turned off.

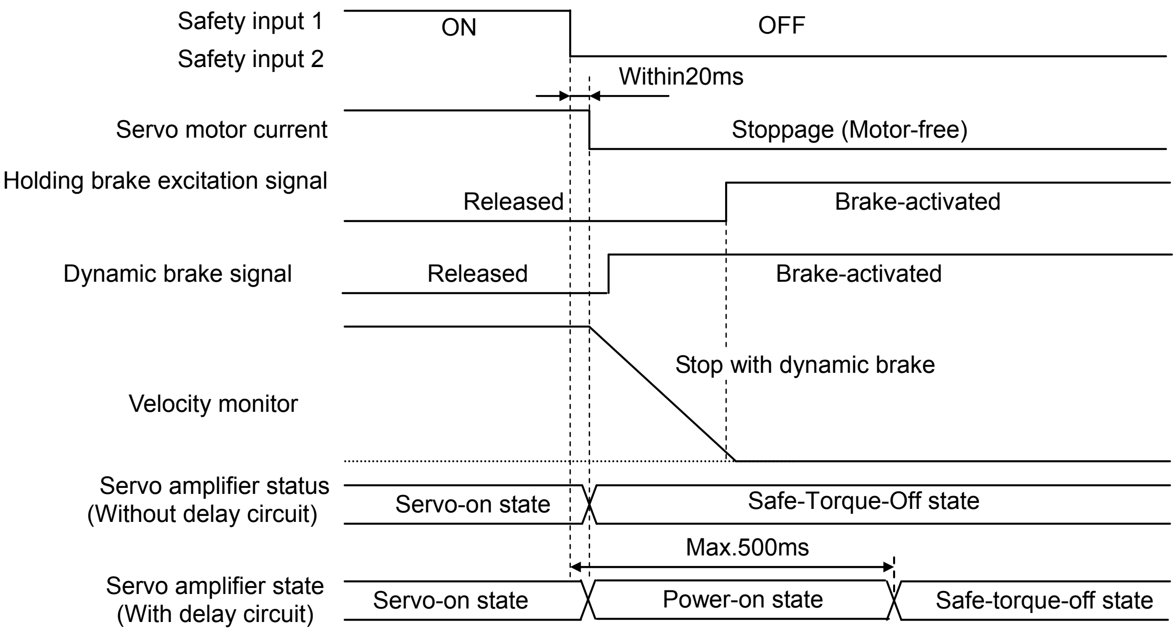


- ✔ When set value of BONDLY (holding brake activation delay time: Group B ID13) is more than safe-torque-off delay time (500ms max.), the state becomes motor-free after period of safe-torque-off delay time. Please note that recommended set value for BONDLY is less than 500ms.
- ✔ Servo brake circuit, dynamic brake circuit, and holding brake excitation signal are not safety-related sections.

- When set value is 01. (When motor stopped by dynamic brake)

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.

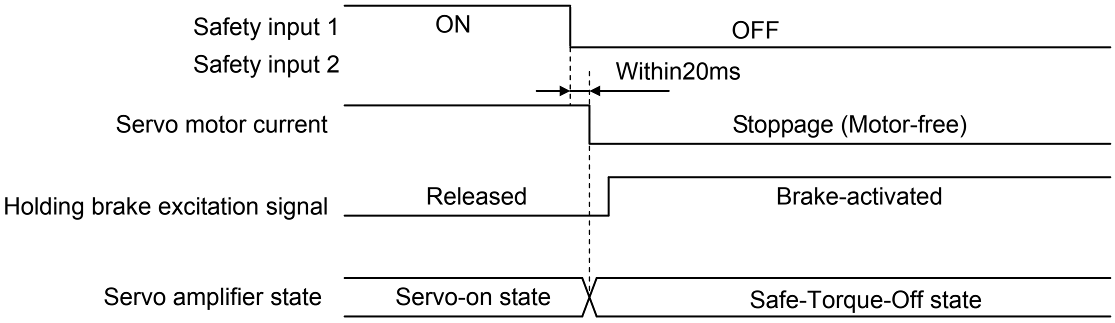
- ◆ RS2#######2 (without safe-torque-off delay circuit)
  Safety input is turned off and then the status comes to safe-torque-off state at the same time dynamic brake applied.
- ◆ RS2#######4 (with safe-torque-off delay circuit)
  The state moves to safe-torque-off state after period of delay time (500ms 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.

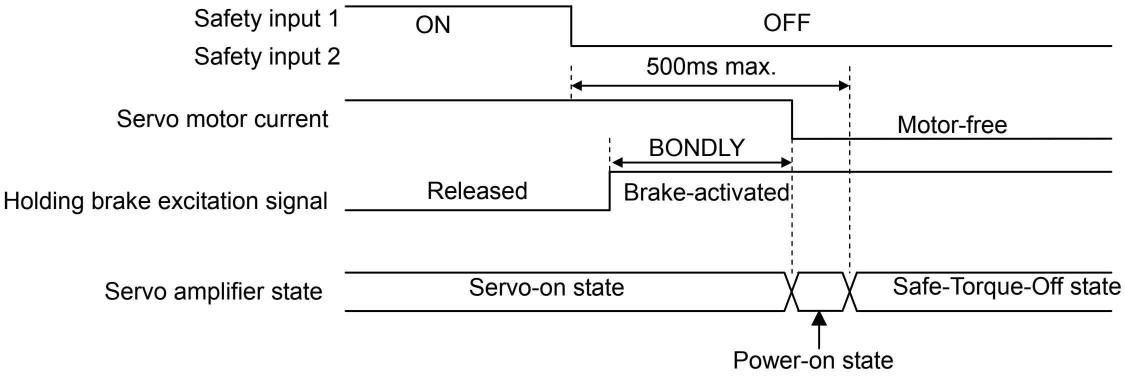
4) Safe Torque Off during servo motor stoppage

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 RS2#######4 (with safe-torque-off delay circuit), you can ensure the time to activate holding brake because of maximum 500ms of delay time by the time safe-torque-off function activated after safety input 1 or 2 is input.

Select amplifier model number RS2#######4 for use in gravity axes.



✔ Set BONDLY (holding brake activation delay time: Group B ID13) to the value less than 500ms.

5) Deviation clear

When selecting Type3 or Type4 (not to clear deviations at servo-off state) on deviation clear selection (CLR Group8 ID19), 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 Type1 or Type2 (to clear deviation at servo-off state) on deviation clear selection (CLR Group8 ID19), position deviation is automatically cleared at servo-off.)

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 HWGOFF-signal disconnection.

■ 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)

1) Specifications

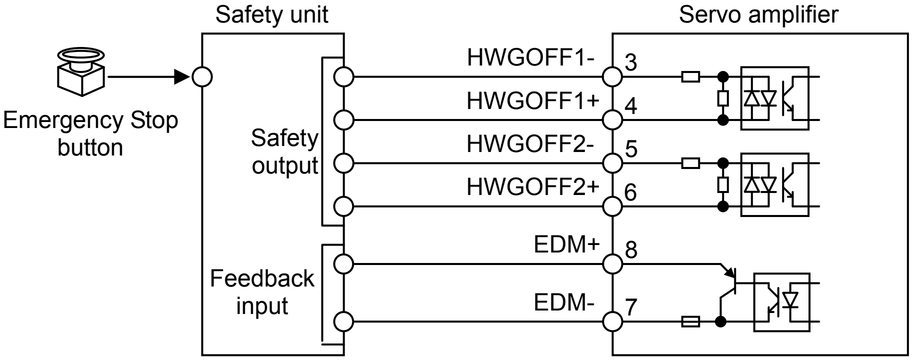
Error detection monitor (EDM) output is a signal to monitor wiring errors in safe-torque-off circuit or between safety equipment and safety input. The following table shows connections between safety input (HWGOFF1 and HWGOFF2) and error detection monitor (EDM) output.

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.

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).

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=d, 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

Please verify that safe-torque-off function properly works before use, at every machine start-up and servo amplifier replacement.

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 “section 3.1, 3 installation” through “section 5.3, Test Operation (5-13) ” for installation, wiring, and test operation.

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.

3) Acceptance criteria

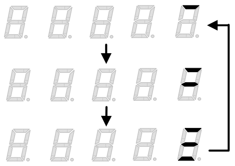
In steps 2 to 4, verify the states listed below.

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.

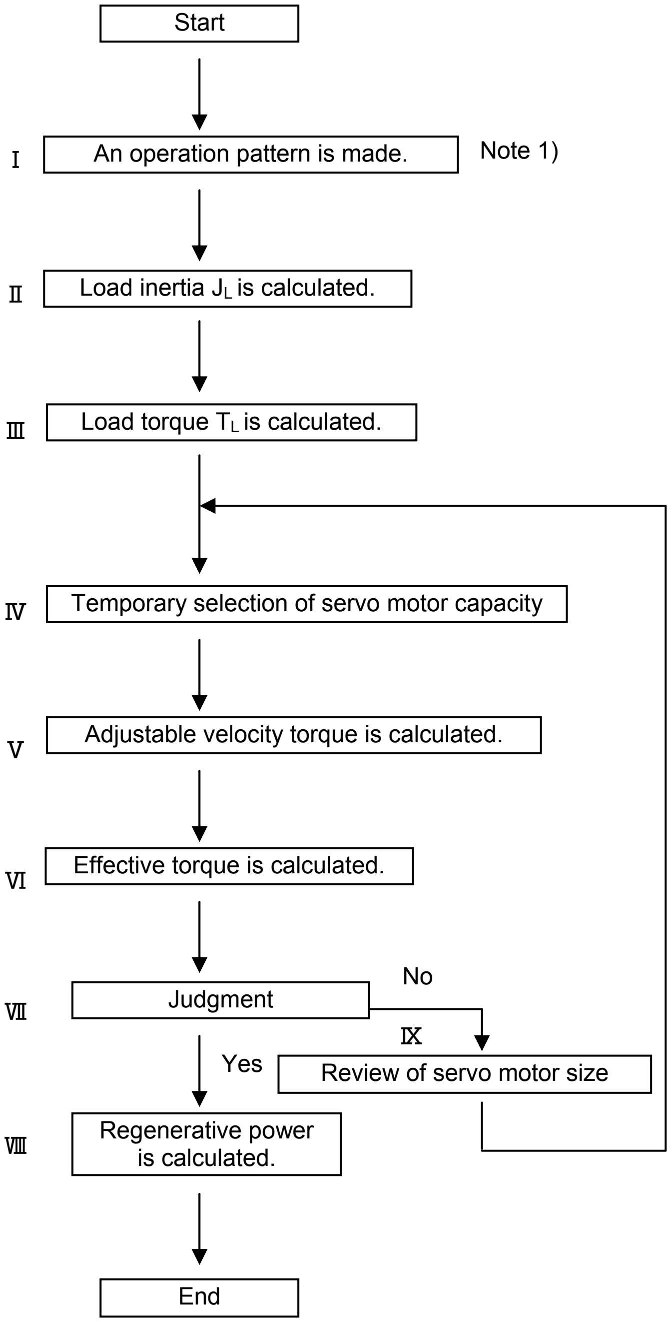
11

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.

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.

$J_L \leqq J_M \times 10$

$T_L \leqq T_R \times 0.8$

Calculate the required adjustable velocity torque from an operation pattern.

Calculate the effective torque from a torque pattern.

Ⅴ. Ⅵ. 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

$T_a \leqq T_p \times 0.8$

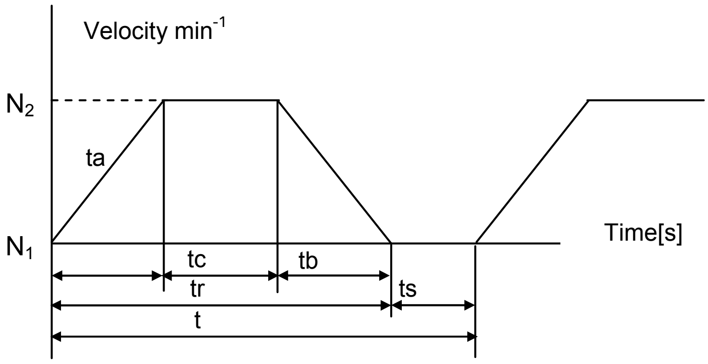
$T_b \leqq T_p \times 0.8$

$Trms \leqq T_R \times 0.8$

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.

Note 1) Create the pattern so that motor average revolution speed shall not exceed maximum revolution speed in continuous range.

2) Make an operation pattern



ta= Acceleration time

tb= Deceleration time

tr= Constant velocity time

ts= Stop time

t=1 cycle

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=πD)

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)

$$T_L = \frac{F}{\eta} \times \frac{P}{2\pi} \times \frac{}{1} \times 9.8 \quad [N \cdot m]$$

■ 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)

$$T_L= \frac{(F+(\mu+1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

- Belt pulley (in vertical axis)

When motor drives upward

$$T_L= \frac{(F+ (\mu+1)W)}{\eta} \times \frac{D}{2} \times \frac{1}{G} \times 9.8 \quad [N\cdot m]$$

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]
D : Diameter of a pulley [m]
G : Reduction ratio

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 [$kg \cdot m^2$]

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 [$kg \cdot m^2$]

7) Calculate effective torque (Trms)

$$Trms = \sqrt{\frac{(T_a^2 \times ta) + (T_L^2 \times tr) + (T_b^2 \times tb)}{t}} \quad [N \cdot m]$$

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)
◆ Deceleration torque load ratio	$T_b \leqq T_P \times 0.8$ (Deceleration torque is 80% or less of 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 Capacity 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.

1) How to find "regeneration effective power (PM)" of the horizontal axis drive by a formula

- Calculate regeneration energy.

$$EM = Ehb = \frac{1}{2} \times N \times 3 \cdot Ke\Phi \times \frac{Tb}{KT} \times tb - \left[\frac{Tb}{KT}\right]^{2} \times 3 \cdot R\Phi \times tb$$

EM: Regeneration energy during operations along horizontal axis [J]

Ehb: Regeneration energy during deceleration [J]

KeΦ: Voltage constant for each phase [Vrms/min^{-1}] (Motor constant)

KT: Torque constant [N･m/Arms] (Motor constant)

N: Motor rotation speed [min^{-1}]

RΦ: 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]

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]
KeΦ	: Voltage constant for each phase [Vrms/min^{-1}] (motor constant)
KT	:Torque constant [N・m/Arms] (motor constant)
N	: Motor rotational velocity [min^{-1}]
RΦ	: 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]

3) Capacity 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 regeneration resistor except it.

Servo amplifier model number	Allowable regeneration resistance power to be used with an internal regenerative resistor [PRI]	Resistance value
RS2#01A#AA0	Less than 5W	50Ω
RS2#03A#AA0	Less than 5W	50Ω
RS2#05A#AA0	Less than 20W	17Ω
RS2#10A#AA0	90W or less	10
RS2#15A#AA0	120W or less	6
RS2#30A#AA0	---	---

- ■ Allowable power of an external regeneration resistor

  When regeneration effective power "PM" turns into more than the allowable power of the amplifier internal regenerative resistor, the external regeneration resistor (option) of the following table can be connected to operate.

Servo amplifier model number	Allowable regeneration resistance power to be used by an external regeneration resistor [PR0]
RS2#01A#AL0	Less than 220W
RS2#03A#AL0	Less than 220W
RS2#05A#AL0	Less than 500W
RS2#10A#AA0	500W or less
RS2#15A#AA0	500W or less
RS2#30A#AA0	500W or less

✔ When regeneration effective power PM exceeds the maximum permitted power (PRO) of the external regeneration resistor, reconsider the acceleration constant, load inertia, etc.

4) Capacity 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]	10W or less	30W or less	55W or less	60W or less	110W or less	Less than 220W	220W or more
RS2#01A#AL0 RS2#03A#AL0	Resistor Sign	B×1	D×1	F×1	C×2	E×2	F×4	Please contact us.
	Connection Number	Ⅲ	Ⅲ	Ⅲ	Ⅴ	Ⅴ	Ⅵ	

Servo amplifier model number	[PM]	55W or less	125W or less	250W or less	Less than 500W	500W or more
RS2#05A#AL0	Resistor Sign	G×1	H×1	I×2	H×4	Please contact us
	Connection Number	Ⅲ	Ⅲ	Ⅳ	Ⅵ	

Servo amplifier model number	[PM]	125W or less	250W or less	500W Less than	500W or more
RS2#10A#AL0	Resistor Sign	I×1	H×2	I×4	Please contact us
	Connection Number	Ⅲ	Ⅴ	Ⅵ	

Servo amplifier model number	[PM]	125W or less	250W or less	Less than 500W	500W or more
RS2#15A#AL0	Resistor Sign	J×1	K×2	J×4	Please contact us
	Connection Number	Ⅲ	Ⅴ	Ⅵ	
Servo amplifier model number	[PM]	125W or less	250W or less	Less than 500	500W or more
RS2#30A#AL0	Resistor Sign	J×1	L×1	L×2	Please contact us
	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.
- ✔ A regeneration resistance usage rate can be raised about a maximum of 50% by carrying out an air cooling with blower using a cooling fan.

5) Capacity of external regenerative resistor and resistor model name

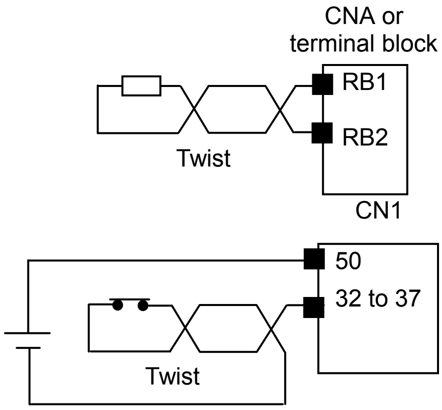
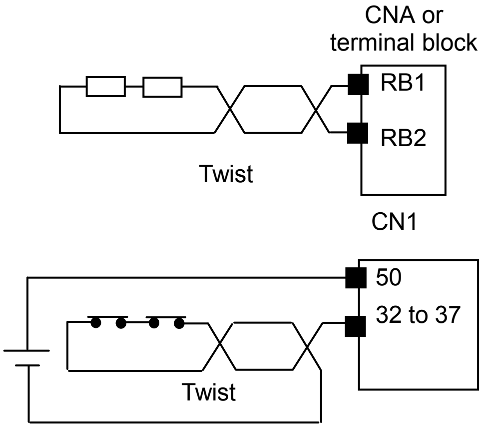
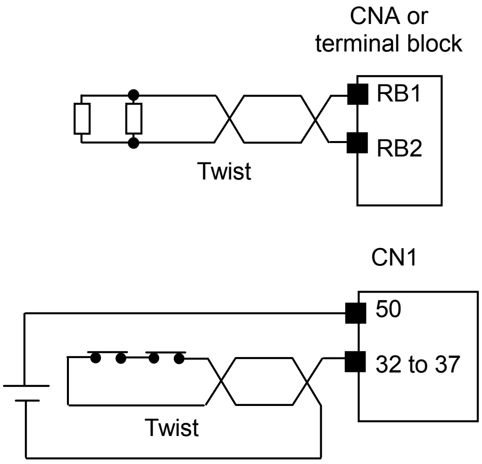
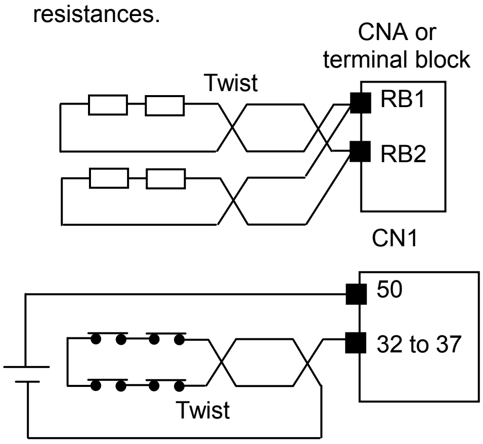
The resistor model name corresponds with the sign of the external regeneration resistor selected for the preceding clause.

Resistor Sign	Resistor Model Number	Resistance Value	Thermostat Detection temperature (Contact specification)	Permissible Effective Power [PM]	Allowable instantaneous capacity [JI]	Mass	Outline Drawing
A	REGIST-080W100B	100Ω	135°C±7°C (Switching contact b)	10W	35J	0.19kg	“Outline dimensional drawing of regenerative resistor (12-54)”
B	REGIST-080W50B	50Ω		10W	35J		
C	REGIST-120W100B	100Ω		30W	50J	0.24kg	
D	REGIST-120W50B	50Ω		30W	80J		
E	REGIST-220W100B	100Ω		55W	90J	0.44kg	
F	REGIST-220W50B	50Ω		55W	125J		
G	REGIST-220W20B	20Ω		55W	210J		
H	REGIST-500CW0B	20Ω	100°C±5°C (Switching contact b)	125W	9700J	1.4kg	
I	REGIST-500CW10B	10Ω		125W	9300J		
J	REGIST-500CW7B	7Ω		125W	7500J		
K	REGIST-500CW14B	14Ω		125W	13000J		
L	REGIST-1000W6R7B	6.7Ω	140°C±5°C (Switching contact b)	250W	26000J	3.0kg	

6) Connection of regenerative resistance

The connection method of a resistor corresponds with the connection number of the external regeneration resistor selected by the 4) clause.

- Connection of regenerative resistance

Connection Number Ⅲ	Connection Number Ⅳ
■ One resistance is connected.  Connect a thermostat and thermal to the general-purpose input of CN1.	■ Series connection about two resistances.  Connect a thermostat and thermal to the general-purpose input of CN1.
Connection Number Ⅴ	**Connection Number Ⅵ**
■ Parallel connection about two resistances.  Connect a thermostat and thermal to the general-purpose input of CN1.	■ Series/parallel connection about four resistances.  Connect a thermostat and thermal to the general-purpose input of CN1.

- ✔ Please make sure to install the external regenerative resistor with twisted wires and use as a short wire that is up to 5 meters long as possible.
- ✔ Use nonflammable electric wire or perform non-combustible processing (silicon tube, etc.) for connecting cable and wired, and install wiring so as to not come in contact with the built-in unit.
- ✔ Please make sure to change the set-up of “System Parameter” and “Regenerative Resistor Selection” in line with the kind of regenerative resistor you connect.
- ✔ When you use amplifier size 100A and 150A, remove the short bar between the RB1 and RB4 terminals, then connect the external regenerative resistor between the RB1 and RB2 terminals.

7) Thermostat connection of external regenerative resistor

Connect a thermostat to either of "the general-purpose inputs CONT1-CONT6."

Please allocate the connected general-purpose input signal to [Group9 ID40: External Trip Input Function of General Parameter [EXT-E]].

- ■ Example: when connecting the thermostat to CONT6

  The external trip function will be valid when [0DH:CONT6_OFF] CONT6 is turned off in [Grop9 ID40 External Trip Input Function]. Alarm (ALM-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 [Wiring with host unit for the wiring method (4-12)].

8) Protection function of regenerative resistance

The regenerative resistance protection function is specified by parameter selections. Appropriate protection for regenerative resistance is applied by setting parameters according to the type of regenerative resistance to be connected. Set the appropriate parameters by following the instructions given below.

- ■ The two parameters requiring settings are given below.

◆ Regenerative Resistor Selection	System parameter ID02
◆ External Trip Input Function	General parameter [Group9 ID40]

- ■ The protection functions are divided into three main types:
  - ◆ Protection for a short-time, high load factor (using built-in or external regenerative resistance):

    An error is detected when the power absorption of regenerative resistance is extremely high over a short time period (100msec to 10 seconds). A ‘Regenerative Error’ alarm (“ALM_43”) is issued when this error is detected.
    - ● When the internal regenerative resistor is being used, be sure to set a setup of "system-parameter ID02" Regeneration Resistor Selection as [01:_Built-in_R.]
    - ● When external regeneration resistance is being used, be sure to set a setup of "system-parameter ID02" Regeneration Resistor Selection as [02:_External_R.]
  - ◆ Protection when allowable power absorption is exceeded for long time (using built-in regenerative resistance):

    An error is detected when the power absorption of the built-in regenerative resistance exceeds the allowable power absorption over a long time period (from a few seconds to a few minutes). An ’Internal Overheat’ alarm (“ALM_54”) is issued when this error is detected.
    - ● When the internal regenerative register is being used, be sure to set it as a setup [01:_Built-in_R] of "system-parameter ID02" Regeneration resistor Selection.
  - ◆ Protection during thermostat operation of the external regenerative resistor:

    An error is detected when the external trip function is started. An ‘External error / external trip’ alarm (“ALM_55”) is issued when this error is detected.
    - ● When the thermostat is connected to servo amplifier, be sure to set up [general parameter Group9 ID40: external trip input function [EXT-E]].

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 ID1A･Regenerative Resistor Operation Percentage
- Setup software･･･････Monitor display ID1A･RegP･Regenerative Resistor Operation Percentage

✔ 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

$$\text{Regeneration effective power PM (W)} = \frac{400(\text{V}) \times 400(\text{V})}{\text{Regeneration resistance } (\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

◆ Input Supply Voltage: In case of AC100V specification

$$\text{Regeneration effective power PM (W)} = \frac{200(\text{V}) \times 200(\text{V})}{\text{Regeneration resistance } (\Omega)} \times \frac{\text{Regenerative Resistor Operation Percentage (\%)}}{100(\%)}$$

- Calculation Example

Input Supply Voltage: [AC200V Specification]

Regeneration resistance value: 50Ω[Built-in Regenerative Resistor]

Monitor Value (RegP): 0.12%

$$\text{Regeneration effective power PM (W)} = \frac{400(\text{V}) \times 400(\text{V})}{50(\Omega)} \times \frac{0.12(\%)}{100(\%)} = 3.84(\text{W})$$

✔ The regeneration power calculated from this monitor value continues to be the target until the end of operations. Regeneration power varys 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.

10) Installation

- 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.

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12. Appendix

12.1 Standards conformity

For SANYO DENKI products, compatibility examinations of overseas standards are conducted by certificate authorities, and attestation markings are performed based on the published certificate of attestation.

1) Standards conformity

■ The following overseas standard examinations are implemented.

Product model NO.	Applicable laws and Regulations	Standard code	Certificate authorities
RS2####### #	UL/c-UL standard	UL508C	UL (Underwriters Laboratories inc.)
RS2####### **0** (Safe Torque Off function Unequipped model)	Low Voltage Directive: LVD	EN61800-5-1	TÜV (TÜV SÜD Japan, Ltd.)
	EMC Directive: EMC (Electromagnetic Compatibility)	EN55011 G1 Class A EN61000-6-2 EN61800-3	TÜV (TÜV SÜD Japan, Ltd.)
RS2####### **2** RS2####### **4** (Safe Torque Off function equipped model)	Machinery Directive: MD Safety standard: FS (Functional Safety)	EN61800-5-1 EN61800-5-2 EN55011 G1 Class A EN61800-3 EN61326-3-1 IEC61508, SIL2 IEC62061, SILCL2 ISO13849-1, Cat.3, PL=d EN954-1, Cat.3	TÜV (TÜV SÜD Japan, Ltd.) (Blue octagon)
RS2####### #	KC standard: (Korea Certification)	KN22 (EMI) KN24 (EMS)	National Radio Research Agency Korea Communications Commission Republic of Korea

■ The servo motor implements the attestation examination to the following standards.

Standard	Standard code	Certificate authorities
UL standard	UL1004 UL1446	UL (Underwriters Laboratories inc.)
EN standard	IEC-34-1 IEC34-5	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 the manufacturer for more details.

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 (polution level 1, 2). The protection grade of servo amplifier is IP1X. The control panel installation configuration (under IP54) must exclude exposure to water, oil, carbon, dust, etc.
- ■

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.

4) UL file number

The UL file number of servo amplifier and servo motor is as follows. You can check them on the website of UL. http://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

SANYO DENKI implements 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.

1) Conformity verification test

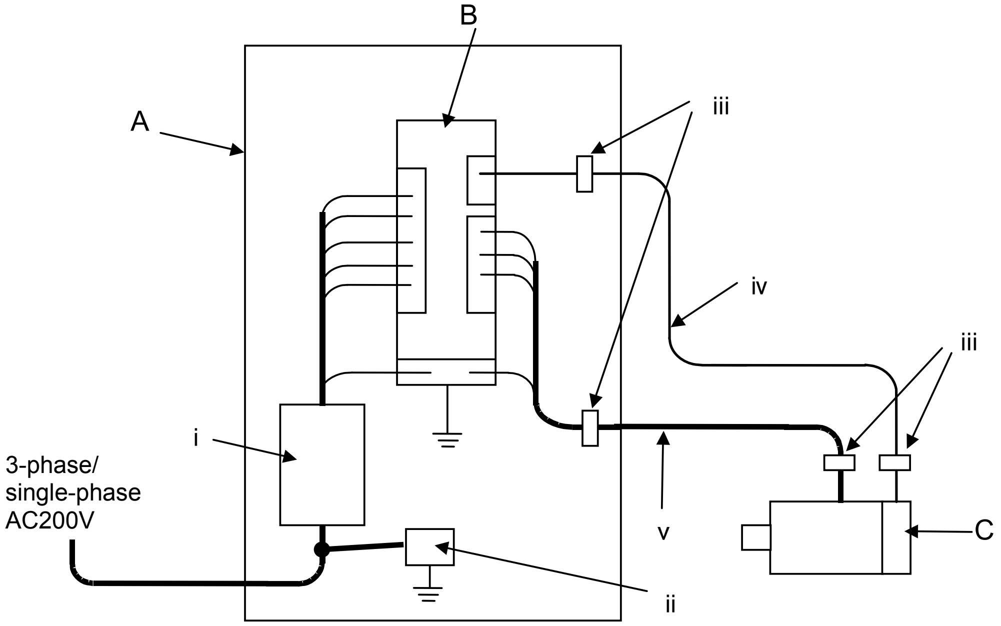
The following conformity verification tests are implemented.

Directive classification	Classification	Test	Test standard
Low voltage Directive (Servo amplifier)	-	-	EN61800-5-1: 2007
Low voltage Directive (Servo motor)	-	Rotating electrical machines-Part1: Rating and performance	IEC-34-1
		Rotating electrical machines-Part5: Classification of degrees of protection provided by enclosures of rotating electrical machines (IP code)	IEC34-5
		Rotating electrical machines-Prat9: Noise limits	IEC34-9
EMC Directive (Servo amplifier/ servo motor)	Emission	Conducted emission	EN55011: A2/2007
		Radiated emission	EN55011: A2/2007
	Immunity	Electrostatic discharge immunity	EN61000-4-2: A2/2001
		Radiated electromagnetic field immunity	EN61000-4-3: A1/2002
		Electrical first transient/ burst immunity	EN61000-4-4: 2004
		Conducted disturbance immunity	EN61000-4-6: A1/2001
		Surge immunity	EN61000-4-5: A1/2001
		Voltage Dips & Interruptions immunity	EN61000-4-11 : 2004
		Adjustable speed electrical power drive system	EN61800-3/ 2004
		Electrical equipment for measurement, control and laboratory use	IEC61326-3-1: 2008 Note.1)
		Safety of machinery	EN62061: 2005 (Annex E) Note.1)

Note1) Standards applicable only to Safe-Torque-Off function equipped models.

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.

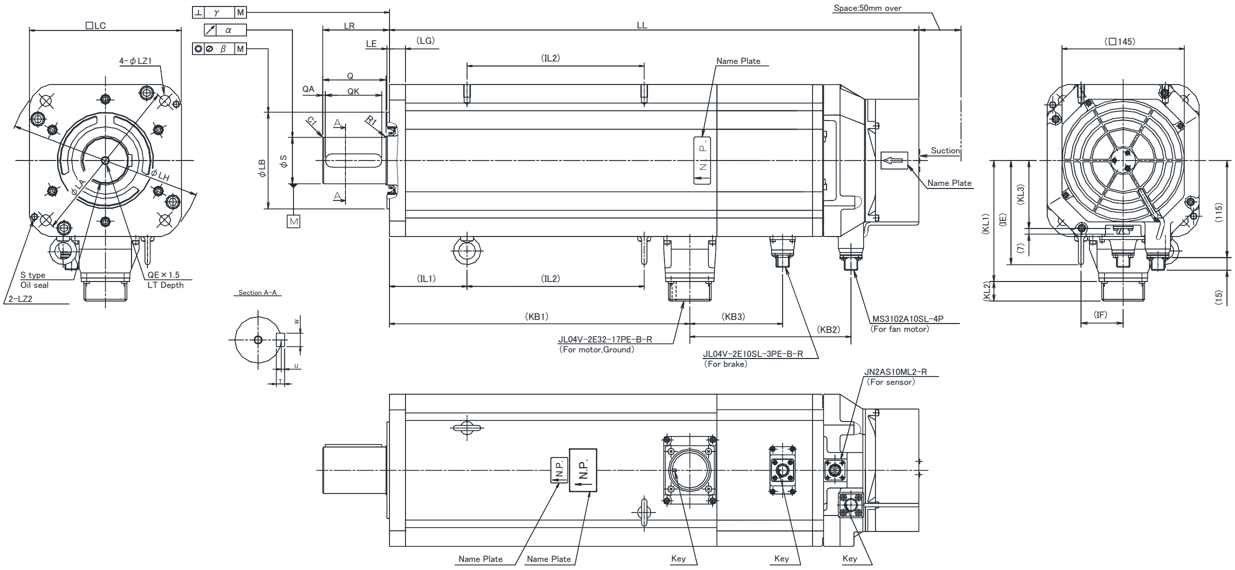


No	Name	Remarks
A	Control panel	-
B	Servo amplifier	-
C	Servo motor	-
i	Noise filter (Recommended prevention components)	RS2*01-RS2A15: HF3030C-UQA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/ rated armature current: Line-Line 480V AC/ 30A RS2A15 (R2AA22700S/Q2AA22700S-combined): HF3050C-UQA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/ rated armature current: Line-Line 480V AC / 50A RS2A30: HF3080C-UQA: SOSHIN ELECTRIC Co. Ltd. Rated voltage/ rated armature current: Line-Line 480V AC / 80A
ii	Surge-absorber (Recommended prevention components)	LT-C32G801WS: SOSHIN ELECTRIC Co. Ltd.
iii	Clamp grounding	-
iv	Encoder cable	Shielded cable
v	Servo motor power cable	Shielded 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 noise filter frame to 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.

12.3 Servo motor dimensions

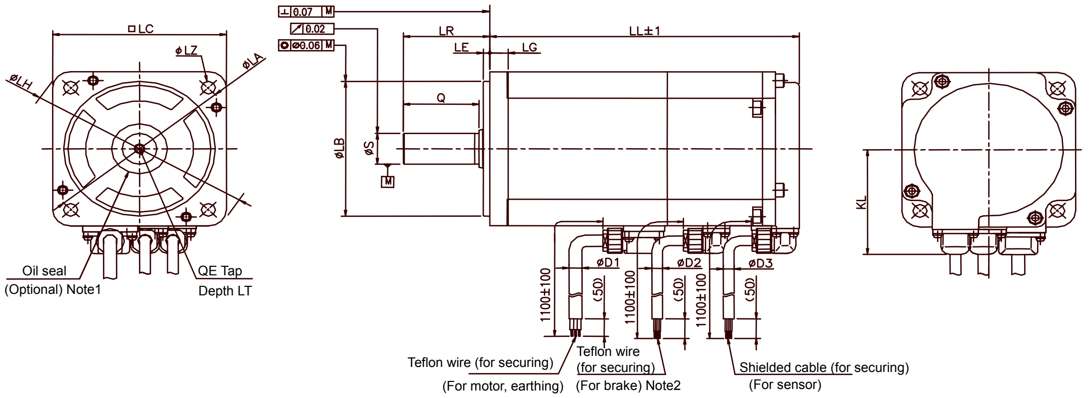
1) R1 motor, flange size 180mm



	Battery backup method absolute encoder Absolute encoder for incremental system																	
	Without Brake				With Brake													
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA	KB	LE	LH	LC	LZ1	LZ2
R1AA18550△□◇	333	80	-	81	383	130	54	81	19	143	23	200	0 114.3-0.035	3	230	180	13.5	M8
R1AA18750△□◇	368				418	130	63											
R1AA1811K△□◇	438				517	158	79											
R1AA1815K△□◇	516				628	191	110											

Servo motor model number	LR	S	Q	QA	QK	W	T	U	KB1	α	β	γ	QE	LT	IE	IF	IL1	IL2
R1AA18550△□◇	79	0 42-0.016	75	3	67	0 12-0.043	8	3	173	0.02	0.08	0.08	M10	25	124	50	54	65
R1AA18750△□◇									208								68	85
R1AA1811K△□◇									278	0.03	0.08	0.10					68	163
R1AA1815K△□◇		0 55-0.019				0 16-0.043	10	4	356								92	210

2) R2 motor, flange size 40mm, 60mm, 80mm, 86mm and 100mm

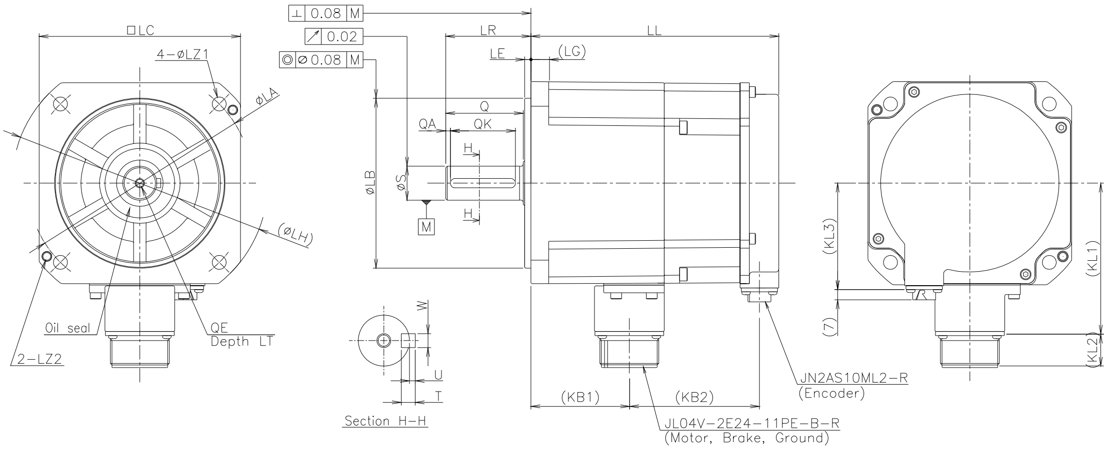


	Without Oil Seal		With Oil Seal										
	Battery backup method absolute encoder Absolute encoder for incremental system												
	Without Brake	With Brake	Without Brake	With Brake									
Servo motor model number	LL	LL	LL	LL	LG	KL	LA	LB	LE	LH	LC	LZ	LR
R2□A04003△□◇	51.5	87.5	56.5	92.5	5	35.4	46	0 30-0.021	2.5	56	40	2-Φ4.5	25
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	6	44.6	70	0 50-0.025	3	82	60	4-Φ5.5	25
R2□A06020△□◇	69.5	97.5	76.5	104.5									30
R2AA08020△□◇	66.3	102	73.3	109	8	54.4	90	0 70-0.030		108	80	4-Φ6.6	
R2AA06040△□◇	95.5	123.5	102.5	130.5	6	44.6	70	0 50-0.025		82	60	4-φ5.5	
R2AA08040△□◇	78.3	114	85.3	121	8	54.4	90	0 70-0.030	3	108	80	4-Φ6.6	
R2AA08075△□◇	107.3	143	114.3	150									40
R2AAB8075△□◇	114.3	140.2	114.3	140.2		59.4	100	0 80-0.03		115.5	86		35
R2AAB8100△□◇	137	163	137	163									
R2AA10075△□◇	111.3	128.8	111.3	128.8	10	66.8	115	0 95-0.035	3	130	100	4-Φ9	45
R2AA10100△□◇	128.3	145.8	128.3	145.8									

Servo motor model number	S	Q	QE	LT	D1	D2	D3
R2□A04003△□◇	0 6 -0.008	20	-	-	6	5	5
R2□A04005△□◇	0 8 –0.009						
R2EA04008△□◇							
R2AA04010△□◇							
R2□A06010△□◇	0 8 –0.009		-	-			
R2□A06020△□◇	0 14 –0.011	25	M5	12			
R2AA08020△□◇							
R2AA06040△□◇							
R2AA08040△□◇			M5	12			
R2AA08075△□◇	0 16 –0.011	35					
R2AAB8075△□◇		30					
R2AAB8100△□◇							
R2AA10075△□◇	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.

3) R2 motor, flange size 130mm 0.5kW to 1.8kW

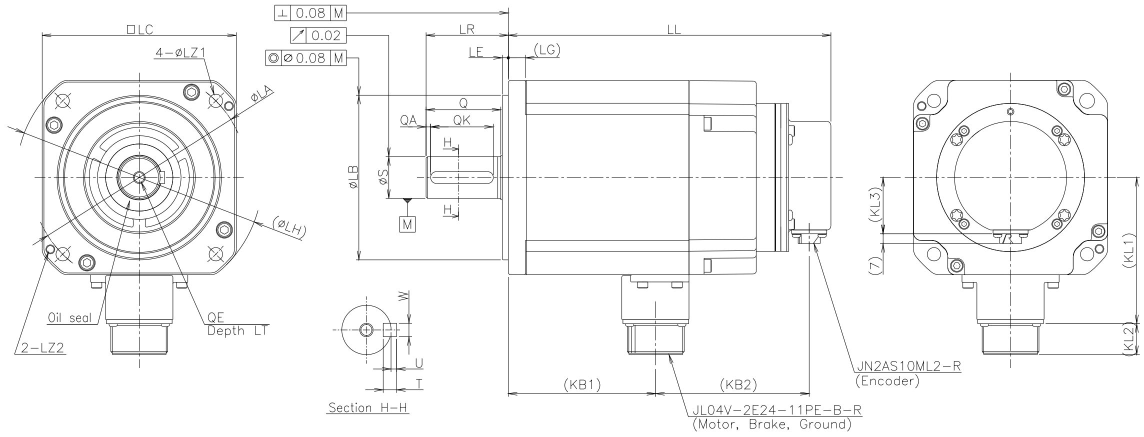


	Battery backup method absolute encoder Absolute encoder for incremental system						Incremental encoder									
	Without Brake			With Brake			Without Brake			With Brake						
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LG	KL1	KL2	LA
R2AA13050△□◇	103	44	69	139.5	81	69	115.5	57	38	153.5	93	38	12	98	21	145
R2AA13120△□◇	120.5			160	84		133			174	96					
R2AA13180△□◇	138			179	86		150.5			192	96					

Servo motor model number	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	QE	LT
R2AA13050△□◇	0 110-0.035	4	165	130	9	M6	55	0 22-0.013	50	3	42	0 6-0.030	6	2.5	46	M6	20
R2AA13120△□◇															64		
R2AA13180△□◇															81		

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

4) R2 motor, flange size 130mm 2kW

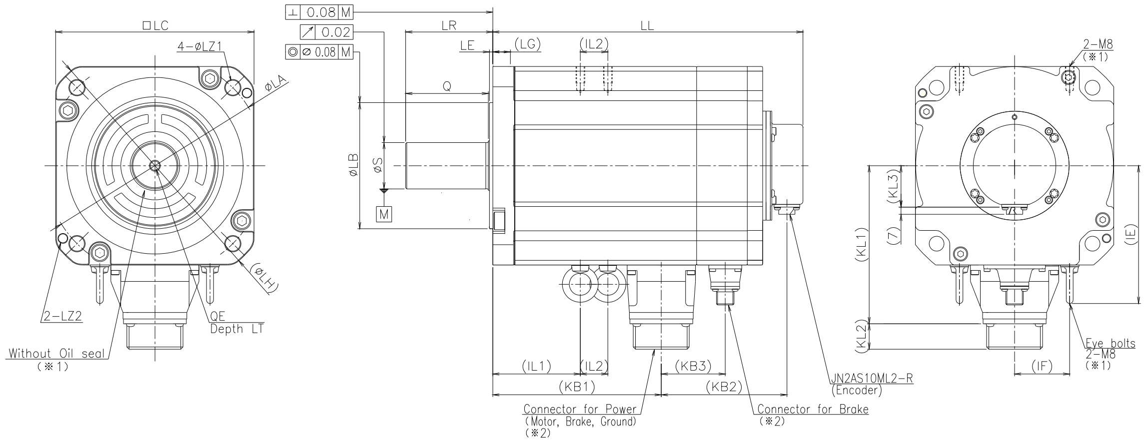


	Battery backup method absolute encoder Absolute encoder for incremental system						Incremental encoder									
	Without Brake			With Brake			Without Brake			With Brake						
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LG	KL1	KL2	LA
R2AA13200△□◇	171	57	38	216	103	38	185	64	65	230	110	65	12	98	21	145

Servo motor model number	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	QE	LT
R2AA13200△□◇	0 110-0.035	4	165	130	9	M6	55	0 28-0.013	50	3	42	0 8-0.036	7	3	99	M8	25

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

5) R2 motor, flange size 180mm 3.5kW to 7.5Kw



	Battery backup method absolute encoder Absolute encoder for incremental system								Incremental encoder														
	Without Brake				With Brake				Without Brake				With Brake										
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA	LB	LE	LH
R2AA18350△□◇	155	48	-	38	204	97	-	38	172	59	-	65	221	108	-	65	16	123	21	200	0 114.3-0.035	3	230
R2AA18450△□◇	172				221				189				238										
R2AA18550△□◇	228	59			281	114	58		242	66			295	121	58		19	144	22				
R2AA18750△□◇	273				336	124	68		287				350	131	68								

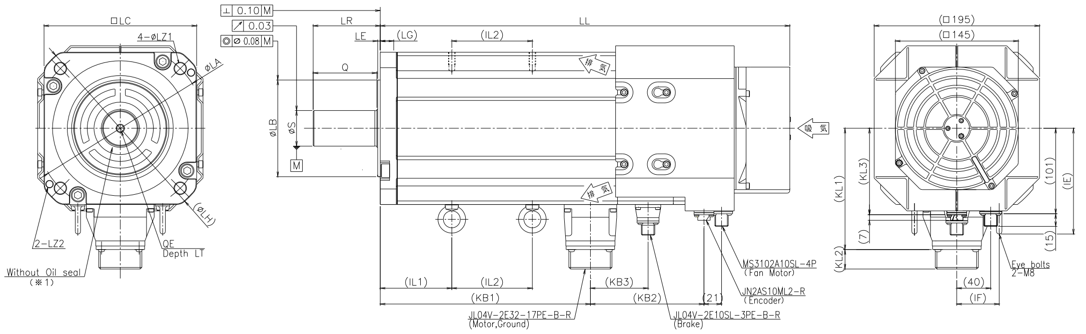
Servo motor model number	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2	Model NO,. of connector for power line	Model NO,. of connector for brake line
R2AA18350△□◇	180	13.5	M8	65	0 35-0.016	60	92	M8	25	123 (1)	50 (1)	50 (1)	20 (1)	JL04V-2E24-11PE-B-R	- (2)
R2AA18450△□◇							109			123	50	57	20		
R2AA18550△□◇				79	0 42-0.016	75	153	M10				63	41	JL04V-2E32-17PE-B-R	JL04V-2E10SL-3PE-B-R
R2AA18750△□◇							198						86		

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

Note1) No eyebolts are supplied with R2AA18350 motor with no brake.

Note2) Connector for powering line is used in common with braking line.

6) R2 motor, flange size 180mm 11kW

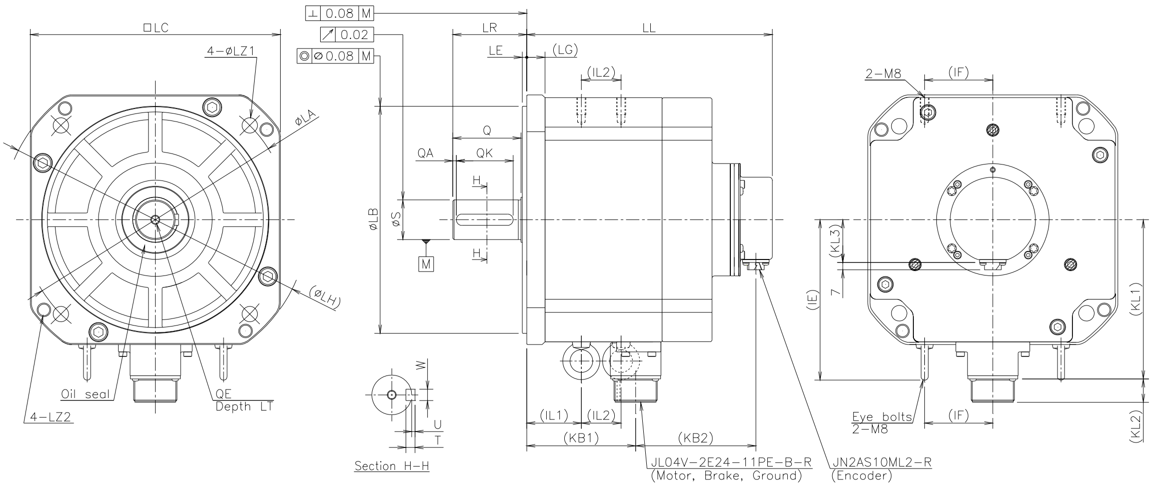


	Battery backup method absolute encoder Absolute encoder for incremental system								Incremental encoder											
	Without Brake				With Brake				Without Brake				With Brake							
Servo motor model number	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LL	KB2	KB3	KL3	LG	KL1	KL2	LA
R2AA1811K△□◇	385	59	-	102	478	154	83	102	385	-	66	102	478	161	83	102	19	144	22	200

Servo motor model number	LB	LE	LH	LC	LZ1	LZ2	LR	S	Q	KB1	QE	LT	IE	IF	IL1	IL2
R2AA1811K△□◇	0 114.3-0.035	3	230	180	13.5	M8	79	0 42-0.016	75	223	M10	25	123	50	63	111

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

7) R2 motor, flange size 220mm 3.5kW to 5kW

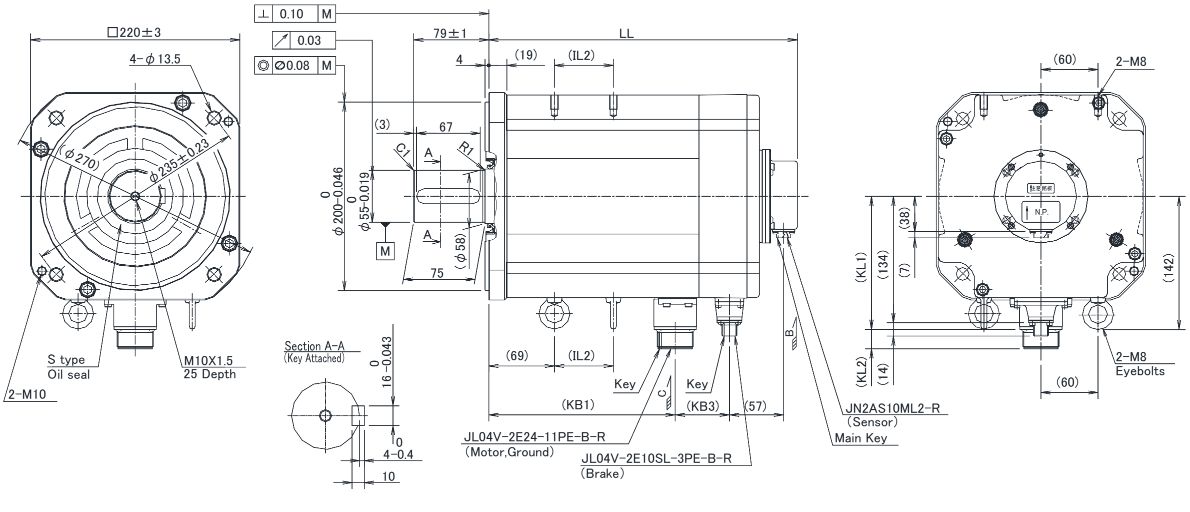


	Battery backup method absolute encoder Absolute encoder for incremental system						Incremental encoder													
	Without Brake			With Brake			Without Brake			With Brake										
Servo motor model number	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LL	KB2	KL3	LG	KL1	KL2	KL3	LA	LB	LE	LH
R2AA22500△□◇	163	52	38	216	106	38	177	59	65	230	113	65	16	142	21	38	235	0 200-0.046	4	270

Servo motor model number	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	QE	LT	IE	IF	IL1	IL2
R2AA22500△□◇	220	13.5	M12	65	0 35-0.016	60	3	50	0 10-0.036	8	3	96	M8	25	142	60	48	35

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

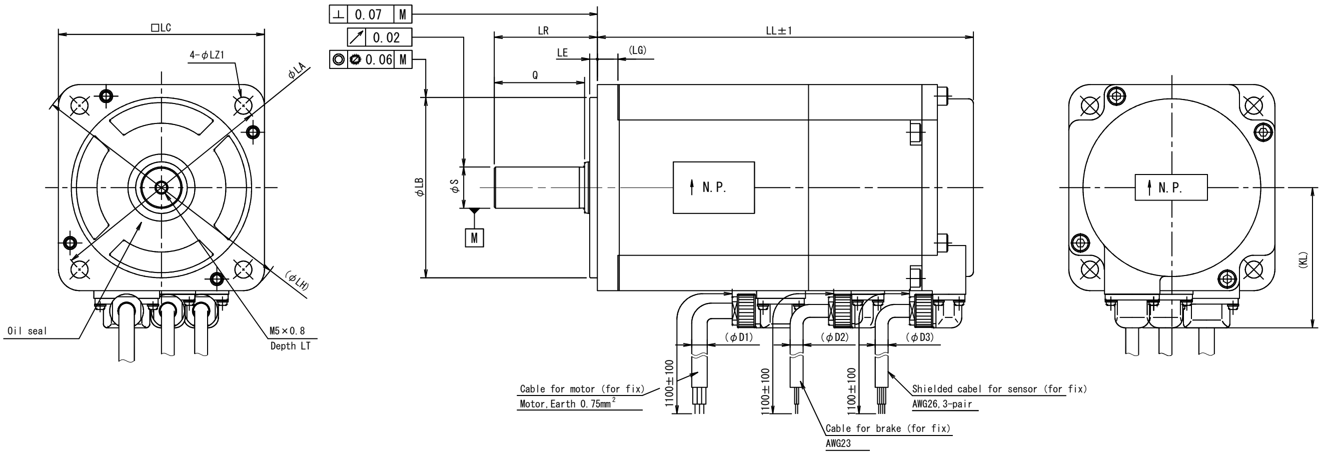
8) R2 motor, flange size 220mm 7kW to 15kW



	Battery backup method absolute encoder Absolute encoder for incremental system				Incremental encoder							
	Without Brake		With Brake		Without Brake		With Brake					
Servo motor model number	LL	KB3	LL	KB3	LL	KB3	LL	KB3	KL1	KL2	KB1	IL2
R2AA22700△□◇	265	–	325	57	279	–	339	57	141	21	196	62
R2AA2211K△□◇	304		364	66	318		378	66			226	101
R2AA2215K△□◇	343		403		357		417		162	22	265	140

✔ Please contact us for the dimensions for the encoder below. Battery less absolute encoder [RA035C]

9) R5 motor, flange size 60mm, 80mm

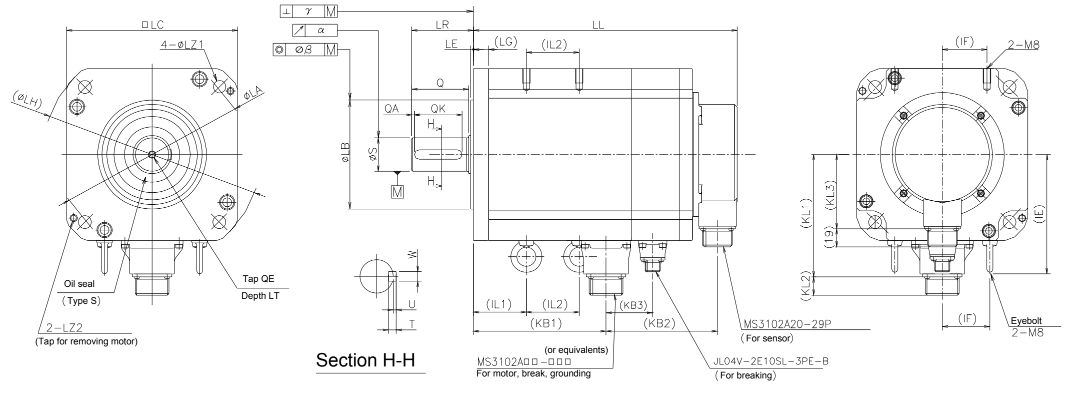


	Without Oil Seal		With Oil Seal										
	Absolute encoder for incremental system												
	Without Brake	With Brake	Without Brake	With Brake									
servo motor model number	LL	LL	LL	LL	LG	KL	LA	LB	LE	LH	LC	LZ	LR
R5AA06020△□◇	72.5	100.5	79.5	107.5	6	44.6	70	0 50-0.025	3	82	60	4- φ 5.5	30
R5AA06040△□◇	98.5	126.5	105.5	133.5									
R5AA08075△□◇	110.3	146	117.3	153	8	54.4	90	0 70-0.03	3	108	80	4- φ 6.6	40

servo motor model number	S	Q	QE	LT	D1	D2	D3
R5AA06020△□◇	0 14 -0.011	25	M5	12	6	5	5
R5AA06040△□◇							
R5AA08075△□◇	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.

10) Q1 motor, flange size 100mm, 120mm, 130mm, and 180mm



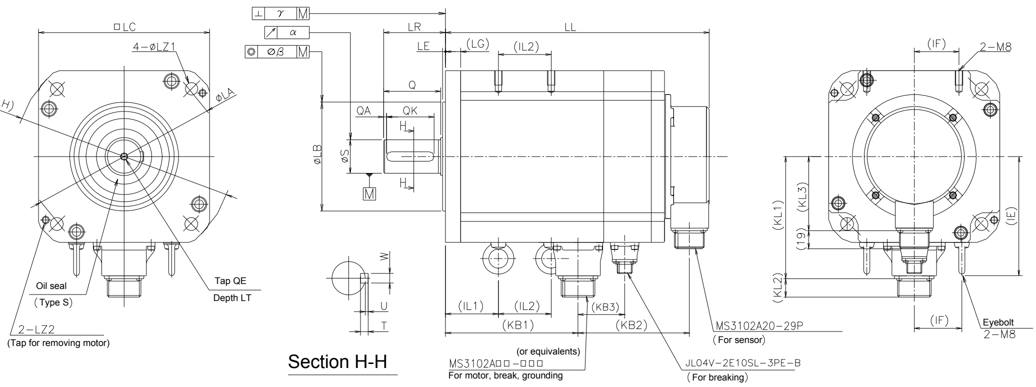
	Wire-saving incremental encoder					Battery backup absolute encoder					Connector, Note1)					[PP062]	[PA035C]		
	No brake		With brake			No brake		With brake			Motor earth	Brake (With brake-motor only, Note2)							
Servo motor model number	LL	KB2	LL	KB2	KB3	LL	KB2	LL	KB2	KB3	MS3102A	JL04V-2E	LG	KL1	KL2	KL3	KL3	LA	LB
Q1AA10100△□◇	184	80	219	116	51	193	90	229	125	51	20-15P	10SL-3PEB	10	78	19	63	63	115	0 95-0.035
Q1AA10150△□◇	209		244	116	51	218		254											
Q1AA10200△□◇	234		269	116	51	243		279											
Q1AA10250△□◇	259		294			268		304											
Q1AA12100△□◇	168	72	204	108	45	183	87	219	123	45	24-11P	10SL-3PE-B	12	93	21	67	63	135/ 145	0 110-0.035
Q1AA12200△□◇	205	72	241			220		256											
Q1AA12300△□◇	242		278			257		293											
Q1AA13300△□◇	205	67	254	117	-	220	84	270	134	-	24-11P		12	98	21	80	63	145	0 110-0.035
Q1AA13400△□◇	232		281			247		297											
Q1AA13500△□◇	269		318			284		334											
Q1AA18450△□◇	288	67	338	117	-	304	84	354	134	-	24-11P		16	123	21	80	63	200	0 114.3-0.035
Q1AA18750△□◇	384	72	434	122	54	400	89	450	139	54	32-17P	10SL-3PE-B	19	144	22				

Servo motor model number	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	α	β	γ	QE	LT	IE	IF	IL1	IL2
Q1AA10100△□◇	3	130	100	9	-	45	0 22-0.013	40	3	32	0 6-0.030	6	2.5	84	0.02	0.08	0.08	M6	20	-	-	-	-
Q1AA10150△□◇														109									
Q1AA10200△□◇														134									
Q1AA10250△□◇														159									
Q1AA12100△□◇	3	162	120	9	-	45	0 22-0.013	40	3	32	0 6-0.030	6	2.5	76	0.02	0.08	0.08	M6	20	-	-	-	-
Q1AA12200△□◇														113									
Q1AA12300△□◇						55	0 28-0.013	50	3	42	0 8-0.036	7	3	150				M8	25				
Q1AA13300△□◇	4	165	130	9	M6	55	0 28-0.013	50	3	42	0 8-0.036	7	3	117	0.02	0.08	0.08	M8	25	-	-	-	-
Q1AA13400△□◇														144									
Q1AA13500△□◇														181									
Q1AA18450△□◇	3	230	180	13.5	M8	65	0 35-0.016	60	3	50	0 10-0.036	8	3	200	0.02	0.08	0.08	M8	25	124	50	93	50
Q1AA18750△□◇						79	0 42-0.016	75	3	67	0 12-0.043	8	3	291				M10	25	124	50	85	145

Note1) Use waterproof connector for receptacle plug when compliance with IP67 required, as connector is waterproof when fit.

Note2) All the brake connectors are JL04V-2E70SL-3PE-B, when DC24V-brake conforms to CE.

11) Q2 motor, flange size 130mm, 180mm, and 220mm



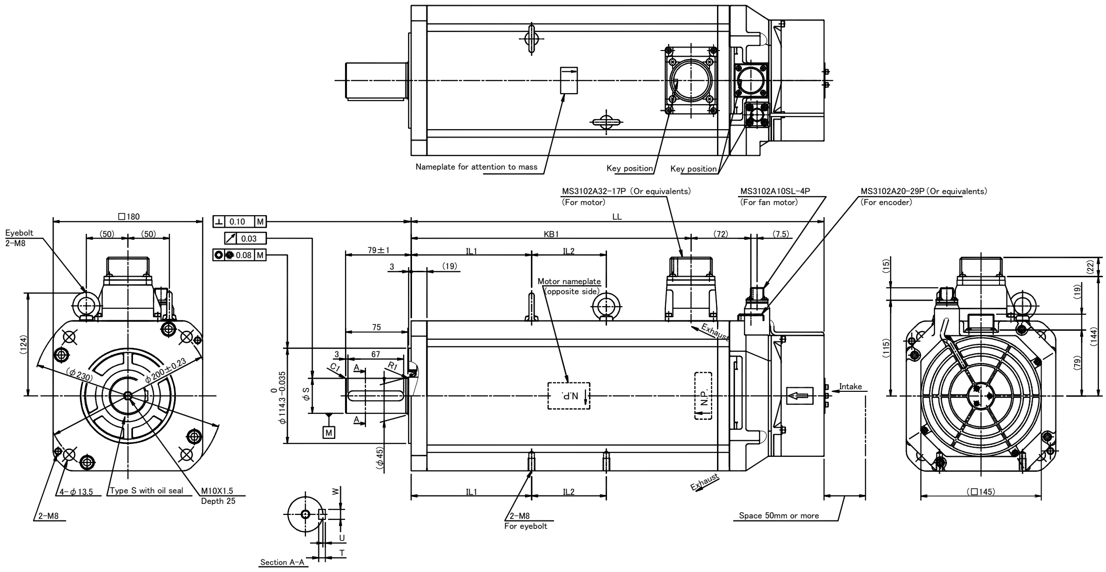
	Wire-saving incremental encoder					Battery backup absolute encoder					Connector, Note1)								
	No brake		With brake			No brake		With brake			Motor earth	Brake (with-brake motor only, Note2)				[PP 062]	[PA03 5C]		
Servo motor model number	LL	KB2	LL	KB2	KB3	LL	KB2	LL	KB2	KB3	MS3102A	JL04V-2E	LG	KL1	KL2	KL3	KL3	LA	LB
Q2AA13200△□◇	186	67	226	107	-	201	84	241	124	-	24-11P		12	98	21	80	63	145	0 110-0.035
Q2AA18200△□◇	171	67	221	117	-	186	84	236	134	-	24-11P		16	123	21	80	63	200	0 114.3-0.035
Q2AA18350△□◇	203		253			218		268											
Q2AA18450△□◇	218		268			234		284											
Q2AA18550△□◇	282	72	332	122	54	298	89	348	139	54	32-17P	10SL-3PE-EB	19	144	22	80	63	200	0 114.3-0.035
Q2AA18750△□◇	332		382			348		398											
Q2AA22550△□◇	252	82	309	140	82	265	97	323	155	82	24-11P	10SL-3PE-EB	19	141	21	80	63	235	0 200-0.046
Q2AA22700△□◇	310		368			323		381											
Q2AA2211K△□◇	335	73	393	131	61	355	94	406	145	61	32-17P	10SL-3PE-EB	19	162	22	80	63	235	0 200-0.046
Q2AA2215K△□◇	394		452			414		465											

Servo motor model number	LE	LH	LC	LZ1	LZ2	LR	S	Q	QA	QK	W	T	U	KB1	α	β	γ	QE	LT	IE	IF	IL1	IL2
Q2AA13200△□◇	4	165	130	9	M6	55	0 28-0.013	50	3	42	0 8-0.036	7	3	98	0.02	0.08	0.08	M8	25	-	-	-	-
Q2AA18200△□◇	3	230	180	13.5	M8	65	0 35-0.016	60	3	50	0 10-0.036	8	3	83	0.02	0.08	0.08	M8	25	-	-	-	-
Q2AA18350△□◇														115						124	50	61	20
Q2AA18450△□◇														130									35
Q2AA18550△□◇	3	230	180	13.5	M8	79	0 42-0.016	75	3	67	0 12-0.043	8	3	189	0.02	0.08	0.08	M10	25	124	50	85	50
Q2AA18750△□◇														239									100
Q2AA22550△□◇	4	270	220	13.5	M10	79	0 55-0.019	75	3	67	0 16-0.043	10	4	149	0.03	0.08	0.10	M10	25	142	60	55	50
Q2AA22700△□◇														207									110
Q2AA2211K△□◇	4	270	220	13.5	M10	79	0 55-0.019	75	3	67	0 16-0.043	10	4	241	0.03	0.08	0.10	M10	25	142	60	69	120
Q2AA2215K△□◇														300									180

Note1) Use waterproof connector for receptacle plug when compliance with IP67 required, as connector is waterproof when fit.

Note2) All the brake connectors are JL04V-2E70SL-3PE-B, when DC24V-brake conforms to CE.

12) Q4 motor, flange size 180mm



	Wire-saving incremental encoder	Connector, Note1)					
	No brake	Motor earth					
Servo motor model number	LL	MS3102A	S	W	T	U	KB1
Q4AA1811K△□◇	497	32-17P	0 42-0.016	0 12-0.043	8	3	337
Q4AA1815K△□◇	587		0 55-0.019	0 16-0.043	10	4	427

Note1) Motor connector is waterproof when being mated, so please use waterproof connector for receptacle plug when compliance with IP67 required.

12.4 Servo motor data sheet

1) Characteristics table

■ Specification of R1 motor, AC200V

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 Note1)	J_M	$kg\cdot m^2(GD^2/4)$ $x10^{-4}$	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	t20×540	t20×540	t30×610	t30×610

Note1) Contains battery backup method absolute encoder.

- ✔ 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, AC200V

Servo motor model number R2AA			04003F	04005F	04010F	06010F	06020F	06040H	08020F
Amplifier size combined			RS2A01	RS2A01	RS2A01	RS2A01	RS2A01	RS2A01	RS2A01
*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 Note1)	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	t6×250	t6×250	t6×250	t6×250	t6×250	t6×250	t6×250

Servo motor model number R2AA			06040F	08040F	08075F	B8075F	B8100H	B8100F	10075F
Amplifier size combined			RS2A03	RS2A03	RS2A03	RS2A05	R2SA03	RS2A05	RS2A03
*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 Note 2)	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 Note 2)	23.7	15.5	25.7	15.5
*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 Note1)	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	t6×250	t6×250	t6×250	t12×305	t12×305	t12×305	t12×305

Note1) Contains battery backup method absolute encoder.

Note2) Peak armature current at stall 8.5[N.m] is the value when using 3-phase 200V. The value when using single-phase 200V is 7[N.m]. Peak armature current 15.5 [Arms] is the value when using 3-phase 200V. The value when using single-phase 200V is 13.1[Arms].

- ✔ 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			RS2A05	RS2A03	RS2A03	RS2A03	RS2A05	RS2A05	RS2A05
*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 Note1)	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	t12×305	t20×305	t20×305	t20×400	t20×400	t20×400	t20×470

Servo motor model number R2AA			13180D	13200L	13200D	18350L	18350D	18450H	18550R
Amplifier size combined			RS2A10	RS2A05	RS2A10	RS2A10	RS2A15	RS2A15	RS2A15
*Rated output	P_R	kW	1.8	2.0	2.0	3.5	3.5	4.5	5.5
*Rated velocity	N_R	min^{-1}	2000	2000	2000	2000	2000	2000	1500
*Maximum velocity	N_{max}	min^{-1}	5000	3000	5000	3000	4000	3500	2500
*Rated torque	T_R	N·m	8.6	9.5	9.5	17.0	17.0	21.5	35.0
*Continuous Torque at stall	T_S	N·m	10.0	12.0	12.0	22.0	22.0	30.0	37.3
*Peak Torque at stall	T_P	N·m	25.0	24.0	30.0	49.0	60.0	75.0	90.0
*Rated armature current	I_R	Arms	15.6	11.0	14.3	19.1	21.7	23.7	31.6
*Armature current at stall	I_S	Arms	17.3	12.0	17.5	23.7	27.0	31.7	32.9
*Peak armature current at stall	I_P	Arms	43.0	26.5	45.5	55.0	83.0	83.0	83.0
*Torque constant	K_T	N·m/Arms	0.63	0.97	0.7	1.0	0.88	1.02	1.23
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	21.8	33.7	24.3	34.8	30.6	35.6	42.8
Phase resistance	R_Φ	Ω	0.13	0.22	0.11	0.085	0.075	0.065	0.059
*Rated power rate	Q_R	kW/s	82	74	74	72	72	92	180
Moment of inertia Note1)	J_M	kg·m^2(GD^2/4) x10^{-4}	9.0	12.2	12.2	40	40	50	68
Mass Note1)	WE	Kg	7.7	10.0	10.0	15.5	15.5	19.5	27.7
Brake mass	W	kg	1.5	1.5	1.5	2.4	2.4	2.8	2.8
Aluminum plate		mm	t20×470	t20×470	t20×470	t20×470	t20×470	t20×470	t20×540

Note1) Contains battery backup method absolute encoder.

- ✔ 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			18550H	18750H	1811KR	22500L	22700S
Amplifier size combined			RS2A30	RS2A30	RS2A30	RS2A15	RS2A15
*Rated output	P_R	kW	5.5	7.5	11	5.0	7.0
*Rated velocity	N_R	min^{-1}	1500	1500	1500	2000	1000
*Maximum velocity	N_{max}	min^{-1}	3000	3000	2500	4000	1000
*Rated torque	T_R	N·m	35.0	48.0	70.0	24.0	67.0
*Continuous Torque at stall	T_S	N·m	37.5	54.9	80.0	32.0	70.0
*Peak Torque at stall	T_P	N·m	107.0	140.0	170.0	75.0	150.0
*Rated armature current	I_R	Arms	46.2	51.2	61.9	22.0	34.0
*Armature current at stall	I_S	Arms	48.0	56.8	66.0	34.0	34.0
*Peak armature current at stall	I_P	Arms	155.0	155.0	155.0	83.0	83.0
*Torque constant	K_T	N·m/Arms	0.84	1.04	1.25	1.0	2.25
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	29.3	36.6	43.8	34.9	78.6
Phase resistance	R_Φ	Ω	0.03	0.03	0.035	0.047	0.085
*Rated power rate	Q_R	kW/s	180	235	445	105	330
Moment of inertia Note1)	J_M	kg·m^2(GD^2/4) x10^{-4}	68	98	110	55	136
Mass Note1)	WE	Kg	27.7	35.7	40	22.5	43
Brake mass	W	kg	2.8	6	5.5	5.5	7.8
Aluminum plate		mm	t20×540	t20×540	T30×610	t20×540	t20×540

■ Specification of R2 motor, AC200V

Servo motor model number R2AA			2211KB	2215KB
Amplifier size combined			RS2A30	RS2A30
*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 Note1)	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	t30×610	t30×610

Note1) Contains battery backup method absolute encoder.

- ✔ 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			RS2E01	RS2E01	RS2E01	RS2E01	RS2E03
*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 Note1)	J_M	kg·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	t6x250	t6x250	t6x250	t6x250	t6x250

Note1) Contains battery backup method absolute encoder.

✔ 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			RS2A01	RS2A01	RS2A01	RS2A03	RS2A03	RS2A03
*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 Note1)	J_M	kg·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	t6×250	t6×250	t6×250	t6×250	t6×250	t6×250

Note1) Absolute encoder for incremental system included.

✔ 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 Q1 motor, AC200V

Servo motor model number Q1AA			10100D	10150D	10200D	10250D	12100D	12200D
Amplifier size combined			RS2A05	RS2A05	RS2A10	RS2A10	RS2A05	RS2A10
*Rated output	P_R	kW	1	1.5	2	2.5	1	2
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	3000	3000
*Maximum velocity	N_{max}	min^{-1}	5000	4500	5000	5000	5000	5000
*Rated torque	T_R	N·m	3.19	4.79	6.37	7.97	3.19	6.37
*Continuous Torque at stall	T_S	N·m	3.92	4.9	7.36	8.82	3.92	7.36
*Peak Torque at stall	T_P	N·m	10.5	14.7	19.6	24.4	11.0	21
*Rated armature current	I_R	Arms	6.5	8.2	15.9	16.6	6.2	14.3
*Armature current at stall	I_S	Arms	7.8	8.2	18	17.2	7.5	16.2
*Peak armature current at stall	I_P	Arms	24.5	26.5	55	55	24.5	53
*Torque constant	K_T	N·m/Arms	0.55	0.705	0.470	0.587	0.578	0.534
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	19.3	24.6	16.4	20.5	20.2	18.6
Phase resistance	R_Φ	Ω	0.34	0.272	0.0860	0.104	0.19	0.07
*Rated power rate	Q_R	kW/s	78.9	143	189	240	45.2	93
Moment of inertia Note1)	J_M	$kg\cdot m^2(GD^2/4)$ $x10^{-4}$	1.29	1.61	2.15	2.65	2.25	4.37
Mass Note1)	WE	Kg	5.4	6.5	8.7	9.4	5.4	8.7
Brake mass	W	kg	1.3	1.5	1.5	1.5	1.3	1.5
Aluminum plate		mm	t20x400	t20x400	t20x470	t20x470	t20x400	t20x470

Servo motor model number Q1AA			12300D	13300D	13400D	13500D	18450M	18750H
Amplifier size combined			RS2A10	RS2A10	RS2A15	RS2A15	RS2A15	RS2A30
*Rated output	P_R	kW	3	3	4	5	4.5	7.5
*Rated velocity	N_R	min^{-1}	3000	3000	3000	3000	1500	1500
*Maximum velocity	N_{max}	min^{-1}	5000	4500	4500	4500	1500	3000
*Rated torque	T_R	N·m	9.6	9.5	12.7	15.7	28.5	48
*Continuous Torque at stall	T_S	N·m	11	10.8	14.7	18.1	31.6	55
*Peak Torque at stall	T_P	N·m	31	28.4	39.2	47.6	105	125
*Rated armature current	I_R	Arms	16.2	16.7	23.4	25.8	20	55
*Armature current at stall	I_S	Arms	17.3	17.6	26.4	27.5	22.2	60
*Peak armature current at stall	I_P	Arms	55	55	83	83	83	155
*Torque constant	K_T	N·m/Arms	0.73	0.693	0.612	0.724	1.71	0.91
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	25.4	24.2	21.4	25.3	59.6	31.7
Phase resistance	R_Φ	Ω	0.082	0.087	0.048	0.0461	0.129	0.021
*Rated power rate	Q_R	kW/s	143	184	251	291	295	443
Moment of inertia Note1)	J_M	$kg\cdot m^2(GD^2/4)$ $x10^{-4}$	6.4	4.92	6.43	8.47	27.5	52
Mass Note1)	WE	Kg	11.4	11.4	14.4	16	21.7	47
Brake mass	W	kg	1.7	1.7	2.2	2.2	5	6
Aluminum plate		mm	t20x470	t20x470	t20x470	t20x540	t20x540	t20x540

Note1) Wire-saving incremental encoder included.

- ✔ 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 Q2 motor, AC200V

Servo motor model number Q2AA			13200H	18200H	18350H	18450H	18550R	22550B
Amplifier size combined			RS2A10	RS2A10	RS2A15	RS2A15	RS2A15	RS2A15
*Rated output	P_R	kW	2	2	3.5	4.5	5.5	5.5
*Rated velocity	N_R	min^{-1}	2000	2000	2000	2000	1500	1500
*Maximum velocity	N_{max}	min^{-1}	3500	3500	3500	3000	2500	2000
*Rated torque	T_R	N·m	9.55	9.5	16.7	21.5	35	35
*Continuous Torque at stall	T_S	N·m	12	12	21.1	27.1	37.3	42
*Peak Torque at stall	T_P	N·m	30.5	31	55	70	88	90
*Rated armature current	I_R	Arms	13.1	15	22.6	24	32.2	30
*Armature current at stall	I_S	Arms	16.3	18	28	29	33.7	35.1
*Peak armature current at stall	I_P	Arms	48	55	83	81	83	79.7
*Torque constant	K_T	N·m/Arms	0.822	0.75	0.840	1.04	1.24	1.32
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	29	25.9	29.3	36.4	43.2	46.0
Phase resistance	R_Φ	Ω	0.128	0.075	0.048	0.044	0.039	0.0464
*Rated power rate	Q_R	kW/s	78	45.7	73	84	180	129
Moment of inertia Note1)	J_M	kg·m^2(GD^2/4) x10^{-4}	12	20	38	55	69	95
Mass Note1)	WE	Kg	9.8	13.6	17.7	20	30	34.8
Brake mass	W	kg	1.7	5	5	5	6	5.9
Aluminum plate		mm	t20x470	t20x470	t20x470	t20x470	t20x540	t20x540

Servo motor model number Q2AA			22700S	18550H	18750L	2211KV	2215KV
Amplifier size combined			RS2A15	RS2A30	RS2A30	RS2A30	RS2A30
*Rated output	P_R	kW	7	5.5	7.5	11	15
*Rated velocity	N_R	min^{-1}	1000	1500	1500	1500	1500
*Maximum velocity	N_{max}	min^{-1}	1000	3000	3000	2000	2000
*Rated torque	T_R	N·m	67	35	48	70	95.5
*Continuous Torque at stall	T_S	N·m	70	37.3	54.9	80	95.5
*Peak Torque at stall	T_P	N·m	150	95	137	176	215
*Rated armature current	I_R	Arms	34	47	52	60	66
*Armature current at stall	I_S	Arms	34	47	57	66	66
*Peak armature current at stall	I_P	Arms	83	155	160	155	157
*Torque constant	K_T	N·m/Arms	2.13	0.83	1.03	1.29	1.54
Voltage constant for each phase	$K_{E\Phi}$	mV/min^{-1}	74.5	29.0	36.0	45.1	53.6
Phase resistance	R_Φ	Ω	0.057	0.018	0.017	0.015	0.016
*Rated power rate	Q_R	kW/s	243	168	240	260	360
Moment of inertia Note1)	J_M	kg·m^2(GD^2/4) x10^{-4}	185	73	95	186	255
Mass Note1)	WE	Kg	46	30	40	58	70
Brake mass	W	kg	10.4	6	6	11	11
Aluminum plate		mm	t20x540	t20x540	t20x540	t20x540	t20x540

Note1) Wire-saving incremental encoder included.

- ✔ 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 Q4 motor, AC200V

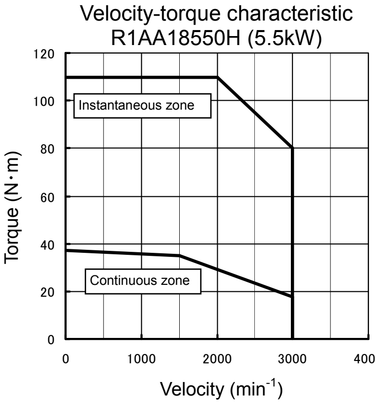
Servo motor model number Q4AA			1811KB	1815KB
Amplifier size combined			RS2A30	RS2A30
*Rated output	P_R	kW	11	15
*Rated velocity	N_R	min-1	1500	1500
*Maximum velocity	N_{max}	min-1	2000	2000
*Rated torque	T_R	N·m	70	95.5
*Continuous stall torque	T_S	N·m	70	95.5
*Peak armature current at stall	T_P	N·m	190	220
*Rated armature current	I_R	Arms	54	61
*Peak armature current at stall	I_S	Arms	53	59
*Peak armature current	I_P	Arms	155	155
*Torque constant	K_T	N·m/Arms	1.42	1.75
Voltage constant for each phase	$K_{E\Phi}$	mV/min-1	49.7	61.1
Phase resistance	R_Φ	Ω	0.025	0.032
*Rated power rate	Q_R	kW/s	780	1100
Moment of inertia Note1)	J_M	$kg\cdot m^2$ $(GD^2/4)$ $x10^{-4}$	63	85
Mass Note1)	WE	kg	60	75
Brake mass	W	kg	-	-
Aluminum plate		mm	t30x610	t30x610
Fan motor characteristic		VAC	Single phase 200	
		Hz	50/60	
		W	39/33	
		A	0.31/0.26	

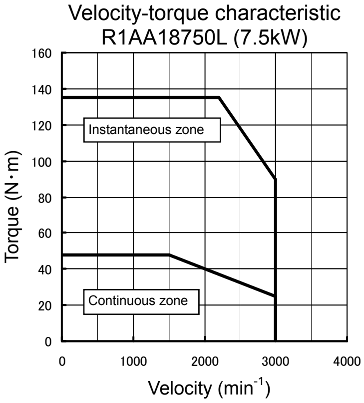
Note1) Wire-saving incremental encoder included.

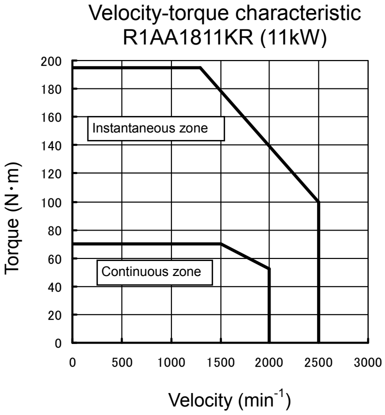
- ✔ Constant in the table above is the value when motor is installed on heat releasing aluminum plate, indicates “thickness” x “length of a side of square.
- ✔ Items marked with * and Velocity-Torque Characteristics indicate values after temperature rise saturation. The others indicate values at 20°C.
- ✔ Each value indicates TYP.

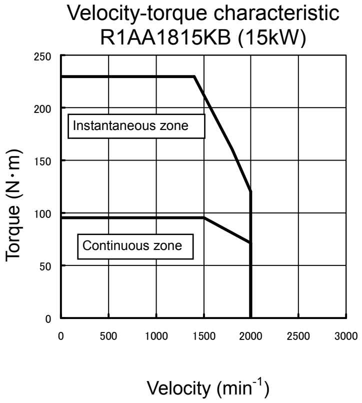
2) Velocity-torque characteristics

R1AA Motor velocity-torque characteristics indicate the values when amplifier power supply is AC200V. Instantaneous zone decreases when amplifier power supply is below 200V.

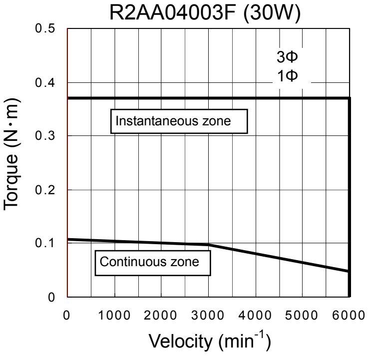

Velocity-torque characteristic
R1AA18550H (5.5kW)


Velocity-torque characteristic
R1AA18750L (7.5kW)


Velocity-torque characteristic
R1AA1811KR (11kW)


Velocity-torque characteristic
R1AA1815KB (15kW)

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
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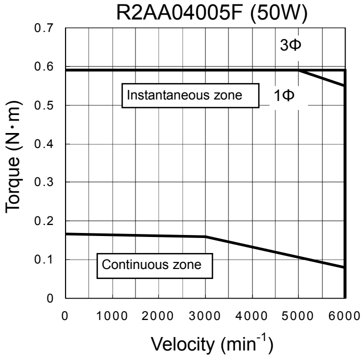
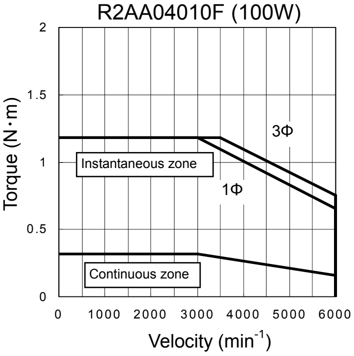
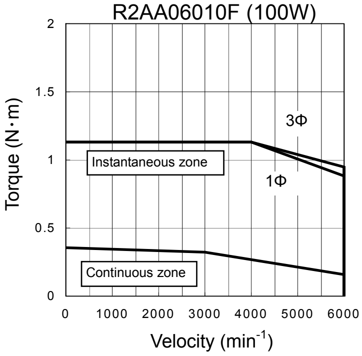
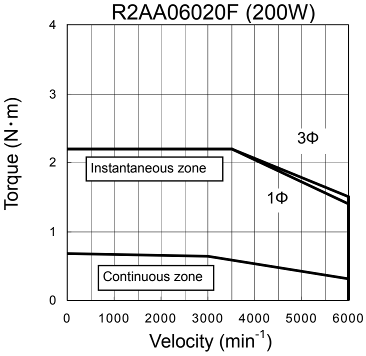
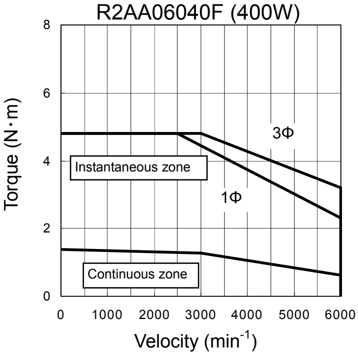
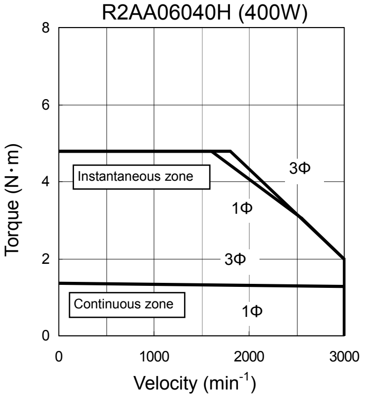

Velocity-torque characteristic
R2AA04005F (50W)


Velocity-torque characteristic
R2AA04010F (100W)


Velocity-torque characteristic
R2AA06010F (100W)


Velocity-torque characteristic
R2AA06020F (200W)


Velocity-torque characteristic
R2AA06040F (400W)


Velocity-torque characteristic
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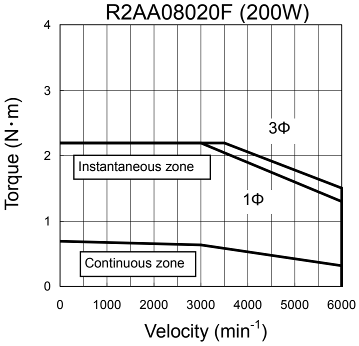
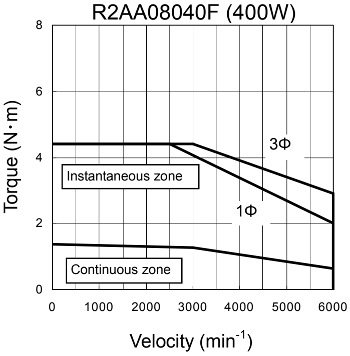
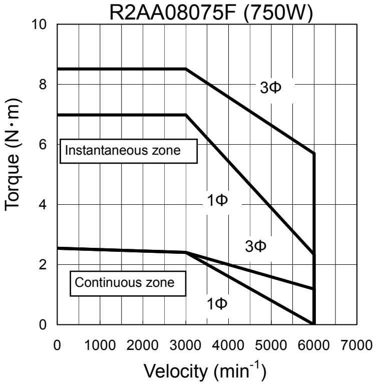

Velocity-torque characteristic
R2AA08020F (200W)


Velocity-torque characteristic
R2AA08040F (400W)


Velocity-torque characteristic
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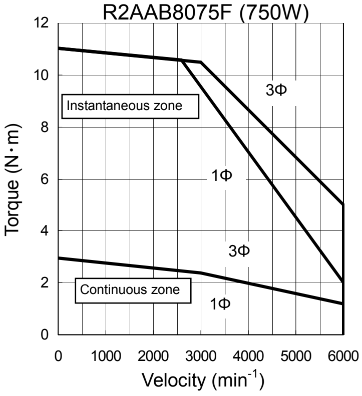
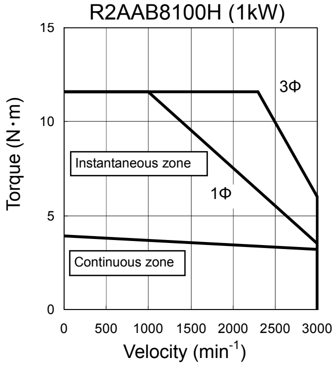
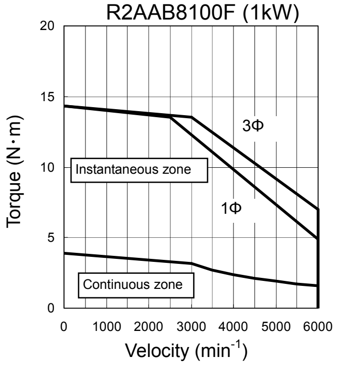
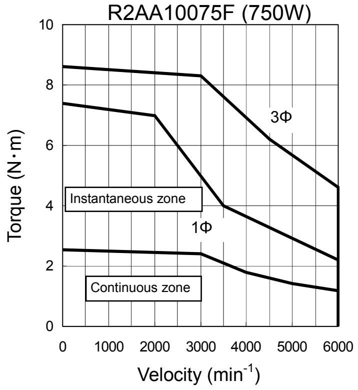

Velocity-torque characteristic
R2AAB8075F (750W)

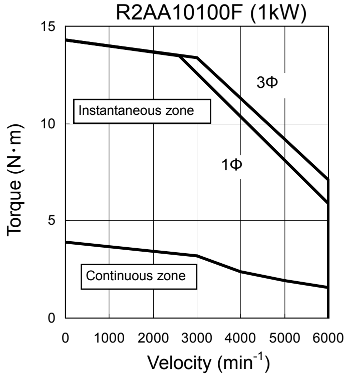

Velocity-torque characteristic
R2AAB8100H (1kW)



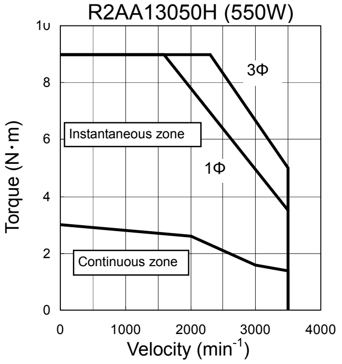
Velocity-torque characteristic
R2AAB8100F (1kW)



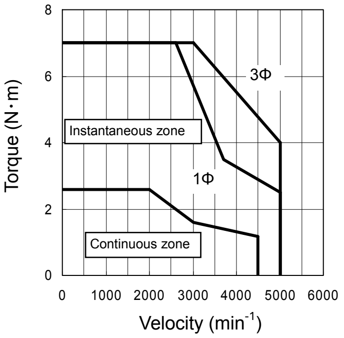
Velocity-torque characteristic
R2AA10075F (750W)



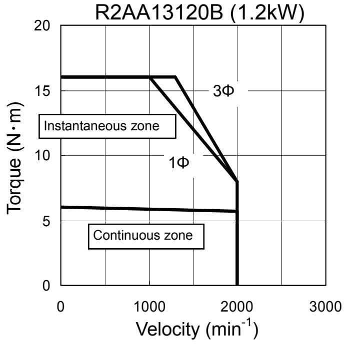
Velocity-torque characteristic
R2AA10100F (1kW)



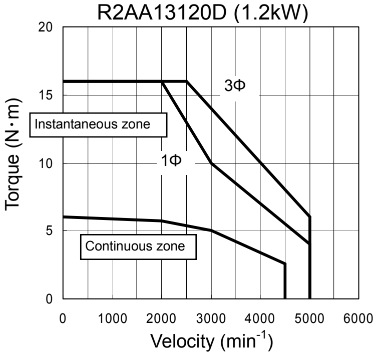
Velocity-torque characteristic
R2AA13050H (550W)



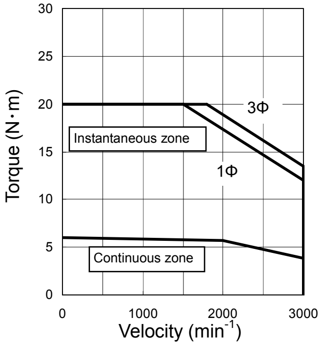
Note1)
Velocity-torque characteristic
R2AA13050D (550W)



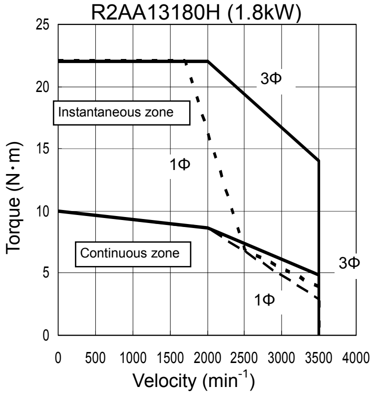
Velocity-torque characteristic
R2AA13120B (1.2kW)



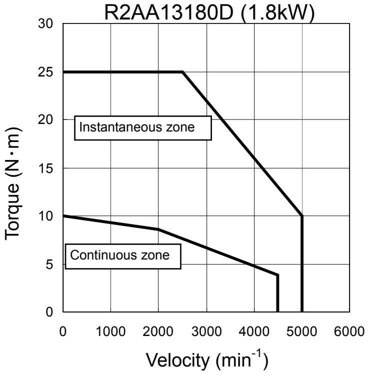
Note)1
Velocity-torque characteristic
R2AA13120D (1.2kW)



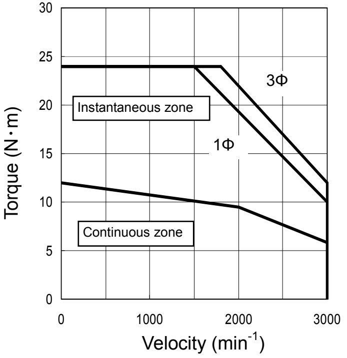
Velocity-torque characteristic
R2AA13120L (1.2kW)



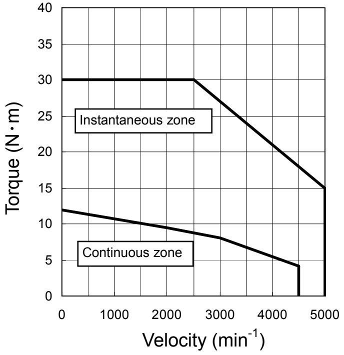
Velocity-torque characteristic
R2AA13180H (1.8kW)



Velocity-torque characteristic
R2AA13180D (1.8kW)



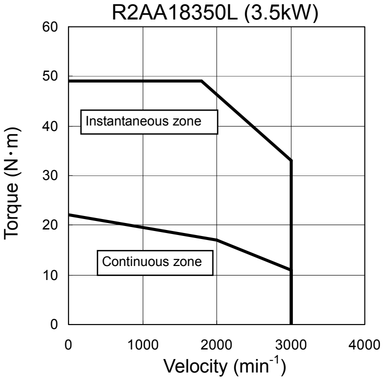
Velocity-torque characteristic
R2AA13200L (2kW)



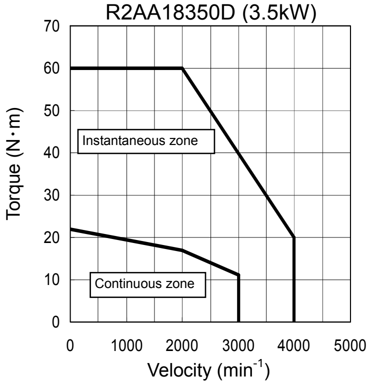
Velocity-torque characteristic
R2AA13200D (2kW)

Note1) When you use motor (R2AA13050D, R2AA13120D, R2AA13180D, R2AA13200D, R2AA18450H, R2AA1811KR or 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.

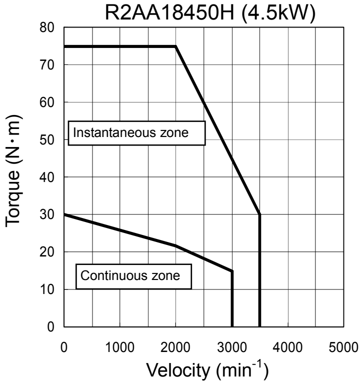
Velocity-torque characteristic
R2AA18350L (3.5kW)



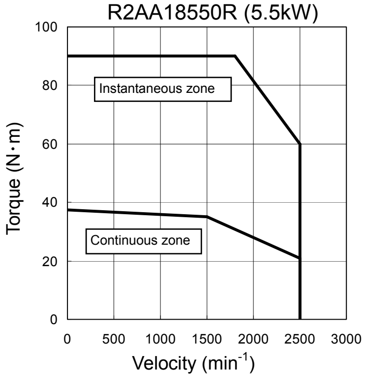
Velocity-torque characteristic
R2AA18350D (3.5kW)



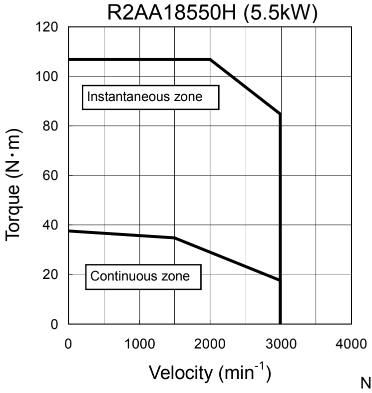
Velocity-torque characteristic
R2AA18450H (4.5kW)



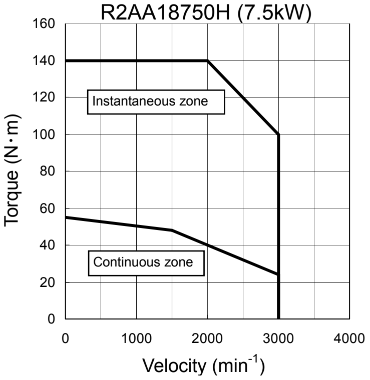
Velocity-torque characteristic
R2AA18550R (5.5kW)



Velocity-torque characteristic
R2AA18550H (5.5kW)

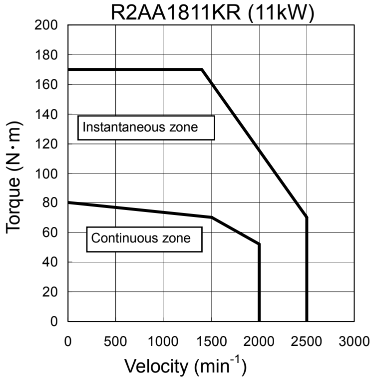


Velocity-torque characteristic
R2AA18750H (7.5kW)

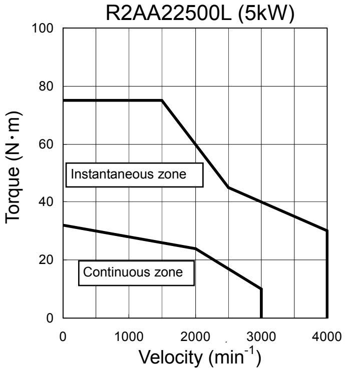


Note 1

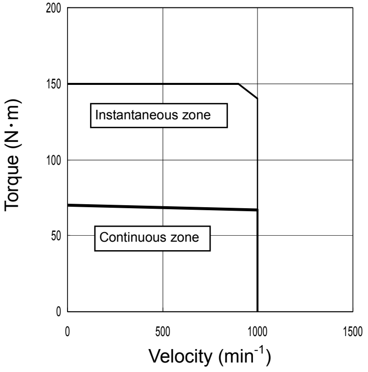
Velocity-torque characteristic
R2AA1811KR (11kW)



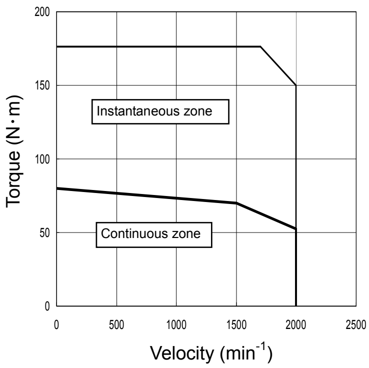
Velocity-torque characteristic
R2AA22500L (5kW)



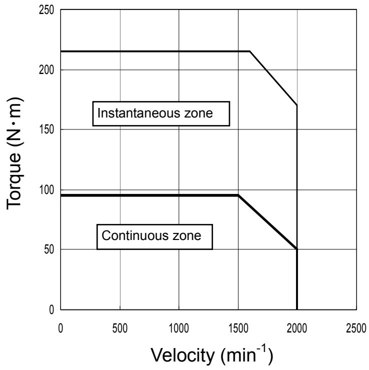
Velocity-torque characteristic
R2AA22700S (7kW)



Velocity-torque characteristic
R2AA2211KB (11kW)

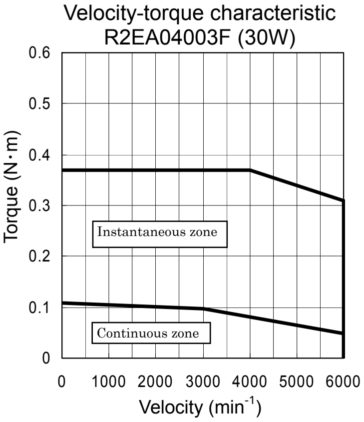


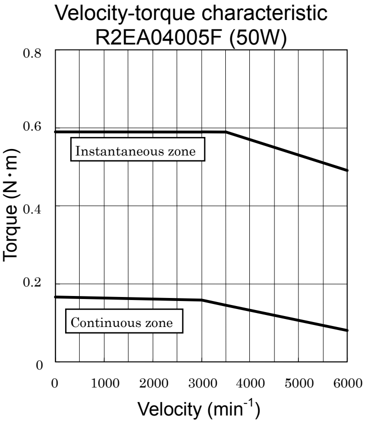
Velocity-torque characteristic
R2AA2215KB (15kW)

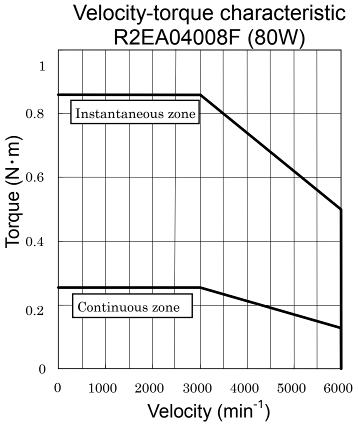


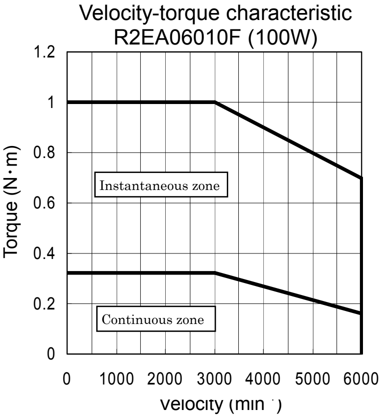
Note1) When you use motor (R2AA13050D, R2AA13120D, R2AA13180D, R2AA13200D, R2AA18450H, R2AA1811KR or R2AA22500L) whose maximum rotational velocity Nmax and maximum rotational velocity in the continuous zone are different, use the motor so that the motor average rotational velocity does not exceed maximum rotational velocity in the continuous zone.

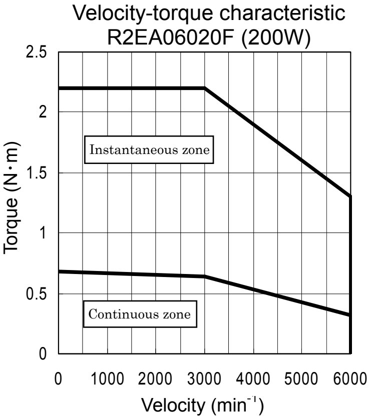
R2EA Motor velocity-torque characteristics indicate the values when amplifier power supply is AC100V. Instantaneous zone decreases when amplifier power supply is below 100V.


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)

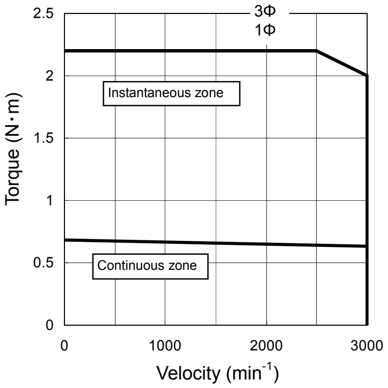
For servo motor with oil-seal and/or brake, the following decrease-rating ratios have to be applied to the torque characteristic in the continuous velocity zone.

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

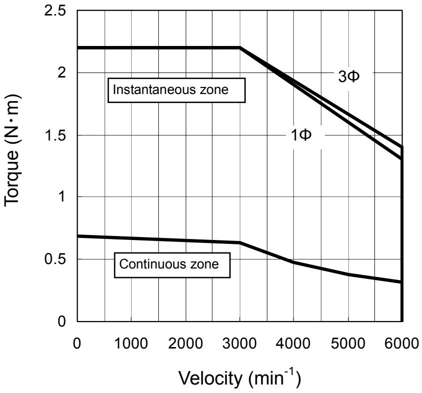
	R2AA04005F	R2AA04010F	R2AA06040□	R2AA08075F	R2EA04005F
Degree of decrease rating 1	-	90%	90%	-	-
Degree of decrease rating 2	90%	85%	80%	90%	90%

R5AA Motor velocity-torque characteristics indicate the values when amplifier power supply is AC200V. Instantaneous zone decreases when amplifier power supply is below 200V.

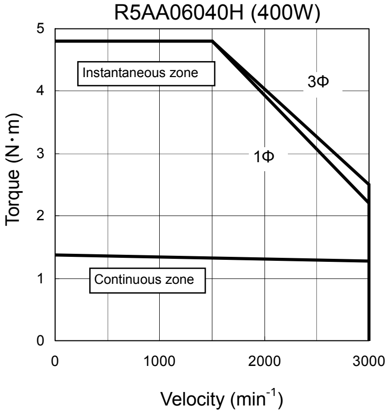
Velocity-torque characteristic
R5AA06020H (200W)



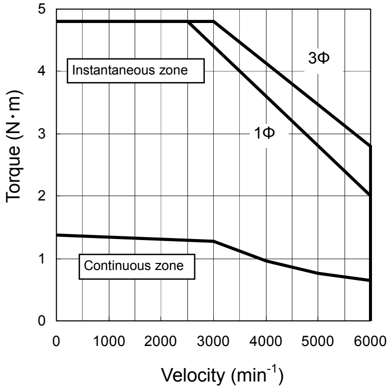
Velocity-torque characteristic
R5AA06020F (200W)



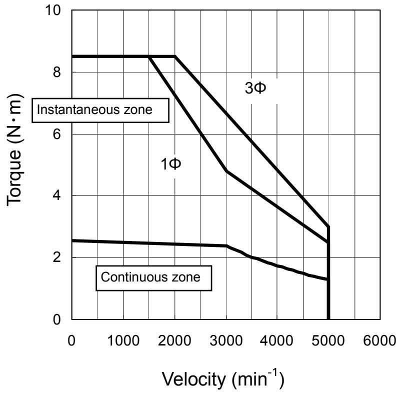
Velocity-torque characteristic
R5AA06040H (400W)



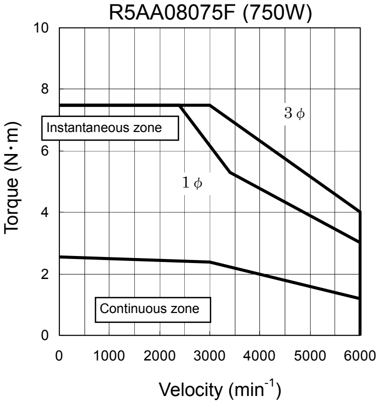
Velocity-torque characteristic
R5AA06040F (400W)



Velocity-torque characteristic
R5AA08075D (750W)

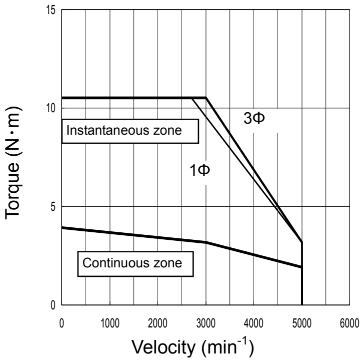


Velocity-torque characteristic
R5AA08075F (750W)

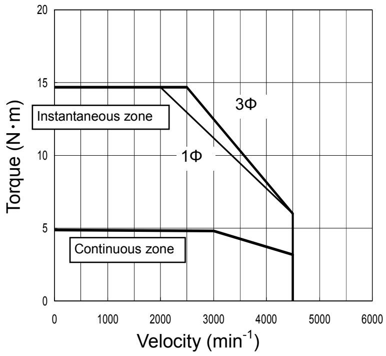


Velocity-torque characteristics of Q1AA motor show the values when 3-phase AC200V is used for input power supply. When power voltage is less than 200V, the momentary range decreases.

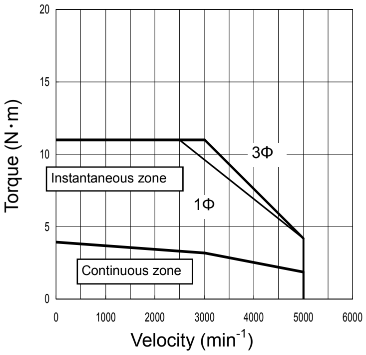
Velocity-torque characteristic
Q1AA10100D (1kW)



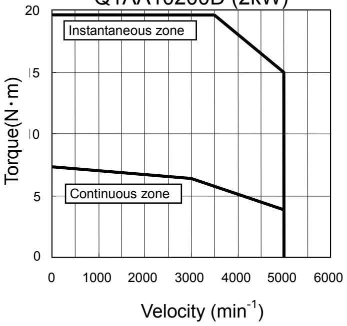
Velocity-torque characteristic
Q1AA10150D (1.5kW)



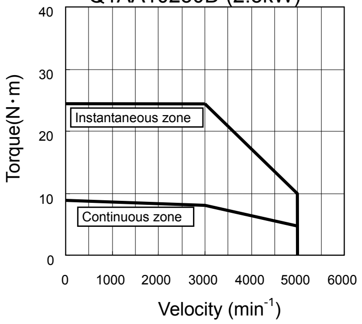
Velocity-torque characteristic
Q1AA12100D (1kW)



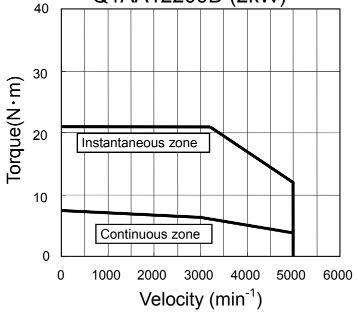
Velocity–torque characteristic
Q1AA10200D (2kW)



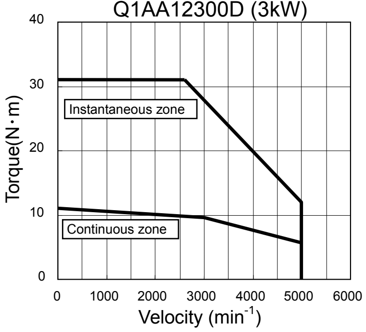
Velocity– torque characteristic
Q1AA10250D (2.5kW)



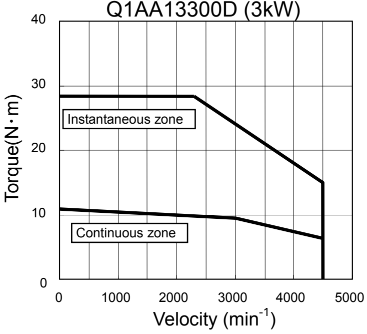
Velocity– torque characteristic
Q1AA12200D (2kW)



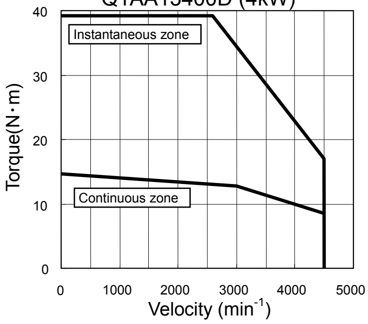
Velocity–torque characteristic
Q1AA12300D (3kW)



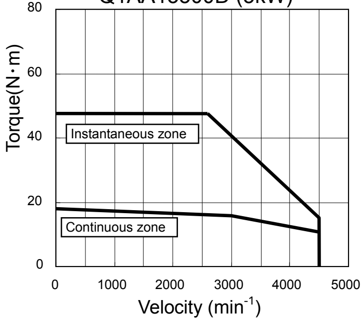
Velocity–torque characteristic
Q1AA13300D (3kW)



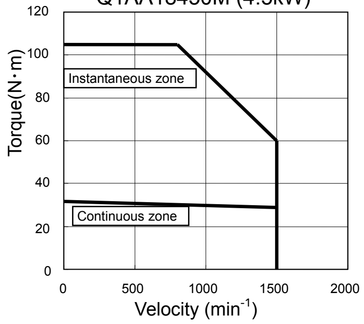
Velocity–torque characteristic
Q1AA13400D (4kW)



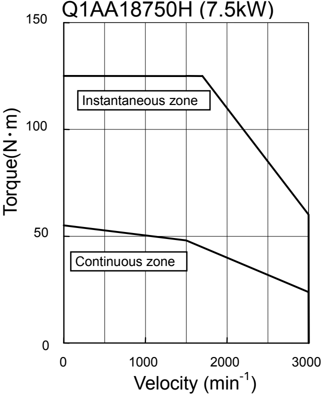
Velocity– torque characteristic
Q1AA13500D (5kW)



Velocity– torque characteristic
Q1AA18450M (4.5kW)

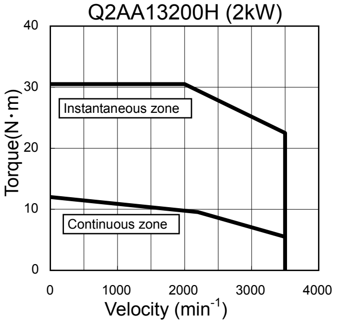


Velocity– torque characteristic
Q1AA18750H (7.5kW)

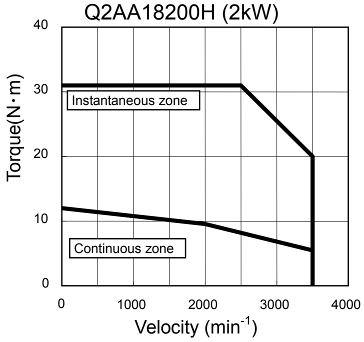


Velocity-torque characteristics of Q2AA motor show the values when 3-phase AC200V is used for input power supply. When power voltage is less than 200V, the momentary range decreases.

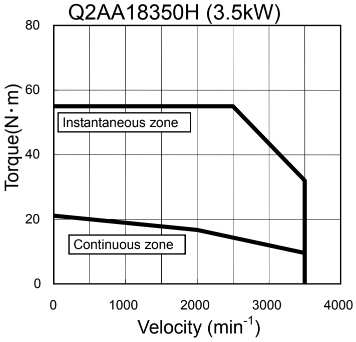
Velocity-torque characteristic
Q2AA13200H (2kW)

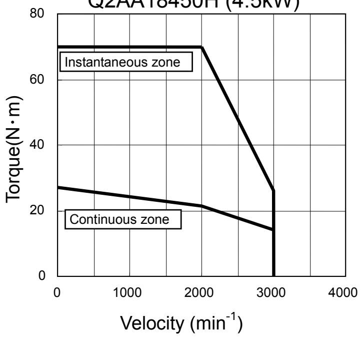


Velocity-torque characteristic
Q2AA18200H (2kW)

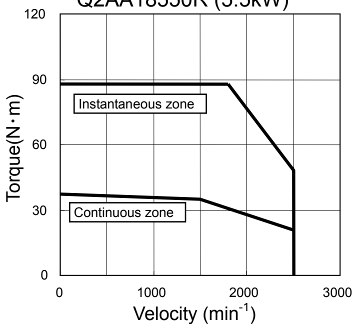


Velocity-torque characteristic
Q2AA18350H (3.5kW)

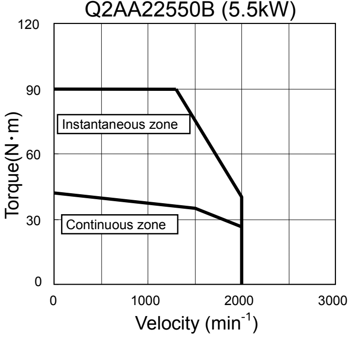




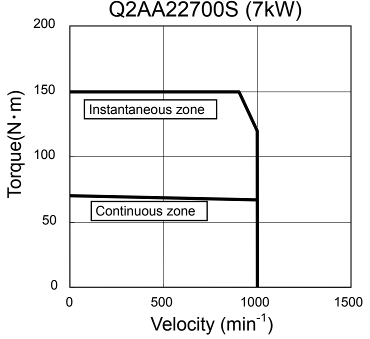
Velocity-torque characteristic
Q2AA18450H (4.5kW)



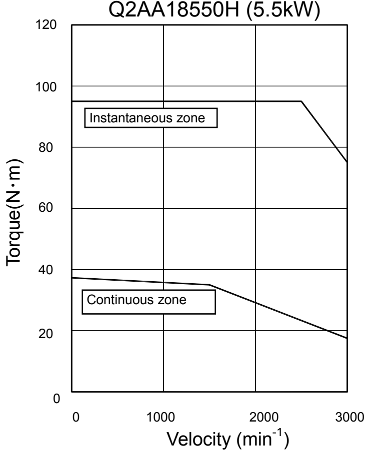
Velocity-torque characteristic
Q2AA18550R (5.5kW)



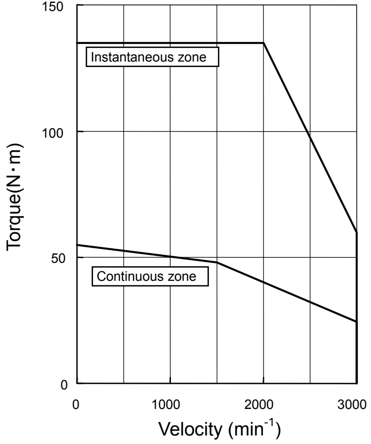
Velocity-torque characteristic
Q2AA22550B (5.5kW)



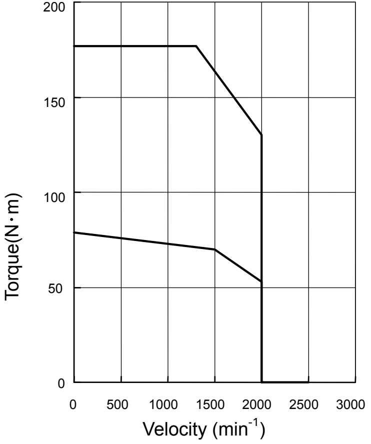
Velocity-torque characteristic
Q2AA22700S (7kW)



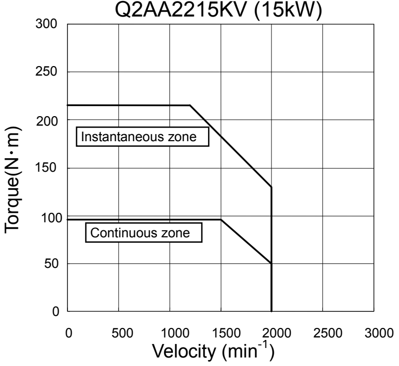
Velocity-torque characteristic
Q2AA18550H (5.5kW)



Velocity-torque characteristic
Q2AA18750L (7.5kW)

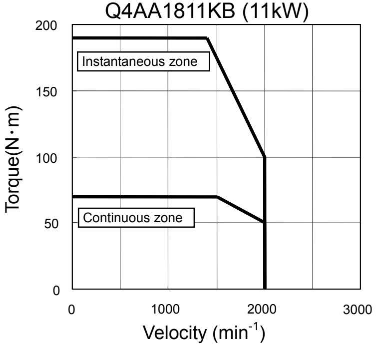


Velocity-torque characteristic
Q2AA2211KV (11kW)

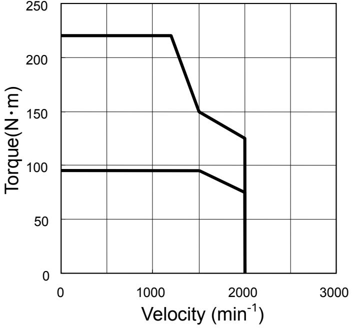


Velocity-torque characteristic
Q2AA2215KV (15kW)

Velocity-torque characteristics of Q4AA motor show the values when 3-phase AC200V is used for input power supply. When power voltage is less than 200V, the momentary range decreases.



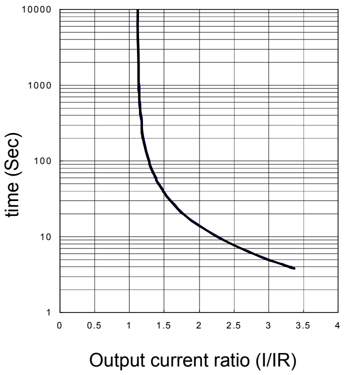
Velocity-torque characteristic
Q4AA1811KB (11kW)



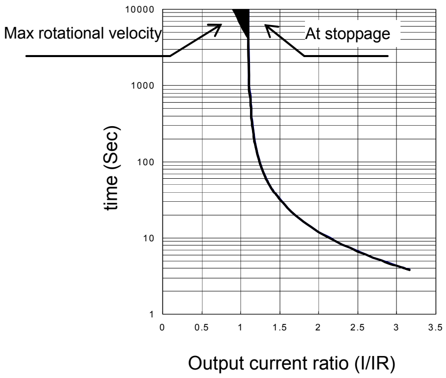
Velocity-torque characteristic
Q4AA1815KB (15kW)

3) Overload characteristic

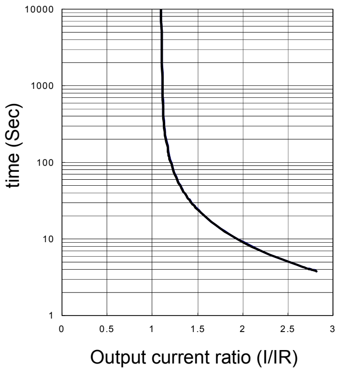
The following show overload characteristic of R1AA motor.



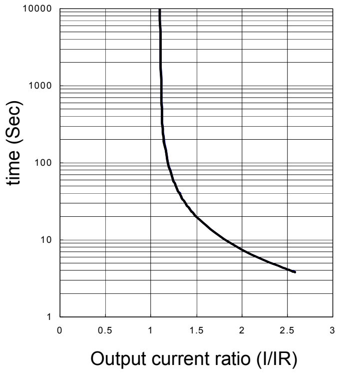
Overload characteristic
R1AA18550H (5.5kW)



Overload characteristic
R1AA18750L (7.5kW)



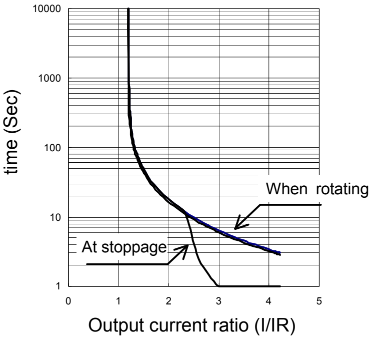
Overload characteristic
R1AA1811KR (11kW)



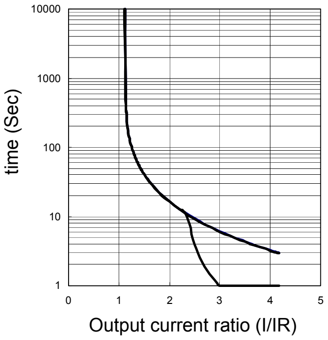
Overload characteristic
R1AA1815KB (15kW)

The following show overload characteristic of R2AA motor.

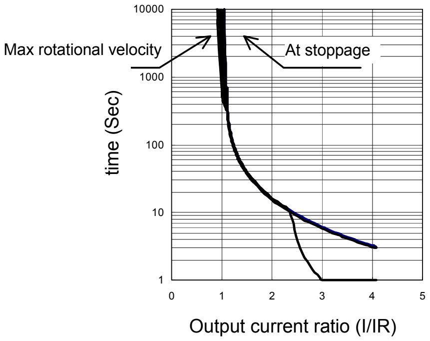
Overload characteristic
R2AA04003F (30W)



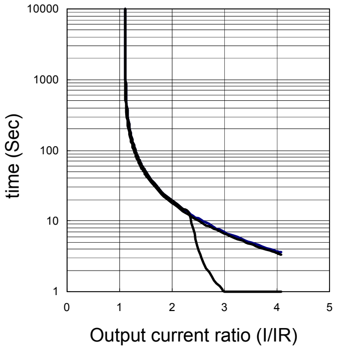
Overload characteristic
R2AA04005F (50W)



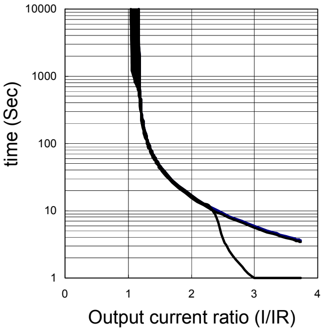
Overload characteristic
R2AA04010F (100W)



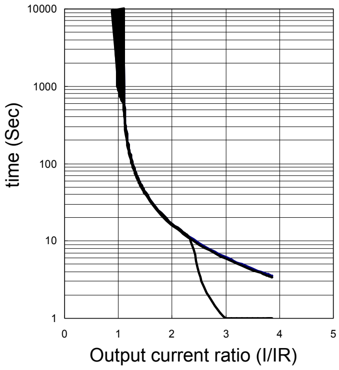
Overload characteristic
R2AA06010F (100W)



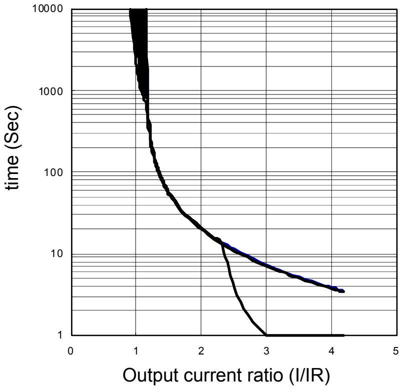
Overload characteristic
R2AA06020F (200W)



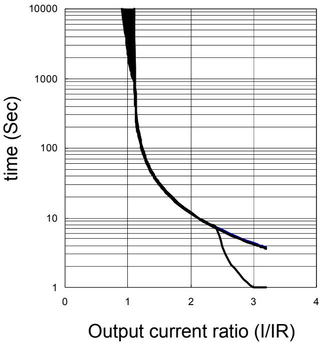
Overload characteristic
R2AA06040F (400W)



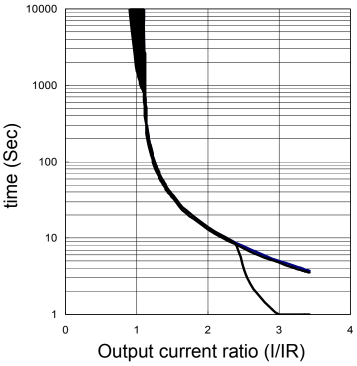
Overload characteristic
R2AA06040H (400W)



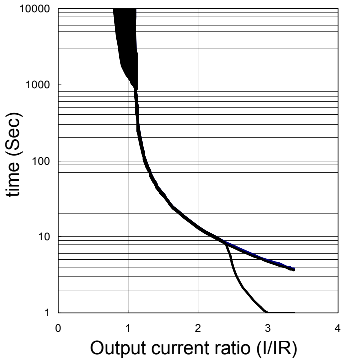
Overload characteristic
R2AA08020F (200W)



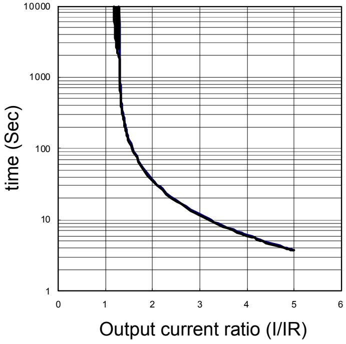
Overload characteristic
R2AA08040F (400W)



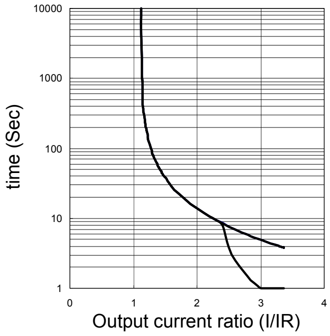
Overload characteristic
R2AA08075F (750W)

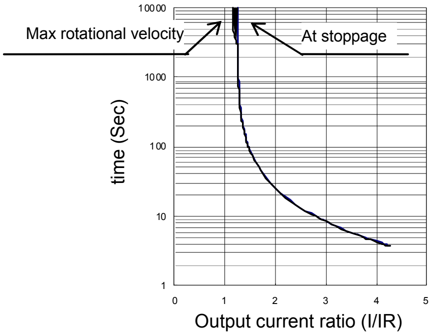


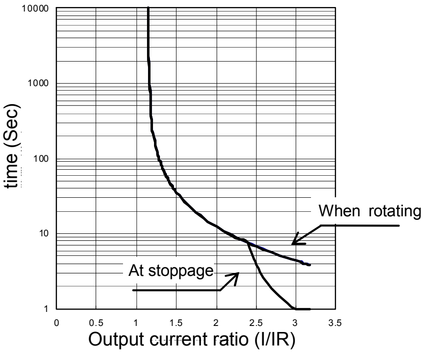
Overload characteristic
R2AAB8075F (750W)

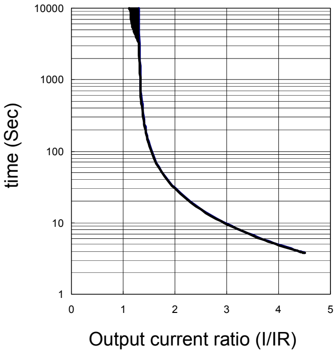


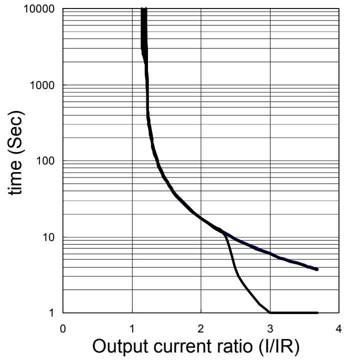
Overload characteristic
R2AAB8100H (1kW)

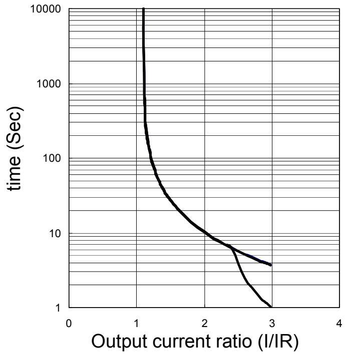


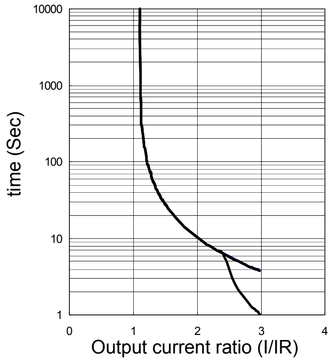

Overload characteristic
R2AAB8100F (1kW)

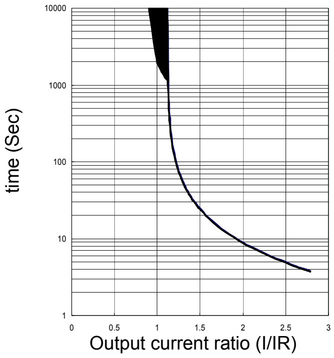

Overload characteristic
R2AA10075F (750W)

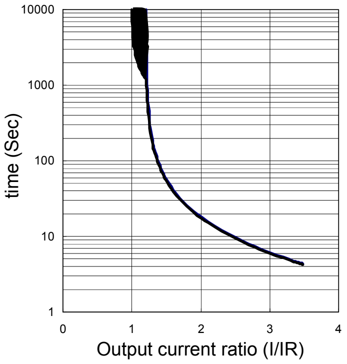

Overload characteristic
R2AA10100F (1kW)

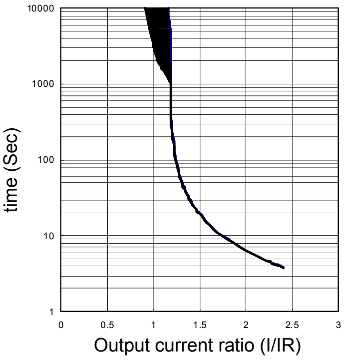

Overload characteristic
R2AA13050H (550W)

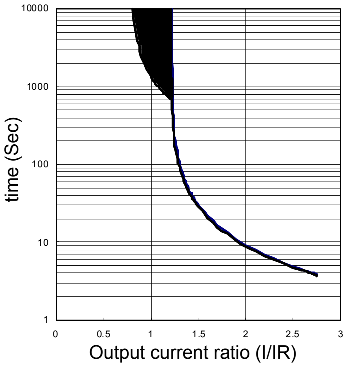

Overload characteristic
R2AA13050D (550W)

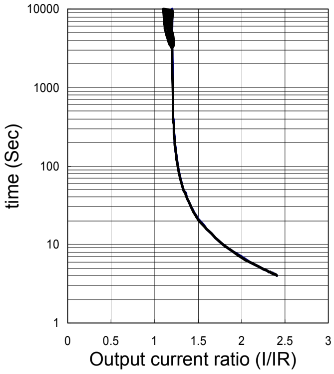

Overload characteristic
R2AA13120B (1.2kW)

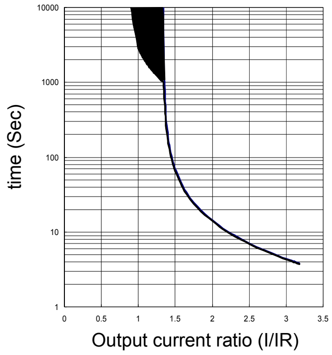

Overload characteristic
R2AA13120D (1.2kW)

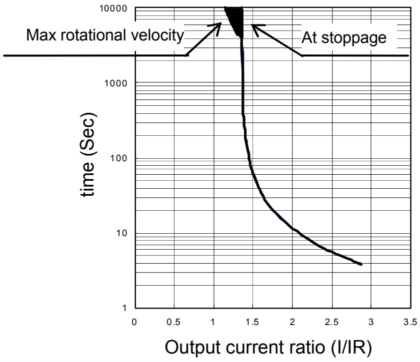

Overload characteristic
R2AA13120L (1.2kW)


Overload characteristic
R2AA13180H (1.8kW)

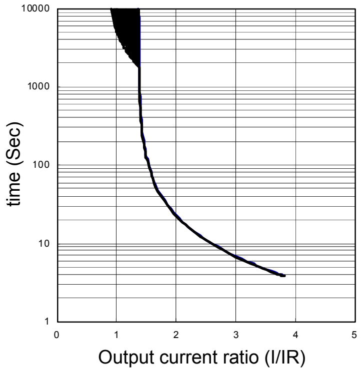

Overload characteristic
R2AA13180D (1.8kW)


Overload characteristic
R2AA13200L (2kW)

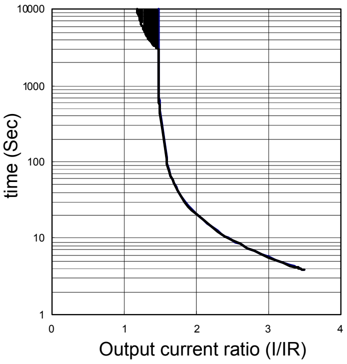

Overload characteristic
R2AA13200D (2kW)



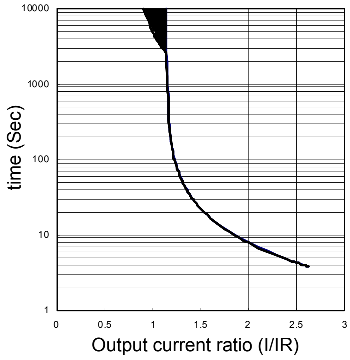
Overload characteristic
R2AA18350L (3.5kW)



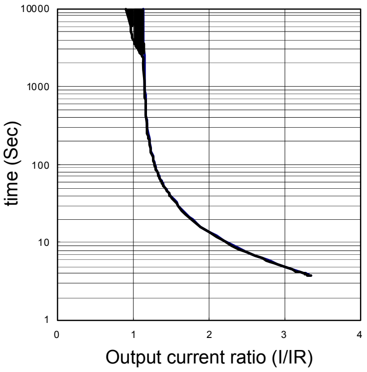
Overload characteristic
R2AA18350D (3.5kW)



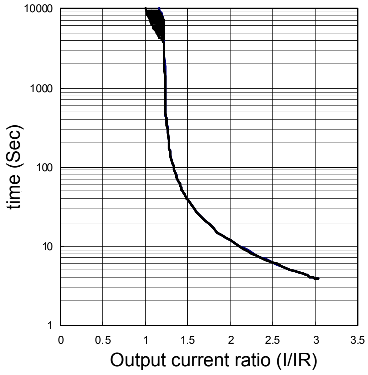
Overload characteristic
R2AA18450H (4.5kW)



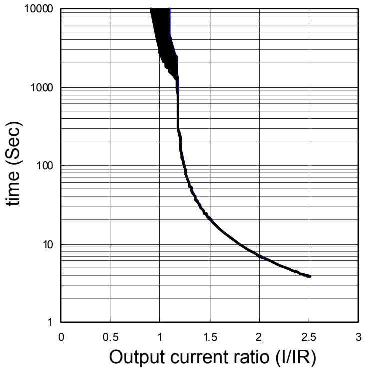
Overload characteristic
R2AA18550R (5.5kW)



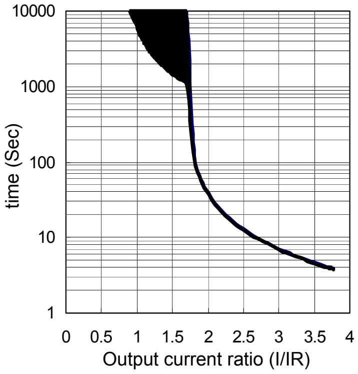
Overload characteristic
R2AA18550H (5.5kW)



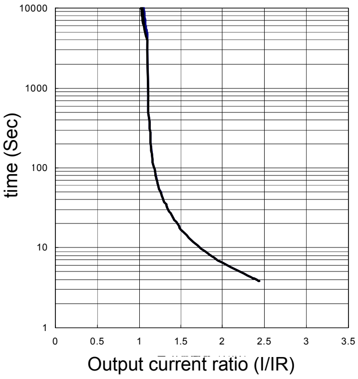
Overload characteristic
R2AA18750H (7.5kW)



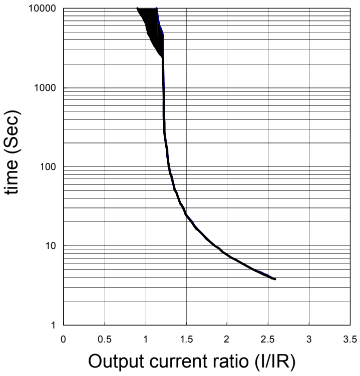
Overload characteristic
R2AA1811KR (11kW)



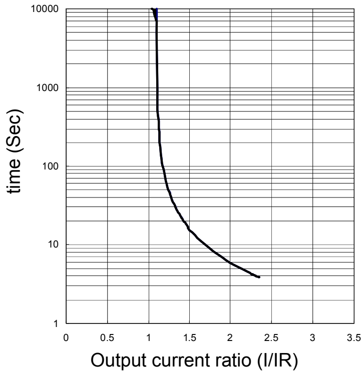
Overload characteristic
R2AA22500L (5kW)



Overload characteristic
R2AA22700S (7kW)



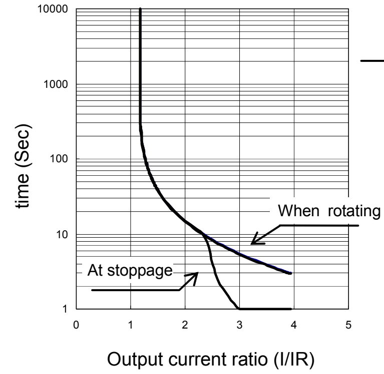
Overload characteristic
R2AA2211KB (11kW)



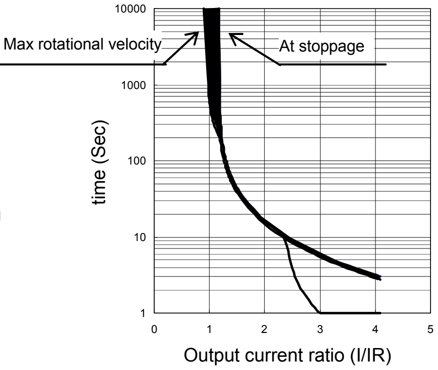
Overload characteristic
R2AA2215KB (15kW)

The following show overload characteristic of R2EA motor.

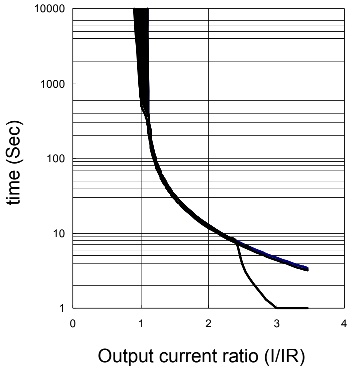
Overload characteristic
R2EA04003F (30W)



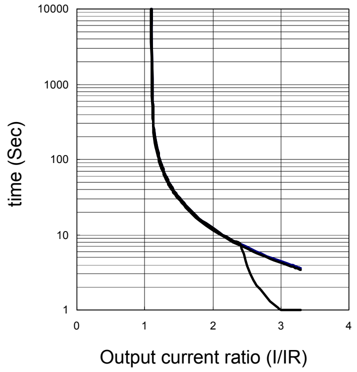
Overload characteristic
R2EA04005F (50W)



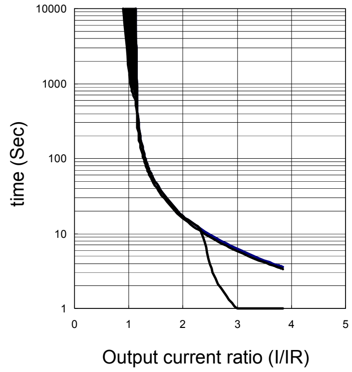
Overload characteristic
R2EA04008F (80W)



Overload characteristic
R2EA06010F (100W)

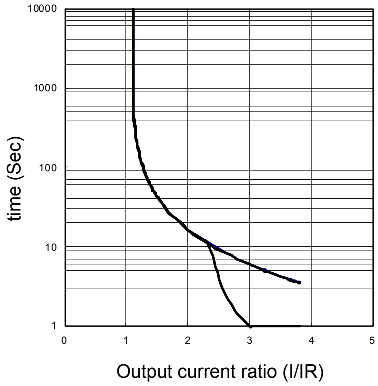


Overload characteristic
R2EA06020F (200W)

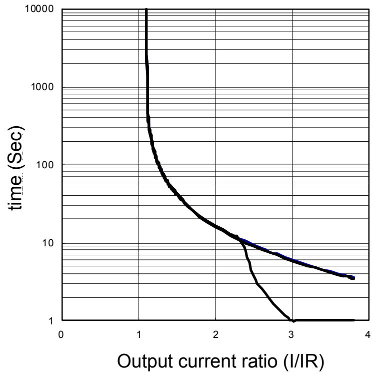


The following show overload characteristic of R5AA motor.

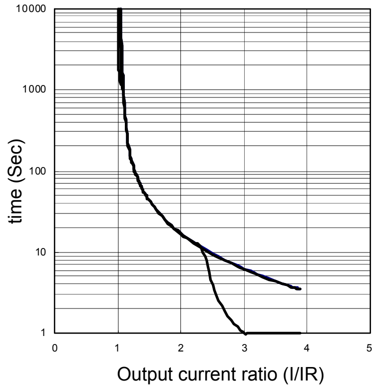
Overload characteristic
R5AA06020H (200W)



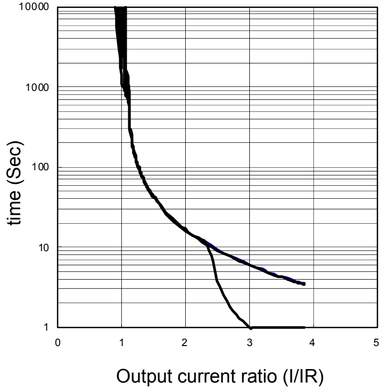
Overload characteristic
R5AA06020F (200W)



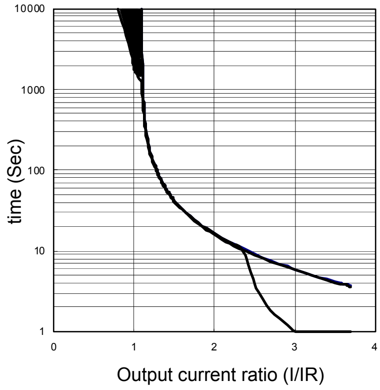
Overload characteristic
R5AA06040H (400W)



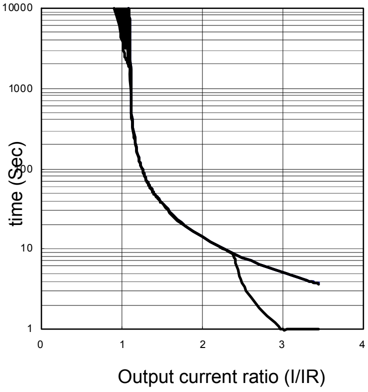
Overload characteristic
R5AA06040F (400W)



Overload characteristic
R5AA08075D (750W)

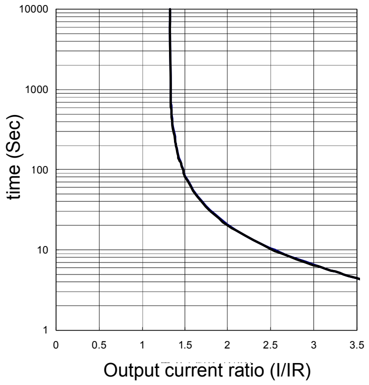


Overload characteristic
R5AA08075F (750W)

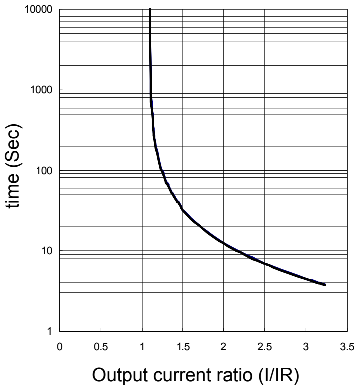


The following show overload characteristic of Q1AA motor.

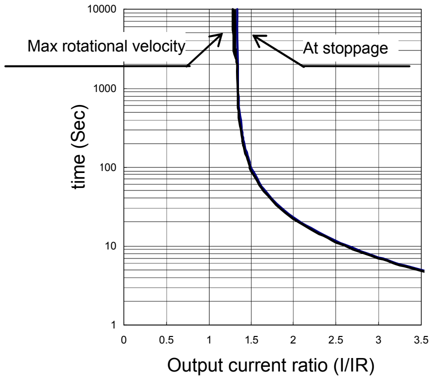
Overload characteristic
Q1AA10100D (1kW)



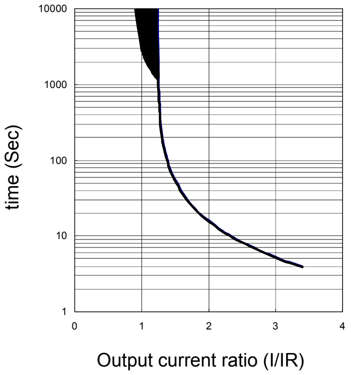
Overload characteristic
Q1AA10150D (1.5kW)



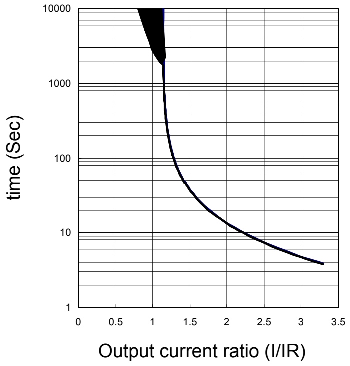
Overload characteristic
Q1AA12100D (1kW)



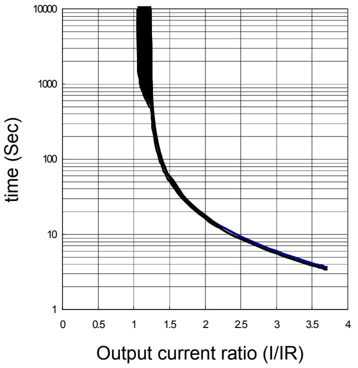
Overload characteristic
Q1AA10200D (2kW)



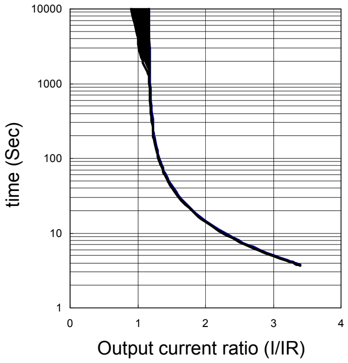
Overload characteristic
Q1AA10250D (2.5kW)



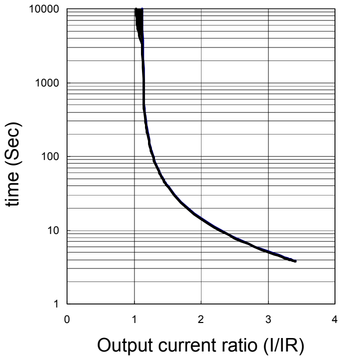
Overload characteristic
Q1AA12200D (2kW)



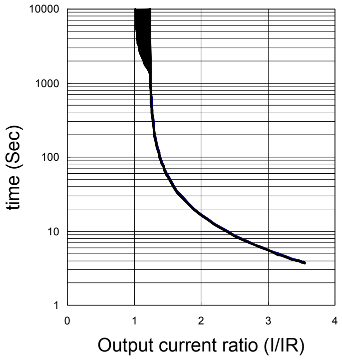
Overload characteristic
Q1AA12300D (3kW)



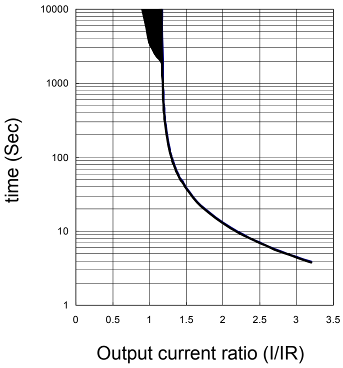
Overload characteristic
Q1AA13300D (3kW)



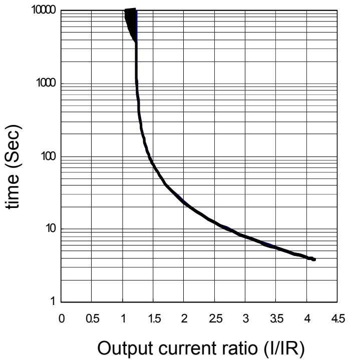
Overload characteristic
Q1AA13400D (4kW)



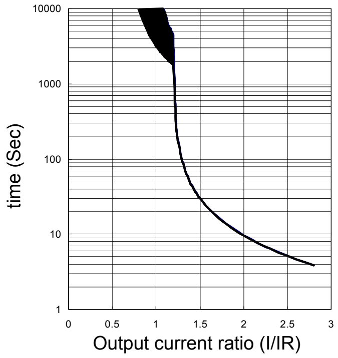
Overload characteristic
Q1AA13500D (5kW)



Overload characteristic
Q1AA18450M (4.5kW)

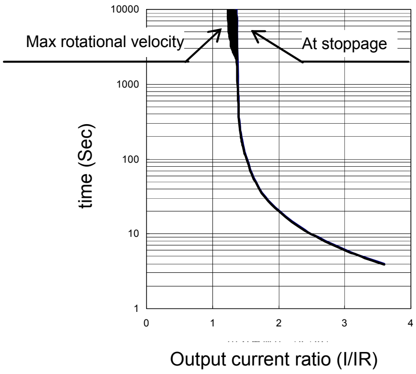


Overload characteristic
Q1AA18750H (7.5kW)

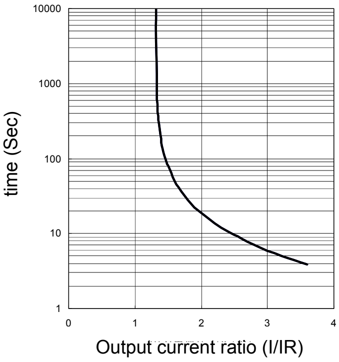


The following show overload characteristic of Q2AA motor.

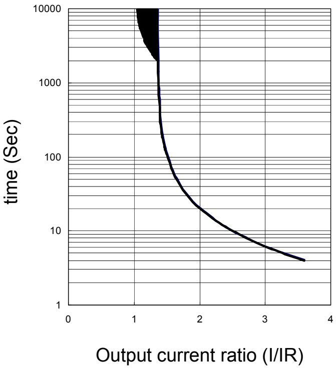
Overload characteristic
Q2AA13200H (2kW)



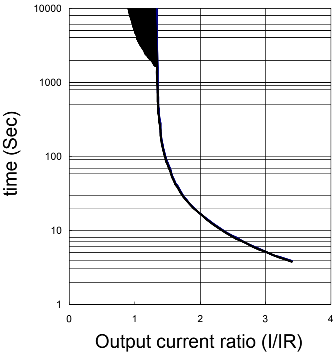
Overload characteristic
Q2AA18200H (2kW)



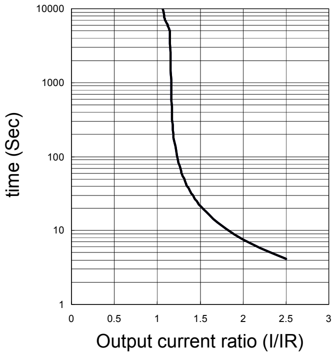
Overload characteristic
Q2AA18350H (3.5kW)



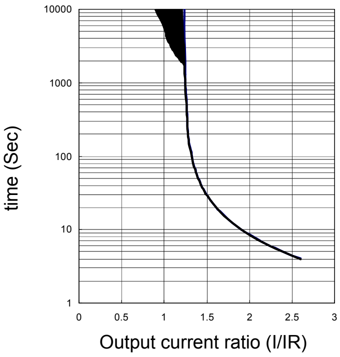
Overload characteristic
Q2AA18450H (4.5kW)



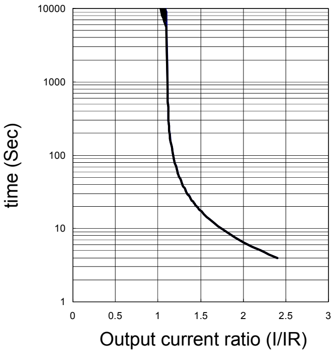
Overload characteristic
Q2AA18550R (5.5kW)



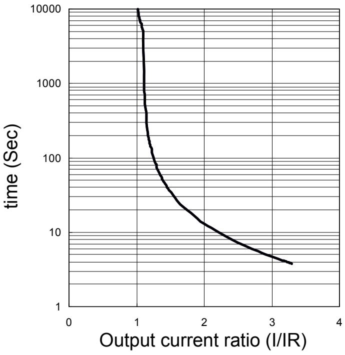
Overload characteristic
Q2AA22550B (5.5kW)



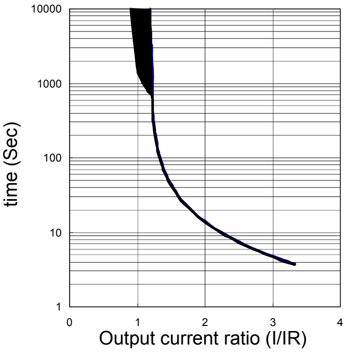
Overload characteristic
Q2AA22700S (7kW)



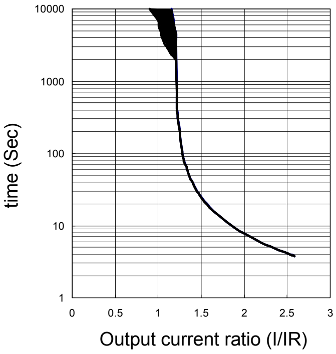
Overload characteristic
Q2AA18550H (5.5kW)



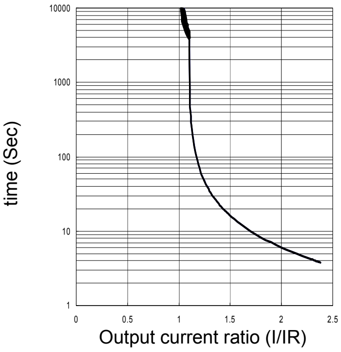
Overload characteristic
Q2AA18750L (7.5kW)



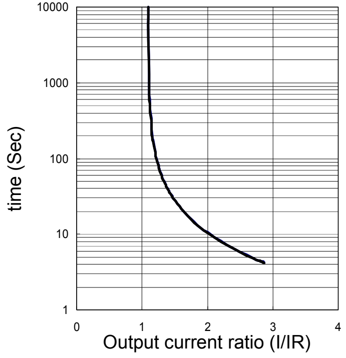
Overload characteristic
Q2AA2211KV (11kW)

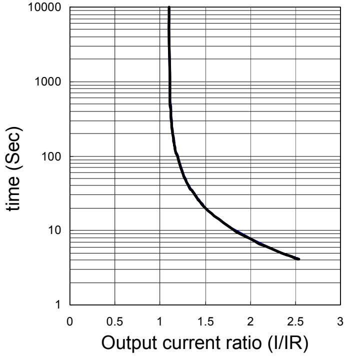


Overload characteristic
Q2AA2215KV (15kW)



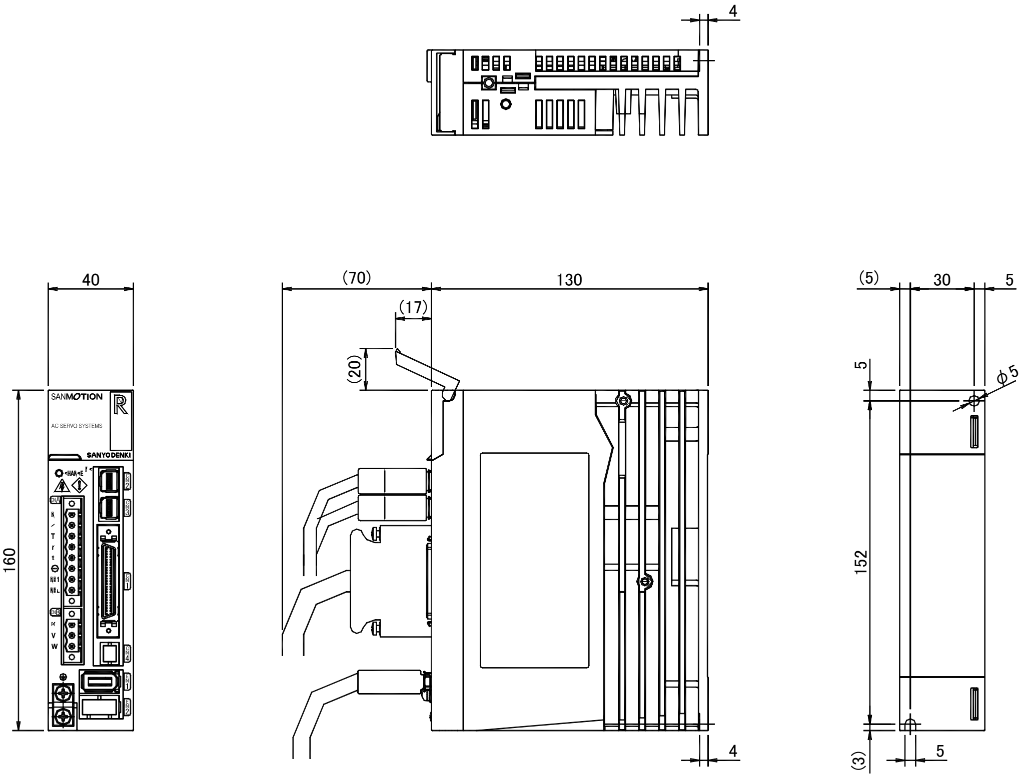
The following show overload characteristic of Q4AA motor.


Overload characteristic
Q4AA1811KB (11kW)

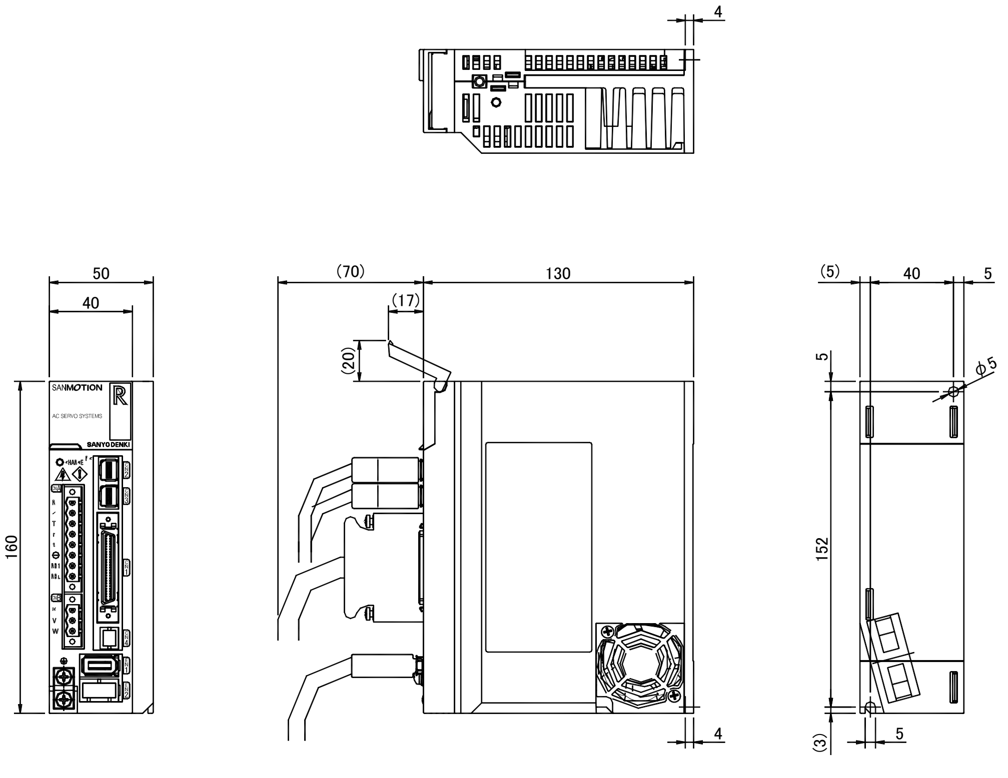

Overload characteristic
Q4AA1815KB (15kW)

12.5 Servo amplifier dimensions

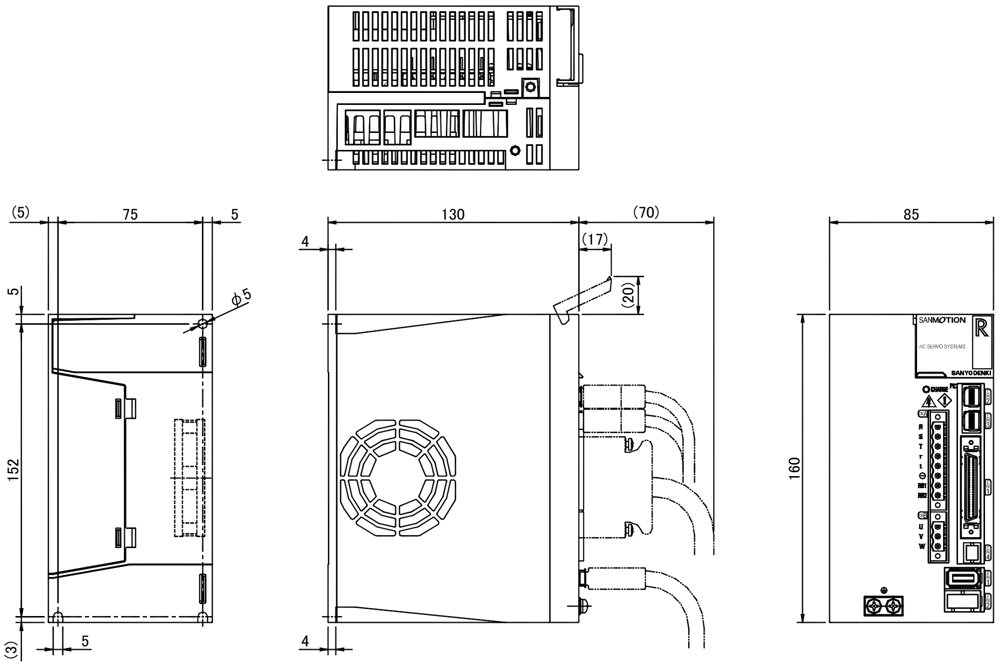
1) RS2□01A□□L□



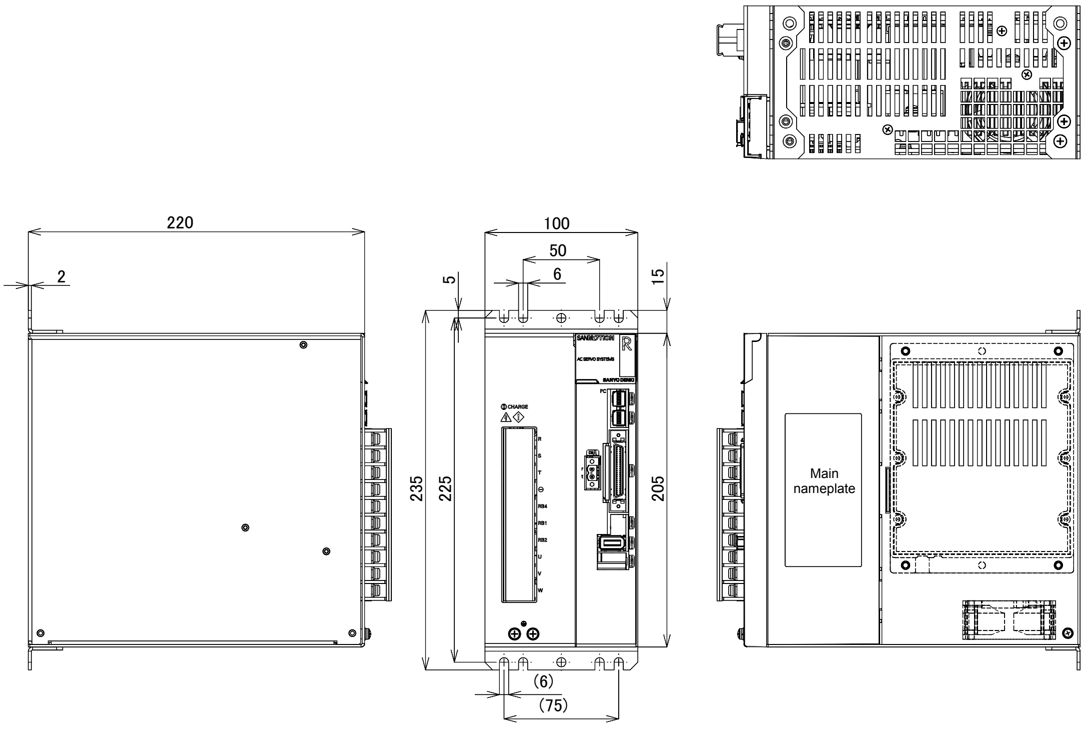
2) RS2□03A□□L□



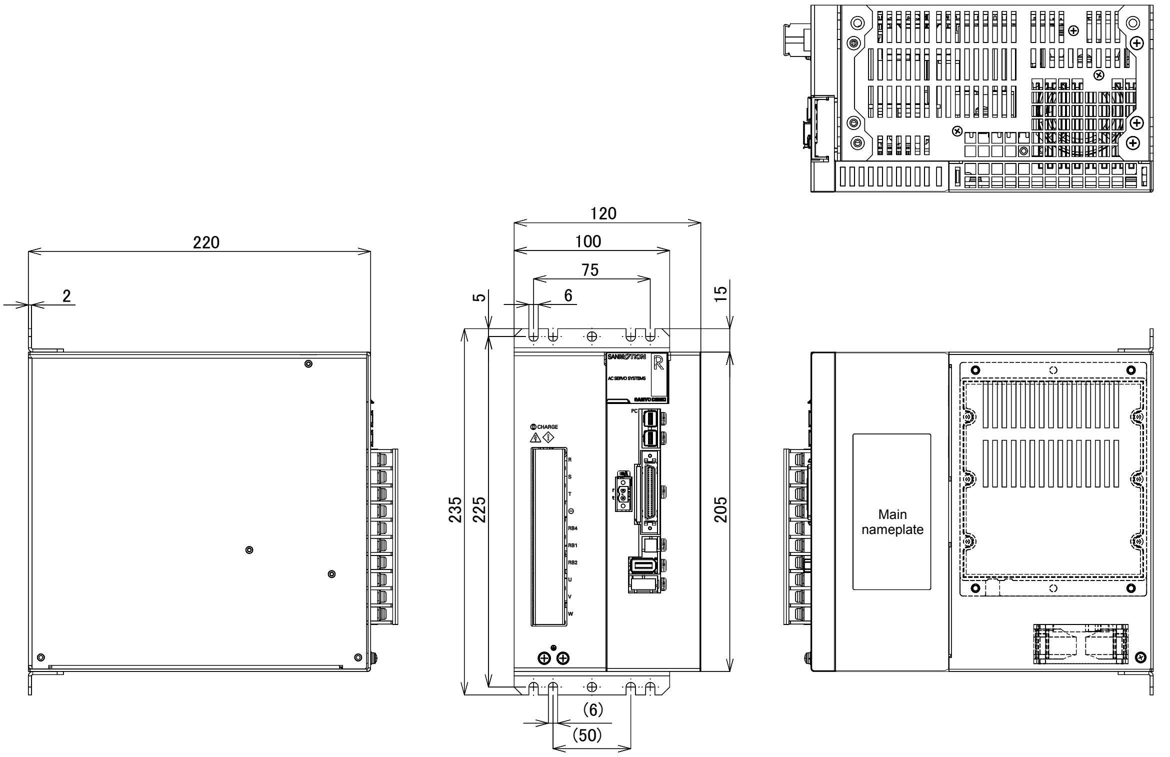
3) RS2☐05A☐☐L☐



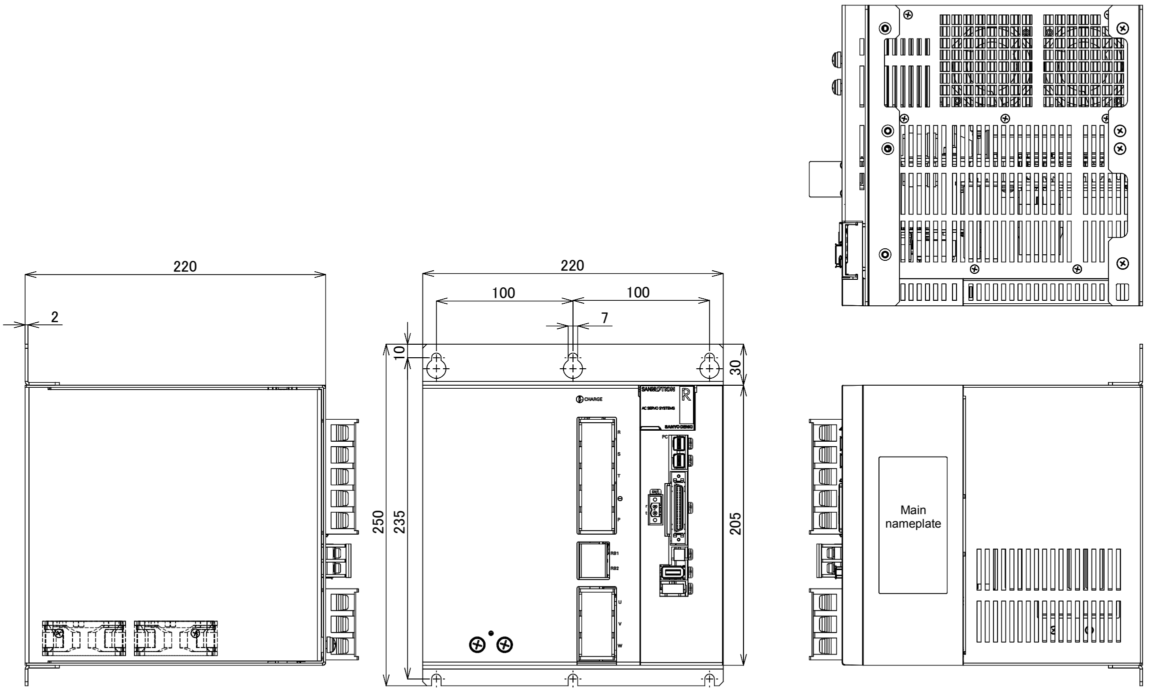
4) RS2☐10A☐☐A☐



5) RS2☐15A☐☐A☐



6) RS2☐30A☐☐L☐



12.6 Optional parts

SANYO DENKI offers the following optional parts.

1) Connectors of servo amplifier

■ Model numbers of single connectors for RS2*01, RS2*03, and RS2A05

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	Sumitomo 3M Ltd.
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-5.08LUB	Phoenix Contact Co. Ltd.
CNB	For servo motor connection	AL-Y0004079-01	MSTBT2.5/3-STF-5.08	
CN4 Note 1)	For safety device connection (For short circuit)	AL-00718251-01	2040978-1	Tyco Electronics AMP K.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 RS2*01, RS2*03, and RS2A05. (No safe-torque-off function)

Connector No.	Item	Our model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CNA, CNB	Standard	AL-00723282	RS2###A0#L0/RS2###A8#L0	No regenerative resistance
CN1, EN1, CNB	Standard	AL-00723284	RS2###A0#A0/RS2###A8#A0	With regenerative resistance
CN1, EN1, EN2, CNA, CNB	For fully-closed control system	AL-00723286	RS2###A2#L0/RS2###AA#L0	No regenerative resistance
CN1, EN1, EN2, CNB		AL-00723288	RS2###A2#A0/RS2###AA#A0	With regenerative resistance
CN1, EN1	Low voltage set	AL-00723290	RS2###A0##0/RS2###A8##0	-
CNA, CNB	High voltage set	AL-00696037	RS2###A##L0	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.

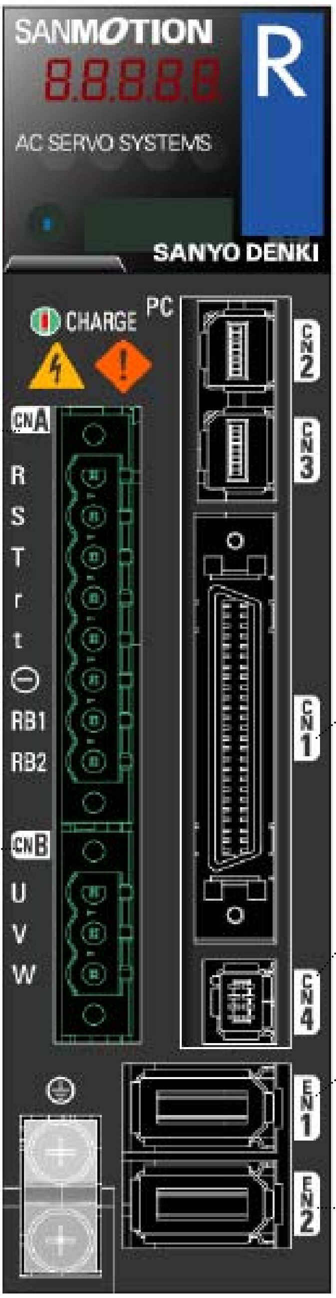
■ Model numbers of connector-kits for RS2*01, RS2*03, and RS2A05

(With Safe-torque-off function)

Connector No.	Contents	SANYO DENKI model No.	Applicable servo amplifier model number	Remarks
CN1, EN1, CNA, CNB, CN4	Standard	AL-00723155	RS2###A0#L2(4) /RS2###A8#L2(4)	No regenerative resistance
CN1, EN1, CNB, CN4	Standard	AL-00723156	RS2###A0#A2(4) /RS2###A8#A2(4)	With regenerative resistance
CN1, EN1, EN2, CNA, CNB, CN4	For fully-closed control system	AL-00723157	RS2###A2#L2(4) /RS2###AA#L2(4)	No regenerative resistance
CN1, EN1, EN2, CNB, CN4		AL-00723158	RS2###A2#A2(4) /RS2###AA#A2(4)	With regenerative resistance
CN1, EN1, CN4	Low voltage set	AL-00723159	RS2###A0##2(4) /RS2###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.

RS2*01, RS2*03, and RS2A05



For input power supply, and regenerative resistance connection CNA

(For servo motor connection) CNB

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 external pulse encoder connection)
Used only for fully-closed control system

■ Model numbers of single connectors for RS2A10, RS2A15, and RS2A30

Connector number	Intended use	Model number	Manufacturer model number	Manufacturer
CN1	To connect host equipment	AL-00385594	10150-3000PE and 10350-52A0-008	Sumitomo 3M 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.K.K
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	

When wiring for CN4 is not needed, make sure to insert safety device connector (for short-circuiting) to CN4 on servo amplifier.

■ Model numbers for connector-kits for RS2A10, RS2A15, and RS2A30 (No safe-torque-off function)

Connector number	Intended use	Model number	Applicable servo amplifier model number
CN1, EN1, and CNA	Standard	AL-00751448	RS2###A0##0/RS2###A8##0
CN1, EN1, EN2, and CNA	For fully closed control system	AL-00751450	RS2###A2##0/RS2###AA##0
CN1 and EN1	Kit for low-voltage	AL-00723290	RS2###A0##0/RS2###A8##0

- ✔ Mark ”#” shows arbitrary numerical values or alphabets.

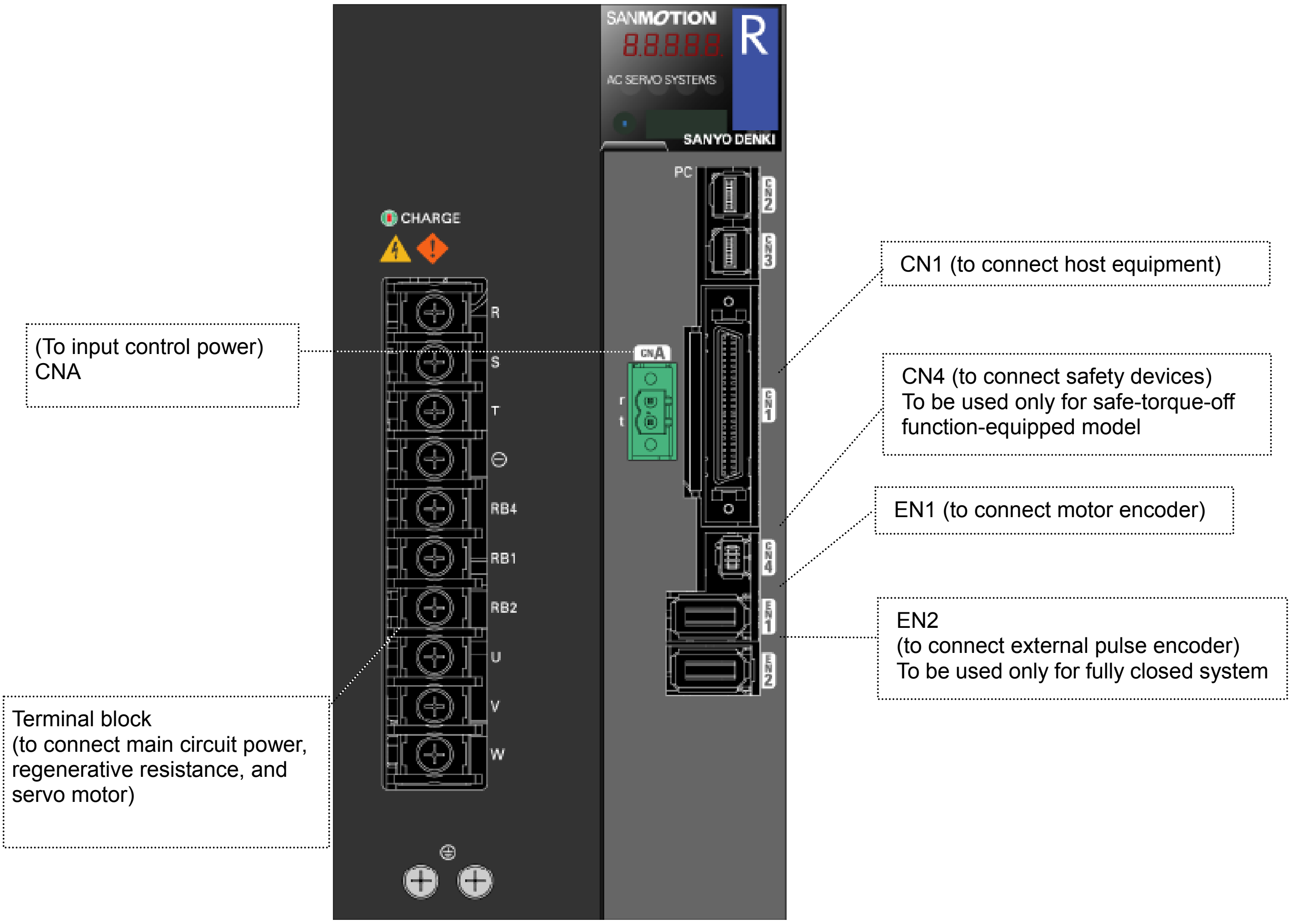
■ Model numbers for connector-kits for RS2A10, RS2A15, and RS2A30 (With safe-torque-off function)

Connector number	Intended use	Model number	Applicable servo amplifier model number
CN1, EN1, CNA, and CN4	Standard	AL-00751452	RS2###A0##2(4)/ RS2###A8##2(4)
CN1, EN1, EN2, CNA, and CN4	For fully closed control system	AL-00751454	RS2###A2##2(4)/ RS2###AA##2(4)
CN1, EN1, and CN4	Kit for low-voltage	AL-00723159	RS2###A0##2(4)/ RS2###A8##2(4)

- ✔ Mark “#” shows arbitrary numerical values or alphabets.
- ✔ Connector-set CN4 is model number: AL-00718252-01, to connect safety device (for wiring).

RS2A10, RS2A15, and RS2A30

Front view of RS2A10



2) Fixing bracket

Fixing brackets are supplied with servo amplifier, RS2☐01, RS2☐03, RS2☐05, and RS2☐30.

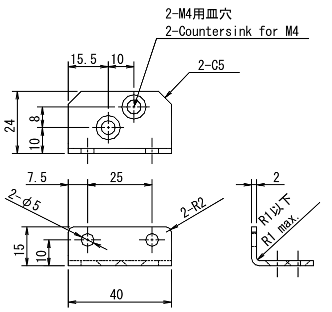
- ■ List of fixing brackets for RS2☐01 - 05, 30.

Servo amplifier model number	Bracket fixing position	Model number	Contents
RS2☐01 and 03	Front	AL-00736863-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS2☐05	Front	AL-00736864-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 4 ea
RS2☐30	Front	AL-00828413-01	Fixing bracket (upper/bottom): 1 ea, respectively Tightening screw: 8 ea

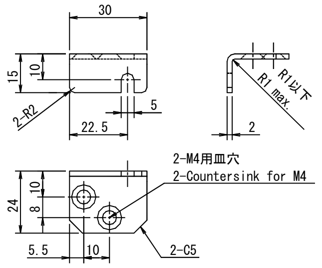
These optional fixing brackets are processed trivalent chromium plating.
(Surface color: blue-silver/ different from body color.)
RS2☐10/15 can be mounted on the front surface of the amplifier after removing rear mounting fixture.

AL-00736863-01

Upper

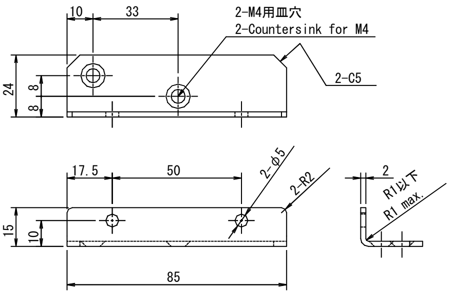


Bottom



AL-00736864-01

Upper



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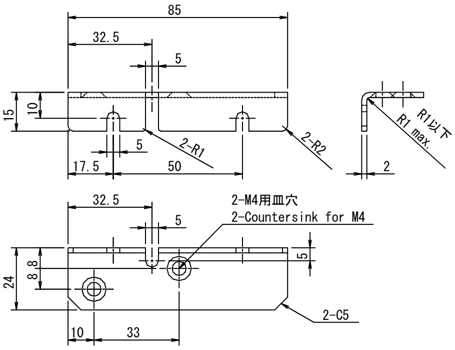
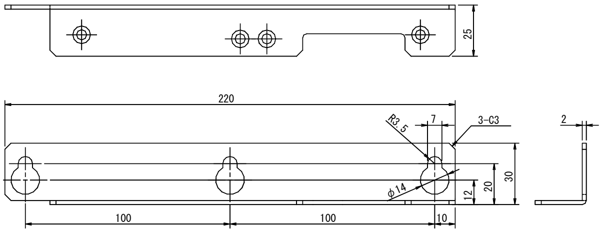
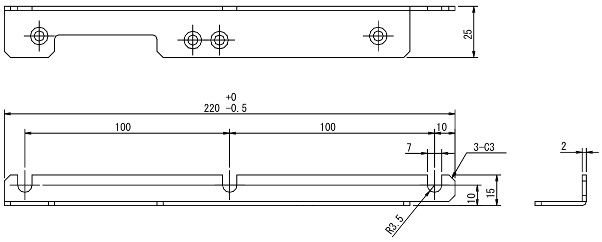


AL-00828413-01

Upper



Bottom



3) Setup software, serial communication related items

Name	Details	SANYO DENKI model No.
Cable for personal computer communications	Between personal computer and servo amplifier (CN2)	AL-00689703-01
Cable for communication between amplifier (0.2m)	Between servo amplifier (CN2) and servo amplifier (CN3)	AL-00695974-01
Cable for communication between amplifier (3.0m)		AL-00695974-02
Communication converter	Between RS-232C and RS-422A	SAU-024-01
Connector with terminator	RS-422A terminator for communication	AL-00695977-01

4) Battery for battery backup absolute encoder related items

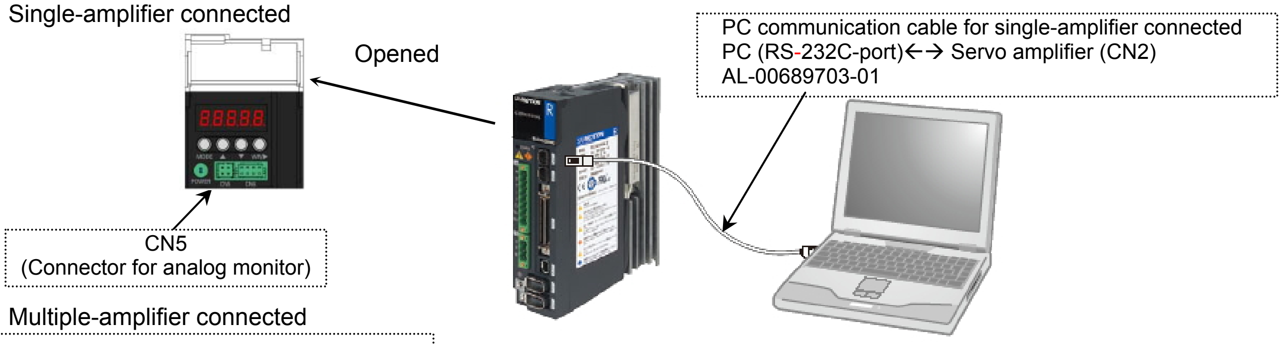
Name	Details	SANYO DENKI model No.
Battery body (Lithium battery)	Lithium battery: ER3VLY TOSHIBA LIFESTYLE PRODUCTS & SERVICES CORPORATION	AL-00697958-01
Battery trunk cable	-	AL-00697960-01 to 06
Battery trunk cable	-	AL-00731792-01

5) Analog monitor related item

Name	Details	SANYO DENKI model No.
Monitor Box	Monitor box body 2 dedicated cables	Q-MON-3
Dedicated cable	2 dedicated cables	AL-00690525-01

Wiring for communication cable

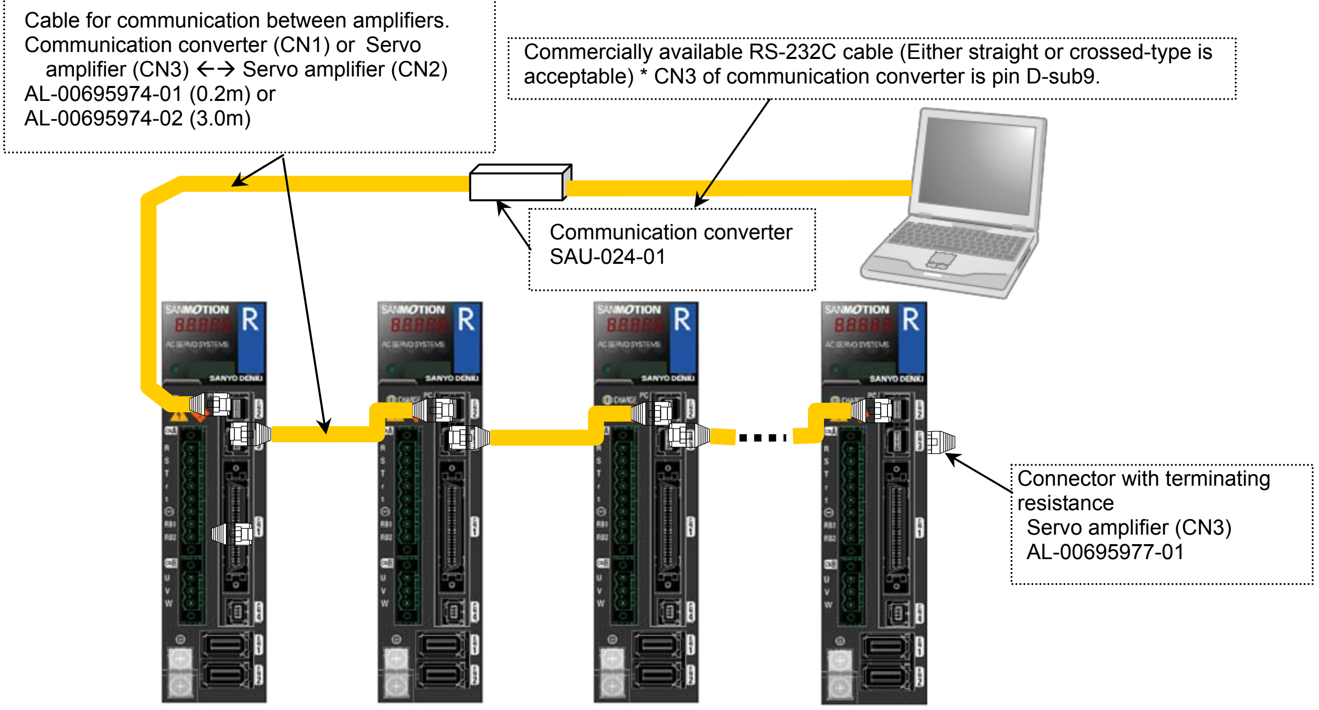
1. Single-amplifier connected



PC communication cable for single-amplifier connected
PC (RS-232C-port)←→ Servo amplifier (CN2)
AL-00689703-01

CN5
(Connector for analog monitor)

2. Multiple-amplifier connected



Cable for communication between amplifiers.
Communication converter (CN1) or Servo amplifier (CN3) ←→ Servo amplifier (CN2)
AL-00695974-01 (0.2m) or
AL-00695974-02 (3.0m)

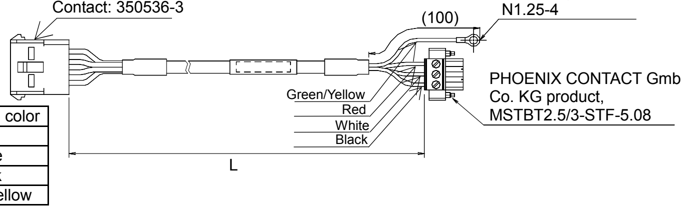
Commercially available RS-232C cable (Either straight or crossed-type is acceptable) * CN3 of communication converter is pin D-sub9.

Communication converter
SAU-024-01

Connector with terminating resistance
Servo amplifier (CN3)
AL-00695977-01

6) Junction cable for servo motor

Power cable



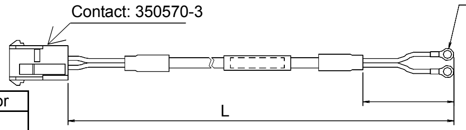
AMP INC. product,
Connector: 1-480703-0
Contact: 350536-3

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

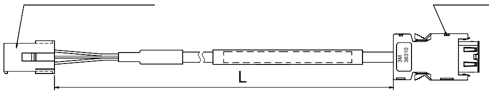


AMP INC. product,
Connector: 1-480699-0
Contact: 350570-3

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

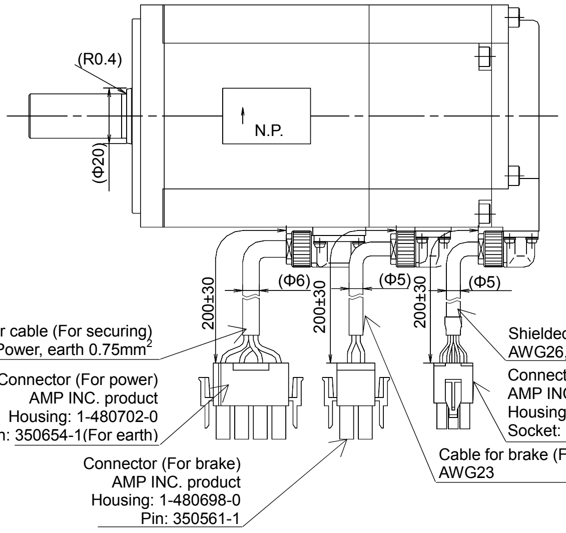
NO.	Lead wire color	Signal name
1	Black	0V
2	Red	+5V
3	Blown	ES+
4	Blue	ES-
5	Green	EBAT+
6	Purple	EBAT-
9	White/Black(Shielded)	Earth

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	



Cable for Power cable (For securing)
Power, earth 0.75mm^2

Connector (For power)
AMP INC. product
Housing: 1-480702-0
Pin: 350654-1(For earth)

Connector (For brake)
AMP INC. product
Housing: 1-480698-0
Pin: 350561-1

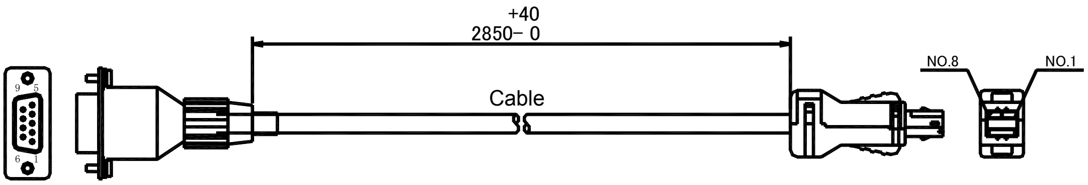
Shielded cable for encoder (For securing)
AWG26, 3-pair

Connector (For encoder)
AMP INC. product
Housing: 172169-1
Socket: 1-770834-1

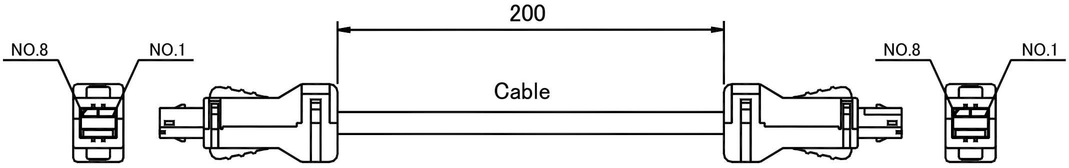
Cable for brake (For securing)
AWG23

12.7 Optional parts dimensions for setup software

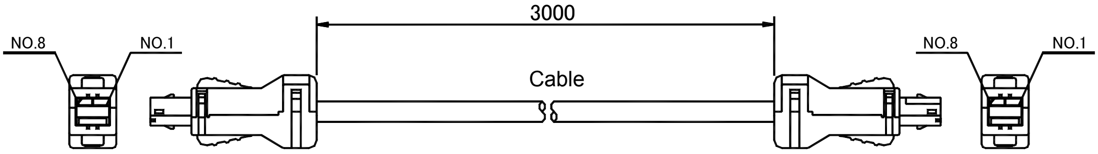
1) Cable for personal computer communications (Model No.: AL-00689703-01)



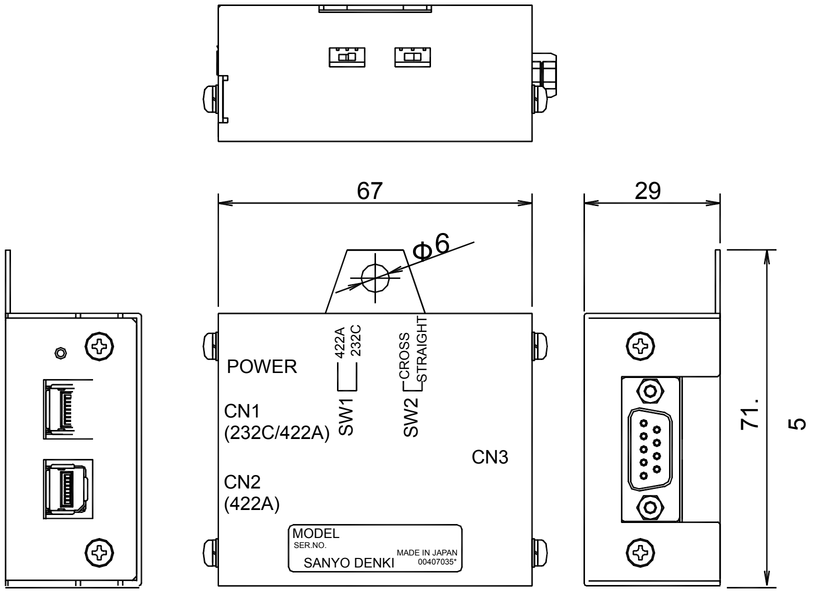
2) Cable for communication between amplifier (0.2m) (Model No.: AL-00695974-01)



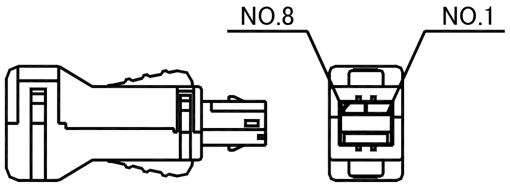
3) Cable for communication between amplifier (3.0m) (Model No.: AL-00695974-02)



4) Communication converter (Model No.: SAU-024-01)

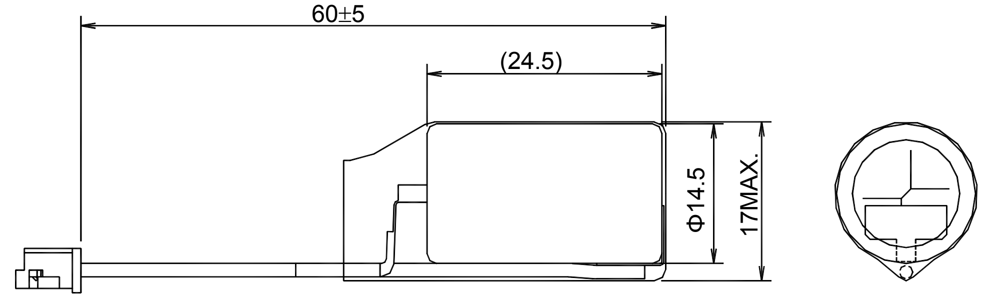


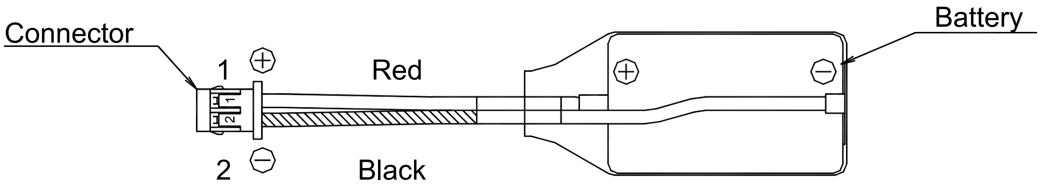
5) Connector with terminator (Model No.: AL-00695977-01)



12.8 Battery peripherals dimensions

1) Battery body (Model No.: AL-00697958-01)

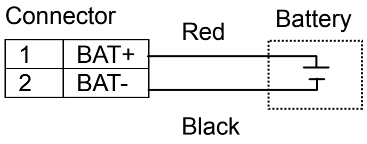




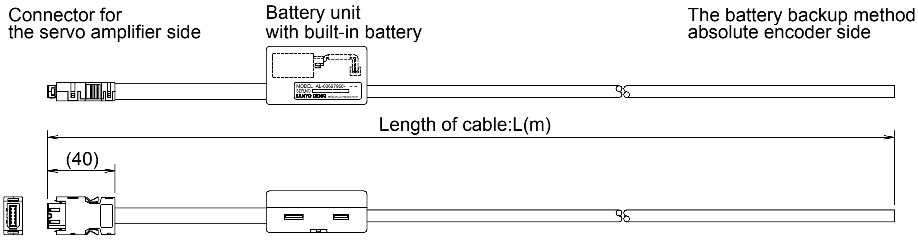
1. Battery and connector specifications

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

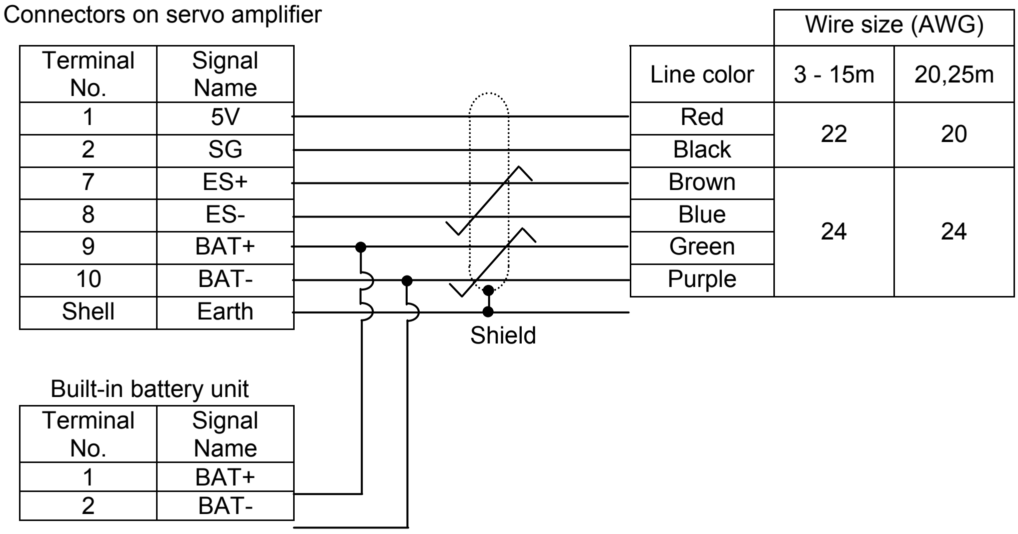


2) Battery trunk cable (Model No.: AL-00697960-☐☐)



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. Specification: Relay 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. Specification for wiring:



Connectors on servo amplifier

Terminal No.	Signal Name
1	5V
2	SG
7	ES+
8	ES-
9	BAT+
10	BAT-
Shell	Earth

Line color	Wire size (AWG)	
	3 - 15m	20,25m
Red	22	20
Black		
Brown	24	24
Blue		
Green		
Purple		

Built-in battery unit

Terminal No.	Signal Name
1	BAT+
2	BAT-

3. Specification for the connector and the battery unit

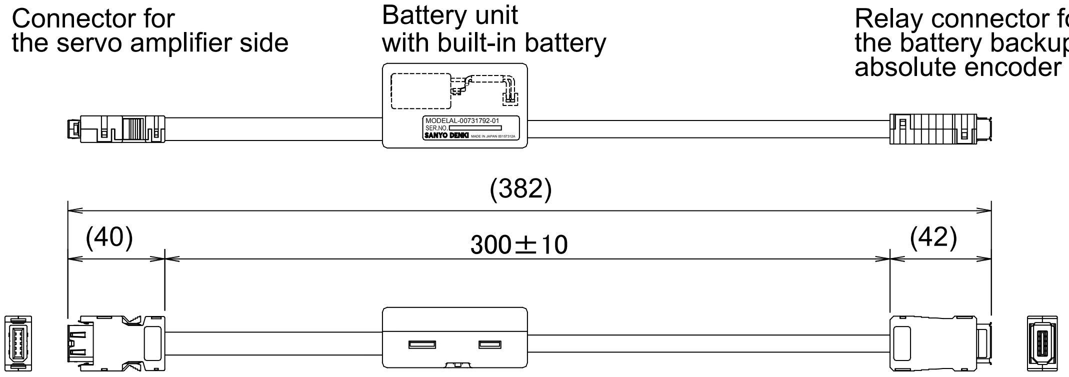
Connector for servo amplifier	36210-0100PL; Wiremount Receptacle (3M) 36310-3200-008; Shell Kit (3M)
Battery unit	Built-in battery; ER3VLY (TOSHIBA LIFESTYLE PRODUCTS & SERVICES CORPORATION) Nominal Voltage: 3.6V Nominal Capacity: 1000mAh Lithium-metal mass: 0.31g

4. Outline specification for cable

<table>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="2">UL STYLE NO. 20276 (Ratings: 80°C, 30V)</td></tr>
<tr><td>AL-00697960-01 - 04; 3 - 15m</td><td>AL-00697960-05, 06; 20,25m</td></tr>
<tr><td>22 AWG x 2C + 24 AWG x 2P
Sheath thickness: 1.0mm
Cable outer diameter: Φ7.1±0.5mm</td><td>20 AWG x 2C + 24 AWG x 2P
Sheath thickness 1.0mm
Cable outer diameter: Φ7.1±0.5mm</td></tr>
<tr><td colspan="2">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</td></tr>
</table>

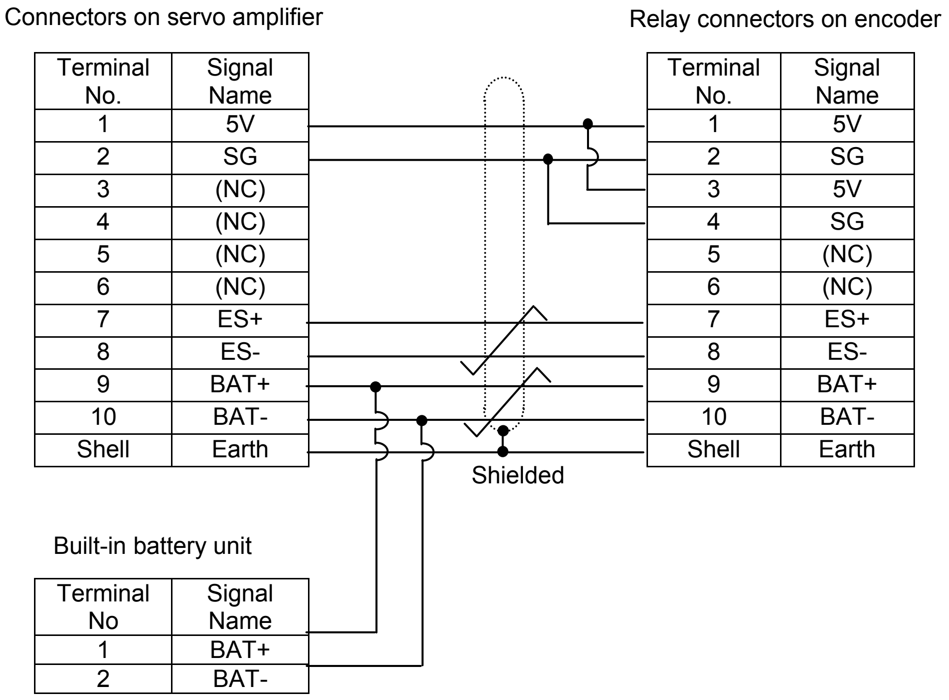
5. Battery model number for replacement: AL-00697958-01

3) 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. Specification for wiring:



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-

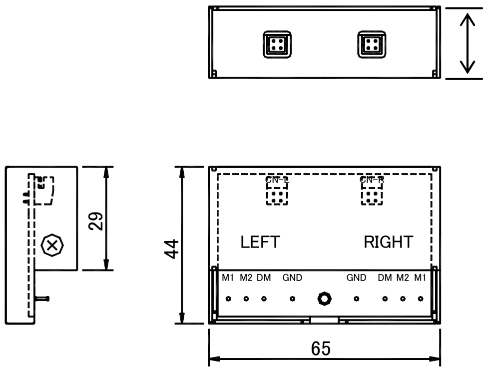
3. Specification for the connector and the battery unit

Connectors for servo amplifier	36210-0100PL; Wiremount Receptacle (3M) 36310-3200-008; Shell Kit (3M)
Relay 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

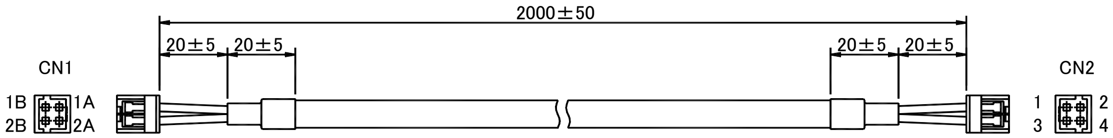
4. Battery model number for replacement: AL-00697958-01

12.9 Monitor box and dedicated cable dimensions

1) Monitor Box (Model No.: Q-MON-3)



2) Dedicated Cable (Model No.: AL-00690525-01)



Note 1) Units of dedicated cables per above 2 (PN# AL-00690525-01) are supplied with Monitor Box (PN# Q-MON-3).

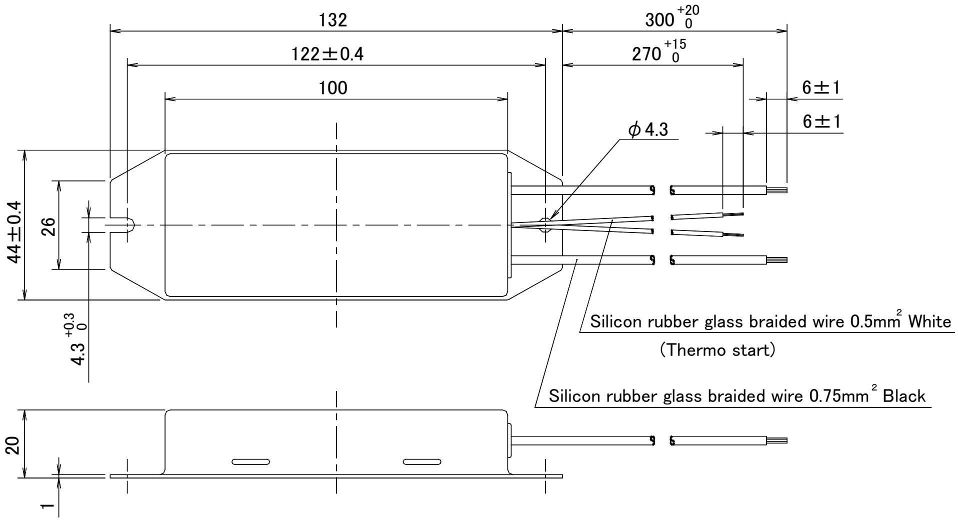
Terminal NO. on CN1	Signal name	Terminal NO. on CN2
1A	Analog monitor 1	3
1B	Analog monitor 2	4
2A	GND	1
2B	Digital monitor	2

CN1	Manufacturer model NO.	Manufacturer
Connector	LY10-DC4BR	Japan Aviation Electronics Industry, Limited
Contact	LY10-C1-A1-1000	Japan Aviation Electronics Industry, Limited

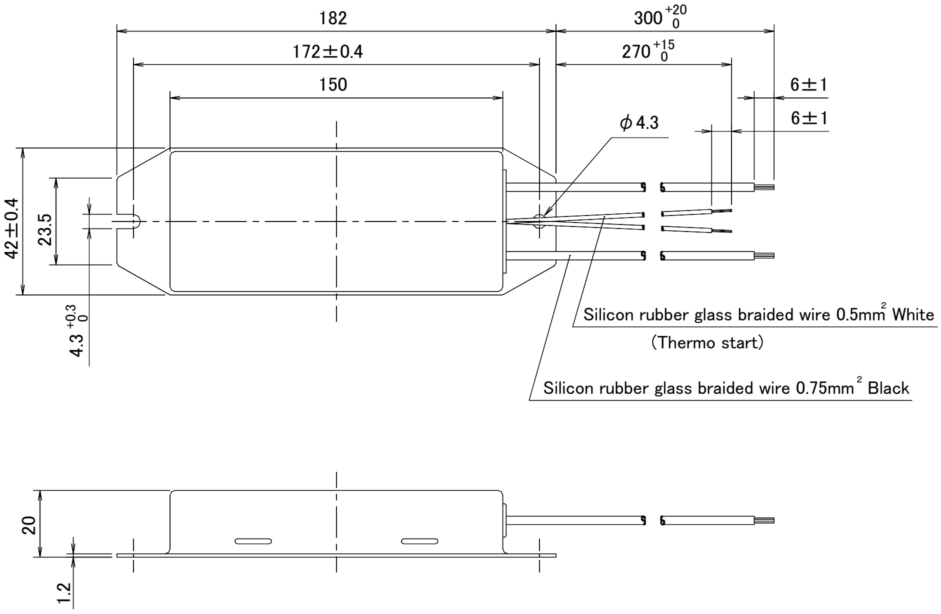
CN2	Manufacturer model NO.	Manufacturer
Connector	DF11-4DS-2C	HIROSE ELECTRIC CO., LTD.
Contact	DF11-2428SCA	HIROSE ELECTRIC CO., LTD.

12.10 External dimension of regenerative resistor

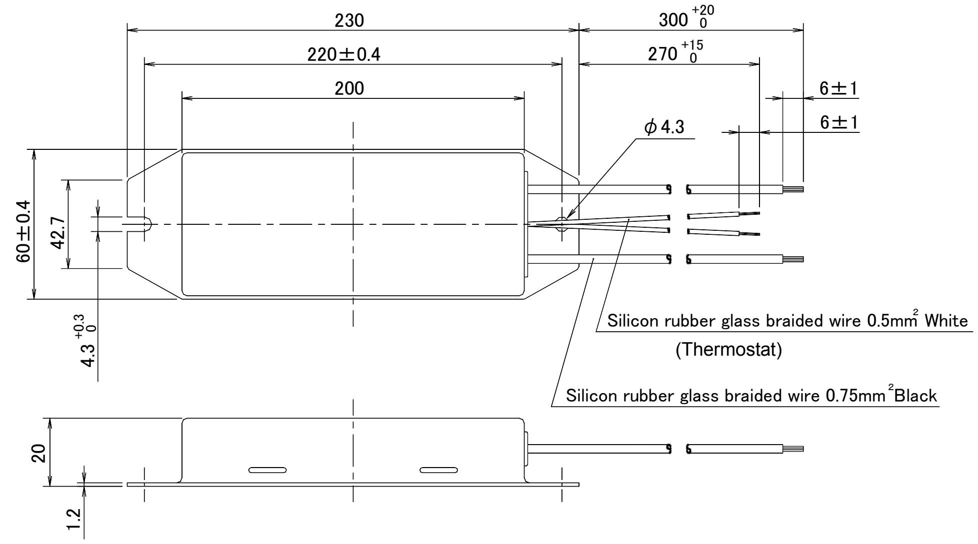
■ REGIST-080W



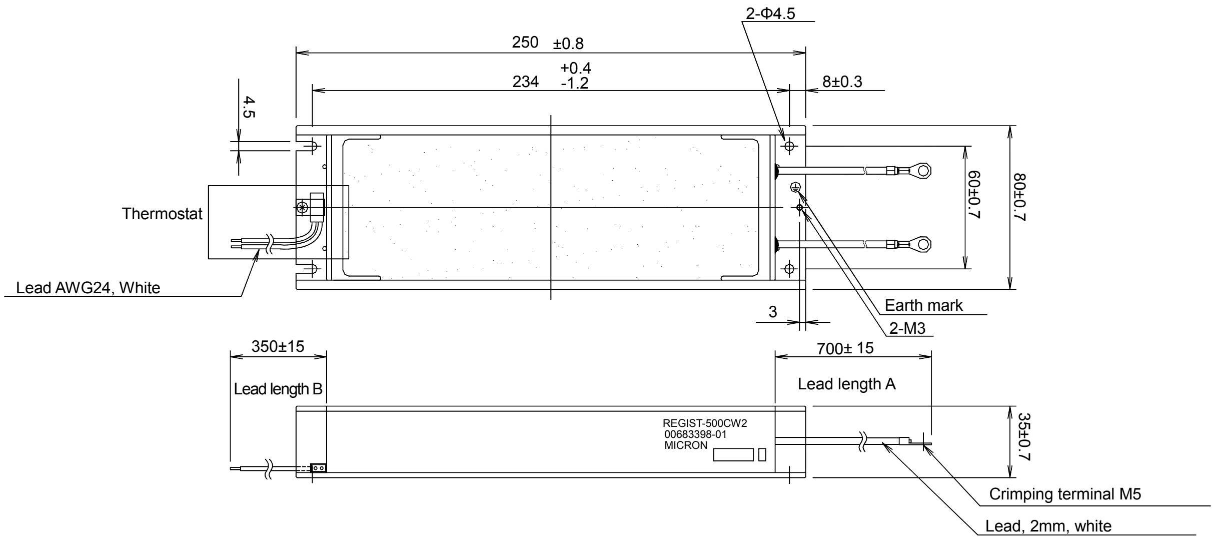
■ REGIST-120W



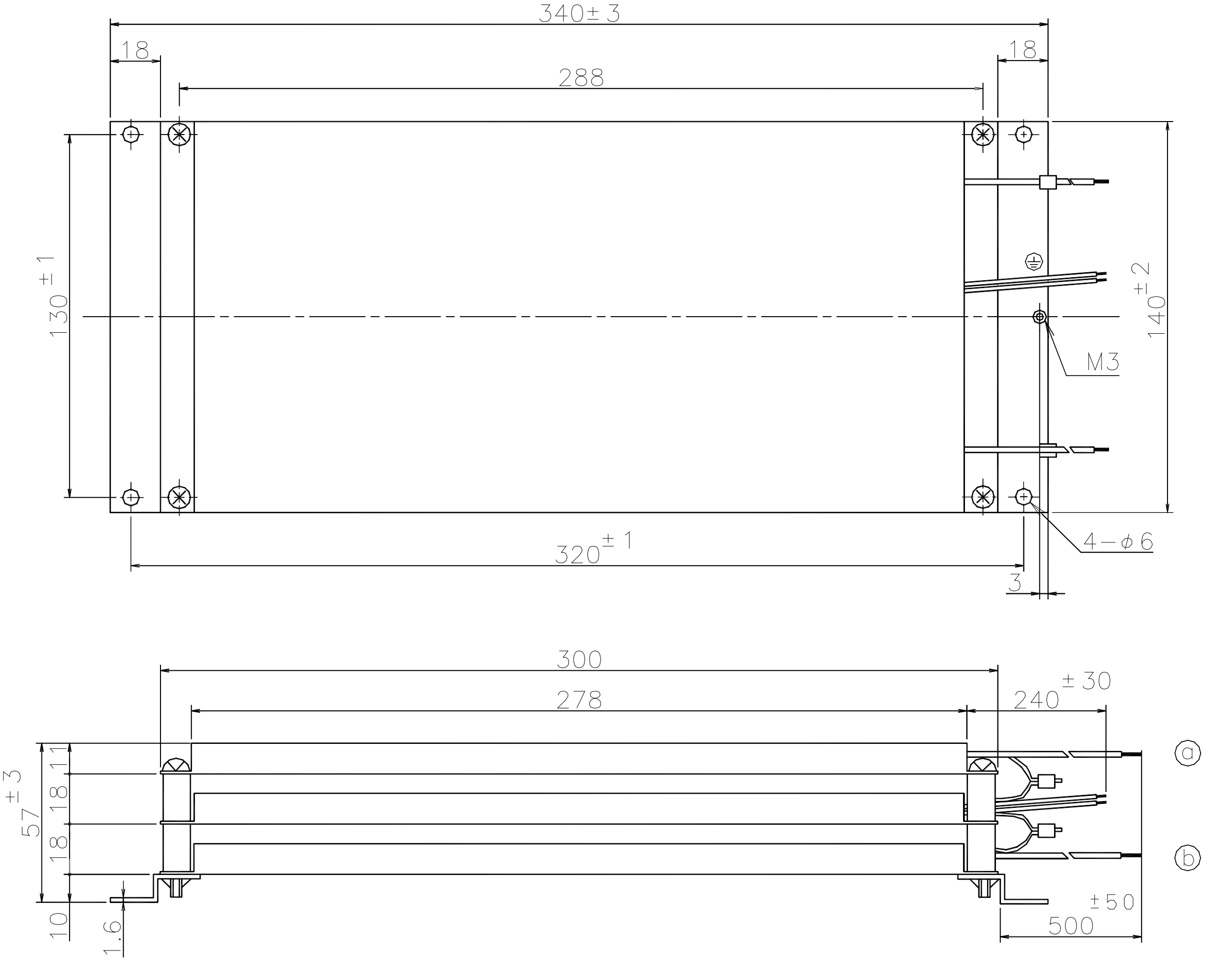
■ REGIST-220W

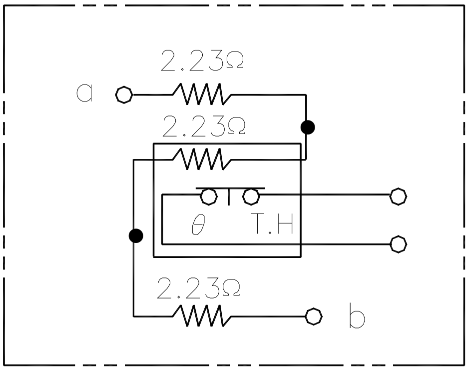


■ REGIST-500CW



■ REGIST-1000W





Connection wiring diagram

Release	
Revision A	Dec. 2008
Revision C	Jul. 2009
Revision D	Mar. 2010
Revision E	Nov. 2010
Revision F	Apr.2013
Revision G	Dec.2013
Revision H	Aug.2014
Revision J	Feb.2015

■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.

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